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SHOP MANUAL

RK250-3

APPLICABLE : EZ-5003~

Book Code No. S5EZ0005E

Read and understand these instructions.
Faillure to do so will increase risk of injury.

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1. GENERAL TERMINOLOGY

1.1 TERMINOLOGY OF OUTSIDE VIEW

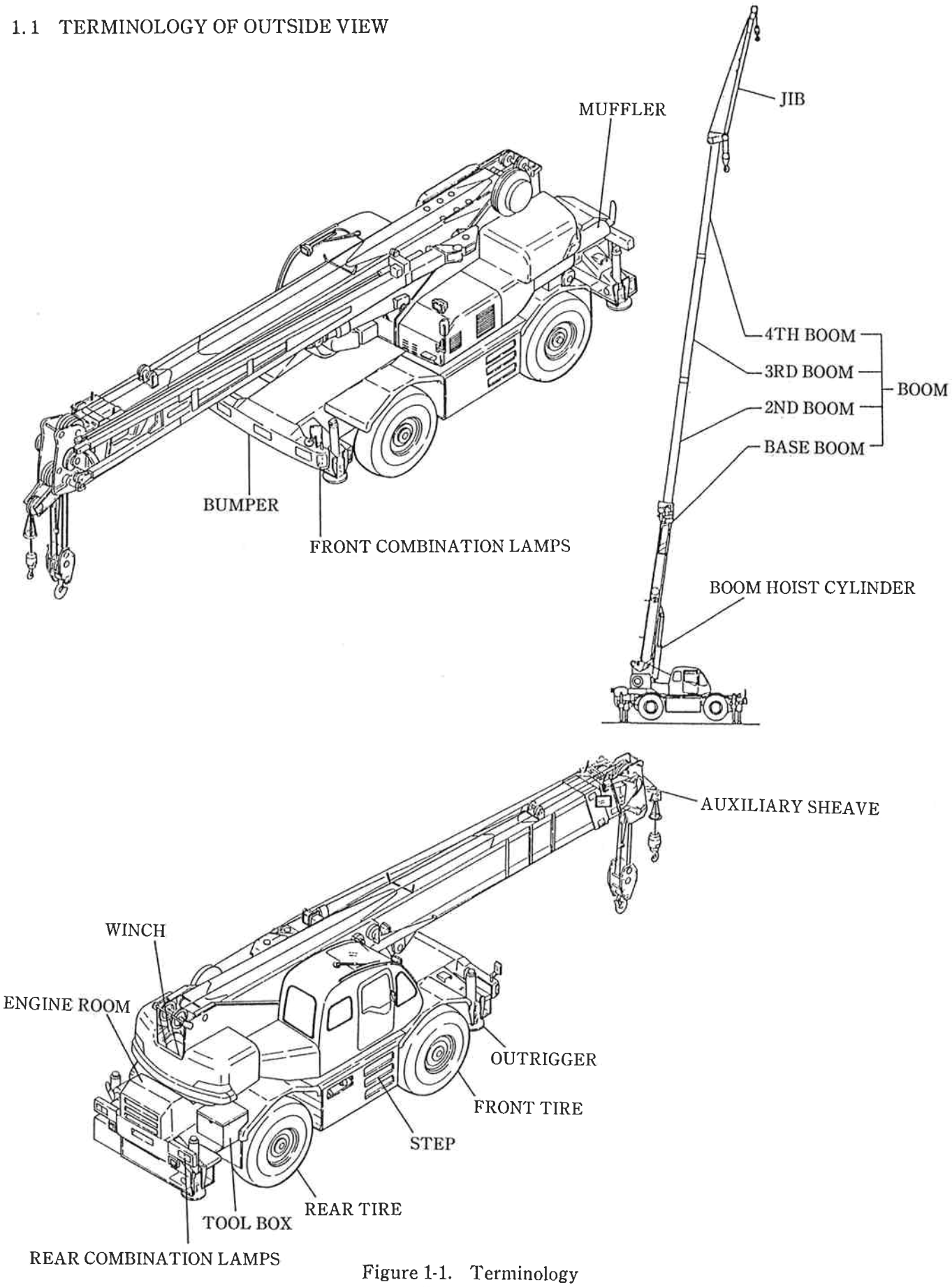
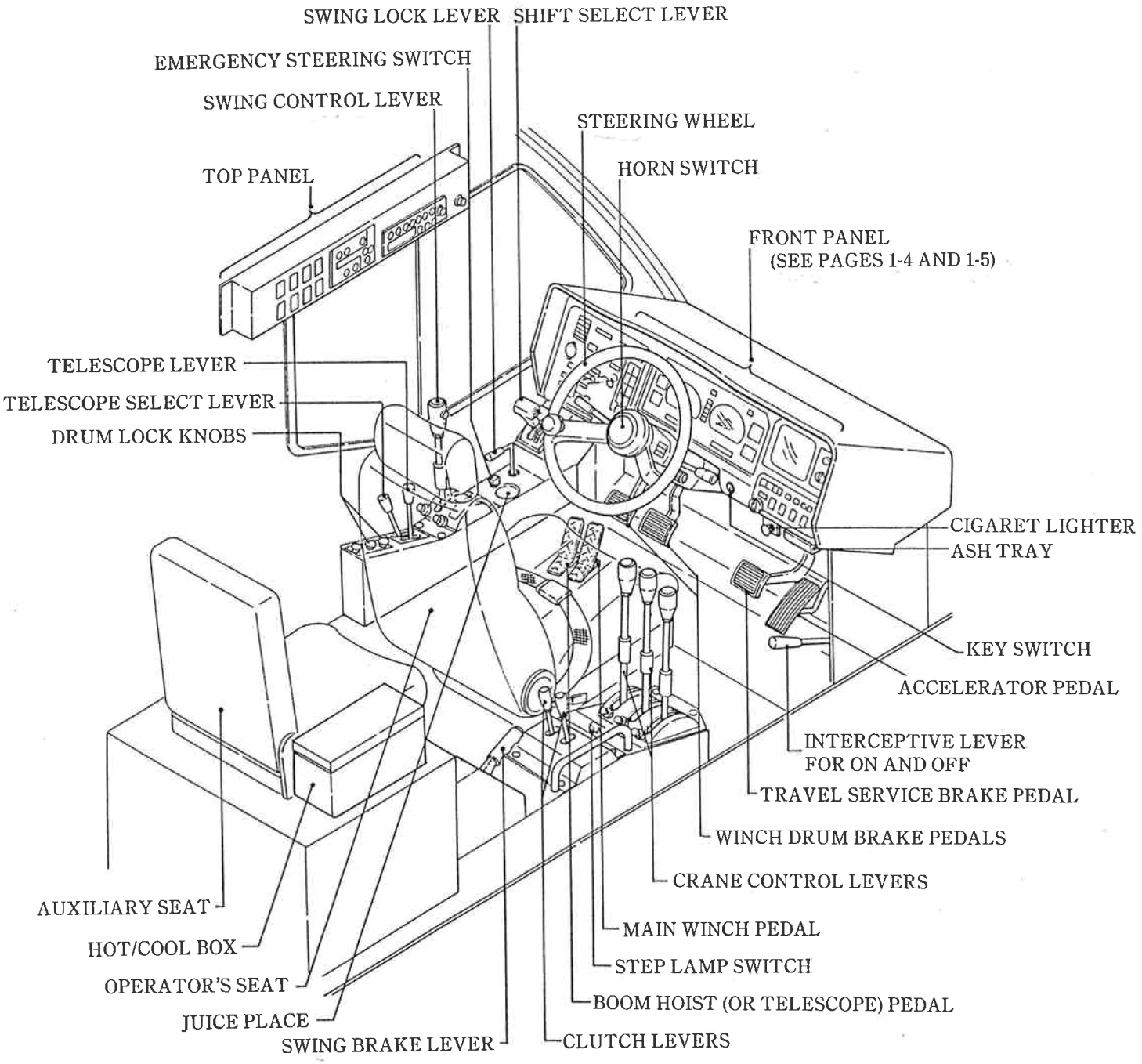


Figure 1-1. Terminology

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1.2 TERMINOLOGY OF INSIDE OF OPERATOR'S ROOM



TOP PANEL

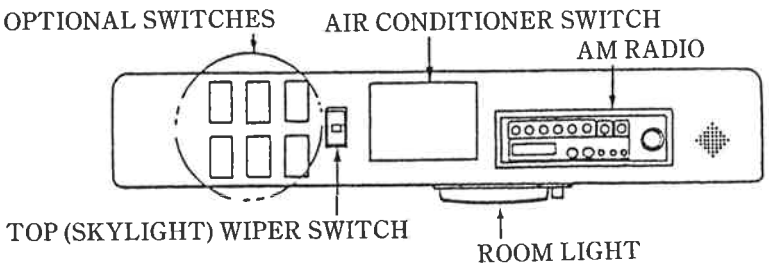


Figure 1-2

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1.3 TERMINOLOGY OF UPPER / LOWER

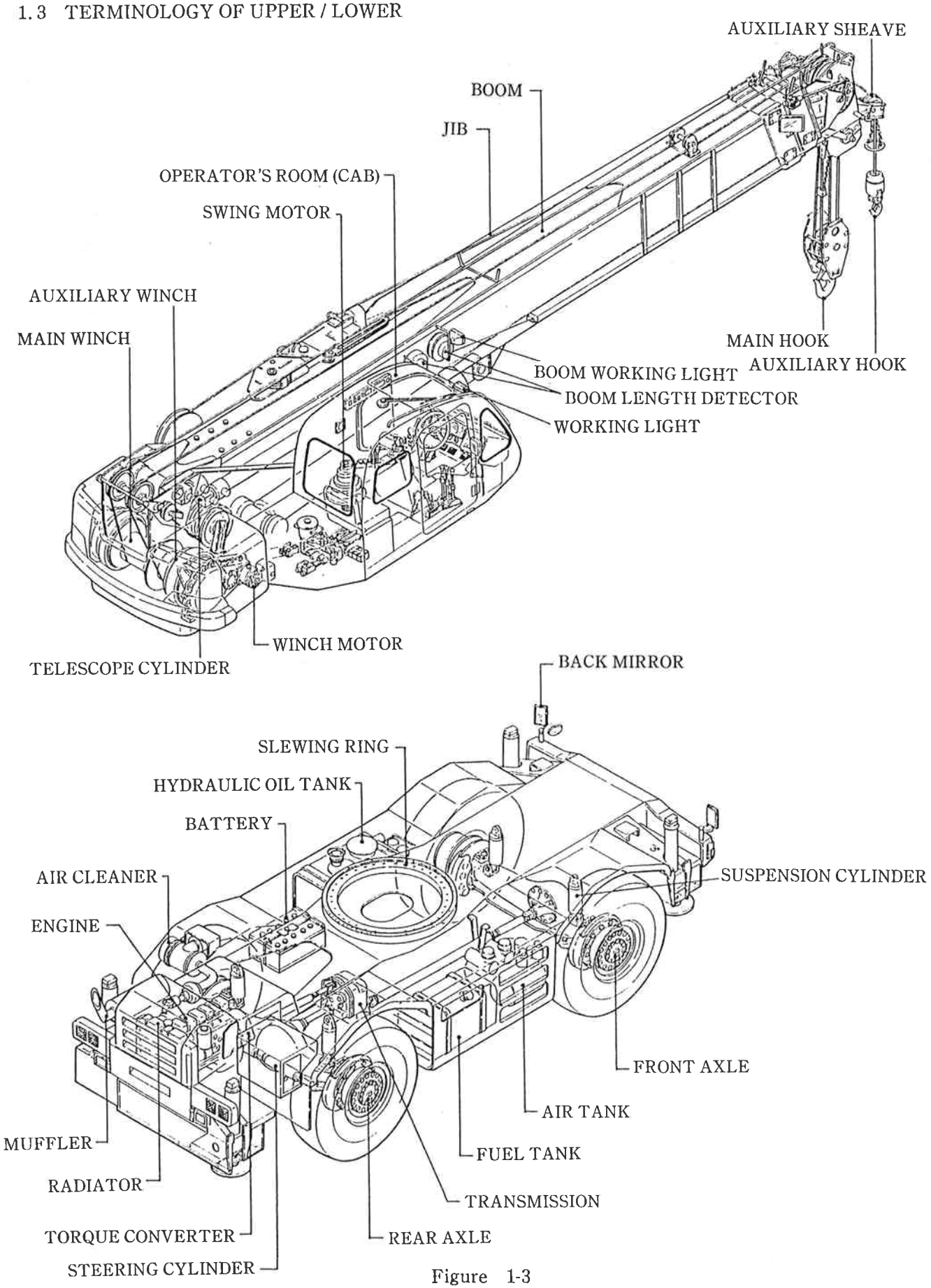
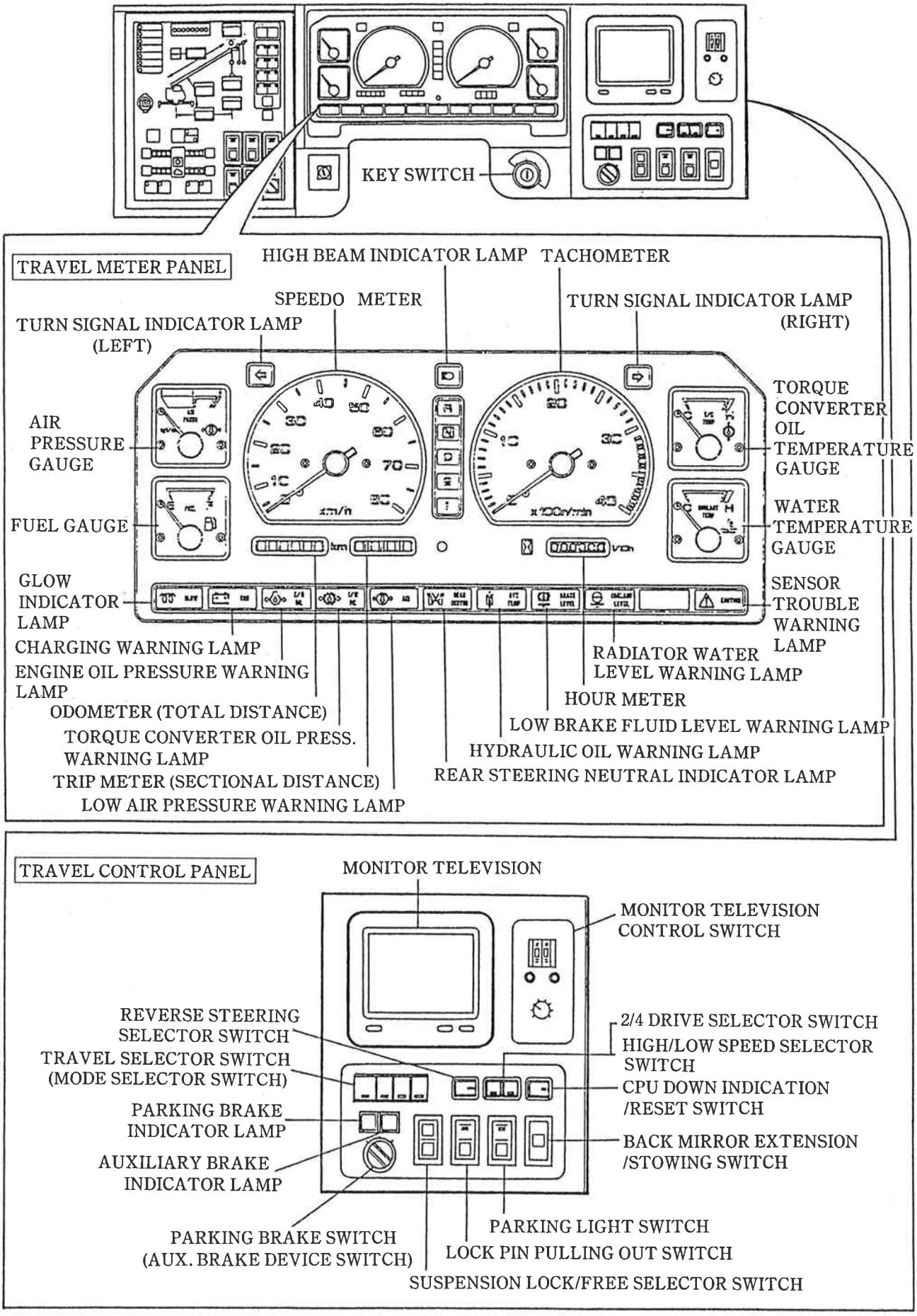


Figure 1-3

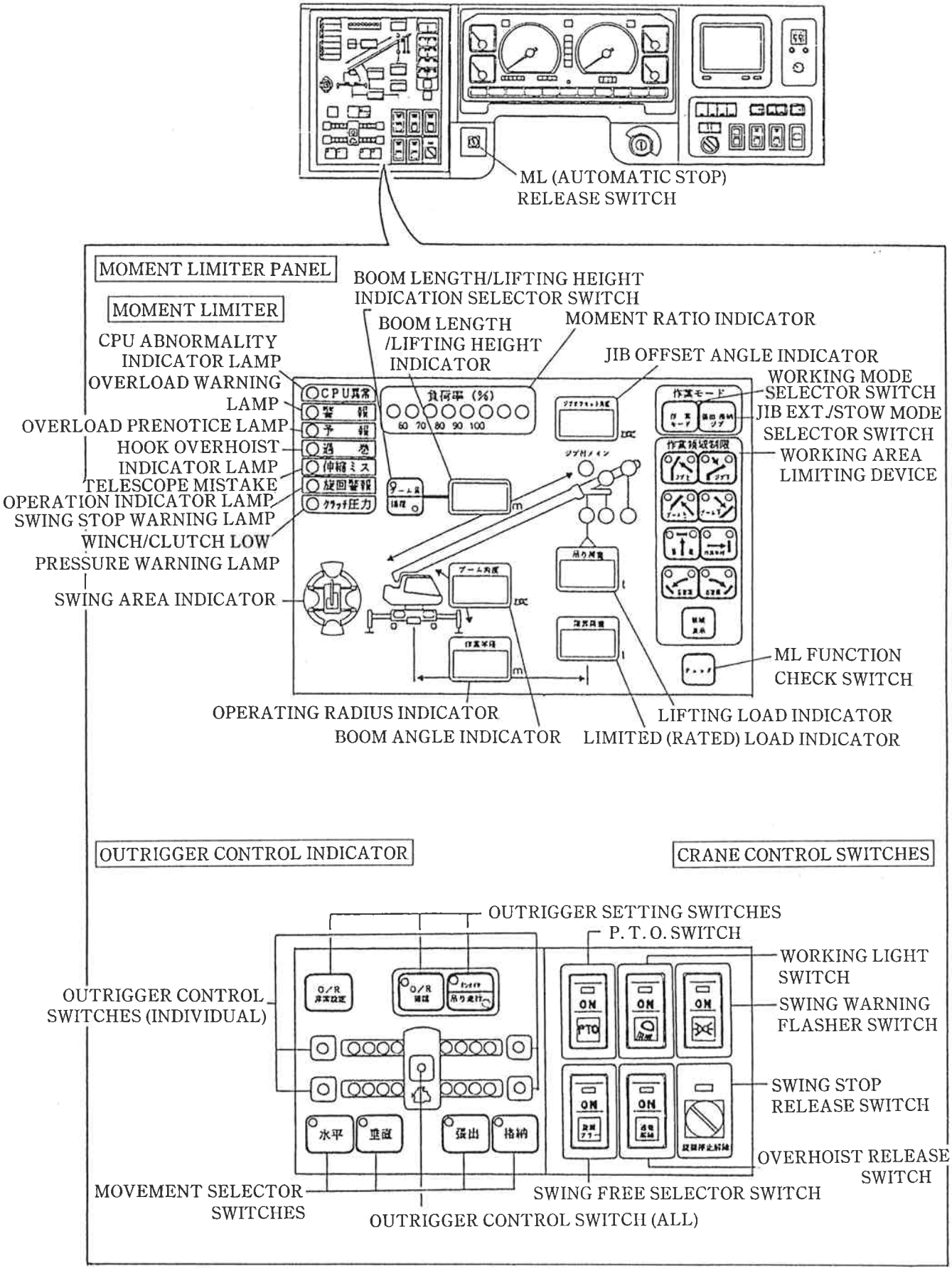
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1.4 FRONT PANEL



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■ MOMENT LIMITER (LOAD SAFETY DEVICE) PANEL



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2. GENERAL SPECIFICATIONS

2.1 SPECIFICATIONS

(1) PERFORMANCE OF CRANE

Maximum Rated Capacity	Boom Boom length × lifting capacity (No. of reeving parts)	9.3m (30.52ft) Boom × 25.0t (55, 115 lbs) (8 parts)
		16.4m (53.81ft) Boom × 18.0t (39, 683 lbs) (6 parts)
		23.5m (77.10ft) Boom × 11.5t (25, 353 lbs) (4 parts)
		30.6m (100.4ft) Boom × 7.0t (15, 432 lbs) (4 parts)
	Jib Jib length (offset angle) × lifting capacity (No. of reeving parts)	7.5m (24.61ft) Jib (5°) × 3.0t (6, 614 lbs) (1 part)
		7.5m (24.61ft) Jib (25°) × 2.1t (4, 630 lbs) (1 part)
		7.5m (24.61ft) Jib (45°) × 1.25t (2, 756 lbs) (1 part)
		12.0m (39.37ft) Jib (5°) × 2.0t (4, 409 lbs) (1 part)
		12.0m (39.37ft) Jib (25°) × 1.2t (2, 646 lbs) (1 part)
		12.0m (39.37ft) Jib (45°) × 1.0t (2, 205 lbs) (1 part)
	Auxiliary Sheave	3.2t (7, 055 lbs) (1 part)
Lifting Capacity at Max. Operating Radius with Boom		0.95t (2, 094ft) at 28.0m (91.86ft)
Maximum Boom Length		30.6m (100.4ft)
Jib Length		7.5m (24.61ft) / 12m (39.37ft)
Maximum Lifting Height	Main hook / Jib hook	31.8m (104.3ft) / 43.7m (143.4ft)
Main Winch Line Speed	High speed / Low speed	124m (406.8ft) / 60m (196.85ft) / min (4th layer)
Aux. Winch Line Speed	High speed / Low speed	107m (351.1ft) / 52m (170.6ft) / min (2nd layer)
Boom Extending Speed		95.2sec / 21.3m (69.88ft)
Boom Raising Speed		47.6sec / 0° to 82°
Slewing Speed		3.06rpm
Swing Radius to Rear End		3.03m (9.94ft)

(2) MAIN STRUCTURE OF CRANE

Type of Boom		Box type, 4 section, 2nd independent, 3rd / 4th synchronous / independent telescope selection type.
Type of Jib (Offset angle)		Side stowing and down extending type, new lift up twist jib (power tilt twist jib as an option). Basic truss / tip box type drawing out form, variable inclining type (5°, 25° and 45° at offset angle).
Boom Telescoping Device		Two hydraulic cylinders together with use of wire ropes.
Boom Raising / Lowering Device (Boom angle)		One directly pushing hydraulic cylinder type (0° to 82°).
Winch System		Hydraulic motor drive (2 units), spur gear reduction type, with free fall device and automatic brake attached.
Swing System		Hydraulic motor drive, planetary gear reduction type. Free / lock selector type with hand brake attached.
Outrigger	Type	Full hydraulic type, and type H / type X selector type.
	Extended Width	6.3m (20.67ft) / 5.1m (16.73ft) / 3.8m (12.47ft) / 2.1m (6.89 ft) (H-type outrigger only)

(3) WIRE ROPE

Main Winch Wire Rope	IWRC 6 × Fi (22+7) c / o, special class 2, hard to twist type. 16㎜ dia. × 170meters. (5 / 8″×558′)
Auxiliary Winch Wire Rope	IWRC 6 × Fi (22+7) c / o, special class 2, hard to twist type. 16㎜ dia. × 90meters. (5 / 8″×295′)

(4) HYDRAULIC SYSTEM

Hydraulic Pump Type	2-tandem (variable plunger) + 3-tandem gear.
Hydraulic Oil tank capacity	358 ℓ (94.57gals) 〔420 ℓ 110.95gals)〕

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(5) TRAVELING PERFORMANCE

Maximum Traveling Speed	49km / h (30. 4mph)
Minimum Turning Radius 2 wheel steer / 4 wheel steer.	9. 3m (30. 51ft) / 5. 35m (17. 55ft)
Gradability in tan θ (degree)	0. 6 (31°)
Steering Mode	4 modes (normal, crab, cramp and rear)

(6) ENGINE

Model	Mitsubishi 6D16T
Type	Water cooled, 4 cycle, direct injection type, with turbo charger.
Total Displacement	7, 545cc (460. 4cu. in)
Maximum Output	220ps at 2, 800rpm
Maximum Torque	65kg · m (470ft · lbs) at 1, 600rpm

(7) MAIN STRUCTURE OF CARRIER

Drive Type		2 wheel drive (4×2) / 4 wheel drive (4×4) selection type
Torque Converter Type		3 elements, 1 stage, 2 phases. Electronic control, full automatic, with lock-up clutch
Transmission	Type	Electronic control, full automatic shift
	Number of shift ranges	Forward 6 ranges / reverse 2 ranges. (with high / low selection)
Type of Gear Reducer		Axle 2 stage reduction type
Type of Axles Front axle / Rear axle		All floating type / all floating type
Type of Steering		Fully hydraulic power steering. Eng. rpm sensitive travel, power loss reducing system. With emergency steering device and reverse steering correcting device attached.
Brake	Main Brake	Air over hydraulic type, disc type 4 wheel brakes, with electronic control exhaust brake linked with torque converter lock-up clutch.
	Parking Brake	Propeller shaft braking internal expanding type, with auxiliary brake for work attached.
Suspension Form		Hydro-pneumatic suspension (with hydraulic lock cylinder)
Capacity of Fuel Tank		300 ℓ (79. 25gals)
Tires		16.00-25-28PR (OR)

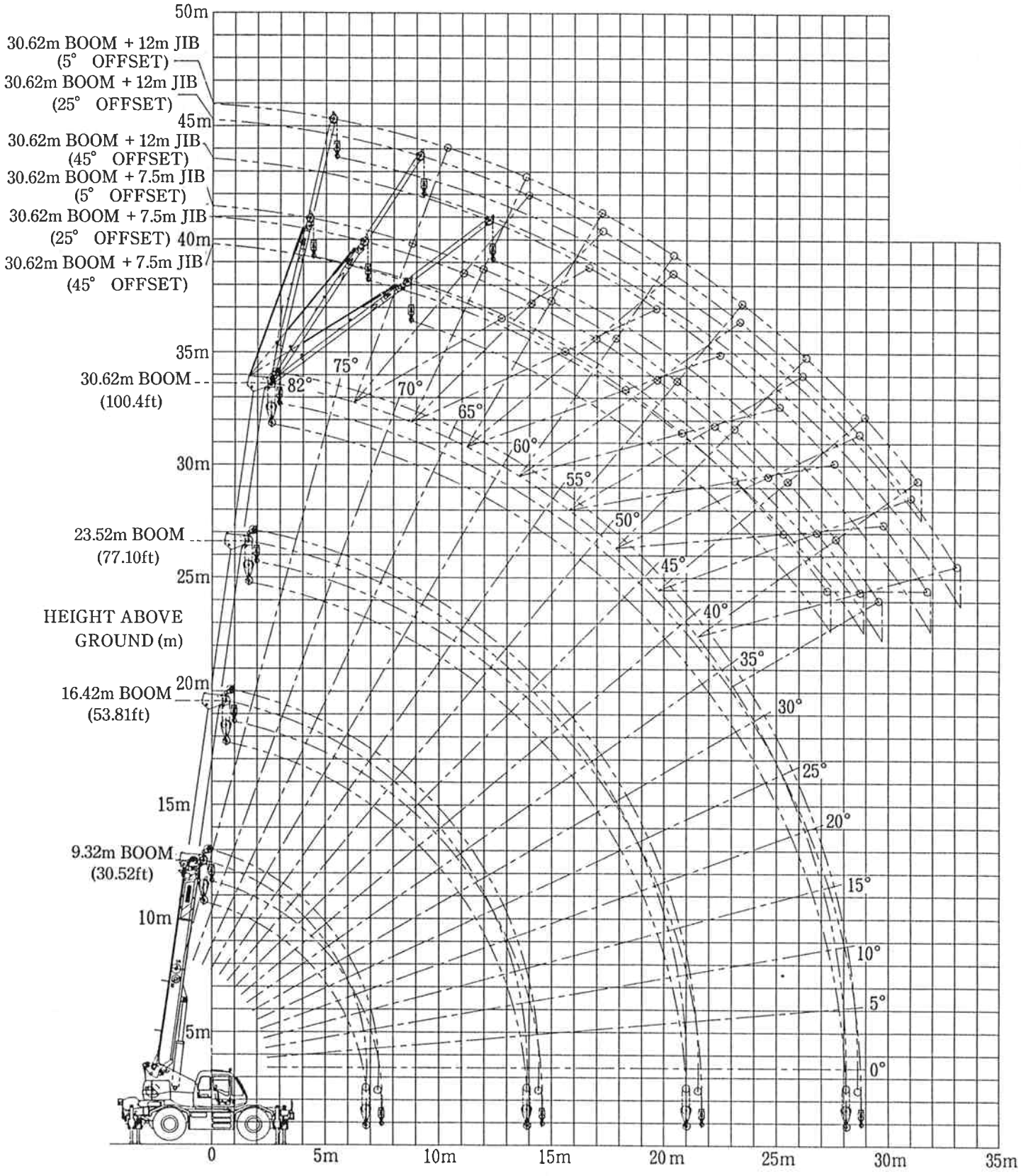
(8) GENERAL DIMENSIONS AND WEIGHT

Overall Length of Machine	11, 010mm (36. 12ft)
Overall Length of Carrier	7, 590mm (24. 90ft)
Overall Width	2, 490mm (8. 17ft)
Overall Height	3, 450mm (11. 32ft)
Wheel Base	3, 700mm (12. 14ft)
Tread Front Wheels / Rear Wheels	2, 020mm (6. 63ft) / 2, 020mm (6. 63ft)
Overall Weight of Machine	26, 500kg (58, 420 lbs)

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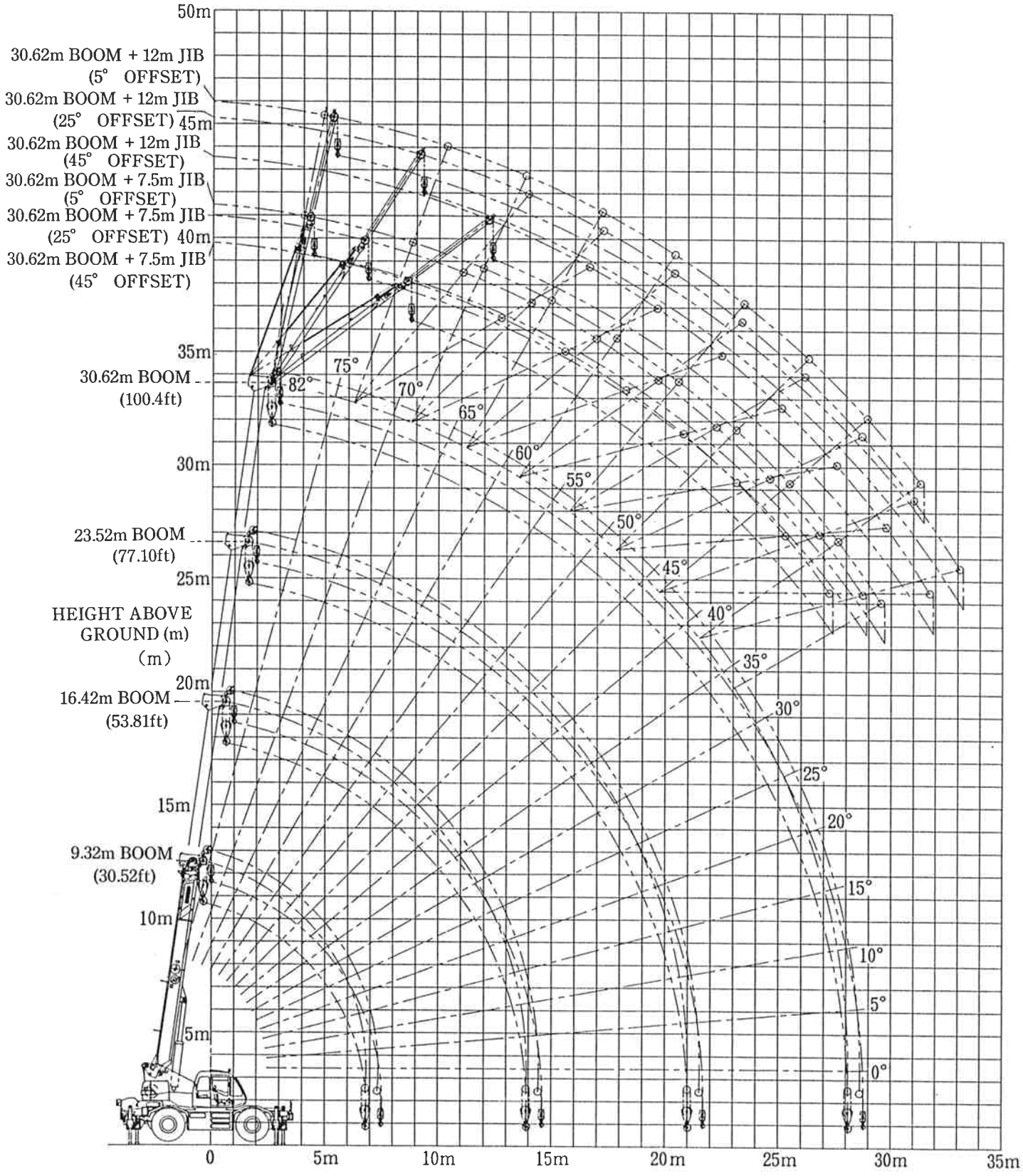
2. 2 WORKING RANGE

(1) H-TYPE OUTRIGGER



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(2) SKY TILT JIB



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2.3 RATED LIFTING CAPACITY

(1) RATING CHART ON OUTRIGGERS IN TONS

Boom Length / Operating Radius in meters	Outrigger fully extended (all around)					Outrigger mid-point extended (over side) (5.1m)					Outrigger mid-point extended (over side) (3.8m)					Outrigger minimum extended (over side)				
	9.32m	16.42m	23.52m	30.62m		9.32m	16.42m	23.52m	30.62m		9.32m	16.42m	23.52m	30.62m		9.32m	16.42m	23.52m	30.62m	
2.5	25.00	18.00				25.00	18.00				25.00	18.00				11.10	10.00			
3.0	25.00	18.00				25.00	18.00				25.00	18.00				11.10	10.00			
3.5	25.00	18.00	11.50			25.00	18.00	11.50			20.00	18.00	11.50			8.40	8.00	9.30		
4.0	23.00	18.00	11.50			23.00	18.00	11.50			15.70	15.60	11.50			6.70	6.30	7.20		
4.5	21.20	18.00	11.50			21.20	18.00	11.50			12.60	12.60	11.50			5.50	5.10	5.90		
5.0	19.40	16.70	11.50	7.00		18.10	16.00	11.50	7.00		10.60	10.30	10.25	7.00		4.55	4.20	4.90	5.30	
5.5	17.80	15.50	11.50	7.00		15.35	14.60	11.50	7.00		9.05	8.70	9.00	7.00		3.85	3.50	4.15	4.50	
6.0	16.30	14.40	10.85	7.00		12.90	12.40	10.06	7.00		7.70	7.50	7.80	7.00		3.30	2.95	3.55	3.90	
6.5	15.10	13.40	10.25	7.00		11.10	10.80	9.90	7.00		6.60	6.50	6.85	7.00		2.85	2.45	3.05	3.35	
6.8	7.00	12.80	9.90	7.00			9.90	9.40	7.00			5.90	6.40	6.65			2.20	2.75	3.05	
7.0		12.50	9.70	7.00			9.40	9.15	7.00			5.60	6.10	6.40			2.05	2.60	2.85	
7.5		11.70	9.15	7.00			8.20	8.50	7.00			4.90	5.50	5.75			1.70	2.20	2.45	
8.0		10.90	8.70	6.70			7.30	7.80	6.70			4.40	4.90	5.15			1.40	1.90	2.10	
9.0		8.65	7.70	6.15			5.85	6.45	6.05			3.50	3.95	4.20			0.90	1.40	1.60	
10.0		7.05	6.90	5.60			4.75	5.35	5.55			2.80	3.25	3.50				1.05	1.25	
11.0		5.85	6.25	5.15			3.90	4.50	4.75			2.25	2.70	2.95					0.95	
12.0		4.95	5.45	4.70			3.30	3.80	4.10			1.80	2.25	2.50	(H-type outrigger only)					
13.0		4.20	4.70	4.30			2.75	3.25	3.50			1.40	1.90	2.15						
13.5		3.90	4.40	4.15			2.50	3.00	3.25			1.20	1.75	2.00						
13.9		3.70	4.15	4.05				2.85	3.10				1.65	1.90						
14.0			4.10	4.00				2.80	3.05				1.60	1.85						
15.0			3.60	3.70				2.45	2.65				1.35	1.55						
16.0			3.15	3.45				2.10	2.35				1.10	1.35						
17.0			2.80	3.05				1.80	2.05				0.95	1.15						
18.0			2.45	2.70				1.55	1.80				0.75	1.00						
19.0			2.15	2.45				1.35	1.55				0.60	0.85						
20.0			1.90	2.20				1.15	1.40					0.70						
21.0			1.70	1.95					1.20											
22.0				1.75					1.05											
24.0				1.40					0.75											
26.0				1.15					0.50											
28.0				0.95																
28.1				0.95																
Min. boom angle	0°	0°	0°	0°		0°	0°	15°	23°		0°	0°	26°	44°		0°	48°	60°	65°	

Load rating include weight of hook block and all other load handling accessories.

Rating in [ ] area are based on the machine structural strength, and others are based on the machine stability.

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(2) RATING CHART WITHOUT USE OF OUTRIGGERS IN TONS

	Stationary lifting (over front)			Stationary lifting (all around)			Pick and carry (over front) [max. 2km/h (1.24mph)]			Pick and carry (all around) [max. 2km/h (1.24mph)]		
Boom Length Operating Radius in meters	9.32m	16.42m	23.52m	9.32m	16.42m	23.52m	9.32m	16.42m	23.52m	9.32m	16.42m	23.52m
3.0	14.00	9.00		8.15	7.30		10.10	6.50		5.90	5.30	
3.5	14.00	9.00	6.50	6.05	5.60	4.50	10.10	6.50	4.70	4.40	4.00	3.20
4.0	12.60	9.00	6.50	4.65	4.40	4.50	9.10	6.50	4.70	3.30	3.20	3.20
4.5	11.25	9.00	6.50	3.65	3.40	3.90	8.10	6.50	4.70	2.60	2.40	2.80
5.0	9.90	8.15	6.50	2.90	2.70	3.35	7.10	5.90	4.70	2.10	1.90	2.40
5.5	8.55	7.35	6.15	2.30	2.10	2.80	6.20	5.30	4.40	1.70	1.50	2.00
6.0	7.20	6.60	5.80	1.80	1.65	2.30	5.20	4.80	4.20	1.30	1.20	1.70
6.5	6.15	5.90	5.45	1.40	1.30	1.90	4.40	4.20	3.90	1.00	0.90	1.40
6.8											0.70	1.20
7.0		5.20	5.10		1.00	1.60		3.70	3.70			0.80
8.0		4.00	4.40		0.50	1.10		2.90	3.20			0.50
9.0		3.05	3.70			0.70		2.20	2.70			
10.0		2.40	3.00					1.70	2.20			
11.0		1.85	2.45					1.30	1.80			
12.0		1.40	2.00					1.00	1.40			
13.0		1.05	1.65					0.80	1.20			
14.0			1.35						1.00			
15.0			1.10						0.80			
16.0			0.85						0.60			
17.0			0.65						0.50			
Min. boom angle	0°	22°	36°	20°	53°	62°	0°	22°	36°	20°	53°	62°

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(3) RATING CHART WITH BOOM AND JIB IN TONS

● Outrigger Maximum Extended

Boom Angle (°)	Boom + 7.5m jib Outrigger max. (6.3m) extended (all around)			Boom + 12.0m jib Outrigger max. (6.3m) extended (all around)		
	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)
80.0	3.00	2.10	1.25	2.00	1.20	1.00
75.0	3.00	2.10	1.25	2.00	1.13	1.00
73.5	3.00	2.10	1.22	1.87	1.11	1.00
71.0	3.00	2.10	1.17	1.70	1.08	0.95
69.0	2.28	2.10	1.13	1.58	1.06	0.91
65.0	2.50	1.88	1.06	1.40	1.01	0.84
60.0	2.10	1.65	1.00	1.20	0.94	0.74
55.0	1.51	1.28	0.95	1.10	0.88	0.64
52.0	1.22	1.08	0.88	0.92	0.84	0.59
50.0	1.05	0.95	0.83	0.81	0.74	0.54
48.0	0.91	0.82	0.78	0.72	0.65	0.51
45.0	0.74	0.66	0.70	0.59	0.53	0.45
40.0	0.50	0.44		0.44	0.38	
37.0	0.39	0.32				
35.0	0.32					
Min. boom angle	35°	37°	45°	40°	40°	45°

● Outrigger Mid-point Extended (1)

Boom Angle (°)	Boom + 7.5m jib Outrigger mid-point (5.1m) extended (over side)			Boom + 12.0m jib Outrigger mid-point (5.1m) extended (over side)		
	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)
80.0	3.00	2.10	1.25	2.00	1.20	1.00
75.0	3.00	2.10	1.25	2.00	1.15	1.00
73.5	3.00	2.10	1.22	1.86	1.12	1.00
72.0	3.00	2.10	1.17	1.75	1.10	0.97
71.0	2.84	2.10	1.15	1.70	1.09	0.95
70.0	2.67	2.10	1.13	1.62	1.08	0.93
69.0	2.52	2.00	1.10	1.55	1.06	0.91
65.0	1.95	1.60	1.03	1.40	1.01	0.84
63.0	1.70	1.42	0.98	1.23	0.99	0.81
60.0	1.34	1.15	0.92	1.02	0.82	0.75
55.0	0.86	0.76	0.70	0.69	0.56	0.52
52.0	0.63	0.56	0.56	0.52	0.42	0.40
50.0	0.50	0.45	0.45	0.40	0.35	
49.0	0.45	0.40	0.40			
Min. boom angle	49°	49°	49°	50°	50°	52°

● Outrigger Mid-point Extended (2)

Boom Angle (°)	Boom + 7.5m jib Outrigger mid-point (3.8m) extended (all around)			Boom + 12.0m jib Outrigger mid-point (3.8m) extended (all around)		
	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)	5° offset Load (ton)	25° offset Load (ton)	45° offset Load (ton)
80.0	3.00	2.10	1.25	2.00	1.20	1.00
75.0	3.00	2.10	1.25	2.00	1.15	1.00
73.5	2.60	1.94	1.21	1.82	1.13	1.00
71.0	2.00	1.61	1.14	1.52	1.10	0.90
69.0	1.60	1.36	1.00	1.27	0.94	0.80
65.0	1.00	0.88	0.75	0.83	0.66	0.57
60.0	0.52	0.48	0.47	0.45	0.35	0.33
Min. boom angle	60°	60°	60°	60°	60°	60°

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2.4 NOTES FOR RATED CAPACITY CHARTS

[RATINGS WITH USE OF OUTRIGGERS]

◎Load ratings do not exceed 78 percents of tipping load with the machine set horizontally on a firm and level ground, satisfy the specified stability over front, and include weight of hook block (s) and other load handling accessories.
Rating in the [ ] area are based on the machine's structural strength, and others are determined by the machine's stability.

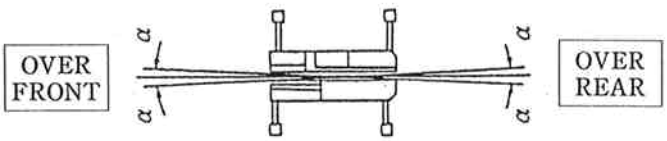
Kind of hook	25ton	3.2ton
Weight	210kgs (463 lbs)	70kgs (154 lbs)

◎Since the operating radius given in the chart includes allowances for laden boom deflection, the machine must always be operated on the basis of actual operating radius.

◎Jib operation must be based on main boom angle.

◎The outrigger maximum extended width is 6.3m (20.7ft), mid-point extended widths are 5.1m (16.7ft) and 3.8m (12.5ft), and minimum extended width (H-type outrigger only) is 2.1m (6.89ft).

◎Ratings in "Over Side" vary according to the outrigger extended width condition, therefore, operation must be based on the rating chart corresponding to each outrigger extended condition. Operation in "Over Front" and "Over Rear" areas must be as per the ratings when the outrigger is extended to maximum.



Outrigger extended condition	Mid-point width 5.1m (16.7ft)	Mid-point width 3.8m (12.5ft)	Minimum width 2.1m (6.89ft)
Area α	28°	20°	5°

◎Ratings with use of the auxiliary sheave are the same as the ratings with the boom less weight of 25ton hook (210kgs), but should not exceed 3,200 kgs (7,055 lbs).

◎When the boom length exceeds the specified length shown in the rating chart, operation must be performed basing on the smaller rating of the specified length or the rating for the next longer boom length shown.

◎When operating with the boom with the jib attached deduct 1,550kgs (3,417 lbs) when one step jib is extended, and deduct 1,750kgs (3,858 lbs) when two step jib is extended besides weight of lifting slings, etc. At this time, do not use the auxiliary sheave.

◎Do not operate in a condition not shown in the rating chart. When the min. boom angle is indicated at the bottom of the rating chart, tipping may result if the boom is lowered beyond the stated angle.

◎The minimum reeving is determined so that the single line load does not exceed 3,125kgs (6,889 lbs).
The standard reevings of the hook block are shown below.

Boom length	9.3m	16.4m	23.5m
Used hook	25ton hook		
Number of reeving	8	6	4

Boom length	30.6m	Jib / aux. sheave
Used hook	25ton hook	3.2ton hook
Number of reeving	4	1

◎Free falling operation shall be, as a rule, be used when lowering the hook block only. When it is required to free fall a load, the load should not exceed one fifth of the rated load, and sudden brake must be absolutely avoided.

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[RATING WITHOUT USE OF OUTRIGGERS]

◎Since the operating radius given in the chart includes allowances for laden boom deflection, the machine must always be operated on the basis of actual operating radius.

◎Load ratings are the approved maximum lifting capacity with the specified air pressure of the tires and with the suspension lock cylinders fully retracted on a firm and level ground, and include weight of hook block (s) and other load handling accessories.

Rating in the [ ] area are based on the machine's structural strength, and others are determined by the machine's stability.

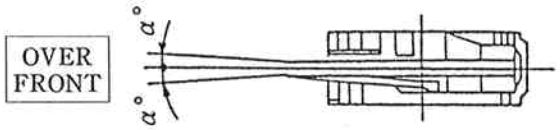
Kind of hook	25ton	3.2ton
Weight	210kgs (463 lbs)	70kgs (154 lbs)

Specified air pressure of tire : 7.75kg / cm² (110psi)

◎Ratings in "Over Front" and ratings in "Over Side" are different. When swinging from "Over Front" to "Over Side" , sufficiently be carefull not to exceed the rated load. (The capacity in "Over Front" is set with the swing lock pin inserted.)



AXLE LOCK



Crane operation	Stationary lifting	Pick and carry
Area α	1°	1°

◎Ratings with use of the auxiliary sheave are equal to the ratings with the boom less weight of the 25ton hook block (210kgs) (463 lbs), but should not exceed 3,200kgs (7,055 lbs).

◎Do not perform free falling operation and operation with the jib.

◎When performing stationary lifting, be sure to engage the parking brake and the auxiliary brake for work.

◎When performing picking and carrying operation, be sure to place the high speed / low speed selector switch in the LOW range position.

◎When picking and carrying a load, hold the load near the ground and travel within 2km (1.24 miles) per hour of speed not to allow the load to be swung.

Especially be careful for cornering, sudden start and sudden stop.

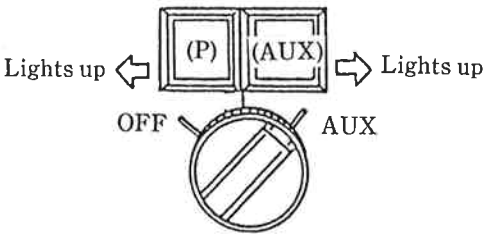
◎Do not perform crane operation while traveling with a load suspended.

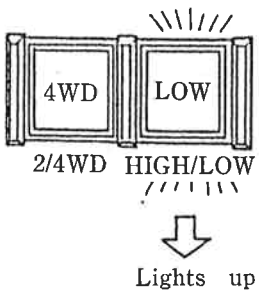
◎The minimum reeving is determined so that the single line load does not exceed 3,125kgs (6,889 lbs).

The standard reevings of the hook block are shown below.

Boom length	9.3m	16.4m	23.5m
Used hook	25ton hook		
Number of reeving	8	4	4

	Auxiliary sheave
Used hook	3.2ton hook
Number of reeving	1

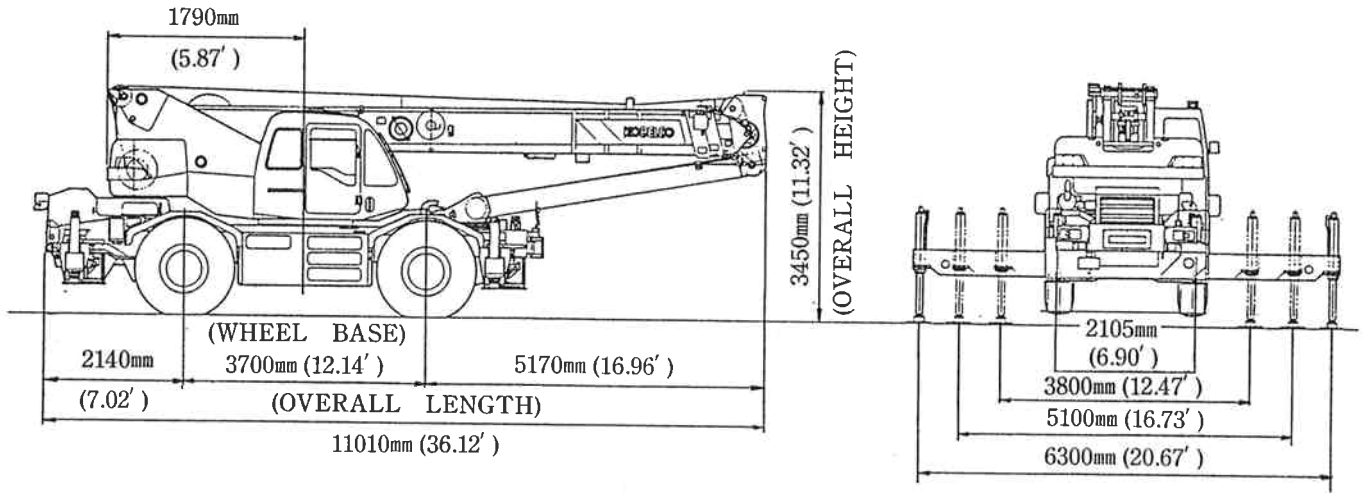




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2.5 GENERAL DIMENSIONS

(1) Machine Equipped with "H" Type Outriggers



(2) Machine Equipped with "X" Type Outriggers

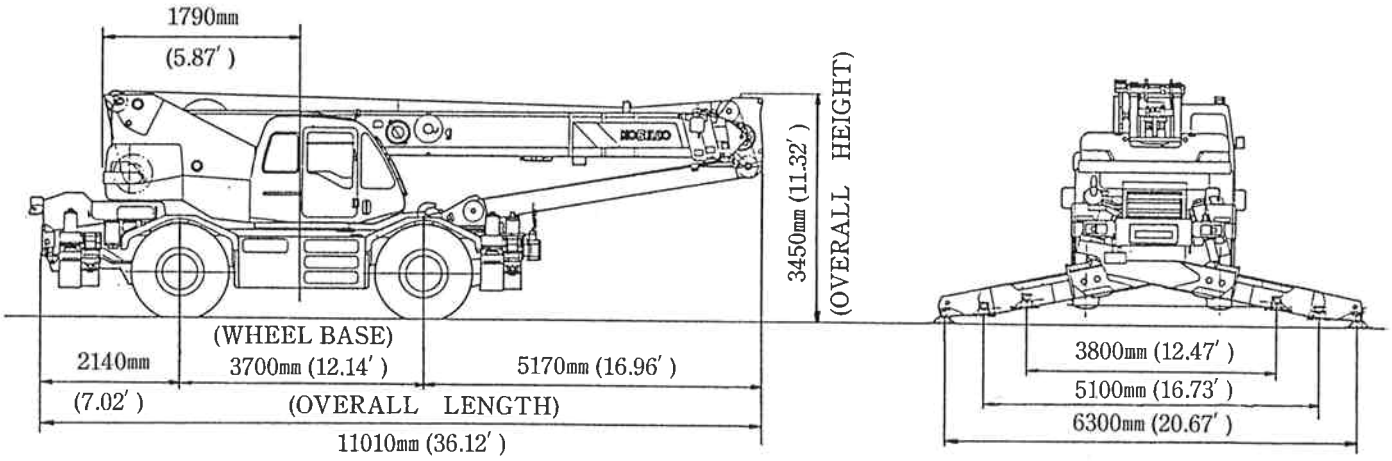
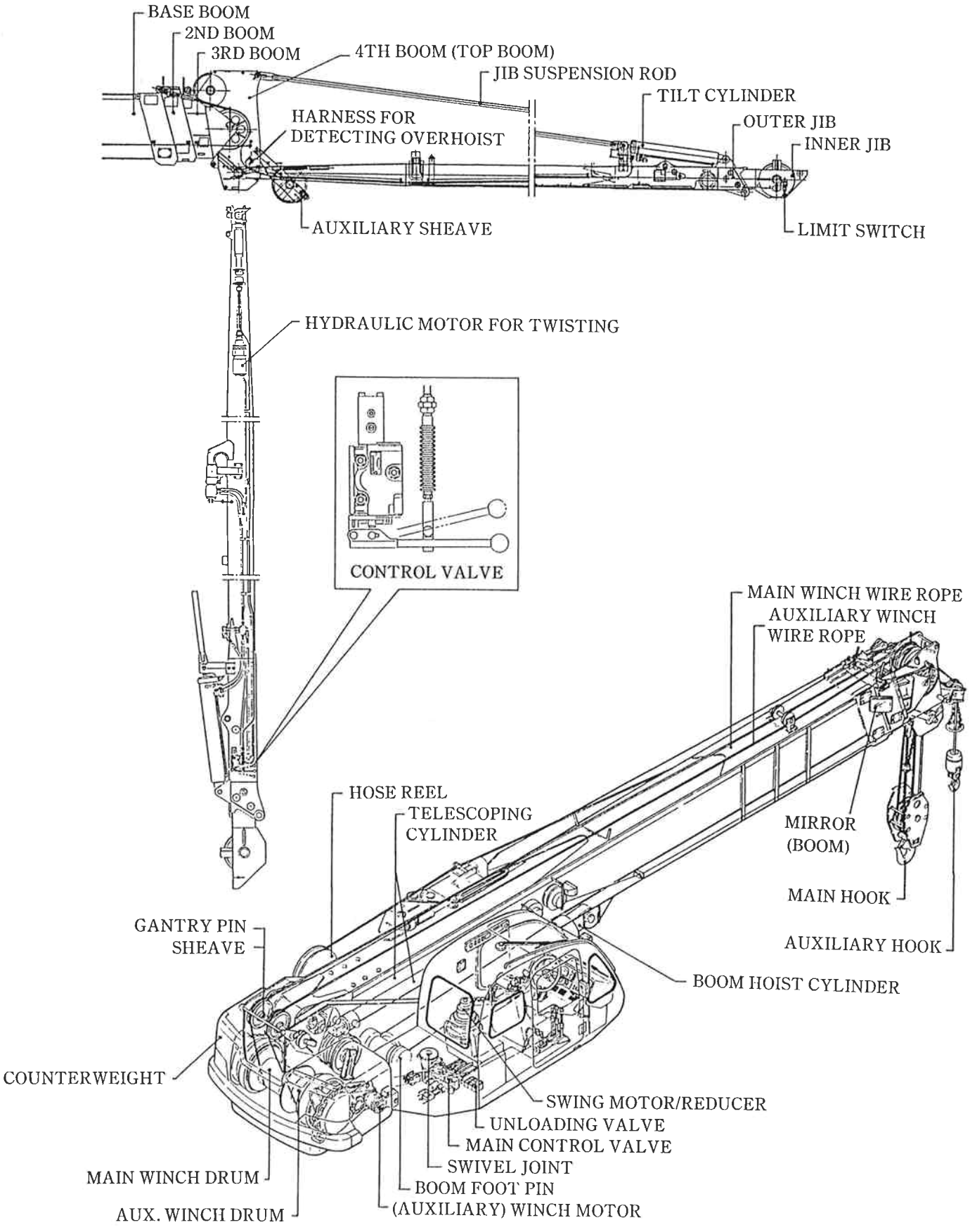


Figure 2-1. General Dimensions

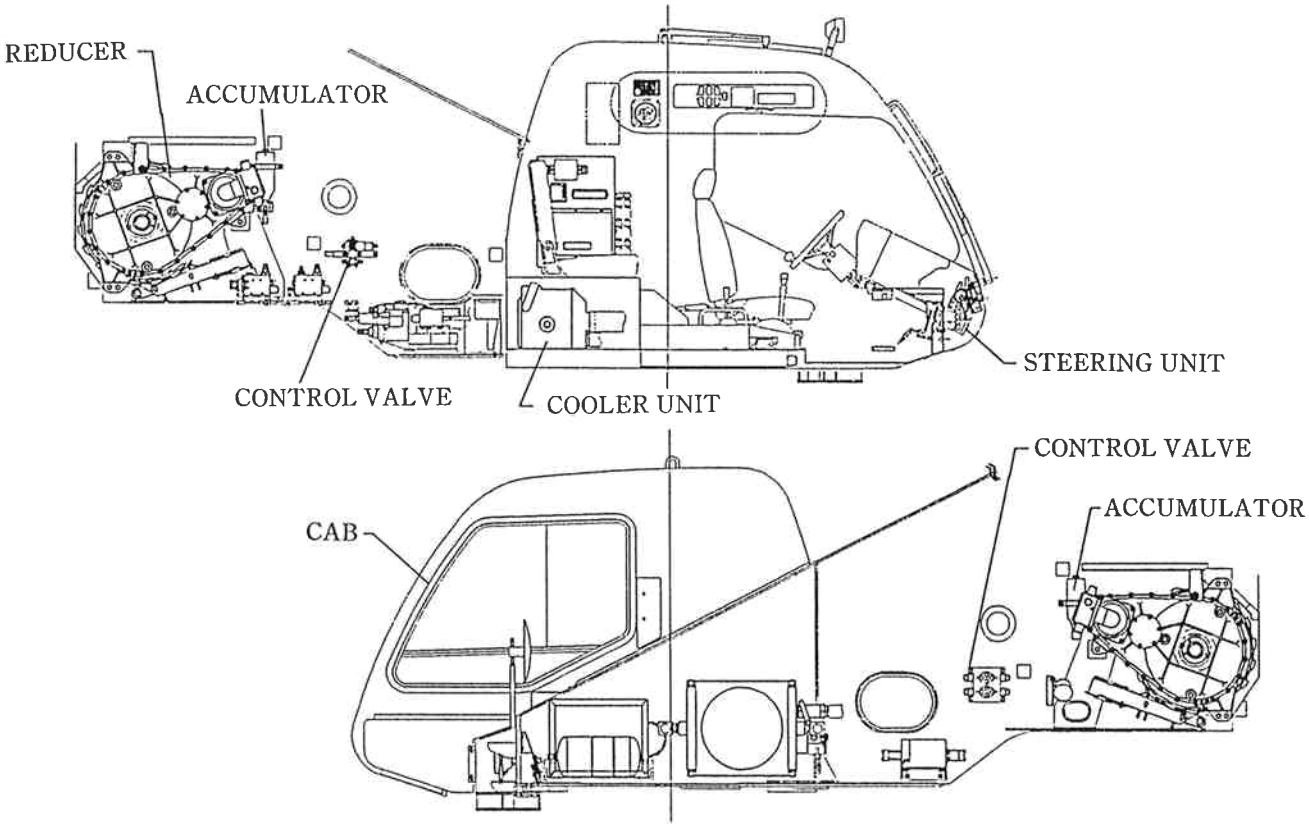
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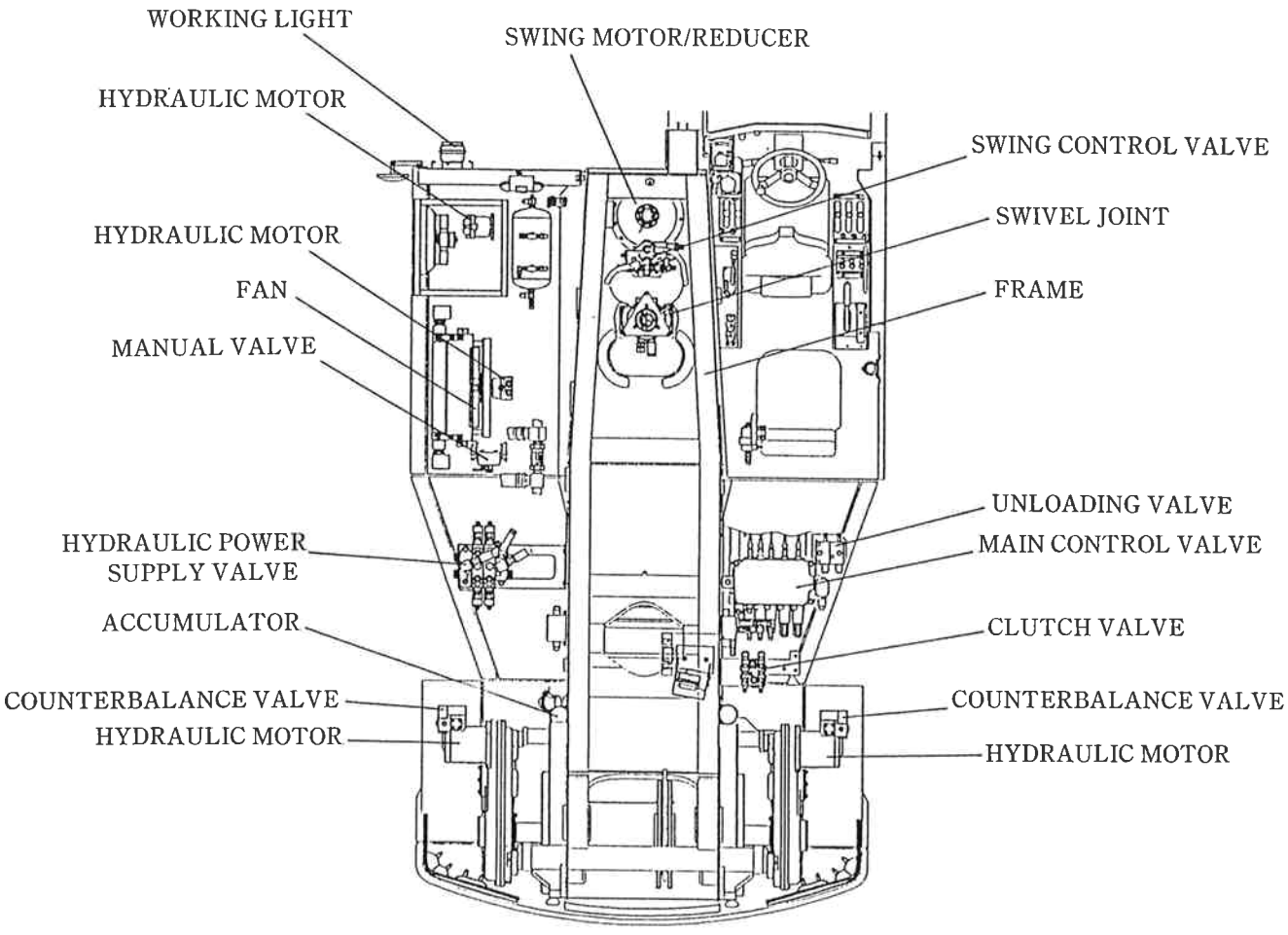
1. LOCATION OF MAIN PARTS

1.1 UPPER



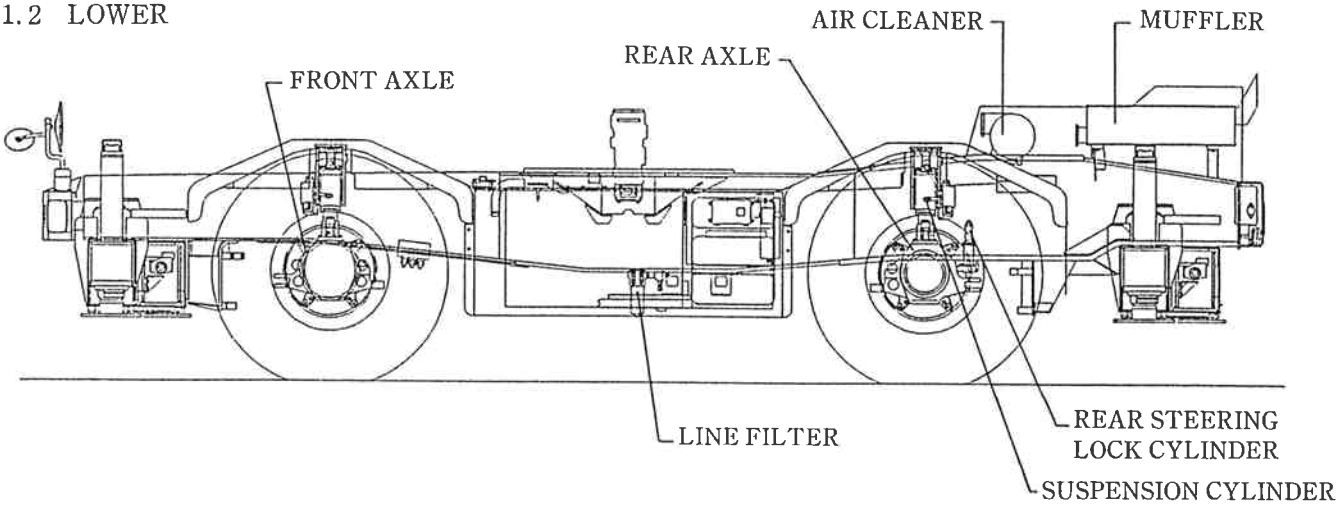
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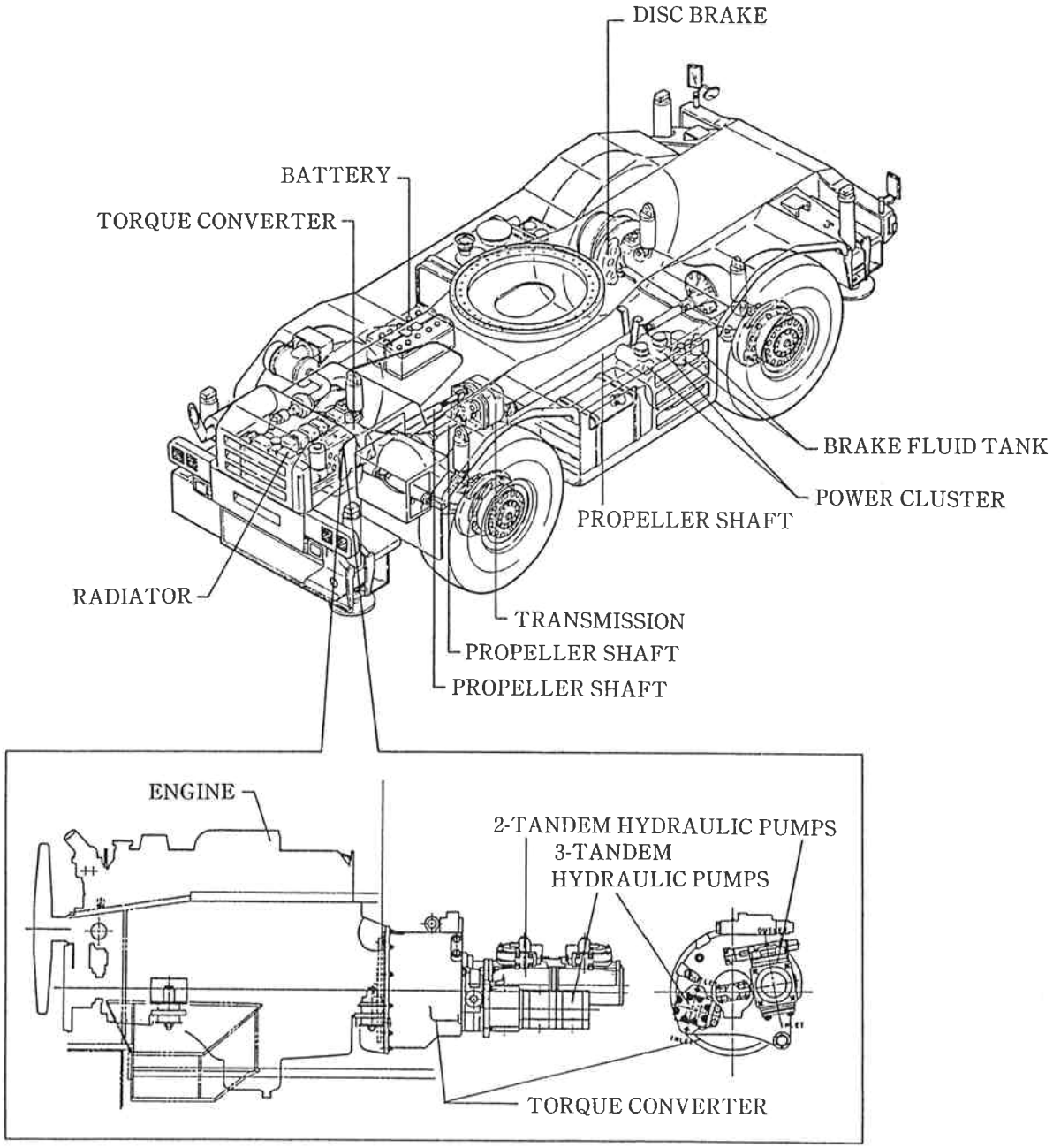




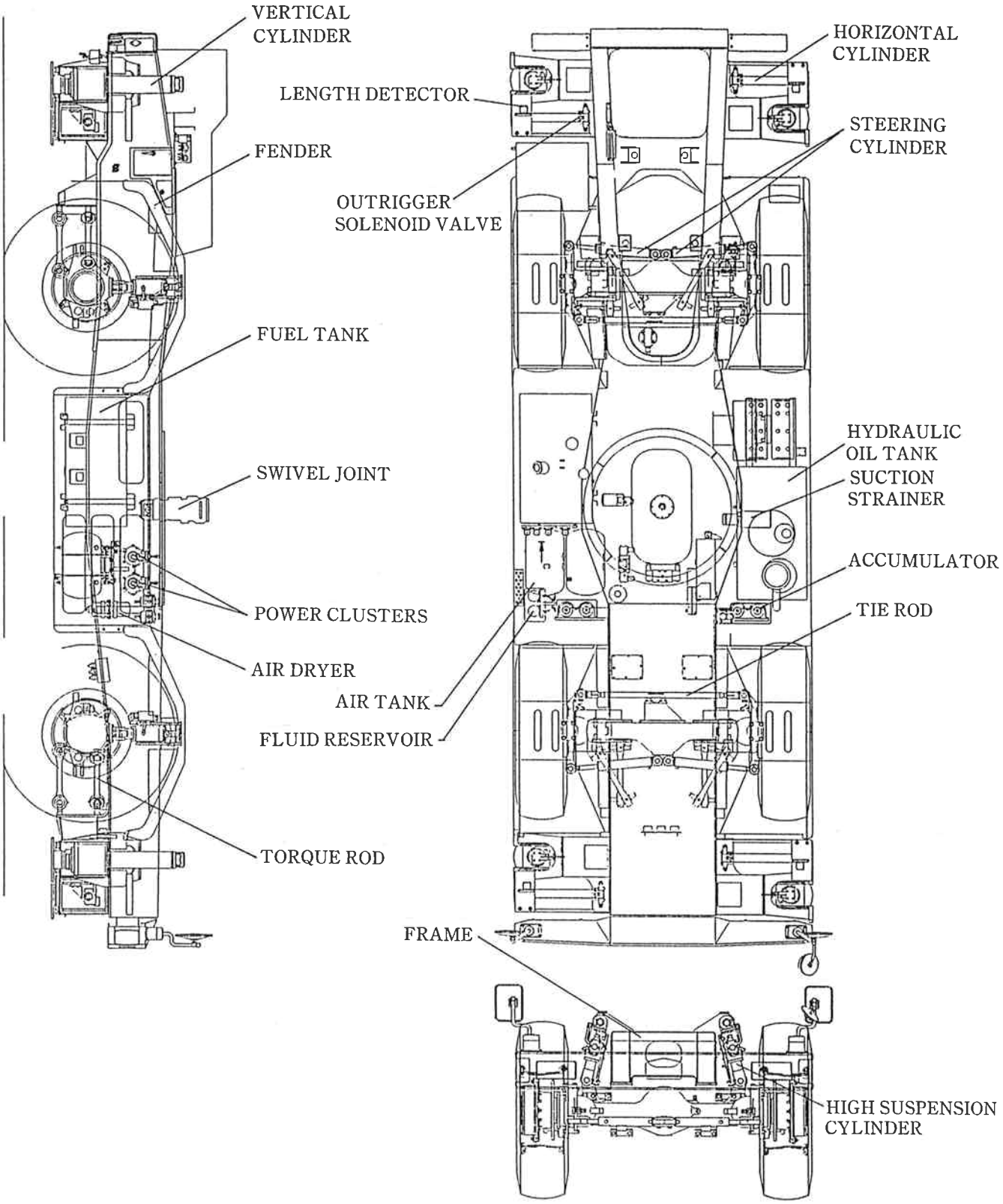
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1.2 LOWER



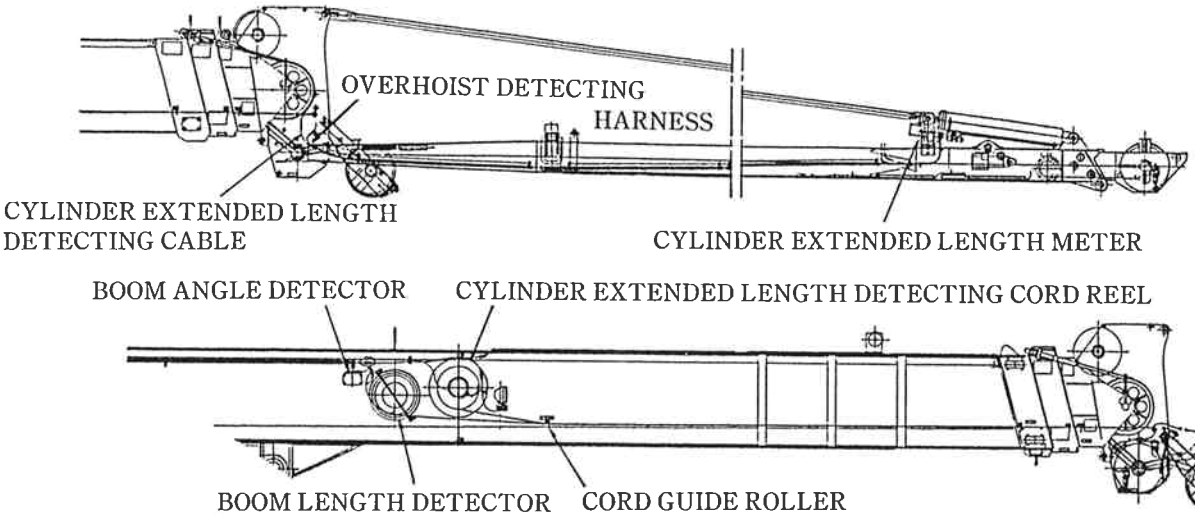


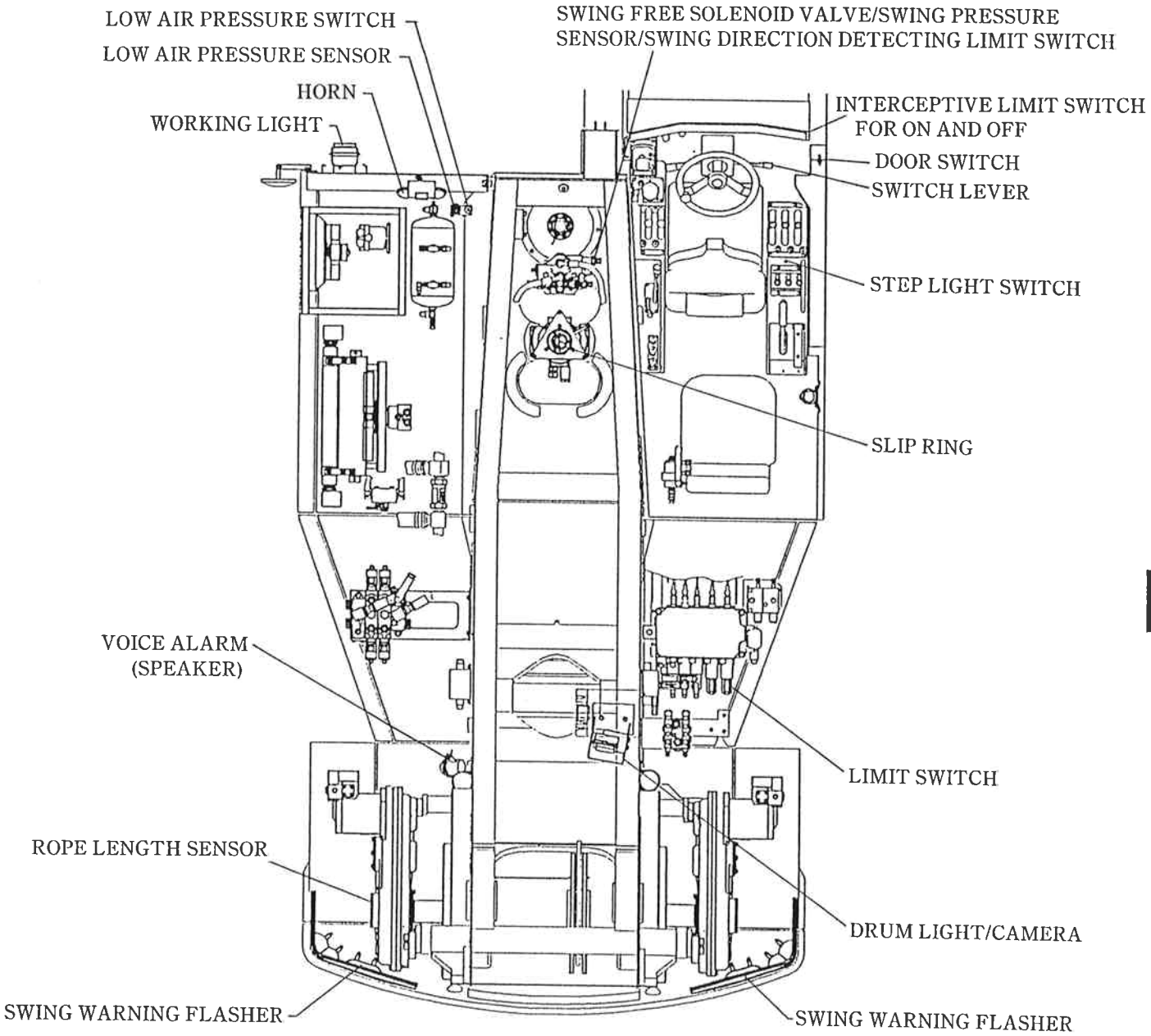
https://truckmanualshub.com/



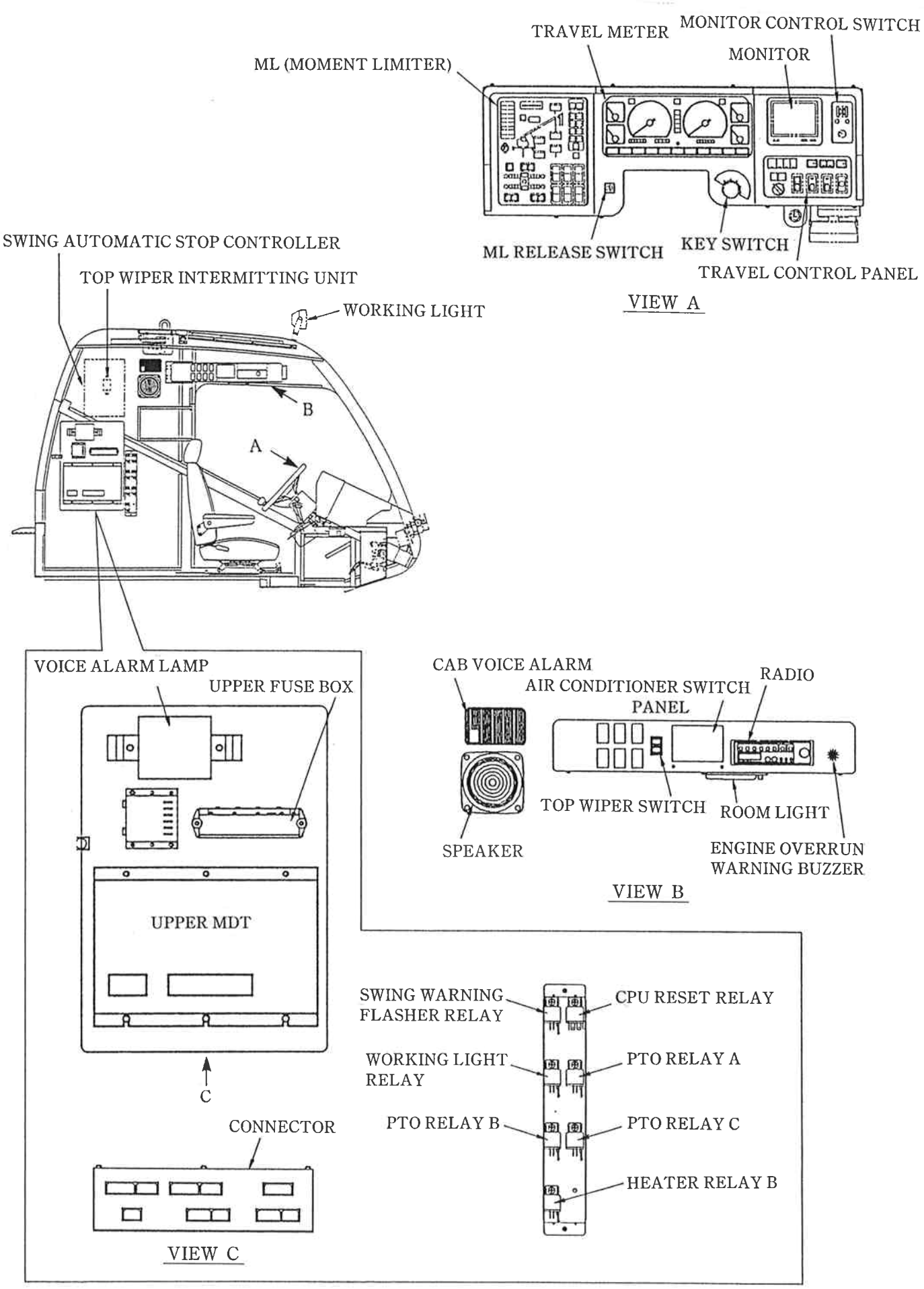
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1.3 ELECTRICAL APPARATUS



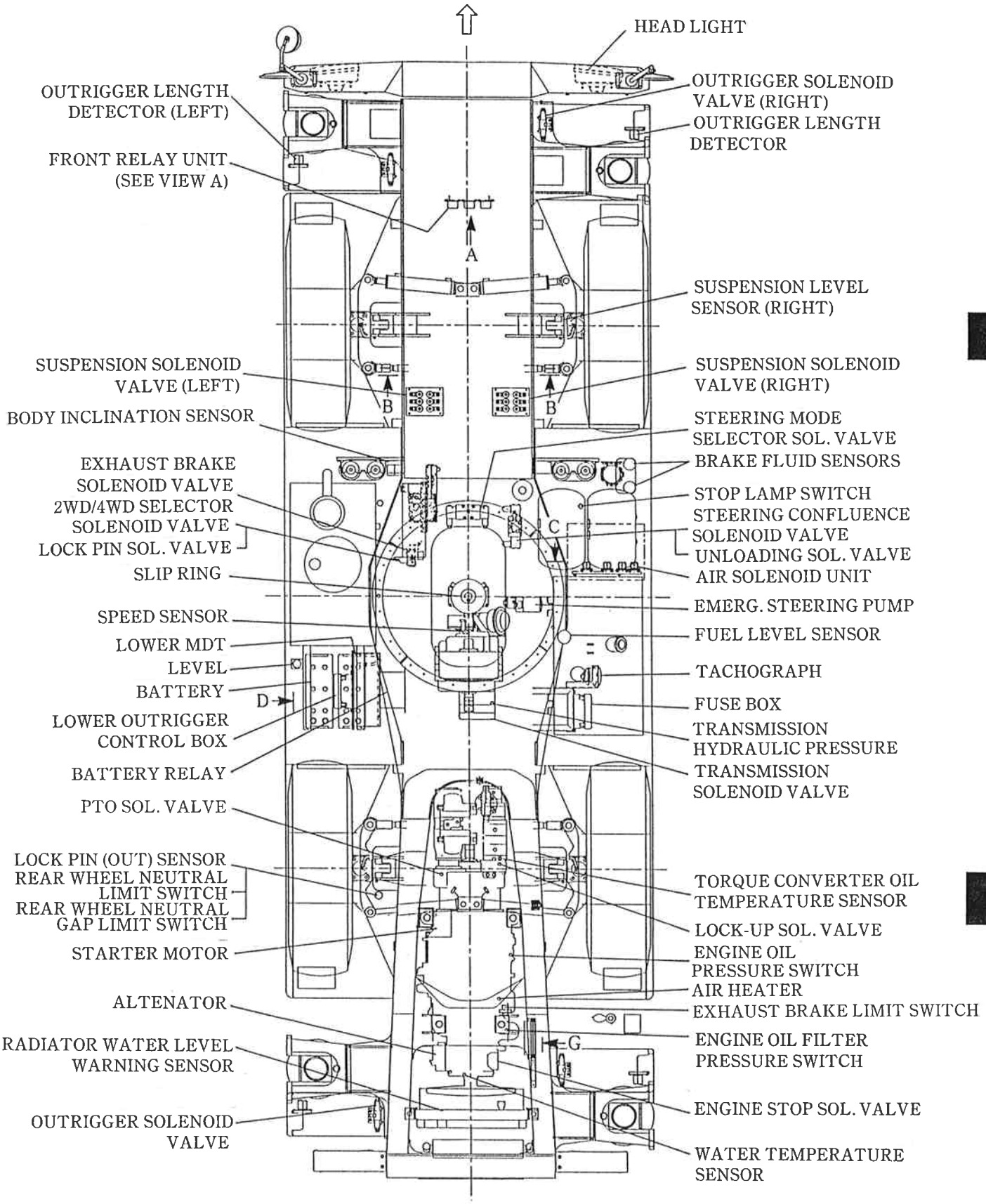


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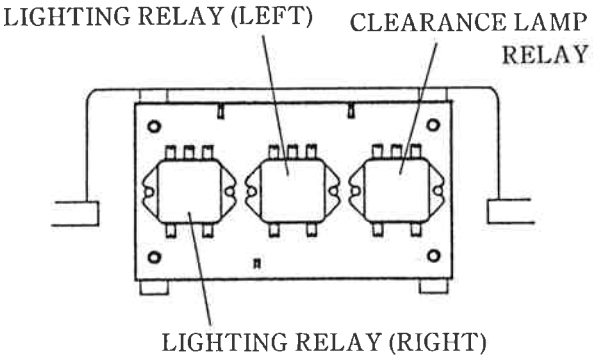


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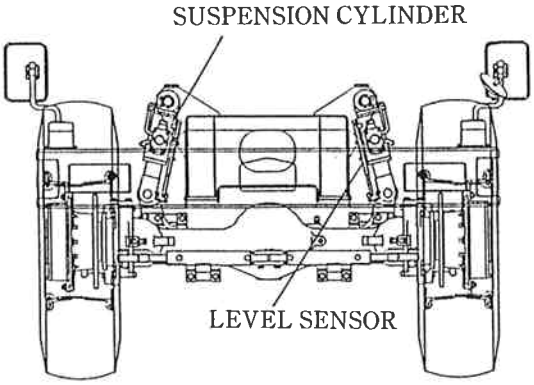
1.4 SETTING POSITIONS FOR LOWER SOLENOID



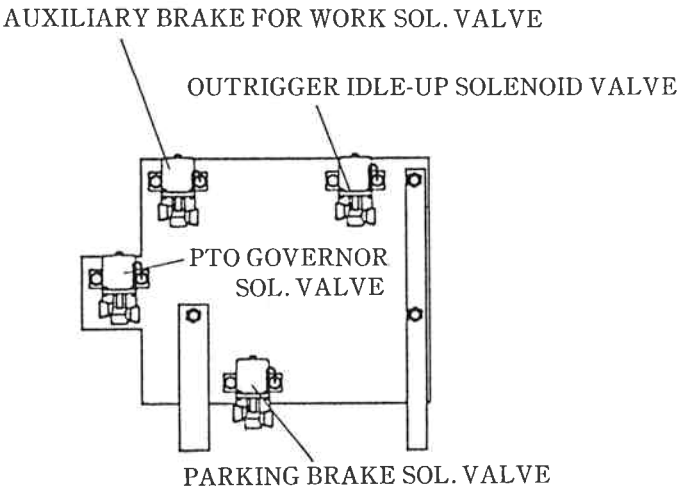
https://truckmanualshub.com/



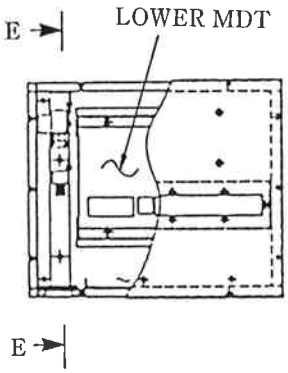
View A. Front Relay Unit



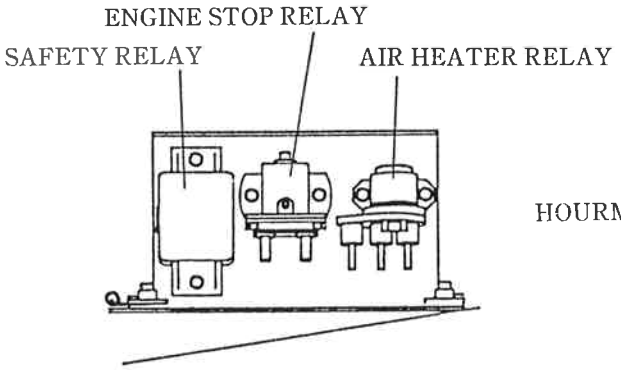
View from B



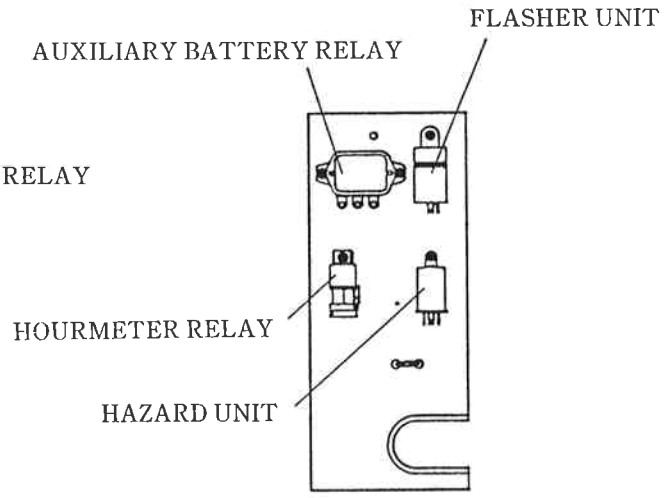
View C. Air Solenoid Unit



View D. Lower MDT



View G. Rear Relay Unit



View E-E. MDT Relay Unit

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2. WEIGHT

Unit : kg (lb)

No.	Name	Weight
1	BOOM ASSEMBLY	4620 (10187)
2	BASE BOOM SECTION	1370 (3021)
2-1	BOOM FOOT PIN	61 (135)
3	2ND BOOM SECTION	1030 (2271)
4	3RD BOOM SECTION	765 (1687)
5	4TH BOOM SECTION	600 (1323)
5-1	SHEAVE (1 QTY)	3.5 (8) (Fig. 2-3)
5-2	PIN	20 (44) (Fig. 2-3)
6		
7	AUXILIARY SHEAVE	32 (70.5)
8	OUTER JIB	310 (684)
9	INNER JIB	160 (353)
10	2ND BOOM TELESCOPE CYLINDER	350 (772)
11	3RD / 4TH BOOM TELESCOPE CYLINDER	350 (772)
12		
13	BOOM HOIST CYLINDER	590 (1301)
13-1	PIN (FRAME)	50 (110)
13-2	PIN (BOOM)	8 (18)
14	COUNTERWEIGHT	590 (1301)
15	MAIN HOOK (25t)	210 (463)
16	OPTION HOOK (18t)	180 (397)
17	BALL HOOK	70 (154)
18	MAIN WINCH WIRE ROPE	195 (430)
19	AUXILIARY WINCH WIRE ROPE	103 (227)
	WIRE ROPE FOR THIRD DRUM	80 (176)

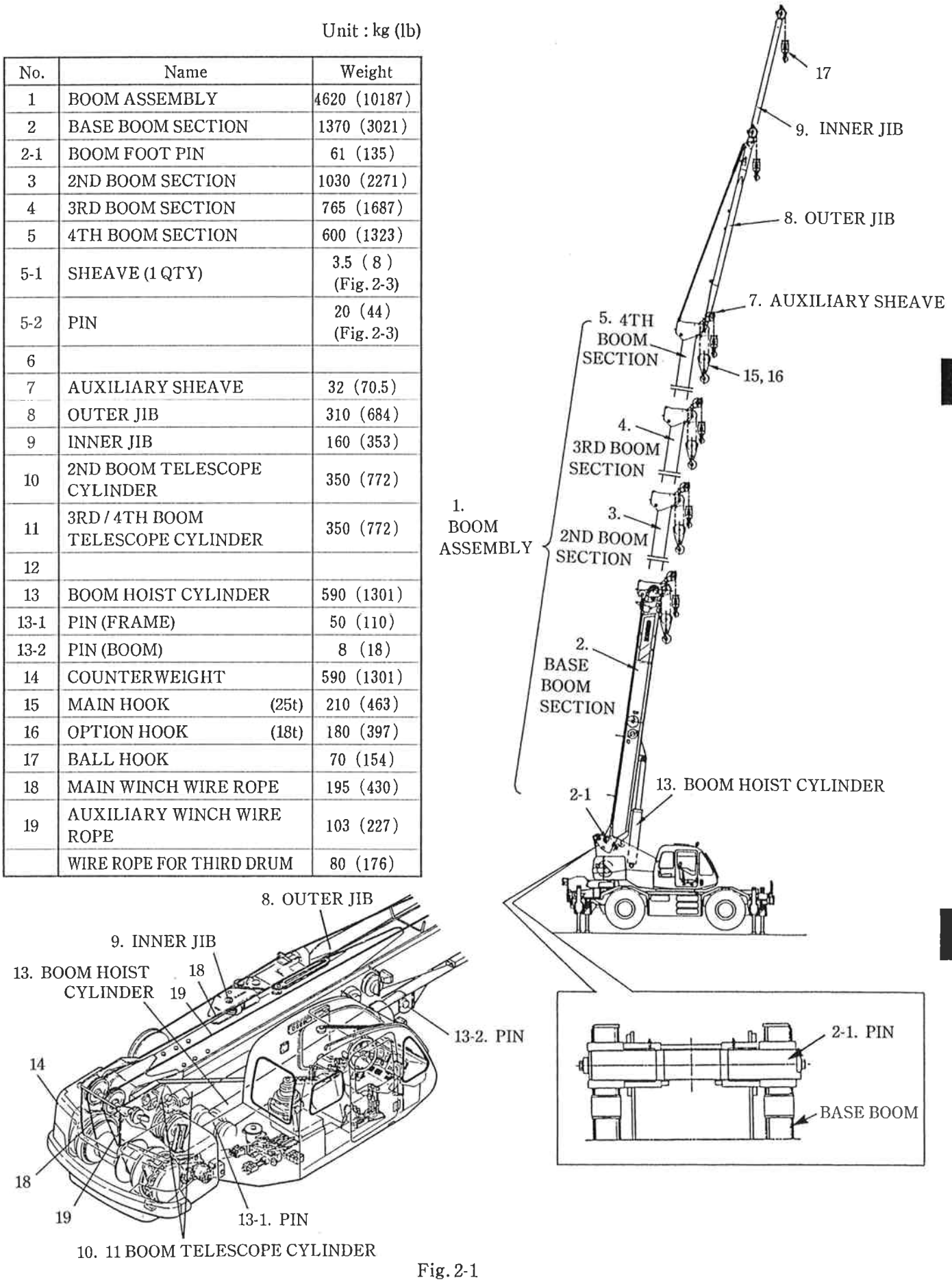


Fig. 2-1

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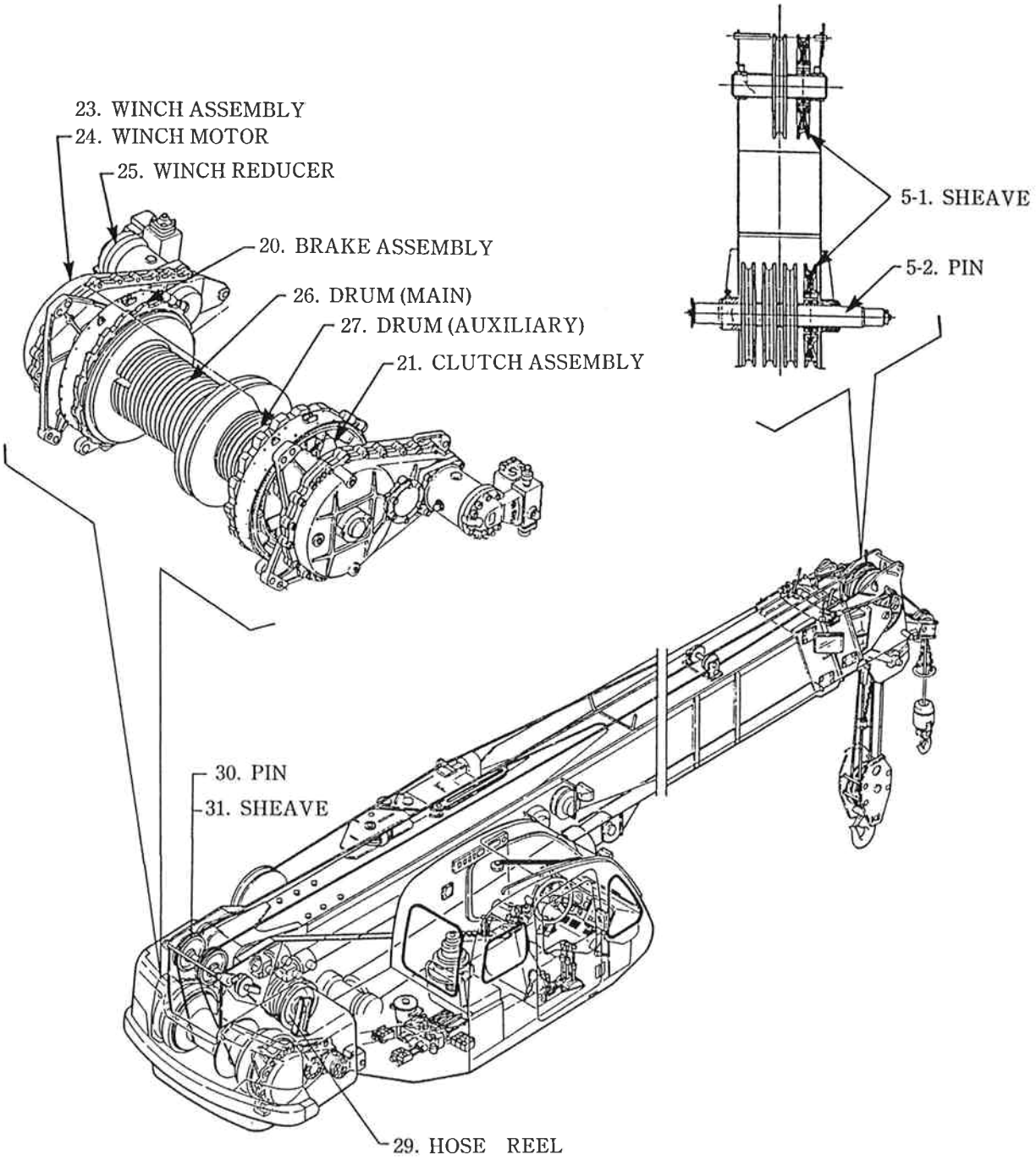


Fig. 2-3

Unit : kg (lb)

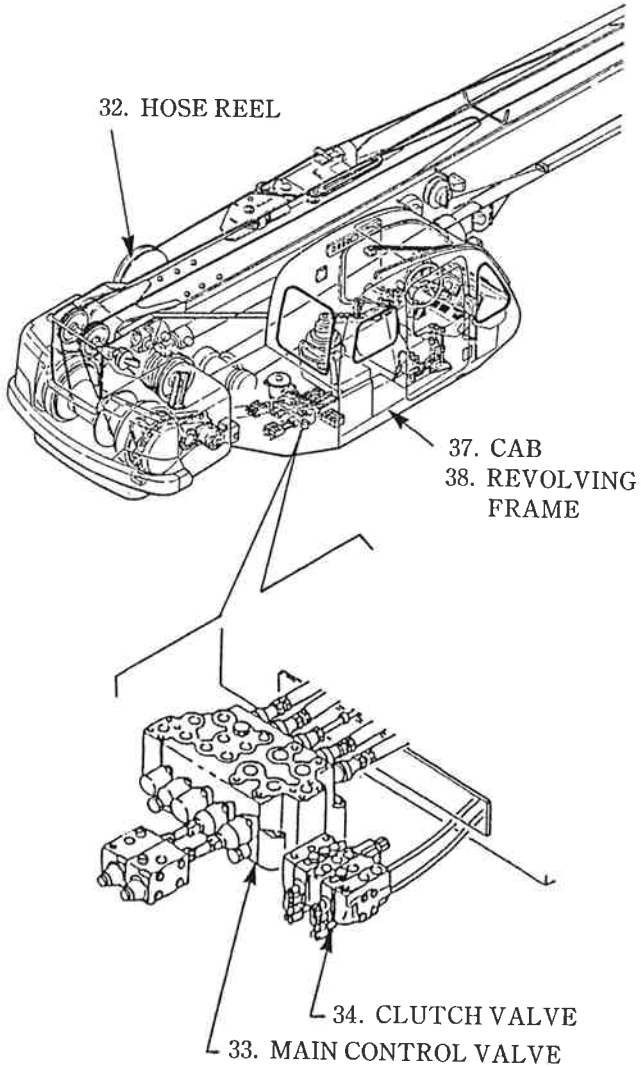
No.	Name	Weight
20	BRAKE ASSEMBLY	30 (66)
21	CLUTCH ASSEMBLY	20 (44)
22	WINCH ASSEMBLY (MAIN)	450 (992)
23	WINCH ASSEMBLY (AUXILIARY)	415 (915)
	THIRD WINCH ASSEMBLY	355 (783)
24	WINCH MOTOR ASSEMBLY	54 (119)
25	WINCH REDUCER (WITH MOTOR)	240 (529)

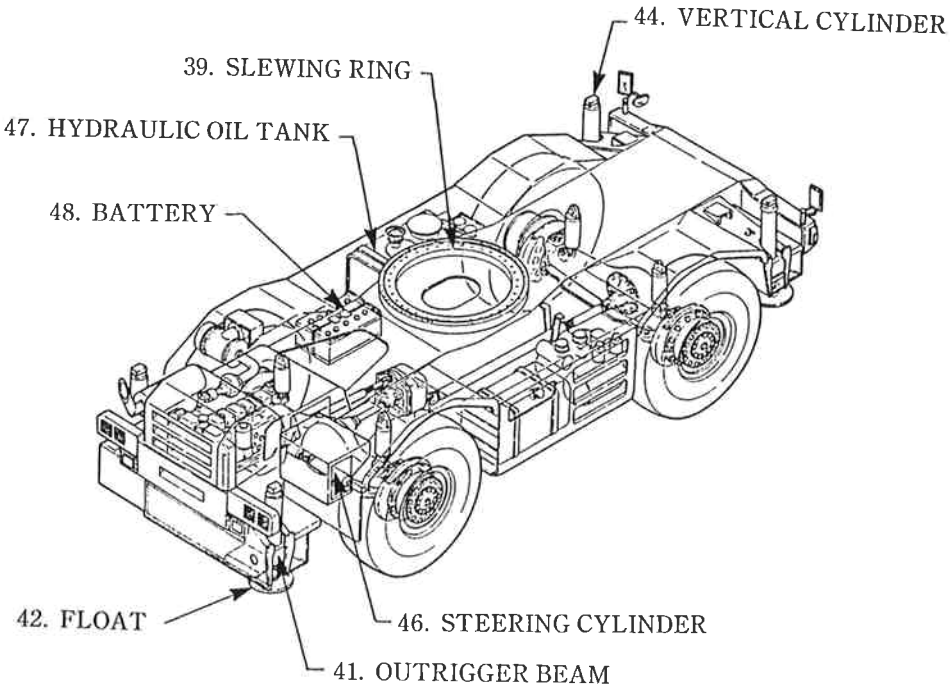
No.	Name	Weight
26	DRUM (MAIN)	141 (311)
27	DRUM (AUXILIARY)	121 (267)
28	SWING REDUCER	121 (267)
29	HOSE REEL	
30	PIN (FOR GANTRY)	35 (77)
31	SHEAVE (FOR GANTRY)	9 (20)

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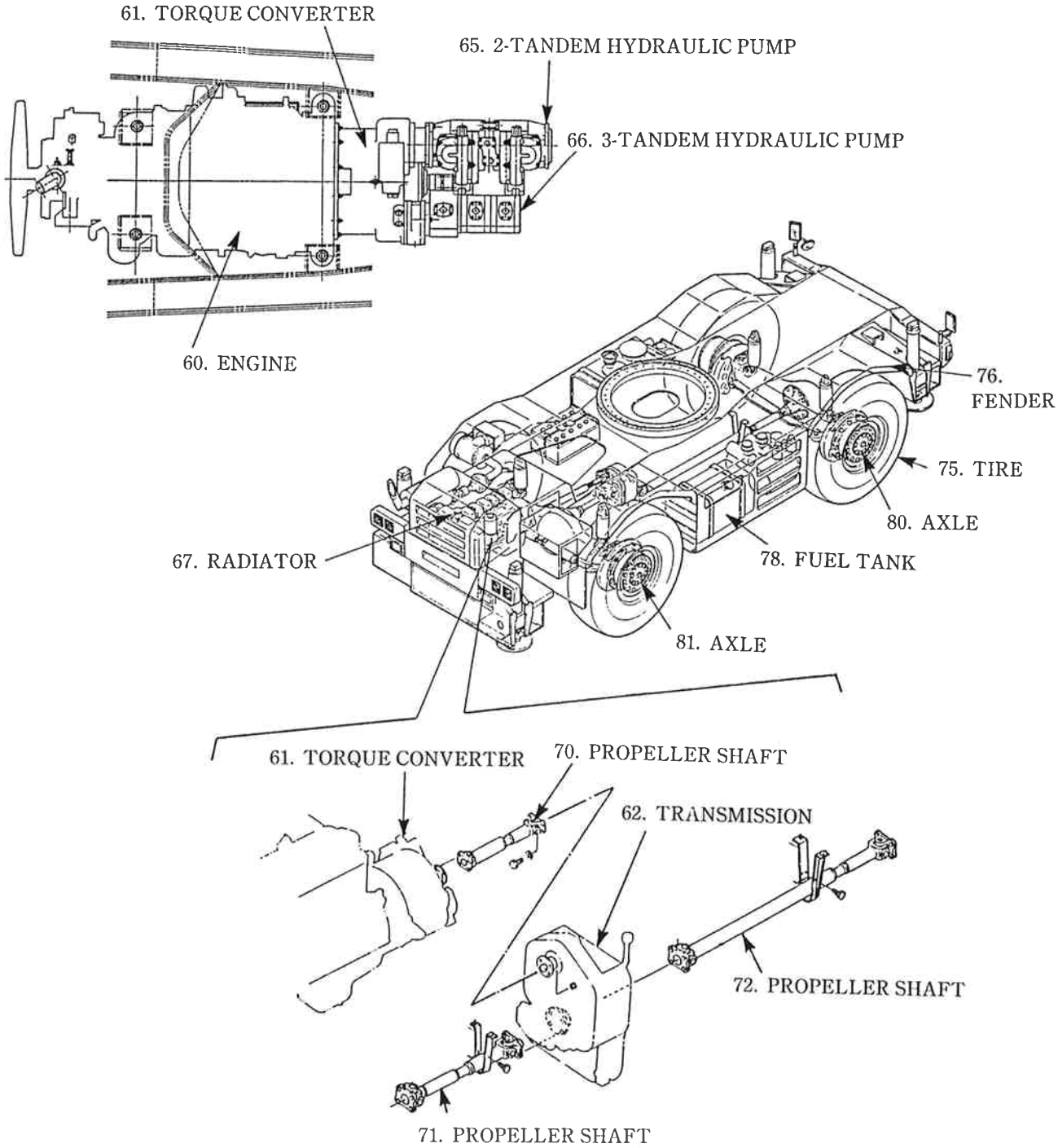
Unit : kg (lb)

No.	Name		Weight
32	HOSE REEL		90 (198)
33	MAIN CONTROL VALVE		83 (183)
34	CLUTCH VALVE		10 (22)
35	SWING CONTROL VALVE		16 (35)
37	CAB		
38	REVOLVING FRAME		
39	SLEWING RING		355 (783)
40	SWIVEL JOINT		73 (161)
41	OUTRIGGER BEAM	X-TYPE	250 (551)
		H-TYPE	340 (750)
42	FLOAT	X-TYPE	31 (68)
		H-TYPE	25 (55)
43	HORIZONTAL CYLINDER	X-TYPE	43 (95)
		H-TYPE	42 (93)
44	VERTICAL CYLINDER	X-TYPE	117 (258)
		H-TYPE	102 (225)
45	AXLE LOCK CYLINDER		48 (106)
46	STEERING CYLINDER		16 (35)
47	HYDRAULIC OIL TANK		136 (300)
48	BATTERY		





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Unit : kg (lb)

No.	Name	Weight
60	ENGINE	550 (1213)
61	TORQUE CONVERTER	160 (353)
62	TRANSMISSION	350 (772)
65	2-TANDEM HYDRAULIC PUMP	80 (176)
66	3-TANDEM HYDRAULIC PUMP	31 (68)
67	RADIATOR	55 (121)
70	PROPELLER SHAFT	11 (24)
71	PROPELLER SHAFT	30 (66)
72	PROPELLER SHAFT	15.5 (34)

No.	Name	Weight
73	TORQUE ROD	12 (26)
75	TIRE	340 (750)
76	FENDER	57 (126)
77		
78	FUEL TANK	40 (88)
79	BRAKE CALIPER (FOR DISC BRAKE)	45 (99)
80	AXLE (FRONT)	1030 (2271)
81	AXLE (REAR)	960 (2116)

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1. PERFORMANCE STANDARDS AND TEST PROCEDURES

(1) Terms used in the standards tables have the following meanings :

Standard value : Standard to be applied to a new machine when it is assembled. Unless specifically noted, standards apply to machines (fitted with standard attachments).

Allowable value : Limit above which the machine must not be used. If this value is reached, the machine must be repaired or components must be replaced to maintain machine performance and safety.

Oil temperature : That of the object in question. The temperature of hydraulic oil refers to that of the hydraulic oil in the tank. Circulate hydraulic oil so that the temperature of the hydraulic oil in the circuit will be equal to that in the tank.

(2) When no allowable value is mentioned, use the standard value as the approximate allowable value for repair or replacement.

(3) Since rubber components such as hydraulic hoses, O-rings and oil seals deteriorate with time, replace them periodically or during overhaul.

(4) For hoses and the like that are particularly important to safety, it is recommended that they be designated "very important parts" (V. I. P.) for safety and be replaced regularly.

(5) Before any attempt to service the machine, a full understanding is required of procedures and precautions for handling it safely, and of check and lubrication procedures. To this end, read the operator's manual together carefully.

1.1 ENGINE REVOLUTIONS

● Test Procedures

a. Machine posture : With outriggers extended.

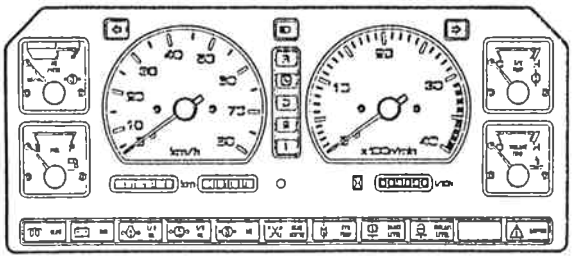
b. Measurement : Measure after warming running.

c. Load : No load.

d. Number of measurements : 3, use average for value.

e. To confirm engine revolutions when the exhaust brake functions, lower the engine speed to a low idling speed after the exhaust brake functions, then depress the accelerator pedal, and read the engine rpm when the exhaust brake switch is turned off.

(Unit : rpm)

Item		Standard Value	Remarks
High idle	P.T.O. 「ON」	1980~2000	Confirm the engine rpm with the engine tachometer in front of the operator's seat. 
	P.T.O. 「OFF」	2940~3040	
Low idle	P.T.O. 「OFF」	660~700	
When exhaust brake functions.		700~750	

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1.2 OIL TIGHTNESS

(1) Boom hoist cylinder

● Test procedures

a. Machine conditions : Outriggers extended, and boom fully retracted.

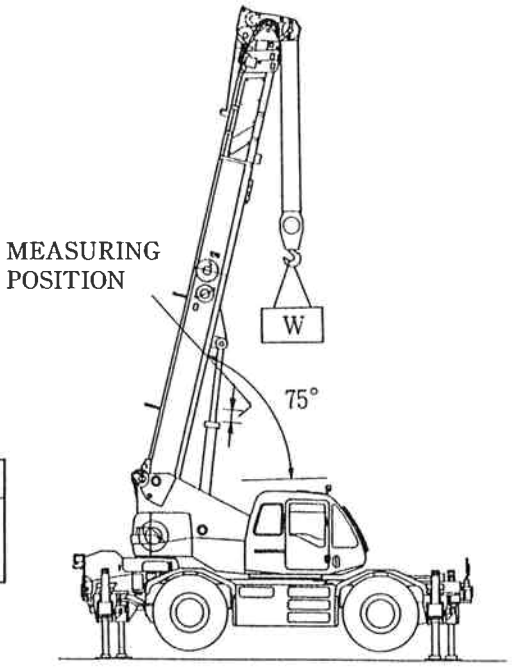
b. Boom angle : After raising boom to max., lower it to 75° , then measure

c. Load : 2.3tons (5071 lbs.)

d. Hydraulic oil temperature : Normal temperature

e. Test time : 30 minutes

f. Part of rope reeving : 4 parts



Item	Standard Value	Remarks
Amount of boom hoist cylinder retraction	Less than 10㎜ / 30min (0.4 inch)	

(2) Boom telescoping cylinder and whole boom system

● Test procedures

a. Machine conditions : Outriggers extended

b. Boom angle : 75°

c. Reeving : 4 parts

d. Load : 2.3tons (5071 lbs.)

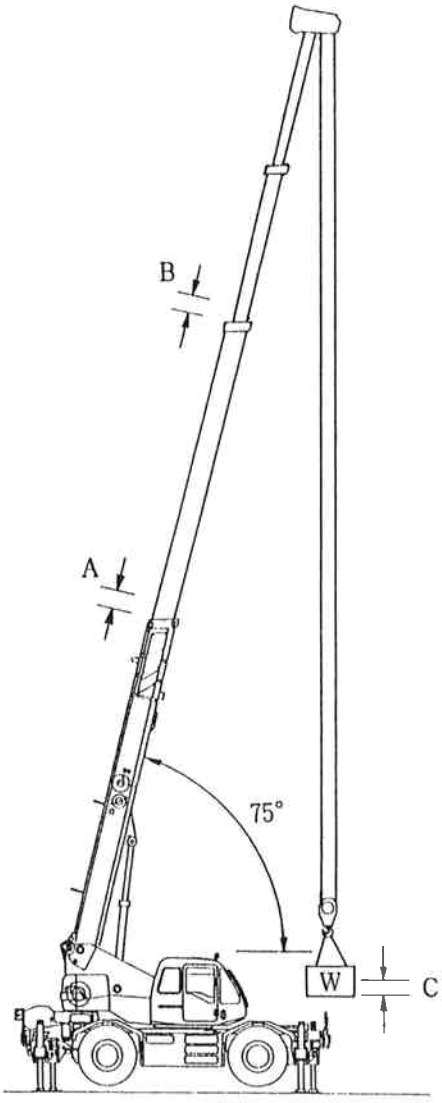
e. Hydraulic oil temperature : Normal temperature

f. Test time : 30 minutes

g. Boom length when starting measurement
2nd boom : Extend fully and retract 1m.
3rd / 4th booms : Extend to more than half length, then retract to half length

h. Place a mark on each boom section and measure how far the boom retracts under load.

i. Determine overall oil tightness of the whole boom system by measuring how much the load falls.



Item	Standard Value	Remarks
Amount of 2nd boom retraction ; A (Oil tightness of 2nd boom telescoping cylinder)	Less than 25㎜ (0.984″) / 30min	
Amount of 3rd / 4th boom retraction ; B (Oil tightness of 3rd and 4th boom telescoping cylinder)	Less than 25㎜ (0.984″) / 30min	
Amount of suspending load fall ; C (Overall oil tightness boom system)	Less than 120㎜ (4.72″) / 30min	Including amount of boom hoist cylinder fall

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(3) Winch

With winch negative brake on, winch drum shouldn't rotate.

(4) Winch motor drain volume, and, swing motor drain volume

● Test procedures

a. Hydraulic oil temperature : 50±5℃ (122±9°F)

b. Engine revolutions : High idle

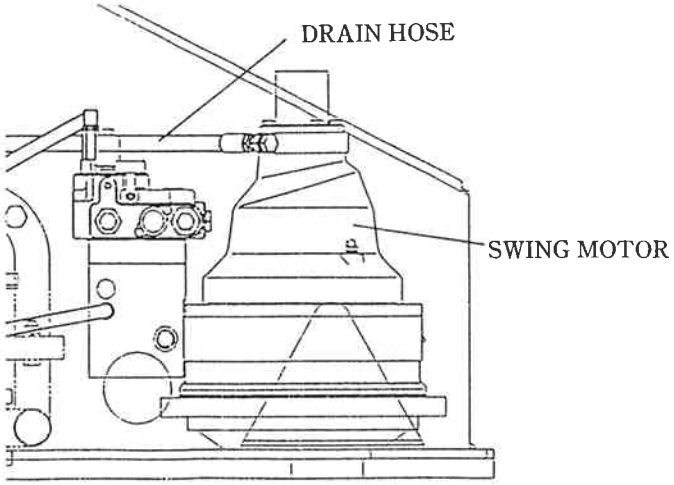
c. Hydraulic load : Relief

d. Measuring point : Disconnect the drain piping then measure the drain volume caught in a container

e. Before testing the winch motor, be sure to apply the drum lock and move the lever to the LOWERING side.

f. Before testing the swing motor, be sure to apply the swing brake lock.

g. Test time : 1 minute



DRAIN OF SWING MOTOR

Item	Standard Value	Remarks
Amount of drain from winch motor	Less than 10ℓ / min (2.6gals)	
Amount of drain from swing motor	Less than 10ℓ / min (2.6gals)	

1.3 OIL PRESSURE

(1) Oil pressure measurement precautions

a. Use pressure gauges with capacity at least 50kg / ㎠ (711 psi) greater than the pressure to be measured.

b. Only use pressure gauges that have passed rigid inspection.

(2) Boom hoist / telescope circuit and winch circuit

● Test procedures

a. Engine revolutions : high idle

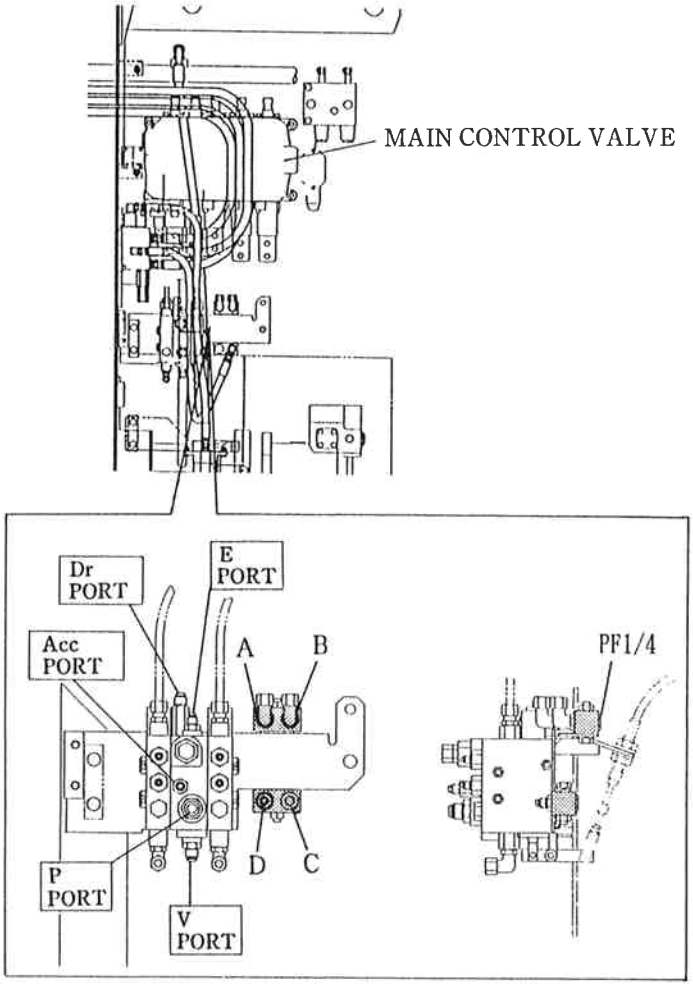
b. Hydraulic oil temperature : Normal temperature

c. Boom hoist :

Relieve hydraulic pressure by fully extending and retracting the boom hoist cylinder with the boom fully retracted, and measure relief pressure at pressure measure port "A" .

d. Boom telescope :

Relieve hydraulic pressure by fully extending and retracting the 2nd boom, and measure relief pressure at pressure measure port "A" .



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(3) Winch

With winch negative brake on, winch drum shouldn't rotate.

(4) Winch motor drain volume, and, swing motor drain volume

● Test procedures

a. Hydraulic oil temperature : 50±5℃ (122±9°F)

b. Engine revolutions : High idle

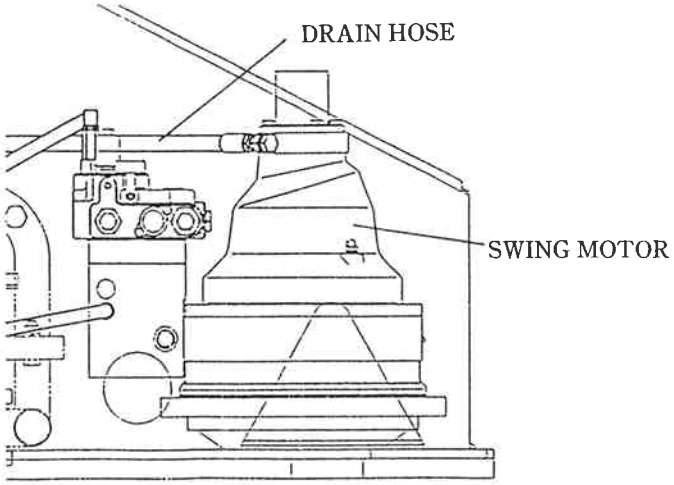
c. Hydraulic load : Relief

d. Measuring point : Disconnect the drain piping then measure the drain volume caught in a container

e. Before testing the winch motor, be sure to apply the drum lock and move the lever to the LOWERING side.

f. Before testing the swing motor, be sure to apply the swing brake lock.

g. Test time : 1 minute



DRAIN OF SWING MOTOR

Item	Standard Value	Remarks
Amount of drain from winch motor	Less than 10ℓ / min (2.6gals)	
Amount of drain from swing motor	Less than 10ℓ / min (2.6gals)	

1.3 OIL PRESSURE

(1) Oil pressure measurement precautions

a. Use pressure gauges with capacity at least 50kg / ㎠ (711 psi) greater than the pressure to be measured.

b. Only use pressure gauges that have passed rigid inspection.

(2) Boom hoist / telescope circuit and winch circuit

● Test procedures

a. Engine revolutions : high idle

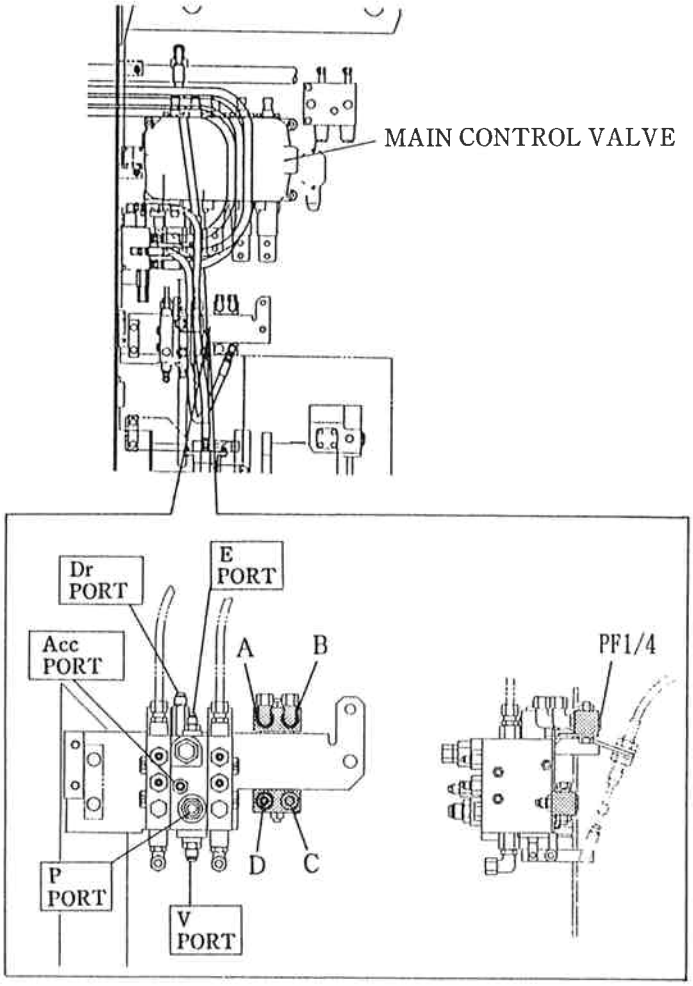
b. Hydraulic oil temperature : Normal temperature

c. Boom hoist :

Relieve hydraulic pressure by fully extending and retracting the boom hoist cylinder with the boom fully retracted, and measure relief pressure at pressure measure port "A" .

d. Boom telescope :

Relieve hydraulic pressure by fully extending and retracting the 2nd boom, and measure relief pressure at pressure measure port "A" .



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e. Winch circuit :
Relieve hydraulic pressure by operating lowering with the drum locked, and measure relief pressure at pressure measure port "B" .

f. Tilt jib hoist :
Relieve hydraulic pressure by fully extending and retracting the jib hoist cylinder with the jib extended and with the basic boom length, and measure relief pressure at pressure measure port "C" .

Unit : kg / cm² (psi)

Measuring Position	Item		Standard Value	Remarks
A	Relief pressure of boom hoist circuit	Ext.	245 to 255 (3484 to 3626)	Main relief valve
		Retr.	130 to 140 (1849 to 1991)	Port relief valve
A	Relief pressure of boom telescope circuit	Ext.	160 to 170 (2275 to 2417)	Port relief valve
		Retr.	200 to 215 (2844 to 3057)	Port relief valve
B	Relief pressure of winch circuit		250 to 260 (3555 to 3697)	Main relief valve
C	Relief pressure of tilt jib hoist circuit	Ext.	75 to 85 (1067 to 1209)	Port relief valve
		Retr.	205 to 215 (2915 to 3057)	Main relief valve

(3) Pilot circuit

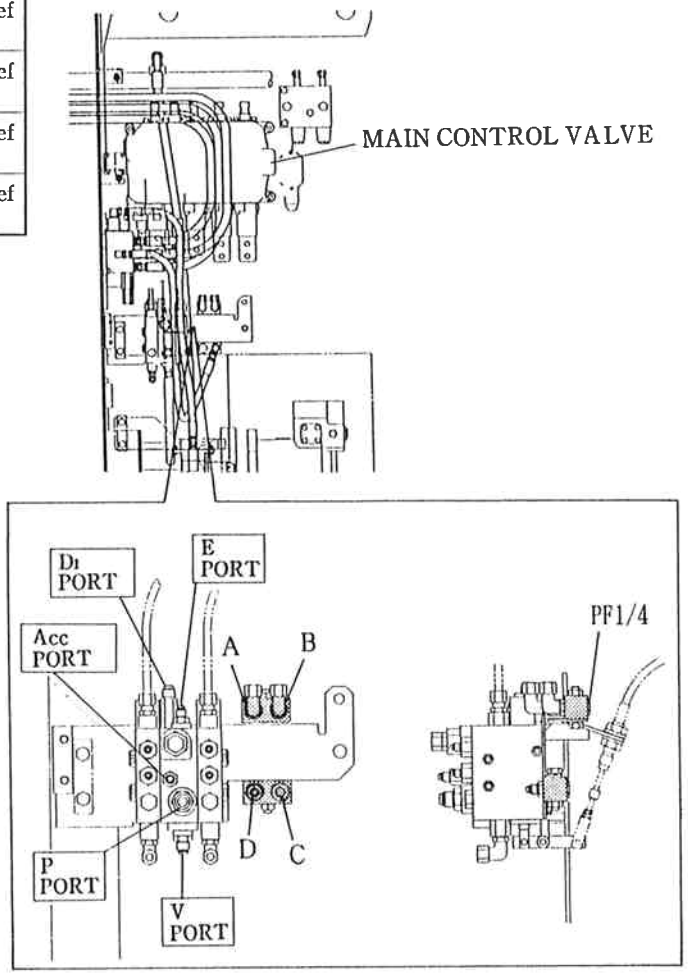
● Test procedures

a. Engine revolutions : Low idle

b. Hydraulic oil temperature : Normal temperature

c. Measure unloading pressure and loading pressure of clutch valve.
Unloading pressure :
Measure pressure when the gauge pressure stops at the highest pressure.
Loading pressure :
Operate the clutch lever to ON and OFF continuously from the unloading condition, and measure the pressure when the gauge pressure stats rising again from lowering condition.

NOTE : When operating the clutch lever to ON and OFF continuously, be sure to operate with the drum lock applied.



Measuring Position of Pilot Circuit

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Unit : kg / cm² (psi)

Measure position	Item	Standard value	Remarks
D	Clutch pressure "Loading pressure"	85 to 95 (1209 to 1351)	
	Clutch pressure "Unloading pressure"	115 to 130 (1635 to 1849)	

(4) Swing Circuit

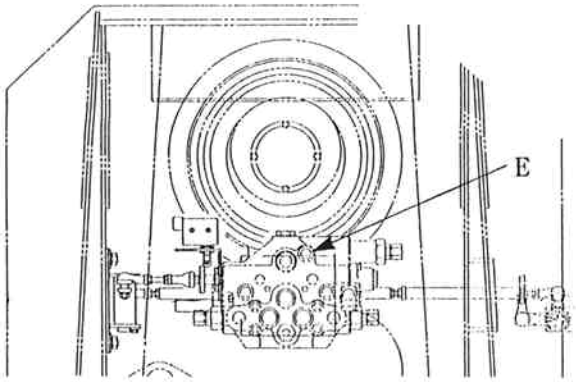
● Test procedures

a. Engine revolutions : High idle

b. Hydraulic oil temperature : Normal temperature

c. Swing Circuit :

With the swing brake engaged and with the swing lock pin engaged, operate swing, and measure the relief pressure. Measure the pressure for left swing and right swing respectively.



Measuring Position of Swing Circuit

Unit : kg / cm² (psi)

Measure position	Item	Standard Value	Remarks
E	Swing main relief pressure	200 to 210 (2844 to 2986)	Gauge port : PF1 / 4

(5) Outrigger Circuit

● Test procedures

a. Engine revolutions : High idle

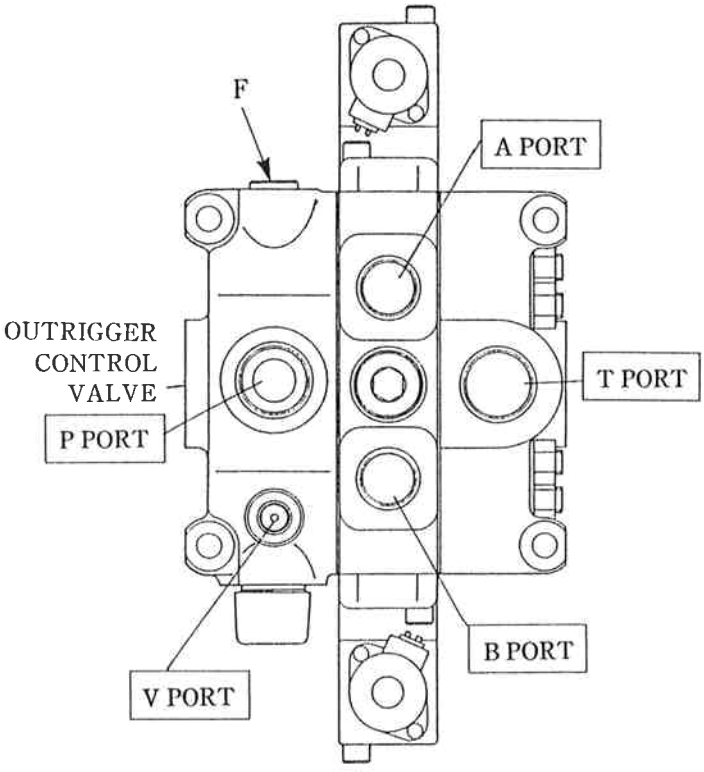
b. Hydraulic oil temperature : Normal temperature

c. Outrigger Circuit :

Measure relief pressure of the vertical cylinder or horizontal cylinder.

Unit : kg / cm² (psi)

Measure position	Item	Standard Value	Remarks
F	Outrigger main relief pressure	165 to 175 (2346 to 2489)	Gauge port : PF1 / 4



Measuring Position of Outrigger Circuit

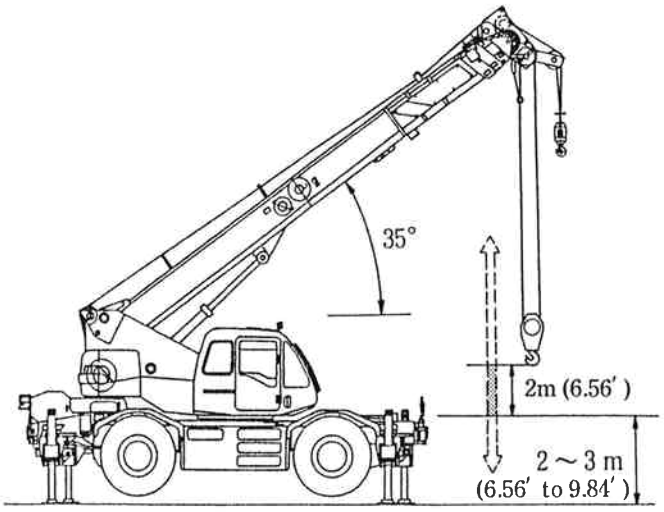
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1.4 SPEED PERFORMANCE

(1) Raising and Lowering Speeds of Main Winch

● Test procedures

a. Machine conditions : Outriggers extended.
b. Engine revolutions : High idle
c. Hydraulic oil temperature : Normal temperature
d. Load : No load
e. Reeving : 4 parts
f. Boom length : Fully retracted.
g. Boom angle : 35°
h. Measuring range : 2 meters (6.56ft.) (Measure in process of raising and lowering.)



Unit : sec

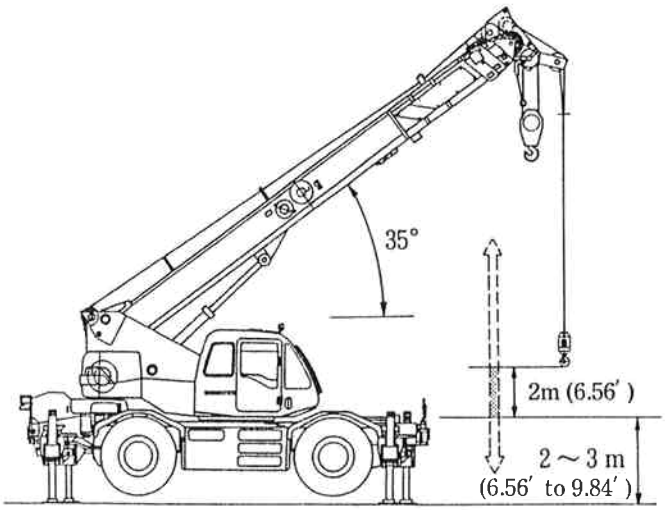
Item		Standard Value	Remarks
Raising Speed	1st speed	Upto 8.0	· Drive winch motor.
	2nd speed	Upto 4.3	· Measure three times and average the results.
Lowering Speed	1st speed	Upto 8.0	· Standard value shows the time required for moving 2 meters (6.56 ft).
	2nd speed	Upto 4.5	

For measurement of the 1st speed, measure with the telescoping relieved.

(2) Raising and Lowering Speeds of Auxiliary Winch

● Test procedures

a. Machine conditions : Outriggers extended
b. Engine revolutions : High idle
c. Hydraulic oil temperature : Normal temperature
d. Load : No load
e. Reeving : 1 part
f. Boom length : Fully retracted
g. Boom angle : 35°
h. Measuring range : 2 meters (6.56ft) (Measure in process of raising and lowering.)



Unit : sec

Item		Standard Value	Remarks
Raising Speed	1st speed	Upto 2.1	· Drive winch motor.
	2nd speed	Upto 1.1	· Measure three times and average the results.
Lowering Speed	1st speed	Upto 2.0	· Standard value shows the time required for moving 2 meters (6.56 ft).
	2nd speed	Upto 1.2	

For measurement of the 1st speed, measure with the telescoping relieved.

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(3) Free Fall of Main Winch

● Test procedures

a. Engine revolutions : Low idle

b. Hydraulic oil temperature : Normal temperature

c. Load : No load

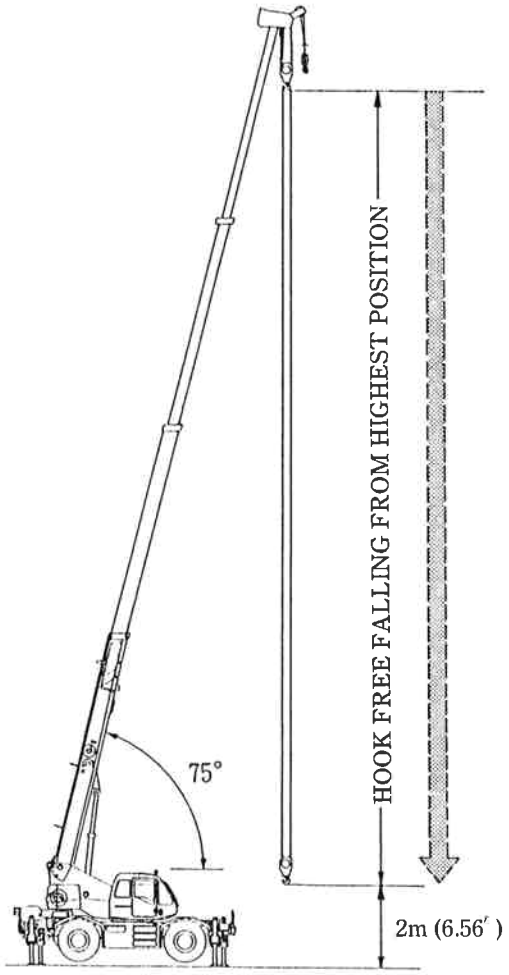
d. Reeving : 4 parts

e. Boom length : Extended fully

f. Boom angle : 75°

g. Measure range : Time required for hook falling from the bottom of the overhoist preventive device weight to 2 meters (6.56ft.) above the ground.

Item	Standard Value	Remarks
Free fall	Less than 30 sec	Measure three times, and average the results



(4) Free Fall of Auxiliary Winch

● Test procedures

a. Engine revolutions : Low idle

b. Hydraulic oil temperature : Normal temperature

c. Load : No load

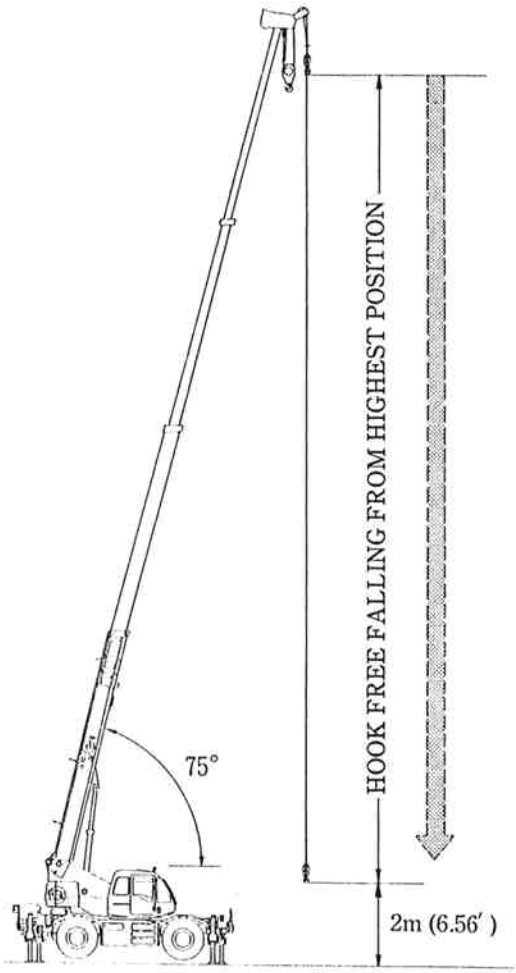
d. Reeving : 1 part

e. Boom length : Extended fully

f. Boom angle : 75°

g. Measure range : Time required for hook falling from the bottom of the overhoist preventive device weight to 2 meters (6.56ft) above the ground.

Item	Standard Value	Remarks
Free fall	Less than 8.5 sec	Measure three times, and average the results



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(5) Boom hoist speed

● Test procedures

a. Machine conditions : Outriggers extended

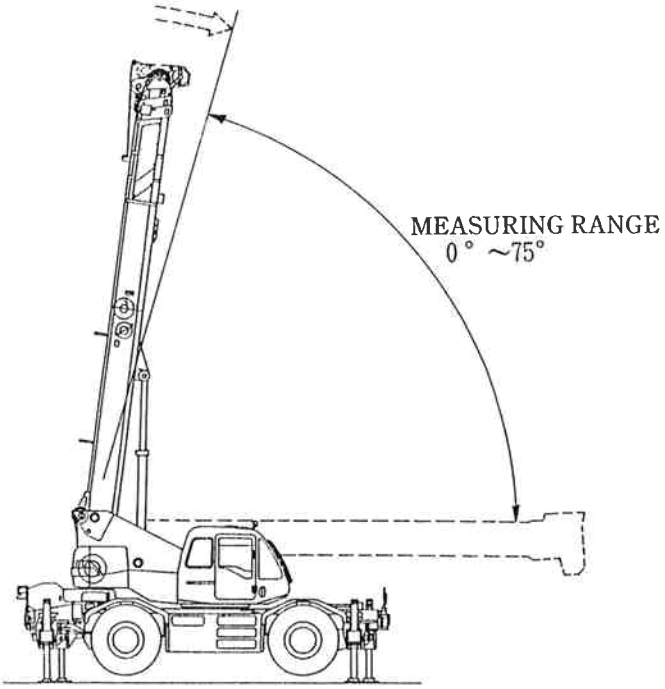
b. Engine revolutions : High idle

c. Hydraulic oil temperature : Normal temperature

d. Load : No load

e. Boom length : Retracted fully

Measuring range : 0~75°



Item	Standard Value	Remarks	
Boom raising speed	Less than 50 sec.	Measure the time required for boom to be raised from 0° to 75° of boom angle.	· Measure three times, and average the results.
Boom lowering speed	Less than 60 sec.	Lower boom from 80° of boom angle, and measure the time required for boom to be lowered from 75° to 0° of boom angle.	

(6) Boom telescoping speed

● Test procedures

a. Machine conditions : Outriggers extended

b. Engine revolutions : High idle

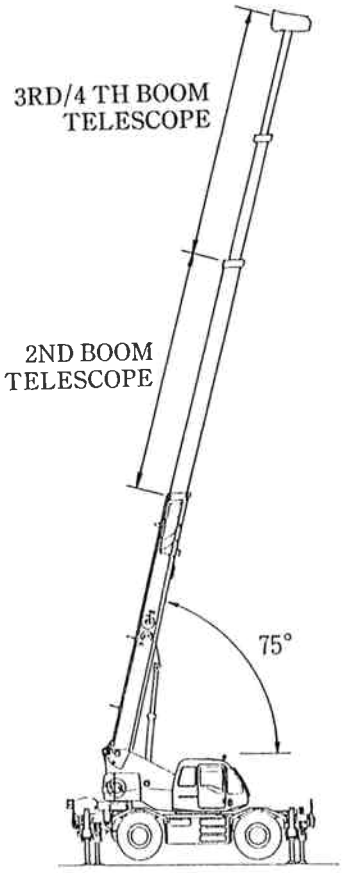
c. Hydraulic oil temperature : Normal temperature

d. Load : No load

e. Reeving : 4 parts

f. Boom angle : 75°

g. Measure the time it takes for the boom telescope cylinder to go from the fully retracted (or extended) position to the fully extended (or retracted) position.



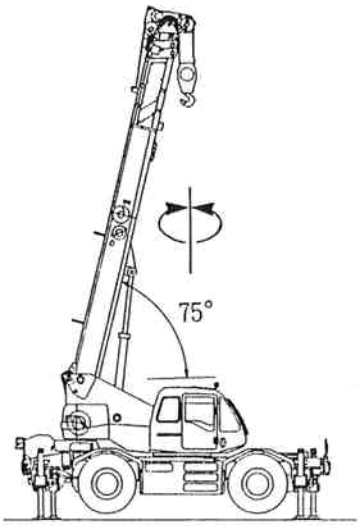
Item	Standard Value	Remarks
2nd boom extending speed	Less than 51.7 sec.	Measure three times and average the results.
2nd boom retracting speed	Less than 52 sec.	
3rd / 4th booms extending speed	Less than 58.3 sec.	
3rd / 4th booms retracting speed	Less than 72 sec.	

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(7) Swing speed

● Test procedures

a. Machine conditions : Outriggers extended.
b. Engine revolutions : High idle
c. Hydraulic oil temperature : Normal temperature
d. Boom length : Retracted fully
e. Boom angle : 75°
f. Load : No load
g. Measure the time required for two turns from the end of the 1st turn to the end of the 3rd turn.

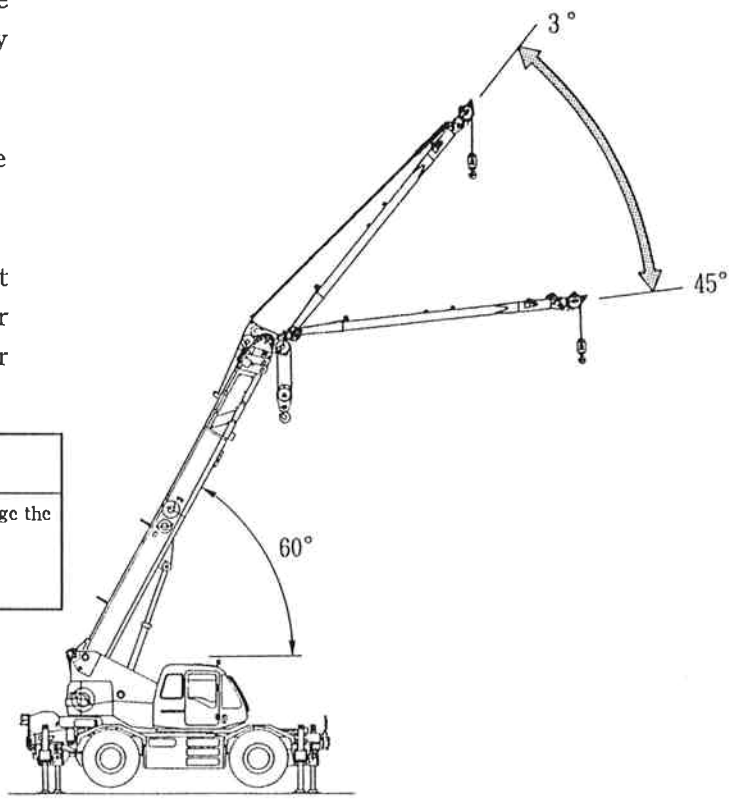


Item	Standard Value	Remarks
Swing speed (left)	Less than 47.3 sec / 2 turns	Measure the time required for 2 turns from the end of the 1st turn to the end of the 3rd turn.
Swing speed (right)		

(8) Sky tilt jib hoist speed

● Test procedures

a. Machine conditions : Outriggers extended, one step jib extended and boom fully retracted.
b. Engine revolutions : High idle
c. Hydraulic oil temperature : Normal temperature
d. Load : No load
e. Boom angle : 60°
f. Measure the time it takes for the jib hoist cylinder to go from the fully retracted (or extended) position to the fully extended (or retracted) position.



Item	Standard Value	Remarks
Jib raising speed	Less than 34.4 sec. / full stroke	Measure three times, and average the results.
Jib lowering speed	Less than 65.0 sec. / full stroke	

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1. TIGHTENING TORQUE OF CAPSCREWS AND NUTS

Unless otherwise specified, torque all screws and nuts on this machine to the values shown in the following tables.

1.1 METRIC COARSE THREADS

Unit : kg-m (ft-lbs)

Classification / Nominal size	Metric Coarse Threads					
	4T		7T		10T	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M 6	0.45 (3.25)	0.38 (2.75)	0.9(6.51)	0.8(5.79)	1.7(12.3)	1.5(10.9)
M 8	1.09 (7.88)	0.9 (6.51)	2.4(17.4)	2.0(14.5)	4.3(31.1)	3.6(26.0)
M 10	2.2 (15.9)	1.8 (13.0)	4.7(34.0)	4.0(28.9)	8.5(61.5)	7.2(52.1)
M 12	3.7 (26.8)	3.2 (23.2)	8.1(58.6)	6.8(49.2)	14.6(106)	12.3(89.0)
M 14	5.9 (42.7)	5.0 (36.2)	12.8(92.6)	10.8(78.1)	23.0(166)	19.5(141)
M 16	9.0 (65.1)	7.6 (55.0)	19.5(141)	16.4(119)	35.0(253)	29.0(210)
M 18	12.4 (89.7)	10.5 (76.0)	27.0(195)	23.0(166)	49.0(354)	41.0(297)
M 20	17.5 (127)	14.7 (106)	38.0(275)	32.0(232)	68.0(492)	57.0(412)
M 22	23.0 (166)	19.6 (142)	51.0(369)	43.0(311)	92.0(665)	77.0(557)
M 24	30.0 (217)	24.0 (174)	65.0(470)	53.0(383)	118.0(854)	96.0(964)
M 27	44.0 (318)	36.0 (260)	96.0(694)	78.0(564)	173.0(1251)	140.0(1012)
M 30	60.0 (434)	50.0 (362)	131.0(948)	110.0(796)	–	–
M 33	81.0 (586)	68.0 (492)	176.0(1273)	148.0(1070)	–	–
M 36	105.0 (760)	88.0 (637)	–	–	–	–

1.2 METRIC FINE THREADS

Unit : kg-m (ft-lbs)

Classification / Nominal size	Fine Threads					
	4T		7T		10T	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M 6	1.1 (7.96)	0.4 (2.89)	2.5(15.2)	2.1(15.2)	4.5(32.6)	3.8(27.5)
M 10	2.3 (16.6)	1.9 (13.7)	4.9(35.4)	4.2(30.4)	8.9(64.4)	7.5(54.3)
M 12	4.0 (28.9)	3.4 (24.6)	8.7(62.9)	7.3(52.8)	15.7(114)	13.2(95.5)
M 16	9.0 (65.1)	7.3 (52.8)	20.0(145)	17.2(124)	37.0(268)	31.0(224)
M 20	19.0 (137)	15.8 (114)	41.0(297)	34.0(246)	74.0(535)	62.0(448)
M 24	32.0 (232)	27.0 (195)	70.0(506)	56.0(405)	126.0(911)	105.0(760)
M 30	65.0 (470)	54.0 (391)	142.0(1027)	118.0(854)	–	–
M 36	109.0 (788)	91.0 (658)	–	–	–	–

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1. TIGHTENING TORQUE OF CAPSCREWS AND NUTS

Unless otherwise specified, torque all screws and nuts on this machine to the values shown in the following tables.

1.1 METRIC COARSE THREADS

Unit : kg-m (ft-lbs)

Classification / Nominal size	Metric Coarse Threads					
	4T		7T		10T	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M 6	0.45 (3.25)	0.38 (2.75)	0.9(6.51)	0.8(5.79)	1.7(12.3)	1.5(10.9)
M 8	1.09 (7.88)	0.9 (6.51)	2.4(17.4)	2.0(14.5)	4.3(31.1)	3.6(26.0)
M 10	2.2 (15.9)	1.8 (13.0)	4.7(34.0)	4.0(28.9)	8.5(61.5)	7.2(52.1)
M 12	3.7 (26.8)	3.2 (23.2)	8.1(58.6)	6.8(49.2)	14.6(106)	12.3(89.0)
M 14	5.9 (42.7)	5.0 (36.2)	12.8(92.6)	10.8(78.1)	23.0(166)	19.5(141)
M 16	9.0 (65.1)	7.6 (55.0)	19.5(141)	16.4(119)	35.0(253)	29.0(210)
M 18	12.4 (89.7)	10.5 (76.0)	27.0(195)	23.0(166)	49.0(354)	41.0(297)
M 20	17.5 (127)	14.7 (106)	38.0(275)	32.0(232)	68.0(492)	57.0(412)
M 22	23.0 (166)	19.6 (142)	51.0(369)	43.0(311)	92.0(665)	77.0(557)
M 24	30.0 (217)	24.0 (174)	65.0(470)	53.0(383)	118.0(854)	96.0(964)
M 27	44.0 (318)	36.0 (260)	96.0(694)	78.0(564)	173.0(1251)	140.0(1012)
M 30	60.0 (434)	50.0 (362)	131.0(948)	110.0(796)	–	–
M 33	81.0 (586)	68.0 (492)	176.0(1273)	148.0(1070)	–	–
M 36	105.0 (760)	88.0 (637)	–	–	–	–

1.2 METRIC FINE THREADS

Unit : kg-m (ft-lbs)

Classification / Nominal size	Fine Threads					
	4T		7T		10T	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
M 6	1.1 (7.96)	0.4 (2.89)	2.5(15.2)	2.1(15.2)	4.5(32.6)	3.8(27.5)
M 10	2.3 (16.6)	1.9 (13.7)	4.9(35.4)	4.2(30.4)	8.9(64.4)	7.5(54.3)
M 12	4.0 (28.9)	3.4 (24.6)	8.7(62.9)	7.3(52.8)	15.7(114)	13.2(95.5)
M 16	9.0 (65.1)	7.3 (52.8)	20.0(145)	17.2(124)	37.0(268)	31.0(224)
M 20	19.0 (137)	15.8 (114)	41.0(297)	34.0(246)	74.0(535)	62.0(448)
M 24	32.0 (232)	27.0 (195)	70.0(506)	56.0(405)	126.0(911)	105.0(760)
M 30	65.0 (470)	54.0 (391)	142.0(1027)	118.0(854)	–	–
M 36	109.0 (788)	91.0 (658)	–	–	–	–

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1.3 COARSE THREDS UNC

Unit : kg-m (ft-lbs)

Classification / Nominal size	Coarse Threads UNC					
	Grade 2		Grade 5		Grade 8	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4	0.8(5.79)	0.7(5.06)	1.3(9.40)	1.1(7.96)	1.8(13.0)	1.5(10.8)
5/16	1.6(11.6)	1.4(10.1)	2.6(18.8)	2.2(15.9)	3.6(26.0)	3.1(22.4)
3/8	2.9(21.0)	2.4(17.4)	4.5(32.6)	3.8(27.5)	6.3(45.6)	5.3(38.3)
7/16	4.5(32.5)	3.8(27.5)	7.0(50.6)	5.9(42.7)	9.9(71.6)	8.3(60.0)
1/2	7.0(50.6)	5.9(42.7)	10.8(78.1)	9.1(65.8)	15.2(110)	12.8(92.6)
9/16	10.0(72.3)	8.4(60.8)	15.5(112)	13.0(94.0)	22.0(159)	18.4(133)
5/8	14.0(101)	11.8(85.3)	22.0(159)	18.2(132)	31.0(224)	26.0(188)
3/4	25.0(181)	21.0(152)	38.0(275)	32.0(232)	54.0(391)	45.0(325)
7/8	29.0(210)	25.0(181)	61.0(441)	51.0(369)	86.0(622)	72.0(521)
1	35.0(253)	30.0(217)	91.0(658)	76.0(550)	128.0(926)	108.0(781)
1 1/8	51.0(369)	43.0(311)	114.0(825)	95.0(687)	184.0(1331)	154.0(1114)
1 1/4	71.0(514)	59.0(427)	159.0(1150)	133.0(962)	257.0(1859)	216.0(1562)
1 3/8	93.0(673)	78.0(564)	209.0(1512)	175.0(1266)	338.0(2445)	284.0(2054)
1 1/2	124.0(897)	104.0(752)	277.0(2004)	232.0(1678)	449.0(3248)	376.0(2720)

1.4 FINE THREADS UNF

Unit : kg-m (ft-lbs)

Classification / Nominal size	Fine Threads UNF					
	Grade 2		Grade 5		Grade 8	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4	0.9 (6.51)	0.8 (5.79)	1.4(10.1)	1.2(8.68)	2.1(15.2)	1.7(12.3)
5/16	1.8 (13.2)	1.5 (10.8)	2.8(20.3)	2.4(17.4)	4.0(28.9)	3.4(24.6)
3/8	3.2 (23.1)	2.7 (19.5)	4.9(35.4)	4.1(29.7)	7.0(50.6)	5.8(42.0)
7/16	5.0 (36.2)	4.2 (30.4)	7.7(55.7)	6.4(46.3)	10.8(78.1)	9.1(65.8)
1/2	7.7 (55.7)	6.4 (46.3)	11.9(86.1)	9.9(71.6)	16.8(122)	14.0(101)
9/16	10.9 (78.8)	9.2 (66.5)	16.9(122)	14.1(102)	24.0(174)	19.9(144)
5/8	15.5 (112)	12.9 (93.3)	24.0(174)	20.0(145)	34.0(246)	28.0(203)
3/4	27.0 (195)	22.0 (159)	42.0(304)	35.0(253)	58.0(420)	49.0(354)
7/8	31.0 (224)	25.0 (181)	66.0(477)	55.0(398)	93.0(673)	77.0(557)
1	38.0 (275)	31.0 (224)	98.0(709)	82.0(593)	138.0(998)	115.0(832)
1 1/8	56.0 (405)	46.0 (333)	124.0(897)	104.0(752)	201.0(1454)	168.0(1215)
1 1/4	77.0 (557)	64.0 (463)	153.0(1107)	143.0(1034)	279.0(2018)	232.0(1678)
1 3/8	103.0 (745)	86.0 (622)	231.0(1671)	192.0(1389)	374.0(2705)	311.0(2249)
1 1/2	136.0 (984)	113.0 (817)	304.0(2199)	253.0(1830)	493.0(3566)	410.0(2966)

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1.3 COARSE THREDS UNC

Unit : kg-m (ft-lbs)

Classification / Nominal size	Coarse Threads UNC					
	Grade 2		Grade 5		Grade 8	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4	0.8(5.79)	0.7(5.06)	1.3(9.40)	1.1(7.96)	1.8(13.0)	1.5(10.8)
5/16	1.6(11.6)	1.4(10.1)	2.6(18.8)	2.2(15.9)	3.6(26.0)	3.1(22.4)
3/8	2.9(21.0)	2.4(17.4)	4.5(32.6)	3.8(27.5)	6.3(45.6)	5.3(38.3)
7/16	4.5(32.5)	3.8(27.5)	7.0(50.6)	5.9(42.7)	9.9(71.6)	8.3(60.0)
1/2	7.0(50.6)	5.9(42.7)	10.8(78.1)	9.1(65.8)	15.2(110)	12.8(92.6)
9/16	10.0(72.3)	8.4(60.8)	15.5(112)	13.0(94.0)	22.0(159)	18.4(133)
5/8	14.0(101)	11.8(85.3)	22.0(159)	18.2(132)	31.0(224)	26.0(188)
3/4	25.0(181)	21.0(152)	38.0(275)	32.0(232)	54.0(391)	45.0(325)
7/8	29.0(210)	25.0(181)	61.0(441)	51.0(369)	86.0(622)	72.0(521)
1	35.0(253)	30.0(217)	91.0(658)	76.0(550)	128.0(926)	108.0(781)
1 1/8	51.0(369)	43.0(311)	114.0(825)	95.0(687)	184.0(1331)	154.0(1114)
1 1/4	71.0(514)	59.0(427)	159.0(1150)	133.0(962)	257.0(1859)	216.0(1562)
1 3/8	93.0(673)	78.0(564)	209.0(1512)	175.0(1266)	338.0(2445)	284.0(2054)
1 1/2	124.0(897)	104.0(752)	277.0(2004)	232.0(1678)	449.0(3248)	376.0(2720)

1.4 FINE THREADS UNF

Unit : kg-m (ft-lbs)

Classification / Nominal size	Fine Threads UNF					
	Grade 2		Grade 5		Grade 8	
	Dry	Lubricated	Dry	Lubricated	Dry	Lubricated
1/4	0.9 (6.51)	0.8 (5.79)	1.4(10.1)	1.2(8.68)	2.1(15.2)	1.7(12.3)
5/16	1.8 (13.2)	1.5 (10.8)	2.8(20.3)	2.4(17.4)	4.0(28.9)	3.4(24.6)
3/8	3.2 (23.1)	2.7 (19.5)	4.9(35.4)	4.1(29.7)	7.0(50.6)	5.8(42.0)
7/16	5.0 (36.2)	4.2 (30.4)	7.7(55.7)	6.4(46.3)	10.8(78.1)	9.1(65.8)
1/2	7.7 (55.7)	6.4 (46.3)	11.9(86.1)	9.9(71.6)	16.8(122)	14.0(101)
9/16	10.9 (78.8)	9.2 (66.5)	16.9(122)	14.1(102)	24.0(174)	19.9(144)
5/8	15.5 (112)	12.9 (93.3)	24.0(174)	20.0(145)	34.0(246)	28.0(203)
3/4	27.0 (195)	22.0 (159)	42.0(304)	35.0(253)	58.0(420)	49.0(354)
7/8	31.0 (224)	25.0 (181)	66.0(477)	55.0(398)	93.0(673)	77.0(557)
1	38.0 (275)	31.0 (224)	98.0(709)	82.0(593)	138.0(998)	115.0(832)
1 1/8	56.0 (405)	46.0 (333)	124.0(897)	104.0(752)	201.0(1454)	168.0(1215)
1 1/4	77.0 (557)	64.0 (463)	153.0(1107)	143.0(1034)	279.0(2018)	232.0(1678)
1 3/8	103.0 (745)	86.0 (622)	231.0(1671)	192.0(1389)	374.0(2705)	311.0(2249)
1 1/2	136.0 (984)	113.0 (817)	304.0(2199)	253.0(1830)	493.0(3566)	410.0(2966)

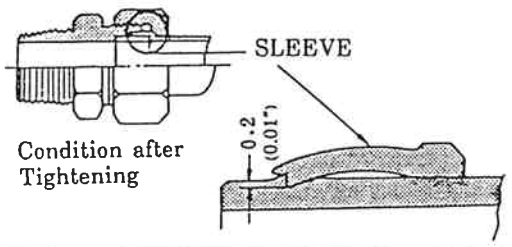
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1.5 TIGHTENING TORQUE OF HYDRAULIC FITTINGS

Excessive or insufficient tightening of hose or tube fittings can cause oil leak and deformation or damage to the metal fittings.

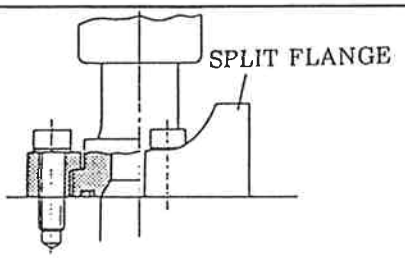
Therefore, to secure and obtain good fixing and performance of fittings it is necessary to tightin to the proper torque. The follows are the recommended torques.

(1) BITE TYPE TUBE FITTINGS

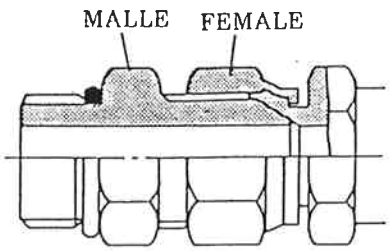
Size in mm (inch) (Outside diameter × thicknes	Tightening torque in kg-m (ft-lbs)	Remarks
10 (0.364) × 1.5 (0.059)	5 to 7 (36 to 51)	
15 (0.591) × 2.0 (0.079)	13 to 16 (94 to 116)	
18 (0.709) × 2.5 (0.098)	16 to 17 (116 to 123)	
22 (0.866) × 3.0 (0.118)	20 to 22 (145 to 159)	
28 (1.102) × 4.0 (0.157)	25 to 29 (181 to 210)	
35 (1.378) × 5.0 (0.197)	33 to 36 (239 to 260)	

(2) SPLIT FIANGES

(From SAE Standard)

Size	Tightening torque in kg-m (ft-lbs)		Remarks
	3000 psi (210 kg/cm^2)	6000 psi (420 kg/cm^2)	
1/2"	2 to 2.6 (14.5 to 19)	–	
3/4"	2.9 to 4.0 (21 to 29)	3.45 to 4.6 (25 to 33)	
1"	3.75 to 4.9 (27 to 35)	5.75 to 6.9 (42 to 50)	
1 1/4"	4.9 to 6.3 (35 to 45)	8.6 to 10.3 (62 to 74)	
1 1/2"	6.3 to 8.0 (45 to 58)	16.1 to 18.4(116 to 133)	
2"	7.5 to 9.5 (54 to 69)	27.6 to 30.0(200 to 217)	

(3) FLARE TYPE TUBE FITTINGS (30°FLARE, PF THREADS)

Size	Tightening torque in kg-m (ft-lbs)	Remarks
1/4"	2.5 to 3.5 (18 to 25)	
3/8"	5 to 7 (36 to 51)	
1/2"	6 to 8 (43 to 58)	
3/4"	12 to 16 (87 to 116)	
1"	15 to 19 (108 to 137)	
1 1/4"	17 to 23 (123 to 166)	
1 1/2"	22 to 28 (159 to 202)	
2"	26 to 34 (188 to 246)	

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(4) Jubilee Clip (Low Pressure and Suction)

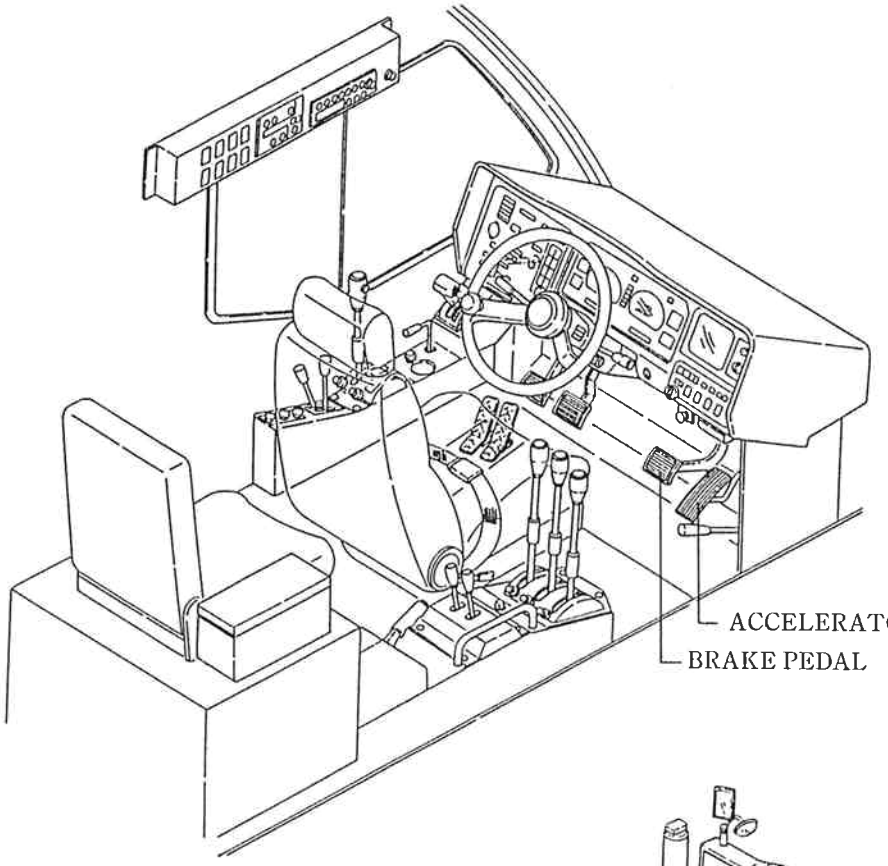
Nominal cord	Diameter		Recomended torque		Working pressure range	
BS5315	inches	m · m	kg · cm	in · lbs.	kg/cm^2	psi
12	3/8″ – 1/2″	9.5– 12	34.5	29.9	56.0	796
16	1/2″ – 5/8″	11– 16	34.5	29.9	56.0	796
20	1/2″ – 3/4″	13– 20	34.5	29.9	56.0	796
22	5/8″ – 7/8″	16– 22	45.7	39.7	56.0	796
25	3/4″ – 1″	18– 25	45.7	39.7	56.0	796
30	7/8″ – 1 1/8″	22– 30	45.7	39.7	56.0	796
35	1″ – 1 3/8″	25– 35	45.7	39.7	56.0	796
40	1 1/8″ – 1 5/8″	27– 40	45.7	39.7	35.0	498
50	1 1/4″ – 1 7/8″	35– 50	45.7	39.7	35.0	498
55	1 1/2″ – 2 1/8″	40– 55	60.4	52.4	21.0	299
60	1 3/4″ – 2 3/8″	45– 60	60.4	52.4	21.0	299
70	2″ – 2 3/4″	55– 70	60.4	52.4	16.8	239
80	2 3/8″ – 3 1/8″	60– 80	60.4	52.4	16.8	239
90	2 3/4″ – 3 1/2″	70– 90	69.0	59.9	16.8	239
100	3 1/4″ – 4″	85–100	69.0	59.9	16.8	239
120	3 3/4″ – 4 1/2″	90–120	69.0	59.9	10.5	149
140	4 1/8″ – 5 1/2″	110–140	69.0	59.9	10.5	149
150	5″ – 5 3/4″	130–150	69.0	59.9	10.5	149
165	5 1/4″ – 6 1/2″	135–165	69.0	59.9	9.8	139
190	6 1/4″ – 7 1/2″	160–190	69.0	59.9	9.8	139
215	7 1/4″ – 8 1/2″	185–215	78.0	67.7	9.0	128
240	8 1/4″ – 9 1/2″	205–240	78.0	67.7	9.0	128
270	9 1/4″ –10 1/2″	235–270	78.0	67.7	9.0	128
290	10 1/4″ –11 1/2″	255–290	78.0	67.7	9.0	128
320	11 1/4″ –12 1/2″	285–320	78.0	67.7	9.0	128

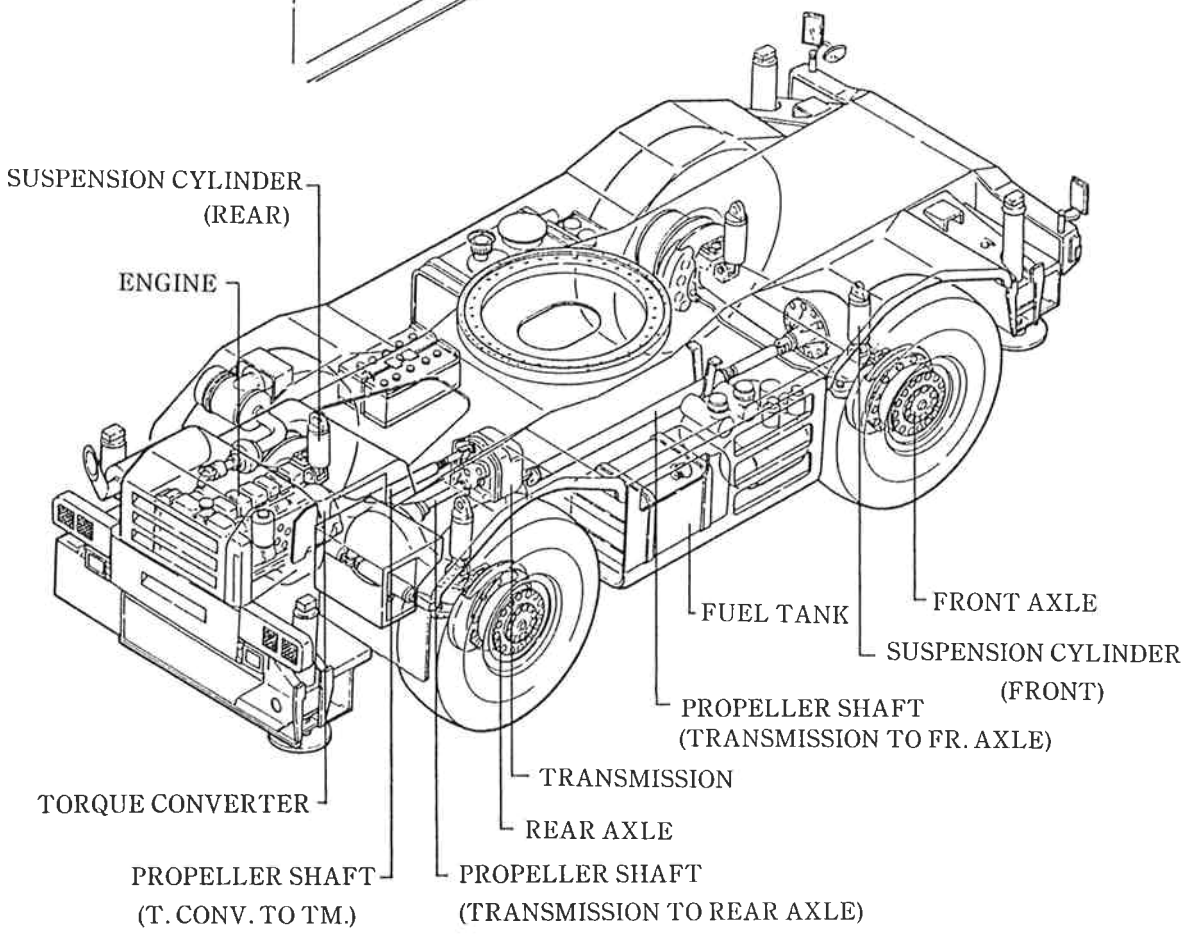
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1. GENERAL

1.1 LOCATION OF SYSTEM COMPONENTS

The locations of the drive / travel system components are as follows.



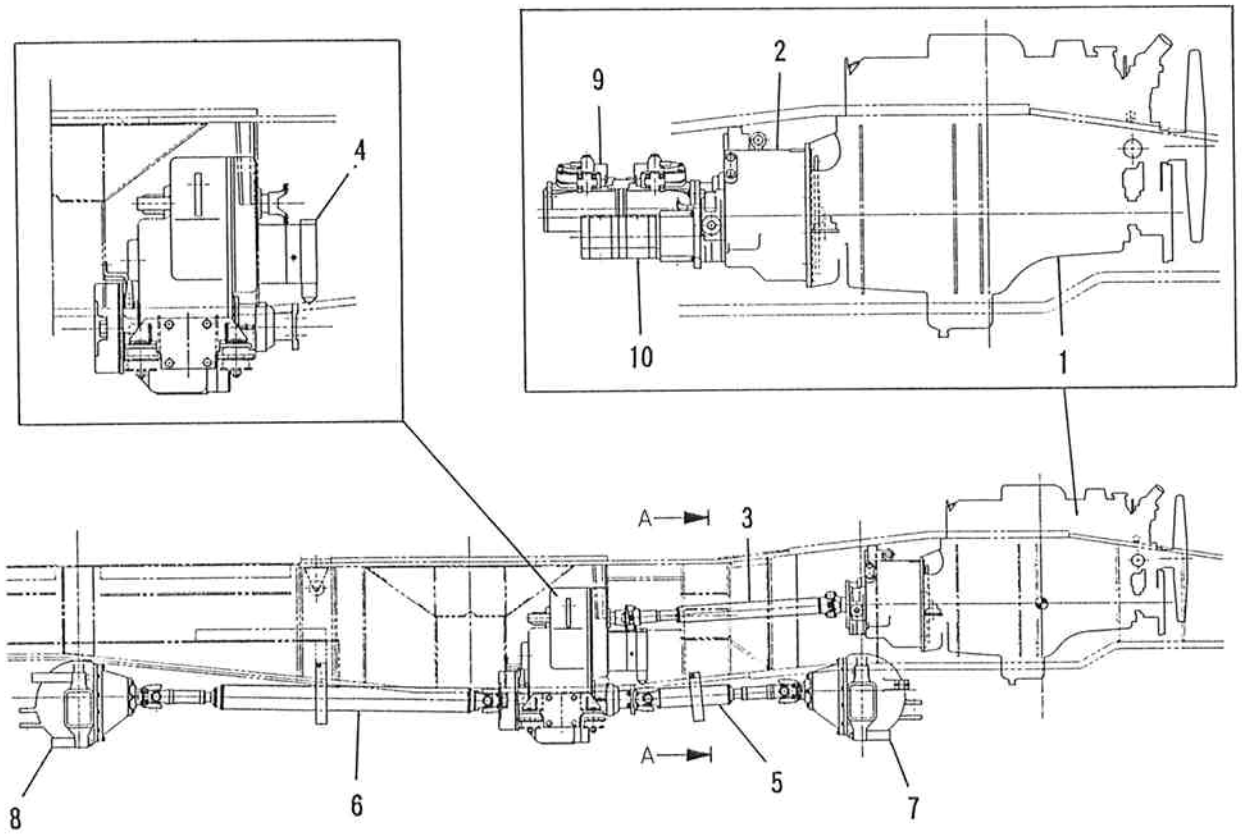


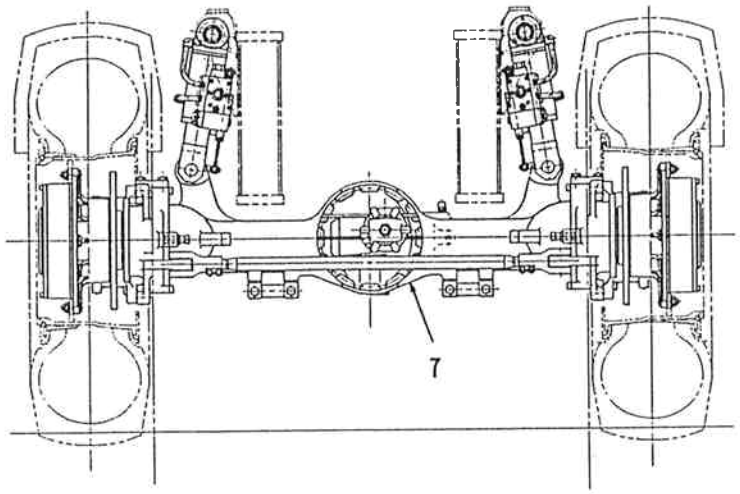
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2. CONSTRUCTION AND FUNCTION

2.1 DRIVE SYSTEM

The engine driving power enters torque converter (2) directly connected to the engine, rotates hydraulic pumps (9 & 10), and the same time is transmitted to front axle (8) and rear axle (7) through propeller shafts (5 and 6) from transmission (4).





VIEW FROM "A-A"

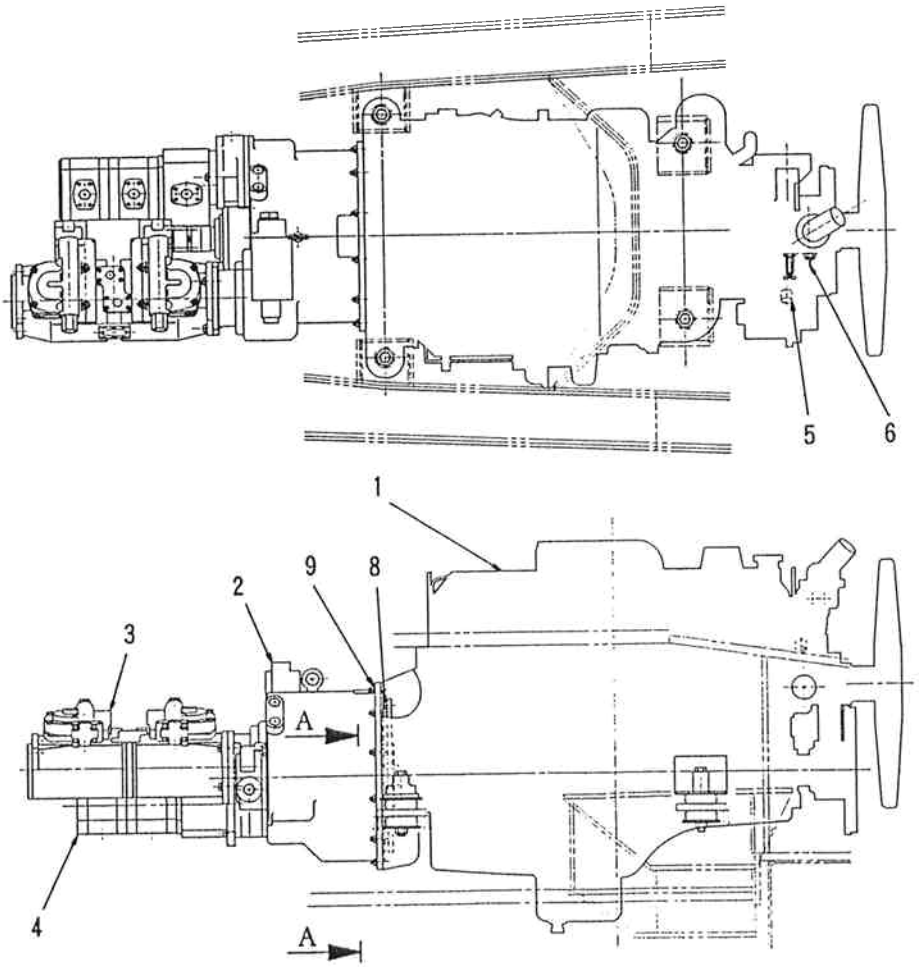
1. ENGINE
2. TORQUE CONVERTER
3. PROPELLER SHAFT
4. TRANSMISSION
5. PROPELLER SHAFT
6. PROPELLER SHAFT
7. REAR AXLE
8. FRONT AXLE
9. 2-TANDEM PUMPS
10. 3-TANDEM PUMPS

Fig. 2-1 Drive System

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(1) Power Plant Mounting

Engine (1) is mounted on the lower frame by rubber mounts (7). Torque converter (2) is directly connected to the engine flywheel by capscrews (8) ; the flywheel housing and torque converter housing are fitted together with nuts (9). Two knock pins are provided to match the joint positions of the engine flywheel and torque converter.



SECTION "A-A"

1. ENGINE
2. TORQUE CONVERTER
3. 2-TANDEM PUMPS (VARIABLE PUMP + VARIABLE PUMP)
4. 3-TANDEM PUMPS (GEAR PUMP + GEAR PUMP + GEAR PUMP)
5. SENSOR (ENGINE RPM)
6. THERMO-SENSOR
7. RUBBER MOUNT
8. CAPSCREW
9. NUT
10. CAPSCREW
11. NUT

☞ Regarding the tightening torques of the main parts, refer to 4. Maintenance Standards.

Fig. 2-2 Power Plant Mounting

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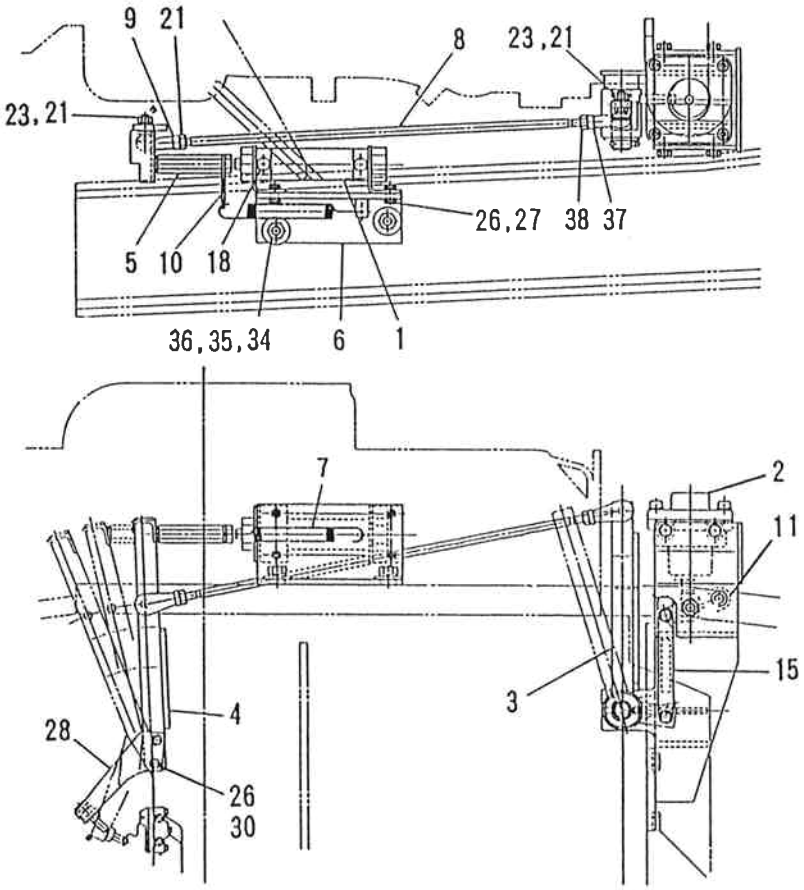
(2) Governor Control Mounting

The governor control functions as follows :

① When the accelerator pedal in the operator's cab is depressed, air chamber (2) functions to control the governor control lever for the injection pump via lever (3).

② When the PTO which drives the hydraulic pumps for work is turned on, air cylinder (1) functions to limit the movement of lever (3).

Therefore, when the PTO functions, the engine revolution are limited to approximately 2000 rpm at maximum, considering decrease of noise and save of fuel consumption during operation as compared when traveling.



1. AIR CYLINDER
2. AIR CHAMBER
3. LEVER
4. LEVER
5. NUT
6. BRACKET
7. SPRING
8. ROD
9. ROD END
10. PLATE
11. LEVER
12. SPLIT PIN
13. PIN
14. PIN
15. LEVER
16. SPLIT PIN
17. WASHER
18. FILTER
19. PIN
20. SEMS BOLT
21. NUT
22. FLANGE NUT
23. WASHER
24. WASHER
25. WASHER
26. CAPSCREW
27. BOLT
29. BOLT
30. LOCK WASHER
31. SPLIT PIN
32. NEEDLE BEARING

VIEW FROM "A-A"

Fig. 2-3 Governor Control Mounting

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③ Operating system diagram

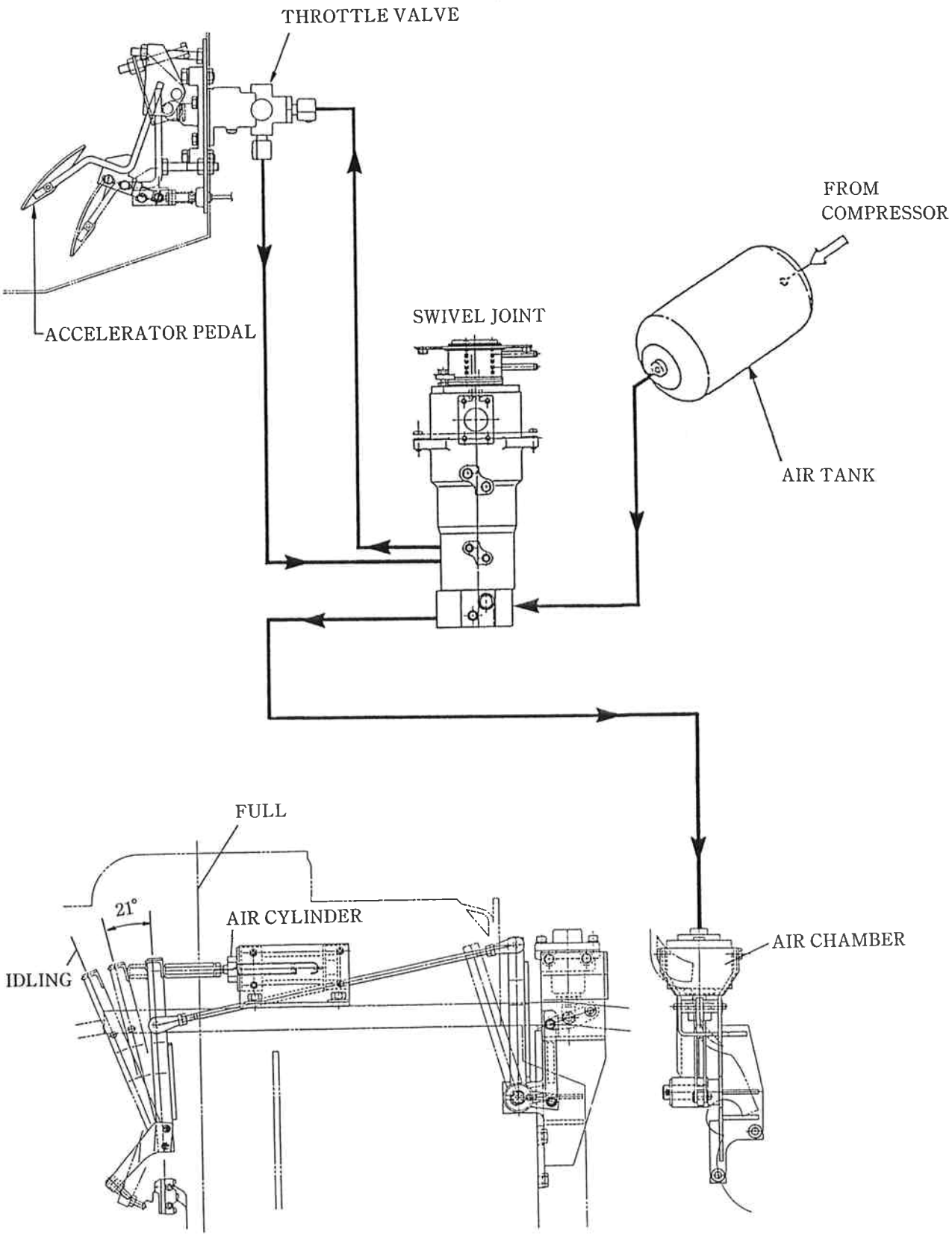


Fig. 2-4 Governor Control Operating System Diagram

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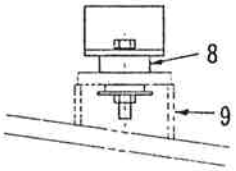
(3) Radiator Mounting

Radiator (1) and hydraulic oil cooler (2) form one single unit and are mounted on lower frame (10) with rubber mount (8). Torque converter oil cooler (6) is mounted on lower frame (10) under radiator (1) (see Fig.2-5).

Specifications

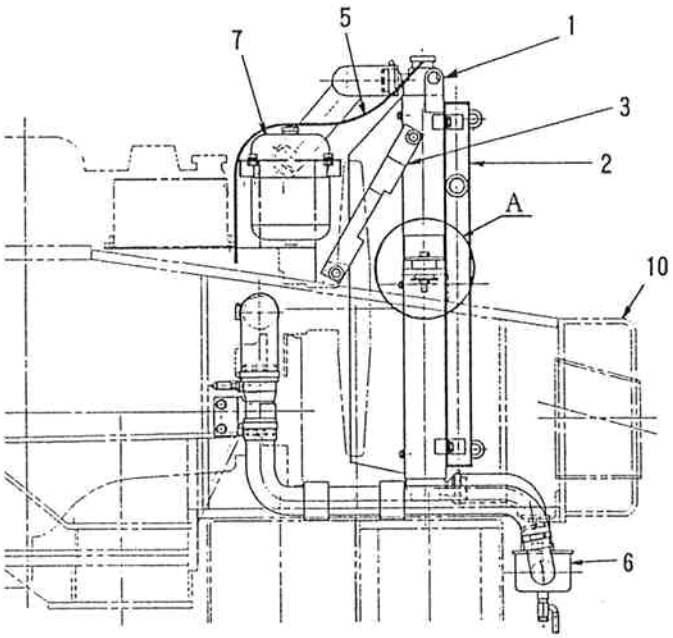
Radiator

Pressure Cap Relief Pressure	0.5kg / cm² (7.11psi)
Radiator Water Capacity	approx. 23 ℓ (6.08gal)

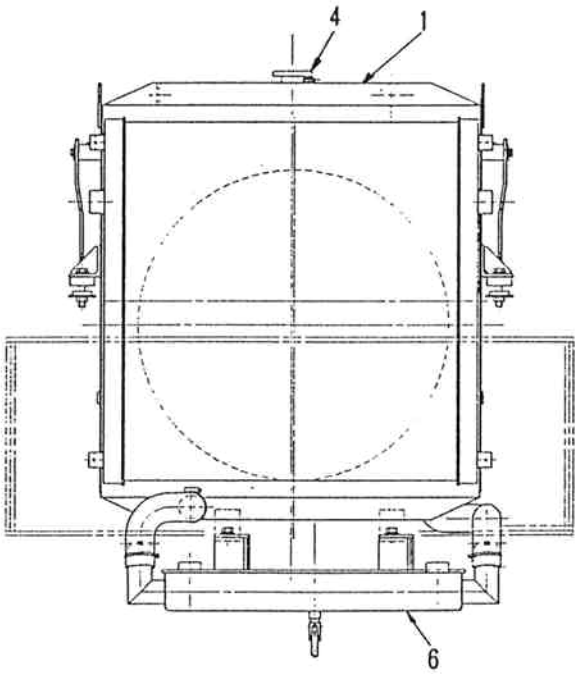


DETAIL OF "A"

1. RADIATOR
2. HYDRAULIC OIL COOLER
3. CROSS STAY
4. PRESSURE CAP
5. OVER-FLOW PIPE
6. OIL COOLER (FOR TORQUE CONVERTER)
7. RESERVE TANK
8. RUBBER MOUNT
9. BRACKET
10. LOWER FRAME



☞ Regarding the tightening torques of the main parts, refer to 4. Maintenance Standards.



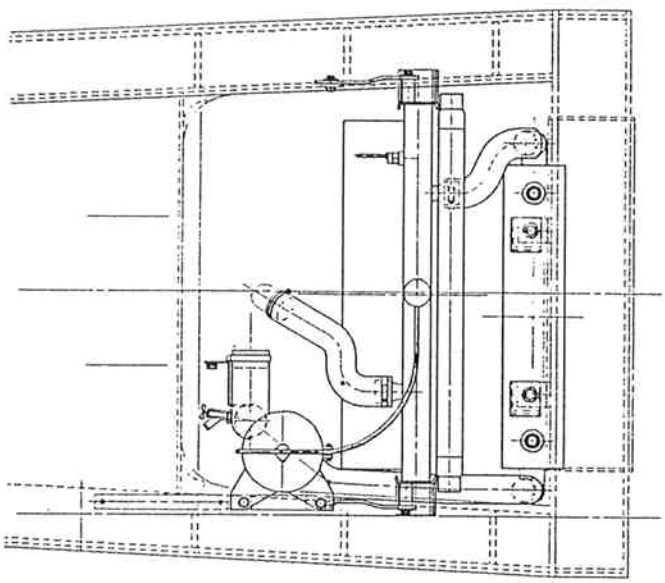
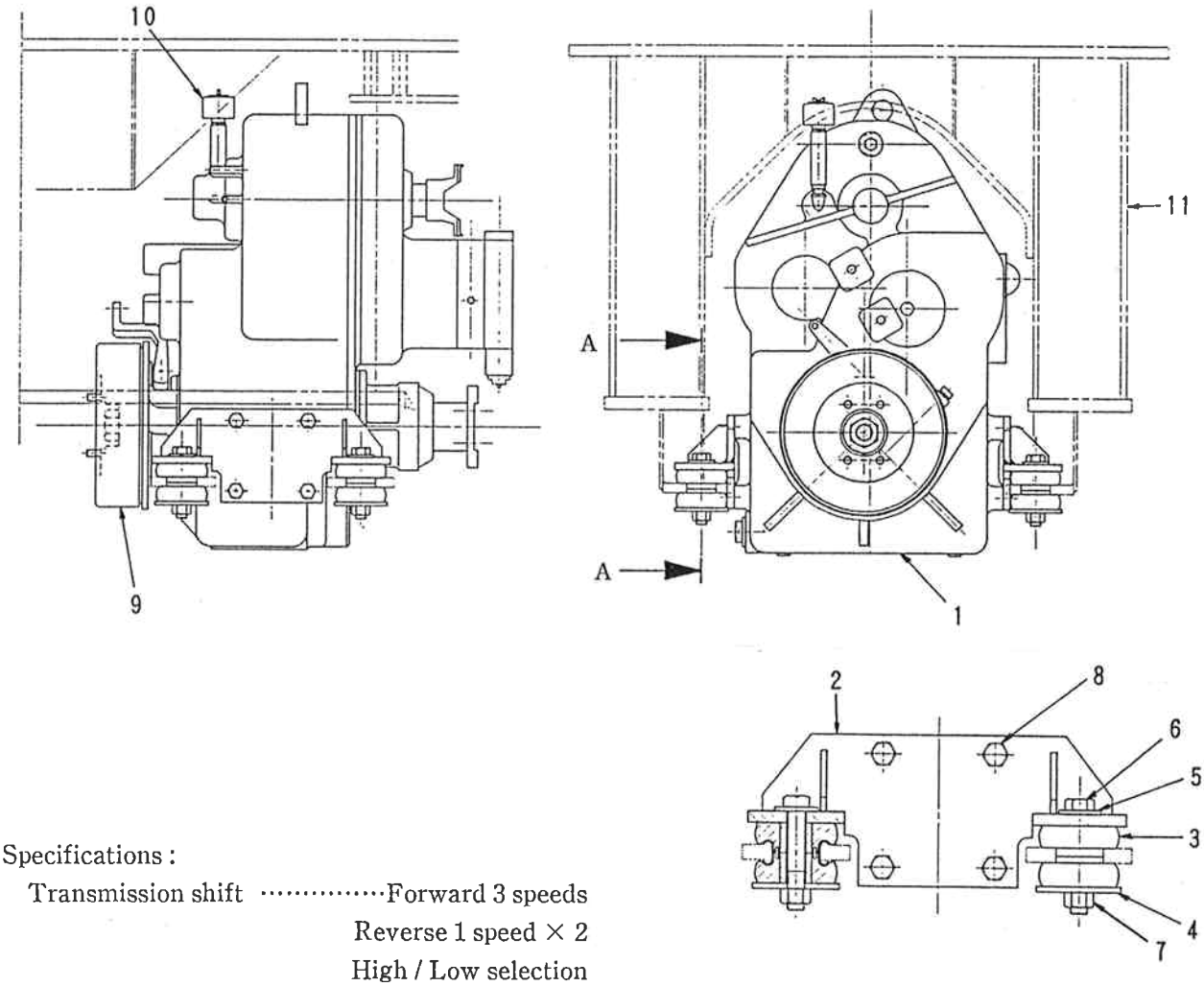


Fig. 2-5 Radiator Mounting and Torque Converter Oil Cooler Mounting

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(4) Transmission Mounting



SECTION "A-A"

Specifications :

Transmission shift ·····Forward 3 speeds
Reverse 1 speed × 2
High / Low selection

Direction of rotation

Input side (view from input side) ··· Clockwise
Output side (view from input side) ·····
For forward : Clockwise
For reverse : Counterclockwise

Transmission oil : Equivalent to ATF Dexron II

Capacity of oil···H level : approx. 29 ℓ (7.66gal)
···L level : approx. 26 ℓ (6.87gal)

However, the oil should be supplied in accordance with the specified level. Regarding the way of supply, see the operator's manual.

1. TRANSMISSION
2. BRACKET
3. RUBBER MOUNT
4. PLATE
5. WASHER
6. CAPSCREW
7. NUT
8. CAPSCREW
9. PARKING BRAKE
10. AIR BREATHER
11. LOWER FRAME

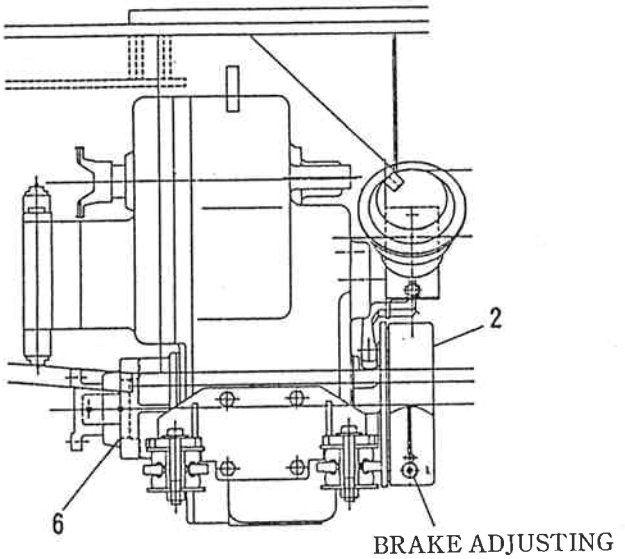
Fig. 2-6 Transmission Mounting

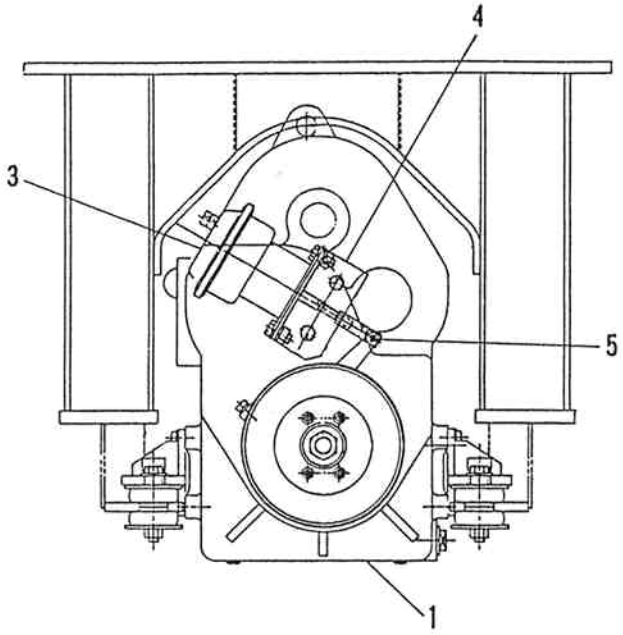
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(5) Parking Brake

Operation of Parking Brake

The parking brake, provided on the transmission output shaft, works on the spring force of air chamber (3), and is released by air pressure.

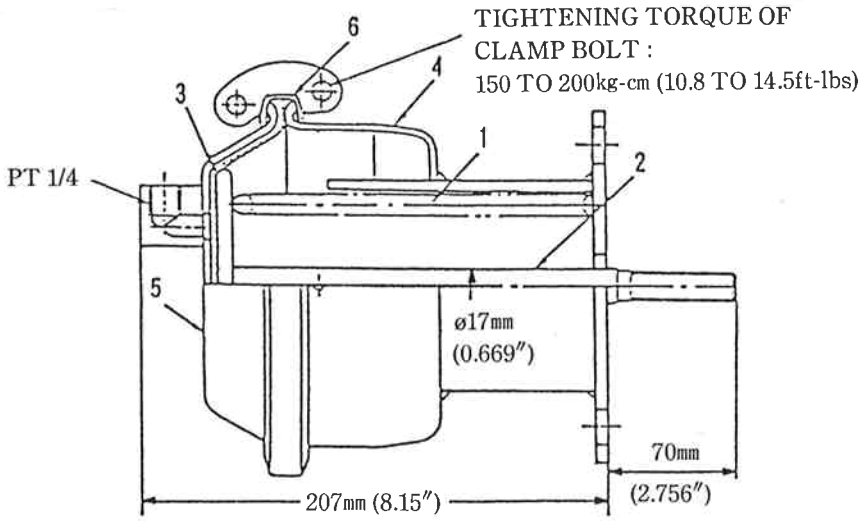




1. TRANSMISSION
2. PARKING BRAKE
3. AIR CHAMBER
4. BRACKET
5. ROD
6. AIR CYLINDER (BUILT IN TRANSMISSION)

Fig. 2-7 Parking Brake

(6) Air Chamber



1. SPRING
2. PUSH ROD
3. DIAPHRAGM
4. BODY
5. COVER
6. CLAMP

Fig. 2-8 Air Chamber

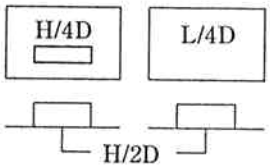
Specifications

Stroke	40mm (1.575in)
Maximum using pressure	20kg / cm² (284psi)
Spring load (stroke = 0mm)	170kg (375 lbs)
Spring load [stroke = 40mm(1.575in)]	242kg (534 lbs)

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(7) Shift Operation of High Speed / Low Speed

Shift of High / Low speed of the transmission is operated by shifting the High speed hydraulic clutch and the Low speed hydraulic clutch built in the transmission with the hydraulic pressure of the transmission. Shift operation is performed with the selector switch provided in the operator's room.



· Selection of High and Low

Shift of High speed and Low speed can be operated even during travel at a speed less than 10㎞ / h (6.2 mph). When the Low speed is selected, the driving mode becomes automatically 4 wheel drive.

① Shifting from High Speed to Low Speed

[When traveling speed is more than 1㎞ / h (0.62mph) and less than 15㎞ / h (9.32mph)]

HIGH-2nd → LOW-3rd

HIGH-1st → LOW-2nd

When traveling with the HIGH-3rd, the speed is not shifted to the LOW even by pushing the LOW switch.

② Shifting from Low Speed to High Speed

[When traveling speed is more than 1㎞ / h (0.62mph) and less than 10㎞ / h (6.2mph)]

LOW-1st → HIGH-1st

LOW-2nd → HIGH-1st

LOW-3rd → HIGH-2nd

③ Shifting High Speed and Low Speed (When carrier stops)

Position of shift lever

R HIGH-R ←→ LOW R

D (Automatic)* ←→ LOW 3rd

2 HIGH-2nd ←→ LOW 2nd

1 HIGH-1st ←→ LOW 1st

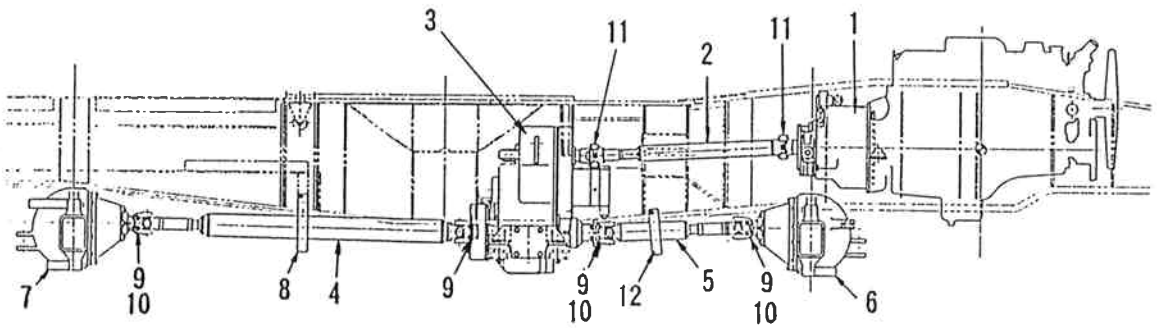
＊Shift of 2 Wheel Drive and 4 Wheel Drive

Shifting 2 wheel drive and 4 wheel drive is operated by the air cylinder which is built in the transmission.

(8) Propeller Shaft Mounting

(a) Function

The propeller shafts transmit power from the torque converter to the transmission, and from the transmission to the front axle and rear axle (Fig.2-10).

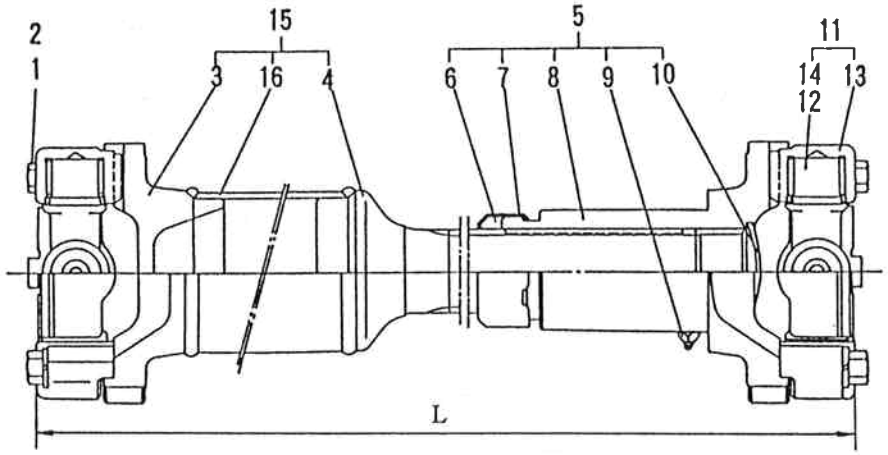


1. TORQUE CONVERTER
2. PROPELLER SHAFT
3. TRANSMISSION
4. PROPELLER SHAFT
5. PROPELLER SHAFT
6. REAR AXLE
7. FRONT AXLE
8. GUARD
9. NUT
10. CAPSCREW
11. CAPSCREW
12. GUARD

Fig. 2-10 Propeller Shaft Mounting

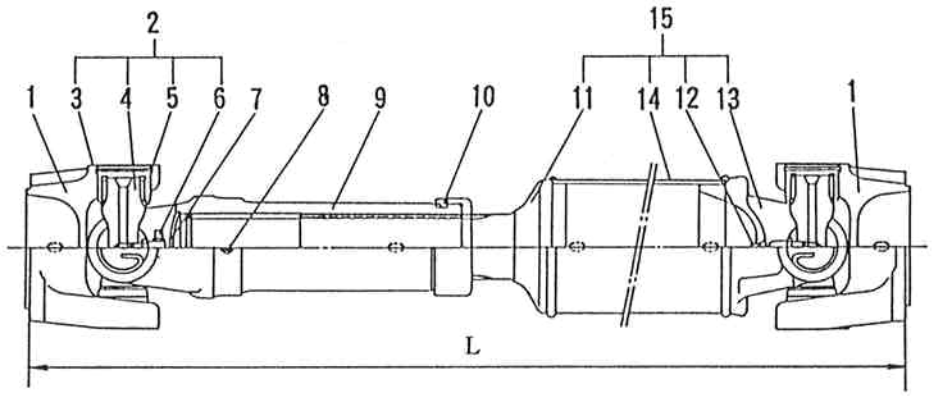
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(b) Propeller Shafts



1. CAPSCREW
2. LOCKWASHER
3. WELDED FLANGE
4. SHAFT END
5. FLANGE ASSEMBLY
6. FELT RING
7. RETAINER
8. SLIDE FLANGE
9. GREASE FITTING
10. PLUG
11. JOURNAL ASSEMBLY
12. SPIDER
13. BEARING ASSEMBLY
14. GREASE FITTING
15. TUBE ASSEMBLY
16. TUBE

Fig. 2-11 Propeller Shaft (Torque Converter to Transmission)



1. FLANGE YOKE
2. JOURNAL ASSEMBLY
3. BEARING
4. SPIDER
5. SNAP RING
6. GREASE FITTING
7. PLUG
8. GREASE FITTING
9. SLEEVE YOKE
10. SEAL
11. SHAFT END
12. PLUG
13. WELDED YOKE
14. TUBE
15. TUBE ASSEMBLY

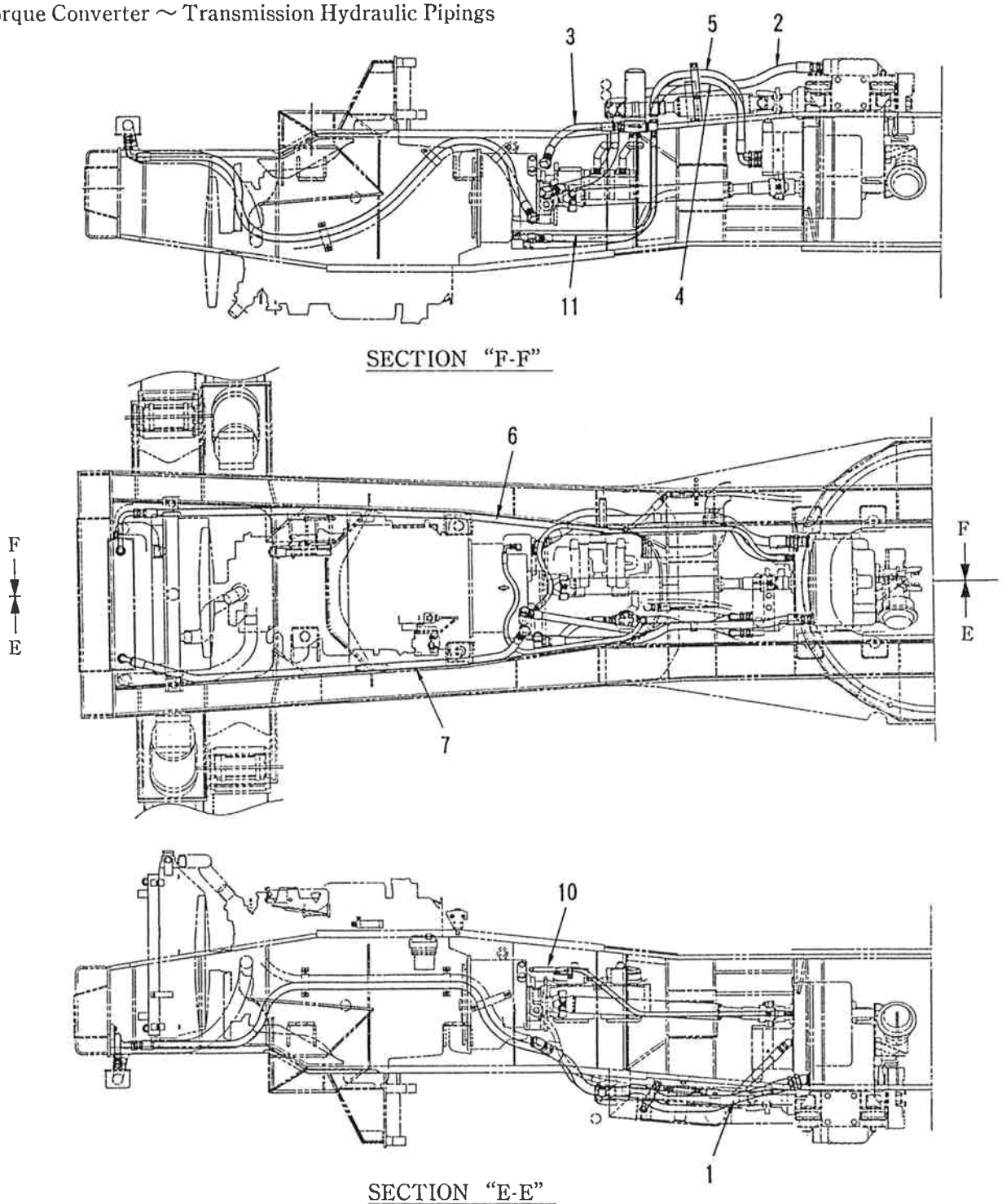
Fig. 2-12 Propeller Shaft (Transmission to Axles)

Specifications

Use / Item	Torque converter to transmission	Transmission to front axle	Transmission to rear axle
	Fig. 2-11	Fig. 2-12	Fig. 2-12
L : Length at mounting	760 to 800mm (29.92 to 31.50in)	1666 to 1706mm (65.59 to 67.17in)	753 to 793mm (29.65 to 31.22in)

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(9) Torque Converter ~ Transmission Hydraulic Pipings



1. PIPING FROM TORQUE CONVERTER TO TRANSMISSION(OIL PASS)
2. PIPING FROM TRANSMISSION TO TORQUE CONVERTER (TO PUMP)
3. PIPING FROM TORQUE CONVERTER TO LINE FILTER (FROM PUMP)
4. PIPING FROM TRANSMISSION TO TORQUE CONVERTER (FROM VALVE)
5. PIPING FROM LINE FILTER TO TRANSMISSION (TO VALVE)
6. PIPING FROM OIL COOLER TO TRANSMISSION
7. PIPING FROM TORQUE CONVERTER TO OIL COOLER
10. PIPING FROM TRANSMISSION TO TORQUE CONVERTER (AIR PASS)
11. PIPING FROM LINE FILTER TO TORQUE CONVERTER

Fig. 2-13 Torque Converter to Transmission Hydraulic Pipings

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(10) Axle Mounting

Both the front and rear axles are mounted on the lower frame through the torque rods. The four suspension cylinders work as suspensions by the function of the hydro-pneumatic suspension system when traveling on roads. They are also fully retracted to offer no suspension function during crane operation and improve stability by unifying the axles and chassis into one.

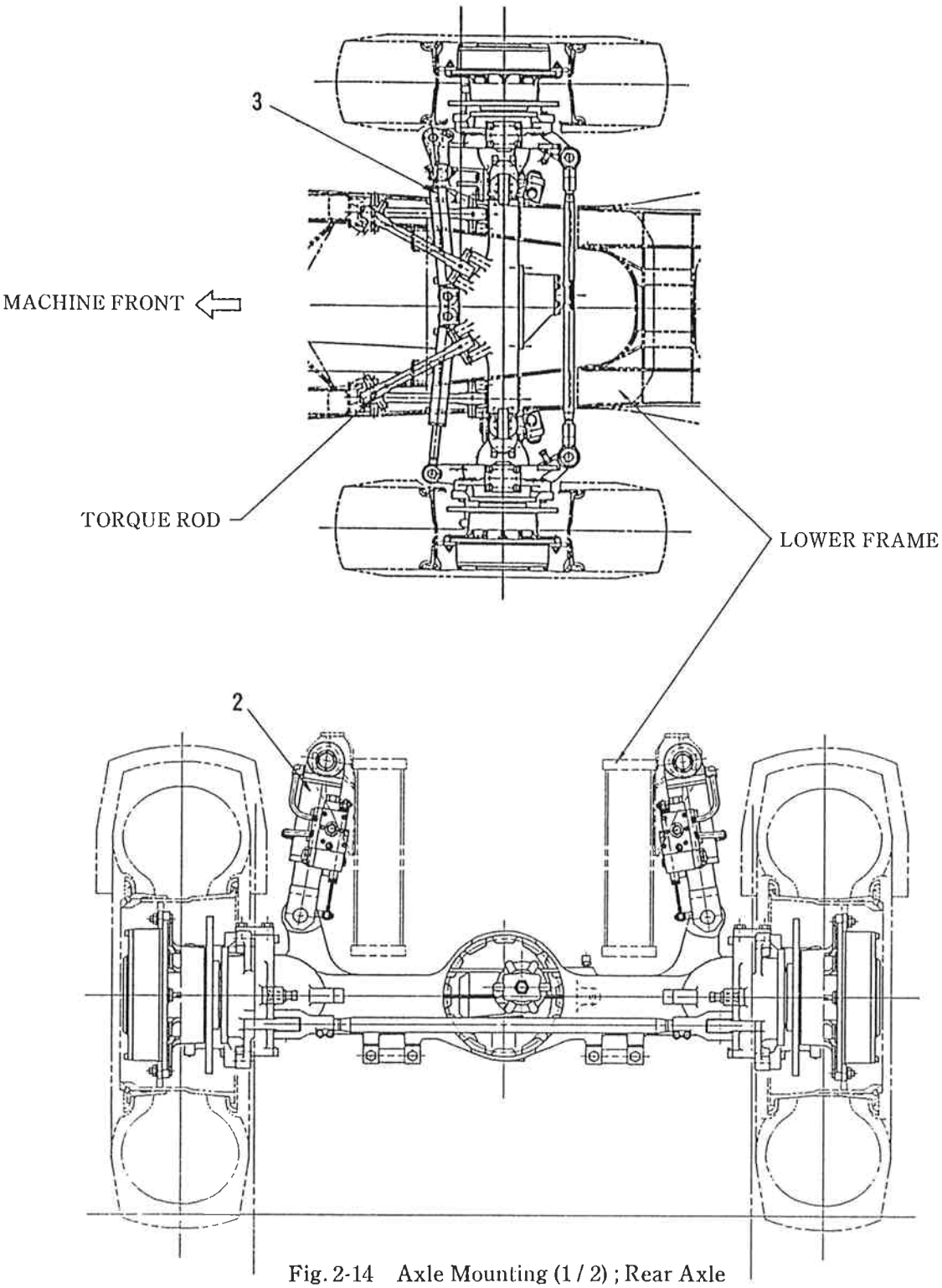
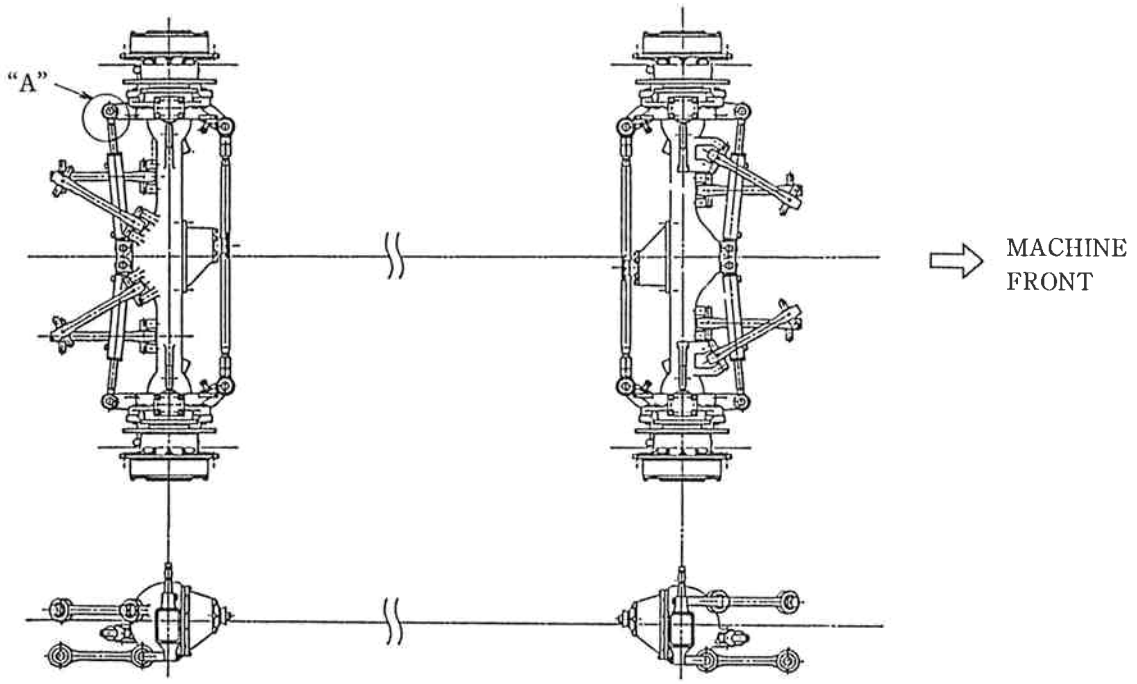
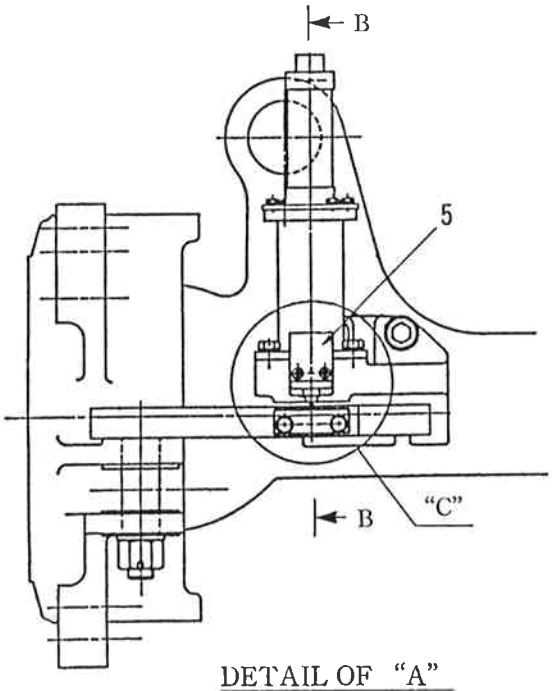


Fig. 2-14 Axle Mounting (1 / 2) ; Rear Axle

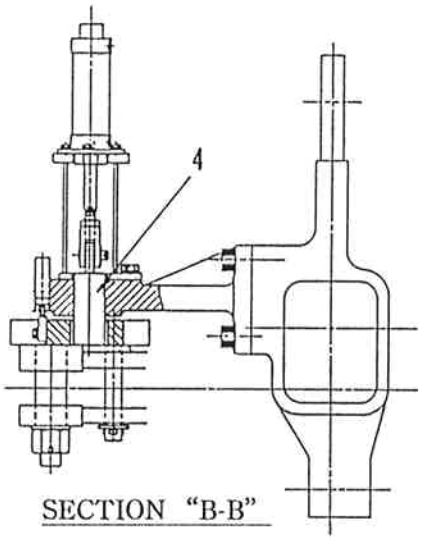
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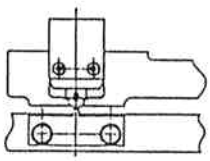


DETAIL OF "A"

(SHOWS LEFT SIDE MOUNTING OF REAR WHEEL)



SECTION "B-B"



DETAIL OF "C"

☞ Regarding the tightening torque, refer to 4. Maintenance Standards.

2. SUSPENSION CYLINDER
3. STEERING CYLINDER
4. REAR STEERING LOCK PIN
5. STEERING NEUTRAL POSITION DETECTING LIMIT SWITCH

Fig. 2-14 Axle Mounting (2 / 2)

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3. INSPECTION AND ADJUSTMENT

3.1 ADJUSTMENT OF GOVERNOR CONTROL (FIG. 3-1)

With the PTO switch, which is provided on the meter switch panel in the left front of the operator's seat, placed in the OFF position, depress the accelerator pedal to operate air chamber (2), and to control governor control lever (4) for the injection pump via lever (3).

The engine speed will rise to approximately 3000 rpm at maximum.

When the PTO switch is placed in the ON position, air cylinder (1) operates to limit movement of lever (3), and the engine speed is limited to approximately 2000rpm at maximum.

When adjustment is required, proceed as follows :

(1) Place the shift lever in the neutral position, and the parking brake switch in the ON position.

(2) Adjust the set bolt of air cylinder (1) so that engine speed comes in the following values.
When the PTO switch in the ON position (when operating).
2000 ± 20rpm (without load)

(3) Adjust and fix bolt (25) so that the exhaust brake limit switch operates with engine speed at 700 to 750rpm. (When the PTO switch in the OFF position).

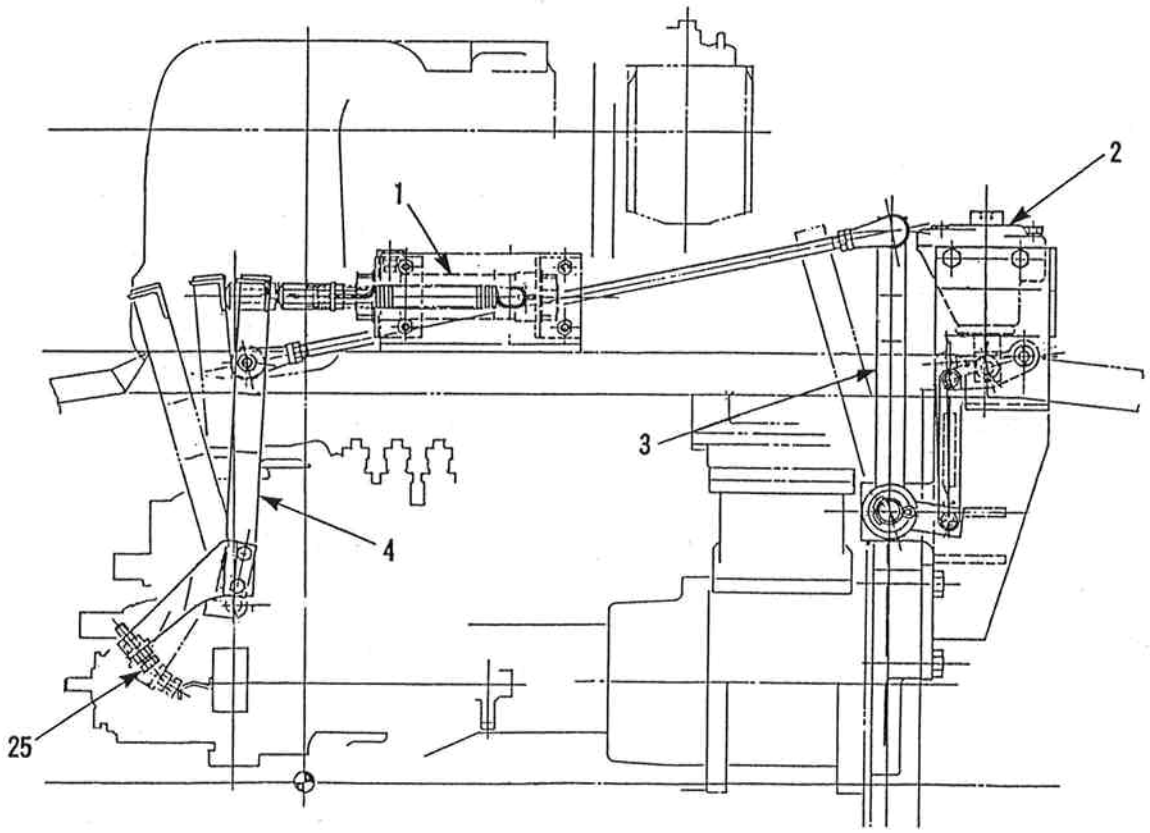


Fig. 3-1 Adjustment of Governor Control

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3.2 ADJUSTMENT OF PARKING BRAKE (FIG. 3-2)

(1) Normally the parking brake is adjusted with brake drum adjusting wheel (6).

(a) With the parking brake released (travel position), feed compressed air into the air chamber.

(b) Turn the adjusting wheel in the shoe expansion direction (arrow) until the shoe is tight against the drum.

(c) Then back off 8 notches ; this way, the clearance between the drum and the shoe will be adjusted to 0.23㎜ (0.009″).

(2) When installing a new air chamber, proceed as follows :

(a) Install air chamber (3) to bracket (4) without air supplied.

(b) Loosen nuts (7 and 8), and adjust rod (5) so that the distance from the end surface of bracket (4) to the center of yoke pin comes in 113^{+0}_{-2}㎜ ($4.45^{+0}_{-0.079}$in). Then tighten nuts (7 and 8).

(c) Then, perform the normal adjustment (step 1).

(d) Connect yoke (5) and the parking brake lever.

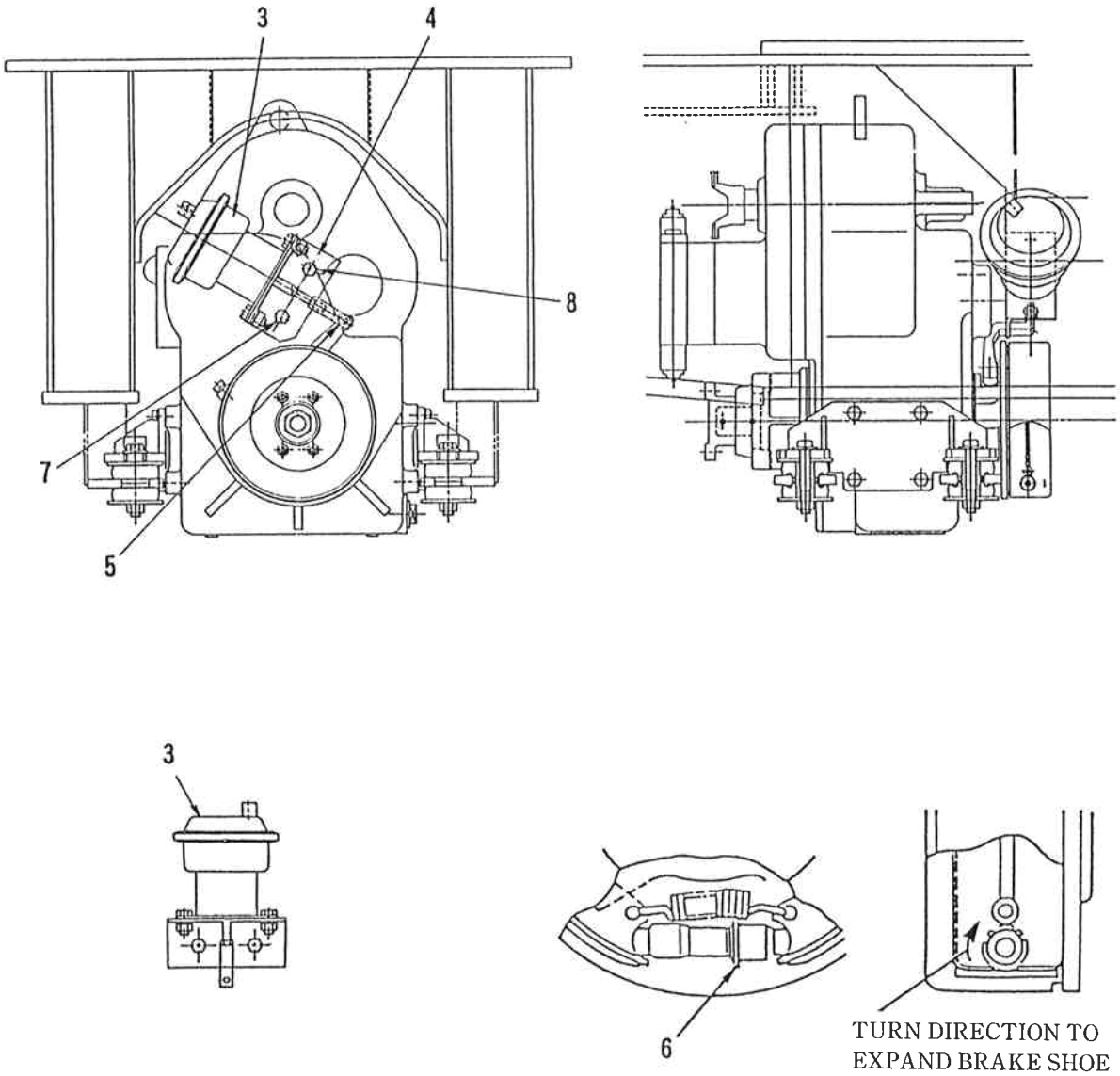
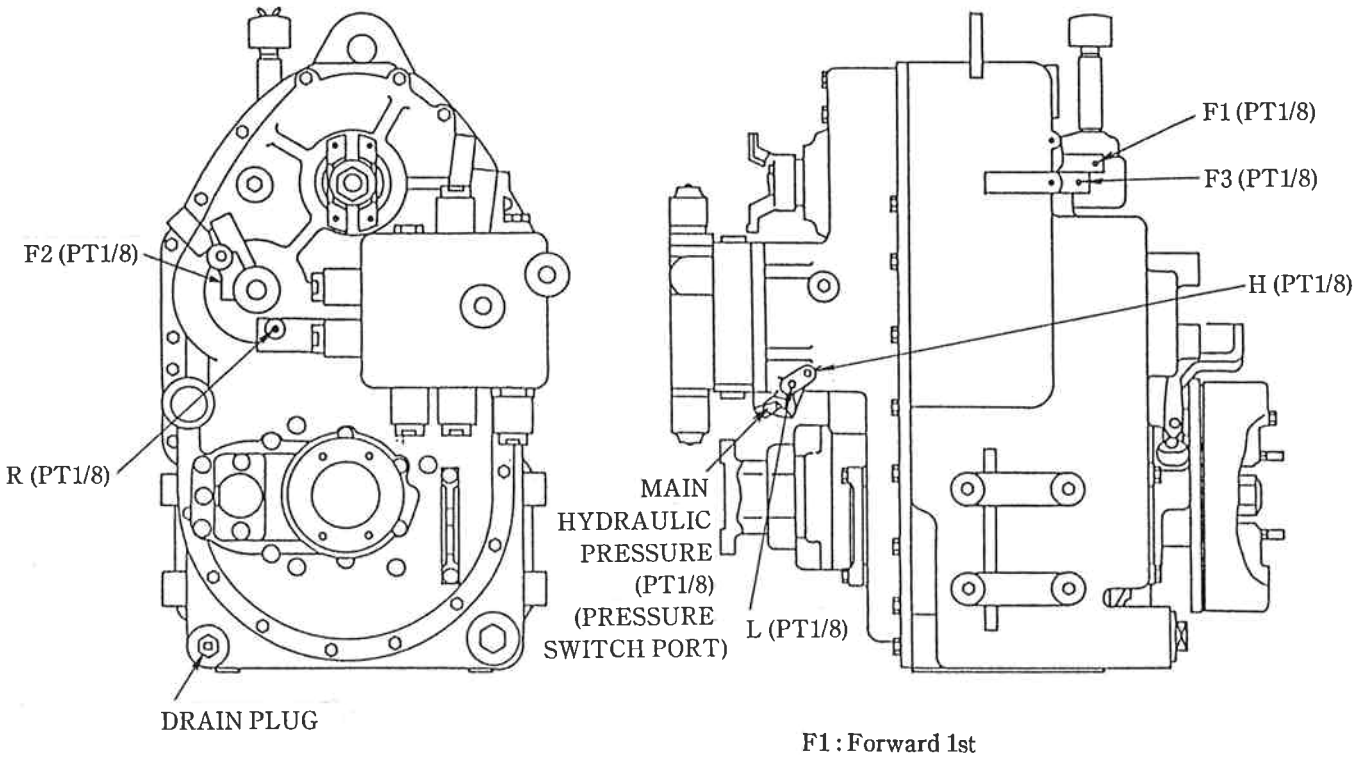


Fig. 3-2 Adjustment of Parking Brake

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3.3 HYDRAULIC PRESSURE TAKING OUT PORTS FOR TRANSMISSION CONTROL VALVE

TRANSMISSION



F1 : Forward 1st
F2 : Forward 2nd
F3 : Forward 3rd
R : Reverse

TORQUE CONVERTER

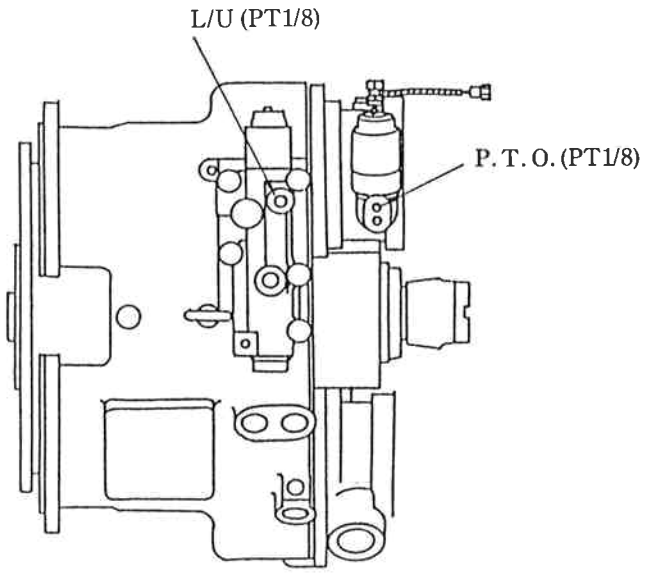


Fig. 3-3 Hydraulic Pressure Port Size

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4. MAINTENANCE STANDARDS

(1) Power Plant Mounting (Fig. 4-1)

Code	Item	Standard Value	Remarks
A	Tightening torque of capscrews for engine mount.	23 to 29kg · m (166 to 210ft-lbs.)	Tighten after applying Locktite # 271 or equivalent to threaded section.
B	Tightening torque of nuts for torque converter housing mount.	4.1 to 5.1kg · m (30 to 37ft-lbs.)	Tighten after applying Locktite # 242 or equivalent to threaded section.
C	Tightening torque of capscrews for gear pump mount.	6.1 to 7.5kg · m(44 to 54ft-lbs.)	
D	Tightening torque of capscrews for engine flywheel and torque converter mount.	4.1 to 5.1kg · m(30 to 37ft-lbs.)	
E	Mounting faces of engine flywheel housing and torque converter.	Align knock pins attached to engine.	

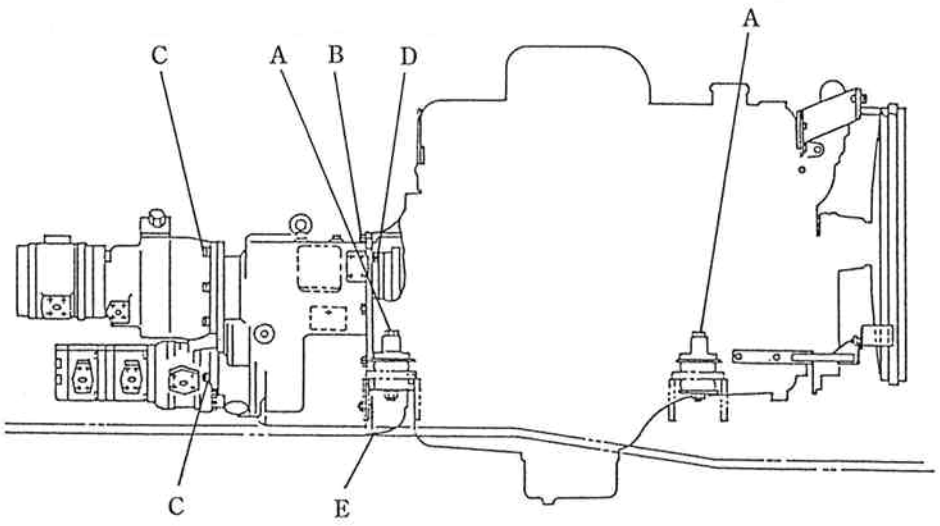


Fig. 4-1 Power Plant Mounting

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(2) Governor Control Mounting (Fig.4-2)

Code	Item	Standard Value	Remarks
A	Tightening torque of bracket mount nut.	2.4kg · m (17.3ft-lbs.)	Tighten after applying Locktite # 242 or equivalent to threaded section.
B	Tightening torque of bracket mount nut.	4.1 to 5.1kg · m (30 to 37ft-lbs.)	
C	Tightening torque of air chamber mount capscrew.	0.83 to 1.0kg · m (6.00 to 7.22ft-lbs.)	

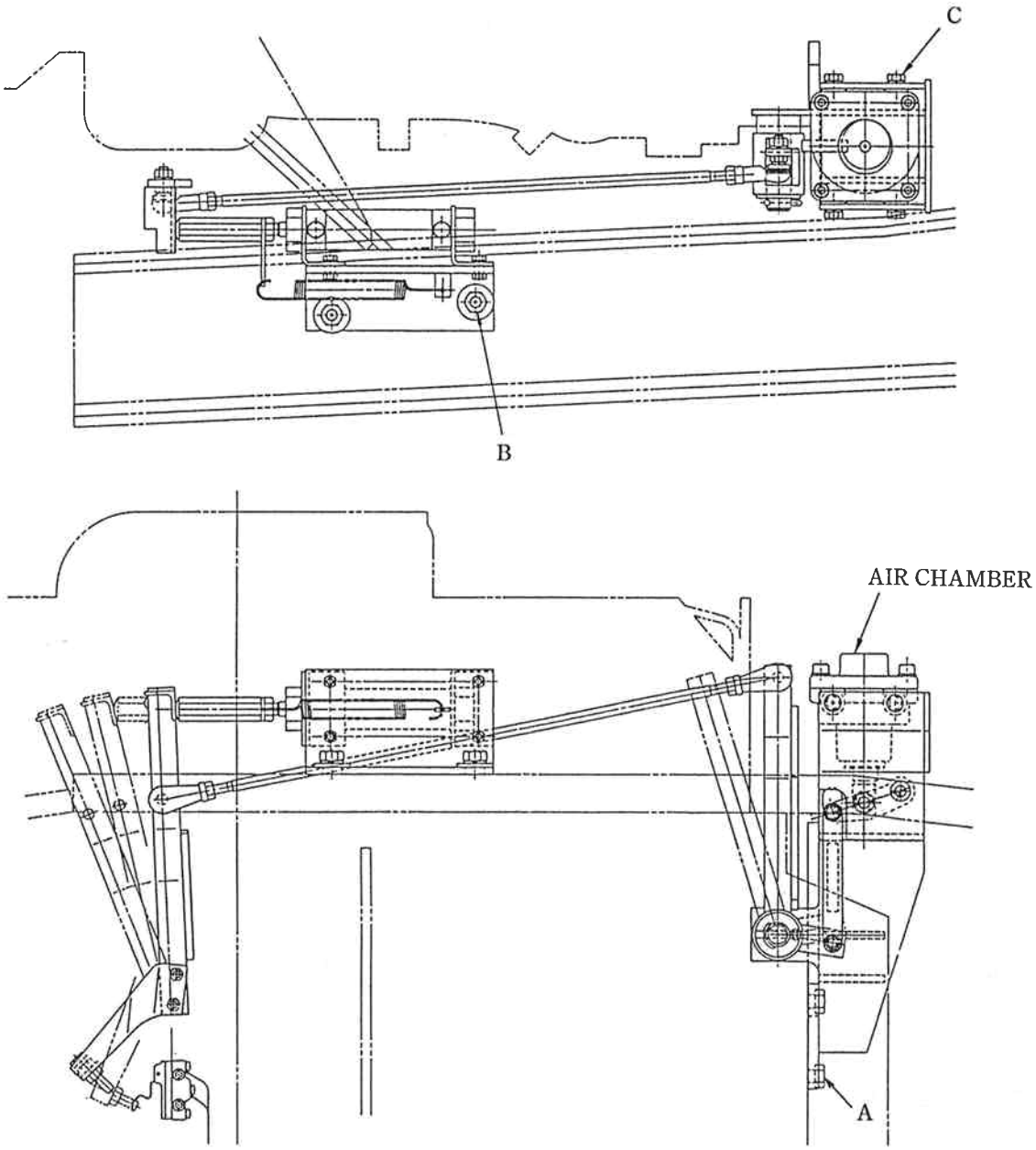


Fig. 4-2 Governor Control Mounting

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(3) Radiator Mounting (Fig. 4-3)

Code	Item	Standard Value	Remarks
A	Tightening torque of bolt and nut for rubber mount.	4.9 to 5.9kg · m (35.4 to 42.6ft-lbs)	

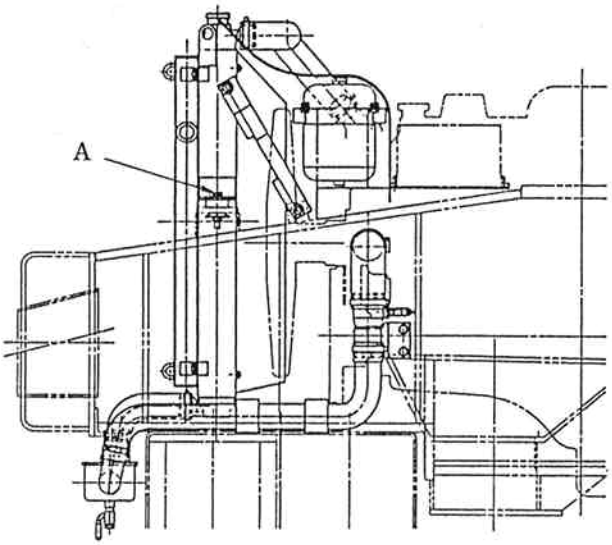


Fig. 4-3 Radiator Mounting

(4) Transmission Mounting (Fig. 4-4)

Code	Item	Standard Value	Remarks
A	Tightening torque of bolt and nut for rubber mount.	23 to 29kg · m (166 to 209ft-lbs)	Tighten after applying Locktite # 271 or equivalent to threaded section
B	Tightening torque of bracket mounting capscrew.	16.9 to 20.7kg · m (122 to 150ft-lbs)	Tighten after applying Locktite # 242 or equivalent to threaded section

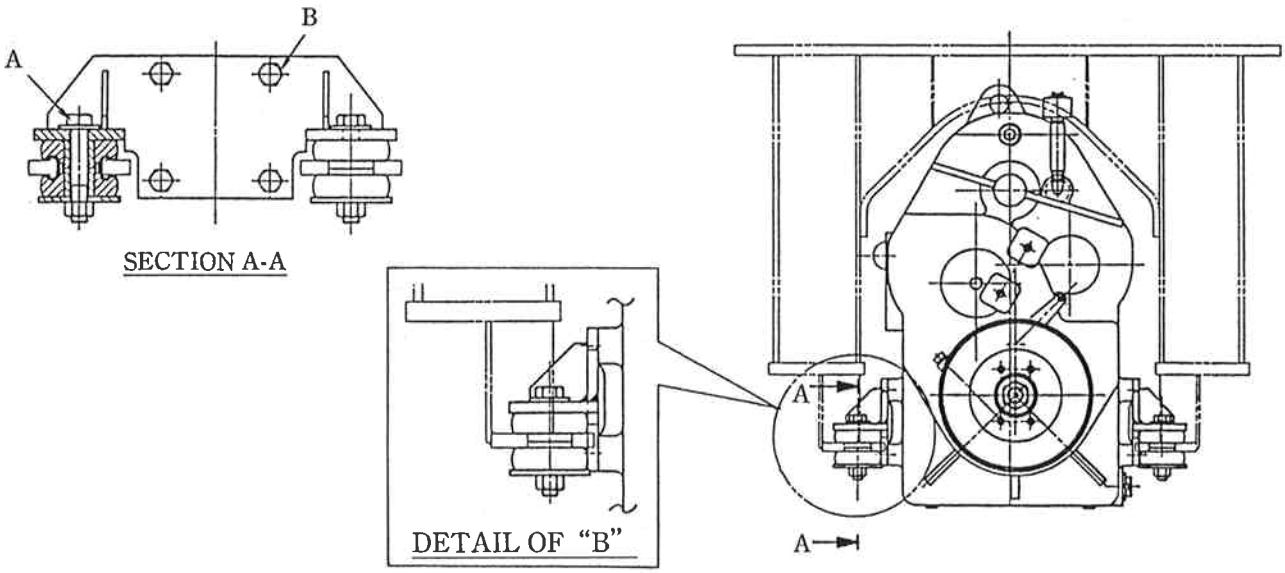


Fig. 4-4 Transmission Mounting

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(5) Parking Brake (Fig. 4-5)

Code	Item	Standard Value	Remarks
A	Tightening torque of capscrews for air chamber bracket mount.	16.9 to 20.7kg · m (122 to 150ft-lbs)	Apply Locktite #242 or equivalent to threaded section
B	Rod adjusting length when mounting air chamber. (When air pressure is 0kg / cm²)	111 to 113mm (4.37 to 4.45in)	
C	Tightening torque of nut for yoke fixing	5.6 to 6.8kg · m (40.5 to 49.1ft-lbs)	

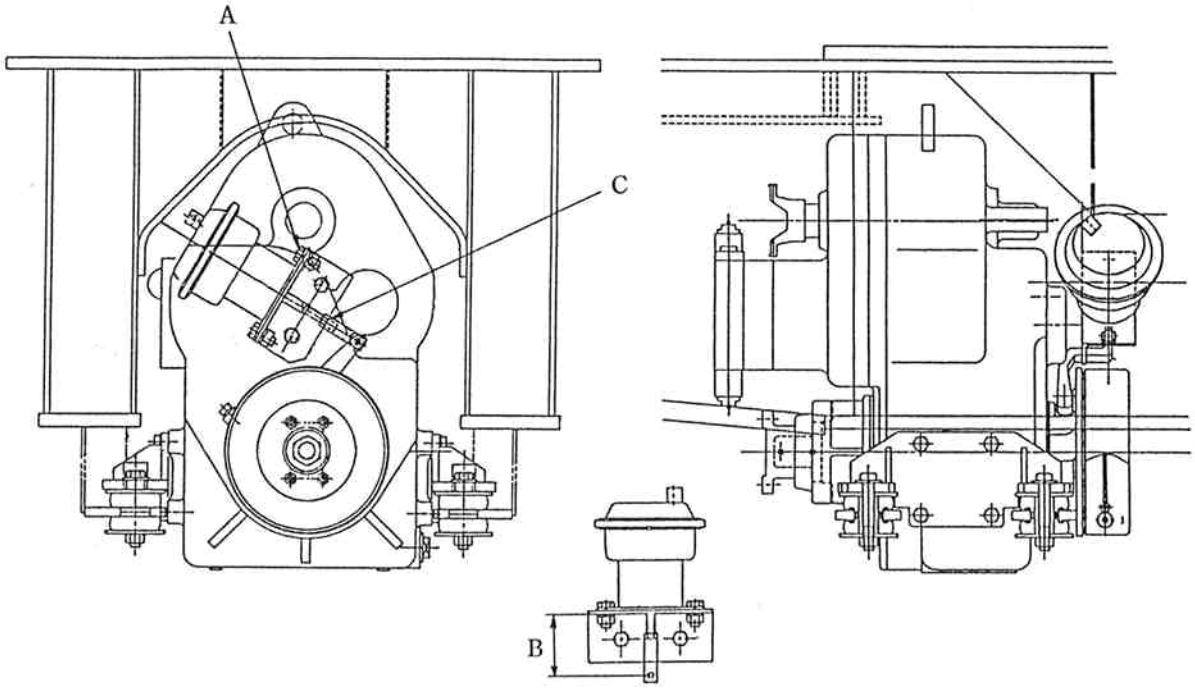


Fig. 4-5 Parking Brake

(6) Propeller Shaft Mounting (Fig. 4-6)

Code	Item	Standard Value	Remarks
A	Tightening torque of capscrews for mount of propeller shaft between torque converter and transmission.	5.5 to 6.5kg · m (39.7 to 47.0ft-lbs)	Apply Locktite #242 or equivalent to threaded section.
B	Tightening torque of capscrews for mount of propeller shaft between transmission and front axle.	13.5 to 14.5kg · m (97.5 to 104.7ft-lbs)	
C	Tightening torque of capscrews for mount of propeller shaft between transmission and rear axle.	13.5 to 14.5kg · m (97.5 to 104.7ft-lbs)	

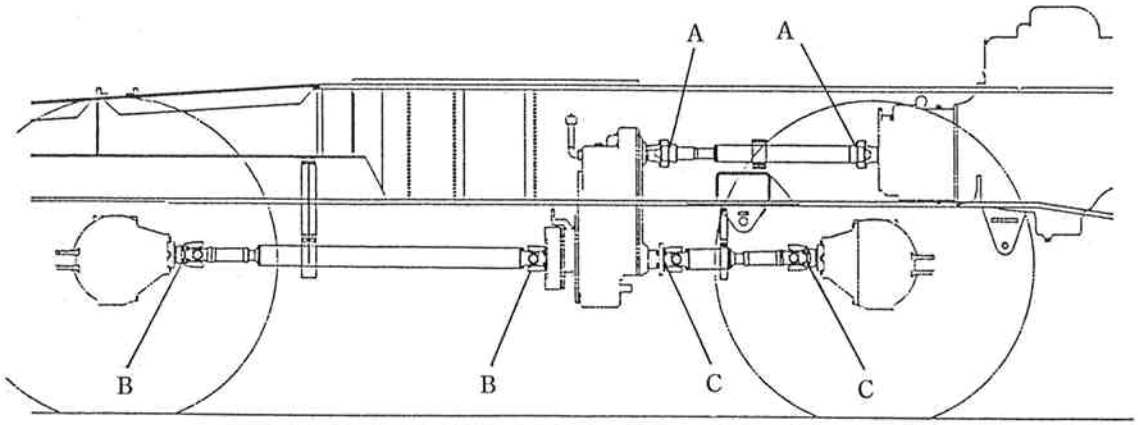
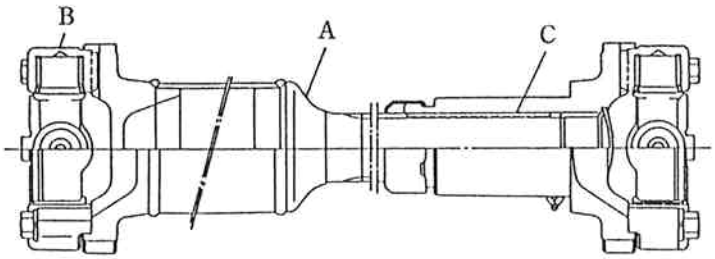


Fig. 4-6 Propeller Shaft Mounting

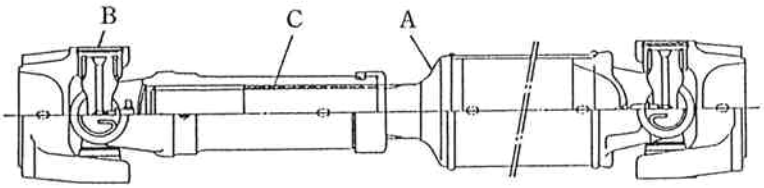
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(7) Propeller Shaft

Code	Item		Standard Value		Remarks
A	Shaft Bend (one side in center)		Standard Value	Service Limit	Replace.
			—	0.5mm (0.02″)	
B	Clearance between Spider and Needle Bearing		—	0.25mm (0.01″)	
C	Play in Spline	Circumferential Direction	—	1.0mm (0.04″)	
		Centripetal Direction	—	0.5mm (0.02″)	



BETWEEN TORQUE CONVERTER AND TRANSMISSION



BETWEEN TRANSMISSION AND AXLE

Fig. 4-7 Propeller Shaft

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(8) Axle Mounting (Fig. 4-8)

Code	Item		Standard Value	Remarks
A	Tightening torque of torque rod mounting bolts.		31 to 37kg · m (224 to 267ft-lbs)	Apply Locktite #242 or equivalent to threaded section
B	Tightening torque of steering cylinder mounting pin fixing capscrews		6.5 to 7.9kg · m (47.0 to 57.1ft-lbs)	
C	Tightening torque of rear steering lock device mounting capscrews		1.65 to 2.01kg · m (11.9 to 14.5ft-lbs)	
E	Tightening torque of tire wheel nuts		62 to 69kg · m (448 to 498ft-lbs)	
F	Wheel alignment	Toe in	0°	
		Camber	0°	
		Caster	0°	
		King pin angle	0°	

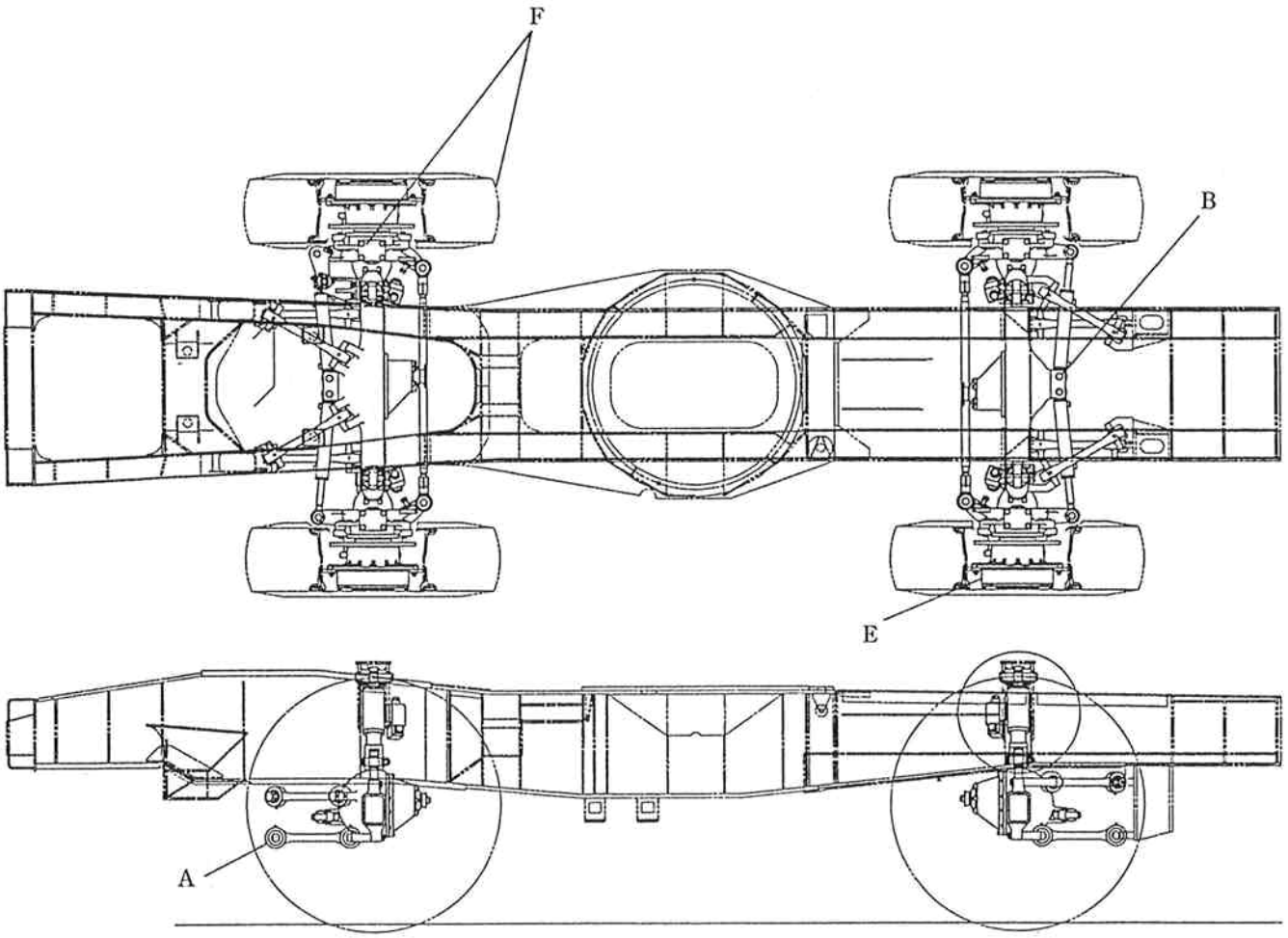
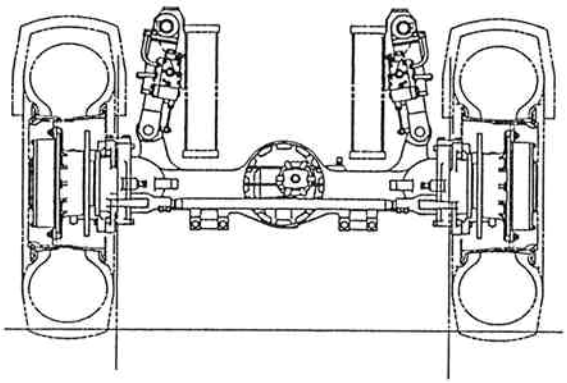
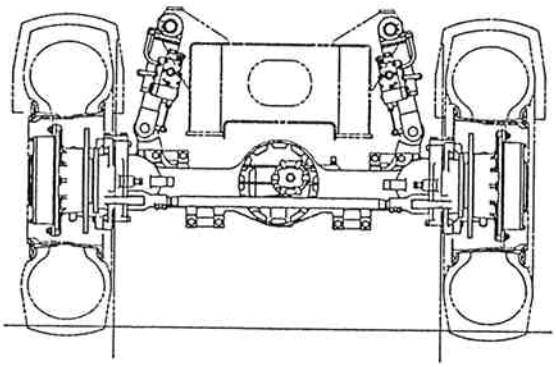
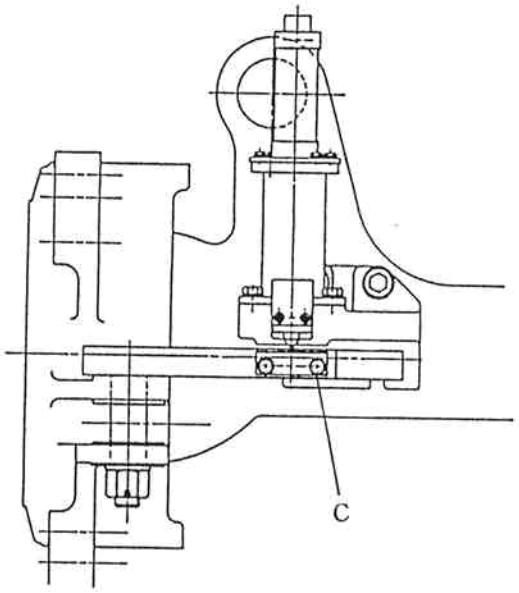


Fig. 4-8 Axle Mounting

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CAUTION

When removing or installing the torque rod from or to the axle and lower frame, do not incline it more than ± 7° in the upward and downward direction from the horizontal.
(Inclining more than ± 7° has possibility to damage the torque rod seal or to allow it to get out.)

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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY OF TORQUE ROD

5.1.1 DISASSEMBLY

(1) Remove four seals (5). Since these are damaged when they are removed, replace with new ones.

(2) Remove four snap rings (4). Draw out pins (2) with spherical bushings (3) attached from torque rod (1).

(3) Removing snap rings (8), draw out spherical bushings (3) from pins (2).

5.1.2 ASSEMBLY

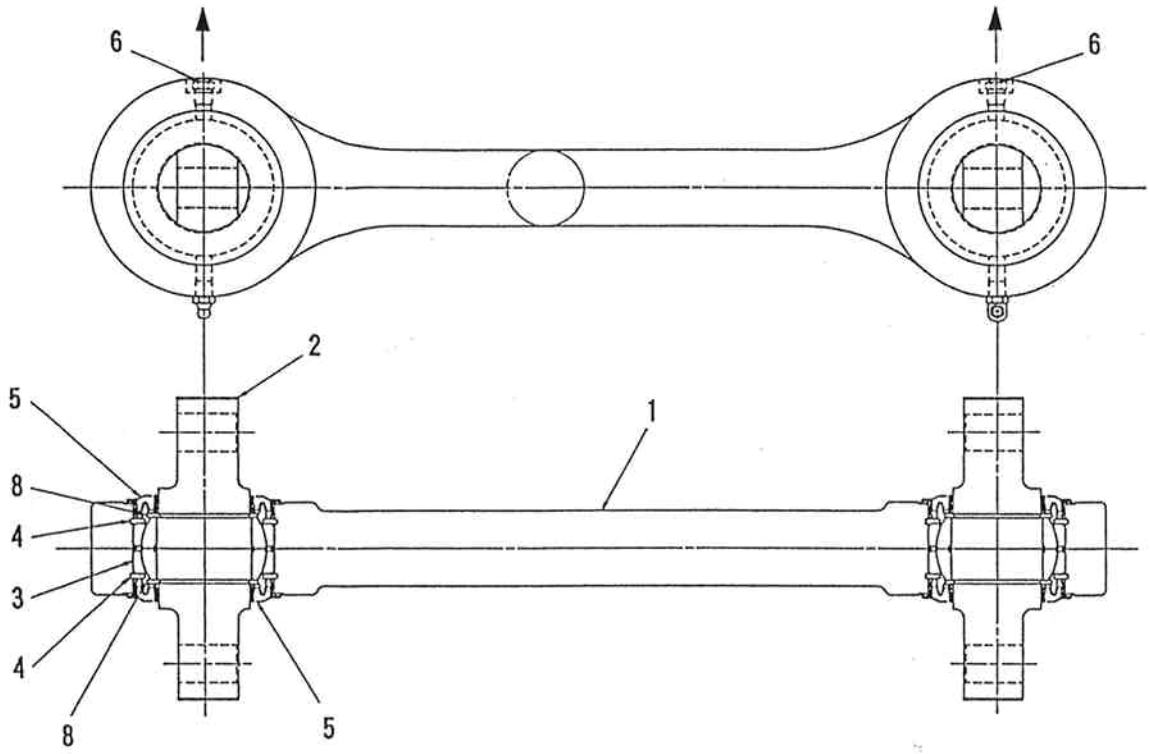
(1) Remove rust preventive oil coated on the spherical surface of spherical bushings (3) before assembling. (For bleeding the inside air when pressing the dust seal in.)

(2) Install spherical bushing (3) so that the split section on the outer race of the bushing is directed in the direction of the arrow mark shown in the figure.

(3) Confirm that pin (2) can lightly shake and move before installing dust seal (5).

(4) Coat Locktite #515 on the outside circumference of dust seal (5) when installing it. However, do not coat anything on the inside circumference.
Press the outside circumference brim in until it contacts closely the end surface of rod (1).

(5) After assembly is completed, supply Nippon Oil Molynoc grease 2 (containing molybdenum disulfide) or equivalent until grease comes out through relief fitting (6).



1. TORQUE ROD
2. PIN
3. BUSHING
4. SNAP RING
5. DUST SEAL
6. RELIEF FITTING
7. GREASE FITTING
8. SNAP RING
9. GREASE FITTING

Fig. 5-1

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5. DISASSEMBLY AND ASSEMBLY

5.1 DISASSEMBLY AND ASSEMBLY OF TORQUE ROD

5.1.1 DISASSEMBLY

(1) Remove four seals (5). Since these are damaged when they are removed, replace with new ones.

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5.1.2 ASSEMBLY

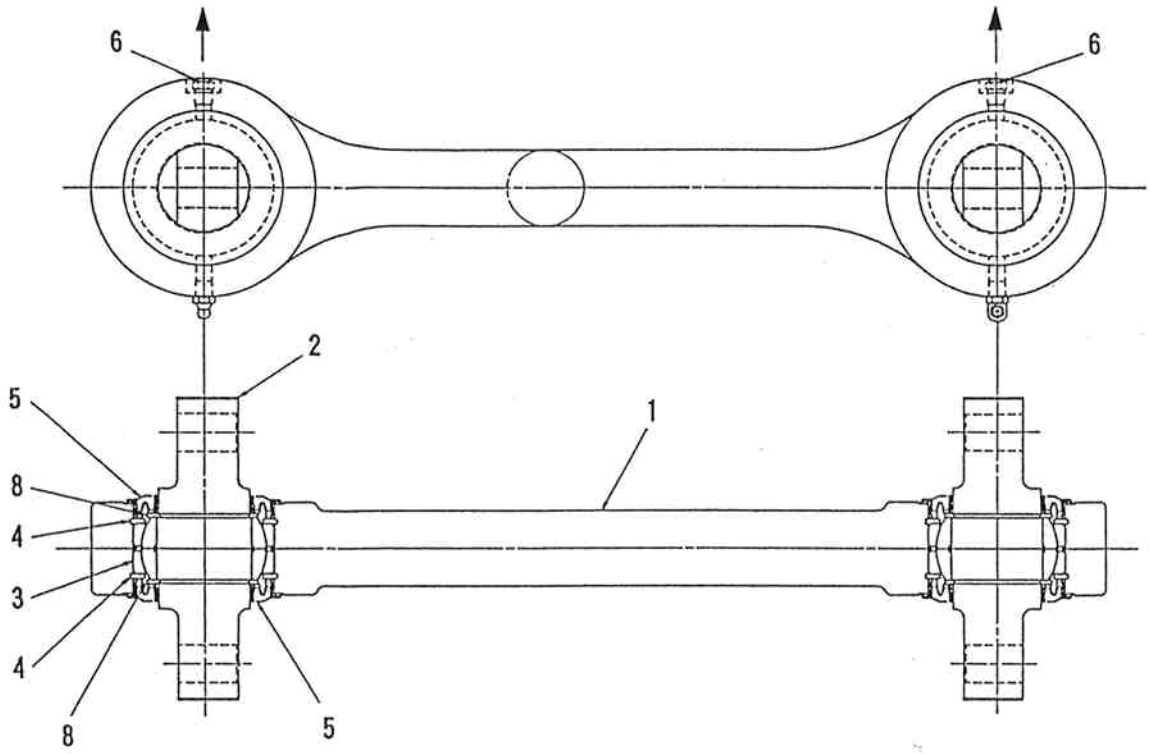
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(2) Install spherical bushing (3) so that the split section on the outer race of the bushing is directed in the direction of the arrow mark shown in the figure.

(3) Confirm that pin (2) can lightly shake and move before installing dust seal (5).

(4) Coat Locktite #515 on the outside circumference of dust seal (5) when installing it. However, do not coat anything on the inside circumference.
Press the outside circumference brim in until it contacts closely the end surface of rod (1).

(5) After assembly is completed, supply Nippon Oil Molynoc grease 2 (containing molybdenum disulfide) or equivalent until grease comes out through relief fitting (6).



1. TORQUE ROD
2. PIN
3. BUSHING
4. SNAP RING
5. DUST SEAL
6. RELIEF FITTING
7. GREASE FITTING
8. SNAP RING
9. GREASE FITTING

Fig. 5-1

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1. TERMINOLOGY AND LOCATION OF MAIN HYDRAULIC EQUIPMENTS

Fig. 1-1 shows the terminologies and locations of the main hydraulic equipments.

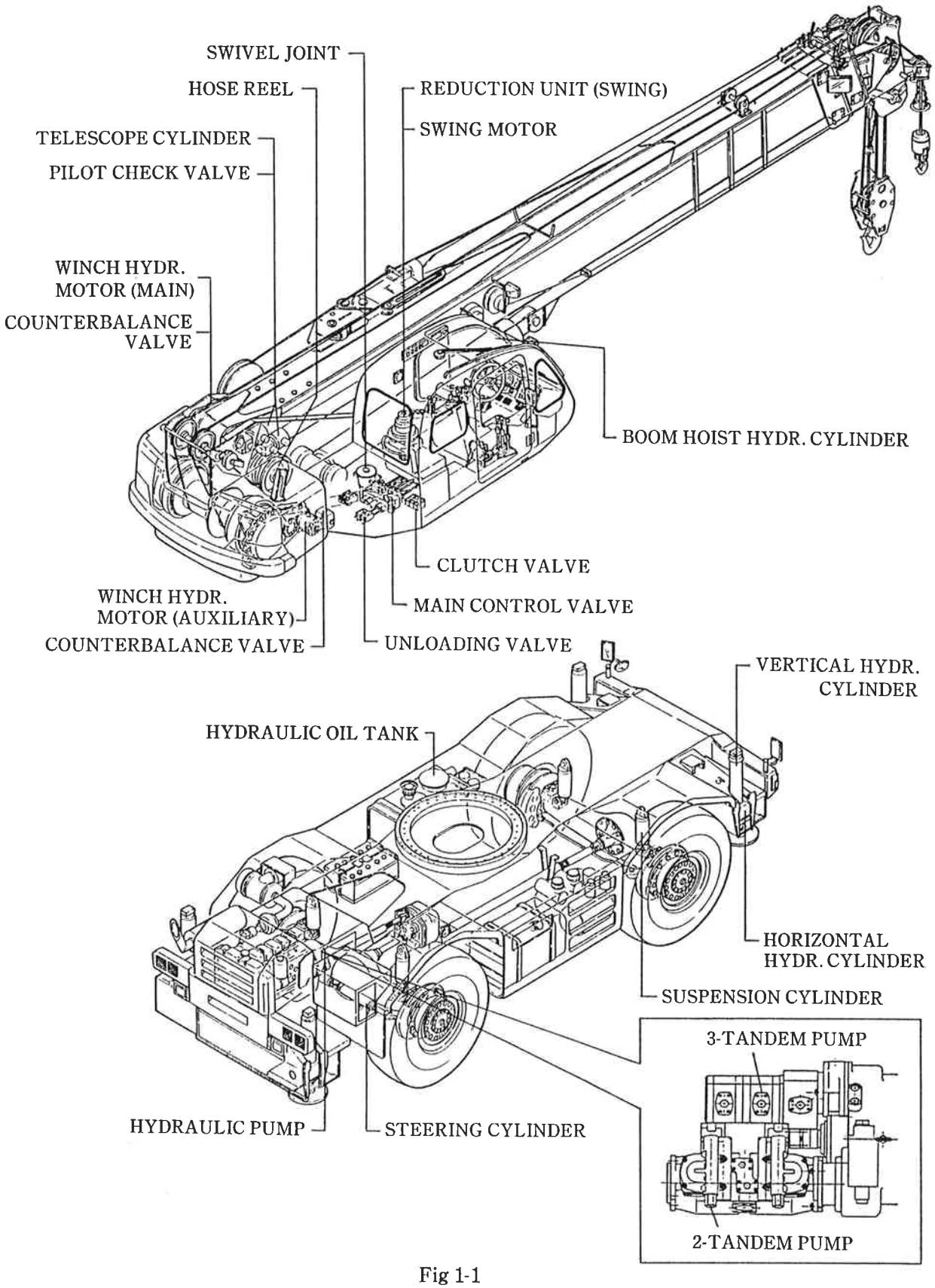


Fig 1-1

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2. COMPOSITION

2.1 HYDRAULIC CIRCUIT DIAGRAM AND SPECIFICATIONS OF COMPONENTS

2.1.1 Standard Specification (Figure 2-1 and Figure 2-2)

The part names (terminologies) for the numbers in these circuit diagrams are described in 2. 1. 3 Specifications of Components on page 2-4.

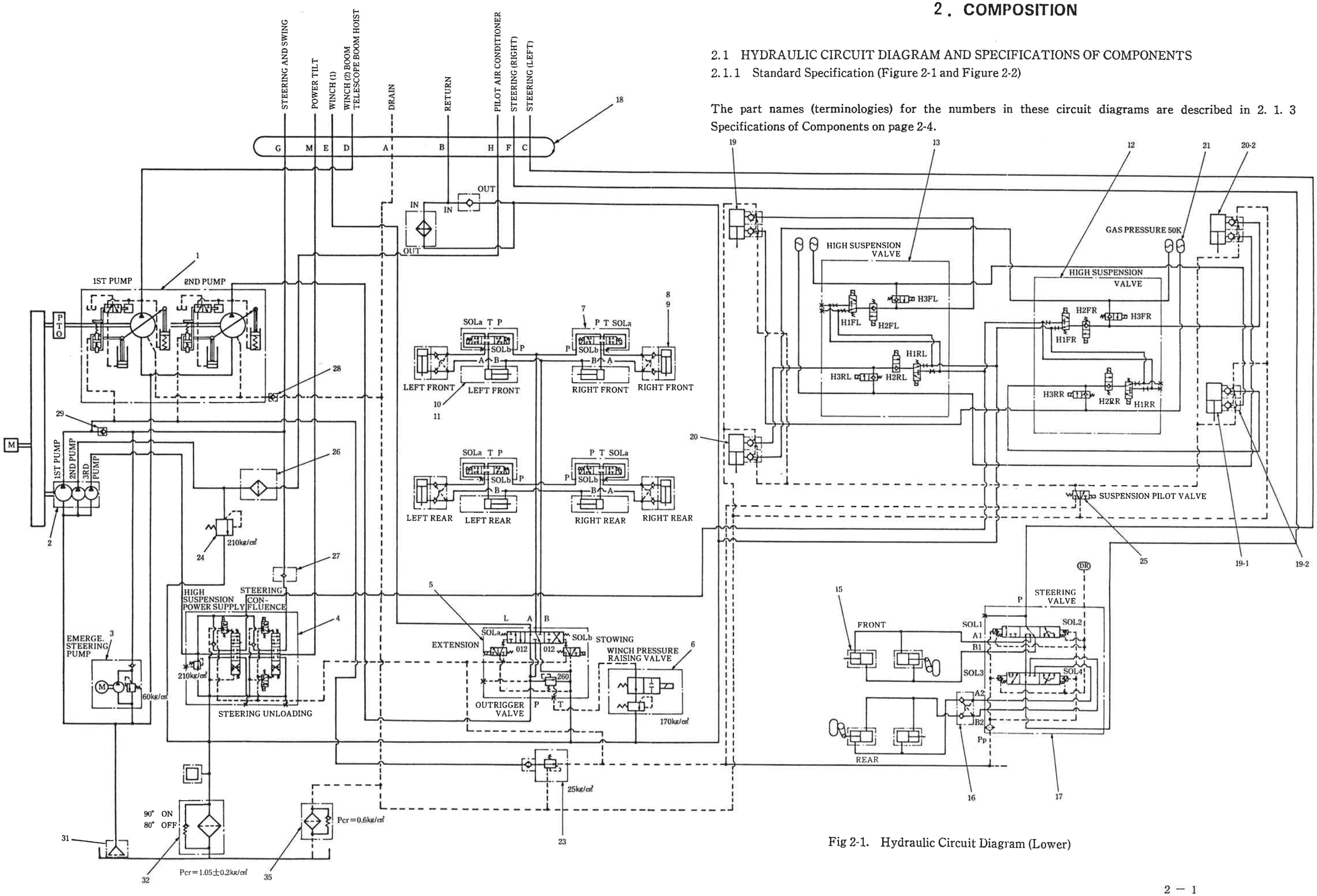


Fig 2-1. Hydraulic Circuit Diagram (Lower)

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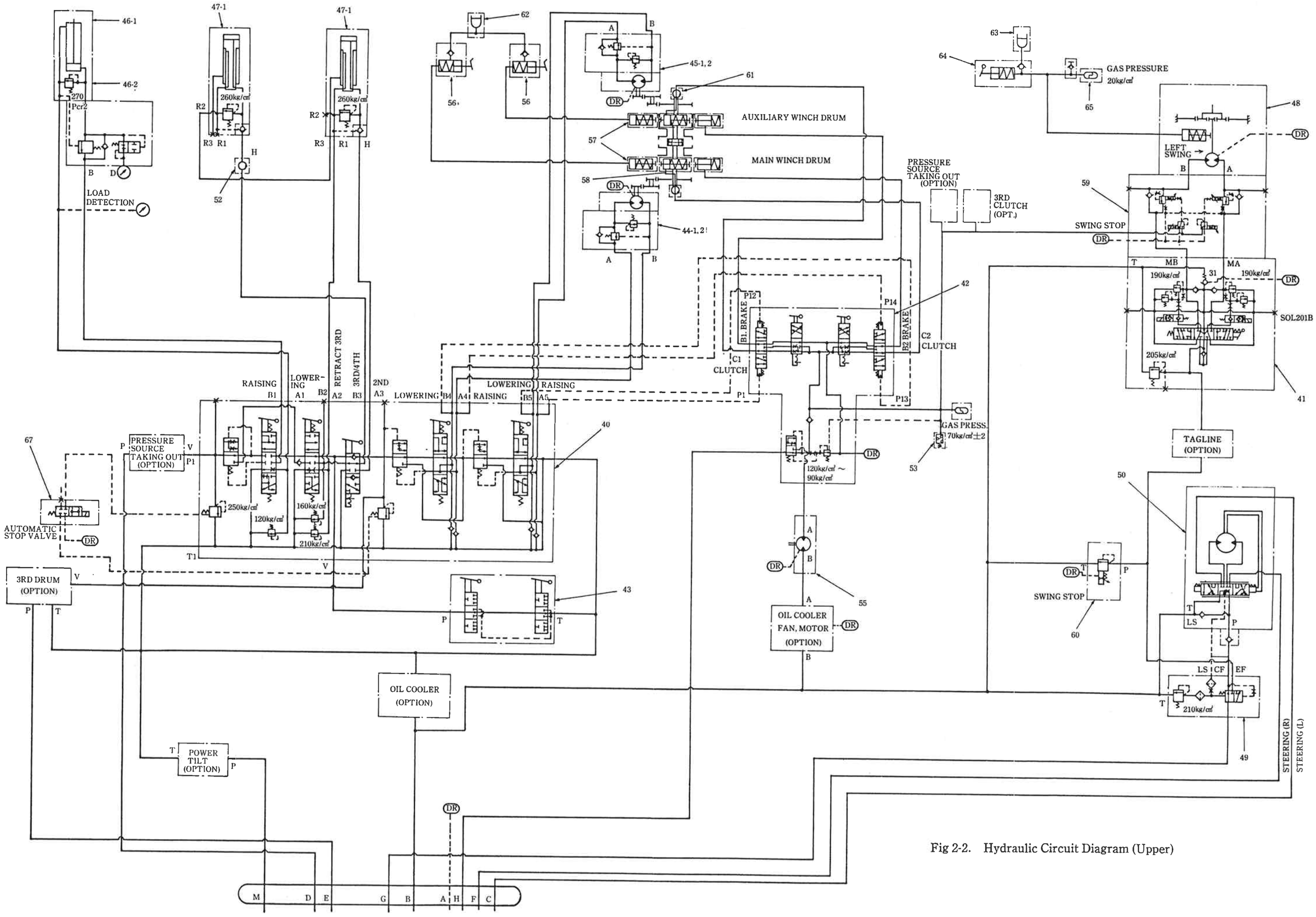
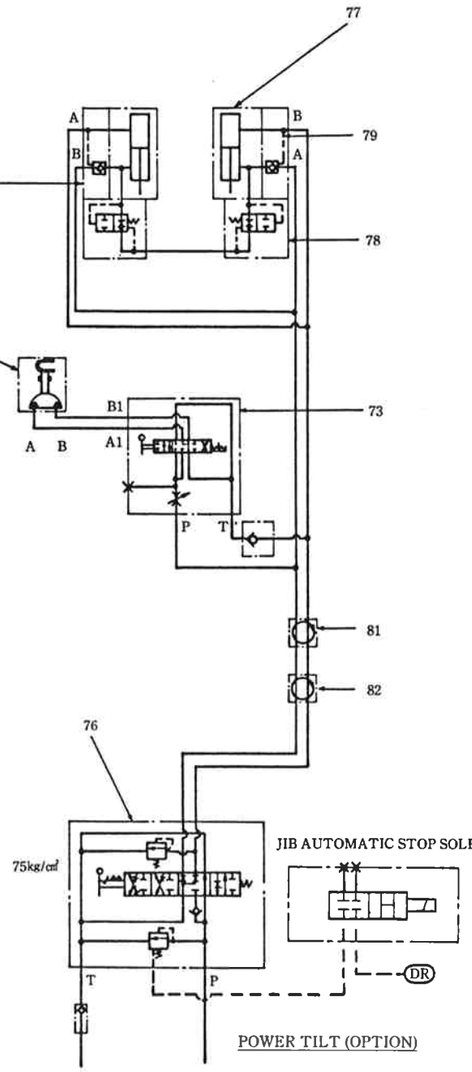


Fig 2-2. Hydraulic Circuit Diagram (Upper)

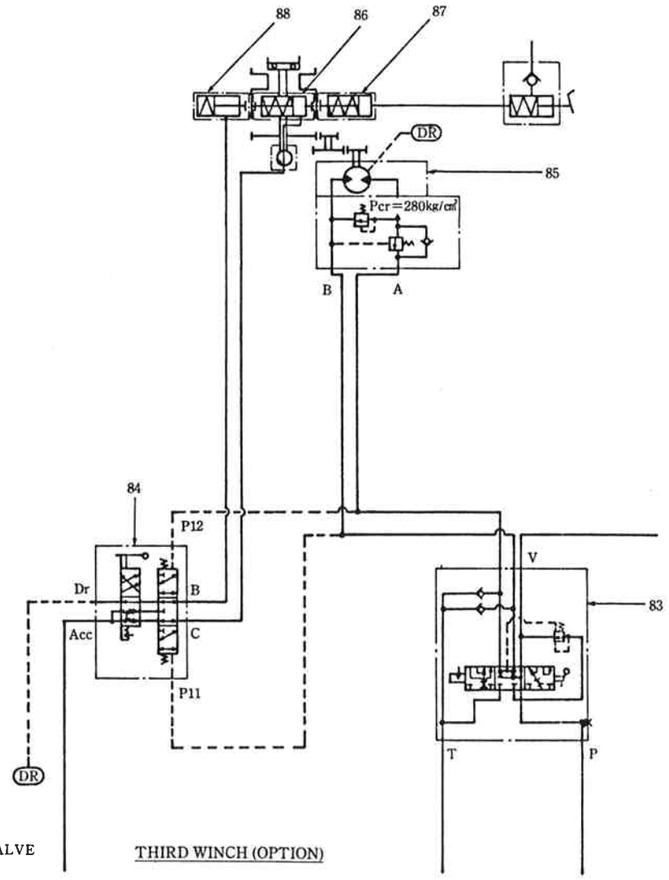
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2.1.2 Optional specification (Fig 2-3)

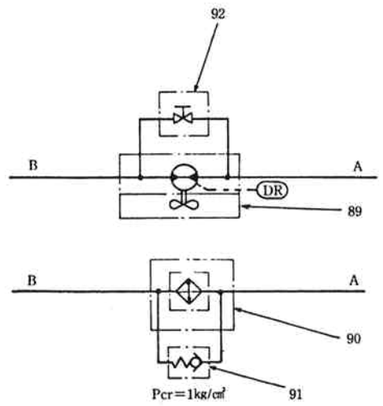


JIB AUTOMATIC STOP SOLENOID VALVE

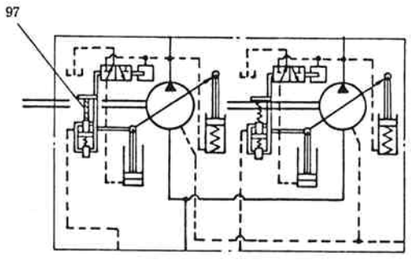
POWER TILT (OPTION)



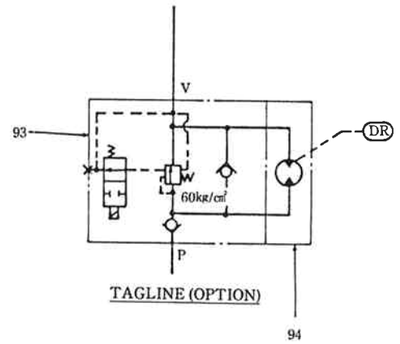
THIRD WINCH (OPTION)



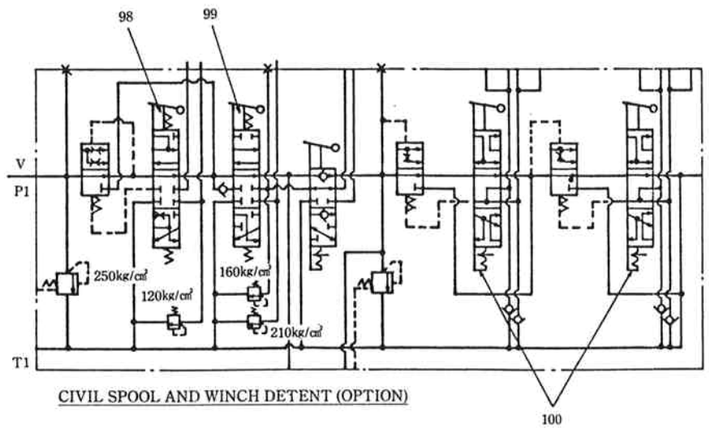
OIL COOLER (OPTION)



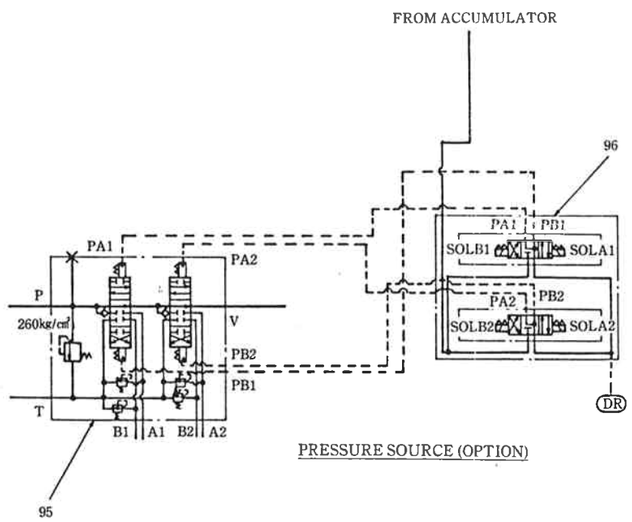
PUMP FIXING (FRONT) (OPTION)



TAGLINE (OPTION)



CIVIL SPOOL AND WINCH DETENT (OPTION)



PRESSURE SOURCE (OPTION)

Fig 2-3. Optional Devices

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2.1.3 Specifications of Components

Item No.	Name of Components		Specifications (Use, specification, and set value)
1	Hydraulic pump	1-1 Variable displacement pump	For boom hoist, boom telescope and winch 2nd speed 12.9 to 146 ℓ (0.46 to 5.16cu. ft) / min delivery, 260kg / ㎠ (3697psi) set pressure at 70 ℓ (2.47cu. ft) / min.
		1-2 Variable displacement pump	For winch 1st speed. 12.9 to 146 ℓ (0.46 to 5.16cu. ft) / min delivery, 250kg / ㎠ (3555psi) set pressure at 70 ℓ (2.47cu. ft) / min.
2	Hydraulic pump	2-1 Gear pump	For swing and steering. Pilot low pressure 86.2 ℓ (3.04cu. ft) / min delivery, 205kg / ㎠ (2915psi) set pressure.
		2-2 Gear pump	For pilot (clutch / negative brake) and option (cabin cooler and oil cooler 37.0 ℓ (1.31cu. ft) / min delivery, 210kg / ㎠ (2986psi) set pressure.
		2-3 Gear pump	For steering flow joining 37.0 ℓ (1.31cu. ft) / min delivery, 210kg / ㎠ (2986psi) set pressure at 35 ℓ / min.
3	Electric motor drive pump unit		For emergency steering. 1.4kw (DC 24 volts) electric motor drive 7.2 ℓ (0.25cu. ft) / min delivery, 60kg / ㎠ (853psi) set pressure.
4	Control valve (for steering flow joining and high suspension pressure source)		Relief valve set pressure : 210kg / ㎠ (2986psi). DC 24 volts.
5	Solenoid valve (Outrigger control valve)		For outrigger extension / stowing. DC 24 volts. Relief valve set pressure : 260kg / ㎠ (3697psi).
6	Winch pressure raising valve		Relief valve set pressure : 170kg / ㎠ (2417psi).DC 24 volts.
7	Solenoid valve		Outrigger cylinder selection. DC 24 volts.
8	Vertical hydraulic cylinder (for "X" type outriggers)		Double-acting type. 175㎜ (6.89in) inside dia. × 130㎜ (5.12in) rod dia. × 320㎜ (12.60in) stroke.
9	Vertical hydraulic cylinder (for "H" type outriggers)		Double-acting type. 120㎜ (4.72in) inside dia. × 100㎜ (3.94in) rod dia. × 643㎜ (25.3in) stroke.
10	Horizontal hydraulic cylinder (for "X" type outriggers)		Double-acting type. 63㎜ (2.48in) inside dia. × 40㎜ (1.57in) rod dia. × 2095㎜ (82.48in) stroke.
11	Horizontal hydraulic cylinder (for "H" type outriggers)		Double-acting type. 63㎜ (2.48in) inside dia. × 40㎜ (1.57in) rod dia. × 2103㎜ (82.8in) stroke.
12, 13	High suspension valve		For high suspension control. DC 24 volts.
15	Steering cylinder		Double-acting type. 60㎜ (2.36in) inside dia. × 35㎜ (1.38in) rod dia. × 302㎜ (11.9in) stroke.
16	Double pilot check valve		Maximum using pressure : 380kg / ㎠ (5404psi).
17	Solenoid valve (steering)		Selection of steering mode. DC 24 volts.
18	Swivel joint	13 ports	A. drain B. return C. steering (left) D. Boom hoist and telescope E. Winch F. Steering (right) G. swing and steering H. pilot, air condit. I. air source J. air (front brake) K. air (rear brake) L. air (accelerator) M. tilt jib (optional).
19-1	High suspension cylinders (Left front and right rear)		Double-acting type. 105㎜ (4.13in) inside dia. × 85㎜ (3.35in) rod dia. × 95㎜ (3.74in) stroke.
20-1	High suspension cylinders (Right front and left rear)		Double-acting type. 105㎜ (4.13in) inside dia. × 85㎜ (3.35in) rod dia. × 95㎜ (3.74in) stroke.

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Item No.	Name of Components		Specifications (Use, specification, and set value)
19-2 20-2	Double pilot check valve		For high suspension lock. Maximum using pressure : 230kg / ㎠ (3271psi).
21	Accumulator		For high suspension circuit. Precharged gas pressure : 50kg / ㎠ (711psi).
23	Pressure reducing valve		Set pressure : 25kg / ㎠ (355psi).
24	Relief valve		Set pressure : 210kg / ㎠ (2986psi) at 70 ℓ (2.47cu. ft) / min:
25	Solenoid valve		DC 24 volts.
26	In line strainer		Filtering accuracy : 102 μ (0.004in). Flow : 37 ℓ (1.31cu. ft) / min. Relief valve opening pressure : 5kg / ㎠ (71.1psi)
27	Check valve		Cracking pressure : 0.5kg / ㎠ (7.1psi) Port diameter : PF 3 / 8.
28	Check valve		Cracking pressure : 0.1kg / ㎠ (1.4psi) Port diameter : PF 1 / 2.
29	Check valve		Cracking pressure : 4kg / ㎠ (56.8psi) Port diameter : PF 3 / 4.
31	Suction strainer		Filtering accuracy : 105 μ (0.0041in) (150 mesh). Filtering area : 2550㎠ 395sq. in). Flow : 500 ℓ (17.66cu. ft) / min.
32	Return filter		Filtering accuracy : 10 μ (0.0004in). Flow : 450 ℓ (15.89cu. ft) / min. Bypass valve opening pressure : 1.05kg / ㎠ (14.93psi).
35	Drain filter		Bypass cracking pressure : 0.6kg / ㎠ (8.5psi).
40	Main control Valve	18-A Main relief valve	(For 1-2 vari. pump) Set pressure : 250kg / ㎠ (3555psi) at 70 ℓ (2.47cu.ft) / min.
		18-B Main relief valve	(For 1-1 variable pump) Set pressure : 260kg / ㎠ (3697psi) at 70 ℓ (2.47cu. ft) / min.
		18-C Port relief valve	(For boom extension) Set pressure : 160kg / ㎠ (2275psi) at 120 ℓ (4.24cu. ft) / min.
		18-D Port relief valve	(For boom retraction) Set pressure : 210kg / ㎠ (2986psi) at 85 ℓ (3.00cu. ft) / min.
	(Winch spring return)	18-E Port relief valve	(For boom lowering) Set pressure : 120kg / ㎠ (1706psi) at 100 ℓ (3.53cu. ft) / min.
41	Swing control valve		Main relief valve set pressure : 190kg / ㎠ (2702psi) Pressure gauge port : PF 1 / 4.
42	Clutch valve		Unloading set pressure : 120kg / ㎠ (1706psi) Loading set pressure : 90kg / ㎠ (1280psi)
43	Winch unloading valve		Maximum using pressure : 280kg / ㎠ (3982psi) Maximum using flow : 150 ℓ (5.30cu. ft) / min.
44-1	Winch hydraulic motor (main)		Swash plate type, axial punger type. 149cc (9.09cu. in) / rev displacement.
44-2, 45-2	Counterbalance valve (winch)		Maximum using pressure : 350kg / ㎠ (4977psi) Relief valve set pressure : 280kg / ㎠ (3982psi)
45-1	Winch hydraulic motor (auxiliary winch)		Swash plate type, axial plunger type. Displacement : 148.5cc (9.06cu. in) / rev.
46-1	Boom hoist hydraulic cylinder		Double-acting type. 290㎜ (11.42in) inside dia. × 180㎜ (7.09in) rod dia. × 1715㎜ (67.52in) stroke, 270 kg / ㎠ (3839psi) overload relief valve set pressure.
46-2	Counterbalance valve (boom hoist)		Maximum using pressure : 280kg / ㎠ (3982psi)

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Item No.	Name of Components	Specifications (Use, specification, and set value)
47-1	Boom telescope hydraulic cylinder	Double-acting type. 140㎜ (5.51in) inside dia. × 120㎜ (4.72in) rod dia. × 7110㎜ (280in) stroke, 260kg / ㎠ (3697psi) overload relief valve set pressure.
48	Swing hydraulic motor (with planetary 1 step reducer)	Swash plate type, axial punger type. 184.1cc (11.23cu. in) / rev displacement.
49	Priority valve	Maximum using flow : 81.1 ℓ (2.86cu. ft) / min. Relief valve set pressure : 210kg / ㎠ (2986psi)
50	Orbit roll	Maximum using flow : 81.1 ℓ (2.86cu. ft) / min. Displacement : 277cc (16.9cu.in) / rev.
52	Hose reel	Hose : 12.7㎜ (0.500in) inside dia. × 19.9㎜ (0783in) outside dia. × 11000㎜ (433.1 in) length.
53	Pressure switch	For detecting pilot circuit accumulator pressure. ON for less than 70kg / ㎠ (995psi), and OFF for more than 75kg / ㎠ (1065psi)
55	Fan motor	Swash plate type, axial plunger type. Displacement : 16cc (0.98 cu.in) / rev.
56	Master cylinder	For winch positive brake. 7 / 8inch (22.26㎜ dia). Stroke : 35㎜ (1.38in).
57-1	Brake cylinder	For winch positive brake. 35㎜ (1.38in) dia. Maximum stroke : 12㎜ (0.47in).
57-2	Brake cylinder	For winch negative brake. 45㎜ (1.77in) dia. Maximum stroke : 20㎜ (0.79in)
58	Clutch cylinder	For winch clutch. 1 3/8 inches (34.93㎜ dia). Maximum stroke : 12㎜ (0.47in).
59	Swing motor control valve	For swing automatic stop. DC 24 volts.
60	Swing pump control valve	For swing automatic stop. DC 24 volts.
61	Swivel joint	For winch clutch. Rated pressure : 120kg / ㎠ (1706psi).
62	Oil reservoir	For Winch positive brake. Capacity : 180cc (10.98cu. in). 2 hose inserts.
63	Oil reservoir	For swing positive brake. Capacity : 180cc (10.98cu. in). 1 hose insert.
64	Master cylinder	For swing positive brake. 5 / 8inch (15.88㎜ dia). Stroke : 35㎜ (1.38in).
65	Accumulator	For swing positive brake. Precharged gas pressure : 20kg / ㎠ (284psi) Capacity : 30cc (1.83cu. in).
67	Solenoid valve	For automatic stop. DC 24 volts.
73	Control valve (for power twist)	Rated flow : 10 ℓ (0.35cu. ft) / min.
74	Motor (for power twist)	Capacity 132.7cc (8.10cu. in)
76	Control valve (for power tilt)	Relief valve set pressure : 210kg / ㎠ (2986psi) at 30 ℓ (1.06cu. ft). Port relief valve set pressure : 75kg / ㎠ (1065psi)

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Item No.	Name of Components	Specifications (Use, specification, and set value)	
77	Tilt cylinder (for power tilt)	Double-acting type. 100㎜ (3.94in) inside dia. × 40㎜ (1.57in) rod dia. × 686㎜ (27.01in) stroke.	
78	Fuse valve (for power tilt)	Maximum using pressure : 210kg / ㎠ (2986psi).	
79, 80	Pilot check valve (for power tilt)	Maximum using pressure : 380kg / ㎠ (5404psi).	
81	Swivel joint (for power tilt)	Maximum using pressure : 210kg / ㎠ (2986psi). 2 ports	
82	Hose reel (for power tilt)	Maximum using pressure : 210kg / ㎠ (2986psi).	
83	Control valve (for third drum winch)	Relief valve set pressure : 270kg / ㎠ (3839psi). Pressure gauge port : PF 1 / 4	
84	Clutch valve (for third drum winch)	Maximum clutch using pressure : 280kg / ㎠ (3982psi).	
85	Winch motor (for third drum winch)	Swash plate type, axial plunger type. Displacement : 80cc (4.88cu. in) rev. Counterbalance valve relief set pressure : 280kg / ㎠ (3982psi).	
86	Clutch cylinder (for third drum winch)	1 3/8 inches (34.93㎜)dia. Maximum stroke : 12㎜ (0.47in).	
87	Brake cylinder (for third drum winch)	For positive brake. 1 3/8 inches (34.93㎜)dia. Stroke : 12㎜ (0.47in).	
88	Brake cylinder (for third drum winch)	For negative brake. 38.1㎜ (1 1/2inches) dia. Stroke : 20㎜ (0.79in).	
89	Fan (for oil cooler)	Outside diameter : 420㎜ (16.54in). Number of blades : 10	
90	Oil cooler core	Maximum using pressure : 20kg / ㎠ (284psi). Amount of flowing-in oil : 280 ℓ (9.89cu.ft) / min.	
91	Check valve	Cracking pressure : 1.0kg / ㎠ (14.2psi).	
92	Manual valve (for oil cooler)	Maximum using pressure : 210kg / ㎠ (2986psi).	
93	Control valve (for tagline)	Sequence valve set pressure : 60kg / ㎠ (853psi).	
94	Motor (for tagline)	Orbit motor. Displacement : 78cc (4.76cu.in) / rev.	
95	2 tandem control valve (for taking out pressure source)	Port relief valve set pressure : A1, B1, A2 and B2 : 230kg / ㎠ (3271psi) at 70 ℓ (2.47cu. ft). Pilot minimum working pressure : 45kg / ㎠ (640psi). Pilot maximum working pressure : 120kg / ㎠ (1706psi).	
96	Solenoid valve (for taking out pressure source)	DC 24 volts	
100	Main control valve (Winch detent kit)	Main relief valve set pressure	P1 : 250kg / ㎠ (3555psi) at 70 ℓ (2.47cu. ft) / min. P2 : 260kg / ㎠ (3697psi) at 70 ℓ (2.47cu. ft) / min.
		Port relief valve set pressure	A2 : 160kg / ㎠ (2275psi) at 120 ℓ (4.24cu. ft) / min. B2 : 210kg / ㎠ (2986psi) at 85 ℓ (3.00cu. ft) / min. A1 : 120kg / ㎠ (1706psi) at 100 ℓ (3.53cu. ft) / min.

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2.2 LOCATION OF HYDRAULIC COMPONENTS

The locations of the main hydraulic components are shown in Figures 2-4, 2-5 and 2-6. The item numbers in figures are linked with the item numbers in the hydraulic circuit diagrams.

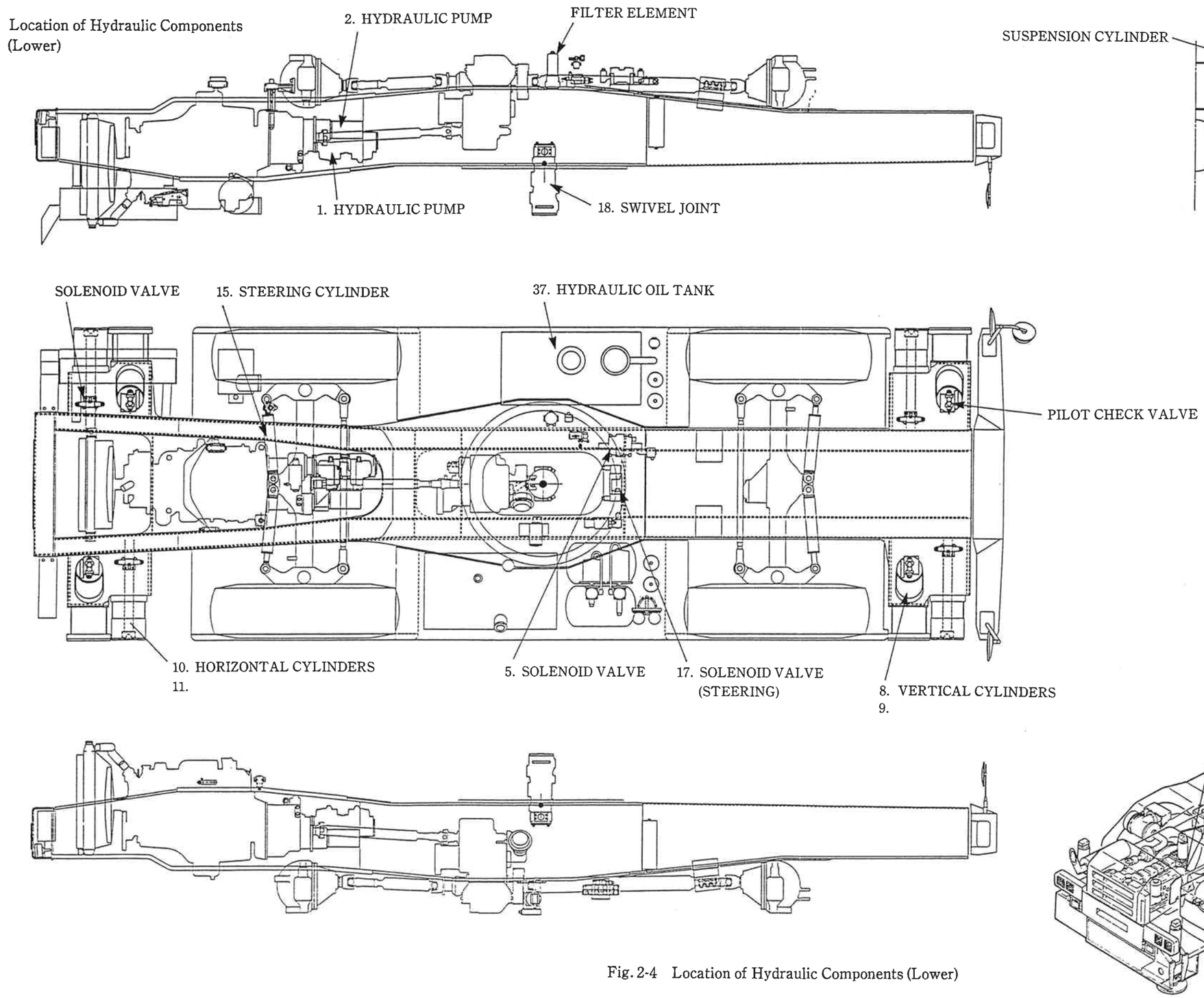


Fig. 2-4 Location of Hydraulic Components (Lower)

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Location of Hydraulic Components (Upper)

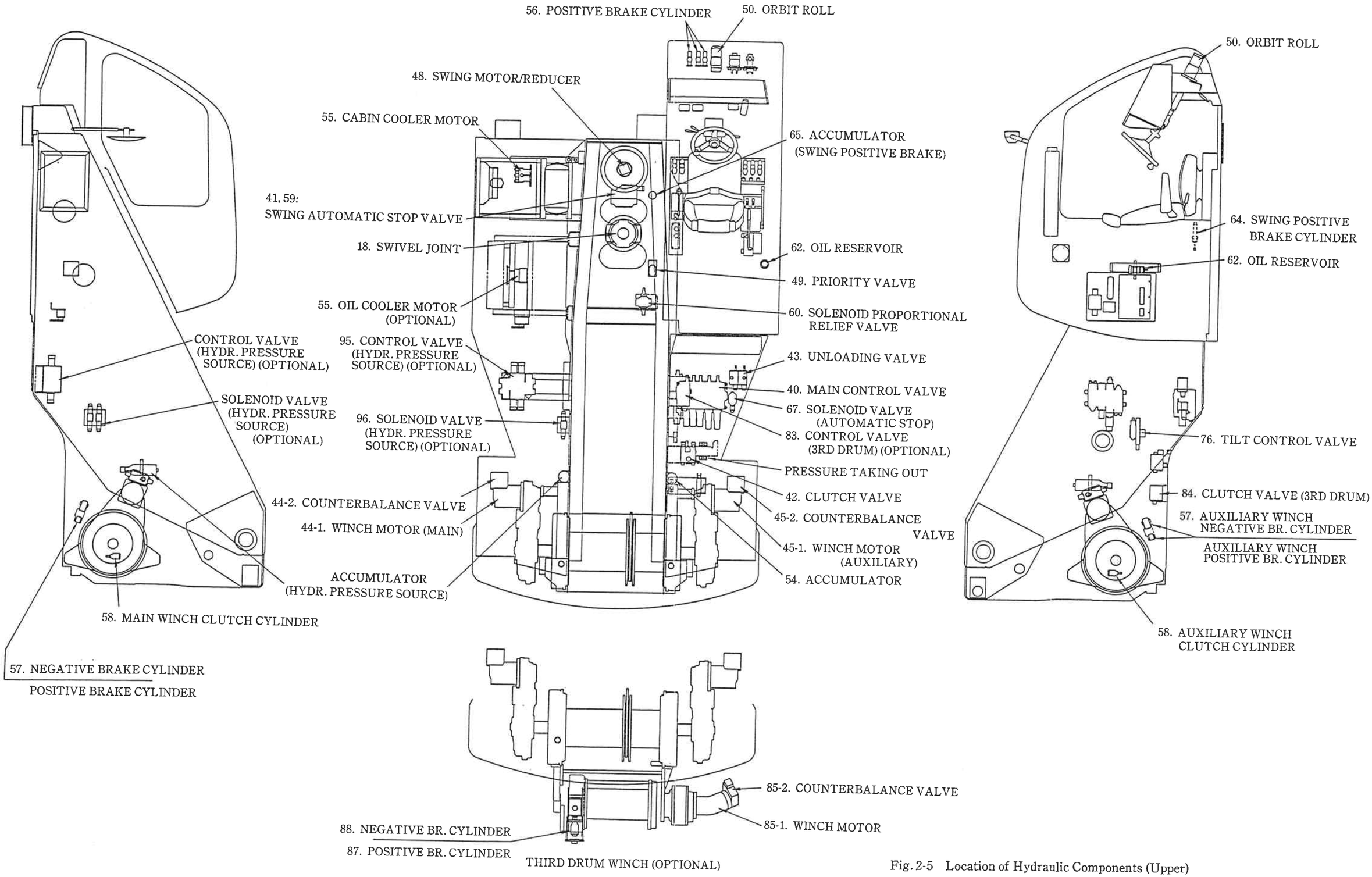


Fig. 2-5 Location of Hydraulic Components (Upper)

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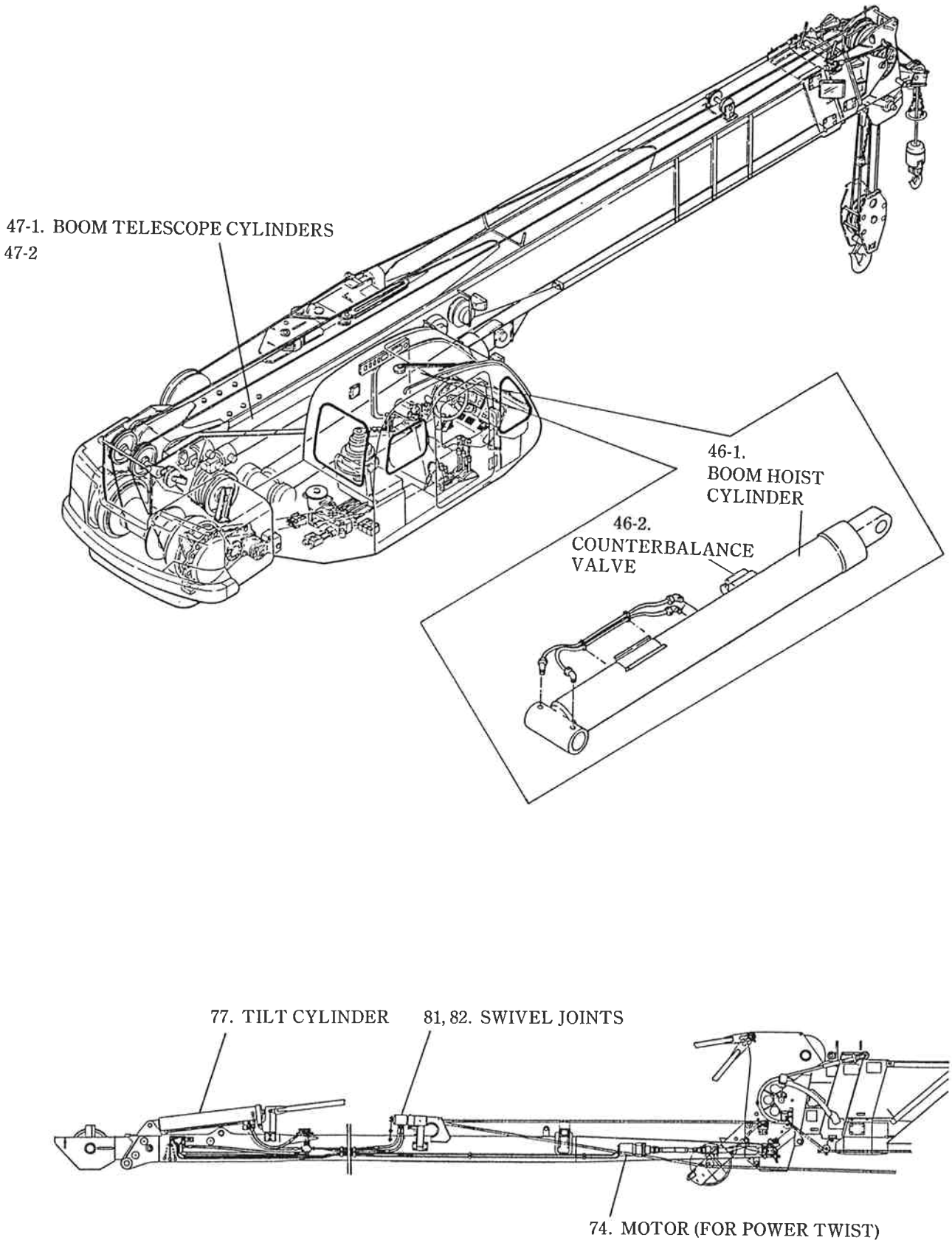


Fig. 2-6 Location of Hydraulic Components (Boom)

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3. CIRCUIT COMPOSITION OF EACH SYSTEM

The hydraulic pumps are installed on the torque converter. No. 1 pumps (2 tandem variable piston pumps) and No. 2 pumps (3 gear pumps) are the hydraulic power sources for the hydraulic system.

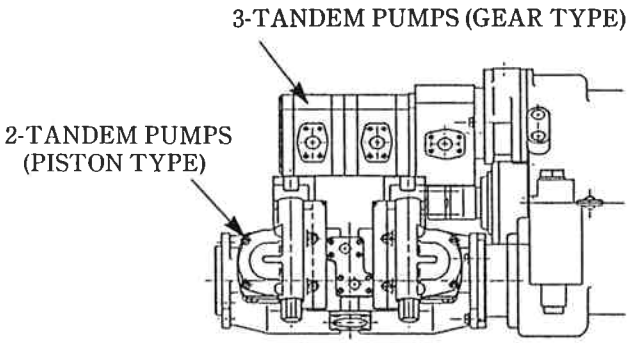


Fig. 3-1 Installing Location of Pumps

3.1 HYDRAULIC PUMP SYSTEM

3.1.1 FULL POWER CONTROL

These are controlled with the regulator valve provided on the No. 1-1 variable displacement piston pump.

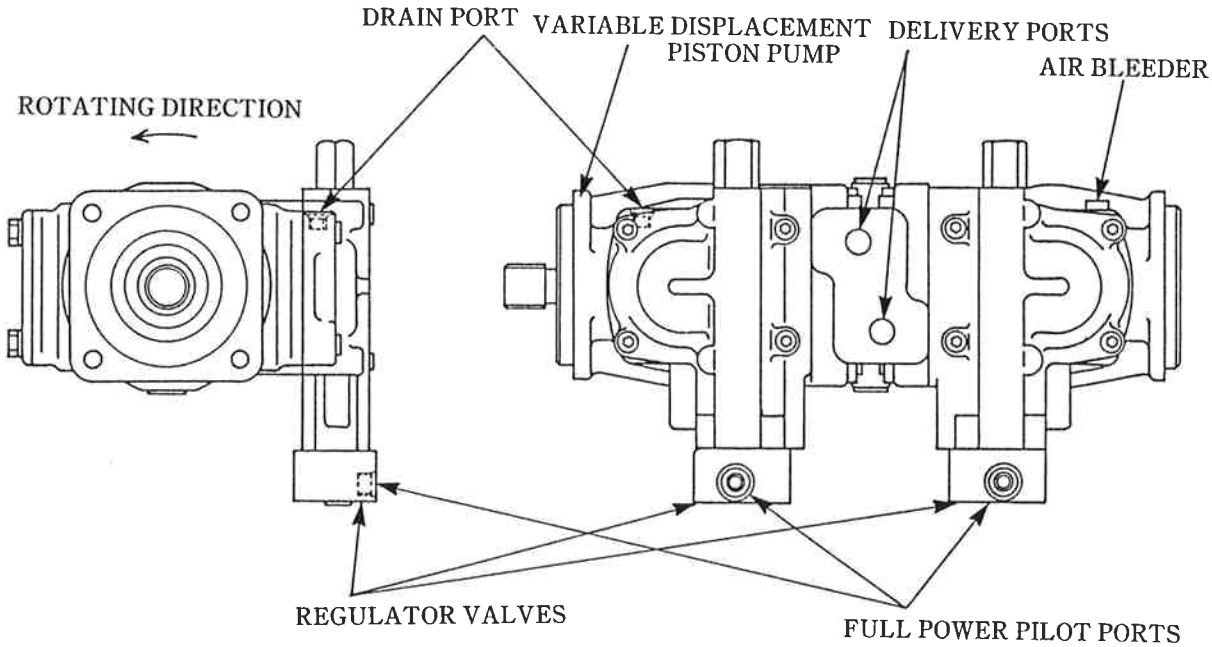


Fig. 3-2 Installation of Regulator Valve

(1) The basic control method is what is called a 'position control method' which controls the pump delivery by allowing the servo spool to be displaced according to the balance of the self pump delivery pressure with the spring force and by allowing the cam lever, fixed to the swash plate through the power piston, to follow this displacement of the spool.

(2) Operation of regulator valve
Fig. 3-3 shows the circuit schematic diagram.
The regulator controls the full power of the self pump delivery pressure and gear pump delivery pressure.

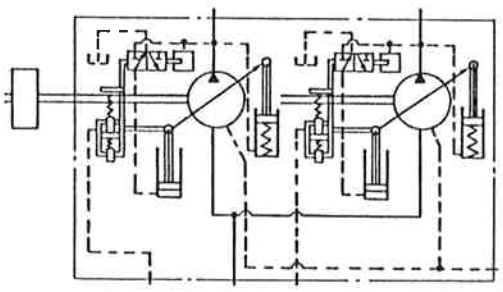


Fig. 3-3

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(Under the condition shown in Fig.3-4, self pump delivery pressure (P_d) flows into the servo system, and always acts on the shaded section.)

When pressure (P_d) is lower than a value, the cam lever, that is, the pump swash plate is held in the preset maximum inclined position shown in Fig. 3-4 with spring (R) and pressure (P_d) which acts on the piston.

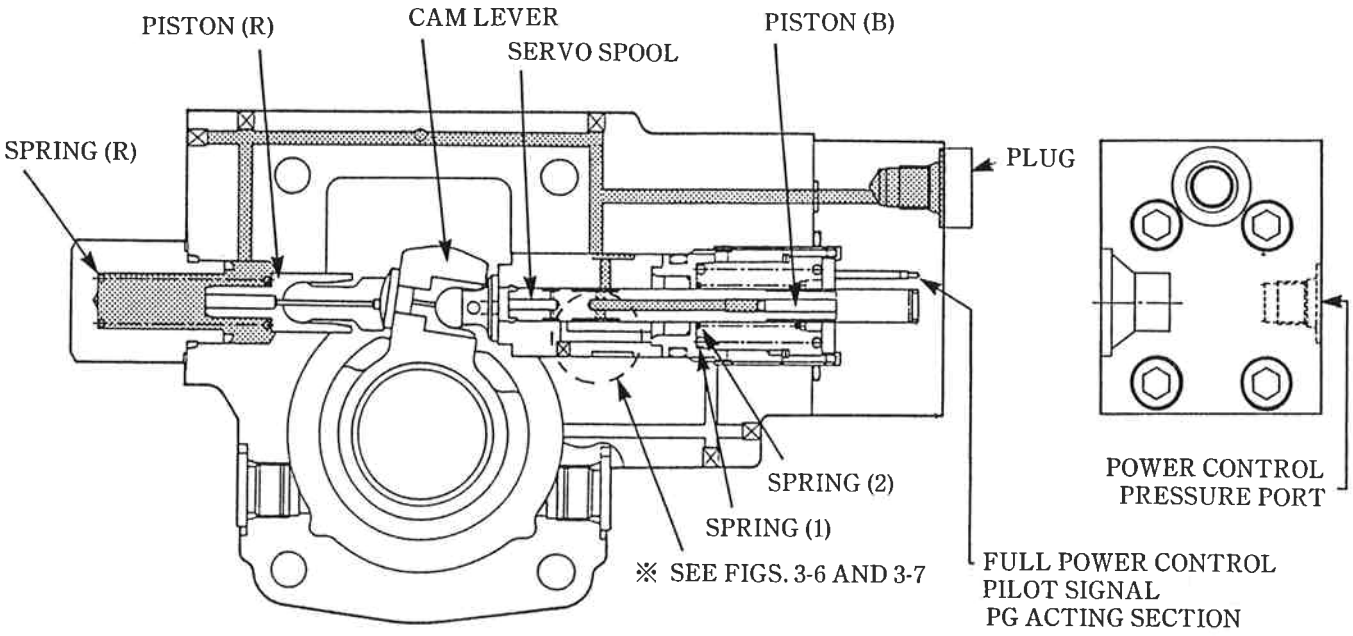


Fig. 3-4

(3) Next, when the self pump delivery pressure rise until it exceeds the first bent point pressure (P_1) in Fig. 3-5, the servo spool receives hydraulic reaction force acting on inserted piston (B), and moves to the left against force of spring (1) or springs (1 and 2). As the result, the secondary pressure chamber is opened at the high pressure section (shaded section), and high pressure flows into the right end of the power piston.

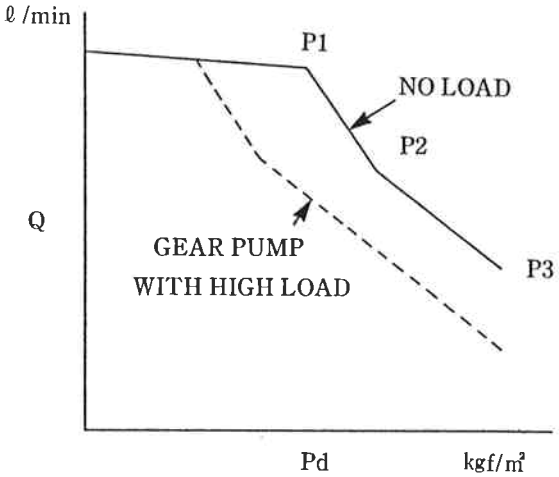


Fig. 3-5 Full Power Control

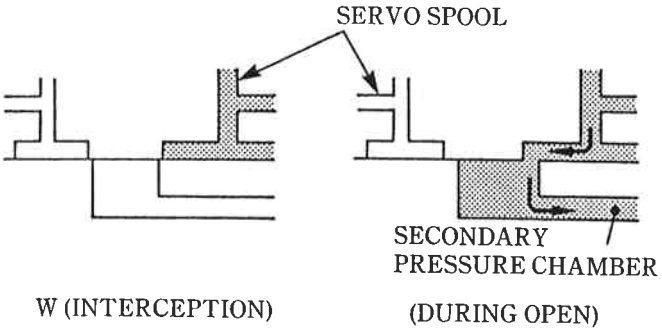


Fig. 3-6 Servo Spool

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(4) Since the sectional area of this power piston is larger than that of piston (R), the piston overcomes the reacting force of the swash plate and the force of piston (R), and follows the movement of the servo spool to move to the left (delivery decreasing direction), then stops at the position where it intercepts the servo secondary pressure chamber.

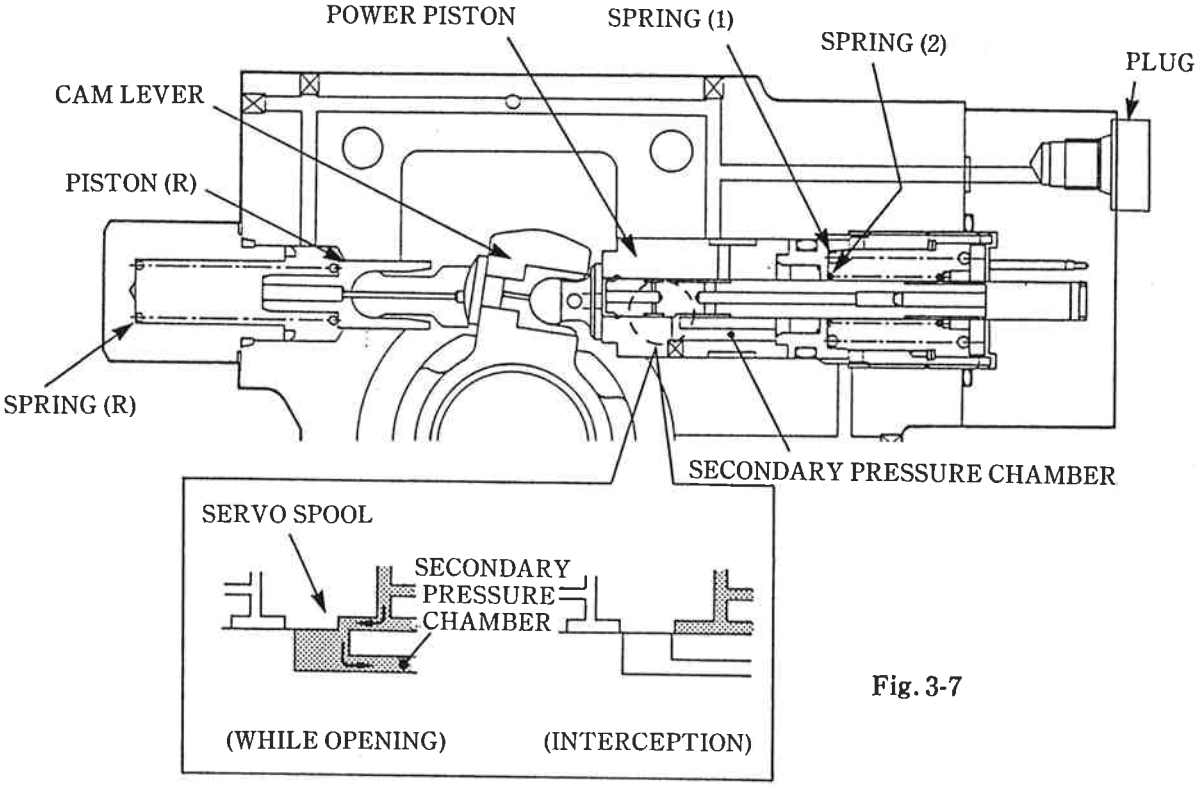


Fig. 3-7

(5) When the spring force acting on the servo spool is that of spring (1) only, the delivery is in the range of P_1 to P_2 in Fig. 3-5, and when force is both of spring (1) and spring (2), the delivery is in the range of P_2 to P_3.

In opposition, when the self pump delivery pressure is changed from high pressure to low pressure, the hydraulic pressure acting on piston (B) is lowered. Therefore, the servo spool is returned to the right by the force of springs (1 and 2), and the secondary pressure chamber is opened to the tank circuit.

Therefore, the cam lever is returned to the right (delivery increasing direction) by the force of spring (R) and piston (R), and stops at the position where it intercepts the servo secondary pressure chamber.

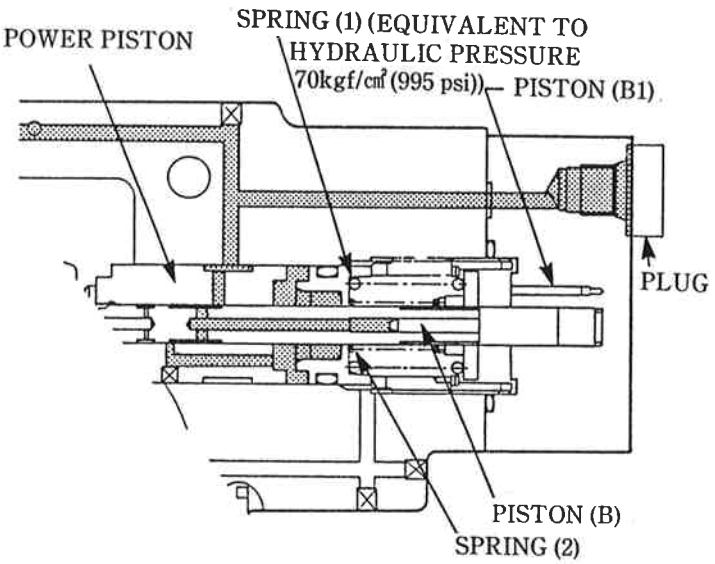


Fig. 3-8

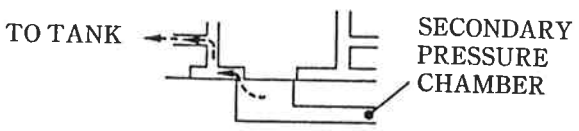


Fig. 3-9 Drain of Secondary Chamber

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(6) Besides, when the delivery pressure of the gear pump rises, signal pressure (P_G) acts on piston (B_1) from the full power control pilot port. By balance of this pressure and piston (B) with the force of springs (1 and 2), the servo spool is displaced to control the delivery with the same operation as mentioned above.

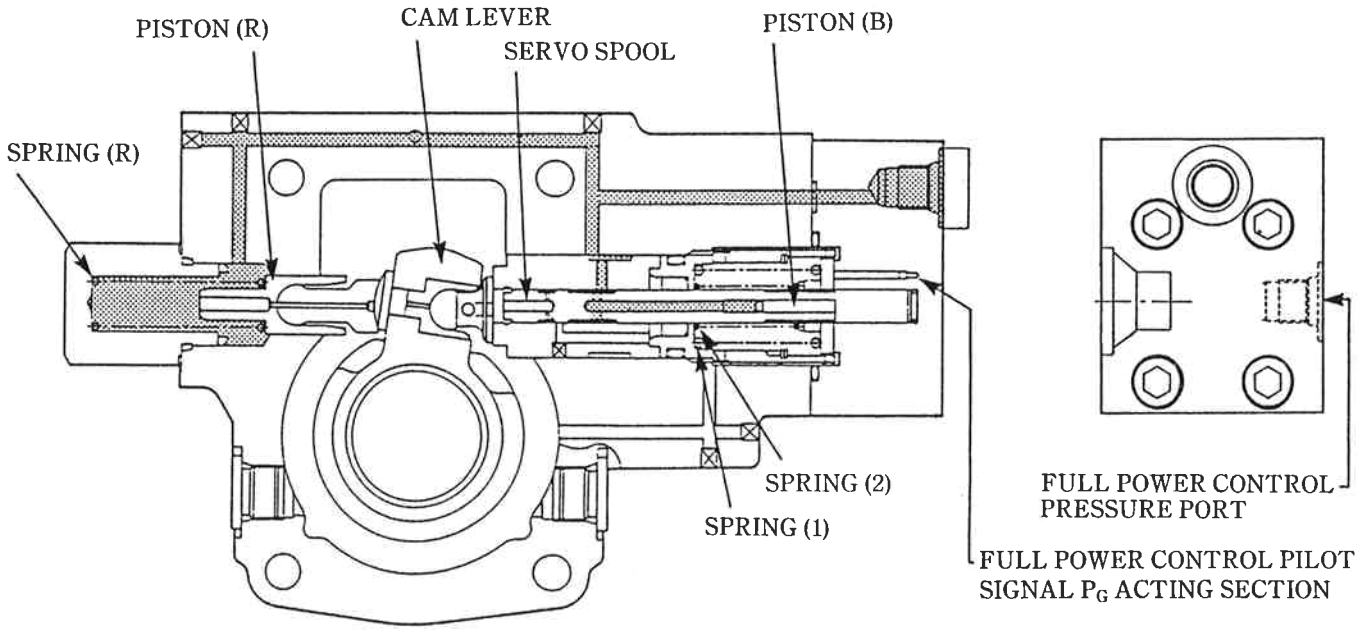


Fig. 3-10

As mentioned above, this pump system moves the servo spool to the left and right by balance of the hydraulic pressure acting on pistons (B and B_1) with the force of the power setting springs, and allows the power piston to follow this spool movement, changing the cam lever, namely the swash plate inclining angle.

(7) Fig. 3-5 shows controlled P_d-Q conditions. The broken line shows the condition when the gear pump delivery pressure is the maximum and the solid line shows that in case of no load.

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ADJUSTING METHOD OF CONTROL

A. Adjusting Method of Set Theoretical Delivery (See Fig. 3-11)

The cam lever fixed to the swash plate is held in the maximum inclining position by the self pressure and force of spring (R) until the delivery pressure reaches a preset value.

This maximum inclining position, that is the set theoretical delivery can be adjusted via the power piston by screwing in or loosening the sleeve.

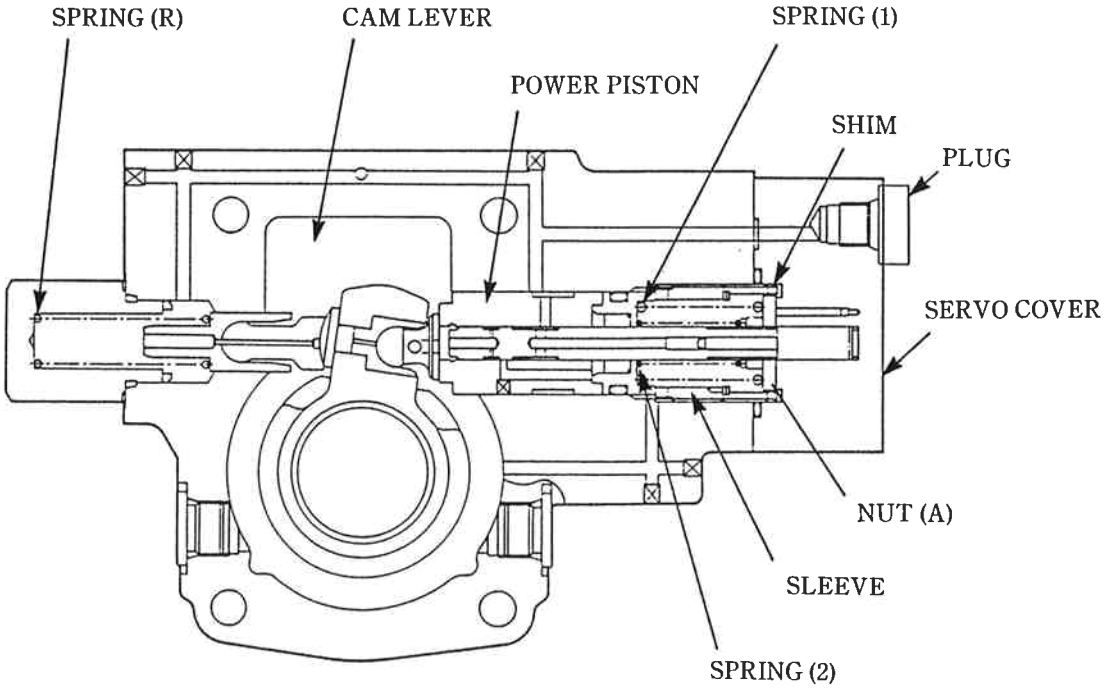


Fig. 3-11

B. Adjusting Method of Set Power (See Figs. 3-11 and 3-12)

The first bent point can be adjusted by changing the screwing in position of nut (A) for the servo spool.

When changing the second bent point, change the thickness of the shim.

Adjustments A and B above cannot be performed from the outside. Therefore, it is necessary to remove the servo cover when changing after setting has once been done.

CAUTION

Do not perform control adjustment.

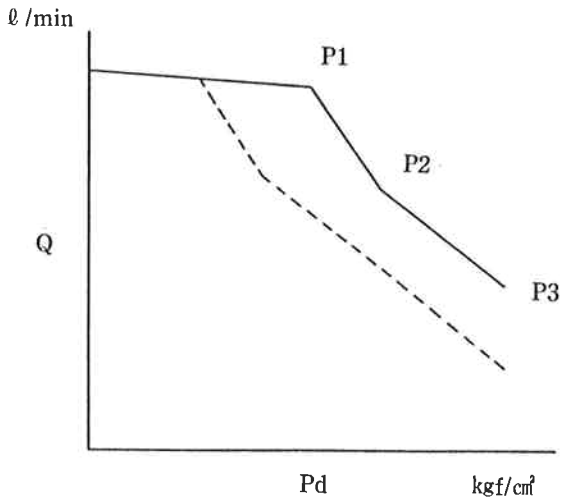


Fig. 3-12 Full Power Control

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3.1.2 HYDRAULIC PUMP SYSTEM-1 (PTO SHIFT NO. 1-1 PUMP)

· PTO Shift No. 1-1 Pump

This pump is of variable displacement type, and the delivery pressure is supplied to the circuits of ① boom hoist, ② boom telescope and ③ confluence of winch 2nd speed

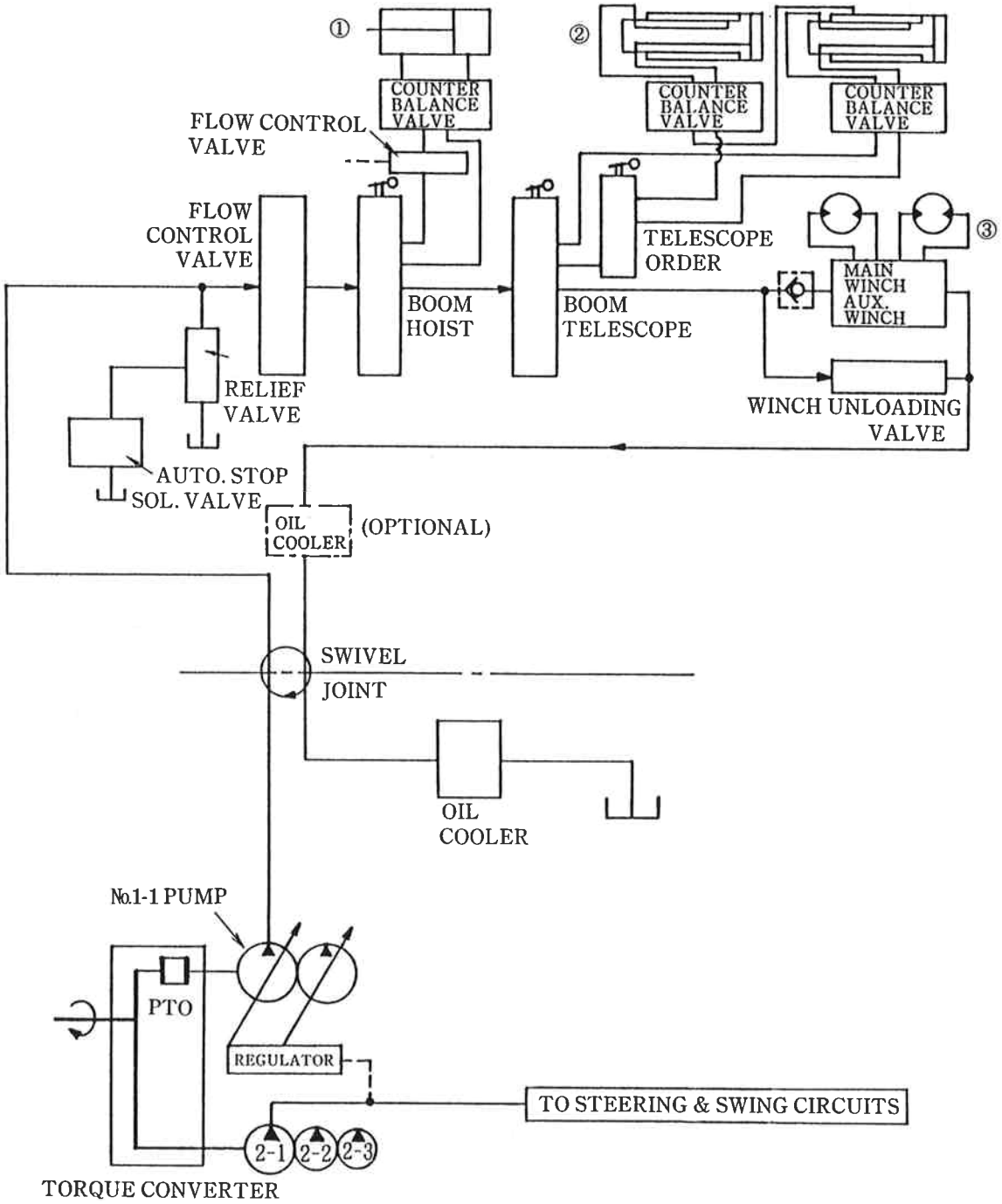


Fig. 3-13 PTO Shift No. 1-1 Pump Circuit

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3.1.3 HYDRAULIC PUMP SYSTEM-2 (PTO SHIFT NO. 1-2 PUMP)

· PTO Shift No.1-2 Pump

This pump is of variable displacement type, and the delivery pressure is supplied to ① outrigger circuit and ② winch 1st speed circuit of the main winch and auxiliary winch.

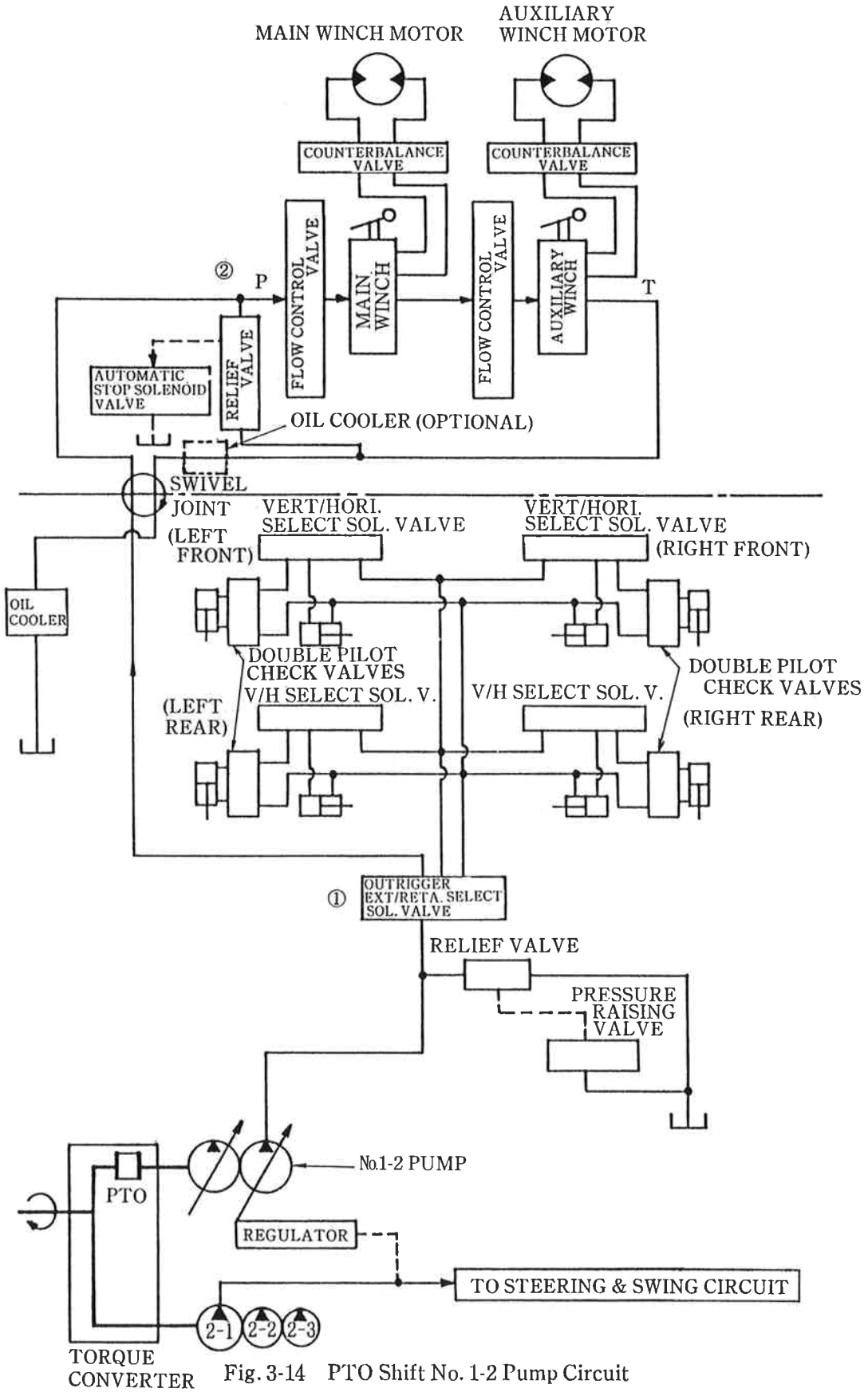


Fig. 3-14 PTO Shift No. 1-2 Pump Circuit

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3.1.4 HYDRAULIC PUMP SYSTEM-3 (ALWAYS DRIVEN NO. 2-1 PUMP)

- Always driven No. 2-1 pump is of fixed displacement type, and the delivery pressure is supplied to the circuits of ① steering (main pressure and pilot pressure), ② high suspension (pilot pressure for free / lock), ③ swing, ④ outrigger extension / retraction select valve (pilot pressure) and ⑤ steering confluence valve. ① and ③ are divided by the priority valve, but the load sensing pilot pressure from the steering valve gives priority to the steering circuit and controls necessary flow.
- In case of transmission stop of the multiplex transmission system (CPU down) or trouble of the pump itself, by operating the emergency steering switch, the minimum necessary oil flow is secured from the motor pump unit provided separately.

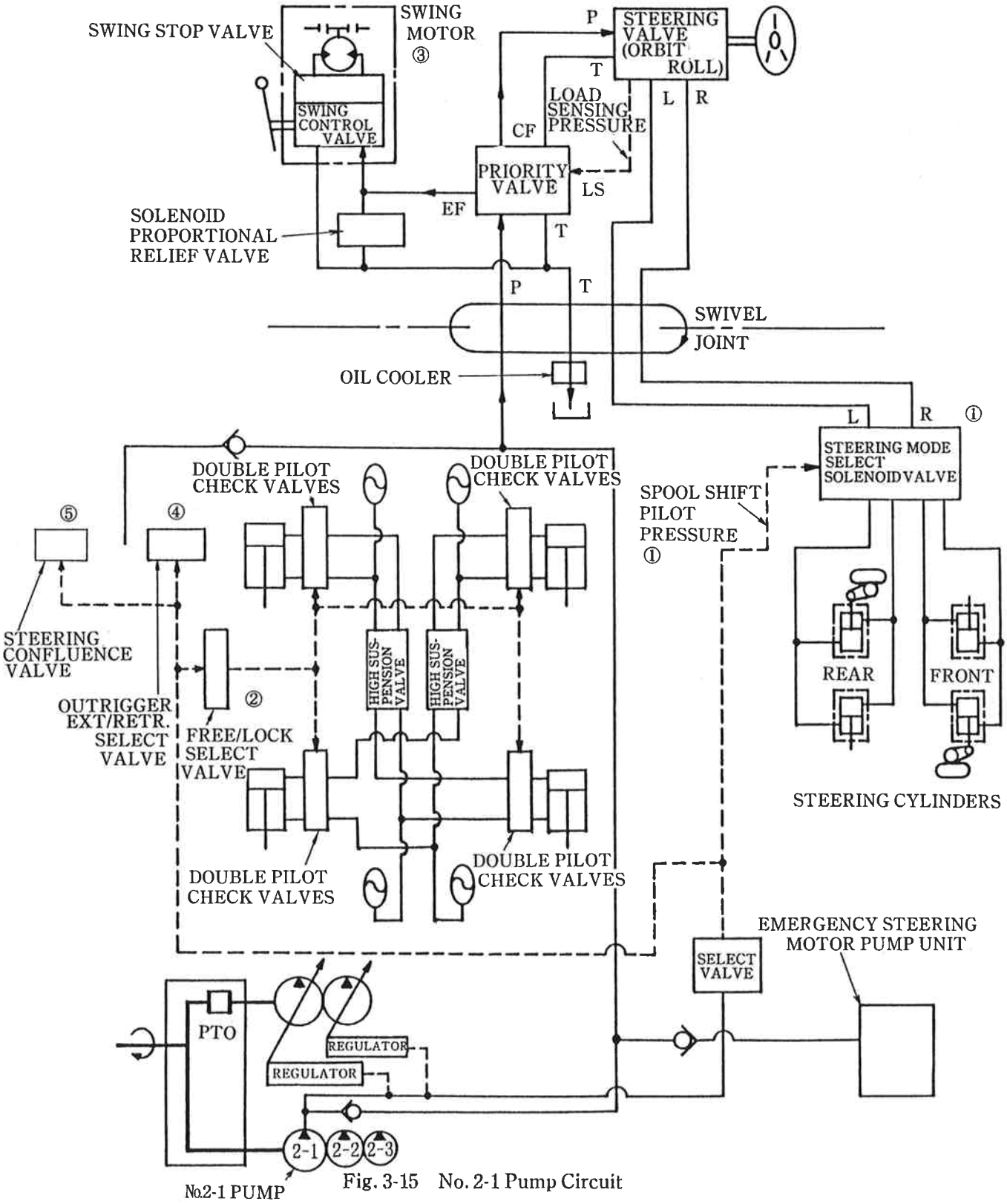


Fig. 3-15 No. 2-1 Pump Circuit

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3.1.5 HYDRAULIC PUMP SYSTEM-4 (ALWAYS DRIVEN NO. 2-2PUMP)

· Always driven No. 2-2 pump is of fixed displacement type, and the delivery pressure is mainly supplied to the following circuits as the pilot pressure.

① Clutch and negative brake cylinders of winches through clutch valve

② Swing stop valve pilot pressure source

③ Cabin cooler and oil cooler fan (optional)

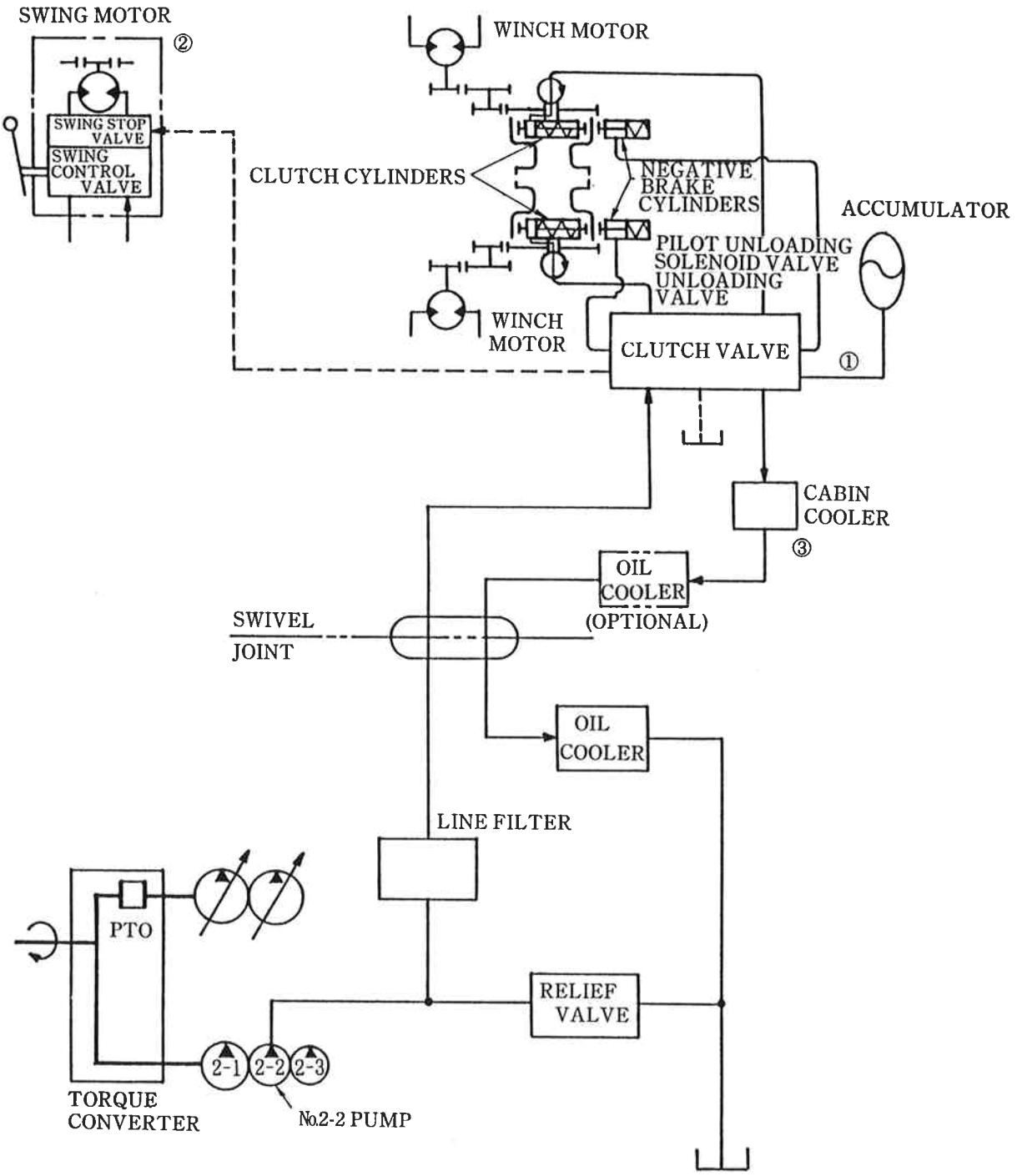


Fig. 3-16 No. 2-2 Pump Circuit

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3.1.6 HYDRAULIC PUMP SYSTEM-5 (ALWAYS DRIVEN NO. 2-3 PUMP)

This pump is of fixed displacement type, and the delivery pressure is supplied to the following circuits.

① Steering confluence (when PTO switch is in OFF and engine speed is less than 1000rpm.)

② High suspension (when PTO switch is in OFF and high suspension signal is in ON)

③ Power tilt (when PTO switch is in ON)

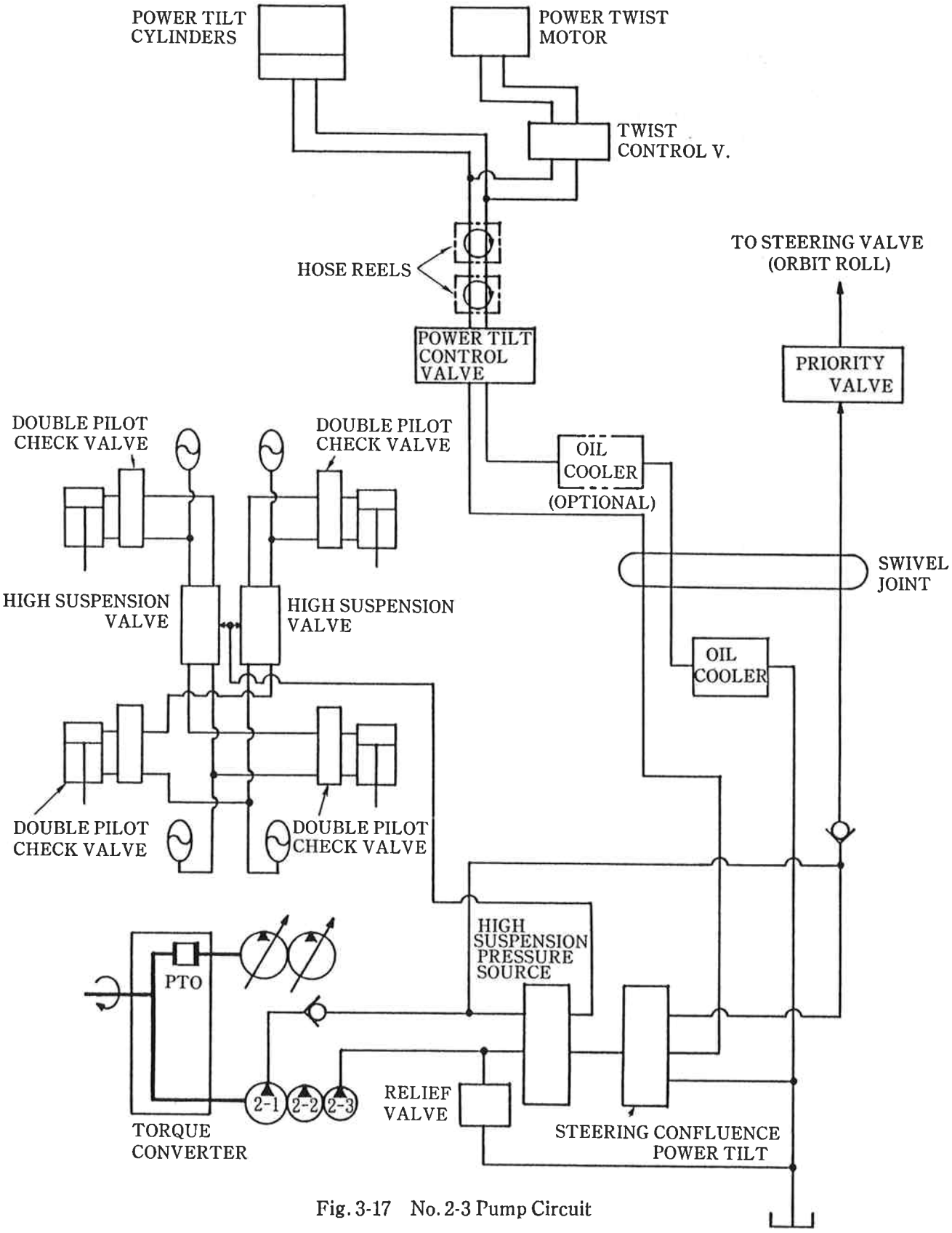


Fig. 3-17 No. 2-3 Pump Circuit

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3.2 SYSTEM FOR EACH FUNCTION

3.2.1 HIGH SUSPENSION CIRCUIT

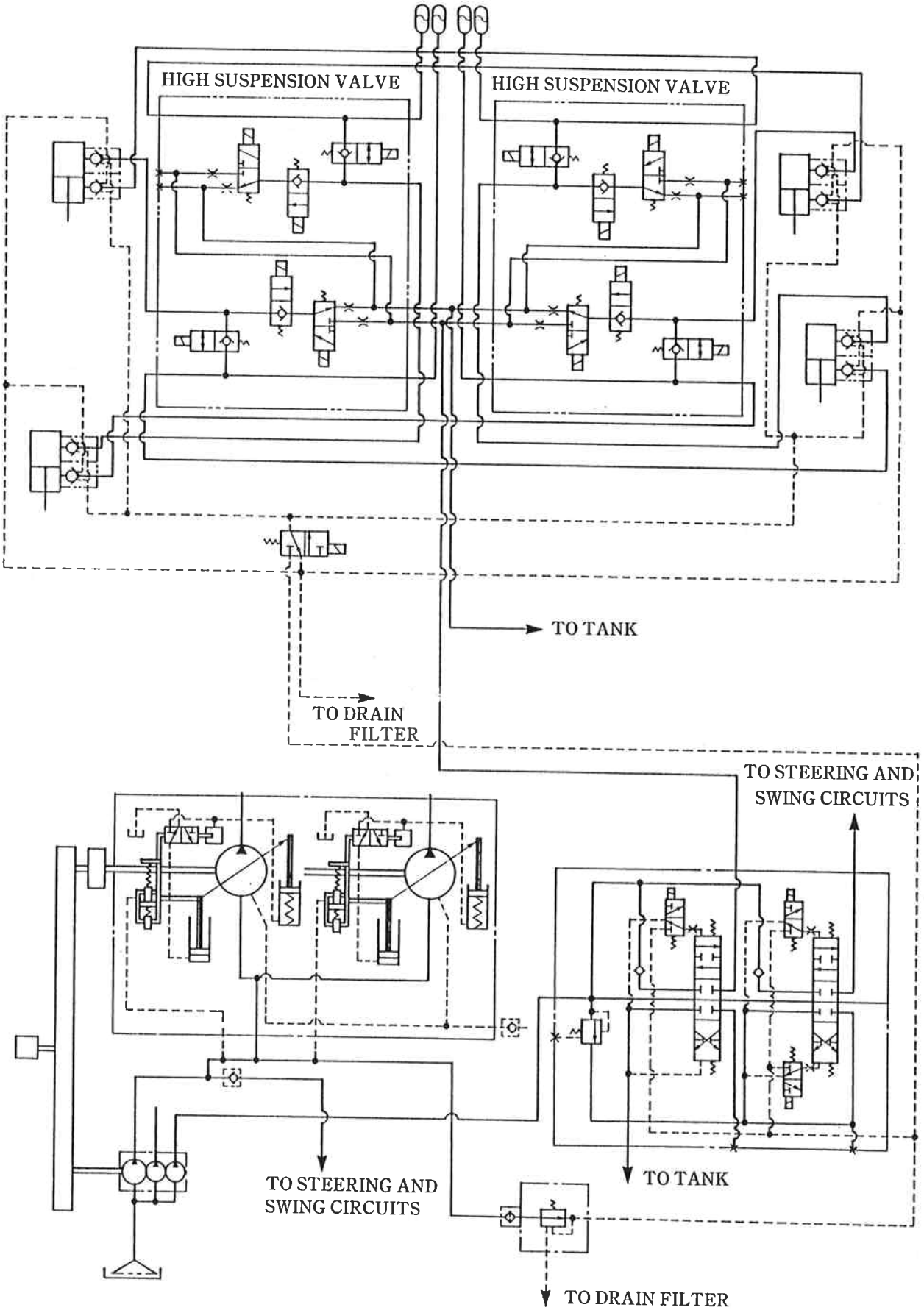


Fig. 3-18 High Suspension Circuit

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3.2.2 STEERING CIRCUIT

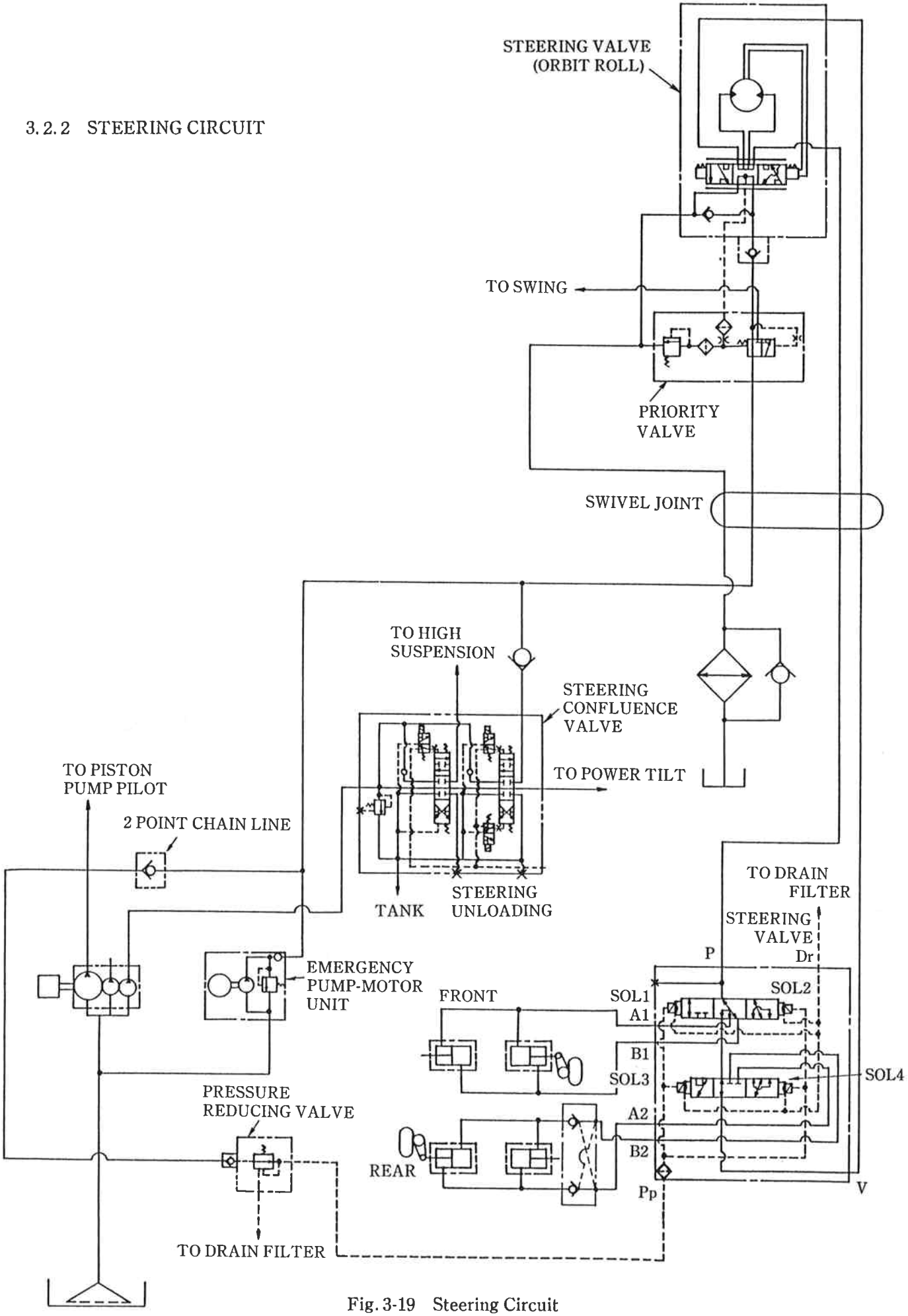


Fig. 3-19 Steering Circuit

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3.2.3 OUTRIGGER CIRCUIT

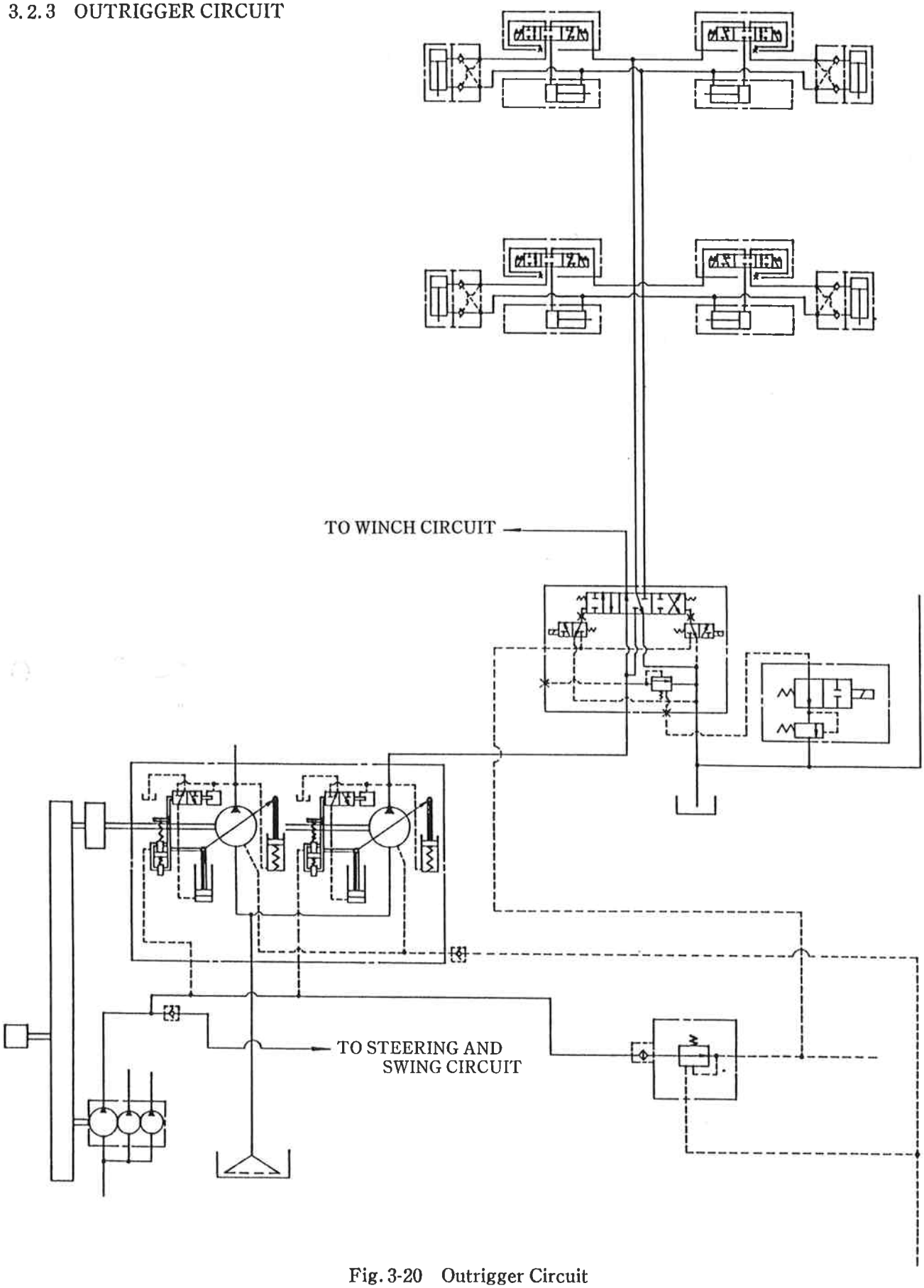


Fig. 3-20 Outrigger Circuit

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3.2.4 SWING CIRCUIT

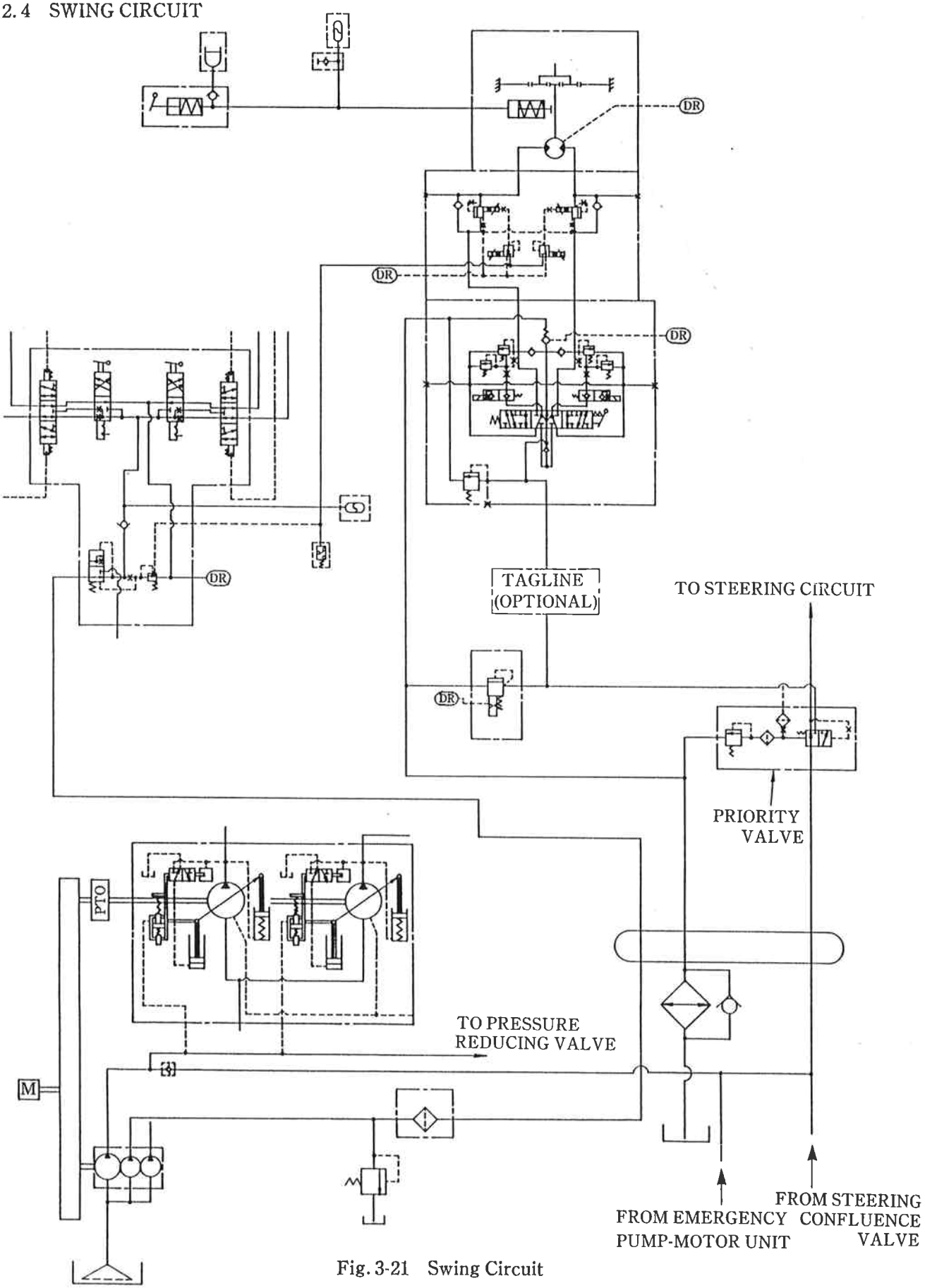


Fig. 3-21 Swing Circuit

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3.2.5 BOOM HOIST CIRCUIT

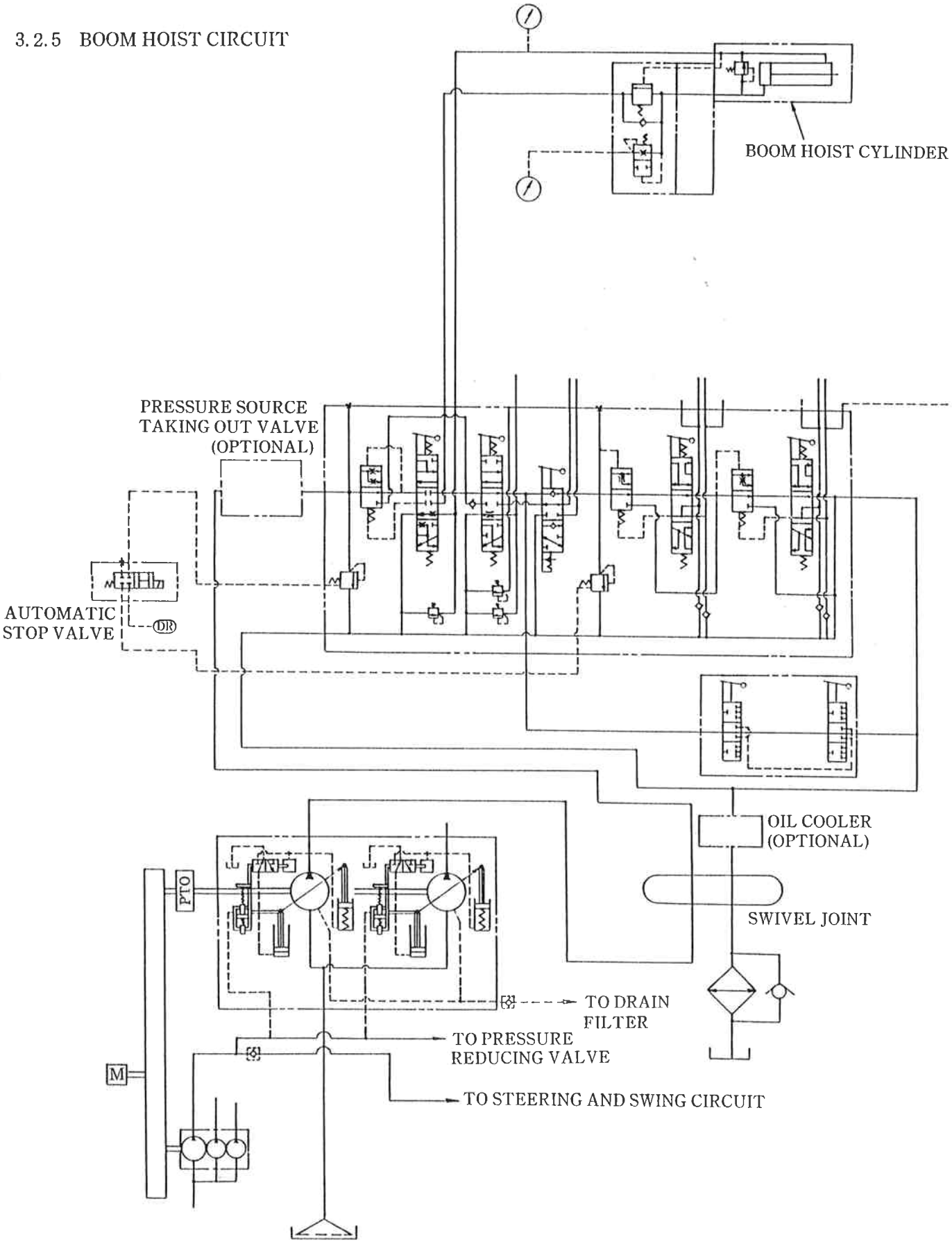


Fig. 3-22 Boom Hoist Circuit

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3.2.6 BOOM TELESCOPE CIRCUIT

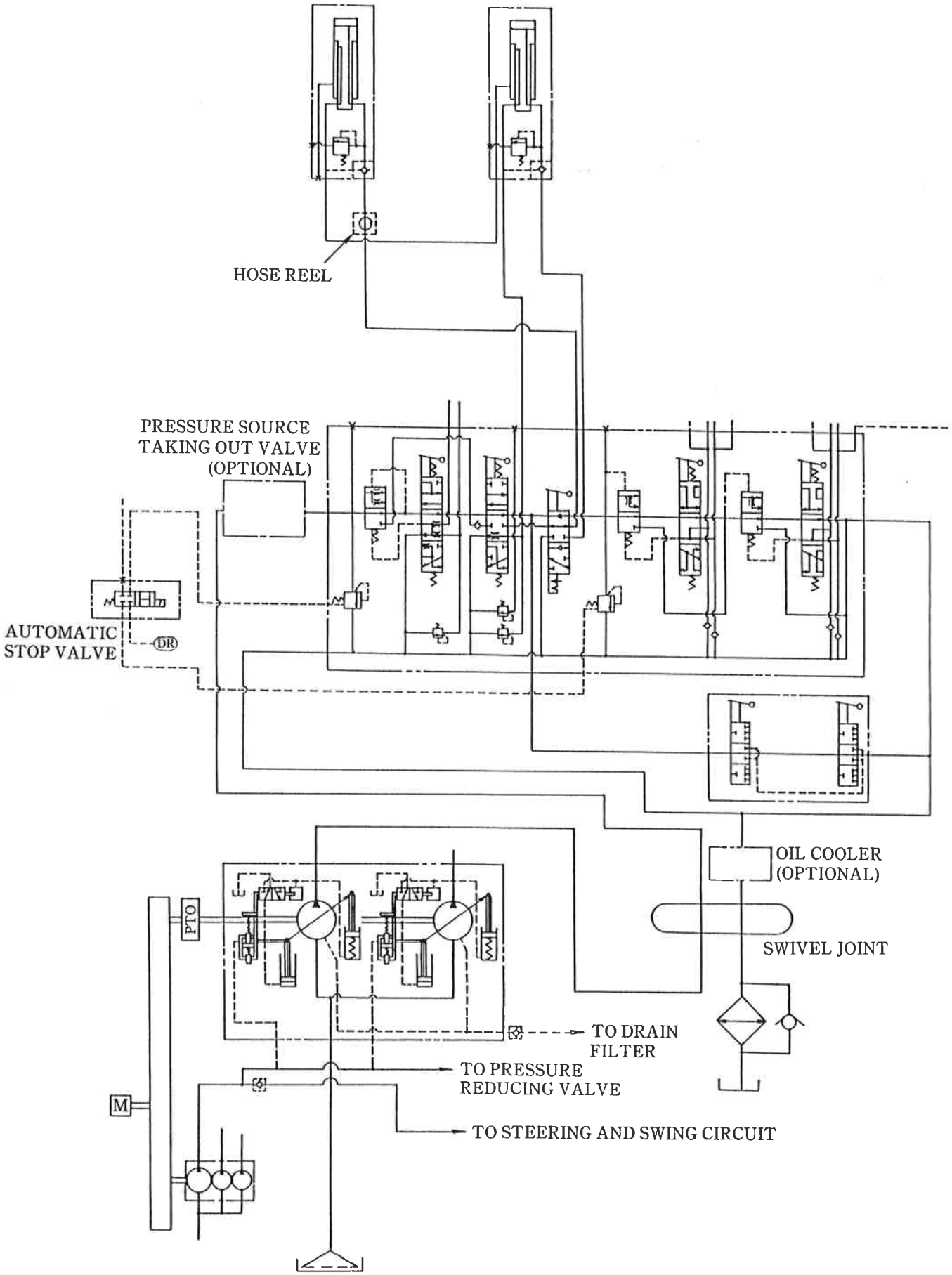


Fig. 3-23 Boom Telescope Circuit

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3.2.7 WINCH CIRCUIT

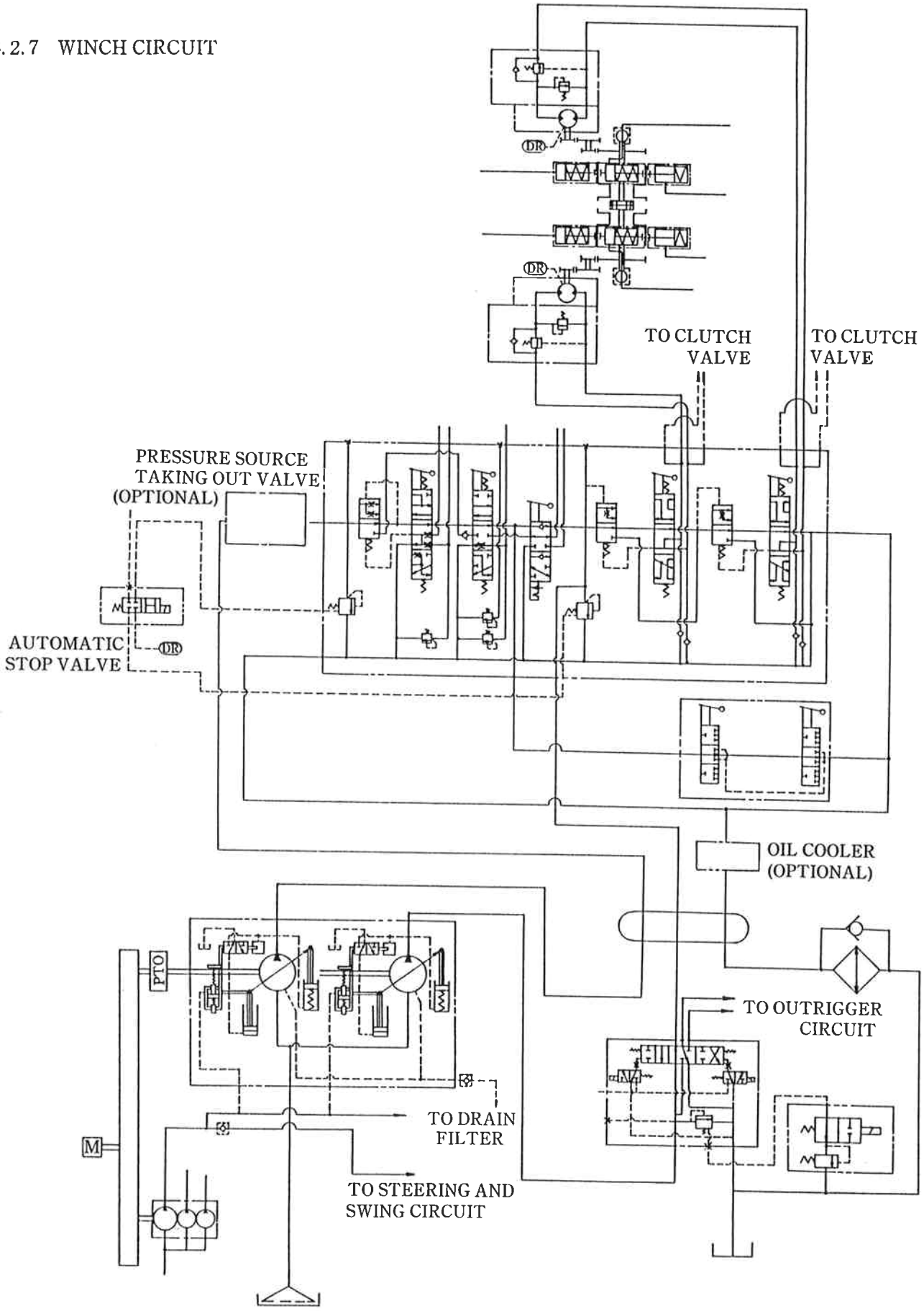


Fig. 3-24 Winch Circuit

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3. 2. 8 WINCH PILOT (CLUTCH, NEGATIVE BRAKE AND POSITIVE BRAKE) CIRCUIT

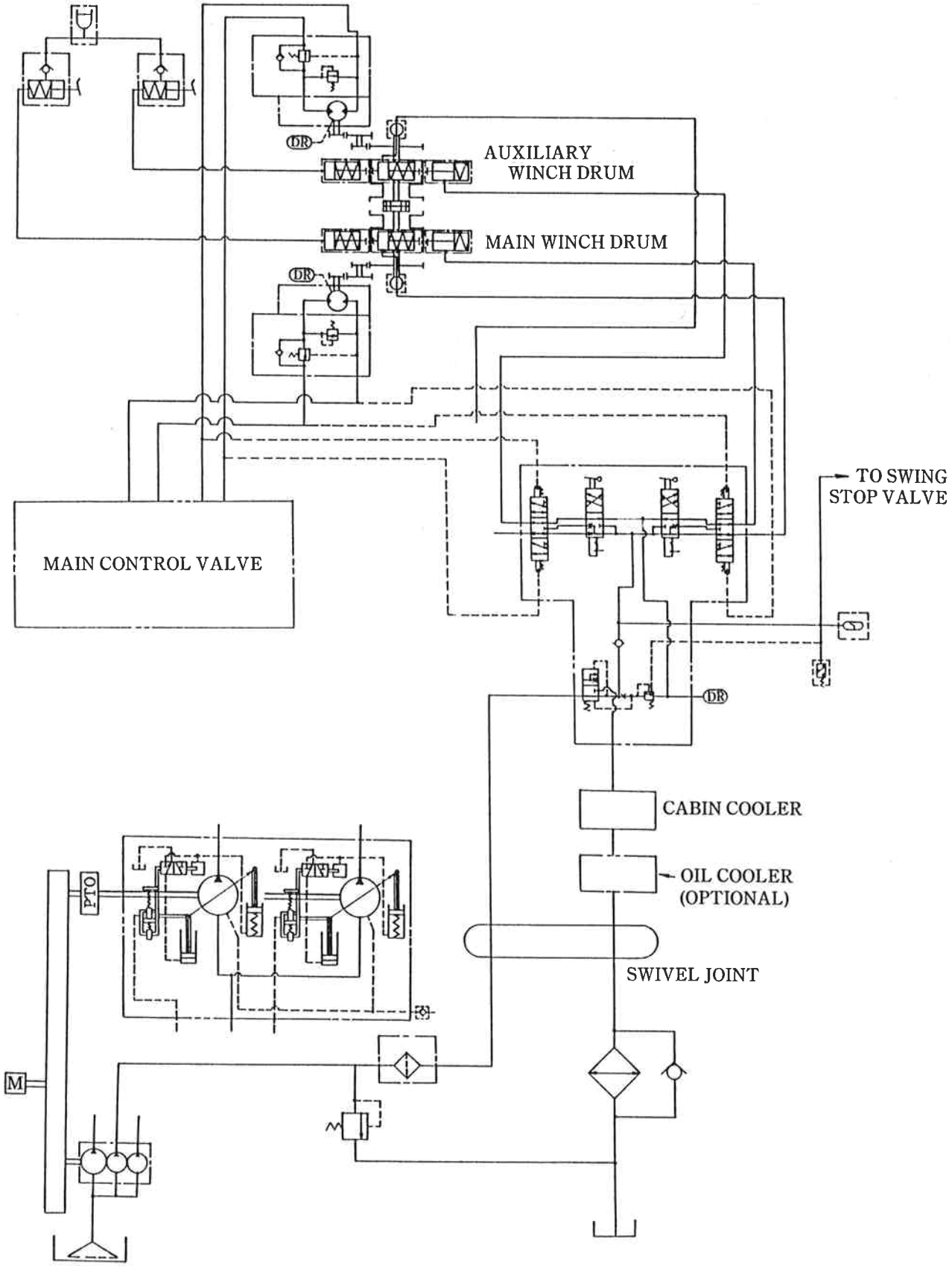
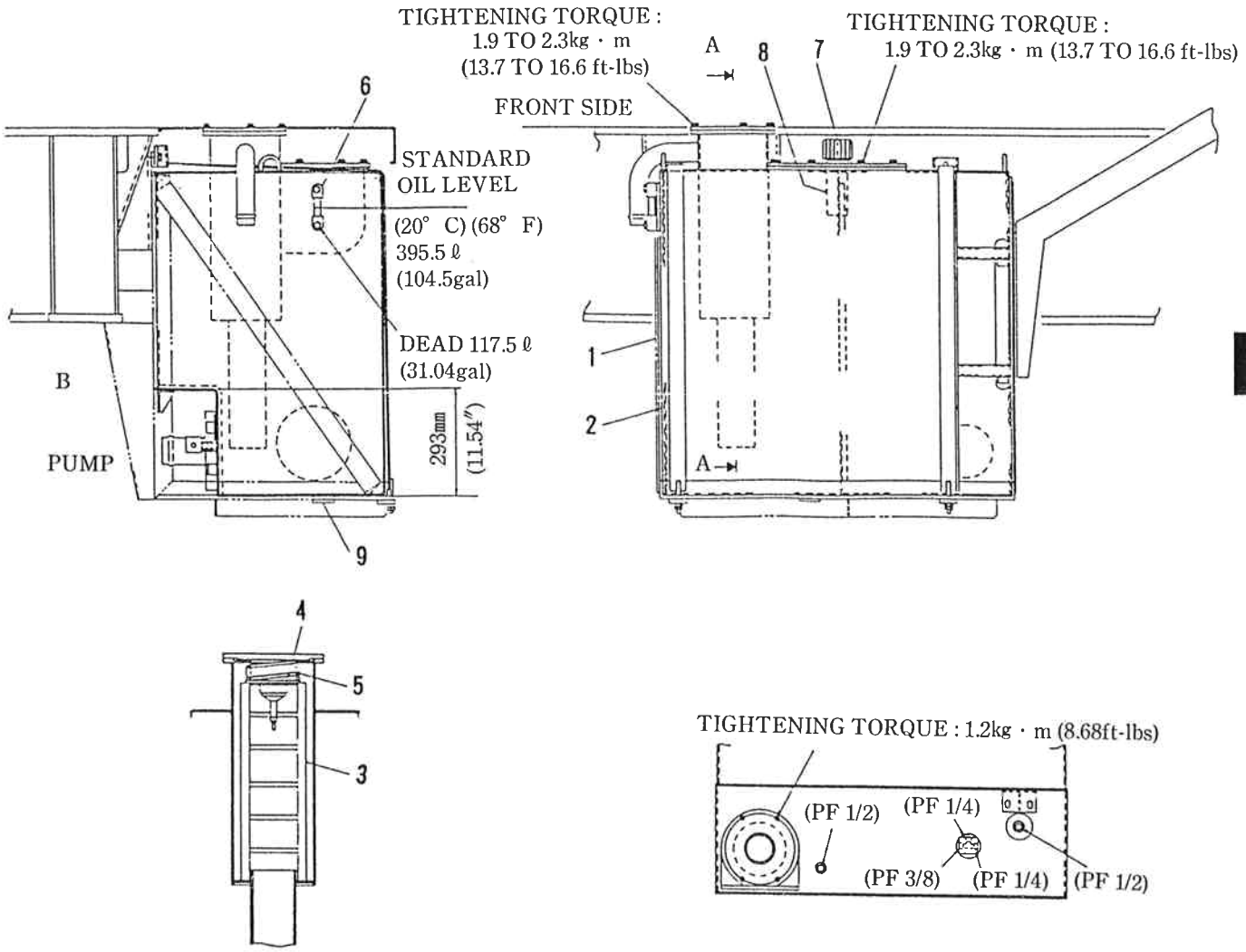


Fig. 3-25 Winch Pilot Circuit

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4. CONSTRUCTION OF MAIN HYDRAULIC COMPONENTS

4.1 HYDRAULIC OIL TANK



1. TANK
2. BAND
3. RETURN FILTER
4. BYPASS VALVE
5. SPRING
6. LEVEL GAUGE
7. FILL PORT CAP
8. STRAINER
9. DRAIN PLUG

Fig. 4-1 Hydraulic Oil Tank

● Tank Specifications

Tank Capacity	368 ℓ (97.2gal)
Bypass Valve Release Pressure	1.05kg / ㎠ (14.93psi)
Weight (excluding hydraulic oil)	Approx. 90kg (198 lbs)

● If return filter (3) is clogged, bypass valve (4) is opened to prevent damage to the filter.

● 10 ℓ (2.64gal) of oil corres ponds to 17mm (0.67 inch) of change in the oil level.

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4.2 HYDRAULIC PUMPS

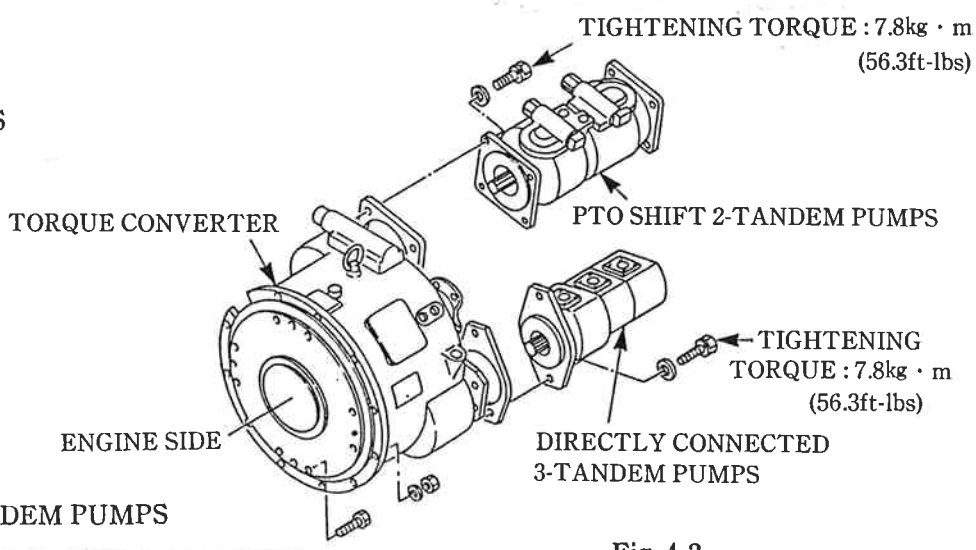


Fig. 4-2

4.2.1 PTO SHIFT 2-TANDEM PUMPS

	Plunger pump	Plunger pump
Delivery	24 to 82cc (1.46 to 5.00cu.in) / rev.	
Using pressure	260kg / cm² (3697psi)	250kg / cm² (3555psi)
Rotating direction	Counterclockwise	
Weight	79kg(1741 lbs)	

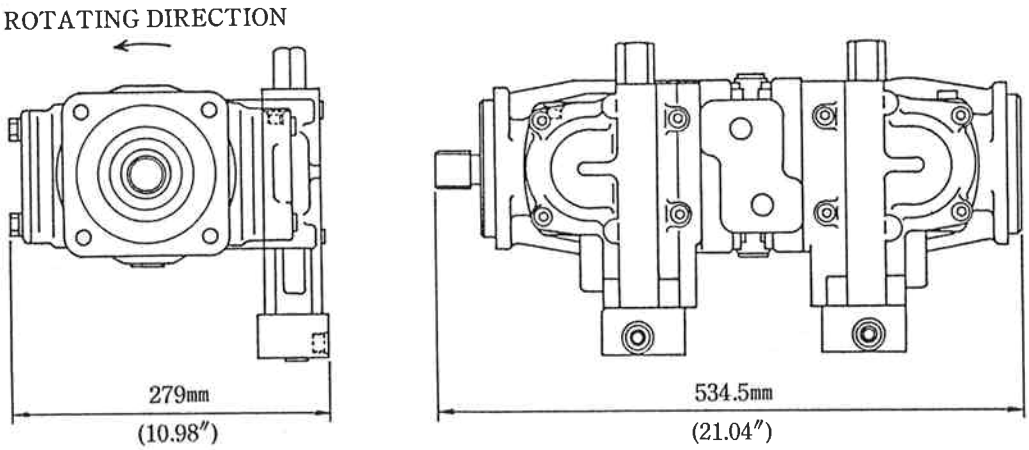


Fig. 4-3

4.2.2 DIRECTLY CONNECTED 3-TANDEM PUMPS

	PHS 3035	PLS 2516	PLS 2516
Delivery	37.2cc (2.27cu. in) / rev.	16cc (0.98cu. in) / rev.	16cc (0.98cu. in) / rev.
Set pressure	205kg / cm² (2915psi)	210kg / cm² (2986psi)	210kg / cm² (2986psi)
Weight	Approx. 31kg (68 lbs)		

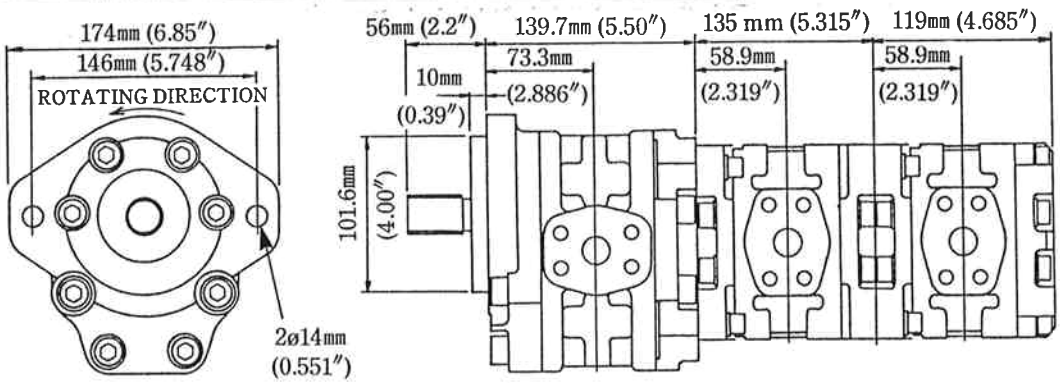


Fig. 4-4

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4.2 HYDRAULIC PUMPS

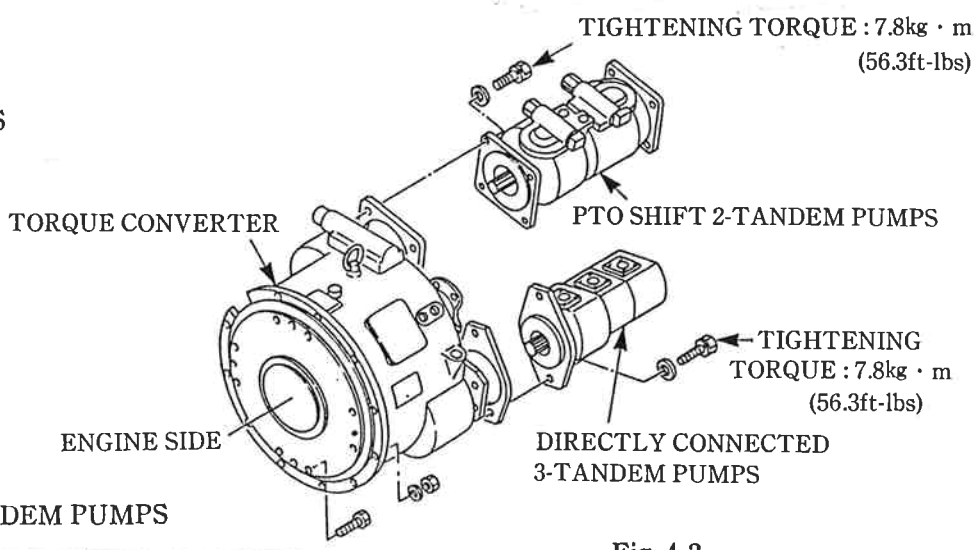


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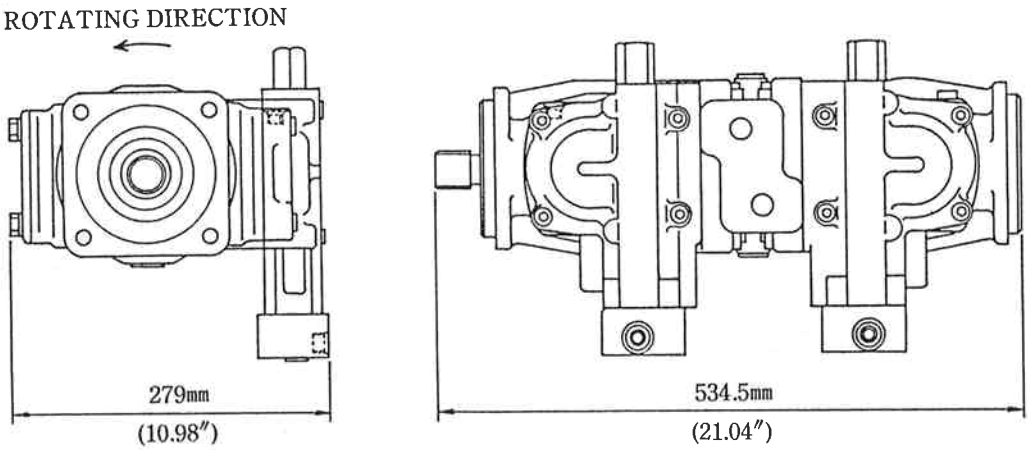


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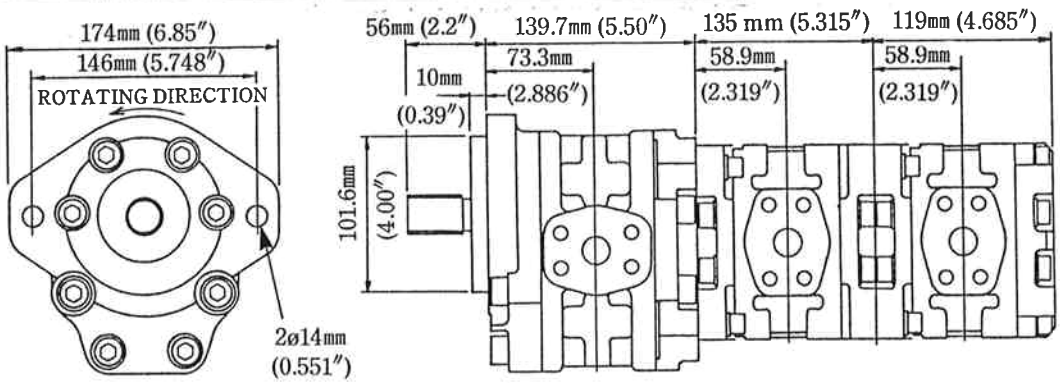
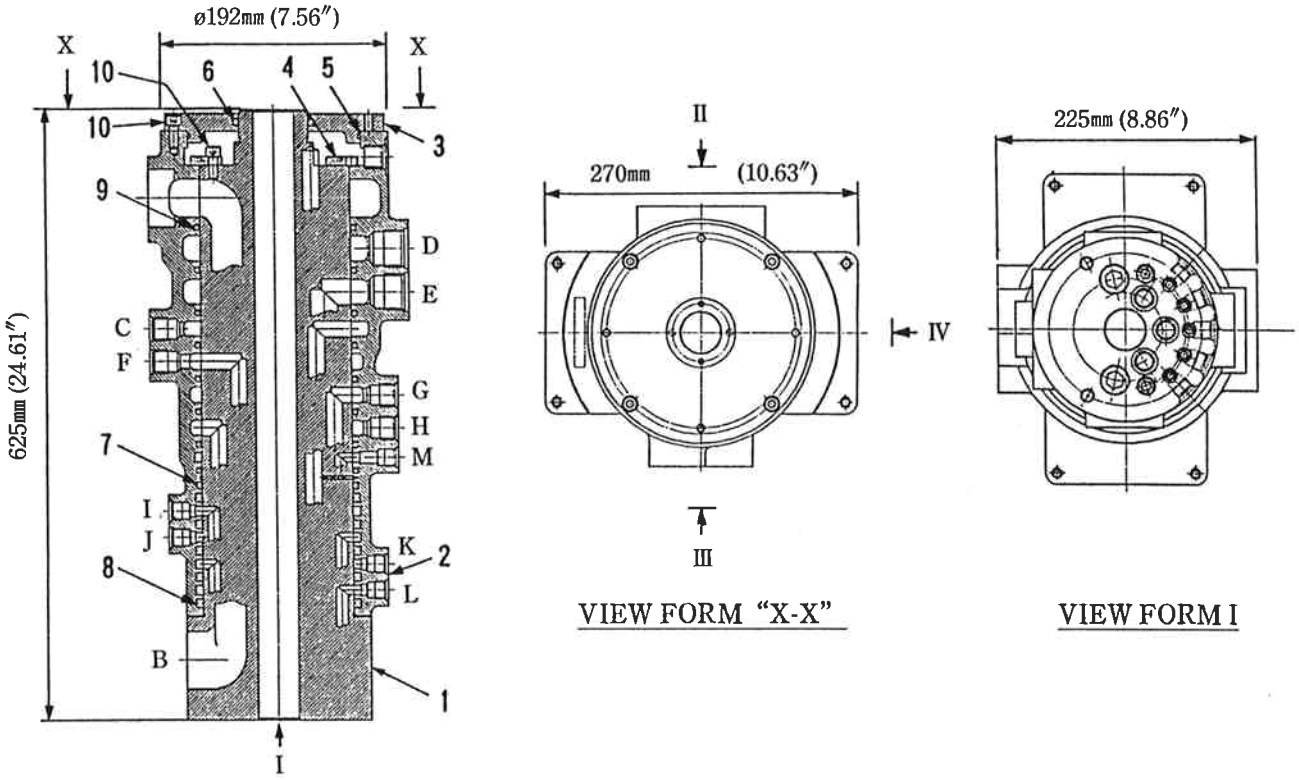


Fig. 4-4

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4.3 SWIVEL JOINT



1. STEM
2. BODY
3. COVER
4. THRUST PLATE
5. O-RING
6. O-RING
7. O-RING
8. SEAL
9. SLIPPER SEAL
10. CAPSCREW
11. PLUG
12. PLUG
13. PLUG
14. PLUG
19. WASHER
20. O-RING
21. O-RING
22. O-RING
23. O-RING
24. O-RING
25. SPRING PIN

Fig. 4-5

Symbol	Name of circuit	Port size	Usual pressure	Flow
A	Drain	PF 1/2	0.5kg / cm² (7.1psi)	10 ℓ (0.35cu. ft) / min
B	Return	ø50	10kg / cm² (142psi)	400 ℓ (14.13cu. ft) / min
C	Steering (left)	PF 1/2	210kg / cm² (2986psi)	60 ℓ (2.12cu. ft) / min
D	Winch, boom hoist, telescope	PF1	250kg / cm² (3555psi)	146 ℓ (5.16cu. ft) / min
E	Winch	PF1	260kg / cm² (3697psi)	146 ℓ (5.16cu. ft) / min
F	Steering (right)	PF 1/2	210kg / cm² (2986psi)	60 ℓ (2.12cu. ft) / min
G	Swing	PF 1/2	205kg / cm² (2915psi)	86 ℓ (3.04cu. ft) / min
H	Pilot	PF 1/2	150kg / cm² (2133psi)	37 ℓ (1.31cu. ft) / min
I	Air source	PF 3/8	10kg / cm² (142psi)	
J	Air (front brake)	PF 3/8	10kg / cm² (142psi)	
K	Air (rear brake)	PF 3/8	10kg / cm² (142psi)	
L	Air (accelerator)	PF 3/8	10kg / cm² (142psi)	
M	Sky tilt	PF 3/8		
Number of revolution		3.5rpm		
Weight (dry)		Approx. 71kg (156.5lbs)		

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5. DISASSEMBLY AND ASSEMBLY

5.1 HANDLING HYDRAULIC COMPONENTS

Keep the following points in mind whenever handling hydraulic components :

1. All mechanical components have strength and durability limits. Because the relief valves are provided to limit the amount of pressure that acts on each hydraulic component, thereby preventing internal damage to the various parts of the machine, do NOT tamper with the set pressure.
2. Hydraulic components are high-precision devices in which even a speck of dust or foreign matter in the hydraulic circuit could cause wear or damage ; this could lead to machine failure or erratic performance and may be even to an accident. Hydraulic oil MUST be clean at all times and the return circuit filter element should be inspected periodically and replaced when necessary.
3. Every 6 months, take out approximately 200cc (12.2cu. in) of hydraulic oil after the oil is heated to normal working temperature. If possible, have a specialist analyze it to determine whether to replace all of it or not. Replacement intervals vary due to location and operating conditions. Hydraulic oil must always be CLEAN.
4. Metal particles and foreign matter often show up in a circuit when a component is damaged. If this happens, drain and flush the circuit, replace the filter element and clean the tank thoroughly. Then fill the circuit with all NEW oil.
5. If metal particles are found on the filter element, drain and flush the circuit, and then fill the circuit with all new oil. The presence of metal particles indicates that some component might be damaged so investigate the SOURCE and repair or replace.
6. When adding or replacing the hydraulic oil, use only the recommended hydraulic oil. (Refer to the recommended Lubrication Chart in the respective Operator's Manual.) Do NOT mix different types or brands of hydraulic oil.
7. When replacing hydraulic oil, use a clean container and funnel to pour the oil into the tank. Do NOT use any pieces of cloth, since lint may enter the circuit.

5.2 REMOVING AND INSTALLING HYDRAULIC COMPONENTS

The following are general notes to be kept in mind when removing or installing hydraulic components :

1. Secure the machine with wires, blocks, etc. to prevent abrupt movement during work.
2. Hydraulic oil will gush out from those sections directly linked to the hydraulic tank by piping, so drain the tank thoroughly.
3. When removing the hydraulic components, relieve any remaining pressure from the system.
4. When removing the hydraulic components, be sure to place plugs and caps on the hoses, tube lines or ports of the removed components, and place mating marks or indexes to facilitate later matching.
5. Disassemble or assemble the hydraulic components in a place free from any dirt and dust. Be sure to note the interchangeability of each part and clean the disassembled parts with clean mineral cleaning oil. Also clean the internal passages. After they have dried, wipe them with a clean lint-free cloth, and be certain that parts have no lint on them.
6. When overhauling the hydraulic components, replace all the O-rings, backup rings and oil seals. Coat the new O-rings with grease or vaseline before installing.
7. Replenish the amount of oil which was lost when a hydraulic component was removed after the component has been re-installed.

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The following are general notes to be kept in mind when removing or installing hydraulic components :

1. Secure the machine with wires, blocks, etc. to prevent abrupt movement during work.
2. Hydraulic oil will gush out from those sections directly linked to the hydraulic tank by piping, so drain the tank thoroughly.
3. When removing the hydraulic components, relieve any remaining pressure from the system.
4. When removing the hydraulic components, be sure to place plugs and caps on the hoses, tube lines or ports of the removed components, and place mating marks or indexes to facilitate later matching.
5. Disassemble or assemble the hydraulic components in a place free from any dirt and dust. Be sure to note the interchangeability of each part and clean the disassembled parts with clean mineral cleaning oil. Also clean the internal passages. After they have dried, wipe them with a clean lint-free cloth, and be certain that parts have no lint on them.
6. When overhauling the hydraulic components, replace all the O-rings, backup rings and oil seals. Coat the new O-rings with grease or vaseline before installing.
7. Replenish the amount of oil which was lost when a hydraulic component was removed after the component has been re-installed.

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8. Tighten the joints securely. Hydraulic oil will leak from any loose joint. This lowers the oil level in the tank and could damage the pump when air is drawn into the tank. When the joint on the suction line is loose, the pump will draw in air, developing abnormal noise, malfunctions and damage.

5.3 REMOVING AND INSTALLING SWIVEL JOINT

1. Removing Swivel Joint
When removing the swivel joint, bear in mind the following points :

(1) Remove the slip ring fitted on top of the swivel joint. Refer to the Electrical System.

(2) Remove the swivel joint with piping attached.

(3) Attach M8 eyebolt to the tapped holes on the top of the swivel joint, and temporarily suspend the swivel joint with a crane. Remove the fixing link and capscrews.
Weight of Swivel Joint : approx. 82kgs (180 lbs).

2. Installing Swivel Joint
Install the swivel joint by following the removal procedure in reverse order. Pay attention to the following points :

(1) Apply Locktite #242 or equivalent to threaded parts of capscrews fixing the swivel joint and tighten.

(2) Fix the swivel joint after attaching the piping to the main body. Ensure that no leakage occurs at any part. Once the swivel joint is mounted on the frame, joints, etc., can be mounted or removed only with difficulty.

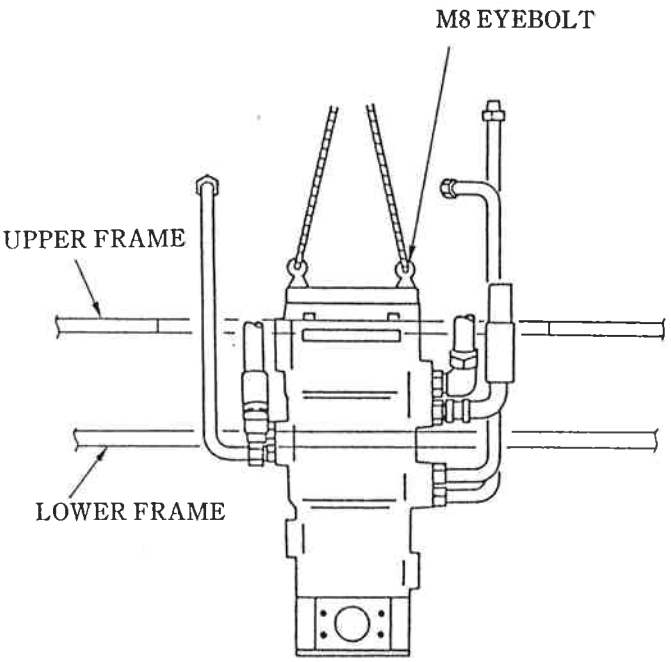


Fig. 5-1 Removal and Installation of Swivel Joint

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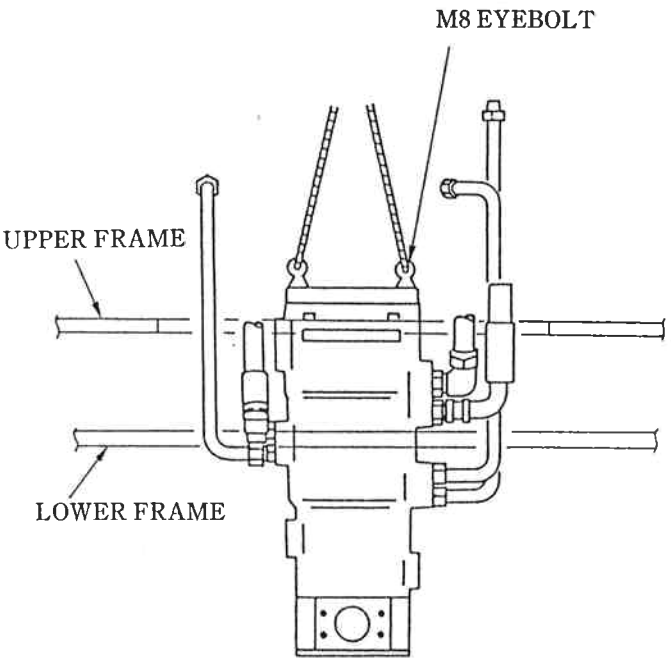


Fig. 5-1 Removal and Installation of Swivel Joint

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1. LOCATION OF MAIN COMPONENTS

The main and auxiliary winches are located in the rear of the upper. The right side winch is the auxiliary winch, and the left side is the main winch. The winch motors are driven by the pressurized oil produced in No. 1-1 pump of the two sets of the 2-tandem pumps.

The pressurized oil produced in No. 1-2 pump also flows into the winch motors when boom hoisting and telescoping are not operated (see 2. 1 Hydraulic Schematics).

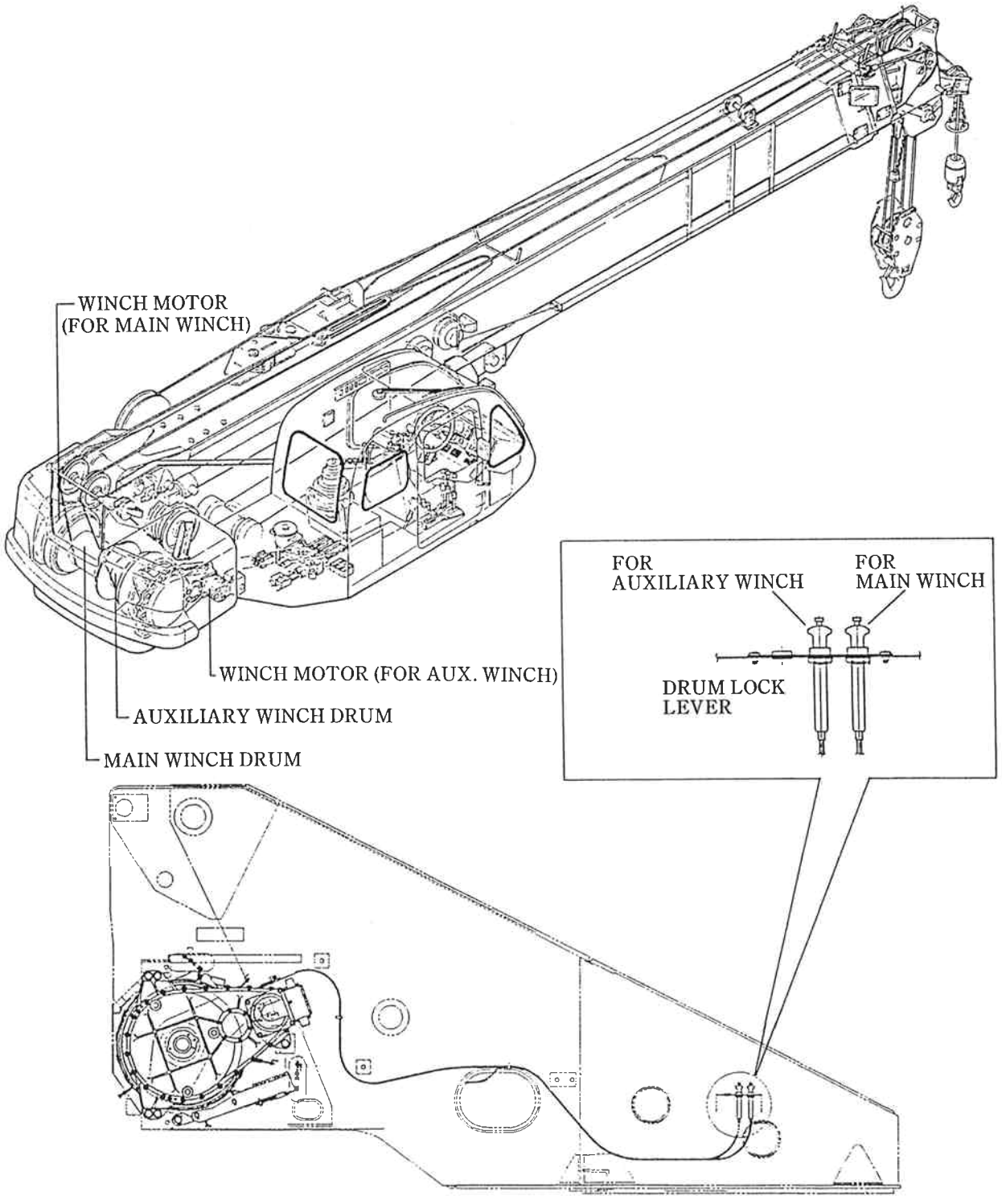


Fig. 1-1 Location of Main and Auxiliary Winches

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In addition to the main and auxiliary winch drums, the third drum can be provided as an option in rear of the main and auxiliary winch drums.

The clutch and brake of the third drum can be operated independently.

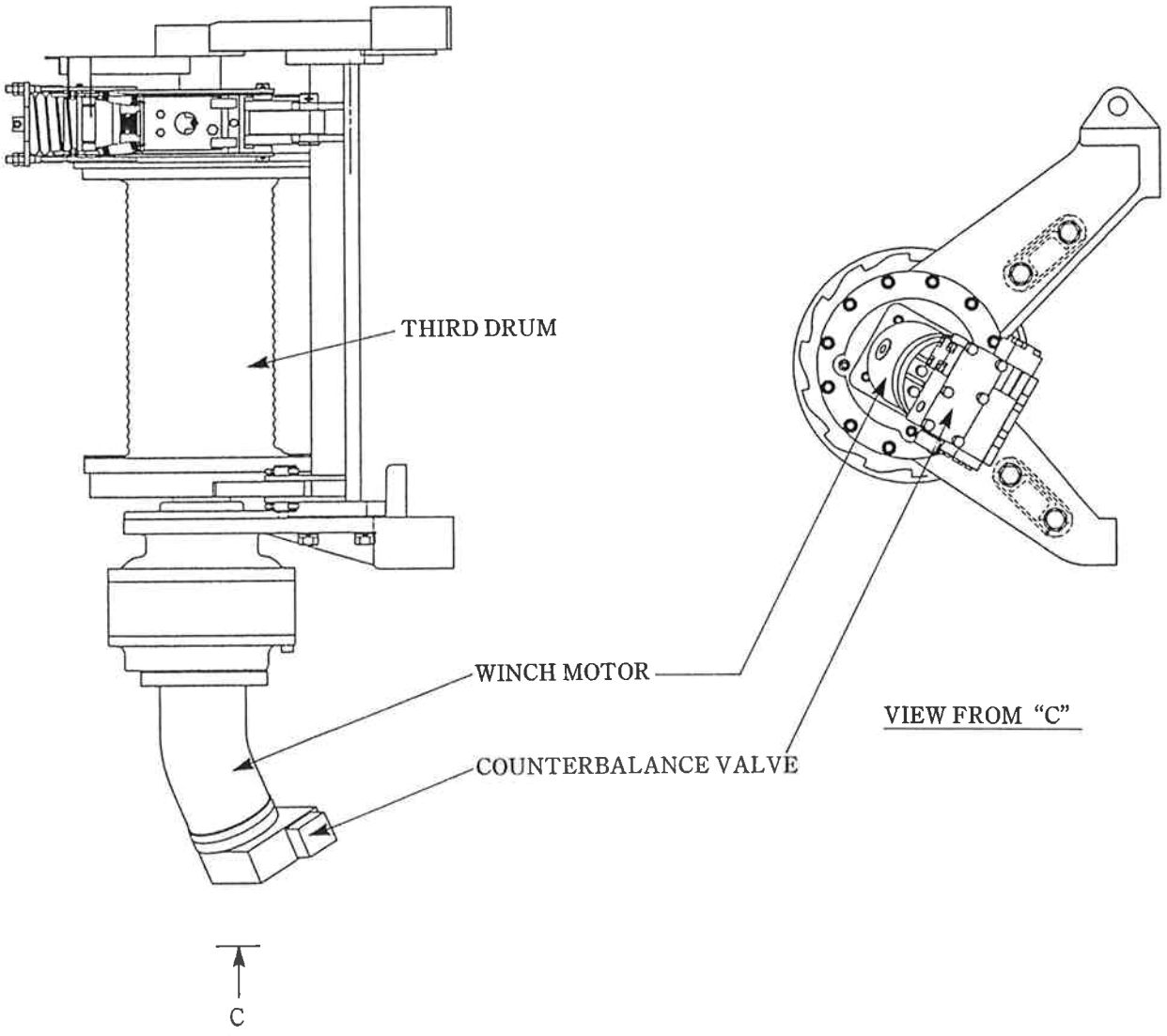


Fig. 1-2 Location of Third Drum Winch (Optional)

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2. CONSTRUCTION AND FUNCTION

2.1 HYDRAULIC SCHEMATICS

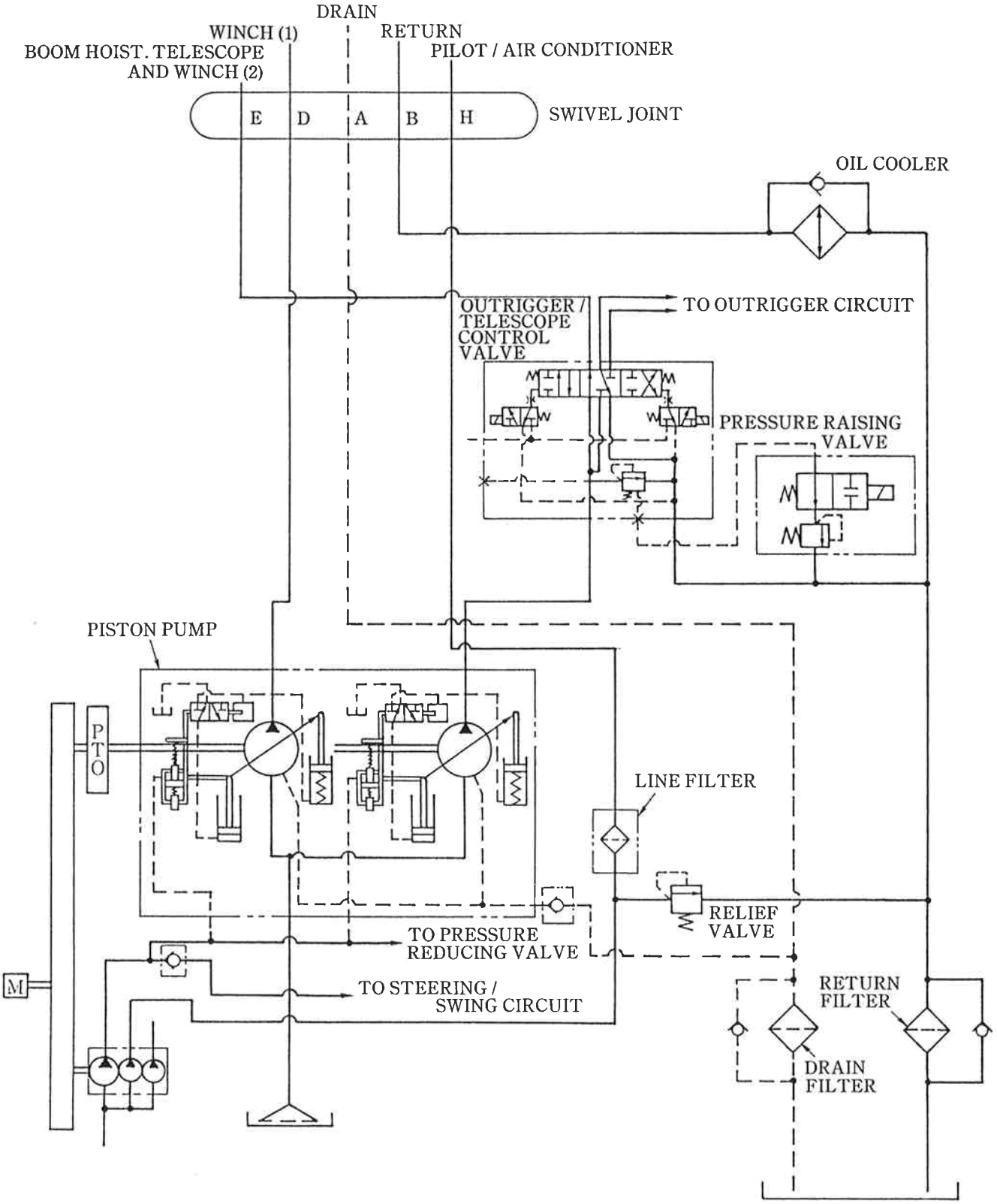


Fig. 2-1 Hydraulic Circuit Schematic (1 / 2) (Lower)

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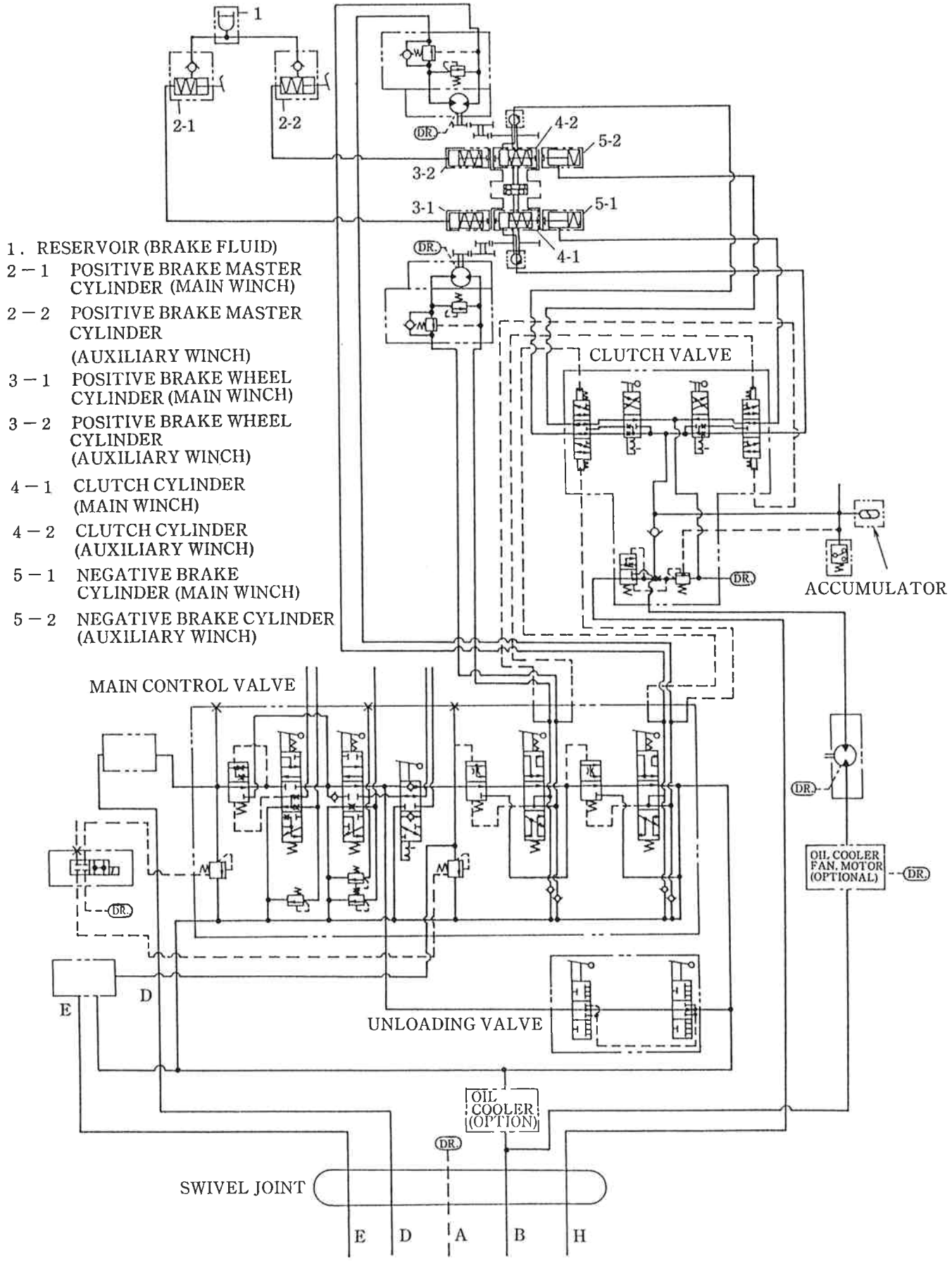


Fig. 2-1 Hydraulic Circuit Schematic (2 / 2) (Upper)

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The table below shows the position of the clutch lever and the winch lever in relation to the state of the load.

Clutch lever position	Winch clutch state	Winch lever position	Negative brake state	Load state
Forward	Off	—	Off	Free fall
Backward	On	Neutral	On	Hold
	On	Raising	Off	Raising
	On	Lowering	Off	Lowering

(1) Winch Raising Operation
Clutch lever position : backward
Winch lever position : Raising position

(a) Oil from No. 2-2 pump enters the clutch valve and branches into two directions ; one supplies the clutch cylinder and extends it, causing the clutch to be engaged, and the other goes through the pilot-actuated directional control valve to the negative brake cylinder, releasing the negative brake.
The unloading valve and the accumulator located between pump and clutch valve maintain the pressure in the circuit within the set pressure range.

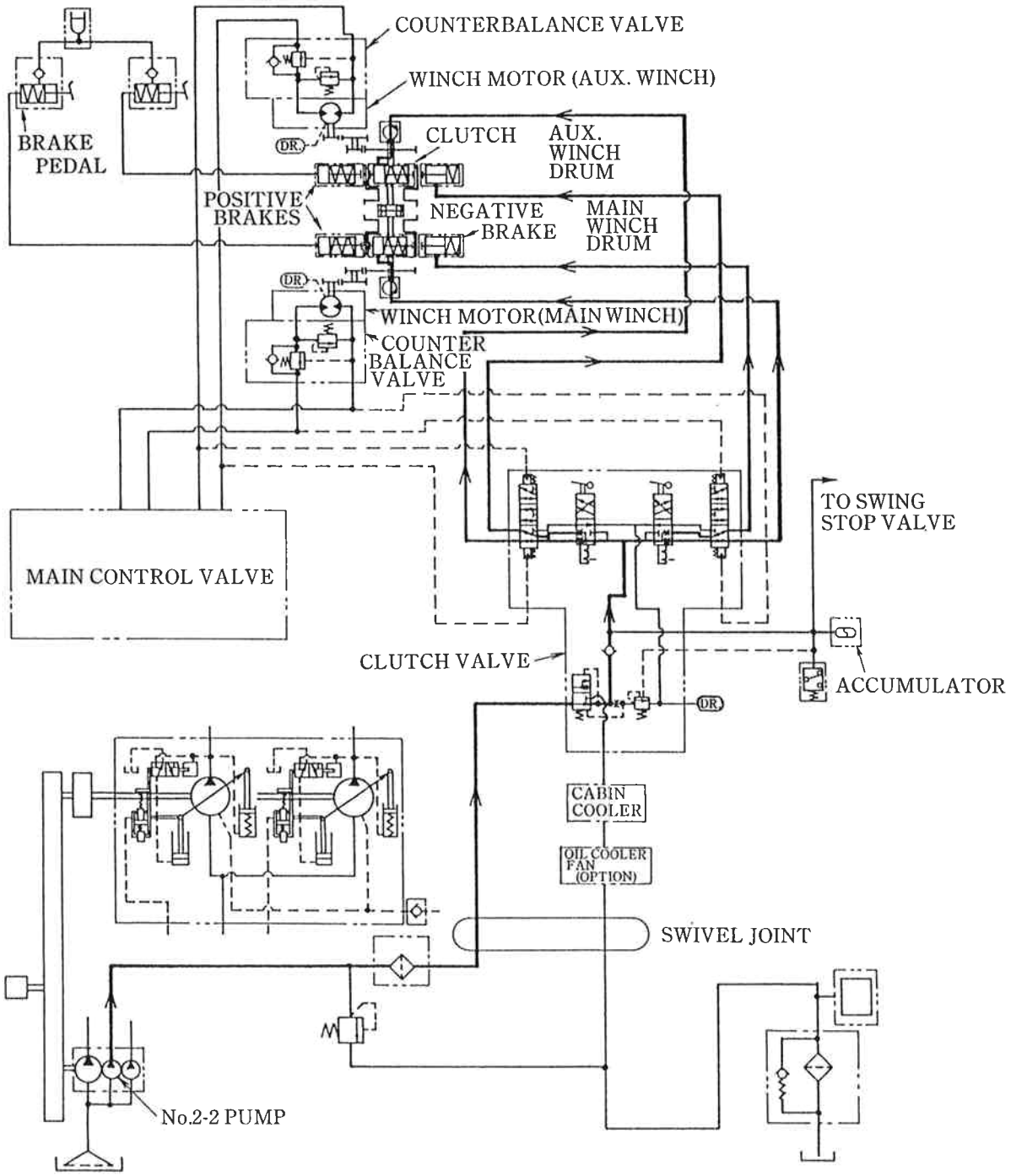


Fig. 2-2 Clutch and Brake Hydraulic Circuit (Raising)

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(b) Raising can be done at two speeds : low and high. When the winch lever is pulled a half stroke distance, the hook is raised at low speed. Oil from No. 1-2 pump passes through the control valve and counterbalance valve and enters the winch motor to rotate it. At this time, oil from No. 1-1 pump returns to the hydraulic oil tank through the unloading valve. When the winch lever is pulled a full stroke distance, the hook is raised at high speed.

Since the passage from the unloading valve to the tank is closed, oil from No. 1-1 pump joins oil from No. 1-2 pump in the control valve, passes through the counterbalance valve, enters the winch motor, and rotates it.

The turning force of the winch motor is transmitted through the reduction unit to the drum, rotates the drum and raises the load.

When the boom is raised, lowered or telescoped, the amount of joining oil from No. 1-1 pump, becomes less as much the amount of oil flowing to the boom hoist cylinder or telescope cylinder.

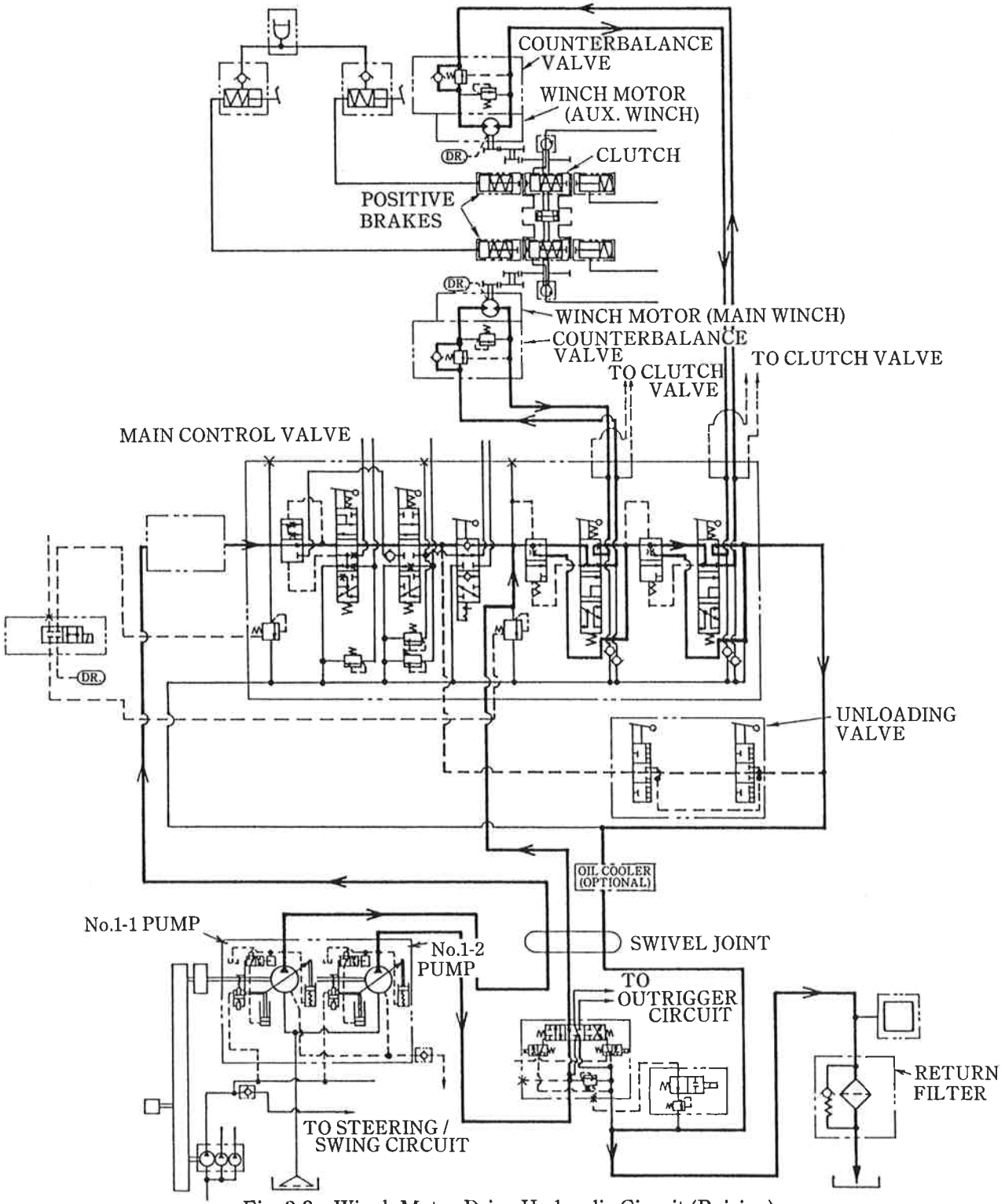


Fig. 2-3 Winch Motor Drive Hydraulic Circuit (Raising)

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(2) Holding (in neutral)
Clutch lever position : backward
Winch lever position : neutral

(a) Oil from No. 2-2 pump is supplied through the clutch valve to the clutch cylinder, extending the clutch cylinder and causing the clutch to be engaged.
Because the winch lever is in neutral, the pilot-actuated directional control valve is also in neutral, connecting the brake cylinder hydraulic circuit to the tank through the pilot-actuated directional control valve and the clutch valve drain. Therefore, the negative brake is in operation and keeps the winch drum is stop condition.

(b) Oil from pumps 1-1 and 1-2 returns to the tank through the control valve.

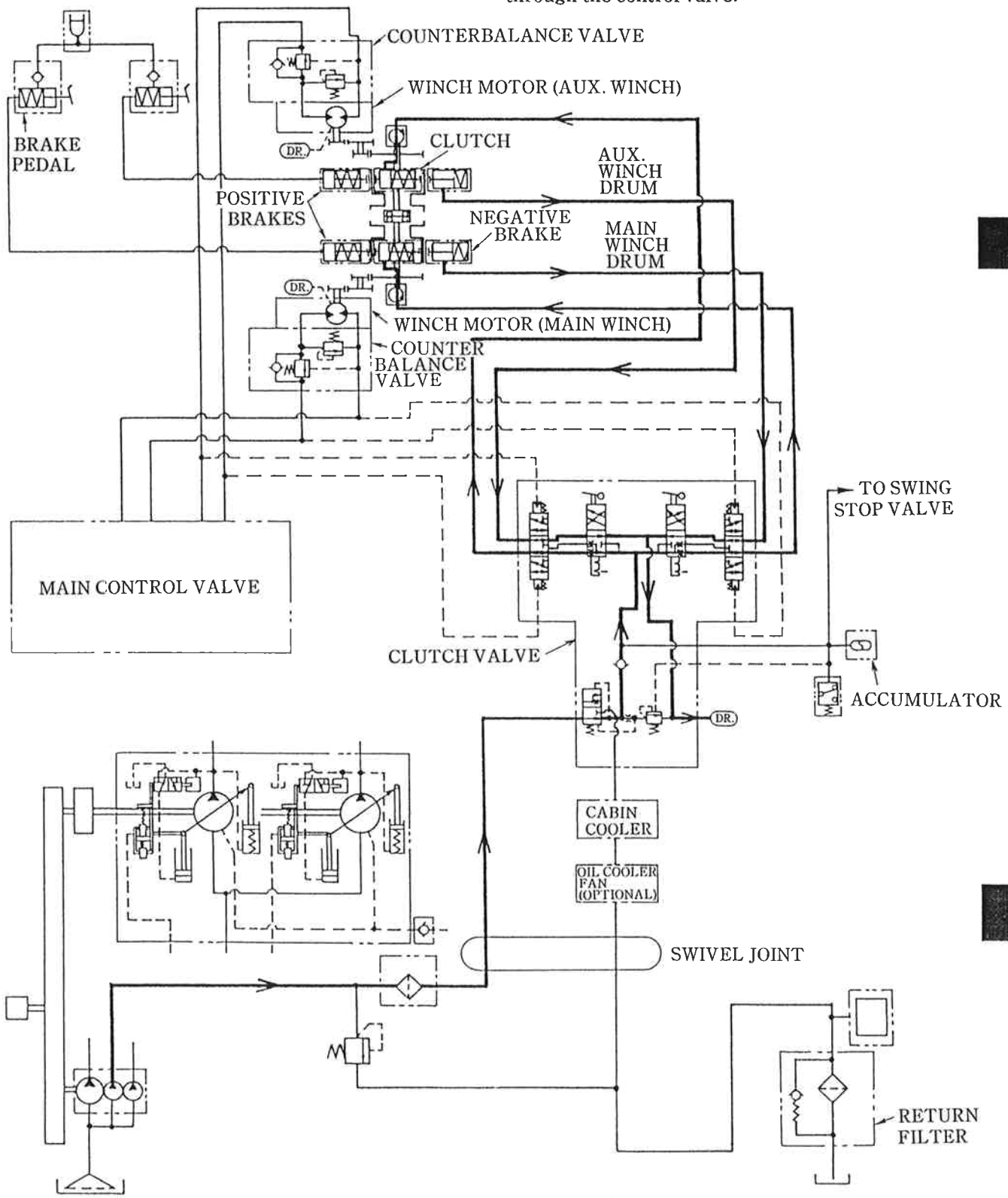


Fig. 2-4 Clutch and Brake Hydraulic Circuit (Holding)

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(3) Free fall

Clutch lever position : forward

Oil from pump No. 2-2 passes through the clutch valve and the pilot-actuated directional control valve and is supplied to the negative brake cylinder, releasing the negative brake. Since the circuit to the clutch cylinder is led to the tank through the drain of the clutch valve, the clutch cylinder is opened, and the clutch is disengaged.

Because both brake and clutch are disengaged under this condition, the drum is free and the load free falls under its own weight. In this condition, operating the winch lever will have no effect on the free fall except that the drum shaft is rotated clockwise, stopped, and rotated counterclockwise. Depressing the brake pedal causes the positive brake cylinder to function, stopping drum rotation.

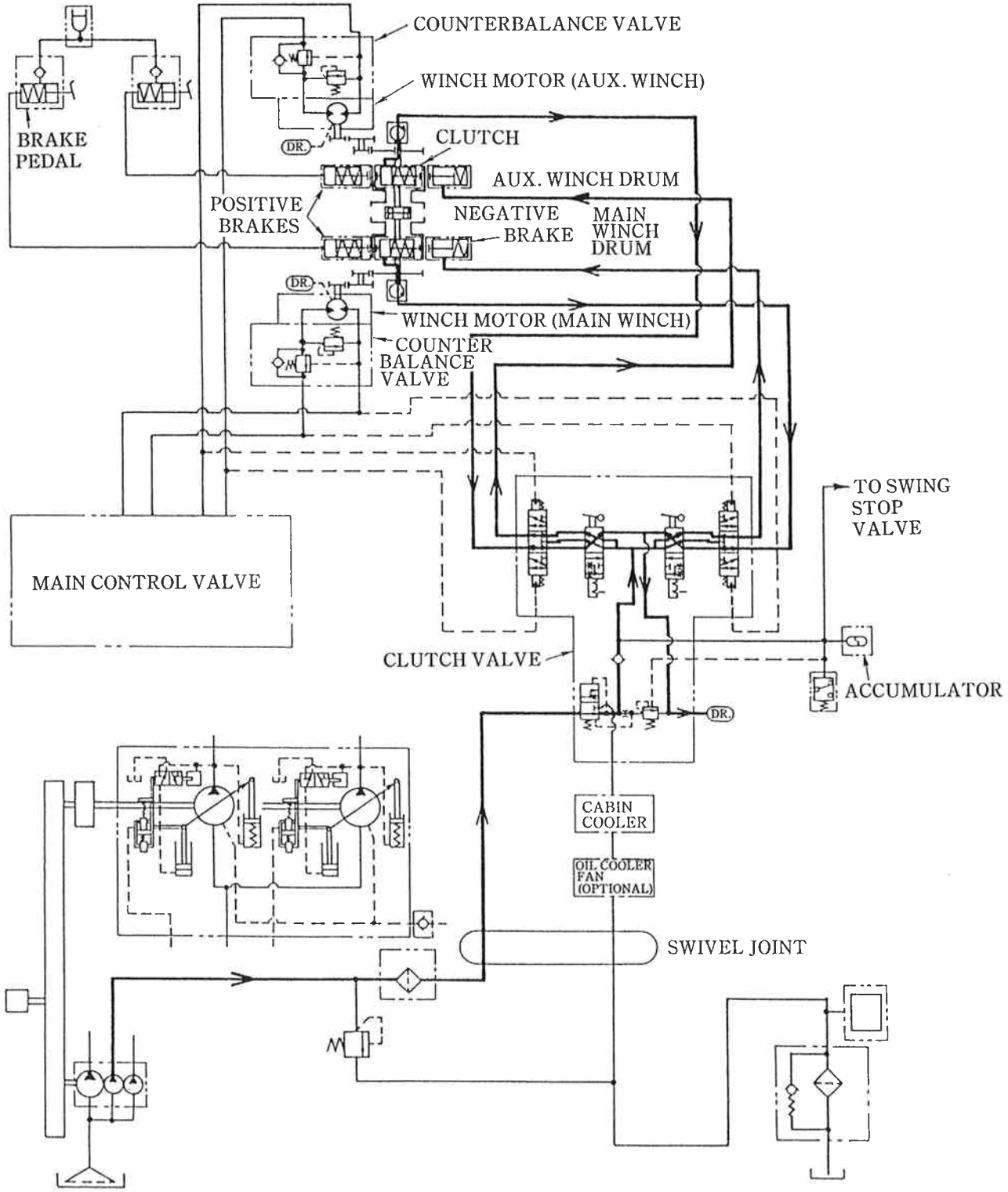


Fig. 2-5 Clutch and Brake Hydraulic Circuit (Free Fall)

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(4) Lowering operation
Clutch lever position : backward
Winch lever position : lowering

(a) See (1)-(a).

(b) As raising the hook, two speeds are available here, low and high. Pushing the winch lever a half stroke distance causes the hook to be lowered at the low speed. Oil from No. 1-2 pump passes through the control valve and the counterbalance valve into the winch motor, rotating the motor. When the winch lever is pushed a full stroke distance, the hook is lowered at the high speed. When the boom is not being hoisted or telescoped, oil from pump No. 1-1 joins oil from No. 1-2 pump, passes through the counterbalance valve into the winch motor and rotates the motor. The turning force of the winch motor is transmitted through the reduction unit to the drum and lowers the load.

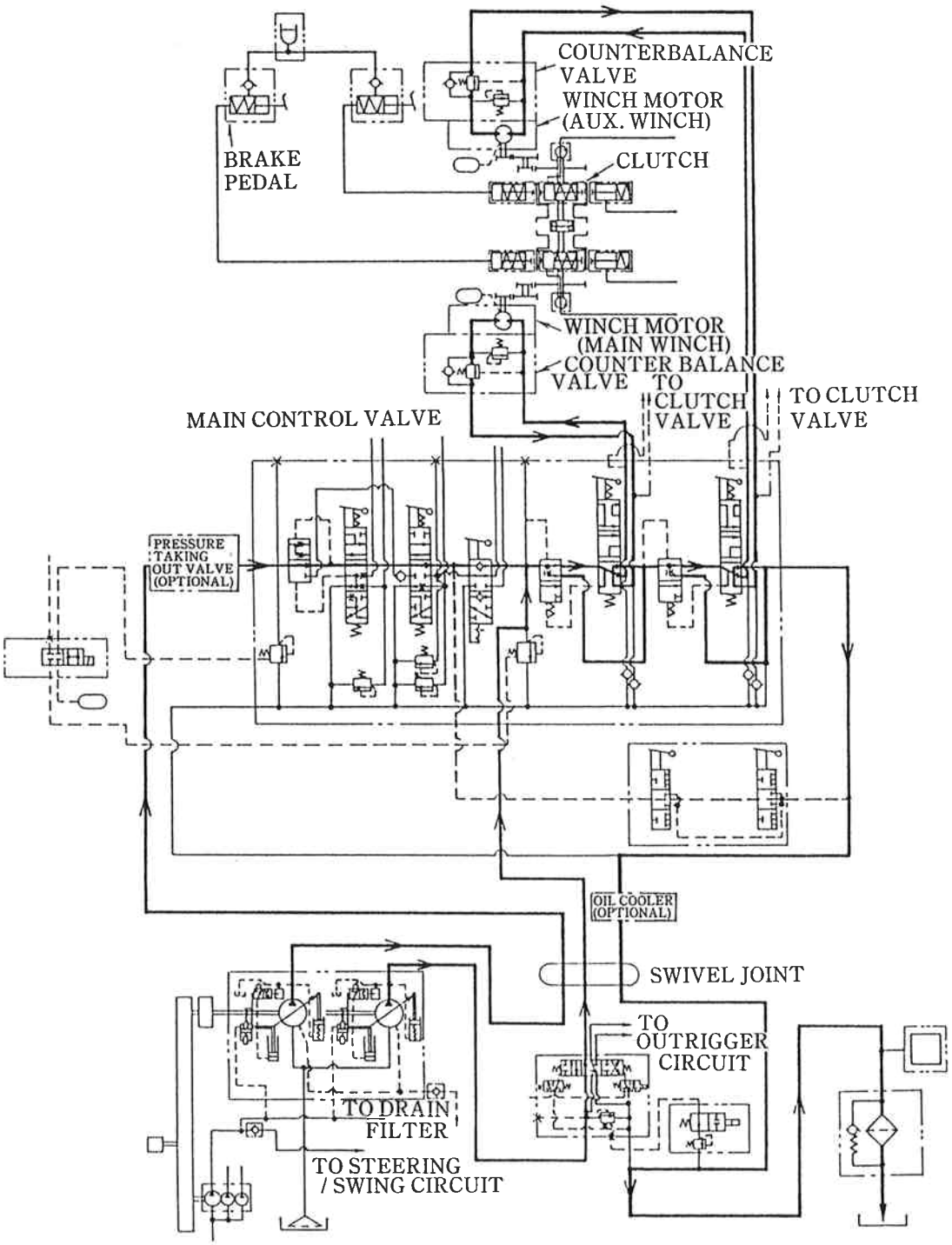


Fig. 2-6 Winch Motor Drive Hydraulic Circuit (Lowering)

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(5) Third winch (optional) hydraulic circuit

The third drum (optional) is mounted behind the main and auxiliary winch drums, and added, as an option, including the exclusive winch motor, counterbalance valve, clutch and brake.

Operation of the third drum is performed with the added exclusive clutch lever, control lever and brake pedal, etc.

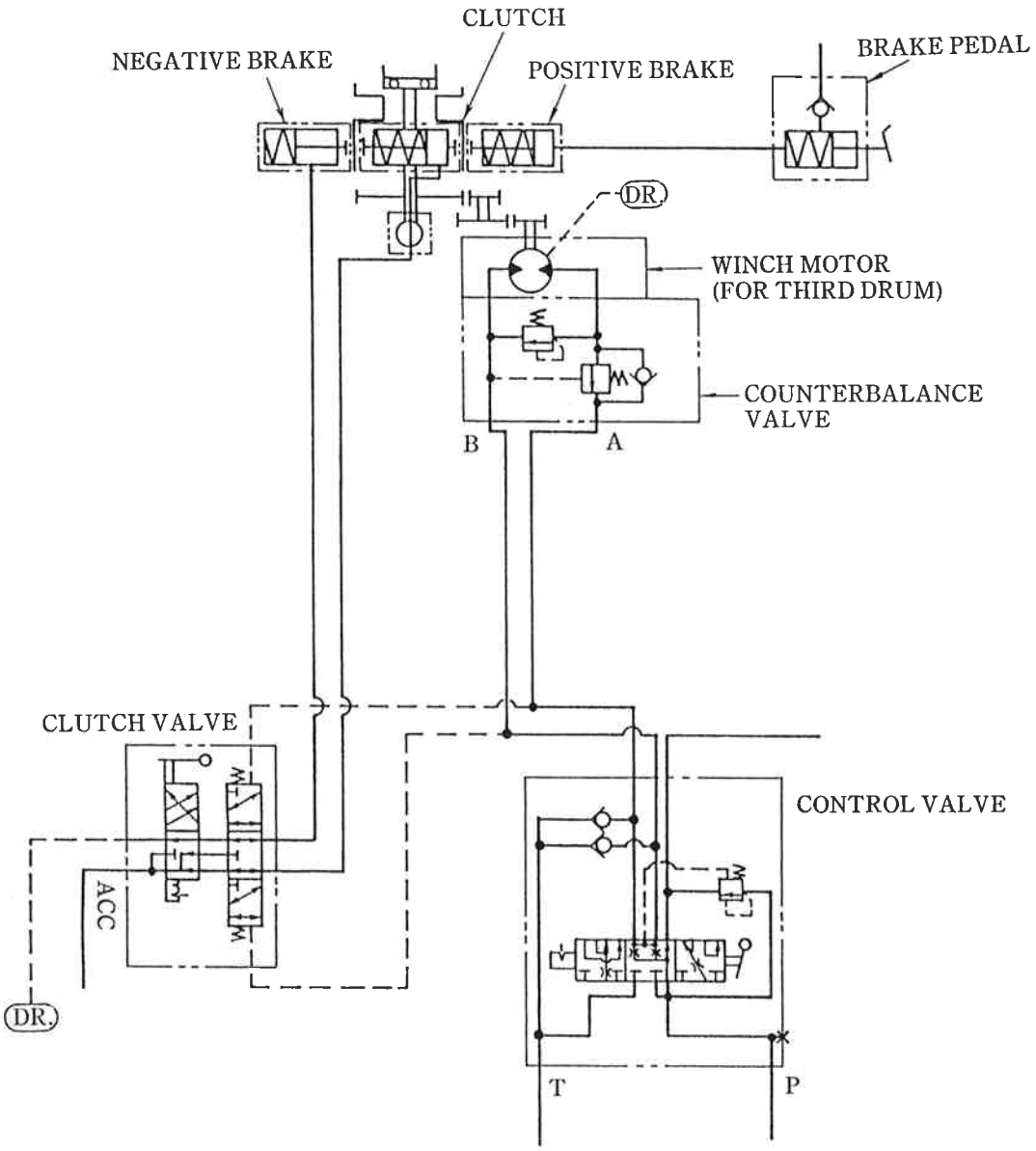


Fig. 2-7 Third Winch (Optional) Hydraulic Circuit

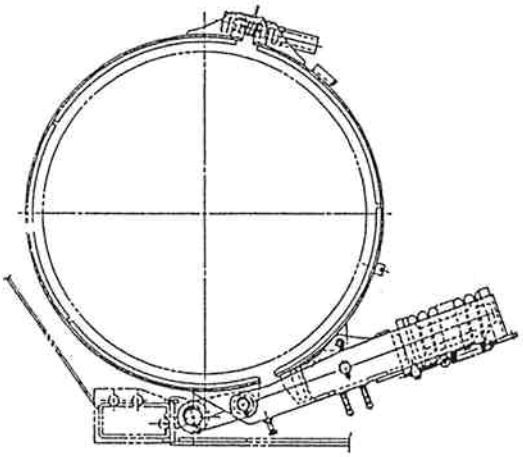
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2.2 WINCH BRAKE

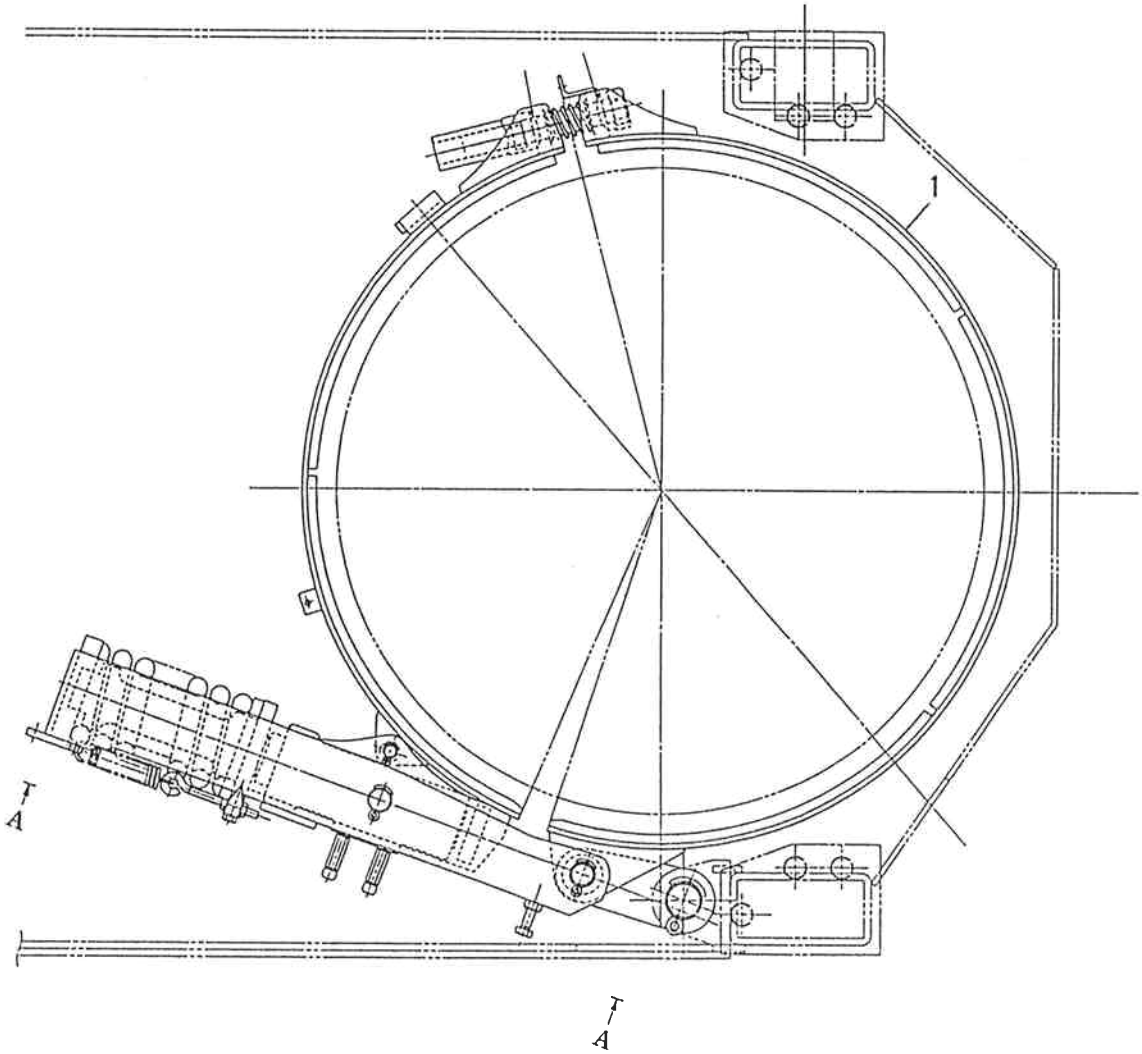
(1) Main and auxiliary winch brakes.

The winch brake for the main winch and auxiliary winch are of exactly the same construction with the exception of opposite mounting. The dead end of the brake band is secured to the side wall of the revolving frame and the band is supported in the revolving frame by a spring. It is so designed that the band does not come into contact with the drum while it is rotating. Fig. 2-8 shows the construction of the winch brakes.

The winch brake is a two way type that functions as both a spring set, hydraulically released negative brake and a hydraulically set, spring released positive brake.



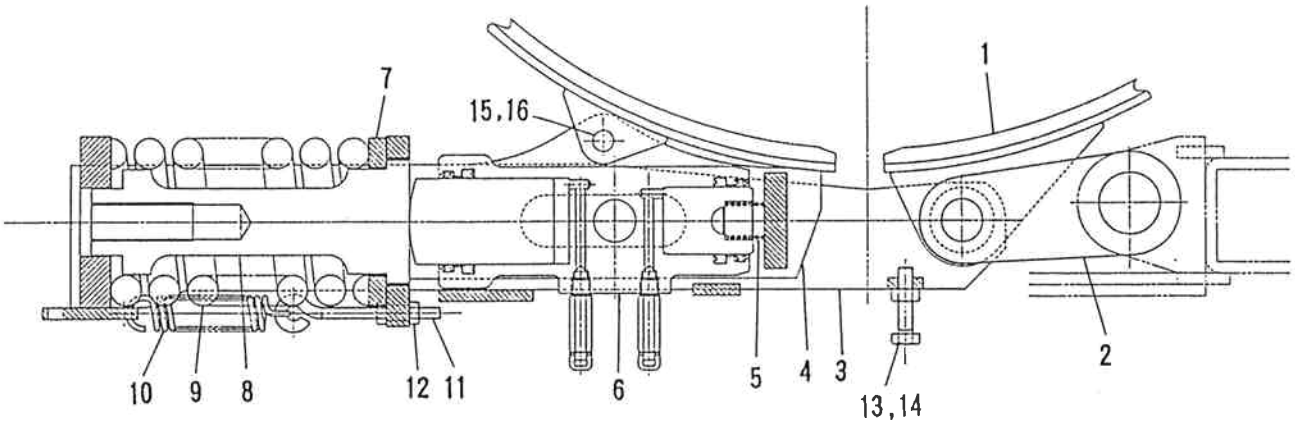
AUXILIARY WINCH
BRAKE ASSEMBLY



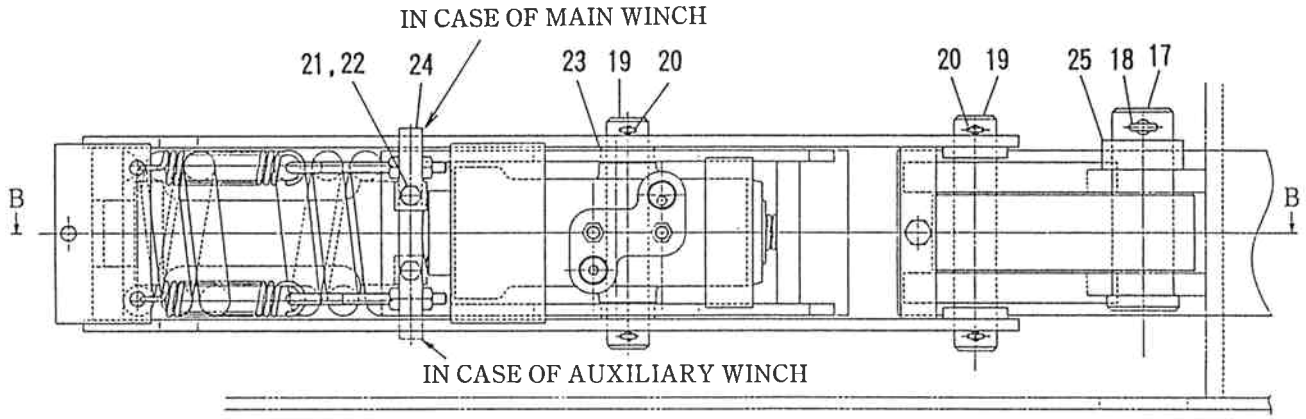
MAIN WINCH
BRAKE ASSEMBLY

Fig. 2-8 Brake Band Assembly (1 / 2)

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SECTION B-B



VIEW FROM A-A

1. BRAKE BAND
2. LINK
3. BRACKET
4. BRACKET
5. SPRING
6. CYLINDER
7. PLATE
8. RETAINER
9. SPRING
10. SPRING
11. EYEBOLT
12. NUT
13. CAPSCREW
14. NUT
15. PIN
16. COTTER PIN
17. PIN
18. COTTER PIN
19. PIN
20. COTTER PIN
21. CAPSCREW
22. LOCKWASHER
23. SPACER
24. POINTER
25. SPACER

Fig. 2-8 Main and Auxiliary Winch Brake Assemblies (2 / 2)

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(2) Third drum brake (optional)

The third drum brake is somewhat different from the main and auxiliary winch brakes. The dead end of the brake band is secured to the third frame, and the brake band is supported to the third frame by a spring so that the band does not come into contact with the drum while it is rotating. Fig. 2-9 shows the construction of the third drum winch brake.

The third drum brake is of a two way type that functions as both a negative brake of spring set-hydraulically release and a positive brake of hydraulically set-spring release.

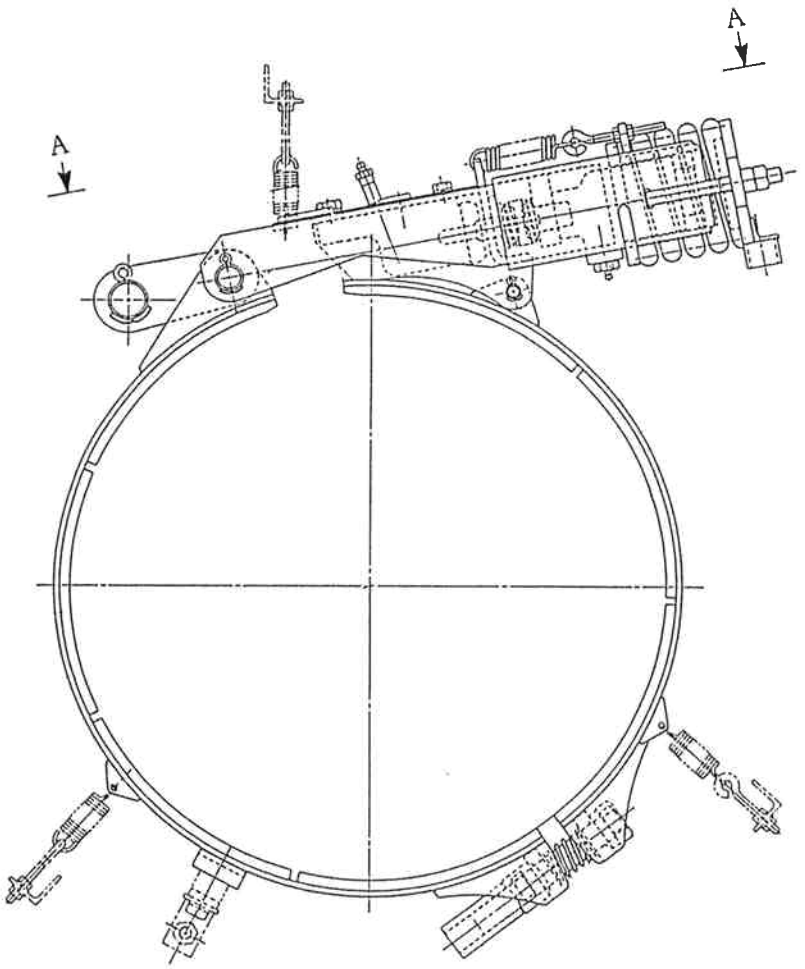
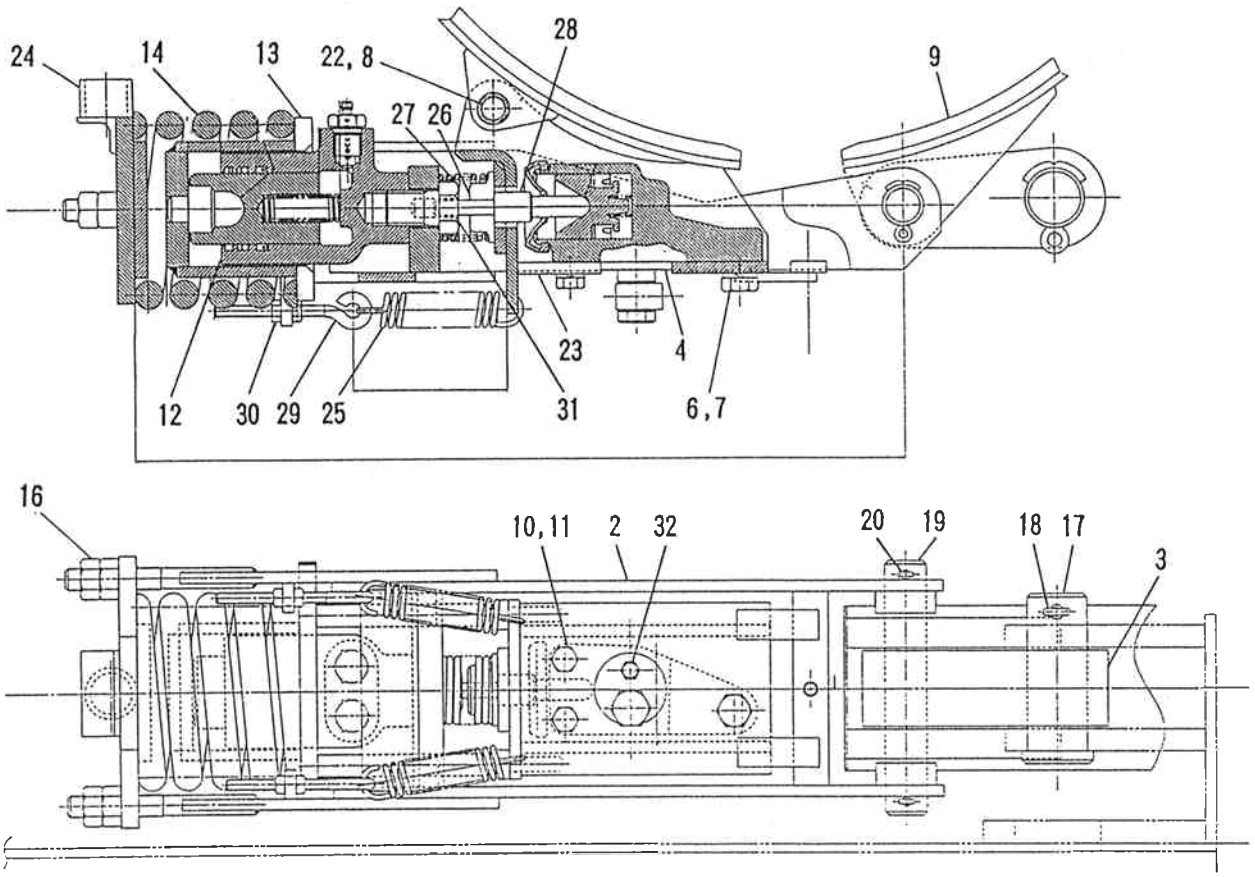


Fig. 2-9 Third Drum Brake Assembly (1 / 2)

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2. LINK
3. DEAD END LINK
4. CYLINDER
6. CAPSCREW
7. LOCKWASHER
8. PIN
9. BRAKE BAND
10. CAPSCREW
11. LOCKWASHER
12. CYLINDER
13. GUIDE
14. SPRING
16. NUT
17. PIN
18. COTTER PIN
19. PIN
20. COTTER PIN
22. COTTER PIN
23. BRACKET
24. SPRING RETAINER
25. SPRING
26. FLANGE
27. COMPRESSION SPRING
28. PUSH ROD
29. EYEBOLT
30. NUT
31. BOLT
32. AIR BLEEDER

Fig. 2-9 Third Drum Brake Assembly (2 / 2)

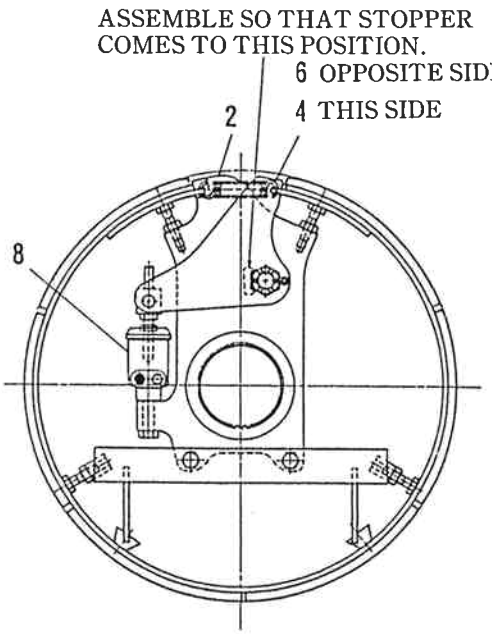
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2.3 CLUTCH

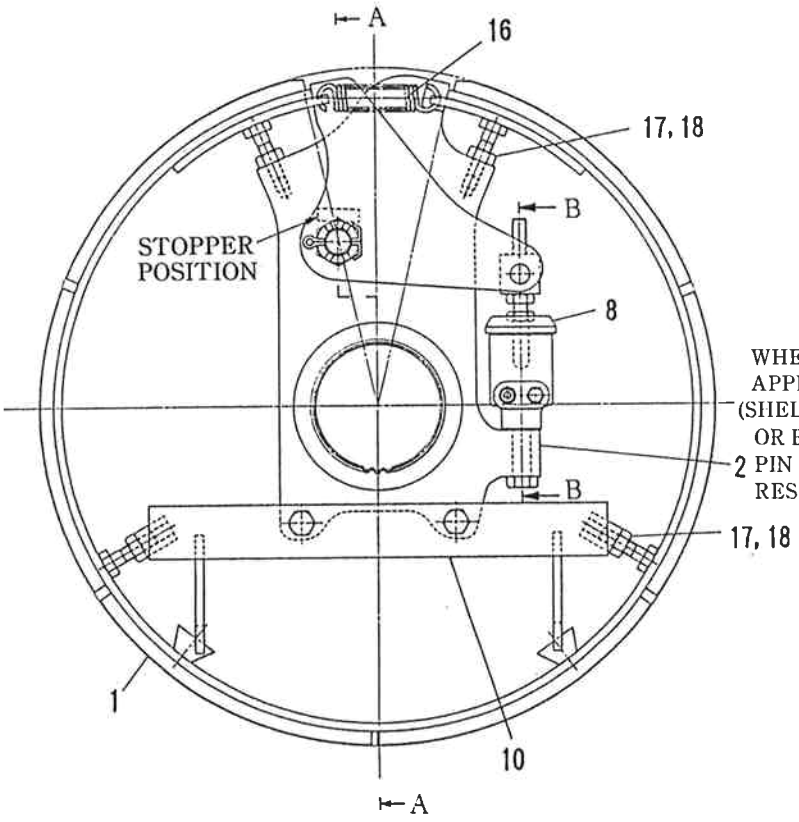
(1) Main and auxiliary winch clutches.

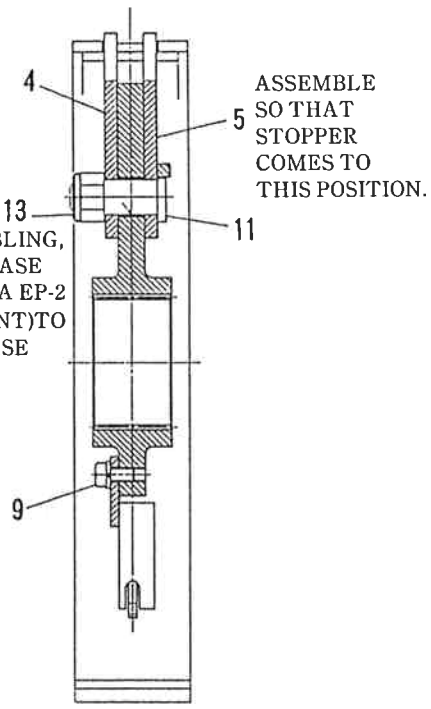
The winch clutches for the main winch and auxiliary winch are of exactly the same construction with the exception of the opposite installation. They are fixed to the drum shaft with the spline by means of the clutch spider, and control the transmission of power between the winch drum shaft and the drum.

1. CLUTCH BAND
2. SPIDER
3. CAPSCREW
4. LEVER
5. LEVER (FOR MAIN)
6. LEVER (FOR AUX.)
7. NUT
8. CYLINDER
9. SEMS BOLT

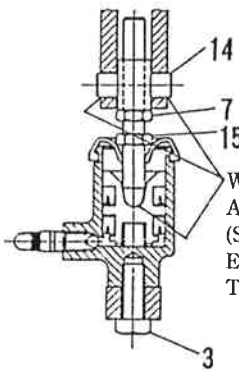


FOR AUXILIARY WINCH





SECTION "A-A"



FOR MAIN WINCH

SECTION "B-B"

10. BAND GUIDE
11. BOLT
12. NUT
13. COTTER PIN
14. TRUNNION
15. PUSH ROD
16. TENSION SPRING
17. BOLT
18. NUT

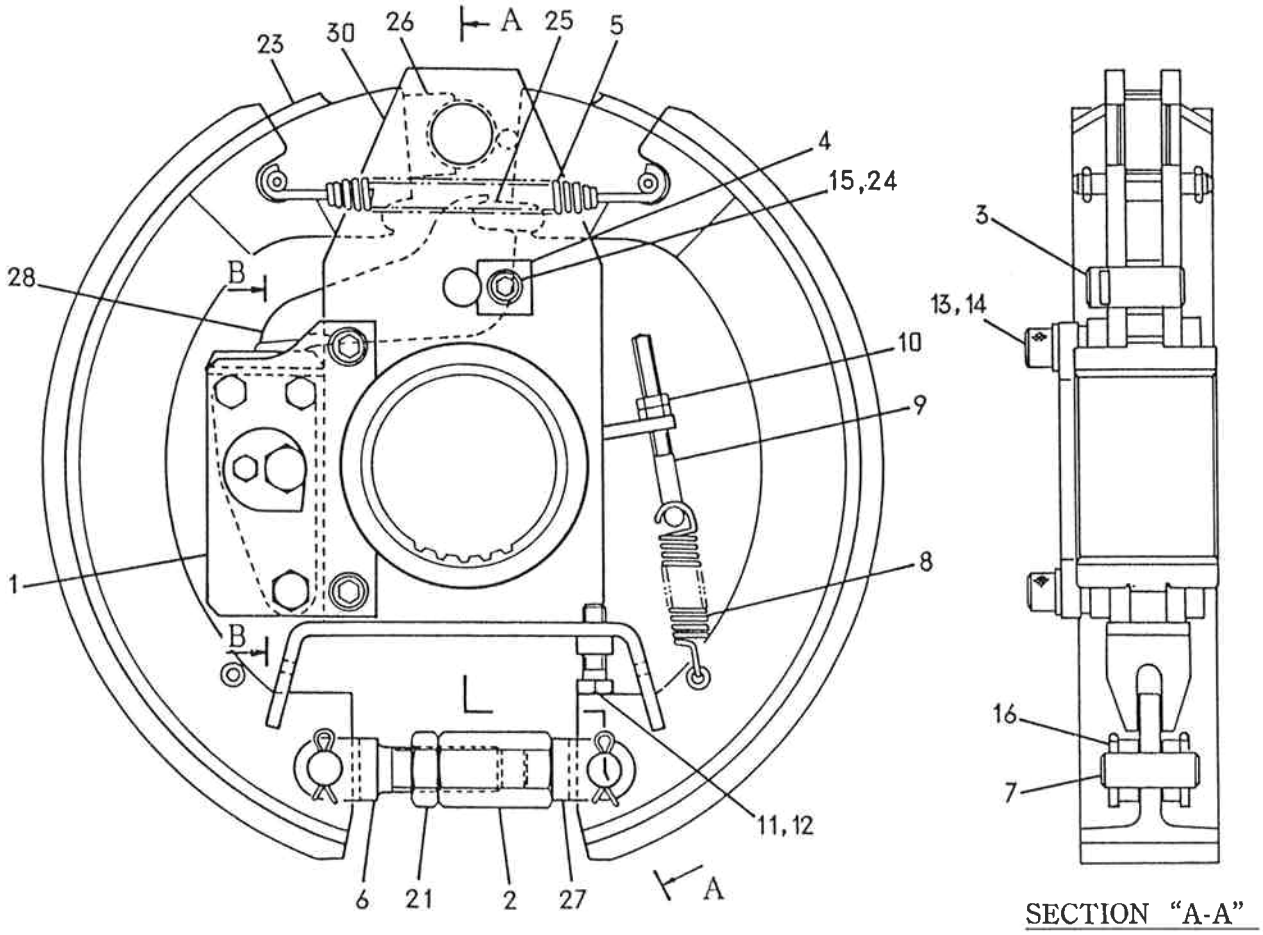
Fig. 2-10 Main and Auxiliary Winch Clutch Assembly

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(2) Third drum clutch (optional)

The third drum clutch is of a shoe type construction, and is fixed to the drum shaft with the spline by means of the clutch spider.

This clutch is used to control the transmission of power between the winch drum shaft (front) and the third drum.



1. BRACKET
2. NUT
3. PIN
4. LOCK PLATE
5. SPRING
6. CLEVIS
7. PIN
8. SPRING
9. EYEBOLT
10. NUT
11. CAPSCREW
12. NUT
13. CAPSCREW
14. WASHER
15. CAPSCREW
16. COTTER PIN
17. CAPSCREW
18. LOCKWASHER
19. CAPSCREW
20. LOCKWASHER
21. NUT
22. CLUTCH CYLINDER
23. CLUTCH SHOE
24. LOCKWASHER
25. LINK
26. LATCH PLATE
27. CLEVIS
28. LEVER
29. PUSH ROD
30. CLUTCH SPIDER

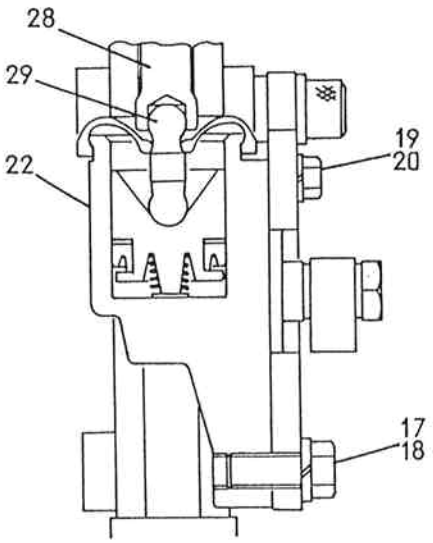


Fig. 2-11 Third Drum Clutch Assembly

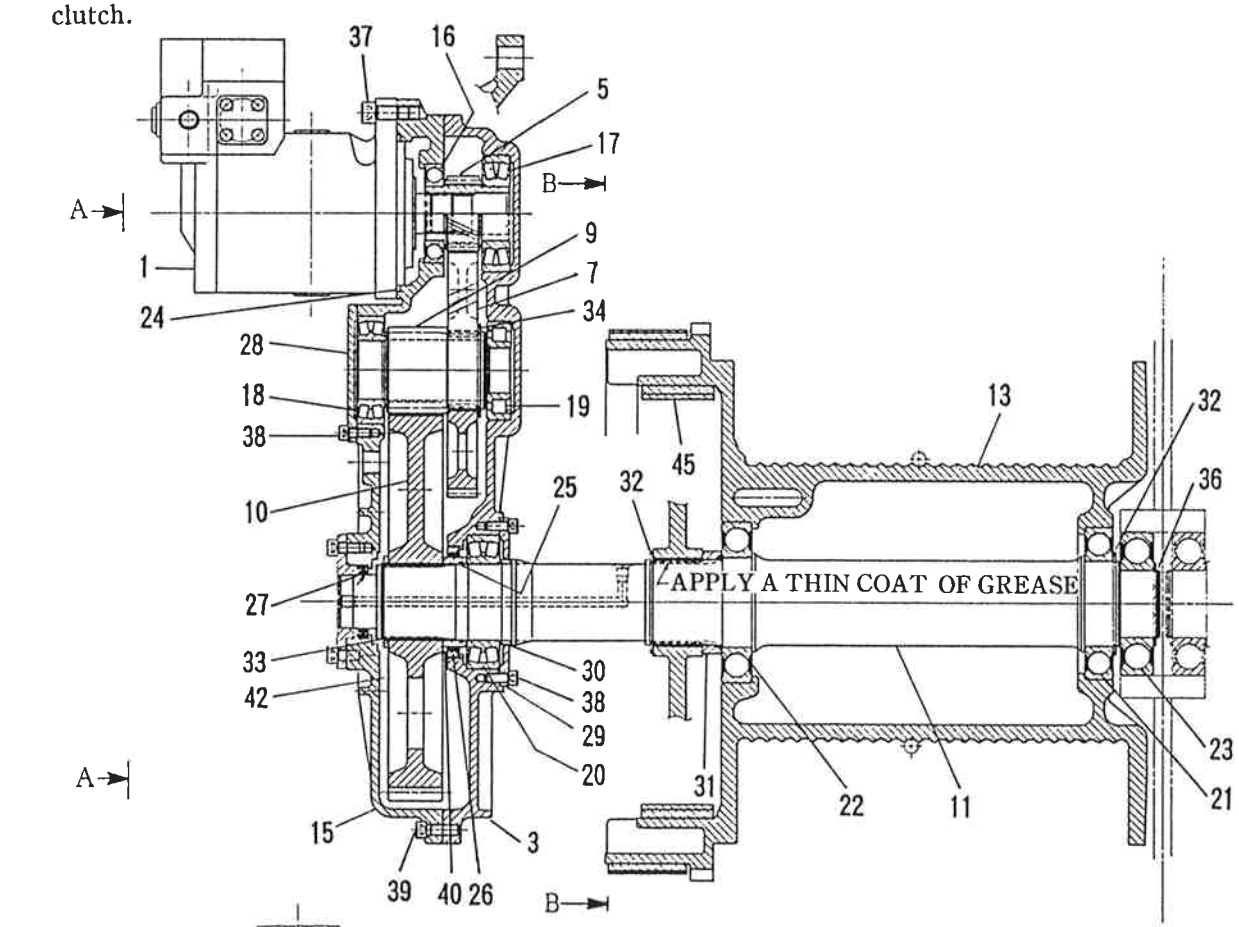
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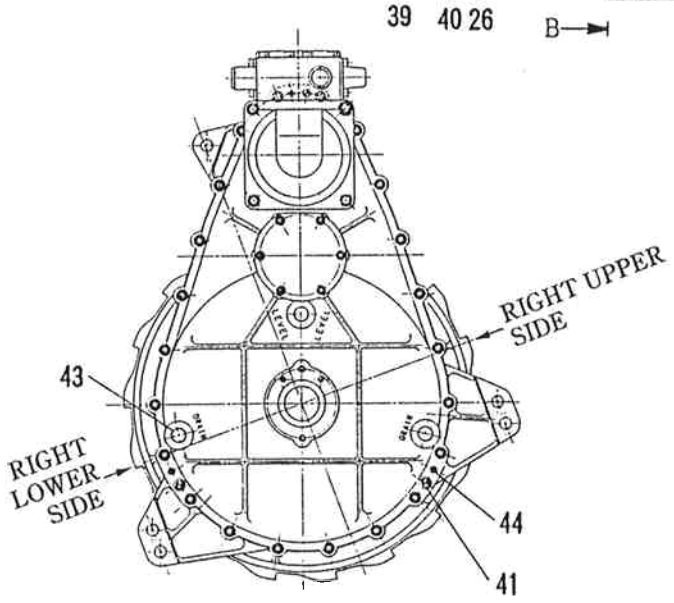
2. 4 WINCH ASSEMBLY

(1) Main and auxiliary winches (standard).

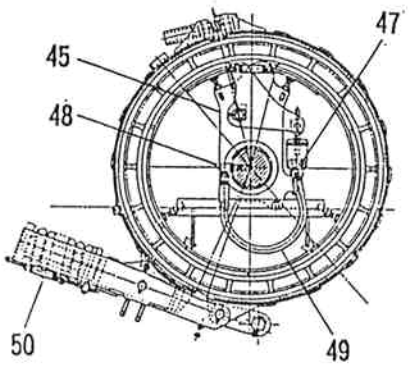
The winch drums, installed at the rear of the machine, consist of the main drum located at the left and the auxiliary drum at the right when see from the counterweight side. As shown in Fig. 2-12, the output side gear in the second reduction unit is fixed to the drumshaft with splines, and power is transmitted to the drum by means of the clutch.

The clutch and the brake drums are integrally cast with the wire drum, and the flange of the drum is provided with drum lock pawl ratchets.





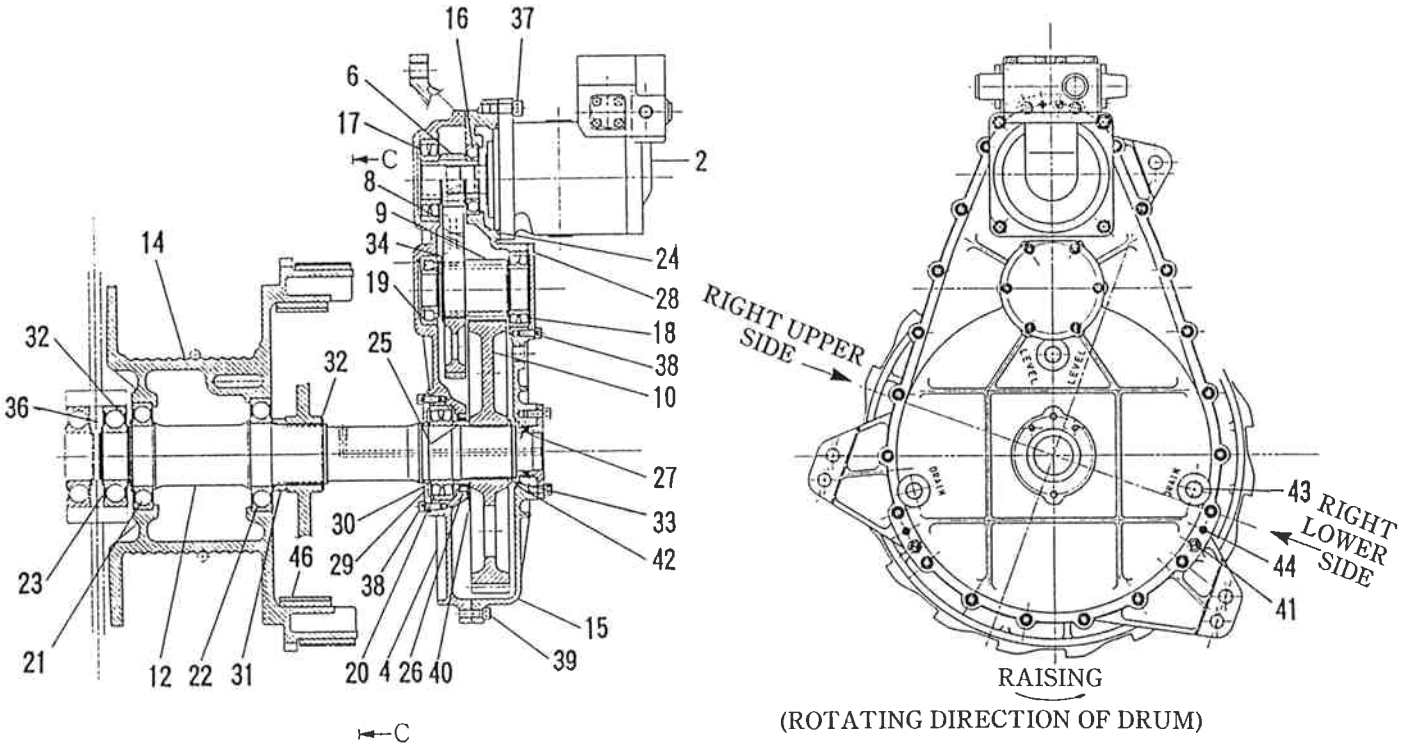
VIEW FROM "A-A"



VIEW FROM "B-B"

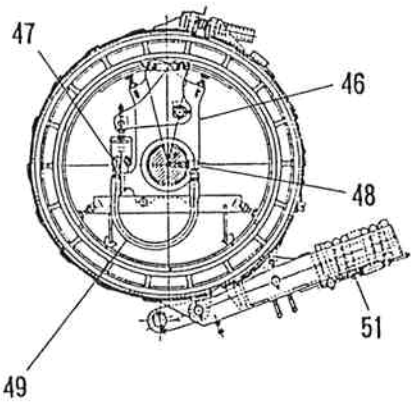
Fig. 2-12 Main Winch Assembly (1 / 2)

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IN CASE OF AUXILIARY WINCH

1. MOTOR ASSEMBLY (MAIN WINCH)
2. MOTOR ASSEMBLY (AUX. WINCH)
3. GEAR CASE (OUTSIDE)
4. GEAR CASE (INSIDE)
5. PINION (MAIN WINCH)
6. PINION (AUX. WINCH)
7. GEAR (MAIN WINCH)
8. GEAR (AUX. WINCH)
9. PINION
10. GEAR
11. SHAFT (MAIN WINCH)
12. SHAFT (AUX. WINCH)
13. DRUM (MAIN WINCH)
14. DRUM (AUX. WINCH)
15. GEAR CASE (OUTSIDE)
16. BALL BEARING
17. ROLLER BEARING
18. ROLLER BEARING
19. ROLLER BEARING
20. ROLLER BEARING
21. BALL BEARING
22. BALL BEARING
23. BALL BEARING
24. O-RING
25. O-RING
26. OIL SEAL
27. OIL SEAL
28. COVER
29. COVER
30. SPACER
31. SPACER
32. SNAP RING
33. SNAP RING
34. SNAP RING
35. ——
36. SNAP RING
37. CAPSCREW
38. CAPSCREW
39. CAPSCREW
40. SLEEVE
41. PIN
42. SPACER
43. PLUG
44. SET SCREW
45. CLUTCH ASSEMBLY (MAIN WINCH)
46. CLUTCH ASSEMBLY (AUX. WINCH)



VIEW FROM "C-C"

47. ELBOW
48. ELBOW
49. HOSE
50. BRAKE ASSEMBLY (MAIN WINCH)
51. BRAKE ASSEMBLY (AUXILIARY WINCH)

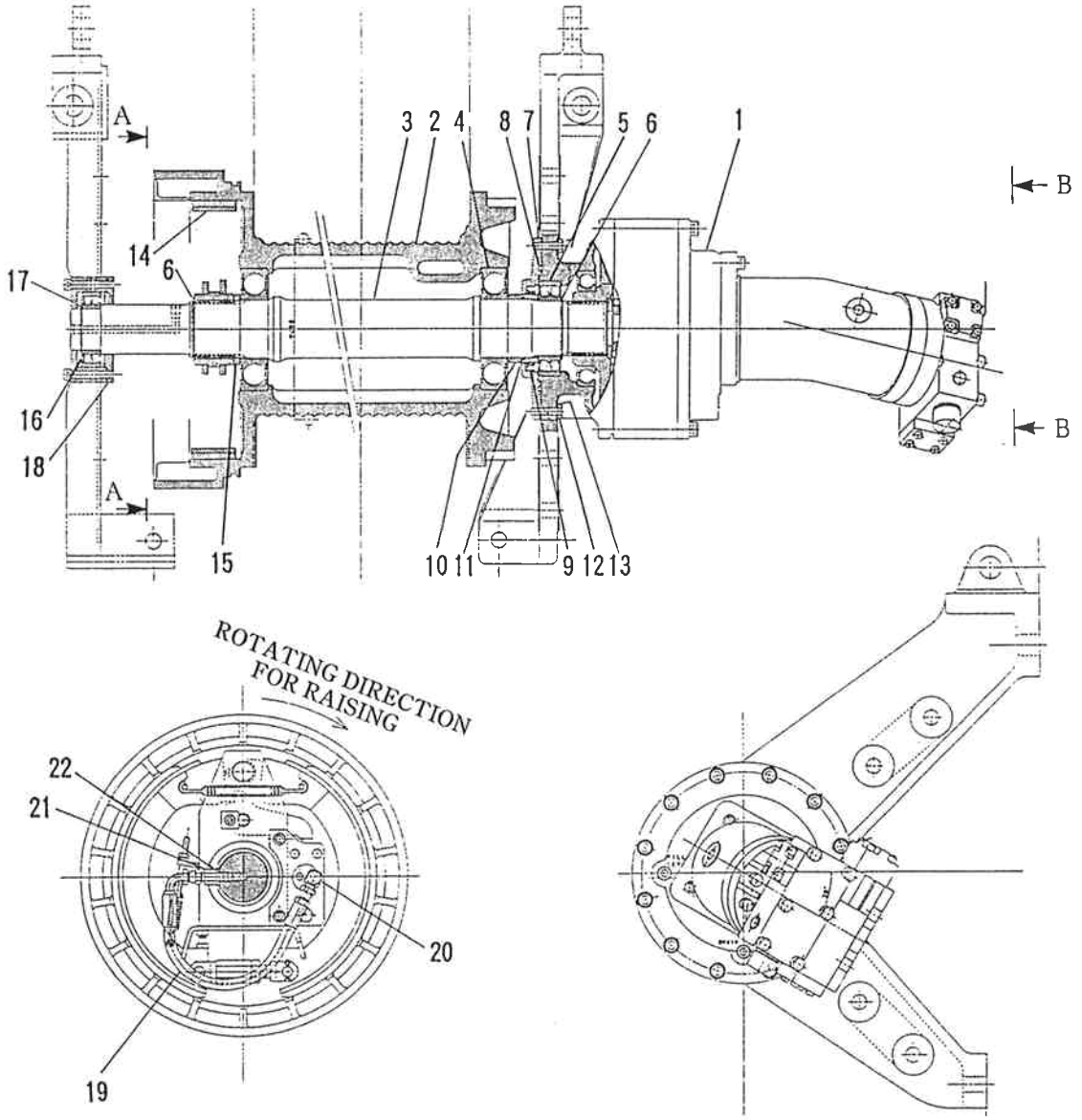
Fig. 2-12 Main and Auxiliary Winch Assembly (2 / 2)

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(2) Third drum winch (optional)

Third drum winch is installed behind the main and auxiliary winches. As shown in Fig. 2-13, the output side spider in the planetary reduction unit is fixed to the drumshaft with splines, and power is transmitted to the drum by means of the clutch.

The clutch and brake drums are integrally cast with the wire drum, and the flange on the other end of the drum is provided with the drum lock pawl ratchets.



1. REDUCTION UNIT
2. DRUM
3. SHAFT
4. BEARING
5. BEARING
6. SNAP RING
7. COVER
8. O-RING
9. OIL SEAL
10. SPACER
11. O-RING
12. CAPSCREW
13. WASHER
14. CLUTCH ASSEMBLY
15. SPACER
16. BEARING
17. SNAP RING
18. COVER
19. HOSE ASSEMBLY
20. CONNECTOR
21. CONNECTOR
22. O-RING

Fig. 2-13 Third Drum Winch Assembly

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2.5 DRUM LOCK

(1) Main and auxiliary drum locks.

Construction of the winch drum lock is shown in Fig. 2-14.

The winch drum lock is a safety device preventing the drum from winding off when the operator leaves his seat with the load kept aloft, when the machine is not at work, when the vehicle travels and so on.

ON / OFF operation of the lock is performed by the lock knob mounted at the left side of the operator's seat in the operator's cab.

Do not stop the lifted load by use of the lock during power or free falling.

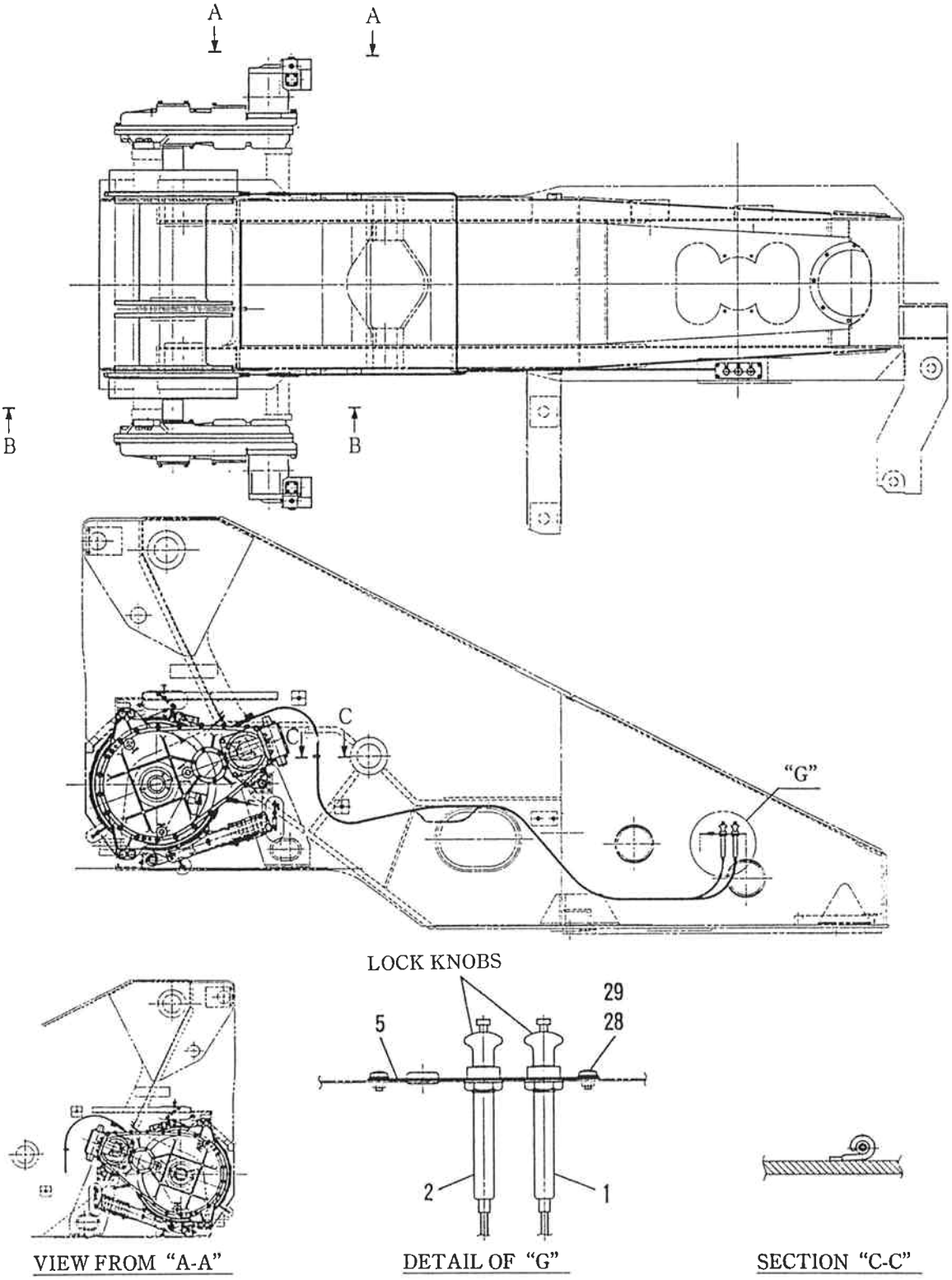
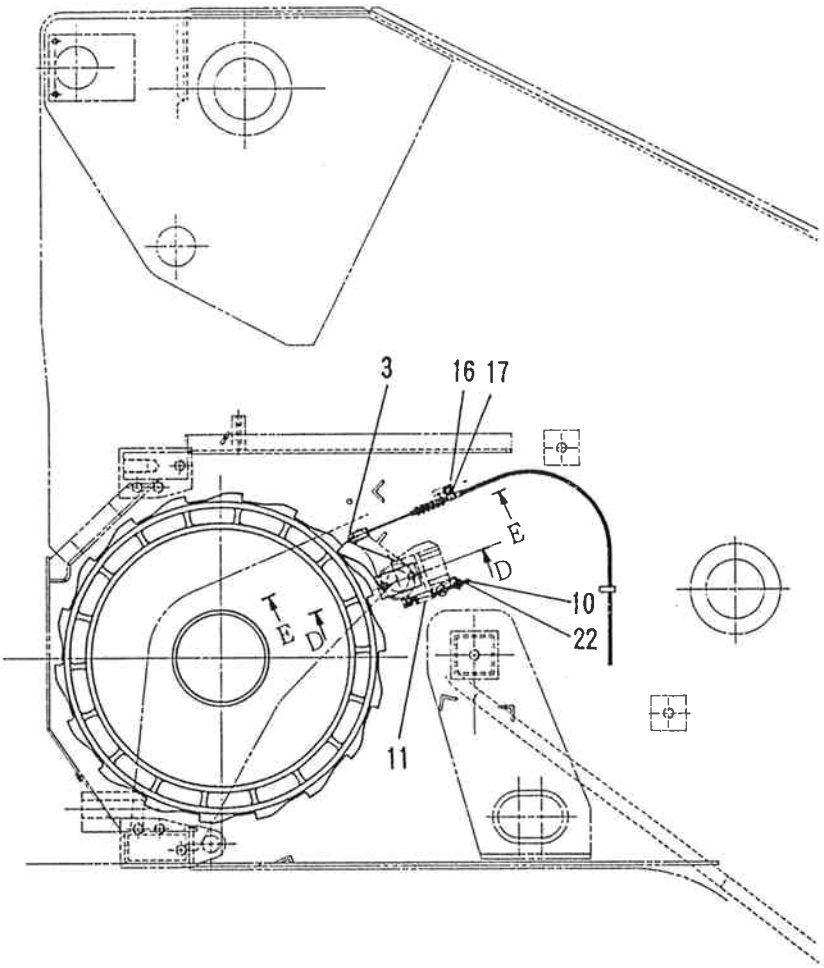
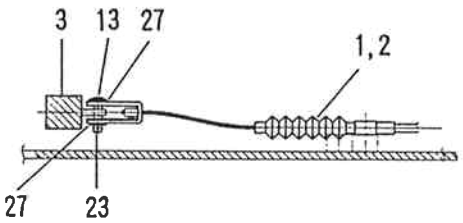


Fig. 2-14 Main and Auxiliary Winch Drum Lock (1 / 2)

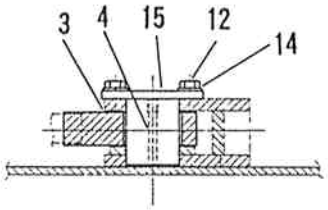
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SECTION "B-B"



SECTION "E-E"



SECTION "D-D"

1. CONTROL CABLE (FOR MAIN WINCH)
2. CONTROL CABLE (FOR AUXILIARY WINCH)
3. PAWL
4. PIN
5. COVER
10. EYEBOLT
11. SPRING
12. CAPSCREW
13. PIN
14. WASHER
15. PLATE
16. LOCKWASHER
17. CAPSCREW
22. NUT
23. COTTER PIN
27. WASHER
28. MACHINE SCREW
29. WASHER

Fig. 2-14 Main and Auxiliary Winch Drum Lock (2 / 2)

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(2) Third drum lock (optional).

Fig. 2-15 shows construction of the third drum lock.

ON / OFF operation of the drum lock is performed by the lock knob mounted at the left side of the operator's seat in the operator's cab.

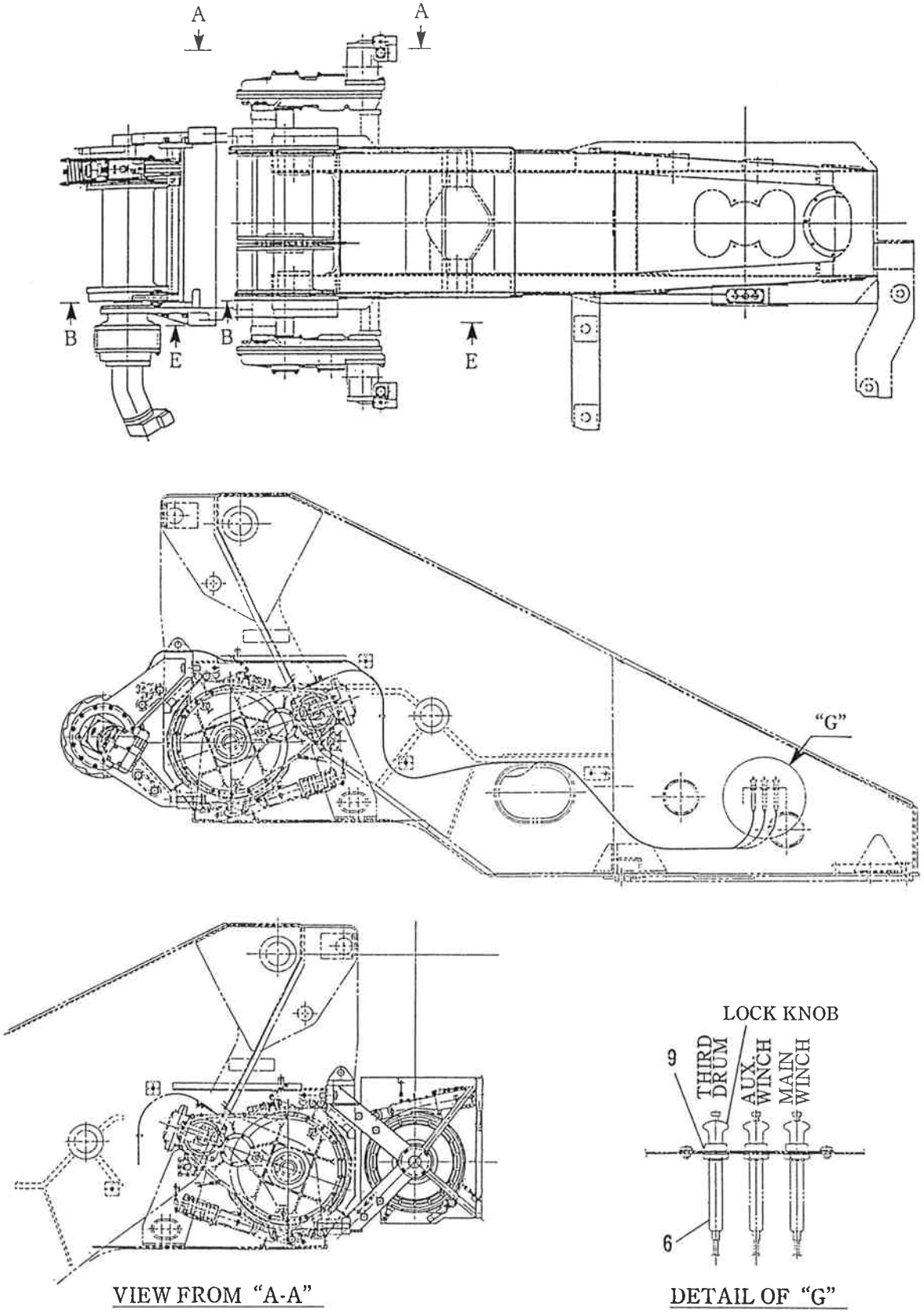
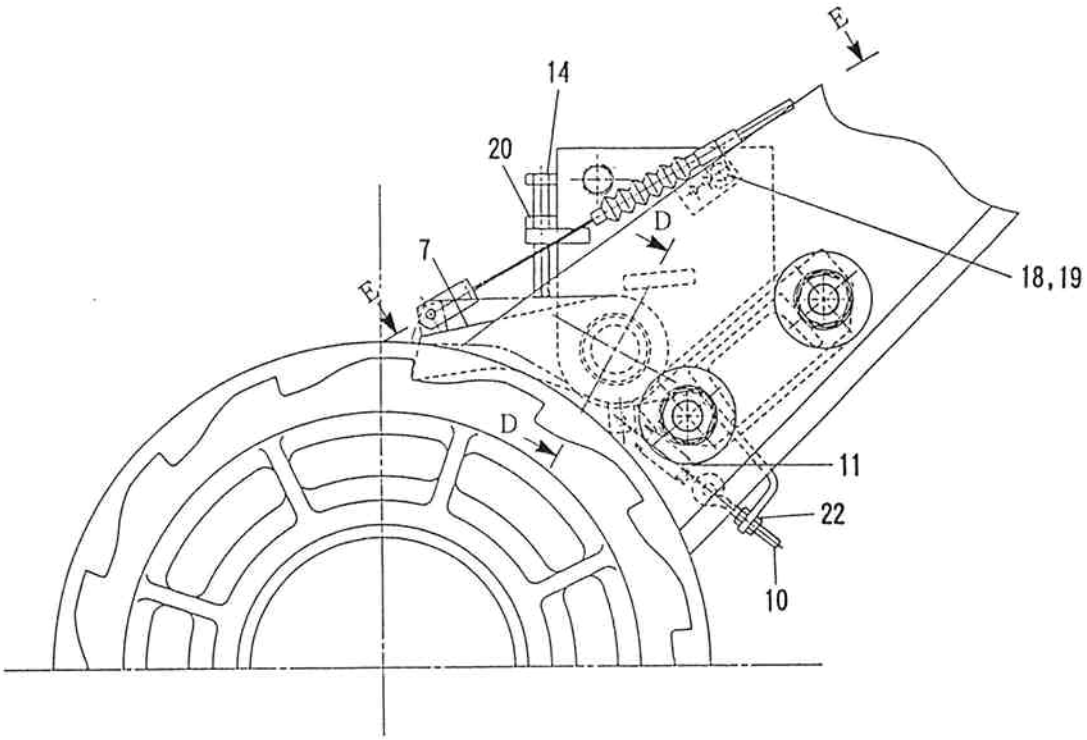
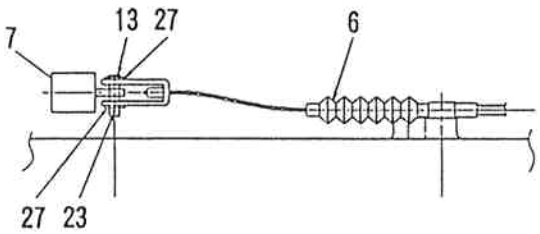


Fig. 2-15 Third Drum Lock (1 / 2)

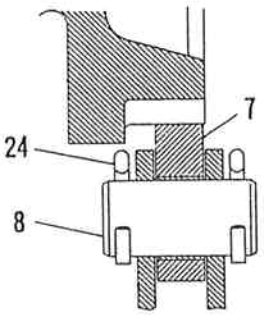
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SECTION "B-B"



SECTION "E-E"



SECTION "D-D"

6. CONTROL CABLE (FOR THIRD DRUM)
7. PAWL
8. PIN
9. COVER
10. EYEBOLT
11. SPRING
13. PIN
14. BOLT
18. CAPSCREW
19. LOCKWASHER
20. NUT
22. NUT
23. COTTER PIN
24. COTTER PIN
27. WASHER

Fig. 2-15 Third Drum Lock (2 / 2)

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3. REMOVAL

3.1 BRAKE BAND

To remove the brake band, follow these steps separately for the main winch and auxiliary winch :

(a) Stop the engine, and set the drum lock ON. Then free the brake pedal.

(b) Remove the brake piping, cotter pin for fixing the brake band, brake band hanging eyebolts and brake adjusting bolt and nut.

(c) Remove the brake band.

NOTE

When the brake band for the third drum (optional) is equipped, the brake band can be removed with the same procedures.

3.2 MASTER CYLINDER

To remove the main and auxiliary winch brake master cylinders, proceed as follows respectively for the main winch and auxiliary winch (see Fig. 3-1) :

(a) After setting the drum locks (main and auxiliary) ON, free the brake pedals (main and auxiliary).

(b) Remove the piping and hose connected to the master cylinders.

CAUTION

Plug the piping and hose to prevent brake oil from flowing out.

(c) Remove the pin and mounting bolts and take out the master cylinder from the front panel.

NOTE

When the brake pedal for the third drum (optional) is equipped also, the master cylinder can be removed with the same procedures.

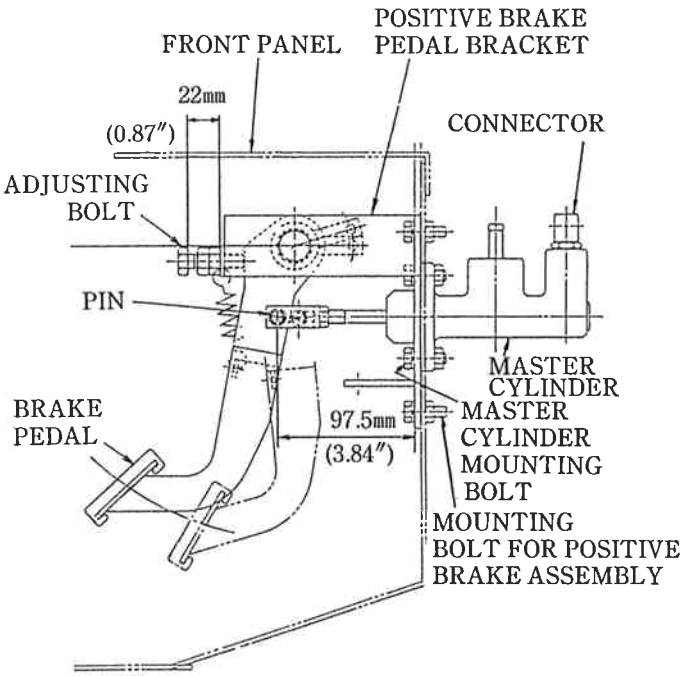


Fig. 3-1 Brake Master Cylinder

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3. REMOVAL

3.1 BRAKE BAND

To remove the brake band, follow these steps separately for the main winch and auxiliary winch :

(a) Stop the engine, and set the drum lock ON. Then free the brake pedal.

(b) Remove the brake piping, cotter pin for fixing the brake band, brake band hanging eyebolts and brake adjusting bolt and nut.

(c) Remove the brake band.

NOTE

When the brake band for the third drum (optional) is equipped, the brake band can be removed with the same procedures.

3.2 MASTER CYLINDER

To remove the main and auxiliary winch brake master cylinders, proceed as follows respectively for the main winch and auxiliary winch (see Fig. 3-1) :

(a) After setting the drum locks (main and auxiliary) ON, free the brake pedals (main and auxiliary).

(b) Remove the piping and hose connected to the master cylinders.

CAUTION

Plug the piping and hose to prevent brake oil from flowing out.

(c) Remove the pin and mounting bolts and take out the master cylinder from the front panel.

NOTE

When the brake pedal for the third drum (optional) is equipped also, the master cylinder can be removed with the same procedures.

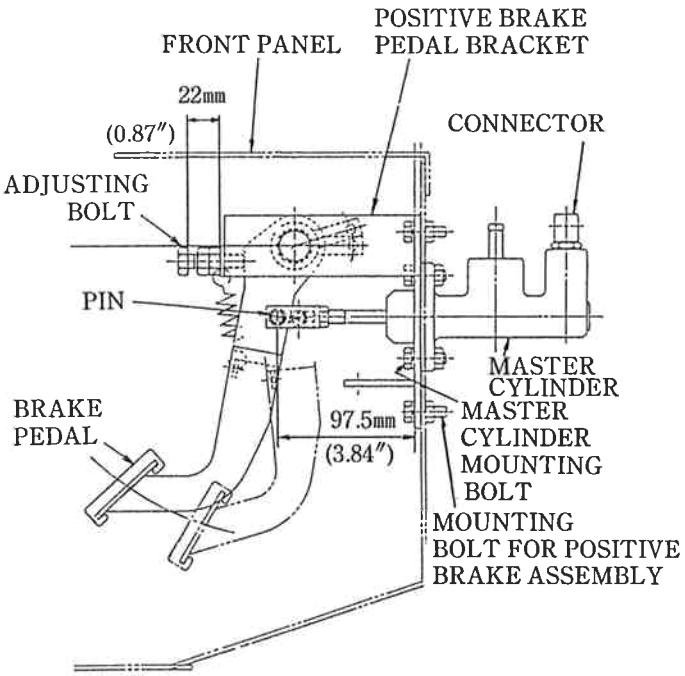


Fig. 3-1 Brake Master Cylinder

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3.3 CLUTCH

(1) Main and auxiliary winch clutches.

Removal and installation of the band assemblies and wheel cylinders on the main and auxiliary winch clutches are possible with the winch units installed on the machine. However, removal and installation of the clutch spiders are impossible. To remove the clutch band, proceed as follows respectively for the main winch and auxiliary winch.

(a) Stop the engine, and set the drum lock in ON and the clutch lever in FREE.

(b) Turning the clutch band adjusting bolt to loosen the clutch fully, remove the clutch band return spring.

(c) After turning the band in the direction of the circumference to shift the guide, take out the band to the outside and remove it.

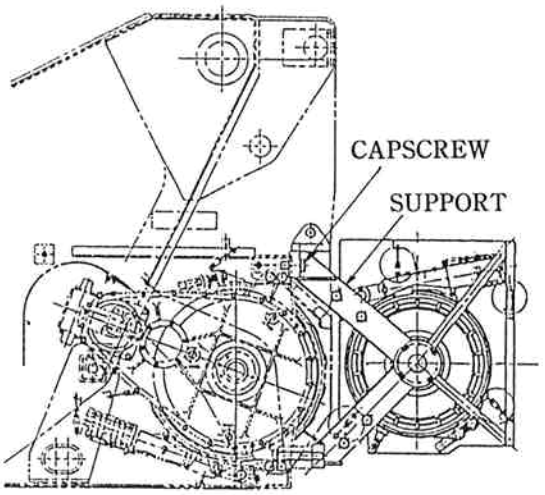


Fig. 3-2 Third Drum Support

(2) Third drum clutch (optional)

To remove the third drum clutch (optional), proceed as follows :

(a) Stop the engine, and set the drum lock in ON and the clutch lever in FREE.

(b) Remove the swivel joint for the clutch together with the piping for the clutch.

(c) Using a suitable crane or chain block, hold the third drum.

(d) Remove the support mounting capscrews (see Fig. 3-2).

(e) Remove cover (1) (see Fig. 3-3).

(f) Using a bearing puller, remove the support. At that time, use a protective metal not to injure the mounting face of the swivel joint.

(g) Remove snap ring (2).

(h) Remove the clutch piping and connector.

(i) Remove snap ring (3).

(j) Draw out the clutch assembly from the drumshaft.

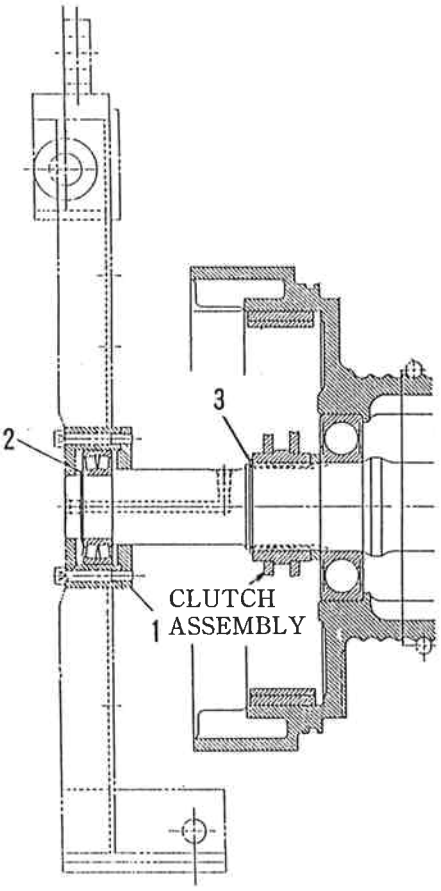


Fig. 3-3 Third Drum Clutch

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3. 4 WINCH ASSEMBLY

For removal, proceed as follows :

(a) Wind the rope onto the drum and tie it to the drum with tie-wire, or remove all the wire rope from the drum, and stop the engine.

(b) Set the brake pedal free (release) and the clutch lever and drum lock OFF.

(c) Remove the cotter pins fixing the brake band, lifting eyebolt, swivel joint and brake piping.

(d) Remove the clutch swivel joint from the drum shaft.

(e) Remove the drum plug of the reduction unit, and drain the gear oil.

(f) Remove the winch motor piping.

(g) Install a support for carring to the end of the drum shaft with the capscrews (see Fig. 3-4).

(h) Remove the mounting capscrews, and remove the winch assemblies (main winch, auxiliary winch, reduction units and motors) from the revolving frame with the use of a suitable crane (see Fig. 3-5).

Weight : Main winch assembly approx. 452kgs (996 lbs)

Auxiliary winch assembly approx. 417kgs (919 lbs)

Third drum winch assembly (optional) approx. 442kgs (974 lbs)

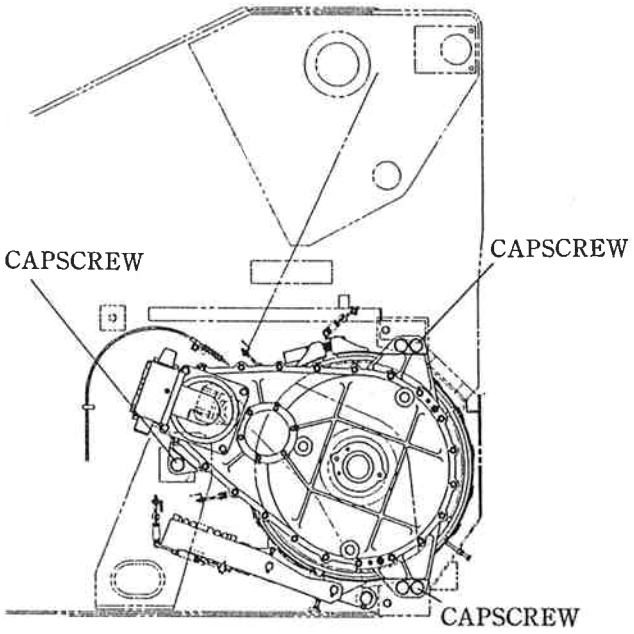
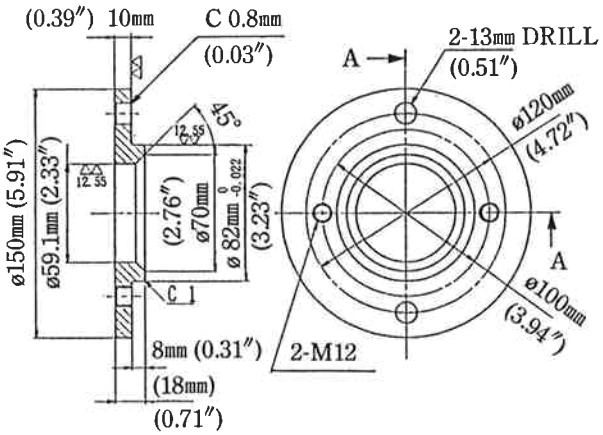


Fig. 3-5 Winch Assembly



SECTION A-A

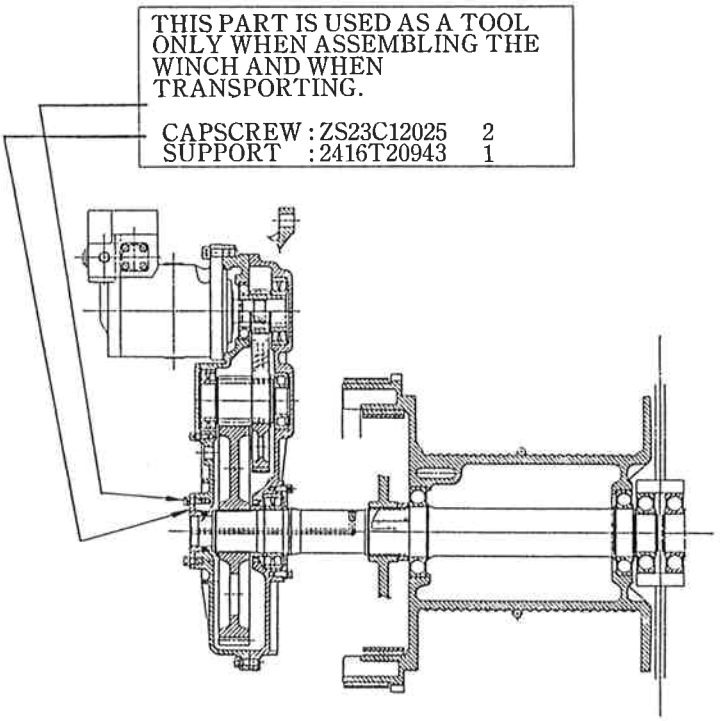


Fig. 3-4

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4. DISASSEMBLY AND ASSEMBLY

4.1 BRAKE AND BRAKE CYLINDER

4.1.1 BRAKE

To disassemble and assemble the brake, referring to Fig. 2-8 on page 2-10, proceed as follows :

(1) Disassembly

(a) With spring (9) compressed by hydraulic pressure, tighten spring retainer (8) for the negative brake until it contacts closely with a M20 bolt of 40 to 50㎜ (1.57 to 1.97inches) length under its head.

(b) Removing cotter pins (20) and pin (19), take out cylinder (6).

(2) Assembly

To assemble, proceed in the reverse order of disassemble, taking care in the following respects.

(a) Cleanly wipe dust off from each part (to prevent misadjustment when adjusting dimensions).

(b) Before assembling, apply a thin coat of extreme pressure grease (Shell Albania EP-2 or equivalent) to each pin.

(c) Be careful not to allow oil and grease to adhere to the lining surface of brake band (1).

(d) Since the negative brake cylinder and the positive brake cylinder are of one body type, be careful for installing direction.

Install the cylinder so that the larger side of the piston diameter comes to the negative brake spring (9) side.

Besides, since the installing position of pointer (24) is different for the main winch side and the auxiliary winch side, carefully install it as shown in Fig. 2-8 on page 2-10.

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4.1.2 BRAKE CYLINDER

To disassemble and assemble the brake cylinder, referring to Fig. 4-1, proceed as follows :

(1) Disassembly

(a) Send compressed air through the air beeding port or oil supply port into the cylinder to push pistons (2 and 5) out from the cylinder.

(b) Remove packings (3 and 6) and scrapers (4 and 7) from the cylinder.

(2) Assembly

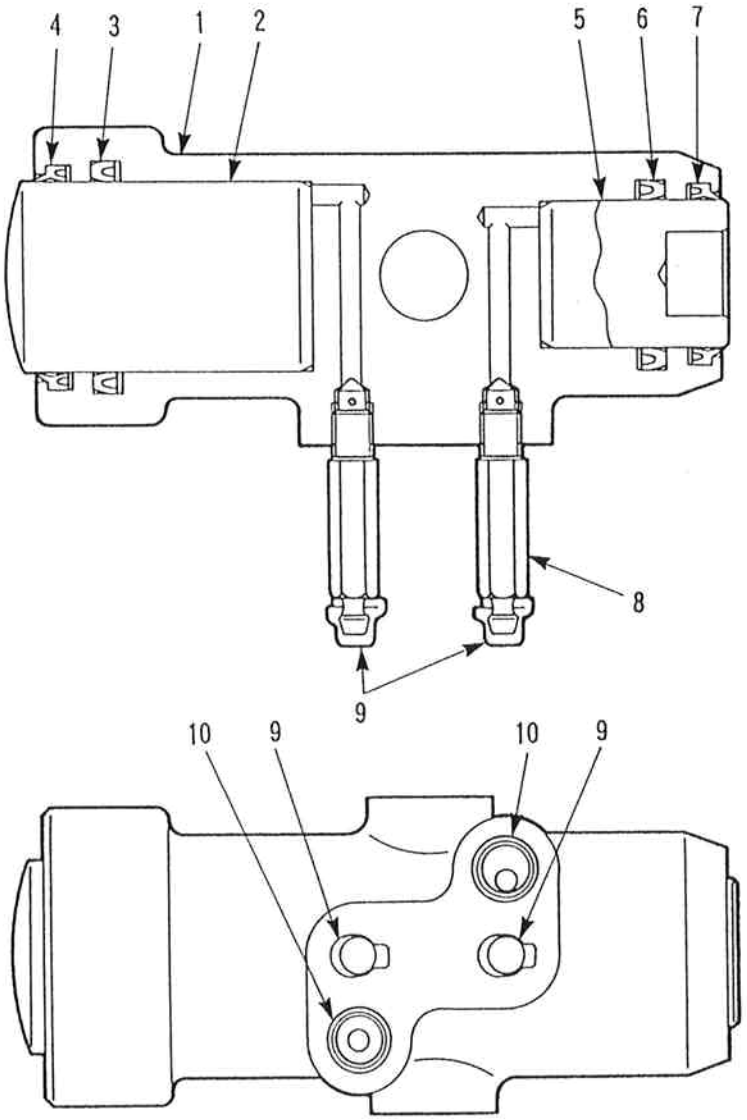
To assemble the brake cylinder, proceed in the reverse order of the disassembly, but take care for the following respects.

(a) Carefully wash each part with hydraulic oil for the positive brake. Do not assemble the parts as they are dry.

(b) If wear, scratches or rust is observed on the inner wall of cylinder (1) and pistons (2 and 5), replace the brake cylinder assembly with a new one.

(c) When installing packings (3 and 6) and scrapers (4 and 7), be careful for the direction of the lips. Apply a thin coat of grease to the sealing surface.

(d) Install the bleeder screws after the brake assembly has been installed to the winch.
Plug the bleeder screw holes with tape, etc. to prevent dust from entering.



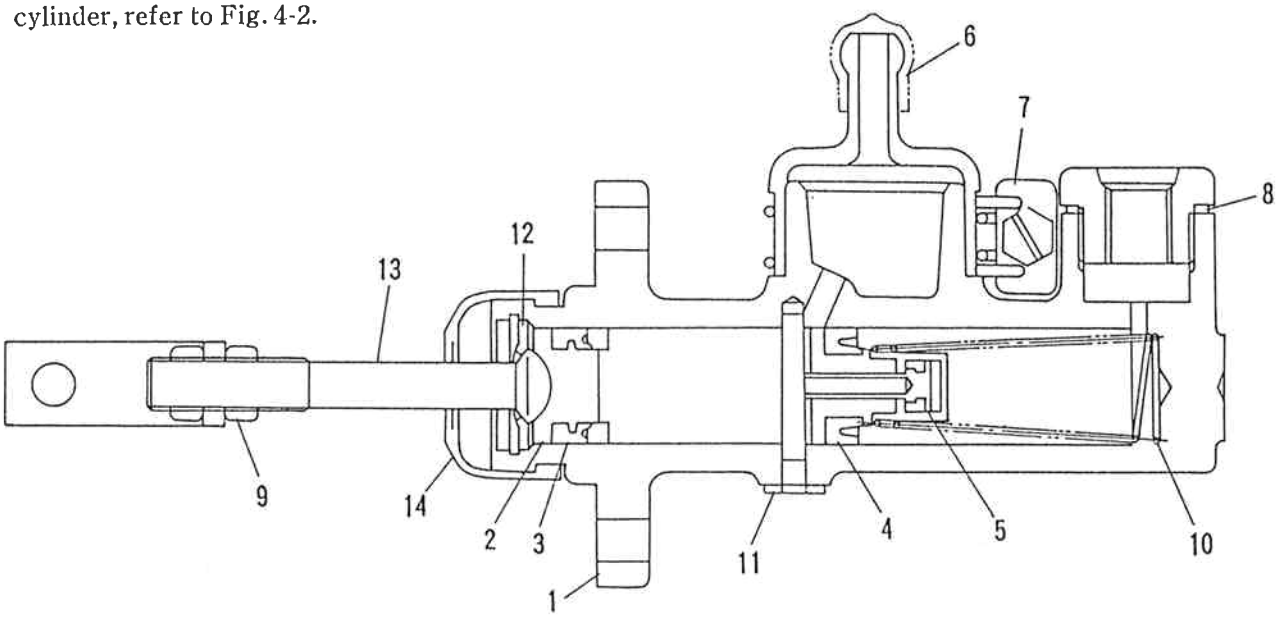
1. CYLINDER
2. PISTON(NEGATIVE BR.)
3. PACKING(NEGATIVE BR.)
4. SCRAPER(NEGATIVE BR.)
5. PISTON(POSITIVE BR.)
6. PACKING(POSITIVE BR.)
7. SCRAPER(POSITIVE BR.)
8. BLEEDER SCREW
9. CAP

Fig. 4-1

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4.1.3 MASTER CYLINDER

For disassembly and assembly of the master cylinder, refer to Fig. 4-2.



1. CYLINDER
2. PISTON
3. CUP
4. CUP
5. VALVE ASSEMBLY
6. CAP
7. CLAMP
8. GASKET
9. LOCK NUT
10. SPRING
11. STOP PIN
12. STOP PLATE
13. PUSH ROD
14. BOOT

Fig. 4-2 Construction of Master Cylinder

4.2 CLUTCH AND CLUTCH CYLINDER

4.2.1 CLUTCH (see Fig. 4-4)

For disassembly and assembly of the clutch, referring to Fig. 2-10 on page 2-13, proceed as follows :

(1) Disassembly

(a) Loosen four lock nuts (18), turn back four adjusting bolts (17), contract clutch band (1), and remove two return springs (16) for clutch band (1).

(b) Remove guide (10).

(c) Remove band (1).

(d) Removing cotter pin (13), remove nut (12), and remove bolt (11).

(e) Remove levers (4 and 5).

(f) Remove cylinder mounting capscrew (3).

(2) Assembly

To assemble, proceed in the reverse order of the disassembly, but take care for the following respects.

(a) Apply a thin coat of extreme pressure grease (Shell Albania EP-2 or equivalent) respectively to the spherical surface of push rod (15), the sliding section of trunnion (14), the outside circumference of bolt (11) and its grease reservoir, then install these parts.

(b) Be careful not to allow oil and grease to adhere to the surface of the lining.

(c) Coat Locktite #242 or equivalent to capscrew (3), then tighten it.

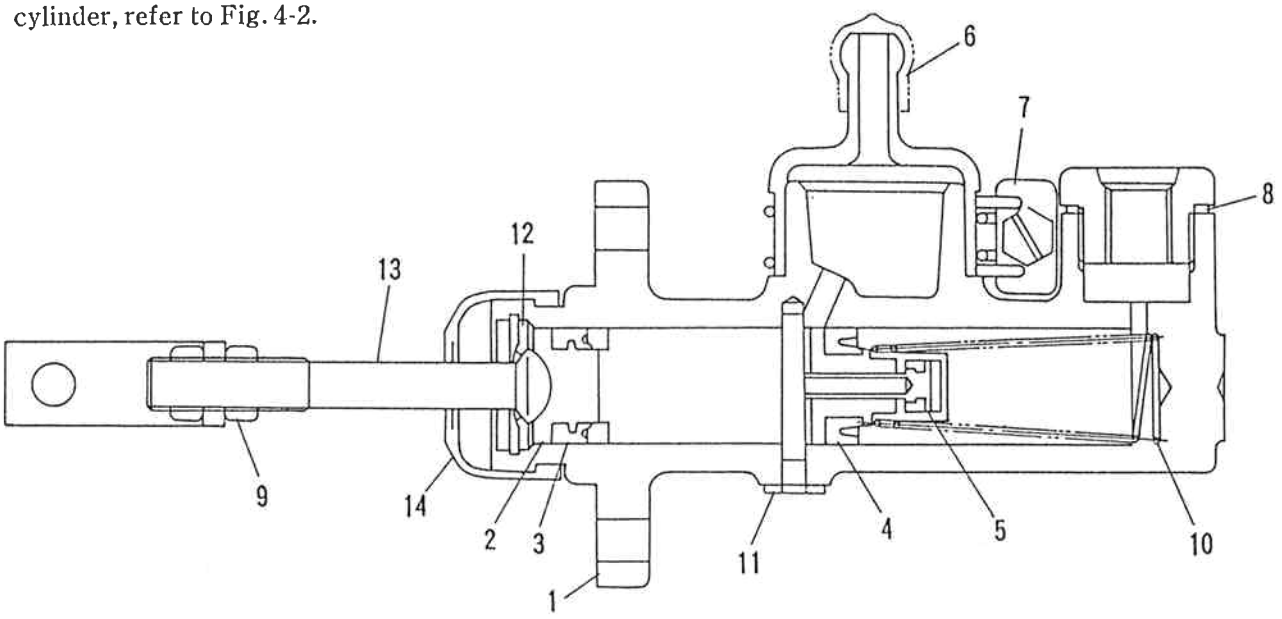
CAUTION

The levers are different for the main winch and the auxiliary winch. Carefully install them as shown in Fig. 2-10.

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4.1.3 MASTER CYLINDER

For disassembly and assembly of the master cylinder, refer to Fig. 4-2.



1. CYLINDER
2. PISTON
3. CUP
4. CUP
5. VALVE ASSEMBLY
6. CAP
7. CLAMP
8. GASKET
9. LOCK NUT
10. SPRING
11. STOP PIN
12. STOP PLATE
13. PUSH ROD
14. BOOT

Fig. 4-2 Construction of Master Cylinder

4.2 CLUTCH AND CLUTCH CYLINDER

4.2.1 CLUTCH (see Fig. 4-4)

For disassembly and assembly of the clutch, referring to Fig. 2-10 on page 2-13, proceed as follows :

(1) Disassembly

(a) Loosen four lock nuts (18), turn back four adjusting bolts (17), contract clutch band (1), and remove two return springs (16) for clutch band (1).

(b) Remove guide (10).

(c) Remove band (1).

(d) Removing cotter pin (13), remove nut (12), and remove bolt (11).

(e) Remove levers (4 and 5).

(f) Remove cylinder mounting capscrew (3).

(2) Assembly

To assemble, proceed in the reverse order of the disassembly, but take care for the following respects.

(a) Apply a thin coat of extreme pressure grease (Shell Albania EP-2 or equivalent) respectively to the spherical surface of push rod (15), the sliding section of trunnion (14), the outside circumference of bolt (11) and its grease reservoir, then install these parts.

(b) Be careful not to allow oil and grease to adhere to the surface of the lining.

(c) Coat Locktite #242 or equivalent to capscrew (3), then tighten it.

CAUTION

The levers are different for the main winch and the auxiliary winch. Carefully install them as shown in Fig. 2-10.

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4.2.2 CLUTCH CYLINDER

For disassembly and assembly of the clutch cylinder, referring to Fig. 4-3, proceed as follows :

(1) Disassembly

(a) Remove boot (5). Then piston (2) can be taken out of the cylinder.

(b) Remove cup (3) and back-up ring (4) from the piston.

(c) Remove bleeder screw (7). Be sure not to miss ball (5).

(2) Assembly

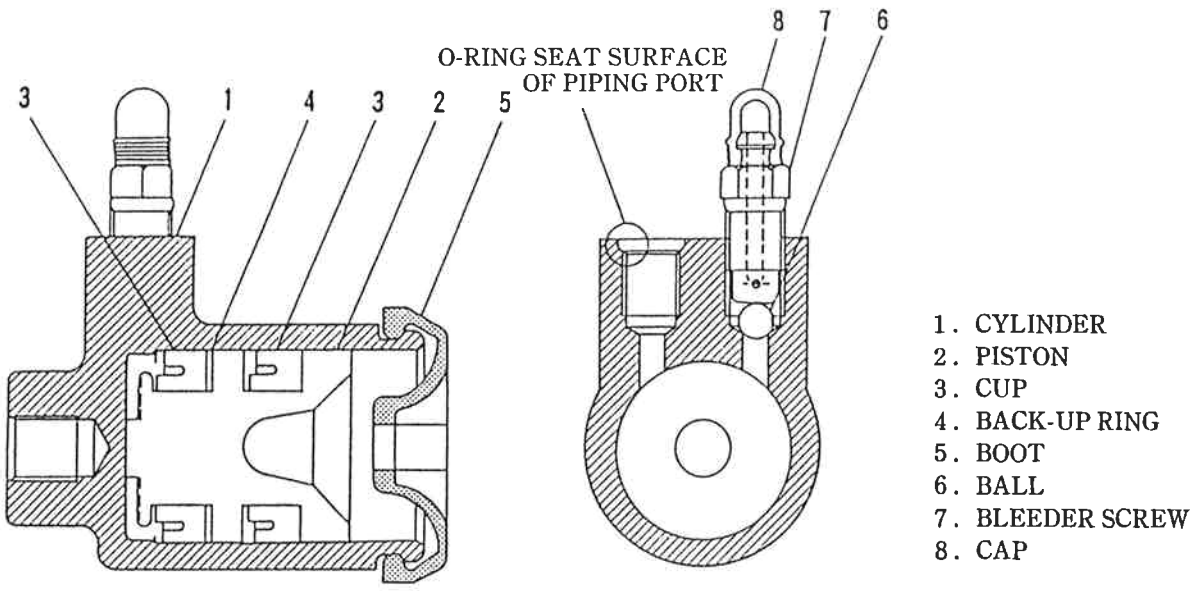
To assemble, proceed in the reverse order of disassembly, being careful to the followings :

(a) Wash each part with new hydraulic oil, and reassemble before they dry. Apply a thin coat of grease to the sealing surface.

(b) If wear, scratches or rust is observed on the inner wall of cylinder (1) or the surface of piston (2), replace the clutch assembly.

(c) In assembling cup (3) into piston (2), be sure the direction of the lip is correct.

(d) Be careful not to mistake the bleeder screw port and the piping port.
(The port which has the O-ring seat surface is the piping port.)



1. CYLINDER
2. PISTON
3. CUP
4. BACK-UP RING
5. BOOT
6. BALL
7. BLEEDER SCREW
8. CAP

Fig. 4-3 Clutch Cylinder

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4. 3 WINCH ASSEMBLY

(1) Disassembly of the main and auxiliary winches (see Fig. 4-4).

Since the main and auxiliary winches are of the same construction, describe disassembly of the main winch as follows :

(a) Place the winch assembly on the workbench.

NOTE

When removing the winch assembly, oil in the reduction unit was drained in 3. 4 Winch Assembly, step (e). If oil has not been drained, remove plug (43), and drain oil.

(b) Match mark motor (1), gear cases (15 and 4) and covers (28 and 29) so that they will be assembled in the same positions.

(c) Remove four capscrews (37), and remove the motor. Weight of the motor with the counterbalance valve attached is approx. 54kgs (119 lbs).

(d) Remove each six capscrews (38), and remove covers (28 and 29) from gear cases (15 and 4).

(e) Remove twenty-two capscrews (39), and separate outside gear case (15) from inside gear case (4). At this time, use the three puller bolt tapped holes (M12) to prevent damage to three pins (41) which are installed into the matching surfaces of gear cases (15 and 4). The tapped holes are protected with set screws (44). When using the holes, remove the set screws (see Fig. 4-5).

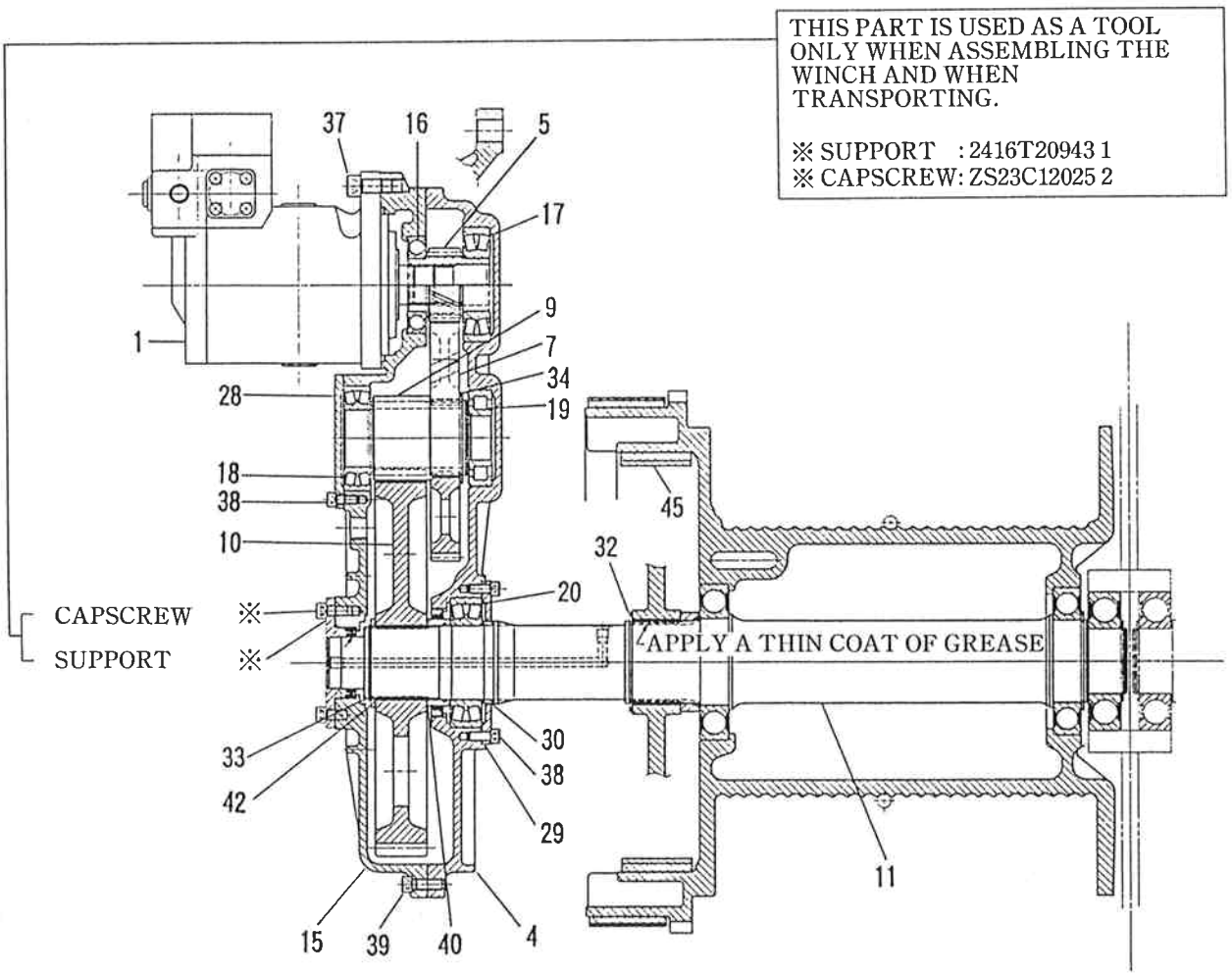


Fig. 4-4 Winch Assembly (Main Winch)

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(f) After match marking pins (41) and gear case (4), remove pins (41) from gear case (4).
(g) Using a bearing puller, remove bearing (18) from pinion (9).
(h) Remove snap ring (33), and remove spacer (42) and gear (10).
(i) Remove pinion (8), snap ring (34), gear (7), pinion (5) and bearing (16) as assembled.
(j) Remove bearings (17 and 19).
(k) Remove snap ring (34), and remove gear (7).
(l) Remove bearing (16) from pinion (5).
(m) Remove inside gear case (4) from the drumshaft assembly.
(n) Using a bearing puller, remove sleeve (40) and bearing (20) from drumshaft (11).
(o) Remove spacers (30).
(p) Remove snap ring (32), and remove the clutch assembly from drumshaft (11).
(q) Press out shaft (11) from drum (13) with the procedure shown in Fig. 4-6, and remove the drum.
(r) Remove spacer (31). Using a bearing puller, pull bearing (22) out from drum (13).
(s) Remove snap ring (36). Using a bearing puller, pull out bearing (23) from the other end of shaft (11). With the same procedure, remove snap ring (32), and pull out bearing (21) from shaft (11).

(2) Disassembly of third drum winch (optional) (see Fig. 4-7)
(a) Place the third drum winch assembly (optional) on the workbench.

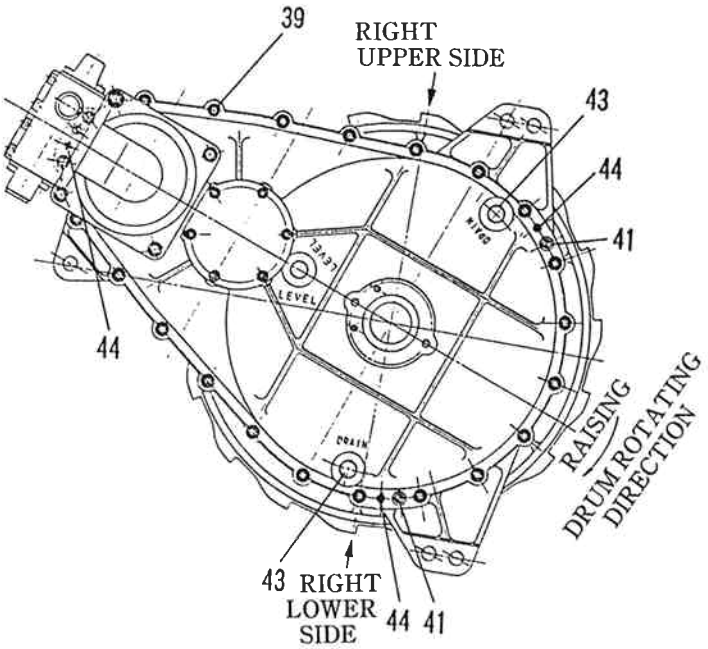


Fig. 4-5 Gear Case

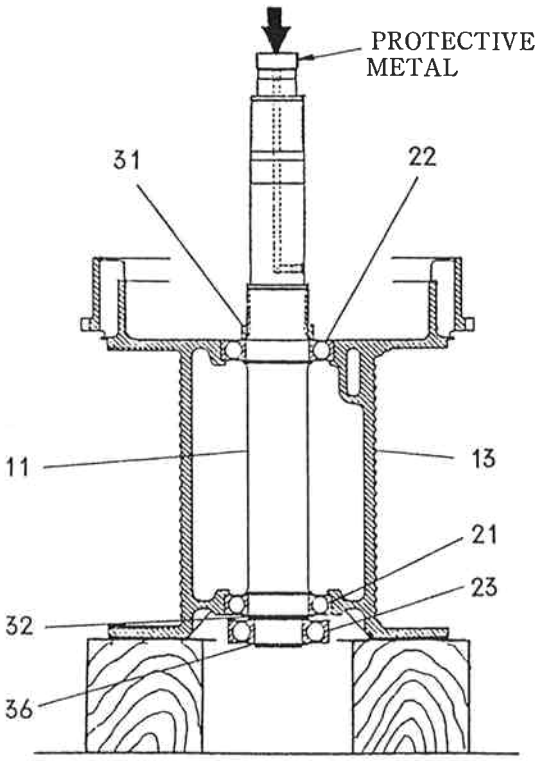


Fig. 4-6 Disassembly of Drum

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(b) Match mark motor (110), cover (108), internal gear (117) and housing (101) so that they will be assembled in the same positions.

(c) Remove four capscrews (111), and remove the motor. At this time, spacer (107) and sun gear (106) will be removed together with the motor shaft.
Weight of the motor with the counterbalance valve attached is approximately 44kgs (97 lbs).

(d) Remove twelve capscrews (115), and remove cover (108) and internal gear (117) from housing (101).

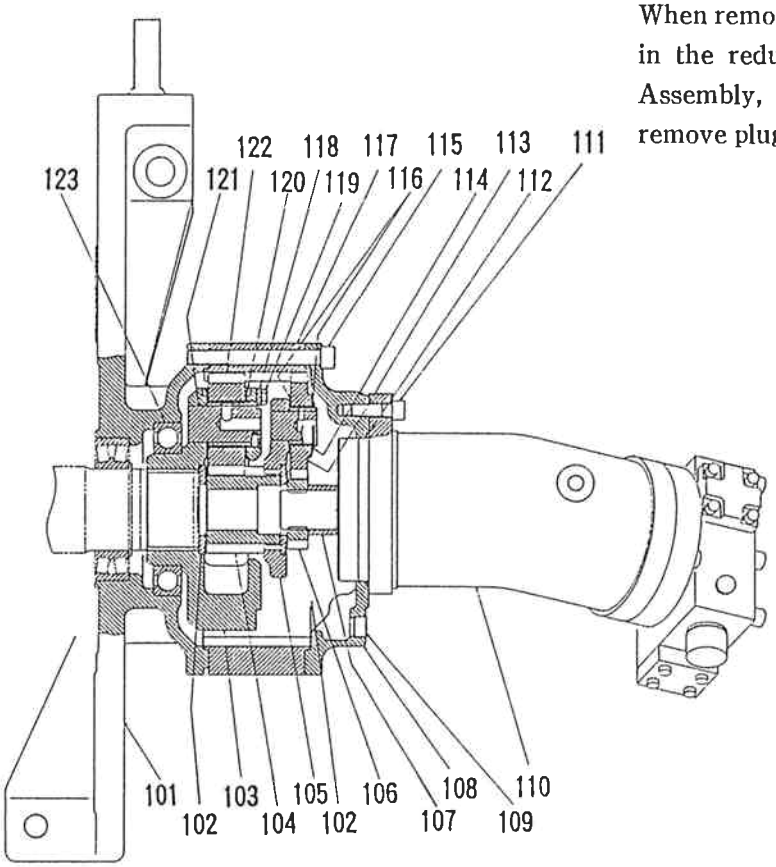
(e) Remove snap ring (114), and remove pinion (113) together with thrust washer (116). Then, pull out sun gear (104).

(f) Remove spider (105) together with thrust washer (102). Then, pull out sun gear (104).

(g) Remove capscrews (119) and lock plates (118), and pull out shaft (121). Extend thrust washer (120) flat. Move pinions (122) in spider (103), and remove the pinions in order.

NOTE

When removing the third drum winch assembly, oil in the reduction unit was drained in 3.4 Winch Assembly, step (e). If oil has not been drained, remove plug (109), and drain oil.



101. HOUSING
102. THRUST WASHER
103. SPIDER
104. SUN GEAR
105. SPIDER
106. SUN GEAR
107. SPACER
108. COVER
109. PLUG
110. MOTOR ASSEMBLY
111. CAP SCREW
112. O-RING
113. PINION
114. SNAP RING
115. CAPSCREW
116. THRUST WASHER
117. INTERNAL GEAR
118. LOCK PLATE
119. CAPSCREW
120. THRUST WASHER
121. SHAFT
122. PINION
123. BEARING

Fig. 4-7 Third Drum Winch Reduction Unit

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(h) Pull out spider (103) together with thrust washer (102) from the drumshaft. At this time, bearing (123) will be pulled out with the spider. Using a suitable bearing puller, remove the bearing from the spider.

(i) Insert a wooden block into between the drum and the workbench to hold the drum not to be moved.

(j) Remove capscrews (12), and remove housing (101) (see Fig. 4-8). Bearing (5) will be left on the shaft.

(k) Remove snap ring (6). While pushing cover (7) toward the drum side, using a bearing puller, remove bearing (5) from the shaft.

(i) Remove cover (7) and spacer (10) together with oil seal (9) and O-rings (8 and 11).

(m) Remove cover (18) (see Fig. 4-9).

(n) Using a bearing puller, remove the support. At that time, use a protective metal not to injure the swivel joint mounting face.

(o) Remove snap ring (17) and bearing (16).

(p) Remove snap ring (6), clutch assembly (14) and spacer (15).

(q) Push shaft (3) out from drum (2) with the procedure shown in Fig. 4-10, and remove the drum.

(r) Using a bearing puller, pull out bearings (4) from drum (2) and shaft (3) respectively.

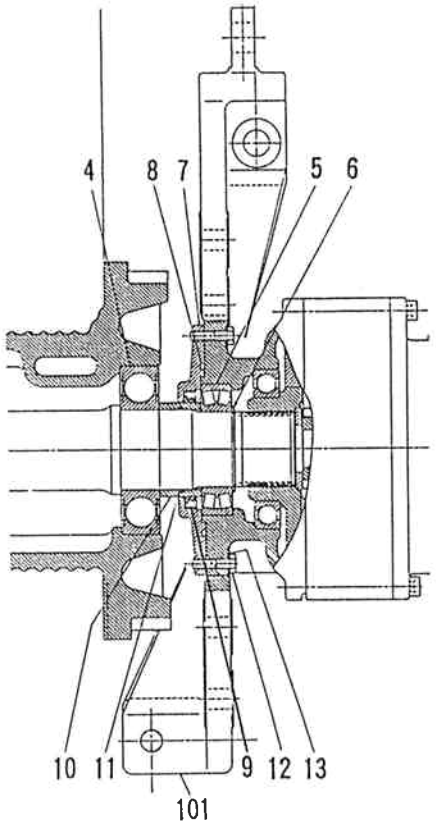


Fig. 4-8 Removal of Housing

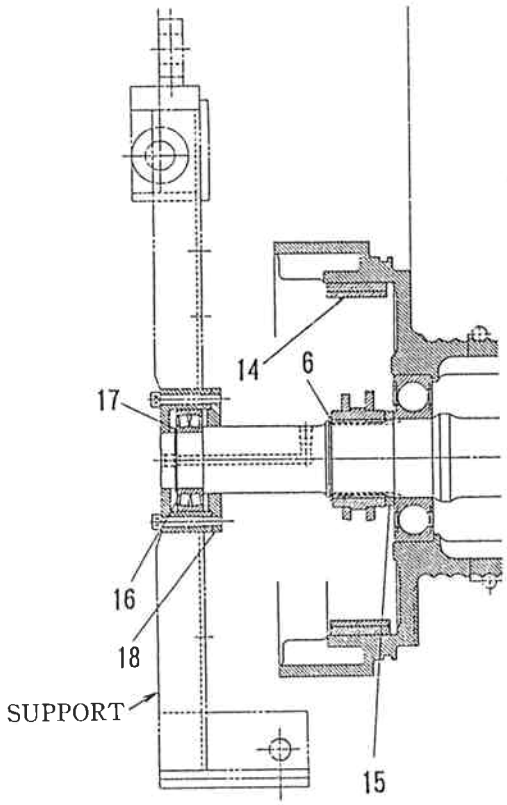


Fig. 4-9 Removal of Clutch

(3) Checking component parts

Clean and wash all component parts before they are checked. Remove all locktite with spatula, etc. If there are any burrs, dents, etc. caused during disassembly, remove them with care.

(a) Check gears for pitting, scratches on tooth face, cracks, chips. wear, etc. If they are found detective, replace them.

(b) If bearings do not rotate smoothly, have pitting and wear on the rolling surface, or are damaged in retainers, balls, rollers, etc., replace them.

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(c) Check splines for deformation. If they are found outside the allowable ranges, replace them. For allowable ranges, refer to Section 6. TEST PROCEDURES AND MAINTENANCE STANDARDS.

(d) Replace all oil seals and O-ring.

(e) If other parts are found defective because of cracks, bending, strain, scratches, etc., replace them.

(4) Assembly of the main and auxiliary winches

For assembly, reverse the steps taken for disassembly, and pay attention to the following respects :

(a) When assembling pinions (5 and 6) and gears (7 and 8), confirm their helix direction not to mistake (see Figs. 4-11 and 4-13).

(b) Take care not to allow grease or oil to adhere to the clutch lining surface and drum surface. When assembling the clutch assembly onto the drumshaft, be sure to arrange the relative positions between the connector mounting hole of the drumshaft and the clutch cylinder as shown in Fig. 4-12. Be careful not to mistake the directions of the main winch clutch and the auxiliary winch clutch.

Apply a thin coat of grease which contains molybdenum di-sulfide to the splines of the shaft on which the clutch is assembled.

(c) Take care not to allow grease and the like to adhere to the brake lining and the drum on the link side.

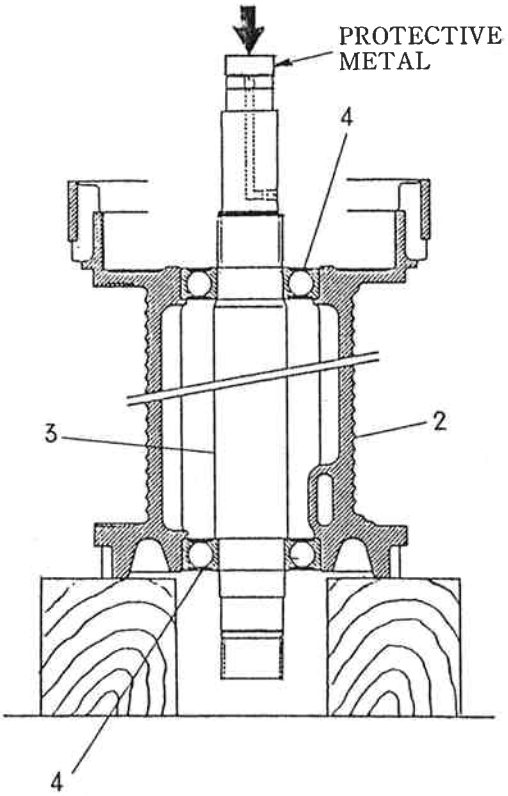


Fig. 4-10 Disassembly of Drum

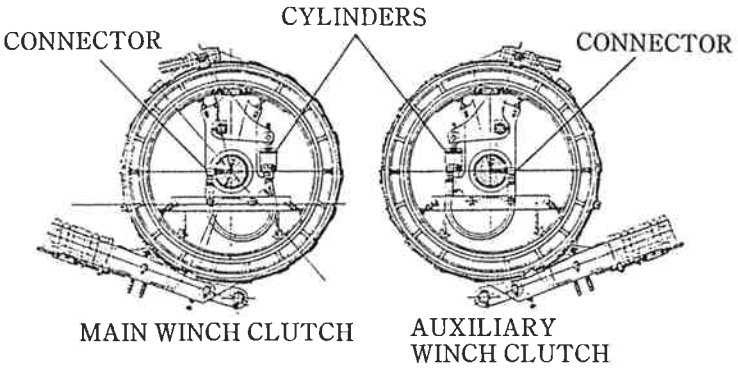


Fig. 4-12 Installation of Clutches

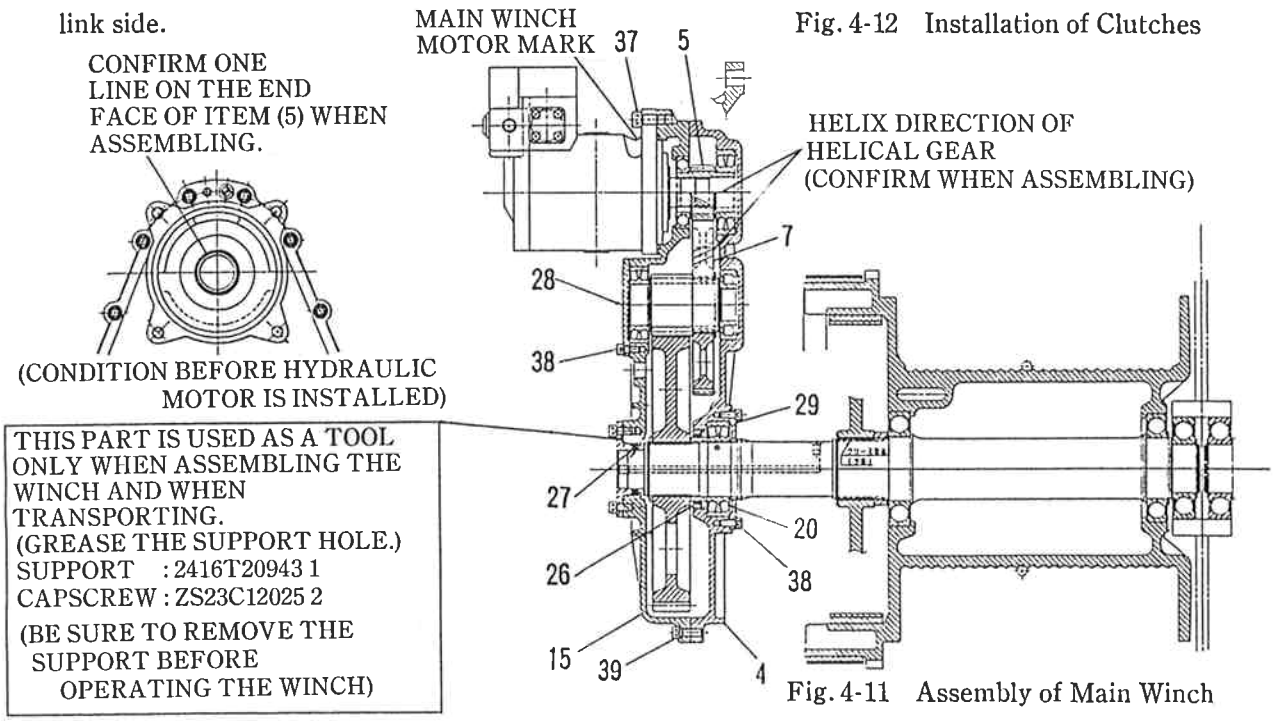
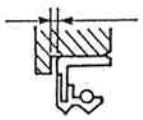


Fig. 4-11 Assembly of Main Winch

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(d) Be sure to install the each oil seal in the correct direction. Before installing them, be sure to apply Locktite #515 to the periphery of oil seal (26), apply grease to the periphery of oil seal (27) and fill about 1 / 3 grease of the empty space between the sealing lips and the dust lips of the oil seals.
When inserting the oil seals into the gear case, do not insert them to the bottom, but provide approximately 0.5mm (0.02in) of clearance as shown.



When assembling, apply a thin coat of grease to the oil seal lip contacting surface of the shaft.

(e) Before installing the each O-ring, apply a thin coat of grease to them.

(f) Coat the each capscrew with Locktite #242 or equivalent, then tighten it with a torque shown below.
Tightening torque :
Item (37)···25.5 to 31.5kg · m (185 to 228ft-lbs)
Item (38)···6.0 to 7.4kg · m (43.4 to 53.5ft-lbs)
Item (39)···10.5 to 12.9kg · m (76.0 to 93.3ft-lbs)

(g) Coat Locktite #515 or equivalent to the respective mating surface between covers (28 and 29) and gear cases (15 and 4), and the mating surface between gear case (15) and gear case (4), then assemble them. Besides, using benzine, etc. , degrease thoroughly the surface to be applied with Locktite.

(h) Fill about 1/2 grease (heat proof type multipurpose grease No. 2) of the empty space of bearings (20) shown in Figs. 4-11 and 4-13.

(i) After assembling, supply gear oil (Spirax EP #90 or equivalent) to the gear case until the oil level reaches the opening of the level plug.

(j) Cover the end hole of the drumshaft and the motor mounting bore on the gear case, before mounting the motor, to prevent dust from entering them.

NOTE

If a support is used to the hole of the drumshaft end as a tool only when assembling the winch and when transporting, be sure to remove the support before operating the winch. Do not operate the winch as the support is attached.

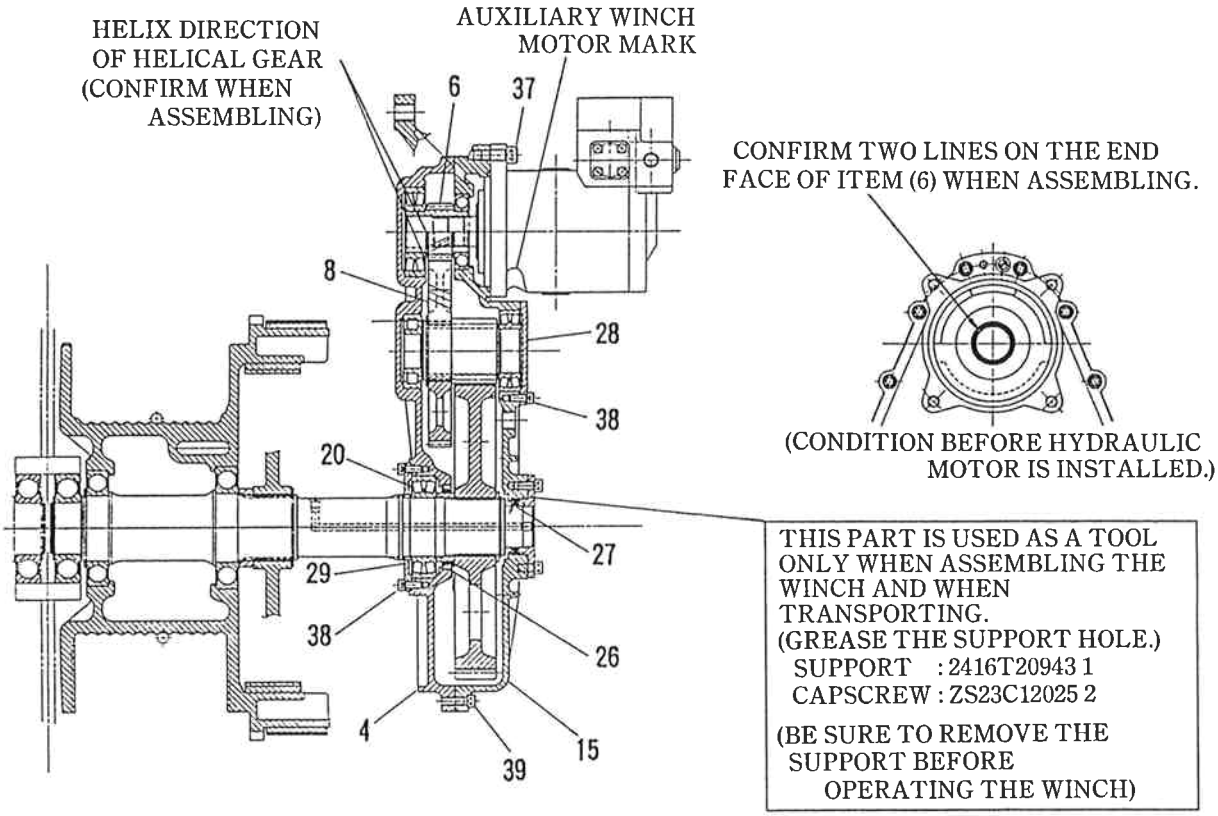


Fig. 4-13 Auxiliary Winch Assembly

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(5) Assembly of the Third Drum Winch (Optional)
For assembly, reverse the steps taken for disassembly, and pay attention to the following respects :

(a) Be careful for the direction of each oil seal when installing. Apply grease to the lip brake, and apply Locktite #515 to the periphery of oil seal (9) of the reduction unit cover, then install them.
When inserting the oil seal into cover (7), do not insert it to the bottom, but provide approximately 0.2 to 0.5㎜ (0.008 to 0.02in) of clearance.

(b) Fill about 1/3 grease (heatproof type multipurpose grease No. 2) of the empty spaces of bearings (5 and 16).

(c) Apply grease containing molybdenum disulfide to the splines of spider (103) of the reduction unit and shaft (3) on which the clutch is assembled.

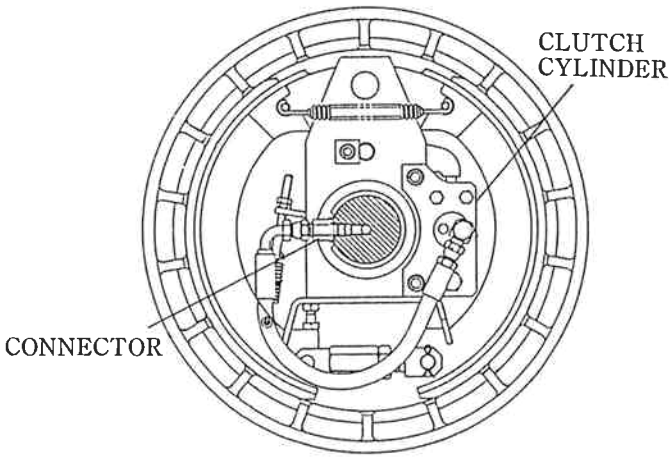
(d) When assembling the clutch assembly onto the drumshaft, be sure to arrange the relative positions between the connector mounting hole of the drumshaft and the clutch cylinder as shown in Section A-A.

(e) Take care not to allow grease or oil to adhere to the clutch lining surface and the drum surface.

(f) Fill about 1/3 grease of the empty space between the sealing lip and the dust lip of oil seal (9).
When assembling, apply a thin coat of grease to the outside surface of the shaft where the oil seal contacts.

(g) Coat the each capscrew with Locktite #242 or equivalent, then tighten it with a torque shown below.
Tightening torque :
Item (12) ··· 6.0 to 7.4kg · m (43.4 to 53.5ft-lbs)
Item (111) ··· 10.5 to 12.9kg · m(76.0 to 93.3ft-lbs)
Item (115) ··· 16.5 to 20.5kg · m(119 to 148ft-lbs)
Item (119) ··· 3.05 to 3.75kg · m(22.1 to 27.1ft-lbs)

(h) Apply a thin coat of grease to the each O-ring, then install it.



SECTION "A-A"

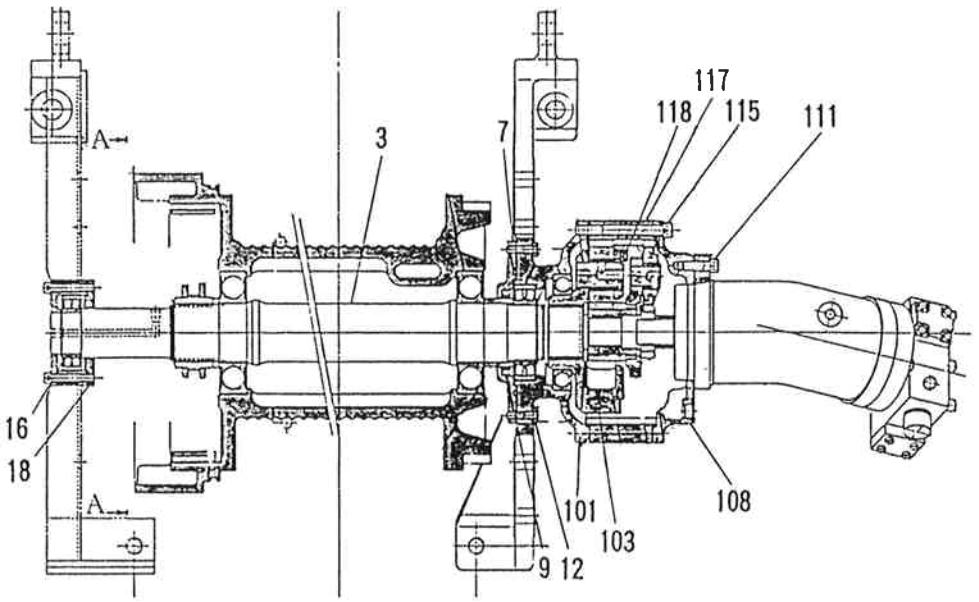


Fig. 4-14 Third Drum Winch Assembly

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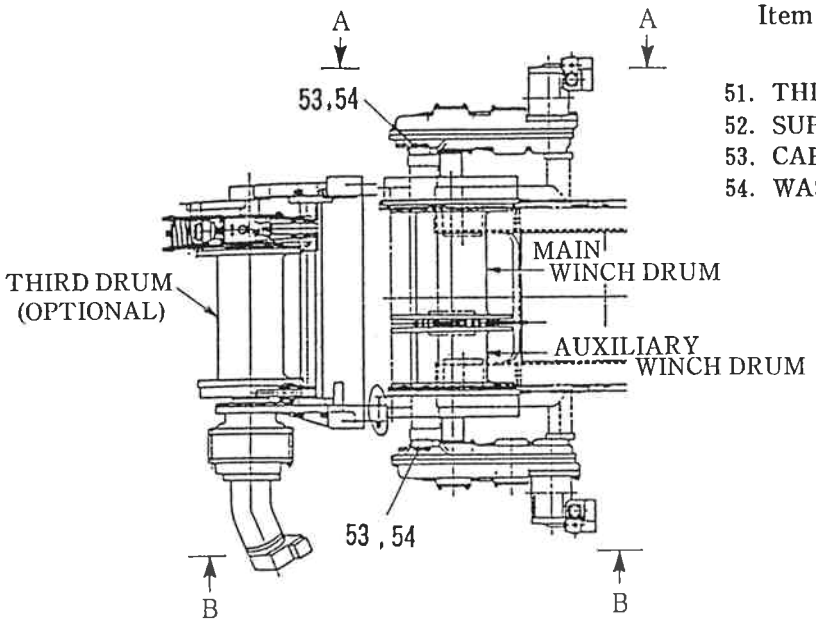
(i) Coat Locktite #515 to the mating surface between cover (18) and the mating support and the mating surfaces between the both surfaces of internal gear (117) and housing (101) and cover (108). At this time, Using benzine, etc., degrease thoroughly the surfaces to be applied with Locktite.

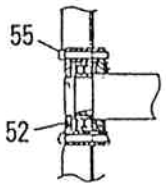
(j) After assembling, supply gear oil (Spirax EP #90 or equivalent) to the reduction unit until the oil level reaches to the opening of the level plug.

(6) Installation of the winch assemblies (Fig. 4-15)
For installation, reverse the steps taken for removal, and pay attention to the following respects :

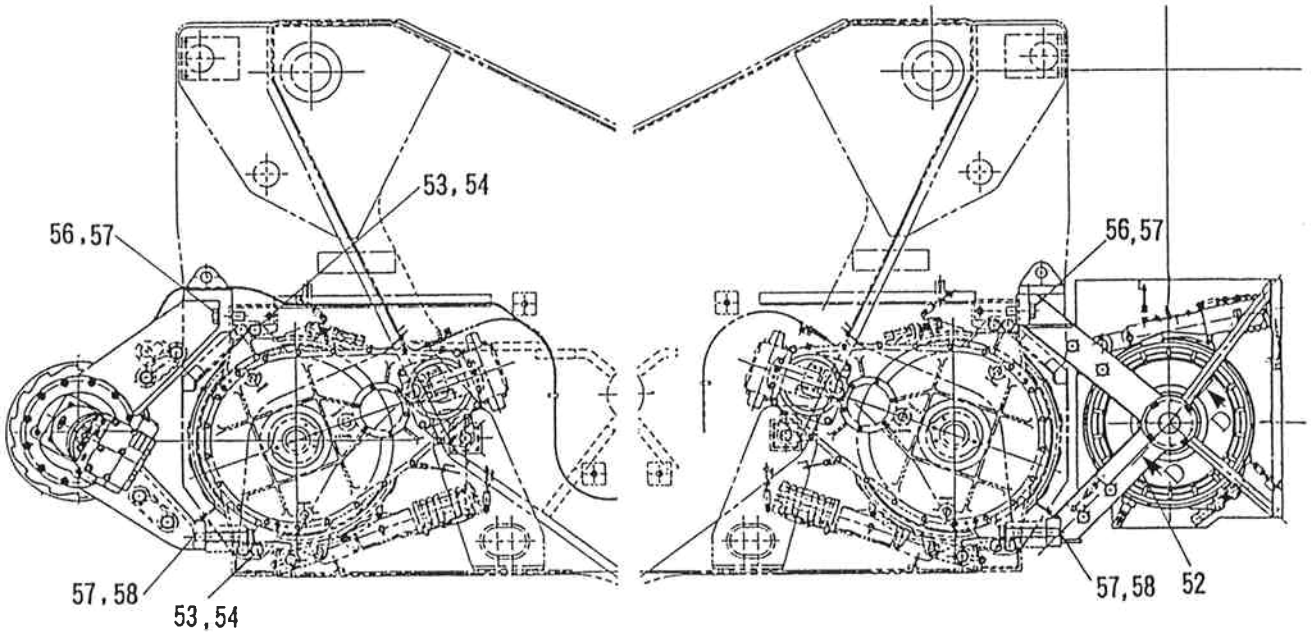
(a) Coat the each capscrew with Locktite #242 or equivalent, then tighten with a torque shown below.
Tightening torque :
Item (53)···51 to 63kg · m (369 to 456ft-lbs)
Item (55)···3.6 to 4.4kg · m (26.0 to 31.8ft-lbs)
Item (56)···48 to 58kg · m (347 to 420ft-lbs)

51. THIRD FRAME
52. SUPPORT
53. CAPSCREW
54. WASHER
55. CAPSCREW
56. CAPSCREW
57. WASHER
58. CAPSCREW





SECTION "D-D"



VIEW FROM "B-B"

VIEW FROM "A-A"

Fig. 4-15 Installation of Winch Assemblies

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5. ADJUSTMENT AND AIR BLEEDING

5.1 POSITIVE AND NEGATIVE BRAKES

If the drum brake lining is worn or if air is trapped in the piping, braking force will lower. Adjust and bleed air from the drum brakes for the main and auxiliary winches separately, as follows :

(1) Adjustment of Brake

If the brake lining is worn and the pointer on the negative brake adjusting spring is in the red zone, the braking force is below specification.

In that case, adjust the pointer with the adjusting nut © on the top of the brake band so that the pointer comes to the black zone as follows :

(a) Engage the drum lock.

(b) Move the crane to a level and firm ground. Set the clutch lever in FREE, release the drum brake pedal slowly, and check that the drum lock functions surely.

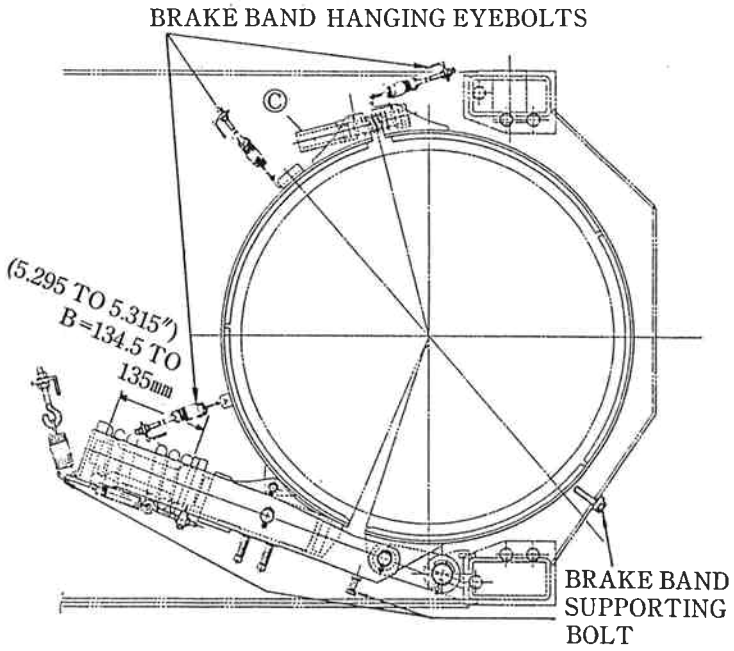
(c) Place the clutch lever in the ON position, and confirm that the set length of the negative brake adjusting spring (B) is 134.5 to 135mm (5.295 to 5.315inches). If dimension (B) is out of 134.5 to 135mm, place the clutch lever in the FREE position, and adjust brake band upper adjusting nut ©. Repeat this operation until the spring set length becomes 134.5 to 135mm.

(d) When spring set length (B) is 134.5 to 135mm, confirm that the pointer on the spring is in the black zone of the wappen (Fig. 5-4).

(e) Place the clutch lever in the FREE position, adjust the brake band hanging eyebolts, brake band supporting bolt and brake assembly hanging bolt so that the clearance between the brake drum and the lining is uniformly 0.6 to 1.0mm (0.24 to 0.04inch) all around.

(f) Place the winch clutch lever in the ON position, raise the hook slightly by operating the winch lever, and release the drum lock.

(g) Place the winch clutch lever in the FREE position, slowly release the brake pedal, and confirm that the hook free falls with no load.



MAIN WINCH BRAKE : AS SHOWN IN THIS FIG.
AUXILIARY WINCH BRAKE : OPPOSITE TO THIS FIG.

Fig. 5-1 Main and Auxiliary Winch Drum Brake Adjustment

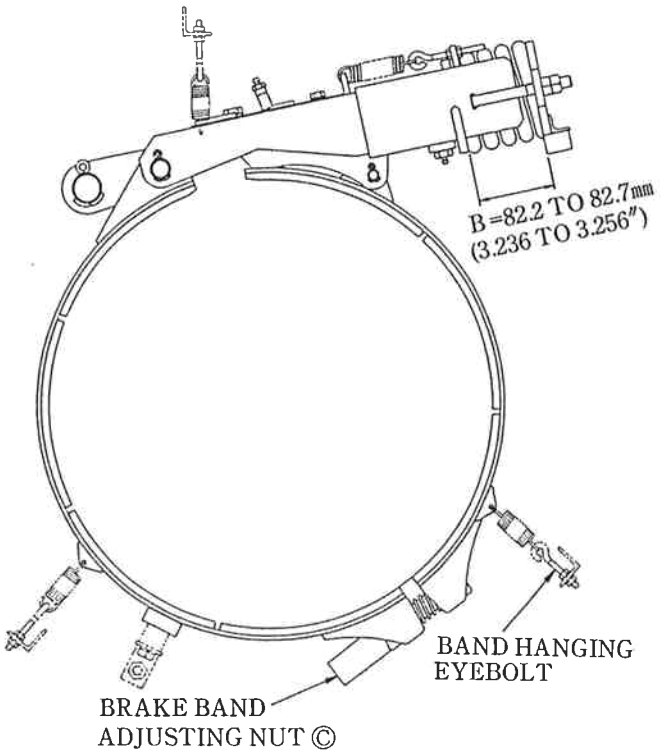


Fig. 5-2 Third Drum Brake Adjustment

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NOTE

If the hook does not free fall with no load, readjust the clearance between the brake drum and lining with the eyebolts and supporting bolt.

(h) Place the clutch lever in the ON position, lift a load, depress the brake pedal, then place the clutch lever in the FREE position.
At this time, confirm that the allowable maximum load per single wire rope can be held. (Confirmation of the positive brake performance.)

(i) Place the clutch lever in the ON position, lift a load as the same as step (h), shut down the engine, and leave as it is for a while.
At this time, confirm that the allowable maximum load per single wire rope can be held. (Confirmation of the negative brake performance.)

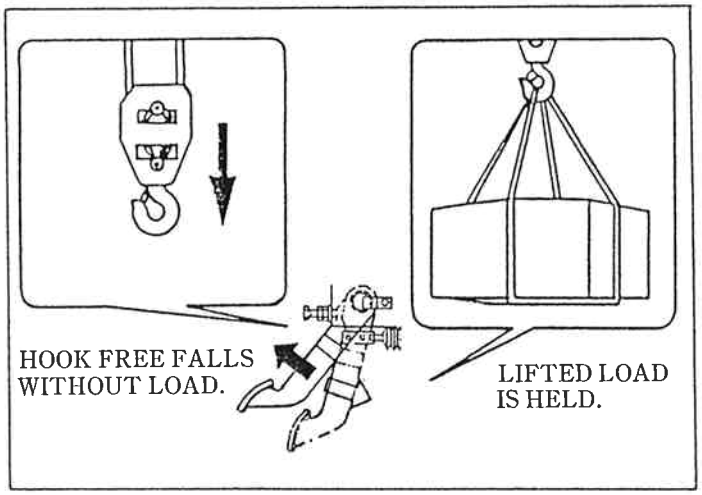


Fig. 5-3 Correct Adjustment of Brake

NOTE

If the lifted load cannot be held, it is considered that the contact of the brake drum and the lining is improper. Allow a light load to slip with the brake pedal to improve the contact.

NOTE

For adjustment of the third drum brake, adjust the brake band adjusting nut, band hanging eyebolt and adjusting bolt with the same procedure as adjustment of the main and auxiliary winch drum brakes (see Fig. 5-2).

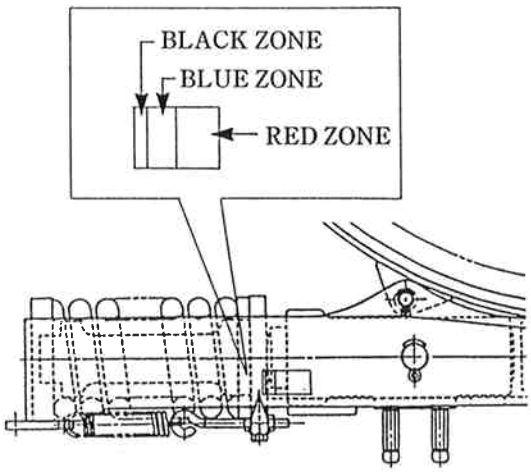


Fig. 5-4 Winch Brake Adjustment

NOTE

After readjusting, confirm again that the hook can be free fallen.

(2) Bleeding Air from Positive Brake Cylinder.

(a) Engage the winch drum lock, attach a vinyl hose to the positive brake wheel cylinder bleed screw and submerge the other end of the hose into a container holding a small amount of brake fluid (see Fig. 5-6).

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(b) Push the brake pedal several times and with the pedal depressed, loosen the bleed screw slowly.
Brake fluid containing air bubbles will come out of the vinyl hose.

(c) Tighten the bleed screw once, depress the brake pedal again, and loosen the bleed screw. Repeat these steps until no air bubbles come out.

(d) After air is removed completely, tighten the bleed screw and detach the vinyl hose.

CAUTION

Be careful not to allow hydraulic oil for the positive brake to get on the clutch lining and brake lining.

(3) Bleeding Air from Negative Brake Cylinder (see Fig. 5-6).

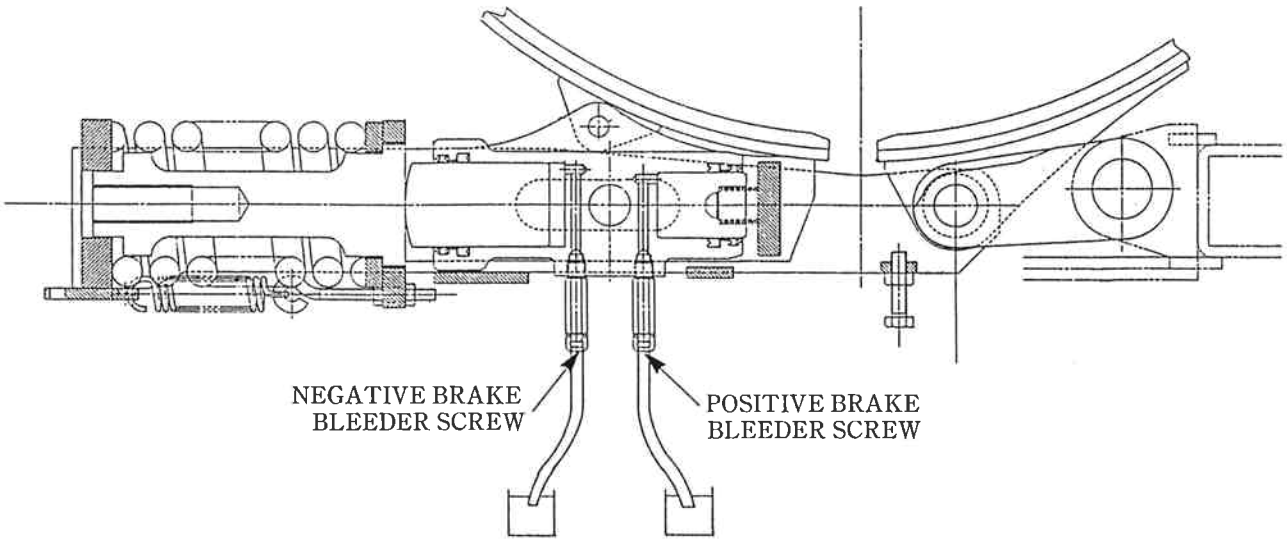
(a) Engage the drum lock. Attach a vinyl hose to the negative brake wheel cylinder bleed screw and submerge the other end of the hose into a container holding a small amount of brake fluid.

(b) Start the engine, turn the clutch lever FREE, and loosen the bleed screw. Brake fluid containing air bubbles will come out of the vinyl hose. When no air bubbles come out, tighten the bleed screw and detach the vinyl hose.

CAUTION

Be careful not to allow hydraulic oil for the brake to get on the clutch lining and brake lining.

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MAIN WINCH BRAKE : AS SHOWN IN THIS FIGURE.
AUXILIARY WINCH BRAKE : OPPOSITE TO THIS FIGURE.

Fig. 5-6 Bleeding the Negative and Positive Brake Cylinders of the Main and Auxiliary Winches

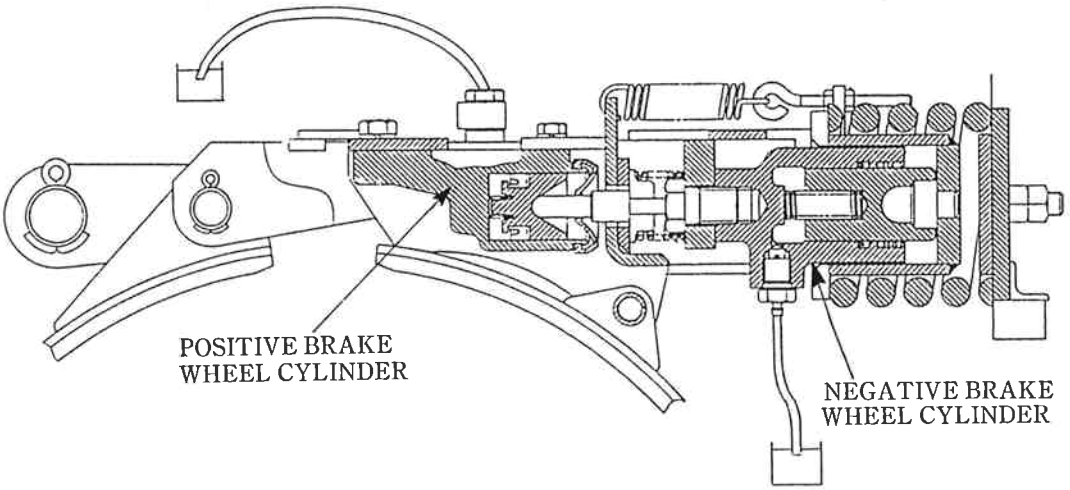


Fig. 5-7 Air Bleeding of Third Drum Brake Cylinder

5.2 MASTER CYLINDER

(1) Adjusting master cylinder

To adjust the master cylinder, follow these steps for the main winch, auxiliary winch and third drum separately. Adjust the adjusting bolt so that the distance from the inside surface of the front panel, on which the master cylinder flange is mounted, to the center of the yoke pin is 97.5㎜ (3.84in), and lock the adjusting bolt.

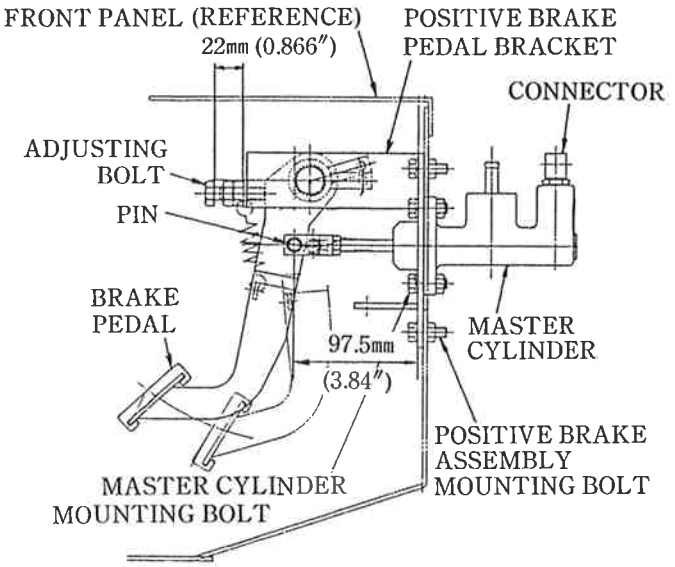
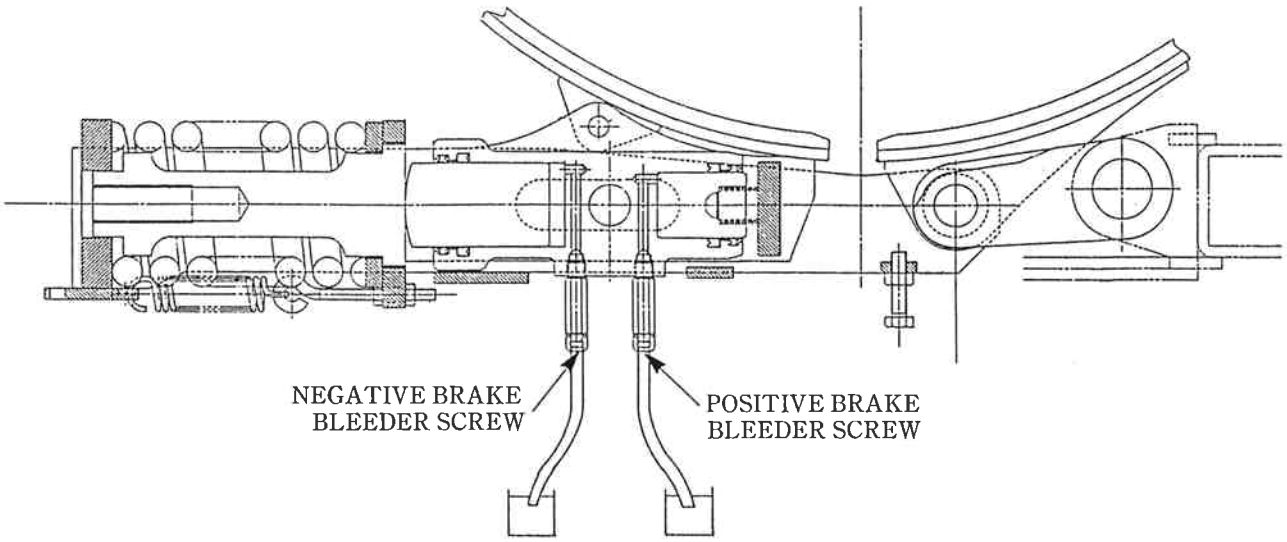


Fig. 5-8 Adjusting the Master Cylinder

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MAIN WINCH BRAKE : AS SHOWN IN THIS FIGURE.
AUXILIARY WINCH BRAKE : OPPOSITE TO THIS FIGURE.

Fig. 5-6 Bleeding the Negative and Positive Brake Cylinders of the Main and Auxiliary Winches

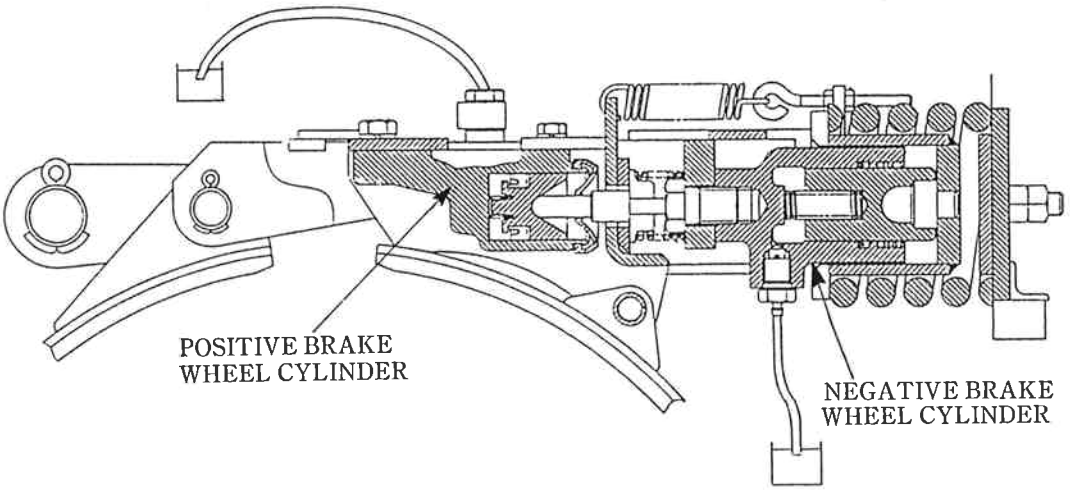


Fig. 5-7 Air Bleeding of Third Drum Brake Cylinder

5.2 MASTER CYLINDER

(1) Adjusting master cylinder

To adjust the master cylinder, follow these steps for the main winch, auxiliary winch and third drum separately. Adjust the adjusting bolt so that the distance from the inside surface of the front panel, on which the master cylinder flange is mounted, to the center of the yoke pin is 97.5㎜ (3.84in), and lock the adjusting bolt.

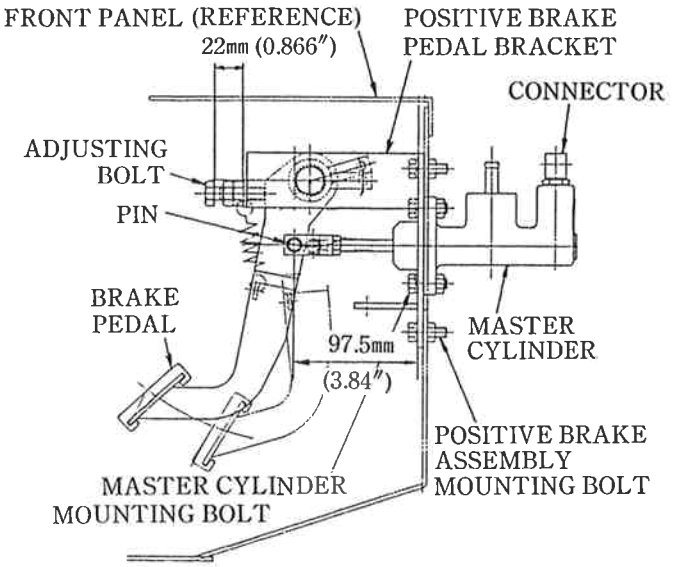


Fig. 5-8 Adjusting the Master Cylinder

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5.3 MAIN AND AUXILIARY (INCL. THIRD) WINCH BRAKE

(1) Adjustment of Main and Auxiliary Winch Brakes

(a) Set dimension (B) to 134.5 to 135mm (5.295 to 5.315inches) (adjusting with brake band upper adjusting nut Ⓒ in Fig. 5-1).

(b) Set dimension (A) to 80 to 80.5mm (3.15 to 3.17 inches) 〔adjusting with item (12)〕.

CAUTION

1. Be careful not to allow oil and grease to adhere to the lining surface of brake band (1).
2. Apply a thin coat of extreme pressure grease (Shell Albania EP-2 or equivalent) to pins (15 and 19) when asembling.

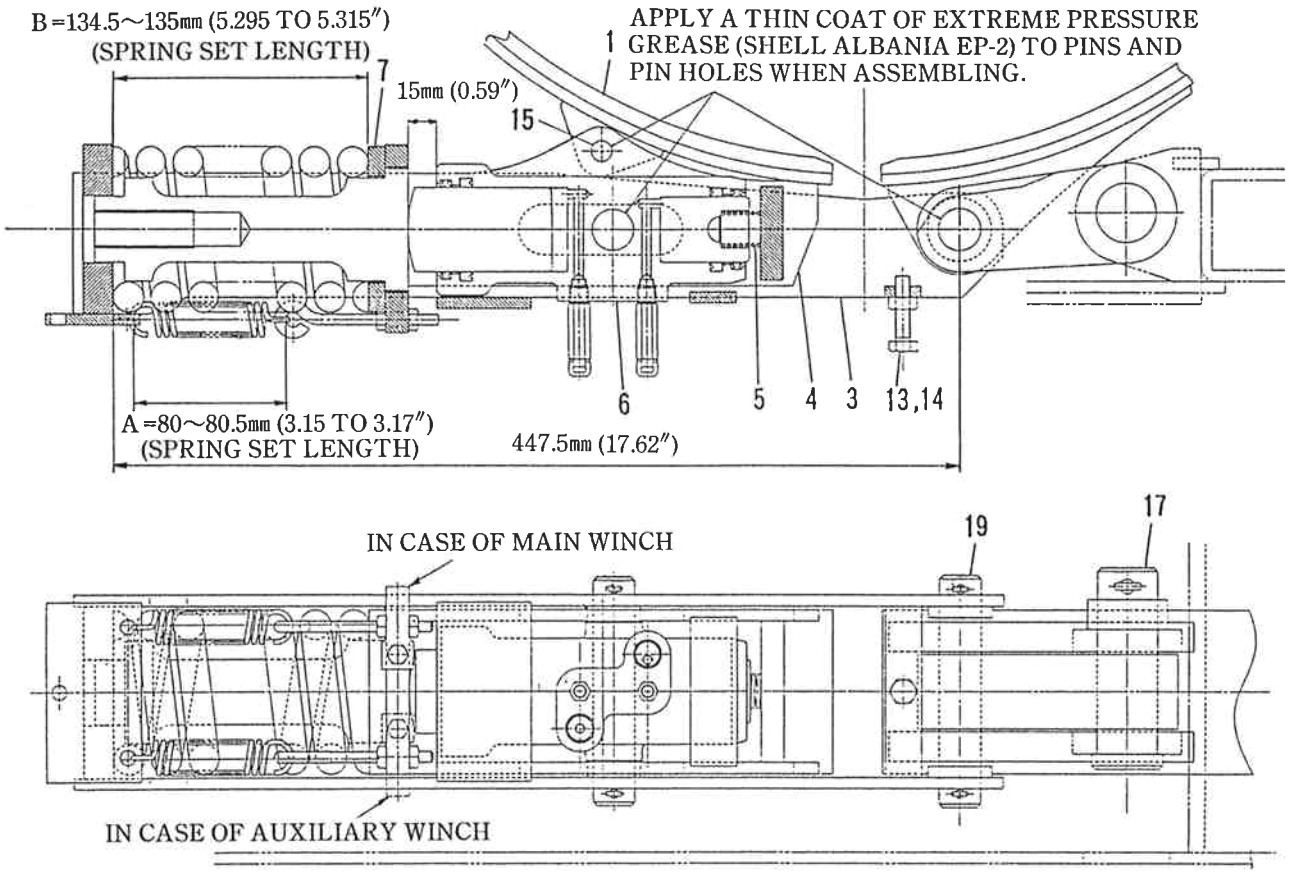


Fig. 5-9 Main and Auxiliary Brake Assembly

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(2) Adjustment of Third Drum Brake

(a) Set dimension (A) to 408.0mm (16.06in) by adjusting item (16).

(b) Set dimension (E) to 30mm (1.181in) by adjusting item (30).

(c) With the negative brake engaged, set dimension (C) to 35mm (1.378in). Adjust dimensions (C) with the brake band adjusting nut (see Fig. 5-2).

(d) With the negative brake released, adjust dimension (C) to 29mm (1.142in) and stroke (F) to 6mm (0.236in).

(e) After adjusting step (d), set dimension (B) to 82.7mm (3.256in) by adjusting item (16).

CAUTION

1. Be careful not to allow oil and grease to adhere to the lining surface of brake band (1).
2. Apply a thin coat of extreme pressure grease (Shell Albania EP-2 or equivalent) to pins (8, 17 and 19) when assembling.

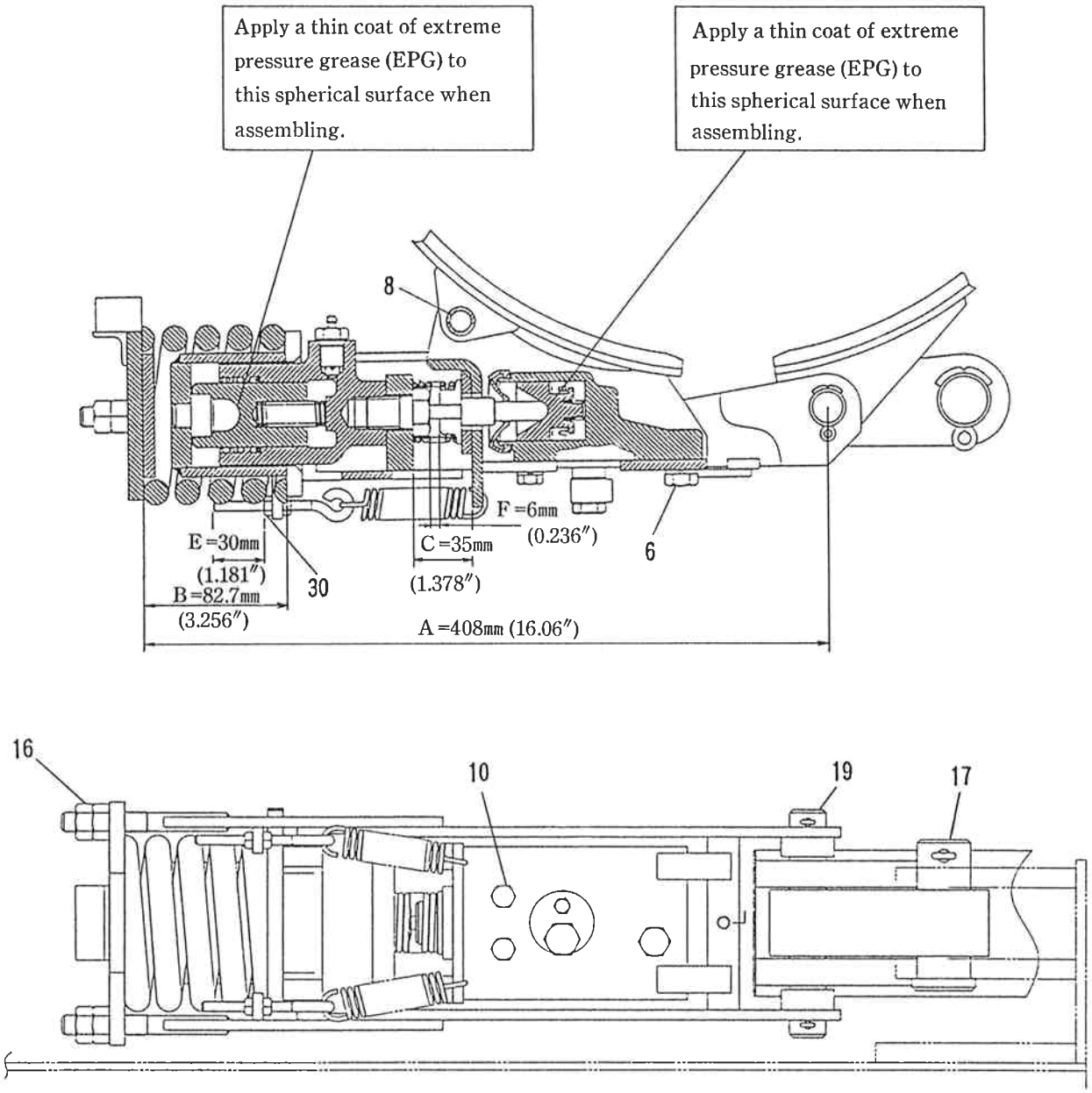


Fig. 5-10 Third Drum Brake Adjustment

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5.4 MAIN AND AUXILIARY (INCL. THIRD) WINCH CLUTCHES

(1) Adjustment of Main and Auxiliary Winch Clutches

If the clearance between the clutch lining and the clutch drum is not proper, or if air exists in the clutch cylinder, the winch operation might be impossible. To adjust the winch clutch, proceed as follows :

(a) Engage the winch drum lock.

(b) Place the winch clutch lever in the FREE position.

(c) Loosen lock nuts (1), loosen adjusting bolts (2, 3 and 4) so that the clutch band does not contact the head of the adjusting bolts.

(d) Adjust dead end adjusting bolt (3) in the dead end of the clutch band so that the clearance between the drum and the clutch lining becomes approximately 0.6㎜ (0.024″).

In the same way, adjust adjusting bolt (4) in the live end so that the clearance becomes approximately 1.0㎜ (0.04″).

(e) Turn push rod (5) so that wheel cylinder (6) is retracted completely when the clutch is released.

NOTE

The piston in the wheel cylinder must return to the stroke end position in the cylinder whenever the clutch is disengaged.

(f) Adjust two adjusting bolts (2) so that the clutch lining face does not contact the drum when the clutch is released. (Adjust the clearance to be approximately 0.6㎜.)

NOTE

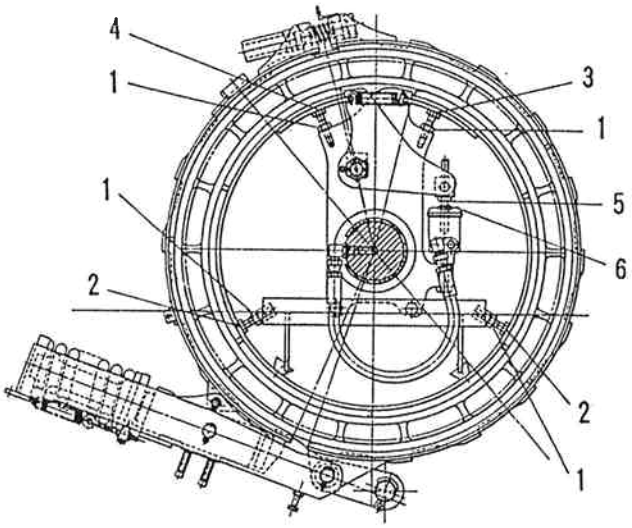
To raise the performance of the clutch, repeat the procedures of steps (d) to (f).

(g) Pull the main winch clutch lever toward the operator to engage the clutch and check for performance.

After confirming that the performance is proper, tighten all lock nuts (1) firmly.

(h) Release the drum lock.

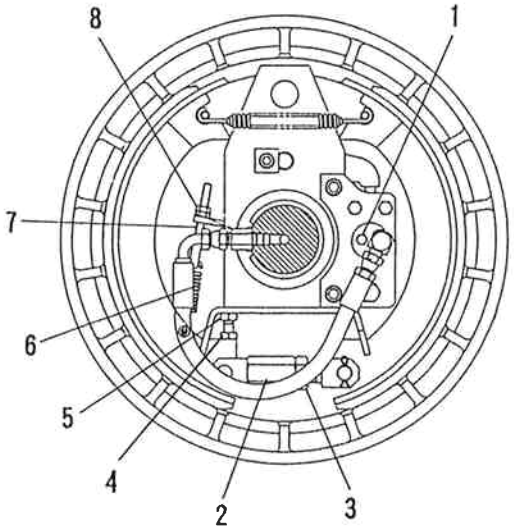
(i) Upon completion of adjustment, under the conditions of free fall, make sure that the hook can be lowered freely.



1. LOCK NUT
2. ADJUSTING BOLT
3. ADJUSTING BOLT (DEAD END SIDE)
4. ADJUSTING BOLT (LIVE END SIDE)
5. PUSH ROD
6. WHEEL CYLINDER

MAIN WINCH CLUTCH : AS SHOWN IN THIS FIG.
AUXILIARY WINCH CLUTCH : OPPOSITE TO THIS FIG.

Fig. 5-11 Main and Auxiliary Winch Clutch Adjustment



1. BLEEDER SCREW
2. ADJUSTING NUT
3. LOCK NUT
4. ADJUSTING BOLT
5. NUT
6. SPRING
7. EYEBOLT
8. LOCK NUT

Fig. 5-12 Third Drum Clutch Adjustment

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Next, lift a weight which is sufficiently heavy (allowable maximum load per one rope), and confirm that the clutch is engaged surely without any slippage.

NOTE

It is necessary to adjust the clearance between the clutch lining and the clutch drum according to wear of the lining.

(2) Adjustment of Third Drum Winch Clutch

(a) Lower the hook, and place it on the ground.

(b) Place the clutch lever in the FREE position.

(c) Loosen lock nut (5), turn adjusting bolt (4) so that the clearance between the clutch shoe and the bolt becomes 1.5㎜ to 3㎜, (0.059″ to 0.118″), and lock nut (5). This adjustment is necessary only when using a new clutch shoe or new linings.

(d) Loosen lock nut (3), turn adjusting nut (2) so that the clutch shoe slightly clears the clutch drum and so that operating feeling is proper when operating the clutch lever, and secure lock nut (3).

(e) With eyebolt (7) and nut (8), adjust the length of spring (6) so that engagement and disengagement are proper and so that the clutch lining does not contact the clutch drum during rotation when the clutch is released.

(f) Upon completion of adjustment, lower the hook under the condition of free fall, and make sure that the hook can be lowered smoothly.
Next, lift a load, and confirm that the clutch is surely engaged without any slippage.

(g) Tighten the all lock nuts securely.

NOTE

1. The piston in the wheel cylinder must return to the stroke end position in the cylinder whenever the clutch is disengaged.
2. Distance of the clutch shoes should be adjusted according to wear of the linings.

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5.5 AIR BLEEDING AND DRUM LOCK

(1) Bleeding Air from the Clutch Cylinder

(a) Place the machine on a firm and level ground. Engage the winch drum lock.

(b) Rotate the clutch so that the bleeder screw of the clutch cylinder comes to the top position.

NOTE

Keep the engine in an idle running

(c) Put the clutch lever in the FREE position.

(d) Attach a vinyl hose to the bleed screw and submerge the other end of the hose in a container holding a small amount of hydraulic oil (Fig. 5-13).

(e) Pull the clutch lever to turn it ON and loosen the bleed screw, and hydraulic oil containing air bubbles will come out of the hose.

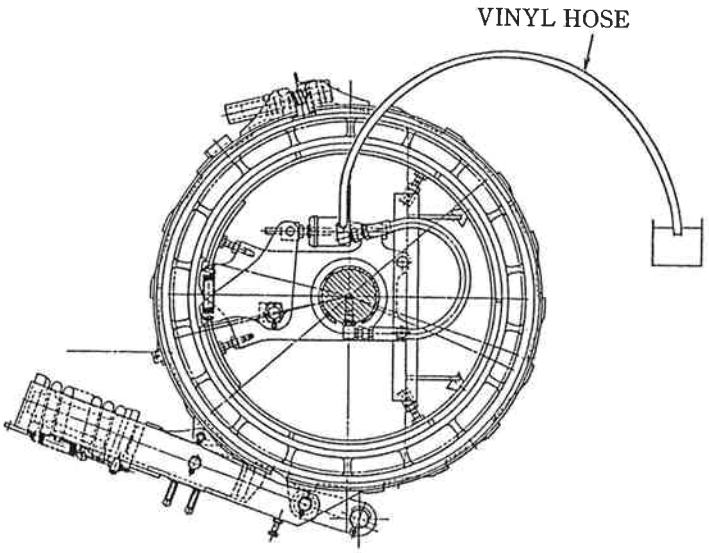
(f) Tighten the bleed screw once, turn the clutch lever ON again and loosen the bleed screw. Repeat these steps until no bubbles appear.

(g) After air is removed completely, tighten the bleed screw and detach the vinyl hose.

(h) Air bleed the other clutch cylinder in the same way, and check that the clutch works properly.

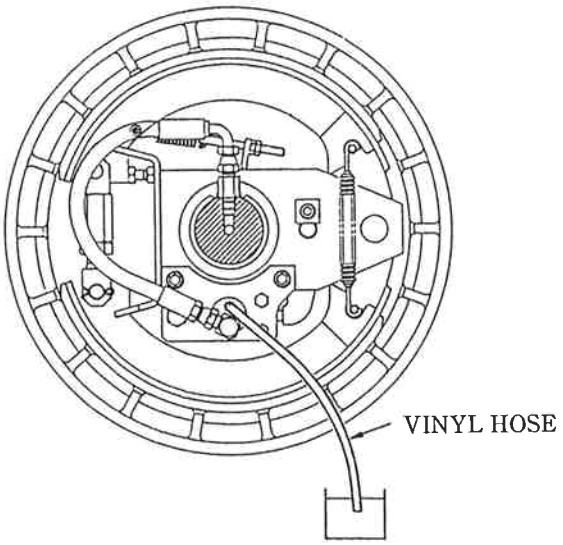
NOTE

Because of the high pressure hydraulic oil involved, be sure to use vinyl hose for safety. Make sure that no spilled oil is on the clutch lining and brake lining.



MAIN WINCH CLUTCH : AS SHOWN IN THIS FIG.
AUXILIARY WINCH CLUTCH : OPPOSITE TO THIS FIG.

AIR BLEEDING OF MAIN AND AUXILIARY WINCH CLUTCHES



AIR BLEEDING OF THIRD DRUM CLUTCH

Fig. 5-13 Air Bleeding of Clutch Cylinder

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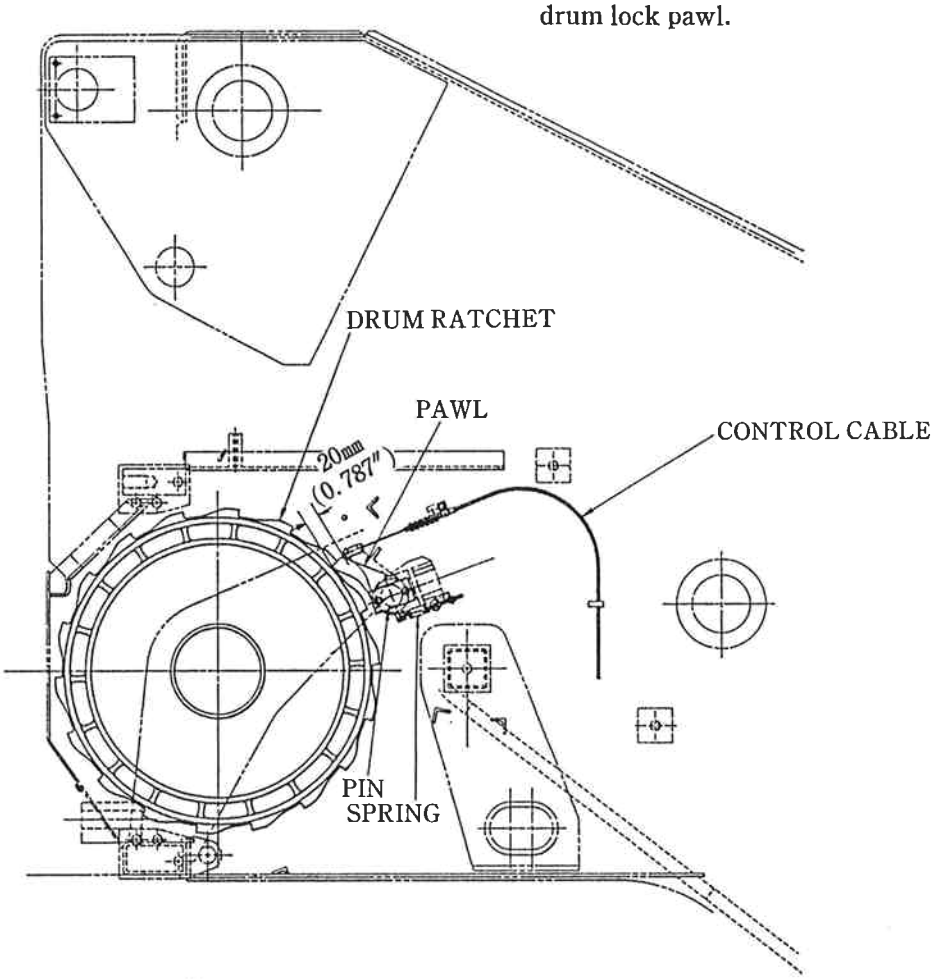
(2) Adjusting the Drum Lock

To adjust the drum lock, proceed as follows :

(a) With the drum lock ON, make sure the pawl is completely engaged with the bottom of the drum ratchet.

(b) With the drum lock disengaged, adjust the adjusting bolt so that the clearance between the pawl and the top of the drum ratchet teeth is 10㎜ (0.394in), then tighten the lock nut securely.

(c) Do not forget lubrication to the pin for the drum lock pawl.



MAIN WINCH DRUM LOCK : AS SHOWN IN THIS FIG.
AUXILIARY WINCH DRUM LOCK : OPPOSITE TO THIS FIG.

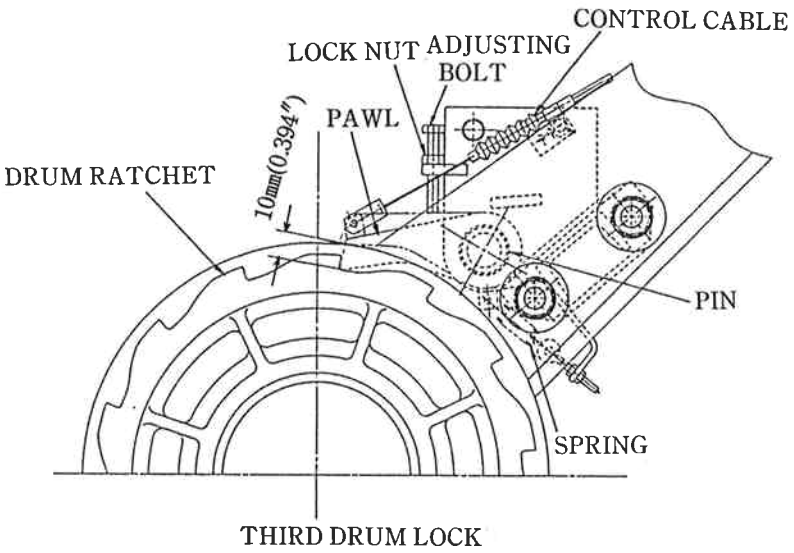


Fig. 5-14 Adjustment of Drum Lock

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5.6 ADJUSTMENT OF FREE FALL INTERLOCK

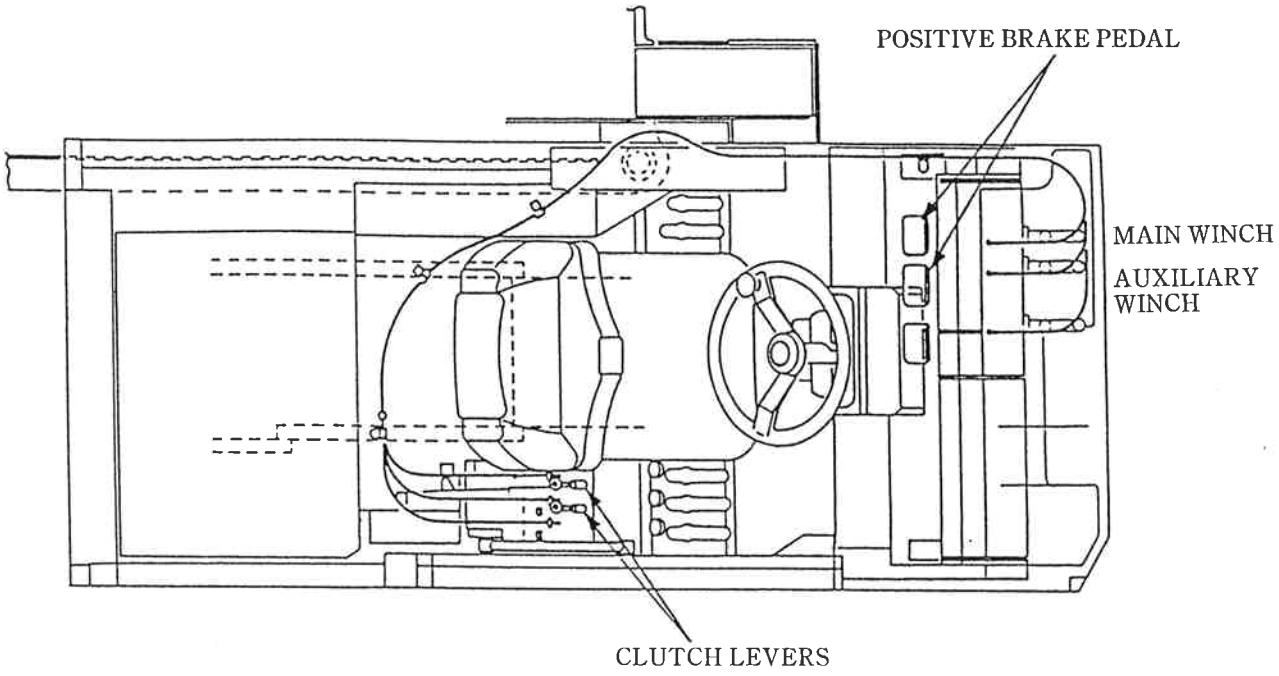


Fig. 5-15 Free Fall Interlock Device

(a) Normal condition
When stroke Ⓐ reaches 50 to 55㎜ (1.97 to 2.16 inches), interlock of the clutch lever is released and the clutch lever can be operated freely. This case is normal and adjustment is unnecessary.

(b) When adjustment is required.
After adjusting the master cylinder, adjust the cable lock nut so that point ② comes in contact with point Ⓑ surely without depressing the pedal, and that the interlock is released when the pedal stroke is 50 to 55㎜.

(c) After adjustment, make sure the pedal stroke by step (a)

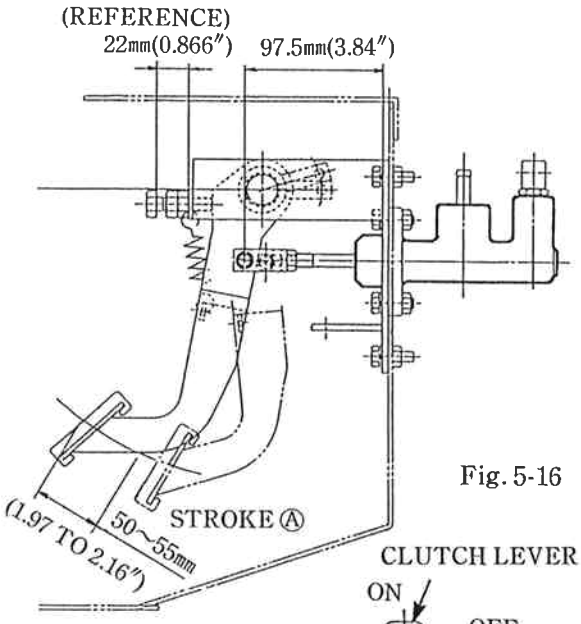


Fig. 5-16

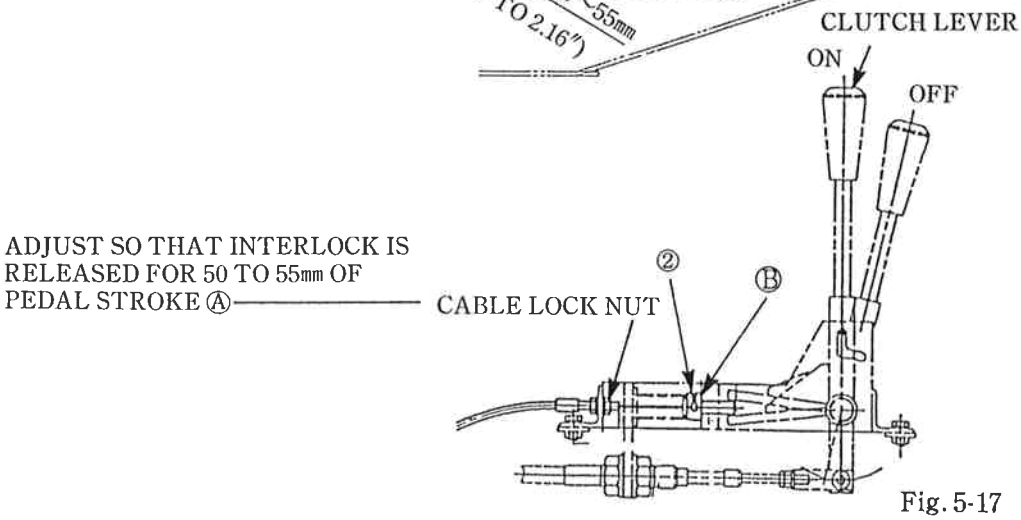


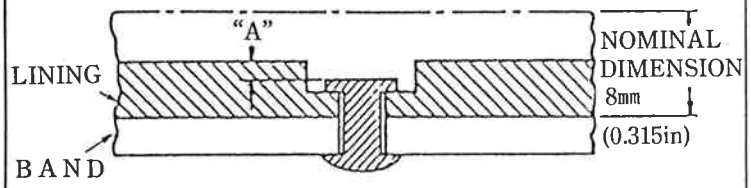
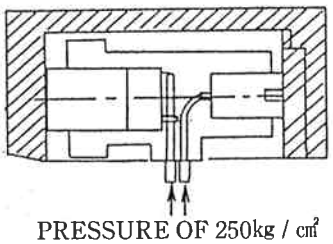
Fig. 5-17

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6. TEST PROCEDURES AND MAINTENANCE STANDARDS

6.1 TEST PROCEDURES

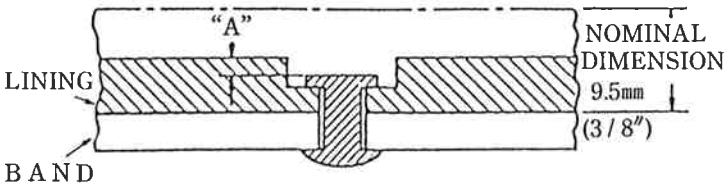
(1) BRAKE

Test Procedure	Maintenance Standards
1. Lining Wear Limit Measure "A" for minimum thickness.  	Replace lining when "A" is less than 1mm (0.04in).
2. Brake Cylinder Pressure Test Apply 250kg / cm² (3555psi) hydraulic pressure to brake cylinder for 5 seconds. NOTE Do not allow brake cylinder to reach its stroke end. Limit stroke before applying pressure as shown.  	Cylinder should be free from oil leakage and any other abnormal condition.
3. Check brake cylinder and piston for wear and scratches. Measure clearance between cylinder and piston.	Recommended clearance for replacement of those units is 0.13mm (0.005in).
4. Master Cylinder Pressure Test Apply 250kg / cm² (3555psi) hydraulic pressure to master cylinder for 5 seconds.	Cylinder should be free from oil leakage and any other abnormal condition.
5. Time Required for Cylinder Piston Returning Fill cylinder with brake fluid at normal temperature. Check time for piston to return when delivery port is closed with piston full extended.	Within 1 second.
6. Check for wear and scratches on master cylinder and piston. Measure clearance between cylinder and piston.	Recommended clearance for replacement of those units is 0.2mm (0.008in)

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Test Procedure	Maintenance Standards
7. Brake Performance Check Lift load, under free fall condition, depress foot brake pedal and release clutch (OFF). Make sure that the load can be held only by the brake. $W = N \times F$ W : Load N : Number of part line of wire rope F : Wire rope allowable load (Main : 3.125t, Aux. : 3.2t) NOTE 1. Lifting load (W) should not exceed rated lifting load. 2. Auxiliary winch brake performance check should be carried out by using auxiliary sheave. Jib should not be used. 3. Testing load should not be lifted high up.	Load must be held in mid-air without slippage.
8. Hook Free-fall Check With maximum of parts of hoist line, maximum of boom angle, maximum of lifting height and no load, check to see whether hook falls freely or not, with brake pedal released and clutch lever in OFF.	Hook lifted should fall freely. Correct clearance between drum and lining is 0.6 ~ 1.0 mm (0.024 to 0.04in).
9. Function Test While testing in preceding step 8, check for abnormal noise and / or oil leakage from brake piping.	No abnormal noise or oil leakage should be observed.

(2) CLUTCH

Test Procedure	Maintenance Standards
1. Lining Wear Limit Measure "A" for minimum thickness 	Replace lining when dimension "A" is less than 1mm (0.04in).
2. Clutch Cylinder Pressure Test Test procedure is the same as (1)-2 "Brake Cylinder Pressure Test."	The same maintenance standards as (1)-2 Brake Cylinder Pressure Test should be applied.

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Test Procedure	Maintenance Standards
3. Clutch Performance Check With the same conditions as (1)-7 "Brake Performance Check" lift load and check clutch lining contacting condition.	No slippage is allowed and clutch should be securely engaged. Clearance between drum and lining should be 0.6㎜ (0.024in) at dead end and 1.0㎜ (0.04in) at live end.
4. Function Test While testing in step 3 above, check for oil leakage from clutch piping and / or abnormal noise.	No abnormal noise or oil leakage should be observed.

(3) DRUMSHAFT

Test Procedure	Maintenance Standards
1. Function Test With the same conditions as (1)-7 "Brake Performance Check" check for oil leakage and abnormal noise while lifting or lowering load and free-falling hook with no load.	There should be no oil leakage or abnormal noise.

(4) DRUM LOCK

Test Procedure	Maintenance Standards
1. Function Test When drum lock lever is operated, check to see if pawl functions surely and smoothly.	When drum lock lever is ON, pawl should engage perfectly with drum ratchet. With lever in OFF, 20㎜ (0.787in) of clearance should be maintained between pawl and ratchet top. When lever is operated, the said pawl should be turned smoothly ON or OFF.

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6.2 TIGHTENING TORQUE OF MOUNTING BOLTS

Table 6-1. Tightening torque of mounting capscrews

Unit : kg-m (ft-lb)

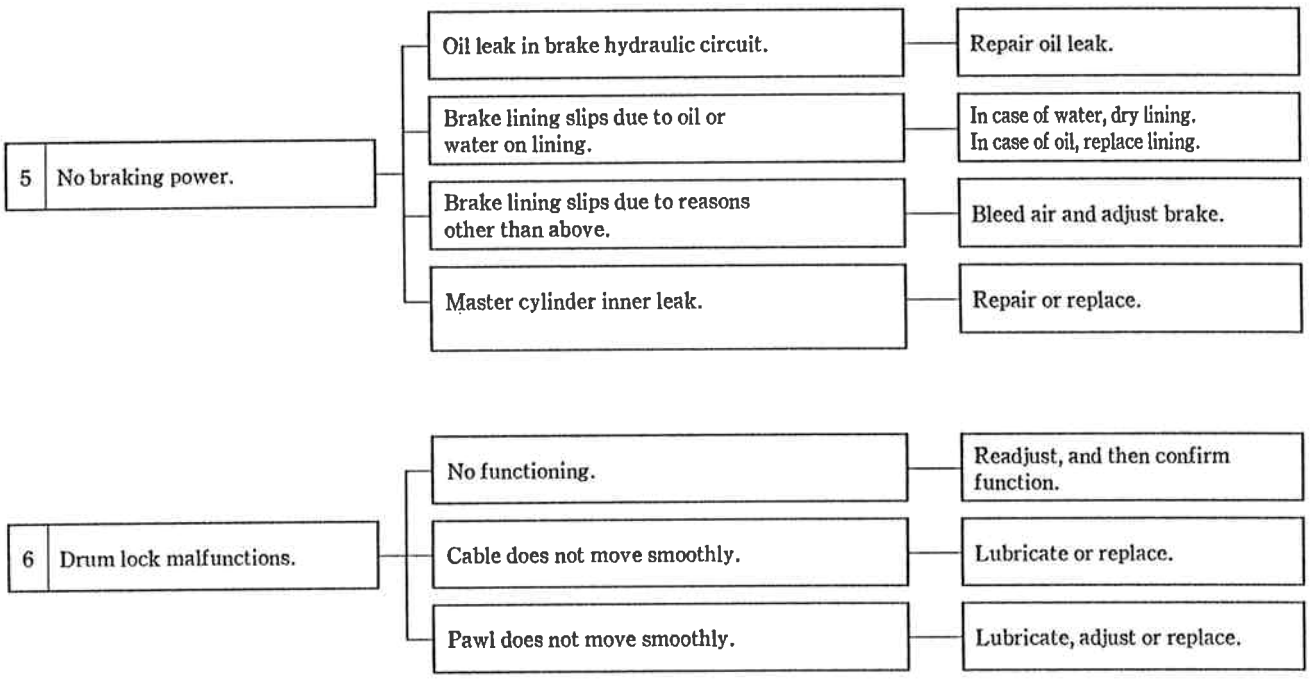
Device	Fig.	Item No.	Name	Tightening Torque	
				Coated with Locktite #242 or equivalent	Lubricated with oil
Winch assembly	Fig. 4-11	37	Motor mounting capscrew	25.5 to 31.5 (184 to 228)	
		38	Cover mounting capscrew	6.0 to 7.4 (43.4 to 53.5)	
		39	Gear case mounting capscrew	10.5 to 12.9 (76 to 93)	
	Fig. 4-14	12	(Third) Cover mounting capscrew	6.5 to 7.9 (47.0 to 57.1)	
	Fig. 4-15	53	Winch mounting capscrew	51 to 63 (369 to 455)	
Brake assembly	Fig. 5-10	6	Cylinder mounting capscrew		3.3 to 4.6 (23.8 to 33.2)
		10	Cylinder mounting capscrew		0.9 to 1.3 (6.5 to 9.4)
Clutch assembly	Fig. 2-10	3	Cylinder mounting capscrew	3.1 to 3.7 (22.4 to 26.8)	

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7. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
1 Load cannot be lifted.	Oil leak in clutch control circuit.	Repair oil leak.
	Clutch slips due to oil or water on clutch lining.	In case of water, dry lining. In case of oil, replace lining.
	Clutch slips.	Bleed air and adjust clutch.
	Malfunction of relief valve.	Adjust relief valve.
2 Load can neither be lifted nor lowered.	Failure of reduction unit and drum shaft.	Repair or replace.
	Wrong winch motor and control valve.	Repair or replace.
	Malfunction of relief valve and flow control valve.	Adjust relief valve. Wash or replace flow control valve.
3 Hook does not fall freely.	Interference between brake lining and drum.	Adjust brake.
	Interference between clutch lining and drum.	Adjust clutch.
	Malfunction of clutch valve.	Replace valve.
4 Abnormal noise while lifting / lowering and free-falling.	Interference between clutch lining and drum, drum and frame, or brake band and drum.	Adjust or repair.
	Failure of reduction unit gear.	Replace.
	Failure of drum shaft bearing.	Replace.
	Failure of winch motor.	Replace.

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1. LOCATION OF COMPONENTS

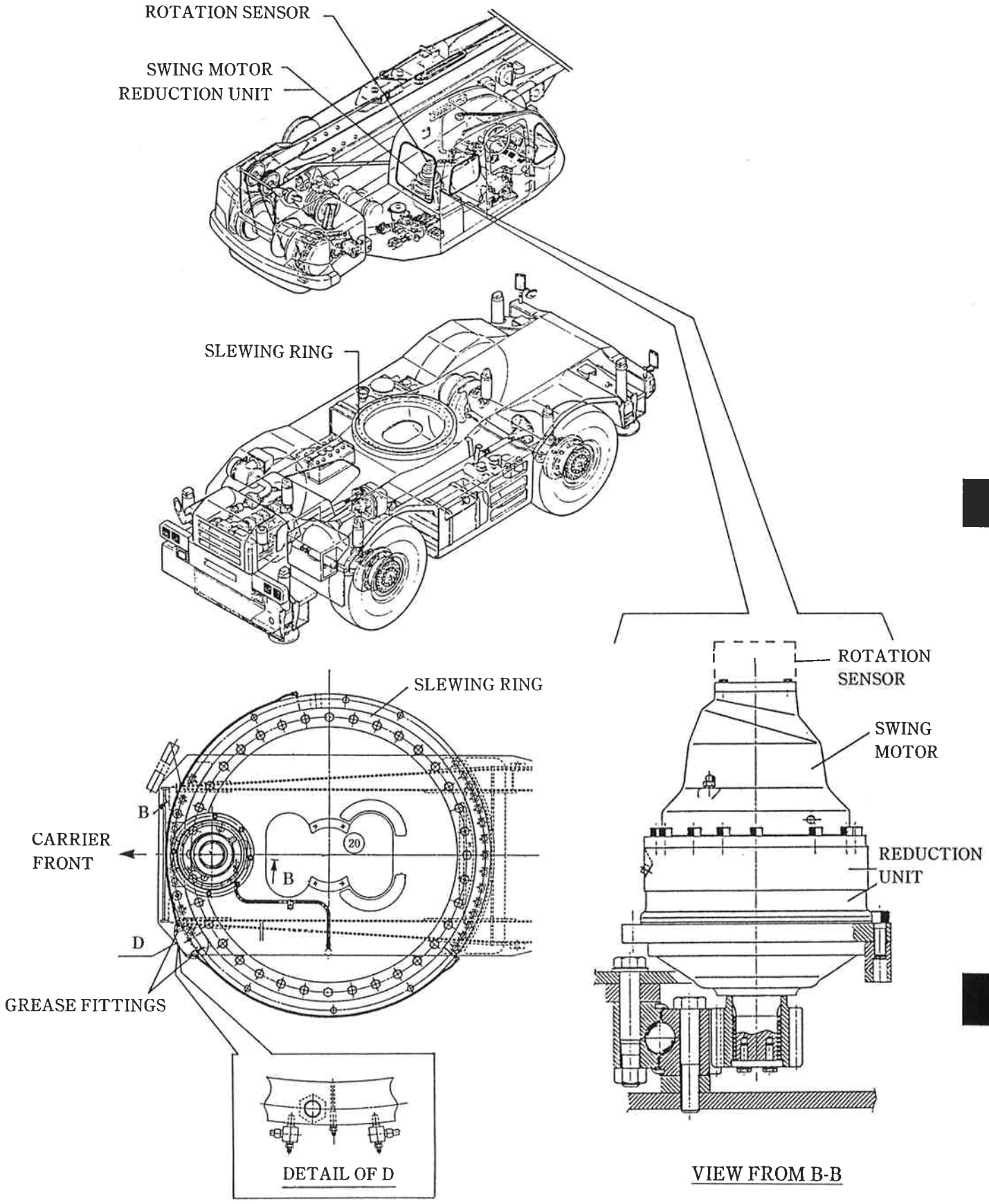
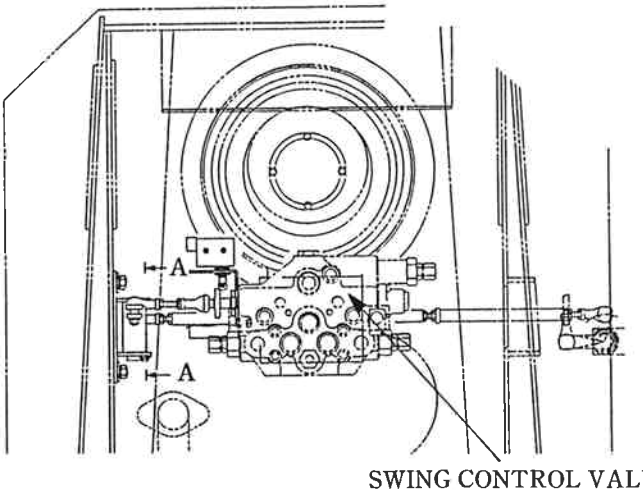
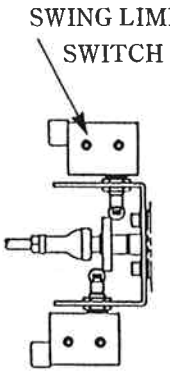


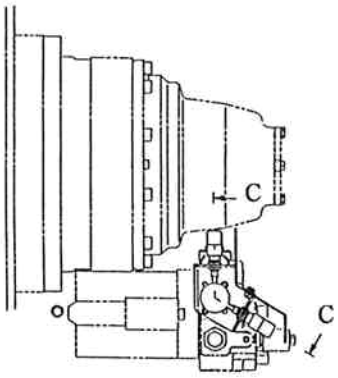
Fig. 1-1 Location of Swing System and Components

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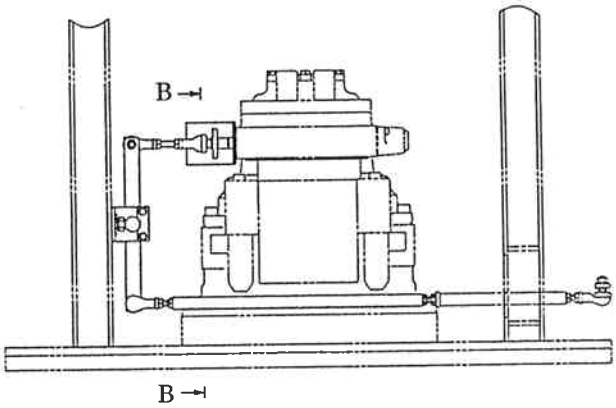


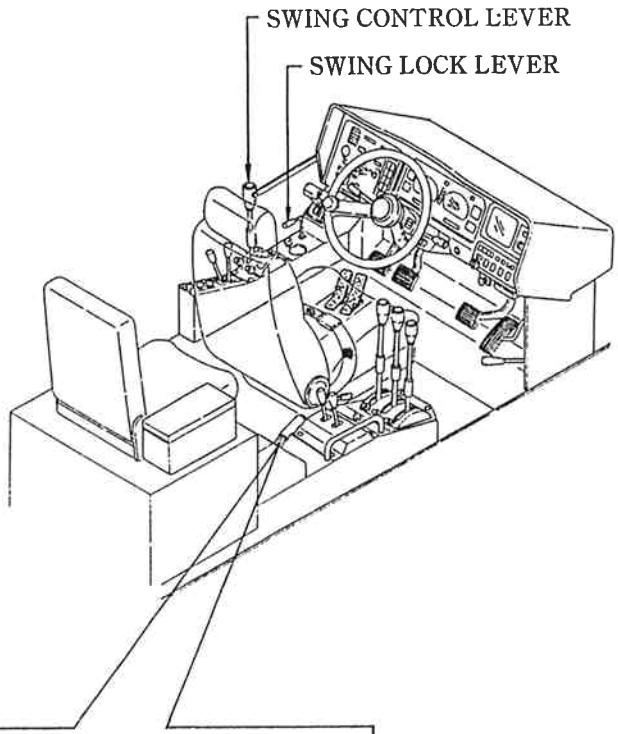


SECTION C-C



SECTION B-B





WIRING AND OPERATION MATRIX OF LIMIT SWITCH

	SYMBOL	OPERATION OF LIMIT SW.	OUTPUT TO SOLENOID
RIGHT SWING LIMIT SWITCH	NO	DO NOT PUSH. / RIGHT / NEU-TRAL / LEFT	ON / OFF / RIGHT / NEU-TRAL / LEFT
LEFT SWING LIMIT SWITCH	NO	DO NOT PUSH. / RIGHT / NEU-TRAL / LEFT	OFF / ON / RIGHT / NEU-TRAL / LEFT

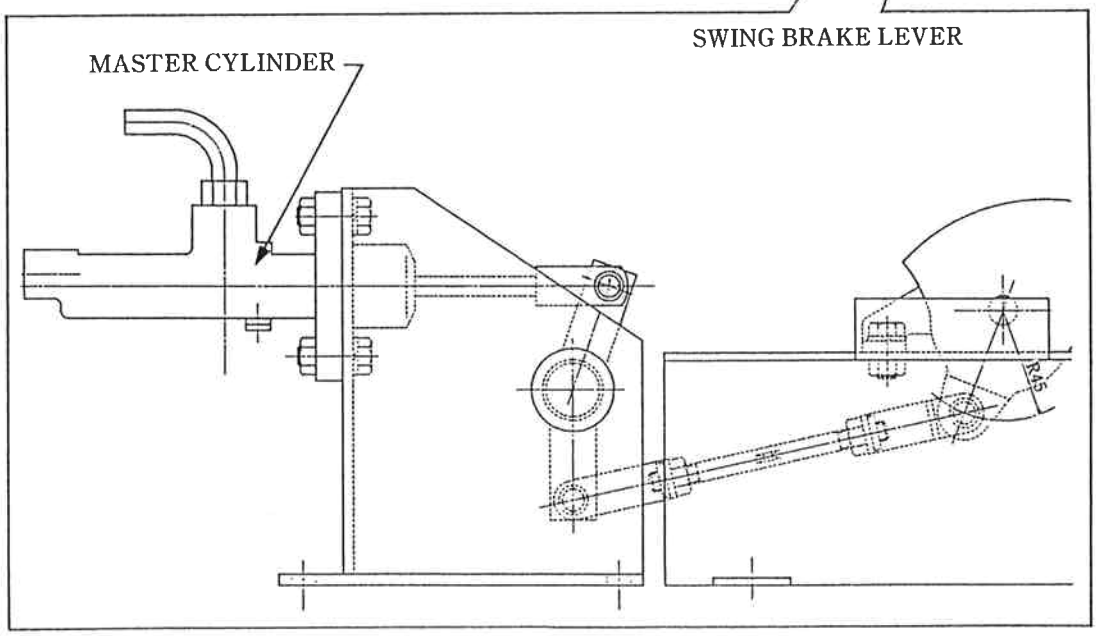


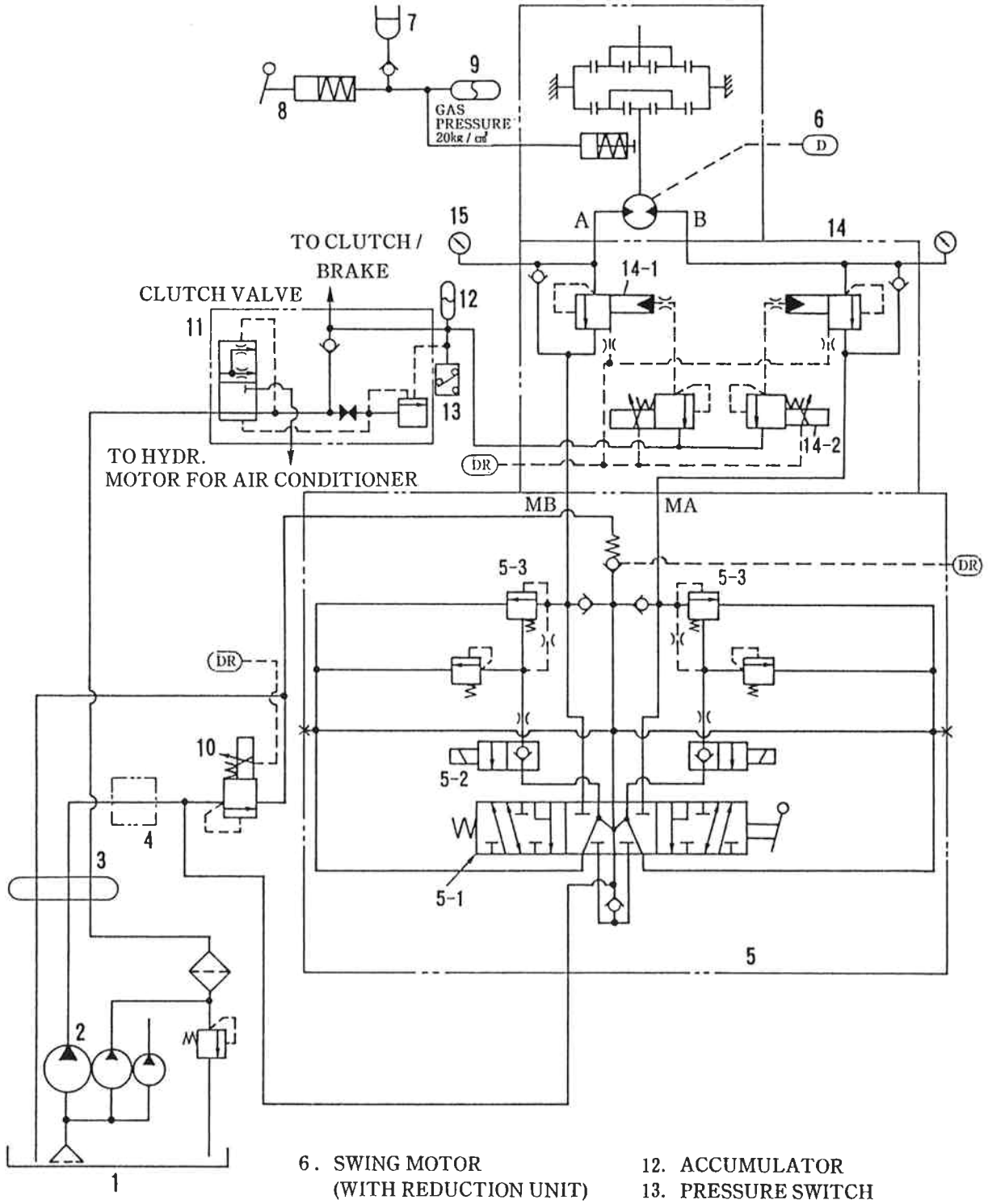
Fig. 1-2

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2. CONSTRUCTION AND FUNCTION

2.1 HYDRAULIC SCHEMATICS

Fig.2-1 shows the hydraulic circuit of the swing system.



1. HYDRAULIC OIL TANK
2. HYDRAULIC PUMP (FOR SWING AND STEERING)
3. SWIVEL JOINT
4. PRIORITY VALVE
5. SWING CONTROL VALVE
6. SWING MOTOR (WITH REDUCTION UNIT)
7. OIL RESERVOIR
8. MASTER CYLINDER
9. ACCUMULATOR
10. MAGNETIC PROPORTIONAL RELIEF VALVE
11. CLUTCH VALVE
12. ACCUMULATOR
13. PRESSURE SWITCH
14. SWING STOP VALVE
14－1. PRESSURE CONTROL VALVE
14－2. MAGNETIC PROPORTIONAL PRESSURE REDUCING VALVE
15. PRESSURE SENSOR

Fig. 2-1 Hydraulic Circuit Schematic of Swing System

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(1) Swing in Neutral (Swing Lever in the Neutral Position) (swing Neutral Lock)

Pressurized oil delivered from the hydraulic pump enters the swing control valve through the swivel joint and through the priority valve. However, the pressurized oil flows as shown with the arrow mark shown in Fig. 2-2, returns to the hydraulic oil tank as it is, and generates no slewing force in the swing motor.

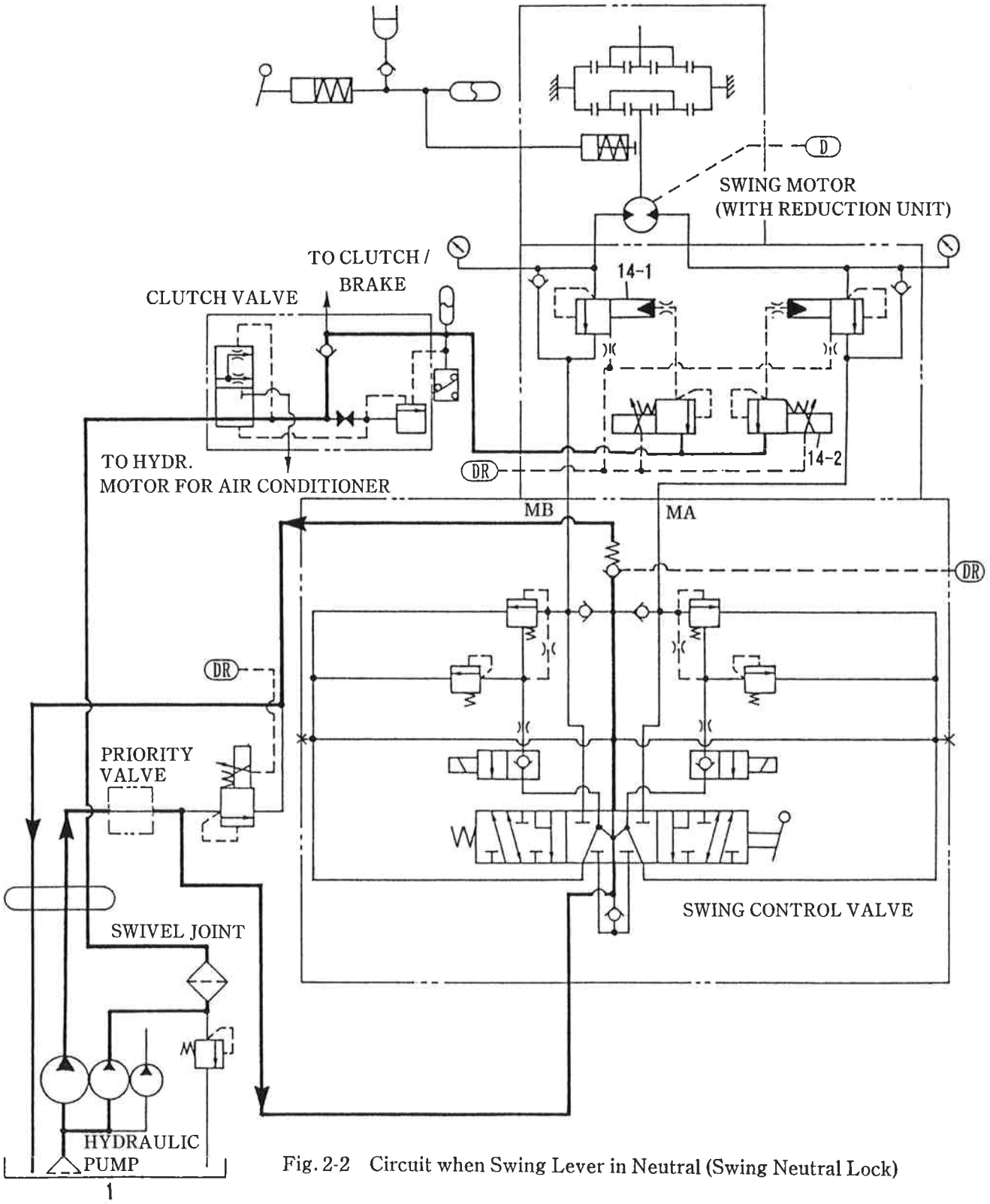


Fig. 2-2 Circuit when Swing Lever in Neutral (Swing Neutral Lock)

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(2) Swinging to the Right (Pulling the Swing lever toward the Operator)

When pulling the swing lever toward the operator, pressurized oil delivered from the hydraulic pump enters the swing motor through port MB as shown in Fig. 2-3, and rotates the swing motor to the left.

Therefore, the swing pinion also rotates to the left, turning to the right along the slewing ring gear. Then the upper turns to the right.

While, the return oil from the swing motor passes port MA, enters the swing control valve, and returns to the hydraulic oil tank as shown in Fig. 2-3.

In case of automatic stop mode, pressurized oil from the 2nd pump is led to the primary side of the magnetic proportional pressure reducing valve and generates a secondary pressure according to the stop signal. This secondary pressure generates braking pressure at the motor outlet port as a pilot pressure through the pressure control valve, and also controls the motor inlet pressure through the magnetic proportional relief valve. Therefore, the revolving upper is stopped smoothly. (In case of neutral free, the same control is operated.)

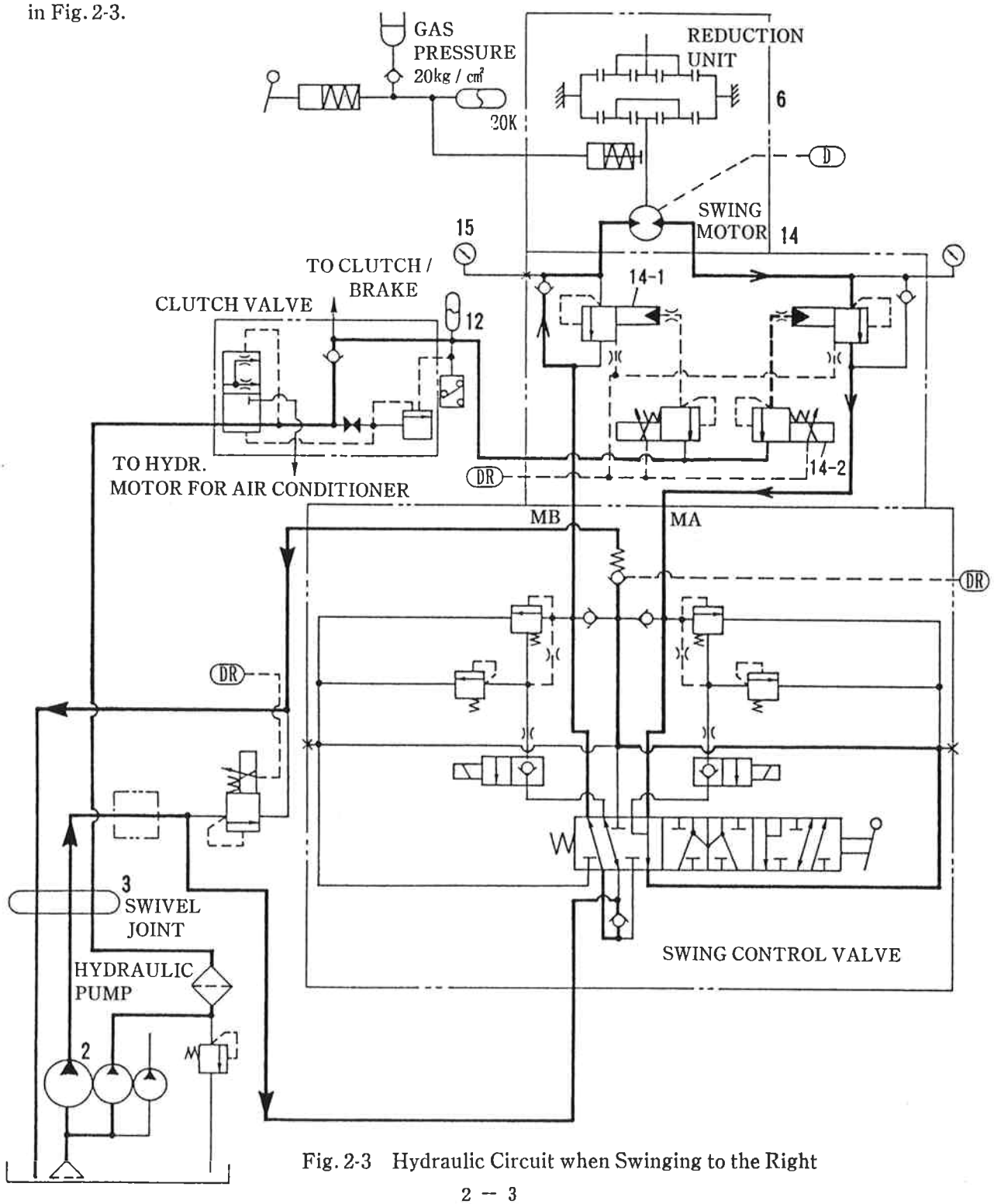


Fig. 2-3 Hydraulic Circuit when Swinging to the Right

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(3) Swinging to the Left (Pushing the Swing Lever forward)
Pressurized oil flows in the opposite direction to the flow in topic (2) (see Fig. 2-4)

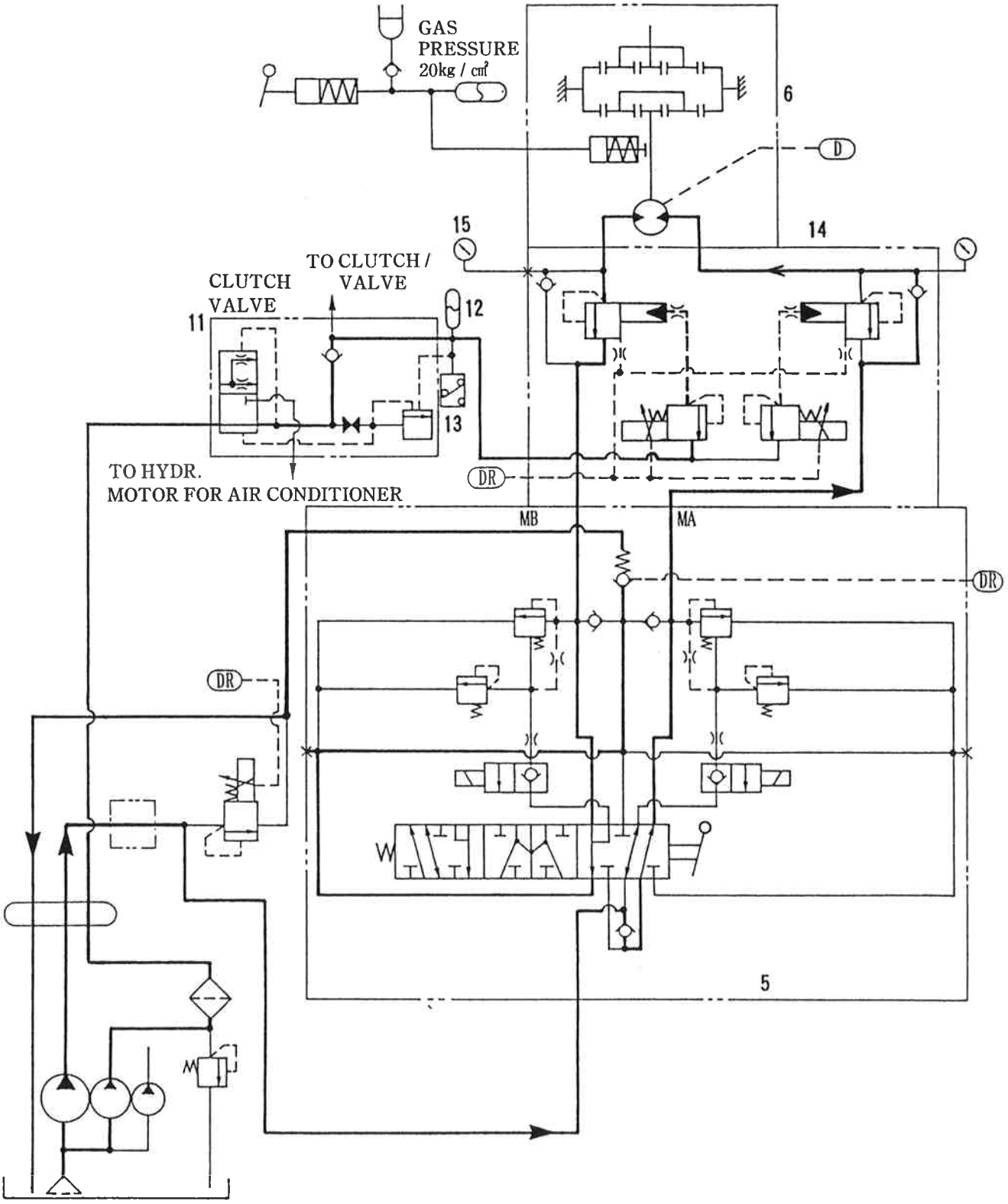


Fig. 2-4 Hydraulic Circuit when Swinging to the Left.

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(4) Swing in Neutral Free

The swing in neutral free is operated with the swing lock / free selector switch on the crane operation control switch panel in the left side of the operator's seat or with the side-pull preventive switch on the winch lever.

When placing the selector switch in the SWING FREE position, or when pushing the side-pull preventive switch, the solenoid valve functions to open the relief valve, and the return oil from the swing motor passes the relief valve as shown in Fig. 2-5, then the both left and right return oil return to the hydraulic oil tank.

Therefore, the machine becomes free for swing, and the boom is turned toward the center of a load when the winch lever is operated.

(5) Swing in Neutral Lock.

When placing the selector switch in the LOCK position, the oil flow becomes the condition shown in Fig. 2-2, and the return oil from the swing motor is blocked.

By operating the swing brake lever also, swing motion can be locked (see page 2-9).

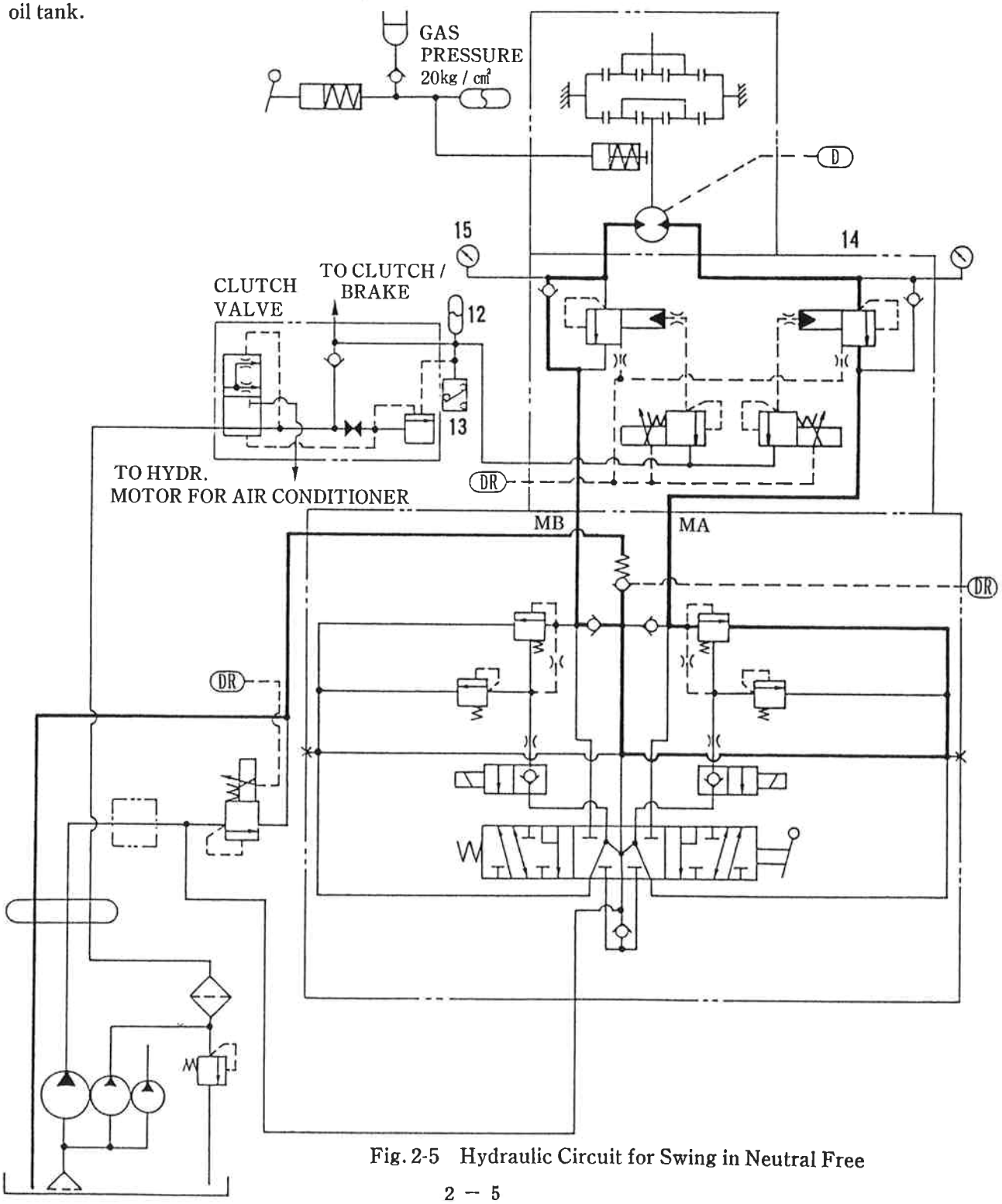
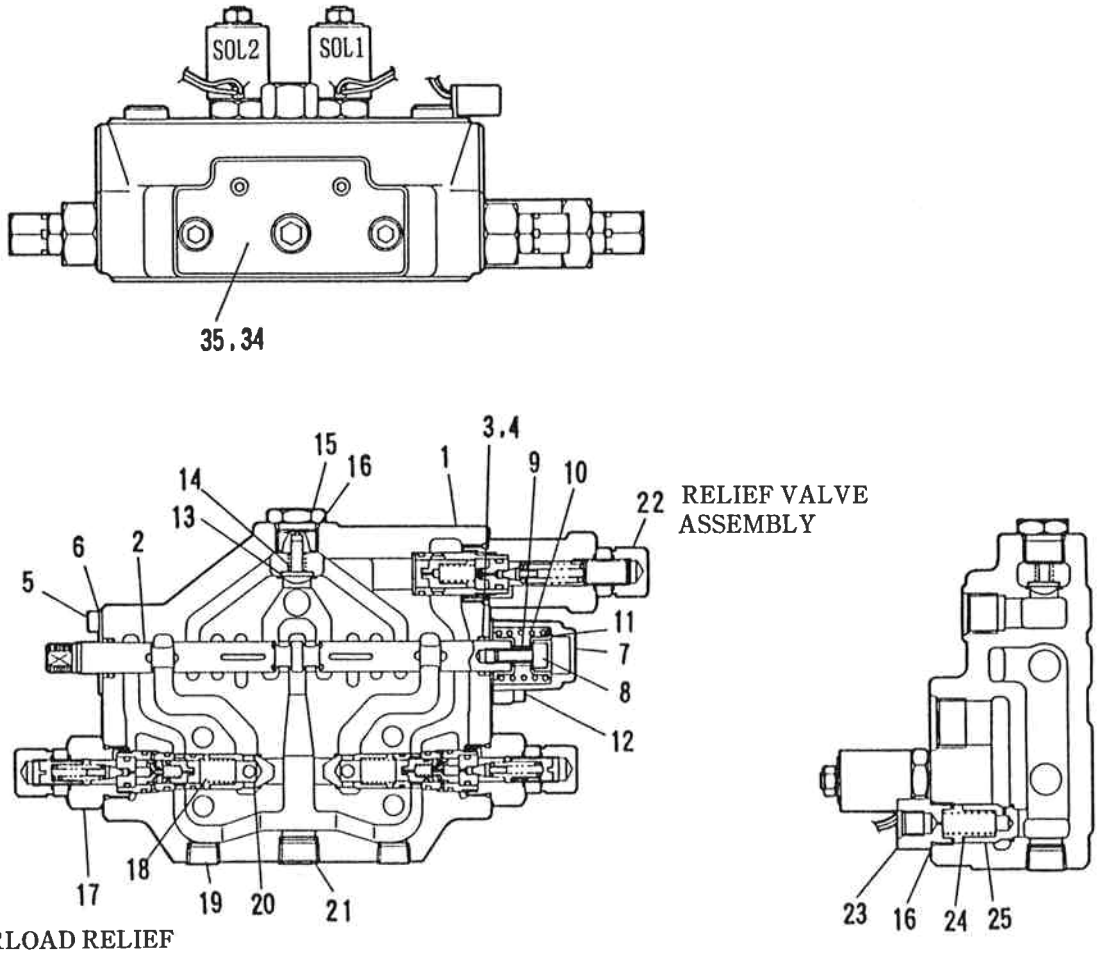


Fig. 2-5 Hydraulic Circuit for Swing in Neutral Free

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2.2 SWING CONTROL VALVE

(1) Construction



1. BODY
2. SPOOL
3. DUST SEAL
4. O-RING
5. CAPSCREW
6. RETAINER
7. COVER
8. CAPSCREW
9. SPACER
10. RETURN SPRING
11. SPRING SEAT
12. CAPSCREW
13. CHECK VALVE
14. SPRING
15. VALVE SEAT
16. O-RING
17. OVERLOAD VALVE
18. SPRING
19. PLUG
20. CARTRIDGE ASSEMBLY
21. PLUG
22. RELIEF VALVE
23. BUSHING
24. SPRING
25. CHECK VALVE
26. PLUG
27. O-RING
29. CAPSCREW
31. ORIFICE
32. SOLENOID VALVE
33. O-RING
37. O-RING

Fig. 2-6

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(2) Neutral Position

Oil, which entered port P, passes the bypass passage, pushes valve (23), and returns to port T.

At this time, the motor circuit is blocked by spool (2).

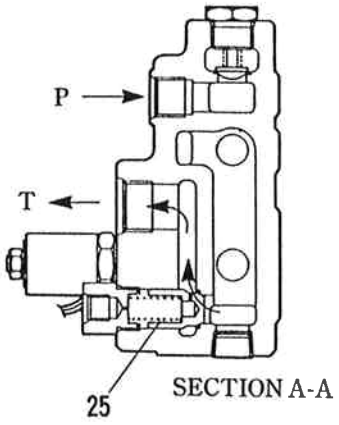


Fig. 2-7

(3) Operation of Spool

By switching the spool to the arrow (⇦) direction, oil from port P pushes to open check valve (13), and flows to the motor (MB).

At this time, the return oil from the motor passes as shown by the arrow marks (···→) from port MA, and flows to port T from valve (13).

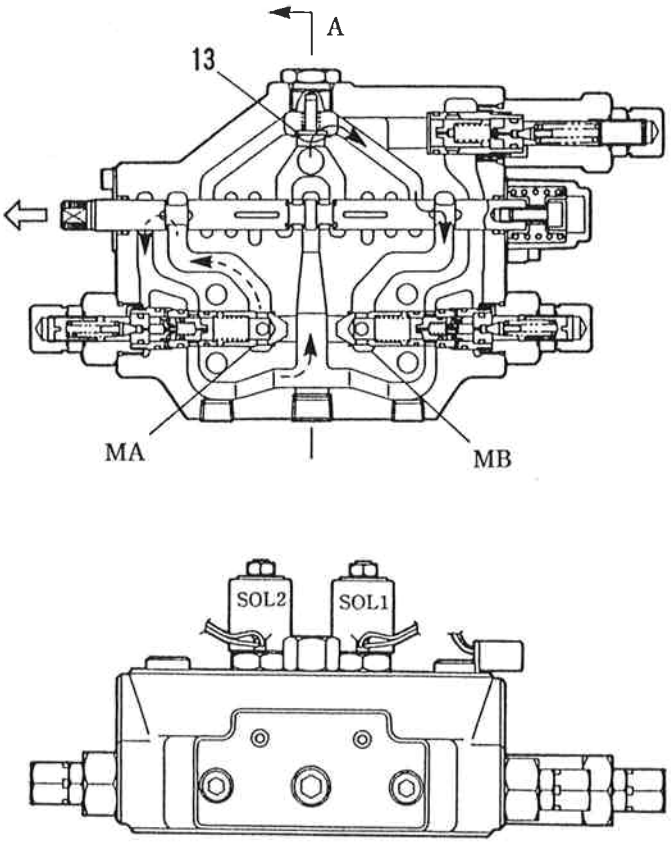


Fig. 2-8

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2.3 SWING MOTOR WITH REDUCTION UNIT

(1) Motor

As shown in Fig. 2-9, the swing motor is mounted directly on the swing reduction unit and drives the swing pinion through the reduction unit, making the upper swing.

The swing motor is of swash plate, axial piston type.

A single-plate disc brake is mounted on the cylinder block of the motor (see Fig. 2-10), and is spring released - hydraulically set. When pressurized oil fed to the brake pressure port, the brake is engaged. This oil pressure works to press the brake piston against the friction disc, retarding the disc rotation.

When there is no pressure in the brake chamber, the brake spring actuates the brake piston to release the brake discs, there by separating the input shaft from the housing and allowing the motor to turn.

(2) Reduction unit

The reduction unit is a planetary reduction unit, and is motor-driven.

The hydraulic swing motor drives the sun gear of the reduction unit, and the swing pinion is intermeshed with the ring gear of the slewing ring.

Therefore, when the oil leaving the pump is supplied to the motor, the upper begins to swing.

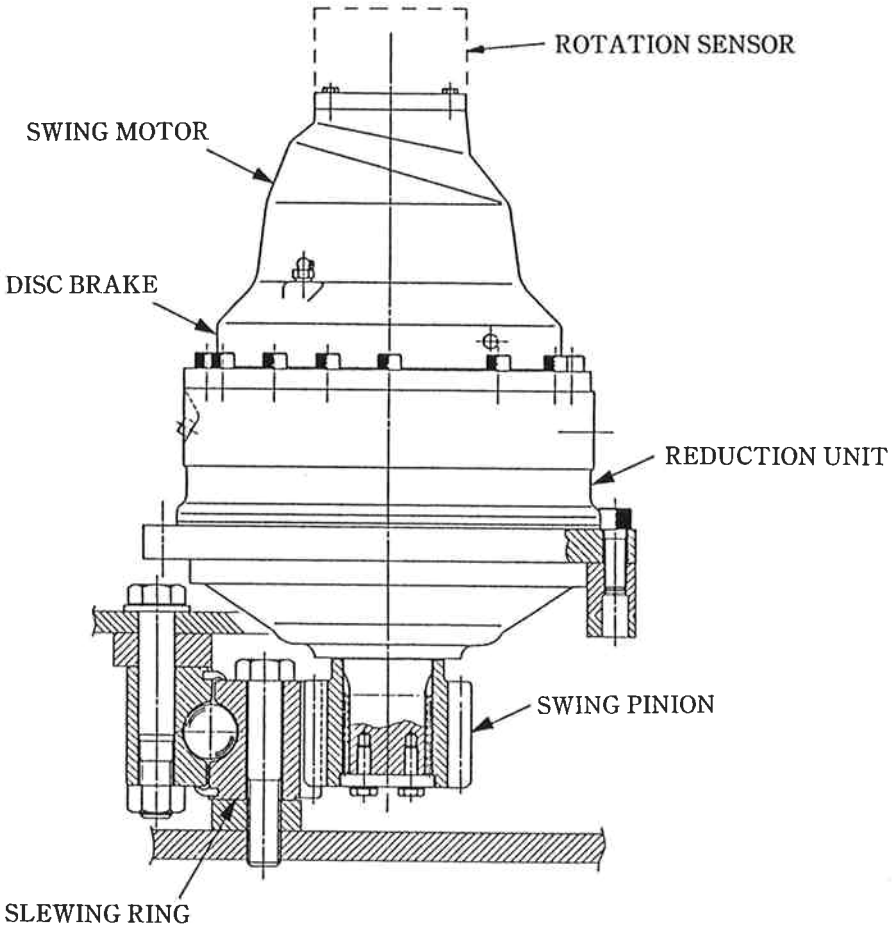


Fig. 2-9 Swing Motor

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2.4 SWING BRAKE (FOR LOCK)

The brake lock is manually operated.

When the control lever is raised, the resulting pressure in the master cylinder depresses the brake piston and forces it against the brake discs mounted on the cylinder block of the swing motor, preventing the input shaft from rotaing.

Lowering the control lever removes the pressurized brake oil. This allows the force of the spring to raise the brake piston, releasing the discs and allowing the input shaft to rotate.

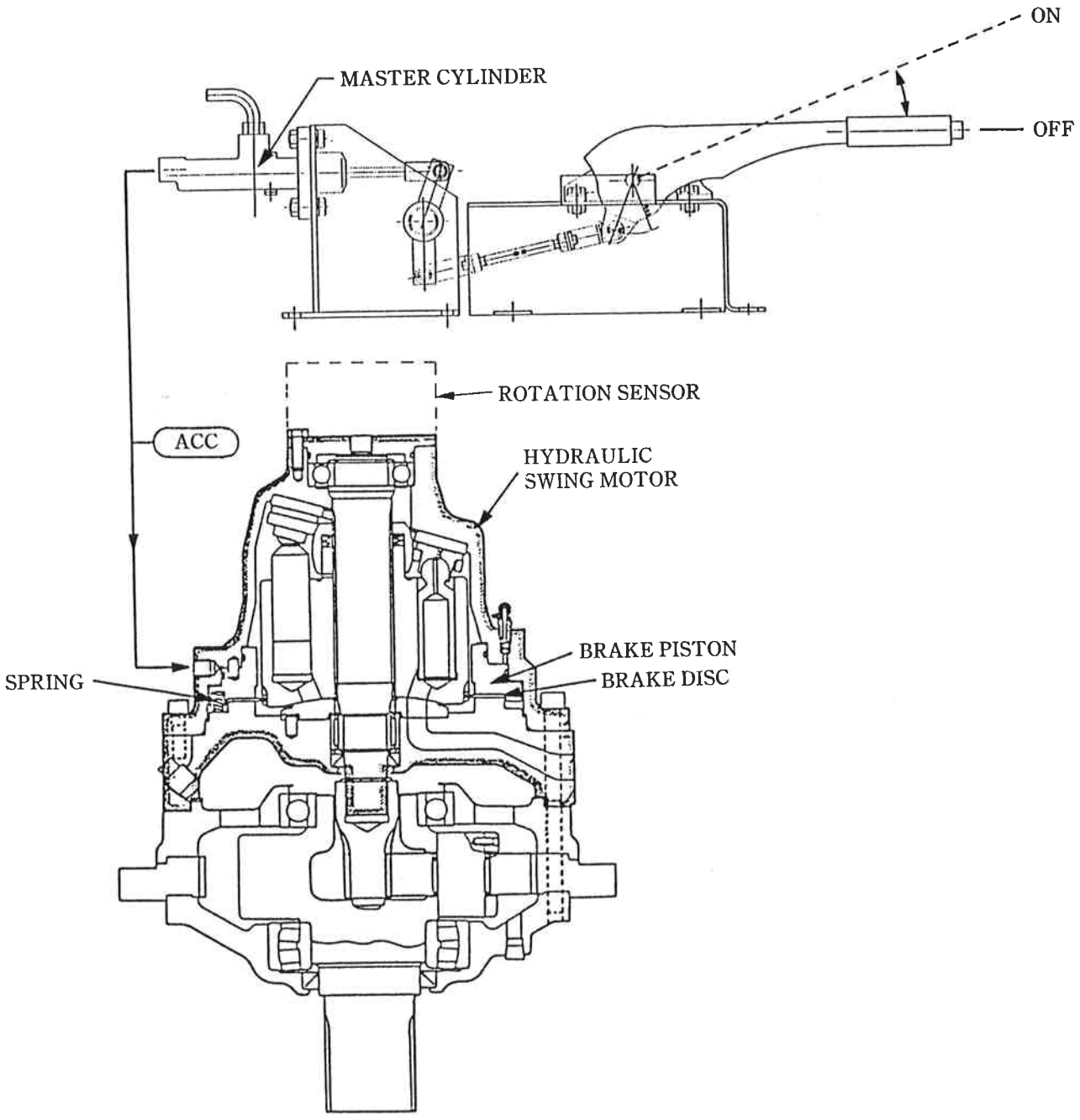


Fig. 2-10 Operation of Swing Brake Lock

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2.5 SWING LOCK PIN

Fig. 2-11 shows the construction of the swing lock pin.

The swing lock pin locks the crane upper to the carrier mechanically to hold the upper from swinging, and can be engaged at the two positions of the forward position and backward position. When traveling on roads or when picking and carrying a load, use this lock pin.

ON and OFF of the swing lock are operated with the swing lock lever provided in the left side of the operator's seat. Lift the lever a little and move it to the side to release the swing lock, and push it down to engage the lock.

When locking, be sure to arrange the upper to be parallel with the carrier. When releasing the lock, pull the lifted lever backward, and place it surely in the lock-release position.

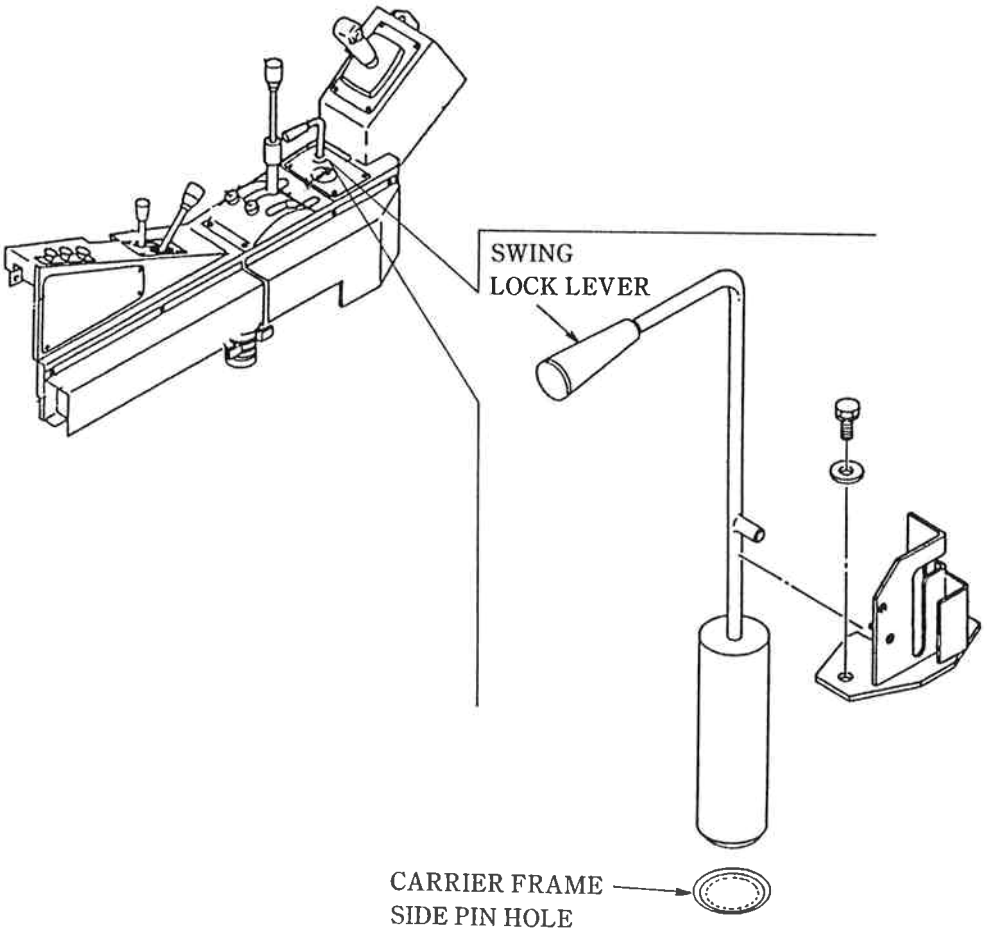
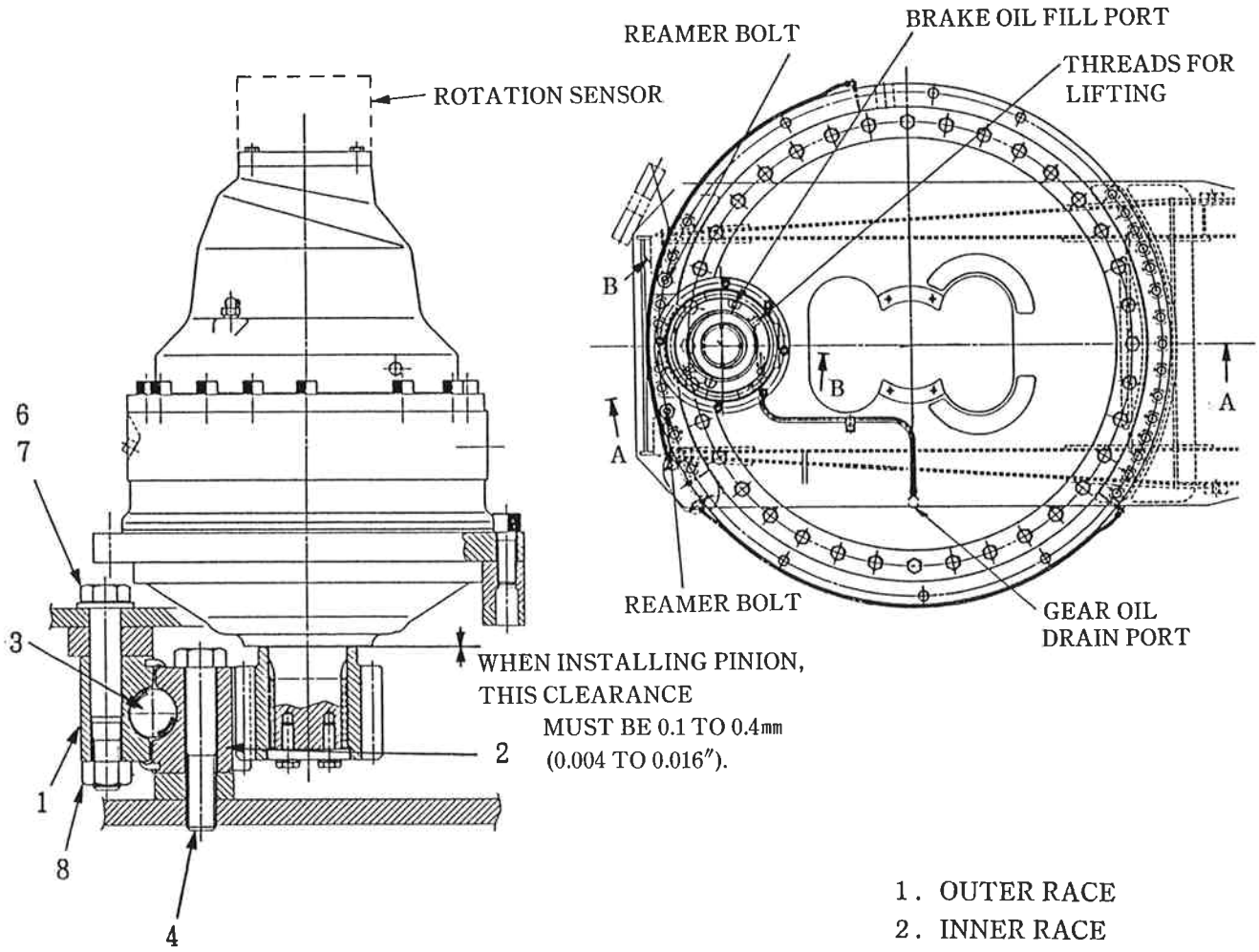


Fig. 2-11 Swing Lock Pin

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2.6 SLEWING RING

As shown in Fig. 2-12, the slewing ring consists of an inner race, an outer race and balls. The inner race (swing ring gear) is secured to the bearing seat of the carrier, and the outer race is secured to the revolving frame respectively with the capscrews. The pinion of the swing reduction unit is meshed with the swing ring gear of the inner race, making it possible for the upper to rotate 360 degrees continuously.



1. OUTER RACE
2. INNER RACE
3. BALL
4. CAPSCREW
5. CAPSCREW
6. REAMER BOLT
7. WASHER
8. NUT

Fig. 2-12 Slewing Ring

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3. REMOVAL AND INSTALLATION

3.1 SWING MOTOR (WITH REDUCTION UNIT)

Since the swing motor and the reduction unit are integral, they are to be removed and installed as an assembly.

(1) Removal

(a) Extend outriggers, raise boom to maximum angle and stop engine.

(b) Move swing control lever back and forth several times to relieve residual pressure from hydraulic circuit.

(c) Remove gear oil from inside reduction unit.

(d) Clean motor and piping connections.

(e) Disconnect pipings to the swing control valve, motor drain and disc brake (brake lock).

NOTE

Be sure to keep swing brake lever in the brake release position.

(f) After piping is disconnected, cap motor ports and hydraulic hose ends to prevent dust from entering.

(g) Remove the six reducer mounting bolts. Attach suitable rope between motor and a hoist. Use puller bolt holes to raise assembly until it goes out of fit.

(h) Lift motor vertically and remove from the upper.

Weight of motor (with reduction unit) :

about 117kg (258 lbs)

(i) Fix the removed motor (with reduction unit) to the workbench upright.

(j) Remove the lifting wires. Loosen the capscrews and remove the swing pinion.

CAUTION

After the motor and the reduction unit are removed, the upper becomes free to move and may swing. For this reason, fix the revolving frame to the carrier with the swing lock pin shown in Fig. 2-11.

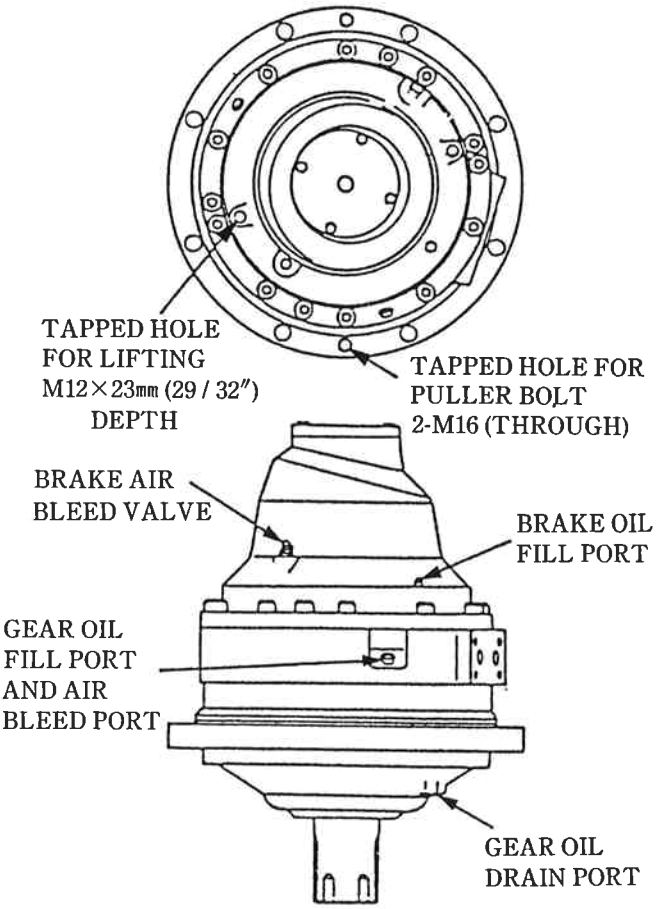


Fig. 3-1 Swing Motor Assembly

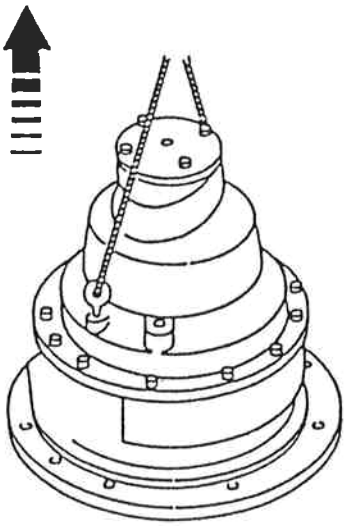


Fig. 3-2 Removing Swing Motor Assembly

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(2) Installation
To install, reverse the removal procedure, paying attention to the following :

(a) When the pinion is to be installed, adjust with shims so that the clearance (a) shown in Fig. 3-3 is 0.1 to 0.4㎜ (0.004 to 0.016in).

(b) Tightening torque :
Swing motor (with reduction unit) mounting capscrews ··· 26 to 32kg · m (188 to 231ft-lbs)
Swing pinion mounting capscrews ····· 6.5 to 7.9kg · m (47 to 57ft-lbs) (with Locktite #271 or equivalent coated to threads).

(c) Gear oil for the reduction unit after installation : #90, 1.3 liters (0.34gals).

(d) Bleed air from the brake lock circuit.

(e) Start the engine. With the swing brake lock in ON, operate left and right swing to relive and bleed air.

(f) Idle the motor to check for noise and oil leak during operation.

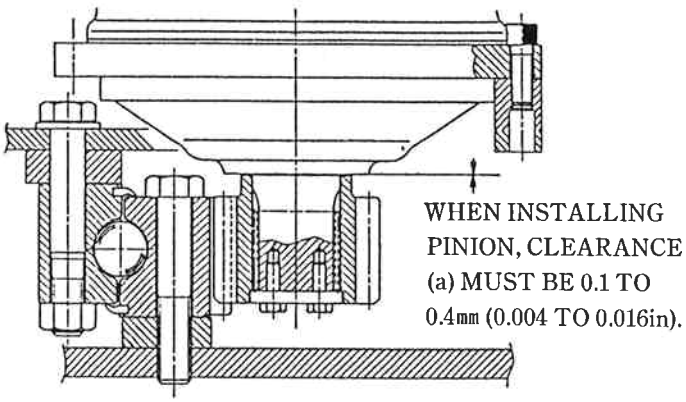


Fig. 3-3 Installing Swing Pinion

3.2 MASTER CYLINDER

(1) Removal

(a) Place the lever in the OFF position and remove the pin connecting the lever and the master cylinder.

(b) Disconnect the tube and hose from the master cylinder.

NOTE

Plug tube and hose to keep oil from flowing out.

(c) Remove the mounting bolts and take out the master cylinder.

(2) Installation
To install the master cylinder, reverse the removal procedure.

NOTE

The machine's swing brake lock system is a static hydraulic pressure type. If any air reminas in the piping, the brake will be ineffective. Because of this, after the piping is connected, fill it with brake fluid and then be sure to bleed air from the bleeder and block of the swing reduction unit.

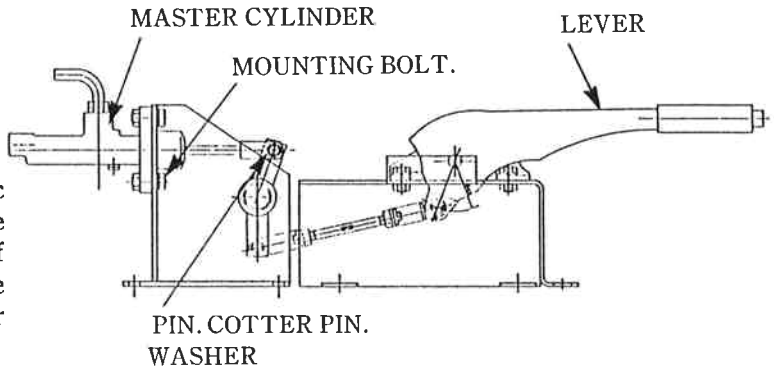


Fig. 3-4 Master Cylinder

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(2) Installation
To install, reverse the removal procedure, paying attention to the following :

(a) When the pinion is to be installed, adjust with shims so that the clearance (a) shown in Fig. 3-3 is 0.1 to 0.4㎜ (0.004 to 0.016in).

(b) Tightening torque :
Swing motor (with reduction unit) mounting capscrews ··· 26 to 32kg · m (188 to 231ft-lbs)
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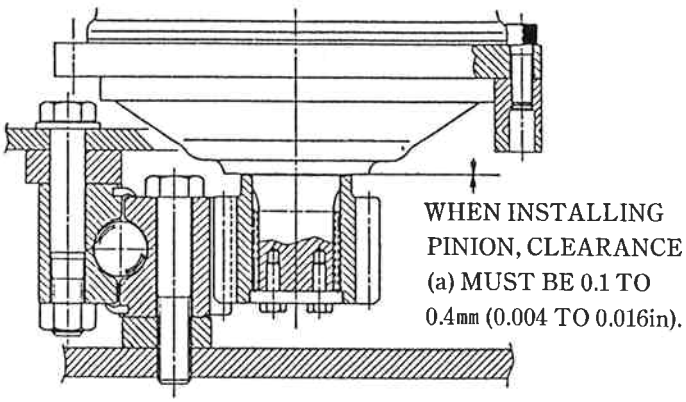


Fig. 3-3 Installing Swing Pinion

3.2 MASTER CYLINDER

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(b) Disconnect the tube and hose from the master cylinder.

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Plug tube and hose to keep oil from flowing out.

(c) Remove the mounting bolts and take out the master cylinder.

(2) Installation
To install the master cylinder, reverse the removal procedure.

NOTE

The machine's swing brake lock system is a static hydraulic pressure type. If any air reminas in the piping, the brake will be ineffective. Because of this, after the piping is connected, fill it with brake fluid and then be sure to bleed air from the bleeder and block of the swing reduction unit.

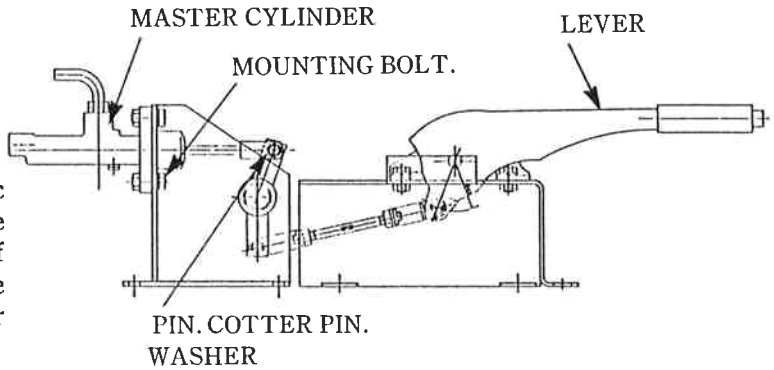


Fig. 3-4 Master Cylinder

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3.3 SLEWING RING

(1) Removal

When the slewing ring is to be dismounted, the upper and crane attachment must first be removed.

(a) Remove the boom (see the separate shop manual "Boom System" .

(b) Remove everything fitted to the swivel joint, such as the hydraulic piping, electric wires, and links. It is recommended to tag each pipe and wire so that they may be more easily identified for reassembly.

It is also recommended to cap hydraulic pipes and swivel joint ports to prevent dirt or dust from entering the hydraulic system.

(c) Temporarily raise the upper with a crane.

(d) Remove the bolts fixing the slewing ring outer race to the upper. If the upper tilts when the bolts are loosened, keep it level with a crane.

(e) After all the bolts have been removed, slowly lift the upper straight up and then lower it.

(f) Remove the bolts fixing the inner race of the slewing ring to the carrier.

(g) Install eye bolts at two points on the slewing ring, and hoist and dismount the ring with a suitable crane (see Fig. 3-5).

Weight of the slewing ring : approx. 354kg (780 lbs)

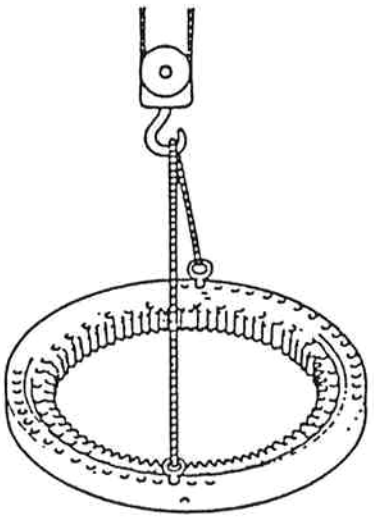


Fig. 3-5 Removing the Slewing Ring

(2) Installation (Slewing Ring and Carrier)

(a) Before installing the slewing ring, clean the installing face of the carrier deck thoroughly to remove all dirt, dust or oil.

(b) Coat the tooth section of the swing ring gear with grease containing molybuden disulphide (showa sunlight grease MB2 or equivalent).

(c) Apply locktite #242 or equivalent to the mounting bolt threads.

(d) Hand-tighten all bolts to hold the slewing ring temporarily.

(e) Choose any two bolts located 180° apart and tighten them to torque 11kg-m (79.5 ft-lbs).

(f) Tighten to torque 11kg-m (79.5ft-lbs) each pair of bolts in a position 90° from the bolts tightened in (e) above.

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(g) By following the above procedure, tighten to torque 11kg-m (79.5ft-lbs) all the bolts symmetrically located two by two.

(h) Finally torque all the bolts to specified torque. Specified torque : 97 to 119kg. m (701 to 860ft-lbs).

(3) Installation (Slewing Ring and Upper)
After the slewing ring has been installed to the carrier, combine the upper to the slewing ring by the following procedure :

(a) Lift the upper horizontally and lower it slowly onto the slewing ring while aligning the centers of ring and upper.

(b) After the swing pinion has intermeshed with the slewing ring gear, lower the upper and aligh the bolt holes of both, using fixing bolts.

(c) Insert the two reamer bolts marked with ○ to fix the position, and then mount other bolts and nuts (see Fig. 3-6).

Apply Locktite #242 or equivalent to the all mounting bolt threads.

(d) Tightening procedures and torque of the reamer bolts and mounting bolts are the sam as those for mounting the inner race.

(e) After the slewing ring and upper are completely reinstalled, reconnect the slewing ring lubrication piping, and all the hydraulic piping, electric cables and links fitted to the swivel joint.

NOTE

After 200 hours of operation, recheck the slewing ring mounting bolt tightening torque.

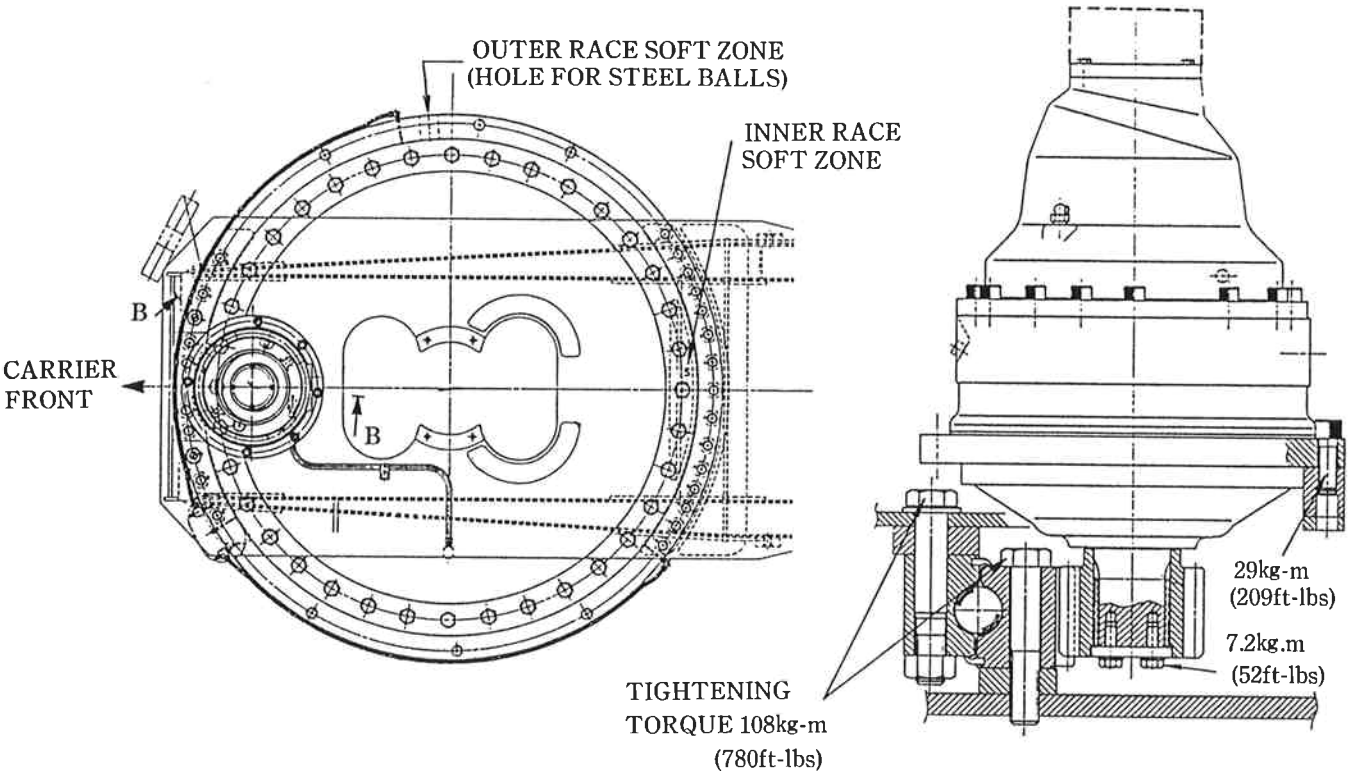


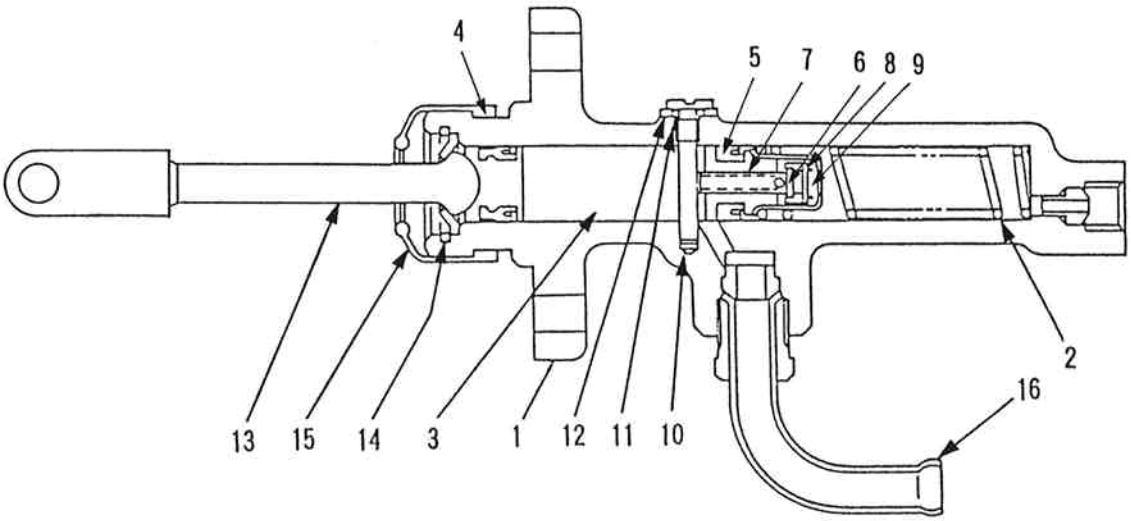
Fig. 3-6

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4. DISASSEMBLY AND ASSEMBLY

4.1 MASTER CYLINDER

To disassemble and assemble the master cylinder, follow the procedures below referring to Fig. 4-1.



1. CYLINDER ASSEMBLY
2. RETURN SPRING
3. PISTON
4. SECONDARY CUP
5. PRIMARY CUP
6. SUPPLY VALVE
7. ROD
8. SPRING
9. SPRING SEAT
10. STOPPER
11. GASKET
12. SPEACER
13. PUSH ROD ASSEMBLY
14. STOP RING
15. BOOT
16. FILLER TUBE ASSEMBLY

Fig. 4-1 Construction of Master Cylinder

(1) Disassembly

(a) Remove boot (15) and stop ring (14), and then remove push rod assembly (13).

(b) Remove stopper (10), gasket (11) and spacer (12), and take out piston (3) and spring (2).

(c) From piston (3), remove secondary cup (4), primary cup (5), spring seat (9), supply valve (6) and rod (7).

(2) Assembly

To assemble the master cylinder, reverse the steps of disassembly while paying attention to the following items :

(a) Thoroughly clean all parts with new brake fluid. Do not attempt to reassemble them dry.

(b) If the internal walls of cylinder assembly (1) or the surface of piston (3) show signs of wear, damage, or rust, replace the master cylinder assembly as an assembly.

(c) Check the edges of cups (4 and 5) for damage. If any, replace.

(d) The oil inlet, exit and bypass ports must be open. Clean them by passing through a wire, etc.

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5. BLEEDING AIR FROM SWING BRAKE

Air trapped in the swing brake piping lowers the braking force. To bleed air from the swing brake, follow the same steps as for the winch brake.

(a) Drive the crane to level, solid ground, pull the swing brake lever, and raise the boom. Thereafter, connect one end of a vinyl hose to the bleeder screw of the swing reduction unit, and submerge the other end of the hose in a container containing a small amount of hydraulic oil.

(b) Operate the swing brake lever several times, and the with the lever pulled back fully, loosen the bleeder screw, and hydraulic oil mixed with air bubbles will come out through the vinyl hose.

(c) Tighten the bleeder screw, operate the swing brake lever again and loosen the bleeder screw. Repeat this procedure until no air bubbles appear.

(d) After the swing brake has completely been bled, tighten the bleeder screw securely and disconnect the vinyl hose.

(e) In the same manner, bleed air from the master cylinder too, then check brake function.

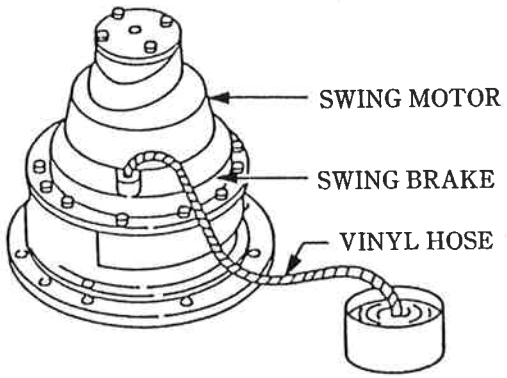
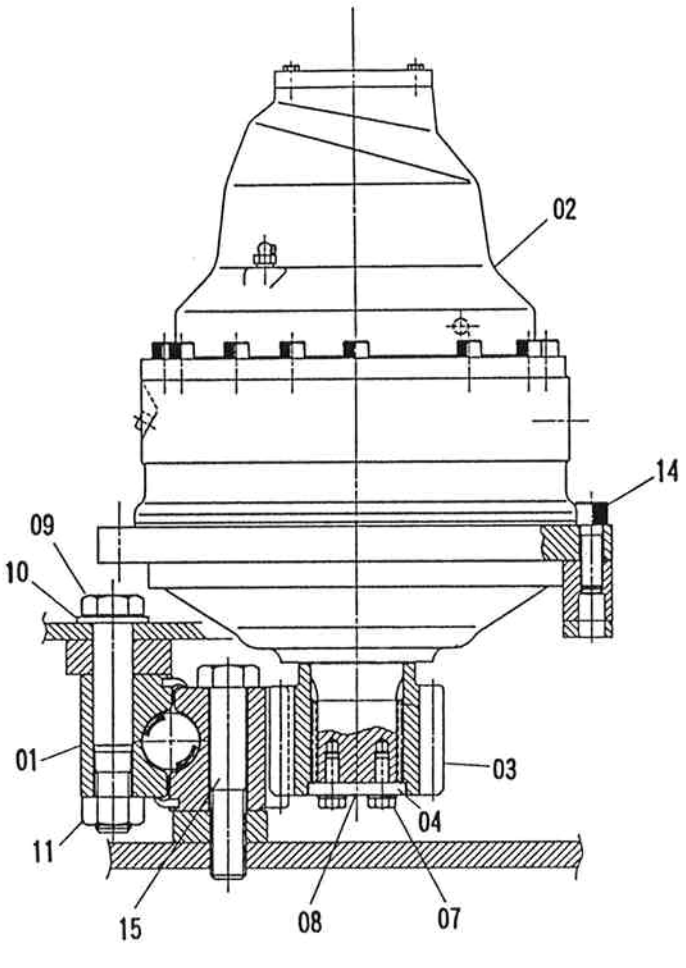


Fig. 5-1 Bleeding Air from Swing Brake

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6. MAINTENANCE STANDARDS



01. SLEWING RING
02. SWING MOTOR (WITH REDUCTION UNIT)
03. PINION
04. RETAINER
07. CAPSCREW
08. LOCK WASHER
09. REAMER BOLT
10. WASHER
11. NUT
14. CAPSCREW
15. CAPSCREW
16. CAPSCREW

Fig. 6-1 Swing System

6.1 TIGHTENING TORQUE

Item No.	Name	Tightening Torque (with Locktite #242 or equivalent)
07	Swing pinion mounting capscrew	6.5 to 7.9kg-m (47 to 57ft-lbs)
14	Swing reduction unit mounting capscrew	26 to 32kg-m (188 to 231ft-lbs)
15	Slewing ring (inner race) mounting capscrew	97 to 119kg-m (701 to 860ft-lbs)
09	Slewing ring (outer race) mounting reamer bolt	97 to 119kg-m (701 to 860ft-lbs)
16	Slewing ring (outer race) mounting capscrew	97 to 119kg-m (701 to 860ft-lbs)

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6.2 GEARS AND SPLINES

Name	Serviceable limit
Slewing ring gear	No unusual wear, pitting and injury on the tooth surface.
Swing pinion	
Other gears	
Fitting clearance of all splines	0.1mm (0.004inch)

6.3 BEARINGS

Name	Serviceable limit
Play of inner race and outer race of slewing ring	0.3mm (0.012inch)
Other bearings	No wear, pitting and injury

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6.2 GEARS AND SPLINES

Name	Serviceable limit
Slewing ring gear	No unusual wear, pitting and injury on the tooth surface.
Swing pinion	
Other gears	
Fitting clearance of all splines	0.1mm (0.004inch)

6.3 BEARINGS

Name	Serviceable limit
Play of inner race and outer race of slewing ring	0.3mm (0.012inch)
Other bearings	No wear, pitting and injury

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7. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
1. Swing inoperative.		
1 Faulty swing motor	Broken piston	Repair or replace assembly.
	Piston seizing	
	Bearing failure	
	Broken drive shaft	
2 Malfunction of swing control valve	Relief valve malfunctioning	Repair or replace assembly.
	Check valve malfunctioning	
3 Reduction unit failure	Gear or pinion failure	Repair or replace assembly.
	Shaft or bearing failure	
4 Faulty brake lock	Piston seizing	Repair or replace assembly.
	Disc seizing or failed	
5 Faulty slewing ring	Slewing ring bearing failure	Repair or replace assembly.
	Slewing ring gear failure	
6 Malfunction of swing stop valve	Malfunction of magnetic proportional pressure reducing valve	Check electric wiring.
		Repair or replace valve.
	Malfunction of pressure control valve	Repair or replace valve.
7 Malfunction of magnetic proportional relief valve	Wrong set pressure of relief valve	Repair or replace valve.
		Check electric wiring.
2. Low swing speed.		
1 Faulty swing motor	Excessively worn valve plate	Repair or replace assembly.
	Excessively worn piston	
	Excessively worn cylinder	
	High hydraulic oil temperature	Lower oil temperature.
2 Malfunction of magnetic proportional relief valve	High hydraulic oil temperature	Lower oil temperature.
3 Malfunction of swing control valve	Incorrectly set relief valve pressure	Adjust, repair or replace.
4 Faulty brake lock	Disc release malfunctioning	Repair or replace parts.

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3. Excessive over-swing

1	Faulty swing motor	Excessive wear throughout the motor leading to excessive drain volume	Repair or replace assembly.
2	Malfunction of swing control valve	Relief valve malfunctioning	Repair or replace assembly.
		Solenoid valve failure	Repair or replace.
		Check valve malfunctioning	Replace assembly.
3	Malfunction of stop valve	Malfunction of magnetic proportional pressure reducing valve	Repair or replace.

4. Abnormal noise while swinging

1	Faulty swing motor	Air inside motor casing	Bleed out the air.
		Motor parts failure	Repair or replace.
2	Malfunction of swing control valve	Relief valve malfunctioning	Repair or replace assembly.
		Air in the valve	Bleed out air.
3	Faulty reduction unit	Bearing failure	Repair or replace assembly.
		Low level or deterioration of lubricant	Add or change oil.
		Pinion failure	Replace assembly.
4	Faulty brake lock	Disc seizing	Repair or replace.
5	Faulty slewing ring	Lack of lubricant	Lubricate.
6	Swing free impossible	Solenoid valve malfunctioning	Repair or replace.
		Stop valve malfunctioning	Repair or replace.
7	Malfunction of stop valve	Malfunction of magnetic proportional pressure reducing valve	Repair or replace.
		Malfunction of pressure control valve	Repair or replace.
8	Malfunction of magnetic proportional relief valve	Incorrective set pressure	Adjust or replace.

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1. LOCATION OF BOOM SYSTEM COMPONENTS

TERMINOLOGY AND LOCATION OF MAIN COMPONENTS

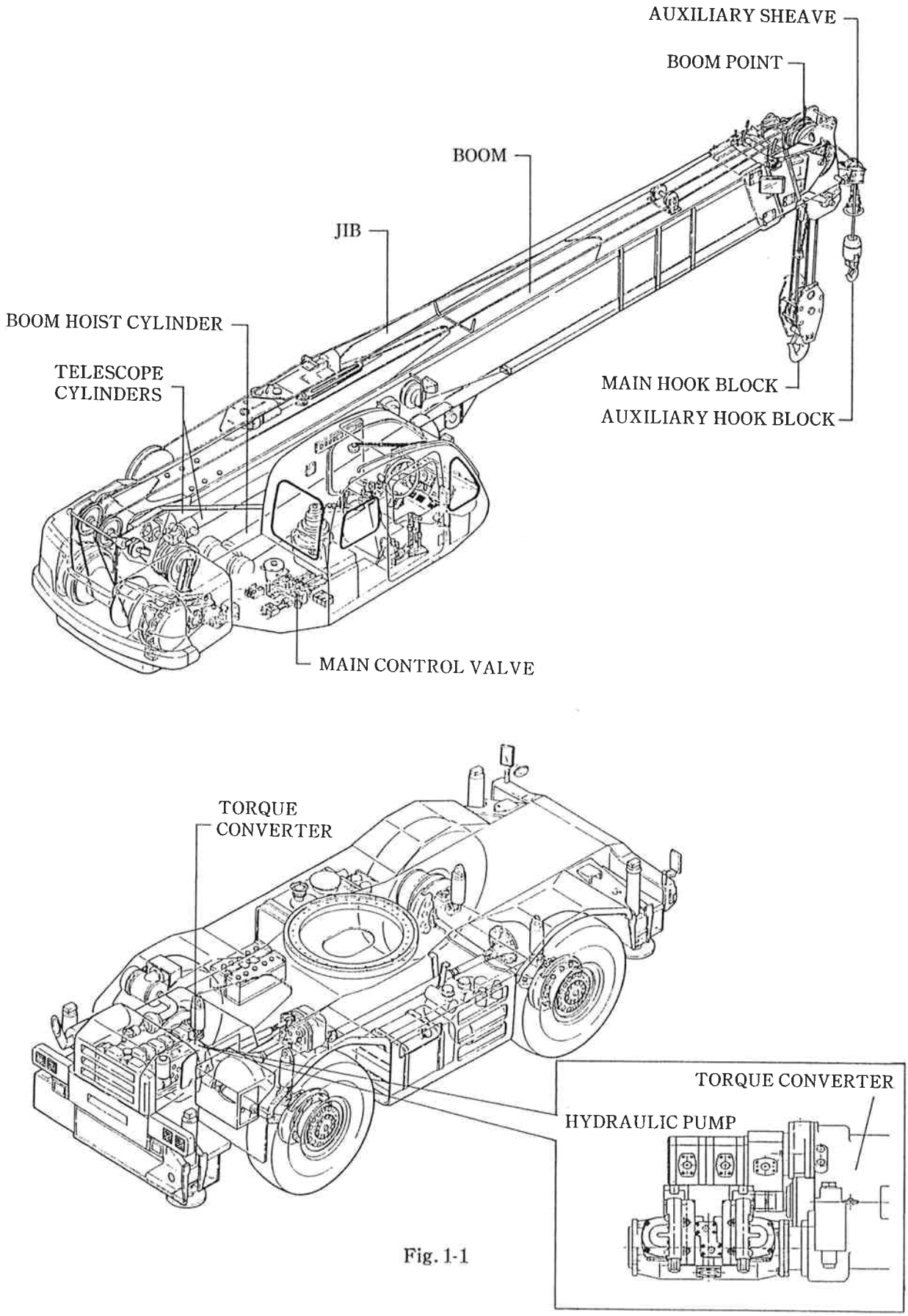


Fig. 1-1

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2. CONSTRUCTION

2.1 BOOM TELESCOPING SYSTEM

(1) General construction and hydraulic units

As shown in Fig. 2-1, the telescoping mechanism is composed of four boom sections from base to 4th, a 4th boom telescoping wire rope, and the hydraulic components that operate them, such as two telescope cylinders, hose reels, pilot check valves extend / retract selector valve and control valve.

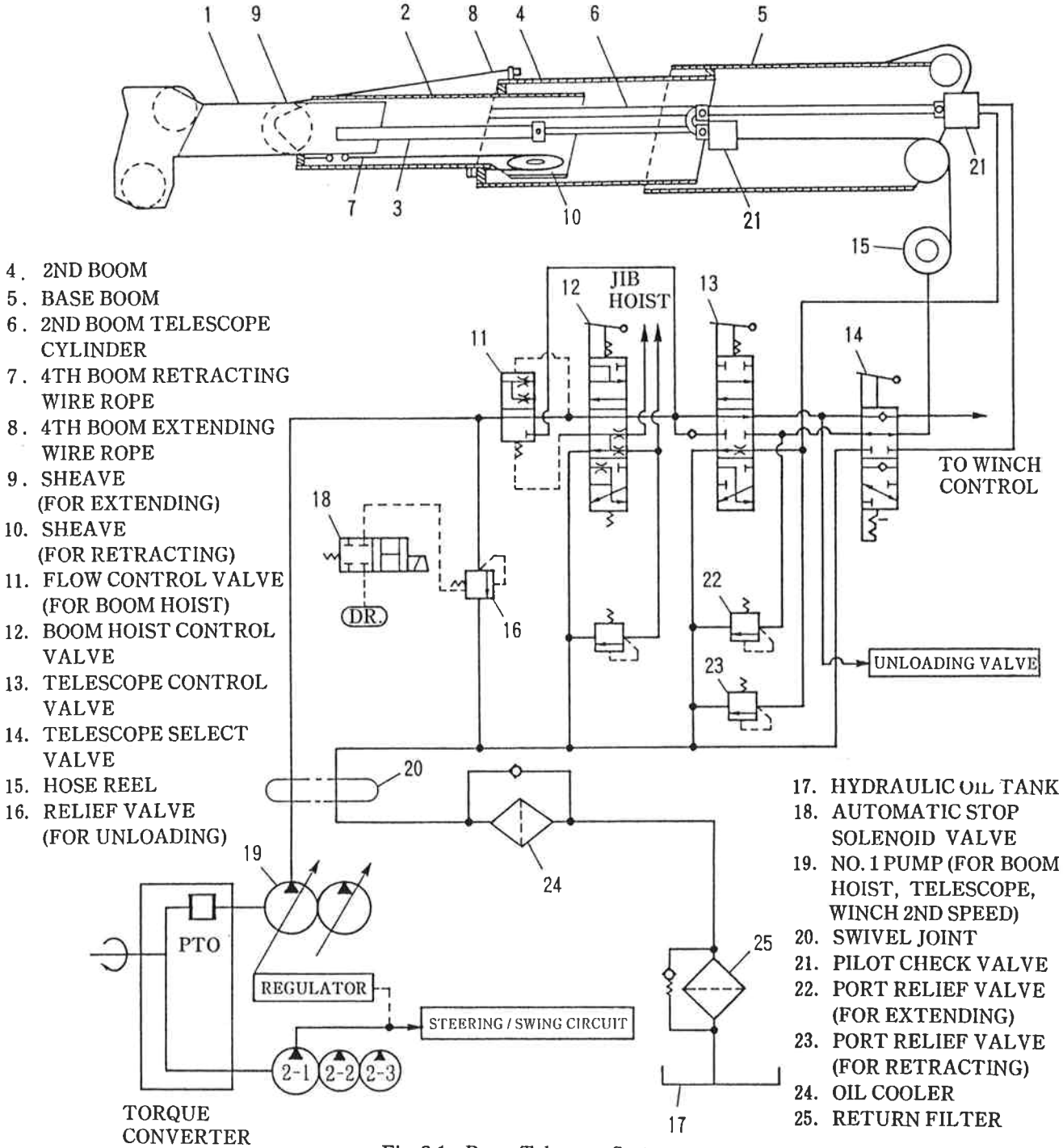


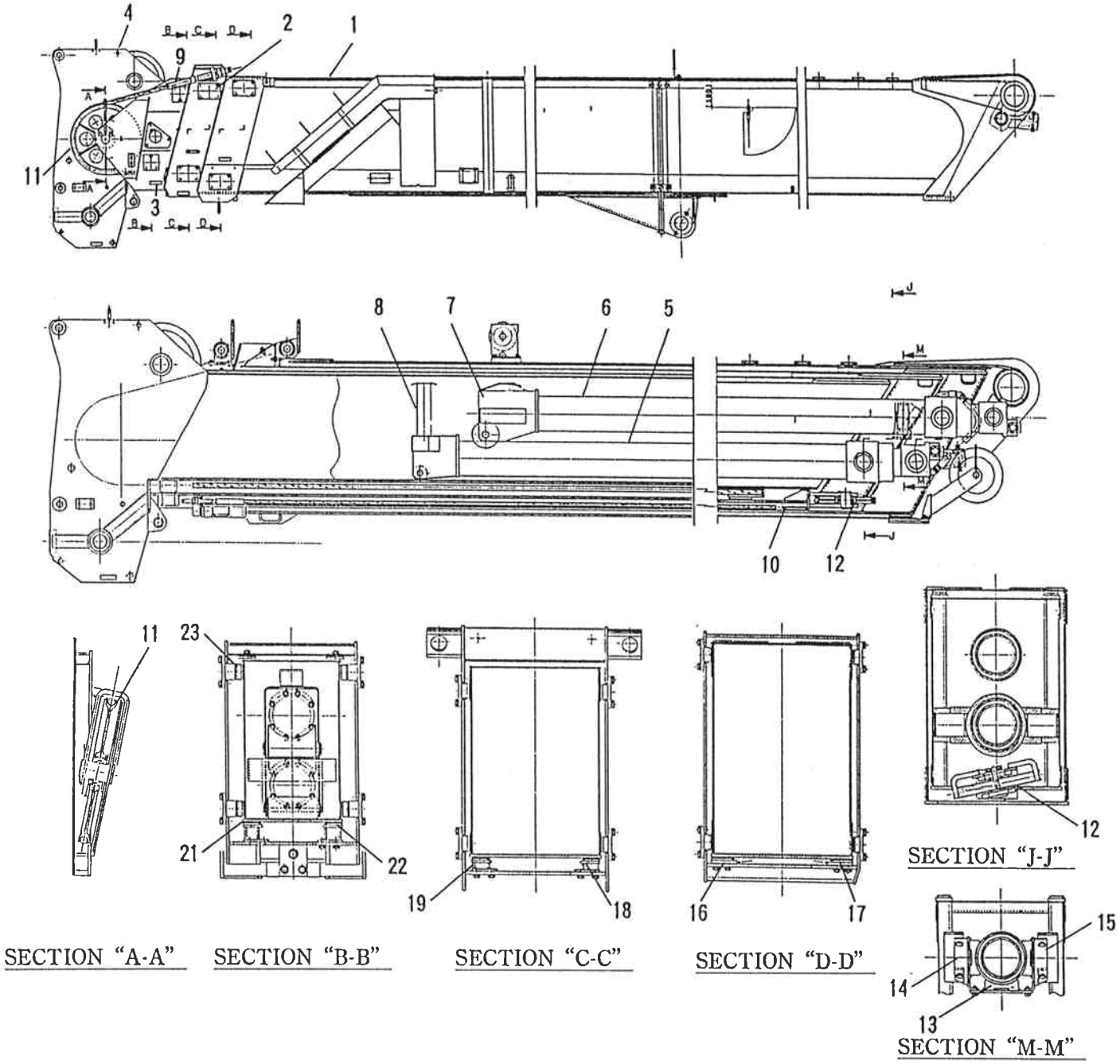
Fig. 2-1 Boom Telescope System

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(2) Sectional construction

The boom is of all welded box type construction of high tensile steel plates, and is composed of four boom sections ; one base sections and three telescoping sections.

Two double acting hydraulic cylinders and two kinds of wire ropes are installed in the boom for the purpose of boom telescoping operation.



1. BASE BOOM
2. 2ND BOOM
3. 3RD BOOM
4. 4TH BOOM
5. TELESCOPE CYLINDER (FOR 3RD AND 4TH BOOMS)
6. TELESCOPE CYLINDER (FOR 2ND BOOM)
7. GUIDE ROLLER ASSEMBLY
8. GUIDE ROLLER ASSEMBLY
9. WIRE ROPE (FOR EXTENDING)
10. WIRE ROPE (FOR RETRACTING)
11. SHEAVE (FOR EXTENDING)
12. SHEAVE (FOR RETRACTING)
13. PAD CARRIER
14. PAD CARRIER
15. PAD CARRIER
16. PAD CARRIER
17. PAD CARRIER
18. PAD CARRIER
19. PAD CARRIER
20. PAD CARRIER
21. PAD CARRIER
22. PAD CARRIER
23. PAD CARRIER

Fig. 2-2 Sectional Construction of Boom

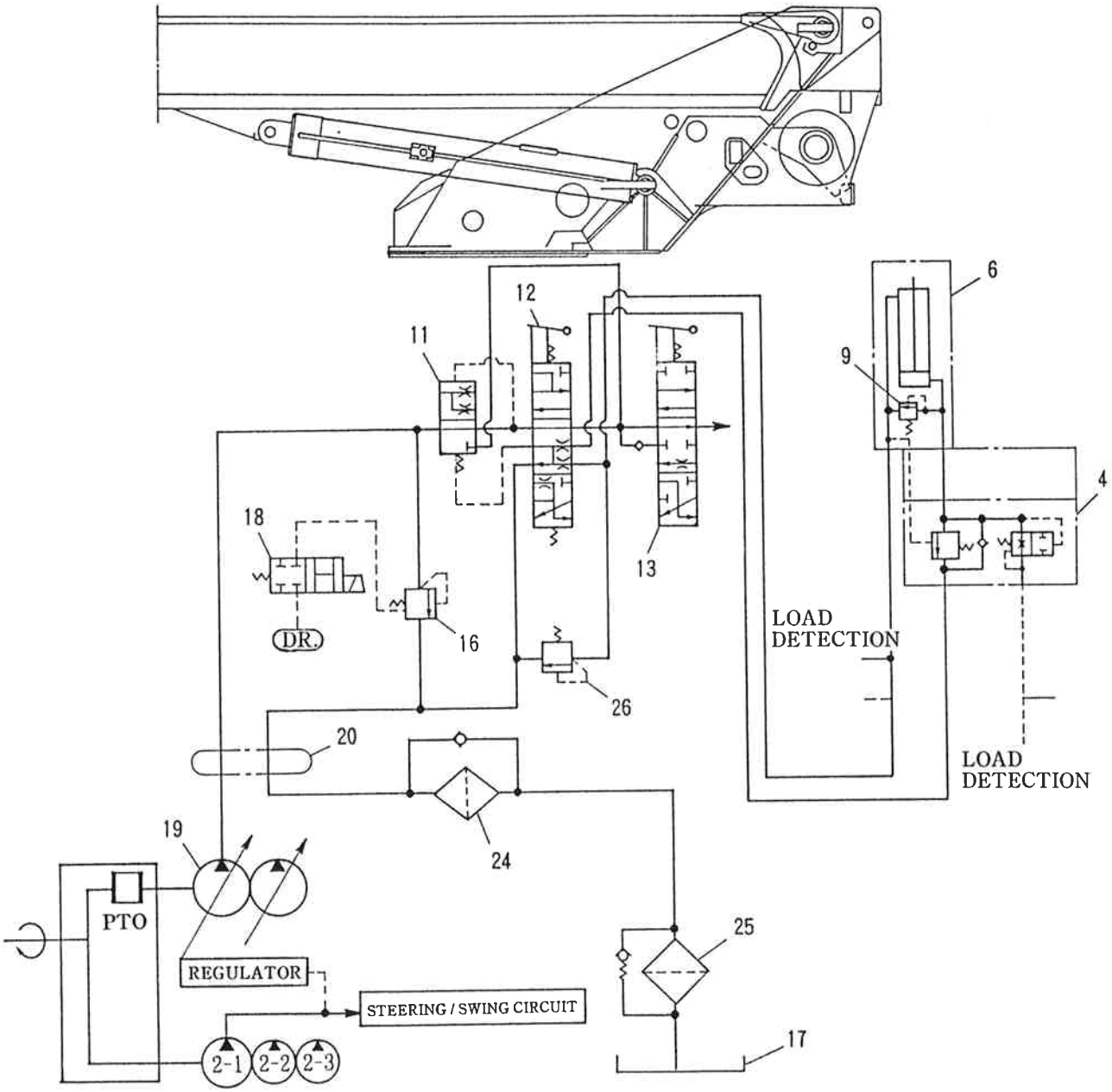
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2.2 BOOM HOIST SYSTEM

The boom hoist system is operated fully hydraulically with one double-acting cylinder. Boom can be hoisted and lowered within a range of 0° to 82° to the horizontal.

Besides the boom hoist cylinder, hydraulic components such as control valve, counterbalance valve are included in the hoist mechanism (see Fig. 2-3).

The hydraulic cylinder is fitted with a counterbalance valve. In the even of the hose connected to the cylinder rupturing, the counterbalance valve functions to prevent the boom from suddenly falling.



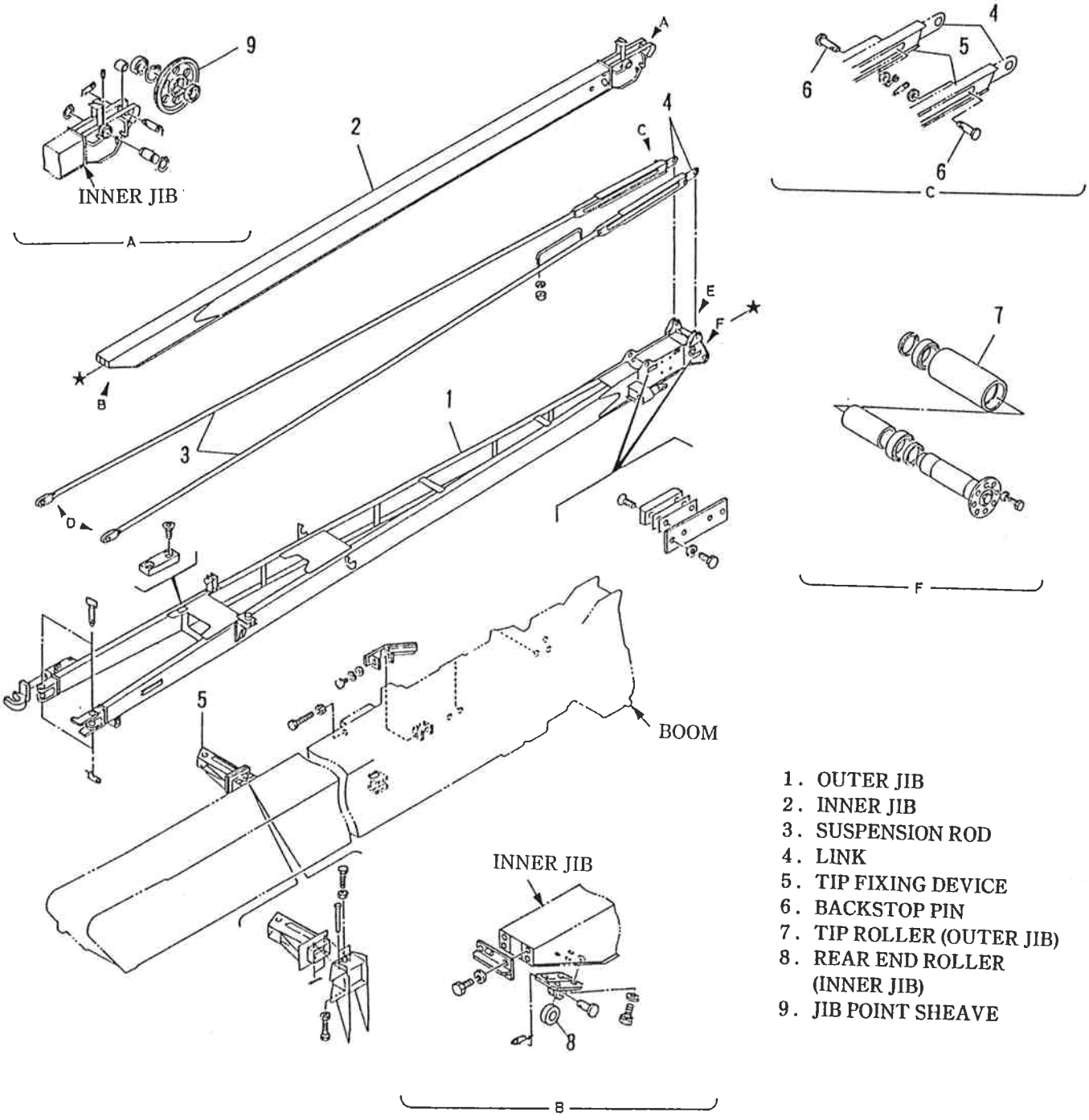
4. COUNTERBALANCE VALVE
6. BOOM HOIST CYLINDER
9. OVERLOAD VALVE
11. FLOW CONTROL VALVE (FOR BOOM HOIST)
12. BOOM HOIST CONTROL VALVE
13. TELESCOPE CONTROL VALVE
16. RELIEF VALVE
17. HYDRAULIC OIL TANK
18. AUTOMATIC STOP SOLENOID VALVE
19. NO. 1 PUMP (FOR BOOM HOIST, TELESCOPE, WINCH 2ND SPEED)
20. SWIVEL JOINT
24. OIL COOLER
25. RETURN FILTER
26. OVERLOAD VALVE (FOR RETRACTING)

Fig. 2-3 Boom Hoist System

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2.3 JIB

The jib is of all welded lattice construction of high tensile steel, two step telescoping constitution, variable offset angle type, and is extended beyond the boom point. It is made to be easily extended from and folded against the side face of the base boom.
The jib is composed of the parts shown in Fig. 2-4.



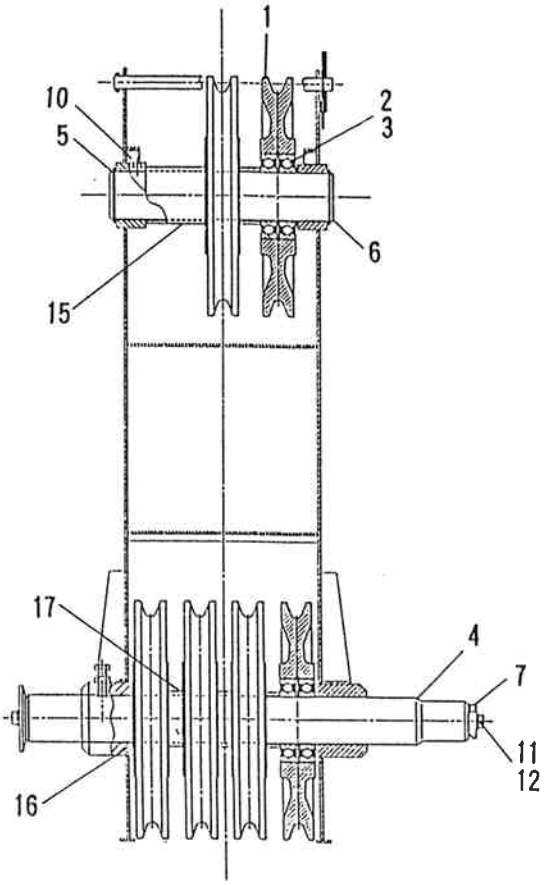
1. OUTER JIB
2. INNER JIB
3. SUSPENSION ROD
4. LINK
5. TIP FIXING DEVICE
6. BACKSTOP PIN
7. TIP ROLLER (OUTER JIB)
8. REAR END ROLLER (INNER JIB)
9. JIB POINT SHEAVE

Fig. 2-4 Jib Assembly

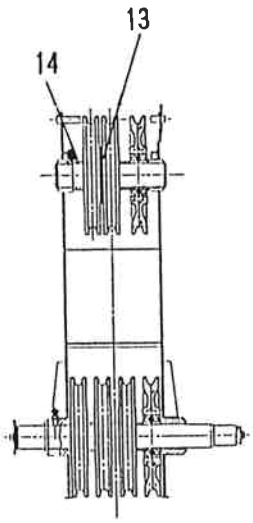
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2. 4 BOOM POINT ASSEMBLY

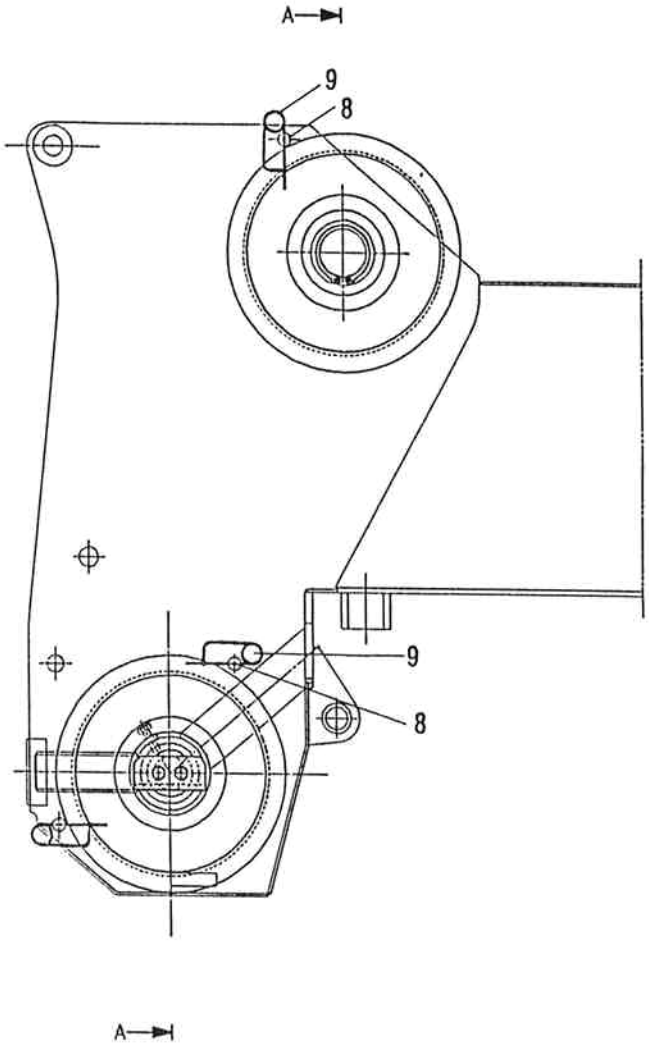
The boom point assembly is mounted on the tip of the 4th boom, and has two upper sheaves (three sheaves for the optional third drum) and four lower sheaves as shown in Fig. 2-5.



SECTION "A-A" (STANDARD)



SECTION "A-A" (FOR THIRD)



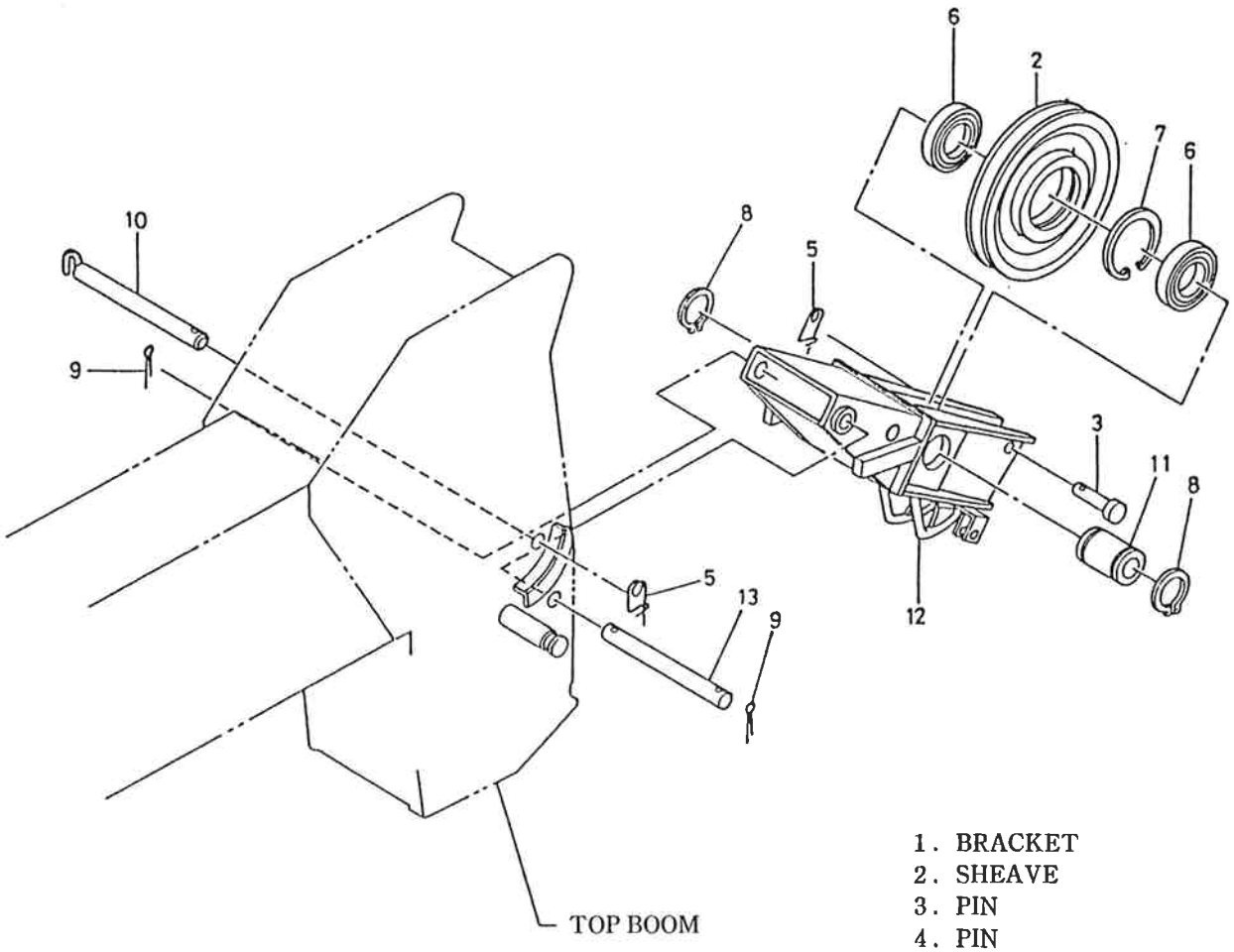
1. SHEAVE
2. BALL BEARING
3. SNAP RING
4. POINT PIN
5. PIN
6. SNAP RING
7. RETAINER
8. PIN
9. LOCK SPRING PIN
10. SET SCREW
11. CAPSCREW
12. LOCKWASHER
13. SPACER
14. SPACER
15. SPACER
16. SPACER
17. SPACER

Fig. 2-5 Boom Point Assembly

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2.5 AUXILIARY SHEAVE

The auxiliary sheave is mounted to the upper end of the 4th boom, having one sheave as shown in Fig. 2-6.



1. BRACKET
2. SHEAVE
3. PIN
4. PIN
5. LOCK SPRING PIN
6. BEARING
7. SNAP RING
8. SNAP RING
9. COTTER PIN
10. PIN
11. PIN

Fig. 2-6 Auxiliary Sheave Assembly

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2.6 HOOK BLOCK

Three kinds of hook blocks ; 25 ton, 18 ton and 3 ton hook blocks, are prepared.
Each hook block is of a swivel type with a wire stopper.

(1) 25 ton (55,100 lbs) Hook Block

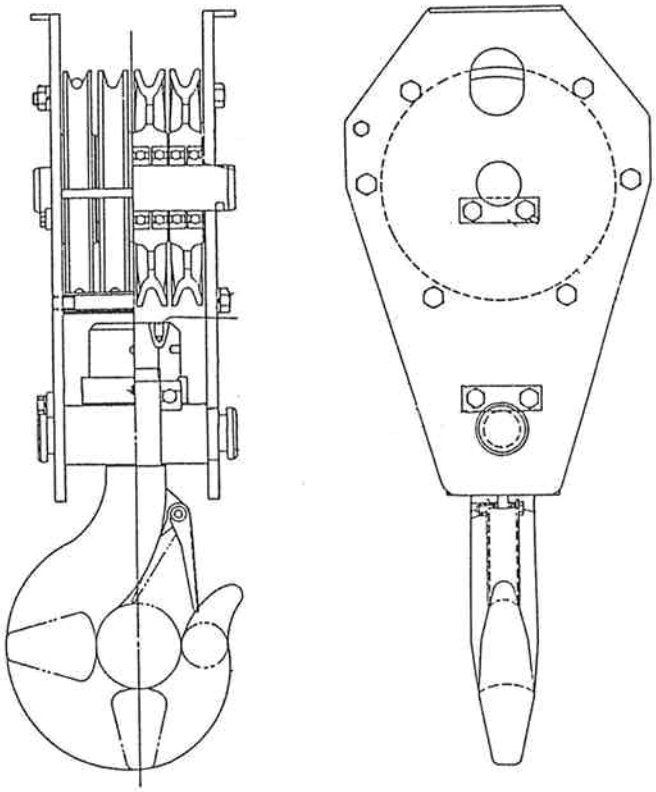


Fig. 2-7 25 ton Hook Block

(2) 18 ton (39,700 lbs) Hook Block

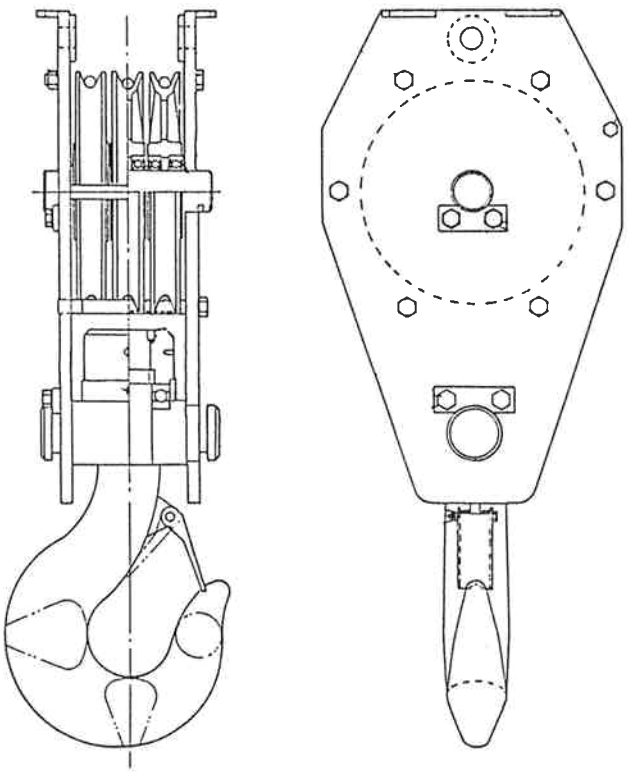


Fig. 2-8 18 ton Hook Block

(3) 3 ton (6,600 lbs) Ball Hook

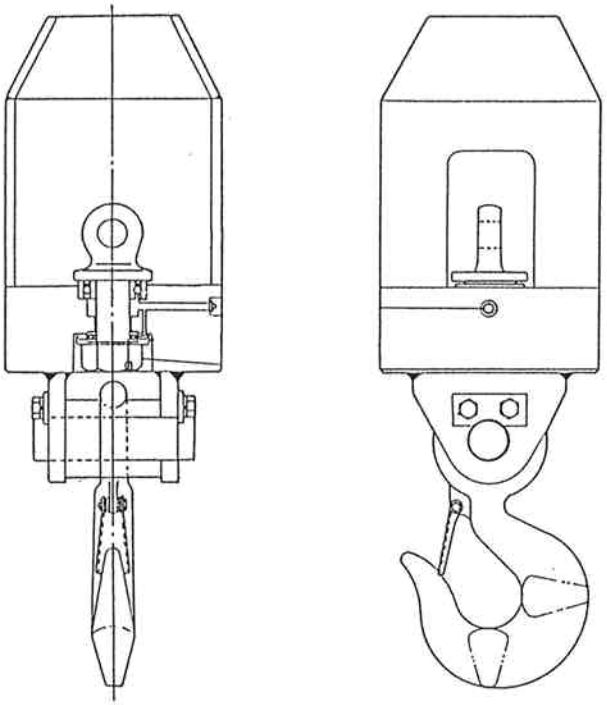


Fig. 2-9 3 ton Ball Hook

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3. FUNCTION

3.1 BOOM TELESCOPING SYSTEM

(1) Boom Extension

The booms are extended in two steps ; first, the 2nd boom is extended with the 2nd boom telescope cylinder, then the 3rd and 4th booms are simultaneously extended with the 3rd boom telescope cylinder and the wire rope.

(a) 2nd boom extension

As shown in Fig. 3-1, pressurized oil from PTO No. 1 pump enters the telescope valve, where the oil is directed to the cylinder extension. Then, the oil is directed to the 2nd boom cylinder by the telescope select valve, and finally it is fed to the 2nd boom telescope cylinder through the pilot check valve, extending the 2nd boom.

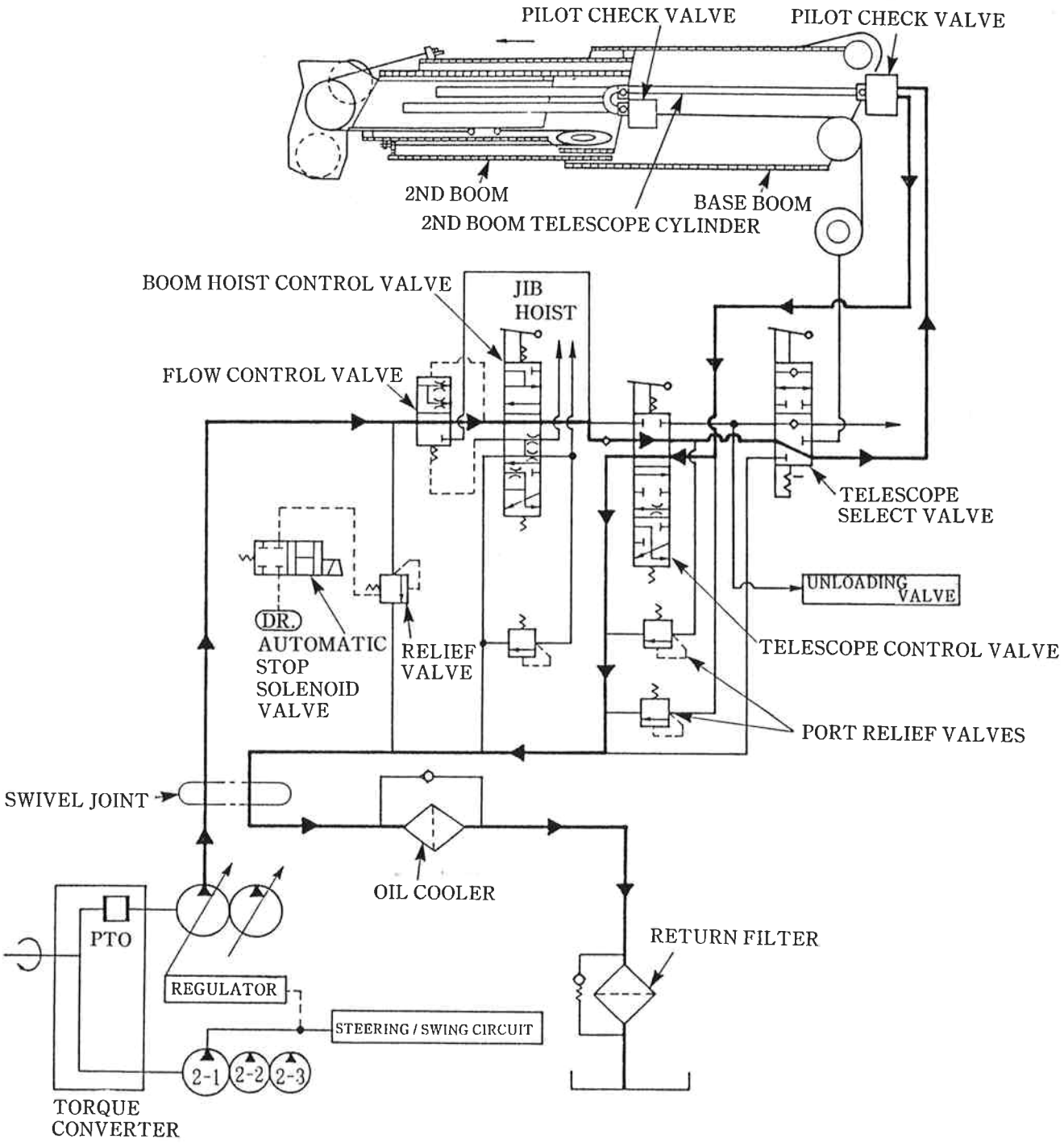


Fig. 3-1 2nd Boom Extension Circuit

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(b) 3rd / 4th boom extension

After the 2nd boom has been extended to the specified stroke as shown in Fig. 3-2, shift the telescope select lever from the 2ND BOOM position to the 2ND / 3RD BOOM position. Then, the telescope select valve is directed to the 3rd boom telescope cylinder position.

Pressurized oil passes the pilot check valve, and is supplied to the 3rd boom telescope cylinder through the pilot check valve, extending the 3rd / 4 th booms. The 4th boom is extended with the 3rd boom by the wire rope linked to the movement of the 3rd boom.

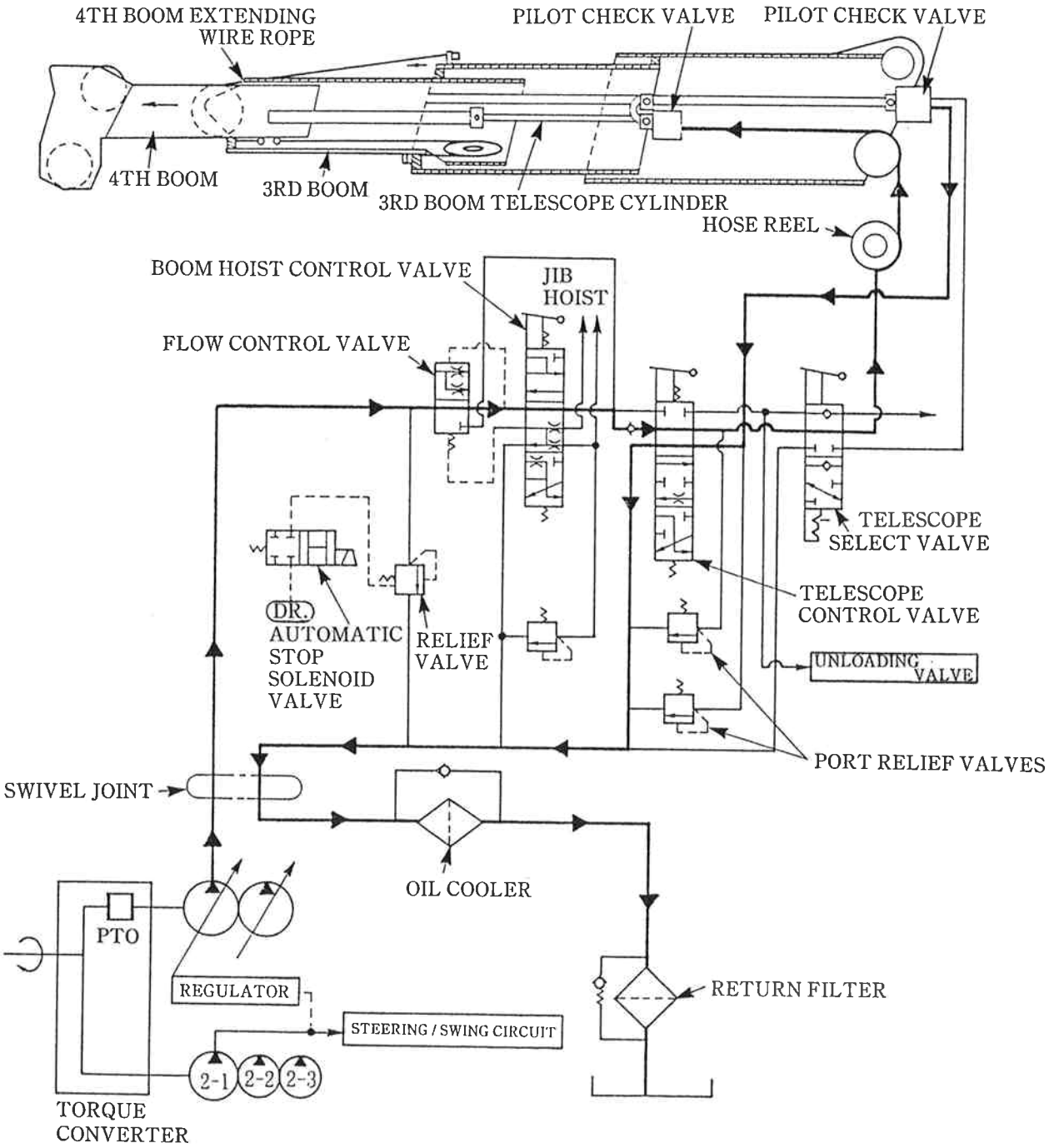


Fig. 3-2 3rd / 4th Boom Extension Circuit

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(2) Boom Retraction

The booms are retracted in the order of the 3 rd and 4th together, and then the 2nd.

(a) 3rd and 4th boom retraction

As shown in Fig. 3-3, by shifting the telescope select lever to the 3RD / 4TH position and shifting the control valve into the retracting direction, the pressurized oil from the pump passes the piping in the rod of the 2nd boom telescope cylinder, and is supplied to the rod side of the 3rd boom telescope cylinder. At the same time, the oil in the bottom side of the 3rd boom cylinder passes the pilot check valve, returning from the control valve to the hydraulic oil tank. This retracts the 3rd boom telescope cylinder.

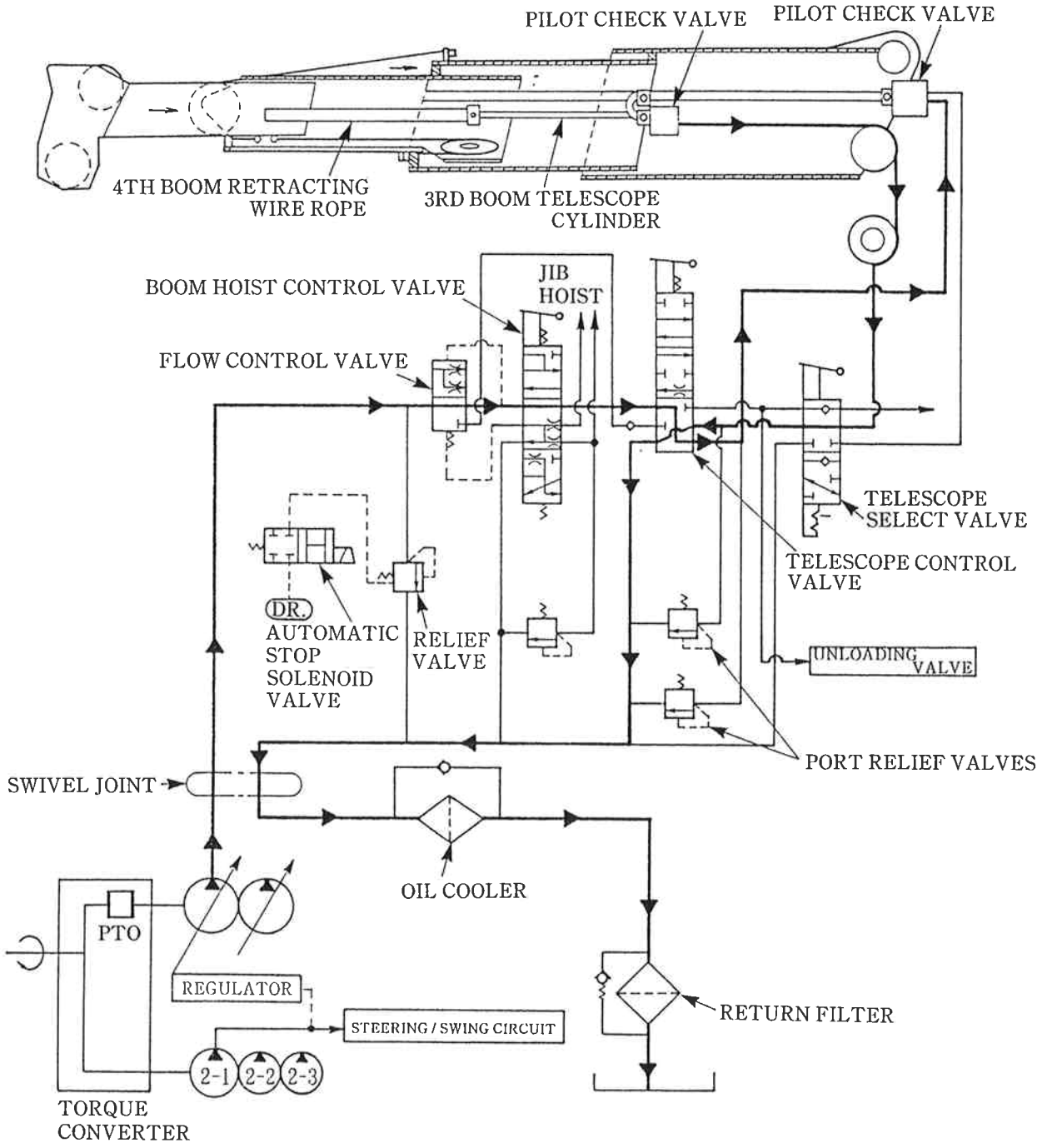


Fig. 3-3 3rd / 4th Boom Retraction Circuit

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(b) 2nd boom retraction

When the boom telescope select lever is placed in the 2ND BOOM position with the 3rd / 4th booms fully retracted, by shifting the control valve to the retraction as shown in Fig. 3-4, pressurized oil from the pump is supplied to the rod side of the 2nd boom telescope cylinder and the bottom side circuit is connected to the tank, so the 2nd boom is retracted.

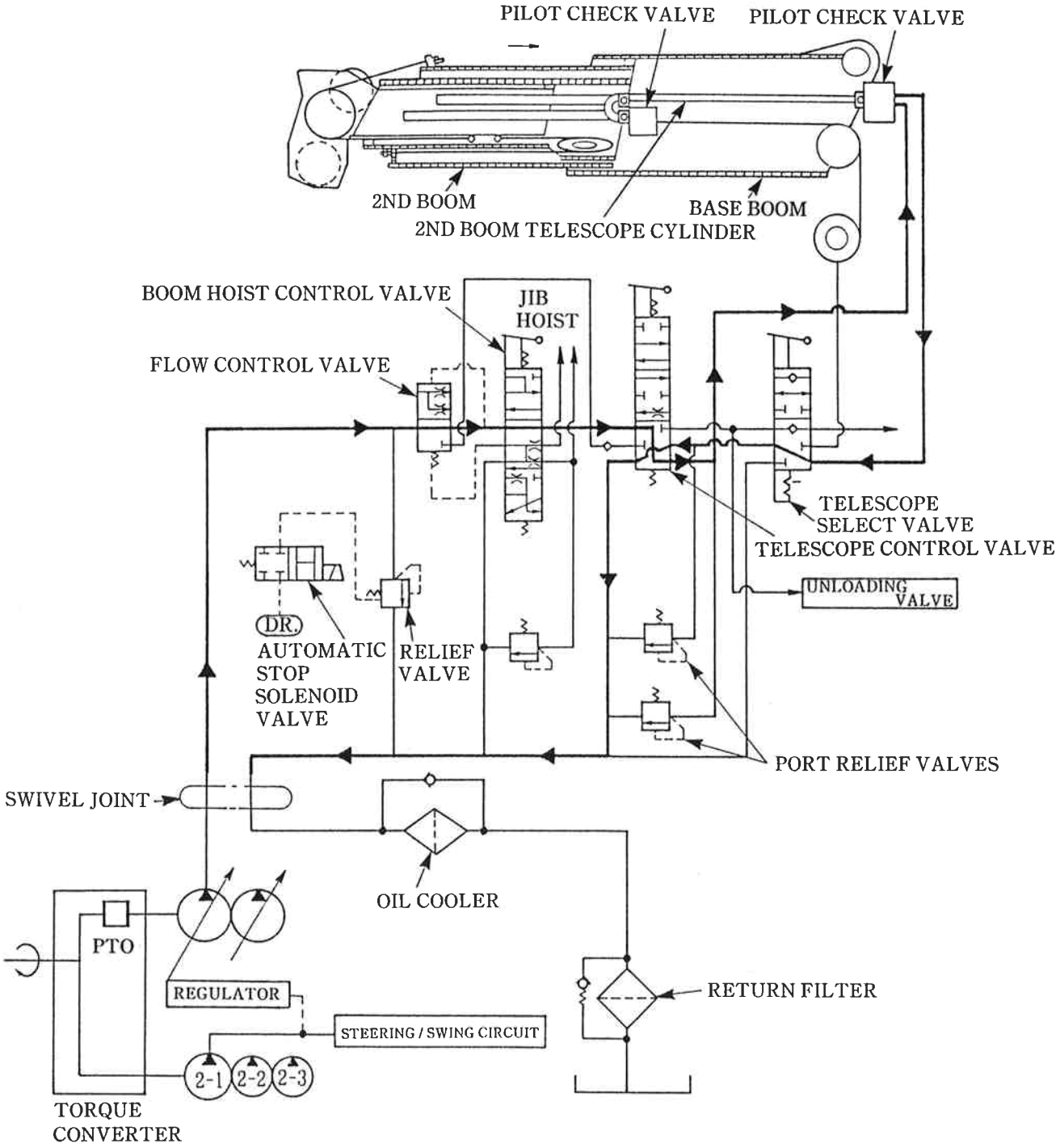


Fig. 3-4 2nd Boom Retraction Circuit

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(3) Detail of 4th Boom Telescoping

(a) Extension

When 3rd boom (B) is extended by 3rd boom telescoping cylinder (A) extension, the 4th boom is drawn out by the 4th boom extending wire rope attached to the bottom of the 4th boom and the upper end of the 2nd boom via sheave (C), and the 4th boom is extended simultaneously with extension of the 3rd boom.

(b) Retraction

When 3rd boom (B) is retracted, the 4th boom is drawn in by the 4th boom retracting wire rope attached to the lower end of the 4th boom and the upper end of the 2nd boom via sheave (D), and the 4th boom is retracted simultaneously with retraction of the 3rd boom.

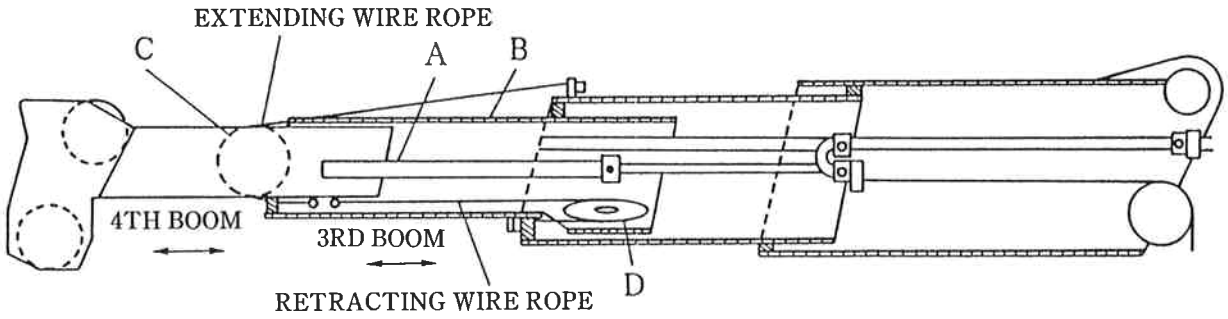


Fig. 3-5 Extension and Retraction of 4th Boom

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(4) Operation of Boom Telescope Selection

By operating the boom telescope select lever in the left side of the operator's seat, the telescope select valve is shifted. After the 2nd boom has been completely extended, push this lever forward to lead hydraulic oil for extending the cylinder to the 3rd boom telescope cylinder to extend the 3rd / 4th booms. After the 3rd / 4th booms have been completely retracted from full extension, pull this lever backward to shift the telescope select valve from the 3rd boom telescope cylinder circuit to the 2nd boom telescope cylinder circuit.

If the telescoping order is mistaken, boom telescoping is impossible, and the telescope mistake alarm lamp on the electronic meter panel in front of the operator's seat lights up.

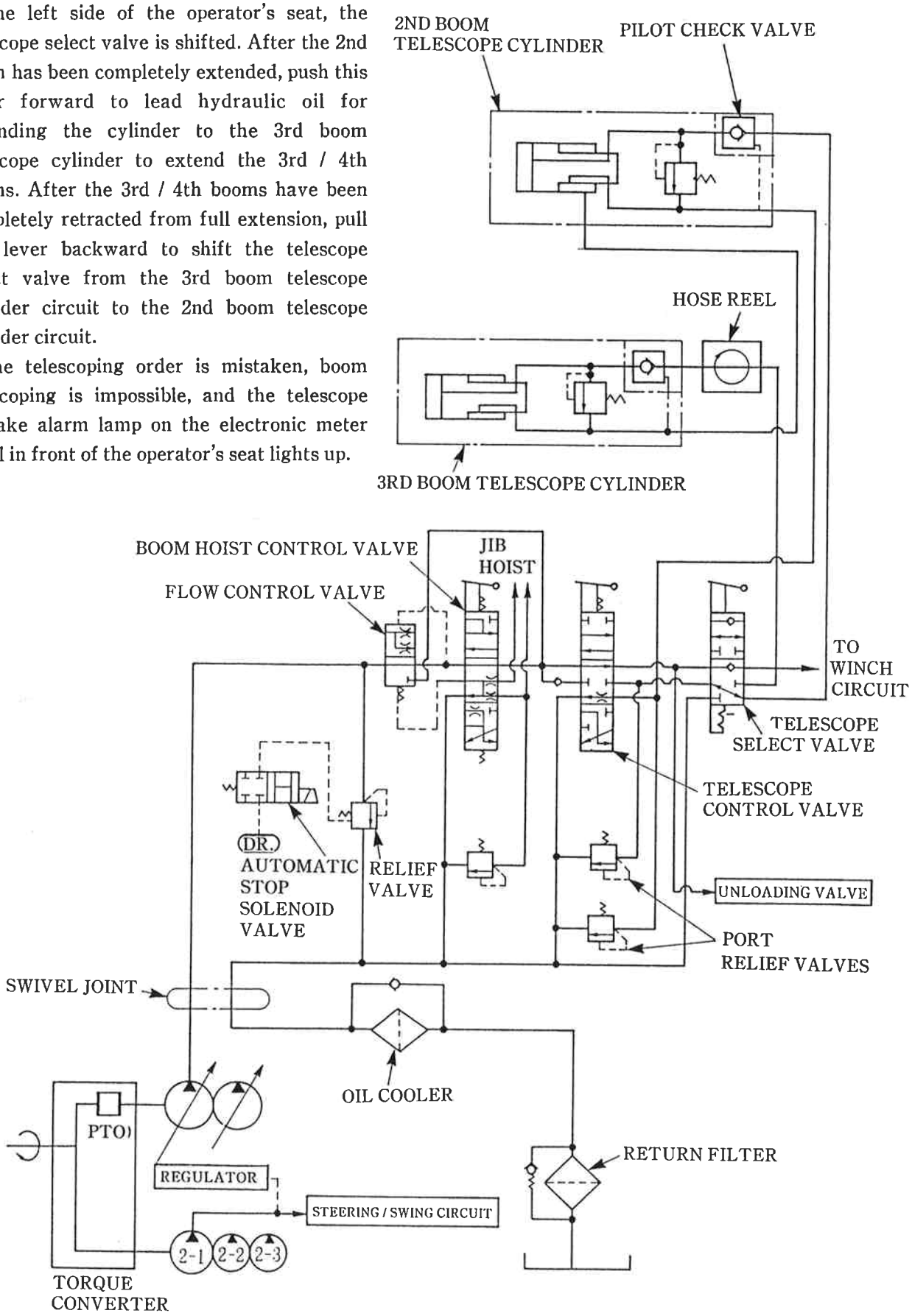


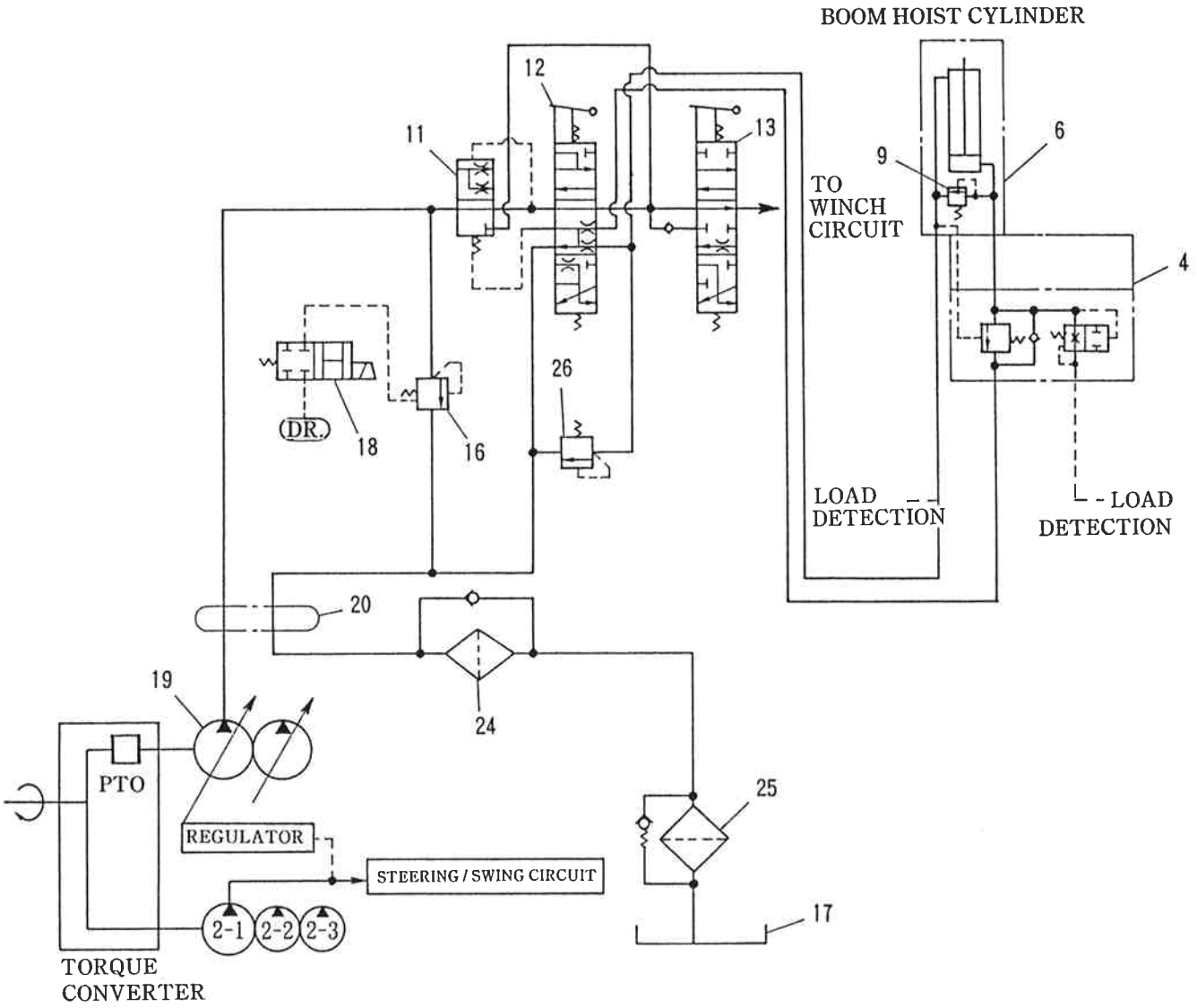
Fig. 3-6 Boom Telescope Selection Circuit

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3.2 BOOM HOIST SYSTEM

(1) Holding the Boom (Neutral)

As shown in Fig. 3-7, the bottom side of boom hoist cylinder (6) is under hydraulic pressure, but the circuit is blocked by counterbalance valve (4), and oiltight is kept. By this, the boom is held stationary, not to lower, even if it is loaded.



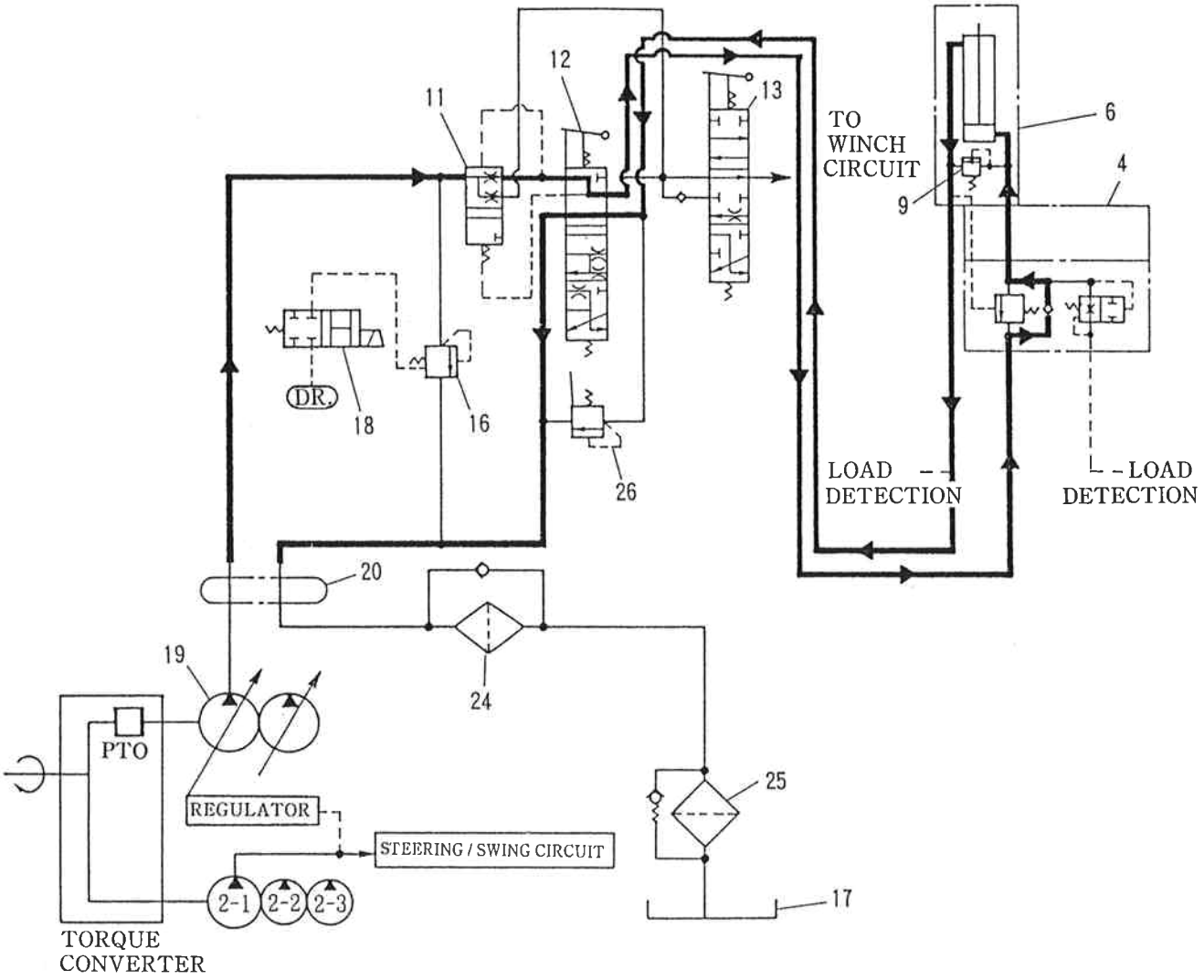
4. COUNTERBALANCE VALVE
6. BOOM HOIST CYLINDER
9. OVERLOAD VALVE
11. FLOW CONTROL VALVE
12. BOOM HOIST CONTROL VALVE
13. TELESCOPE CONTROL VALVE
16. RELIEF VALVE
17. HYDRAULIC OIL TANK
18. AUTOMATIC STOP SOLENOID VALVE
19. NO. 1 PUMP (FOR BOOM HOIST, TELESCOPE, WINCH 2ND SPEED)
20. SWIVEL JOINT
24. OIL COOLER
25. RETURN FILTER
26. OVERLOAD VALVE (FOR RETRACTING)

Fig. 3-7 Boom Holding (Neutral) Circuit

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(2) Raising the Boom (see Fig. 3-8).

When the spool of control valve (3) is shifted, pressurised oil flows into the bottom side of boom hoist cylinder (6) through the control valve and counterbalance valve (4)'s check valve, while oil in the rod side of the boom hoist cylinder passes to hydraulic oil tank (17) through boom hoist control valve (12). This raises the boom. If a surge pressure develops in the boom hoist cylinder (6)'s bottom side circuit, overload valve (9) functions to let the surge pressure pass to the rod side circuit of the cylinder.



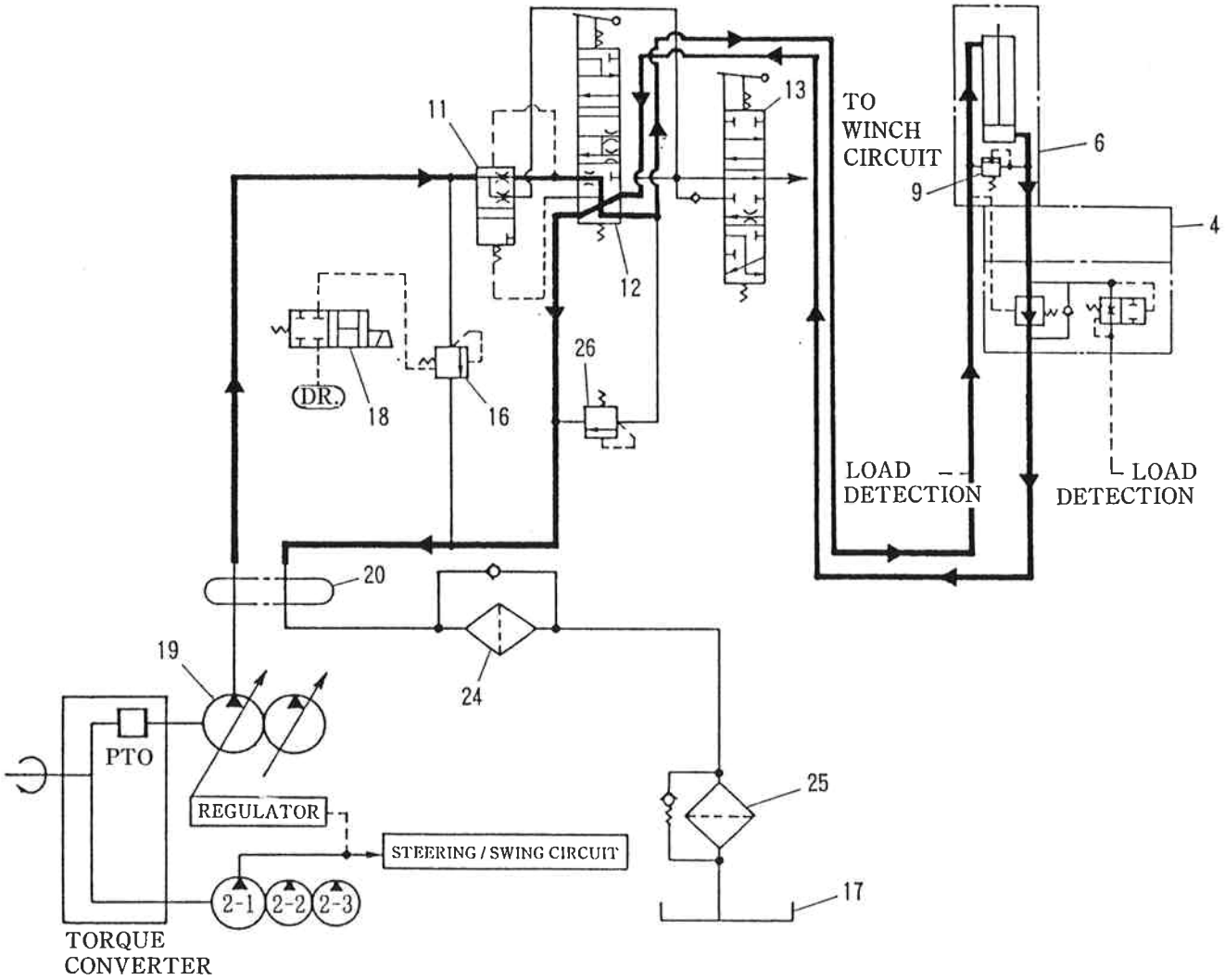
4. COUNTERBALANCE VALVE
6. BOOM HOIST CYLINDER
9. OVERLOAD VALVE
11. FLOW CONTROL VALVE (FOR BOOM HOIST)
12. BOOM HOIST CONTROL VALVE
13. TELESCOPE CONTROL VALVE
16. RELIEF VALVE
17. HYDRAULIC OIL TANK
18. AUTOMATIC STOP SOLENOID VALVE
19. NO. 1 PUMP (FOR BOOM HOIST, TELESCOPE, WINCH 2ND SPEED)
20. SWIVEL JOINT
24. OIL COOLER
25. RETURN FILTER
26. OVERLOAD VALVE (FOR RETRACTING)

Fig. 3-8 Boom Raising Operation Circuit

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(3) Lowering the Boom (see Fig. 3-9).

When the spool of control valve (12) is shifted, pressurized oil is fed directly into the rod side of the boom hoist cylinder (6). Meanwhile, the oil in the bottom side of the boom hoist cylinder returns to hydraulic oil tank (17) through counterbalance valve (4) and control valve (12), because the spool of the counterbalance valve is shifted by pressure developed in the rod side of the line as a result of the bottom side being closed off from the rest of the line by the check valve in counterbalance valve (4).



4. COUNTERBALANCE VALVE
6. BOOM HOIST CYLINDER
9. OVERLOAD VALVE
11. FLOW CONTROL VALVE (FOR BOOM HOIST)
12. BOOM HOIST CONTROL VALVE
13. TELESCOPE CONTROL VALVE
16. RELIEF VALVE
17. HYDRAULIC OIL TANK
18. AUTOMATIC STOP SOLENOID VALVE
19. NO. 1 PUMP (FOR BOOM HOIST, TELESCOPE, WINCH 2ND SPEED)
20. SWIVEL JOINT
24. OIL COOLER
25. RETURN FILTER
26. OVERLOAD VALVE (FOR RETRACTING)

Fig. 3-9 Boom Lowering Operation Circuit

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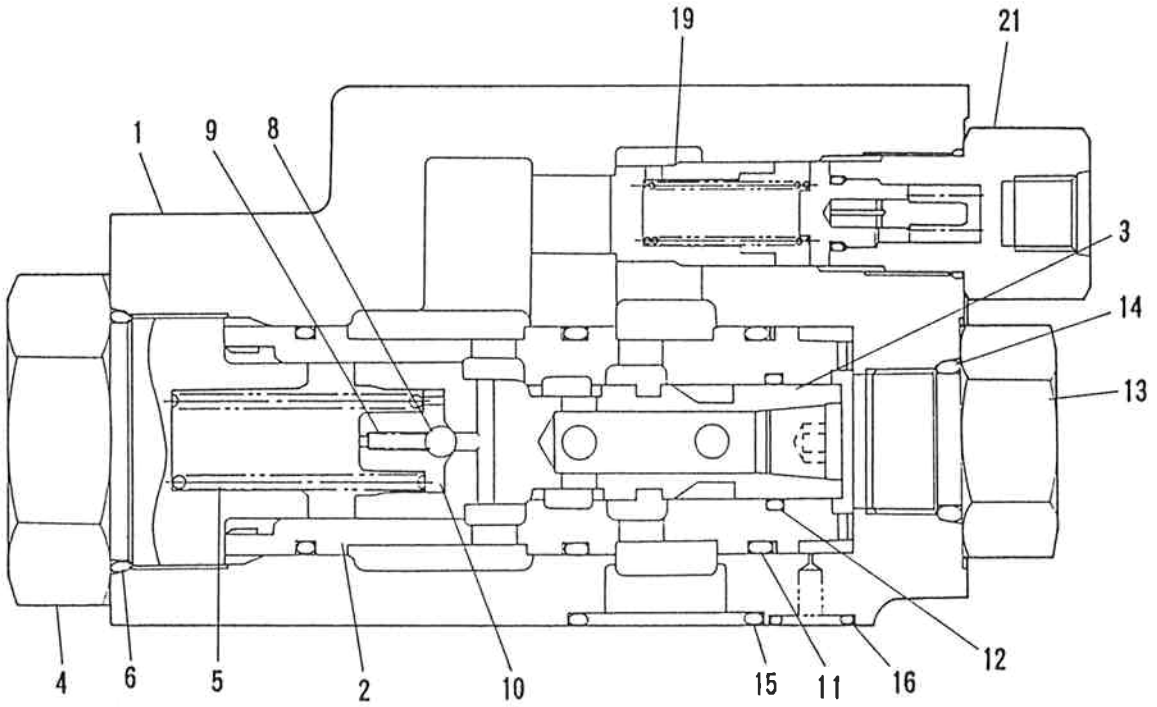
3.3 AUTO-STOP SOLENOID VALVE

When the load safety device operates during boom hoist or telescope, auto-stop solenoid valve (18) functions to return hydraulic oil, from pump (19) to control valve (12), to the hydraulic oil tank, through relief valve (16), and stops the operation.

At this time, the automatic stop device can be temporarily released by operating the automatic stop release switch on the side console in the operator's room.

■ CONSTRUCTION OF VALVE

(1) Inching Speed Valve

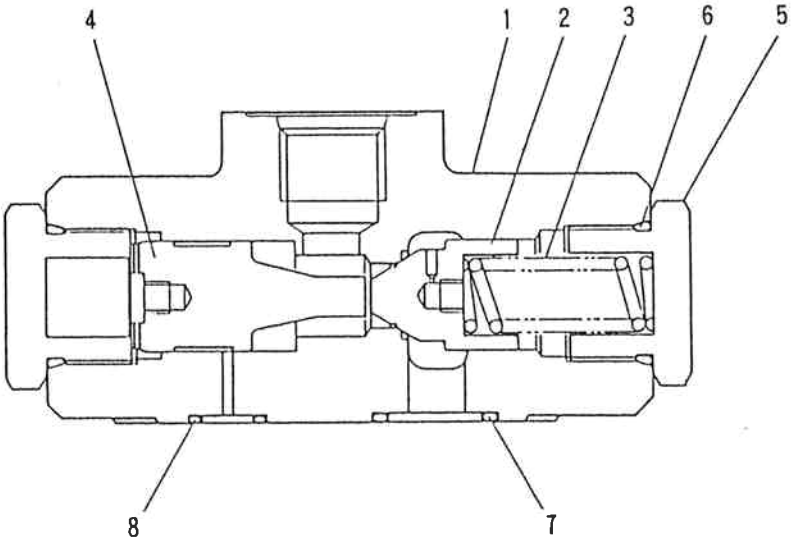


1. BODY
2. SOCKET
3. SPOOL
4. PLUG
5. SPRING
6. O-RING
7. O-RING
8. BALL
9. SPRING
10. STOPPER
11. BACK-UP RING
12. O-RING
13. PLUG
14. O-RING
15. O-RING
16. O-RING
19. CHECK VALVE
20. SPRING
21. FUSE VALVE
22. PLUG (NOT SHOWN)
23. O-RING (NOT SHOWN)

Fig. 3-11 Inching Speed Valve

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(2) Pilot Check Valve



1. BODY	3. SPRING	5. PLUG	7. O-RING
2. CHECK VALVE	4. SPOOL	6. O-RING	8. O-RING

Fig. 3-12 Pilot Check Valve

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4. DISASSEMBLY AND ASSEMBLY

4.1 BOOM TELESCOPING SYSTEM

4.1.1 REMOVAL AND INSTALLATION

(1) Removal

To remove the boom, proceed as follows :

(a) Set crane in the travelling condition.
When the auxiliary sheave is attached, fold and stow it to the tip end of the 4th boom.

(b) Remove the main winch wire rope from the main hook block. Remove the auxiliary winch wire rope socket from the bracket on the boom. Wind the both wire ropes on the respective drum, and fix them not to come out from the drums.

(c) Remove the jib from the boom as follows :

1. Extend the boom so that the boom length is 9.5 to 10.5 meters (31′ -2″ to 34′ -5″).
2. Remove the intermediate fixing pin located on the left bottom of the base boom approximately 1.4 meters (4′ -7″) from the base jib tip.
3. While paying attention to the center of gravity of the jib, hook sling wire ropes on the jib (see Fig. 4-1), and lift the jib with a suitable crane.
4. Remove the "top fixing pin" from the horn around the jib tip end.
5. Remove the "intermediate fixing pin" located on the left bottom face of the base boom approximately 2 meter (6′ -7″ from the boom tip.
6. Move the crane which suspends the jib to the left (front of the machine) first, then move it toward the left, obliquely down (front, obliquely down of the machine), and remove the guide roller of the jib along the base boom roller guide (see Fig. 4-1).
7. After the guide roller is removed from the roller guide, lift the jib apart from the boom, and move it to the side, placing it.
8. Replace the intermediate fixing pin and the top fixing pin to the jib foot.
9. Remove the overhoist preventive weight and wiring, and the length and angle detector wire, etc.

(d) Move the boom hoist and telescoping levers back and forth two or three times to remove the residual pressure in the hydraulic components and pipings.

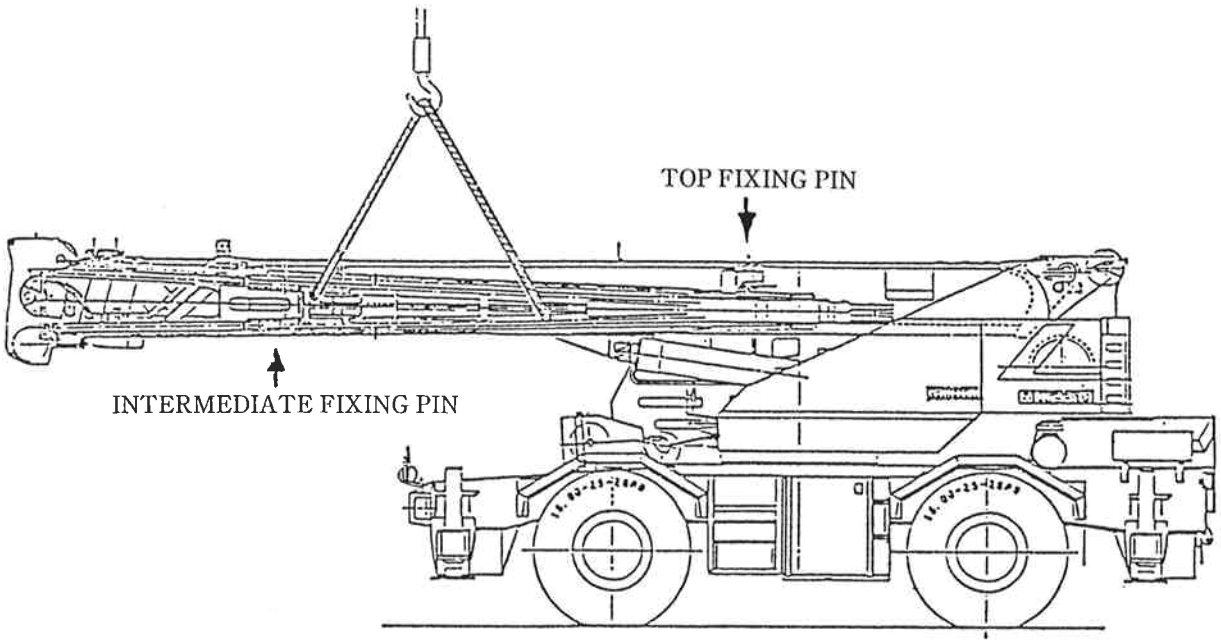


Fig. 4-1 Holding Jib

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(e) Remove the boom hoist cylinder in the following order (see Fig. 4-3).

1. Hold the tip of the boom assembly with a crane.
2. Remove the cord reel cable for the boom length detector from the 4th boom and wind it up on the reel.
   Marking the knot on the cable at this point will facilitate installation later.
3. Hook a wire rope around the hoist cylinder and hold it with a crane.
4. Loosen four capscrews which secure the counterbalance valve to the boom hoist cylinder, and remove the residual pressure in the cylinder. (The four capscrews are not necessary to be removed. When loosening them, take precautions to prevent oil from splashing, such as by using a rug.)
5. Remove mounting pin (A) on the boom hoist cylinder rod side.
6. Lift boom hoist cylinder with the crane and lower it onto wooden blocks set on the carrier frame (see Fig. 4-4).

NOTE

If the height of the blocks is low, the slip ring may be injured. Arrange the height so that the boom hoist cylinder is held a little lower than the height when the boom is horizontal.

(f) Remove the pipings related to telescoping (see Fig. 4-2).
   To prevent the hose reel from rotating, tie the hose mouth to the revolving frame with wire, etc.

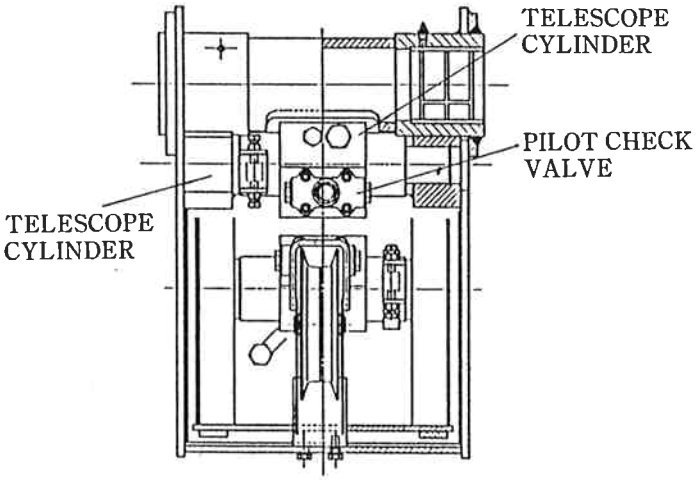


Fig. 4-2

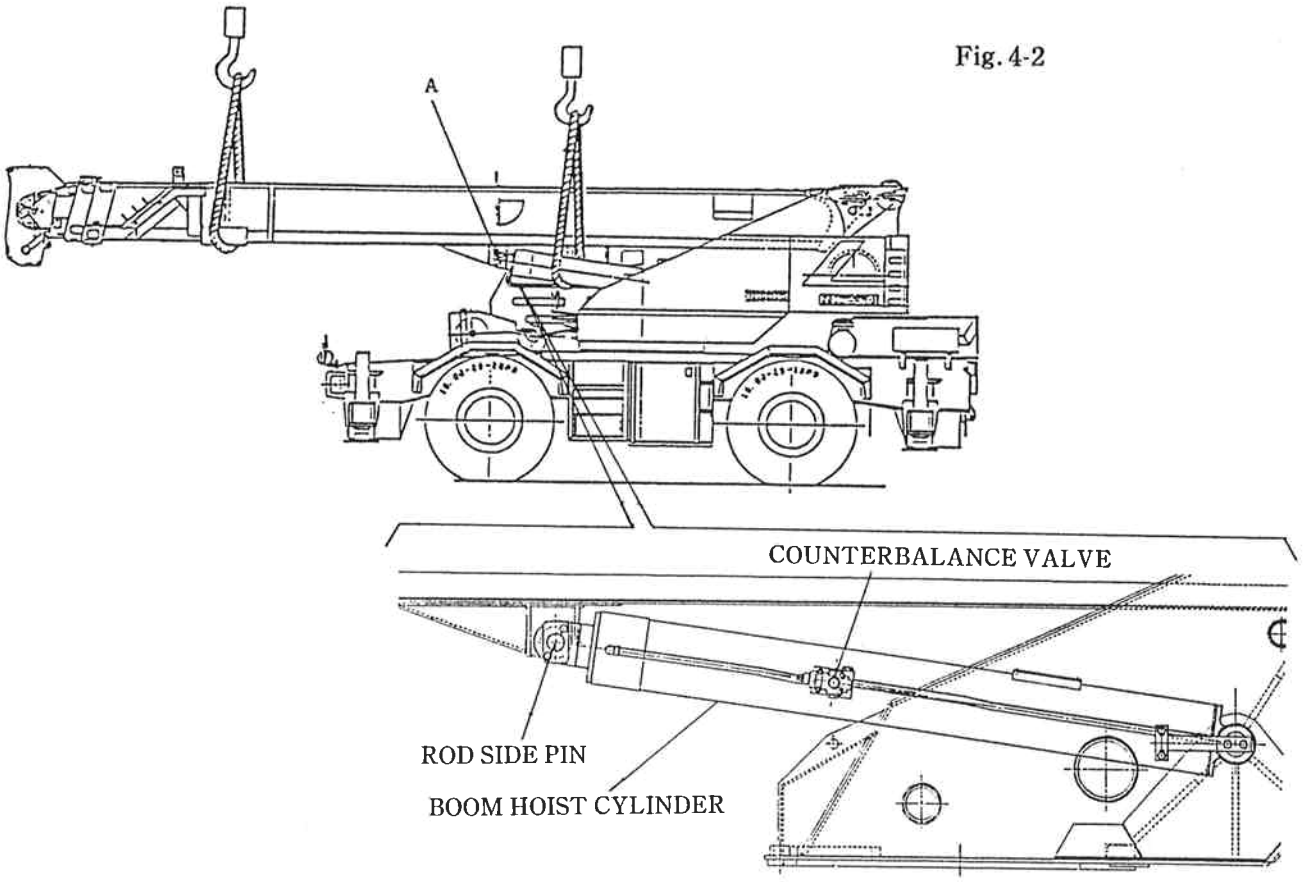


Fig. 4-3

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(g) Remove the boom assembly from the revolving frame as follows (See Fig. 4-4) :

1. Hold the boom assembly with two cranes.
2. Remove the boom foot pins (B).
3. Lift the boom assembly and remove it from the basic machine.

(2) Installation

To install the boom assembly, reverse the removal procedure, paying attention to the following points.

(a) Initial tension of hose reel ·····4 turns

(b) After attaching the cable from the cord reel, check that the correct length indication is given.

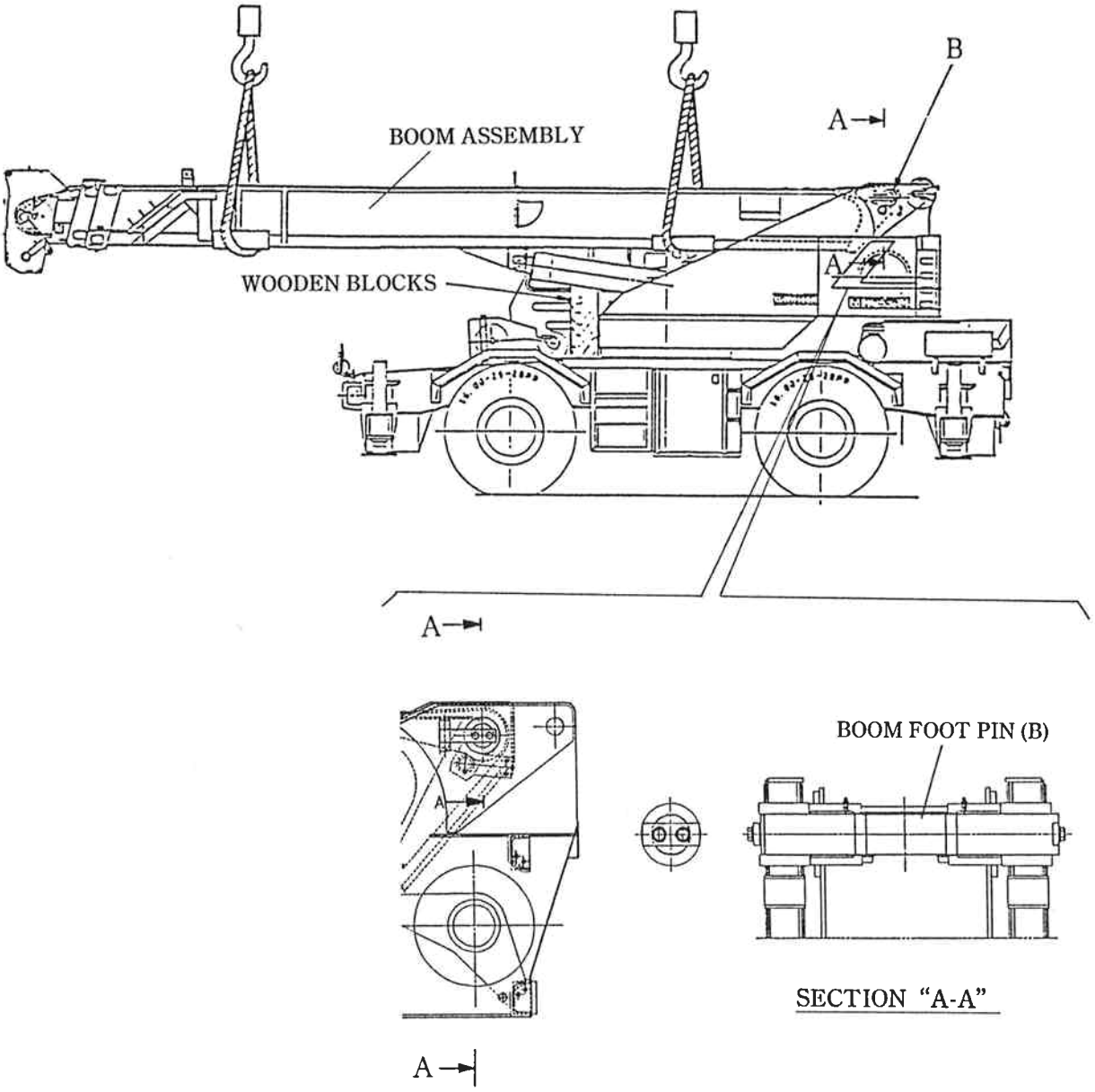


Fig. 4-4

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4.1.2 DISASSEMBLY AND ASSEMBLY

(1) Disassembly

The boom can be disassembled in two ways ; one is performed after removing the whole booms from the basic machine, and the other is performed by taking the 2nd to the 4th booms only off the basic machine leaving the base boom on it. Below is described the former method, following paragraph 4. 1. 1.

(a) Removing the 2nd to the 4th booms.

1. Place the removed boom assembly on a firm bench.
2. Remove the four side sliding pads from the base boom tip (see Fig. 4-6).
3. Remove fixing pin (B) for the 2nd boom telescope cylinder and the base boom by removing the snap rings (Fig. 4-5).
4. Pull the 2nd boom about 5m (16′ -5″) from the base boom, remove bottom sliding pads on the base boom tip. Then, remove the 2nd to the 4 th booms from the base boom as shown in Fig. 4-6.

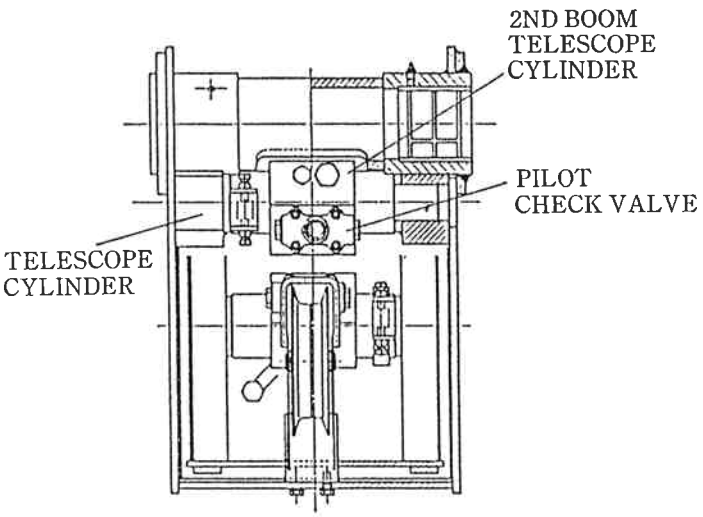


Fig. 4-5 Fixing Pin for 2nd Boom Telescope Cylinder to Base Boom

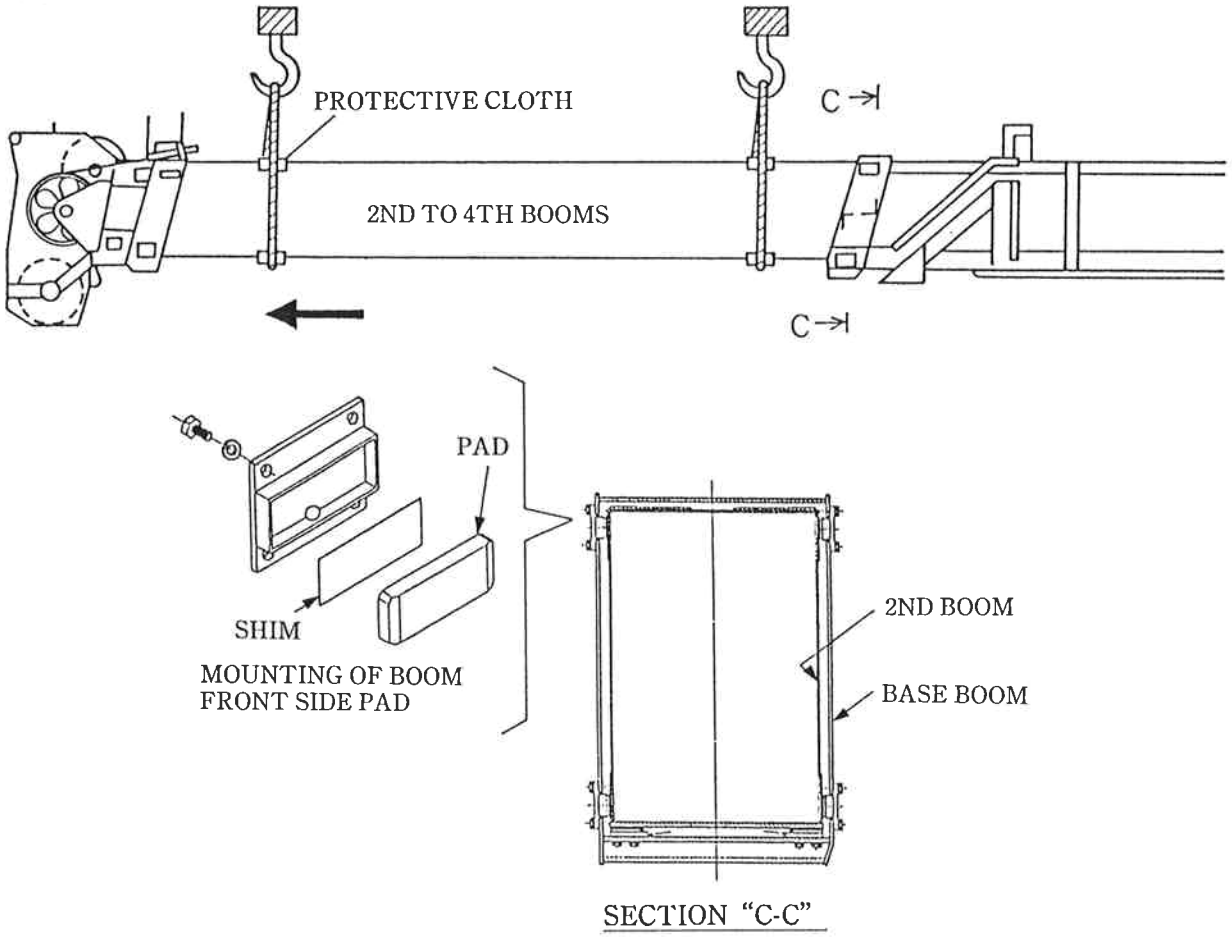


Fig. 4-6

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(b) Removing the 3rd and 4th booms.

1. Remove all the sliding pads (four) on the top end of the 2nd boom.
2. Remove the snap ring shown in Fig. 4-7, and pull out trunnion pin (F) which secures the 2nd boom telescope cylinder to the 2nd boom. Using of an puller bolt (M12) will facilitate the work.
3. Remove the snap ring for pin (G) which secures the 3rd boom telescope cylinder rod end to the 2nd boom (see Fig. 4-7).
4. Remove the nut at point (D) where the 4th boom extending wire rope is secured to the top of the 2nd boom, and remove the bolt (see Fig. 4-8).
5. Remove the nut at point (E) where the 4th boom retracting wire rope is secured to the bottom of the 2nd boom tip, then remove the bracket, to which the wire rope end is attached, from the 2nd boom (see Fig. 4-8).
6. Draw the 3rd boom about 5m (16′ -5″) out of the 2nd boom, and remove the bottom sliding pads from the 2nd boom tip. Hook two slinging wire ropes around the 3rd boom as shown in Fig. 4-9, and pull out the 3rd and 4th booms, anchoring the 2nd boom so that it will not move.

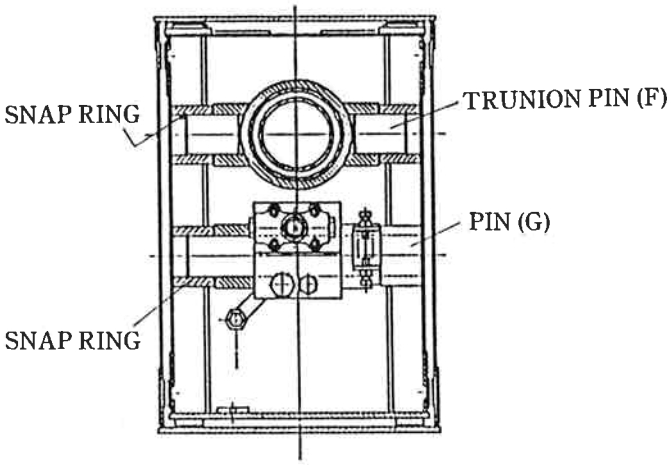


Fig. 4-7

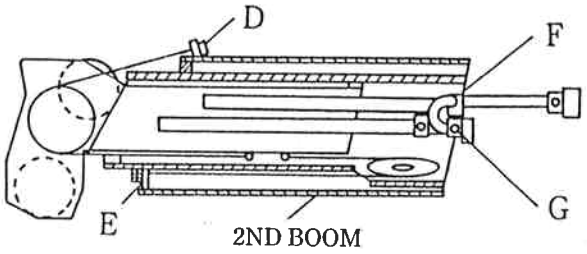


Fig. 4-8

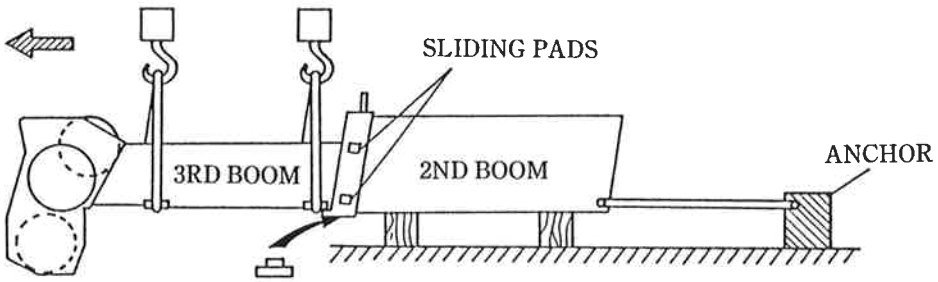


Fig. 4-9 Removal of 3rd / 4th Booms

(c) Removing the 4th boom

1. Remove rod side hose (C) connecting 2nd boom telescope cylinder (A) and 3rd boom telescope cylinder (B) (see Fig. 4-10).

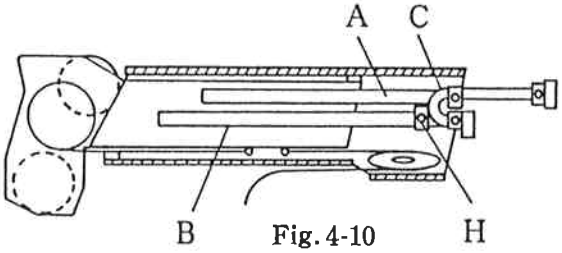


Fig. 4-10

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2. Remove the four sliding pads on the 3rd boom tip.
3. Pull out trunnion pin (H), which secures the 3 rd boom telescope cylinder to the 3rd boom, by removing the snap ring (see Fig. 4-10).
4. As shown in Fig. 4-11, using slings, pull 2nd boom telescope cylinder (A) and 3rd boom telescope cylinder (B) out from the boom at the same time. Lifting the two cylinders, draw them out of the boom.
   Weight of two cylinders is approximately :
   370kgs × 2 = 740kgs
   (816 lbs.× 2 = 1632 lbs.)

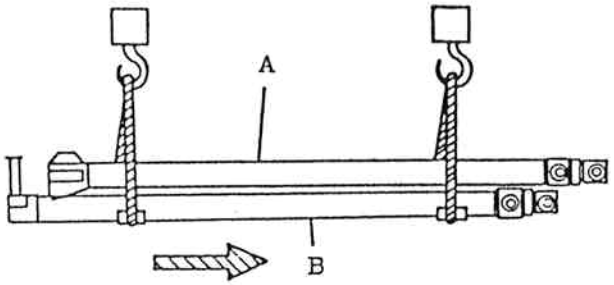


Fig. 4-11 Removal of 2nd and 3rd Boom Telescope cylinders.

5. Remove the sheave mounted on the bottom of the 3rd boom rear end (see Fig. 4-12).

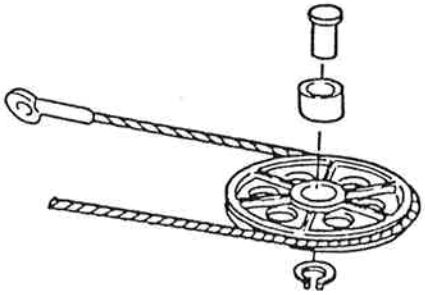


Fig. 4-12 Removal of Sheave

6. Place the 4th boom retracting wire rope in the 4th boom (see Fig. 4-13).
7. Remove the 4th boom extending wire rope from the sheave on the 3rd boom tip, and temporarily fix the rope to the 4th boom with tie wires (see Fig. 4-13).

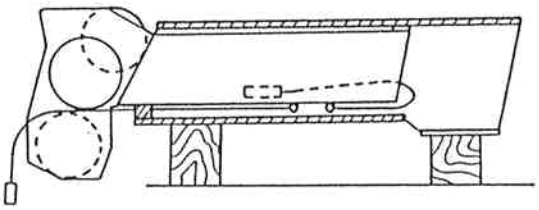


Fig. 4-13

8. Remove the side sliding pads from the 3rd boom tip end.
9. Draw the 4th boom about 4m (13′ -1 1 / 2″) out of the 3rd boom, and remove the bottom sliding pads (D) from the 3rd boom tip. Thereafter, pull the 4th boom completely out from the 3rd boom (see Fig. 4-14).

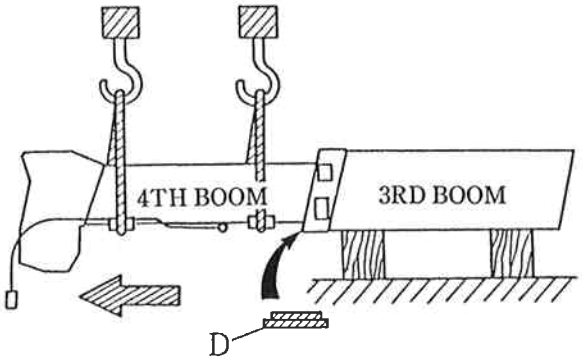


Fig. 4-14 Removal of 4th Boom

10. Remove the extending wire rope from the removed 4th boom. Remove pin (C), and remove the retracting wire rope (see Fig. 4-15).

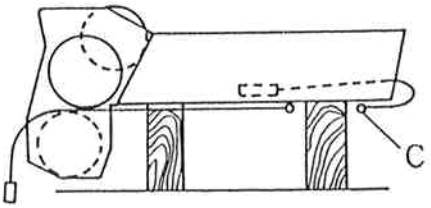


Fig. 4-15

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(2) Assembly

To assemble the booms, reverse the order in the above-mentioned disassembly procedure, paying full attention to the following points.

(a) Set the 4th boom extending and retracting wire ropes in place before inserting the 4th boom into the 3rd boom. Install the end of the extending wire rope to the 4th boom rear end with the block, and extend the other end to the boom tip, temporarily fixing it. At this time, fix the retracting wire rope to the 4th boom rear end, and extend it into the boom inside.

(b) Install the sheave on the 3rd boom rear end after inserting the 4th boom into the 3rd boom.

(c) Insert the 2nd boom telescope cylinder and the 3rd boom telescope cylinder after inserting the 4th boom into the 3rd boom.

(d) Make sure that the computer indication of lengh when connecting the cord reel cable to the tip end of the 4th boom. For detailed method of adjustment, see the separate shop manual entitled "Overload Preventive System (Load Safety Device)."

(e) Adjust the clearance between each boom and its sliding pads to the allowable minimum by using shims, and apply adequate grease.

(f) Adjust the 3rd / 4th booms extending and retracting wire ropes as follows (see Fig. 4-16):

1. With the 3rd / 4th booms fully retracted, tighten spherical nut (1) to the extent that the retracting wire rope (2) won't be slack, then tighten nut (3).
2. Then, tighten the left and right extending wire rope (6) adjusting spherical nuts (4) alternately to the extent that the wire rope is somewhat slack, then tighten nut (5).
3. Before tightening sperical nuts (1 and 4), coat the tightening surfaces with grease containing molybdenum di-sulfide.

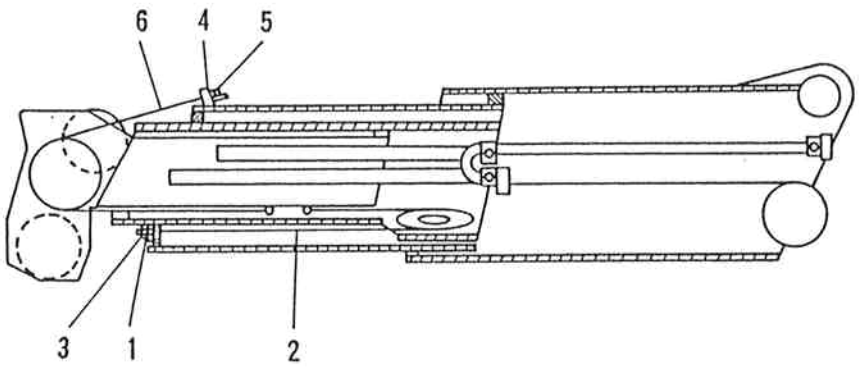


Fig. 4-16

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4.2 BOOM HOIST SYSTEM

4.2.1 REMOVAL AND INSTALLATION

(1) Removal

(a) Fully retract the boom, and hold the boom end with a crane, then stop the engine.

(b) Move the boom hoist and telescoping levers back and forth two or three times to remove residual pressure in the hydraulic components and the pipings.

(c) Remove the two hydraulic hoses connected to the counterbalance valve on the center of the boom hoist cylinder.

(d) Remove the hose leading to the pressure detector from the counterbalance valve connected to the boom hoist cylinder.

(e) Remove the cord reel cable from the 4th boom and wind it up on the reel. Marking the knot will facilitate installing the cable later.

(f) Hook slinging wire ropes around the boom hoist cylinder, and hold the cylinder with a crane (see Fig. 4-3).

(g) Remove the hoist cylinder rod mounting pin.

(h) Lift up the hoist cylinder and put it onto a wooden block on the carrier. Then, check it for center of gravity, and hold it up again.

(i) Using a hammer, remove the boom hoist cylinder foot pin.

(j) Lift up the boom hoist cylinder, and remove it by sliding it away from the revolving frame. If the slinging wire ropes are not positioned around the center of gravity of the boom hoist cylinder, which is dangerous, once put the hoist cylinder down on the wooden block and re-hook the wire ropes so as to position around the center of gravity.

Weight of the boom hoist cylinder :

approx. 580kgs. (1280 lbs)

(2) Installation

To install the boom hoist cylinder, reverse the removal procedure, paying attention to the following points :

(a) Put the hoist cylinder down on the carrier so that it is positioned right under the boom.

(b) To mount the boom cylinder rod fitting pin, first install the cylinder foot to the revolving frame and connect the hydraulic hose, and then insert the pin in the holes aligned by extending or retracting the rod.

4.2.2 DISASSEMBLY AND ASSEMBLY

For disassembly and assembly of the boom hoist cylinder, see separate shop manual "Hydraulic Cylinder" .

4.3 AUXILIARY SHEAVE

(1) Removal

1. Remove the auxiliary hoist wire rope.
2. Remove the overhoist alarm cord.
3. With the auxiliary sheave assembly supported, remove the one pin, and the assembly will easily be removed.
   Weight : Approx. 30kgs (66 lbs).

(2) Installation

1. Mount the auxiliary sheave assembly directly on the tip of the 4th boom with the one pin.
2. Reeve the auxiliary hoist wire rope through the auxiliary sheave by removing the rope lock pin which is to be installed afterwards.
3. Connect the overhoist alarm cord to the main hook's limit switch wiring.

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4.2 BOOM HOIST SYSTEM

4.2.1 REMOVAL AND INSTALLATION

(1) Removal

(a) Fully retract the boom, and hold the boom end with a crane, then stop the engine.

(b) Move the boom hoist and telescoping levers back and forth two or three times to remove residual pressure in the hydraulic components and the pipings.

(c) Remove the two hydraulic hoses connected to the counterbalance valve on the center of the boom hoist cylinder.

(d) Remove the hose leading to the pressure detector from the counterbalance valve connected to the boom hoist cylinder.

(e) Remove the cord reel cable from the 4th boom and wind it up on the reel. Marking the knot will facilitate installing the cable later.

(f) Hook slinging wire ropes around the boom hoist cylinder, and hold the cylinder with a crane (see Fig. 4-3).

(g) Remove the hoist cylinder rod mounting pin.

(h) Lift up the hoist cylinder and put it onto a wooden block on the carrier. Then, check it for center of gravity, and hold it up again.

(i) Using a hammer, remove the boom hoist cylinder foot pin.

(j) Lift up the boom hoist cylinder, and remove it by sliding it away from the revolving frame. If the slinging wire ropes are not positioned around the center of gravity of the boom hoist cylinder, which is dangerous, once put the hoist cylinder down on the wooden block and re-hook the wire ropes so as to position around the center of gravity.

Weight of the boom hoist cylinder :

approx. 580kgs. (1280 lbs)

(2) Installation

To install the boom hoist cylinder, reverse the removal procedure, paying attention to the following points :

(a) Put the hoist cylinder down on the carrier so that it is positioned right under the boom.

(b) To mount the boom cylinder rod fitting pin, first install the cylinder foot to the revolving frame and connect the hydraulic hose, and then insert the pin in the holes aligned by extending or retracting the rod.

4.2.2 DISASSEMBLY AND ASSEMBLY

For disassembly and assembly of the boom hoist cylinder, see separate shop manual "Hydraulic Cylinder" .

4.3 AUXILIARY SHEAVE

(1) Removal

1. Remove the auxiliary hoist wire rope.
2. Remove the overhoist alarm cord.
3. With the auxiliary sheave assembly supported, remove the one pin, and the assembly will easily be removed.
   Weight : Approx. 30kgs (66 lbs).

(2) Installation

1. Mount the auxiliary sheave assembly directly on the tip of the 4th boom with the one pin.
2. Reeve the auxiliary hoist wire rope through the auxiliary sheave by removing the rope lock pin which is to be installed afterwards.
3. Connect the overhoist alarm cord to the main hook's limit switch wiring.

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4.2 BOOM HOIST SYSTEM

4.2.1 REMOVAL AND INSTALLATION

(1) Removal

(a) Fully retract the boom, and hold the boom end with a crane, then stop the engine.

(b) Move the boom hoist and telescoping levers back and forth two or three times to remove residual pressure in the hydraulic components and the pipings.

(c) Remove the two hydraulic hoses connected to the counterbalance valve on the center of the boom hoist cylinder.

(d) Remove the hose leading to the pressure detector from the counterbalance valve connected to the boom hoist cylinder.

(e) Remove the cord reel cable from the 4th boom and wind it up on the reel. Marking the knot will facilitate installing the cable later.

(f) Hook slinging wire ropes around the boom hoist cylinder, and hold the cylinder with a crane (see Fig. 4-3).

(g) Remove the hoist cylinder rod mounting pin.

(h) Lift up the hoist cylinder and put it onto a wooden block on the carrier. Then, check it for center of gravity, and hold it up again.

(i) Using a hammer, remove the boom hoist cylinder foot pin.

(j) Lift up the boom hoist cylinder, and remove it by sliding it away from the revolving frame. If the slinging wire ropes are not positioned around the center of gravity of the boom hoist cylinder, which is dangerous, once put the hoist cylinder down on the wooden block and re-hook the wire ropes so as to position around the center of gravity.

Weight of the boom hoist cylinder :

approx. 580kgs. (1280 lbs)

(2) Installation

To install the boom hoist cylinder, reverse the removal procedure, paying attention to the following points :

(a) Put the hoist cylinder down on the carrier so that it is positioned right under the boom.

(b) To mount the boom cylinder rod fitting pin, first install the cylinder foot to the revolving frame and connect the hydraulic hose, and then insert the pin in the holes aligned by extending or retracting the rod.

4.2.2 DISASSEMBLY AND ASSEMBLY

For disassembly and assembly of the boom hoist cylinder, see separate shop manual "Hydraulic Cylinder" .

4.3 AUXILIARY SHEAVE

(1) Removal

1. Remove the auxiliary hoist wire rope.
2. Remove the overhoist alarm cord.
3. With the auxiliary sheave assembly supported, remove the one pin, and the assembly will easily be removed.
   Weight : Approx. 30kgs (66 lbs).

(2) Installation

1. Mount the auxiliary sheave assembly directly on the tip of the 4th boom with the one pin.
2. Reeve the auxiliary hoist wire rope through the auxiliary sheave by removing the rope lock pin which is to be installed afterwards.
3. Connect the overhoist alarm cord to the main hook's limit switch wiring.

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5. MAINTENANCE STANDARDS

5.1 TIGHTENING TORQUE

(1) Boom Telescope System

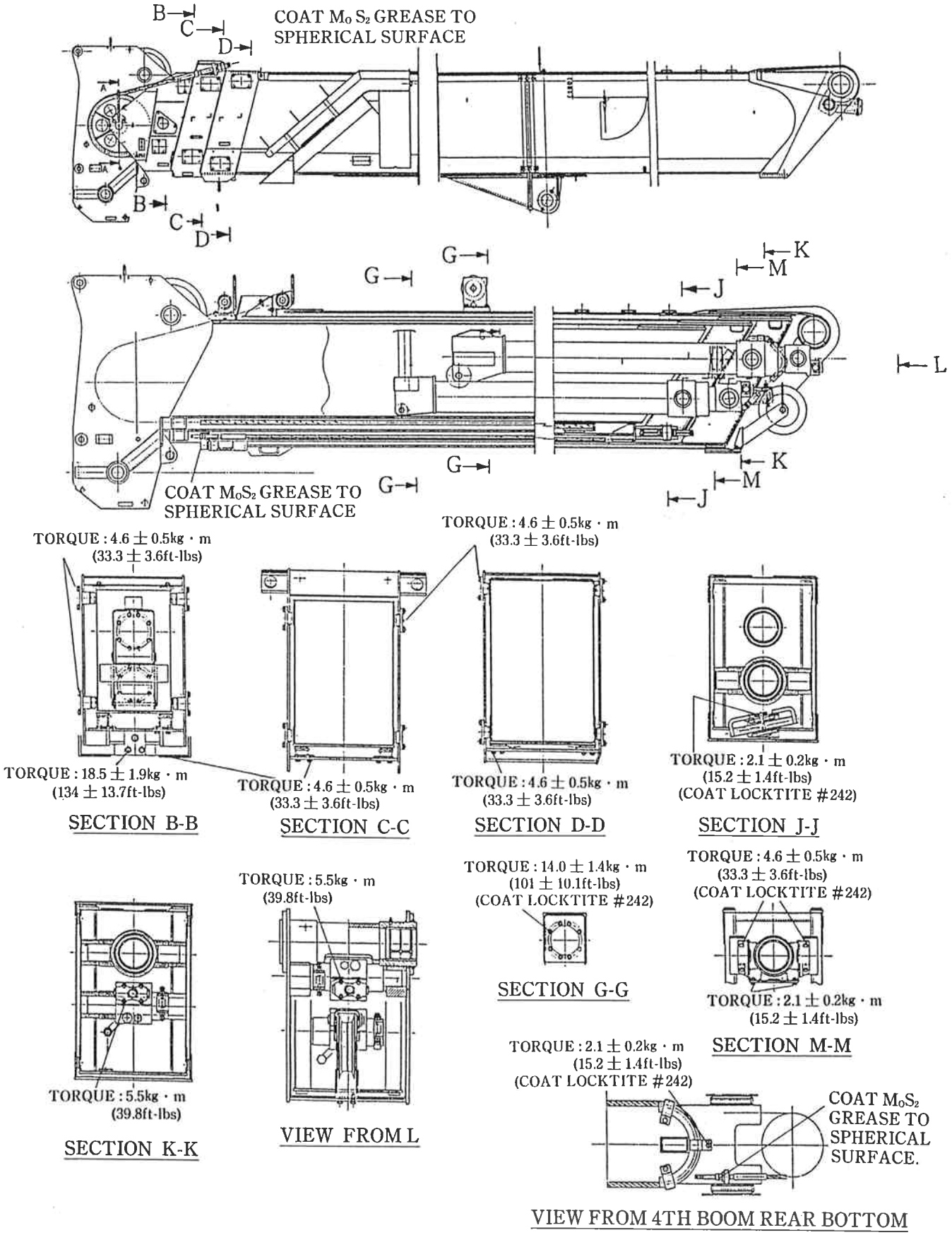


Fig. 5-1

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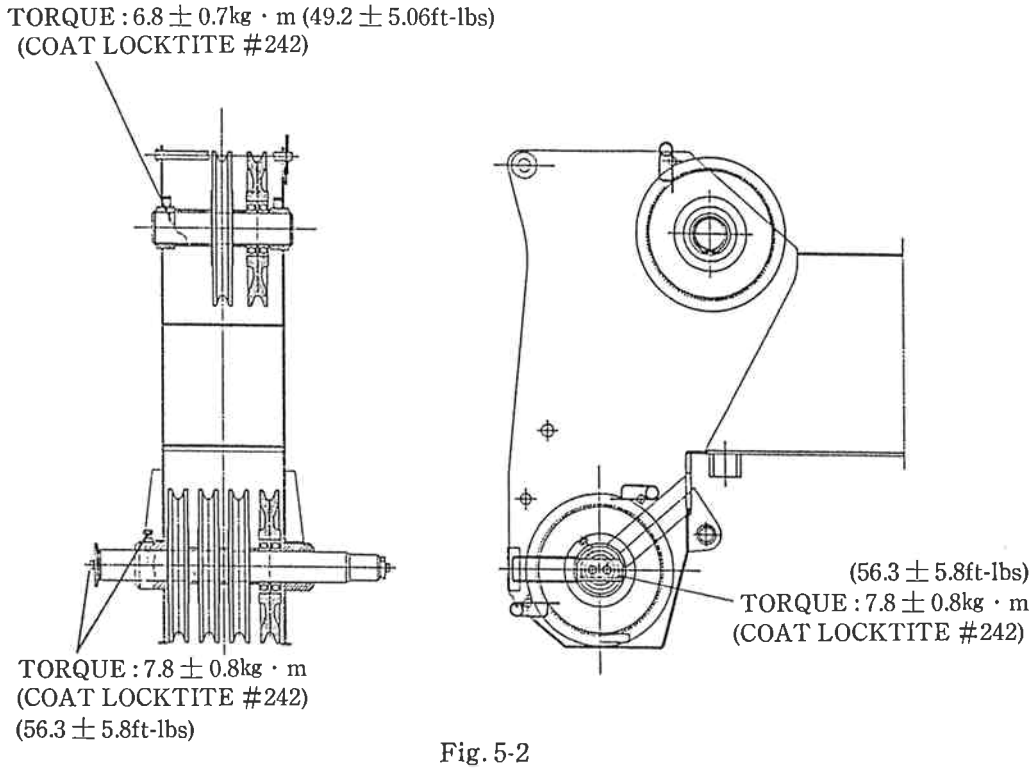


Fig. 5-2

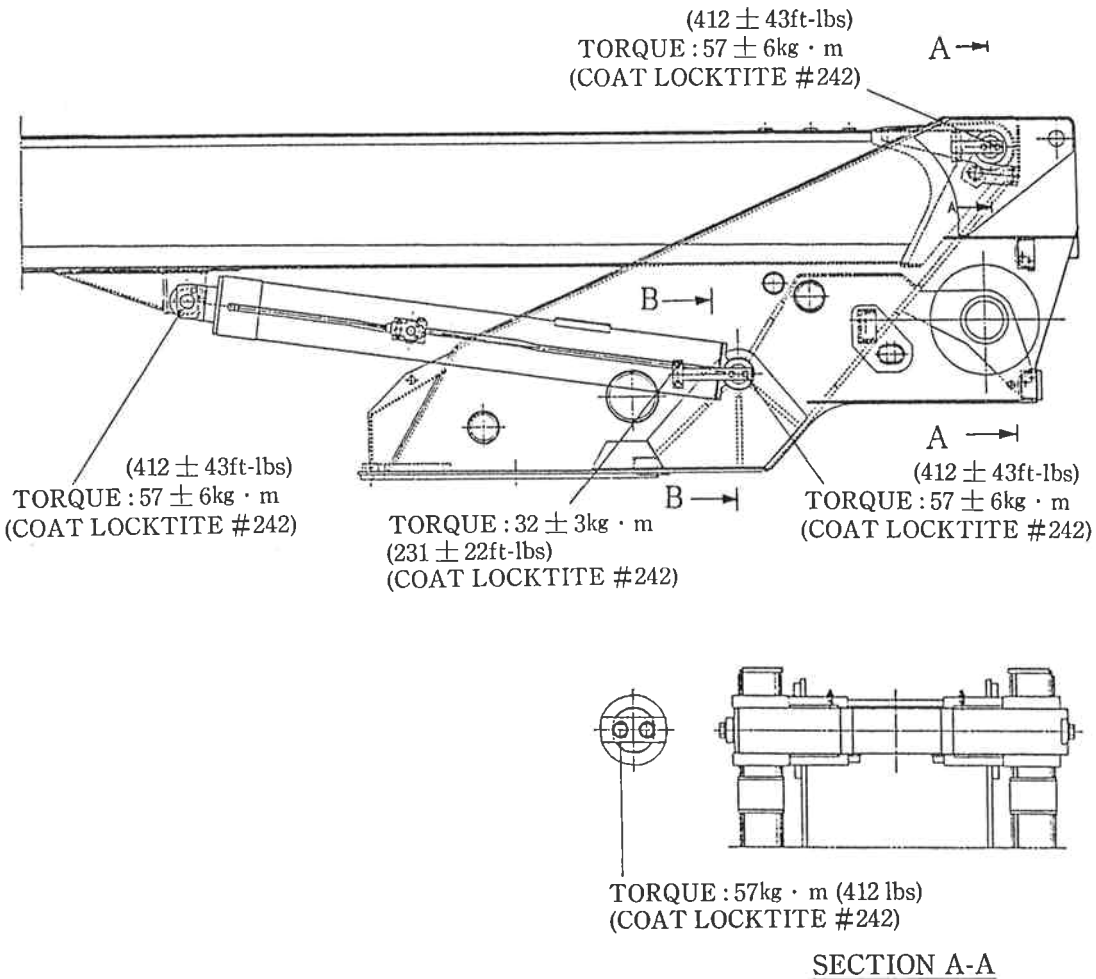


Fig. 5-3

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5.2 PIN / HOLE CLEARANCES (See Fig. 5-4)

Symbol		Item	Standard Value for Replacement	Remedy
1	Between pin and hole	Boom foot mounting pin and bushing clearance	1.0㎜ (0.04in.)	Replace.
2		Boom hoist cylinder fitting pin	1.0㎜ (0.04in.)	〃
3		Boom hoist cylinder and rod fitting pin	0.4㎜ (0.016in.)	〃
4		Telescoping cylinder trunnion mount	1.0㎜ (0.04in.)	〃
5		Telescoping cylinder fitting pin	1.0㎜ (0.04in.)	〃
6		Aux. Jib mounting pin (4th boom tip end)	0.6㎜ (0.024in.)	〃

5.3 SLIDING PADS (See Fig. 5-5)

After disassembling the booms, sliding pads should be measured for the amount of wear. When reassembling them, adjustment should be accordingly made by adding shims to bring the clearance between pad and boom side within 1.5㎜ (0.06in) and then mount the pad carriers to them. If the shim adjustment is not effective, replace the pads by reference to the table below.

Unit : ㎜ (inch)

Pad location			Symbol	Standard thickness	Recommended replacement value	Serviceable limit	Remarks
Base boom	Front	Bottom	1	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	2	15 (0.59)	12 (0.472)	10 (0.394)	
2nd boom	Front	Bottom	3	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	4	15 (0.59)	12 (0.472)	10 (0.394)	
	Rear	Top	5	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	6	6.5 (0.256)	5.5 (0.217)	5 (0.197)	
3rd boom	Front	Bottom	7	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	8	15 (0.59)	12 (0.472)	10 (0.394)	
	Rear	Top	9	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	10	6.5 (0.256)	5.5 (0.217)	5 (0.197)	
		Inside	11	15 (0.59)	12 (0.472)	10 (0.394)	For cylinder
4th boom	Rear	Top	12	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	13	10 (0.394)	9 (0.354)	8.5 (0.335)	
Base jib	Front	Side	14	20 (0.787)	15 (0.59)	13 (0.512)	

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5.2 PIN / HOLE CLEARANCES (See Fig. 5-4)

Symbol		Item	Standard Value for Replacement	Remedy
1	Between pin and hole	Boom foot mounting pin and bushing clearance	1.0㎜ (0.04in.)	Replace.
2		Boom hoist cylinder fitting pin	1.0㎜ (0.04in.)	〃
3		Boom hoist cylinder and rod fitting pin	0.4㎜ (0.016in.)	〃
4		Telescoping cylinder trunnion mount	1.0㎜ (0.04in.)	〃
5		Telescoping cylinder fitting pin	1.0㎜ (0.04in.)	〃
6		Aux. Jib mounting pin (4th boom tip end)	0.6㎜ (0.024in.)	〃

5.3 SLIDING PADS (See Fig. 5-5)

After disassembling the booms, sliding pads should be measured for the amount of wear. When reassembling them, adjustment should be accordingly made by adding shims to bring the clearance between pad and boom side within 1.5㎜ (0.06in) and then mount the pad carriers to them. If the shim adjustment is not effective, replace the pads by reference to the table below.

Unit : ㎜ (inch)

Pad location			Symbol	Standard thickness	Recommended replacement value	Serviceable limit	Remarks
Base boom	Front	Bottom	1	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	2	15 (0.59)	12 (0.472)	10 (0.394)	
2nd boom	Front	Bottom	3	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	4	15 (0.59)	12 (0.472)	10 (0.394)	
	Rear	Top	5	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	6	6.5 (0.256)	5.5 (0.217)	5 (0.197)	
3rd boom	Front	Bottom	7	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	8	15 (0.59)	12 (0.472)	10 (0.394)	
	Rear	Top	9	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	10	6.5 (0.256)	5.5 (0.217)	5 (0.197)	
		Inside	11	15 (0.59)	12 (0.472)	10 (0.394)	For cylinder
4th boom	Rear	Top	12	10 (0.394)	8 (0.315)	7 (0.276)	
		Side	13	10 (0.394)	9 (0.354)	8.5 (0.335)	
Base jib	Front	Side	14	20 (0.787)	15 (0.59)	13 (0.512)	

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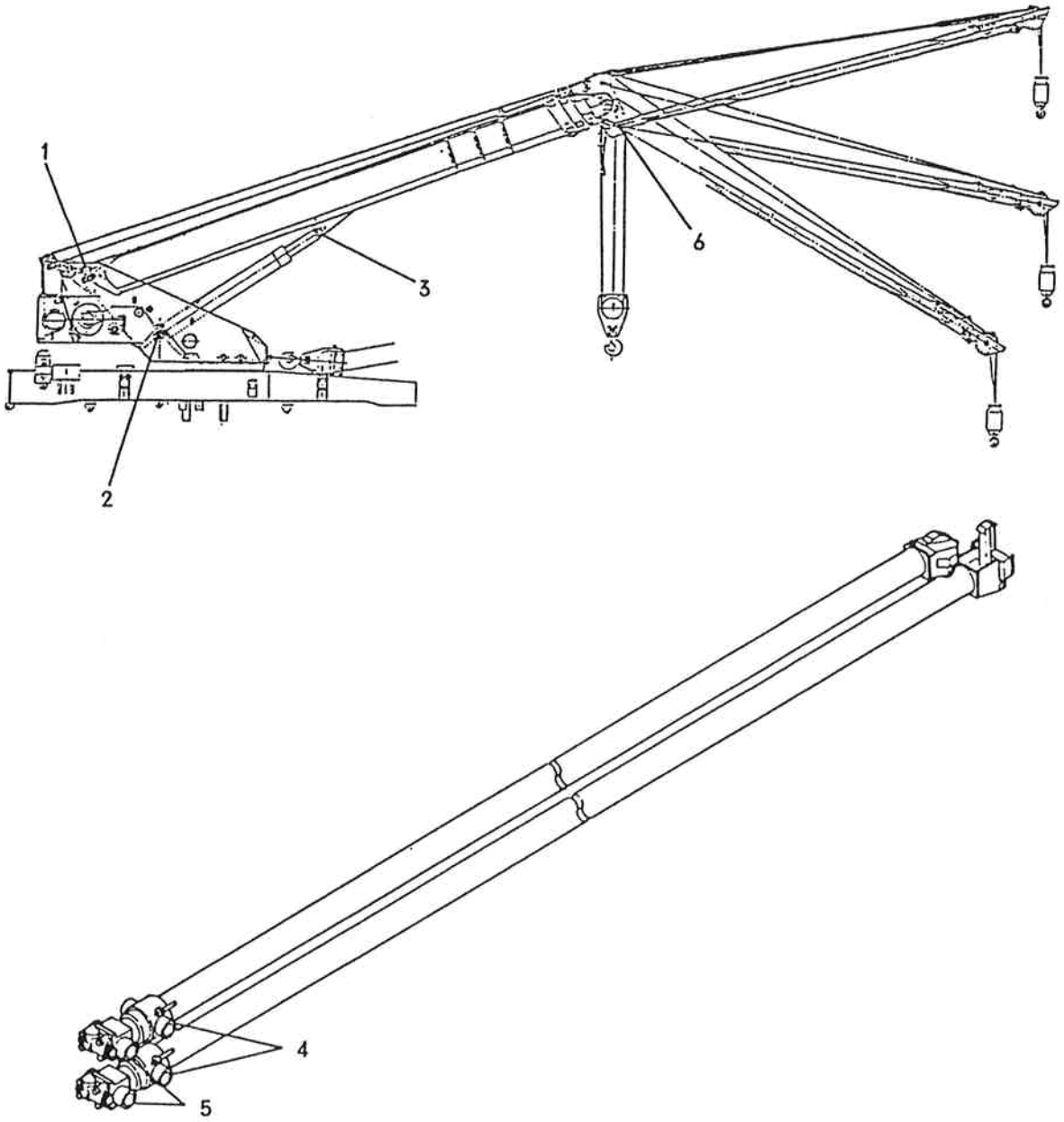
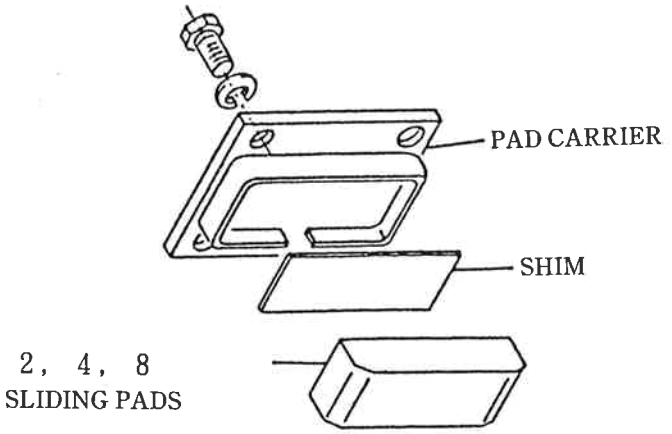
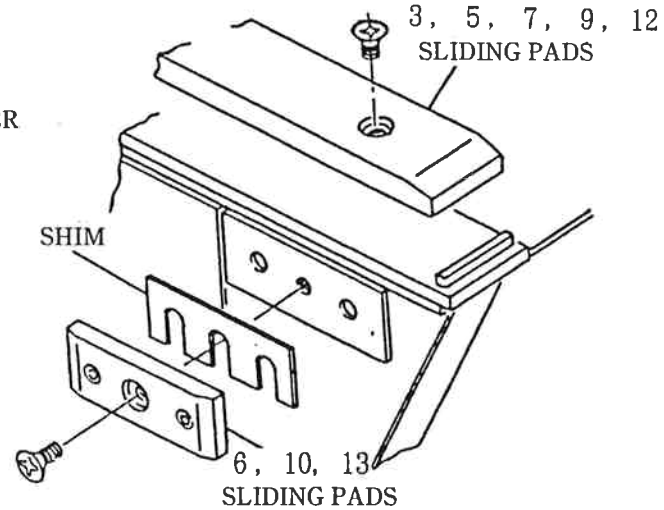


Fig. 5-4 Location of Pin

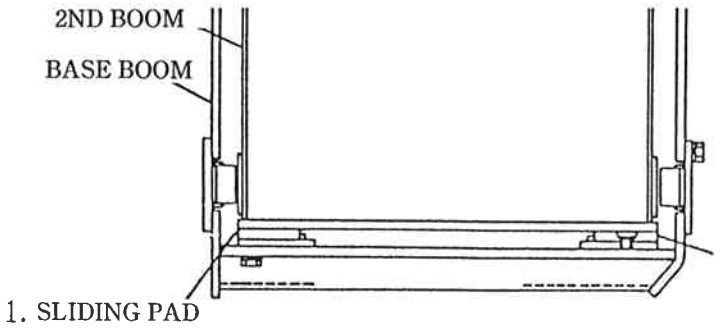
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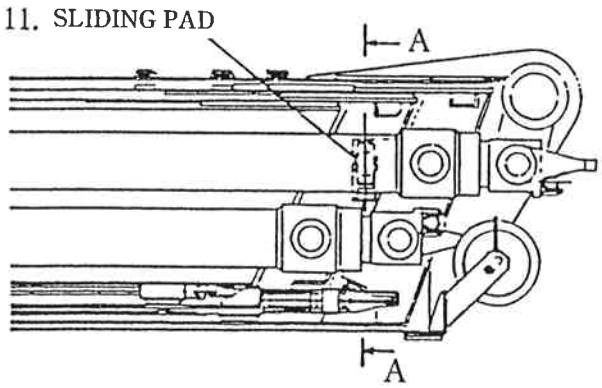
Base, 2nd and 3rd Each Boom
Front Side Sliding Pad

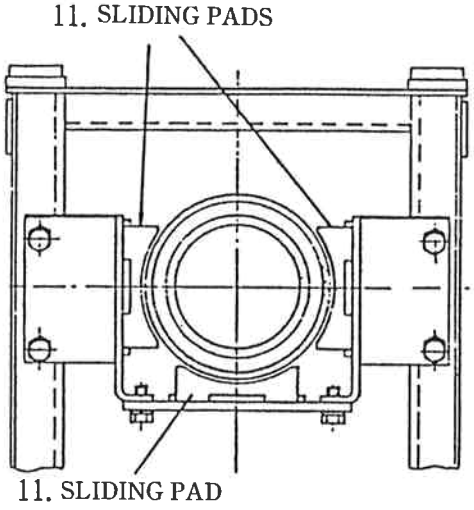


2nd, 3rd and 4th Each Boom Rear Top and Side, and 2nd and 3rd Each Boom Front Bottom Sliding Pads



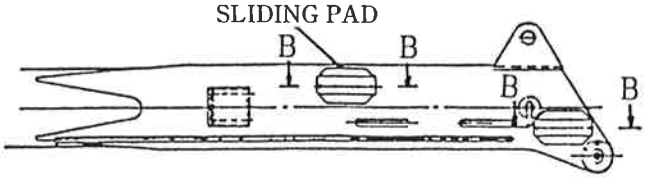
Base Boom Front Bottom Sliding Pads

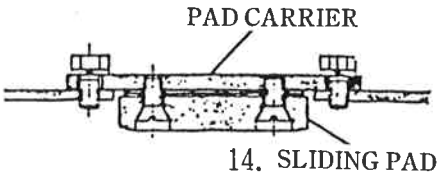




SECTION A-A

Boom Telescoping Cylinder Sliding Pads





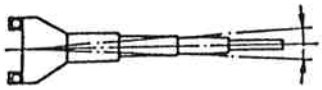
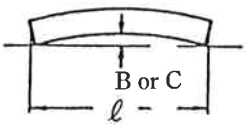
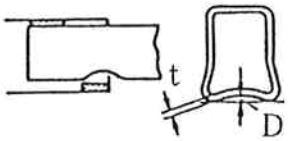
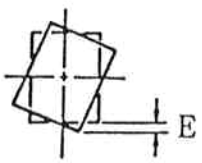
SECTION B-B

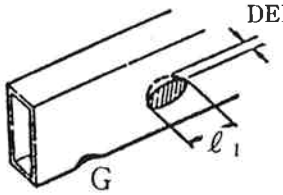
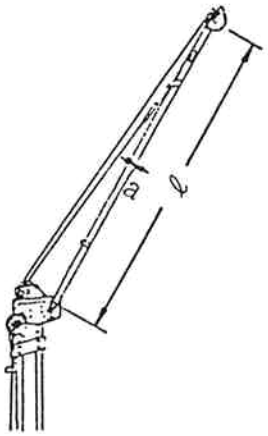
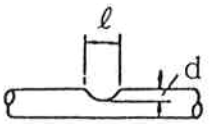
Base Jib Front Side Sliding Pads

Fig. 5-5 Sliding Pads.

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5.4 BENDING AND STRAIN OF BOOM AND JIB

Testing Procedure	Maintenance Standard
1. Boom (1) With the boom fully extended and raised to the maximum angle, apply the rated load to the boom and check the bend of them as a whole. During this operation, keep the machine level and the sliding pads adjusted. 	(1) No marked bend, vertical or horizontal, over the entire length.
(2) As for bending of individual boom first make sure they telescope without problem and then check the vertical and horizontal bend of each. 	(2) Vertical length $B \leqq 1.5 \times \frac{\ell}{1000}$(mm) (0.06× ℓ / 1000inch) Horizontal bend $C \leqq 1.0 \times \frac{\ell}{1000}$(mm) (0.04× ℓ / 1000inch)
(3) Check boom laps for dent (bending of bottom plate). 	(3) $D \leqq \frac{1}{2}t$ or $\frac{1}{3}t$
(4) Check side plate for strain.	(4) No marked strain on the compressed side (lower half) in particular.
(5) With the boom fully extended, check boom for latitudinal distortion. 	(5) E ≦ 5(mm) (0.197inch)

Testing Procedure	Maintenance Standard
(6) Check for partial concavity like dents. 	(6) F ≦ 2(mm) at (0.079inch) ℓ 1 ≧ 50(mm) (1.97inch) Dents G at the four corners are generally impossible to repair.
(7) Check the sliding pads for wear and boom for gap.	(7) Appropriate clearance must be maintained. Wear must not exceed one third of the original thickness.
2. Jib (1) Check for overall bend of auxiliary jib. 	(1) No marked bend, either vertical or horizontal. $a \leqq 1.5 \times \frac{\ell}{1000}$(mm) (0.06 × ℓ / 1000inch)
(2) Check for partial concavity like dents or bend. 	(2) d ≦ 0.8(mm) (0.031inch) for concabity ℓ 1 ≦ 15(mm) (0.591inch)

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5.5 CHECKING THE HOOK BLOCK

The hook block is a vitally important part. Check it by the following method for safety's sake. If found defective, repair or replace it immediately. The replacement needs to be tested before being mounted to the machine.

(1) The sheave groove must be smooth or it will damage the wire rope. Round off any sharp edges with a grinder.

(2) Check the sheave for smooth rotation. Stiff rotation causes friction as the wire rope moves along the sheave and this causes damage to the wire rope. Also, it makes block free fall difficult. In this case, check each sheave bearing and replace or lubricate it as necessary.

(3) Check sheave pins and fitting bolts for tightness.
Retighten or lock them as required.

(4) Check hook nuts for tightness. Retighten or lock them, as required.

(5) If hook nuts are worn out or damaged, replace them immediately.

(6) Check the wire rope stopper for correct operation.
Replace the spring as required.

(7) Check the hook for cracks, etc. by the magnetic particle test at least once a year. If any cracks are found replace the hook.

(8) The hook has punch marks, as shown in Fig. 5-6.
If the distance between them increases 1. 5 percent, replace the hook.

(9) Hook operating limits.

Unit : mm (inch)

Item \ Hook	25ton (55,100 lbs)	18ton (39,700 lbs)	3ton (6,600 lbs)
(a) Deformation	190 (7.48)	190 (7.48)	85 (3.35)
(b) Wear	3.6 (0.142)	3.6 (0.142)	1.3 (0.051)

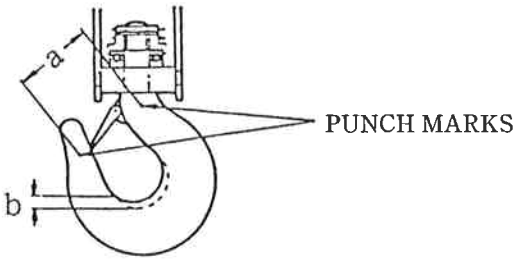


Fig. 5-6

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6. TROUBLESHOOTING

	TROUBLE	CAUSE	REMEDY
1	Boom hoist and telescoping impossible.	Faulty pump	Repair or replace pump.
		Faulty PTO	Repair PTO.
		Faulty relief valve	Adjust, repair or replace relief valve.
2	Boom hoist and telescoping are slow and power weak.	Deteriorated pump performance	Repair or replace pump.
		Faulty relief valve	Adjust, repair or replace relief valve.
		Swivel joint internally leaking	Repair or replace swivel joint.
		Malfunction of flow control valve	Replace flow control valve
3	Boom hoist (hoist cylinder) output is poor.	Control valve spool poorly moving	Check and repair control valve.
		Overload valve malfunctioning	Replace valve.
		Counterbalance valve malfunctioning	Check and repair or replace valve.
		Boom hoist cylinder internally leaking	Overhaul, repair or replace cylinder.
4	Boom (hoist cylinder) lowers by itself.	Internal leak of cylinder	Overhaul, repair or replace cylinder.
		Overload valve malfunctioning	Replace valve.
		Counterbalance valve malfunctioning	Check and repair or replace valve.
5	Boom lowering malfunctions (chattering)	Counterbalance valve malfunctioning	Check and repair or replace counterbalance valve.
6	Boom telescoping is slow and power weak.	Control valve spool poorly moving	Check and repair control valve.
		Overload valve malfunctioning	Check and replace overload valve.
		Pilot check valve malfunctioning	Check and repair replace valve.
		Telescoping cylinder internally leaking	Overhaul, repair or replace cylinder.

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7	Boom retracts by itself.	Telescoping cylinder internally leaking	Overhaul,repair or replace cylinder.
		Pilot check valve malfunctioning	Check and repair replace valve.
		Overload valve malfunctioning	Check and replace valve.
8	3rd and 4th booms do not telescope simultaneously.	Faulty 4th boom telescoping wire rope	Adjust or replace wire rope.
9	Boom bent laterally when extended.	Sliding pads being abnormally worn or improperly adjusted.	Adjust or replace sliding pads.
		Bent boom	Replace boom.
10	Boom telescopes jerkily, making unusual noise.	Deformed boom	Replace boom.
		Worn sliding pads	Adjust or replace pads.
		Lack of lubrication	Lubricate.

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1. GENERAL

1.1 OUTLINE OF CONSTRUCTION

The steering mechanism is a component for guiding the machine in any desired direction.

The RK series steering mechanism offers all-hydraulic-type power steering operated easily by a steering wheel and utilises a load sensing system which combines a steering unit with orbit roll and steering priority valve. The steering operation is powered and piloted by pressurized oil from No. 1 pump.

When the steering wheel is rotated, the hydraulic oil passages inside the steering unit are switched over, pressurized oil from the pump is led into the right or left steering cylinder and telescopes the cylinder, and the wheels are turned to right or left.

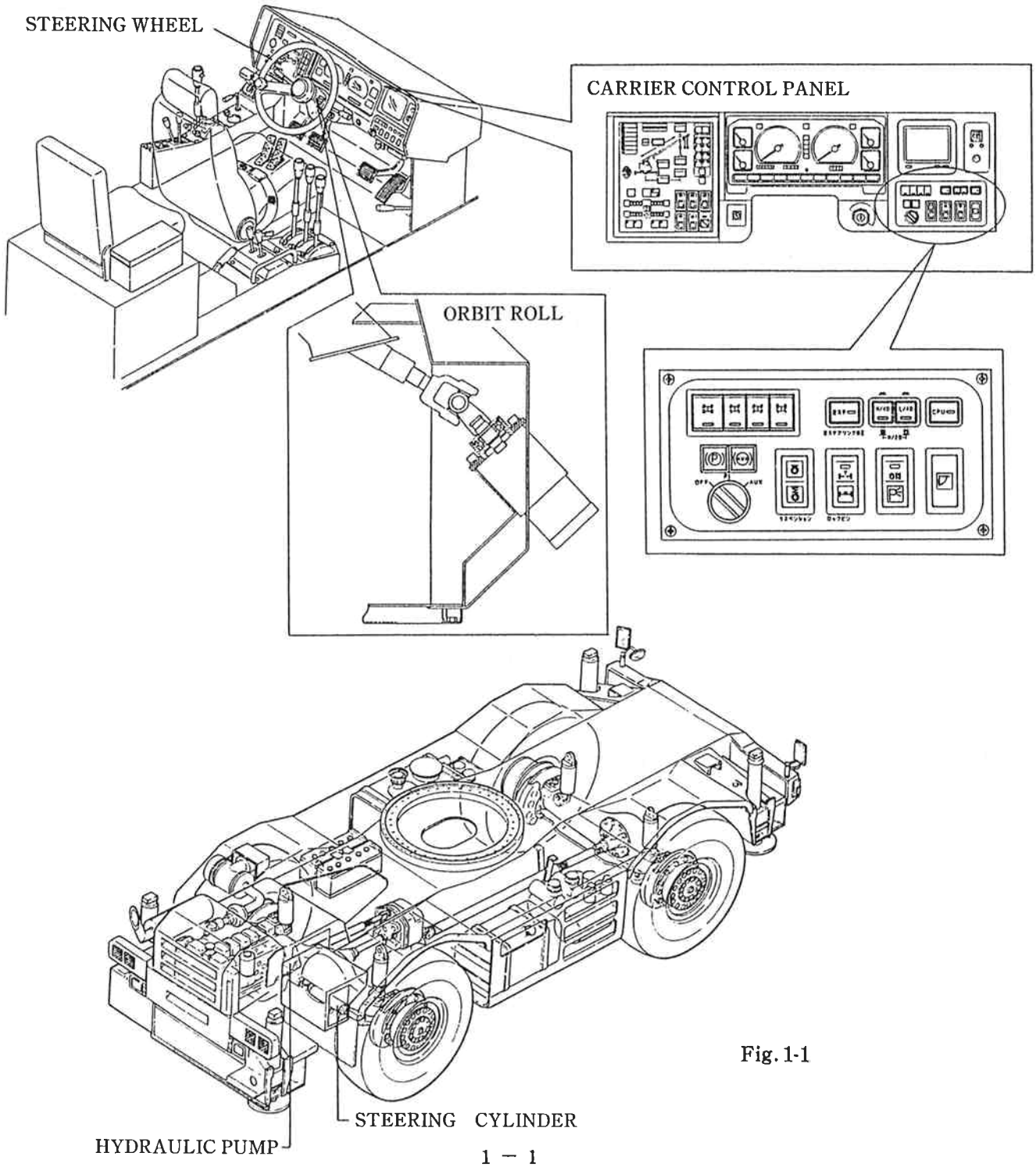


Fig. 1-1

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1.2 LOCATION OF COMPONENTS

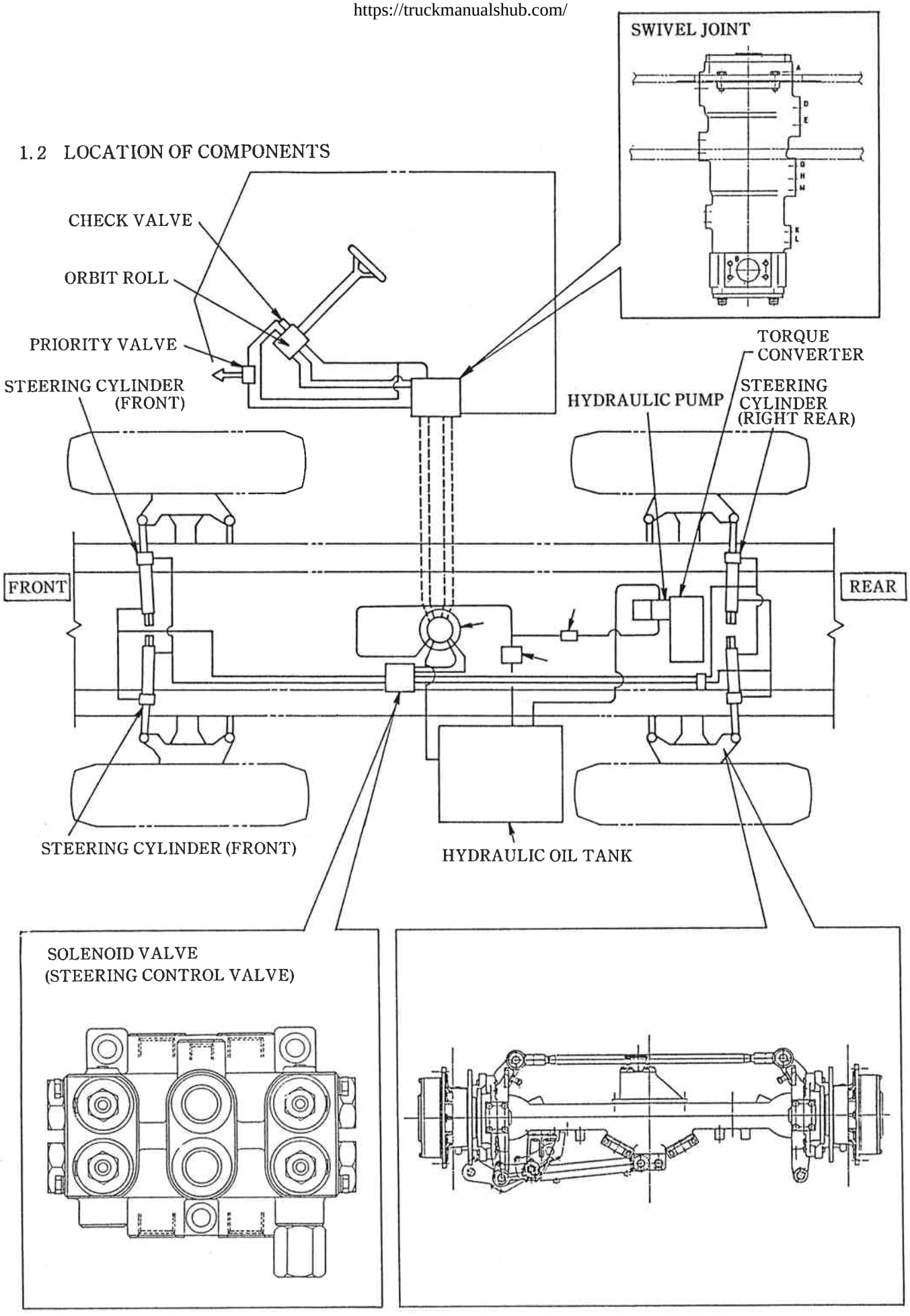
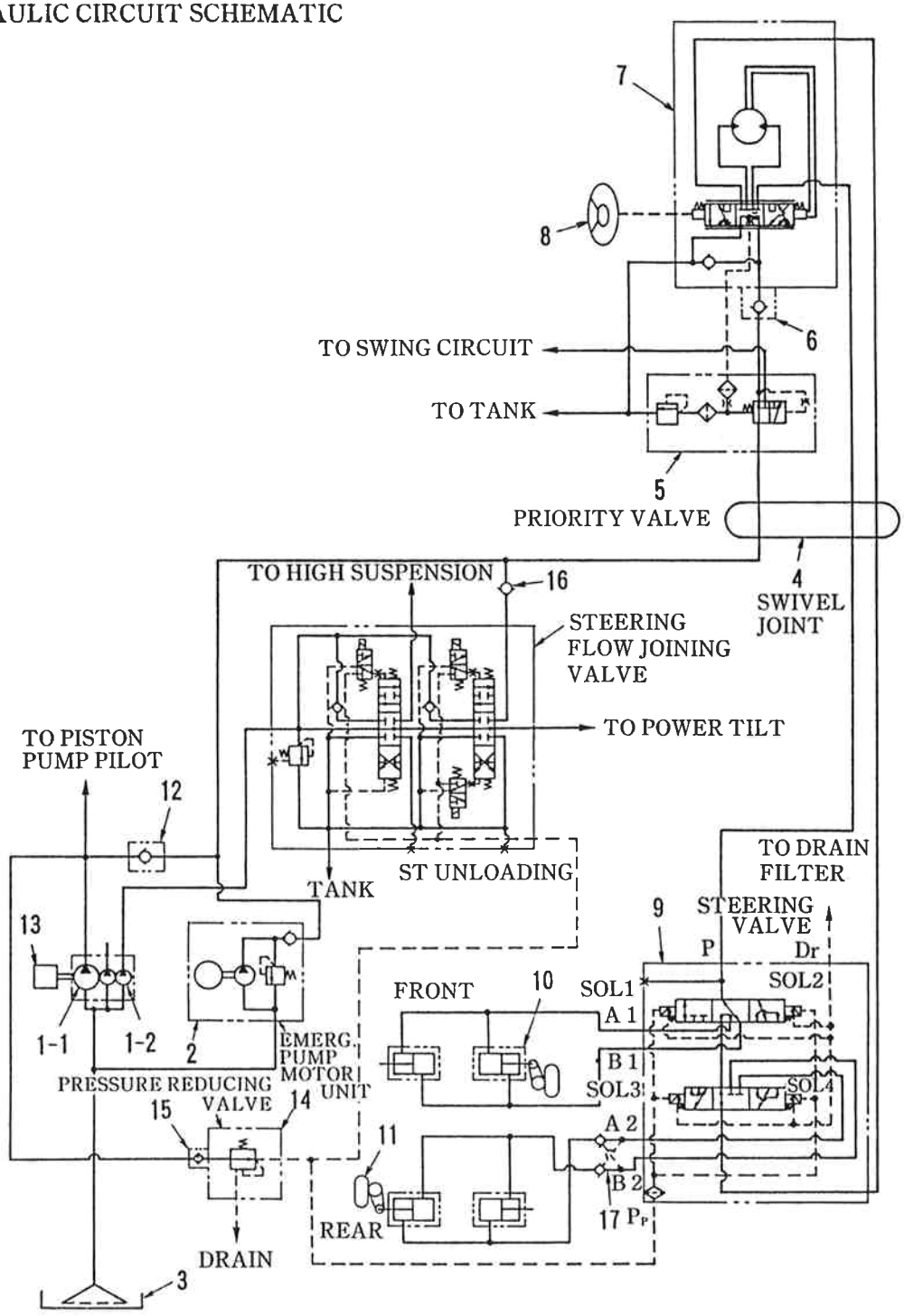


Fig. 1-2

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2. CONSTRUCTION

2.1 HYDRAULIC CIRCUIT SCHEMATIC

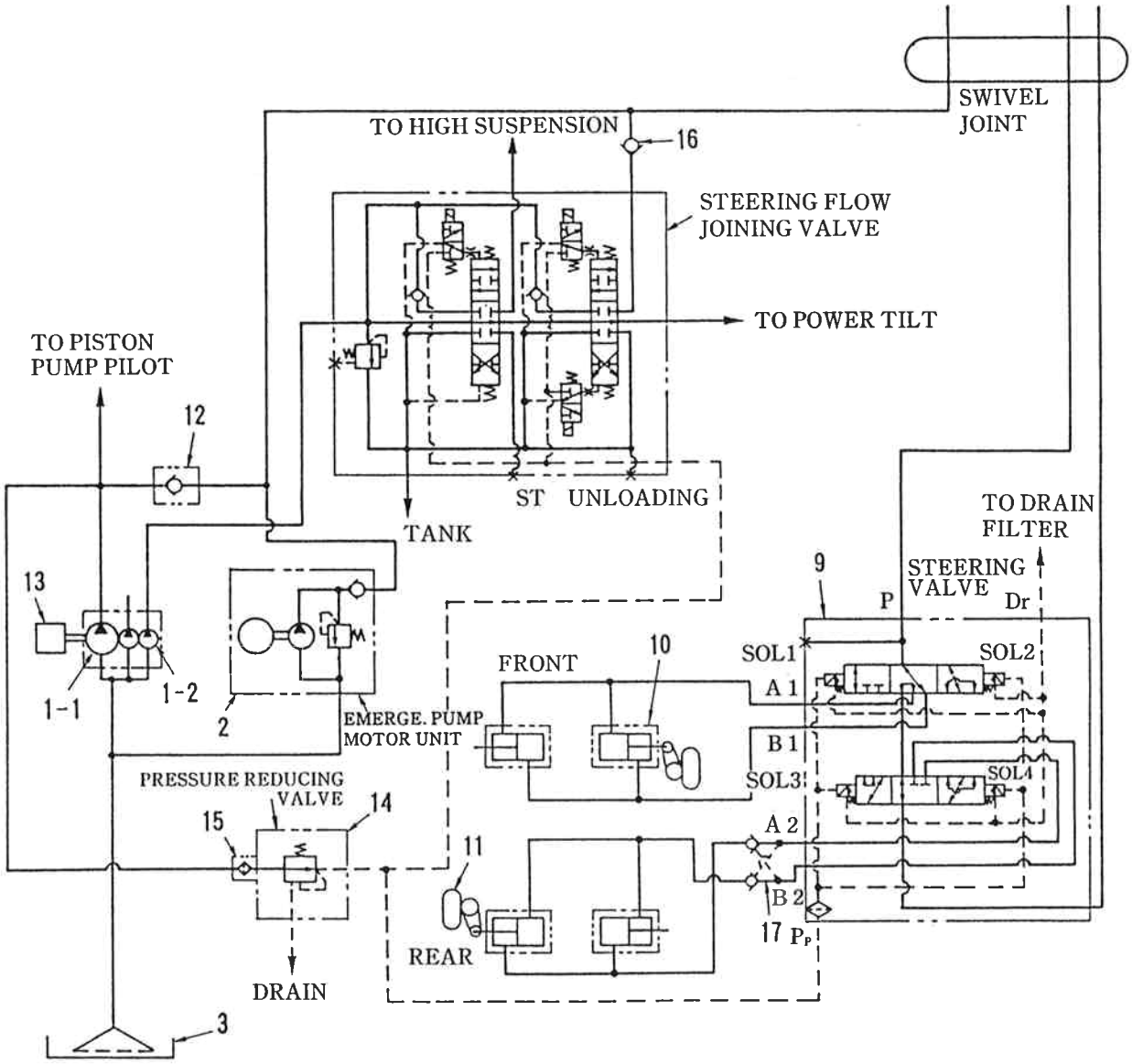


1－1 No. 2-1 HYDRAULIC PUMP
1－2 No. 2-3 HYDRAULIC PUMP
2. PUMP MOTOR UNIT
3. HYDRAULIC OIL TANK
4. SWIVEL JOINT
5. PRIORITY VALVE
6. CHECK VALVE
7. ORBIT ROLL
8. STEERING WHEEL
9. SOLENOID VALVE (STEERING VALVE)
10. STEERING CYLINDER
11. WHEEL
12. CHECK VALVE
13. TORQUE CONVERTER
14. PRESSURE REDUCING VALVE
15. IN LINE STRAINER
16. CHECK VALVE
17. DOUBLE PILOT CHECK VALVE

Fig. 2-1 Steering System Hydraulic Circuit Schematic

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2.2 OPERATION OF HYDRAULIC SYSTEM



1－1 No. 2-1 HYDRAULIC PUMP
1－2 No. 2-3 HYDRAULIC PUMP
2. PUMP MOTOR UNIT
3. HYDRAULIC OIL TANK
9. SOLENOID VALVE (STEERING VALVE)
10. STEERING CYLINDER
11. WHEEL
12. CHECK VALVE
13. TORQUE CONVERTER
14. PRESSURE REDUCING VALVE
15. IN LINE STRAINER
16. CHECK VALVE
17. DOUBLE PILOT CHECK VALVE

Steering System Hydraulic Circuit Schematic

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(1) Steering operation (see Figs. 2-2 and 2-3)

Four mode steerings of front wheel steering, rear wheel steering, crab steering and cramp steering are selected with the steering mode selector switch on the carrier control panel in front right of the operator's seat. The steering unit is provided with such safety devices as the steering lock pin and the reverse steering correction device.

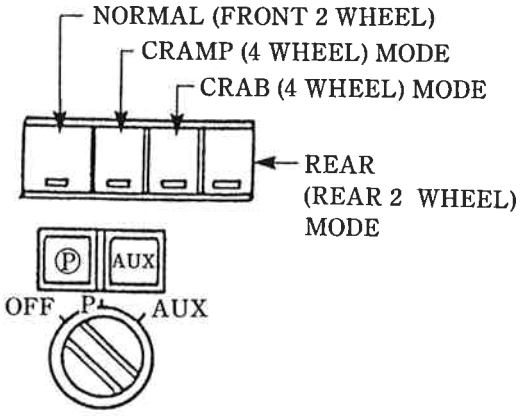


Fig. 2-2 Steering Mode Selector Switch

(2) Four wheel steering modes

By operating the steering mode selector switch on the carrier control panel, a desired steering mode can be selected among four types of steering modes.

Front 2 wheel steering is used for normal traveling. When operating, 4 wheel steering also can be used in addition to 2 wheel steering.

Crab steering : The front wheels and rear wheels are steered in the same direction, and the carrier moves diagonally. Cramp steering : The front wheels and rear wheels are steered in the opposite direction, and the carrier can be steered with a small turning radius.

These special mode steering makes it easy to enter even small site and narrow alleys.

When traveling under normal circumstances, 2 wheel steering using only the front wheels is used, and the rear steering is locked with the rear wheel steering lock pin by operating the steering mode selector switch and the rear lock pin switch on the carrier control panel.

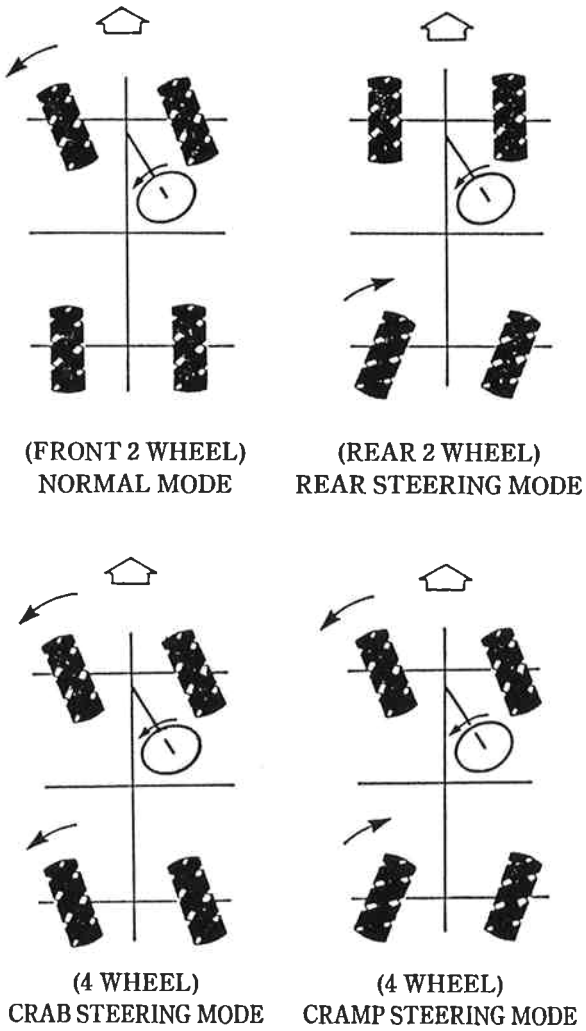


Fig. 2-3 Steering Modes

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(3) Reverse steering correction device

In the normal traveling condition with the upper frame turned to face the front of the carrier, when the steering wheel is turned to the right, the carrier moves to the right, and when the steering wheel is turned to the left, the carrier moves to the left. But, when the upper frame is turned 180 degrees and the machine moves backward, steering becomes rear wheel steering unless this switch is pushed, steering is very difficult. In order to avoid this phenomenon, even when the upper is turned to face the rear and the machine moves backward, the carrier can be steered with the same operation of the steering wheel as those when the upper is faced toward the front by function of the reverse steering correction device, so safe and easy steering can be obtained.

This correction device functions also for other three mode steering (crab, clamp and rear) similarily.

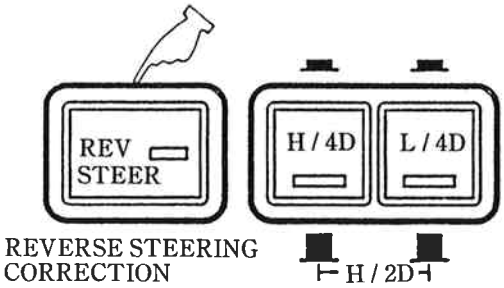


Fig. 2-4 Reverse Steering Switch

(4) Load sensing system

The load sensing system in the steering unit consists of an orbit roll and priority valve.

A steering unit with a load sensing-type orbit roll assembled to it is affixed to the steering wheel shaft.

The job of the orbit roll is to transmit the angle at which the steering wheel is rotating to the priority valve.

The priority valve is a valve which controls the flow of pressurized oil from Nos. 2-1 and 2-3 pumps, giving priority to steering.

It is designed to move the spool in proportion to the angle at which the steering wheel is rotating, supply the steering circuit with exactly the amount of flow necessary for steering operation, and to send the rest to the swing circuit. Since the energy from the oil delivered from Nos. 2-1 and 2-3 pumps used effectively and without waste, it is possible to obtain powerful steering with little input of effort.

When no steering operation is being done, all the pressurized oil from Nos. 2-1 and 2-3 pumps is sent to the swing circuit.

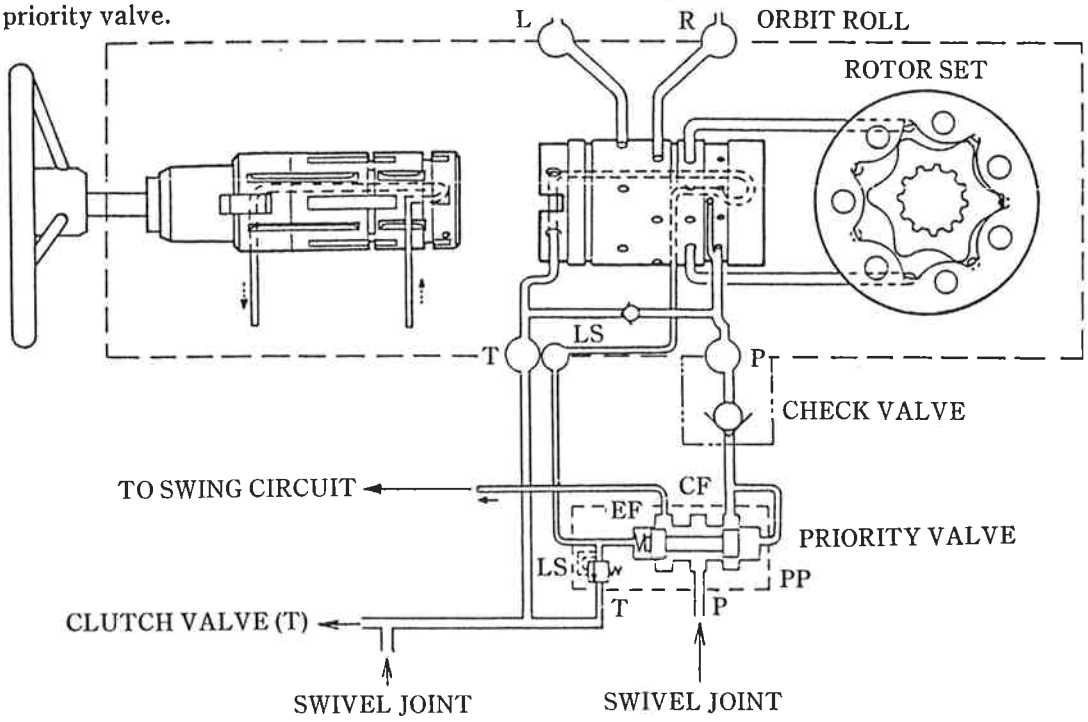


Fig. 2-5

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2.3 OPERATION OF STEERING PUMP

(1) When the PTO is in ON (for crane operation)

When the PTO is in ON, pressurized oil delivered from No. 2-3 pump functions as the supply source of pressure for the power tilt cylinder.

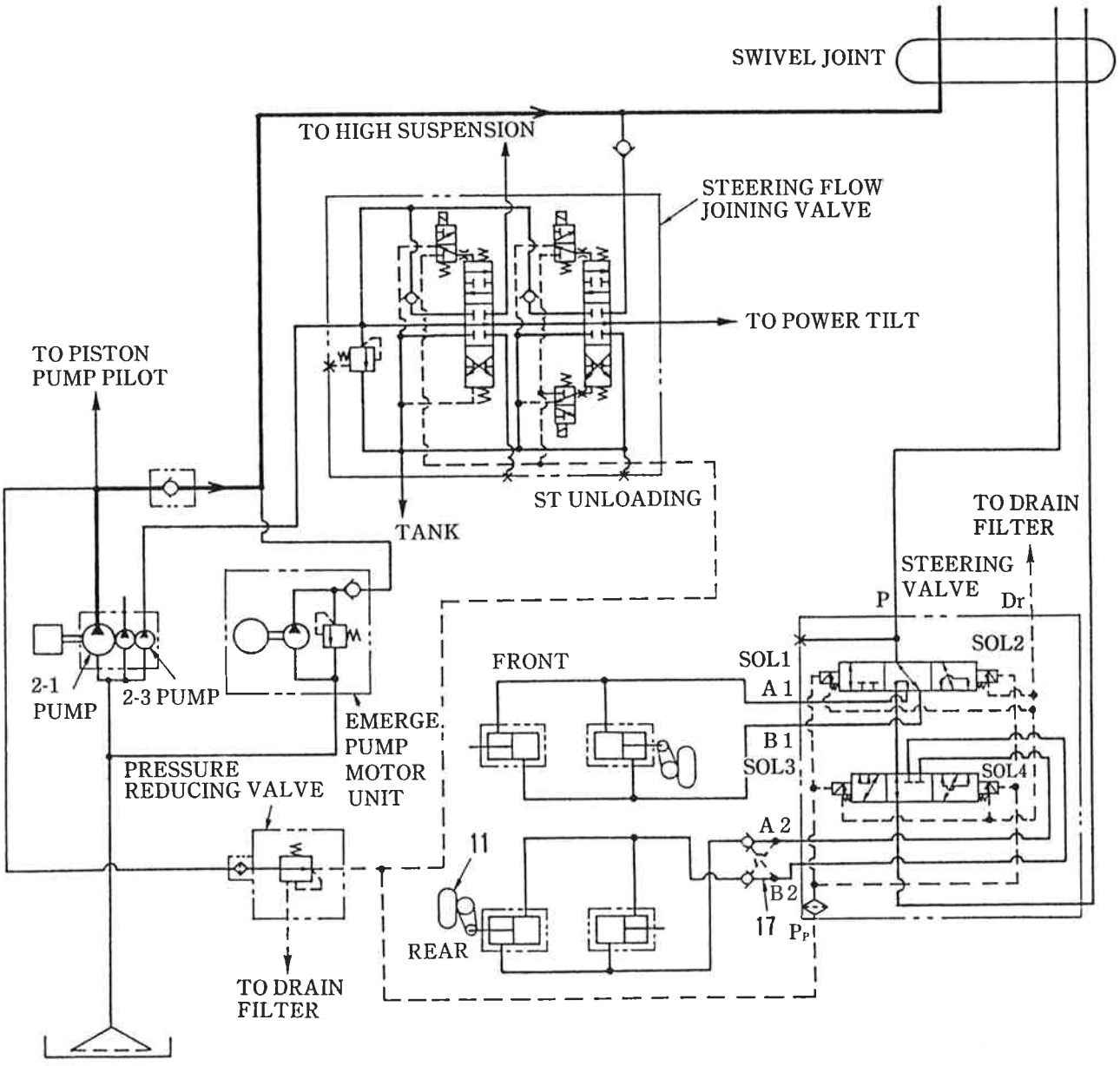


Fig. 2-6 Steering Pump Operation When PTO in ON

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(2) When the PTO is in OFF (for traveling)

① When traveling at a low speed (Fig. 2-7-1)

Solenoid valve (1) in the steering flow joining valve is magnetized, and pressurized oil from No. 2-3 pump joins to pressurized oil from No. 2-1 pump via the check valve.

A part of pressurized oil delivered from No. 2-1 pump is reduced through the pressure reducing valve, and is supplied as the spool shifting pilot pressure for the steering flow joining valve and steering valve.

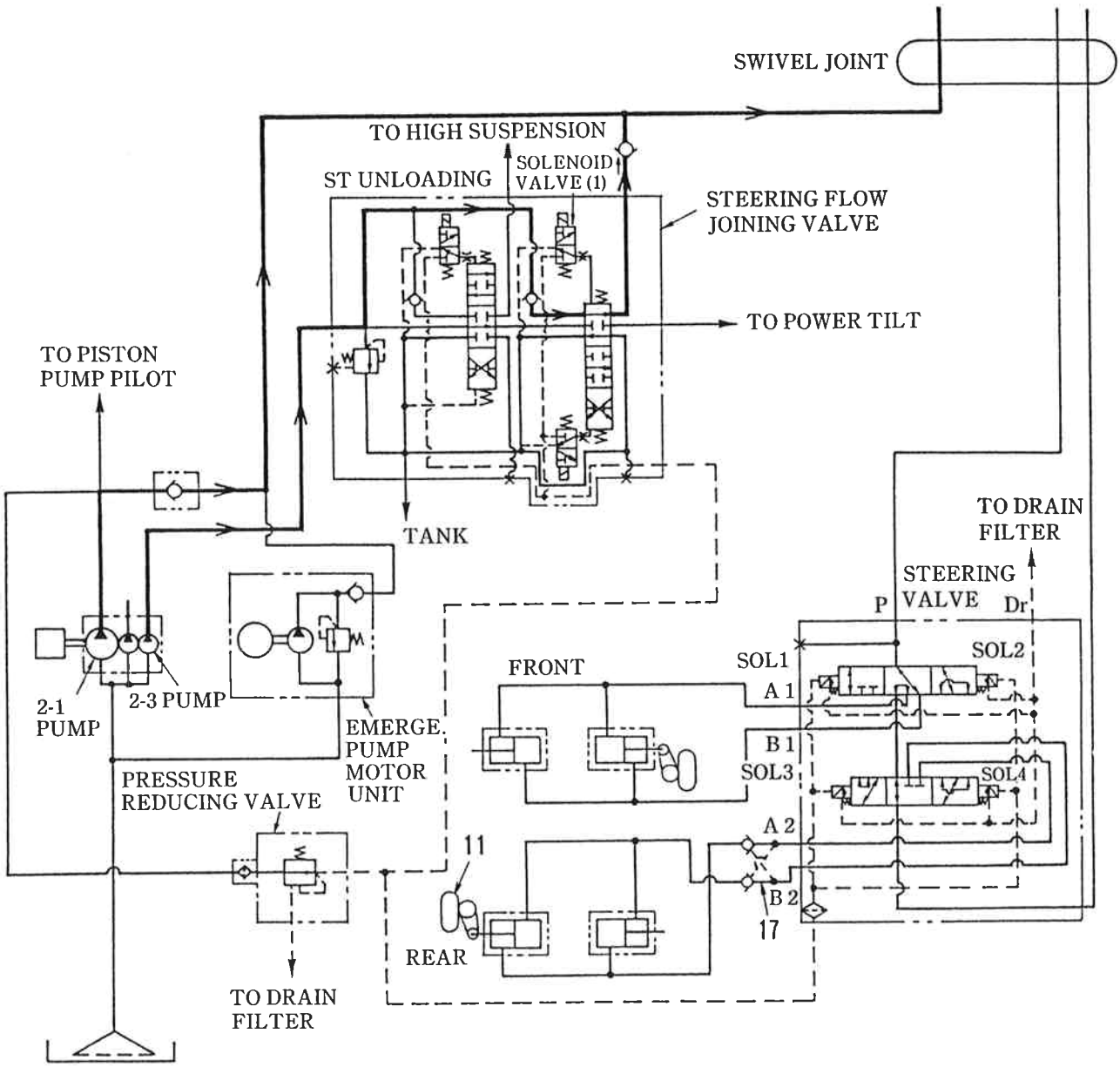


Fig. 2-7-1 Steering Pump Operation when PTO in OFF

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② When traveling at a high speed (Fig.2-7-2)
Solenoid valve (2) in the steering flow joining valve is magnetized, pressurized oil from No. 2-3 pump is unloaded to the tank.
Pressurized oil delivered from No. 2-1 pump only flows to the steering circuit.

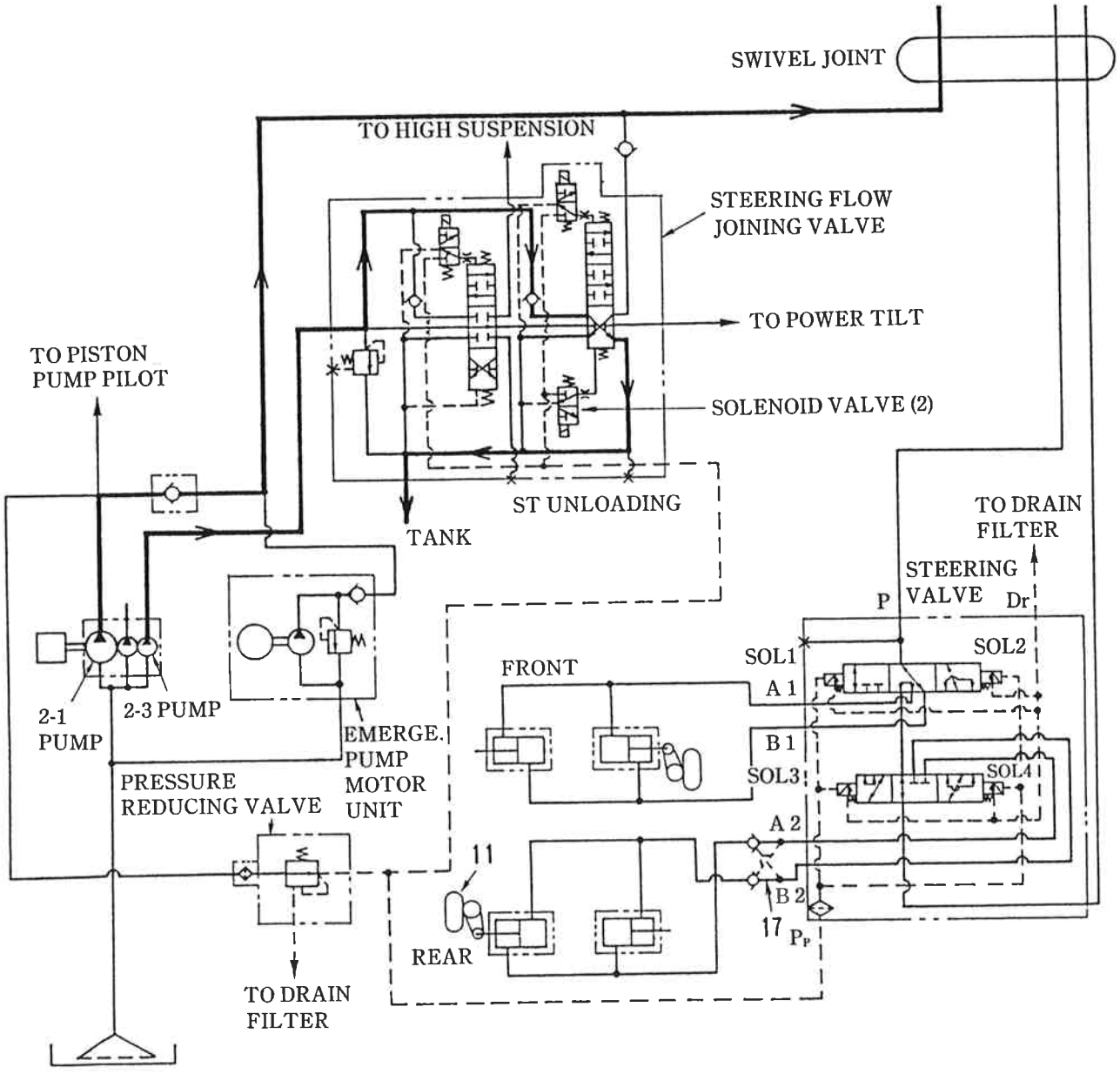
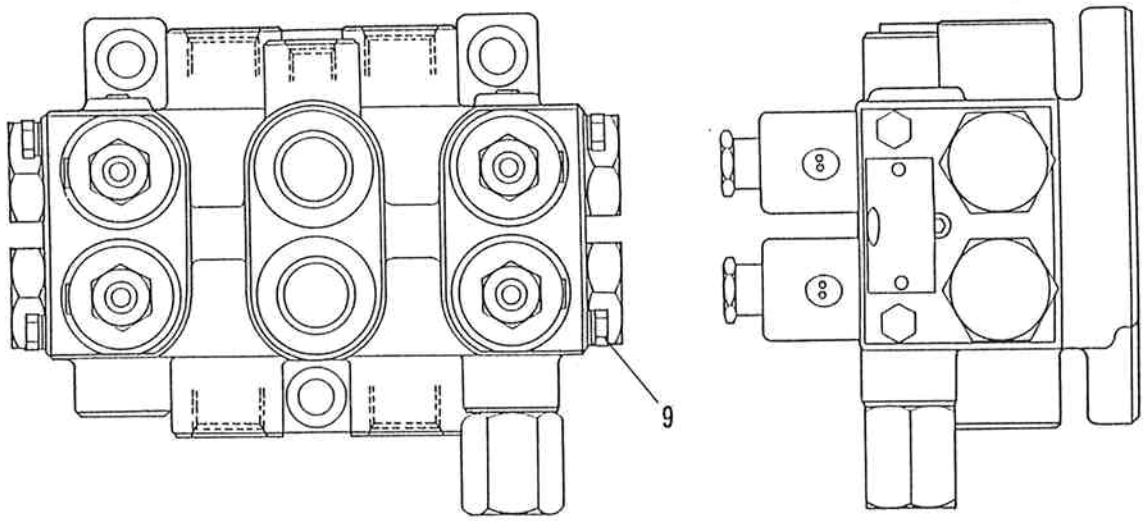


Fig. 2-7-2

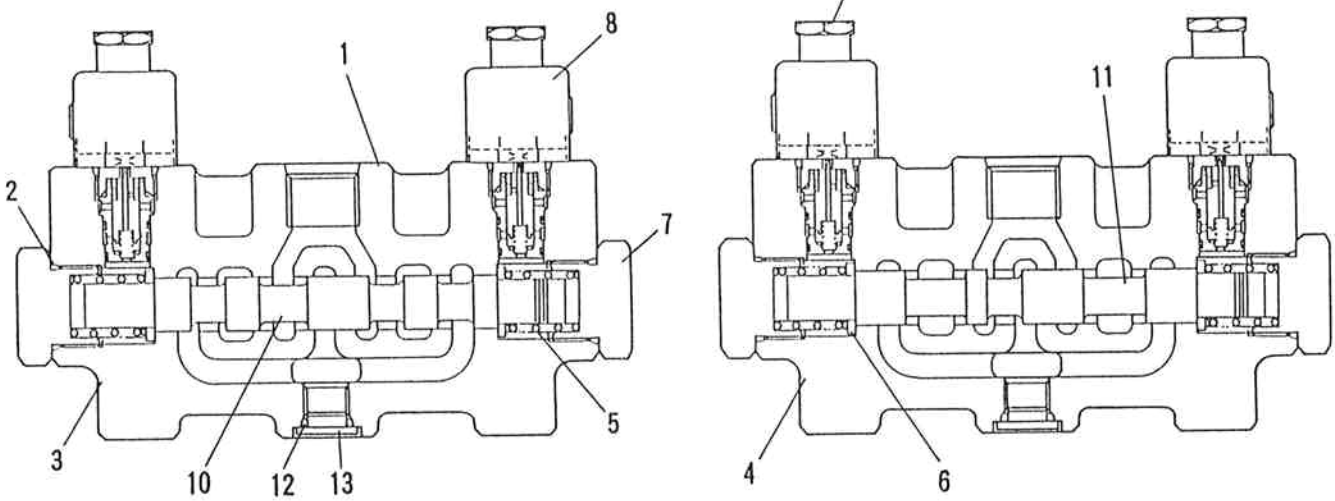
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2.4 CONSTRUCTION OF MAIN COMPONENTS

(1) SOLENOID VALVE (STEERING VALVE)



TIGHTENING TORQUE :
1.5~2.0kg · m (10.85 TO 14.46ft · lbs)



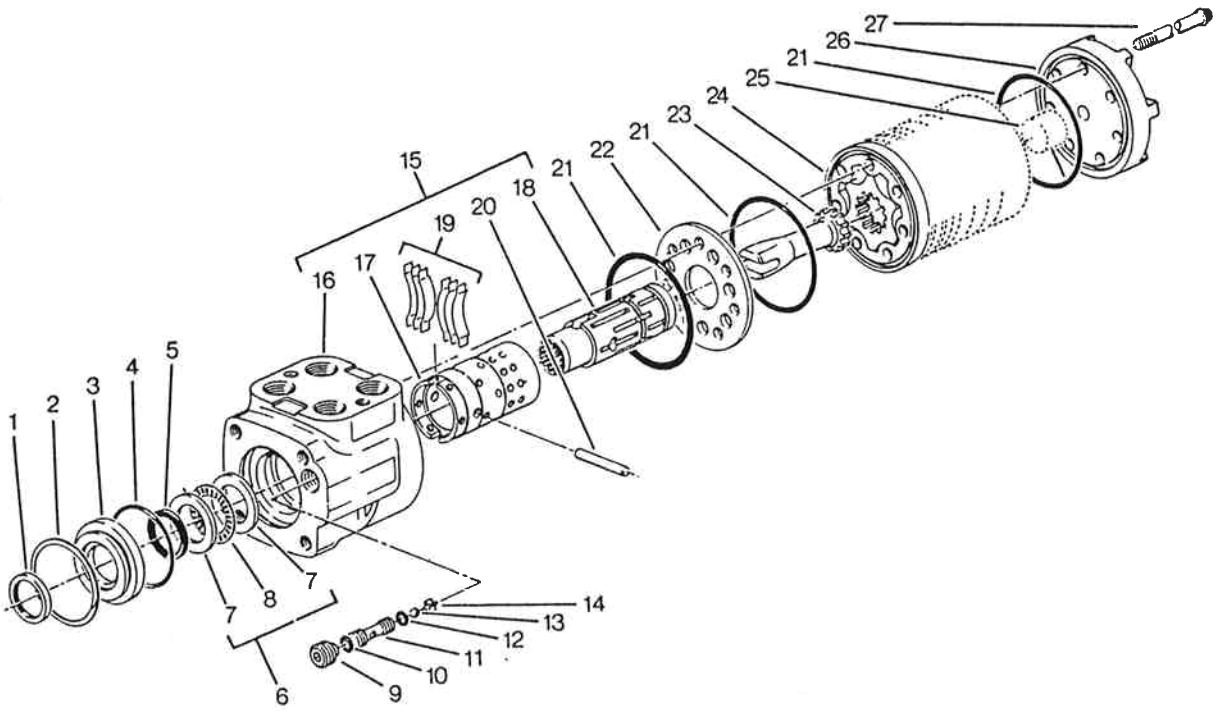
1. BODY
2. O-RING
3. VALVE SECTION
4. VALVE SECTION
5. SPRING
6. RETAINER
7. PLUG
8. SOLENOID VALVE
9. CAPSCREW
10. SPOOL
11. SPOOL
12. O-RING
13. PLUG

Fig. 2-8

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(2) ORBIT ROLL

NOTE : For details of the orbit roll, refer to separate shop manual "Orbit Roll" .



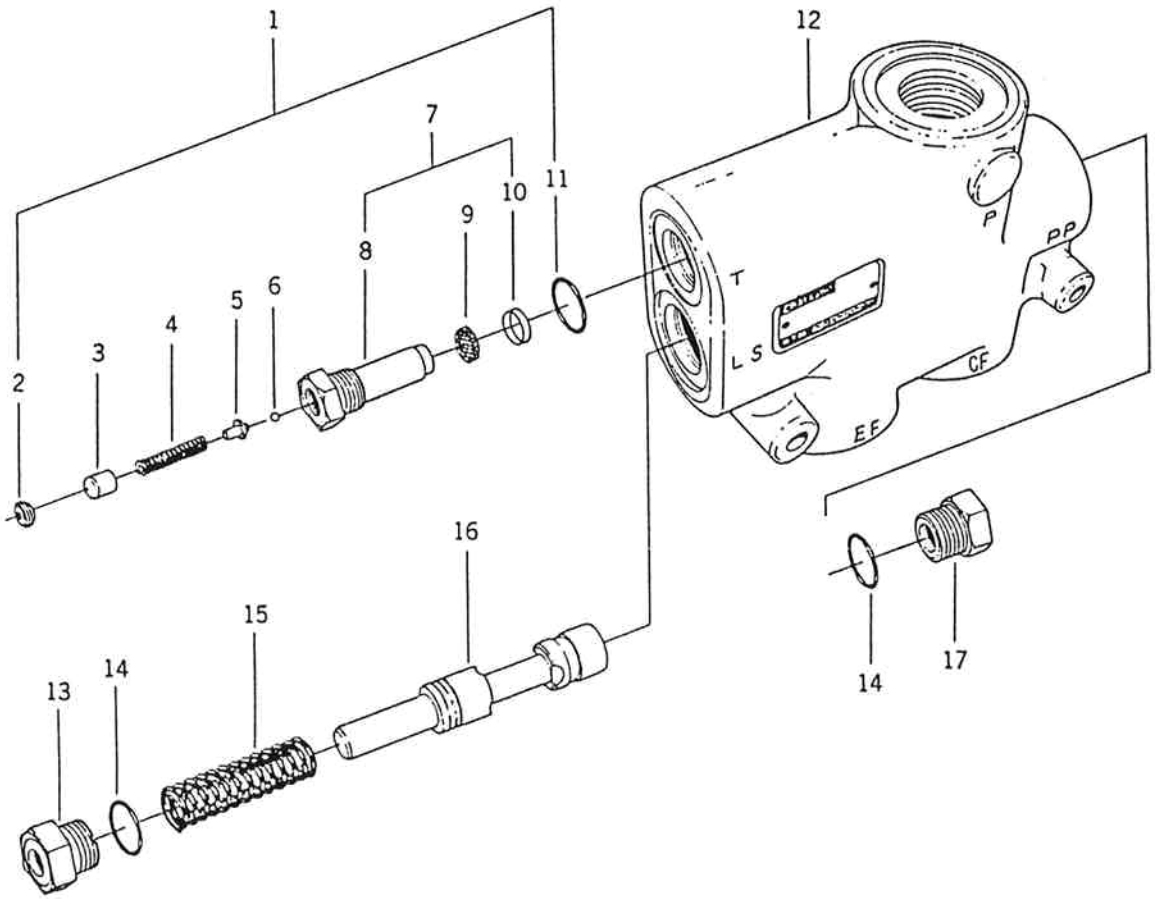
1. DUST SEAL
2. RETAINING RING
3. GLAND SEAL BUSHING
4. O-RING (47.2mm I. D. × 3.5mm) (1.858″ × 0.138″)
5. OIL SEAL (X-RING)
6. NEEDLE BEARING KIT
7. RACE BEARING
8. THRUST NEEDLE
9. SETTING SCREW
10. O-RING (9.3mm I. D. × 1.8mm) (0.366″ × 0.071″)
11. CHECK SET
12. O-RING (7.6mm I. D. × 1.8mm) (0.299″ × 0.071″)
13. BALL
14. RETAINER / CHECK BALL
15. CONTROL PARTS ASSEMBLY
16. HOUSING
17. CONTROL SLEEVE
18. CONTROL SPOOL
19. CENTERING SPRING
20. PIN
21. O-RING (72.7mm I. D. × 1.8mm) (2.862″ × 0.071″)
22. SPACER PLATE
23. DRIVE
24. ROTOR SET
25. SPACER
26. END CAP
27. SCREW

Fig. 2-9 Orbit Roll

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(3) PRIORITY VALVE

NOTE : For details of the priority valve, refer to separate shop manual "Priority Valve" .

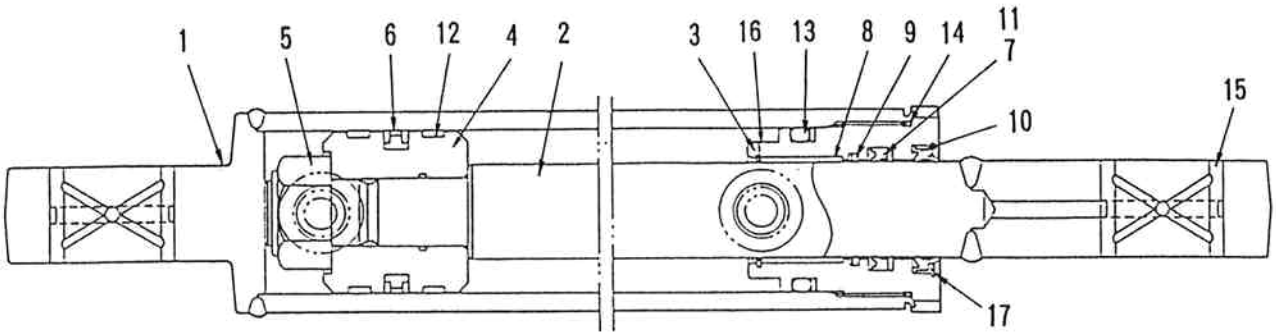


1. RELIEF VALVE / CARTRIDGE
2. SCREW
3. GUIDE
4. SPRING
5. HOLDER
6. BALL
7. BODY SUB-ASSEMBLY
8. RELIEF VALVE BODY
9. SCREEN
10. RING
11. O-RING
12. HOUSING
13. PLUG
14. O-RING
15. SPRING
16. SPOOL
17. PLUG

Fig. 2-10 Priority Valve

https://truckmanualshub.com/

(4) STEERING CYLINDER



Inside diameter of tube	60mm (2.36in)
Diameter of rod	35mm (1.378in)
Stroke	302mm (11.89in)

1. CYLINDER TUBE
2. PISTON ROD
3. CYLINDER HEAD
4. PISTON
5. U-NUT
6. PISTON PACKING
7. U-RING
8. BUSHING
9. BUFFER RING
10. DUST SEAL
11. BACK-UP RING
12. WEAR RING
13. O-RING
14. O-RING
15. BUSHING
16. SNAP RING
17. SNAP RING

Fig. 2-11 Steering Cylinder

(5) PUMP MOTOR UNIT

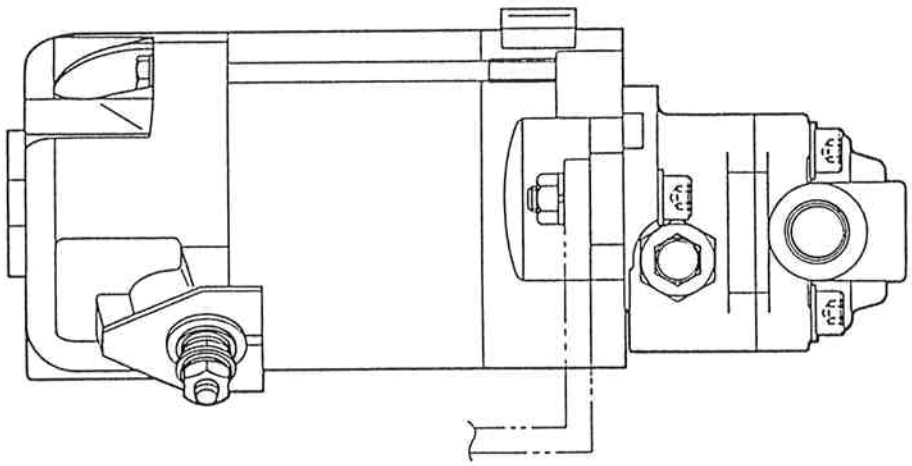


Fig. 2-12 Pump Motor Unit

https://truckmanualshub.com/

3. OPERATION

3.1 STEERING WHEEL OPERATION

(1) Outline to operation

The volume of flow and pressure of the oil from the steering pump is controlled by the priority valve and the oil is led to the orbit roll. The orbit roll is directly coupled to the steering column shaft ; when a steering operation is carried out, the orbit roll goes into operation and a volume of oil corresponding to the steering operation is sent from the orbit roll to the steering cylinders.

When the steering wheel is in neutral, the oil passes through the orbit roll and returns to the oil tank.

The orbit roll is composed of the control valve assembly (15), made up of the housing (16), control spool (18) and control sleeve (17), and the rotor set (24).

When the steering wheel is not being turned, the control valve assembly is maintained in the neutral position by the centering spring (19).

When the steering wheel is then turned, the control spool (18) rotates to cause a relative angle of displacement between it and the control sleeve (17), the oil passages are switched over, and the oil is sent to the rotor set. The rotor of this mechanism revolves according to the oil pressure and through the drive shaft the sleeve rotates to exactly the same degree.

A continuation of this allows steering operation.

Also, the rotor set constantly acts as hydraulic motor and acts as a hand pump in the case of breakdown of the steering pump or engine to enable the carrier to be steered.

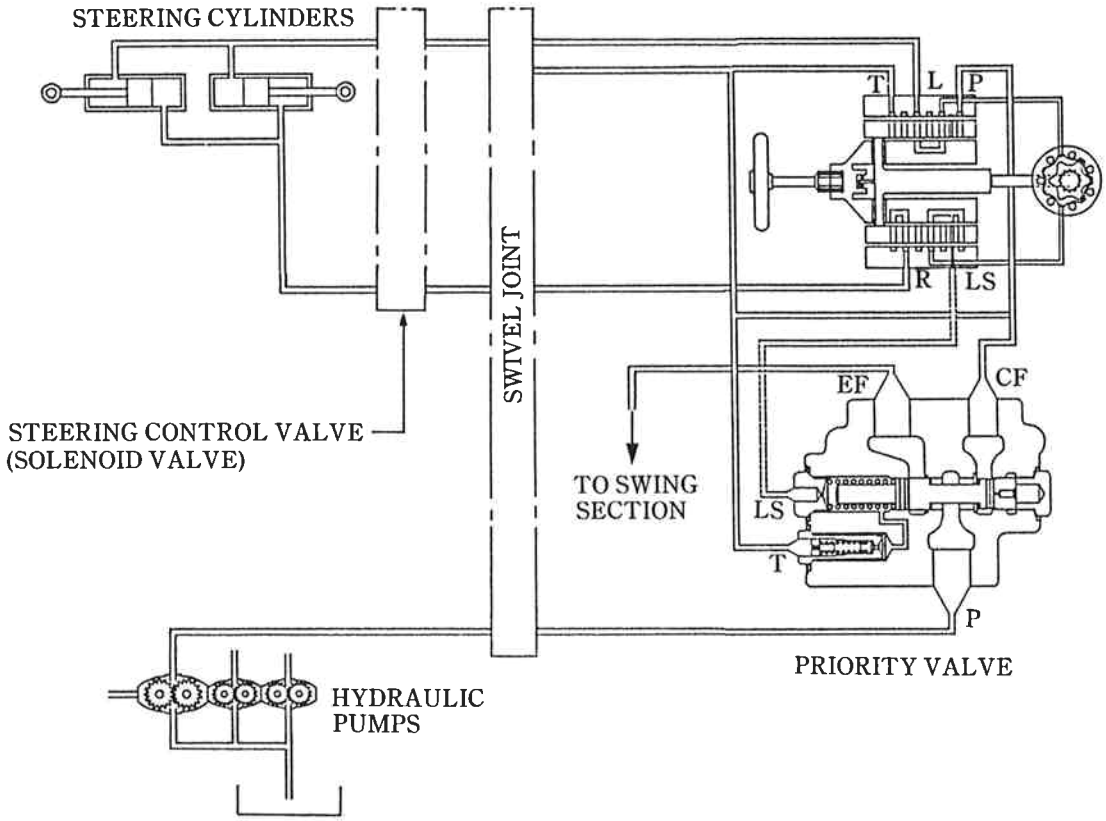


Fig. 3-1

https://truckmanualshub.com/

(2) Priority valve operation

Fig.3-2 shows the priority valve hydraulic circuit ; the distribution ports lead to the following five circuits :

"P" : connects to hydraulic pump outlet

"C F" : connects to "P" port of load sensing orbit roll

"E F" : connects to other actuator circuit (boom hoist circuit).

"L S" : connects to "LS" port of orbit roll

"T" : on the hydraulic circuit return line, this port facilitates the escape to the tank of oil expelled from the relief valve (2)

The spool moves to left and right according the difference in pressure between pressure chambers A and B and according to the tension balance of the spring and controls the degree to which "CF" and "EF" open on the circuit side.

Now, since no oil is flowing into port "P" , the spool has been pushed to the far left by the control spring leaving the "EF" side fully closed and the "CF" side fully open.

Next, if oil flows into port "P" , a difference in pressure arises around variable orifice C_1 and is transmitted to pressure chambers A and B. Consequently, the spool is forced to the right against the control spring and the oil which has flowed into port "P" flows into circuits "CF" and "EF" .

Also, the ratio in which the flow is divided and sent to each port can be controlled completely flexibly between 0 to 100% by changing the difference in pressure around variable orifice C_1 by adjusting the degree at which it is open.

When variable orifice C_1 is used in cimbination with the load sensing orbit roll, it becomes the internal orifice of the orbit roll and the degree at which it is open is controlled by turning speed of the steering wheel.

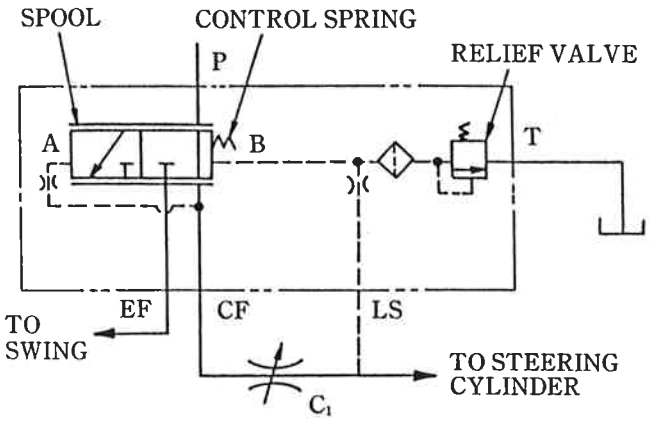


Fig. 3-2 Priority Valve Operation

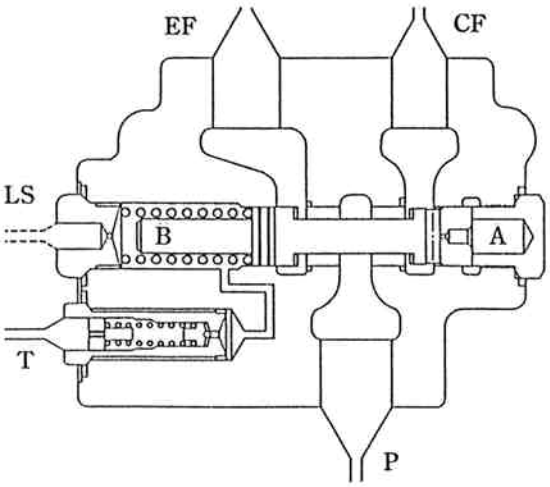


Fig. 3-3

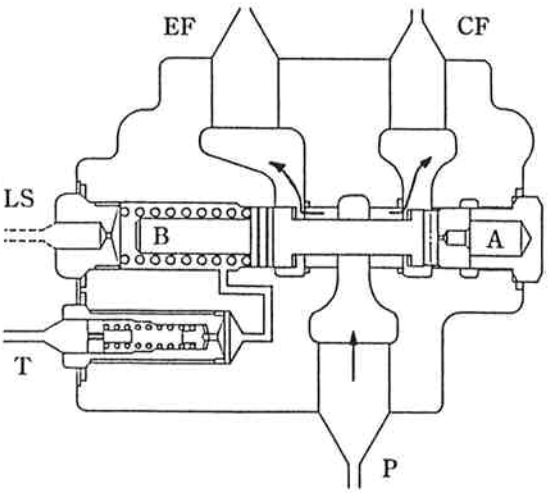


Fig. 3-4

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(3) Operation of the load sensing system

1) When the steering wheel is in neutral

When the engine is stopped, the spool in the priority valve is pushed to the far left by the contorl spring, making the "CF" side fully open and the "EF" side fully closed.

When the engine then starts to rotate, the oil expelled from the hydraulic pump passes through port "P" of the priority valve and port "CF" to flow into port "P" of the orbit roll ; the pressure in circuit "CF" rises, and thus so does the pressure in pressure chamber A of the priority valve.

At that time, because pressure chamber B is connected to the tank line via port "LS" in the orbit roll and port "T" , a difference in pressure arises between pressure chambers A and B ; when the value of that pressure difference exceeds that of the control spring, the spool in the priority valve moves from its position at the far left towards the right, leaving the "EF" side almost completely open and the "CF" side slightly open, and because this position remains stable, most of the oil output from the hydraulic pump can flow to the "EF" side. Also, since the rotor in the orbit roll and ports L and R are maintained in the blocked state, even if external load operates on the steering cylinders, this is not transferred to the steering wheel.

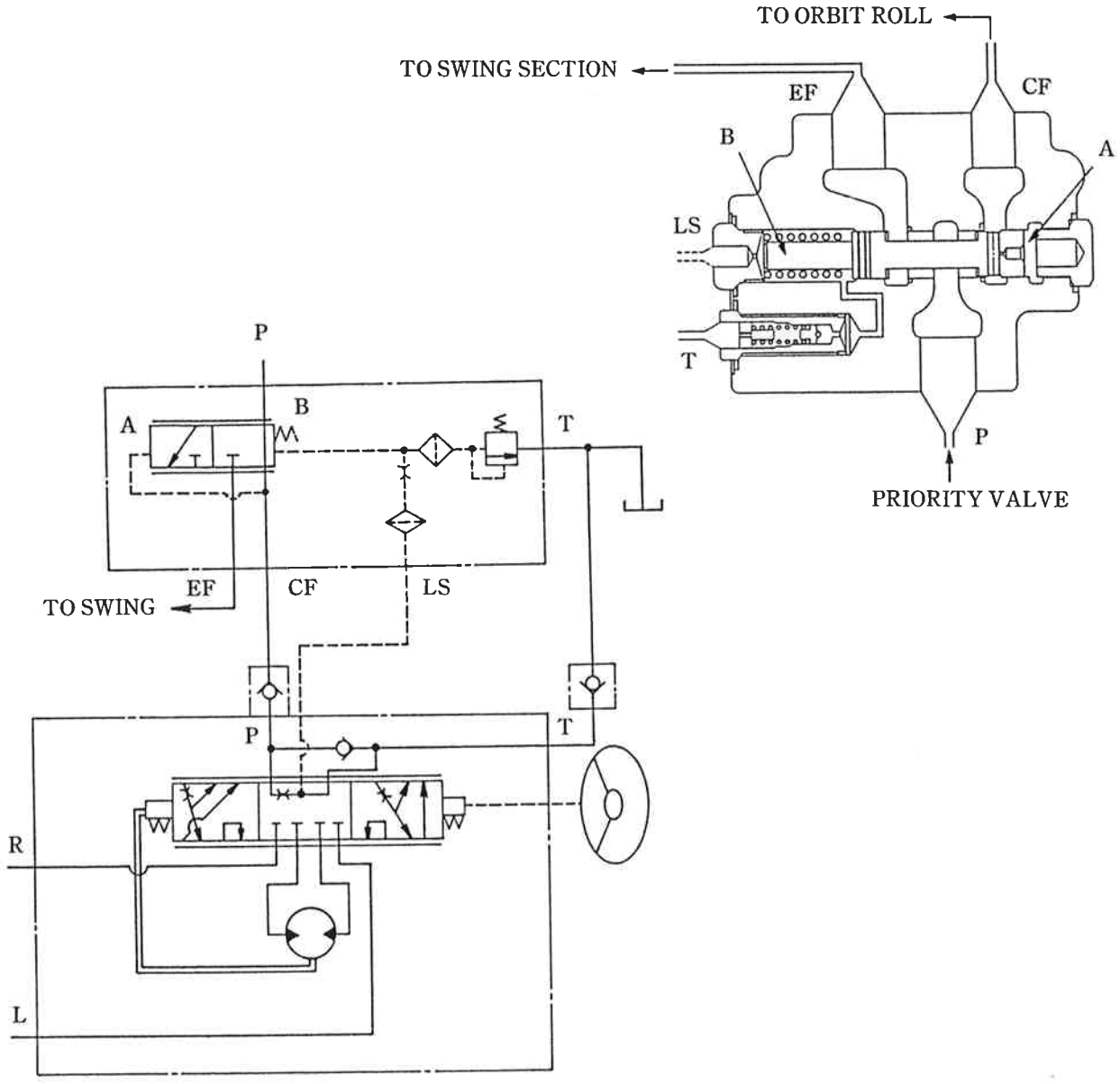


Fig. 3-5 Operation of Load Sensing System (when Steering Wheel in Neutral)

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2) Steering right

When the steering wheel is turned from the neutral condition to the right, the orbit roll spool, which is directly connected to the steering wheel, is rotated, and so the internal oil passages of the orbit roll are switched as shown in Fig. 3-6. The oil which has flowed into port "P" of the orbit roll passes orifice C_1. At that time, the pressure difference before and behind orifice C_1 becomes the pressure difference of port LS and port CF of the priority valve, and the stroke position of the priority valve spool is stabilized where the pressure difference and the control spring force are balanced.

At the end of the orbit roll is a rotor set composed of a type of internal gear. The pressurized oil coming from the orbit spool flows into the rotor, which operates as an hydraulic motor. The oil expelled from the rotor passes through the spool of the orbit valve and is supplied to the steering cylinders.

The oil expelled from the steering cylinders is returned to the tank via the orbit roll.

At this time, since the orbit roll spool and rotor are directly connected and the amount of the rotor rotation is equal to that of the sleeve rotation, oil flows as much as the amount of the spool rotation by turning of the steering wheel, then returns to the neutral condition again.

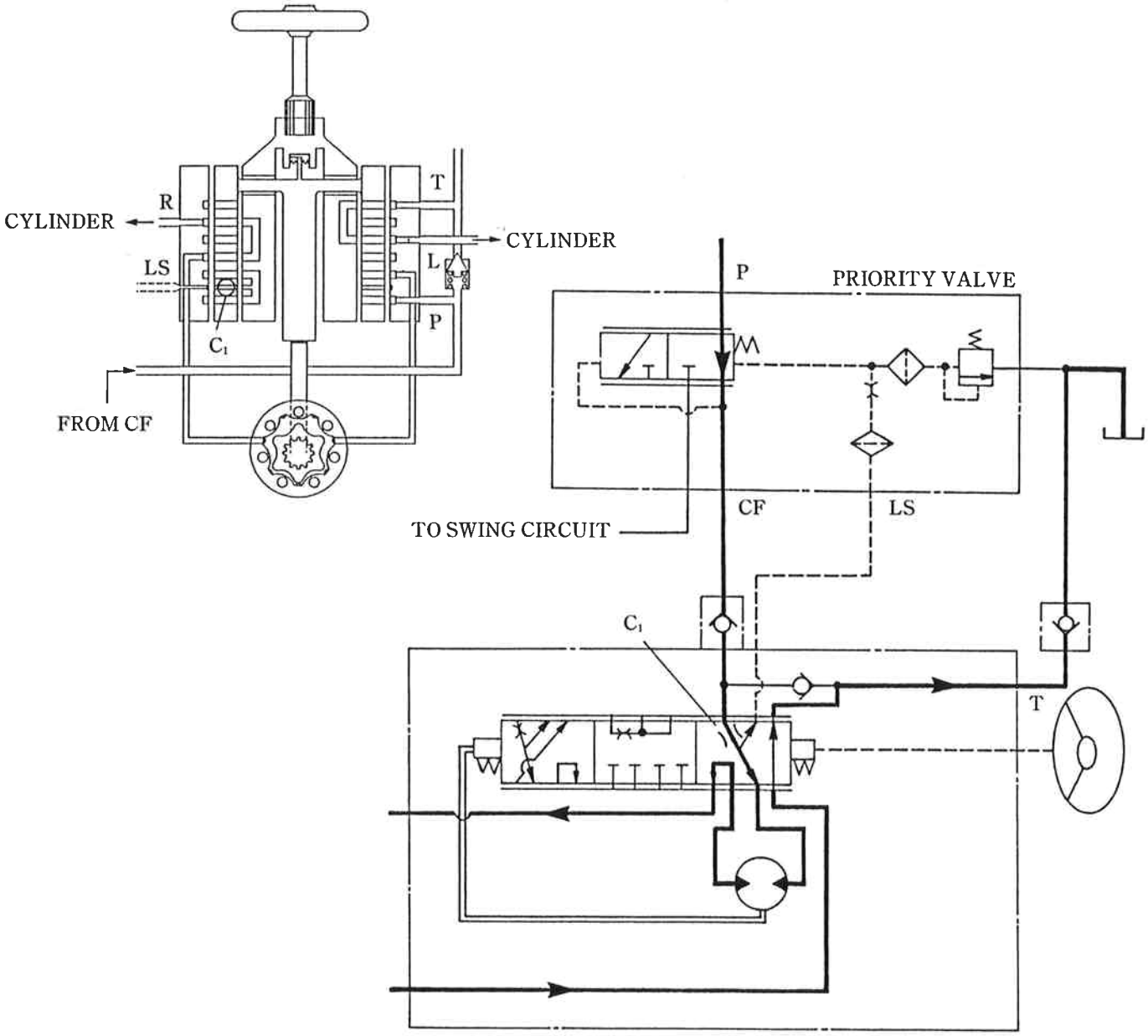


Fig. 3-6

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3) In the case of right steering stroke end

When the hydraulic cylinder reaches the end of the stroke and yet wants to turn the steering wheel, relief valve P_J in the priority valve blows.

Consequently, oil flow occurs in the orifice C_2 on the "LS" line of the priority valve, the difference in pressure around C_2 is transmitted to pressure chambers A and B, the spool moves from the position in the "Figure showing operation during right steering" even further to the right and stabilizes where the "CF" side is slightly open and the "EF" side almost wide open.

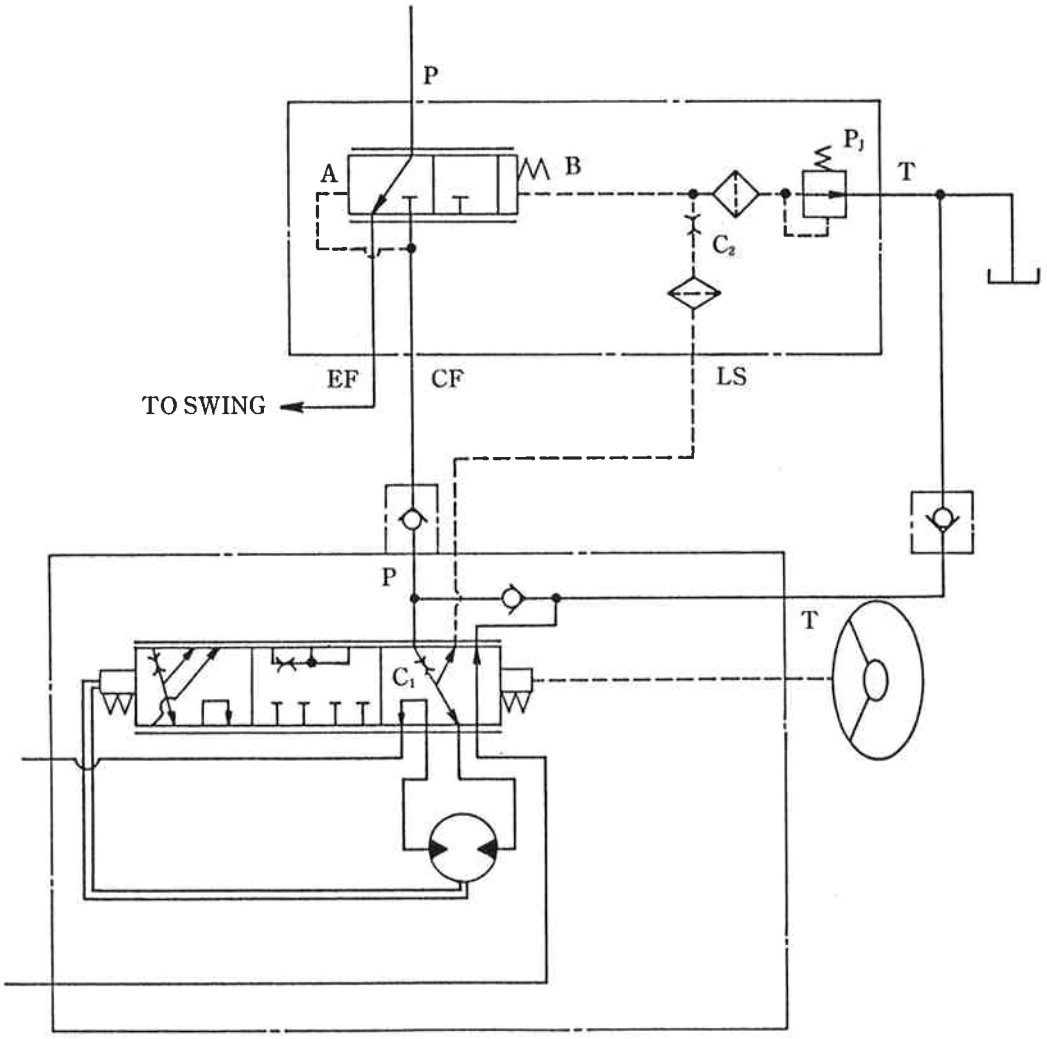


Fig. 3-7 In Case of Right Steering Stroke End

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3.2 SELECTION OF EACH STEERING MODE

The hydraulic oil is sent to the priority valve from the steering pump via the swivel joint and is efficiently apportioned between the steering circuit and winch circuit depending on the purpose of operation.

Oil which has entered the steering circuit is sent according to the strokes of the steering wheel by the orbit roll to the solenoid valve used for steering via the swivel joint.

(1) Front two wheel steering

In this case, any solenoid valve does not operate. By operating the steering wheel, the front two wheels move in the normal direction. The rear two wheels are maintained in the neutral condition by the double pilot check valve.

Fig. 3-8 shows the hydraulic circuit for right turn, and Fig. 3-9 shows the circuit for left turn.

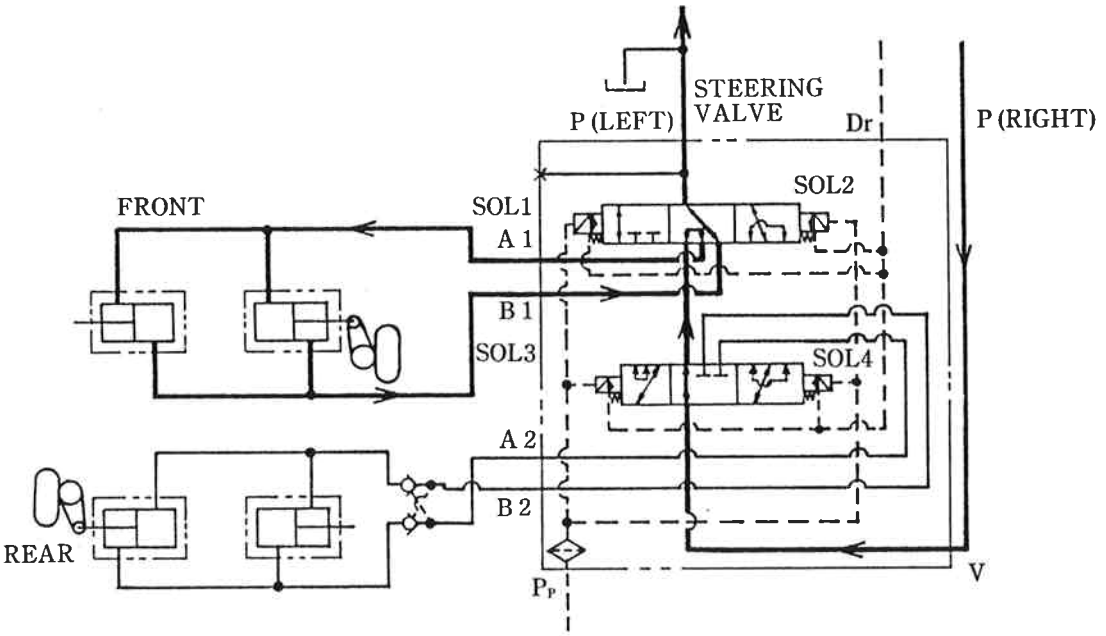


Fig. 3-8 Hydraulic Circuit for Front Two Wheel Steering (Right Turn)

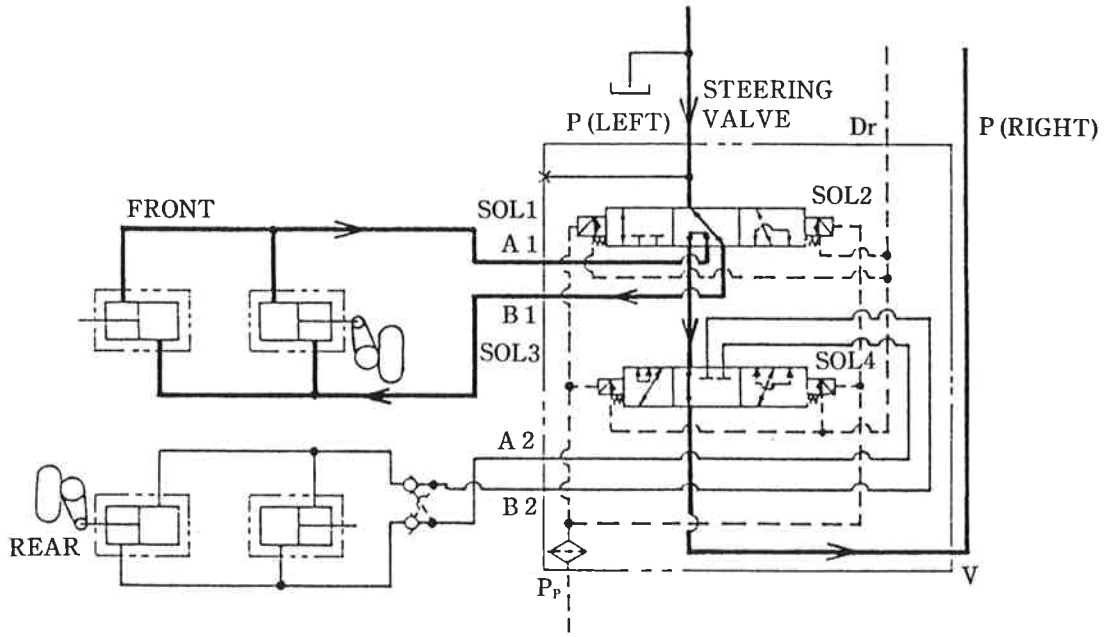


Fig. 3-9 Hydraulic Circuit for Front Two Wheel Steering (Left Turn)

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(2) Crab steering

When the steering mode selector switch is placed in the CRAB STEERING position, solenoid valve (4) operates. Fig. 3-10 shows the hydraulic circuit for crab steering to the right. For crab steering to the left, pressurized oil enters circuit P, and flows in the reverse direction of the circuit shown in Fig. 3-10. (Fig. omitted.)

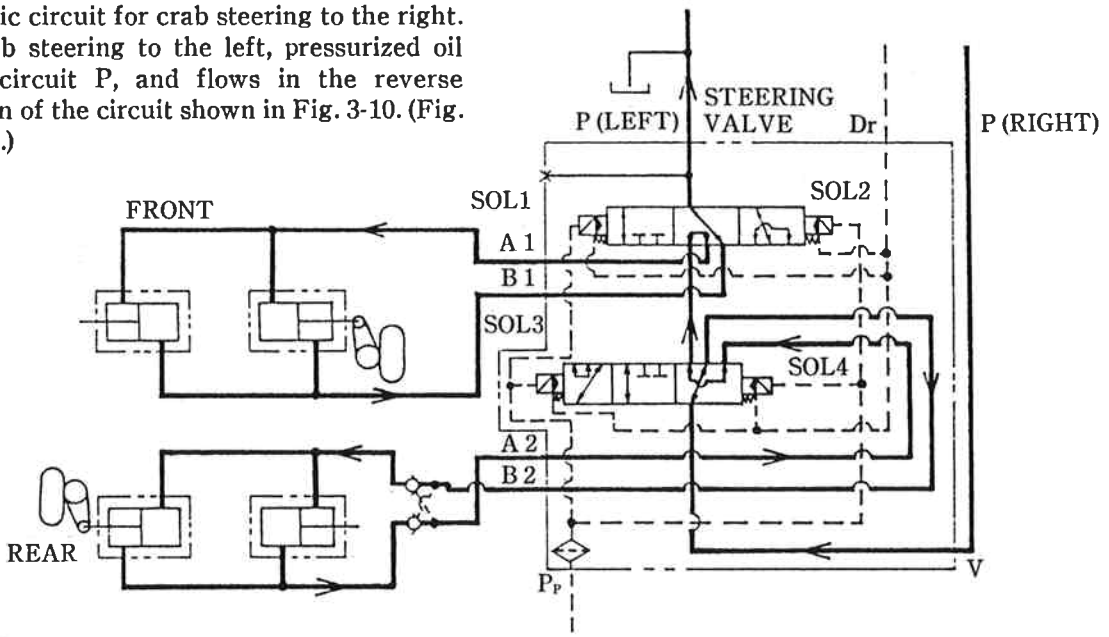


Fig. 3-10 Hydraulic Circuit for Crab Steering (Right Turn)

(3) Cramp steering

When the steering mode selector switch is placed in the CRAMP STEERING position, solenoid valve (3) operates. Fig. 3-11 shows the hydraulic circuit for cramp steering to the right. When steering to the left, pressurized oil enters circuit P, and flows in the reverse direction of the circuit shown in Fig. 3-11. (Fig. omitted.)

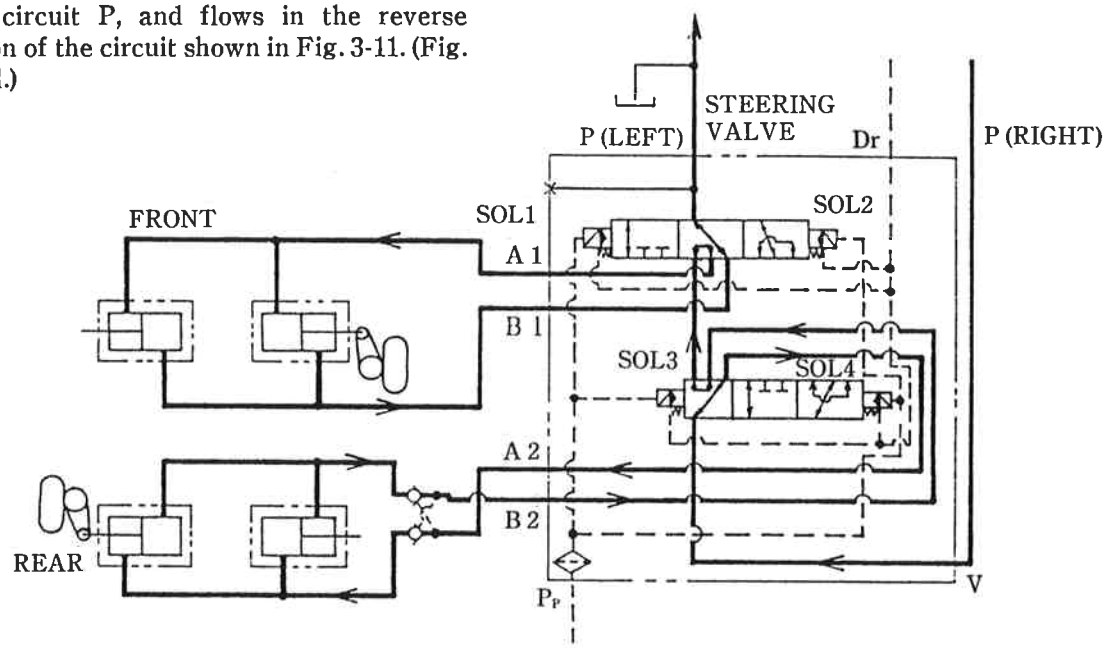


Fig. 3-11 Hydraulic Circuit for Cramp Steering (Right Turn)

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(4) Rear two wheel steering
When the steering mode selector switch is placed in the REAR TWO WHEEL STEERING position, solenoid valve (1 and 3) operates. Fig. 3-12 shows the circuit for right turn. When turning to the left, pressurized oil enters circuit P, and flows in the reverse direction of the circuit shown in Fig. 3-12. (Figure omitted.)

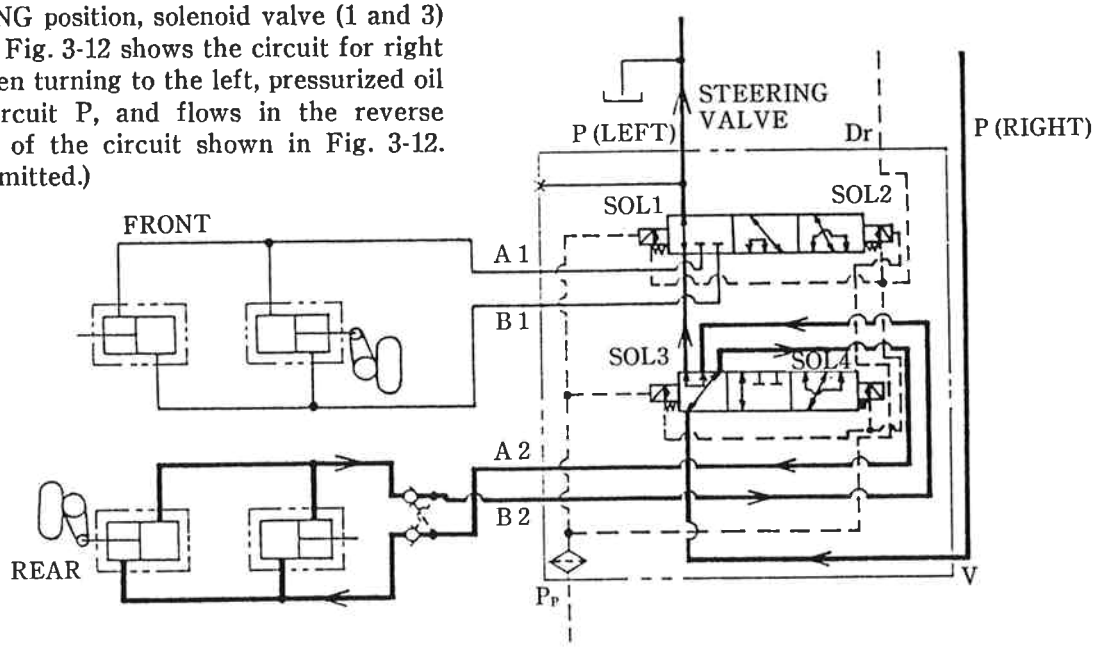


Fig. 3-12 Hydraulic Circuit for Rear Two Wheel Steering (Right Turn)

(5) Two wheel reverse steering
When the reverse steering switch is pushed and the indicator lamp lights up, solenoid valves (1 and 3) operates. The wheels are turned to the opposite direction to the normal steering direction when the steering wheel is turned with the upper faced toward the rear of the carrier. Fig. 3-13 shows the circuit for right turn. For left turn, oil enters circuit P, and flows in the reverse direction of the circuit shown in this figure. (Figure omitted.)

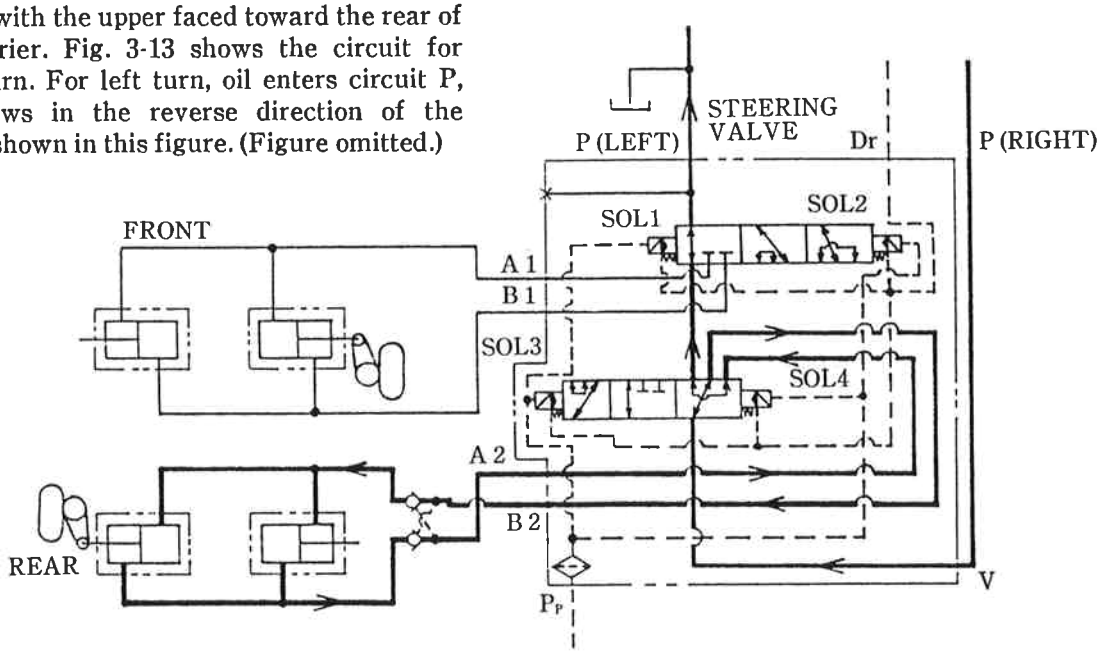


Fig. 3-13 Hydraulic Circuit for Two Wheel Reverse Steering (Right Turn)

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(6) Cramp reverse steering
When the reverse steering switch is pushed, and when the steering mode selector switch is placed in the CRAMP STEERING position, solenoid valve (2 and 4) operates. When the upper facing the rear of the carrier, cramp steering is performed by the same operation as operation when the upper facing forward. Fig. 3-14 shows the circuit for right turn. For left turn, oil enters circuit P, and flows in the reverse direction. (Fig. omitted.)

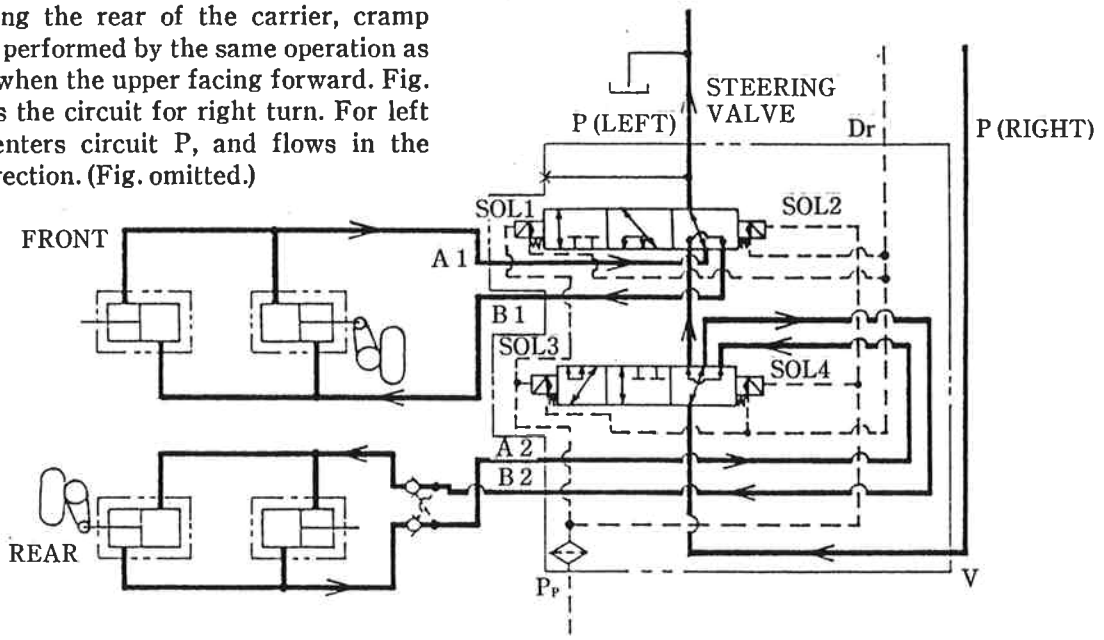


Fig. 3-14 Hydraulic Circuit for Cramp Reverse Steering (Right Turn)

(7) Rear two wheel reverse steering
When the reverse steering switch is pushed, and when the steering mode selector switch is placed in the REAR TWO WHEEL STEERING position, solenoid valve (2) operates. With the upper facing the rear of the carrier, rear two wheel steering is performed by the same operation as operation when the upper facing forward. Fig. 3-15 shows the circuit for right turn. For left turn, oil enters circuit P, and flows in the reverse direction. (Figure omitted.)

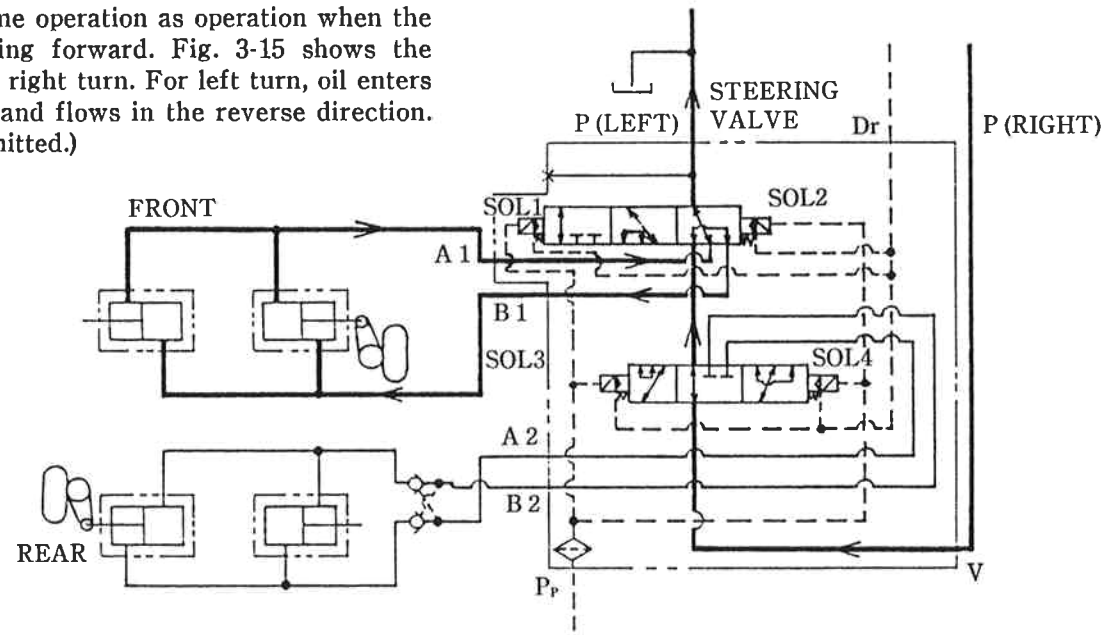


Fig. 3-15 Hydraulic Circuit for Rear Two Wheel Reverse Steering (Right Turn)

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3.3 PUMP MOTOR UNIT OPERATION

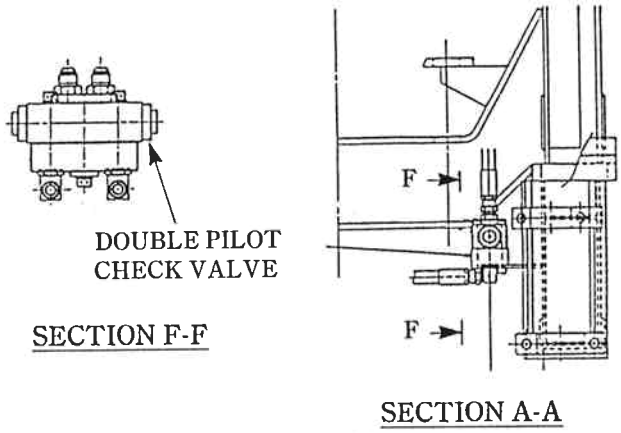
If the emergency steering switch, on the emergency travel switch panel in the left of the operator's seat, is pushed (ON), the motor is run on power from the battery, operates the emergency steering pump and it is possible to temporarily use the power steering.

3.4 STEERING LOCK SYSTEM

(1) GENERAL

The steering system of this machine is of construction that the all wheel steering is possible for work. However, since the two front wheel steering only is used for normal traveling, a device which locks the rear wheel steering is provided.

(2) CONSTRUCTION OF STEERING LOCK SYSTEM



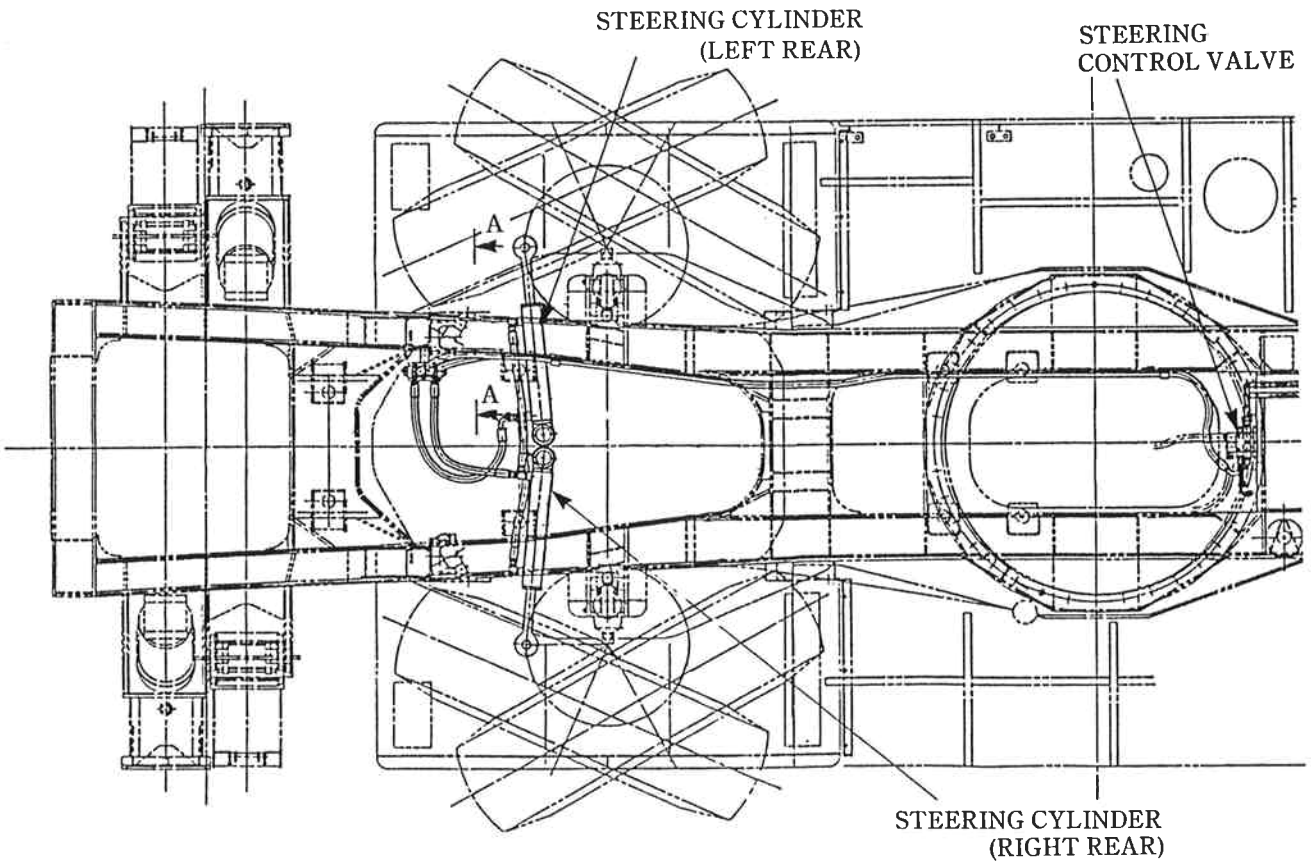


Fig. 3-16 Location of Equipments

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3.3 PUMP MOTOR UNIT OPERATION

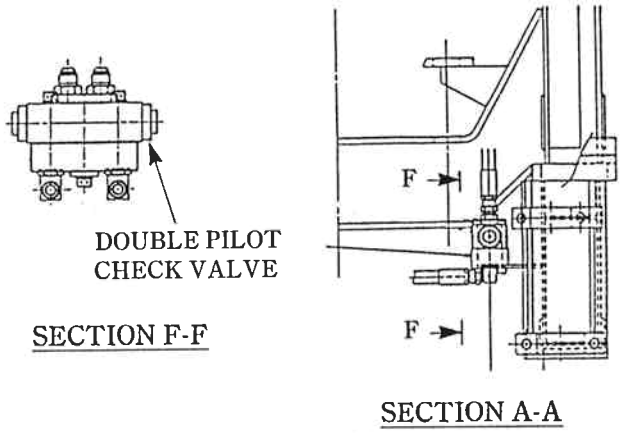
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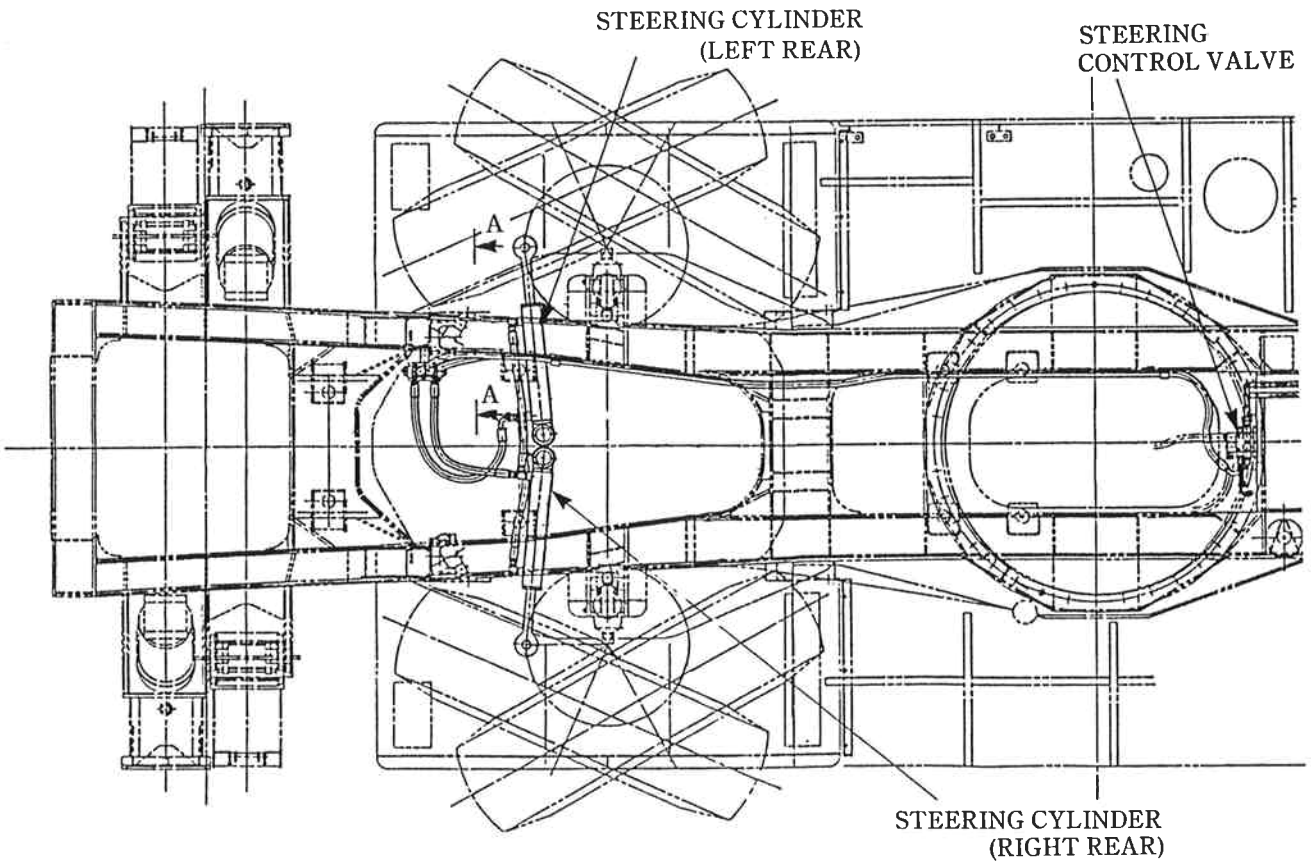
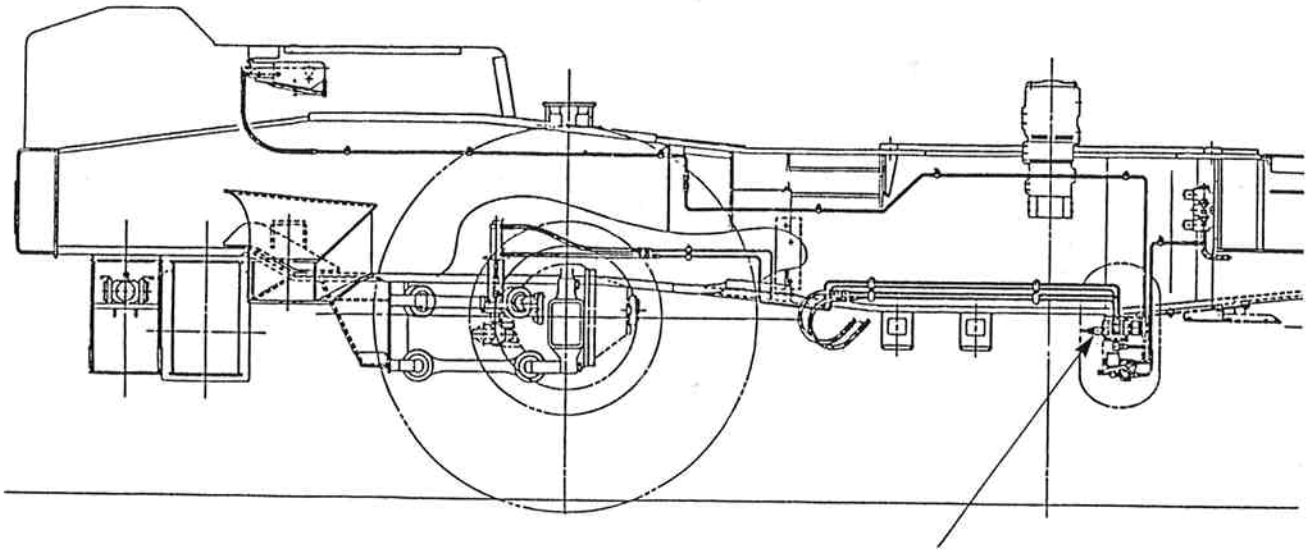
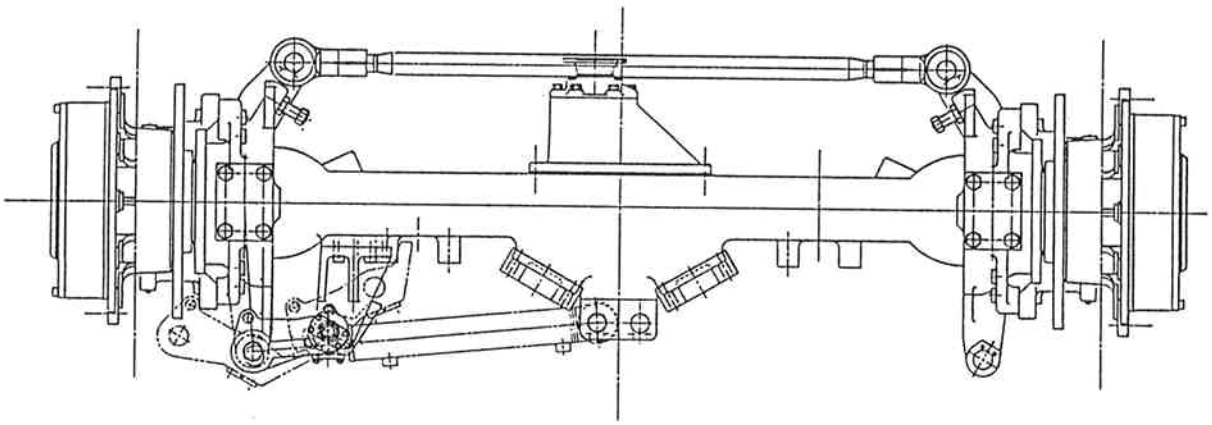


Fig. 3-16 Location of Equipments

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AIR SOLENOID VALVE
(FOR REAR STEERING LOCK PIN "IN" AND "OUT")



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(3) OPERATION OF REAR WHEEL STEERING LOCK SYSTEM

The rear wheel steering lock system is composed of a double pilot check valve and lock pin. When the rear wheels are set in the neutral condition with the steering neutral position detecting limit switch and the normal mode (front two wheels) is selected, the double pilot check valve functions to fix the rear wheel steering cylinder in the neutral position with hydraulic pressure, and also the lock pins operate to "IN" by the air cylinder to lock the rear wheels mechanically.

When the four steering modes (clamp, crab and rear two wheels) are selected, the lock pins operate to "OUT" automatically by the air cylinder and the mode is changed to the four steering modes.

This system operates when the carrier stops and when the carrier travels at a speed less than 10km / h (6.2mph).

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4. MAINTENANCE STANDARDS

(1) STEERING PUMP

Item	Standard value	Remarks
Revolutions per minute	2317rpm	At 2800rpm of engine revolution
Rated delivery	81.0 ℓ (2.86cu. ft) / min	
Relief set pressure	210kg / ㎠ (2986psi)	

(2) STEERING CYLINDER

Item	Standard value	Remarks
Inside diameter of cylinder	60㎜ (2.36in)	
× outside diameter of rod	× 35㎜ (1.378in)	
Mounting length	581㎜ (22.87in)	
Stroke	302㎜ (11.89in)	Effective stroke.
Relief set pressure	210kg / ㎠ (2986psi)	For both of extending and retracting
Tightening torque of U-nut	40kg-m (289ft-lbs)	
Tightening torque of cylinder head	30kg-m (217ft-lbs)	

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5. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
1 Steering is heavy.	Damage of steering pump	Repair or replace.
	Malfunction of priority valve.	Repair or replace.
	Malfunction of orbit roll.	Repair or replace.
	Insufficiency of hydraulic oil.	Add oil to specified level.
	Clogged return filter element.	Wash or replace.
	Insufficiency of tire air pressure.	Supply air to specified pressure.
2 Selection of each steering mode is impossible.	Faulty solenoid valve for steering.	Repair.
	Abnormality of steering electrical circuit.	Repair.
	Malfunction of steering cylinder.	Repair.
	Oil leak from steering cylinder piping.	Retighten.
3 Steering is unsteady.	Loose or damaged mounting pin of steering cylinder.	Replace.
	Insufficient relief set pressure of steering cylinder.	Replace.
	Damaged control spring of priority valve.	Replace.
	Damaged centering spring of orbit roll.	Replace.
	Wrong holding of double pilot check valve.	Replace.

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1. CONSTRUCTION AND FUNCTION

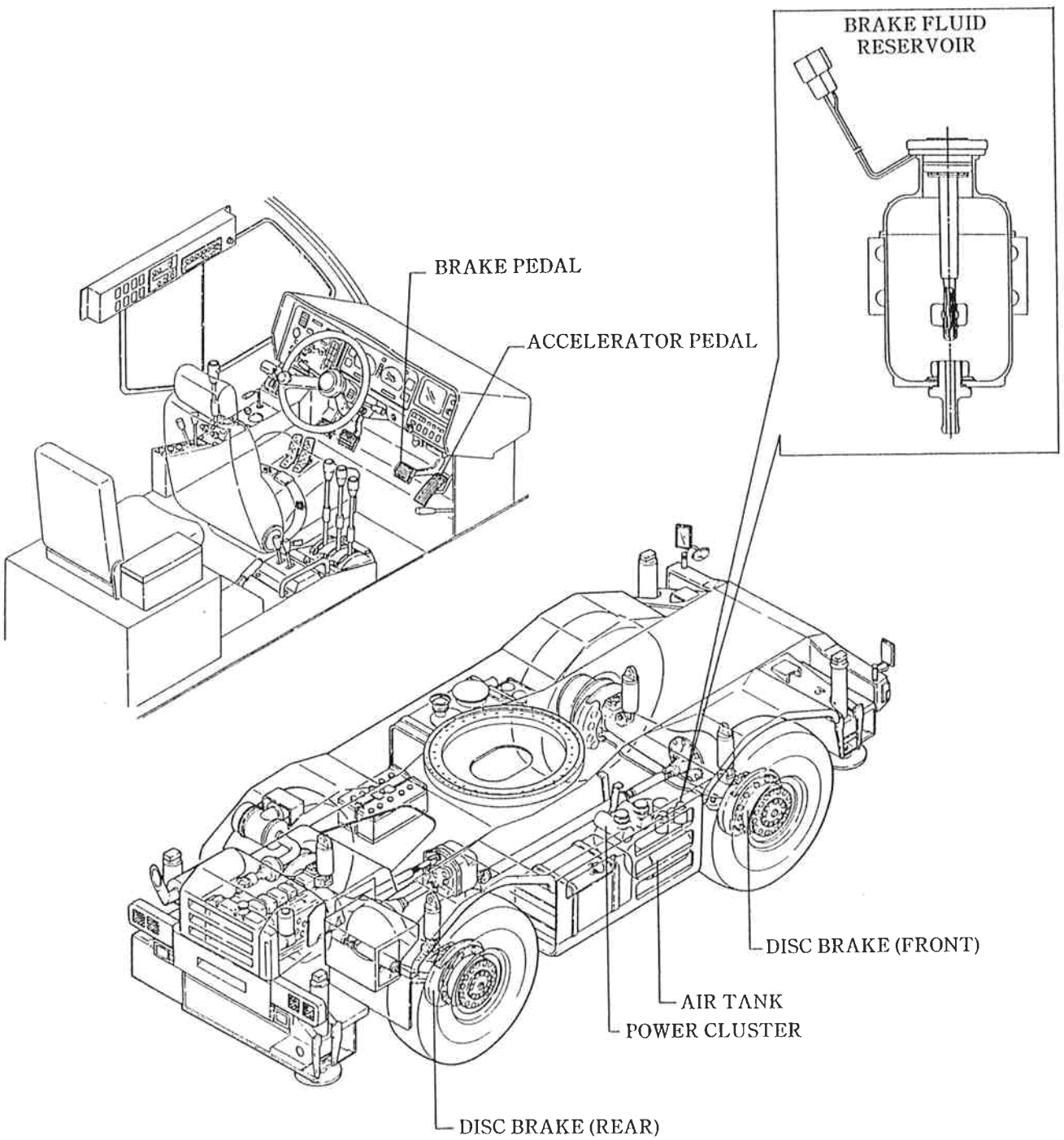
1.1 OUTLINE OF SYSTEM

(1) The air and brake hydraulic system is largely made up of the following five circuits :

1. Air supply circuit
2. Service brake circuit
3. Parking brake circuit
4. Air cylinder control circuit
5. Engine throttle circuit

(2) Pressure inside the air system is controlled by the following four kinds of valves :

1. Pressure governor
2. Safety valve
3. Protection valve
4. Reduction valve



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1.2 PIPING DIAGRAM

Item numbers in Fig. 1-1 correspond to the numbers in paragraph 1.3.

■LOWER

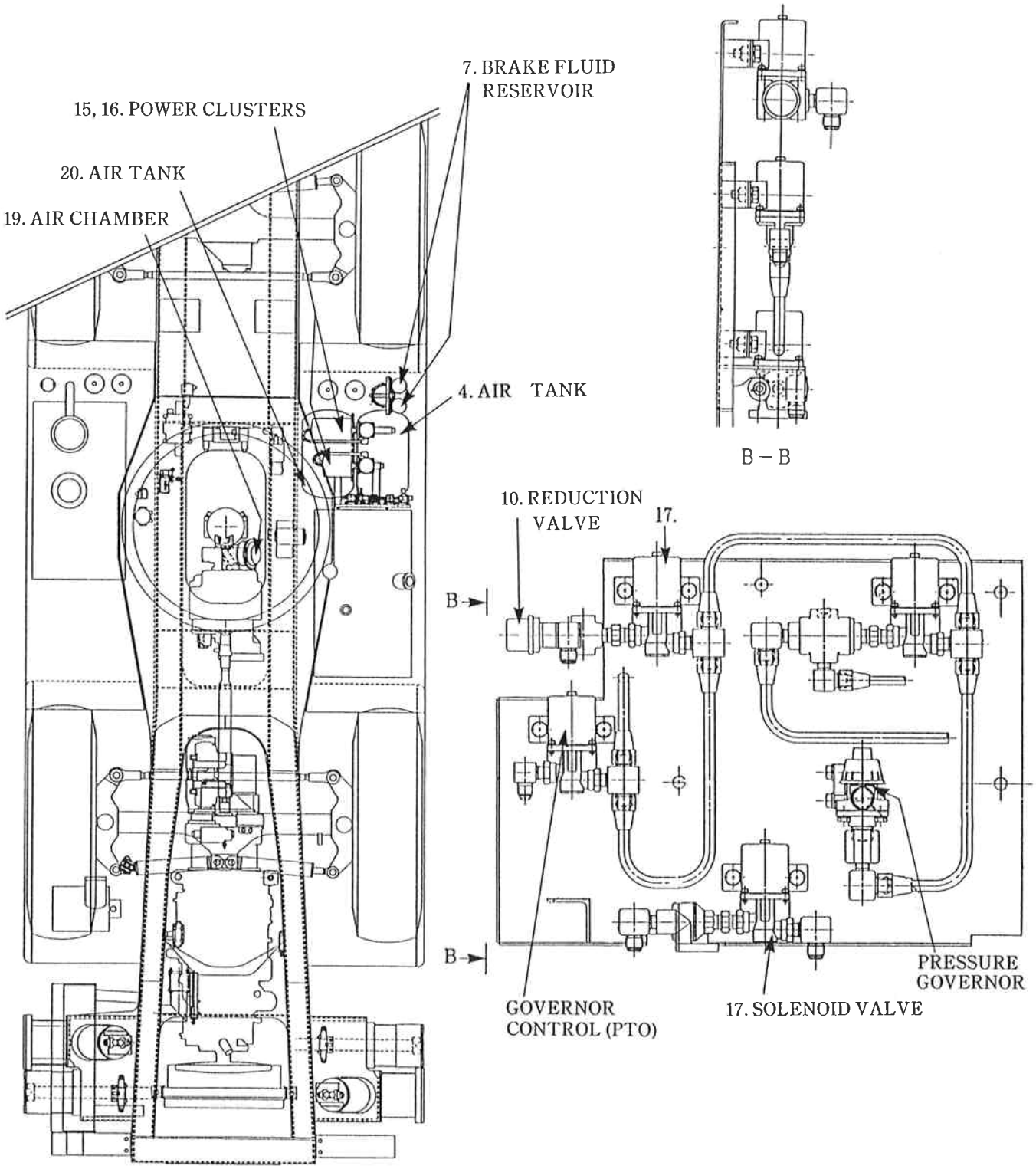


Fig. 1-1 Air and Static Hydraulic Piping Assembly (1 / 2)

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■UPPER

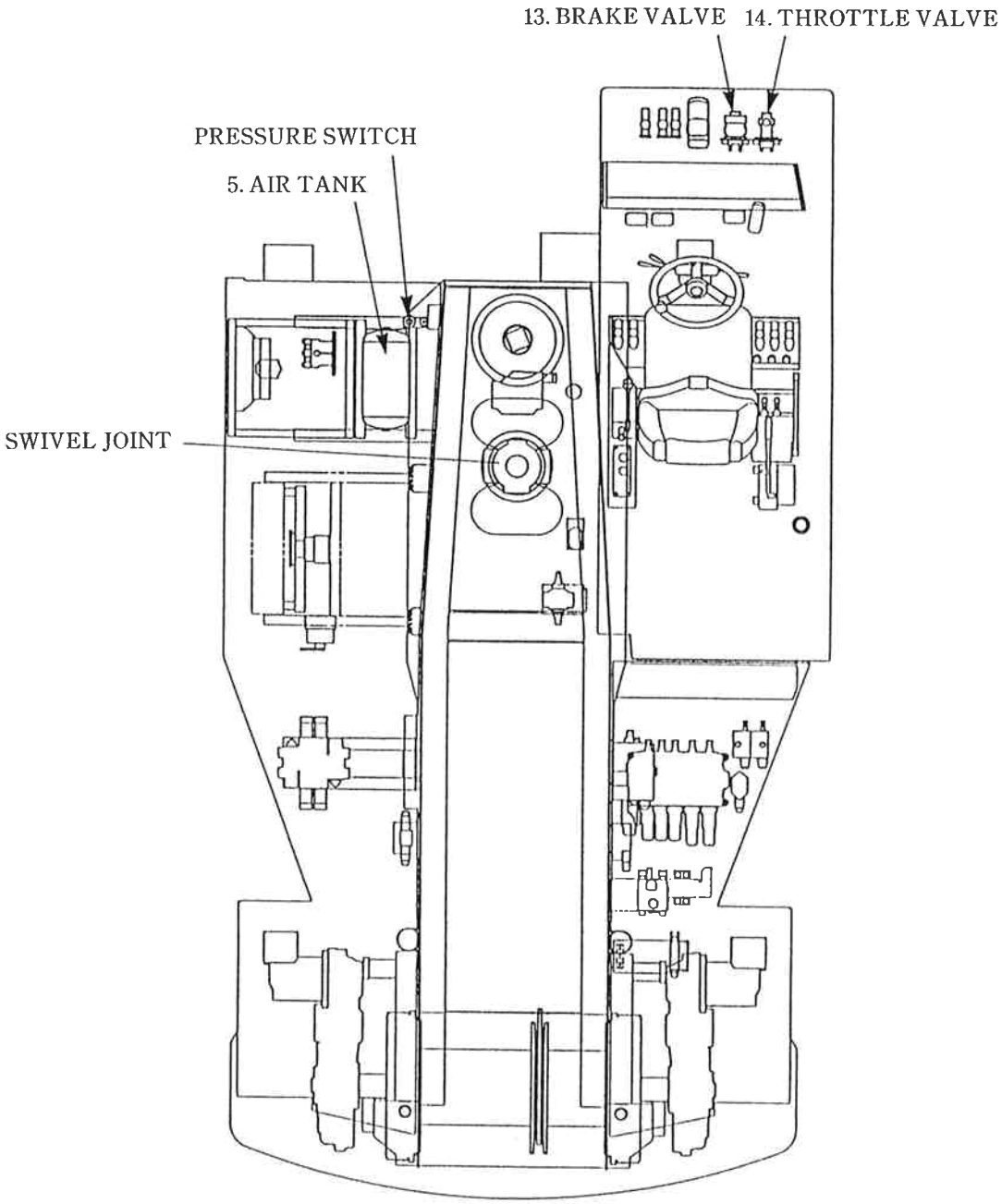
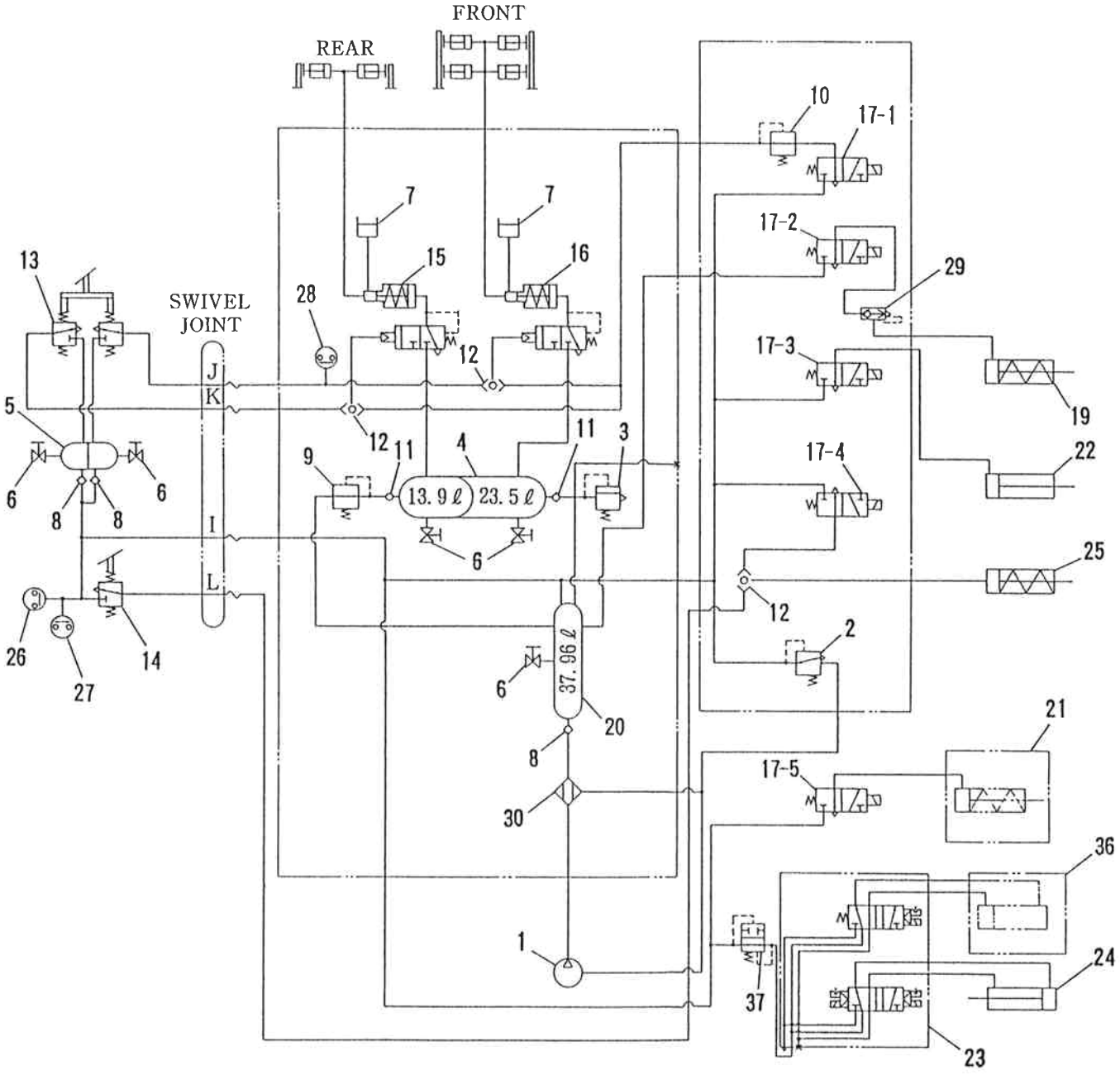


Fig. 1-1 Air and Static Hydraulic Piping Assembly (2 / 2)

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1.3 AIR AND BRAKE HYDRAULIC SYSTEM SCHEMATIC



1. AIR COMPRESSOR
2. PRESSURE GOVERNOR
3. SAFETY VALVE
4. AIR TANK (2ND)
5. AIR TANK (FOR PILOT)
6. DRAIN COCK
7. BRAKE FLUID RESERVOIR
8. CHECK VALVE
9. REDUCTION VALVE
10. REDUCTION VALVE
11. CHECK VALVE
12. SHUTTLE VALVE
13. BRAKE VALVE (FOR TRAVEL)
14. THROTTLE VALVE (ACCEL. CONTROL)
15. POWER CLUSTER (REAR)
16. POWER CLUSTER (FRONT)
17. SOLENOID VALVE (17-1 TO 17-5)
19. AIR CHAMBER (FOR PARKING BRAKE)
20. AIR TANK (1ST)
21. AIR CYLINDER (FOR EXHAUST BR.)
22. AIR CYLINDER (FOR PTO SHIFT)
23. SOLENOID VALVE (2/4 SELECT & REAR STEERING LOCK)
24. AIR TANK (FOR REAR STEERING LOCK)
25. AIR CYLINDER (FOR THROTTLE)
26. LOW PRESSURE SWITCH
27. AIR PRESSURE SENDER
28. STOP LIGHT SWITCH
29. CONTROL VALVE (QUICK RELEASE)
30. AIR DRYER
36. AIR CYLINDER (FOR 2WD / 4WD SELECT)
37. PROTECTION VALVE

Fig. 1-2 Air and Brake Hydraulic System Schematic

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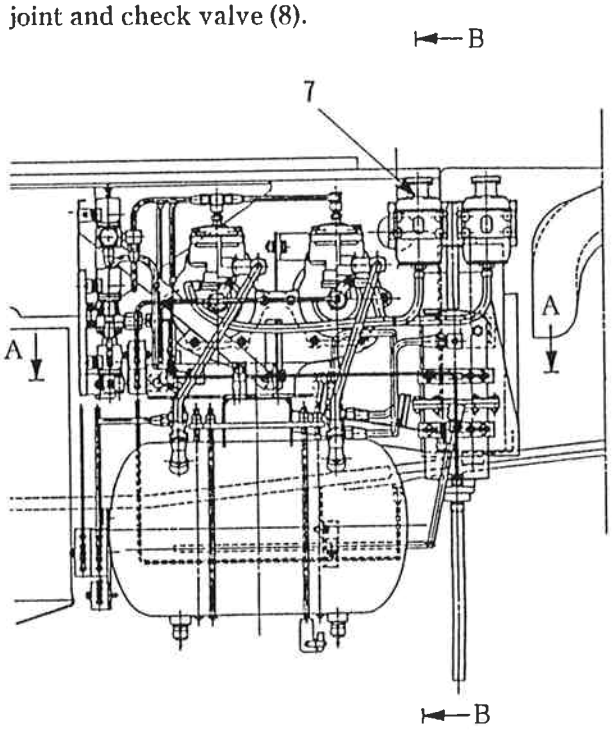
1.4 AIR SUPPLY CIRCUIT (FIGS. 1-3)

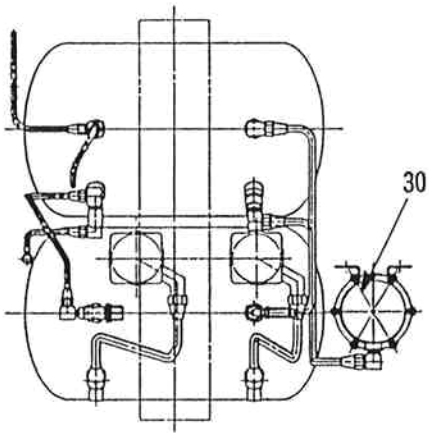
Air discharged from air compressor (1) enters air dryer (30), where moisture and oil are removed. Next, air passes check valve (8), and enters 1st tank (20), then passes check valve (11) or reduction valve (9), and enters 2nd tank (4) which is divided into two sections.

Besides, air is supplied also to air tank (5) for pilot, which is divided into two sections, provided on the upper revolving body, through port I of the swivel joint and check valve (8).

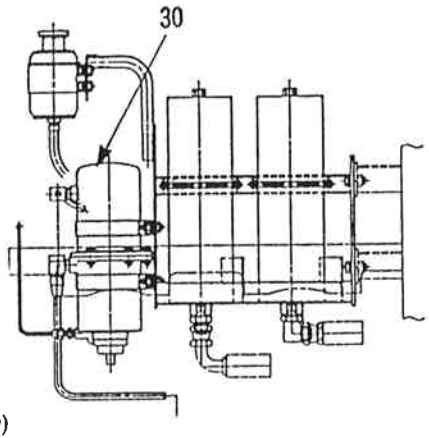
Pilot air from air pressure governor (2) is led to the air compressor unloading valve, which repeats loading and unloading within the range of the pressure governor set pressure.

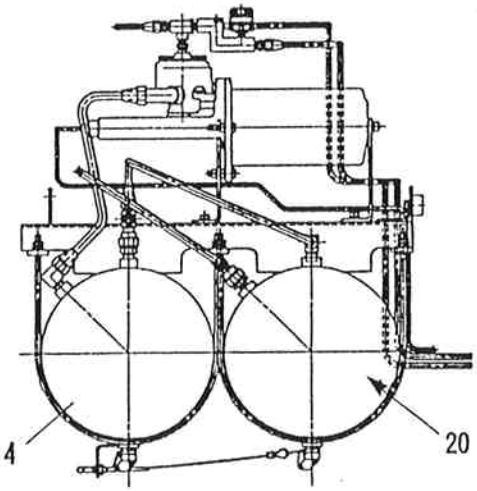
Safety valve (3), low pressure switch (26) for low air pressure alarm and air pressure sender (27) for the air pressure gauge are provided between the 1 st tank and the 2nd tank or the pilot tank in order to prevent troubles due to abnormal pressure.





DETAIL A-A





DETAIL B-B

4. AIR TANK (2ND)
7. BRAKE FLUID RESERVOIR
20. AIR TANK (1ST)
30. AIR DRYER

Fig. 1-3 Air Supply Circuit (Lower)

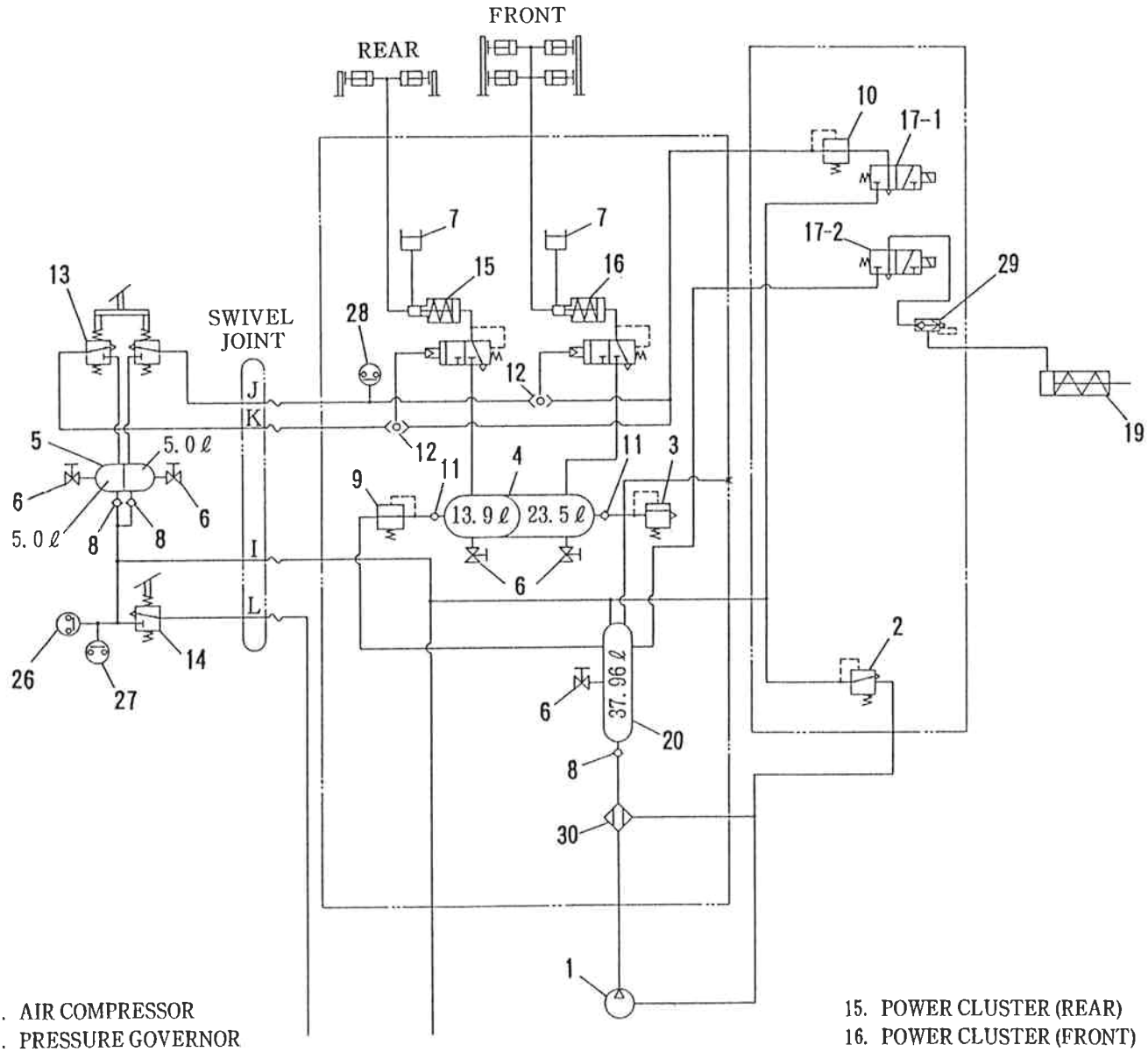
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1.5 SERVICE BRAKE CIRCUIT (FIG. 1-4)

The service brake is a hydraulic brake with air booster. When the operator depresses the brake pedal, brake valve (13) sends pilot air out. The pilot air passes the swivel joint, enters the lower and gives pilot pressure to the valve sections of power clusters (15, 16). Besides, air from 2nd tank (4) enters the valve sections of the power clusters. Pressurized air, corresponding to the brake valve operation, is sent to power clusters (15 and 16), and convert it into further boosted hydraulic pressure in the power cluster. This hydraulic pressure operates the disc brakes provided on the axles.

Pilot air for the brake valve on the upper is supplied from pilot tank (5) on the upper, and brake fluid to the power clusters on the lower is supplied from brake fluid reservoir (7) on the lower.

In front of power clusters (15 and 16), stop light switch (28) for brake oepration is installed.



1. AIR COMPRESSOR
2. PRESSURE GOVERNOR
3. SAFETY VALVE
4. AIR TANK (2ND)
5. AIR TANK (PILOT)
7. BRAKE FLUID RESERVOIR
8. CHECK VALVE
9. REDUCTION VALVE
11. CHECK VALVE
12. SHUTTLE VALVE
13. BRAKE VALVE
15. POWER CLUSTER (REAR)
16. POWER CLUSTER (FRONT)
20. AIR TANK (1ST)
26. LOW PRESSURE SWITCH
27. AIR PRESSURE SENDER
28. STOP LIGHT SWITCH

Fig. 1-4 Service Brake Circuit

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1.6 PARKING BRAKE AND AUXILIARY BRAKE CIRCUITS (FIG. 1-5)

- Parking Brake

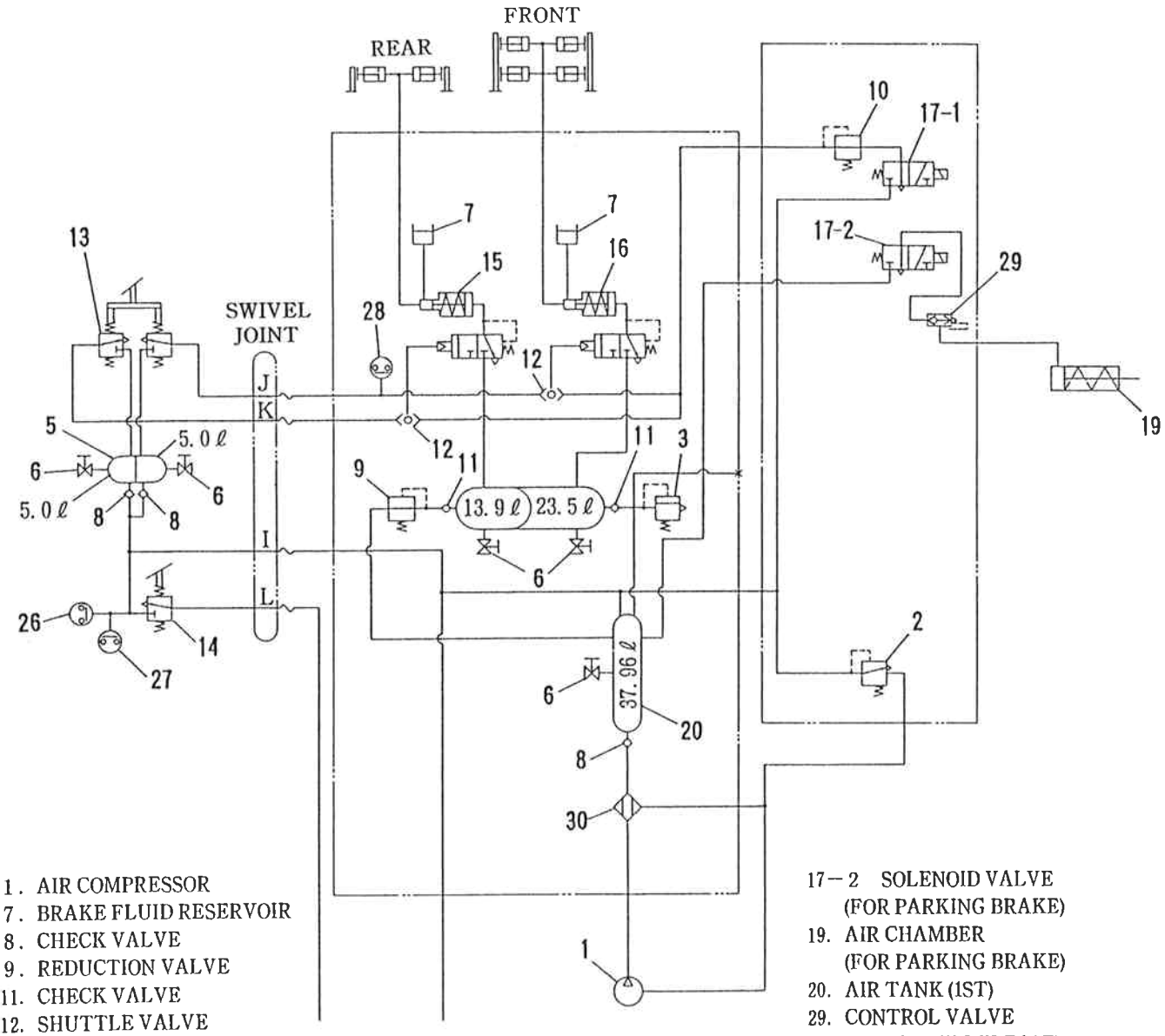
  The parking brake is released by sending air from 1st tank (20) to air chamber (19). When air is interrupted, the brake is applied by the spring force in the air chamber. Solenoid valve (17-2) controls this air.

  The air chamber is also provided with control valve (29) for quick release.

- Auxiliary Brake

  Though the parking brake is used for general parking, the auxiliary brake is used together with the parking brake when stronger braking force is required for such as on-tire operation (without the outrigger extended) and etc.

  This auxiliary brake is operated by supplying air, which enters the air cylinder control circuit from tank (20) to the valve section of power clusters (15 and 16), as a pilot pressure, through solenoid valve (17-1), reduction valve (10) and shuttle valve (12), and by operating the front and rear disc brakes. This pilot air is controlled by solenoid valve (17-1).



1. AIR COMPRESSOR
7. BRAKE FLUID RESERVOIR
8. CHECK VALVE
9. REDUCTION VALVE
11. CHECK VALVE
12. SHUTTLE VALVE
15. POWER CLUSTER (REAR)
16. POWER CLUSTER (FRONT)
17−1 SOLENOID VALVE (FOR AUXILIARY BRAKE)
17−2 SOLENOID VALVE (FOR PARKING BRAKE)
19. AIR CHAMBER (FOR PARKING BRAKE)
20. AIR TANK (1ST)
29. CONTROL VALVE (FOR QUICK RELEASE)
37. PROTECTION VALVE

Fig. 1-5 Parking Brake and Auxiliary Brake Circuits

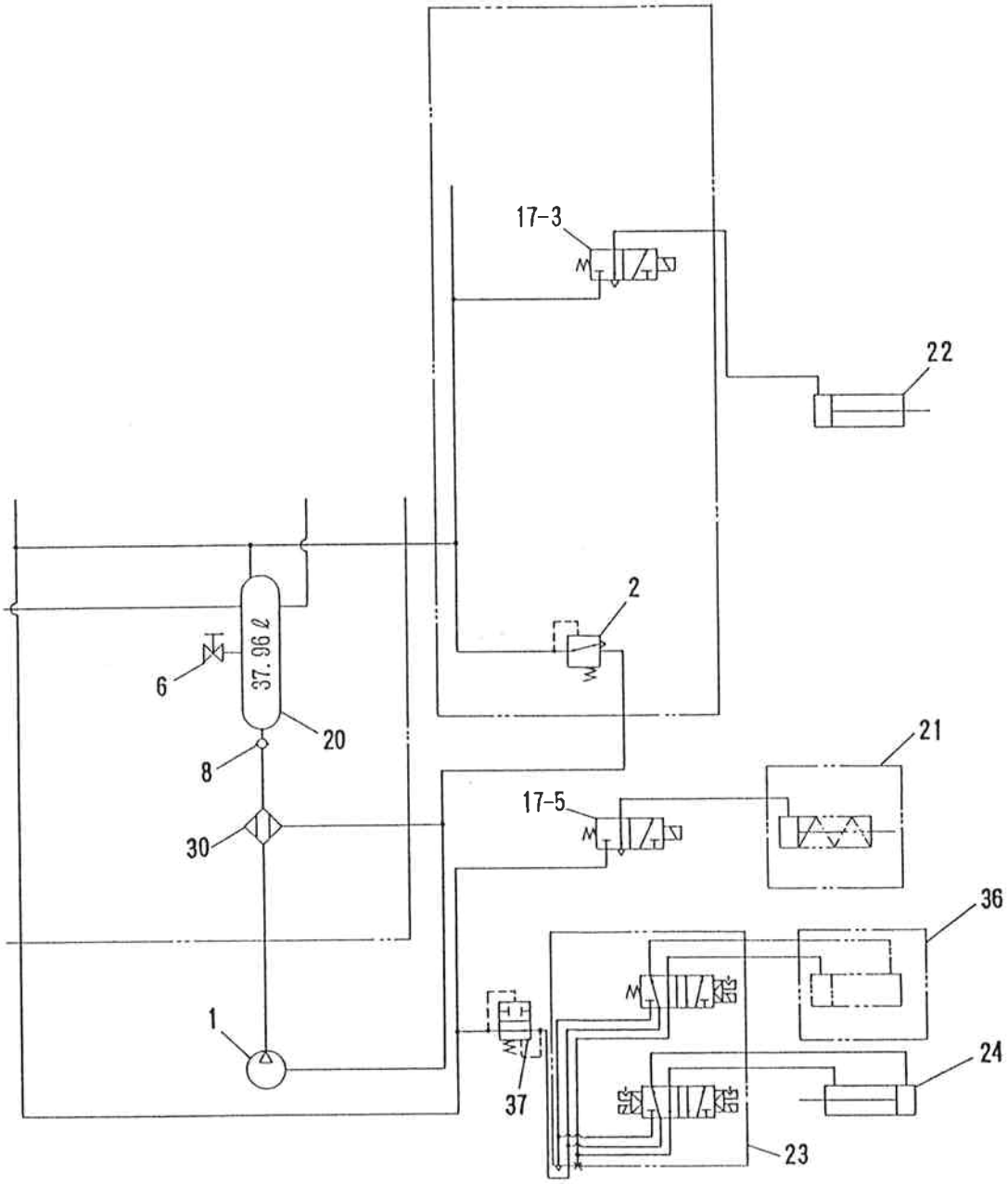
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1.7 AIR CYLINDER CONTROL CIRCUIT

Air from 1st tank (20) passes protection valve (37), and enters 2-tandem solenoid valves (23). And, air from 1st tank (20) enters solenoid valves (17-3 and 17-5), too (Fig. 1-6).

Solenoid valves (17-3 and 17-5) control PTO control cylinder (22) and exhaust brake cylinder (21), and 2-tandem solenoid valves (23) control 2WD / 4WD shifting cylinder (36) and rear steering lock cylinder (24).

For air cylinder, refer to separate shop manual TRAVEL AND DRIVE SYSTEM.



1. AIR COMPRESSOR
2. PRESSURE GOVERNOR
8. CHECK VALVE
17－3 SOLENOID VALVE (FOR PTO SHIFT)
17－5 SOLENOID VALVE (FOR EXHAUST BRAKE)
20. AIR TANK (1ST)
21. AIR CYLINDER (FOR EXHAUST BRAKE)
22. AIR CYLINDER (PTO SHIFT)
23. 2-TANDEM SOLENOID VALVE (FOR 2WD / 4WD SHIFT AND REAR STEERING LOCK)
24. AIR CYLINDER (FOR REAR STEERING LOCK)
37. PROTECTION VALVE

Fig. 1-6 Air Cylinder Control Circuit

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1.8 ENGINE THROTTLE CIRCUIT

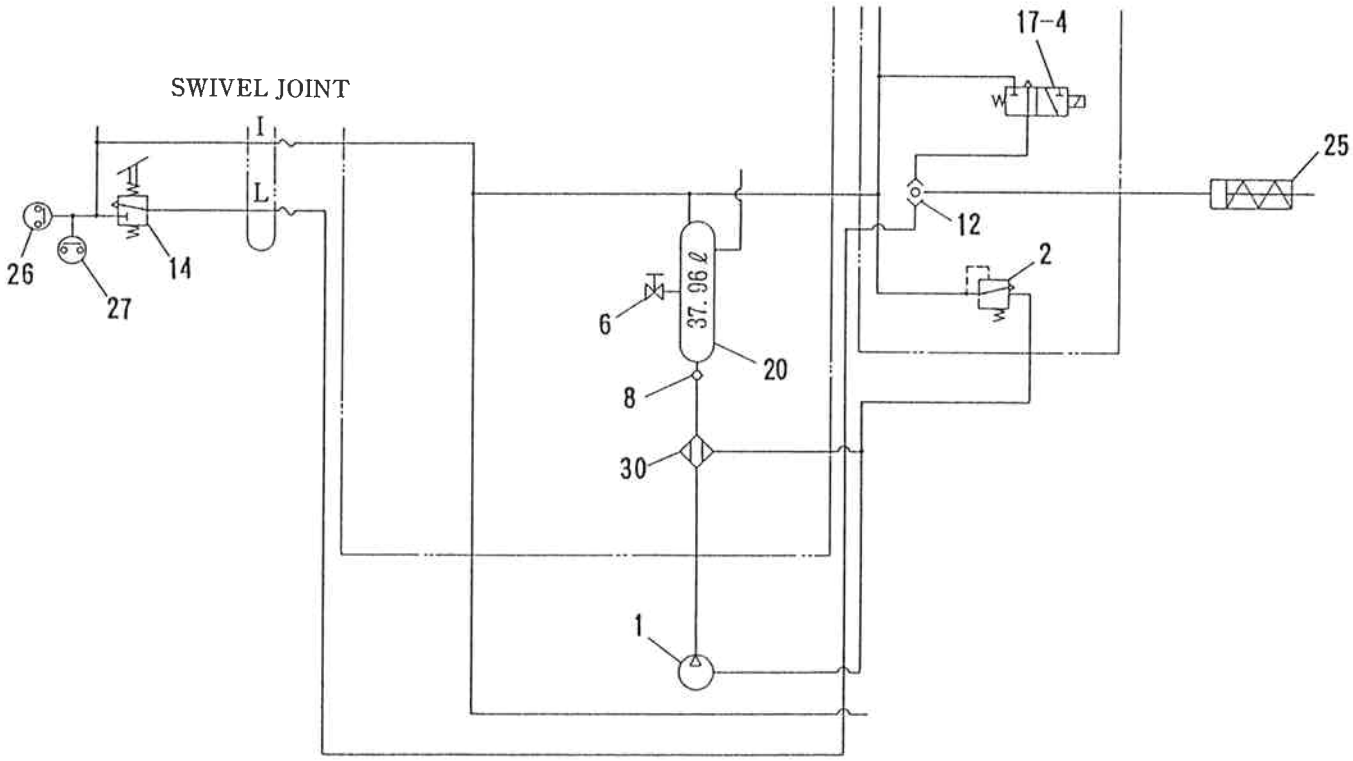
(1) Operation in Operator's Room

When the operator depresses the accelerator pedal, air from tank (20), which passes through swivel joint port I and enters the upper, passes through throttle valve (14) and swivel joint port L, and is sent to the lower again to operate throttle air cylinder (25) via shuttle valve (12).

When air is sent to air cylinder (25), the engine speed is increased, and when air is exhausted from the cylinder, the engine speed is decreased.

(2) Operation Outside Operator's Room (When all outriggers are operated)

Air from 1st tank (20) passes solenoid valve (17-4) and shuttle valve (12), and operates throttle air cylinder (25) to increase the engine speed to the maximum.



1. AIR COMPRESSOR
2. PRESSURE GOVERNOR
8. CHECK VALVE
12. SHUTTLE VALVE
14. THROTTLE VALVE
17－4 SOLENOID VALVE
20. AIR TANK (1ST)
25. AIR CYLINDER (FOR THROTTLE)
26. LOW PRESSURE SWITCH
27. AIR PRESSURE SENDER

Fig. 1-7 Engine Throttle Circuit

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1.9 PRESSURE GOVERNOR

Keeps air circuit pressure fixed by controlling the unloading function of the air compressor (Fig. 1-8)

Valve opening pressure	$8.0^{+0.35}_{-0.05}$ kg / cm² ($114^{+5.0}_{-0.7}$ psi)
Valve closing pressure	$7.1^{+0.2}_{-0.2}$ kg / cm² ($101^{+2.8}_{-2.8}$ psi)

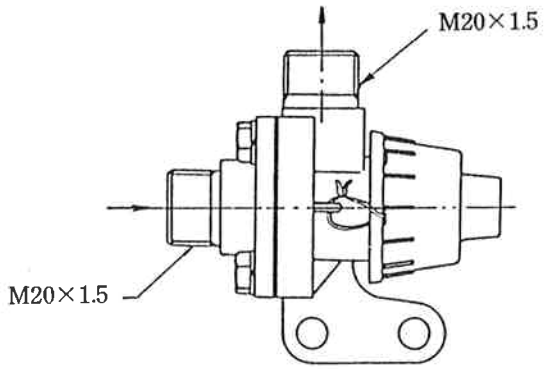


Fig. 1-8 Pressure Governor

1.10 SAFETY VALVE

Provided to maintain overall security of the air system ; functions only when pressure inside the circuit exceeds the pre-set level (Fig. 1-9)

Valve opening pressure	9.5 ± 0.4kg / cm² (135 ± 5.7psi)

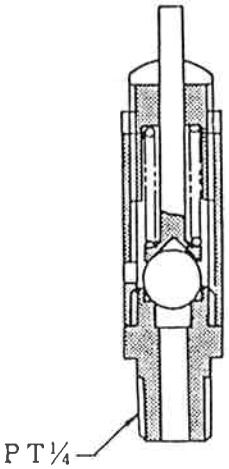


Fig. 1-9 Safety Valve

1.11 PROTECTION VALVE

Opens the passage when air pressure reaches pre-set level, or closes when it falls below the said level. So even if air leaks out due to failure of any subsequent circuit, at least the air pressure inside the brake circuit is maintained (Fig. 1-10)

Valve opening pressure	6.7kg / cm² (95.3psi)
Valve closing pressure	5.3kg / cm² (75.4psi)

NOTE

Confirm pressure level for both opening and closing.

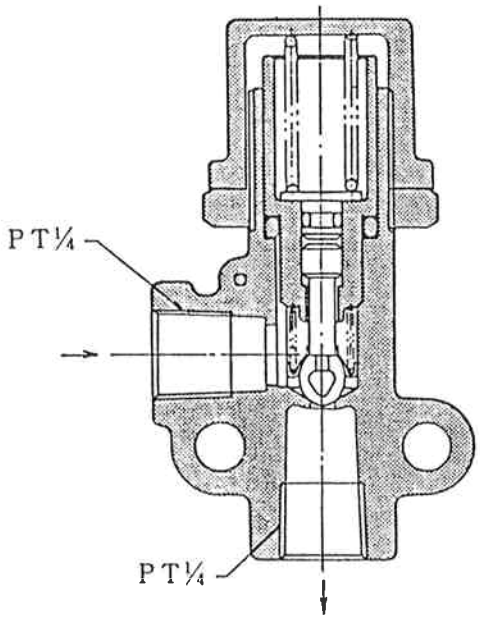


Fig. 1-10 Protection Valve

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1.9 PRESSURE GOVERNOR

Keeps air circuit pressure fixed by controlling the unloading function of the air compressor (Fig. 1-8)

Valve opening pressure	$8.0^{+0.35}_{-0.05}$ kg / cm² ($114^{+5.0}_{-0.7}$ psi)
Valve closing pressure	$7.1^{+0.2}_{-0.2}$ kg / cm² ($101^{+2.8}_{-2.8}$ psi)

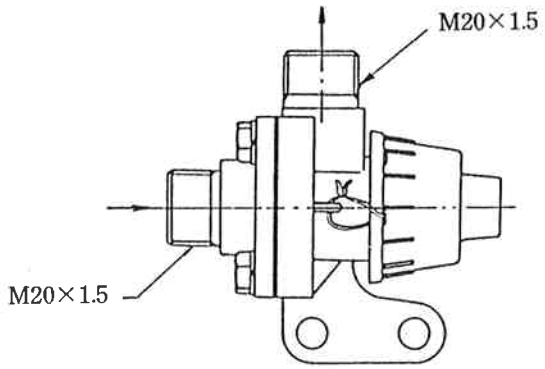


Fig. 1-8 Pressure Governor

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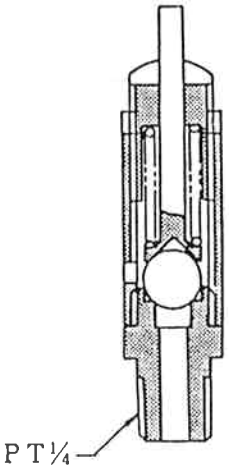


Fig. 1-9 Safety Valve

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Opens the passage when air pressure reaches pre-set level, or closes when it falls below the said level. So even if air leaks out due to failure of any subsequent circuit, at least the air pressure inside the brake circuit is maintained (Fig. 1-10)

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NOTE

Confirm pressure level for both opening and closing.

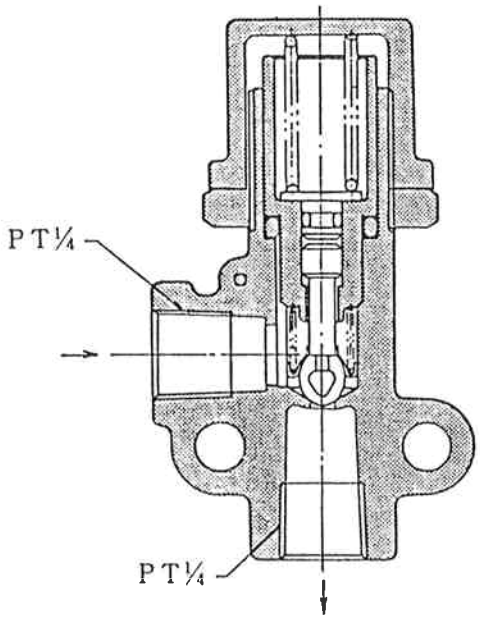


Fig. 1-10 Protection Valve

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1.9 PRESSURE GOVERNOR

Keeps air circuit pressure fixed by controlling the unloading function of the air compressor (Fig. 1-8)

Valve opening pressure	$8.0^{+0.35}_{-0.05}$ kg / cm² ($114^{+5.0}_{-0.7}$ psi)
Valve closing pressure	$7.1^{+0.2}_{-0.2}$ kg / cm² ($101^{+2.8}_{-2.8}$ psi)

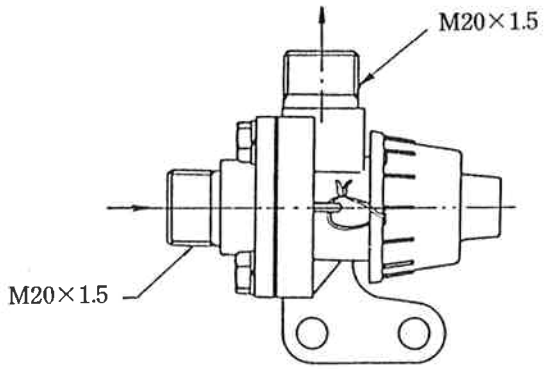


Fig. 1-8 Pressure Governor

1.10 SAFETY VALVE

Provided to maintain overall security of the air system ; functions only when pressure inside the circuit exceeds the pre-set level (Fig. 1-9)

Valve opening pressure	9.5 ± 0.4kg / cm² (135 ± 5.7psi)

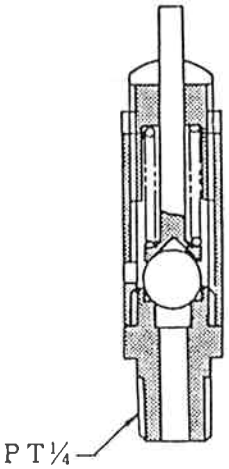


Fig. 1-9 Safety Valve

1.11 PROTECTION VALVE

Opens the passage when air pressure reaches pre-set level, or closes when it falls below the said level. So even if air leaks out due to failure of any subsequent circuit, at least the air pressure inside the brake circuit is maintained (Fig. 1-10)

Valve opening pressure	6.7kg / cm² (95.3psi)
Valve closing pressure	5.3kg / cm² (75.4psi)

NOTE

Confirm pressure level for both opening and closing.

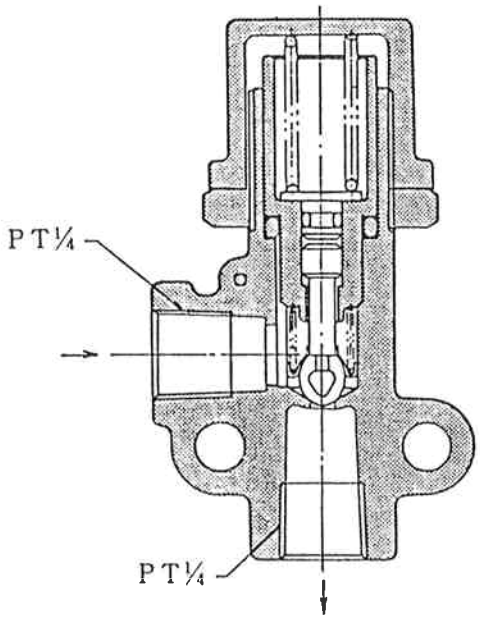


Fig. 1-10 Protection Valve

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1.12 AIR TANKS

This machine is equipped with three tanks of the 1 st tank, 2nd tank and pilot tank.

Air discharged from the air compressor enters the air dryer, where moisture and oil are removed, and enters the 1st tank, then enters the 2nd tank and pilot tank which are divided into two sections for the front and rear via the check valve. However, air to the section for the rear of the 2nd tank passes through the reduction valve.

Air supply to the each service circuit is performed from the 1st tank.

The specifications of the each tank is as follows :

Item	Unit	1st tank	2nd tank		Pilot tank	
			Front	Rear	Front	Rear
Capacity	ℓ (cu. ft)	37.96(1.34)	23.5(0.83)	13.9(0.49)	5.0(0.177)	5.0(0.177)
Normal pressure	kg / ㎠ (psi)	8 (113.8)	8 (113.8)	5 (71.1)	8(113.8)	
Maximum service pressure	kg / ㎠(psi)	9.5(13.5)				
Weight (approx.)	kg(lb)	10.1 (22.3)	14.5(31.97)		8.4(18.5)	

1.13 CHECK VALVES

Two check valves are provided between the 1st tank and the 2nd tank, two check valves between the 1st tank and the pilot tank, and one check valve is provided in the inlet of the 1st tank. In the event of failure of a part of the circuit, these check valves function to prevent air from leaking from the all circuit (Fig. 1-11).

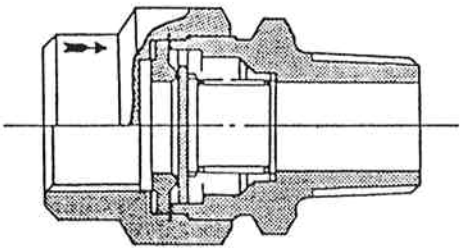


Fig. 1-11 Check Valve

1.14 REDUCTION VALVE

Two reduction valves are provided ; one is between the 1st tank and the 2nd tank and the other is between the auxiliary brake solenoid brake and the shuttle valve. These reduction valves function to reduce pressure in the lower flow side to the following values respectively, and keep them fixed (Fig. 1-12).

Air pressure in the rear section side of the 2nd tank : 5.0kg / ㎠ (71.1psi)

Air pressure of pilot for auxiliary brake : 3.5kg / ㎠ (49.8psi)

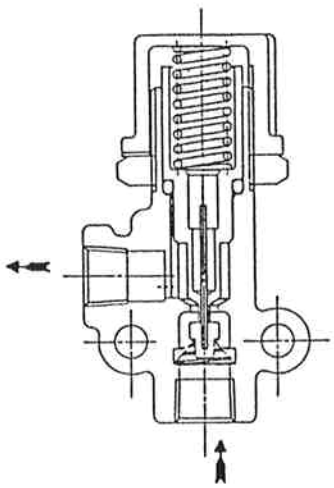


Fig. 1-12 Reduction Valve

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1.12 AIR TANKS

This machine is equipped with three tanks of the 1 st tank, 2nd tank and pilot tank.

Air discharged from the air compressor enters the air dryer, where moisture and oil are removed, and enters the 1st tank, then enters the 2nd tank and pilot tank which are divided into two sections for the front and rear via the check valve. However, air to the section for the rear of the 2nd tank passes through the reduction valve.

Air supply to the each service circuit is performed from the 1st tank.

The specifications of the each tank is as follows :

Item	Unit	1st tank	2nd tank		Pilot tank	
			Front	Rear	Front	Rear
Capacity	ℓ (cu. ft)	37.96(1.34)	23.5(0.83)	13.9(0.49)	5.0(0.177)	5.0(0.177)
Normal pressure	kg / ㎠ (psi)	8 (113.8)	8 (113.8)	5 (71.1)	8(113.8)	
Maximum service pressure	kg / ㎠(psi)	9.5(13.5)				
Weight (approx.)	kg(lb)	10.1 (22.3)	14.5(31.97)		8.4(18.5)	

1.13 CHECK VALVES

Two check valves are provided between the 1st tank and the 2nd tank, two check valves between the 1st tank and the pilot tank, and one check valve is provided in the inlet of the 1st tank. In the event of failure of a part of the circuit, these check valves function to prevent air from leaking from the all circuit (Fig. 1-11).

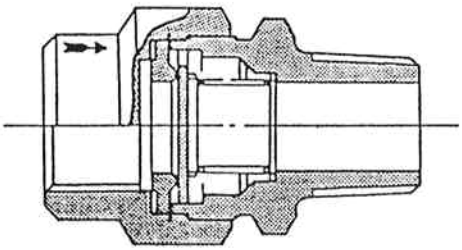


Fig. 1-11 Check Valve

1.14 REDUCTION VALVE

Two reduction valves are provided ; one is between the 1st tank and the 2nd tank and the other is between the auxiliary brake solenoid brake and the shuttle valve. These reduction valves function to reduce pressure in the lower flow side to the following values respectively, and keep them fixed (Fig. 1-12).

Air pressure in the rear section side of the 2nd tank : 5.0kg / ㎠ (71.1psi)

Air pressure of pilot for auxiliary brake : 3.5kg / ㎠ (49.8psi)

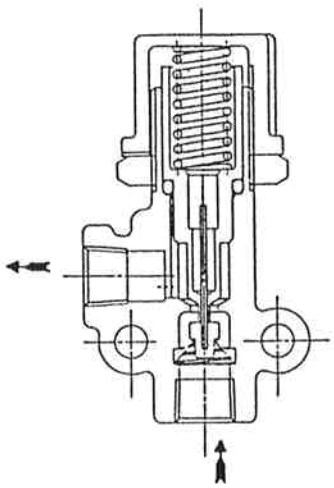


Fig. 1-12 Reduction Valve

https://truckmanualshub.com/

1.12 AIR TANKS

This machine is equipped with three tanks of the 1 st tank, 2nd tank and pilot tank.

Air discharged from the air compressor enters the air dryer, where moisture and oil are removed, and enters the 1st tank, then enters the 2nd tank and pilot tank which are divided into two sections for the front and rear via the check valve. However, air to the section for the rear of the 2nd tank passes through the reduction valve.

Air supply to the each service circuit is performed from the 1st tank.

The specifications of the each tank is as follows :

Item	Unit	1st tank	2nd tank		Pilot tank	
			Front	Rear	Front	Rear
Capacity	ℓ (cu. ft)	37.96(1.34)	23.5(0.83)	13.9(0.49)	5.0(0.177)	5.0(0.177)
Normal pressure	kg / ㎠ (psi)	8 (113.8)	8 (113.8)	5 (71.1)	8(113.8)	
Maximum service pressure	kg / ㎠(psi)	9.5(13.5)				
Weight (approx.)	kg(lb)	10.1 (22.3)	14.5(31.97)		8.4(18.5)	

1.13 CHECK VALVES

Two check valves are provided between the 1st tank and the 2nd tank, two check valves between the 1st tank and the pilot tank, and one check valve is provided in the inlet of the 1st tank. In the event of failure of a part of the circuit, these check valves function to prevent air from leaking from the all circuit (Fig. 1-11).

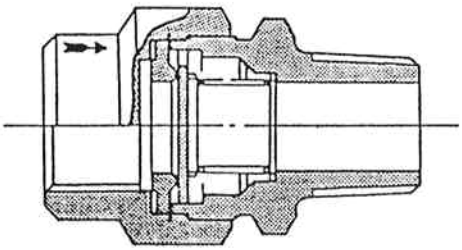


Fig. 1-11 Check Valve

1.14 REDUCTION VALVE

Two reduction valves are provided ; one is between the 1st tank and the 2nd tank and the other is between the auxiliary brake solenoid brake and the shuttle valve. These reduction valves function to reduce pressure in the lower flow side to the following values respectively, and keep them fixed (Fig. 1-12).

Air pressure in the rear section side of the 2nd tank : 5.0kg / ㎠ (71.1psi)

Air pressure of pilot for auxiliary brake : 3.5kg / ㎠ (49.8psi)

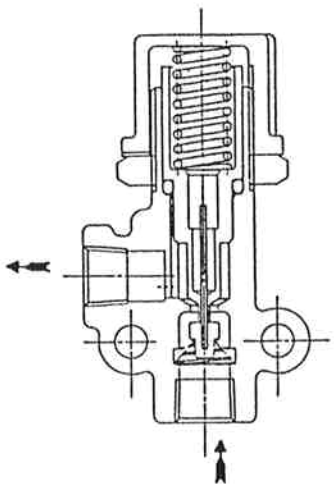
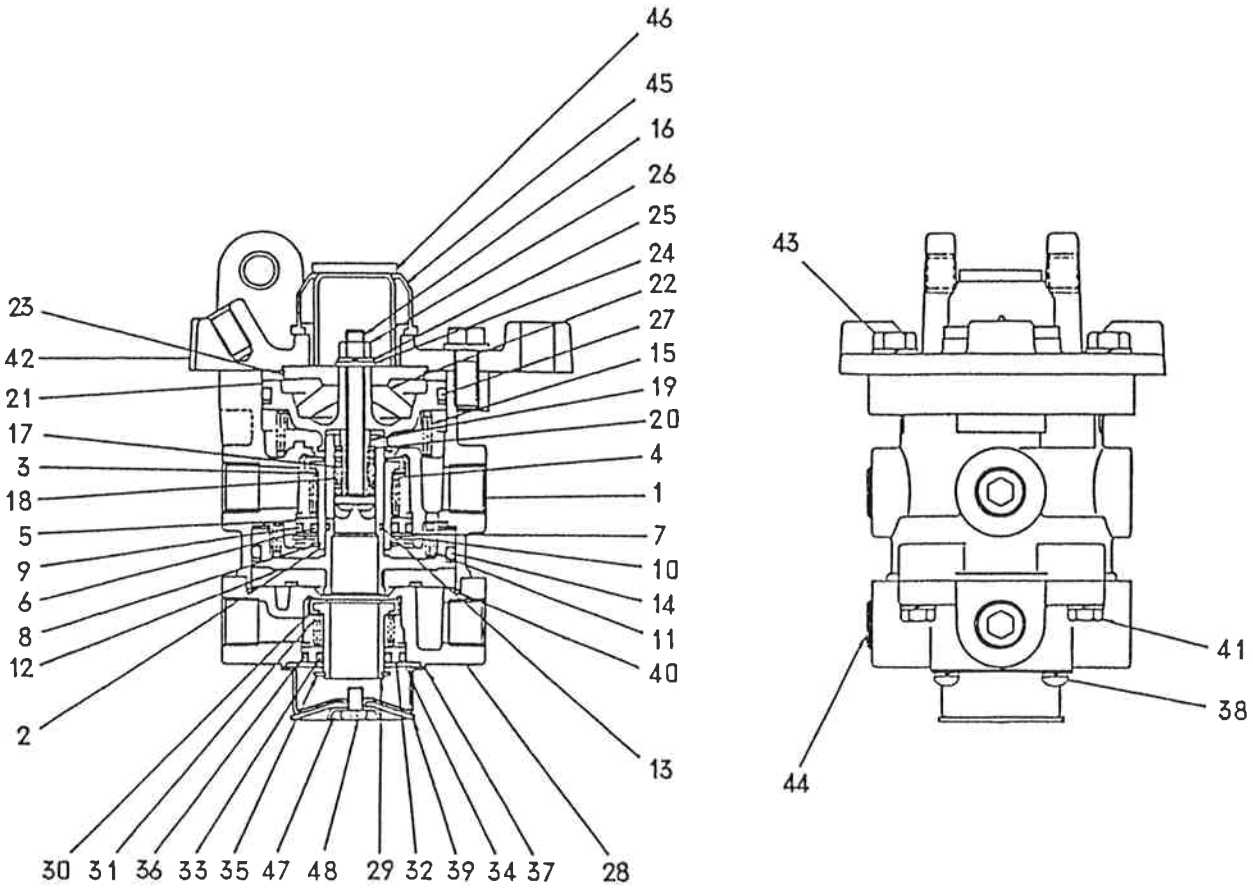


Fig. 1-12 Reduction Valve

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1.15 BRAKE VALVE



1. UPPER BODY
2. UPPER VALVE
3. VALVE RETAINER
4. SPRING
5. O-RING RETAINER
6. O-RING
7. SPECIAL WASHER
8. SNAP RING
9. O-RING
10. SNAP RING
11. SPRING
12. RELAY PISTON
13. O-RING
14. O-RING
15. RETURN SPRING
16. STEM
17. INNER SPRING
18. OUTER SPRING
19. SLEEVE
20. STEM WASHER
21. UPPER PISTON
22. RUBBER SPRING
23. SPRING SEAT
24. WASHER
25. LOCKWASHER
26. NUT
27. O-RING
28. LOWER BODY
29. LOWER VALVE
30. VALVE RETAINER
31. SPRING
32. O-RING RETAINER
33. O-RING
34. SPECIAL WASHER
35. SNAP RING
36. O-RING
37. COVER
38. MACHINE SCREW AND LOCKWASHER
39. CHECK VALVE
40. O-RING
41. CAPSCREW AND LOCKWASHER
42. MOUNTING PLATE
43. CAPSCREW AND LOCKWASHER
44. PLUG
45. BOOT
46. PLUNGER
47. WASHER
48. MACHINE SCREW

Fig. 1-13 Brake Valve

https://truckmanualshub.com/

(1) Normal brake operation (Fig. 1-14)

When the brake pedal is depressed, depressing force is transmitted to upper piston (21) via plunger (46), spring seat (23) and rubber spring (22), and the exhaust valve seat on the bottom end of the piston contacts upper valve (2) to close the middle exhaust passage. The piston pushes return spring (15) more to compress it, and the upper valve clears the air supply valve seat of upper body (1). Then, air from the supply port flows out of the upper output port, and is supplied to the rear brake power cluster as a pilot pressure. Meanwhile, when the upper section functions, a part of air pressure passes through the body passage, and is supplied to the top of relay piston (12) of the lower section to move the relay piston downward.

The air exhaust valve seat on the bottom end of the relay piston contacts lower valve (29), and the middle exhaust passage is closed. The lower valve is pushed downward more, and the lower valve is cleared from the supply valve seat of lower body (28). Air from the supply port flows out of the output port of the lower section, and is supplied to the front brake power cluster as a pilot pressure.

Since air volume required to move the relay piston is a little, the lower valve and the upper valve operate almost at the same time.

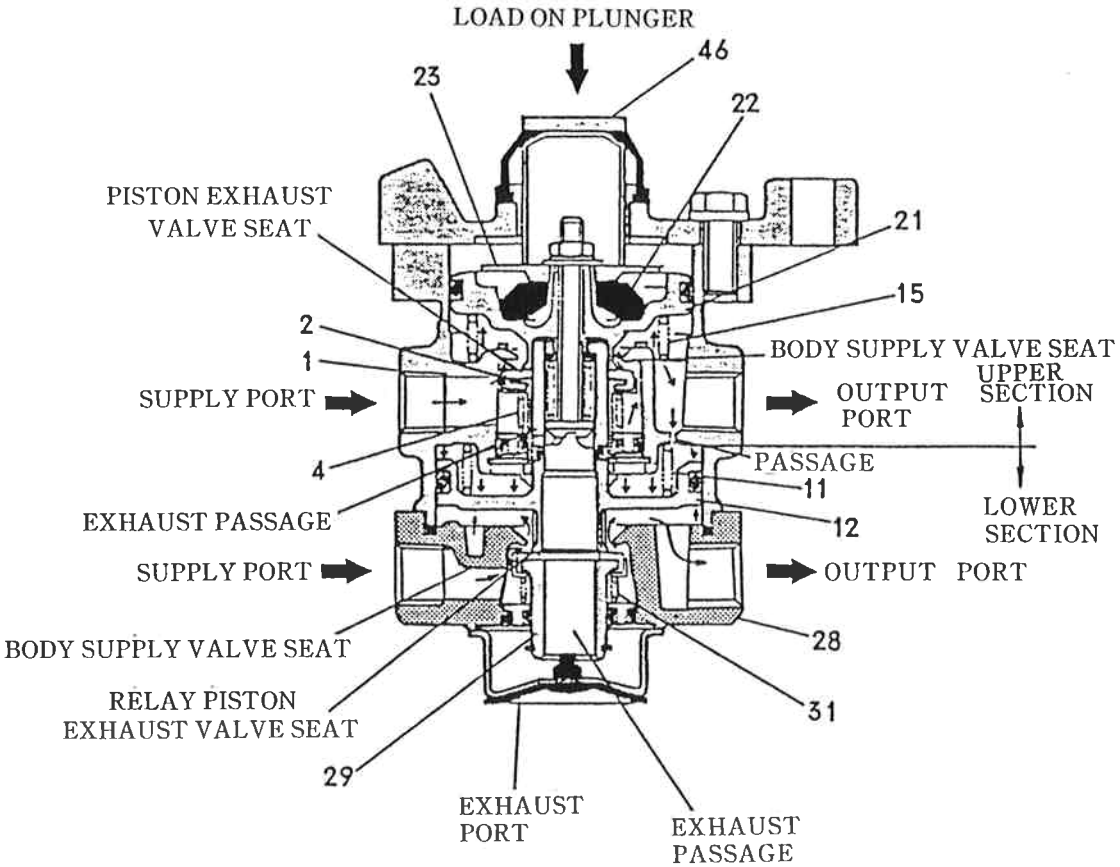


Fig. 1-14 Normal Brake Operation of Brake Valve

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(2) One side brake operation (Fig. 1-15 and 1-16)
Even if air is supplied only to one side due to an abnormality in the front or rear air system, the brakes still can be applied on one side.

(a) Only upper valve operation (Fig. 1-15)
Since the upper section is separated from the lower section by relay piston (12), the upper section operates normally even when the lower valve brake system (front brake system) is out of order.

(b) Only lower valve operation (Fig. 1-16)
Since air pressure of the upper valve system does not generate when the upper valve brake system (rear brake system) is out of order, the lower section does not operate by the upper air pressure to relay piston (12). At the case, the bottom end of upper piston (21) contacts the top of the relay piston by depressing the brake pedal more deeply than normal, and the exhaust valve seat of the relay piston pushes directly the lower valve. Then, generation, stability and release of air pressure are operated with the same mechanism as when the upper valve is normal.

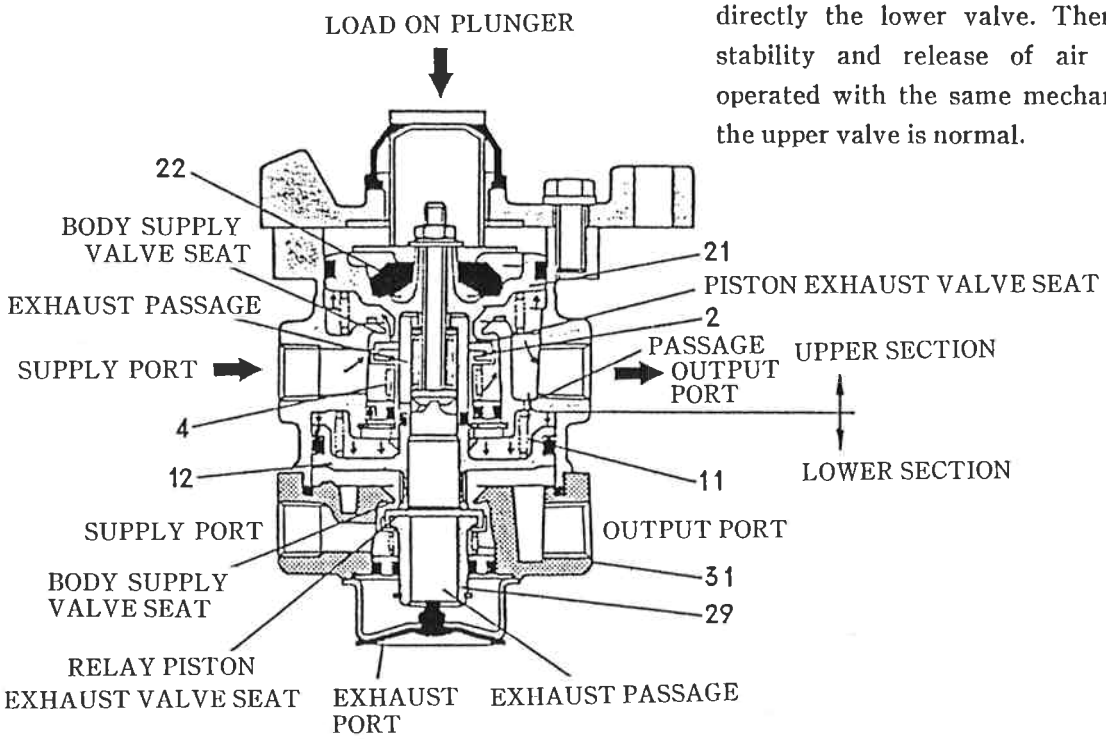


Fig. 1-15 Only Upper Valve Operation

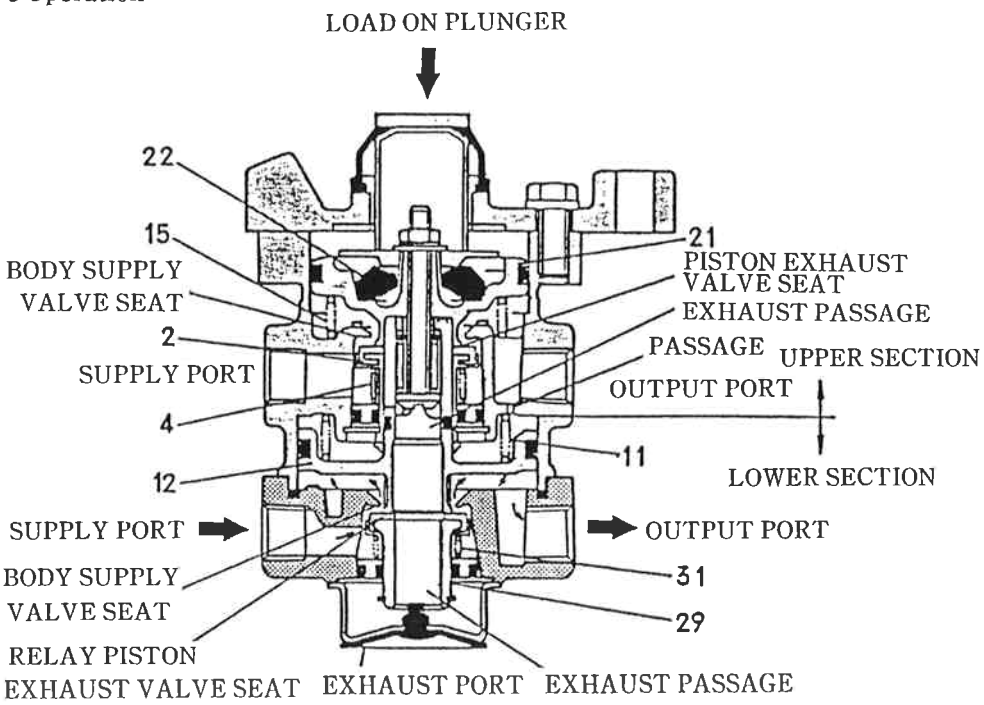


Fig. 1-16 Only Lower Valve Operation

https://truckmanualshub.com/

(3) Balancing operation

Air pressure generated by depressing the brake pedal is stabilized at a pressure corresponding to the depressing angle if the angle is held at a fixed angle as follows. When the pedal is depressed, the exhaust passage is closed, and the supply valve is opened to supply air as mentioned above. This air pressure functions to the bottom of the piston at the same time and is going to push the piston up. If the depressing angle is held at a fixed angle, air pressure against the bottom face of the piston pushes the rubber spring on the top of the piston to rise, and the upper valve contacts the body supply valve seat to stop air supply. Since the piston contacts the upper valve, air pressure is stabilized at this time.

In the lower valve system, the relay piston moves downward according to the air pressure in the upper section to generate air pressure in the lower section, and this air pressure operates to the bottom of the relay piston at the same time.

When pressure against the bottom of the relay piston in the lower section equals the pressure to the top of the relay piston in the upper section, pushing force the relay piston down does not exist, and the relay piston moves upward as it contacts the lower valve. When the lower valve contacts the supply valve seat of the lower body, air supply from the supply port to the output port is stopped.

At this time the exhaust valve seat of the relay piston contacts the lower valve, and air pressure rising stops. Then air pressure in the lower valve system is stabilized at a pressure equivalent to air pressure in the upper valve system.

At this time, return spring (15), stem springs (17 and 18) and relay piston spring (11) function to decrease pressure difference between the upper valve system and lower valve system.

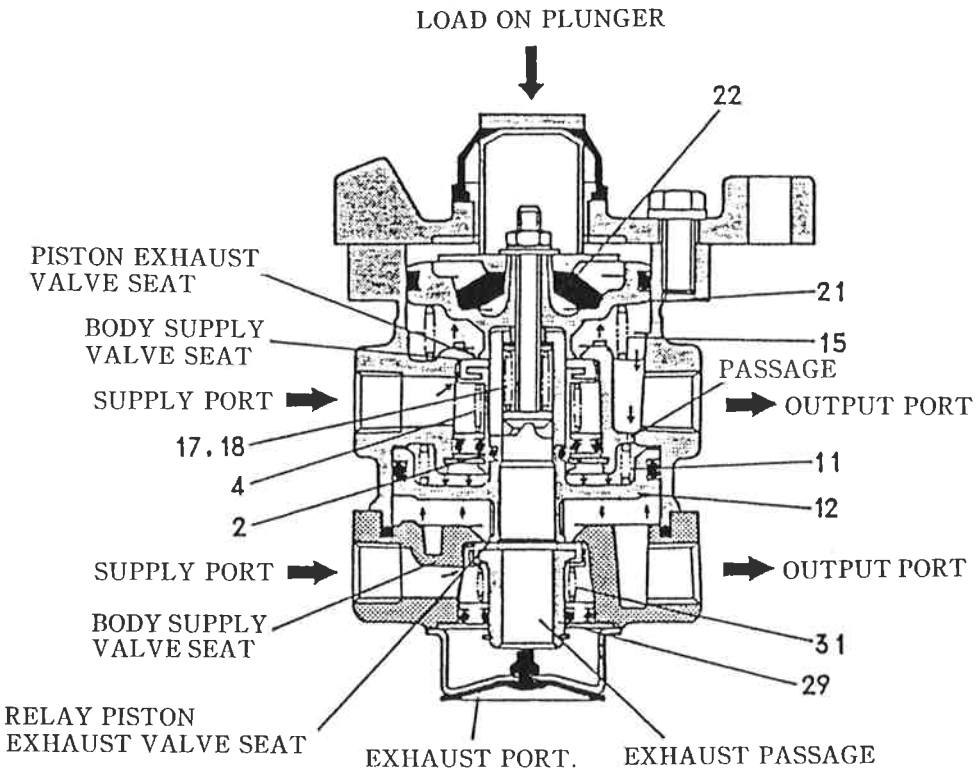


Fig. 1-17 Balance of Air Pressure

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(4) Releasing Operation

When the pedal is released, plunger (46) and piston (21) are pushed upward by rubber spring (22), return spring (15) and air pressure of the upper valve system. The exhaust valve seat on the bottom of the piston parts from upper valve (2), and the middle exhaust port is opened. Then, air pressure in the upper valve system passes the exhaust passage and is exhausted from the exhaust port.

When air pressure in the upper valve system lowers, relay piston (12) is pulled up by air pressure in the lower valve system and stem springs (17 and 18). The exhaust valve seat on the bottom of the relay piston parts from lower valve (29), and the middle exhaust passage is opened to the atmosphere. Therefore, air pressure in the lower valve system passes through the exhaust passage, and is exhausted from the exhaust port.

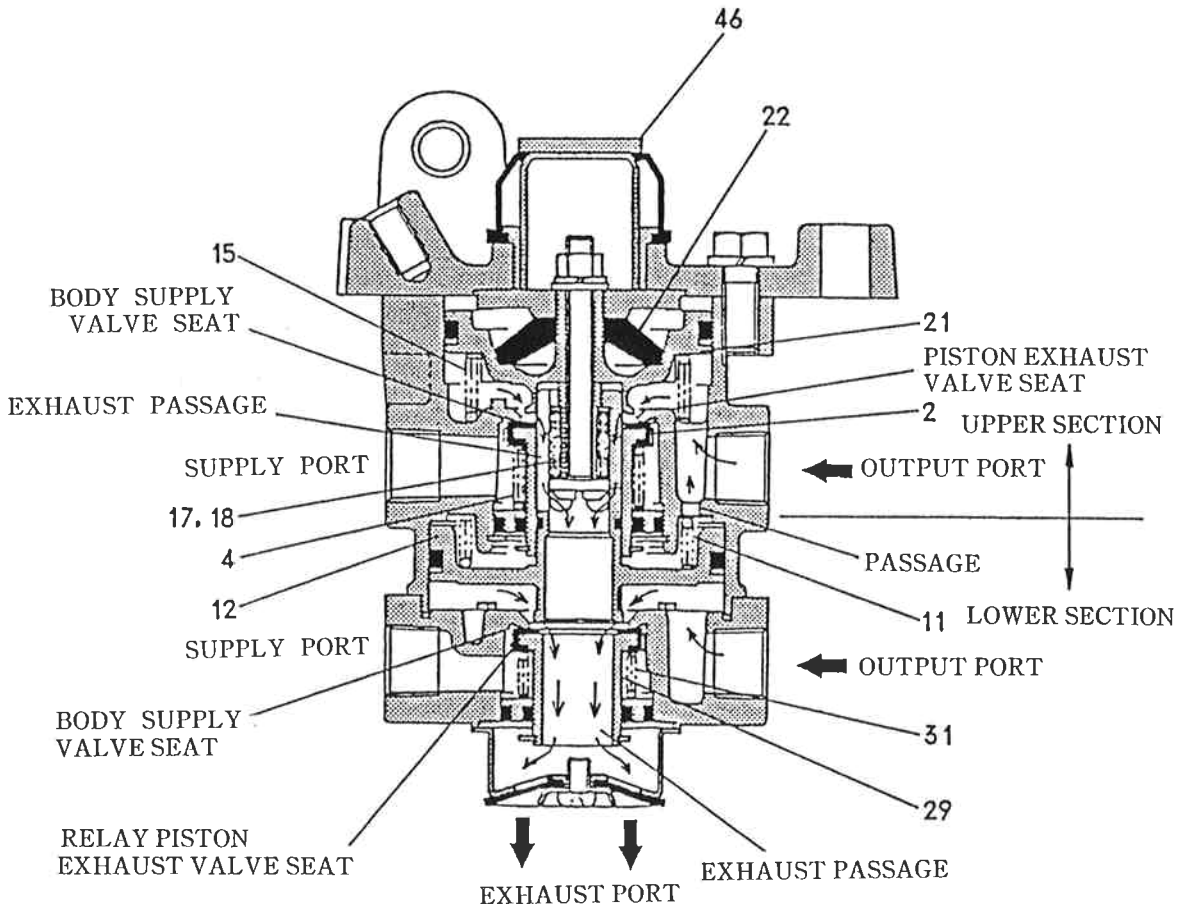
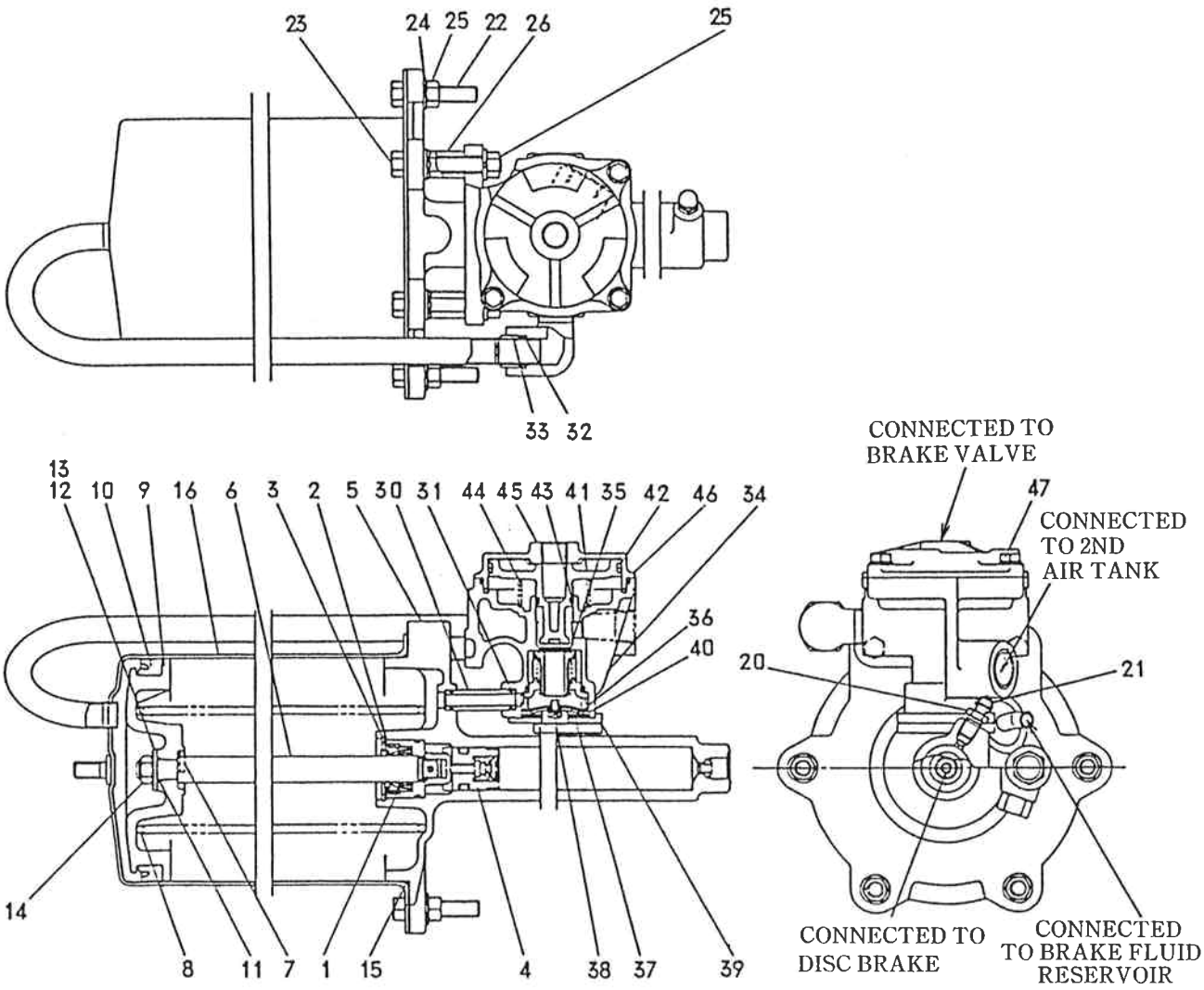


Fig. 1-18 Air Pressure Release

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1.16 POWER CLUSTER

(1) Power Cluster for Front

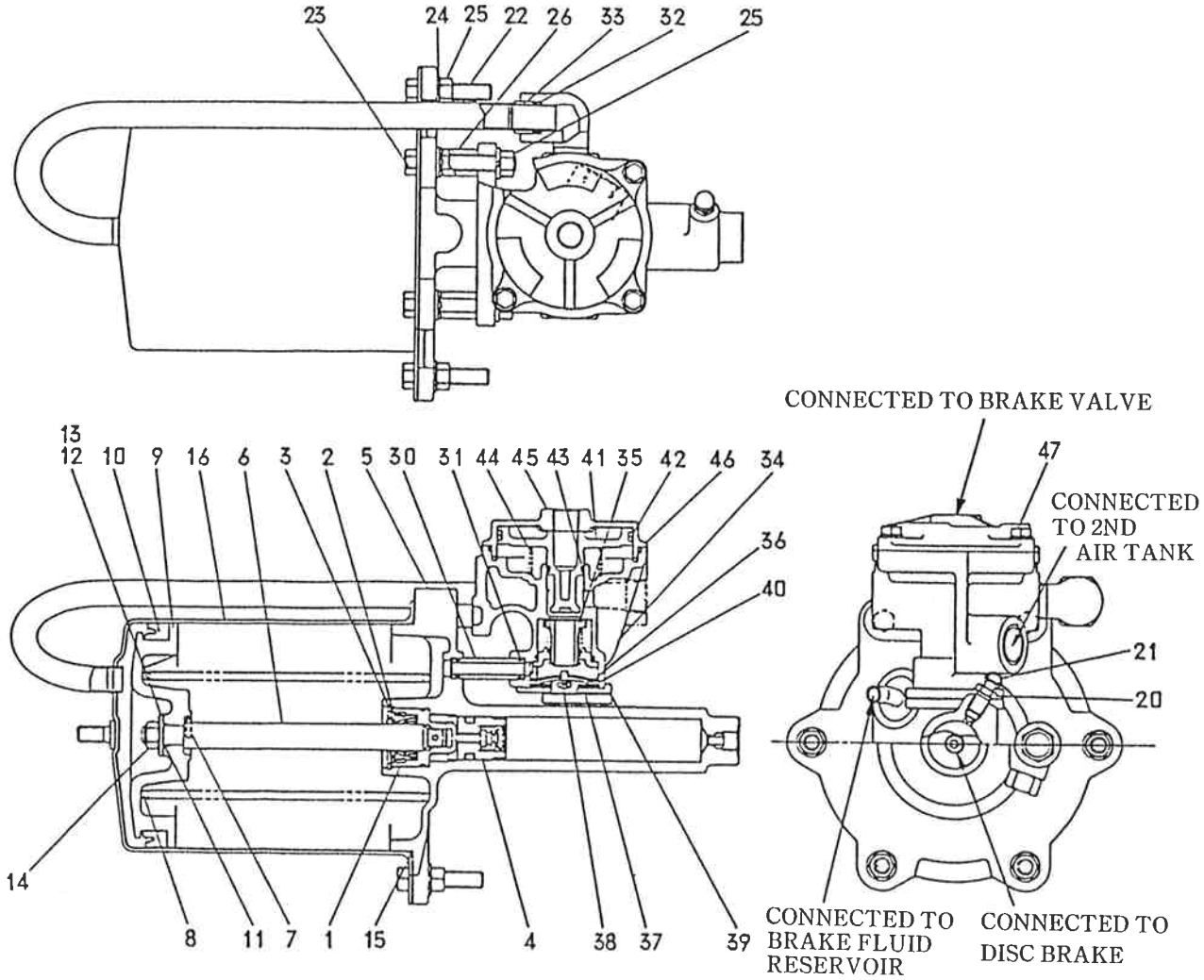


1. RETAINER ASSEMBLY
2. WASHER
3. SNAP RING
4. HYDRAULIC PISTON ASSEMBLY
5. BODY ASSEMBLY
6. PUSH ROD
7. PIN
8. SPRING
9. PISTON PLATE
10. CUP PACKING
11. O-RING
12. WASHER
13. WASHER
14. NUT
15. O-RING
16. CYLINDER SHELL ASSEMBLY
20. BLEEDER SCREW
21. CAP
22. BOLT
23. BOLT
24. LOCKWASHER
25. NUT
26. NUT
30. PIPE
31. O-RING
32. O-RING
33. COLLAR
34. BODY ASSEMBLY
35. VALVE ASSEMBLY
36. EXHAUST CHECK VALVE SEAT
37. EXHAUST CHECK VALVE
38. MACHINE SCREW
39. EXHAUST COVER ASSEMBLY
40. SNAP RING
41. RELAY PISTON
42. O-RING
43. O-RING
44. SPRING
45. COVER
46. O-RING
47. CAPSCREW

Fig. 1-19 Power Cluster for Front

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(2) Power Cluster for Rear



1. RETAINER ASSEMBLY
2. WASHER
3. SNAP RING
4. HYDRAULIC PISTON ASSEMBLY
5. BODY ASSEMBLY
6. PUSH ROD
7. PIN
8. SPRING
9. PISTON PLATE
10. CUP PACKING
11. O-RING
12. WASHER
13. WASHER
14. NUT
15. O-RING
16. CYLINDER SHELL ASSEMBLY
20. BLEEDER SCREW
21. CAP
22. BOLT
23. BOLT
24. LOCKWASHER
25. NUT
26. NUT
30. PIPE
31. O-RING
32. O-RING
33. COLLAR
34. BODY ASSEMBLY
35. VALVE ASSEMBLY
36. EXHAUST CHECK VALVE SEAT
37. EXHAUST CHECK VALVE
38. MACHINE SCREW
39. EXHAUST COVER ASSEMBLY
40. SNAP RING
41. RELAY PISTON
42. O-RING
43. O-RING
44. SPRING
45. COVER
46. O-RING
47. CAPSCREW

Fig. 1-20 Power Cluster for Rear

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The power cluster operates the disc brakes by increasing hydraulic pressure nearly 27 times by means of the air pressure sent from the brake valve.

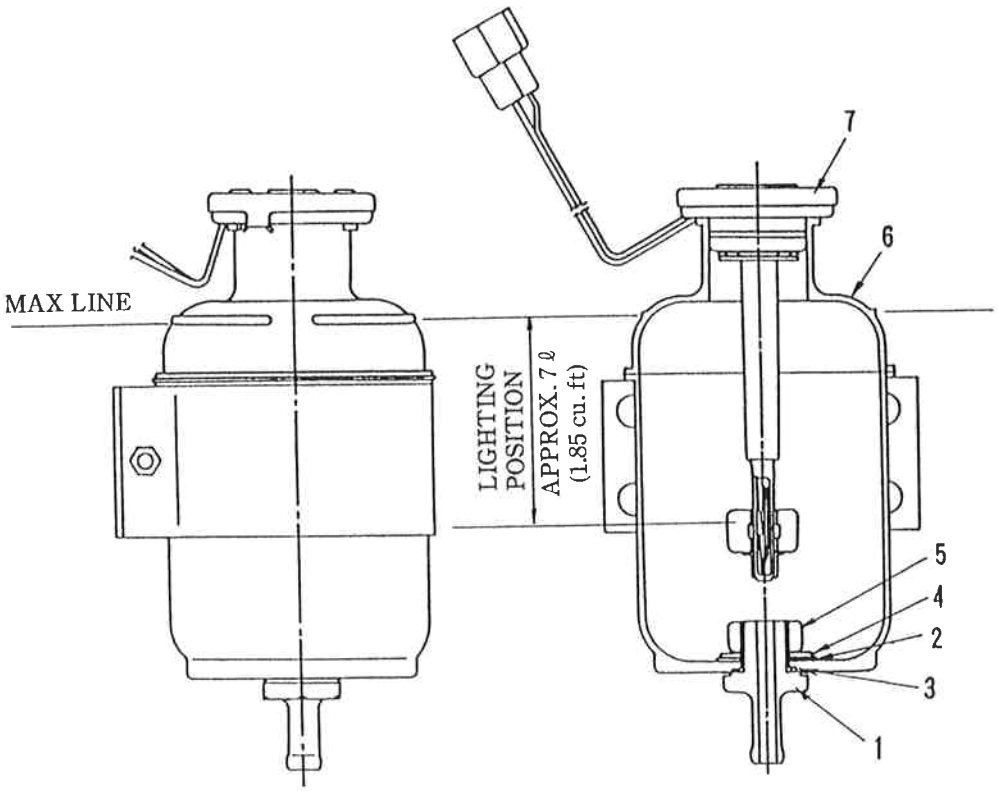
This machine is provided with the different power clusters for the front and the rear, and a larger capacity one is provided to the front than that for the rear.

Item	Power cluster for front	Power cluster for rear
Air cylinder Inside diameter × stroke	138mm × 188mm (5.43in × 7.40in)	138mm × 118mm (5.43in × 4.64in)
Hydraulic cylinder Inside diameter × stroke	26.7mm × 185mm (1.05in × 7.28in)	26.7mm × 115mm (1.05in × 4.52in)
Displacement of hydraulic piston	Approx. 103cc (6.29cu. in)	Approx. 64cc (3.91cu. in)
Service temperature range	-30 to 70℃ (-22 to 158°F)	-30 to 70℃ (-22 to 158°F)
Weight	Approx. 9.5kg(20.9 lbs)	Approx. 8.4kg (18.5 lbs)

1.17 BRAKE FLUID RESERVOIR

Since the brake fluid reservoir is provided respectively to the front brake circuit and the rear brake circuit, even if one brake system should leak, this can secure enough brake fluid quantity to be used for the remaining other brake system.

And, if the brake fluid falls below the specified level, the warning lamp on the front panel will be lit with the level indicator.



1. FITTING
2. WASHER
3. O-RING
4. WASHER
5. NUT
6. BODY
7. INDICATOR

Fig. 1-21 Brake Fluid Reservoir

https://truckmanualshub.com/

The power cluster operates the disc brakes by increasing hydraulic pressure nearly 27 times by means of the air pressure sent from the brake valve.

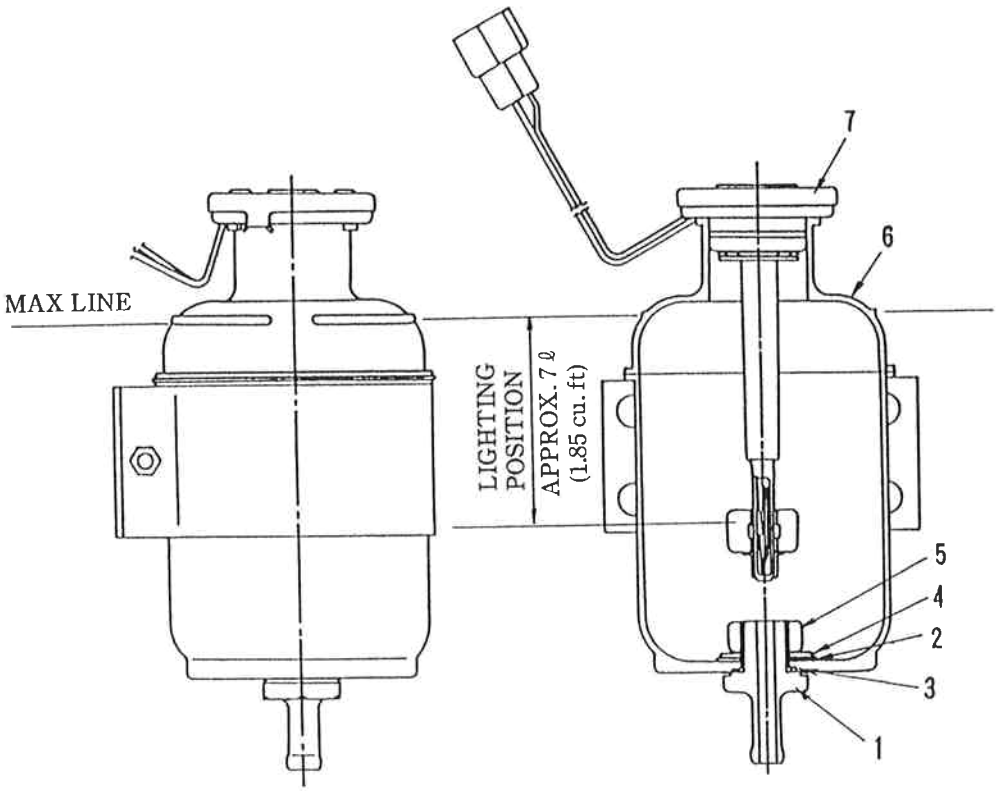
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Item	Power cluster for front	Power cluster for rear
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1.17 BRAKE FLUID RESERVOIR

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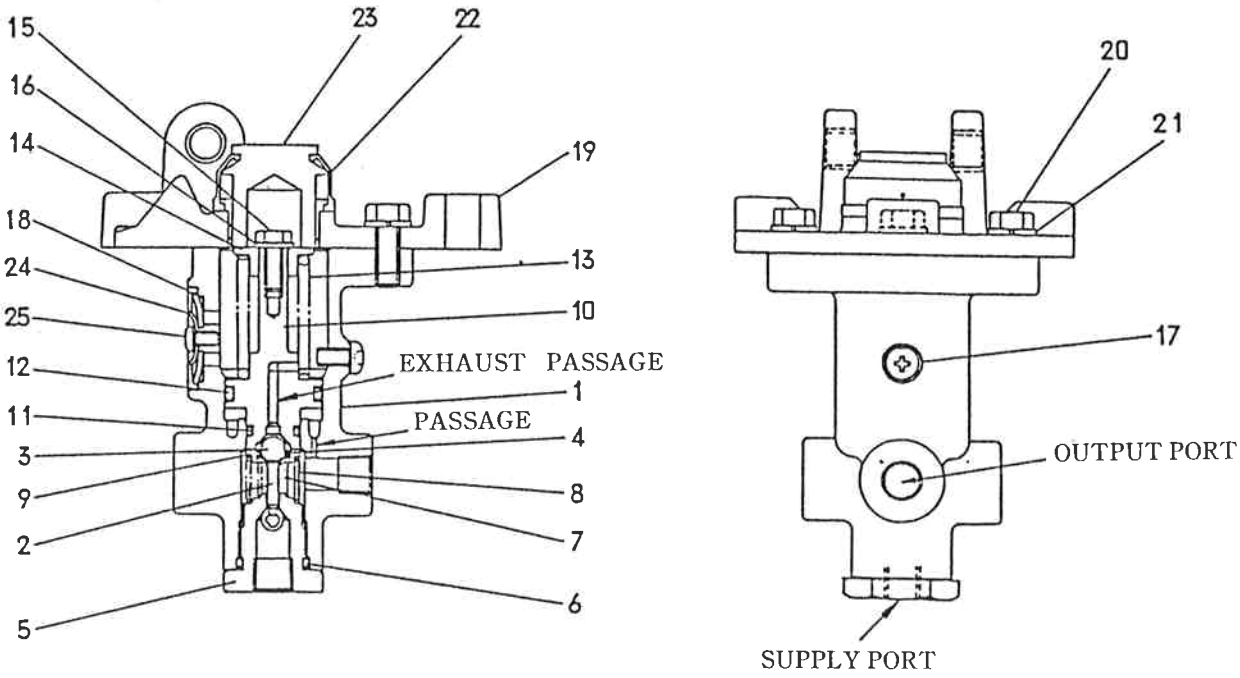


1. FITTING
2. WASHER
3. O-RING
4. WASHER
5. NUT
6. BODY
7. INDICATOR

Fig. 1-21 Brake Fluid Reservoir

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1.18 THROTTLE VALVE



1. BODY
2. VALVE
3. VALVE HEAD
4. VALVE RETAINER
5. PLUG
6. O-RING
7. SPRING
8. SPRING
9. SPRING SEAT
10. PISTON
11. O-RING
12. O-RING
13. SPRING
14. SPRING SEAT
15. CAPSCREW
16. WASHER
17. MACHINE SCREW
18. EXHAUST CHECK VALVE
19. MOUNTING PLATE
20. CAPSCREW
21. LOCKWASHER
22. BOOT
23. PLUNGER
24. WASHER
25. MACHINE SCREW

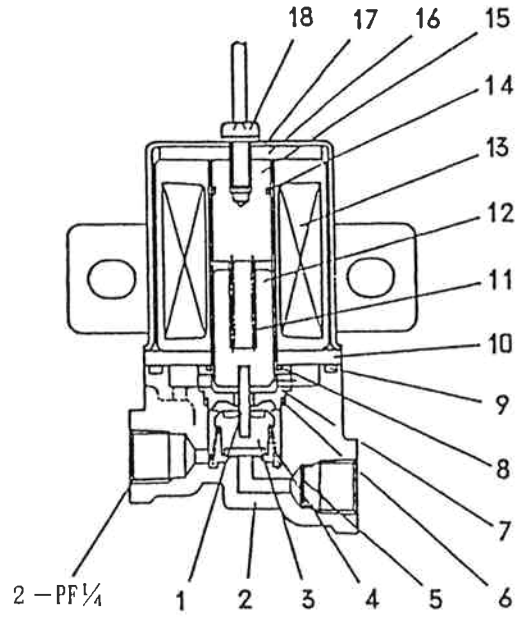
Fig. 1-22 Throttle Valve

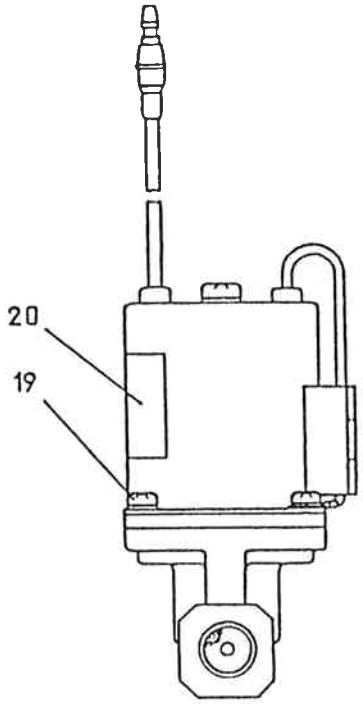
When the accelerator pedal is depressed, depressing force is transmitted to piston (10) through plunger (23), spring seat (14) and spring (13). The exhaust valve seat on the bottom of the piston contacts valve head (3), and the middle exhaust passage is closed. The piston pushes spring (7) more to compress it, and the valve head on the bottom of valve (2) parts from the supply port seat of plug (5). Then air from the supply port flows out from the output port, and is supplied to the throttle air cylinder as air pressure.

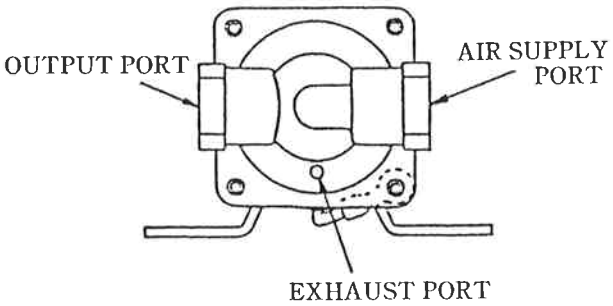
Meanwhile, a part of air pressure passes through the passage of the body, and is supplied to the bottom surface of piston (10), then the air is going to push the piston upward. If the pedal depressing angle is held at a fixed angle, the air pressure to the bottom surface of the piston pushing to compress spring (13) on the top of the piston, moves upward. At this time, the piston moves upward with the top end of valve (2) contacting the valve head, and the bottom end valve head contacts the supply valve seat of plug (5) to stop air supply. Since the piston contacts the top end valve head, the air pressure is stabilized at this time.

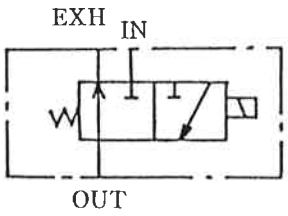
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1.19 SOLENOID VALVES (FOR PARKING BRAKE, GOVERNOR CONTROL, EXHAUST BRAKE, AUXILIARY BRAKE AND PTO)









1. ROD
2. BODY
3. VALVE
4. SPRING
5. FILTER
6. O-RING
7. VALVE SEAT
8. O-RING
9. O-RING
10. COIL COVER
11. SPRING
12. PLUNGER
13. COIL ASSEMBLY
14. O-RING
15. CORE
16. COIL COVER
17. CASE ASSEMBLY
18. MACHINE SCREW
19. MACHINE SCREW
20. NAME PLATE

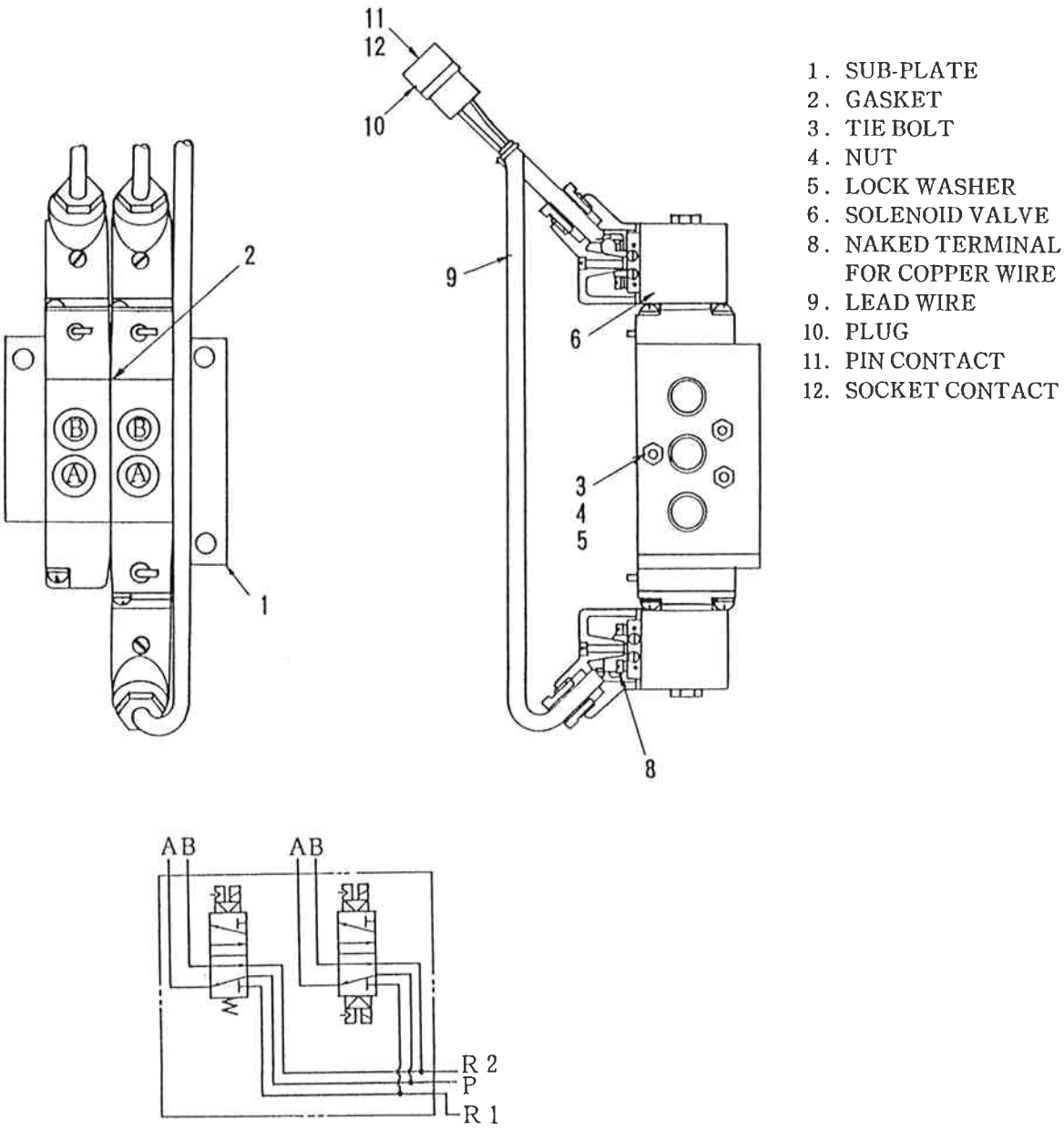
Fig. 1-23 Solenoid Valve (For Parking Brake, Governor Control, Exhaust Brake, Auxiliary Brake and PTO Shift)

When coil assembly (13) is energized, core (15) is excited, and pulls plunger (12). Then, valve (3) contacts exhaust valve seat (7), and at the same time parts from the supply valve seat of body (2). As a result, air is supplied to the output port from the supply port.

When energizing the coil is intercepted, excitation of the core is removed, valve (3) is pushed down through plunger (12) and rod (1) by force of spring (11). Then the supply valve seat is closed, and the exhaust valve seat is opened.

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1. 20 2-TANDEM SOLENOID VALVE (FOR REAR STEERING LOCK AND 2WD / 4WD SHIFT)



1. SUB-PLATE
2. GASKET
3. TIE BOLT
4. NUT
5. LOCK WASHER
6. SOLENOID VALVE
8. NAKED TERMINAL FOR COPPER WIRE
9. LEAD WIRE
10. PLUG
11. PIN CONTACT
12. SOCKET CONTACT

Fig. 1-24 2-Tandem Solenoid Valve (for Rear Steering Lock and 2WD / 4WD Shift)

Shifting the solenoid valves for the rear steering lock shift and the 2WD / 4WD shift are operated by operating the appropriate switch on the switch panel of the front panel in the operator's room.

The rear steering lock pin is operated with the rear lock pin switch on the carrier control panel in front of the operator's seat.

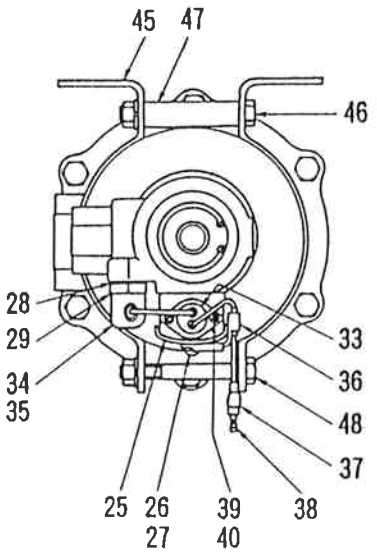
The lock pin switch returns automatically to the neutral position when released. The solenoid valve, which controls the air cylinder, is of a detent type, and is shifted to operate the lock pin when the solenoid is energized.

Except when the solenoid is energized, position of the valve is held by detent. Confirmation whether the lock pin is completely inserted or not is detected with the auto-switch in the air cylinder, and indicated with the indicator lamps on the front panel in the operator's seat.

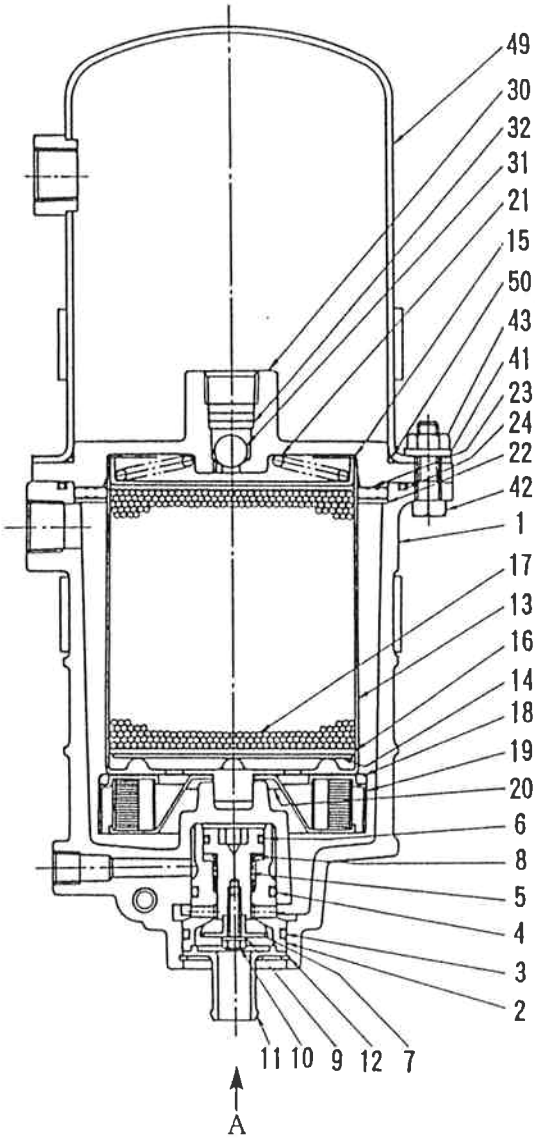
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1.21 AIR DRYER

1.21.1 COMPONENT PARTS



VIEW A



1. BODY
2. VALVE BODY
3. O-RING
4. O-RING
5. PISTON
6. O-RING
7. VALVE
8. VALVE SPRING
9. LOCKWASHER
10. CAPSCREW
11. EXHAUST COVER
12. RETAINING RING
13. CASE
14. FILTER PLATE (1)
15. FILTER PLATE (2)
16. FILTER
17. DESICCANT
18. FILTER GASKET
19. OIL FILTER
20. GASKET RING
21. SET SPRING
22. CASE GUIDE
23. SEALING RING
24. O-RING
25. PROTECTOR
26. LOCKWASHER
27. ROLLING SCREW
28. GASKET
29. HEATER
30. COVER
31. BALL CHECK VALVE
32. STOP PLATE
33. THERMOSTAT
34. HEATER
35. TERMINAL
36. CLAMP PLATE
37. TERMINAL COVER
38. TERMINAL
39. LOCKWASHER
40. FT SCREW
41. LOCKWASHER
42. BOLT
43. NUT
45. BRACKET
46. BOLT
47. SPACER
48. BOLT
49. PLUG CHAMBER
50. O-RING

Fig. 1-25

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1.21.2 FUNCTION

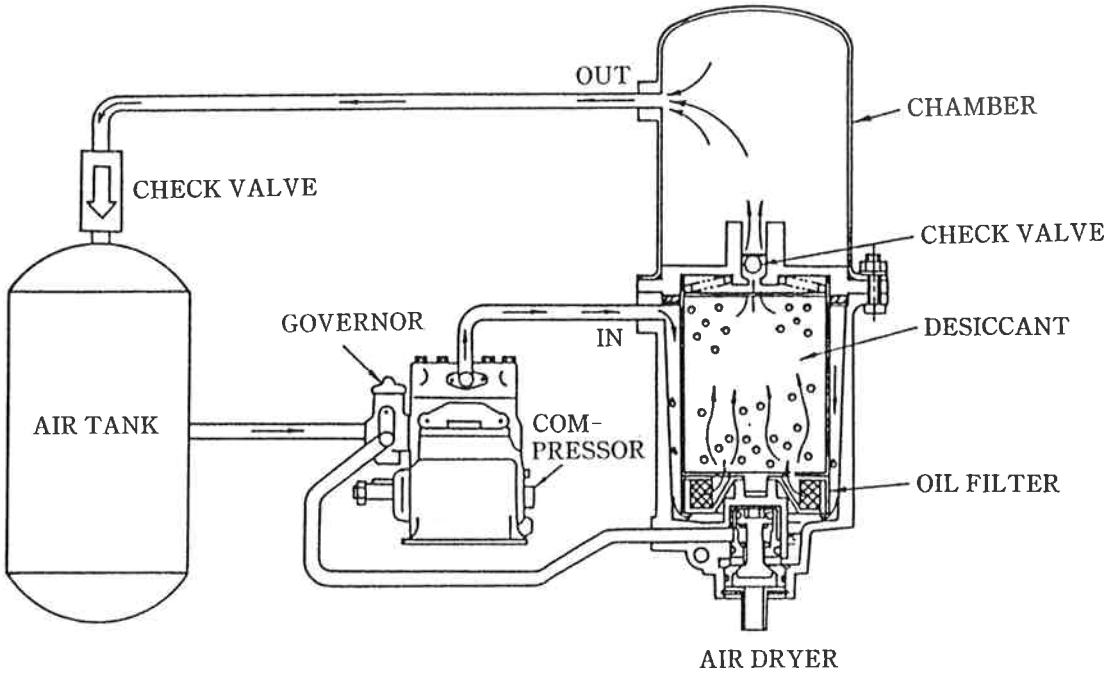


Fig. 1-26

Dehumidifying Function

When the compressor cycles with load, air from the compressor enters the inlet port of the air dryer, is cooled by the outside circumference of the drying cylinder, and moisture and oil mist are settled on the bottom of the body. Air passes the oil filter with the oil mist separator attached, where small oil drops and dust are removed, and is sent into the drying cylinder. Moisture which is still included in the air is removed there by desiccant which has strong affinity against water. As air goes from the lower section of the drying cylinder to the upper section, air contacts more dryed desiccant, so moisture is reduced more, air will be dryed air at the upper end of the drying cylinder. This dryed air is supplied to the air tank via the check valve and purge chamber.

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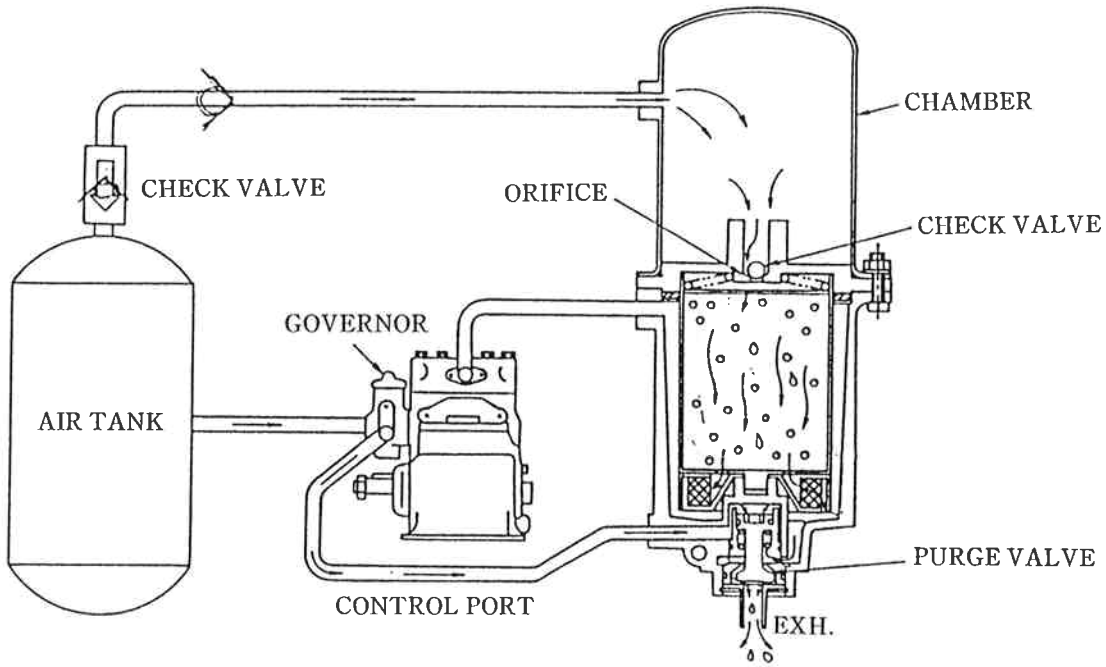


Fig. 1-27

Regenerating Function

When air pressure in the system reaches the upper limit, the air compressor becomes unloading condition by the order of the governor, and runs idle. The control port of the air dryer also receives the same order, the purge chamber opens, and the inside of the drying cylinder is opened to the atmosphere. Since this is sudden opening, the oil filter is cleaned with the pressure in the drying cylinder, and oil mist and condensed water are discharged to the atmosphere. After air pressure is suddenly reduced, the dryed air in the purge chamber passes the orifice, pressure is reduced, air is expanded.

The air becomes super dryed air, flows reversely in the drying cylinder, and takes moisture out of the desiccant to the atmospher, completing regeneration of the desiccant.

When the compressor cycles with load again, the purge valve closes by the order of the governor and functions to dehumidify.

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2. DISASSEMBLY AND ASSEMBLY

2.1 REMOVING AND INSTALLING AIR EQUIPMENTS

When removing and installing the air equipments, observe the following matters that demand special cautions.

(1) Place the machine in a horizontal place, and secure the machine with some method other than air brake.
(2) Set the machine in the travel position, and lock all the crane section.
(3) Stop the engine, and place the key switch in the OFF position.
(4) Open the drain cocks of the front tank, rear tank and pilot tank, and remove all air from the circuits.
(5) Attach name tags to all the removed parts and pipes.
(6) To install the air equipments, reverse the order of removal, and correctly install them.
(7) After installing, check for leak with soapy water.

2.2 REMOVING AND INSTALLING BRAKE HYDRAULIC EQUIPMENTS

When removing and installing the brake hydraulic equipments, observe the following cautions.

(1) Carry out (1) throught (4) of the topic 2.1
(2) When removing the piping, catch oil in a container because oil leaks.
(3) Brake fluid is used in the reservoir tank. If a wrong kind of oil is used, seals in various parts might become useless. Pay close attention.
(4) To install the brake components, reverse the order of removal, and install them correctly.
(5) After installing, be sure to check for oil leak, and bleed air from the all removed components. Every components is provided with an air bleeder.

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2. DISASSEMBLY AND ASSEMBLY

2.1 REMOVING AND INSTALLING AIR EQUIPMENTS

When removing and installing the air equipments, observe the following matters that demand special cautions.

(1) Place the machine in a horizontal place, and secure the machine with some method other than air brake.
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(5) Attach name tags to all the removed parts and pipes.
(6) To install the air equipments, reverse the order of removal, and correctly install them.
(7) After installing, check for leak with soapy water.

2.2 REMOVING AND INSTALLING BRAKE HYDRAULIC EQUIPMENTS

When removing and installing the brake hydraulic equipments, observe the following cautions.

(1) Carry out (1) throught (4) of the topic 2.1
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(4) To install the brake components, reverse the order of removal, and install them correctly.
(5) After installing, be sure to check for oil leak, and bleed air from the all removed components. Every components is provided with an air bleeder.

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2.3 DISASSEMBLY AND ASSEMBLY OF BRAKE VALVE

2.3.1 DISASSEMBLY

To disassemble the brake valve, proceed as follows (see Fig. 2-1).

(1) Remove capscrews and lockwashers (43), and separate mounting plate (42) from upper body (1).

(2) Remove capscrews and lockwashers (41), and separate lower body (28) from upper body (1).

(3) Remove machine screws and lockwasher (38), and remove check valve assembly (39) and lower valve assembly (29) from lower body (28).

(4) Remove snap ring (35), and remove special washer (34), O-ring (33 and 36), retainer (32), spring (31) and valve retainer (30) from lower valve (29) in order.

(5) Insert a screwdriver into the center hole of relay piston (12), and hold the groove on the bottom head of stem (16). Then, remove nut (26), lockwasher (25) and washer (24) from the top end of the stem, and take out spring seat (23), rubber spring (22), upper piston (21) and return spring (15) from upper body (1) in order.

(6) Draw out stem (16), springs (17 and 18), washer (20) and sleeve (19) from relay piston (12).

(7) Remove relay piston (12) and spring (11) from upper body (1).

(8) Remove snap ring (10), and remove upper valve (2) assembly from upper body (1).

(9) Remove snap ring (8), and remove special washer (7), O-rings (6 and 9), retainer (5), spring (4), and valve retainer (3) from upper valve (2) in order.

2.3.2 ASSEMBLY

To assemble the brake valve, proceed in the reverse order of disassembly, and observe the following matters that demand special cautions.

(1) All the O-rings and seals must be replaced with new ones.

(2) Apply a proper coat of Lithum base grease (NA-141M) to the sliding surface of the piston, O-ring and O-ring grooves.

(3) Properly apply Lithum base grease containing Molybdenum di-sulfide (NA-114M) to the sliding section of plunger.

(4) Tightening torque of piping connectors shall be 3 to 4kg-m (21.6 to 28.9ft-lbs).

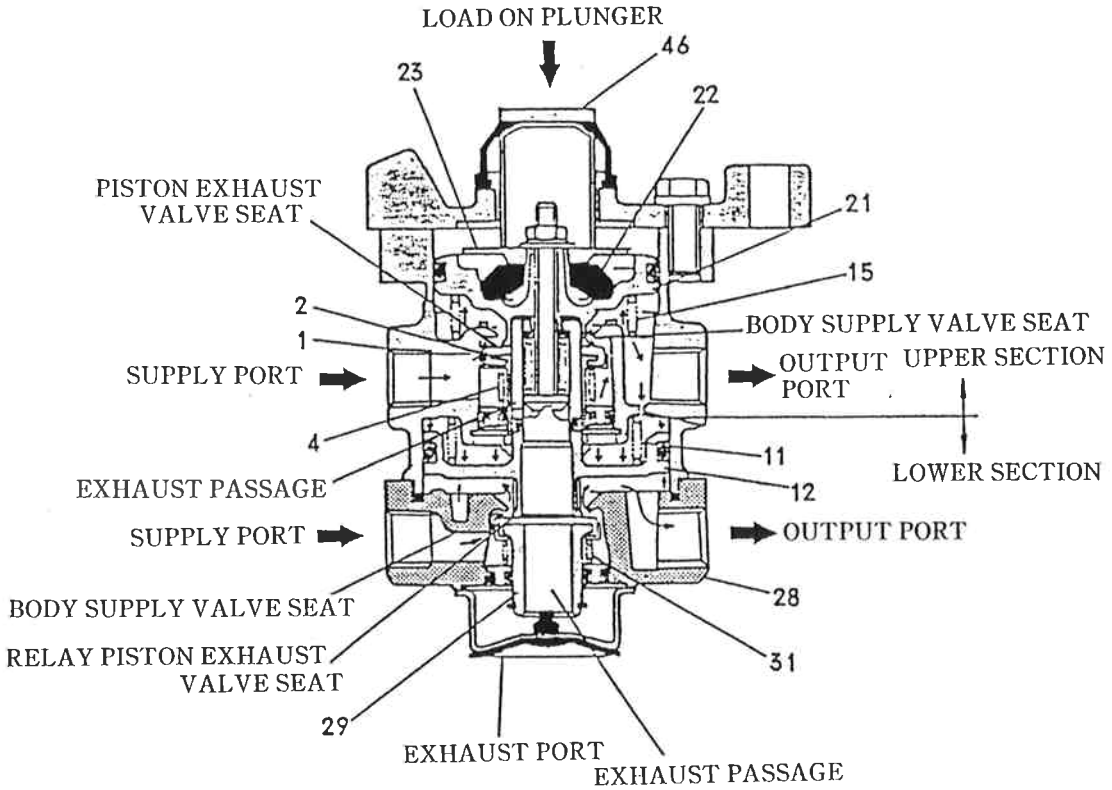


Fig. 2-1 Brake Valve

https://truckmanualshub.com/

2.3 DISASSEMBLY AND ASSEMBLY OF BRAKE VALVE

2.3.1 DISASSEMBLY

To disassemble the brake valve, proceed as follows (see Fig. 2-1).

(1) Remove capscrews and lockwashers (43), and separate mounting plate (42) from upper body (1).

(2) Remove capscrews and lockwashers (41), and separate lower body (28) from upper body (1).

(3) Remove machine screws and lockwasher (38), and remove check valve assembly (39) and lower valve assembly (29) from lower body (28).

(4) Remove snap ring (35), and remove special washer (34), O-ring (33 and 36), retainer (32), spring (31) and valve retainer (30) from lower valve (29) in order.

(5) Insert a screwdriver into the center hole of relay piston (12), and hold the groove on the bottom head of stem (16). Then, remove nut (26), lockwasher (25) and washer (24) from the top end of the stem, and take out spring seat (23), rubber spring (22), upper piston (21) and return spring (15) from upper body (1) in order.

(6) Draw out stem (16), springs (17 and 18), washer (20) and sleeve (19) from relay piston (12).

(7) Remove relay piston (12) and spring (11) from upper body (1).

(8) Remove snap ring (10), and remove upper valve (2) assembly from upper body (1).

(9) Remove snap ring (8), and remove special washer (7), O-rings (6 and 9), retainer (5), spring (4), and valve retainer (3) from upper valve (2) in order.

2.3.2 ASSEMBLY

To assemble the brake valve, proceed in the reverse order of disassembly, and observe the following matters that demand special cautions.

(1) All the O-rings and seals must be replaced with new ones.

(2) Apply a proper coat of Lithum base grease (NA-141M) to the sliding surface of the piston, O-ring and O-ring grooves.

(3) Properly apply Lithum base grease containing Molybdenum di-sulfide (NA-114M) to the sliding section of plunger.

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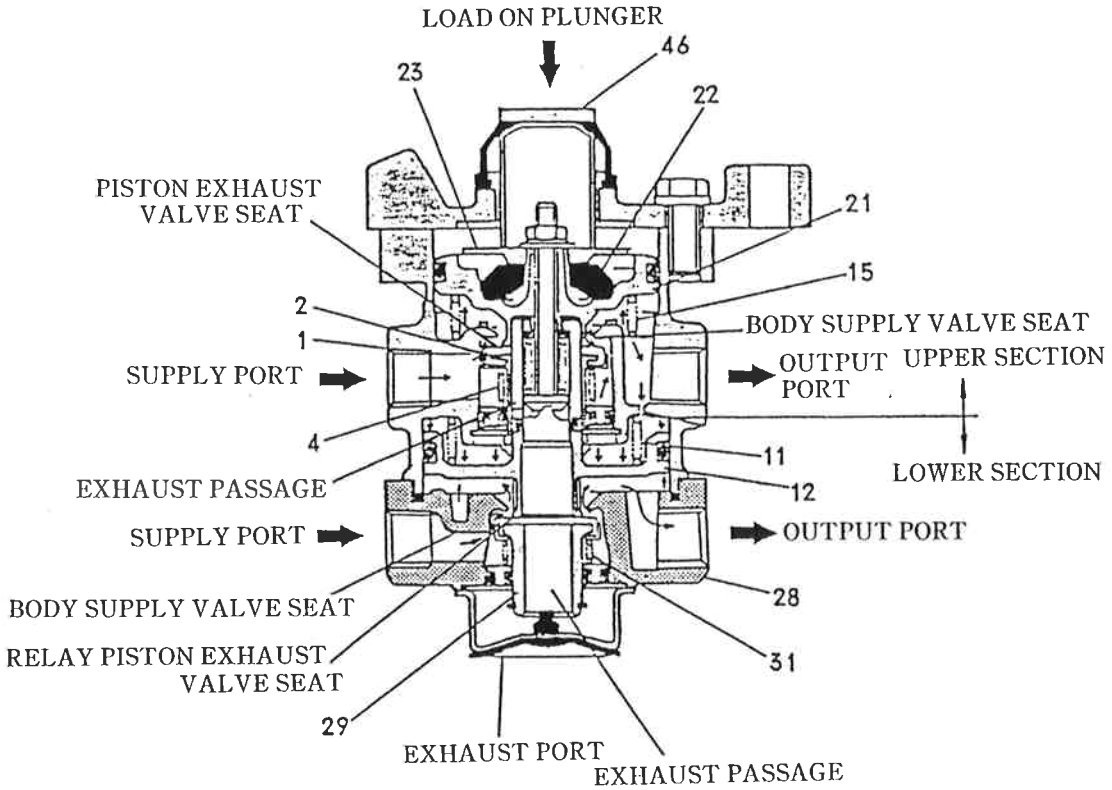


Fig. 2-1 Brake Valve

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2.4 DISASSEMBLY AND ASSEMBLY OF POWER CLUSTER

Since constructions of the power clusters for the front and the rear are identical, explain the power cluster for the front as follows (Fig. 2-2).

2.4.1 DISASSEMBLY

(1) Remove nuts (25) and lockwashers (24) from bolts (23), and remove body assembly (34) of the relay valve first.

(2) Next, remove nuts (26) from bolts (23), remove nuts (25) and lockwashers (24) from bolts (22), and separate cylinder shell assembly (16) from body assembly (5).

(3) Remove nut (14) and washers (12 and 13), draw out piston plate (9) from push rod (6), and remove spring (8).

(4) Remove snap ring (3), and draw out washer (2), retainer assembly (1), hydraulic piston assembly (4) and push rod (6) from body assembly (5) at the same time.

(5) Remove pin (4-1), and separate hydraulic piston assembly (4) from push rod (6).

(6) By removing capscrews (47) and removing cover (45) from relay valve body (34), relay piston (41) and spring (44) can be drawn out.

(7) Remove snap ring (40), and draw out exhaust check valve seat (36), and valve guide and valve assembly (35) from relay valve body (34).

2.4.2 ASSEMBLY

To assembly, proceed in the reverse order of disassembly. Pay attention to the following matters :

(1) Replace the all O-rings and seals with new ones.

(2) Coat the inner face of cylinder shell (16) and the sliding face of cup packing (10) with air master paste (JS-D6002). (Apply approx. 20g (0.70oz.) of paste to the inner face of the shell, and approx. 10g (0.35oz.) or paste to the packing.)

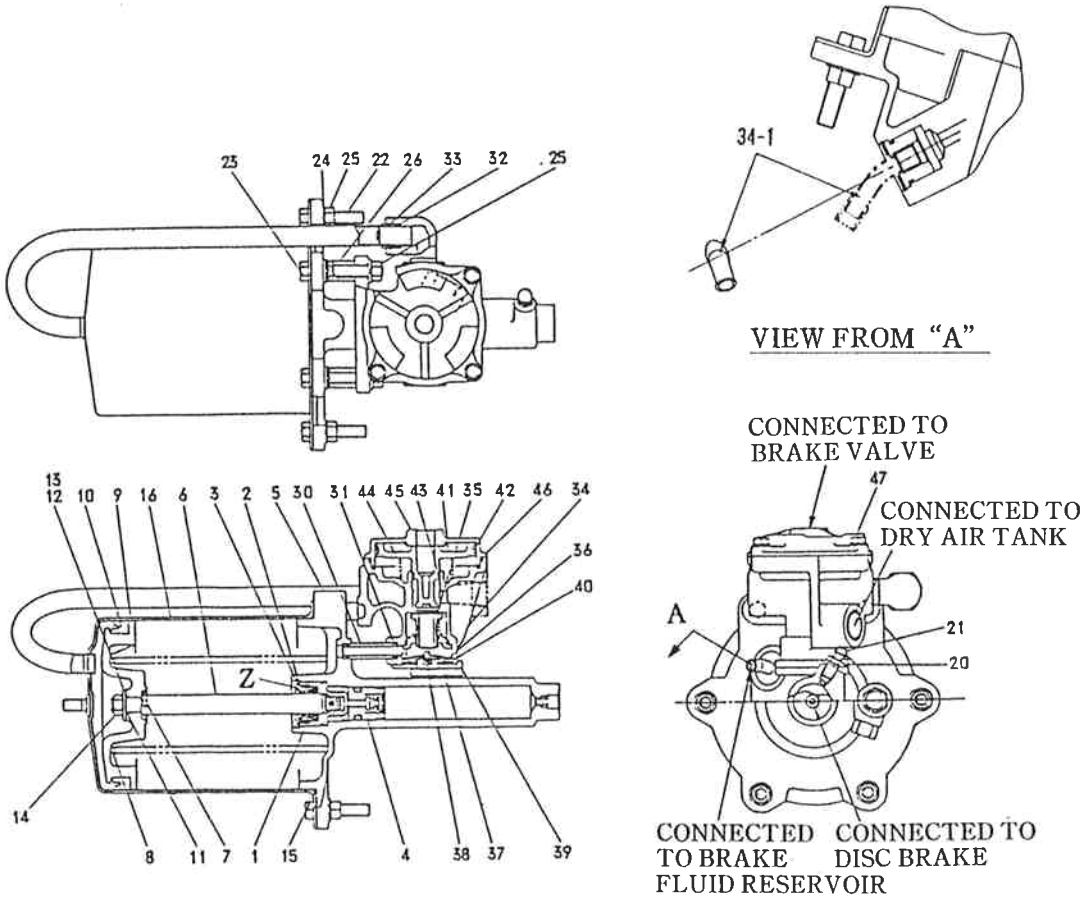


Fig. 2-2 Power Cluster (for the Front)

https://truckmanualshub.com/

2.4 DISASSEMBLY AND ASSEMBLY OF POWER CLUSTER

Since constructions of the power clusters for the front and the rear are identical, explain the power cluster for the front as follows (Fig. 2-2).

2.4.1 DISASSEMBLY

(1) Remove nuts (25) and lockwashers (24) from bolts (23), and remove body assembly (34) of the relay valve first.

(2) Next, remove nuts (26) from bolts (23), remove nuts (25) and lockwashers (24) from bolts (22), and separate cylinder shell assembly (16) from body assembly (5).

(3) Remove nut (14) and washers (12 and 13), draw out piston plate (9) from push rod (6), and remove spring (8).

(4) Remove snap ring (3), and draw out washer (2), retainer assembly (1), hydraulic piston assembly (4) and push rod (6) from body assembly (5) at the same time.

(5) Remove pin (4-1), and separate hydraulic piston assembly (4) from push rod (6).

(6) By removing capscrews (47) and removing cover (45) from relay valve body (34), relay piston (41) and spring (44) can be drawn out.

(7) Remove snap ring (40), and draw out exhaust check valve seat (36), and valve guide and valve assembly (35) from relay valve body (34).

2.4.2 ASSEMBLY

To assembly, proceed in the reverse order of disassembly. Pay attention to the following matters :

(1) Replace the all O-rings and seals with new ones.

(2) Coat the inner face of cylinder shell (16) and the sliding face of cup packing (10) with air master paste (JS-D6002). (Apply approx. 20g (0.70oz.) of paste to the inner face of the shell, and approx. 10g (0.35oz.) or paste to the packing.)

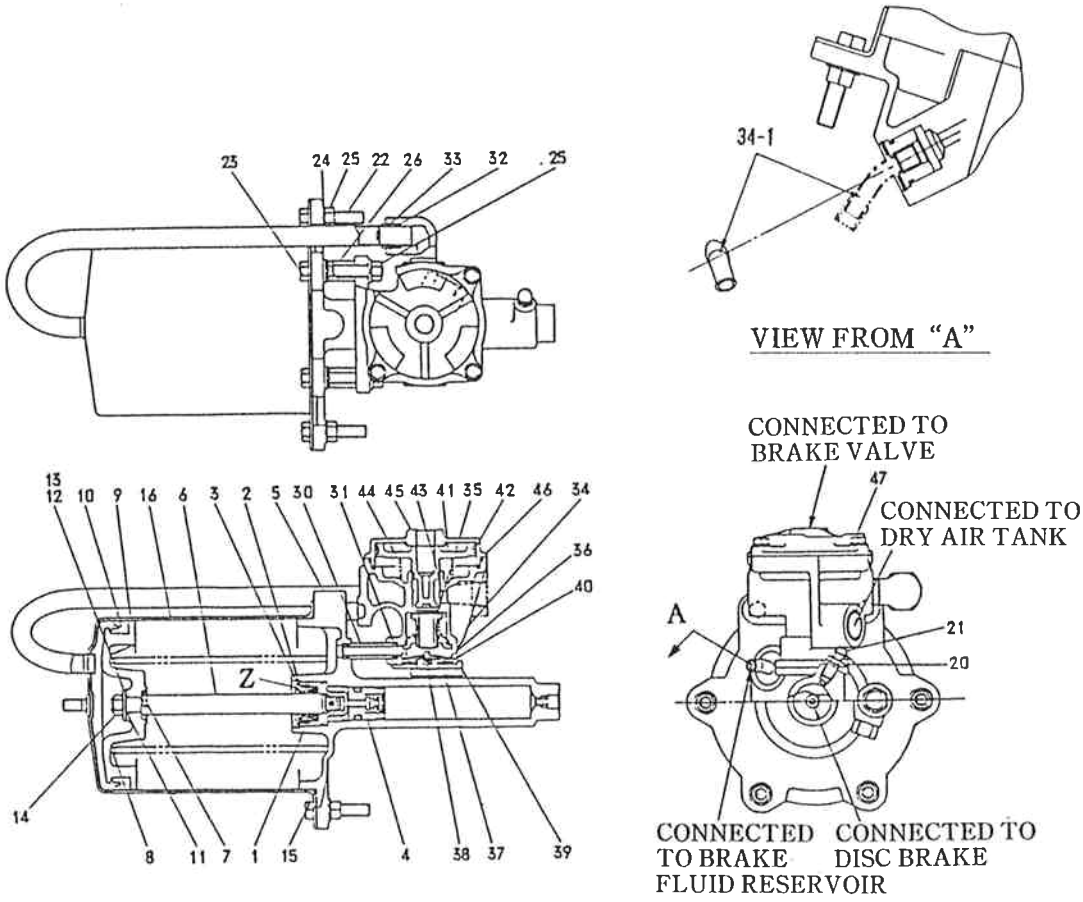


Fig. 2-2 Power Cluster (for the Front)

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(3) Fill silicon grease (G40M) into space (z) of air system side seal of retainer assembly (1).

(4) Coat air master paste to the sliding surface of relay valve side piston (41), sliding surface of valve (35) and O-ring. Sufficiently fill the O-ring groove, too.

(5) Coat air master paste or Silicon oil to other air system O-ring.

(6) Coat Silicon oil to hydraulic system side seal of retainer assembly (1).

(7) Coat brake fluid to the sliding surfaces of the hydraulic system cylinder and piston assembly (4).

(8) Coat brake fluid to the other hydraulic system cups and O-rings.

(9) Tightening torque of every threaded parts :

Nut (14) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Bleeder Screw (20) 0.7 to 1.3kg-m (5.1 to 9.4ft-lbs)
Nut (25) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Nut (26) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Elbow (34-1)1.5 to 2.0kg-m (10.8 to 14.5ft-lbs)
Capscrew (47)1.2 to 1.9kg-m (8.7 to 13.7ft-lbs)

When tightening elbow (34-1), arrange the specified direction within one turn just after the torque exceeds the lower limit. However, do not exceed the upper limit.

2.5 DISASSEMBLY AND ASSEMBLY OF THROTTEL VALVE

2.5.1 DISASSEMBLY

(1) Remove capscrews (20) and lockwashers (21), and separate mounting plate (19) from body (1).

(2) Remove machine screw (17), and draw out piston assembly (10) from body (1).

(3) Remove capscrew (15) and washer (16), and remove spring seat (14) and spring (13) from piston (10).

(4) Remove plug (5), and draw out valve (2), valve head (3), springs (7 and 8) and spring seat (9) from body (1).

(5) Remove machine screw (25) and washer (24), and remove exhaust check valve (18) from body (1).

2.5.2 ASSEMBLY

To assemble, proceed in the reverse order of disassembly, and observe the following cautions.

(1) The O-rings and seals must be replaced with new ones.

(2) Coat Lithum base grease (NA-141M) to the sliding surface of the piston, O-rings and O-ring grooves.

(3) Properly apply Lithum base grease containing Molybdenum di-sulfide (NA-114M) to the sliding surface of the plunger.

(4) Tightening torque of piping connectors is 1.5 to 2.5kg-m (10.8 to 18.1ft-lbs).

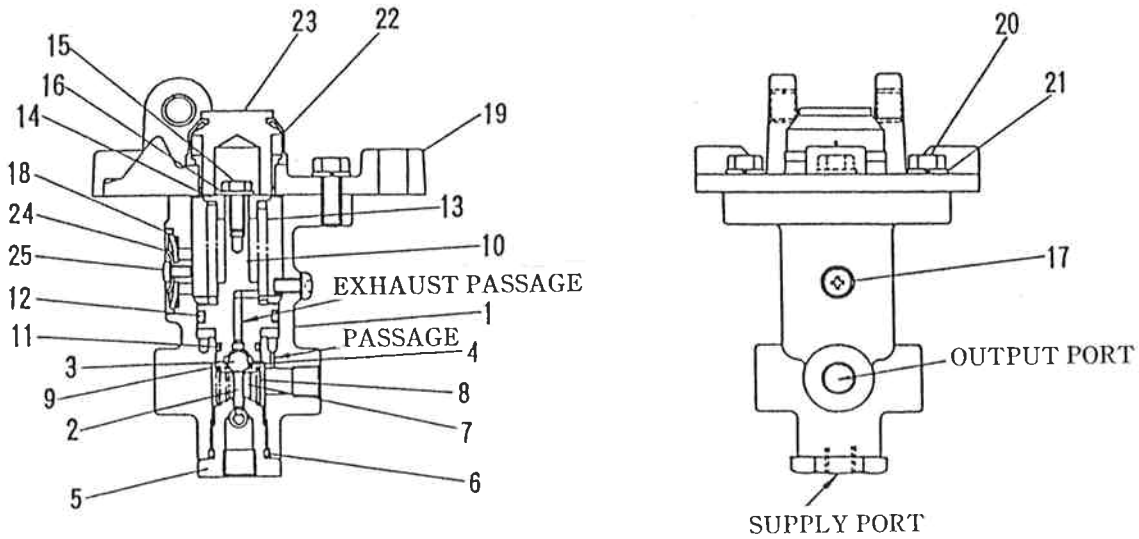


Fig. 2-3 Throttle Valve

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(3) Fill silicon grease (G40M) into space (z) of air system side seal of retainer assembly (1).

(4) Coat air master paste to the sliding surface of relay valve side piston (41), sliding surface of valve (35) and O-ring. Sufficiently fill the O-ring groove, too.

(5) Coat air master paste or Silicon oil to other air system O-ring.

(6) Coat Silicon oil to hydraulic system side seal of retainer assembly (1).

(7) Coat brake fluid to the sliding surfaces of the hydraulic system cylinder and piston assembly (4).

(8) Coat brake fluid to the other hydraulic system cups and O-rings.

(9) Tightening torque of every threaded parts :

Nut (14) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Bleeder Screw (20) 0.7 to 1.3kg-m (5.1 to 9.4ft-lbs)
Nut (25) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Nut (26) 2 to 3kg-m (14.5 to 21.7ft-lbs)
Elbow (34-1)1.5 to 2.0kg-m (10.8 to 14.5ft-lbs)
Capscrew (47)1.2 to 1.9kg-m (8.7 to 13.7ft-lbs)

When tightening elbow (34-1), arrange the specified direction within one turn just after the torque exceeds the lower limit. However, do not exceed the upper limit.

2.5 DISASSEMBLY AND ASSEMBLY OF THROTTEL VALVE

2.5.1 DISASSEMBLY

(1) Remove capscrews (20) and lockwashers (21), and separate mounting plate (19) from body (1).

(2) Remove machine screw (17), and draw out piston assembly (10) from body (1).

(3) Remove capscrew (15) and washer (16), and remove spring seat (14) and spring (13) from piston (10).

(4) Remove plug (5), and draw out valve (2), valve head (3), springs (7 and 8) and spring seat (9) from body (1).

(5) Remove machine screw (25) and washer (24), and remove exhaust check valve (18) from body (1).

2.5.2 ASSEMBLY

To assemble, proceed in the reverse order of disassembly, and observe the following cautions.

(1) The O-rings and seals must be replaced with new ones.

(2) Coat Lithum base grease (NA-141M) to the sliding surface of the piston, O-rings and O-ring grooves.

(3) Properly apply Lithum base grease containing Molybdenum di-sulfide (NA-114M) to the sliding surface of the plunger.

(4) Tightening torque of piping connectors is 1.5 to 2.5kg-m (10.8 to 18.1ft-lbs).

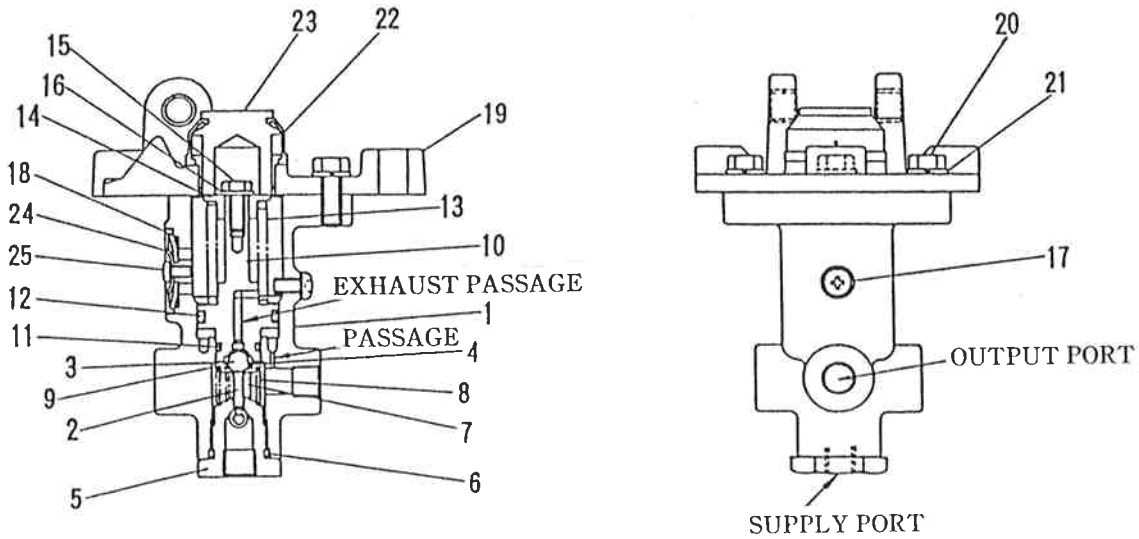


Fig. 2-3 Throttle Valve

https://truckmanualshub.com/

(3) Fill silicon grease (G40M) into space (z) of air system side seal of retainer assembly (1).

(4) Coat air master paste to the sliding surface of relay valve side piston (41), sliding surface of valve (35) and O-ring. Sufficiently fill the O-ring groove, too.

(5) Coat air master paste or Silicon oil to other air system O-ring.

(6) Coat Silicon oil to hydraulic system side seal of retainer assembly (1).

(7) Coat brake fluid to the sliding surfaces of the hydraulic system cylinder and piston assembly (4).

(8) Coat brake fluid to the other hydraulic system cups and O-rings.

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2.5 DISASSEMBLY AND ASSEMBLY OF THROTTEL VALVE

2.5.1 DISASSEMBLY

(1) Remove capscrews (20) and lockwashers (21), and separate mounting plate (19) from body (1).

(2) Remove machine screw (17), and draw out piston assembly (10) from body (1).

(3) Remove capscrew (15) and washer (16), and remove spring seat (14) and spring (13) from piston (10).

(4) Remove plug (5), and draw out valve (2), valve head (3), springs (7 and 8) and spring seat (9) from body (1).

(5) Remove machine screw (25) and washer (24), and remove exhaust check valve (18) from body (1).

2.5.2 ASSEMBLY

To assemble, proceed in the reverse order of disassembly, and observe the following cautions.

(1) The O-rings and seals must be replaced with new ones.

(2) Coat Lithum base grease (NA-141M) to the sliding surface of the piston, O-rings and O-ring grooves.

(3) Properly apply Lithum base grease containing Molybdenum di-sulfide (NA-114M) to the sliding surface of the plunger.

(4) Tightening torque of piping connectors is 1.5 to 2.5kg-m (10.8 to 18.1ft-lbs).

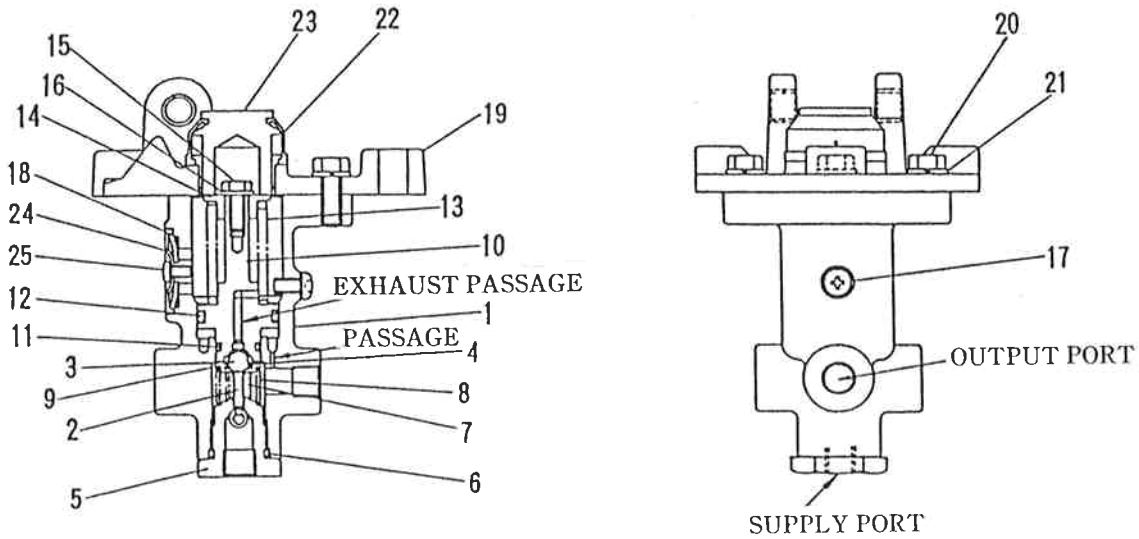


Fig. 2-3 Throttle Valve

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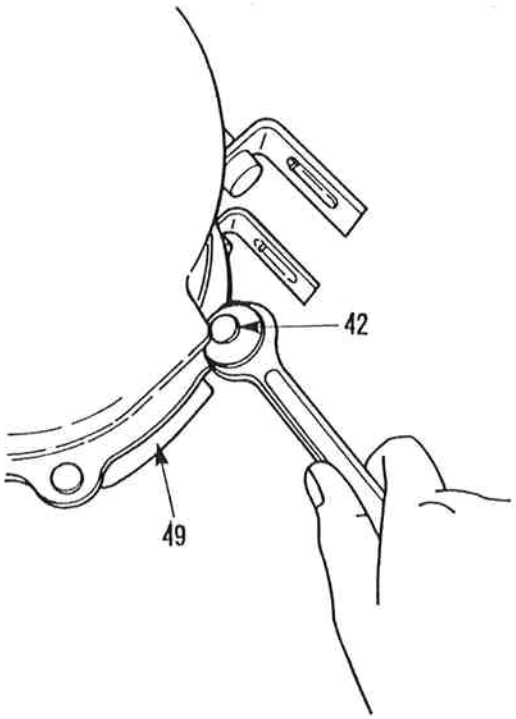
2.6 DISASSEMBLY AND ASSEMBLY OF AIR DRYER

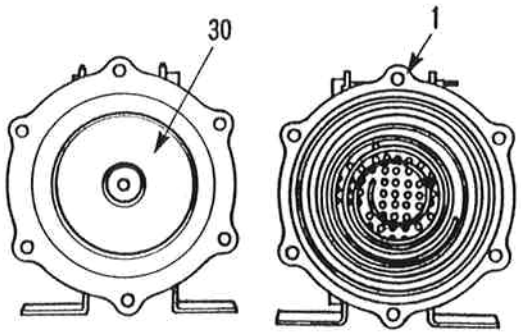
2.6.1 REMOVAL AND DISASSEMBLY (FIG. 1-25)

(1) Fix the machine with some method other than the air brake.
(2) Remove air from the brake piping.
(3) Remove the wiring from the thermostat.
(4) Remove all pipings (for IN, OUT and CONTROL) connected to DR-3.
(5) Loosen four mounting bolts of DR-3, and remove DR-3.

2.6.2 DISASSEMBLY OF DR-3

(1) Securing body (1) of DR-3 with a vise, remove four bolts of six bolts (42) which are tightened to the body first, and loosen the remaining two bolts. At that time, fix purge chamber (49), cover (30) and the flange section of body in the up and down direction, then loosen the bolts.





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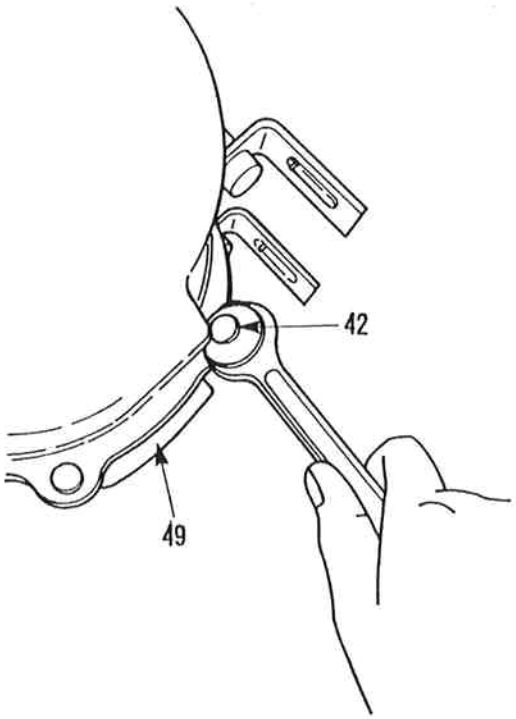
2.6 DISASSEMBLY AND ASSEMBLY OF AIR DRYER

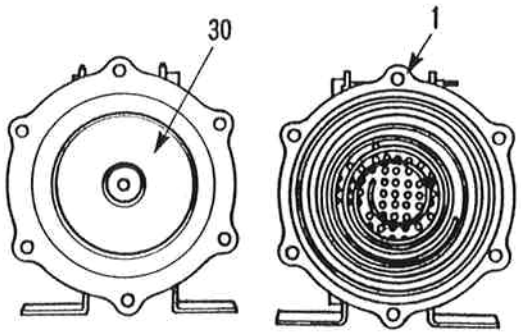
2.6.1 REMOVAL AND DISASSEMBLY (FIG. 1-25)

(1) Fix the machine with some method other than the air brake.
(2) Remove air from the brake piping.
(3) Remove the wiring from the thermostat.
(4) Remove all pipings (for IN, OUT and CONTROL) connected to DR-3.
(5) Loosen four mounting bolts of DR-3, and remove DR-3.

2.6.2 DISASSEMBLY OF DR-3

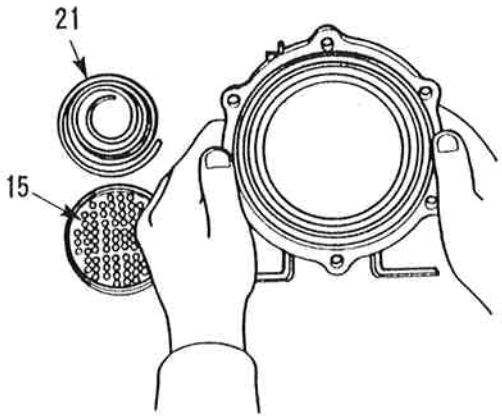
(1) Securing body (1) of DR-3 with a vise, remove four bolts of six bolts (42) which are tightened to the body first, and loosen the remaining two bolts. At that time, fix purge chamber (49), cover (30) and the flange section of body in the up and down direction, then loosen the bolts.

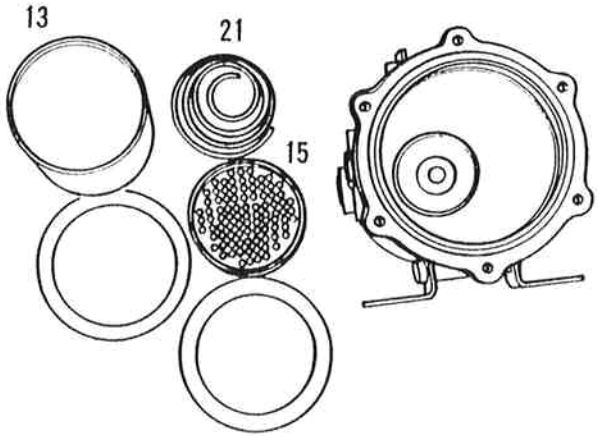




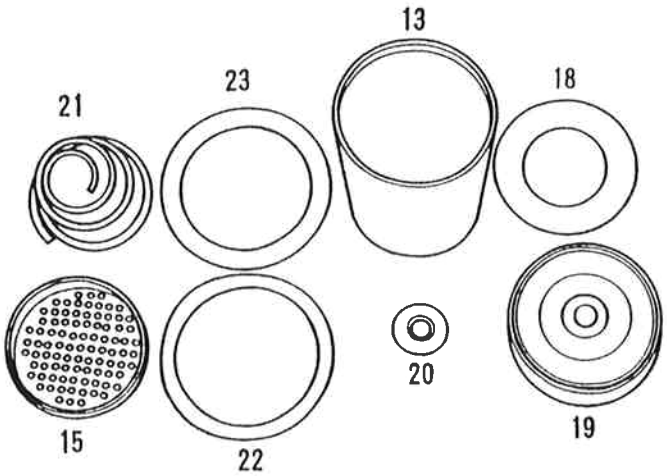
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(2) Remove set spring (21) and filter plate (15). Then draw out case (13), case guide (22), oil filter (19) and gasket ring (20) in order.



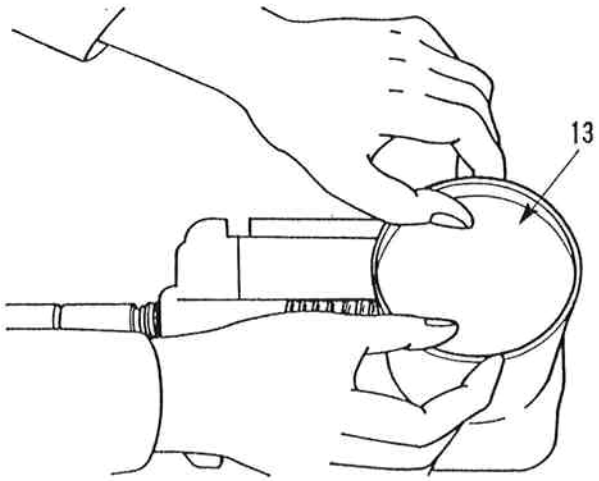


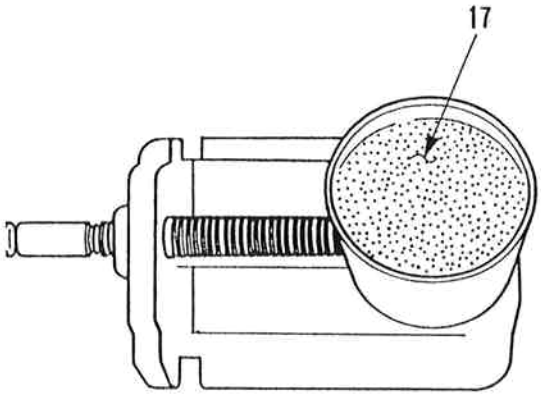
From Left in Upper Row
21 SET SPRING, 23 SEALING RING, 13 CASE [2 sheets of upper and lower FILTERS (16), DESICCANT (17) and FILTER PLATE (14)] and 18 FILTER GASKET.
From Left in Lower Row
15 FILTER PLATE, 22 CASE GUIDE, 20 GASKET RING and 19 OIL FILTER.



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(3) Draw out upper filter (16), move inside desiccant (17) to the outside, then draw out lower filter (16) and filter plate (14).



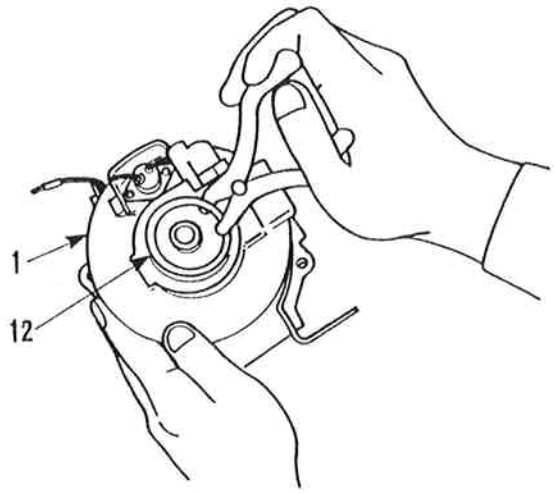


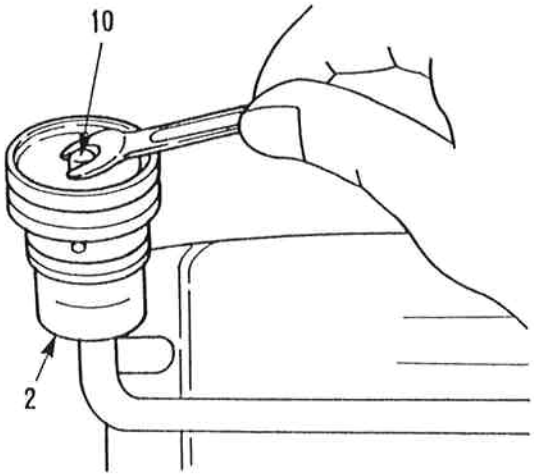
2.6.3 DISASSEMBLY OF VALVE BODY

(1) Place body (1) with the flange side down. Remove retaining ring (12) with the use of C-shape snap ring pliers (for hole), and draw out valve body complete (2 through 11).

(2) Remove exhaust cover (11) from valve body (2).

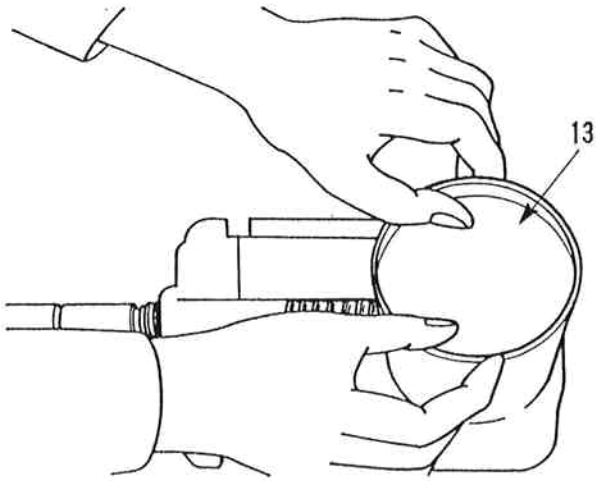
(3) Secure piston (5)with 10㎜(25 / 64″) hexagon wrench, loosen bolt (10) which secures valve (7), and remove piston (5), valve spring (8) and valve (7).

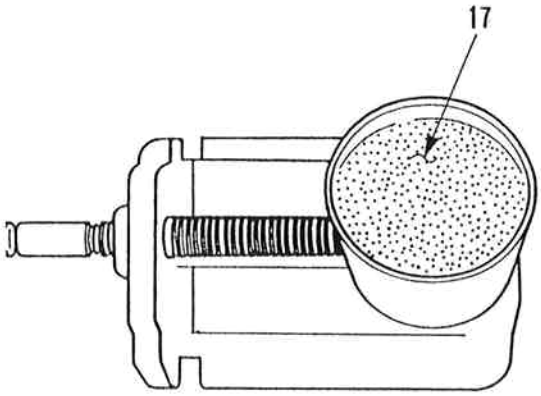




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(3) Draw out upper filter (16), move inside desiccant (17) to the outside, then draw out lower filter (16) and filter plate (14).



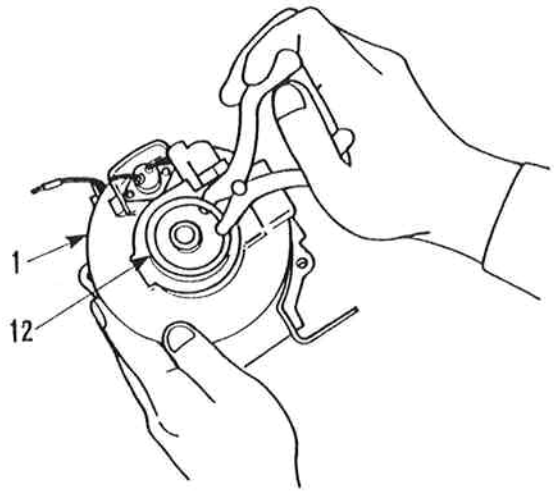


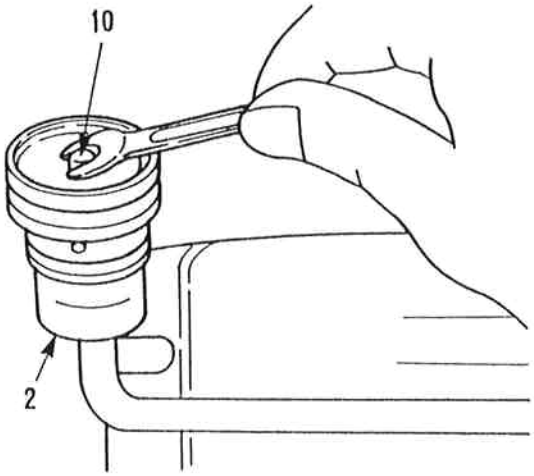
2.6.3 DISASSEMBLY OF VALVE BODY

(1) Place body (1) with the flange side down. Remove retaining ring (12) with the use of C-shape snap ring pliers (for hole), and draw out valve body complete (2 through 11).

(2) Remove exhaust cover (11) from valve body (2).

(3) Secure piston (5)with 10㎜(25 / 64″) hexagon wrench, loosen bolt (10) which secures valve (7), and remove piston (5), valve spring (8) and valve (7).

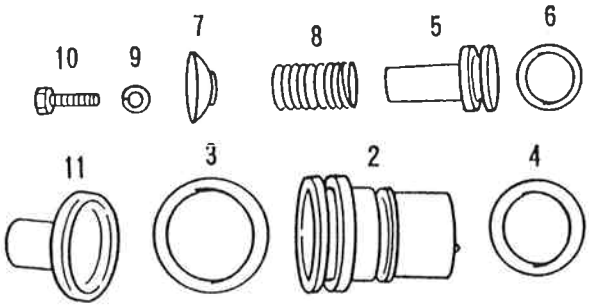




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From Right in Lower Row
4 O-RING, 2 VALVE BODY, 3 O-RING, and 11 EXHAUST COVER
From Right in Upper Row
6 O-RING, 5 PISTON, 8 VALVE SPRING, 7 VALVE, 9 LOCKWASHER, and 10 BOLT

Components of Valve Body Complete



2.6.4 ASSEMBLY

Carefully wash the disassembled parts except the rubber parts and desiccant with clean washing oil, wipe adhesive off, then sufficiently dry them.
When reusing rubber parts, cleanly wipe them with wastes.
Replace desiccant with a new one.

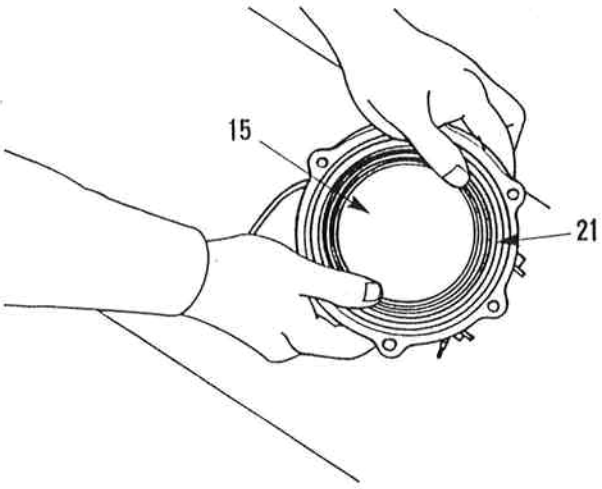
① Assembly of Main Body

(1) Direct the mouth of case (13) upward, push filter plate (14) and filter (16) into the case, then insert desiccant (17). The standard weight of desiccant is 480kgs (1058 lbs). However, if desiccant is purchased as a repair kit, insert all of a bag of desiccant.
Insert the filter so that soft and thick layer side of the filter comes to the upper side.

(2) In order settle the desiccant properly, lightly tap the outside circumference of case (13) with a plastic hammer, then install second filter (16). Install the filter so that soft and thick layer side of the filter comes to the upper side.

(3) Securing body (1) to a vise, insert the gasket ring, and insert the filter gasket together with the oil filter.
Then, install case (13) and case guide (22) in order.

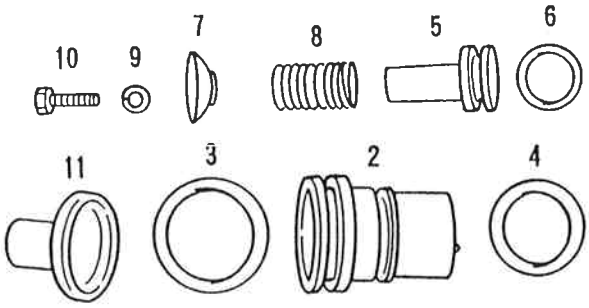
(4) After coating grease to sealing ring (23) and body O-ring (24), install them.
Use silicon or Limax #2 equivalent grease.



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From Right in Lower Row
4 O-RING, 2 VALVE BODY, 3 O-RING, and 11 EXHAUST COVER
From Right in Upper Row
6 O-RING, 5 PISTON, 8 VALVE SPRING, 7 VALVE, 9 LOCKWASHER, and 10 BOLT

Components of Valve Body Complete



2.6.4 ASSEMBLY

Carefully wash the disassembled parts except the rubber parts and desiccant with clean washing oil, wipe adhesive off, then sufficiently dry them.
When reusing rubber parts, cleanly wipe them with wastes.
Replace desiccant with a new one.

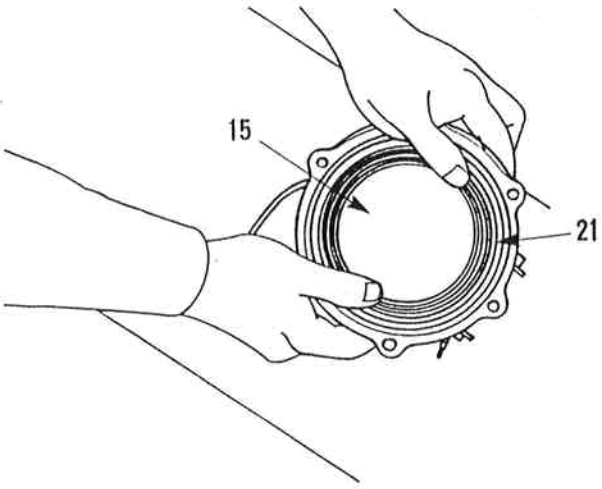
① Assembly of Main Body

(1) Direct the mouth of case (13) upward, push filter plate (14) and filter (16) into the case, then insert desiccant (17). The standard weight of desiccant is 480kgs (1058 lbs). However, if desiccant is purchased as a repair kit, insert all of a bag of desiccant.
Insert the filter so that soft and thick layer side of the filter comes to the upper side.

(2) In order settle the desiccant properly, lightly tap the outside circumference of case (13) with a plastic hammer, then install second filter (16). Install the filter so that soft and thick layer side of the filter comes to the upper side.

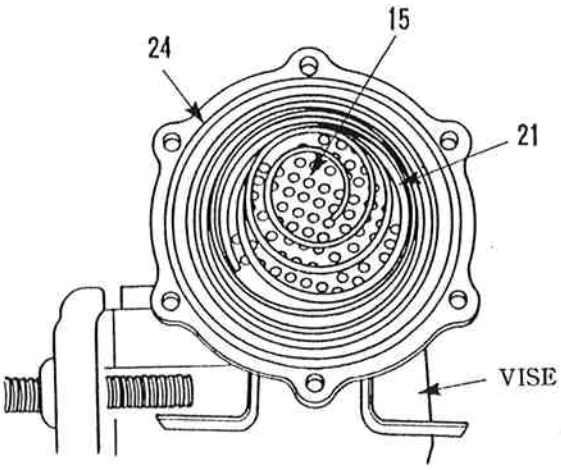
(3) Securing body (1) to a vise, insert the gasket ring, and insert the filter gasket together with the oil filter.
Then, install case (13) and case guide (22) in order.

(4) After coating grease to sealing ring (23) and body O-ring (24), install them.
Use silicon or Limax #2 equivalent grease.



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(5) Next, insert filter plate (15) and set spring (21) into case (13).



(6) Coat grease to O-ring (50) for the purge chamber, then install the O-ring.

(7) Finally, place cover (30) and purge chamber (49) on body (1), pass the six bolts from the bottom side, and tighten with nuts (43).
Tightening torque is 90 to 140kg-cm (6.51 to 10.13ft-lbs)

② Assembly of Valve Body

(1) Coat grease to O-ring (6) for piston (5), then install the O-ring into the piston.

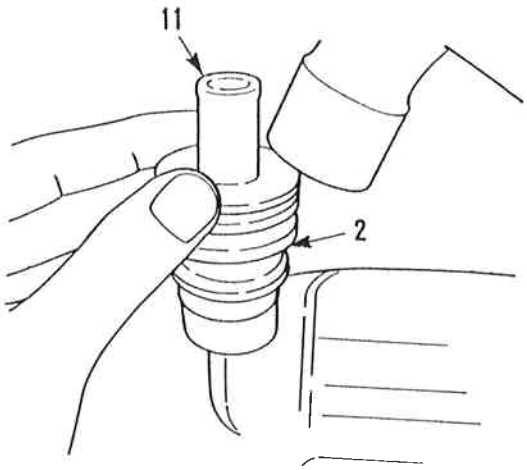
(2) Coat grease to the piston sliding section of valve body (2) and the piston side of the section which guides the piston. Then, insert valve spring (8) into the valve body, and install the piston. Fix the piston with 10mm (25 / 64″) hexagon wrench, secure valve (7) with bolt (9). Tightening torque of the bolt is 40 to 70kg-cm (2.89 to 5.06ft-lbs).

(3) After coating grease to O-rings (3 and 4) for valve body (2), install the O-rings to the valve body.

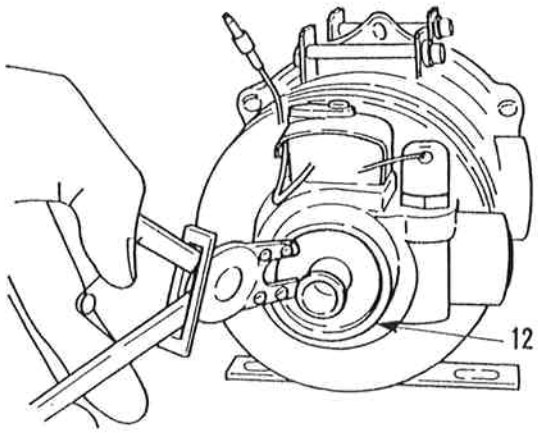
(4) Install exhaust cover (11) to valve body (2). When installing, lightly tap the all around the end face of the exhaust cover with a plastic hammer.

(5) After coating grease to the O-ring sealing section of body (1) side, install valve body complete (2 through 11).

(6) With the use of C-shape snapring pliers, install retaining ring (12).



VALVE ASSEMBLY



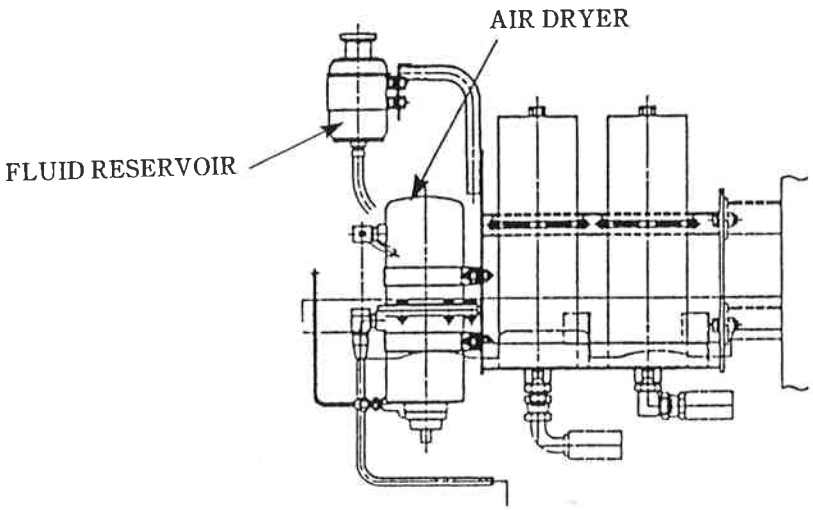
https://truckmanualshub.com/

2.6.5 INSPECTION OF AIR DRYER AFTER INSTALLATION TO CARRIER

(1) Run the engine to raise air pressure. When the air pressure reaches the highest pressure and when loading condition changes to unloading condition, air must be exhausted from the exhaust port of the air dryer.
Amount of exhausted air must be much in the beginning, and must become little to an extent exhausting sound cannot be heard in approximately three seconds.

(2) When air pressure lowers to the lowest pressure and when unloading condition changes to loading condition, amount of air leak from the exhaust port of the air dryer must be less than 20cc (1.22cu. in) / min.

(3) Air must not leak from the connected section of each piping.



Air Dryer Mounting Position

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3. MAINTENANCE STANDARDS

(1) OPERATING PRESSURE

Pressure Setting Standard (Fig. 3-1)

Symbol	Item		Standard Value	Remarks
A	Pressure governor operating pressure	Valve opening pressure	$8.0^{+0.35}_{0.05}$kg / cm² ($114^{+5.0}_{0.7}$psi)	Replace.
		Valve closing pressure	$7.1^{+0.2}_{0.2}$kg / cm² ($101^{+3.0}_{3.0}$psi)	
B	Safety valve opening pressure		9.5 ± 0.4kg / cm² (135 ± 5.7psi)	Adjust or replace.
C	Low-pressure switch operating pressure		5.5kg / cm² (78psi)	Replace.
D	Stop light switch operating pressure		0.5kg / cm² (7.1psi)	Replace.
E	Protection valve operating pressure	Valve opening pressure	6.7kg / cm² (95psi)	Adjust or replace.
		Valve closing pressure	5.3kg / cm² (75psi)	
F	Reduction valve operating pressure		5.0 ± 0.15kg / cm² (71.1 ± 2.1psi)	Adjust or replace.
G	Reduction valve operating pressure		3.5 ± 0.15kg / cm² (49.8 ± 2.1psi)	Adjust or replace.

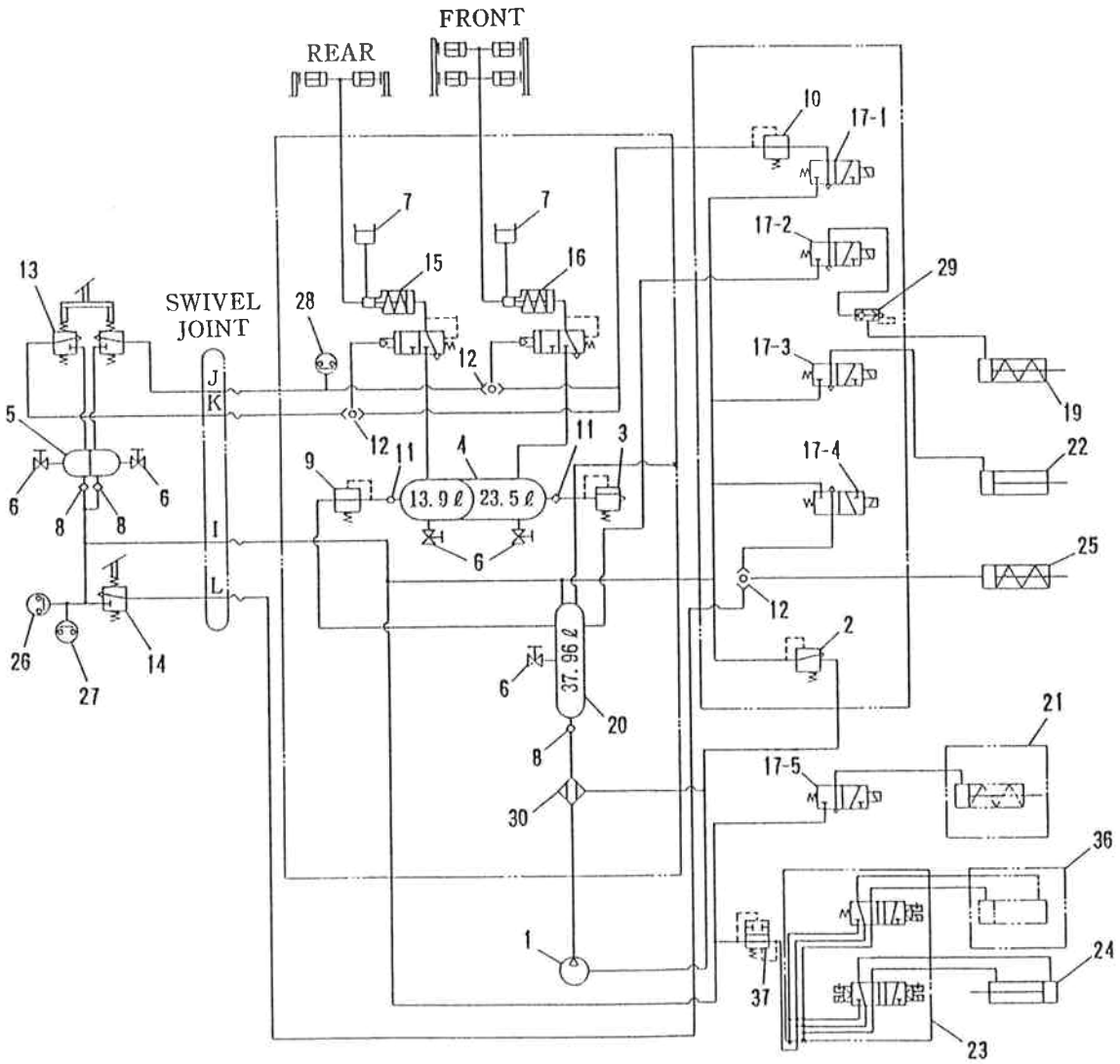


Fig. 3-1 Air System Schematic

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4. TROUBLESHOOTING

Follow this troubleshooting chart carefully to precisely grasp the nature of trouble and take suitable measures.

TROUBLE	POSSIBLE CAUSE	REMEDY
Braking force unstisfactory	Faulty brake	See Disc Brake Manual.
	Pad worn out	See Disc Brake Manual.
	Low air pressure	Repair air leakage.
		Repair or replace compressor.
		Replace governor.
		Replace safety valve.
	Brake fluid leaking	Replace or retighten hose and tubes.
	Low brake fluid level	Replenish.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.
	Faulty master cylinder	Repair or replace.
Brake slow to engage	Faulty brake	See Disc Brake Manual.
	Low air pressure	Repair air leakage.
		Repair or replace compressor.
		Replace governor.
		Replace safety valve.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.
Brake slow to release	Faulty brake	See Disc Brake Manual.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.

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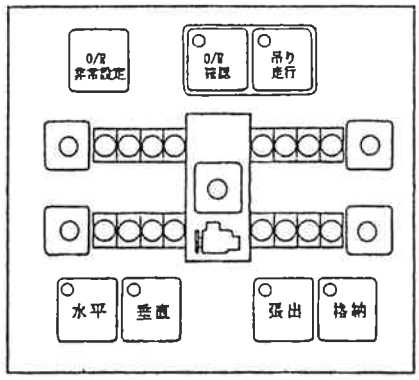
TROUBLE	POSSIBLE CAUSE	REMEDY
Brake ineffective	Extremely low air pressure	Raise air pressure.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.
	Extremely low brake fluid level	Replenish brake fluid.
Brake not released	Faulty brake	See Disc Brake Manual.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.
	Brake pedal stuck	Repair
	Pedal return spring broken	Replace.
Air pressure does not reach set level	Faulty pressure gauge	Replace.
	Air leakage from air system	Repair or parts replace.
	Drain cock is opened	Tighten.
	Faulty compressor	Repair or replace.
	Faulty air solenoid valve	Repair or replace.
	Faulty governor	Replace.
	Faulty air chamber	See Travel System Manual.
Brake not working smoothly	Faulty brake	See Disc Brake Manual.
	Faulty brake valve	Repair or replace.
	Faulty power cluster	Repair or replace.
	Low brake fluid level	Replenish.
	Air mixed in brake fluid	Bleed air.

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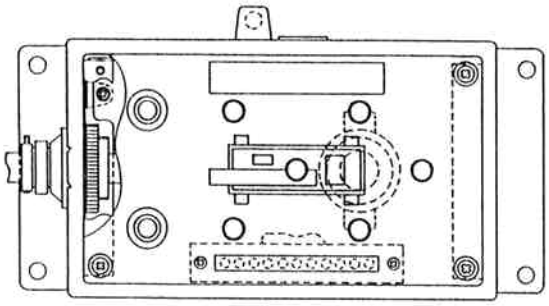
TROUBLE	POSSIBLE CAUSE	REMEDY
Air pressure rises slowly	Remarkable air leak	Repair.
	Low engine revolutions	Increase engine revolution.
	Leak from compressor discharge valve	Repair.
	Compressor piston ring worn out	Repair.
	Carbon stuck onto cylinder head or inside discharge line	Clean.
Pressure lowers quickly after stopping engine or at brake releasing operation	Air leakage from brake valve	Repair or replace.
	Air leakage from tube and hose	Repair or replace.
	Air leakage from compressor discharge valve	Repair or replace.
	Air leakage from governor	Repair.
Large quantity of oil or water mixed in the system	Insufficient drain	Drain daily.
	Much flow of oil coming from compressor	Repair or replace.
	Faulty air dryer	Repair or replace.
Safety valve whistles	Faulty safety valve	Replace.
	Excessively high air pressure	Replace air governor.
Air cylinder inoperative	Low air pressure	Check air system.
	Faulty air solenoid valve	Repair or replace.
	Faulty protection valve	Repair or replace.
	Faulty electrical system	See Electric System Manual.
Parking brake not released	Low air pressure	Check air system.
	Faulty air solenoid valve	Repair or replace.
	Faulty electrical system	See Electric System Manual.

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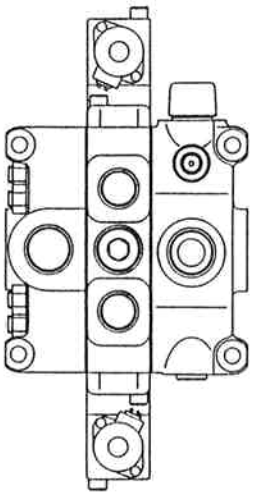
1. LOCATION OF COMPONENTS



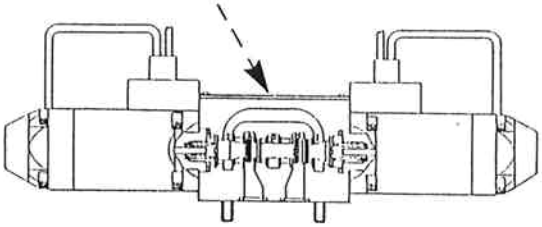
OUTRIGGER CONTROL SWITCHES
(IN THE OPERATOR'S ROOM)



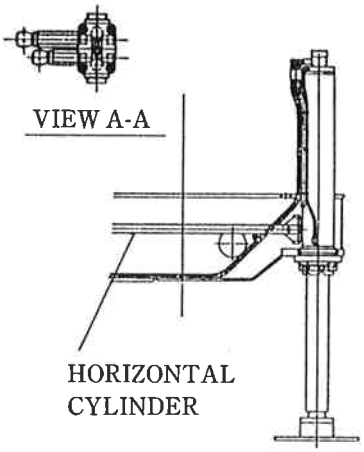
CARRIER SIDE CONTROL PANEL



CONTROL VALVE
(SOLENOID VALVE)



SOLENOID VALVE (VERTICAL / HORIZONTAL)



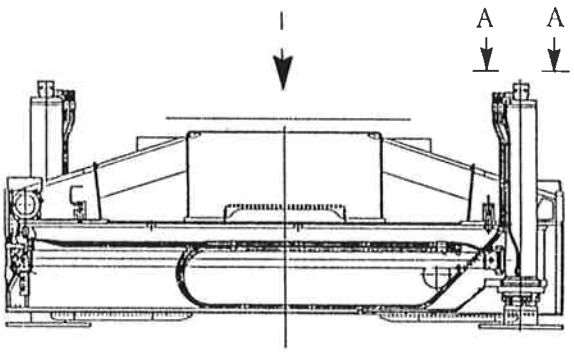


Fig. 1-1 Outrigger System and Components

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2. CONSTRUCTION AND FUNCTION

2.1 OUTRIGGER HYDRAULIC PIPING

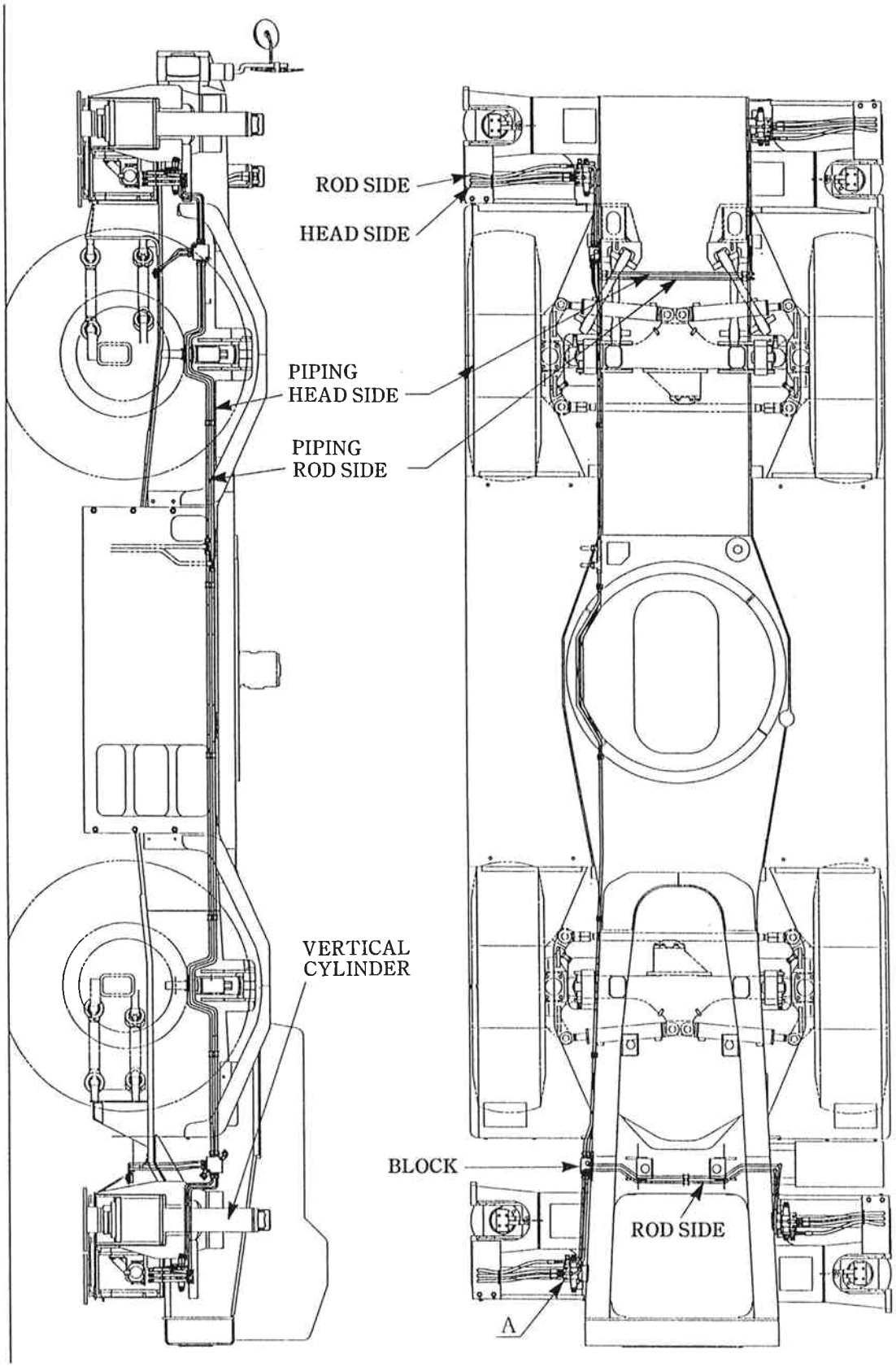


Fig. 2-1 Outrigger Hydraulic Piping Schematic (1 / 2)

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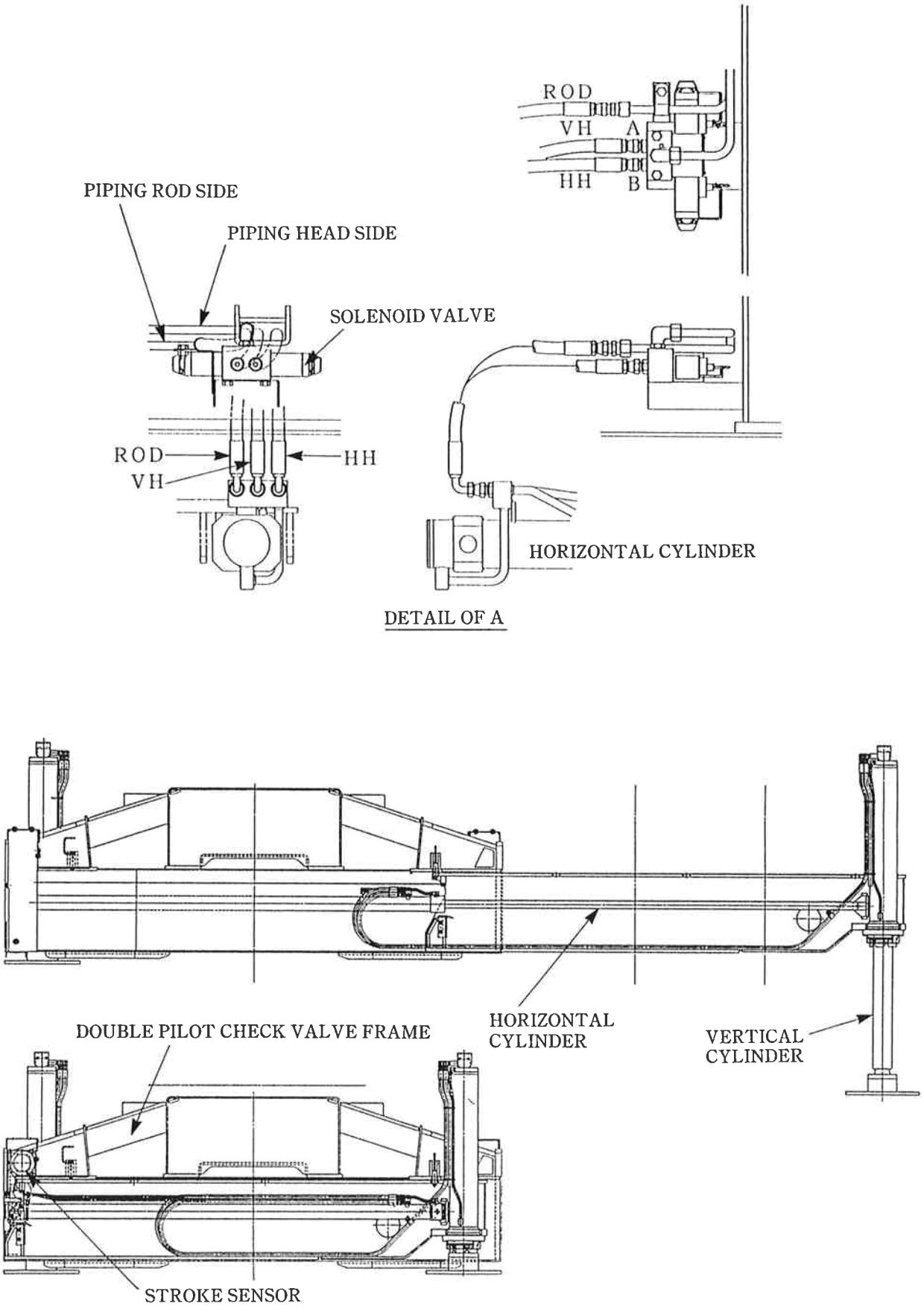


Fig. 2-2 Outrigger Hydraulic Piping Schematic (2 / 2)

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2.2 HYDRAULIC CIRCUIT

The hydraulic circuit on this machine is shown in Fig. 2-3. The selector switch for the vertical cylinders and horizontal cylinders, the selector switch for extension and retraction, the control switch for operating the all outriggers simultaneously, and the control switches for operating respectively the each outrigger in the front, rear, left and right sides of the carrier are provided respectively on the side control in the operator's cab and on the left side of the carrier.

When these switches are operated, the circuit is selected by function of the selector solenoid valve of the vertical cylinders / horizontal cylinders, and the spool is moved by pilot hydraulic pressure selected with the solenoid valve of extension / retraction, then the four outriggers are operated simultaneously or individually. Fig. 2-3 shows the circuit when the outrigger control switches are not operated.

The circuit pressure is usually at 175kg / cm² (2489 psi), but by pushing the O / R CONFIRM switch, the winch pressure raising valve operates to raise the circuit pressure to 260kg / cm² (3697 psi) (the highest pressure of winch circuit).

2.3 FUNCTION OF OUTRIGGERS

(a) Outriggers in Neutral (Fig. 2-3)

When the outrigger control switch is not operated, the spool is in the neutral position. At this time, pressurized oil delivered from the hydraulic pump passes through the spool of the outrigger control valve and the swivel joint, then flows into the winch (1st speed) circuit.

Therefore, the outriggers do not move.

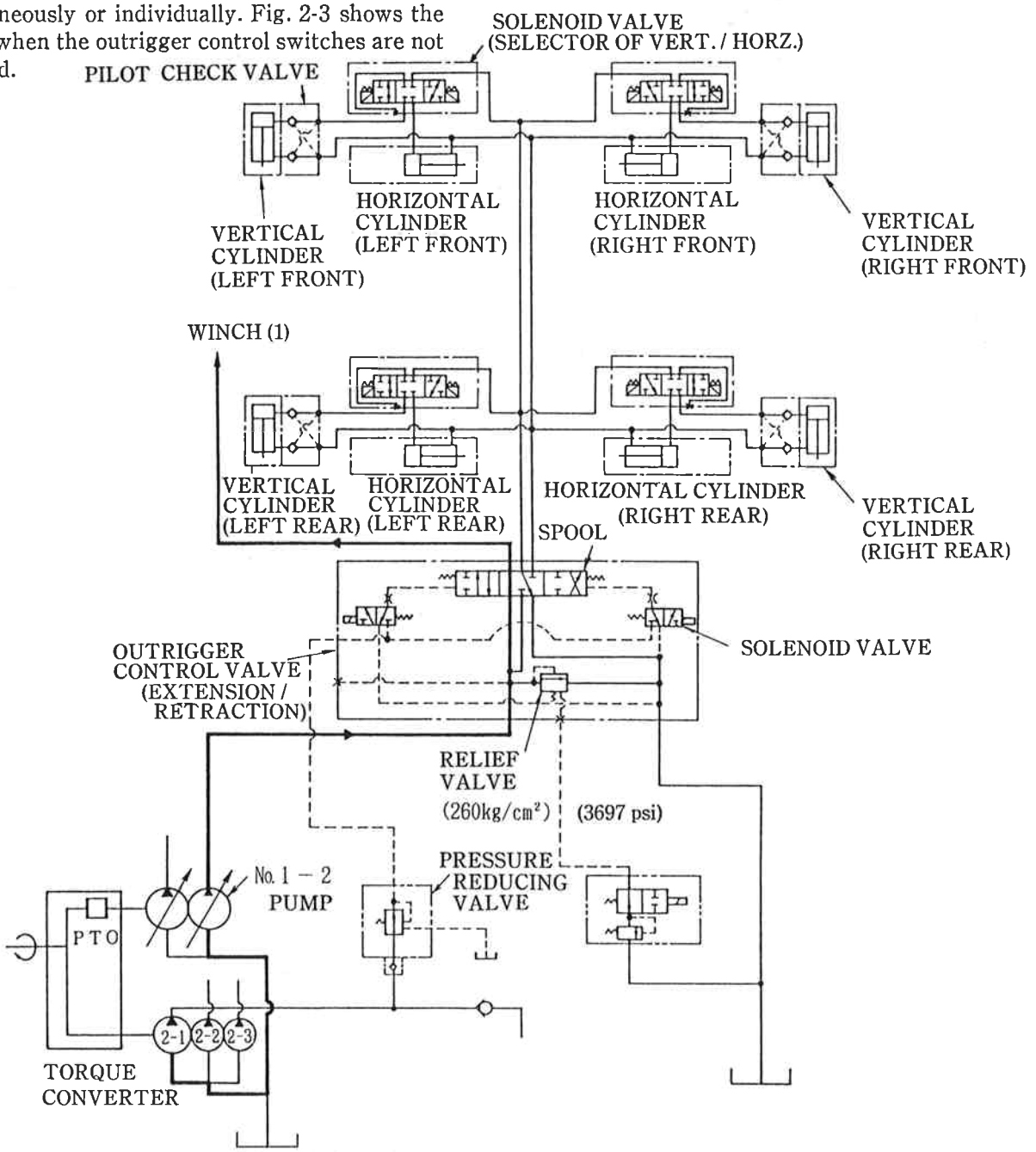


Fig. 2-3 Outrigger Hydraulic Circuit (Neutral)

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2.2 HYDRAULIC CIRCUIT

The hydraulic circuit on this machine is shown in Fig. 2-3. The selector switch for the vertical cylinders and horizontal cylinders, the selector switch for extension and retraction, the control switch for operating the all outriggers simultaneously, and the control switches for operating respectively the each outrigger in the front, rear, left and right sides of the carrier are provided respectively on the side control in the operator's cab and on the left side of the carrier.

When these switches are operated, the circuit is selected by function of the selector solenoid valve of the vertical cylinders / horizontal cylinders, and the spool is moved by pilot hydraulic pressure selected with the solenoid valve of extension / retraction, then the four outriggers are operated simultaneously or individually. Fig. 2-3 shows the circuit when the outrigger control switches are not operated.

The circuit pressure is usually at 175kg / cm² (2489 psi), but by pushing the O / R CONFIRM switch, the winch pressure raising valve operates to raise the circuit pressure to 260kg / cm² (3697 psi) (the highest pressure of winch circuit).

2.3 FUNCTION OF OUTRIGGERS

(a) Outriggers in Neutral (Fig. 2-3)

When the outrigger control switch is not operated, the spool is in the neutral position. At this time, pressurized oil delivered from the hydraulic pump passes through the spool of the outrigger control valve and the swivel joint, then flows into the winch (1st speed) circuit.

Therefore, the outriggers do not move.

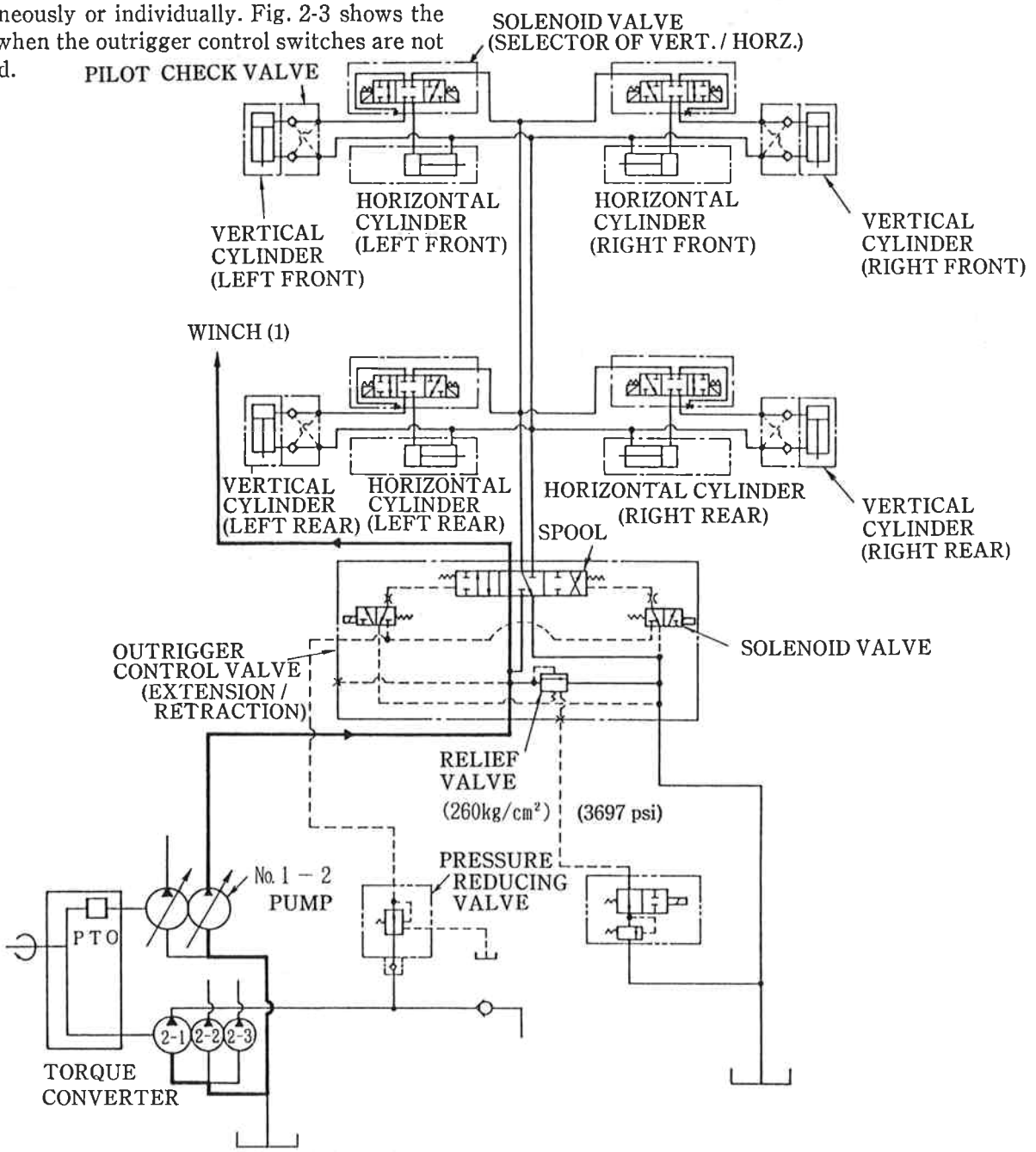


Fig. 2-3 Outrigger Hydraulic Circuit (Neutral)

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(b) Outrigger Horizontal Extension (Fig. 2-4)
Place the selector switch of the vertical cylinders / horizontal cylinders in the HORIZONTAL position, and the selector switch for extension / retraction in the Extension position. With this condition, when the outrigger control switch is operated, pressurized oil from the hydraulic pump passes through the extension side passage of the extension / retraction control valve spool and the horizontal cylinder side passage of the solenoid valve for selector of horizontal / vertical cylinders, then flows into the bottom side of the each horizontal cylinder to extend the horizontal cylinder, and to extend the outrigger beam connected to the horizontal cylinder.

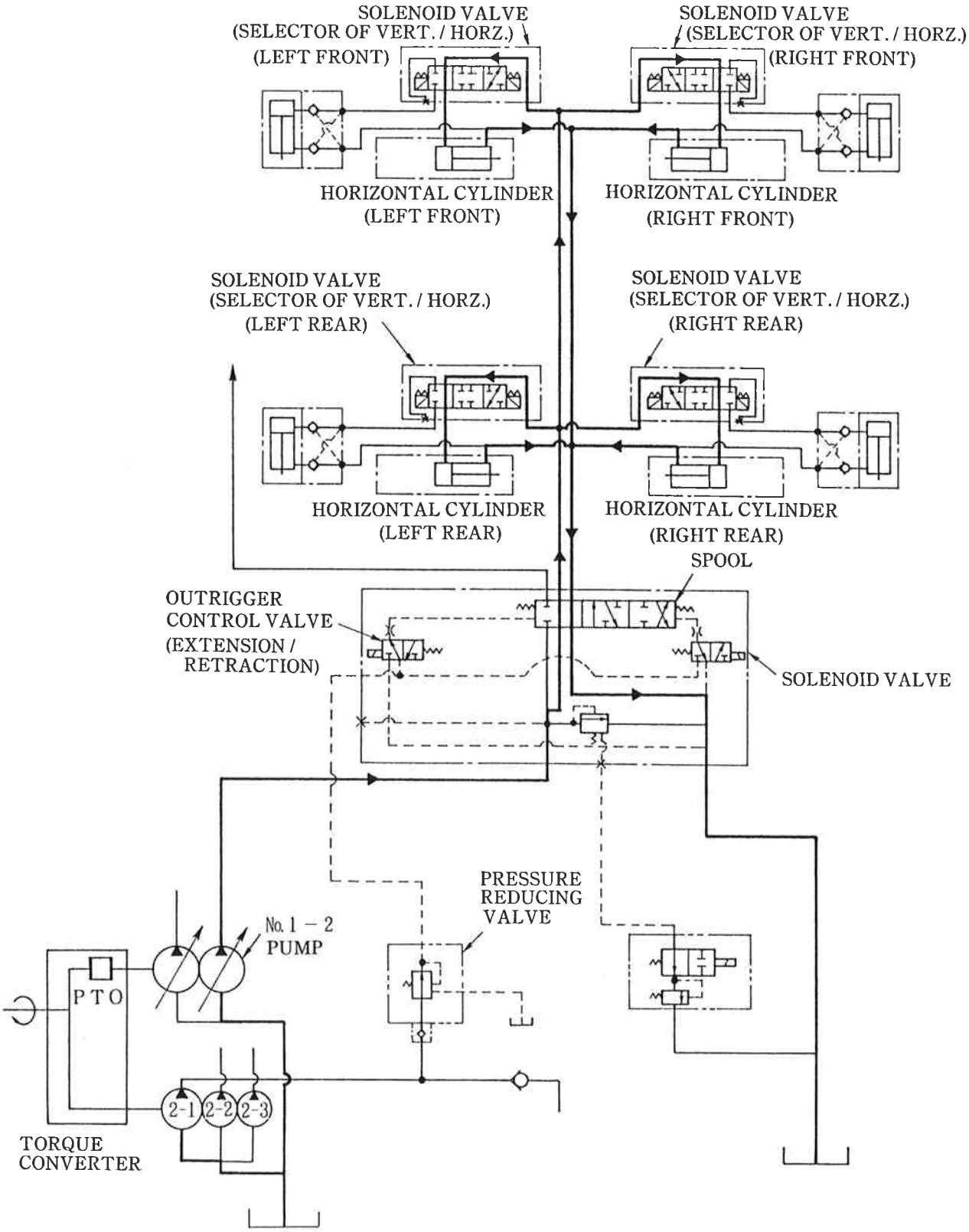


Fig. 2-4 Outrigger Hydraulic Circuit (Horizontal Extension)

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(c) Outrigger Horizontal Retraction (Fig. 2-5)
When the selector switch for extension / retraction is placed in the RETRACTION position with the selector switch of the horizontal / vertical cylinders placed in the HORIZONTAL position, the spool in the extension / retraction control valve moves in the opposite direction to extension to compose the reverse circuit of the extension circuit. Therefore, pressurized oil from the hydraulic pump is sent to the rod side of the horizontal cylinder to retract the horizontal cylinder and to retract the outrigger beam connected to the horizontal cylinder.

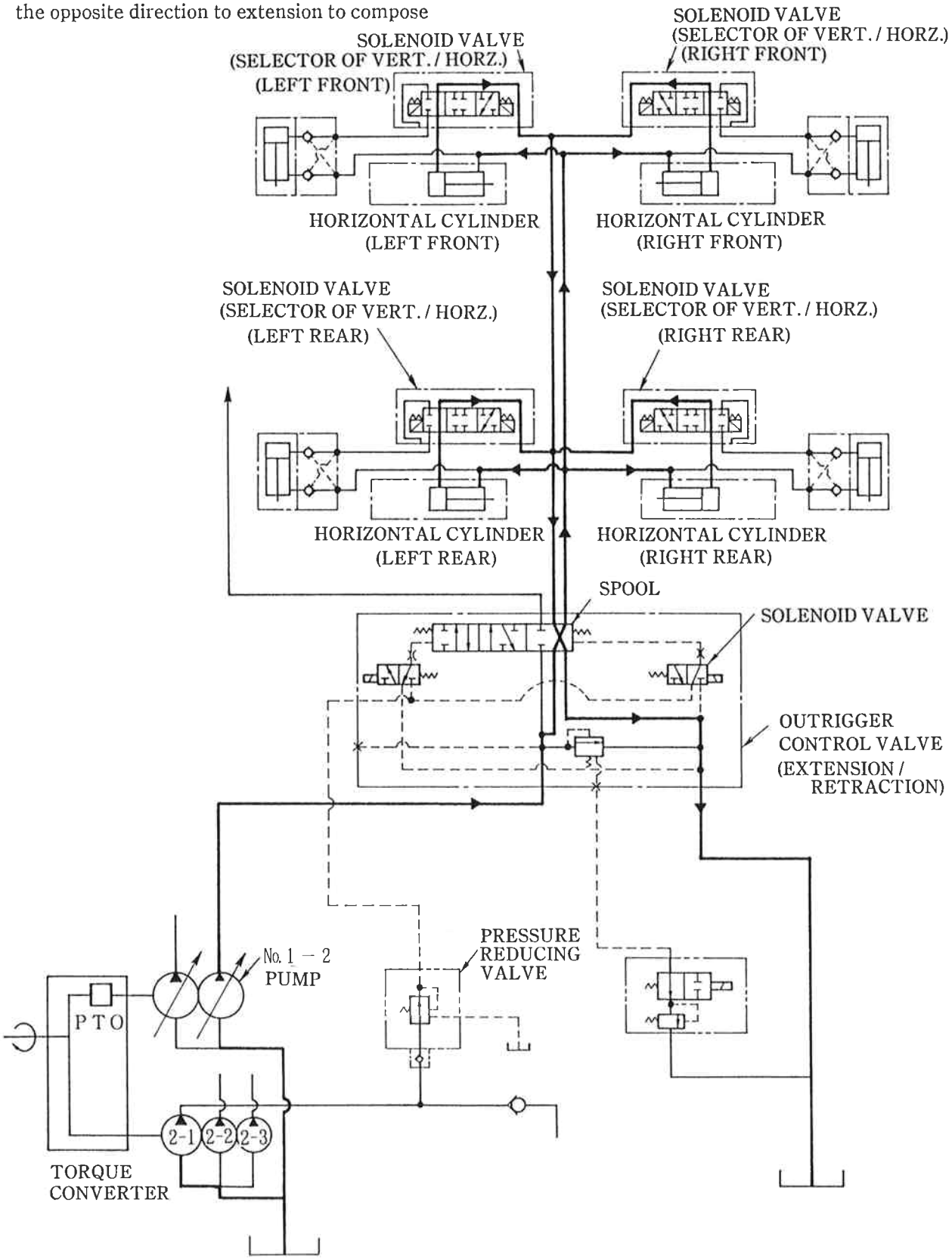


Fig. 2-5 Outrigger Hydraulic Circuit (Horizontal Retraction)

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(d) Outrigger Vertical Extension (Fig. 2-6)
Place the selector switch of the vertical / horizontal cylinders in the VERTICAL position and the selector switch for extension / retraction in the EXTENSION position. When the outrigger control switch is operated with this condition, pressurized oil from the hydraulic pump passes through the extension side passage of the extension / retraction control valve spool and the vertical cylinder side passage of the solenoid valve for selector of the horizontal / vertical cylinders, then passes through the check valve provided on the vertical cylinder and flows into the bottom side of the vertical cylinder to extend the vertical cylinder.
At this time, pressurized oil to the bottom side of the vertical cylinder also opens the pilot check valve on the rod side at the same time. Therefore, oil in the rod side passes the pilot check valve, and returns to the hydraulic oil tank via the spool of the control valve.
Pressurized oil in the vertical cylinder after extended is held with the check valve.

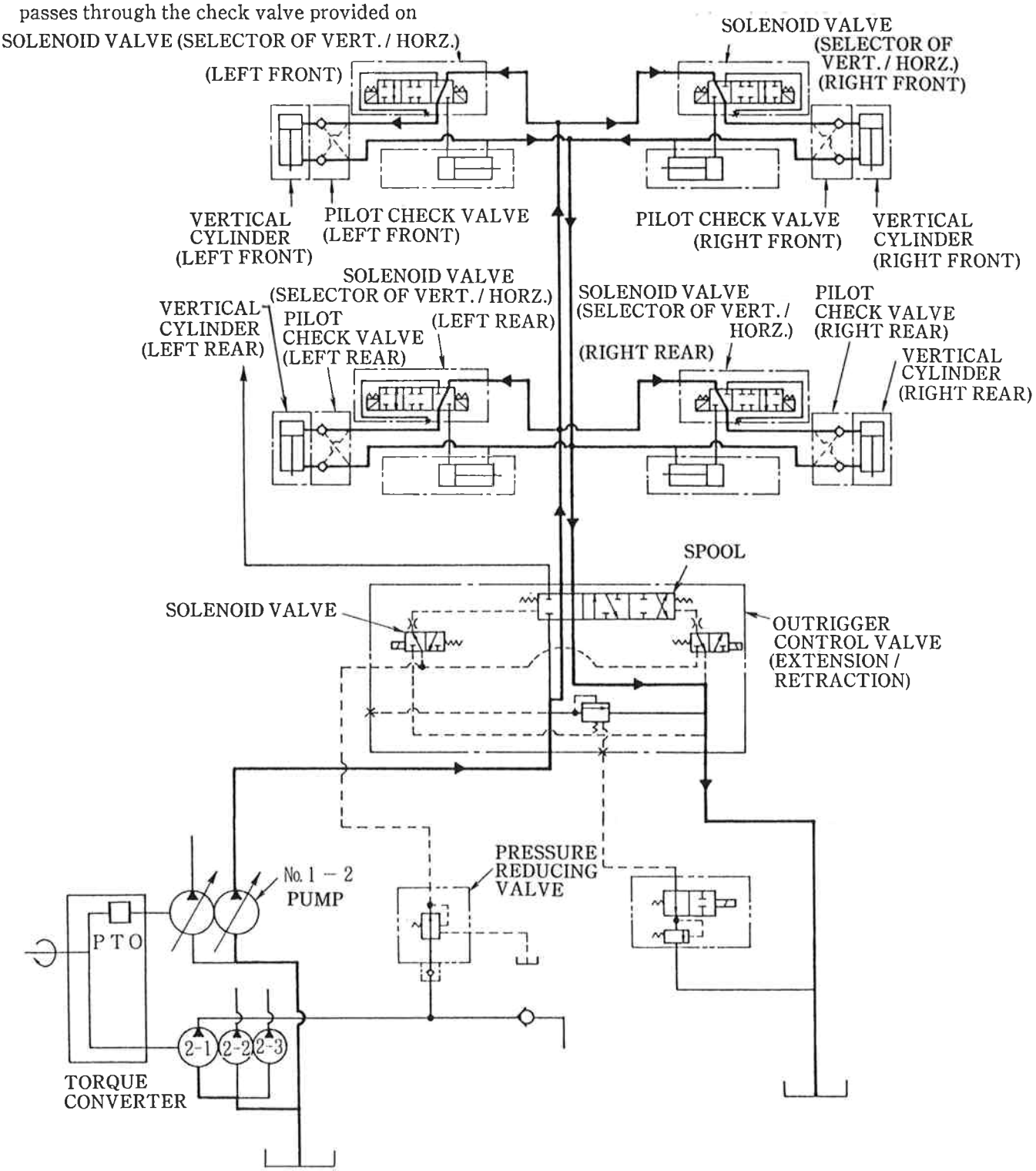


Fig. 2-6 Outrigger Hydraulic Circuit (Vertical Extension)

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(e) Outrigger Vertical Retraction (Fig. 2-7)
When the selector switch for extension / retraction is placed in the RETRACTION position with the selector switch of the vertical / horizontal cylinders placed in the VERTICAL position, the spool in the extension / retraction control valve is moved in the opposite direction to extension. Therefore, pressurized oil from the hydraulic pump passes through the check valve and flows into the rod side of the vertical cylinder to retract the vertical cylinder.
At this time, pressurized oil to the rod side of the vertical cylinder also opens the pilot check valve on the bottom side at the same time. So, oil in the bottom side passes through the pilot check valve, vertical cylinder side passage of the solenoid valve for the selector of vertical / horizontal cylinders, and returns to the hydraulic oil tank via the spool of the control valve.
Therefore, the vertical cylinder is retracted, causing the outrigger float to be raised.

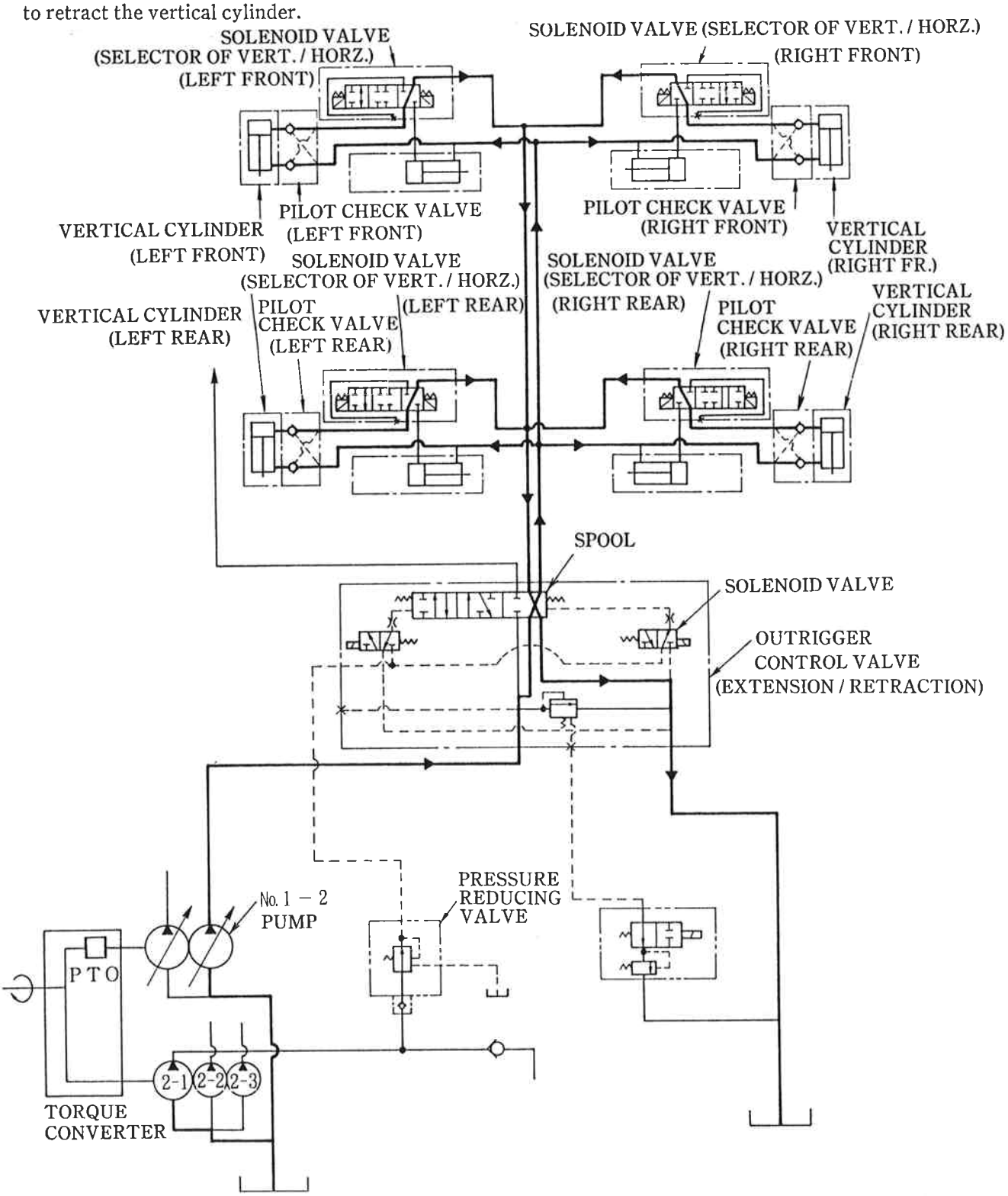


Fig. 2-7 Outrigger Hydraulic Circuit (Vertical Retraction)

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2. 4 OUTRIGGER ASSEMBLY

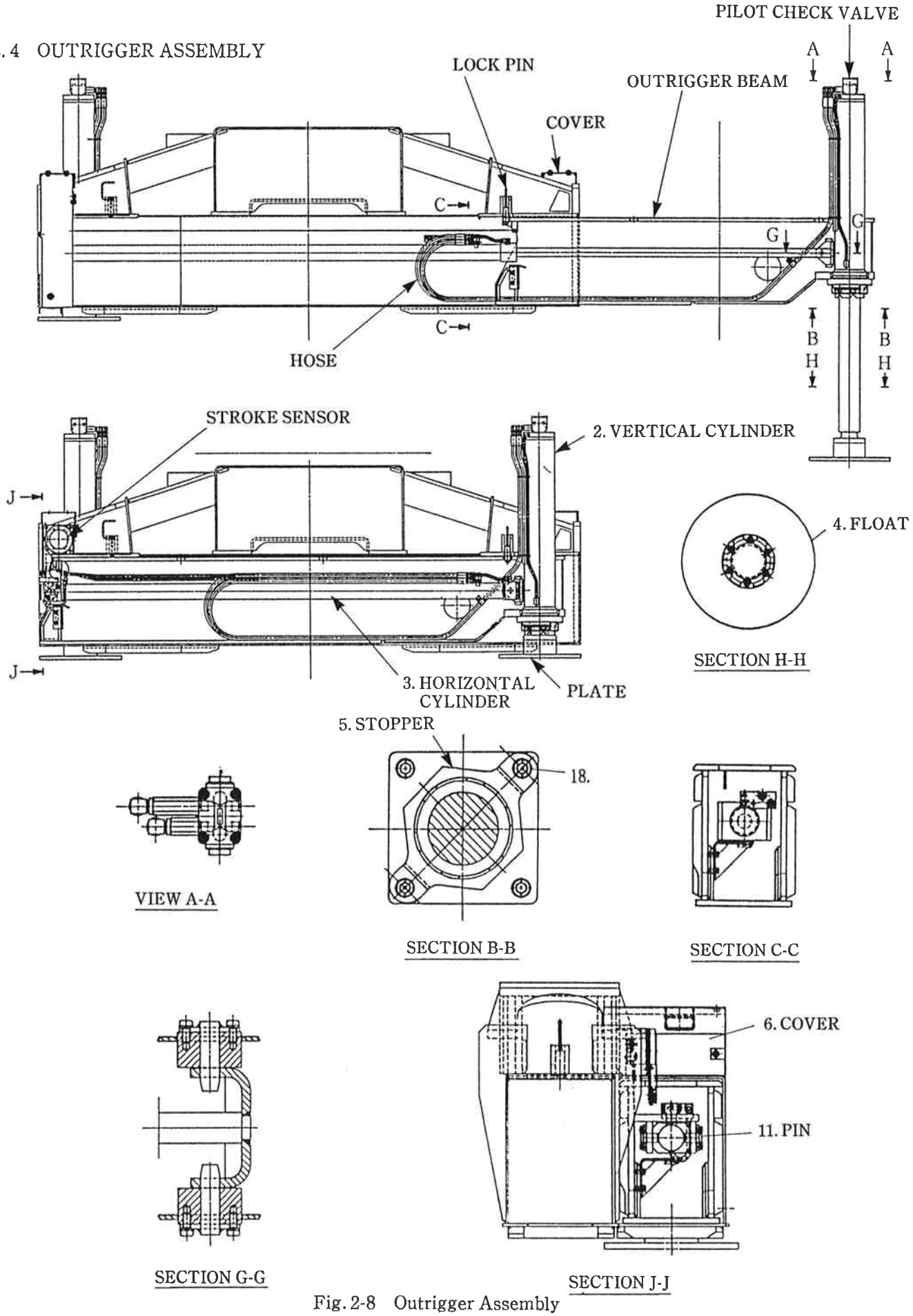
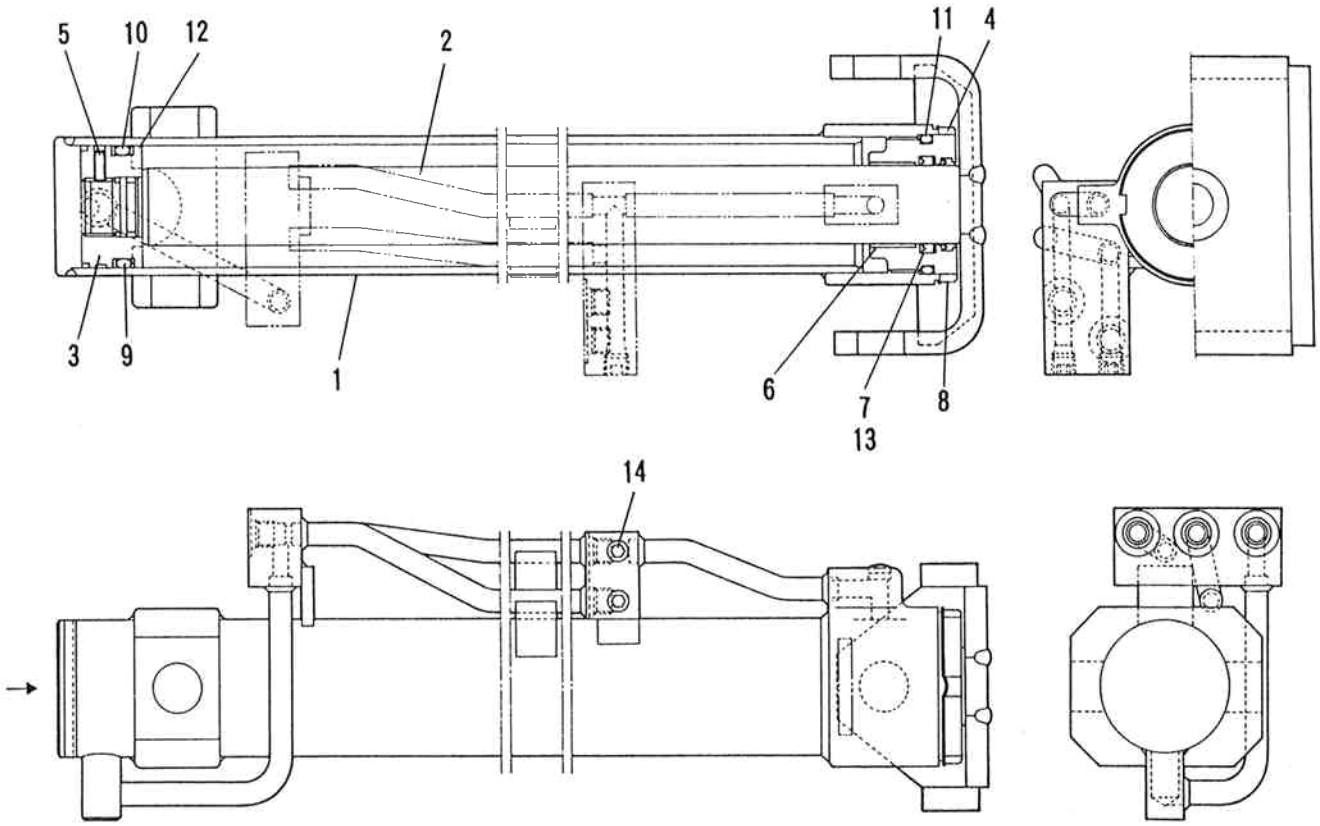


Fig. 2-8 Outrigger Assembly

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2.5 OUTRIGGER HORIZONTAL CYLINDER



1. CYLINDER TUBE
2. PISTON ROD
3. PISTON
4. ROD COVER
5. SET SCREW
6. DU BUSHING
7. ROD PACKING
8. DUST SEAL
9. O-RING
10. O-RING
11. O-RING
12. BACK-UP RING
13. BACK-UP RING
14. PLUG

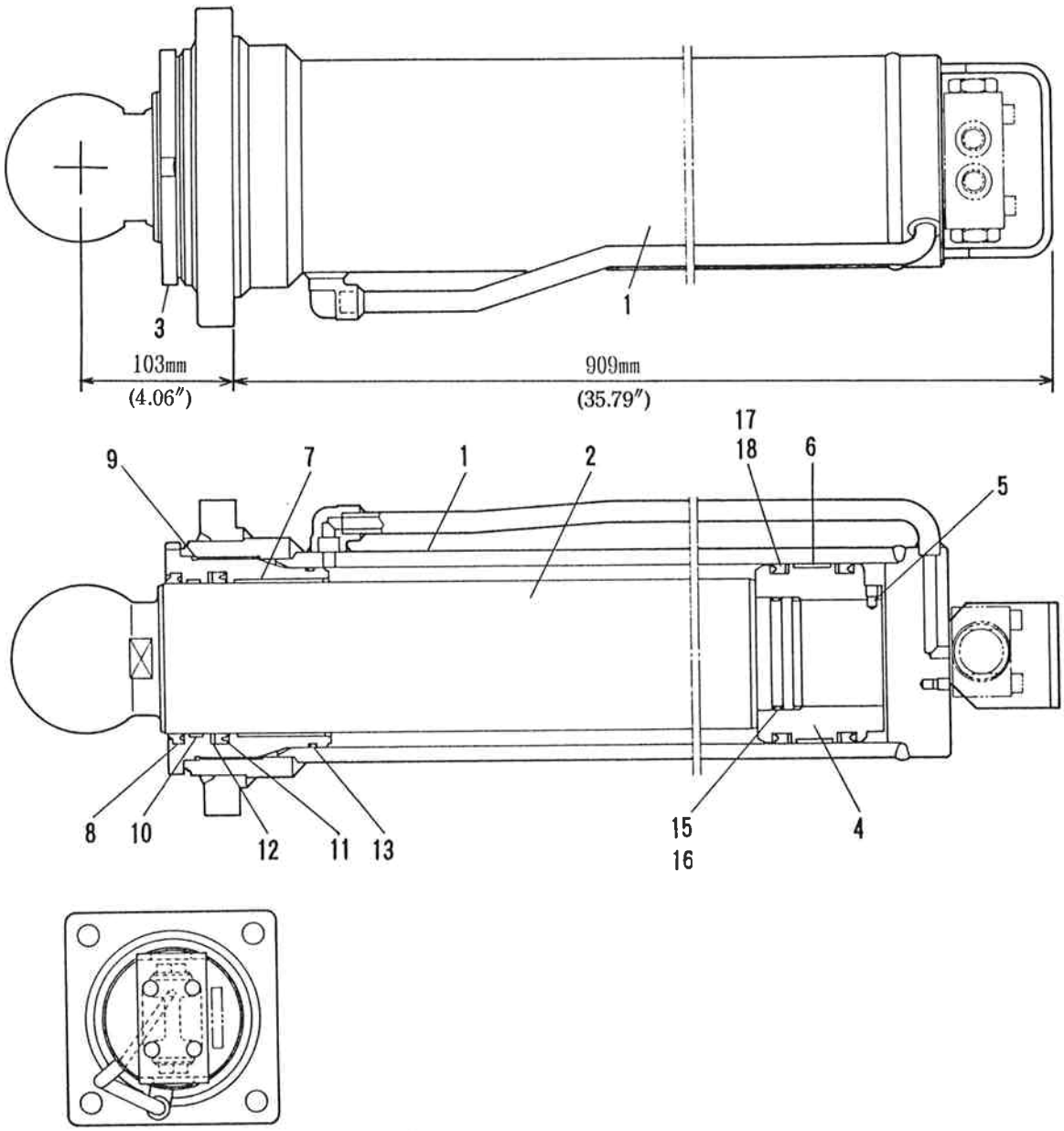
SPECIFICATIONS

Tube I. D.	(mm)	63 (2.48 inch)
Rod O. D.	(mm)	40 (1.575 inch)
Stroke	(mm)	2101 to 2105 (82.72 to 82.87 inch)
Cylinder cover tightening torque	(kg · m)	50 to 70 (361 to 506 ft-lbs)
Piston tightening torque	(kg · m)	18 to 22 (130 to 159 ft-lbs)
Weight (APPROX.)	(kg)	46 (101 lbs)

Fig. 2-9 Horizontal Cylinder

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2.6 OUTRIGGER VERTICAL CYLINDER



1. CYLINDER TUBE
2. PISTON ROD
3. ROD COVER
4. PISTON
5. SET SCREW
6. WEAR RING
7. DU BUSHING
8. DUST SEAL
9. O-RING
10. WEAR RING
11. ROD PACKING
12. BACK-UP RING
13. O-RING
15. O-RING
16. BACK-UP RING
17. PISTON PACKING
18. BACK-UP RING

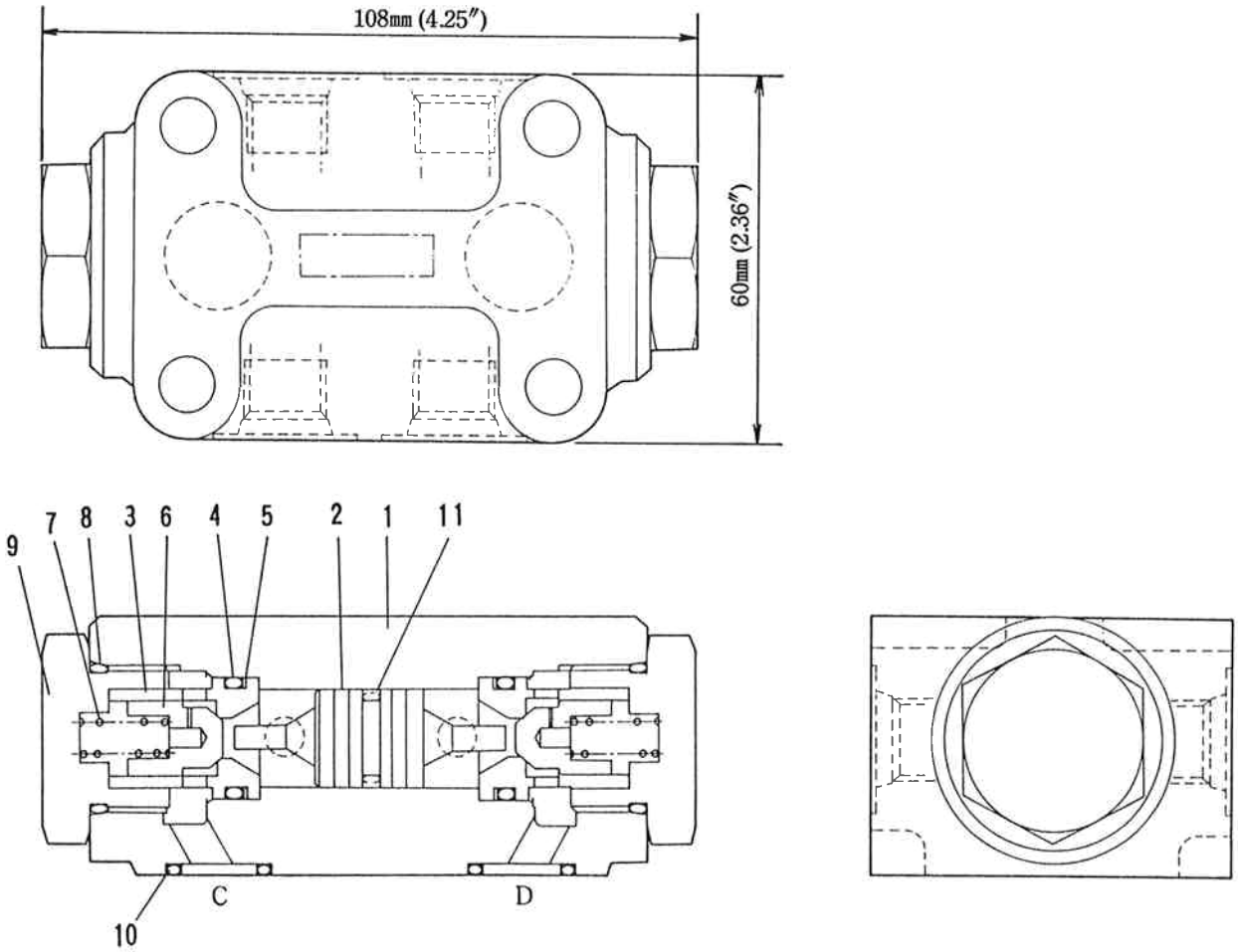
SPECIFICATIONS

Tube I. D.	120mm (4.72 inch)
Rod O. D.	100mm (3.94 inch)
Stroke	643±2mm (25.31±0.08 inch)
Cylinder cover tightening torque	78 to 106kg · m (563 to 766 ft-lbs)
Piston tightening torque	250 to 290kg · m (1806 to 2095 ft-lbs)
Weight (APPROX.)	99kg (218 lbs)

Fig. 2-10 Vertical Cylinder

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2.7 DOUBLE PILOT CHECK VALVE



1. BODY
2. PILOT PISTON
3. VALVE SEAT
4. O-RING
5. BACK-UP RING
6. CHECK VALVE
7. SPRING
8. O-RING
9. SPRING COVER
10. O-RING
11. CAP SEAL

SPECIFICATIONS

Max. operating pressure	400kg / cm² (5688 psi)
Cracking pressure	6kg / cm² (85 psi)
Pilot pressure	20% of main circuit pressure
Operating temperature range	-30 ~ +90° C (-22 to 194°F)
Oil to be used	Antiwear hydraulic oil

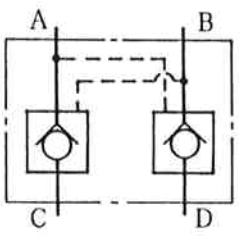


Fig. 2-11 Double Pilot Check Valve

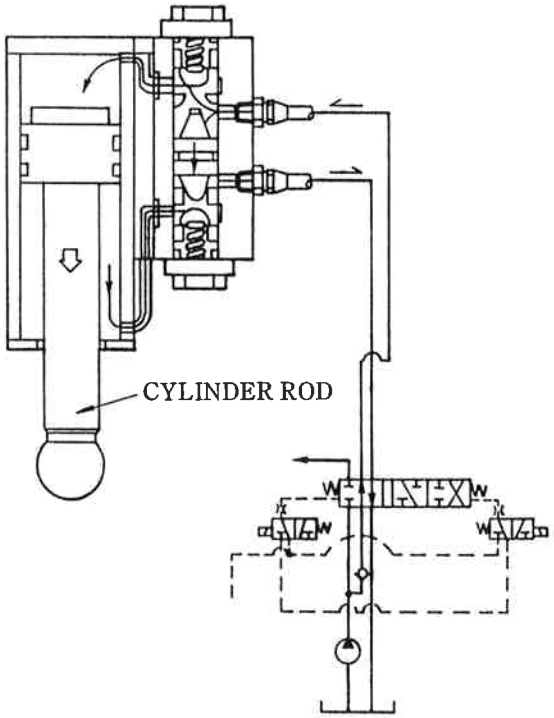
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One of these valves is attached to each vertical cylinder to prevent the cylinder from extending or retracting itself.

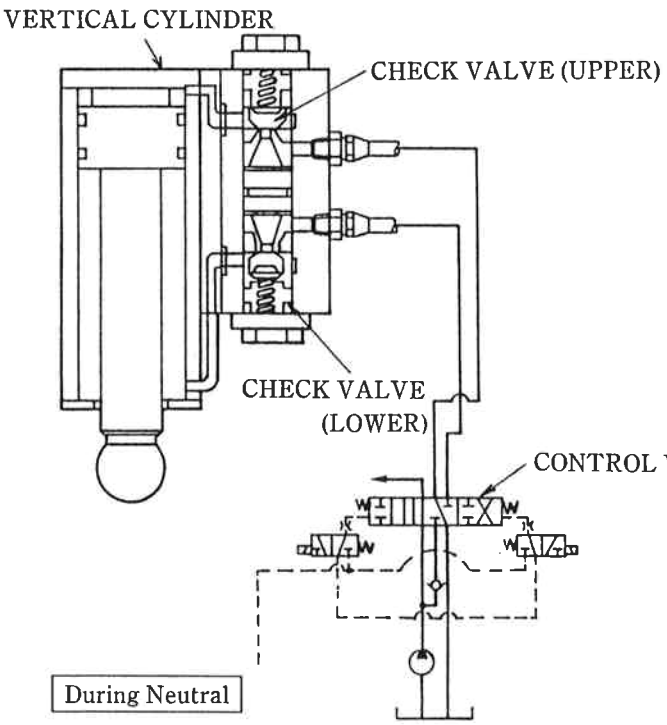
(1) VERTICAL CYLINDER IN NEUTRAL
Normally the vertical cylinder rod is immobilized by the check valve.

(2) VALVE FUNCTION DURING VERTICAL CYLINDER EXTENSION
Shifting the control valve causes the hydraulic oil flow to push open the upper check valve while simultaneously forcing the pilot piston to open the lower check valve. Oil enters the bottom side, extending the cylinder while the rod side oil exits through the lower check valve to return to the tank.

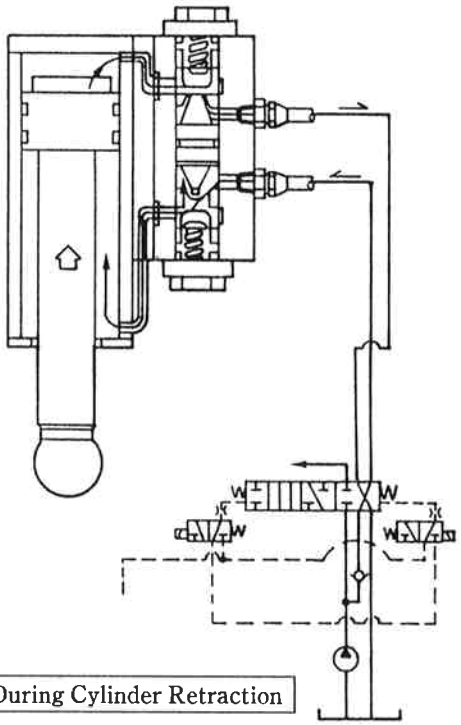
(3) VALVE FUNCTION DURING VERTICAL CYLINDER RETRACTION
This time shifting the control valve causes the hydraulic flow to push open the lower check valve while simultaneously forcing the pilot piston to open the upper check valve. Oil enters the rod side, retracting the cylinder while the bottom side oil exits through the upper check valve to return to the tank.



During Cylinder Extension



During Neutral



During Cylinder Retraction

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3. REMOVAL AND INSTALLATION

3.1 HORIZONTAL CYLINDER

(1) REMOVAL (Fig. 3-1)

① Stop the engine and remove the residual pressure in the hydraulic circuits and components by moving the control switch of the control valve back and forth several times. Remove lock pins (9).

② Remove covers (6 on 34).

③ Remove the three high pressure hoses installed on the rear side of the horizontal cylinder, and remove mounting pin (11).

④ Remove capscrew (15), and remove the wiring of the outrigger span detector from the beam.

⑤ Using a suitable crane, draw out the beam (1) and horizontal cylinder (3) at the same time.

⑥ Remove pin (10) located at the end of the beam, and remove the horizontal cylinder.

(2) INSTALLATION

To install the horizontal cylinder, proceed in the reverse order of REMOVAL.

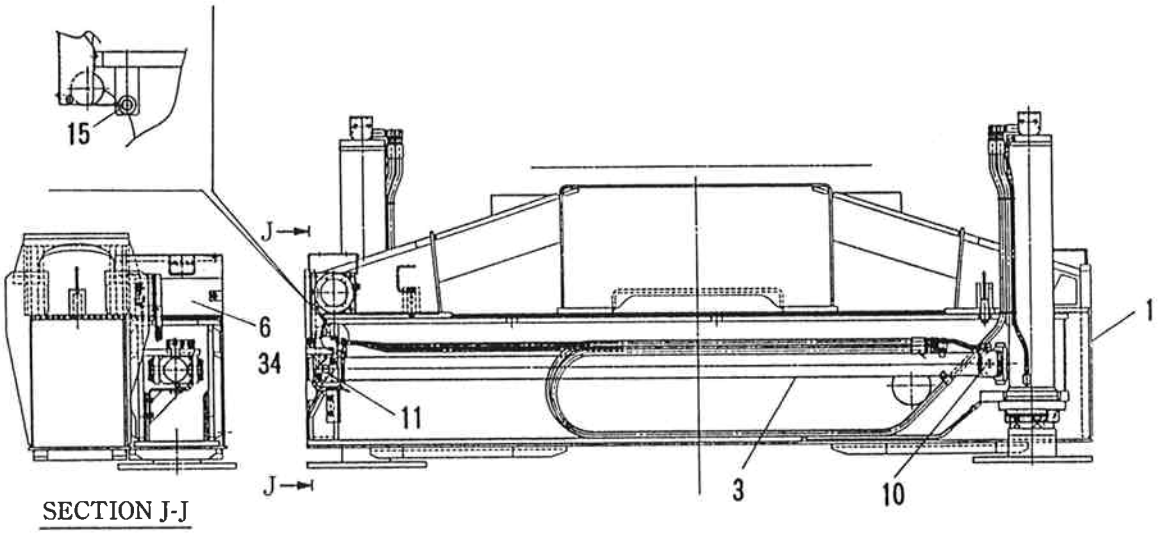


Fig. 3-1 Removal of Horizontal Cylinders

3.2 VERTICAL CYLINDER

(1) REMOVAL (Fig. 3-2)

① Operate vertical cylinder (2) to move float (4) approximately 400mm (15-3 / 4in).

② Stop the engine and move the control switch of the control valve back and forth several times to remove the residual pressure in the hydraulic circuits and components.

③ Remove hose assemblies (7), elbows (8) and connectors (25 and 26).

④ Using a suitable crane, hold the vertical cylinder. (Use the pilot check valve cover as a lifting ring.)

⑤ Remove capscrews (18), and remove stopper (5).

⑥ Lift the vertical cylinder with use of the crane, and remove it. At this time, pull out the vertical cylinder while turning the cylinder along the hole cut of the flange not to allow the vertical cylinder piping tube to interfere with the beam side flange hole.

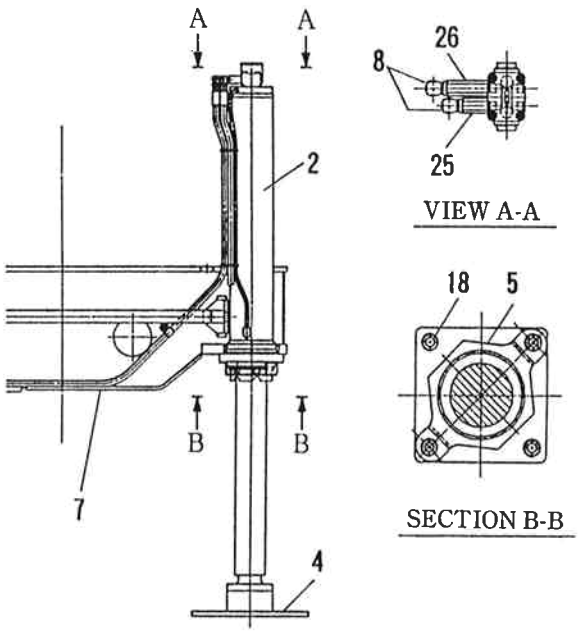


Fig. 3-2 Removal of Vertical Cylinders

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3. REMOVAL AND INSTALLATION

3.1 HORIZONTAL CYLINDER

(1) REMOVAL (Fig. 3-1)

① Stop the engine and remove the residual pressure in the hydraulic circuits and components by moving the control switch of the control valve back and forth several times. Remove lock pins (9).

② Remove covers (6 on 34).

③ Remove the three high pressure hoses installed on the rear side of the horizontal cylinder, and remove mounting pin (11).

④ Remove capscrew (15), and remove the wiring of the outrigger span detector from the beam.

⑤ Using a suitable crane, draw out the beam (1) and horizontal cylinder (3) at the same time.

⑥ Remove pin (10) located at the end of the beam, and remove the horizontal cylinder.

(2) INSTALLATION

To install the horizontal cylinder, proceed in the reverse order of REMOVAL.

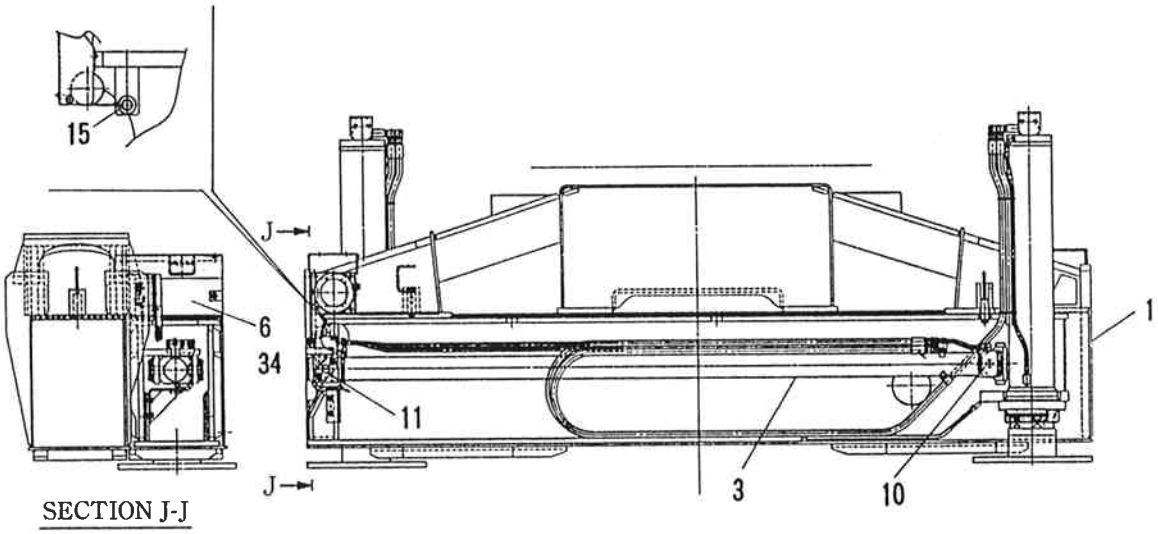


Fig. 3-1 Removal of Horizontal Cylinders

3.2 VERTICAL CYLINDER

(1) REMOVAL (Fig. 3-2)

① Operate vertical cylinder (2) to move float (4) approximately 400mm (15-3 / 4in).

② Stop the engine and move the control switch of the control valve back and forth several times to remove the residual pressure in the hydraulic circuits and components.

③ Remove hose assemblies (7), elbows (8) and connectors (25 and 26).

④ Using a suitable crane, hold the vertical cylinder. (Use the pilot check valve cover as a lifting ring.)

⑤ Remove capscrews (18), and remove stopper (5).

⑥ Lift the vertical cylinder with use of the crane, and remove it. At this time, pull out the vertical cylinder while turning the cylinder along the hole cut of the flange not to allow the vertical cylinder piping tube to interfere with the beam side flange hole.

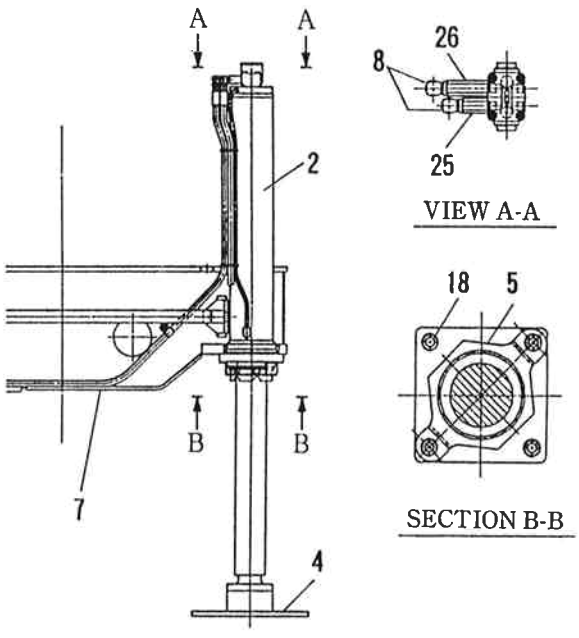


Fig. 3-2 Removal of Vertical Cylinders

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(2) INSTALLATION

To install the vertical cylinder, proceed in the reverse order of REMOVAL.

As the same as the removal, lift and install the vertical cylinder while turning it along the hole cut of the flange.

3.3 DOUBLE PILOT CHECK VALVE

(1) REMOVAL

① Operate the vertical cylinder until the outrigger float touches the ground.

② Stop the engine and place the select switch of the control valve in vertical position releasing the residual pressure in the hydraulic circuits and components.

③ Remove the two hoses, elbows (8) and connectors (25 and 26). At this time, tape the hoses to distinguish between the bottom side and rod side.

④ Remove the four bolts holding the double pilot check valve.

(2) INSTALLATION

① Be sure that the mating surfaces of the cylinder and valve are thoroughly clean.

② Being carefull not to allow the O-ring on the valve mounting surface to be crowded out, tighten the mounting bolts to install the valve.

③ Install the two hoses not to mistake the bottom side for the rod side.

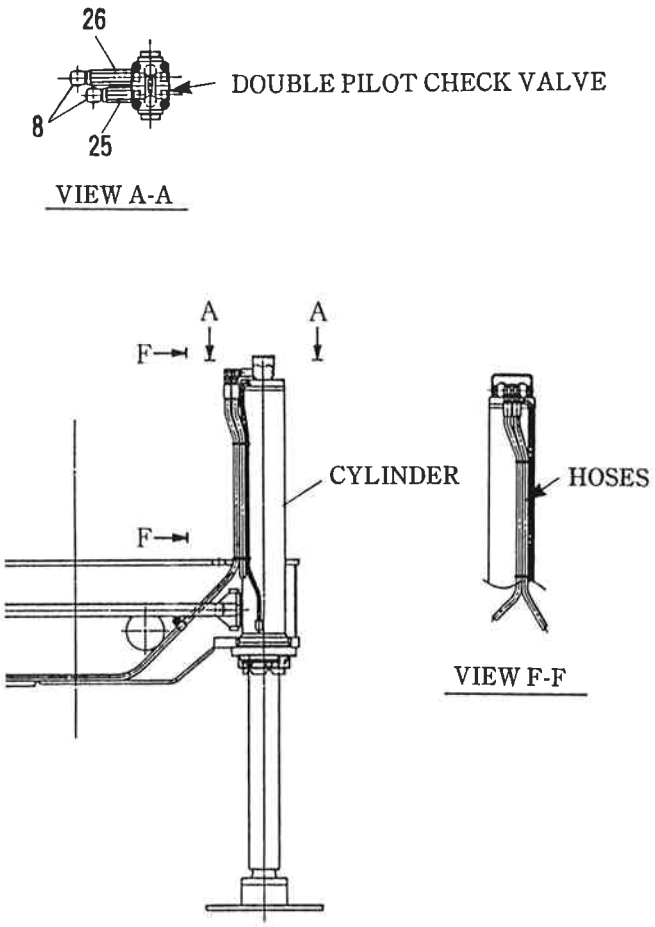


Fig. 3-3 Removal of Double Pilot Check Valve

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(2) INSTALLATION

To install the vertical cylinder, proceed in the reverse order of REMOVAL.

As the same as the removal, lift and install the vertical cylinder while turning it along the hole cut of the flange.

3.3 DOUBLE PILOT CHECK VALVE

(1) REMOVAL

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② Stop the engine and place the select switch of the control valve in vertical position releasing the residual pressure in the hydraulic circuits and components.

③ Remove the two hoses, elbows (8) and connectors (25 and 26). At this time, tape the hoses to distinguish between the bottom side and rod side.

④ Remove the four bolts holding the double pilot check valve.

(2) INSTALLATION

① Be sure that the mating surfaces of the cylinder and valve are thoroughly clean.

② Being carefull not to allow the O-ring on the valve mounting surface to be crowded out, tighten the mounting bolts to install the valve.

③ Install the two hoses not to mistake the bottom side for the rod side.

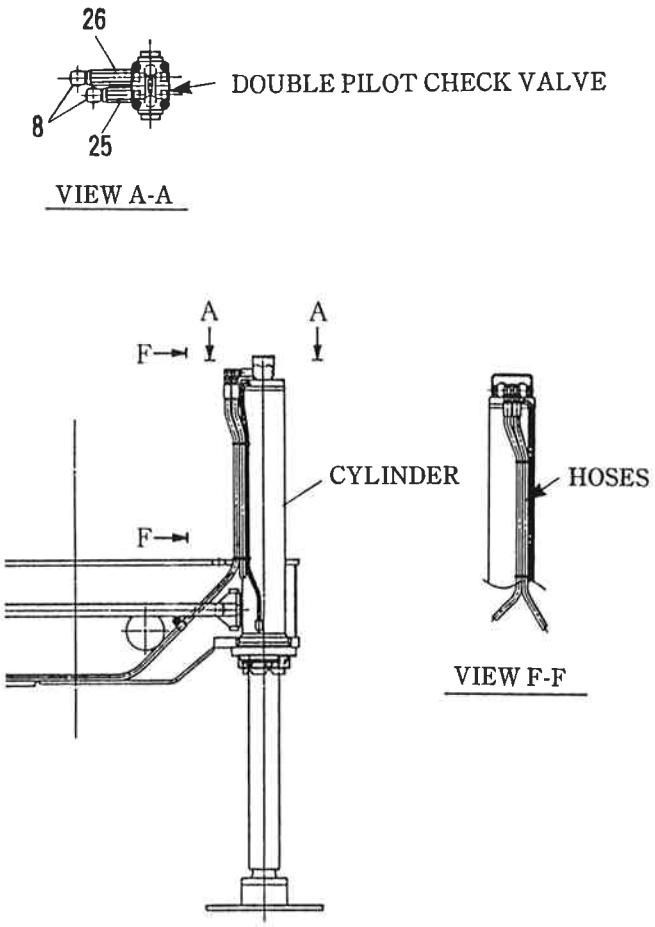


Fig. 3-3 Removal of Double Pilot Check Valve

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4. DISASSEMBLY AND ASSEMBLY

4.1 OUTRIGGER ASSEMBLY

(1) Precautions during assembly

① Apply grease which contains molybdenum disulphide to each pin before assembling.

② Coat Locktite #242 or equivalent to the capscrews which secure the cylinder tube flange and the stopper of the vertical cylinder to the outrigger beam, then tighten them with a torque of 41 to 51kg · m (296 to 368ft-lbs) (see Fig. 4-1).

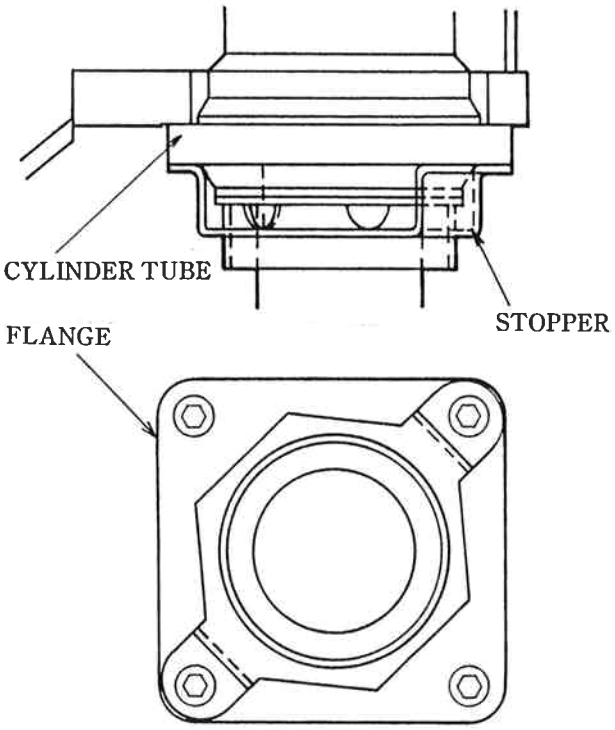


Fig. 4-1 Installation of Vertical Cylinder

③ Install the outrigger float. Tighten the capscrews, which secure the float retainer to the float, with a torque of 6.5 to 7.9kg · m (47 to 57 ft-lbs) after applying Locktite #242 (see Fig. 4-2).

Fill grease which contains molybdenum disulphide through the grease fitting.

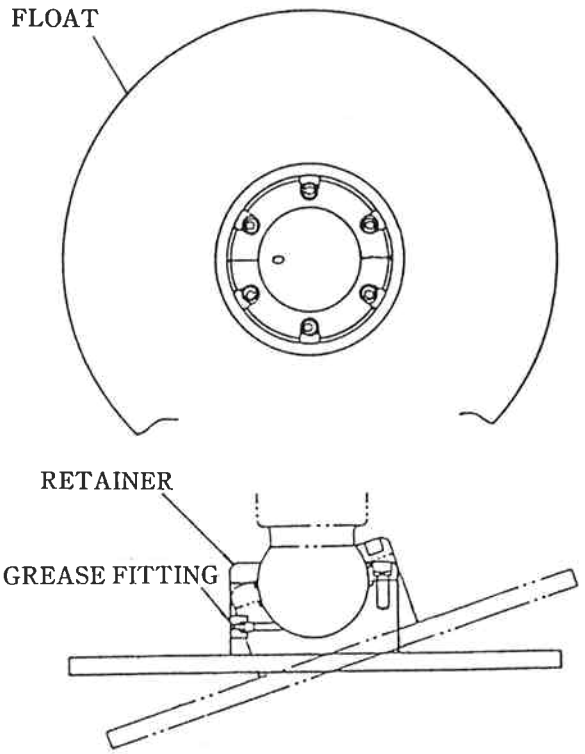


Fig. 4-2 Installation of Float

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4.2 DOUBLE PILOT CHECK VALVE

(1) DISASSEMBLY

1. By removing spring cover (9), spring (7), check valve (6), valve seat (3), and pilot valve (2) can be removed respectively together with the each O-ring.
2. Clean the all removed parts carefully, and arrange them on a clean place.

(2) ASSEMBLY

Reassemble by reversing the order of disassembly.

However, pay attention to the following points during assembly.

1. Apply a little grease to the O-rings before installing them and be sure that the back-up ring (5) is seated properly.
2. Make sure that the pilot valve and check valve slide smoothly before installing them.
3. Tighten the spring cover with 5kg · m (36 ft-lbs) of torque.

1. BODY
2. PILOT PISTON
3. VALVE SEAT
4. O-RING
5. BACK-UP RING
6. CHECK VALVE
7. SPRING
8. O-RING
9. SPRING COVER
10. O-RING
11. CAP SEAL

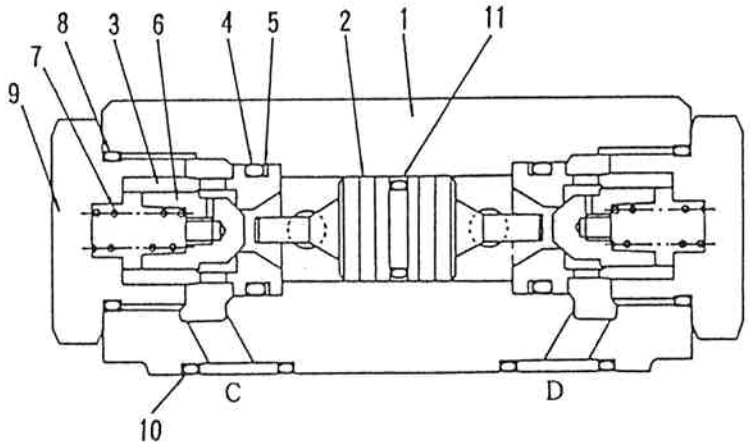


Fig. 4-3 Double Pilot Check Valve

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5. MAINTENANCE STANDARDS

5.1 ASSEMBLY STANDARDS

5.1.1 Tightening Torque for Nuts and Bolts (See Fig. 5-1)

Unit : kg · m (ft-lb)

Item No.	Name	Standard Value	Remarks
15	Sems bolt	0.52±0.05 (3.76±0.36)	Without lubrication.
16	Sems bolt	2.5±0.3 (18.1±2.2)	
17	Sems bolt	4.6±0.5 (33.2±3.6)	Apply Locktite #242
18	Capscrew	46±5 (332±36)	
19	Capscrew	3.6±0.4 (26.0±2.9)	
30	Sems bolt	2.5±0.3 (18.1±2.2)	Without lubrication.
37	Capscrew	0.52±0.05 (3.76±0.36)	

5.2 COMPONENT REPLACEMENT STANDARDS.

5.1.2 Pin (See Fig. 5-1)

Unit : mm (inch)

Item No.	Name	Standard Value		Limit of Wear	Remedy
		Inside dia.	Outside diameter		
9	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	Replace with a new one
10	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	
11	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	

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5. MAINTENANCE STANDARDS

5.1 ASSEMBLY STANDARDS

5.1.1 Tightening Torque for Nuts and Bolts (See Fig. 5-1)

Unit : kg · m (ft-lb)

Item No.	Name	Standard Value	Remarks
15	Sems bolt	0.52±0.05 (3.76±0.36)	Without lubrication.
16	Sems bolt	2.5±0.3 (18.1±2.2)	
17	Sems bolt	4.6±0.5 (33.2±3.6)	Apply Locktite #242
18	Capscrew	46±5 (332±36)	
19	Capscrew	3.6±0.4 (26.0±2.9)	
30	Sems bolt	2.5±0.3 (18.1±2.2)	Without lubrication.
37	Capscrew	0.52±0.05 (3.76±0.36)	

5.2 COMPONENT REPLACEMENT STANDARDS.

5.1.2 Pin (See Fig. 5-1)

Unit : mm (inch)

Item No.	Name	Standard Value		Limit of Wear	Remedy
		Inside dia.	Outside diameter		
9	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	Replace with a new one
10	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	
11	Pin		$25\ {}^{0}_{-0.033}(0.984\ {}^{0}_{-0.0013})$	24.5 (0.965)	

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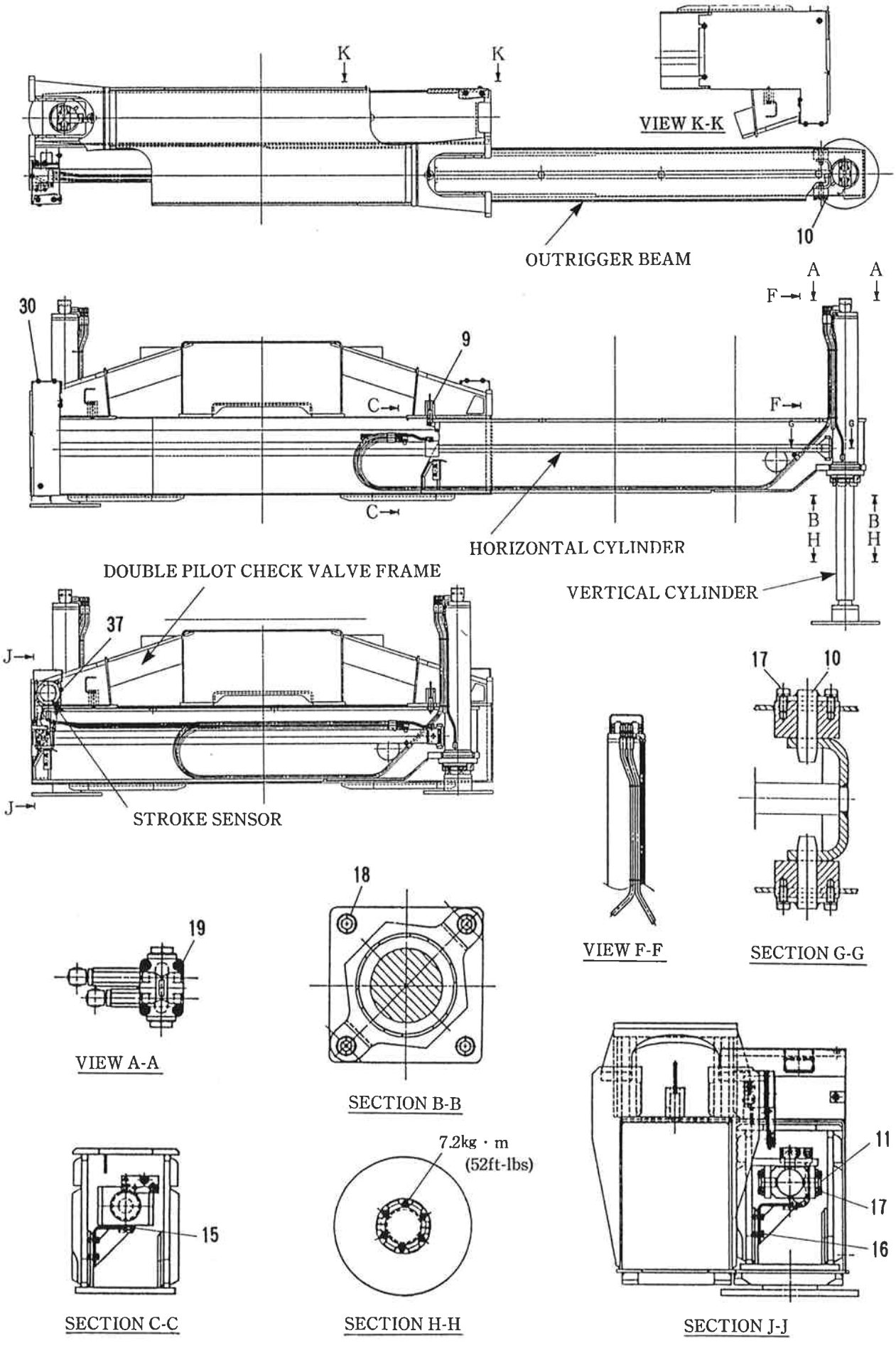


Fig. 5-1 Outrigger Assembly

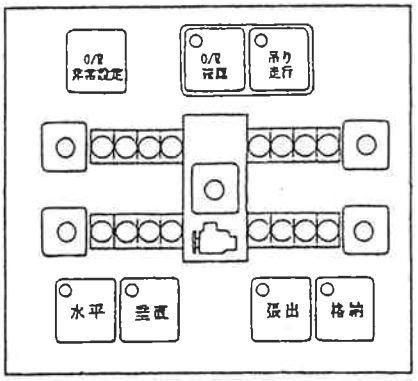
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6. TROUBLESHOOTING

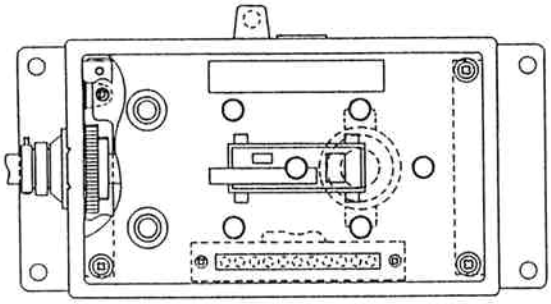
TROUBLE	CAUSE	REMEDY
1 Outriggers do not function.	1 Solenoid valve malfunction	1 Check electric wiring. Replace valve.
	2 Relief valve malfunction	2 Repair or adjust relief valve.
	3 No output from pump	3 Check pump.
2 Outriggers function too slowly.	1 No output from pump	1 Repair or replace No. 1-2 pump.
	2 Relief valve set pressure too low	2 Adjust or repair relief valve.
	3 Leaking inside cylinder	3 Disassemble and repair cylinder.
3 Outrigger beams extend during machine travel.	1 Internal leak from rod side to bottom side in horizontal cylinder	1 Disassemble and repair cylinder.
	2 Leak in horizontal / vertical valve spool	2 Replace valve.
4 Vertical cylinder retracts during machine operation.	1 Leak into vertical cylinder rod side from bottom side	1 Disassemble and repair cylinder.
	2 Internal leak in double pilot check valve	2 Disassemble check valve ; repair or replace as required.

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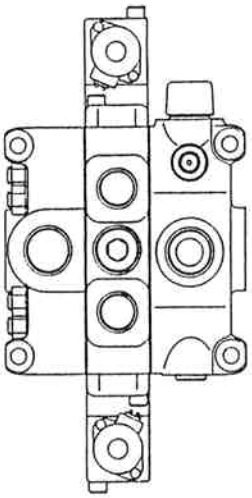
1. LOCATION OF COMPONENTS



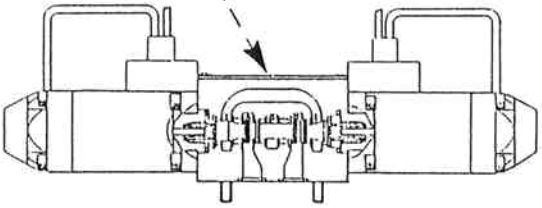
OUTRIGGER CONTROL SWITCHES
(IN THE OPERATOR'S ROOM)



CARRIER SIDE CONTROL PANEL



CONTROL VALVE
(SOLENOID VALVE)



SOLENOID VALVE (VERTICAL / HORIZONTAL)

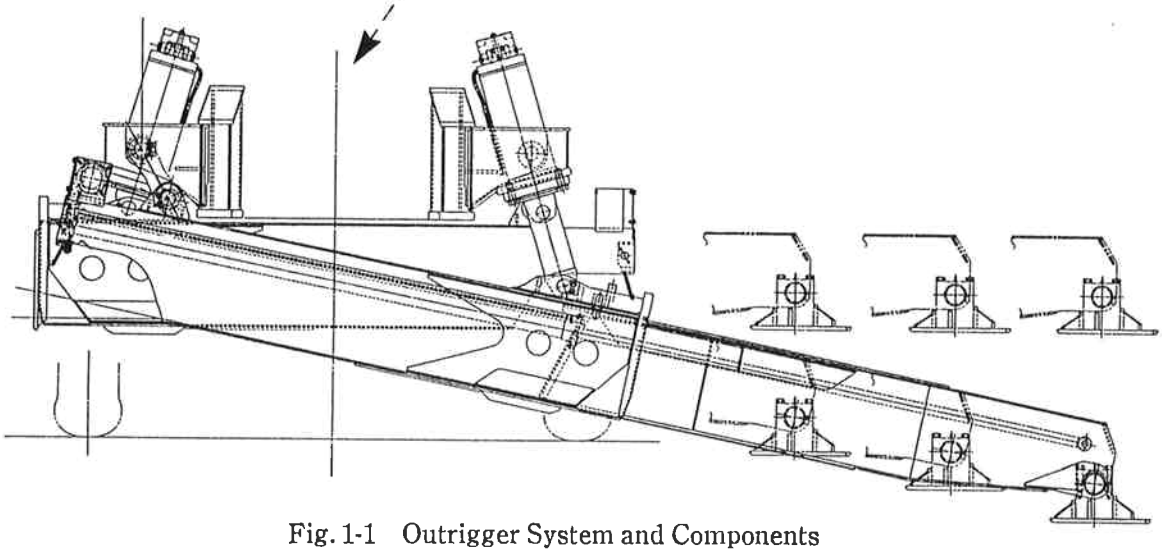


Fig. 1-1 Outrigger System and Components

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2. CONSTRUCTION AND FUNCTION

2.1 OUTRIGGER HYDRAULIC PIPING

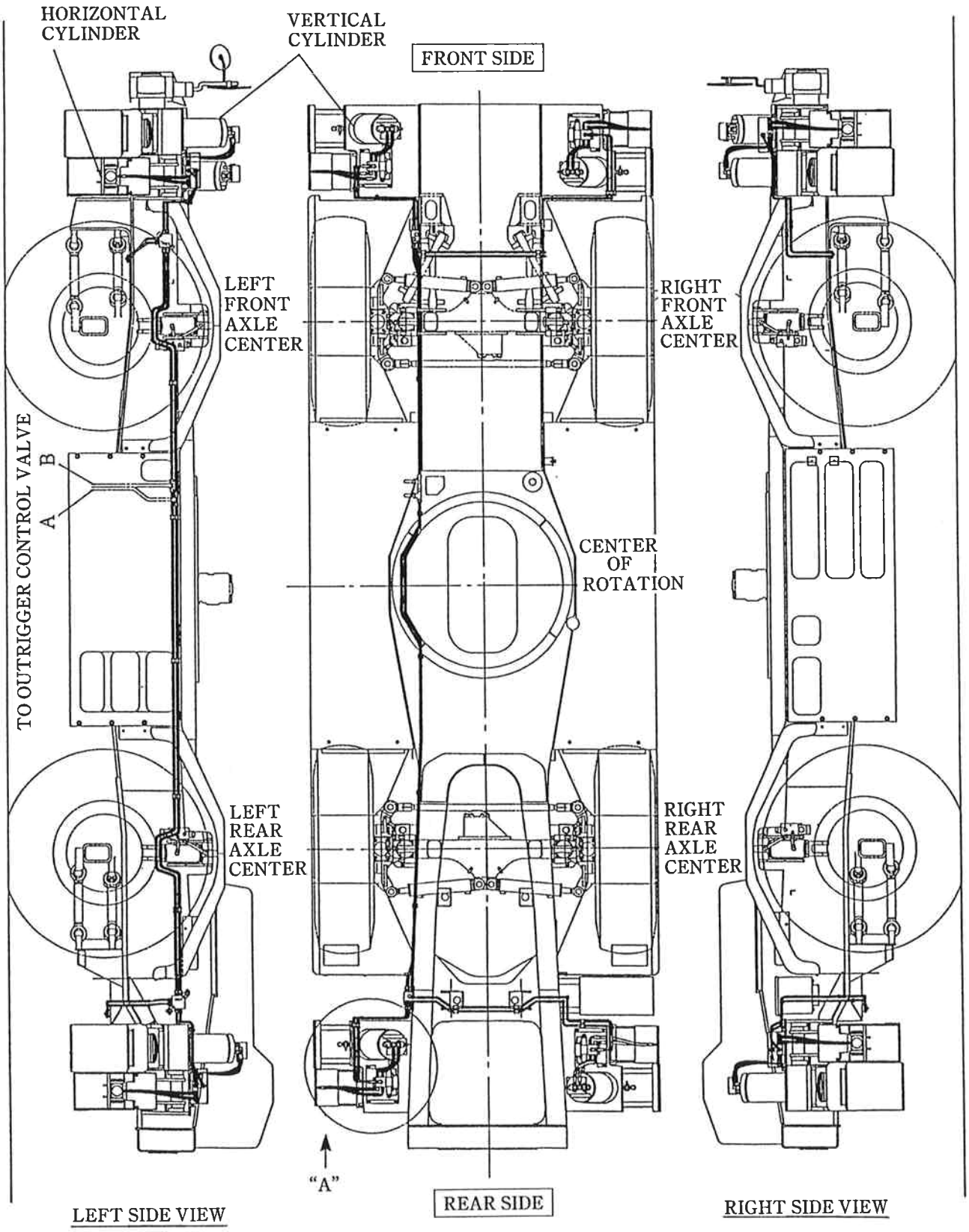
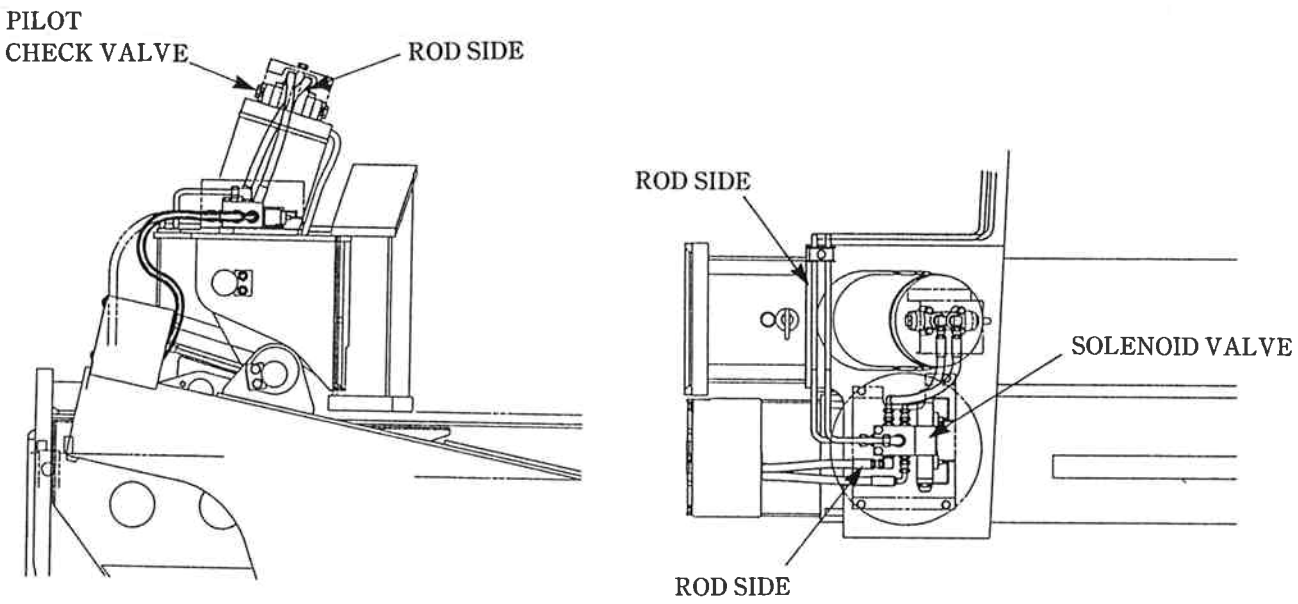


Fig. 2-1 Outrigger Hydraulic Piping Schematic (1 / 2)

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DETAIL OF "A" (HORIZONTAL CYLINDER HOSE PIPING)

Fig. 2-1 Outrigger Hydraulic Piping Schematic (2 / 2)

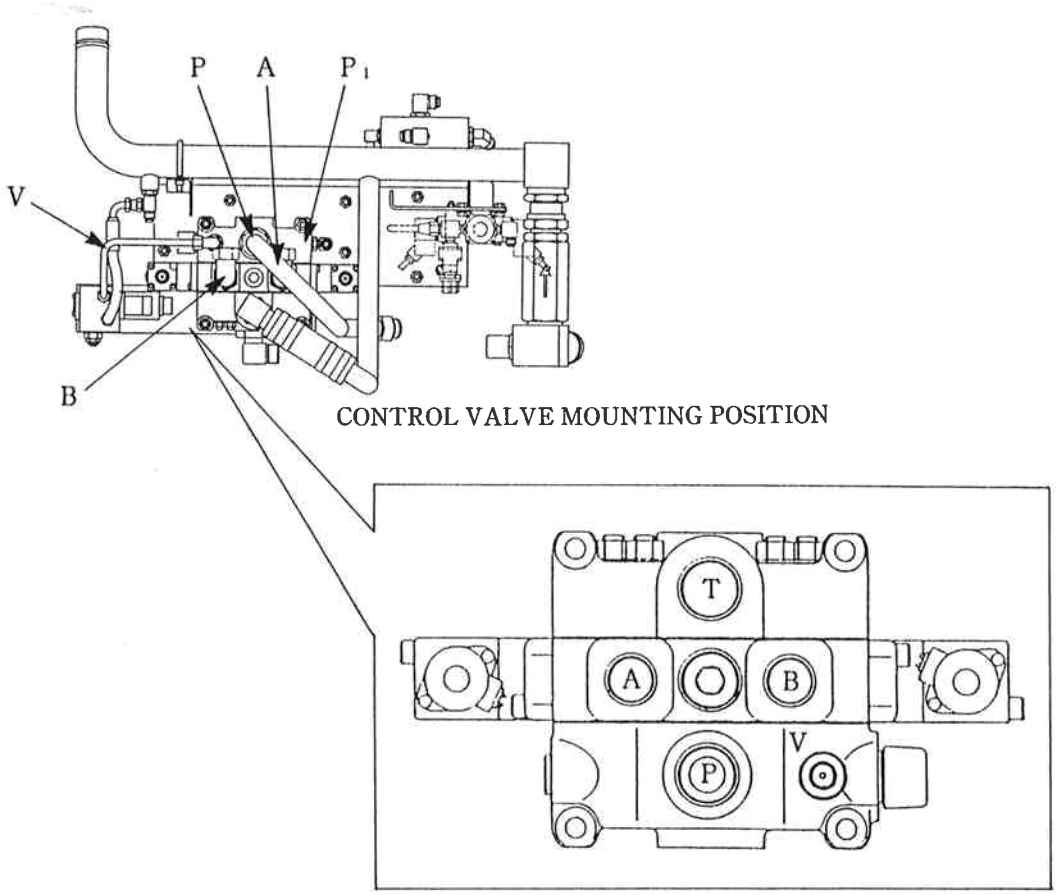


Fig. 2-2 Outrigger Control Valve

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2.2 HYDRAULIC CIRCUIT

The hydraulic circuit on this machine is shown in Fig. 2-3. The selector switch for the vertical cylinders and horizontal cylinders, the selector switch for extension and retraction, the control switch for operating the all outriggers simultaneously, and the control switches for operating respectively the each outrigger in the front, rear, left and right sides of the carrier are provided respectively on the side control in the operator's cab and on the left side of the carrier.

When these switches are operated, the circuit is selected by function of the selector solenoid valve of the vertical cylinders / horizontal cylinders, and the spool is moved by pilot hydraulic pressure selected with the solenoid valve of extension / retraction, then the four outriggers are operated simultaneously or individually. Fig. 2-3 shows the circuit when the outrigger control switches are not operated.

The circuit pressure is usually at 175kg / cm² (2489 psi), but by pushing the O / R CONFIRM switch, the winch pressure raising valve operates to raise the circuit pressure to 260kg / cm² (3697 psi) (the highest pressure of winch circuit).

2.3 FUNCTION OF OUTRIGGERS

(a) Outriggers in Neutral (Fig. 2-3)

When the outrigger control switch is not operated, the spool is in the neutral position. At this time, pressurized oil delivered from the hydraulic pump passes through the spool of the outrigger control valve and the swivel joint, then flows into the winch (1st speed) circuit.

Therefore, the outriggers do not move.

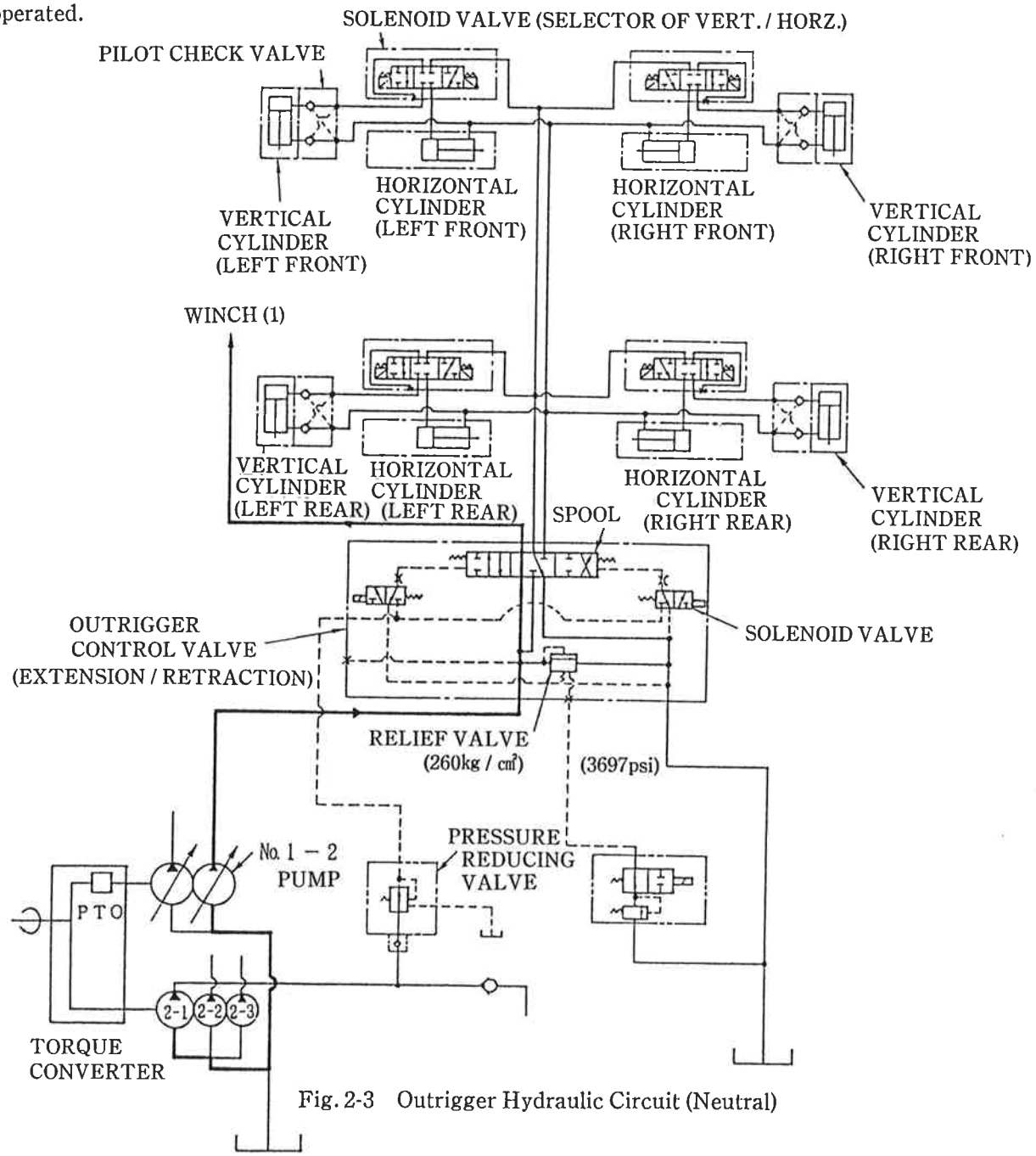


Fig. 2-3 Outrigger Hydraulic Circuit (Neutral)

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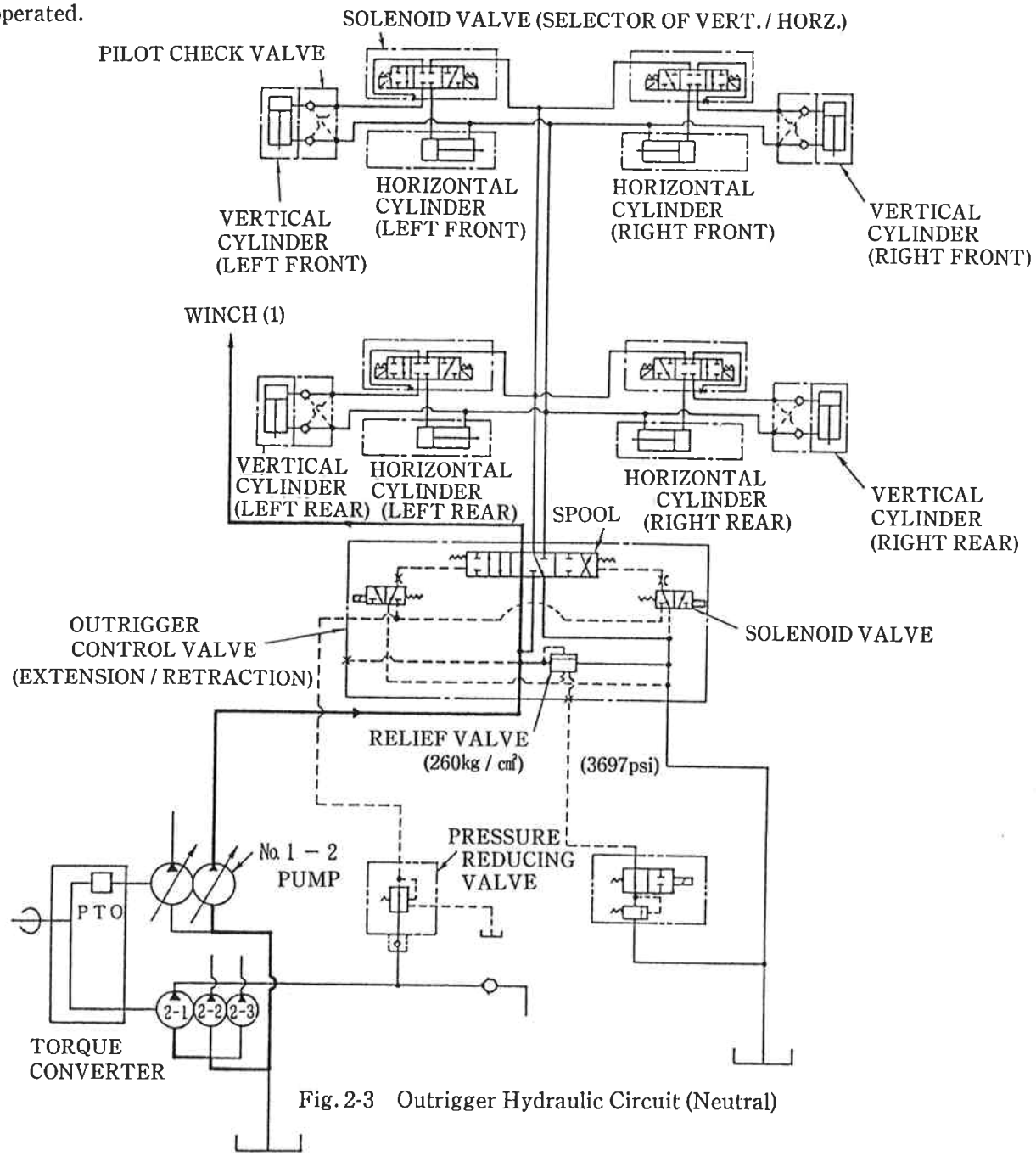


Fig. 2-3 Outrigger Hydraulic Circuit (Neutral)

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(b) Outrigger Horizontal Extension (Fig. 2-4)
Place the selector switch of the vertical cylinders / horizontal cylinders in the HORIZONTAL position, and the selector switch for extension / retraction in the Extension position. With this condition, when the outrigger control switch is operated, pressurized oil from the hydraulic pump passes through the extension side passage of the extension / retraction control valve spool and the horizontal cylinder side passage of the solenoid valve for selector of horizontal / vertical cylinders, then flows into the bottom side of the each horizontal cylinder to extend the horizontal cylinder, and to extend the outrigger beam connected to the horizontal cylinder.

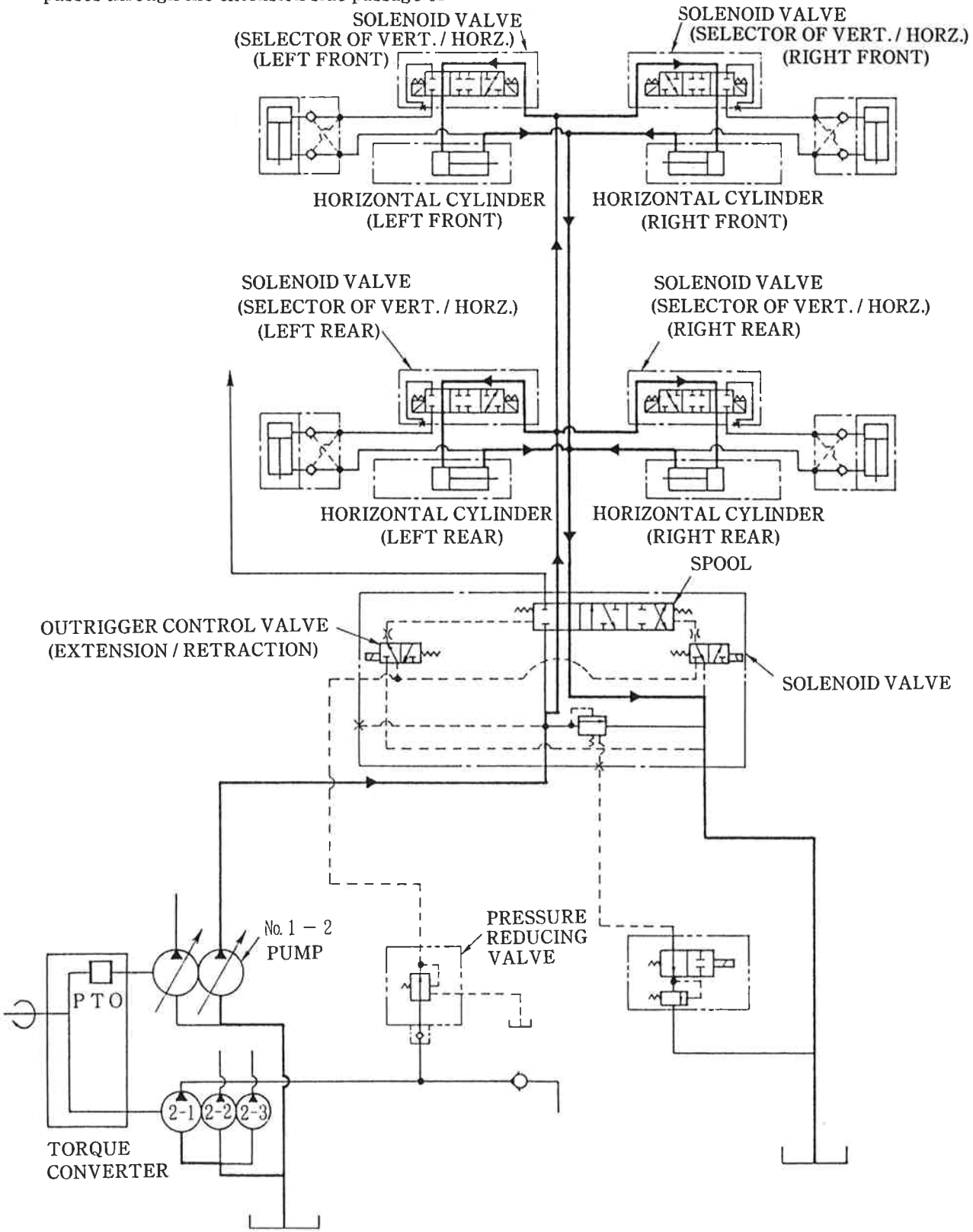


Fig. 2-4 Outrigger Hydraulic Circuit (Horizontal Extension)

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(c) Outrigger Horizontal Retraction (Fig. 2-5)
When the selector switch for extension / retraction is placed in the RETRACTION position with the selector switch of the horizontal / vertical cylinders placed in the HORIZONTAL position, the spool in the extension / retraction control valve moves in the opposite direction to extension to compose the reverse circuit of the extension circuit. Therefore, pressurized oil from the hydraulic pump is sent to the rod side of the horizontal cylinder to retract the horizontal cylinder and to retract the outrigger beam connected to the horizontal cylinder.

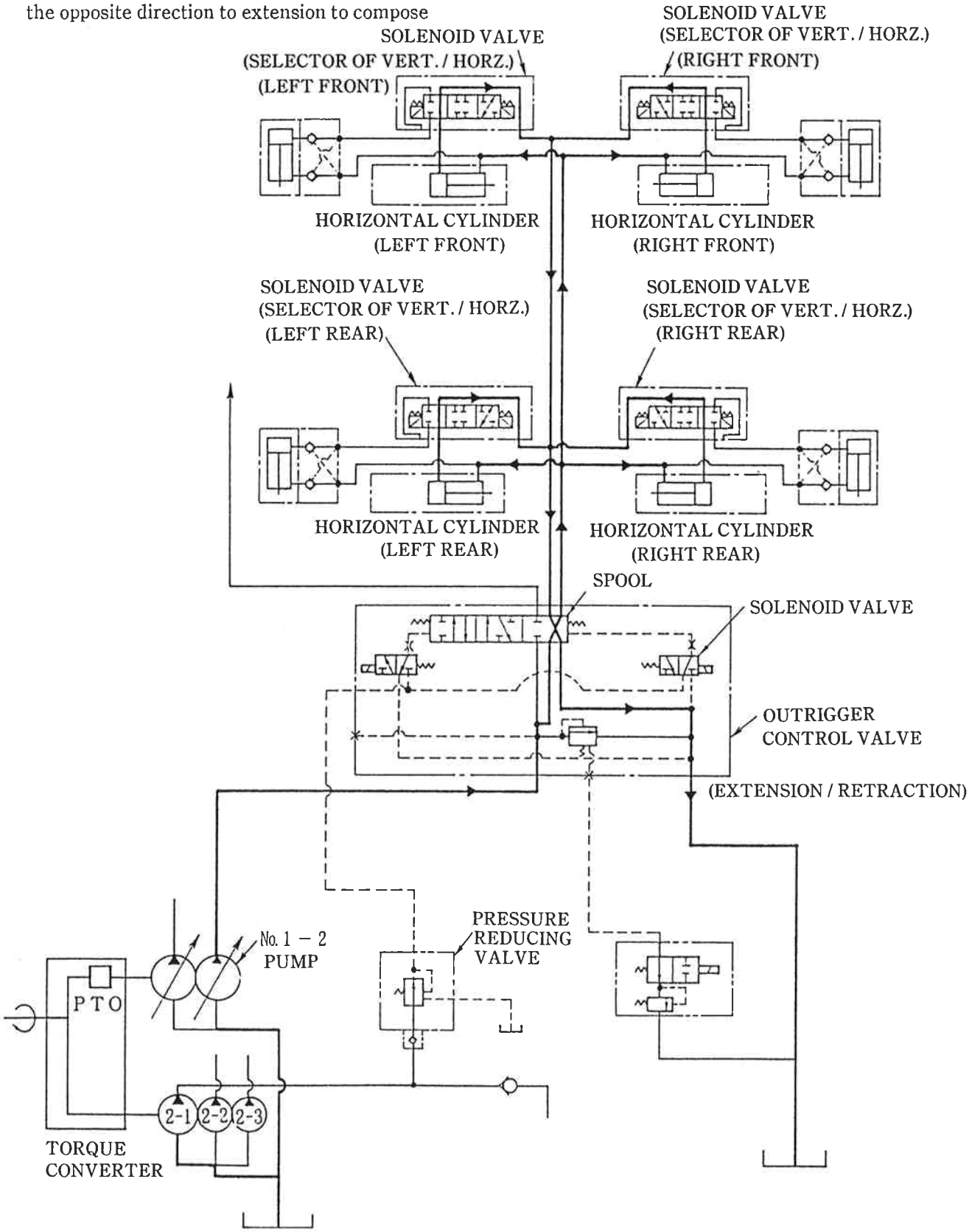


Fig. 2-5 Outrigger Hydraulic Circuit (Horizontal Retraction)

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(d) Outrigger Vertical Extension (Fig. 2-6)
Place the selector switch of the vertical / horizontal cylinders in the VERTICAL position and the selector switch for extension / retraction in the EXTENSION position. When the outrigger control switch is operated with this condition, pressurized oil from the hydraulic pump passes through the extension side passage of the extension / retraction control valve spool and the vertical cylinder side passage of the solenoid valve for selector of the horizontal / vertical cylinders, then passes through the check valve provided on the vertical cylinder and flows into the bottom side of the vertical cylinder to extend the vertical cylinder.
At this time, pressurized oil to the bottom side of the vertical cylinder also opens the pilot check valve on the rod side at the same time. Therefore, oil in the rod side passes the pilot check valve, and returns to the hydraulic oil tank via the spool of the control valve.
Pressurized oil in the vertical cylinder after extended is held with the check valve.

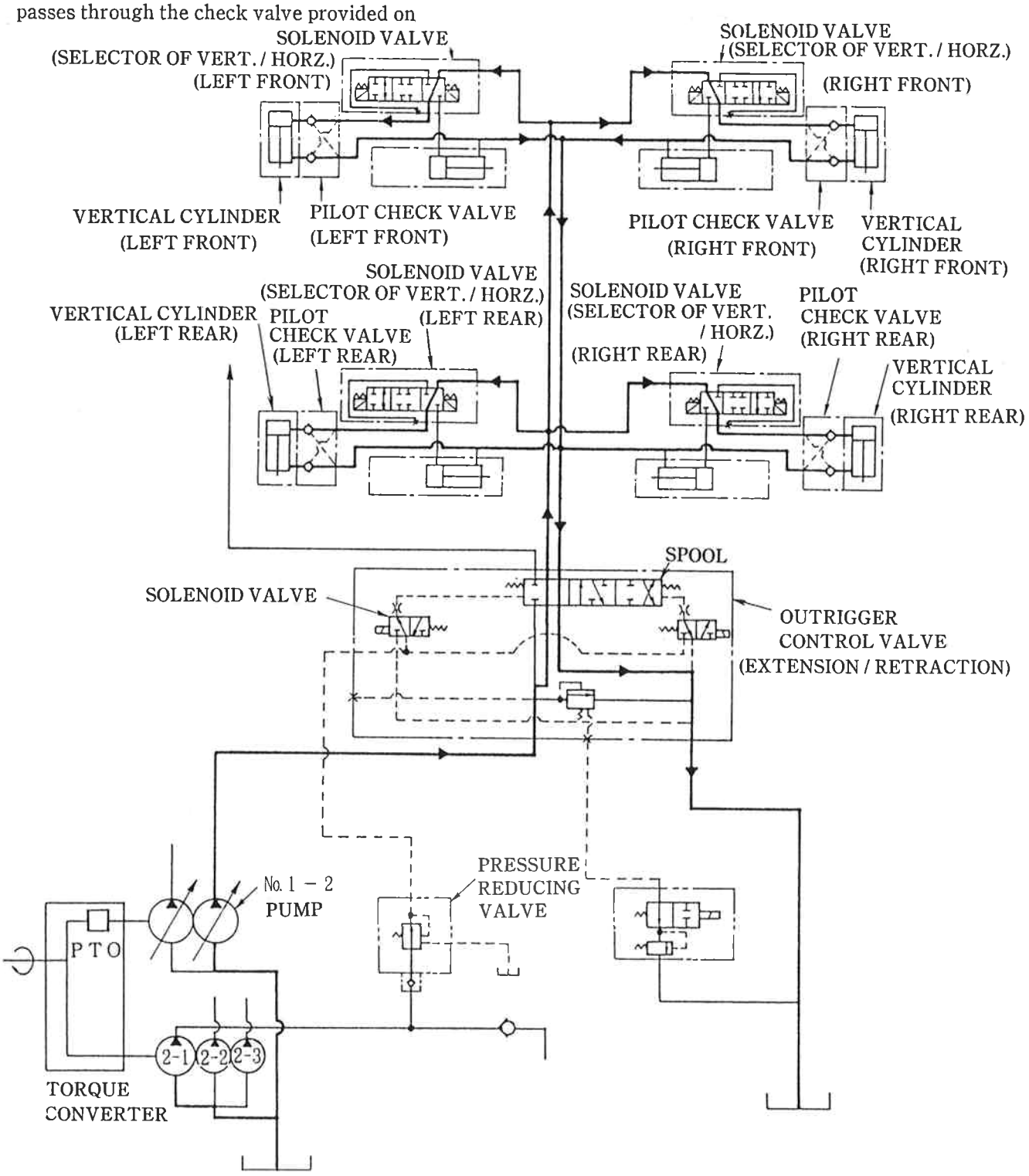


Fig. 2-6 Outrigger Hydraulic Circuit (Vertical Extension)

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(e) Outrigger Vertical Retraction (Fig. 2-7)
When the selector switch for extension / retraction is placed in the RETRACTION position with the selector switch of the vertical / horizontal cylinders placed in the VERTICAL position, the spool in the extension / retraction control valve is moved in the opposite direction to extension. Therefore, pressurized oil from the hydraulic pump passes through the check valve and flows into the rod side of the vertical cylinder to retract the vertical cylinder.
At this time, pressurized oil to the rod side of the vertical cylinder also opens the pilot check valve on the bottom side at the same time. So, oil in the bottom side passes through the pilot check valve, vertical cylinder side passage of the solenoid valve for the selector of vertical / horizontal cylinders, and returns to the hydraulic oil tank via the spool of the control valve.
Therefore, the vertical cylinder is retracted, causing the outrigger float to be raised.

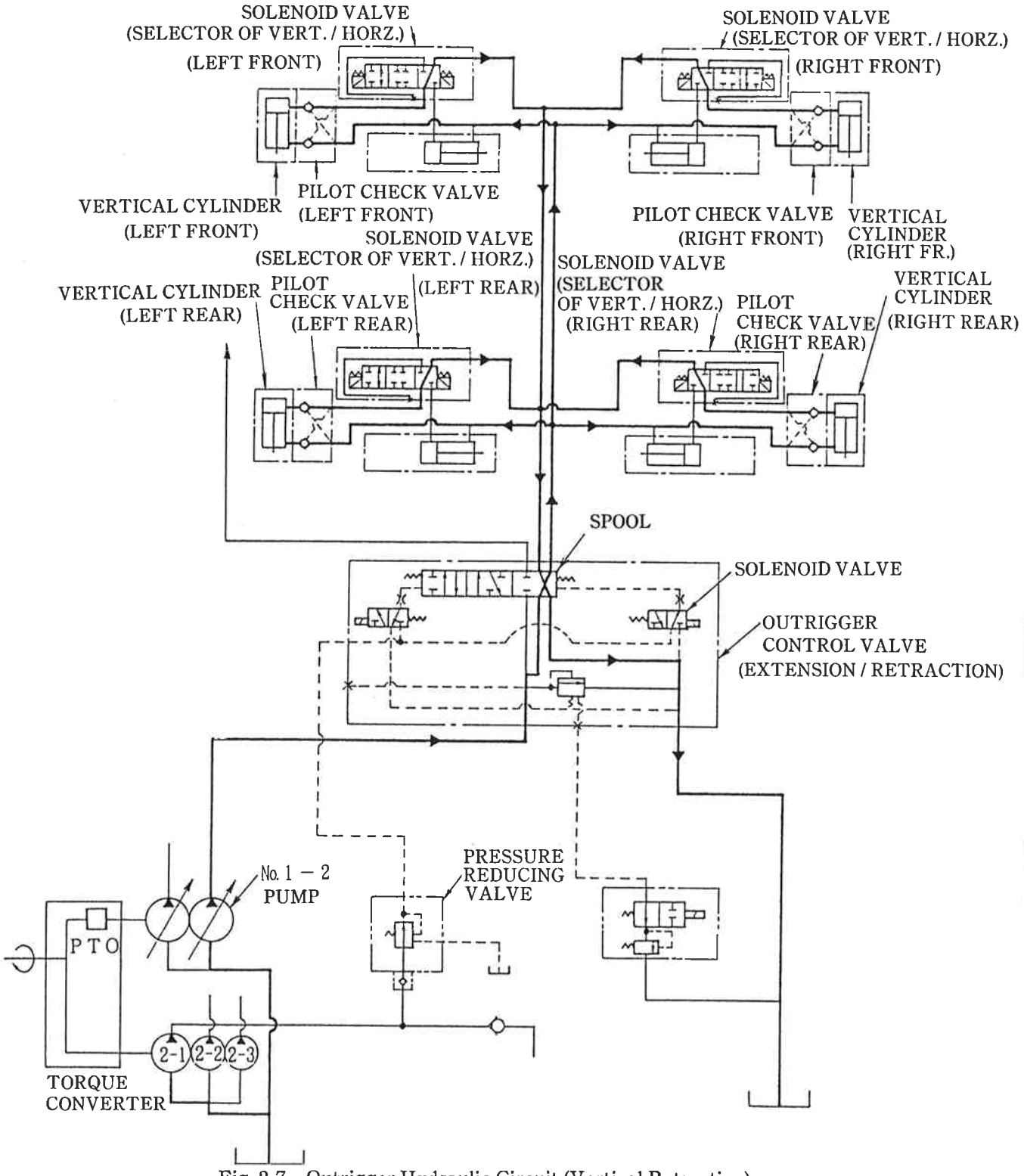


Fig. 2-7 Outrigger Hydraulic Circuit (Vertical Retraction)

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2.4 OUTRIGGER ASSEMBLY

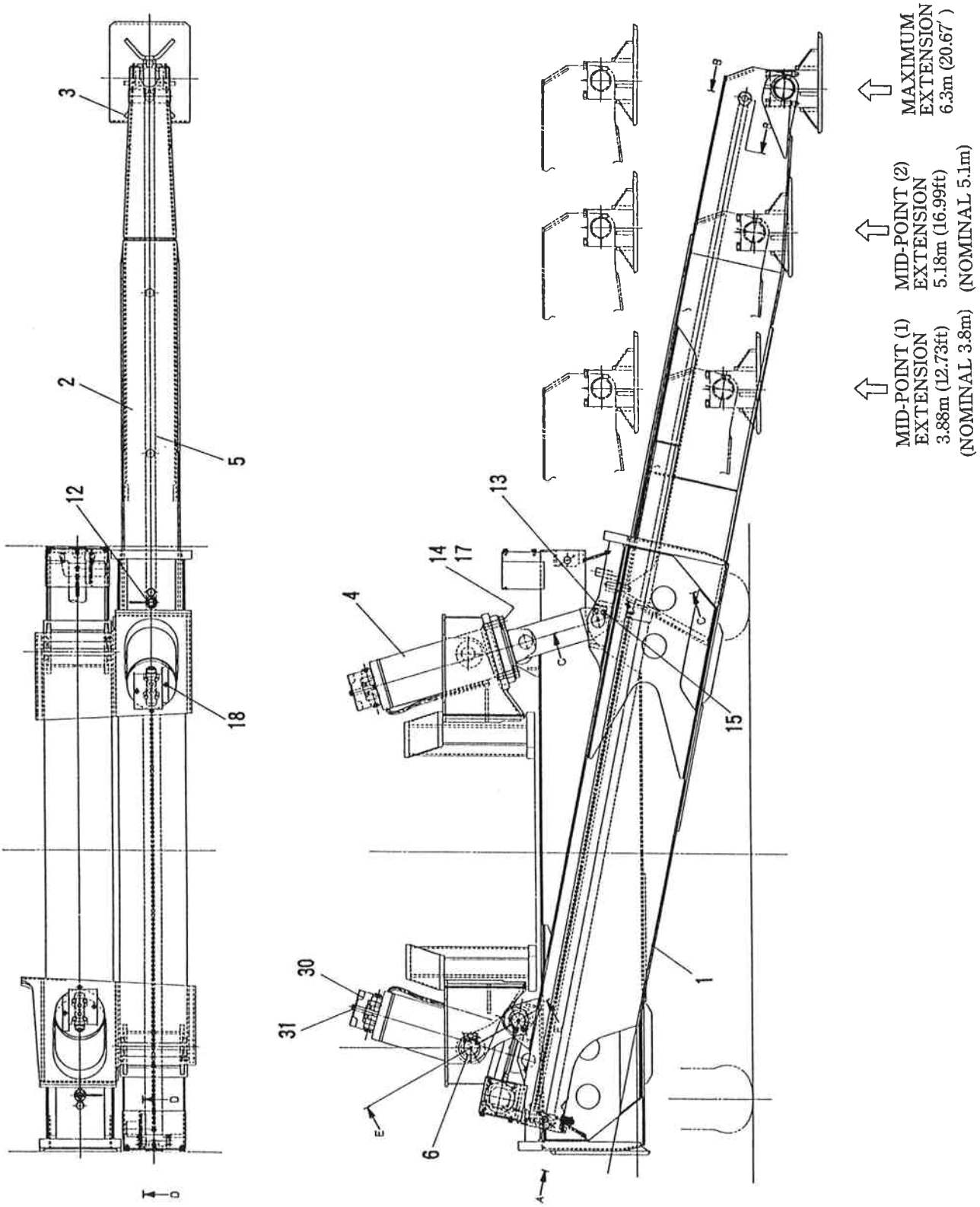
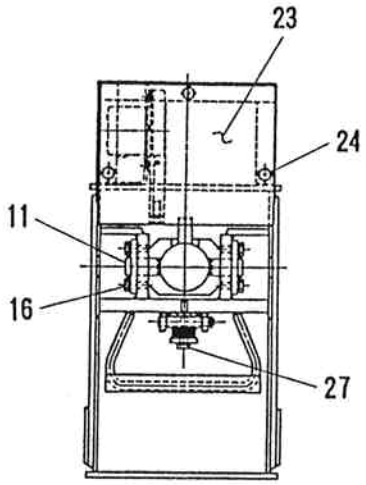
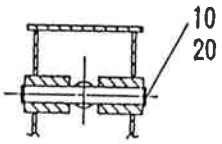


Fig. 2-8 Outrigger Assembly (1 / 2)

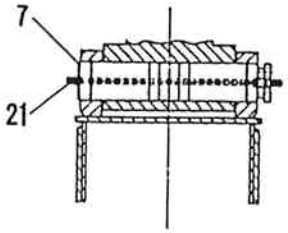
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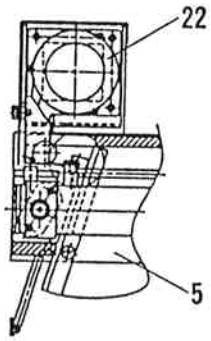
VIEW A



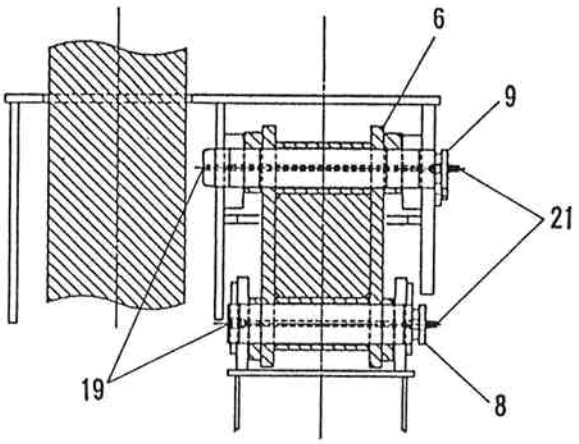
SECTION B-B



SECTION C-C



SECTION D-D



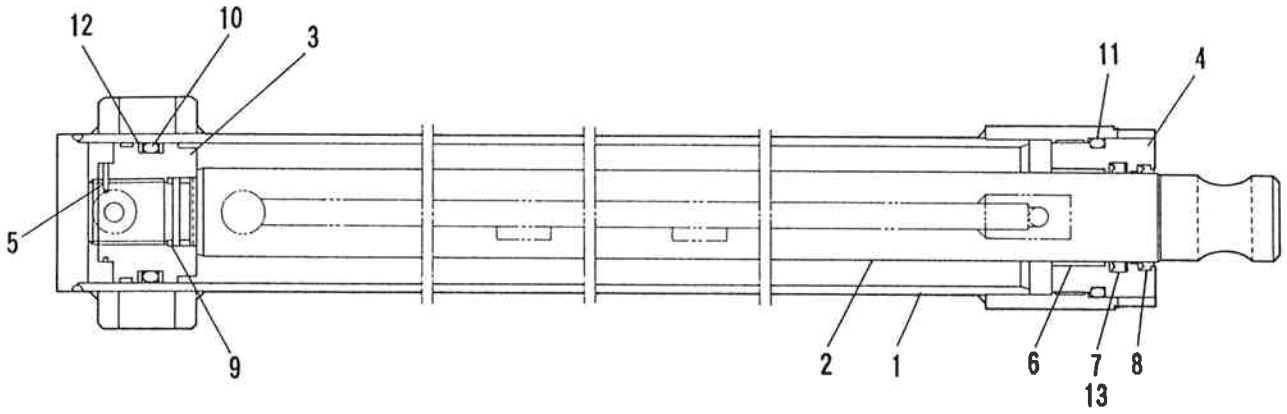
SECTION E-E

1. OUTRIGGER BOX
2. OUTRIGGER BEAM
3. FLOAT ASSEMBLY
4. VERTICAL CYLINDER
5. HORIZONTAL CYLINDER
6. LINK
7. PIN
8. PIN
9. PIN
10. PIN
11. PIN
12. PIN
13. PIN
14. CAPSCREW
15. CAPSCREW
16. CAPSCREW
17. WASHER
18. LOCKWASHER
19. GREASE FITTING
20. SNAP RING
21. GREASE FITTING
22. STROKE SENSOR
23. COVER
24. BOLT
30. COVER
31. SPACER
32. CAPSCREW

Fig. 2-8 Outrigger Assembly (2 / 2)

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2.5 OUTRIGGER HORIZONTAL CYLINDER



1. CYLINDER TUBE
2. PISTON ROD
3. PISTON
4. ROD COVER
5. STOPPER
6. BUSHING
7. ROD PAKING
8. DUST SEAL
9. O-RING
10. O-RING
11. O-RING
12. BACK-UP RING
13. BACK-UP RING

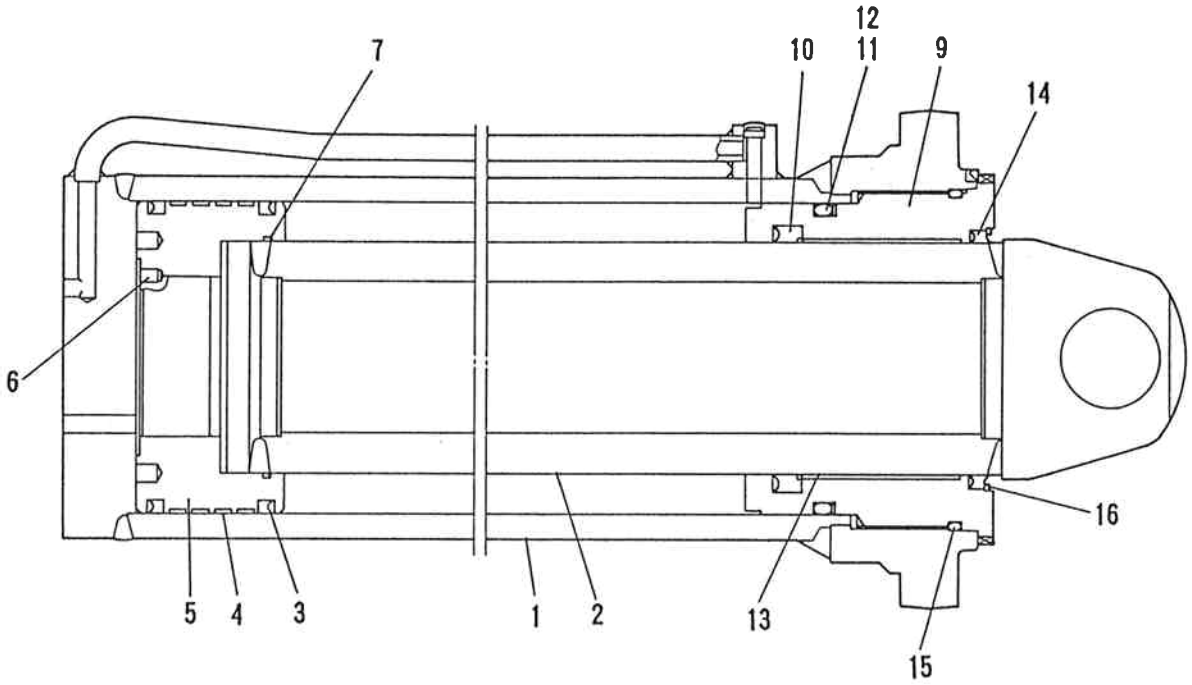
SPECIFICATIONS

Tube I. D.	(㎜)	63 (2.48 inch)
Rod O. D.	(㎜)	40 (1.575 inch)
Stroke	(㎜)	2095 (82.48 inch)
Cylinder cover tightening torque	(kg · m)	50 ~ 70 (361 - 506 ft-lbs)
Piston tightening torque	(kg · m)	30 ~ 35 (217 ~ 253 ft-lbs)
Weight (APPROX.)	(kg)	41 (90.4 lbs)

Fig. 2-9 Horizontal Cylinder

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2.6 OUTRIGGER VERTICAL CYLINDER



1. CYLINDER TUBE
2. PISTON ROD
3. PISTON PACKING
4. WEAR RING
5. PISTON
6. SET SCREW
7. O-RING
9. ROD COVER
10. ROD PACKING
11. O-RING
12. BACK-UP RING
13. BUSHING
14. DUST SEAL
15. O-RING
16. LOCK RING

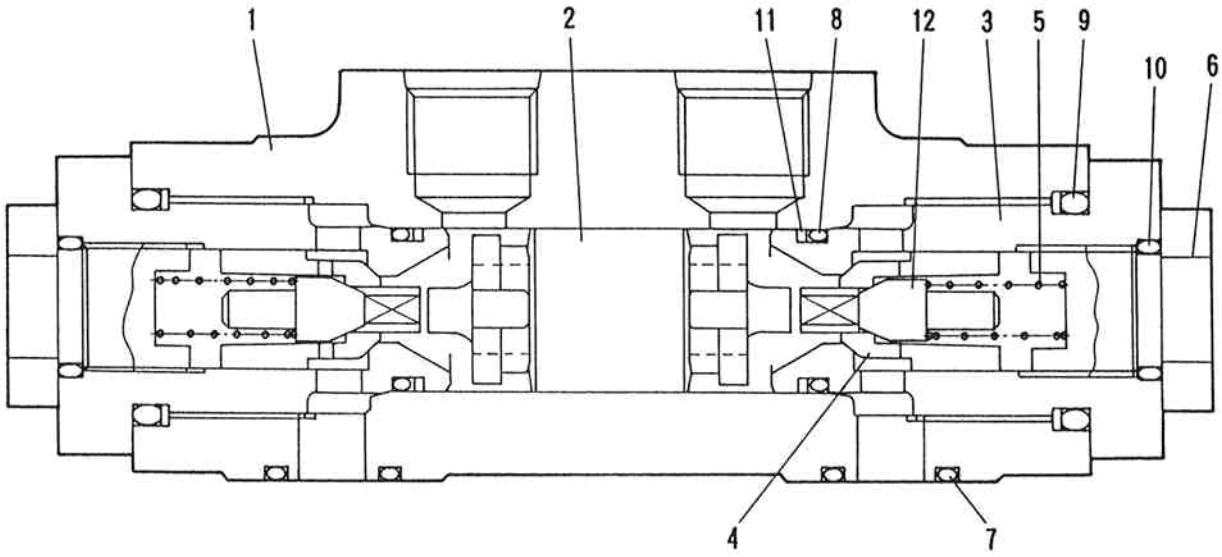
SPECIFICATIONS

Tube I. D.	175㎜ (6.89 inch)
Rod O. D.	130㎜ (5.12 inch)
Stroke	320㎜ (12.60 inch)
Cylinder cover tightening torque	50 to 70kg · m (361 to 506 ft-lbs)
Piston tightening torque	50 to 70kg · m (361 to 506 ft-lbs)
Weight (APPROX.)	131kg (289 lbs)

Fig. 2-10 Vertical Cylinder

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2.7 DOUBLE PILOT CHECK VALVE



1. BODY
2. PILOT PISTON
3. SOCKET
4. VALVE
5. SPRING
6. COVER
7. O-RING
8. O-RING
9. O-RING
10. O-RING
11. BACK-UP RING
12. CHECK VALVE

SPECIFICATIONS

Max. operating pressure	380kg / ㎠ (5404 psi)
Cracking pressure	2kg / ㎠ (28 psi)
Pilot pressure	8.5% of main circuit pressure
Operating temperature range	-30 ~ +90℃ (-22 to 194℉)
Oil to be used	Antiwear hydraulic oil

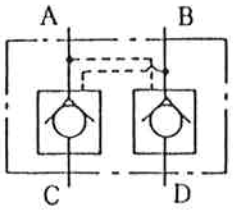


Fig. 2-11 Double Pilot Check Valve

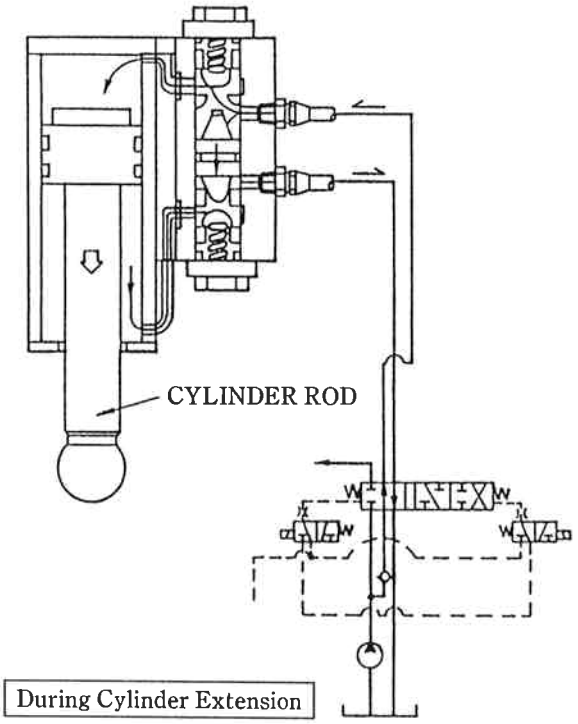
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One of these valves is attached to each vertical cylinder to prevent the cylinder from extending or retracting itself.

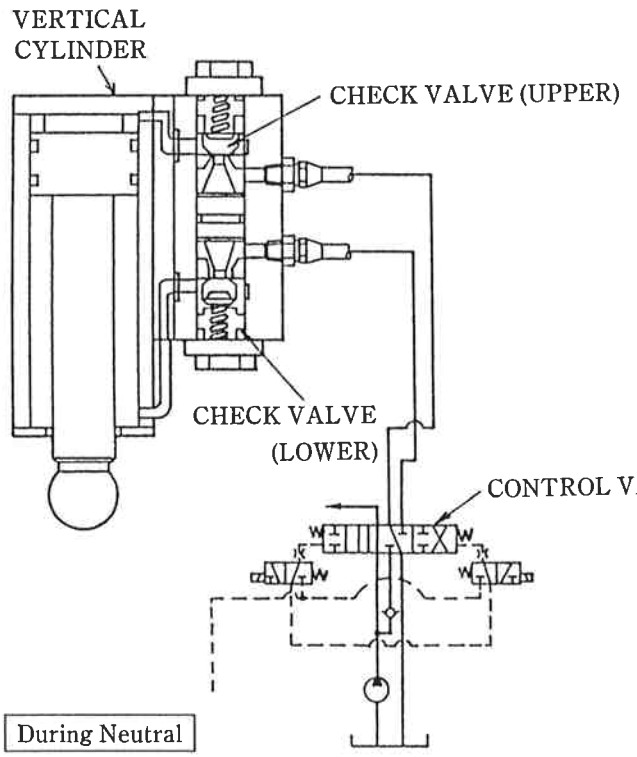
(1) VERTICAL CYLINDER IN NEUTRAL
Normally the vertical cylinder rod is immobilized by the check valve.

(2) VALVE FUNCTION DURING VERTICAL CYLINDER EXTENSION
Shifting the control valve causes the hydraulic oil flow to push open the upper check valve while simultaneously forcing the pilot piston to open the lower check valve. Oil enters the bottom side, extending the cylinder while the rod side oil exits through the lower check valve to return to the tank.

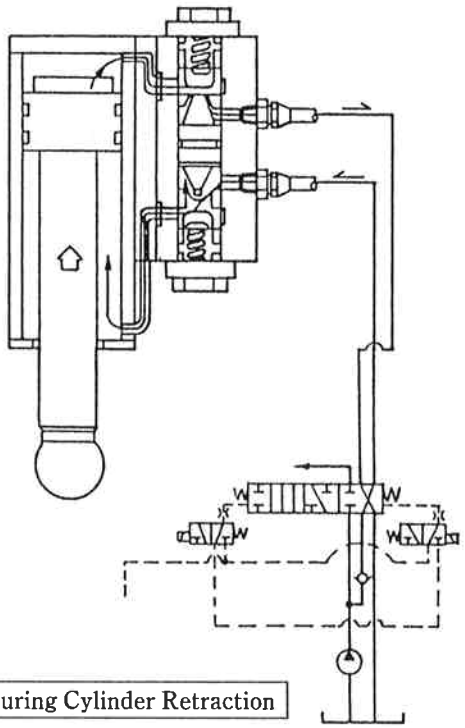
(3) VALVE FUNCTION DURING VERTICAL CYLINDER RETRACTION
This time shifting the control valve causes the hydraulic flow to push open the lower check valve while simultaneously forcing the pilot piston to open the upper check valve. Oil enters the rod side, retracting the cylinder while the bottom side oil exits through the upper check valve to return to the tank.



During Cylinder Extension



During Neutral



During Cylinder Retraction

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3. REMOVAL AND INSTALLATION

3.1 HORIZONTAL CYLINDER

(1) REMOVAL (Fig. 3-1)

① Stop the engine and remove the residual pressure in the hydraulic circuits and components by moving the control switch of the control valve back and forth several times.

② Remove cover (23).

③ Remove capscrew (25), and remove the wiring for the outrigger span detector from the beam.

④ Remove the high pressure hoses installed on the rear side of the horizontal cylinder, and remove mounting pin (11).

⑤ Using a suitable crane, draw out the beam and horizontal cylinder at the same time.

⑥ Remove snap ring (20) and pin (10) located at the end of the beam, and remove the horizontal cylinder.

(2) INSTALLATION

To install the horizontal cylinder, proceed in the reverse order of REMOVAL.

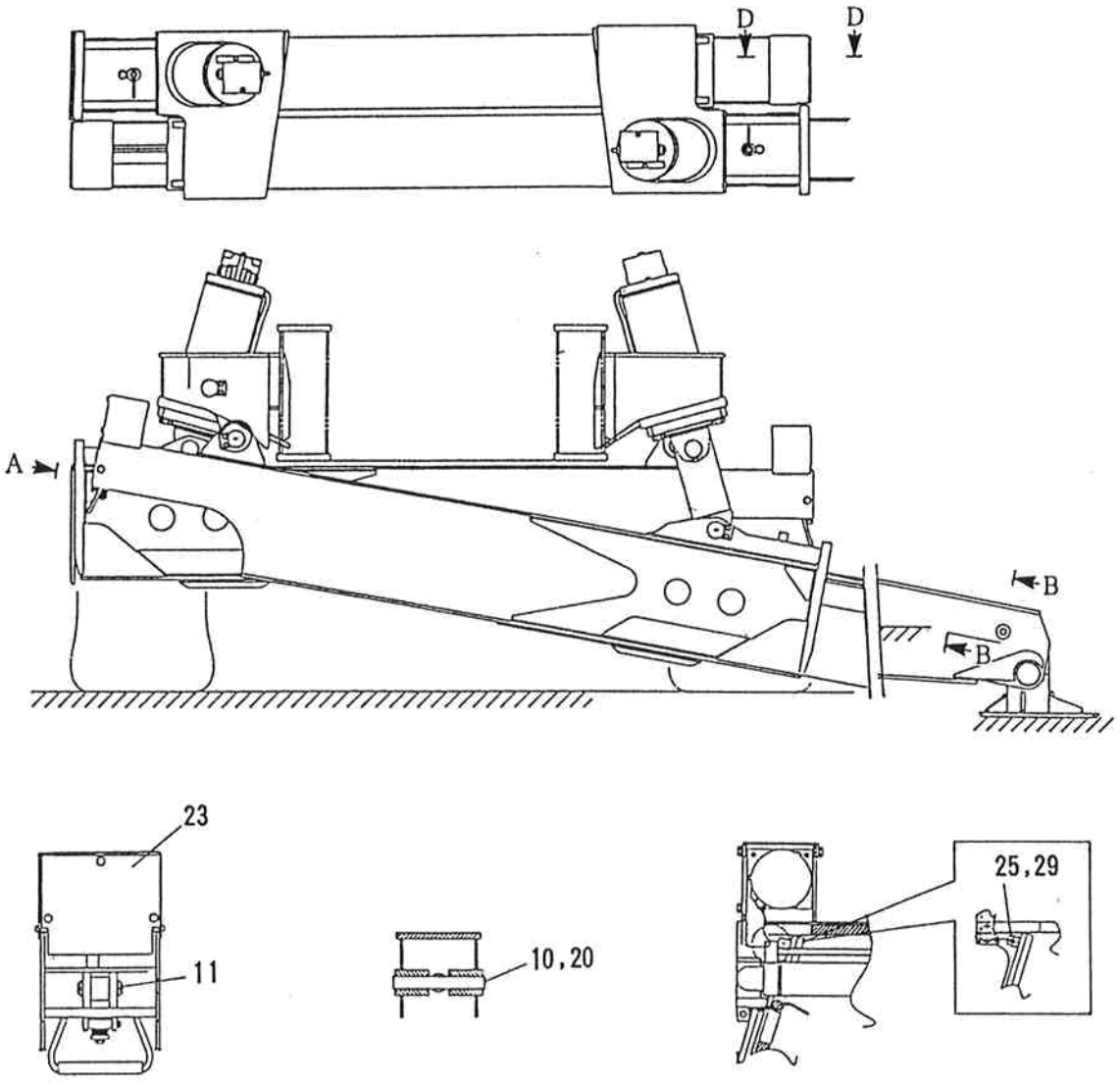


Fig. 3-1 Removal of Horizontal Cylinders

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3.2 VERTICAL CYLINDER

(1) REMOVAL (Fig. 3-2 and Fig. 3-3)

① In order to remove load from the pin, operate the vertical cylinder to place the float onto the ground, or support the outrigger box with wooden blocks.

② Stop the engine. Operate the control switch for the control valve several times to remove the residual pressure in the hydraulic components and pipings.

③ Remove cover (30).

④ Remove the two hoses.

⑤ Attach the lifting bolt to the tapped hole (M12, 15㎜ (0.59in) deep, see Fig. 3-3.) on the top of the vertical cylinder for the lifting bolt. Then, using a suitable crane, hold the vertical cylinder.

⑥ Removing capscrews (15) which secure keeper plate (13) to the outrigger box, remove the keeper plate and piston rod pin (7).

⑦ Remove capscrews (14).

⑧ Using the crane, lift the vertical cylinder obliquely to take it out.

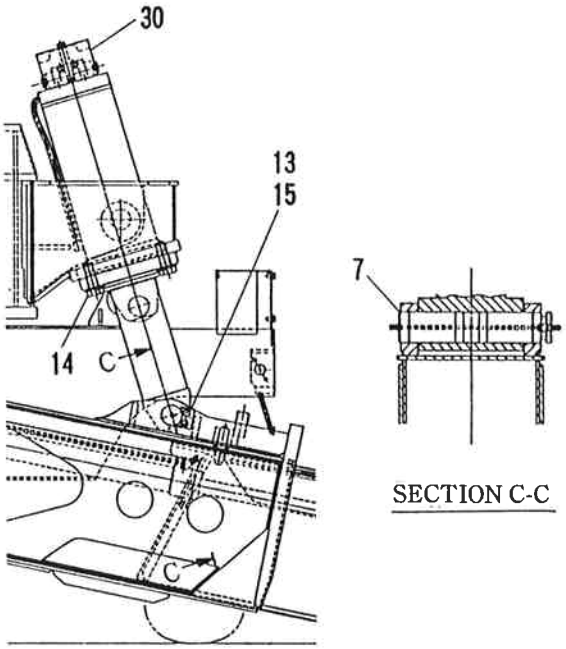


Fig. 3-2 Removal of Vertical Cylinders

(2) INSTALLATION

To install the vertical cylinder, proceed in the reverse order of REMOVAL.

When installing also, attach the lifting bolt to the tapped hole shown in Fig. 3-3, and lift obliquely.

CAUTION

1. After applying Locktite #242 to capscrews (14), tighten them with a torque of 86 to 106kg · m (621 to 766 ft-lbs).
2. After applying Locktite #242 to sems bolts (15), tighten them with a torque of 7.0 to 8.6kg · m (51 to 62 ft-lbs).

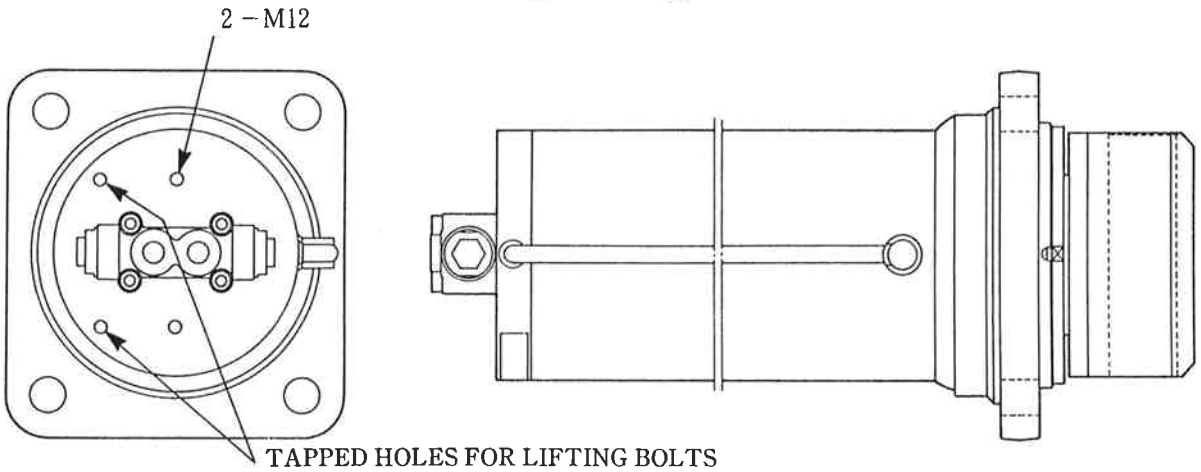


Fig. 3-3 Removal of Vertical Cylinder

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3.3 DOUBLE PILOT CHECK VALVE

(1) REMOVAL (Fig. 3-4)

① Operate the vertical cylinder to ground the float, or support the outrigger box with wooden blocks.

② Stop the engine and place the select switch in vertical position releasing the residual pressure in the hydraulic circuits and components.

③ Remove cover (30).

④ Remove the two hoses. At this time, distinguish the hoses between the bottom side and the rod side with tapes and so on.

⑤ Remove the four bolts holding the double pilot check valve.

(2) INSTALLATION

① Be sure that the mating surfaces of the cylinder and valve are thoroughly clean.

② Being careful not to allow the O-ring on the valve mounting surface to be crowded out, tighten the mounting bolts to install the valve to the cylinder.

③ Install the two hoses not to mistake the bottom side for the rod side.

④ Install cover (30).

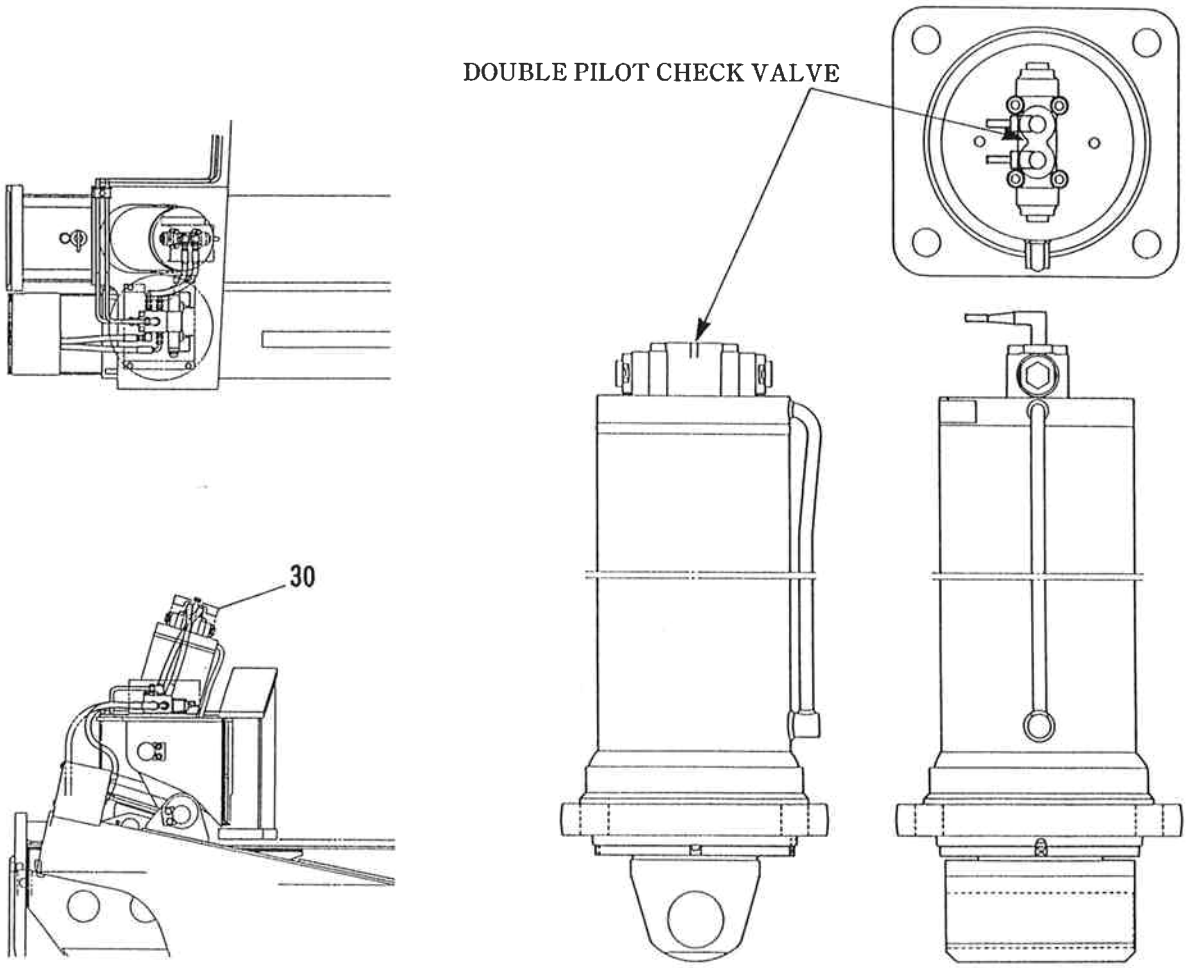


Fig. 3-3 Removal of Double Pilot Check Valve

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4. DISASSEMBLY AND ASSEMBLY

4.1 OUTRIGGER ASSEMBLY

(1) Precautions during assembly

① Coat grease containing molibudenum disulphide to the each pin before assembling.

② Install grease fitting (21) so that the greasing port faces the outside of the carrier (see Fig. 4-1).

③ After applying Locktite #242, tighten the outrigger float and the retainer with a torque of 36 to 44kg · m (260 to 318 ft-lbs).

④ Capscrews (15) (M12×30mm long) and capscrews (16) (M10×25mm long) must be used with bolts equivalent to 7T.

⑤ Capscrews (14), which secure the vertical cylinders to the basic machine, must be coated with Locktite #242, then be tightened with a torque of 86 to 106kg · m (621 to 766ft-lbs).

⑥ Install link (6) so that the greasing ports face the outside of the carrier.

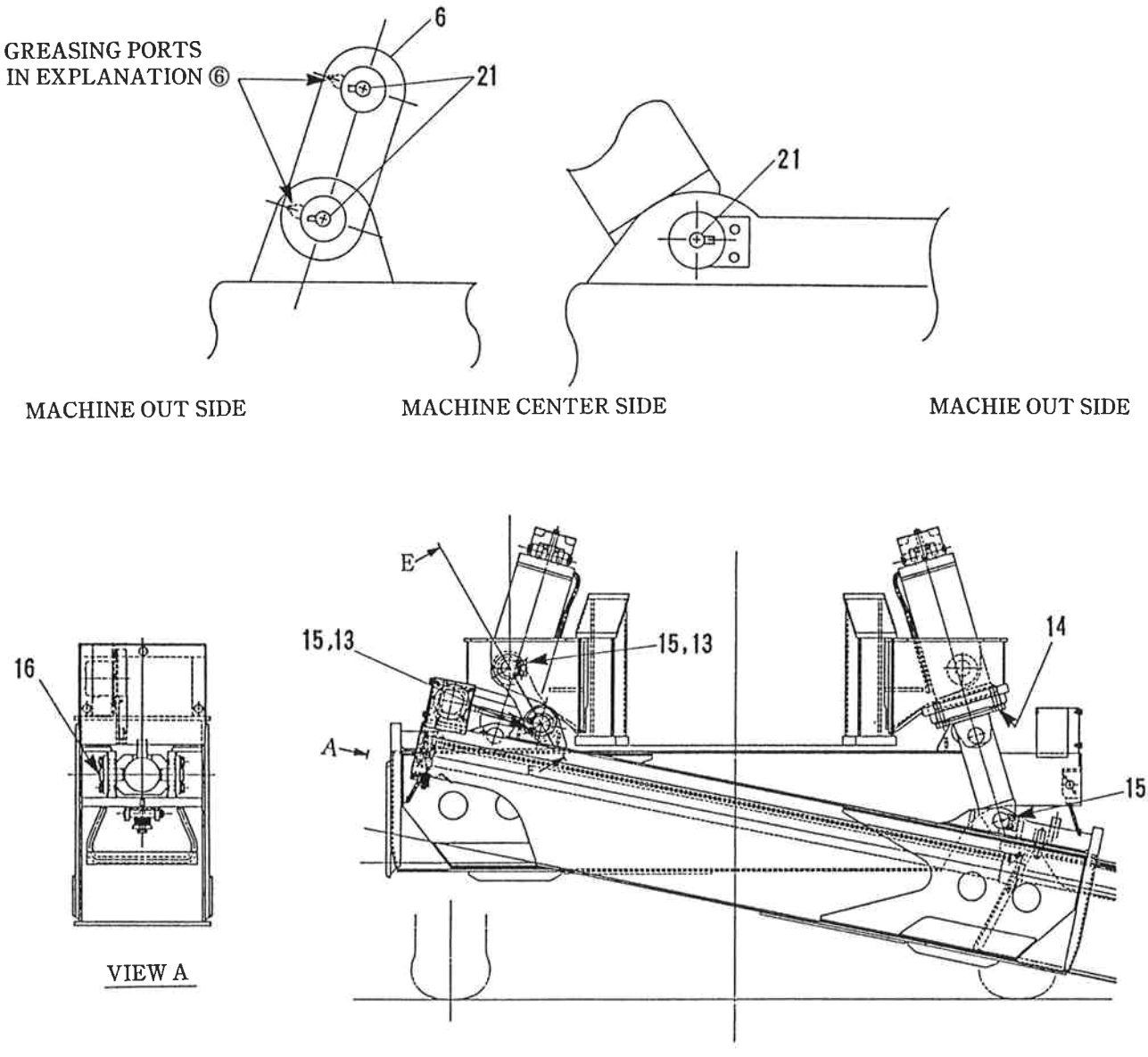


Fig. 4-1 Installation of Vertical Cylinder and Link

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4.2 DOUBLE PILOT CHECK VALVE

(1) DISASSEMBLY (Fig. 4-2)

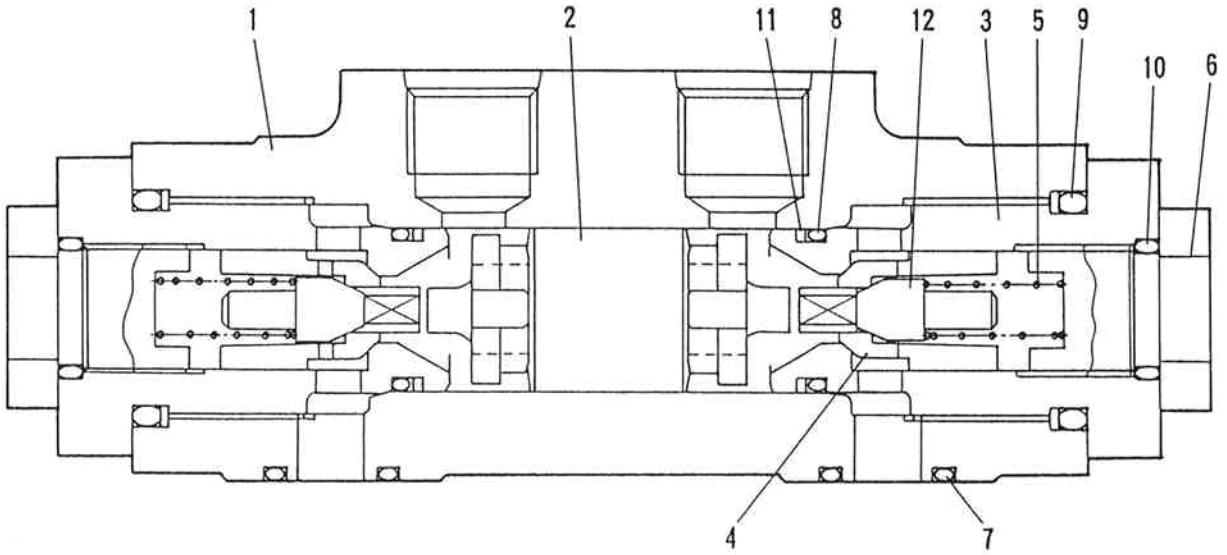
1) By removing socket (3), pilot valve (2) can be taken out.

2) Removing cover (6), remove check valve (12) and spring (5).

(2) ASSEMBLY

Reassemble by reversing the order of disassembly. However, pay attention to the following points during assembly.

1) Apply a little grease to the O-rings before installing them.



1. BODY
2. PILOT VALVE
3. SOCKET
4. VALVE
5. SPRING
6. COVER
7. O-RING
8. O-RING
9. O-RING
10. O-RING
11. BACK-UP RING
12. CHECK VALVE

Fig. 4-2 Double Pilot Check Valve

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5. MAINTENANCE STANDARDS

5.1 ASSEMBLY STANDARDS

5.1.1 Tightening Torque for Nuts and Bolts (See Fig. 5-1)

Unit : kg · m (ft-lb)

Item No.	Name	Standard Value	Remarks
14	Capscrew	96±10 (694±72)	Apply Locktite #242
15	Capscrew	7.8±0.8 (56.4±5.8)	—do—
16	Capscrew	4.6±0.5 (33.2±3.6)	—do—
24	Bolt	2.5±0.3 (18.1±2.2)	Without lubrication
32	Capscrew	4.2±0.4 (30.4±2.9)	—do—
33	Capscrew	4.2±0.4 (30.4±2.9)	—do—
34	Capscrew	0.52±0.05 (3.76±0.36)	—do—

5.2 COMPONENT REPLACEMENT STANDARDS.

5.1.2 Pin (See Fig. 5-1)

Unit : mm (inch)

Item No.	Name	Standard Dimension		Limit of Wear	Remedy
		Inside dia.	Outside diameter		
7	Pin		$57^{-0.030}_{-0.076}$ $(2.244^{-0.0012}_{-0.0030})$	55.9 (2.201)	Replace with a new one
8	Pin		$57^{-0.030}_{-0.076}$ $(2.244^{-0.0012}_{-0.0030})$	55.9 (2.201)	—do—
9	Pin		$57^{-0.030}_{-0.076}$ $(2.244^{-0.0012}_{-0.0030})$	55.9 (2.201)	—do—
10	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—
11	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—
12	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—

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32	Capscrew	4.2±0.4 (30.4±2.9)	—do—
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34	Capscrew	0.52±0.05 (3.76±0.36)	—do—

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8	Pin		$57^{-0.030}_{-0.076}$ $(2.244^{-0.0012}_{-0.0030})$	55.9 (2.201)	—do—
9	Pin		$57^{-0.030}_{-0.076}$ $(2.244^{-0.0012}_{-0.0030})$	55.9 (2.201)	—do—
10	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—
11	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—
12	Pin		$25^{0}_{-0.033}$ $(0.984^{0}_{-0.0013})$	24.5 (0.965)	—do—

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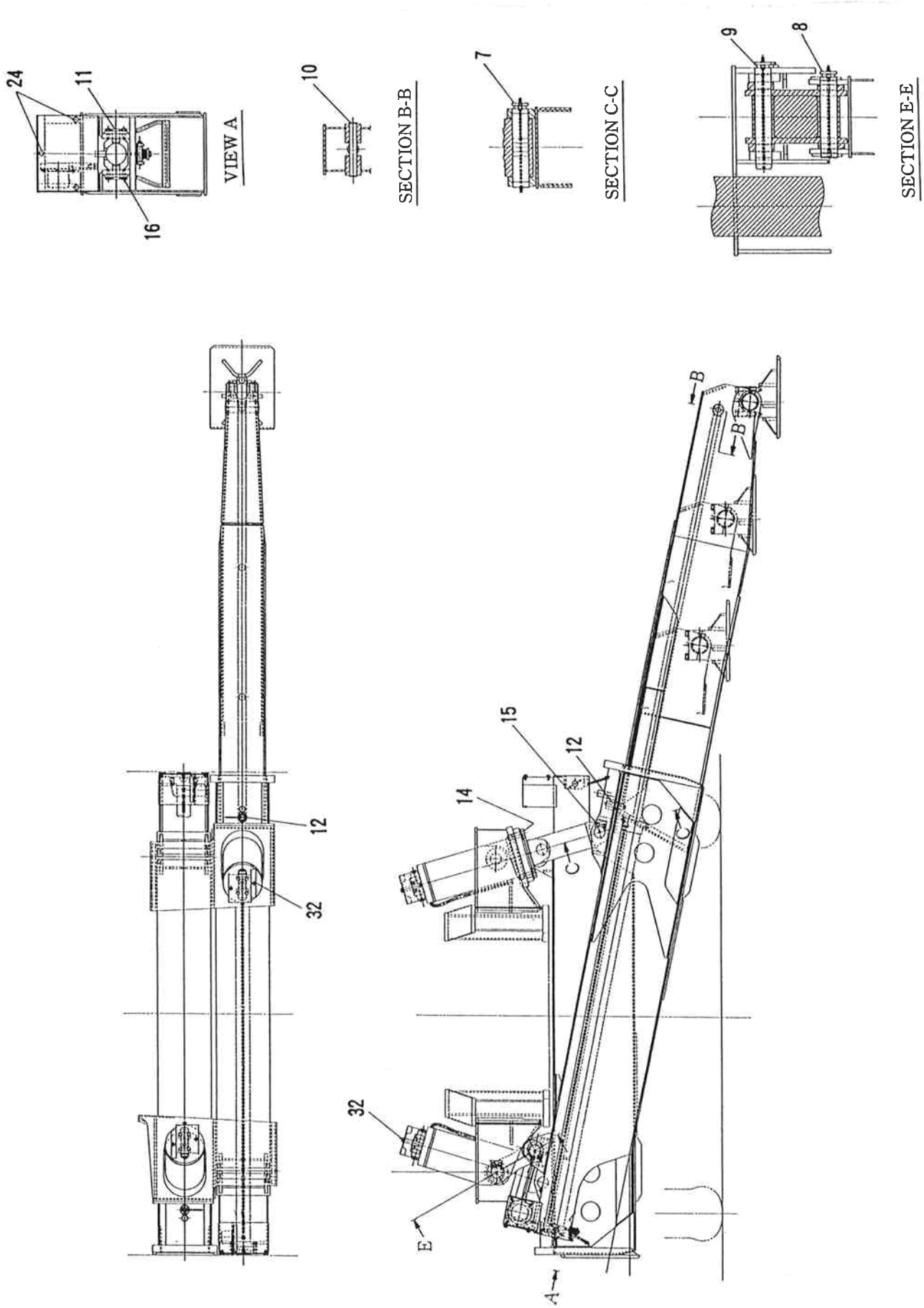


Fig. 5-1 Outrigger Assembly

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6. TROUBLESHOOTING

TROUBLE	CAUSE	REMEDY
1 Outriggers do not function. (Machine swing system dead too.)	1 Solenoid valve malfunction	1 Check electric wiring. Replace valve.
	2 Relief valve malfunction	2 Repair or adjust relief valve.
	3 No output from pump	3 Check pump.
2 Outriggers function too slowly.	1 No output from pump	1 Repair or replace No. 3 pump.
	2 Relief valve set pressure too low	2 Adjust or repair relief valve.
	3 Leaking inside cylinder	3 Disassemble and repair cylinder.
3 Outrigger beams extend during machine travel.	1 Internal leak from rod side to bottom side in horizontal cylinder	1 Disassemble and repair cylinder.
	2 Leak in horizontal / vertical valve spool	2 Replace valve.
4 Vertical cylinder retracts during machine operation.	1 Leak into vertical cylinder rod side from bottom side	1 Disassemble and repair cylinder.
	2 Internal leak in double pilot check valve	2 Disassemble check valve ; repair or replace as required.

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I SKY TILT JIB

1. LOCATION OF COMPONENTS AND OUTLINE

1.1 LOCATION OF COMPONENTS

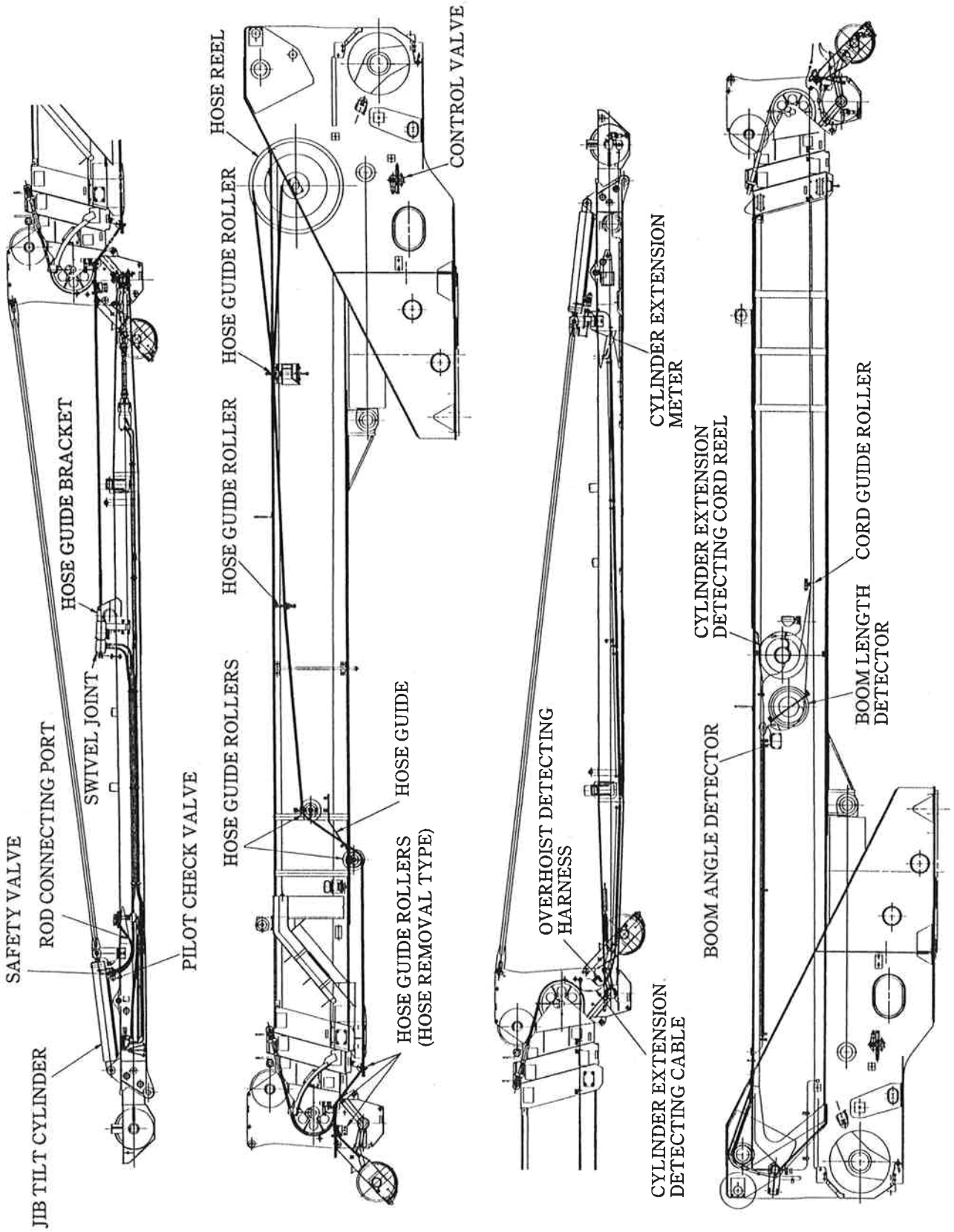


Fig. 1-1

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1.2 OUTLINE

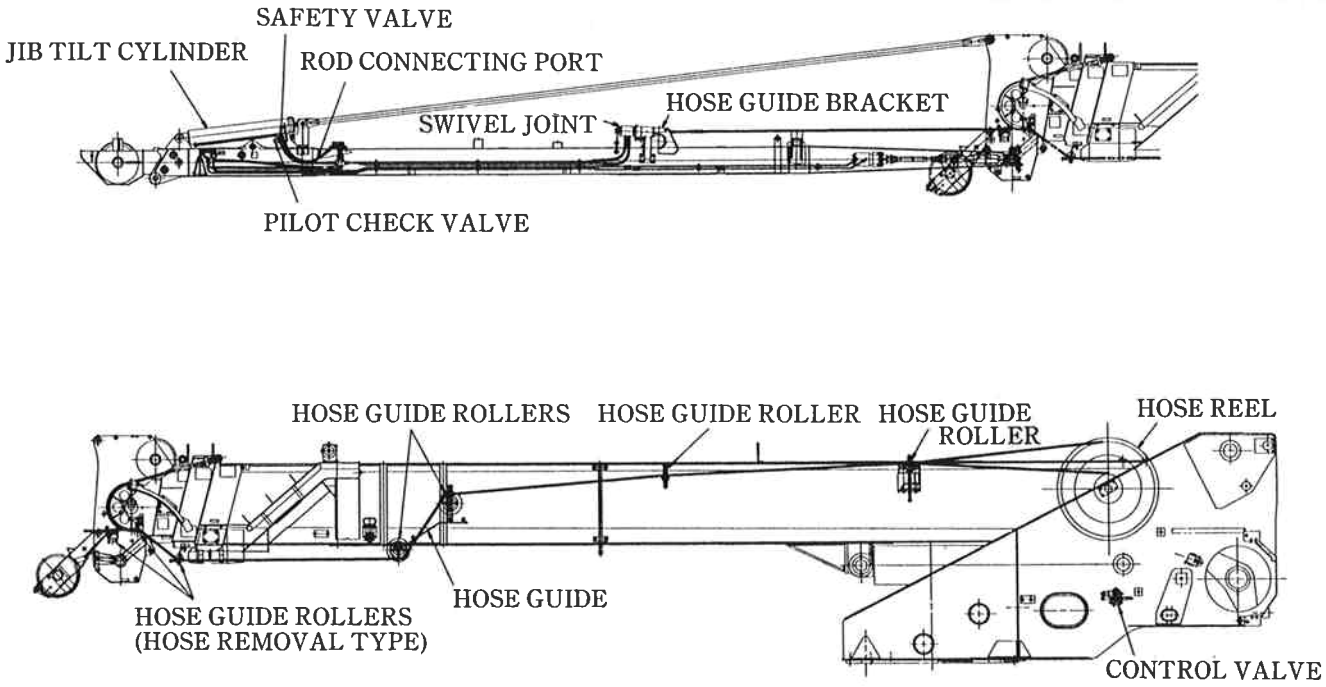


Fig. 1-2

Two jib tilt cylinders of the left and right are mounted on the jib tip side of the jib suspension rod, and pressurized oil, controlled by the control valve on the basic machine, is supplied to the said cylinders through the hose reel and swivel joint.

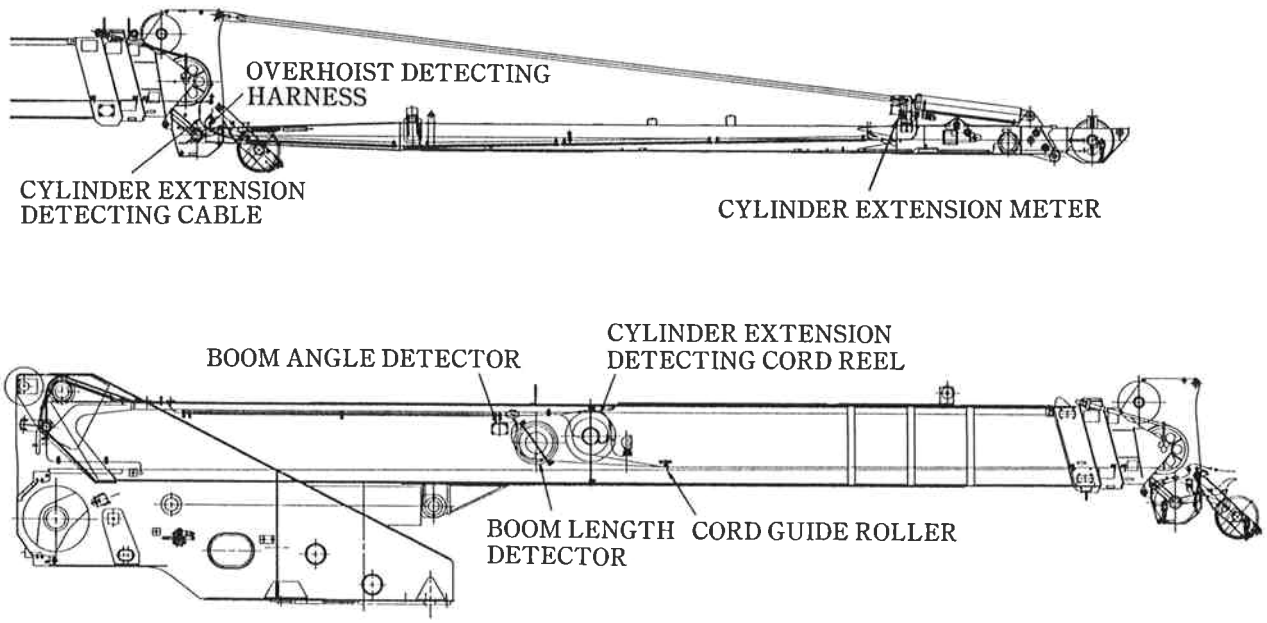


Fig. 1-3

The extension meter, which detects the cylinder stroke, is provided on the right cylinder supporting bracket, and this signal from the meter is dealed by the computer in operator's room through the cord reel to indicate the jib offset angle on the load safety device panel.

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2. CONSTRUCTION AND FUNCTION

2.1 HYDRAULIC CIRCUITS

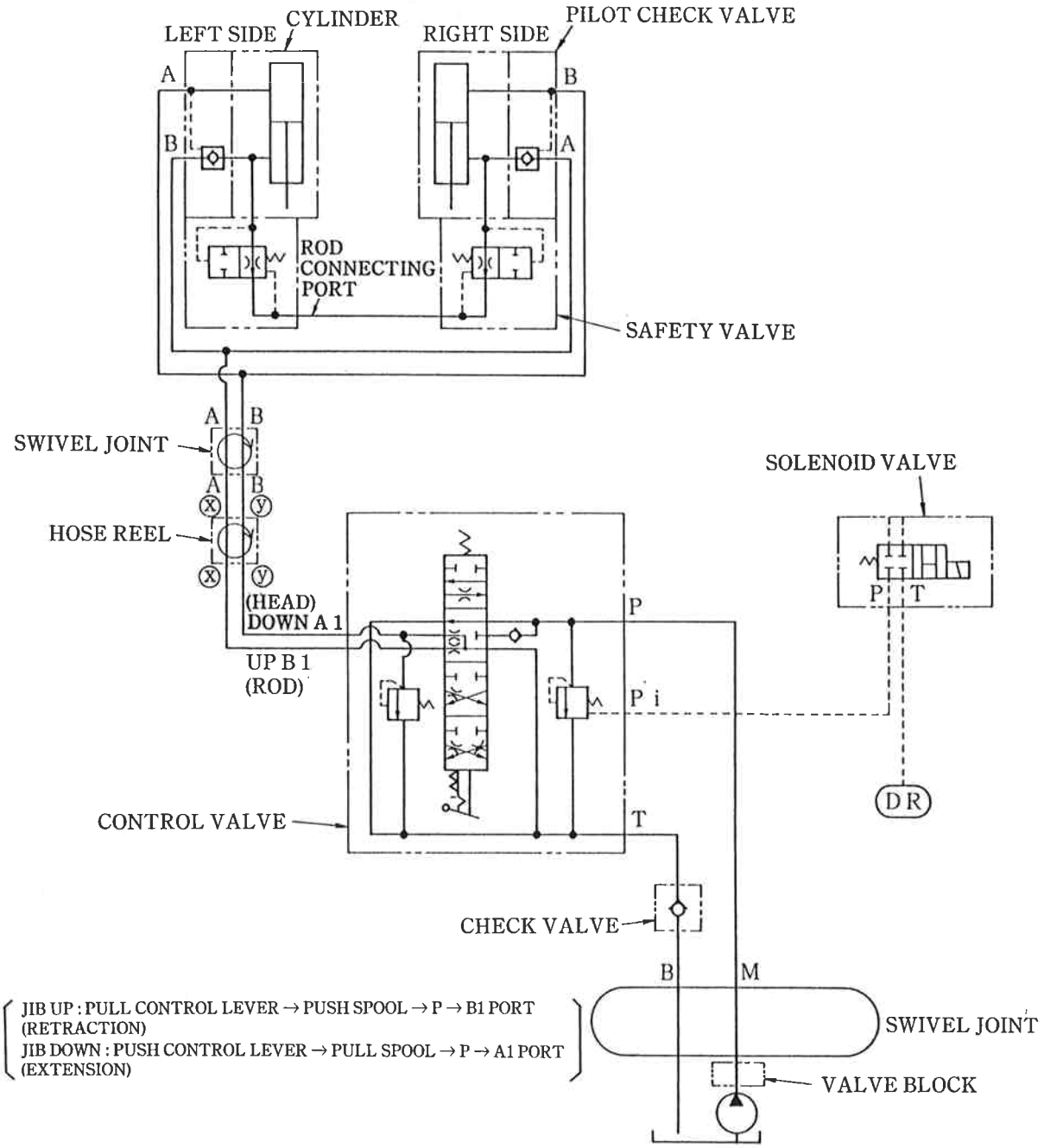


Fig. 2-1 Hydraulic Circuit (Neutral)

Pressurized oil from the hydraulic pump is supplied to port M of the swivel joint by the valve block only when the PTO is in ON. When the PTO is in OFF, the oil joins to the steering circuit.
Besides, for the following conditions, the solenoid valve for automatic stop is magnetized by the signal from the control device, vent circuit (Pi) of the control valve relief valve is connected to the drain, and pressurized oil from the pump returns to the tank to stop motion of the cylinder.

1. When the lever is set in the LOWERING position with an overloaded condition.
2. When the lever is set in the LOWERING position with abnormal condition (disconnection) of the cylinder extension meter.
3. When the lever is set in the RAISING or LOWERING position with a condition over the working area limit.
4. When the lever is set in the LOWERING position with a ML mode other than the JIB WORK mode selected.
5. When the lever is set in the RAISING position with a ML mode other than the JIB WORK and JIB EXT / STOW modes selected.

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(1) Raising the Jib (Cylinder Retraction)

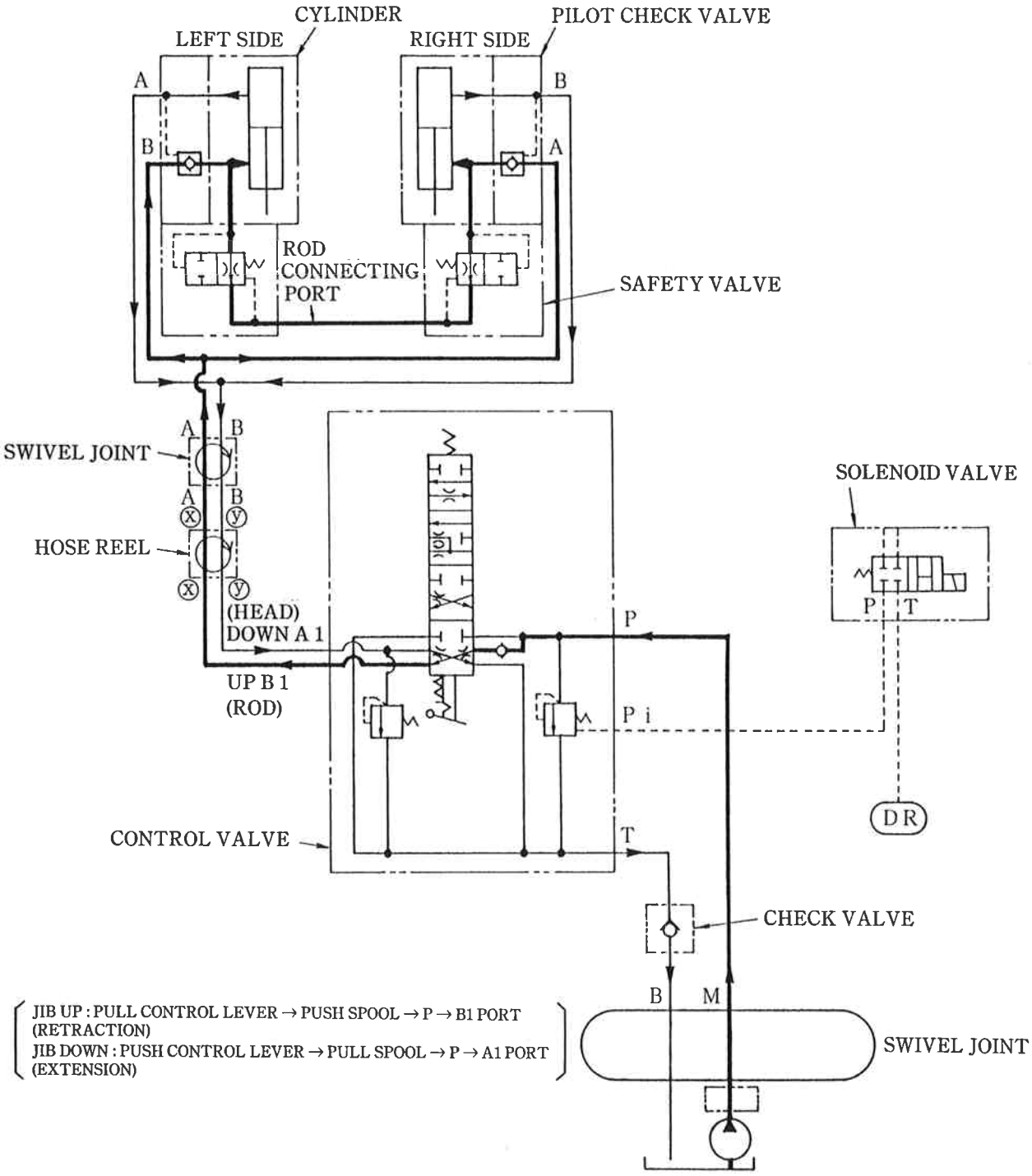


Fig. 2-2 Hydraulic Circuit (Raising Jib)

When the control lever in the operator's room is pulled toward the operator, the spool in the control valve is pushed in, pressurized oil is supplied to the cylinder rod side through port B1 of the control valve, and the cylinder is retracted to raise the jib.

The rod side pressure of the left and right cylinders becomes the same pressure by the connecting port, and the both cylinder motion is synchronized.

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(2) Lowering the Jib (Cylinder Extension)

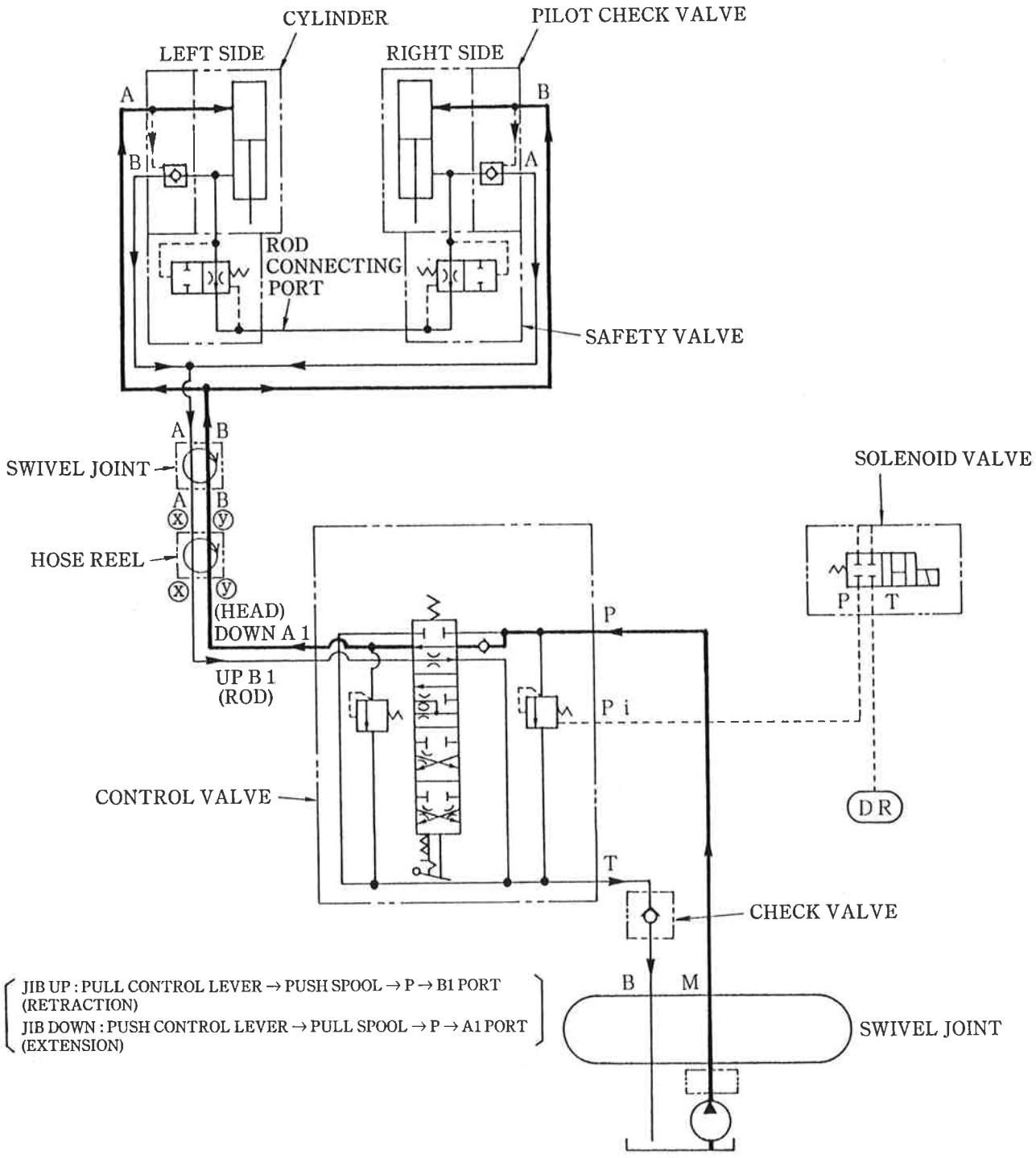


Fig. 2-3 Hydraulic Circuit (Lowering Jib)

When the control lever in the operator's room is pushed forward, the spool in the control valve is pulled out, pressurized oil is supplied to the cylinder head side through port A1 of the control valve.

At the same time, the check of the pilot check valve is opened by the head pressure, the port in the cylinder rod side is connected to the tank port, and the cylinder is extended to lower the jib.

When lowering the jib, the spool and the long hose of the hose reel function as a meter outer control, and the jib is lowered with nearly constant speed.

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(3) Holding the Jib (Neutral)

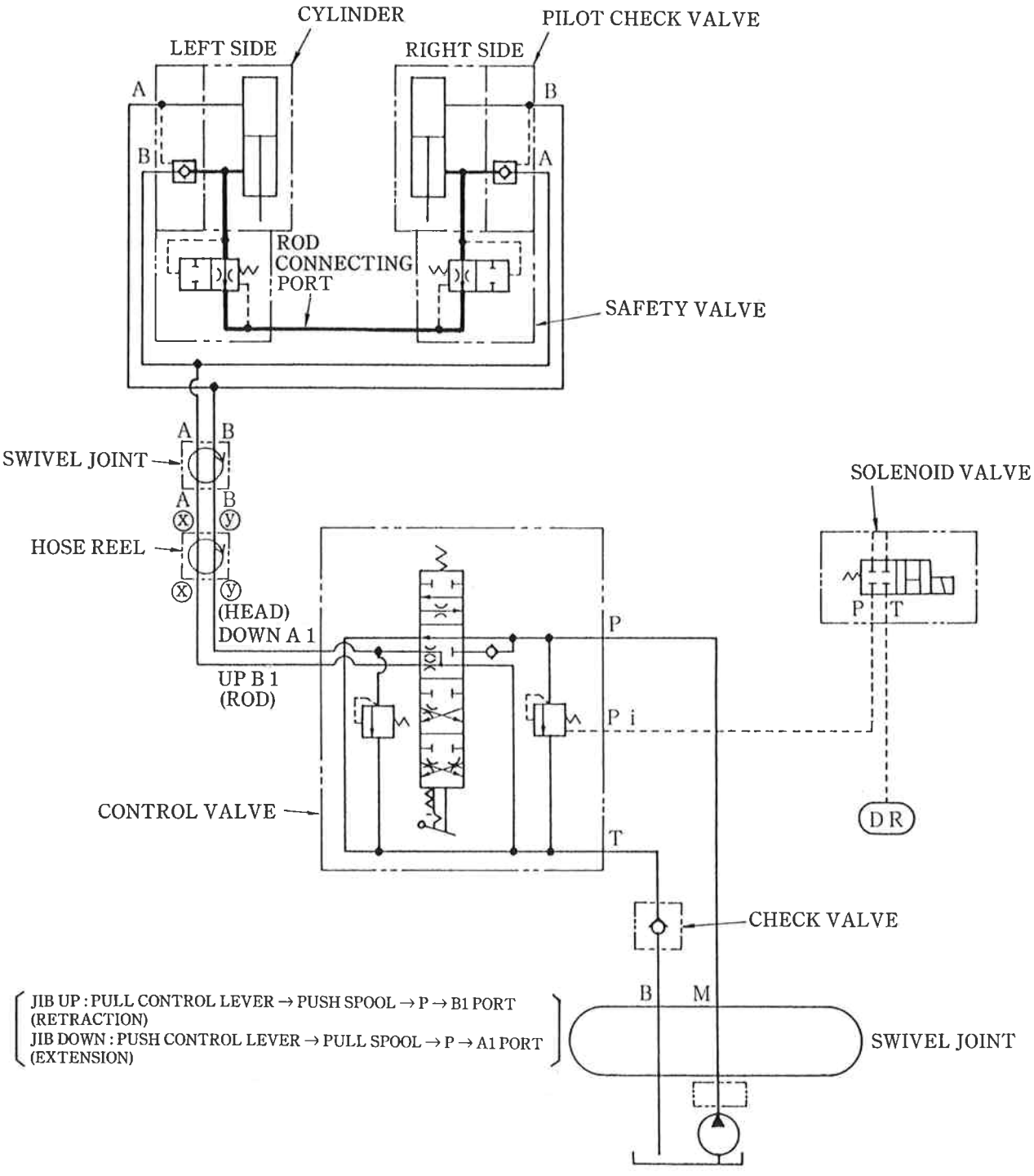


Fig. 2-4 Hydraulic Circuit (Neutral)

The loading pressure (holding pressure) in the cylinder rod side is intercepted by the check of the pilot check valve, and oiltight is held. Even when the check of the pilot check valve is faulty, the pressure is restricted by the spool (neutral semi-open) of the control valve, and holding pressure is not lowered rapidly.

A back pressure check valve (5kg / cm²-71.1 psi) is provided at T port of the control valve and prevent oil in the hose reel from dropping into the tank to diminish occurrence of time lag when the cylinder starts again.

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(4) Function of Safety Valve

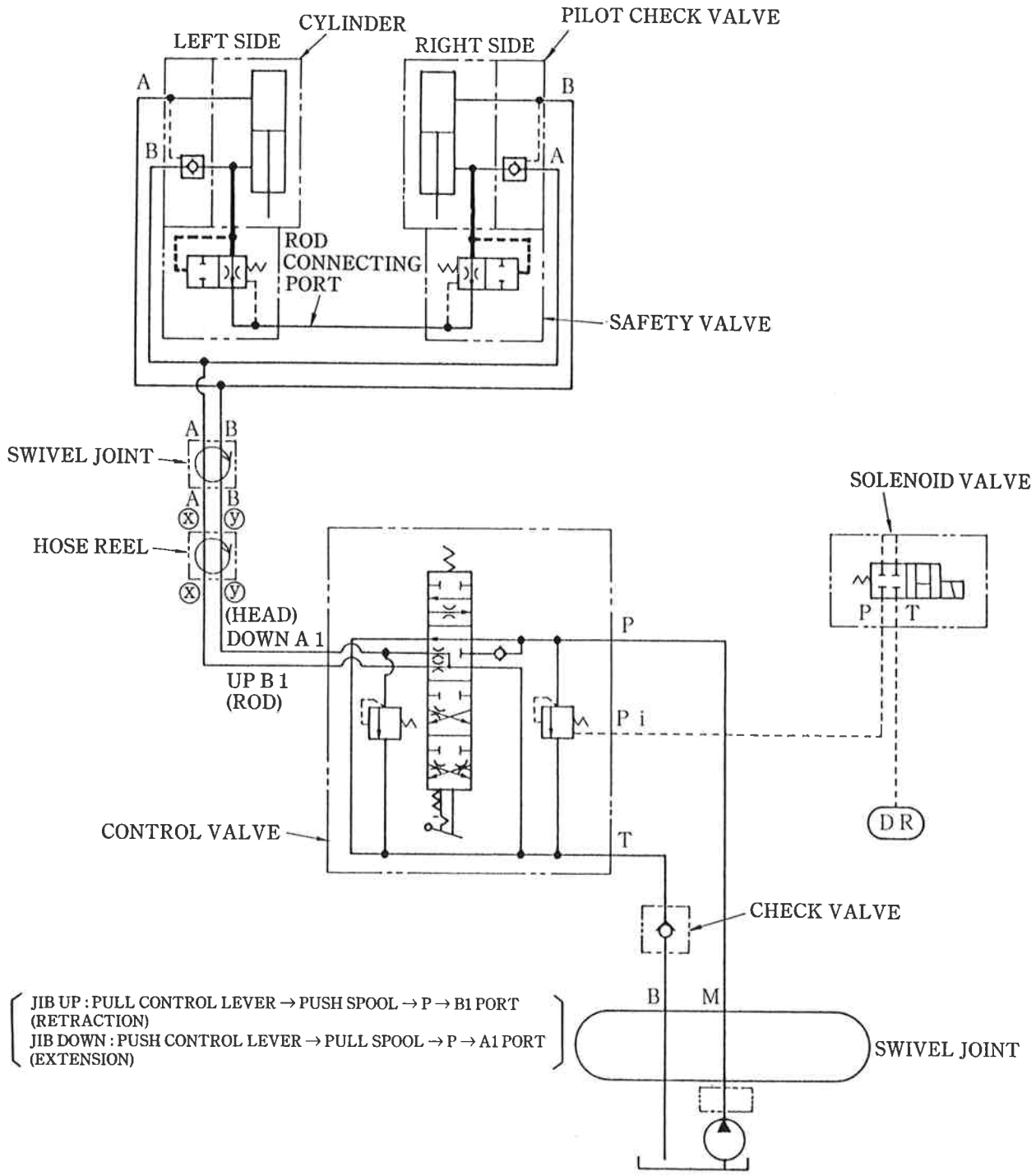


Fig. 2-5 Hydraulic Circuit

The rod connecting port of the left and right cylinders is a necessary port in order to synchronize the left and right cylinders. When this port is damaged, the flow which passes the safety valve is rapidly increased and the safety valve is closed.

(Intercepted flow is 10 ℓ (610 cu. in) / min)
Although the jib is lowered first, the jib is soon stopped, then is not lowered rapidly.

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3. SPECIFICATIONS OF COMPONENTS AND JIB RAISING AND LOWERING SPEEDS

3.1 SPECIFICATION OF COMPONENTS

(1) CYLINDER

Inside diameter of cylinder	100㎜ (3.937in)
Diameter of rod	40㎜ (1.575in)
Stroke	686㎜ (27.01in)

(2) CONTROL VALVE

Relief set pressure	210kg / ㎠ (2986 psi) at 30 ℓ (1.06 cu. ft) / min.
Port relief pressure	75kg / ㎠ (1067 psi) at 30 ℓ (1.06 cu. ft) / min.

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3.2 JIB RAISING AND LOWERING SPEEDS

a. Posture of machine : Outriggers fully extended.
b. Boom length : 30.6m (100.39 ft.) (fully extended)
c. Boom angle : 75°
d. Jib length : 7.5m (24.608 ft.) (one step jib)
e. Load : No load
f. Engine revolution : High idling
g. Temperature of hydraulic oil : 45 to 55℃ (113 to 131°F)
h. Measure the time required for extending the jib tilt cylinder from full retraction (3° offset) to full extension and retracting from full extension (45° offset) to full retraction.

Unit : sec. / full stroke

Jib raising : offset angle 45° → 3°	26 to 30	Measure 3 times and take average of the values.
Jib lowering : offset angle 3° → 45°	45 to 50	

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4. TROUBLESHOOTING

4.1 JIB RELATIONS

	TROUBLE	PROBABLE CAUSE	REMEDY
1	Jib does not rise. (Cylinder does not retract.)	ML is not JIB mode	Set to JIB mode.
		Trouble of electrical system	Repair.
		Faulty automatic stop solenoid valve	Repair or replace.
		Low set pressure of relief valve	Adjust.
		Faulty control valve	Repair or replace.
		Faulty pilot check valve	Repair or replace.
		Internal leak of cylinder	Repair or replace.
2	Jib does not lower. (Cylinder does not extend.)	M / L is not JIB mode	Set to JIB mode.
		Trouble of electrical system	Repair.
		Faulty automatic stop solenoid valve	Repair or replace.
		Low set pressure of relief valve or overload relief valve	Adjust.
		Faulty control valve	Repair or replace.
		Faulty pilot check valve	Repair or replace.
3	Jib retracts by itself during operation.	External leak from connectors of cylinder, valves and piping	Repair.
		Faulty pilot check valve	Repair or replace.
		Internal leak of cylinder	Repair or replace.
4	Left and right cylinders do not synchronize.	Faulty safety valve	Repair or replace.

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4.2 TREATMENT FOR BREAKDOWN OF SKY TILT HOSE

When the hose is broken during sky tilt operation, take the following steps.

As mentioned in section 2 Construction and Function, the jib does not lower for breakdown of hoses other than the rod connecting port. Even when the rod connecting port hose is broken, the jib lowers first but soon stop as mentioned before. Then the jib does not lower rapidly, so take the following steps :

(1) When a load is suspended, lower the load onto a safe place by operation (mainly load lowering and swinging) other than tilt operation.
In this case, boom lowering is a operation toward a overload, so be careful sufficiently for overload.

CAUTION

Since tilt operation allows oil to spout, absolutely never apply tilt operation.

(2) Retract the boom fully. At this time, some oil enters by back pressure of the tank, and some oil leaks from the hose. Therefore, when retracting the boom, decrease engine speed to prevent relieving by retracting, and proceed work efficiently.

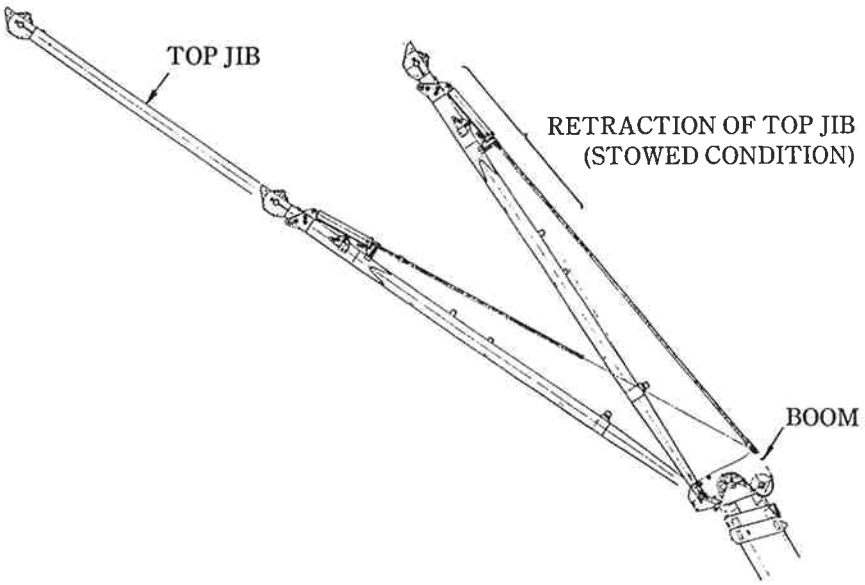


Fig. 4-1 Retracted Boom and Stowed Top Jib

(3) When the top jib is extended, stow the top jib.

(4) Lower the boom until the jib tip reaches the ground to remove tension from the suspension rod.

When placing the jib tip on the ground, take care of ground or place wooden blocks not to damage the jib point.

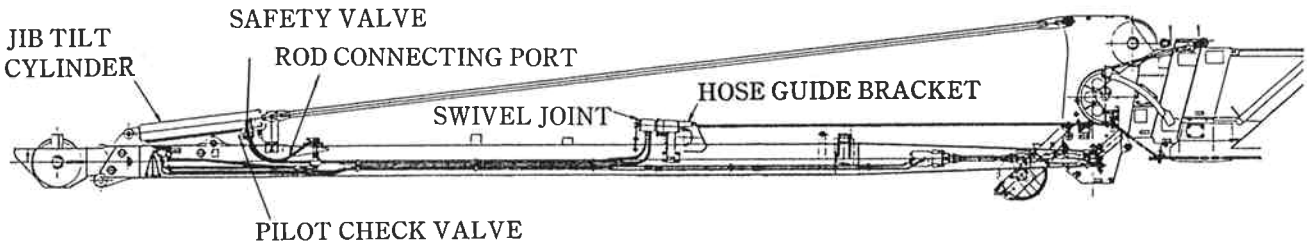


Fig. 4-2

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(5) Stop the engine.

NOTE

With this condition, replace the piping and hoses around the tilt cylinder.

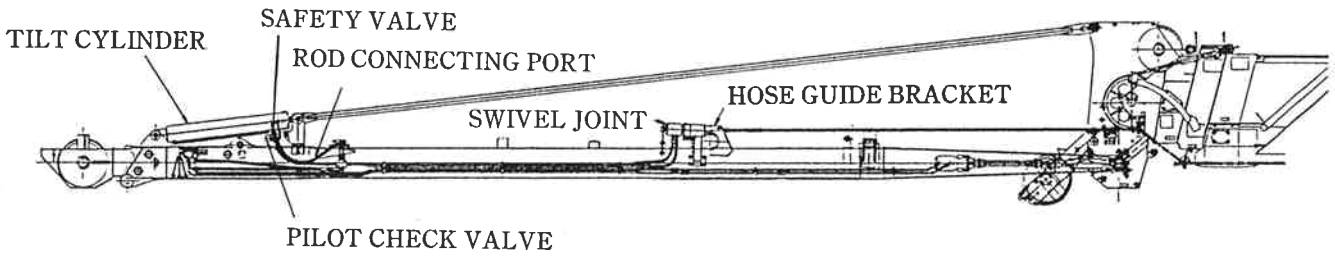


Fig. 4-3

When the hose of the hose reel is damaged with the jib tilt cylinder extended and a large jib offset angle, the height of the boom point above the ground is too high to replace the hose, so lower the height of the boom as follows :

Since the piping is removed, store the oil in a waste oil can.

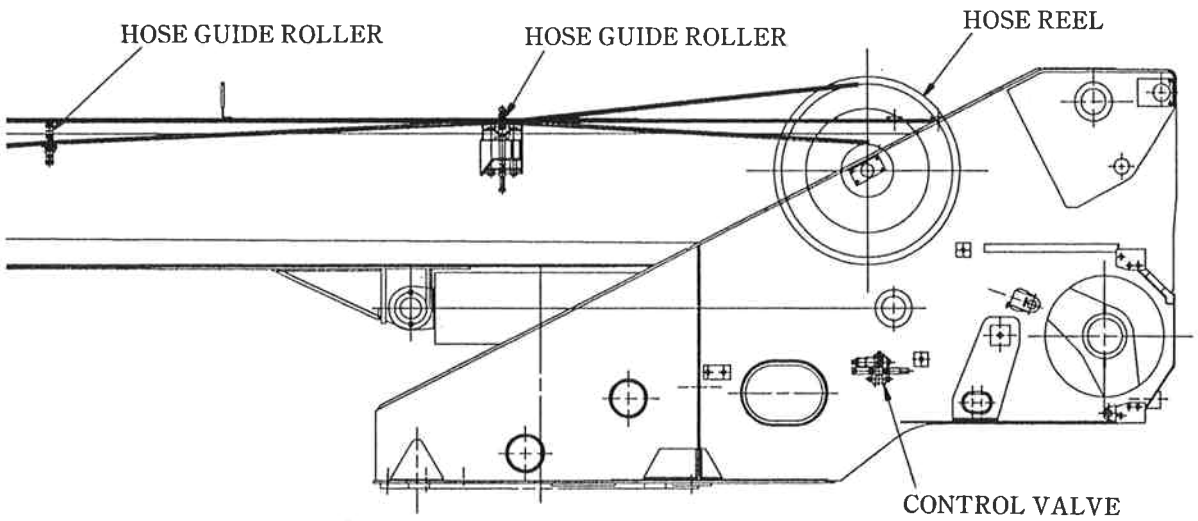


Fig. 4-4

(6) Start the engine, and raise the boom until the height of the jib point is approx. 50cm (19 11 / 16″) above the ground.

(7) Raise the auxiliary hook until it contacts the boom point to remove tension from the suspension rod.
Then, engage the auxiliary winch drum lock.

(8) With the auxiliary hook contacted to the boom point, lower the boom until the jib point is placed on the ground. When lowering the jib on the ground, place wooden blocks under the jib point not to damage the jib point.

(9) Stop the engine.

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(10) After the wire cable for the cylinder extension meter is removed, remove the connecting pins which connect the rod sides of the tilt cylinders and the suspension rods (two places of the left and right).

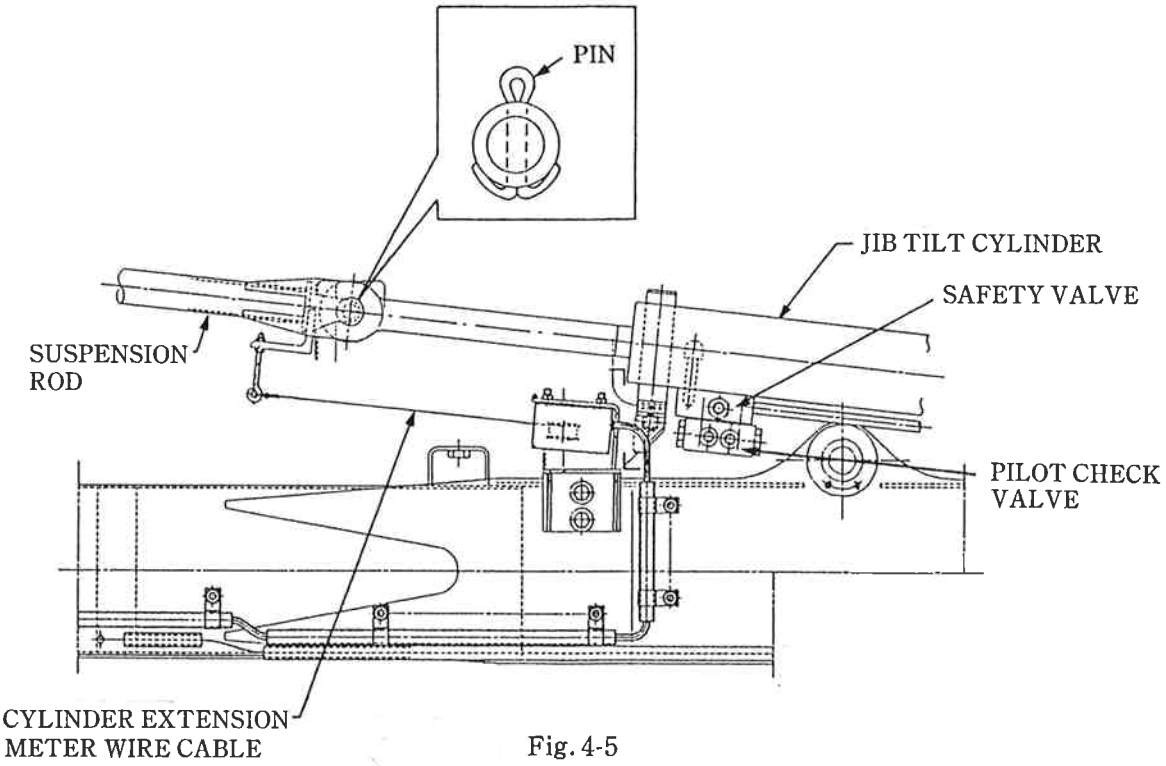


Fig. 4-5

(11) Start the engine, and raise the boom. After raising the jib point from the ground, while extending the boom slowly, lower the boom so that the boom and the jib become horizontal, then lower the jib point on the ground. When lowering the jib on the ground, place wooden blocks.

CAUTION : Becareful not to allow the tip of the suspension rod to be caught by the tilt cylinder and the outer jib.

(12) Stop the engine, and replace the hose(s).

(13) Install the connecting pins of the tilt cylinders and suspension rods which were removed in step (10).

CAUTION : At this time, split the cotter pin into anchor shape as shown below to prevent the cotter pin from moving laterally (to prevent biting the cylinder supporting bracket).

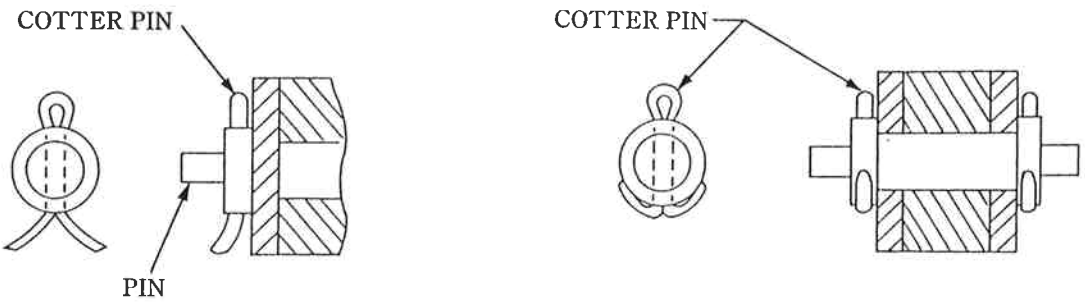


Fig. 4-6

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(14) After repair has been completed, operate the tilt cylinder several times to bleed air.

When the machine is brought into a service shop to be repaired, take the following steps :

(15) Remove the tilt cylinders and suspension rods from the jib (with the procedures in steps (6) to (11)). Cover the openings after the hoses, etc. have been removed.

(16) Stow the jib on the side face of the boom.

(17) Raise the boom to approx. 30 degrees, and stop the engine.

(18) Remove plug (ZE72X06000) of the return tube to the swivel joint, and install 90° elbow (ZH 32X06000) (see Fig. 4-7).

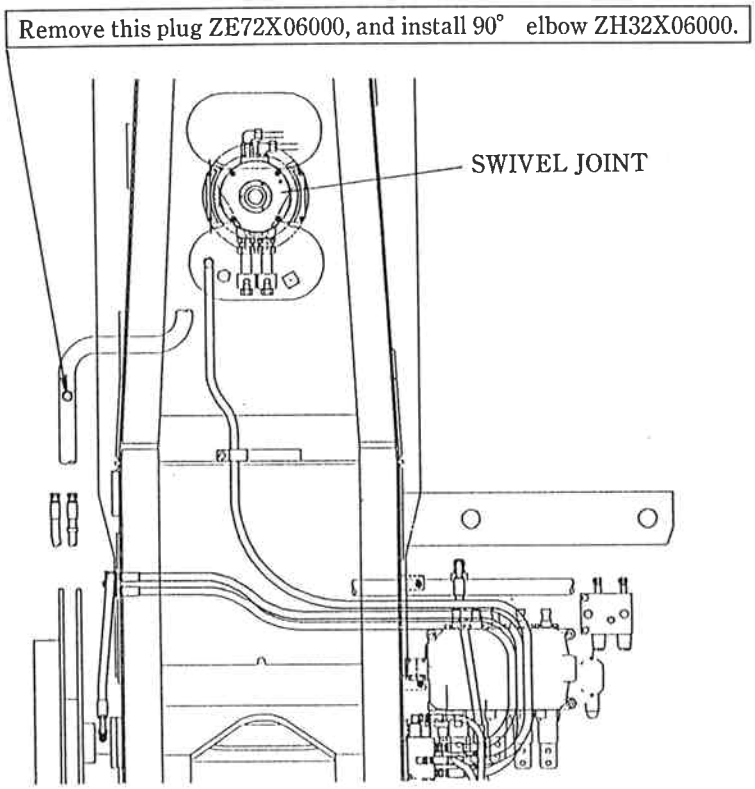


Fig. 4-7

CAUTION

In the case that the tilt cylinder has been replaced with a new one, bleed air from the cylinder with the following procedures.

1. When the jib is extended.
   Allow the tilt cylinder to go to and return from the stroke end several times to bleed air.
2. When the jib is stowed.
   If air exists in the rod side of the cylinder, the cylinder extends sometimes due to back pressure to damage the suspension rod mounting bracket.
   Before starting the engine, take the following steps.

A. Turn the PTO on.
B. Set the ML mode to the JIB EXTENSION mode. Or raise the interceptive lever for on and off to the traveling position.
C. Place the tilt lever in the Raising position in detent (fix).
D. Start the engine with this condition, and hold for approximately three minutes to fill oil in the rod side of the cylinder.
E. Then, before extending the jib and operating work, bleed air by the procedure of step 1.

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(19) Remove the tilt control valve from port M and the connector of the hose at the control valve side of the hose which reaches the pump port, and connect the hose from port M of the swivel joint to the 90° elbow mentioned above.
Cover P port of the control valve.
By this, the pressure supply port to the tilt control valve is interrupted, swivel port M is bypassed to the return.

(20) Remove the return tube side of the tank port hose of the tilt control valve, and remove return tube side connector (ZH32X08012), then install plug ZE72X12000. Cover the hose side.
By this, the tilt control valve does not receive back pressure from the return, so oil does not leak from the damaged section of the hose.

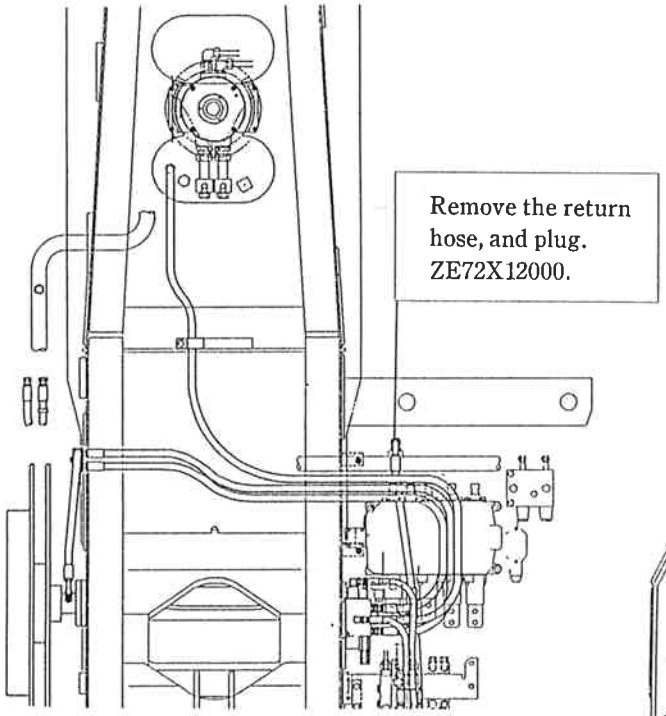


Fig. 4-8

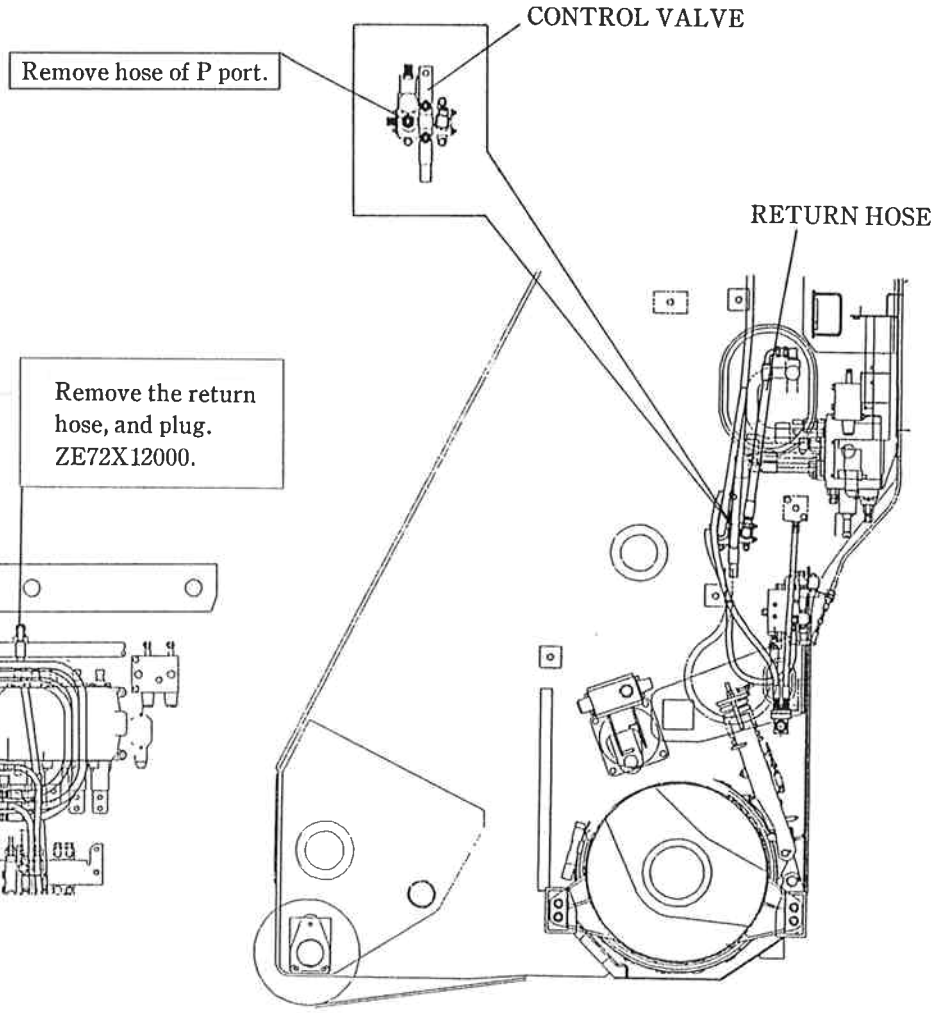


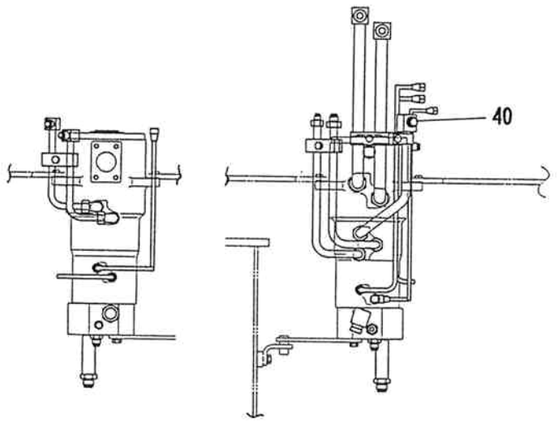
Fig. 4-9

(21) Take the above measures, then move the machine to the service shop.

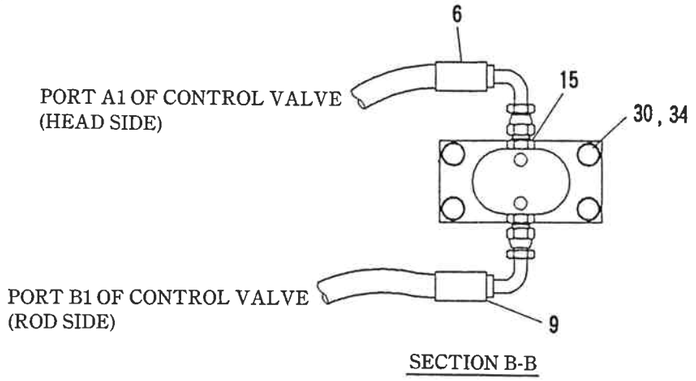
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4.3 PIPING ASSEMBLY SCHEMATIC (Refer to Fig. 4-9)

This figure shows the part numbers at the times this manual was arranged.

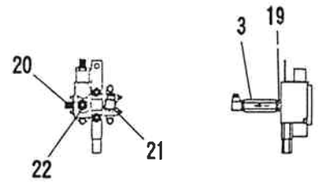


VIEW FROM C

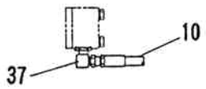


SECTION B-B

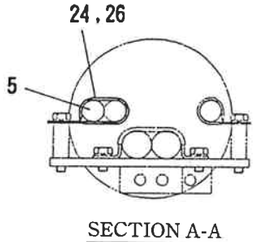
TIGHTENING TORQUE : 8±0.8kg · m (57.8±5.8ft-lbs)



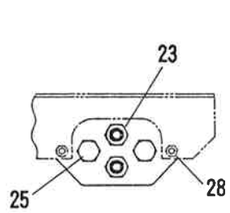
DETAIL OF TILT VALVE



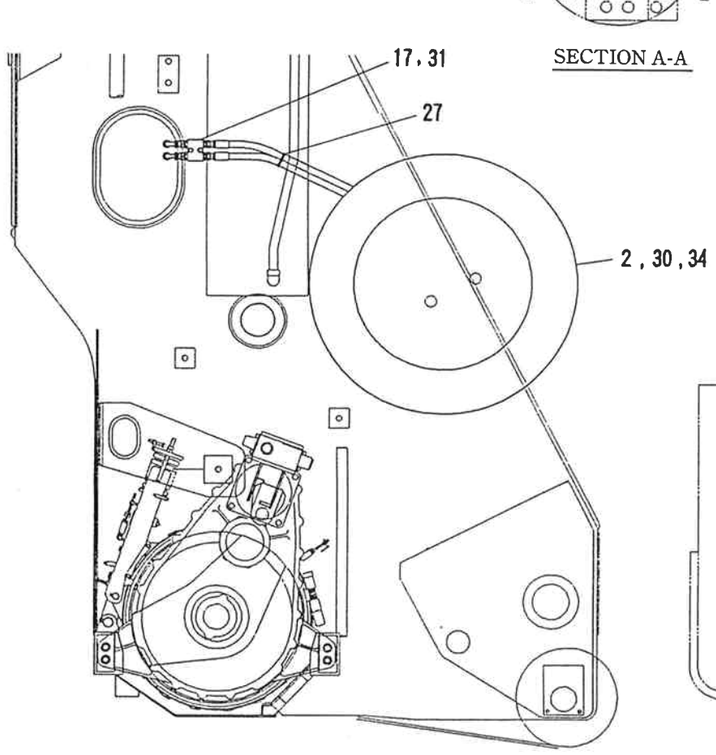
SECTION E-E

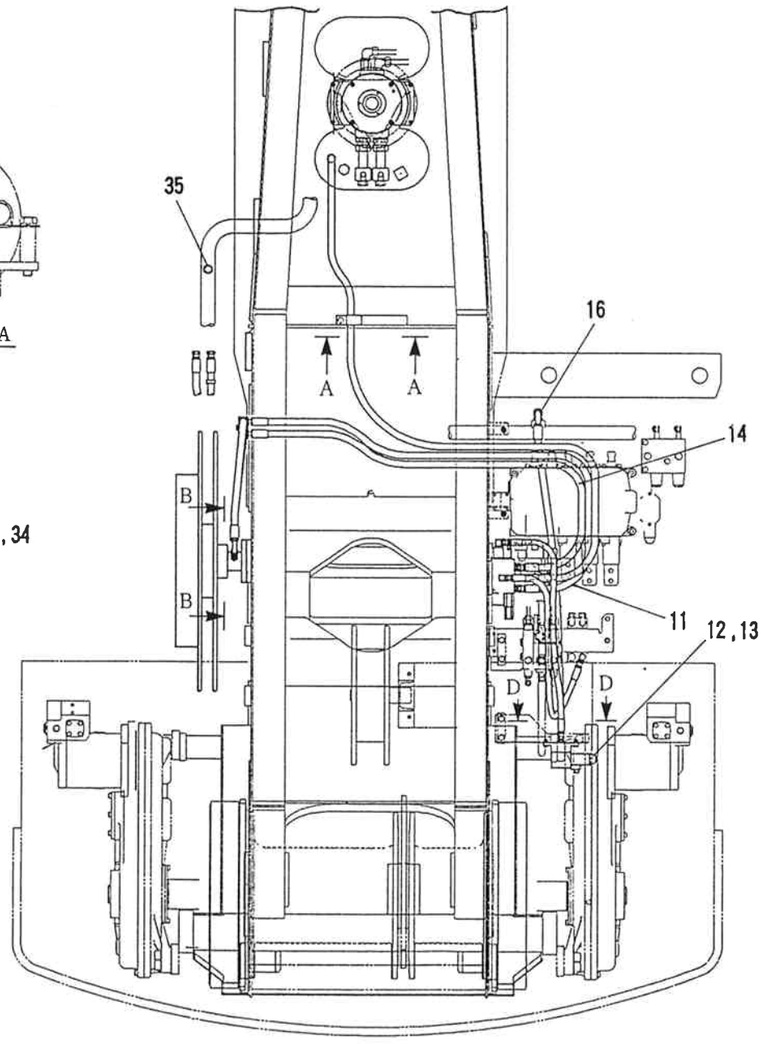


SECTION A-A



SECTION D-D





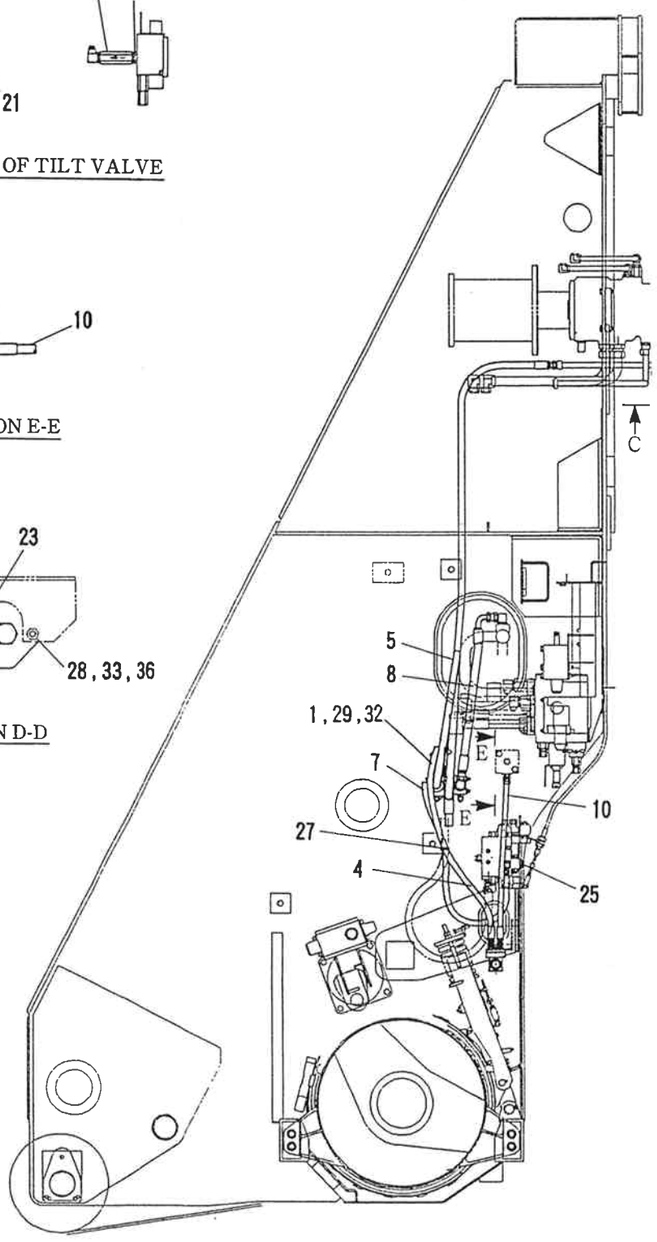
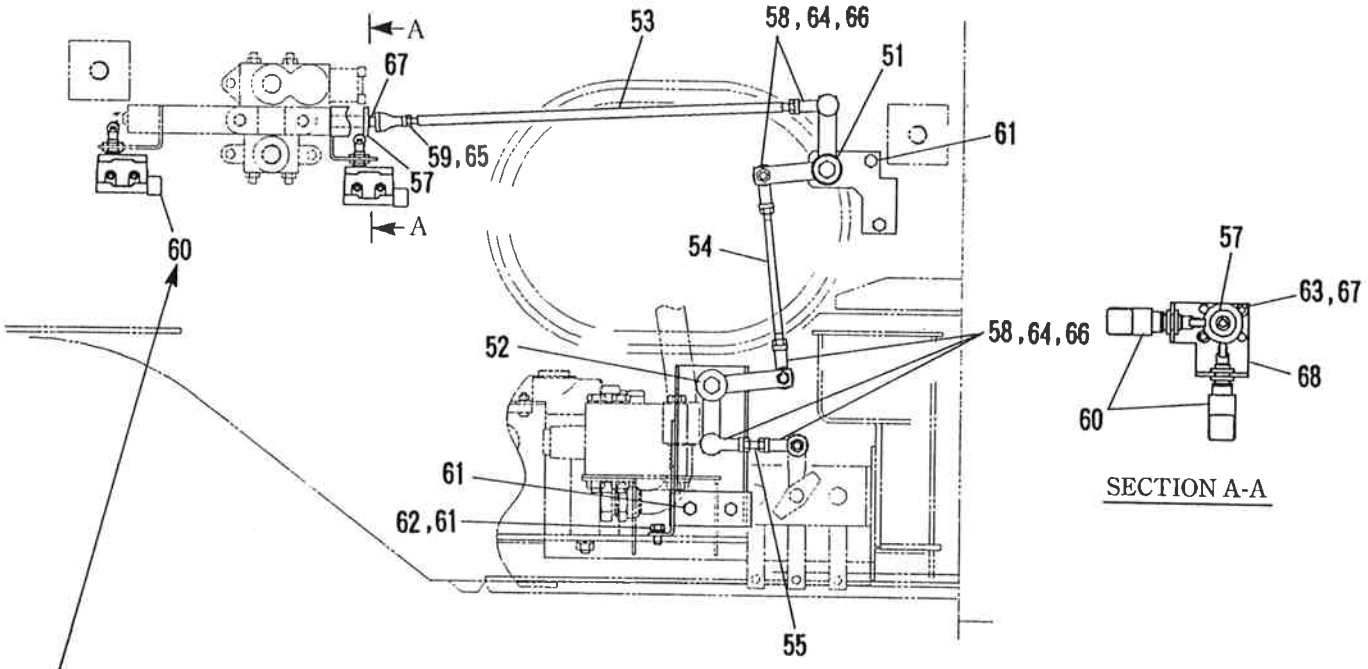


Fig. 4-10 Piping Assembly (1 / 2)

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Limit Switch Wiring and Operation Matrix

	Symbol of Contact	Operation of limit switch	Output against solenoid valve
Detent detecting limit switch	NO	Do not push. DE-TENT UP NEU. DOWN	ON OFF DE-TENT UP NEU. DOWN

	Symbol of Contact	Operation of limit switch	Output against solenoid valve
Upper limit switch	NO	Do not push. UP NEU.	ON OFF UP NEU.
Lower limit switch	NO	Do not push DOWN	OFF ON DOWN

Fig. 4-10 Piping Assembly (2 / 2)

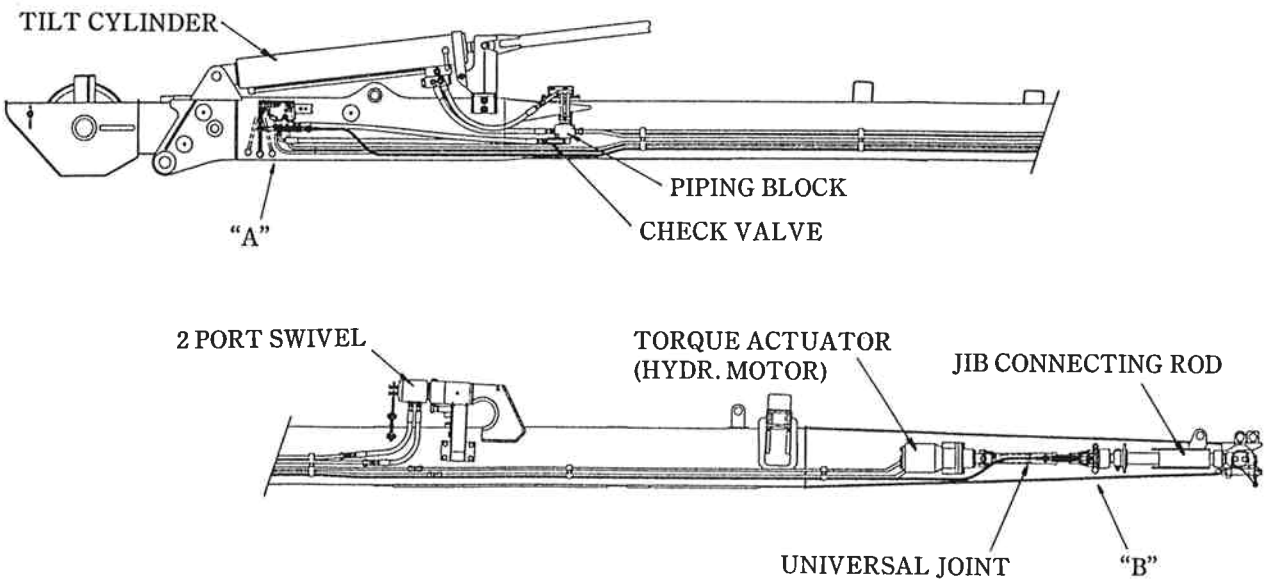
1. CONTROL VALVE
2. HOSE REEL
3. CHECK VALVE
4. HOSE ASSEMBLY
5. HOSE ASSEMBLY
6. HOSE ASSEMBLY
7. HOSE ASSEMBLY
8. HOSE ASSEMBLY
9. HOSE ASSEMBLY
10. HOSE ASSEMBLY
11. HOSE ASSEMBLY
12. SOLENOID VALVE
13. PLATE
14. HOSE ASSEMBLY
15. CONNECTOR
16. 90° ELBOW
17. BLOCK
19. CONNECTOR
20. 90° ELBOW
21. 90° ELBOW
22. CONNECTOR
23. CONNECTOR
24. WASHER
25. PLUG
26. CLAMP
27. CLAMP
28. CAPSCREW
29. CAPSCREW
30. CAPSCREW
31. SEMS BOLT
32. LOCKWASHER
33. LOCKWASHER
34. LOCKWASHER
35. PLUG
36. NUT
37. 90° ELBOW
40. TUBE
51. LINK ASSEMBLY
52. LINK ASSEMBLY
53. ROD
54. ROD
55. ROD
57. CAM
58. BALL JOINT
59. BALL JOINT
60. LIMIT SWITCH
61. SEMS BOLT
62. WASHER
63. CAPSCREW
64. NUT
65. NUT
66. LOCKWASHER
67. LOCKWASHER
68. BRACKET

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II POWER TWIST SYSTEM

5. LOCATION OF COMPONENTS AND OUTLINE

5.1 LOCATION OF COMPONENTS



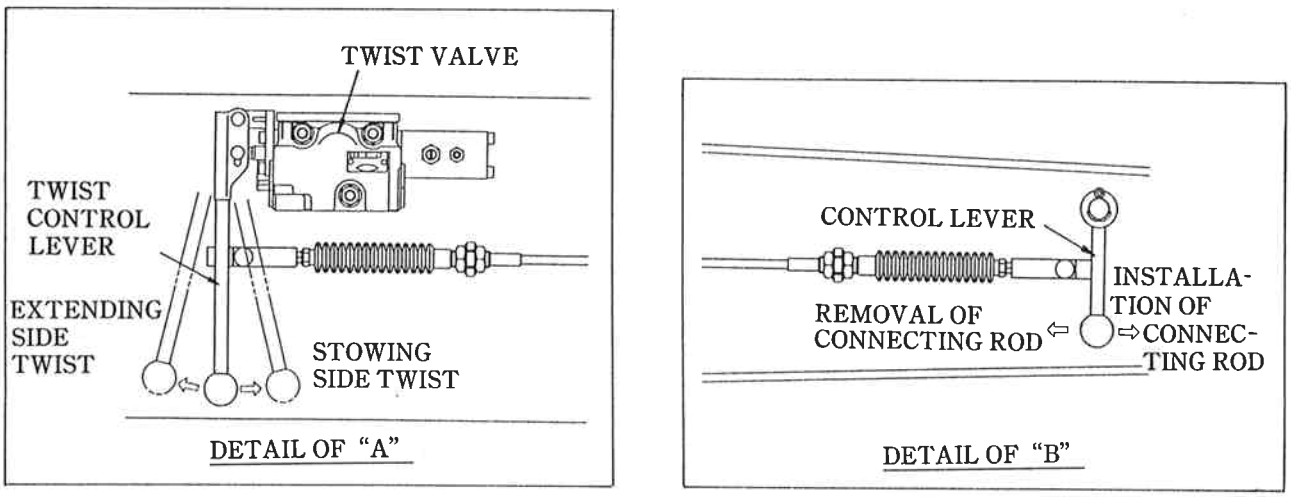


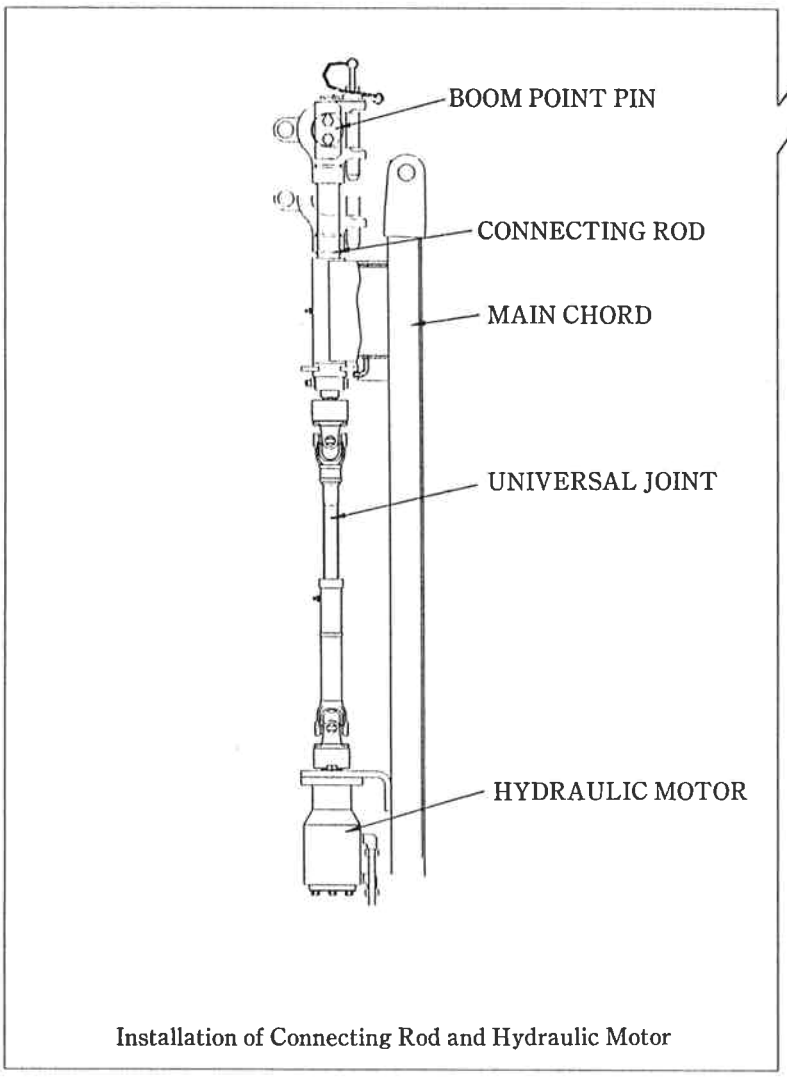
Fig. 5-1

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5.2 OUTLINE

The torque actuator (hydraulic motor) is mounted on the bracket in the base end of the left side main chord of the outer jib, and its output shaft and the jib connecting rod end are connected with a slide type universal joint.

The output torque of this torque actuator is transmitted to the jib connecting rod, and the jib itself rotates (power twists) through the connector connected to the boom point pin.



Installation of Connecting Rod and Hydraulic Motor

As for hydraulic power supply, pressurized oil distributed from the piping block enters the twist valve, and its flow is controlled.

〔When the tilt control lever is placed in the neutral position, the connecting rod can be turned by hand.〕

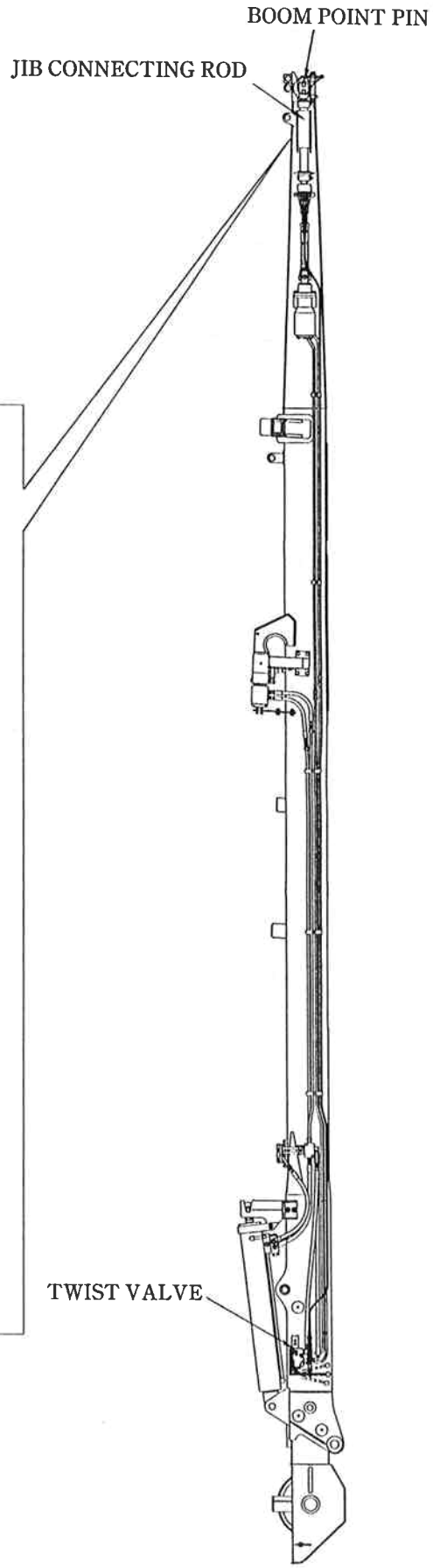


Fig. 5-2
Power Tilt Jib Assembly

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6. CONSTRUCTION AND FUNCTION

6.1 HYDRAULIC CIRCUITS

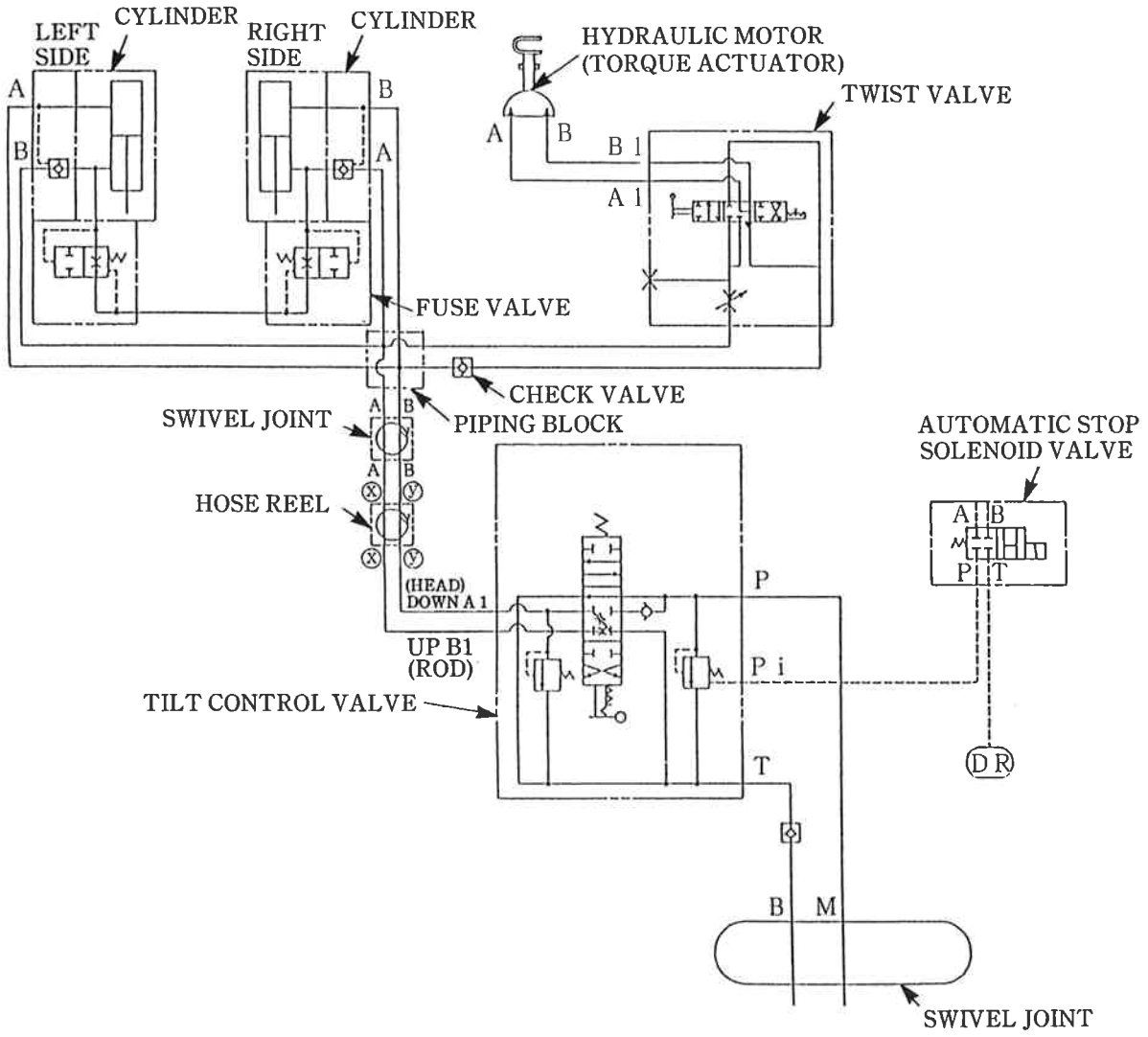


Fig. 6-1 Hydraulic Circuit (Power Twist Sky Tilt)

JIB EXTENSION : PULL CONTROL LEVER → PULL SPOOL → P → B1 PORT → MOTOR B PORT
(MOTOR RIGHT TURN, LOOKING FROM JIB POINT SIDE)
JIB STOWING : PUSH CONTROL LEVER → PUSH SPOOL → P → A1 PORT → MOTOR A PORT
(MOTOR LEFT TURN)

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Since the power twist is carried with the use of the hydraulic power supply of the sky tilt system, the hydraulic circuit is arranged as follows :

- A piping block is provided between the two port swivel of the sky tilt piping and the tilt cylinder, and the rod side and head side pipings, which branch from the block, are connected to the pump port and tank port of the twist valve respectively.

- The cylinder rod side port and the twist valve pump port are connected. To operate the torque actuator, move the tilt lever in the operator's seat to the RAISING side to detent in (fix the lever in the RAISING position) to send pressurized oil to the pump port of the twist valve. At this time, pressurized oil is also sent to the tilt cylinder rod side, but the tilt cylinder is fully retracted, so the pressure in the rod side circuit is raised upto the relief pressure.

- A flow control valve is provided at the inlet of the twist valve pump port, and controls the operating speed of the torque actuator at a constant speed.

- A check valve is provided between the twist valve tank port and the piping block, and prevents the pressurized oil, which generates when the tilt cylinder is extended, from flowing into the tank port of the twist valve. (Prevention of damage to the seal.)

- Since port A, port B and port T are connected with the twist valve in the neutral position, the output shaft of the torque actuator can be turned by a force from the outside in the neutral position.

6.2 FUNCTION

(※1) To send pressurized oil to the torque actuator to twist the jib, turn the PTO on, and raise the interceptive lever for on and off up to the traveling position.

(2) Move the tilt lever to the RAISING side fully to detent in.

↓

Pressurized oil is not sent to port P of the twist valve until this condition is set.

(3) By moving the control lever of the twist valve to the EXTENDING direction or STOWING direction, pressurized oil is sent to the torque actuator from the twist valve to rotate the output shaft, and the jib is power-twisted.

(4) After twisting has been completed, return the twist valve to the neutral condition. With this condition, the outlet / inlet ports and the tank port are connected, so the torque actuator can be turned by a force from the outside. (The jib can be twisted manually.)

(※1) When the interceptive lever for on and off is placed in the crane operating position, set the ML mode in the JIB EXTENSION or JIB STOWING mode.

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Since the power twist is carried with the use of the hydraulic power supply of the sky tilt system, the hydraulic circuit is arranged as follows :

- A piping block is provided between the two port swivel of the sky tilt piping and the tilt cylinder, and the rod side and head side pipings, which branch from the block, are connected to the pump port and tank port of the twist valve respectively.

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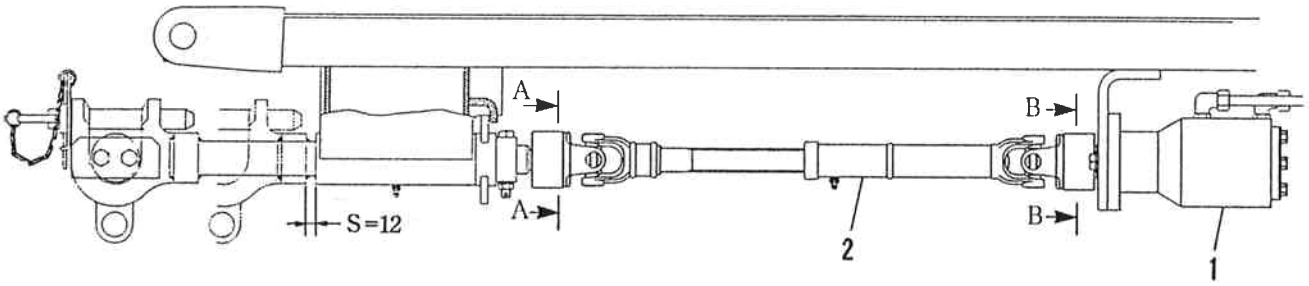
6.3 INTERLOCK

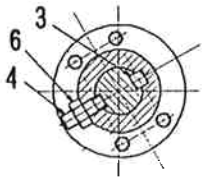
With the interceptive lever for on and off is placed in the CRANE position (lowered) and with the work mode set in a mode other than JIB EXTENSION, JIB STOWING and JIB WORK modes, when the tilt lever is set in the RAISING side, the automatic stop solenoid valve is magnetized at the same time the alarm sounds, the vent circuit (Pi) of the tilt control valve relief valve is connected to the drain, pressurized oil from the pump returns to the tank, pressurized oil from the tilt control valve cannot be supplied, and power twist and sky tilt cannot be operated. (This prevents the tilt lever from forgetting returning to the neutral position after the jib extension or stowing.)

Besides, when the interceptive lever for on and off is placed in the traveling position (raised), placing the tilt lever in the RAISING (detent in) makes the pressure power supply for power twist possible.

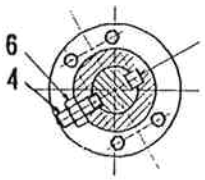
6.4 DETAIL OF TWIST MOTOR (TORQUE ACTUATOR) MOUNTING

1. Apply grease which contains molybdenum disulphide to the rod bearing section and the splined section of the universal joint.





SECTION A-A



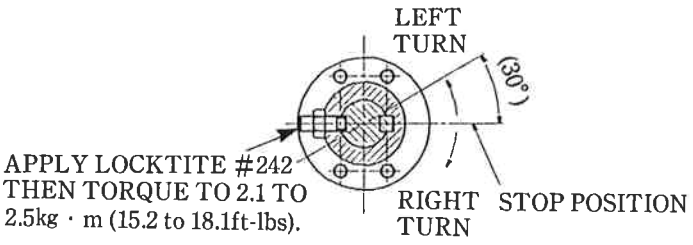
SECTION B-B

2. Installing Procedure of Universal Joint (2)

(1) Set the jib connecting rod to the boom point pin.

(2) Install universal joint (2) to the motor (1) side with the key (attached part to the motor), and secure with set screw (4) to lock it.

(3) Turn the shaft of motor (1) clockwise looking from section B-B direction until it stops (see the right figure).



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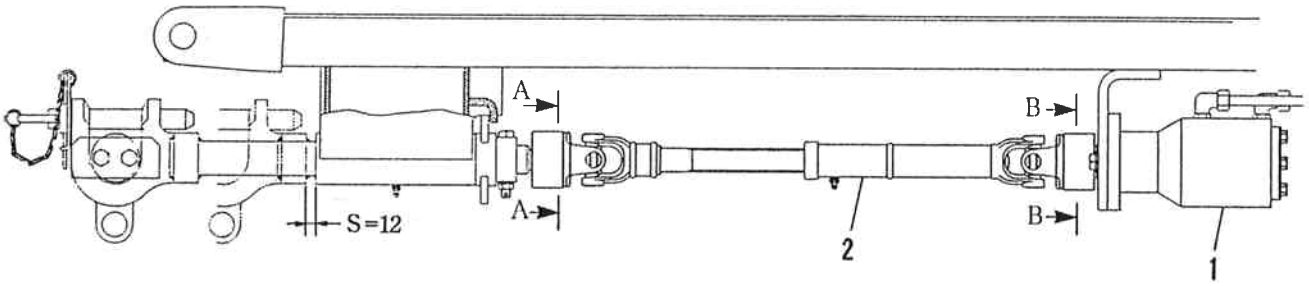
6.3 INTERLOCK

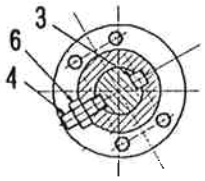
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Besides, when the interceptive lever for on and off is placed in the traveling position (raised), placing the tilt lever in the RAISING (detent in) makes the pressure power supply for power twist possible.

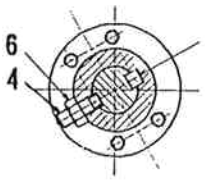
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SECTION A-A



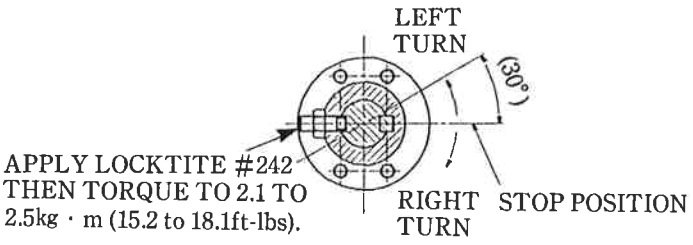
SECTION B-B

2. Installing Procedure of Universal Joint (2)

(1) Set the jib connecting rod to the boom point pin.

(2) Install universal joint (2) to the motor (1) side with the key (attached part to the motor), and secure with set screw (4) to lock it.

(3) Turn the shaft of motor (1) clockwise looking from section B-B direction until it stops (see the right figure).



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(4) Return counterclockwise (left turn) approximately 30° from the above stop position. Install universal joint (2) to the connecting rod side with key (3), and secure with setscrew (4) to lock it securely.

(5) Retract the connecting rod (s=12mm), and confirm that the sliding section of universal joint (2) does not push the bottom.

3. Air Bleeding Procedure

After extending the boom approximately 50cm (19.7in), with the connecting rod extended fully, operate the torque actuator to go to and return from the stroke end several times.

The torque actuator moves each 330° to the left and right.

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7. SPECIFICATIONS OF COMPONENTS AND JIB TWISTING SPEED

7.1 SPECIFICATIONS OF COMPONENTS

(1) TWIST CONTROL VALVE

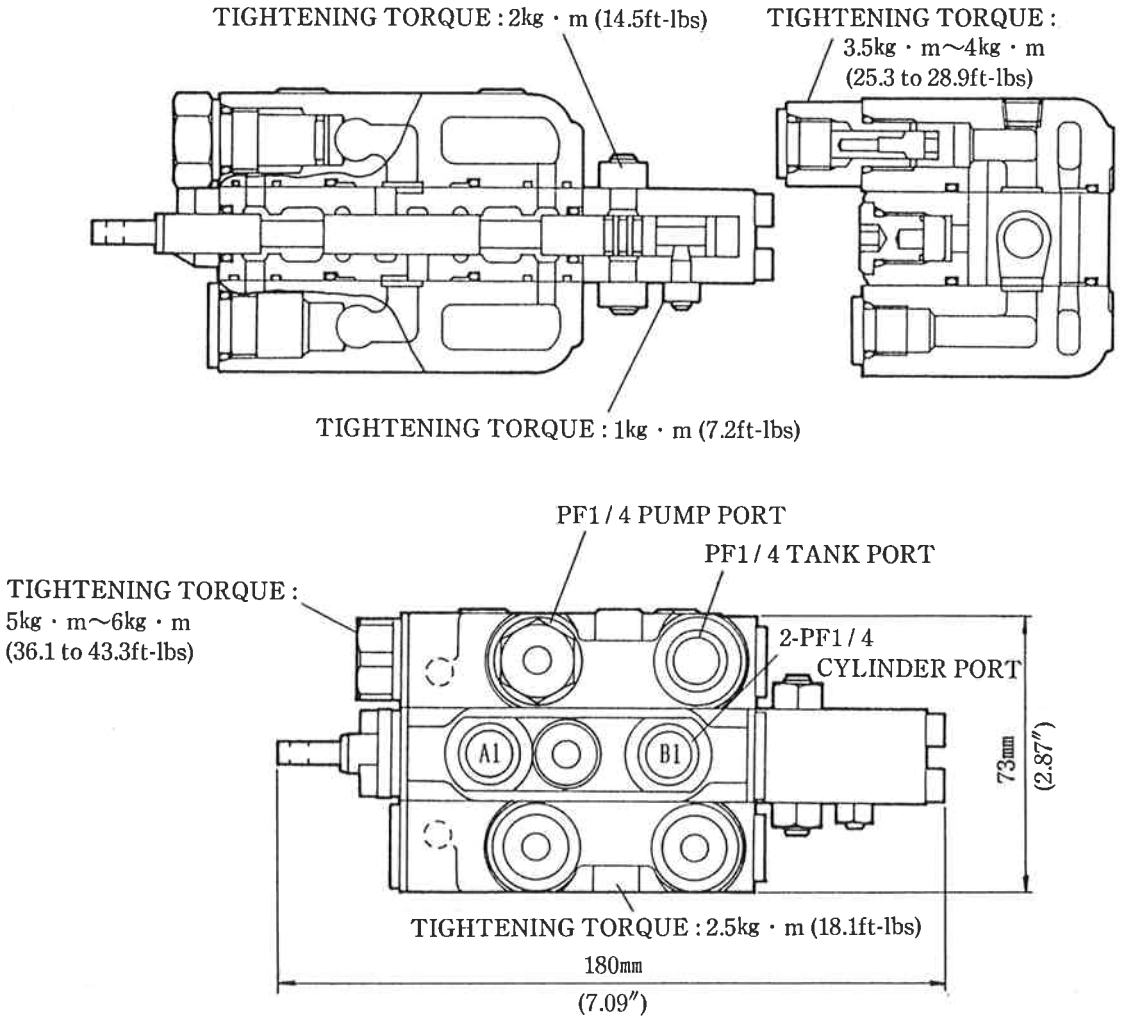


Fig. 7-1

Specification of Valve

- Rated pressure : 210kgf / cm² (2986 psi)
- Rated flow : 10 ℓ (0. 35 cu. ft) / min
- Spool transfer : Less than 10cc (0.61 cu. in) / min
  at 100kgf / cm² (1422 psi) with 37cst of oil viscosity.
- Allowable tank back pressure : Less than 10kgf / cm² (142 psi)
- Using oil : General mineral hydraulic oil.
- Using temperature range : -20 to +80℃ (-4 to 176°F)

Using Conditions

- Using pressure : 210kgf / cm² (2986 psi)
- New flow : 480 to 550cc (29.3 to 33.5 cu. in) / min
  at 100kgf / cm² (1422 psi) (ambient temperature 35℃-95°F)
- Using oil : VG32 or VG46 equivalent
- Max. using temperature of actual results : +90℃ (194°F) (in an instant)

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(2) HYDRAULIC MOTOR (TORQUE ACTUATOR)

Construction

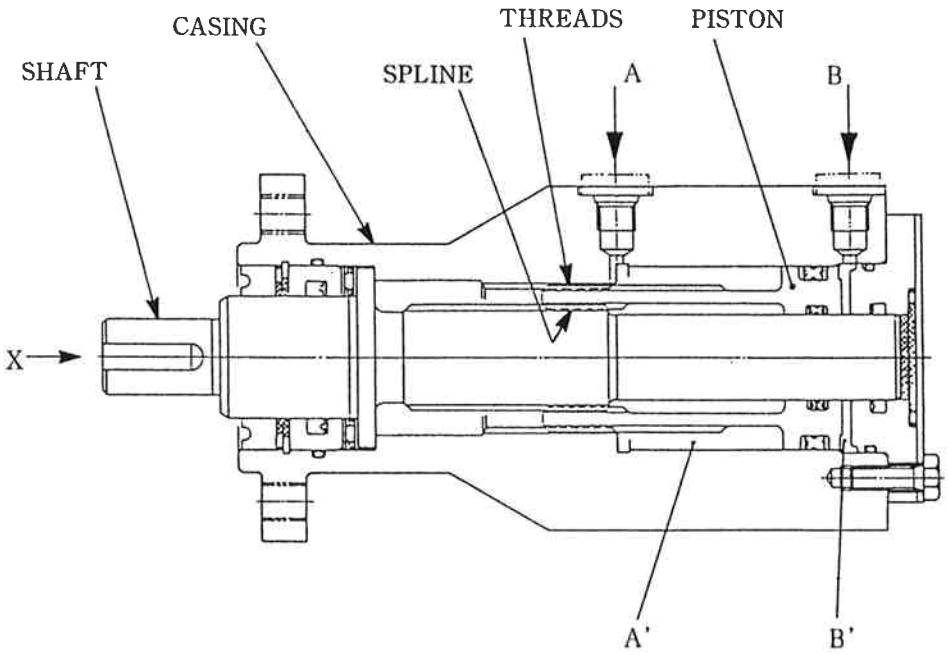


Fig. 7-2

The construction is shown in Fig. 7-2.

The external circumference is of trapezoidal thread, and the internal circumference is of spline. The internal circumference of the casing is machined to trapezoidal threads, and the external circumference of the shaft is machined to spline. When pressurized oil is led to chamber B' from port B, while the piston is rotating by the thread mechanism, it moves to the left by this hydraulic pressure. This rotation is transmitted to the shaft by the spline machined to the inside of the piston, and necessary torque can be taken out.

Besides, when pressurized oil is led to chamber A' from port A, the piston moves to the right, and the reverse rotation of the shaft can be taken out with the same principle as the above.

Rotating Direction

When oil is supplied through port A : Right turn looking from × direction.

When oil is supplied through port B : Left turn looking from × direction.

Regarding disassembly and assembly, see the separate shop manual.

7.2 JIB TWISTING SPEED

With the boom extended by approximately 30cm (1ft) with the jib stowed condition, draw out the jib connecting rod. Set the connecting rod condition so that the rod does not touch the boom even by turning the rod, then measure the time required for rotation.

Wall temperature of twist valve	Time for full stroke (330°)
0℃	36 sec.
30℃	15 sec.
50℃	11 sec.

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(2) HYDRAULIC MOTOR (TORQUE ACTUATOR)

Construction

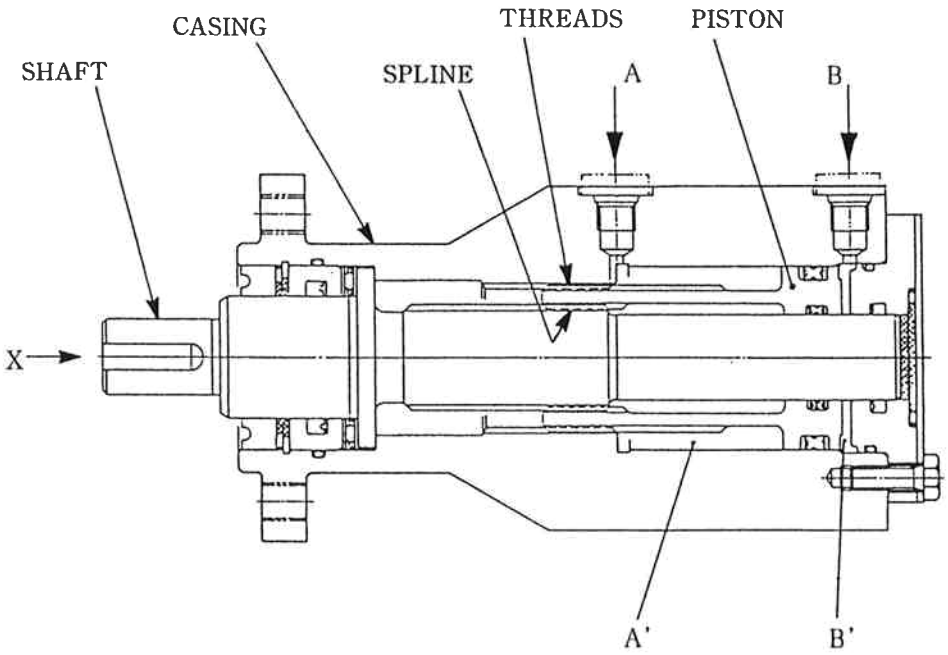


Fig. 7-2

The construction is shown in Fig. 7-2.

The external circumference is of trapezoidal thread, and the internal circumference is of spline. The internal circumference of the casing is machined to trapezoidal threads, and the external circumference of the shaft is machined to spline. When pressurized oil is led to chamber B' from port B, while the piston is rotating by the thread mechanism, it moves to the left by this hydraulic pressure. This rotation is transmitted to the shaft by the spline machined to the inside of the piston, and necessary torque can be taken out.

Besides, when pressurized oil is led to chamber A' from port A, the piston moves to the right, and the reverse rotation of the shaft can be taken out with the same principle as the above.

Rotating Direction

When oil is supplied through port A : Right turn looking from × direction.

When oil is supplied through port B : Left turn looking from × direction.

Regarding disassembly and assembly, see the separate shop manual.

7.2 JIB TWISTING SPEED

With the boom extended by approximately 30cm (1ft) with the jib stowed condition, draw out the jib connecting rod. Set the connecting rod condition so that the rod does not touch the boom even by turning the rod, then measure the time required for rotation.

Wall temperature of twist valve	Time for full stroke (330°)
0℃	36 sec.
30℃	15 sec.
50℃	11 sec.

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8. TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Torque actuator does not turn.	PTO is not turned on.	Turn PTO on.
	Interceptive lever for on and off is placed in CRANE control position.	Raise interceptive lever up to TRAVEL position.
	Tilt lever in operator's seat is not in detent for RAISING side.	Raise tilt lever up in detent of RAISING side. At this time limit switches for RAISING side and DETENT must be pushed. Do not push limit switch for LOWERING side.
	Pressurized oil is not supplied.	· Check tilt control valve relief valve. · Check twist control valve flow control valve for dust biting. · Check automatic stop solenoid valve, etc.
	Seizure of sliding section. Damage of bearing, etc.	Disassembly and repair, or replace.
Insufficiency of rotating speed.	Supplied oil flow is insufficient.	Check or replace twist control valve flow control valve.
	Internal leak.	Replace seal.
It takes time to start rotation.	Air exists in circuit and torque actuator.	Operate actuator to go to and return from stroke end about five times to bleed air.

NOTE : Even when the torque actuator does not rotate with hydraulic pressure, if the torque actuator is not mechanically out of order, by placing the twist control valve in the neutral position, the jib can be twisted by an outside force.

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1. OUTLINE OF ELECTRICAL SYSTEM

1.1 GENERAL

Fig. 1-1 shows the entire electrical system.

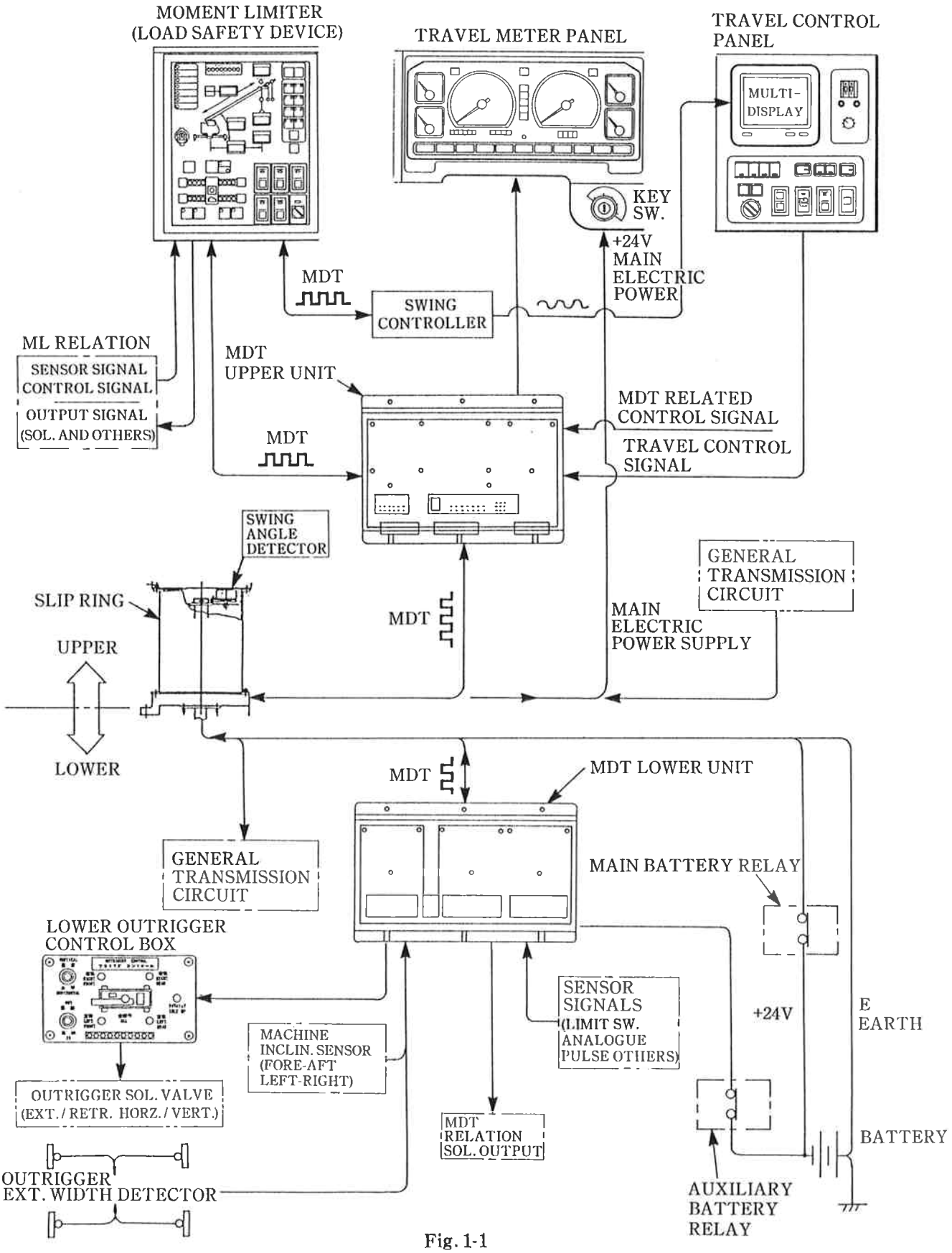


Fig. 1-1

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The electrical system of this machine is largely divided into the controls and indicators on the revolving upper and the drive system on the lower carrier.

(1) The electrical system of this machine is composed of the following systems for the use.
   ① Engine control system
   ② Travel control system
   ③ Crane control system
   (including load safety device)
   (including multiplex data transmission device.)
   ④ Accessory control system
   And, two kinds of micro computer units are installed to control the above ① and ② systems.

(2) The revolving upper is provided mainly with the switch controls and condition indicators or the crane operating devices, and the lower carrier is provided with the electrical (electronic) devices such as the travel drive system and sensors.
   The electrical (electronic) circuits, which connect the upper and lower electrical devices, are connected through the slip ring shown in Fig. 1-7.

(3) In Table 1-1, the electrical system is classified into the respective system circuit in the respect of the use or transmission method, and the numbers (SP. .) of the relative connecting slip rings are arranged.
   1. Electrical power earth (ground) system circuit.
   2. General transmission system circuit.
   3. Multiplex data transmission (MDT) system circuit.
   4. Emergency system circuit.

Table 1-1 System Circuits and Connecting Slip Rings

System	Circuit	Connecting slip ring
1. Power (source) and earth	①Power (directly connected to battery)	SP6, 9
	②Power (connected when key sw. in ON)	SP5 SP20 SP (7, 8, 19)
	③Battery earth (E)	SP16
2. General transmission	①Engine start operation	SP15
	②Parking brake operation	SP4
	③Aux. brake operation	SP18
	④Parking light operation	SP14
	⑤Lower Outrigger stowing operation signal (feed back to M / L)	SP13
3. Multiplex data transmission	①PTO operation ②Outrigger operation ③Transmission shift operation (manual and automatic) ④High / low operation ⑤2WD / 4WD operation ⑥Suspension operation ⑦Rear steering lock pin on / off operation ⑧Steering mode operation ⑨Reverse steering operation	SP1 · SP2 · SP3

System	Circuit	Connecting slip ring
3. Multiplex data transmission (continued)	⑩Exhaust brake operation ⑪Engine air heater operation ⑫Winch pressure raising operation ⑬Various sen sing operation ⑭Travel meter indicating operation ⑮ Automatic T / M shift operation ⑯ Automatic T / C lock-up operation ⑰Steering joining operation ⑱Turn signal and hazard operation ⑲Headlight operation ⑳Tail light, clearance light and license number light operation mirror operation ㉑Outrigger inching speed (Only 45t)	SP1 · SP2 · SP3
4. Emergency operation	①3rd speed shift signal ②2nd speed shift signal ③1st speed shift signal Automatically operate for CPU trouble.	SP10 SP11 SP12
	④Reverse (RE) shift signal	SP14
	⑤Emergency steering operation	SP17
	⑥Emergency direct connecting cable operation	—
	⑦Emergency PTO operation	—

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Fig. 1-2 General Wiring Schematic (1 / 3)

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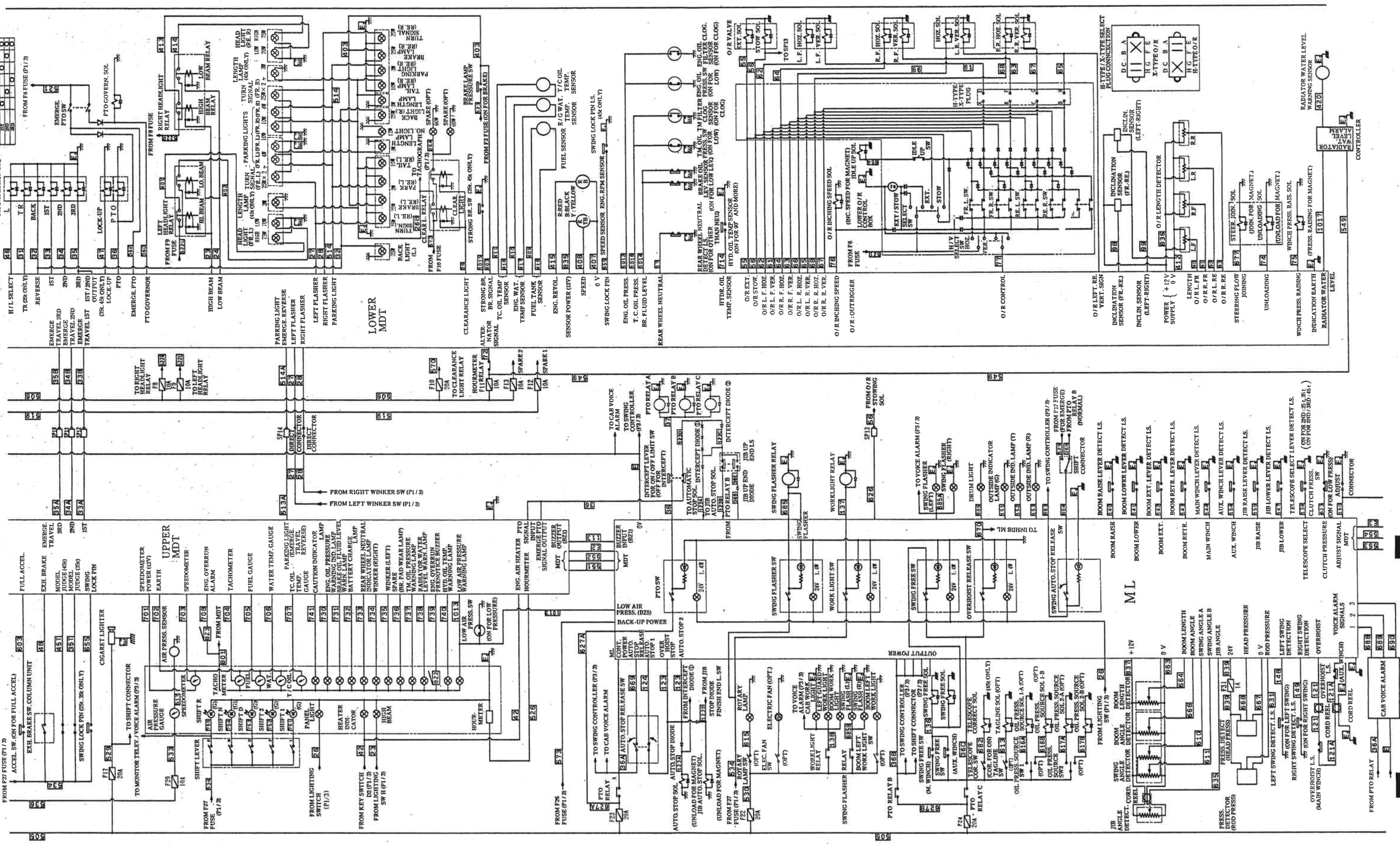
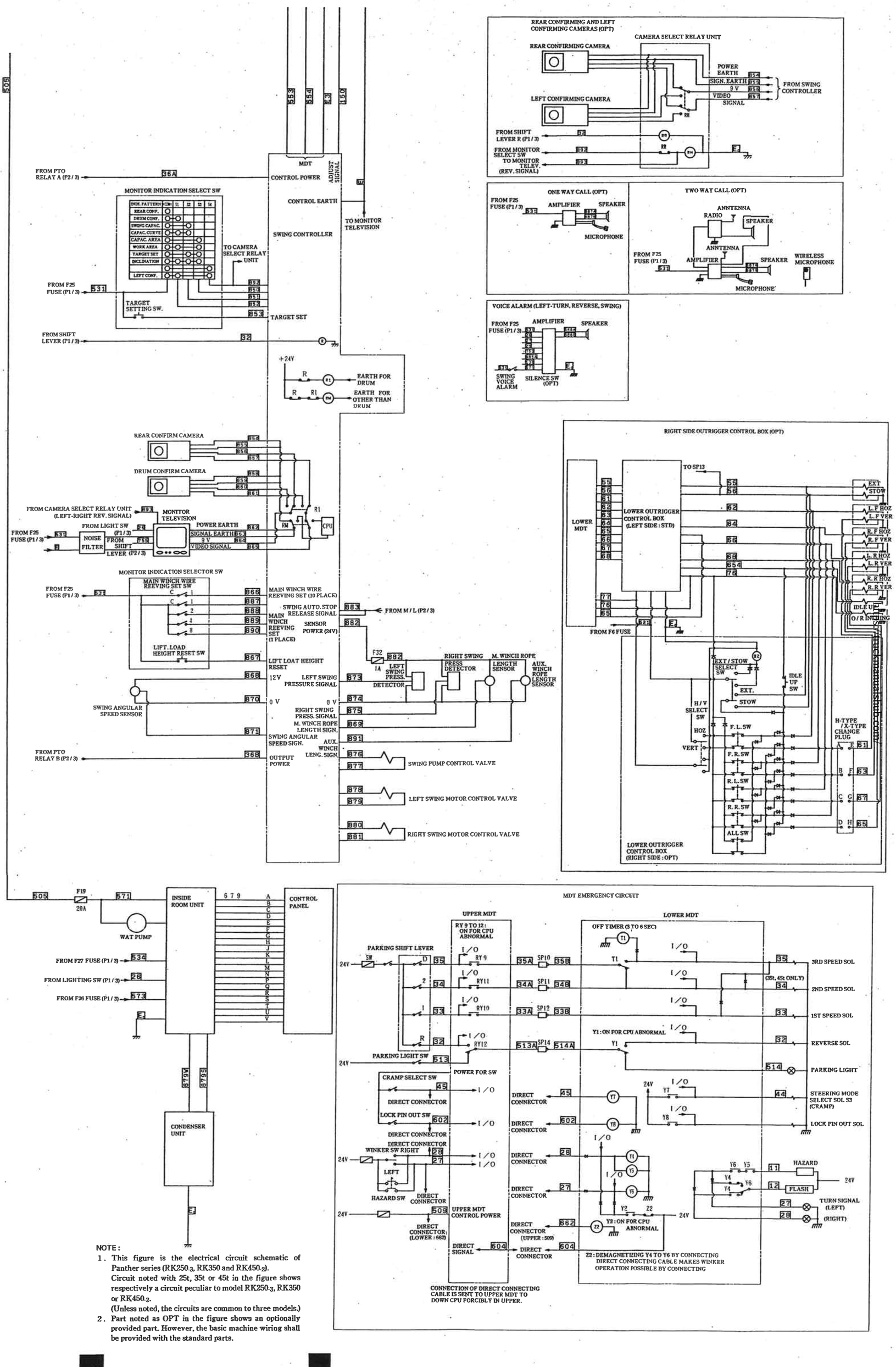


Fig. 1-2 General Wiring Schematic (2 / 3)

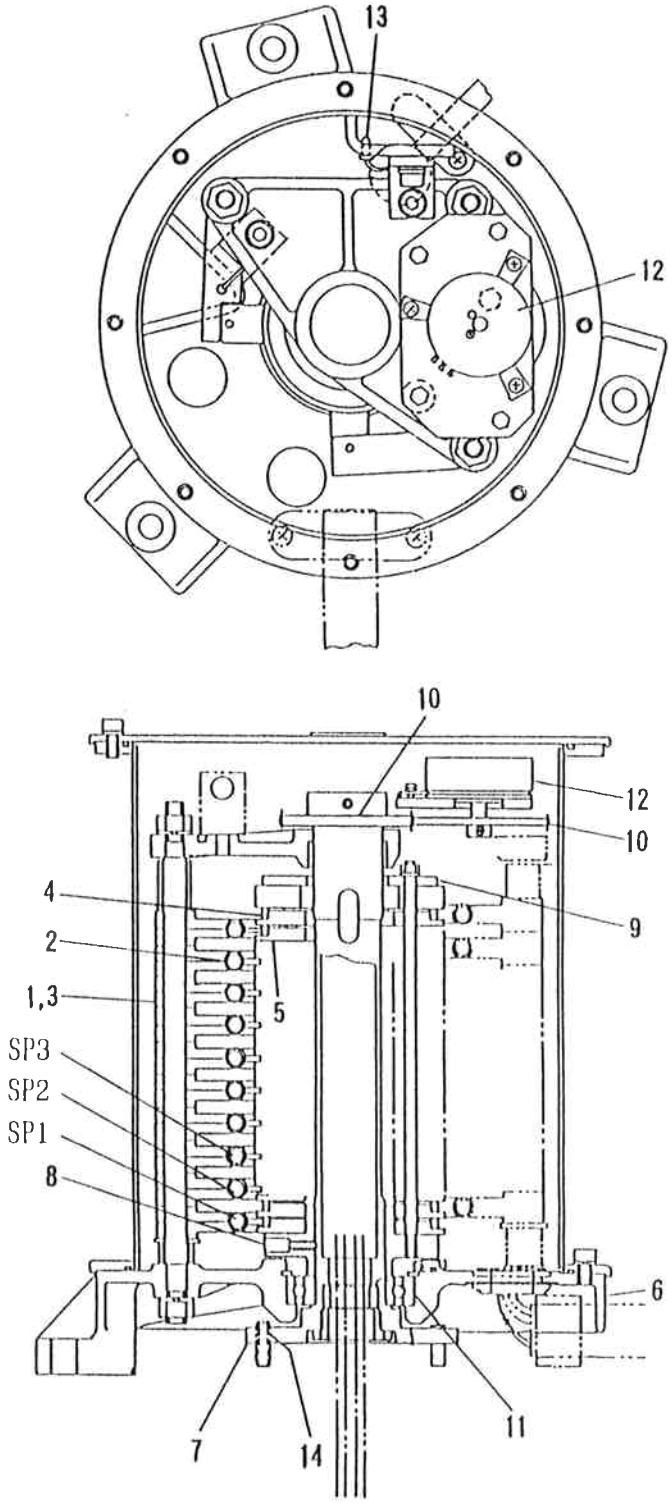


NOTE :

1. This figure is the electrical circuit schematic of Panther series (RK250-3, RK350 and RK450-2).
   Circuit noted with 25t, 35t or 45t in the figure shows respectively a circuit peculiar to model RK250-3, RK350 or RK450-2.
   (Unless noted, the circuits are common to three models.)
2. Part noted as OPT in the figure shows an optionally provided part. However, the basic machine wiring shall be provided with the standard parts.

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1.3 CONSTRUCTION OF SLIP RING



1. BRUSH HOLDER
2. SPRING
3. BRUSH
4. RING
5. HUB
6. BASE
7. ROTOR
8. RETAINER
9. STOPPER
10. GEAR
11. BEARING
12. POTENTIOMETER (SWING ANGLE)
13. TERMINAL
14. SPRING PIN

Fig. 1-3 Slip Ring Assembly

NOTE: The ring number of the slip ring shown in the general electrical circuit schematic starts from No. 1 of the lowest ring.

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1.4 WIRE HARNESS

(1) UPPER

Wire No.	Wire Color	Name	Wire Size	Connection
15	R. W	Parking SW	0.85	Travel control panel → Slip ring
15B		Parking SW		Travel control panel → Travel cont. panel
22	Br. W	Starter	0.85	Ignition SW → Shift lever
22A	R. B	Starter	0.85	Shift lever → Slip ring
23	Y. W	High beam	0.85	Column unit → Upper MDT
24	Y. G	Low beam	0.85	Column unit → Upper MDT
26	R. G	Clearance light	0.85	Column unit → Upper MDT
27	L	Left flasher	0.85	Column unit → Upper MDT
28	Y	Right flasher	0.85	Column unit → Upper MDT
32	G. B	Shift R	0.85	Shift lever → Upper MDT
33	L. R	Shift 1	0.85	Shift lever → Upper MDT
33A	L. G	Emerge travel 1st speed	0.85	Upper MDT → Slip ring
34	Br	Shift 2	0.85	Shift lever → Upper MDT
34A	R. L	Emerge travel 2nd speed	0.85	Upper MDT → Slip ring
35	W. L	Shift D	0.85	Shift lever → Upper MDT
35A	G. W	Emerge travel 3rd speed	0.85	Upper MDT → Slip ring
36	Y. L	PTO switch signal	0.85	ML → Upper MDT
36A	R	ML control power	0.85	Upper relay unit → ML
36B	R. Y	Power for output	0.85	ML → Upper relay unit
36C	G	PTO relay C signal	1.25	Upper relay unit → ML
37	Y	PTO	0.85	Intercept for on / off LS → PTO relay
42	Y. L	Engine air heater	0.85	Ignition SW → Upper MDT
44	R. Y	Crab selection	0.85	Travel control panel → Upper MDT
45	L	Cramp selection	0.85	Travel control panel → Upper MDT
46	L. Y	High 4WD selection	0.85	Travel control panel → Upper MDT
48	G. L	Exhaust brake	0.85	Column unit → Upper MDT
48A	R. L	Suspension down	0.85	Travel control panel → Upper MDT
48B	W. L	Suspension free	0.85	Travel control panel → Upper MDT
85	L. W	Mirror ext. / stow.	0.85	Travel control panel → Upper MDT
113	Gr	Buzzer output	0.85	Upper MDT → ML
121	G. Y	Overhoist	0.85	Overhoist LS (main winch) ← ML
121A	G	Overhoist LS (Main) signal	0.85	Cord reel ← Overhoist LS (aux. winch)
121B	Y. B	Overhoist LS (Aux) signal	0.85	Overhoist LS (aux. winch) → Cord reel
123	G. R	Overhoist stop	0.85	ML → Automatic stop diode
123A	G	Automatic stop	0.85	Auto. stop diode → Auto. stop sol.
123B	L. Y	Jib stop	0.85	Jib up end LS → Jib stop sol.
123C	L	Jib stop LS	0.85	Intercept. for on / off diode → Jib up end LS
123D	Y	Interception for on / off LS	0.85	Intercept. for on / off LS → Intercept. diode
124	R. G	Automatic stop 1	0.85	ML → Auto. stop release SW
134	W	Telescope select lever det.	0.85	Telescope shift lever detect. LS → ML
135	L. B	Top wiper (LOM)	0.85	Top wiper motor → Intermit unit
135A	L	Top wiper (L)	0.85	Top wiper motor → Intermit unit
135B	L. R	Top wiper (INT)	0.85	Intermit unit → Top wiper SW.
135C	L. Y	Top wiper (ON)	0.85	Intermit unit → Top wiper SW.
135D		Top wiper washer	0.85	Washer tank → Top wiper SW.
136	Br. W	Swing free SW signal	0.85	ML → Swing free sol.
137	W. L	Worklight SW signal	0.85	ML → Upper relay unit
138	L	Worklight relay signal	0.85	Upper relay unit → Left guard worklight
140	R. L	Boom up lever detection	0.85	Boom up lever detect. LS → ML
141	Y. W	Boom down lever detect.	0.85	Boom down lever detect. LS → ML
142	Y. R	Boom ext. lever detect.	0.85	Boom ext. lever detect. LS → ML
143	O. W	Boom retr. lever detect.	0.85	Boom retr. lever detect. LS → ML
144	G. Y	Main winch lever detect.	0.85	Main winch lever detect. LS → ML
145	R	Normal selection	0.85	Travel control panel → Upper MDT
146	G. B	Rear selection	0.85	Travel control panel → Upper MDT
147	L. G	Jib down lever detect.	0.85	Jib down lever detect. LS → ML
148	R. G	Left swing detection	0.85	Left swing detect. LS → ML
149	R. Y	Right swing detection	0.85	Right swing detect. LS → ML
150	G. R	Adjusting signal	0.85	ML → Adjusting connector
151	W. L	Outside ind. light (green)	0.85	ML → Outside ind. light (green)
152	L. R	Outside ind. light (yellow)	0.85	ML → Outside ind. light (yellow)
153	L. Y	Outside ind. light (red)	0.85	ML → Outside ind. light (red)
154	L. Y	Aux. winch lever detect.	0.85	Aux. winch lever detect. LS → ML
155	G. R	Jib up lever detection	0.85	Jib up lever detect. LS → ML
202	B. W	Roomlight. Door SW	0.85	Roomlight → Door SW
203	Y	Step light	0.85	Step light SW → Step light
301	R	Horn relay signal	0.85	Horn relay → Horn
302	P	Horn signal	0.85	Horn relay → Horn SW
501	R	Upper signal output	Shield 1.25	Upper MDT → Slip ring
503	W	Lower signal input	Shield 1.25	Slip ring → Upper MDT
505	R. L	Power supply	2.00	Slip ring → Fuse box
507	P	Power supply	0.85	Slip ring → Ignition SW
509	Y. W	Upper MDT contr. power (24V)	0.85	Upper MDT → Slip ring
511	Y. L	L 4WD select.	0.85	Travel control panel → Upper MDT
513	R. W	Parking light	0.85	Parking light SW → Upper MDT
513A	G. W	Parking light	0.85	Upper MDT → Slip ring
517	W. R	Air pressure sensor signal	0.85	Travel meter → Air pressure sensor
526	Y	Hourmeter	0.85	Upper MDT → Travel meter
529	W. R	Power supply	0.85	Fuse box → Cigaret lighter
530	R. L	Power supply	2.00	Fuse box → Upper relay unit
531	G	Power for radio	0.85	Fuse box → Radio assembly
531A	W	Radio speaker	Twist pair 0.85	Radio → Speaker
531B	L	Radio speaker		Radio → Speaker
532	R. Y	Power supply	0.85	Fuse box → Column unit
533	G. W	Power supply	0.85	Fuse box → Travel meter
534	W. Y	Emerge. steering SW	0.85	Fuse box → Emerge steering SW
535	R. B	Wiper power	1.25	Fuse box → Wiper SW
536	R. W	Power supply	0.85	Slip ring → Fuse box
536A	Gr	CPU reset relay	0.85	Upper relay unit → Fuse box
537	L	ACC	2.00	Key SW → Fuse box
551	R	Upper MDT-ML transmis.	Shield 0.75	Upper MDT → ML
552	W	Upper MDT-ML transmis.	Shield 0.75	ML → Upper MDT
553	R	ML-CRT controller	Shield 0.75	ML → CRT controller
554	W	ML-CRT controller	Shield 0.75	CRT controller → ML
560	R	Power supply	0.85	Slip ring → Fuse box
560A	Gr	Horn	0.85	Fuse box → Horn relay
566	L. G	Rev. steering	0.85	Travel control panel → Upper MDT
569	Y. R	Emerge. steer. SW signal	0.85	Emerge. steering SW → Slip ring
571	R. W	Air conditioner power	2.00	Fuse box → Air cond. control panel
572	Y. R	Power for output	0.85	Fuse box → Upper MDT
573	L. Y	Power for back-up	0.85	Fuse box → Upper MDT
602	G. Y	Lock pin out	0.85	Travel control panel → Upper MDT
603	L. W	Full accel.	0.85	Full accel. SW → Upper MDT
604	R. W	Direct con. signal input	0.85	Direct con. cable → Upper MDT
606	L. W	Parking SW	0.85	Travel control panel → Slip ring
610	R. Y	Swing angle A	0.85	Swing angle detector → ML
611	Br. Y	Swing angle B	0.85	Swing angle detector → ML
613	Y. W	Tagline SW signal	0.85	Tagline SW → Tagline SW sol.
615	Y. R	Rotary lamp	0.85	Rotary lamp SW → Rotary lamp
616A	L. W	Hydr. source SW1 signal	0.85	Hydr. source SW1 → Hydr. source sol 1-A
616B	L. G	Hydr. source SW1 signal	0.85	Hydr. source SW1 → Hydr. source sol 1-B
617A	W. L	Hydr. source SW2 signal	0.85	Hydr. source SW2 → Hydr. source sol 2-A
617B	W	Hydr. source SW2 signal	0.85	Hydr. source SW2 → Hydr. source sol 2-B
618	L	Swing unloading	0.85	Upper MDT → Swing unloading sol.
622	G. Y	Parking SW	0.85	Fuse box → Travel control panel
623	O. W	Accumulator pressure	0.85	Accumulator press. SW → ML
626	Br. W	O / R stowing signal	0.85	Slip ring → ML
627A	Y. L	Power supply	2.00	Fuse box → Upper relay unit
627B	Y. B	PTO power	2.00	Fuse box → Upper relay unit
631	G	Rod pressure	0.85	Pressure detector (rod press.) → ML
635	L. R	Jib angle	0.85	Power supply reel → ML
655	Y. R	Swing lock pin signal	0.85	Swing lock pin → Upper MDT
663	B	OV	0.85	ML → Boom length detector
664	O	Boom length	0.85	Boom length detector → ML
666	R. L	Boom angle	0.85	Boom angle detector → ML
667	B	OV	0.85	ML → Pressure detector (head press.)
668	G. L	Head pressure	0.85	Press. detector (head press.) → ML
669	Y	Auto. stop release	0.85	Auto. stop release SW → ML
669	Y	Auto. stop release	0.85	Auto. stop release SW → ML
669	Y	Auto. stop release	0.85	Auto. stop release SW → ML
670		Overhoist release	0.85	ML → ML
671	Y. R	Voice alarm (swing silent)	0.85	Swing silent SW → Voice alarm
679A	L. W	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679B	Br. W	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679C	G. W	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679D	R. B	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679E	Y. G	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679F	R. G	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679G	W. G	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679H	Y. R	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679J	O	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679K	W. R	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679L	Y. L	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679M	W. L	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679N	R. Y	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679P	W	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679Q	B	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679R	Lg	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679S	L	Air conditioner	2.00	Air cond. contr. panel → Air cond. room unit
679T	Br	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679U	Y	Air conditioner	0.85	Air cond. contr. panel → Air cond. room unit
679V	B	Air conditioner	2.00	Air cond. contr. panel → Air cond. room unit
679W	G	Air conditioner	1.25	Air cond. room unit → Air cond. outdoor unit
682	O	Telescope corr. SW signal	0.85	Telescope corr. SW → Telescope corr. sol
685	L	Swing warning flasher SW signal	0.85	Swing warn. flash SW → Swing flash relay
685A	Y. R	Swing warning flasher	0.85	ML → Swing warning flasher

NOTE

WIRE COLOR SYMBOLS

W ··· White　　Br ··· Brown
B ··· Black　　G ··· Green
R ··· Red　　O ··· Orange
Y ··· Yellow　　Gr ··· Gray
L ··· Blue　　P ··· Pink
Lg ··· Light green

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UPPER (CONTINUED)

Wire No.	Wire Color	Name	Wire Size	Connection
685B	G. W	Swing warn. flash relay signal	0.85	Swing warn. flasher relay → Swing flasher
686A	W	Voice alarm speaker	Twist pair 0.85	Voice alarm → Speaker
686B	L	Voice alarm speaker		Voice alarm → Speaker
687A	Y	Field communication	0.85	Field communication → Speaker
687B	Y. R	Field communication	0.85	Field communication → Speaker
688	L. W	Voice signal①	0.85	ML → Cab voice alarm
689	L. Y	Voice signal②	0.85	ML → Cab voice alarm
690	L. R	Voice signal③	0.85	ML → Cab voice alarm
701	R. W	Speedometer power (12V)	0.85	Upper MDT → Travel meter
702	B. Y	Earth	0.85	Upper MDT → Travel meter
703	W. L	Speedometer	0.85	Travel meter → Upper MDT
704	L. Y	Tachometer	0.85	Travel meter → Upper MDT
705	G	Fuel gauge	0.85	Travel meter → Upper MDT
706	G. R	Water temp. gauge	0.85	Travel meter → Upper MDT
707	L. R	T. C. oil temp. gauge	0.85	Travel meter → Upper MDT
708	L. G	Engine overrun alarm	0.85	Upper MDT → BZ3
713	L. Y	CPU abnormality indicat.	0.85	Upper MDT → CPU reset SW
713A	Y. R	CPU reset SW signal	0.85	CPU reset SW → CPU reset relay
716	Y. R		0.85	Upper MDT → Travel control panel
720	R. G	Rev. steering indication	0.85	Upper MDT → Travel control panel
721	G. W	Normal indicator lamp	0.85	Upper MDT → Travel control panel
722	Y. B	Rear indication	0.85	Upper MDT → Travel control panel
723	W. L	Crab indication	0.85	Upper MDT → Travel control panel
724	Y. W	Cramp indication	0.85	Upper MDT → Travel control panel
725	R. L	4WD indication	0.85	Upper MDT → Travel control panel
726	W. G	Lock pin out indication	0.85	Upper MDT → Travel control panel
727	L. W	Suspension free indicat.	0.85	Upper MDT → Travel control panel
730	R. W	Eng. oil press. warn. lamp	0.85	Upper MDT → Travel meter
731	L. Y	Brake oil level warn. lamp	0.85	Upper MDT → Travel meter
732	Y. G	Battery charge lamp	0.85	Upper MDT → Travel meter
733	Y. L	Rear wheel neutral lamp	0.85	Upper MDT → Travel meter
734	Y	Winker (right)	0.85	Upper MDT → Travel meter
735	L	Winker (left)	0.85	Upper MDT → Travel meter
736	W. R	Br. pad wear warn. lamp	0.85	Upper MDT → Travel meter
737	L. R	TM. oil press. warn. lamp	0.85	Upper MDT → Travel meter
738	G. R	Radiator wat level warn. lamp	0.85	Upper MDT → Travel meter
739	G. Y	Eng. overrun prenotice buz.	0.85	Upper MDT → Travel meter
740	G. B	Hyd. oil temp. ind. lamp	0.85	Upper MDT → Travel meter
741	G	Spare	0.85	Upper MDT → Travel meter
742	W. B	Model judge (45t)	0.85	Direct connect. cable → Upper MDT
743	W. R	Model judge (35t)	0.85	Direct connect. cable → Upper MDT
751	L	Shift 1	0.85	Shift lever 1 → Travel meter
752	L. W	Shift 2	0.85	Shift lever 2 → Travel meter
753	L. R	Shift D	0.85	Shift lever D → Travel meter
754	L. Y	Shift N	0.85	Shift lever N → Travel meter
755	L. B	Shift R	0.85	Shift lever R → Travel meter
801	R	Power for SW (24V)	1.25	Upper MDT → Travel meter
810	Y	Front wiper	0.85	Front wiper relay → Front wiper motor
811		Front wiper	0.85	Column unit → Front wiper relay (3)
812	L	Window washer	0.85	Column unit → Window washer
813		Front wiper	0.85	Column unit → Front wiper relay (5)
814	W	Front wiper (L)	0.85	Column unit → Front wiper motor (L)
815	L. W	Front wiper (H)	0.85	Column unit → Front wiper motor (H)

Wire No.	Wire Color	Name	Wire Size	Connection
837	Br	Power supply (+12V)	0.85	ML → Boom length detector
839	R. W	Power supply (24V)	0.85	ML → Pressure detector
850	Br	Monitor select SW signal	0.85	Monitor control panel → CRT controller
851	L. B	Monitor select SW signal	0.85	Monitor control panel → CRT controller
852	G	Monitor select SW signal	0.85	Monitor control panel → CRT controller
853	L. W	Target setting	0.85	Monitor control panel → CRT controller
854		Rear confirm. camera	Cab-tyre cable	Rear confirming camera → CRT controller
855		Rear confirm. camera		Rear confirming camera → CRT controller
856		Rear confirm. camera		CRT controller → Rear confirm. camera
857		Rear confirm. camera		CRT controller → Rear confirm. camera
858		Drum watch. camera	Cab-tyre cable	Drum watch. camera → CRT controller
859		Drum watch. camera		Drum watch. camera → CRT controller
860		Drum watch. camera		CRT controller → Drum watch. camera
861		Drum watch. camera		CRT controller → Drum watch. camera
862		Monitor television	Cab-tyre cable	CRT controller → Monitor television
863		Monitor television		CRT controller → Monitor television
864		Monitor television		Monitor television → CRT controller
865		Monitor television		Monitor television → CRT controller
866	R	Wire reev. no. set. (10 place)	0.85	Monitor control panel → Swing controller
867	Y. G	Rope length reset.	0.85	Monitor control panel → Swing controller
868	R. B	Power supply (12V)	Shield 0.75	Swing controller → Rope length sensor
869	Y	Rope length signal (main)	Shield 0.75	Rope length sensor (main) → Swing controller
870	B. G	OV	Shield 0.75	Swing controller → Rope length sensor
871	W. R	Swing angular spd. sign.	Shield 0.75	Swing angl. spd. sensor → Swing controller
872	R	Power supply (24V)	0.85	Swing controller → Pressure detector
873	Y	Left swing press. signal	0.85	Pressure detector → Swing controller
874	B. Y	OV	0.85	Swing controller → Pressure detector
875	Y. L	Right swing press. signal	0.85	Pressure detector → Swing controller
876	G. R	Swing pump contr. valve	Shield 0.75	Swing controller → Swing pump contr. valve
877	G. L	Swing pump contr. valve	Shield 0.75	Swing controller → Swing pump contr. valve
878	G. B	Left swing motor contr. v.	Shield 0.75	Swing controller → Left swing motor cont. v.
879	G. Y	Left swing motor contr. v.	Shield 0.75	Swing controller → Left swing motor cont. v.
880	Y. G	Right swing motor contr. v.	Shield 0.75	Swing controller → Right swing motor cont. v.
881	G. W	Right swing motor contr. v.	Shield 0.75	Swing controller → Right swing motor cont. v.
882	W. B	Rope length sensor power	Shield 0.75	Swing controller → Rope length sensor
883	W. G	Swing stop release signal	0.85	ML → Swing controller
884	R. G	Swing stop release signal	0.85	ML → Swing controller
885	Y. W	Drum light signal	0.85	ML → Drum light
887	R. B	Wire reev. no. set (1 place)	0.85	Monitor control panel → CRT controller
888	G. L	Wire reev. no. set (1 place)	0.85	Monitor control panel → CRT controller
889	Y	Wire reev. no. set (1 place)	0.85	Monitor control panel → CRT controller
890	O	Wire reev. no. set (1 place)	0.85	Monitor control panel → CRT controller
891	W	Rope length signal (aux.)	Shield 0.75	Rope length sensor (aux.) → Swing controller
892	Y. R	Monitor indi. select signal	0.35	Monitor control panel → CRT controller
893	Y	Monitor left-right change sign.	0.85	Camera shift relay unit → Monitor telev.
1013	Y. B	Low air pressure	0.85	ML → Low air pressure SW
E1	B	Signal earth (MDT)	Shield 0.85	Upper MDT → Lower MDT
E	B. W	Battery earth	2.00	Slip ring → ML, MDT
E2	B	Signal earth (ML)	Shield 0.85	MDT → ML
E3	B	Signal earth (CRT, swing)	Shield 0.85	ML → CRT, swing controller

Wire No.	Wire Color	Name	Wire Size	Connection
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(2) LOWER

Wire No.	Wire Color	Name	Wire Size	Connection
11	W. G	Hazard power	0.85	Hazard unit → Lower MDT
12	W. Y	Flasher power	0.85	Flasher unit → Lower MDT
15A	G. W	Parking brake	0.85	Slip ring → Parking brake sol.
17	Y. L	Rear wheels neutral	0.85	Rear wheel neut. detect. LS → Lower MDT
22B	Br. W	Starter	0.85	Slip ring → Starter relay
23	G. W	High beam	0.85	Lower MDT → High beam relay
24	G. B	Low beam	0.85	Lower MDT → Low beam relay
26	G. Y	Clearance light	0.85	Lower MDT → Clearance light relay
26A	L	Clearance light relay	0.85	Clearance light relay → Under light
26B	Y	Clearance light relay	0.85	Clearance light relay → Clear. light
27	G. B	Left flasher	0.85	Direct connect. cable → Lower MDT
27	G. B	Left flasher	0.85	Lower MDT → Turn signal (left, fr. rear)
28	G. L	Right flasher	0.85	Direct connect. cable → Lower MDT
28	G. L	Right flasher	0.85	Lower MDT → Turn signal (right, fr. rear)
31	L	TR	0.85	Lower MDT → Transmission
32	L. R	Reverse	0.85	Lower MDT → Transmission
32B	L. W	Emergency reverse	0.85	Slip ring → Lower MDT
33	L. B	1st speed	0.85	Lower MDT → Transmission
33B	R. W	Emergency 1st speed	0.85	Slip ring → Lower MDT
34	L. Y	2nd speed	0.85	Lower MDT → Transmission
34B	O. W	Emergency 2nd speed	0.85	Slip ring → Lower MDT
35	L. W	3rd speed	0.85	Lower MDT → Transmission
36	Br. W	PTO	0.85	Lower MDT → Transmission
36D	G. R	PTO governor	0.85	Lower MDT → PTO governor sol.
36E	Y. G	Emergency PTO signal	0.85	Emergency PTO SW → Lower MDT
42	L. W	Air heater	0.85	Lower MDT → Air heater relay
44	G. R	Steering mode S3	0.85	Lower MDT → Steer. mode select. sol
45	L	Cramp select. input	0.85	Direct connecting cable → Lower MDT
45A	G	Steering mode S4	0.85	Lower MDT → Steer. mode select. sol
46	G. Y	H / L selection	0.85	Lower MDT → Transmission
46A	W. G	2WD / 4WD selection	0.85	Lower MDT → 2WD / 4WD select. sol
47	Br. R	Lock-up	0.85	Lower MDT → Transmission
48	Br.	Exhaust brake	0.85	Lower MDT → Exhaust brake LS
49	G. W	Steering mode S1	0.85	Lower MDT → Steer. mode select sol
50	G. B	Steering mode S2	0.85	Lower MDT → Steer. mode select sol
55	O. W	O / R extension	0.85	Lower MDT → Lower O / R control box
56	O	O / R stowing	0.85	Lower MDT → Lower O / R control box
61	R. B	O / R left front vertical	0.85	Lower MDT → Lower O / R control box
62	R. W	O / R left front horizontal	0.85	Lower MDT → Lower O / R control box
63	L. B	O / R right front vertical	0.85	Lower MDT → Lower O / R control box
64	L. W	O / R right front horizontal	0.85	Lower MDT → Lower O / R control box
65	R. G	O / R left rear vertical	0.85	Lower MDT → Lower O / R control box
66	R. Y	O / R left rear horizontal	0.85	Lower MDT → Lower O / R control box
67	L. G	O / R right rear vertical	0.85	Lower MDT → Lower O / R control box
68	L. Y	O / R right rear horizontal	0.85	Lower MDT → Lower O / R control box
72	Y. B	Alternator generat. signal	0.85	Hourmeter relay → Lower MDT
74	R. Y	Unloading	0.85	Lower MDT → Unloading sol
75	Y	Winch pressure raising	0.85	Lower MDT → Winch press. raising sol
76	Y. L	Outrigger inching speed	0.85	Lower MDT → O / R inching speed sol
77	R. W	Outrigger control	0.85	Lower MDT → O / R control box
80	W. R	Suspension pilot	0.85	Lower MDT → Suspension pilot sol
81A	L. Y	Suspension H1FL	0.85	Lower MDT → Suspension sol (left, front)
81B	Y	Suspension H2FL	0.85	Lower MDT → Suspension sol (left, front)
81C	L	Suspension H3FL	0.85	Lower MDT → Suspension sol (left, front)
82A	Y. G	Suspension H1FR	0.85	Lower MDT → Suspension sol (right, front)
82B	Y	Suspension H2FR	0.85	Lower MDT → Suspension sol (right, front)
82C	L	Suspension H3FR	0.85	Lower MDT → Suspension sol (right, front)
83A	O	Suspension H1RL	0.85	Lower MDT → Suspension sol (left, rear)
83B	G. W	Suspension H2RL	0.85	Lower MDT → Suspension sol (left, rear)
83C	R. Y	Suspension H3RL	0.85	Lower MDT → Suspension sol (left, rear)
84A	L. W	Suspension H1RR	0.85	Lower MDT → Suspension sol (right, rear)
84B	O. W	Suspension H2RR	0.85	Lower MDT → Suspension sol (right, rear)
84C	R. Y	Suspension H3RR	0.85	Lower MDT → Suspension sol (right, rear)

Wire No.	Wire Color	Name	Wire Size	Connection
85A	G. Y	Mirror ext. / stow.	0.85	Lower MDT → Mirror ext. / stow. motor
85B	G	Mirror ext. / stow.	0.85	Lower MDT → Mirror ext. / stow. motor
86	G	Suspension press. source	0.85	Lower MDT → Suspen. press. source sol
90	W	O / R length, left front	Shield 0.75	O / R length detector, L. F. → Lower MDT
91	W	O / R length, right front	Shield 0.75	O / R length detector, R. F. → Lower MDT
92	W	O / R length, left rear	Shield 0.75	O / R length detector, L. R. → Lower MDT
93	W	O / R length, right rear	Shield 0.75	O / R length detector, R. R. → Lower MDT
94H	Y. R	Suspension H signal (L. F)	0.85	Suspension level sensor → Lower MDT
94L	L. R	Suspension L signal (L. F)	0.85	Suspension level sensor → Lower MDT
95H	R. L	Suspension H signal (R. F)	0.85	Suspension level sensor → Lower MDT
95L	R. W	Suspension L signal (R. F)	0.85	Suspension level sensor → Lower MDT
96H	L	Suspension H signal (L. R)	0.85	Suspension level sensor → Lower MDT
96L	Y	Suspension L signal (L. R)	0.85	Suspension level sensor → Lower MDT
97H	G. W	Suspension H signal (R. R)	0.85	Suspension level sensor → Lower MDT
97L	G. L	Suspension L signal (R. R)	0.85	Suspension level sensor → Lower MDT
98	W	Inclination sensor (fore-aft)	Shield 0.75	Inclin. sensor (fore-aft) → Lower MDT
99	W	Inclination sensor (left-right)	Shield 0.75	Inclin. sensor (left-right) → Lower MDT
401	R. W	Headlight (fr. left)	0.85	High beam relay → Headlight (fr. left)
402	R. Y	Headlight (fr. left)	0.85	Low beam relay → Headlight (fr. left)
403	G	Brake signal	0.85	Brake light press. SW → Lower MDT
404	B	Air heater	0.85	Air heater relay → Air heater
406	W. L	Alternator (L)	0.85	Alternator → Battery
407	B	Speed signal	Shield 0.75	Speed sensor → Lower MDT
408	W	Speed sensor earth	Shield 0.75	Lower MDT → Speed sensor
409	W	Fuel tank sensor	Twist pair	Fuel tank sensor → Lower MDT
410	W	Eng. water temp. sensor		Eng. water temp. sensor → Lower MDT
411	W	T. C. oil temp. sensor		T. C. oil temp. sensor → Lower MDT
412	B	O / R length (earth)	Shield 0.75	MDT → O / R length detector
413	L. W	Headlight (fr. right)	0.85	High beam relay → Headlight (fr. right)
414	L. Y	Headlight (fr. right)	0.85	Low beam relay → Headlight (fr. right)
415	W	Eng. revolution signal	Shield 0.75	Eng. revolution sensor → Lower MDT
416	L	Fuel tank sensor	Twist pair	Lower MDT → Fuel tank sensor
417	L	Eng. water temp. sensor		Lower MDT → Eng. water temp. sensor
418	L	T. C. oil temp. sensor		Lower MDT → T. C. oil temp. sensor
419	Y	Engine start	0.85	Starter relay → Safety relay
420	W	Radiator wat. level warn.	Shield 0.75	Radiator level contr. → Radi. wat. level sensor
502	R	Upper signal input	Shield	Slip ring → Lower MDT
504	W	Lower signal input	1.25	Lower MDT → Slip ring
506	W. Y	Alternator	5.2	Alternator → Slip ring
508	R. W	Power supply	0.85	Fuse box → Slip ring
510	Y. W	Lower MDT control power	0.85	Slip ring → Aux. battery relay
514	Y. G	Parking light	0.85	Lower MDT → Parking light
514A	G	Parking light	0.85	Slip ring → Lower MDT
516	B. R	Engine stop	0.85	Lower MDT → Engine stop relay
519	W. B	Power supply	0.85	Battery → Slip ring
519A	B	Emergency steering pump	30.0	Emerge. steer. relay → Emerge. steer. motor
521	R. Y	Air dryer	0.85	Fuse box → Air dryer
522F	G. W	Flasher unit	0.85	Fuse box → Flasher unit
522L	R	Left headlight relay power	0.85	Fuse box → Left headlight relay
522R	R. G	Right headlight relay power	0.85	Fuse box → Right headlight relay
523	R. G	Engine stop power	0.85	Fuse box → Engine stop rely

Wire No.	Wire Color	Name	Wire Size	Connection
524	O	Alternator (P)	0.85	Alternator P terminal → Safety relay (P)
527	Y. R	Eng. stop relay sol	0.85	Eng. stop relay → Eng. stop sol
528	W. L	Power supply	0.85	Aux. battery relay → Fuse box
528A	W. B	Crane system output power	1.25	Fuse box → Lower MDT
528B	Y. B	Travel system output power	1.25	Fuse box → Lower MDT
528C	Gr	Lights & others output power	1.25	Fuse box → Lower MDT
536A	O. W	Eng. stop signal	0.85	Slip ring → Lower MDT
549	R. L	Hourmeter signal	0.85	Fuse box → Hourmeter relay
561	O	Auto-greaser signal	0.85	Auto-greaser contr. → Auto-greaser SW
562	O. W	Auto-greaser OFF	0.85	Auto-greaser SW → Auto-greaser contr.
563	O. L	Auto-greaser ON	0.85	Auto-greaser SW → Auto-greaser contr.
564	Br. L	Exhaust brake feed back	0.85	Exhaust brake LS → Lower MDT
568	R. Y	Emergency steering signal	0.85	Slip ring → Emerge. steering relay
570	Y. R	Clearance light signal	0.85	Fuse box → Clearance light relay
601	Y. R	Lock pin insert	0.85	Lower MDT → Lock pin insert. sol
602	G. R	Lock pin pull out input	0.85	Direct conn. cable → Lower MDT
602A	Y	Lock pin pull out	0.85	Lower MDT → Lock pin pull out sol
604	G	Direct connection sig. output	0.85	Lower MDT → Direct connect. cable
607	L. R	Aux. brake signal	0.85	Slip ring → Aux. brake sol
654	L. G	Idle up signal	0.85	O / R control box → Idle up sol
655	L. R	Swing lock pin	0.85	MDT → Swing lock pin LS
660	W. L	Lock pin in detection	0.85	Lock pin detect. sensor → Lower MDT
661	L. W	Lock pin out detection	0.85	Lock pin detect. sensor → Lower MDT
662	G. W	Direct connect. sign. input	0.85	Direct connect. cable → Lower MDT
665	B	Sensor earth	0.85	Lower MDT → Suspension level sensor
677	L. W	Steering flow joining	0.85	Lower MDT → Steering flow joining sol
714	L. Y	Hydr. oil temper. sensor	0.85	Hydr. oil temp. sensor → Lower MDT
835	R	Sensor power supply (12V)	0.85	Lower MDT → Speed sensor
836	R	Sensor power supply (12V)	0.85	Lower MDT → O / R length detector
837A	Y. G	Sensor power supply (24V)	0.85	Lower MDT → Suspension sensor (LF, RR)
837B	L. Y	Sensor power supply (24V)	0.85	Lower MDT → Suspension sensor (RF, LR)
1012	Y. R	Engine oil pressure	0.85	Engine oil pressure SW → Lower MDT
1014	Y	Brake oil level	0.85	Br. oil level sensor → Lower MDT
1015	W. L	Strong brake	0.85	Strong brake SW → Lower MDT
1016	R. G	T. C. oil pressure	0.85	TM. oil pressure SW → Lower MDT
1017	R. Y	Radiator water level	0.85	Radiator water level sensor → Lower MDT
E	B. W	Power supply earth	2.00	Battery → Lower MDT
E0	B	Body earth	1.25	Actuator → Body
E1	B	Transmission earth	Shield 0.75	Slip ring → Lower MDT

NOTE

WIRE COLOR SYMBOL

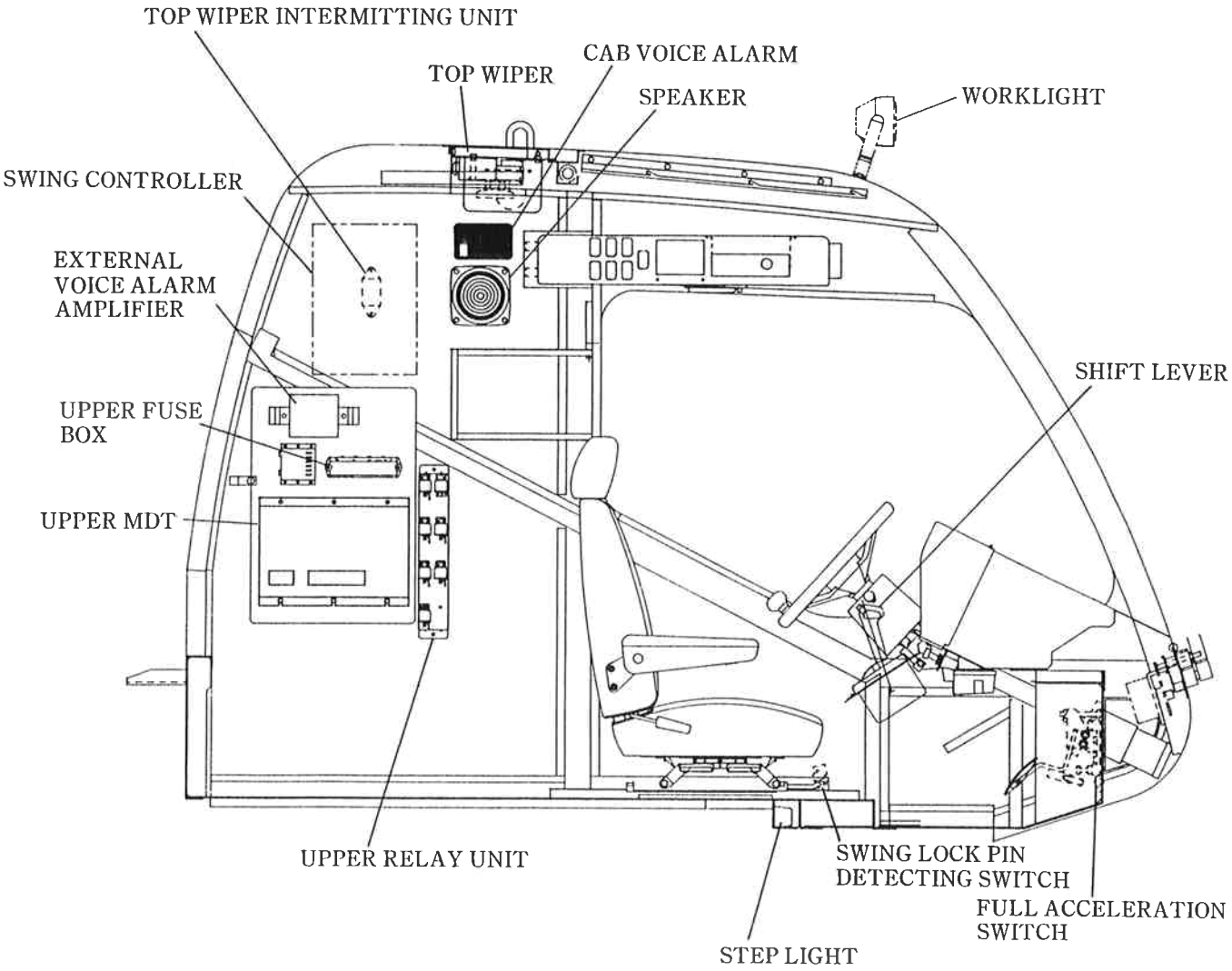
W ··· White	Br ··· Brown
B ··· Black	G ··· Green
R ··· Red	O ··· Orange
Y ··· Yellow	Gr ··· Gray
L ··· Blue	P ··· Pink

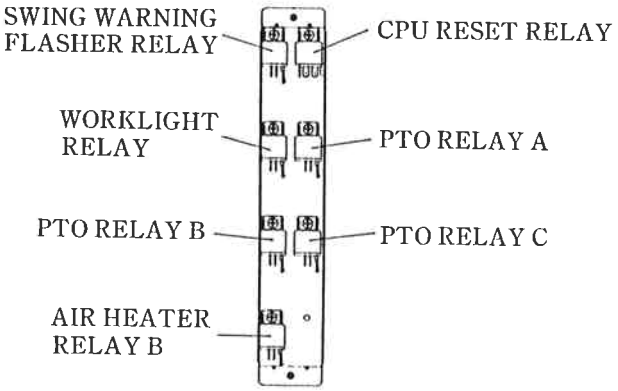
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2. ARRANGEMENT AND CONNECTION OF ELECTRICAL APPARATUS

2.1 ARRANGEMENT OF ELECTRICAL APPARATUS

(1) INSTALLATION OF ELECTRICAL APPARATUS IN CAB

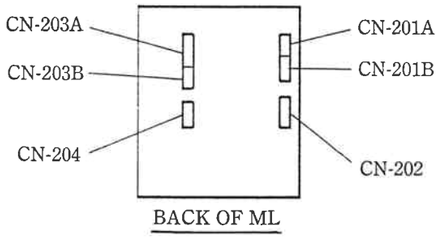


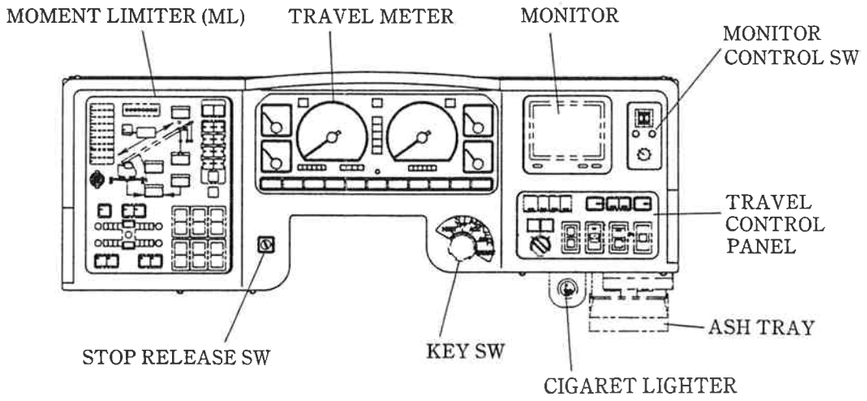


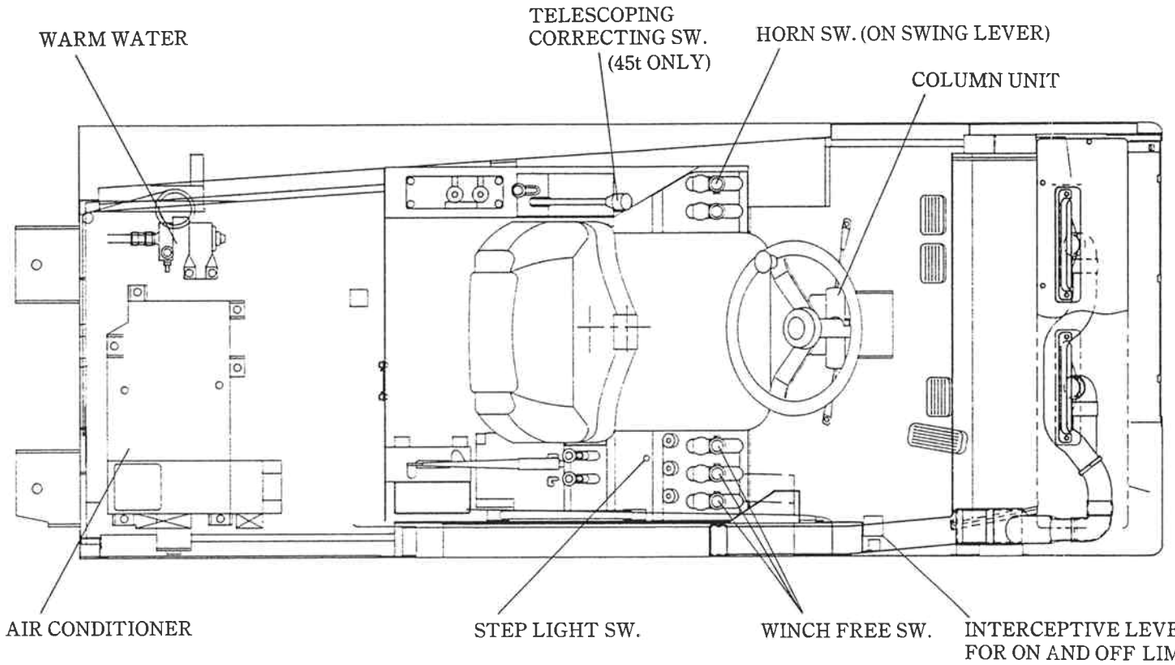
UPPER RELAY UNIT

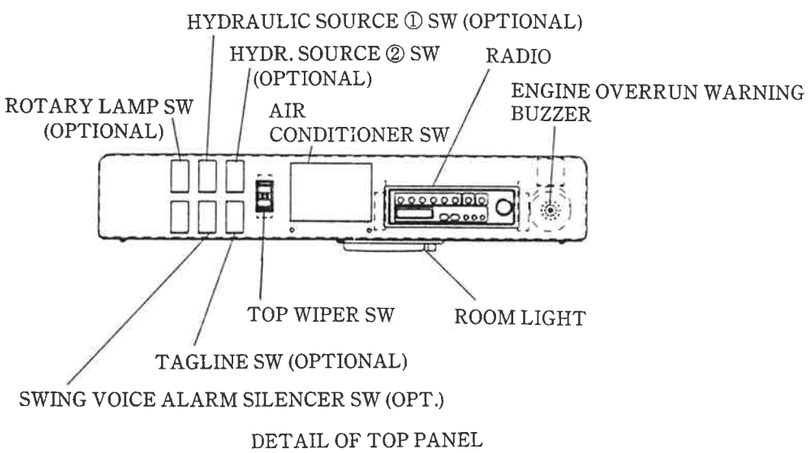
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(2) INSTALLATION OF UPPER ELECTRICAL APPARATUS





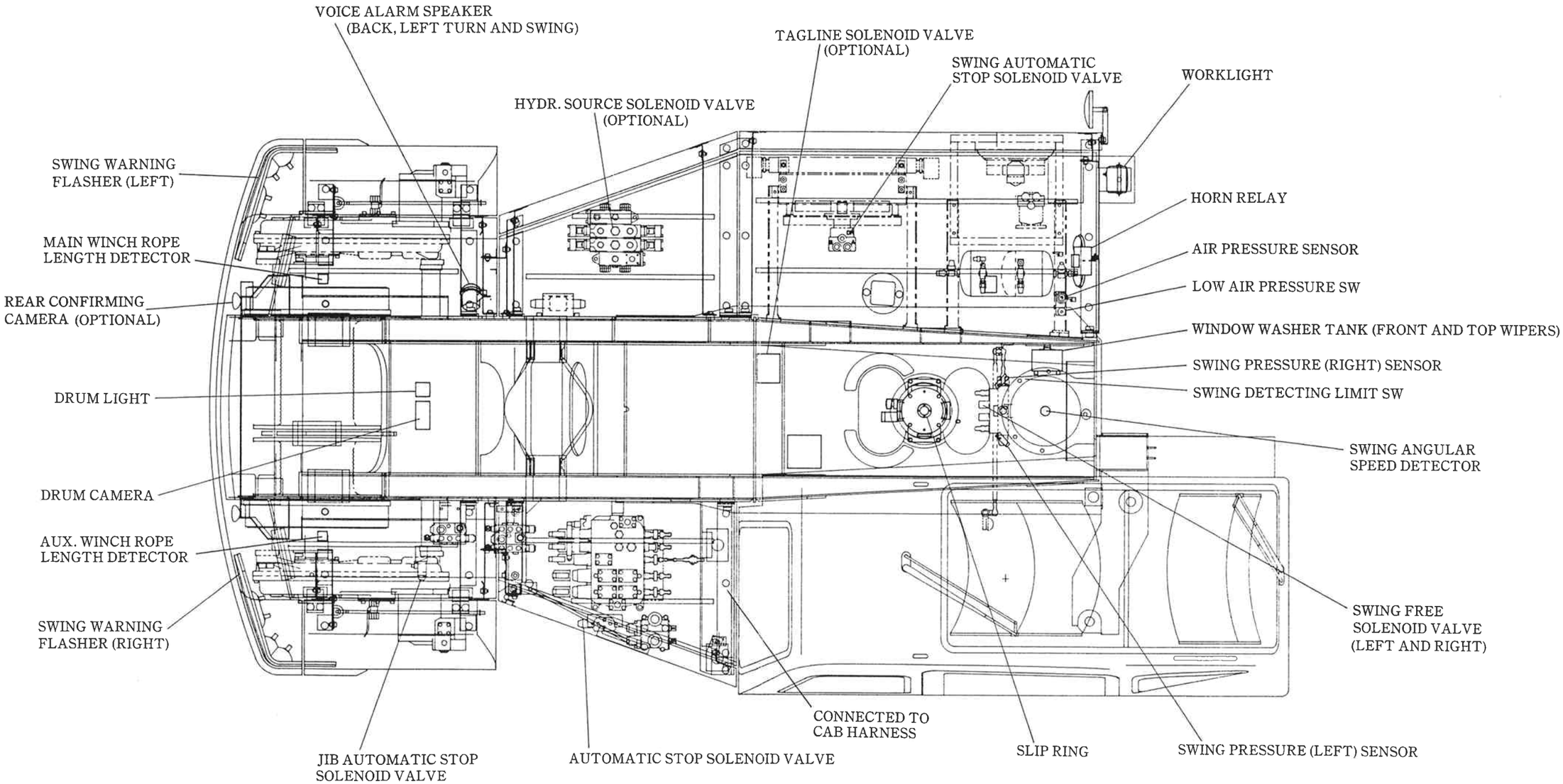




DETAIL OF TOP PANEL

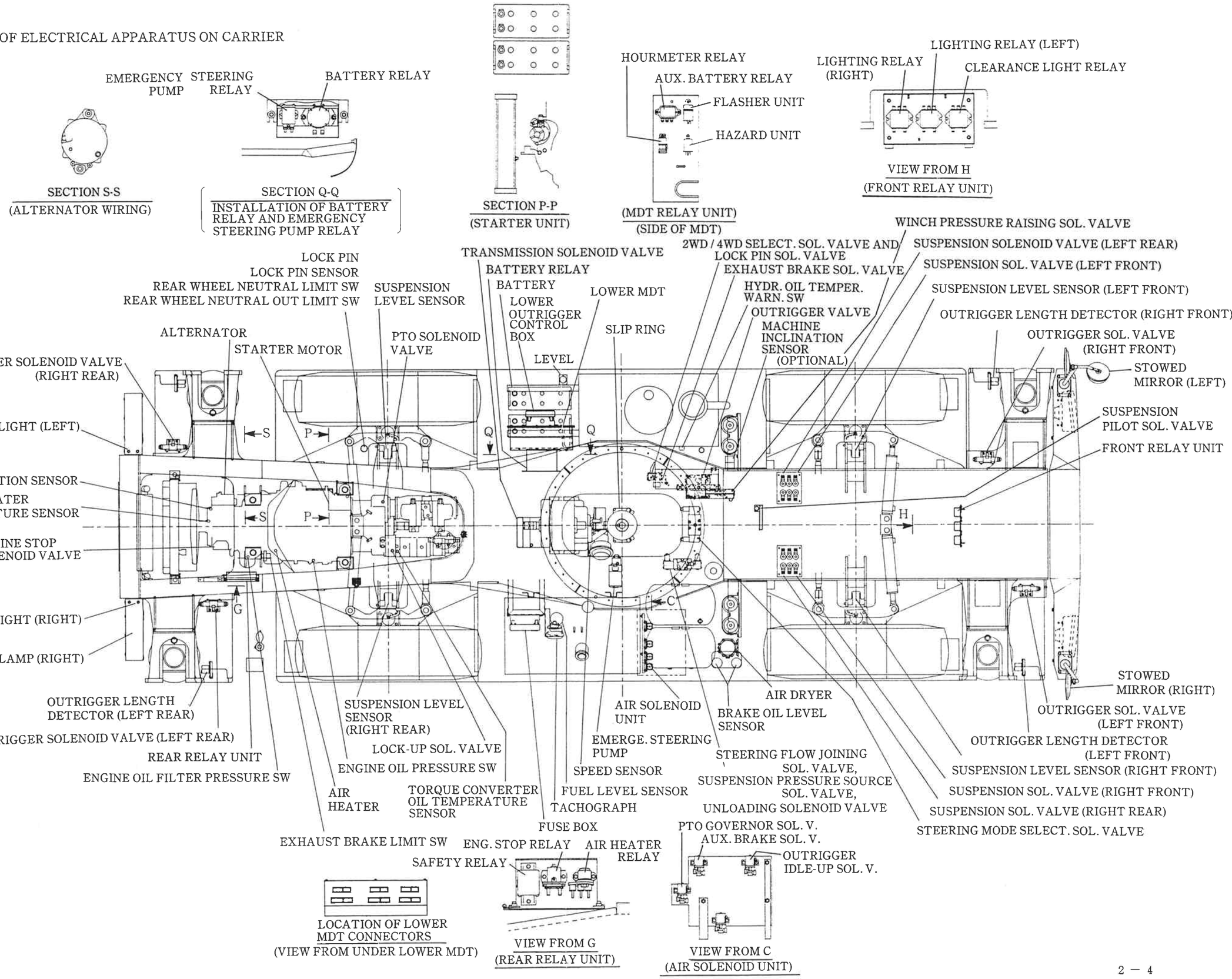
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INSTALLATION OF UPPER ELECTRICAL APPARATUS (CONTINUED)



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(3) INSTALLATION OF ELECTRICAL APPARATUS ON CARRIER



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CN-245 (M: CRT CONTROLLER SIDE / F: HARNESS SIDE)

M							F						
853 LW	892 YR		852 G	851 LB	850 Br		850 Br	851 LB	852 G		892 YR	853 LW	
		32 GB								32 GB			

CN-259A (M: TOP WIPER INTERMIT UNIT SIDE / F: HARNESS SIDE)

M				F		
INT LR	ON LB	GND B		E₀ B	135C LY	1358 LR
MOTOR LY	COM Y	MOTOR LW		135A L	135 LB	535 RB

CN-247 (M: VOICE ALARM LAMP SIDE / F: HARNESS SIDE)

M								F							
KEY SW R	LIGHT LgW	WORK			LIGHT LB	BACK L		755 LB	138 L				26 RG	531 G	
SPEAKER (−) BW	G	SILENC. O	SWING P	FLASH. R. Br	Y	GND B		E₀ B	27 L	28 Y	685A YR	671 YR	686A W	686B L	
SPEAKER (+)					FLASH. L.										

CN-244A (M: SWING CONTROLLER SIDE / F: HARNESS SIDE)

M								F							
887 RB	866 R	867 YG				883 WG		883 WG				867 YG	866 R	887 RB	
				891 G	869 Y	888 GL		888 GL	869 Y	891 G					

CN-272 (M: MONITOR SELECT RELAY SIDE / F: HARNESS SIDE)

M			F		
32 GB		E₀ B	E₀ B		32 GB
892 YR	893 Y			893 Y	892 YR

CN-259 (M: TOP WIPER SIDE / F: HARNESS SIDE)

M			F		
LR	LW		135A L		
LB	L		535 RB	135 LB	

CN-264 (M / F: HARN. SIDE)

M		F	
45T WB		534 WY	
45T WB		45T WB	

CN-265 (M / F: HARN. SIDE)

M		F	
35T WR		534 WY	
35T WR		35T WR	

CN-246 (M: CRT CONTROLLER SIDE / F: HARNESS SIDE; F32 1A)

M					F					
882 WB		E BW	36A R		36A R	E BW				882 WB
E3 B	554 W	553 R	150 GR	368 RY	368 RY	150 GR	553 R	554 W	E3 B	

CN-243B (M: SWING CONTROLLER SIDE / F: HARNESS SIDE)

M			F		
	875 YL	873 Y	873 Y	875 YL	
874 BY				874 BY	

CN-271 (M: CAB VOICE ALARM SIDE / F: HARNESS SIDE)

M				F			
36A R	E BW		E BW		E BW	E BW	36A R
688 LW	689 LY		690 LR	690 LR	689 LY	688 LW	

CN-275 (M: AUTO. STOP. DIODE SIDE / F: HARNESS SIDE)

M	F
+	123 GR
−	123A G

CN-276 (M: JIB STOP DIODE SIDE / F: HARNESS SIDE)

M	F
+	123 GR
−	123B LY

CN-243A (M: SWING CONTROLLER SIDE / F: HARNESS SIDE)

M					F					
877 L	876 R	883 WG				883 WG	876 R	877 L		
881 W	880 G		879 Y	878 Br	878 Br	879 Y			880 G	881 W

CN-208 (M / F: HARNESS SIDE)

M			F		
L	W			814 W	815 LW
Y	R	R	535 RB		810 Y

CN-273 (M / F: HARNESS SIDE; ON AND OFF INTERCEPT DIODE ① SIDE)

M	F
+	123C L
−	123A G

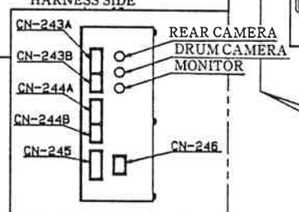
CN-274 (M / F: HARNESS SIDE; ON AND OFF INTERCEPT DIODE ② SIDE)

M	F
+	123D Y
−	123C L

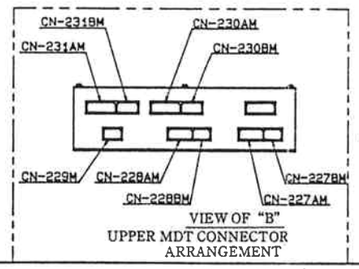
CN-244B (M: SWING CONTROLLER SIDE / F: HARNESS SIDE)

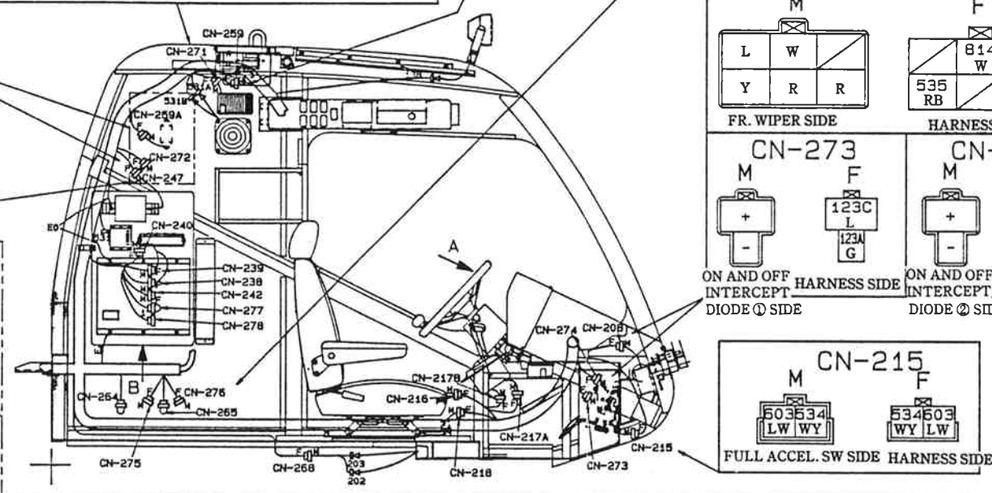
M					F					
		870 B	871 W			871 W	870 B			
868 R			890 O	889 Y	889 Y	890 O				868 R

DETAILS OF SWING AND CRT CONTROLLERS



VIEW OF "B" UPPER MDT CONNECTOR ARRANGEMENT





CN-215 (M / F: FULL ACCEL. SW SIDE HARNESS SIDE)

M		F	
603 LW	534 WY	534 WY	603 LW

CN-230B (M: UPPER MDT SIDE / F: HARNESS SIDE)

M							F							
44 RY	146 GB			46 LY	602 GY	488 WL	488 WL	602 GY	46 LY			146 GB	44 RY	
145 R	45 L		566 LG	511 YL		603 LW	48A RL		603 LW	511 YL	566 LG		45 L	145 R

CN-227B (M: UPPER MDT SIDE / F: HARNESS SIDE)

M			F		
552 W	501 R			501 R	552 W
E2 B					E2 B

CN-231A (M: UPPER MDT SIDE / F: HARNESS SIDE)

M								F							
572 YR	E₀ B	36 YL			113 Gr	35 WL	35A GW	34 Br	34 Br	35A GW	35 WL	113 Gr		36 YL	E₀ B	572 YR
			618 L			526 Y					526 Y		618 L			

CN-231B (M: UPPER MDT SIDE / F: HARNESS SIDE)

M							F							
34A RL	33 LR			513 RW	32 GB	36 YL	36 YL	32 GB	513 RW			33 LR	34A RL	
33A LG		713 LY	513A GW			655 YR	655 YR			513A GW	713 LY			33A LG

CN-228B (M: UPPER MDT SIDE / F: HARNESS SIDE)

M							F							
727 LW	716 YR			722 YB	726 WG		726 WG	722 YB				716 YR	727 LW	
708 LG	723 WL	725 RL	720 RG	724 YW	721 GW		721 GW	724 YW	720 RG	725 RL		723 WL	708 LG	

CN-227A (M: UPPER MDT SIDE / F: HARNESS SIDE)

M								F							
801 R	704 LY	707 LR			706 GR	551 R	702 BY	702 BY	551 R	706 GR			707 LR	704 LY	801 R
	703 WL		701 RW	705 G		503 W	E1 B		E1 B	503 W	705 G	701 RW		703 WL	

CN-230A (M: UPPER MDT SIDE / F: HARNESS SIDE)

M								F							
	27 L	23 YW	26 RG			35T WR			35T WR			26 RG	23 YW	27 L	
28 Y	24 YG	48 GL			45T WB	85 LW	42 YL	604 RW	604 RW	42 YL	85 LW	45T WB	48 GL	24 YG	28 Y

CN-229 (M: UPPER MDT SIDE / F: HARNESS SIDE)

M		F	
536 RW	509 YW	509 YW	536 RW
536A Gr	E BW	E BW	536A Gr

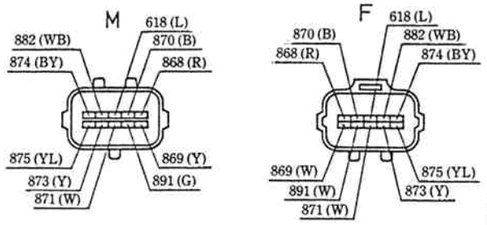
CN-228A (M: UPPER MDT SIDE / F: HARNESS SIDE)

M								F							
730 RW	573 LY	1013 YB			741 G	734 Y	735 L	735 L	734 Y	741 G			1013 YB	573 LY	730 RW
740 GB	738 GR	737 LR	736 WR	733 YL	732 YG	739 GY	731 LY	731 LY	739 GY	732 YG	733 YL	736 WR	737 LR	738 GR	740 GB

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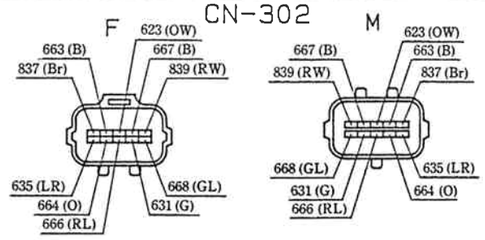
(1) HARNESS DIAGRAM INSIDE OF CAB (2 / 4)

CN-303



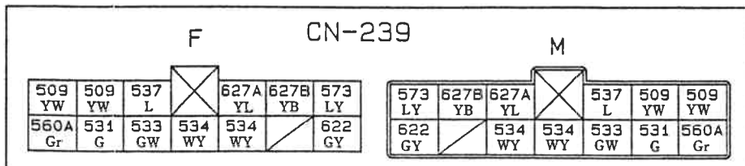
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARN. SIDE

CN-302



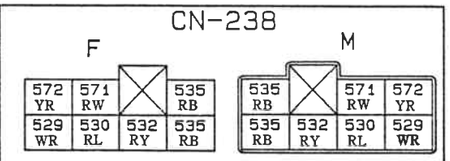
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARN. SIDE

CN-239



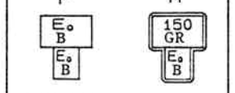
UPPER FUSE BOX SIDE — HARNESS SIDE

CN-238



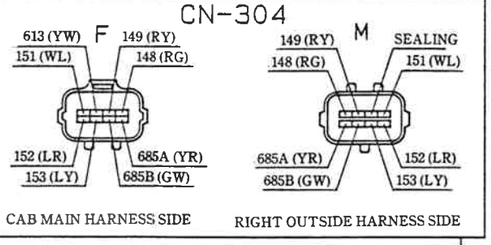
UPPER FUSE BOX SIDE — HARNESS SIDE

CN-242



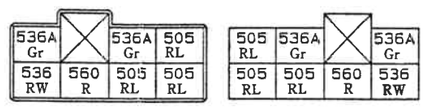
ADJUSTING CONNECTOR SIDE — HARNESS SIDE

CN-304



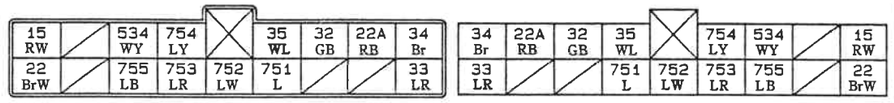
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARNESS SIDE

CN-240



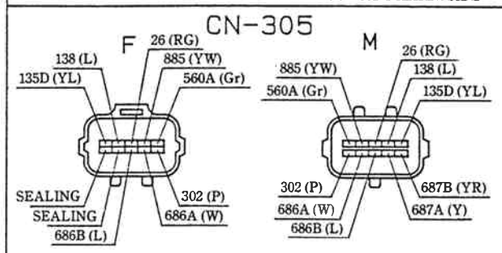
UPPER FUSE BOX SIDE — HARNESS SIDE

CN-217A



SHIFT LEVER SIDE — HARNESS SIDE

CN-305

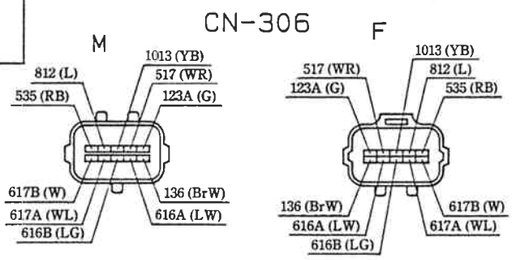


MAIN HARN. SIDE — RIGHT OUTSIDE HARN. SIDE

CN-277

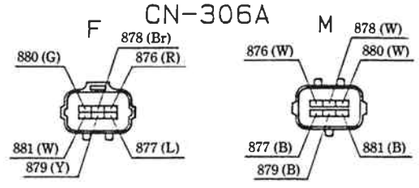


CN-306



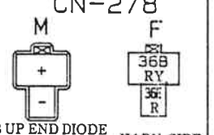
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARN. SIDE

CN-306A



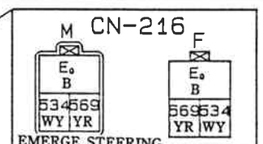
CAB MAIN HARN. SIDE — RIGHT OUTSIDE HARN. SIDE

CN-278



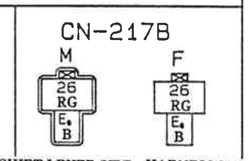
JIB UP END DIODE SIDE — HARN. SIDE

CN-216



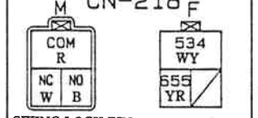
EMERGE. STEERING PUMP SW. SIDE — HARN. SIDE

CN-217B



SHIFT LEVER SIDE — HARNESS SIDE

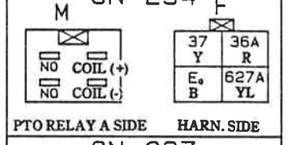
CN-218



SWING LOCK PIN — HARN. SIDE

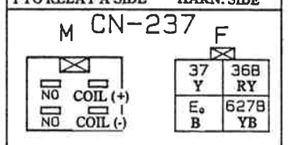
DETECT SW. SIDE

CN-234



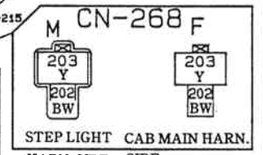
PTO RELAY A SIDE — HARN. SIDE

CN-237



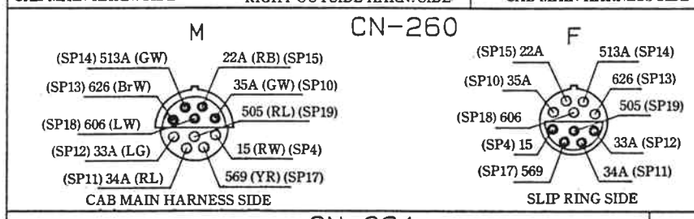
PTO RELAY B SIDE — HARN. SIDE

CN-268



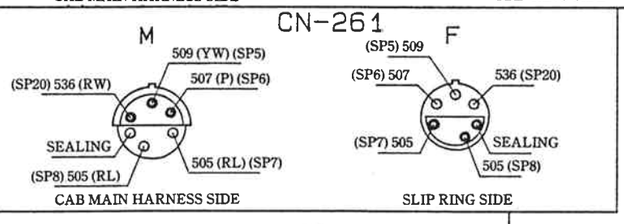
STEP LIGHT HARN. SIDE — CAB MAIN HARN. SIDE

CN-260



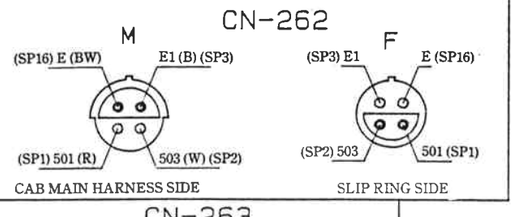
CAB MAIN HARNESS SIDE — SLIP RING SIDE

CN-261



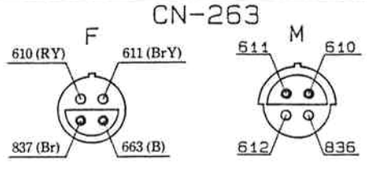
CAB MAIN HARNESS SIDE — SLIP RING SIDE

CN-262



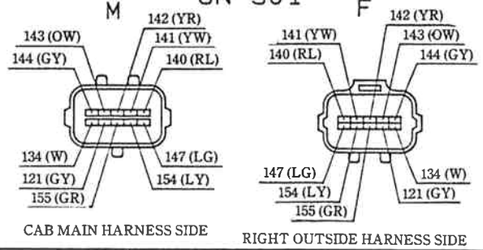
CAB MAIN HARNESS SIDE — SLIP RING SIDE

CN-263



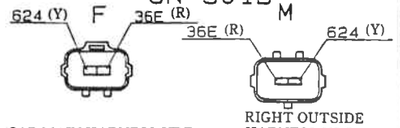
CAB MAIN HARNESS SIDE — SLIP RING SIDE

CN-301



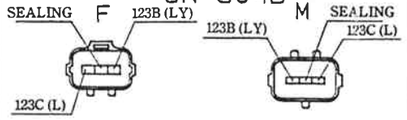
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARNESS SIDE

CN-301B



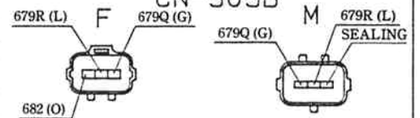
CAB MAIN HARNESS SIDE — RIGHT OUTSIDE HARNESS SIDE

CN-304B



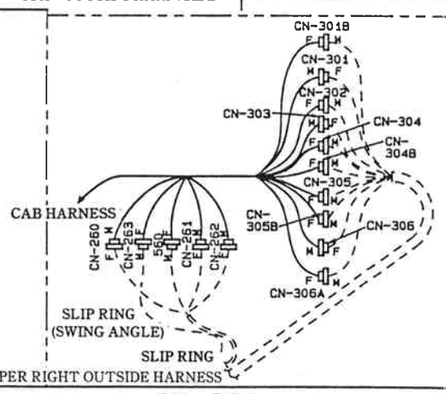
CAB M. HARN. SIDE — RIGHT OUTSIDE HARN. SIDE

CN-305B

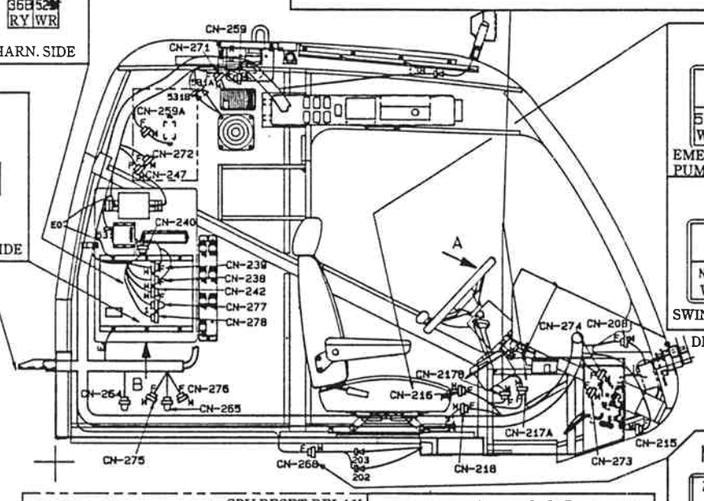


CAB M. HARN. SIDE — RIGHT OUTSIDE HARN. SIDE

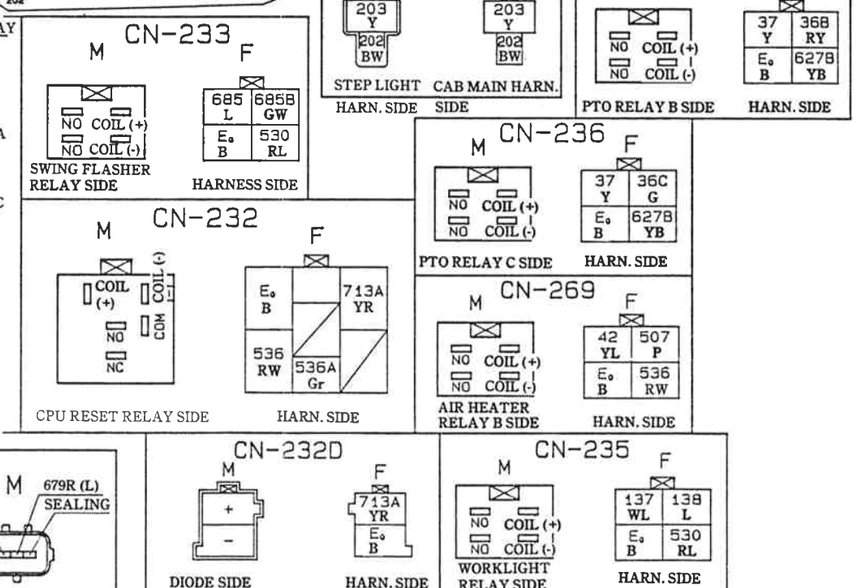
CN-301B / CN-303 / CN-304 / CN-305B / CN-306A / CN-306



CN-259 / CN-271 / CN-259A / CN-272 / CN-247 / CN-240 / CN-239 / CN-238 / CN-277 / CN-278 / CN-264 / CN-265 / CN-276 / CN-275 / CN-268 / CN-203 / CN-202 / CN-218 / CN-217A / CN-273 / CN-215 / CN-216 / CN-217B / CN-274 / CN-208 / CN-218

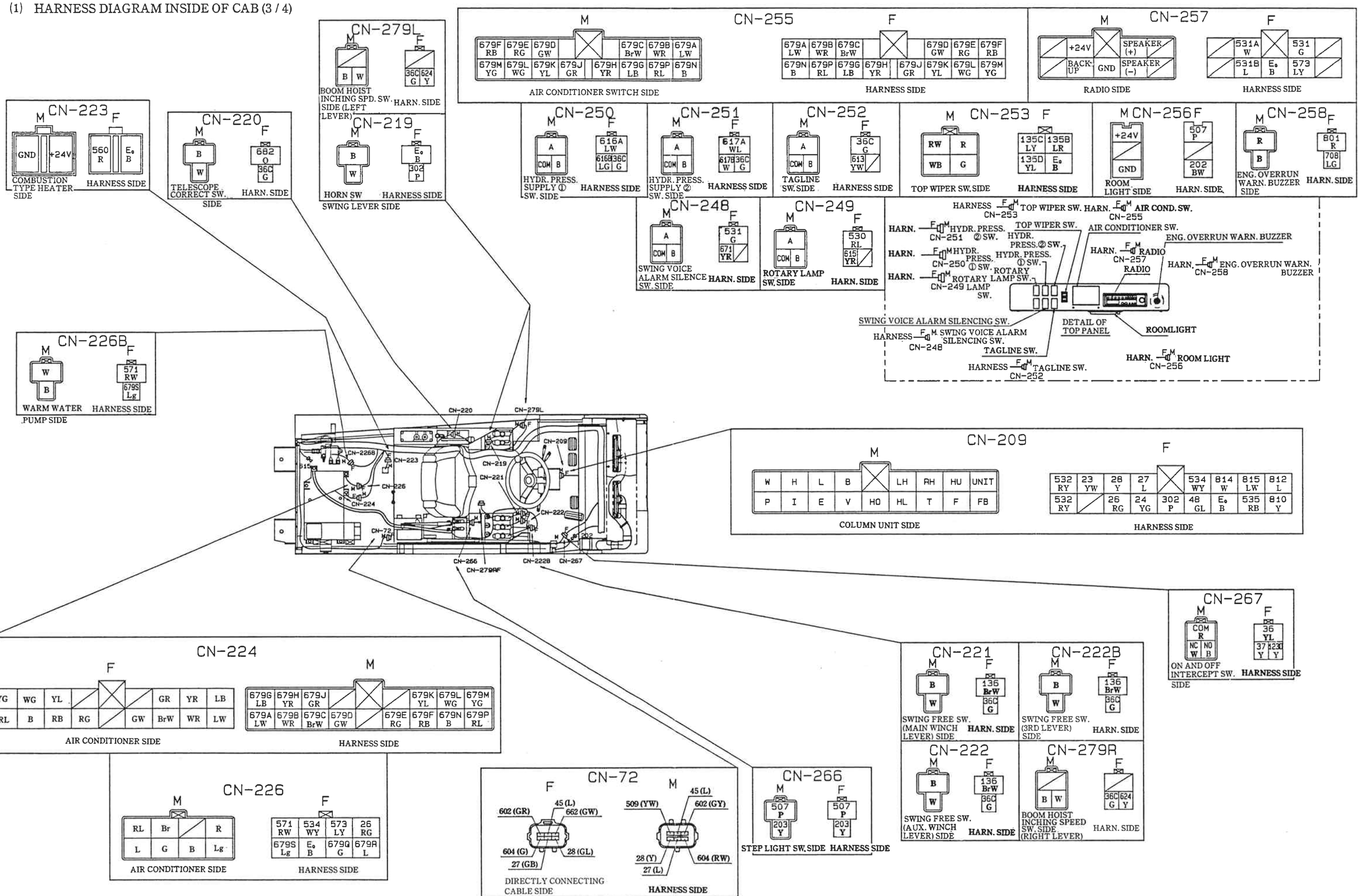


CN-233 / CN-232D / CN-232 / CN-236 / CN-269 / CN-235



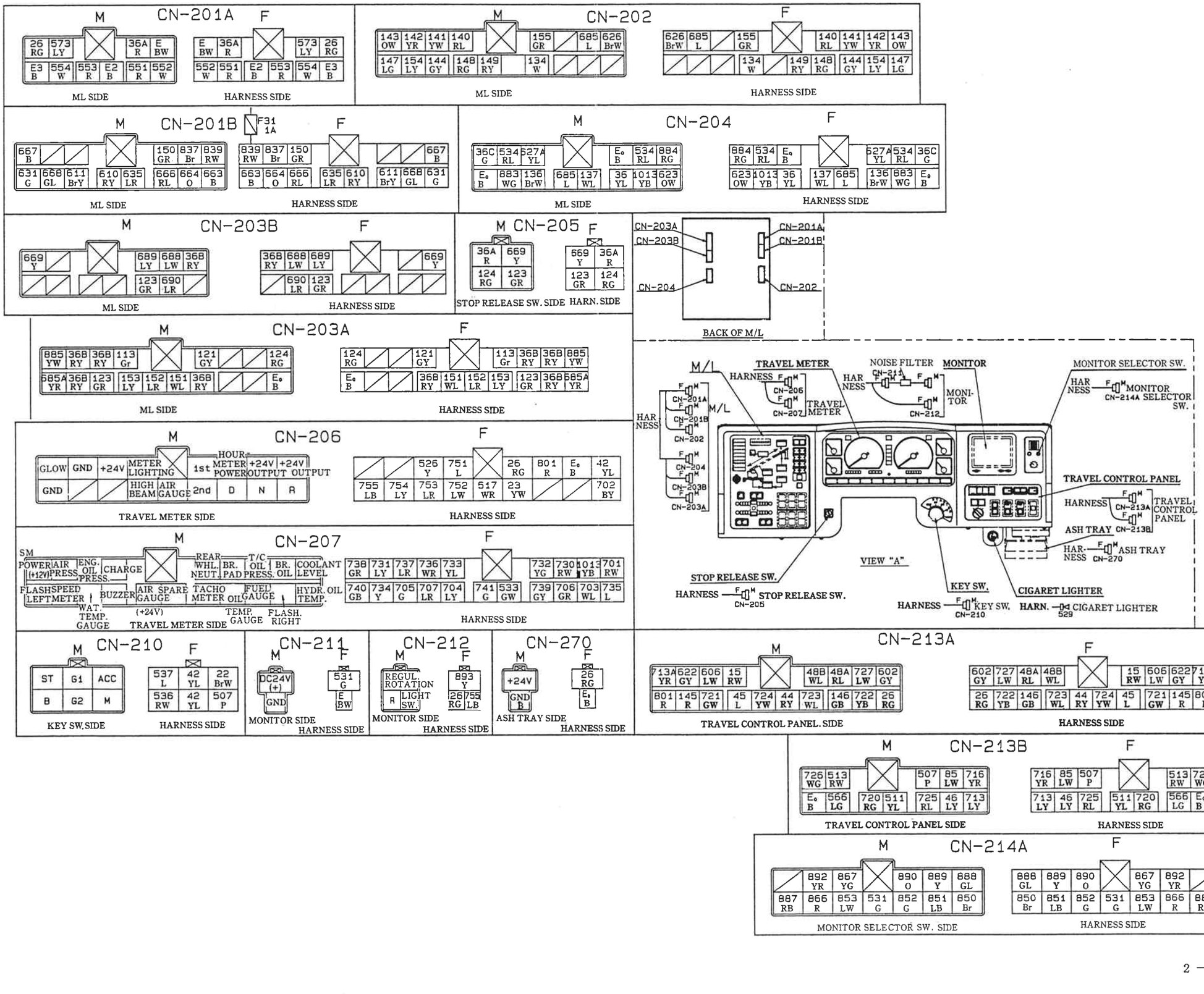
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(1) HARNESS DIAGRAM INSIDE OF CAB (3 / 4)



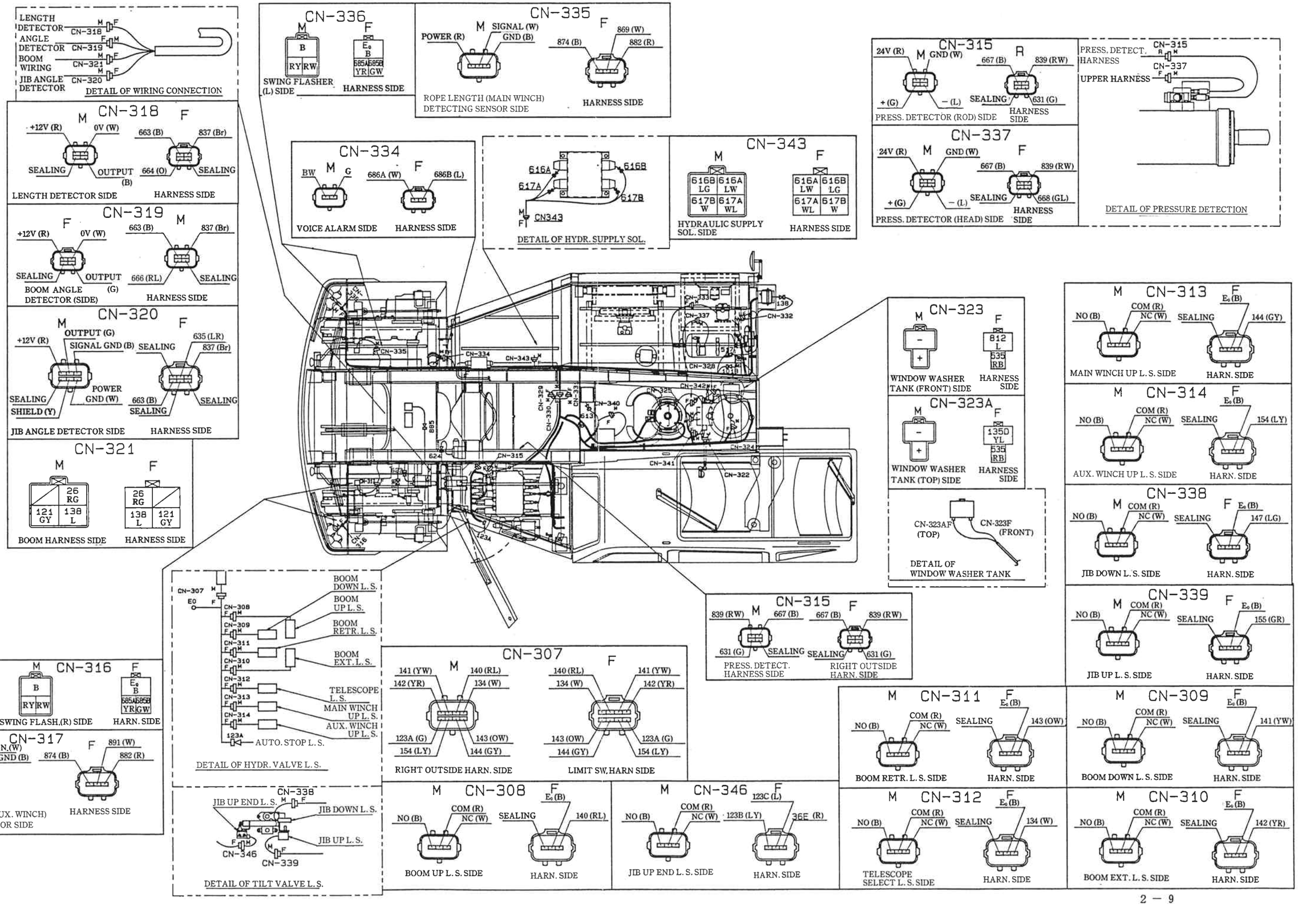
https://truckmanualshub.com/

(1) HARNESS DIAGRAM INSIDE OF CAB (4 / 4)



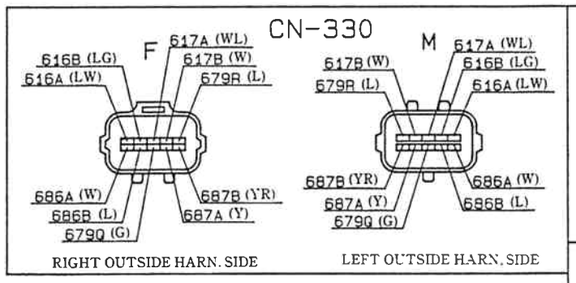
https://truckmanualshub.com/

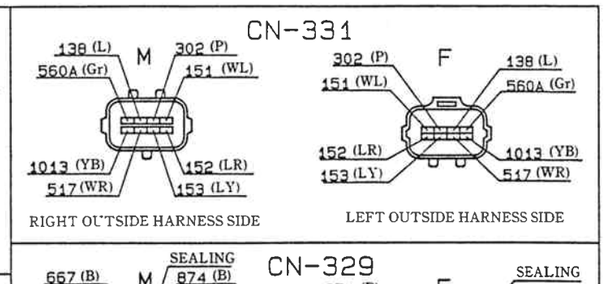
(2) UPPER HARNESS DIAGRAM (OUTSIDE OF CAB) (1 / 2)

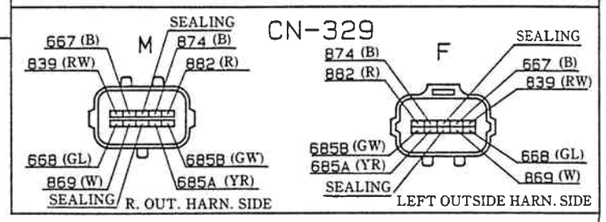


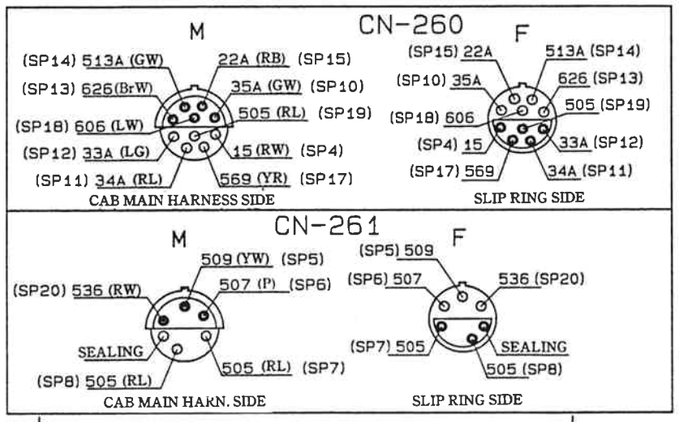
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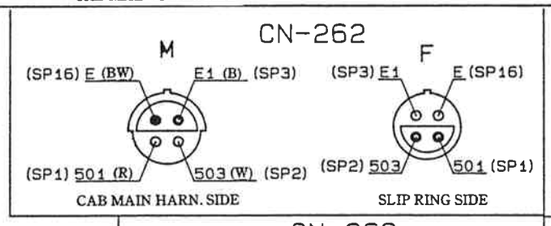
(2) UPPER HARNESS DIAGRAM (OUTSIDE OF CAB) (2 / 2)

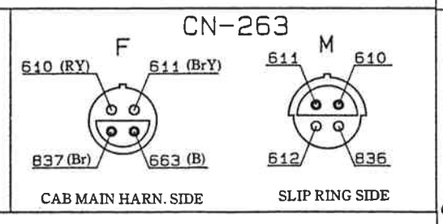


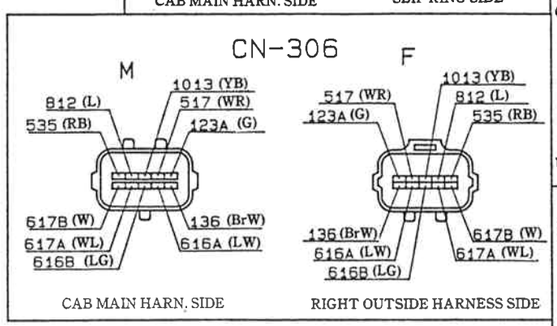


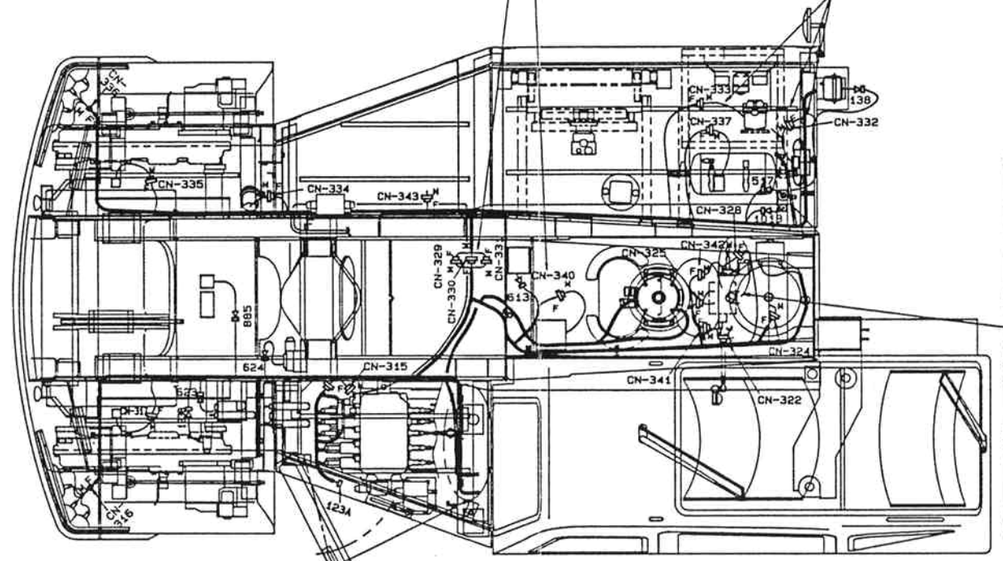


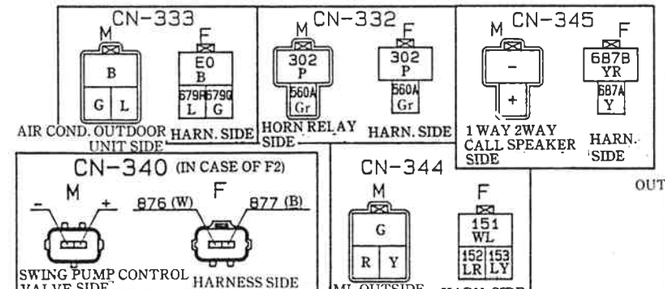


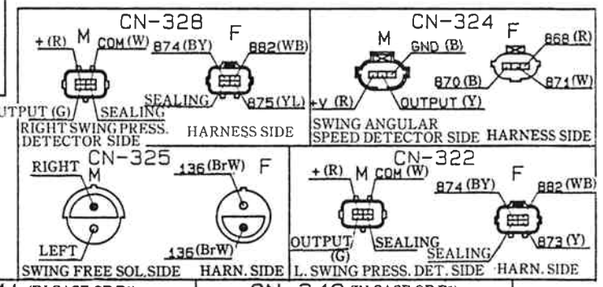


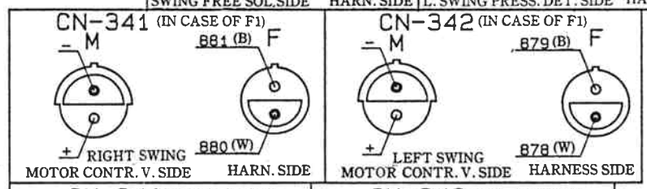


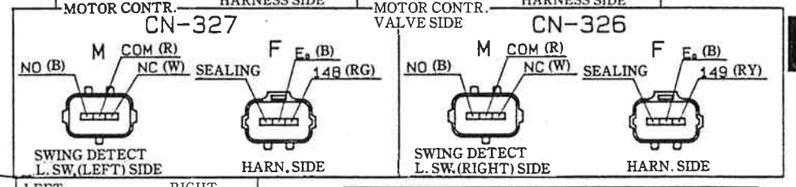


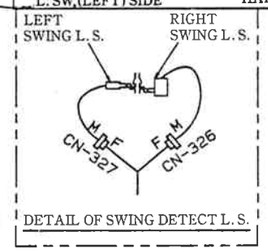


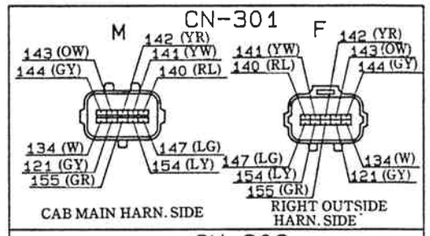


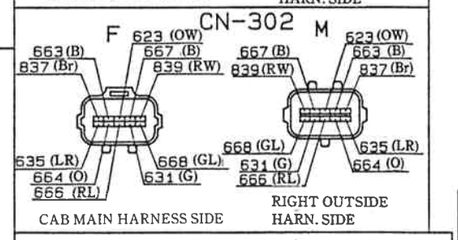


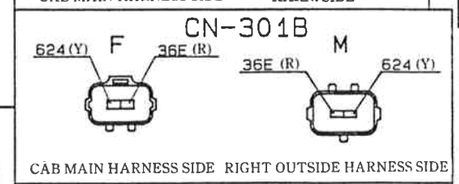


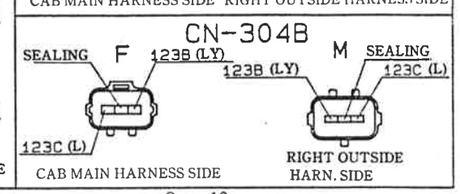


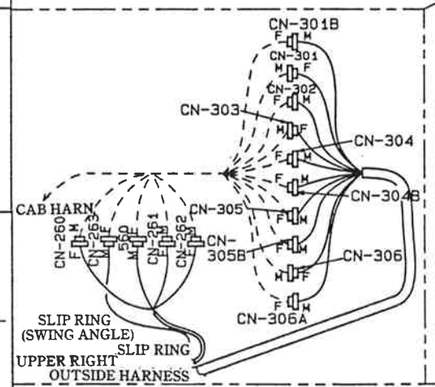


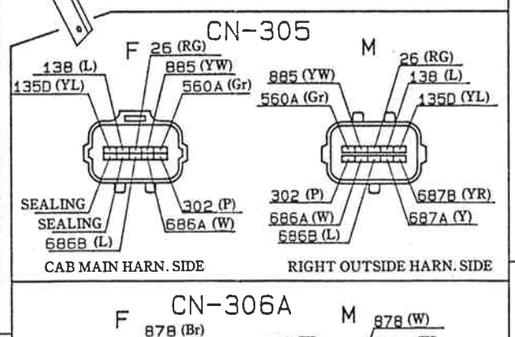


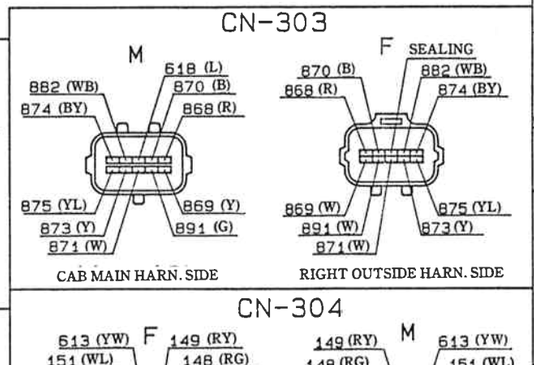


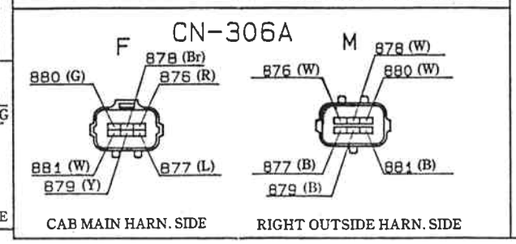


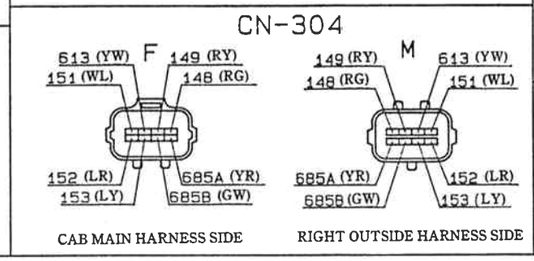


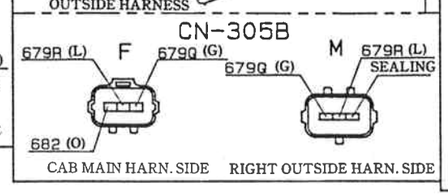






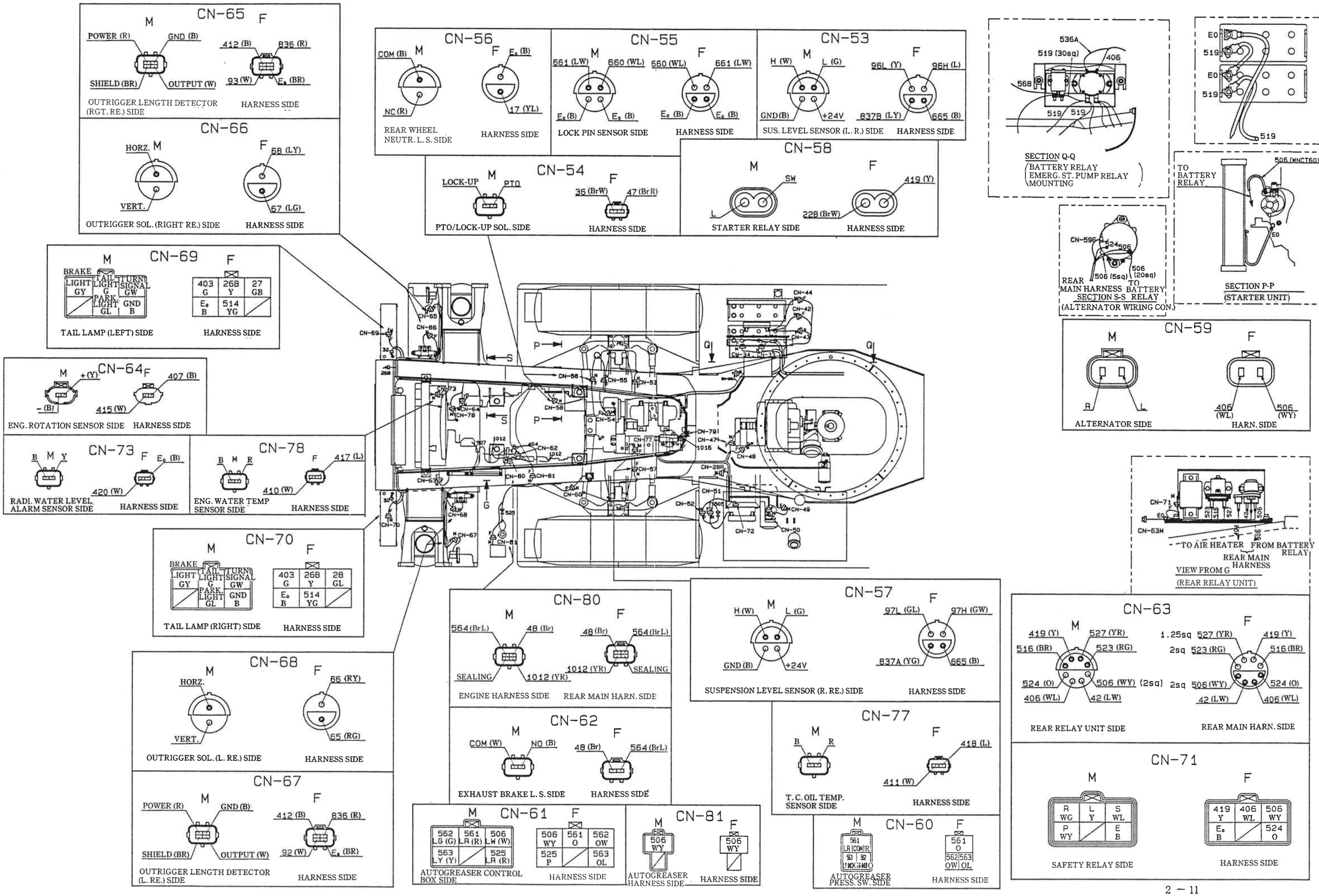






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(3) LOWER HARNESS DIAGRAM (1 / 4)



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(3) LOWER HARNESS DIAGRAM (2 / 4)

CN-33

M

837B LY	837A YG	98 W	836 R	836 R		95L RW	95H RL	94L LR	94H YR	93 W
665 B	665 B	665 B	836 R	99 W	17 YL	1012 YR	415 W	412 B	407 B	403 G

FRONT MAIN HARNESS SIDE

F

93 W	94H YR	94L LR	95H RL	95L RW		836 R	836 R	98 W	837A YG	837B LY
403 G	407 B	412 B	415 W	1012 YR	17 YL	99 W	836 R		665 B	665 B

REAR MAIN HARNESS SIDE

CN-34

M

528C Gr	523 RG	516 BR	601 YR		50 GB	49 GW	45A G	44 GR
27 GB	28 GL	46A WG	412 B	536A OW	36 BrW	514 YG	662 GW	602A Y

FRONT MAIN HARNESS SIDE

F

44 GR	45A G	49 GW	50 GB		601 YR	516 BR	523 RG	528C Gr
602A Y	662 GW	514 YG	36 BrW	536A OW	412 B	46A WG	28 GL	27 GB

REAR MAIN HARNESS SIDE

CN-28L

M F

26A L

TIRE LIGHT (LEFT) SIDE HARNESS SIDE

CN-41

M

519 WB	11 WG	12 WY	72 YB	528 WL
549 RL	406 WL	522F GW	536A OW	E₀ B

MDT RELAY UNIT SIDE

F

528 WL	72 YB	12 WY	11 WG	519 WB
E₀ B	536A OW	522F GW	406 WL	549 RL

HARNESS SIDE

528 519 522F 12 11 522F REAR MAIN HARNESS CN-41

(MDT RELAY UNIT)

3rd R 1st L Tr

TRANSMISSION SOL.

CN-30A

M F

FR. MAIN HARN. SIDE RE. MAIN HARN. SIDE

CN-32

22B (BrW) M 26A (L) 26A (L) F 22B (BrW)

26B (Y) 564 (BrL) 564 (BrL) 26B (Y)

FRONT MAIN HARNESS SIDE REAR MAIN HARNESS SIDE

CN-30

M F

2sq 506 (WY) 508 (RW) SEALING 570 (YR) 522B (RG) SEALING 522L (R) 521 (RY)

FR. MAIN HARNESS SIDE

RE. MAIN HARNESS SIDE

CN-31

F M

55 (O) 55 (OW) 61 (RB) 62 (RW) 63 (LB) 64 (LW) 654 (LG) 36D (GR)

FRONT MAIN HARNESS SIDE REAR MAIN HARNESS SIDE

REAR SIDE FRONT SIDE CN-32 CN-31 CN-30A CN-30 519

FRONT/REAR HARN. CONNECT. (UNDER BATTERY RELAY)

CN-44

M F

PALE-BLUE 77 (POINT 1) SPARE (B. POINT 1) 521 (PALE-BLUE) 521 (RY) SEALING 77 (RW) 554 (PT. 2) 76 (W. PT. 2) E₀ (B) SEALING 654 (LG)

O/R CONTR. BOX SIDE HARN. SIDE

CN-42

M F

62 (W. PT. 1) 51 (P. PT. 1) 68 (O. PT. 1) 63 (Gr. PT. 1) 64 (Lg. PT. 1) 63 (LB) 64 (LW) 68 (LY) 62 (RW) 61 (RB) 56 (R. PT. 1) 55 (BT. PT. 1) 67 (Y. PT. 1) 65 (L. PT. 1) 66 (G. PT. 1) 65 (RG) 66 (RY) 67 (LG) 56 (O) 55 (OW)

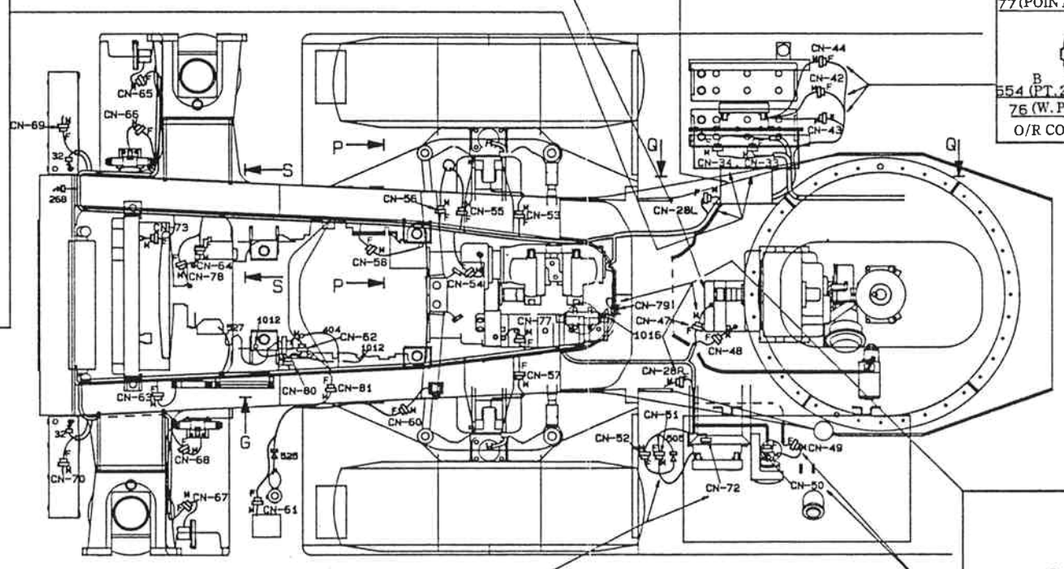
OUTRIGGER CONTR. BOX SIDE HARNESS SIDE

CN-43

F M

63 (Gr) 64 (Lg) 68 (O) 62 (W) 61 (P) 62 (RW) 61 (RB) 68 (LY) 63 (LB) 64 (LW) 65 (L) 66 (G) 67 (Y) 56 (R) 55 (Br) 56 (O) 55 (OW) 67 (LG) 65 (RG) 66 (RY)

OUTRIGGER CONTROL BOX SIDE HARNESS SIDE



CN-51

M F

522A (RG) 522L (R) SEALING 521 (RY) 528 (WL) 36 (BrW) 508 (RW) 506 (WY) 522F (GW) 506 (WY) 2sq

FUSE BOX SIDE HARNESS SIDE

CN-72

M F

509 (YW) 28 (Y) 27 (L) 45 (L) 602 (GY) 604 (RW) 602 (GR) 604 (G) 27 (GB) 45 (L) 562 (GW) 28 (GL)

DIRECTLY CONNECTING CABLE SIDE HARN. SIDE

CN-52

F M

549 (RL) 523 (RG) 528C (Gr) SEALING 519 (WB) 528A (WB) 528B (YB) 36E (YG) 570 (YR) 36D (GR) 2sq

FUSE BOX SIDE HARNESS SIDE

CN-49

M F

GND (B) FUEL METER (YR) 409 (W) 415 (L)

FUEL SENSOR SIDE HARNESS SIDE

CN-50

M F

GND B		E₀ B
LIGHT R	+24V Y	519 WB / 268 Y

TACHOGRAPH SIDE HARNESS SIDE

CN-47

M F

2nd 1st 3rd Low Rev SEALING Tr GND 35 (LW) 46 (GY) 34 (LY) 33 (LB) 31 (L) E₀ (B) 32 (LR) BLIND

TRANSMISSION SOL. SIDE HARNESS SIDE

CN-48

B M B F

E₀ (B) 1015 (RG)

TRANSMISSION OIL PRESSURE SW. SIDE HARNESS SIDE

CN-79

M F

		OUT-PUT			
GND	SEN-SOR	POWER (+)	1017 YR		
			549 RL	420 W	E₀ B

RADIATOR WATER LEVEL ALARM CONTROLLER SIDE HARNESS SIDE

CN-28R

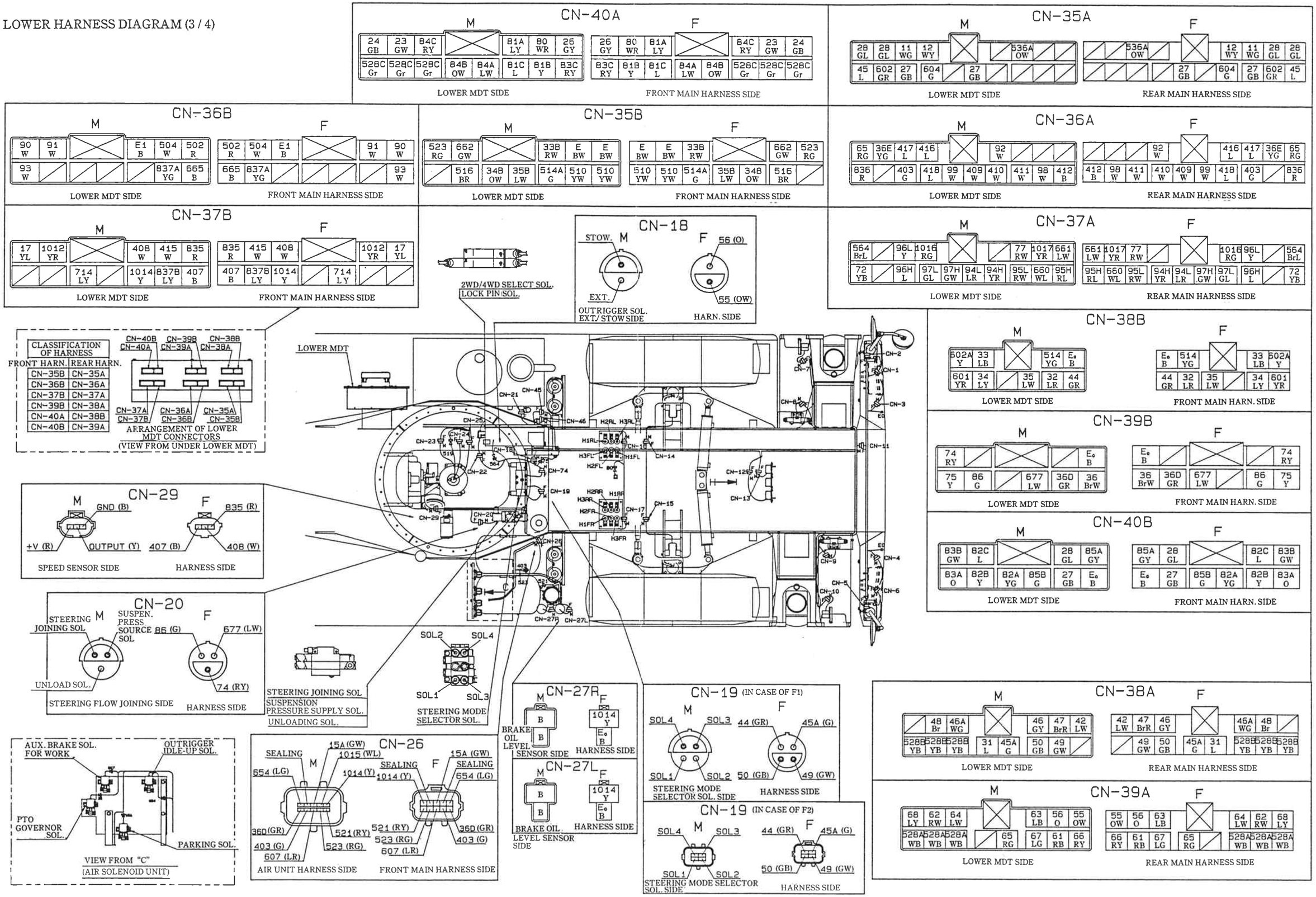
M F

26A L

TIRE LIGHT (RIGHT) SIDE HARNESS SIDE

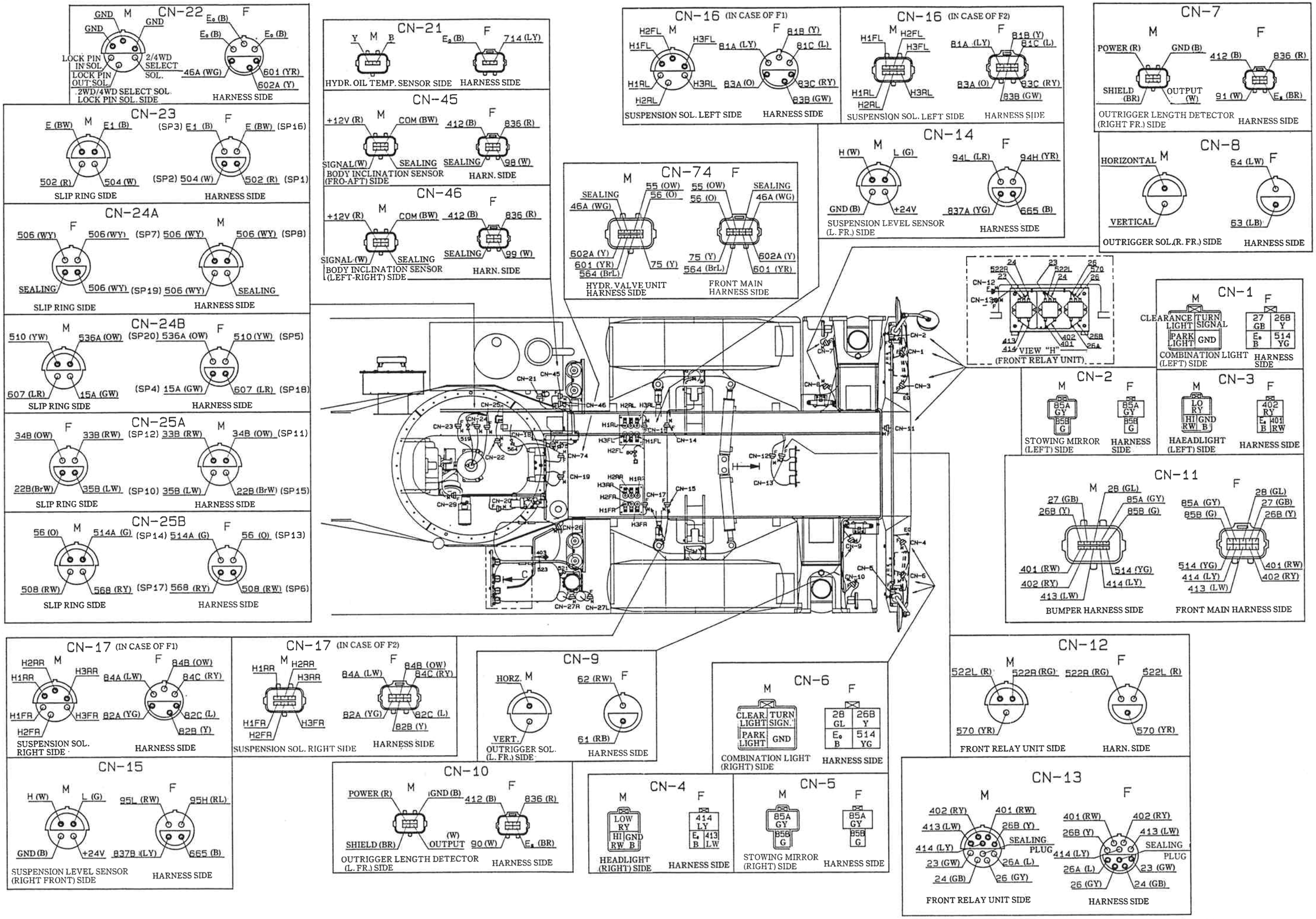
https://truckmanualshub.com/

(3) LOWER HARNESS DIAGRAM (3 / 4)



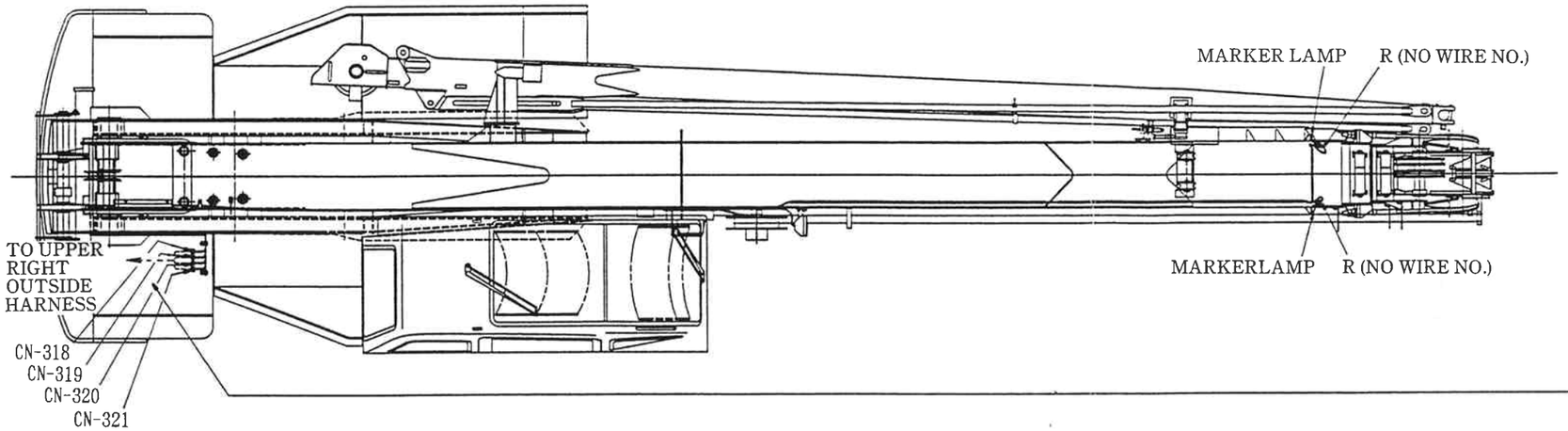
https://truckmanualshub.com/

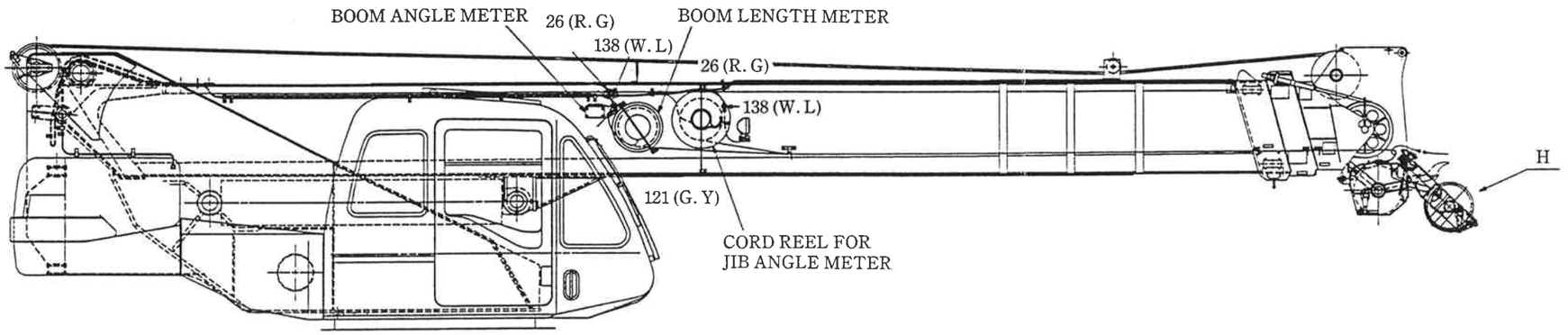
(3) LOWER HARNESS DIAGRAM (4 / 4)

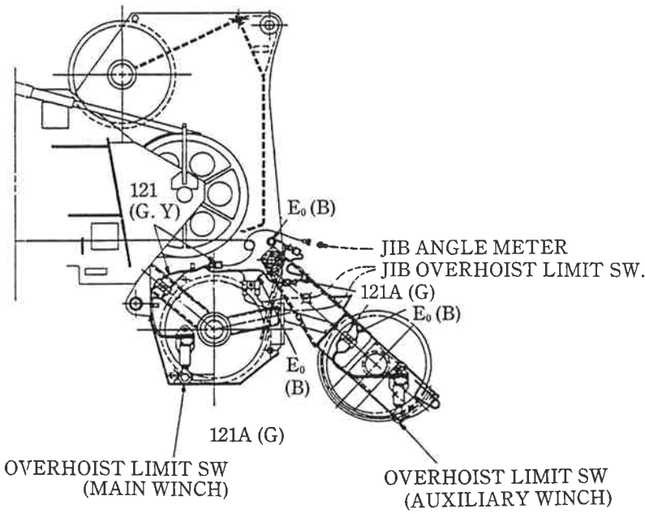


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(4) BOOM HARNESS CONNECTION

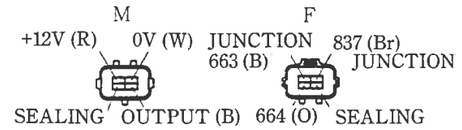




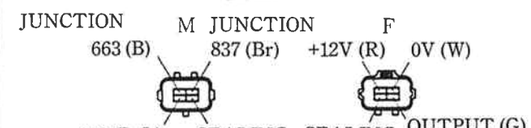


DETAIL OF H SECTION (S = 1/10)

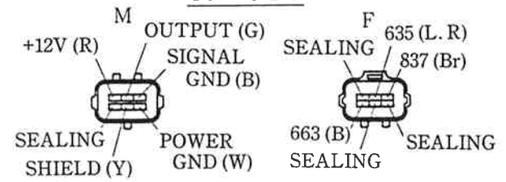
CN－318



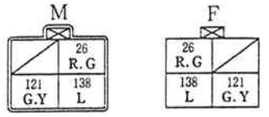
CN－319



CN－320



CN－321



NOTE

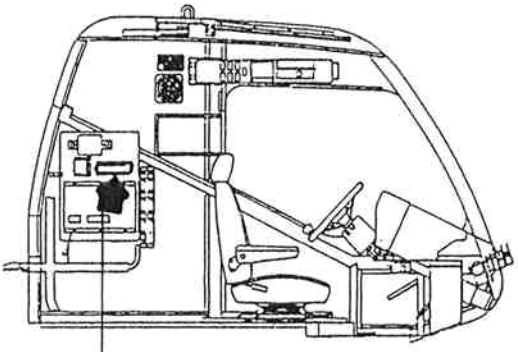
WIRE COLOR SYMBOLS

W ··· WHITE	Br ··· BROWN
B ··· BLACK	G ··· GREEN
R ··· RED	O ··· ORANGE
Y ··· YELLOW	Gr ··· GRAY
L ··· BLUE	P ··· PINK
Lg ··· LIGHT GREEN	

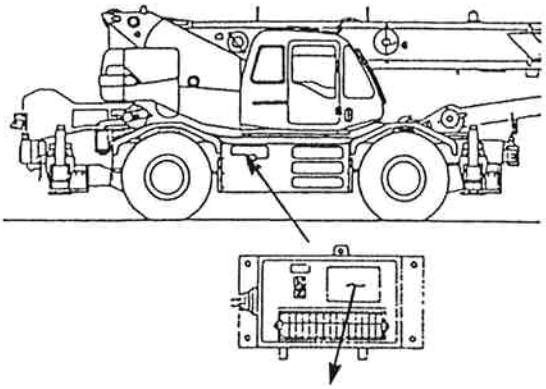
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2.3 FUSES

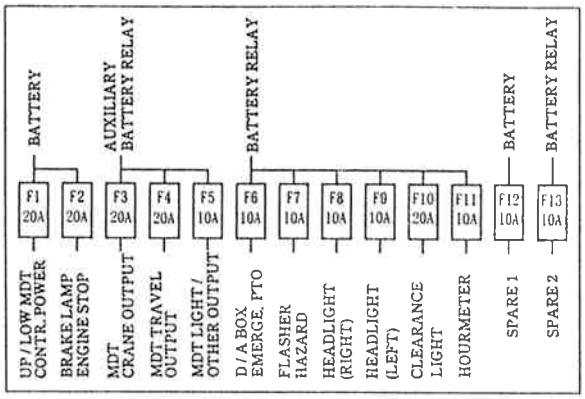
OPERATOR'S ROOM SIDE (UPPER FUSE BOX)



LOWER CARRIER SIDE (LOWER FUSE BOX)

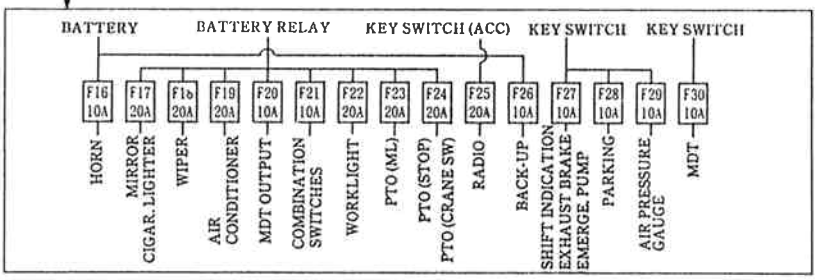


STICKER (FUSE BOX)



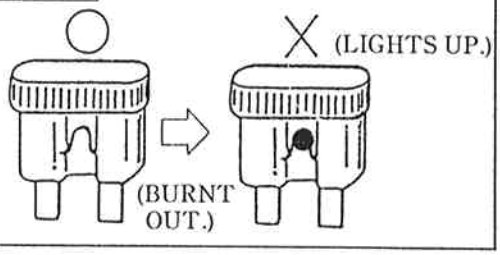
The fuses used in this machine are the KOBELCO genuine parts of 10A and 20A fuses which have function to indicate fuse burning out.
Parts No. of 10A
·····EN73E00001S003
Parts No. of 20A
·····EN73E00001S004

STICKER (FUSE STAND COVER)



INDICATION OF FUSE BURNING OUT

- When the fuse used in this machine is burnt out due to short circuit and so on, the built-in indicator lamp for burning out of the fuse lights up.
- When checking the fuses for burning out, check them with the key switch placed in the ON position.



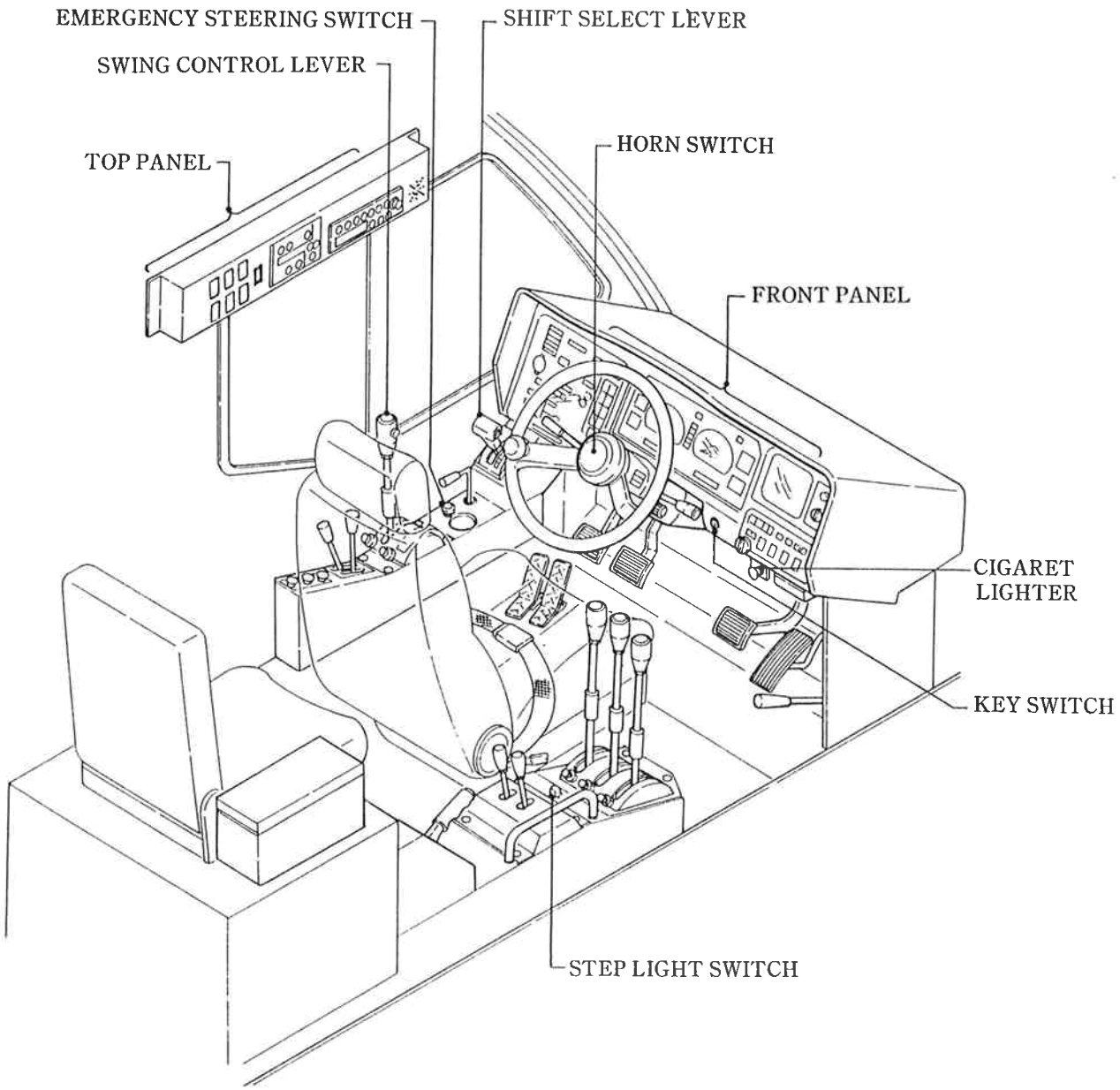
CAUTION

1. In the case that a same fuse is frequently burnt out, it is considered that burning out of the fuse may be due to some fault in the electric circuit and it is not yet repaired. In such case, absolutely do not replace the burnt fuse simply with a fuse over the specified capacity. This could cause damage to the wiring and electrical apparatus.
2. In the above case, or when installing a new optional apparatus, be sure to consult the service shop of our representative. They will make a proper treatment or give a proper instruction.

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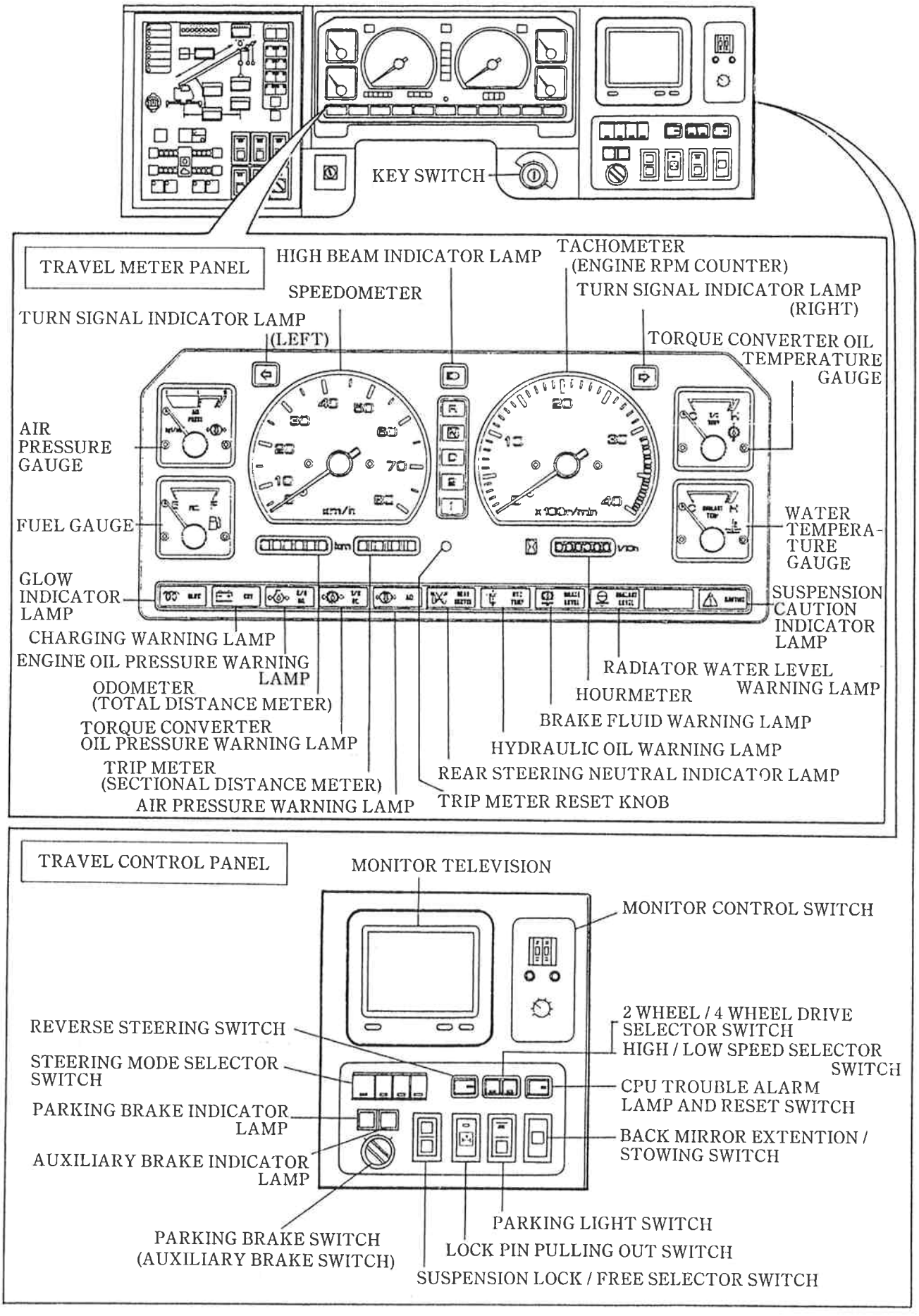
3. OPERATION OF ELECTRICAL APPARATUS

3.1 OUTLINES OF APPARATUS



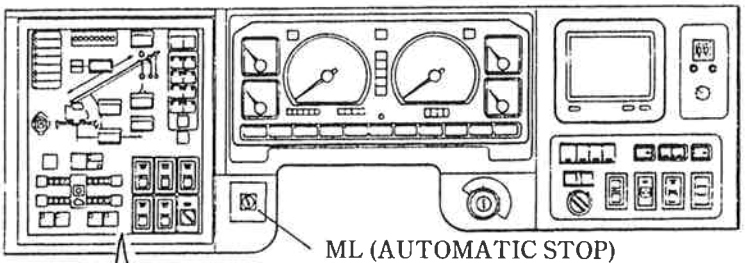
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FRONT PANEL



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■MOMENT LIMITER (ML) PANEL



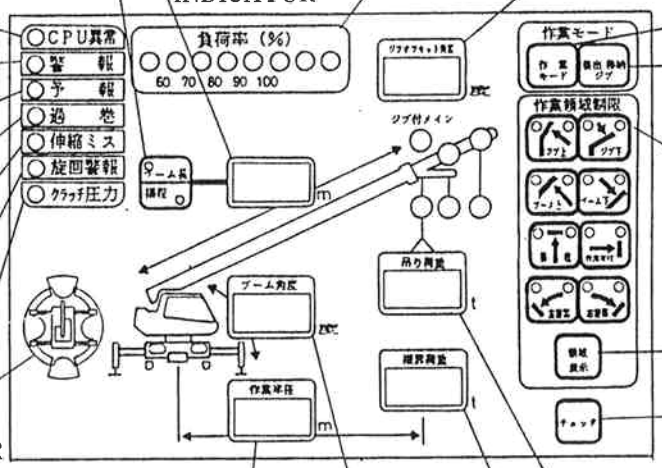
ML (AUTOMATIC STOP)
RELEASE SWITCH

MOMENT LIMITER PANEL

MOMENT LIMITER

CPU ABNORMALITY INDICATOR LAMP
OVERLOAD WARNING LAMP
OVERLOAD PRE-NOTICE LAMP
HOOK OVERHOIST INDICATOR LAMP
TELESCOPE MISOPERATION INDICATOR LAMP
SWING STOP WARNING LAMP
LOW WINCH CLUTCH PRESSURE WARNING LAMP
SWING AREA INDICATOR

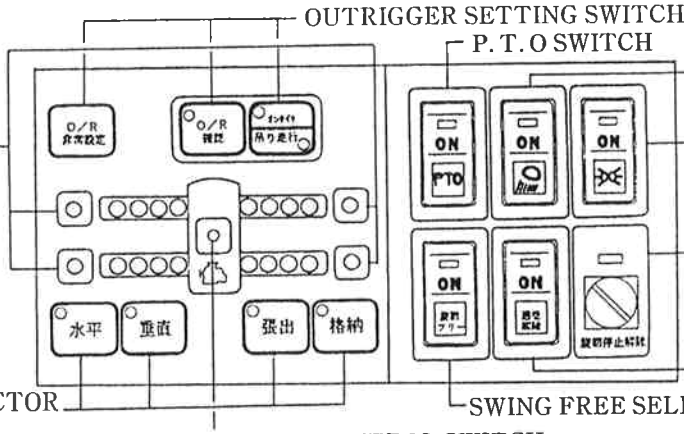
BOOM LENGTH / LIFTING HEIGHT INDICATION SELECTOR SWITCH
BOOM LENGTH / LIFTING HEIGHT INDICATOR
LOAD RATIO INDICATOR
JIB OFFSET ANGLE INDICATOR
WORKING MODE SELECTOR SWITCH
JIB EXT. / STOW. MODE SELECTOR SWITCH
WORKING AREA LIMITING DEVICE
WORKING AREA LIMIT INDICATION SWITCH
ML FUNCTION CHECK SWITCH
LIFTING LOAD INDICATOR
LIMITED (RATED) LOAD INDICATOR
OPERATING RADIUS INDICATOR
BOOM ANGLE INDICATOR



OUTRIGGER CONTROL INDICATOR

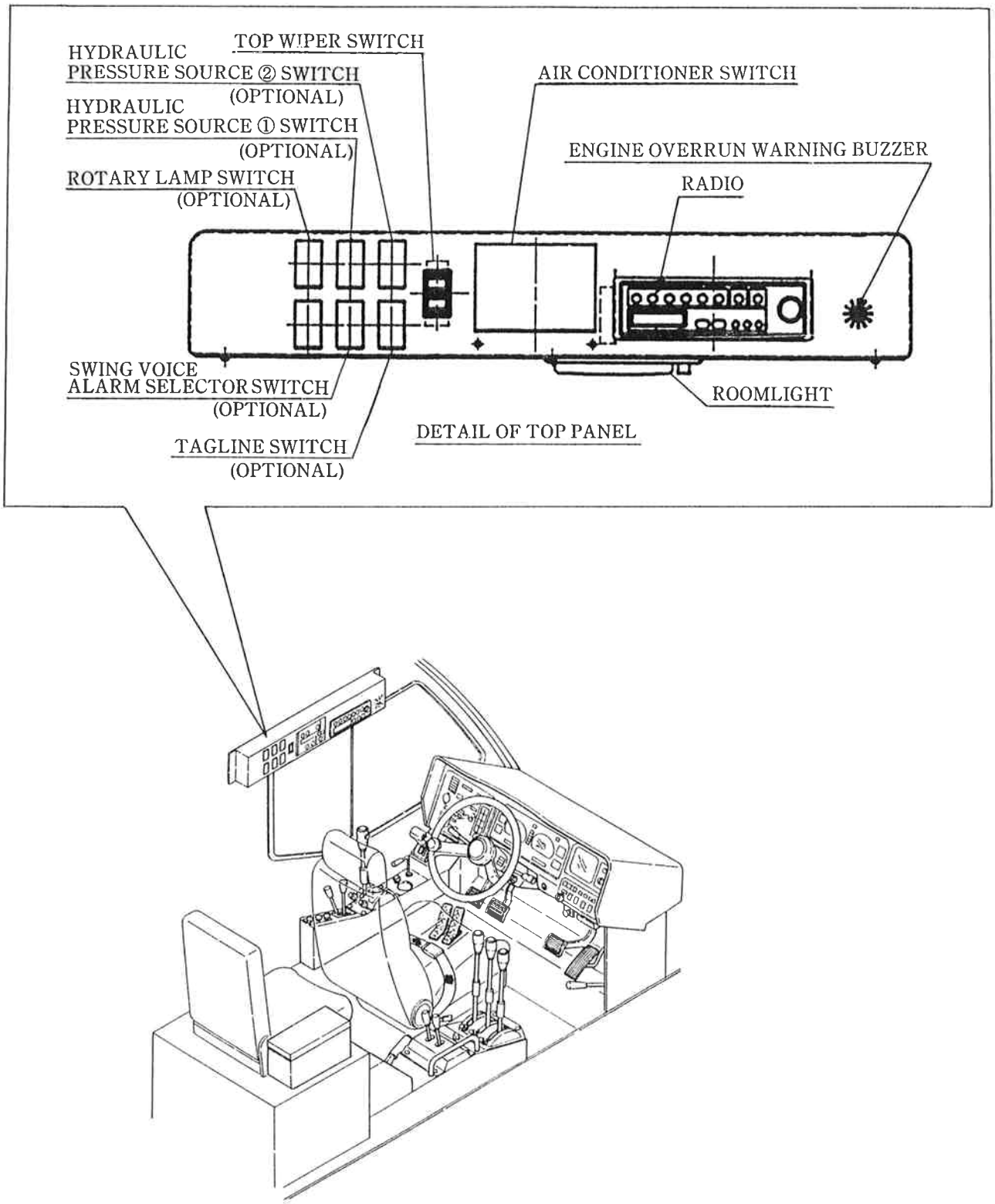
CRANE CONTROL SWITCH

OUTRIGGER SETTING SWITCHES
P. T. O SWITCH
WORKLIGHT SWITCH
SWING WARNING FLASHER SWITCH
SWING STOP RELEASE SWITCH
OVERHOIST RELEASE SWITCH
SWING FREE SELECTOR SWITCH
OUTRIGGER CONTROL SWITCHES (INDIVIDUAL)
MOVEMENT SELECTOR SWITCHES
OUTRIGGER CONTROL SWITCH (ALL OPERATION)



https://truckmanualshub.com/

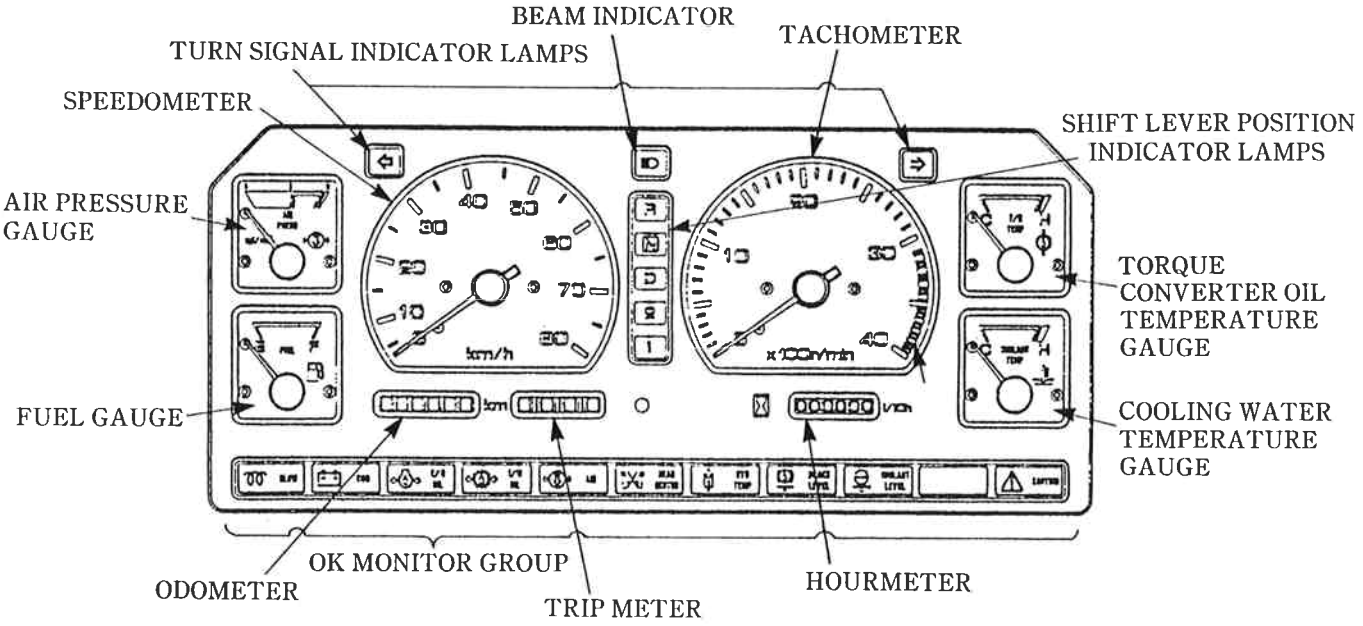
TOP PANEL



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3.2 FUNCTION OF ELECTRICAL APPARATUS

1) TRAVEL METER PANEL

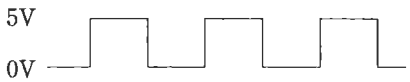


① Function of Speedometer



Pulse signal is as shown above.

② Function of Tachometer (Engine rpm counter)



Pulse signal is as shown above.

③ Function of Torque Converter Oil Temperature Gauge

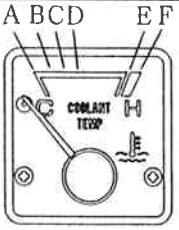
Sensor Signal (Ω)	Water Temperature (converted value)	Meter Indicating Point
More than 66Ω	Lower than 55℃ (131°F)	A
56Ω	60℃ (140°F)	B
44Ω	67℃ (152.6°F)	C
33Ω	75℃ (167°F)	D
14.7Ω	105℃ (221°F)	
10Ω	120℃ (248°F)	E
Less than 8.5Ω	Higher than 125℃ (257°F)	F

	Oil Temper. Gauge
D I A L SCALE	A B C D E F

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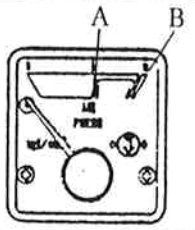
④ Function of Cooling Water Temperature Gauge

Sensor Signal (Ω)	Water Temperature (converted value)	Meter Indicating Point
More than 80Ω	Lower than 50℃ (122°F)	A
66Ω	55℃ (131°F)	B
52Ω	62℃ (143.6°F)	C
37Ω	72℃ (161.6°F)	D
17Ω	100℃ (212°F)	
11.5Ω	115℃ (239°F)	E
Less than 10Ω	Higher than 120℃ (248°F)	F

	Water Temper. Gauge
D I A L SCALE	

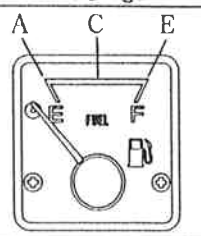
⑤ Function of Air Pressure Gauge

Sensor Signal kg / ㎠ (psi)	Meter Indicating Point
5.7 (81)	A
9.3 (132)	B

	Air Pressure Gauge
D I A L SCALE	

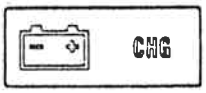
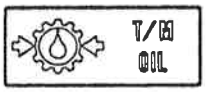
⑥ Function of Fuel Gauge

Sensor Signal (Ω)	Fuel (converted value)	Meter Indicating Point
More than 125Ω	E	A
78Ω	1/4	
50Ω	1/2	C
30Ω	3/4	
Less than 18Ω	F	E

	Fuel Gauge
D I A L SCALE	

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⑦ OK Monitor Group

<table>
<tr><th>No.</th><th>Name of Lamp</th><th>Function</th></tr>
<tr><td>1</td><td>Glow lamp
  </td><td>This lamp lights up when the preheating heater of the engine is electrified (when the key switch is placed in the HEAT position).</td></tr>
<tr><td>2</td><td>Wrong battery charging warning indicator lamp
  </td><td>
<table>
<tr><th></th><th>Lower Input</th><th>Indicating Output</th><th>Indicating Order ※</th></tr>
<tr><td>①</td><td>When the alternator generates electricity, the contact point of the hourmeter opens. (0 volt)</td><td>Lamp goes out.</td><td>3</td></tr>
<tr><td>②</td><td>When generation of electric power of the alternator stops, the contact point of the hourmeter closes. (24 volts)</td><td>Lamp lights up.</td><td>1</td></tr>
<tr><td>③</td><td>When
10 volts≦Voltage of power≦19 volts</td><td>Lamp goes on and off (period : 1 second).</td><td>2</td></tr>
<tr><td>④</td><td>When
19 volts≦Voltage of power≦23. 5 volts</td><td>Lamp goes on and off (period : 2 seconds).</td><td>2</td></tr>
</table>
※ The indicating order is priority of 1>2>3.
</td></tr>
<tr><td>3</td><td>Low engine oil pressure and engine oil filter clogging warning lamp.
  </td><td>
<table>
<tr><th></th><th>Lower Input</th><th>Indicating Output</th></tr>
<tr><td>①</td><td>When the engine oil pressure reaches a value more than the set value, the pressure switch opens.</td><td>Lamp goes out.</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>Low transmission oil pressure and transmission oil filter clogging warning lamp.
  </td><td>
<table>
<tr><th></th><th>Lower Input</th><th>Indicating Output</th></tr>
<tr><td>①</td><td>When the transmission oil pressure reaches a value more than the set value, the pressure switch opens.</td><td>Lamp goes out.</td></tr>
<tr><td>②</td><td>The transmission oil pressure continues for more than 2 seconds when the switch is turned on.</td><td>Lamp lights up.</td></tr>
</table>
</td></tr>
<tr><td>5</td><td>Rear wheels neutral out indicator lamp
  </td><td>
<table>
<tr><th>Actual Steering Mode</th><th>Steering Mode Selector Switch</th><th>Neutral Detecting Limit Switch</th><th>Neutral Out Indication</th><th>Buzzer 2</th><th>Remarks</th></tr>
<tr><td rowspan="3">Normal</td><td>Normal</td><td>—</td><td>Goes out.</td><td></td><td rowspan="5">Limit switch ON … ○
Limit switch OFF … ×</td></tr>
<tr><td rowspan="2">4 wheels steering</td><td>○ (other than Neutral)</td><td>Goes on and off.</td><td>Inter-mittent</td></tr>
<tr><td>× (Neutral)</td><td>Goes out.</td><td></td></tr>
<tr><td rowspan="3">4 wheel steering</td><td>Normal</td><td>○ (other than Neutral)</td><td>Goes on and off.</td><td>Inter-mittent</td></tr>
<tr><td>Normal</td><td>× (Neutral)</td><td>Goes out.</td><td rowspan="3"></td></tr>
<tr><td rowspan="2">4 wheels steering</td><td>○ (other than Neutral)</td><td>Lights up.</td></tr>
<tr><td>× (Neutral)</td><td>Goes out.</td></tr>
</table>
</td></tr>
</table>

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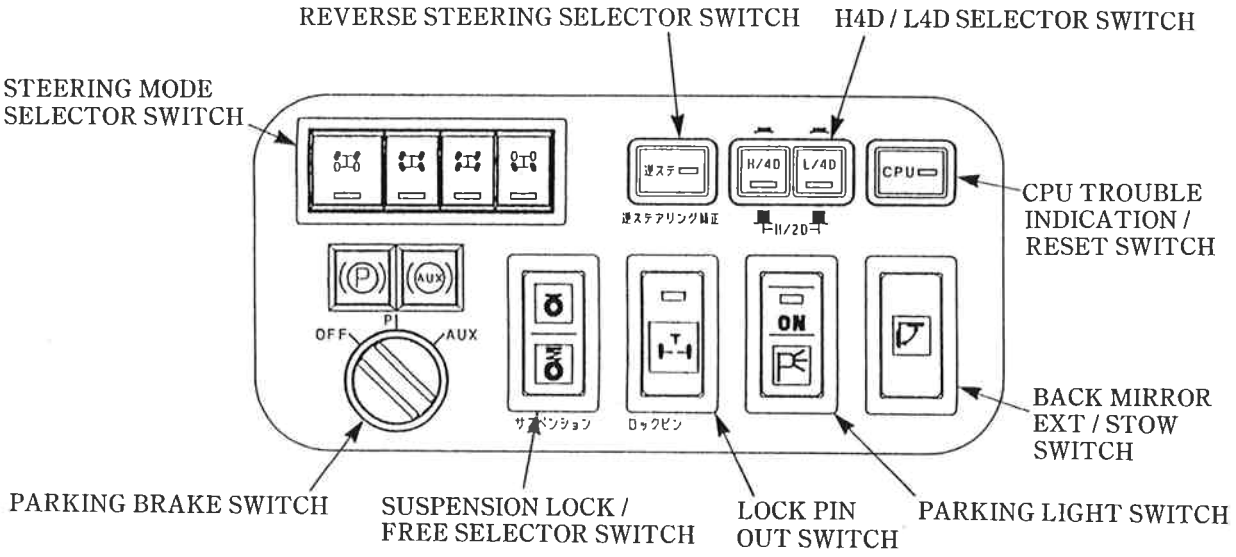
<table>
<tr><th>No.</th><th>Name of Lamp</th><th>Function</th></tr>
<tr><td>6</td><td>Low air pressure warning lamp
  </td><td>When the pressure in the air system lowers to a pressure lower than the standard value (approx. 5.5 atmospheric pressure), this lamp lights up, and the alarm buzzer sounds intermittently (kyu, kyu, kyu, ……).</td></tr>
<tr><td>7</td><td>Hydraulic oil temperature warning lamp
  </td><td><table><tr><th></th><th>Lower Input</th><th>Indicating Output</th></tr><tr><td>①</td><td>When the hydraulic oil temperature rises more than the set value, the switch closes.</td><td>Lights up.</td></tr><tr><td>②</td><td>When the hydraulic oil temperature lowers less than the set value, the switch opens.</td><td>Goes out.</td></tr></table></td></tr>
<tr><td>8</td><td>Low brake oil level warning lamp
  </td><td><table><tr><th></th><th>Lower Input</th><th>Indicating Output</th></tr><tr><td>①</td><td>When the oil level reaches a level more than the set value, the switch opens.</td><td>Goes out.</td></tr><tr><td>②</td><td>When the oil level reaches a level lower than the set value, the switch closes.</td><td>Lights up.</td></tr></table></td></tr>
<tr><td>9</td><td>Low radiator water level warning lamp
  </td><td><table><tr><th></th><th>Lower Input</th><th>Indicating Output</th></tr><tr><td>①</td><td>When the water level reaches a level more than the set value, the switch opens.</td><td>Goes out.</td></tr><tr><td>②</td><td>When the water level reaches a level less than the set value, the switch closes.</td><td>Lights up.</td></tr></table></td></tr>
<tr><td>10</td><td>Each sensor abnormality warning lamp
  </td><td>This lamp goes on and off when discrimination of model of the upper and lower MDTs is abnormal and when the high suspension level sensor is abnormal.</td></tr>
</table>

⑧ Function of Hourmeter

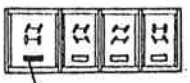
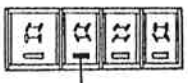
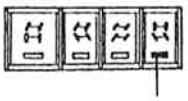
Input	Output
Alternator generating Signal	Hourmeter
○ (24 volt input)	○ (24 volt output)
×	×

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2) TRAVEL CONTROL PANEL



① Steering Mode Selecting Operation and Function

Steering Mode	Selector Switch and Indicator Lamp	Operation and Use	Specifications
Normal (Front 2 wheels)	 Indicator lamp (green)	2 front wheels only are steered. Be sure to use this mode for usual traveling.	• When traveling speed is more than 15km / h (9.3mph), shifting cannot be operated. • Shifting from 4 wheel steering (cramp and crab) and rear steering to normal steering is available by automatic centering (shifted when rear wheels becomes neutral). (Automatic centering is available only when 1km / h (0.62mph) ≦ V < 15km / h (9.3mph). • All kind of shiftings are possible when the carrier stops. • When switches more than 2 are duplicate, the mode which has been selected is kept. (Indicator lamp goes on and off.) • When any switch signal is vanished, the mode which has been selected is kept. (Indicator lamp goes on and off.) (When the key switch is turned on, the mode is normal.)
Cramp (Four wheels)	 Indicator lamp (red)	Front and rear wheels are steered in opposite direction each other. Smallest turning radius is available.	
Crab (Four wheels)	 Indicator lamp (red)	All four wheels of front and rear are steered in the same direction. Diagonal traveling is available.	
Rear (Rear 2 wheels)	 Indicator lamp (red)	Rear 2 wheels only are steered	

NOTE : The indicator lamp shows the actual steering mode.
When the actual steering mode differs from the mode of the switch selection, the switch selection side indicator lamp goes on and off. There is no automatic centering function for reverse steering.
Pulling out and inserting the lock pin is automatically carried out by selecting the steering mode with these switch only. (For normal steering mode, the lock pin is inserted, and for a mode other than the normal mode, the lock pin is pulled out.)

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② Reverse Steering Selecting Operation and Function

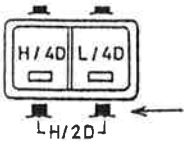
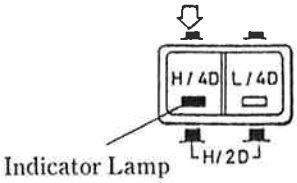
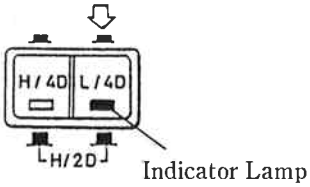
Traveling Posture	Indicator Lamp	Correcting Item	Function
Normal (Facing forward)	Goes out.		· The switch is not accepted for a speed more than 1km / h (0.62mph). · When the key switch is turned on, the steering mode begins from the normal mode.
Reverse (Facing backward)	Lights up.	· Steering mode (for all four modes) · Speed change (Forward / reverse) · Turn signals (Left and right turns)	

Every pushing the switch, the set condition is shifted. (Spring return type)



Indicator Lamp

③ H4D / L4D Selecting Operation and Function

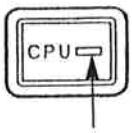
2 Wheel Drive · High Speed		4 Wheel Drive · High Speed	4 Wheel Drive · Low Speed
		 Indicator Lamp	 Indicator Lamp
4 wheel drive solenoid valve	×	○ (24 volt output)	○ (24 volt output)
Low speed solenoid valve	×	×	○ (24 volt output)
			Shifting to 4WD. Low speed cannot be operated unless traveling speed is less than 15km / h (9.3mph). ※1

※1 ···When shifting with traveling speed of more than 15km / h (9.3mph), shift to 4WD output (4 wheel solenoid valve) first, and when traveling speed lowers to a speed less than 15km / h, shift to Low speed output (low speed solenoid valve).

④ CPU Trouble Indication / Reset Switch Operation and Function.

Condition	Indicator Lamp	Function
When CPU is out of order	Lights up (red)	When abnormality occurs in the CPU (microcomputer) and function around the CPU in this machine, the indicator lamp lights up.
Normal	Goes out.	

When CPU is out of order, the CPU returns to the normal condition by pushing the switch.



Indicator Lamp

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⑤ Back Mirror Extension / Stowing Operation and Function

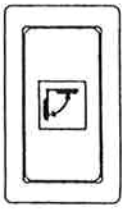
When entering a narrow place, push this switch to stow the back mirror. This makes entering easy.

When it is desired to extend the mirror again. push this switch again.

※When traveling on a public load, be sure to travel with the back mirror extended.

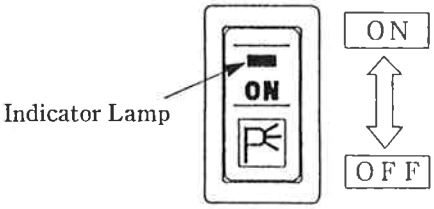
※The signals for extension and stowing are put our for 8 seconds after pushing the switch.

Every pushing the switch, the set condition is shifted.



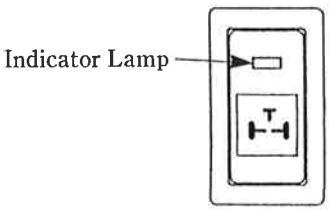
⑥ Parking Light Operation and Function

parking light lights up.



⑦ Lock Pin Pulling Out Operation and Function

Condition of Lock Pin	Indicator Lamp
When pin is pulled out.	Lights
When pin is inserted.	Goes out.



(NOTE 1) When the pin is not pulled out for other mode than the normal mode.

The indicator lamp goes on and off, and the buzzer sounds intermittently.

When the pin is not inserted for the normal made.

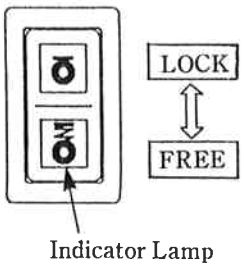
The indicator lamp goes on and off, and the buzzer sounds intermittently.

(NOTE 2) When the mode is shifted from the normal mode to a mode other than the normal mode with the steering mode selector switch, sometimes the lock pin may not be pulled out due to the machine condition.

At that time, while pushing this switch (since the mode becomes a selected steering mode), turn the steering wheel to the right and left a little.

⑧ Suspension Lock / Free Selecting Operation and Function.

Switch Operation	Condition of Suspension	Indicator Lamp
Push upper side.	Lock (the most retracted condition)	Goes out.
Push lower side.	Free	Lights up.



The suspension operation interlock is shown on the next page.

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(1) Suspension Lock

When the following conditions are satisfied, the suspension becomes the suspension lock mode.

① PTO in ON
② Engine rpm in ON
③ Suspension lock switch in ON

(2) Suspension Free

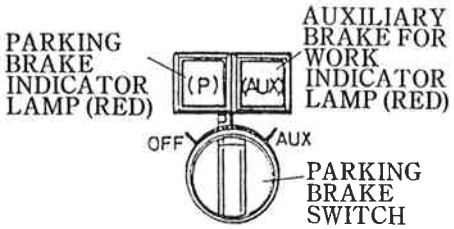
When the following conditions are satisfied, the suspension becomes the suspension free mode.

① PTO in OFF
② Swing lock pin in ON
③ Engine rpm in ON
④ Suspension free switch in ON

○ The engine rpm shall be judged to be in ON (◯) for more than 300rpm of engine rpm or for the hourmeter in ON or for the engine oil pressure in ON.
○ When the power is turned on, if the previous power OFF condition is free condition and the swing lock pin is in ON, the suspension becomes the free mode.
○ When the power is turned on and when the engine rpm is in OFF, the output of each mode shall be all in OFF.

⑨ Parking Brake Operation and Function

Switch Position	Brake Operating Condition	Indicator Lamp (red color)	Use
OFF	Both of parking brake and aux. brake are released	Lamp goes out.	
P	Parking brake only operates	Lights (P) AUX Does not light.	Usual parking
AUX.	Both of parking brake and aux. brake operate	Lights (P) AUX Lights	Stronger braking force than on-tire work



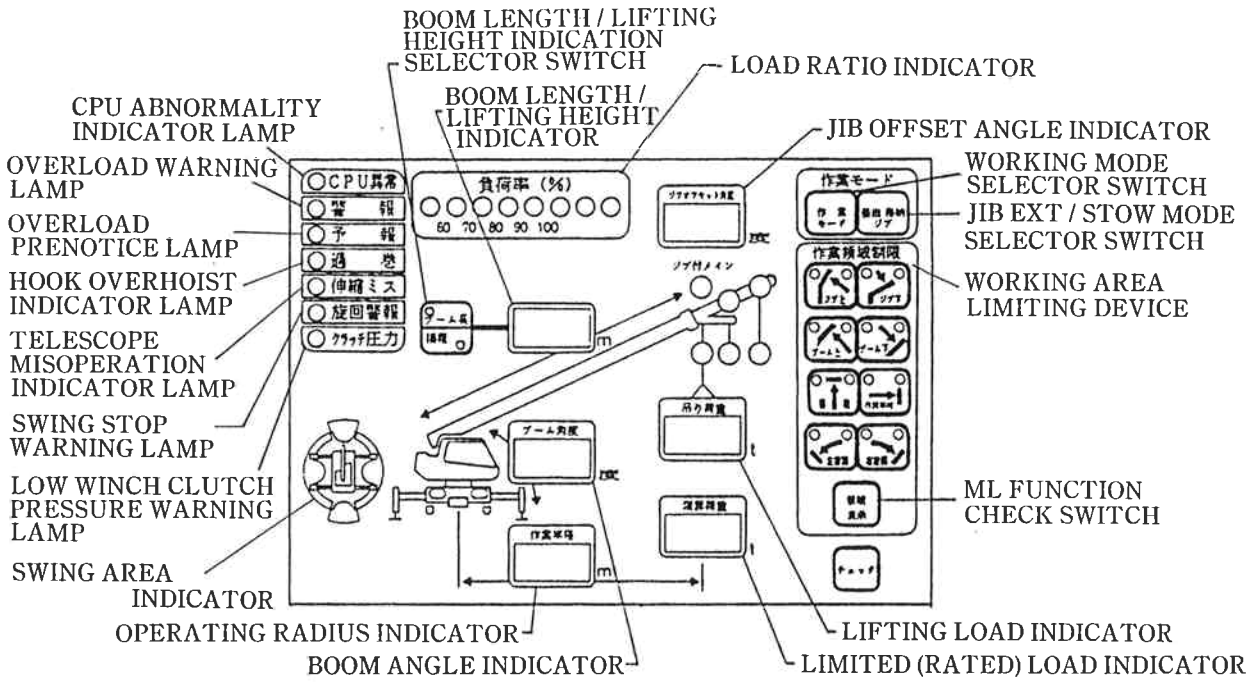
CAUTION : The AUX (auxiliary brake for work) is operated by air pressure.
In the case that the engine is stopped and the carrier is parked for a long time, do not use it.

Arrangement of Contact Points of Parking Brake Switch

Switch Position	Power Supply (622)	Auxiliary Brake for Work (606)	Parking Brake Lamp (15B)	Shift Lever Power (15)
OFF	○			○
P	○		○	
AUX.	○	○	○	

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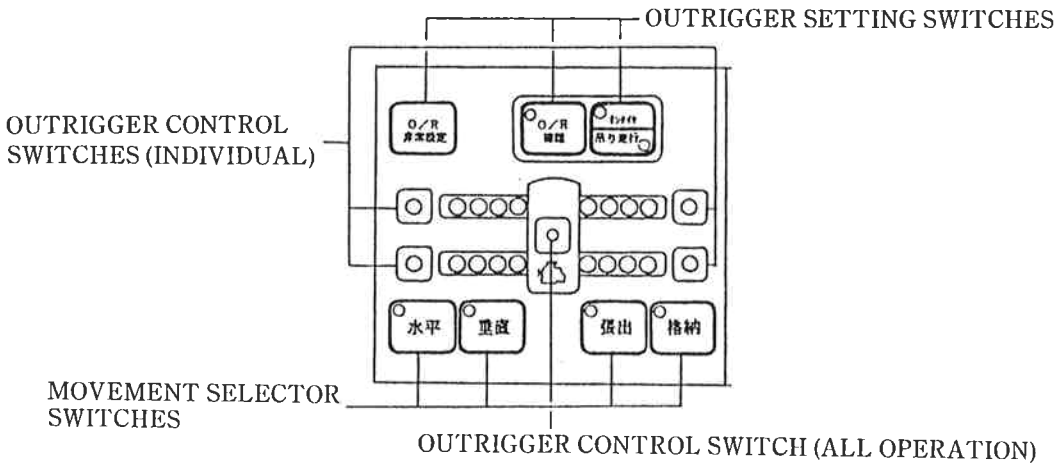
3) MOMENT LIMITER PANEL



① Operating Method and Function of Moment Limiter Panel

See separate shop manual Load Safety Device (Moment Limiter) paragraph 3. 2.

4) OUTRIGGER CONTROL PANEL

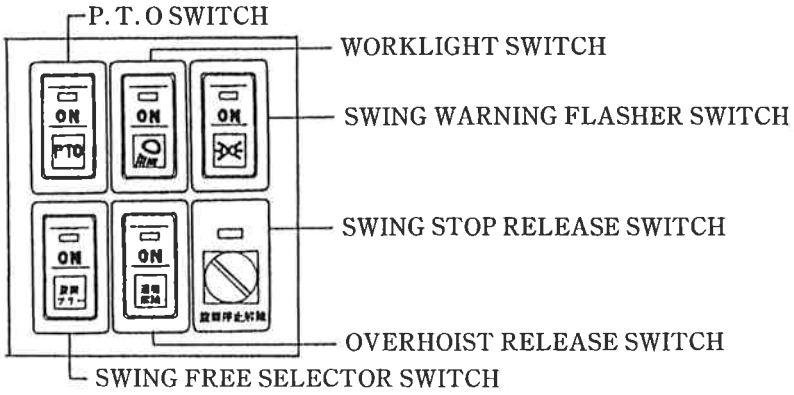


① Operating Method and Function of Outrigger Control Panel

See separate shop manual Load Safety Device (Moment Limiter) paragraph 3. 3.

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5) CRANE CONTROL PANEL



① PTO Switch
The PTO solenoid valve is magnetized by turning the PTO switch on, and further the load safety device (moment limiter) is supplied with electric power by lowering the interceptive lever for on and off, then crane operation becomes possible.

② Worklight Switch
Electric power (137) is supplied to the worklight relay, and the cab worklight, the left guard worklight and the boom worklight light up. In addition, volume of the voice alarm lowers.

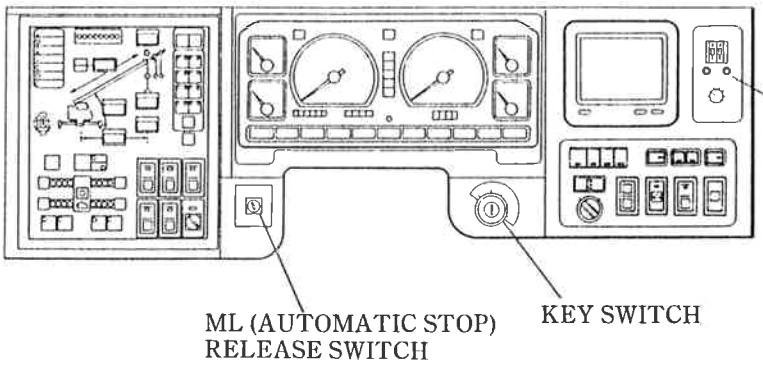
③ Swing Warning Flasher Switch
Electric power (685) is supplied to the swing warning flasher relay, and the left and right swing warning flashers light up.

④ Swing Free Selector Switch
The left and right swing free solenoid valves are magnetized, and swing becomes free condition.

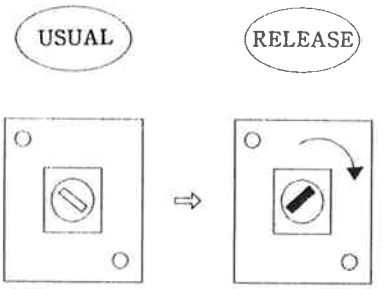
⑤ Overhoist Release Switch
See separate shop manual Load Safety Device (Moment Limiter) paragraph 3. 4.

⑥ Swing Stop Release Switch
See separate shop manual Load Safety Device (Moment Limiter) paragraph 3. 4.

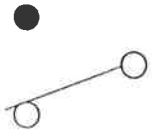
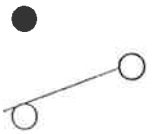
https://truckmanualshub.com/

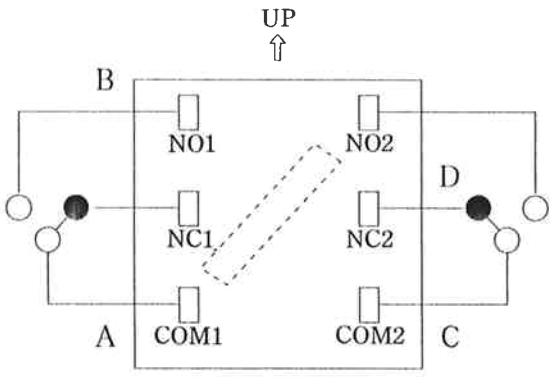


6) ML (AUTOMATIC STOP) RELEASE SWITCH

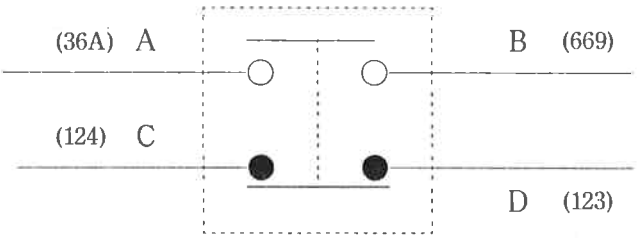


(While turning to the right and holding, automatic stop is released.)

Key Position	Arrangement of Contact Points	
	1	2
		
		



Soldered Surface of Switch
(View from Back of Switch)

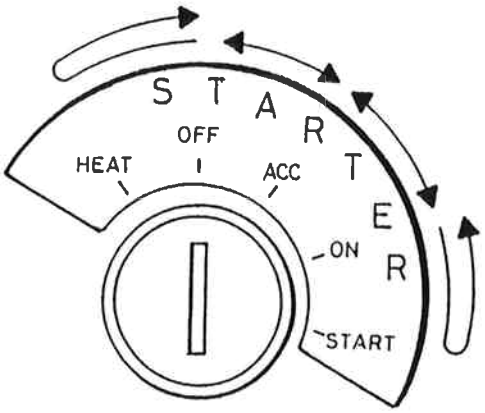


Electrical Circuit of Switch Section

※ Regarding the operating method and function, see separate shop manual Load Safety Device (Moment Limiter) paragraphs 3. 4 and 4. 1.

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7) KEY SWITCH



Arrangement of Contact Points

Contact Points / Position	Power Supply (507)	Air Heater Relay Power G1 (42)	Air Heater Relay Power G2 (42)	ACC (537)	Battery Relay Power M (536)	Starter Power ST (22)
HEAT	○	○				
OFF						
ACC	○			○		
ON	○			○	○	
START	○		○		○	○

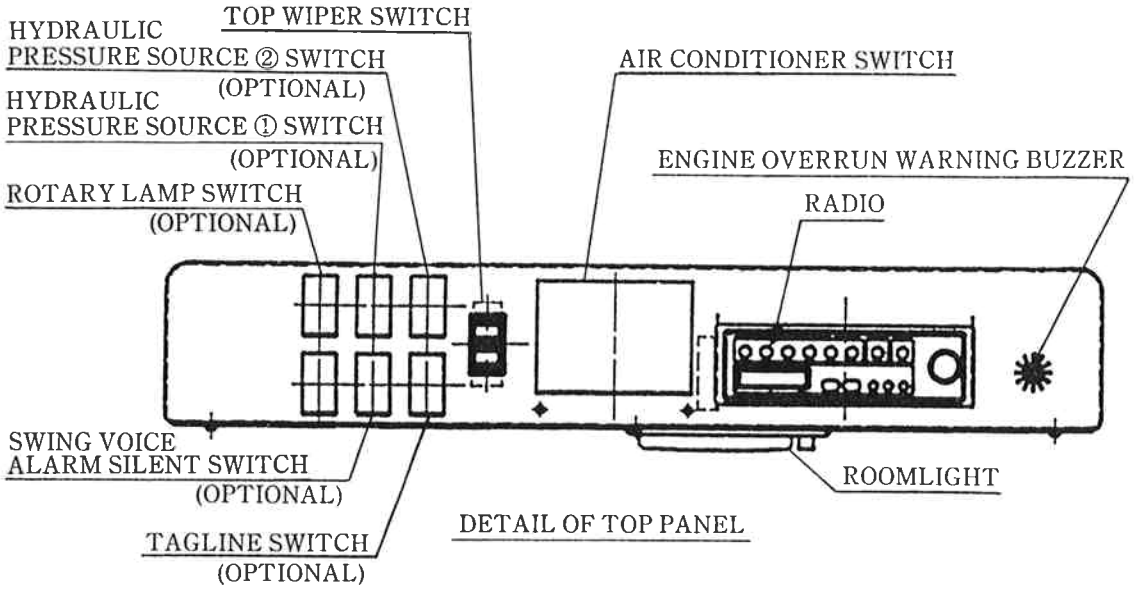
※ Supply power voltage for the key switch is 24 volts.

8) MONITOR CONTROL PANEL

See separate shop manual Swing Automatic Stop System paragraph 2. 4

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9) TOP PANEL



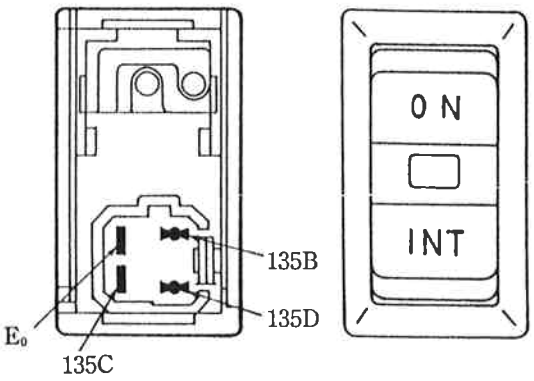
DETAIL OF TOP PANEL

① Function of Top Wiper Switch

Arrangement of Switch Contact Points

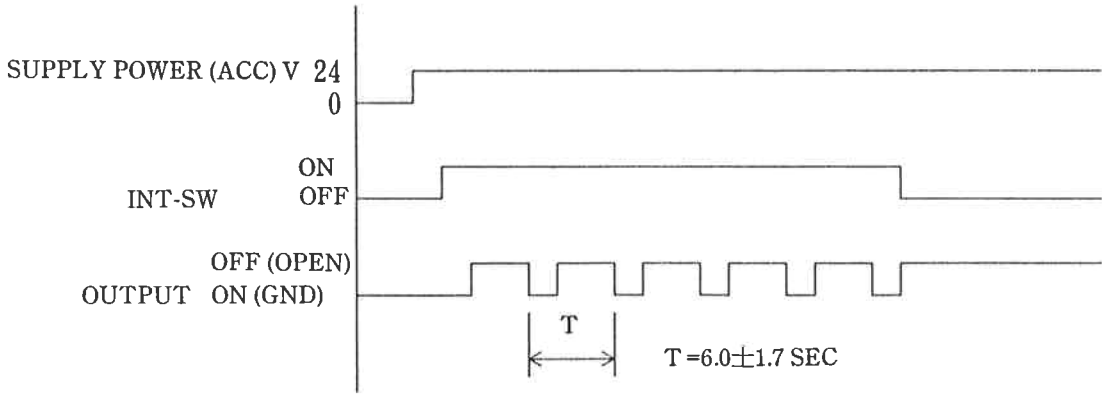
Position \ Contact Point	135B	135C	E_o (Earth)	135D
W	○		○	○
INT	○		○	
OFF				
ON		○	○	
W		○	○	○

Arrangement of Pins



View from Back

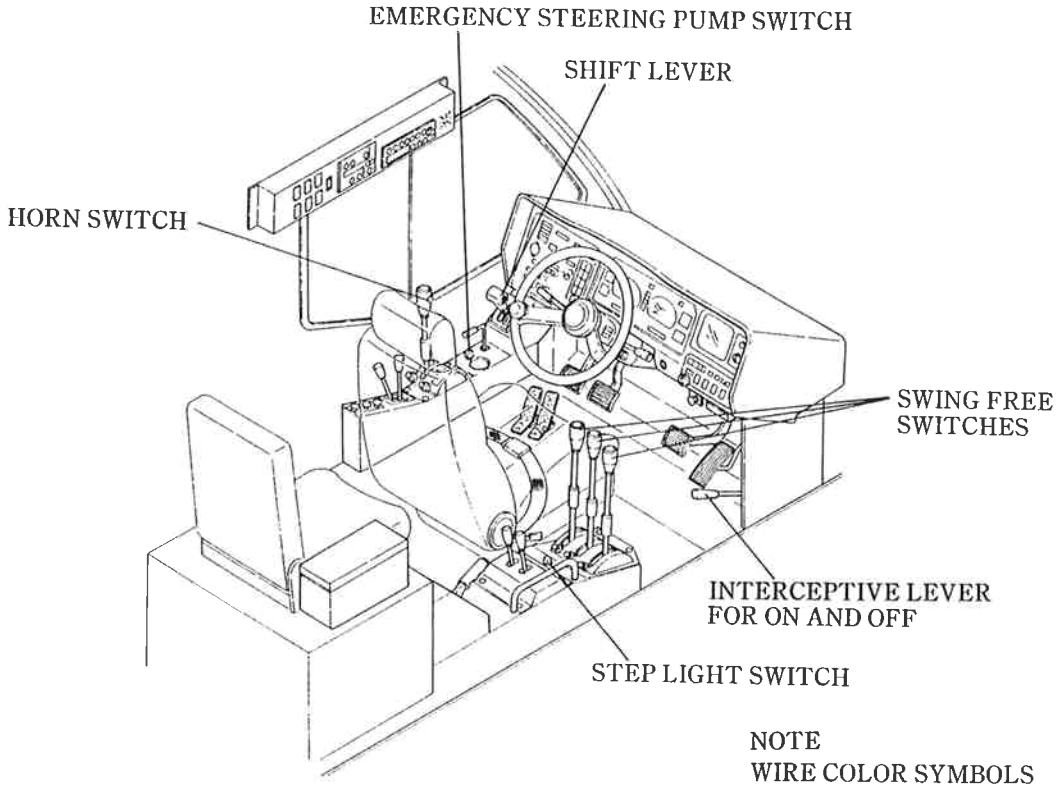
Following the INT and ON positions of the switch, the intermittent relay is supplied with electric power, and the wiper operates respectively according to the following movement time table.



Movement Time Table

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10) INSIDE CAB



NOTE
WIRE COLOR SYMBOLS

W ··· WHITE	Br ··· BROWN
B ··· BLACK	G ··· GREEN
R ··· RED	O···ORANGE
Y ··· YELLOW	Gr ··· GRAY
L ··· BLUE	P ··· PINK

① Shift Lever

Arrangement of Contact Points

Connector Pin / Lever Position	W.Y 534	L 751	L.W 752	L.R 753	L.Y 754	L.B 755	R.W 15	L.R 33	Br 34	W.L 35	R.B 22A	G.B 32	Br.W 22
(1)	○	○					○	○					
(2)	○		○				○		○				
(D)	○			○			○			○			
(N)	○				○						○		○
(R)	○					○	○					○	

Arrangement of Connector Pins

M

15 R.W		534 W.Y	754 L.Y		35 W.L	32 G.B	22A R.B	34 Br
22 Br.W		755 L.B	753 L.R	752 L.W	751 L			33 L.R

Shift Lever Side

CN-217A

M



Shift Lever Side

CN-217B (For Back Light)

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② Emergency Steering Pump Switch Function
When the engine stops during travel, by turning this switch, electric power is supplied to the emergency steering relay to operate the steering pump, and to make steering operation possible even when the engine stops.

③ Interceptive Lever for On and Off.
See separate shop manual Load Safety Device (Moment Limiter) paragraph 3. 1.

④ Swing Free Switch
While this switch is turned on, the swing free solenoid valve is magnetized to make swing free.

⑤ Step Light Switch
Opening the door with this switch turned on lights up the step light (12 watts).

⑥ Horn Switch
While this switch is turned on, electric power is supplied to the horn relay to sound the horn.

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4. MULTIPLEX DATA TRANSMISSION SYSTEM

4.1 MULTIPLEX DATA TRANSMISSION (M. D. T) SYSTEM

(1) In the crane the transmission and receipt of electrical signals between the upper and the lower are generally conducted through the slip rings.

Besides, in the case that the transmission and receipt of operation signals to the lower (carrier) and various sensor signals from the carrier are conducted in the rough terrain crane, transmitting each signal respectively through one slip ring requires massive slip rings.

Therefore, excluding the electric power source, earth and other basic circuits, most of signals are transmitted between the upper and the lower through electronic treatment with microcomputers. That is, the system of combining and transmitting many digitalized signals as one digital signal through one slip ring (one transmitting line) is adopted. We call this system as Multiplex Data Transmission (M. D. T) System.

In addition, transmission of signals between the upper MDT and ML and between the ML and CRT / swing controller also is conducted through the MDT.

Fig. 4-1 is a block diagram showing this multiplex data transmission system.

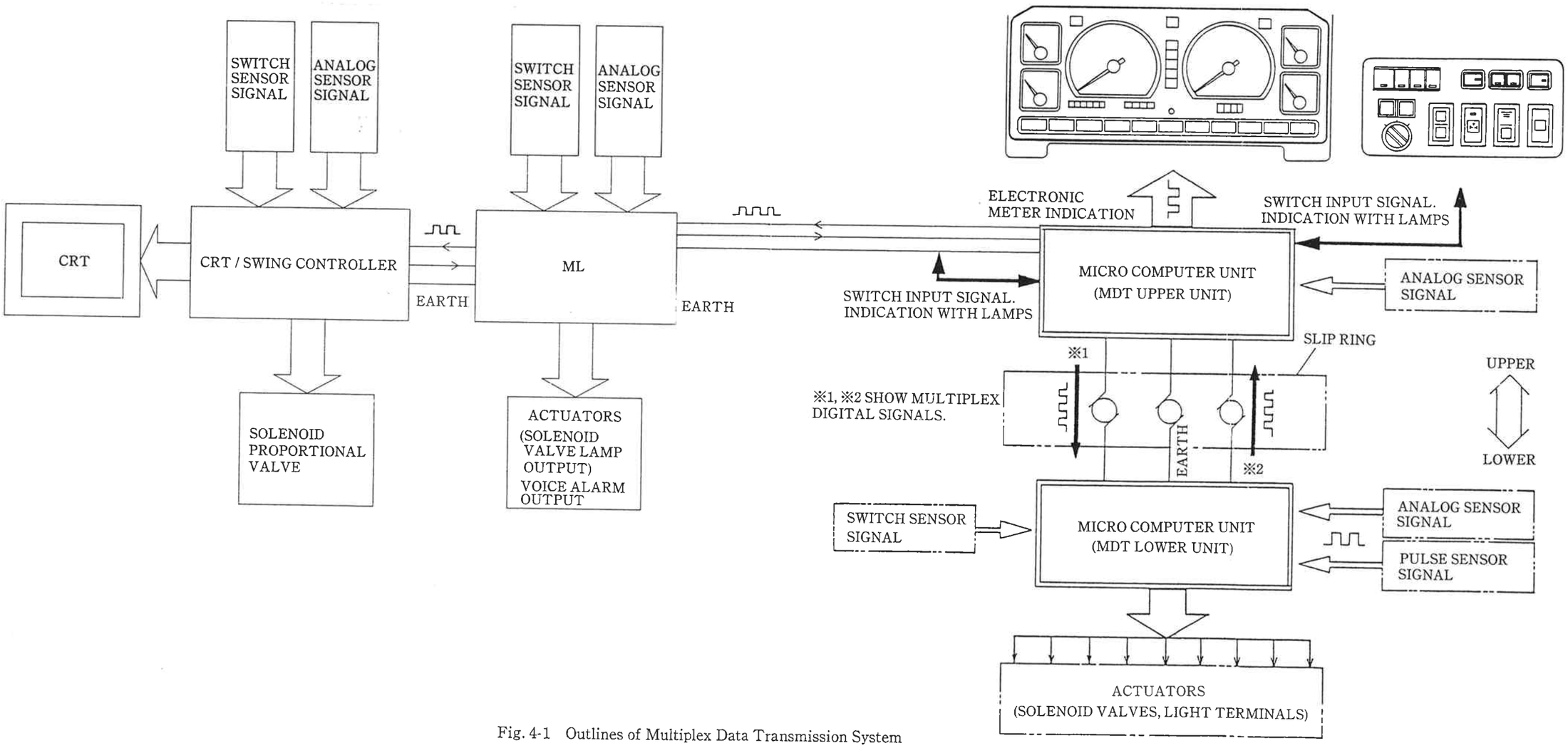


Fig. 4-1 Outlines of Multiplex Data Transmission System

https://truckmanualshub.com/

(2) By adopting this multiplex data transmission system, the following measures also are available.

(A) Function of Interlock

- By input of one switch operation signal, combined output of more than two signals can be issued.
- Operation with condition is conducted, such as, when input of combined operation signal is operated, if this combination becomes the dangerous side as the operating condition, this signal is not issued to the output section.

(B) Function of Error Check (Watch)

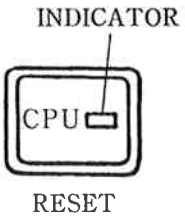
In this system, when abnormality (error) such as abnormal voltage of the electric power, disconnection of the signal wire, or incongruousness of the signal and action, etc., the control section of the micro computer has functions to detect this abnormality, and to take measure to prevent the machine from wrong operation, and further of watching in order to indicate and warn occurrance of troubles.

These functions are controlled by ROM (read-only-memory) which remembers the basic function and CPU (central processing unit) which computes and indicates execution.

By this, this machine is designed so that it does not run away even if electrical trouble would occur in this system.

Further, this system has also function to indicate trouble code which will be a help to quick service follow for reference of troubleshooting when electrical trouble occurs.

Indicator Lamp and Reset Switch for CPU Trouble



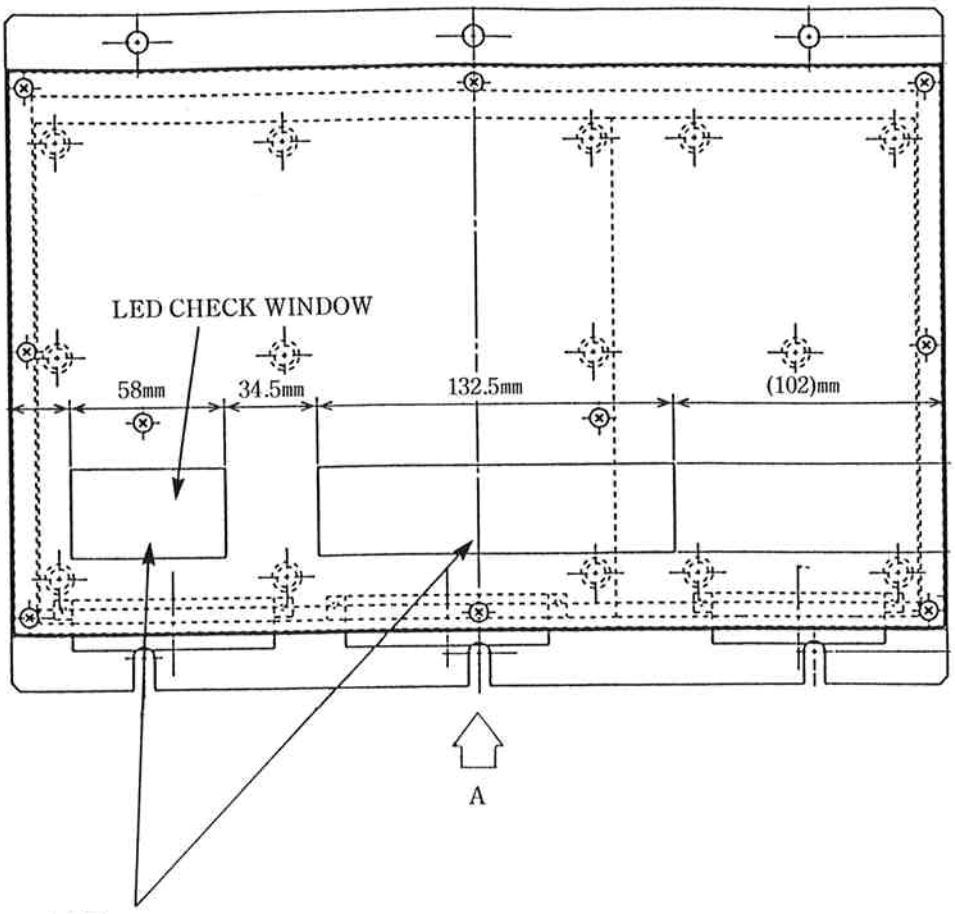
Condition	Indicator lamp
CPU trouble	Lights up (red).
Normal	Does not light.

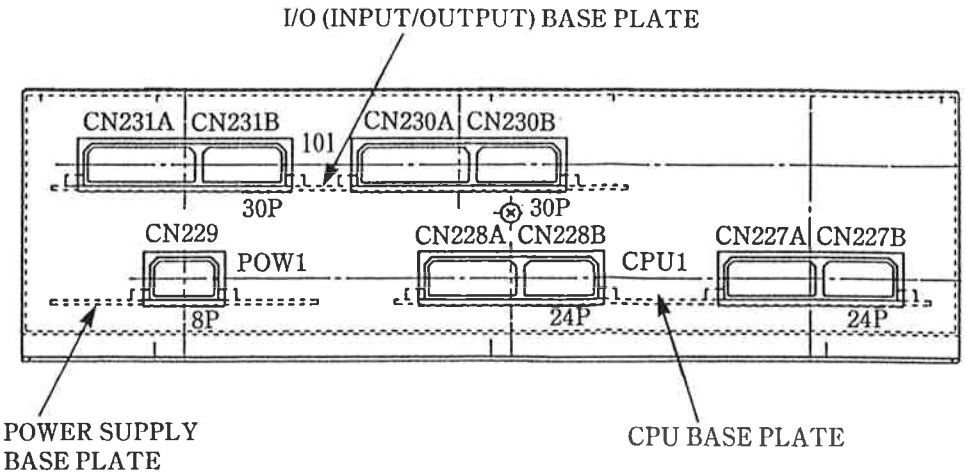
https://truckmanualshub.com/

4.2 ARRANGEMENT

(1) UPPER MULTIPLEX DATA TRANSMISSION UNIT

1. OUTSIDE VIEW



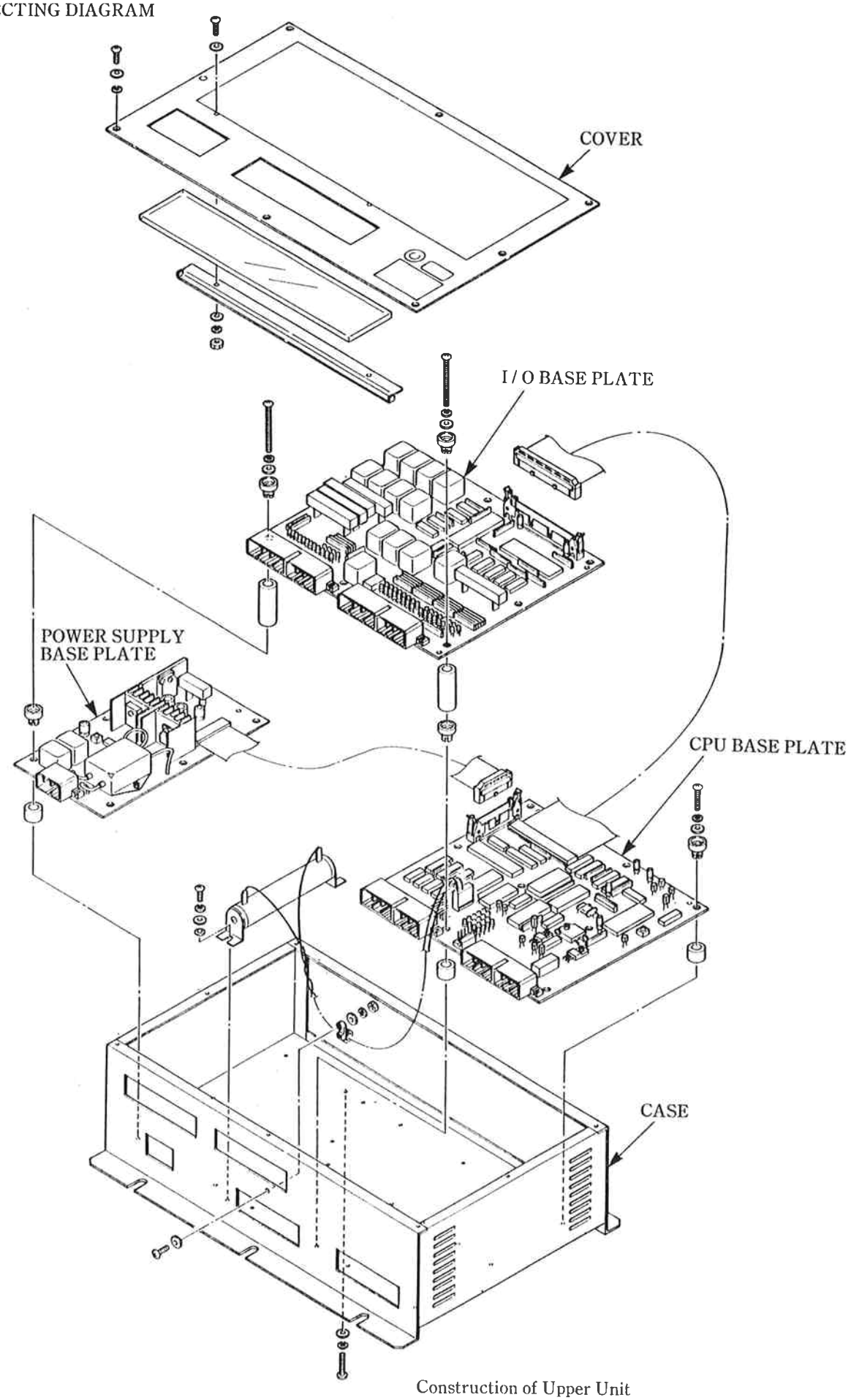


VIEW FROM A

https://truckmanualshub.com/

2. ARRANGEMENT OF UPPER UNIT

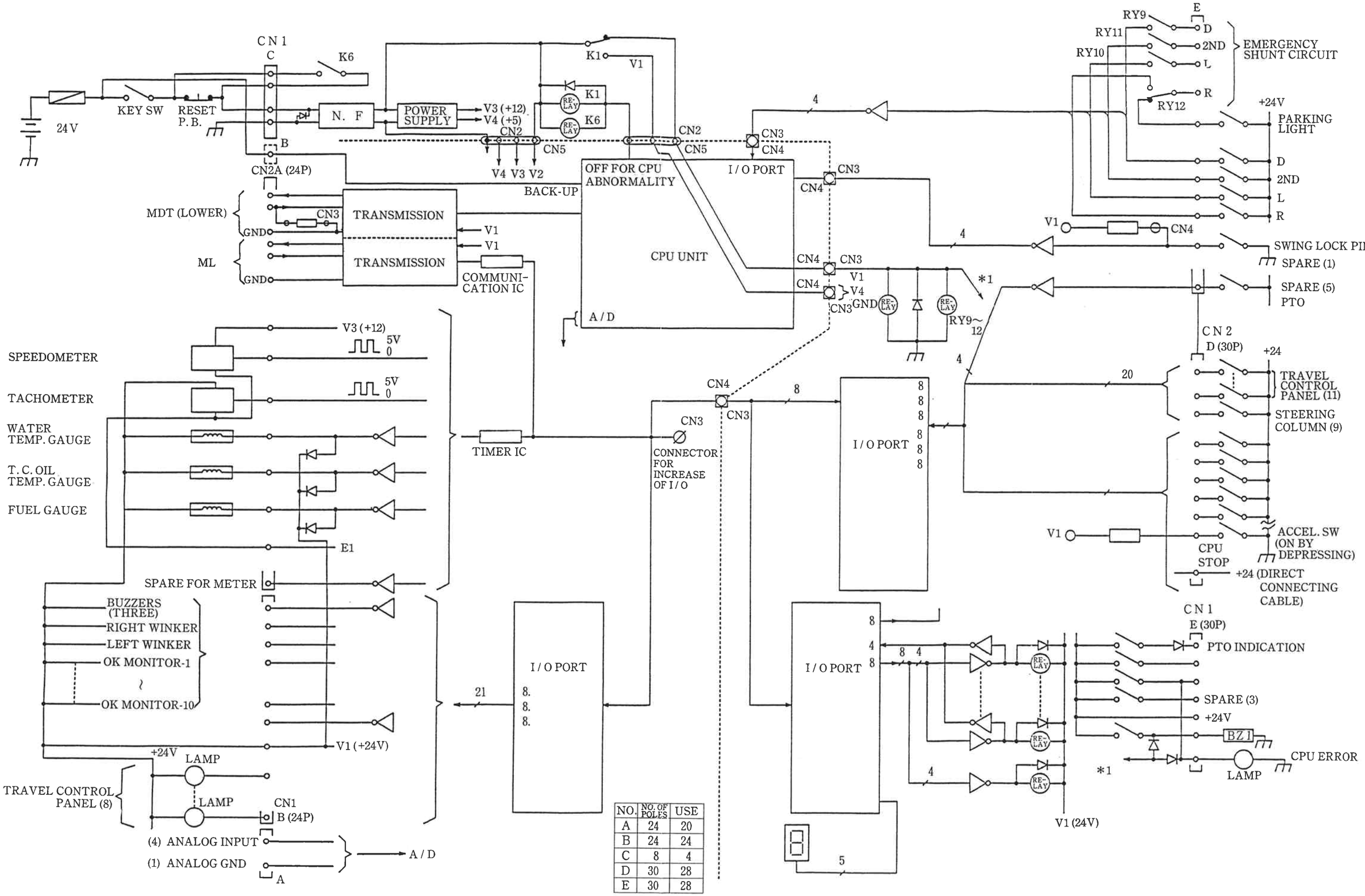
CONNECTING DIAGRAM



Construction of Upper Unit

https://truckmanualshub.com/

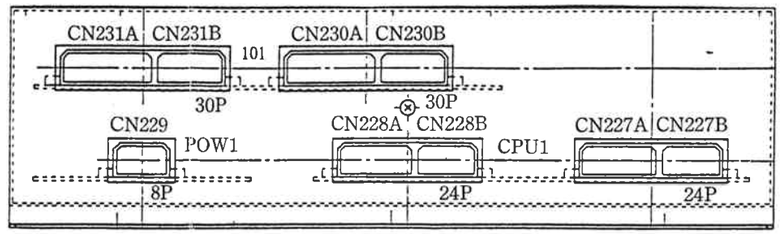
3. ELECTRICAL CIRCUIT SCHEMATIC OF UPPER MDT



NO.	NO. OF POLES	USE
A	24	20
B	24	24
C	8	4
D	30	28
E	30	28

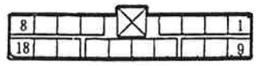
https://truckmanualshub.com/

4. ARRANGEMENT OF CONNECTOR PINS OF UPPER MDT



Arrangement of Connectors (View from Bottom)

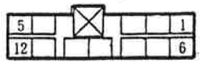
CN231A



Pin No.	Name	Classification	Specification	Wire No.
1	Shift 2 signal	D / I	24V Input	34
2	Direct cable 3rd sign. output	D / O	24V Output	35A
3	Shift D signal	D / I	24V Input	35
4	BZ1 output	D / O	24V Output	113
5	Spare output	D / O	24V Output	
6	Emerge. PTO output	D / O	24V Output	36
7	Indication GND	GND		E0
8	Power for output	Power	24V	572
9	Spare input	D / I	Earth input	
10	〃	〃	〃	
11	〃	〃	〃	
12	Hourmeter output	D / O	24V Output	526
13	Spare output	〃	〃	
14	〃	D / O		
15	〃	D / O		618
16	〃	D / O		
17	Vacant			
18	〃			

〃 … ditto

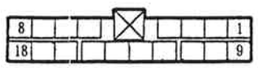
CN231B



Pin No.	Name	Classification	Specification	Wire No.
1	PTO signal	D / I	24V Input	36
2	Shift R signal	D / I	〃	32
3	Parking light	D / I	〃	513
4	Shift 1 signal	D / I	〃	33
5	Direct cable 2nd sig. output	D / O	24V Output	34A
6	Swing lock pin (25t, 35t)	D / I	24V Input	655
7	Spare input	〃	〃	
8	〃	〃	〃	
9	Direct cable Rev. sig. output	D / O	24V Output	513A
10	CPU abnorm. indic. lamp	D / O	24V Output	713
11	Spare input	D / I	Earth input	
12	Direct cable 1st sign. output	D / O	24V Output	33A

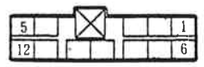
〃 … ditto

CN230A



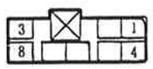
Pin No.	Name	Classification	Specification	Wire No.
1	Spare input	D / I	24V Input	
2	〃	〃	〃	
3	Spare input	〃	〃	
4	Model judge (35T)	〃	〃	35T
5	Clearance light	〃	〃	26
6	High beam	〃	〃	23
7	Left flasher	〃	〃	27
8	Vacant			
9	CPU stop	D / I	24V Input	604
10	Engine air heater	〃	〃	42
11	Ext. / stow. mirror	〃	〃	85
12	Model judge (45T)	〃	〃	45T
13	Spare input	〃	〃	
14	〃	〃	〃	
15	Exhaust brake	〃	〃	48
16	Low beam	〃	〃	24
17	Right flasher	〃	〃	28
18	Vacant			

CN230B



Pin No.	Name	Classification	Specification	Wire No.
1	Suspention free	D / I	24V Input	48B
2	Rear steer. lock pin out	〃	〃	602
3	H / 4WD	〃	〃	46
4	Rear steering	〃	〃	146
5	Crab 〃	〃	〃	44
6	Spare input	〃	Earth signal	
7	Suspension down	〃	24V Input	48A
8	Accelerator SW	〃	〃	603
9	L / 4WD	〃	〃	511
10	Reverse steering	〃	〃	566
11	Cramp 〃	〃	〃	45
12	Normal 〃	〃	〃	145

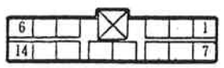
CN229



Pin No.	Name	Classification	Specification	Wire No.
1	Vacant			
2	Power supply	Power	+24V Input	509
3	CPU reset	D / I	+24V Input	536
4	Power supply	Power	Earth	E
5	Vacant			
6	〃			
7	〃			
8	CPU reset	D / O	+24V Output	536A

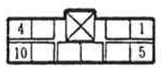
〃 … ditto

CN228A



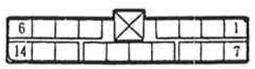
Pin No.	Name	Classification	Specification	Wire No.
1	Left winker indication	D / O	Earth signal (open collector)	735
2	Right winker indication	〃	〃	734
3	CPU abnormality	〃	〃	741
4	OK monitor (Low air press.)	〃	〃	1013
5	RAM back-up power	Power	+24V	573
6	OK monitor (engine oil pressure)	D / O	Earth signal (open collector)	730
7	OK monitor (br. oil level)	〃	〃	731
8	Eng. overrun prenot. (BZ2)	〃	〃	739
9	OK monitor (bat. charge)	〃	〃	732
10	〃 (re. wheel neutr.)	〃	〃	733
11	〃 (br. pad wear)	〃	〃	736
12	〃 (TM oil press.)	〃	〃	737
13	〃 (radi. wat. level)	〃	〃	738
14	〃 (Hyd. oil temper.)	〃	〃	740

CN228B



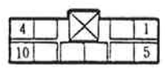
Pin No.	Name	Classification	Specification	Wire No.
1	Lock pin out indication	D / O	Earth signal (open collector)	726
2	Steering rear indication	〃	〃	722
3	Winker buzzer (BZ4)	〃	〃	716
4	Suspen. free indication	〃	〃	727
5	Steering normal indicat.	〃	〃	721
6	Steering cramp indicat.	〃	〃	724
7	Steer. rev. steer. indicat.	〃	〃	720
8	Travel mode 4WD indicat.	〃	〃	725
9	Steering crab indication	〃	〃	723
10	Eng. overrun alarm (BZ3)	〃	〃	708

CN227A



Pin No.	Name	Classification	Specification	Wire No.
1	GND for meter	Power	Earth	702
2	Communic. port (ML)		Transmission	551
3	Water temperature gauge output		Pulse signal (open collector)	706
4	Oil temp. gauge output		〃	707
5	Tachometer signal		〃 (0 / 5V)	704
6	Power for meter	Power	+24V	801
7	Vacant			
8	Commu. port (low. MDT)		Earth	E1
9	〃 (low. MDT)		Receipt	503
10	Fuel gauge output		Pulse signal (open collector)	705
11	Power for meter	Power	+12V	701
12	Vacant			
13	Speedometer signal		Pulse signal (0 / 5V)	703
14	Vacant			

CN227B

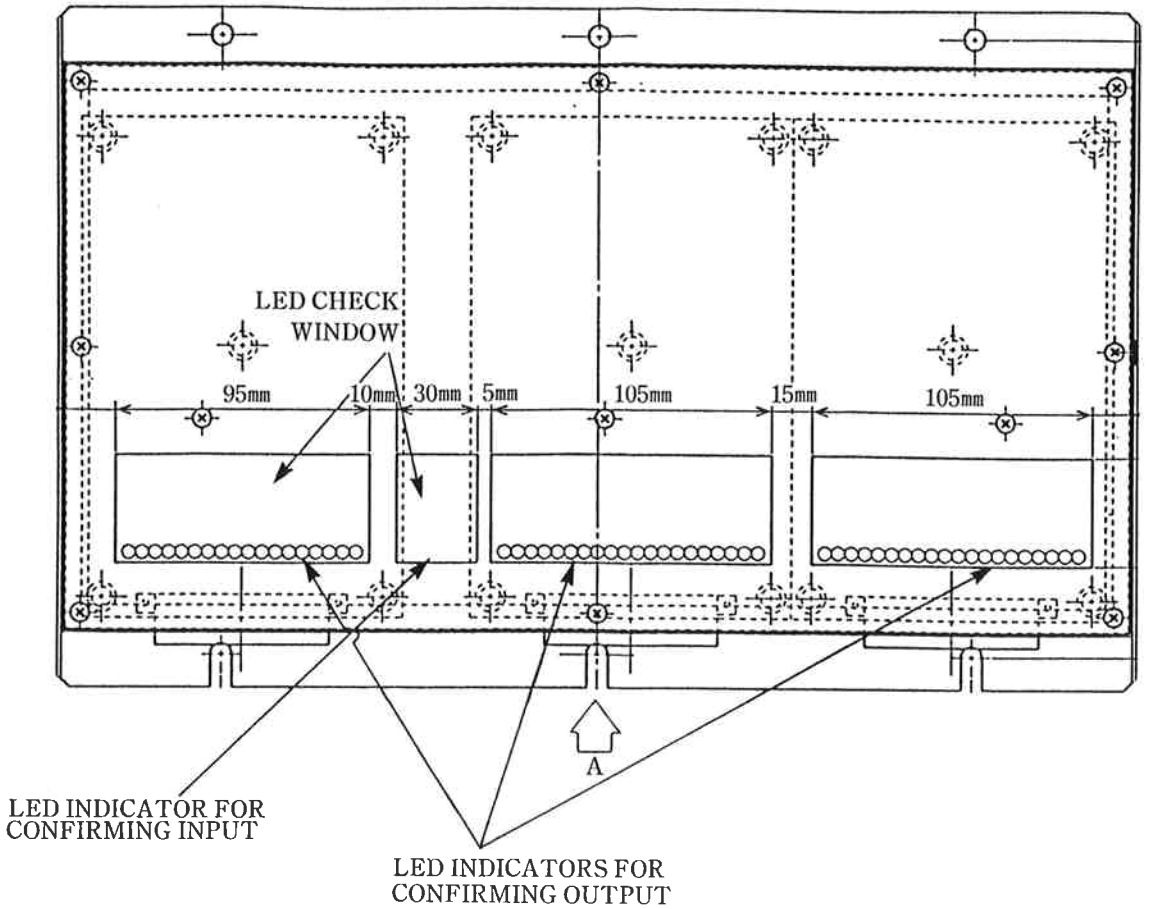


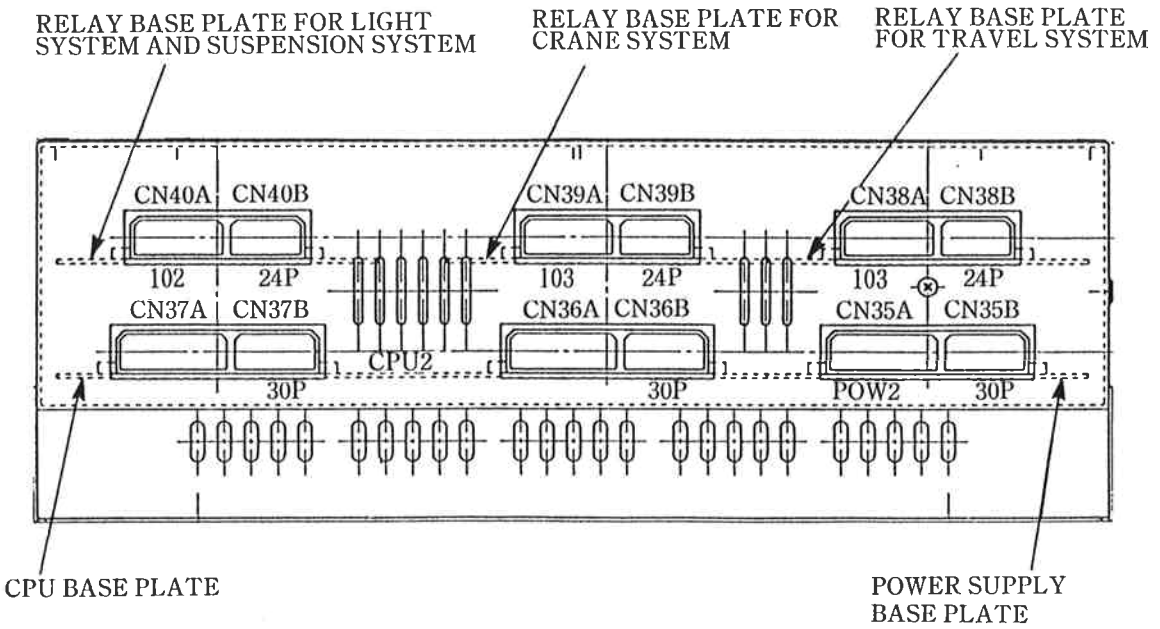
Pin No.	Name	Classification	Specification	Wire No.
1	Analog signal earth		Earth	
2	Analog input (spare)	A / I	8 bit A / D	
3	Commu. port (low. MDT)		Transmission	501
4	〃 (ML)		Receipt	552
5	Analog signal earth		Earth	
6	〃		Earth	
7	Analog input (spare)	A / I	8 bit A / D	
8	〃	〃	8 bit A / D	
9	Analog input (spare)	〃	8 bit A / D	
10	Commu. port (ML)		Earth	E2

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(2) LOWER MULTIPLEX DATA TRANSMISSION UNIT

1. OUTSIDE VIEW



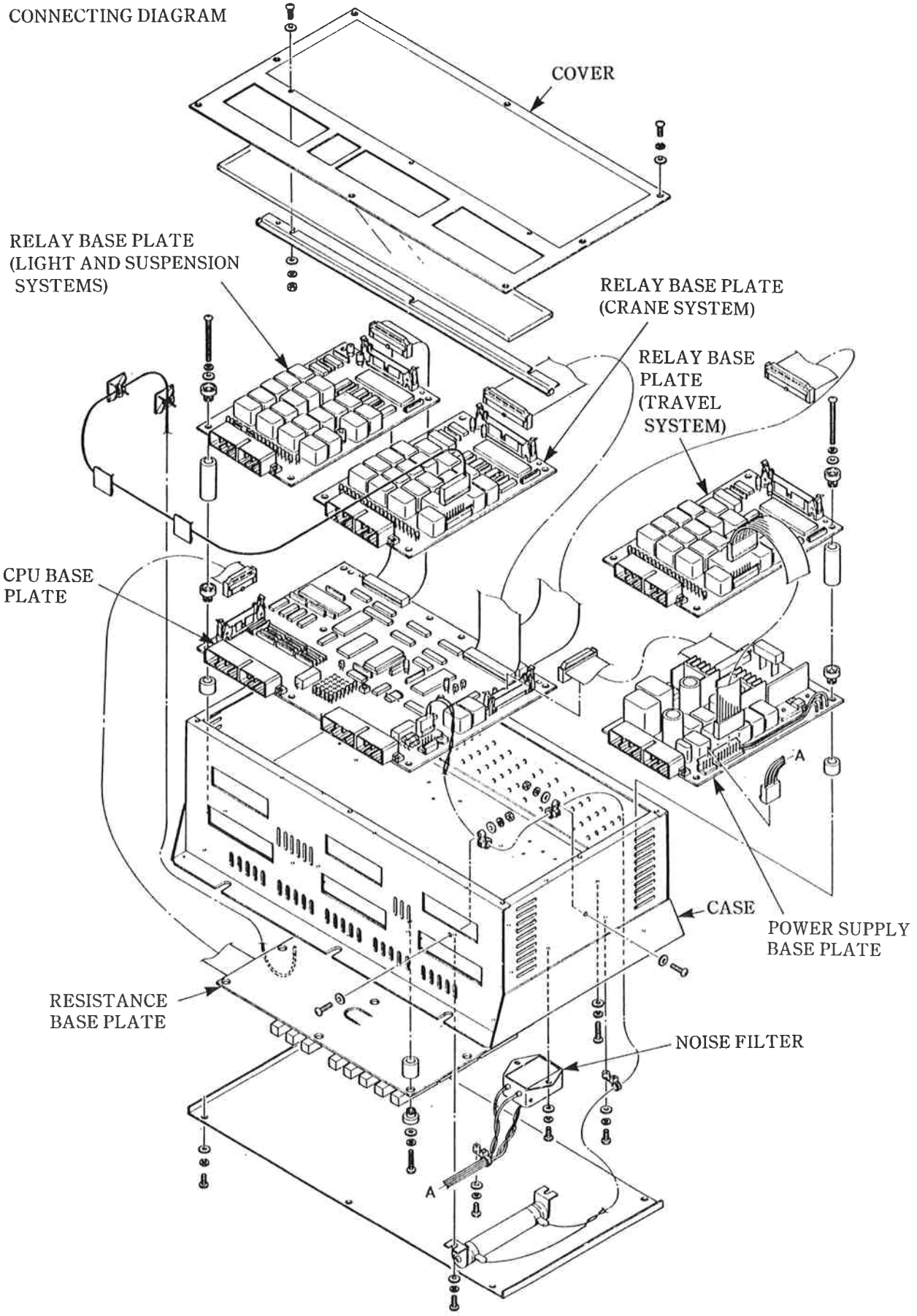


VIEW FROM A

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2. ARRANGEMENT OF LOWER UNIT

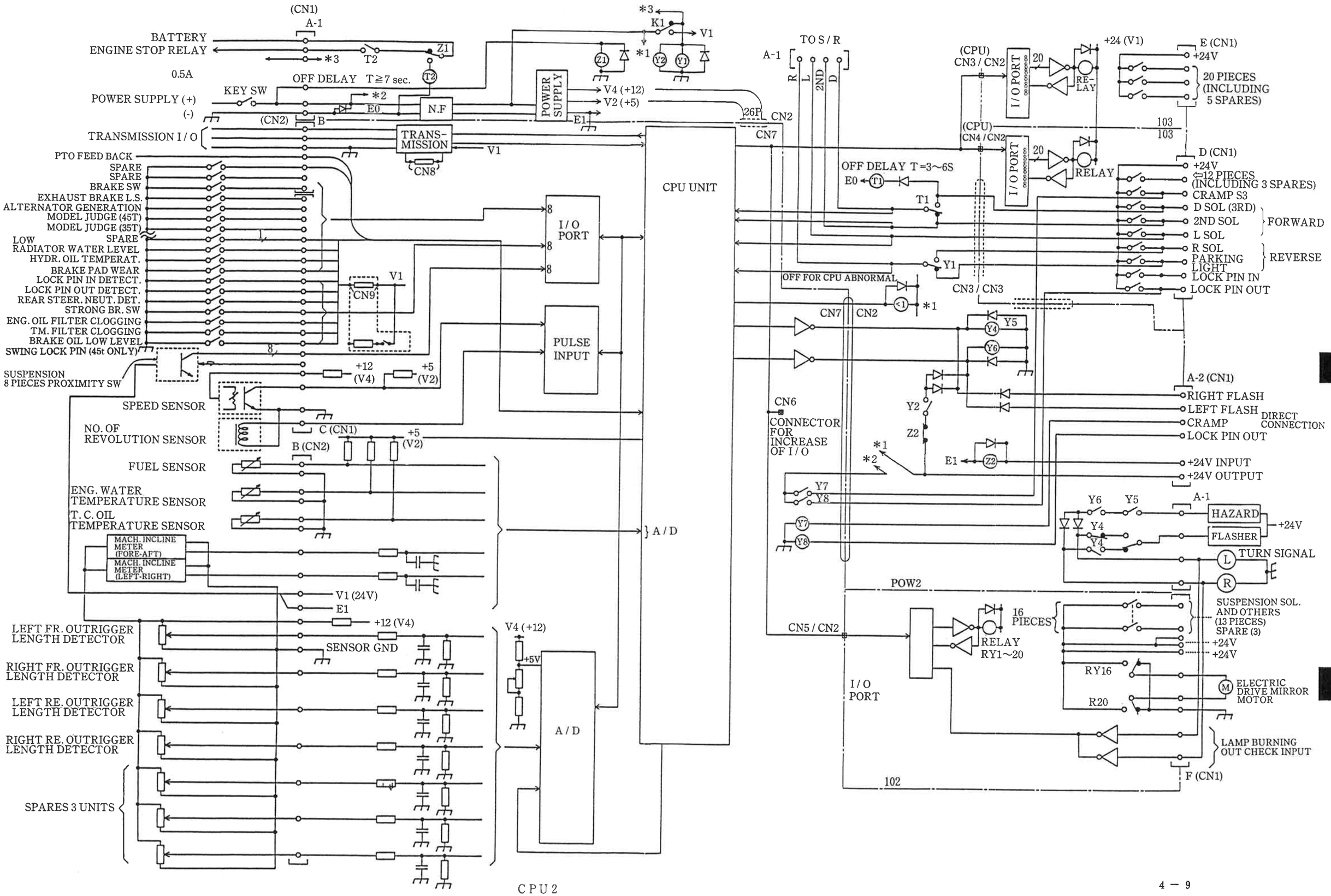
CONNECTING DIAGRAM



Construction of Lower Unit

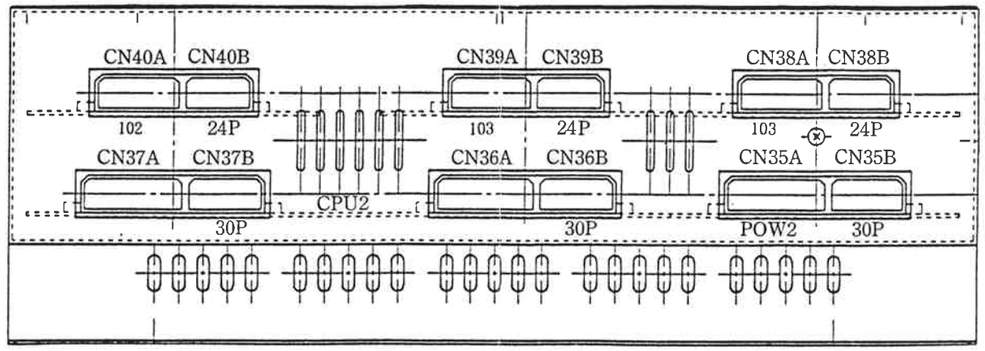
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3. ELECTRICAL CIRCUIT SCHEMATIC OF LOWER MDT



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4. ARRANGEMENT OF CONNECTOR PINS OF LOWER MDT



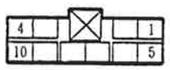
Arrangement of Connectors (View from Bottom)

CN40A



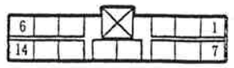
Pin No.	Name	Classification	Specification	Wire No.
1	Clearance light relay	D/O		26
2	Suspen. pilot SOL	〃	24V SOL (1A)	80
3	Suspen. SOL H1FL	〃	〃	81A
4	Suspen. SOL H3RR	〃	〃	84C
5	High beam relay	〃	Relay coil	23
6	Low beam relay	〃	〃	24
7	Suspen. SOL H3RL	〃	24V SOL (1A)	83C
8	Suspen. SOL H2FL	〃	〃	81B
9	Suspen. SOL H3FL	〃	〃	81C
10	Suspen. SOL H1RR	〃	〃	84A
11	Suspen. SOL H2RR	〃	〃	84B
12	Power for relay	Power supply	24V Input (for elec. mir.)	528C
13	〃	〃	24V	528C
14	〃	〃	〃	528C

CN40B



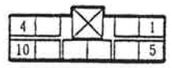
Pin No.	Name	Classification	Specification	Wire No.
1	Elec. drive mirror (extension)	D/O	Elec. mirror motor (W)	85A
2	R. flash. lamp ch. input	D/I	+24V Input	28
3	Suspen. SOL H3FR	D/O	24V SOL (1A)	82C
4	Suspen. SOL H2RL	〃	〃	83B
5	Earth for elec. mirror	Earth		E0
6	L. flash lamp ch. input	D/I	+24V Input	27
7	Elec. drive mirror (stowing)	D/O	Elec. mirror motor (W)	85B
8	Suspen. SOL H1FR	〃	24V SOL (1A)	82A
9	Suspen. SOL H2FR	〃	〃	82B
10	Suspen. SOL H1RL	〃	〃	83A

CN39A



Pin No.	Name	Classification	Specification	Wire No.
1	O/R ext. SOL	D/O	24V SOL (1A)	55
2	O/R Retr. SOL	〃	〃	56
3	O/R R.F. vert. SOL	〃	〃	63
4	O/R R.F. horz. SOL	〃	〃	64
5	O/R L.F. horz. SOL	〃	〃	62
6	O/R R.R. horz. SOL	〃	〃	68
7	O/R L.R. horz. SOL	〃	〃	66
8	O/R L.F. vert. SOL	〃	〃	61
9	O/R R.R. vert. SOL	〃	〃	67
10	O/R L.R. vert. SOL	〃	〃	65
11	O/R inching speed	〃	〃	76
12	Power for relay	Power	24V Input	528A
13	〃	〃	〃	528A
14	〃	〃	〃	528A

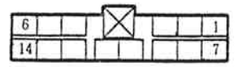
CN39B



Pin No.	Name	Classification	Specification	Wire No.
1	Earth for indication	Earth		E0
2	Spare output	D/O		
3	Do not use.	〃		
4	Unloading SOL	〃	24V SOL (1A)	74
5	PTO SOL	〃	24V SOL (1A×2)	36
6	PTO governor SOL	〃	24V SOL (0.6A)	36D
7	Steer. joining SOL	〃	24V SOL (1A)	677
8	Do not use.			
9	Suspen. press. source SOL	D/O		86
10	Winch press. raise SOL	〃	24V SOL load (1A)	75

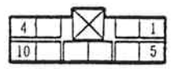
O/R ··· Outrigger

CN38A



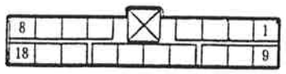
Pin No.	Name	Classification	Specification	Wire No.
1	Engine air heater output	D/O	24V SOL (2, 3A)	42
2	Lock-up output	〃	24V SOL (1A)	47
3	L output	〃	〃	46
4	4W output	〃	〃	46A
5	Exhaust brake output	〃	〃	48
6	Spare output	〃		
7	〃			
8	Steering S1 output	〃	24V SOL (1A)	49
9	Steering S2 output	〃	〃	50
10	Steering S4 output	〃	〃	45A
11	Tr SOL	〃	24V relay (1A)	31
12	Power for relay	Power	+24V	528B
13	〃	〃	〃	528B
14	〃	〃	〃	528B

CN38B



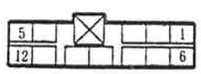
Pin No.	Name	Classification	Specification	Wire No.
1	Earth for indication			E0
2	Parking light	D/O	Lamp 3W×2nd 4W×2nd	514
3	1st speed output	〃	24V SOL (1A)	33
4	Lock pin out output	〃	〃	602A
5	Steering S3 output	〃	〃	44
6	Reverse output	〃	〃	32
7	3rd speed output	〃	〃	35
8	1st, 2nd speed output	〃		35
9	2nd speed output	〃	24V SOL (1A)	34
10	Lock pin in output	〃		601

CN37A



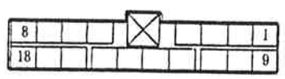
Pin No.	Name	Classification	Specification	Wire No.
1	Lock pin out input	D/I	Earth input	661
2	Radi. low water level	〃	〃	1017
3	Outrigger operation	〃	〃	77
4	Spare input	〃	〃	
5	TM filter clog. input	〃	〃	1016
6	Suspension (RLL) input	〃	〃	96L
7	Model judge (45t) input	〃	+24V Input	528C
8	Exh. br. feed back input	〃	〃	564
9	Suspension (FRH) input	〃	Earth input	95H
10	Lock pin in input	〃	〃	660
11	Suspension (FRL) input	〃	〃	95L
12	Suspension (FLH) input	〃	〃	94H
13	Suspension (FLL) input	〃	〃	94L
14	Suspension (RRH) input	〃	〃	97H
15	Suspension (RRL) input	〃	〃	97L
16	Suspension (RLH) input	〃	〃	96H
17	Model judge (35t) input	〃	+24V Input	528C
18	Alternator generat input	〃	〃	72

CN37B



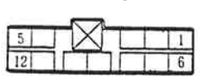
Pin No.	Name	Classification	Specification	Wire No.
1	Speed sensor power	Power	+12V	835
2	Tachometer sensor input		10.5V (at 2000rpm) P-P	415
3	Speed sensor input		Pulse signal (open collector)	408
4	Eng. oil filter clogging	D/I	Earth input	1012
5	Re. ste. neut. det. input	〃	〃	17
6	rpm/speed sensor GND	Power	Earth	407
7	Suspen. sensor power	〃	+24V	837
8	Brake oil low level	D/I	Earth input	1014
9	Spare input	〃	〃	
10	Hydr. oil temperature	〃	〃	714
11	Strong brake SW	〃	〃	1015
12	Swing lock pin (45t)	〃	〃	655

CN36A



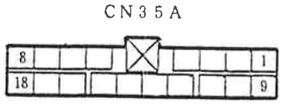
Pin No.	Name	Classification	Specification	Wire No.
1	Analog input (spare)		10 bit A/D	
2	〃		〃	
3	〃		〃	
4	O/R L. Re. sensor input		〃	92
5	Fuel sensor sign. earth		8 bit A/D earth	416
6	Wat. temp. sens. sig. earth		〃	417
7	Emerg. PTO sign. input	D/I	+24V Input	36E
8	O/R L. Re. vert. sign. input	〃	〃	65
9	Analog input earth	Power	10 bit A/D earth	412
10	Mach. inclin. (Fore-aft)		8 bit A/D	98
11	T.C. oil temp. sens. input		〃	411
12	Eng. wat. temp. sign. input		〃	410
13	Fuel sensor input		〃	409
14	Mach. inclin. (left-right)		〃	99
15	T.C. oil temp. sig. earth		8 bit A/D earth	418
16	Brake SW input	D/I	+24V input	403
17	Spare input	〃	〃	
18	Sensor power	Power	+12V	836

CN36B



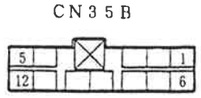
Pin No.	Name	Classification	Specification	Wire No.
1	Communication port		Recept	502
2	〃		Transmission	504
3	〃		Earth	E1
4	O/R R. Fr. sensor input		10 bit A/D	91
5	O/R L. Fr. sensor input		〃	90
6	Sensor earth		High suspen. earth	665
7	Suspen. sensor power	Power	+24V	837B
8	Vacant			
9	〃			
10	〃			
11	〃			
12	O/R R.R. sensor input		10 bit A/D	93

CN35A



Pin No.	Name	Classification	Specification	Wire No.
1	CPU abnorm. sig. output	D/O	24V Output	
2	Vacant			
3	Engine stop signal	D/I	24V Input	536A
4	Vacant			
5	Flasher input	D/I	24V Input	12
6	Hazard input	D/I	24V Input	11
7	Right flasher	D/O	Lamp load 25W 3 para.	28
8	Direct cable (right flash)	D/I	+24V Input	28
9	Vacant			
10	〃			
11	〃			
12	〃			
13	Direct cable (left flash)	D/I	+24V Input	27
14	Vacant			
15	Direct cable (+24V)	Power	+24V Input	604
16	Left flasher	D/O	25W 3 para.	27
17	Direct cable (lock pin out)	D/I	+24V Input	602
18	Direct cable (cramp)	D/I	+24V Input	45

CN35B



Pin No.	Name	Classification	Specification	Wire No.
1	Power	Earth		E
2	Power	〃		E
3	Emerge [L]	D/O	+24V Output	33B
4	Direct cable (+24V)	Power	+24V Input	622
5	Power for eng. stop	Power	+24V Input	523
6	Power	Power	+24V Input	510
7	Power	Power	+24V Input	510
8	Parking light (emerge [R])	D/O	+24V Output	514A
9	Emerge [D]	D/O	+24V Output	35B
10	Emerge [2ND]	D/O	+24V Output	34B
11	Eng. stop relay	D/O	+24V Output	516
12	Vacant			

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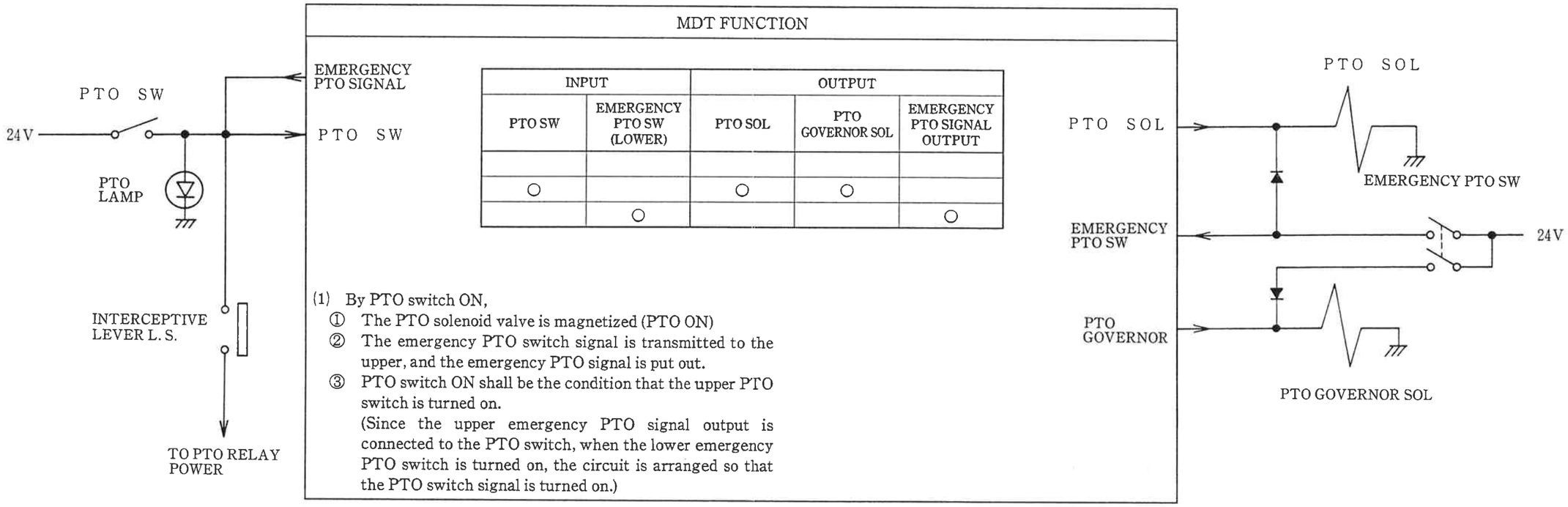
4.3 RELATED MAIN SYSTEM

1. PTO CONTROL

(1) GENERAL

When operating crane work, turning the PTO switch on magnetizes the PTO solenoid valve.
Not only the PTO switch, by turning the emergency PTO switch in the lower fuse box on also, the PTO solenoid valve is magnetized.
When the PTO switch is placed in the ON position, powering on and off to the ML (moment limiter) is carried out by turning the interceptive lever for on and off, on and off.

(2) SPECIFICATION



· Not only when the PTO switch is turned on, but also when the emergency PTO switch is turned on, the upper PTO lamp (LED) lights up.

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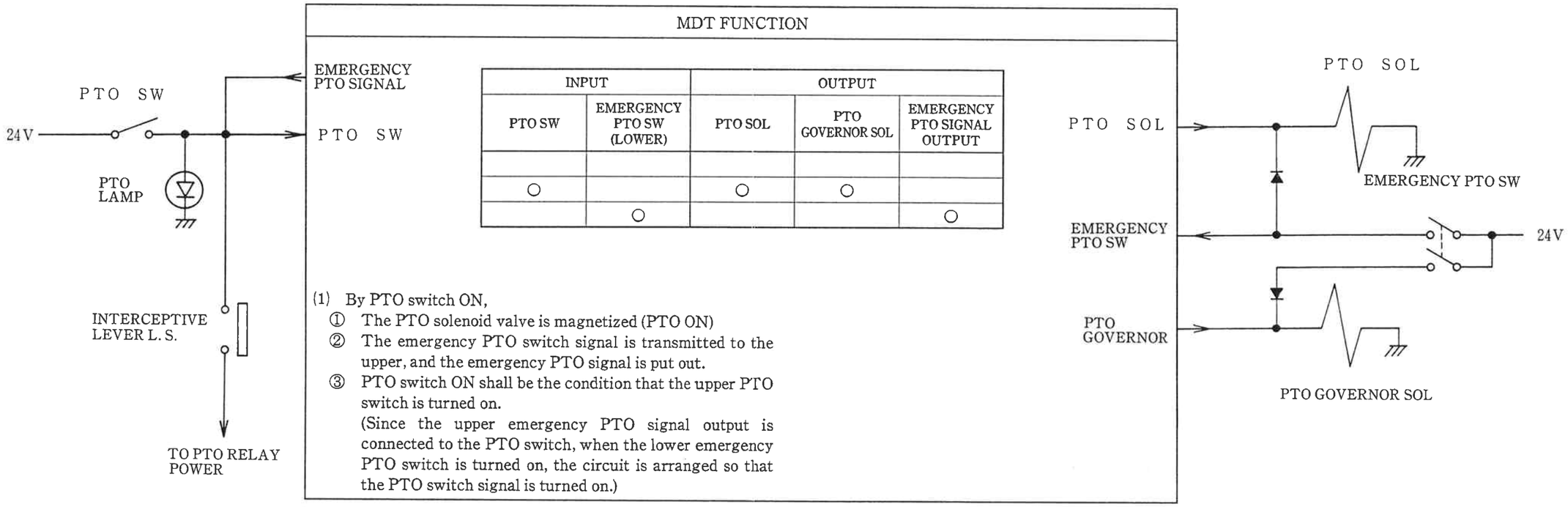
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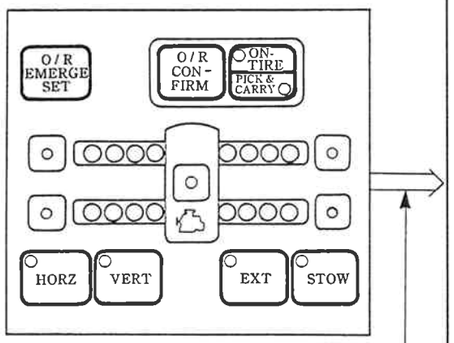
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2. OUTRIGGER CONTROL

(1) GENERAL

The outrigger control switch signal which has been transmitted from the moment limiter (ML) is treated in the MDT, and controls the outrigger solenoid valves. The output signal from the MDT and the output signal from the lower outrigger control box are duplicated to magnetized the each outrigger solenoid valve.

(2) SPECIFICATION



SIGNAL INPUT FROM ML IS MADE THROUGH MDT.

MDT FUNCTION

INPUT											OUTPUT										Remarks
PTO SW	VERTICAL SW	HORIZONTAL SW	LEFT FRONT SW	RIGHT FRONT SW	LEFT REAR SW	RIGHT REAR SW	ALL OPER. SW	EXTENDING SW	RETRACTING SW	EXTENDING SOL.	RETRACTING SOL.	L. RE. HORZ. SOL.	L. RE. VERT. SOL.	R. RE. HORZ. SOL.	R. RE. VERT. SOL.	L. FR. HORZ. SOL.	L. FR. VERT. SOL.	R. FR. HORZ. SOL.	R. FR. VERT. SOL.	Corresponding item
×	–	–	–	–	–	–	–	–	–											No output with PTO off.
○	○																			Movement is not made unless 3 signals of vert / horiz. and ext / retr. are put in.
○								○												
○							○													
○	○							○												
○	○						○													
○							○	○												
○	○						○	○		○			○		○		○		○	ditto
○																				
○	○		○					○									○			Movement with 3 signals
○	○		○				○	○		○			○		○		○		○	All has priority when all and individual pushed

Mark - : Any condition. NOTE : The above is a combination. Other combination is omitted.

(1) Movement of the outriggers is not made with the PTO switch turned off.

(2) After selecting the vertical / horizontal and extending / stowing switches, movement starts by operating the each position switch.

(3) When each position switch of vertical / horizontal and extending / stowing is pushed, the appropriate mode is selected.
- When the vertical switch is pushed, the vertical lamp lights up (the horizontal lamp goes out).
- When the horizontal switch is pushed, the horizontal lamp lights up (the vertical lamp goes out).
- (For the extending / stowing switch also, the same selection is made.)

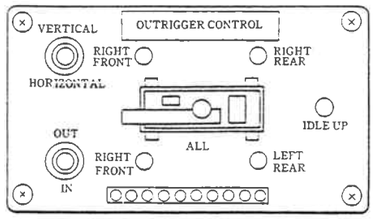
(4) When the all operation switch and individual switch are pushed at the same time, duplicated output is issued.

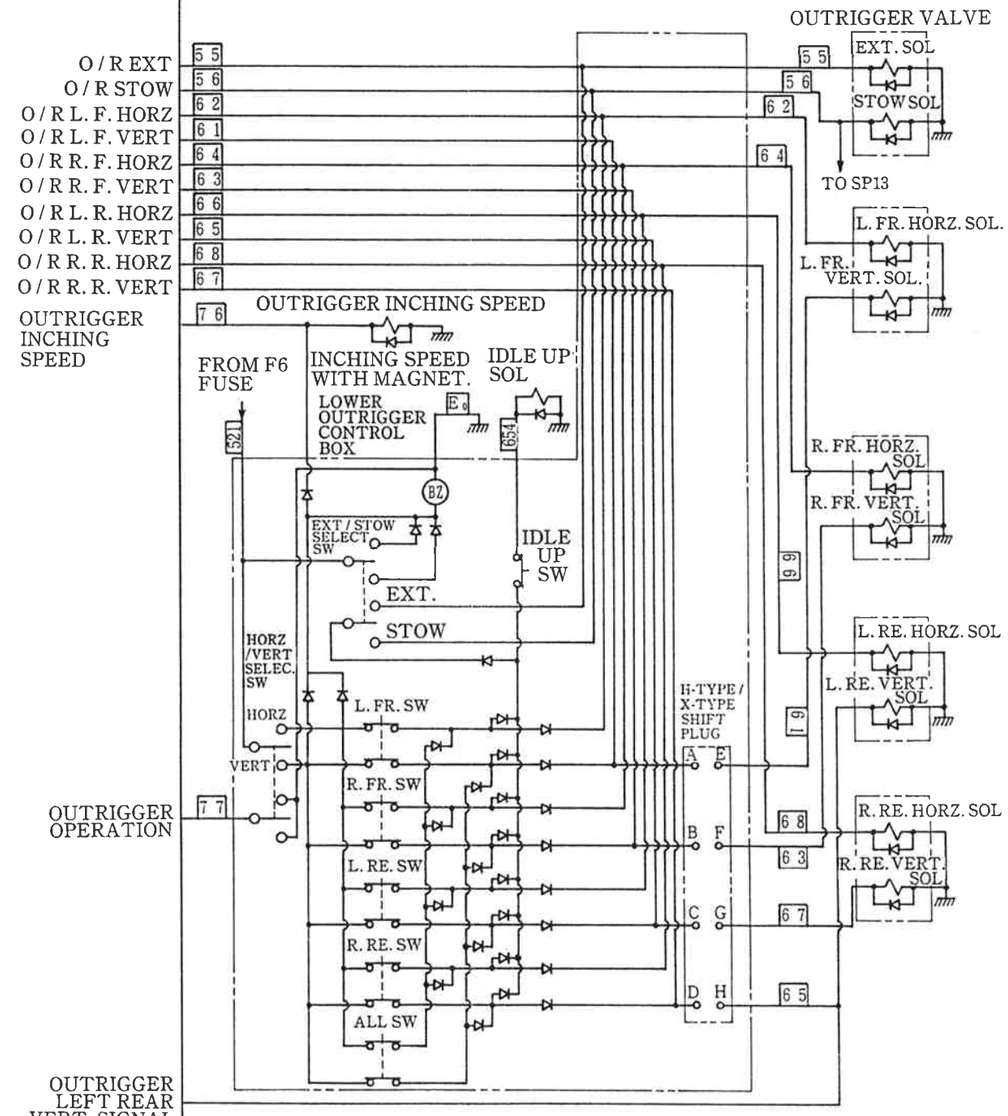
(5) Operation of the lower outrigger control magnetizes the solenoid directly.

(6) Even by operating any outrigger switch during travel, any solenoid is not magnetized. Starting to travel while operating the outrigger demagnetizes all solenoid valves. Judgment of "during travel" shall be the case that traveling speed signal is more than 1km / h (0.62mph).

(7) When power supply is turned on and when the outrigger confirming switch or on-fire switch in the ML is turned on, all of each vertical / horizontal and extending / stowing modes are turned off. (All switches and lamps are turned off.) (For the lower outrigger control, no consideration is required.)

OUTRIGGER CONTROL BOX (LOWER)





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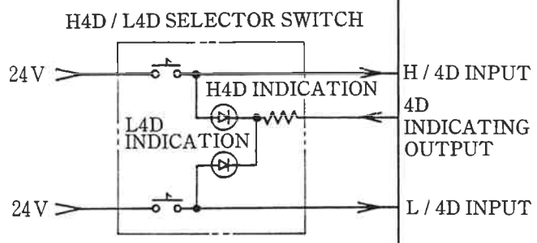
3. CONTROL OF H4D / L4D SHIFTING

(1) GENERAL

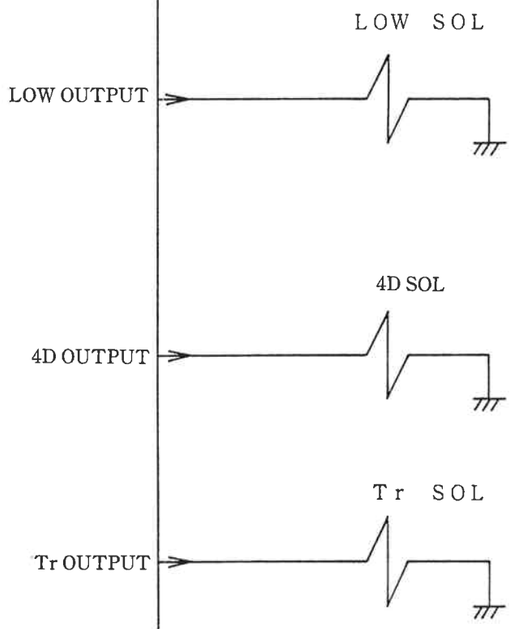
The H / L solenoid and 2 / 4D solenoid are controlled with the H / 4D and L / 4D selector switches on the travel control panel.

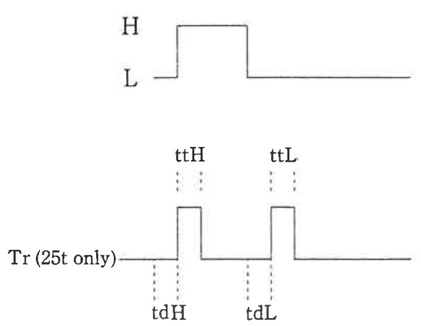
(2) SPECIFICATION

MDT FUNCTION



1) When the carrier stops (※1), selection of each operation is possible.
2) When LOW speed is selected, the carrier shall be driven with the four wheel drive.
3) When traveling speed is more than 13㎞ / h (8.06mph) (※2), shifting H→L is impossible (L→H possible).
4) When traveling speed is under 13㎞ / h, shifting H→L is possible.
However, output of the transmission is as follows :
When L / 4D is selected at H・3rd speed travel → L・3rd speed
When L / 4D is selected at H・2nd speed travel → L・3rd speed
When L / 4D is selected at H・1st speed travel → L・2nd speed
5) Shifting 2 / 4D is possible regardless of traveling speed.
〔Therefore, when L / 4D is selected during travel at a speed more than 13㎞ / h, 4D solenoid is magnetized first, then when traveling speed reaches a speed under 13㎞ / h, L solenoid is magnetized.〕
6) When shifting H / L solenoid, the Tr solenoid is magnetized as follow.
7) When H / L is not completely switched, 4D indicating output is indicated by going on and off.
8) This specification is operated not only when the shift lever is placed in the D position, but when the lever is placed in the D, 2 or 1 position.





tdH, tdL =0mS

ttH, ttL =180mS

※1 ··· When traveling speed is under 1㎞ / h (0.62mph).

※2 ··· Meter indicating value is approximately 15㎞ / h.

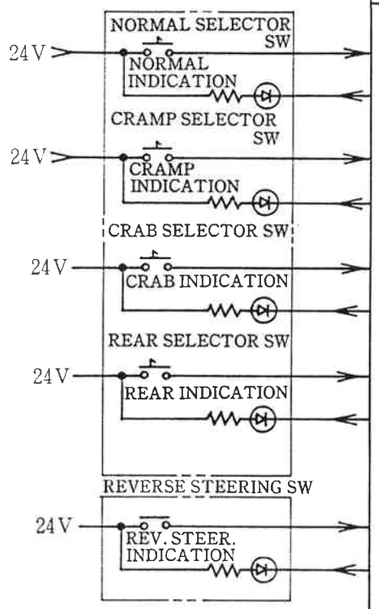
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4. STEERING MODE CONTROL

(1) GENERAL

Four solenoid valves (S1 to S4) and condition indication are controlled according to the selected positions of the steering mode selector switches and reverse steering switch, traveling speed and condition of rear wheel neutral detecting limit switch.

(2) SPECIFICATION

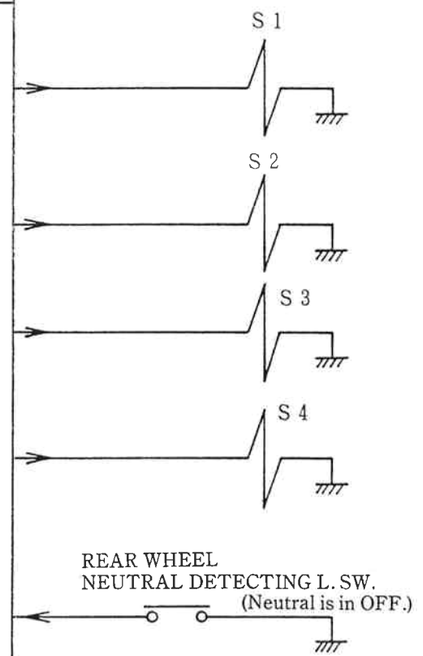


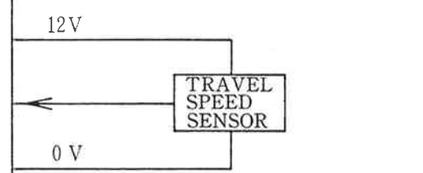
MDT FUNCTION

1) Basic Control

INPUT SW					OUTPUT SOL				INDICATOR LAMP				
Reverse steering	Normal steering	Crab steering	Cramp steering	Rear steering	S1	S2	S3	S4	Reverse steering	Normal steering	Crab steering	Cramp steering	Rear steering
	○									○			
		○						ON			○		
			○				ON					○	
				○	ON		ON						○
○	○				ON			ON	○	○			
○		○						ON	○		○		
○			○			ON		ON	○			○	
○				○		ON			○				○

- Reverse steering switch is changeable only when carrier stops.
- When power is supplied, steering mode starts from order steering mode (does not start from reverse steering).
- While carrier stops, any mode is changeable.
- Normal steering shall be normal mode only when reverse steering is in OFF.
- Movement of speed more than 1km / h (0.62mph) shall be regardeds as "during travel".





2) Detailed Control

Travel speed	Steering selector switch	Rear wheel neutral detecting limit switch	Lock pin pull out switch	Output mode	Remarks
V≧13km / h	4 wheel steering ↓ 4 wheel steering	—	—	Holding (holding until steering selector switch is operated again).	Actual mode indicator lamp lights up. Selected mode indicator lamp goes on and off.
	4 wheel steering ↓ Normal steering	—	—	4 steering mode is held (ditto)	ditto
	Normal steering ↓ 4 wheel steering	—	—	Normal steering is held (ditto)	ditto
1≦V<13km / h	4 steering → 4 steering	—	—	Changing is impossible.	
	4 wheel steering ↓ Normal steering	○ (Other than neutral)	—	Changing is impossible.	Automatic centering function (Mode cannot be changed to normal steering unless rear wheels are neutral.)
		× (Neutral)	—	Changing is possible.	
	Normal steering ↓ 4 wheel steering	○ (Other than neutral)	×	Changing is impossible.	
			○	Changing is possible.	
		× (Neutral)	—	Changing is possible.	

- When traveling speed is more than 13km / h, changing steering mode is impossible.
  (Even if selecting operation of steering mode is made at a speed under 13km / h, before actual mode is changed, if traveling speed reaches more than 13km / h, changing steering mode becomes impossible.)

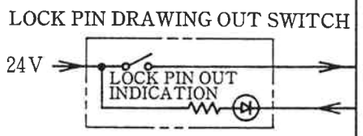
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5 . REAR STEERING LOCK PIN CONTROL

(1) GENERAL

Linking with the steering mode, inserting and drawing out of the rear steering lock pin is automatically controlled. At the same time, drawing out indicator lamp on the lock pin drawing out switch is also controlled.

(2) SPECIFICATION



MDT FUNCTION

1) Control

Actual steering mode	Neutral detecting limit switch	Lock pin drawing out solenoid valve	Lock pin inserting solenoid valve
One second after normal mode is selected	× (When neutral)	×	○ ＊1
	○ (Other than neutral)	○	×
Other than normal	–	○	×

Mark - : Any condition will do.

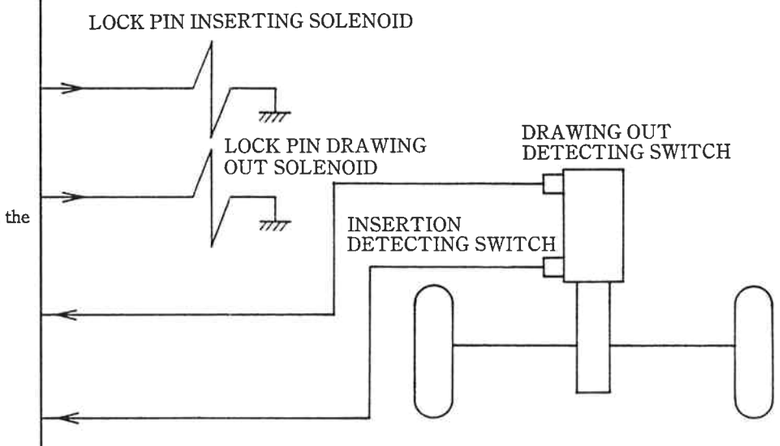
＊1 After the lock pin is once inserted for the normal mode, if the rear wheels become other than neutral condition, the lock pin shall be as it is inserted.

2) Indication

Actual steering mode	Steering mode selector switch	Travel speed in km / h	Insertion detecting limit switch	Drawing out detecting limit switch	Draw. out indicator lamp	Buzzer 2
4 wheel steering	–	–	×	○	Lights up	
			–	×	Goes on and off	Intermittently
Normal steering	4 wheel steering	V<13	–	–	Goes on and off	Intermittently
	Other than above.		○	×	Goes out	
			×	–	Goes on and off	Intermittently

Mark - : Any condition will do. Going on and off cycle (buzzer 2 also same period) : 2 seconds

NOTE : Normal mode is normal mode when the reverse steering switch is turned off.



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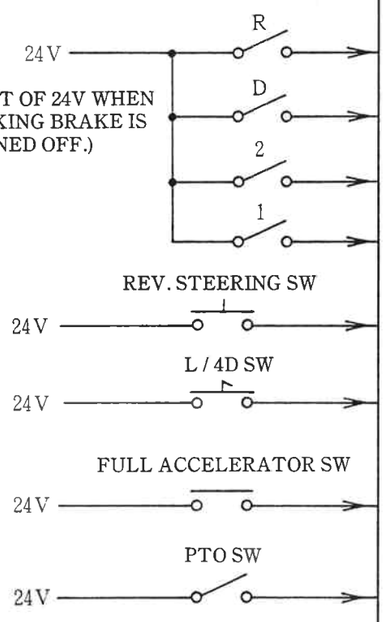
6. SPEED CHANGE CONTROL (INCLUDING LOCK-UP CONTROL)

(1) GENERAL

In order to reduce operator's load on driving operation, by minimum required switch setting beforehand, the computer controls shifting operation of the transmission and torque converter at most suitable timing according to the traveling condition at that time.

Since variation of traveling condition is always put into the computer as various sensor signals (engine rpm, traveling speed and full acceleration), the computer puts out shift signal and lock-up signal automatically, acording to variation of traveling condition (Starting, acceleration, reducing, etc.).

(2) SPECIFICATION



MDT FUNCTION

1) Speed Change Control

(1) When the L / 4 switch is turned off and the PTO switch (including the emergency PTO) with the shift lever placed in the D position, the carrier travel with full automatic.
1st speed ⟷ 2nd speed ⟷ 3rd speed

(2) When the shift lever is placed in the 2 position, the carrier travels with 2nd speed.
(not full automatic travel)

(3) Gear shifting speed varies by the accelerator pedal depressing limit switch.

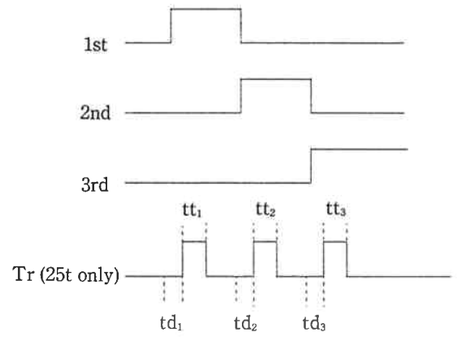
(4) When the shift lever is placed in the R, D, 2 or 1 position, the above output is issued even when the carrier stops. (When traveling speed is under 1km / h, the carrier shall be regarded as "during stop".).

(5) The shift outputs are shown below.

Shift Output				Solenoid Output				
Rev. Output	3rd Output	2nd Output	1st Output	Rev. SOL	1st SOL	2nd SOL	3rd SOL	Tr*1 SOL (25t only)
○				○				△
	○						○	△
		○				○	○*2	△
			○		○		○*2	△

*2 The 3rd solenoid output also is made duplicately in models 35t and 45t. (No duplicate output in 25t)

*1 Just after transmission solenoid valve has been shifted, keep Tr solenoid in ON. (Set time respectively in Rev, 1st, 2nd and 3rd.) (25t only)



(6) The constant of Tr is as follow (25t only)

tt_1=150mS td_1=100mS
tt_2=150mS td_2=100mS
tt_3=100mS td_3=0mS

2) Lock-up Control

(1) The lock-up range varies according to the shift mode.

(2) The torque converter rpm judges the solenoid which is magnetized among the 1st, 2nd and 3rd speed solenoids from the speed signal, and computes from the gear ratio of each output.

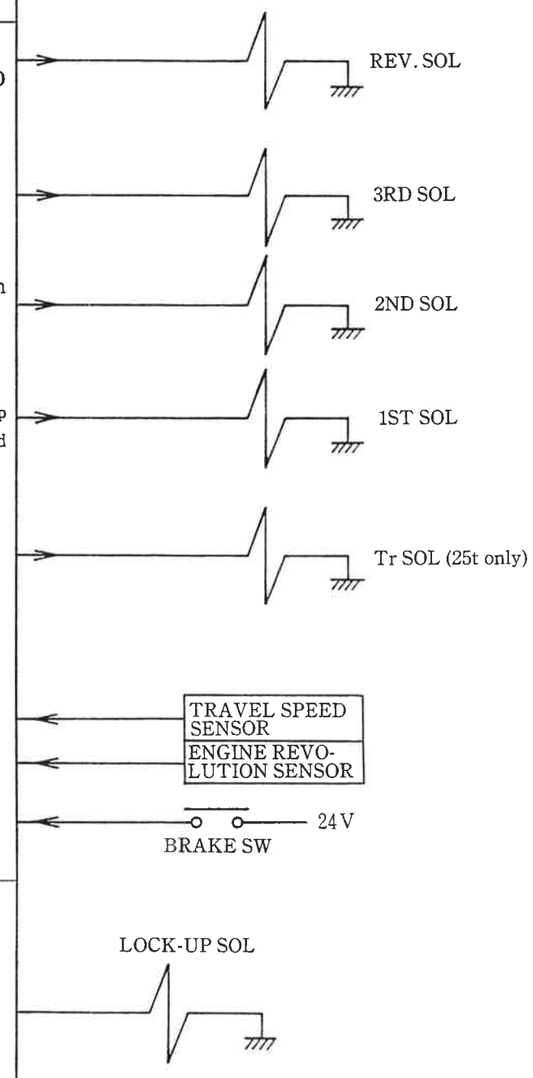
When the L / 4 signal is in ON, lock-up is not made.
When the PTO signal is in ON, lock-up is not made.

Relation of lock-up and shift is as follow :
With High range travel.

Shift lever D	1C-2C-2ℓ-3C-3ℓ
Shift lever 2	2C-2ℓ
Shift lever L	1C-1ℓ

C : Travel with T. C.
ℓ : Travel with lock-up

In case other than above, lock-up is not made.



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7. EXHAUST BRAKE CONTROL

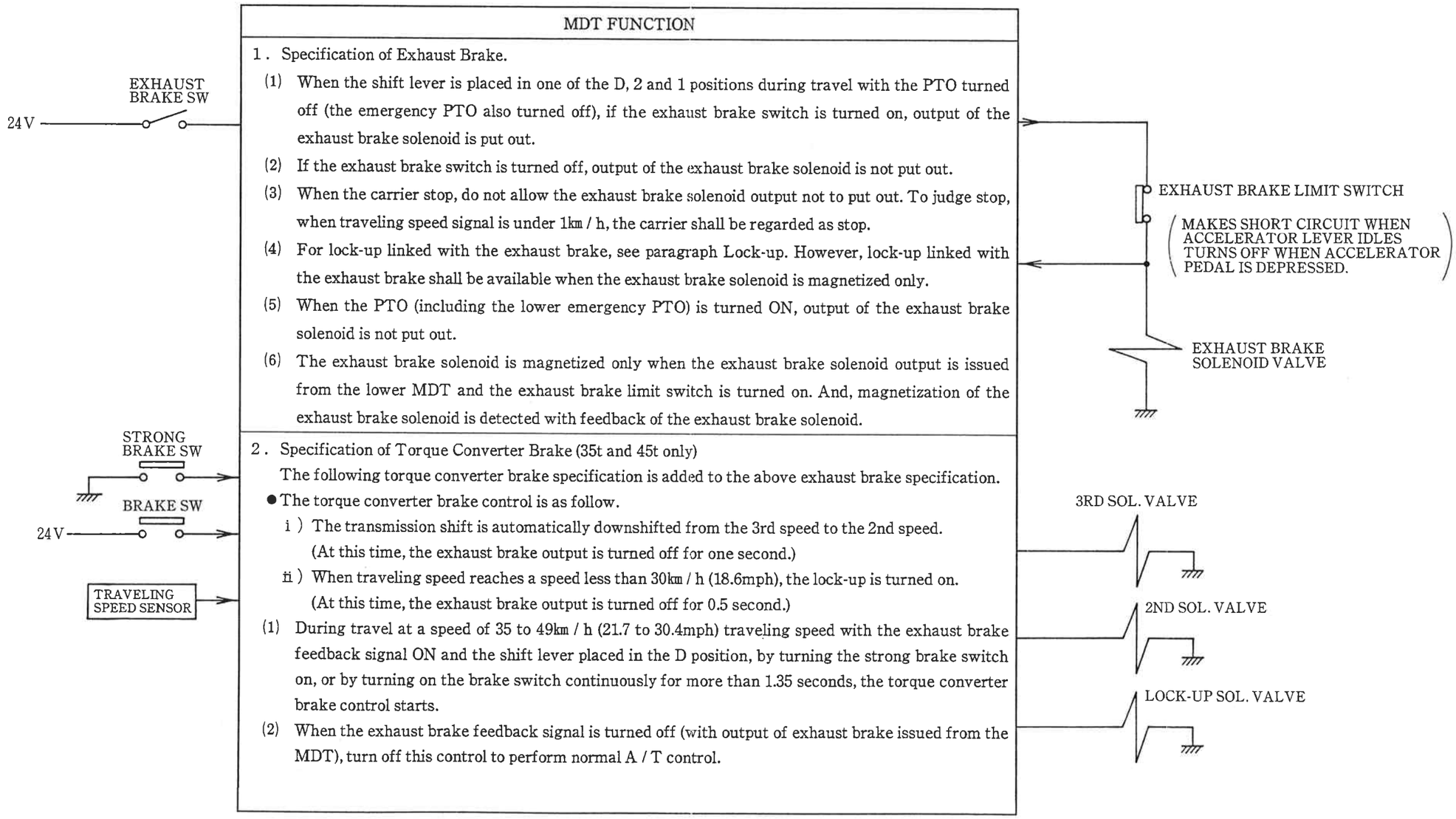
(1) GENERAL

The rough terrain crane is a more severe vehicle than the truck or other heavy vehicle in the traveling weight.

Therefore, it is required to apply the exhaust brake, not to mention when descending a slope, according to the condition even when normally traveling. Therefore, this mach is provided with the exhaust brake control system mentioned as below.

Further, in models RK350 and RK450-2, the torque converter brake system also is provided in order to obtain stronger braking force.

(2) SPECIFICATION



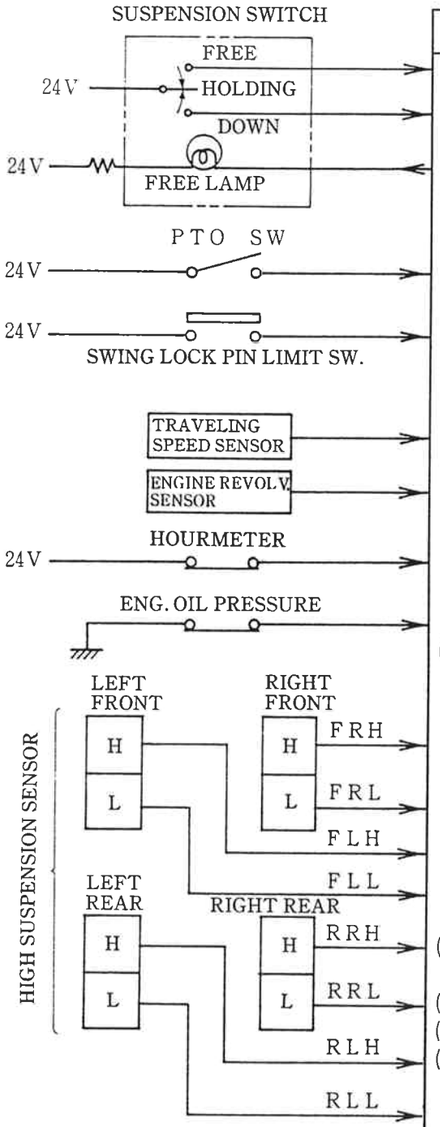
MDT FUNCTION

1. Specification of Exhaust Brake.
   (1) When the shift lever is placed in one of the D, 2 and 1 positions during travel with the PTO turned off (the emergency PTO also turned off), if the exhaust brake switch is turned on, output of the exhaust brake solenoid is put out.
   (2) If the exhaust brake switch is turned off, output of the exhaust brake solenoid is not put out.
   (3) When the carrier stop, do not allow the exhaust brake solenoid output not to put out. To judge stop, when traveling speed signal is under 1km / h, the carrier shall be regarded as stop.
   (4) For lock-up linked with the exhaust brake, see paragraph Lock-up. However, lock-up linked with the exhaust brake shall be available when the exhaust brake solenoid is magnetized only.
   (5) When the PTO (including the lower emergency PTO) is turned ON, output of the exhaust brake solenoid is not put out.
   (6) The exhaust brake solenoid is magnetized only when the exhaust brake solenoid output is issued from the lower MDT and the exhaust brake limit switch is turned on. And, magnetization of the exhaust brake solenoid is detected with feedback of the exhaust brake solenoid.

2. Specification of Torque Converter Brake (35t and 45t only)
   The following torque converter brake specification is added to the above exhaust brake specification.
   ● The torque converter brake control is as follow.
   i) The transmission shift is automatically downshifted from the 3rd speed to the 2nd speed.
   (At this time, the exhaust brake output is turned off for one second.)
   ii) When traveling speed reaches a speed less than 30km / h (18.6mph), the lock-up is turned on.
   (At this time, the exhaust brake output is turned off for 0.5 second.)
   (1) During travel at a speed of 35 to 49km / h (21.7 to 30.4mph) traveling speed with the exhaust brake feedback signal ON and the shift lever placed in the D position, by turning the strong brake switch on, or by turning on the brake switch continuously for more than 1.35 seconds, the torque converter brake control starts.
   (2) When the exhaust brake feedback signal is turned off (with output of exhaust brake issued from the MDT), turn off this control to perform normal A / T control.

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8. SUSPENSION CONTROL



MDT FUNCTION

1) Basic movements are as follows :

Mode	Suspension Level Sensor FRH	FRL	RLH	RLL	FLH	FLL	RRH	RRL	SOL Output: Suspension Pilot	H1FR	H2FR	H3FR	H1RL	H2RL	H3RL	H1FL	H2FL	H3FL	H1RR	H2RR	H3RR	Sus. press. source sol.	Suspension Free Lamp	Buzzer (BZ2)
Holding	–	–	–	–	–	–	–	–	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Down	–	–	–	–	–	–	–	–	○	×	○	×	×	○	×	×	○	×	×	○	×	○	×	×
Leveling	× ○ × ○ × ○ × ○	○ ○ ○ ○ × × ○ ○	× ○ × ○ × ○ × ○	○ ○ × × ○ ○ × ×	× × × × ○ ○ ○ ○	○ ○ ○ ○ × × × ×	× ○ × ○ × ○ × ○	○ ○ × × ○ ○ × ×	○ ○ ○ ○ ○ ○ ○ ○	○ ○ × × × × ○ ○	× × × × ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○ ○	○ × × ○ × × ○ ×	× × ○ × × ○ × ×	○ ○ ○ ○ ○ ○ ○ ○	○ × × × × × × ×	× × × × ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○ ○	○ × × × × × × ×	× × ○ × × ○ × ×	○ ○ ○ ○ ○ ○ ○ ○	○ ○ ○ ○ ○ ○ ○ ○	Goes on and off.	OFF
When all sensors are in ON, or after continuing 0.2 seconds. ○ ○ ○ ○ ○ ○ ○ ○									○	×	×	○	×	×	○	×	×	○	×	×	○	×	Lights	※1 ON for 0.2 sec. only
Free	–	–	–	–	–	–	–	–	○	×	×	○	×	×	○	×	×	○	×	×	○	×	Lights	OFF

(1) Down Mode
When the following conditions are satisfied, mode becomes down mode.
① PTO ON
② Engine rpm ON
③ Suspension down switch ON
④ During stop

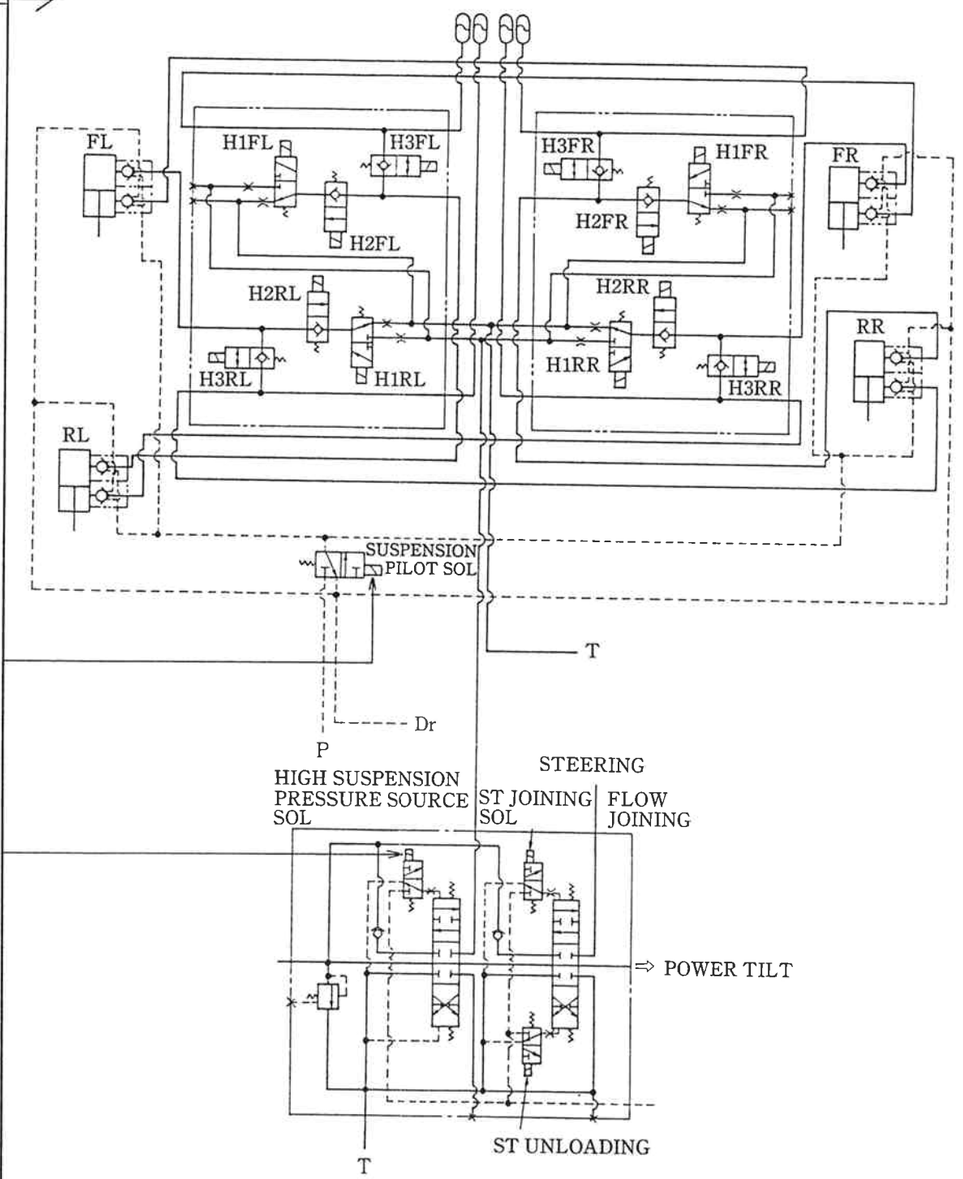
(2) Leveling Mode
When the following conditions are satisfied, mode becomes leveling mode.
① PTO OFF
② Swing lock pin ON
③ Engine rpm ON
④ Suspension free switch ON
⑤ During stop
When leveling mode is completed, mode becomes free mode.

(3) When power is supplied, if the previous condition when power was not supplied is the free condition (Free, leveling) and the swing lock pin is inserted, mode become free mode.
(4) If mode is not down mode when the PTO is turned on, mode shall be holding mode.
(5) When power is supplied, if engine rpm is turned off, output of each mode is not put out.
(6) To judge engine rpm, if engine rpm is more than 300rpm, or if the hourmeter is in ON, or engine oil pressure is in ON, it is judged that engine rpm is ON.

2) Measures for Abnormality of Sensor
(1) To judge the sensor abnormality, if both of H signal and L signal are OFF (OPEN) in every sensor (right front, left front, right rear and left rear), it is judged that the sensor is abnormal.
(2) Leveling, when the sensor is abnormal, is as follows :

Condition	Measures
In the case that one of high suspension sensor is normal.	Apply other high suspension sensor, manually perform leveling.
In the case that all sensors are abnormal.	After performing suspension down for five seconds, perform suspension up for ten seconds to make mode Free 2 Mode.

12 Solenoids.



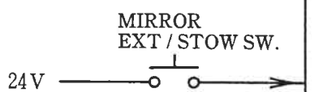
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9. MIRROR DRIVE CONTROL

(1) GENERAL

The electric drive stowing mirror (which uses a d. c. motor) is arranged so that the motor rotates ordinarily and reversely by shifting the output signal to the mirror.

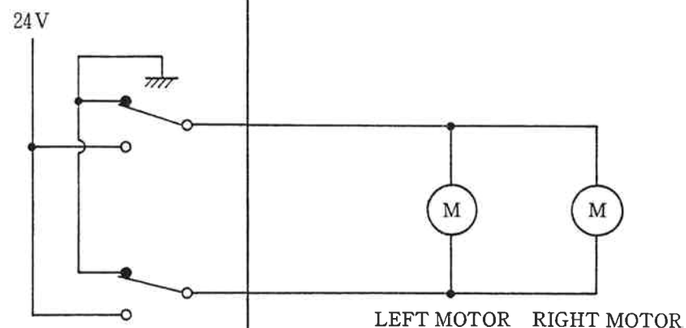
(2) SPECIFICATION



MDT FUNCTION

INPUT		OUTPUT		
Electric mirror SW	Condition Memory	Elec. mirror extending output	Elec. mirror stowing output	Condition Memory
	—	0V	0V	
○	When stowing	24V *1	0V	Extending
○	When extending	0V	24V *1	Stowing

*1 : Output is issued for 8 seconds after the switch is turned on. Then, 0 volt output is issued.



(1) The electric drive mirror switch is of momentary type.

(2) Memory of condition is memorized in the RAM (battery back-up) in the MDT, and the condition reverses after 8 seconds from the time when the electric drive mirror switch is turned on.

(3) In the case that the electric drive mirror switch is pushed for a long time (more than 8 seconds), the signal is ignored. (After the switch is once turned off, the signal is accepted.)

(4) When the electric drive mirror switch is pushed again while the electric drive mirror moves, the reversal output is issued.

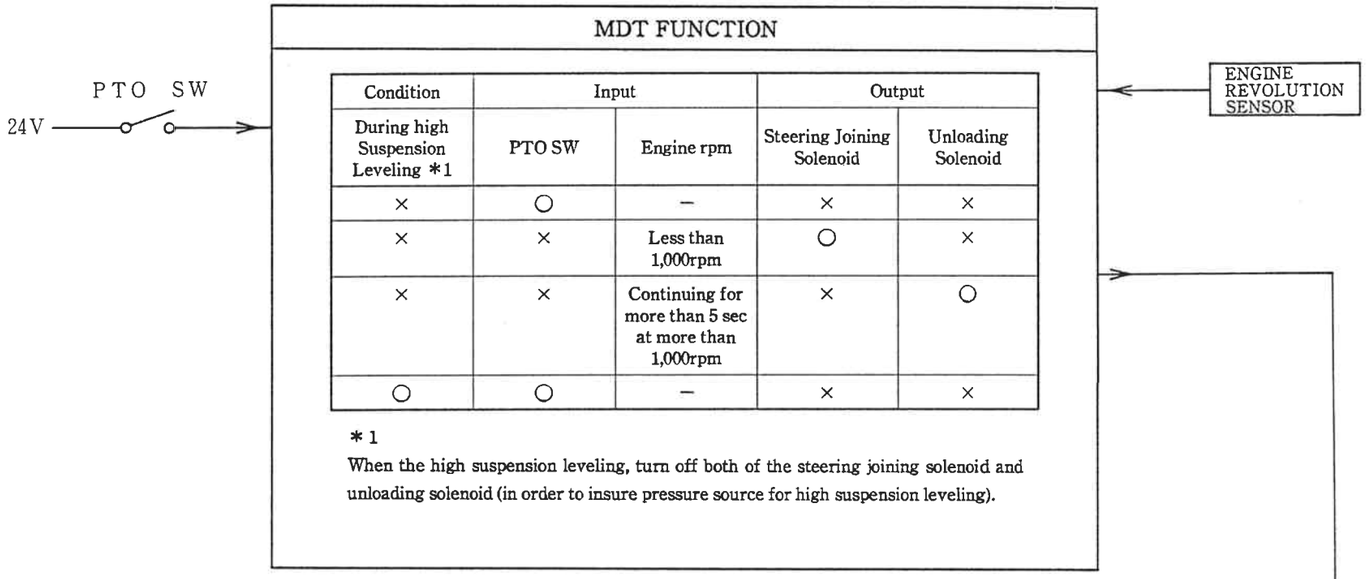
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10. STEERING FLOW JOINING CONTROL

(1) GENERAL

Since the steering pump flow is insufficient when the steering wheel is turned quickly with the engine running at a low speed, flow from other pump is controlled to join to the steering flow.
Besides, since the steering joining valve confronts the unloading valve, it is required to turn off the unloading solenoid valve.

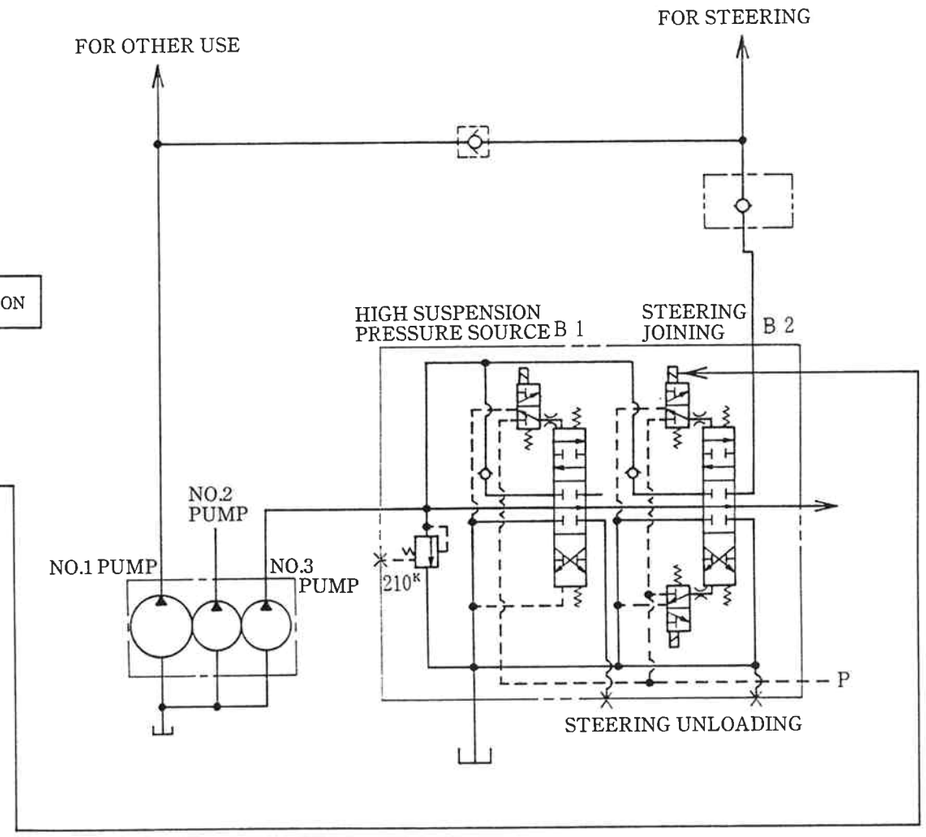
(2) SPECIFICATION



MDT FUNCTION

Condition	Input		Output	
During high Suspension Leveling *1	PTO SW	Engine rpm	Steering Joining Solenoid	Unloading Solenoid
×	○	–	×	×
×	×	Less than 1,000rpm	○	×
×	×	Continuing for more than 5 sec at more than 1,000rpm	×	○
○	○	–	×	×

*1
When the high suspension leveling, turn off both of the steering joining solenoid and unloading solenoid (in order to insure pressure source for high suspension leveling).



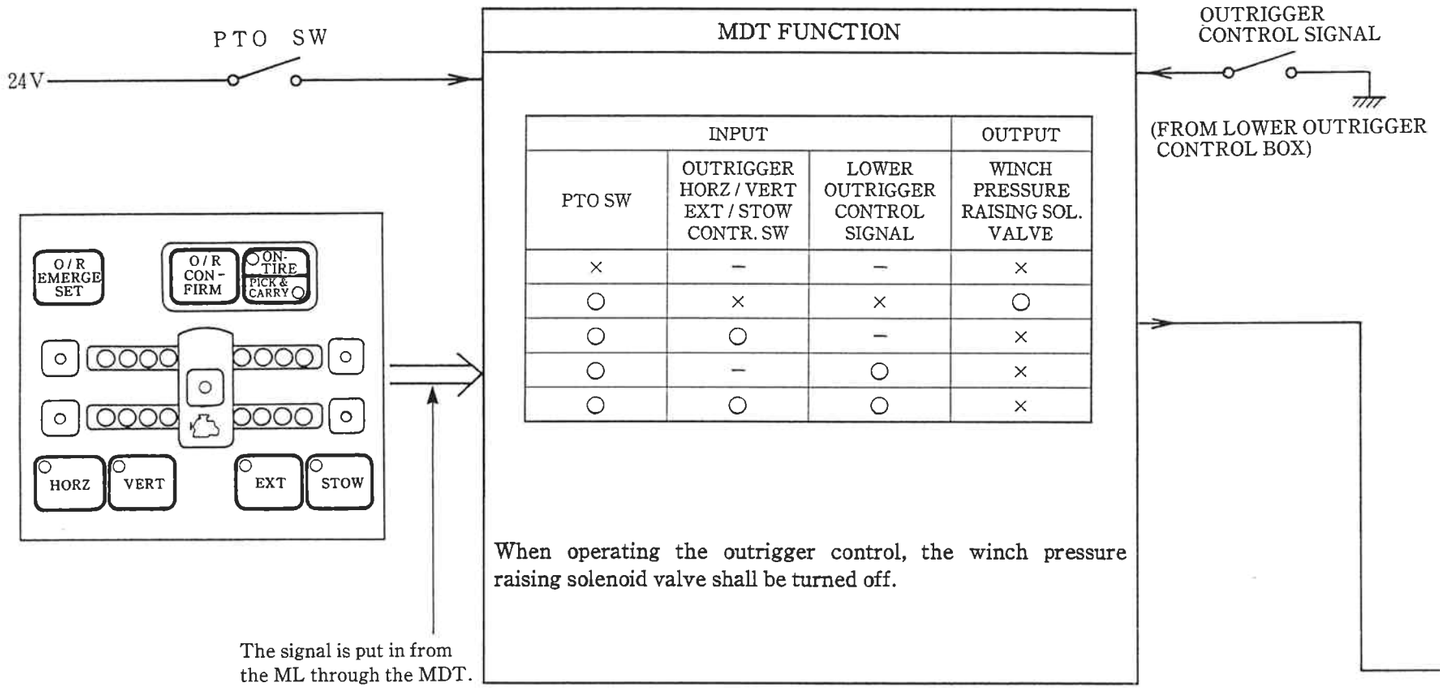
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11. WINCH PRESSURE RAISING CONTROL

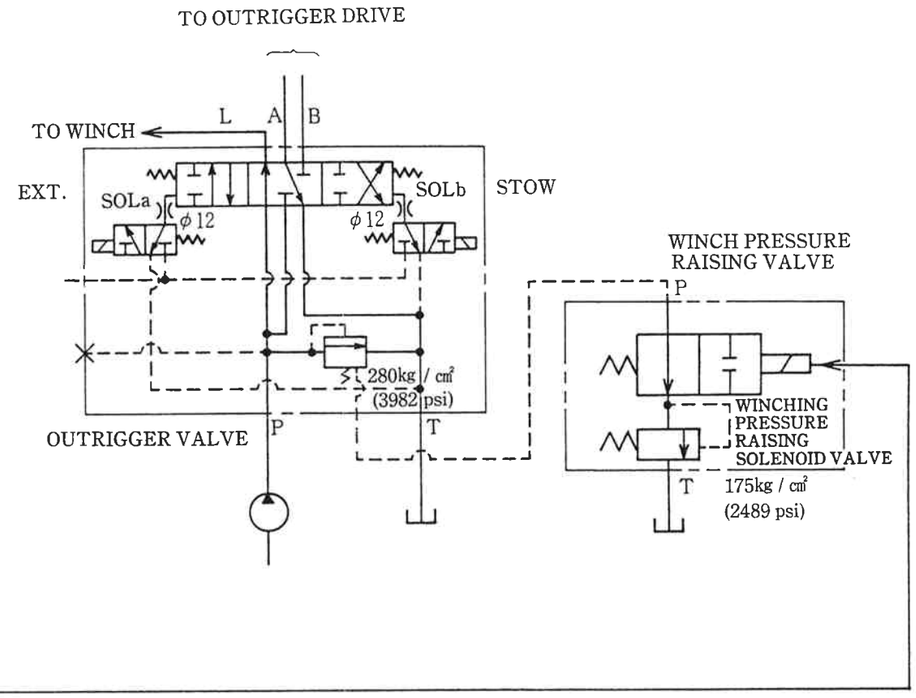
(1) GENERAL

Since the hydraulic oil delivered from the same pump is used for driving of the outriggers and the winch, and the pressure required for the winch is higher than that for the outrigger drive, set the pressure at two degrees by shifting the solenoid valve.

(2) SPECIFICATION



INPUT			OUTPUT
PTO SW	OUTRIGGER HORZ / VERT EXT / STOW CONTR. SW	LOWER OUTRIGGER CONTROL SIGNAL	WINCH PRESSURE RAISING SOL. VALVE
×	–	–	×
○	×	×	○
○	○	–	×
○	–	○	×
○	○	○	×



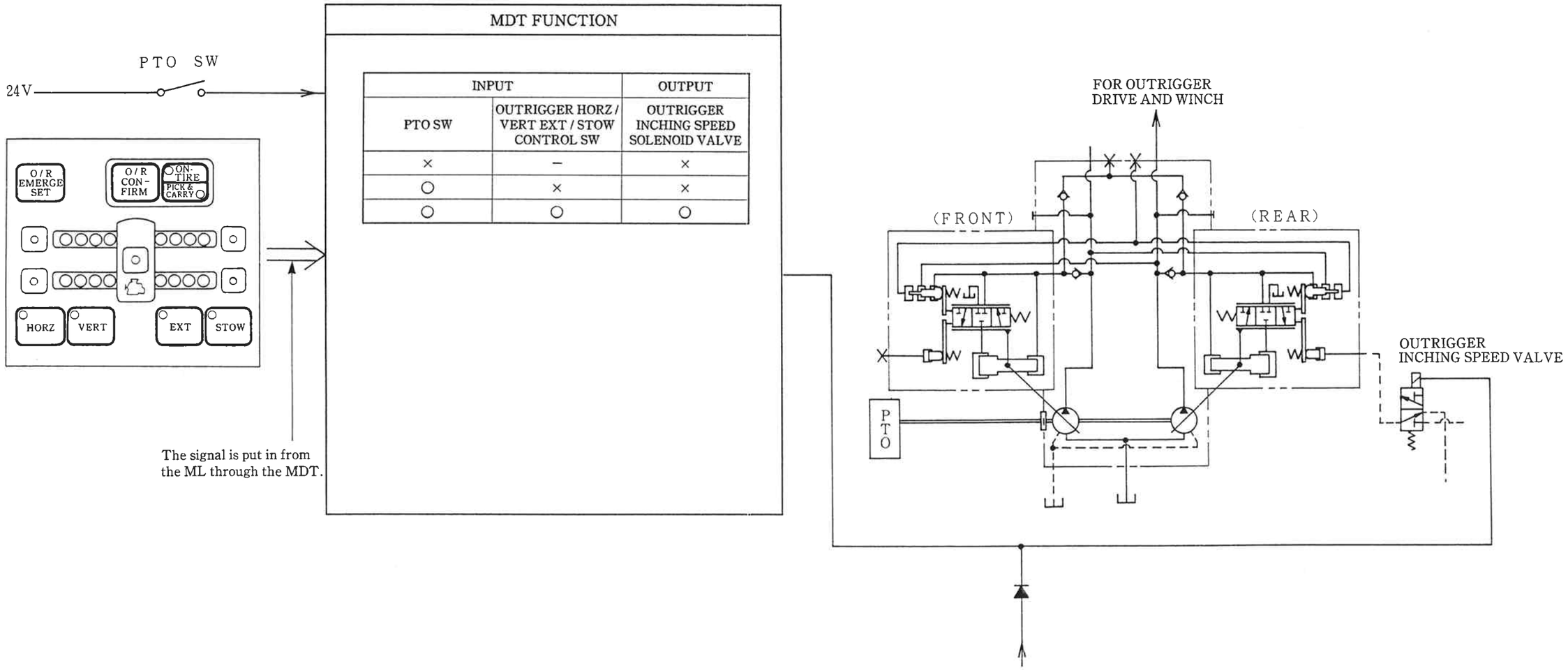
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12. OUTRIGGER INCHING SPEED CONTROL (45t only)

(1) GENERAL

Since the hydraulic oil delivered from the same pump is used for the outrigger drive and the winch, and the pump capacity is larger when driving the outrigger, the capacity is changed by shifting the solenoid valve.

(2) SPECIFICATION



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13. MODEL JUDGMENT

(1) GENERAL

The A / T constant and various specifications are varied for every model of 25t, 35t and 45t, and the specifications of the all models are incorporated into the software of the MDT. Besides, the hardware specifications of the MDT are composed so that the are common in the three models, and the same parts are used in these three models.

Therefore, in order to classify the software specification for every model, the following model judgment is arranged.

(2) SPECIFICATION

MDT FUNCTION

MODEL JUDGMENT (45t)
24 V

MODEL JUDGMENT (35t)
24 V

Lower \ Upper	45t	35t	ON	OFF	OFF
45t			—	ON	OFF
ON	—		45t Spec.	45t Spec.*1	45t Spec.*1
OFF	ON		45t Spec.*1	35t Spec.	35t Spec.*1
OFF	OFF		45t Spec.*1	35t Spec.*1	25t Spec.

*1 The error code is indicated, and at the same time, the CAUTION indication in the travel meter goes on and off.
(The specifications are shown in the following table.)

MODEL JUDGMENT (45t)
24 V

MODEL JUDGMENT (35t)
24 V

Error Code	Contents
A→2→3	Upper / lower MDT model judgments differ. (upper : 25t spec., lower : 35t spec.)
A→2→4	Upper / lower MDT model judgments differ. (upper : 25t spec., lower : 45t spec.)
A→3→2	Upper / lower MDT model judgments differ. (upper : 35t spec., lower : 25t spec.)
A→3→4	Upper / lower MDT model judgments differ. (upper : 35t spec., lower : 45t spec.)
A→4→2	Upper / lower MDT model judgments differ. (upper : 45t spec., lower : 25t spec.)
A→4→3	Upper / lower MDT model judgments differ. (upper : 45t spec., lower : 35t spec.)

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14. TRAVEL METER INDICATION CONTROL

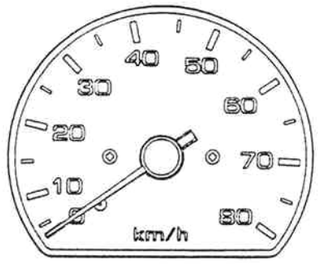
(1) GENERAL

Most of the travel meter drive is operated by the signals from the upper MDT. The methods of drive and indication of each meter are described individually as follows.

(2) SPECIFICATION

2 — 1 Speedometer

Specification





The meter drive pulse signal is as above.

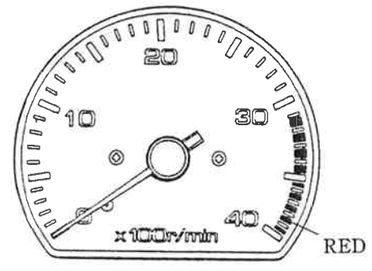
Function

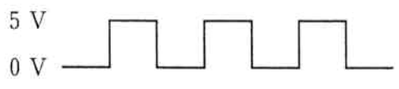
*1 Input Sensor Frequency (Hz)	Indicator Scale (km / h)	Allowable Error (rpm)
45	10	+5 +1
90	20	+6.5 +0.5
134	30	+6.5 +0.5
156	35	+5 +3
179	40	+5.5 +0.5
223	50	+6.5 +1.5
268	60	+6.5 +1.5
313	70	+6 +1

*1 : Frequency of input sensor to lower MDT.

2 — 2 Engine Tachometer

Specification





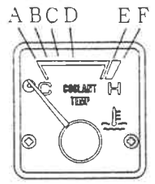
The meter drive pulse signal is as above.

Function

	Indicator Scale (km / h)	Frequency (Hz)
25t	500	(37.5)
	2000	150
	3500	(262.5)
35t 45t	500	(50)
	1500	150
	2500	(250)

2 — 3 Water Temperature Gauge

Specification

	Water Temperature Gauge	
Dial Scale		
Measuring Point		
Allowable Error (Target Value)	50℃ (±5°)	115℃ (±3°)

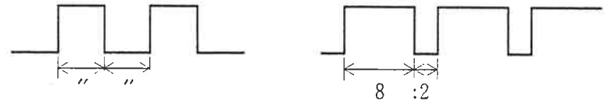
The meter drive is of rectangular wave of 100Hz, and the indicating value varies according to variation of duty ratio.*2

Function

Sensor Signal (Ω)	Water Temper. (converted value)	Meter Indicating Point
≧80Ω	≦50℃ (122°F)	A
66Ω	55℃ (131°F)	B
52Ω	62℃ (143.6°F)	C
37Ω	72℃ (161.6°F)	D
17Ω	100℃ (212°F)	
11.5Ω	115℃ (239°F)	E
≦10Ω	120℃ (248°F)	F

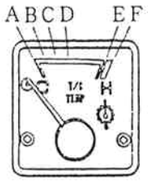
Meter indication for above table space shall be computed by interpolation. (Integration of duty ratio shall be every 1%.)

*2 : Width ratio of ON and OFF (ex)



2 — 4 Oil Temperature Gauge

Specification

	Oil Temperature Gauge	
Dial Scale		
Measuring Point		
Allowable Error (Target Value)	55℃ (±5°)	120℃ (±3°)

The meter drive is of rectangular wave of 100Hz, and the indicating value varies according to variation of duty ratio.

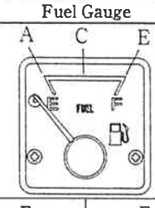
Function

Sensor Signal (Ω)	Oil Temperature (converted value)	Meter Indicating Point
≧66Ω	≦55℃ (131°F)	A
56Ω	60℃ (140°F)	B
44Ω	67℃ (152.6°F)	C
33Ω	75℃ (167°F)	D
14.7Ω	105℃ (221°F)	
10Ω	120℃ (248°F)	E
≦8.5Ω	125℃ (257°F)	F

Meter indication for above table space shall be computed by interpolation. (Integration of duty ratio shall be every 1%.)

2 — 5 Fuel Gauge

Specification

	Fuel Gauge	
Dial Scale		
Measuring Point	E	F
Allowable Error (Target Value)	0° -6°	+10° +2°

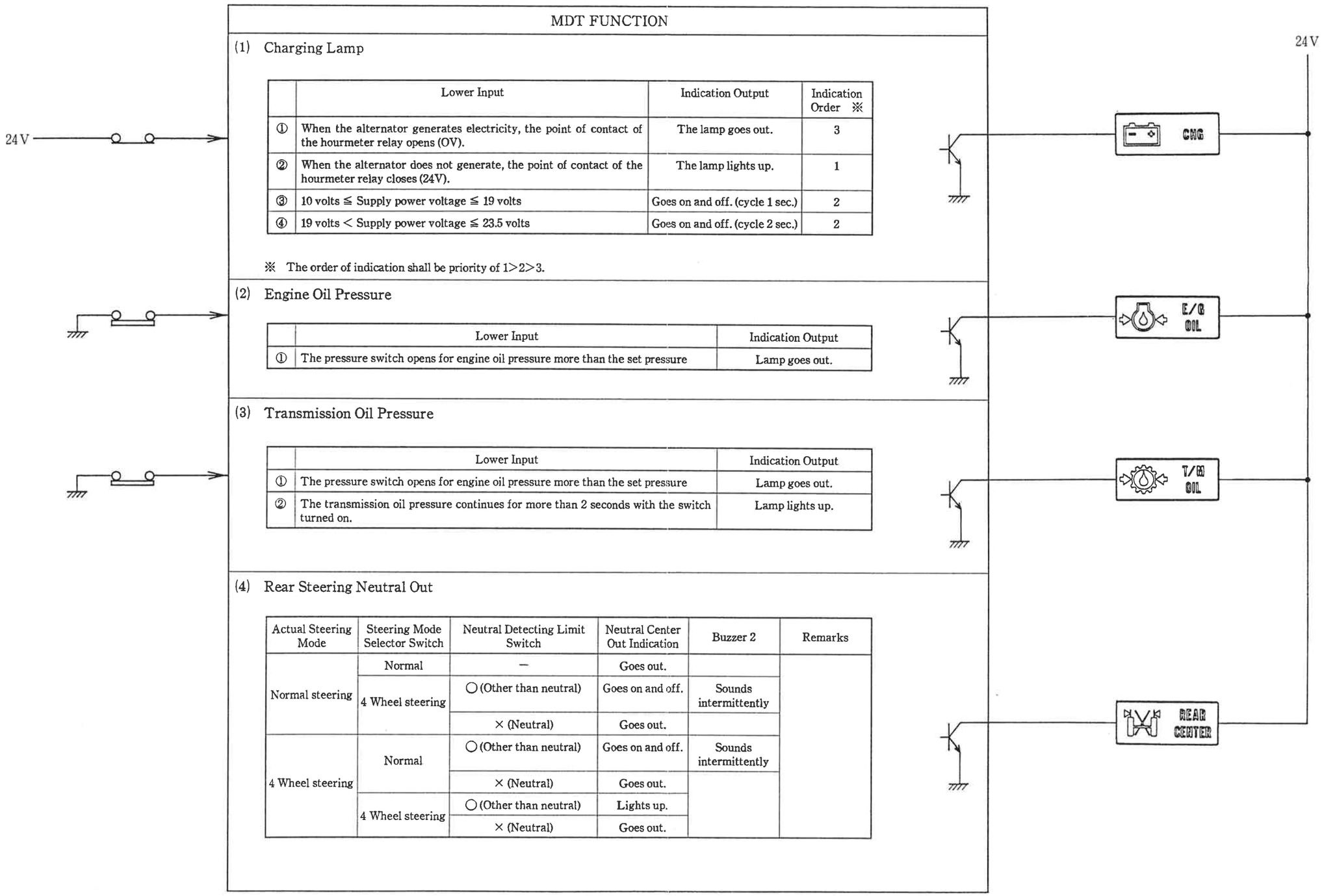
The meter drive is of rectangular wave of 100Hz, and the indicating value varies according to variation of duty ratio.

Function

Sensor Signal (Ω)	Fuel gauge (converted value)	Meter Indicating Point
≧125Ω	E	A
78Ω	1 / 4	
50Ω	1 / 2	C
30Ω	3 / 4	
≦18Ω	F	E

Meter indication for above table space shall be computed by interpolation. (Integration of duty ratio shall be every 1%.)

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MDT FUNCTION

(1) Charging Lamp

	Lower Input	Indication Output	Indication Order ※
①	When the alternator generates electricity, the point of contact of the hourmeter relay opens (OV).	The lamp goes out.	3
②	When the alternator does not generate, the point of contact of the hourmeter relay closes (24V).	The lamp lights up.	1
③	10 volts ≦ Supply power voltage ≦ 19 volts	Goes on and off. (cycle 1 sec.)	2
④	19 volts < Supply power voltage ≦ 23.5 volts	Goes on and off. (cycle 2 sec.)	2

※ The order of indication shall be priority of 1>2>3.

(2) Engine Oil Pressure

	Lower Input	Indication Output
①	The pressure switch opens for engine oil pressure more than the set pressure	Lamp goes out.

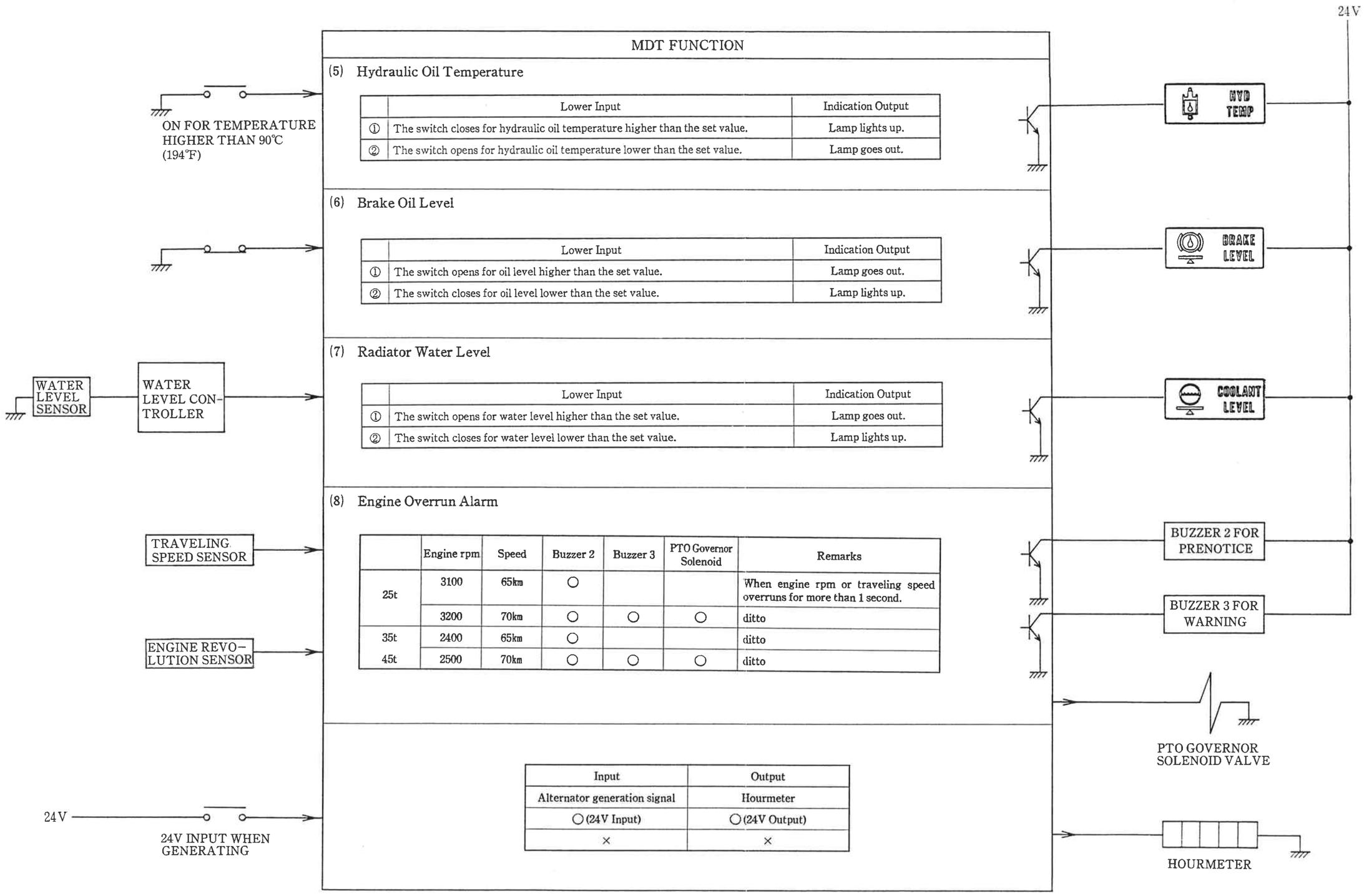
(3) Transmission Oil Pressure

	Lower Input	Indication Output
①	The pressure switch opens for engine oil pressure more than the set pressure	Lamp goes out.
②	The transmission oil pressure continues for more than 2 seconds with the switch turned on.	Lamp lights up.

(4) Rear Steering Neutral Out

Actual Steering Mode	Steering Mode Selector Switch	Neutral Detecting Limit Switch	Neutral Center Out Indication	Buzzer 2	Remarks
Normal steering	Normal	—	Goes out.		
	4 Wheel steering	○ (Other than neutral)	Goes on and off.	Sounds intermittently	
		× (Neutral)	Goes out.		
4 Wheel steering	Normal	○ (Other than neutral)	Goes on and off.	Sounds intermittently	
		× (Neutral)	Goes out.		
	4 Wheel steering	○ (Other than neutral)	Lights up.		
		× (Neutral)	Goes out.		

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	Lower Input	Indication Output
①	The switch closes for hydraulic oil temperature higher than the set value.	Lamp lights up.
②	The switch opens for hydraulic oil temperature lower than the set value.	Lamp goes out.

	Lower Input	Indication Output
①	The switch opens for oil level higher than the set value.	Lamp goes out.
②	The switch closes for oil level lower than the set value.	Lamp lights up.

	Lower Input	Indication Output
①	The switch opens for water level higher than the set value.	Lamp goes out.
②	The switch closes for water level lower than the set value.	Lamp lights up.

	Engine rpm	Speed	Buzzer 2	Buzzer 3	PTO Governor Solenoid	Remarks
25t	3100	65km	○			When engine rpm or traveling speed overruns for more than 1 second.
	3200	70km	○	○	○	ditto
35t	2400	65km	○			ditto
45t	2500	70km	○	○	○	ditto

Input	Output
Alternator generation signal	Hourmeter
○ (24V Input)	○ (24V Output)
×	×

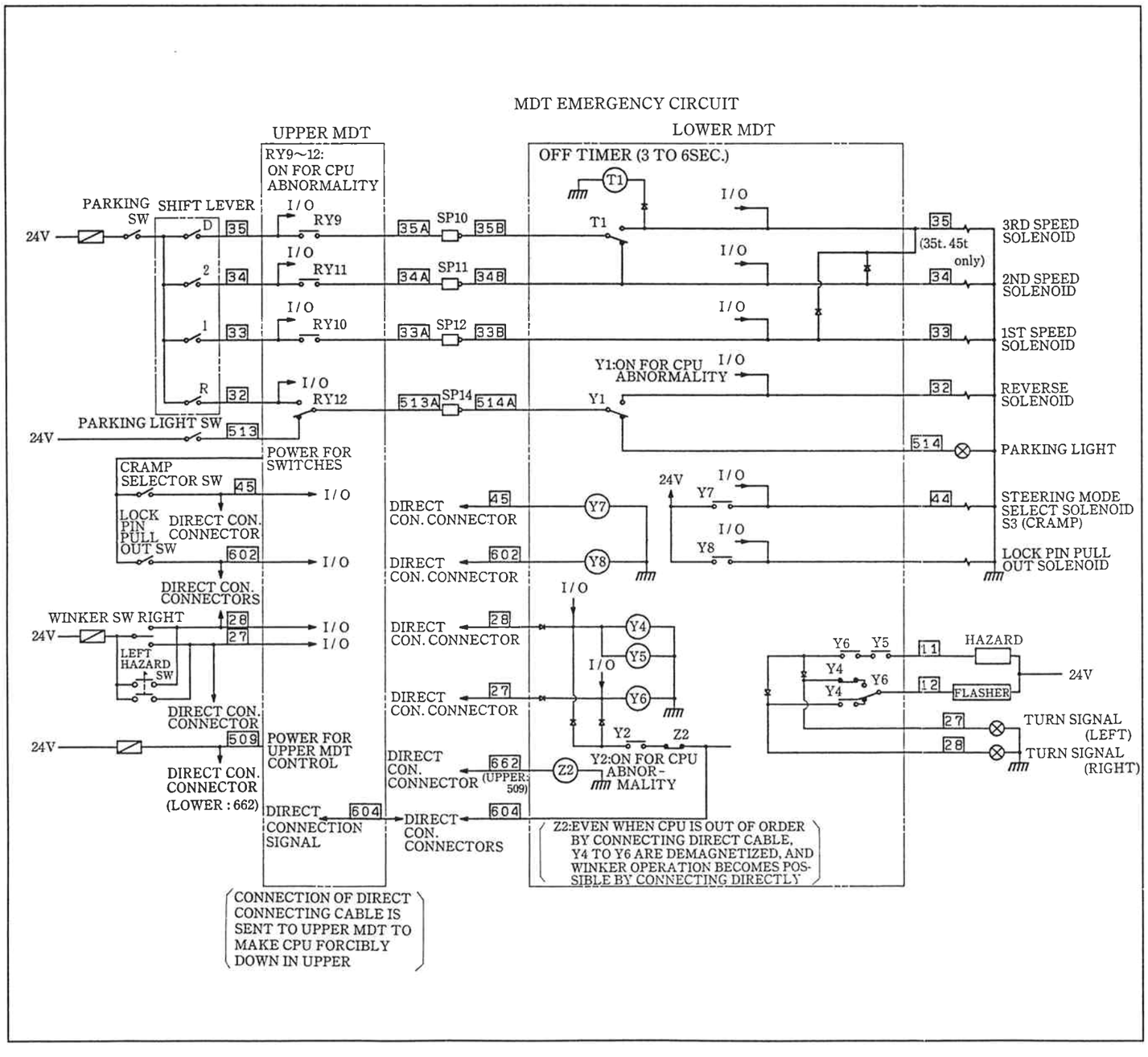
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15. EMERGENCY CIRCUITS

(1) GENERAL

In order to make traveling possible without trouble even when abnormality occurs in the MDT, the emergency circuit is arranged. When the MDT is normal, usual movement is operated, and when the MDT becomes abnormal, the circuit is switched to the emergency circuit automatically.

(2) SPECIFICATION



2 — 1 Basic Function

i) Functions which are automatically switched when the CPU is out of order.

- Forward 1st speed function
- Forward 2nd speed function
- Reverse drive function

} Drive is not automatic drive, but becomes manual drive.

〈 However, regarding forward 3rd speed function, when the CPU is out of order during travel with the 3rd speed, the 3rd speed output is available, but after the CPU is out of order during travel with the 1st or 2nd speed, the 3rd speed travel is impossible and travel becomes 2nd speed even when the shift lever is placed in the D position. 〉

ii) Function added by connecting the direct connecting connectors.

- Steering mode (cramp only) selecting function.
- Lock pin pulling out function.
- Turn signal and hazard function.

2 — 2 Explanation of Circuit Diagram

i) When the CPU is out of order, RY9 through RY12 (upper) and Y1 and Y2 (lower) are automatically switched, the travel solenoid valves (1st to 3rd speeds and reverse) are directly magnetized according to the shift lever position.

〈 However, the 3rd speed solenoid valve is provided with off timer (T1), and when the CPU is out of order during travel with the 3rd speed, it is arranged so that the 3rd speed output is available, and when the CPU is out of order during travel with a condition other than the 3rd speed, it is arranged so that the 3rd speed output is not available even when the shift lever is placed in the D position. 〉

ii) When the direct connecting connectors are connected, it is arranged so that the CPU is forcibly out of order and that the CPU does not recover (in order to prevent the duplicate outputs after the CPU recovers).

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5. MAIN ELECTRICAL PARTS AND CLASSIFICATION FOR USE

5.1 ELECTRICAL PARTS CLASSIFICATION FOR USE (SOLENOID VALVES)

No.	Use	Circuit No. Line Color	Function	Remarks
1	Automatic stop	123A (G) —— Body earth	Crane operation stops by magnetization.	24V 26W
2	Jib automatic stop	123B (L. Y) —— Body earth	Jib movement stops by magnetization.	24V 26W
3	Swing free	136 (Br. W) —— Body earth	Swing becomes free by magnetization.	24V 12W
4	Telescope correction	682 (O) —— Body earth	Corrects by magnetization.	45t only, 24V 29W
5	Swing pump (control)	876 (G. R) —— 877 (G. L)	Stops by demagnetization,	Proportional valve, 19.5Ω (20℃) 28.8Ω
6	Left swing motor control	878 (G. B) —— 879 (G. Y)	Stops by magnetization,	Proportional valve, 24Ω
7	Right swing motor control	880 (Y. G) —— 881 (G. W)	Stops by magnetization,	Proportional valve, 24Ω
8	Tagline	613 (Y. W) —— Body earth		Optional, 24V 17W
9	Hydraulic pressure source 1-A	616A (L. W) —— Body earth		Optional, 24V 26W
10	Hydraulic pressure source 1-B	616B (L. G) —— Body earth		Optional, 24V 26W
11	Hydraulic pressure source 2-A	617A (W. L) —— Body earth		Optional, 24V 26W
12	Hydraulic pressure source 2-B	617B (W) —— Body earth		Optional, 24V 26W
13	Engine stop	527 (Y. R) —— Body earth	Engine stops by magnetization	25t OFF:1.1Ω ON:6.6Ω
		523 (R. G) —— E₀ (B)		35t, 45t OFF:1.1Ω ON:48.5Ω
14	Parking brake	15A (G. W) —— Body earth	Parking brake is released by magnetization.	24V 13W
15	Auxiliary brake for work	607 (L. R) —— Body earth	Auxiliary brake is applied by magnetization.	24V 13W
16	Exhaust brake	564 (Br. L) —— Body earth	Exhaust brake is applied by magnetization.	24V 13W
17	2 / 4 drive selection	46A (W. G) —— E₀ (B)	4 wheel drive by magnetization.	24V 15W

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ELECTRICAL PARTS CLASSIFICATION FOR USE (SOLENOID VALVES)

No.	Use	Circuit No. Line Color	Function	Remarks
18	Steering mode selection	49 (G. W) —— Body earth		24V 18W
19	Steering mode selection	50 (G. B) —— Body earth		24V 18W
20	Steering mode selection	44 (G. R) —— Body earth		24V 18W
21	Steering mode selection	45A (G) —— Body earth		24V 18W
22	Steering lock pin insertion	601 (Y. R) —— Body earth	Inserts by magnetization	24V 15W
23	Steering lock pin pulling out	602A (Y) —— Body earth	Pulls out by magnetization	24V 15W
24	Suspension pressure source	86 (G) —— Body earth		24V 12W
25	Suspension pilot	80 (W. R) —— Body earth		24V 12W
26	Suspension H1FL	81A (L. Y) —— Body earth		24V 23W
27	Suspension H2FL	81B (Y) —— Body earth		24V 23W
28	Suspension H3FL	81C (L) —— Body earth		24V 23W
29	Suspension H1FR	82A (Y. G) —— Body earth		24V 23W
30	Suspension H2FR	82B (Y) —— Body earth		24V 23W
31	Suspension H3FR	82C (L) —— Body earth		24V 23W
32	Suspension H1RL	83A (O) —— Body earth		24V 23W
33	Suspension H2RL	83B (G. W) —— Body earth		24V 23W
34	Suspension H3RL	83C (R. Y) —— Body earth		24V 23W
35	Suspension II1RR	84A (L. W) —— Body earth		24V 23W

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ELECTRICAL PARTS CLASSIFICATION FOR USE (SOLENOID VALVES)

No.	Use	Circuit No. Line Color	Function	Remarks
36	Suspension II2RR	84B —— Body (O. W) earth		24V 23W
37	Suspension II3RR	84C —— Body (R. Y) earth		24V 23W
38	Transmission L	46 —— E_0 (G. Y) (B)	L by magnetization.	25t ; 24V 23W 35t, 45t ; 24V 19W
39	Transmission TR	31 —— E_0 (L) (B)		25t only 24V 23W
40	Transmission Rev.	32 —— E_0 (L. R) (B)		
41	Transmission 1st	33 —— E_0 (L. B) (B)		
42	Transmission 2nd	34 —— E_0 (L. Y) (B)		25t ; 24V 23W
43	Transmission 3rd	35 —— E_0 (L. W) (B)		35t, 45t ; 24V 19W
44	Lock-up	47 —— Body (Br. R) earth		
45	PTO	36 —— Body (Br. W) earth		
46	PTO governor	36D —— Body (G. R) earth	PTO governor operates by magnetization.	24V 13W
47	Outrigger extension	55 —— Body (O. W) earth		24V 14W
48	Outrigger stowing	56 —— Body (O) earth		24V 14W
49	Outrigger left front, horizontal	62 —— Body (R. W) earth		
50	Outrigger left front, vertical	61 —— Body (R. B) earth		
51	Outrigger right front, horizontal	64 —— Body (L. W) earth		24V 26W
52	Outrigger right front, vertical	63 —— Body (L. B) earth		
53	Outrigger left rear, horizontal	66 —— Body (R. Y) earth		

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ELECTRICAL PARTS CLASSIFICATION FOR USE (SOLENOID VALVES)

No.	Use	Circuit No. Line Color	Function	Remarks
54	Outrigger left rear, vertical	65 (R. G) —— Body earth		24V 26W
55	Outrigger right rear, horizontal	68 (L. Y) —— Body earth		
56	Outrigger right rear, vertical	67 (L. G) —— Body earth		
57	Outrigger inching speed	76 (Y. L) —— Body earth	Inching speed by magnetization.	24V 12W
58	Idle up	654 (L. G) —— Body earth	Idle up by magnetization.	24V 13W
59	Steering flow joining	677 (L. W) —— Body earth	Flow joins by magnetization.	24V 12W
60	Unloading	74 (R. Y) —— Body earth	Unloads by magnetization.	24V 12W
61	Winch pressure raising	75 (Y) —— Body earth	Pressure rises by magnetization.	24V 21.5W

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5.2 ELECTRICAL PARTS CLASSIFICATION FOR USE (RELAYS)

RL No.	Name	Line Color · Circuit No.		Remarks
		Coil	Point of Contact	
1	Air heater relay B	42 (Y. L) — E_0 (B)	NO — 536 (R. W); 507 (P); NC	
2	Horn relay	560A (Gr) — 302 (P)	560A (Gr) — 301 (R)	
3	CPU reset relay	713A (Y. R) — E_0 (B)	NO; 536 (R. W); NC — 536A (Gr)	When CPU reset switch is turned on, upper MDT control power (F30) is turned off. (When CPU is abnormal only.)
4	PTO relay A	37 (Y) — E_0 (B)	627A (Y. L) — 36A (R)	When PTO switch is turned on, 1. ML control power is turned on. 2. Swing controller control power is turned on.
5	PTO relay B	37 (Y) — E_0 (B)	627B (Y. B) — 36B (R. Y)	When PTO switch is turned on, 1. ML output power is turned on. 2. Swing controller output power is turned on.
6	PTO relay C	37 (Y) — E_0 (B)	627B (Y. B) — 36C (G)	
7	Swing warning flasher relay	685 (L) — E_0 (B)	530 (R. L) — 685B (G. W)	
8	Worklight relay	137 (W. L) — E_0 (B)	530 (R. L) — 138 (L)	
9	Front wiper relay	E_0 (B) — 6; 4 5 3 1 2; 812 (L); WIRING IN COLUMN UNIT; 810 (Y); 535 (R. B)		
10	Top wiper intermit unit	135B (L. R); 135C (L. Y); LR LB; LY Y LW B; 535 (R. B); 135 (L. B); 135A (L); E_0 (B)		

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ELECTRICAL PARTS CLASSIFICATION FOR USE (RELAYS)

RL No.	Name	Line Color · Circuit No.		Remarks
		Coil	Point of Contact	
11	Battery relay	536A (Gr) — Body earth 406 (W. L)	506 (R) (B) — 519 (W. B) (B)	· When ignition switch is turned on, magnetization. · When alternator generates, magnetization.
12	Hourmeter relay	406 (W. L) — E_0 (B)	549 (R. L) — NO 72 (Y. B) / NC	When alternator generates, magnetization.
13	Emergency steering relay	568 (R. Y) — Body earth	519 (B) — 519A (B)	When emergency steering switch is turned on, emergency steering pump operates.
14	Auxiliary battery relay	536A (O. W) — E_0 (B)	519 (W. B) — NO 528 (W. L) / NC	When ignition switch is turned on, magnetization.
15	Engine stop relay	516 (B. R) — Body earth	523 (R. G) — 527 (Y. R)	
16	Left headlight relay	(HIGH BEAM) 23 (G. W) — Body earth (LOW BEAM) 24 (G. B) — Body earth	(HIGH BEAM) 522L (R) — 401 (R. W) (LOW BEAM) 522L (R) — 402 (R. Y)	
17	Right headlight relay	(HIGH BEAM) 23 (G.W) — Body earth (LOW BEAM) 24 (G. B) — Body earth	(HIGH BEAM) 522R (R. G) — 413 (L. W) (LOW BEAM) 522R (R. G) — 414 (L. Y)	
18	Clearance light relay	26 (G. Y) — Body earth (Optional) 26 (G. Y) — Body earth	570 (Y. R) — 26B (Y) (Optional) 570 (Y. R) — 26A (L)	(Optional spare light)
19	Safety relay	419 (Y) — S; 408 (W. L) — L; 508 (R) — R; E — E_0 (B); P — 524 (O)		

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ELECTRICAL PARTS CLASSIFICATION FOR USE (RELAYS)

RL No.	Name	Line Color · Circuit No.		Remarks
		Coil	Point of Contact	
20	Air heater relay A	42 (Y. L) —— Body earth	506 (R) —o o— 404 (B)	
21	Flasher unit	522F (G. W) — B L — 12 (W. Y)		
22	Hazard unit	522F (G. W) — B; L — 11 (W. G); E — BODY EARTH		

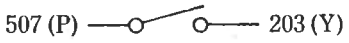
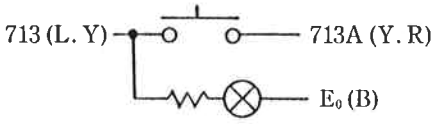
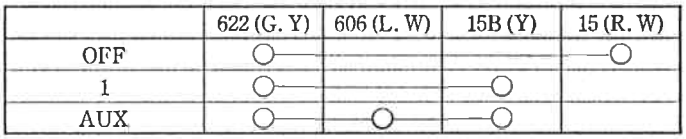
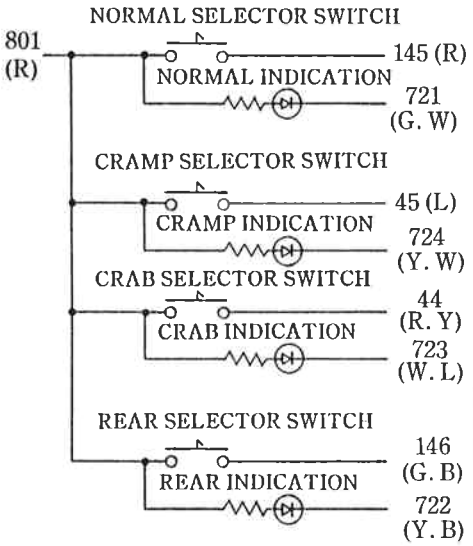
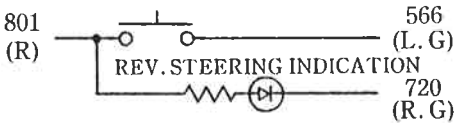
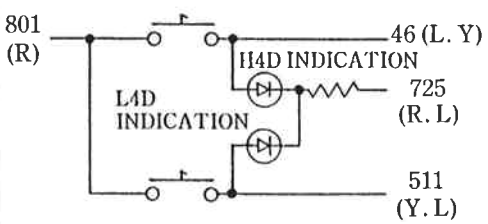
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5.3 ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

<table>
<tr><th>SW No.</th><th>Name</th><th>Line Color
Circuit No.</th><th>Function</th><th>Remarks</th></tr>
<tr><td>1</td><td>Ignition switch</td><td>
<table>
<tr><th>Point of contact / Position</th><th>507
(P)</th><th>42
(Y. L)</th><th>42
(Y. L)</th><th>537
(L)</th><th>536
(R. W)</th><th>22
(Br. W)</th></tr>
<tr><td>HEART</td><td>○—○</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>OFF</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>ACC</td><td>○—</td><td></td><td></td><td>—○</td><td></td><td></td></tr>
<tr><td>ON</td><td>○—</td><td></td><td></td><td>—○—</td><td>○</td><td></td></tr>
<tr><td>START</td><td>○—</td><td></td><td>○</td><td></td><td>○</td><td>—○</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>2</td><td>Horn switch</td><td>302 (P) —o o— E_0 (B)</td><td></td><td>Steering wheel</td></tr>
<tr><td>3</td><td>Horn switch</td><td>302 (P) —o o— E_0 (B)</td><td></td><td>Swing lever</td></tr>
<tr><td>4</td><td>Emergency steering switch</td><td>531 (G) — 569 (YR)
E_0 (B)
R</td><td>When switch is pushed, lamp in switch lights up.</td><td></td></tr>
<tr><td>5</td><td>Top wiper switch</td><td>
<table>
<tr><th>Point of contact / Position</th><th>135B
(L. R)</th><th>135C
(L. Y)</th><th>E_0
(B)</th><th>135D
(Y. L)</th></tr>
<tr><td>W</td><td>○—</td><td></td><td>—○</td><td>○</td></tr>
<tr><td>INT</td><td>○—</td><td></td><td>—○</td><td></td></tr>
<tr><td>OFF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>ON</td><td></td><td>○—</td><td>—○</td><td></td></tr>
<tr><td>W</td><td></td><td>○—</td><td>○—</td><td>○</td></tr>
</table>
</td><td></td><td>Top panel</td></tr>
<tr><td>6</td><td>Wiper switch</td><td>
<table>
<tr><th>Switch position</th><th>Wiring in column unit</th><th>E_0
(B)</th><th>814
(W)</th><th>Wiring in column unit</th><th>814
(W)</th><th>815
(L. W)</th><th>E_0
(B)</th><th>812
(L)</th><th>E_0
(B)</th></tr>
<tr><td>OFF</td><td></td><td></td><td></td><td>○—</td><td>—○</td><td></td><td></td><td></td><td></td></tr>
<tr><td>INT</td><td>○—</td><td>—○</td><td>○—</td><td>—○</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Low speed</td><td></td><td></td><td></td><td></td><td>○—</td><td>—</td><td>○</td><td></td><td></td></tr>
<tr><td>Hiigh speed</td><td></td><td></td><td></td><td></td><td></td><td>○—</td><td>—○</td><td></td><td></td></tr>
<tr><td>Washer</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>○—</td><td>—○</td></tr>
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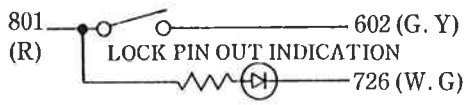
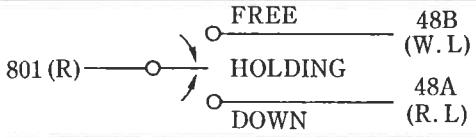
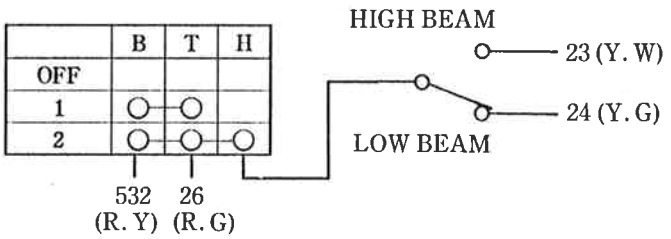
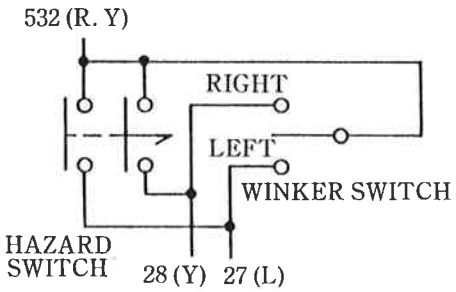
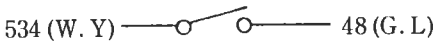
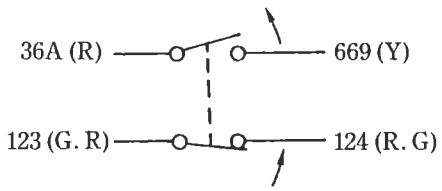
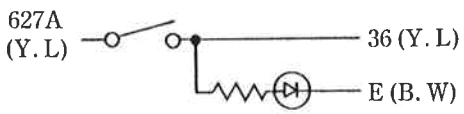
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

SW No.	Name	Line Color Circuit No.	Function	Remarks
7	Step light switch			
8	CPU reset switch		When the CPU is abnormal, the lamp in the switch lights up.	Travel control panel
9	Parking switch			Travel control panel
10	Steering mode selector switch			Travel control panel
11	Reverse steering switch			Travel control panel
12	H4D / L4D selector switch			Travel control panel

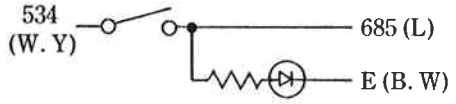
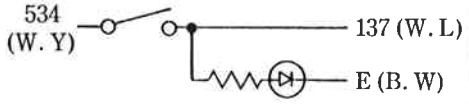
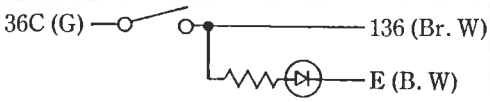
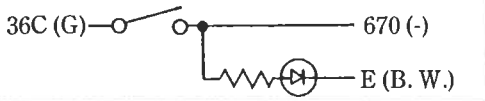
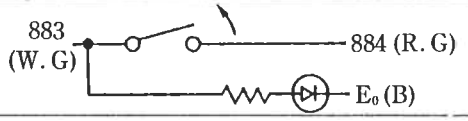
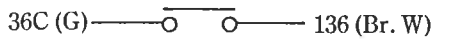
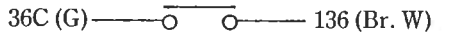
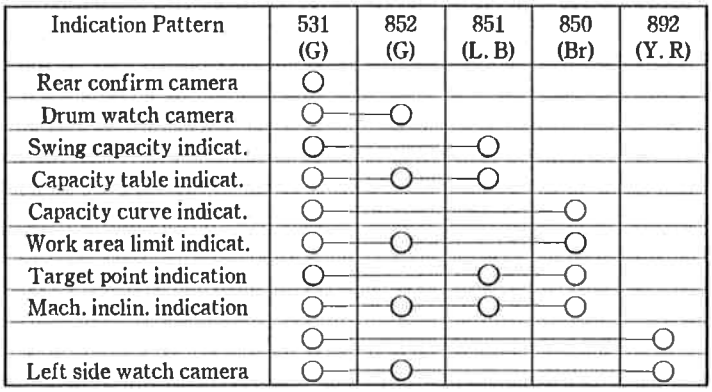
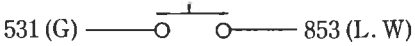
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

SW No.	Name	Line Color Circuit No.	Function	Remarks
13	Lock pin pulling out switch			Travel control panel
14	Suspension switch			Travel control panel
15	Parking light switch			Travel control panel
16	Mirror extension / stowing switch			Travel control panel
17	Lighting switch			Column unit
18	Winker / hazard switch			Column unit
19	Exhaust brake switch			Column unit
20	Automatic stop release switch		When the key switch is turned on, automatic stop solenoid and jib automatic stop solenoid power is turned off.	
21	PTO SW		When contact point is turned on, the PTO operates. (PTO relays A,B and C are magnetized.) NOTE:When interceptive lever is pushed down.	M / L

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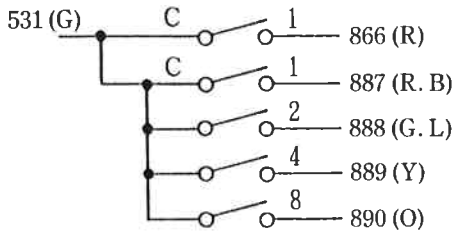
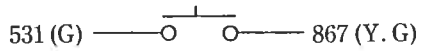
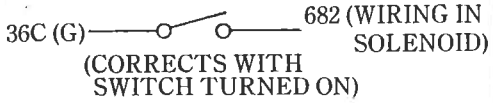
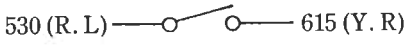
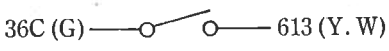
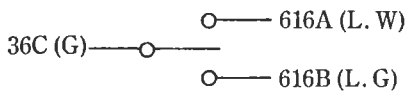
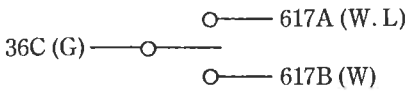
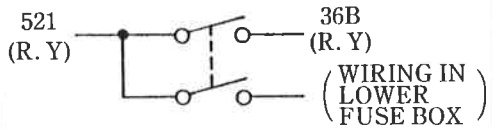
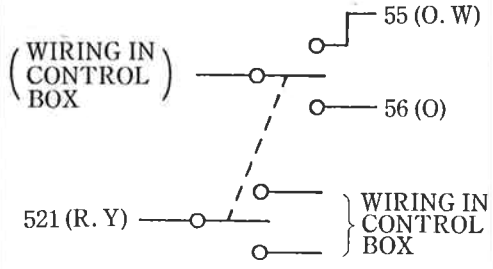
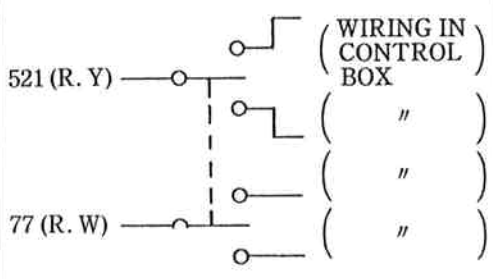
ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

SW No.	Name	Line Color / Circuit No.	Function	Remarks
22	Swing warning flasher switch		When the switch is turned on, the swing warning flasher relay power is supplied.	M / L
23	Worklight switch		When the point of contact for cab worklight, left guard worklight and boom worklight is turned on, lights light up, and built-in LED lights up.	M / L
24	Swing free switch		When the switch is turned on, the swing free solenoid is magnetized.	M / L
25	Overhoist release switch			M / L
26	Swing automatic stop release switch		When the switch is turned on, the swing pump control valve is magnetized.	M / L
27	Swing free switch (main winch)		When the switch is turned on, the swing free solenoid is magnetized.	Main winch lever
28	Swing free switch (auxiliary winch)		When the switch is turned on, the swing free solenoid is magnetized.	Auxiliary winch lever
29	Monitor indication selector switch			Monitor indication selector panel
30	Target setting switch			Monitor indication selector panel

Indication Pattern	531 (G)	852 (G)	851 (L. B)	850 (Br)	892 (Y. R)
Rear confirm camera	○				
Drum watch camera	○	○			
Swing capacity indicat.	○		○		
Capacity table indicat.	○	○	○		
Capacity curve indicat.	○			○	
Work area limit indicat.	○	○		○	
Target point indication	○		○	○	
Mach. inclin. indication	○	○	○	○	
	○				○
Left side watch camera	○	○			○

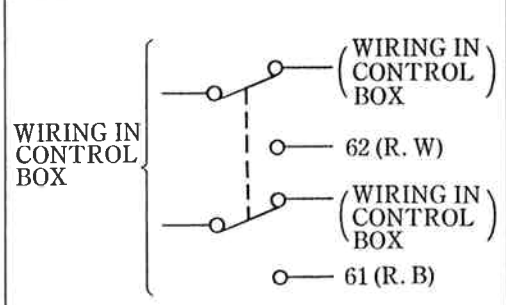
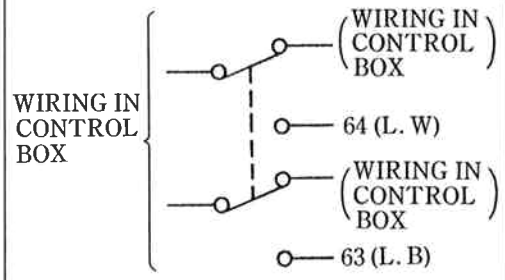
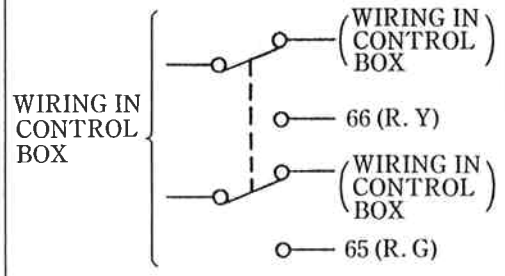
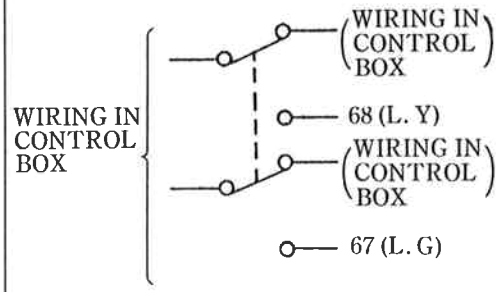
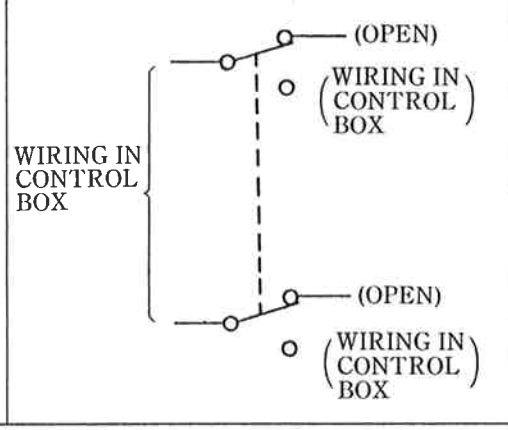
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

SW No.	Name	Line Color Circuit No.	Function	Remarks
31	Main winch reeving part no. setting switch			Monitor indication selector panel
32	Lifting height reset switch			Monitor indication selector panel
33	Telescope correcting switch		When the switch is turned on, the telescope correcting solenoid is magnetized.	45t only
34	Rotary lamp switch (optional)			
35	Tagline switch (optional)			
36	Hydraulic pressure source switch 1 (optional)			
37	Hydraulic pressure source switch 2 (optional)			
38	Emergency PTO switch		When the switch is turned on, the PTO governor solenoid is magnetized.	Lower fuse box
39	Lower outrigger extension / stowing selector switch		EXTENSION STOWING	Lower outrigger control box
40	Lower outrigger horizontal / vertical selector switch		IIORIZONTAL VERTICAL	Lower outrigger control box

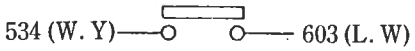
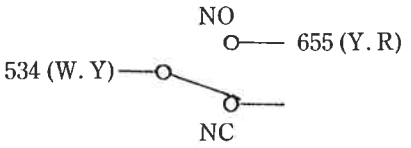
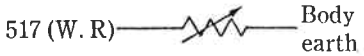
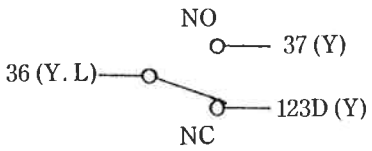
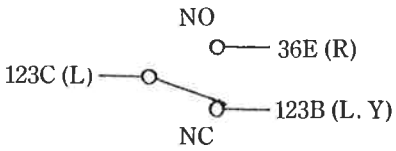
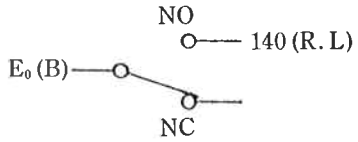
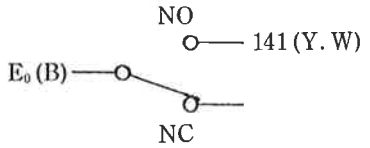
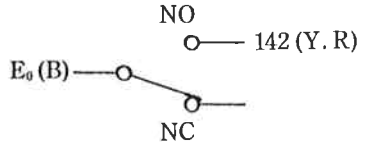
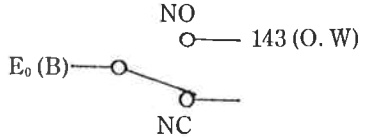
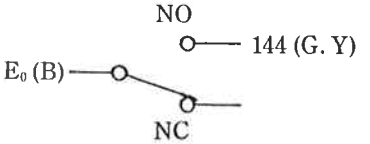
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SWITCHES)

SW No.	Name	Line Color Circuit No.	Function	Remarks
41	Lower outrigger left front switch		LEFT FRONT, HORIZONTAL LEFT FRONT, VERTICAL	Lower outrigger control box
42	Lower outrigger right front switch		RIGHT FRONT, HORIZONTAL RIGHT FRONT, VERTICAL	Lower outrigger control box
43	Lower outrigger left rear switch		LEFT REAR, HORIZONTAL LEFT REAR, VERTICAL	Lower outrigger control box
44	Lower outrigger right rear switch		RIGHT REAR, HORIZONTAL RIGHT REAR, VERTICAL	Lower outrigger control box
45	Lower all outrigger control switch		ALL HORIZONTAL ALL VERTICAL	Lower outrigger control box

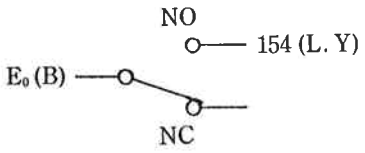
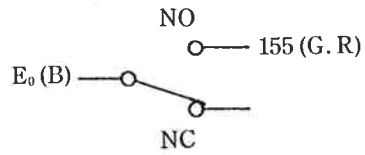
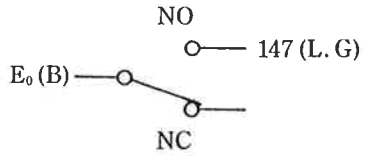
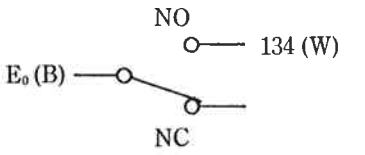
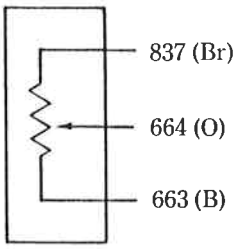
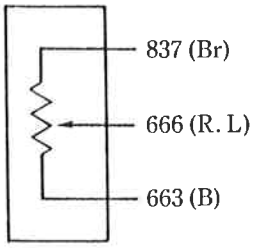
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5. 4 ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
1	Full accelerator switch			Contact point is turned on for full acceleration.
2	Swing lock pin limit switch			Contact point is turned on when lock pin is inserted (excluding 45t).
3	Air pressure sensor		For travel meter air pressure gauge	
4	Low air pressure warning switch		Alarm sounds and indicates for low air pressure	Contact point is turned on for lower than 5.5kg / ㎠ (78.2 psi) pressure.
5	Interceptive lever for on and off detecting limit switch		When NO contact point is turned on, ML operates. When NC contact point is turned on, automatic stop sol. is magnetized.	Contact point is turned on when interceptive lever is pushed down.
6	Jip up end limit switch		When NC contact point is turned on, jib automatic stop solenoid is magnetized	NC contact point is turned off with jib control lever up detent.
7	Boom up lever detecting limit switch			NO contact point is turned on with boom control lever up position.
8	Boom lower lever detecting limit switch			NO contact point is turned on with boom control lever down position.
9	Boom extension lever detecting limit switch			NO contact point is turned on with telescope lever in extension position.
10	Boom retraction lever detecting limit switch			NO contact point is turned on with telescope lever in retraction position.
11	Main winch lever detecting limit switch			NO contact point is turned on with main winch lever in up position.

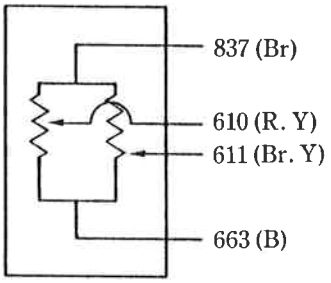
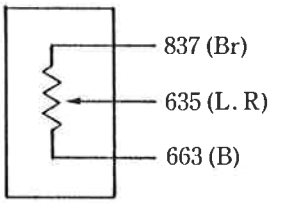
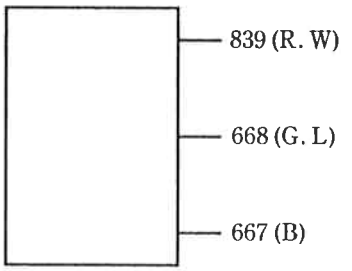
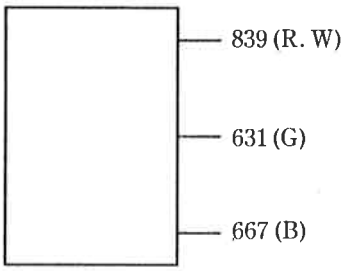
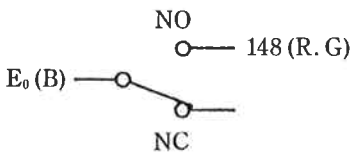
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
12	Auxiliary winch lever detecting limit switch			NO contact point is turned on with auxiliary winch lever in up position.
13	Jib up lever detecting limit switch			NO contact point is turned on with jib control lever in up position.
14	Jib down lever detecting limit switch			NO contact point is turned on with jib control lever in down position.
15	Telescope select lever detecting limit switch			NO contact point is turned on with telescope selector lever in lower side.
16	Clutch pressure switch		Alarm sounds for low crane clutch pressure	
17	Boom length detector		Length detector power (+12 volts) Length detector output signal Earth (0 volt)	All resistance 2KΩ (0.275V / m) Full retra. / Full exten. 25t: 0.3V / 6.16V (0.05KΩ) / (1.03KΩ) 35t: 0.3V / 7.35V (0.05KΩ) / (1.23KΩ) 45t: 0.3V / 8.0V (0.05KΩ) / (1.33KΩ)
18	Boom angle detector		Angle detector power (+12 volts) Angle detector output signal Earth (0 volt)	All resistance 1KΩ 0° 1.2V (100Ω) / 80° 10.8V (900Ω)

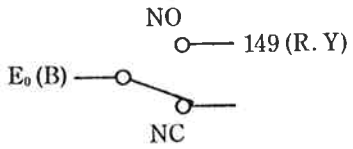
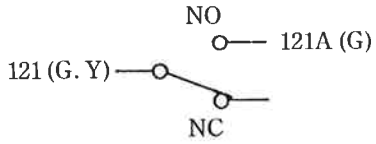
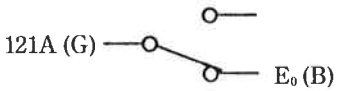
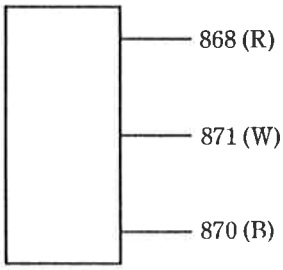
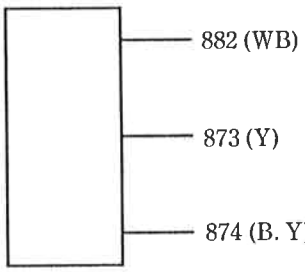
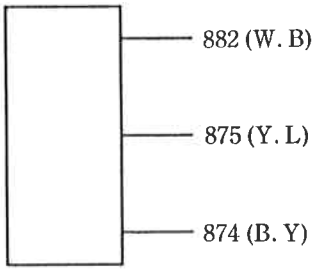
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

<table>
<tr><th>No.</th><th>Name</th><th>Circuit No.
Line Color</th><th>Function</th><th>Remarks</th></tr>
<tr><td>19</td><td>Swing angle detector</td><td> 
</td><td>Swing angle detector power (+12 volts)
Swing angle output signal A
Swing angle output signal B
Earth (0 volt)</td><td>All
resistance 5KΩ
<table>
<tr><th>Swing angle</th><th>Output A</th><th>Output B</th></tr>
<tr><td>0°
(Machine front)</td><td>Approx. 3V
(1.25KΩ)</td><td>Approx. 9V
(3.75KΩ)</td></tr>
<tr><td>180°
(Machine rear)</td><td>Approx. 9V
(3.75KΩ)</td><td>Approx. 3V
(1.25KΩ)</td></tr>
</table></td></tr>
<tr><td>20</td><td>Jib angle detector</td><td> 
</td><td>Jib angle detector power (+12 volts)
Jib angle detector signal
Earth (0 volt)</td><td><table>
<tr><th>Offset angle</th><th>Wire pulling out length</th><th>Output voltage</th></tr>
<tr><td>25t, 35t
3°
45t
5°</td><td>Approx.
53mm</td><td>Approx.
1.6V</td></tr>
<tr><td>45°</td><td>Approx.
739mm</td><td>Approx.
9.6V</td></tr>
</table></td></tr>
<tr><td>21</td><td>Pressure (head) pressure detector</td><td> 
</td><td>Pressure detector power (+24 volts)
Head pressure output signal
Earth (0 volt)</td><td>0.8V (0kg / cm²) ／ 12V (280kg / cm²)</td></tr>
<tr><td>22</td><td>Pressure (rod) pressure detector</td><td> 
</td><td>Pressure detector power (+24 volts)
Rod pressure output signal
Earth (0 volt)</td><td>0.8V (0kg / cm²) ／ 12V (280kg / cm²)</td></tr>
<tr><td>23</td><td>Left swing detecting limit switch</td><td> 
</td><td></td><td>NO contact point is turned on with swing control lever in left swing.</td></tr>
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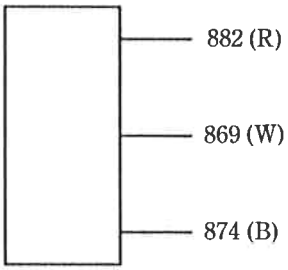
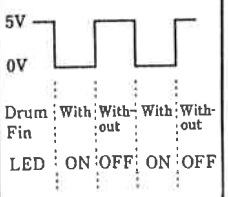
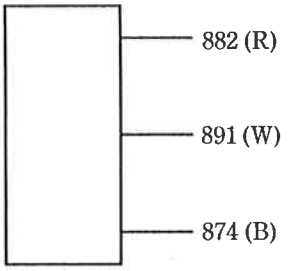
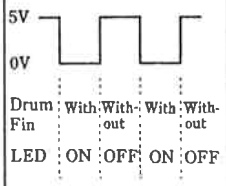
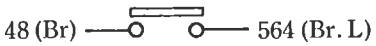
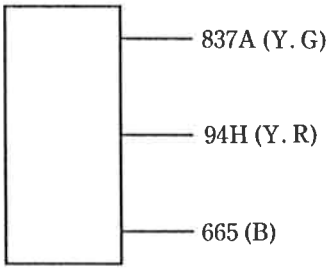
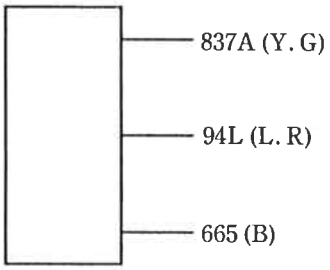
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
24	Right swing detecting limit switch			NO contact point is turned on with swing control lever in right swing.
25	Overhoist limit switch (main winch)			NC contact point is turned off when main winch hook is overhoisted.
26	Overhoist limit switch (auxiliary winch)			NC contact point is turned off when auxiliary winch hook is overhoisted.
27	Swing angular speed sensor		Swing angular speed power (+12 volts) Swing angular speed sensor signal Earth (0 volt)	Sensor output 12 pulses / 1 revolution Output wave shape 
28	Left swing pressure detector		Swing pressure detector power (+24 volts) Left swing pressure signal Earth (0 volt)	0V (0kg / cm²) / 5V (200kg / cm²)
29	Right swing pressure detector		Swing pressure detector power (+24 volts) Right swing pressure signal Earth (0 volt)	0V (0kg / cm²) / 5V (200kg / cm²)

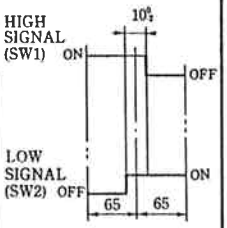
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
30	Main winch rope length sensor		Rope length sensor power (+24 volts) Main winch rope length signal Earth (0 volt)	With movement confirming LED attached. Output wave shape. 
31	Auxiliary winch rope length sensor		Rope length sensor power (+24 volts) Auxiliary winch rope length signal Earth (0 volt)	With movement confirming LED attached. Output wave shape. 
32	Exhaust brake limit switch		Contact point is turned on when acceleration is idling.	
33	Suspension level sensor (FLH)		Level sensor power (+24 volts) HIGH output signal (+24 volts / 0 volt) Earth (0 volt)	
34	Suspension level sensor (FLL)		Level sensor power (+24 volts) LOW output signal (+24 volts / 0 volt) Earth (0 volt)	

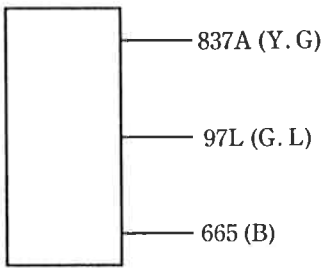
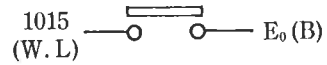
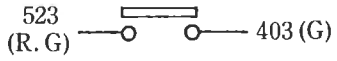
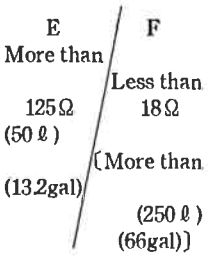
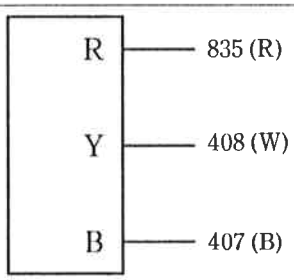
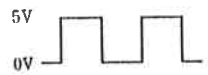
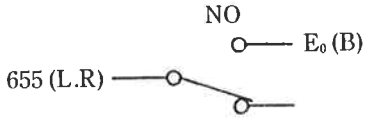
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
35	Suspension level sensor (FRH)	837B (L. Y) 95H (R. L) 665 (B)	Level sensor power (+24 volts) IIIGII output signal (+24 volts / 0 volt) Earth (0 volt)	Suspension Level Sensor Movement 
36	Suspension level sensor (FRL)	837B (L. Y) 95L (R. W) 665 (B)	Level sensor power (+24 volts) LOW output signal (+24 volts / 0 volt) Earth (0 volt)	
37	Suspension level sensor (RLH)	837B (L. Y) 96H (L) 665 (B)	Level sensor power (+24 volts) IIIGII output signal (+24 volts / 0 volt) Earth (0 volt)	
38	Suspension level sensor (RLL)	837B (L. Y) 96L (Y) 665 (B)	Level sensor power (+24 volts) LOW output signal (+24 volts / 0 volt) Earth (0 volt)	
39	Suspension level sensor (RRH)	837A (Y. G) 97H (G. W) 665 (B)	Level sensor power (+24 volts) IIIGII output signal (+24 volts / 0 volt) Earth (0 volt)	

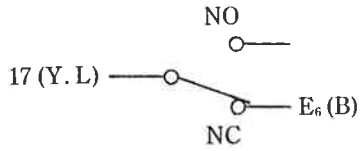
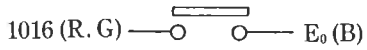
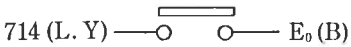
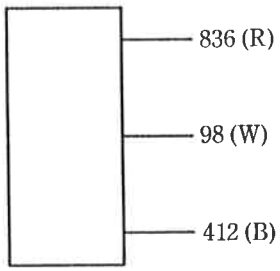
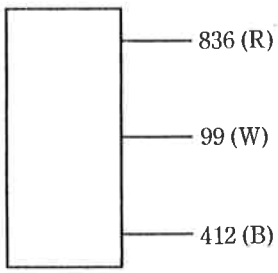
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

No.	Name	Circuit No. Line Color	Function	Remarks
40	Suspension level sensor (RRL)		Level sensor power (+24 volts) LOW output signal (+24 volts / 0 volt) Earth (0 volt)	
41	Strong brake switch			35t and 45t only. Contact point is turned on for pressure higher than 1.5kg / cm² (21.3psi).
42	Brake lamp pressure switch		Contact point is turned on when brake is applied	Contact point is turned on for pressure higher than 0.5kg / cm² (7.1psi).
43	Fuel sensor		Travel meter fuel gauge	
44	Engine water temperature sensor		Travel meter water temperature gauge	80±10Ω for 50℃ (122° F) of water temperature
45	Torque converter oil temperature sensor		Travel meter torque converter oil temperature gauge	80±10Ω for 50℃ (122°F) of oil temperature
46	Speed sensor		Sensor power (+12 volts) Sensor output (pulse) Earth (0 volt)	Sensor output 12 pulses / 1 revolution Output wave shape 
47	Swing lock pin limit switch		Contact point is turned on when lock pin is inserted	45t only

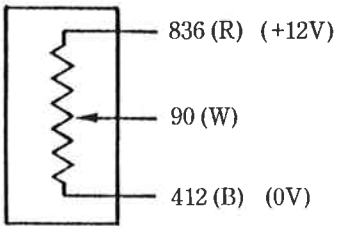
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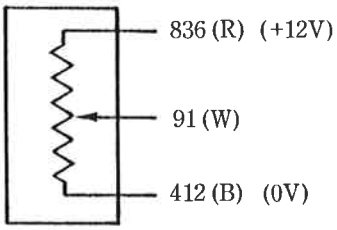
ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

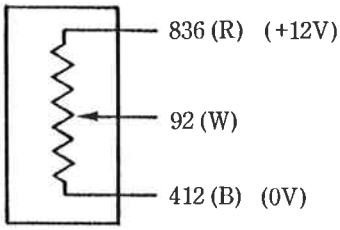
No.	Name	Circuit No. Line Color	Function	Remarks
48	Rear wheel neutral detecting limit switch		Contact point is turned on when rear wheels are not neutral. Travel meter warning lamp	
49	Brake oil level sensor (front)		Travel meter brake oil indicator. When contact point is turned on, this lamp lights up. Travel meter warning lamp	Brake oil reservoir tank. Contact point is turned on for low oil level.
50	Brake oil level sensor (rear)		Travel meter brake oil indicator. When contact point is turned on, this lamp lights up. Travel meter warning lamp	Brake oil reservoir tank. Contact point is turned on for low oil level.
51	Transmission oil pressure switch		Contact point is turned on for low pressure. Travel meter warning lamp	Contact point is turned on for pressure lower than 4.0kg / cm² (56.88psi).
52	Transmission filter clogging sensor		Contact point is turned on for clogging. Travel meter warning lamp	Contact point is turned on for pressure higher than 2.8kg / cm² (39.82psi).
53	Hydraulic oil temperature sensor			Contact point is turned on for temperature higher than 90℃ (194°F).
54	Inclination sensor (Fore-aft)		Sensor power (+12 volts) Sensor output Earth (0 volt)	Incline angle / Output voltage To rear 2° ⇨+5V 0° ⇨+3V To front 2° ⇨+1V
55	Inclination sensor (Left-right)		Sensor power (+12 volts) Sensor output Earth (0 volt)	Incline angle / Output voltage To left 2° ⇨+5V 0° ⇨+3V To right 2° ⇨+1V

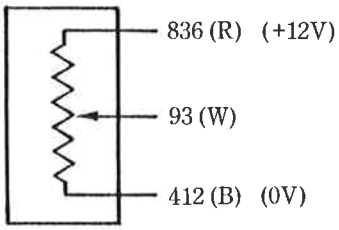
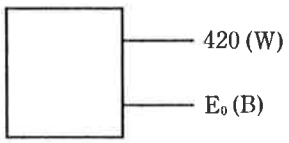
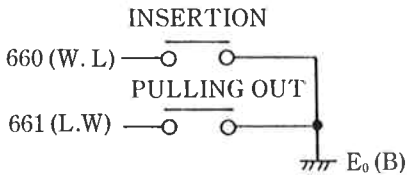
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ELECTRICAL PARTS CLASSIFICATION FOR USE (SENSORS)

<table>
<tr><th>No.</th><th>Name</th><th>Circuit No.
Line Color</th><th>Function</th><th>Remarks</th></tr>
<tr><td>56</td><td>Outrigger length detector (left front)</td><td rowspan="4"> 





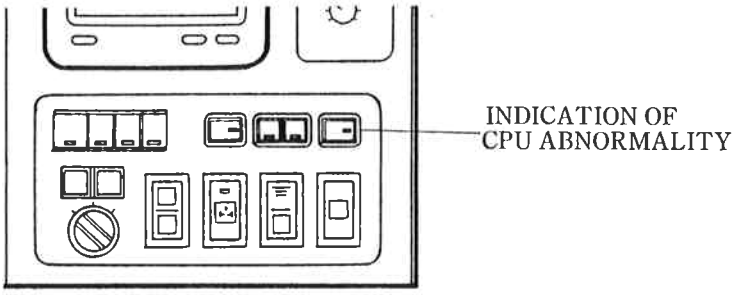

</td><td rowspan="4">Sensor Output Voltage
(common to H-type and X-type)
<table><tr><th>Outrigger condition / Model</th><th>Minimum extension</th><th>Maximum extension</th></tr><tr><td>25t</td><td>Approx. 1.2V</td><td>Approx. 9.0V</td></tr><tr><td>35t</td><td>Approx. 1.2V</td><td>Approx. 10.0V</td></tr><tr><td>45t</td><td>Approx. 1.2V</td><td>Approx. 10.6V</td></tr></table>
Resistance Value between
Sensor Output and Earth
(common to H-type and X-type)
<table><tr><th>Outrigger condition / Model</th><th>Minimum extension</th><th>Maximum extension</th></tr><tr><td>25t</td><td rowspan="3">Approx. 0.5K Ω</td><td>Approx. 3.8K Ω</td></tr><tr><td>35t</td><td>Approx. 4.0K Ω</td></tr><tr><td>45t</td><td>Approx. 4.3K Ω</td></tr></table>
All resistance:5K Ω
(common to H-type and X-type of Each Mode)</td><td rowspan="4"></td></tr>
<tr><td>57</td><td>Outrigger length detector (right front)</td></tr>
<tr><td>58</td><td>Outrigger length detector (left rear)</td></tr>
<tr><td>59</td><td>Outrigger length detector (right rear)</td></tr>
<tr><td>60</td><td>Radiator water level warning sensor</td><td> 
</td><td>Travel meter warning lamp</td><td></td></tr>
<tr><td>61</td><td>Steering lock pin detecting sensor</td><td> 
</td><td>Lead switch with movement indication attached</td><td></td></tr>
<tr><td>62</td><td>Engine revolution sensor</td><td> 
</td><td></td><td>Internal resistance 2.3K Ω
3 pulses /
1 revolution</td></tr>
</table>

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6. TROUBLESHOOTING

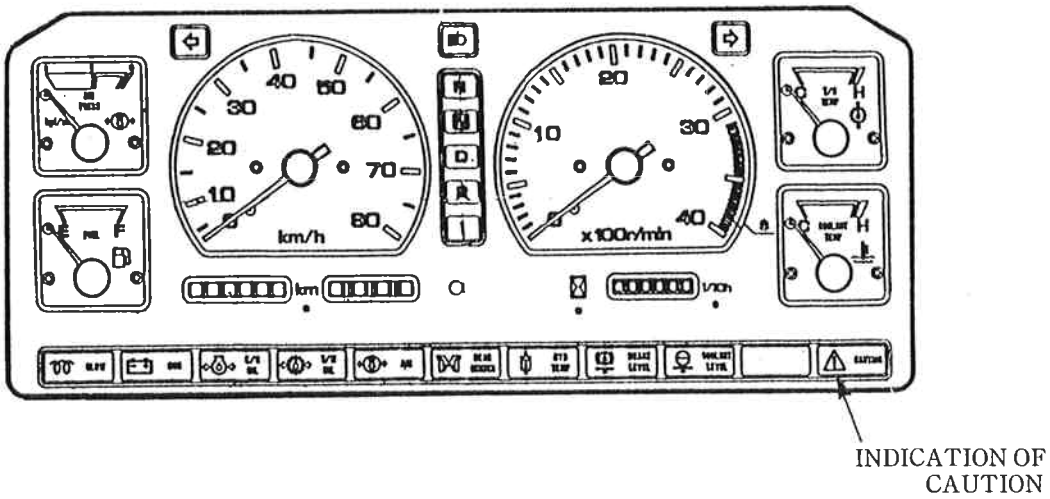
The following functions are provided as functions for troubleshooting in this electrical system.

Function of Diagnosis	Contents
CPU abnormality indicating function	When the multiplex data transmission unit operation has been abnormal, the CPU abnormality indicator lamp on the travel control panel indicates abnormality. Besides, the error code is indicated on the error code indicator in the upper multiplex data transmission unit.
Caution indicating function	When abnormality occurs in the suspension level sensor, outrigger length meter and multiplex data transmission unit, this indicator goes on and off. Besides, the error code is indicated on the error code indicator in the upper multiplex data transmission unit.
Error code indicating function	When abnormality occurs in the multiplex data transmission unit, suspension level sensor and outrigger length meter, the error code is indicated in the error code indicator in the upper multiplex data transmission unit.
Input / output signal indicating function	The input / output signals are indicated in the upper and lower multiplex data transmit units and lower outrigger control box.

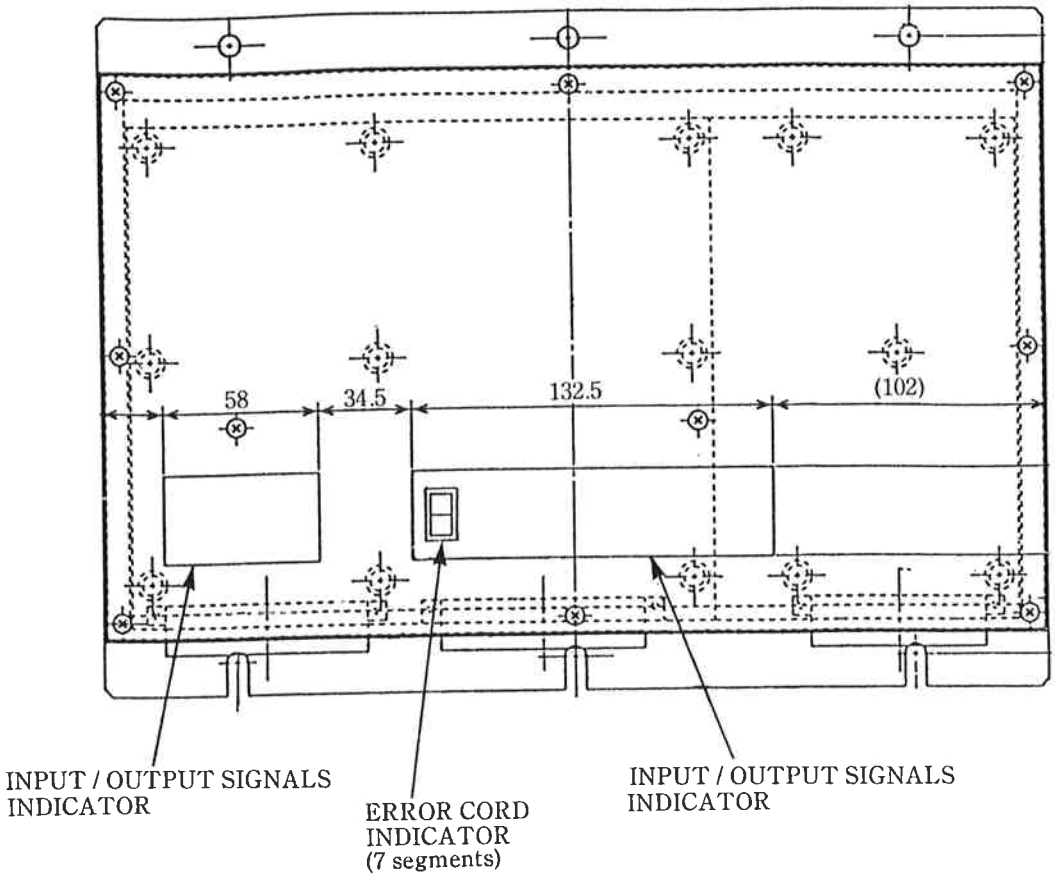


TRAVEL CONTROL PANEL

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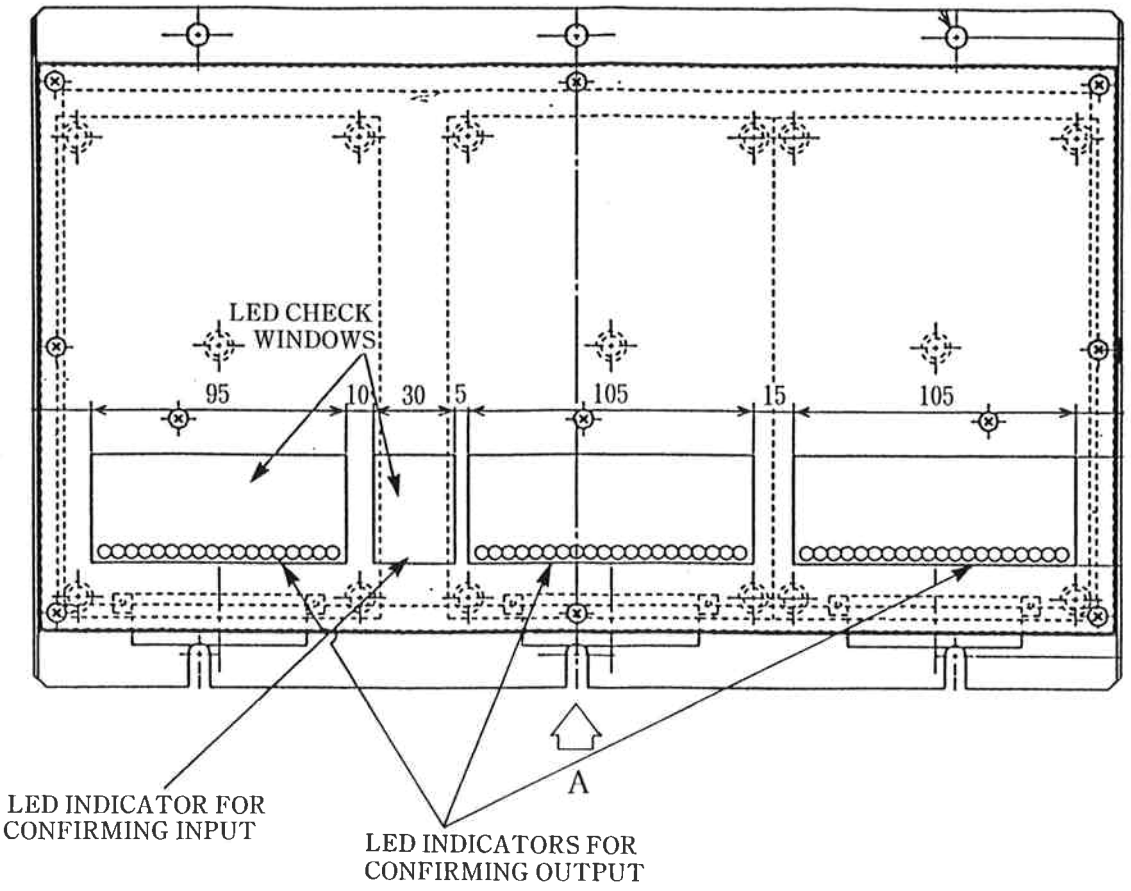


TRAVEL METER

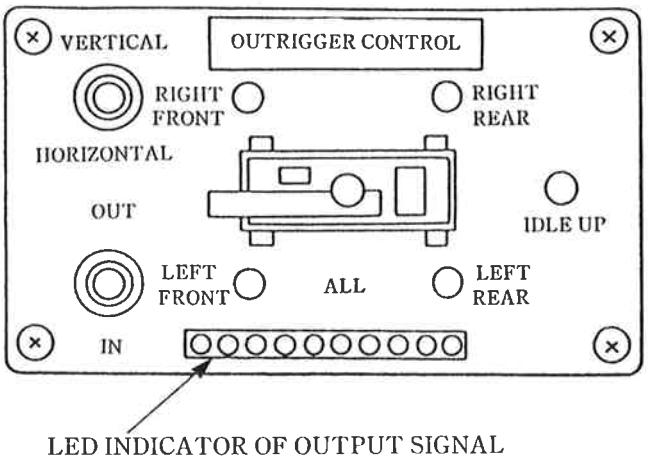


UPPER MULIPLEX DATA TRANSMISSION UNIT

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LOWER MULTIPLEX DATA TRANSMISSION UNIT



			FRONT				REAR				
Outrigger	○	○	○	○	○	○	○	○	○	○	○
H-type	Extension	Stowing	Left Horz.	Right Vert.	Right Horz.	Left Vert.	Left Horz.	Right Vert.	Right Horz.	Left Vert.	Idle up
X-type	Extension	Stowing	Left Horz.	Left Vert.	Right Horz.	Right Vert.	Left Horz.	Left Vert.	Right Horz.	Right Vert.	Idle up

LOWER OUTRIGGER CONTROL BOX

ERROR INDICATION

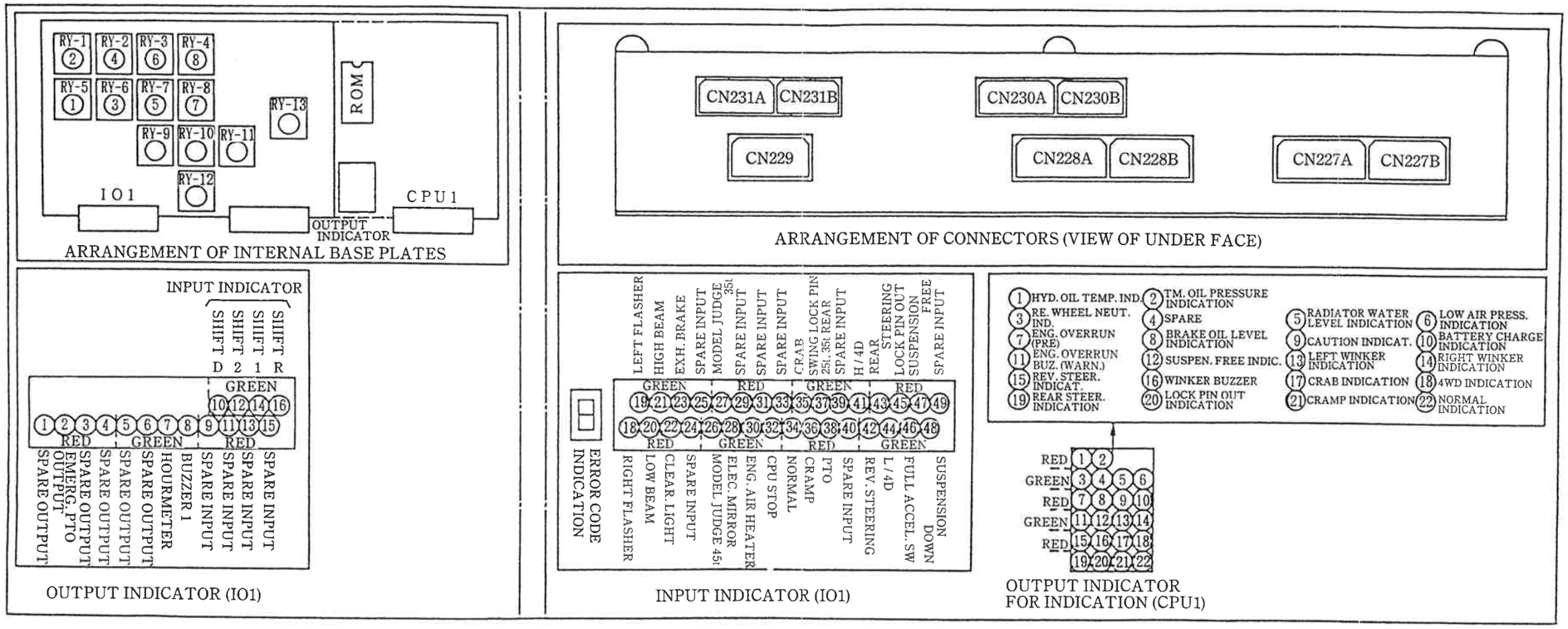
- The error indicator alters indication every one second.
- When plural error occur, indication begins from low number error in order. ○:lights, ☼:goes on and off (1 second cycle)

Contents of Indication				Item of Abnormality	Contents	Remarks
Caution indication	CPU lamp	Buzzer	Error indicator			
	○	○	E→0→1	Abnormal transmission (Upper MDT → Lower MDT	Transmission to lower MDT from upper MDT is off for more than 2 seconds.	
	○	○	E→1→0	Abnormal transmission (Lower MDT → Upper MDT	Transmission to upper MDT from lower MDT is off for more than 2 seconds.	
	○	○	C→0→1	Abnormal lower MDT output (Travel system)	Signal of travel system output of lower MDT differs more than 150 times for 3 seconds.	Judges only when PTO is off.
	○	○	C→0→2	Abnormal lower MDT output (Crane system)	Signal of crane system output of lower MDT differs more than 150 times for 3 seconds.	Judges only when PTO is on.
	○	○	C→0→3	Abnormal lower MDT output (Lighting system)	Signal of lighting system output of lower MDT differs more than 150 times for 3 seconds.	
			E→0→2	Abnormal transmission (Upper MDT → ML)	Transmission to ML from upper MDT is off for more than 2 seconds.	Judges only when PTO is on.
			E→2→0	Abnormal transmission (ML → Upper MDT)	Transmission to upper MDT from ML is off for more than 2 seconds.	Judges only when PTO is on.
☼			A→2→3	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:25t specification, lower:35t spec.)	
☼			A→2→4	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:25t specification, lower:45t spec.)	
☼			A→3→2	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:35t specification, lower:25t spec.)	
☼			A→3→4	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:35t specification, lower:45t spec.)	
☼			A→4→2	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:45t specification, lower:25t spec.)	
☼			A→4→3	Model judgments differ.	Upper / lower MDT model judgments differ. (Upper:45t specification, lower:35t spec.)	
☼ ※1			H→1	Left front high suspension level sensor abnormal.	Abnormal when off condition of both H signal and L signal continue for more than 2 seconds.	Judges only when PTO is off. ※1 Caution indicator indicates only when left front and right rear or right front and left rear are judged to be abnormal at the same time. (Error indicator indicates individually.)
☼ ※1			H→2	Right front high suspension level sensor abnormal.	Abnormal when off condition of both H signal and L signal continue for more than 2 seconds.	
☼ ※1			H→3	Left rear high suspension level sensor abnormal.	Abnormal when off condition of both H signal and L signal continue for more than 2 seconds.	
☼ ※1			H→4	Right rear high suspension level sensor abnormal.	Abnormal when off condition of both H signal and L signal continue for more than 2 seconds.	

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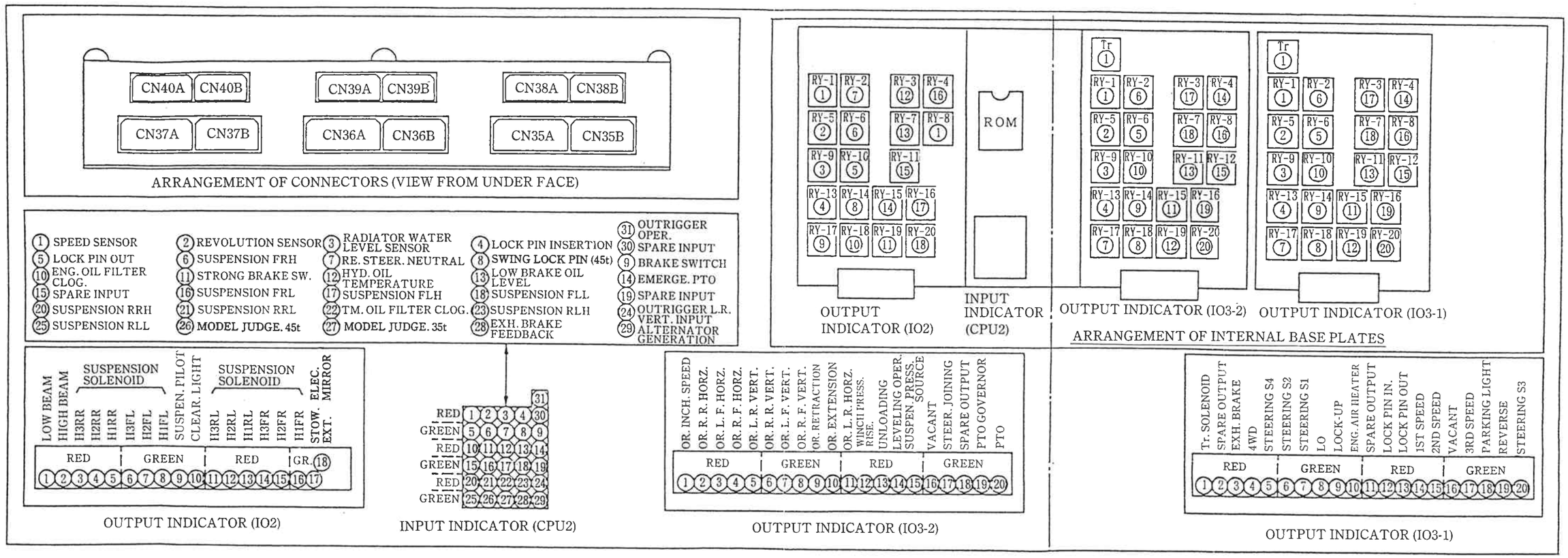
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CORRESPONDENCE FIGURE OF I / O (Input / Output) SIGNALS - LED LAMPS
(Including Arrangement of Connectors and Arrangement of Internal Base Plates)
(UPPER MULTIPLEX DATA TRANSMISSION UNIT)



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CORRESPONDENCE FIGURE OF I / O (Input / Output) SIGNALS - LED LAMPS
(Including Arrangement of Connectors and Internal Base Plates)
(LOWER MULTIPLEX DATA TRANSMISSION UNIT)



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1. CONSTRUCTION AND FUNCTION

1.1 OUTLINES OF SYSTEM

(1) Legal Regulation

・In order to prevent occurrence of accidents caused by overloading and hook overhoisting during crane operation, and to insure safety machines and persons related to crane work, installation of the load safety device (moment limiter) to crane function, and practical application and strict enforcement of check and maintenance by operators are obliged by the related laws and ordinances mentioned below in Japan.

	Related Laws and Ordinances
Installation and specification of load safety device.	Construction standard of mobile crane.
Prohibition of safety device release, and enforcement duty of periodical check and maintenance.	Safety rules for cranes and so on. (chapter 3)

(2) Basic Functions from Standpoints of Handling and Operation.

・The Outlines of the basic functions required for the moment limiter system are as follows :

- ○ Computation and indication of working postures and loading conditions.
- ○ Judgment of abnormalities such as overload, overhoist, boom telescope mistaking condition and so forth.
- ○ Outputs of warning alarms and automatic stop signals accompanied with the above.

(3) Functions added newly.

The following functions are newly added as compared with the old model (CCS11-type moment limiter) system in order to in sure further safety.

- ○ Automatically detecting function of the outrigger extended width.
- ○ Objective items of self diagnosis function.
- ○ Working area limiting function which regulates working range of attachments.
- ○ Data communicating function with swing automatic stop system.

Outlines of ML System Functions

- ○ Indication of working posture …… (boom condition, swing angle and outrigger extended width).
- ○ Setting operation and computation / indication of lifting capacity (rated load).
- ○ Computation / indication of lifting load (actual load).
- ○ Computation / indication of moment ratio and output indication of prenotice and warning alarms.
- ○ Judgment of overload, hook overhoist, boom telescope mistake and so on.
- ○ Output of automatic stop signal and warning alarm indication (including data communication with swing automatic stop system).
- ○ Working area limiting function.
- ○ Self diagnosis indicating function, and I / O (main sensor signal) check function.
- ○ Adjusting function.

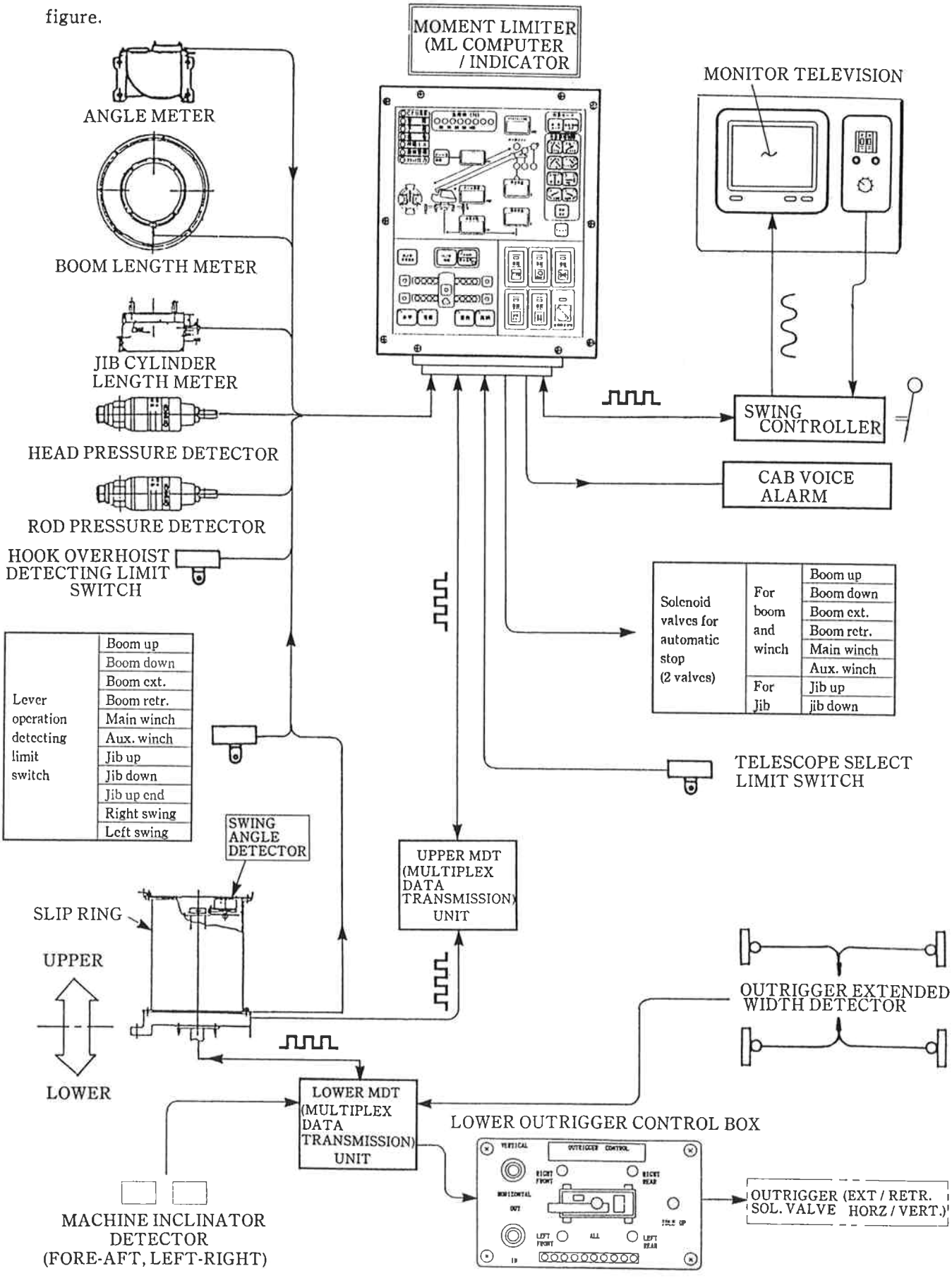
NOTE : For the details, see paragraph ML Computation / Indication Functions on page 1-12.

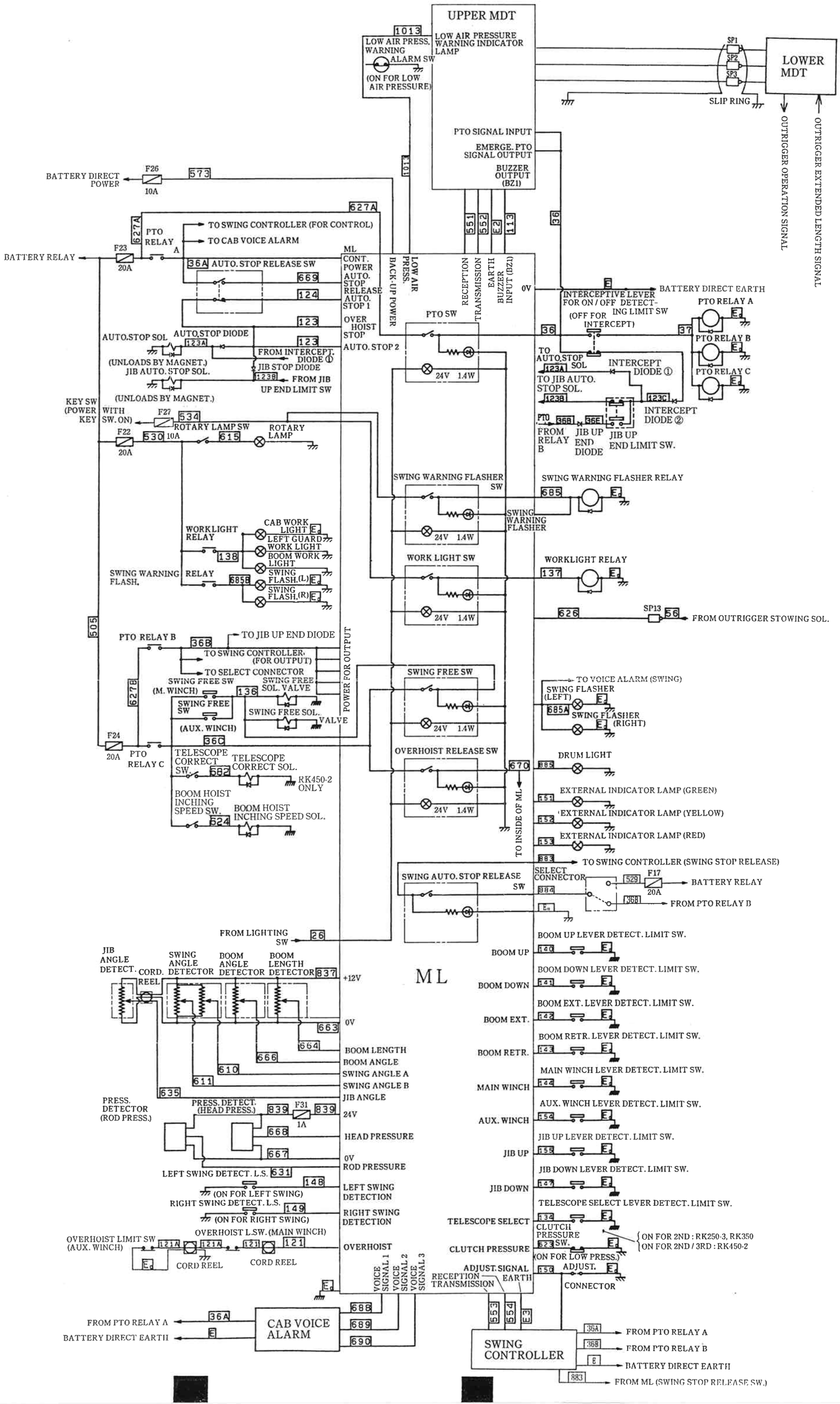
https://truckmanualshub.com/

1.2 ARRANGEMENT OF SYSTEM

(1) Outlines of ML System Arrangement

· Centering around the moment limiter (ML computer / indicator) unit, the moment limiter system is arranged as shown in the following figure.





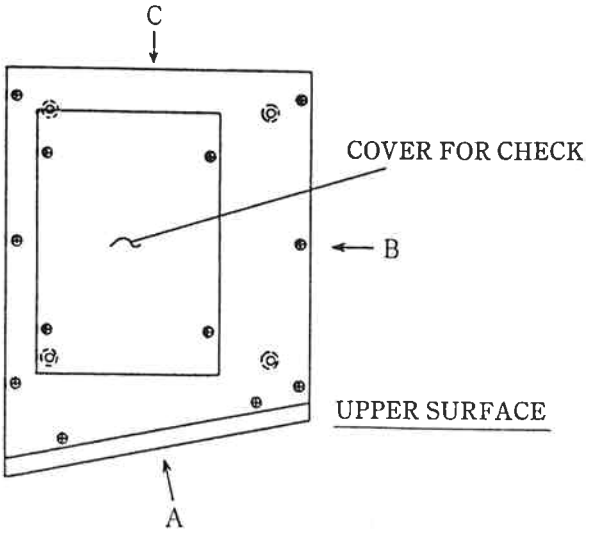
https://truckmanualshub.com/

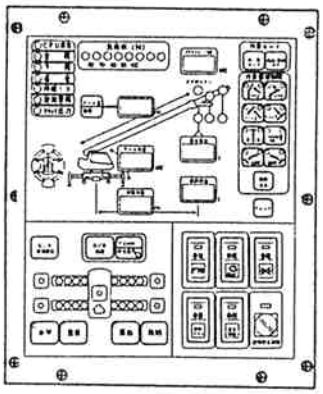
https://truckmanualshub.com/

1.3 CONSTRUCTION AND FUNCTION OF ML COMPUTER / INDICATOR

(1) CONSTRUCTION

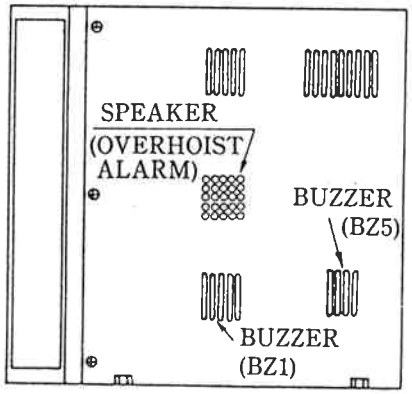
1) Outside View





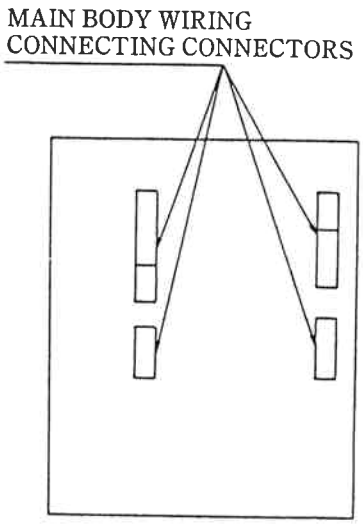
VIEW A

(PANEL FRONT)



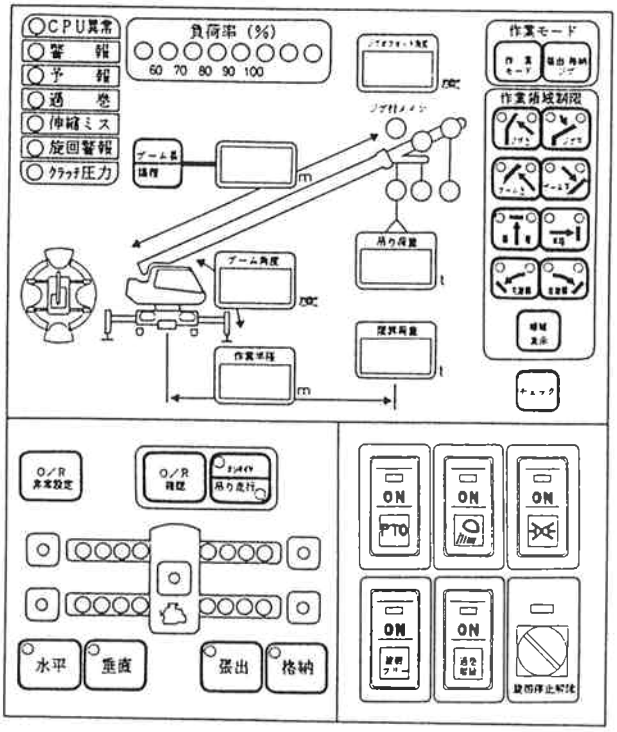
VIEW B

(RIGHT SIDE VIEW)

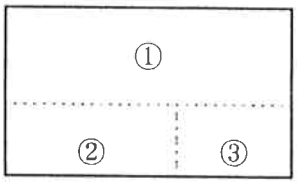


VIEW C

(BACK FACE)



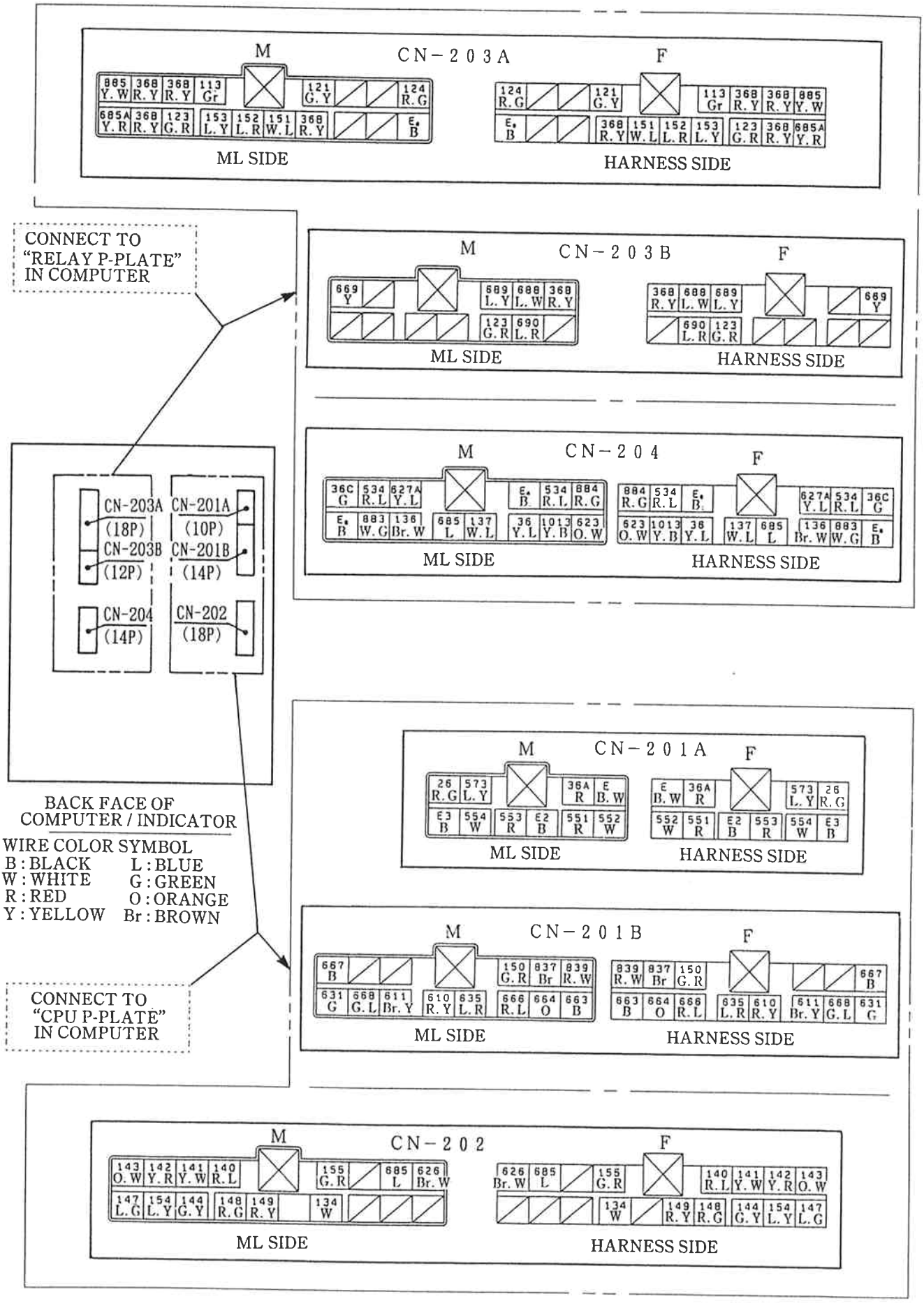
ARRANGEMENT OF PANEL



① CRANE CONDITION INDICATOR
② OUTRIGGER OPERATION INDICATOR
③ CRANE CONTROL SWITCHES

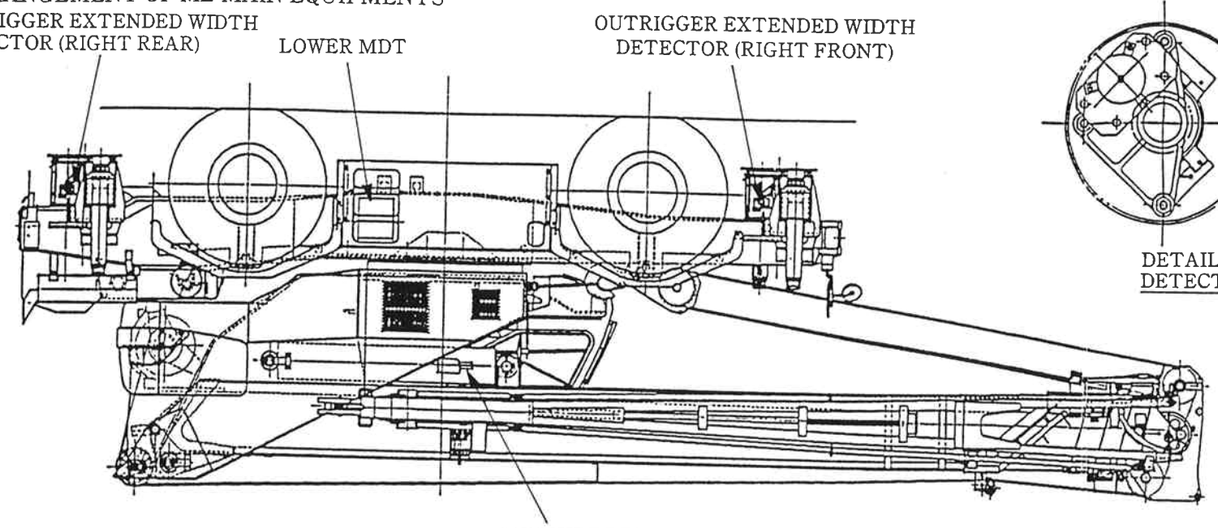
https://truckmanualshub.com/

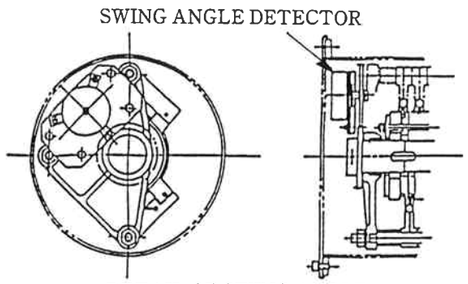
2) Details of Main Body Wiring Connecting Connectors



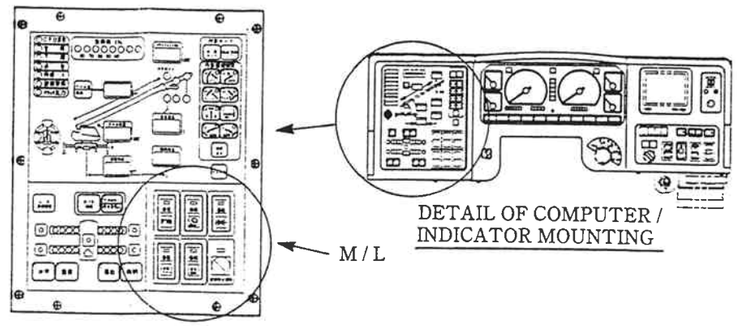
https://truckmanualshub.com/

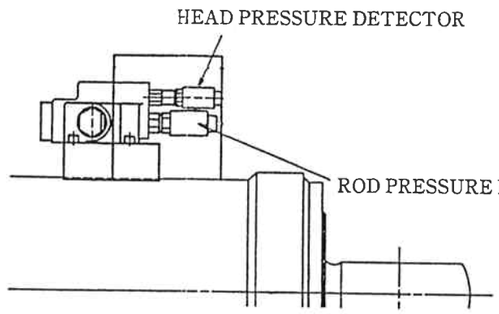
(2) ARRANGEMENT OF ML MAIN EQUIPMENTS



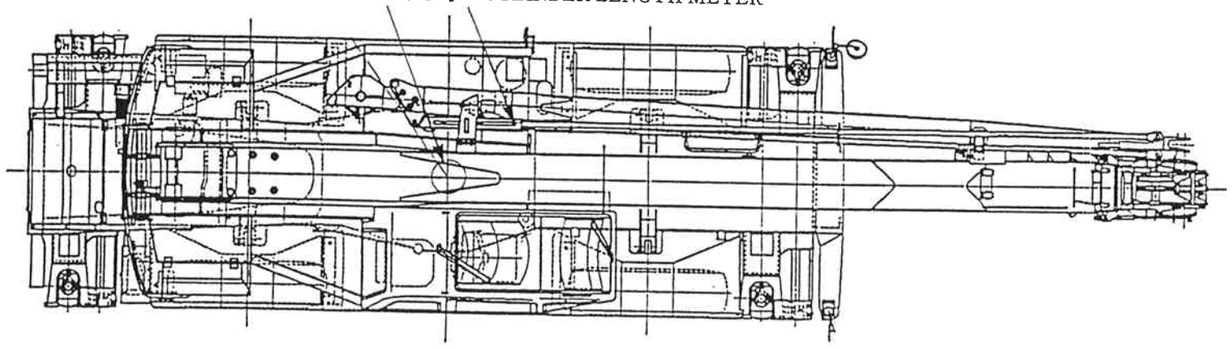


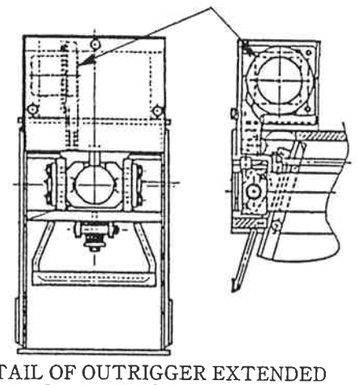
DETAIL OF SWING ANGLE DETECTOR MOUNTING



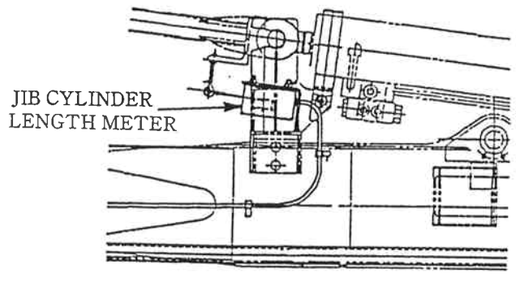


DETAIL OF PRESSURE (LOAD) DETECTOR MOUNTING

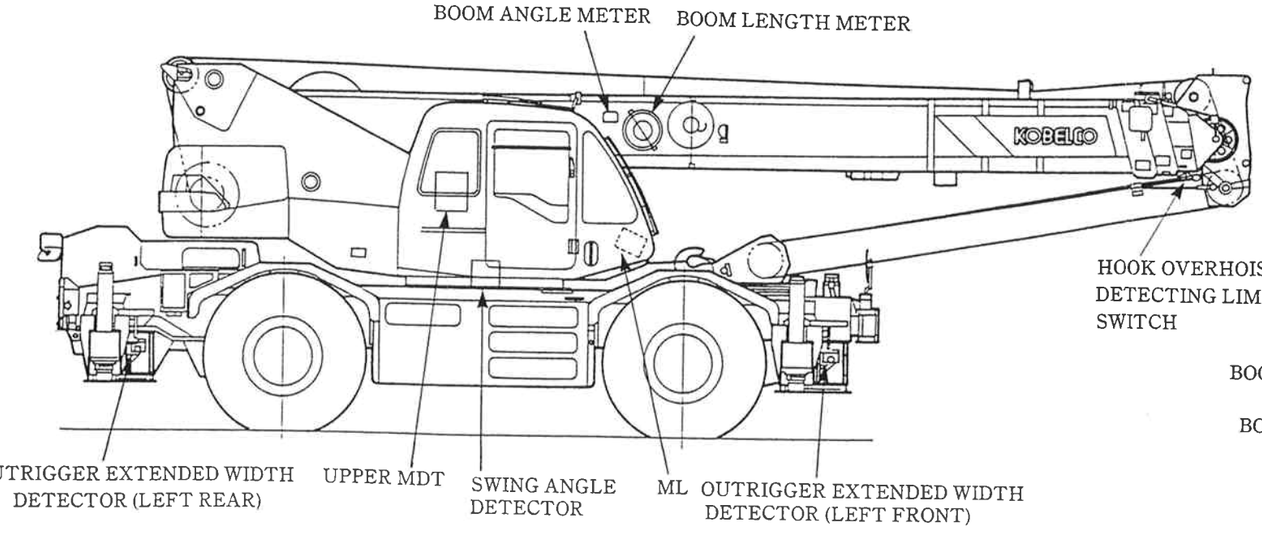


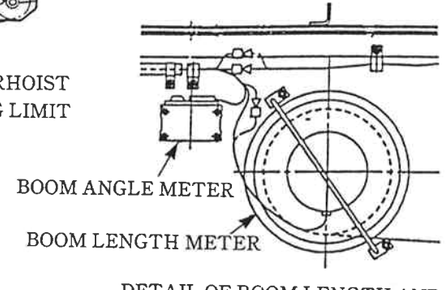


DETAIL OF OUTRIGGER EXTENDED LENGTH DETECTOR MOUNTING

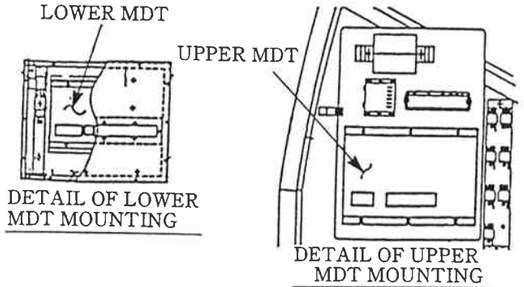


DETAIL OF JIB CYLINDER LENGTH DETECTOR MOUNTING





DETAIL OF BOOM LENGTH AND ANGLE DETECTORS MOUNTING

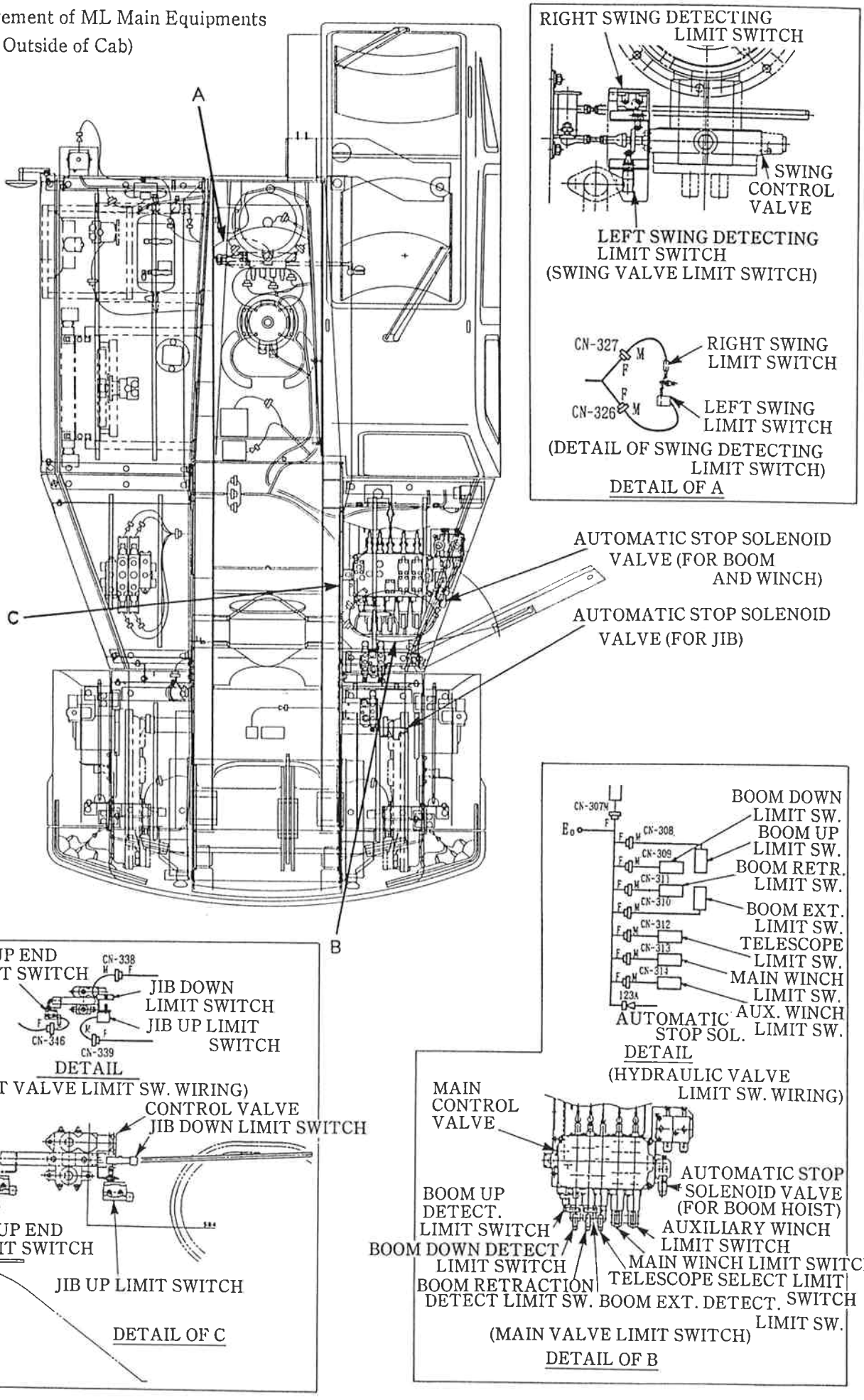


DETAIL OF LOWER MDT MOUNTING

DETAIL OF UPPER MDT MOUNTING

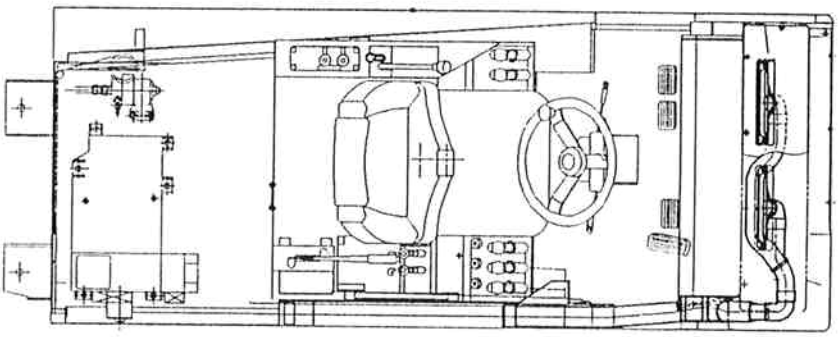
https://truckmanualshub.com/

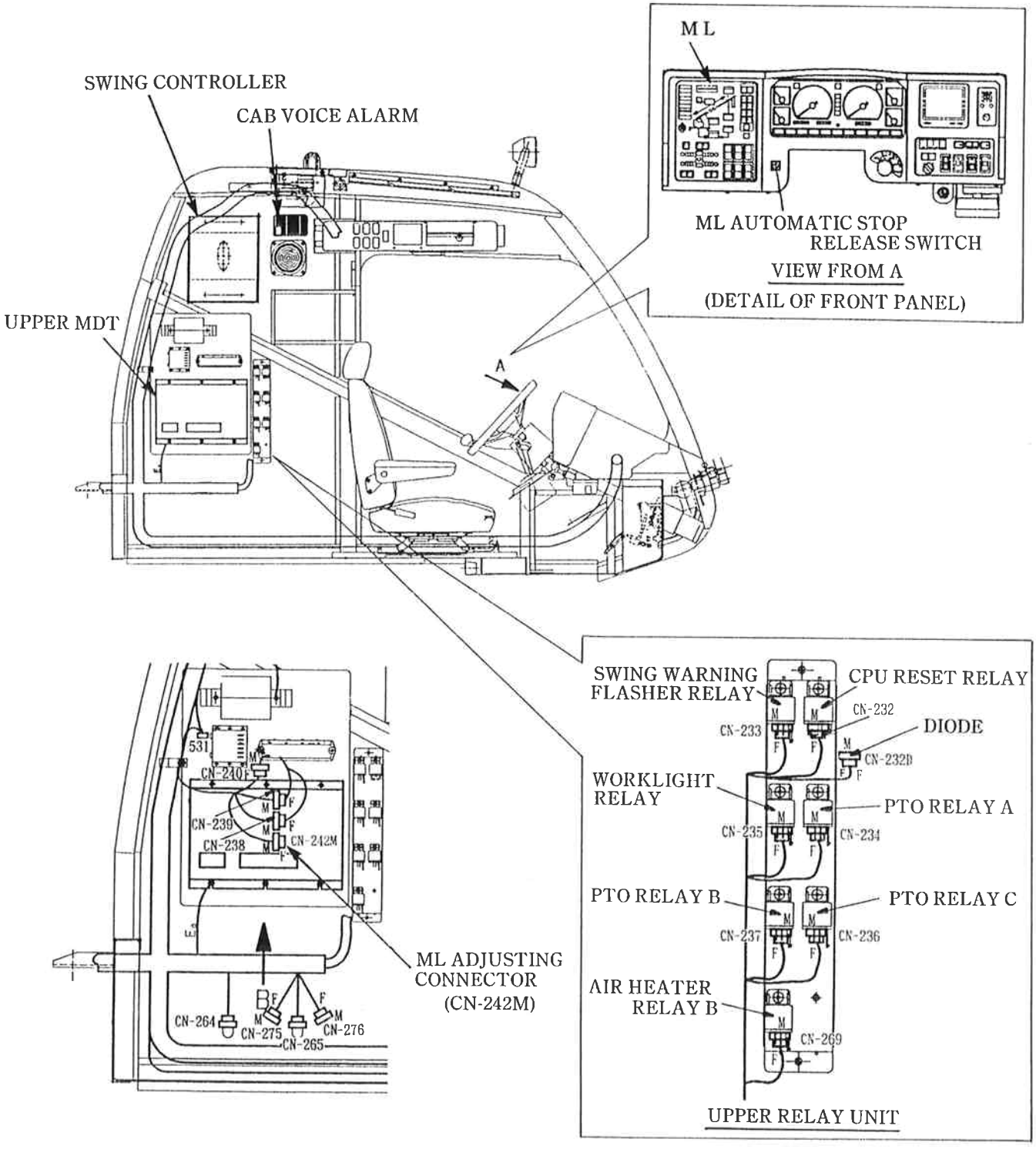
1) Arrangement of ML Main Equipments
(Upper Outside of Cab)



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2) Arrangement of ML Main Equipments (Inside Cab)

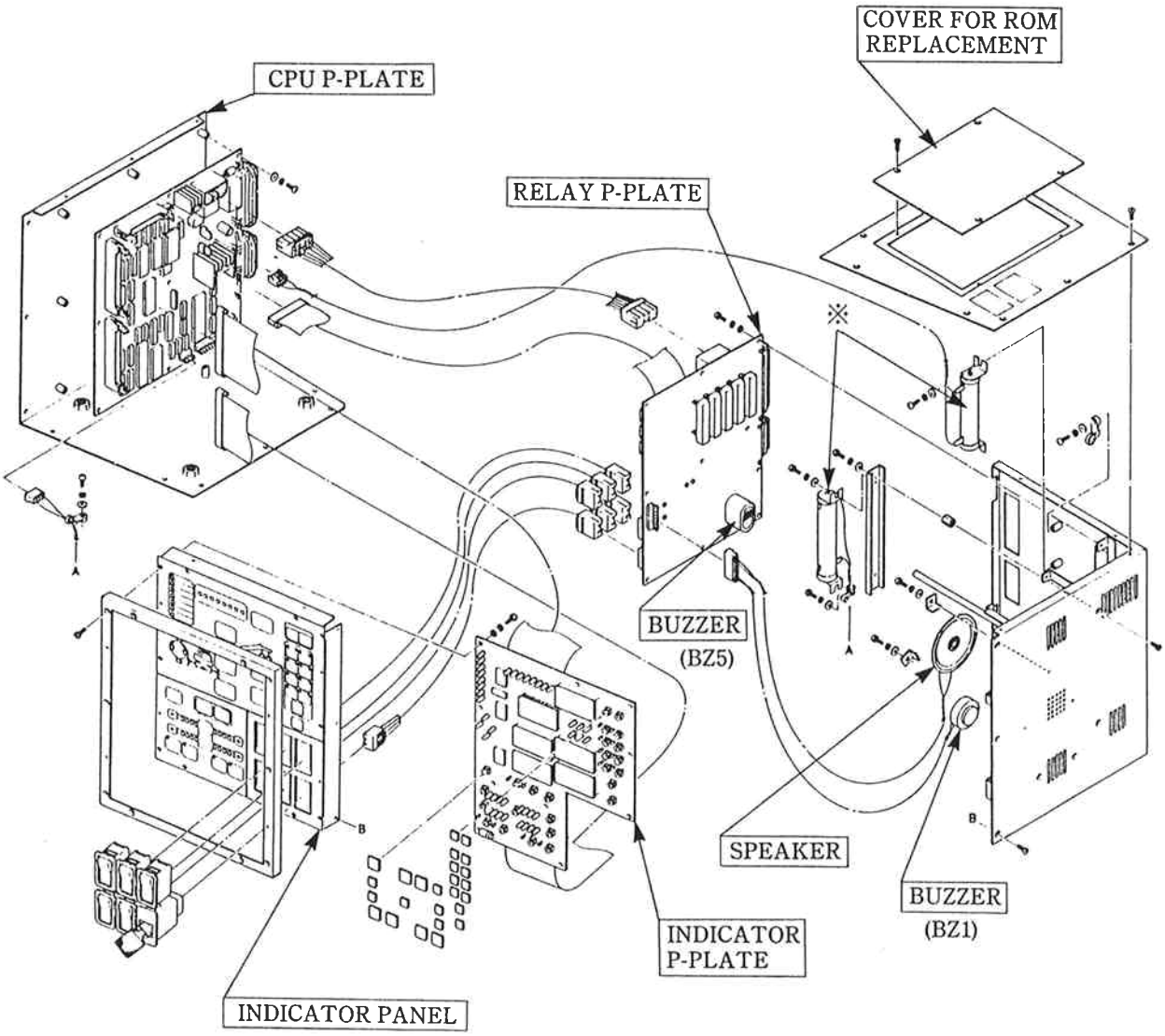




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(3) CONNECTING DIAGRAM OF INSIDE OF ML COMPUTER / INDICATOR

· The following figure shows the connecting diagram of the inside of the computer / indicator centering around P-plates (base plates).
This is for reference when replacing P-plates and small parts.



NOTE ※……RESISTANCE TO PROTECT SENSOR POWER

Connection in ML Computer / Indicator

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(4) ARRANGEMENT OF P-PLATES (IN ML COMPUTER / INDICATOR)

- The inside of the ML computer / indicator is composed of buzzers and lamps centering around the main three P-plates (CPU P-plate, relay P-plate and indicating P-plate).
  The shape and rough specification of the each P-plate (called base plate, too) are described as follows.

A. CPU P-PLATE ····· This plate is the central base plate to control this system

- The main parts of this base plate are as follows.

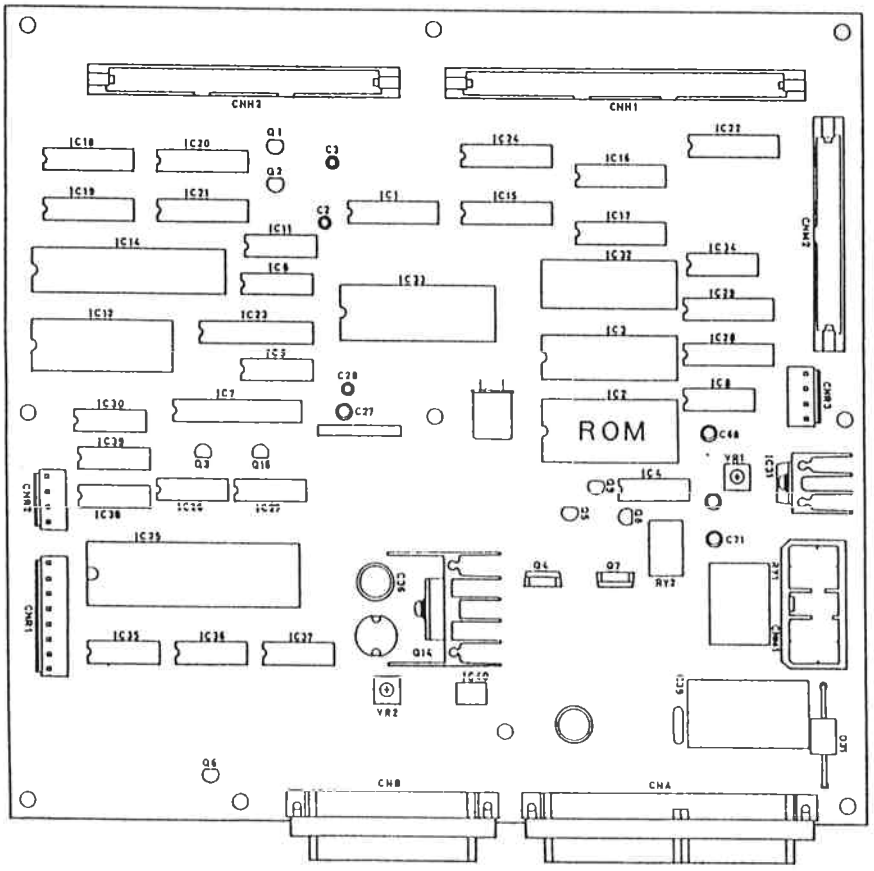
① Constant Voltage Generating Function :
Basing on input voltage from the PTO switch, this base plate generates and supplies the constant voltage required for this system drive.

Constant Voltage	Use	Adjusting Volume
+5 volts	Power voltage for driving the IC on the each P-plate	VR-2
+12 volts	Power voltage for the detectors of boom angle, boom extended length and swing angle, etc.	VR-1

② CPU Function :
Basing on rated load curve and driving soft data, this plate controls the outputs of computation, automatic stop, warning alarm or working condition indication, etc.

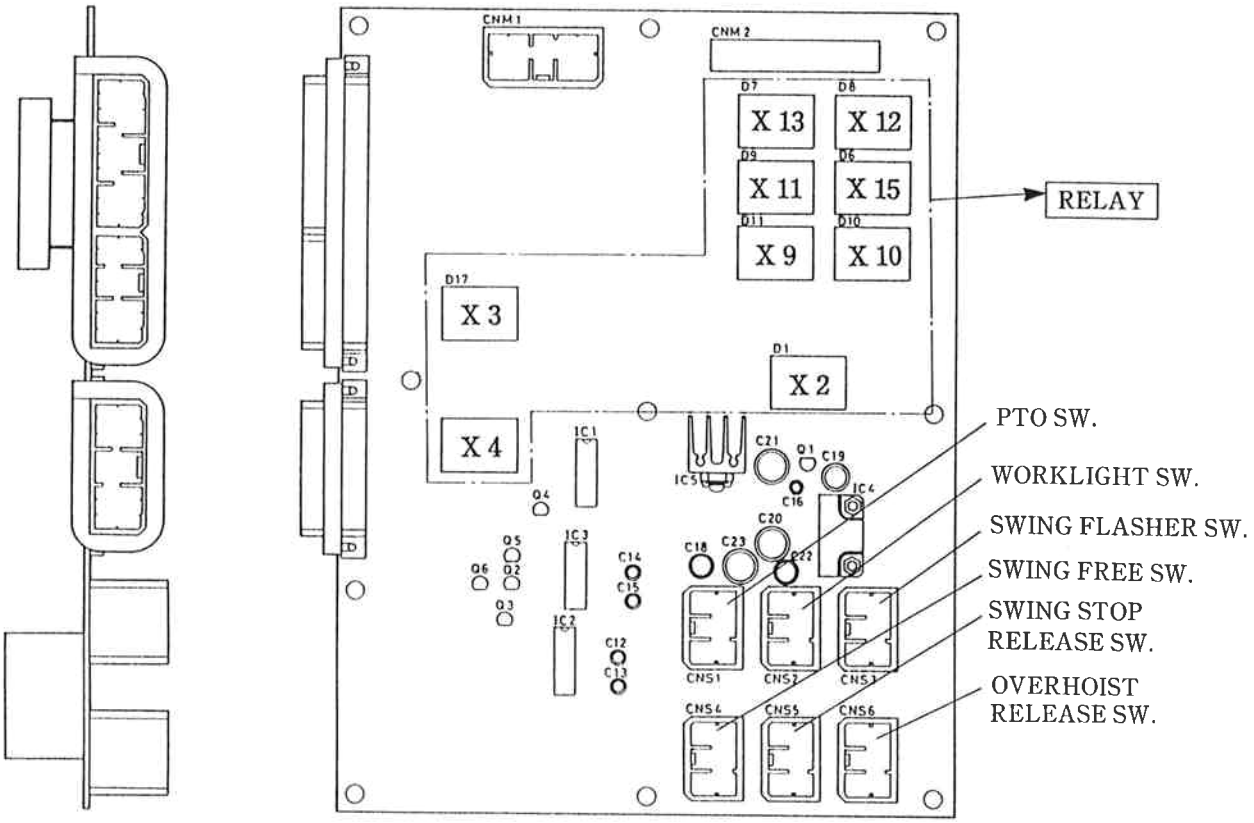
③ I / O Function :
This plate plays the part of gates for input / output such as input signal from the outside (switch signal and sensor signal, etc.), input signal from the switches on the computer / indicator panel, output toward the outside and so on, according to the various input data variation.

④ Adjusting Function and Troubleshooting : See page 5-1 and page 6-1.

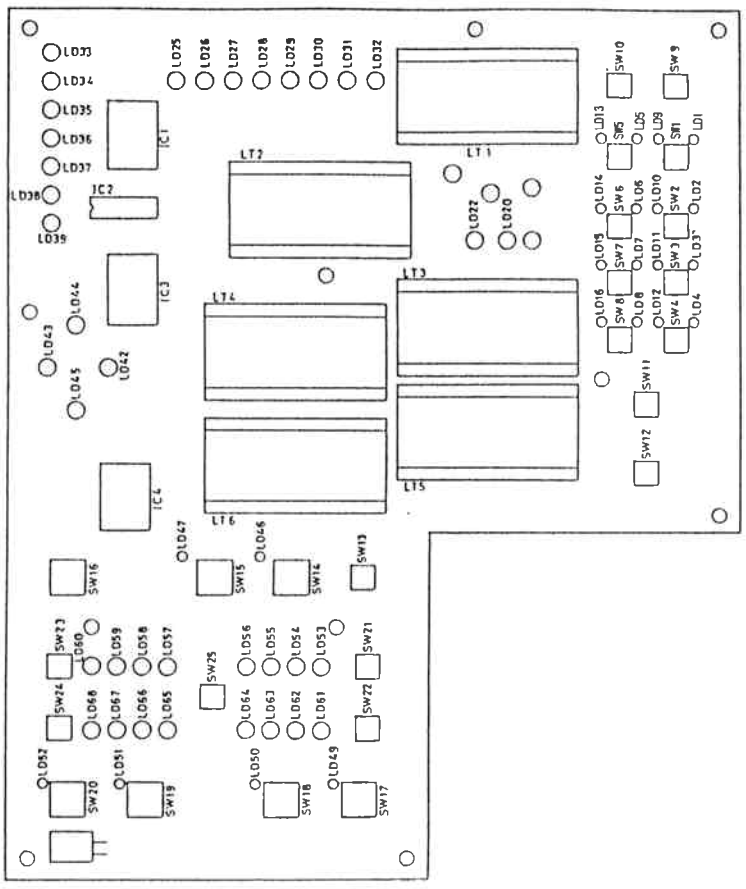


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B. RELAY P-PLATE ····· Basing on signals from the CPU P-plate, this puts out crane movement stop output and warning alarm output.



C. INDICATING P-PLATE ····· Basing on indicating signal from the CPU P-plate, this indicates loaded condition of crane operation and so on.

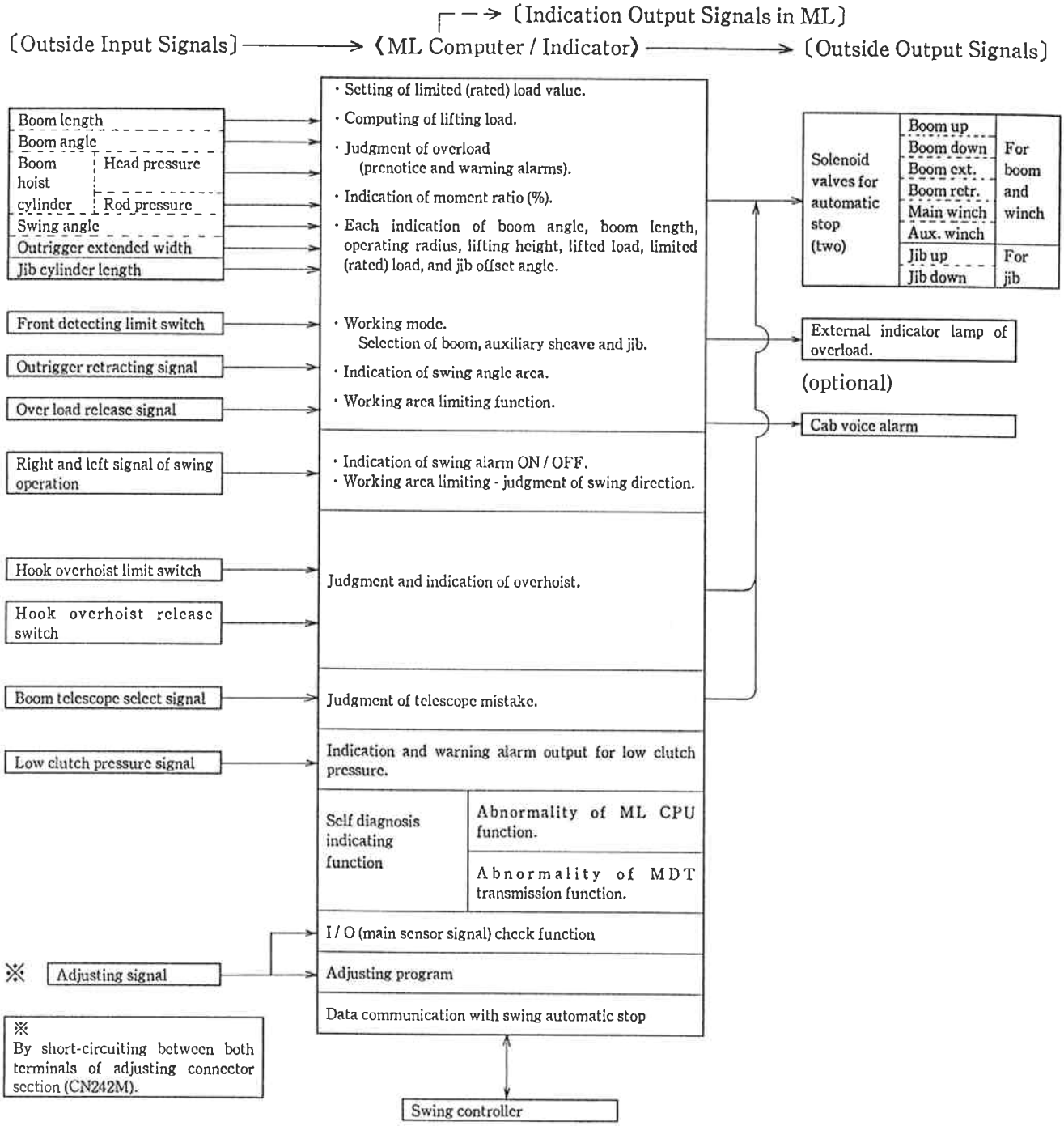


X 2 : OVERHOIST
X 3 : AUTOMATIC STOP (OVERLOAD)
X 4 : OVERHOIST STOP
X 9 : GREEN LAMP
X 10 : YELLOW LAMP
X 11 : RED LAMP
X 12 : AUTOMATIC STOP 2
X 13 : SWING ALARM FLASHER
X 15 : DRUM LIGHT OUTPUT

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(5) COMPUTATION AND INDICATION FUNCTIONS OF ML

The following figure shows each input / output signals related to the ML computer / indicator and relation of computation and indication functions operated in this unit.



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2. CONSTRUCTION AND FUNCTION OF EACH DETECTOR

2.1 ANGLE DETECTOR

(1) CONSTRUCTION

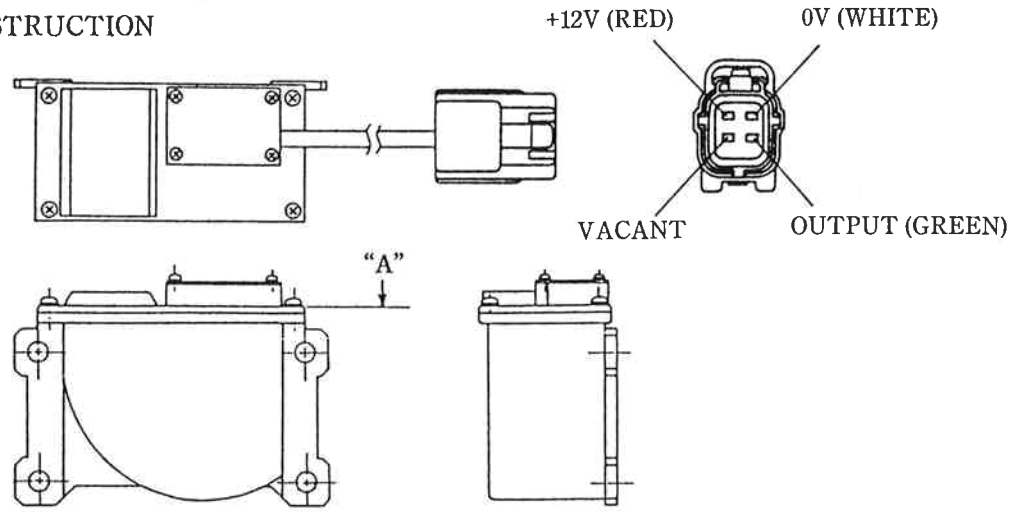


Fig. 2-1

(2) PRINCIPLE OF FUNCTION

This detector comprises a variable resistor housed in a case filled with oil, and angle of the boom from the ground. The principle of function is explained by Fig. 2-2 ; the flange shaft is fitted with a weight and when the unit assembly is vertically fitted onto the boom and voltage is applied to the variable resistor, the brush moves in the direction of the arrow as the boom angle increases ; voltage corresponding to the increase in voltage at the output terminal is output.

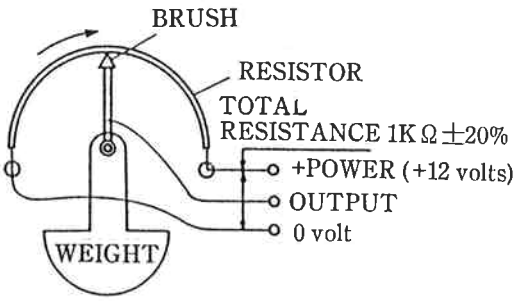


Fig. 2-2 Rough Construction of Boom Angle Detector Inside.

(3) INSTALLATION

1) Confirm that the machine is set horizontally with the monitor in the operator's room.

2) Retract the boom fully, and set it horizontally. Place a level (measurement precision must be better than ±0.5°) on the top face of the base boom near the boom foot, and set the boom horizontally.

3) Install the angle detector to the boom sides so that top face "A" (Fig. 2-1) is horizontal by checking with the level.

(4) FUNCTION CHECK

When the relation between the boom angle and the output voltage is within the output value (shown in Fig. 2-3) ±0.3 volts, it is normal. If the voltage is out of this range, check the installing condition of the angle detector again.

(Voltage varies by 0.12 volts every 1° of angle.)

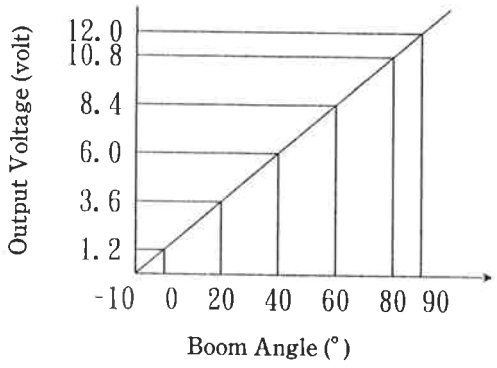


Fig. 2-3

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2.2 LENGTH DETECTOR

(1) CONSTRUCTION

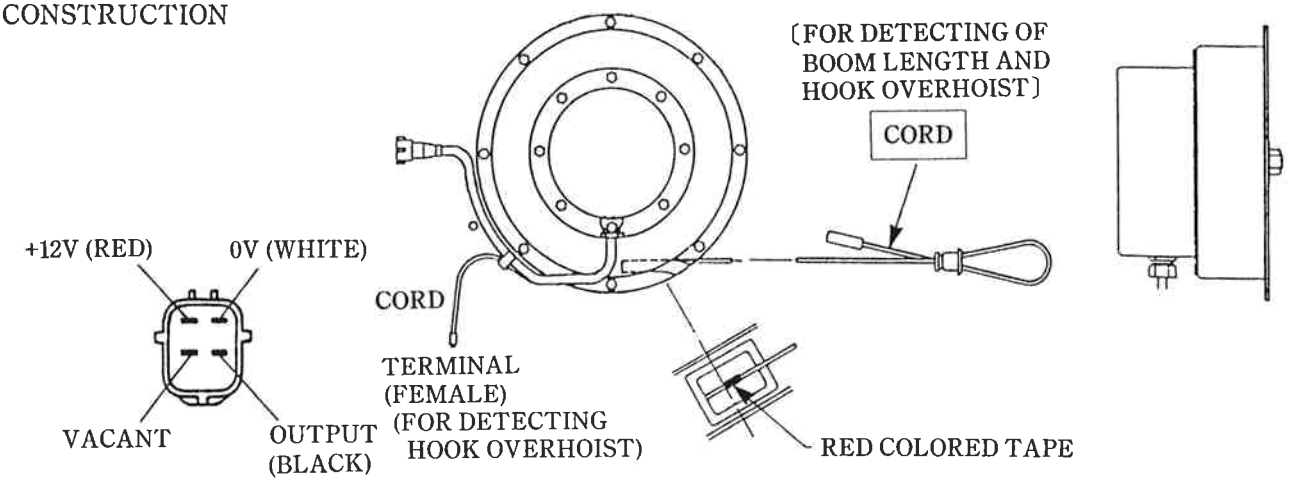


Fig. 2-4

(2) PRICIPLE OF FUNCTION

This detector consists of a reduction gear box and variable resistor, the input end of the gear box is fitted into the spline at the cord reel shaft end, and the output end of the gear box is directly connected to the variable resistor.
Being linked to cord reel rotation, the brush of the variable resistor moves in the direction of the arrow as the boom is extended ; voltage matching the boom length is output at the output terminal. (See Fig. 2-5)

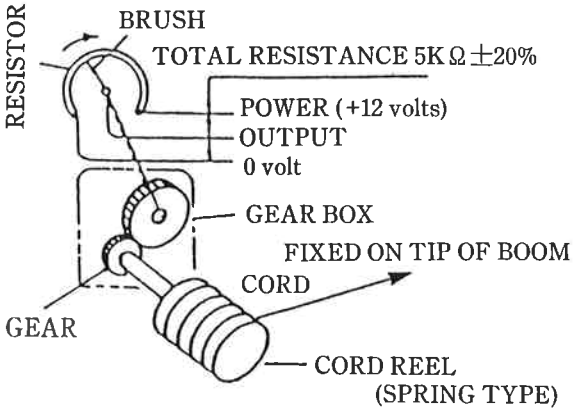


Fig. 2-5

(3) INSTALLATION

1) Retract the boom to the basic length. At this time, retract the boom surely until hydraulic relieving sound can be heard by operating boom retraction.
2) Draw out the cord until the red colored tape stuck on the cord comes out at the inlet of the reel.
3) After confirming that the length indication is put in the indication range of the basic length (9.3m)±0.5m, wind and fix the cord to the cord mounting pin on the top (4th) boom.

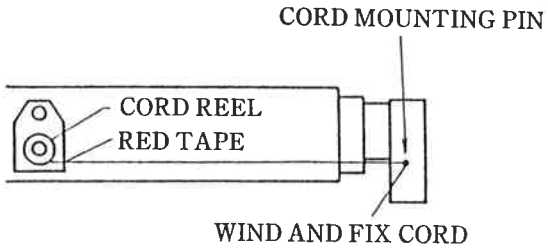


Fig. 2-6

(4) FUNCTION CHECK

If the relation between the length detector and the output voltage is within the output value (shown in Fig. 2-7)±0.275 volts, it is normal. If the voltage is out of this range, check the installing condition of the length detector again.
(When the red tape positions at the outlet of the cord reel, the relation will become as shown in Fig. 2-7.)

〔Voltage varies by 0.275 volts every 1 meter of length.〕

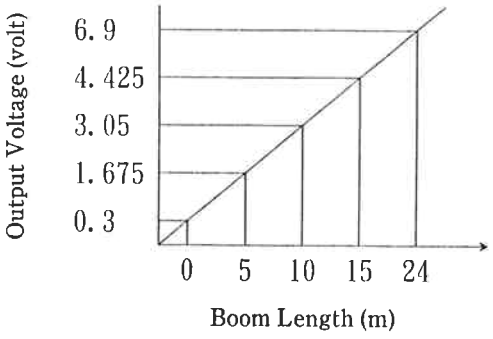
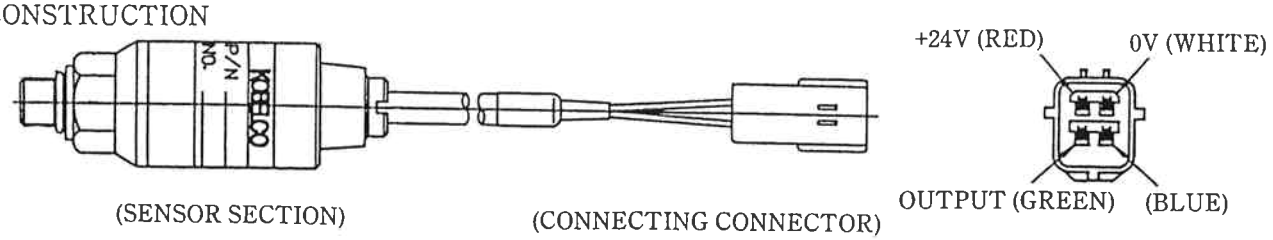


Fig. 2-7

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2.3 PRESSURE DETECTOR
(IDENTICAL PARTS FOR HEAD PRESSURE AND ROD PRESSURE)

(1) CONSTRUCTION



※ The detector of same specification (max. 280kg / cm²) is used for both head side and rod side.

(2) PRINCIPLE OF FUNCTION

The pressure detector is designed to convert the boom hoist cylinder hydraulic pressure into electronic signals for output. Fig. 2-8 shows the function, and Fig. 2-9 shows the unit for converting pressure detector pressure into electronic signals ; there, distorsion in the diaphragm due to pressure is sensed as variations in resistance values on the strain gauge.

In order to minimize the variation in pressure signals during the boom angle change, pressure is detected on both rod and head sides of the cylinder, and the results are put separately into the computer.

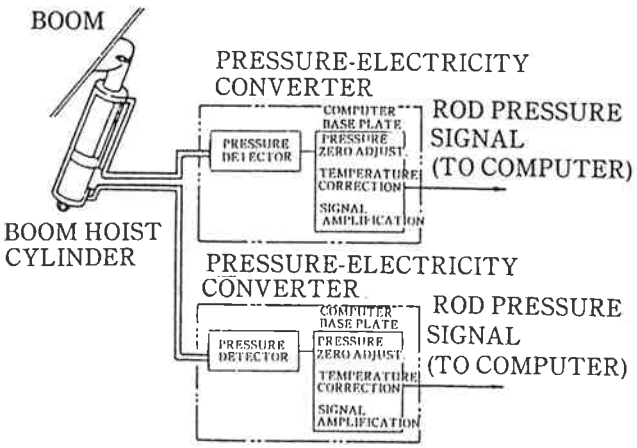


Fig. 2-8 Pressure Detector Block Diagram

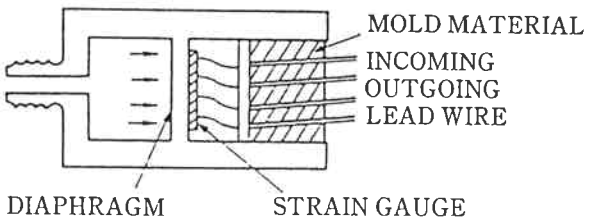


Fig. 2-9 Outline of Pressure Detector (sensor) Inside

(3) INSTALLATION

The head pressure detector is installed directly to the counterbalance valve part of the boom hoist cylinder. The rod pressure detector is installed to the rod side piping part in the interior of the main control valve. There is no special caution for the above installation, but pay attention to the following items only.

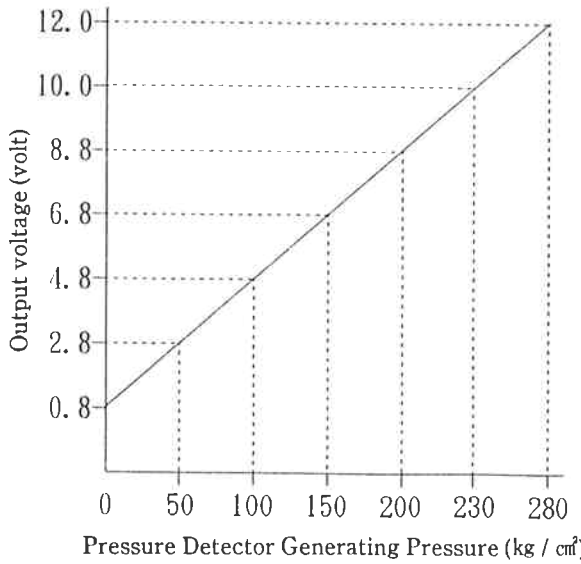
1) Surely bleed air from the hydraulic piping for the each pressure detector.
〔If air exists, pressure cannot be correctly detected. This could cause wrong operation and automatic stop, so be careful.〕

2) Absolutely do not disassemble the sensor section (pressure converting section).
〔There is no adjusting volume at all inside. If there is abnormality in the output voltage, replace with assembly.〕

(4) CHECK OF FUNCTION

If the relation between the pressure detector and the output voltage is within the output value shown in the figure ±1%, it is normal. If the voltage is out of this range, check the power supply voltage (±24 volts) of the pressure detector and earth circuit. If the output voltage is abnormal in spite of that these are normal, confirm again if air exists or not, then replace the detector assembly with a new one.

(Voltage varies by 0.4 volts every 10kg/cm² of pressure.)

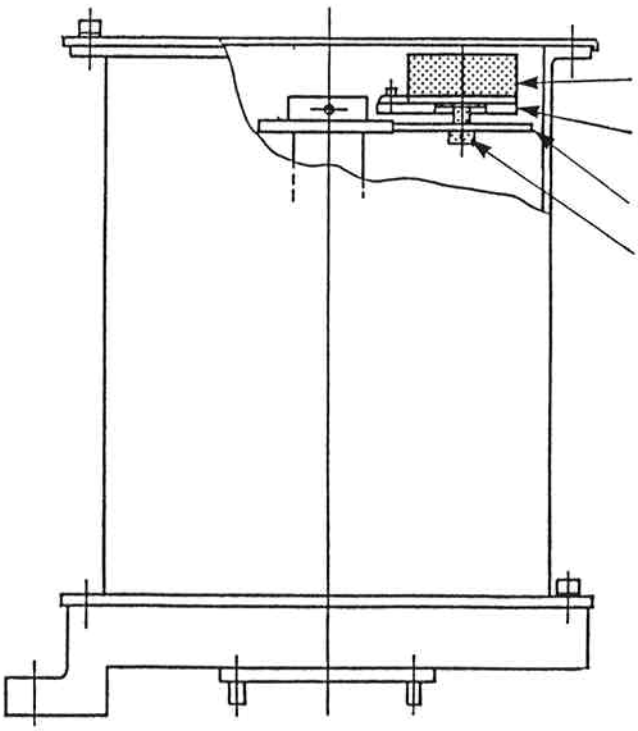


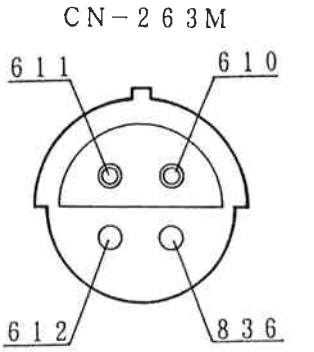
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2.4 SWING ANGLE DETECTOR

(1) CONSTRUCTION

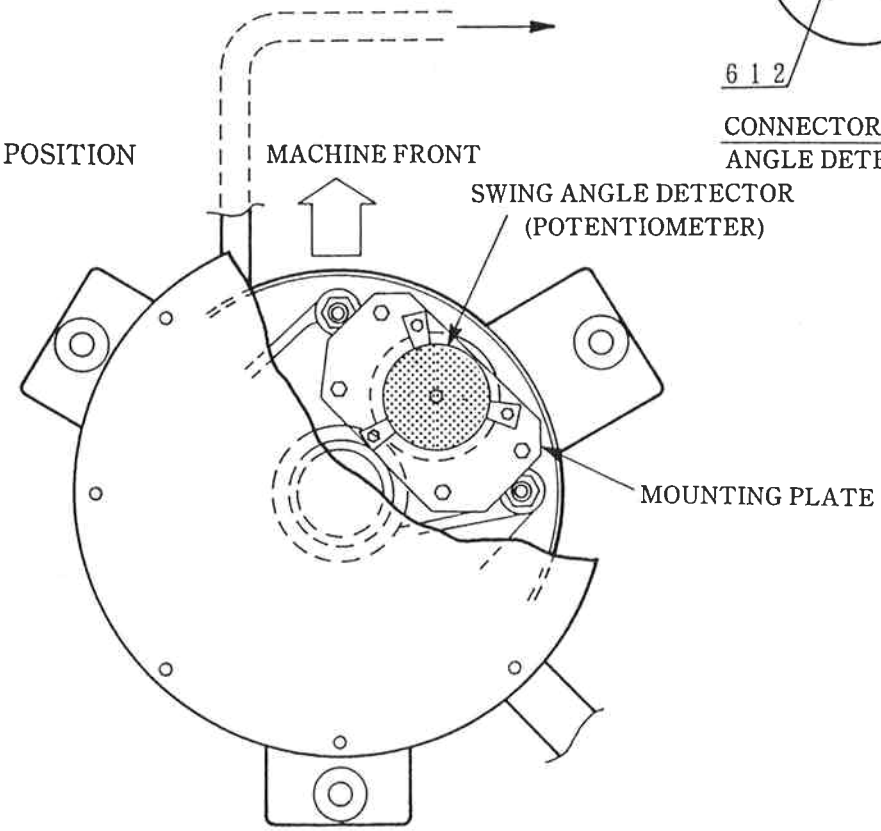
・The swing angle detector (potentiometer) is installed inside the slip ring as shown in the following figure.





CONNECTOR FOR SWING ANGLE DETECTOR

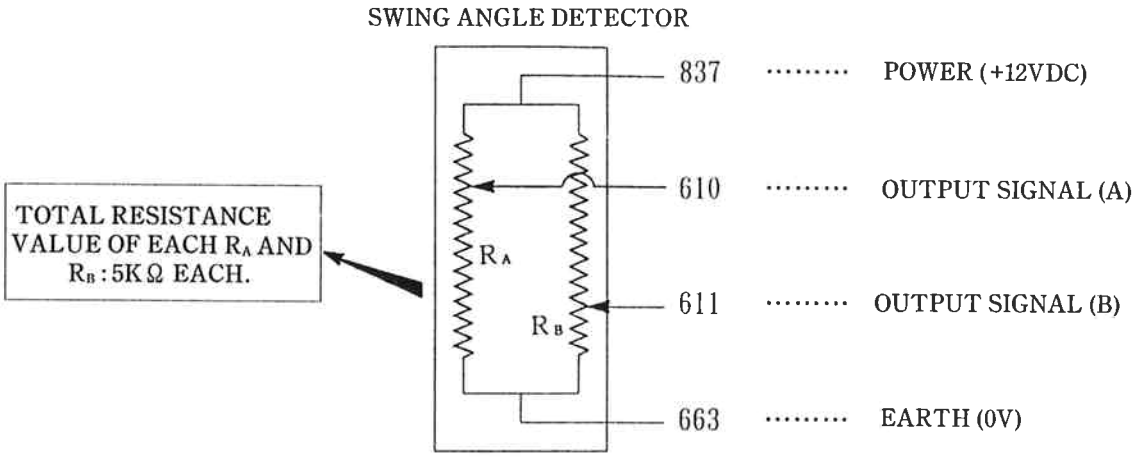
(2) MOUNTING POSITION



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(3) SPECIFICATION OF FUNCTION

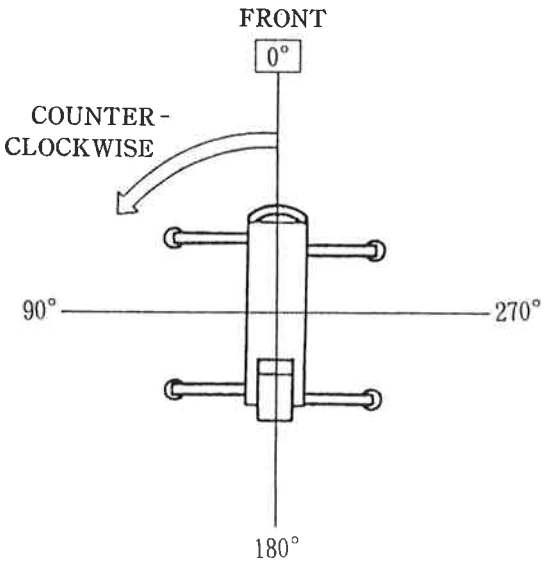
1) Arrangement of Potentiometer Circuit

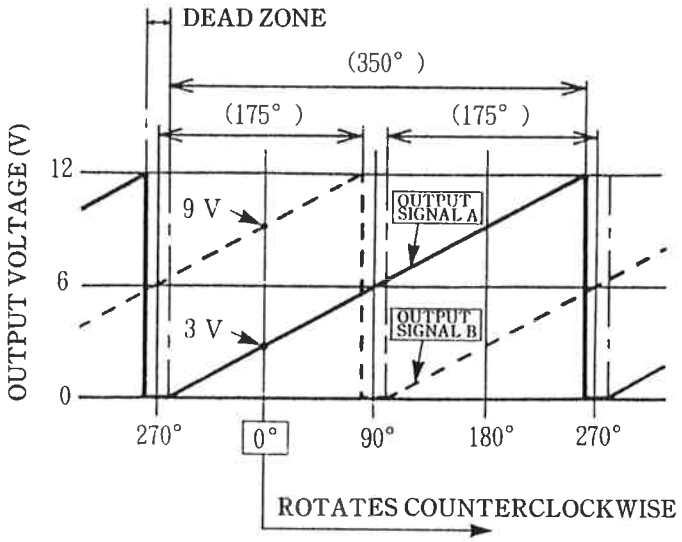


・This swing angle detector (potentiometer) consists of 2 phase resistances (R_A and R_B).

2) Output Signal Diagram

・The following diagram shows variation conditions of 2 phase swing angle output signal (voltage value) which is put out according to swing motion of the machine.
The moment limiter (ML) computes the average value of this 2 phase output signals as the swing angle, and performs various indications and controls.



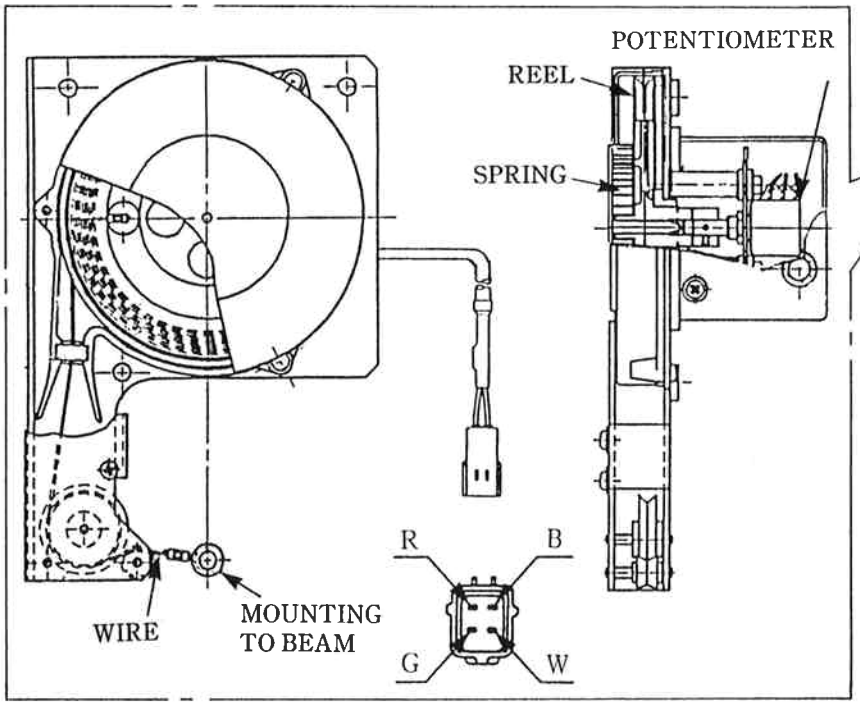


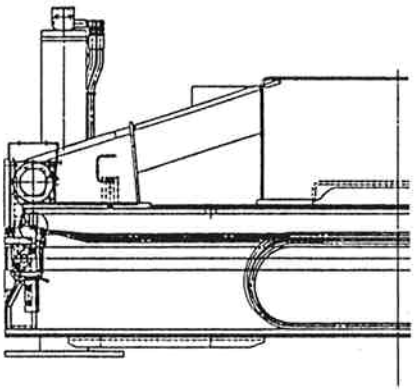
Swing Angle \ Output Signal	A	B
0° (Machine front)	Approx. 3 volts	Approx. 9 volts
180° (Machine rear)	Approx. 9 volts	Approx. 3 volts

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2.5 OUTRIGGER EXTENDED WIDTH DETECTOR

(1) CONSTRUCTION AND INSTALLING POSITION

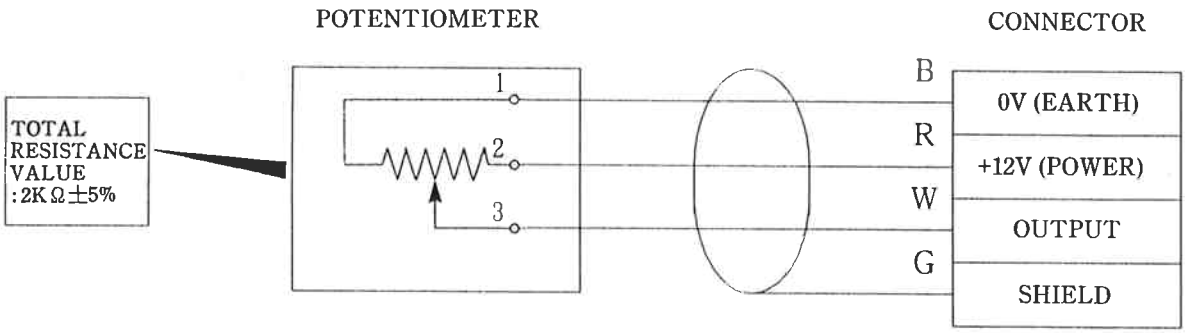




- By removing the cover at the end of the outrigger box, the installation of this detector can be confirmed.
- One detector is installed to each outrigger of the front, rear, left and right.

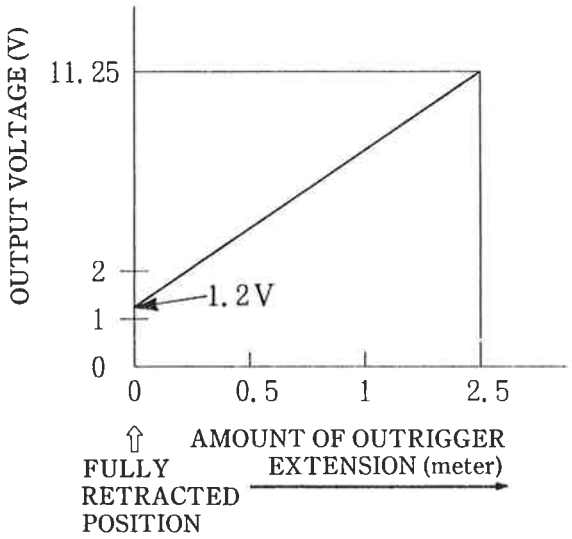
(2) SPECIFICATION

1) Arrangement of Potentiometer Circuit



2) Output Signal Diagram

The following diagram shows variation condition of the outrigger extended length signal (voltage value) which is put out according to the outrigger extending movement.



O/R Type	OUT-RIGGER EXTENDED WIDTH	Amount of O/R extension (mm)	Output voltage (V)
X Type	Min. (fully retr'd)	0	Approx. 1.2
	Mid-point 1	716	Approx. 3.9
	Mid-point 2	1428	Approx. 6.5
	Max. (fully ext'd)	2343	Approx. 10.0
H Type	Min. (fully retr'd)	0	Approx. 1.2
	Mid-point 1	745	Approx. 4.0
	Mid-point 2	1445	Approx. 6.6
	Max. (fully ext'd)	2345	Approx. 10.0

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2.6 JIB CYLINDER LENGTH AND OFFSET ANGLE DETECTOR

(1) CONSTRUCTION

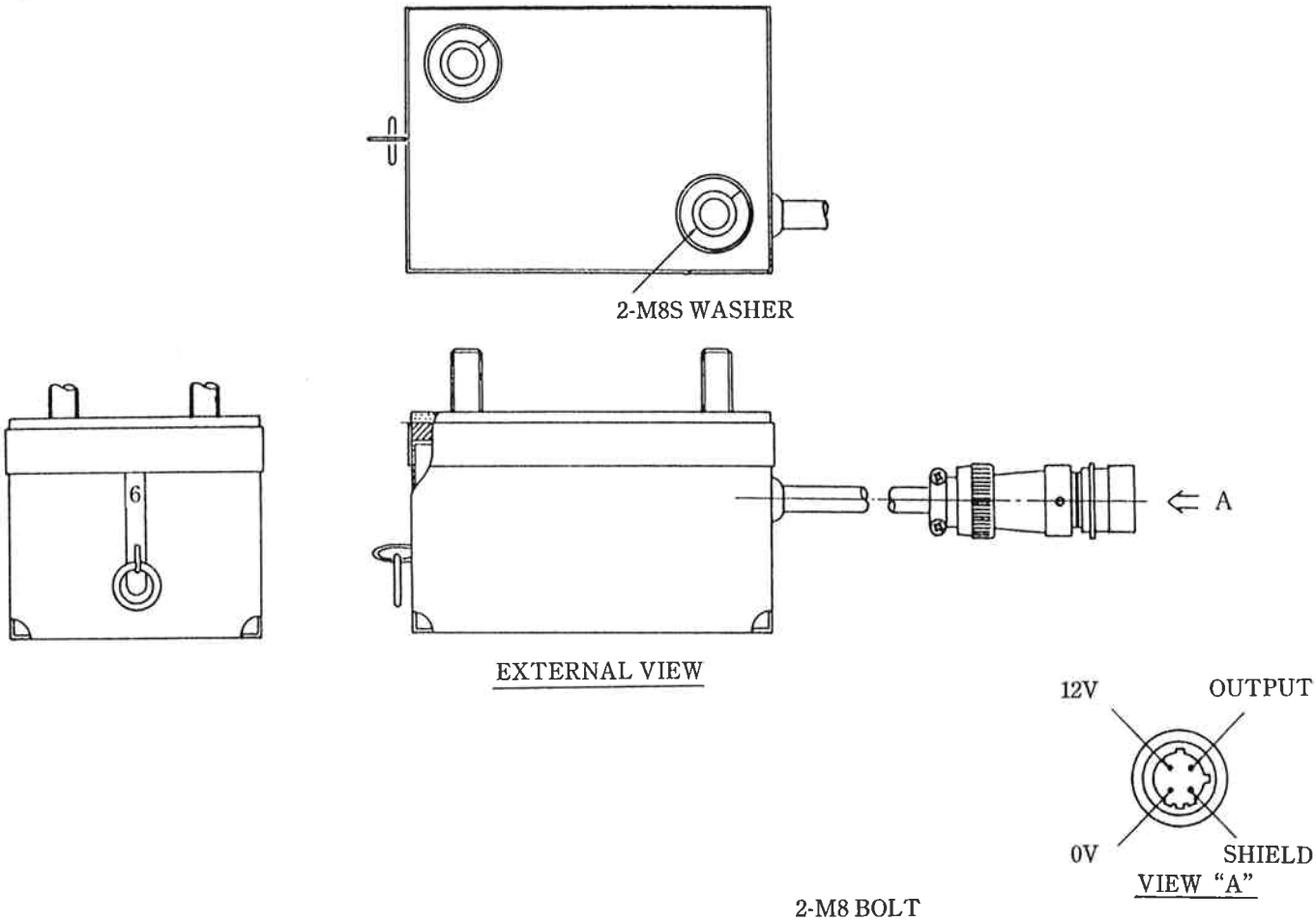


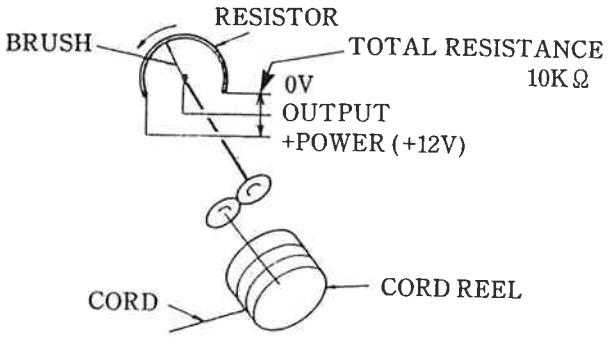
Fig. 2-10 Construction and External View

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(2) PRINCIPLE OF FUNCTION

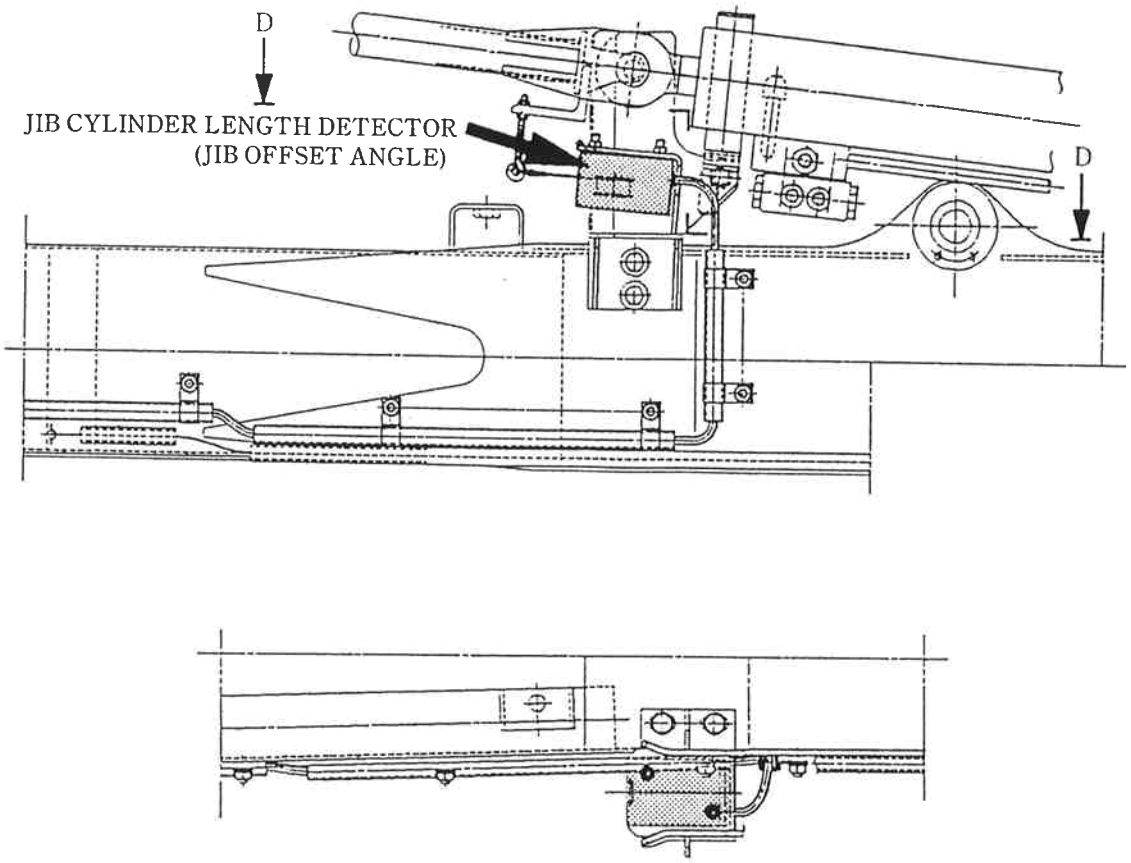
This length detector detects the jib cylinder length and is explained with the figure.

This length detector is composed of a resistor and gear box, and the input end of the gear box is fitted into the gear provided at the shaft end of the cord reel. A variable resistor is directly connected to the output end of the gear box through gears, and when the unit is fixed to the base jib and voltage is applied to the variable resistor, the cord reel shaft rotates and the brush of the variable resistor moves in the direction of arrow ↶ as the cylinder extends ; then the voltage of the output terminal is increased, so the voltage corresponding to the cylinder length is put out.



(3) INSTALLATION

For installation of the length detector, see Fig. 2-11.



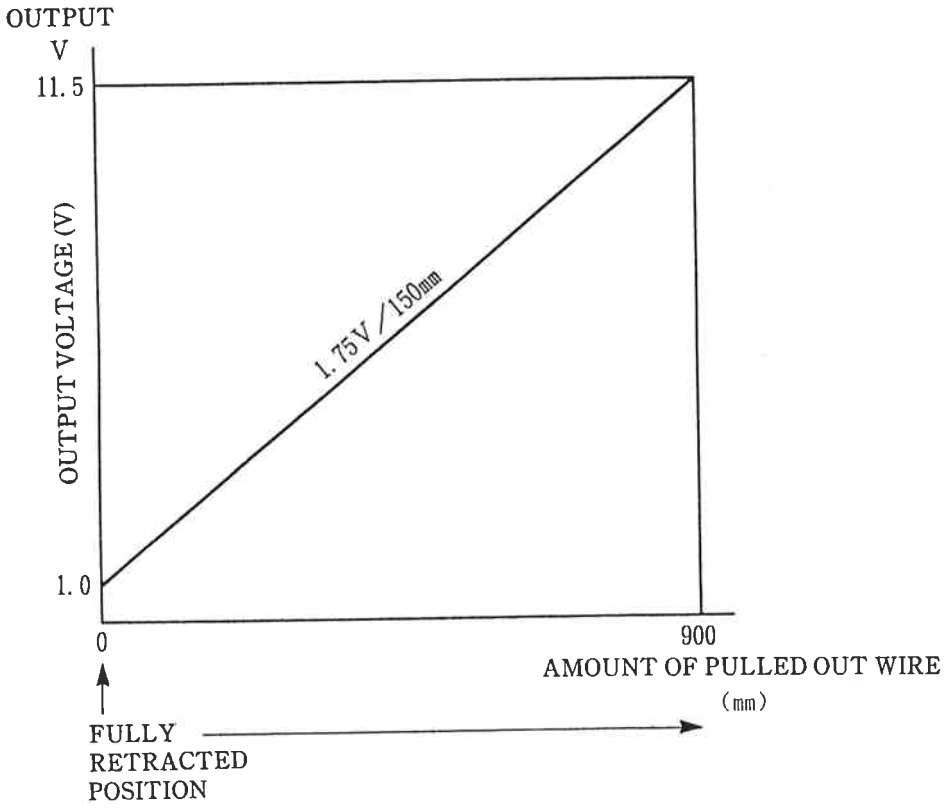
VIEW "D-D"

Fig. 2-11

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(4) OUTPUT SIGNAL DIAGRAM

The following diagram shows variation condition of the output voltage value which is put out according to the amount of paid out wire of the jib cylinder length detector.



· The relation with the jib offset angle is as follows :

Jib Offset Angle	Amount of Pulled out Wire	Output Voltage
3°	107mm (4.2 inches)	Approx. 2.2V
45°	790mm (31.1 inches)	Approx. 10.2V

Reference : The stroke length of the jib cylinder is 686mm (27 inches).

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3. METHOD OF OPERATION

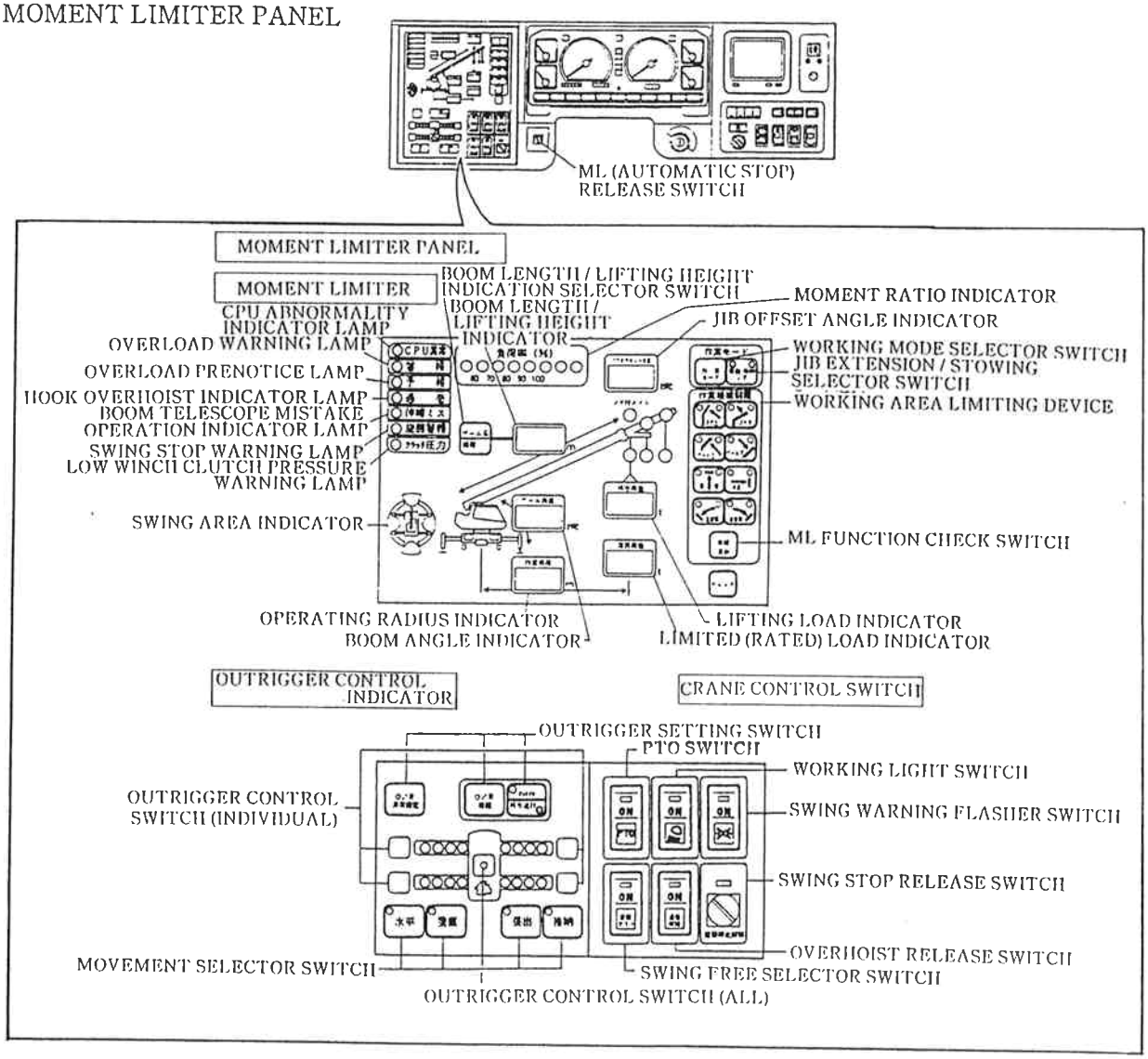
3.1 OUTLINE OF USE OF MOMENT LIMITER

The moment limiter (ML) (load safety device) is a safety device provided in order to prevent such accident as breakdown of cranes or overturn due to overload. Therefore, be sure to use this device in order to perform more safely crane operation without fail.

CAUTION

1. Although the swing system is provided with the automatic stop device for overload (for details, refer to para. 3. 4 Swing Automatic Stop Device.), if the left and right outrigger extended widths are different, especially be careful when turning the upper from the large extended width side to the small extended width side.
2. Before operating crane work, be sure to make the preoperation check to confirm that there is no abnormality.
3. Set this device so that the each indicator lamp lights up in the position which corresponds to the work condition.
4. Always pay attention to indications of the moment limiter, and operate the machine not to be overloaded.
5. When the machine is operated toward unsafe side (boom extension, boom raising or boom lowering) and when the machine stops automatically, operate the machine toward safe side (retracting the boom, raising or lowering the boom) to return the machine to its original state.
6. When lifting a load from the ground, raise the load with the winch, stop the machine once and confirm safety when the load clears the ground. Do not raise a load from the ground by raising the boom.

■MOMENT LIMITER PANEL

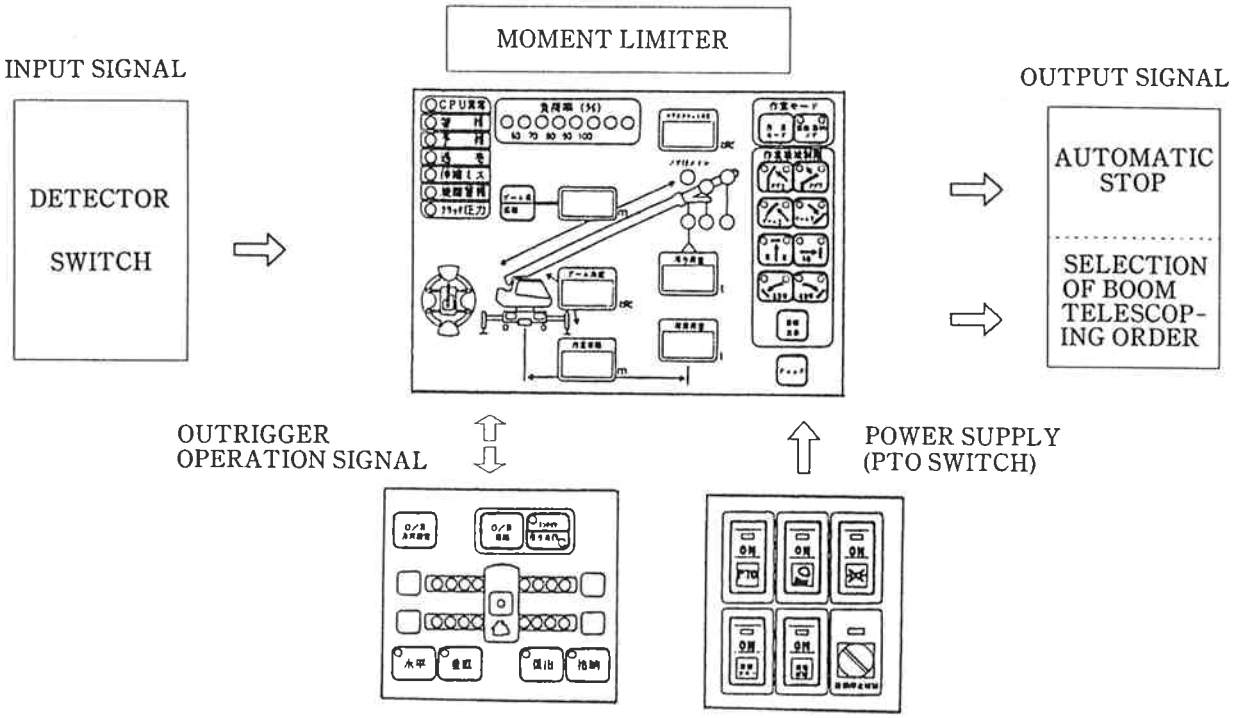


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■FUNCTION OF MOMENT LIMITER

・The main functions (duties) of the moment limiter are as follows :

- ○ Computation and indication of working postures and loaded conditions.
- ○ Judgment of abnormality such as overload, hook overhoist and boom telescoping mistake, etc.
- ○ Outputs of warning alarm and automatic stop signals for the above abnormalities (including data communication with the swing automatic stop system).
- ○ Automatic detecting function of swinging angle and outrigger extended width.
- ○ Working area limiting function which regulates working range of attachment.
- ○ Trouble indicating function.



■SETTING OF CRANE CAPACITY / AUTOMATIC SWITCHING

・To decide the lifting capacity, it is necessary that all conditions for the following items ① through ④ are completed.

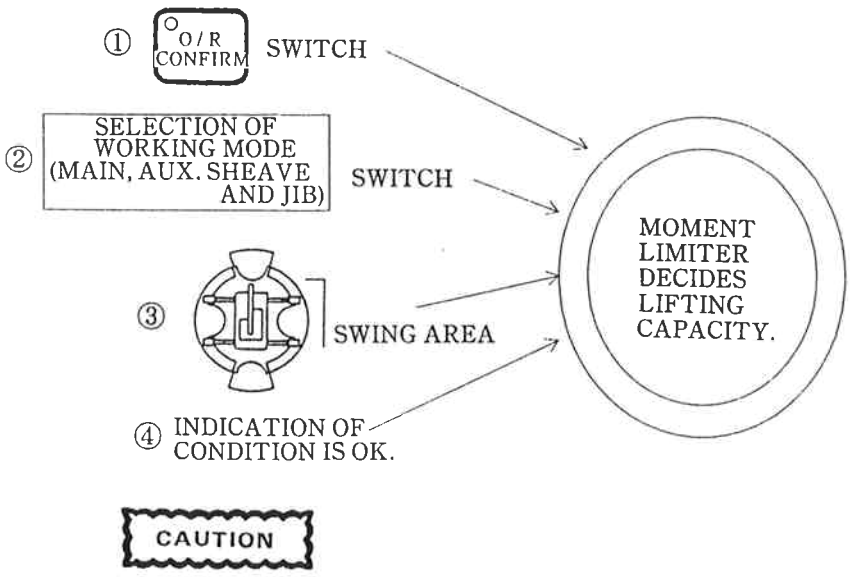
① SETTING OF OUTRIGGER EXTENDED WIDTH

② SETTING OF BOOM POSTURE

③ AUTOMATIC DETECTION OF SWINGING ANGLE

④

WORKING CONDITIONS	BOOM ANGLE
	BOOM LENGTH
	LOAD
	JIB OFFSET ANGLE



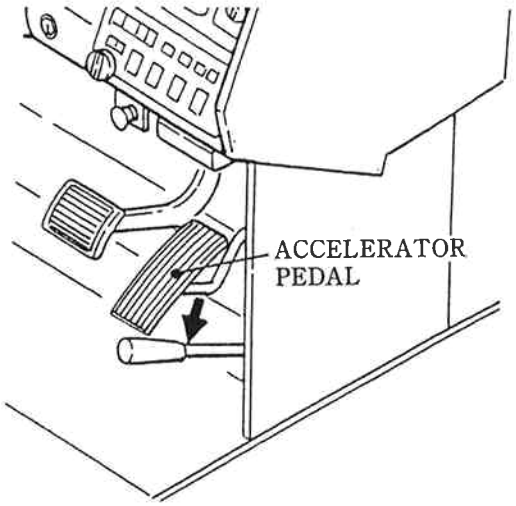
CAUTION

If even one of the above items is not completed, crane capacity is not fully exhibited. Setting must be surely done.

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■TO ALLOW MOMENT LIMITER TO OPERATE

① Lowering Interceptive Lever for ON and OFF → ② Operating P. T. O Switch

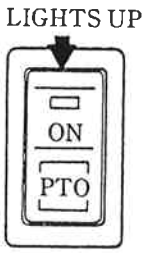


INTERCEPTIVE LEVER
FOR ON AND OFF

(With key switch turned to ON)

· Push the P. T. O switch to light up the indicator lamp.

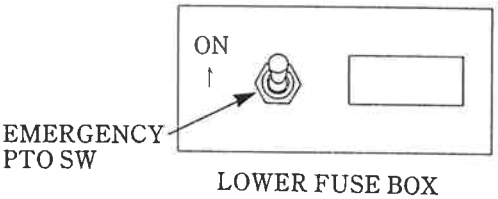
Now, the moment limiter has been supplied with power, and can operate.



② ' Operating Emergency P. T. O Switch

(With key switch turned on)

· By pushing the emergency P. T. O switch in the lower fuse box, the LED on the P. T. O switch lights up, the power is supplied to the moment limiter, and the moment limiter operates.



■OUTLINES OF INDIVIDUAL SETTING OR OF DETECTING

① Operate the outriggers in accordance with the manual of operation, and visually confirm the extended and grounding conditions, then push the switch O / R CONFIRM. Now, setting of the outrigger extended width is completed (see page 3-21).

② Select the boom posture. Using the selector switch WORKING MODE, select the mode which coincides with the work (see page 3-7).

③ Check the swinging area. If it is roughly in the swinging area, it is O. K. (see page 3-14).

CAUTION

When the swing warning lamp lights up, the work exceeds the capacity. If the work is operated with this condition, the machine has possibility to overturn.

④ Set the machine in the working condition. Confirm that there is not overhoisting condition nor overloading condition. (Overhoisting condition and overloading condition, etc. are informed with the buzzer or indicator lamp.)

⑤ When extending or stowing the jib, using the jib extending / stowing selector switch, select the mode which coincides with the work.

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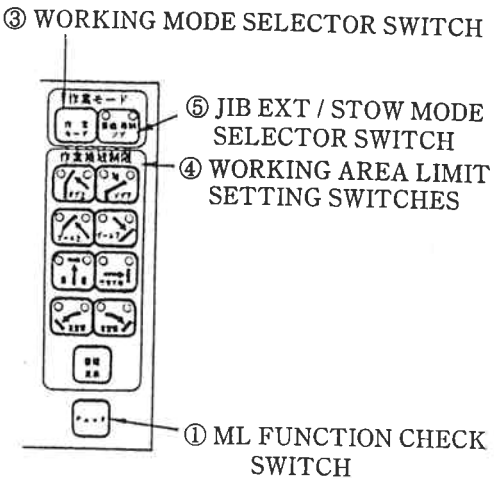
3.2 USING METHOD OF MOMENT LIMITER

■OPERATING METHOD OF MOMENT LIMITER PANEL SWITCHES AND WAY OF LOOKING AT VARIOUS INDICATIONS

1. Using Method of Control Switches

・The following control switches are provided on the moment limiter panel.

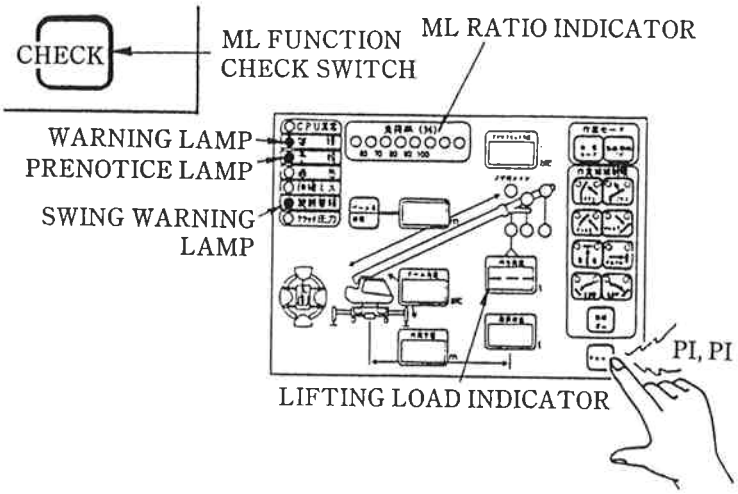
	Name of Switch	Purpose of Use
①	ML function check switch	Preoperation check
②	Outrigger control switches	Operation of outriggers and setting of extended width
③	Working mode selector switch	Selection of boom posture when using (depending on operation with boom, operation with auxiliary sheave and operation with jib).
④	Working area limit setting switch	Limiting of working area within set capacity of moment limiter.
⑤	Jib ext / stow mode selector switch	Selection when operating jib ext / stow. (For detail, see page 3-7.)



① ML Function Check Switch

・Before starting operation, push this check switch to check the alarm performance (function) of the moment limiter for normality. If the alarm conditions are as follows while pushing the switch, it is normal.

- All of the prenotice lamp, warning lamp and moment ratio indicator lamp light.
- The lifting load indicator indicates [– – –].
- The rapid intermittent alarm sounds (pi, pi, pi,……).



CAUTION

When the pre-notice and warning lamp do not light up even by pushing the check switch, the system is abnormal. Immediately consult the service shop.

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② Outrigger Control Switches

- Using the each outrigger control switch, operate the outrigger horizontal extension and jack-up, and confirm horizontal of the chassis.
- At this time, the outrigger length indicator lamps go on and off which correspond to the set extended widths of the front, rear, left and right outriggers.

1) When Operating with Outriggers Extended

(Normal working condition)

- Carry out horizontal extension of the outriggers and jack-up operation, and confirm horizontal of the chassis.
- Since the length of the outrigger extended width is automatically detected, the outrigger length indicator lamps go on and off.
- Push the outrigger control switches.
  Since the indicator lamp lights up, the set condition of the outrigger is automatically put in to the ML.

CAUTION

Unless vertical operation is made after horizontal operation, recognition during extension is not made.

2) When Working With On Tire / Pick & Carry

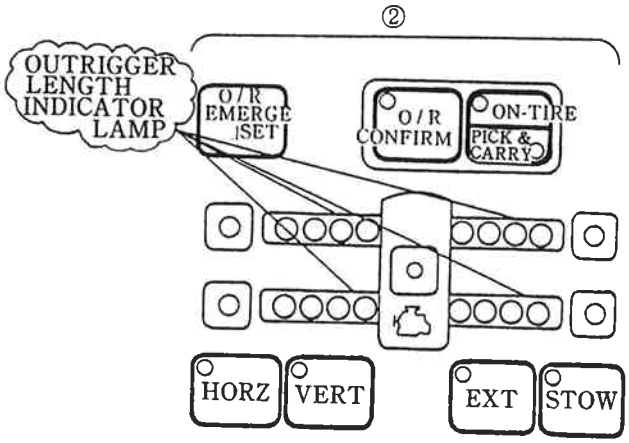
- Push the switch to light up the indicator lamp, and set to the On Tire mode.
- Push the switch again. The mode is set to the Pick and Carry mode.
- Push the switch once more. The reset lamp goes out, and the mode returns to the above normal condition.

3) O / R (outrigger) Emergency Set Switch

- The O / R (outrigger) Emergency Switch is can be used when the outrigger extended length detecting system is abnormal only.
  However, in the normal condition, even operating this emergency set switch is not accepted.
- Condition when abnormality occurs and emergency setting procedures are explained in the following table. Take this as reference for emergency.

CAUTION

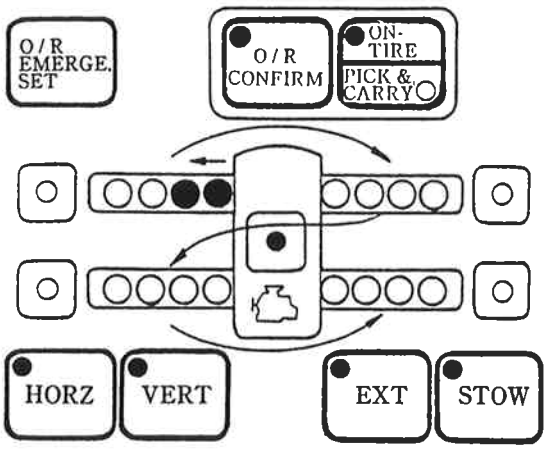
After the step for the time being is finished, the fundamental repair is required, and so connect to the service shop.



NOTE

The outrigger extended width is automatically detected, but jack-up is not detected. After confirming jack-up, push the O / R CONFIRM switch without fail.





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Condition When Outrigger Extended Length Detection is Abnormal and Emergency Measure

	Indication of Abnormality Detection	Condition of ML Function
Machine Condition at Abnormality	· Either of the following abnormality indications (Error code No.) is put out on the Lifting Load Indicator of the ML panel. L-1 L-3 E20 L-2 L-4 E02 · At the same time of the above error code, a part or all of the O / R (outrigger) length indicator lamps (full extension only) repeat going on and off.	· Capacity is automatically changed to the capacity of on-tire.

⇩

Operation of Emergency Set	1. Every pushing the O / R Emerge. Set switch, the indicator lamp of the left front outrigger indicates in the order of MIN → MID-POINT 1 → MID-POINT 2 → MAX. When the lamp coincides with the actual extended width, push the O / R Confirm Switch. Now, setting of the left front outrigger is completed. 2. Repeat the same operation to the right front outrigger, left rear outrigger and right rear outrigger. 3. After the four outrigger extended widths setting is completed, the outrigger setting condition is automatically put in to the ML. 4. The ML capacity is the capacity of On Tire untill the setting of the four outriggers is completed.

③ Working Mode Selector Switch

· Select the working mode

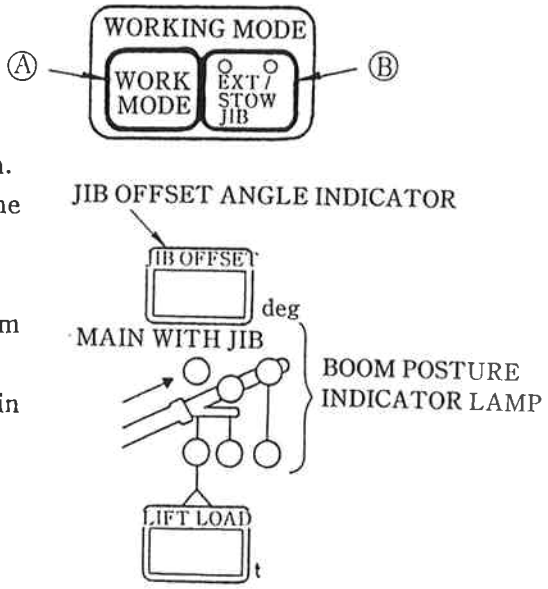
When selecting boom posture ··· Select Ⓐ Work Mode switch.

When operating jib ext / stow ··· Select Ⓑ Ext / Stow Jib switch.

(Corresponding indicator lamp lights in the selector switch part.)

Every pushing Ⓐ work mode switch, the corresponding boom posture indicator lamp lights.

When operating the jib, the jib offset angle is indicated in numeral on the jib offset angle indicator.



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Type of Jib	Standard Jib			Sky-Tilt Jib		
Work Mode Switch for Boom Posture Selection	Indicator Lamp and Jib Offset Angle Indicator		Applied Operation	Indicator Lamp and Jib Offset Angle Indicator		Applied Operation
WORK MODE			Operation with boom			Operation with boom
			Operation with aux. sheave			Operation with aux. sheave
	5	Operation with jib	One step Jib. 5° offset	(NOTE 1)	Operation with jib	One step Jib
	25		One step Jib. 25° offset	(NOTE 1)		Two step Jib
	45		One step Jib. 45° offset	(NOTE 1)	Operation with boom with jib attached	One step Jib
	5		Two step Jib. 5° offset	(NOTE 1)		Two step Jib
	25		Two step Jib. 25° offset	NOTE 1 : The jib offset angle at present is indicated.		
	45		Two step Jib. 45° offset			
	5	Operation with boom with jib attached	One step jib 5° offset			
	25		One step jib 25° offset			
	45		One step jib 45° offset			
	5		2 step jib 5° offset			
	25		2 step jib 25° offset			
	45		2 step jib 45° offset			

Every pushing and by continuing to push the work mode switch.

WORK MODE

Every pushing the jib ext / stow switch.

Jib Extension / Stowing Switch	Indicator Lamp and Jib Offset Angle Indicator	Applied Operation
EXT STW JIB		Jib extension mode
EXT STW JIB		Jib stowing mode
EXT STW JIB		Boom work (main mode)

- Push the work mode selector switch, during selection of jib extension mode and stowing mode, changes the mode to the work mode again.
- While selecting the jib extension / stowing mode, capacity of the ML is the main mode capacity.

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④ Working Area Limit Setting Switch

● Purpose of Use

· This working area limiting device is provided in order to prevent the boom and so on from trouble due to contact by careless mistake even within the capacity set with the moment limiter when working in the inside of a building or in a narrow place.

CAUTION

The working area limit can be set only when the outriggers are extended. Be sure to use this with the outriggers extended. (This cannot be set in the on-tire and pick & carry modes.)

● Setting Method of Working Area

1) Setting and Releasing the Upper Limit of the Jib Angle.

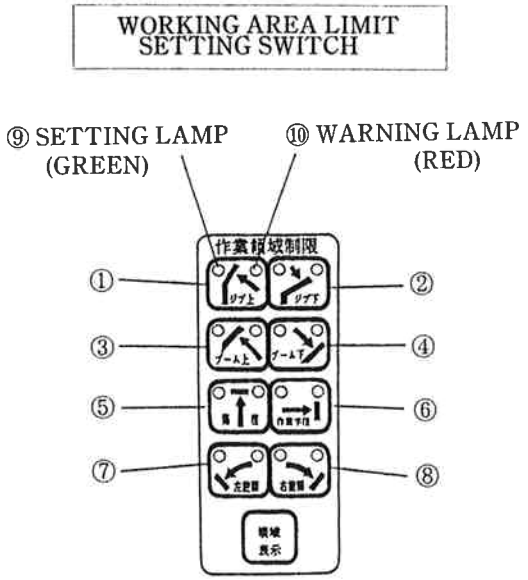
1 Operate the jib to set the jib angle desired to be limited.

2 Push switch JIB UP of ① to set the upper limit angle of the jib.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, when operating the jib to the raising side, warning lamp ⑩ (red) lights up, the buzzer sounds and voice "It's the area limit" sounds.

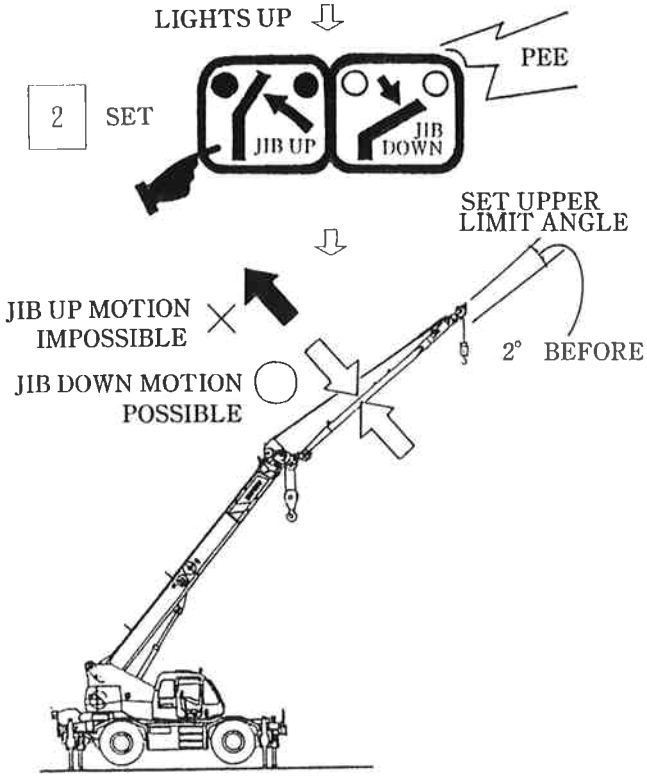
The buzzer sounds intermittently and the lamp goes on and off from 2° before the set upper limit boom angle.

3 Operate the jib to the raising side to confirm that the jib stops.

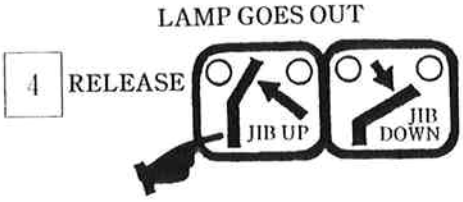
4 When releasing setting, push switch JIB UP again.
The lamp goes out.



1 Set the Jib Angle desired to be Limited



3 Confirm that the jib stops rising.



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2) Setting and Releasing the Lower Limit of Jib Angle

1 Operate the jib to set the jib angle desired to be limited.

2 Push switch JIB DOWN of ② to set the lower limit angle of the jib.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if the jib is operated to the lowering side, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." sound.

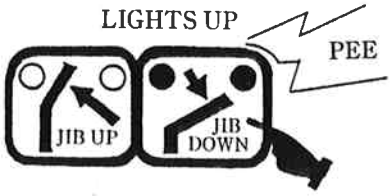
3 Operate the jib to lowering side to confirm that the jib stops lowering motion.

4 When releasing the setting, push switch JIB DOWN again. The lamp goes out.

1 Set the Jib Angle desired to be Limited.

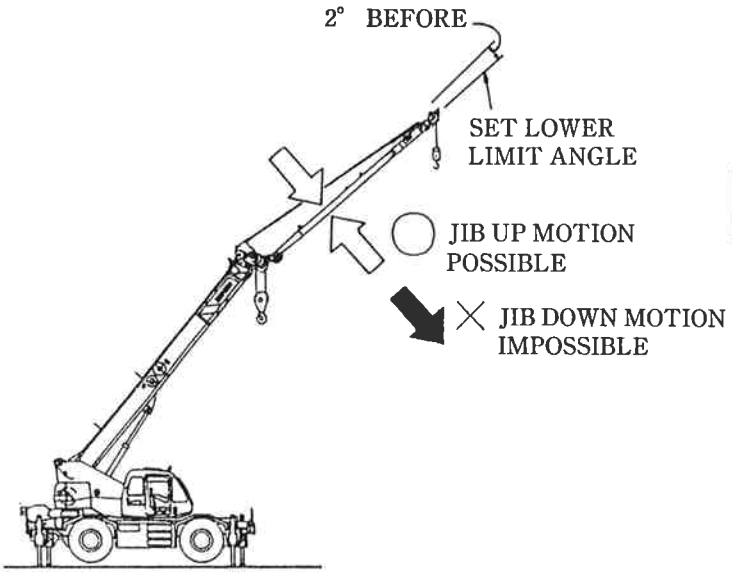
⇩

2 SET



⇩

The buzzer sounds intermittently and the lamp goes on and off from 2° before the set lower limit angle.



3 Confirm that the jib stops lowering motion.

LAMP GOES OUT

4 RELEASE



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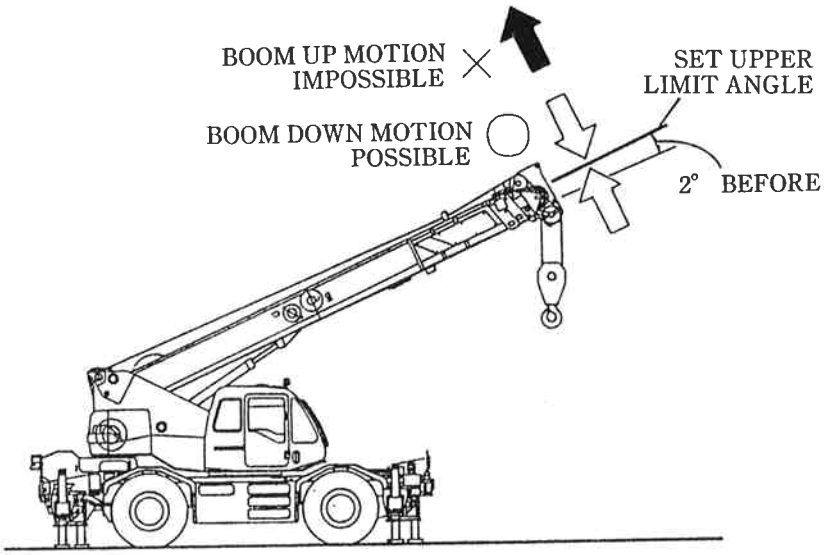
3) Setting and Releasing the Upper Limit of Boom Angle

1 Operate the boom to set the boom angle desired to be limited.

2 Push switch 

of ③ to set the upper limit angle of the boom.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if the boom is operated to be raised, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's area limit." sound.

The buzzer sounds intermittently and the lamp goes on and off from 2° before the set upper limit boom angle.

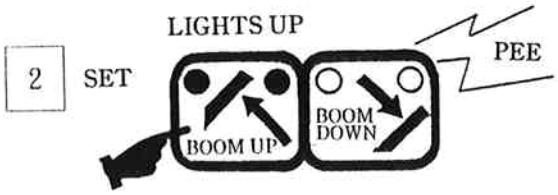


3 Operate the boom to be raised side to confirm that the boom stops.

4 When releasing setting, push switch 

again. The lamp goes out.

1 Set the Boom Angle desired to be Limited.



3 Confirm that the boom stops rising.



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4) Setting and Releasing the lower Limit Angle of the Boom

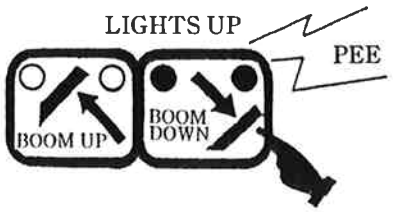
1 Operate the boom to set the boom angle desired to be limited.

2 Push switch BOOM DOWN of ④ to set the lower limit angle of the boom.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if the boom is operated to the lowering side, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." sound.

1 Set the Boom Angle desired to be Limited.

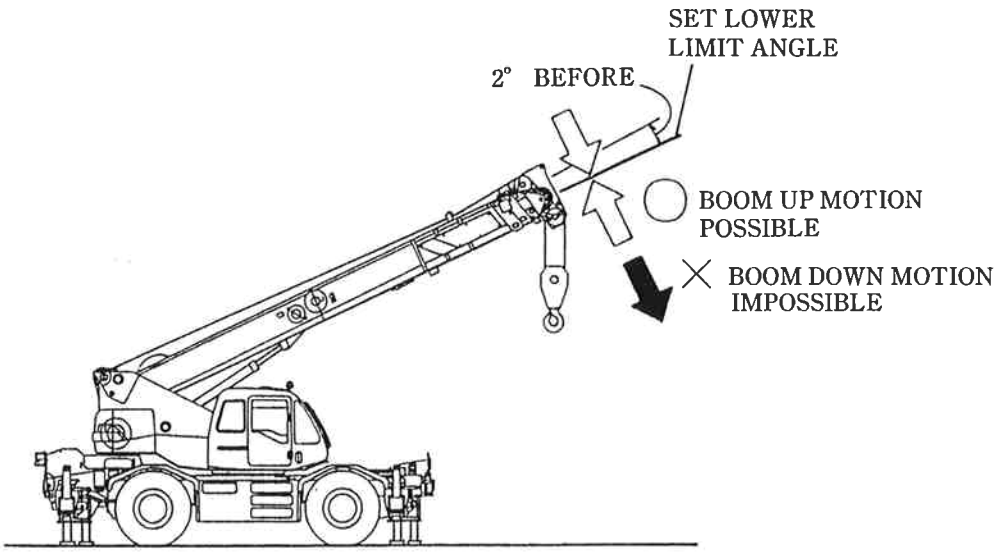
⇩

2 SET



⇩

The buzzer sounds intermittently, and the lamp goes on and off from 2° before the set lower limit boom angle.

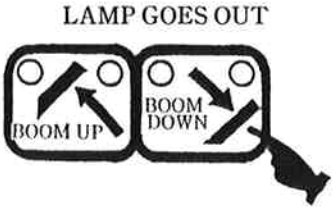


3 Operate the boom to lowering side to confirm that the boom stops.

4 To release setting, push switch BOOM DOWN again.
The lamp goes out.

3 Confirm that the boom stops lowering.

4 RELEASE



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5) Setting and Releasing the Lifting Height

1 Operate the boom upto the height desired to be limited.

NOTE

The lifting height mentioned here is the Height of the Boom (height to the center of the boom point pin from the ground).
It is not the normal lifting height of the hook.

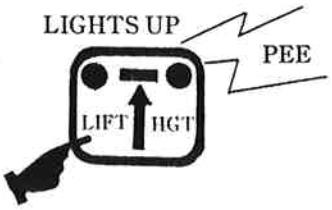
2 Push switch  of ⑤ to set the lifting height.

Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if the lever is operated toward the dangerous side, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." sound.

1 Set the Lifting Height desired to be Limited.

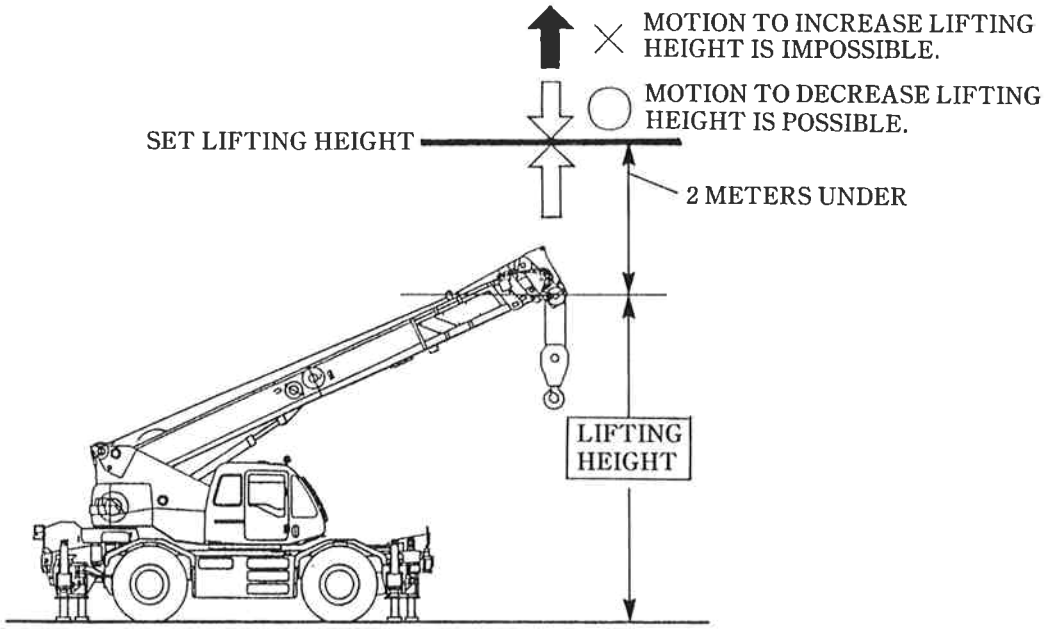
⇩

2 SET



⇩

The buzzer sounds intermittently, and the lamp goes on and off from 2 meters under the set lifting height.



3 Operate the boom toward the direction that the lifting height is increased, and confirm that the boom stops.

3 Confirm that the boom stops rising.

4 When releasing setting, push switch  again. The lamp goes out.

LAMP GOES OUT

4 RELEASE



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6) Setting and Releasing the Operating Radius

1 Operate the boom upto the operating radius desired to be limited.

The operating radius is the distance from the center of rotation to the centerline through the hook block.

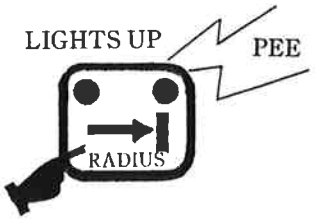
2 Push switch 

of ⑥ to set the operating radius.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if the lever is operated toward the dangerous side, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." sound.

1 Set the Operating Radius desired to be Limited.

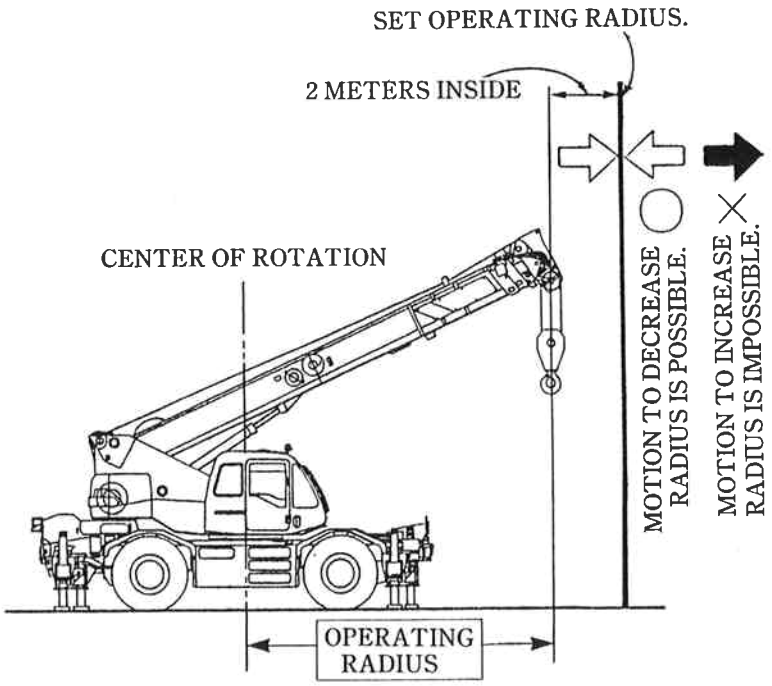
⇩

2 SET



⇩

The buzzer sounds intermittently, and the lamp goes on and off from 2 meters to the set operating radius.



3 Operate the boom toward the larger operating radius to confirm that the boom is stopped.

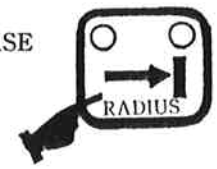
3 Confirmation of the boom stop toward the larger operating radius.

4 When releasing setting, push switch 

again.
The lamp goes out.

LAMP GOES OUT

4 RELEASE



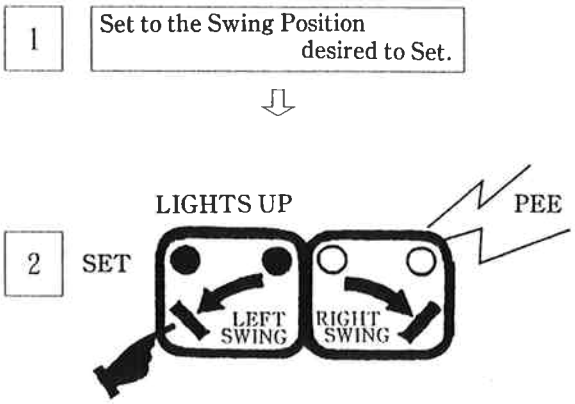
https://truckmanualshub.com/

7) Setting and Releasing the Left Swing Area

1 Operate swinging upto the swing position desired to set.

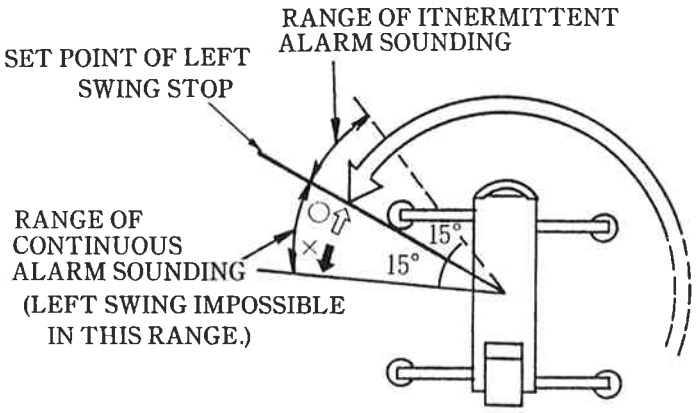
2 Push switch 

of ⑦ to set the left swing area.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if operating swing to the left, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." and "Swing stops." sound.



CAUTION

- The warning alarm sounds only within ±15° from the set point. Sufficient caution is necessary.
- This is for left swing operation only. Right swing operation has no relation with this.
- The voice "Attention to swing." sounds in the pre-notice area.

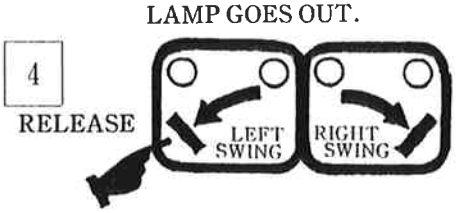


3 Operate swing to the left to confirm that swing motion stops.

3 Confirm that left swing stops.

4 When releasing setting, push switch 

again.
The lamps goes out.



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8) Setting and Releasing the Right Swing Area

1 Operate swinging upto the swing position desired to set.

2 Push switch 

of ⑧ to set the right swing area.
Setting lamp ⑨ (green) lights up to indicate that it is accepted.
At this time, if operating swing to the right, warning lamp ⑩ (red) lights up, and the buzzer and voice "It's the area limit." and "Swing stops." sound.

CAUTION

- The warning alarm sounds only within ±15° from the set point. Sufficient caution is necessary.
- This is for right swing operation only. Left swing operation has no relation with this.
- The voice "Attention to swing." sounds in the pre-notice area.

3 Operate swing to the right to confirm that swing motion stops.

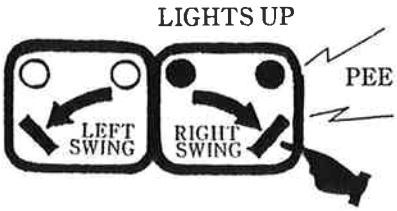
4 When releasing setting, push switch 

again.
The lamp goes out.

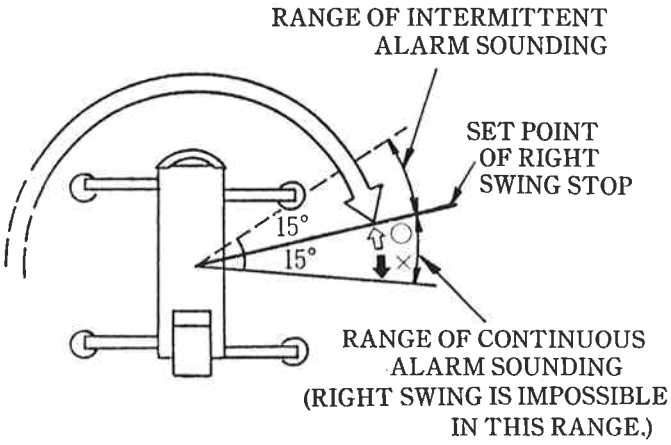
1 Set to the Swing Position desired to Set.

⇩

2 SET

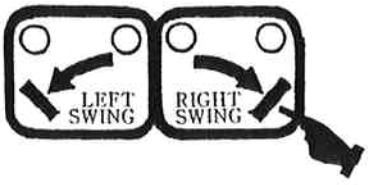


⇩



3 Confirm that right swing stops.

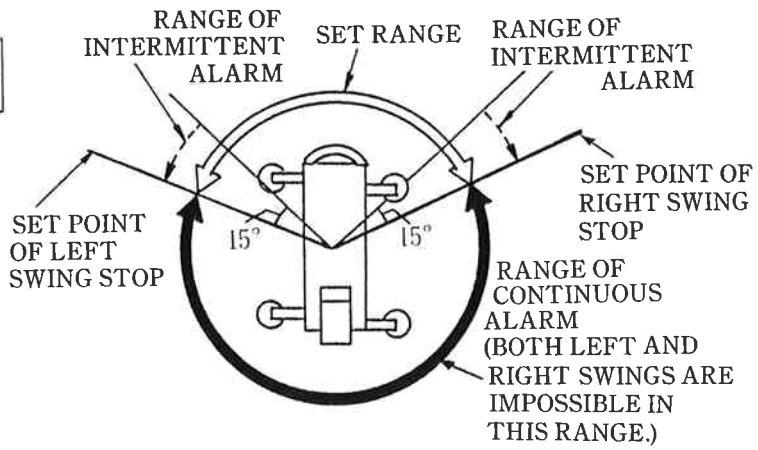
4 RELEASE



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9) Alarm Range when the Both Arears of Left Swing and Right Swing are set.

When the both of the left swing area and right swing area are set, the warning alarm sounds in the all area other than the set ranges as shown in the right figure.



· Confirming Method of Working Area Limit Set Point

It is possible to confirm the set point(s) with the numerical value. Proceed as follows :

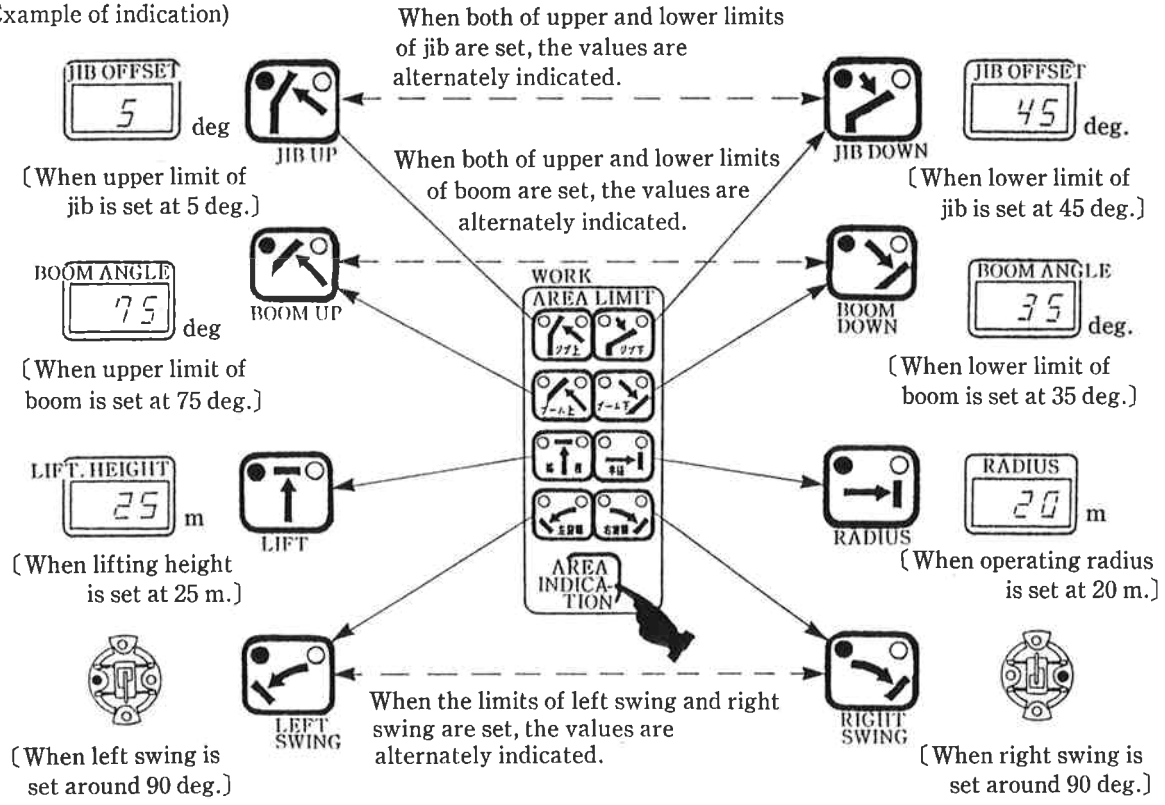
1 Push switch AREA INDICATION



CONTINUE PUSHING

2 The each value is indicated on the indicator at the same time as shown below only while the switch is pushed. However, the upper and lower limits of the jib, the upper and lower limits of the boom, and the left and right swing limits are respectively indicated alternately when the each both limits are set. Besides, the working area which is not set is indicated as ---- on the numerical indicator, and the all lamps (four) of the swing indication go out.

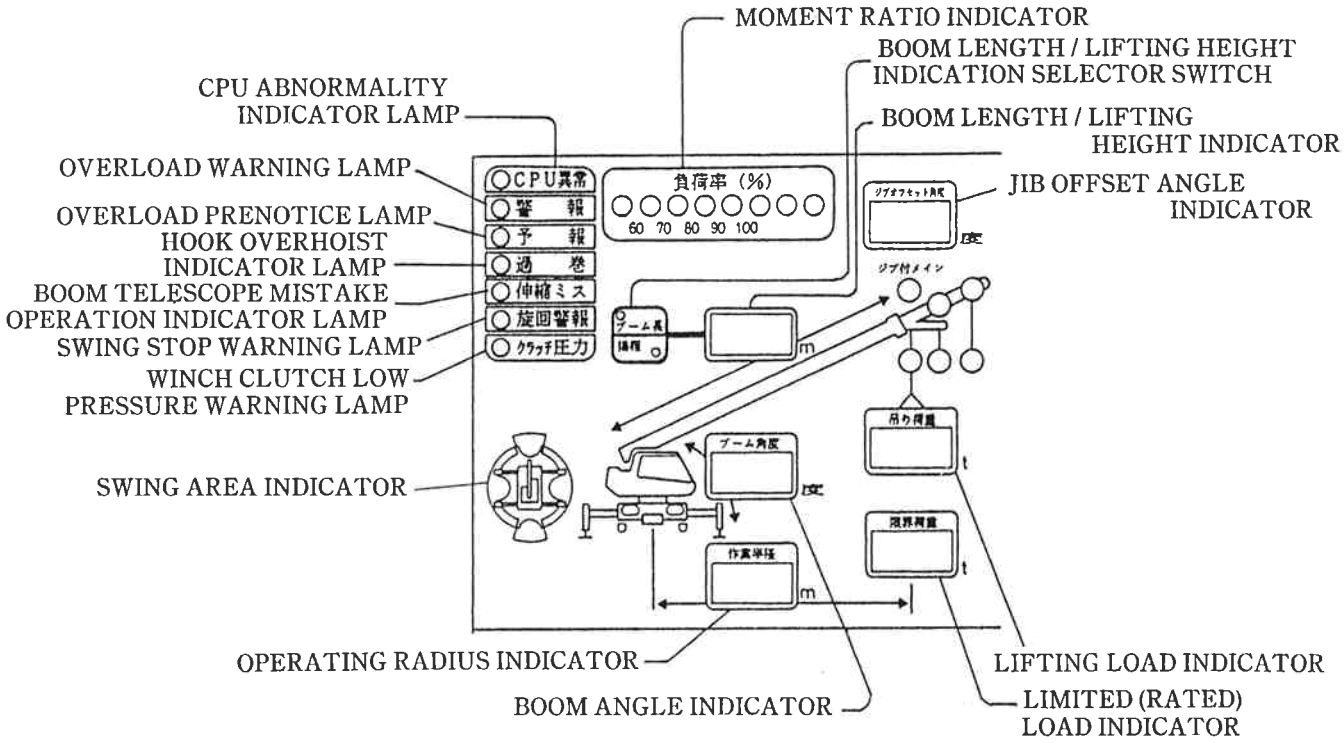
(Example of indication)



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2. Way of Looking at Each Indication

● Indicators of Moment Limiter



1) Digital (Numerical Value) Indication

(An Example of Indication)

BOOM ANGLE INDICATOR BOOM ANGLE 51.2 deg	Boom angle is indicated in unit of 0.2 degrees. (Figures below 0.2 deg. are discarded.)
BOOM LENGTH / LIFT HEIGHT INDICATOR 26.1 m	Boom length / lifting height is indicated in unit of 0.1 meter. (Figures below 0.1 meter are discarded.)
OPERATING RADIUS INDICATOR OPER. RADIUS 24.1 m	Operating radius is indicated in unit of 0.1 meter. (Figures below 0.1 meter are discarded.)

JIB OFFSET ANGLE INDICATOR JIB OFFSET AGL 26.2 deg	Jib offset angle is indicated in unit of 0.2 degrees. (Figures below 0.2 degrees are discarded.)
LIMITED LOAD INDICATOR LIMITED LOAD 15.1 t	Limited load of capacity is indicated in unit of 0.1 ton. ※ Indication of rated load. (Excludes weight of hook block.)
LIFTING LOAD INDICATOR LIFTING LOAD 10.1 t	Present (actual) lifted load is indicated in unit of 0.1 ton. ※ This excludes weight of hook block.

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2) Lamp Indication

MOMENT RATIO INDICATOR MOMENT RATIO (%) ○○○○○○○○ 60 70 80 90 100	The lamps of the moment ratio indicator light up in order from the left side lamp as the ratio increases.

Moment Ratio	Condition of Indication
Under 60%	● ○ ○ ○ ○ ○ ○ ○ 60
75%	● ● ● ○ ○ ○ ○ ○ 60 70 80
More than 90% and under 100%	● ● ● ● ● ○ ○ ○ 60 70 80 90 100
105%	● ● ● ● ● ● ○ ○ 100

OVERLOAD PRENOTICE LAMP ●PRENOTICE PEE, PEE,···	When the moment ratio exceeds 90%, the overload prenotice lamp lights up, and the buzzer sounds intermittently. Moment Ratio = $\frac{\text{Lifted Load (ton)}}{\text{Rated Load (ton)}}$
OVERLOAD WARNING LAMP ●WARNING PEE···	When the moment ratio exceeds 100%, the overload warning lamp lights up, the buzzer sounds continuously, and the hook is automatically stopped. When the ratio exceeds further, the buzzer sounds rapidly intermittently.
HOOK OVERHOIST INDICATOR LAMP ●OVERHOIST PLULU, PLULU,···	When the hook raises the overhoist preventive weight, the hook overhoist indicator lamp lights up, the buzzer sounds (plulu, plulu,·····) intermittently, and raising motion is automatically stopped.
BOOM TELESCOPE MISTAKE OPERATION INDICATOR LAMP ●TELESCOPE MISTAKE PEE···	· When Selection of the boom telescoping order selector switch is wrongly selected for the actual boom length when telescoping the boom, the automatic stop system operates to make the boom telescoping operation only impossible in order to protect the machine. · As an example, when the telescoping order selector switch is placed in the 3 rd / 4th boom position with the boom retracted fully, or when the switch is placed in the 2nd boom position with the boom extended fully, the boom telescope mistake operation indicator lamp lights up, and the buzzer sounds continuously.
CPU ABNORMALITY INDICATOR LAMP ●CPU ABNORMAL PEE···	When operation of the microcomputer (function of the moment limiter computer) is abnormal, the CPU abnormality indicator lamp lights up. Immediately, consult the service shop.

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WINCII CLUTCH LOW PRESSURE WARNING LAMP

● CLUTCII PRESSURE — KIN KON

When the driving hydraulic pressure of the winch clutch lowers, the winch clutch low pressure warning lamp lights up, and the buzzer sounds intermittently (kin kon sound).

SWING STOP WARNING LAMP

● SWING ALARM — PEE, PEE

CAUTION

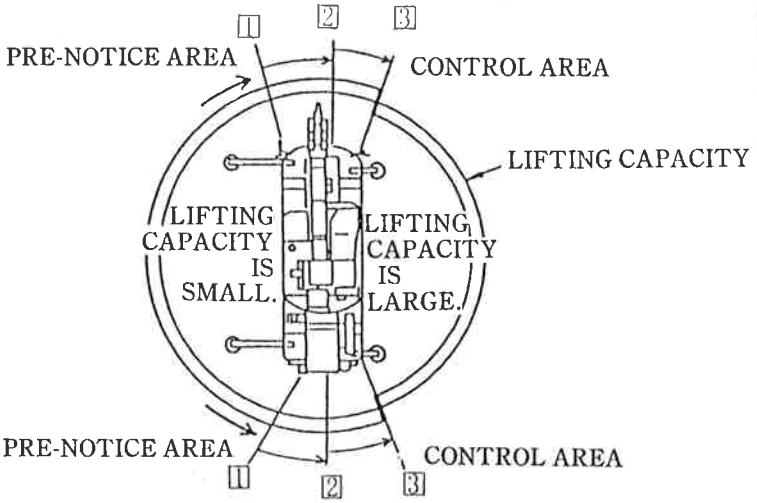
For overload in the condition of on-tire and minimum extension, the alarm is not intermittent alarm, but is continuous alarm for 100%

・When swinging with different extended width of the front, rear, left and right outriggers, the moment ratio varies as the swing area varies.

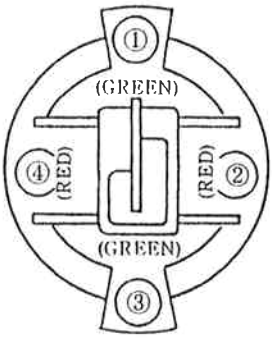
1 The swing warning lamp begins on and off slowly in the pre-notice area before the swing angle in which the moment ratio reaches 100% and the swing angle which limits the working area, and the intermittent alarm (pee, pee,…) and voice "Attention to swing" sounds.

2 When the upper is turned further foward the dangerous direction and enters control area, these intermittent lamp lighting and alarm sounding become quick, and the voice "Swing motion stops" sounds.

3 When the moment ratio becomes more than 100%, swing motion stops, and the continuous alarm (pee) and voice "Swing motion stops." sound.
(For details, see paragraph Swing Automatic Stop Device.)

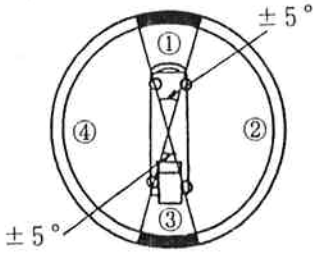


SWING AREA INDICATOR

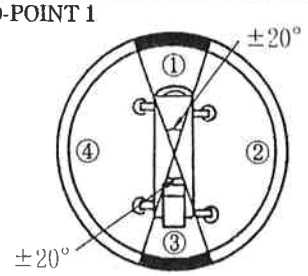


Indication of swing area varies depending upon the outrigger extended width as shown in the following figures.

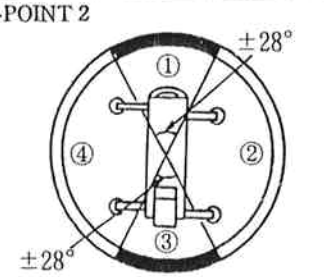
MINIMUM



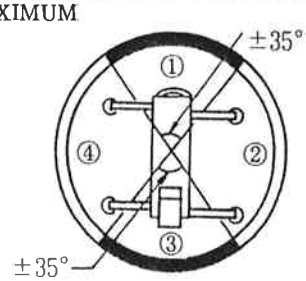
MID-POINT 1



MID-POINT 2



MAXIMUM



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3.3 USE OF OUTRIGGER OPERATION INDICATORS

■GENERAL CAUTIONS FOR OUTRIGGER OPERATION

1. The crane shall be as a rule set horizontally on a firm and level ground. When it is required to place the crane on a soft or inclined ground, be sure to lay steel plates or wooden block to secure a firm and level surface.
2. After the crane has been set, make sure all tires are off the ground.
3. After the crane has been set, confirm that the each outrigger float complete grounds and that there is no danger of the ground caving in or road shoulder collapsing.

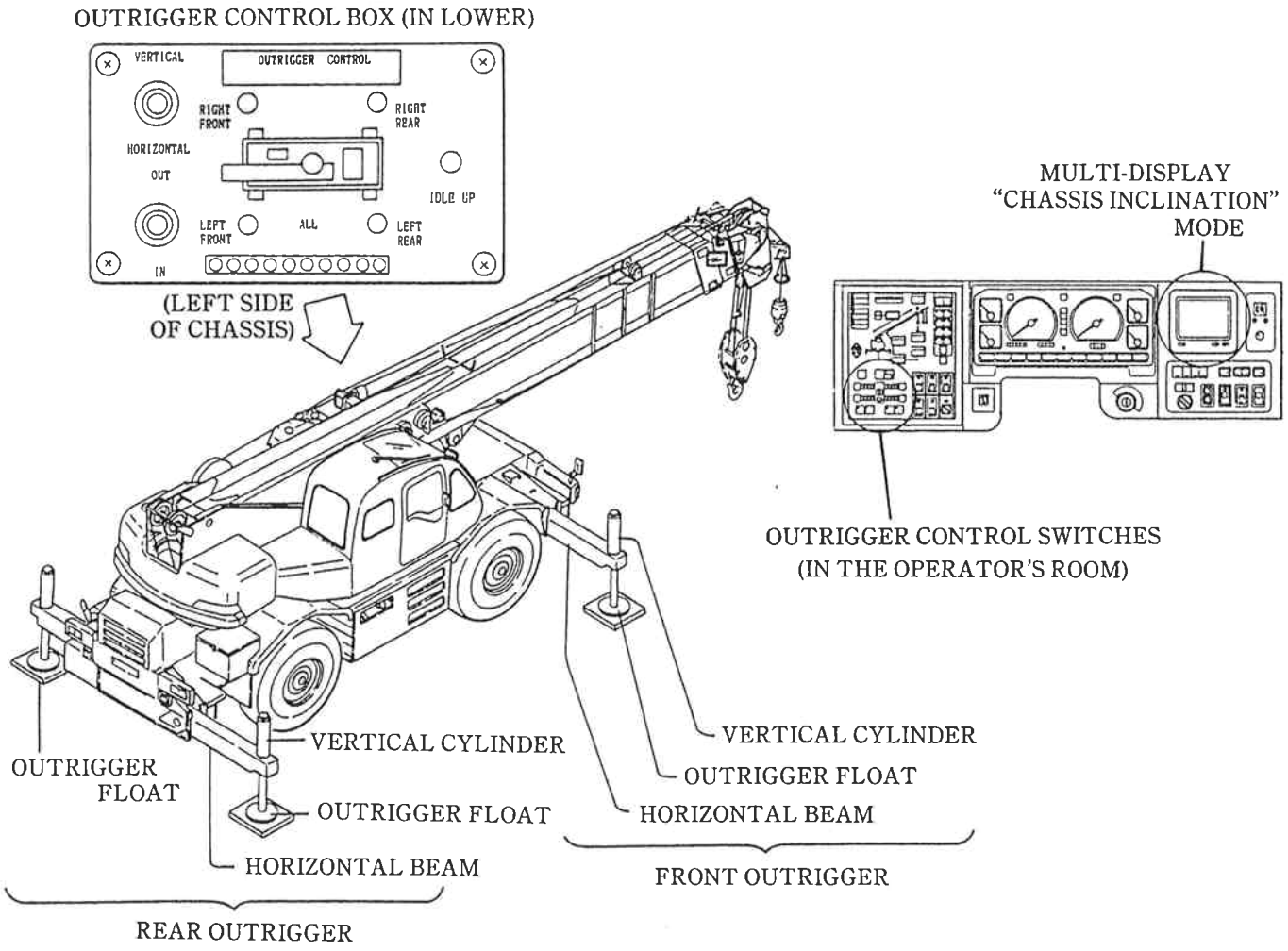
CAUTION

- Forgetting the outrigger extending.
- Swinging to the small extended width side of the outrigger.
- No land readjustment (caving of ground)

These are the main causes for overturn accident. The outriggers are the only supports which connect you and ground.

■TERMINOLOGY OF EACH PART OF OUTRIGGER

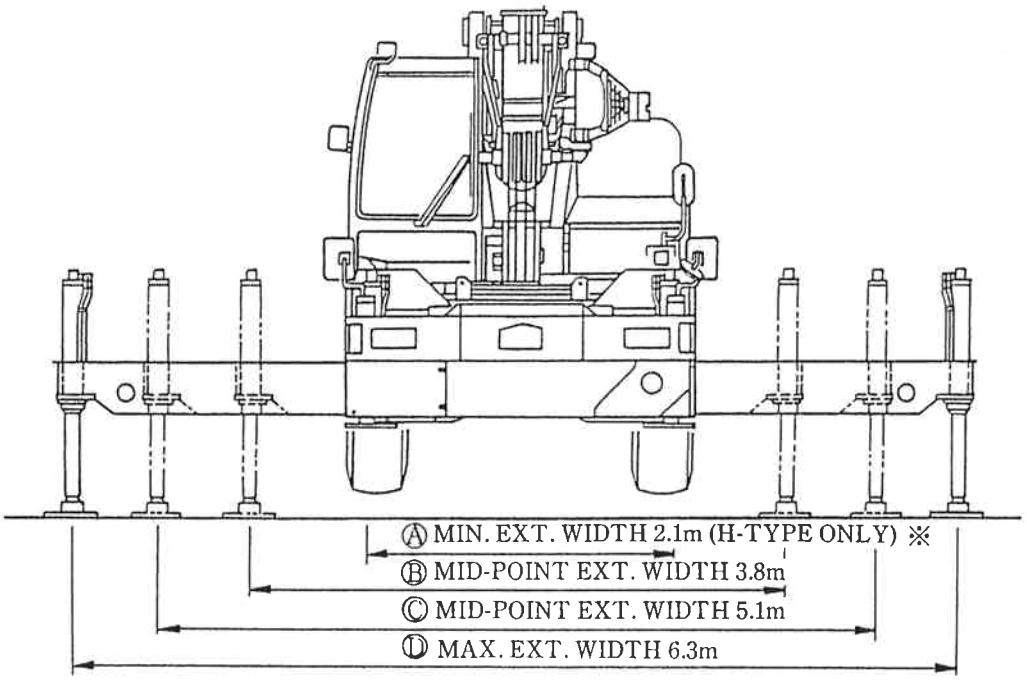
- The outrigger control switches are provided in the operator's room and in the left side of the chassis. Normally, operate the outriggers in the operator's room.



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■SETTING OF OUTRIGGER SET CONDITION AND OUTRIGGER EXTENDED WIDTH OF MOMENT LIMITER

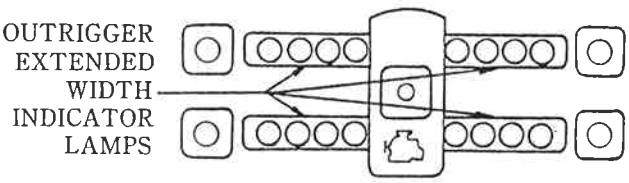
● Outrigger Extended Width and Dimension



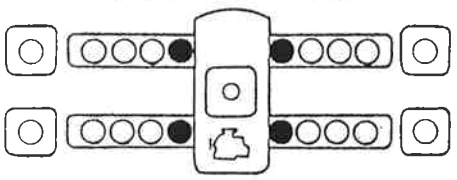
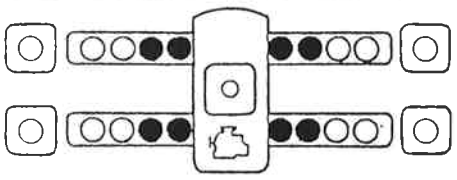
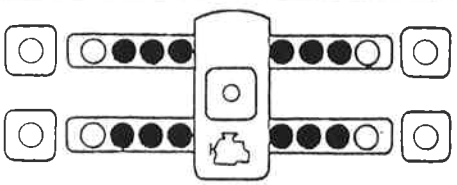
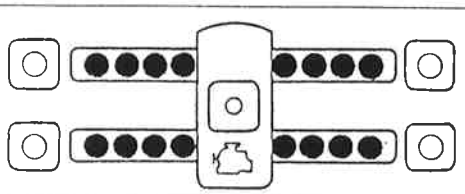
※ The extended width of X-type outrigger is different from that of the H-type outrigger.

● Lighting Position of Outrigger Extended Width Indicator Lamps

· The indicator lamp of the outrigger extended width on the outrigger operation indicator of the moment limiter lights up automatically when the width reaches the extended width shown above as the outriggers are extended.



· The following figures show the lighting condition when the left and right are equally extended.

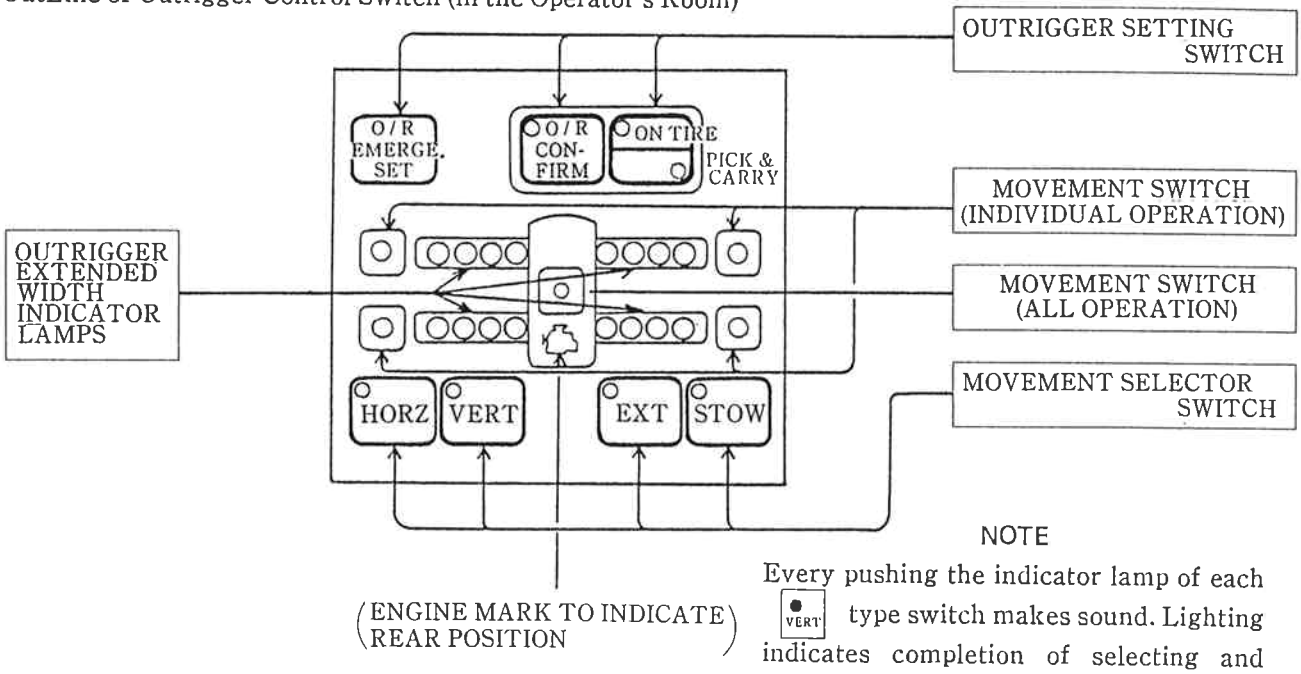
Ⓐ MIN. EXTENSION	
Ⓑ MID-POINT EXTENSION ①	
Ⓒ MID-POINT EXTENSION ②	
Ⓓ MAX. EXTENSION	

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■USUAL OUTRIGGER OPERATING PROCEDURES

● The outrigger operating procedures from the stowed condition to extension are explained with the case of operation in the operator's room as follows :

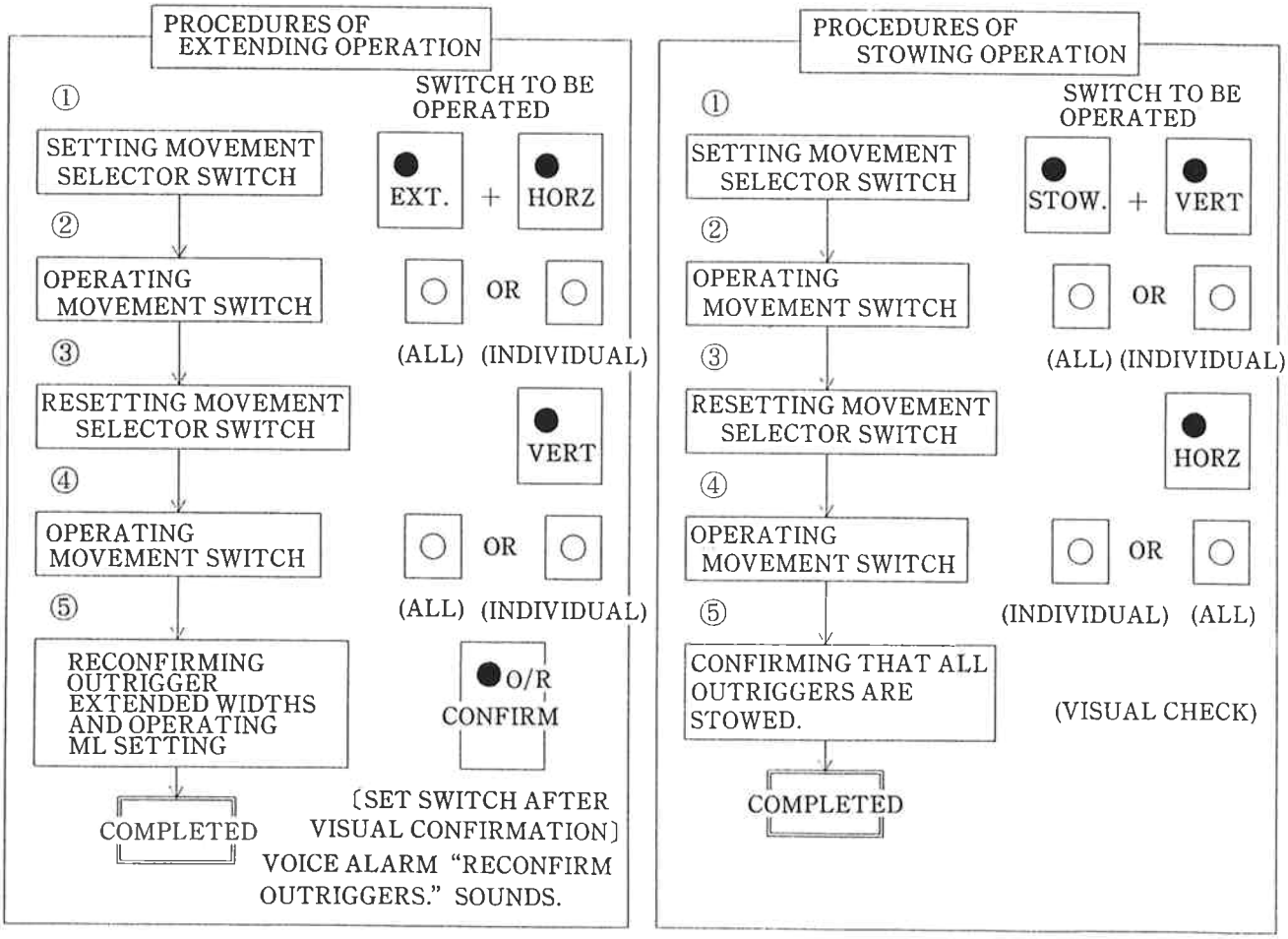
● OutLine of Outrigger Control Switch (in the Operator's Room)



NOTE

Every pushing the indicator lamp of each VERT type switch makes sound. Lighting indicates completion of selecting and setting, and light going out indicates cancel. And, pushing the other sounds "PI."

● Rough Procedures of Outrigger Extending and Stowing



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● EXTENDING THE OUTRIGGERS

(1) Confirmation of Outrigger Setting Ground and Readjustment

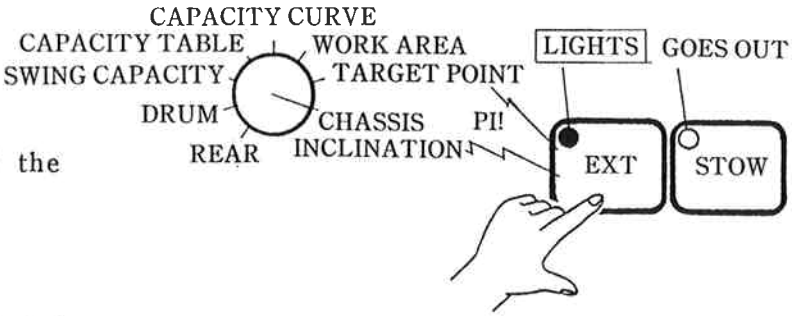


Get out of the machine to the ground, make round of the machine, and make sure no obstacle and ground condition. Secure a firm and level surface by laying steel plates or wooden blocks as required.

○ Set the multi-display to the CHASSIS INCLINATION indication.

(2) Horizontally Extending Operation

Setting Movement Selector Switch

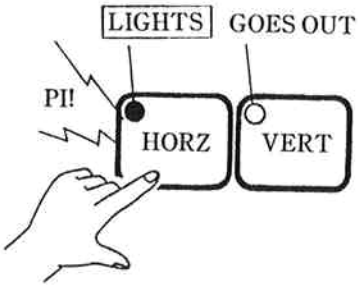


1) Push the EXT (extension) of the movement selector switch.
The red lamp (●) lights up.

NOTE

At this time, the lamp in the STOW side goes out.

2) Push the HORZ (horizontal) of the movement selector switch.
The red lamp (●) lights up.

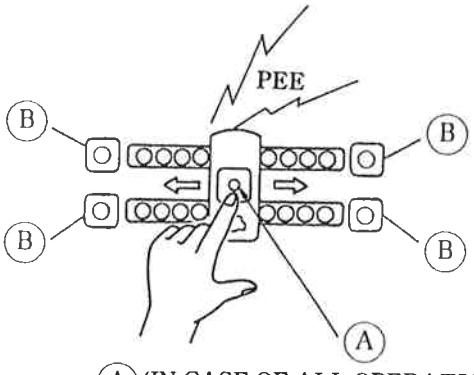


NOTE

At this time, the lamp in the VERT side goes out.

Operation of Moment Switch

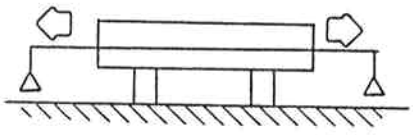
● Push the movement switch for individual movement or all simultaneous movement. The horizontal cylinder (s) is extended while the movement switch is pushed, and sound (pee···) is heard.



Ⓐ (IN CASE OF ALL OPERATION)

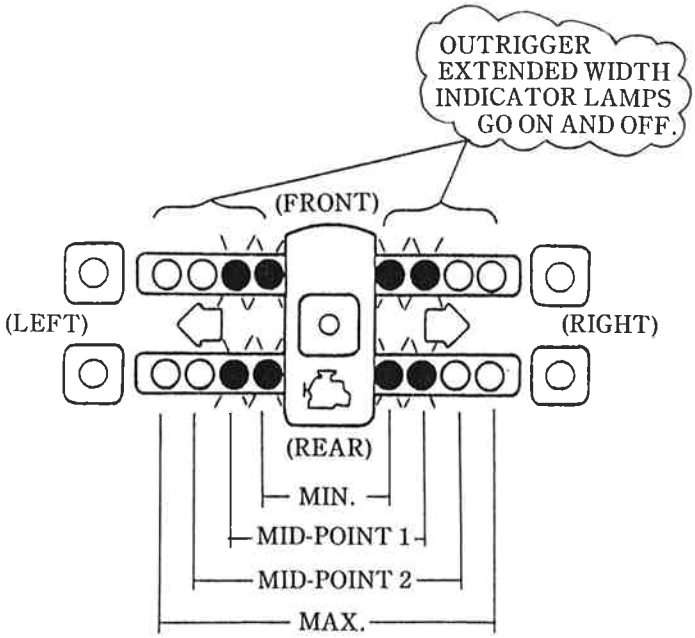
NOTE

· For all simultaneous movement, use switch Ⓐ (all).
· For individual movement, use switch Ⓑ (individual).



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● The outrigger extended width indicator lamps (green) light up in order as this horizontal extension is operated as shown in the right figure, and the actual outrigger extended width is indicated by lamp going on and off.



NOTE

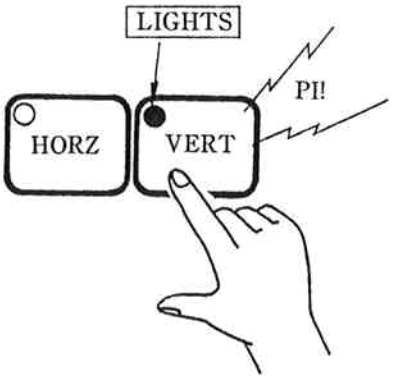
This is due to the automatic detecting device of the outrigger extended width provided in this machine.

(3) Vertically Extending Operation

Setting Movement Selector Switch

1) Leave setting of the EXT selector switch as it is.

2) Push the VERT (vertical) of the movement selector switch. Since the movement setting is transferred to the vertical side, the vertical switch side lamp lights up, and the horizontal side lamp goes out automatically.



Operation of Movement Switch

● Push the movement switch for individual movement or all simultaneous movement. The vertical cylinder (s) is extended and the machine body is jacked up while the switch is pushed.

NOTE

The using method of the each switch as the same as those of the preceding clause.

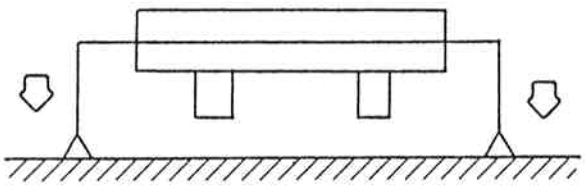
● After the four vertical cylinders have been completely extended, confirm that the machine is horizontally set with the level.

● Caution when extending the X-type outrigger to the minimum width.

After setting the basic machine horizontally confirm that the four outrigger floats are grounded completely.

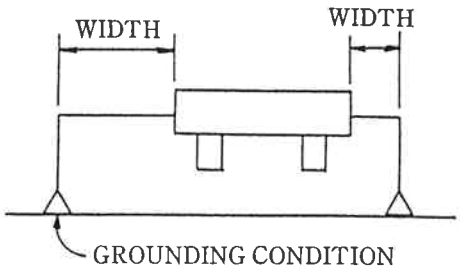
It is recommended to place suitable wooden blocks or plates under the floats because extending stroke may be somewhat insufficient when extending to the minimum.

In this machine, set the machine horizontally while viewing the multi-display indication. For the details, refer to page 3-26.



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(4) RECONFIRMATION OF OUTRIGGER EXTENDED WIDTH AND SETTING OPERATION TO ML



1) After the outrigger extending operation and horizontally setting have been finished, reconfirm the actual extended conditions of the front, rear, left and right outrigger extended width and the grounding conditions of the floats.

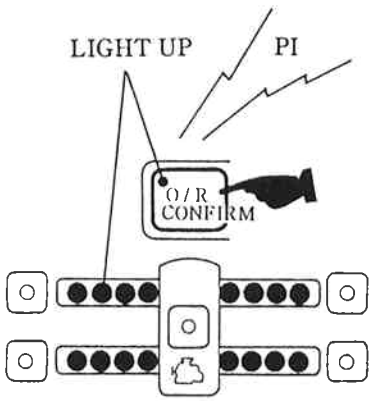
CAUTION

Especially for the outrigger extended width, the operator should visually confirm actually by himself.

WARNING

The machine may be horizontal with three vertical cylinders only. Get out of the machine to the ground, and confirm that the each outrigger float is grounded completely and that there is no danger of ground caving in and of road shoulder collapsing.

2) After confirming the above, push the outrigger confirming switch to light the green color lamp in order to make the moment limiter (ML) memorize the outriggers set condition.
Now, the outrigger extended width indicator lamp is changed from going on and off to lighting.
At this time, voice "Reconfirm the outriggers." sounds.

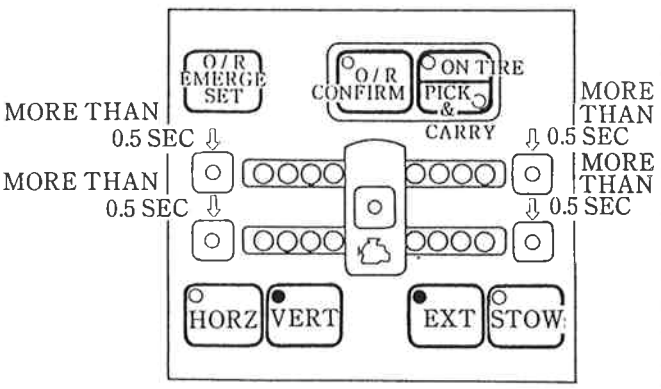


Now extending operation is completed.

NOTE

Unless the vertical extending operation is performed for the all outriggers for more than 0.5 second, the outrigger extended width indicator lamp does not transfer to lighting even by pushing the outrigger confirm switch.

IN CASE OF INDIVIDUAL OPERATION



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● METHOD OF SETTING HORIZONTALLY

After the vertical cylinders have been extended, if the machine is not horizontally, set the machine horizontally as follows.

Example :

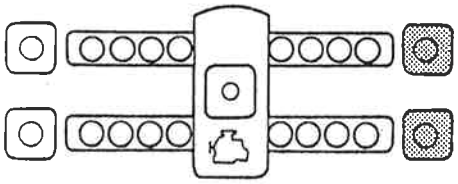
When the right side is lower.



(1) Push the movement selector switch to set the EXT and VERT.

CAUTION

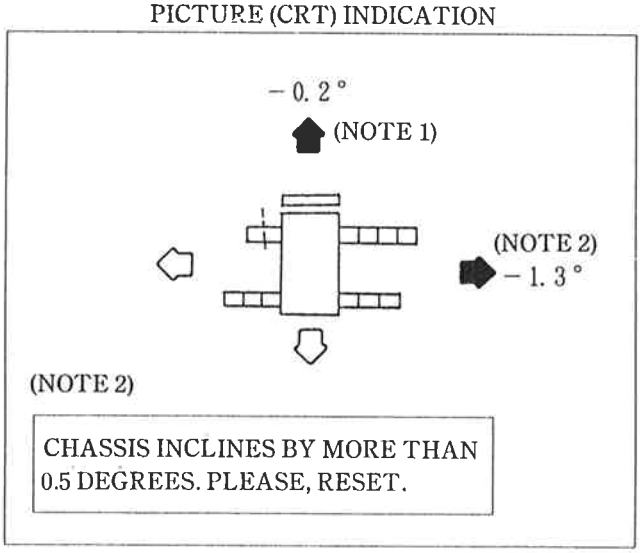
Do not place the switch in the HORZ position. This could damage the horizontal cylinder.

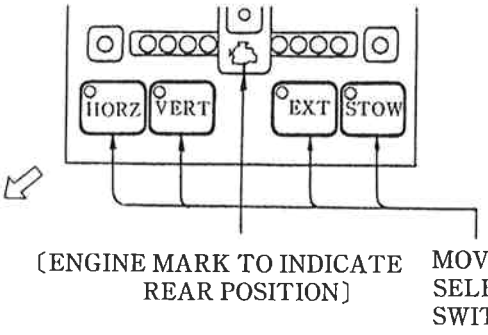


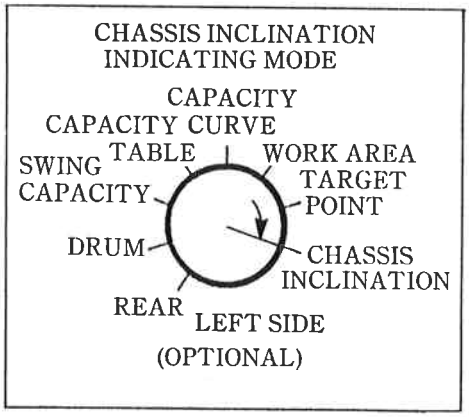
(2) While seeing the indicated picture (CRT), push the movement switches for the right front and right rear outriggers little by little.

(3) Since this machine is provided with the machine inclination detecting device, select the chassis inclination indicating mode with the indication selector switch, or set the movement selector switch of the outrigger control (however, the indication selector switch is a position other than the REAR position). The machine inclination is automatically indicated on the picture (CRT).

PICTURE (CRT) INDICATION







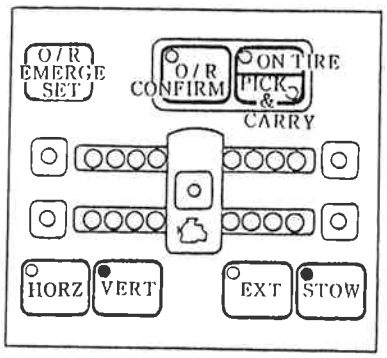
(INDICATION SELECTOR SWITCH)

NOTE 1. The lower side of inclination is shown with the black colored arrow marks, and inclination is indicated in unit of 0.1 degree.

NOTE 2. When the machine inclines by more than 0.5 deg. , this message is issued. And voice "Set the machine horizontally." also sounds.

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● STOWING THE OUTRIGGERS ·····
The stowing operation is the reverse operation of the extending operation except operation of the outrigger confirmation setting switch.



(1) Set the movement selector switches in the [STOW] and [VERT] positions.

CAUTION

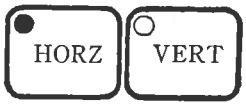
Do not set the switch in the [HORZ] side. Retracting the horizontal beam with the float grounded could damage the vertical cylinder.

(2) Push the movement switch to retract the vertical cylinder and raise the float. Push the all movements switch in the center to retract the four vertical cylinders simultaneously.

CAUTION

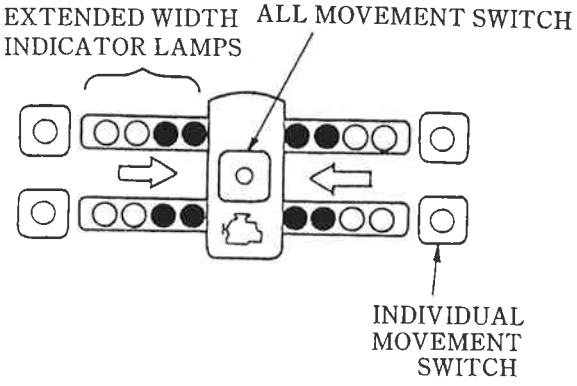
Retract the vertical cylinders completely to the end. If the cylinders are not completely retracted, the floats could catch something while traveling.

● Confirm the left and right rear outriggers with the mirrors.



(3) Set the movement selector switch in the [HORZ] side.

(4) Push the movement switch to retract the horizontal beam.



CAUTION

Retract the horizontal beams completely to the end. If the horizontal cylinders are not completely retracted, the beam could be caught by other vehicle while traveling.

● Confirm the left and right rear beams with the mirrors.

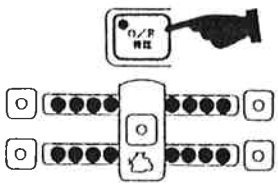
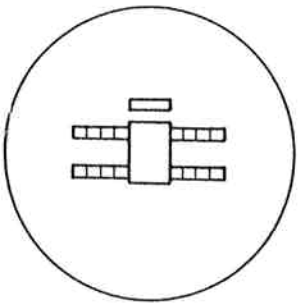
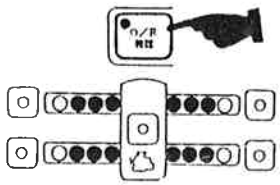
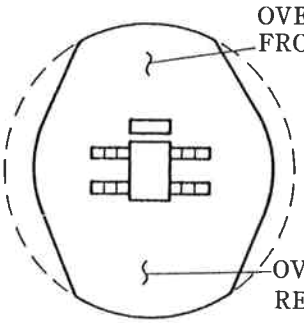
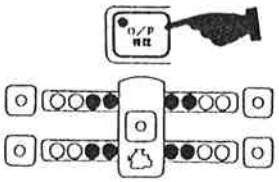
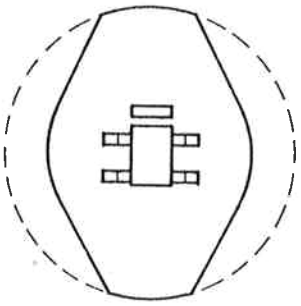
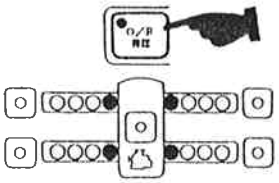
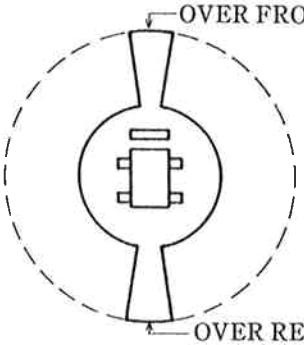
NOTE

If the parking brake only is not sufficient when parking on an inclined ground, it is convenient to use the auxiliary brake device for work. Since this device cannot be used for a long time, release the brake immediately after extending or stowing of the outriggers has been finished.

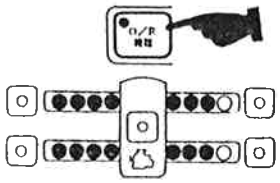
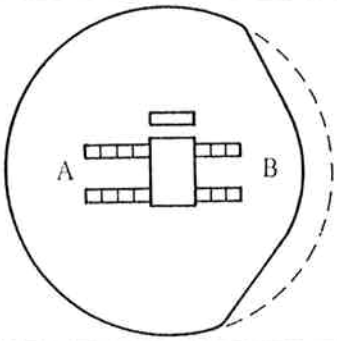
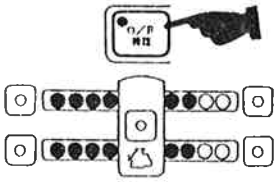
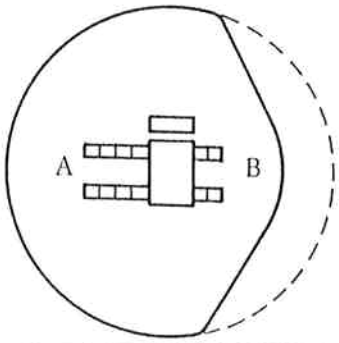
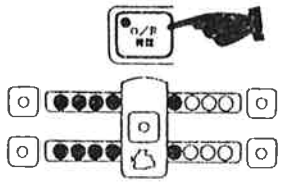
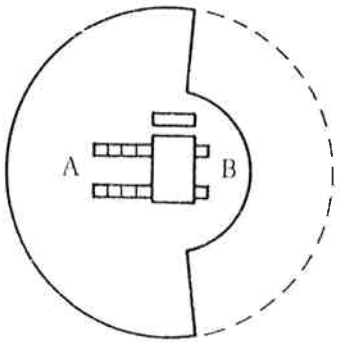
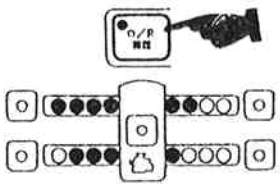
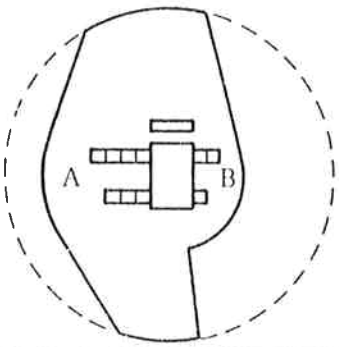
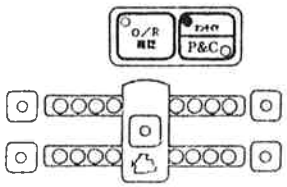
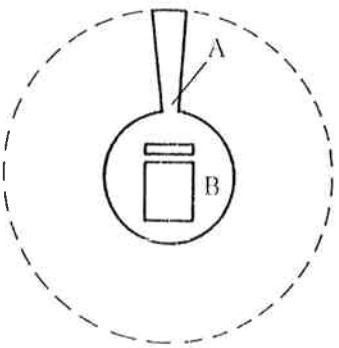
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■OUTRIGGER SETTING CONDITION AND CAUTION FOR OPERATION

● The area, in which operation can be done according to the outriggers set condition, is computed with the moment limiter, and indicated with the multi-display (swing capacity mode). When swinging, before capacity reaches 100% , the warning alarm is issued from the prenotice area, and swing motion is automatically stopped. In such operation, however, alway operate the machine without forgetting the following CAUTIONS.

Outrigger Extension Setting on Moment Limiter.	Picture (Swing Capacity Mode) Indication. ※ Capacity varies according to boom length. An example is shown below.	Range in which Operation can be done following Moment Limiter.
LEFT AND RIGHT MAX. EXTENSION 		Operation can be done with capacity for maximum extended width all round.
LEFT AND RIGHT MID-POINT 2 EXTENSION 		Operation can be done with capacity for mid-point 2 extension of outrigger over side. Capacity increases gradually as upper turns toward front and rear. Operation can be done with capacity for maximum extension of outrigger over front and over rear. CAUTION : The machine could overturn sooner after the outrigger rises from ground as compared with condition of max. extension (little tenacity). Overloading is dangerous.
LEFT AND RIGHT MID-POINT 1 EXTENSION 		Operation can be done with capacity for mid-point 1 extension of outrigger over side. Capacity increases gradually as upper turns toward front and rear. Operation can be done with capacity for maximum extension of outrigger over front and over rear. CAUTION : The machine could overturn sooner after the outrigger rises from ground as compared with condition of max. extension (little tenacity). Overloading is dangerous.
LEFT AND RIGHT MIN. EXTENSION  H-TYPE ONLY		・H-type Outrigger Specification Operation can be performed with capacity of outrigger minimum extension over side. However, operation can be performed with capacity of outrigger maximum extension only over front and over rear. ・X-type Outrigger Specification. The same setting is possible with outriggers grounded, more than 2.98 meters (9.777ft) of outrigger extended width. However, capacity over side is capacity on tire. NOTE : Extend outriggers with suspension cylinders fully retracted and with suspensions locked. CAUTION : Use minimum extension in unavoidable case only. The machine will overturn in a moment when outrigger rises from ground as compared with condition of mid-point extension. Overloading should be absolutely avoided.

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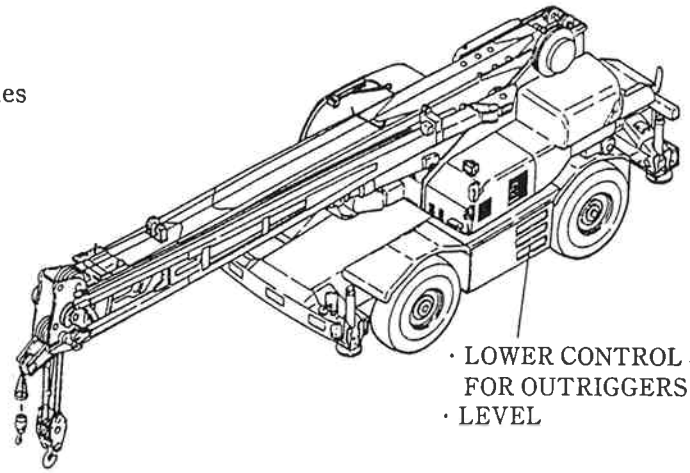
Outrigger Extension Setting on Moment Limiter.	Picture (Swing Capacity Mode) Indication. ※ Capacity varies according to boom length. An example is shown below.	Range in which Operation can be done following Moment Limiter.
LEFT AND RIGHT DIFFERENT EXTENSION : MAX. / MID-POINT 2 		Operation can be done with capacity for max. extension of outrigger in range A only. In range B, operation can be operated with capacity for mid-point 2 extension of outrigger. Before entering range B, slowly stop swing motion being careful not to swing load. Operation can be done with capacity for max. extension of outrigger over front and over rear. CAUTION : Entering range B with full load for max. extension suspended will overturn the machine.
LEFT AND RIGHT DIFFERENT EXTENSION : MAX. / MID-POINT 1 		Operation can be done with capacity for max. extension of outrigger in range A only. In range B, operation can be operated with capacity for mid-point 1 extension of outrigger. Before entering range B, slowly stop swing motion being careful not to swing load. Operation can be done with capacity for max. extension of outrigger over front and over rear. CAUTION : Entering range B with full load for max. extension suspended will overturn the machine.
LEFT AND RIGHT DIFFERENT EXTENSION : MAX. / MIN. 		· II-type Outrigger Specification Operation can be performed with capacity of outrigger maximum extension in range A only. In range B, operation can be performed with capacity of outrigger minimum extension. Before entering range B, slowly stop swinging not to allow load to be swung. However, operation can be performed with capacity of outrigger maximum extension over front and over rear. · X-type Outrigger Specification. In range B, the same setting is possible with outriggers grounded, more than 1.49 meters (4.888ft) in one side of outrigger extended width. However, capacity in range B is capacity on tire. NOTE : Extend outriggers with suspension cylinders fully retracted and with suspensions locked. CAUTION : Entering range B with full load for max. extension suspended will overturn the machine. Use of min. extension must be avoided as far as possible.
ALL DIFFERENT 		In range A only, operation can be done with capacity for mid-point 2 extension of outrigger. In range B, operation can be done with capacity for min. extension of outrigger. Before entering range B, slowly stop swing motion being careful not to swing load. Operation can be done with capacity for max. extension of outrigger over front and over rear. Avoid such setting as far as possible. CAUTION : Entering range B with full load for mid-point extension suspended will overturn the machine.
OUTRIGGER NOT USED. 1. PICK AND CARRY 2. OPERATION ON TIRE 		· When swing lock pin is inserted (over front ±1°), capacity over front is A, and capacity in range other than over front is B. · When swing lock pin is not inserted, capacity is B all round. NOTE When the shift lever is placed in other position than the N position, capacity becomes automatically "Pick and Carry" capacity.

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■LOWER OUTRIGGER CONTROL SWITCH

The lower outrigger control is provided in the lower left side of the carrier.

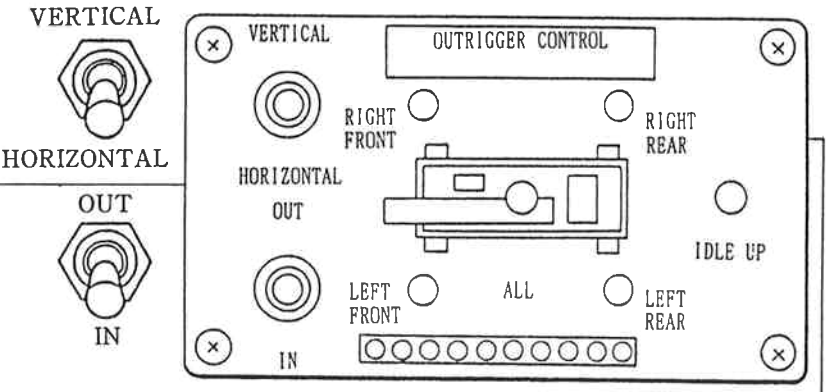
Operate the lower outrigger control switches through the space between the steps.



· LOWER CONTROL SWITCHES FOR OUTRIGGERS
· LEVEL

Select moving of the horizontal beam or moving of the vertical cylinder.

Select extending or stowing of the horizontal beam and vertical cylinder.



Push the button switch for the each outrigger position to move the outrigger. When moving the all outriggers at the same time, push the center switch ALL.

MOVEMENT SELECTOR SWITCHES (3 POSITION TOGGLE SWITCHES)

MOVEMENT SWITCHES FOR EACH OUTRIGGER AND OPERATING SWITCH FOR ALL (PUSH BUTTON SWITCHES)

CAUTION

After extending or stowing is finished, return the switch to the neutral position.

FINAL SETTING

To confirm the final setting of the outrigger, push the O. / R CONFIRM button switch on the outrigger control panel in the operator's room.

IDLE-UP PUSH BUTTON SWITCH

When it is required to raise the outrigger moving speed, pushing this switch makes the engine speed rise.

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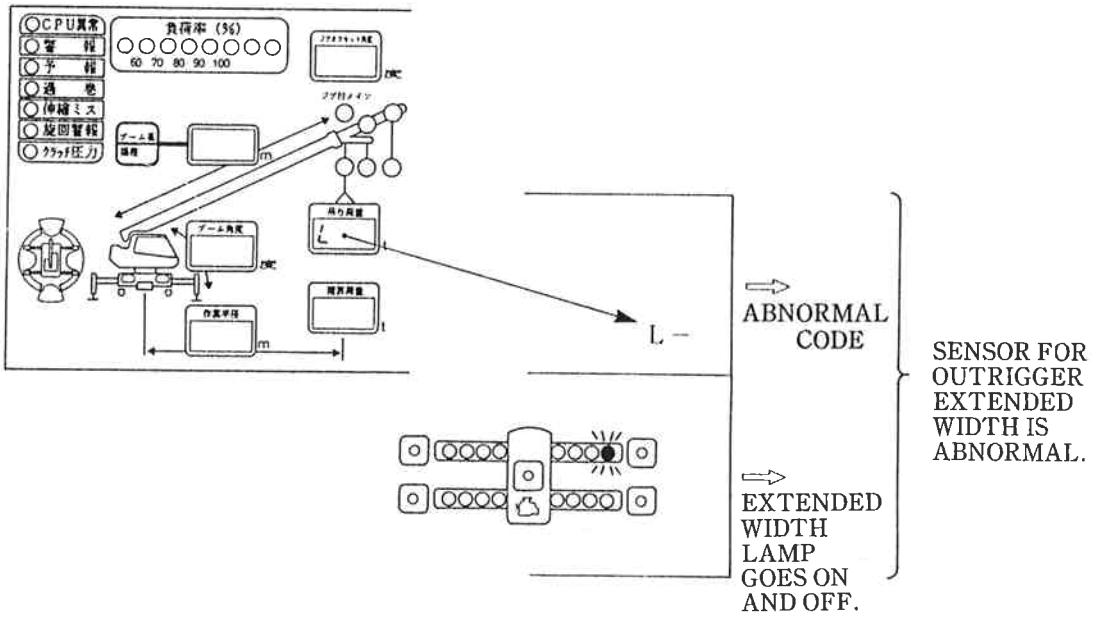
OUTRIGGER CONTROL RELATION IN SUCH CASE !

1. When retracting operation (vertical or horizontal) is made again after confirmation setting has been completed.

   · This is a case or so on such as horizontal setting is done over again after operation of the outriggers has been completed. When retracting operation is made, the outrigger extended width indicator lamp is changed from lighting to going on and off once.

   In this case, push the confirmation switch again, and set again.
   However, if the lamp does not changed to lighting, carry out vertical extending operation again, and push the confirmation switch.

2. When abnormality related to the outrigger is indicated on the indicator of the moment limiter panel, during operation, as shown in the following figure.



   · Crane operation can be continued, but crane capacity is automatically changed to capacity on tire.
   In such case, it is necessary to reset the outrigger extended width so that crane capacity agrees with the capacity corresponding to the actual outrigger extended width. This is called "Emergency setting operation" of the outrigger.

3. When the shift lever is placed in other position than the [N] position, the mode becomes automatically "Pick and Carry" mode. If the shift lever is operated with the outrigger extended by mistake, push the [ON TIRE/CREEP] switch to put the pick & carry mode out, then push the [SET] (O/R confirm) button to return to the normal condition.

Emergency Setting Operation

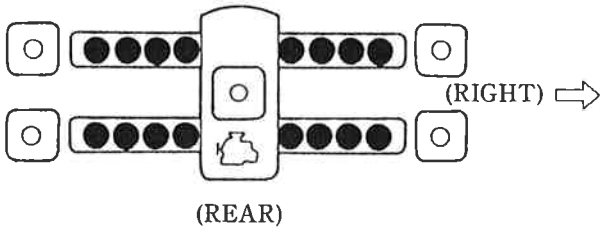
1. Every pushing the O / R (outrigger) emergency setting switch, the left front O / R indicator lamp indicates in the order of [MIN] → [MID-POINT 1] → [MID-POINT 2] → [MAX]. When the width agrees with the actual extended width, push the confirm switch. Now, the left front outrigger setting is completed.
2. Carry out the same operation to the right front outrigger, left rear outrigger and right rear outrigger.
3. When the setting of the four outrigger extended widths is completed, the outrigger setting condition is automatically memorized by the moment limiter (ML).
4. The capacity of the ML is the capacity on tire until the four outriggers setting is completed.

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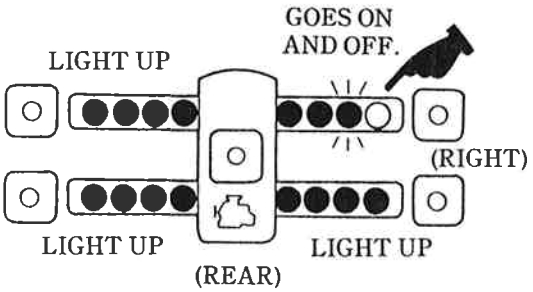
3. When operation is carried out without insertion of the horizontal beam lock pins.
   · If retraction of the horizontal beam is occurred during operation, indication is changed to the following indication.

〈Example〉 When the outriggers are fully extended.

When normal



When abnormality occurs.
(Right front beam retracts.)



In such case, crane capacity is automatically changed to capacity on tire.

When this condition occurs with a load suspended, in order to lower the load first, push the confirm switch and set the capacity in that condition.

   · When beginning operation again, extend the horizontal beam to the specified position, then insert the lock pin, and operate confirm setting over again.

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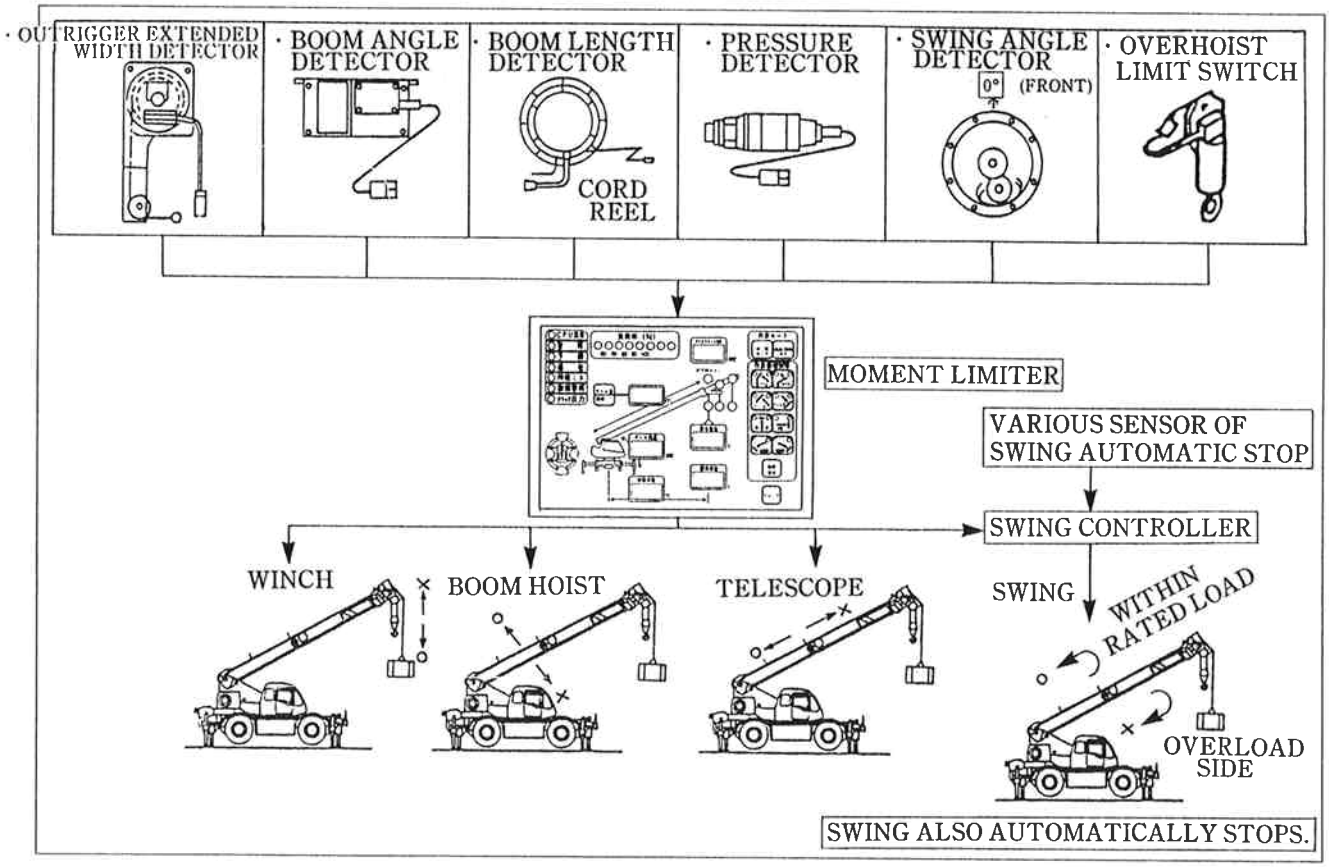
3.4 AUTOMATIC STOP FUNCTION AND USE OF RELEASE SWITCH

1) AUTOMATIC STOP FUNCTION

This is a function to automatically stop the crane in order to avoid danger when operating condition becomes overloaded condition or overhoisted condition, and when operation is stopped, all operations toward the dangerous side become impossible.

Even when the automatic stop function operates, operation toward the safe side is possible.

For the swing automatic stop function, see paragraph Swing Automatic Stop Device.



Automatic Stop Function

2) CONTENTS OF AUTOMATIC STOP FUNCTION AND METHOD OF RELEASE

Contents of Automatic Stop Function and Method of Release

Working Condition		Contents	Method of Release (1)	Method of Release (2)
1	Overload work	When lifting load exceeds limited load, and alarm is put out.	Operate lever, which causes overload, to safe side.	· Turn automatic stop release switch on. · For swing direction, turn swing stop release switch on.
2	Overhoist of hook	When hook is overhoisted, alarm is put out.	Lower hook.	Turn overhoist release switch on.
3	Telescope mistake (Telescope motion only automatically stops.)	When selection of telescope lever for 2nd and 3rd / 4th booms is mistaken.	Correct selection of telescope selector switch.	By turning automatic stop release switch on, motion which is selected with telescope selector switch becomes possible.
4	When working area is limited.	When alarm is put out by point where working area is limited.	Push corresponding setting switch again.	· Turn automatic stop release switch on. · When swing area is limited, turn swing automatic stop release switch on.

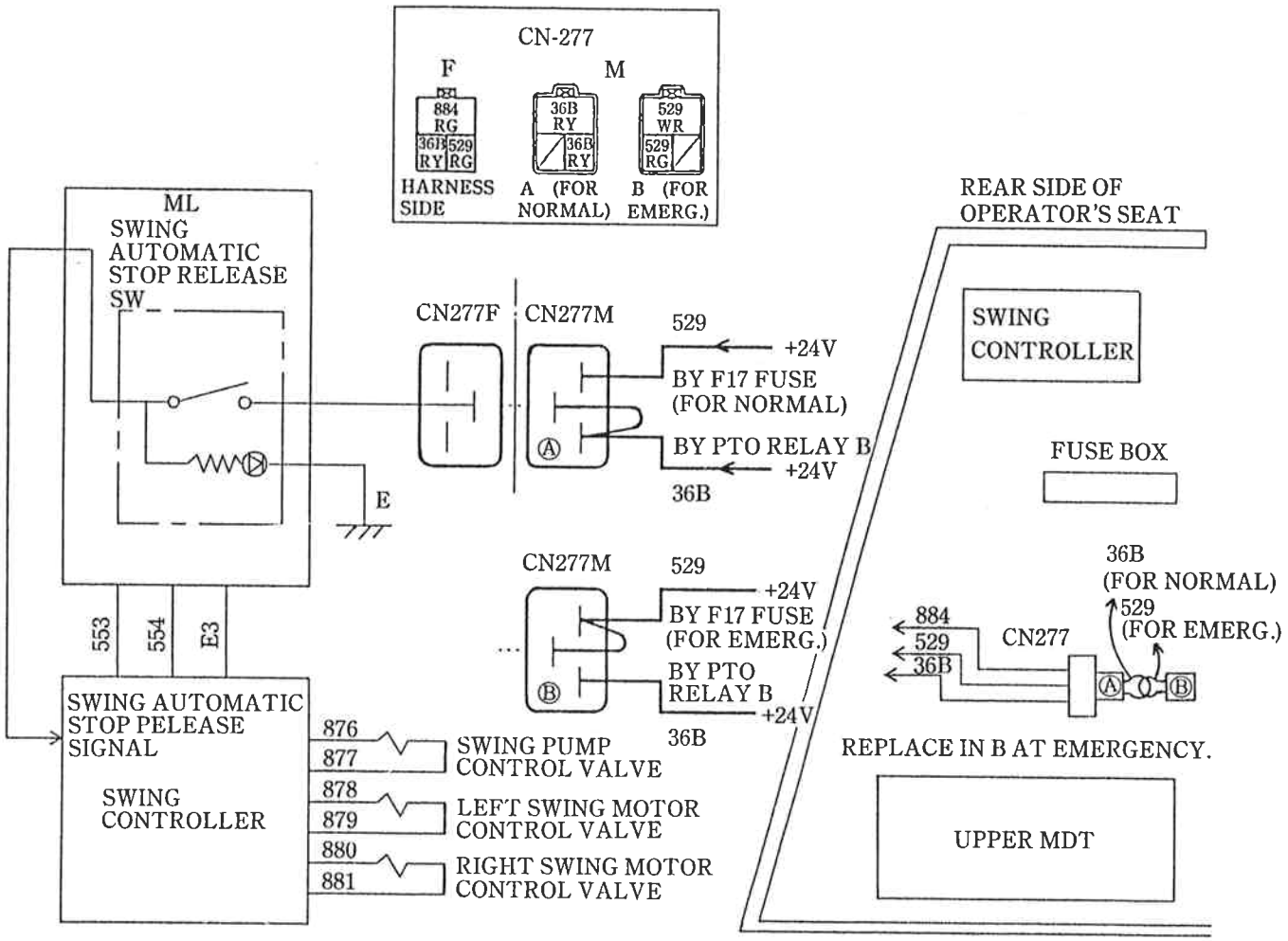
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Working Condition		Contents	Method of Release (1)	Method of Release (2)
5	Mistake of jib lever operation.	When jib lever is operated at other mode than jib mode and jib ext / stow mode.	Return jib lever to neutral position.	(Even by turning automatic stop release switch on, release is impossible.)

Method of release (1) ····· Method of release by normal operation.
Method of release (2) ····· Method of release made forcibly at emergency.

NOTE 1. : When abnormality occurs in the sensors of crane system (when error codes, except rope length sensors E-C and E-D, occur), swing automatic stop control cannot be normally operated.
(When abnormality occurs during swing motion, swing motion begins slowly to stop, and after stop, start is impossible.
When abnormality occurs during stop, start is impossible.)
Therefore, when the sensor is abnormal, turn the swing stop release switch on, then operate.

NOTE 2.



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3) USE OF RELEASE SWITCH

● ML AUTOMATIC STOP RELEASE SWITCH (SPRING RETURN TYPE)

By turning this switch to the right and holding it, the following automatic stop function can be released.

When overload is lifted.	○
When telescoping is mistaken.	○
When working area is limited.	○
When hook is overhoisted.	×
When swing motion is stopped.	×

○ : Release is possible.
× : Release is impossible.

CAUTION

- Use this switch only when check and maintenance are performed or for an unavoidable emergency.
- Operating with a condition always released is very dangerous. Absolutely avoid such operation.
- During crane operation, pull out this key from the switch section, and the safe administrator must administer it.

● OVERHOIST RELEASE SWITCH

When the hook is overhoisted, the overhoist preventive function operates to stop the hook automatically. When it is required to release the overhoist preventive function, turn this switch on.

CAUTION

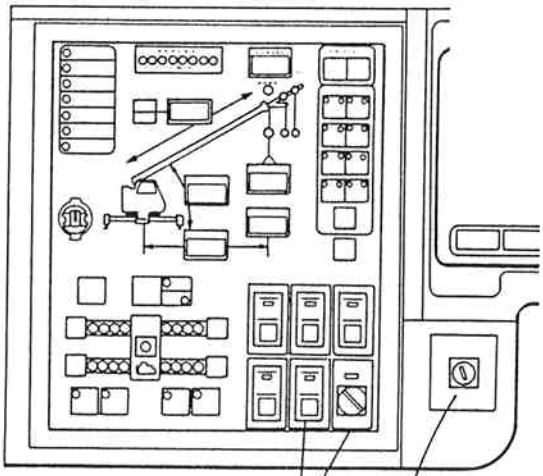
- During usual crane operation, absolutely do not use the overhoist release switch turned on.
  Since overhoisting the hook has possibility to cause damage to the boom and to fall a load, be sure confirm that this switch is turned off before beginning operation.

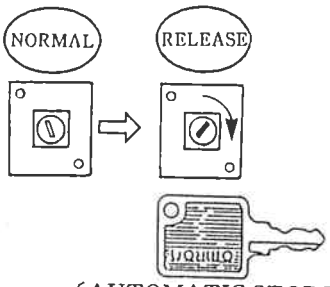
● SWING AUTOMATIC STOP RELEASE SWITCH (SPRING RETURN)

When a load becomes overload in a swinging direction, or when the swing area is limited, the swing automatic stop function operates, and swing motion is automatically stopped. When it is required to release the swing stop function, insert the key into the switch, and turn it to the right.

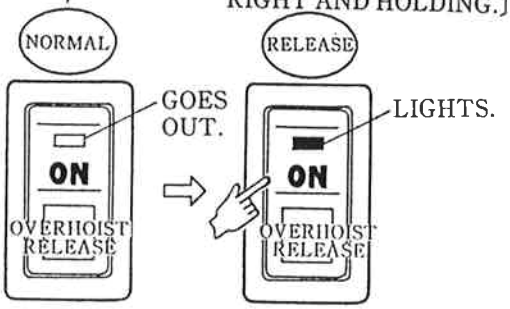
CAUTION

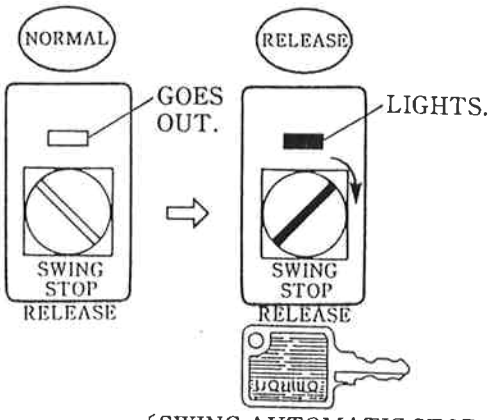
- Use this switch in an unavoidable emergency only.
- Always holding this switch in the released condition and operating are very dangerous. Absolutely avoid such operation.
- During crane operation, pull out this key from the switch, and the safety administrator must administer it.
- When abnormality occurs in the sensors of crane system, the swing automatic stop cannot be normally operated (swing motion slowly stops, and starting is impossible). At this time, using the swing automatic stop release switch, operate toward the safe side.





〔AUTOMATIC STOP IS RELEASED BY TURNING THIS SWITCH TO THE RIGHT AND HOLDING.〕





〔SWING AUTOMATIC STOP IS RELEASED BY TURNING THIS KEY TO THE RIGHT AND HOLDING.〕

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4. SPECIFICATION OF OPERATION

4.1 OUTPUT MOVEMENT TABLE

□ : Rapid intermittent (0.4 sec. cycle)

No		Condition		Switch Input (including Lever Detection): Boom up L. Sw.	Boom down L. Sw.	Boom ext. L. Sw.	Boom retr. L. Sw.	Main winch L. Sw.	Aux. winch L. Sw.	Jib up L. Sw.	Jib down L. Sw.	Telescope Select L. Sw.	Overhoist L. Sw.	Left swing L. Sw.	Right swing L. Sw.	Overload release	Output: Automatic stop 1	Automatic stop 2	Swing flasher	Exter. indication	Exter. indication	Exter. indication	Overhoist stop	Alarm sound: Buzzer	Electronic sound	Indication: CPU abnormality	Warning alarm	Prenotice alarm	Overhoist	Telescope mistake	Swing alarm	Clutch pressure	Remarks
1	Loading Condition	When moment ratio (LED indication) is	under 90 %																	○													＊1 Cycle (period) of going on and off is as follows :
			90 to 100 %																		○			＊1 △				＊1 △				
2			more than 100 %		○	○		○	○		○						○					○		○			○	○					
			more than 120 %		○	○		○	○		○						○					○		□			○	○					
		When indication of limited load is 0 ton	Lifting capacity is 0 ton due to machine working condition.		○	○		○	○		○						○							○			○	○					
			Setting of combination of each working condition selector switch is improper.		○	○		○	○		○						○							○			○	○					
3		When push button switch for check is pushed (when false overload signal occurs).															○					○		□			○	○					
4	Sensor Check	Abnormal boom angle meter (less than 0.3V or more than 11.7V)																						□								Lifting load indicator. Indicates "E-1"	"0" goes on and off in boom angle indicator
		Abnormal boom length meter (less than 0.1V or more than 11.7V)																						□								Indicates "E-2"	"0" goes on and off in boom length indicator
		Abnormal head pressure (less than 0.3V or more than 12.5V)																						□								Indicates "E-3"	
		Abnormal rod pressure (less than 0.3V or more than 12.5V)																						□								Indicates "E-4"	
		Abnormal jib angle meter (less than 0. 6V or more than 11.4V)																						□								Indicates "E-5"	"0" goes on and off in jib angle indicator
		Abnormal swing angle meter 1 (When voltage is other than range of 2.6V＜V＜3.2V with swing lock pin in ON.)																						□						□		Indicates "E-6A"	Swing angle indicator goes on and off.
		Abnormal swing angle meter 2 (When voltage is other than range of 8.7V＜V＜9.4V with swing lock pin in ON.)																						□						□		Indicates "E-6B"	Swing angle indicator goes on and off.
		Abnormal swing angle meters 1, 2 (When voltage difference between swing angle meters 1 and 2 is other than range of 5.0V＜V＜7.0V.)																						□						□		Indicates "E-6A" and "E-6B" alternately.	Swing angle indicator goes on and off.
		Abnormal machine fore-aft inclination meter (transmitted from MDT)																						□								Indicates "E-7"	
		Abnormal machine left-right inclination meter (transmitted from MDT)																						□								Indicates "E-8"	
		Abnormal swing angular speed meter(transmitted from swing controller)																						□								Indicates "E-9"	
		Abnormal swing brake left pressure gauge (transmitted from swing controller)																						□								Indicates "E-A"	
		Abnormal swing brake right pressure gauge (transmitted from swing controller)																						□								Indicates "E-b"	
		Abnormal main winch rope length (transmitted from swing controller)																						□								Indicates "E-c"	
		Abnormal auxiliary winch rope length (transmitted from swing controller)																														Indicates "E-d"	
		Abnormal left front outrigger length meter (transmitted from MDT)																						□								Indicates "L-1"	Full extension only goes on and off in corresponding O/R length indicator.
		Abnormal right front outrigger length meter (transmitted from MDT)																						□								Indicates "L-2"	— do —
		Abnormal left rear outrigger length meter (transmitted from MDT)																						□								Indicates "L-3"	— do —
		Abnormal right rear outrigger length meter (transmitted from MDT)																						□								Indicates "L-4"	— do —
5		Overload release switch is turned on														○																	

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No	Condition					Switch Input (including Lever Detection)													Output							Alarm sound		Indication							Remarks
						Boom up L. Sw.	Boom down L. Sw.	Boom ext. L. Sw.	Boom retr. L. Sw.	Main winch L. Sw.	Aux. winch L. Sw.	Jib up L. Sw.	Jib down L. Sw.	Telescope Select L. Sw.	Overhoist L. Sw.	Left swing L. Sw.	Right swing L. Sw.	Overload release	Automatic stop 1	Automatic stop 2	Swing flasher	Exter. indication	Exter. indication	Exter. indication	Overhoist stop	Buzzer	Electronic sound	CPU abnormality	Warning alarm	Prenotice alarm	Overhoist	Telescope mistake	Swing alarm	Clutch pressure	
6	Overhoist limiting	Overhoisting when overhoist release switch is		turned off			○	○		○	○		○											○		○				○				
				turned on			○	○		○	○		○					○						×		○				○				
7	Angle limiting	i) When boom is raised or retracted with boom length under 13 meters and boom angle more than 79.5 degrees.	Boom length	Boom angle	Boom up L. Sw. or boom retr. L. Sw.																													
			Under 13 m	More than 79.5°	ON	○			○									○							○			○						
			do	do	OFF																				○			○						
		ii) Boom length is more than 13 meters.			More than 80.3° —																				○			○						
					Under 80.3° —																														
8	Telescoping operation	Telescope mistake detection	Boom length: Under L meter	Boom length: More than L meter																														When boom length is in the following range, telescope mistake is not judged.
			○					○											○						○					○				
			○																						○					○				
				○										○											○					○				
				○					○					○					○						○					○				
9	Computer is out of order.																										○							
10	Jib mistake operation	Sky tilt specification only. [Automatic stop when jib is operated (lowering) with mode other than jib mode.]	Work mode	When jib cylinder length signal is abnormal.																														
			Other than jib mode	—								○							○					○			○							
			When jib mode is abnormal. (Sky tilt specification only)									○							○					○			○							
11	Swing warning flasher	When swing detecting limit switch is turned on.	When left swing detecting limit switch is turned on.												○					○														
			When right swing detecting limit switch is turned on.													○				○														
12	Swing warning alarm	Swing warning alarm due to overload.	When prenotice alarm is put out. *2																					△						○			*2 Judgment of prenotice and warning is transmitted from swing controller.
			When warning alarm is put out. *2																					○						○			*2 Judgment of prenotice and warning is transmitted from swing controller.
13		When accumulator switch is turned on.																							○							○		
		When low air pressure switch is turned on.																							○									
15	Working area	When boom up is set.	When normal.		—																													
			When prenotice is issued.		○																				＊3 △									
			When warning is issued.		○													○							○									
		When boom down is set.	When normal.																															
			When prenotice is issued.			○																			＊3 △									
			When warning is issued.			○													○							○									

	Boom length in meter
RK250-3	15.92≦L<16.92
RK350	15.26≦L<16.26
RK450-2	24.21≦L<24.91

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No.	Condition		Switch Input (including Lever Detection)														Output							Alarm sound		Indication							Remarks
			Boom up L. Sw.	Boom down L. Sw.	Boom ext. L. Sw.	Boom retr. L. Sw.	Main winch L. Sw.	Aux. winch L. Sw.	Jib up L. Sw.	Jib down L. Sw.	Telescope Select L. Sw.	Overhoist L. Sw.	Left swing L. Sw.	Right swing L. Sw.	Overload release	Automatic stop 1	Automatic stop 2	Swing flasher	Exter. indication	Exter. indication	Exter. indication	Overhoist stop	Buzzer	Electronic sound	CPU abnormality	Warning alarm	Prenotice alarm	Overhoist	Telescope mistake	Swing alarm	Clutch pressure	
15	Working Area	When lifting height is set. — When normal.	–		–				–																							
		When prenotice is issued.	○		○				○														*3 △									*3 Period of buzzer on/off is mentioned before. When there is more than 2 kinds of periods, earlier period takes priority.
		When warning is issued.	○		○				○							○							○									
		When operating radius is set. — When normal.		–	–				–																							
		When prenotice is issued.		○	○				○														*3 △									
		When warning is issued.		○	○				○							○							○									
		When left swing is set. — When normal.											–																			
		When prenotice is issued.											○										*3 △							*3 △		
		When warning is issued.											○										○							○		
		When right swing is set. — When normal.												–																		
		When prenotice is issued.												○									*3 △							*3 △		
		When warning is issued.												○									○							○		
		When jib up is set. — When normal.							–																							
		When prenotice is issued.							○														*3 △									
		When warning is issued.							○							○							○									
		When jib down is set. — When normal.								–																						
		When prenotice is issued.								○													*3 △									
		When warning is issued.								○						○							○									
16	Measure for Stroke End of Boom up	Boom angle is under 78° and moment ratio is under 100% — Boom up — After boom angle reaches more than 78°, moment ratio reaches 100%	○																				○									It is judged that load pressure has been raised at the stroke end of boom up, and automatic stop does not function.
		Boom angle is under 78° and moment ratio is more than 100% — Boom up — After boom angle reaches more than 78°, moment ratio continues more than 100%	○																				○									Since load pressure is raised at a place other than the stroke end of boom up, automatic stop functions.

● For control of jib extension / stowing, see paragraph 4.3.

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4.2 OPERATION OF LEVER OPERATION DETECTING LIMIT SWITCHES

(1) LIMIT SWITCHES RELATED TO BOOM HOIST, TELESCOPE AND WINCHES

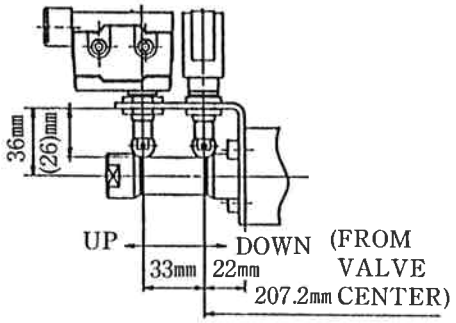
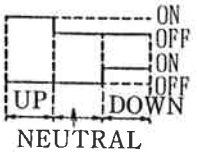
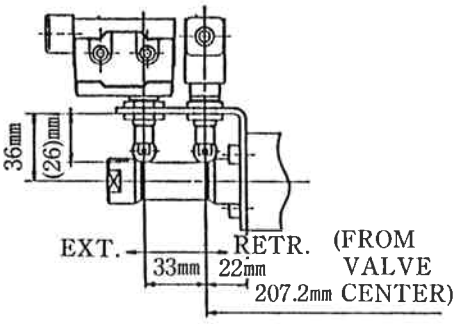
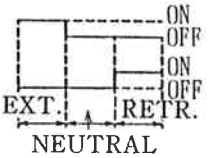
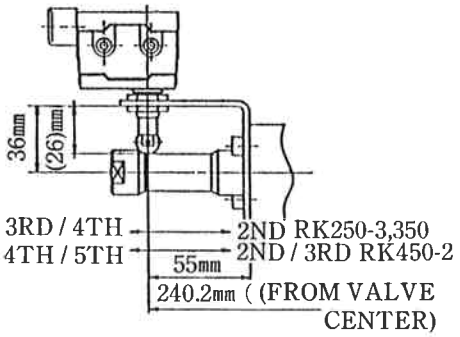
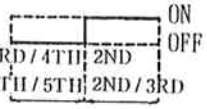
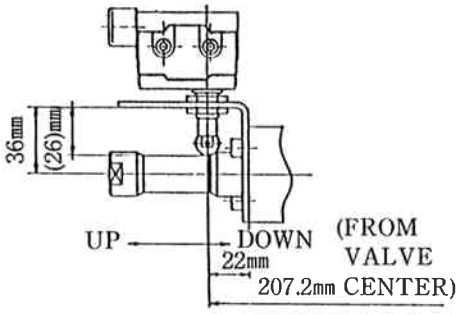
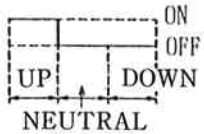
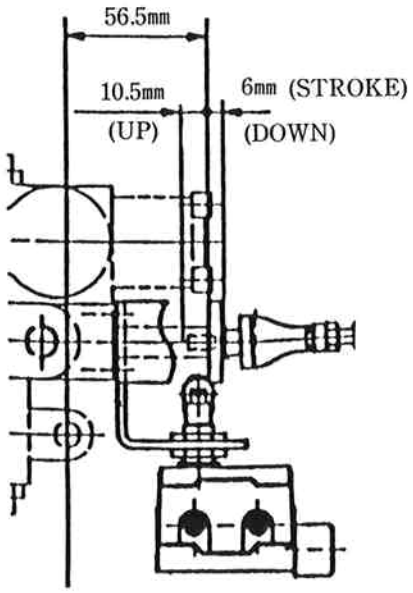
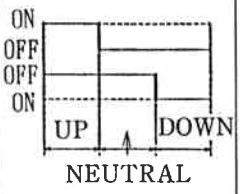
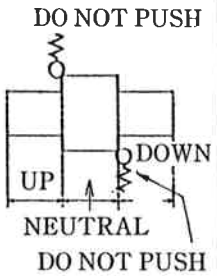
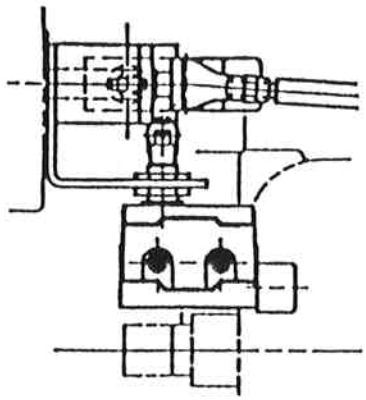
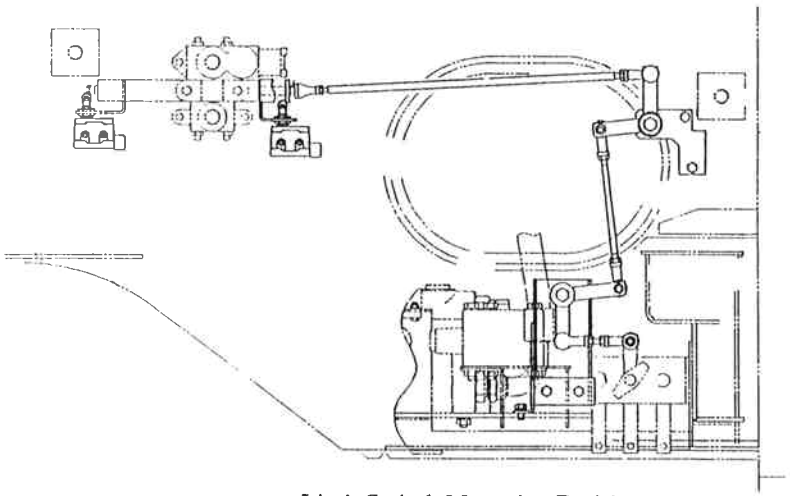
classification	Mounting Condition of Limit Switch	Symbol of Point of Contact	Operating Condition of Limit Switch	Solenoid Valve for Overload.
Boom Hoist	 When spool is in Neutral, actuator is in Free position.	UP SIDE LIMIT SWITCH NO DOWN SIDE LIMIT SWITCH NO	DO NOT PUSH DOWN DETECT UP DETECT UP ⟷ DOWN	
Telescoping	 When spool is in Neutral, actuator is in Free position.	EXT. SIDE LIMIT SWITCH NO RETR. SIDE LIMIT SWITCH NO	DO NOT PUSH RETR. DETECT EXT. DETECT EXT. ⟷ RETR.	
Telescope Selection	 When spool is in Neutral, actuator is in Free position.	NO (RK250-3, RK350) (RK450-2)	DO NOT PUSH. 2ND DETECT 2ND / 3RD DETECT 3RD / 4TH ⟷ 2ND 4TH / 5TH 2ND / 3RD	
Winches (main and auxiliary)	 When spool is in Neutral, actuator is in Free position.	NO	DO NOT PUSH. UP DETECT UP ⟷ DOWN	

Fig. 4-1 Limit Switch for Evasion to Safe side

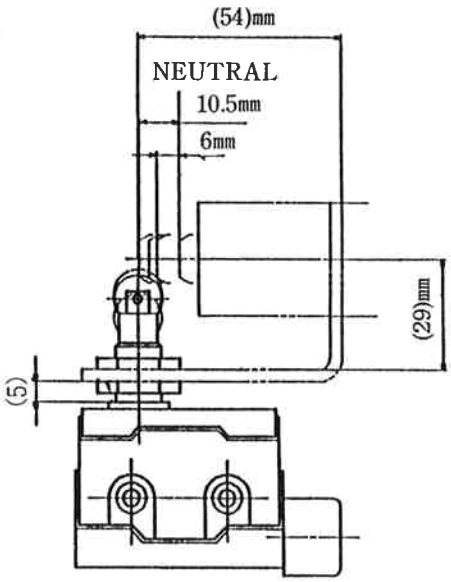
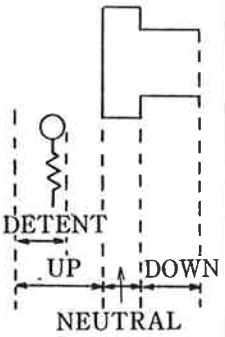
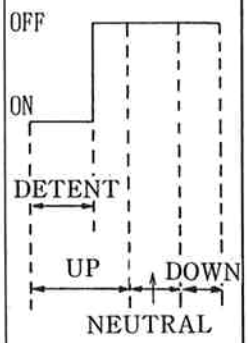
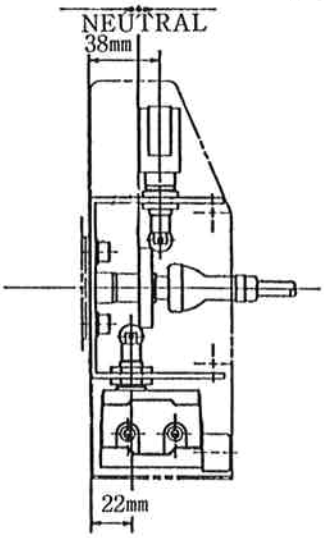
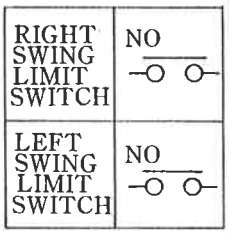
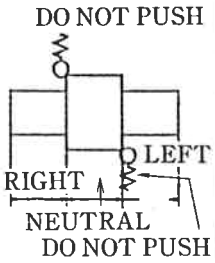
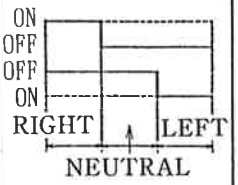
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classification	Mounting Condition of Limit Switch	Symbol of Point of Contact	Operating Condition of Limit Switch	Solenoid Valve for Overload.
Tilt (Jib up)		UP SIDE LIMIT SWITCH NO DOWN SIDE LIMIT SWITCH NO		
Tilt (Jib down)				



Limit Switch Mounting Position

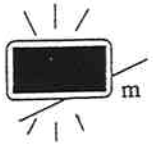
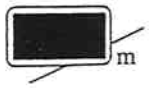
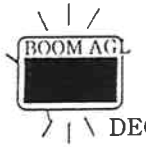
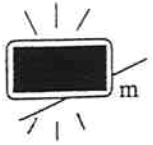
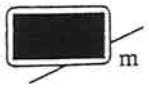
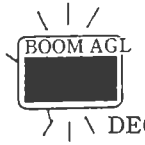
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classification	Mounting Condition of Limit Switch	Symbol of Point of Contact	Operating Condition of Limit Switch	Solenoid Valve for Overload.
Tilt (Jib up end)				
Swing	RIGHT SWING 8mm 8mm LEFT SWING 			

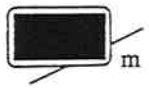
4.3 SPECIFICATION OF JIB EXTENDING / STOWING CONTROL

1) JIB EXTENDING CONTROL

- When the jib extending mode starts, the mode starts from mode 1.
- When power is supplied again in the midst of the jib extending mode, the mode restarts from the midst of the mode.

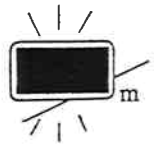
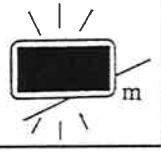
Mode	Indication of Boom Length	Indication of Boom Angle	Indicators of Other LCDs	Condition	Specification		Remarks
1.	Goes on and off. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	When condition of "boom length≦ℓ1+0.1 m" continues for more than 1 sec., the mode shifts to mode 2. (When mode shifts, sound "Pi" sounds.)	Boom up Boom down Boom extension Jib down (tilt specification)	When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	Value of ℓ1 RK250-3: 9.32m RK350: 9.35m RK450-2: 10.20m
2.	Lights up. (Present value is indicated.) 	Goes on and off. (Present value is indicated.) 	Go out.	When boom angle is "boom angle≧78°", the mode shifts to mode 3. (When mode shifts, sound "Pi" sounds.)	Boom down Boom extension Jib down (tilt specification)	When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	
3.	Goes on and off. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	When boom length is "boom length≧※1 set value -0.05m", the mode shifts to mode 4. (When mode shifts, sound "Pi" sounds.)	Boom up Boom down Jib down (tilt specification)	When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	※1 Set value : Set value of jib extending point adjustment set by ML adjustment. (Basic length + around 1.3 m)
4.	Lights up. (Present value is indicated.) 	Goes on and off. (Present value is indicated.) 	Go out.	When boom angle is "boom angle≦40°", the mode shifts to mode 5. (When mode shifts, sound "Pi" sounds.)	Boom up Boom extension Jib down (tilt specification)	When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	

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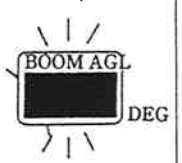
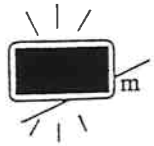
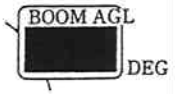
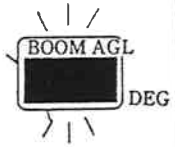
Mode	Indication of Boom Length	Indication of Boom Angle	Indicators of Other LCDs	Condition	Specification	Remarks
5.	Lights up. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	The jib extending mode is continued, and capacity shall be of main mode.	Each boom can be operated. (However, the movement shall be stopped for overload and overhoist.)	

2) JIB STOWING CONTROL

- When the jib stowing mode starts, the mode starts from mode 6.
- When power is supplied again in the midst of the jib stowing mode, the mode restarts from the midst of the mode.

Mode	Indicators of Boom Length	Indication of Boom Angle	Indicators of Other LCDs	Condition	Specification	Remarks
6.	Lights up. (Present value is indicated.) 	Goes on and off. (Present value is indicated.) 	Go out.	With boom angle≦70° , When boom length is over "set value (※1) + 0.05m" , the mode shifts to mode 7. When boom length is under "set value-0.05 m" , the mode shifts to mode 8. ("Pi" sounds when shifting.)	Boom up Boom retraction Boom extension Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	※1 Set value : Set value of jib extending point adjustment set by ML adjustment. (Basic length + around 1 . 3 m)
7.	Goes on and off. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	When boom length is less than "set value (※) + 0.05m" , the mode shifts to mode 8. (When mode shifts, sound "Pi" sounds.)	Boom up Boom down Boom extension Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	
8.	Goes on and off. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	When boom length is more than "set value (※ 1) -0.05m" and when boom retracting lever is set in neutral, the mode shifts to mode 9. (When mode shifts, sound "Pi" sounds.)	Boom up Boom down Boom retraction Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	

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Mode	Indication of Boom Length	Indication of Boom Angle	Indicators of Other LCDs	Condition	Specification	Remarks
9.	Lights up. (Present value is indicated.) 	Goes on and off. (Present value is indicated.) 	Go out.	When boom angle is more than 78° , the mode shifts to mode 10. (When mode shifts, sound "Pi" sounds.)	Boom down Boom extension Boom retraction Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	
10.	Goes on and off. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out.	When boom length is less than "ℓ_1+0.1m" , and when the condition continues for more than 1 second, the mode shifts to mode 11 (When mode shifts, sound "Pi" sounds.)	Boom extension Boom up Boom down Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	Value of ℓ_1 RK250-3 : 9.32m RK350 : 9.35m RK450-2 : 10.20m
11.	Lights up. (Present value is indicated.) 	Goes on and off. (Present value is indicated.) 	Go out.	When the boom angle is less than 40° , the mode shifts to mode 12. (When mode shifts, sound "Pi" sounds.)	Boom up Boom extension Boom retraction Jib down (tilt specification) } When one of these levers is turned on, automatic stop 2 solenoid is turned on. (Alarm lamp and buzzer are turned on.)	
12.	Lights up. (Present value is indicated.) 	Lights up. (Present value is indicated.) 	Go out. (Present value is indicated.)	The jib stowing mode is continued, and capacity shall be of main mode.	Each boom can be operated. (However, movement shall be stopped for overload and overhoist.)	

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5. ADJUSTMENT

5.1 GENERAL

Since this load safety device is arranged so that various adjusting values are memorized by memorizing IC in the device, the adjusting variable resistances, which have been hitherto used in the load safety device, are not used at all in this device, and adjustment can be made by operating the push button switches on the indicator panel. Therefore, even when adjusting, adjustment can be made easily without touching the base plates of the load safety device.

5.2 ADJUSTING ITEMS

(1) The following table shows the necessary adjusting items and operating order when detectors are replaced.

Adjusting Item Table

Adjusting Item \ Replacement of Detectors and so on		Item No. (indicated on jib angle indicator)	Boom	ML assembly or CPU-P-plate	Detectors: Outrigger extended length	Boom angle	Boom length	Swing angle	Pressure	Jib angle	Fore-aft chassis inclination	Left-right chassis inclination
①	Model code setting	0		●								
②	Release indication select mode setting			●								
③	Outrigger extended length adjustment	12		●	●							
④	Boom angle adjustment	1	●	●		●						
⑤	Boom length adjustment	2	●	●		⇩	●					
⑥	Oper. radius adjustment	3	●	●		○(※)	○(※)					
⑦	Jib angle adjustment	Present Jib angle		●						●		
⑧	Swing angle adjustment	5	⇩	●				●				
⑨	Weight element adjust.	6-0~2	●	●					●			
⑩	Lifting load indication adjustment	7-0~2	●	●					●			
⑪	Warning alarm point adjustment	8	‖	●								
⑫	Fore-aft. chassis inclination adjustment	9	‖	●							●	
⑬	Left-right chassis inclination adjustment	10	‖	●								●
⑭	Jib extending point adjustment	11	●	●			●					

NOTE : 1) Mark ● means indispensable adjusting item, and mark ○ means confirming item.
2) Item ② "Release indication select mode setting" is optional, and required when external indicator lamp is provided.
3) When ROM of ML only is replaced, adjustment is not required. However, it is replaced with ROM, of which soft content has been changed, sometimes specified items require adjustment.

(2) OVERALL ADJUSTMENT and INDIVIDUAL ADJUSTMENT

OVERALL ADJUSTMENT ····· · When the moment limiter (ML computer / indicator) assembly or CPU-P-plate only is replaced, adjustment and confirmation for all items are required as shown above.
· When the boom is replaced also, it is the same.

INDIVIDUAL ADJUSTMENT ····· · This is the case that each detector has been replaced. However, after adjustment related to the boom angle and / or boom length detector has been made, mark ※ in the above table, that is, confirmation of indicated value of the operating radius should be carried out faithfully.
· Besides, regardless of replacement of detectors and etc. , adjustment, such as lifting load indication adjustment, is sometimes required in order to correct the indicated value as required by the operator.

5.3 PREPARATION FOR ADJUSTMENT

(1) PREPARATION OF NECESSARY EQUIPMENTS FOR ADJUSTMENT

①	Alligator clip for shifting to adjusting mode.
②	Bevel protractor with level attached for measuring boom angle.
③	Lifting weight, of which weight is clear, and sling wire rope.
④	Tape measure (20 meters) for measuring operating radius.

· Detail of use of necessary equipments is explained in paragraph 5.4 Adjusting Function on page 5-2.
· ③ lifting weight is necessary for operating radius indication adjustment and lifting load indication adjustment.

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5. ADJUSTMENT

5.1 GENERAL

Since this load safety device is arranged so that various adjusting values are memorized by memorizing IC in the device, the adjusting variable resistances, which have been hitherto used in the load safety device, are not used at all in this device, and adjustment can be made by operating the push button switches on the indicator panel. Therefore, even when adjusting, adjustment can be made easily without touching the base plates of the load safety device.

5.2 ADJUSTING ITEMS

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Adjusting Item Table

Adjusting Item \ Replacement of Detectors and so on		Item No. (indicated on jib angle indicator)	Boom	ML assembly or CPU-P-plate	Detectors: Outrigger extended length	Boom angle	Boom length	Swing angle	Pressure	Jib angle	Fore-aft chassis inclination	Left-right chassis inclination
①	Model code setting	0		●								
②	Release indication select mode setting			●								
③	Outrigger extended length adjustment	12		●	●							
④	Boom angle adjustment	1	●	●		●						
⑤	Boom length adjustment	2	●	●		⇩	●					
⑥	Oper. radius adjustment	3	●	●		○(※)	○(※)					
⑦	Jib angle adjustment	Present Jib angle		●						●		
⑧	Swing angle adjustment	5	⇩	●				●				
⑨	Weight element adjust.	6-0~2	●	●					●			
⑩	Lifting load indication adjustment	7-0~2	●	●					●			
⑪	Warning alarm point adjustment	8	‖	●								
⑫	Fore-aft. chassis inclination adjustment	9	‖	●							●	
⑬	Left-right chassis inclination adjustment	10	‖	●								●
⑭	Jib extending point adjustment	11	●	●			●					

NOTE : 1) Mark ● means indispensable adjusting item, and mark ○ means confirming item.
2) Item ② "Release indication select mode setting" is optional, and required when external indicator lamp is provided.
3) When ROM of ML only is replaced, adjustment is not required. However, it is replaced with ROM, of which soft content has been changed, sometimes specified items require adjustment.

(2) OVERALL ADJUSTMENT and INDIVIDUAL ADJUSTMENT

OVERALL ADJUSTMENT ····· · When the moment limiter (ML computer / indicator) assembly or CPU-P-plate only is replaced, adjustment and confirmation for all items are required as shown above.
· When the boom is replaced also, it is the same.

INDIVIDUAL ADJUSTMENT ····· · This is the case that each detector has been replaced. However, after adjustment related to the boom angle and / or boom length detector has been made, mark ※ in the above table, that is, confirmation of indicated value of the operating radius should be carried out faithfully.
· Besides, regardless of replacement of detectors and etc. , adjustment, such as lifting load indication adjustment, is sometimes required in order to correct the indicated value as required by the operator.

5.3 PREPARATION FOR ADJUSTMENT

(1) PREPARATION OF NECESSARY EQUIPMENTS FOR ADJUSTMENT

①	Alligator clip for shifting to adjusting mode.
②	Bevel protractor with level attached for measuring boom angle.
③	Lifting weight, of which weight is clear, and sling wire rope.
④	Tape measure (20 meters) for measuring operating radius.

· Detail of use of necessary equipments is explained in paragraph 5.4 Adjusting Function on page 5-2.
· ③ lifting weight is necessary for operating radius indication adjustment and lifting load indication adjustment.

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5. ADJUSTMENT

5.1 GENERAL

Since this load safety device is arranged so that various adjusting values are memorized by memorizing IC in the device, the adjusting variable resistances, which have been hitherto used in the load safety device, are not used at all in this device, and adjustment can be made by operating the push button switches on the indicator panel. Therefore, even when adjusting, adjustment can be made easily without touching the base plates of the load safety device.

5.2 ADJUSTING ITEMS

(1) The following table shows the necessary adjusting items and operating order when detectors are replaced.

Adjusting Item Table

Adjusting Item \ Replacement of Detectors and so on		Item No. (indicated on jib angle indicator)	Boom	ML assembly or CPU-P-plate	Detectors: Outrigger extended length	Boom angle	Boom length	Swing angle	Pressure	Jib angle	Fore-aft chassis inclination	Left-right chassis inclination
①	Model code setting	0		●								
②	Release indication select mode setting			●								
③	Outrigger extended length adjustment	12		●	●							
④	Boom angle adjustment	1	●	●		●						
⑤	Boom length adjustment	2	●	●		⇩	●					
⑥	Oper. radius adjustment	3	●	●		○(※)	○(※)					
⑦	Jib angle adjustment	Present Jib angle		●						●		
⑧	Swing angle adjustment	5	⇩	●				●				
⑨	Weight element adjust.	6-0~2	●	●					●			
⑩	Lifting load indication adjustment	7-0~2	●	●					●			
⑪	Warning alarm point adjustment	8	‖	●								
⑫	Fore-aft. chassis inclination adjustment	9	‖	●							●	
⑬	Left-right chassis inclination adjustment	10	‖	●								●
⑭	Jib extending point adjustment	11	●	●			●					

NOTE : 1) Mark ● means indispensable adjusting item, and mark ○ means confirming item.
2) Item ② "Release indication select mode setting" is optional, and required when external indicator lamp is provided.
3) When ROM of ML only is replaced, adjustment is not required. However, it is replaced with ROM, of which soft content has been changed, sometimes specified items require adjustment.

(2) OVERALL ADJUSTMENT and INDIVIDUAL ADJUSTMENT

OVERALL ADJUSTMENT ····· · When the moment limiter (ML computer / indicator) assembly or CPU-P-plate only is replaced, adjustment and confirmation for all items are required as shown above.
· When the boom is replaced also, it is the same.

INDIVIDUAL ADJUSTMENT ····· · This is the case that each detector has been replaced. However, after adjustment related to the boom angle and / or boom length detector has been made, mark ※ in the above table, that is, confirmation of indicated value of the operating radius should be carried out faithfully.
· Besides, regardless of replacement of detectors and etc. , adjustment, such as lifting load indication adjustment, is sometimes required in order to correct the indicated value as required by the operator.

5.3 PREPARATION FOR ADJUSTMENT

(1) PREPARATION OF NECESSARY EQUIPMENTS FOR ADJUSTMENT

①	Alligator clip for shifting to adjusting mode.
②	Bevel protractor with level attached for measuring boom angle.
③	Lifting weight, of which weight is clear, and sling wire rope.
④	Tape measure (20 meters) for measuring operating radius.

· Detail of use of necessary equipments is explained in paragraph 5.4 Adjusting Function on page 5-2.
· ③ lifting weight is necessary for operating radius indication adjustment and lifting load indication adjustment.

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5.4 ADJUSTING FUNCTION

(1) OUTLINE OF ADJUSTING FUNCTION

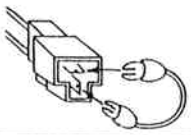
- Various adjustment related to the ML is made by rewriting the adjusting memory in the ML computer / indicator by operating the related switch for adjustment on the indicator panel.
- The following flow chart shows its adjusting step and the outline of the shifting switch operation to each adjusting item.

STEP	Switch Operation (Shifting and Setting)

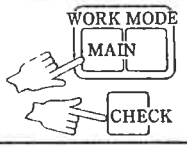
STEP (1)

Shifting and setting to adjusting mode

(A) Short Circuit of Adjusting Connectors → (B) Operation of Adjusting Mode Setting Switch



CN-242M(2P) in lower side of upper fuse box. Short-circuit between 2P with alligator clip.



Push the both switches at the same time for more than 3 seconds. When sound "Pee" is issued, ① Model cord setting starts.

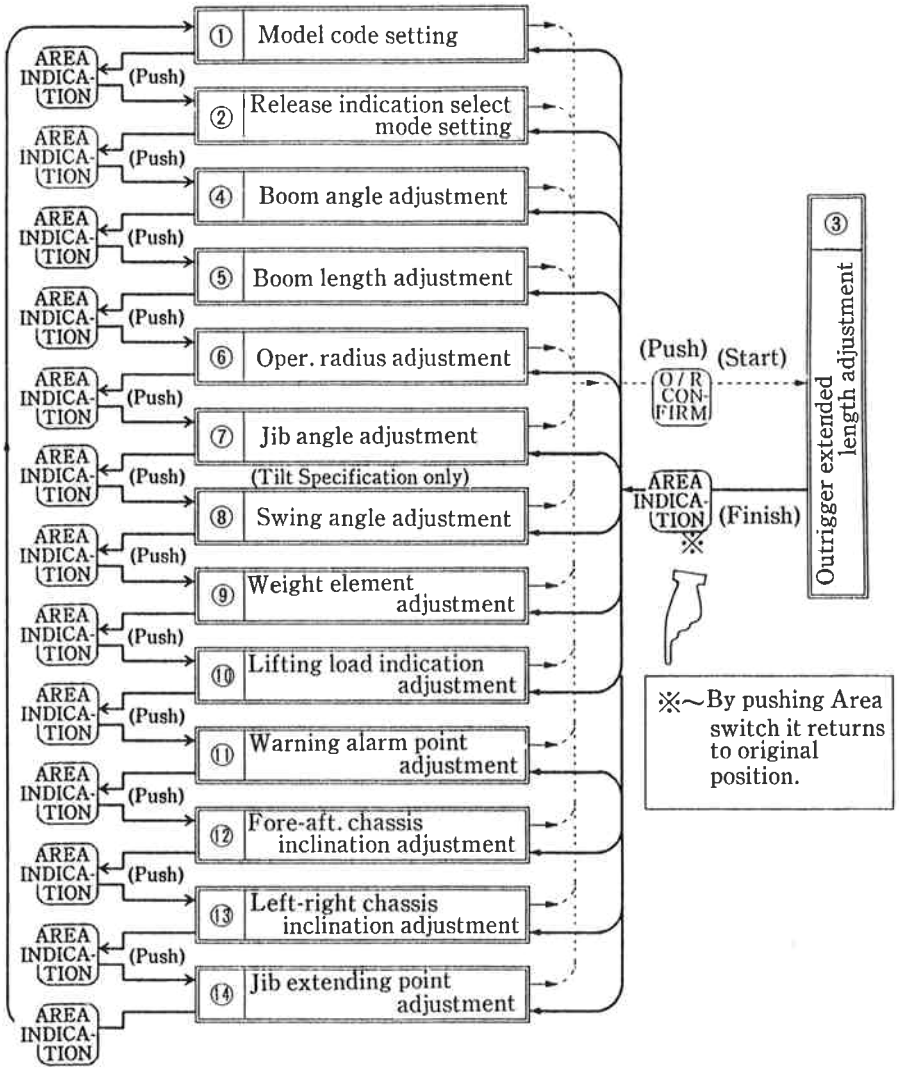
⇩

STEP (2)

Shifting and setting of adjusting item.

〔Adjusting program is functioning.〕

Adjusting and Setting start.

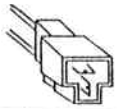


⇩

STEP (3)

Release of adjusting mode.
(Return to normal mode.)

Release of short circuit of connector for adjustment.

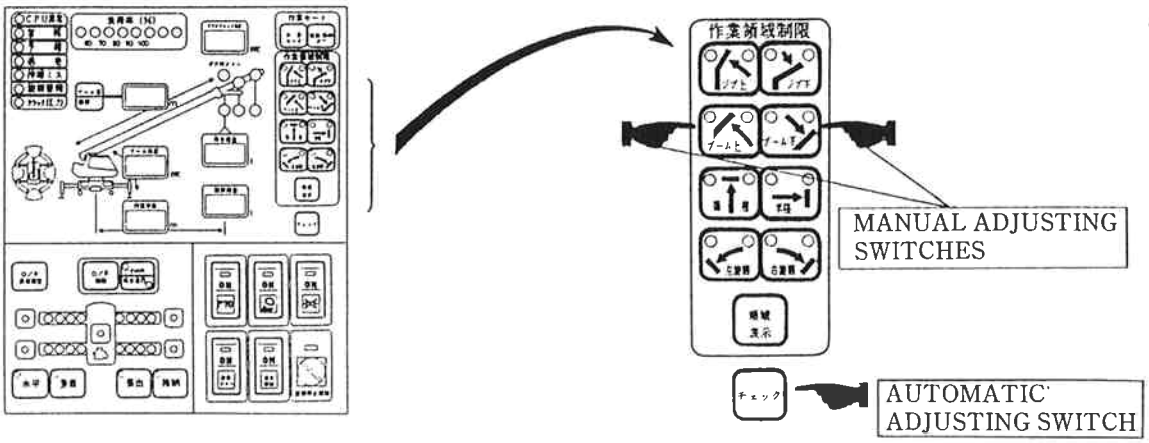


Remove alligator clip.

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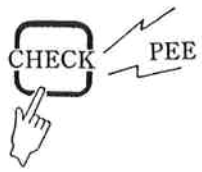
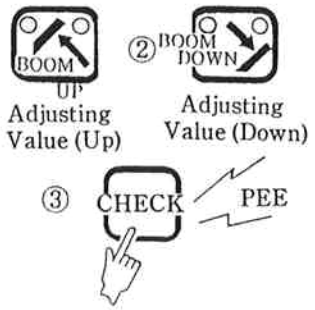
(2) FUNCTION OF AUTOMATIC ADJUSTMENT AND MANUAL ADJUSTMENT ····· Related to STEP(2) in preceeding table.

· The adjusting program of this moment limiter is provided with both adjusting software of Automatic and Manual as the adjusting function in order to correct and confirm the adjusting value by utilizing the following adjusting switches.



NOTE : These adjusting switches do not function as the adjusting switches when the moment limiter is in the normal operation, but function only when it is in the adjusting mode.

· Outline of Adjusting Method

	Outline of Adjusting Method	Adjusting Switch
Automatic Adjustment	① Set the machine condition to the basic adjusting posture every adjusting item to be adjusted from now, first. ② Then, correct and memorize the adjusting value corresponding to the posture automatically only by pushing the check switch.	
Manual Adjustment	① Set the machine condition to the basic adjusting posture according to the adjusting item as the same as the above. ② Operate the Boom Up or Boom Down switch, and rewrite the adjusting memorized value indicated on the digital indicator by manual operation. ③ Push the check switch to fix the adjusting value.	

· Recommended Adjusting Method

The following table shows the recommended adjusting method to be used every adjusting item.

Item / Method	Outrigger extended width	Boom angle	Boom length	Operating radius indication	Swing angle	Weight element	Lifting load indication	Warning alarm point	Fore-aft chassis inclination	Left-right chassis inclination	Jib extending point
Automatic adjustment	●	○	●	–	●	●	–	–	○	○	●
Manual adjustment	–	●	–	●	–	–	●	●	●	●	–

Although boom angle and chassis inclination can be automatically adjusted, manual adjustment is recommended to insure accuracy of adjustment.

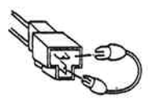
https://truckmanualshub.com/

5.5 ADJUSTING PROCEDURE

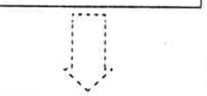
STEP (1) SHIFTING / SETTING TO ADJUSTING MODE

Ⓐ Shifting ⇨ Ⓑ Setting

CN-242M(2P) in lower side of Upper Fuse Box

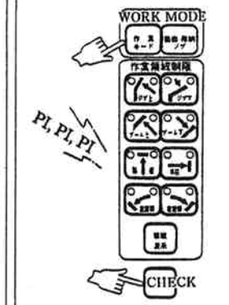


Short-circuit between 2P with alligator clip.

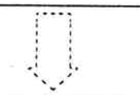


C is indicated on small scale on the LIMITED LOAD indicator.

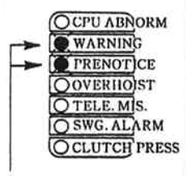
However, other digital condition indicators are all blank (no indication).



Continue to push CHECK and WORK MODE switches at the same time for more than 3 seconds.



C is indicated on large scale on 100 places, and model code on 10 and 1 places of the LIMITED LOAD indicator.



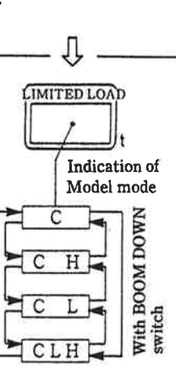
Going on and off continues during adjustment.

STEP (2) ADJUSTMENT

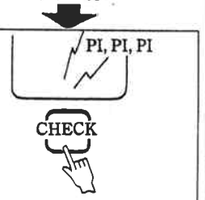
① Setting of Model Code (Jib type and Outrigger type)

Adjusting item No. 0 is indicated on the jib offset angle indicator.





C : Standard jib, X-type
C H : Standard jib, H-type
C L : Tilt jib, X-type
C LH : Tilt jib, H-type



Push CHECK switch to make ML memorize.

② Release Indication Select Mode
(Not required when external indicator lamp is not provided.)



Every pushing BOOM UP / BOOM DOWN switches, following model mode are indicated in order on the LIMITED LOAD indicator as follows:



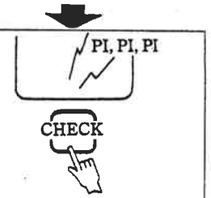
Every pushing JIB EXT / STOW switch, LED lights up alternately



When released output to external indicator lamp is put out.



When released, output to external indicator lamp is not put out.



Push CHECK switch to make ML memorize.

② Adjustment of Outrigger Extended length.

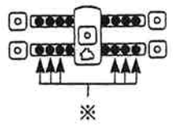


Adjusting item No.12 is indicated on the jib offset angle indicator.



Adjustment of Min. Extension

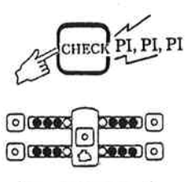
Fully retract all outrigger horizontal cylinders.



※

MIN. lights up within adjusting range.
- First time, ※ lamps go on and off.
- After 2nd time, ※ lamps go out.

Lamps do not light up for out of adjusting range.

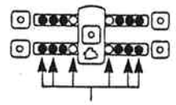


MIN. lamp goes out.

Adjustment of Midpoint 1 Extension

Set all outrigger horizontal cylinders to midpoint 1 extension.

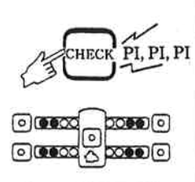
(Insert midpoint 1 lock pin, and set outrigger horizontal to retract side.)



※

MIDPOINT 1 lamp lights up within adjusting range.
- First time, ※ lamps go on and off.
- After 2nd time, ※ lamps go out.

Lamps do not light up for out of adjusting range.

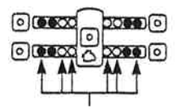


MIDPOINT 1 lamp goes out.

Adjustment of Midpoint 2 Extension

Set all outrigger horizontal cylinders to midpoint 2 extension.

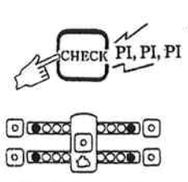
(Insert midpoint 2 lock pin, and set outrigger horizontal to retract side.)



※

MIDPOINT 2 lamp lights up within adjusting range.
- First time, ※ lamps go on and off.
- After 2nd time, ※ lamps go out.

Lamps do not light up for out of adjusting range.

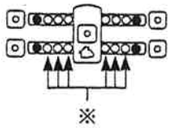


MIDPOINT 2 lamp goes out.

Adjustment of Max. Extension

Fully extend all outrigger horizontal cylinders.

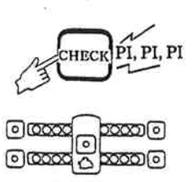
(Insert full extension lock pin, and set outrigger horizontal to retract side.)



※

Full extension lamp lights up within adjusting range.
- First time, ※ lamps go on and off.
- After 2nd time, ※ lamps go out.

Lamps do not light up for out of adjusting range.



FULL EXTENSION lamp goes out.

Adjustment of the outrigger extension can be made for all simultaneous extension and individual extension of the outrigger.

※ Continued to next page.

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Continued from preceding page (STEP (2))

ADJUSTMENT

Item	Adjusting Posture: Boom Posture	Adjusting Posture: Lifting Load	Indication of Adjusting Item No. (Jib offset angle indication)	Setting of Adjusting Item	Rewriting and Confirmation of Setting Value: Switch Operation	Rewriting and Confirmation of Setting Value: Indication of Adjusting Value	Confirming Operation
④ Zero Adjustment: Angle	↺		JIB OFFSET ADJ. 1	AREA INDICATOR SWITCH		MANUAL ADJUSTMENT: Boom Angle (deg.) under adjustment; Amount of correction (reference value)	
④ Boom Angle Adjustment: Length	Basic Length						
④ Boom Angle Span Adjustment: Angle	70°						
⑤ Zero Adjustment: Angle	Any Angle		JIB OFFSET ADJ. 2			MANUAL ADJUSTMENT: Boom Length (m) under adjustment; Amount of correction (reference value)	
⑤ Zero Adjustment: Length	Basic Length						
⑤ Boom Length Span Adjustment: Angle	Any Angle						
⑤ Boom Length Span Adjustment: Length	Maximum Length						
⑥ Zero Adjustment: Angle	Any Angle	Side lifting of (ton s)ing weight).	JIB OFFSET ADJ. E			MANUAL ADJUSTMENT: Operating Radius(m) under adjustment; Amount of correction (reference value)	
⑥ Zero Adjustment: Length	Basic Length	Lifting aux. hook near overhead.					
⑥ Operating Radius Span Adjustment: Angle	50°	Side lifting of (ton s)ing weight).					
⑥ Operating Radius Span Adjustment: Length	Maximum Length	Lifting aux. hook near overhead.					
⑦ Zero Adjustment: Angle	Any Angle		JIB OFFSET ADJ. 0	Shift with WORK		AUTOMATIC ADJUSTMENT: Weight Element Value (kg / ot) of adjusting value; Amount of correction (reference value)	
⑦ Zero Adjustment: Length	Basic Length	Lift main hook upto just before overhoist.					
⑦ Weight Element Boom Weight Element (Maximum Length) Span Adjustment: Angle	50°	Lift main hook up approx. 1m from ground.					
⑦ Weight Element Boom Weight Element (Maximum Length) Span Adjustment: Length	Maximum Length	Lift aux. hook upto just before overhoist.					
⑦ Weight Element (Basic Length) Span Adjustment: Angle	50°	Lift main hook up approx. 1m from ground.					
⑦ Weight Element (Basic Length) Span Adjustment: Length	Basic Length	Lift aux. hook upto just before overhoist.					
⑧ Front Position	Insert swing lock pin (Adjustable range ± 10°)						
⑧ Rear Position	Align axle line of operator's cab with axle line of carrier by eye measurement in rear swing direction (adjustable range ± 10°)		JIB OFFSET ADJ. 5	Lights up for Rear.		AUTOMATIC ADJUSTMENT: Swing Angle (deg) under adjustment; Amount of Correction (reference value)	Adjustment completed
⑨ Warning Alarm point (Automatic stop point)			JIB OFFSET ADJ. 8			MANUAL ADJUSTMENT: Warning Alarm Point (automatic stop point) (%) under adjustment	
⑩ Classic Inclination (Fore-aft)	Set classic horizontally (within ± 0.3°). (When front is lower, - is indicated.) (When fore-aft inclination is more than ± 0.3° , buzzer sounds continuously. When left-right inclination is more than ± 0.3° , buzzer sounds intermittently.		JIB OFFSET ADJ. 9	Lights up for Front.		MANUAL ADJUSTMENT: Angle (deg.) under adjustment; DEG; Value of Correction (reference value)	PL. PI. PI CHECK
⑪ Classic Inclination (left - right)	Set classic horizontally (within ± 0.3°). (When right is lower, - is indicated.) (When fore-aft inclination is more than ± 0.3° , buzzer sounds intermittently.) When left-right inclination is more than ± 0.3° , buzzer sounds intermittently.)		JIB OFFSET ADJ. 10			MANUAL ADJUSTMENT: Angle (deg) under adjustment; DEG; Value of Correction (reference value)	
⑫ Boom Extending Point	After jib has been installed, extend boom so that jib jrutde roller comes to center position of jrutde plate. (Approx. 1.5m from base length)		JIB OFFSET ADJ. 11			AUTOMATIC ADJUSTMENT: Boom Length (m) under adjustment; Value of Correction (reference value)	Adjustment completed

Adjustment of Lifting Load

Item	Adjusting Posture: Boom Posture	Adjusting Posture: Lifting Load	Indication of Adjusting Item No. (Jib offset angle indication)	Setting of Adjusting Item	Rewriting and Confirmation of Setting Value: Switch Operation	Rewriting and Confirmation of Setting Value: Indication of Adjusting Value	Confirming Operation
① Adjustment of Lifting Load with Boom	Select working posture at adjustment from "Adjusting working posture at adjustment"	Lifting Load of 100 to 60% of rated load in	JIB OFFSET ADJ. 7-0	Shift with WORK switch.		MANUAL ADJUSTMENT: Lifting Load Value (ton) of adjusting value; Value of K (coefficient of lifting load)	
② Adjustment of Lifting Load with one step Jib			JIB OFFSET ADJ. 7-1	MODE Switch.		MANUAL ADJUSTMENT: Lifting Load Value (ton) of adjusting value; Value of K (coefficient of lifting load)	
③ Adjustment of Lifting Load with two step Jib			JIB OFFSET ADJ. 7-2	MODE Switch.		MANUAL ADJUSTMENT: Lifting Load Value (ton) of adjusting value; Value of K (coefficient of lifting load)	
① Two step Jib Weight Element: Angle	Jib Maximum	Lift aux. hook up approx. 1m from ground.	JIB OFFSET ADJ. 6-2	MODE switch.		AUTOMATIC ADJUSTMENT: Weight Element Value (kg / ot) of adjusting value; Amount of correction (reference value)	
① Two step Jib Weight Element: Length	Jib One step	Lift aux. hook up approx. 1m from ground.		Shift with WORK			
① Two step Jib Weight Element: Angle	Boom Maximum	Lift main hook upto just before overhoist.	JIB OFFSET ADJ. 6-1	MODE Switch.		AUTOMATIC ADJUSTMENT: Weight Element Value (kg / ot) of adjusting value; Amount of correction (reference value)	
① Two step Jib Weight Element: Length	Boom 50°	Lift main hook upto just before overhoist.					

Weight Element

Item	Adjusting Posture: Boom Posture	Adjusting Posture: Lifting Load	Indication of Adjusting Item No. (Jib offset angle indication)	Setting of Adjusting Item	Rewriting and Confirmation of Setting Value: Switch Operation	Rewriting and Confirmation of Setting Value: Indication of Adjusting Value	Confirming Operation
⑦ Zero Adjustment: Angle	Any Angle		JIB OFFSET ADJ. 0	Shift with WORK		AUTOMATIC ADJUSTMENT: Weight Element Value (kg / ot) of adjusting value; Amount of correction (reference value)	
⑦ Zero Adjustment: Length	Basic Length	Lift main hook upto just before overhoist.					
⑦ Weight Element Boom Weight Element (Maximum Length) Span Adjustment: Angle	50°	Lift main hook up approx. 1m from ground.	JIB OFFSET ADJ. 6-9				
⑦ Weight Element Boom Weight Element (Maximum Length) Span Adjustment: Length	Maximum Length	Lift aux. hook upto just before overhoist.					
⑦ Weight Element (Basic Length) Span Adjustment: Angle	50°	Lift main hook up approx. 1m from ground.					
⑦ Weight Element (Basic Length) Span Adjustment: Length	Basic Length	Lift aux. hook upto just before overhoist.					

Swing Angle

Item	Adjusting Posture: Boom Posture	Adjusting Posture: Lifting Load	Indication of Adjusting Item No. (Jib offset angle indication)	Setting of Adjusting Item	Rewriting and Confirmation of Setting Value: Switch Operation	Rewriting and Confirmation of Setting Value: Indication of Adjusting Value	Confirming Operation
⑧ Front Position	Insert swing lock pin (Adjustable range ± 10°)						
⑧ Rear Position	Align axle line of operator's cab with axle line of carrier by eye measurement in rear swing direction (adjustable range ± 10°)		JIB OFFSET ADJ. 5	Lights up for Rear.		AUTOMATIC ADJUSTMENT: Swing Angle (deg) under adjustment; Amount of Correction (reference value)	Adjustment completed

Jib Angle

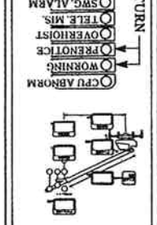
Item	Adjusting Posture: Boom Posture	Adjusting Posture: Lifting Load	Indication of Adjusting Item No. (Jib offset angle indication)	Setting of Adjusting Item	Rewriting and Confirmation of Setting Value: Switch Operation	Rewriting and Confirmation of Setting Value: Indication of Adjusting Value	Confirming Operation
⑨ Warning Alarm point (Automatic stop point)			JIB OFFSET ADJ. 8			MANUAL ADJUSTMENT: Warning Alarm Point (automatic stop point) (%) under adjustment	
⑩ Classic Inclination (Fore-aft)	Set classic horizontally (within ± 0.3°). (When front is lower, - is indicated.) (When fore-aft inclination is more than ± 0.3° , buzzer sounds continuously. When left-right inclination is more than ± 0.3° , buzzer sounds intermittently.)		JIB OFFSET ADJ. 9	Lights up for Front.		MANUAL ADJUSTMENT: Angle (deg.) under adjustment; DEG; Value of Correction (reference value)	PL. PI. PI CHECK
⑪ Classic Inclination (left - right)	Set classic horizontally (within ± 0.3°). (When right is lower, - is indicated.) (When fore-aft inclination is more than ± 0.3° , buzzer sounds continuously. When left-right inclination is more than ± 0.3° , buzzer sounds intermittently.)		JIB OFFSET ADJ. 10			MANUAL ADJUSTMENT: Angle (deg) under adjustment; DEG; Value of Correction (reference value)	
⑫ Boom Extending Point	After jib has been installed, extend boom so that jib jrutde roller comes to center position of jrutde plate. (Approx. 1.5m from base length)		JIB OFFSET ADJ. 11			AUTOMATIC ADJUSTMENT: Boom Length (m) under adjustment; Value of Correction (reference value)	Adjustment completed

STEP (3)

RELEASE OF ADJUSTING MODE (Return to Normal Mode)

CN-242M

Take off alligator clip.



All digital condition indicators (LCD) and indicator lamps (LED) return to normal indication.

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● ADJUSTING POINT OF LIFTING LOAD

When correcting the lifting load indication in the adjustment of lifting load mentioned before, the stowing area of the correcting value is classified as shown in the following table so that the correcting value can be changed every boom form (mode, number of boom sections and boom angle).
(All 60 points : K_{21} through K_{80})
Therefore, when adjusting the lifting load, perform adjustment every stowing area. (Adjusting with single area only also is possible.)

· Each correcting value can be corrected between 0.60 and 1.40.

The stowing areas of lifting load adjusting points are as follows:

Adjusting Point Table

Mode		Adjusting Angle				
Mode	Boom Length	30	50	67.5	75	
Main mode ; lifting with boom	Basic length	K_{21}	K_{22}	K_{23}	K_{24}	
	2nd boom	K_{25}	K_{26}	K_{27}	K_{28}	
	3rd boom	K_{29}	K_{30}	K_{31}	K_{32}	
	4th boom	K_{33}	K_{34}	K_{35}	K_{36}	
	(5th boom)	K_{37}	K_{38}	K_{39}	K_{40}	None in RK250,
Jib 1 Step mode ; lifting with jib	Basic length		K_{41}	K_{42}	K_{43}	
	2nd boom		K_{44}	K_{45}	K_{46}	
	3rd boom		K_{47}	K_{48}	K_{49}	
	4th boom		K_{50}	K_{51}	K_{52}	
	(5th boom)		K_{53}	K_{54}	K_{55}	None in RK250,
Jib 2 Step mode ; lifting with jib	Basic length		K_{56}	K_{57}	K_{58}	
	2nd boom		K_{59}	K_{60}	K_{61}	
	3rd boom		K_{62}	K_{63}	K_{64}	
	4th boom		K_{65}	K_{66}	K_{67}	
	(5th boom)		K_{68}	K_{69}	K_{70}	None in RK250,

All adjusting points : 50 points (K_{21} through K_{70})

(Example) · When angle is less than 39.9° , write into area of 30° .
(Write into 50° for 40.0 to 58.7° , 67.5° for 58.8 to 71.2° , and 75° for more than 71.3° .)
· When length is less than 13.0m, write into area of 9.54m.
(Write into 16.54m for 13.1 to 20.0m, and 23.54m for 20.1 to 27.0m.)

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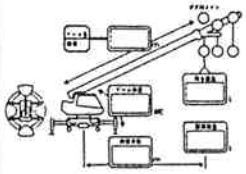
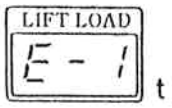
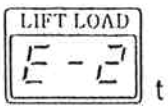
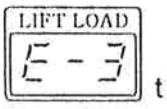
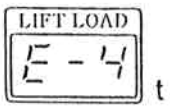
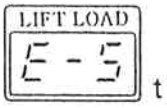
6. TROUBLESHOOTING

· This moment limiter is provided with the following function as function for trouble shooting.

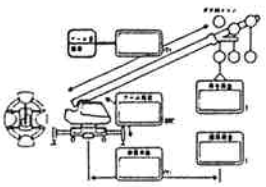
Diagnosis Function	Contents
Error code indicating function	This checks the ML sensor signals and multiplex data transmission signals related to the outrigger, and indicates the results as the error codes on the LIFTING LOAD indicator.
I / O signal check function	This indicates input voltage of the ML main sensor signals to the ML and various input / output signals in order on the LIFTING LOAD indicator.

〔When abnormality occurs in the ML system, utilize these diagnosis functions effectively.

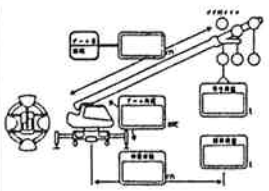
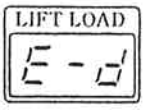
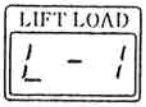
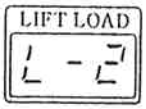
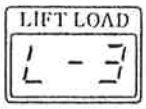
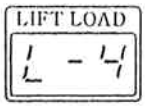
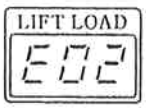
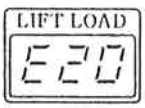
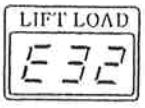
6.1 ERROR CODE INDICATING FUNCTIONS

No.	Error Code and Indication	Item	Contents	Measure
1	  "E − 1"	Boom angle signal is abnormal.	When condition that voltage signal from angle detector is less than 0.3V or more than 11.7V continues for more than 3 seconds.	Check angle detector. Check harness on the way.
2	 "E − 2"	Boom length signal is abnormal.	When condition that voltage signal from length detector is less than 0.1V or more than 11.7V continues for more than 1 second.	Check length detector. Check harness on the way.
3	 "E − 3"	Head pressure signal is abnormal.	When condition that voltage signal from head pressure detector is less than 0.3V or more than 12.5 V continues for more than 1 sec.	Check head pressure detector. Check harness on the way.
4	 "E − 4"	Rod pressure signal is abnormal.	When condition that voltage signal from rod pressure detector is less than 0.3V or more than 12.5V continues for more than 1 second.	Check rod pressure detector. Check harness on the way.
5	 "E − 5"	Jib cylinder length (jib offset angle) signal is abnormal.	When condition that voltage signal from length detector is less than 0.3V or more than 11.4V continues for more than 1 second.	Check length detector. Check harness on the way.
6	 "E 6 A"	Swing angle (1) signal is abnormal.	With front detect limit sw. on, and with range out of 2.6 to 3.2, when angle indicator goes on and off for more than 1 second.	Check swing angle meter. Check front detecting limit switch.

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No.	Error Code and Indication	Item	Contents	Measure
7	 LIFT LOAD E6b t "E 6 B"	Swing angle (2) signal is abnormal.	With front detect limit sw. on, and with range out of 8.7 to 9.4, when angle indicator goes on and off for more than 1 second.	Check swing angle meter. Check front detecting limit switch.
8	"E 6 A" LIFT LOAD E6A t and "E 6 B" LIFT LOAD E6b t are indicated alternately.	Swing angle signal is abnormal.	When condition that voltage difference between swing angle signals(1) and (2) is out of 5.0 to 7.0V range continues for more than 1 second.	
9	"E – 7" LIFT LOAD E - 7 t	Fore-aft chassis inclination signal is abnormal.	When condition that detector signal is less than 0.3V continues for more than 2 seconds.	Check fore-aft chassis inclination meter. Check harness on the way.
10	"E – 8" LIFT LOAD E - 8 t	Left-right chassis inclination signal is abnormal.	When condition that detector signal is less than 0.3V continues for more than 2 seconds.	Check left-right chassis inclination meter. Check harness on the way.
11	"E – 9" LIFT LOAD E - 9 t	Swing angular speed signal is abnormal.	※1 When swing angular speed signal is not put in for more than 1 sec. for swinging motion.	Check swing angular speed meter. Check harness on the way.
12	"E – A" LIFT LOAD E - A t	Left swing pressure signal is abnormal.	※1 When left swing pressure signal is not put in for swinging motion. ※2	Check swing brake left pressure detector. Check harness on the way.
13	"E – b" LIFT LOAD E - b t	Right swing pressure signal is abnormal.	※1 When right swing pressure signal is not put in for swinging motion. ※2	Check swing brake right pressure detector. Check harness on the way.
14	"E – c" LIFT LOAD E - C t	Main winch rope length signal is abnormal.	In spite of that main winch raising signal is continuously put in for more than 180 seconds, when main winch rope length signal is not put in.	Check main winch drum proximity sensor and main winch lever limit switch. Check harness on the way.

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No.	Error Code and Indication	Item	Contents	Measure
15	 "E – d" 	Auxiliary winch rope length signal is abnormal.	In spite of that auxiliary winch raising signal is continuously put in for more than 180 seconds, when auxiliary winch rope length signal is not put in.	Check auxiliary winch drum proximity sensor and auxiliary winch lever limit switch. Check harness on the way.
16	"L – 1" 	Left front outrigger length signal is abnormal.	When condition that detector signal is less than 0.6V or more than 11V continues for more than 2 seconds.	Check left front outrigger length meter.
17	"L – 2" 	Right front outrigger length signal is abnormal.	When condition that detecor signal is less than 0.6V or more than 11V continues for more than 2 seconds.	Check right front outrigger length meter.
18	"L – 3" 	Left rear outrigger length signal is abnormal.	When condition that detector signal is less than 0.6V or more than 11V continues for more than 2 seconds.	Check left rear outrigger length meter.
19	"L – 4" 	Right rear outrigger length signal is abnormal.	When condition that detector signal is less than 0.6V or more than 11V continues for more than 2 seconds.	Check right rear outrigger length meter.
20	"E 0 2" 	Abnormal transmission (ML←MDT)	When transmission signal is abnormal for more than 2 seconds.	Check MDT power supply. Check transmission lines of MDT and ML.
21	"E 2 0" 	Abnormal transmission (ML→MDT)	When transmission signal is abnormal for more than 2 seconds.	Check MDT power supply. Check transmission lines of MDT and ML.
22	"E 3 2" 	Abnormal transmission (swing controller →ML)	When transmission signal is abnormal for more than 2 seconds.	Check swing controller power supply. Check transmission line between ML and controller.
Reference	"Communication abnormality" is indicated on multi-display.	Abnormal transmission (ML→swing controller)	When transmission signal is abnormal for more than 2 seconds.	Check swing controller power supply. Check transmission line between ML and controller.

※1. When variation of more than 1 degree / second occurs in swing angle signal.

※2. When pressure signal is under 1kg / cm² (nearly equals to 0.025 volts).

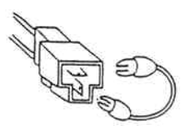
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6.2 CHECK PROCEDURES OF I / O SIGNALS

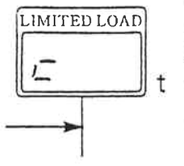
STEP (1) SHIFTING / SETTING TO I / O CHECK MODE

Ⓐ Shifting to Adjusting Mode

CN-242M (2P) in lower side of Upper Fuse Box.



Short-circuit between 2 P with alligator clip



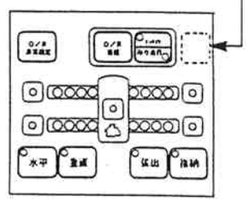
C is indicated on a small scale on the LIMITED LOAD indicator.

However, all other digital condition indicators are blank (no indication).

Ⓑ Shifting to I / O Check Mode

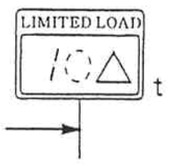
Push switches ① and ② shown in figures.

① Hidden CHECK for I / O check

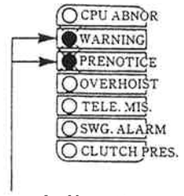


② ML CHECK SWITCH

CHECK



" / (°)△" is indicated on the LIMITED LOAD indicator.
((°) is blank, and △ is unfixed.)
→This indication shows that mode has shifted to Digital Input Check Mode.



Going on and off continues during adjustment.

STEP (2) SELECTION OF I / O CHECK MODE

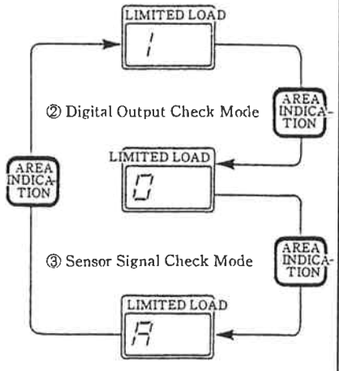
Kinds of I / O Check Modes

- ① Digital Input Check Mode
- ② Digital Output Check Mode
- ③ Sensor Signal Check Mode

Selecting Operation of Check Mode

AREA INDICATION Every pushing this switch, check mode is shifted as shown below :

① Digital Input Check Mode



When ③ mode is selected, voltage value of each sensor signal also is indicated on the OPER. RADIUS indicator.

STEP (3) CHECK OF I / O SIGNALS

① Digital Input Check Mode			② Digital Output Check Mode		③ Sensor (Analogue) Signal Check Mode	
Indication	Input Signal	Operation	Indication	Output Signal	Indication	Sensor Signal
LIMITED LOAD 1 1	Boom up limit sw. is turned on. (Earth by on)	Boom up operation	① LIMIT LOAD 0 1 ②	Automatic stop 1 output signal (+24V)	③ LIMIT LOAD A 1 ④	Boom angle voltage indication OPE RADIUS 2.1
LIMITED LOAD 1 2	Boom down limit sw. is turned on. (〃)	Boom down operation	LIMIT LOAD 0 2	Overhoist stop output signal (+24V)	LIMIT LOAD A 2	Boom length voltage indication OPE RADIUS 10.1
LIMITED LOAD 1 3	Boom ext. limit sw. is turned on. (〃)	Boom extension operation	LIMIT LOAD 0 3	Automatic stop 2 output signal (+24V)	LIMIT LOAD A 3	Head pressure voltage indication OPE RADIUS 1.1
LIMITED LOAD 1 4	Boom retr. limit sw. is turned on. (〃)	Boom retraction operation	LIMIT LOAD 0 4	External indication (green) output signal (+24V)	LIMIT LOAD A 4	Rod pressure voltage indication OPE RADIUS 3.1
LIMITED LOAD 1 5	Main winch limit sw. is turned on. (〃)	Main winch operation	LIMIT LOAD 0 5	External indication (yellow) output signal (+24V)	LIMIT LOAD A 5	Swing angle 1 voltage indication OPE RADIUS 3.1
LIMITED LOAD 1 6	Aux. winch limit sw. is turned on. (〃)	Auxiliary winch operation	LIMIT LOAD 0 6	External indication (red) output signal (+24V)	LIMIT LOAD A 6	Swing angle 2 voltage indication OPE RADIUS 9.1
LIMITED LOAD 1 7	Jib up limit sw. is turned on. (〃)	Jib up operation	LIMIT LOAD 0 7	Swing warning flasher output signal (+24V)	LIMIT LOAD A 7	Left front outrigger ext. voltage indication OPE RADIUS 6.5
LIMITED LOAD 1 8	Jib down limit sw. is turned on. (〃)	Jib down operation	① ②		LIMIT LOAD A 8	Right front outrigger ext. voltage indication OPE RADIUS 6.5
LIMITED LOAD 1 9	Telescope select limit sw. is turned on. (〃)	Set telescope selection to the 2nd.	NOTE : Signal output is put out while CHECK switch is pushed only.		LIMIT LOAD A 9	Left rear outrigger ext. voltage indication OPE RADIUS 6.5
LIMITED LOAD 1 10	Left swing limit sw. is turned on. (〃)	Left swing operation			LIMIT LOAD A 10	Right rear outrigger ext. voltage indication OPE RADIUS 6.5
LIMITED LOAD 1 11	Right swing limit sw. is turned on. (〃)	Right swing operation			LIMIT LOAD A 11	Jib offset angle voltage indication OPE RADIUS 6.5
LIMITED LOAD 1 12	Outrigger retr. signal is turned on. (24V for on)	Outrigger retracting operation.	NOTE : Value of volt indication is indicated in unit of 0.1V.		LIMIT LOAD A 12	Fore-aft chassis inclination voltage indication. OPE RADIUS 3.0
					LIMIT LOAD A 13	Left-right chassis inclination voltage indication OPE RADIUS 3.0
					③ ④	

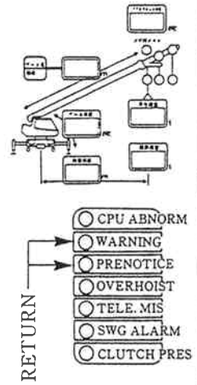
NOTE :
- When duplicate signals are put in, indication shows in order from low number.
- After last indication has been made, indication repeats again from first item.

STEP (4) RELEASE OF ADJUSTING MODE (Return to Normal Mode)

CN-242M



Remove alligator clip.



All digital condition indicators (LCD) and indicator lamps (LED) return to normal indication.

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6.3 TROUBLESHOOTING PROCEDURE

In order to take proper steps without delay for various foulty phenomena, troubleshooting is described every phenomenon as follows.
Utilize abnormality check function mentioned above effectively.

Faulty phenomena are as follows :

1. Power is not supplied to the ML.
2. Error code is indicated.
3. The ML does not operate normally.
   - 3 — 1 Automatic stop does not function.
   - 3 — 2 Automatically stopped condition.
   - 3 — 3 Faulty indicator panel and operating switches.
   - 3 — 4 Faulty outrigger operation.
4. Wrong accuracy of movement.
   - 4 — 1 Wrong accuracy of lifting load.
   - 4 — 2 Wrong accuracy of jib extending / stowing.
5. Voice alarm is not issued.

No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
1	Power is not supplied to the ML. (In condition that the interceptive lever for on and off is lowered.)	・Even by turning the P T O switch on, the LED of the switch does not light up.	・Check upper fuse (F23). ・Check harness (627A) on the way. ・Check the P T O switch for movement.	・If the lower emergency P T O switch is normal, check of the upper switch power supply is required. ・If the P T O is put in the upper MDT, the switch is O. K. ↓ Input indicator No. 38 (red) lights up.
		・The P T O switch is turned on, but the ML is not supplied with power. →At this time, CRT power is		
		← not supplied	・Check the interceptive lever for on and off limit switch. ・Check harness (36 and 37) on the way. ・Check the P T O relay for operation.	・Check the limit switch of the interceptive lever for on and off for operation.
		→ supplied	・Check harness (36A) for the ML.	・Check voltage with connector section (CN-201A) of the ML.
		・The ML power is not supplied by the lower emergency P T O switch		
		→The LED of the upper switch does not light up.	・Check lower fuse (F6). ・Check harness (521 and 36E) on the way.	・Check if the emergency P T O switch signal of the lower MDT is put in or not. ↓ With the input indicator No. 14 (red) lighting, judge the lower harness or upper harness.
		→The LED of the upper switch lights up.	・Check harness (36) on the way.	

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	Error code is indicated. E-1 The boom angle meter is abnormal.	・Confirm the indicated value of the boom angle voltage with the I / O check mode. →When 0.0V is indicated.	・Check harness on the way. Power supply 24V : 837 Signal : 666 Earth : 663 ・Replace the angle meter with a new one.	When the sensor error code other than the angle meter is indicated, there is possibility that sensor power (837) output is not issued.
		→When indication is not 0.0V.	・Check the angle meter for mounting. ・Replace the angle meter.	Voltage for sensor abnormality judgment. Less than 0. 3V or more than 11. 7V.
	E-2 The boom length meter is abnormal.	・Confirm the indicated value of the boom length voltage with the I / O check mode. →When 0.0V is indicated.	・Check harness on the way. Power supply 24V : 837 Signal : 664 Earth : 663 ・Replace the length meter with a new one.	When the sensor error code other than the length meter is indicated, there is possibility that sensor power (837) output is not issued.
		→When indication is not 0. 0V.	・Check the cord reel for operation. ・Replace the length meter.	Voltage for sensor abnormality judgment. Less than 0.3V or more than 11.7V.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E-3 The head pressure detector is abnormal.	・Confirm the indicated value of the head pressure voltage with the I / O check mode.		
		→When 0.0V is indicated.	・Check the harness on the way. Power supply 24V : 839 Signal : 668 Earth : 667 ・Replace pressure detector. ・Check fuse (F31).	
		→When indication is not 0.0V.	・Check the pressure detector (including measurement of pressure).	Since 0.8V output is issued when pressure is 0kg / cm², voltage for sensor abnormality judgment is. Less than 0.3V or more than 12.5V.
	E-4 The rod pressure detector is abnormal.	・Confirm the indicated value of the rod pressure voltage with the I / O check mode.		
		→When 0.0V is indicated.	・Check the harness on the way. Power supply 24V : 839 Signal : 631 Earth : 667 ・Replace the pressure detector. ・Check fuse (F31).	
		→When indication is not 0.0V.	・Check the pressure detector (including measurement of pressure).	Since 0.8V output is issued when pressure is 0kg / cm², voltage for sensor abnormality judgment is. Less than 0. 3V or more than 12.5V.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E-5 The jib cylinder length (jib offset angle meter) is abnormal.	· Confirm the indicated value of the detector voltage with the I / O check mode.		The jib cylinder length detector checks only for the tilt mode.
		→When 0.0V is indicated.	· Check the harness on the way. Power supply 12V : 837 Signal : 635 Earth : 663 · Check and replace the detector.	
		→When indication is not 0.0V.	· Check the cord reel for winding.	Voltage for sensor abnormality judgment. Less than 0.3V or more than 11.4V.
	E6A E6B The swing angle meter is abnormal.	· Confirm the indicated value of the swing angle meter voltage with the I / O check mode.		
		→When 0. 0V is indicated.	· Check the harness on the way. Power supply 12V : 837 Signal A : 610 Signal B : 611 Earth : 663 · Replace the detector.	The 2-tandem potentiometers are used as the swing angle meter, and there are two kinds of signals.
		→When indication is not 0.0V.	· Check the swing lock pin limit switch. · Replace the detector.	After the swing lock pin limit switch is turned off and the power is supplied again, if the error code is indicated again, the swing lock pin limit switch is not faulty. If one of E6A or E6B only is indicated, there is much possibility that the voltage values of signal A and signal B deviates.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E-7 Fore-aft indication angle meter is abnormal.	· Confirm the indicated value of fore-aft inclination angle meter voltage with the I / O check mode.		· When other sensor error codes (left-right inclination angle meter and outrigger length meter) also are indicated, there is much possibility that sensor power (836) output is not issued.
		→When 0.0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 98 Earth : 412	· When the MDT is abnormal, sensor check is not made.
			· Check and replace the angle meter.	· When the chassis is horizontal, 3. 0V is indicated.
		→When indication is not 0.0V.	· Check and replace the angle meter.	
	E-8 Left-right inclination angle meter is abnormal.	· Confirm the indicated value of left-right inclination angle meter voltage with the I / O check mode.		· When other sensor error codes (fore-aft inclination angle meter and outrigger length meter) also are indicated, there is much possibility that sensor power (836) output is not issued.
		→When 0.0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 99 Earth : 412	· When the MDT is abnormal, sensor check is not made.
			· Check and replace the angle meter.	
		→When indication is not 0.0V.	· Check and replace the angle meter.	· When the chassis is horizontal, 3. 0V is indicated.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			*1 When the ML adjusting connector is connected and number of wire reeving parts is set to "02" , the moment ratio indicator on the multi-display indicates the swing angular speed. (Example : When speed is 1 rpm, the angular speed is 6° / sec, and "60" is indicated.)
	E-9 Swing angular speed meter is abnormal.	· The swing angular speed indication *1 on the multi-display.		
		→When 0.0 is indicated.	· Check the harness on the way. Voltage 12V : 868 Signal : 871 Earth : 870 · Check and replace the angular speed meter.	· Since the swing angular speed sensor is pulse sensor of 12 pulses / rev (0 / 5V), by turning the shaft, the output varies.
		→When indication is not 0.0.	· Check and replace the swing controller.	· The sensor abnormality is judged with the swing controller, and is transmitted to the ML.
	E-A Left swing pressure detector is abnormal.	· The left swing pressure indication *2 on the multi-display.		· When other sensor error codes (right swing pressure detector, main winch rope length meter and auxiliary winch rope length meter) also are indicated, there is much possibility that sensor power supply (882) output is not issued.
		→Abnormal indication. 〔When the left swing lever is full with the swing lock pin inserted, "180 to 200" is not indicated.〕	· Check the harness on the way. Voltage 24V : 882 Signal : 873 Earth : 874 · Check and replace the detector. · Check fuse (F32).	*2 When the ML adjusting connector is connected and number of wire reeving parts is set to "05" , the moment ratio indicator on the multi-display indicates the left swing pressure. (Example : When pressure is 170kg / cm², "170" is indicated.)
		→Normal indication.	· Check and replace the detector. · Check and replace the swing controller.	

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E-b Right swing pressure detector is abnormal.	・The right swing pressure indication *3 on the multi-display.	・Check the harness on the way. Voltage 24V : 882 Signal : 875 Earth : 874	・When other sensor error codes (left swing pressure detector, main winch rope length meter and auxiliary winch rope length meter) also are indicated, there is much possibility that sensor power supply (882) output is not issued.
		→Abnormal indication.	・Check and replace the detector. ・Check fuse (F32).	
		〔When the left swing lever is full with the swing lock pin inserted, "180 to 200" is not indicated.〕	・Check and replace the detector. ・Check and replace the swing controller.	*3 When the ML adjusting connector is connected and number of wire reeving parts is set to "05", the moment ratio indicator on the multi-display indicates the right swing pressure. (Example : When pressure is 170kg / cm², "170" is indicated.)
		→Normal indication.		
	E-c The main winch rope length meter is abnormal.	・Does the load height indication on the multidisplay vary normally with the main mode?		・When other sensor error codes (left swing pressure detector, right swing pressure detector and auxiliary winch rope length meter) also are indicated, there is much possibility that sensor power supply (882) output is not issued.
		→The load height does not vary.	・Check the harness on the way. Voltage 24V : 882 Signal : 869 Earth : 874 ・Check and replace the detector. ・Check fuse (F32).	・To judge the main winch rope length meter abnormality, in spite of that the main winch lever is operated to raise (limit switch is turned on), when there is no sensor signal for more than 180 seconds, the meter is judged to be abnormal.
		→The load height varies, but increase and decrease are reverse.	・Replace the swing controller. ・Check the main winch lever operating limit switch.	・If the LED of the sensor itself is turned on / off (lights / goes out), the sensor is normal.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E-d The auxiliary winch rope length meter is abnormal.	· Does the load height indication on the multi-display vary normally with the jib mode?		· When other sensor error codes (left swing pressure detector, right swing pressure detector and main winch rope length meter) also are indicated, there is much possibility that sensor power supply (882) output is not issued. · To judge the auxiliary winch rope length meter abnormality, in spite of that the auxiliary winch lever is operated to raise (limit switch is turned on), when there is no sensor signal for more than 180 seconds, the meter is judged to be abnormal. · If the LED of the sensor itself is turned on / off (lights / goes out), the sensor is normal.
		→The load height does not vary.	· Check the harness on the way. Voltage 24V : 882 Signal : 891 Earth : 874 · Check and replace the detector. · Check fuse (F32).	
		→The load height varies, but increase and decrease are reverse.	· Replace the swing controller. · Check the auxiliary winch lever operating limit switch.	
	L-1 The left front outrigger length meter is abnormal.	· Confirm the indicated value of the left front outrigger length meter voltage with the I / O check mode.		· When other sensor error codes (fore-aft and left-right inclination meters, and right front, left rear and right rear outrigger length meters) also are indicated, there is much possibility that sensor power supply (836) output is not issued.
		→When 0. 0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 90 Earth : 412 · Check and replace the length meter.	· When the MDT is abnormal, sensor check is not made.
		→When indication is not 0.0V.	· Check and replace the length meter.	· Does voltage indication vary during movement of the outrigger? The voltage values of the outrigger are as follows : If potential difference is within ±0.5 volts, it is OK.

	Fully retracted condition	⟷	Fully extended condition
Voltage	1.2 volts	⟷	9.0 volts

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued) L-2 The right front outrigger length meter is abnormal.	· Confirm the indicated value of the right front outrigger length meter voltage with the I / O check mode. →When 0.0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 91 Earth : 412 · Check and replace the length meter.	· When other sensor error codes (fore-aft and left-right inclination meters, and left front, left rear and right rear outrigger length meters) also are indicated, there is much possibility that sensor power supply (836) output is not issued. · When the MDT is abnormal, sensor check is not made.
		→When indication is not 0.0V.	· Check and replace the length meter.	· Does voltage indication vary during movement of the outrigger?
	L-3 The left rear outrigger length meter is abnormal.	· Confirm the indicated value of the left rear outrigger length meter voltage with the I / O check mode. →When 0.0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 92 Earth : 412 · Check and replace the length meter. · Check and replace the length meter.	· When other sensor error codes (fore-aft and left-right inclination meters, and left front, right front and right rear outrigger length meters) also are indicated, there is much possibility that sensor power supply (836) output is not issued. · When the MDT is abnormal, sensor check is not made.
		→When indication is not 0.0V.		· Does voltage indication vary during movement of the outrigger?

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	L-d The right rear outrigger length meter is abnormal.	· Confirm the indicated value of the right rear outrigger length meter voltage with the I / O check mode.		· When other sensor error codes (fore-aft and left-right inclination meters, and left front, right front and left rear outrigger length meters) also are indicated, there is much possibility that sensor power supply (836) output is not issued.
		→When 0. 0V is indicated.	· Check the harness on the way. Voltage 12V : 836 Signal : 93 Earth : 412 · Check and replace the length meter.	· When the MDT is abnormal, sensor check is not made.
		→When indication is not 0.0V.	· Check and replace the length meter.	· Does voltage indication vary during movement of the outrigger?
	E02 Transmission is abnormal (ML←MDT).	· Is the upper MDT normal?	· Check fuse (F30). · Check harnesses (551,552 and E2) on the way. · Check and replace the upper MDT.	· When the upper MDT is abnormal, this error code is indicated. · When E02 and E20 are duplicated, E20 takes priority. · When E02 is indicated, transmission of ML→MDT is OK.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
2	(Continued)			
	E20 Transmission (ML→ MDT) is abnormal.		· Check upper fuse (F30). · Check the harnesses (551, 552 and E2) on the way. · Check and replace the upper MDT.	· The error code indication in the upper MDT shall indicate E20
	E32 Transmission (swing controller→ML) is abnormal.		· Check the harness (553, 554 and E3) on the way. · Check power supply (36A) of the swing controller. · Check the swing controller.	· Unless the swing controller operates normally, the error code is indicated.
	Communication (ML→ swing controller) is abnormal.		· Check the harnesses (553, 554 and E3) on the way.	· Unless the ML operates normally, the error code is indicated.

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
3	The ML does not operate normally.			
	1. Automatic stop does not function.	・The warning alarm is issued, but movement does not stop.	・Check the automatic stop solenoid valve output. ・Check harnesses (123, 124 and 123A) on the way. ・Check the jib automatic stop solenoid valve output. ・Check harnesses (123, 124 and 123B) on the way.	・The exclusive automatic stop solenoid valve is provided to the jib only (the tilt specification only). ・Automatic stop functions with 24 volts output.
		→Even by operating the lever toward the dangerous side, movement does not stop.	・Check the control lever limit switch.	・Check the input lever signal with the I / O check mode. ・The signal of the control lever limit switch can be easily judged by setting the working area limit. (Because the warning alarm sounds for dangerous side operation of the lever.) ・The winch lever limit switch can be judged with the load height indication on the multi-display (because the indication is changed to plus when raising).
		→Even by turning the release switch off, movement does not stop.	・Check the release switch. ・Check and replace the ML.	
		・The warning alarm is not issued, and movement does not stop.		・The control lever limit switch is turned on (grounded) for the operating side.
		→Is the lifting load indication OK?	・Check the pressure detector.	
		→Is the boom condition indication OK?	・Adjust the ML.	
		→Is the work mode set wrongly?	・Check the work mode.	

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
3	(Continued)			
		・Raising does not stop for overhoisting.		
		→The overhoist alarm does not sound for dangerous side lever operation in the overhoisted condition.	・Check the overhoist limit switch. ・Check the harness on the way and cord reel (length meter) (121 and 121A). ・Check the control lever limit switch. ・Replace the ML.	Overhoist alarm does not sound until the lever is operated toward the dangerous side (the limit switch is turned on) when overhoisting.
		→The overhoist alarm sounds, but raising does not stop.	・Check the automatic stop solenoid valve output. ・Check harnesses (123, 124 and 123A) on the way. ・Check the jib automatic stop solenoid valve output. ・Check harnesses (123, 124 and 123B) on the way.	
	2. Automatically stopped condition.	・Movement stops as it is automatically stopped while the alarm (buzzer) is sounding. Even by turning the release switch on, the movement stop is not released.	・Check the control lever limit switch. ・Check the jib control lever limit switch.	When the alarm sounds, one of the following conditions is concerned. ・Overhoist ・Overload ・Telescope mistake ・Jib interlock ・Boom up end ・Working area limit etc. For detail specification, see separate paragraph.
		・Movement stops as it is stop without the alarm (buzzer) sounding.	・Check the automatic stop solenoid valve. (There is the possibility of sticking).	

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No.	Faulty Phenomenon	Confirming Item	Measure	Check Point
3	3. Faulty indicator panel and operating switches.	· Figure indication (liquid crystal) is faulty.	· Check and replace the indicating P-plate. · Check and replace the CPU P-plate.	Since the indicator panel (liquid crystal panel and LED) and the operating switches (seesaw switches) are installed on the same indicating P-plate, even when an individual part is faulty, it is recommended to replace with the assembly.
		· Indicating LED is faulty.	· Check the harness and connectors in the ML.	
		· Back lights do not light up. · The backlights of the seesaw switches (P. T. O. and worklights, etc.) do not light.	· Check harness (26) on the way. · Check the lighting switch. · Check the electric bulb in the seesaw switch for burning out. · Check harness and connectors in the ML.	The seesaw switch can be taken out by opening the top cover of the ML and pushing the single body from the rear.
	4. Faulty outrigger operation.	· Outrigger confirmation is not accepted.	· After the outrigger has been horizontally extended, carry out the outrigger vertical extension operation for more than 0.5 seconds.	After the outrigger horizontal operation (either of extending and stowing) has been carried out, the outrigger confirmation can be accepted only when ① the outrigger vertical extending operation is carried out in the upper, or ② the outrigger left rear vertical movement is carried out in the lower (there is 24 volt output in the solenoid).
		· Outrigger movement is not carried out. →The buzzer sounds during outrigger movement.	· Check the upper MDT and lower MDT for movement.	· The output is judged depending on whether the LED output of the outrigger solenoid is made from the lower MDT or not. · The solenoid output can be judged also by the output LED indication of the lower outrigger control box.
		→The buzzer does not sound while outrigger movement is made.	· Check and replace the indicating P-plate. · Check and replace the CPU P-plate. · Check the harness and connectors in the ML.	· When the upper and lower MDT are abnormal, the outrigger cannot be operated in the upper.

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<table>
<tr><th>No.</th><th>Faulty Phenomenon</th><th>Confirming Item</th><th>Measure</th><th>Check Point</th></tr>
<tr><td>4</td><td>Wrong accuracy of movement.</td><td></td><td></td><td></td></tr>
<tr><td></td><td>1. Wrong accuracy of lifting load.</td><td>・While boom operation is stopped or when the boom is lowered, the indicated value of the lifted load is different from the actual load value. (If the difference is within 0. 1 to 0. 2 tons, it is OK.)
・Does the voltage value of detected pressure indicate the normal value?</td><td>・Check the pressure detector.
・Check the pressure detecting piping.</td><td>・Since the head pressure rises while the boom is raised, the lifting load value is indicated to be larger. When the boom is stopped, the value returns to the original value.
・The standard value of the pressure detected value (voltage) is shown in the following table (pressure voltage value of boom weight when the boom is stopped.)
<table><tr><th></th><th colspan="2">Boom basic length</th><th colspan="2">Boom max. length</th></tr><tr><th></th><th>Boom angle 70°</th><th>Boom angle 30°</th><th>Boom angle 70°</th><th>Boom angle 30°</th></tr><tr><td>Head pressure voltage signal</td><td>1.5V</td><td>2.1V</td><td>2.5V</td><td>4.2V</td></tr><tr><td>Rod pressure voltage signal</td><td>0.8V</td><td>0.8V</td><td>0.8V</td><td>0.8V</td></tr></table>If the detected value is within ±10% to the above value, pressure detection is judged to be normal.</td></tr>
<tr><td></td><td></td><td>・Accuracy is wrong only for special boom condition.</td><td>・Adjust lifting load.</td><td></td></tr>
<tr><td></td><td></td><td>・Accuracy is wrong for all areas.</td><td>・Adjust weight element.
↓
Adjust lifting load.</td><td></td></tr>
<tr><td></td><td>2. Wrong accuracy of jib extending / stowing</td><td>・The boom length stop position is not correct.</td><td>・Adjust the jib extending / stowing.</td><td></td></tr>
</table>

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<table>
<tr><th>No.</th><th>Faulty Phenomenon</th><th>Confirming Item</th><th>Measure</th><th>Check Point</th></tr>
<tr><td>5</td><td>Voice alarm is not issued.</td><td>· All voice alarms are not issued.</td><td>· Check the power supply (fuse F23).
· Check earth.
· Check harness and connector (36A).
· Check volume VR of voice alarm.</td><td rowspan="2">There are 7 kinds of vocal words in the voice alarms, and these are selected with three input lines.
The input signals and vocal words are as follows :
<table><tr><th colspan="3">Input Signal (○ : Earth)</th><th rowspan="2">Vocal Word</th></tr><tr><th>Signal 1 (688)</th><th>Signal 2 (689)</th><th>Signal 3 (690)</th></tr><tr><td>○</td><td></td><td></td><td>Swing docs not stop automatically.</td></tr><tr><td></td><td>○</td><td></td><td>Take care of swing.</td></tr><tr><td>○</td><td>○</td><td></td><td>Set machine horizontally.</td></tr><tr><td></td><td></td><td>○</td><td>It's area limit.</td></tr><tr><td>○</td><td></td><td>○</td><td>Reconfirm outriggers.</td></tr><tr><td></td><td>○</td><td>○</td><td>Swing will stop.</td></tr><tr><td>○</td><td>○</td><td>○</td><td>Stop swing motion.</td></tr></table></td></tr>
<tr><td></td><td></td><td>· A specified vocal word is not issued.</td><td>· Check the signal lines.
(between ML⟷voice alarm)
(688, 689 and 690)</td></tr>
</table>

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1. CONSTRUCTION AND FUNCTION

1.1 OUTLINE OF SYSTEM

(1) PURPOSE

The swing automatic stop system intends to prevent occurrence of accidents such as overturn and collision due to overloading and crossing the swing working area limit during crane operation and to insure the safety of the machine (s) and persons concerned.

(2) BASIC FUNCTION FROM VIEWPOINT OF HANDING AND OPERATION

The basic functions are roughly as follows :

- ○ This stops swing motion before the machine enters an area to be overloaded by swinging with different extended widths of the outriggers and so on.
- ○ This stops swing motion before the machine exceeds the set value of the working area limit (left and right swing).

Regarding the above swing stop, considering swinging speed, lifted load weight and load height, this stops swing motion slowly to minimize swing of the load.

(3) ADDITIONAL FUNCTIONS

In order to make the above basic functions perform more effectively, the following additional functions are provided.

- ○ Before swing automatic stop function operates (approximately 4 seconds before), the prenotices (slowly intermittent sound of the buzzer and voice alarm : "Pay attention to swing.") are issued to warn the operator.
- ○ While swing automatic stop is controlled, the warning alarms (quick intermittent sound of the buzzer and voice alarm "Swing will stop.") are issued and inform the operator that swing braking is operated.

Outline of Swing Automatic Stop System Function

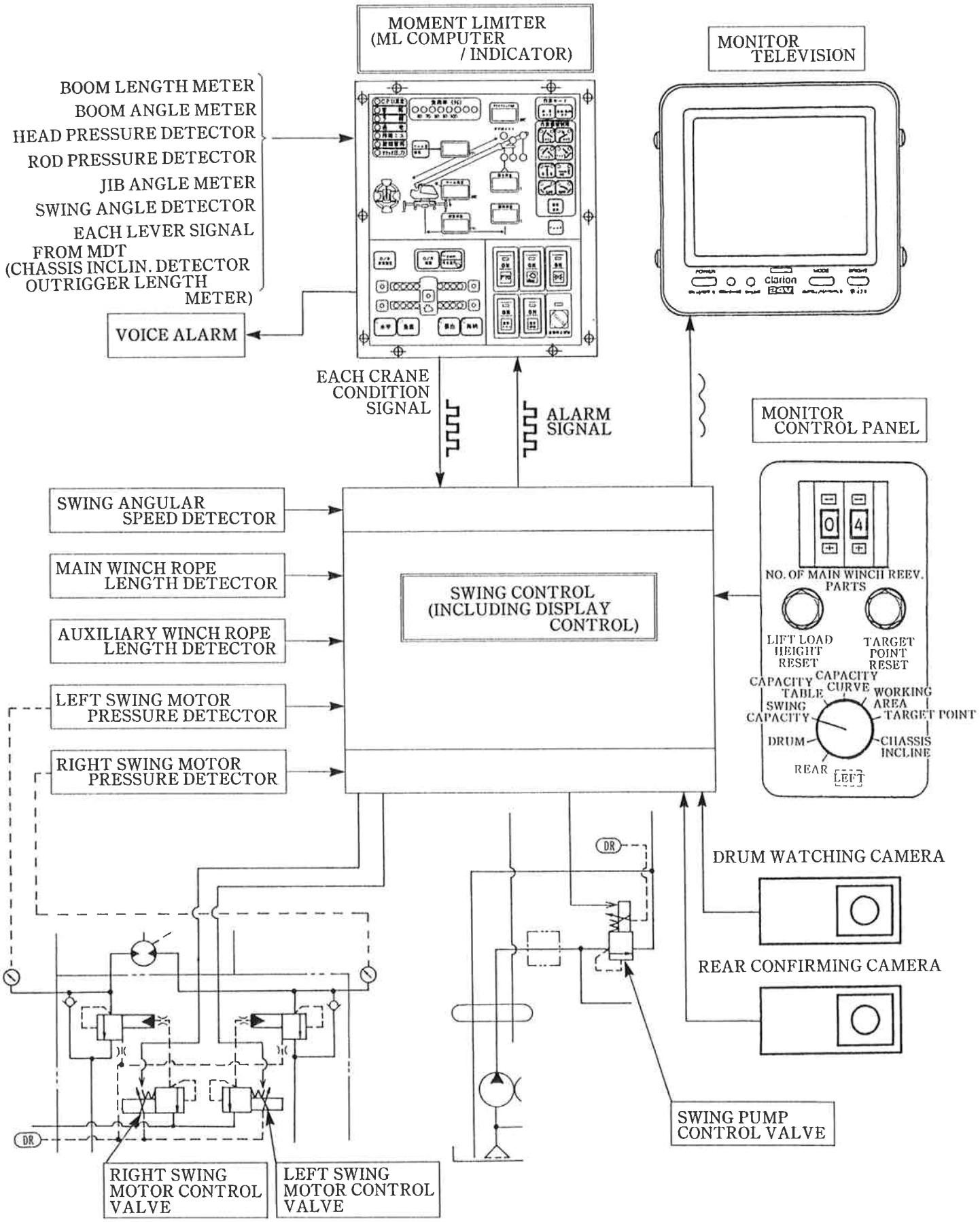
- ○ This stops swing motion slowly before the machine is overloaded.
- ○ This stops swing motion slowly before the machine enters a dangerous area of the working area limit (left and right swing).
- ○ Prenotice output (together with voice alarm) before swing automatic stop control starting.
- ○ Warning alarm output (together with voice alarm) while swing automatic stop control is controlled.
  - ——→Controlling the swing automatic stop due to overload stops motion toward boom lowering and boom extending sides.
  - ——→During stop control due to the working area limit, any crane operation is possible.

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1.2 ARRANGEMENT OF SYSTEM

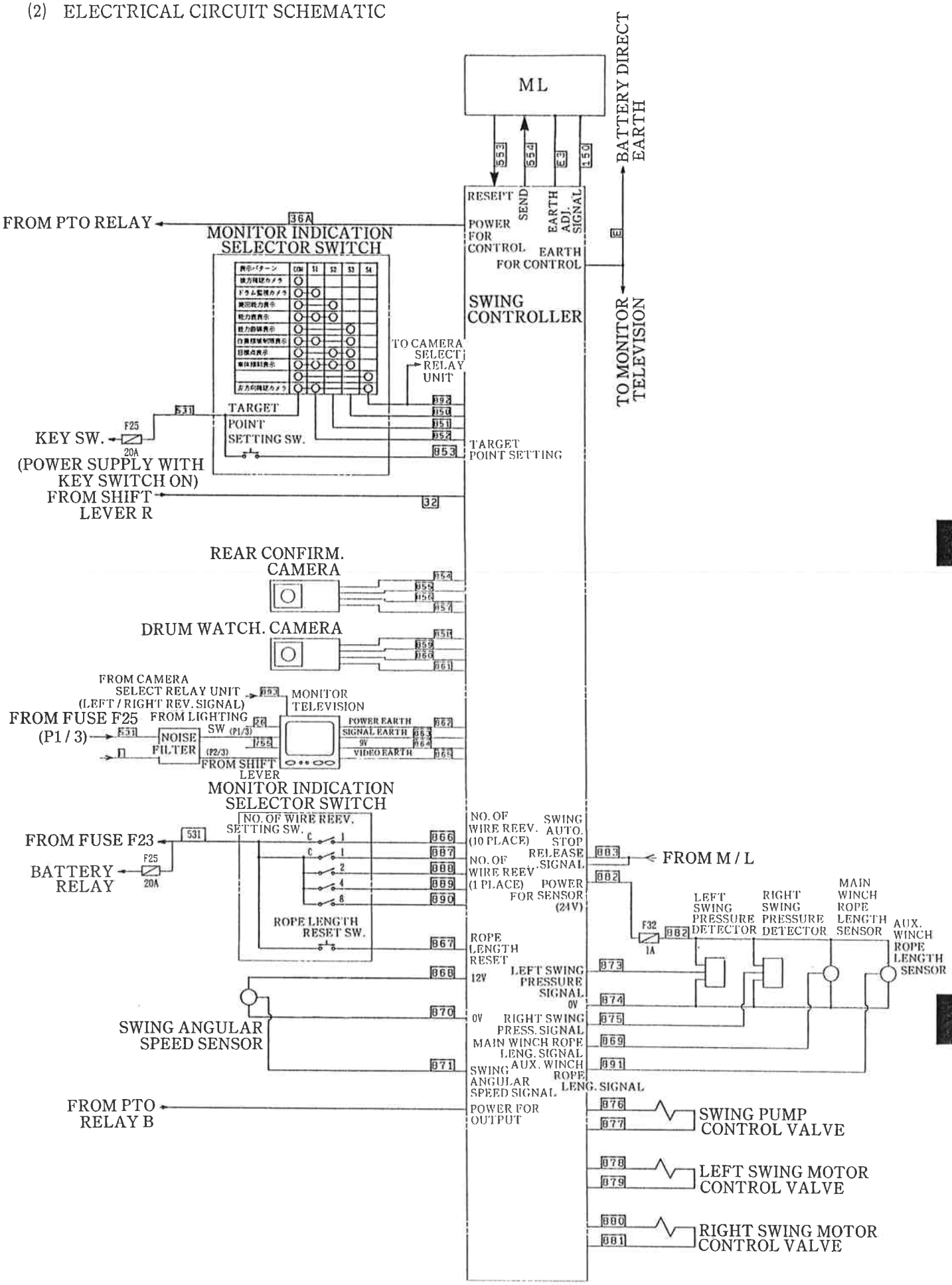
(1) OUTLINE OF SYSTEM ARRANGEMENT

・The swing automatic stop system is, centering around the swing controller (including the multi-display control), arranged as follows :



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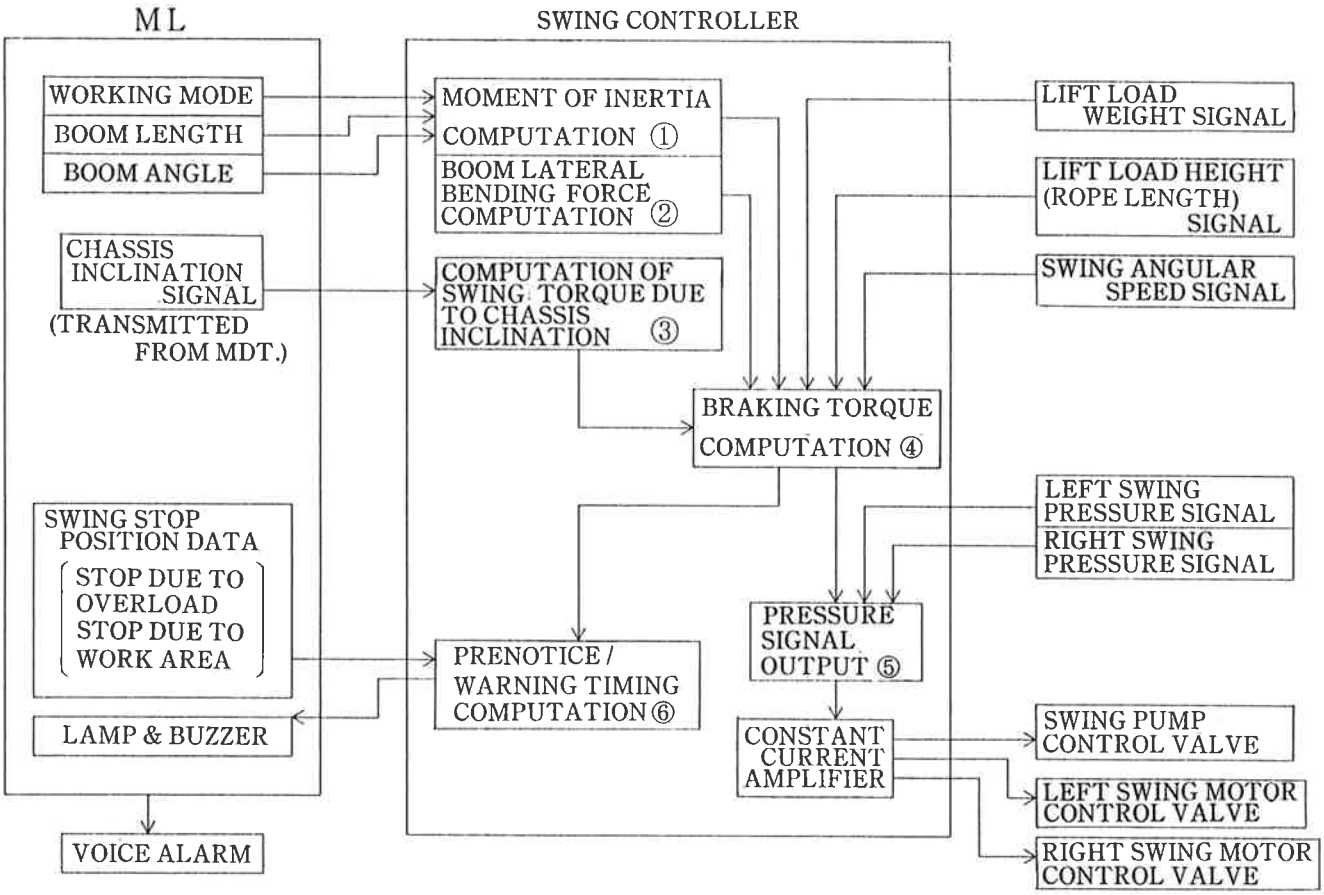
(2) ELECTRICAL CIRCUIT SCHEMATIC



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1.3 PRINCIPLE OF MOVEMENT

The block diagram of movement principle is shown below.



Block Diagram

Explanation of Detail

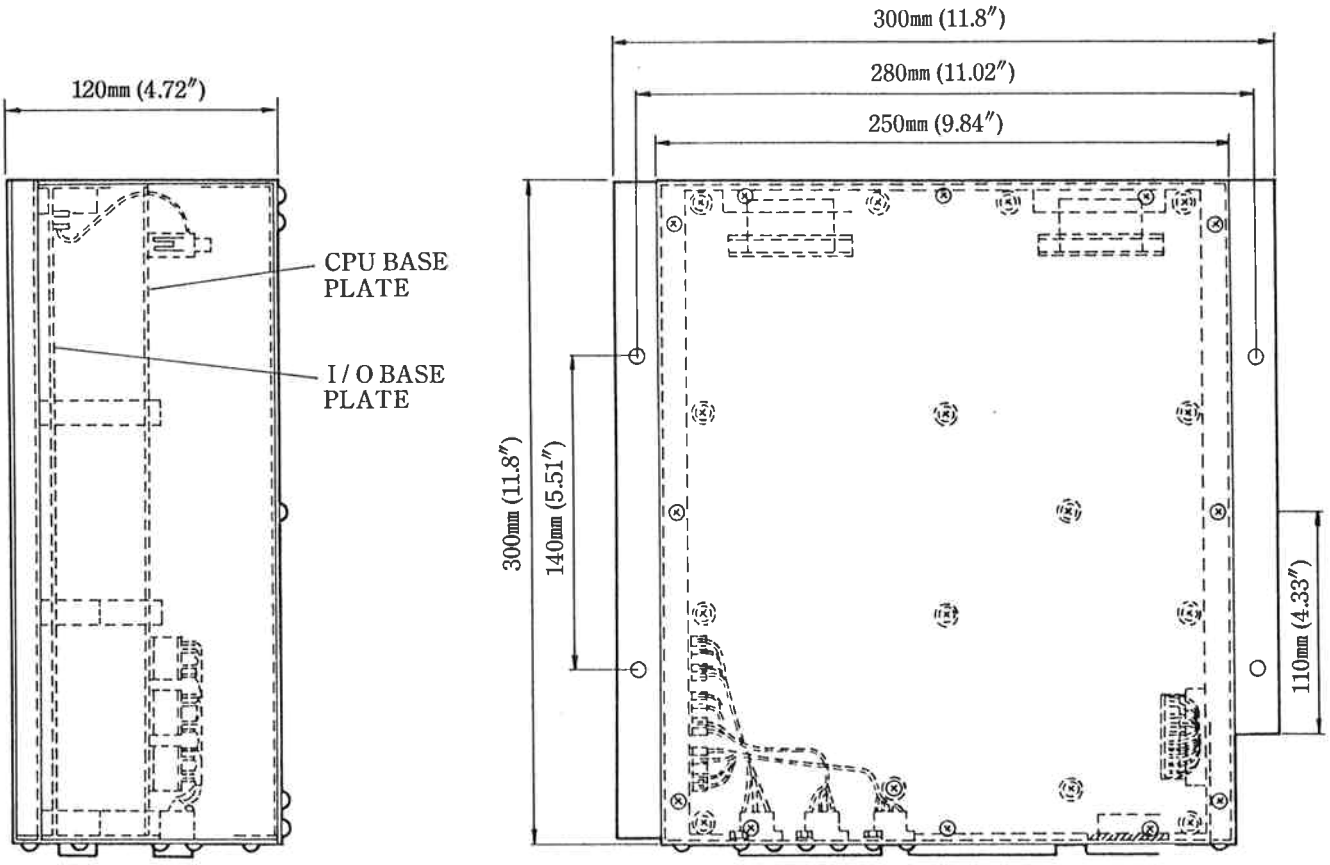
No.	Item	Purpose and Contents	Remarks
①	Moment of inertia computation	Computing of moment of swing inertia according to various crane condition.	
②	Boom lateral bending force computation	Computing of allowable maximum lateral bending force according to various crane condition.	
③	Computation of swing torque due to chassis inclination.	Computing how much does swing torque generate by the chassis inclining.	
④	Braking torque computation.	Computing required braking torque according to moment of inertia, braking force and inclined condition.	
⑤	Pressure signal output.	Computing accelerating side and braking side swing pressures from computed braking torque.	
⑥	Prenotice timing computation.	Computing four seconds timing (prenotice) before braking starts and timing of brake starting, and issuing alarm output.	If swinging continues with present swing speed, braking starts 4 seconds later (prenotice).

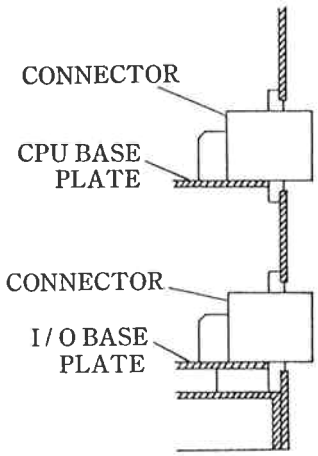
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1.4 CONSTRUCTION AND FUNCTION OF SWING CONTROLLER

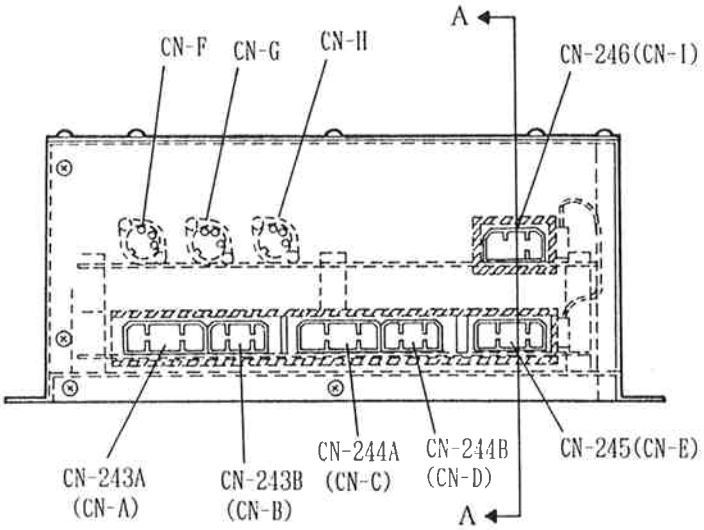
(1) CONSTRUCTION

1) Outside View



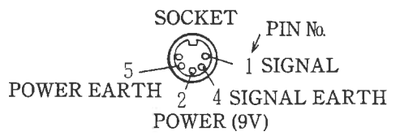


SECTION A-A

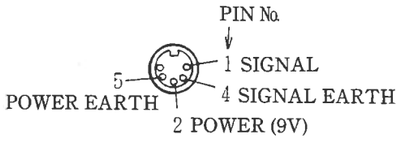


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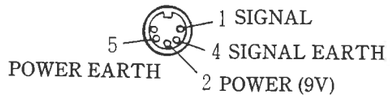
2) Details of Connectors for Connection to Basic Machine Wiring



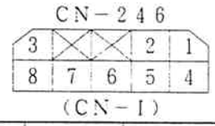
Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−F	2	Power for rear confirming camera	DC9V Output	Rear confirming camera		856
	5	〃 earth		〃		854
	1	〃 signal		〃		857
	4	〃 signal earth		〃		855



Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−G	2	Power for drum watching camera	DC9V Output	Drum watching camera		860
	5	〃 earth		〃		858
	1	〃 signal		〃		861
	4	〃 signal earth		〃		859



Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−H	2	Power for camera	DC9V Input	Monitor television		864
	5	〃 earth		〃		862
	1	〃 signal		〃		865
	4	〃 signal earth		〃		863



Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−246 (CN−1)	1	Power	247			36A
	3	Sensor power	24V Output (filter, right)	Press. sensor Rope length sensor		882
	4	Power for output	24V Input	For proportion valve (×3)		36B
	5	Input signal for adjust.	Earth signal			E0
	6	Trans-mission line	Serial trans-mission (from ML)	M / L		553
	7	〃	〃 (to ML)	〃		554
	8	〃	〃 (earth)	〃		E3

(BASIC MACHINE HARNESS SIDE) CN−243A CN−243B

6	5	4			3	2	1	4	3			2	1
14	13	12	11	10	9	8	7	10	9	8	7	6	5

(CONTROLLER SIDE) (CN−A) (CN−B)

Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−243A (CN−A)	1					
	2	Sensor earth				870
	3	12V power	(Series resistance 10Ω)		For swing angular speed sensor	868
	4					
	5	Sol. proportional valve output +	150〜700mA	Swing pump control valve	Dither 200Hz P-P. 200mA	876
	6	〃 −	〃			877
	7	Sol. proportional valve output +	100〜700mA	Left swing motor control valve	Dither 60Hz P-P. 200mA	878
	8	〃 −	〃			879
	9					
	10					
	11	Trouble indicator lamp	24V-30mA			884
	12					
	13	Sol. proportional valve output +	100〜700mA	Right swing motor control valve	Dither 60Hz P-P. 200mA	880
	14	〃 −				881
CN−243B (CN−B)	1	Left swing pressure signal	0〜5V (0〜200kg / ㎠)	Pressure sensor	A / D input	873
	2	Right 〃	〃	〃	〃	875
	3					
	4					
	5					
	6					
	7					
	8	Earth for sensor			For press. sensor	874
	9					
	10	Earth for sensor				

CN−244A CN−244B

6	5	4			3	2	1	4	3			2	1
14	13	12	11	10	9	8	7	10	9	8	7	6	5

(CN−C) (CN−D)

Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−244A (CN−C)	1	Swing stop release sw.	24V Input	Push button	D / I	883
	2					
	3					
	4					
	5	No. of wire reeving signal ①	24V input	Digital sw.	Place of 10	866
	6	〃 ②	(binary signal)	〃	Place of 1	887
	7	〃 ③		〃	〃	888
	8	Rope length signal (main)	Open collector type	Proximity sw.	D / I	869
	9	〃 (aux.)	〃	〃	〃	891
	10	Spare	Earth signal		〃	
	11	Spare	〃		〃	
	12					
	13					
	14					
CN−244B (CN−D)	1	Swing angular speed ①	Open collector type	Rotation sensor		871
	2	〃				
	3					
	4					
	5	No. of wire reeving signal ④	24V input		Place of 1	889
	6	〃 ⑤	〃		〃	890
	7	Spare input ①	〃		D / I	
	8	〃 ②	〃		〃	
	9					
	10	Sensor power (spare)	12V output		Capacity 0.1A	

CN−245

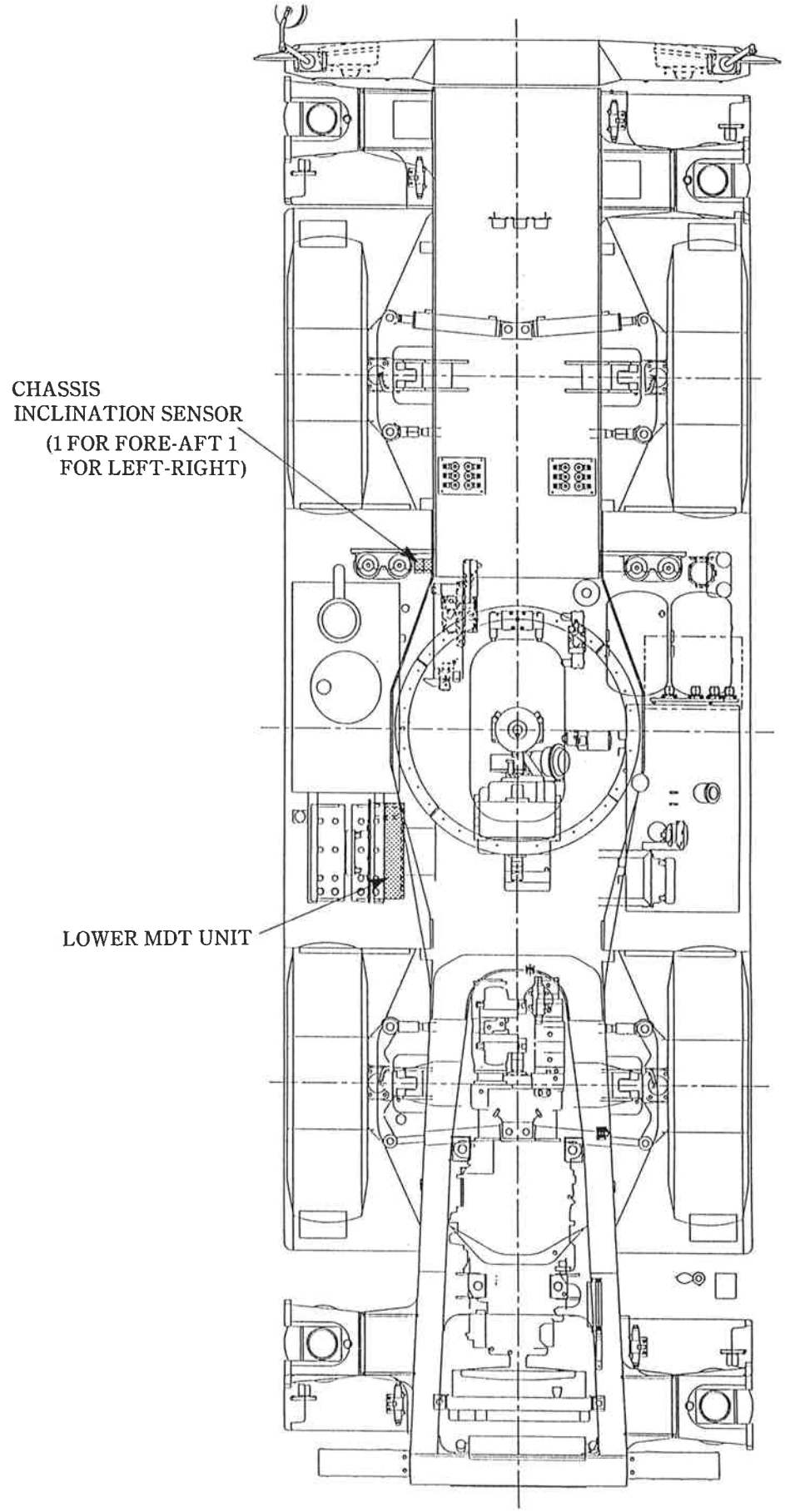
5	4			3	2	1
12	11	10	9	8	7	6

(CN−E)

Connector	Pin No.	Name	Type / specification	Other party	Remarks	Line No.
CN−245 (CN−E)	1	Indication select sw. ③	24V Input	Indication select sw.	D / I	850
	2	〃 ②	〃	〃	D / I	851
	3	〃 ①	〃	〃	D / I	852
	4	〃 ④	〃	〃	D / I	892
	5	Target point set	〃	Push button	D / I	853
	6					
	7	Spare	Earth signal input		D / I	
	8	〃	〃		〃	
	9					
	10	Shift lever R signal	24V Input		Relay input	32
	11					
	12					

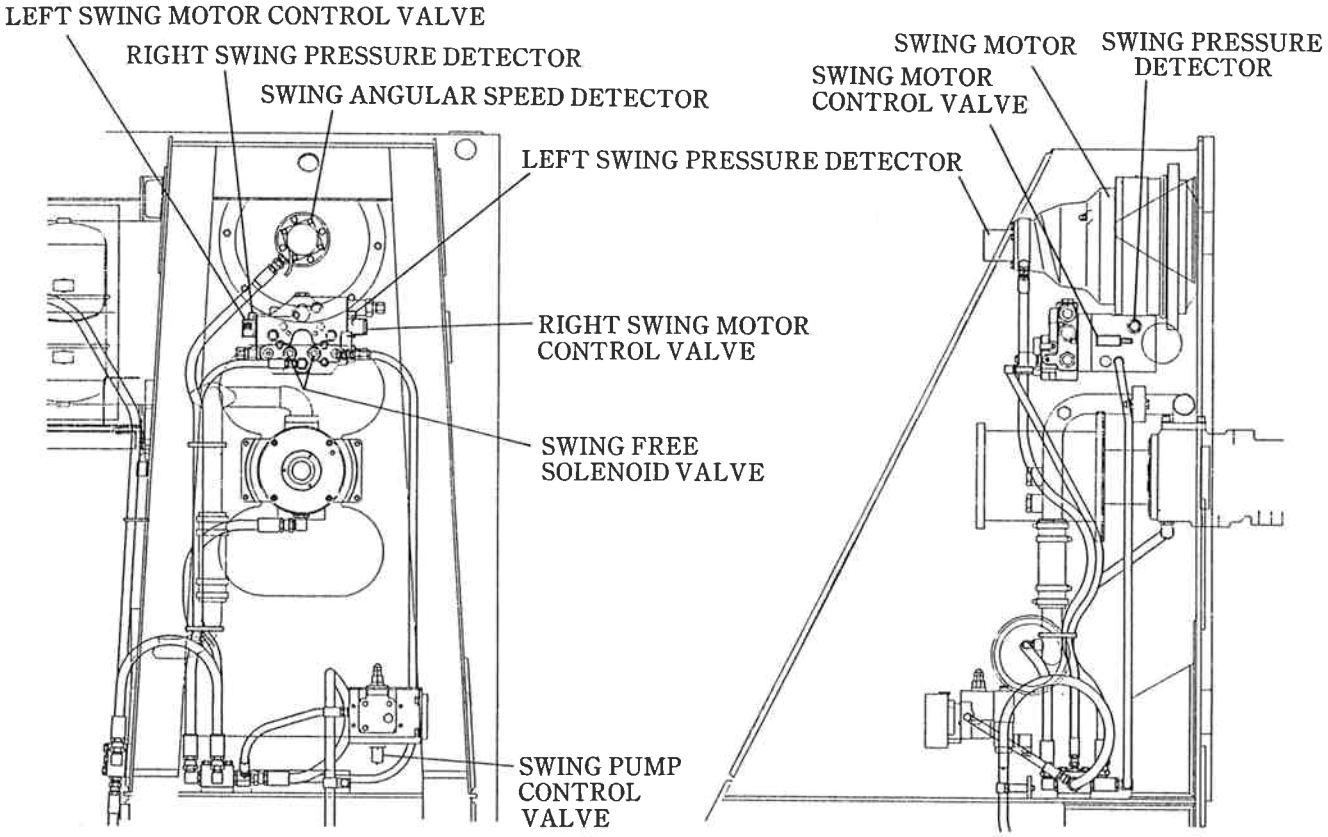
https://truckmanualshub.com/

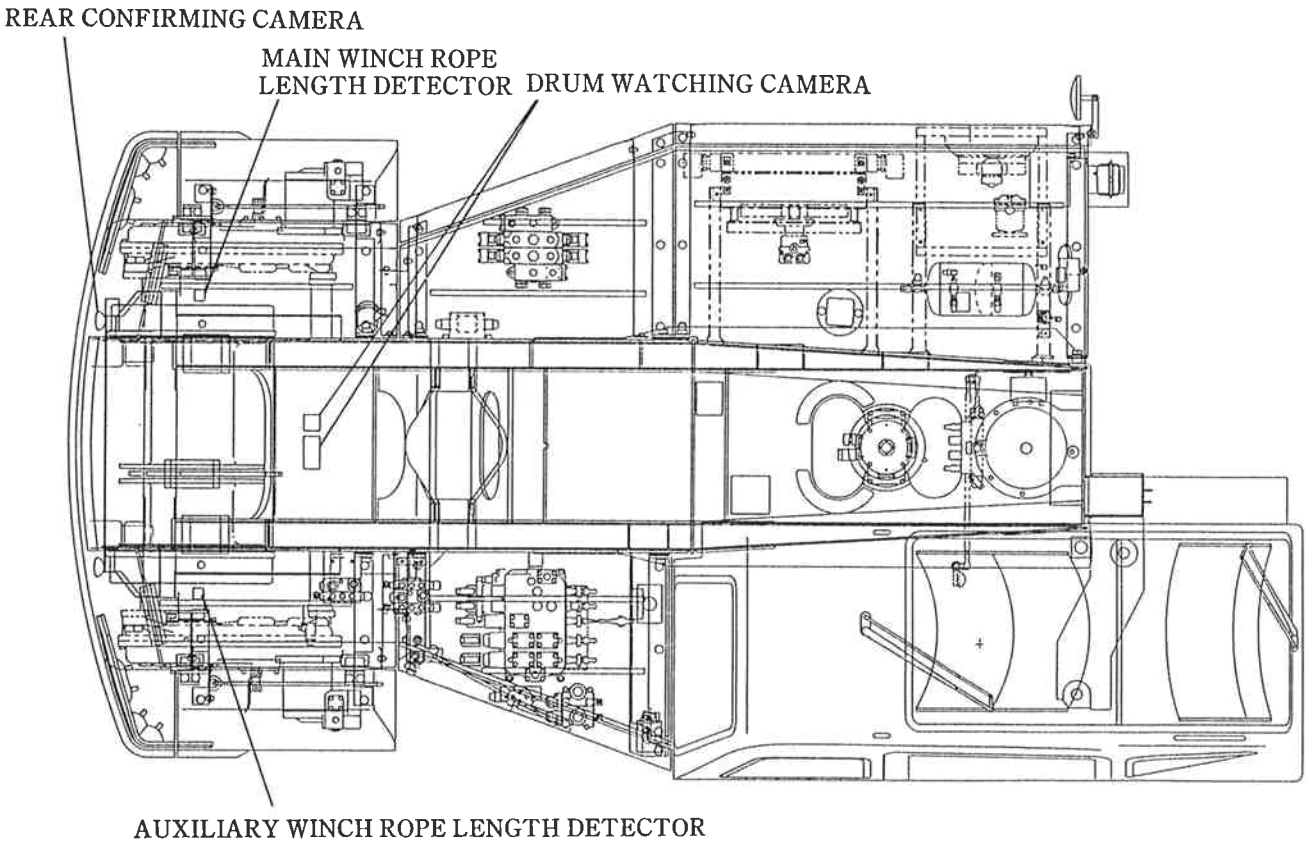
1.5 ARRANGEMENT OF SWING AUTOMATIC STOP MAIN EQUIPMENTS (LOWER)



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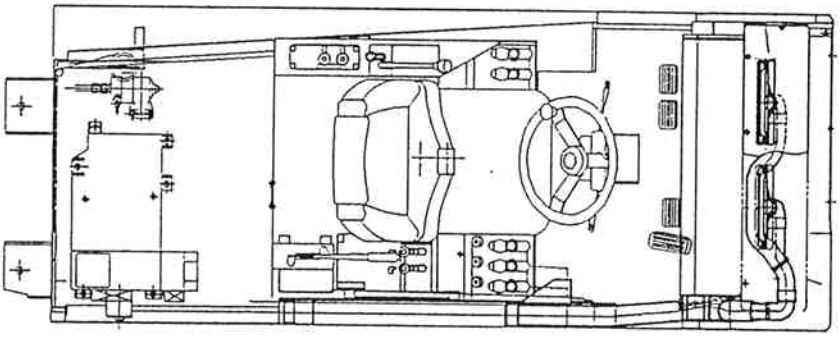
ARRANGEMENT OF SWING AUTOMATIC STOP MAIN EQUIPMENTS
(UPPER OUTSIDE OPERATOR'S ROOM)





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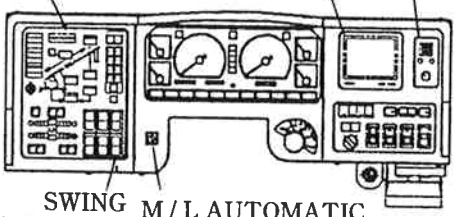
ARRANGEMENT OF SWING AUTOMATIC STOP MAIN EQUIPMENTS
(INSIDE OPERATOR'S ROOM)



MONITOR INDICATION SELECTOR SWITCH PANEL

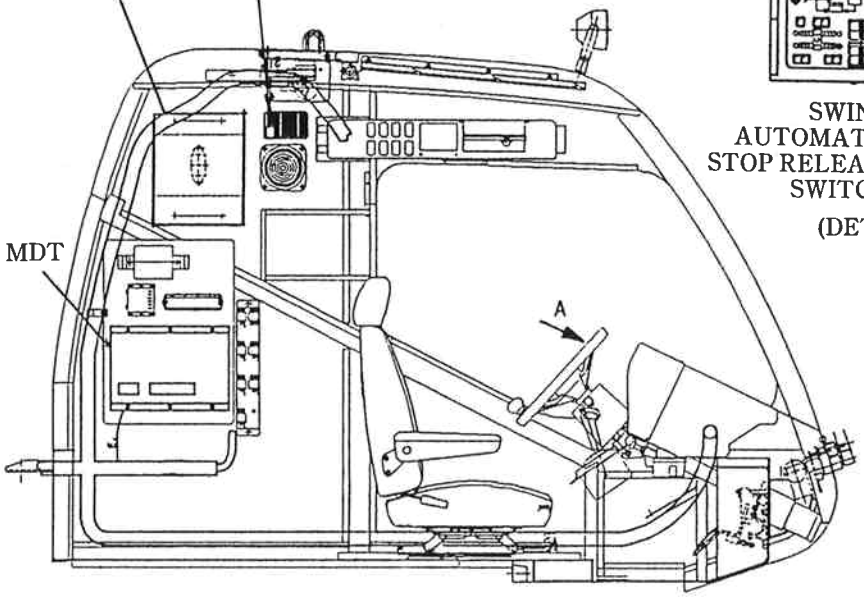
MONITOR TELEVISION

M / L



SWING CONTROLLER

CAB VOICE ALARM



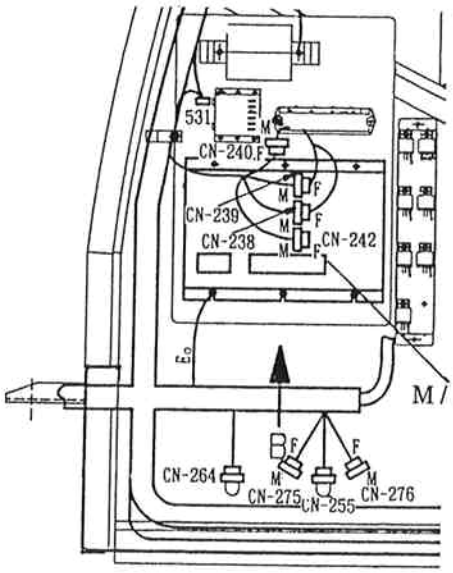
UPPER MDT

SWING AUTOMATIC STOP RELEASE SWITCH

M / L AUTOMATIC STOP RELEASE SWITCH

VIEW FROM "A"

(DETAIL OF FRONT PANEL)



M / L ADJUSTING CONNECTOR (CN-242M)

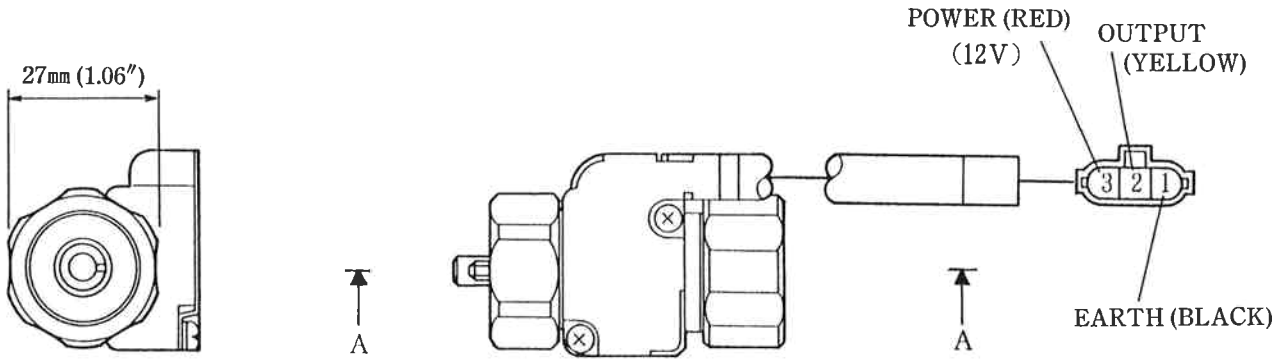
(RELATED TO SWING AUTOMATIC STOP. SERVES ALSO FOR I / O CHECK FUNCTION.)

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2. CONSTRUCTION AND OPERATION OF EACH EQUIPMENT

2.1 SWING ANGULAR SPEED DETECTOR

(1) OUTSIDE VIEW

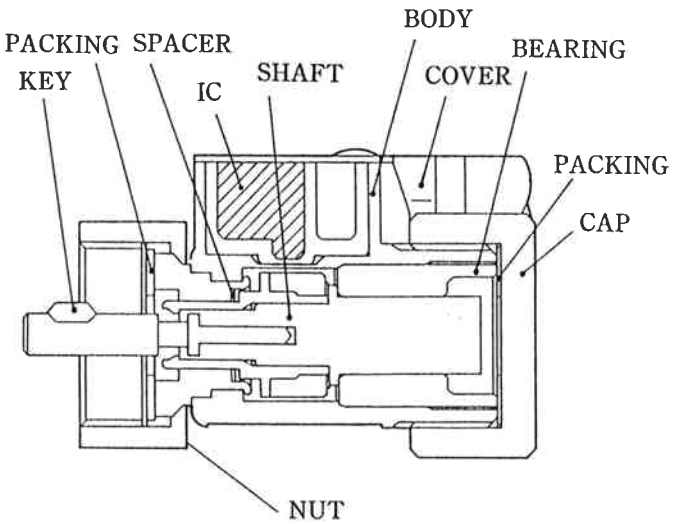


(2) PRINCIPLE OF OPERATION

This detector is a detector which converts the swing angular speed into the ON / OFF signal of pulses / rev. with the use of reluctance element to the magnetized rotating plate installed on the shaft. This detector is the identical part with the traveling speed detector.

(3) CHECK OF OPERATION

If the output wave shape is ON (5V) and OFF (0V) as shown in Fig. 2-2 when the shaft of the swing angular speed detector is turned, it is normal. If the output of this wave shape is not normal, check the power supply (+12V) and the earth circuit. When the output wave shape is abnormal in spite of that these are normal, replace the detector assembly with a new one.



SECTION A-A

Fig. 2-1

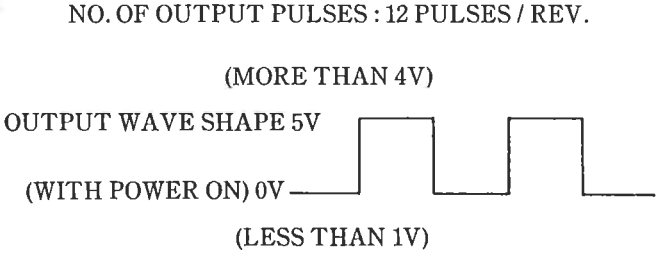


Fig. 2-2 Output Characteristic

https://truckmanualshub.com/

(4) INSTALLATION OF SWING ANGULAR SPEED DETECTOR

NOTE :

1. Fill the inside of the coupling with grease.
2. When tightening the coupling, apply Locktite #242 (or equivalent).
3. The tightening torque of bolts, unless otherwise specified, shall be equivalent to 4T.
4. The installing torque of the swing angular speed detector shall be 70 to 130kg · cm (5.1 to 9.4 ft-lbs).

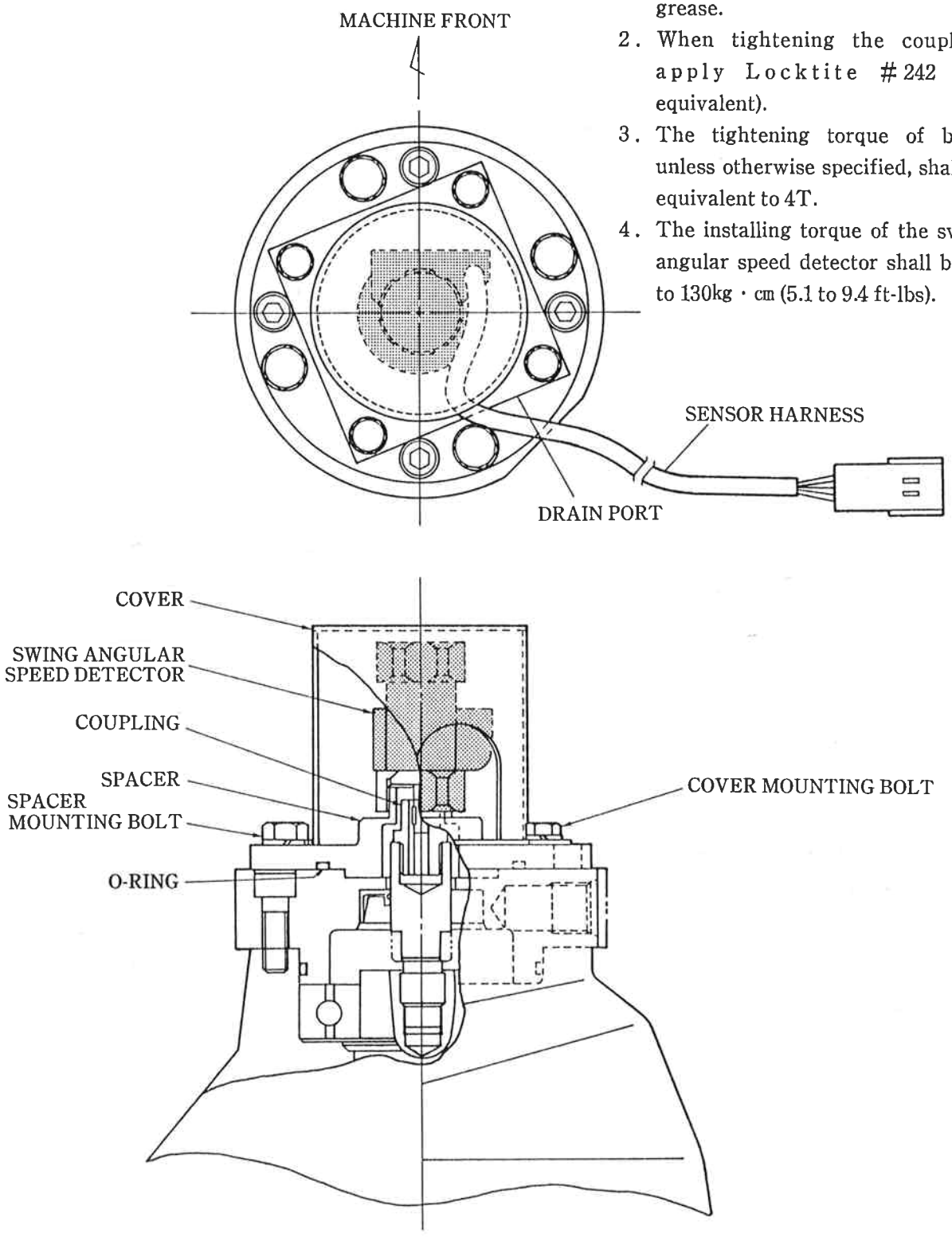


Fig. 2-3

https://truckmanualshub.com/

2.2 ROPE LENGTH DETECTOR
(IDENTICAL PART FOR BOTH MAIN WINCH AND AUXILIARY WINCH)

(1) OUTSIDE VIEW

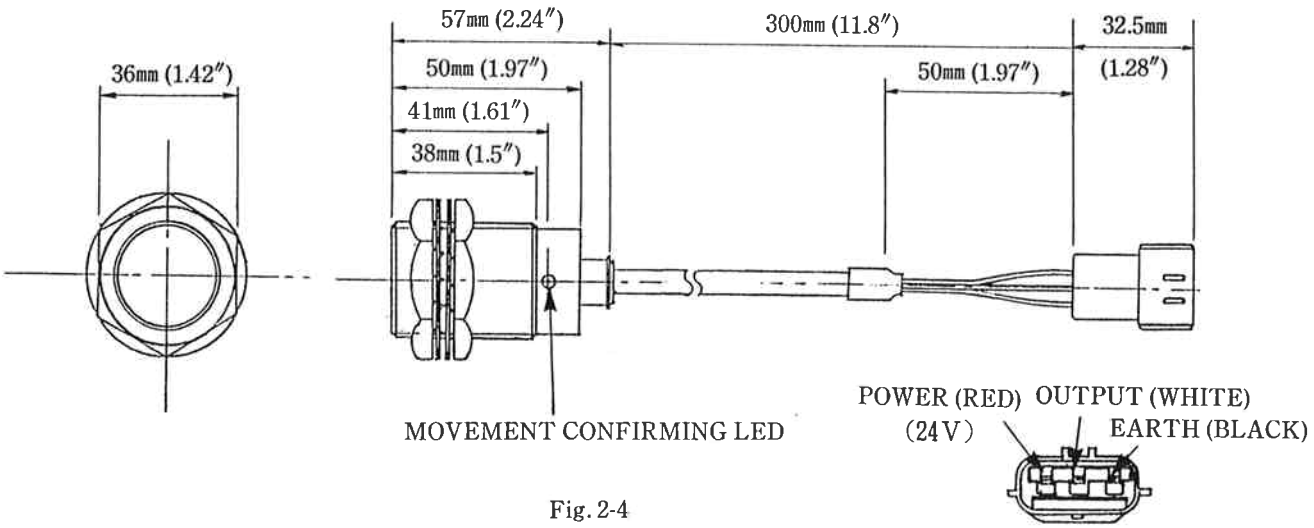


Fig. 2-4

(2) PRINCIPLE OF OPERATION

This rope length detector uses a proximity switch, and the output is turned on (ground output) when a piece of metal approaches within 8mm (0.315inch) from the detecting section. Fig. 2-5 shows the principle of operation.

This detects number of the passed drum fins when the winch drum rotates.

The increasing and decreasing directions are judged with the limit switch signal of the winch control lever.

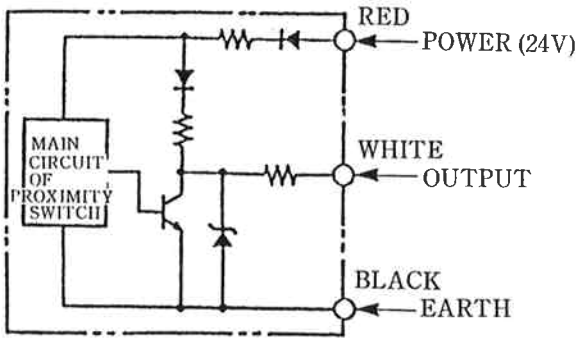


Fig. 2-5

(3) CHECK OF OPERATION

If the relation between the rope length detector and the output value is the output character shown in Fig. 2-6, it is normal. When an iron piece is approached to the detector, if the movement confirming LED lights up, the detector itself is judged to be normal. When the voltage is out of this range, check the supply power voltage (±24V) of the rope length detector and the earth circuit.

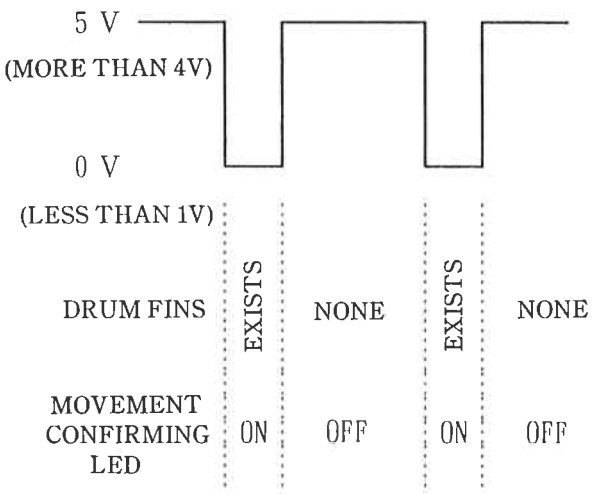
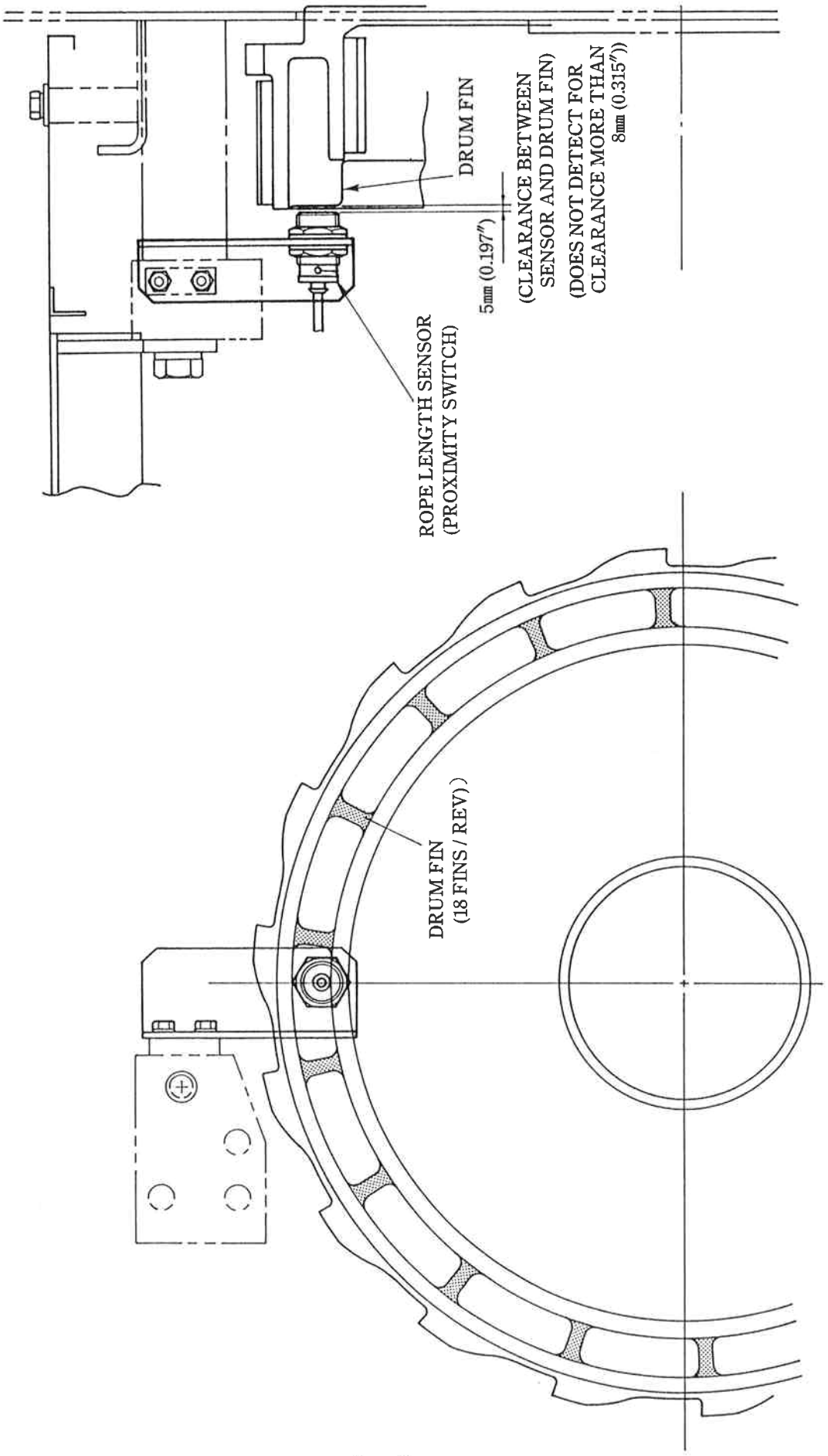


Fig. 2-6 Output Characteristic

https://truckmanualshub.com/

(4) INSTALLATION OF ROPE LENGTH DETECTOR

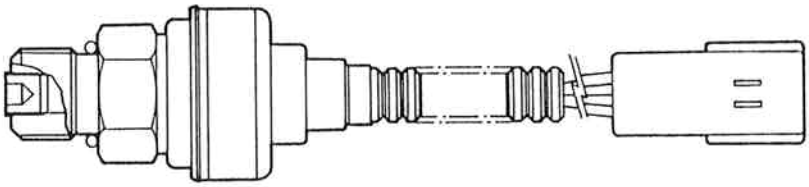


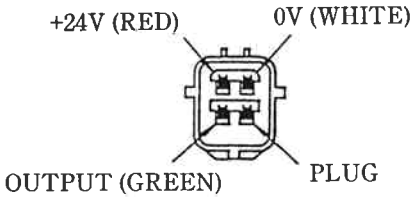
Rope Length Detector Installation

https://truckmanualshub.com/

2.2 SWING PRESSURE DETECTOR (IDENTICAL PART FOR LEFT SWING AND RIGHT SWING PRESSURES)

(1) CONSTRUCTION



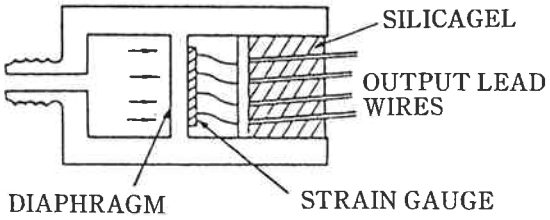


(SENSOR SECTION)

※Pressure detector of same specification (max. 200kg / cm²) for both left swing side and right swing side.

(2) PRINCIPLE OF OPERATION

The pressure detector converts hydraulic pressure of the boom hoist cylinder into the electrical signal, and puts out. The operation is shown in the figure. The section which converts the pressure of the pressure detector into the electrical signal is of construction shown in the figure, and takes out the strain of the diaphragm due to pressure as the variation of resistance value of the strain gauge.



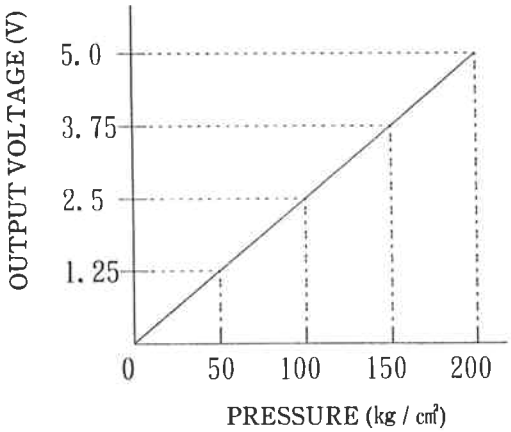
Rough Construction of Pressure Detector (Sensor) Inside

(0.25V varies every 10kg / cm² (142psi) of pressure.)

(3) CHECK OF OPERATION

If the relation between the pressure detector and the output voltage is in the range of ±1% from the output value shown in the figure, it is normal. If the voltage is out of this range, check the supply power voltage (±24V) of the pressure detector and the earth circuit.

In spite of that these are normal, if the output voltage is abnormal, reconfirm if air exists or not, then replace the detector assembly with a new one.



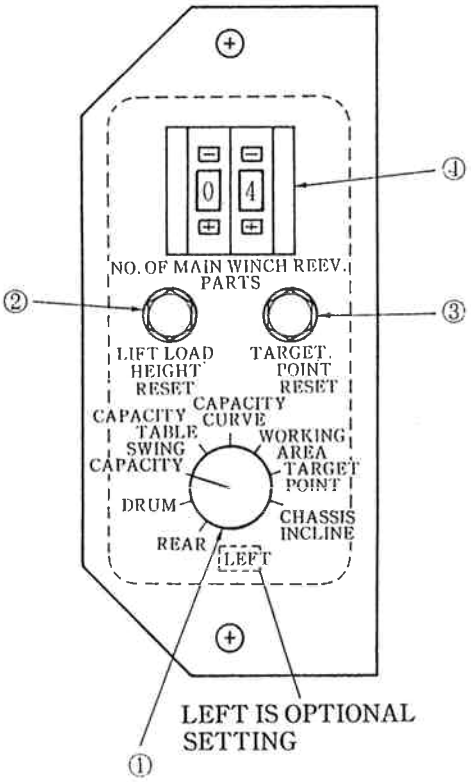
○ Absolutely do not disassemble the sensor section (pressure converting section).

(There is not adjusting volume at all in the inside. If the output voltage is abnormal, replace the assembly with a new one.)

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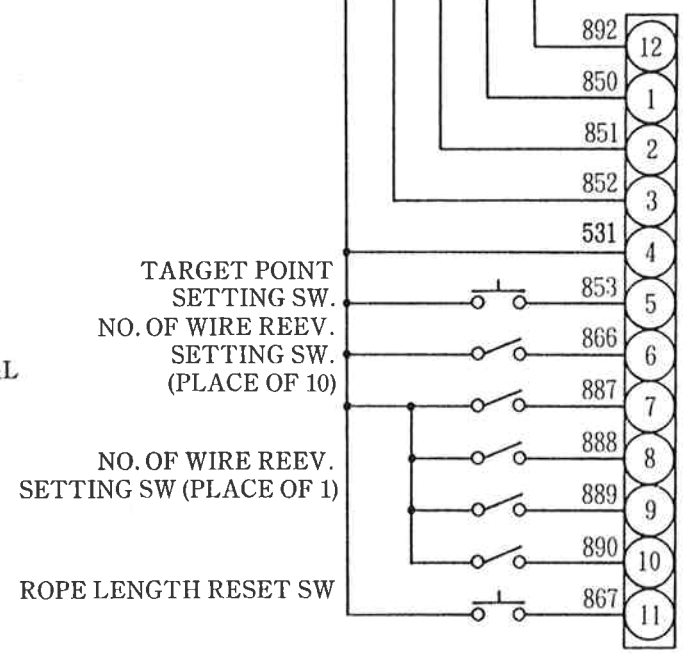
2.4 MONITOR CONTROL PANEL

(1) OUTSIDE VIEW

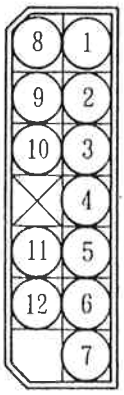


Monitor Indication Selector Sw.

Indication pattern	COM	S1	S2	S3	S4
Rear camera	○				
Drum camera	○	○			
Swing capacity ind.	○		○		
Capacity table ind.	○	○	○		
Capacity curve ind.	○			○	
Work area limit ind.	○	○		○	
Target point ind.	○		○	○	
Chassis inclin. ind.	○	○	○	○	
Left (optional)	○				○
Left (optional)	○	○			○



ELECTRICAL CIRCUIT



CN-214M
PIN POSITION

(2) FUNCTION

No.	Name	Construction	Specification
①	Indication selector switch	Binary output type* rotary switch (360° endless type)	10 kinds (2 kinds optional) of informations are selected with 4 output signals.
②	Lifting height reset switch	Push button switch (momentary type)	Short-circuits with switch turned on.
③	Target point setting sw.	↑	↑
④	No. of wire reeving parts setting switch	Binary output type* digital setting switch (Place of 10 : 0.1 only) (Place of 1 : 0 to 9)	Binary output every place figure. (Example)

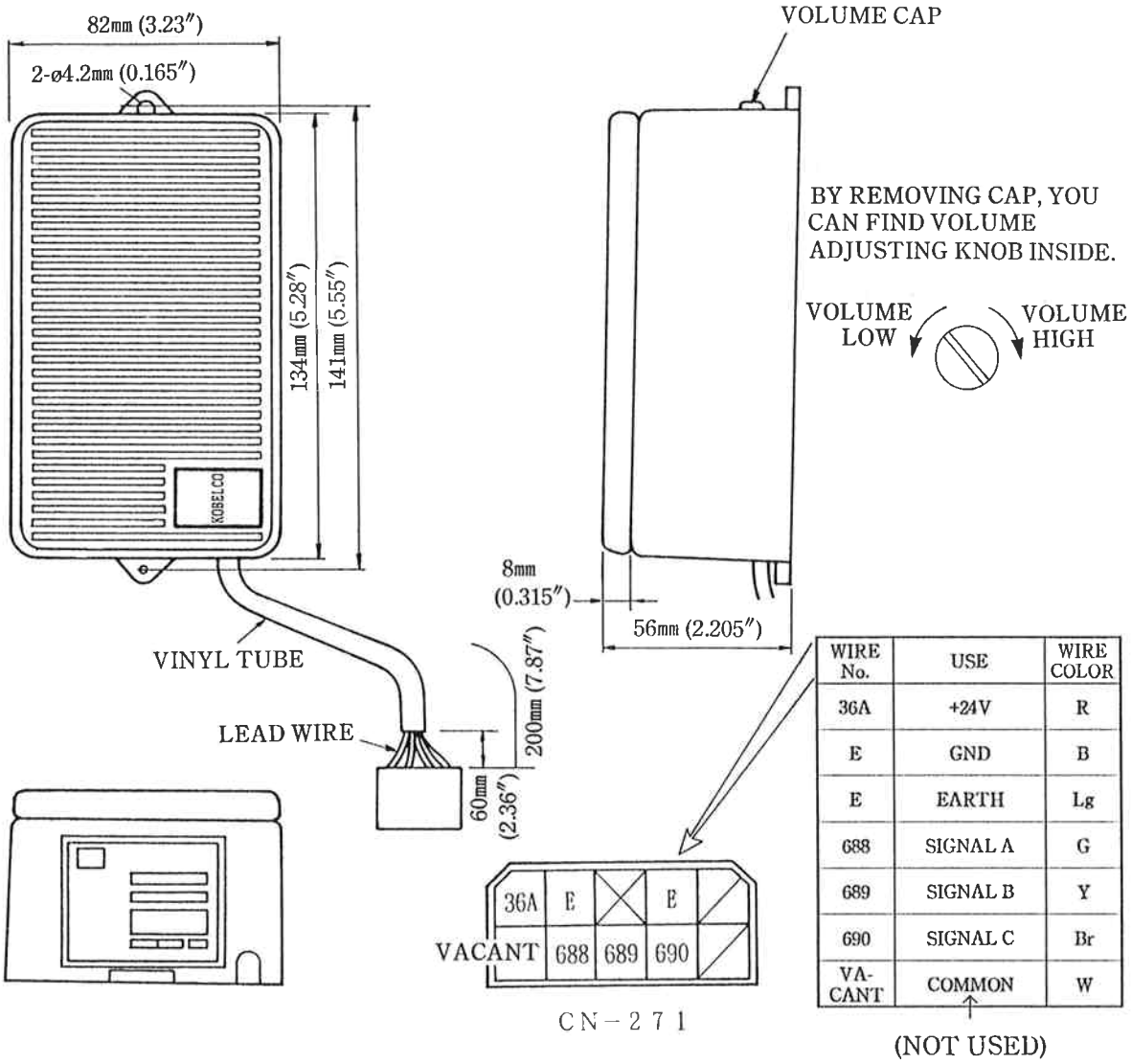
No. of parts	866	887	888	889	890
12	○		○		
4				○	
2			○		
	↑	↑	↑	↑	↑
	10 place (2^0)	1 place (2^0)	1 place (2^1)	1 place (2^2)	1 place (2^3)

*Binary output type : Binary number output type

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2.5 VOICE ALARM

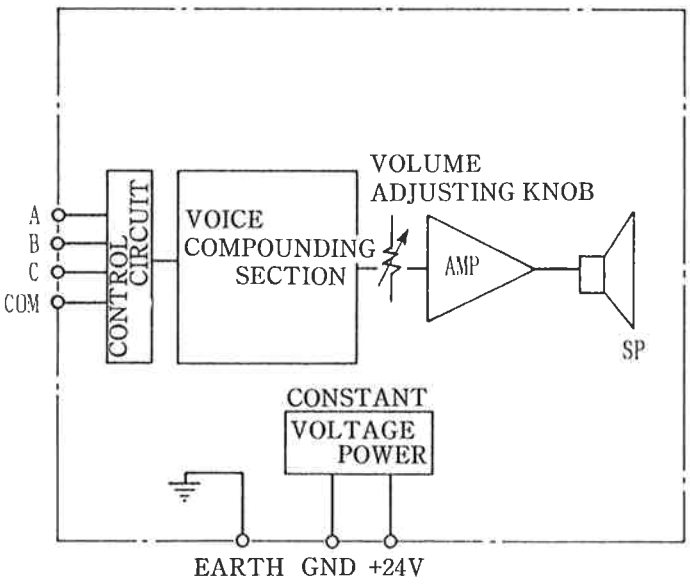
(1) OUTSIDE VIEW AND ARRANGEMENT OF CONNECTOR PINS



WIRE No.	USE	WIRE COLOR
36A	+24V	R
E	GND	B
E	EARTH	Lg
688	SIGNAL A	G
689	SIGNAL B	Y
690	SIGNAL C	Br
VA-CANT	COMMON	W

(NOT USED)

(2) BLOCK DIAGRAM



POWER SUPPLY DC24V

NOTE
WIRE COLOR SYMBOLS
R…Red
B…Black
Lg…Light green
G…Green
Y…Yellow
Br…Brown
W…White

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(3) SPECIFICATIONS

1) Volume

83dB at maximum (forward 1 meter on the centerline)

(Volume is adjusted at maximum when shipping.)

2) Voice Control Input

3 bit binary input (earth signal with ON)

When the open collector is connected,

pressure resistance Vce : more than supply power voltage, and current resistance IC : more than 10mA are required.

3) Number of Channels

7 CH

4) Pulse Width of Input Signal

More than 200ms

5) Control Function

- When the input signal is one shot, the voice output reproducts 1 cycle sound only, then stops.
- If the input signal continues, the voice output reproducts sound repeatedly.
- When other channel input signal is put in on the way of sound reproduction, the voice under reproduction is stopped, and the voice of channel which is put in is reproducted (prior movement of later input).

  However, if the input signal is continued and when its content (channel) is shifted, after the voice under reproduction of present is finished, the selected channel voice is reproducted. Therefore, when the prior movement of later input is required, after the all input signals are turned off, turn on the input signal of the channel to be reproducted next.

6) Uttered Words

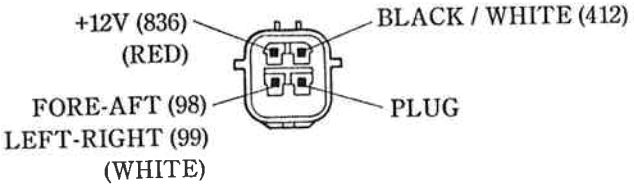
CH.	Input Signal (○ : ON)			Words to be uttered	Reproducting time
	A	B	C		
CH. 1	○			Swing motion does not automatically.	1.7 sec.
CH. 2		○		Pay attention to swing motion.	1.0 sec.
CH. 3	○	○		Set the machine horizontally.	1.8 sec.
CH. 4			○	It's the area limit.	1.3 sec.
CH. 5	○		○	Reconfirm the outriggers.	1.9 sec.
CH. 6		○	○	Swing motion will stop.	1.2 sec.
CH. 7	○	○	○	Stop swing motion.	1.6 sec.

NOTE : For the machine condition when words are uttered, see paragraph 4. 3.

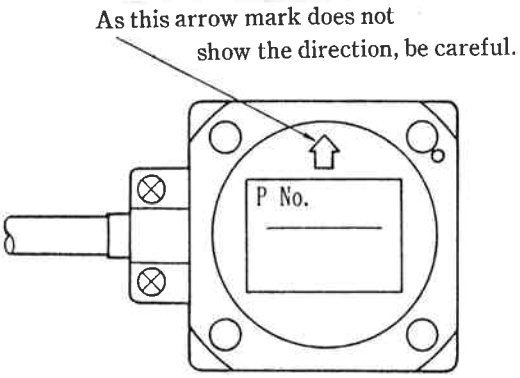
https://truckmanualshub.com/

2.6 CHASSIS INCLINATION DETECTOR

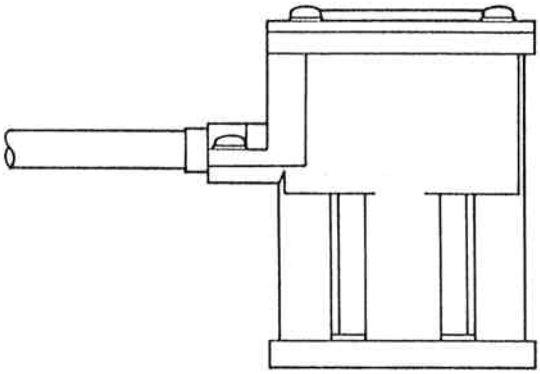
(1) OUTSIDE VIEW



VIEW B (PIN ARRANGEMENT)







(2) PRINCIPLE OF OPERATION

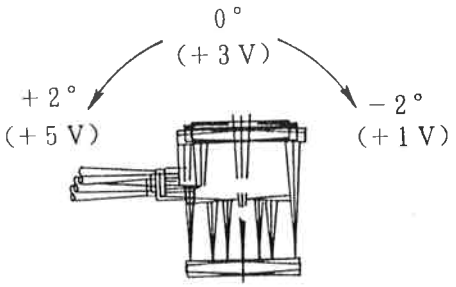
This detector, using the reluctance element and magnet, converts the deflection of the leaf spring type pendulum due to inclination into the electrical signal.

Since this detector detects one direction only, two detectors are provided in the actual machine for fore-aft inclination detecting and left-right inclination detecting.

(3) CHECK OF OPERATION

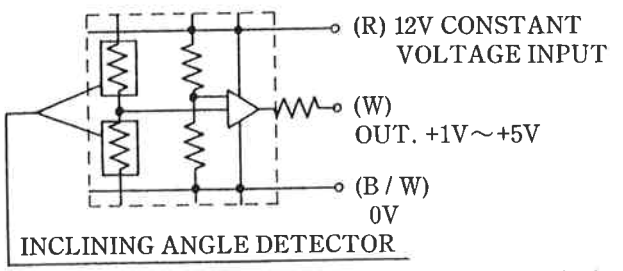
If the relation between the chassis inclination detector and the output voltage is within a range of ±1% from the output value shown in the figure, it is normal. If the voltage is out of this range, check the supply power voltage (+ 12V) and the earth circuit.

In spite of that these are normal, if the output voltage is abnormal, replace the detector assembly with a new one.



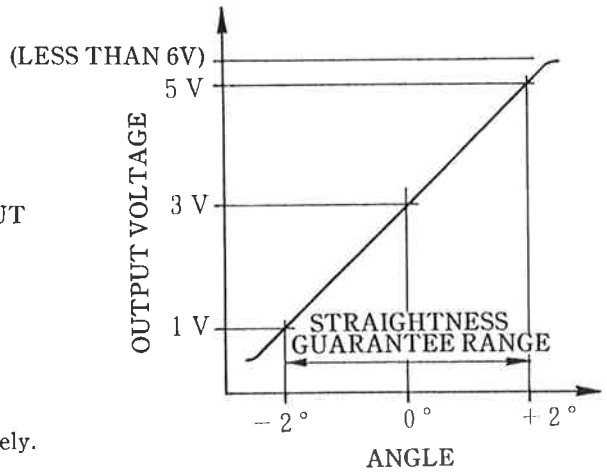
(DETECTING WIDTH 0±2°)

Inclining Angle Detecting Direction



INCLINING ANGLE DETECTOR

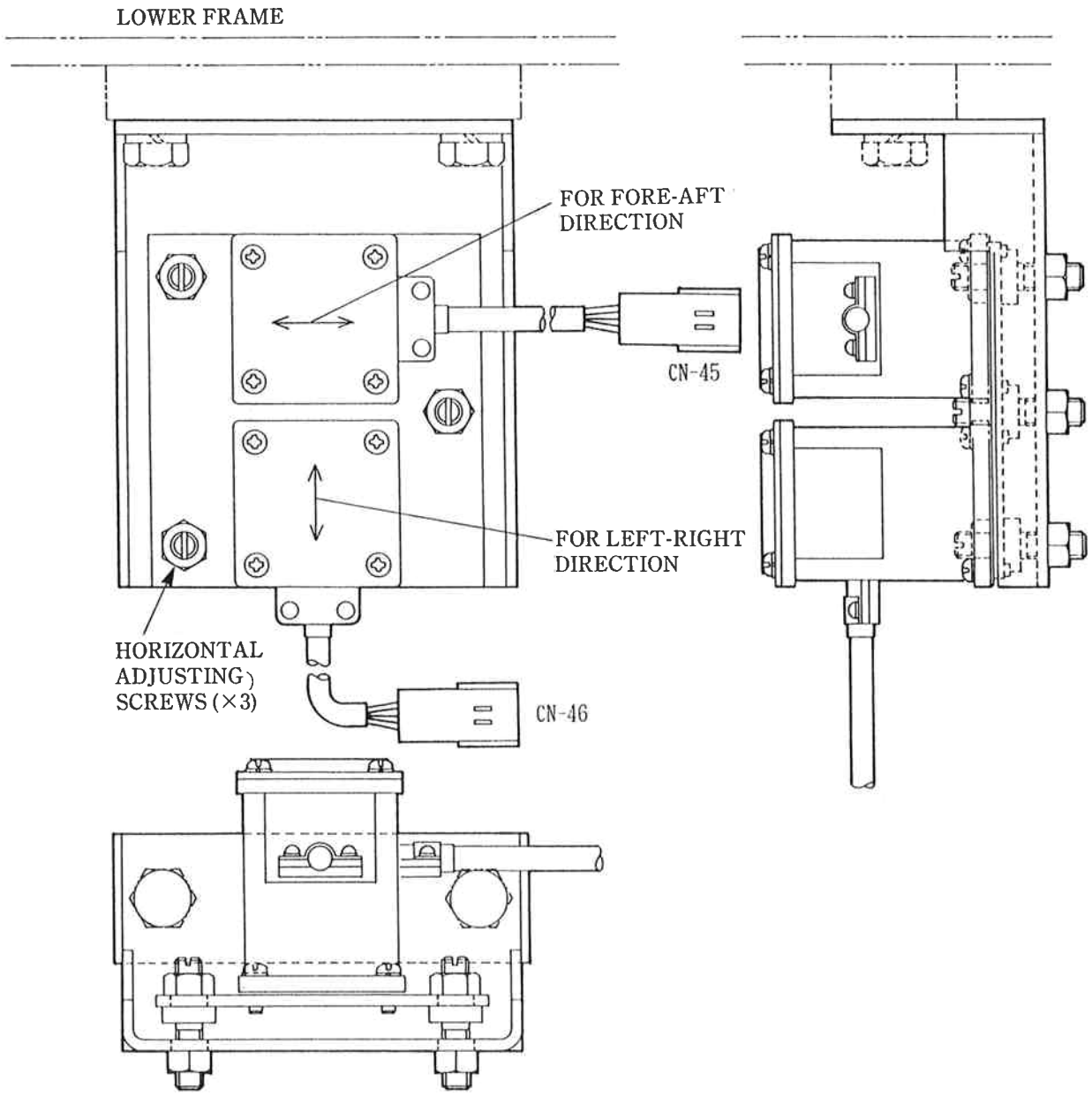
The each color shows color of the lead wire respectively.
(R : RED, W : WHITE, B : BLACK)



Output Characteristic

https://truckmanualshub.com/

Installation of Chassis Inclination Detector



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3. OPERATING METHOD

3.1 USING METHOD OF SWING AUTOMATIC STOP SYSTEM

GENERAL

The swing automatic stop system is a safety device provided in order prevent the machine from accidents such as damage or overturn of the machine due to swinging. Therefore, in order to carry out crane operation more safely, be sure to use this system.

(1) BASIC FUNCTION

1) This system perceives the swinging condition and slowly stops the swing motion before the machine enters a dangerous condition (overloading area or dangerous area of the swing are limit) by swinging when the operator performs swing operation.

2) The conditions that the swing automatic stop operates are as follows.

i) When the machine is going to swing toward the overloading direction in the machine condition that the rated load varies by swinging with different extended widths of the front, rear, left and right outriggers and so on.

ii) When the machine is going to swing toward a direction that the swing angle exceeds the swing angle which is set with swing area limit.

iii) When the machine is going to swing as the machine is in the overloaded condition.

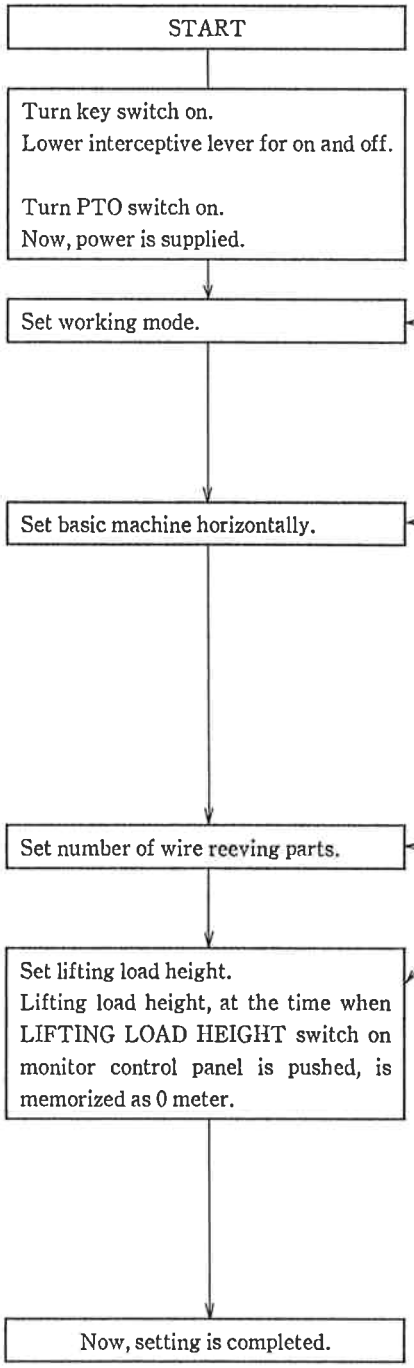
WARNING

The swing automatic stop system stops the swing motion not to allow a lifted load to swing, but cannot remove swinging of the load during swing motion. Operate swinging not to allow the load to swing during swing operation.

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(2) SETTING METHOD OF SWING AUTOMATIC STOP SYSTEM

To make this system operate normally, set in the following procedures.



Since mistaking the working mode setting does not make the rated crane capacity be indicated properly, it is very dangerous. Be sure to set the working mode in accordance with the actual working condition.

If the machine is not set horizontally, some difference is caused in the swing driving force, and the swing automatic stop system does not operate accurately.

When the basic machine is set in a condition inclining more than ±1° , caution message "Swing does not stop automatically." is issued.

If number of wire reeving parts and lifting load height resetting is not set in accordance with the actual machine, the lifting load height cannot be measured correctly, the swing motion cannot be stopped with minimized swinging of the lifting load.

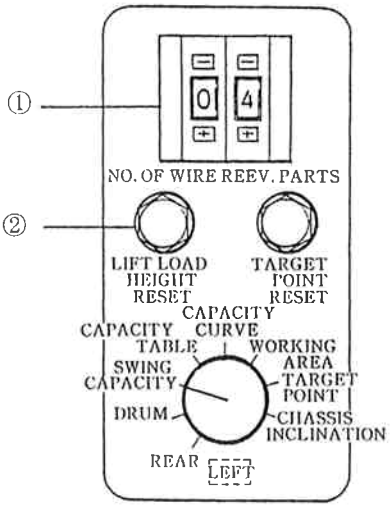
https://truckmanualshub.com/

(3) SETTING METHOD OF EACH PART

1) Monitor Control Panel

i) No. of Wire Reeving Parts Setting Switch ①

● Set the number of wire reeving parts of the main winch hook before starting operation. (Example : Set [0][4] in case of 4 parts.)



CAUTION

Be sure to set the actual number of wire parts. This is very important in order to minimize the load swinging by swing automatic stop.

● By pushing button [−] [+] above and under each place figure, figures can be set in order.

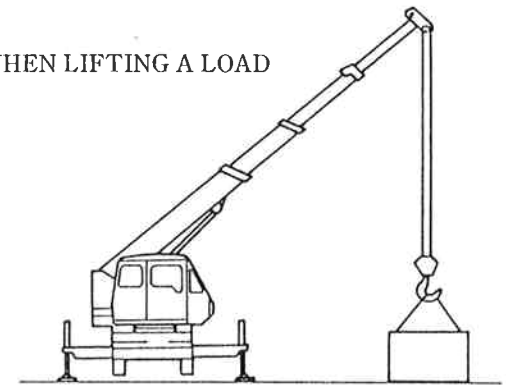
ii) Lifting Load Height Reset Switch ②

Reset the lifting load height before starting operation. (The boom angle and the boom length may be set in any position.)

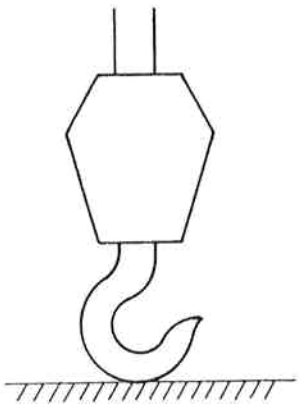
● Resetting Procedures of Lifting Load Height.

1. Set the working mode in accordance with the actual working condition with the work mode selector switch.
2. Set the boom to the boom posture with which the work is operated. (The boom angle and the boom length may be in any condition.)
3. Set the lifting load in the condition just before the load clears the ground.
4. With this condition, push the lifting load height reset switch. With this, the lifting load height is memorized as 0 meter.

· WHEN LIFTING A LOAD



· WHEN LIFTING HOOK ONLY.



When lifting hook only (without load), set the hook to the ground surface, and push the reset switch.

CAUTION

● For the lifting load height, the hook to be reset is selected according to the working mode condition (main winch hook for lifting with the boom and lifting with the boom with the jib attached, and auxiliary winch hook for lifting with the auxiliary sheave and for lifting with the jib). Therefore, when resetting the lifting load height, be sure to set the working mode in accordance with the actual working condition.

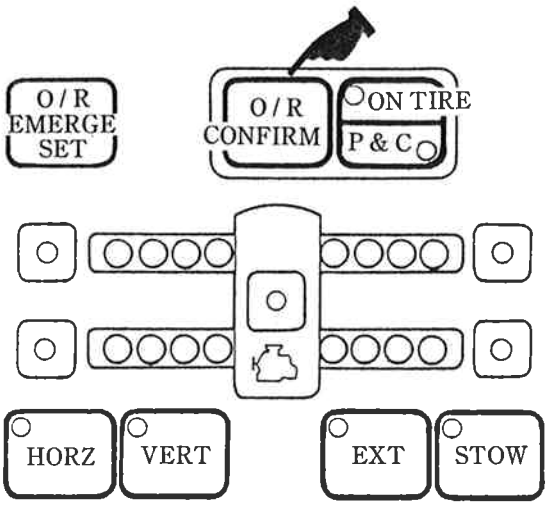
● Since the lifting load setting is very important in order to minimize load swinging, be sure to reset before starting operation.

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2) Outrigger Control Panel

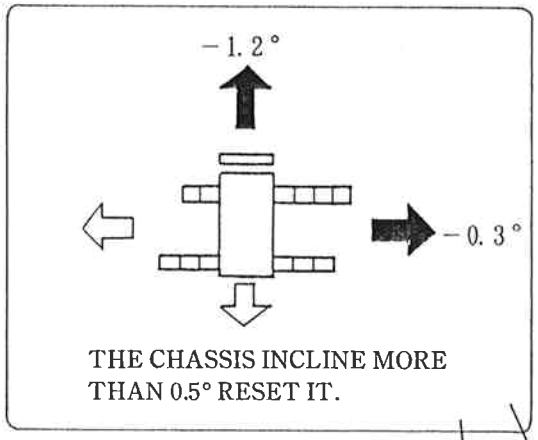
i) Detection of Machine Inclination

● When switch O/R CONFIRM is pushed or the on-tire mode is selected after operating the outriggers (for outrigger operation, see the separate manual), if the machine is inclined more than ±0.5° , caution is indicated on the multi-display. If the machine is inclined more than ±1° , voice message "Swing does not stop automatically." is issued.
At this time, readjust so that the machine is horizontally set.



CAUTION

When the machine is inclined more than ±1° , sometimes the swing motion could not be accurately stopped. Therefore, be sure to set the machine horizontally.



Picture of Multi-display

SWING DOES NOT
STOP AUTOMATICALLY

(When inclination of chassis
is more than ± 1 degree.)

https://truckmanualshub.com/

4. SPECIFICATION OF OPERATION

The outline of specification of the swing automatic stop operation is as follows.

i) This slowly stops swing motion before the machine is overloaded.

ii) This slowly stops swing motion before the machine enters a dangerous area of the working area limit (left swing and right swing).

iii) This issues the prenotice alarm output (together with the voice alarm) before the automatic swing stop controls begins.

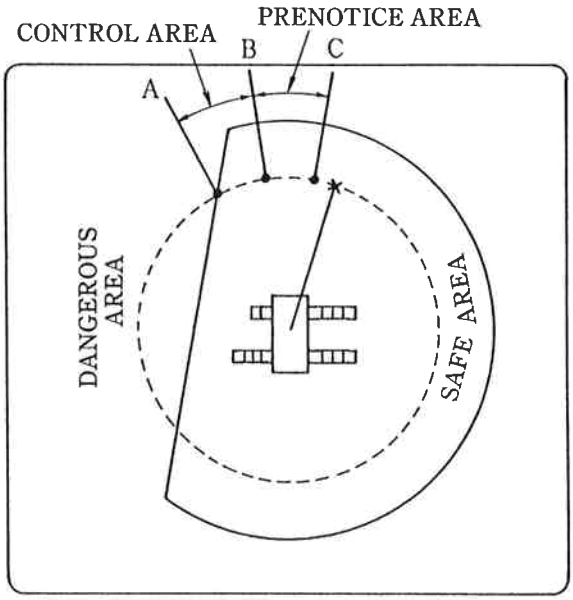
iv) This issues the warning alarm output (together with the voice alarm) during control of the swing automatic stop control.

→While the swing automatic stop due to overload is controlled, boom lowering and boom extending motions are stopped.

→While stop due to the working area limit is controlled, any crane operation is possible.

4.1 SPECIFICATION OF SWING AUTOMATIC STOP DUE TO OVERLOAD

When left swing is operated at the present loaded condition (point ×) as shown in the right figure, the machine becomes of overloaded condition in the left area from point A. Therefore, this system operates as follows in order to slowly stop the swing motion at point A.



(Example : Swing capacity indication on monitor television)

(1) Condition that Swing Stop Release Switch is turned OFF.

No.	Area symbol	Area	Swing movement	Crane movement	Voice alarm	Swing warning lamp
1	~C	Safe area	Normal movement	Normal movement		Goes out.
2	B~C	Prenotice area	↑ If present swing speed is kept, slowly stopping movement begins four seconds later.	↑	"Pay attention to swing."	Slowly goes on and off.
3	B~A	Control area	· If swing lever is kept in ON. motion will slowly stop. · Operation toward safe side is possible.	Crane movement toward dangerous side is impossible.	"Swing will stop."	Quickly goes on and off.
4	A~	Dangerous area	Operation toward dangerous side is impossible. Swing is kept as it stops.	↑	Same as above.	Lights up.

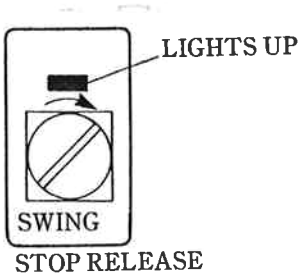
→This movement is different from that of swing stop due to working area limit.

https://truckmanualshub.com/

(2) Condition that Swing Automatic Stop Release Switch is turned ON

When the swing automatic stop release switch is turned on, swing motion does not stop automatically. (However, the swing warning alarm sounds.)

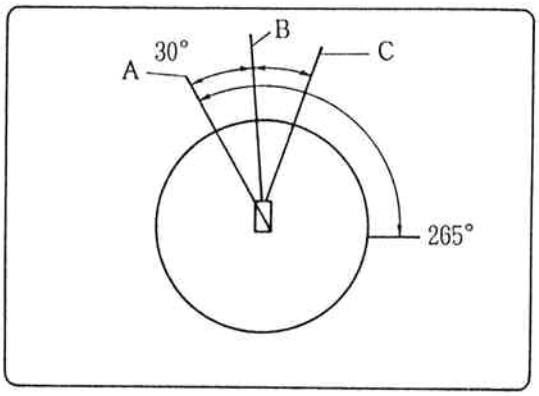
At this time, when the machine enters the control area and dangerous area, the swing warning alarm changes to voice alarm "Stop swing." to inform danger to the operator.



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4.2 SPECIFICATION OF SWING AUTOMATIC STOP DUE TO WORKING AREA LIMIT

This system operates as follows in order to slowly stop the swing motion smoothly at the set value of the working area limit.



Example : Working Area Limit Indication on Monitor Television

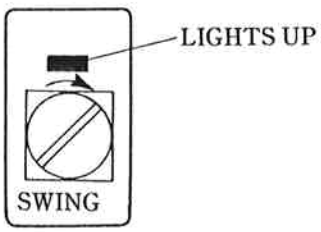
(1) Condition that Swing Stop Release Switch is turned OFF

No.	Area symbol	Area	Swing Movement	Crane movement	Voice alarm	Swing warning lamp
1	~C	Safe area	Normal movement	Normal movement		Goes out.
2	B~C	Prenotice area	↑ If present swing speed is kept, slowly stopping movement begins four seconds later.	↑	"Pay attention to swing."	Slowly goes on and off.
3	B~A	Control area	· If swing lever is kept in ON, motion will slowly stop. · Operation toward safe side is possible.	↑	"Swing will stop."	Quickly goes on and off.
4	A~	Dangerous area	Operation toward dangerous side is impossible. Swing is kept as it stops.	↑	"It's area limit." "Swing will stop."	Lights up.

→This movement is different from that of swing stop due to overload.

(2) Condition that Swing Stop Release Switch is turned ON.

When the swing stop release switch is turned on, swing motion does not stop automatically. (However, the swing warning alarm sounds.) At this time, when the machine enters the control area and dangerous area, the swing warning alarm changes to voice alarm "Stop swinging." to inform danger to the operator.



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4.3 SPECIFICATION OF VOICE ALARM OUTPUT (OUTPUT VIA SWING CONTROLLER MOMENT LIMITER)

No.	Uttered VOICE WORDS	Condition	Signal 1	Signal 2	Signal 3	Pronouncing Pattern	Priority Order	Remarks
1	Stop swinging.	1. During swing control with swing stop release switch turned on. 2. When chassis inclination is more than ±1.5° for more than 1 sec. at beginning of swing control. 3. When chassis inclination is more than ±1.7° for more than 1 sec. during swing control. 4. When swing control sensor*1 is abnormal during control.	○	○	○	Continuous output.	2	*1 Swing control sensor shall be as follows : · Boom length meter · Boom angle meter · Head pressure gauge · Rod pressure gauge · Jib angle meter (tilt jib only) · Swing angle meter · Outrigger length meter · Swing angular speed meter sensor · Rope length sensor (main / aux. winches) · Swing press. sensor
2	Set the basic machine horizontally.	1. When O/R SET is set, when chassis inclination is more than ± 0.5° for more than 1 sec. 2. When inclination is more than ±1.5° for more than 1 sec. with moment ratio within 10% and without operation of control lever.	○	○		ON for 1.8 sec. only.	1-A	After setting outrigger horizontally, when chassis inclines without loading (even without crane operation), alarm is issued.
3	Swinging is not stopped automatically.	1. When swing stop release switch is turned on. 2. When O/R SET is set, when inclination is more than ±1° for more than 1 sec. 3. When swing control sensor*1 is abnormal.	○			ON for 1.7 sec. only.	1-B	
4	Reconfirm the outriggers.	1. After O/R SET is set.	○		○	ON for 2.0 sec. only.	1-C	
5	Swinging will stop.	1. With swing stop release switch turned off, ① When chassis inclination is less than ±1.5° at beginning of control. ② When chassis is inclination is less than ±1.7° during control.		○	○	Continuous output.	2	
6	Pay attention to swing.	1. During swing prenotice.		○		Continuous output.	3	
7	It's area limit.	1. When control lever is operated toward dangerous side in warning area of area limit.			○	ON for 1.3 sec. only.	4	

"During control" shall be when the control signal is transmitted from the swing controller.
When signal outputs are issued duplicately, output of low number only is issued.
When outputs of the same priority order (1-A, 1-B, 1-C) are duplicated, output is issued in order of A⇨B⇨C.

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5. TROUBLESHOOTING

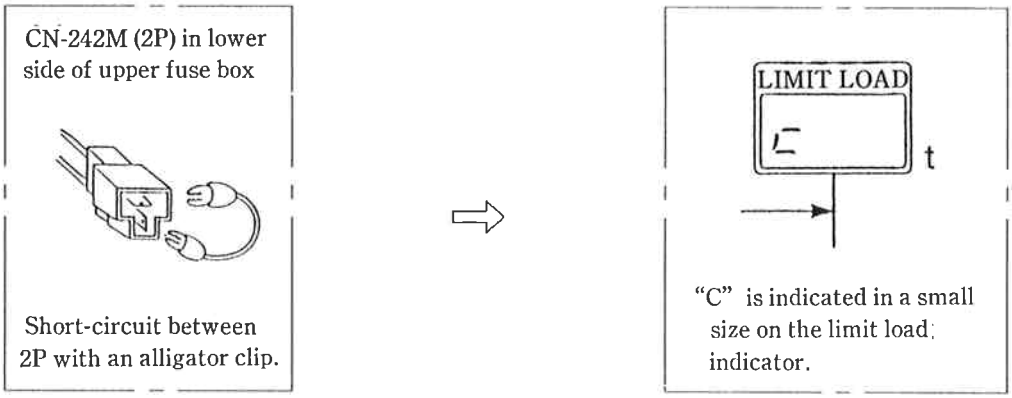
The swing automatic stop system is provided with the following function as a function for troubleshooting.

Diagnostic function	Content
I / O signal check function	Inputs of various sensor signals to the swing controller are indicated on the multi-display.

〔When abnormality occurs in the swing automatic stop system, utilize these diagnostic functions effectively.

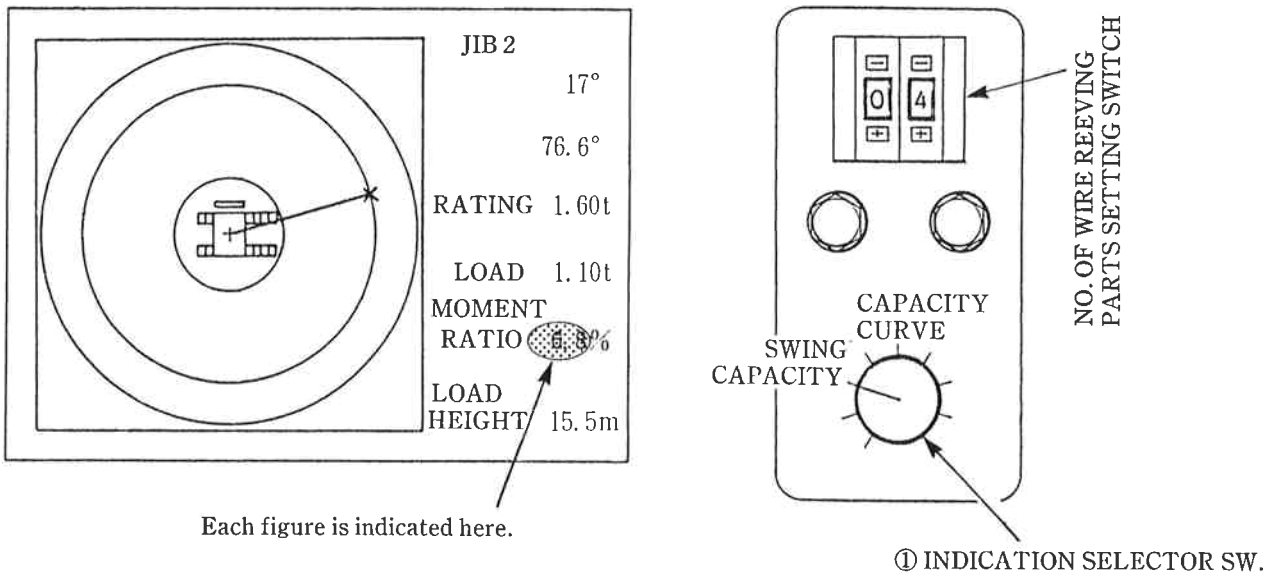
5.1 CHANGE TO I / O CHECK FUNCTION

(1) In the same way of changing method to the adjusting mode of the ML, by short-circuiting CN-242M, the I / O check function is available.



("C" indication is shown on the limit load on the ML.)

(2) Set the indication selector switch on the monitor control panel in the SWING CAPACITY mode (or CAPACITY CURVE mode) to confirm the moment ratio indication.
At this time, various sensor signals are indicated on the moment ratio indicator according to the set number by the number of wire reeving parts setting switch.



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No.	No. of wire reeving parts setting switch	Indicating item	Sensor name to be checked	Indicating contents	Judgment
1	01	Swing angle indication	Swing angle detector	0 to 359 are indicated. Front is 0, and swing angle is indicated every 1° in left swinging.	0 must be indicated at front.
2	02	Swing angular speed indication	Swing angular speed detector.	Variation of 0.1° / sec is indicated. Example : Since angular speed is 6.0° when swing speed is 1rpm, 60 is indicated.	60 must be indicated when swing speed is 1rpm.
3	03	Target angle of swing stop		0 to 359 are indicated. Front is 0, and swing angle is indicated every 1° in left swinging.	When there is target angle of swing stop, angle is indicated. When there is not target angle, blank is indicated.
4	04	Right swing pressure	Right swing pressure detector	Right swing pressure value is indicated in unit of 1kg / cm². Example : 170 is indicated when pressure is 170kg / cm².	When right swing lever is fully operated with swing lock pin inserted, 180 to 200 must be indicated.
5	05	Left swing pressure	Left swing pressure detector	Left swing pressure value is indicated in unit of 1kg / cm². Example : 170 is indicated when pressure is 170kg / cm².	When left swing lever is fully operated with swing lock pin inserted, 180 to 200 must be indicated.

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1. CONSTRUCTION

The hydropneumatic suspension is adopted in both the front axle and rear axle.

By connecting the chassis and the axles with the suspension cylinders, leading the oil in the suspension cylinders to the accumulators, which are filled with nitrogen gas, and arranging the closed circuits between the suspension cylinders and the accumulators, the up and down movement of the axles is absorbed by the pressure variation of the enclosed gas.

The piping between each suspension cylinder and each accumulator is arranged so that the left front cylinder head side and the right rear cylinder rod side, and the left front cylinder rod side and the right rear cylinder head side make respectively a closed circuit with each independent accumulator.

The right front cylinder and the left rear cylinder also make the closed circuit with the accumulator as the same as the above.

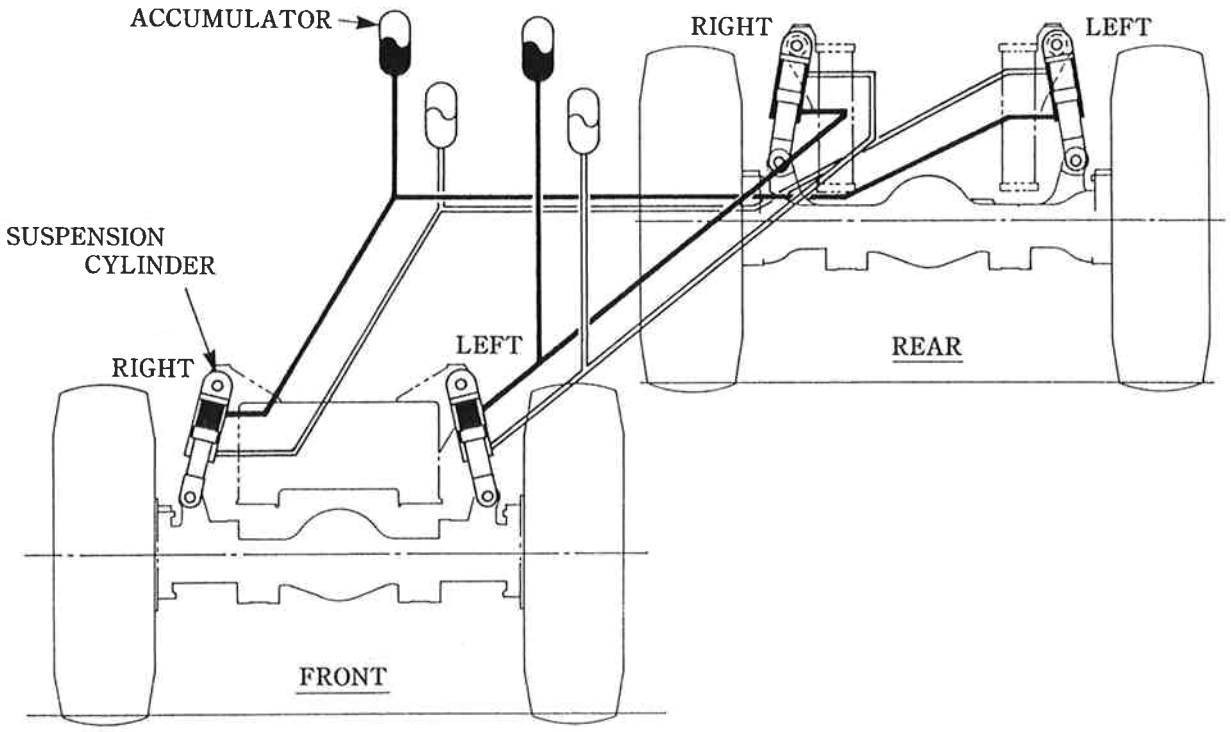


Fig. 1-1 Outline of System

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The axles and the chassis are connected with the two upper torque rods and two lower torque rods (four torque rods in total) respectively.

The fore-aft and left-right movements of the axles against the chassis are restricted within a necessary range by arranging the upper torque rods in a shape of "ハ".

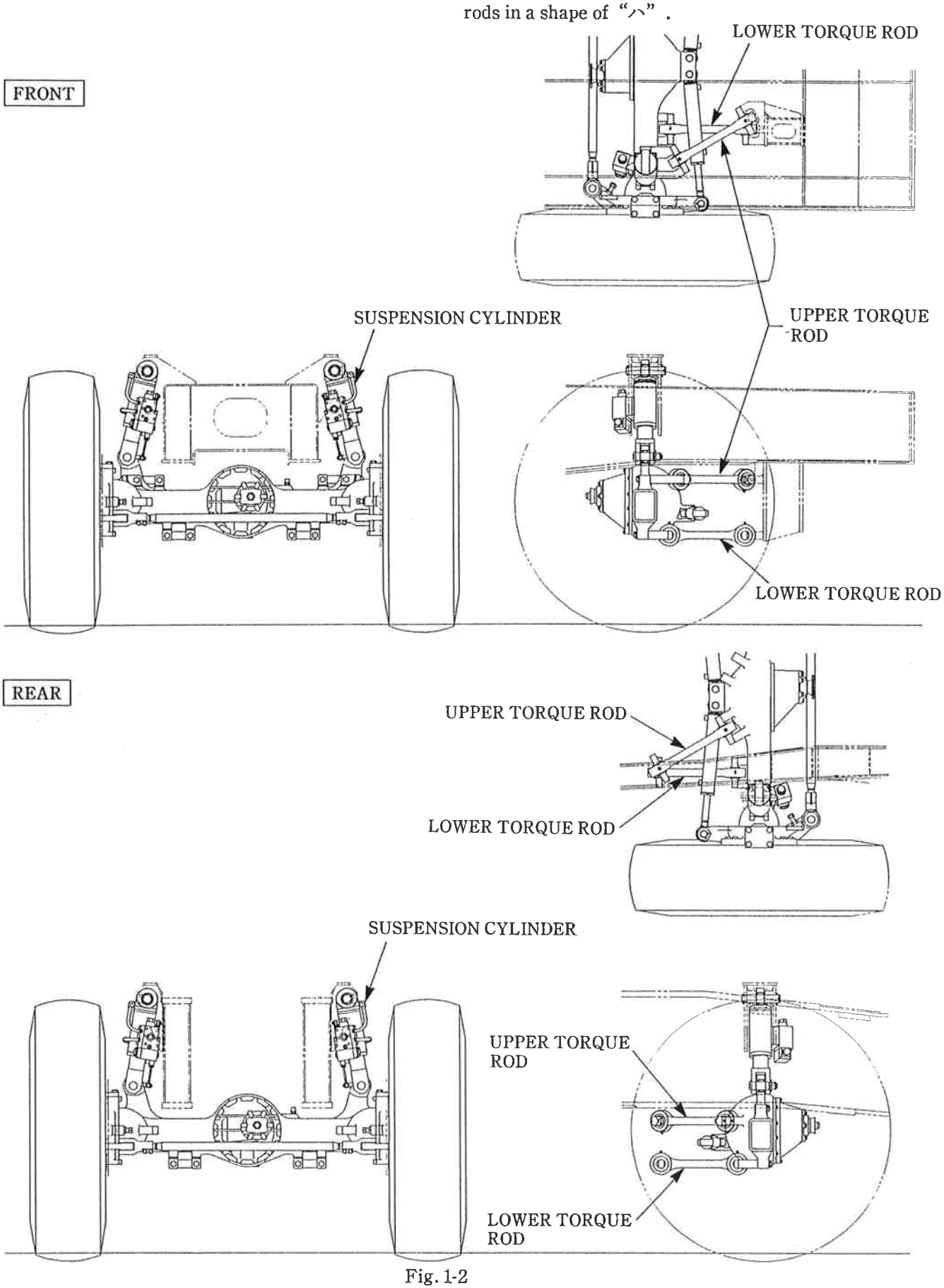


Fig. 1-2

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2.1 TRAVELING CONDITION

To drive the carrier, the following conditions are necessary. (If even one of these condition lacks, the free condition is unavailable.)

① Engine : Revolution
② Swing lock pin : Lock
③ PTO switch : OFF

Then, when the suspension switch on the operator's seat panel is pushed to the FREE side, four hy. suspension valve H3 valves (for H3, four of H3FR, H3FL, H3RR and H3RL) are magnetized at the same time, and the spools are shifted to the opposite position in the hydraulic circuit schematic. And also, the sus. pilot valve is magnetized at the same time, the pilot check valves directly connected to the suspension cylinders are opened, and the closed circuits are composed.

If the carrier height is within the specified level at this time, the green lamp on the suspension switch lights up, and traveling is possible. If the carrier height is out of the level range, the green lamp goes on and off, and while sound "Pee, pee, ……" is sounding, leveling begins automatically.

At this time, in the hydraulic circuits, in addition to the conditions that the sus. pilot valve and H3 valves are magnetized, hy. suspension pressure source solenoid valve B1 is turned on, steering joining solenoid valve B2 and steering unloading solenoid valve B3 are turned off, and H1 valve or H2 valve is magnetized. When the cylinder length is shorter than the specified range, H1 valve is magnetized, and the cylinder is extended. When the cylinder is longer than the specified range, H2 valve is magnetized, and the cylinder is retracted. For magnetization of the valves, the hy. suspension sensors mounted on the suspension cylinders detect the cylinder lengths, and issue the order. When all four suspension cylinder lengths enter the specified range, sound "Pi, Pi" sounds two times, and the green lamp changes to lighting, and the hydraulic circuits become the closed circuits by magnetizing the suspension pilot valve and four H3 valves only.

When the traveling condition is normal, the pilot lamps of the input / output indicator of the lower MDT light as the following figure shows. If the traveling condition is unavailable, confirm the places where the pilot lamps do not light up, and check.

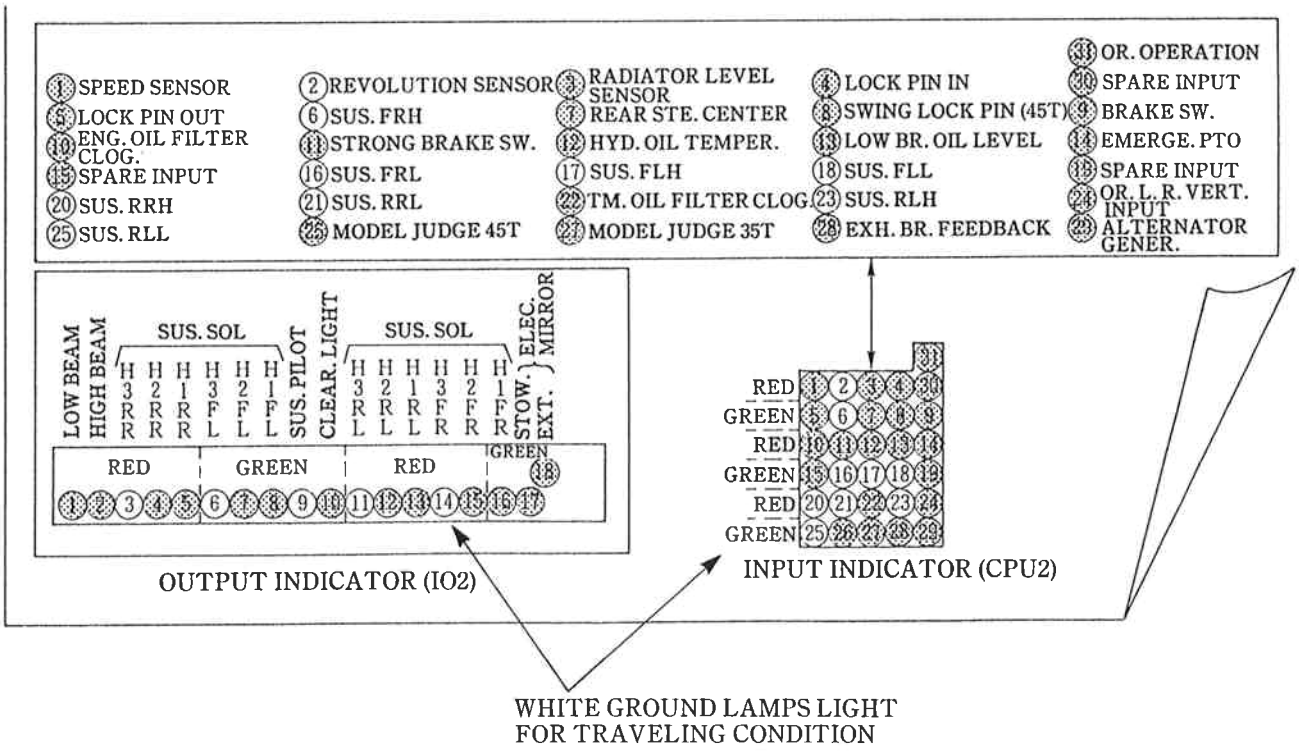


Fig. 2-2

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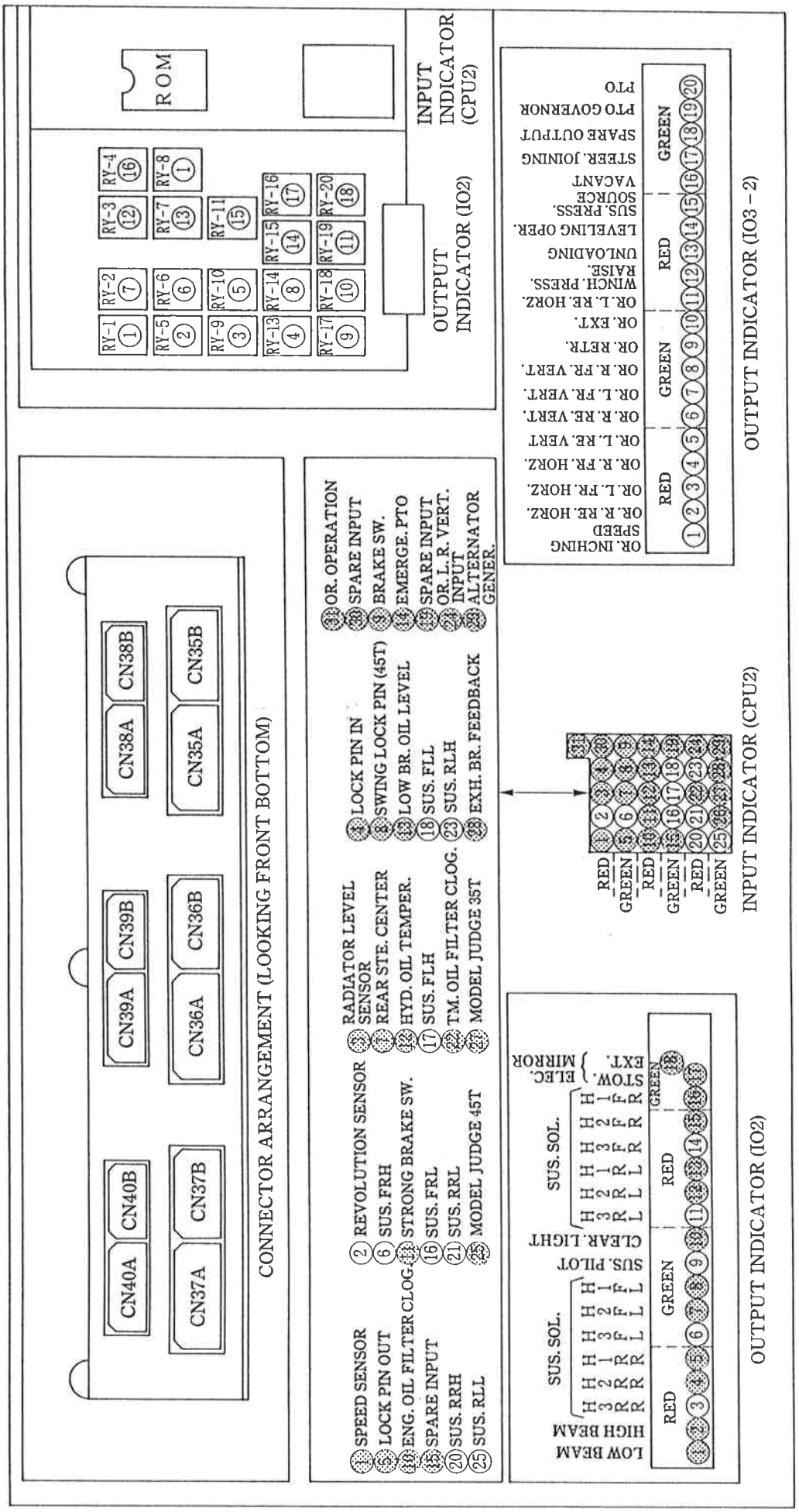


Fig. 2-3

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2. OPERATION

When traveling, after adjusting the carrier height level, arrange the suspension cylinders and accumulators to compose the closed circuits, and when operating crane work, fully retract the suspension cylinders to lock the axles. Therefore, the hydraulic circuits are as follows.

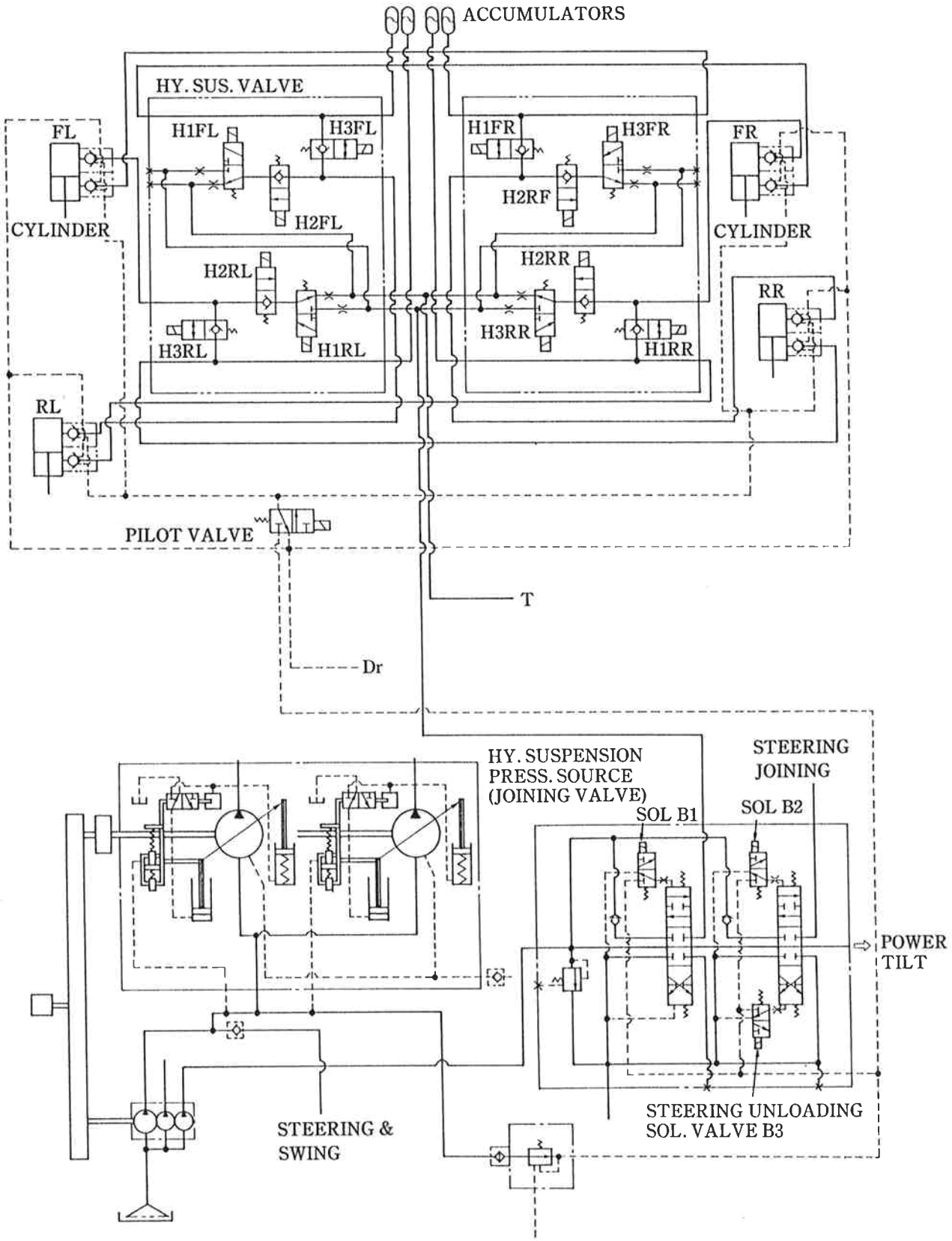


Fig. 2-1

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3. MAINTENANCE

Since pressure is accumulated in the hy. suspension closed circuit by the accumulator, when removing the components and pipings from the circuit, it is necessary to remove pressure as follows.

3.1 REMOVAL OF ACCUMULATOR PRESSURE

(1) Set the machine to the on-tire traveling posture and lock the axles.

(2) Extend the outriggers to raise the all four tires from the ground.
At this time, raise the tires more than the extending stroke length of the suspension cylinders. (The cylinder stroke of $RK250_3$ and RK350 is 95mm (3.74in), and that of $RK450_2$ is 110mm (4.33in).)

> When leveling, the cylinder extends 40 to 50mm (1.58 to 1.97in) in $RK250_3$ and RK350, and 50 to 60mm (1.97 to 2.36in) in $RK450_2$, from the fully retracted condition.

(3) After holding the engine speed at a rpm more than 1500rpm, push the FREE switch. Just after the switch is pushed, the tires drop. so, be careful. Hold the condition for approximately 20 seconds.
(When operating with the engine at low idling speed, sometimes the tires may not drop.)

(4) Repeat steps (1) through (3).

(5) Carefully the all four fittings of the hoses connected to the rod sides of the suspension cylinders. If pressure does not exist, disassembling is possible.
If pressure is not yet removed, repeat steps (1) through (3) again.

(6) Although pressure is sometimes not removed completely due to back pressure of hydraulic circuit, in this case, loosen the fittings of the hoses to remove pressure.

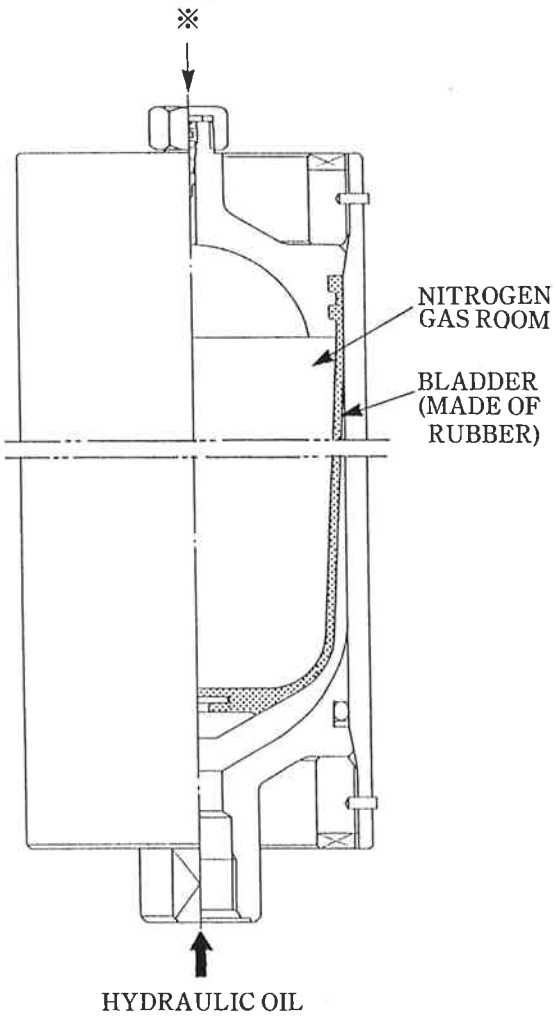


Fig. 3-1

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3.2 CHECK OF ACCUMULATOR NITROGEN GAS

The accumulator itself is precharged with nitrogen gas to 48 to 52kg / cm² (683 to 739 psi) of pressure at gas temperature of 20℃ (68°F).

A bladder type accumulator is used in this machine. The nitrogen gas in the room penetrates, through the rubber film, into the hydraulic oil side for a long time of use. Therefore, it is necessary to charge gas periodically (higher the temperature is, easier the gas leaks).

Interval of gas pressure check : Every 12 months.
Interval of gas charge : Every 2 years, or when gas pressure lowered to a pressure lower than 40kg / cm² (569 psi).

To charge gas, use the exclusive charging valve and hose. Charge gas once to a pressure of 60 to 70 kg / cm² (853 to 995 psi) and stabilize the gas for several minutes, then adjust the charging valve to set the pressure to 48 to 52kg / cm² at gas temperature of 20℃. Correct the gas pressure according to the gas temperature (ambient temperature of the gas bomb storaging place) with the use of the following formula.

$$\text{Gauge pressure (kg / cm}^2\text{)} = \frac{273+T_2}{273+20\ (℃)} \times 50\ (\text{kg / cm}^2\ \text{abs}) - 1\ (\text{kg / cm}^2)$$

T_2 : Gas temperature ≒ Ambient temperature of gas bomb

(Example) When T_2 = 30℃,

$$\text{Gauge pressure to be set} = \frac{273+30}{273+20} \times 50 - 1$$

$$= 50.7\text{kg / cm}^2$$

Confirmation of Gas Pressure

1) Set hydraulic pressure to 0kg / cm² by paragraph 3. 1.
2) Attach the charging kit to the place marked with ※ in Fig. 3-1.
3) By gas pressure checking with the exclusive charging kit, approximately 0.1kg / cm² (1.42psi) of pressure lowers per one time of check.

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3.3 HY. SUSPENSION SENSOR

The hy. suspension sensor is installed to the suspension cylinder, and detects whether the cylinder length is in the specified range or is shorter or longer than the specified range.

A rubber bushing is used in the sensor mounting place, and absorbs transformation due to twisting of the cylinder body and vibration transmitted from the tires.

(See Fig. 3-2.)

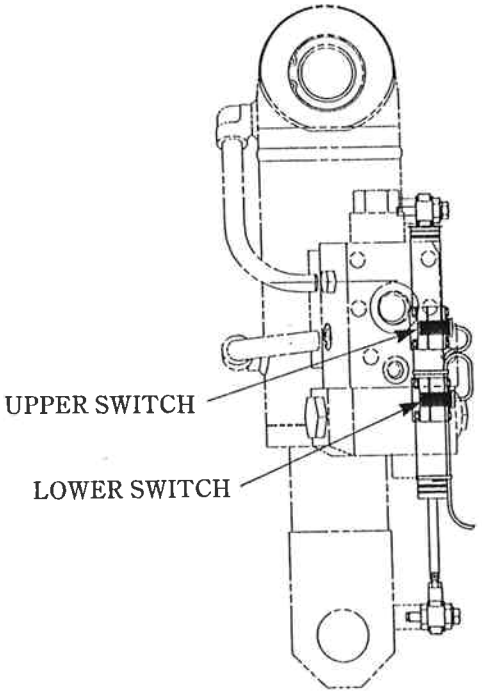


Fig. 3-2

The hy. suspension sensor itself also is of cylinder construction. Two proximity switches are installed in the tube side, and a magnet is installed in the rod side.

These proximity switches are turned on by magnetic force of the magnet, and are turned when magnetic force goes out. The mounting positions are shown in Fig. 3-3.

The figure shows the condition that leveling is in the center, and both the upper and lower switches are turned on. When the suspension cylinder is retracted from this condition, the magnet moves upward, and so the upper switch is as it is turned on, and the lower switch is turned off. When the suspension cylinder is extended, the condition is reversed.

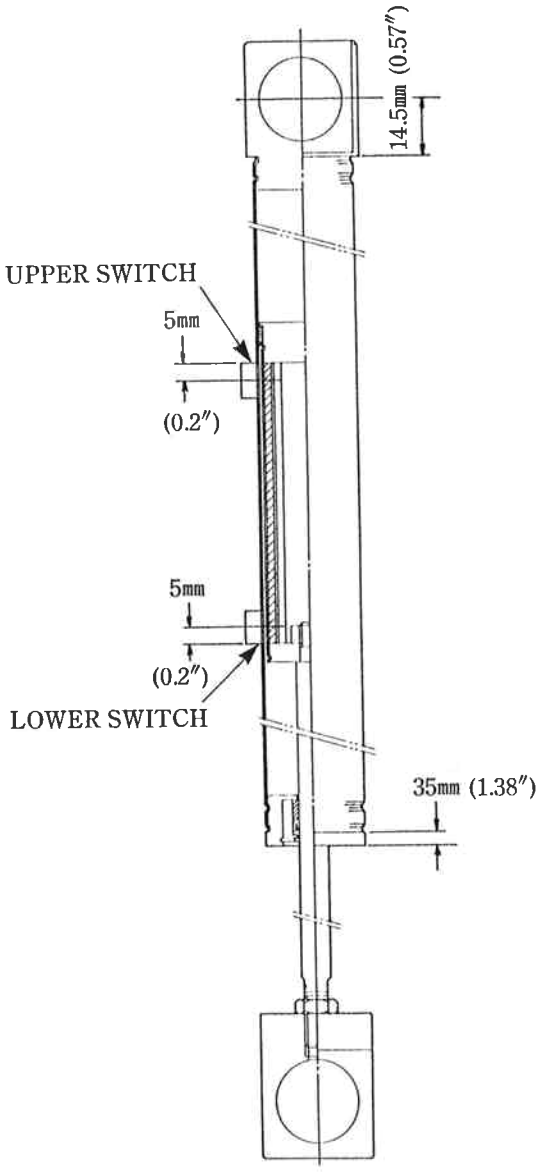


Fig. 3-3

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When the FREE switch in the operator's room is pushed, the computer reads ON-OFF conditions of these upper and lower switches, issues order of magnetization for the solenoid valves in the hydraulic circuit, and the leveling control is made until the all proximity switches attached to the four suspension cylinders are turned on.
As the result, all the lengths of the four suspension cylinders enter a range of ±4 to 6㎜ (0.16 to 0.24in) shown in Fig. 3-3, and the carrier height is set.

Fig. 3-4 shows the arrangement of connection of the hy. suspension valves and pipings.
Fig. 3-5 shows the arrangement of the hy. suspension valve piping connecting ports and solenoid valves.
The both figures are the figures looking from the upward of the machine.

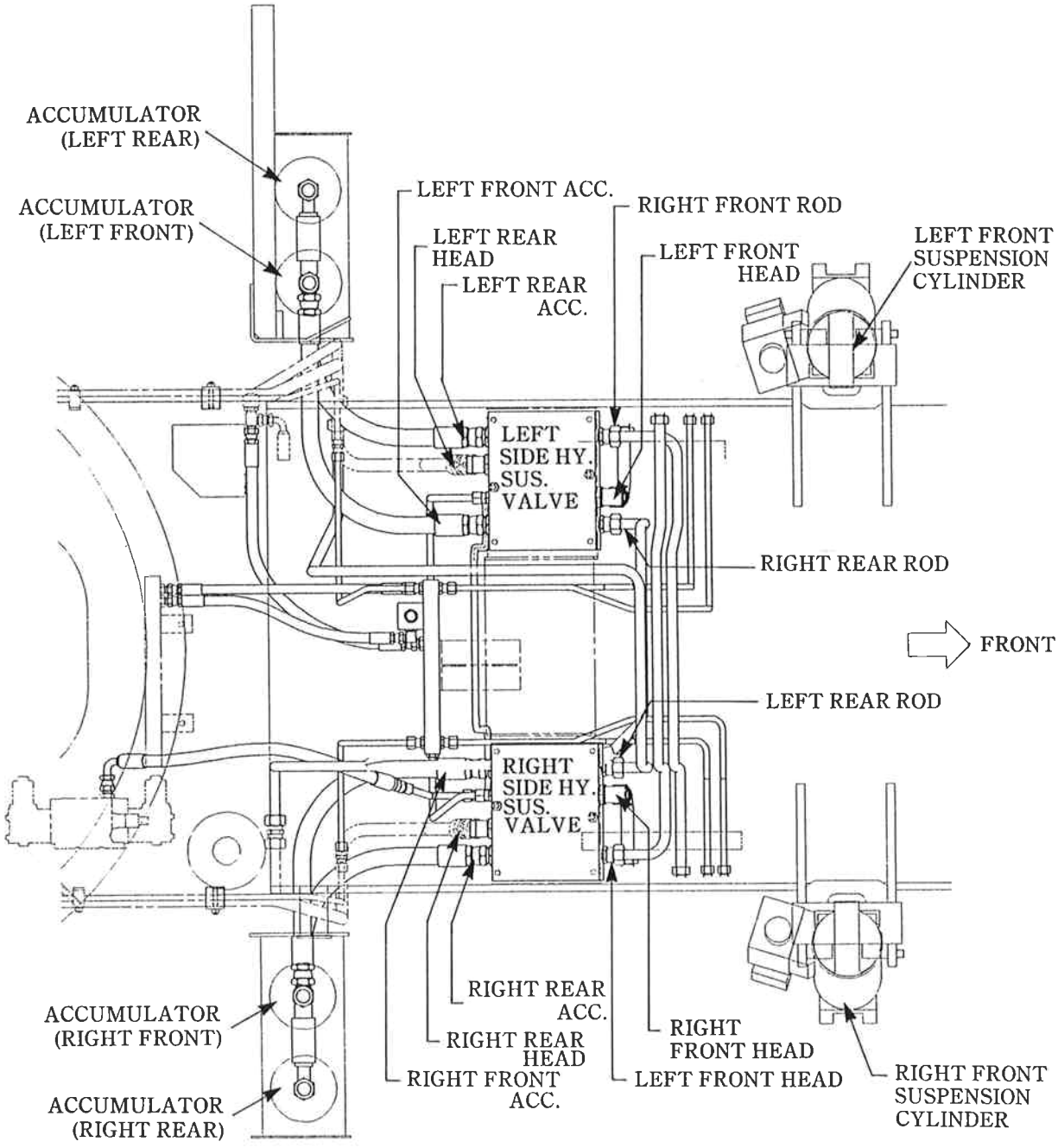


Fig. 3-4

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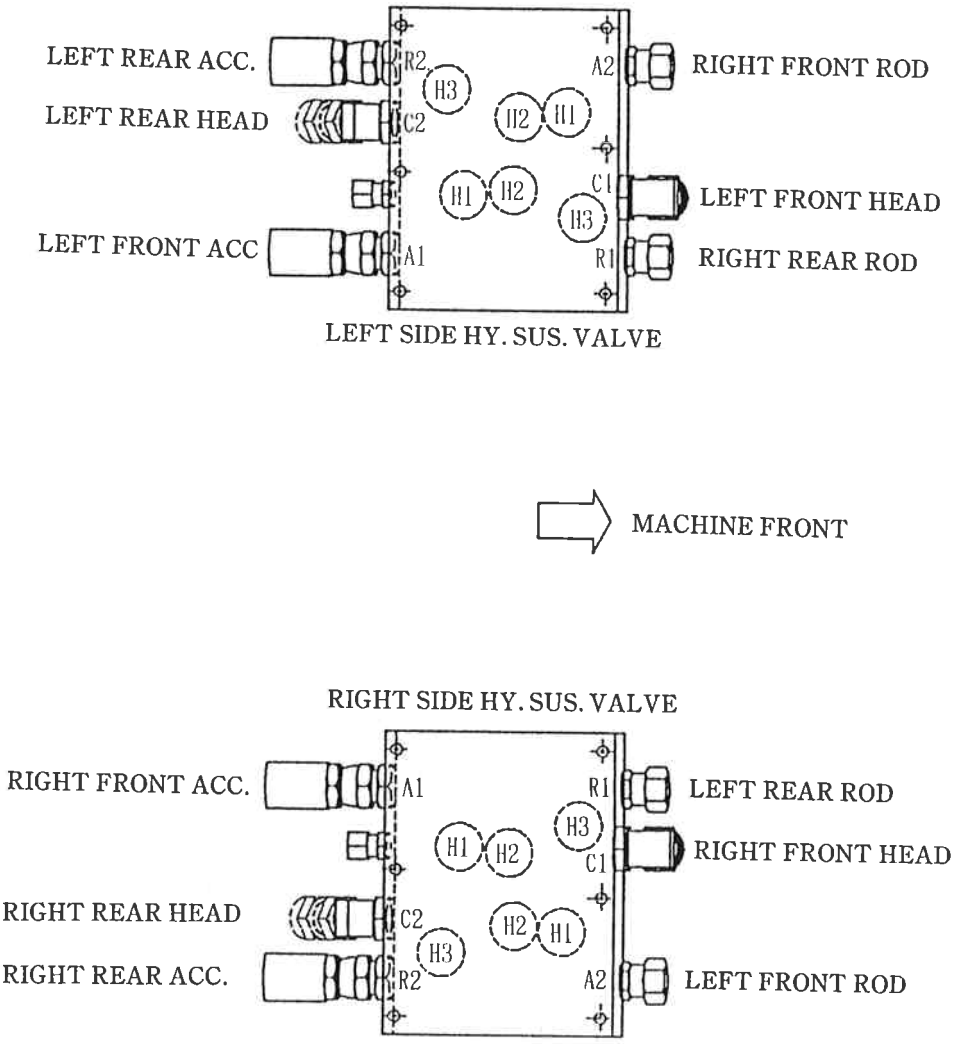


Fig. 3-5

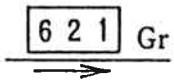
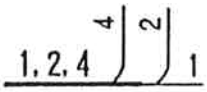
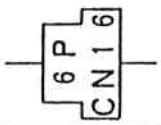
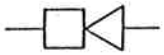
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1. ELECTRICAL CIRCUIT SYMBOLTS AND CONNECTOR ARRANGEMENT

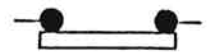
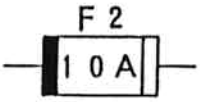
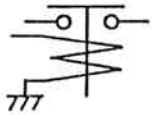
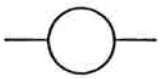
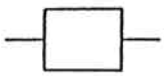
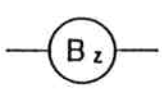
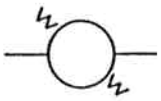
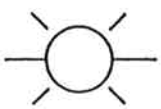
1.1 ELECTRICAL SYMBOLS

To understand the electrial circuit schematics in the RK series, the schematic symbols used in the electrical system are shown in Table 1-1. Refer to them for reference in order to understand the circuits.

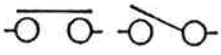
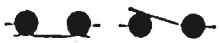
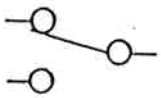
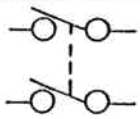
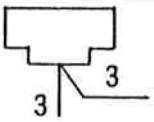
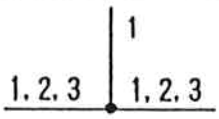
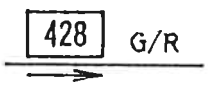
Table 1-1

Schematic Symbol	Symbol	Name	Summary
		Lead wire (or conductor)	
		Circuit symbol green	Wire color is green. Circuit number is 621.
		Crossing of lead wires	Wires are not connected.
		Crossing of lead wires	Wires are connected.
		Fork of lead wires	
		Bundle of wires	Plural lead wire are bundled up.
	EO	Earth (ground)	Body (chassis) earth
		Connector	
		Receptacle	
		Terminal	
	SW	Switch	

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Schematic Symbol	Symbol	Name	Summary
		Microswitch Limit switch	Usually ON OFF for operation (or action)
		Microswitch Limit switch	Usually ON OFF for operation (or action)
	F	Fuse	Packed (pipe) type fuse F2~Fuse No. 10A ~ampere (+ side) (-side)
		Resistance	
		Diode	
		Coil	(Example) Battery relay coil
		Coil	(Example) PTO solenoid Coil for solenoid valve PTO
		Slip ring (including brush)	(Example) No. 1 slip ring SP1
		Sensor	(Example) speed sensor V1
		Meter Gauge	
		Buzzer	
		Horn	
		Lamp	Worklight, room light and panel olight, etc.

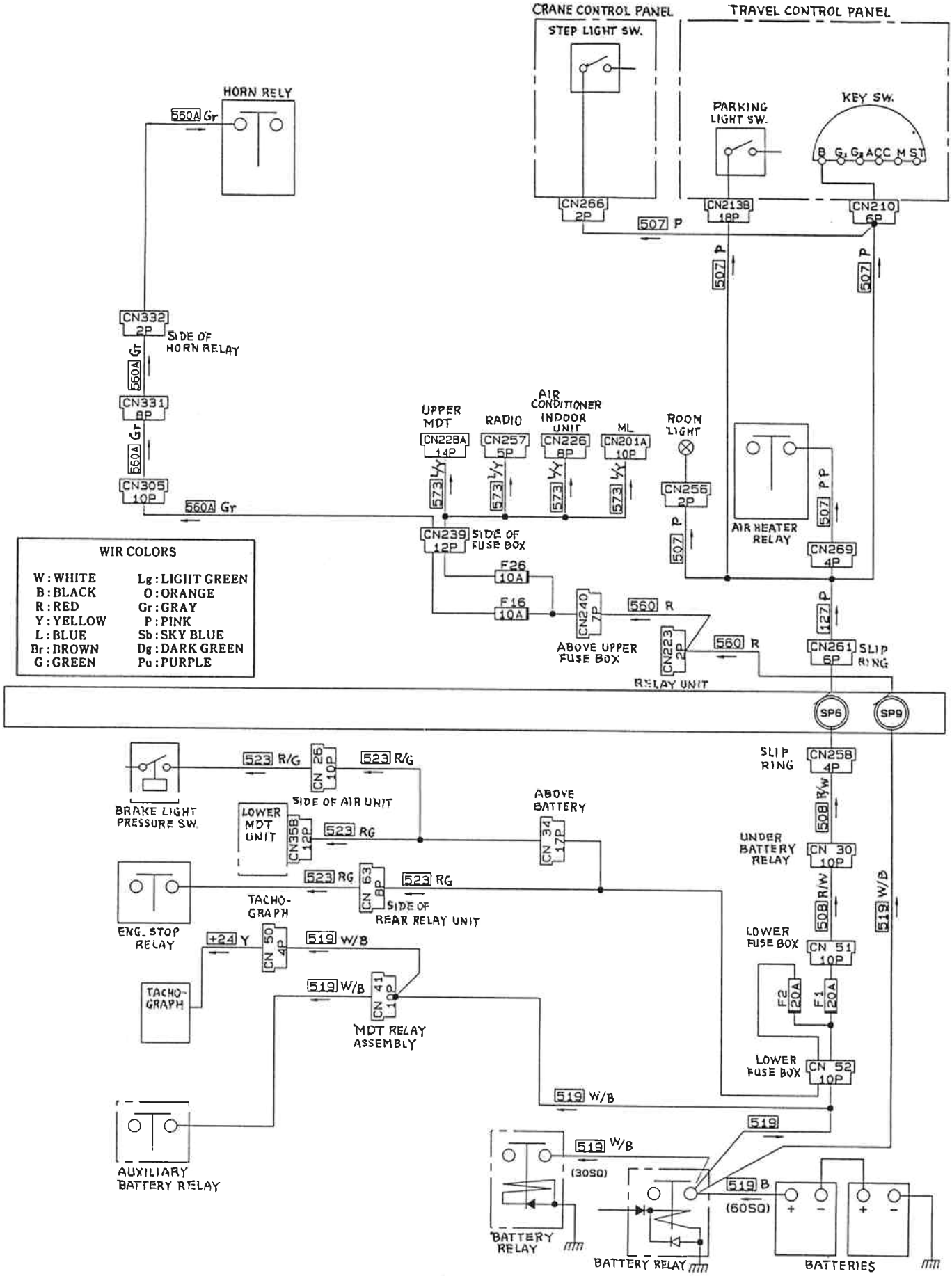
https://truckmanualshub.com/

Schematic Symbol	Symbol	Name	Summary
		Lamp	Combination light, etc.
 o r		Contact point (Small relay and auxiliary contact point)	a contact point (turned on by magnetizing coil).
 o r		Contact point (Small relay and auxiliary contact point)	b contact point (turned off by magnetizing coil).
		Contact point (Small relay and auxiliary contact point)	C contact point (switched by magnetizing coil).
		When linked motion is shown.	
		Direct-current motor	
		Unit	(Example) HORN RELAY
		Base plate, etc	(Example) CONTROL DEVICE BASE PLATE
		Fork of lead wires	Fork by common pressure connection in connector section
		Fork of load wires	Fork in bundled wire section.
		Direction of electric current	From battery to primary of switch.
		Direction of electric current	From secontary of switch to equipment.

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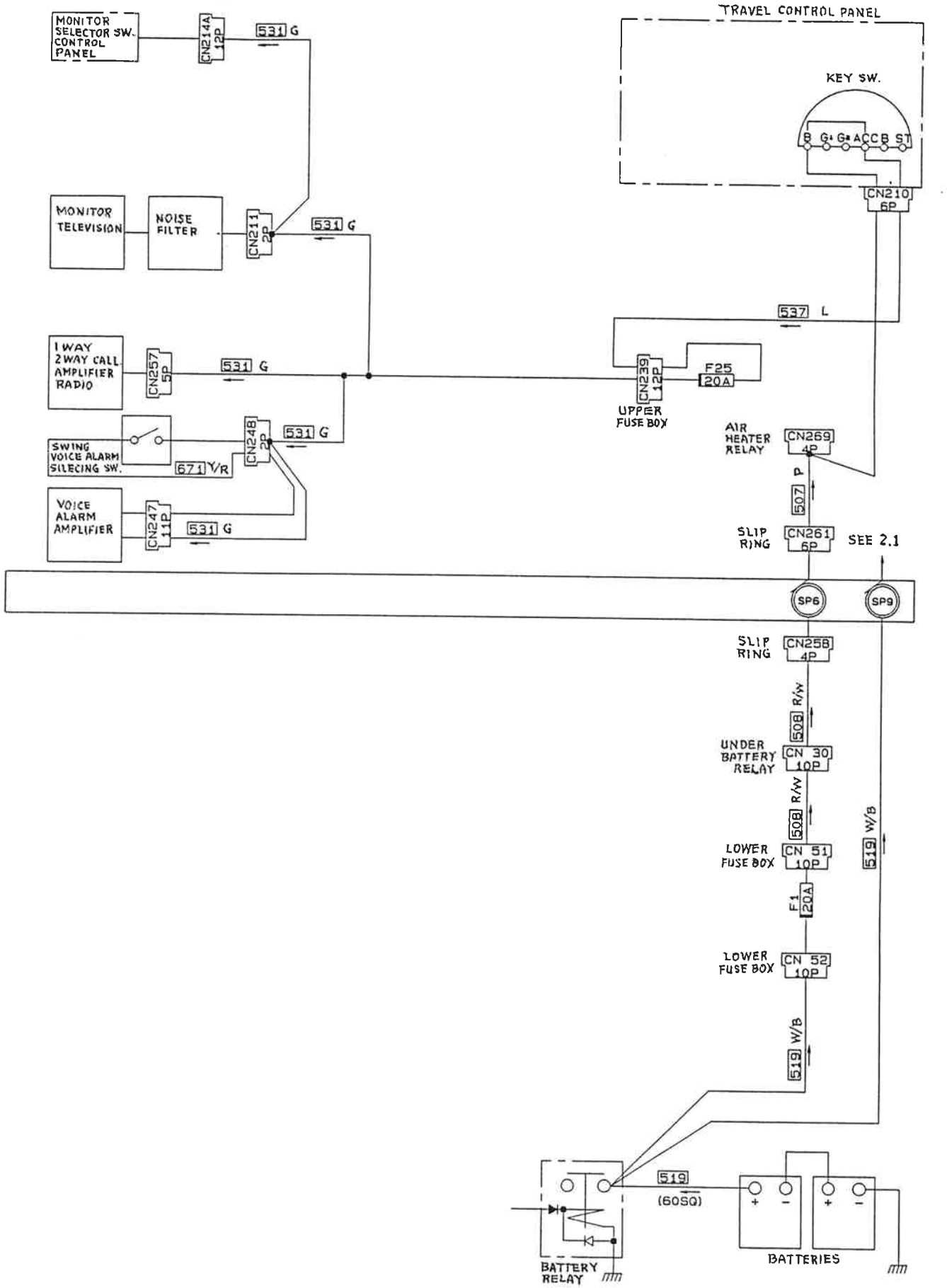
2. ELECTRICAL CIRCUIT SCHEMATIC

2.1 POWER SUPPLY CIRCUIT (LINES ENERGIZED WITH 24 VOLTS EVEN WHEN KEY SWITCH IN OFF)



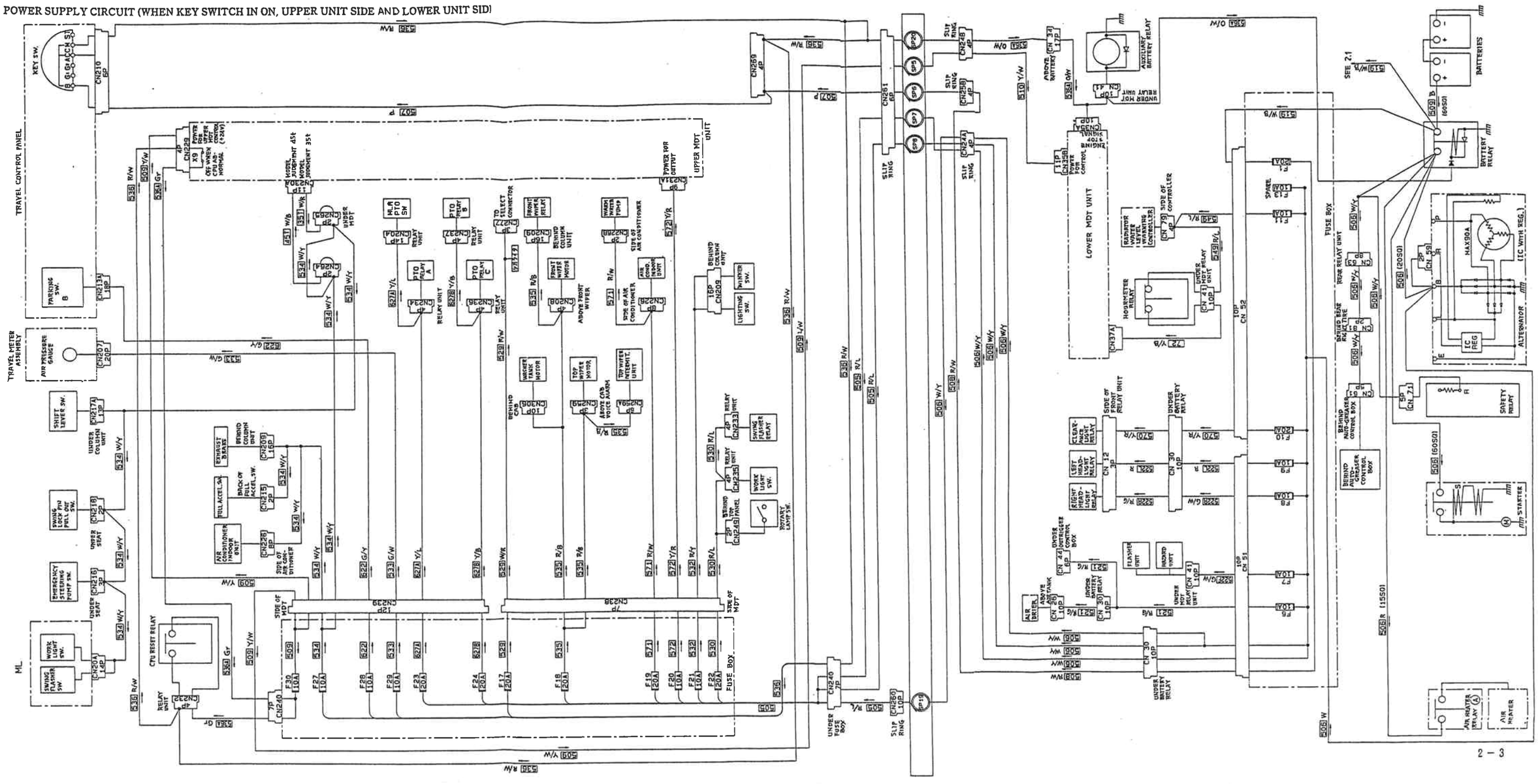
https://truckmanualshub.com/

2. 2 POWER SUPPLY CIRCUIT (LINES ENERGIZED WITH 24 VOLTS WHEN KEY SWITCH IN ACC)



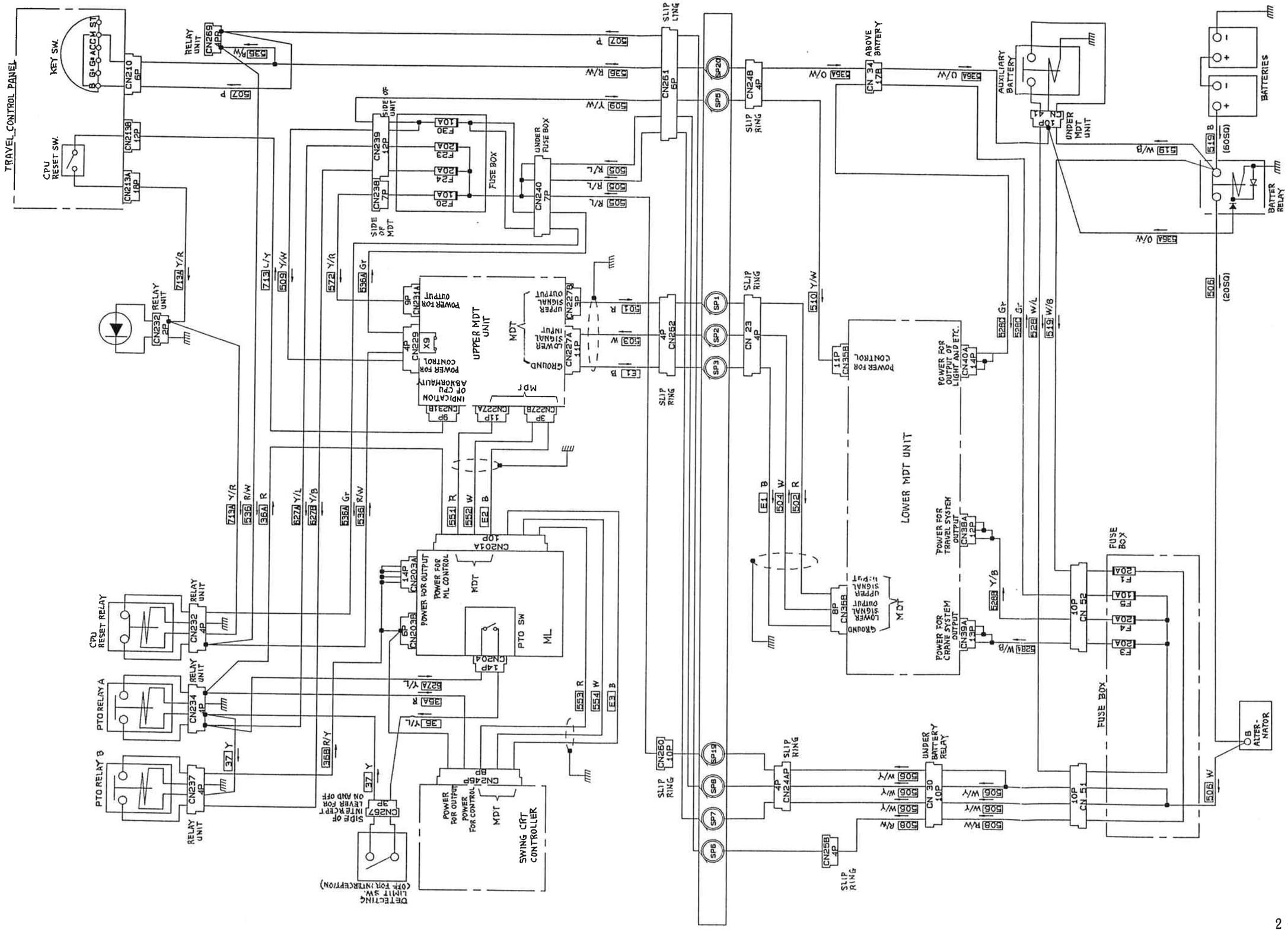
https://truckmanualshub.com/

2. 3 POWER SUPPLY CIRCUIT (WHEN KEY SWITCH IN ON, UPPER UNIT SIDE AND LOWER UNIT SID)



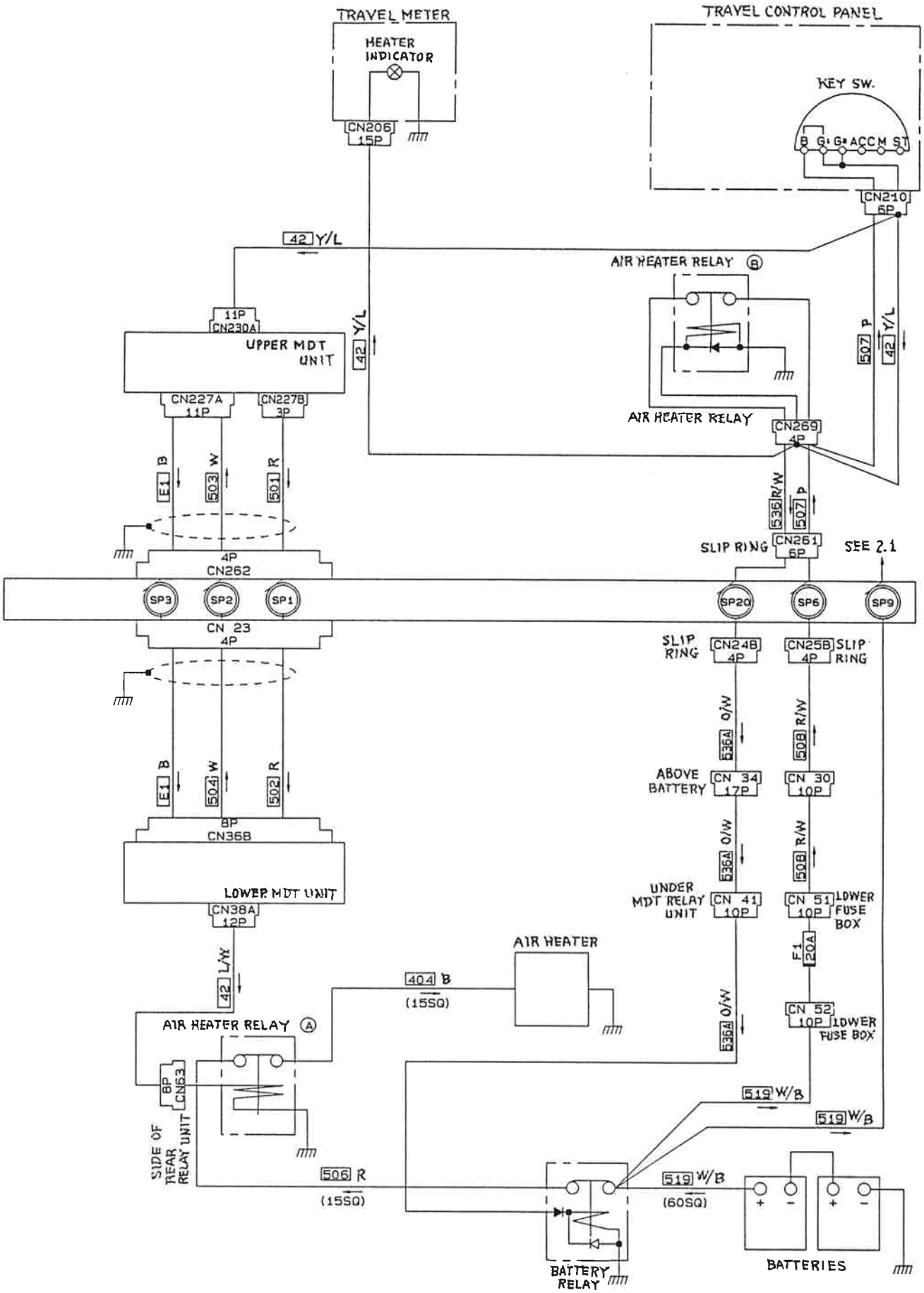
https://truckmanualshub.com/

2. 4 MULTIPLEX TRANSMISSION POWER SUPPLY CIRCUIT



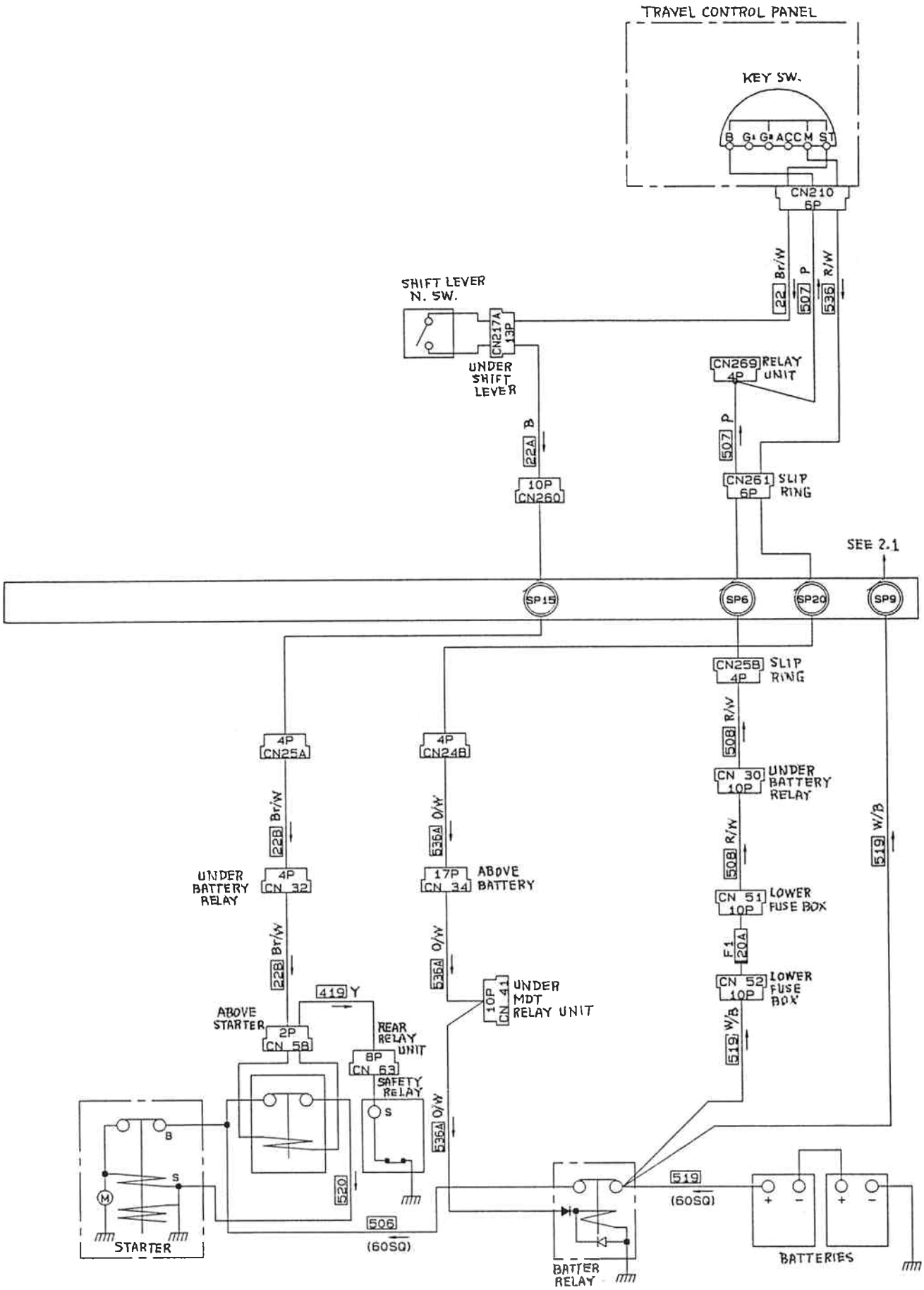
https://truckmanualshub.com/

2. 5 ENGINE AIR HEATER OPERATING CIRCUIT (WHEN KEY SWITCH IN HEAT)



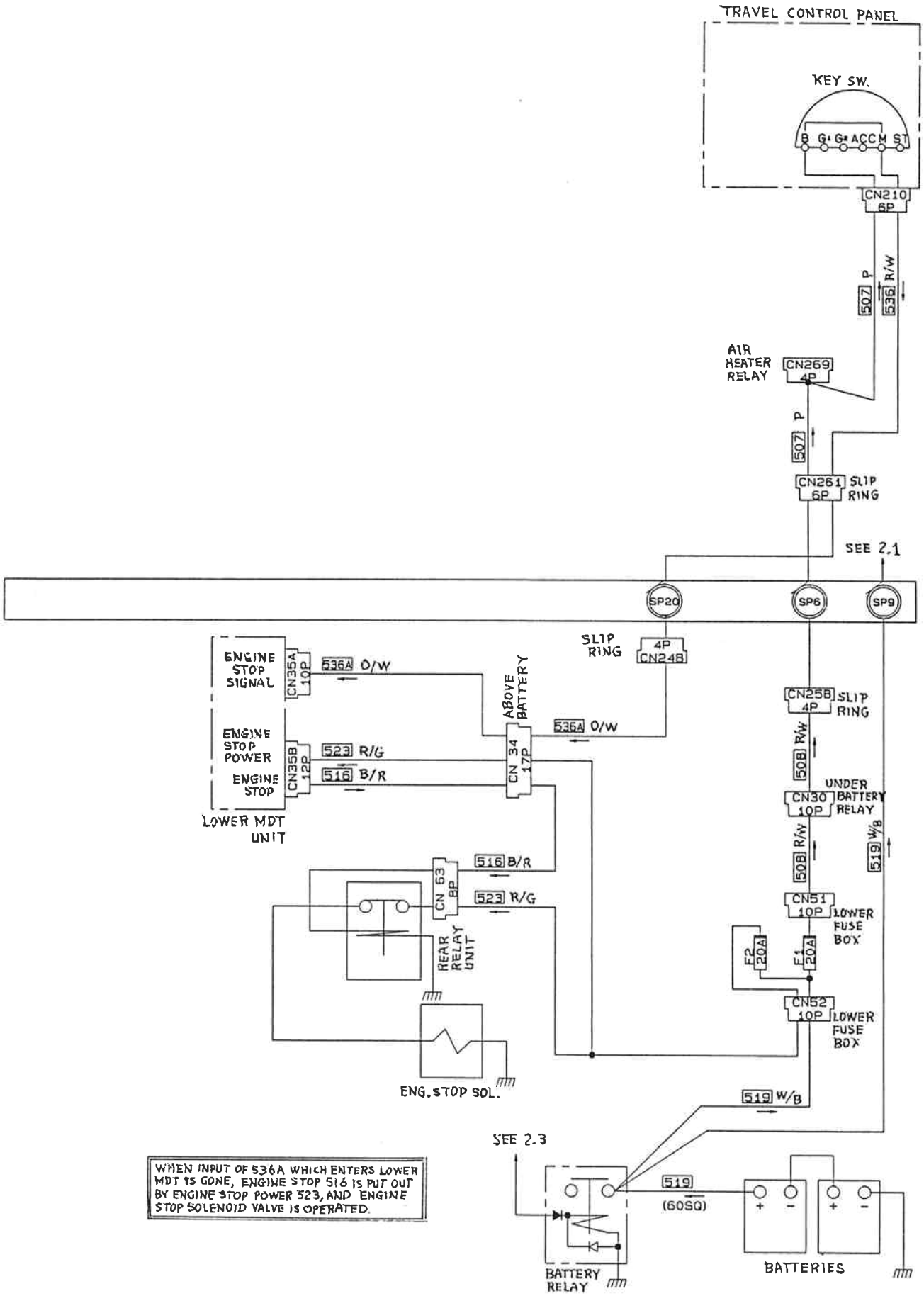
https://truckmanualshub.com/

2. 6 ENGINE START OPERATING CIRCUIT



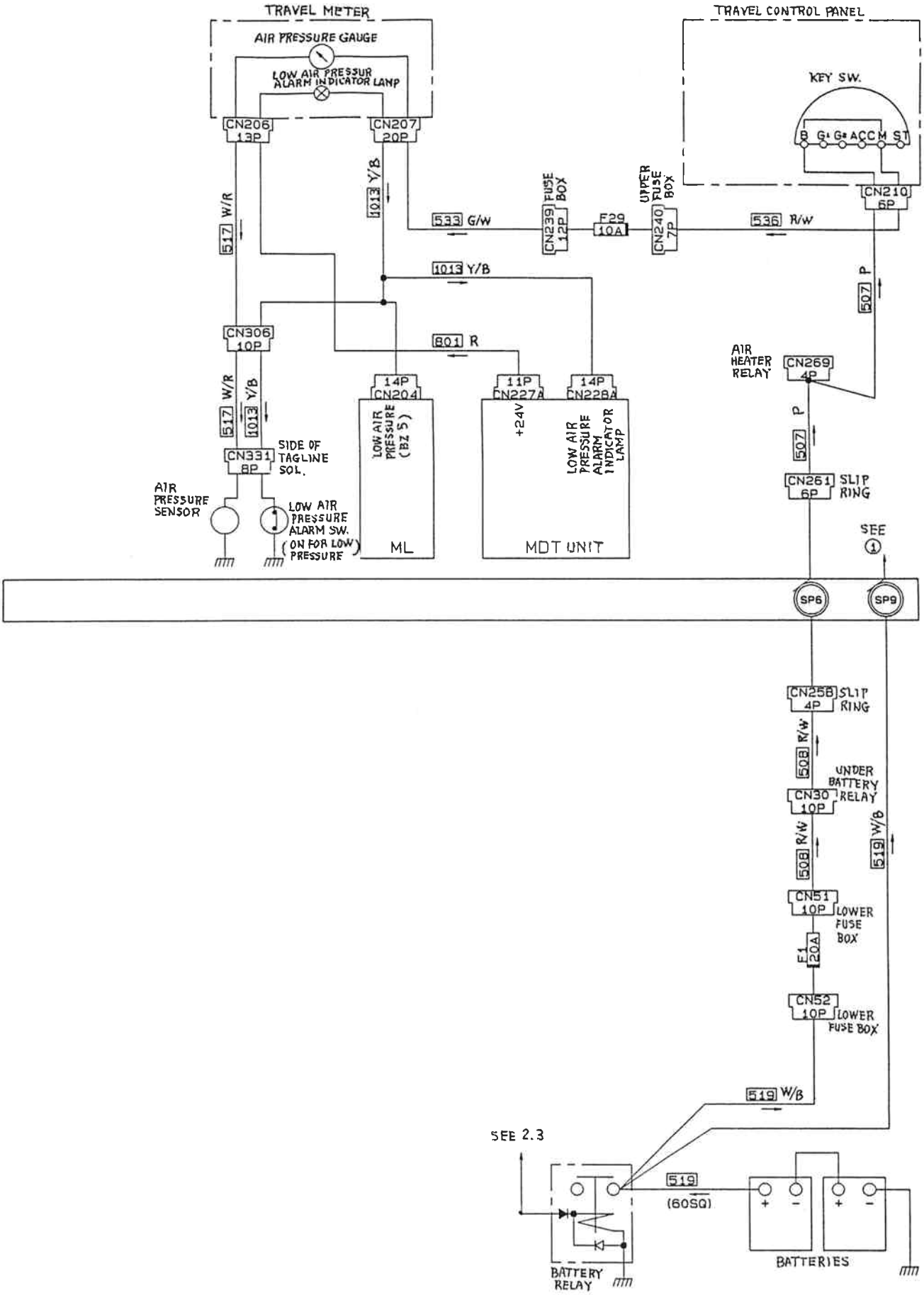
https://truckmanualshub.com/

2. 7 ENGINE STOP OPERATING CIRCUIT



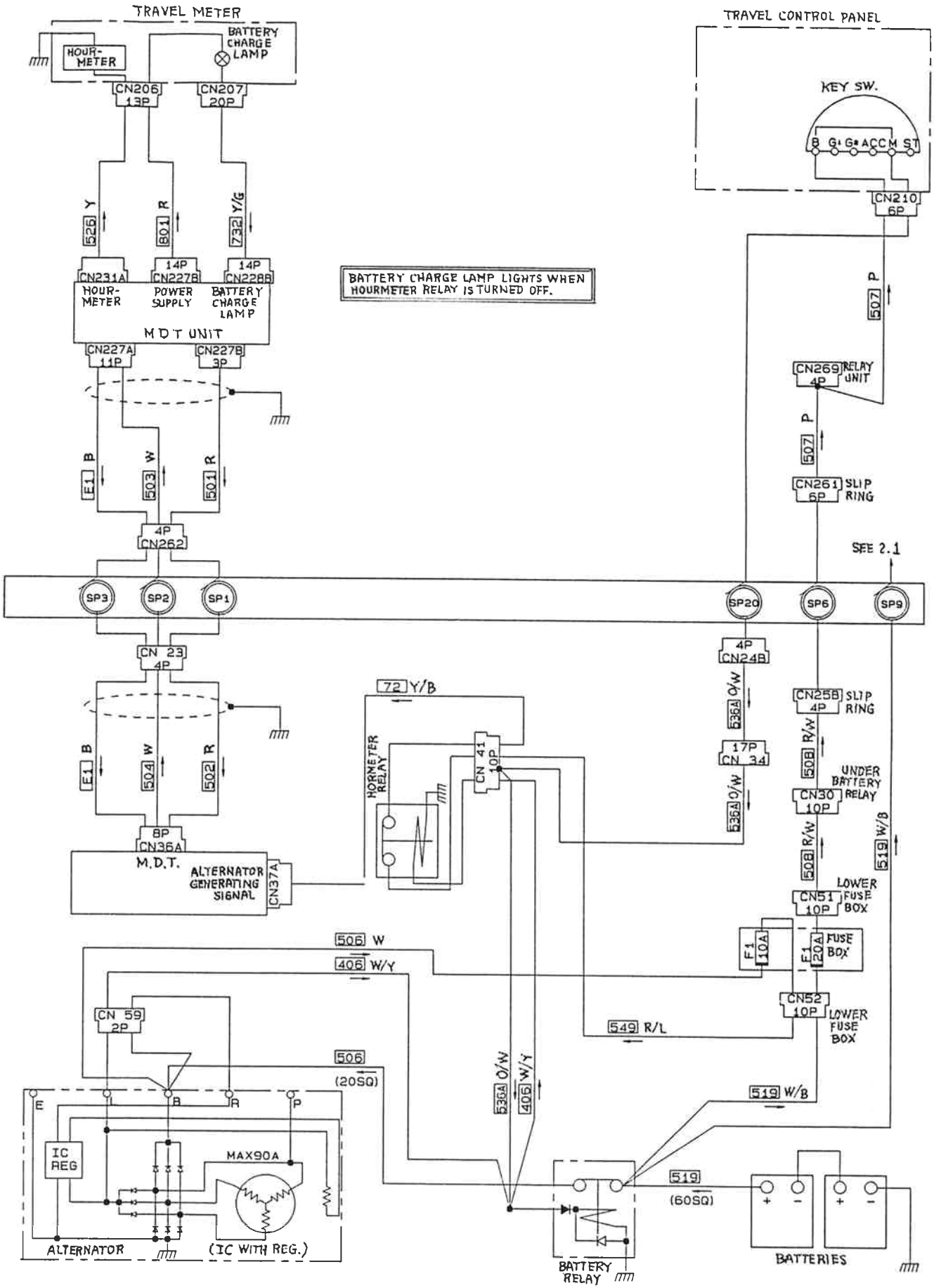
https://truckmanualshub.com/

2. 8 AIR PRESSURE GAUGE OPERATING CIRCUIT



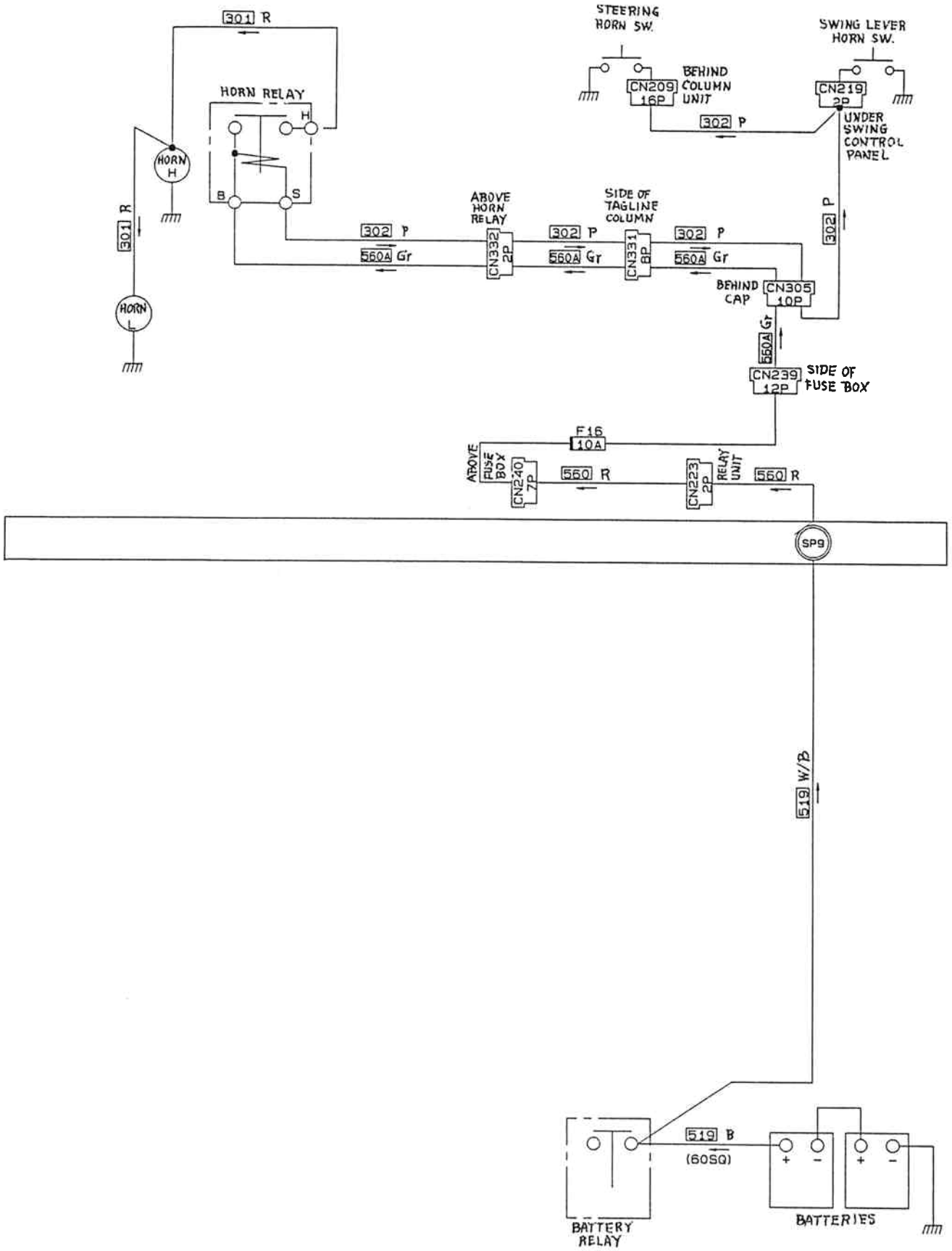
https://truckmanualshub.com/

2. 9 HOURMETER OPERATING CIRCUIT



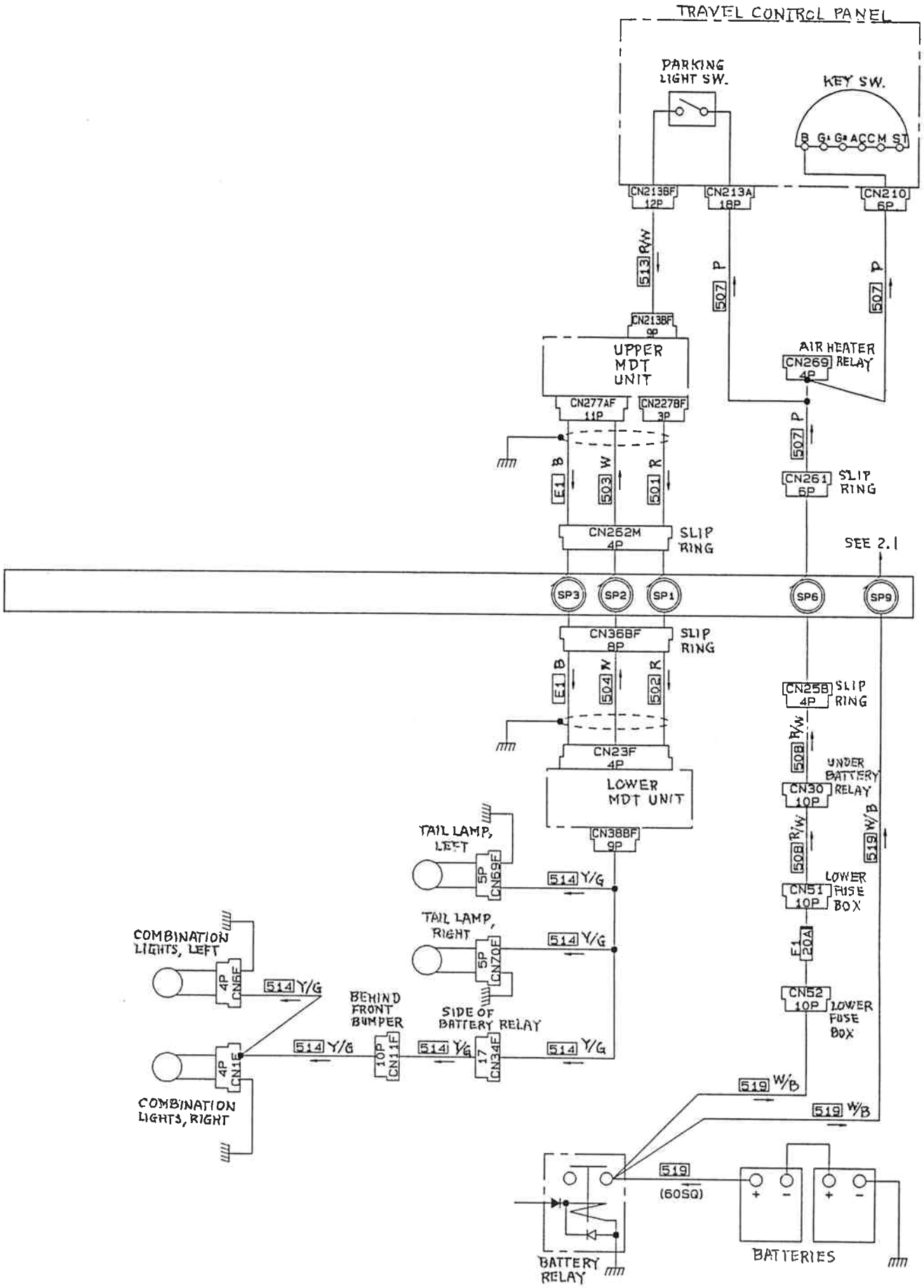
https://truckmanualshub.com/

2.10 HORN OPERATING CIRCUIT



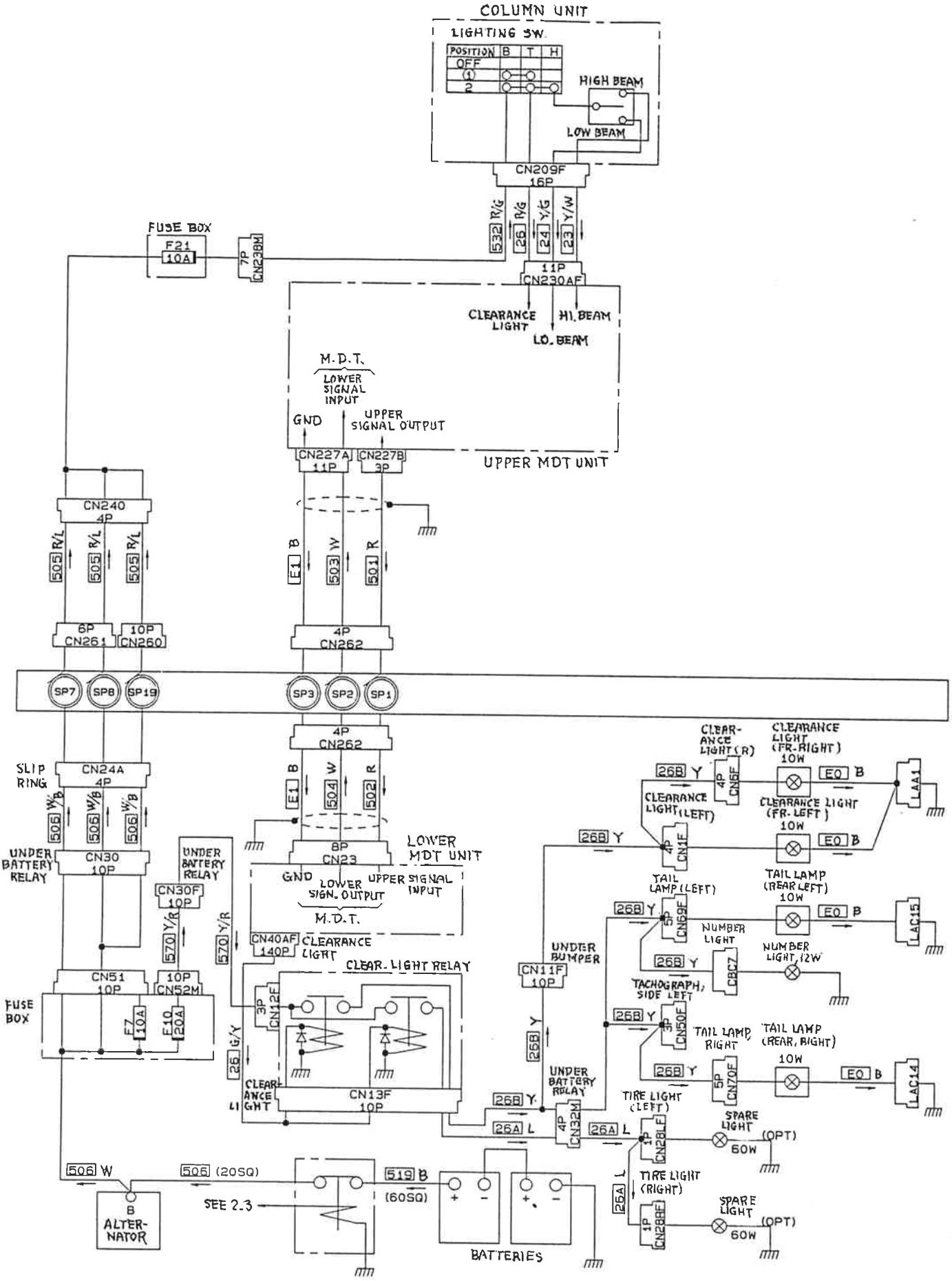
https://truckmanualshub.com/

2. 11 PARKING LIGHT OPERATING CIRCUIT



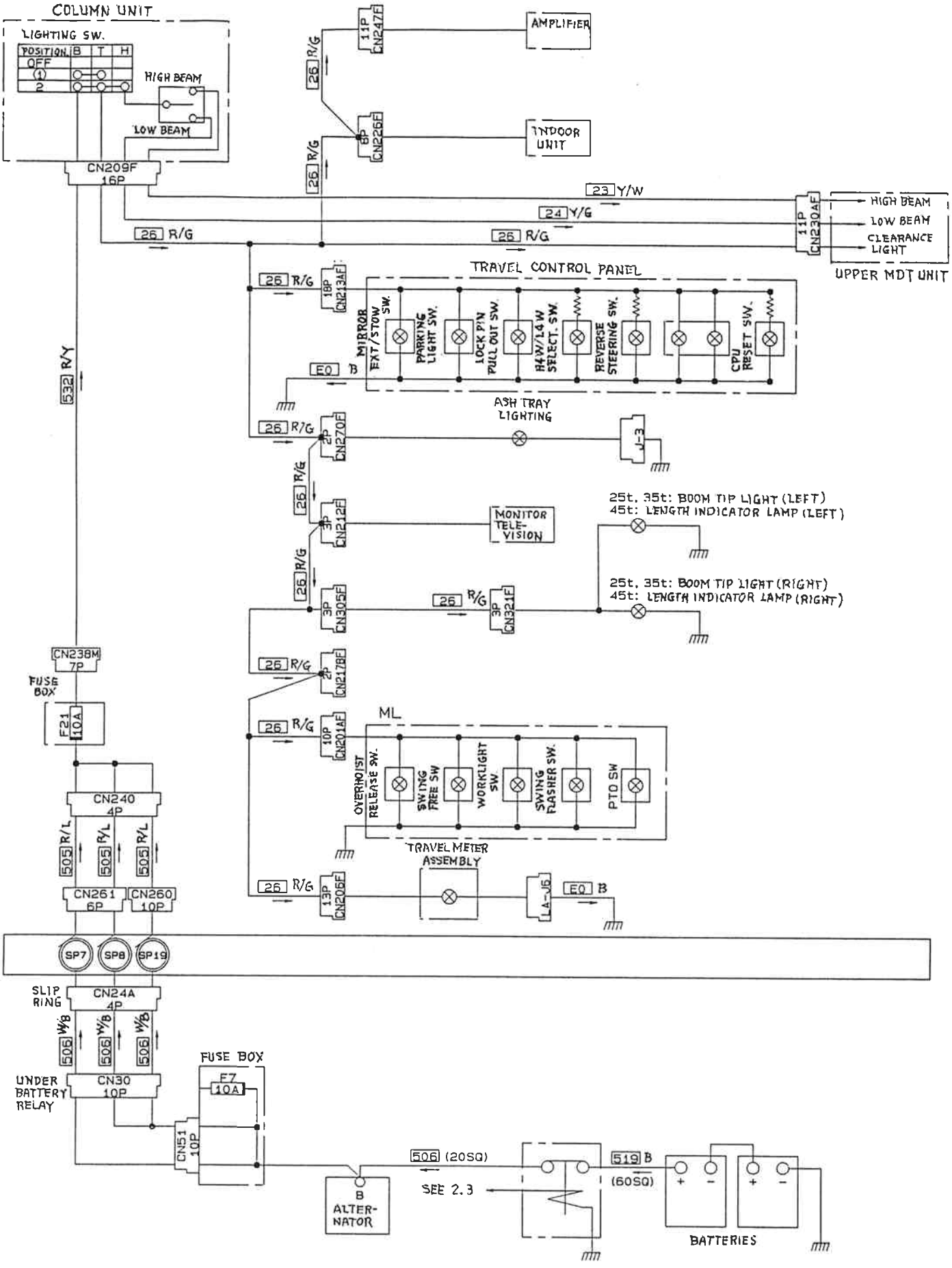
https://truckmanualshub.com/

2. 12 LIGHTING SWITCH OPERATING CIRCUIT (1 - 1)



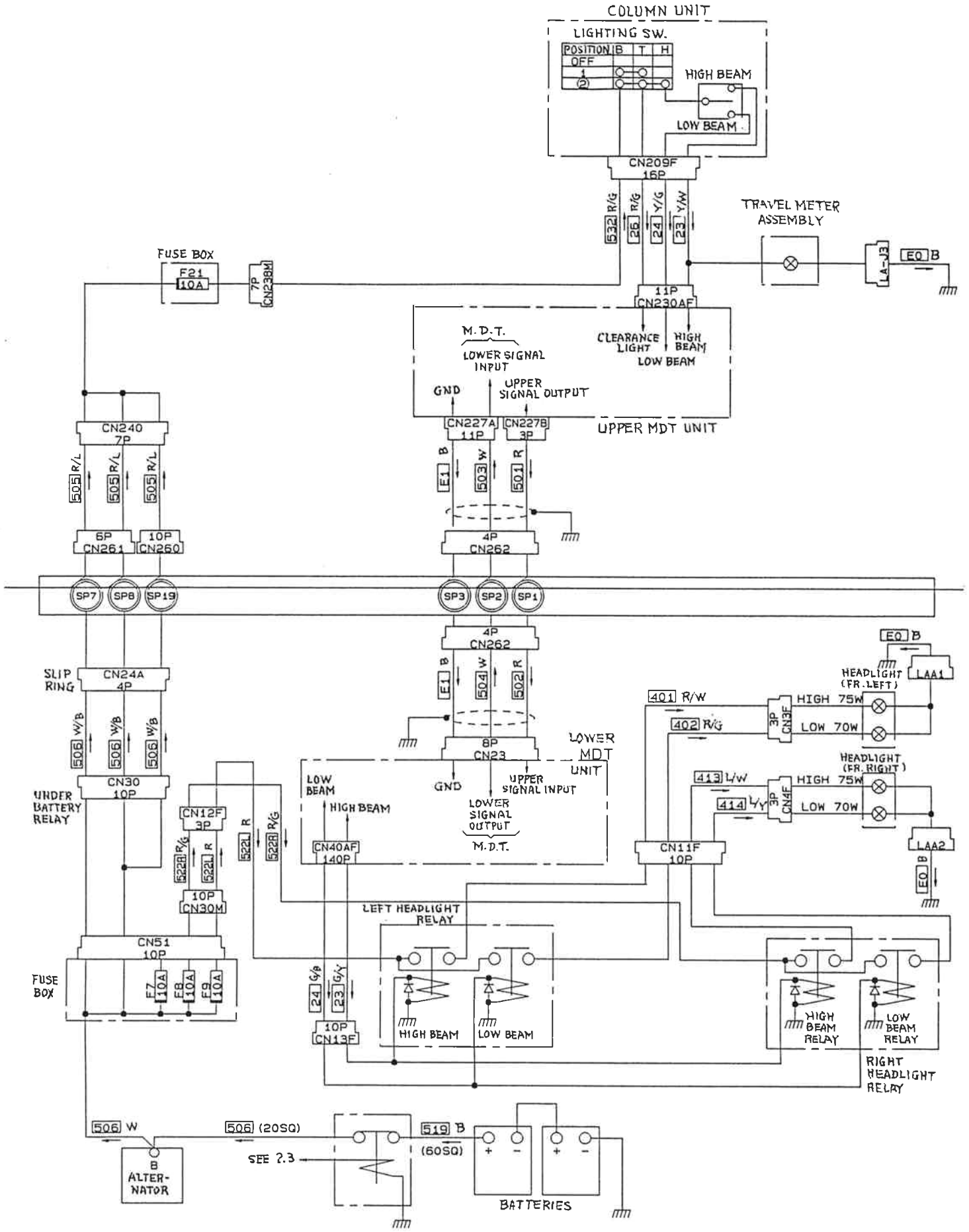
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2. 13 LIGHTING SWITCH OPERATING CIRCUIT (1 - 2)



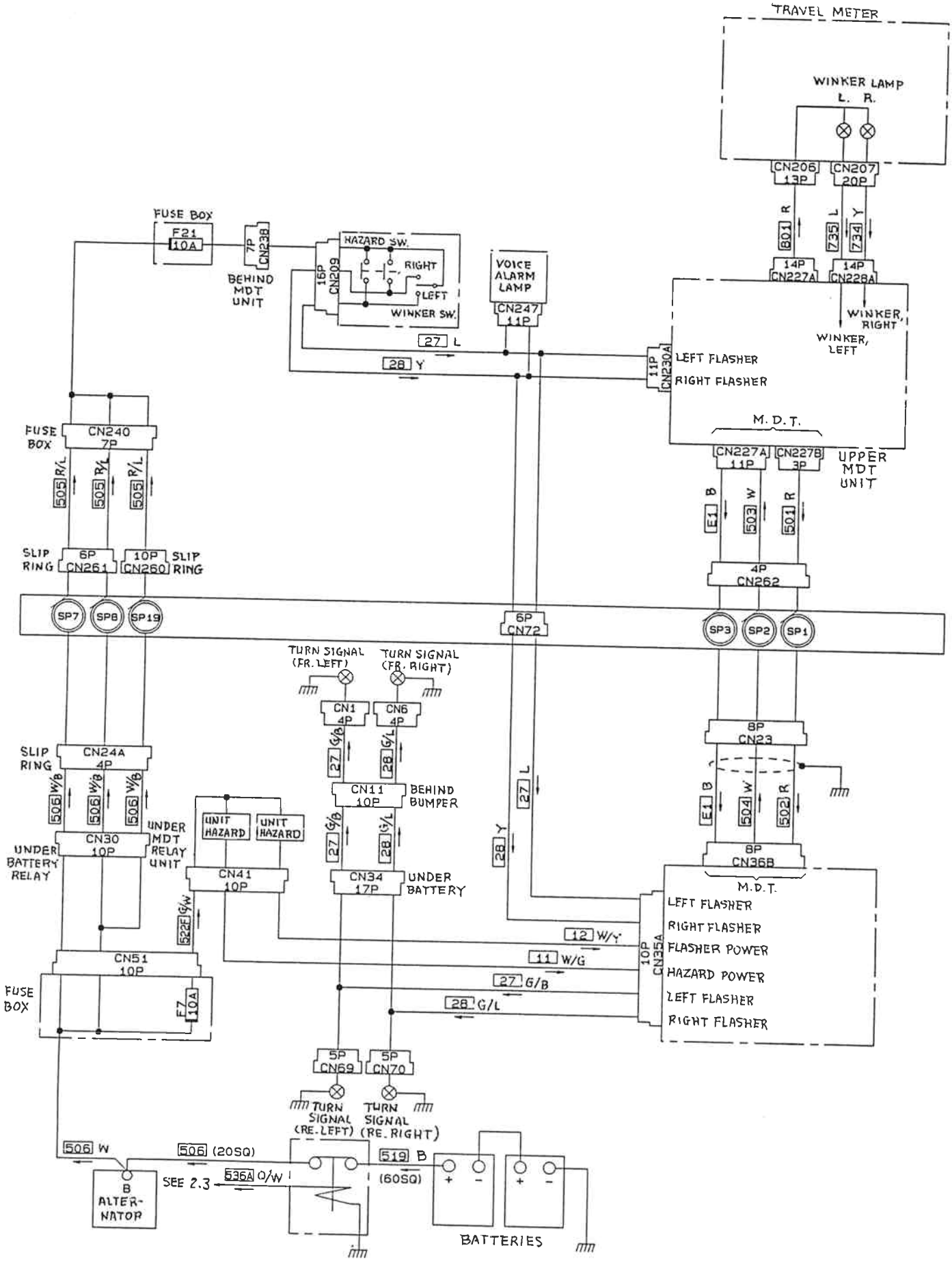
https://truckmanualshub.com/

2.14 LIGHTING SWITCH OPERATING CIRCUIT (2)



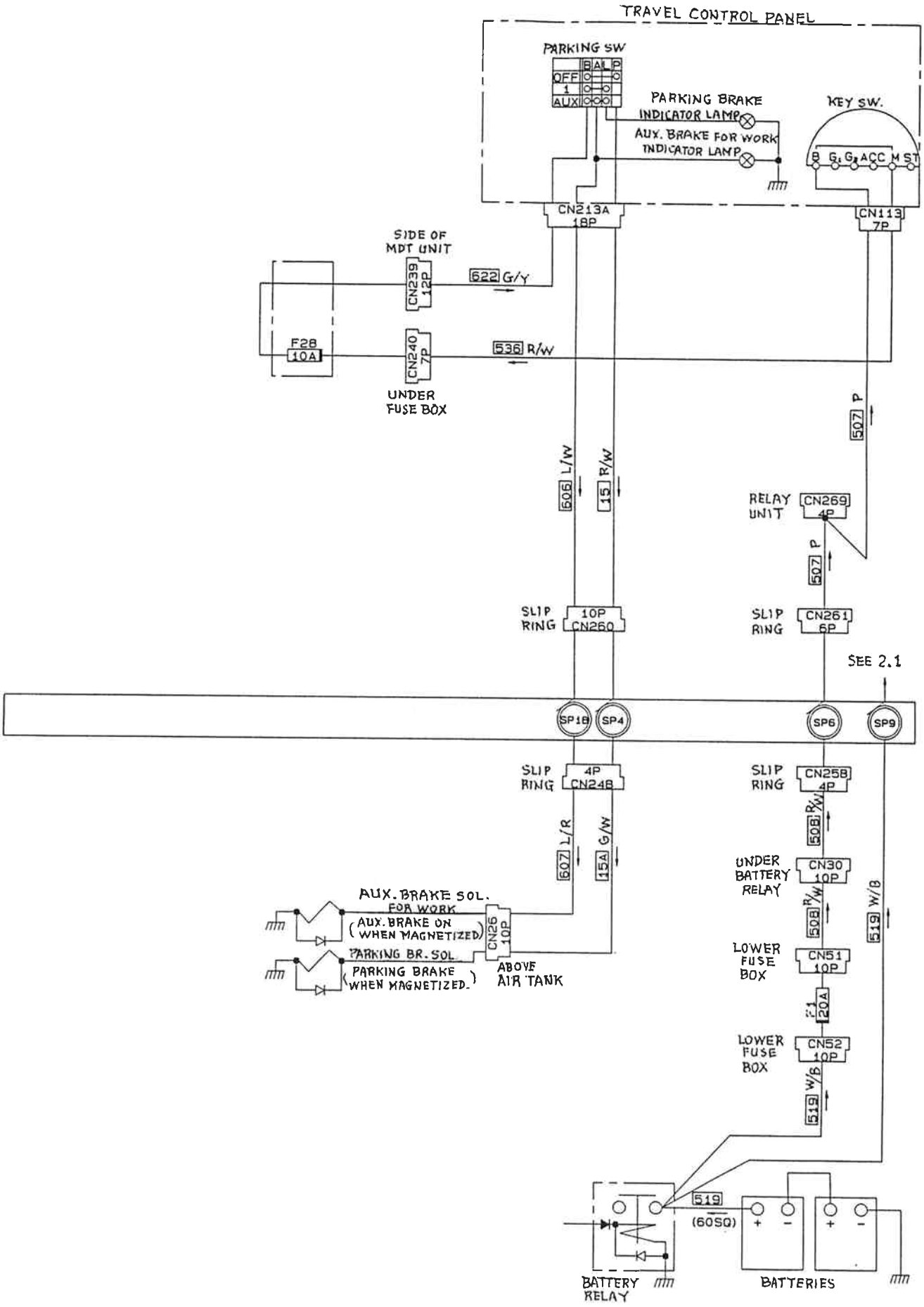
https://truckmanualshub.com/

2. 15 TURN SIGNAL AND HAZARD OPERATING CIRCUIT



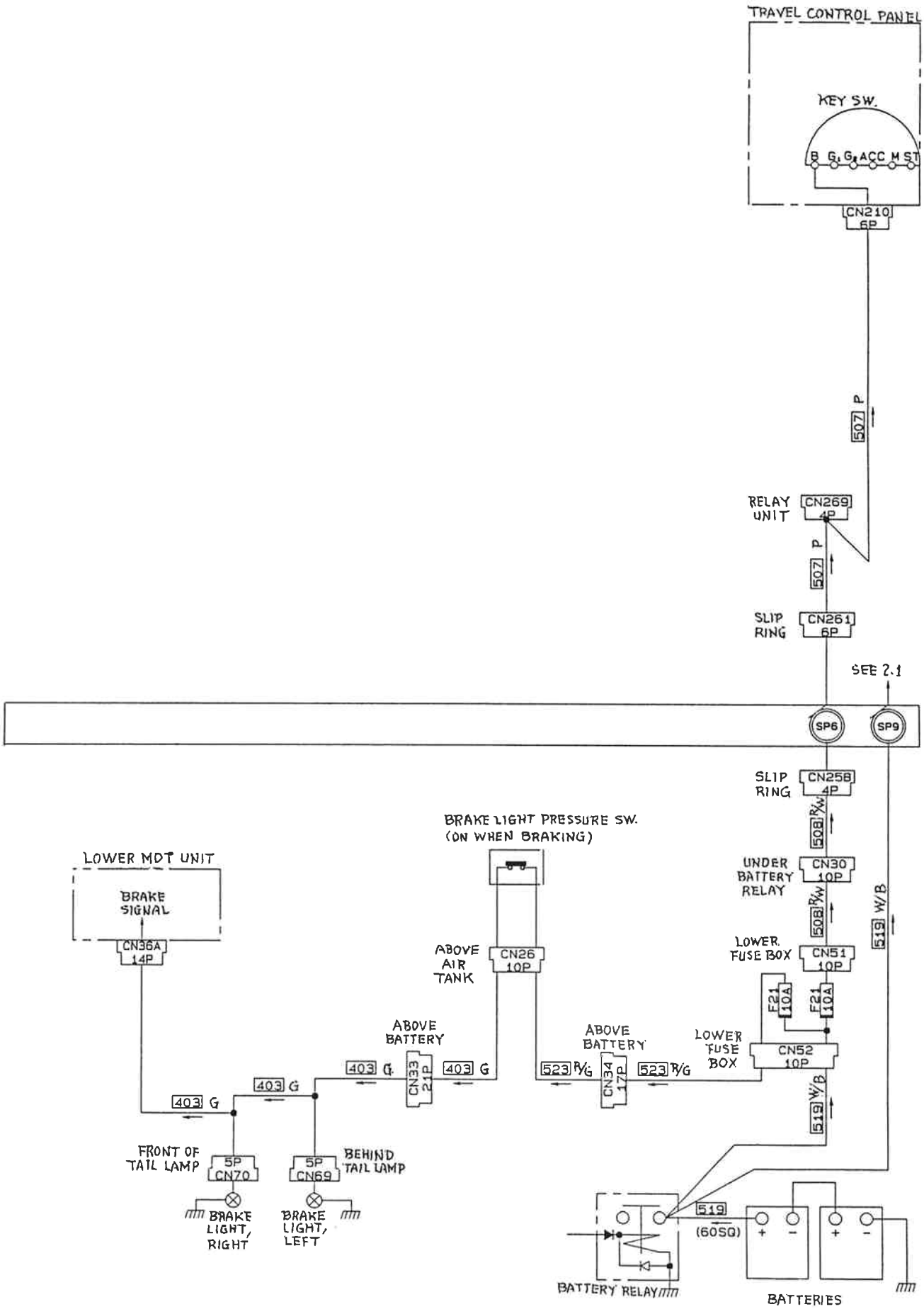
https://truckmanualshub.com/

2. 16 PARKING BRAKE AND AUXILIARY BRAKE FOR WORK OPERATING CIRCUIT



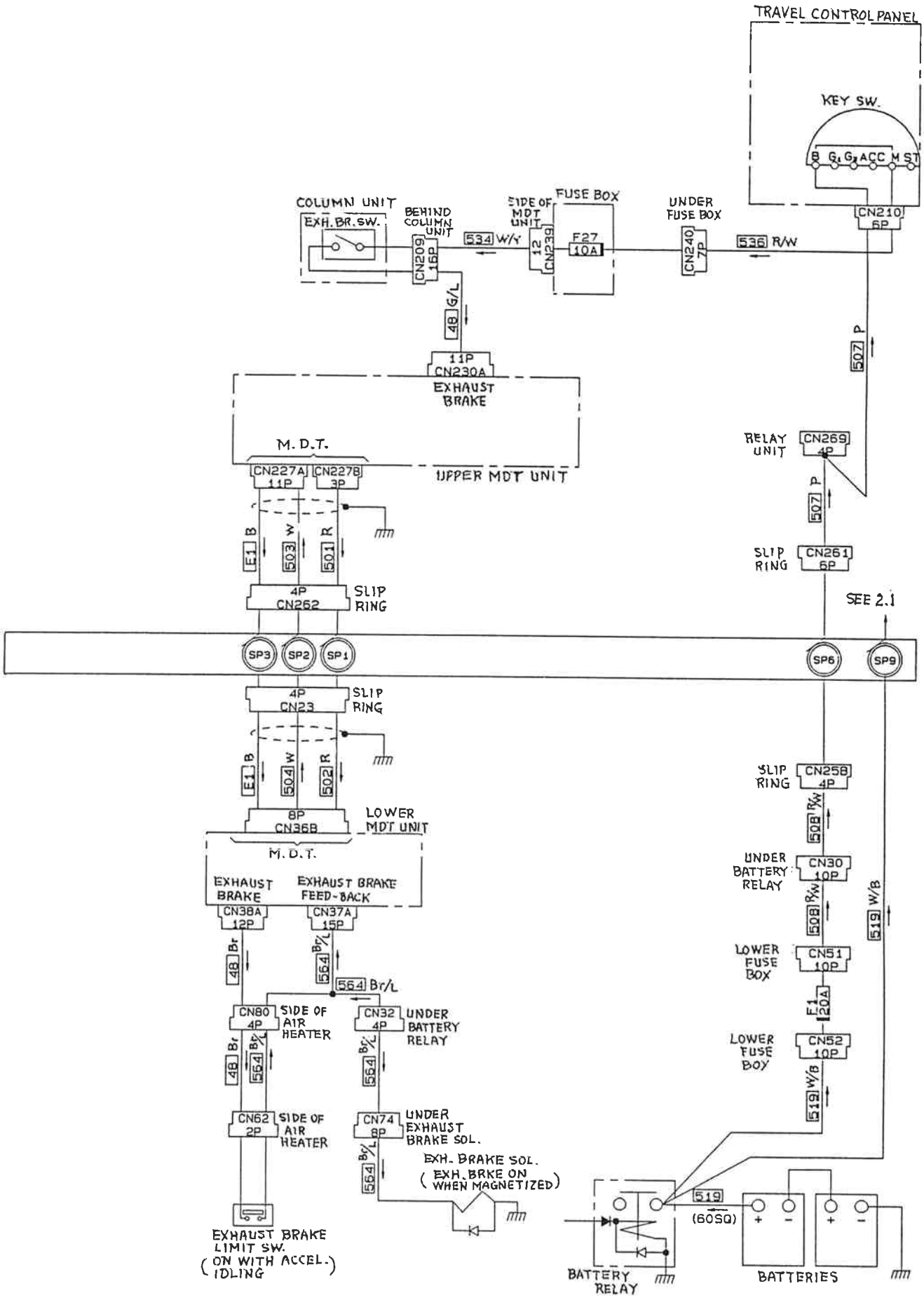
https://truckmanualshub.com/

2. 17 TRAVEL BRAKE OPERATING CIRCUIT



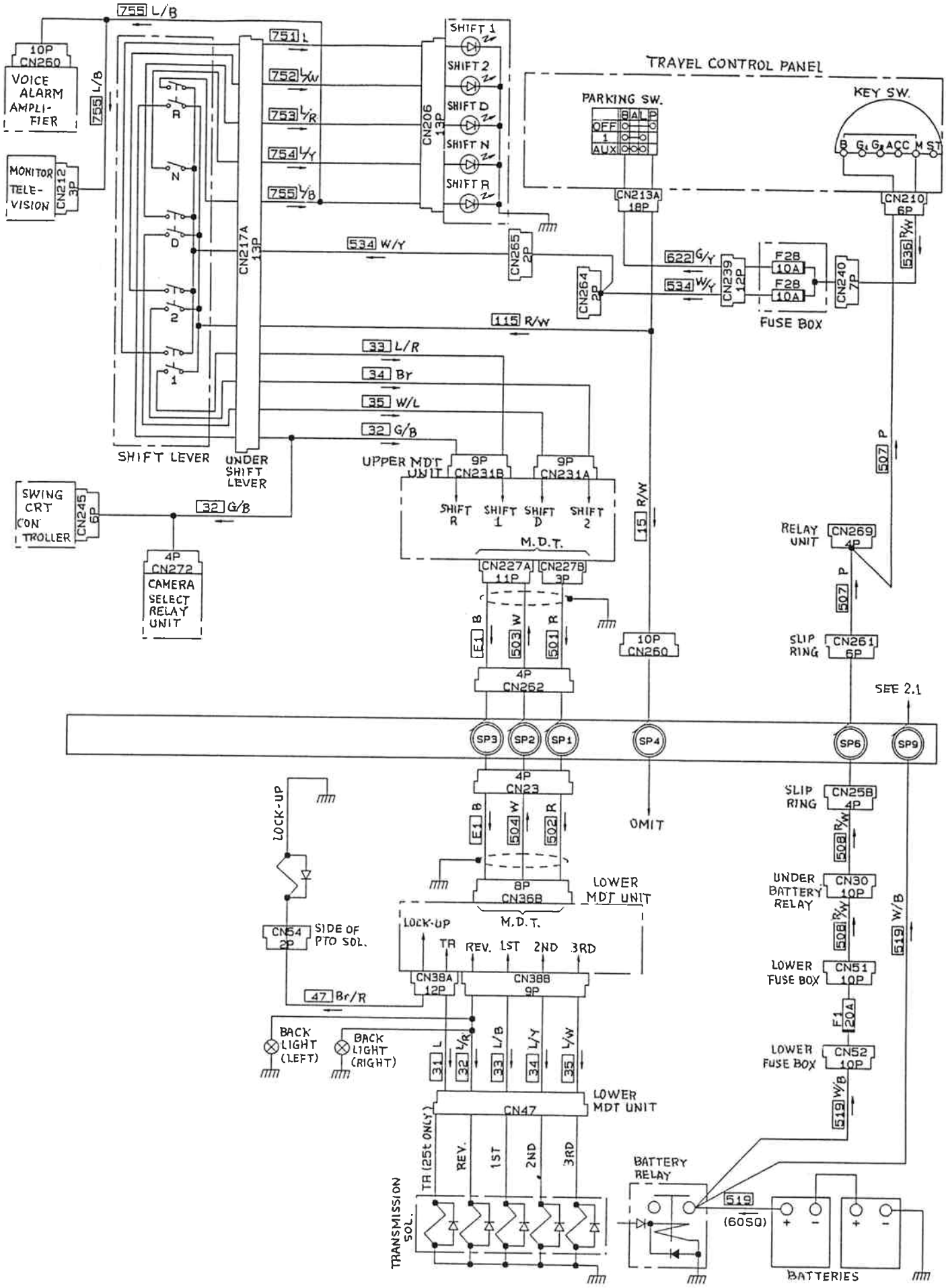
https://truckmanualshub.com/

2. 18 EXHAUST BRAKE OPERATING CIRCUIT



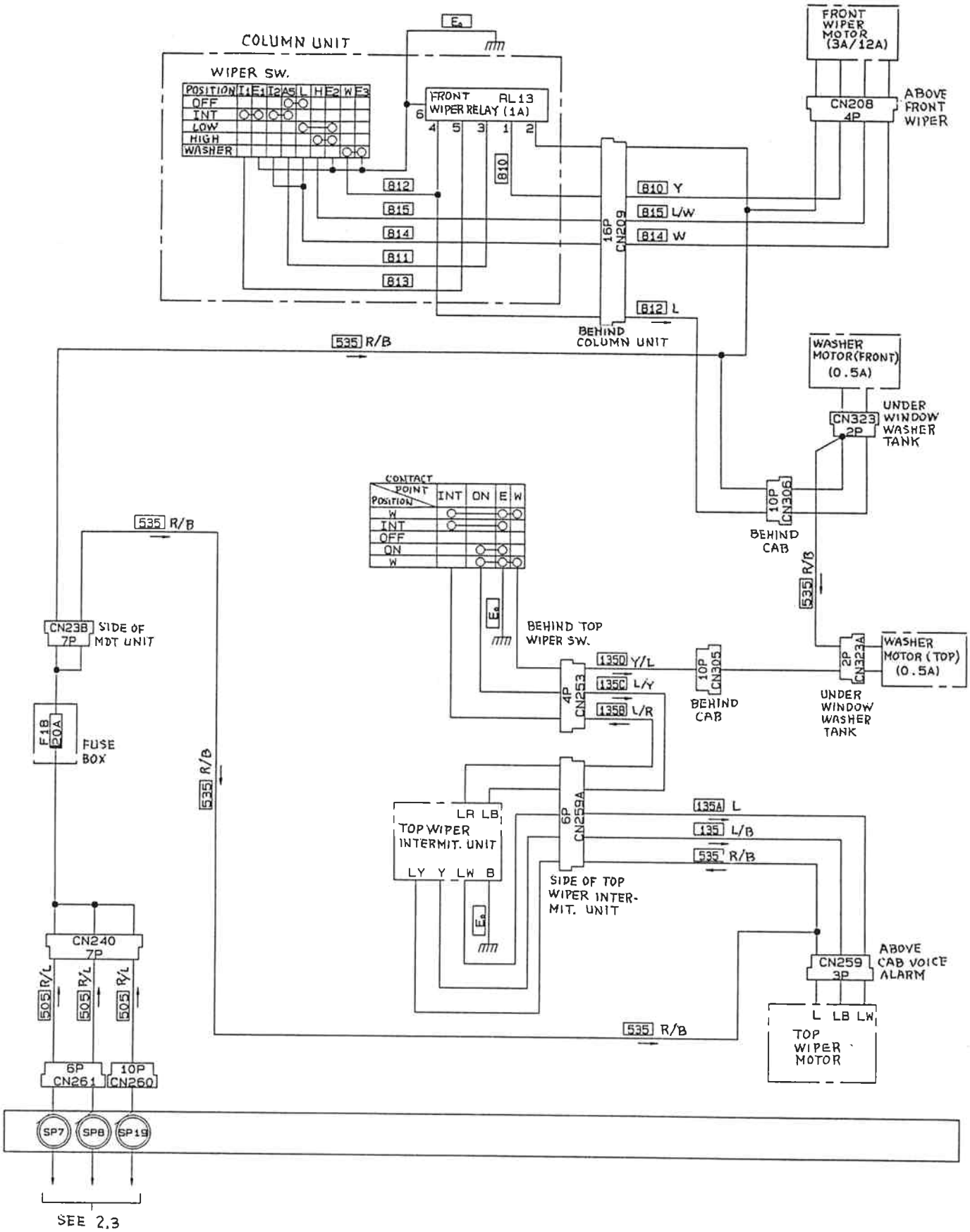
https://truckmanualshub.com/

2.19 SHIFT LEVER OPERATING CIRCUIT



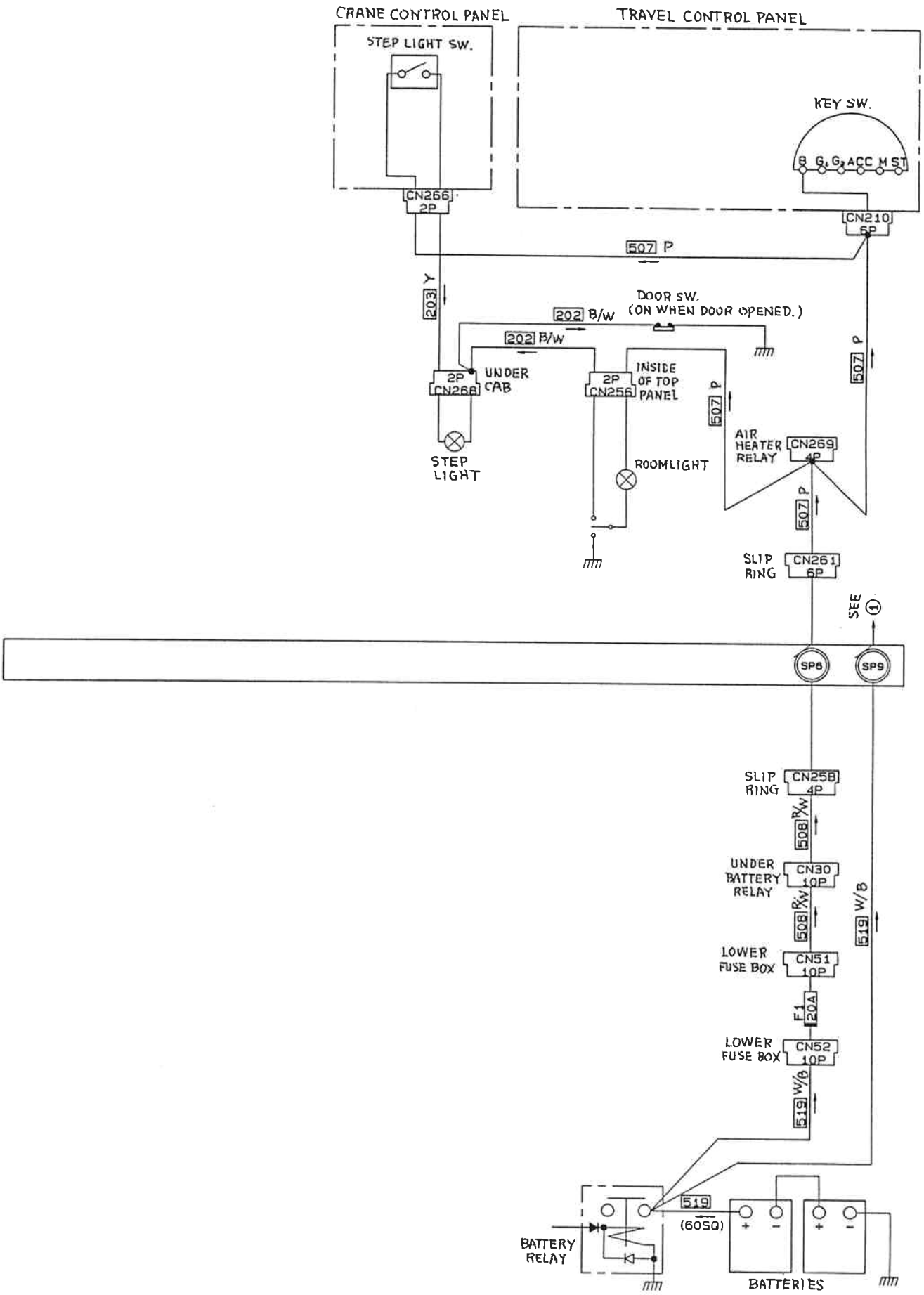
https://truckmanualshub.com/

2. 20 WIPER OPERATING CIRCUIT



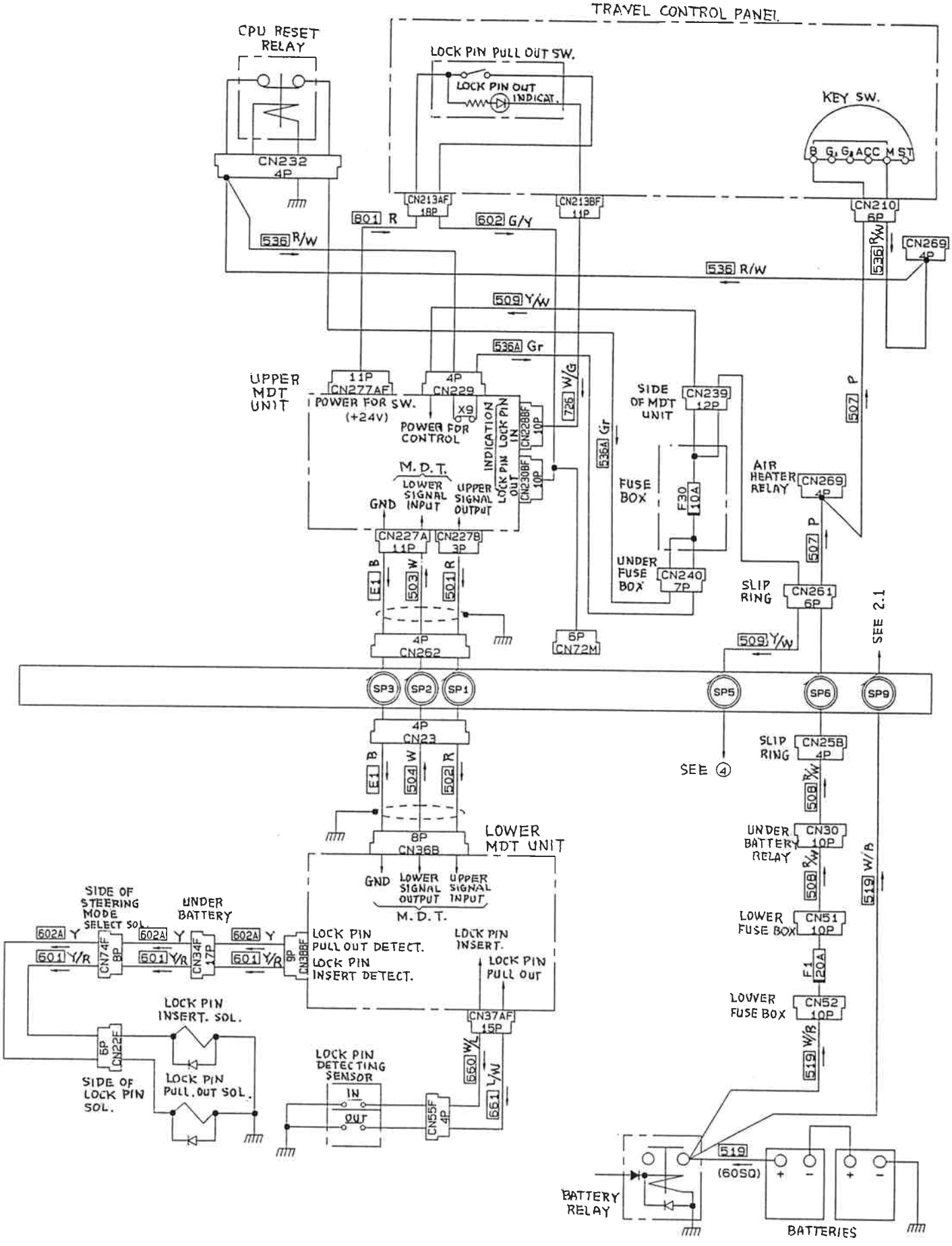
https://truckmanualshub.com/

2. 21 STEP LIGHT AND ROOMLIGHT OPERATING CIRCUIT



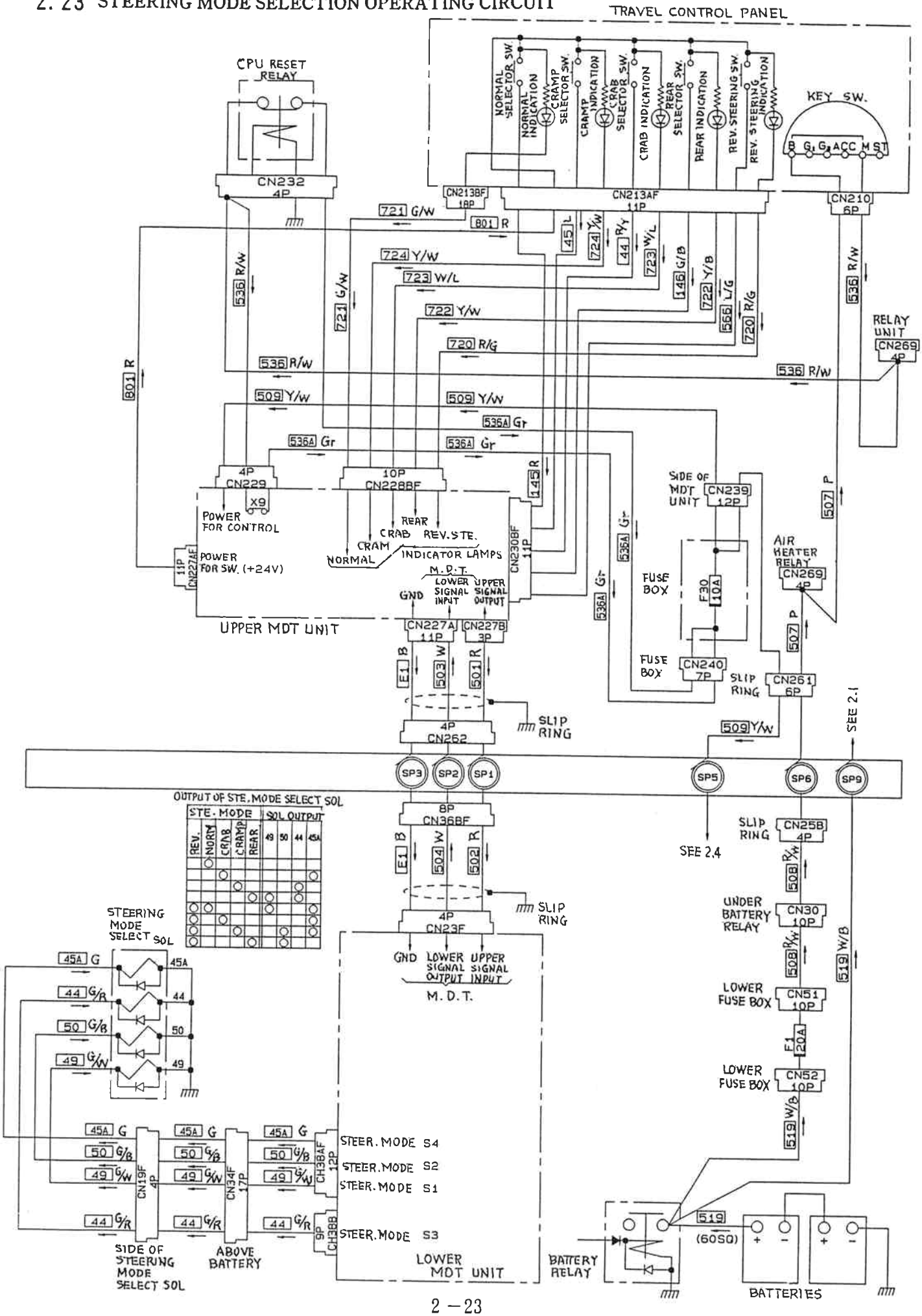
https://truckmanualshub.com/

2. 22 AXLE LOCK PIN OPERATING CIRCUIT



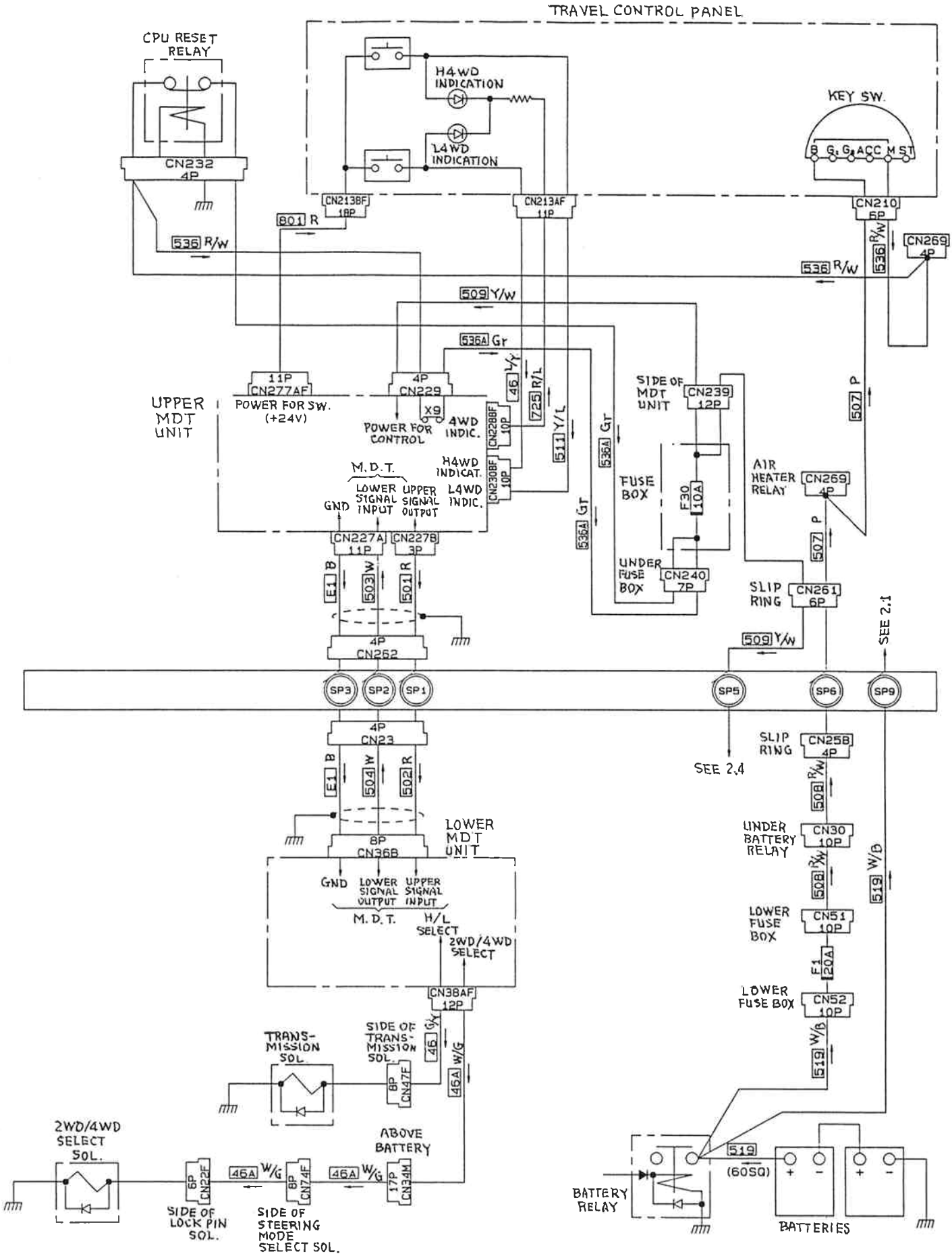
https://truckmanualshub.com/

2. 23 STEERING MODE SELECTION OPERATING CIRCUIT



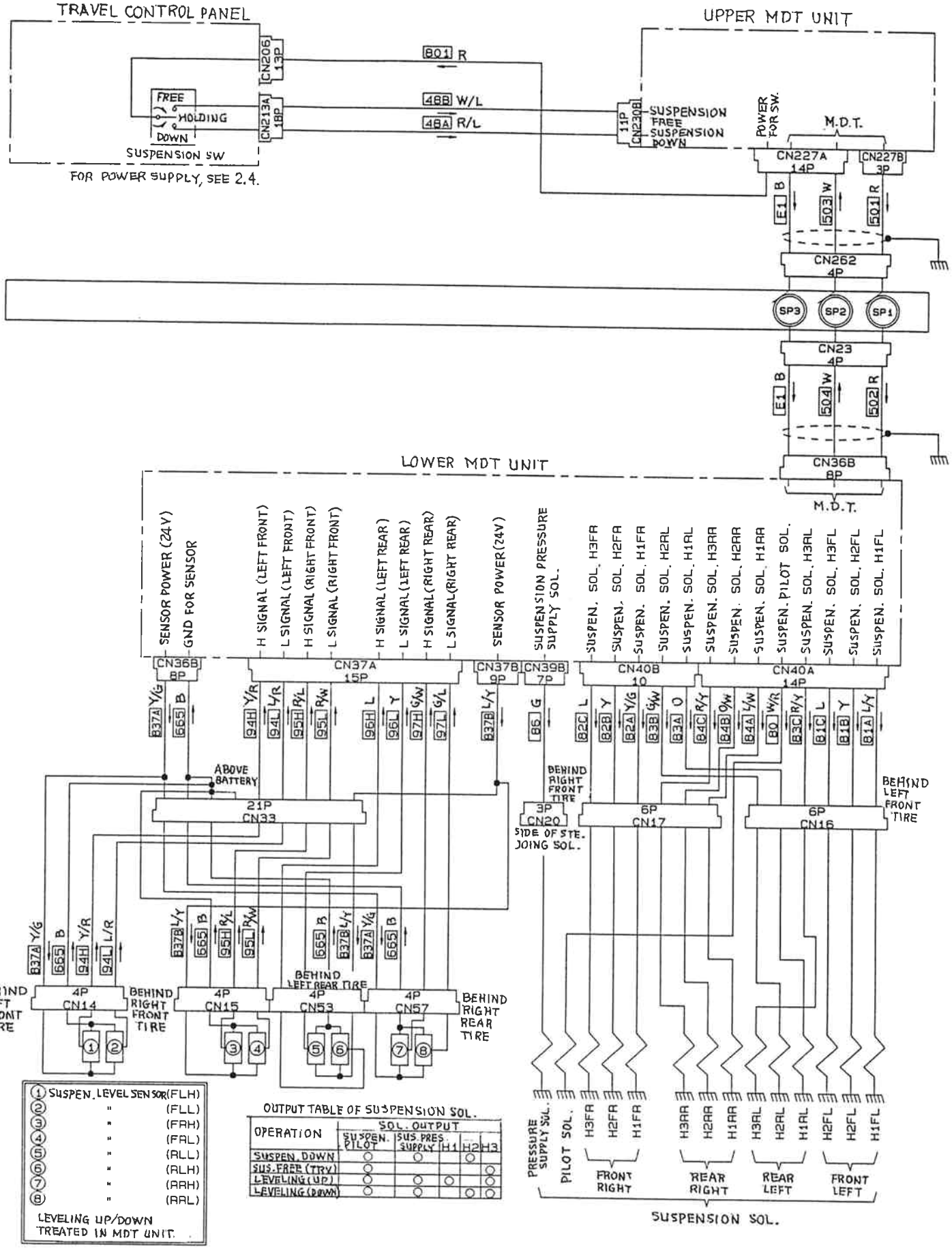
https://truckmanualshub.com/

2. 24 HIGH / LOW (2WD / 4WD) SELECTION OPERATING CIRCUIT



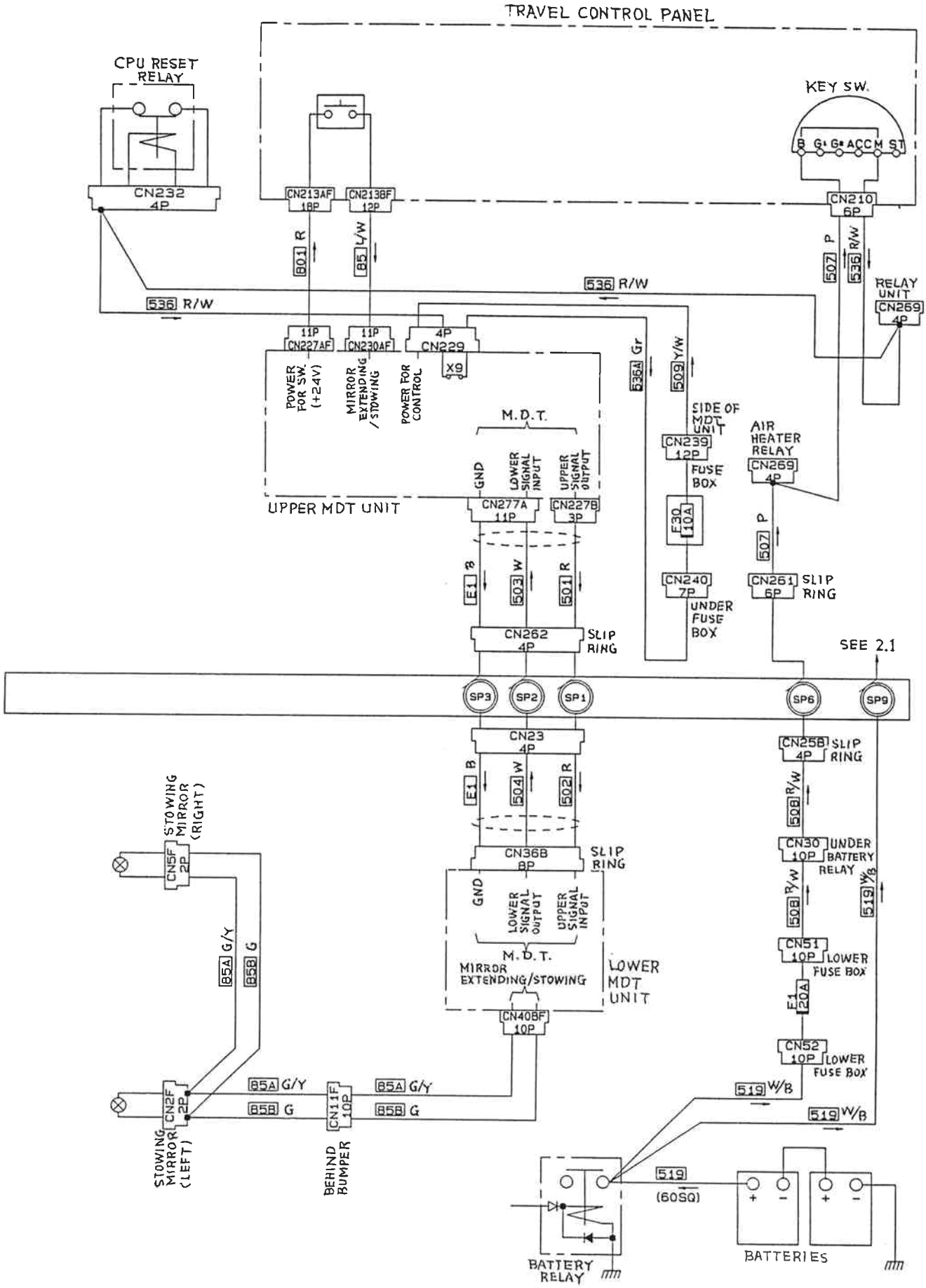
https://truckmanualshub.com/

2. 25 SUSPENSION OPERATING CIRCUIT



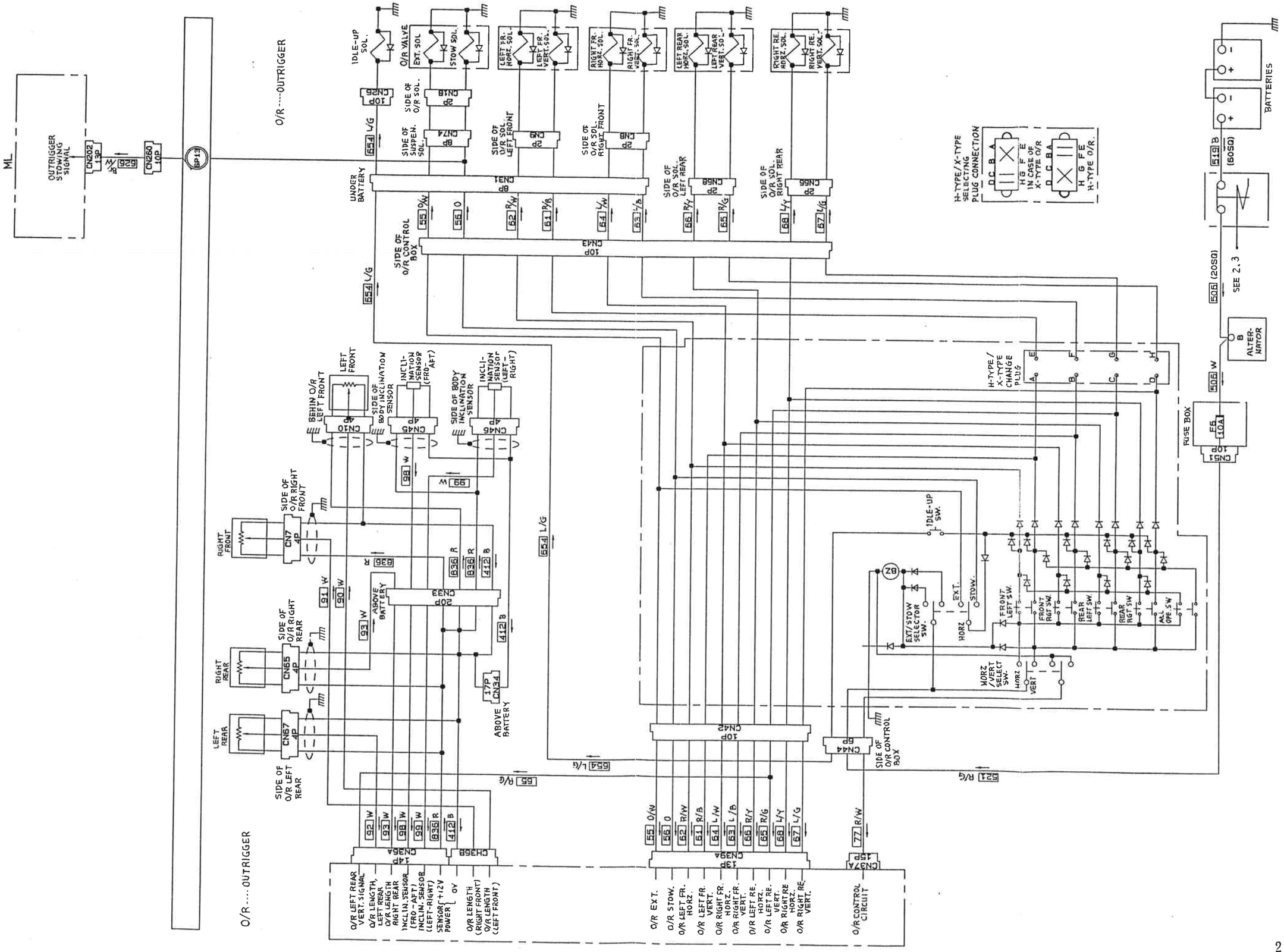
https://truckmanualshub.com/

2. 26 MIRROR EXTENDING/STOWING OPERATING CIRCUIT



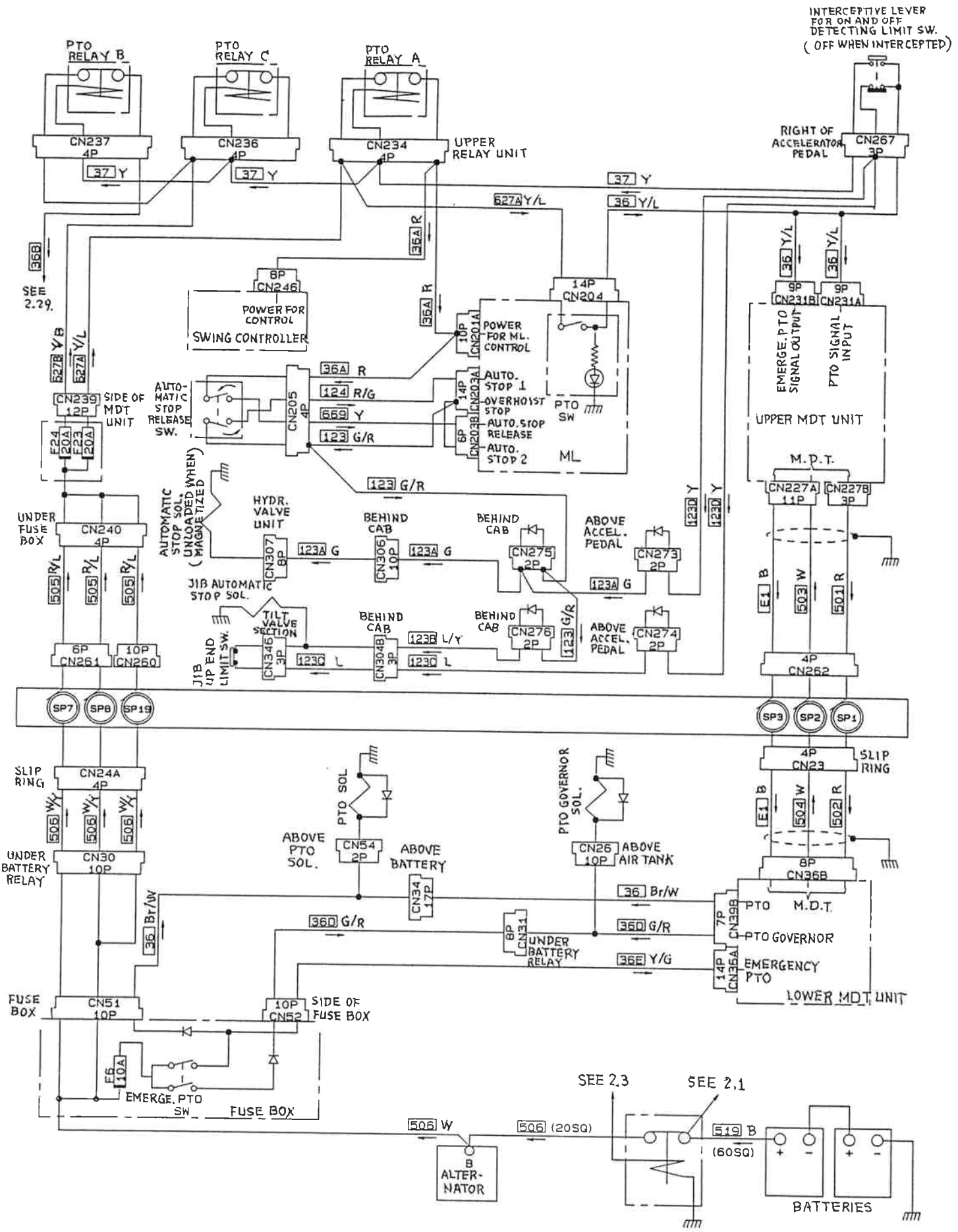
https://truckmanualshub.com/

2. 27 OUTRIGGER OPERATING CIRCUIT



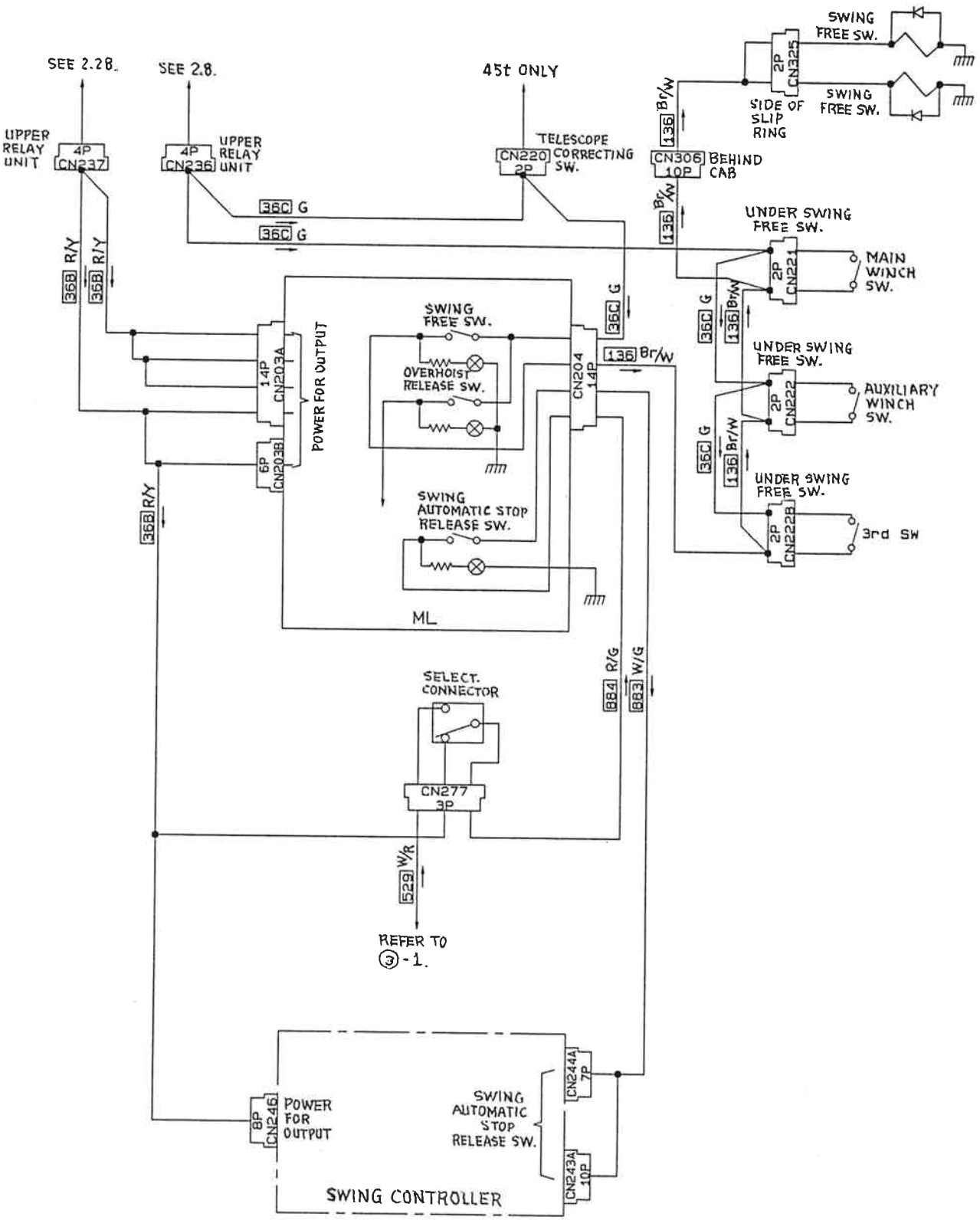
https://truckmanualshub.com/

2. 28 PTO OPERATING CIRCUIT (RELAY A)



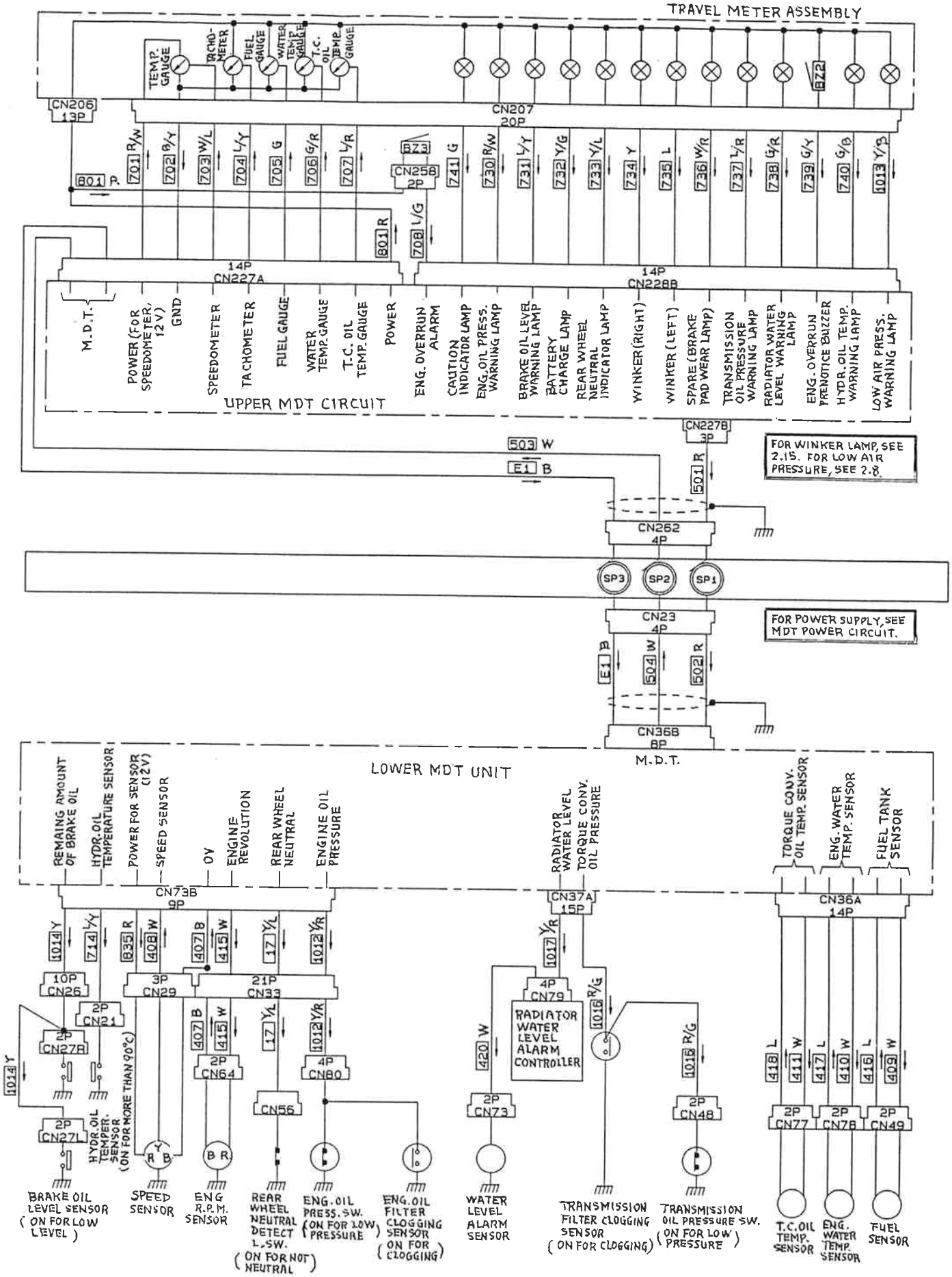
https://truckmanualshub.com/

2. 29 PTO OPERATING CIRCUIT (RELAYS B AND C)



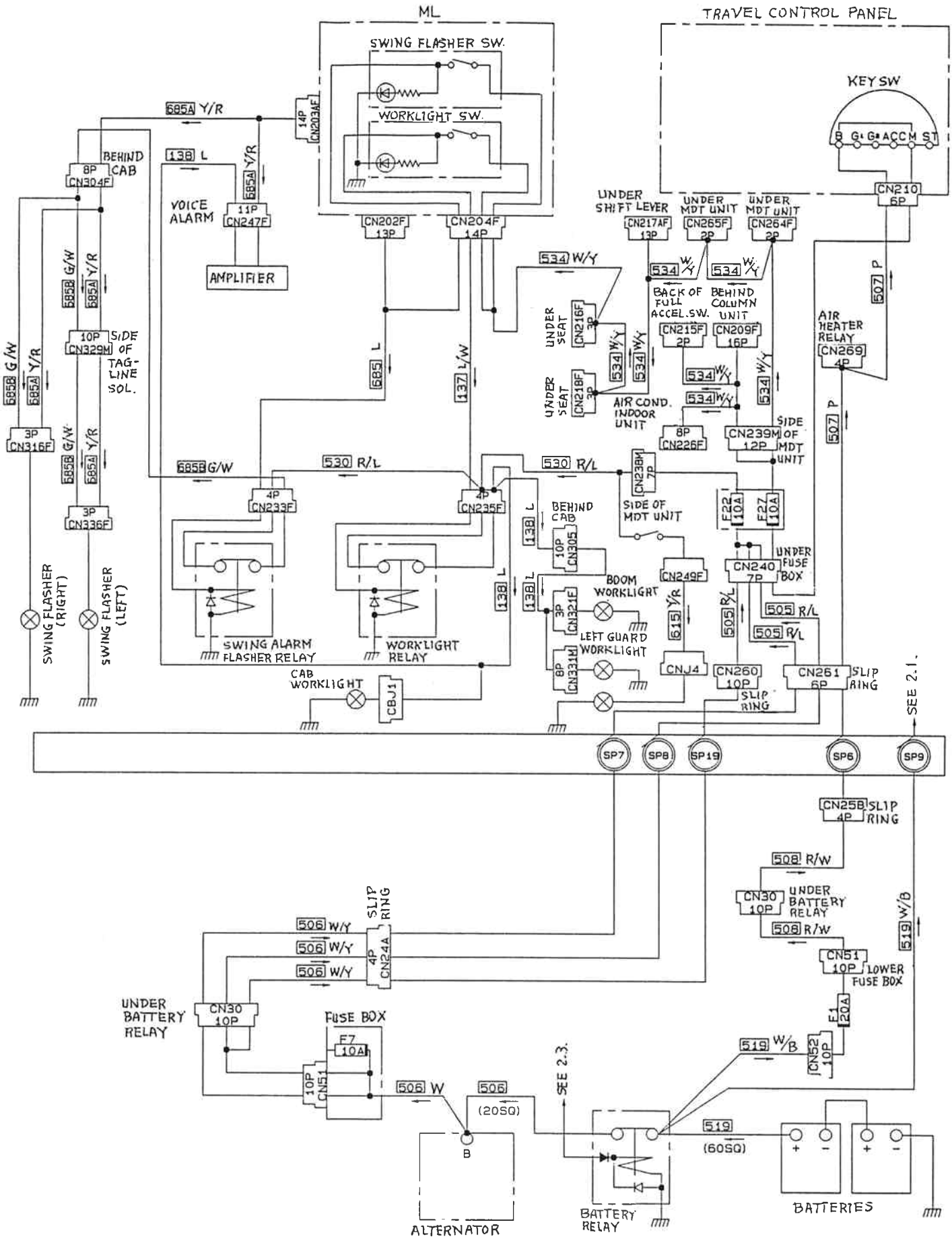
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2. 30 TRAVEL METER INDICATING CIRCUIT



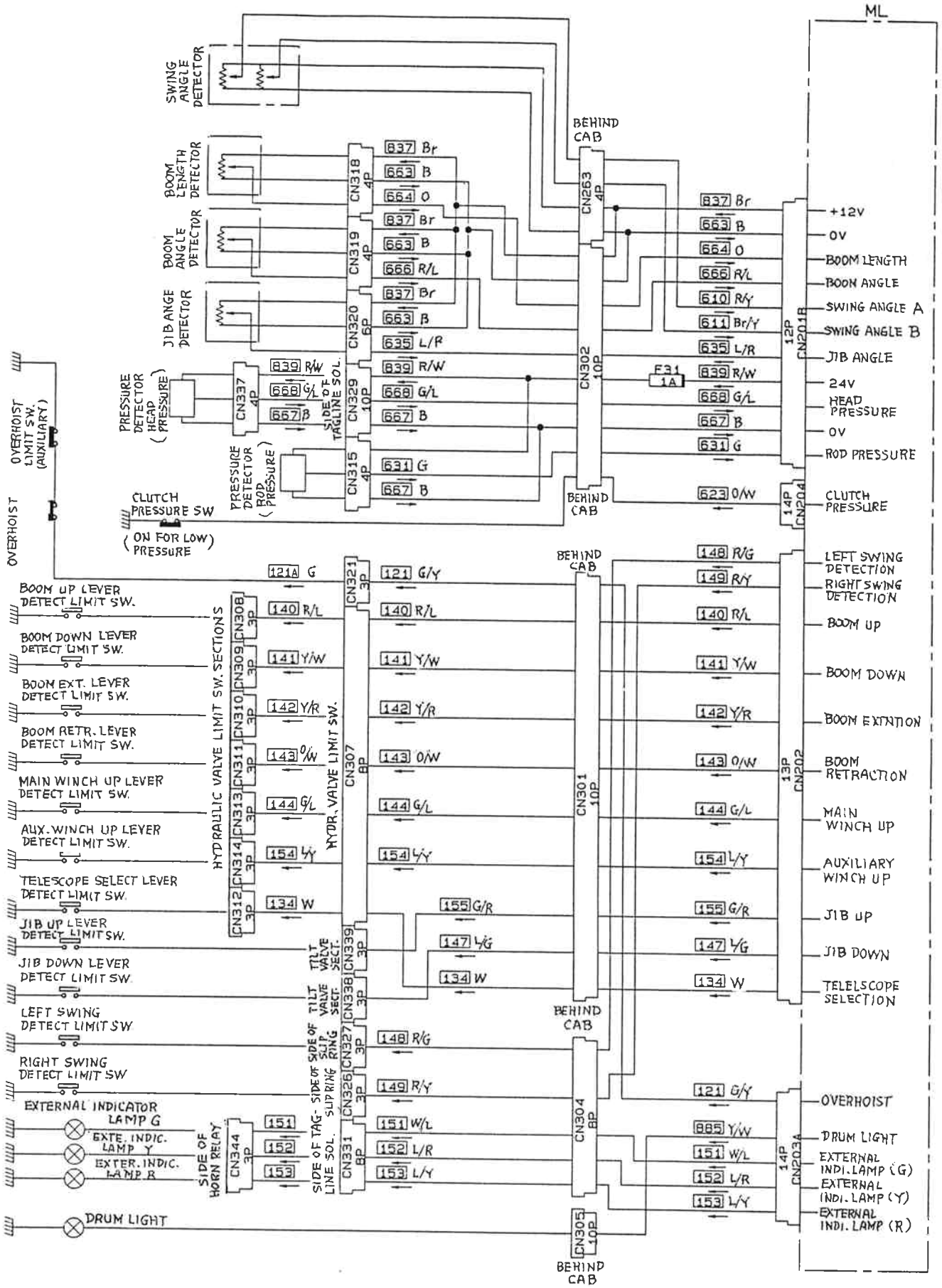
https://truckmanualshub.com/

2. 31 SWING ALARM FLASHER, WORKLIGHT AND ROTARY LAMP OPERATING CIRCUIT

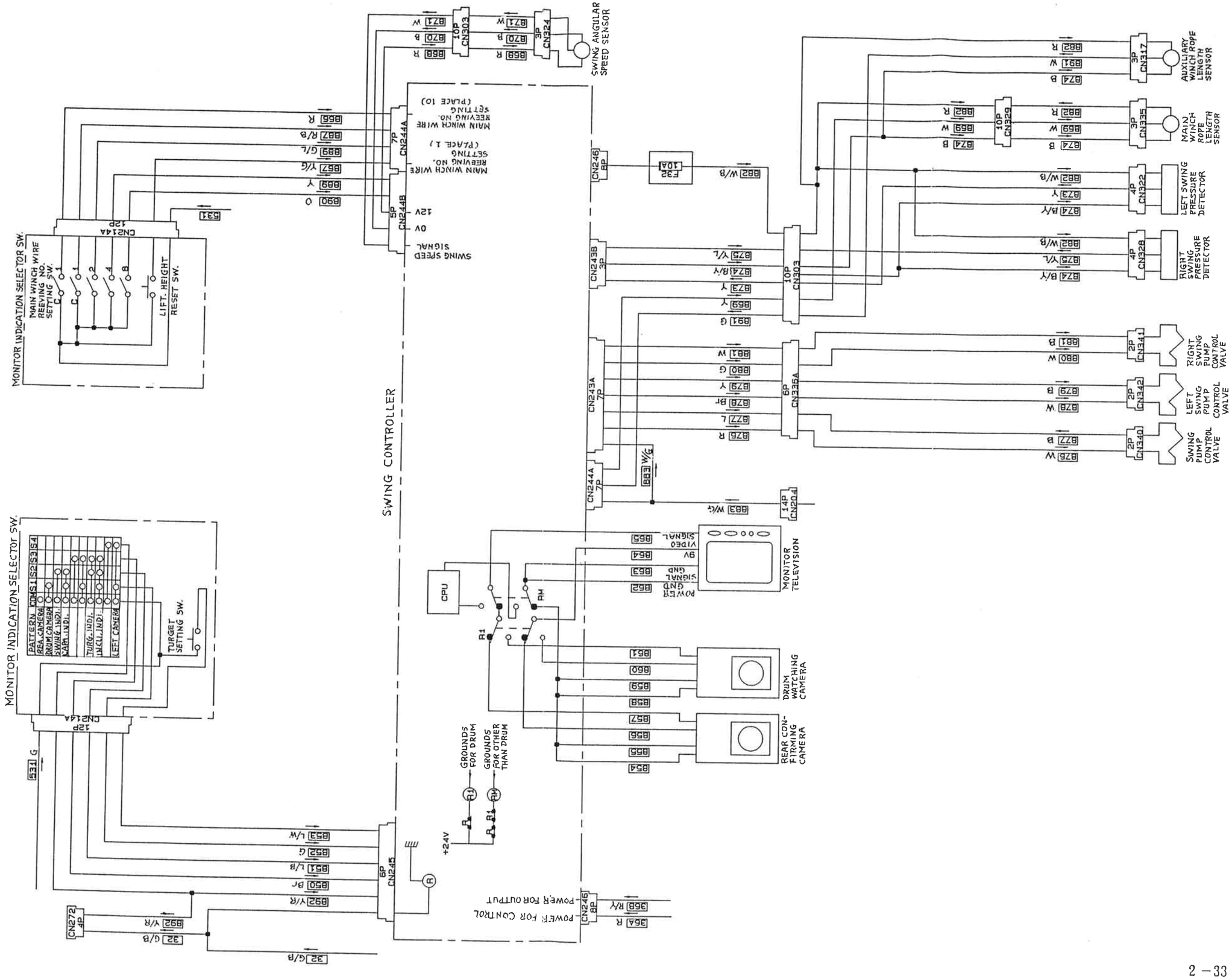


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2. 32 ML (MOMENT LIMITER) INPUT/OUTPUT CIRCUIT

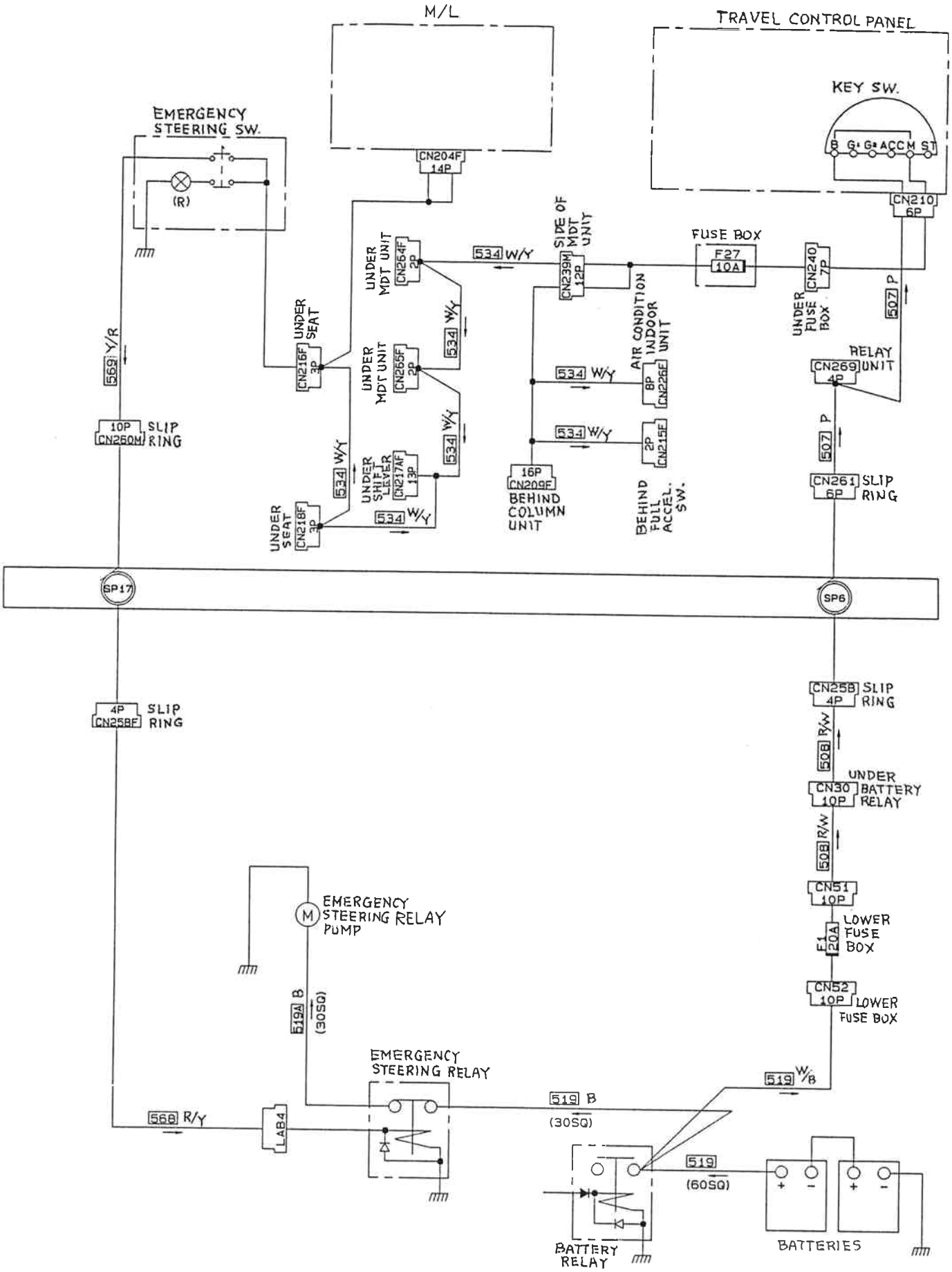


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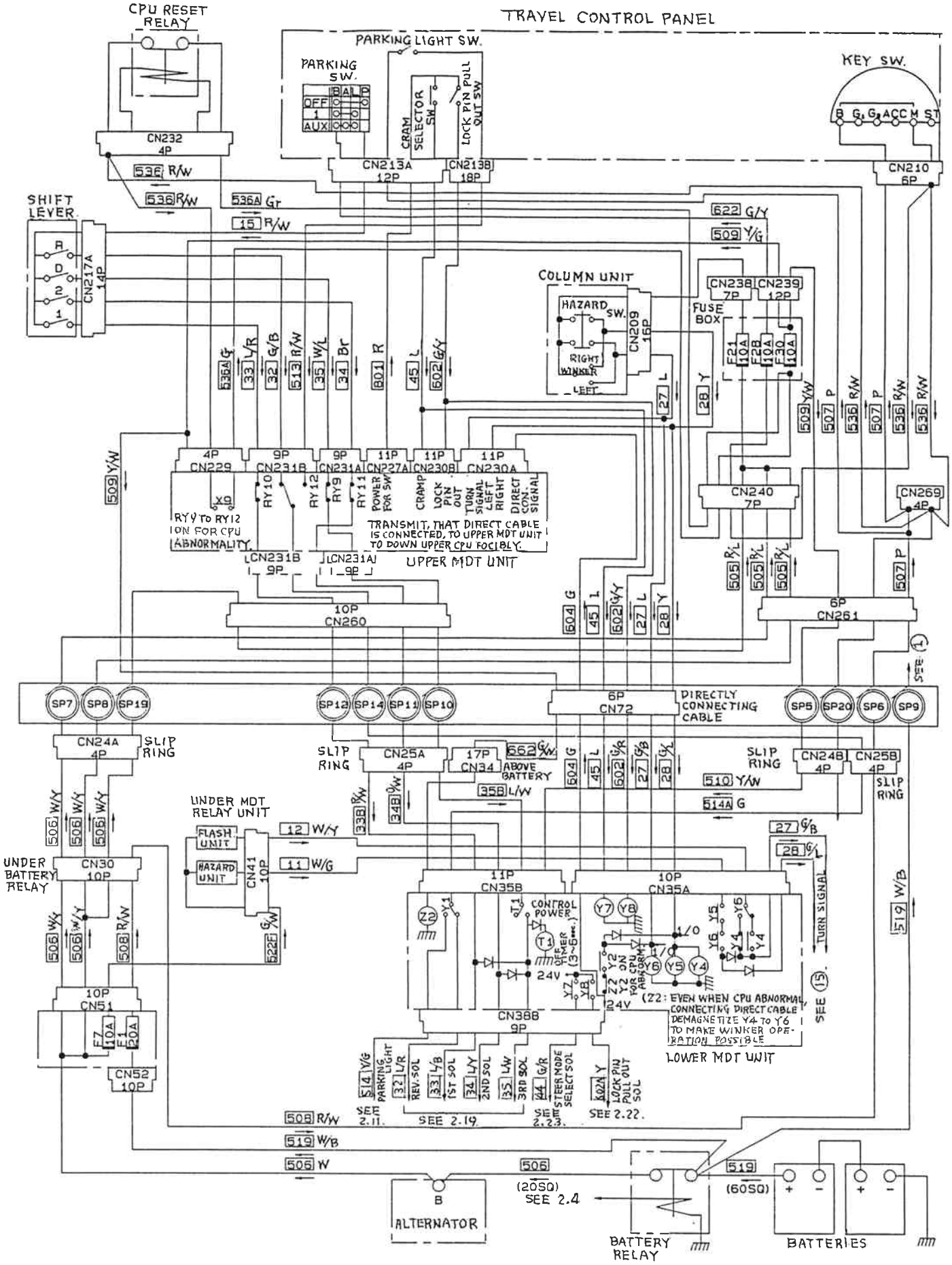
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2. 34 EMERGENCY STEERING OPERATION CIRCUIT



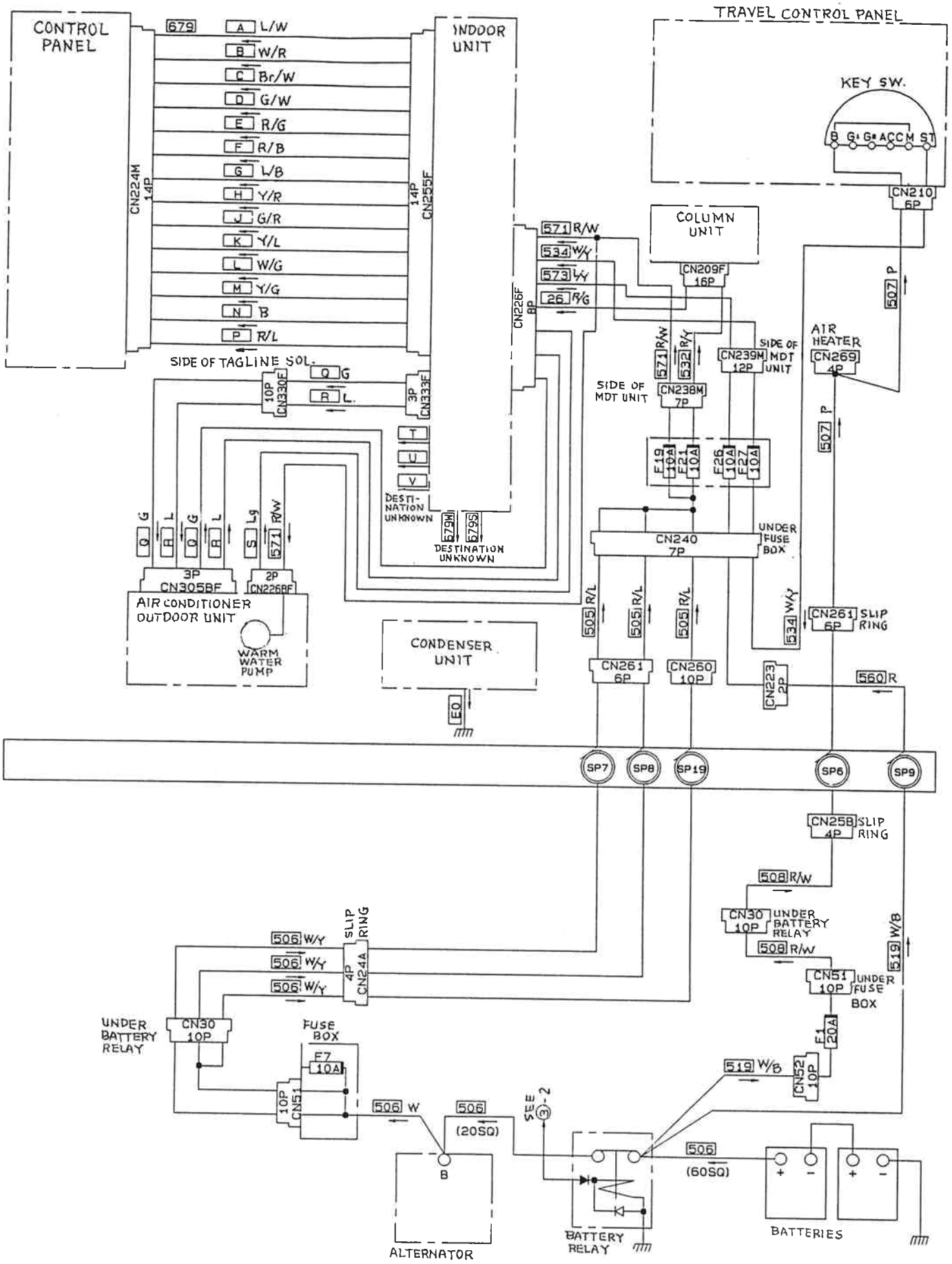
https://truckmanualshub.com/

2. 35 EMERGENCY CABLE DIRECTLY CONNECTING CIRCUIT



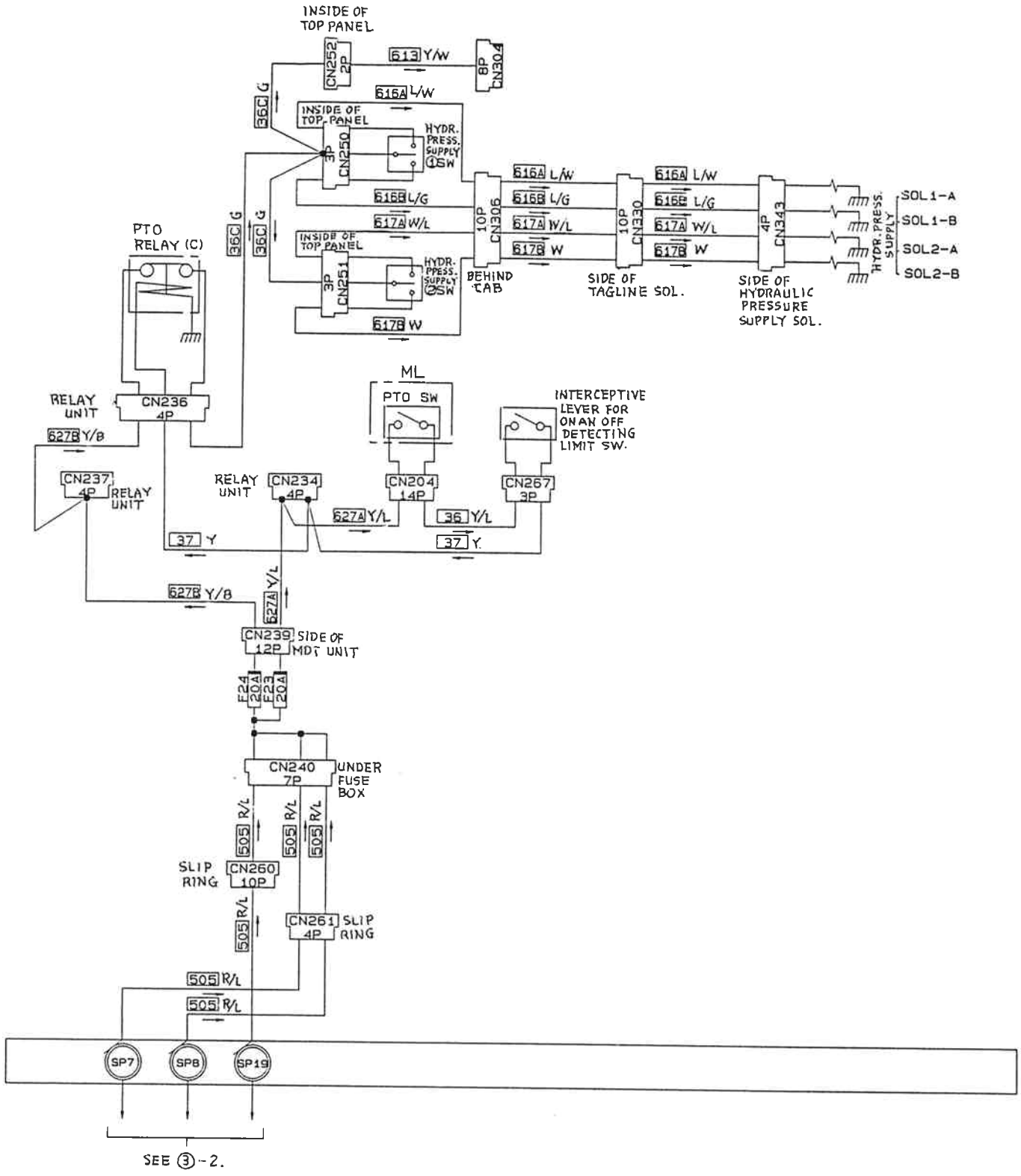
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2. 36 AIR CONDITIONER POWER SUPPLY CIRCUIT



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2. 37 TAGLINE HYDRAULIC PRESSURE SUPPLY OPERATING CIRCUIT



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1. CONSTRUCTION AND CIRCUIT ARRANGEMENT

1.1 CONSTRUCTION

This valve is a mono-block type compound valve so designed that the three motions of winching, boom hoisting and boom telescoping of the hydraulic crane can be most effectively controlled.

□ in Fig. 1-1 shows the port from which pressurized oil is sent out when the spool is shifted for the appropriate motion.

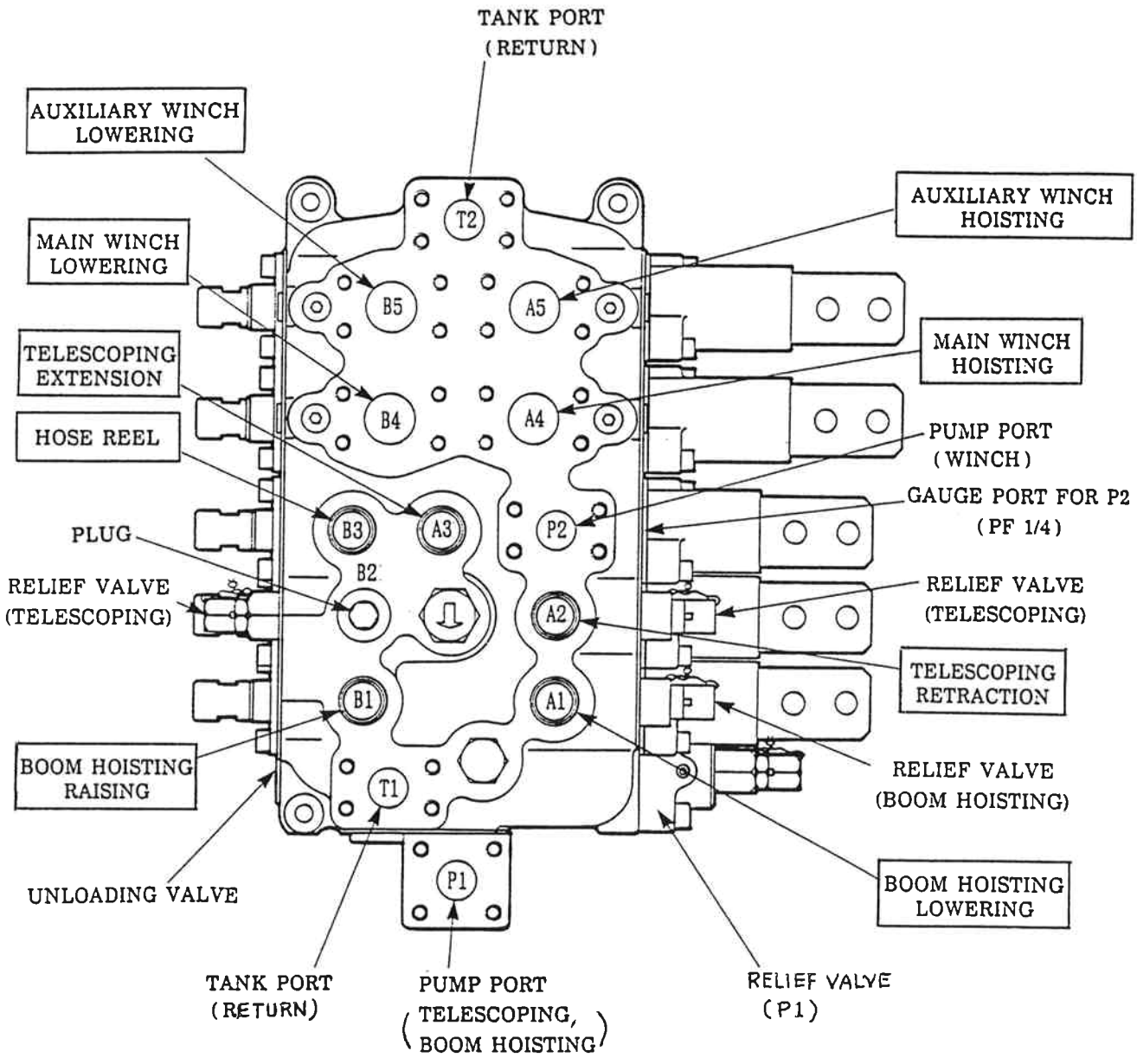
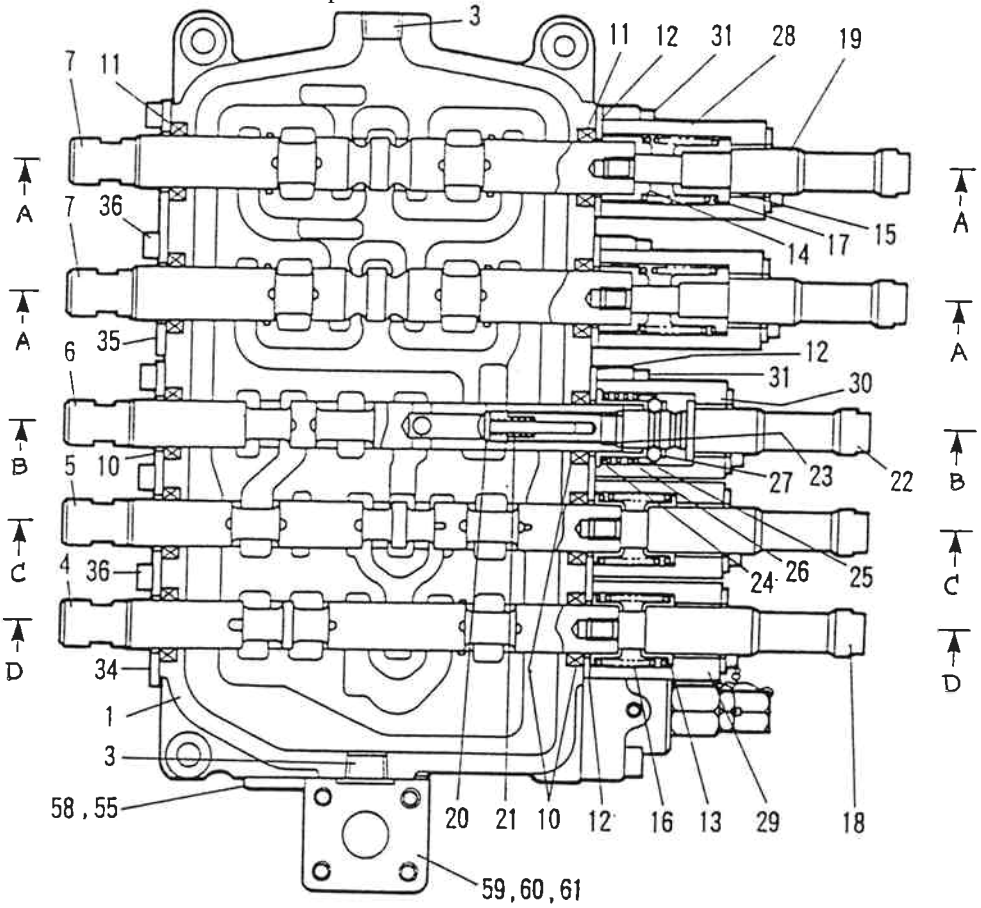
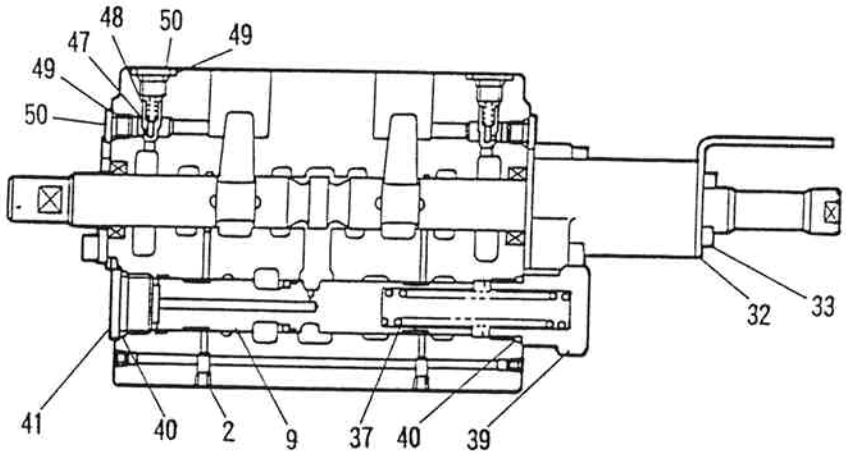


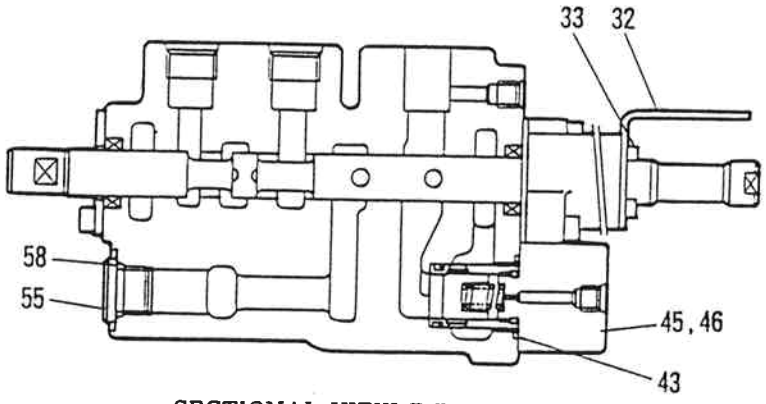
Fig. 1-1. Outside View of Control View

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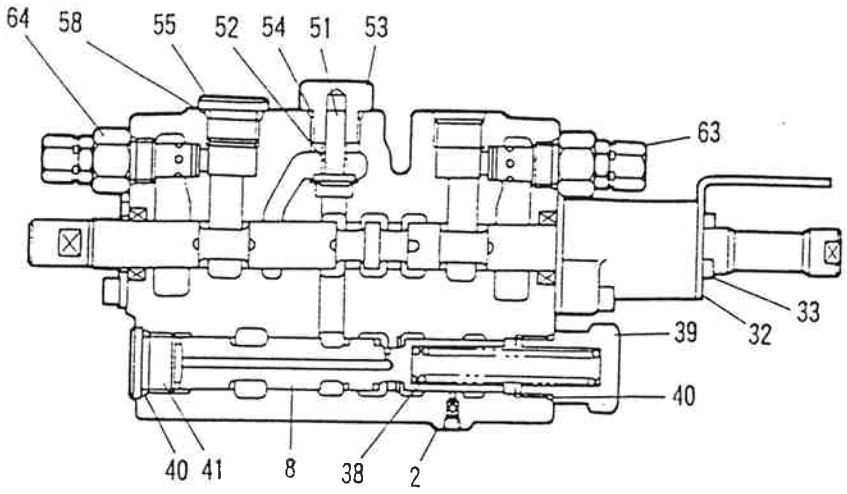
SECTIONAL VIEW A-A



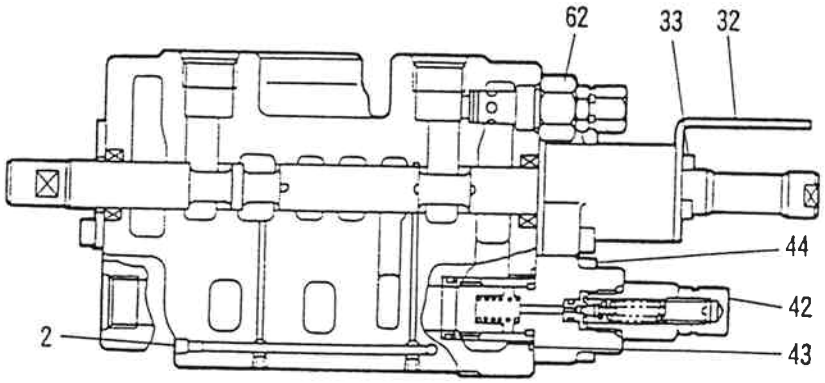
SECTIONAL VIEW B-B

Fig. 1-2. Sectional Construction View of Control Valve

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SECTIONAL VIEW C-C

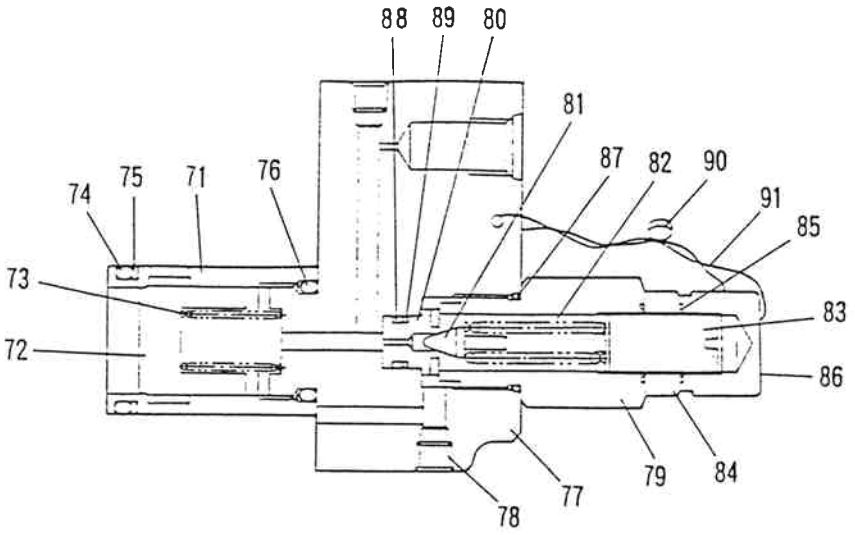


SECTIONAL VIEW D-D

1. VALVE BODY
2. PLUG
3. PLUG
4. SPOOL (BOOM HOIST)
5. SPOOL (TELESCOPE)
6. SPOOL (TELESCOPE SELECTION)
7. SPOOL (WINCH, MAIN)
8. FLOW CONTROL VALVE (BOOM HOIST)
9. FLOW CONTROL VALVE (WINCH)
10. OIL SEAL
11. OIL SEAL
12. OIL SEAL RETAINER
13. SPRING SUPPORT
14. SPRING SUPPORT
15. SPRING SUPPORT
16. SPRING (BOOM)
17. SPRING
18. SPOOL END A (BOOM)
19. SPOOL END B (WINCH)
20. CHECK VALVE
21. SPRING
22. NOTCH END
23. O-RING
24. BALL CASE
25. BALL RETAINER
26. DETENT SPRING
27. BALL (7mm DIA.)
28. SPRING COVER
29. SPRING COVER
30. SPRING COVER
31. BOLT
32. SUPPORT
33. BOLT
34. OIL SEAL RETAINER
35. OIL SEAL RETAINER
36. BOLT
37. FLOW CONTROL VALVE SPRING
38. FLOW CONTROL VALVE SPRING
39. SUPPORT
40. O-RING
41. PLUG
42. RELIEF VALVE ASSEMBLY
43. O-RING
44. BOLT
45. UNLOADING VALVE
46. BOLT
47. CHECK VALVE
48. SPRING
49. O-RING
50. PLUG
51. CHECK VALVE
52. SPRING
53. CHECK VALVE SPRING RETAINER
54. O-RING
55. PLUG
58. O-RING
59. FLANGE
60. O-RING
61. BOLT
62. RELIEF VALVE ASSEMBLY
63. RELIEF VALVE ASSEMBLY
64. RELIEF VALVE ASSEMBLY

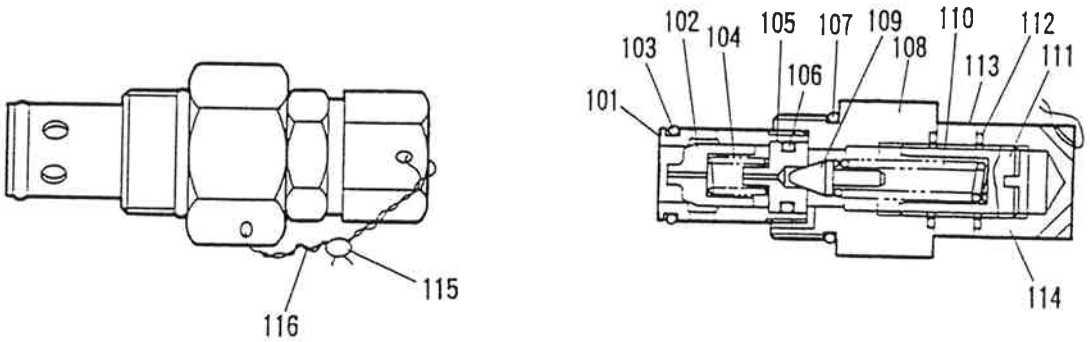
Fig. 1-2. Sectional Construction View of Control Valve (continued)

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71. SOCKET
72. REGULATOR VALVE
73. VALVE SPRING
74. O-RING
75. BACK-UP RING
76. O-RING
77. BODY
78. SPRING PLUB
79. ADJUSTING BODY
80. VALVE SEAT
81. ADJUSTING VALVE
82. ADJUSTING SPRING
83. ADJUSTING SCREW
84. NUT
85. O-RING
86. CAP NUT
87. O-RING
88. O-RING
89. BACK-UP RING
90. SEALING LEAD
91. WIRE

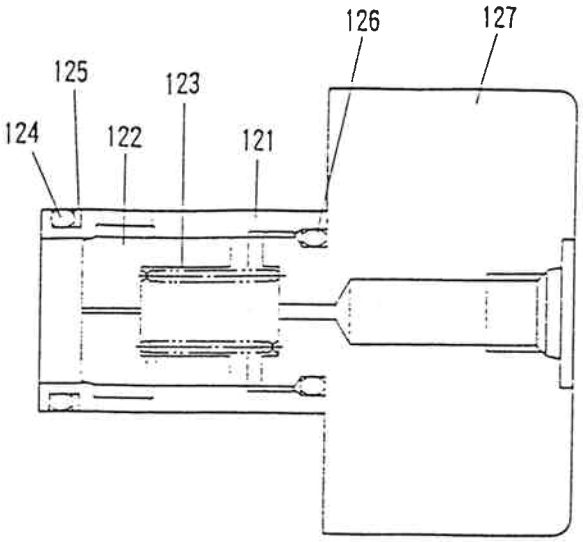
Fig. 1-3. Sectional Construction of Main Relief Valve



101. SOCKET
102. REGULATOR VALVE
103. O-RING
104. VALVE SPRING
105. VALVE SEAT
106. O-RING
107. O-RING
108. BODY
109. ADJUSTING VALVE
110. ADJUSTING SPRING
111. ADJUSTING SCREW
112. O-RING
113. NUT
114. CAP NUT
115. SEALING LEAD
116. WIRE

Fig. 1-4. Sectional Construction of Overload Relief Valve

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121. SOCKET
122. REGULATOR VALVE
123. VALVE SEAT
124. O-RING
125. BACK-UP RING
126. O-RING
127. VALVE BODY

Fig. 1-5. Sectional Construction of Unloading Relief Valve

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1.2 ARRANGEMENT OF CIRCUITS

(See Fig. 1-6.)

The pump ports are provided at the left end and at the bottom of the center in the circuit figure. The oil deliverred from pump P1 flows into the left end port, and oil from pump P2 flows into the bottom port of the center.

The oil from pump P2 is exclusively used for the 1st speed of the winch, and the rate of flow is controlled with the flow control valve and the stroke of the spool. When the boom is not operated, bleed off the bypass passage for increasing speed so that the oil from pump P1 joins the oil from pump P2 to flow into the winch 2nd speed circuit. The joined flow is controlled by the flow control valve and the spool stroke to increase the winch speed.

The circuits for the boom hoisting, telescoping and winch 2nd speed (increased speed) are arranged in tandem circuits, and use the flow from pump P1.

The tandem circuit is the circuit which actuates the actuator nearest to the pump port only when the plural spools are fully stroked.

Therefore, to operate the boom hoisting and telescoping at the same time, since a flow control valve is provided for the boom hoisting, stroke the spool for telescoping. When raising the boom, adjust the boom hoisting spool within a half stroke, and when lowering the boom, the both operations can be performed even when the boom hoisting spool is stroked fully. (In condition of rated flow).

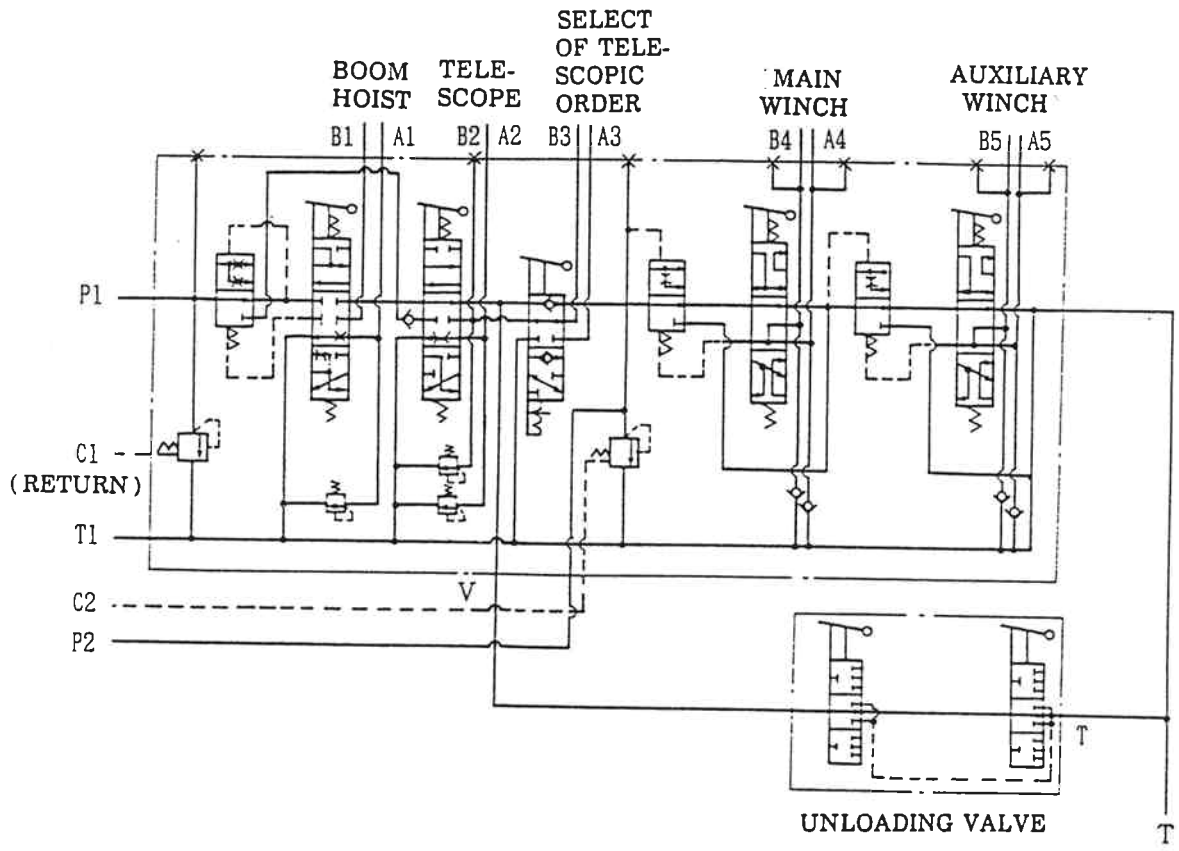


Fig. 1-6. Circuits of Valve

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2. FUNCTION OF VALVE AND FLOW OF OIL

2.1 FUNCTION OF DIRECTIONAL CONTROL SECTION

(1) IN NEUTRAL POSITION (Fig. 2-1)

When the spools are not moved, the oils from the pump ports pass the bypass passages via the boom hoisting flow control valve, and return to the tank from the tank port.

At this time, the connecting passages to the actuators are closed. The oil to port V passes the bypass passage of the unloading valve, and returns to the tank from the tank port.

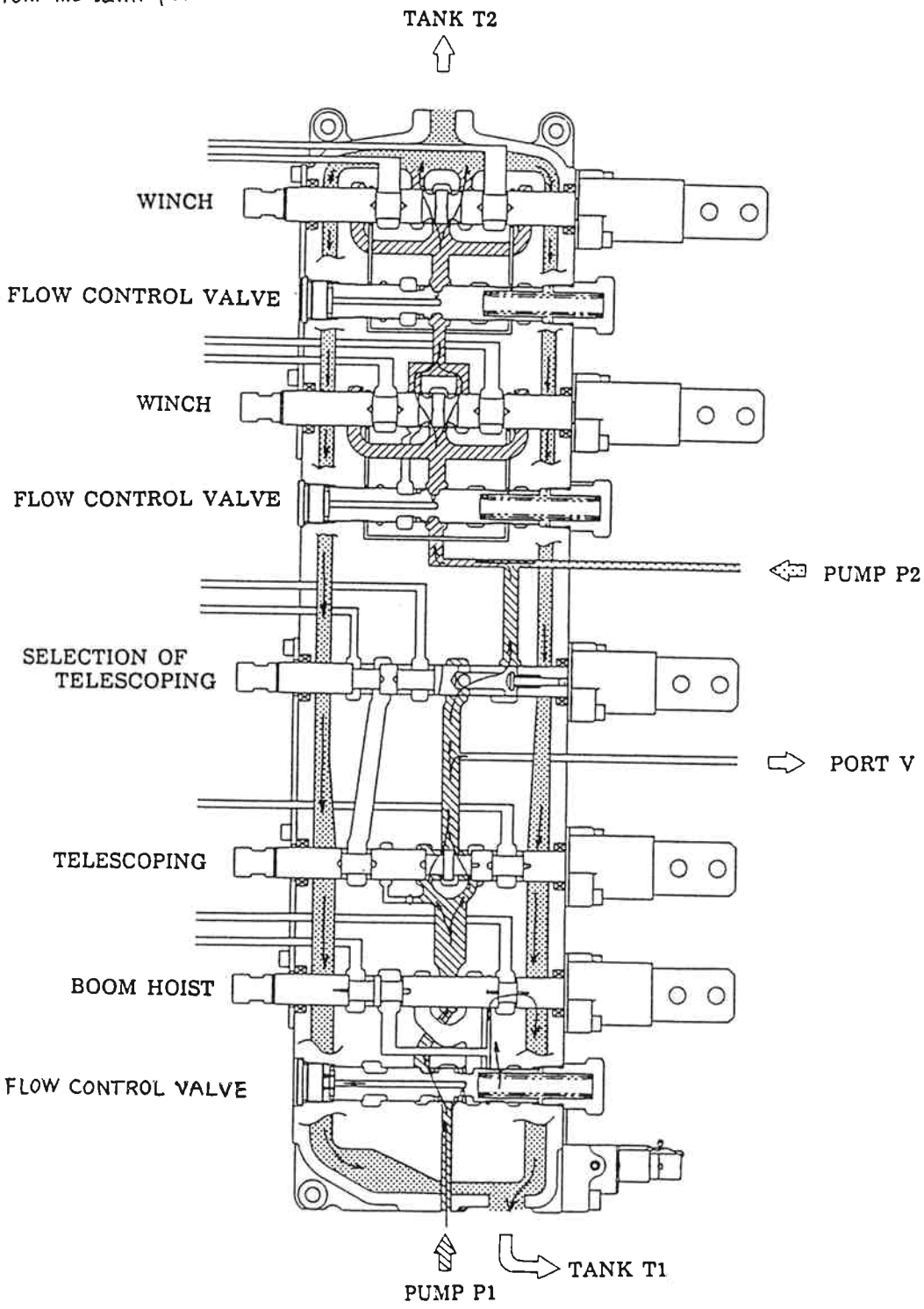


Fig. 2-1. Spool in Neutral Position

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(2) WHEN THE BOOM HOIST SPOOL IS OPERATED (Figs. 2-2 and 2-4.)

When the spool is pushed in, the bypass passage is closed, so the oil from pump P1 passes the notch section (restriction) of the spool, enters the bottom side of the cylinder, and the oil in the rod side is pushed out to return to the tank.

When the spool is pulled out, the oil flows through the notch section (restriction) of the spool in the reverse direction to the flow when the spool is pushed in. Besides, the oil from pump P2 passes the bypass passage, and returns to the tank from the tank port.

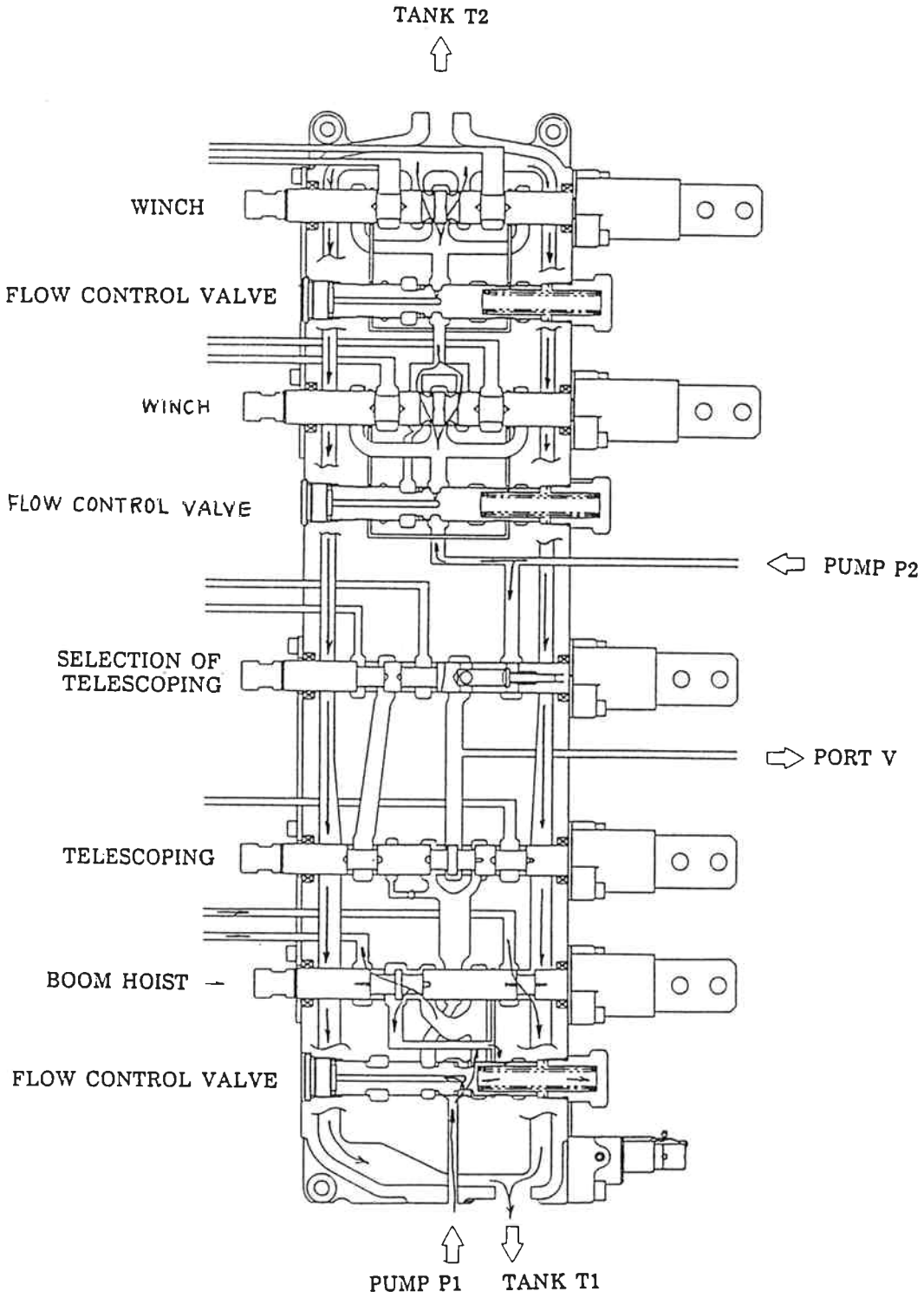


Fig. 2-2. When Boom Hoist Spool is Pushed in.

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(3) WHEN THE TELESCOPING SPOOL IS OPERATED (Fig. 2-3)

When the spool is pushed in, the bypass passage is closed, so the oil from pump P1 passes the load check valve, enters the bottom side of the cylinder, and the oil in the rod side is pushed out to return to the tank. When the spool is pulled out, the oil flows in the reverse direction.

Besides, the oil from pump P2 passes the bypass passage, and returns to the tank from the tank port.

However, when the boom hoisting spool is fully stroked (only pushed in), the oil does not flow to the telescoping spool. When combined operation is required, adjust the boom hoisting spool within a half stroke (Figs. 2-4 and 2-10).

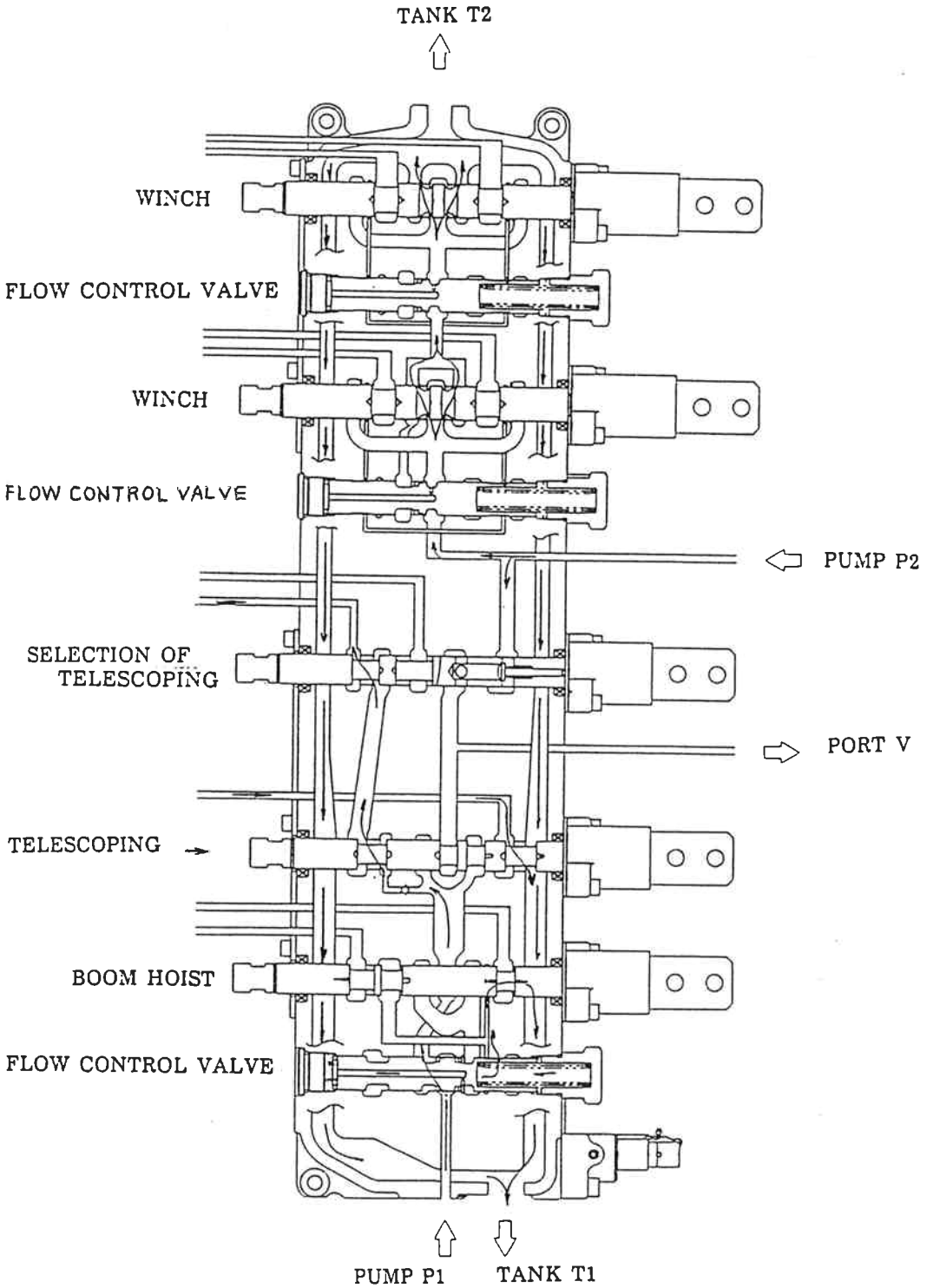


Fig. 2-3. When Telescoping Spool is Pushed in.

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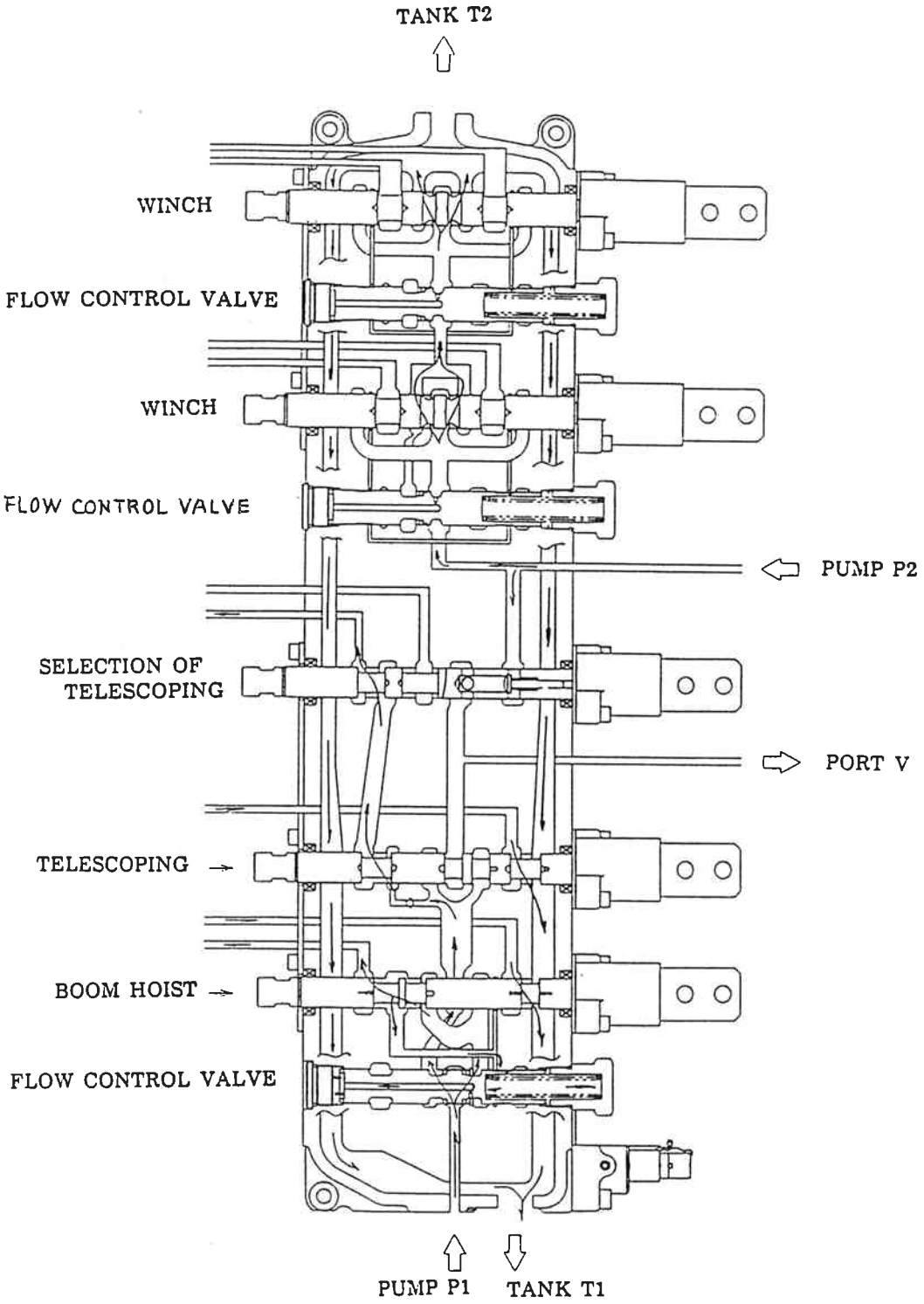


Fig. 2-4. When Operating Boom Hoist and Telescoping Spools at Same time (Combined Operations)

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(4) WHEN THE WINCH SPOOL IS OPERATED (Figs. 2-5 through 2-8 and 2-11)

When the spool is pushed in [the spool stroke of 3 mm (1/8") to 8 mm (5/16")], the bypass passage is closed in Fig. 2-5, so the oil from pump port P2 passes the notched section (restriction) of the spool and flows into the lowering side of the motor.

The load check valve prevents the oil from flowing reversely to the port V side.

The oil from pump port P1 passes the unloading valve (provided separately) from port V and flows to the tank without increasing the speed.

Besides, the oil in the other side of the motor is pushed out to return to the tank.

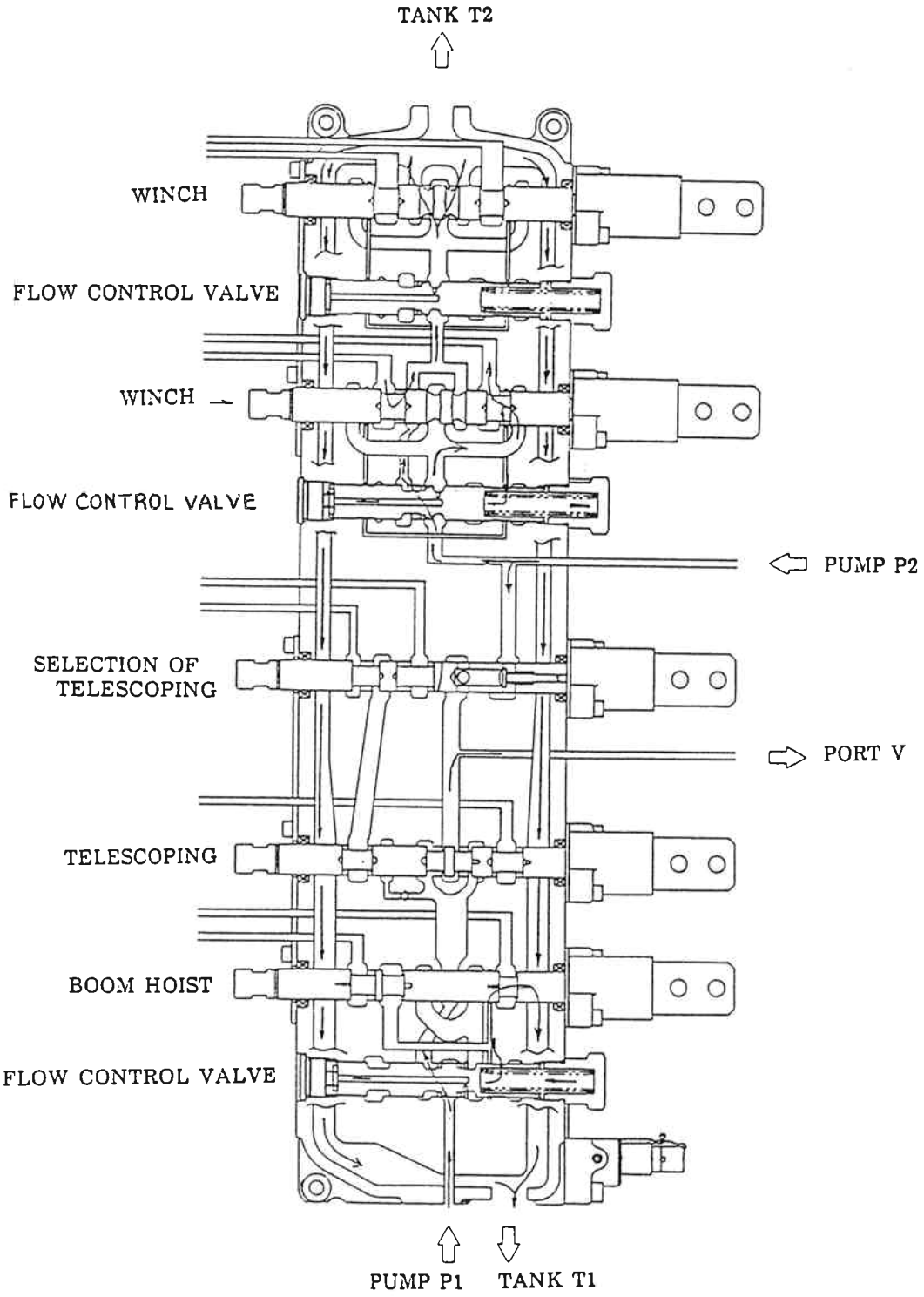


Fig. 2-5. When Winch Spool is Pushed in [Stroke : 3mm (1/8") to 8mm (5/16")]

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When the winch spool stroke is 8 to 11mm (5/16 to 7/16 in.) and when the boom hoisting and telescoping are not used, increase of winch speed is smoothly operated. (Fig. 2-6)

Since the bypass passage is closed, the oil from pump P2 port passes the notch section (restriction) of the spool to flow to the motor.

When the boom hoisting and telescoping are not used, the oil from pump P1 port bleeds off the unloading valve (provided separately) from port V, passes the load check valve, and joins pump P2 side.

When the joined oil passes the notch (restriction) of the spool, pressure difference is generated between the pump side pressure and the motor side pressure, so the flow control valve operates to allow the oil to join smoothly.

The function of the flow control valve is the same as paragraph 2.2.

When the spool is pushed in (spool stroke is 11 to 12mm (7/16 to 15/32 in.)), the bypass passage is closed by the unloading valve, so all of the oil from pump P2 passes the spool, and flows to the lowering side of the motor.

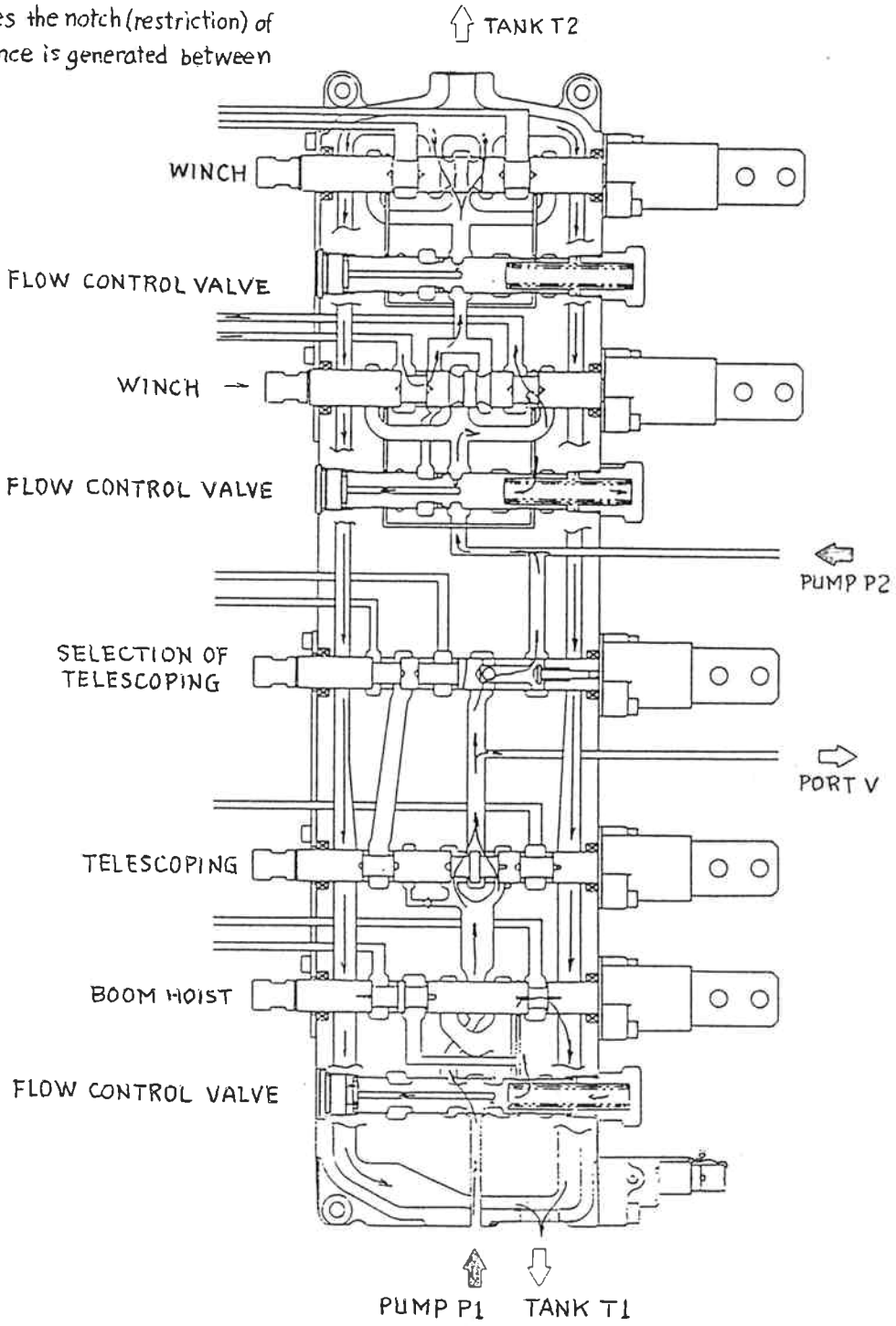


Fig. 2-6. When Winch Spool is Pushed in (Stroke : 8mm (5/16") to 11mm (7/16"))

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At this time, the restrictor of the spool is fully opened. Therefore, the pressure difference between the pump pressure of the flow control valve chamber A and the motor loading pressure of the flow control valve chamber B becomes small, the spool is pushed to the left side by the flow control valve spring to stop leakage to the tank, and all of the oil flows to the motor. When the boom hoisting and telescoping are not used, the unloading valve of port V (provided separately) is closed, so all of the oil from pump P1 port passes the load check valve, and flows to the raising side of the motor to increase speed (Fig. 2-7).

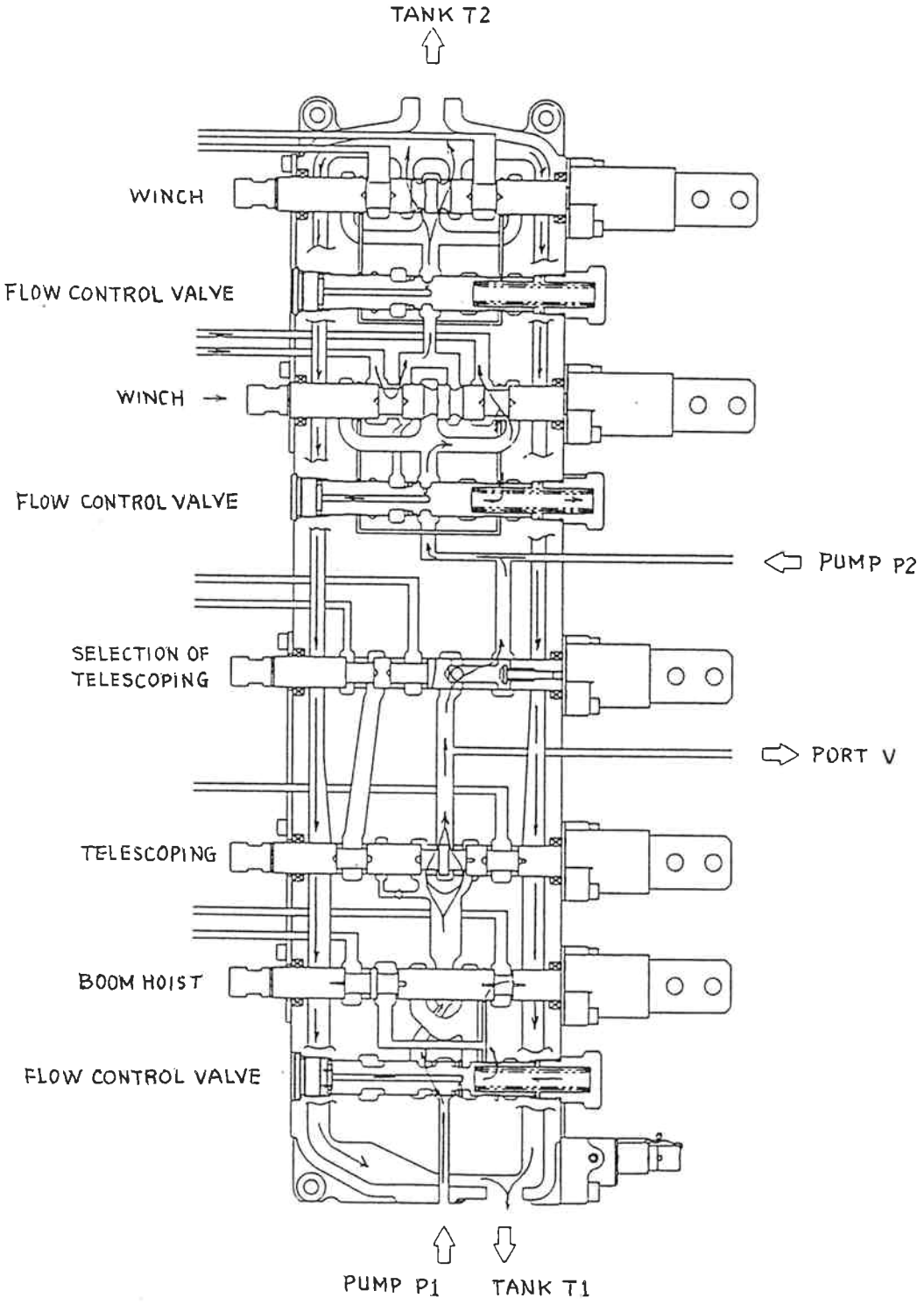


Fig. 2-7. When Winch Spool is Pushed in
(Stroke : 12mm(15/32"))

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Since the bypass passage is closed, the oil from pump P2 flows to the motor through the spool, and the oil delivered from the motor flows to the tank through the spool.
At this time, the restrictor of the spool is fully opened, so the difference between the pump pressure of the flow control valve chamber A and the motor loading pressure of the flow control valve chamber B becomes small, the spool is pushed to the left side by the flow control valve spring to stop leakage to the tank, and all of the oil flows to the motor (Fig. 2-8).

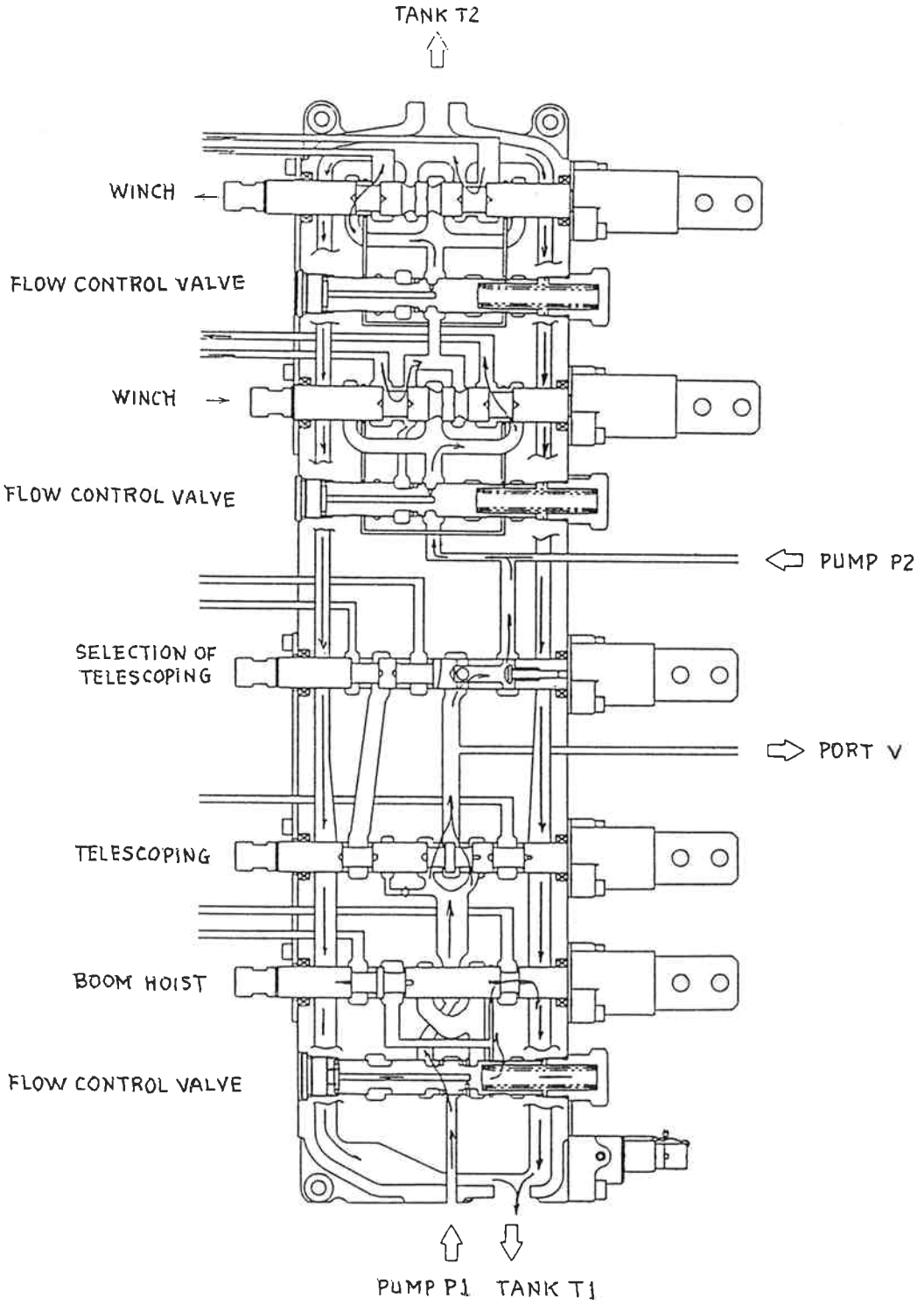


Fig. 2-8. When Combined Operations are Conducted

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2.2 FUNCTION OF FLOW CONTROL VALVE (When Boom Hoist in Neutral)

(1) Function of Flow Control Valve for Boom Hoist.

When the spool is in the neutral position, the pump passage and cylinder passage are closed, and the cylinder and flow control valve chamber B are connected to the tank. Therefore, pressure difference is generated between the pump pressure of flow control valve chamber A and the cylinder pressure of chamber B, the flow control valve moves to chamber B side (right side), the oil supplied from pump P1 is released to the tank through the bypass passage with no load.

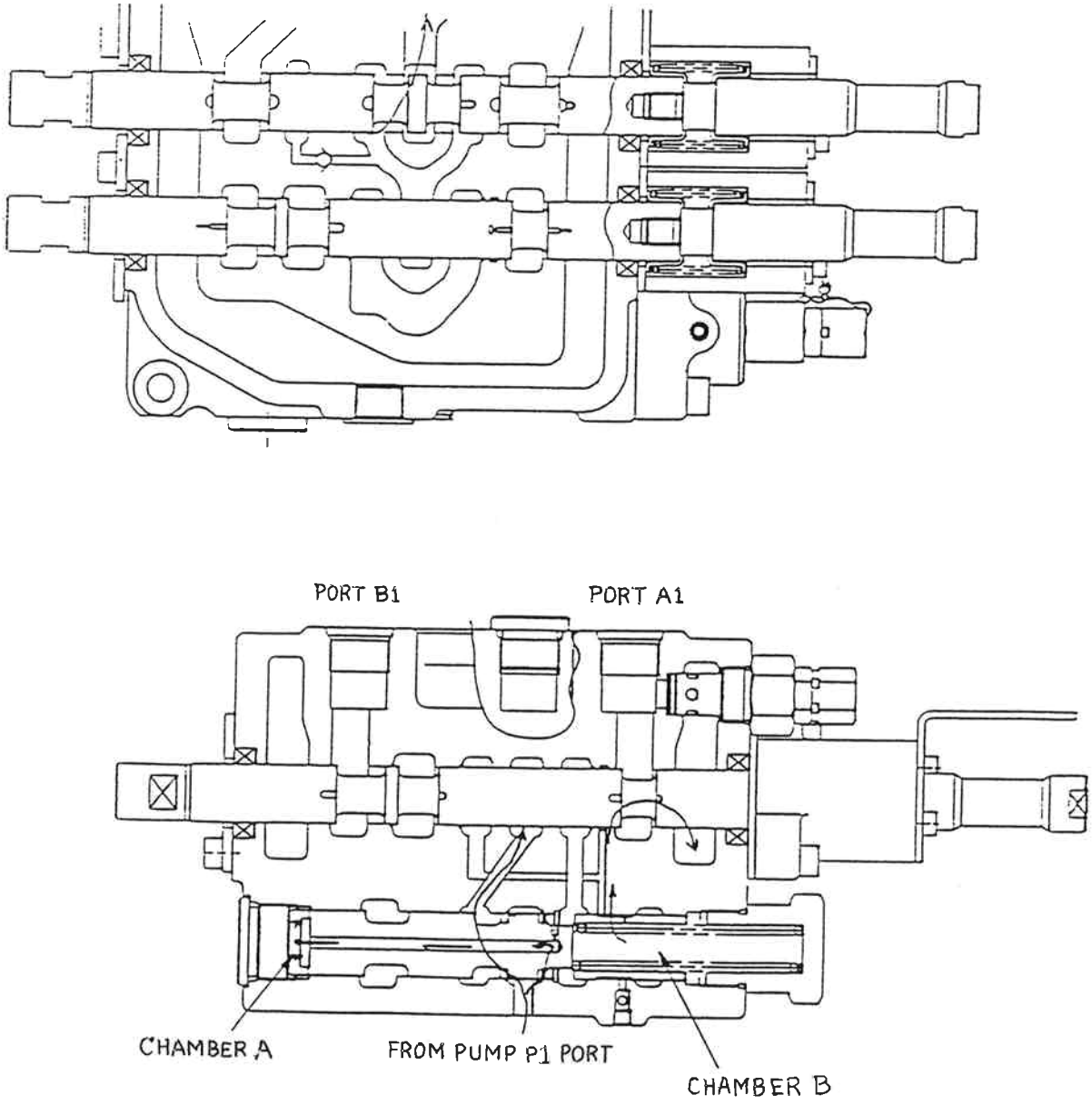


Fig. 2-9 Function of Flow Control Valve (in Neutral)

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(2) Function of Flow Control Valve (for Boom Hoist)

When operating, the flow control valve functions so that the oil from pump P1 passes the restriction of the spool, provided so that the opening area varies in proportion to the stroke of the spool, and that the pressure difference, generated between the pressure in the pump side and the pressure in the cylinder side, is constant.

When the pressure difference is generated by this restriction of the spool, a pressure difference is generated between the pump pressure in chamber A of the flow control valve and the cylinder loading pressure in chamber B, the flow control valve moves to chamber B side (right side), and the necessary amount of the oil supplied from pump P1 is supplied to the boom hoist cylinder, and the rest is supplied to the telescoping cylinder. Besides, the pump circuit pressure is kept with the cylinder load and spring pressure of the flow control valve.

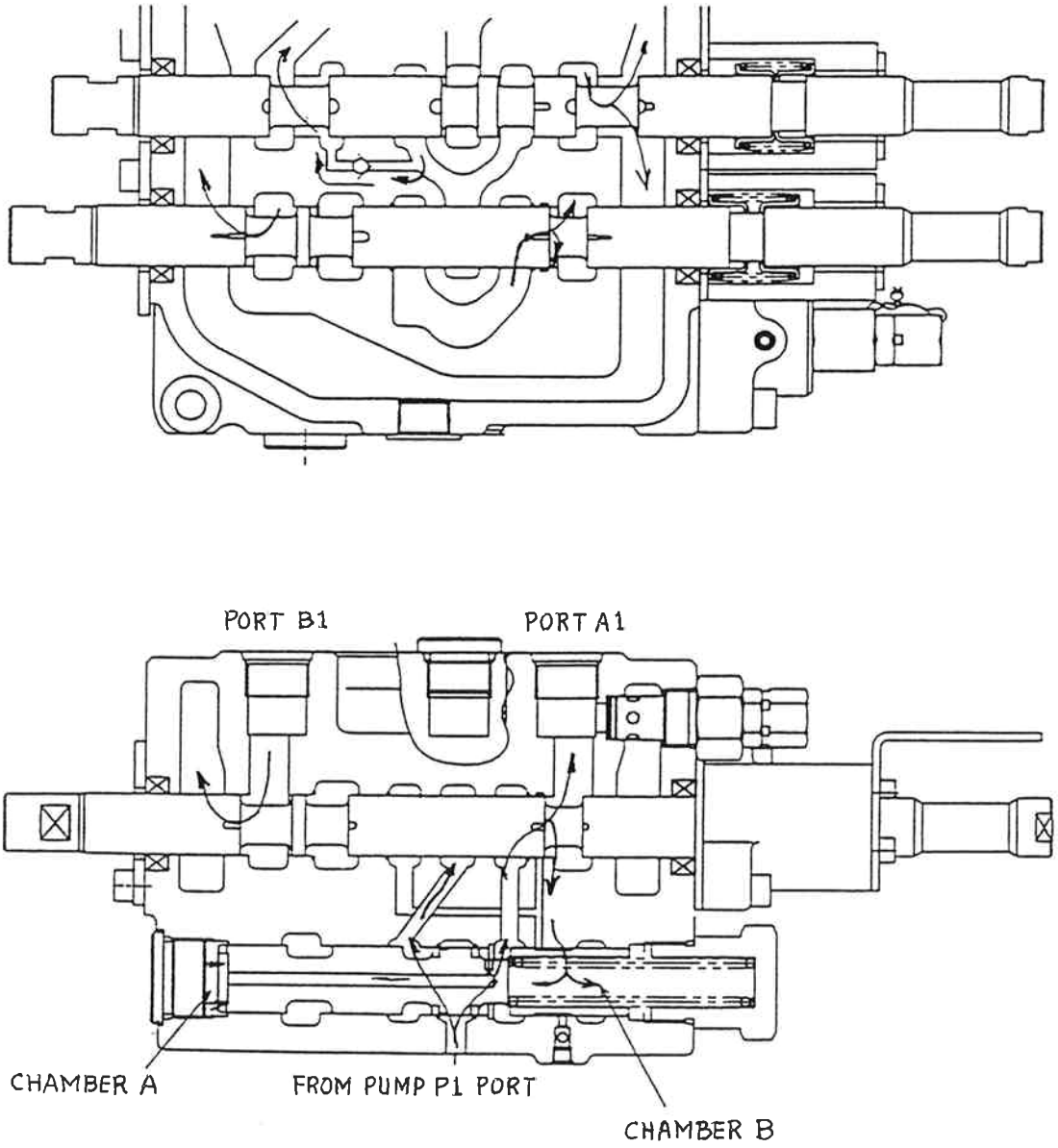


Fig. 2-10. Function of Flow Control Valve (Simultaneous Operation of Boom Hoist and Telescoping (Combined Operation))

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(3) Function of Flow Control Valve For Winch:

When the oil from pump P2 passes the restriction of the spool, provided so that the opening area varies in proportion to the stroke of the spool, in operation of paragraph 2.1-(4), the flow control valve functions so that the pressure difference, generated between the pressure in the pump and the pressure in the motor side, is constant.

When the pressure difference is generated by this restriction of the spool, a pressure difference is generated between the pump pressure in chamber A of the flow control valve and the motor loading pressure in chamber B, the flow control valve moves to chamber B (right side), and the necessary amount of the oil supplied from pump P2 is supplied to the motor and the rest is returned to the tank. Besides, the pump circuit pressure is kept with the motor load and spring pressure of the flow control valve.

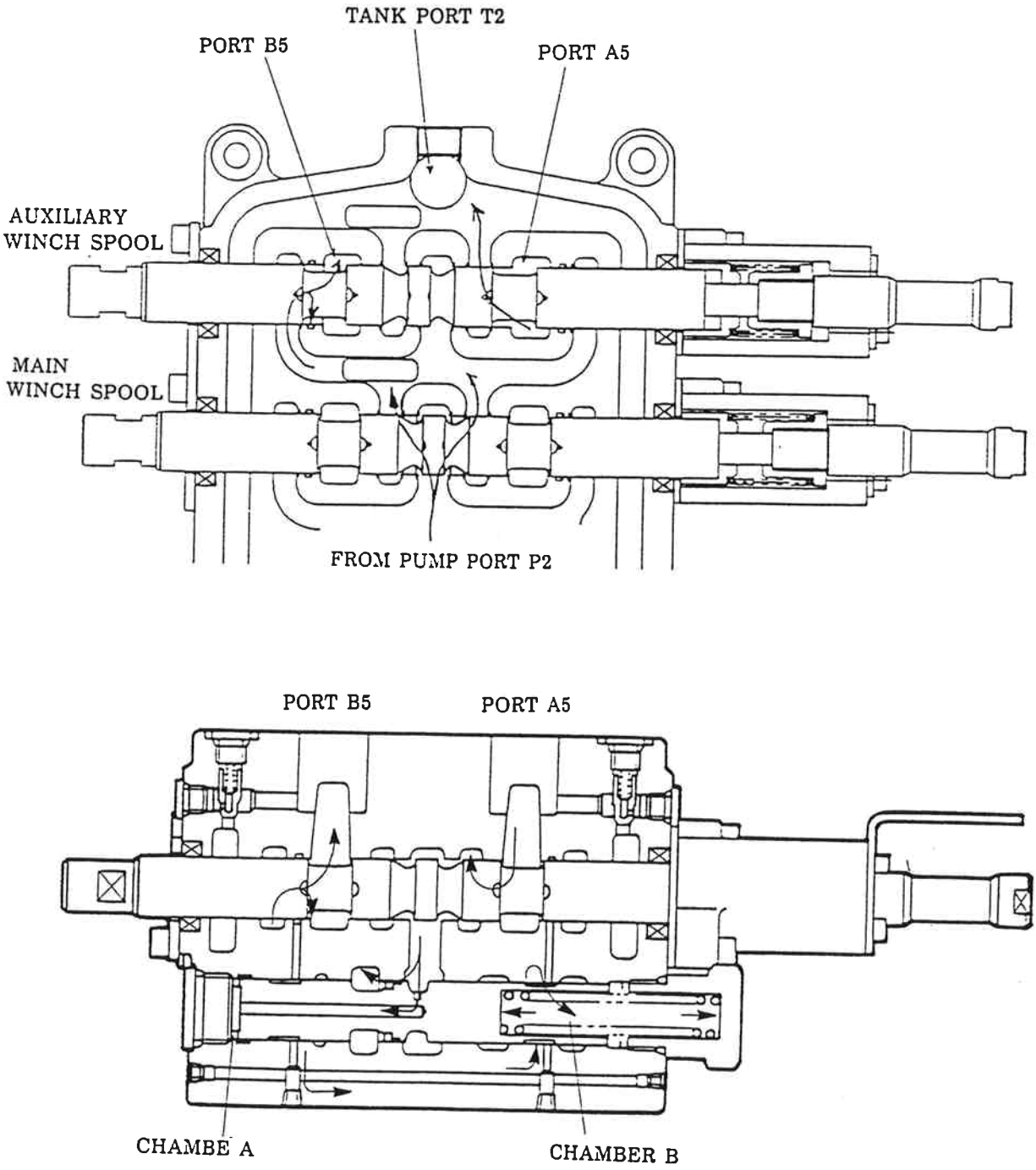


Fig. 2-11. Function of Flow Control Valve [When winch spool is pulled out by 3mm (1/8") to 8mm (5/16")]

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2.3 FUNCTION OF LOAD CHECK VALVE

The load check valve functions to prevent the actuators from unexpected operations such as a reverse operation due to reverse flow of the pressurized oil from the actuator side on the way to shift the control valve.

The control valve spool is designed so that all of the pump circuit, actuator circuit and tank circuit are connected each other on the way of shifting.

Although this is for the purpose of shifting lightly and smoothly and of making slight moving adjustment easy, if the all circuits are connected each other, the circuit pressure lowers to the tank circuit pressure. (This is called underlap.)

Fig. 2-12 shows the condition on the way to shift the spool toward the direction of extending the cylinder as an actuator.

In this condition, the passage from the pump port is opened to both of the tank port and the load check valve. However, the pressure generated in the bottom side of the cylinder loads on the back of the load check valve, so the most of the oil from the pump flows to the tank circuit as it is. And the pressure in the bottom side of the cylinder is kept by the load check valve.

When the spool is more pushed in, the pump circuit is completely intercepted from the tank circuit, and the oil from the pump pushes to open the load check valve , enters the bottom side of the cylinder, and extend the cylinder.

At this time, the oil in the rod side enters from B, and flows to the tank circuit.

If the load check valve is not provided in the condition shown in Fig. 2-12, the oil in the cylinder bottom side passes the section corresponding to the load check valve as shown with the dotted line, once goes out to the pump circuit, then flows to the tank circuit. So the cylinder is restracted with the load. Therefore, when the operator operates the spool to extend the cylinder, a phenomenon that the cylinder is retracted will occur.

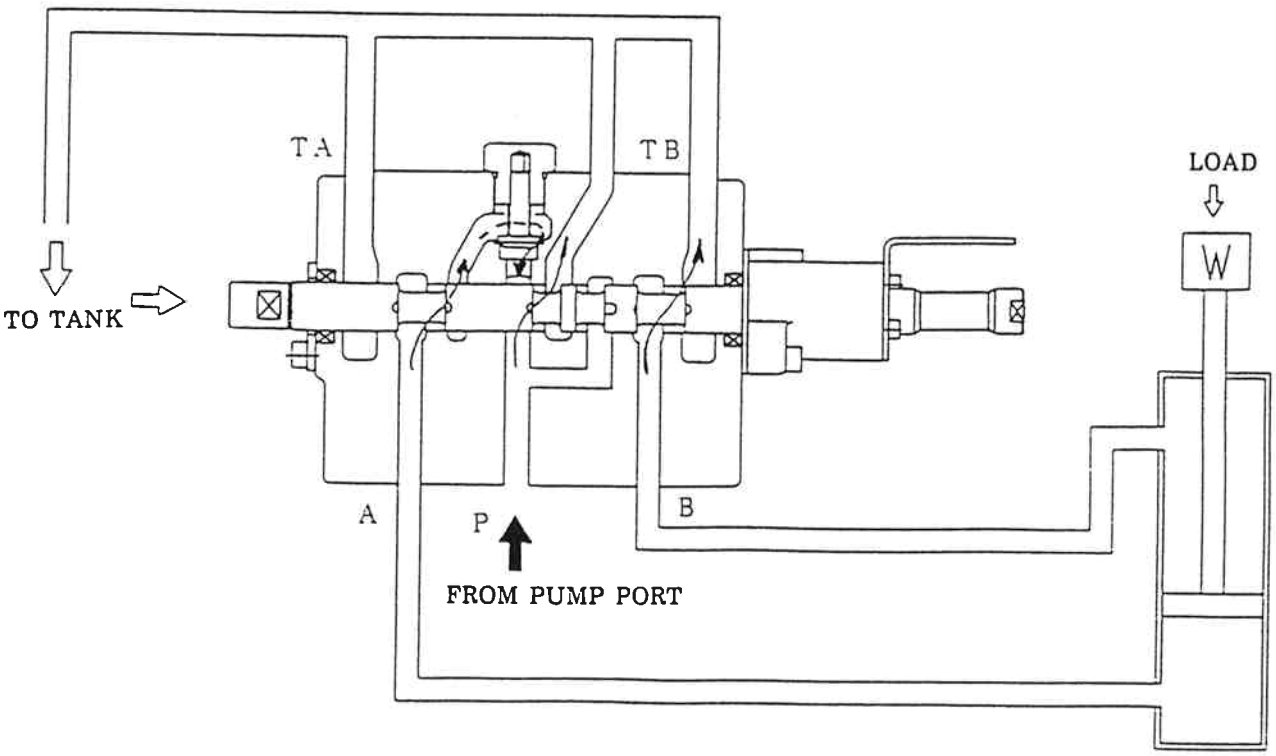


Fig. 2-12. Function of Load Check Valve

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2.4 FUNCTIONS OF RELIEF VALVE AND OVERLOAD RELIEF VALVE

The construction is of balance piston type and cartridge style.

(1) Condition when the Relief Valve does not Function (Fig. 2-13).

When the circuit pressure is enough low against the set value, the circuit of the relief valve to tank (T) is closed.

In the figure, the hydraulic pressure of pump port (P) fills spring chamber (E) of pressure regulator valve (A) through the orifice of the regulator valve, and further reaches the seat of adjusting valve (C).

But, the flow to tank (T) is prevented by the force of spring (D) of adjusting valve (C) which presses the adjusting valve against the seat.

Besides, pressure regulator valve (A) is pressed against the seat by regulator valve spring (B) and oil pressure in chamber E, so the oil does not flow to the tank from here.

Therefore, the oil sent to the circuit is entirely sent to the actuator.

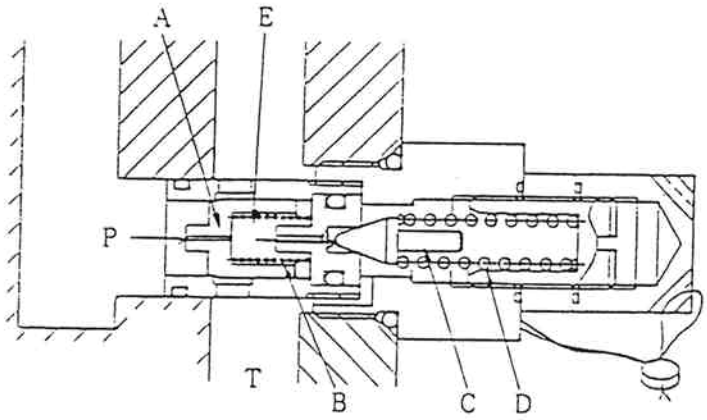


Fig. 2-13. Condition when Relief Valve does not function. (Balanced Condition)

(2) Condition when the Relief Valve Functions (Fig. 2-14).

When the circuit pressure is raised by the load of the actuator to reach the set value, the relief valve functions to prevent the circuit pressure from rising abnormally.

When the circuit pressure reaches the set value by adjusting valve spring (D), the oil enters the regulator valve spring chamber through the orifice of regulator valve (A), the force of the pressurized oil which reaches adjusting valve (C) overcomes the force, which presses adjusting valve spring (D) to the seat, to push to open adjusting valve (C), then the pressurized oil in spring chamber (E) of pressure regulator valve flows to the tank. Then, a pressure difference is generated between the both ends of the orifice, regulator valve (A) which has been pressed to the seat by regulator valve spring (B) and the oil pressure in chamber (E) also is pushed to open, and the pressurized oil in the circuit flows to the tank, so the circuit pressure is kept at the set pressure.

Therefore, while the circuit pressure is more than the set value of pressure, this function is continued.

The relief valve functions at the stroke end of the cylinder and for overload, and protects the components and equipments composing the hydrauilc system from being damaged or broken due to an abnormal high pressure by keeping the circuit pressure at the specified pressure.

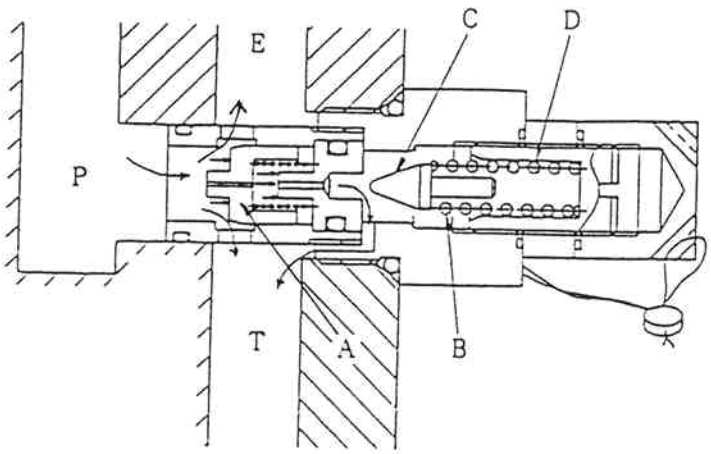


Fig. 2-14. Function of Relief Valve

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3. SPECIFICATION

3.1 SPECIFICATIONS OF EQUIPMENTS

(1) RK250-3

Set pressure of relief valve [Effective (difference) pressure]	P1 : 250^{+5}_{0} kgf/cm² (3555^{+71}_{0} psi) at 70 ℓ (2.47 cu.ft)/min. Pressure loss when relief valve is released to atmosphere : 5 kgf/cm² (71 psi) at 150 ℓ (5.30 cu.ft)/min or less.	
Maximum flow	Winch (P1+P2) : 146+146 ℓ (5.16+5.16 cu.ft)/min Boom (P1) : 146 ℓ (5.16 cu.ft)/min.	
Normal flow	Winch (P1+P2) : 138+138 ℓ (4.87+4.87 cu.ft)/min. Boom (P1) : 138 ℓ (4.87 cu.ft)/min.	
	Boom hoist and telescoping	Winch
Return spring force (boom) Operating force Extra force for return	13 kgf (28.7 lbs) (at stroke). 22 kgf (48.5 lbs) or less. 3 kgf (5.6 lbs) or more.	16.6 kgf (36.6 lbs) (at stroke). 26 kgf (57.3 lbs) or less. 6 kgf (13.2 lbs) or more.
Force required for releasing detent (Selection of telescoping)	13 ± 3 kgf (28.7 ± 6.6 lbs) or less.	
Set pressure of overload relief valve [Effective (difference) pressure]	A2 : 210 ± 5 kgf/cm² (2986 ± 71 psi) at 85 ℓ (3.00 cu.ft)/min. B2 : 160 ± 5 kgf/cm² (2275 ± 71 psi) at 120 ℓ (4.24 cu.ft)/min. A1 : 120 ± 5 kgf/cm² (1706 ± 71 psi) at 100 ℓ (3.53 cu.ft)/min.	
Anti-cavitation valve Cracking pressure Pressure loss	0.5 kg/cm² (7.1 psi) Pressure difference 1 kgf/cm² (14.2 psi) at approx. 3 ℓ (0.1 cu.ft)/min.	
Spool leakage [at 100 kgf/cm² (1422 psi), 37 cst]	Main and auxi. winches : 500 cc (30.5 cu.in)/min or less Ports A3 and B3 : 100 cc (6.1 cu.in)/min or less. Port B1 : 1 ℓ (61 cu.in)/min or less.	
Permissible back pressure of tank	10 kgf/cm² (142 psi) or less.	
Oil to be used	Mineral hydraulic oil VG46	
Working temperature range	−20 to +90°C (−4 to 194°F)	
Weight	83 kgf (183 lbs)	

(2) RK350

Set pressure of relief valve [Effective (difference) pressure]	P1 : 240^{+5}_{0} kgf/cm² (3413^{+71}_{0} psi) at 70 ℓ (2.47 cu.ft)/min. Pressure loss when relief valve is released to atmosphere : 5 kgf/cm² (71 psi) at 150 ℓ (5.30 cu.ft)/min or less.
Maximum flow	Winch (P1+P2) : 146+146 ℓ (5.16+5.16 cu.ft)/min. Boom (P1) : 146 ℓ (5.16 cu.ft)/min.
Normal flow	Winch (P1+P2) : 138+138 ℓ (4.87+4.87 cu.ft)/min. Boom (P1) : 138 ℓ (4.87 cu.ft)/min.

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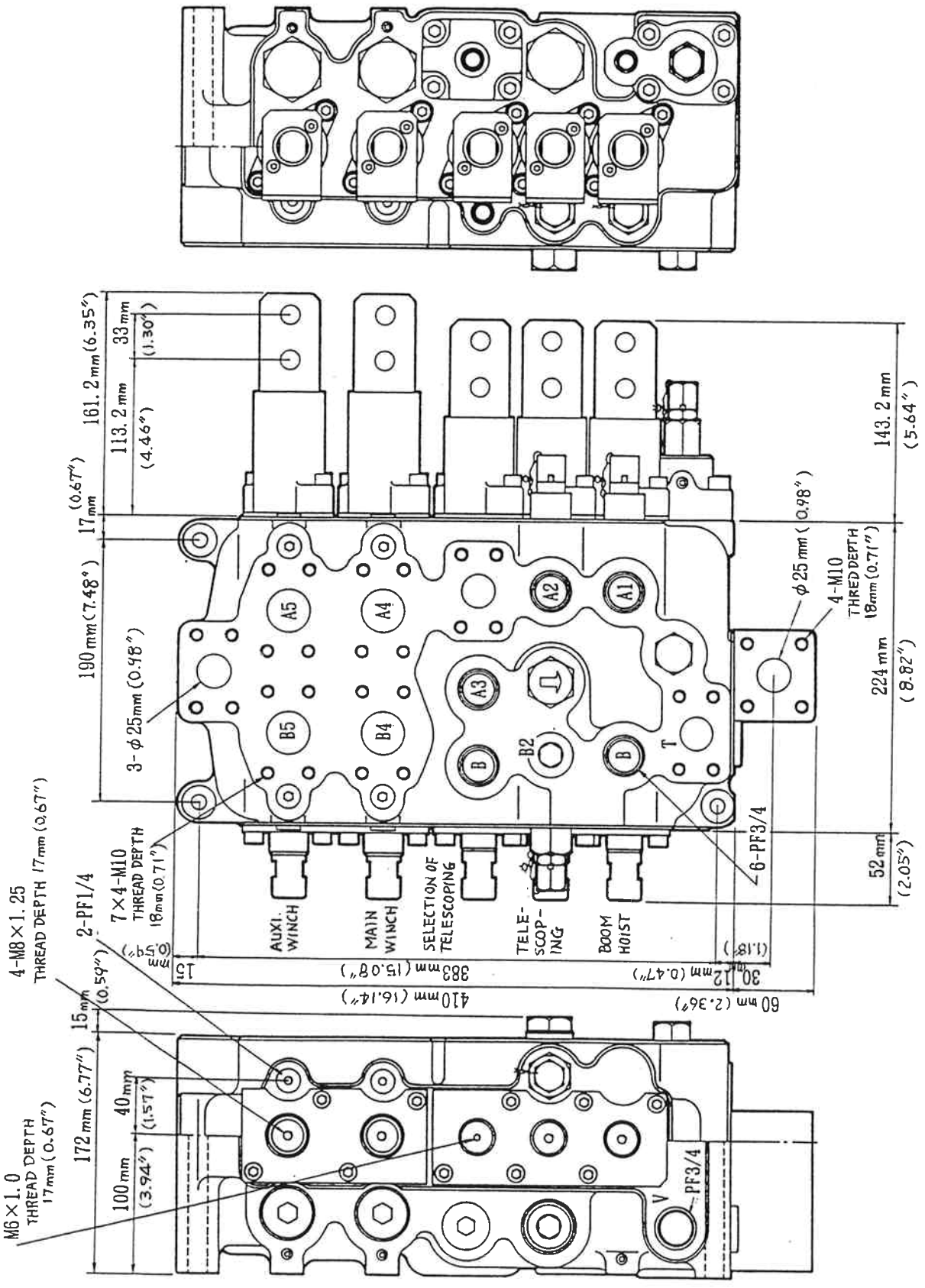
	Boom hoist and telescoping	Winch
Return spring force (boom) Operating force Extra force for return	13 kgf (28.7 lbs) (at stroke). 22 kgf (48.5 lbs) or less. 3 kgf (6.6 lbs) or more.	16.6 kgf (36.6 lbs) (at stroke) 26 kgf (57.3 lbs) or less. 6 kgf (13.2 lbs) or more.
Force required for releasing detent (Selection of telescoping)	13 ± 3 kgf (28.7 ± 6.6 lbs) or less.	
Set pressure of overload relief valve [Effective (difference) pressure]	A2 : 215 ±5 kgf/cm² (3057 ±71 psi) at 85ℓ (3.00 cu.ft)/min. B2 : 165 ±5 kgf/cm² (2346 ±71 psi) at 120ℓ (4.24 cu.ft)/min. A1 : 140 ±5 kgf/cm² (1991 ±71 psi) at 70ℓ (2.47 cu.ft)/min.	
Anti-cavitation valve Cracking pressure Pressure loss	0.5 kgf/cm² (7.1 psi) Pressure difference 1 kgf/cm² (14.2 psi) at approx. 3ℓ (0.1 cu.ft).	
Spool leakage [at 100 kgf/cm² (1422 psi), 37 cst]	Main and auxi. winches : 500 cc (30.5 cu.in)/min or less. Ports A3, B1 and B3 : 100 cc (6.1 cu.in)/min or less.	
Permissible back pressure of tank	10 kgf/cm² (142 psi) or less.	
Oil to be used	Mineral hydraulic oil VG46	
Working temperature range	-20 to +90°C (-4 to 194°F)	
Weight	83 kgf (183 lbs)	

(3) RK450-2

Set pressure of relief valve [Effective (difference) pressure]	P1 : 280 $^{+5}_{0}$ kgf/cm² (3982 $^{+71}_{0}$ psi) at 170ℓ (6.00 cu.ft)/min. Pressure loss when relief valve is released to atmosphere.: 5 kgf/cm² (71 psi) at 150ℓ (5.30 cu.ft)/min or less.	
Maximum flow	Winch (P1+P2) : 174 + 174 ℓ (6.14 + 6.14 cu.ft)/min. Boom (P1) : 174ℓ (6.14 cu.ft)/min.	
Normal flow	Winch (P1+P2) : 165+165 ℓ (5.83+5.83 cu.ft)/min. Boom (P1) : 165ℓ (5.83 cu.ft)/min.	
	Boom hoist and telescoping	Winch
Return spring force (boom) Operating force Extra force for return	13 kgf (28.7 lbs) (at stroke). 22 kgf (48.5 lbs) or less. 3 kgf (6.6 lbs) or more.	16.6 kgf (36.6 lbs) (at stroke). 26 kgf (57.3 lbs) or less. 6 kgf (13.2 lbs) or more.
Force required for releasing detent (Selection of telescoping)	13. ± 3 kgf (28.7 ± 6.6 lbs) or less.	
Set pressure of overload relief valve [Effective (difference) pressure]	A2 : 210 ±5 kgf/cm² (2986 ±71 psi) at 170ℓ (6.00 cu.ft)/min. B2 : 160 ±5 kgf/cm² (2275 ±71 psi) at 170ℓ (6.00 cu.ft)/min. A1 : 140 ±5 kgf/cm² (1991 ±71 psi) at 170ℓ (6.00 cu.ft)/min.	
Anti-cavitation valve Cracking pressure Pressure loss	0.5 kgf/cm² (7.1 psi) Pressure difference 1 kgf/cm² (14.2 psi) at approx. 3ℓ (0.1 cu.ft)/min.	
Spool leakage [at 100 kgf/cm² (1422 psi), 37 cst]	Main and auxi. winches : 500 cc (30.5 cu.in)/min or less. Ports A3, B1 and B3 : 100 cc (6.1 cu.in)/min or less.	
Permissible back pressure of tank	10 kgf/cm² (142 psi) or less.	
Oil to be used	Mineral hydraulic oil VG46.	
Working temperature range	-20 to +90°C (-4 to 194°F)	
Weight	83 kgf (183 lbs)	

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3.2 DIMENSION



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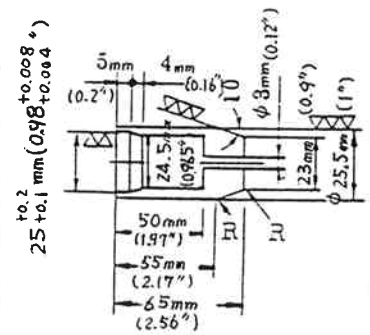
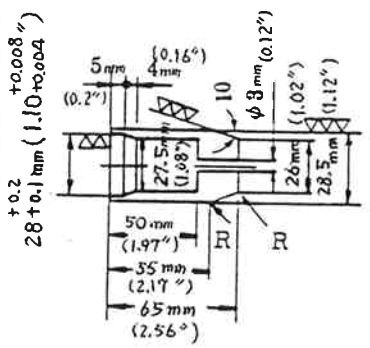
4. DISASSEMBLY AND ASSEMBLY

It is a rule that the disassembly and assembly be proceeded in the manufacturer's factory, but if required, it is recommended that they be proceeded in a factory which has sufficient technique for hydrauilc system.

Since hydraulic equipments including this valve are very precisely manufactured and tolerances of working parts are very close, prepare clean cleaning solvent, oil, grease, various tools and wastes, etc., and disassemble and assemble in spotlessly clean surroundings, paying particular attention to handling.

Even if parts do not move smoothly, never tap them.

4.1 TOOLS TO BE USED (EXCULDING GENERAL TOOLS)

	Name	Dimension	Quantity	Remarks
	Hexagon socket screw keys	3.96mm(5/32"), 8mm(5/16") 5mm(13/64"), 10mm(25/64") 6mm(15/64"), 14mm(35/64")	1 each	
	Spanners	19mm(3/4"), 21mm(53/64") 26mm(1-1/32"), 27mm(1-1/16") 30mm(1-3/16"), 41mm(1-5/8")	1 each	
	Screwdriver	10mm(25/64")×250mm(9-13/16") or less	1	For adjusting relief valve
	Pins		1 each	For disassembly and assembly of spool rod ends
Special tools	Tool for oil seal (for inside dia. of 25mm (0.98 in)		1	For inserting oil seal (for boom hoist and telescoping)
Special tools	Tool for oil seal (for inside dia. of 28mm (1.1 in)		1	For inserting oil seal (for winch)

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4.2 DISASSEMBLY

To disassemble the main control valve, proceed as follows referring to Fig. 1-2:

(1) Relief Valve (Fig. 4-1)

1) Place the control valve, with the face of the cylinder port facing down, on the workbench.
2) Remove four hexagon socket head bolts (44). Since relief valve assembly (42) is fitted in, draw out to remove the valve.
3) When the relief valve is faulty, replace it as assembly with new one. When reusing it, clean the inside, and replace the O-rings with new ones.

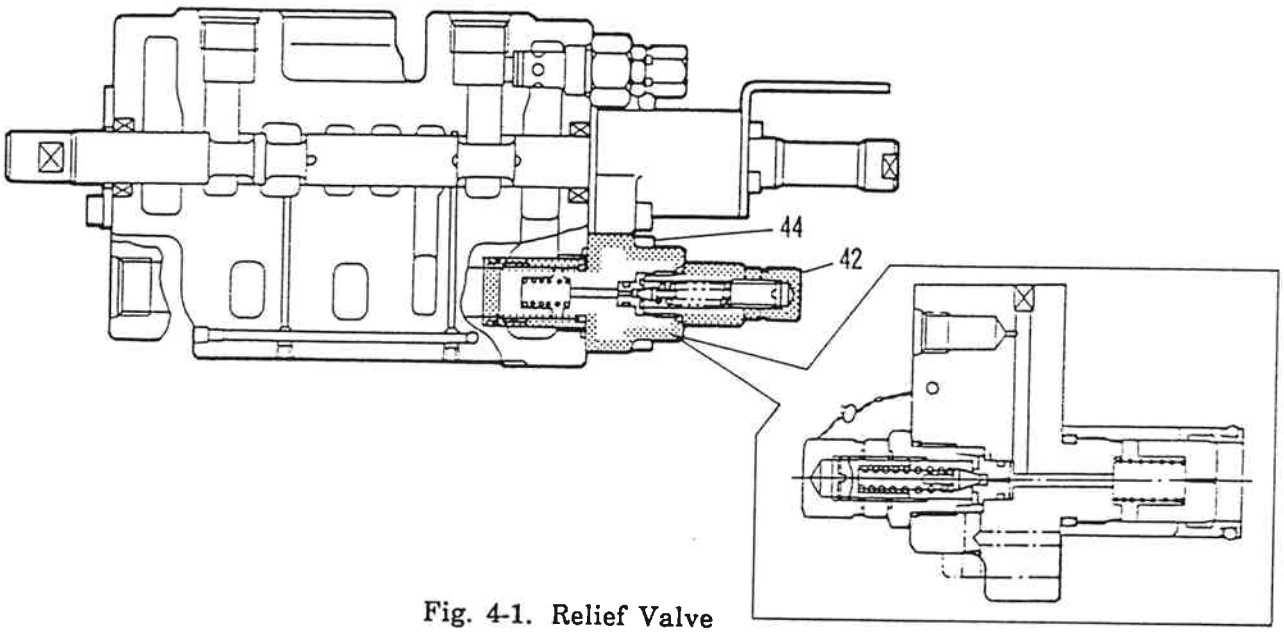


Fig. 4-1. Relief Valve

(2) Overload Relief Valve (Figs. 4-1 and 4-2)

1) Place the control valve, with the face of cylinder ports facing up, on the workbench.
2) Since overload relief valve (62) is screwed in, loosen to remove it.
3) When the overload relief valve is faulty, replace it as assembly with a new one. When reusing it, clean the inside, and replace the O-rings with new ones.

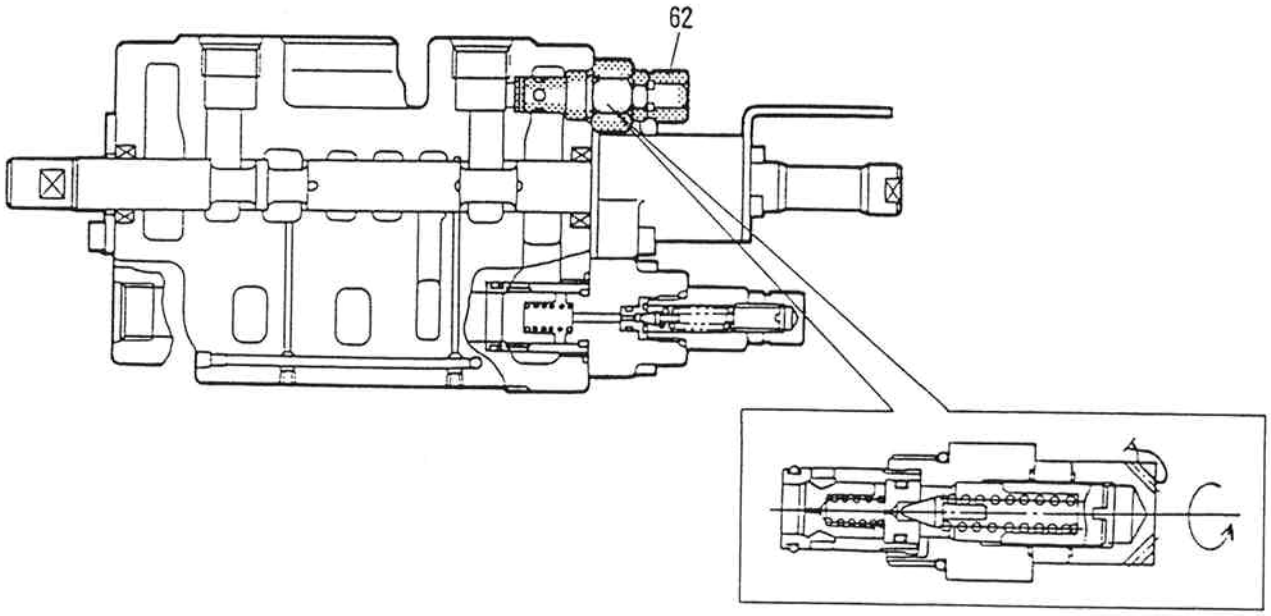


Fig. 4-2. Overload Relief Valve

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(3) Check Valve for Suction (Fig. 4-3)

Remove plug (50), and take out spring (48) and check valve (47).

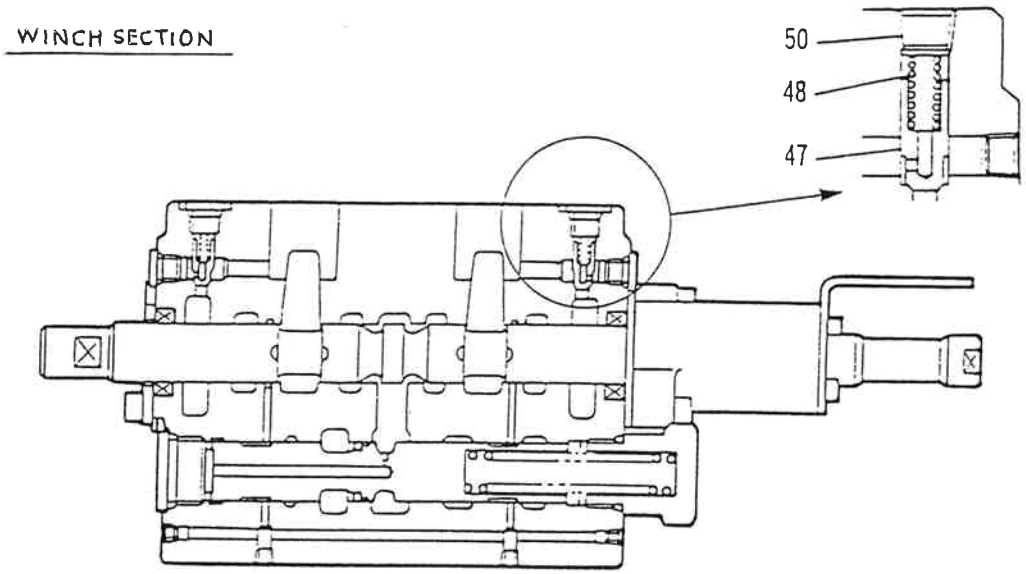


Fig. 4-3. Removal of Check Valve for Suction

(4) Spool Section (Fig. 4-4)

1. Telelscoping Selecting Spool

1) Removing hexagon socket head bolts (31), remove spring cover (30).

2) Securing spool section (6) with a spanner, remove notch end (22). By this, ball retainer (25), balls (27), detent spring (26) and ball case (24) can be removed.

Next, draw out spool (6), check valve (20), spring (21), oil seal (10) and oil seal retainer (12).

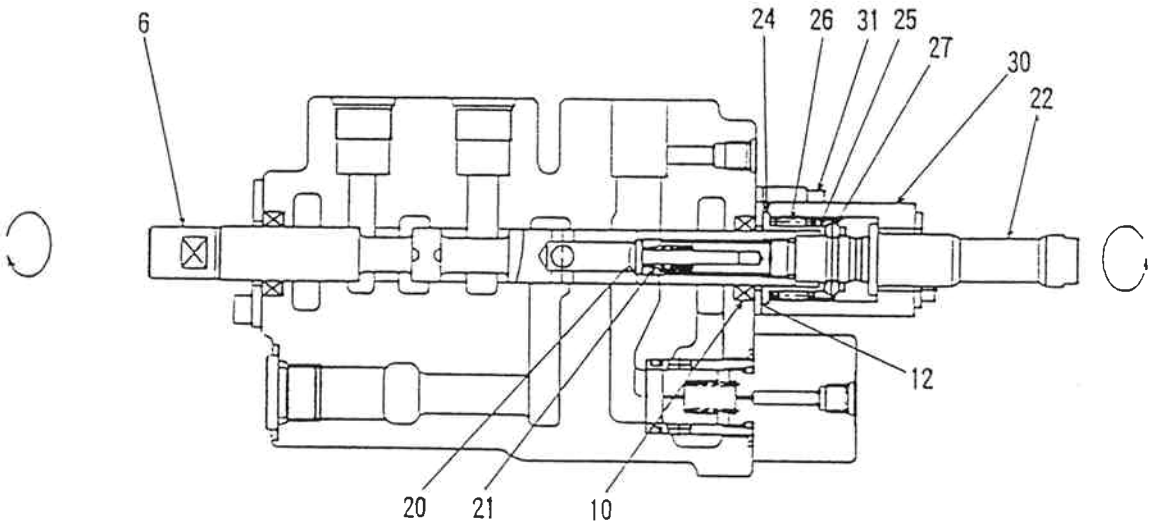


Fig. 4-4. Procedure of Disassembly of Spool End

- Since the clearance between the spool and the body is specified, be sure to mark match marks to reassemble them in the same position where they were.
- Replace O-rings and oil seals with new ones.

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2. Spool for Boom Hoist and Telescoping

1) Remove hexagon socket head bolts (31), and remove spring cover (29).

2) Secure the handle side of the spool with a spanner, and remove spool end (18). By this, spring support (13), spring (16) and oil seal retainer (12) can be removed. Draw out spools (4 and 5) together with oil seal (10). Oil seal (10) in the handle side can be taken out by removing hexagon socket head bolts (36) and by removing oil seal retainer (34).

(1) Flow Control Valve Section

Removing support (39), remove flow control spring (38) and O-ring (40). Then, remove plug (41), and push flow control valve (8) out.

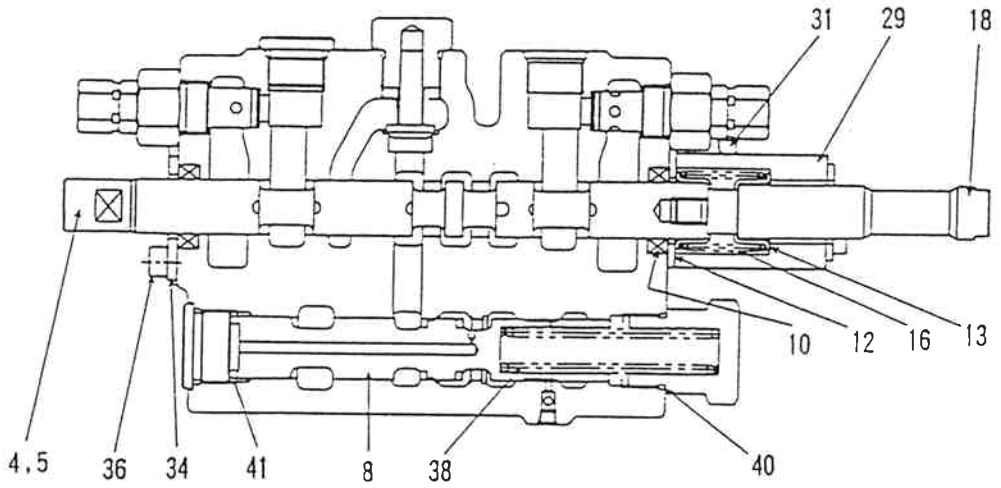


Fig. 4-5. Disassembly of Boom Hoist and Telescoping Spool and Flow Control Valve.

3. Spool for Winch

1) Remove hexagon socket head bolts (31), and remove spring cover (28).

2) Secure the handle side spool end of the spool with a spanner, and remove spool end (19). By this, spring supports (14 and 15) and spring oil seal retainer (12) can be removed. Draw out spool (7) together with oil seal (11). Oil seal (11) in the handle side can be taken out by removing hexagon socket head bolts (36) and by removing oil seal retainer (35)

(1) Flow Control Valve Section

Removing support (39), remove flow control spring (37) and O-ring (40). Then, remove plug (41), and push flow control valve (9) out.

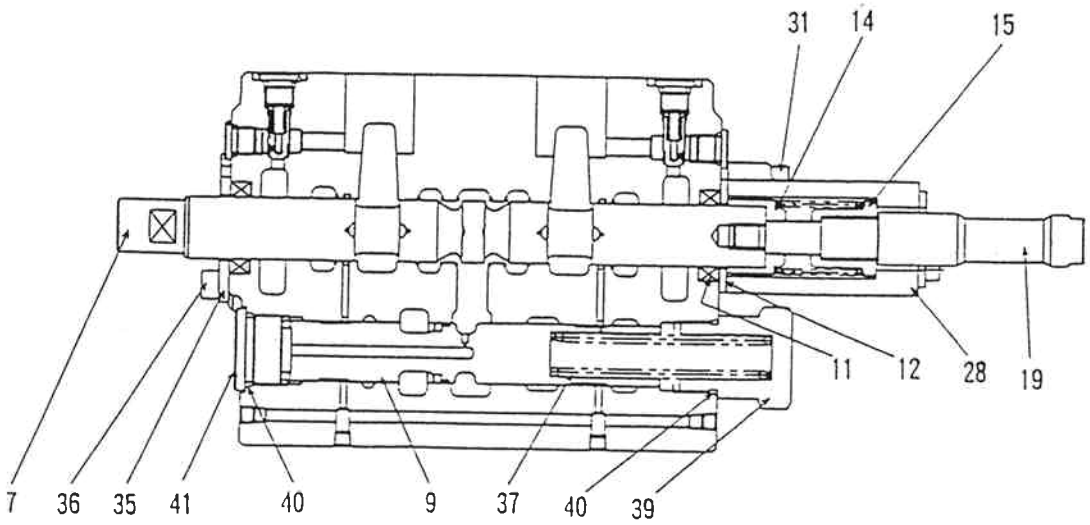


Fig. 4-6. Disassembly of Winch Spool and Flow Control Valve

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4.3 ASSEMBLY

Assembly shall be proceeded in the reverse procedures of disassembly. Referring to Fig. 1-2, and paying attention to the following items, proceed assembly.

(1) Flow Control Valve (Figs. 1-2 and 4-7)

Insert flow control valves (8 and 9) into the body.

Insert O-ring (40) coated with grease into plug (41), and install the plug to the body.

Install O-ring (40) coated with grease to support (39). After flow control springs (38 and 37) have been inserted, install the support to the body with a torque of 9 to 11 kg-m (65.1 to 79.6 ft-lbs).

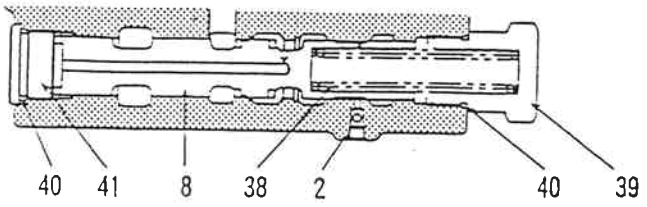


Fig. 4-7 Flow Control Valve

(2) Spool Sections

Insert the original spools respectively in the valve body

1. Winch spool (Figs. 1-2 and 4-8)

1) Insert spool (7) into the valve body.

2) Secure the spool end of the spool with a spanner, attach the tool for oil seal insertion (4.1) to the spool from the opposite side. Then insert oil seal (11), and install oil install oil seal retainer (12).

3) Install spring supports (14 and 15) and spring (17) to spool end (19), and screw spool end (19) into the spool.

Install the return spring cover with hexagon socket head bolts (31).

4) For the handle side, after attach the tool for inserting oil seal to the spool, insert oil seal (11), and install oil seal retainer (35) with hexagon socket head bolts (36).

Tightening torque:

Item no. 19. 5 to 6 kg-m (36.1 to 43.4 ft-lbs)

Item nos. 36 and 31. 2.9 kg-m (21 ft-lbs)

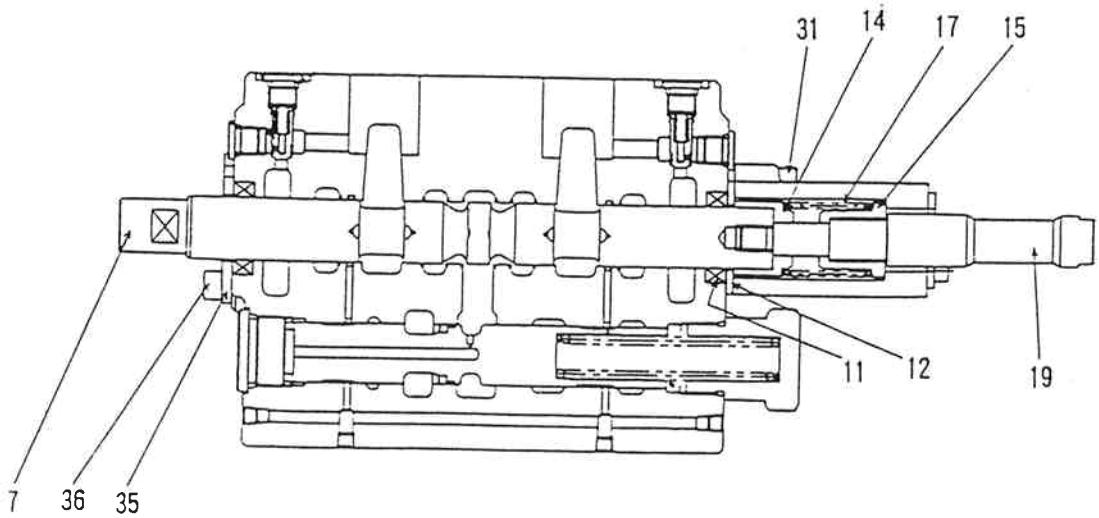


Fig. 4-8

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2. Telescoping selecting spool

1) Insert spool (6) into the valve body.

2) Secure the spool end of the spool with a spanner, attach the tool for oil seal insertion to the spool from the opposite side. Then, insert oil seal (10) and install oil seal retainer (12).

3) Install ball case (24), balls (27), ball retainer (25) and spring (26) to notch end (22).

4) Fixing the spool, insert check valve (20) and spring (21) into the spool, and install O-ring (23) coated with hydraulic oil, then screw notch end (22) into spool securely.

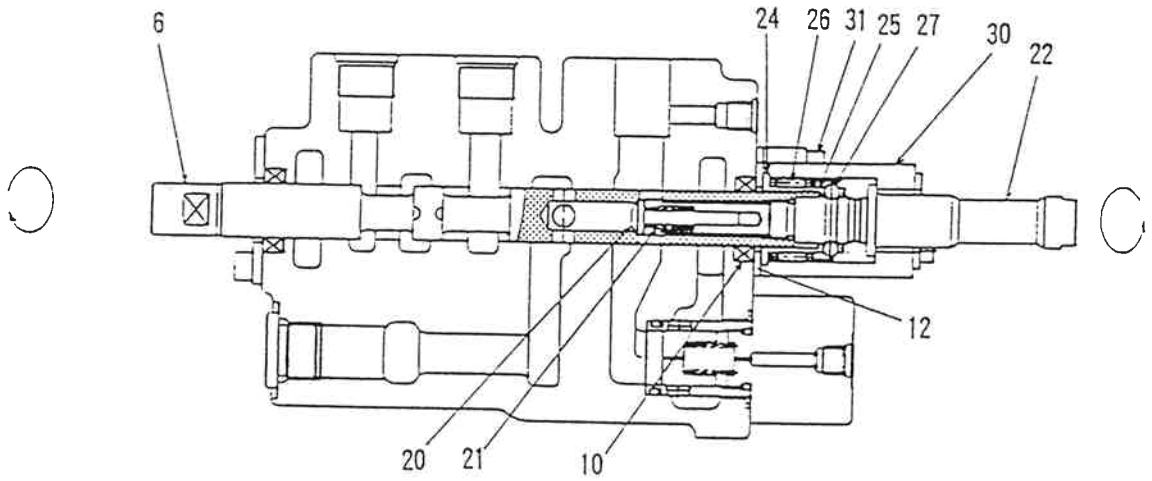


Fig. 4-9. Telescoping Selecting Spool

3. Telescoping and boom hoist spools

1) Insert spools (4 and 5) into the valve body.

2) Secure spool end (18) with a spanner, attach the tool for oil seal insertion to the spool from the opposite side, then insert oil seal (10), and assemble oil seal retainer (12).

3) Install spring support (13) and spring (16) to spool end (18), then screw spool end (18) into the spool. Install return spring cover (29) with hexagon socket head bolts (31).

4) Attach the tool for oil seal insertion to the opposite side spool, insert oil seal (10), and install oil seal retainer (34) with hexagon socket head bolts (36).

Tightening torque :

Items 22, 18. 5 to 6 kg-m (36.1 to 43.4 ft-lbs)

Items 31, 36. 2.9 kg-m (21 ft-lbs)

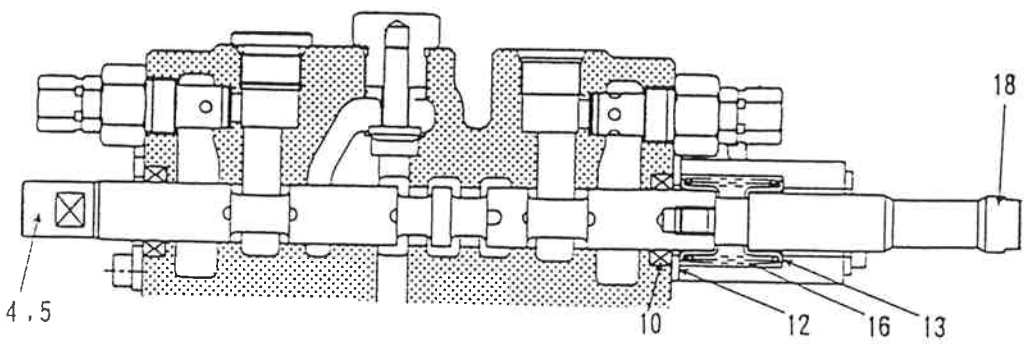


Fig. 4-10. Disassembly of Boom Hoist and Telescoping Spools

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(3) Check Valve for Suction (Fig. 4-11)

Insert check valve (47) and spring (48). Coating O-ring (49) with grease, install it to plug (50). Screw plug (50) into the body securely.

Tightening torque:

Item no. 50 3.5 to 4.5 kgf-m (25.3 to 32.5 ft-lbs)

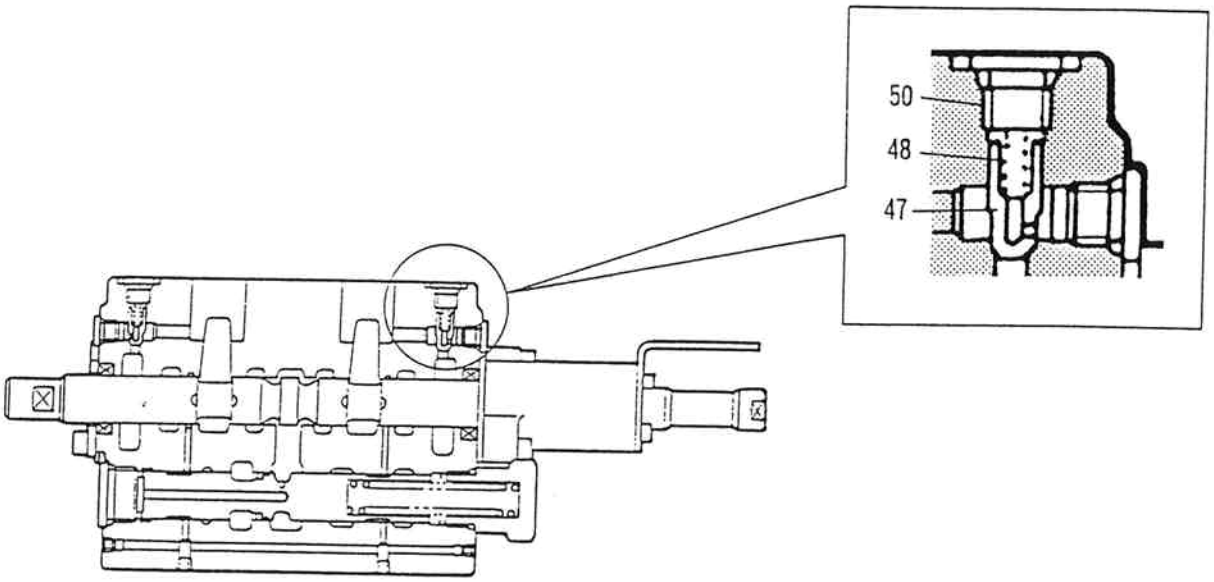


Fig. 4-11. Check Valve for Suction

(4) Relief Valve Section (Figs. 1-3 and 4-12)

Install O-ring (43) coated with grease to the relief valve assembly. Install O-ring (43) to body(1), install the relief valve assembly, and securely tighten hexagon socket head bolts (44).

Tightening torque:

Item no.44 6 kgf-m (43.4 ft-lbs)

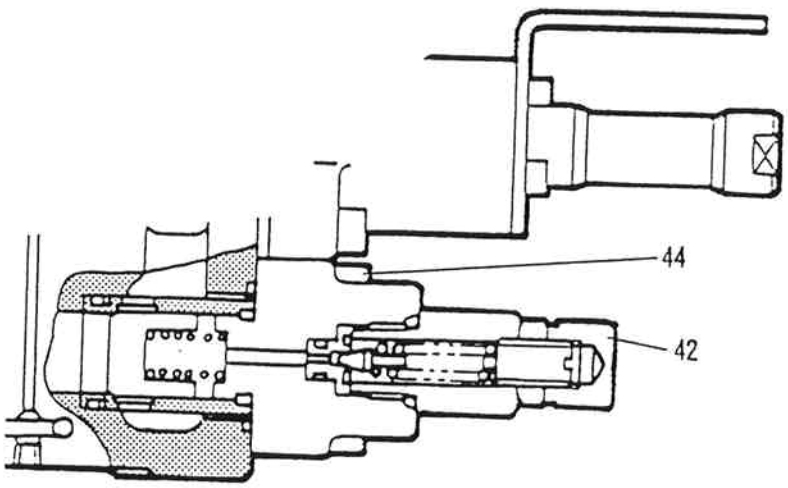


Fig. 4-12

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(5) Unloading Relief Valve

Install O-ring (43) coated with grease to the unloading relief valve. Install O-ring (43) to body (1), install the unloading relief valve, and securely tighten hexagon socket head bolts (44).

Tightening torque:

Item no. 44. 6 kgf·m (43.4 ft-lbs)

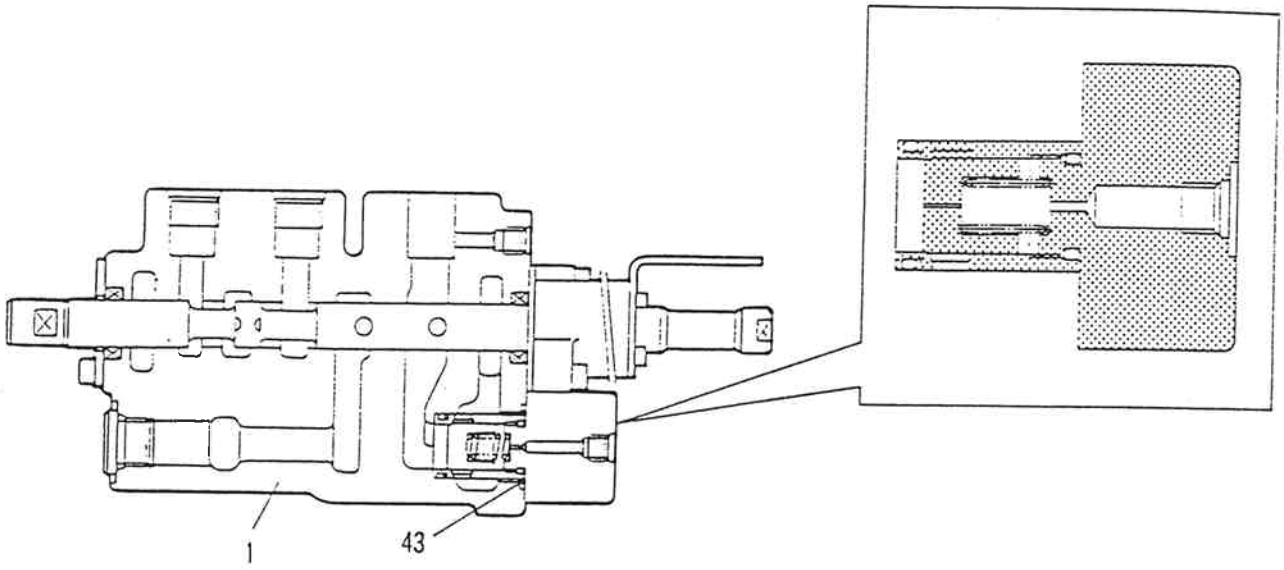


Fig. 4-13. Unloading Valve

(6) Overload Relief Valve (Fig. 1-4)

After installing O-ring (103) coated with grease to the overload relief valve, screw the valve into the body

Tightening torque:

Item nos. 62, 63 and 64. 6.5 kgf·m (47.0 ft-lbs)

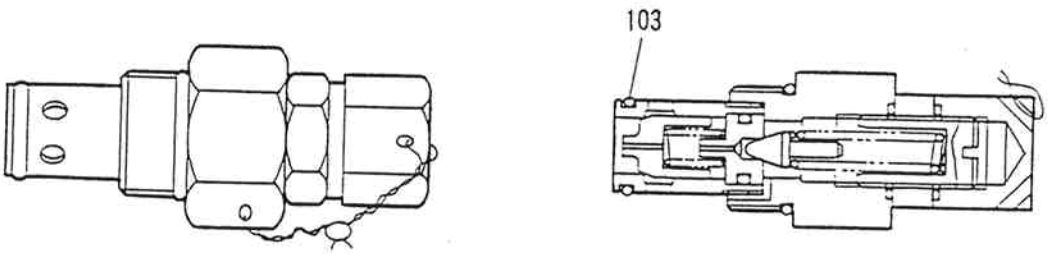


Fig. 4-14. Overload Relief Valve

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4.4 ADJUSTMENT OF PRESSURE

(1) Connect a pressure gauge to the pressure gauge port (Fig. 4-15)

(2) Shift the control valve, and read the pressure gauge when the cylinder is fully stroked.

1) When the pressure does not reach the set value (Fig. 4-16)

Remove the cap nut from the relief valve, loosen the locknut, and turn the adjusting screw clockwise with the screwdriver to raise the pressure to the set value.

NOTE

One turn of the adjusting screw varies the oil pressure approximately 110 kg/cm² (1564 psi), so be sure to confirm the pressure gauge for pressure adjustment.

2) When the pressure exceeds the set valve. Turn the adjusting screw counterclockwise to lower the pressure to the set value.

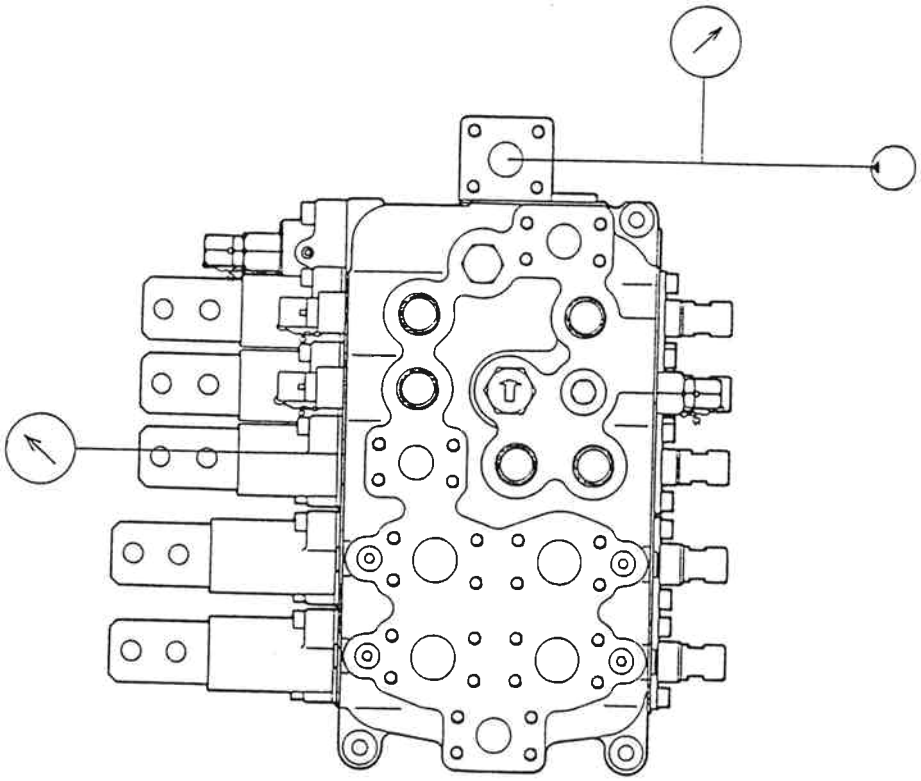


Fig. 4-15. Pressure Gauge Port

(3) When adjustment is completed, fix the adjusting screw with the screwdriver, torque the lock nut and screw the cap nut in.

Tightening torque : 2 kgf·m (14.5 ft·lbs)

NOTE

The O-ring should be replaced with a new one.

(4) Check once more, and confirm the pressure setting.

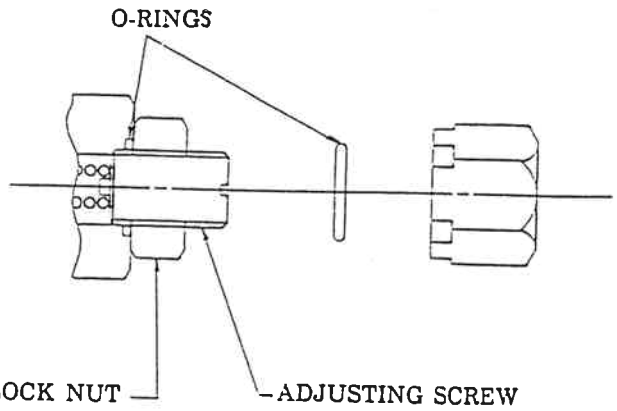
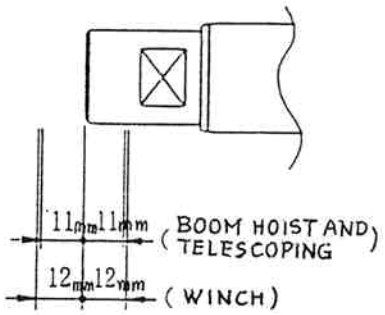


Fig. 4-16. Adjustment of Relief Valve

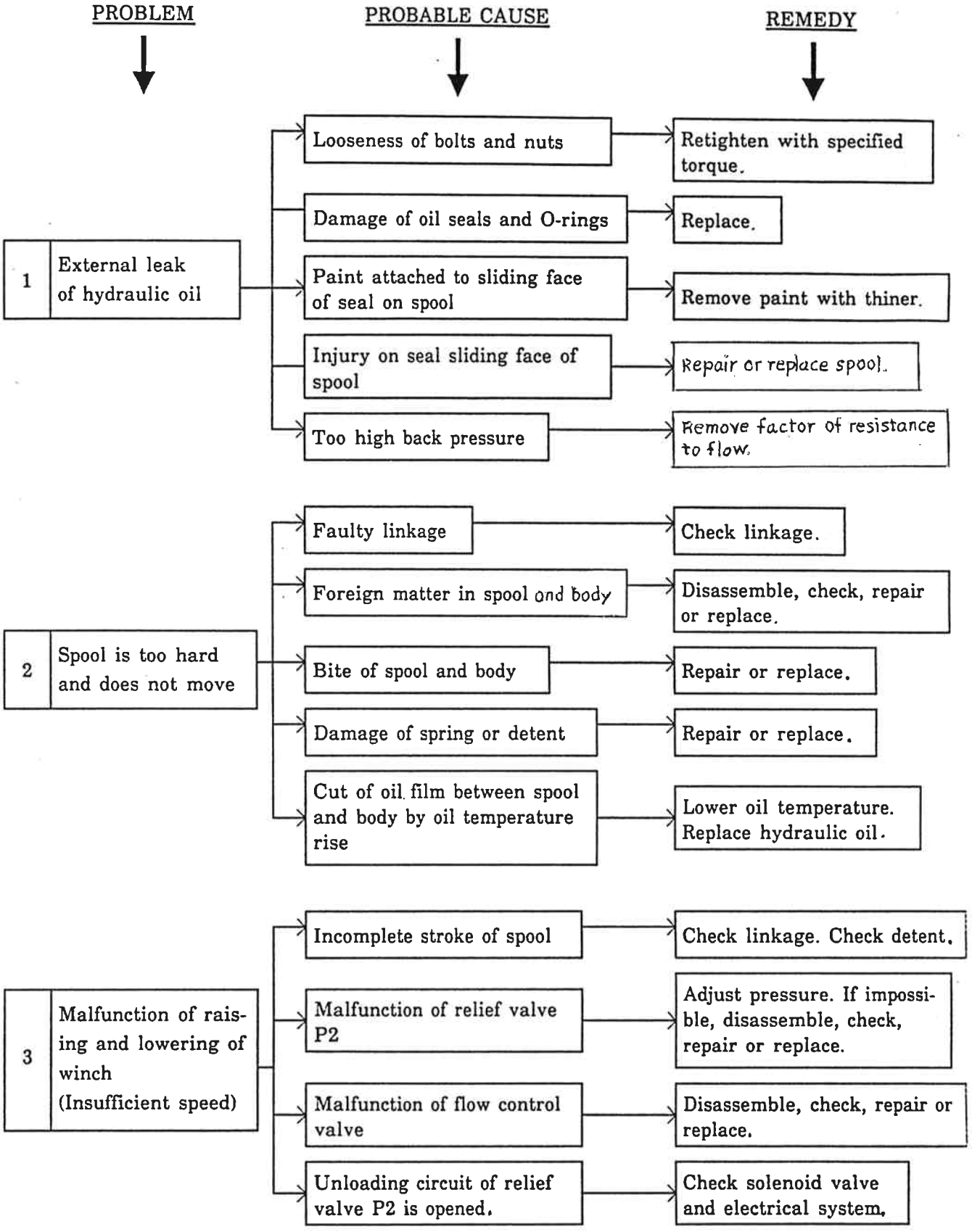
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5. TEST PROCEDURE AND MAINTENANCE STANDARD

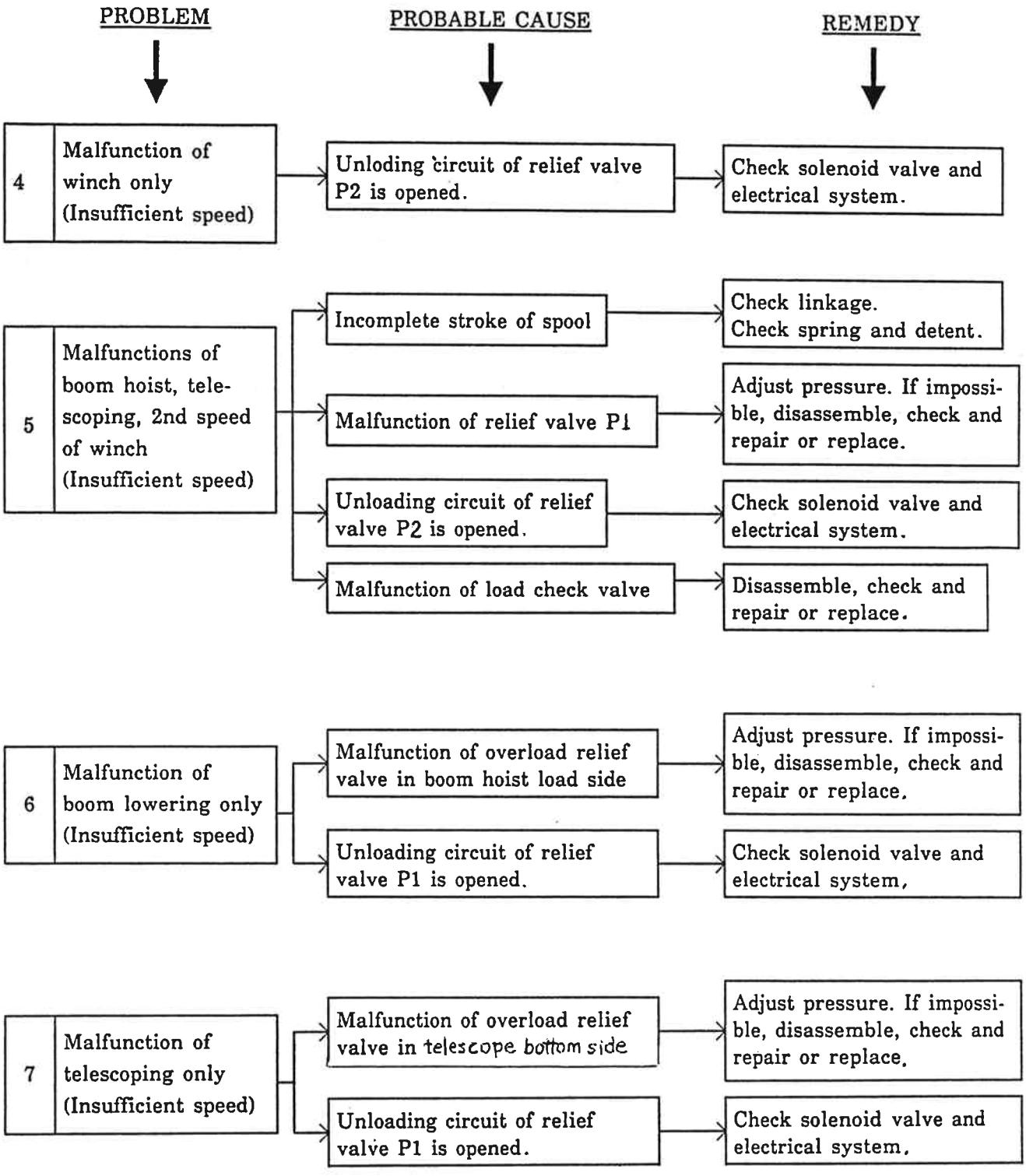
Test procedure	Maintenance standard
1. Check the spools for movement. Operate each control lever to confirm the spool for movement.	1. The spools shall smoothly move without draw.  SPOOL STROKE (11 mm = 0.433 in. 12 mm = 0.472 in.)
2. Check the flow control valve for performance. Operate the winch spool 2 to 5 mm (0.08 to 0.2 in), and change the engine speed to check winch speed.	2. The winch speed shall not vary.

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6. TROUBLESHOOTING



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1. CONSTRUCTION AND FUNCTION

By operating the steering mode selector switch, this solenoid valve functions to select 4 kinds of the steering modes.

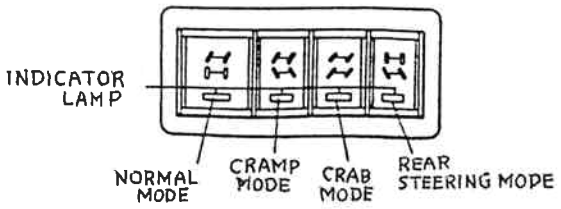


Fig. 1-1 Steering Mode Selector Switch

- KINDS OF STEERING MODES

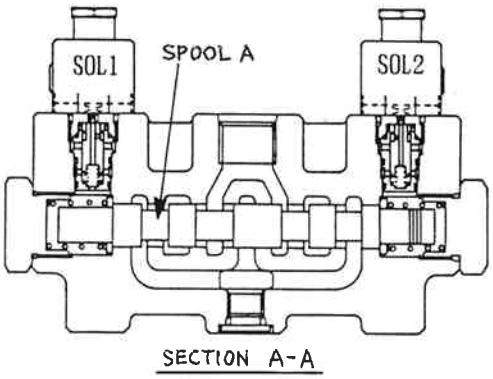
		Road	Steering Mode
Normal Traveling		Ordinary road and in working area	NORMAL MODE (Front 2 wheels)
Special Traveling	Facing front	Working area	CRAMP MODE (4 wheels)
			CRAB MODE (4 wheels)
	Facing back		REAR STEERING MODE (Rear 2 wheels)

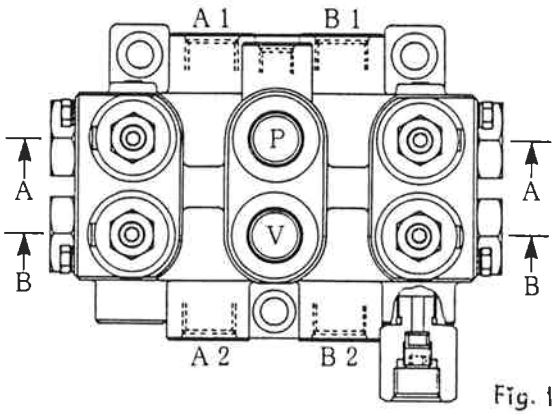
1.1 FUNCTION (FIG. 1-2 THROUGH FIG. 1-5)

(1) TRAVELING MODE WITH FRONT TWO WHEELS

All of the solenoids (1 through 4) are demagnetized, and spool A and spool B are in the neutral condition.

Therefore, port P and port B1, and port V and port A1 are in the connected condition. Port A2 and port B2 are in the closed condition by spool B.





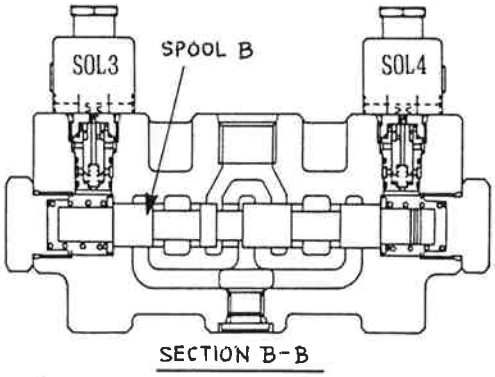


Fig. 1-2 Valve Assembly

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(2) CRAMP TRAVELING MODE

Solenoid (4) only is magnetized. When solenoid (4) is magnetized, spool B is moved to the left. Port P and port B1, port V and port B2, and port A1 and port A2 come into the connected condition.

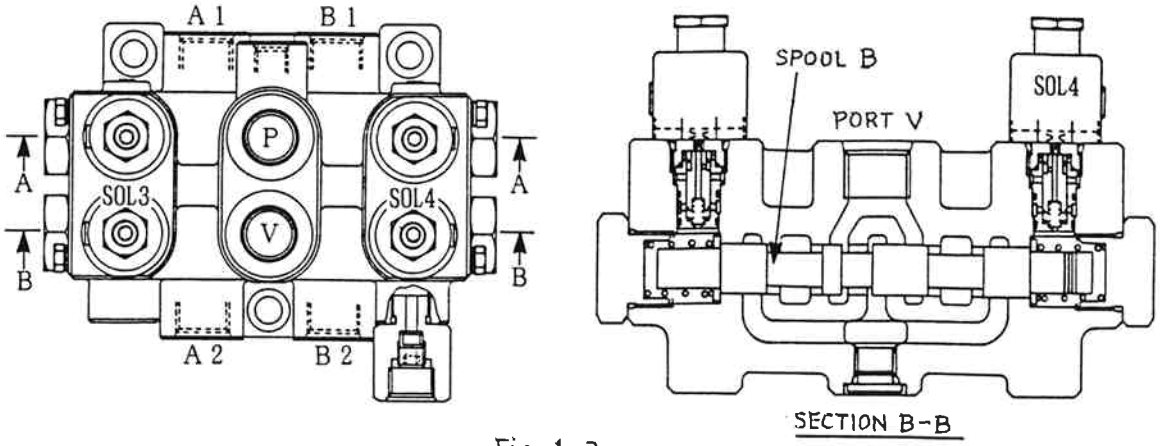


Fig. 1-3

(3) CRAB TRAVELING MODE

Solenoid (3) only is magnetized. When solenoid (3) is magnetized, spool B is moved to the right. Port P and port B1, port V and port A2, and port A1 and port B2 come into the connected condition.

(4) 2 WHEEL REVERSE STEERING TRAVELING MODE

Solenoids (1 and 4) are magnetized. When solenoids (1 and 4) are magnetized, spool A is moved to the right, and spool B is moved to the left respectively. Port P and port A2, and port V and port B2 come into the connected condition. Port A1 and port B1 are closed by spool A.

(5) CRAMP REVERSE STEERING TRAVELING MODE

Solenoids (2 and 4) are magnetized. When solenoids (2 and 4) are magnetized, spool A is moved to the left and spool B also is moved to the left respectively. Port P and port A1, port V and port B2, and port B1 and port A2 come into the connected condition.

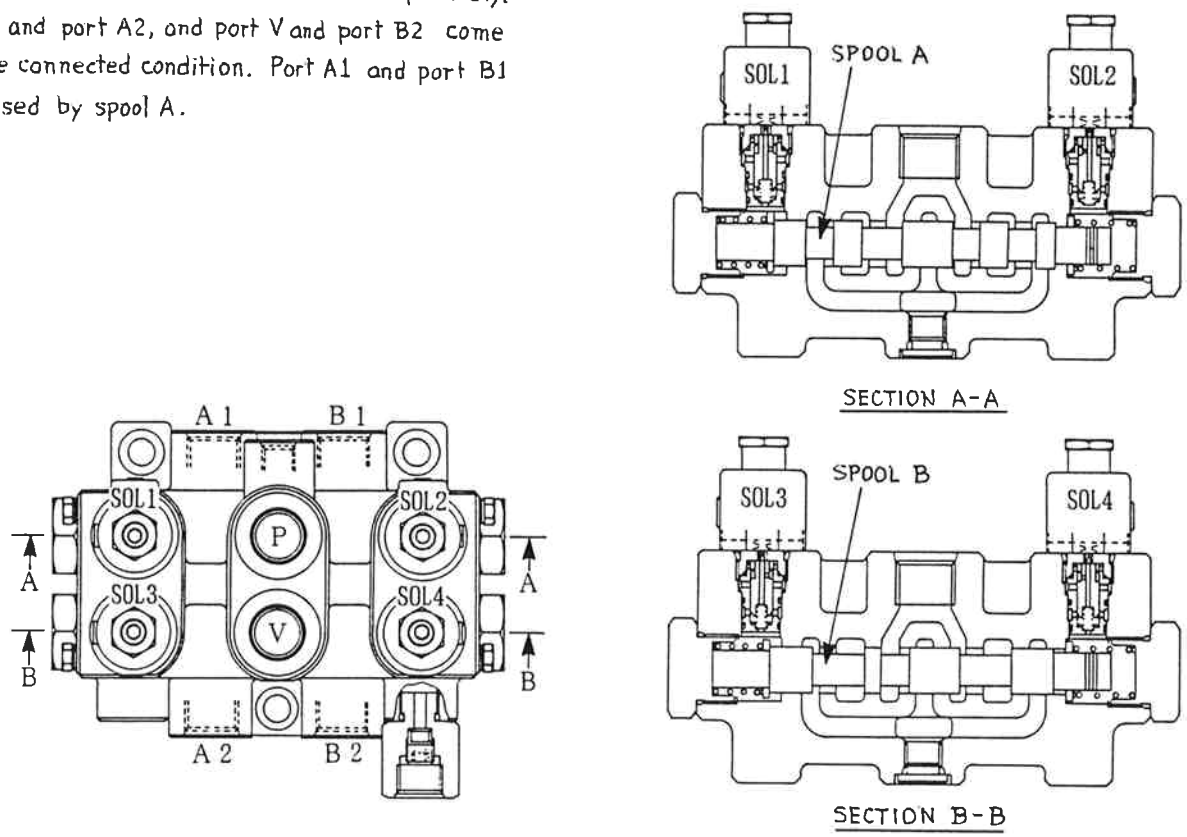


Fig. 1-4

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(6) REAR 2 WHEEL TRAVELING MODE

Solenoid (1) and solenoid (3) are magnetized. When solenoids (1 and 3) are magnetized, spool A is moved to the right, and spool B also is moved to the right. Port P and port B2, and port V and port A2 come into the connected condition. Port A1 and port B1 are closed by spool A.

(7) REAR 2 WHEEL REVERSE STEERING TRAVELING MODE

Solenoid (2) only is magnetized. When solenoid (2) is magnetized, spool A is moved to the left. port P and port A1, and port V and port B1 come into the connected condition. Port A2 and port B2 are closed by spool B.

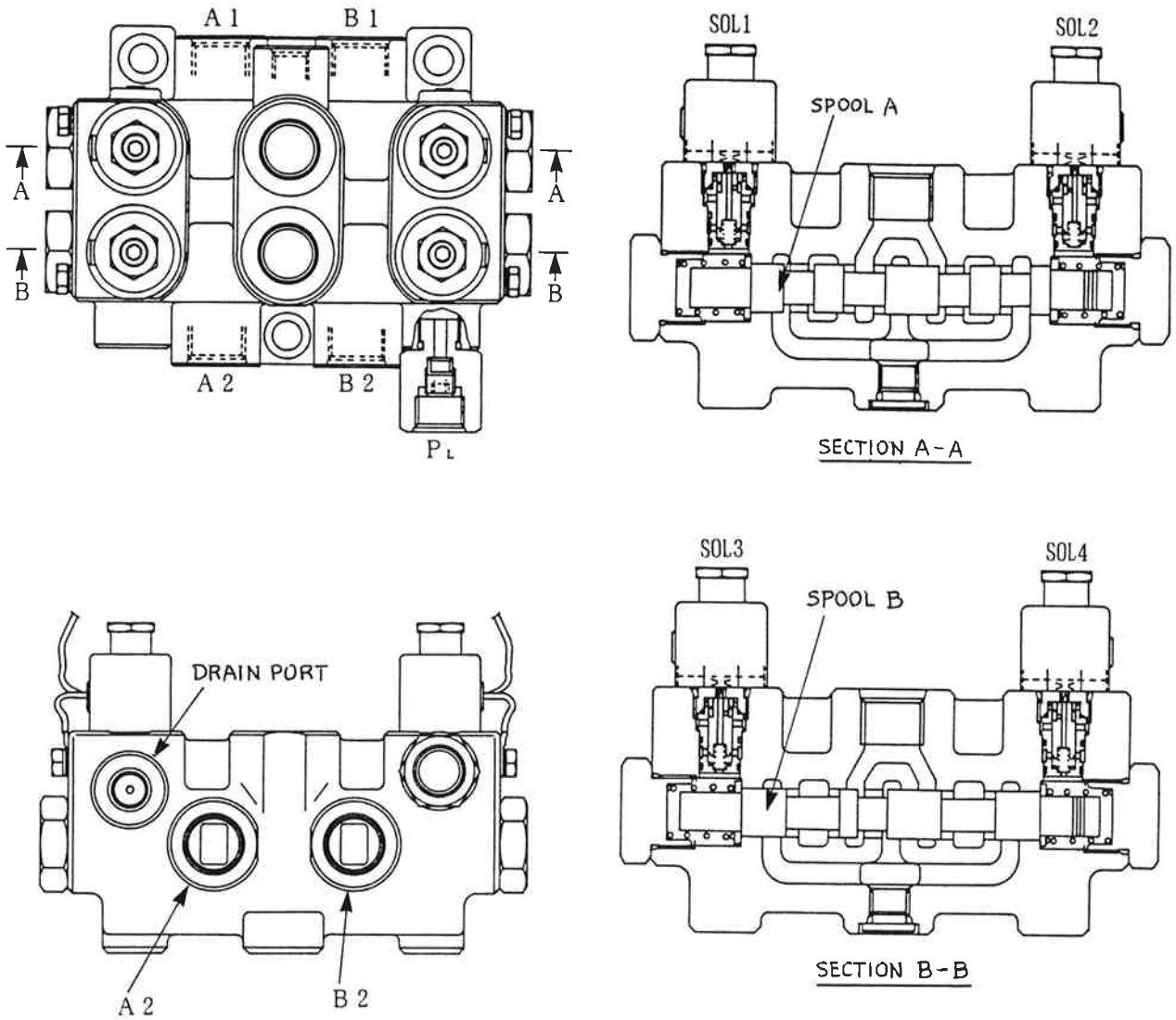
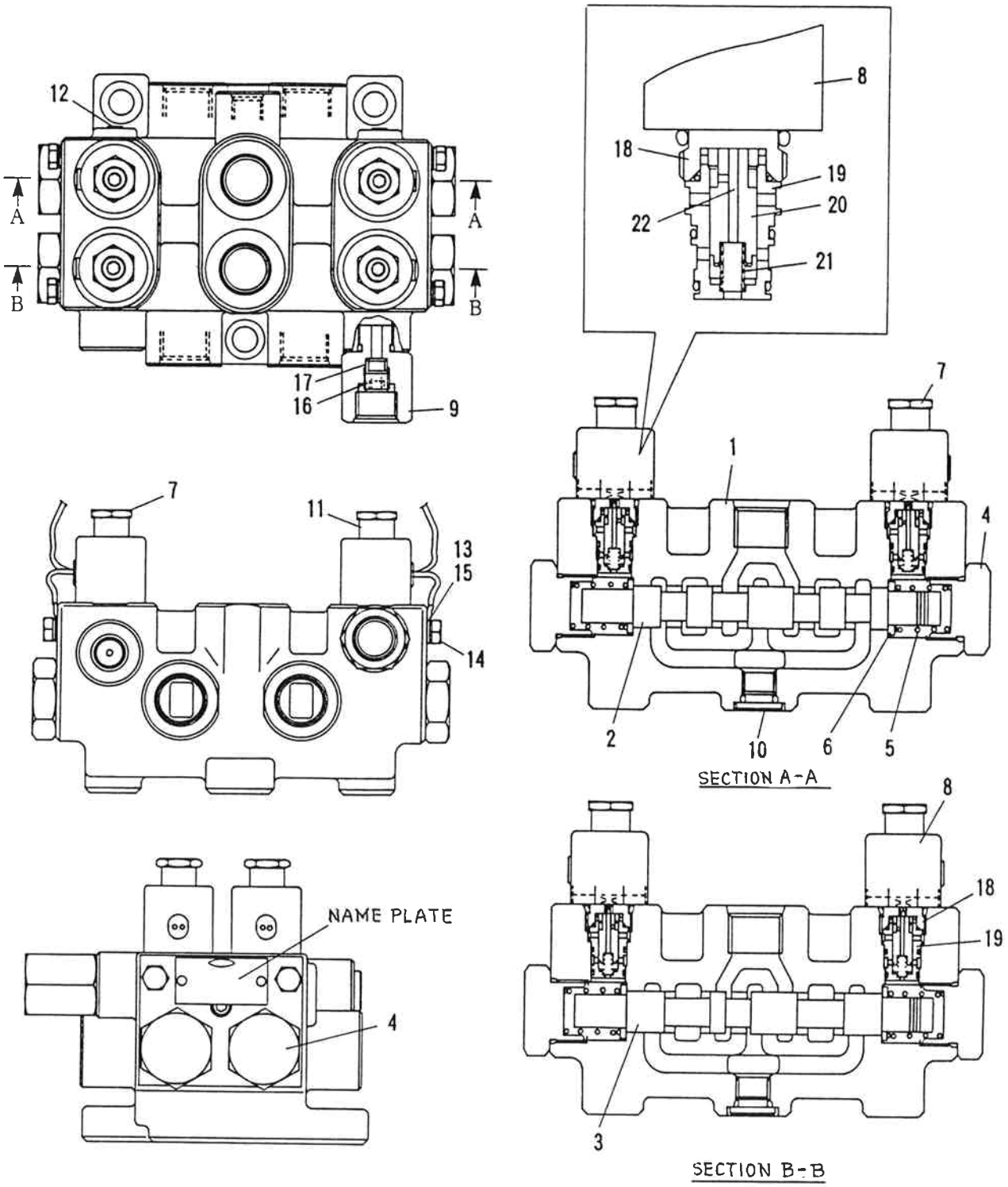


Fig. 1-5

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1.2 ILLUSTRATION OF CONSTRUCTION



1. BODY	7. HEXAGON NUT	12. PLUG	18. IRON CORE
2. SPOOL A	8. SOLENOID VALVE	13. TERMINAL	19. SOCKET
3. SPOOL B	9. CONNECTOR WITH FILTER	14. BOLT	20. PILOT BEARING
4. PLUG	10. PLUG	15. WASHER	21. SPRING
5. SPRING	11. SPACER	16. RETAINER	22. PUSH ROD
6. WASHER		17. FILTER	

Fig. 1-6

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2. SPECIFICATION

2.1 SPECIFICATION AND DIMENSIONS

Specification of Valve		Specification of Solenoid	
Rated pressure	210 kg/cm² (2986 psi)	Rated voltage	d.c. 24 volts
Rated flow	80 ℓ (2.83 cu.ft) /min	Consumption of electric power	approx. 12.6 watts
Pilot pressure range	10 to 25 kg/cm² (142 to 355 psi)		
Spool shifting pressure	4.5 to 7.5 kg/cm² (64.0 to 106.7 psi)		
Weight	Approx. 9.0 kgs (19.8 lbs)		

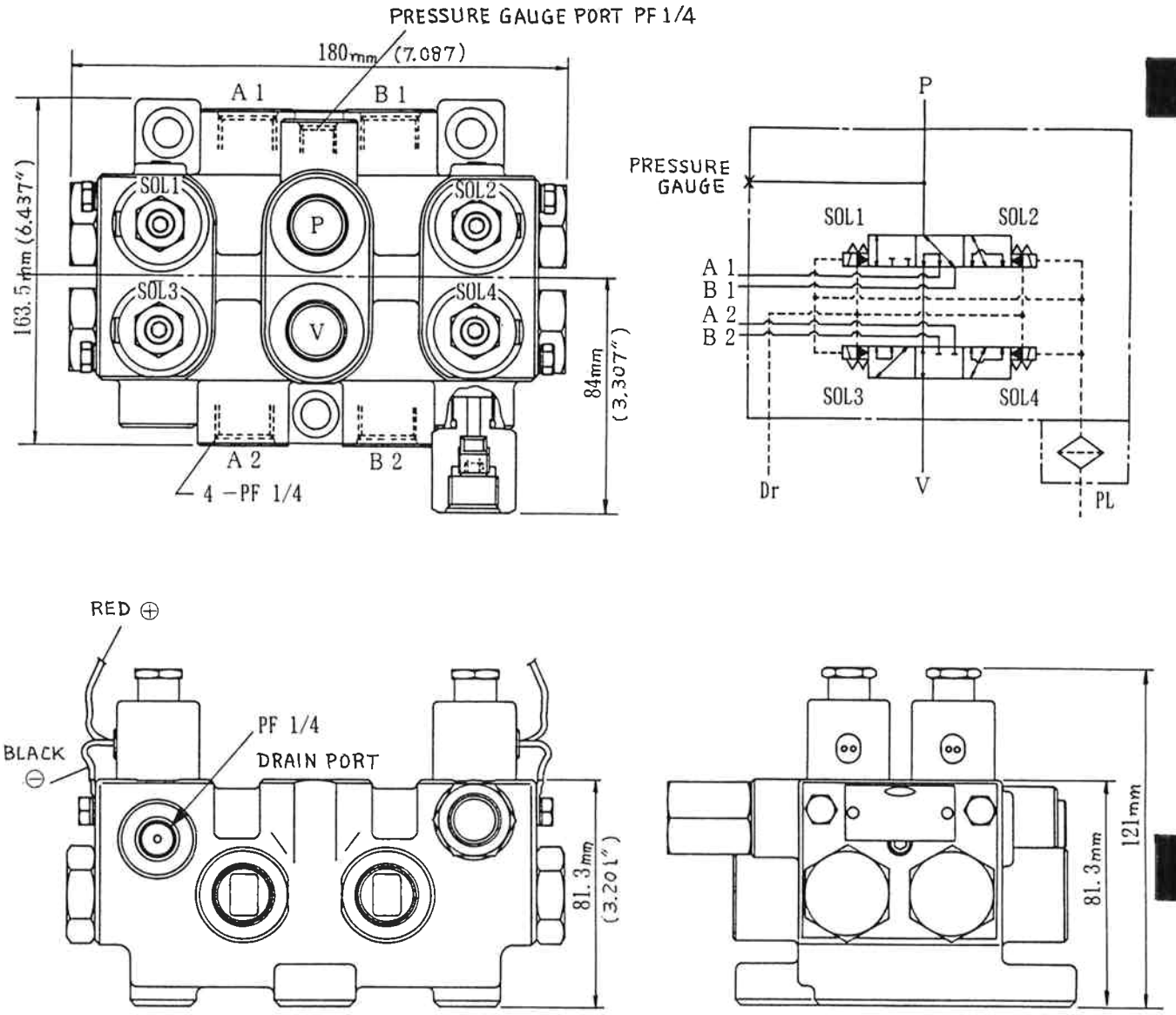


Fig. 2-1

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3. DISASSEMBLY AND ASSEMBLY

Before setting about disassembing and assembling works, prepare the following tools.

Name	Nominal Dimension	Remarks
Torque wrench	0.3 to 2kgf·m (2.2 to 14.5 ft·lbs) torque adjustable.	For tightening iron core section and solenoid.
Torque wrench adapter (spanner type)	26mm	For tightening iron core section, and for disassembling and tightening connector.
Ditto	17mm	For tightening solenoid.
Spanner	10mm	Hexagon head bolt M6×8mm
Ditto	17mm	For disassembling solenoid
Ditto	26mm	For disassembling iron core section
Ditto	30mm	For disassembling and tightening plug
Hexagon bar wrench	5mm	For disassembling and tightening retainer

3.1 PRECAUTIONS FOR WORKING

(1) Work in a place where trash, dust, earth, sand and water, etc. do not enter.
(2) When working, use a suitable workbench, and cover the bench with clean papers or rubber mats.
(3) After disassembling, wash the all disassembled parts with washing oil, then dry them with compressed air.
(4) When assembling, coat each sliding section with clean hydraulic oil, then assemble it.
(5) When assembling, confirm that each sliding section has no burr and scratch and moves smoothly.
(6) When assembling, apply grease to O-rings, then assemble them.
(7) Be careful not to injure the thread section and sealing section of each part.

3.2 DISASSEMBLY

(1) Secure body (1) with a vise, etc. At this time, being careful not to injure the sealing sections of the ports, etc., secure it.
(2) Loosen plug (4), and remove it from body (1).
(3) Remove springs (5) and washers (6) from spool A (2) and spool B (3). Draw spool A (2) and spool B (3) out from body (1).

CAUTION

When drawing the spools out, be careful not to injure body (1).

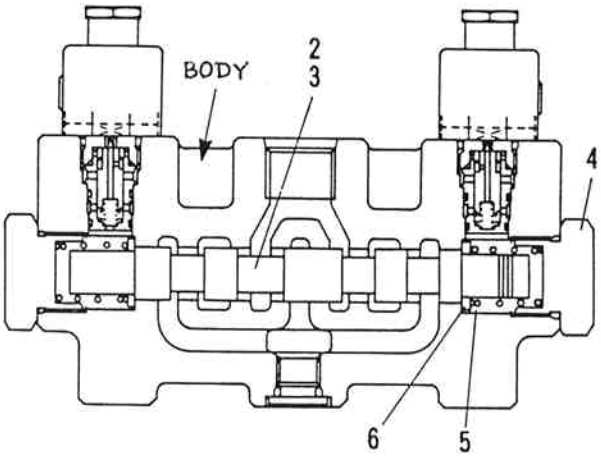


Fig. 3-1

https://truckmanualshub.com/

3. DISASSEMBLY AND ASSEMBLY

Before setting about disassembing and assembling works, prepare the following tools.

Name	Nominal Dimension	Remarks
Torque wrench	0.3 to 2kgf·m (2.2 to 14.5 ft·lbs) torque adjustable.	For tightening iron core section and solenoid.
Torque wrench adapter (spanner type)	26mm	For tightening iron core section, and for disassembling and tightening connector.
Ditto	17mm	For tightening solenoid.
Spanner	10mm	Hexagon head bolt M6×8mm
Ditto	17mm	For disassembling solenoid
Ditto	26mm	For disassembling iron core section
Ditto	30mm	For disassembling and tightening plug
Hexagon bar wrench	5mm	For disassembling and tightening retainer

3.1 PRECAUTIONS FOR WORKING

(1) Work in a place where trash, dust, earth, sand and water, etc. do not enter.
(2) When working, use a suitable workbench, and cover the bench with clean papers or rubber mats.
(3) After disassembling, wash the all disassembled parts with washing oil, then dry them with compressed air.
(4) When assembling, coat each sliding section with clean hydraulic oil, then assemble it.
(5) When assembling, confirm that each sliding section has no burr and scratch and moves smoothly.
(6) When assembling, apply grease to O-rings, then assemble them.
(7) Be careful not to injure the thread section and sealing section of each part.

3.2 DISASSEMBLY

(1) Secure body (1) with a vise, etc. At this time, being careful not to injure the sealing sections of the ports, etc., secure it.
(2) Loosen plug (4), and remove it from body (1).
(3) Remove springs (5) and washers (6) from spool A (2) and spool B (3). Draw spool A (2) and spool B (3) out from body (1).

CAUTION

When drawing the spools out, be careful not to injure body (1).

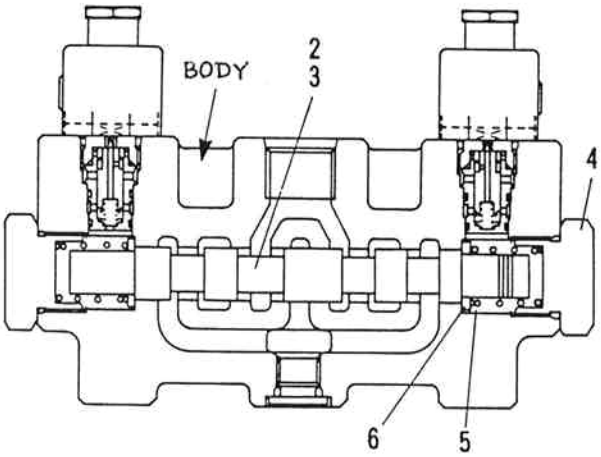


Fig. 3-1

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(4) Loosen hexagon head bolt (14), and remove the wiring for solenoid (8) and washer (15) from the body

(5) Loosen hexagon nut (7), and remove spacer (11) and solenoid (8).

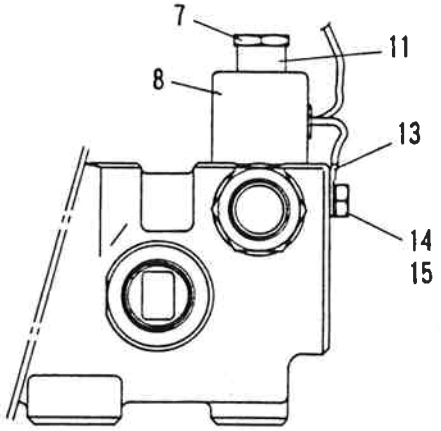


Fig. 3-2

(6) Loosening iron core section (18), remove it from body (1). Then, draw push rod (22) out from the iron core section.

(7) Remove pilot valve (20) and spring (21) from socket (19), and remove socket (19) from body (1).

(8) Loosen connector (9), and remove it from body (1).

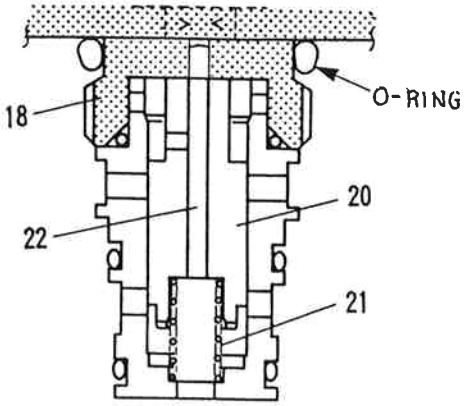


Fig. 3-3 Solenoid Valve

(9) Secure connector (9) with a vise, etc., and remove retainer (16).

(10) Remove filter (17) from connector (9)

(11) Remove the O-rings from removed plug (4), iron core section (18), socket (19) and connector (9).

CAUTION

Do not remove plug (10) and plug (12).

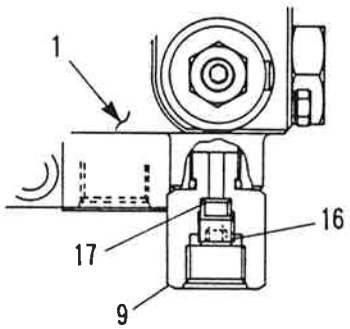


Fig. 3-4 Connector

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3.3 ASSEMBLY

(1) Wash each part with washing oil.

(2) Install the O-rings to plug (4), iron core section (18), socket (19) and connector (9).

CAUTION

The O-rings should be replace with new ones.

(3) Install filter (17) to connector (9).

(4) Tighten and fix filter (17) and retainer (16).

CAUTION

Retainer (16) should be locked with Locktite, etc. At that time, be careful for applying quantity not to clog the filter.

(5) Install connector (9) to body (1).

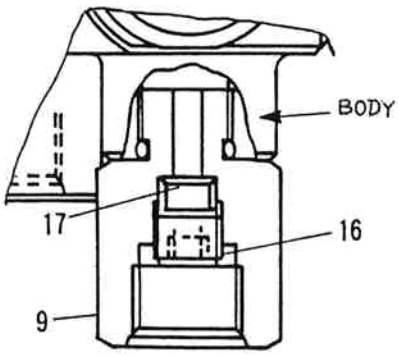


Fig. 3-5 Connector Installation

(6) Insert spring (21) and pilot valve (20) into socket (19).

NOTE

Spring (21) should be certainly inserted upto the cavity of socket (19) bottom. After inserting pilot valve (20), push the pilot valve with hand several times to confirm that the valve operates smoothly without being caught.

(7) Insert socket (19) into body (1).

(8) After inserting push rod (22) into iron core section (18), install them to body (1).

NOTE

Tighten with a torque wrench.
Tightening torque : 2 to 3 kgf·m (14.5 to 21.7 ft·lbs)

(9) Insert solenoid (8) and spacer (11) into iron core section (18), and secure with hexagon nut (7).

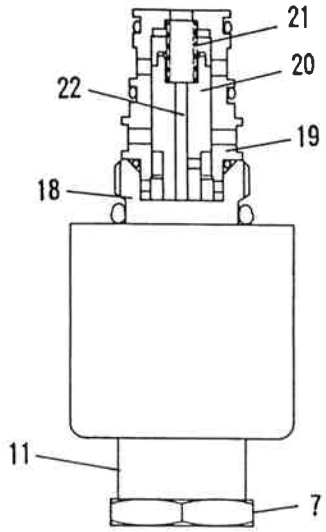


Fig. 3-6 Solenoid Assembly

NOTE

To tighten hexagon nut (7), use a torque wrench.
Tightening torque : 0.3 to 0.4 kgf·m (2.17 to 2.89 ft·lbs).

※ Since too strong tightening force has the possibility that the solenoid is deformed or damaged, be sure to use a torque wrench.

When tightening hexagon nut (7), lock the nut with the use of Locktite, etc.

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(10) Put washer (15) and the wiring for the solenoid on to hexagon head bolt (14), then install hexagon bolt (14) to body (1).

(11) Insert spool A (2) and spool B (3) into body (1).

CAUTION

- When inserting the spools, if it is hard to insert, do not insert forcibly, but pull them out once, and check if there is injury, etc.
- Be careful not to mistake the inserting position of spool A (2) and spool B (3).
- Since the left and the right of both spool A (2) and spool B (3) are not symmetric, be careful for the installing direction.
- After the spools have been inserted, push them with hand to confirm that they move smoothly.

(12) Insert washers (6) and springs (5) onto spool A (2) and spool B (3)

(13) Tighten plugs (4) into body (1).

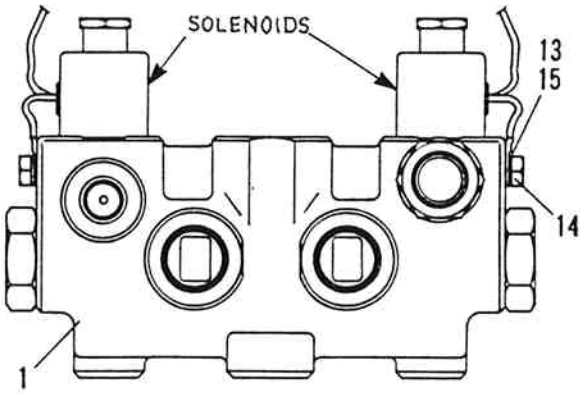


Fig. 3-7 Solenoid Installation

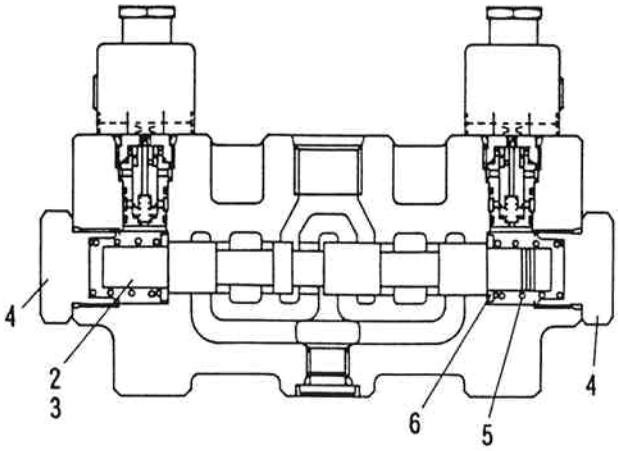


Fig. 3-8 Spool Installation

3.4 TEST PROCEDURE AND MAINTENANCE STANDARDS

(1) Test Procedure

- Perform oil leak test with the condition that the steering wheel is turned to the left and right until the wheel is locked at the maximum revolution of the engine.
- Operate the steering mode selector switches to confirm steering operation with the idling condition and maximum revolution of the engine respectively.

(2) Maintenance Standards

- There shall be no oil leakage.
- Steering shall be operated correctly for the respective mode.

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(10) Put washer (15) and the wiring for the solenoid on to hexagon head bolt (14), then install hexagon bolt (14) to body (1).

(11) Insert spool A (2) and spool B (3) into body (1).

CAUTION

- When inserting the spools, if it is hard to insert, do not insert forcibly, but pull them out once, and check if there is injury, etc.
- Be careful not to mistake the inserting position of spool A (2) and spool B (3).
- Since the left and the right of both spool A (2) and spool B (3) are not symmetric, be careful for the installing direction.
- After the spools have been inserted, push them with hand to confirm that they move smoothly.

(12) Insert washers (6) and springs (5) onto spool A (2) and spool B (3)

(13) Tighten plugs (4) into body (1).

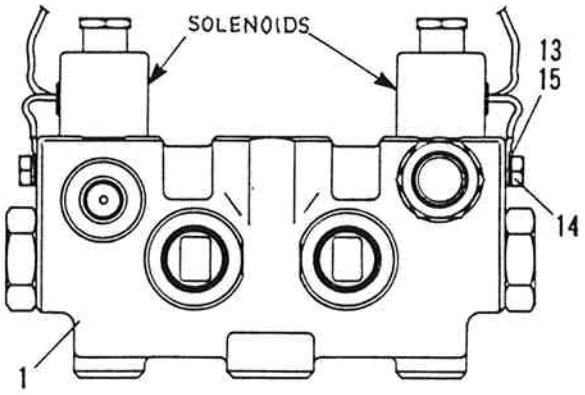


Fig. 3-7 Solenoid Installation

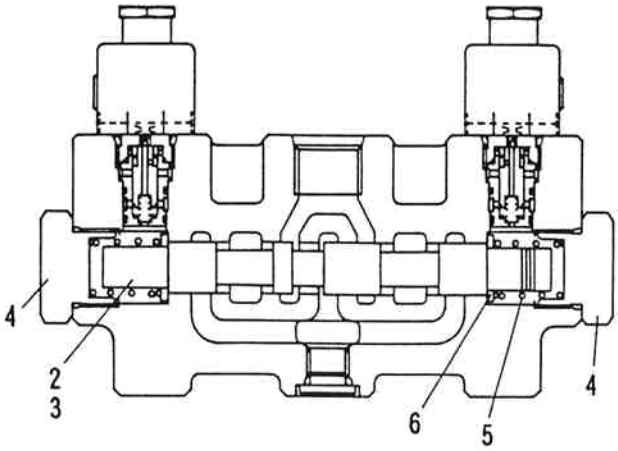


Fig. 3-8 Spool Installation

3.4 TEST PROCEDURE AND MAINTENANCE STANDARDS

(1) Test Procedure

- Perform oil leak test with the condition that the steering wheel is turned to the left and right until the wheel is locked at the maximum revolution of the engine.
- Operate the steering mode selector switches to confirm steering operation with the idling condition and maximum revolution of the engine respectively.

(2) Maintenance Standards

- There shall be no oil leakage.
- Steering shall be operated correctly for the respective mode.

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1. OUTLINES OF CONSTRUCTION

The outside circumference of the piston is machined to trapezoidal threads, and the inside circumference is splined. Trapezoidal threads are machined to the inside circumference of the casing, and the outside circumference of the shaft is splined.

When pressurized oil is led to chamber B' from port B, the piston moves leftward while turning by the thread mechanism by this oil pressure. This turning torque is transmitted to the shaft by the spline provided inside of the piston, and the necessary torque can be taken out.

Besides, by leading pressurized oil to chamber A' from port A, the piston moves rightward, and the shaft turing torque of reverse turning by the same principle as the above.

Turning direction

When oil is supplied from port A :

Right turn looking from direction X.

When oil is supplied from port B :

Left turn looking from direction X.

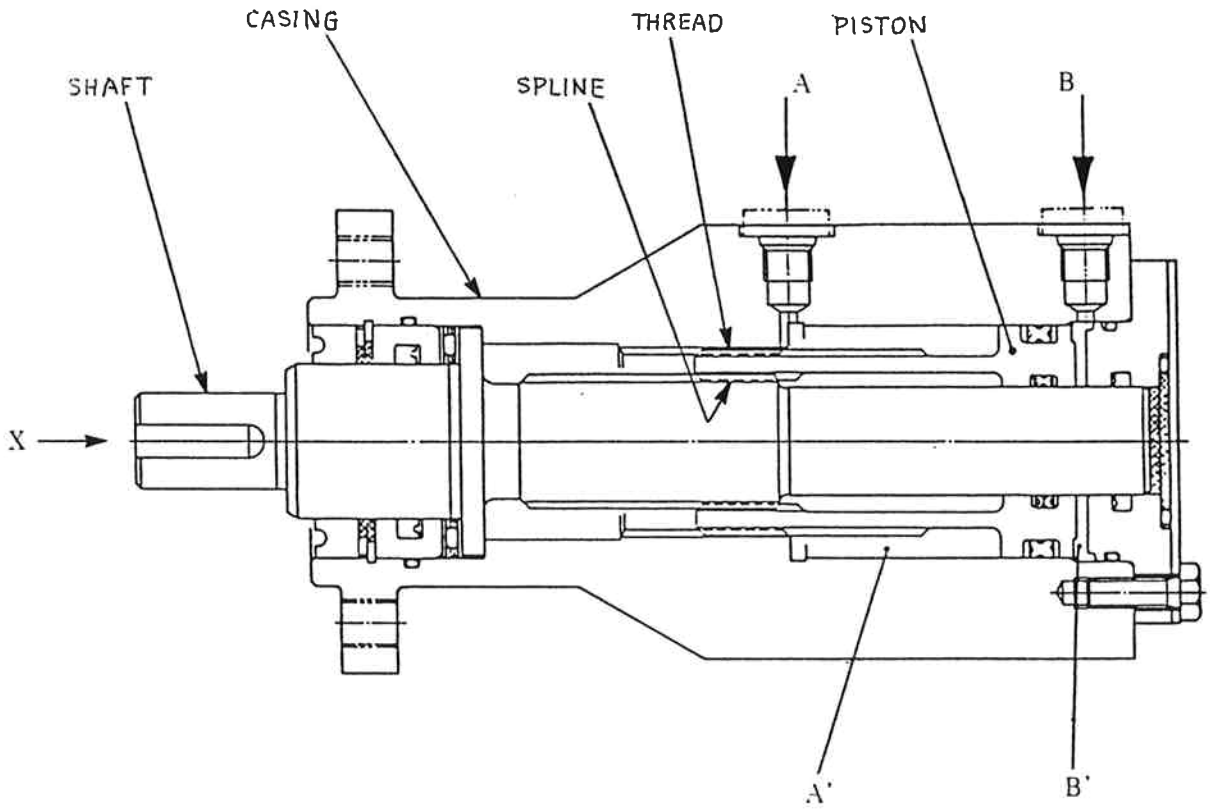
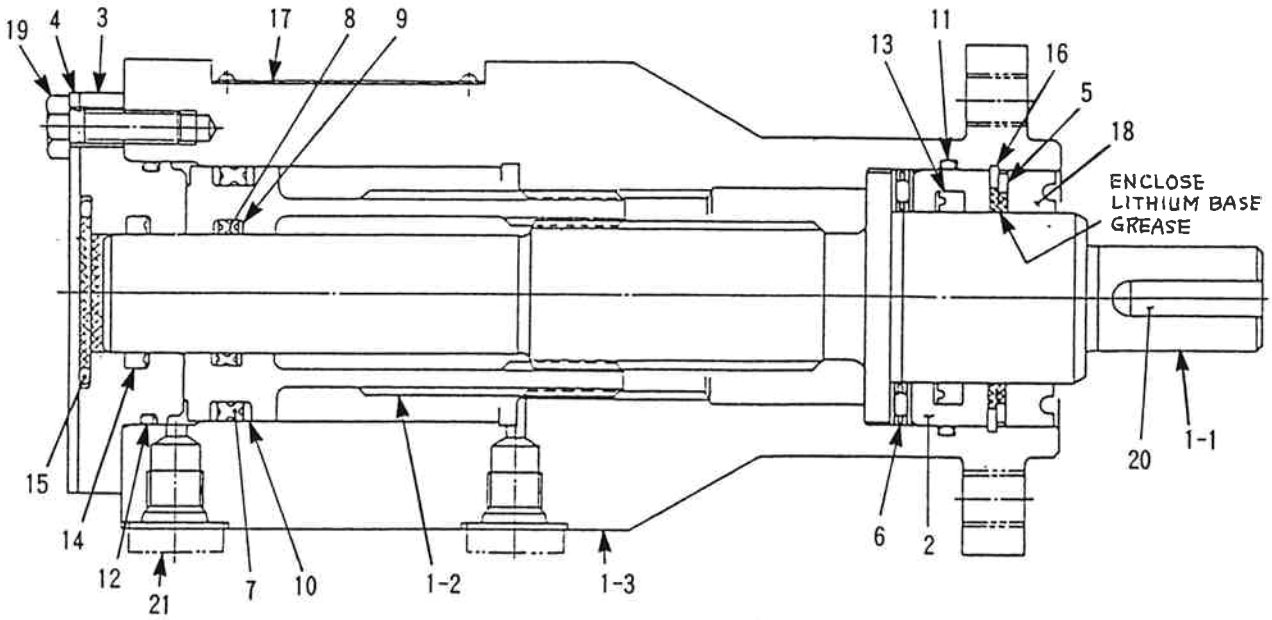


Fig. 1-1

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1. 1 ILLUSTRATION OF CONSTRUCTION



shows enclosure of Lithium grease (Capacity ratio : 50 to 70 %)

1-1. SHAFT	7. RING	15. O-RING
1-2. PISTON	8. RING	16. SNAP RING
1-3. CASING KIT	9. BACK-UP RING	17. NAME PLATE
2. HOLDER	10. BACK-UP RING	18 U-PACKING
3. COVER	11. O-RING	19. HEXAGON HEAD BOLT
4. DUST COVER	12. O-RING	
5. SPACER	13. U-PACKING	20 KEY
6. BEARING	14. U-PACKING	21. PLUG

Fig. 1-2

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2. DISASSEMBLY AND ASSEMBLY

2.1 PRECAUTIONS WHEN DISASSEMBLING

(1) PREPARATION

Before disassembling, make the following preparation.

1) Preparation of workbench.

The workbench shall be steady and strong, and have enough space to place the parts, where the parts do not fall nor move.

2) Preparation of sub-materials.

Prepare the following sub-materials.

- Lithium base grease.
- Oil stone.
- Hydraulic oil.

(2) GENERAL PRECAUTIONS WHEN WORKING

General precautions on working.

1) Select a spotlessly clean place, place a rubber plate or cloth on the workbench, and be carefull not to allow the parts to be injured.

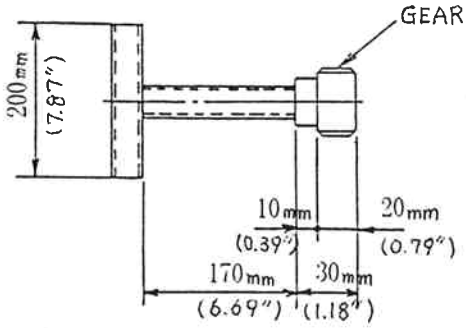
2) Since each part is precisely manufactured, pay particular attention to handling the parts not to allow the parts to strike each other nor to fall. Especially, be careful not to injure absolutely the contacting surfaces of sealing parts such as O-rings and packings, etc., and the sliding section and sealing section.

3) Forcibly tapping or twisting the part to loosen tightness could cause burr or damage to make assembly impossible, or cause oil leakage or performance lowering. Carefully and patiently proceed work.

4) Leaving the disassembled part as it is disassembled or on the way of disassembly may generate rust due to humidity and dust. When it is required to interrupt the work, be sure to pay attention to prevent rust and dust.

(3) SPECIAL TOOLS

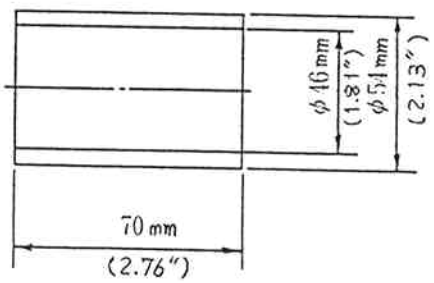
1) Tool for removal and installation of piston



Specification of gear

		External gear
Tooth form		Standard
Tool	Tooth form	Stub gear tooth
	Module	1.0
	Pressure angle	30°
No. of teeth		33
Base pitch circle dia.		33.0mm (1.299 in.)
Thickness over block teeth		$16.5^{-0.017}_{-0.033}$ mm ($0.650^{-0.0007}_{-0.0013}$ in)
No. of block teeth		(6)

2) Copper pipe

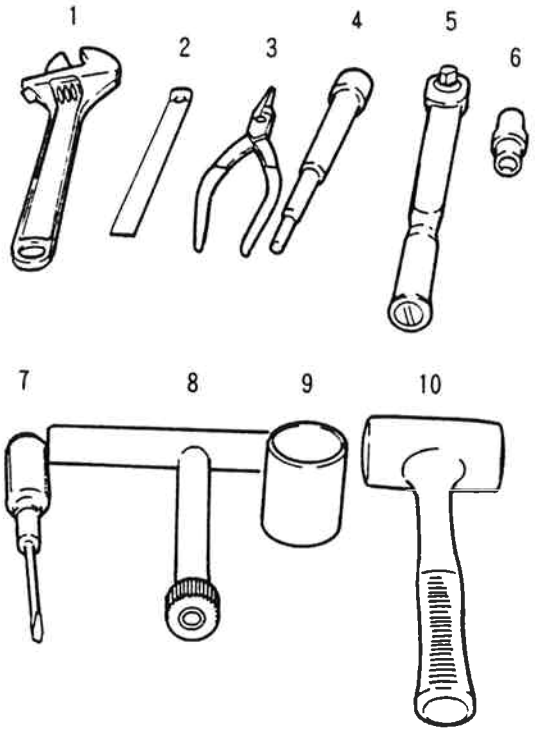


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2.2 DISASSEMBLING PROCEDURES

Before starting to work, the following tools are required.

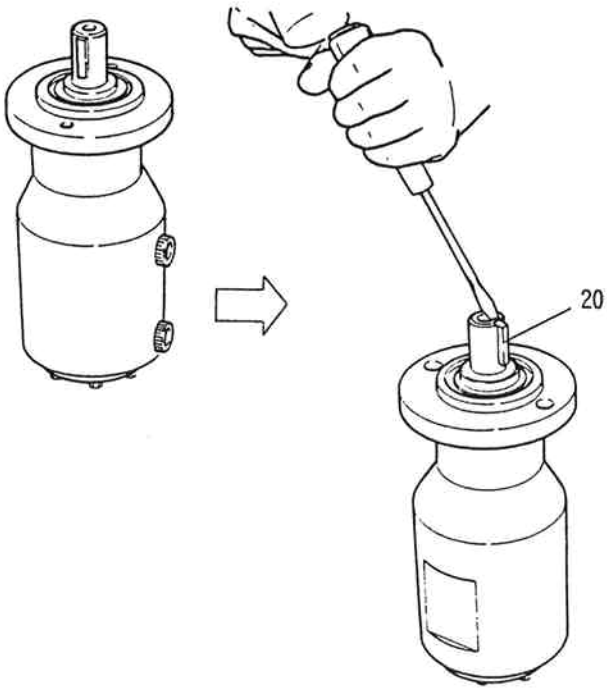
1. Adjustable wrench (monkey spanner)
2. Scale
3. Pliers
4. Copper bar
5. Torque wrench
6. Socket (for M8)
7. Screwdriver
8. Tool for removal and installation of piston
9. Copper pipe
10. Hammer (plastic)



Disassembling Work

(1) Clean the blind plug mounting external face of the piping port.

(2) Place the torque actuator on the workbench, and remove key (20).



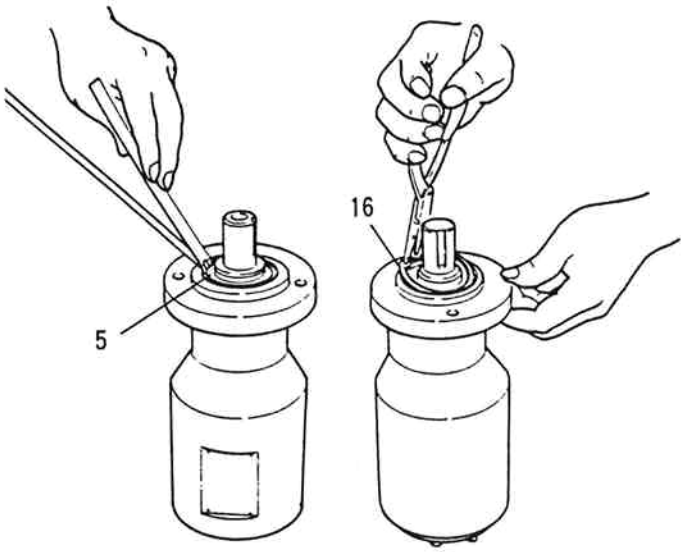
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(3) Removal of U-packing

1) Remove U-packing (18).
Inserting a thin plate such as the scale into the outside circumference of U-packing (18), blow air in through the air nozzle. U-packing (18) can be easily removed.

2) Remove spacer (5).

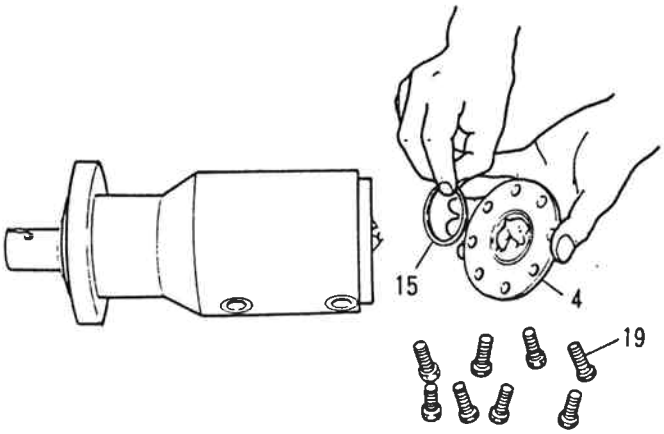
(4) Remove snap ring (16).



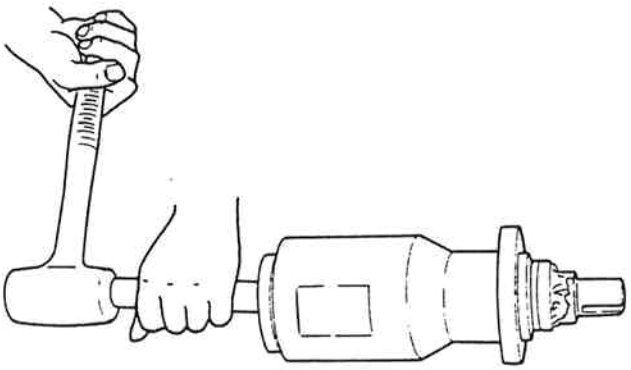
REMOVAL OF U-PACKING

REMOVAL OF SNAP RING

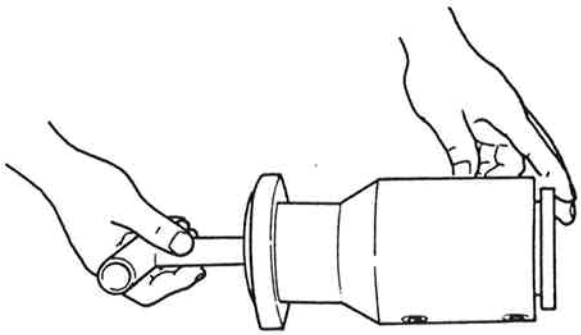
(5) Removing bolts (19), remove dust cover (4) and O-ring (15), etc.



1) Using a bar such as the copper bar which does not injure the shaft, lightly tap the shaft to draw out the shaft.

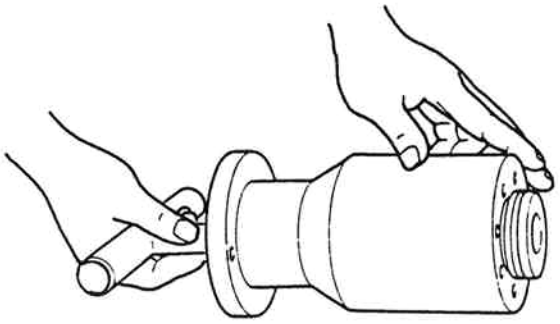


2) Inserting the tool for removal and installation of piston into the spline section of piston (1-2), and turn it to the right to remove cover (3).



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3) Inserting the tool for removal and installation of piston into the spline section of piston (1-2), and turn it to the right to remove piston (1-2). Now, disassembly is finished.



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2.3 MAINTENANCE STANDARDS

Replace the each part of the torque actuator with a new one referring to the following table. The names and numbers of the parts correspond to the illustration of construction (Fig. 1-2).

No.	Applicable part	Place to be inspected and measured	Standard value	Permissible limit value	Repair or remedy
1-1	Shaft	1. Sliding surfaces with packings (13, 14 and 18) are deeply injured or rough.	Roughness 3.2 S	6.5 S	Replace assembly.
		2. Unusual wear, deep injury or seizing phenomenon, etc. is detected in meshing section of spline.	—	—	
1-2	Piston	1. Unusual wear, deep injury or seizing phenomenon, etc. is detected in meshing section of screw thread.	—	—	
		2. Unusual wear, deep injury or seizing phenomenon, etc. is detected in meshing section of spline.	—	—	
1-3	Casing	1. Unusual wear, deep injury or seizing phenomenon, etc. is detected in meshing section of screw thread.	—	—	
		2. Unusual wear, deep injury or seizing phenomenon, etc. is detected in cylinder section.	—	—	
2	Holder	1. Clearance to shaft is large.	< 0.075 mm (0.003 in)	< 0.12 mm (0.0047 in)	Replace.
		2. Deep injury or seizing phenomenon is detected in sliding face with shaft.	—	—	
3.	Cover	1. Clearance to shaft is large.	< 0.041 mm (0.0016 in)	< 0.08 mm (0.0031 in)	Replace.
		2. Deep injury or seizing phenomenon is detected in sliding face with shaft.	—	—	
8	Thrust needle bearing	1. Flaking break away is detected in rolling face.	—	—	Replace.
		2. Pressed dent is detected in rolling face.	—	—	
—	Sealing parts	—			Replace every disassembly and assembly.

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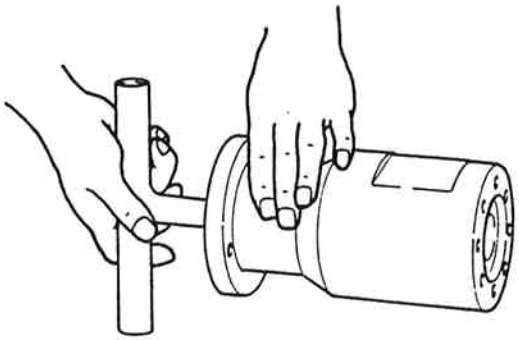
2.4 ASSEMBLY

(1) CAUTIONS ON ASSEMBLY

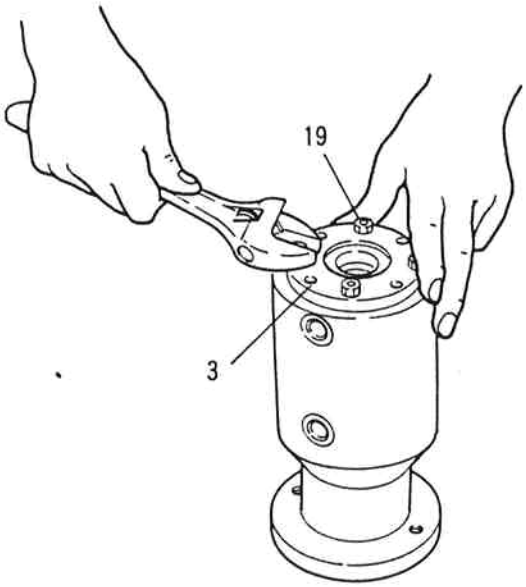
1) Prepare the replacement parts beforehand. Remove metal particles and foreign matters from the all parts, and confirm that there is no burr and bruise, etc. in the ports. If burr or bruise is found, remove it using a oil stone
2) When assembling, apply proper hydraulic oil to the sliding sections and rolling sections.
3) Sealing parts such as O-ring and packing should be replaced with new ones.
4) When installing O-rings, back-up rings and packings, be careful not to damage to them. (Apply a little of grease to them to make smooth.)
5) Tighten the bolt to the specified tightening torque. Using the torque wrench, measure the tightening torque.
6) After assembling has been completed, plug the all ports to prevent dust from entering.

Assembling Procedures

(1) Using the tool for removal and installation of piston, install piston (1-2)

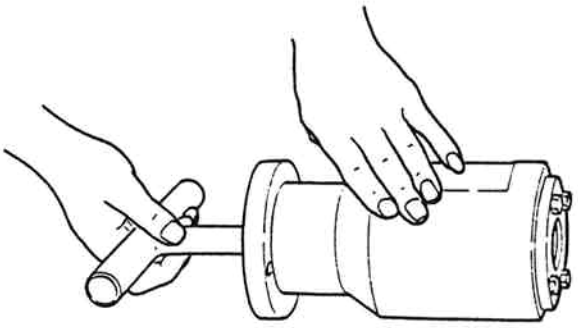


(2) Temporarily install cover(3) only. Four bolts (19) are enough.



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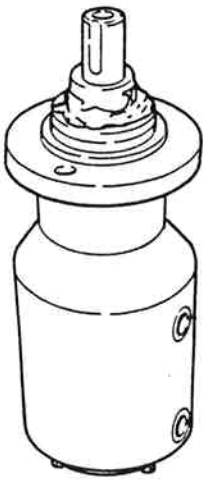
(3) Turn the tool for removal and installation of piston to the right until piston (1-2) touches cover (3).

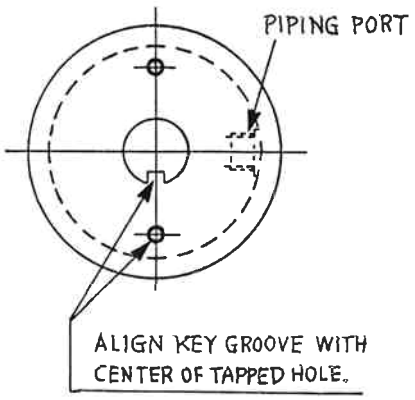


(4) Insert packing (13) into holder (2).

(5) Install thrust needle bearing (7) and holder (3) to shaft (1-1).

(6) Insert the shaft.



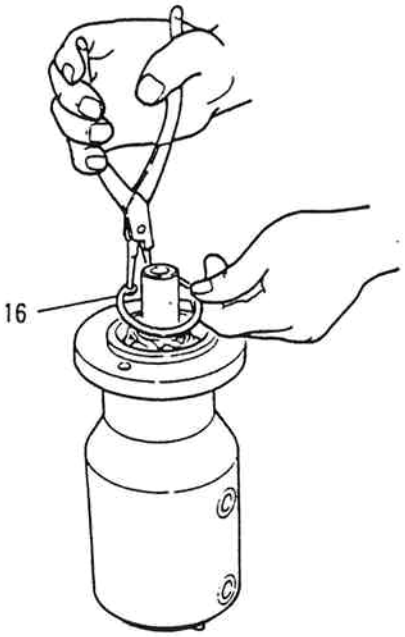


(7) After confirming that the male spline of shaft (1-1) is inserted lightly into the femal spline of piston (1-2), tap holder (2) lightly to insert using the copper bar or like.



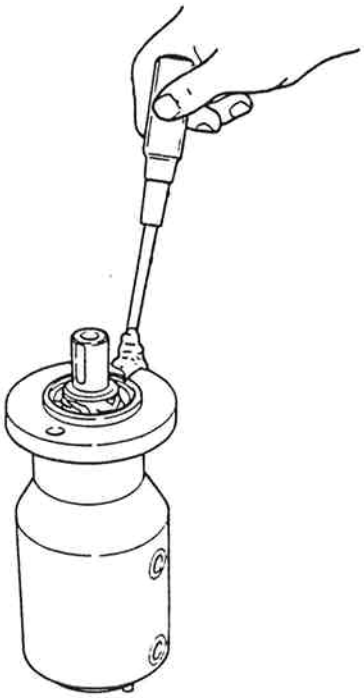
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(8) Install snap ring (16), and confirm that it is certainly inserted into the groove.



(9) Install spacer (5).

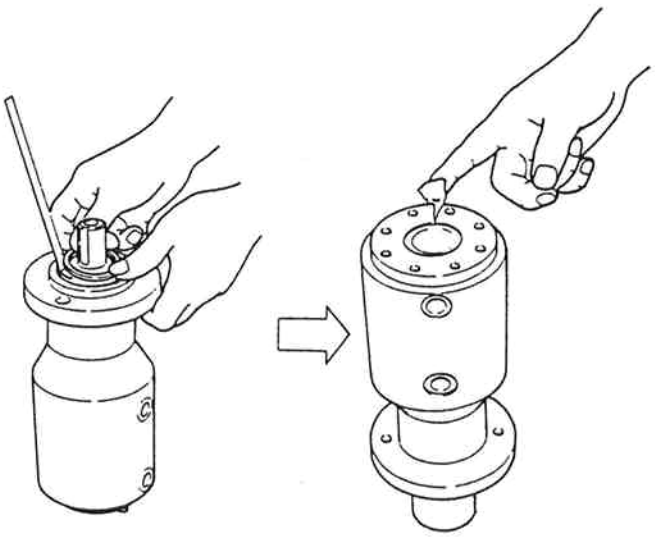
1) Fill Lithium base grease up to the upper face of spacer (5).



(10) Install packing (18).

By placing and inserting a thin plate such as a scale into the outside circumference of the packing, inside air is removed to make assembling easy.

1) Install O-ring (15).
2) Fill Lithium base grease from the under face of O-ring (15) to nearly the middle.

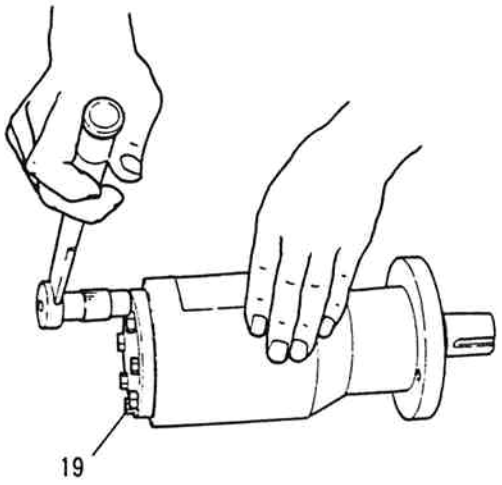


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3) Install dust cover (4), and tighten bolts (19) with the torque wrench.
   Tightening torque : 2 to 2.4 kgf·m
   (14.5 to 17.3 ft-lbs)

4) Install key (20).

(11) Plug the port section to prevent foreign matters from entering.
Now, assembling is finished.



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1. CONSTRUCTION AND FUNCTION

The main part of the swivel joint consists of the body and stem which can rotate reciprocally, a thrust plate to prevent the body and stem from falling out, a cover closing one side of the body, and seals to partition each circuits, etc.

On the body and stem there are a number of ports for each fluid circuit and on either one of them there is a circumferential groove for that number. At the top and bottom of circumferential groove there is a seal groove in which a seal is installed.

The body and stem is constructed so that they can keep rotating, but as the fluid entering from the body (stem) flows to the stem (body) passing through the circumferential groove between the body and stem, the fluid circuit will not be cut off. Because of such construction, it is possible to keep connecting the circuit between the swing body with the swivel joint.

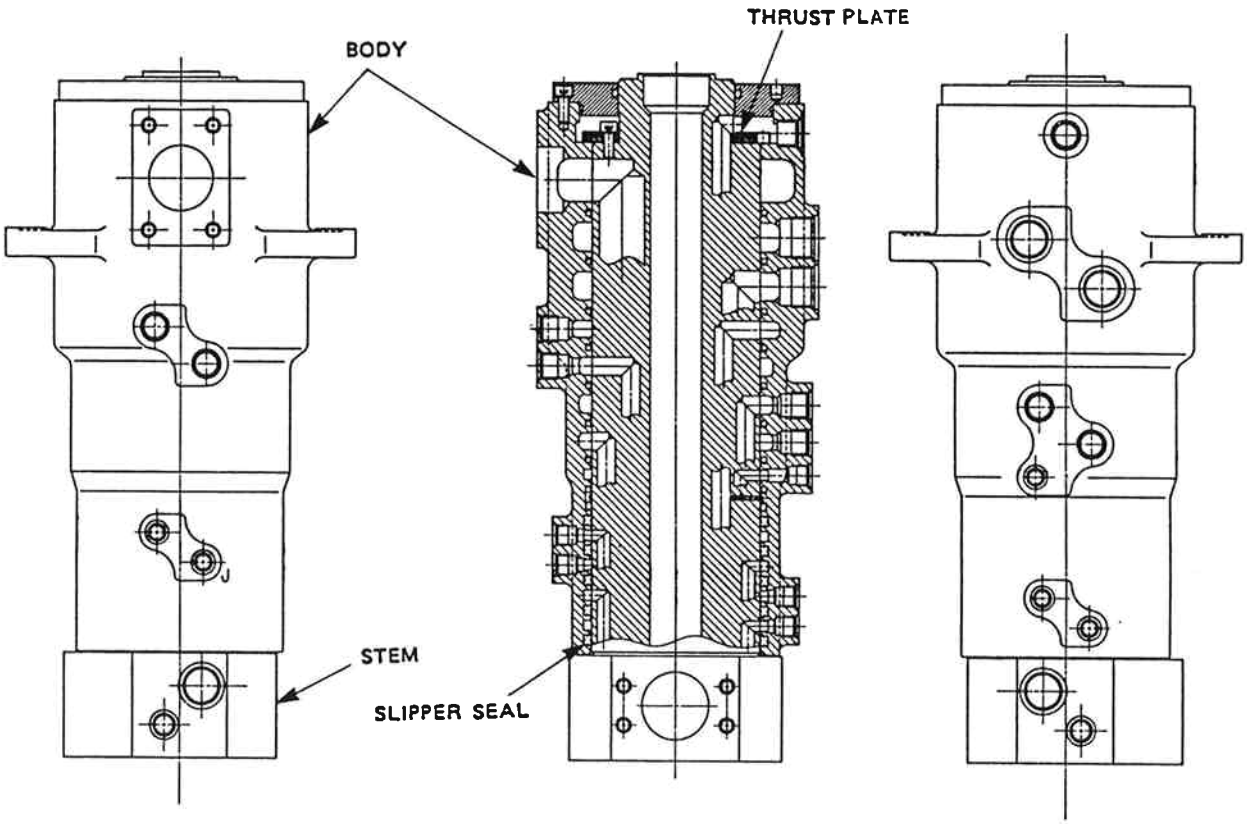


Fig. 1-1 Outer Seal Type

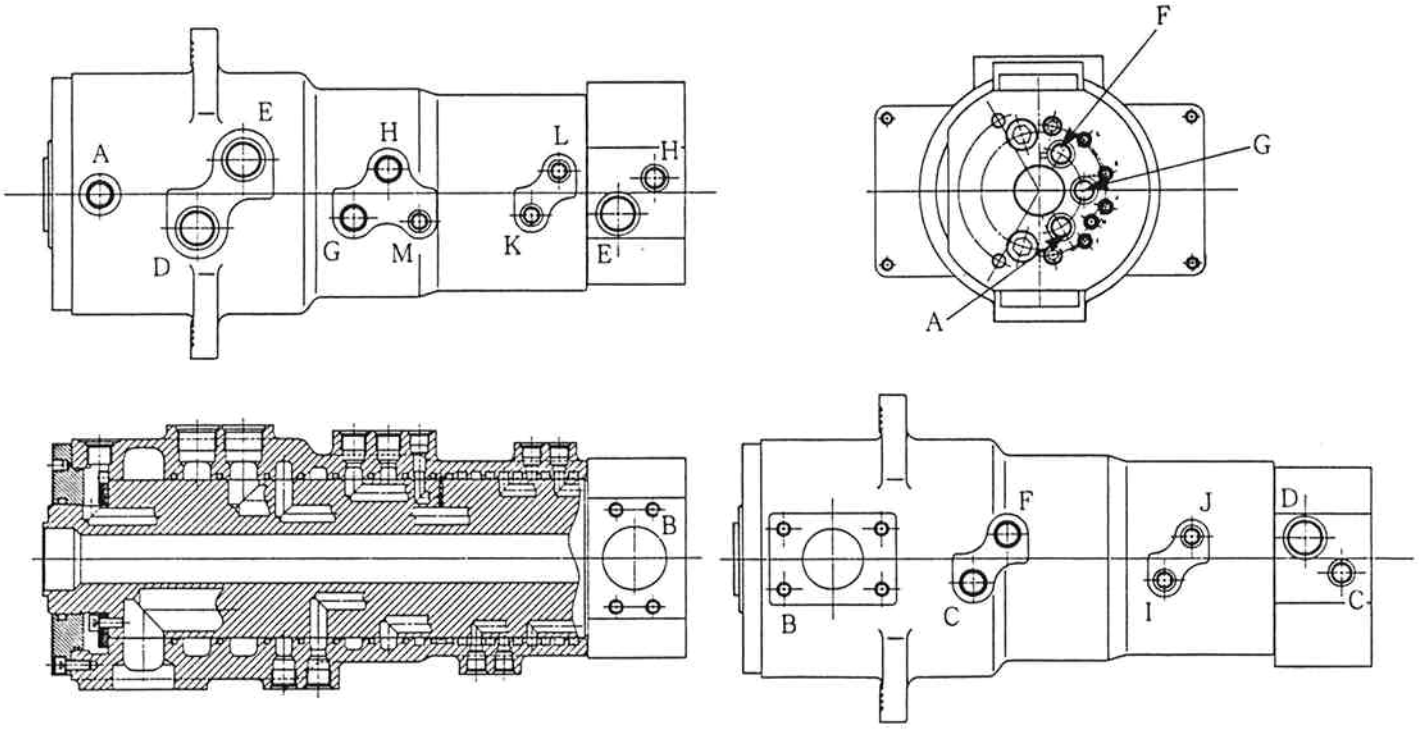
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2. SPECIFICATIONS

2.1 SPECIFICATIONS

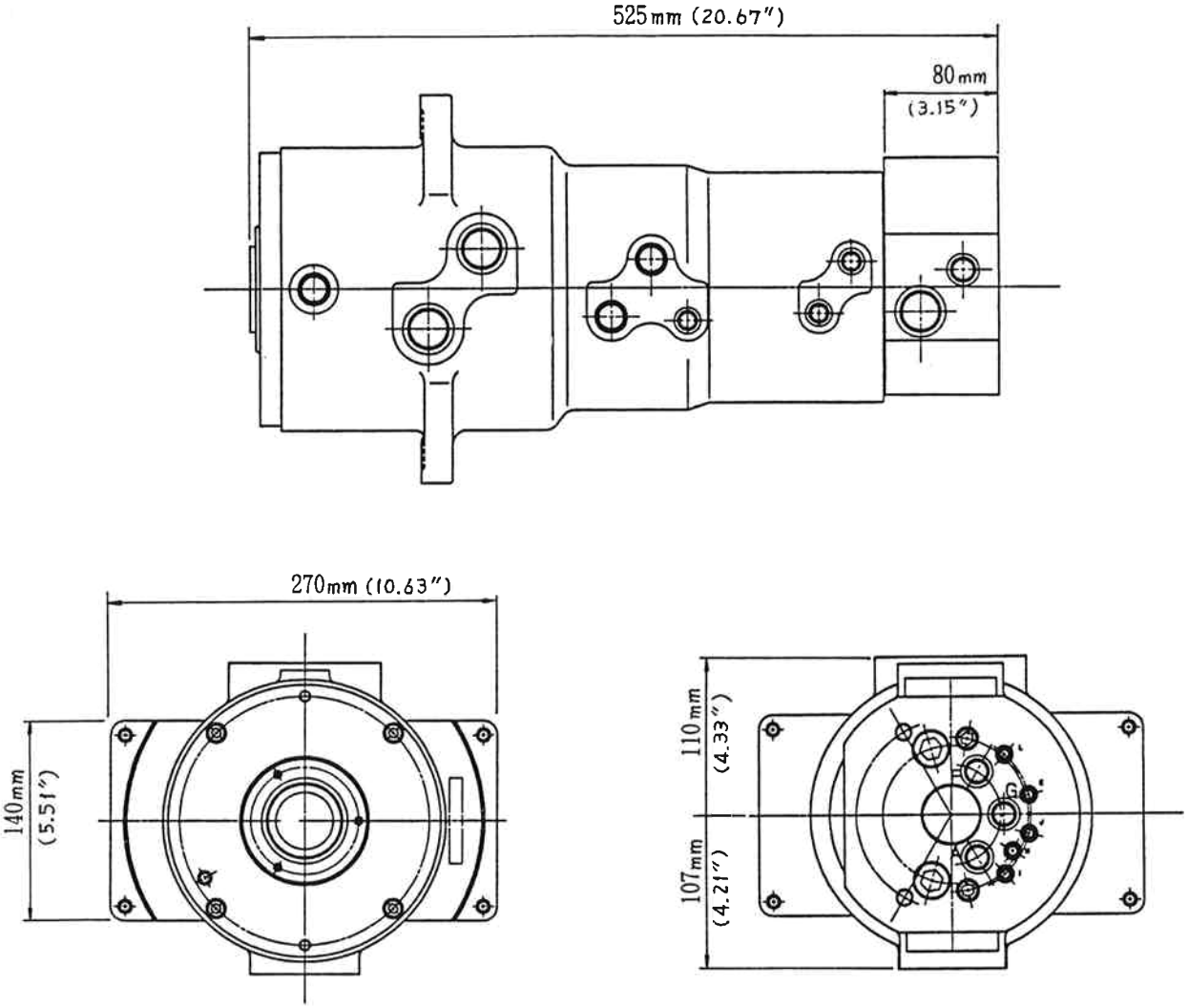
Symbol	Name of Circuit	Port Size	RK250-3/350		RK450-2	
			Working pressure in kg/cm² (psi)	Flow in ℓ (cu. ft) / min	Working pressure in kg/cm² (psi)	Flow in ℓ (cu. ft) / min
A	Drain	PF1/2	0.5 (7.1)	10 (0.35)	0.5 (7.1)	10 (0.35)
B	Return	φ50	10 (142)	400 (14.1)	10 (142)	500 (17.7)
C	Steering (left)	PF1/2	210 (2986)	33 (1.17)	210 (2986)	66 (2.33)
D	Boom hoist, telescope	PF1	250 (3555)	146 (5.16)	280 (3982)	174 (6.15)
E	Winch	PF1	250 (3555)	146 (5.16)	280 (3982)	174 (6.15)
F	Steering (right)	PF1/2	210 (2986)	33 (1.17)	210 (2986)	66 (2.33)
G	Swing	PF1/2	210 (2986)	86 (3.04)	210 (2986)	131 (4.63)
H	Pilot	PF1/2	150 (2133)	37 (1.31)	210 (2986)	37 (1.31)
I	Air source	PF3/8	10 (142)		10 (142)	
J	Air (rear brake)	PF3/8	10 (142)		10 (142)	
K	Air (front brake)	PF3/8	10 (142)		10 (142)	
L	Air (acceleration)	PF3/8	10 (142)		10 (142)	
M	Sky tilt	PF3/8	210 (2986)	37 (1.31)	210 (2986)	37 (1.31)
Revolution per minute		3.5 rpm				
Weight (dry)		Approx. 74 kg (163 lbs.)				

PORT POSITIONS

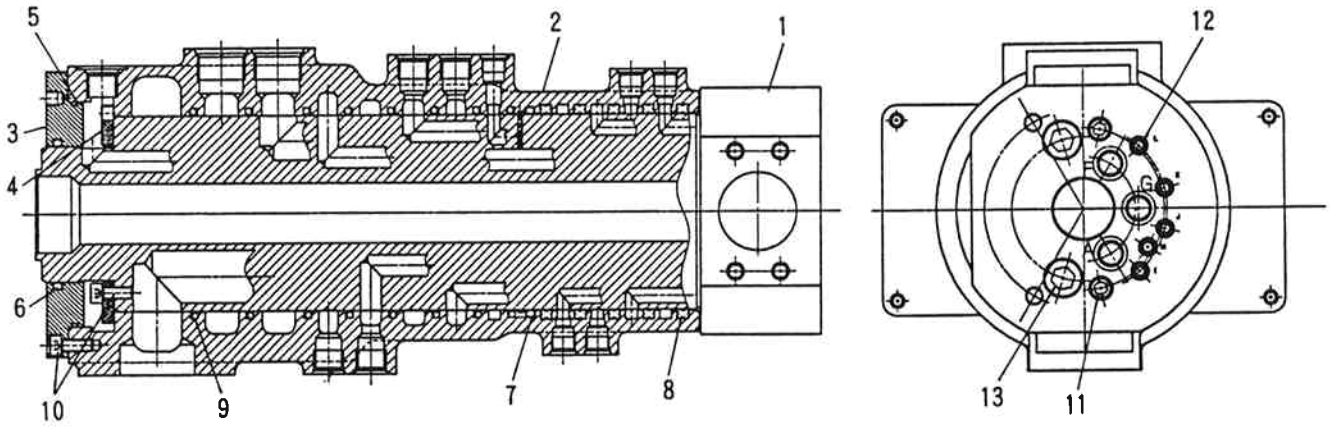


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2. 2 DIMENSIONS



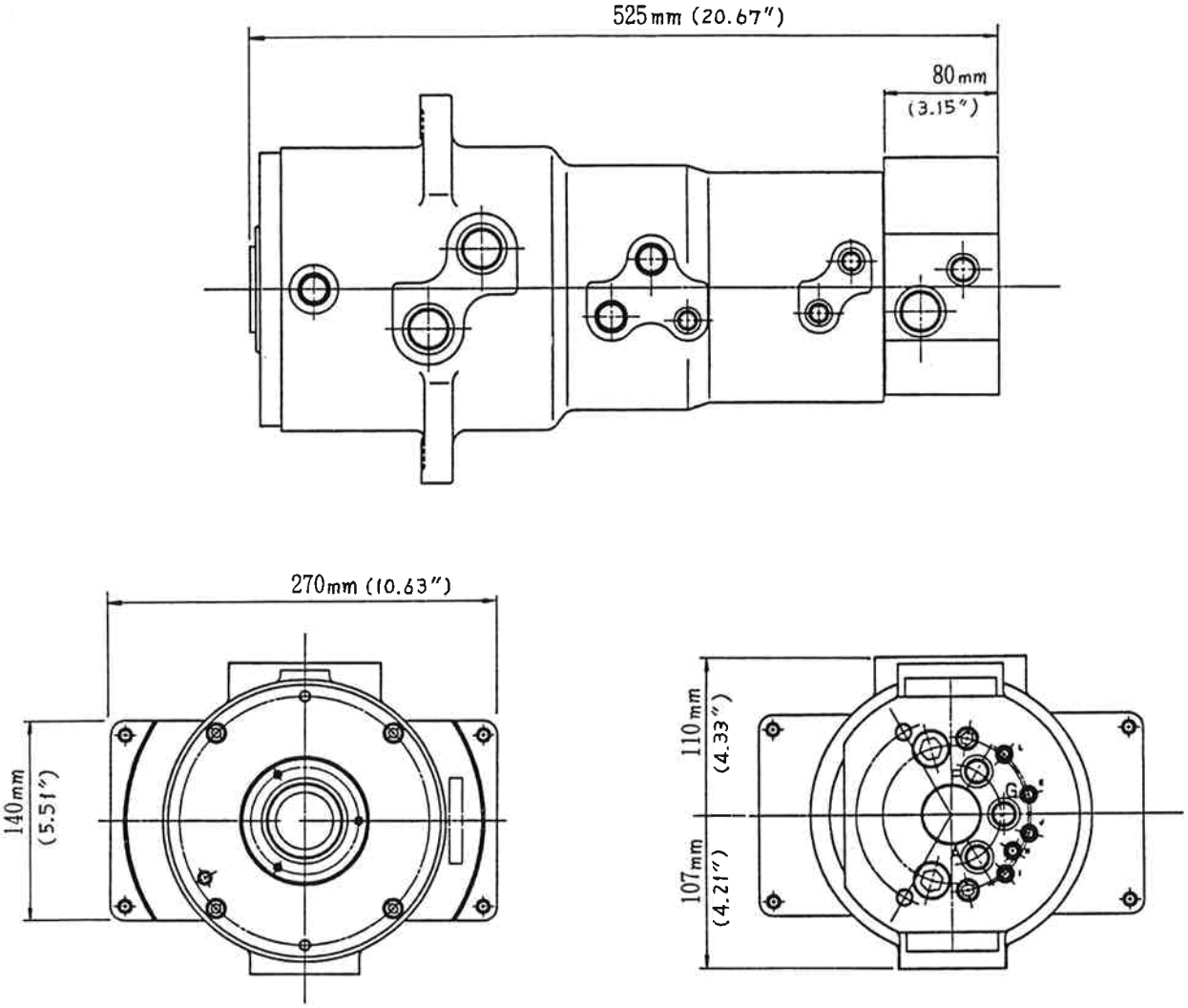
2. 3 CONSTRUCTION



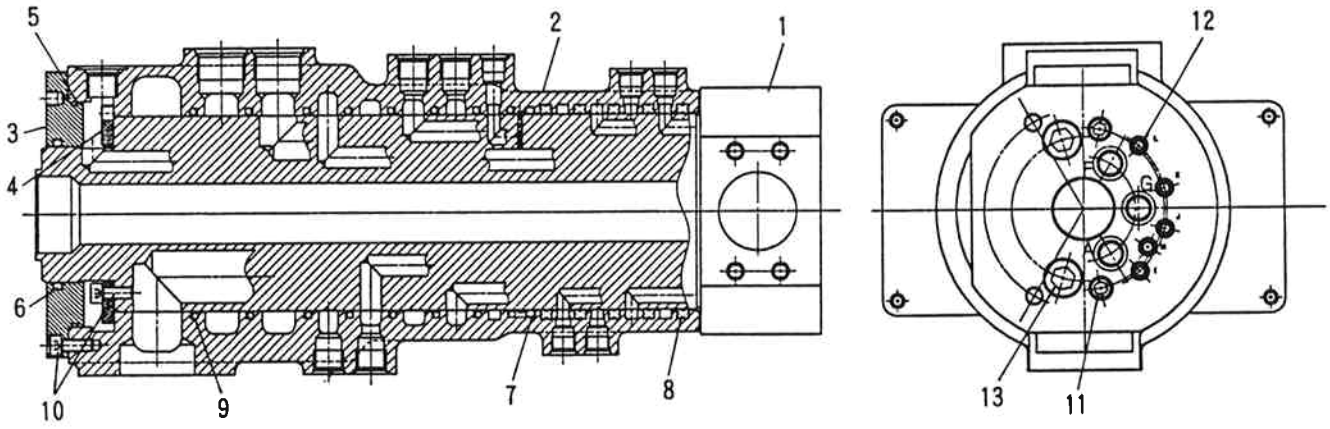
1. STEM
2. BODY
3. COVER
4. THRUST PLATE
5. O-RING
6. O-RING
7. O-RING
8. SEAL
9. SLIPPER SEAL
10. CAPSCREW
11. PLUG
12. PLUG
13. PLUG

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2. 2 DIMENSIONS



2. 3 CONSTRUCTION



1. STEM
2. BODY
3. COVER
4. THRUST PLATE
5. O-RING
6. O-RING
7. O-RING
8. SEAL
9. SLIPPER SEAL
10. CAPSCREW
11. PLUG
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13. PLUG

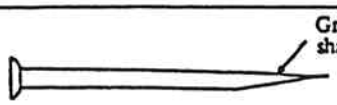
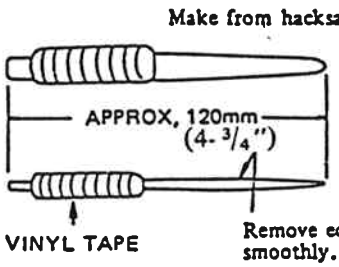
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3. DISASSEMBLY AND ASSEMBLY

3.1 PREPARATION

(1) TOOLS REQUIRED

Table 3-1 Tools Required

Item	Description	Purpose	Remarks
a	Hammer	Disassembly Assembly	1) Steel Hammer 2) Wooden or Plastic Hammer
b	Rubber Mat		Over 500mm (19-3/4") square or clean paper
c	Wrench		1) Allen Wrench 2) Both & Single Open End Wrench 3) Extension Pipe for Wrench
d	Torque Wrench	Assembly	10kg-m (72.3 ft-lbs.)
e	Pin	Disassembly	
f	Spatula	Disassembly Assembly	
g	Vise	Disassembly Assembly	Movable over 150 mm (6")

(2) EQUIPMENT

1) Lifting device or crane
   Capable of lifting and carrying the swivel joint assembly.
2) Work bench
   Required size: approx. 1.2m x 1.5m (3'-11¼"x4"-11")
3) Others
   Waste rags, wooden block, oil pan, etc.

(3) CLEANING

Clean outside of the swivel joint with steam or water to eliminate dirt, dust, etc.

NOTE

Mark match marks on the cover and body to facilitate reassembly.

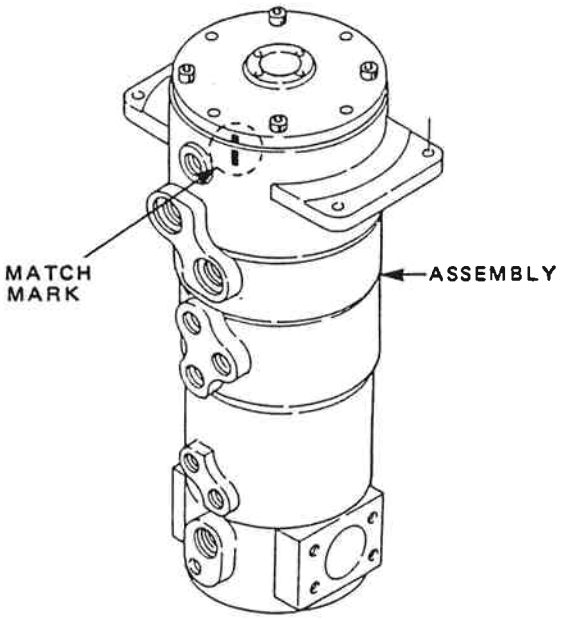


Fig. 3-1

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3.2 DISASSEMBLY

(1) REMOVING THE COVER

1) Place a V-block on the work bench and either place the swivel joint to turn sideways on the block or secure the stem with a vise.
2) Using a pipe and wrench, loosen the capscrews.
3) Remove the cover from the body, and take out the O-ring from the cover.

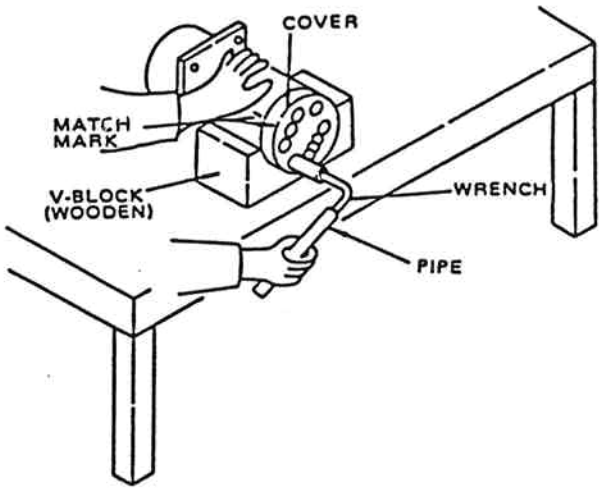


Fig. 3-2 Removing cover

(2) REMOVING THE THRUST PLATE

In the same manner for the cover, loosen the mounting capscrews and remove them. Locktite was used on the capscrews at the time of tightening. When unscrewing the capscrews, use an extension pipe inserted onto the Allen wrench.

(3) EXTRACTION OF THE STEM

Apply a wooden block to the stem, striking it with a hammer, pull the stem out from the body.
Once the stem has been extracted about halfways out from the body, it can then be pulled out easily with your hands. When pulling this out using your hands, be careful not to get your fingers caught under the falling stem which will fall out the instant the end part clears the body.

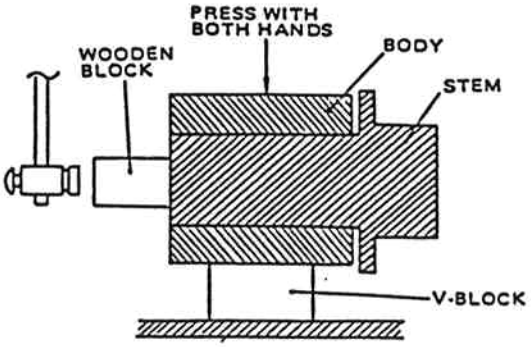


Fig. 3-3 Extracting Stem out

3.3 REMOVAL AND INSTALLATION OF SEALING PARTS

(1) REMOVING THE SEALING PARTS

1) O-rings

Using a spatula, remove the O-ring from the O-ring grooves by the manner shown in Fig. 3-4.

CAUTION

Be careful not to injure the body with the tip of the spatula. Also, do not tap the spatula.

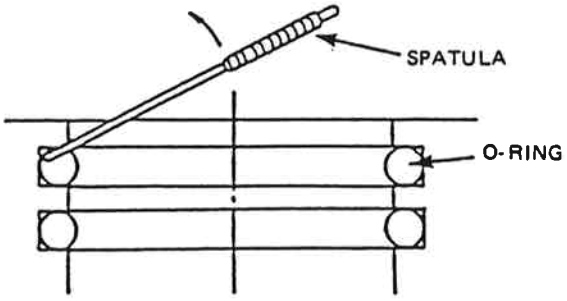


Fig. 3-4 Removing Manner of O-ring

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3.2 DISASSEMBLY

(1) REMOVING THE COVER

1) Place a V-block on the work bench and either place the swivel joint to turn sideways on the block or secure the stem with a vise.
2) Using a pipe and wrench, loosen the capscrews.
3) Remove the cover from the body, and take out the O-ring from the cover.

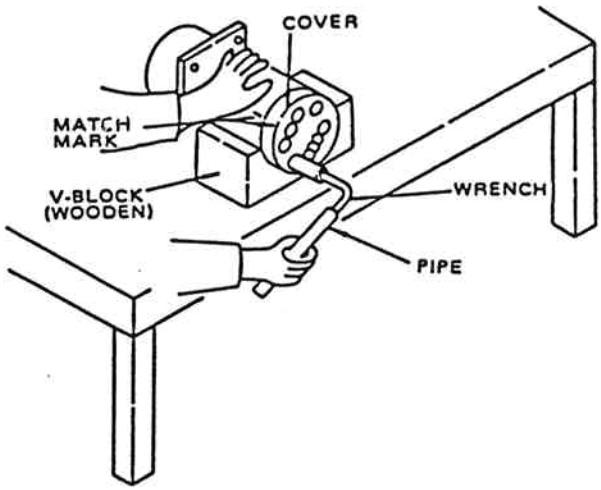


Fig. 3-2 Removing cover

(2) REMOVING THE THRUST PLATE

In the same manner for the cover, loosen the mounting capscrews and remove them. Locktite was used on the capscrews at the time of tightening. When unscrewing the capscrews, use an extension pipe inserted onto the Allen wrench.

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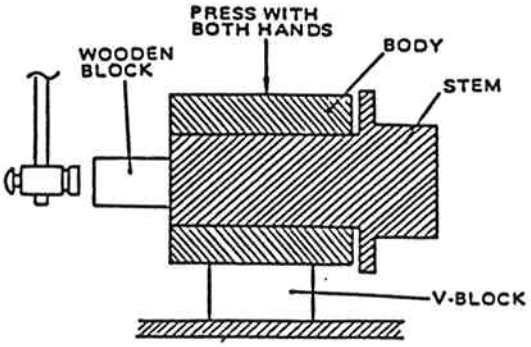


Fig. 3-3 Extracting Stem out

3.3 REMOVAL AND INSTALLATION OF SEALING PARTS

(1) REMOVING THE SEALING PARTS

1) O-rings

Using a spatula, remove the O-ring from the O-ring grooves by the manner shown in Fig. 3-4.

CAUTION

Be careful not to injure the body with the tip of the spatula. Also, do not tap the spatula.

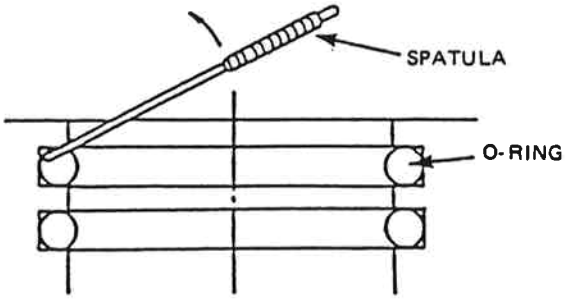


Fig. 3-4 Removing Manner of O-ring

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2) Slipper Seals

To remove the slipper seal, piercing the slipper seal with the pin tool, and twist to take out the slipper seal as shown in Fig. 3-5.

CAUTION

Be careful so much for handling the pin tool not to injure the swivel stem.

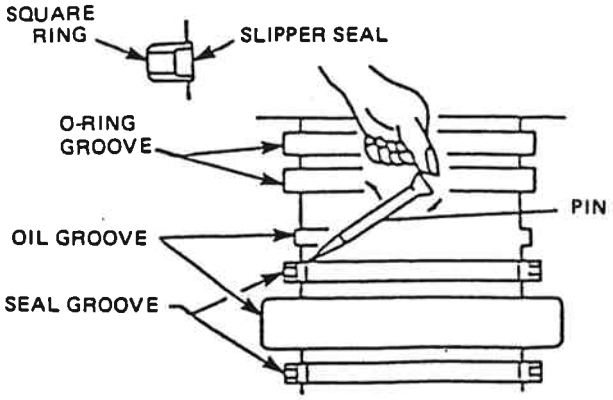


Fig. 3-5 Removing Manner of Slipper Seal

(2) INSTALLING THE SEALING PARTS

1) O-rings

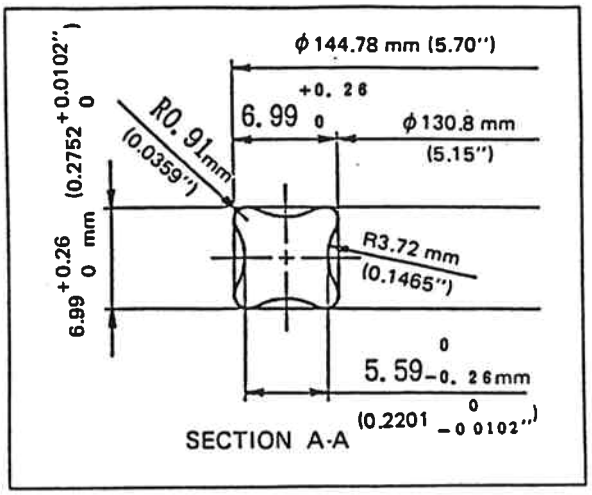
Apply vaseline (or hydraulic oil) to the surface of the O-ring and install this into the O-ring groove. Also, after installation of the O-ring, check the O-ring for shape so that it is neither twisted nor distorted.

2) Slipper Seals

The method of inserting the slipper seal is shown in Fig. 3-6 . Install this by deforming the shape a little and press it into the seal groove.

Also, do not forget to install the square ring first which is a part of the slipper seal set.

After inserting the entire seal parts, firmly install these into the seal groove by using a spatula.



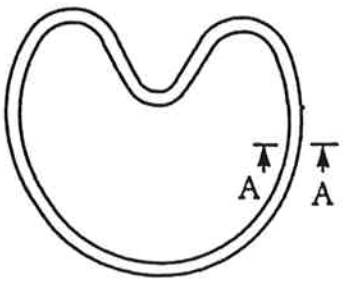


Fig. 3-6 Slipper Seal

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3.4 ASSEMBLY

(1) ASSEMBLY OF THE STEM TO BODY

Lightly coat the outer circumference of the stem and the inner surface of the body with grease, vaseline and slowly push the stem into the body.

CAUTION

Insert the stem slowly. Inserting the stem in vigorously may damage the seal parts. Also, as the clearance between the stem and body is about 0.1mm(0.004 in), assemble this upright in line with the axial center as shown in Fig. 3-7.

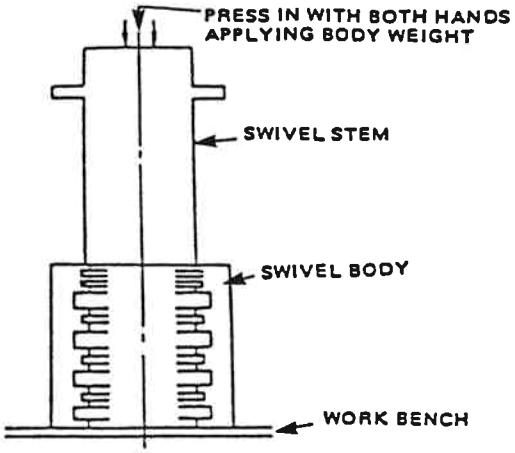


Fig. 3-7 Insertion of the Swivel Stem

(2) ASSEMBLY OF THE THRUST PLATE

As shown in Fig. 3-8, hold the stem and body, and align the plate holes with the stem holes.

Next, after wiping off oil from the thread part of the capscrews, apply locktite # 242, and tighten the capscrews to the stem with 3.1kg-m (22.4ft-lbs) of torque.

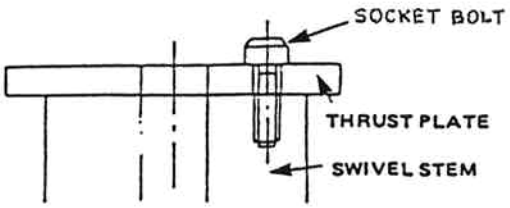


Fig. 3-8

(3) ASSEMBLY OF THE COVER

After installing the O-ring to the cover, match the match mark of the cover and body, and complete assembly by tightening the capscrews as sown in Fig. 3-9.

After wiping off oil from the thread port of the capscrews, apply locktite # 242, and tighten them to the body with 3.1kg-m (22.4ft-lbs) of torque.

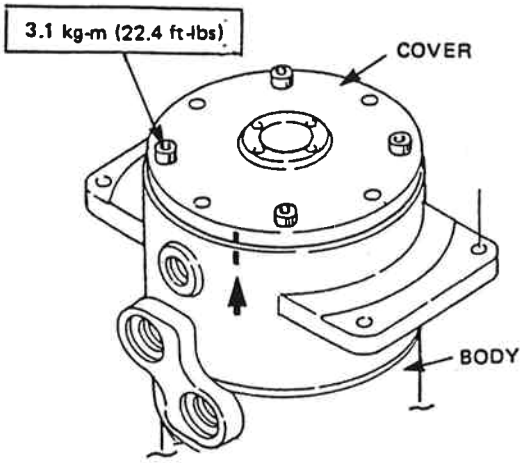
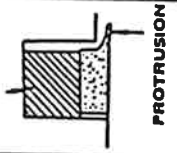
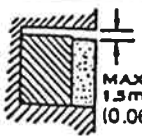
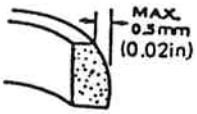


Fig. 3-9 Installation of Cover

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3.5 MAINTENANCE STANDARD

Location		Judgment Criterion	Remedy
Body and Stem	Sliding section with sealing parts.	Peeling of plating layer caused by wearing, seizure or by clogging of foreign matters.	Replace.
	Sliding section of body and stem other than seal part	For flaws over a depth of 0.1mm (0.004in) caused by seizure, clogging of foreign matters or abnormal wearing.	
		Flaws within a depth of 0.1mm (0.004in.)	Smooth out with oil stone.
	Sliding section with thrust plate	Wearing of over 0.5mm (0.02in) and/or abnormal wearing.	Replace.
		Wearing under 0.5mm (0.02in.)	Smooth out.
		Flaws caused by seizure, clogging of foreign matters and is within wearing limit (0.5mm) and repairable. (0.02in.)	Smooth out.
Cover	Sliding section with thrust plate	(1) Wearing over 0.5mm (0.02in) or abnormal wearing.	Replace.
		(2) Wearing under 0.5mm (0.02in)	Smooth out.
		(3) Flaws caused by seizure, clogging of foreign matters and is within wearing limit (0.5mm) and repairable. (0.02in)	Smooth out.
Slipper Seal		(1) Excessive protrusion from seal groove. 	Replace.
		(2) Slipper ring width is over 1.5mm (0.06in) smaller than seal groove width or smaller than back ring width. 	Replace.
		(3) Irregular wear over 0.5mm (0.02in). 	Replace.

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4. TEST PROCEDURE

Test Procedure

After completion of assembly, using an apparatus as shown in the figure below, perform an oil leakage and pressure proof test.

(1) HIGH PRESSURE PORT

Install a control valve and pressure gauge each to the stem side port and the body side port, and while watching the pressure gauge (for high pressure) installed to the body side, adjust the high pressure relief valve to gradually increase the pressure, and when the pressure reaches the highest working pressure x 1.5, close stop valve (3) and confine the pressurized oil to the swivel.

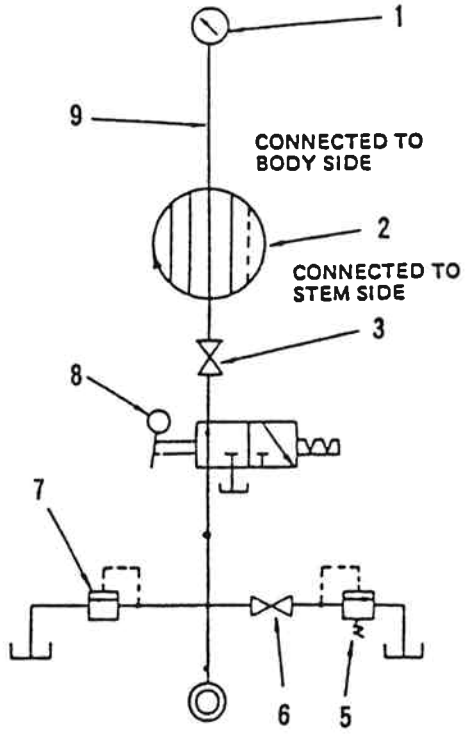
Stop valve (6) of the low pressure relief valve side at this time should be closed.

(2) LOW PRESSURE PORT

(Drain Port, Return Port, etc.)

Similar to the high pressure port, install a control valve and pressure gauge each to the stem side and body side.

Open stop valve (6) in the side of low pressure relief valve (5), and while watching the pressure gauge (for low pressure) connected to the body side, adjust low pressure relief valve (5) to gradually increase pressure, and perform a test (color check) at a pressure of 5kg/cm² (71psi).



Item No.	Description	Remarks
1	Pressure Gauge	For high pressure and low pressure
2	Swivel Joint	
3	Stop Valve	
5	Low Pressure Relief Valve	Set Pressure: 5kg/cm² (71psi)
6	Stop Valve	
7	High Pressure Relief Valve	Set Pressure: Highest Working Pressure x 1.5 times
8	Control Valve	
9	Piping, etc.	

NOTE
The highest working pressure mentioned here is the pressure in the machine on which the swivel joint is mounted.

Maintenance Standard

(1) Perform the test by applying pressure for 3 minutes and at this time, there should be no loose parts, deformation or damages. Also, judge whether there is oil leakage at the first 1 minute, and the pressure drop should be within 10% of the confined pressure.
This test should be performed for each circuit.

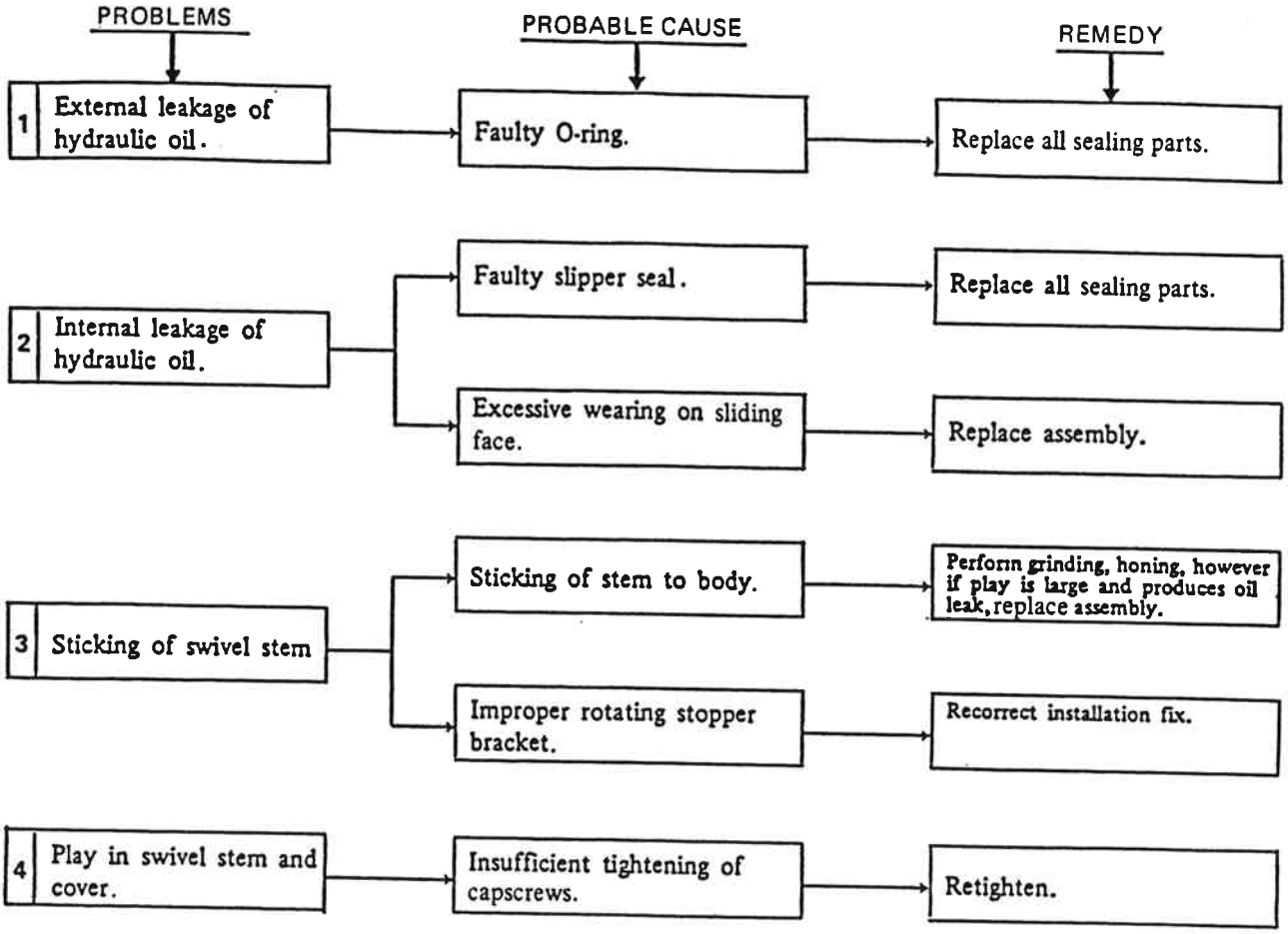
(2) There should be no oil leaks.

Remedy

Perform repair or replacement of the components after verifying the test results of the dimension measurement of each parts and presence of abnormalities with the serviceable limit.

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5. TROUBLESHOOTING



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1. CONSTRUCTION AND FUNCTION

1.1 CONSTRUCTION

1.1.1 SPECIFICATIONS

Type	Super gear counter shaft-type speed selection power shift
Speed selection	(3 forward speeds and 1 reverse speed) x 2 (High / Low selection type) Electromagnetic solenoid speed selection method
Speed shift clutch Type	Multiple disc wet type
Control valve Electromagnetic solenoid valve Regulator valve	6 valves (F1, F2, F3, Rev., Low and Trimmer Rated voltage: DC 24 volts Soft shift type
Parking brake Type Drum dia. Shoe width	Mechanical internal expanding type 254 mm (10 inches) 60 mm (2.36 inches)
Speedometer outlet Rotation direction	Facing mounting holes In forward Clockwise In reverse Counterclockwise

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1.1.2 CONSTRUCTION

(1) General sectional view

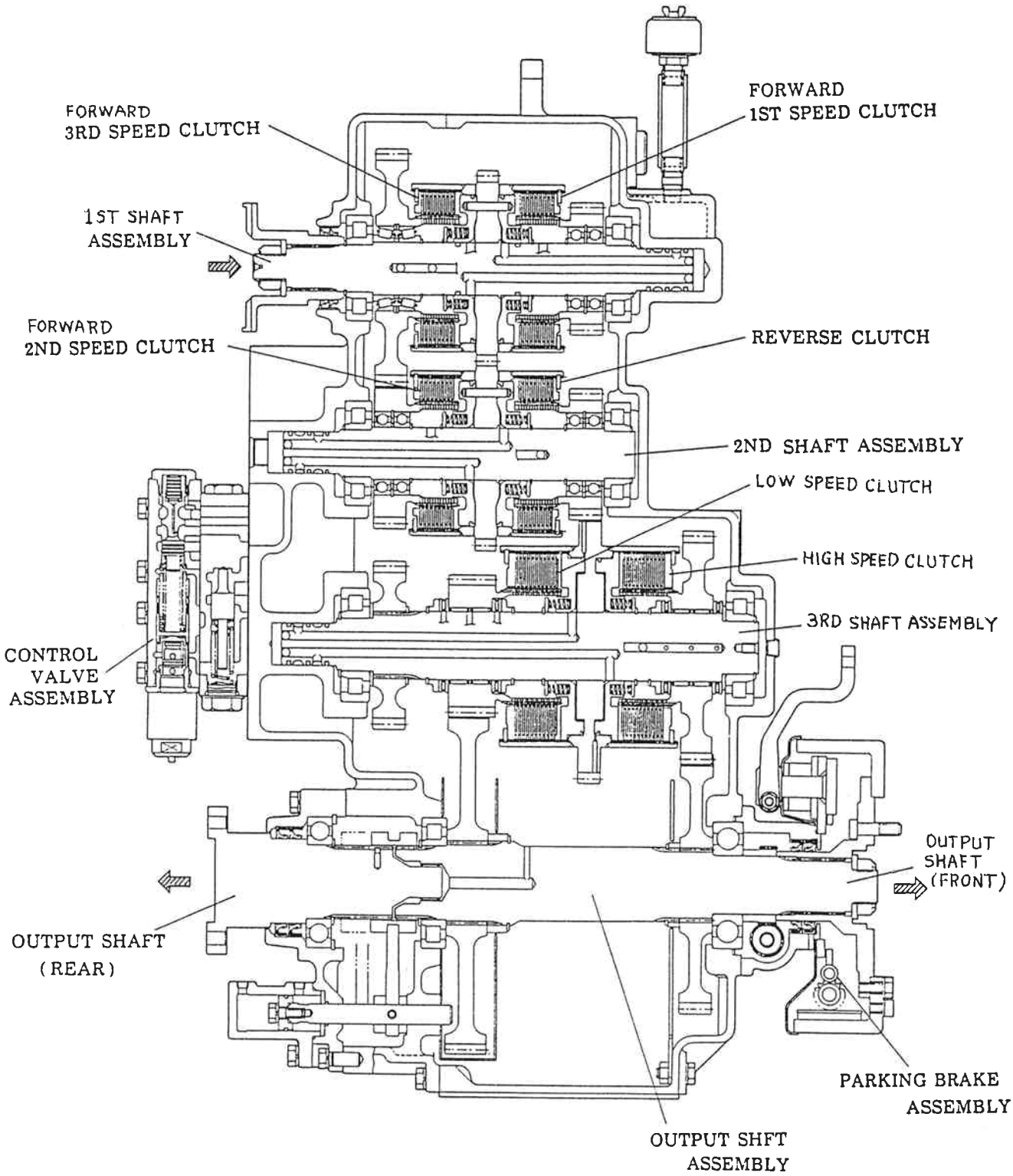
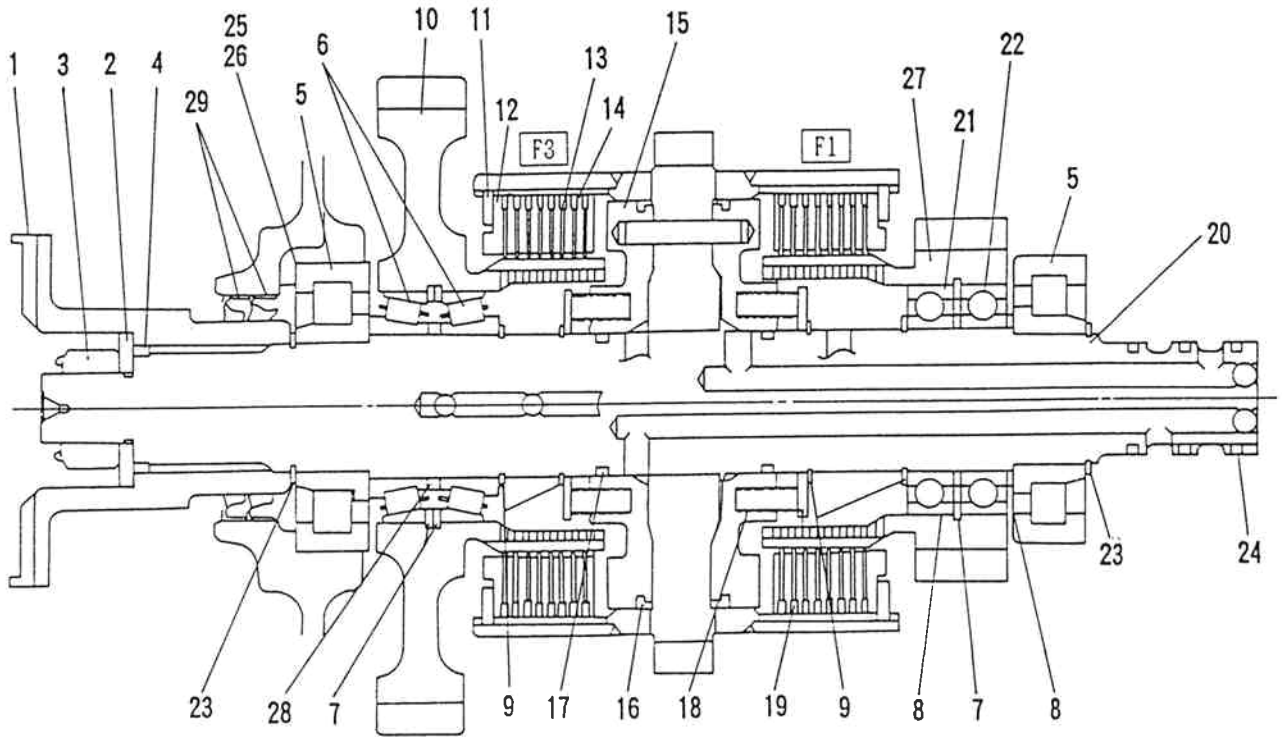


Fig. 1-1. General Sectional View

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(2) 1st shaft assembly

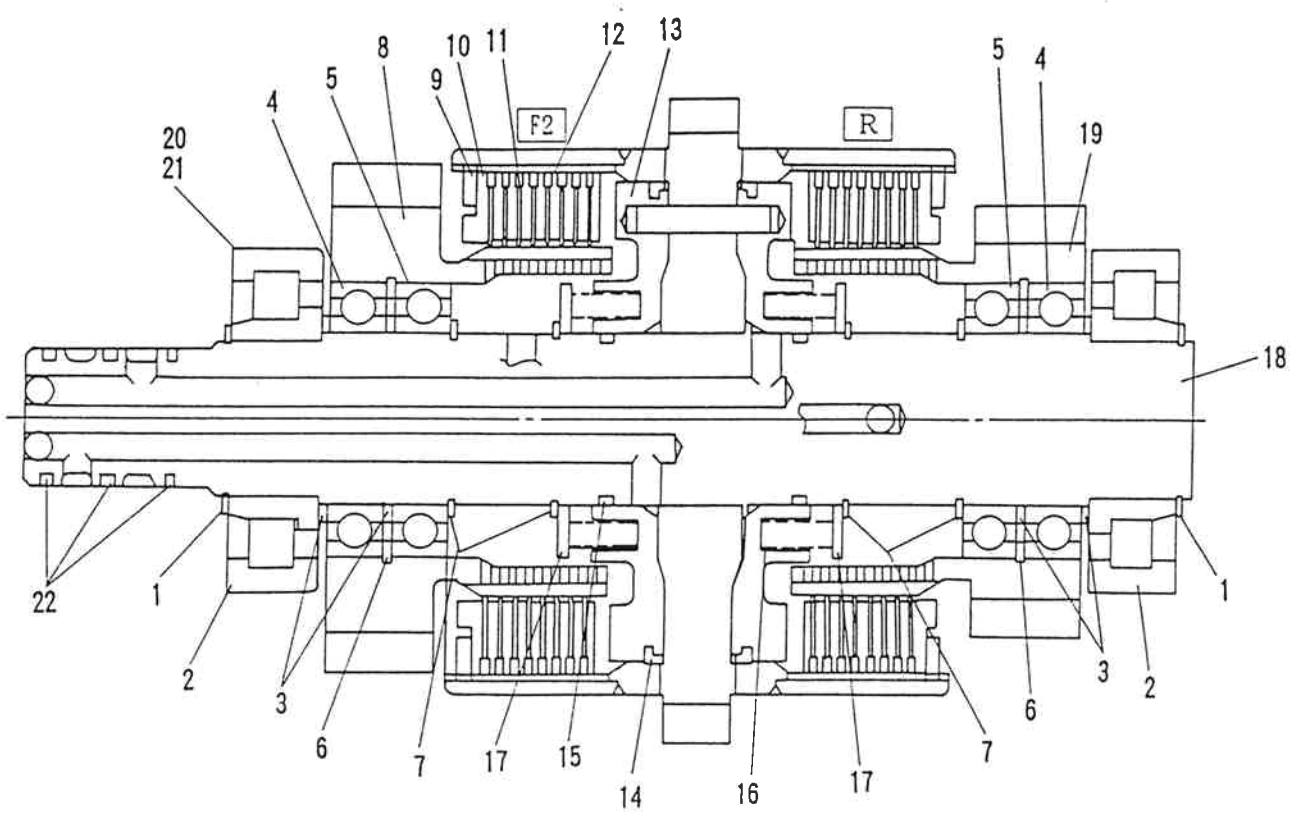


1. INPUT FLANGE	11. SNAP RING	21. BEARING
2. FLANGE WASHER	12. END PLATE	22. BEARING
3. U-NUT	13. FRICTION PLATE	23. SNAP RING
4. O-RING	14. SEPARATOR PLATE	24. SEAL RING
5. ROLLER BEARING	15. PISTON	25. SHIM
6. TAPER ROLLER BEARING	16. SEAL RING	26. SHIM
7. SNAP RING	17. O-RING	27. GEAR
8. SPACER	18. SPRING	28. SPACER
9. SNAP RING	19. PLATE	29. OIL SEAL
10. GEAR	20. SHAFT ASSEMBLY(1)	

Fig. 1-2 1st Shaft Assembly

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(3) 2nd shaft assembly

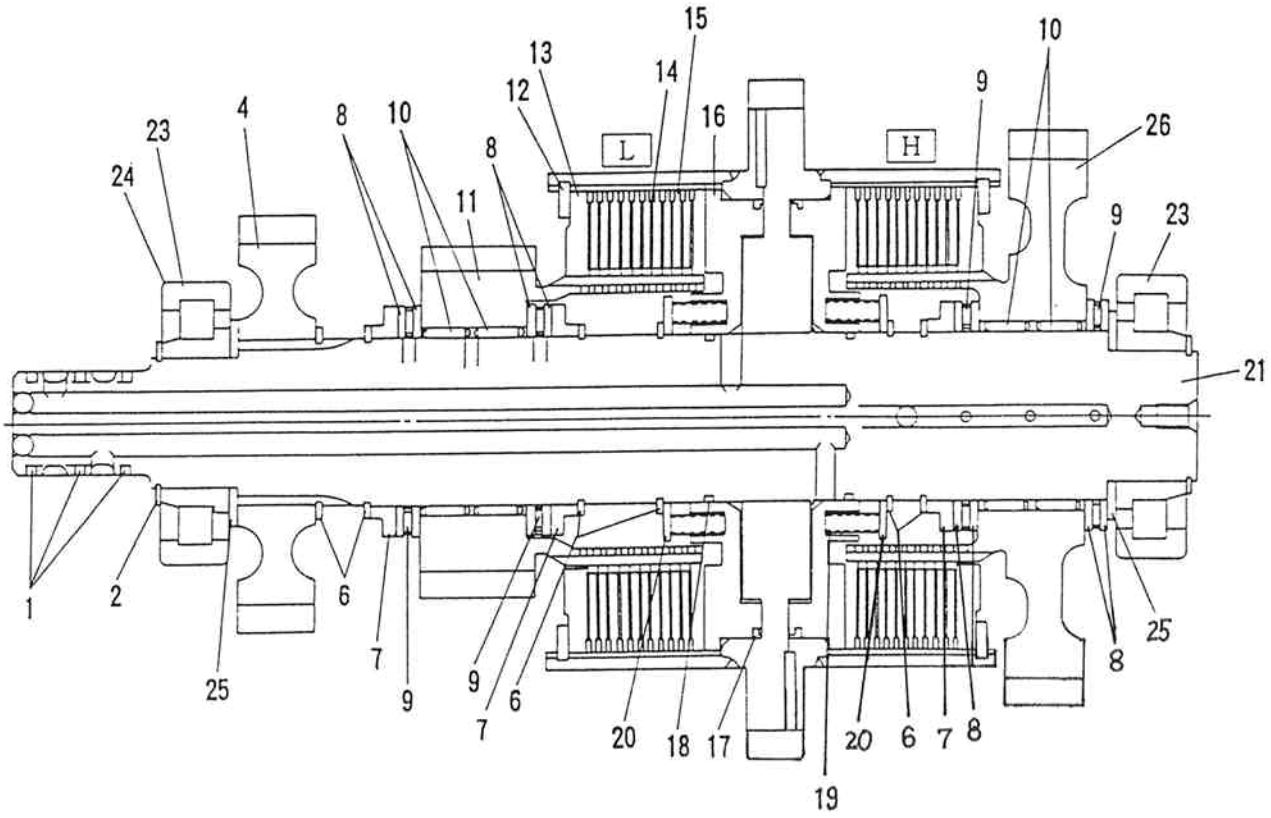


1. SNAP RING	11. FRICTION PLATE	21. SHIM
2. ROLLER BEARING	12. SEPARATOR PLATE	22. SEAL RING
3. SPACER	13. PISTON	
4. BEARING	14. SEAL RING	
5. BEARING	15. O-RING	
6. SNAP RING	16. SPRING	
7. SNAP RING	17. PLATE	
8. GEAR	18. SHAFT ASSEMBLY (2)	
9. SNAP RING	19. GEAR	
10. END PLATE	20. SHIM	

Fig. 1-3 2nd Shaft Assembly

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(4) 3rd shaft assembly



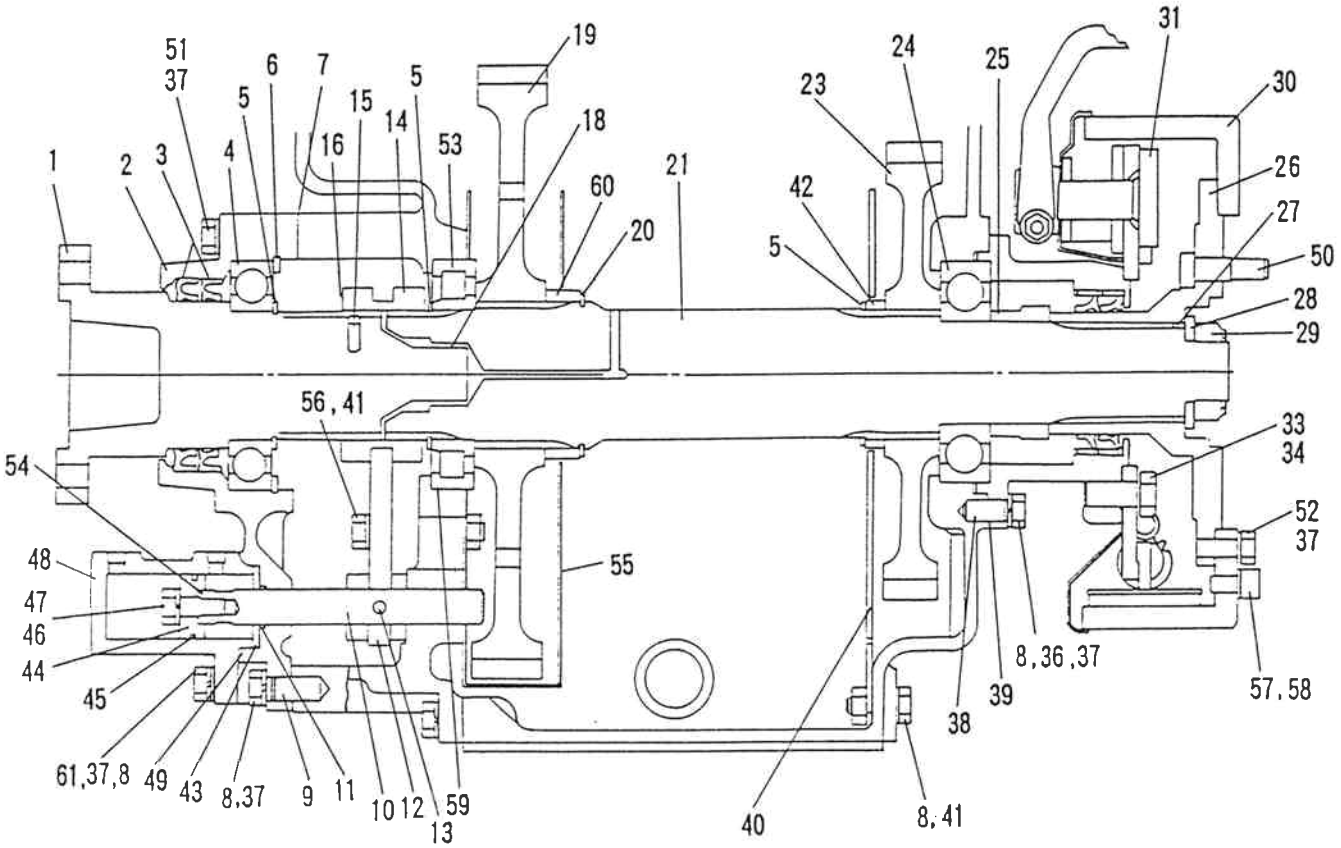
1. SEAL RING
2. SNAP RING
4. GEAR
6. SNAP RING
7. RETAINER
8. THRUST WASHER
9. THRUST NEEDLE BEARING
10. NEEDLE BEARING
11. GEAR
12. SNAP RING
13. END PLATE
14. FRICTION PLATE
15. SEPARATOR PLATE
16. CLUTCH PISTON
17. SEAL RING
18. PISTON RING
19. SPRING
20. PLATE
21. SHAFT ASSEMBLY (3)
23. BEARING
24. SHIM
25. PLATE
26. GEAR

Fig. 1-4 3rd Shaft Assembly

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(5) Output shaft assembly

Fig. 1-5 Output Shaft Assembly

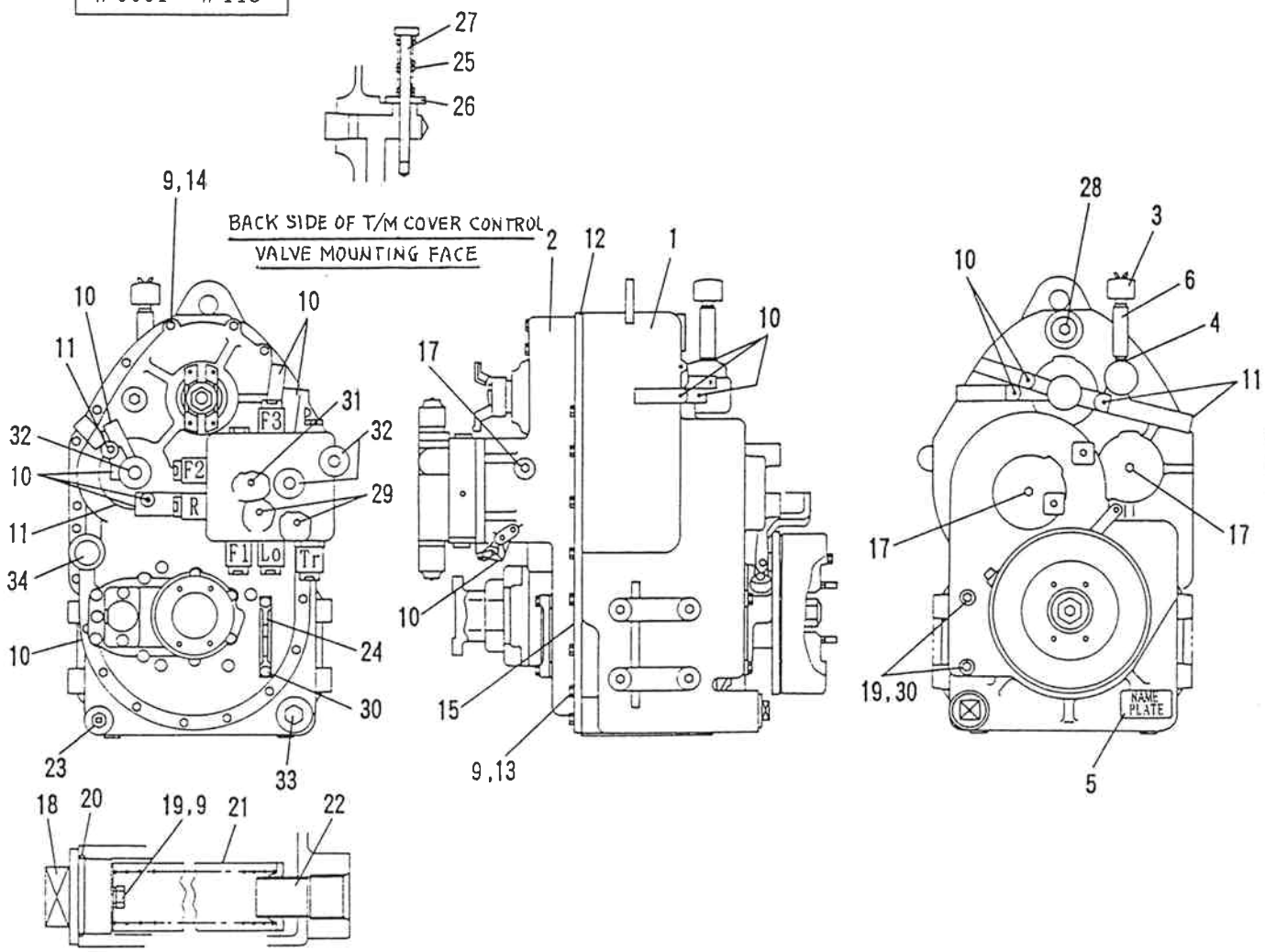


1. OUTPUT SHAFT
2. CASING COVER
3. OIL SEAL
4. BEARING
5. SNAP RING
6. SNAP RING
7. GASKET
8. BOLT (M10×30)
9. PIN
10. SHAFT
11. O-RING
12. FORK
13. PIN
14. SHIFT COLLAR
15. STEEL BALL
16. SPRING
17. PLUG
18. NEEDLE ROLLER BEARING
19. GEAR
20. SNAP RING
21. OUTPUT SHAFT
23. GEAR
24. BEARING
25. DRIVE GEAR
26. OUTPUT FLANGE
27. O-RING
28. WASHER
29. U-NUT
30. BRAKE DRUM
31. BRAKE ASSEMBLY
33. BOLT (M14×30)
34. WASHER (M14)
36. BOLT (M10×70)
37. WASHER (M10)
38. PIN
39. GASKET
40. PLATE
41. SEAL WASHER (M10)
42. SPACER
43. RETAINER
44. PISTON
45. O-RING
46. BOLT (M10×30)
47. WASHER (M10)
48. CYLINDER
49. O-RING
50. BOLT
51. BOLT (M10×60)
52. BOLT (M10×25)
53. ROLLER BEARING
54. O-RING
55. SHROUD
56. BOLT (M10×65)
57. BOLT (M10×16)
58. WASHER (M10)
59. SHIM
60. COLLAR
61. WASHER (M10)

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(6) Transmission case assembly

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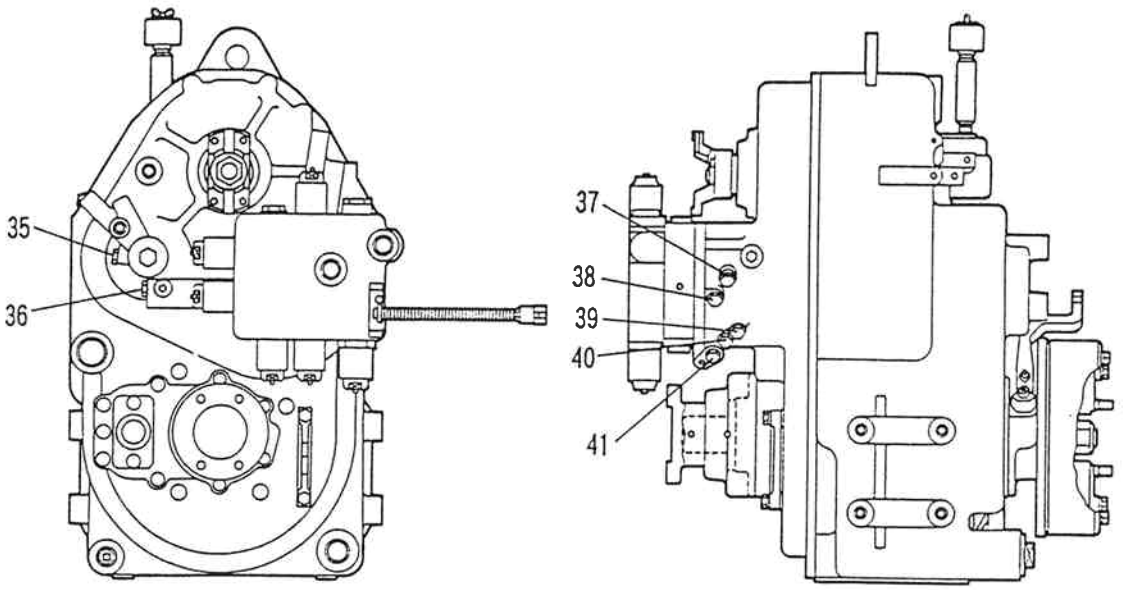


1. TRANSMISSION HOUSING
2. TRANSMISSION COVER
3. AIR BREATHER
4. FITTING (3/8)
5. NAME PLATE
6. PIPE
8. BOLT (M10×25)
9. WASHER (M10)
10. PLUG (1/8)
11. PLUG (1/4)
12. GASKET
13. BOLT (M10×30)
14. BOLT (M10×10)
15. PIN (13×28)
16. PLUG (1/2)
17. PLUG (3/8)
18. PLUG (48)
19. BOLT (M10×15)
20. O-RING
21. STRAINER
22. PIPE
23. PLUG (3/4)
24. LEVEL GAUGE
25. SPRING
26. REGULATOR VALVE
27. GUIDE PIN
28. PLUG (1 1/4)
29. RESTRICTOR
30. STUD
31. RESTRICTOR
32. CAP
33. CAP
34. CAP

Fig. 1-6 Transmission Case Assembly (1/2)

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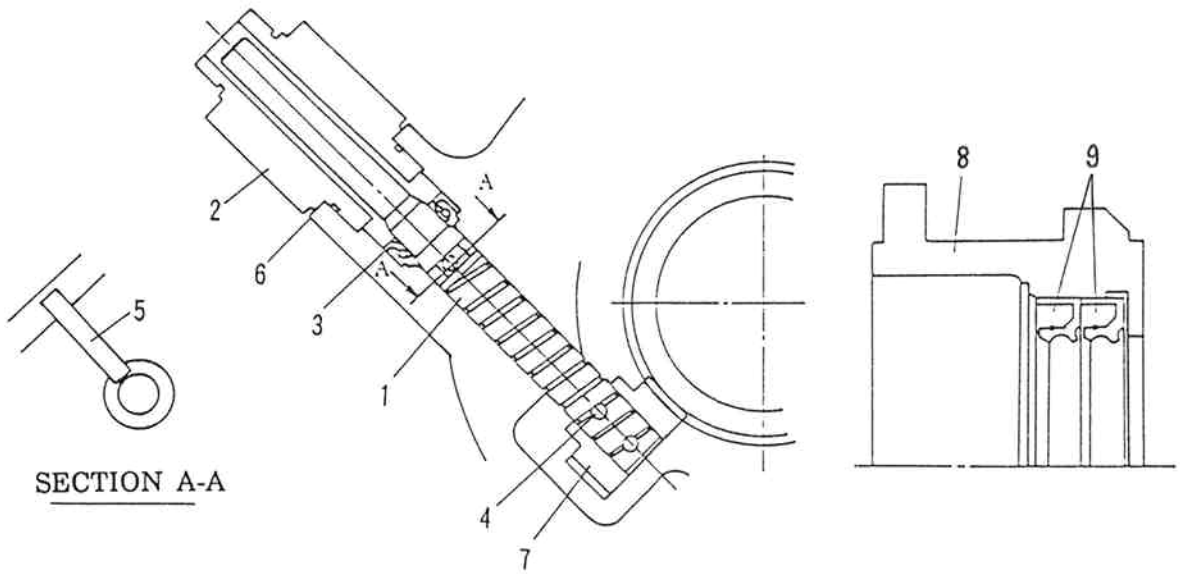
#114~



35. PLUG 1/4 (F2)
36. PLUG 1/4 (REV)
37. PLUG 1/4 (F3)
38. PLUG 1/4 (F1)
39. PLUG 1/4 (High)
40. PLUG 1/4 (Low)
41. MAIN OIL PRESSURE TAKING OUT PORT (PF 1/4 PLUG TIGHTENED)

Fig. 1-6 Transmission Case Assembly (2/2)

(7) Speedometer assembly

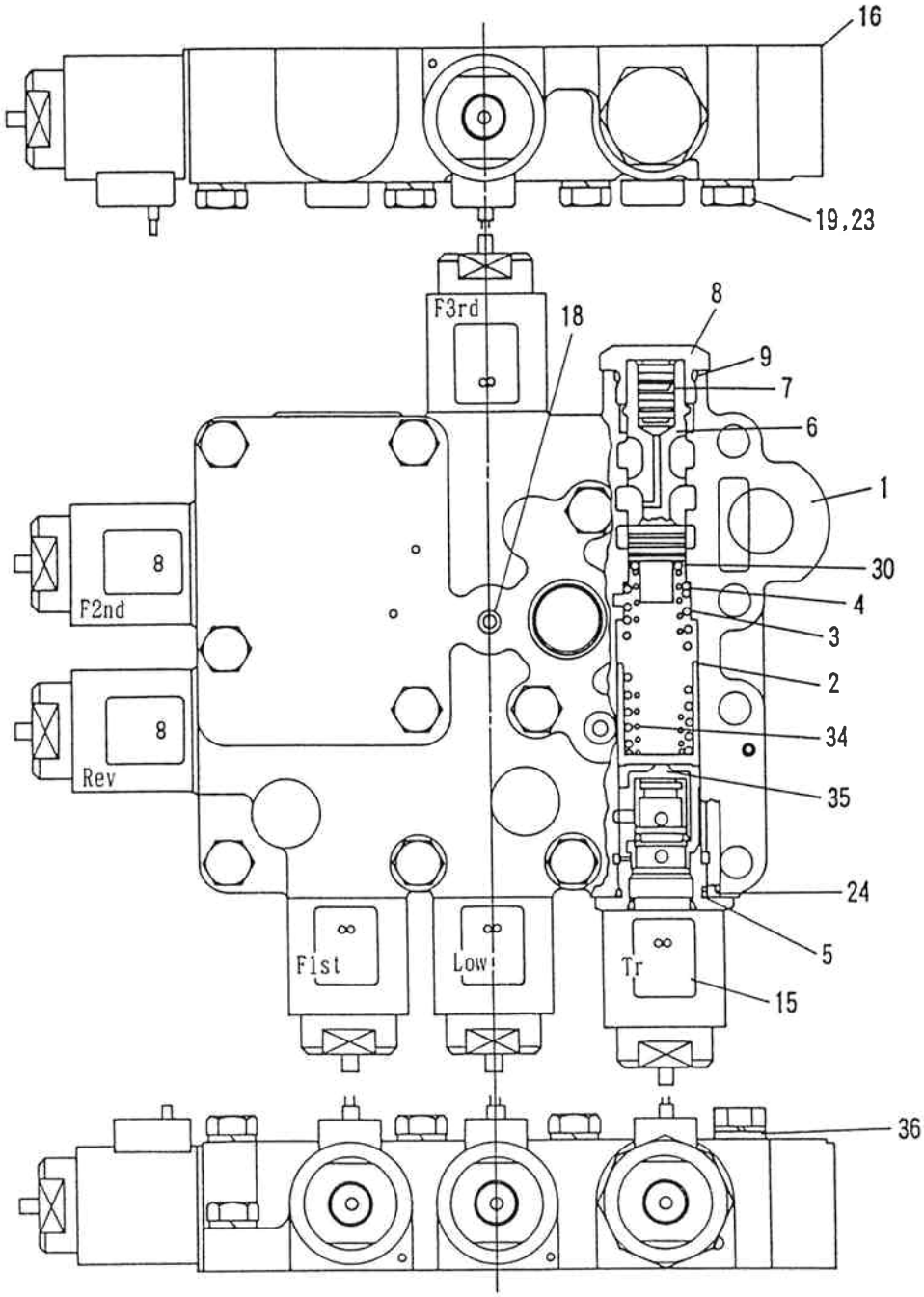


1. SHAFT
2. UNION
3. OIL SEAL
4. PIN
5. PIN
6. GASKET
7. DRIVEN GEAR
8. SEAL RETAINER
9. OIL SEAL

Fig. 1-7. Speedometer Assembly

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(8) Upper control valve assembly

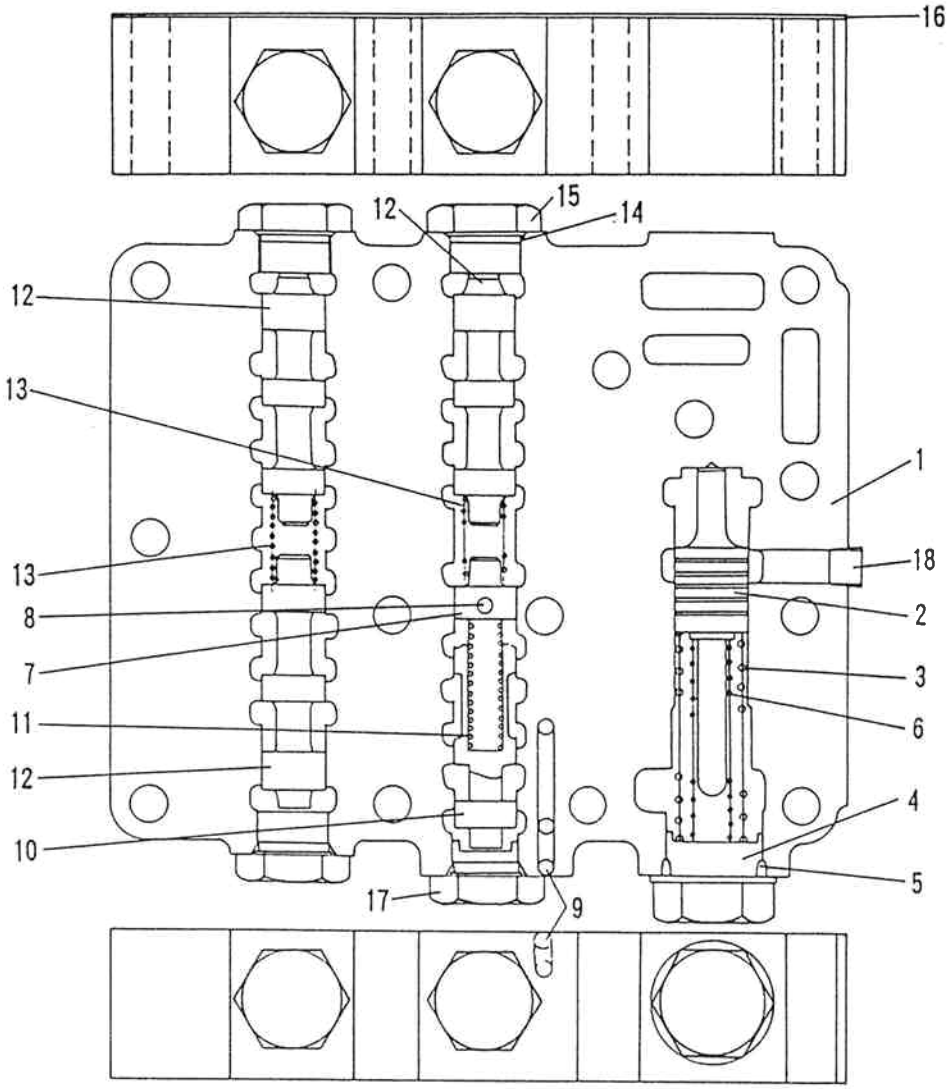


1. UPPER VALVE BODY
2. MODULATOR
3. TRIMMER SPRING
4. REGULATOR SPRING
5. O-RING
6. REGULATOR VALVE
7. SEAL RETAINER
8. PLUG
9. O-RING
15. SOLENOID VALVE
16. GASKET
18. PLUG (1/8)
19. BOLT (M10×110)
23. WASHER (M10)
24. STEEL BALL
30. GASKET
34. PLUG (1/4)
35. SOLENOID BLOCK
36. PLATE

Fig. 1-8 Upper Control Valve Assembly

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(9) Lower control valve assembly

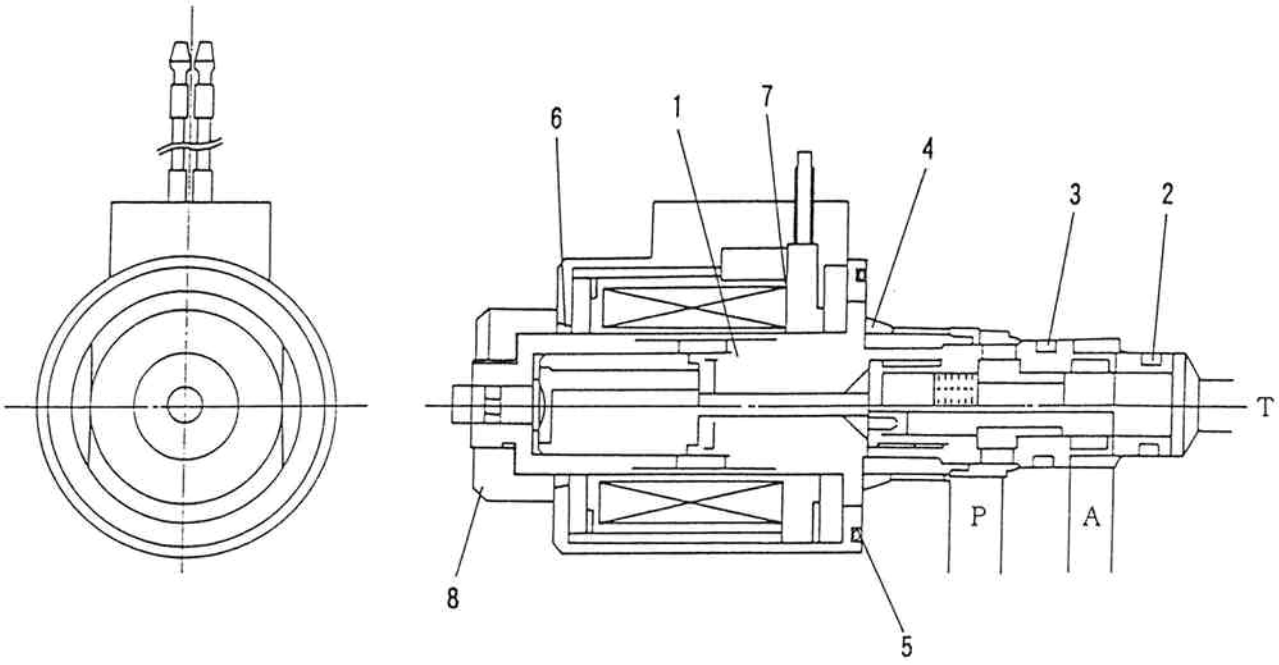


1. LOWER VALVE BODY	7. STOPPER	13. SPRING
2. PRIORITY VALVE	8. PIN	14. O-RING
3. SPRING	9. STEEL BALL	15. PLUG
4. PLUG (30)	10. VALVE SPOOL (L)	16. GASKET
5. O-RING	11. SPRING	17. PLUG
6. SPRING	12. VALVE SPOOL	18. PLUG (1/8)

Fig. 1-9 Lower Control Valve Assembly

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(10) Solenoid valve



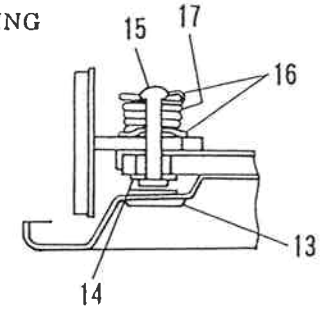
P : FROM REGULATOR
A : TO CLUTCH
T : DRAIN PORT

1. VALVE BODY
2. O-RING
3. O-RING
4. O-RING
5. O-RING
6. O-RING
7. COIL ASSEMBLY
8. NUT

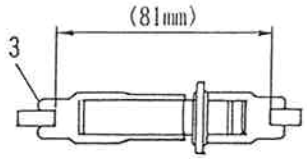
Fig. 1-10 Solenoid Valve

(11) Parking brake assembly

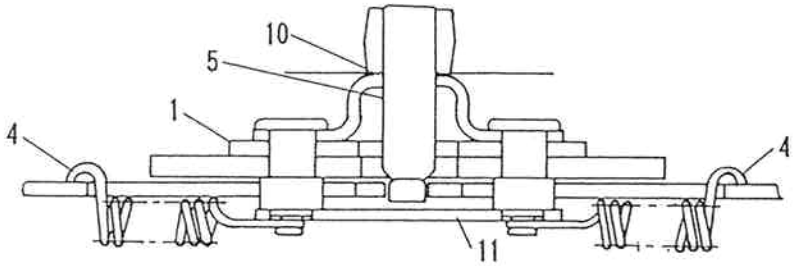
1. SUPPORT PLATE
2. ASSEMBLY SHOE
3. ADJUSTER
4. SPRING
5. CAMSHAFT
6. LEVER
7. LOCKWASHER
8. NUT
9. BOLT
10. WASHER
11. PLATE
12. SPRING
13. COVER
14. WASHER
15. PIN
16. CUP
17. SPRING



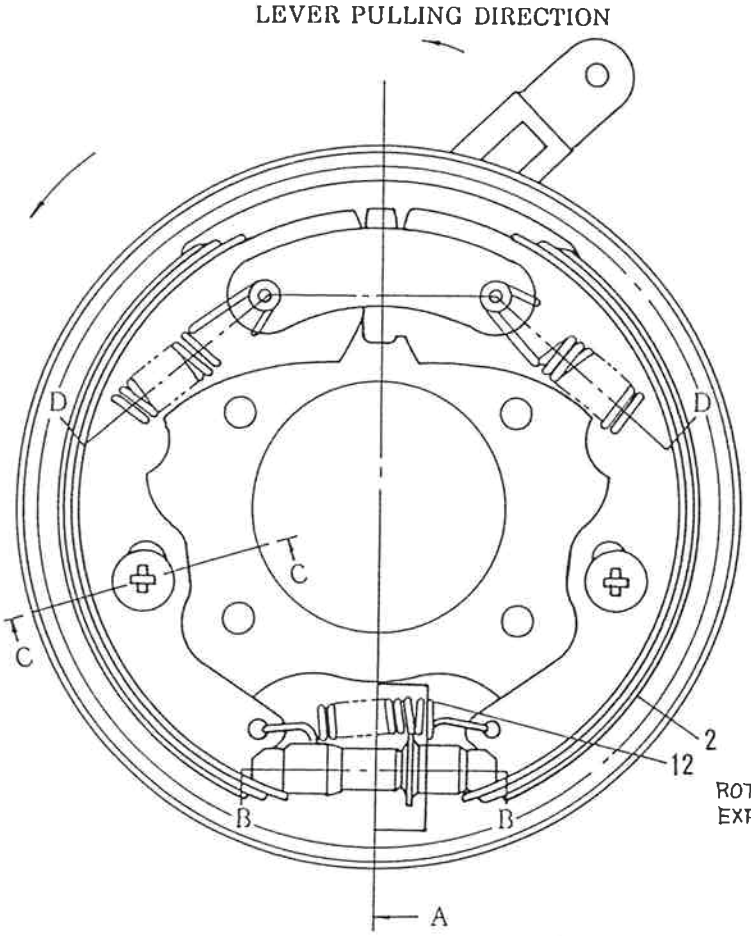
SECTION C-C

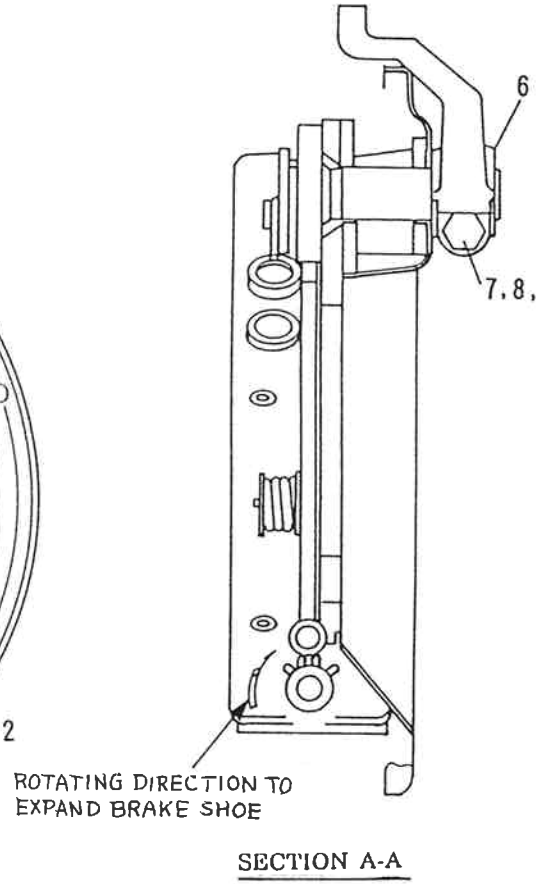


SECTION B-B



SECTION D-D





SECTION A-A

Fig. 1-11 Parking Brake Assembly

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1.2 FUNCTION

This transmission assembly is composed of the following mechanisms:

1 Transmission mechanism
2 Control valve
3 Parking brake

1.2.1 TRANSMISSION MECHANISM

(1) Transmission and forward/reverse shifting

This transmission consists of countershaft-type constantly engaged gears and wet-type clutches. Full power hydraulic shifting between all clutches provides 3 forward and 1 reverse gears (6 forward and 2 reverse with high/low speed changeover).

The countershaft is composed of the 1st shaft assembly with the forward 3rd speed and forward 1st speed clutches attached, the 2nd shaft assembly with the forward 2nd speed and reverse clutches attached, and the 3rd shaft assembly with the low speed and high speed clutches attached.

Each clutch is made of paper and alternately assembled friction plates with internal splines and steel plates with external splines. The plates are engaged by hydraulic power and released by springs.

The hydraulic circuit is provided with a modulator circuit to moderate hydraulic pressure build-up when shifting gears. A degree of clutch slippage is designed to absorb the shock of gear changing and provide more comfortable operation.

(2) High/low speed changeover

Normally the high speed clutch operates, but when the low speed solenoid valve operates by means of signal, the clutch shifts from the high speed to the low speed. At the same time, the air cylinder operates to the four wheel drive.

(3) Clutch function (See Fig. 1-12)

For example, when the speed change lever signal shifts to the forward 1st speed, the F1 solenoid valve operates, and oil pressure from the control valve passes through the oil hole opened in the forward 1st speed clutch assembly shaft to act to the piston of the forward 1st speed clutch. The pistons move against the springs; the friction plate meshed with the inner hub and separator plate meshed with the housing spline are press-set.

When the clutch engages, the power from the gears is transmitted to the drive gear via the inner hub, clutch and housing.

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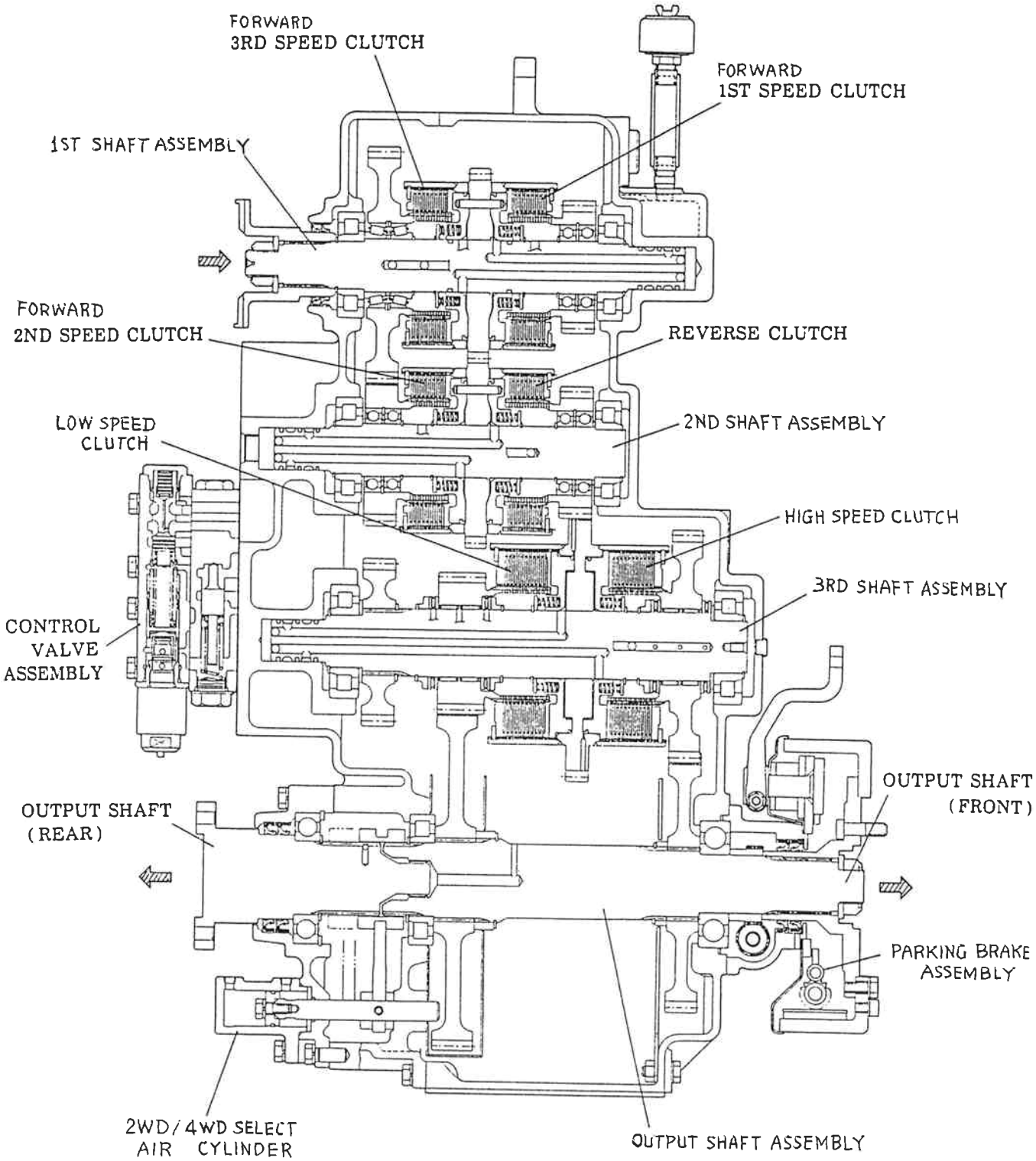
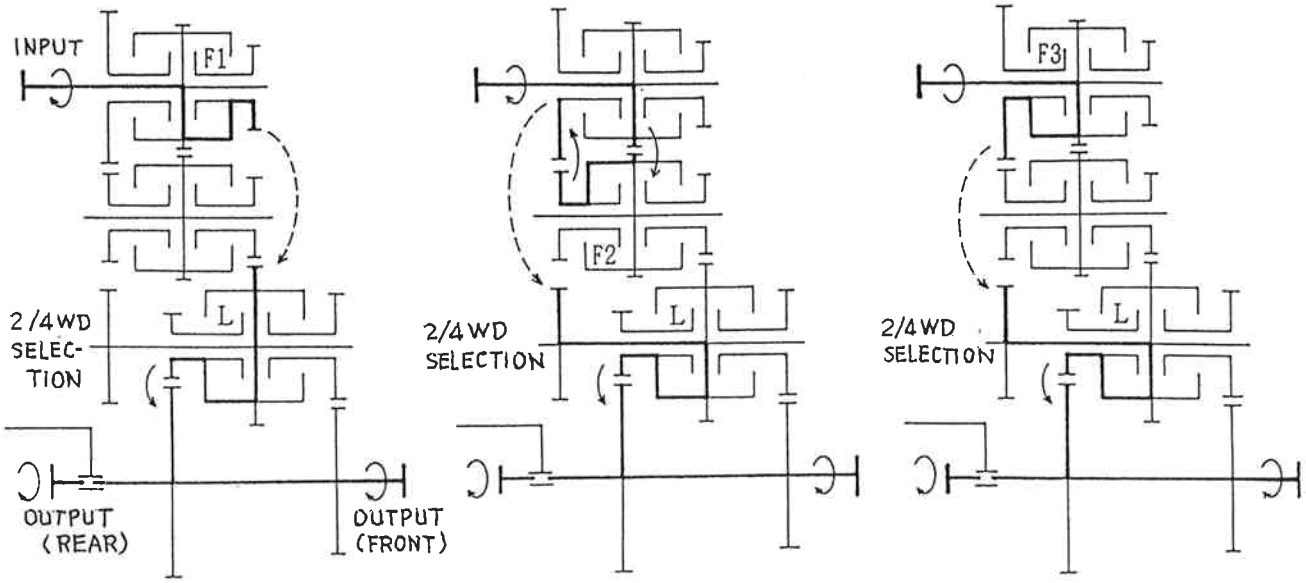


Fig. 1-12

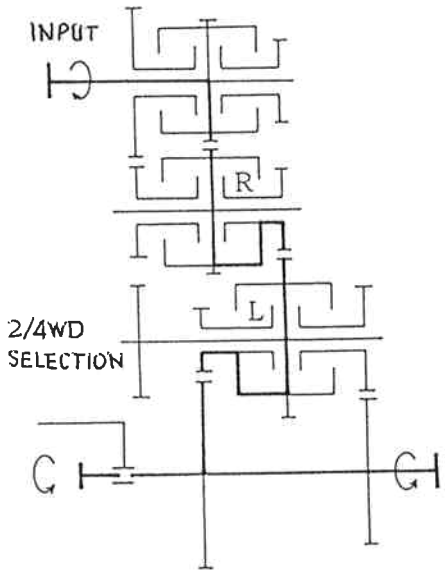
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(4-1) Power transmission routes in the transmission

Fig. 1-13 shows the power transmission routes when the shift lever is shifted into each gear. (In case of Low speed range)



1ST SPEED FORWARD 2ND SPEED FORWARD 3RD SPEED FORWARD



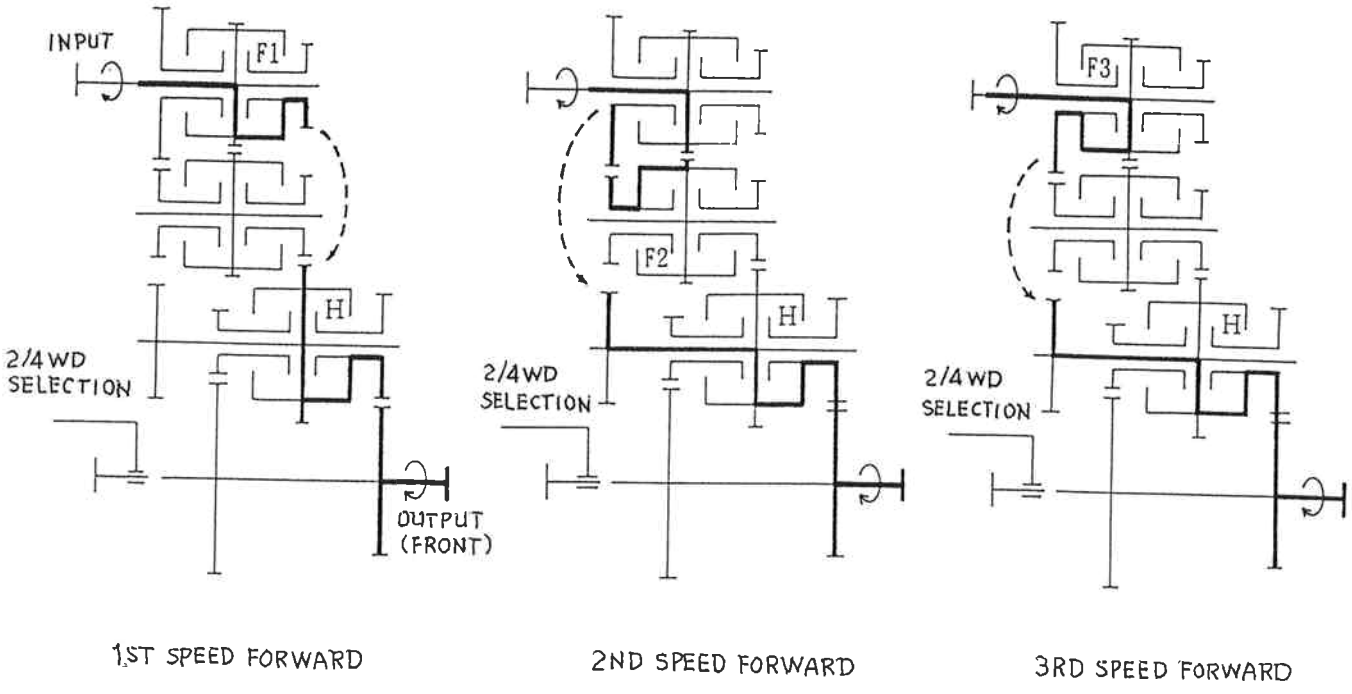
REVERSE

Fig. 1-13. Power Transmission Routes in Transmission (Low Speed)

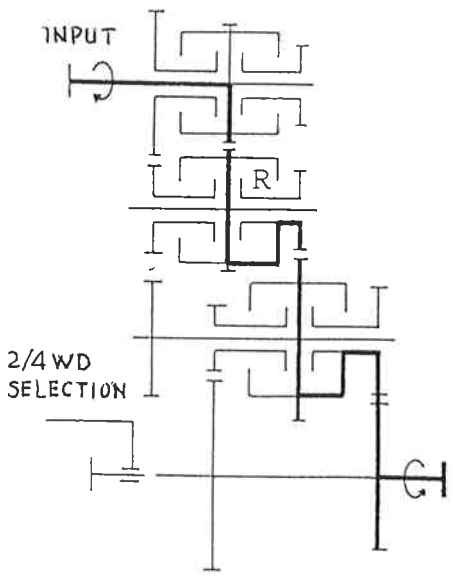
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(4-2) Power transmission routes in the transmission

Fig. 1-14 shows the power transmission routes when the shift lever is shifted into each gear.
(In case of High speed range)



1ST SPEED FORWARD　　2ND SPEED FORWARD　　3RD SPEED FORWARD



REVERSE

Fig. 1-14 Power Transmission Routes in Transmission (High Speed)

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1.2.2 CONTROL VALVE

(1) Construction

The construction of the control valve is shown in Fig. 1-15. Inside the control valve, the lower valve is provided with the priority valve which controls the lock-up circuit and controllable P.T.O. circuit, and the upper valve is provided with the regulator valve, which controls the torque converter circuit, and the modulator valve which controls pressure rising time in one body.

And, the lower valve is equipped with the sequence valve which prevents duplcate engagement of the clutches. The priority valve functions to prevent the oil pressure from lowering even when the travel clutch is operated.

The regulator valve adjusts the clutch pressure and leads the oil which passes through the valve to the converter. The trimmer valve is composed of the solenoid valve and accumulator, and performs smooth shifting. By its pressure, the solenoid valves, for selection of forwand / reverse and for shifting the speed range, are controlled. In the torque converter side, the lock-up circuit is provided with an exclusive solenoid valve to control the torque converter lock-up clutch so that the lock-up operates automatically (at a fixed speed). On and Off of the controllable P.T.O. also is controlled with the exclusive solenoid valve.

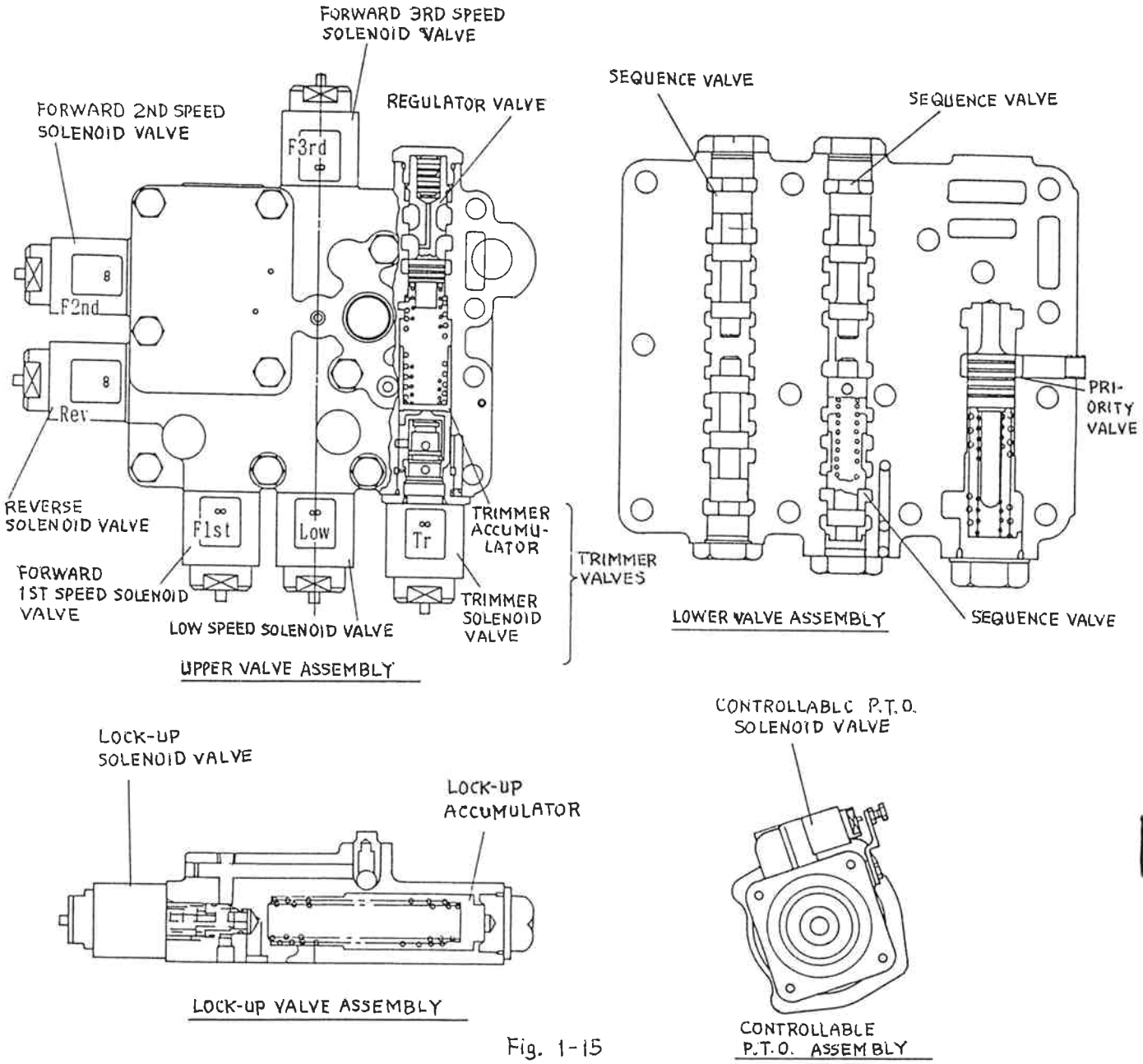
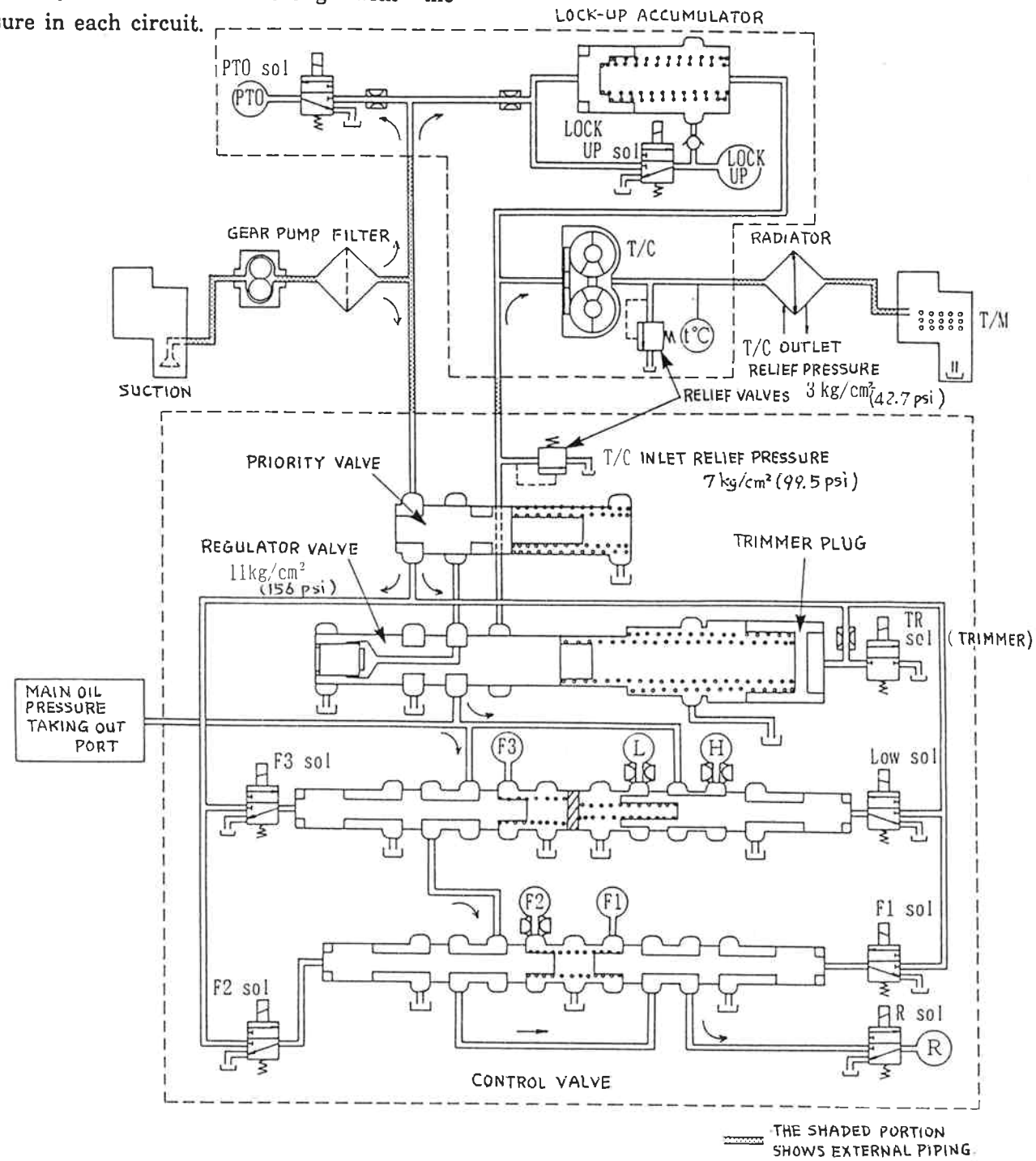


Fig. 1-15

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(2) Hydraulic circuit

Fig. 1-16 shows the transmission and the related hydraulic circuits along with the pressure in each circuit.



◯ Solenoid Valve Operation Table

Shift / Sol	Low				High				Remarks
	F 1	F 2	F 3	R	F 1	F 2	F 3	R	
F 1	◯				◯				
F 2		◯				◯			
F 3			◯				◯		
R				◯				◯	
LOW	◯	◯	◯	◯					
Tr (Trimmer)	◎	◎	◎	◎	◎	◎	◎	◎	Operation at shift only

Fig. 1-16. Hydraulic Circuit

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(3) Priority valve

The oil delivered from the gear pump passes the oil filter and is led to the priority valve. The oil pressure set with the priority valve connects the lock-up clutch and the controllable P.T.O. clutch. Besides, the oil is led to the solenoid valve for the the forward/reverse clutch and for speed shift clutch, and is used as a pilot oil pressure of the sequence valve. Further, the oil is used for the solenoid valve for the trimmer, too. The oil which has passed the priority valve is led to the regulator valve which controls the transmission clutch hydraulic pressure.

This valve has the purpose to prevent oil pressure of the lock-up clutch and controllable P.T.O. clutch from lowering when the transmission clutch is shifted.

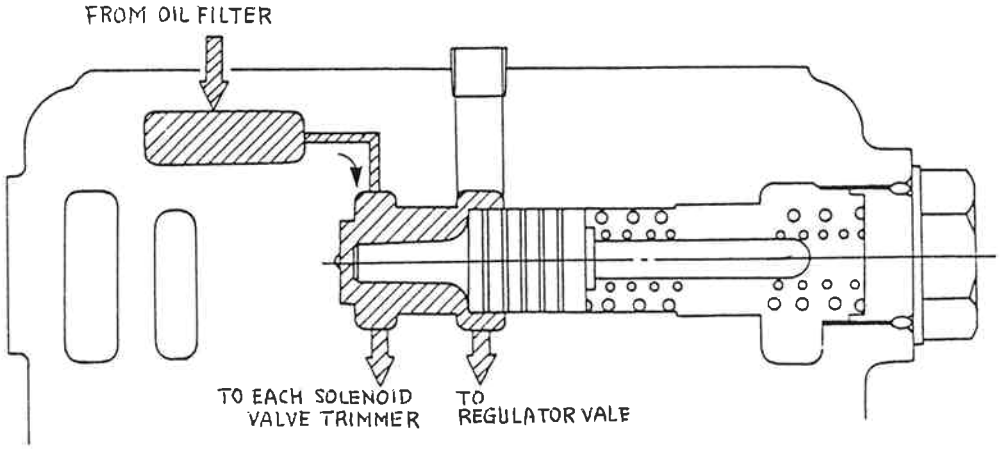


Fig. 1-17

(4) Function of regulator valve and trimmer valve

1. With shift lever in N (neutral) (see Fig. 1-18)

The oil from the priority valve passes the orifice of the regulator valve, and raises the pressure of the space made by the internal diameter of the regulator valve and the pin to move the valve to the right side. At the same time, this supplies oil to the torque converter.

Meanwhile, the trimmer section is loaded with the oil pressure from the priority valve. The oil passes the orifice, raises the pressure in the trimmer chamber to move the modulator to the left side against the spring, and strokes and stops at the step of the valve body.

The oil of which pressure has been adjusted in the regulator valve is led to the sequence valve.

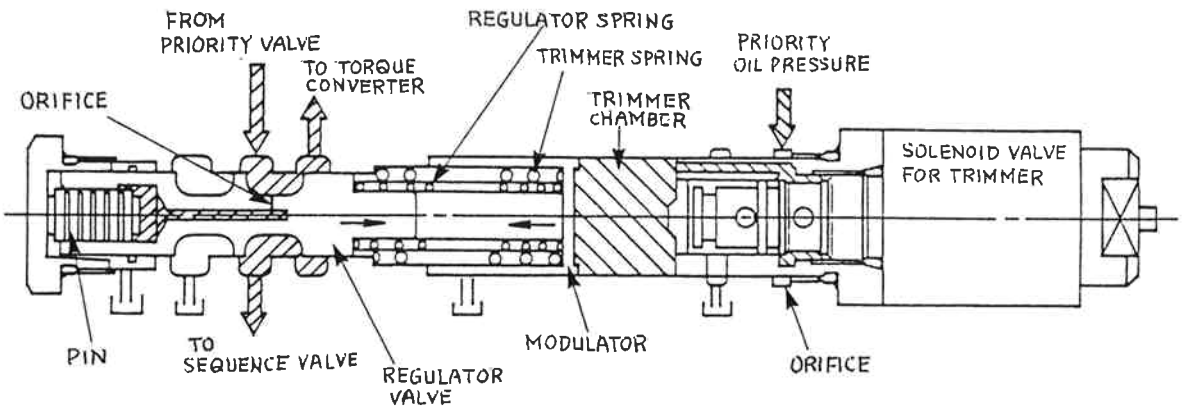


Fig. 1-18

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2, With shift lever in travel

(Step 1)

When selecting the forward and the reverse, or when shifting the speed gear, the trimmer solenoid valve is temporarily energized by the shifting signal, the oil in the trimmer chamber is drained, and the modulator is moved to the right end.

At the same time, the spring force is lowered, and the regulator valve is moved to the right to lower the main oil pressure.

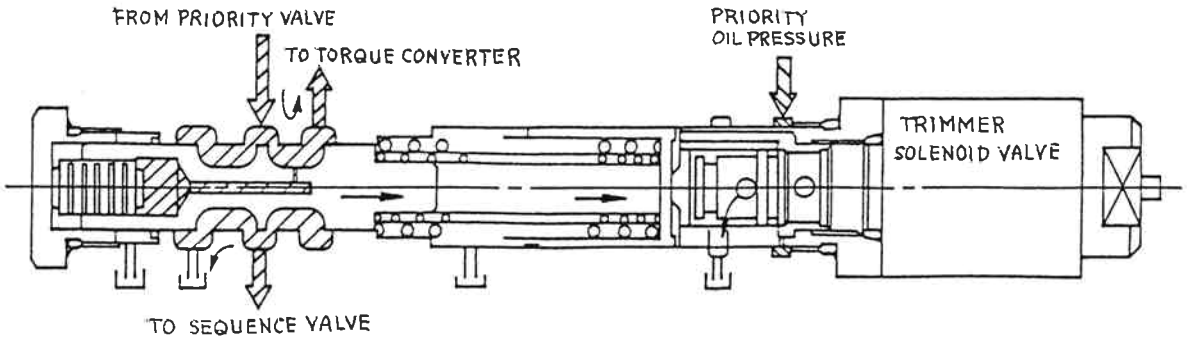


Fig. 1- 19A

(Step 2)

When energizing the trimmer solenoid valve is finished, draing of the trimmer chamber is finished, and the pressure in the trimmer chamber begins to rise to move the modulator to the left.

At the same time, the spring force is enlarged to move the regulator valve to the left and to raise the main oil pressure.

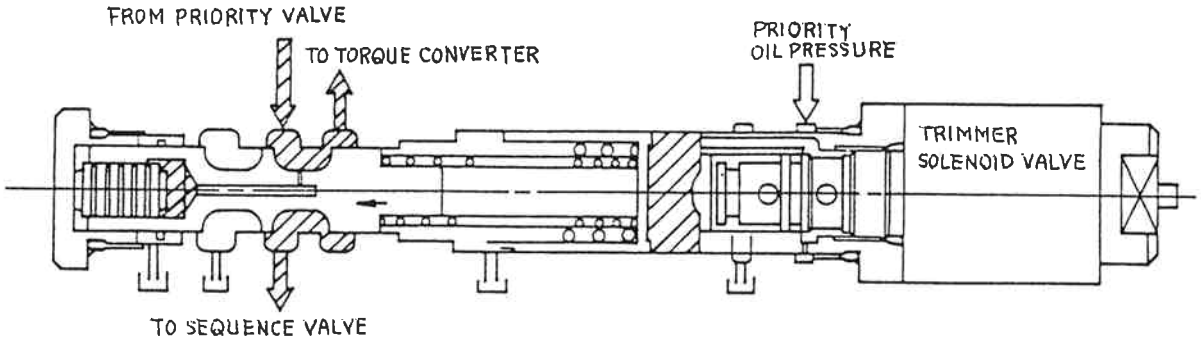


Fig., 1-19B

(Step 3)

When rising of the clutch oil pressure is finished, the modulator also strokes to return to the normal condition before shifting.

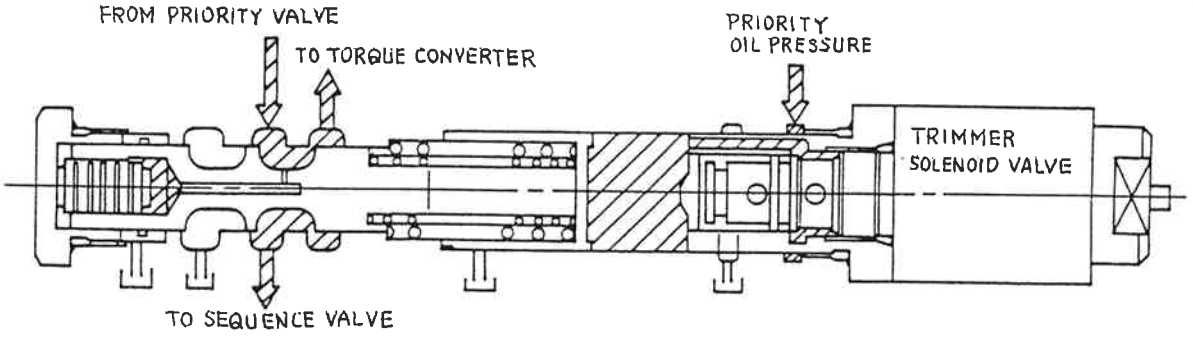


Fig. 1-19C

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(5) Examples for sequence valve operation

1. N range (Fig. 1-20A)
Each solenoid valve is in the OFF condition, and the pressurized oil from the regulator valve fills the clutch High only. Other clutches are not supplied with oil, and the pressurized oil condition is shown by the shaded portion in the figure.

2. N → F1 shifting (Fig. 1-20B)
When solenoid valve F1 is turned into ON from condition 1, the pressurized oil from solenoid valve F1 is led to the right end face of the spool, as shown in the shaded portion of the figure, to move the spool to the left direction. At the same time, port F1 is opened, and the oil is supplied to clutch F1.
Besides, the condition of clutch High is not different from that in the N range.

3. F1 → F2 shifting (Fig. 1-20C)
When solenoid valve F1 is turned into OFF and at the same time solenoid valve F2 is turned into ON, the pressurized oil from solenoid valve F2 moves the spool to the right direction.
The spool, which was moved to the left in F1, is moved to the left at the same time because of drain of the right end oil. Port F1 is closed to drain the oil from clutch F1. At the same time, port F2 is opened, and oil is supplied to clutch F2.

4. F2 → F3 shifting (Fig. 1-20D)
When solenoid valve F2 is turned into OFF and at the same time solenoid valve F3 is turned into ON, the pressurized oil from solenoid valve F3 moves the spool to the right direction. The spool of clutch F2 oil pressure is returned by the spring force to close the port and the oil is drained. At the same time, port F3 is opened, and the oil is supplied to clutch F3.

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1. N range

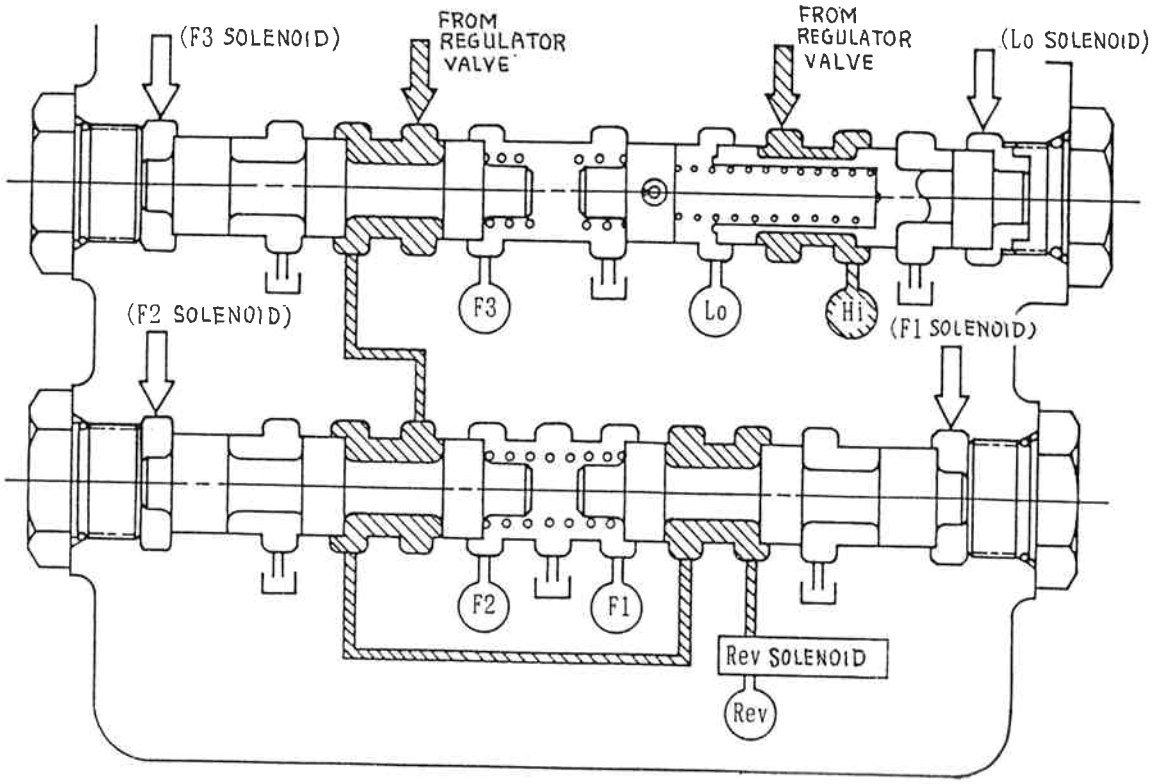


Fig. 1 −20A

2. N → F shifting

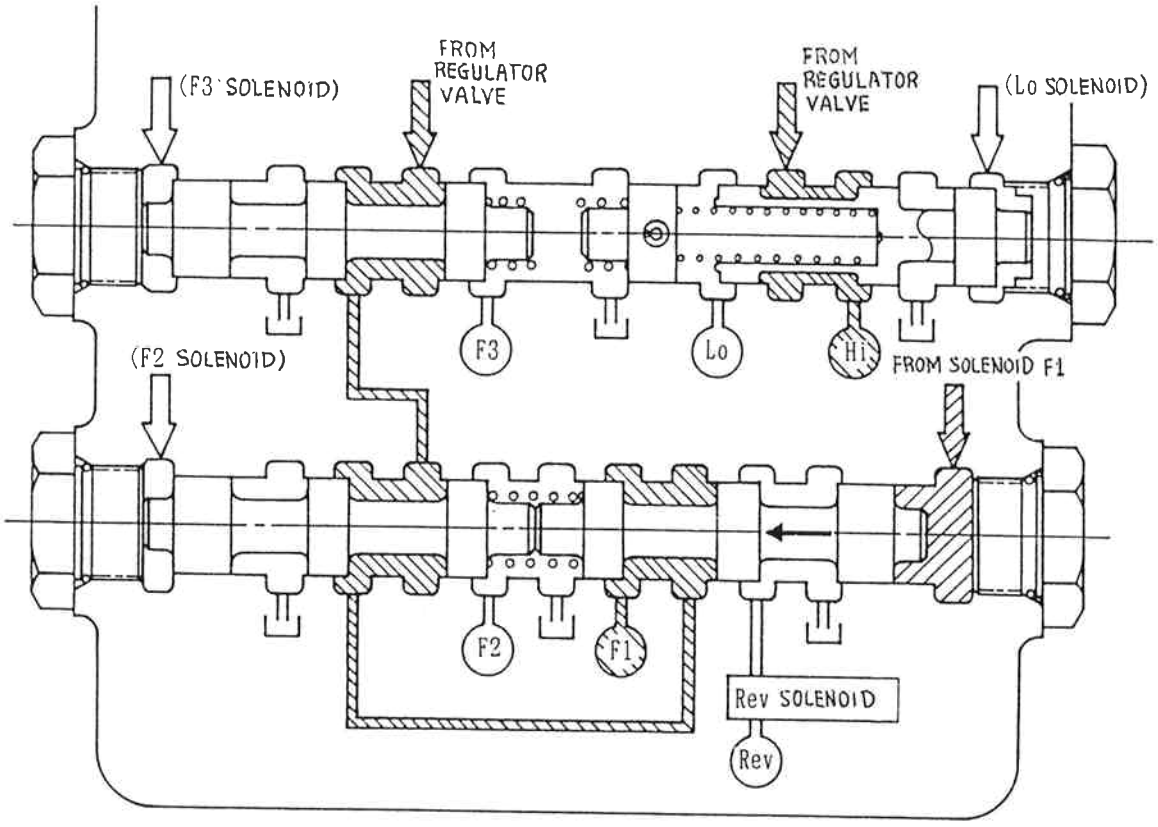


Fig. 1 −20B

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3. F 1 → F 2 shifting

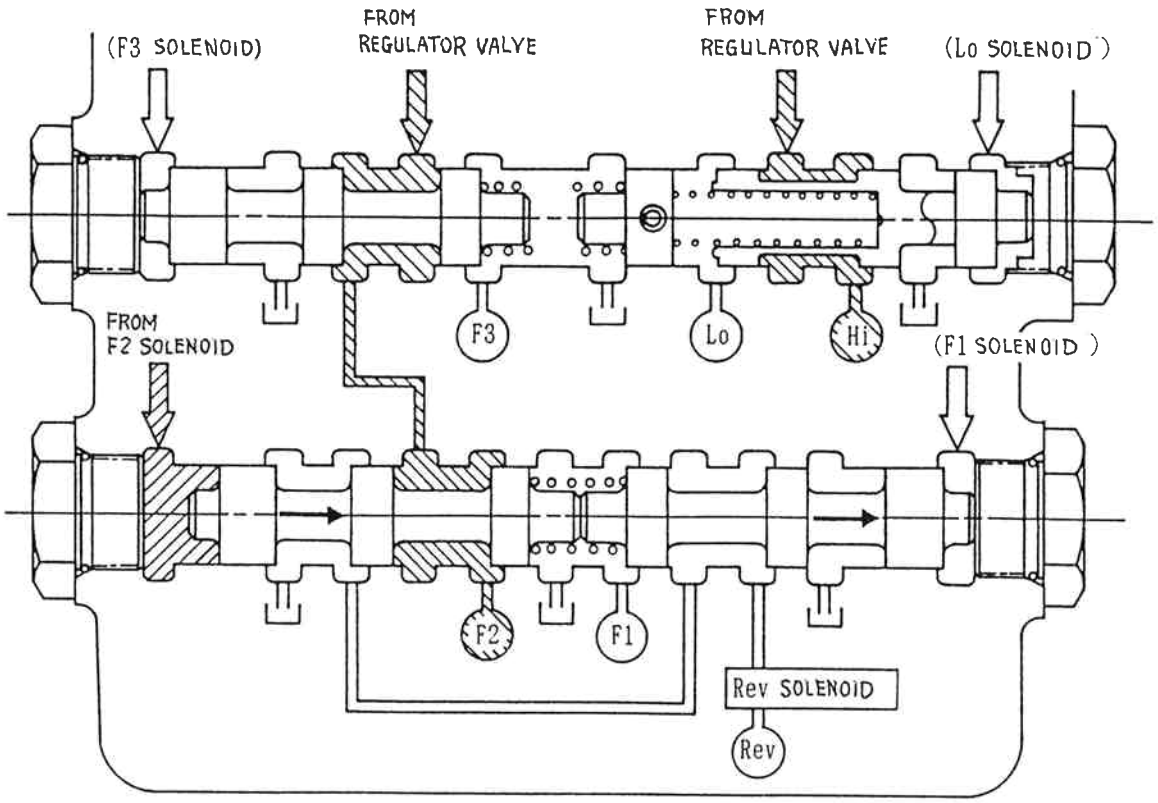


Fig. 1 −20C

4. F 2 → F 3 shifting

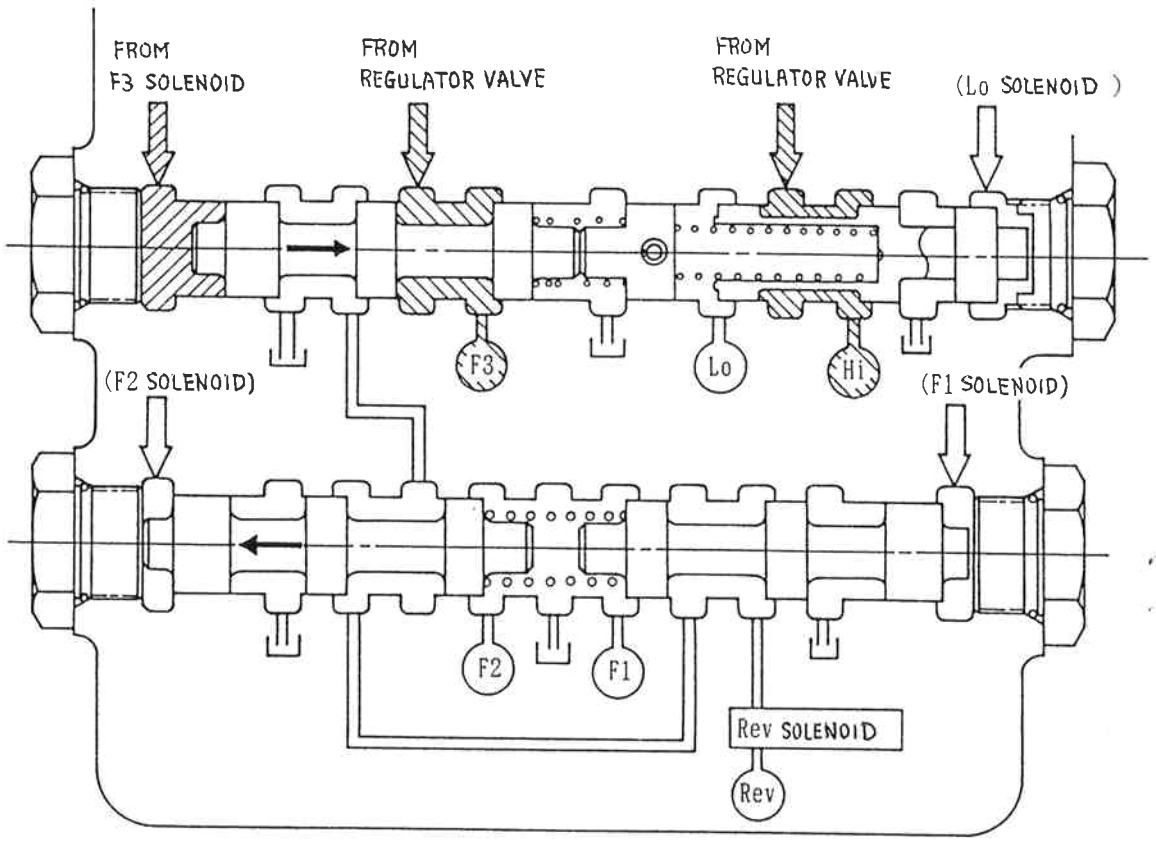


Fig. 1 −20D

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(6) Lock-up circuit (see Fig. 1-16)

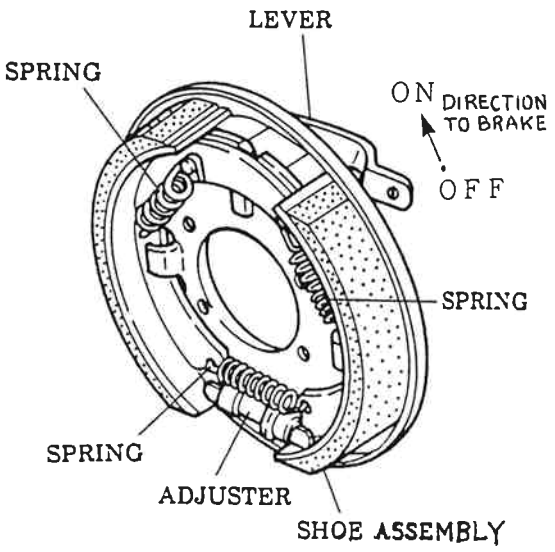
The oil, of which pressure has been adjusted in the priority valve, passes the turbine shaft of the converter through the exclusive solenoid valve, and is led to the lock-up clutch in the front cover. At this time, in order to lessen the shock when the clutch is engaged, an exclusive accumulator

(7) PTO clutch circuit (see Fig. 1-16)

The clutch oil, of which pressure has been adjusted in the priority valve, passes the P.T.O. solenoid valve, then passes the shaft from the P.T.O. housing, and is led to the piston.

1.2.3 PARKING BRAKE (SEE FIG. 1-11)

The parking brake is of the internal expanding type. The shoe assembly is bolted to the seal housing at the rear end of the transmission housing and the brake drum is bolted to the rear output flange. The brake is operated by pulling, and released by the spring.



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(6) Lock-up circuit (see Fig. 1-16)

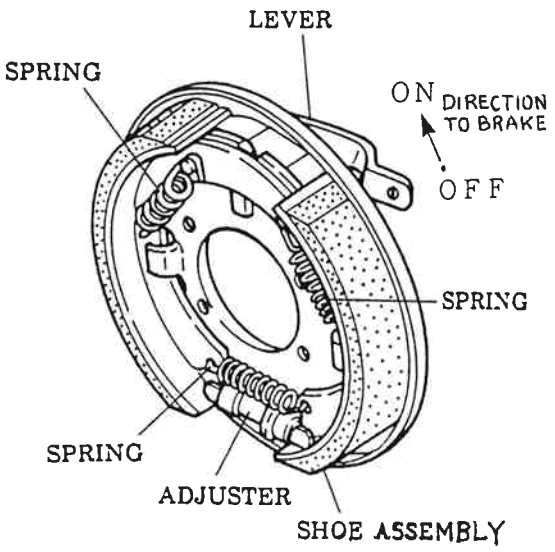
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2. DISASSEMBLY AND ASSEMBLY

2.1 GENERAL PRECAUTIONS

(1) Outline

Clean each part carefully for proper disassembly, inspection, and reassembly. The function of valves and similar parts may be impaired by small foreign objects. Exercise care so that dirt, etc. does not enter the transmission during disassembly and reassembly.

Do not fail to replace the hydraulic system filter elements and flush the system in the following manner after overhauling to prevent foreign matter from entering the system from the separately installed oil cooler, etc.

(1) Add new oil and run for about 10 minutes.
(2) Drain oil and clean the elements and strainers.
(3) Fill with new oil again.

(2) Replacement parts

Replace the following parts with new ones during transmission reassembly.

1. Gaskets
2. O-rings
3. Seal rings
4. Washers and snap rings damaged during disassembly
5. Oil seals (if removed during disassembly)

WARNING

Do NOT burn teflon seals; they release toxic gases.

(3) Notes for handling parts.

Handle all parts carefully during disassembly, cleaning and ressembly to prevent nicks and dents. Sliding parts with a tight operating clearance may stick even if the damage is minor. Damage such as a cut in a smoothly finished oil sealing surface may cause oil leakage.

(4) Cleaning

1) Cleaning parts

1. Clean all metal parts thoroughly with volatile oil or steam. Do not use caustic soda or similar substances for steam cleaning.
2. After cleaning, dry the parts with compressed air. Lubricate parts cleaned with steam immediately after drying.
3. Use compressed air to flush all oil passages with volatile oil. When perfectly clean, dry with compressed air.
4. Carefully inspect all parts, especially oil passages, after cleaning to ensure that they are thoroughly clean.

2) Cleaning bearings

1. Clean disassembled bearings thoroughly with volatile oil.
2. If bearings are extremely dirty or caked with grease, soak in volatile oil before cleaning.
3. Before inspecting bearings, lubricate with the same oil as that used in the transmission.

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CAUTION

Do not dry bearings with compressed air or rotate when unlubricated.

3) Bearing maintenance

Because most bearing damage is caused by dirt or sand, exercise care that these substances do not come into contact with bearings during removal or installation. Paying attention to the following points will ensure longer bearing service life.

1. When new bearings are to be installed, do not open the packing until immediately prior to use.
2. Do not clean off the grease on new bearings.
3. Never place bearings on a dirty workbench. Use a clean sheet of paper.
4. If mounted bearings are exposed during the assembly process, cover or wrap with paper or cloth to protect them from dirt.

2.2 PREPARATION

(1) Necessary tools and equipment, except standard tools

1. Chain hoist (capacity 500 kg or more)
2. Workbenches for disassembly and reassembly
3. Press
4. Rectangular timbers
5. Clean rags (not ginned cotton or similar)
6. Parts stand
7. Parts cleaning equipment (brushes, cleaning oil, etc.)
8. Torque wrench
9. Grease (easily soluble in oil)
10. Snap ring pliers
11. Bearing puller

(2) Special tools

A sling is required for securing and lifting both assemblies in order to extract the clutch assembly and the two PTO shafts. It is best to fabricate the sling as shown in Figures 2-1.

2.3 DISASSEMBLY

(1) Transmission main body disassembly

1. Position with transmission input flange facing up-wards.
2. Remove U-nut (1), and extract input flange (3).
3. Remove bolts (4), and take out housing (2WD/4WD) (5).

   [Removing cylinder (48), lift shaft (10) up, and remove housing (5) (see page 1-6).]
4. Remove bolts (6) and shroud (55) tightening bolts (56) (see page 1-6), and remove transmission cover (7) from the transmission housing.
5. Remove the 1st shaft assembly from the transmission housing.
6. Before removing the 2nd shaft assembly, remove bearing (23) and gear (4) of the 3rd shaft assembly (see page 1-5).
7. Remove roller bearing (53) and gear (19) also from the output shaft assembly.
8. Remove the 2nd shaft assembly and the 3rd shaft assembly.

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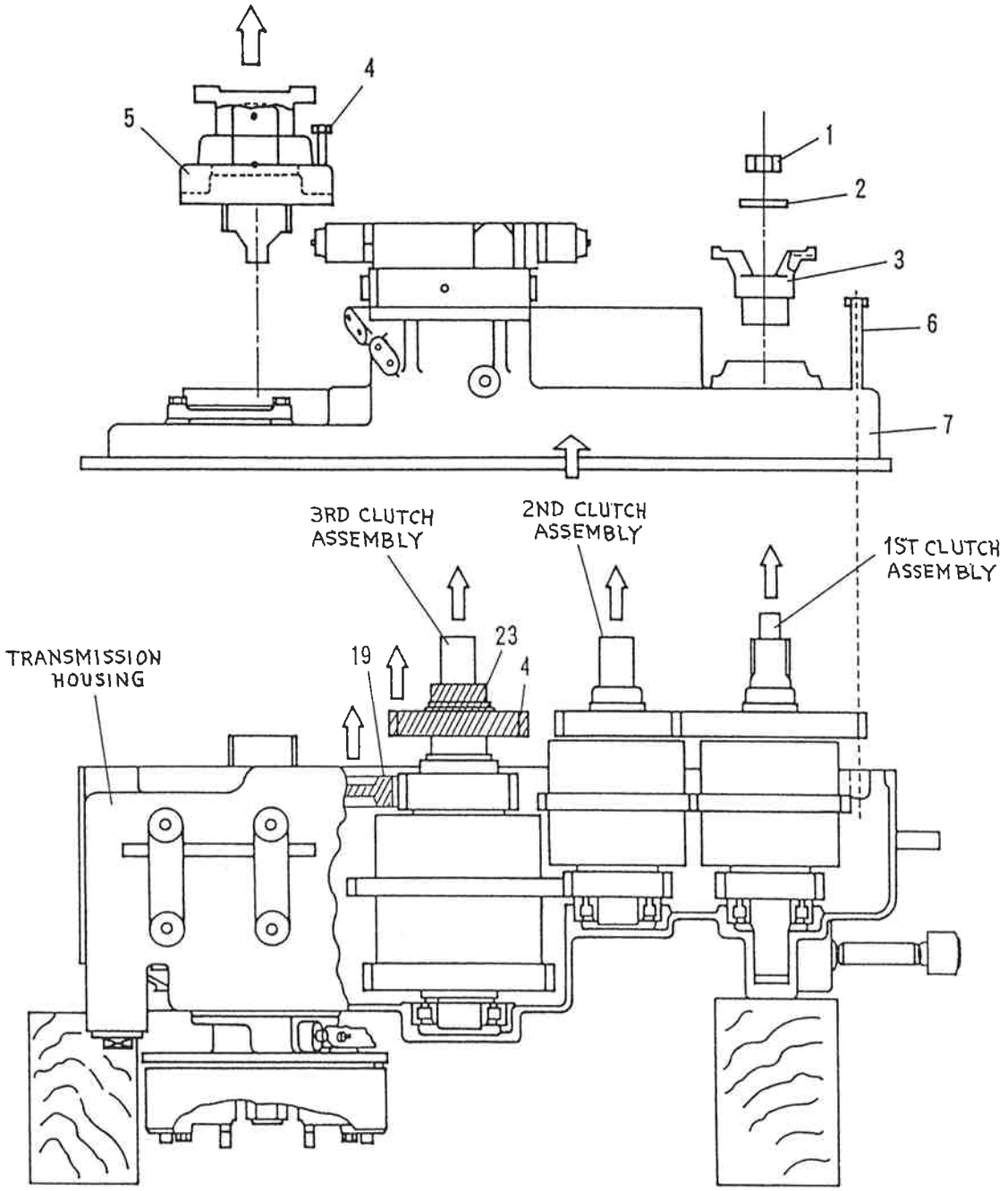
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8. Remove the 2nd shaft assembly and the 3rd shaft assembly.

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1. U-NUT (M24)
2. FLANGE WASHER
3. INPUT FLANGE
4. BOLT
5. HOUSING (2WD/4WD)
6. BOLT
7. TRANSMISSION COVER

Fig. 2-1

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(2) Disassembly of 1st shaft assembly (Fig. 1-3)

1. Remove seal ring (24) from shaft (20).
2. Remove snap ring (23).
3. Attach the puller to gear (27), and pull out the gear together with bearings (21 and 22) at the same time.
4. Remove snap ring (9).
5. Remove snap ring (11).
6. Remove end plate (12), friction plates (13) and separator plates (14).
7. Remove snap ring (9)
8. Remove plate (19) for the spring, and spring (18).
9. Using the pulling bolts (M6 × 1.0), remove piston (15).
10. Disassemble the opposite side (F3) in the same way.

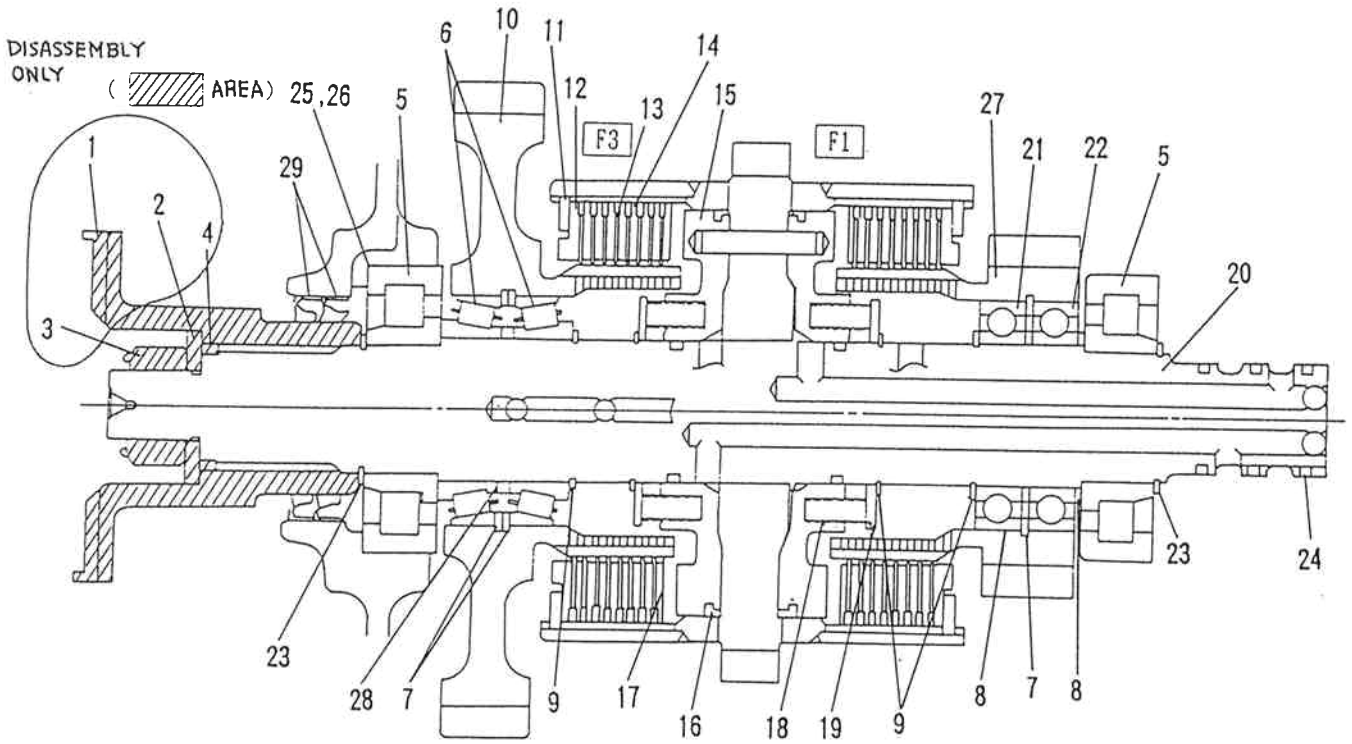


Fig. 2 — 2

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(3) Disassembly of 2nd clutch assembly

1. Remove seal ring (22) from shaft (18).
2. Remove snap ring (1).
3. Attach the puller to gear (8). Being careful not to damage shaft (18), pull out left side bearing (2), spacer (3), bearings (4 and 5) and gear (8) to the left side at the same time.
4. Remove snap ring (9) and end plate (10).
5. Take out friction plates (11) and separator plates (12).
6. Remove two snap rings (7).
7. Pull out plate (17), spring (16) and piston (13).
8. Disassemble the right side in the same way.

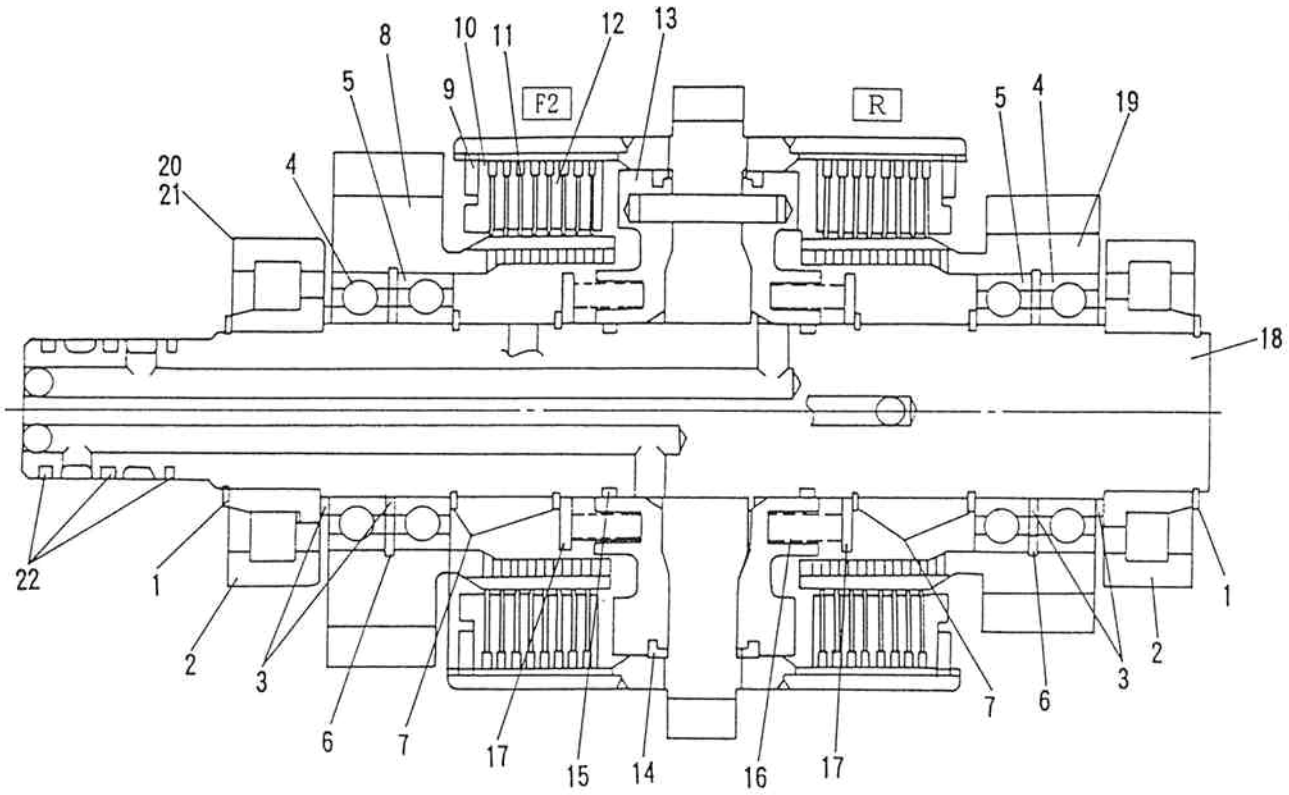


Fig. 2 – 3

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(4) Disassembly of third clutch assembly

1. Remove seal ring (1) from shaft (21).
2. Remove snap ring (2).
3. Attach the puller to gear (4). Being careful not to damage shaft (21), pull out left side bearing (23), spacer (25) and gear (4) to the left side at the same time.
4. Remove two snap rings (6).
5. Pull out spacer (7), thrust washer (8), thrust bearing (9) and gear (11) to the left side.
6. Remove snap ring (12) and end plate (13).
7. Take out friction plates (14) and separator plates (15).
8. Remove two snap rings (6).
9. Pull out plate (20), spring (19) and piston (16).
10. Disassemble the right side in the same way.

These parts were disassembled when the 3rd clutch assembly was removed from the transmission housing. (▨ section)

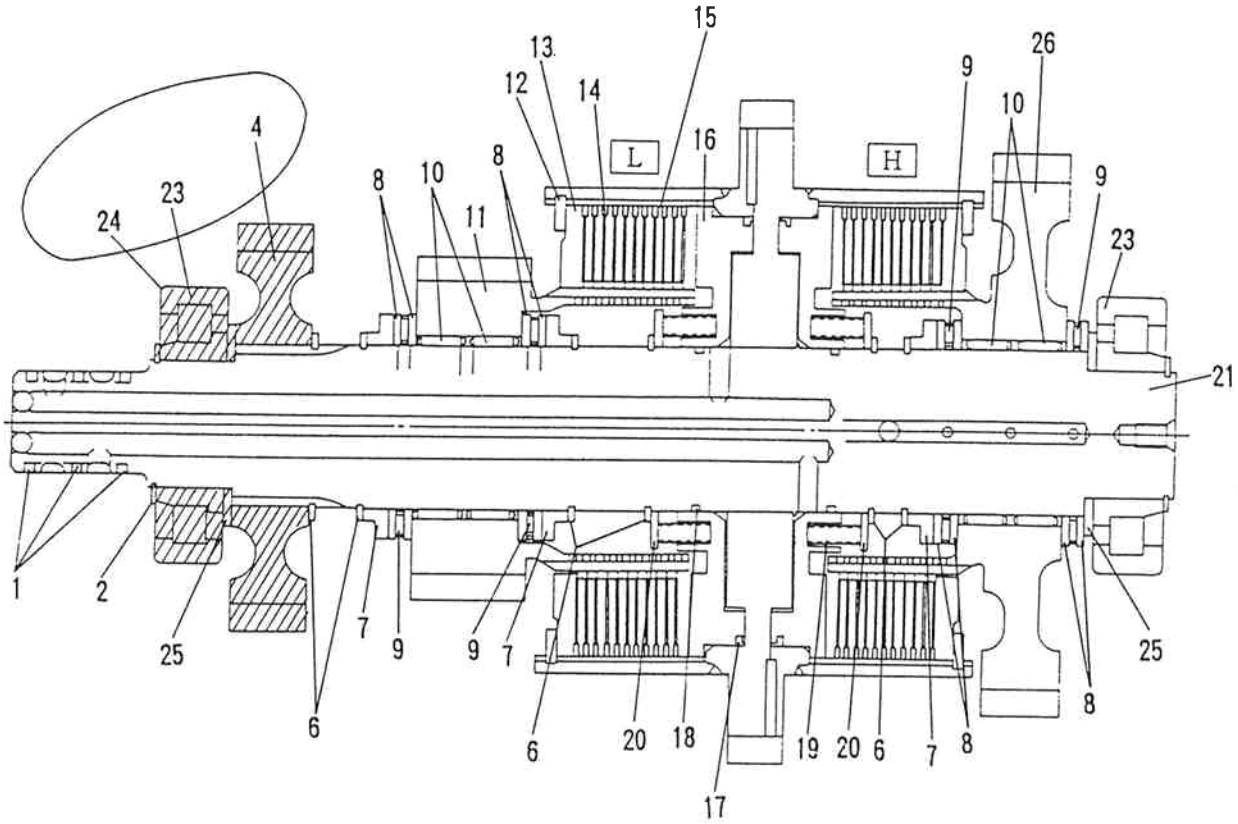


Fig. 2 – 4

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(5) Disassembly of output shaft assembly (Fig. 1-6)

1. Remove the 2WD/4WD selector section [bolts (37)] beforehand.
   Then, remove the transmission cover tightening bolts, shroud tightening bolts (56) and snap ring (5), and remove the transmission cover.
2. Using the screws of shroud (55), pull out bearing (53), gear (19) and shroud (55) at the same time.
3. Pull out collar (60).
4. Turn the whole case upside down, remove nut (29).
   Remove plate (28), flange (26), brake drum (30) and O-ring (27) as one body.
5. Remove brake assembly (31) tightening bolts (33)
6. Remove speedometer housing tightening bolts (8), and remove the housing
7. Pull out speedometer drive gear (25) with the use of the puller.
8. Pull out output shaft (21) in the arrow direction.
   (NOTE: Since the inner race of bearing (24) is tight, be careful sufficiently.)
9. Remove shroud (40) tightening bolts (8), and remove shroud (40) and gear (24)

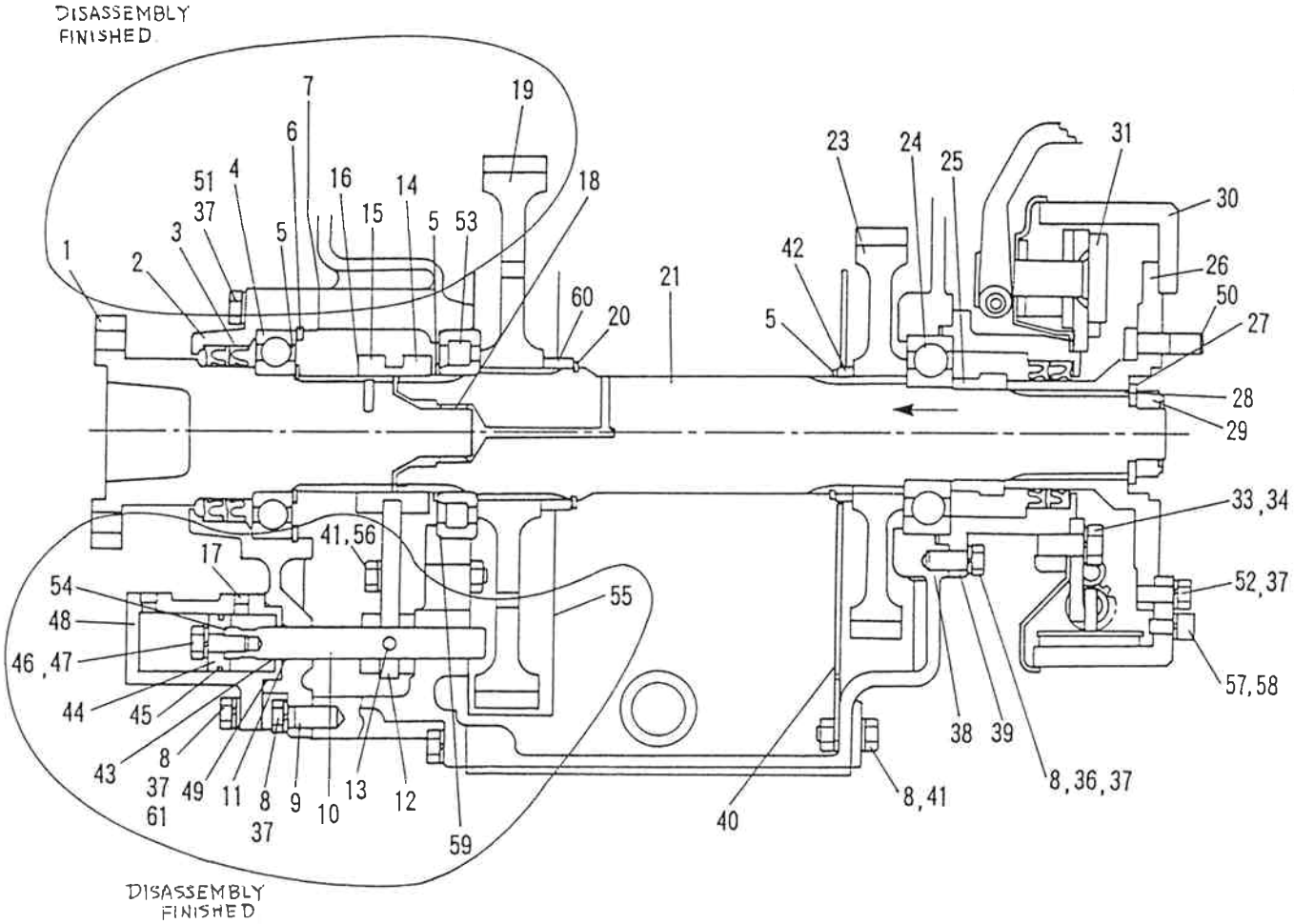


Fig. 2 – 5

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(6) Removal of solenoid valve

1. Loosen nut (1).
2. Pull out coil (2). Be careful not to miss the O-ring.
3. Using the tool for disassembly shown in Fig.2-6, remove body (3).

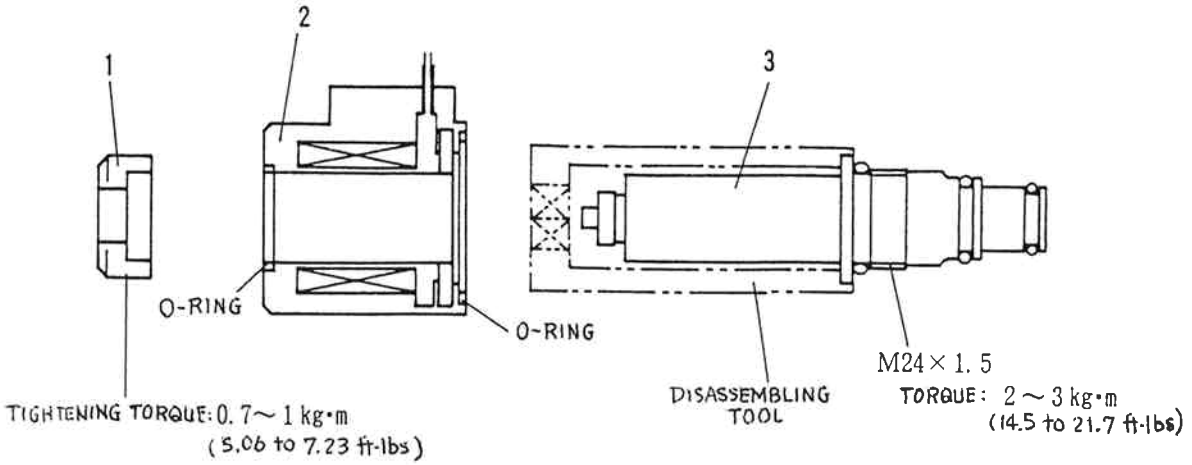
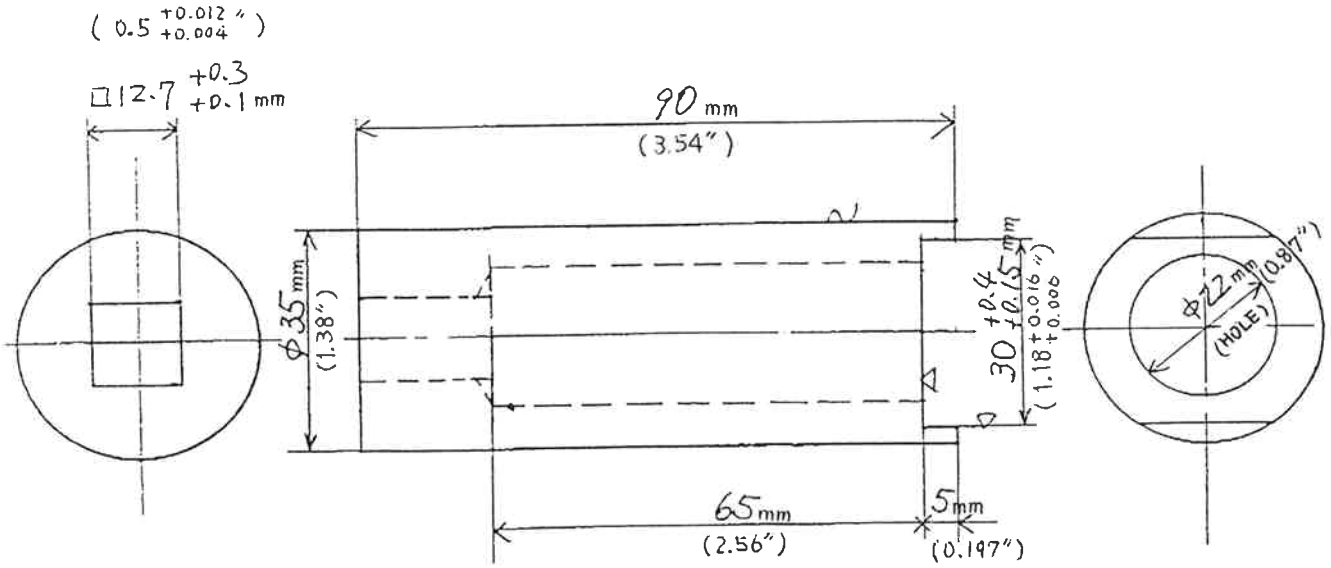


Fig. 2-6 Solenoid Valve



Disassembling Tool

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2.4 REASSEMBLY

(1) Reassembling clutch assembly

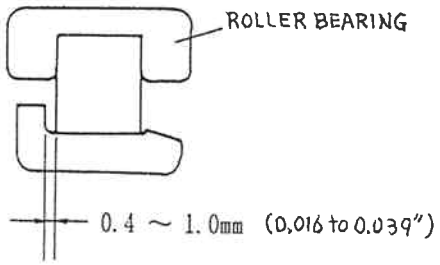
Bear the following points in mind when reassembling.

1) Thoroughly clean and dry each part.
2) Do not use thinner to seals and O-rings.
3) F1, F2, F3 and Rev. clutches
   Put the separator plate in from the piston side, then put the friction plate in. Continue to alternate the each 8 separator plates and friction plates.
4) Hi and Lo clutches
   Put the friction plate in first from the piston side, then put the separator plate in. Continue to alternate the each 11 friction plates and separator plates.
5) Measure the piston strokes, and confirm that the strokes are in the following ranges.

(Standard)

F1	:	4.0 to 4.6 mm (0.157 to 0.181 in)
F2	:	3.0 to 4.0 mm (0.118 to 0.157 in)
F3	:	3.0 to 4.0 mm (0.118 to 0.157 in)
Rev.	:	4.0 to 4.6 mm (0.157 to 0.181 in)
Lo.	:	3.5 to 4.5 mm (0.138 to 0.177 in)
Hi.	:	3.5 to 4.5 mm (0.138 to 0.177 in)

6) After each clutch assembly has been installed to the transmission housing, confirm that the thrust gap of the bearing is 0.4 to 1.0 mm (0.016 to 0.039 in). The gap shall be the following position.



(2) Reassembling output shaft assembly

1) Fill grease in the space between the oil seal lips. (Quantity of grease shall be approx. a half of the space between the lips.)
2) Apply grease containing molybdenum disulphide to nut (29), then tighten it with 40 kg-m (289 ft-lbs). Apply the grease to the splines of flange (26), too.
3) Warm speedometer drive gear (25) up to 100°C (212°F), then install it.
4) To adjust the brake shoe, remove bolt (57), then adjust it.

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(3) Reassembling input flange

Before assembling the input flange to the turbine shaft of the converter and input shaft of the transmission, coat the surface of all splines with molybdenum disulphide base grease.

(4) Reassembling control valve

Bear the following points in mind when reassembling.

1 Carefully clean all the parts before assembling. When assembling, ensure that all valves move smoothly. Apply the specified transmission oil to valves prior to installation.

2 Coat O-ring with grease before inserting into the valve body.

(5) Precautions for reassembling the parking brake assembly.

1 Ensure that the surface of the lining is free from oil, grease, etc.

2 When assembling the brake lever (6), move the match mark on brake lever (6) by two pitches in the counterclockwise direction against that on countershaft (5).

3 Lubricate the following places during assembly:

3.1 The contact surface of anchor pins and shoe webs

3.2 The contact surface of the adjuster ass'y (3) and shoe webs

3.3 Junction and fitting sections of the adjuster assembly

3.4 The contact surface of the support plate and shoe webs

4 At a drum diameter of 254 mm (10 in.), adjust the shoe clearance at assembly to 0.1 to 0.25 mm (0.004 to 0.01 in.) at points X and Y.

5 Adjusting method

Turn the adjusting wheel in the shoe expansion direction until the shoe comes into contact with the drum. Then, turn the adjusting wheel back by 8 pitches. The shoe clearance will be adjusted to 0.23 mm (0.009 in.).

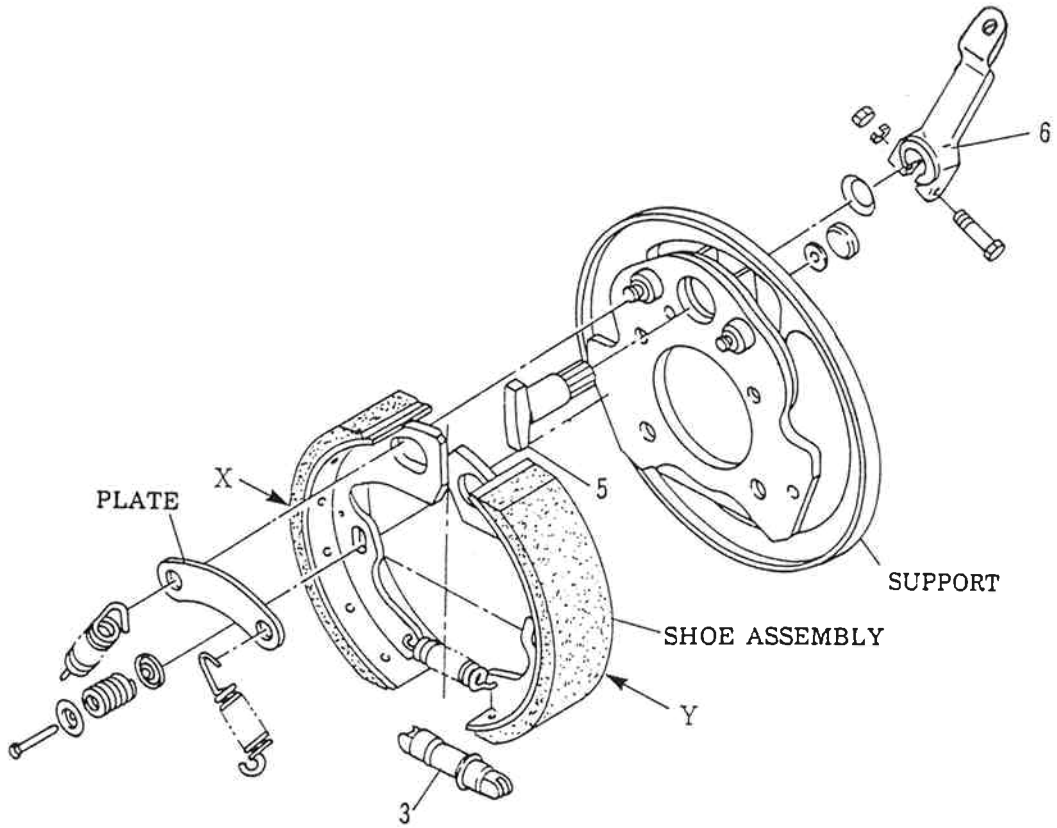


Fig. 2-7

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3. MAINTENANCE STANDARDS

Daily inspection and maintenance should be carried out systematically to ensure that the transmission operates at 100% capacity and the life of each part is as long as possible. It is also important that the maintenance standards should be adhered to during disassembly and reassembly and that the proper procedures should be carefully followed.

3.1 CHECK STANDARDS

(1) Inspection of bearings

1. Turn bearings by hand to be sure they rotate smoothly without abnormal noise. If bearings are abnormal after applying oil following cleaning, replace them.
2. Check bearings for scratches, cracks, chipping, and excessive wear.
   If such defects exist, replace the defective bearings.
3. Check the housing and shaft of faulty bearing for defects.
   If defect cannot be removed by sandpaper, etc., replace the defective part.
4. To shrink fit a bearing onto a shaft, heat the bearing to about 90°C in oil, and apply white lead to mating surfaces. Press the bearing onto the shaft using a suitable sleeve and press. (90°C = 194°F)
5. To remove or install a bearing without using a sleeve, press out or in only the bearing race adjacent to the mating faces with a press. When a press is not available or cannot be used, use a hammer and a punch.

(2) Inspection of cast parts and finished surfaces

1. Check bores, etc., for wear, scratches or contamination. Remove scratches with sandpaper or an oil-stone.
   If scratches are deep, replace the part.
2. Check oil paths for foreign objects. If detected, use compressed air to flush the path with cleaning oil.
3. Check mounting faces for cuts and dents and also for foreign objects.
   Remove any defects using sandpaper or an oil-stone.
   If the damage is deep, replace the defective part.
4. Check threads for damage. If damaged, re-tap the defective threads with the proper tap.
5. Replace cracked housing or cast parts.
6. Re-finish or replace any damaged surface that may cause oil leakage or malfunction.

(3) Inspection of bushings and thrust washers

1. Check bushings for distortion, cuts and sharp edges which may cause overheating. Remove cuts and sharp edges with a scraper or knife. Replace distorted bushings or those with deep cuts or significant wear using a suitably sized replacer.

CAUTION

When a bushing needs to be cut to be removed, do not damage the mating bore wall.

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2. Check thrust washers for distortion, cuts, and excessive wear. Replace damaged or significantly worn thrust washers.
   If damaged bearings, bushings, thrust washers, etc. are not replaced, expensive components in the converter and transmission gears may be damaged.

(4) Inspection of oill seals and gaskets

1. Check seal rings for cuts or hardening. If defective, replace with new parts.
2. When replacing lip-type seal rings, be sure that they are sufficiently worn in to prevent oil leakage.
3. Replace all the gaskets with new ones.
4. Check hook-type seal rings for wear, distortion, and damaged hooks.
5. Replace hook type seal rings if they are worn to such an extent that no space is available between hooks when installed.
6. The sides of seal rings should be smooth. (Maximum tolerable wear is 0.2 mm (0.008″).
   Side walls of grooves in which seal rings are fitted should be smooth. (JIS, 5S)
   The maximum tolerable perpendicular deviation of the groove to the axis is 0.05 mm (0.002 in.).
   When the groove side wall is refinished (maximum tolerable wear is 0.05 mm), install a new seal ring.

(5) Inspection of gears

1. Check gears for rubbing, cuts, chipped teeth, etc. If defects cannot be removed with an oil-stone, etc., replace.
2. If gears are worn to such a degree that the original tooth profile is obviously altered, replace the gears.
3. Check gear surfaces carrying thrust load for damage such as cuts, and replace gears if the defects cannot be repaired with an oil-stone, etc.

(6) Inspection of splined parts

Check splined parts for distortion and chipping, and repair any defects with an oil-stone. Replace parts with other defects.

The wear of splined parts is not a problem if fitting is not adversely affected.

(7) Inspection of clutch

Inspect clutch plates and steel plates for chipping, cracks, rust, etc., and finished surfaces for discoloration and abnormal wear.

(8) Inspection of threaded parts

Check threaded parts for damage to the threads. If damaged, remove with an oil-stone or file. Replace heavily damaged parts.

(9) Inspection of snap rings

Check snap rings for distortion and excessive wear, and replace with new ones if defective.

(10) Inspection of springs

Check springs for traces of overheating, distortion, and wear due to rubbing against adjacent parts, and replace if defective.

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3.2 PEFORMANCE STANDARDS

Item	Measurement conditions	Maintenance standards	Serviceable limits
Main oil pressure	Oil temperature 90 to 110°C (194 to 230°F)		
	Engine 1400 rpm	10 to 14 kg/cm² (142 to 199 psi)	8 to 16 (114 to 227)
	Engine 2600 rpm	11 to 15 kg/cm² (156 to 213 psi)	9 to 17 (128 to 242)

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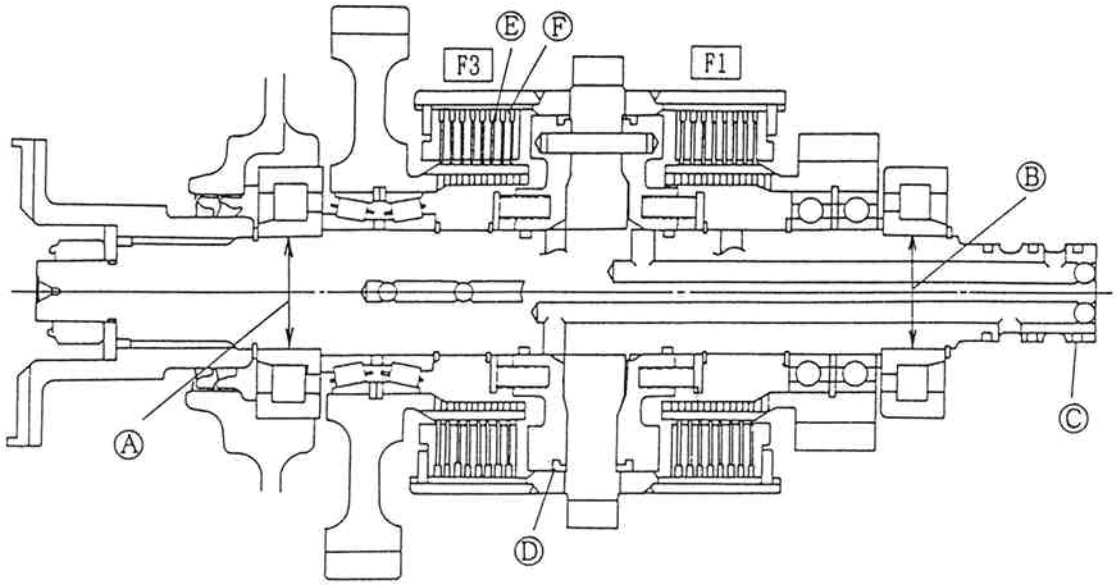
3.3 REPLACEMENT STANDARDS

3.3.1 General

Uniform wear of gears and splines is generally negligible because the wear is very small in comparison with the backlash. In the event of abnormal wear such as pitting or tooth face damage, replace with a new part.

The service life of ball bearings, roller bearings and needle bearings is generally affected by flaking or damage due to foreign objects such as dust rather than wear. Replace bearings, flaked or not running smoothly, with new ones. Paragraph, the sliding portion of oil seals should be in unifrom contact. Exercise care as even a small the sliding face may cause oill leakage.

3.3.2 1ST SHAFT ASSEMBLY



Item symbol	Item		Maintenance Standards	Serviceable limit	Remarks
A	Bearing mounting section (dia.)		45 mm (1.772")	44.9 mm (1.768")	Micrometer
B	Bearing mounting section (dia.)		45 mm (1.772")	44.9 mm (1.768")	
C	Seal ring	Width	3.75 mm (0.148")	3.55 mm (0.140")	Micrometer or slide calipers
		Thickness	3.8 mm (0.150")	3.6 mm (0.142")	
D	Seal ring	Width	3.5 mm (0.138")	3.3 mm (0.130")	
		Thickness	4.3 mm (0.169")	4.1 mm (0.161")	
E	Friction plate		2.2 mm (0.087")	2.0 mm (0.079")	
F	Separator plate (steel)		1.8 mm (0.071")	1.6 mm (0.063")	

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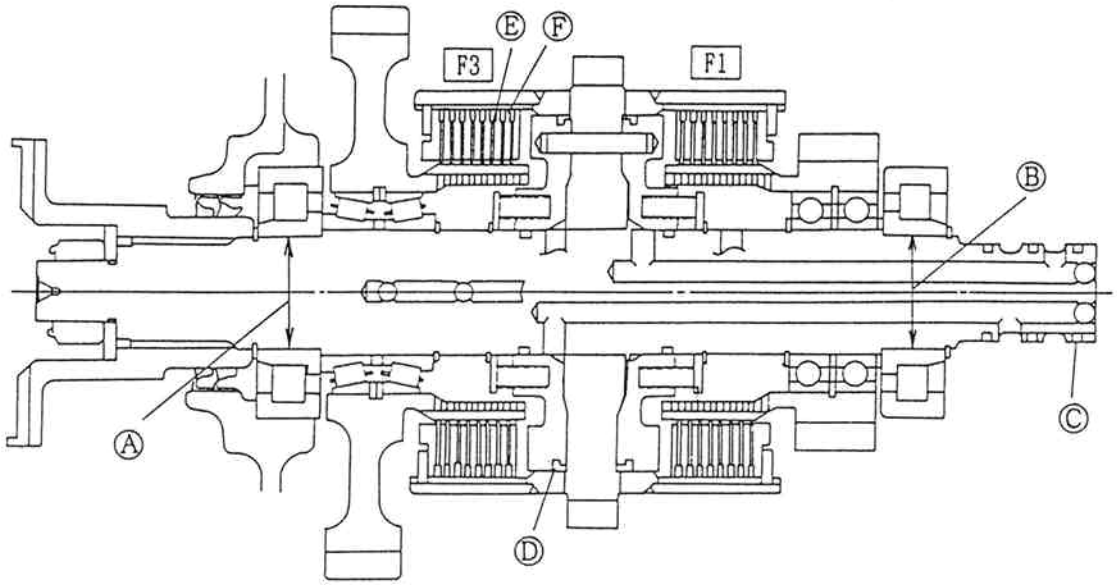
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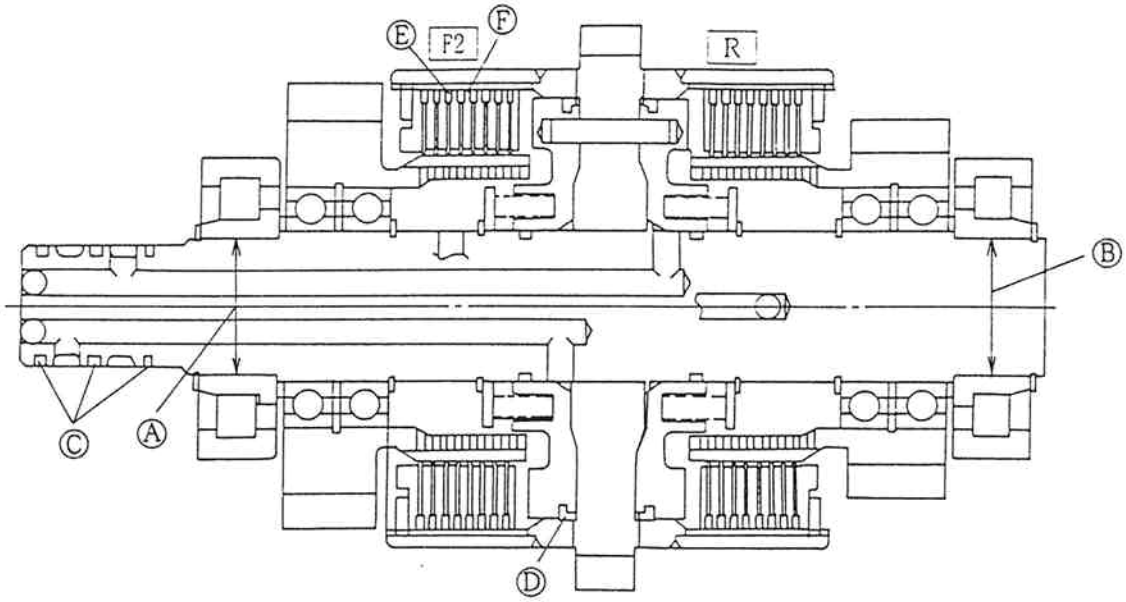
3.3.2 1ST SHAFT ASSEMBLY



Item symbol	Item		Maintenance Standards	Serviceable limit	Remarks
A	Bearing mounting section (dia.)		45 mm (1.772")	44.9 mm (1.768")	Micrometer
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C	Seal ring	Width	3.75 mm (0.148")	3.55 mm (0.140")	Micrometer or slide calipers
		Thickness	3.8 mm (0.150")	3.6 mm (0.142")	
D	Seal ring	Width	3.5 mm (0.138")	3.3 mm (0.130")	
		Thickness	4.3 mm (0.169")	4.1 mm (0.161")	
E	Friction plate		2.2 mm (0.087")	2.0 mm (0.079")	
F	Separator plate (steel)		1.8 mm (0.071")	1.6 mm (0.063")	

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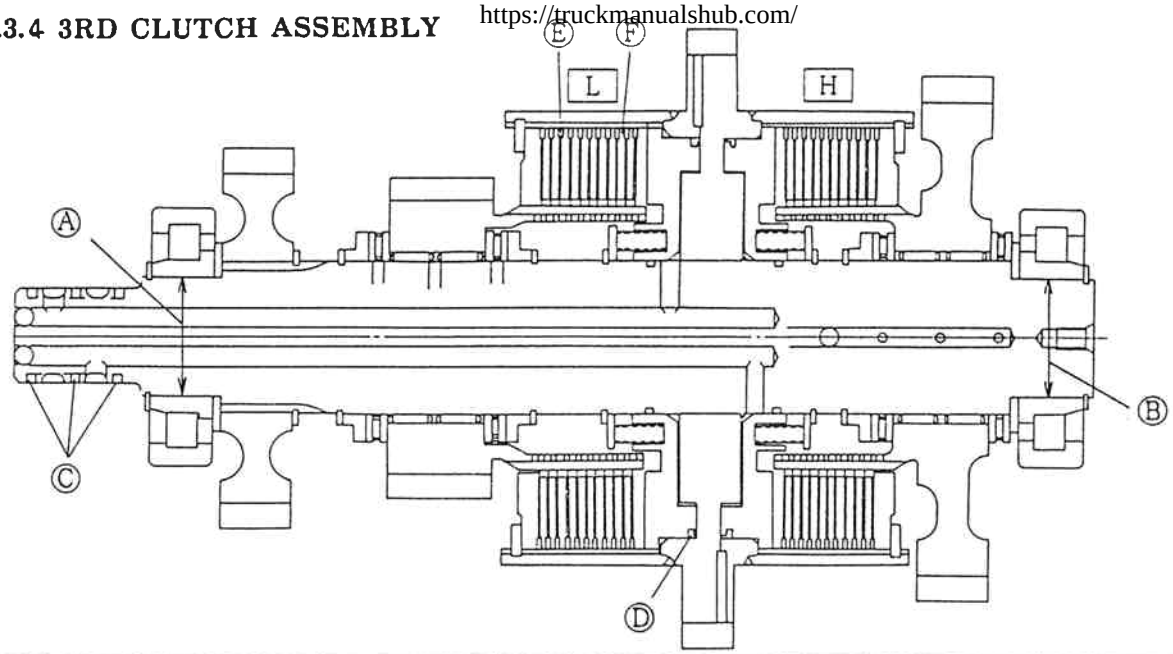
3.3.3 2ND SHAFT ASSEMBLY



Item Symbol	Item		Maintenance standards	Serviceable limit	Remarks
A	Bearing mounting section (dia.)		45 mm (1.772")	44.9 mm (1.768")	Micrometer
B	Bearing mounting section (dia.)		45 mm (1.772")	44.9 mm (1.768")	
C	Seal ring	Width	3.75 mm (0.148")	3.55 mm (0.140")	Micrometer or slide calipers
		Thickness	3.8 mm (0.150")	3.6 mm (0.142")	
D	Seal ring	Width	3.5 mm (0.138")	3.3 mm (0.130")	
		Thickness	4.3 mm (0.169")	4.1 mm (0.161")	
E	Friction plate		2.2 mm (0.087")	2.0 mm (0.079")	
F	Separator plate (steel)		1.8 mm (0.071")	1.6 mm (0.063")	

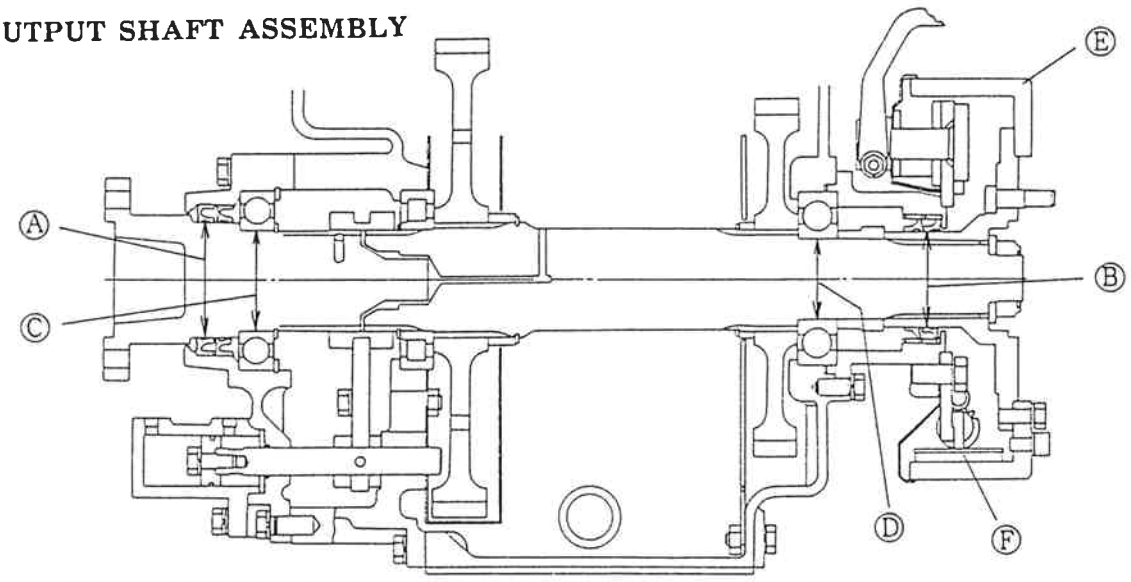
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3.3.4 3RD CLUTCH ASSEMBLY



Symbol	Item		Maintenance standard	Serviceable limit	Remarks
A	Bearing mounting section (dia.)		50 mm (1.969")	49.9 mm (1.965")	Micrometer
B	Bearing mounting section (dia.)		50 mm (1.969")	49.9 mm (1.965")	
C	Seal ring	Width	3.75 mm (0.148")	3.55 mm (0.140")	Micrometer or slide calipers
		Thickness	3.8 mm (0.150")	3.6 mm (0.142")	
D	Seal ring	Width	3.5 mm (0.138")	3.3 mm (0.130")	
		Thickness	4.3 mm (0.169")	4.1 mm (0.161")	
E	Friction plate		2.0 mm (0.079")	1.8 mm (0.071")	
F	Separator plate (steel)		1.8 mm (0.071")	1.6 mm (0.063")	

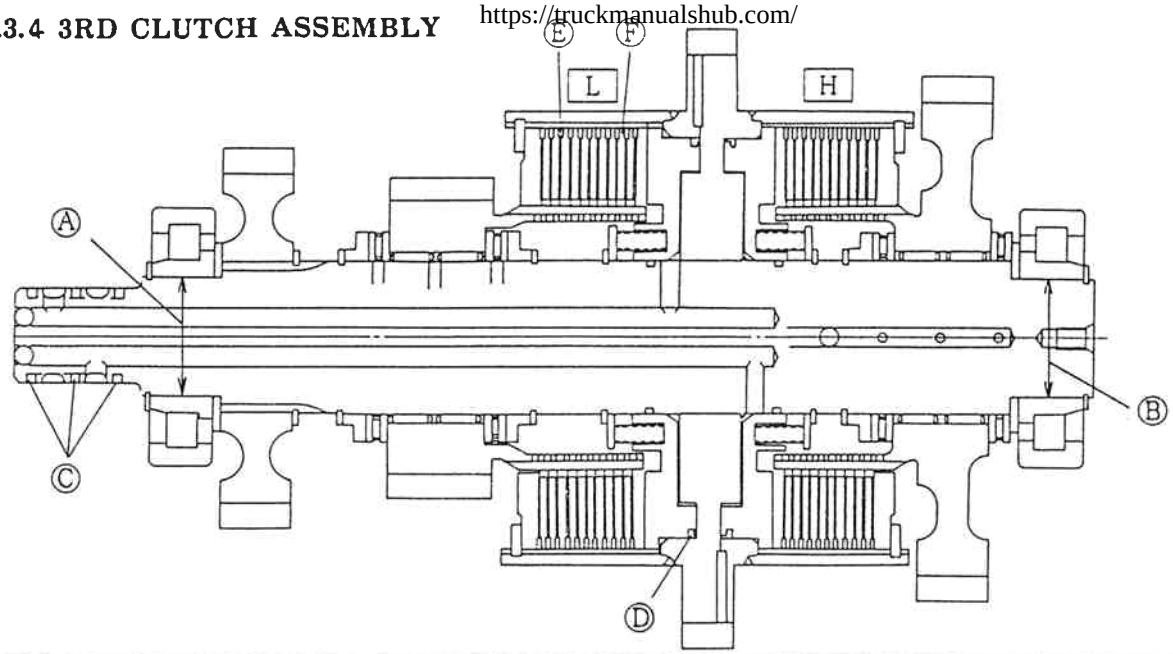
3.3.5 OUTPUT SHAFT ASSEMBLY



Symbol	Item	Maintenance standard	Serviceable limit	Remarks
A	Oil seal section diameter	80 mm (3.15")	79.9 mm (3.146")	Micrometer
B	Oil seal section diameter	65 mm (2.559")	64.9 mm (2.555")	
C	Bearing mounting section (dia.)	70 mm (2.756")	69.9 mm (2.752")	
D	Bearing mounting section (dia.)	55 mm (2.165")	54.9 mm (2.161")	
E	Brake drum inner dia.	254 mm (10")	256 mm (10.08")	Micrometer or slide calipers
F	Brake lining thickness	–	0.5 mm (0.02") from rivet head	

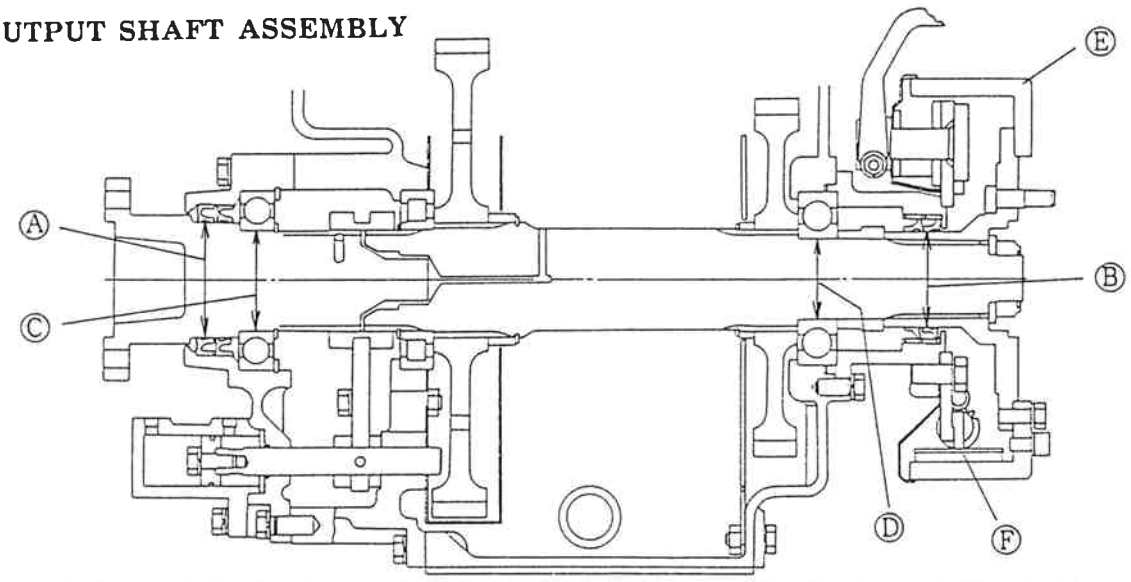
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3.3.4 3RD CLUTCH ASSEMBLY



Symbol	Item		Maintenance standard	Serviceable limit	Remarks
A	Bearing mounting section (dia.)		50 mm (1.969")	49.9 mm (1.965")	Micrometer
B	Bearing mounting section (dia.)		50 mm (1.969")	49.9 mm (1.965")	
C	Seal ring	Width	3.75 mm (0.148")	3.55 mm (0.140")	Micrometer or slide calipers
		Thickness	3.8 mm (0.150")	3.6 mm (0.142")	
D	Seal ring	Width	3.5 mm (0.138")	3.3 mm (0.130")	
		Thickness	4.3 mm (0.169")	4.1 mm (0.161")	
E	Friction plate		2.0 mm (0.079")	1.8 mm (0.071")	
F	Separator plate (steel)		1.8 mm (0.071")	1.6 mm (0.063")	

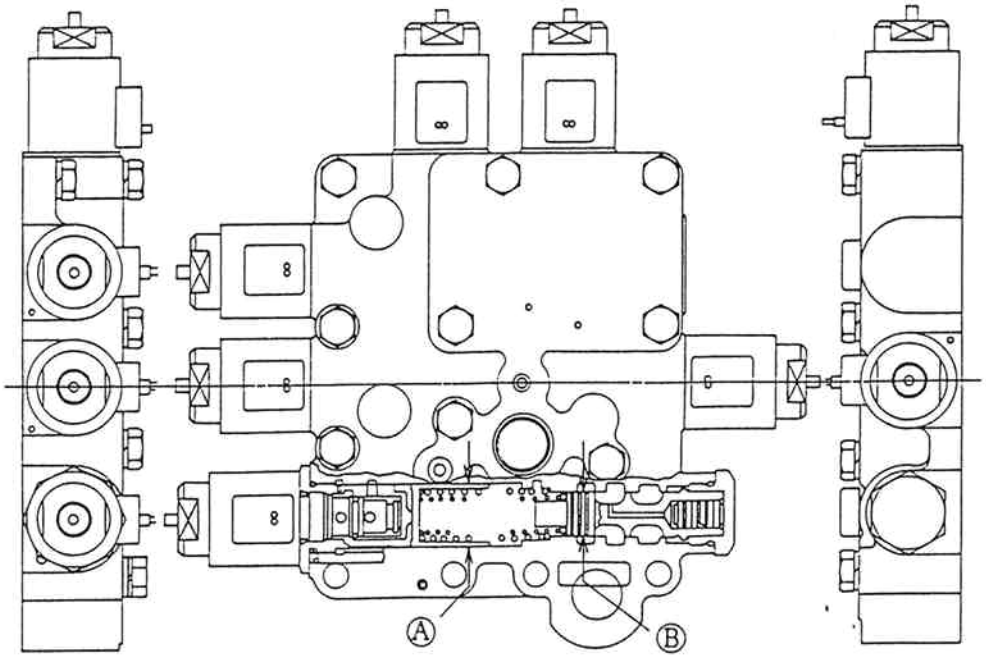
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Symbol	Item	Maintenance standard	Serviceable limit	Remarks
A	Oil seal section diameter	80 mm (3.15")	79.9 mm (3.146")	Micrometer
B	Oil seal section diameter	65 mm (2.559")	64.9 mm (2.555")	
C	Bearing mounting section (dia.)	70 mm (2.756")	69.9 mm (2.752")	
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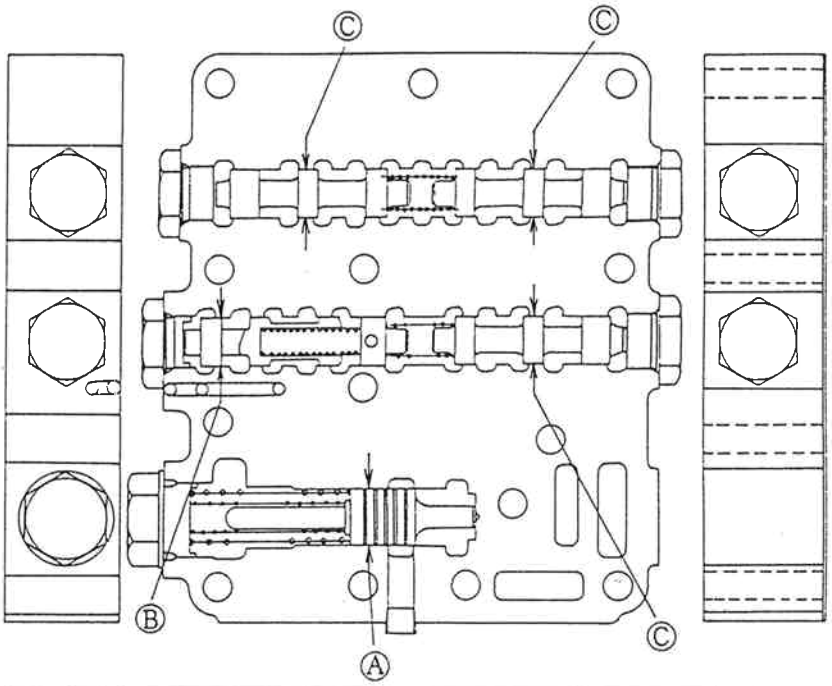
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3.3.6 UPPER CONTROL VALVE ASSEMBLY



Item symbol	Item	Maintenance standards	Serviceable limit	Serviceable limit of body inner dia.	Remarks
A	Accumulator external dia.	31 mm (1.221")	30.9 mm (1.217")	31.1 mm (1.224")	Cylinder gauge Micrometer
B	Regulator valve external dia.	22 mm (0.866")	21.9 mm (0.862")	22.1 mm (0.870")	

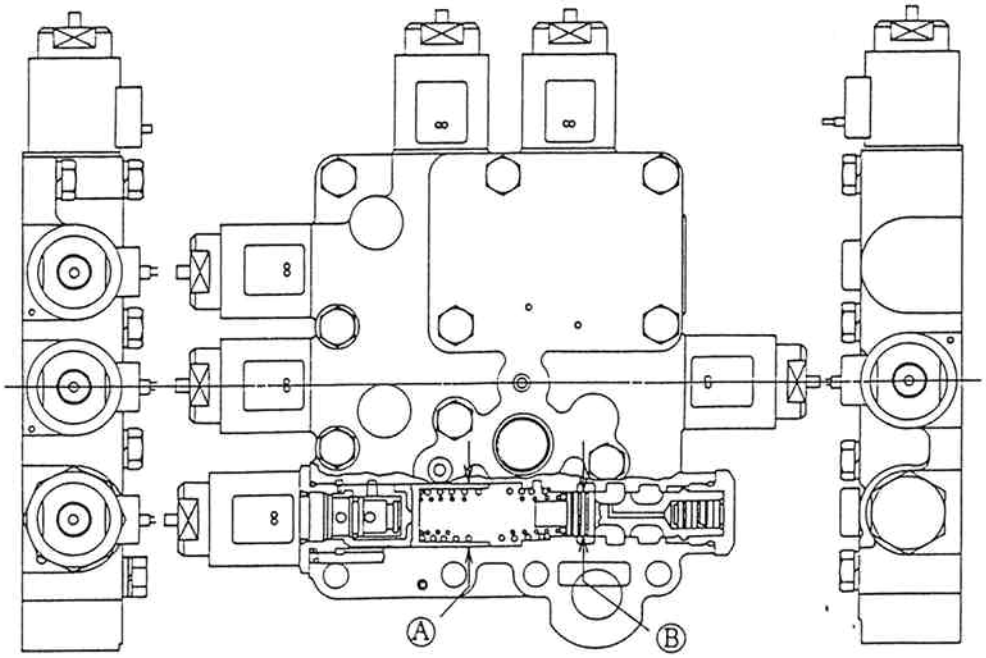
3.3.7 LOWER CONTROL VALVE ASSEMBLY



Item symbol	Item	Maintenance standards	Serviceable limit	Serviceable limit of body inner dia.	Remarks
A	Priority valve (dia.)	22mm (0.866")	21.9mm (0.862")	22.1mm (0.870")	Cylinder gauge Micrometer
B	Valve spool (dia.)	19mm (0.748")	18.9mm (0.744")	19.1mm (0.752")	
C (3 places)	Valve spool (dia.)	19mm (0.748")	18.9mm (0.744")	19.1mm (0.752")	

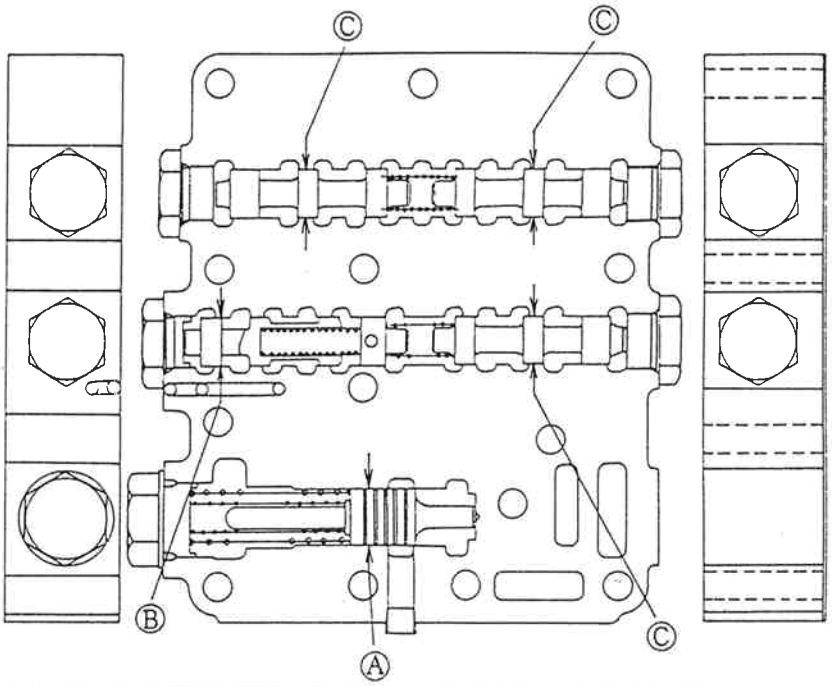
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3.3.6 UPPER CONTROL VALVE ASSEMBLY



Item symbol	Item	Maintenance standards	Serviceable limit	Serviceable limit of body inner dia.	Remarks
A	Accumulator external dia.	31 mm (1.221")	30.9 mm (1.217")	31.1 mm (1.224")	Cylinder gauge Micrometer
B	Regulator valve external dia.	22 mm (0.866")	21.9 mm (0.862")	22.1 mm (0.870")	

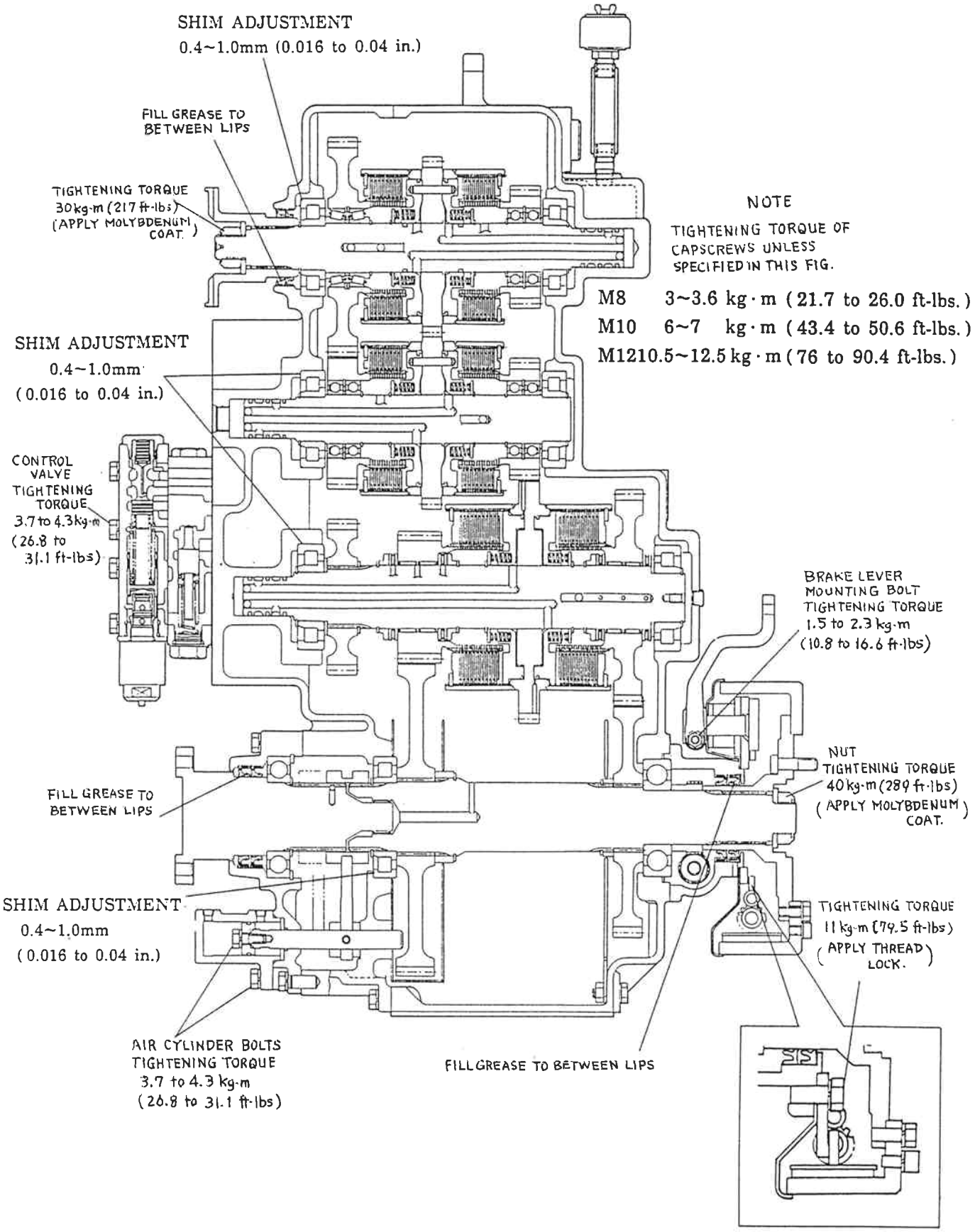
3.3.7 LOWER CONTROL VALVE ASSEMBLY



Item symbol	Item	Maintenance standards	Serviceable limit	Serviceable limit of body inner dia.	Remarks
A	Priority valve (dia.)	22mm (0.866")	21.9mm (0.862")	22.1mm (0.870")	Cylinder gauge Micrometer
B	Valve spool (dia.)	19mm (0.748")	18.9mm (0.744")	19.1mm (0.752")	
C (3 places)	Valve spool (dia.)	19mm (0.748")	18.9mm (0.744")	19.1mm (0.752")	

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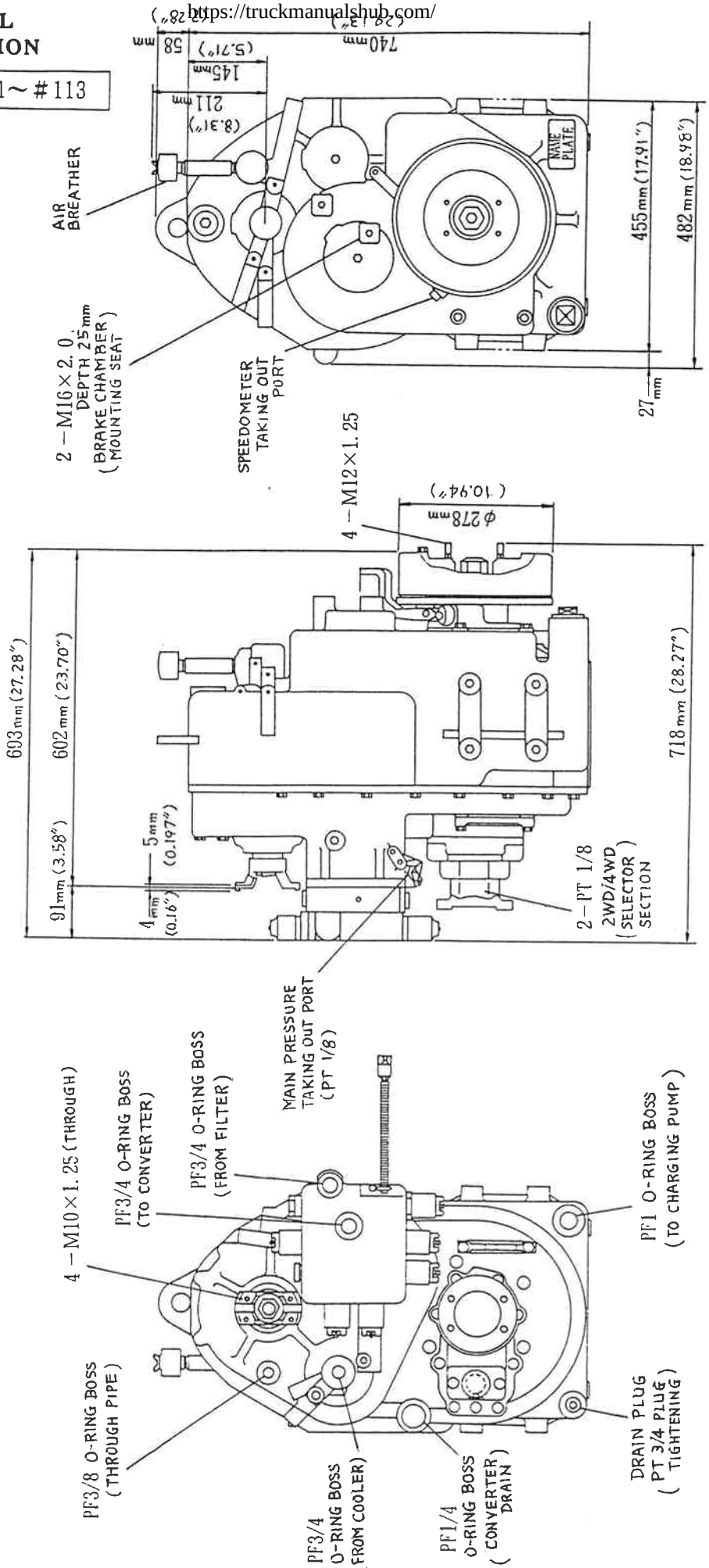
3.4 ASSEMBLY STANDARDS



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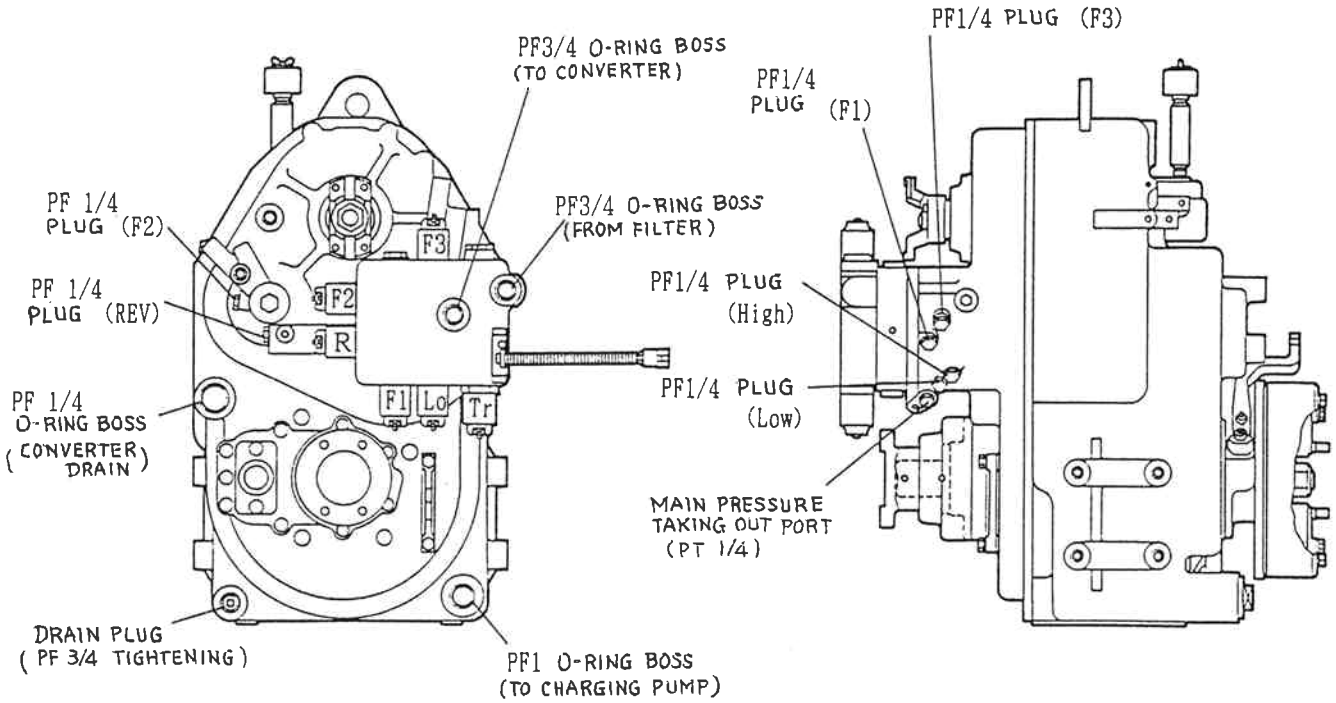
3.5 GENERAL DIMENSION

#0001～#113



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#114～



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4. HANDLING AND PREVENTIVE MAINTENANCE

Proper operation and periodic maintenance are necessary to run the transmission in good order at all times. The frequency of inspection should vary with operating conditions. Especially under harsh or dusty operating conditions, frequent inspection and oil change are required. If oil is overheated (generally accompanied by discoloration and foul odor), change the oil immediately.

4.1 HANDLING

(1) Oil

Transmission oil shall be of a lubricating oil to lubricate gears, bearings, clutches, etc., an hydraulic oil to transmit the power of the hydraulic control system, and also a cooling oil to carry heat generated by the torque converter and clutches to the cooler. Use oil meeting the following standards.

1. CD grade engine oil, series 3, 10W.
2. ATF oil, CM, Dexron Ⅱ, inspection passed oil.
   To fill the transmission initially, approx. 32ℓ (8.45 gal.) of oil is required.

(2) Starting

1) Notes for starting

1. To start, set the transmission in neutral.
2. Run at low speed for several minutes until oil circulates throughout the transmission
3. Be sure that the transmission is free of abnormal vibration, noise, oil leakage, and other irregularities.

2) Warming up

To obtain 100 % performance of the transmission, continue the warming up operation until the converter outlet oil temperature exceeds 50°C (122°F) following the run-in operation. To raise the temperature in a short time, run the transmission with the engine running in a half throttle.

3) Working operation

To operate for working, refer to the operator's manual. Pay special attention to the following points with the transmission:

1. Be careful that the torque converter outlet oil temperature does not exceed 120°C (248 °F) during heavy operation. If the oil temperature exceed 120°C (248°F), stop operation, and run the engine at low speed to lower the temperature. Using at a higher temperature accelerates oil deterioration causing burn out of O-rings and oil seals, etc.
2. Since skipping over of shifting (3rd speed → 1st speed) could damage the transmission, do not operate such shifting.
3. When shifting the forward and reverse, operate after the carrier stops completely.
4. Do not descend a slope with the lever set in the N range.
5. When selecting the high speed and low speed, operate at a speed less than 15 km/h (9.3 m. p.h.).

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4.2 PREVENTIVE MAINTENANCE

(1) Checking oil level

Check the oil level of the transmission with the level gauge provided on the rear of the transmission (see Fig. 4-1).

1) Check while the engine is cold.

1. Do not fail to check the oil level before starting the engine. If the level reaches the upper line of the level gauge, the engine may be started. If the level is below the upper line, add oil until the level reaches the upper line through the top of the torque converter.
2. Run the engine for five minutes with the transmission in neutral at idling speed allowing oil to circulate throughout the each part of the hydraulic system, then check the oil level. It is necessary that the oil level is upto the blue color notched line on the level gauge

2) Check during warming up

Arrang the oil level so that the oil level is between the red color notched line on the level gauge when the torque converter outlet oil temperature is approximately 80 to 100°C (176 to 212 °F) with the transmission in neutral and the engine idling.

(2) Chaging the oil and filter

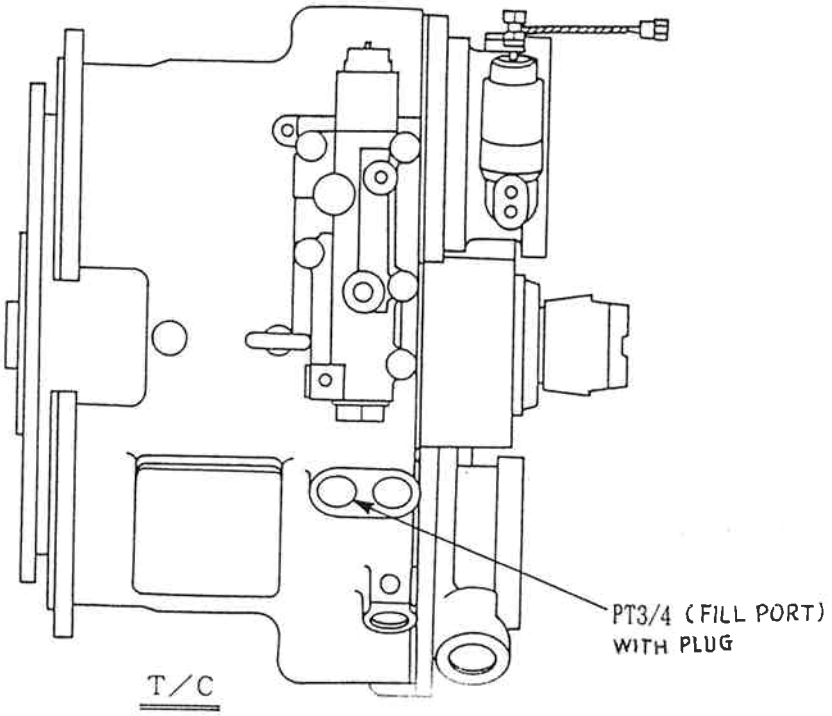
1) Draining oil

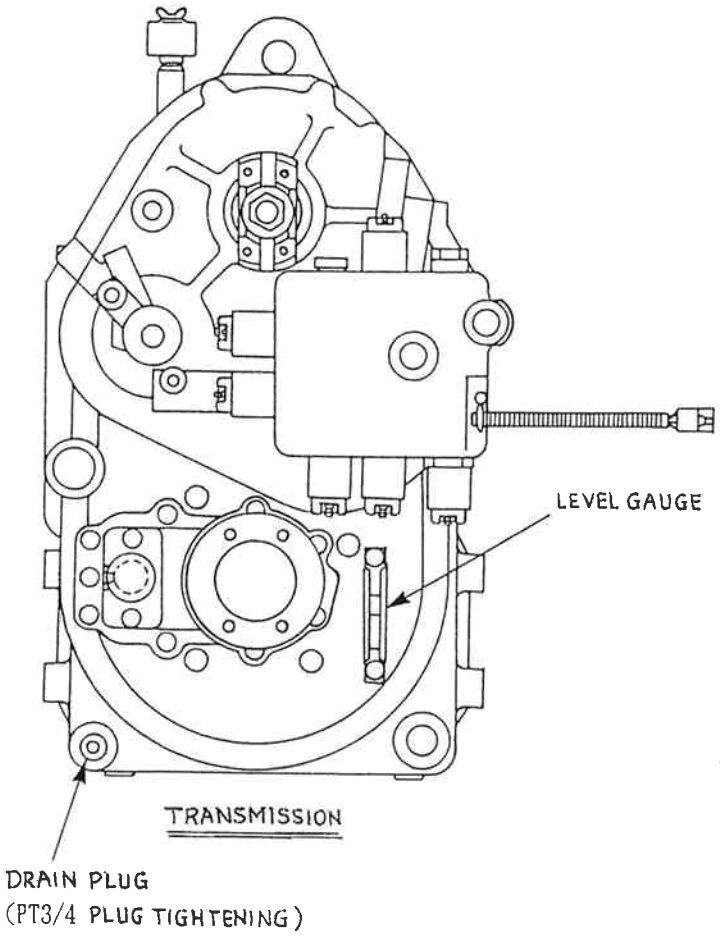
To change the oil, raise the temperature of the transmission oil as high as possible, and then stop the engine. Remove the drain plug provided on the lower left side face of the transmission, and take a sufficient time to thoroughly drain the oil (see Fig. 4-1).

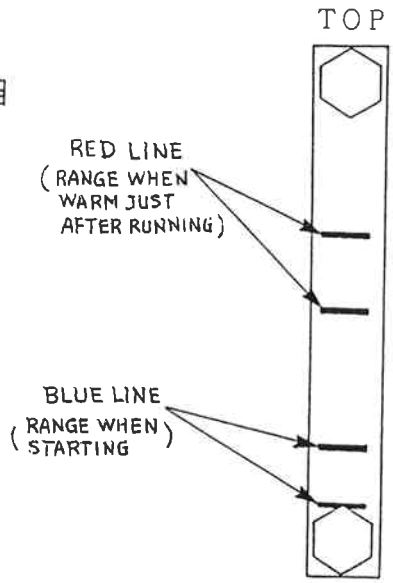
2) Intervals between oil and filter changes

Change the oil filter element every 6 months or 500 operation hours and the oil every year or 1,000 operation hours. Clean the strainer when the oil is changed. Where the operating conditions are severe, check more frequently for oil contamination and reduce the interval between changes.

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DETAIL OF LEVEL GAUGE

Fig. 4 — 1

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3) Cleaning oil strainer (see Fig. 4-2)

Every time oil is changed, remove and clean the oil strainer located to the rear of the oil sump on the lower portion of the transmission. To install the oil strainer in the sump after cleaning, insert one end of the strainer into the oil pick-up tube. Replace the O-ring with a new one if damaged or worn. After tightening, fill the oil sump with oil and check carefully for external oil leakge.

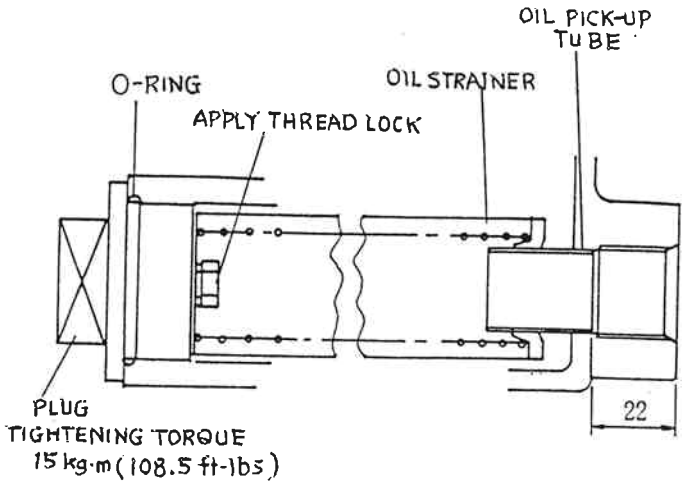


Fig. 4-2. Oil Strainer

4) Dirt or water in oil

Every time oil is drained, check to see if the oil contains dirt or water. A small amount of condensation in the oil is permissible because it is emulsified during transmission operation. But if there is evidence that water is entering the oil, check for leakage between the oil and water sections in the oil cooler. If there is oil in the engine side radiator water, transmission oil leakage may be occurring. However, oil leakage from the engine oil system is also conceivable. Thoroughly wash out dirt and sludge accumulated in the oil sump.

5) Metal chips in oil

Metal particles in the oil indicate that the transmission is damaged. (Tiny particles capable of being removed by the oil filter are not a problem.)

If large metal particles be observed, however, overhaul the transmission and throughly clean every oil path, the filter, cooler, etc.

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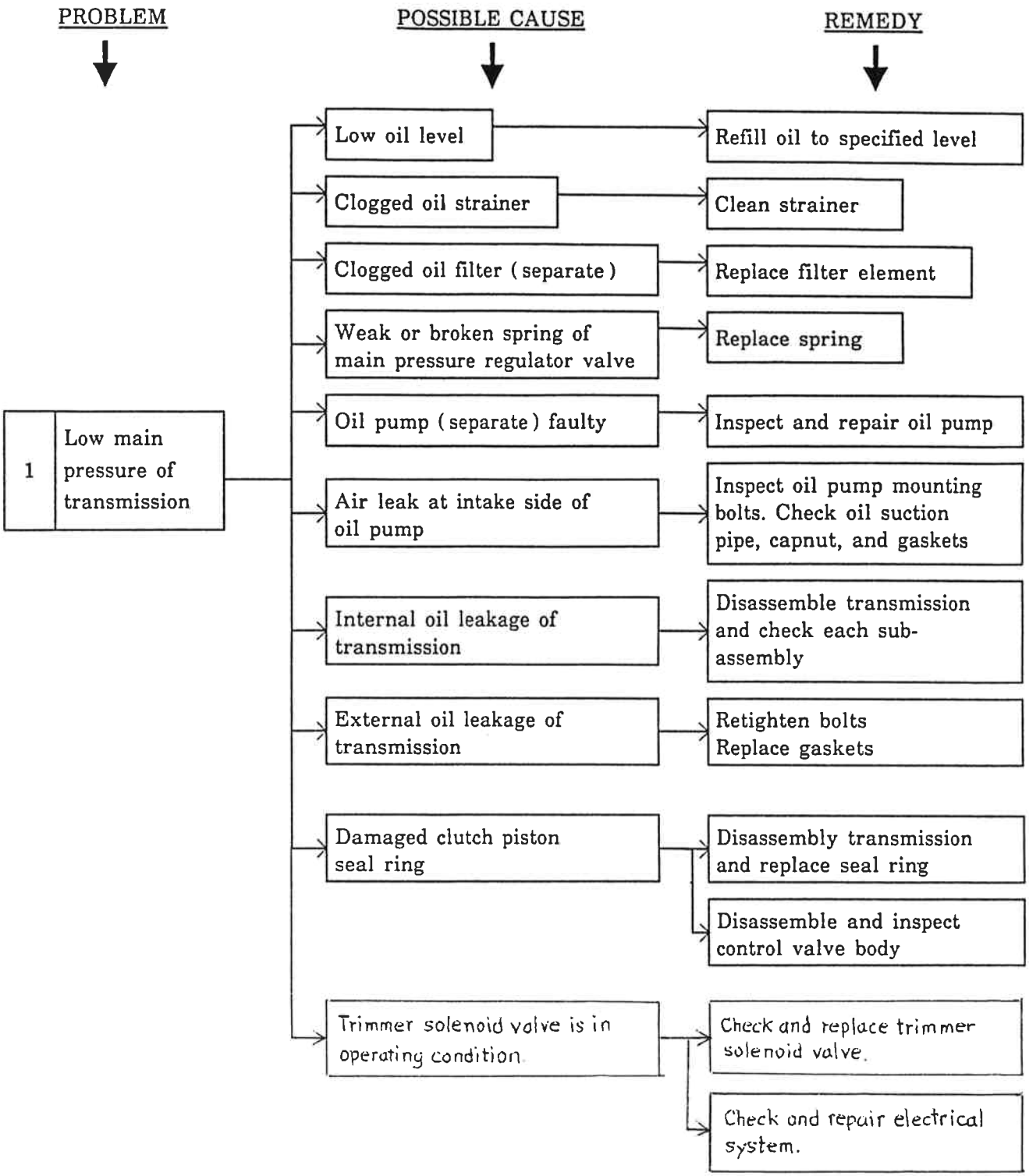
(3) External inspection of transmission

The exterior of the transmission should be kept clean all the time and inspected at regular intervals. Inspect frequently when the transmission is under severe operating conditions. Carefully check for loose bolts, oil leakage, loose or bent linkages, and damage to oil pipes. If oil leakage can not be stopped by retightening the bolts, take proper action. Linkages should be clean and well lubricated with oil.

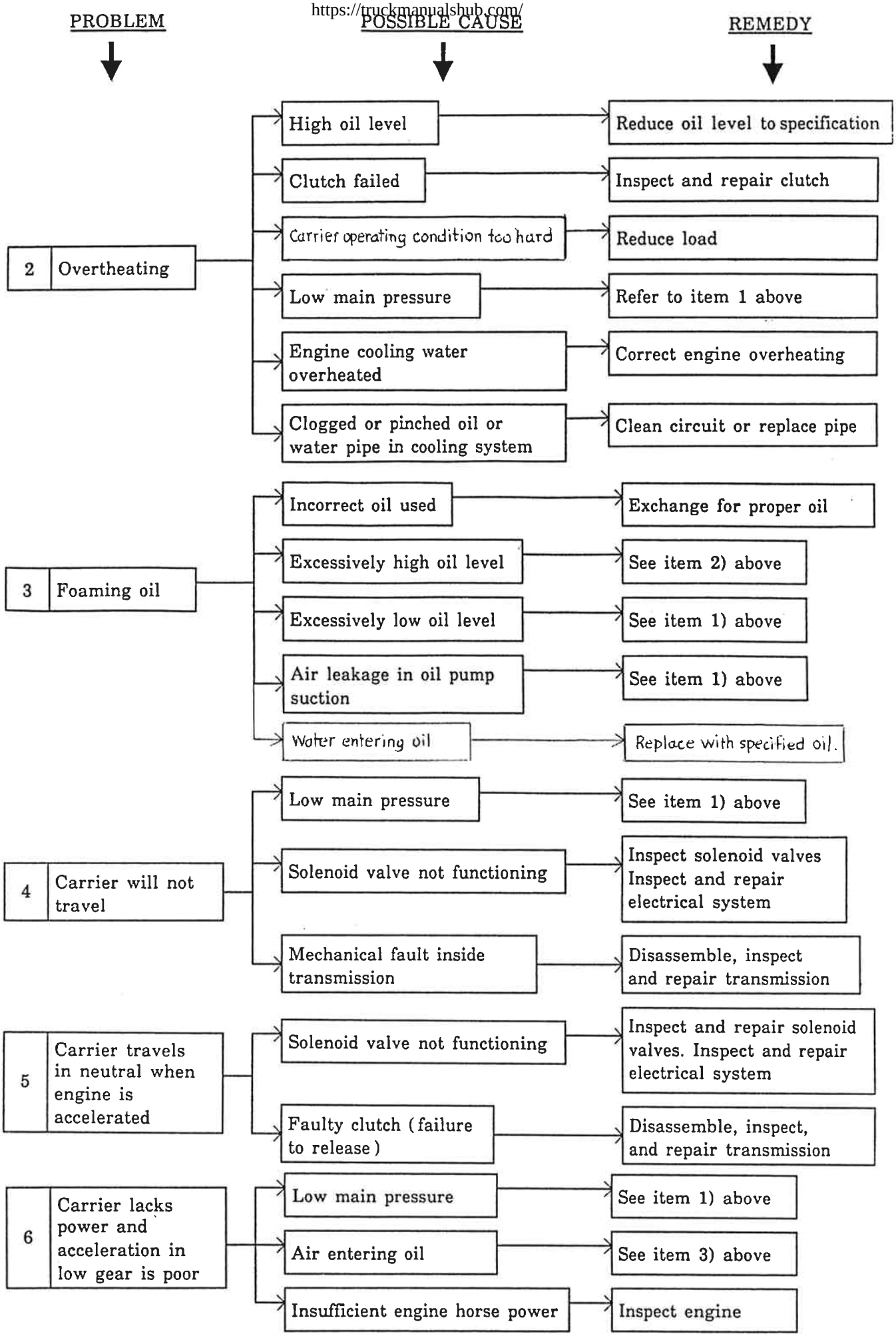
When the machine is operated in a dusty environment, clean the breather cap from time to time. First, clean the surroundings of the breather cap prior to removal. The breather cap should be cleaned with gasoline.

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5. TROUBLESHOOTING



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1. CONSTRUCTION AND FUNCTION

1.1 CONSTRUCTION

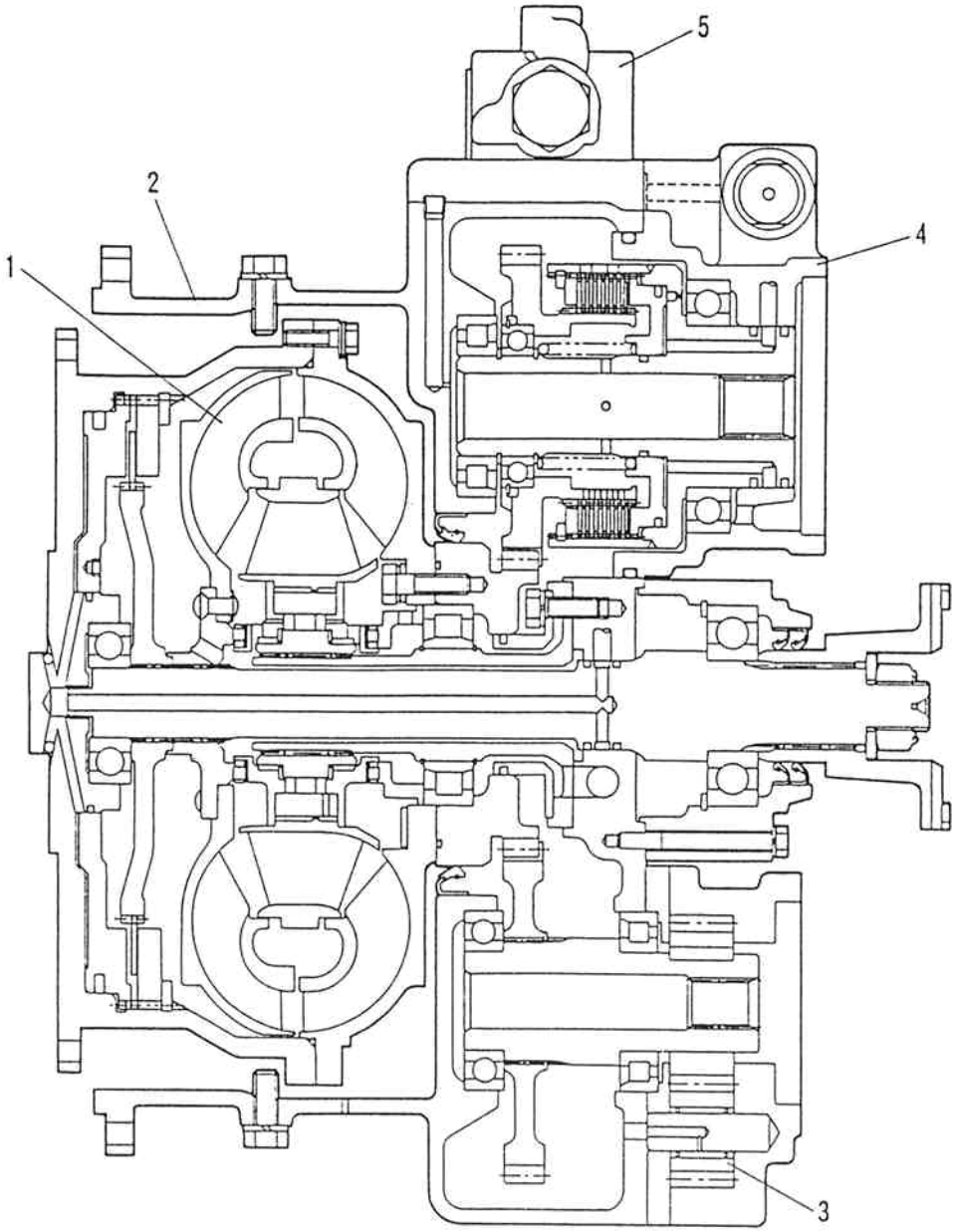
1.1.1 SPECIFICATIONS

Type	3-element, 1-stage, 2-phase With lockup clutch (Magnetic-hydraulic control type)	
Performance	Stall torque ratio	2.37
	Input torque	65 kg · m (470 ft-lbs.)
	Max. operating revolutions	3000 rpm
	Max. horse power	220 ps
	Direction of rotation (input side)	Clockwise viewed from engine side
Lockup device	Type	Wet, single plate
	Operating condition	Travelling speed (different for 2nd, 3rd, manual and automatic)
P.T.O.	Quantity	2 (Selectable and direct-coupled PTO)
	Controllable P.T.O.	
	Speed ratio	1.042: 1 (reduction)
	Direction of rotation	Clockwise viewed from output side
	Direct coupled P.T.O.	
	Speed ratio	1.208: 1 (reduction)
	Direction of rotation	Clockwise viewed from output side
Gear pump	Type	External gear pump, built-in type
Hydraulic line	Hydraulic oil	ATF Dexron II
	Clutch oil pressure	10 to 18 kg/cm² (142 to 256psi)
	Pressure at converter inlet	1 to 7 kg/cm² (14.2 to 99.5 psi)
	Oil capacity	about 32ℓ (8.5 gal.) (Torque conv. 10ℓ)

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1.1.2 Construction

(1) Torque Converter General Assembly.

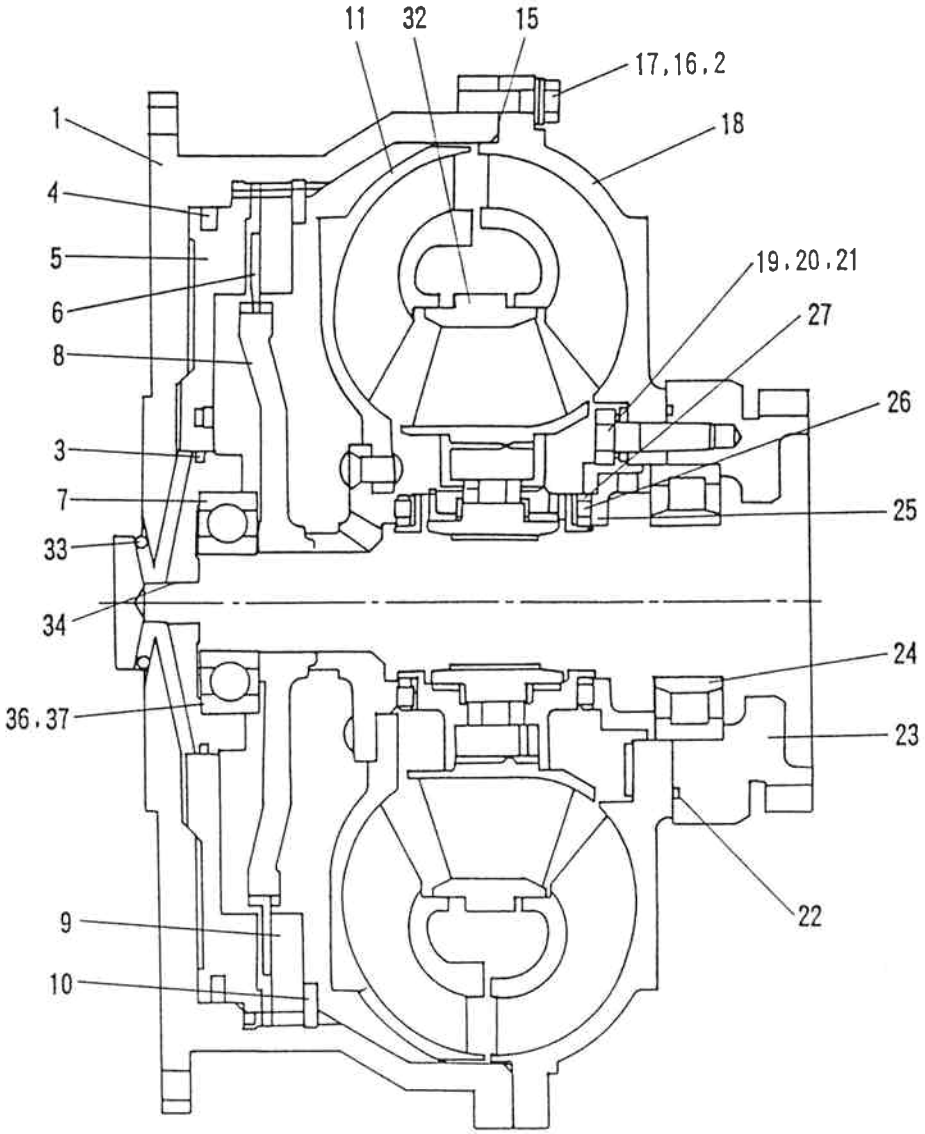


1. TORQUE CONVERTER ASSEMBLY
2. TORQUE CONVERTER CASE ASSEMBLY
3. GEAR PUMP ASSEMBLY
4. CONTROLLABLE PTO ASSEMBLY
5. LOCK-UP VALVE ASSEMBLY

Fig. 1-1 Torque Converter General Assembly

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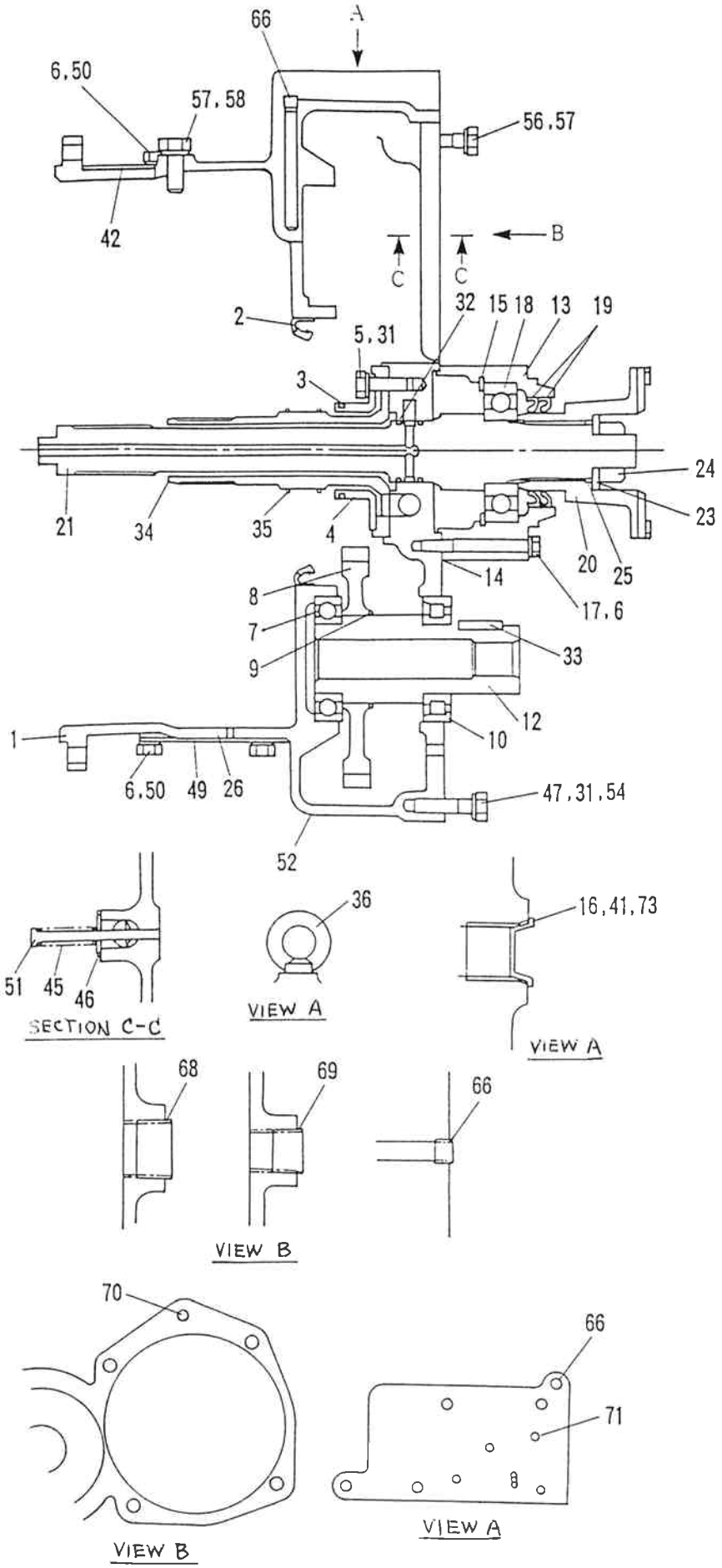
(2) Torque Converter Assembly



1. FRONT COVER	11. TURBINE ASSEMBLY	24. BEARING
2. WASHER (8)	15. O-RING	25 SPACER
3. PISTON RING	16. WASHER (8)	26. BEARING
4. PISTON RING	17. BOLT (M8 x 30)	27. THRUST WASHER
5 PISTON	18 PUMP	32. REACTOR ASSEMBLY
6 FRICTION PLATE	19. BOLT (M10 x 35)	33. STEEL BALL
7. BEARING	20. LOCKWASHER	34 BUSHING
8. CLUTCH HUB	21. WASHER	36. SHIM
9 END PLATE	22. O-RING	37. SHIM
10. SNAP RING	23. INPUT GEAR	

Fig. 1 - 2

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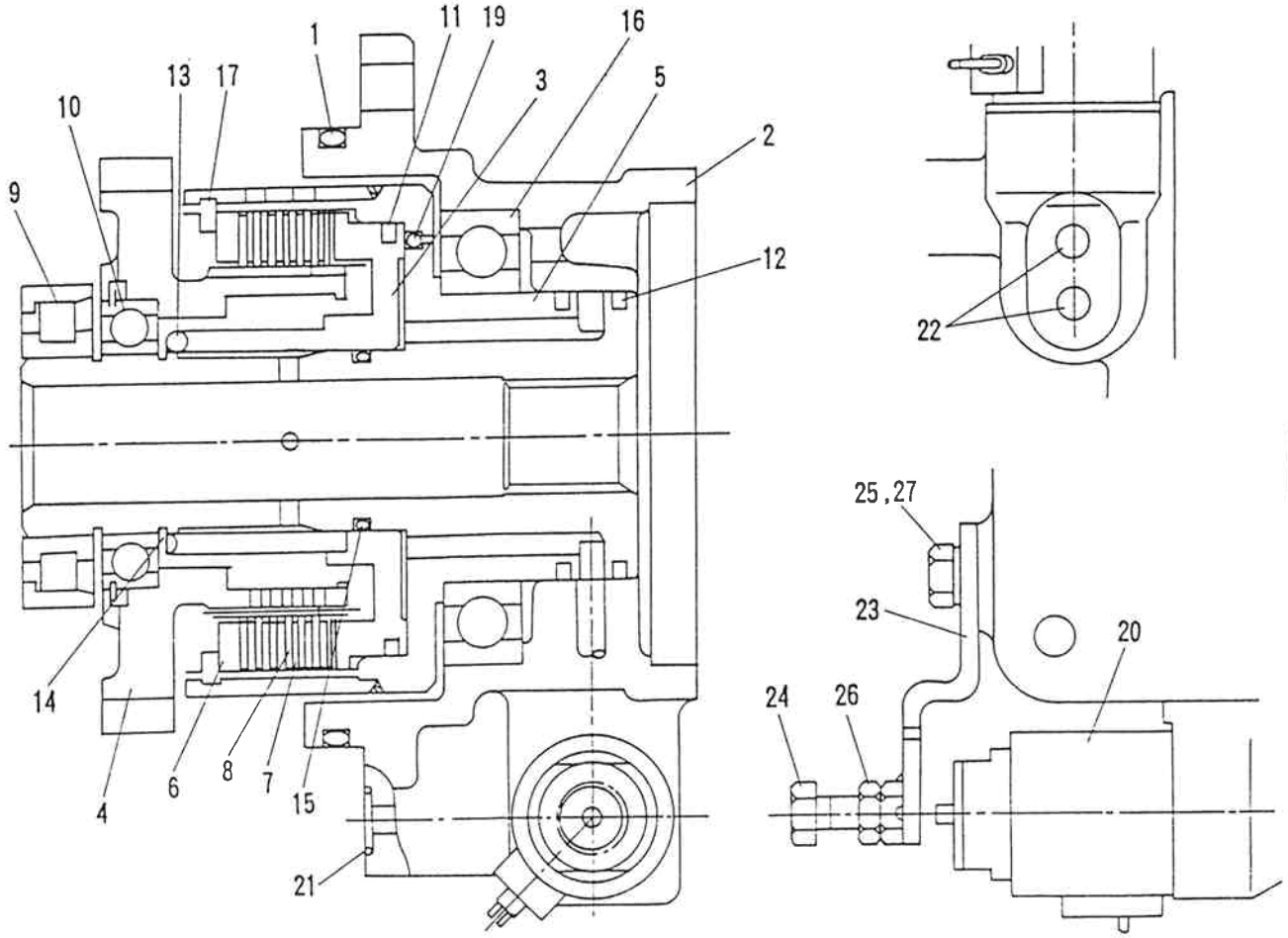


1. CONVERTER HOUSING
2. OIL SEAL
3. SEAL RING
4. SLEEVE
5. BOLT (M10×30)
6. WASHER (M8)
7. BEARING
8. GEAR
9. SNAP RING
10. BEARING
12. P.T.O. SHAFT
13. COVER
14. GASKET
15. SNAP RING
16. CAP (25)
17. BOLT
18. BEARING
19. OIL SEAL
20. INPUT FLANGE
21. TURBINE SHAFT
23. FLANGE WASHER
24. U-NUT
25. O-RING
26. GASKET
31. WASHER (M10)
32. SEAL RING
33. KEY
34. GRAND SHAFT
35. SNAP RING
36. EYEBOLT
41. CAP
42. COVER
45. SPRING
46. REGULATOR VALVE
47. BOLT (M10×45)
49. COVER
50. VOLT (M8×16)
51. GUIDE PIN
52. NAME PLATE
54. BOLT (M10×75)
56. BOLT (M12×35)
57. WASHER (M12)
58. BOLT (M12×30)
66. PLUG (1/8)
68. PLUG (1)
69. PLUG (3/4)
70. SCREW
71. SCREW
73. CAP

Fig. 1-3 Torque Converter Case Assembly

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(4) Controllable P.T.O. Assembly

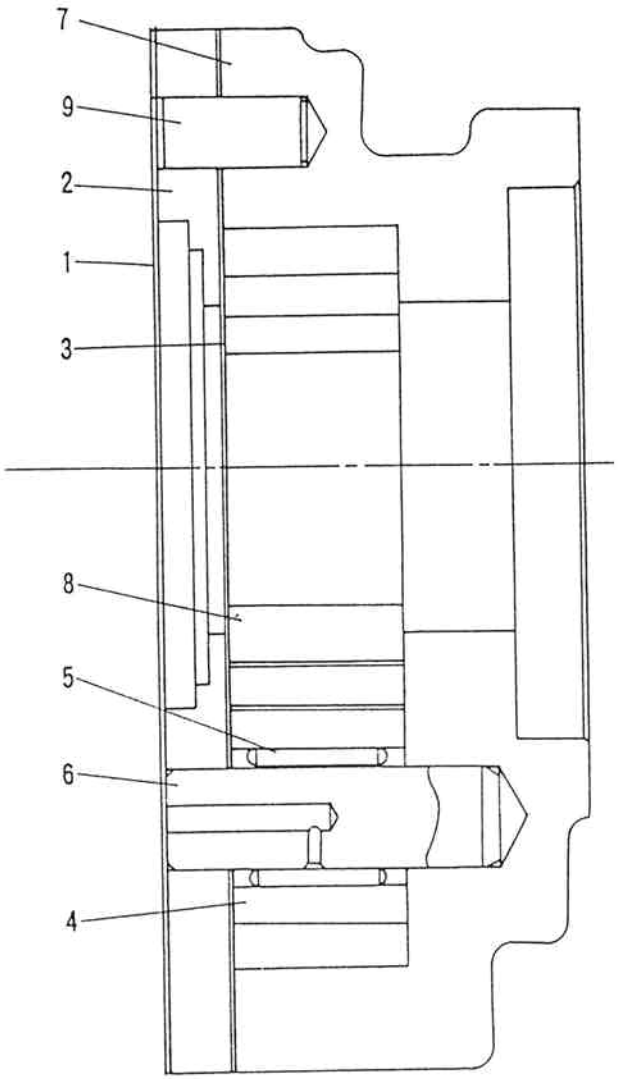


1.	O-RING	10.	BEARING	20	SOLENOID VALVE
2.	HOUSING	11	SEAL RING	21	O-RING
3	PISTON	12.	SEAL RING	22	PLUG (1/8)
4	GEAR	13.	SPRING	23.	PLATE P.T.O.
5.	SHAFT ASSEMBLY	14	SNAP RING	24	BOLT (M10×30)
6	END PLATE	15.	O-RING	25.	WASHER (M10)
7.	CENTER PLATE	16	BEARING	26.	NUT (M10)
8	CLUTCH PLATE	17.	SNAP RING	27.	BOLT (M10×26)
9.	BEARING	19.	STEEL BALL		

Fig. 1-4 Controllable P.T.O Assembly

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(5) Gear Pump Assembly

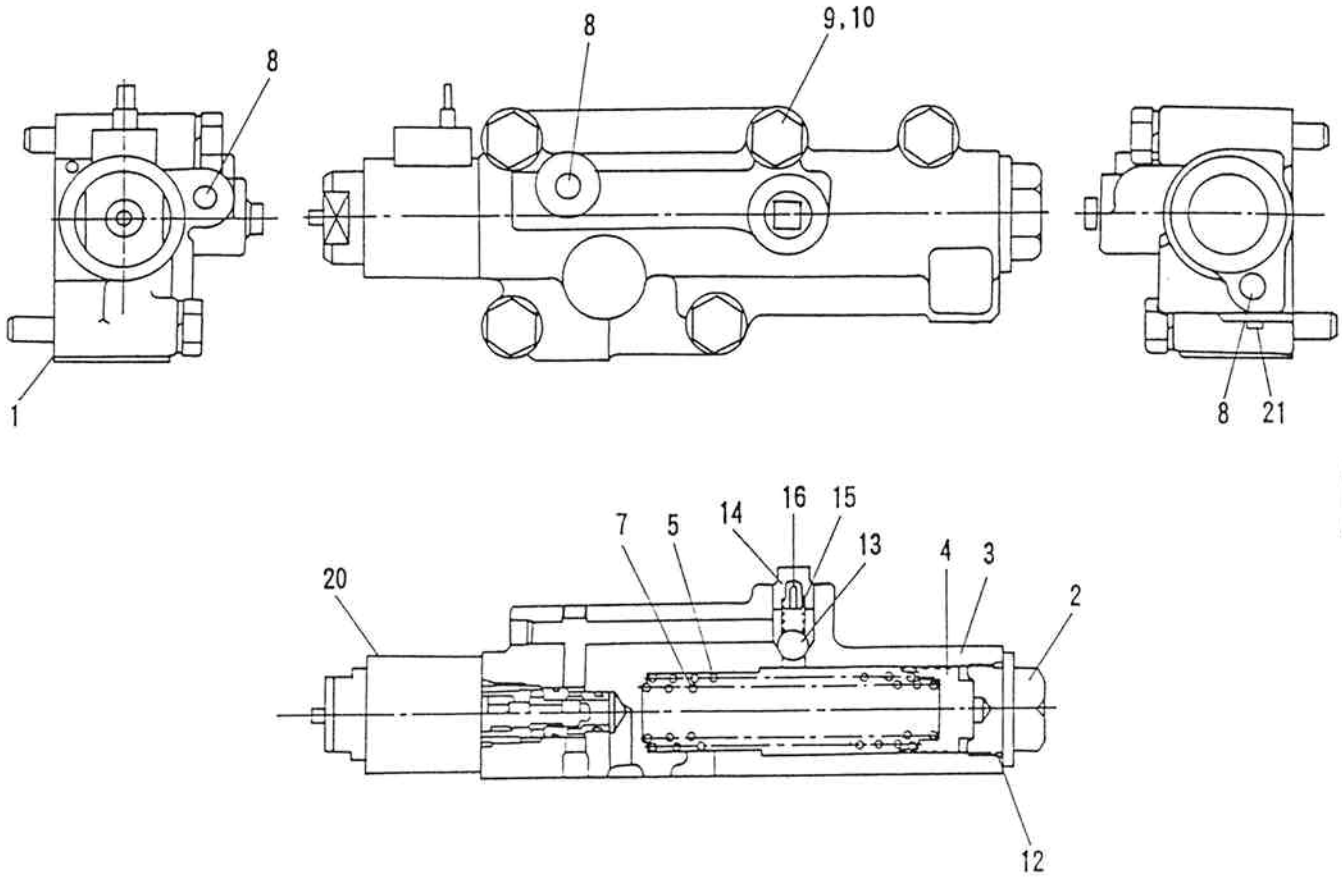


1. GASKET
2. OIL PUMP COVER
3. GASKET
4. DRIVEN GEAR
5. NEEDLE BEARING
6. DRIVEN GEAR
7. OIL PUMP BODY
8. DRIVE GEAR
9. PIN

Fig. 1-5 Gear Pump Assembly

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(6) Lock-up Valve Assembly



1. GASKET
2. PLUG
3. LOCK-UP VALVE BODY
4. TRIMMER PLUG
5. SPRING
7. SPRING
8. PLUG (1/8)
9. BOLT (M10×65)
10. WASHER (M10)
12. O-RING
13. STEEL BALL
14. PLUG (3/8)
15. SPRING
16 SPRING PIN
17. SMALL SCREW (M4×10)
18 WASHER (M4)
19 WASHER (M4)
20. SOLENOID VALVE
21 PLUG (1/4)

Fig. 1-6 Lock-up Valve Assembly

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1.2 FUNCTION

(1) Speed Changing Condition

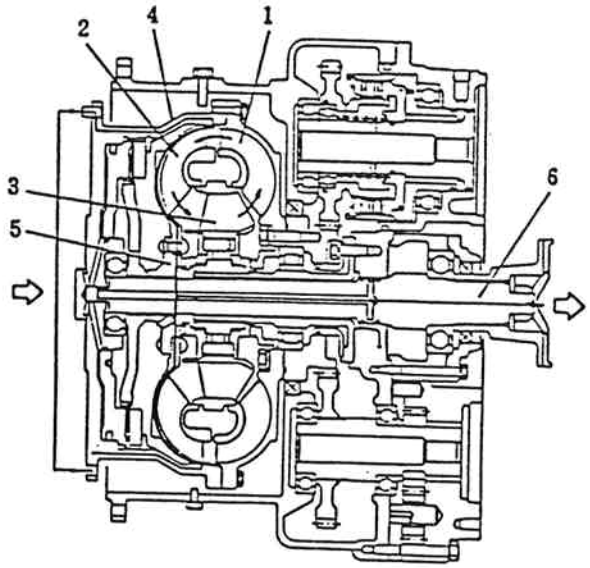
The oil passage through the torque converter is formed by the vanes of the three elements: pump, turbine and reactor (see Fig. 1-7). Converter oil is discharged from the pump and returns to the pump via the turbine and reactor.

Power from the engine is transmitted via the front cover to the pump, and then in the form of oil under pressure, to the turbine, which is riveted to the turbine hub. The turbine hub is splined to the turbine shaft. In other words, the Power from the turbine is transmitted through the turbine hub to the turbine shaft. The number of output members (turbines) is a stage. How oil flows through pump, turbine and reactor is illustrated in Fig. 1-8.

Oil past the vanes of the pump and turbine flows according to the vane tilt angles (in the direction of the dotted lines shown in Fig. 1-8). However, because the pump and turbine are rotating in the direction shown by the arrow, the oil when seen from a stationary point, flows to the reactor, folllowing the solid line shown, and from there it returns to the pump inlet for recirculation as outlined above.

Torque on the turbine is generated by the reaction when the oil from the turbine to the reactor changes direction. Therefore, a decrease in turbine revolutions increases the change in flow direction, as shown in I of Fig. 1-9, thereby increasing the turbine torque, and increased turbine revolutions reduce the change in flow direction, as in II, reducing the turbine torque.

Turbine oil changes the turbine revolutions indefinitely according to the load, and the turbine torque is automatically changed accrodingly.



1 PUMP
2 TURBINE
3 REACTOR
4 FRONT COVER
5 TURBINE HUB
6 TURBINE SHAFT

Fig. 1-7 Torque Converter Drive

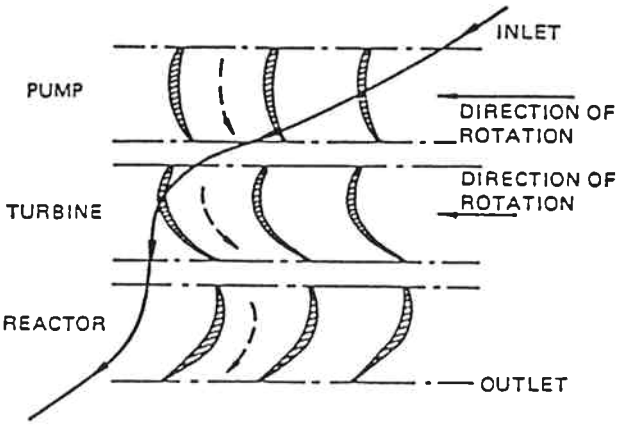


Fig. 1-8 Oil Flow of Torque Converter

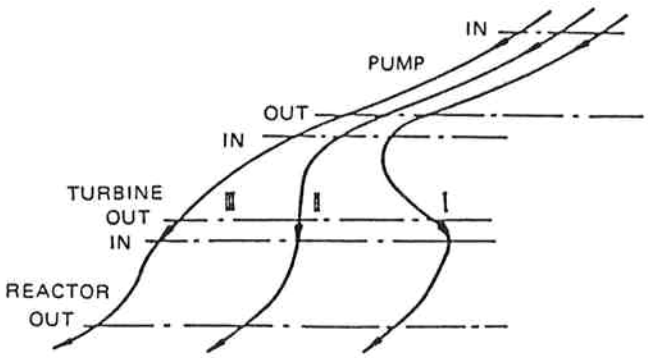


Fig. 1-9 Change of Torque Converter Oil Flow

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Fig. 1-10 shows general performance curves for this type of torque converter. The torque ratio varies according to the turbine oil speed along curve I.

The torque ratio at which the turbine shaft is stopped, namely at a speed ratio of 0, is known as the stall torque ratio, which is multiplied 2.37 times in this torque converter.

(2) Direct-coupled Condition

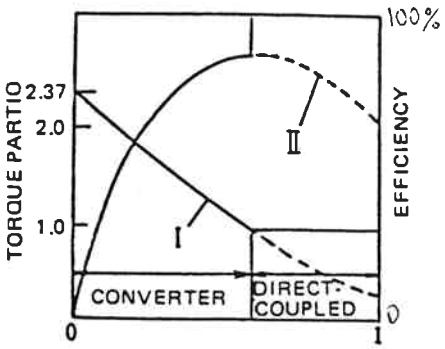
When turbine revolutions exceed a given limit at a reduced load, the change in oil flow direction becomes less as shown by curve III in Fig. 1-9, and the torque on the turbine becomes lower than that on the pump. Consequently, sufficient power is no longer transmitted. Put another way, referring to Fig. 1-10, the torque ratio is reduced as represented by the dotted part of curve I and the efficiency reduced as shown by the dotted part of curve II.

Conseidering this, at low to medium turbine speeds, the advantage of a torque converter can be made use of, but at high speeds, the engine and turbine shaft are directly coupled mechanically for improved efficiency.

The torque converter described in this manual is fitted with a wet, single plate called Lock-up Clutch between front cover and turbine shaft (see Fig. 1-11). When the traveling speed exceeds a fixed speed (which is different for the 2nd speed and 3rd speed) during traveling at the 2nd speed or 3rd speed, the lock-up solenoid valve automatically operates to connect the engine and turbine shaft directly. At this time, in order to lessen shock generated when the clutch is engaged, an exclusive accumulator is provided. Besides, when the speed drops from the speed at that time when the lock-up clutch operated, the lock-up clutch is automatically disengaged to release the direct coupling. In this case also, the lock-up clutch does not operate unless the speed reaches a fixed speed.

When the direct coupling is made, the reactor is at a standstill, so ineffectual flow is generated in the oil circuit, and energy is lost. Therefore, an one-way clutch is provided in the reactor to improve performance.

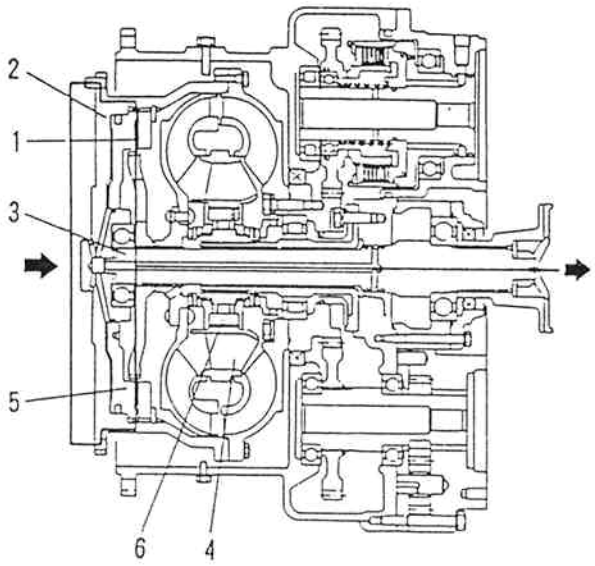
As outline above, the torque converter function improved by classifying into two steps is called two phases.



$$\text{Torque Ratio} = \frac{\text{Turbine Torque}}{\text{Pump Torque}}$$

$$\text{Speed Ratio} = \frac{\text{Turbine Revolutions}}{\text{Pump Revolutions}}$$

Fig. 1-10 Torque Converter Performance Curves



1 LOCK-UP CLUTCH
2 FRONT COVER
3 TURBINE SHAFT
4 REACTOR
5 CLUTCH PISTON
6 ONE-WAY CLUTCH

Fig. 1-11 Power Transmission at Direct Coupling.

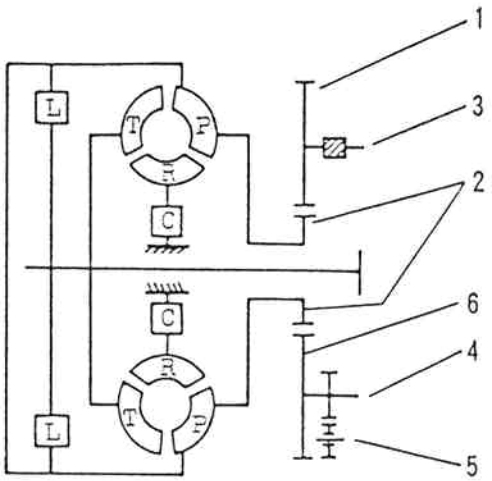
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(3) Power Takeoff (P.T.O.) and Gear Pump (see Fig. 1-12)

At the back of the converter are two flanges for the direct-coupled and the controllable power take off. Power form the engine is transmitted by gears to them without passing through the converter. In other words, power to the fornt cover is transmitted through the pump and P.T.O. drive gear bolted together to the P.T.O. driven gear.

The controllable P.T.O. employs wet, multi-plate clutch form, which allows the exclusive solenoid valve to operate to connect and disconnect the power with the selector switch even while the engine runs. (It is required to confirm that the P.T.O. is not loaded when selecting.)

The direct-coupled P.T.O. has a built-in gear pump.



1 P.T.O. DRIVEN GEAR
2 P.T.O. DRIVE GEAR
3 CONTROLLABLE P.T.O.
4 DIRECT-COUPLED P.T.O.
5 GEAR PUMP
6 DIRECT-COUPLED P.T.O. DRIVEN GEAR

Fig. 1-12 P.T.O. and Gear Pump Drive

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2. DISASSEMBLY AND ASSEMBLY

2.1 GENERAL PRECAUTIONS

(1) General

In order to perform exact disassembly, checking and reassembly, clean every part thoroughly. Since parts contaminated with miniscale foreign matter will function less satisfactorily, take ample care not to allow dirt, dust, etc. to enter when assembling.

For hydraulic components, be sure to replace filter elements with new ones after disassembly and reassembly so that no foreign matter will be allowed to enter from the oil cooler located separately. After replacement, flush as follows:

1. Add new oil and operate for about 10 minutes.
2. Drain the oil and clean filter elements and strainers.
3. Add new oil again.

(2) Replacement Parts

When the torque converter is reassembled, replace the following parts with new ones :

1. Gaskets
2. O-rings
3. Seal rings
4. Washers and snap rings damaged during disassembly
5. Oil seals, if removed for disassembly

CAUTION

When Teflon seals are burned, they emit noxious gas. For this reason, do NOT burn them.

(3) Notes for Handling Parts

Be careful not to cut or dent parts when handling. Sliding parts with tight clearance will stick if damaged even slightly. A notch on a smoothly finished part that controls oiltightness will cause oil leakage. Therefore, handle each part very carefully during disassembly, cleaning, checking and reassembly.

(4) Cleaning and Checking

1) Cleaning parts

1 Clean all metal parts with volatile oil or steam. If steam-cleaning, do not use caustic soda solution or the like.

2 After parts have been cleaned, dry them with compressed air. For steam-cleaned parts, coat them with oil soon after they are dried.

3 Thoroughly flush each oil passage with compressed air to remove volatile oil, then dry with compressed air.

4 After parts, especially oil passages, have been cleaned, check to see that they are clear.

2) Cleaning bearings

1 With bearings that are used to the extent that they require overhaul, clean thoroughly with volatile oil.

2 If bearings are very contaminated or stained with hard grease, immerse them in volatile oil for a while before cleaning them.

3 Prior to checking bearings, coat them with the same oil used on the torque converter.

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CAUTION

Do not attempt to dry bearings with compressed air or turn them without lubrication.

3) Servicing bearings

Since dust, dirt, and sand will normally be causes of damaged bearings, take full care that they are not contaminated with such foreign matter. For longer service life of bearings, keep the following in mind:

1 When new bearings are to be mounted, do not remove the wrapping paper until ready to mount them.
2 Do not remove grease from new bearings.
3 Do not put bearings directly on dirty workbenches but on clean paper.
4 If it takes some time before the part on which a bearing is to be mounted is assembled, do not leave the bearing exposed, wrap or cover it with clean paper or a rag to protect it from dust.

2.2 PREPARATION

(1) Extra Tools and Devices in addition to Normal Tools

1 Chain hoist(with 500kg or more capacity)
2 Workbench for disassembly and reassembly
3 Press
4 Square wooden block
5 Clean pieces of waste cloth (Do not use cotton ginning and the like.)
6 Parts stand
7 Cleaning devices like brush, cleaning oil, etc.
8 Torque wrench
9 Grease that is easy to dissolve in oil
10 Snap ring pliers
11 Bearing puller

(2) Special Tools

Special tools are required to disassemble the direct-coupled P.T.O. as shown in Fig. 2-3

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(2) Special Tools

Special tools are required to disassemble the direct-coupled P.T.O. as shown in Fig. 2-3

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2.3 DISASSEMBLY

Disassemble into each sub-assembly by taking the following steps.

(1) Disassembling the Converter Assembly (see Fig. 2-1)

1 Remove two bolts (1) and lid (2).

2 Using the tool inserted through the hole, remove ten bolts (3).

3 Remove 12 bolts (4) from converter housing (6), and the converter housing assembly from the engine.

4 Place the converter, removed from the engine, with the flange face up.

5 Remove bolt (5).

6 By pulling up gradually converter assembly (7), take it out.

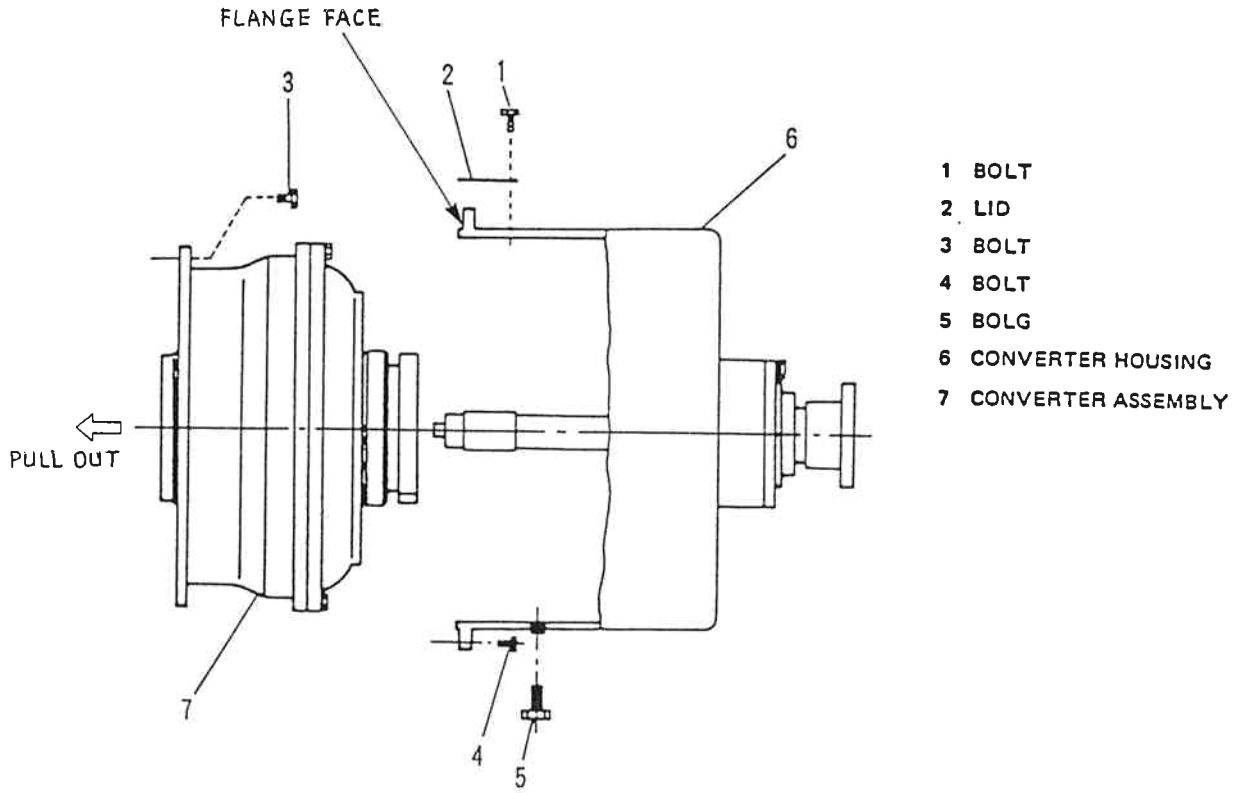


Fig. 2-1 Disassembly of Converter Case

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(2) Disassembling the Converter Assembly (see Fig. 2-2).

1. Place converter with front cover (1) facing down.
2. Remove 18 capscrews (3) which secure pump (2) to front cover (1).
3. Remove 10 capscrews (5) which secure input gear (4) to pump (2).
4. Take out the parts in order from the top from the inside of front cover (1).

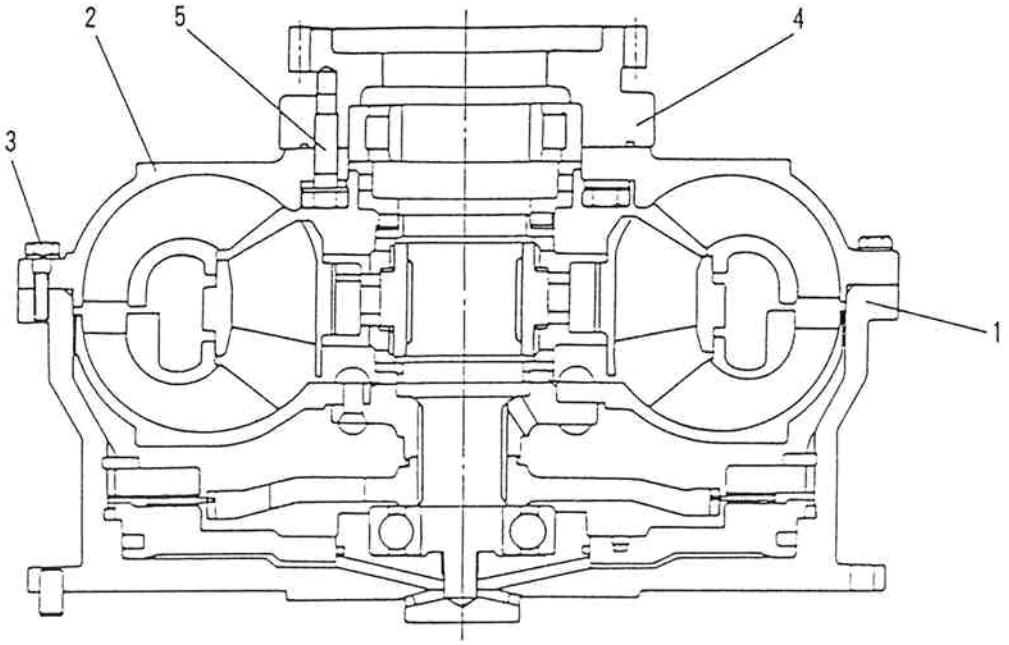


Fig. 2-2 Disassembly of Converter Assembly.

(3) Disassembling the Direct-coupled P.T.O. (see Fig. 2-3).

1. Remove 8 bolts,and remove the gear pump assembly.
2. Using the tool shown in Fig. 2-3, pull shaft (2), and remove the shaft assembly from the converter case.
3. Remove gear (4) and bearing (3) from shaft (2).

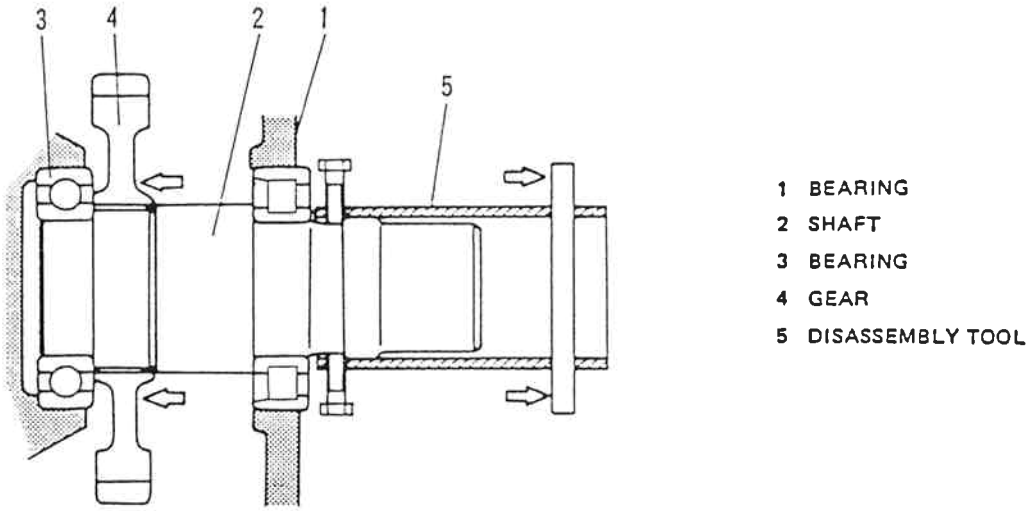


Fig. 2-3 Disassembly of Direct Coupled P.T.O.

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(4) Disassembling the controllable P.T.O. (see Fig. 2-4)

1. Remove P.T.O operating solenoid valve (11).
2. Remove 4 capscrews (1) from the converter housing, and pull out the controllable P.T.O. from the converter housing.
3. Using the bearing puller, remove bearing (3) from shaft (2).
4. Remove snap ring (4) and gear (5) in this order from shaft (2).
5. Remove snap ring (7) and end plate (8) in this order from housing (6).
6. Remove clutch plates (9) and center plates (10) from housing (6).

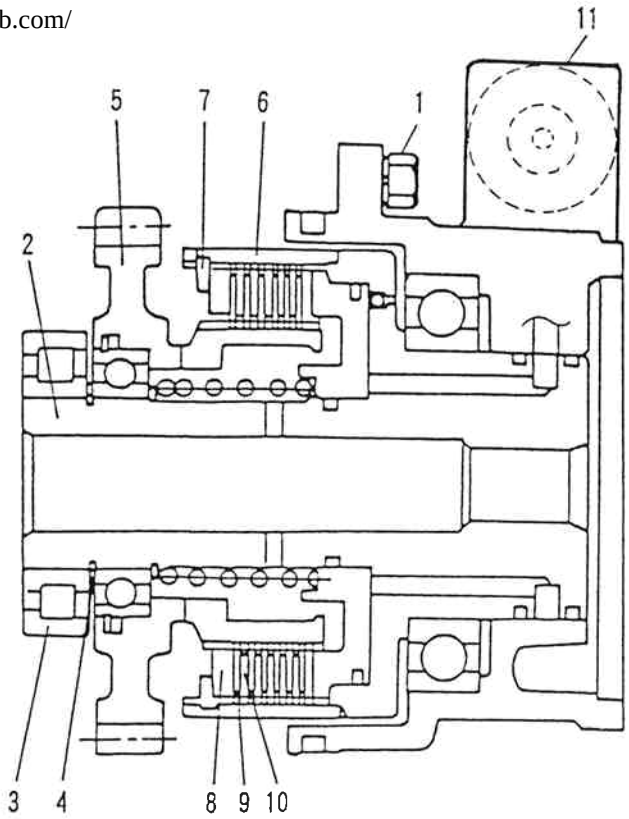


Fig. 2-4 Controllable P.T.O.

2.4 ASSEMBLY

(1) General

General notes for assembly are:

1. Check that every part is clean.
2. Measure the clutch plates, thrust washers, bearings, gears, etc. for wear. If worn beyond specification, replace with new ones.

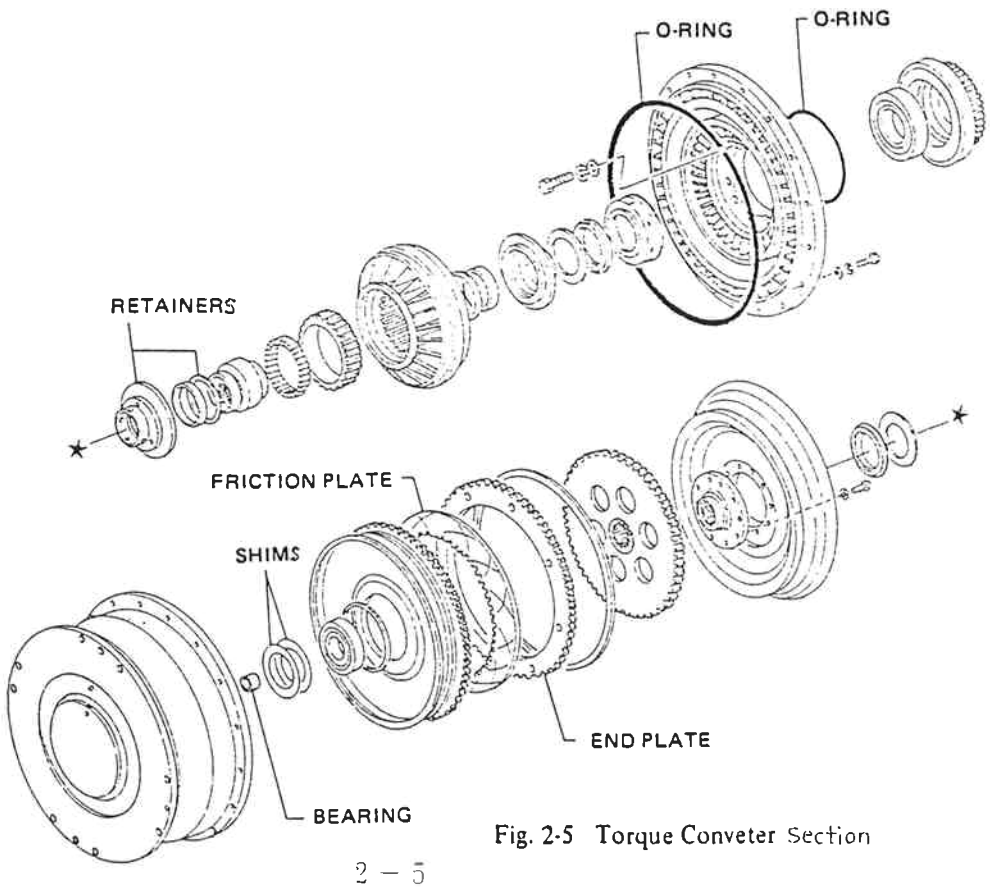


Fig. 2-5 Torque Conveter Section

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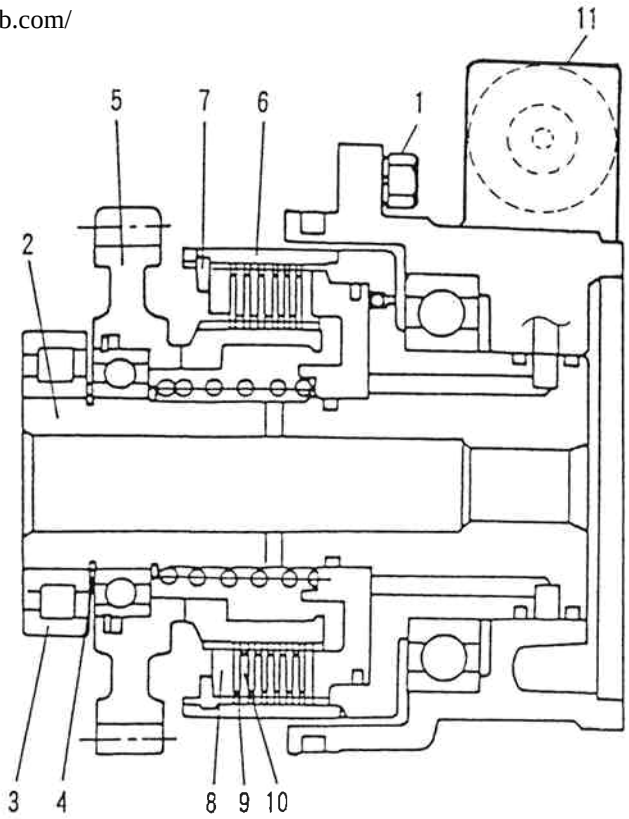


Fig. 2-4 Controllable P.T.O.

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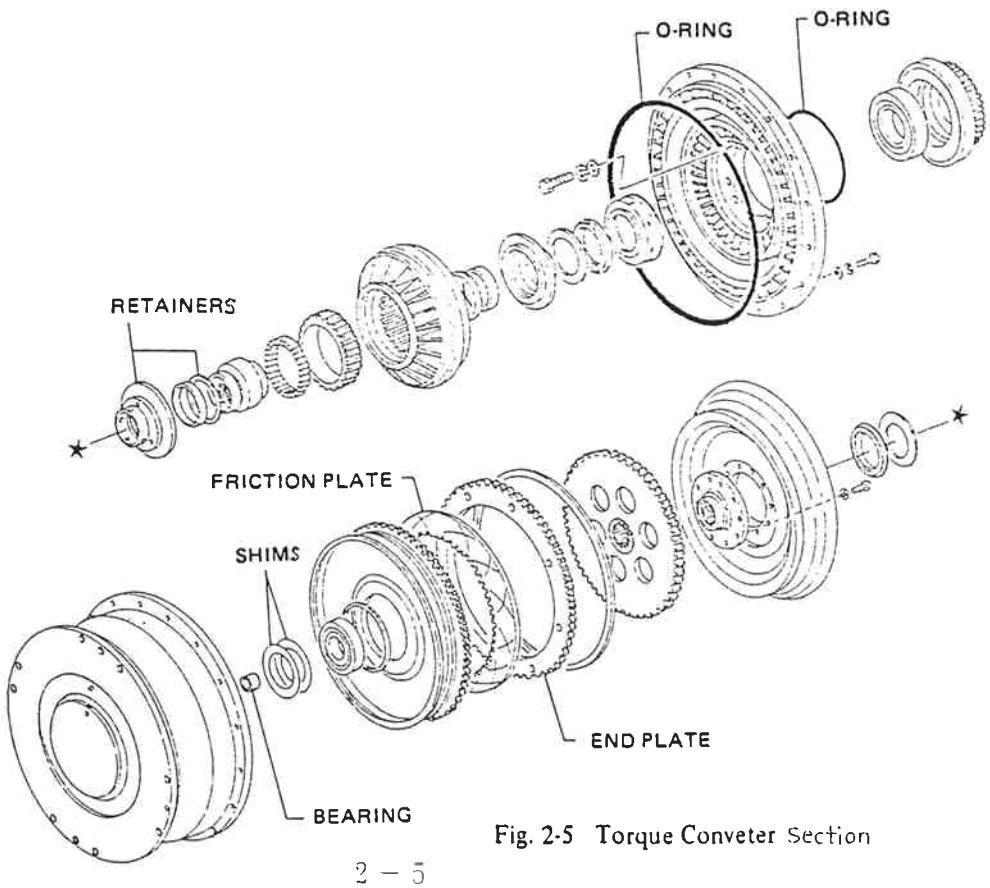


Fig. 2-5 Torque Conveter Section

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3. Check that there is no foreign matter in the housing and oil passage. If any is found, remove it using volatile oil or compressed air.
4. Check mating, thrust, and seat faces for scratches and dents. If any is found, correct by oilstone, scraper, file, sandpaper, etc. If the damage is severe, replace the part with a new one.
5. Fill grease the space between the lips of the oil seal. (Filling quantity is approximately a half of the space between the lips.) When installing, take care not to damage the seal. Be particularly careful especially when passing gears and splines through the oil seal.

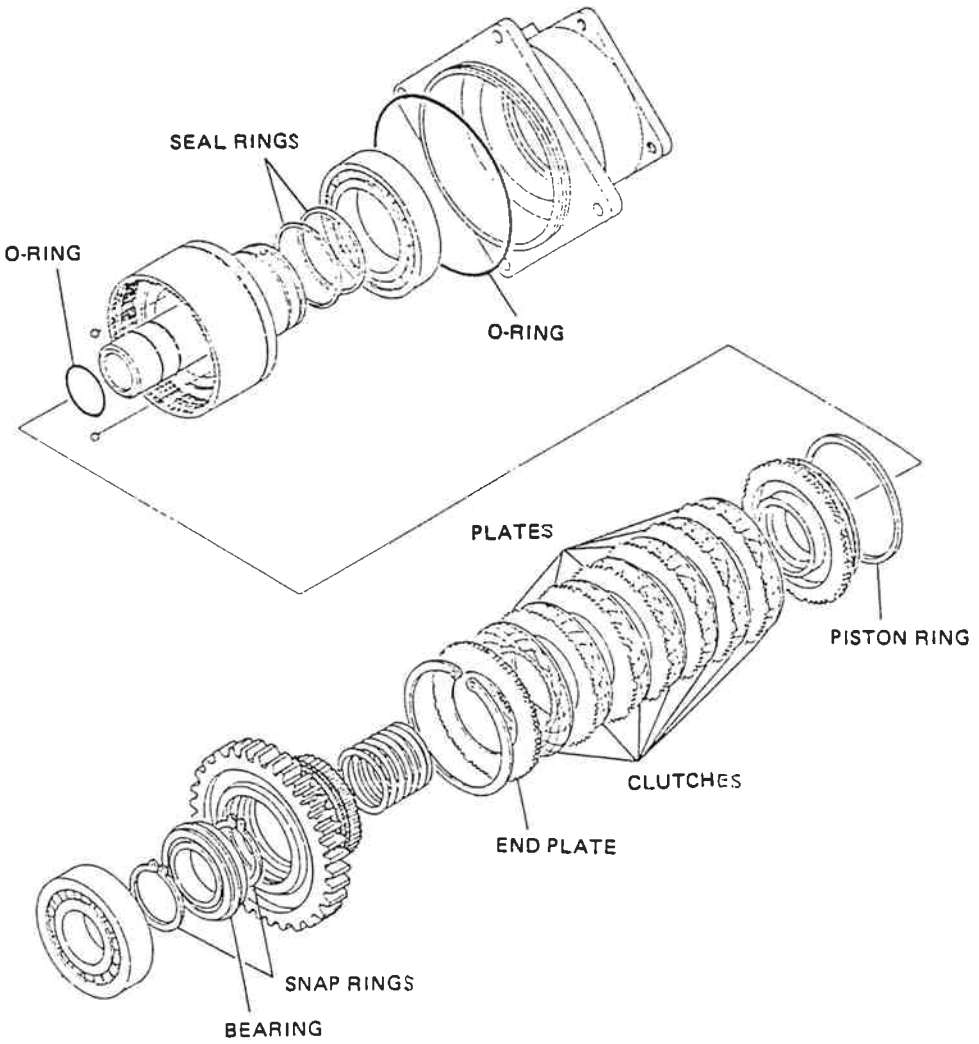


Fig. 2-6. P.T.O. Assembly

(2) Notes for Reassembly of Torque Converter

Pay attention to the following at assembly:

1. It is very important to give thrust bearings the correct clearance at assembly.
2. After the torque converter is reassembled temporarily as shown in Fig. 2-7, measure dimensions A and B using a depth gauge.
3. The correct clearance in the direction of thrust is C = B − A = 0.2 to 0.4 mm (0.008 to 0.016in.). Adjust the clearance by inserting shims as required beneath the thrust bearing.
4. Apply Locktite to the threads of bolts (1) and tighten to 6 kg-m (43.4 ft-lbs) (see Fig. 2-7).

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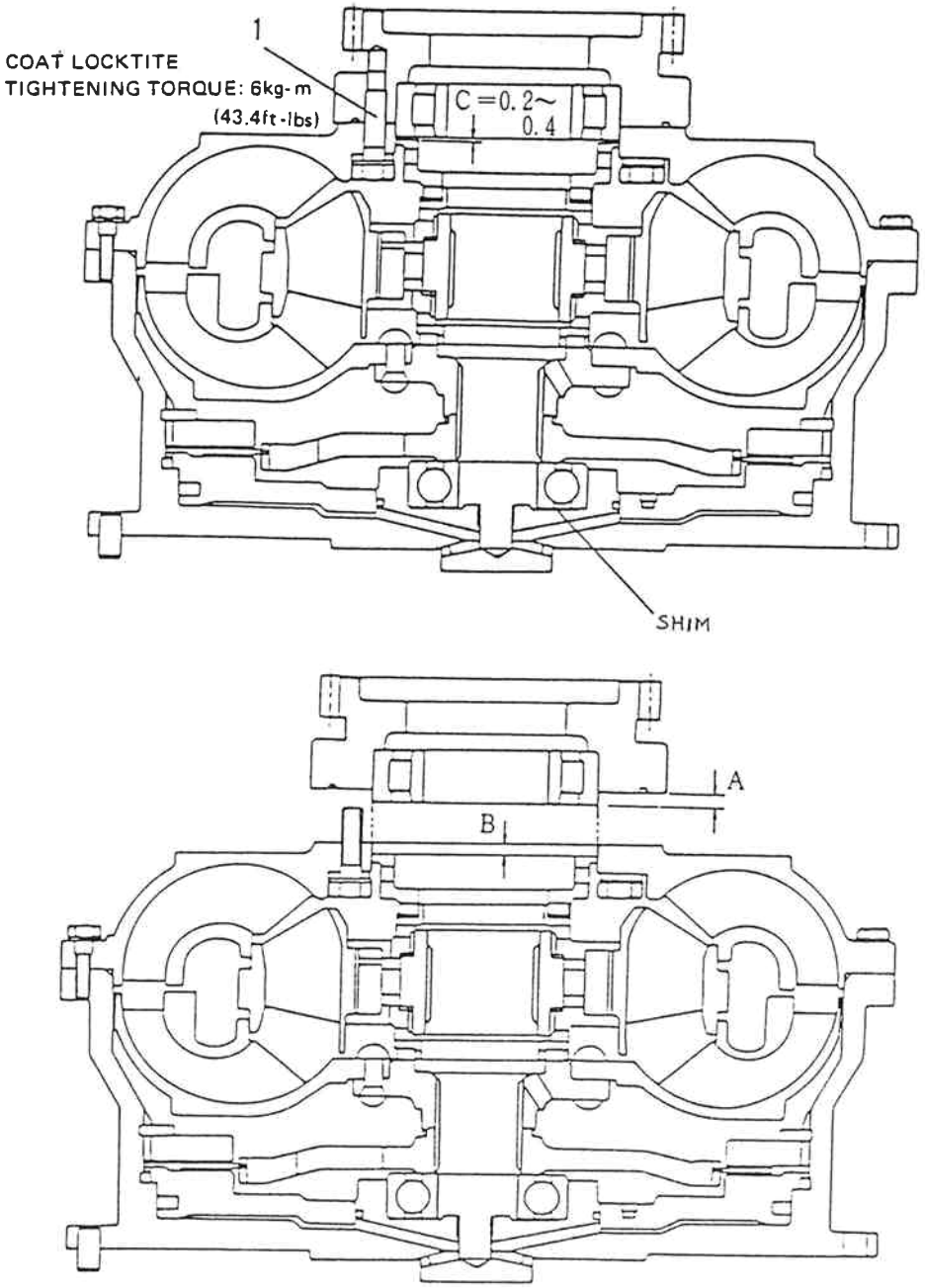


Fig. 2-7 Adjusting Clearance in Thrust Direct of Torque Converter

5 If the converter relief valve has been removed from the converter housing, pay attention to the driving depth of the guide pin. The distance between the finished surface of the housing to the top of the guide pin head must be 44 mm (1.732 in.) as shown in Fig. 2-8.

6 Check that the clearances in the direction of thrust between the outer race of P.T.O. drive shaft bearing and oil pump cover, and between another outer race and the part of the selectable P.T.O. housing onto which bearing is inserted are the values shown in dimensions A and B in Fig. 2-8.

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RELIEF VALVE

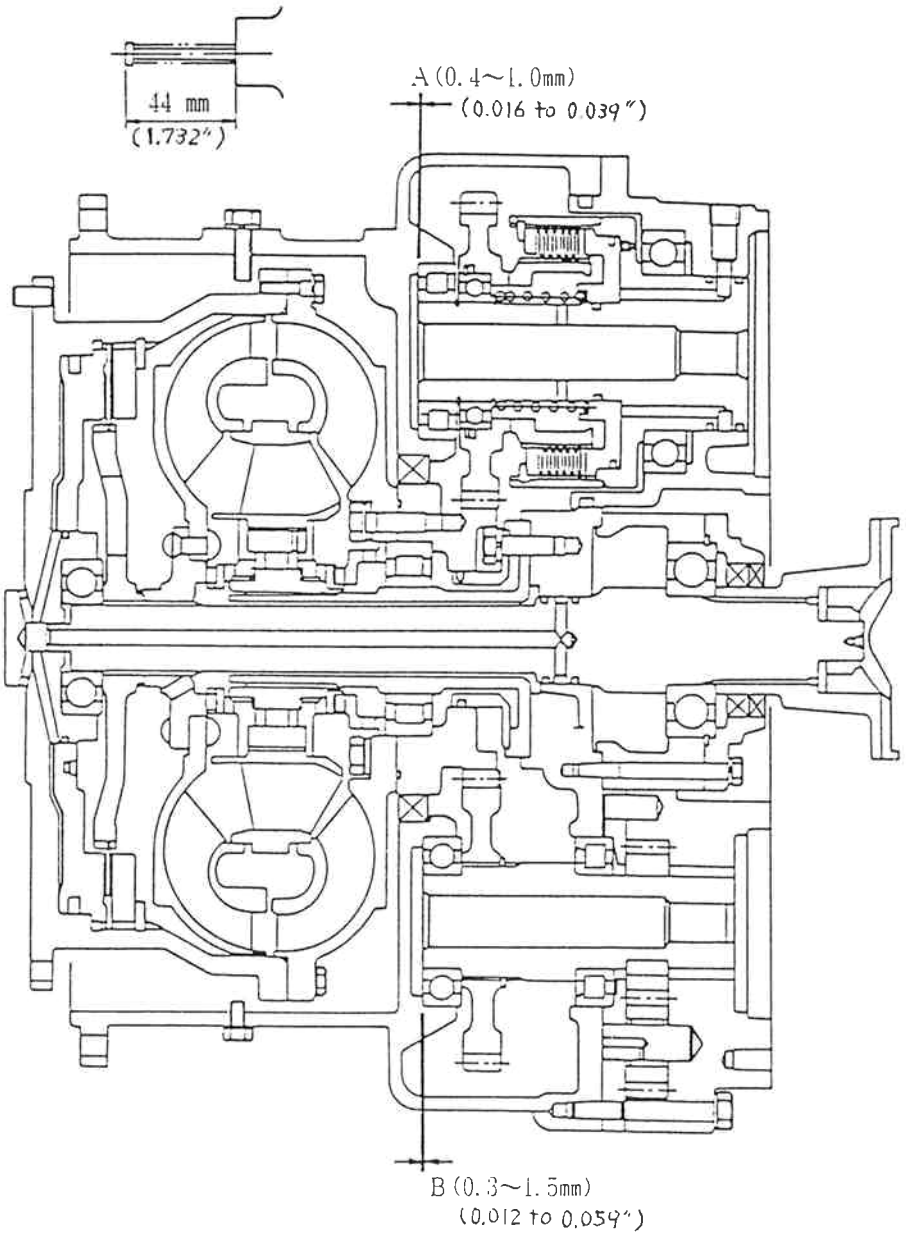


Fig. 2-8. Adjusting clearance in PTO thrust direction and guide pin insertion depth

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(3) Assembling the Torque Converter (see Fig. 2-9)

1. Place converter housing (2) horizontally as shown in Fig. 2-9.
2. Aligning the splines, install converter assembly (1) from the upper side.
3. Install two capscrews (3) for lock to converter housing (2).

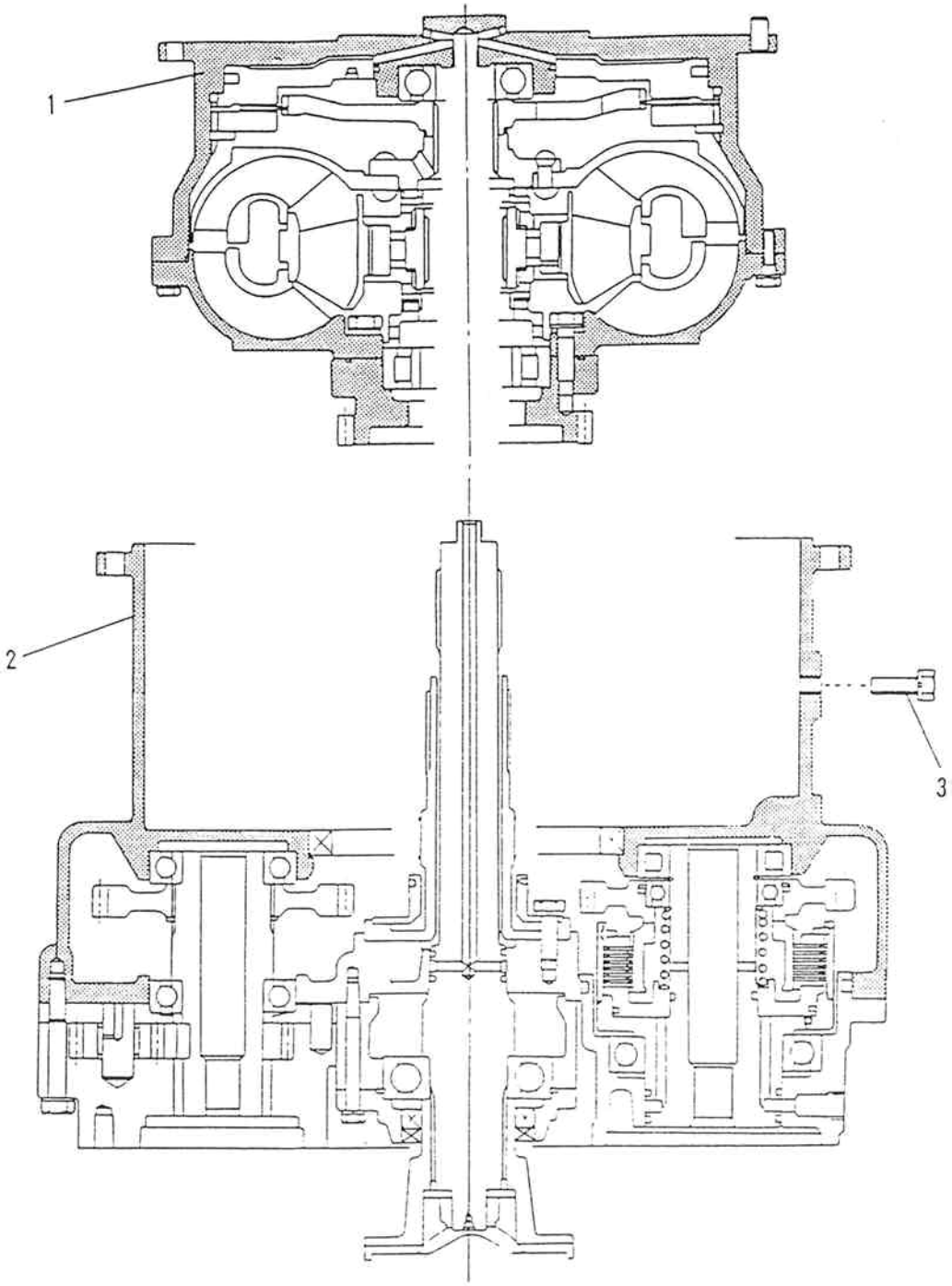


Fig. 2-9 Assembly of Torque Converter

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3. MAINTENANCE STANDARDS

3.1 CHECK STANDARDS

(1) Checking bearings

1. Turn each bearing and check it for abnormal noise and smooth rotation. If any abnormality is observed even after it is cleaned and oiled, replace it.
2. Check each bearing for scratches, cracks, chipping, and excessive wear. If present, replace bearing with new. Check the housing of the defective bearing and the shaft for damage. If any damage is noticed, remove it with sandpaper, etc. If such a method doesn't work, replace the faulty part with a new one.
3. To insert a bearing onto a shaft, heat the bearing to about 90°C (194°F) with heated oil, coat the mating surfaces with white lead, and use an appropriate sleeve and press.
4. When a bearing is to be removed and inserted without using a sleeve, use a press on only the race adjacent to the mating surface of the shaft. If a press cannot be used , use a hammer and driving punch.

(2) Checking cast parts and finished surfaces

1. Check bores, etc. for excessive wear, scratches, and contaminants. Remove scratches and the like with sandpaper or oilstone. If the damage is too deep to correct by this method, replace the part.
2. Check mounting surfaces for notches, dents, and foreign matter. If found, remove with sandpaper or oilstone. If the damage is too deep to repair this way, replace the part.
3. Check threaded portions for damage. If any damaged threads are found, re-cut threads using the correct tap.
4. If there are any components with cracked housing or cast parts, replace the component.
5. If any finished surface is so damaged that oil leaks and functional problems may result, re-finish the surface or replace the damaged part.

(3) Checking bushings and thrust washers

1. Check bushings for deformation and notches that may cause overheating, and for sharp edges. Remove sharp edges if any with a scraper, knife, etc. If deformation, deep notches, or excessive wear is evident, replace the bushing with one of proper size.

CAUTION

If a bushing has to be removed by cutting, take care not to damage the bore into which the bushing is inserted.

2. Check thrust washers for deformation, notches, excessive wear, etc. If damaged or excessively worn, replace the bushing. If damaged bearings, bushings or thrust washers are left mounted, they will cause damage to other components of the torque converter. This in turn requires such other components to be replaced, which is the more costly result. Threfore, be sure to replace before it is too late.

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(4) Checking oil seals and gaskets

1. Check for broken or hardened seal rings. If broken or hardened, replace with new.
2. When a lip type seal ring is to be replaced, make sure that the seal is properly positioned to maintain oiltightness.
3. Replace all gaskets and the like with new ones.
4. With hook type seal rings, check for excessive wear, looseness, and damaged hook.
5. If so worn that there is no longer any gap between hooks as installed, replace the hook type seal rings.
6. The sides of seal rings must be smooth. [Permissible maximum wear : 0.13mm (0.005 in).
   The sides of grooves into which the seal ring is inserted must be smooth (5S in JIS).
   The runout of such a groove must be less than 0.05mm(0.002in) in a direction perpendicular to the shaft.
   When the groove sides are re-finished (the maximum allowable wear limit 0.05mm(0.002in)), mount a new seal ring there.

(5) Checking gears

1. Check abnormal contact marks gears, and chipped teeth. Remove any damage with an oilstone. If this method doesn't work, replace the gear.
2. If teeth are worn to such an extent that the difference from the original is noticeable, replace.
3. Check the thrust receiving surface of gears for damage such as notches. Remove any with an oilstone. If this method doesn't work, replace the gear.

(6) Checking splined parts

Check splined parts for chipping and warp. If they are chipped or warped, remove the damage with an oilstone. If they are otherwise damaged, replace them with new ones. Wear on splined parts will be no marked obstruction as long as it has no effect on the fit between the two splined parts.

(7) Checking threaded parts

Check threaded parts for damaged threads. If damaged, remove the damage with oilstone or file. If the damage is heavy, replace.

(8) Checking snap rings

Check snap rings for deformation and excessive wear. If deformed or excessively worn, replace with new.

(9) Checking clutch

Check the clutch plates and center plates for looseness and wear. If these damages are found, replace with new ones.

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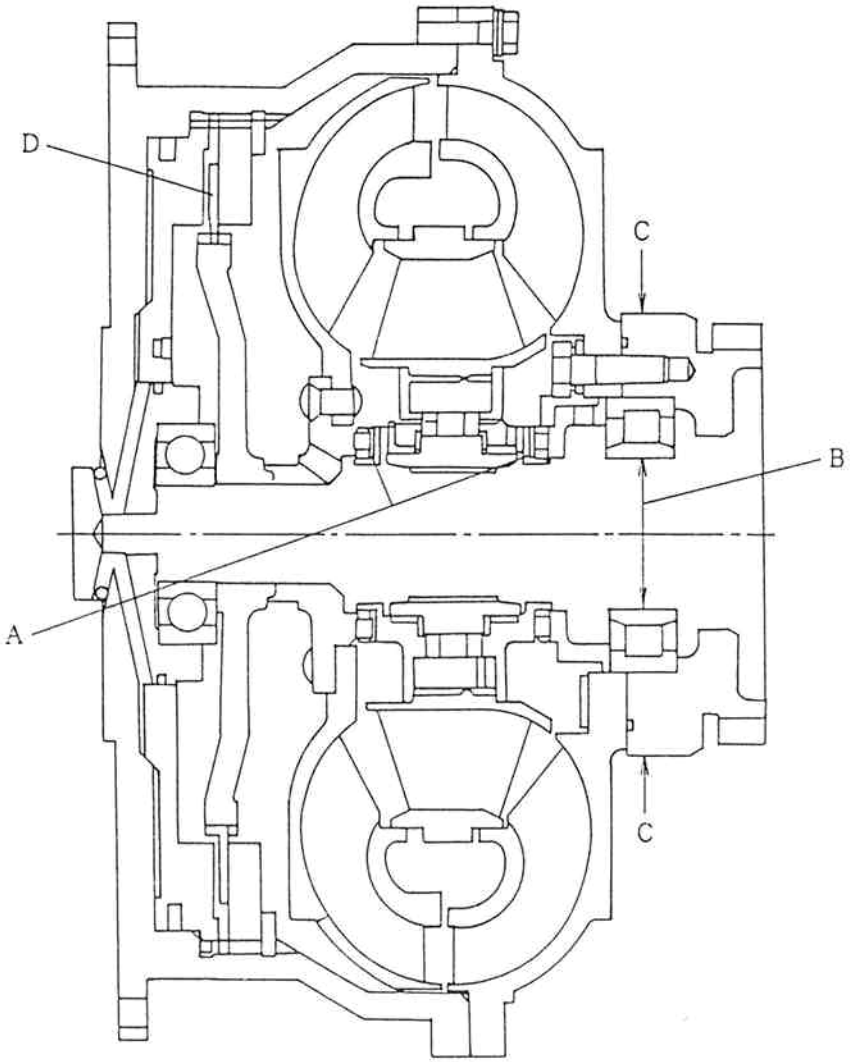
3.2 PERFORMANCE STANDARDS

(1) Standard for Hydraulic Performance

Item	Mesuring conditions	Maintenance standard	Serviceable limit
Torque converter inlet oil pressure	At 90 to 110°C (194 to 230°F) oil temperature and 2300rpm engine speed, in each speed range.	4 to 7 kg/cm² (56.9 to 99.5 psi) [2 to 4 kg/cm² (28.4 to 56.9 psi) at stall]	More than 4 kg/cm² 56.9 psi) to less than 7kg/cm² (99.5psi)

3.3 STANDARDS FOR PARTS REPLACEMENT

(1) Torque Converter Assembly



Item No. in Figure	Item	Maintenance Standard	Serviceable Limit	Measuring Device
1	Wear on part of thrust washer on which bearing rolls	—	0.1mm (0.004in.)	Micrometer. Depth gauge
2	I.D. of bearing (roller) contact face	ϕ 55mm (2.165in.)	—	Micrometer
3	Oil seal	ϕ 160mm (6.30in.)	ϕ 159.9mm (6.295in.)	
4	Friction plate	3.9mm (0.154in.)	3.7mm (0.146in.)	

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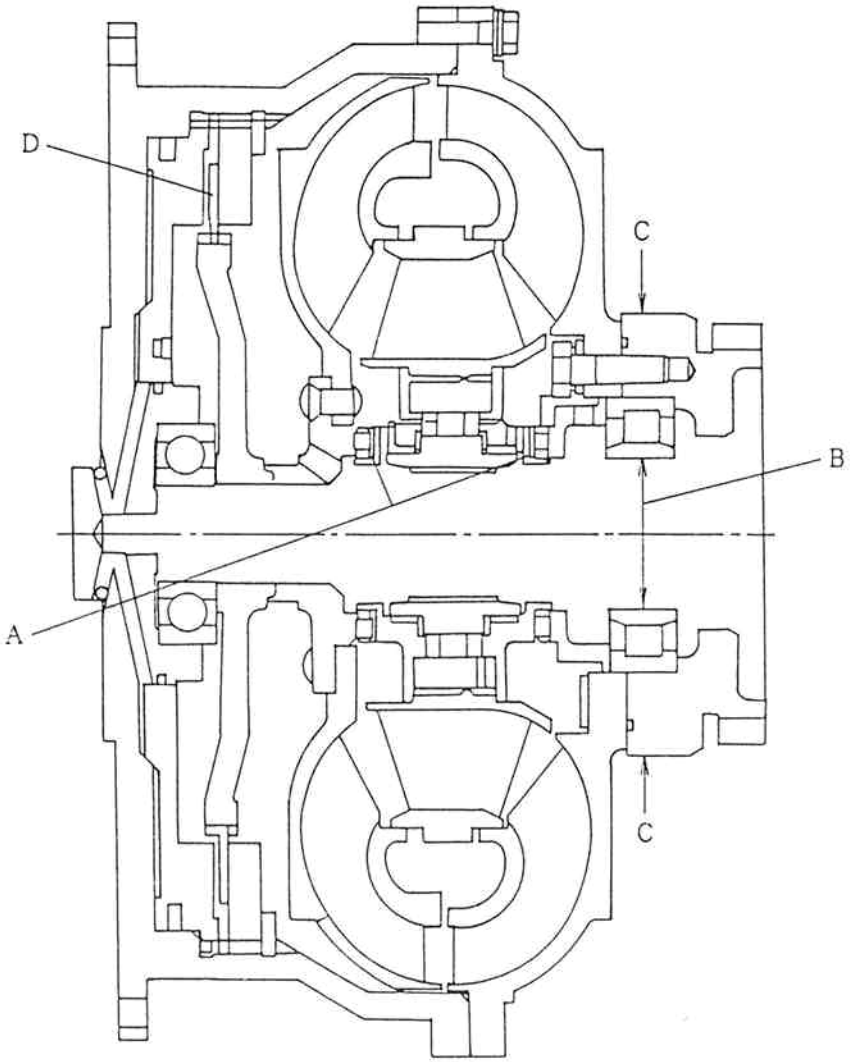
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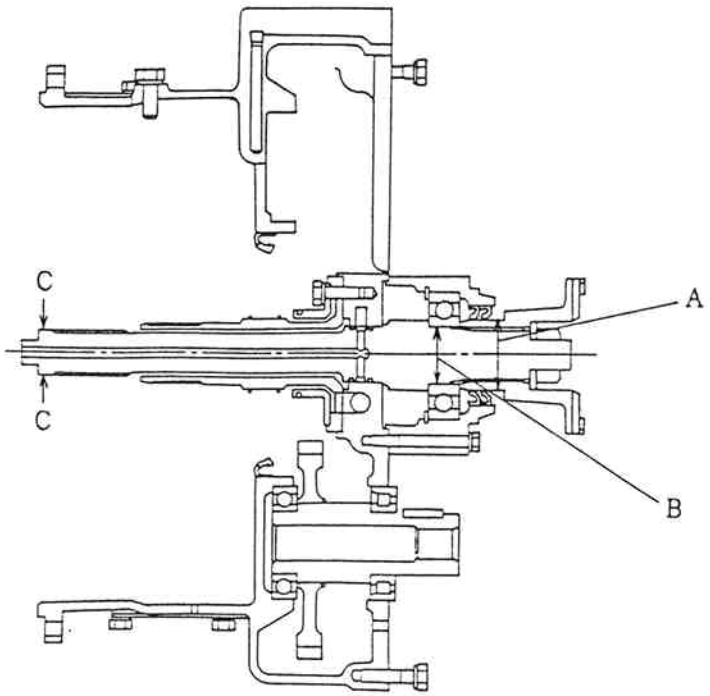
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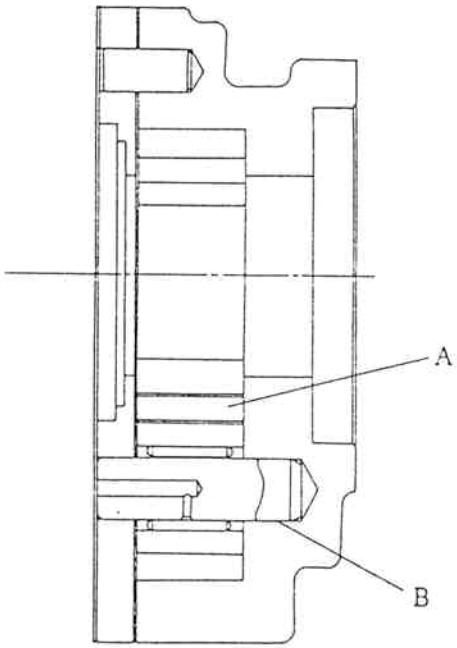
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(2) Torque Converter Case Assembly



Symbol in Fig.	Item	Maintenance Standard	Serviceable Limit	Measuring Device
A	Oil seal	ϕ 55mm (2.166in.)	ϕ 54.9mm (2.161in.)	Micrometer
B	Mating face with bearing	ϕ 45mm (1.772in.)	ϕ 44.9mm (1.768in.)	
C	Mating face with bearing	ϕ 35mm (1.378in.)	ϕ 34.9mm (1.374in.)	

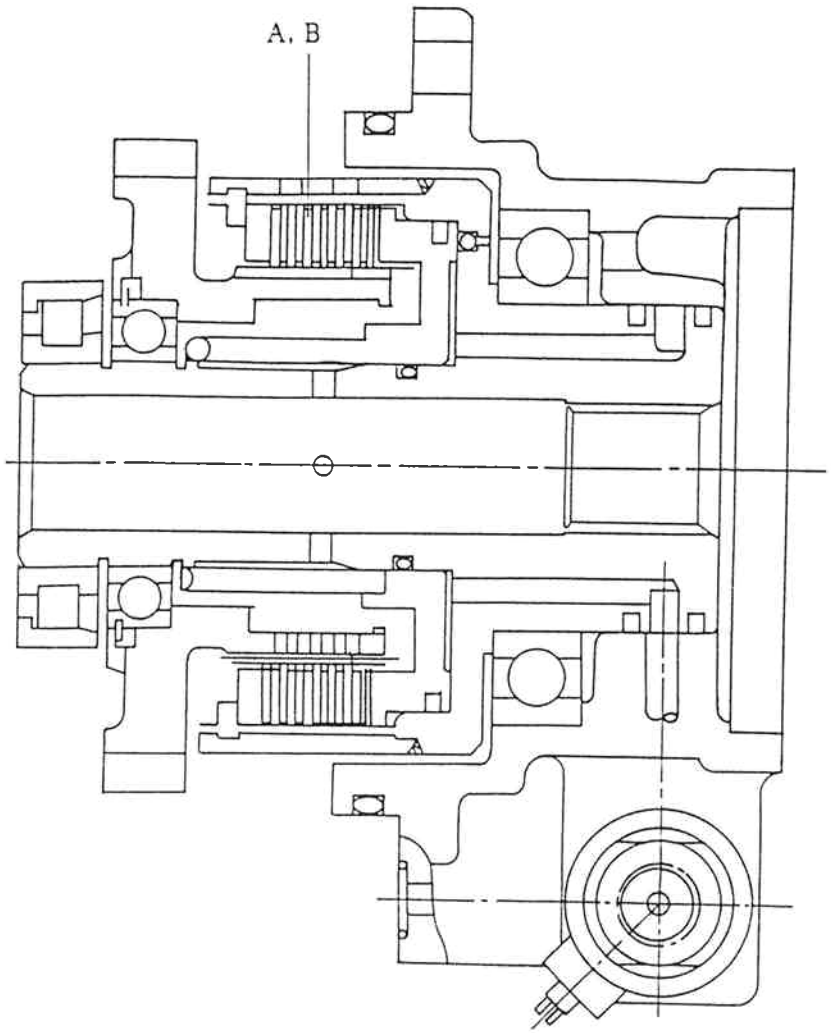
(3) Gear Pump Assembly



Symbol in Fig.	Item		Maintenance Standard	Serviceable Limit	Measuring Device
A	Gear pump	Top clearance	0.09mm (0.0035in.)	0.12mm (0.0047 in)	Clearance gage
		Side clearance	0.1mm (0.004in.)	0.25mm (0.010in.)	
B	Shaft O.D.		ϕ 19mm (0.75 in.)	ϕ 18.9mm (0.744in.)	Micrometer

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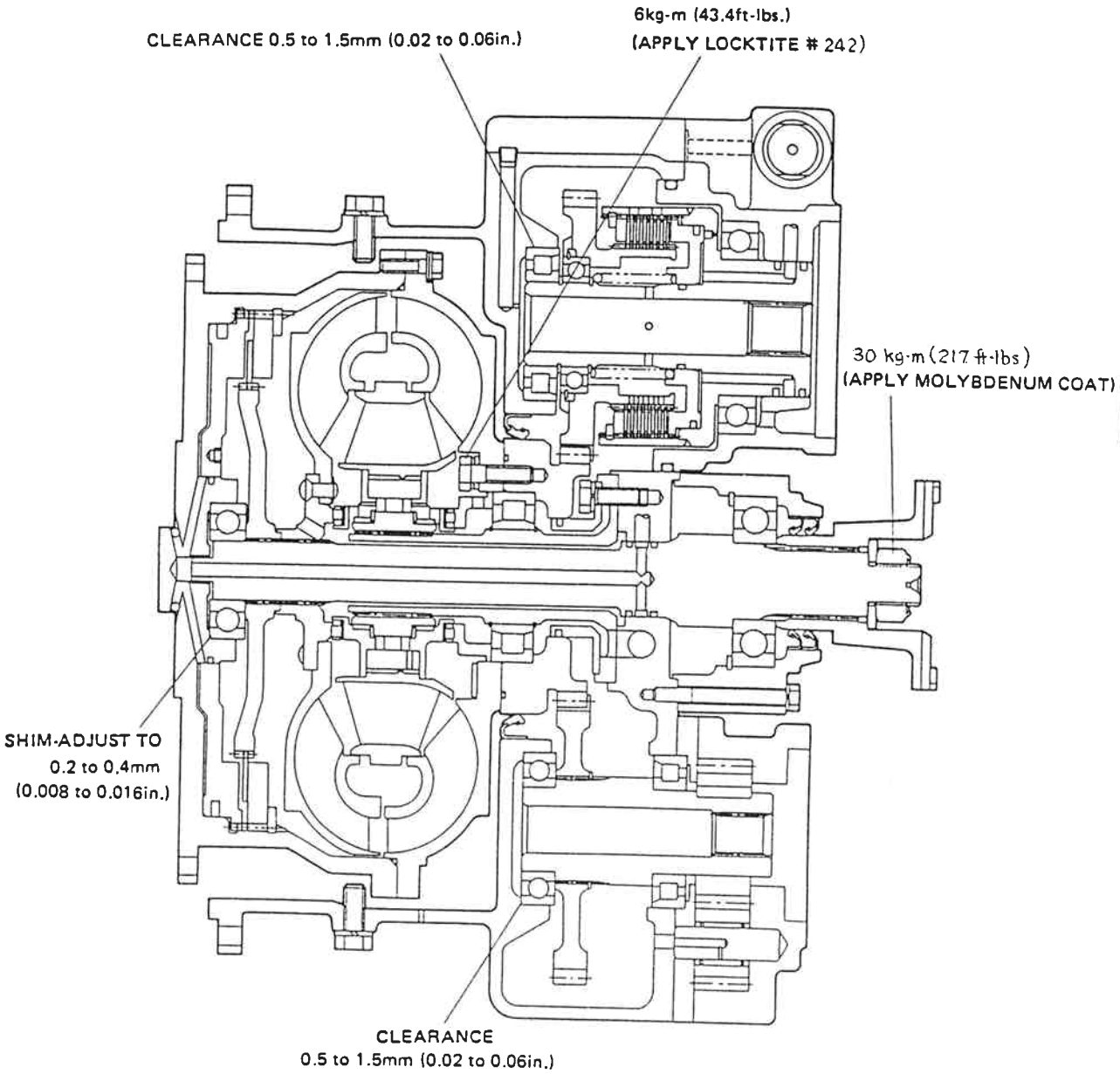
(4) Controllable P.T.O. Assembly



Symbol in Fig.	Item	Maintenance Standard	Serviceable Limit	Measuring Device
A	Clutch plate	2.13 mm (0.084 in)	1.93 mm (0.076 in)	Micrometer
B	Center plate	1.8 mm (0.071 in)	1.6 mm (0.063 in)	

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3.4 ASSEMBLY STANDARDS



NOTE

Tightening torque of capscrews
not in this figure:

M 8 : 3 to 3.6kg-m (21.7 to 26.0ft-lbs.)

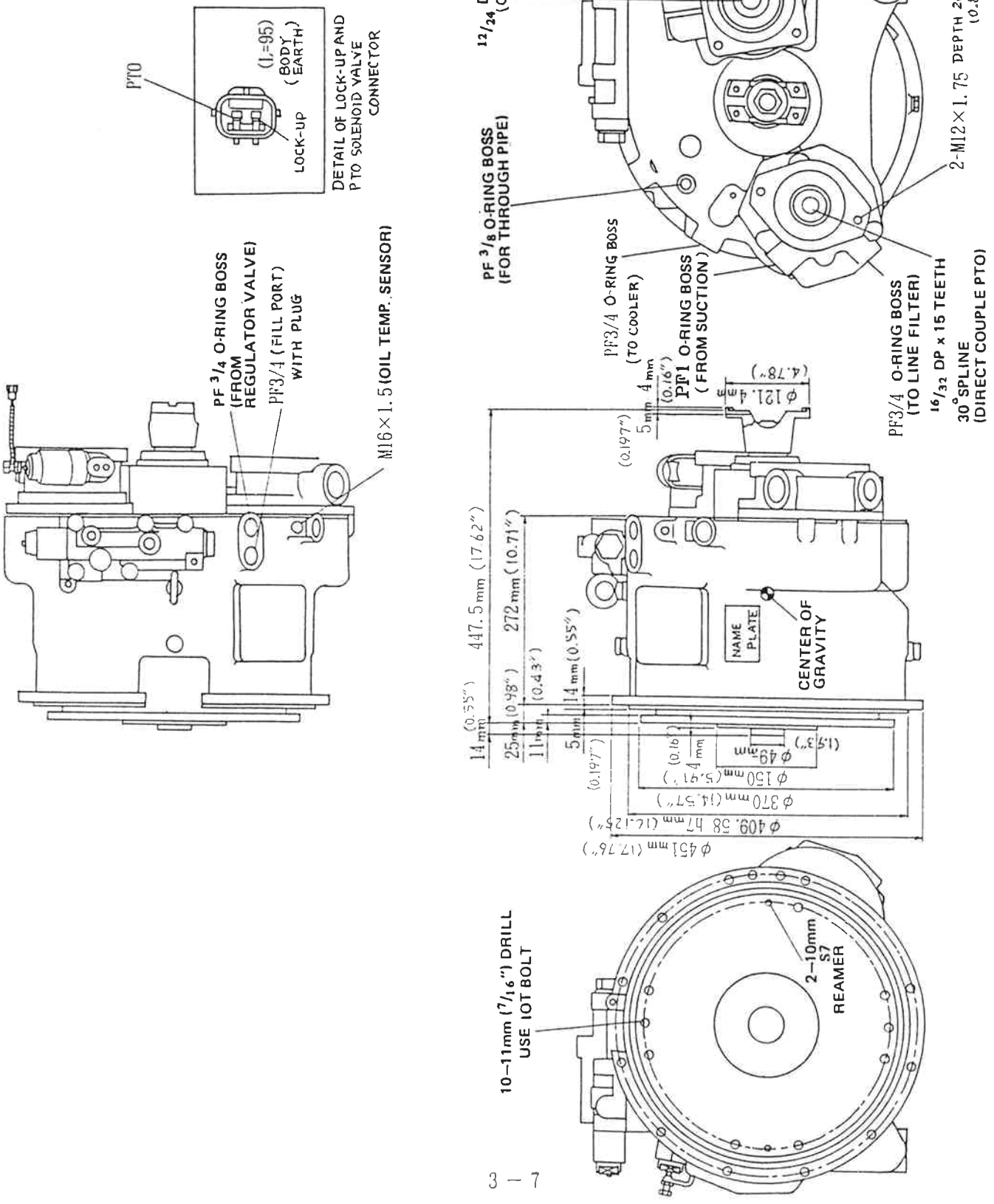
M10 : 6 to 7kg-m (43.4 to 50.6ft-lbs.)

M12 : 10.5 to12.5kg-m (76.0 to 90.4ft-lbs.)

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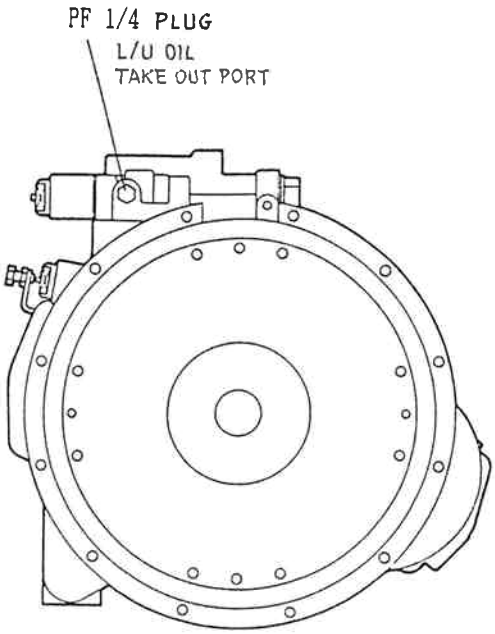
3.5 GENERAL DIMENSION

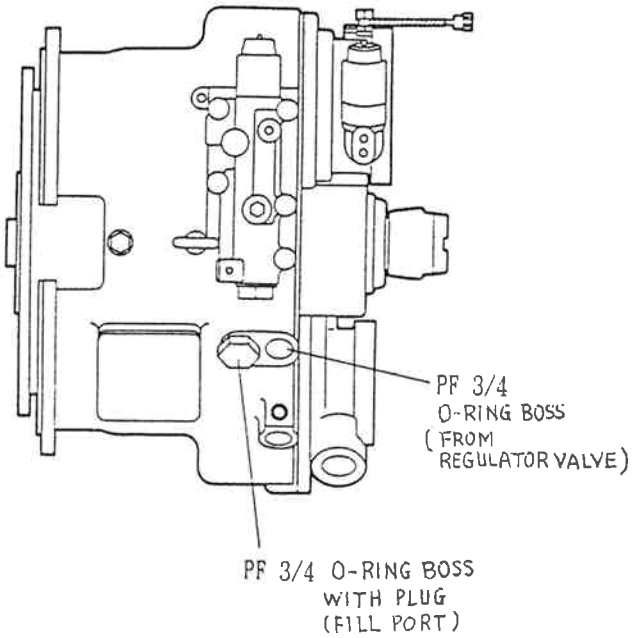
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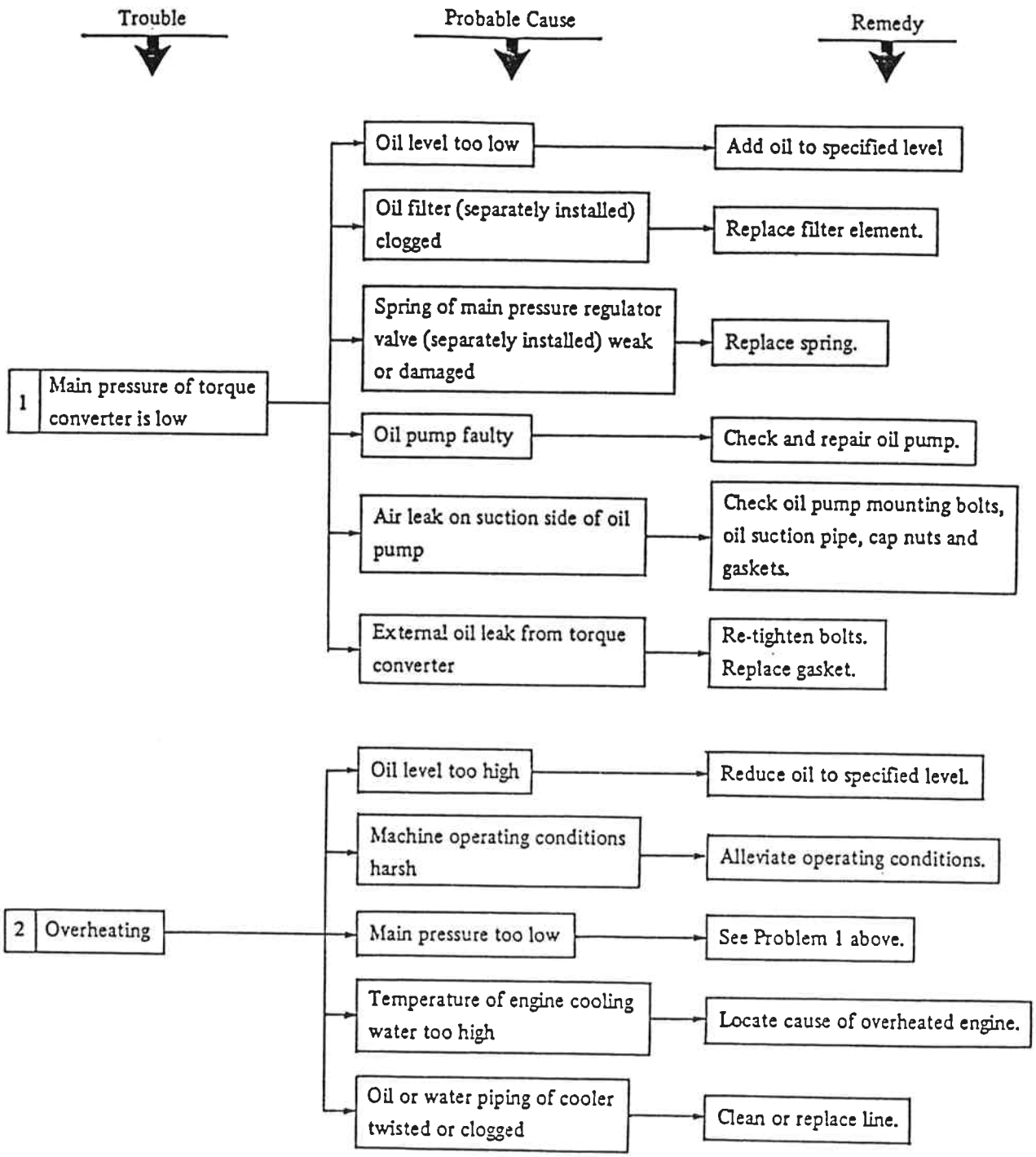
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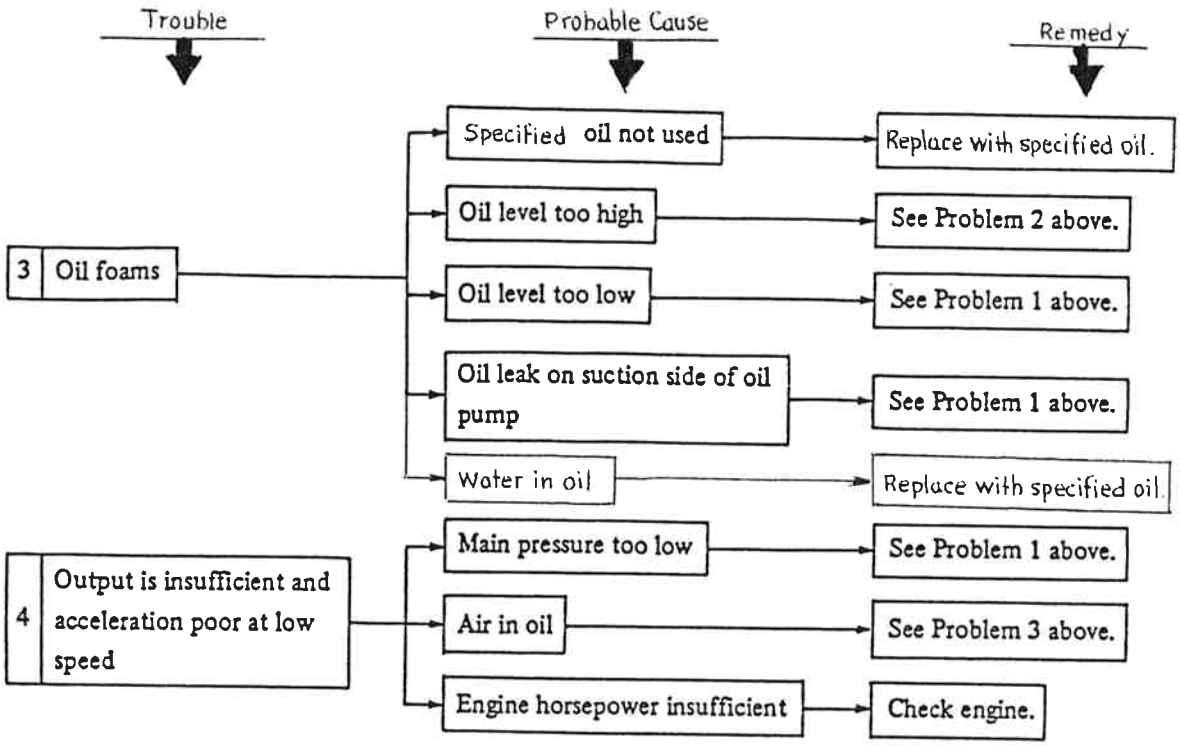


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4. TROUBLESHOOTING



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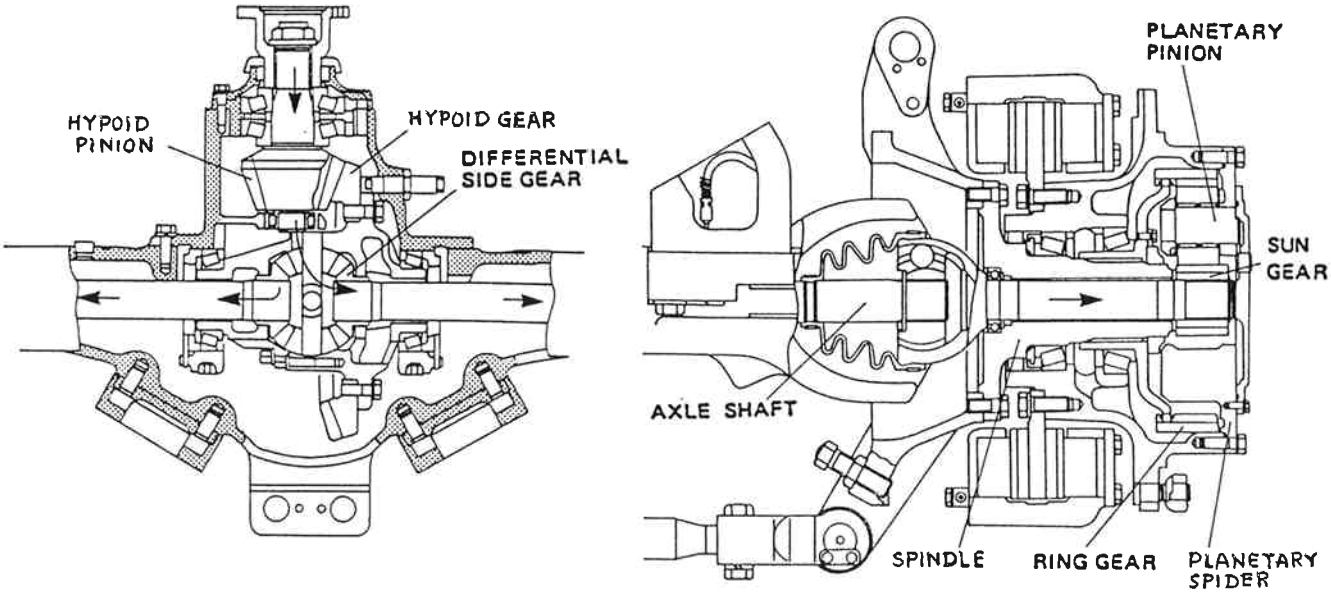
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1. CONSTRUCTION AND FUNCTION

Power is transmitted from the engine through the transmission to the hypoid pinion to drive the hypoid gear. The differential assembly and hypoid gear connected to the differential case roate together and transmit the power through the differential side gear to both the left and right axle shafts.

On the outer end of each axle shaft is a sun gear, and this is engaged with three planetary pinions. These pinions are engaged with the ring gear. This ring gear is splined to the ring gear hub so that it is not ratated by the planetary pinion.

The axle shaft rotation rotates the sun gear, drives the planetary pinions around the ring gear and transmits power to the pinion shaft, planetary spider and wheel hubs in this order.



Arrows indicate direction of power transmission.

Fig. 1-1 Axle

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1.1 DIFFERENTIAL UNIT

The principal operating unit in the axle assembly is the differential. The differential is necessary because the outer wheel turns faster than the inner wheel when steering. Although the differential gives a difference in the speeds of the inner and outer wheels when steering, at the same time it also transmits power to the both wheels. Four differential pinions compose a set, and during operation these pinions turn around the shaft of the differential spider which rotates together with the differential gear.

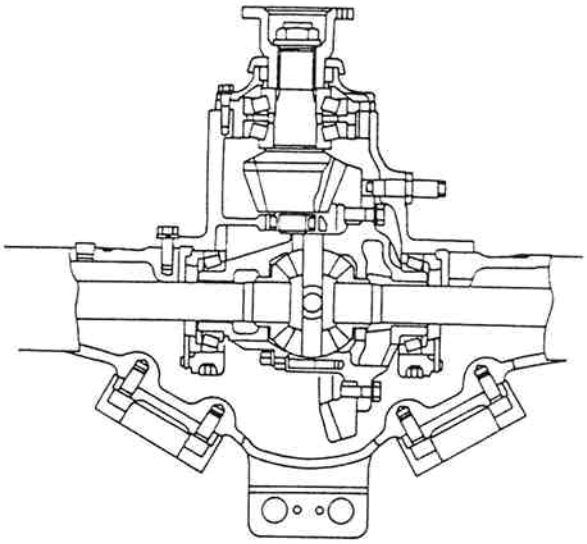


Fig. 1-2 Differential

(1) During straight driving

During straight driving, when all the wheels experience equal resistance, the differential pinions act simply as gear retainers, causing all the side gears rotate at the same speed.

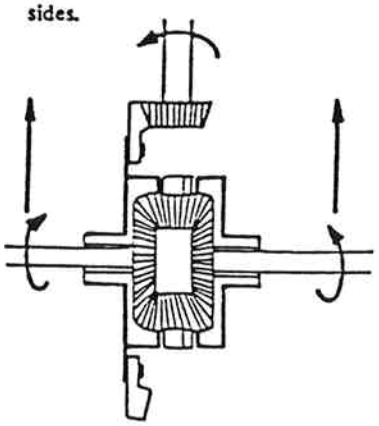


Fig. 1-3 Function Diagram During Straight Driving

(2) During a turn

When the machine is turned in either direction, the inside wheels and the side gear on the shaft on that side rotate slower because of the greater resistance. However, because the revolving speed of the ring gear remains unchanged, the pinions rotate now accoridng to the rpm difference between ring gear and inside side gear, causing the outside side gear to rotate faster by the degree the inside side gear is caused to turn slower.

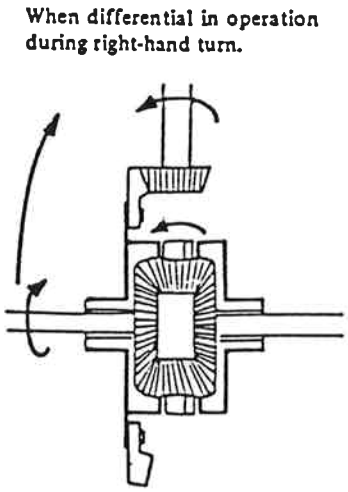


Fig. 1-4 Function Diagram when Differential is in Operation

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1.2 PLANETARY SECTION

The teeth of the ring gear are mounted above teeth of the similar number and shape at the top of the ring gear hub and held in position so as not to rotate the ring gear. Moreover, this gear is mounted from the start at a fixed distance and three planetary pinions placed at 120° above the pinion shaft float the ring gear in precise orbit. Consequently, the ring gear, the three planetary pinions and the shafts are floated in the necessary position to receive uniform load. The sun gear mounted on the axle shaft floats on these planetary pinions working thus on the ring gear and ensures that the load on the planetary pinions is uniform. The ring gear hub is mounted on the spline section of the spindle.

The ring gear hub is held in position by a heavy load lock nut.

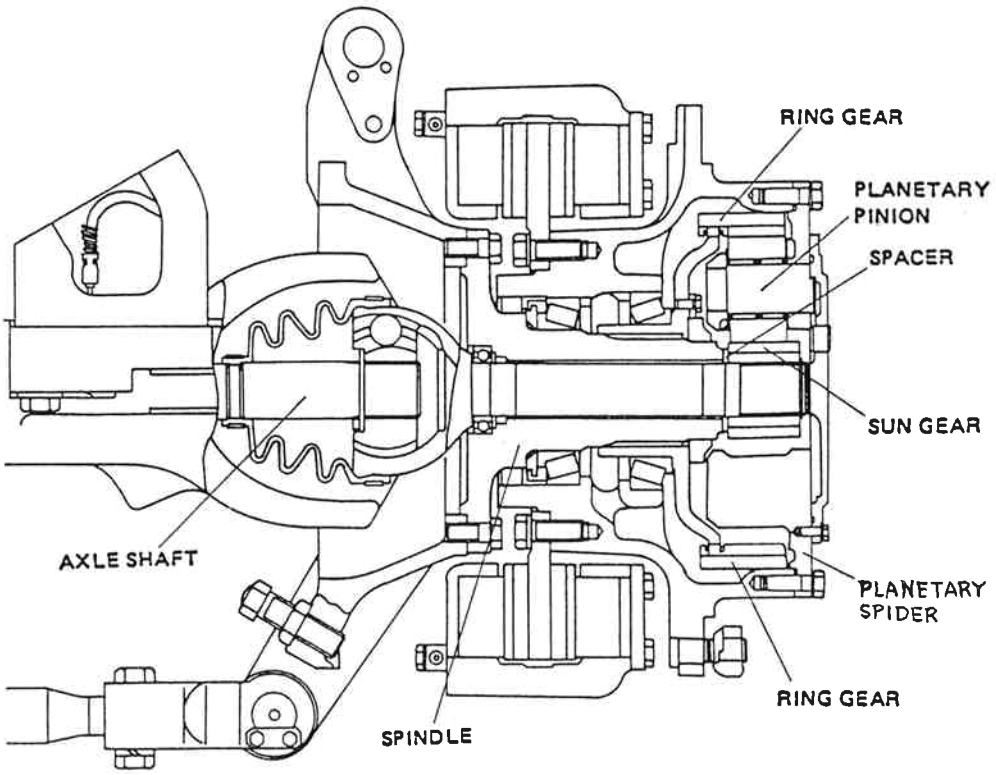


Fig. 1-5 Planetary Section

The planetary pinions are mounted on the pinion shaft. These shafts are fixed on the spider.

At the centre of each pinion shaft is a hole for lubrication, and these link the level sections of the shafts. Centrifugal force flings the oil outwards between the wheel hub and the spider. This oil flows into the three shafts and the ring gear. Oil flows continuously through these parts, thanks to the size of the holes and the spaces at both ends of the pinions, and, simultaneously, oil is passed as far as the spider as the teeth of the gears engage and lubricates the pinion shafts. In addition, holes in the level sections of the shafts open into the centre of the shafts and allow oil to flow freely in from the ends of the shafts to lubricate the entire surface of the holes in the planetary pinions.

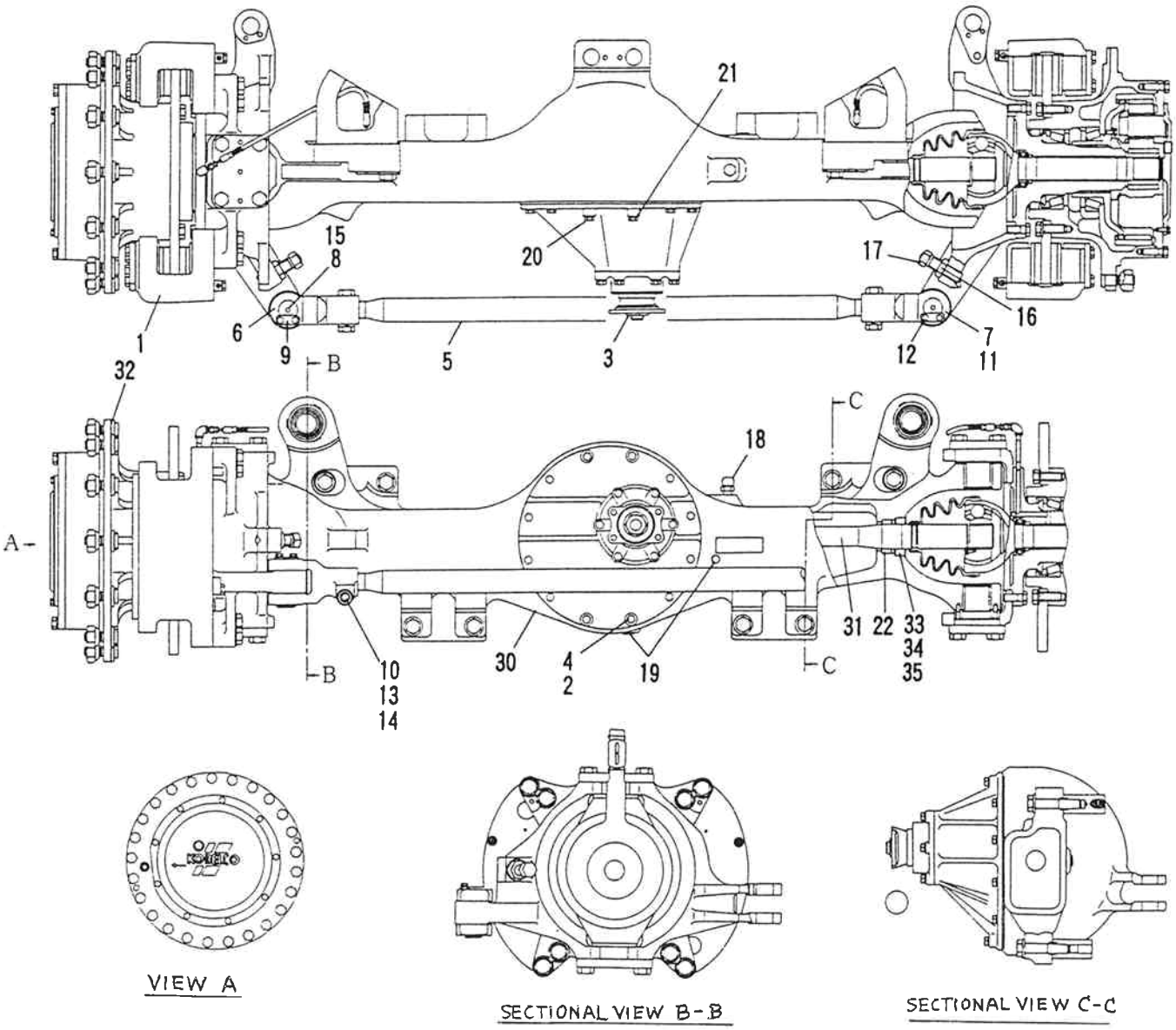
A ball bearing is installed between the ball joint and the inside diameter section of the spindle, and this limits the lateral movement of the sun gear. A space of quenched steel is installed between the sun gear and the spindle to prevent any part from abrasion.

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2. DISASSEMBLY AND ASSEMBLY

2.1 CONSTRUCTION

(1) Axle Assembly



VIEW A

SECTIONAL VIEW B-B

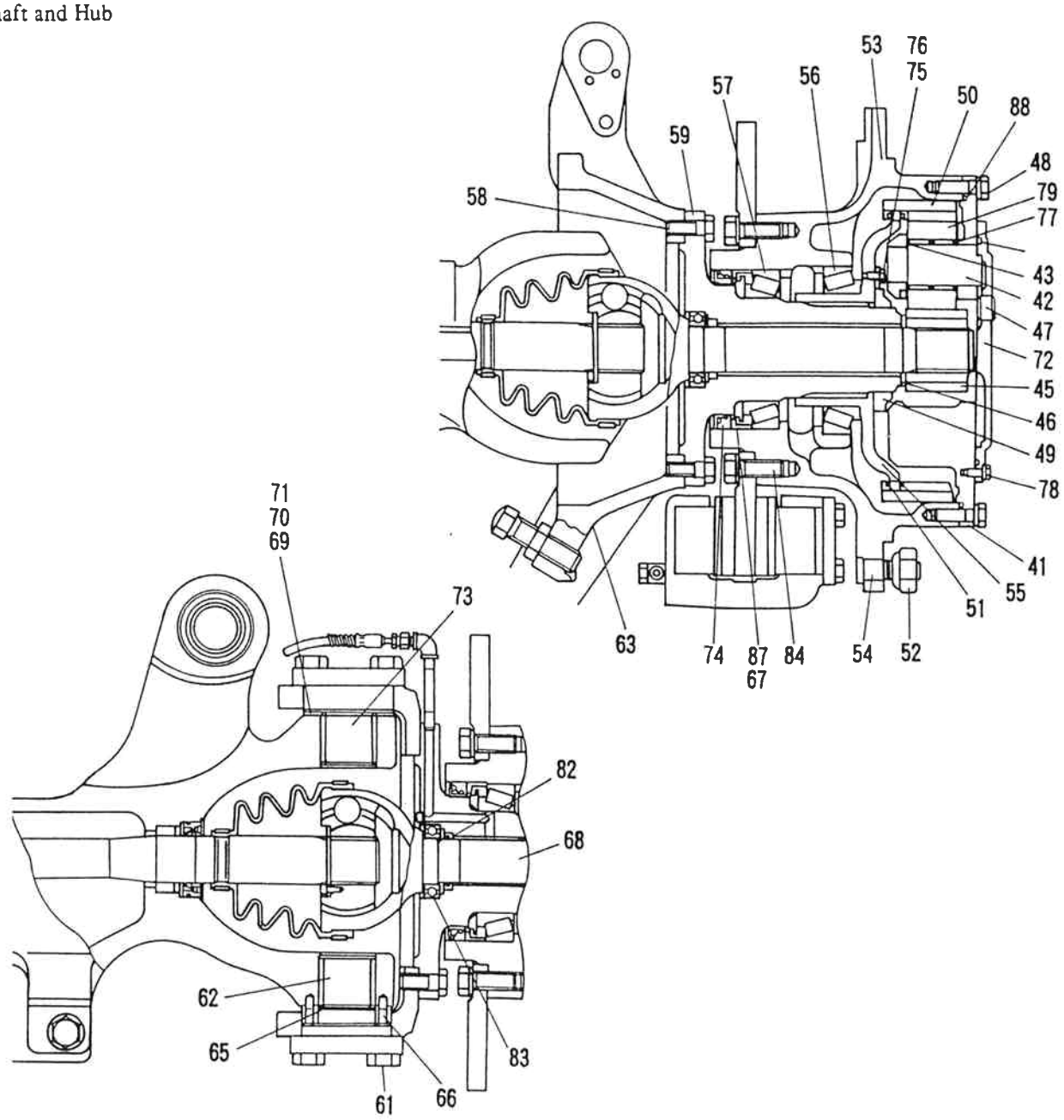
SECTIONAL VIEW C-C

1. BRAKE CALIPER
2. NUT
3. DIFFERENTIAL CARRIER ASSEMBLY
4. NUT
5. TIE ROD
6. YOKE
7. YOKE
8. PIN
9. LOCK PLATE
10. CAPSCREW
11. RING
12. CAPSCREW
13. NUT
14. WASHER
15. GREASE FITTING
16. NUT
17. BOLT
18. BREATHER
19. PLUG
20. STUD BOLT
21. STUD BOLT
22. BUSHING
23. PIN
24. CAPSCREW
25. CAPSCREW
26. LOCKWASHER
30. HOUSING
31. AXLE SHAFT
32. SHAFT AND HUB GROUP
33. OIL SEAL
34. RETAINER
35. O-RING

Fig. 2-1 Axle Assembly

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(2) Shaft and Hub

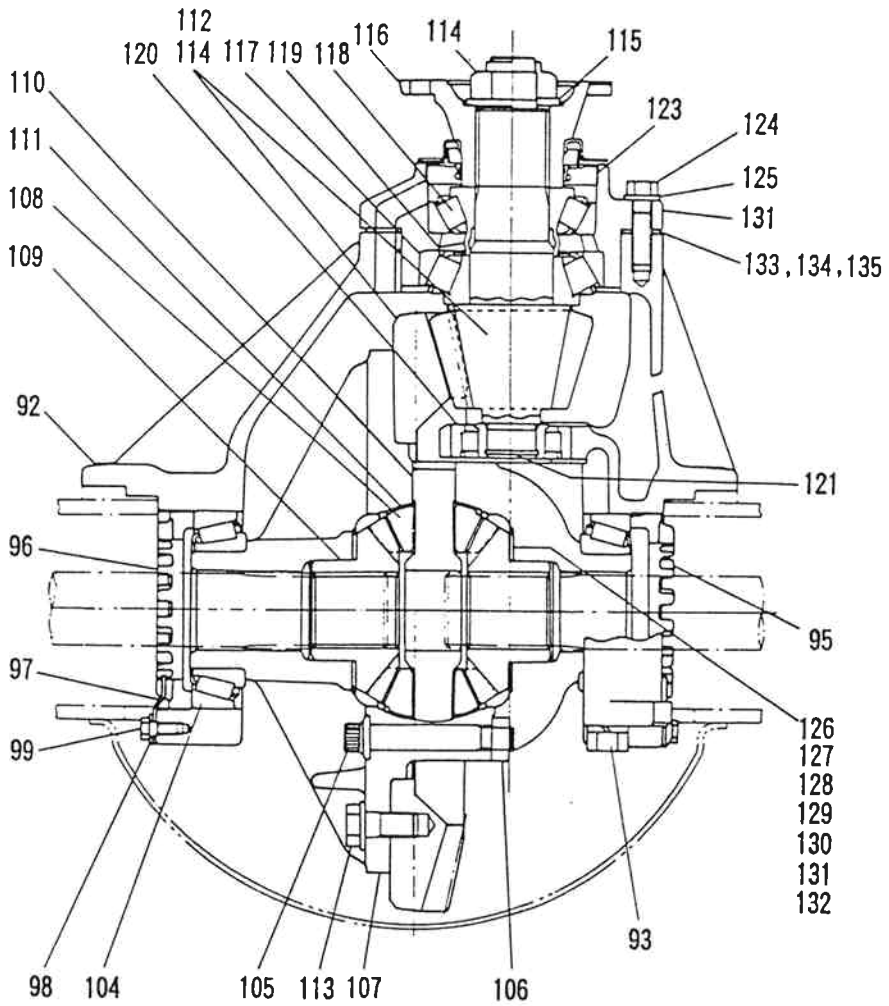


41. SPIDER
42. SHAFT
43. THRUST WASHER
45. SUN GEAR
46. SPACER
47. PLUG
48. CAPSCREW
49. NUT
50. RING GEAR
51. RING
52. NUT
53. WHEEL HUB
54. BOLT
55. RING GEAR HUB
56. BEARING
57. BEARING
58. CAPSCREW
59. SPINDLE
60. GREASE FITTING
61. BOLT
62. KING PIN
63. KNUCKLE
65. THRUST WASHER
66. PIN
67. COLLAR
68. BALL JOINT
69. SHIM, 0.1mm (0.004")
70. SHIM, 0.5mm (0.02")
71. SHIM, 0.15mm (0.006")
72. COVER
73. KING PIN
74. OIL SEAL
75. LOCK PLATE
76. CAPSCREW
77. NEEDLE BEARING
78. BOLT
79. PINION
80. PLUG (See Fig. 2-6.)
81. O-RING
82. OIL SEAL
83. BEARING
84. CAPSCREW
85. SNAP RING
86. SHAFT
87. SPACER

Fig. 2-2

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(3) Differential Carrier



92. CARRIER AND CAP ASSEMBLY	107. CAGE	122. CAGE
93. BOLT	108. PINION	123. OIL SEAL
94. LOCK WASHER	109. GEAR	124. BOLT
95. ADJUSTING NUT	110. SPIDER	125. LOCK WASHER
96. ADJUSTING NUT	111. THRUST WASHER	126. THRUST WASHER
97. LOCK PLATE	112. GEAR ASSEMBLY	127. THRUST WASHER
98. LOCK PLATE	113. BOLT	128. THRUST WASHER
99. BOLT	114. LOCK NUT	129. THRUST WASHER
100. RETAINER	115. WASHER	130. THRUST WASHER
101. BOLT	116. FLANGE ASSEMBLY	131. THRUST WASHER
102. NUT	117. BEARING	132. THRUST WASHER
103. COTTER PIN	118. BEARING	133. SHIM, 0.15mm (0.006")
104. BEARING	119. SPACER	134. SHIM, 0.2mm (0.008")
105. BOLT	120 BEARING	135. SHIM, 0.5mm (0.02")
106. NUT	121. SNAP RING	

Fig. 2-3. Diffrential Carrier Assembly (front)

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2.2 DISASSEMBLY

2.2.1 Planetary spider disassembly

(1) Remove capscrews (78) from spider cover (32). Remove spider cover (32).

(2) Remove capscrews (78) from planetary spider (41). Remove planetary spider (41) together with pinion (79) and pinion shaft (42)

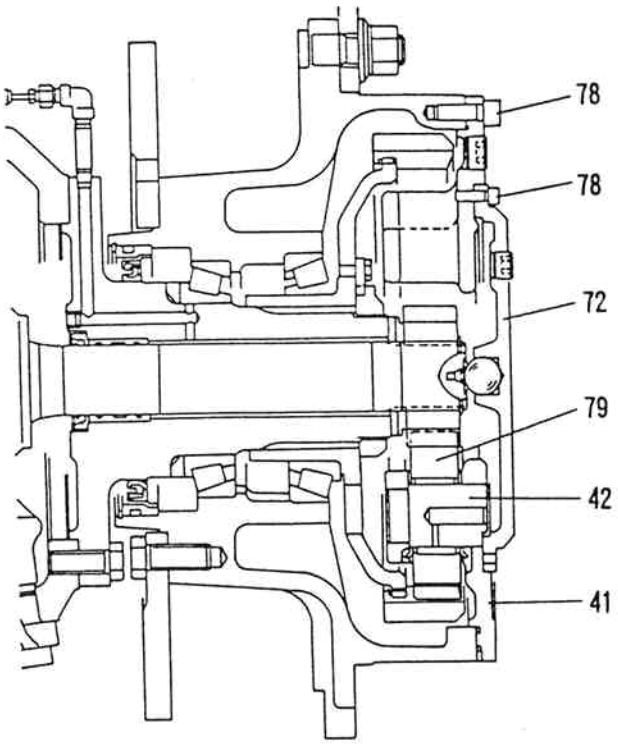


Fig. 2-4. Planetary Spider Assembly

(3) When removing pinion shaft (42) from spider (41), place spider (41) as shown in Fig. 2-5, push pinion shaft (42) out from the spider.

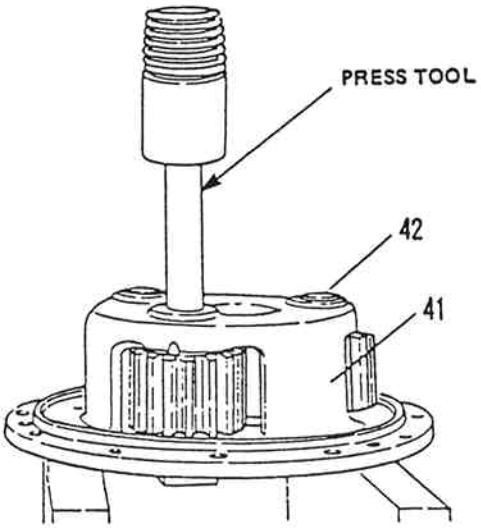


Fig. 2-5. Taking Out Pinion Shaft

(4) Take out pinion (79) and thrust washers (43). Fig. 2-6 shows pinion shaft (42), pinion (79) and washers (43) removed from spider (41).

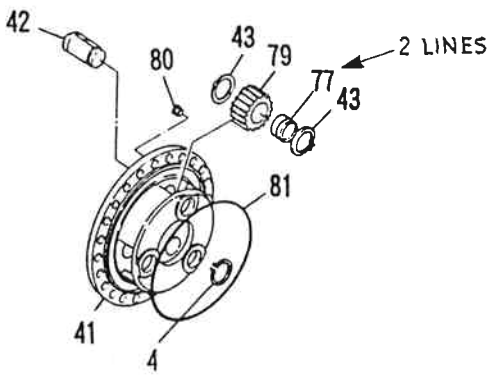


Fig. 2-6. Planetary Spider Assembly

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2.2.2 Ring gear assembly

(1) Remove snap ring (85) from ball joint (68) section.

(2) Remove sun gear (45) from ball joint (68) section.

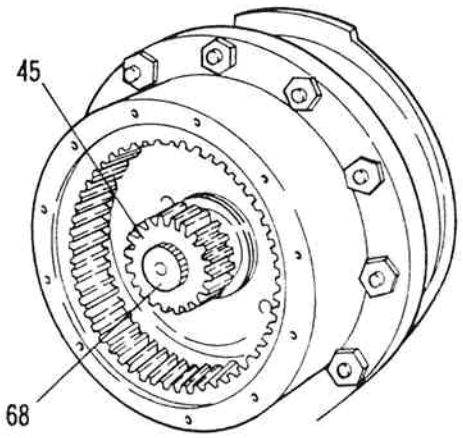


Fig. 2-7. Removing Sun Gear and Ring Gear

(3) Remove two capscrews (76) fixing lock plate (75) from ring gear hub (55). Then, remove plate (75).

(4) Remove wheel bearing adjustment lock nut (49) and then spacer (46).

(5) Pull the ring gear out together with ring gear hub (55) from wheel hub (53).

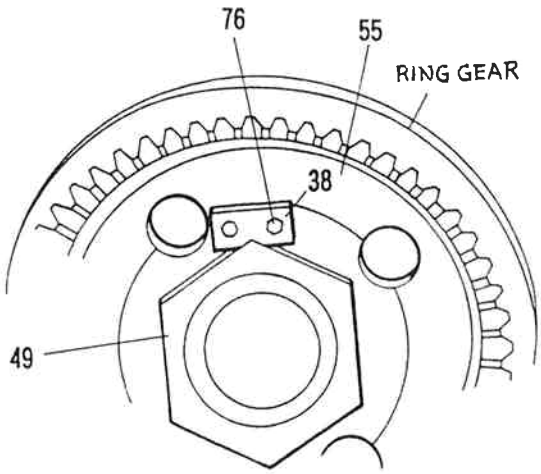


Fig. 2-8. Removing Lock Plate, Lock Nut, and Spacer

(6) Since ring gear (50) is splined to ring gear hub (55), remove stop ring (51), then separate the ring gear from the ring gear hub.

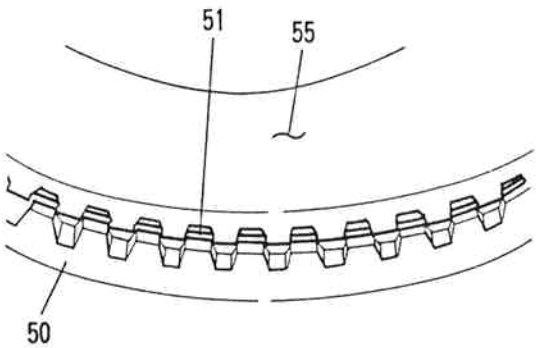


Fig. 2-9. Removing stopper Wire

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(7) Remove the ring gear and taper bearing from the ring gear hub.

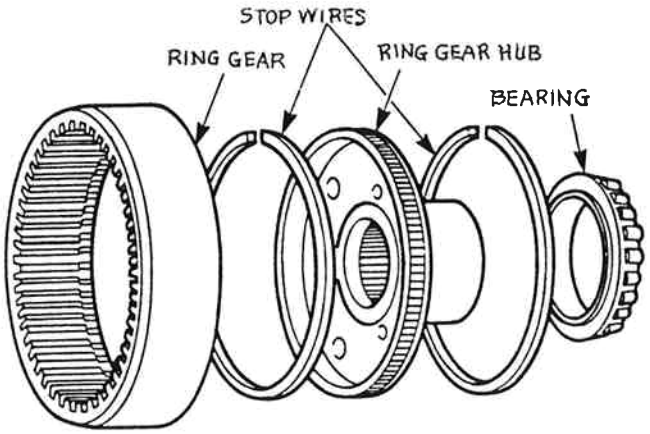


Fig. 2-10. Ring Gear Hub Assembly

2.2.3 Removal of wheel hub, disc and oil seal

(1) Remove the wheel hub (53) and the disc assembly out from the top of the spindle (59). To remove, suspend the wheel hub assembly with a suitable tool and gently remove it horizontally in the direction of the end of the housing.

(2) If necessary, remove the disc mounting capscrews and remove the disc from the wheel hub (53).

(3) Pull out oil seal (74) from wheel hub (53).

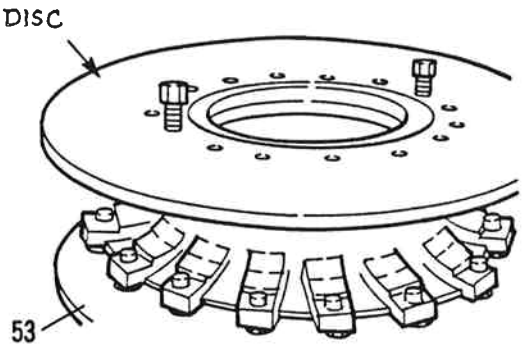


Fig. 2-11. Removing Disc

NOTE

Do not reuse the removed oil seal (74).

(4) Remove bearing inner race(57)with roller.

(5) If necessary, pull out bearing outer races (56 and 57) from wheel hub (53), using the puller.

(6) Remove drain plug (47) from the planetary gear spider.

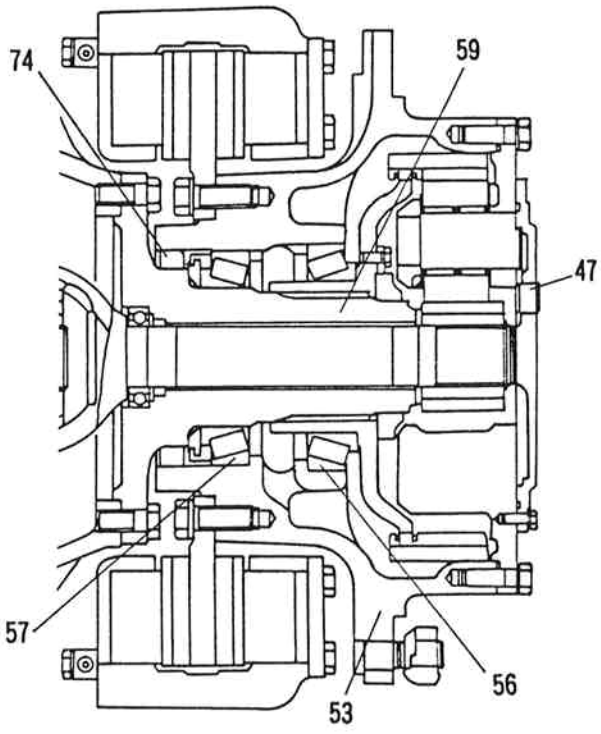


Fig. 2-12. Wheel Hub, Disc and Oil Seal

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(7) Remove the ring gear and taper bearing from the ring gear hub.

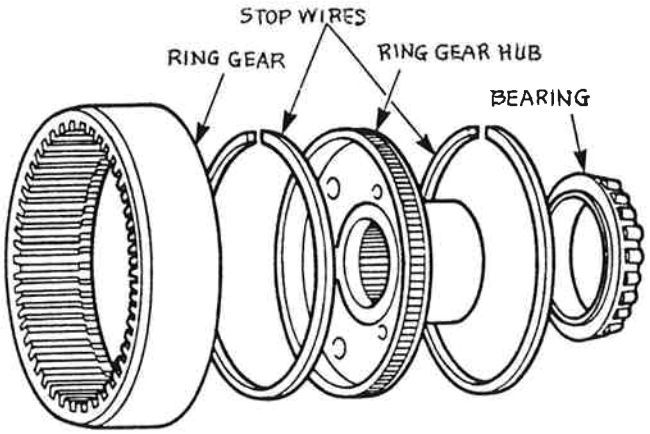


Fig. 2-10. Ring Gear Hub Assembly

2.2.3 Removal of wheel hub, disc and oil seal

(1) Remove the wheel hub (53) and the disc assembly out from the top of the spindle (59). To remove, suspend the wheel hub assembly with a suitable tool and gently remove it horizontally in the direction of the end of the housing.

(2) If necessary, remove the disc mounting capscrews and remove the disc from the wheel hub (53).

(3) Pull out oil seal (74) from wheel hub (53).

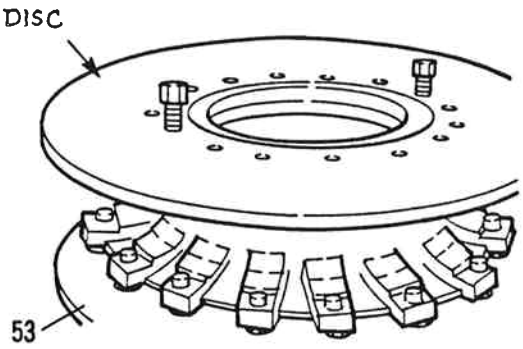


Fig. 2-11. Removing Disc

NOTE

Do not reuse the removed oil seal (74).

(4) Remove bearing inner race(57)with roller.

(5) If necessary, pull out bearing outer races (56 and 57) from wheel hub (53), using the puller.

(6) Remove drain plug (47) from the planetary gear spider.

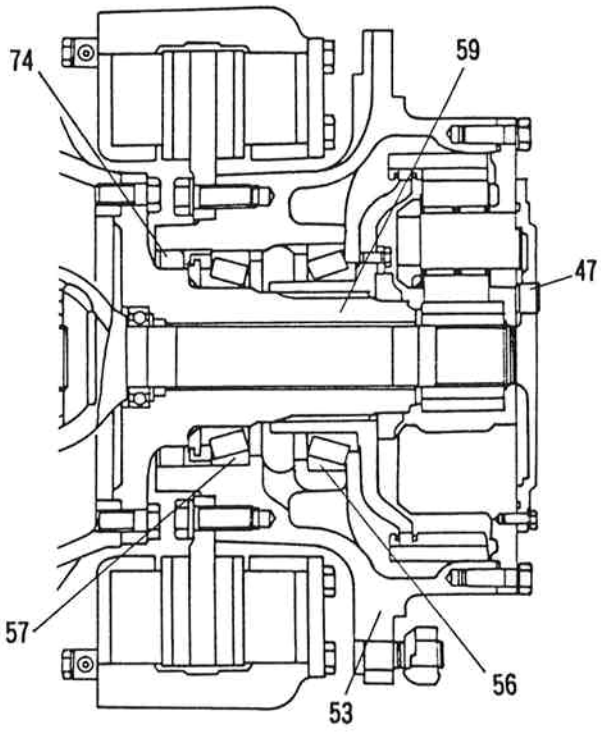


Fig. 2-12. Wheel Hub, Disc and Oil Seal

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2.2.4 Knuckle assembly

(1) Remove capscrew (12) and lock plate (9), pull out pin (8), and detach the tie rod assembly.

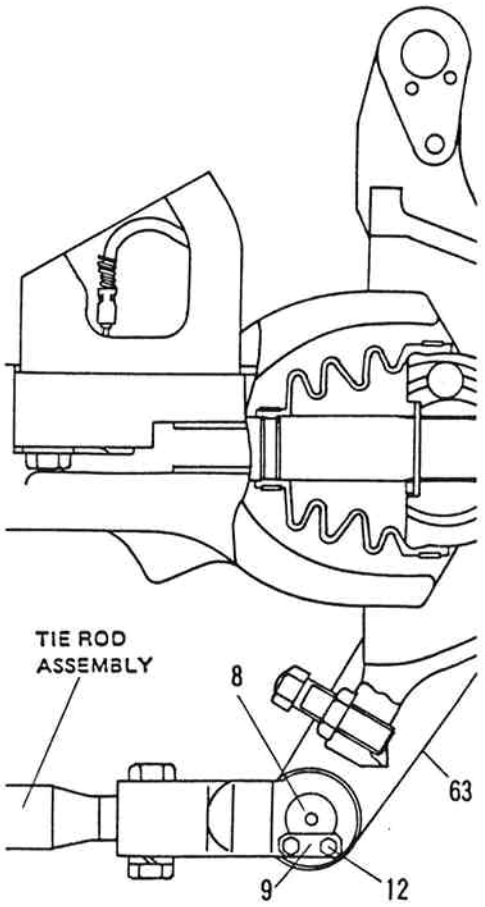


Fig. 2-13 Removing Tie Rod Assembly

(2) Stamp matchmarks on king pins (62 and 73) and knuckle (63) for ease of reassembly.

(3) Loosen and remove king pin mounting bolts (61), and take out the king pins and shims (69, 70 and 71).

NOTE

Do not damage or fold the shims. Mark each shim for correct re-installation place.

(4) Remove thrust washer (65) on the king pin.
(5) Remove the knuckle assembly together with ball joint.
(6) Pull out axle shaft (86).

NOTE

While being removed, the axle shaft tends to come in contact with the oil seal of the axle housing. Be careful not to damage the oil seal lip.

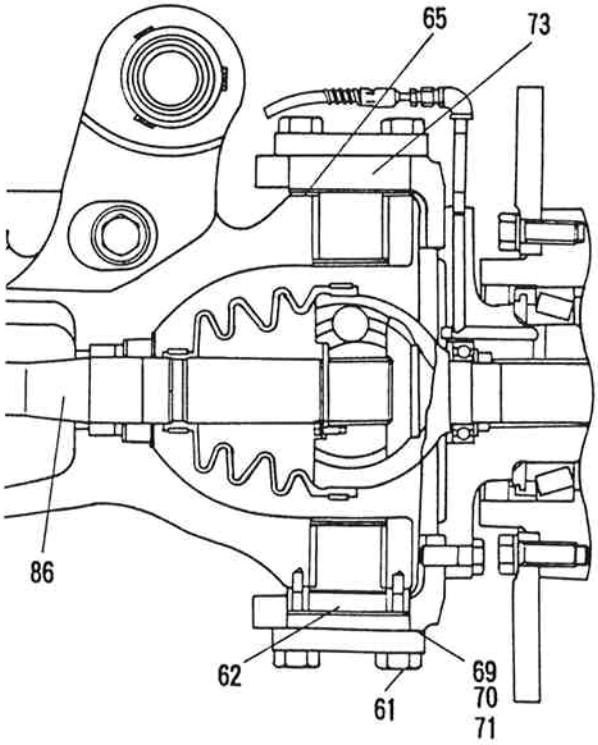


Fig. 2-14. Knuckle Assembly

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(7) Pull out ball joint.

(8) Put matchmark on knuckle (63) and spindle (59), loosen and remove capscrews (58), and separate the knuckle and spindle.

2.2.5 Differential carrier assembly

(1) Removing the differential carrier assembly

1) Unscrew drain plug and drain gear oil from axle case.

At this time, draining gear oil should be done before disassembling the ball joint and axle shaft.

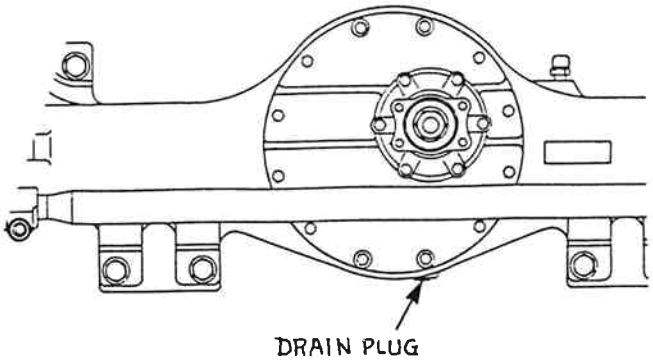


Fig. 2-15 Removing Differential Carrier Assembly

2) Remove differential carrier mounting nuts (2), and pull out the carrier assembly.

(2) Fixing the differential.

Fix the differential assembly to a block securely. (Making a fixing block like that in Fig. 2-16 will facilitate disassembly and assembly.)

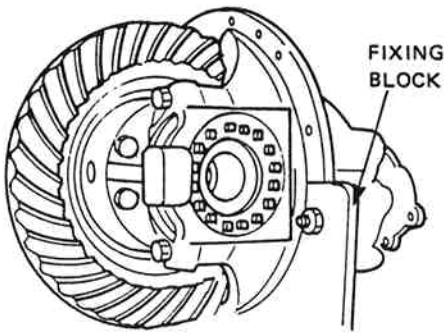


Fig. 2-16 Fixing the Differential

(3) Removing the hypoid pinion gear assembly

Remove pinion cage mounting bolts(124), and then cage assembly (122).

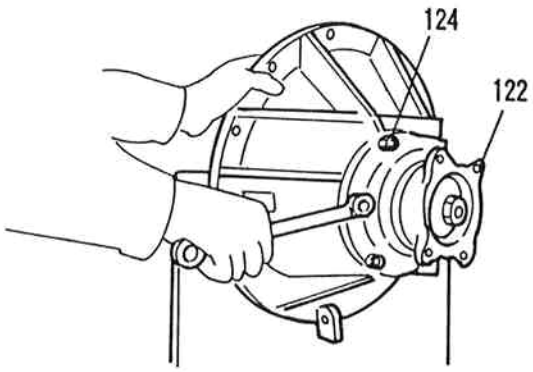


Fig. 2-17 Removal of Final Drive Pinion Gear Assembly

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(7) Pull out ball joint.

(8) Put matchmark on knuckle (63) and spindle (59), loosen and remove capscrews (58), and separate the knuckle and spindle.

2.2.5 Differential carrier assembly

(1) Removing the differential carrier assembly

1) Unscrew drain plug and drain gear oil from axle case.

At this time, draining gear oil should be done before disassembling the ball joint and axle shaft.

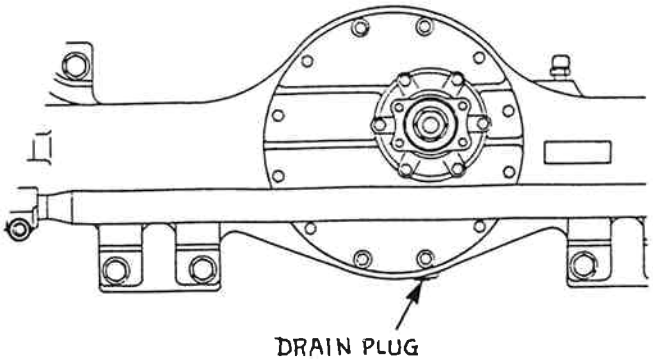


Fig. 2-15 Removing Differential Carrier Assembly

2) Remove differential carrier mounting nuts (2), and pull out the carrier assembly.

(2) Fixing the differential.

Fix the differential assembly to a block securely. (Making a fixing block like that in Fig. 2-16 will facilitate disassembly and assembly.)

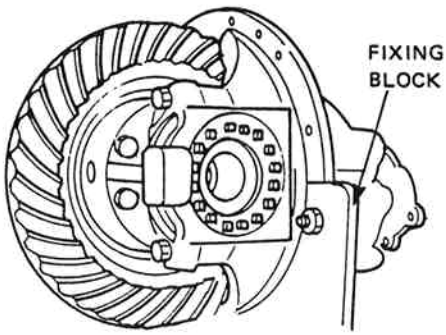


Fig. 2-16 Fixing the Differential

(3) Removing the hypoid pinion gear assembly

Remove pinion cage mounting bolts(124), and then cage assembly (122).

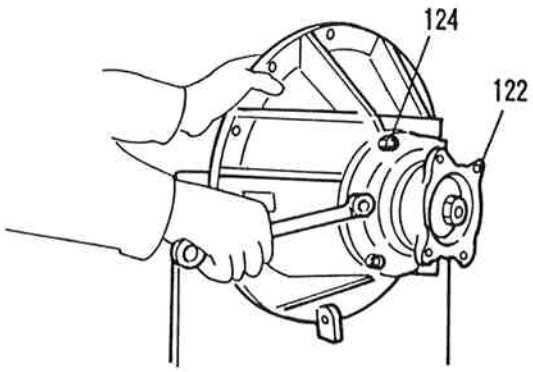


Fig. 2-17 Removal of Final Drive Pinion Gear Assembly

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NOTE

Do not damage pinion cage shims (112, 113 and 114) when removing the cage assembly.

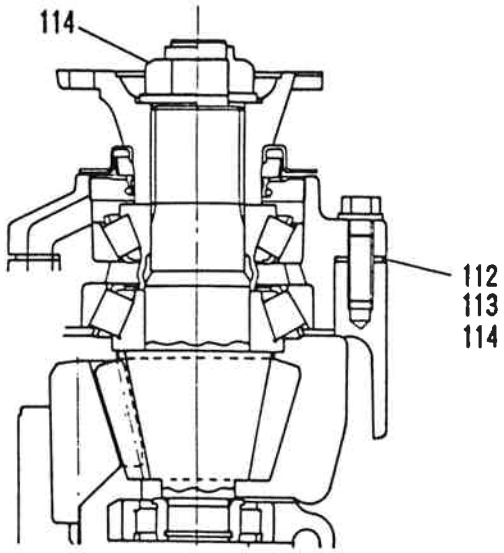


Fig. 2-18. Removing hypoid pinion Assembly

(4) Disassembling the hypoid pinion assembly.

1) Attach the hypoid pinion assembly to the special spline yoke bracket and secure with vise.

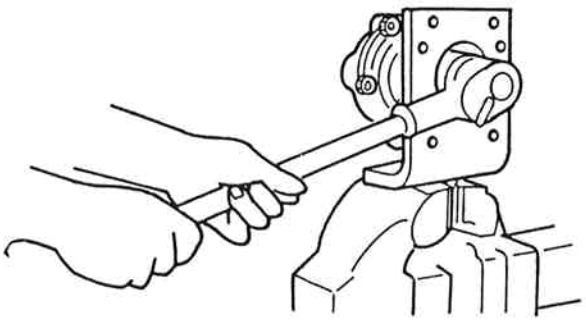


Fig. 2-19 Disassembling Drive Pinion Gear Assembly

2) Using the special box wrench, remove lock nut (114).

3) Tap lightly the rear end of the hypoid pinion with a wooden hammer to remove the pinion. The hypoid pinion assembly can be disassembled into individual parts.

4) Put the special bearing puller attachment onto the pinion inner bearing, and remove the inner bearing using a press; mount a setting tool to the pinion threads so that they won't be damaged by the press.

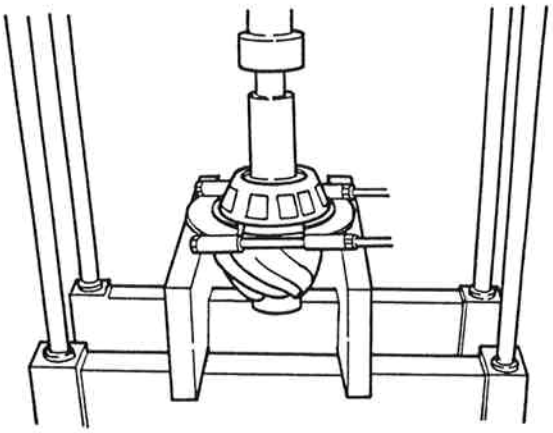


Fig. 2-20. Removing Pinion Inner Bearing

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5) To remove the pinion pilot bearing inner race, remove the snap ring and pull out the race with the special bearing puller.

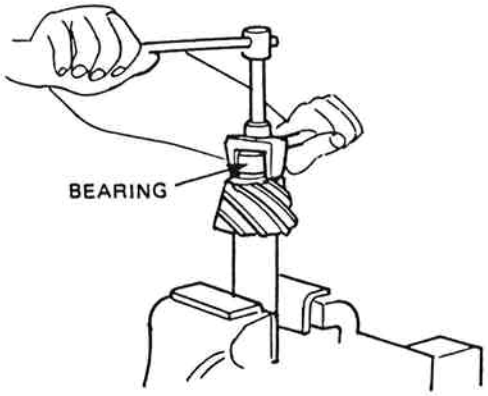


Fig. 2-21. Removing Pinion Pilot Bearing Inner Race

6) Using the two notches in the pinion cage, hammer out the inner bearing and outer bearing outer race remaining in the pinion cage with a brass bar or the like. At the same time, remove the oil seal together.

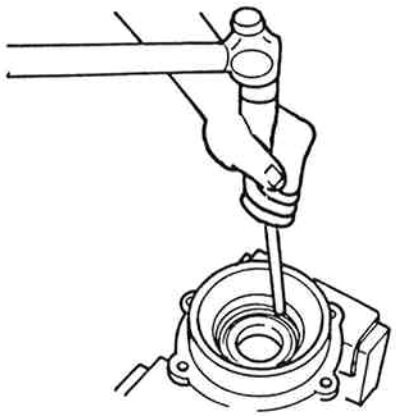


Fig. 2-22. Removing Bearing Outer Race

(5) Removing differential side bearing caps

1) Matchmark each of right and left bearings (92) as a guide for reassembly.
2) Remove lock plate (98) from bearing cap (92).
3) Cut off the lock wire on cap bolts (93) and remove the bolt and cap.

NOTE

To prevent the differential cage assembly from falling off, insert bars into it for support, and remove the cap.

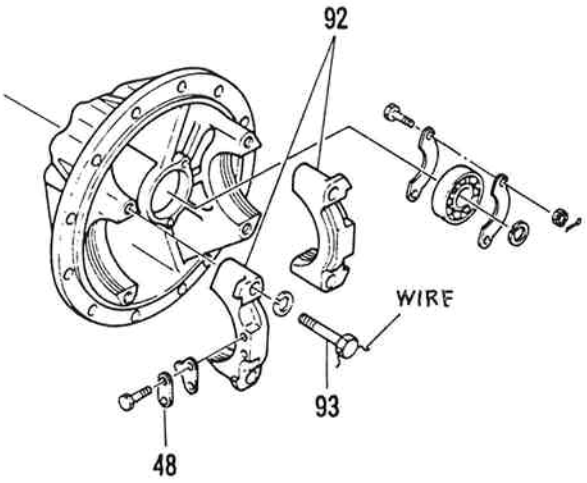


Fig. 2-23. Removing Differential Side Bearing Caps

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(6) Pulling out differential cage assembly

1) Pull out the differential cage assembly, taking care not to let the final gear catch the differential carrier, using a bar inserted into the rear axle shaft hole.

2) Remove bolt (101), and then pinion pilot bearing (120) remaining in the differential carrier, together with retainer (100).

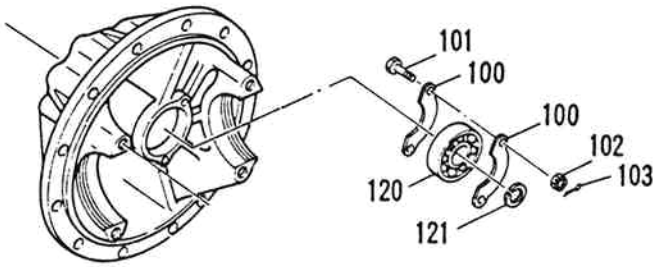


Fig. 2-24. Pulling Out Differential Cage Assembly

(7) Disassembling differential cage assembly (standard)

1) Using the special bearing puller, remove the side bearings on both sides of the differential cage.

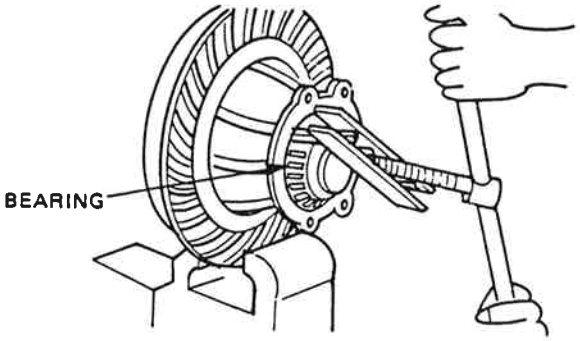
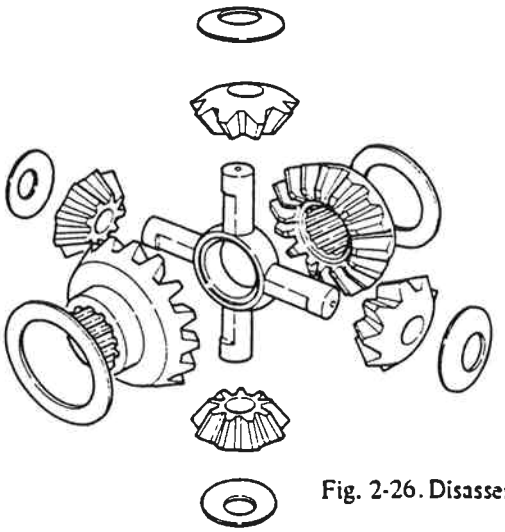


Fig. 2-25. Disassembling Differential Cage Assembly

2) Remove differential cage tightening bolts (105), and disassemble cage (107).

3) Then remove differential spider (110), pinion (108), thrust washer (126), and side gear (109).

4) If driven gear (112) is to be removed from differential cage (107), remove set bolts (113). The driven gear can be removed.



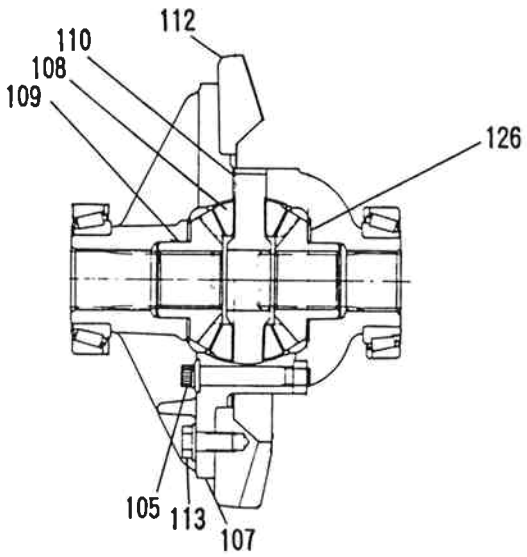


Fig. 2-26. Disassembling Differential Cage Assembly

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2.2.6 Special Notes

(1) Clean gears, spindles, bearings, and shafts that have polished surfaces with emulsion cleaner but not gasoline, carbon tetrachloride, or petroleum-based solvent.

NOTE

Do not clean those parts in a mixture of high temperature solvent or water, and alkalis such as sodium hydroxide, ortho-silicate or phosphate.

(2) For other parts such as wheel hubs, planetary spiders and cast brackets, clean in high temperature, weak alkaline solution.

(3) Remove liquid sealants thoroughly.

NOTE

Immerse those parts in the tank until they become clean and uniformly hot. This will promote the evaporation of the solution and rinsing water. For parts washed with an alkali, rinse thoroughly to remove all traces of alkali, being very careful not to damage your skin or lungs.

(4) When parts are to be reassembled immediately after washing, drying and inspection, coat them with light oil in order to protect them against corrosion. If they are to be stored for an extended period of time, apply corrosion inhibitor and cover them with special paper or rustproof material.

2.3 ASSEMBLY

2.3.1 Wheel hub, disc, and ring gear assembly

(1) If cone (57) and cup (67) have been replaced, press fit new cone (57) and cup (67) into wheel hub (53).

(2) Install the inner bearing and spacer in order to wheel hub (53), and install new oil seal (74) to the position shown in Fig. 2-27.

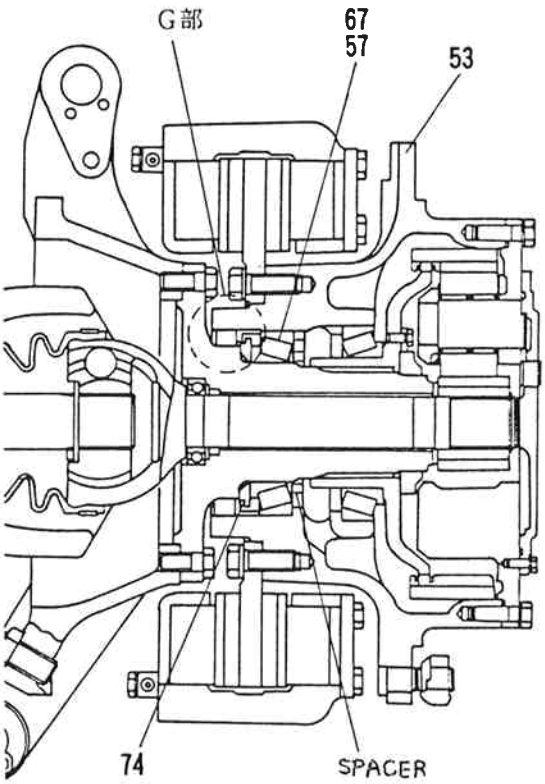


Fig. 2-27. Wheel Hub and Disc Assembly

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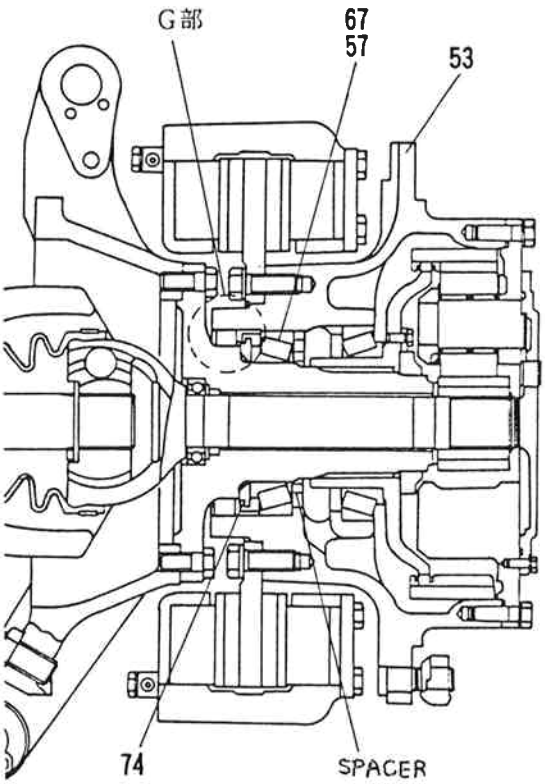


Fig. 2-27. Wheel Hub and Disc Assembly

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(3) Assembling the wheel hub assembly.

1) If bearing (56) has been replaced, press fit the outer race of bearing (56) into the wheel hub, and set the inner race of bearing (56).

2) Put bearing collar (67) and spacer (87) in, and press fit oil seal (74).

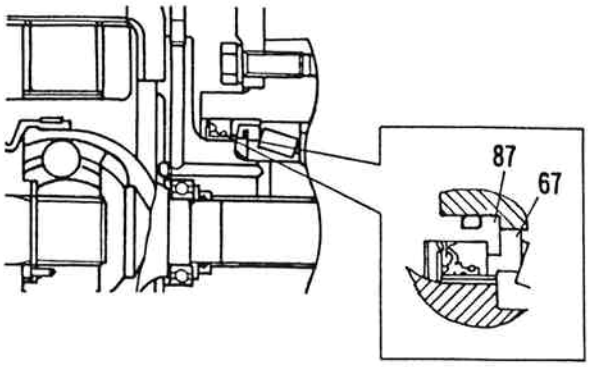


Fig. 2-27. Detail of G (Fig.2-7)

NOTE

1. Apply Three Bond # 1104 or equivalent to the external circumference of the oil seal.
2. Apply grease to the lip face of the oil seal.
3. The oil seal should be pressed fit using a tool not to be inclined.

3) Align the lock of hub bolts (54), and press fit into the wheel hub.

4) Install the disc to the wheel hub, and tighten bolts (84) with a torque of specified 38 to 44 kg·m (275 to 318 ft-lbs).

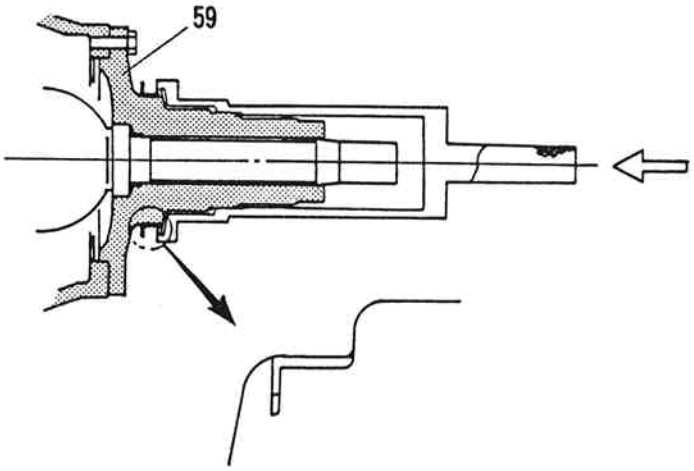


Fig. 2-28.

(4) Installing the wheel hub assembly.

1) Press fit oil seal (74) into spindle (59).

NOTE

Do not injure the sliding face.

2) Lifting the wheel hub assembly with good balance, put it on the knuckle spindle, being careful not to injure the oil seal lip.

NOTE

Apply Three Bond #1104 or equivalent to the external circumference of the seal, then correctly press fit it into the wheel hub.

(5) If outer bearing (56) has been replaced, press fit its cup into wheel hub (53).

(6) If stud (54) has been replaced, press fit a new stud into wheel hub (53).

(7) Mount disc (4) to wheel hub (53). and tighten alternately capscrews (84) to specified torque.

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(8) Using a suitable lifting device, lift wheel hub (53) and disc assembly, install oil seal (74) into the wheel hub. Grease has been filled to the space between the seal lip and dust lip.

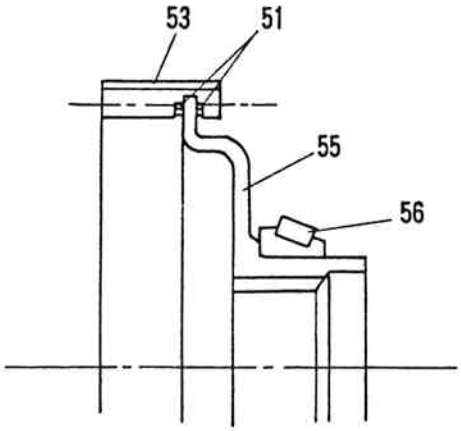


Fig. 2-29

NOTE

Don't damage the seal lip at this time.

(9) Insert the cone of outer roller bearing (56) onto ring gear hub (55).

(10) Insert splined ring gear hub (55) into ring gear (50) flush with the latter's shoulder.

(11) Insert stop ring (51) into the groove of ring gear (50) to secure ring gear (50) to ring gear hub (55).

(12) Install ring gear assembly (50, 51 and 55) to spindle (59), and at the same time seat the cup of outer roller bearing (56) against the cone.

(13) Install spacer (46) to spindle (59).

(14) Install bearing lock nut (49)

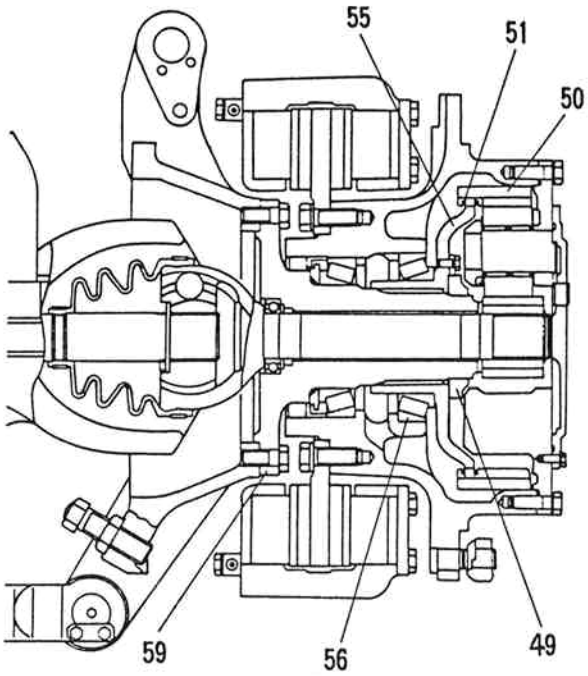


Fig. 2-30 Hub and Disc Assembly

2.3.2 Knuckle

(1) Insert cotter pin(8) into where knuckle ( ) is mounted to the tie rod, and secure with lock plate (9)and capscrews (12).

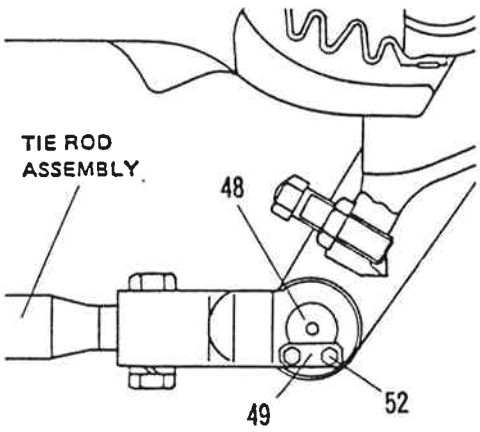


Fig. 2-31 Tie Rod

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(8) Using a suitable lifting device, lift wheel hub (53) and disc assembly, install oil seal (74) into the wheel hub. Grease has been filled to the space between the seal lip and dust lip.

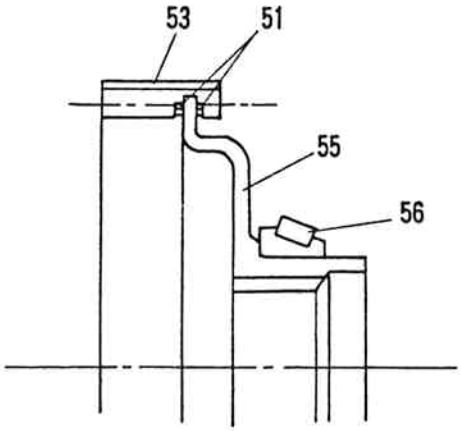


Fig. 2-29

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(12) Install ring gear assembly (50, 51 and 55) to spindle (59), and at the same time seat the cup of outer roller bearing (56) against the cone.

(13) Install spacer (46) to spindle (59).

(14) Install bearing lock nut (49)

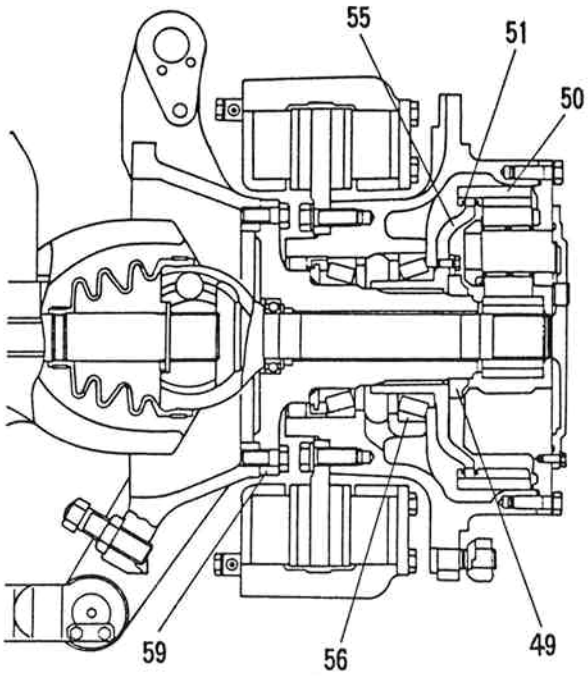


Fig. 2-30 Hub and Disc Assembly

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(1) Insert cotter pin(8) into where knuckle ( ) is mounted to the tie rod, and secure with lock plate (9)and capscrews (12).

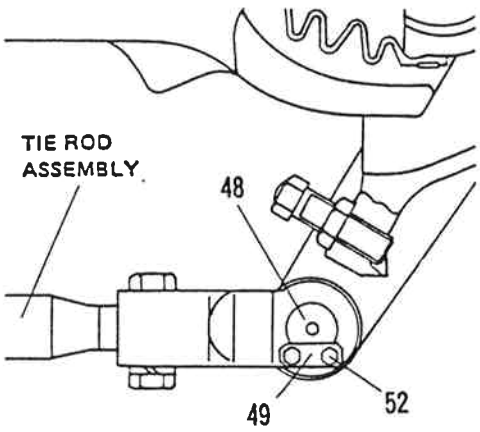


Fig. 2-31 Tie Rod

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(2) Install oil seal (82) to the spindle, mount it to knuckle (63), and tighten capscrews (58) with the specified torque.

(3) Install the axle shaft to the knuckle spindle assembly.

NOTE

Be careful not to damage oil seal (82).

(4) Apply grease to the spline Z of axle shaft (31), then assemble.

(5) Apply Locktite # 242 or equivalent to the thread sections of the bolts, and tighten with specified torque.

(6) Fill the boot with 250 to 300g (8.8 to 10.6 oz) of grease.

(7) Insert the ball bearing to the shaft section.

(8) Insert the axle shaft into the knuckle spindle assembly.

(9) Install the knuckle spindle assembly and axle shaft to the housing.

(10) Install king pins (62 and 73) and their attendant shims (69, 70 and 71). At this time, confirm that clearance C between the end face of the housing boss and the king pin is 0.05 to 0.15mm (0.002 to 0.006 in).

(11) Installing the knuckle assembly.

1) If the parts related to the king pins have not replaced, set king pin thrust washer (65) and shims (69 through 71) to the upper king pin, and thrust washer (65), pin (66) and shims (69 through 71) to the lower king pin respectively in the condition when they were disassembled.

NOTE

Place the lower side thrust washer so that the face provided with the oil groove comes to the king pin side.

2) If the parts related to the king pins have been replaced, compute the respective shim amount of the upper and lower shims by the following procedures.

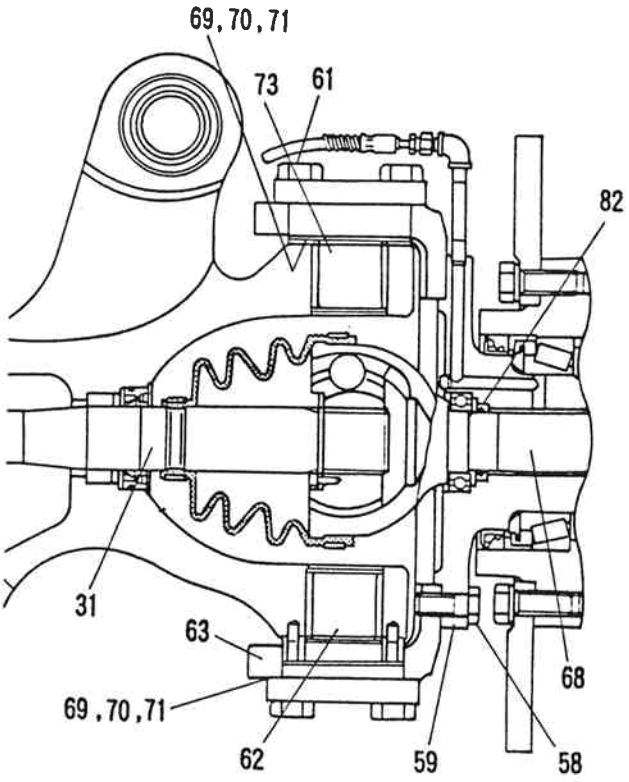


Fig. 2-32. Knuckle

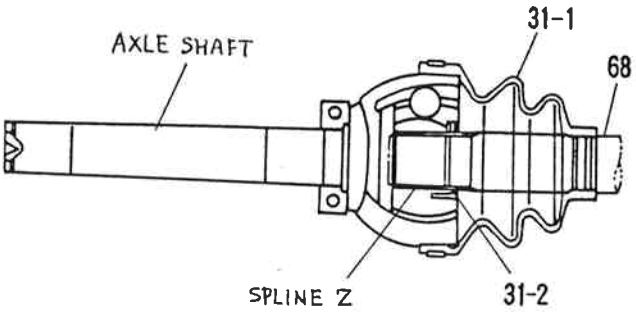


Fig. 2-33. Ball Joint Assembly

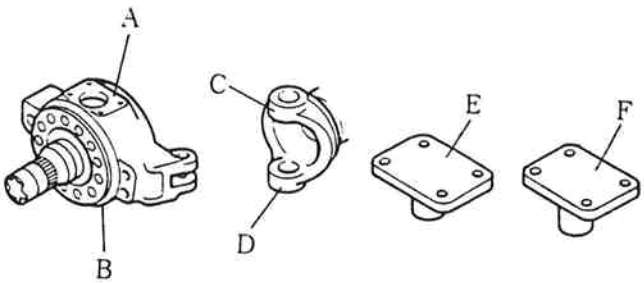


Fig. 2-34

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a) The knuckle, axle housing and king pin are stamped with their manufacturing tolerance for their standard dimensions, and the values of 1/100 of stamped values are regarded as values of A, B, C, D, E and F (Fig. 2-34).
If the stamped value is "−2", the tolerance for the standard value is "−0.02".

b) Measure the thicknesses of upper thrust washer and lower thrust washer. When the values of tolerance are respectively G and H.
G : Tolerance for the standard value 3.0 mm of the upper thrust washer.
H : Tolerance for the standard value 18.5mm of the lower thrust washer.
If the actual measurement value of the upper thrust washer, value of G is "+0.05".

c) Computation of amount of shims
Amount of upper shims = 1.05-A+C+E+G
Amount of lower shims = 1.05-B+D+F+H

NOTE

Apply Lithium base grease containing Molybdenum disulphide (MoS_2) to the king pins and thrust washers.

3) Install bearing (83) to ball joint (68).
4) Carefully insert the ball joint into the knuckle spindle.
5) Sufficiently fill the ball joint with Lithium base grease containing MoS_2 (Molybdenum disulphide) to an extent that the balls of the ball joint body cannot not be seen.
6) Inserting the set plate into the spline (tooth section) of the axle shaft, apply Lithium base grease containing MoS_2 to the spline section of the shaft, and insert it into the ball joint. Set the set plate to the ball joint, apply Three Bond # 1360K to the bolts, and tighten them to a torque of sepecified 0.45 to 0.55 kg-m (3.62 to 3.98 ft-lbs).
7) Put the boot on, and bleed air from the inside of the boot to remove expansion of the boot, then tighten it with the band.
8) While supporting the axle shaft with hand, lift up the knuckle assembly with a lifting device (hoist or like).
9) Carefully insert the axle shaft into the axle housing not to injure the oil seal lip of the trunnion section.
If the axle shaft cannot be inserted completely, while turning the axle shaft carefully with hand, mesh the axle shaft spline to insert it.
10) Apply Lithium base grease containing MoS_2 to the sliding section of the king pin (upper), and install the king pin to the knuckle together with the thrust washer and shims.
11) Apply Three Bond # 1360K or equivalent to the bolts (61), and tighten with a torque of 50 to 60 kg-m (361 to 434 ft-lbs).

NOTE

If the bolts, which were applied with Three Bond # 1360K or equivalent, are reused, remove Three Bond # 1360K completely with a wire brush, then remove fat.

12) As the same way, install the king pin (lower), thrust washer (lower) and shims to the knuckle.

(12) Assembling the knuckle assembly.
Apply Three Bond # 1104 or equivalent to the outer circumference of oil seal (82), then press spindle (59) in.

NOTE

Apply grease to the lip face of the oil seal.

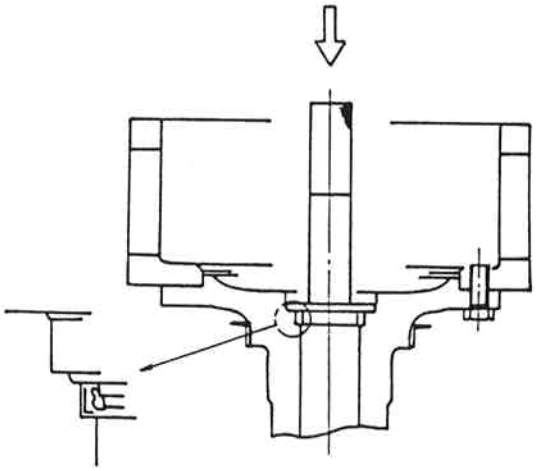


Fig. 2-35

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(13) Assembling the axle housing assembly.

1) Press bushing (22) in to the axle housing.
2) Apply Three Bond # 1104 or equivalent to the outer circumference of oil seal (33), and press it in to retainer (34).
3) Applying grease to O-ring (35), install it in the groove of the retainer.

NOTE

Apply grease to the lip of the oil seal.

4) Press the retainer assembly into the housing.

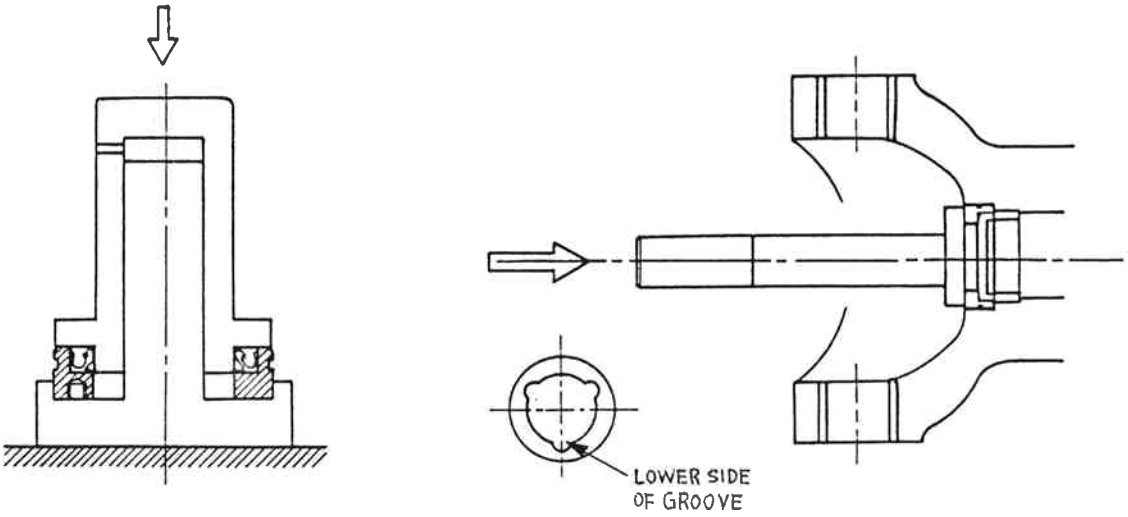


Fig. 2-36

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2.3.3 Wheel bearing adjustment

(1) While rotating the wheel, tighten the adjusting nut.

NOTE

Rotate the wheel in both directions and check that the bearing and the relative parts are installed correctly.

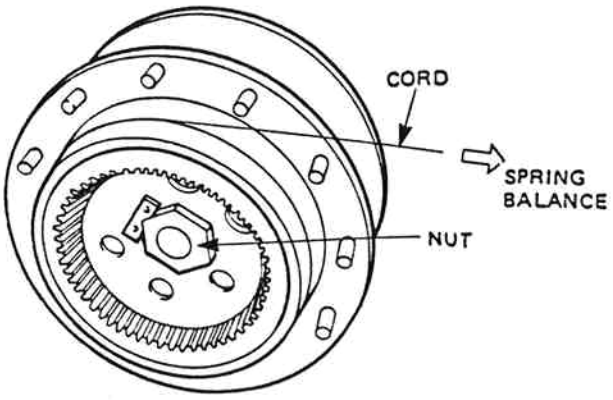


Fig. 2-37. Checking Preload Torque

(2) Turn the adjusting nut 1/4 of a turn back to remove the preload on the bearing.
(3) Tie a suitable cord to the wheel mounting lugs and wrap it around the hub several turns.
(4) Attach a spring balance to the end of the cord.

(5) Having overcome the resistance when starting to rotate, read the rotating torque value on the spring balance.

NOTE

Rotating torque means the torque value needed to continue rotating the hub after it has started to rotate.

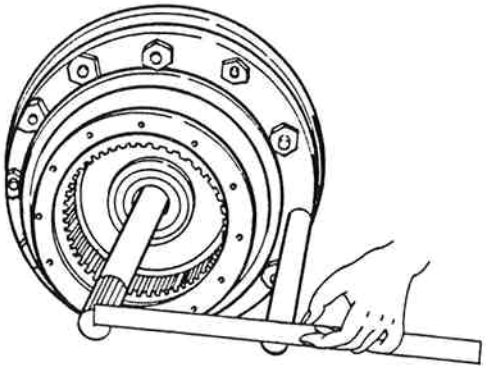


Fig. 2-38. Measuring the Radius

(6) Adjust tightening torque of bearing adjusting nut to obtain specified rotating torque (see step 9).
(7) If it is incovenient to remove the wheel, check the preload torque of the wheel bearing as shown in Fig. 2-37.
(8) The extension shown in Fig. 2-39 enables a reading to be taken without interference from the tyre.

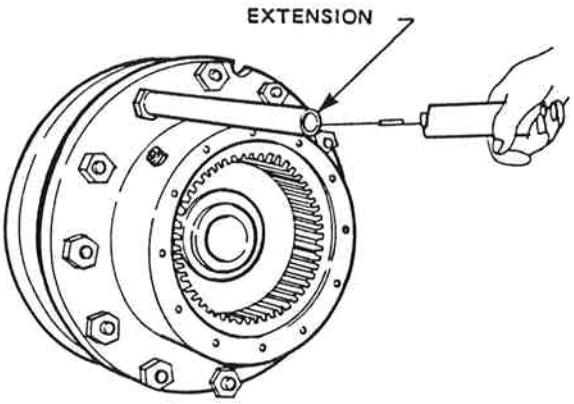


Fig. 2-39. Checking the Preload on the Bearing

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NOTE

To find the preload on the bearing, multiply the value on the spring balance by the radius (the distance from the center of the wheel to the point where the spring balance is connected to the wheel hub).
For example, if, as in Fig. 2-37, the distance from the center of the wheel to the point of contact of the cord is 0.175m (0.574ft.), and the reading on the spring balance is 11kg(24.2lbs), the preload value is 0.175 x 11 = 1.925kg-m (0.574 x 24.2 = 13.89ft-lbs).

(9) If the wheel bearings have been replaced with new ones, measure the rotating torque (not starting torque) with a spring balance and cord, and tighten the adjusting nut (49) little by little until the correct preload (see below) is reached.
Preload is 0.69 to 1.24kg-m (4.99 to 8.97ft-lbs).
Adjust so that the tangential force at the external circumference of wheel hub (53) is 3.9 to 7.1kg. (8.6 to 15.4lbs.)

NOTE

The above torque includes the resistance of the hub and spindle oil seal.

(10) Turn the bearing lock nut to a position where its corner can be locked by plate (75). Using a cord and spring scale, re-check that the turning torque is within specified range.

(11) If turning torque is not within the specified range, remove lock nut (49) again, displace the ring gear hub one spline tooth distant and do step (10) again.

(12) Coat cap screw (76) with Locktite #242 and tighten to specified torque.

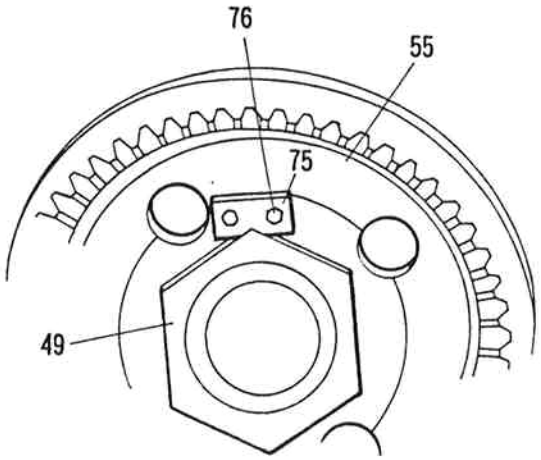


Fig. 2-40. Mounting Bearing Lock Nut

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2.3.4 Planetary Spider

(1) Put planetary spider (41) on a block and position the inner washer so that its lip is placed in the spider dent, then insert bearing (77).

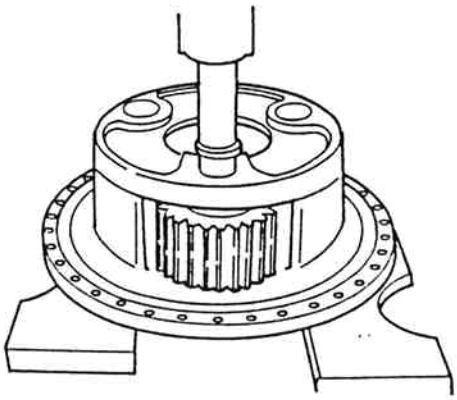


Fig. 2-41. Planetary Spider

(2) Slide in pinion (79) and outer washer (43) and align their holes with the holesin spider through which shaft (42) is put.

(3) Push pinion shaft (42) in the spider hole, with the small diameter end first, making sure that the machined, flat portion of the shaft faces outside the hub circle by turning the outside end of the shaft.

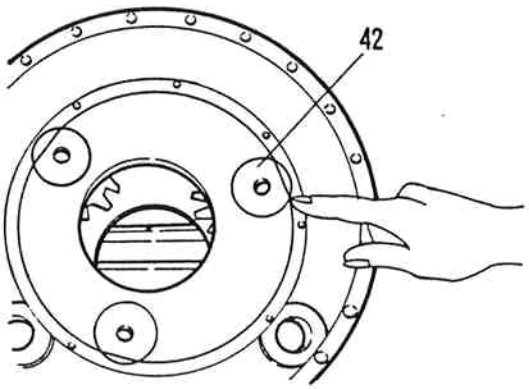


Fig. 2-42. Mounting the Pinion Shaft

(4) Push in pinion shaft (42) until its notched, flat end becomes flush with the surface of spider (41) on which cover (72) is to be installed.

(5) Insert the other two pinion shafts in the same way.

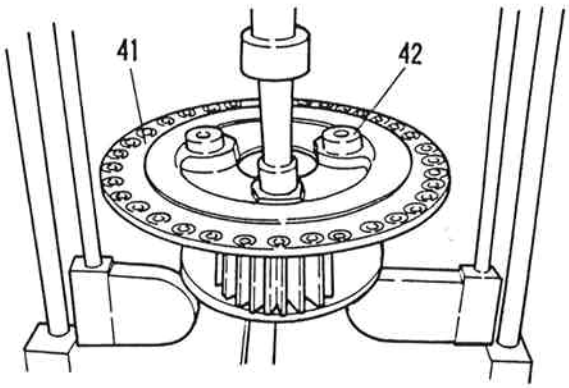


Fig. 2-43. Mounting the Pinion Shaft

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2.3.5 Spider, pinion assembly and cover

As shown in Fig. 2-44, insert thrust washer (46) and sun gear(45) onto axle shaft (68), then insert the snap ring. Then, mount the assembly to the axle housing.

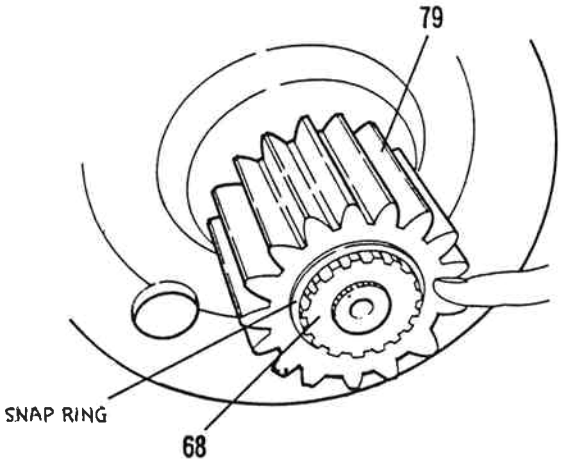


Fig. 2-44 Mounting the Sun Gear

(1) Install the O-ring to the wheel hub mounting face of the planetary spider assembly, then install the assembly to the wheel hub.

(2) Check that the drain port of wheel hub (53) and the marking for direction of cover (41) are positioned correctly, and then install spider (51).

(3) Tighten the hexagon head bolts and plain washers with the specified torque without Locktite coat.

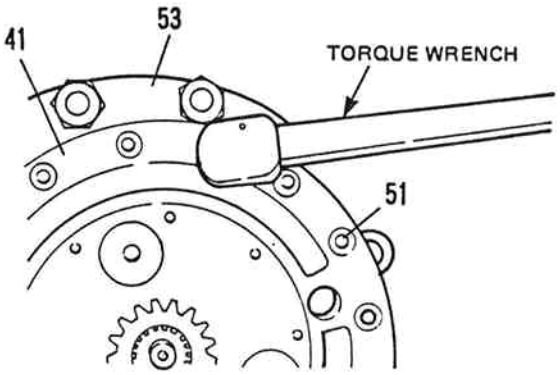


Fig. 2-45 Mounting the Spider

(4) Install the O-ring to the spider cover, then install the spider cover.

(5) Check that the markings for level position of spider and direction of cover are positioned correctly, and then mount cover (72).

(6) Apply Three Bond # 1215 (or equivalent) to capscrews (78) and lockwashers, then tighten the capscrews with the specified torque.

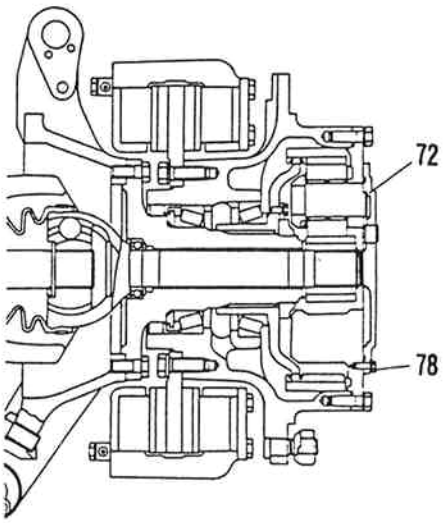


Fig. 2-46. Mounting the Cover

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(7) Fill the planetary hub with the specified amount of lubricant.

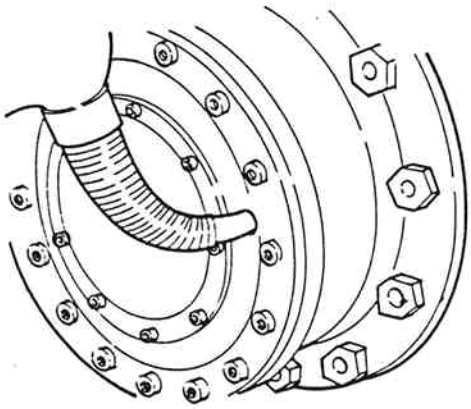


Fig. 2-47 Lubricating

2.3.6 Differential

(1) Hypoid pinion

1) If inner races (117 and 118) have been removed from the pinion cage, press fit them securely using the special setting tool.

2) Tap in pinion pilot bearing inner race (120) and retain it with snap ring (121).

3) Using the setting tool, press in the pinion inner bearing.

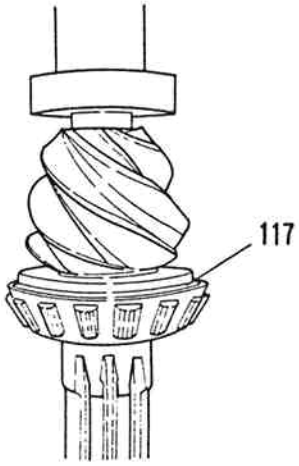


Fig. 2-48 Mounting the Inner Race

4) Insert a new spacer (119) (collapsible type), pinion cage (122) and outer bearings (117 and 118), onto pinion (112).

NOTE

Be sure spacer (119) is new.

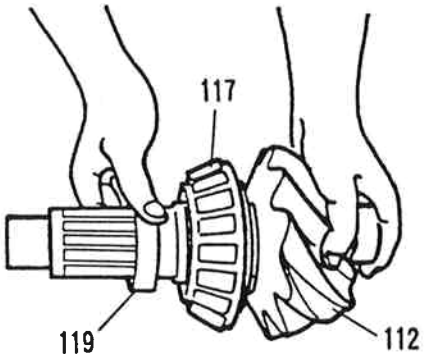


Fig. 2-49 Pinion Assembly

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(7) Fill the planetary hub with the specified amount of lubricant.

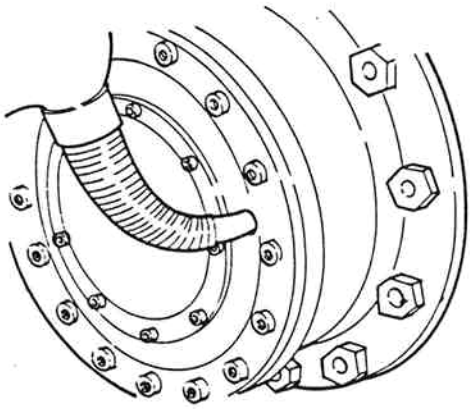


Fig. 2-47 Lubricating

2.3.6 Differential

(1) Hypoid pinion

1) If inner races (117 and 118) have been removed from the pinion cage, press fit them securely using the special setting tool.

2) Tap in pinion pilot bearing inner race (120) and retain it with snap ring (121).

3) Using the setting tool, press in the pinion inner bearing.

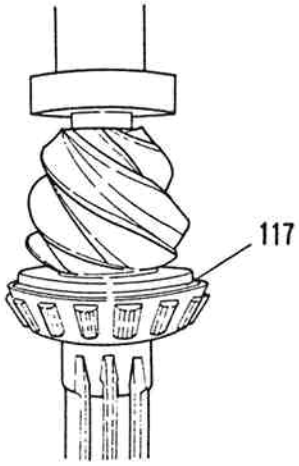


Fig. 2-48 Mounting the Inner Race

4) Insert a new spacer (119) (collapsible type), pinion cage (122) and outer bearings (117 and 118), onto pinion (112).

NOTE

Be sure spacer (119) is new.

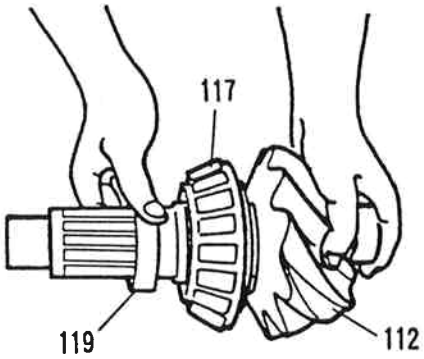


Fig. 2-49 Pinion Assembly

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5) Insert flange yoke (116) onto pinion (112) to match the pinion spline. Insert plain washer (115) and then tighten lock nut (114) to a torque of about 10kg-m (72.3ft-lbs).

NOTE

Apply oil to the threads of lock nut (114) and both faces of plain washer (115).

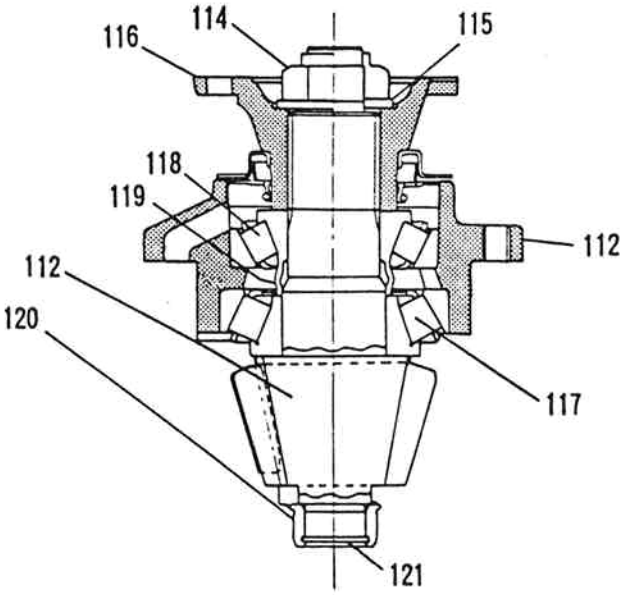


Fig. 2-50 Final Drive Pinion

6) Mount the flange yoke to the special flange yoke bracket, and with the assembly vised, tighten the lock nut to a torque of 35kg-m (253ft-lbs) with a socket wrench.

NOTE

Be careful that the torque does not exceed 35 kg-m (253ft-lbs).

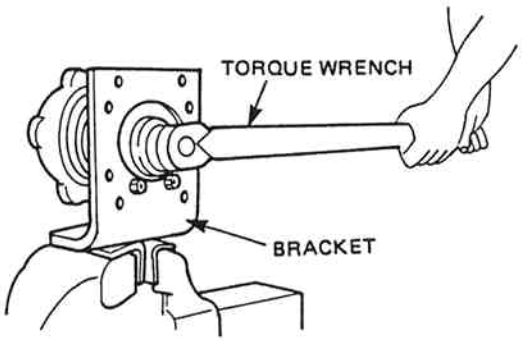


Fig. 2-51 Tightening the Lock Nut

7) Tighten the flange nut more by the following method until bearing preload reaches specified level:
Attach a spring scale to a bolt hole in the pinion cage and pull the scale slowly in a tangential direction. Tighten the flange nut slowly until the cage starts to turn at a scale reading of 3.8 to 4.5 kg (27.5 to 32.5ft-lbs).

CAUTION

① Since the bearing preload increases greatly even with little tightening of the nut, tighten the nut gradually.

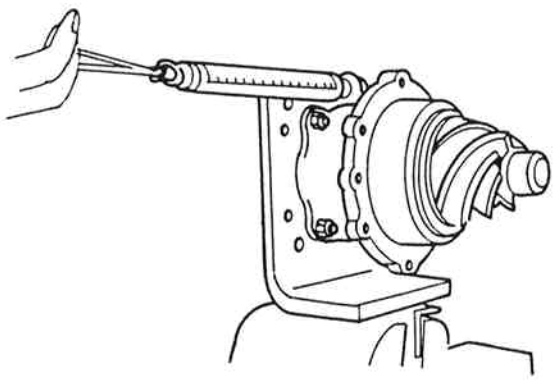


Fig. 2-52 Checking the Preload

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② Pinion nut tightening torque is for reference purpose (of secondary importance) so bearing preload should prevail. In view of this, try to get the tightening torque to fall within the range of 35 to 80 kg-m (253 to 578ft-lbs) after bearing preload reaches specified value [the starting force of 3.8 to 4.5kg (8.4 to 9.9 lbs.)]

③ Just before the specified preload is reached, be especially careful to tighten the nut slowly. If the preload is over specification, replace the spacer with a new one and start all over again. Never attempt to loosen and retighten as it is.

④ Measure the tightening torque in the direction of tightening.

8) When the specified preload has been achieved, calk the lock nut at one point to prevent it from turning.

(2) Differential cage (standard type)

1) If the driven gear has been removed from the differential cage, apply Locktite #242 to the bolt and tighten.

2) Tighten once to a torque of approx. 10kg-m (723ft-lbs), then loosen and re-tighten to 22kg-m (159ft-lbs).

NOTE

Soon after tightening, do not allow great external forces to be applied to where the driven gear is tightened. Allow a minimum of one hour before machine travel.

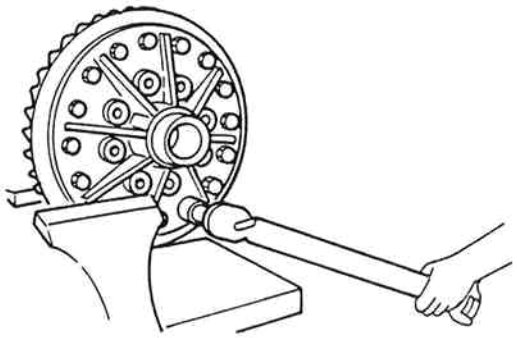


Fig. 2-53 Tightening the Bolts

3) Insert thrust washers (126) into differential cages (107A and 107B) to match the knock pins. Then insert side gear (109).

NOTE

Insert thrust washer (126) with its oil groove facing the side gear face.

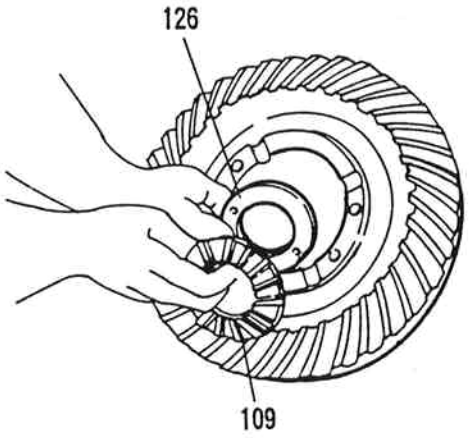


Fig. 2-54 Mounting the Side Gear

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4) Mount differential pinion (108) and thrust washer (111) to spider (110). Insert the assembly into differential cage to mesh with side gear (109).

5) Mount differential cage (107B) togehter with side gear (109), aligning values (e.g. "7") stamped on the side faces of cages (107A and 107B).

6) Tighten differential cage bolts (105), and by inserting a thickness gage into the hole of differential cage (107B), measure the back clearance of side gear (109).

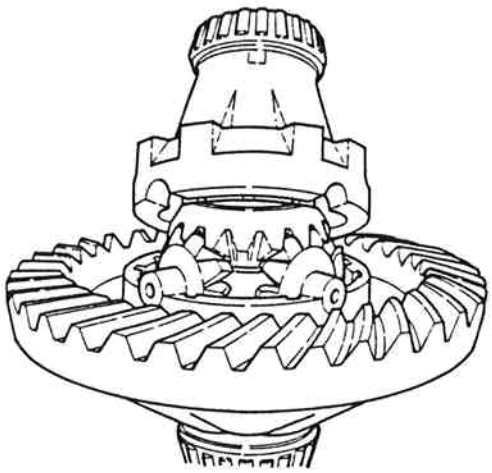
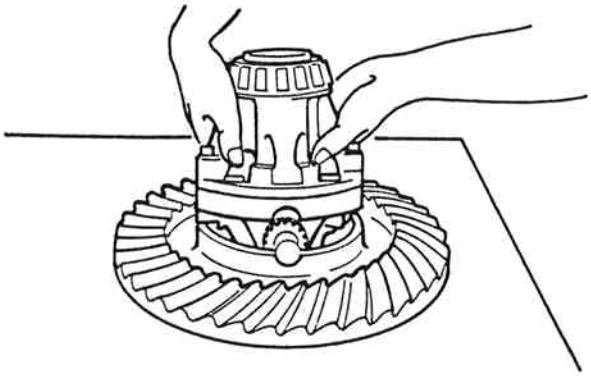


Fig. 2-55 Mounting the Differential Cage



From this clearance, judge the backlash of differential side gear (109) and pinion gear (108). If outside standard value, adjust the clearance by changing the thickness of adjusting thrust washers (126 to 132).

When the adjustment is completed, tighten differential cage bolts (105) to the specified torque and calk the nut at two points to lock them.

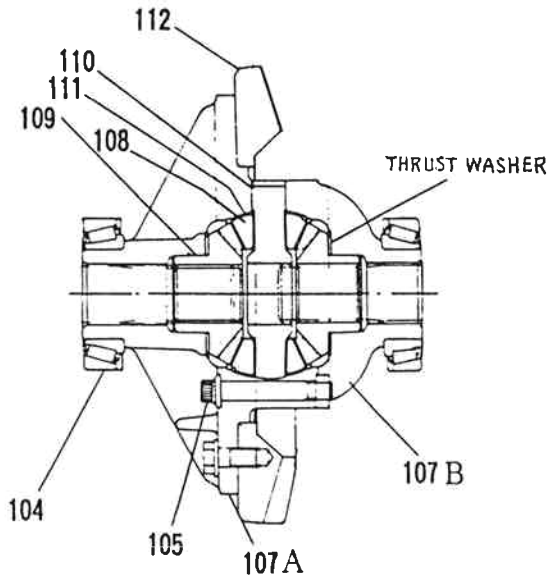


Fig. 2-56 Differential Assembly

Check Item	Standard Assembly Valve
Backlash of side gear and pinion gear in mm (inch)	0.15 to 0.20 (0.006 to 0.008)
Clearance between differential cage and side gear in mm (inch)	0.03 to 0.09 (0.0012 to 0.0036)

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Adjusting thrust washers

No.	
1	2.8 mm (0.11in)
2	3.0 mm (0.118in)
3	3.2 mm (0.126in)
4	3.4 mm (0.134in)

7) Using a press, press in side bearing inner race (104).

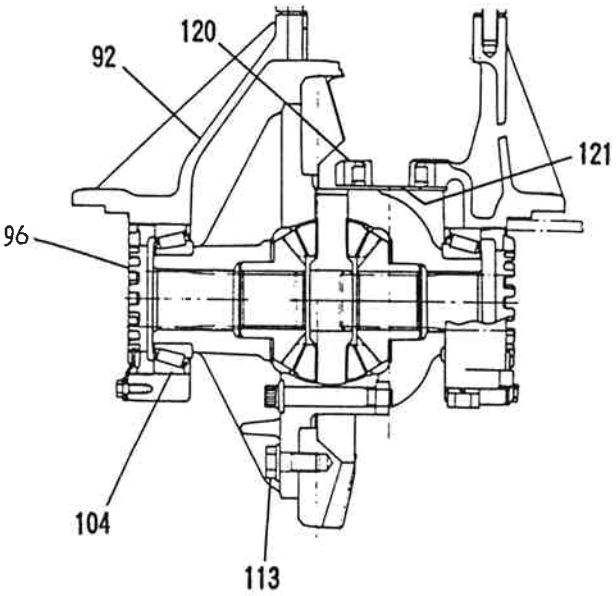


Fig. 2-57 Differential Carrier

(3) Differential carrier

1) Mount drive pinion pilot bearing (120) to carrier (92).

NOTE

When mounting drive pinion pilot bearing (120), the side on which snap ring (121) is located is the differential cage side.

Bearing preload	29 to 35kg-m (210 to 253ft-lbs)
At position of driven gear set bolt	2.4 to 2.8kg (5.3 to 6.2lbs)

2) Insert the outer race onto side bearing (14) on each side of the differential cage assembly. Using a bar inserted into the axle shaft hole, mount the assembly to differential carrier (92).

3) Insert adjusting nut (96) into the bearing cap so that the matchmarks put on at disassembly are each matched. Screw in the adjusting nut on each side, until its face becomes flush with the bearing cap face, uniformly.

4) Tighten the bearing cap to a torque of about 5kg-m and measure the preload on the side bearing. Attach a spring scale to the head of a set bolt on the driven gear and pull the scale slowly in a tangential direction. Take the scale reading at which the driven gear starts to rotate.

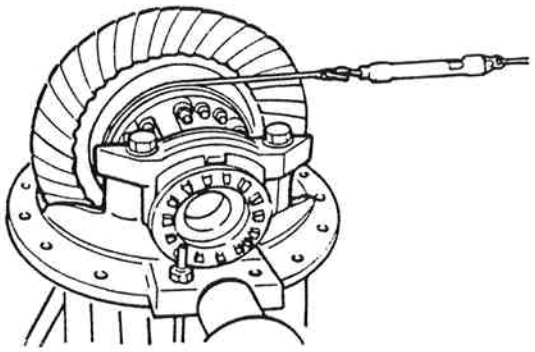


Fig. 2-58 Measuring Preload on Side Bearing

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5) If bearing preload is not to specification, tighten or loosen the right-hand and left-hand adjusting nuts (96) to adjust preload.

6) Using a dial gage, check driven gear (112-2) for runout. Attach the dial gage near the external circumference at the back of the driven gear.

   If the runout is greater than the standard assembly value, possible causes include uneven tightening of driven gear set bolts (113) or foreign material trapped. Take apart and check.

7) Mount the hypoid pinion assembly through position adjusting shims (133, 134 and 135), taking care to align differential carrier(92), shims (133, 134 and 135) and the pinion cage holes. Use the position adjusting shims that were disassembled, but if differential carrier (92), pinion cage (122), pinion gear (112-1) and driven gear (112-2) were replaced, use a combination of the new shims as shown in the right table.

Check Item	Standard Assembly Value	Repair Required
Driven gear runout mm (inch)	Not more than 0.09 (0.0036)	More than 0.2 (0.008)

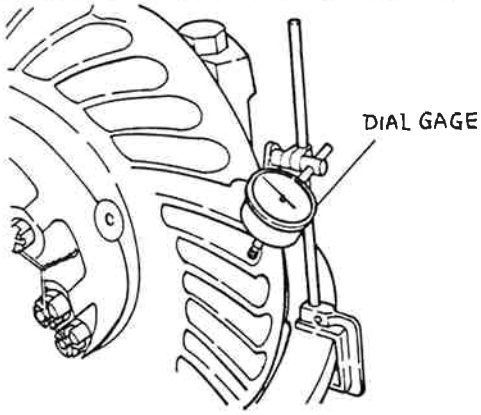


Fig. 2-59 Checking the Driven Gear

No.	Thickness
1	0.15mm (0.006in)
2	0.20mm (0.008in)
3	0.50mm (0.02in)

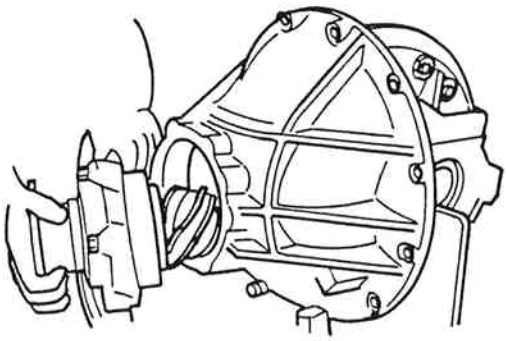


Fig. 2-60 Mounting the Drive Pinion Assembly

NOTE

Apply Bellco Bond No 402 to the end face of differential carrier (92) and the end face of pinion cage (122), but do not apply to shims (133 through 135).

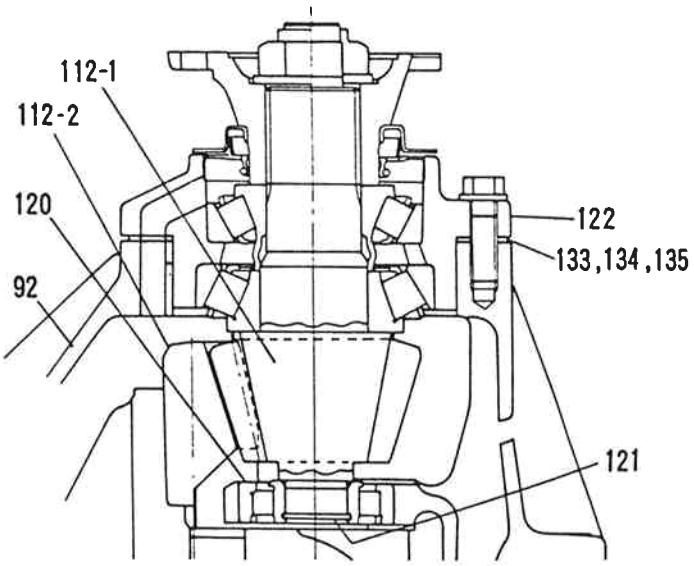


Fig. 2-61 Drive Pinion Assembly

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8) Measure driven gear (112-2) and pinion gear (112-1) for backlash.
Using a dial gage, slowly move the driven gear in the direction it rotates, holding the pinion gear by hand.

Check Item	Standard Assembly Value
Backlash between driven gear and pinion gear	0.25 ~ 0.33 mm (0.01 to 0.013in)

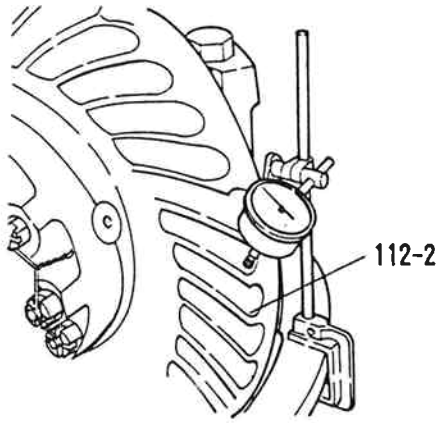
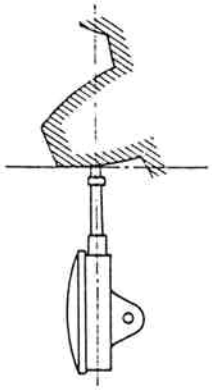


Fig. 2-62 Measuring the Backlash

Adjust the backlash by means of the side bearing adjusting nuts. However, since the preload on the side bearings has already been fixed, adjust by tightening one adjusting nut the same number of grooves by which the other was loosened.

How to install the dial gage



Direct the point normal direction of tangent.

Fig. 2-63 Measuring Method

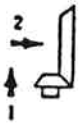
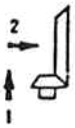
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9) Checking and adjusting the gear tooth contact

(1) Coat the surfaces of 7 or 8 driven gear teetch with red lead kneaded in spindle oil.

(2) While braking the driven gear by hand, rotate the drive pinion forward and backward to check tooth contact.

(3) Adjust tooth contact by the method shown in the table below.

Gear Tooth Contact	Cause	Adjusting Method
	Correct tooth contact pattern: No contact on the toe side abt. 5mm (0.2in) length. Contact toward the heel abt. 70% of entire tooth length, on both sides of the pitch line.	To adjust drive pinion, increase or decrease shims on drive pinion shoulder. To adjust driven gear, use the same method as in adjusting backlash. Drive pinion shim: 0.15mm (0.006in), 0.20mm (0.008in), 0.50mm (0.02in)
	Drive pinion too far from driven gear	1. Decrease drive pinion shims to move pinion near driven gear. 2. Move driven gear away from pinion to correct backlash. 
	Drive pinion too near driven gear	1. Increase drive pinion shims to move pinion away from driven gear. 2. Move driven gear near pinion to correct backlash. 
	Driven gear too near drive pinion	1. Decrease drive pinion shims to move pinion near driven gear. 2. Move driven gear away from pinion to correct backlash. 
	Driven gear too far from driven pinion	1. Increase drive pinion shims to move pinion away from driven gear. 2. Move driven gear near pinion to correct backlash. 

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10) After gear tooth contact has been checked, tighten each bolt to specified torque. Connect bolts with lock wire.
If adjusting-nut lock plate does not fit into adjusting nut groove, turn the nut in the tightening direction to align both.

(5) Lubrication

Since the oil fill plug shows the specified oil level, fill the specified oil to the position of plug (2).

☆ Kind of lubricant	API classification GL-4 equivalent Oil #90	
☆ Capacity of lubricant	Housing	Front: 9ℓ (2.38 gal) Rear: 16ℓ (4.23 gal)
	Planetary	2.6ℓ (0.69 gal)

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3. MAINTENANCE STANDARDS

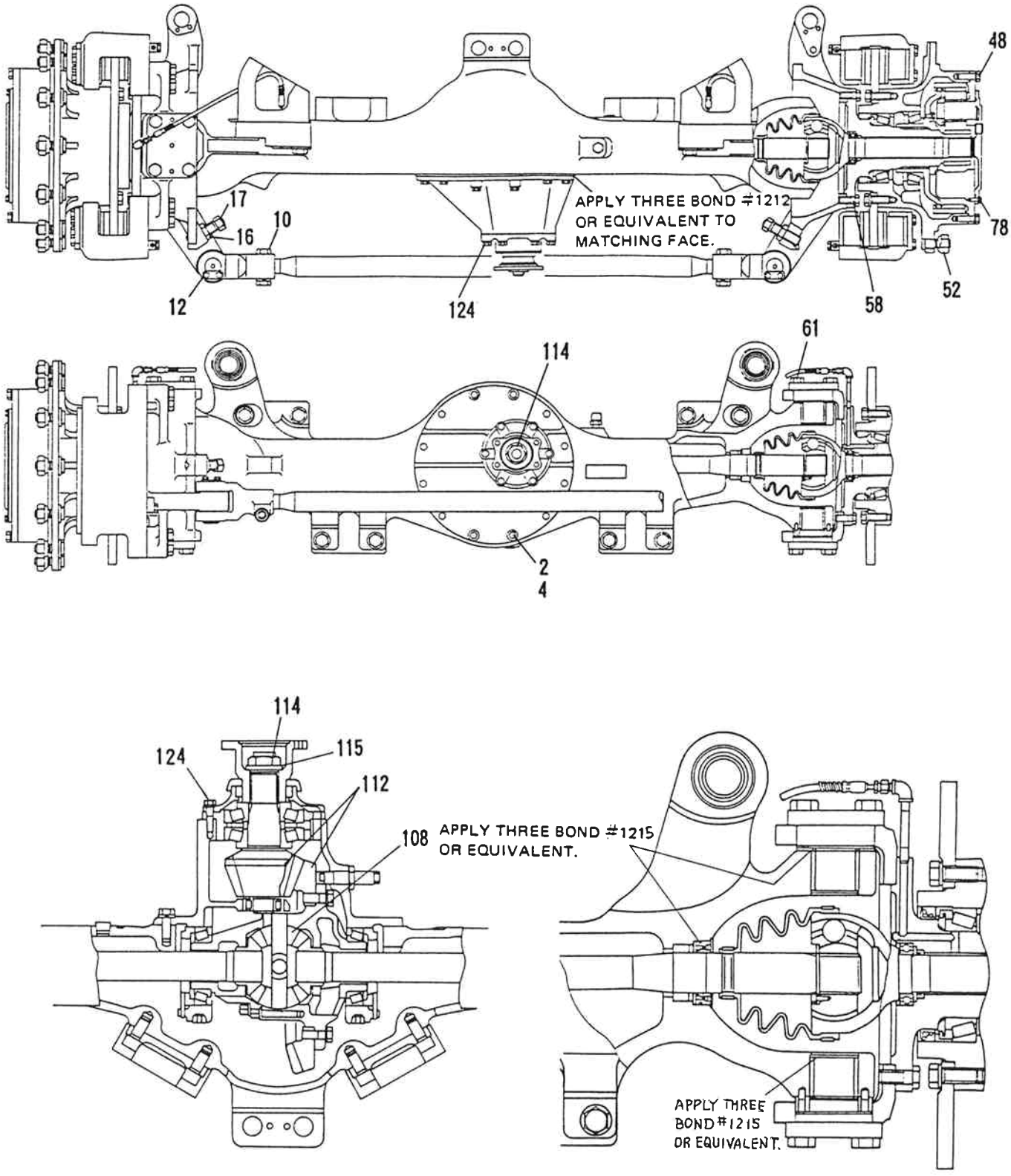


Fig. 3-1

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3.1 TIGHTENING TORQUE OF MOUNTING BOLTS

Unit : kg-m (ft-lbs)

Assembly	Symbol	Part	Standard value	Remarks
Front and rear axle assemblies		Torque rod bracket mounting bolt	55 ± 5 (398 ± 36)	Thread lock
	10	Capscrew	11 ± 2 (79.6 ± 14.5)	Thread lock
	12	Capscrew	3.5 ± 0.6 (25.3 ± 4.3)	
	16	Nut	40 ± 5 (289 ± 36)	
	2	High nut	8 ± 1.3 (57.9 ± 9.4)	Stud side : thread lock. Nut : unnecessary.
	4	Low nut	6.5 ± 1.3 (47.0 ± 9.4)	
Shaft and hub group	48	Capscrew	19.5 ± 1.5 (141 ± 10.9)	Thread lock is unnecessary
	52	Nut	* 57^{+6}_{-5} (412^{+43}_{-36})	Apply thread lock #242 (or equivalent).
	58	Capscrew	26.5 ± 4.0 (192 ± 28.9)	
	61	Capscrew	55.0 ± 5.5 (398 ± 40)	
	76	Capscrew	2.5 ± 0.4 (18.1 ± 2.9)	
	78	Bolt	3.5 ± 0.35 (25.3 ± 2.5)	Three Bond # 1215 or equivalent.
Ball joint assembly (Fig. 3-4)		Hexsocket head bolt	$0.45^{+0.1}_{-0.05}$ ($3.25^{+0.72}_{-0.36}$)	Some as above.
Differential carrier assembly	93	Side bearing cap bolt	16 (115.7)	
	105	Differential cage bolt	12 (86.8)	
	113	Bolt	22 (159)	
	114	Lock nut	35 (253) (for reference)	
	124	Drive pinion cage bolt	8.3 ± 1.3 (60.0 ± 9.4)	
Unless otherwise specified, torque all screws and bolts on this machine to the values shown here. Apply thread lock #242.		M 6 : 1.4 ± 0.15 (10.1 ± 1.1), M 8 : 3.4 ± 0.35 (24.6 ± 2.5), M10 : 6.7 ± 0.7 (48.5 ± 5.1), M12 : 11.7 ± 1.2 (84.6 ± 8.7), M14 : 18.5 ± 2.0 (133.8 ± 14.5),	M16 : 28.5 ± 3.0 (206 ± 22) M18 : 39.0 ± 4.0 (282 ± 29) M20 : 55.0 ± 5.5 (398 ± 40) M22 : 74.5 ± 7.5 (539 ± 54) M24 : 95.0 ± 9.5 (687 ± 69)	

* This standard value is applicable, with lubrication.
Without lubrication, increase tightening torque 10%.

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Differential Related Parts

No.	Description	Maintenance standards	Remarks
112	Hypoid pinion gear and driven gear	Check tooth surface visually for tooth contact, scratches, scuffs, and excessive wear. If defective, replace with new. Replace hypoid pinion gear and driven gear as a set.	Fig. 3-1
108	Differential pinion		
109	Side gear		
104	Bearing	Replace bearings having scratches, scuffed inner races, outer races and rollers or excessive chatter, wear, etc.	Fig. 2-3
117	Bearing		
118	Bearing		
120	Bearing		
115	Washer	Check thrust washers for excessive uneven wear and damage.	Fig. 3-1 Fig. 2-3
126 to 131	Thrust washer		

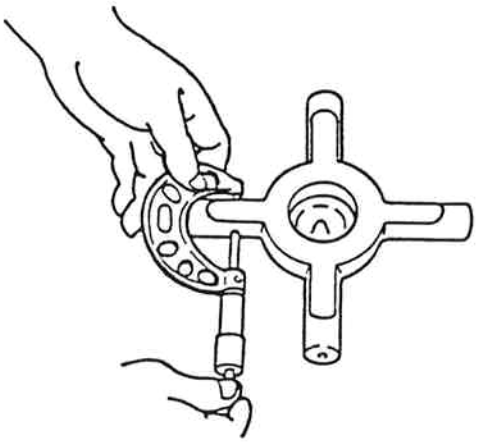


Fig. 3-2 Measuring the spider

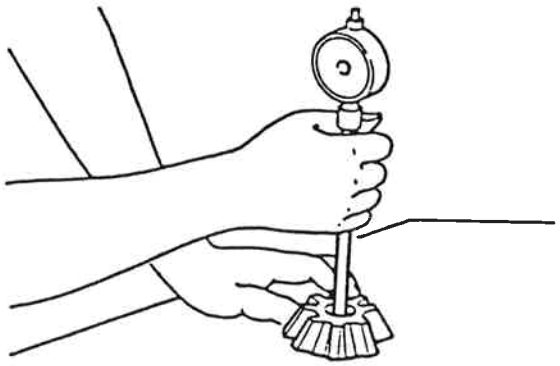


Fig. 3-3 Measuring the pinion

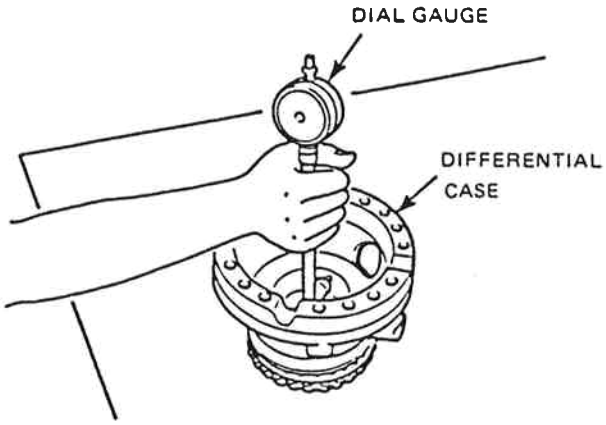


Fig. 3-4 Measuring clearance

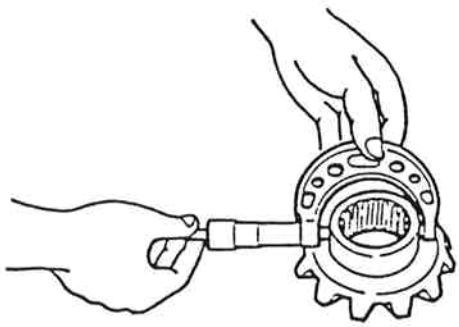


Fig. 3-5 Side gear and differential cage

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Check item	Standard assembly value	Repair required	Remarks
Clearance between pinion (20) and spider (22) in mm (inch)	0.1 (0.004))	More than 0.2 (0.008)	If clearance exceeds repair value, replace the worn out part. (See Figs. 3-2, 3-3 and 3-4.)
Spline play in rotation direction in mm (inch)	0.2 (0.008)	More than 0.5 (0.02)	Fix the axle shaft in a vise, insert side gear (21) onto the shaft, measure play with dial gage. (See Figs. 3-3.)
Clearance between inside diameter of differential cage (19) and side gear (21) in mm (inch)	0.03 ~ 0.09 (0.0012 to 0.0035)		Measure I.D.(d_2) of differential cage and O.D.(d_1) of side gear. If the clearance exceeds standard value remarkably, replace side gear or differential cage. (See Figs. 3-4 and 3-5.)

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4. TROUBLESHOOTING

4.1 GENERAL

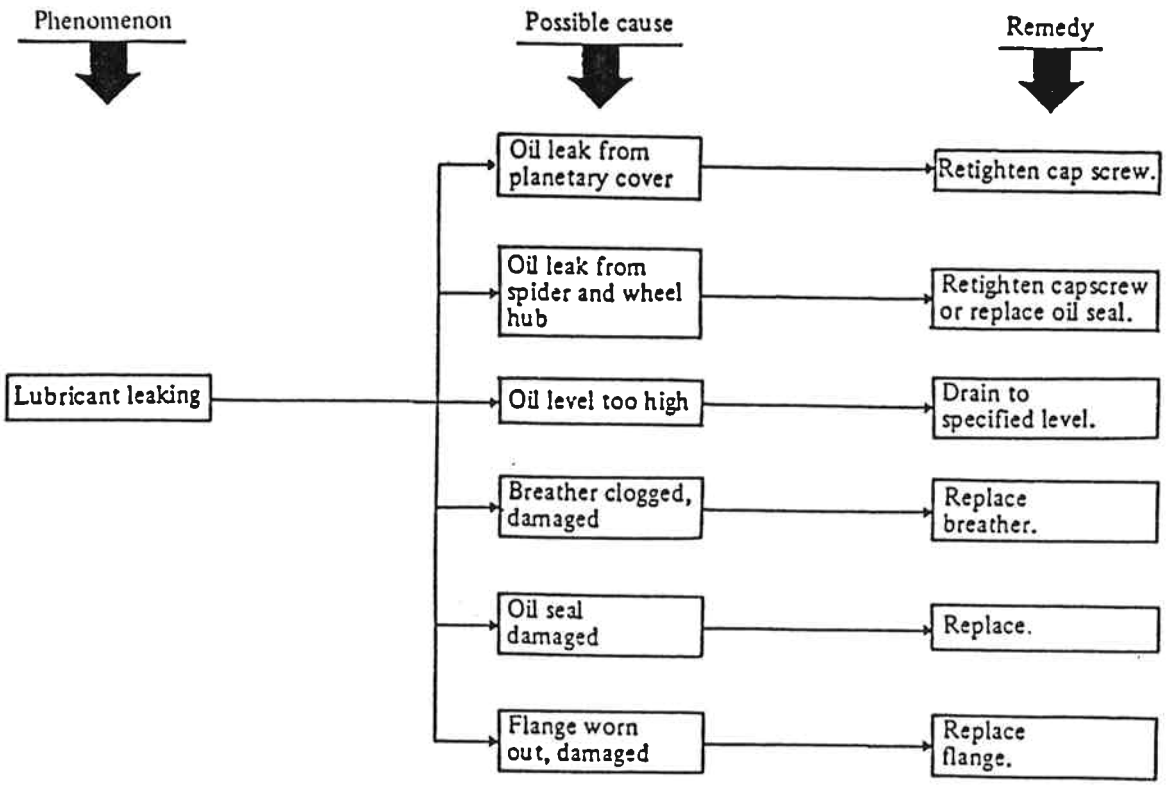
When dealing with faults which influence axle performance, it is necessary to search systematically for the fault and isolate the faulty area. Read the sections on construction and function carefully. An understanding of how each part works will facilitate this.

In cases where there is exceptional noise or vibration, check other possible causes thoroughly before deciding the fault lies with the axle.

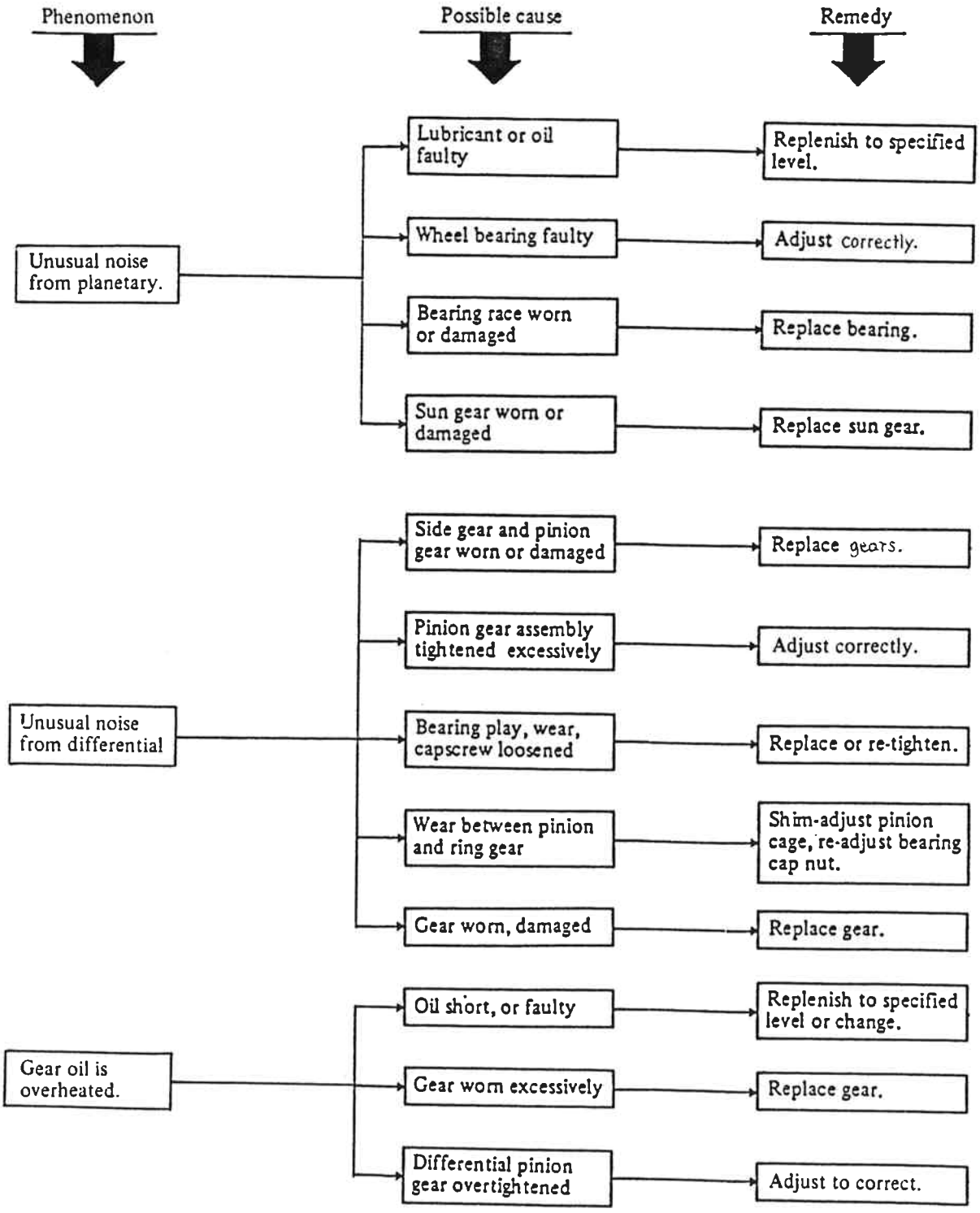
In order to isolate a source of noise in the axle, elevate the machine until the tyres are completely free of the ground. It will be easier to isolate the noise if the drive shaft is removed from the axle not producing the unusual noise. Ensuring that the tyres on both sides are completely off the ground, put the transmission in first gear and run the engine at low speed.

NOTE

Never run the engine if it is believed that the trouble lies in the differential.



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For disc brake related parts, see Shop Manual of disc brakes.

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1. CONSTRUCTION AND FUNCTION

The disc brakes are divided largely into 4 piston type brakes and 6 piston type brakes, and further are classified into several kinds of brakes according to the kinds of actuating oils and the caliper mounting methods.

Since the metallic parts of the each type brakes are entirely common each other and the construction also are similar, this manual explains for the 6 piston type disc brakes.

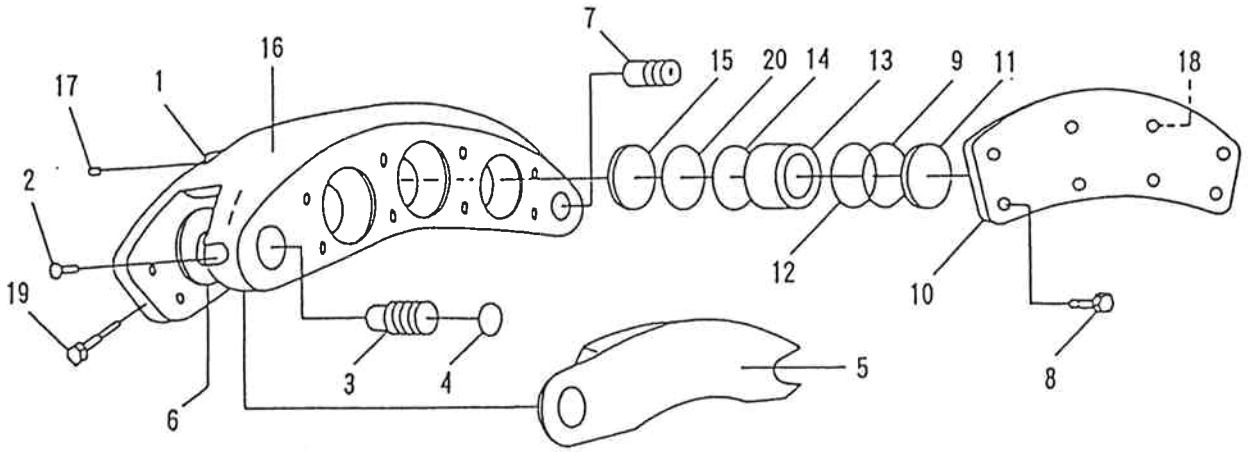
1.1 CONSTRUCTION

The detailed construction of the disc brake is shown in Fig. 1-1.

NOTE

The names and item numbers shown in Fig. 1-1 are the same with items in parentheses in this manual.

(1) Torque plate (16) is provided with six cylinders in all, of which three cylinders each face each other. The one side of the each cylinder is a blind hole, and the other side can be covered with piston plug (11), cap seal (12) and back-up ring (9). Cover plate (10) is secured with cap screws (8).
Torque plate (16) is machined with oil passages which are led to all the six cylinders.



* Parts with mark * show service kit parts and filled with silicone grease.

1. BLEEDER
2. CAPSCREW
3. TORQUE PIN
4. O-RING
5. LINING PAD
6. LINING PAD
7. TORQUE PIN
8. CAPSCREW
* 9. BACK-UP RING
10. COVER (PLATE)
*11. PISTON PLUG
*12. CAP SEAL
13. PISTON ASSEMBLY
*14. PISTON SEAL
*15. SCRAPER RING
16. TORQUE PLATE
17. CAP
18. CAPSCREW (FOR 4 PISTON TYPE)
19. CAPSCREW
*20. BACK-UP RING

Fig. 1-1 Construction

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(2) The inside of the each cylinder is cut with grooves, into which piston seal (14), back-up ring (20) and scraper ring (15) are inserted. The piston seal and back-up ring are inserted into the wider groove, and the scraper ring is inserted into the narrower.

NOTE

The adiabatic material for piston assembly (13) is attached to the piston with screws.
The thickness of adiabatic material :
7 mm (0.276 in.)

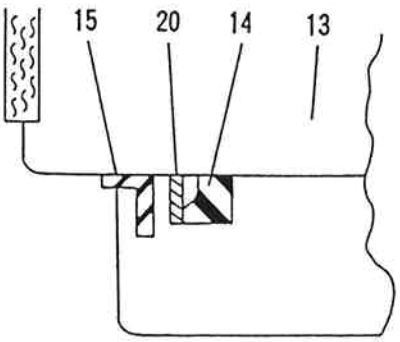


Fig. 1-2

(3) Lining pads (5 and 6)are supported with torque pin with O-ring (3 and 4) and torque pin (7) in the torque plate. Torque pin with O-ring (3 and 4) and torque pin (7) are fixed in the specified positions with capscrews (2).

NOTE

The torque pins are two kind pins of thick pin (3) and thin pin (7), and two of them are respectively provided in the right and left sides. The each torque pin is torqued with capscrews (2 and 19)to 5-5.5 kg-m (36 to 40 ft - lbs).

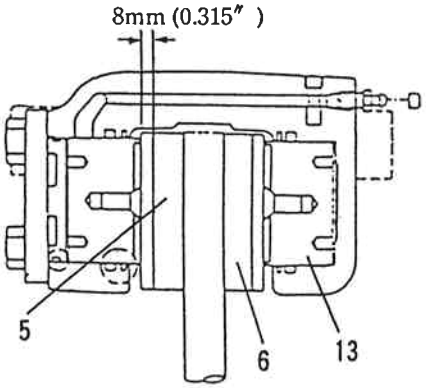


Fig. 1-3

1.2 FUNCTION

(1) The brake is actuated by supplying the brake fluid from the pipe connected to the inlet connector.

(2) The oil passages are connected in the casting of each torque plate (16), and the brake fluid flows freely.

(3) When the brake control is operated, all pistons (13) are pushed out by hydraulic pressure. As the result, the friction materials of lining pads (5 and 6) are pushed against the rotating discs, and the appropriate braking force is generated.

(4) The braking force generated on the friction materials of lining pads (5 and 6) is transmitted to torque pin with O-ring (3 and 4) from the back metals for the lining pads. Torque pin with O-ring (3 and 4) and torque pin (7) support lining pads (5 and 6) even when the brake is released.

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(2) The inside of the each cylinder is cut with grooves, into which piston seal (14), back-up ring (20) and scraper ring (15) are inserted. The piston seal and back-up ring are inserted into the wider groove, and the scraper ring is inserted into the narrower.

NOTE

The adiabatic material for piston assembly (13) is attached to the piston with screws.
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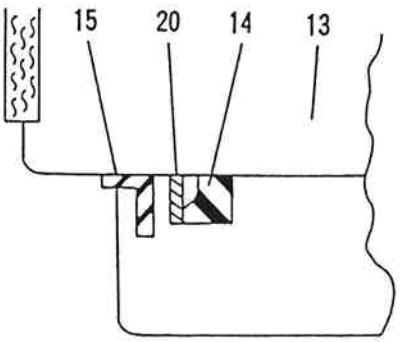


Fig. 1-2

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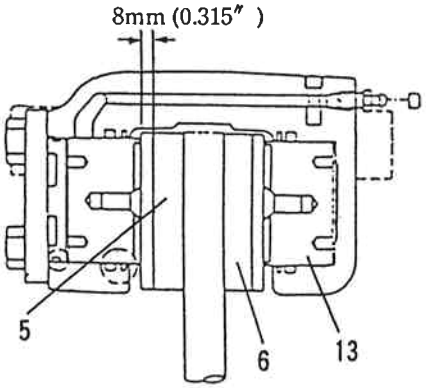


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2. SPECIFICATION

2.1 PRINCIPAL ITEMS

Item \ Specification	Specification-1	Specification-2
	4 pistons	6 pistons
Diameter and number of cylinder mm (inch)	73.03 (2.875)×4	73.03 (2.875)×6
Whole area of cylinder cm² (inch²)	167.6 (26)	251.3 (39)
Thickness of disc mm (inch)	20.0 (0.7874) (standard)	20.0 (0.7874) (standard)
Effective radius of disc mm (inch)	Disc outer dia.×0.5-38.1 (1.5)	Disc outer dia.×0.5-38.1 (1.5)
Dimension of pad (Width×height×thickness) mm (inch)	325.5 (12.815)×100.0 (3.937) ×22 (0.866)	380 (14.96)×105 (4.134) ×22 (0.866)
Area of pad (total of 2 pads) cm² (inch²)	348 (53.94)	474 (73.47)
Allowable wear pad mm (inch)	Approx. 12 (0.473)	Approx. 12 (0.473)
Amount of hydraulic fluid cc (inch³)	Approx. 14.2 (0.866) max.	Approx. 21.2 (1.294) max.
Weight kg (lb)	Approx. 37 (81.6)	Approx. 44 (97.0)

2.2 DIMENSION

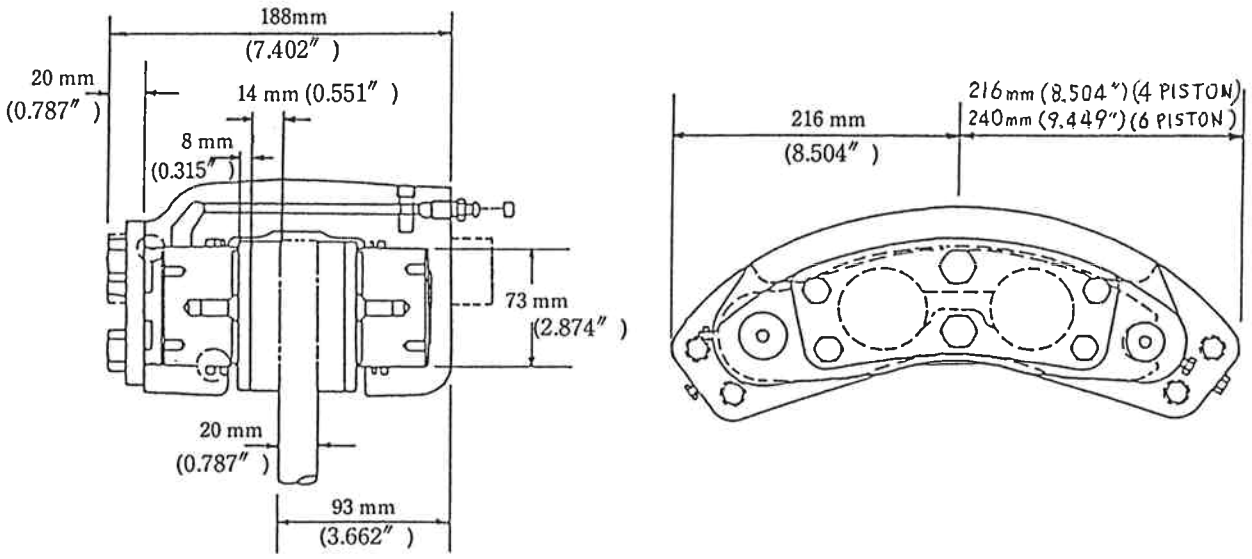


Fig. 2-1 General Dimension

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2. SPECIFICATION

2.1 PRINCIPAL ITEMS

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	4 pistons	6 pistons
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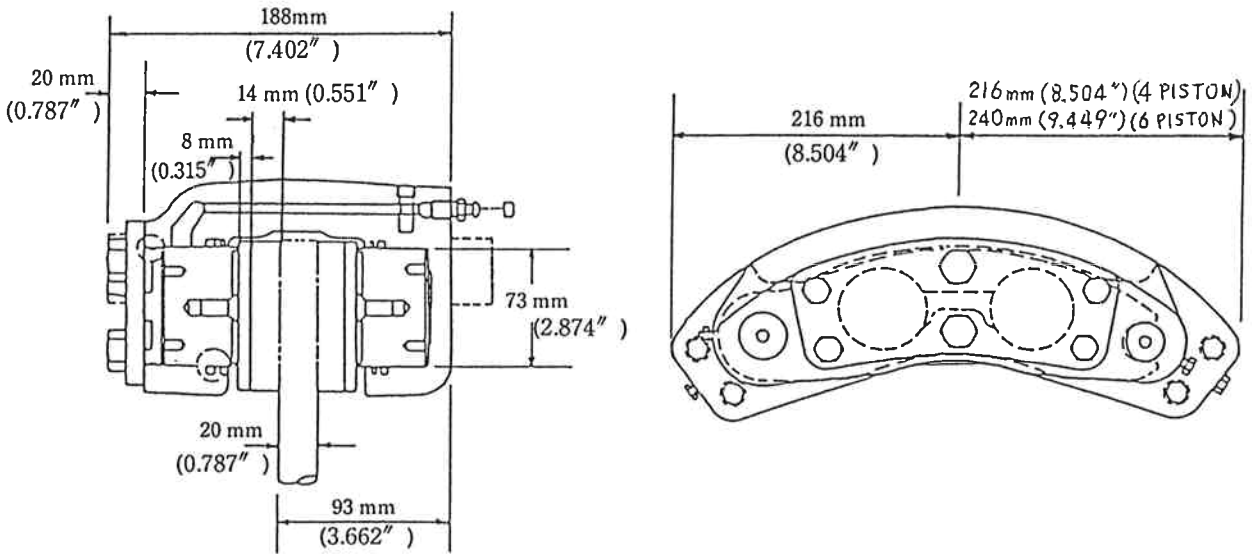


Fig. 2-1 General Dimension

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3. CHECK AND MAINTENANCE

3.1 CHECK OF BRAKE FLUID

(1) Amount of Brake Fluid.
In proportion as the lining wears, the brake fluid level in the reservoir lowers.
When the brake fluid becomes insufficient, air could enter the brake circuit piping to generate a phenomenon same as vapour-lock. This could delay generation of braking force or decrease it to cause serious troubles. Be sure to check always the brake fluid level, and add it if required.

(2) Periodical Check of Brake Fluid.
Use of brake fluid for a long period of time, without replacement, could deteriorate its function due to suction of water or cause fluid leak due to foreign matters. Be sure to replace fluid every six months through one year.

(3) Adding Brake Fluid.
If the brake fluid is insufficient at daily check, add the brake fluid of the same brand.
At this time, check the cover of the reservoir for dust and be careful not to allow foreign matters to enter the brake fluid.
Since the brake fluid could damage painted faces, do not spill fluid. When fluid is dropped on the painted face, wipe fluid off with cloths.
Since the braking force is largely reduced when fluid attaches to the lining pad faces. When the fluid is attached, immediately clean the face with a volatile solvent and dry it.

3.2 CHECK OF LINING PAD (HEREINAFTER REFERRED TO AS "PAD").

(1) To check the pad, use the pad wear check gauge, and check for the remaining thickness.

(2) Since the pad wears by using it for a long period of time, when the remaining thickness excluding the back metal reaches 2.0 mm (0.079 in), replacement is required.

(3) If the pad wears over this limit, the back metal could contacts directly the disc to damage the disc. This could give a deep flaw, if remarkable, to the disc, and the disc also could not be used.

3.3 CHECK OF DISC

Generally, it is not required to correct the sliding surface of the disc.
Also, using a worn disc does not affect the life of the pad, but if the thickness of the disc is less than 17.5 mm (0.689 in) or if the disc is so damaged that it cannot be used, replace the disc.
Wear of the disc over the limit could cause leak of fluid.

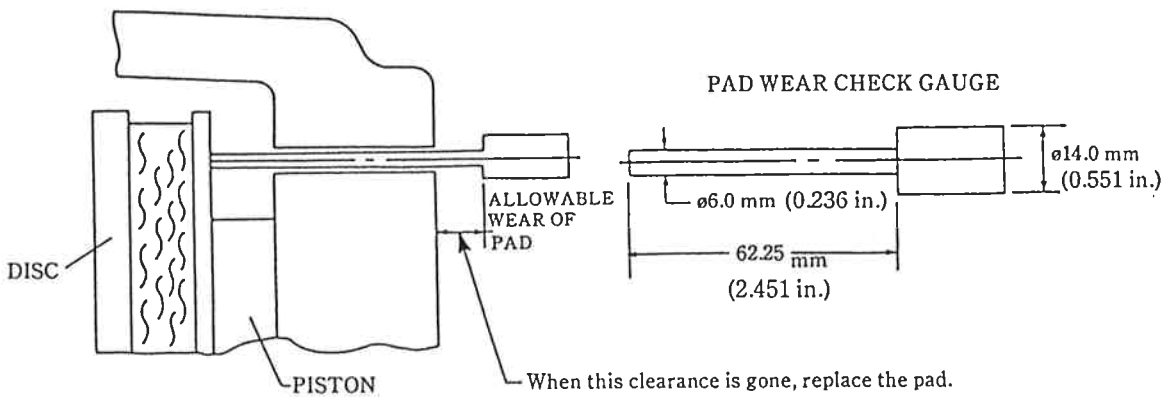


Fig. 3-1

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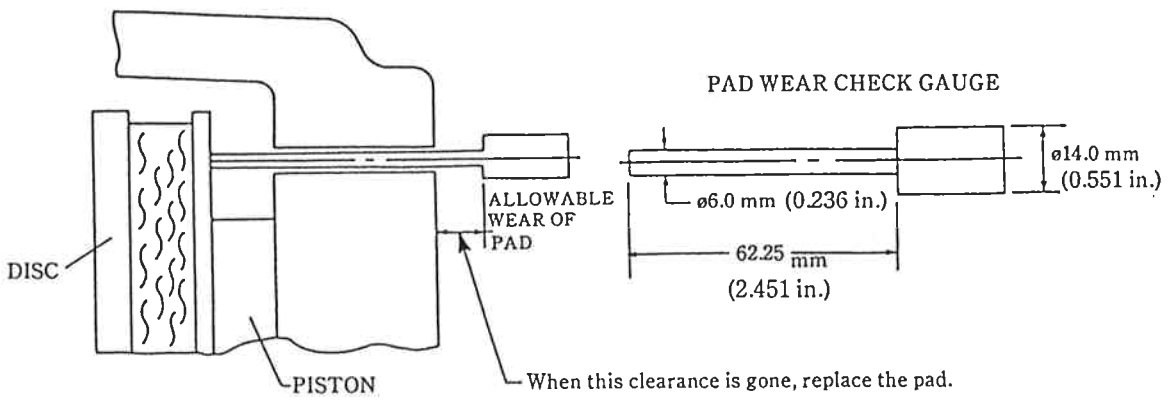


Fig. 3-1

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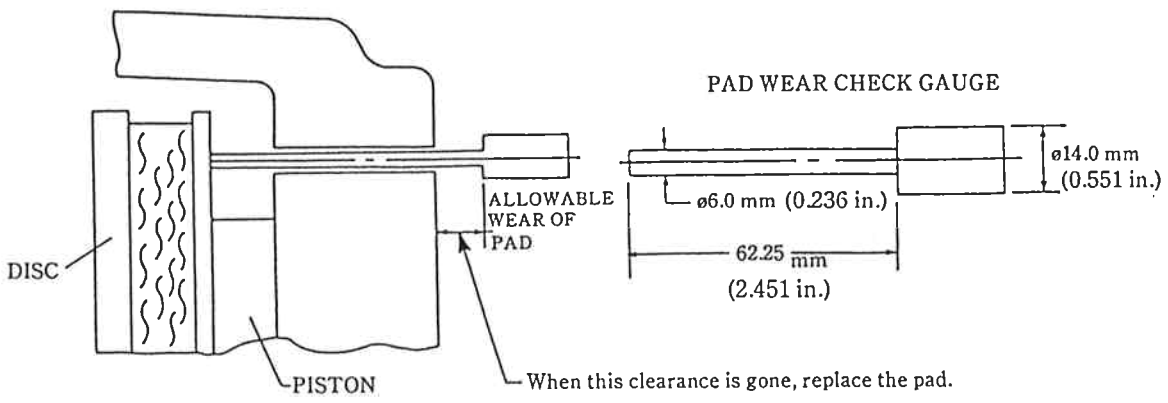


Fig. 3-1

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(1) Check of Mounting Capscrews for Looseness and Play.
Carefully check the brake body and disc mounting bolts for looseness. If loosened, retighten them with the torque specified in the torque table.

(2) Wash of Brake with Water.
Since the disc brake is exposed to the outside, much earth and sand could adhere to the brake. This cause abnormal wear to the lining pads and discs, and further advance to mulfunction of the pistons and damage to the scraper rings, and more to fluid leakage. So, be sure to wash the brake, etc. with water every day.

3.4 REPLACEMENT OF LINING PAD

(1) Pads (5 and 6) should be replaced when the remaining thickness of the friction materials reach less than 2.0 mm (0.079 in.). Before replacing the pad, remove the tires and rim.

NOTE

Wear of the lining over the limit could cause decrease of the braking force and damage to the brake.

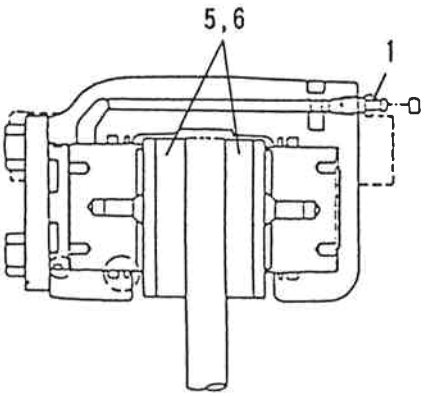


Fig. 3-2

(2) Set a offset wrench of 11 mm (7/16″) to the hexagon section of bleeder valve (1), connect a transparent vinyl tube to the end of the bleeder, and turn the wrench counterclockwise to loosen the bleeder valve.

(3) Insert the returning lever of piston or tire lever into between pads (5 and 6) and discs, and twist the lever to push to return all pistons (13) to the bottom. When the pistons are completely returned, tighten bleeder valve (1).

(4) Loosen capscrews (2) of two places in the side of thick torque pin with O-ring (3 and 4) about three turns, and draw out them in the direction away from the discs.

(5) Draw out pads (5 and 6) from the inside of the brake head.

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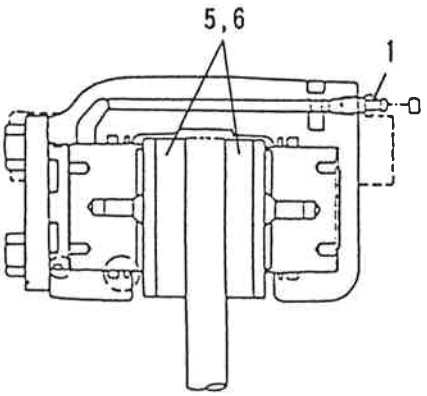


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(5) Draw out pads (5 and 6) from the inside of the brake head.

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(6) Install new pads for replacement so that the friction materials position in the disc side and that the back metals position in the piston side in the brake head.

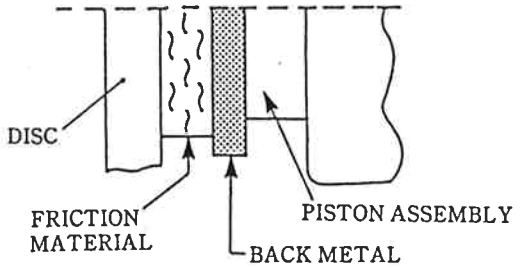


Fig. 3-3

(7) Check O-ring (4) on torque pin (3) for damage. If faulty, replace O-ring (4).

(8) Apply grease to torque pin (3) with O-ring attached and to the hole for the torque pin, and push to return the torque pin as shown in Fig. 3-4. At this time, set the clearance between the disc and torque pin to 1.5 to 3.0 mm (0.06 to 0.12 in).

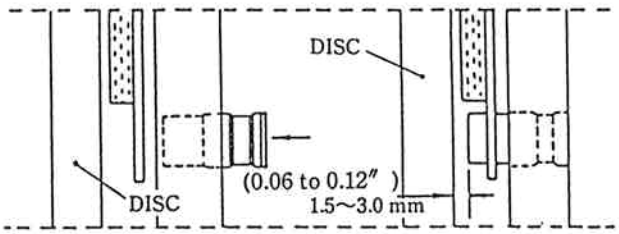


Fig. 3-4

(9) Secure torque pin (3) with O-ring attached with the use of capscrew (2). At this time, check that the capscrew surely enters the groove by moving the torque pin (see Fig. 3-5).
Specified torque of capscrew : 5.2 ± 2 kg-m
(37.6 ± 14.5 ft-lbs)
After the all brake pads have been completely replaced, bleed air.

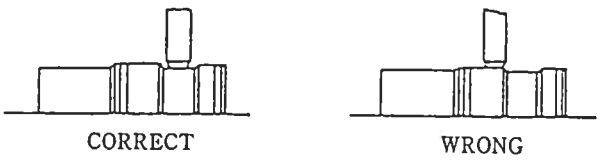


Fig. 3-5

NOTE

When replacing the pads, if one pad wear reaches the serviceable limit, the opposite side pad over the disc also, further other pads also might reach the limit. Then, for the both of the left and right of the front or rear wheels, or all four wheels, it is recommended to replace these pads at the same time.
Although the new pad might not generate sufficient braking force for a while after it is replaced, it will obtain sufficient braking force in a short time.

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3.5 BLEEDING OF AIR

When a brake is newly installed on the carrier, or when the brake piping is repaired, or when the brake is disassembled to repair, or when the brake fluid is drained and refilled, it is required to bleed air from the brake system circuit.
When bleeding air, be sure to connect a soft, transparent vinyl tube (inner diameter : 7.0 to 7.5 mm (0.275 to 0.295 in.)) to the open port of bleeder (1). This prevents the brake fluid from scattering, and makes it easy to confirm bubbles in brake fluid. While adding necessary brake fluid so that the brake fluid is not short, bleed air.
Also, be careful not to allow any other kind of brake fluid to enter.

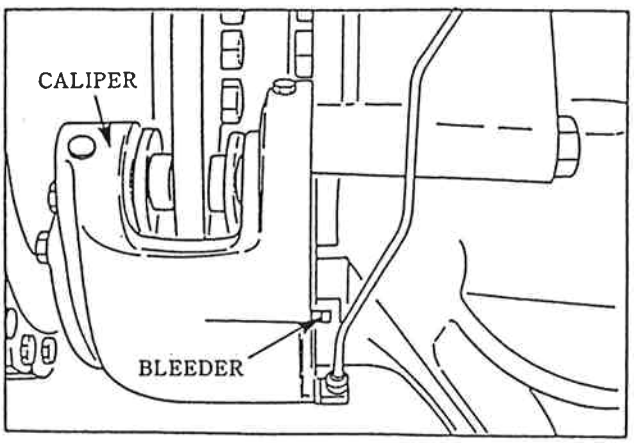


Fig. 3-6

Procedure of Air Bleeding.

(1) Before depressing the brake pedal, loosen bleeder (1) of each brake, leave as it is for 2~3 minutes until the brake fluid flows of itself, and tighten bleeder (1) when the brake fluid begins to flow.

(2) Next, depress the brake pedal several times to allow the lining pads to contact closely the discs.

(3) Loosen each bleeder (1) every brake head with the brake pedal depressed. Tighten bleeder (1) and release the pedal after flow of brake fluid stops.

(4) Repeat step (3) until bubbles are not visible completely when bleeder (1) is loosened.
When bleeding air with a master cylinder provided with a remaining pressure valve, perform the following procedure instead of step 1, then advance to step 2.
With bleeder (1) loosened, depress the pedal to allow brake fluid to flow out, and tighten bleeder (1) not to suck air in, then release the pedal. Repeat this several times until air does not come out.

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4. DISASSEMBLY AND ASSEMBLY

NOTE

1. When disassembling, repairing and assembling, be careful not to allow brake fluid and cleaning solvent to enter your eyes.
2. It is recommended to use a kit for repairing of genuine parts prepared by our company. It is also recommended to replace these parts every one year or 1200 hours of operation.

4.1 DISASSEMBLY

When brake fluid leaks, or when each seal is periodically replaced, it is required to disassemble the brake assembly. O-ring (4) of torque pin (3) with O-ring (4) attached also must be replaced when the O-ring is broken.
When working, in order to keep the removed brake assembly as well as tools and workbench to be sufficiently clean, place clean sheets on the workbench or floor, then arrange the parts on the sheets, and perform disassembly and assembly. To clean parts, use triclene or brake fluid.

NOTE

Never use mineral oil to clean parts.

Procedure of Disassembly

(Bearing the following points in mind, proceed disassembling in the order of the indicated number.)

(1) Remove the tire and rim from the axle, remove the brake system piping, then remove the brake from the axle. If mud is attached, remove mud. By scrubbing with a wire brush or iron spatula, mud can be easily removed.

(2) Remove capscrews (2 and 19), and draw out torque pin (7) and torque pin with O-ring (3 and 4) (four places). Then remove lining pads (5 and 6).

(3) Insert spacers of approx. 5 mm (0.2 in.) into the piston in the cover plate side. Then, supply air of approx. 1 kg/cm² (14.2 psi.) from the inlet port to draw the piston out.

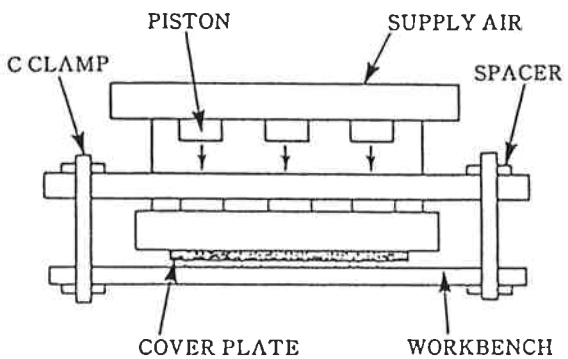


Fig. 4-1 Piston

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(4) Remove capscrews (8), and remove cover plate (10).

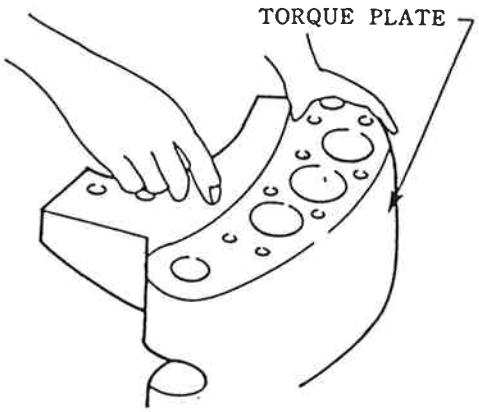


Fig. 4-2 Condition after Removing Cover

(5) Using a cutting pliers or pliers, remove piston plug (11), and remove cap seal (12) and back-up ring (9).



Fig. 4-3 Removal of Piston Plug

(6) To remove piston (13) in the cover plate side, lightly tap the bottom of the piston with a plastic hammer or the like to push the piston out.

(7) Scraper ring (15) can be removed by hand. Using a needle, of which tip is bent, or a thin spatula of about 0.5 mm (0.02 in.), remove piston seal (14) and back-up ring (20).

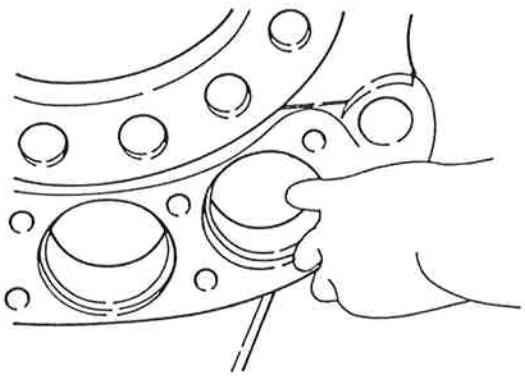


Fig. 4-4 Removal of Seal

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(8) Piston seal (14), back-up ring (20), cap seal (12), and scraper ring (15) shall be replaced with new ones without fail.

(9) Check the lining pads following 3.4 Replacement of Lining Pad.

(10) Clean the inside of torque plate (16) with a cleaning solvent. After cleaning, blow the oil hole and groove of the torque plate with air, and wipe off with cloths so that the solvent does not remain.

(11) Check torque plate (16) being careful for the following points.
Check the cylinder inlet, with which piston plug (11), cap seal (12) and back-up ring (20) come in contact, and the groove and shoulder, into which piston seal (14) and back-up ring (20) are inserted, for injury or dent. When these defects are found, repair with sand papers (# 180 or so). If the defects are remarkable, replace the brake head assembly.

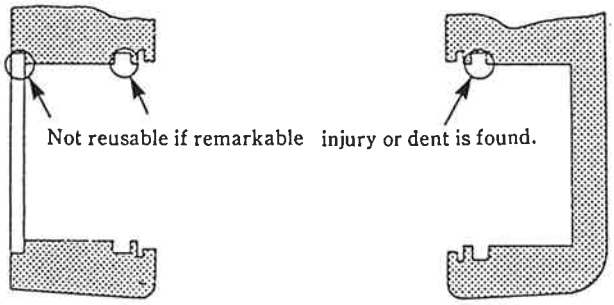


Fig. 4-5

(12) Check piston (13). When the sliding section contacting piston seal (14) is dented, or when plating is worn, and when the insulator is lost or damaged, replace with a new one.

(13) Check torque pin with O-ring (3 and 4) and torque pin (7). When the sections contacting the lining pads are remarkably worn, replace them.

4.2 ASSEMBLY

(1) Thinly apply silicone grease with finger to the dotted line section, shown in Fig. 4-6, of back-up ring (20) and scraper ring (15).



Fig. 4-6

(2) In the order of back-up ring (20), piston seal (14) and scraper ring (15), coat silicone grease, with finger, to the inside circumference of torque plate (16).

(3) Coat silicone grease to chamfered section of piston (13) end, place the piston in the cylinder of torque plate (16).

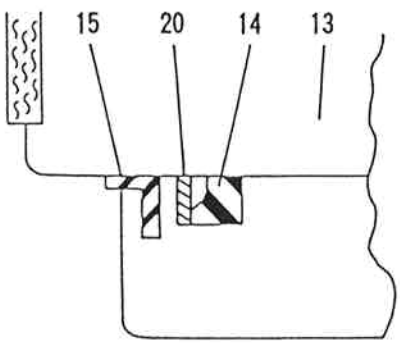


Fig. 4-7

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(8) Piston seal (14), back-up ring (20), cap seal (12), and scraper ring (15) shall be replaced with new ones without fail.

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(10) Clean the inside of torque plate (16) with a cleaning solvent. After cleaning, blow the oil hole and groove of the torque plate with air, and wipe off with cloths so that the solvent does not remain.

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Check the cylinder inlet, with which piston plug (11), cap seal (12) and back-up ring (20) come in contact, and the groove and shoulder, into which piston seal (14) and back-up ring (20) are inserted, for injury or dent. When these defects are found, repair with sand papers (# 180 or so). If the defects are remarkable, replace the brake head assembly.

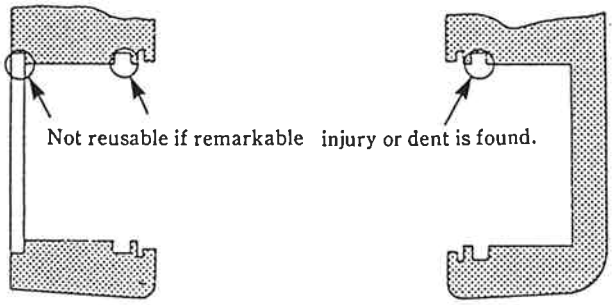


Fig. 4-5

(12) Check piston (13). When the sliding section contacting piston seal (14) is dented, or when plating is worn, and when the insulator is lost or damaged, replace with a new one.

(13) Check torque pin with O-ring (3 and 4) and torque pin (7). When the sections contacting the lining pads are remarkably worn, replace them.

4.2 ASSEMBLY

(1) Thinly apply silicone grease with finger to the dotted line section, shown in Fig. 4-6, of back-up ring (20) and scraper ring (15).



Fig. 4-6

(2) In the order of back-up ring (20), piston seal (14) and scraper ring (15), coat silicone grease, with finger, to the inside circumference of torque plate (16).

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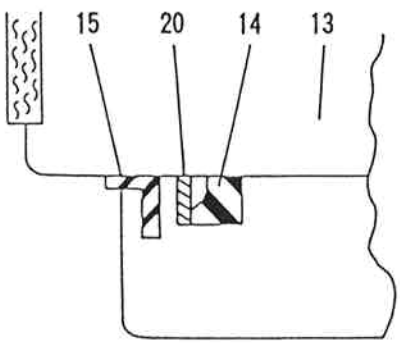


Fig. 4-7

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(4) Insert piston (13) into the cylinder of torque plate (16).

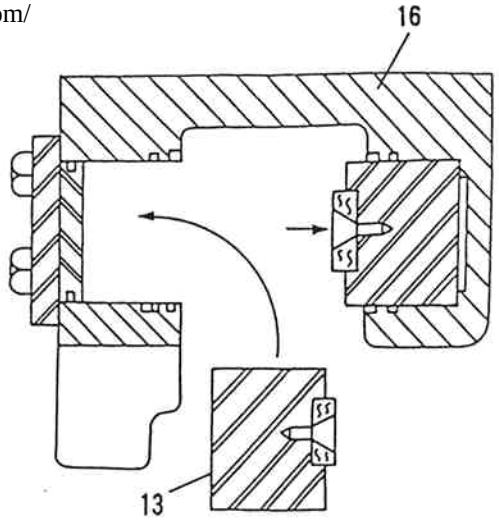


Fig. 4-8

(5) Insert the all pistons with the same way. When inserting the pistons, do not insert them obliquely against the cylinders.
Be sure to insert piston (13) into the cylinder from the inside of torque plate (16) as shown in Fig. 4-9, and to push it in until it passes over the seal.

(6) Insert back-up ring (9) and cap seal (12) into the groove of piston plug (11), coat silicone grease thinly with finger to the outside circumference, then insert the piston plug into the torque plate.

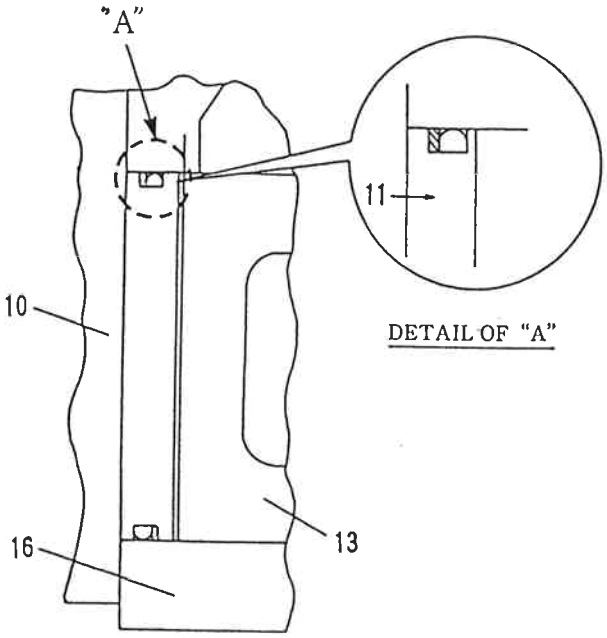


Fig. 4-9

NOTE

1. Assemble cap seal (12) so that the cap seal positions in the piston side.

2. Insert piston plug (11) so that its face be even with the face of the plate. Pushing in too much may cut the seal.

Specified torque of Capscrews

Item Nos. 2 and 19	5.0 to 5.5kg-m (36 to 40 ft - lbs)
Item No.8	22 to 23kg-m (159 to 166 ft - lbs)
Item No.18	32 to 33kg-m (231 to 239 ft - lbs)

(7) When replacing torque pins (3 and 7), O-ring (4), and capscrews (2 and 19), apply grease to the pins and holes for pins.

(8) Assemble piston plug (11) to torque plate (16). Wipe the face on which cover plate (10) is installed, then torque capscrews (8) with 22 to 23 kg-m (159 to 166 ft - lbs).

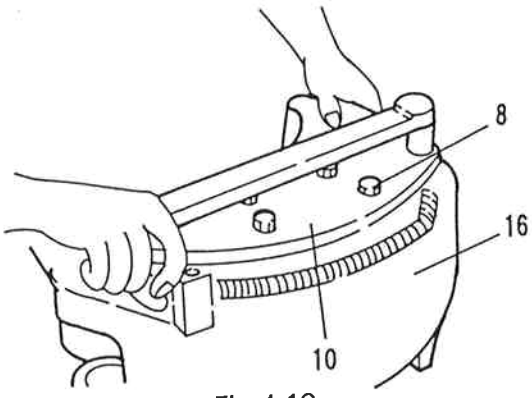
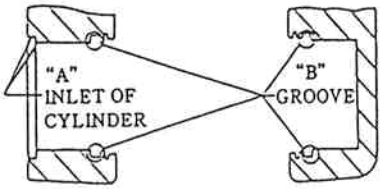
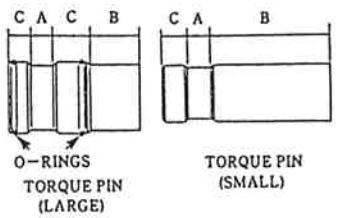
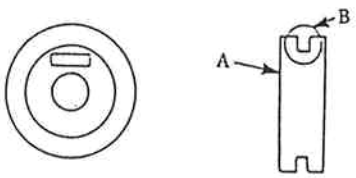
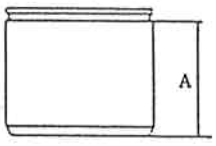
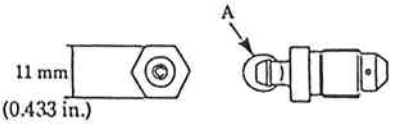


Fig. 4-10

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5. MAINTENANCE STANDARDS

5.1 MAINTENANCE STANDARD

Name	Nomal dimension	Serviceable limit		Remedy	Remarks
		Thickness	Outer dia /inter dia.		
Disc	20mm (0.787 in.)	17.5mm (0.687 in.)	—	Replace.	Measure with micrometer.
Pad (incl.back metal)	22mm (0.866 in.)	(Remaing thickness) 10mm (0.394 in.)	—	Replace.	Measure with slide calipers.
Outer dia.of cylinder Inner dia. of cylinder	73mm (2.874 in.)	See description below.		Replace.	Measure with micrometer.
Sliding face of piston seal	—	When injury, dent or wear of plating is found.		Replace.	
Torque plate	1. Inlet of cylinder (range of "A") 2. Piston seal groove (range of "B") When injury or dent is found, replace with a new one.				
Torque pin	Replace with a new one in case of following 1, 2 and 3. 1. "B" section is remarkably worn. 2. Large injury or dent at "C" section. 3. When O-ring is removed, O-ring. ※ Rust shall be remove with sand papers (#180) or wire brush.				
Piston plug	1. When injury or dent is found in "B" , replace with a new one. ※ Rust in "A" shall be removed with a wire brush.				
Piston	When injury, dent or wear of plating is found in "A" section (approx. 50mm (2in.) range), replace with a new one.				
Bleeder	When injury or deformation is found in "A" , replace with a new one.				

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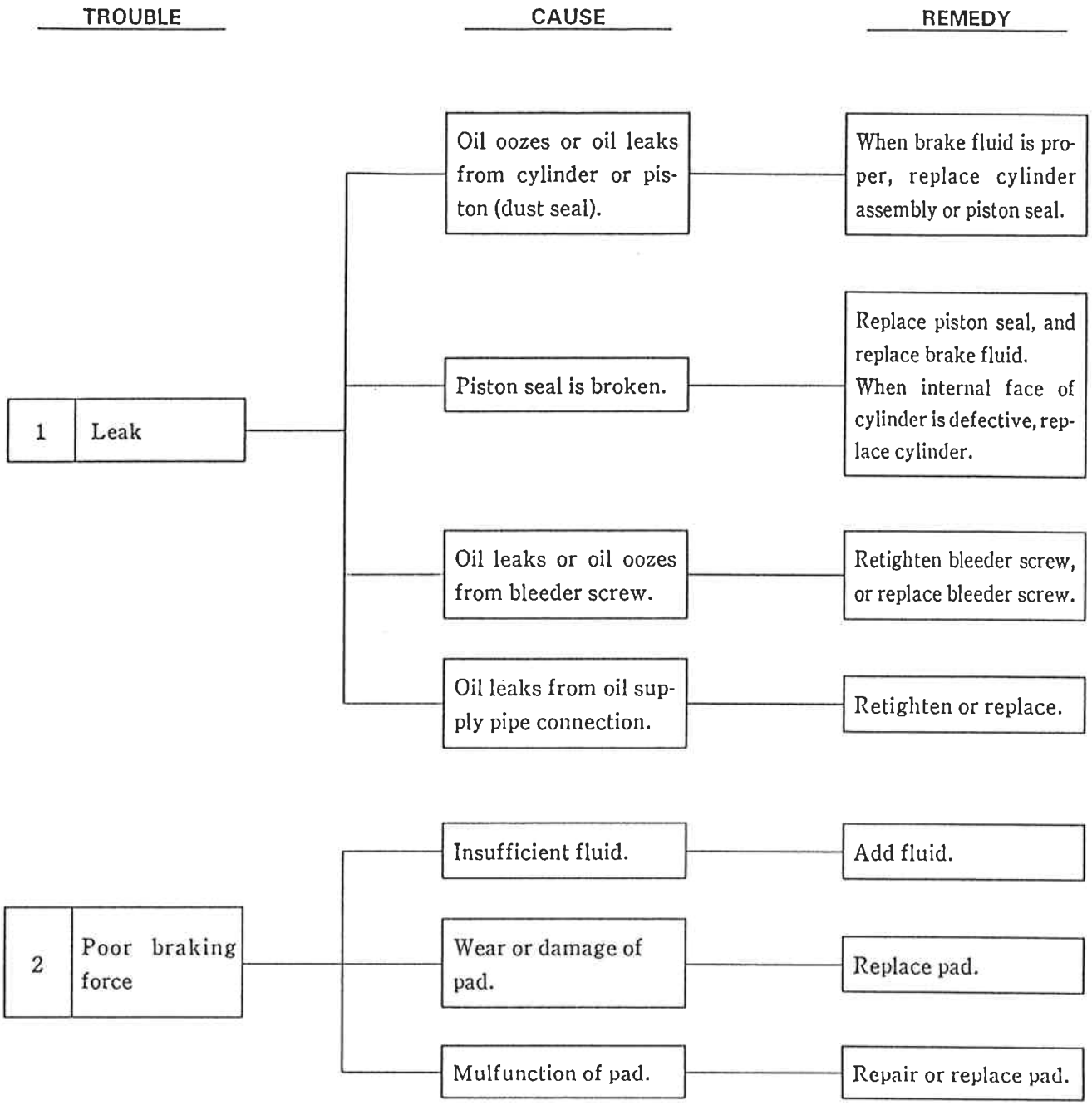
5.2 TIGHTENING TORQUE (WITH LUBRICATION)

Torque Value According to Thread Size of Capscrew (Bolt)

Nominal size of screw thread	Use	Torque value in kg-m (ft-lbs.)
M18-P2.5	Disc mounting capscrew (bolt).	38 to 44 (275 to 318) Apply thread lock TB#1360K.
M20-P1.5	Caliper mounting capscrew (bolt).	61 to 71 (441 to 513)

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6. TROUBLESHOOTING

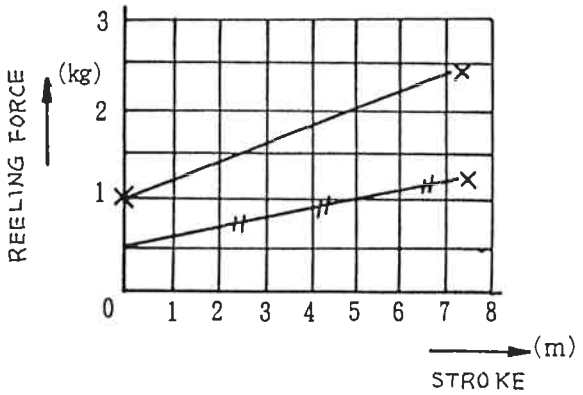


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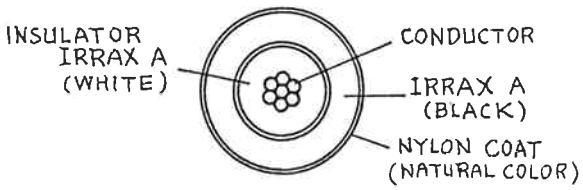
1. OUTLINES OF CONSTRUCTION

1.1 SPECIFICATIONS

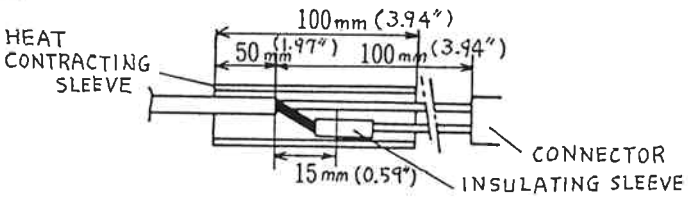
Reeling method	Automatically reeling up by spiral spring.
Rating	DC 24 volts, 2 amperes
Main cord	Conductor: 4 hard copper wires and 4 plated steel wires Insulation: Irrax A of 0.31 mm (0.012 in) thickness Nylon of 0.1 mm (0.004 in) thickness Finished outside diameter: 2.9 mm (0.114 in) Length: 8.5 m (27.9 ft)
Subcord	Same as above.
Spiral spring	Band steel for spring, SK5
	Thickness × width × length: 0.5 mm (0.02 in) × 24 mm (0.945 in) × 9000 mm (354.3 in)
Outside dimension	180 mm (7.087 in) diameter × 50 mm (1.969 in) height



Reeling Force Diagram



Sectional View of Cord



DETAIL OF A

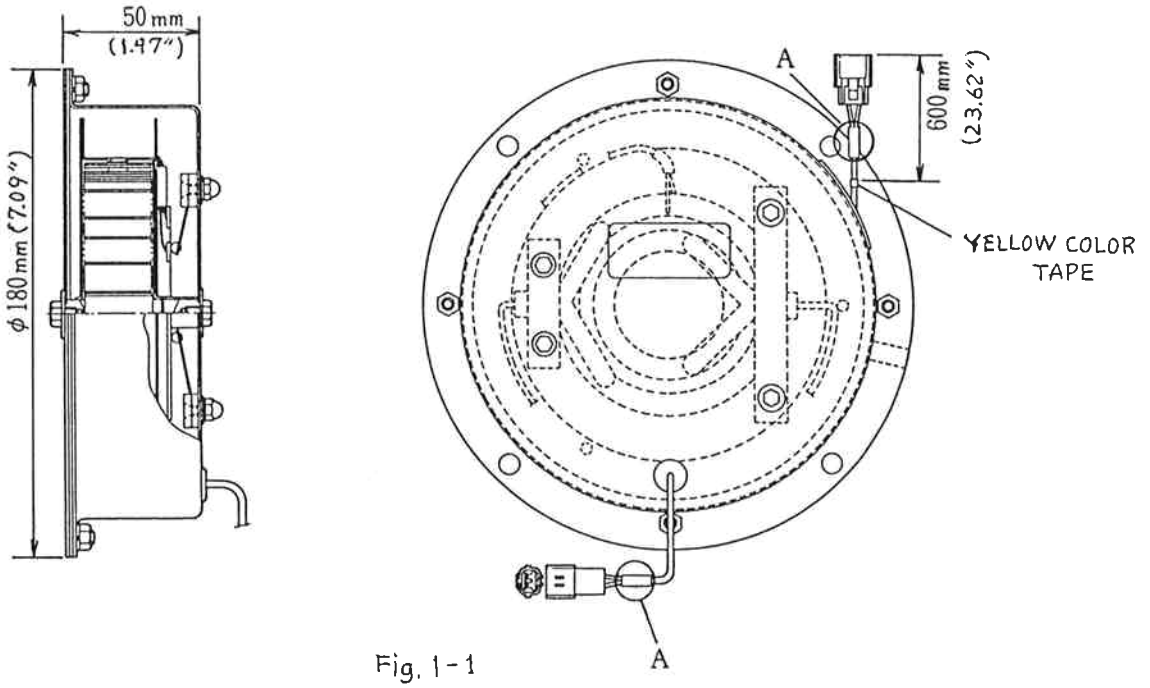


Fig. 1-1

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1.2 CONSTRUCTION

(1) SPIRAL SPRING

A spiral spring is built in the drum, and rotates the drum by its elasticity to take up the cord.

(2) CORD (MAIN CORD)

The cord is a cord, called shield wire, woven with insulator Irrax A. The conductor consists of hard copper wires which send electricity and in addition galvanized steel wires. This strengthens tensile strength of the cord.

(3) CONTACT POINT RING

The ring slides on the point of contact, and functions to send electricity. Brass plate with good conductivity is used to the ring, and grease for the point of contact is applied on the surface.

(4) POINT OF CONTACT

The point of contact is of phosphor bronze for spring, and adjusts contacting pressure generated by run-out of the drum.

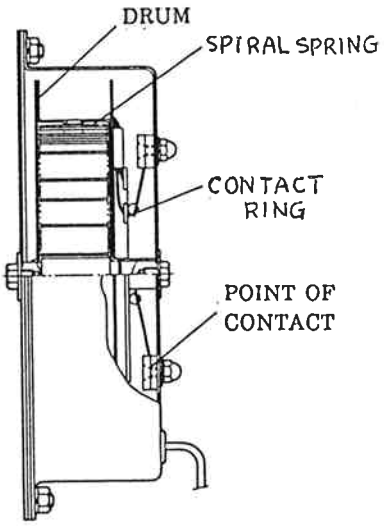


Fig. 1-2

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2. HANDLING

2.1 CAUTIONS FOR HANDLING

(1) REEL

Careless operation of the reel when removing and installing or when handling the reel could cause the following mistakes.

- The all main cords are swallowed up into the case resulting in impossibility of use.
- The main cord gets out of the reeling drum, and the cord cannot be drawn out.
- Forcibly pulling the main cord which has got out of the drum from ignorance could cause breakage of the main cord and/or damge of electrical contacting parts, etc.

In order to prevent these working mistakes, when taking the reel out from the packed box, and when installing it to the actual machine, pay attention to the following items, and handle the reel correctly.

1. When unlacing the string which secures the end of the main cord, be sure to unlace the string with the condition that the main cord is pulled and held as shown in Fig. 2-1 (to prevent the cord from being swallowed up).

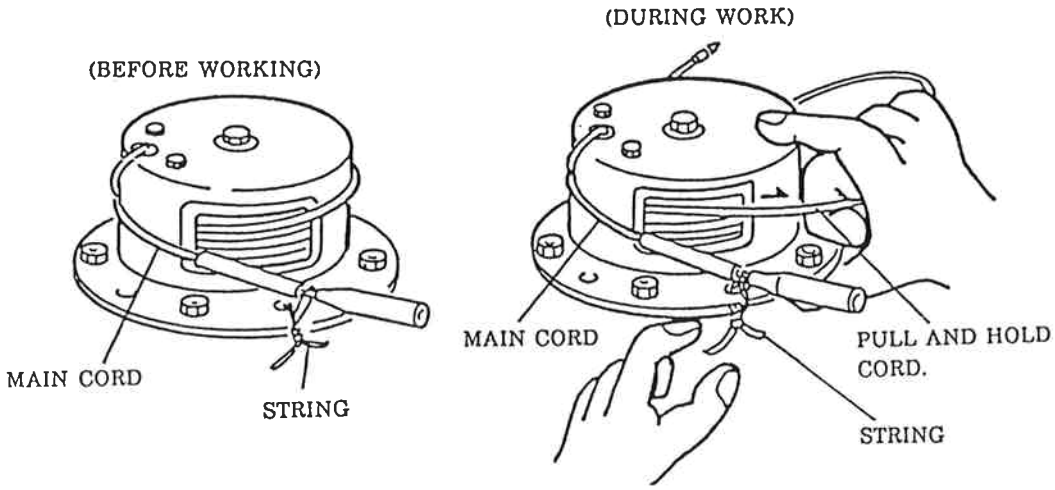


Fig. 2-1

2. After the string is removed, hold the main cord being always pulled, and do not release the cord until the force of the spiral spring in the case is weakened (to prevent the cord from getting out).
3. When there is possibility that the main cord has got out from the drum, do not forcibly pull the cord. Disassembly and repair are necessary (to prevent breakage of the cord and damage of contacting parts).

(2) TRANSPORT

Do not transport the reel with the subcord or the terminal of the cap taken, and do not pull them.

(3) HANDLING OF MAIN CORD

After the main cord has been drawn out, do not suddenly release the cord intentionally. Returning speed of the cord could be faster than returing speed of the spiral spring, causing getting out of the cord from the drum and upset coiling of the cord on the drum. Operation could be impossible.
When installing the reel on the actual machine, be sure to draw out the cord a little, and remove the bound string on the end with the cord stretched. The cord must be held to be always stretched by the force of the spiral spring.

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2.2 CAUTIONS FOR USING

- DRAWING OUT AND WINDING UP OF CORD.
  Be careful that the reel has not a device which stops the cord in the desired position and that the cord cannot be stopped on the way. When the cord is swallowed up into the case by mistake, repair the reel following section 3 Disassembly and Assembly.

2.3 CONNECTION

The terminal of the cap is provided at the end of the cord.
The terminal of the cap is calked, but do not install so that the cap receives a force directly.
The main cord is stuck with a yellow colored tape which indicates FREE LENGTH. When connecting the cord, set the cord so that the yellow tape comes to the outlet position of the cord reel. Wrong set of this position could cause wrong winding up of the cord or breakage of the cord due to insufficient stroke.

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2.2 CAUTIONS FOR USING

- DRAWING OUT AND WINDING UP OF CORD.
  Be careful that the reel has not a device which stops the cord in the desired position and that the cord cannot be stopped on the way. When the cord is swallowed up into the case by mistake, repair the reel following section 3 Disassembly and Assembly.

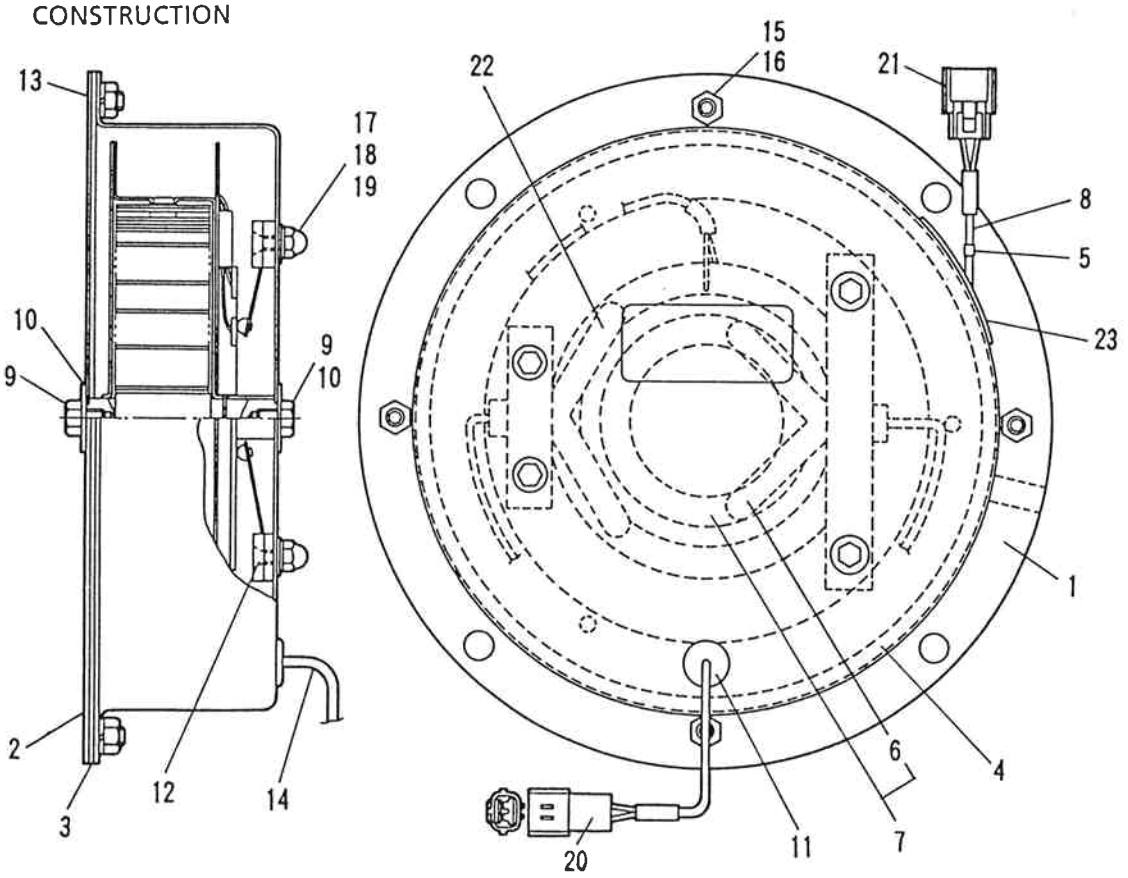
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The terminal of the cap is provided at the end of the cord.
The terminal of the cap is calked, but do not install so that the cap receives a force directly.
The main cord is stuck with a yellow colored tape which indicates FREE LENGTH. When connecting the cord, set the cord so that the yellow tape comes to the outlet position of the cord reel. Wrong set of this position could cause wrong winding up of the cord or breakage of the cord due to insufficient stroke.

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3. DISASSEMBLY AND ASSEMBLY

3.1 CONSTRUCTION



1. CASE	9. CAPSCREW	17. WASHER
2. BASE PLATE	10. WASHER	18. LOCKWASHER
3. PACKING	11. RUBBER BUSHING	19. CAP NUT
4. DRUM	12. MACHINE SCREW	20. CAP
5. TUBE	13. MACHINE SCREW	21. CAP
6. CONTACTOR	14. SUB-CORD	22. CONTACTOR ASSEMBLY
7. CONTACTOR ASSEMBLY	15. LOCKWASHER	23 CORD GUIDE
8. MAIN CORD	16. NUT	

Fig. 3-1

3.2 REPLACEMENT OF MAIN CORD

The cord is one called shied wire woven with insulator Irrax A , and the conductor is reinforced with galvanized steel wires.

If the cord should be injured or cut off, replace the cord as follows :

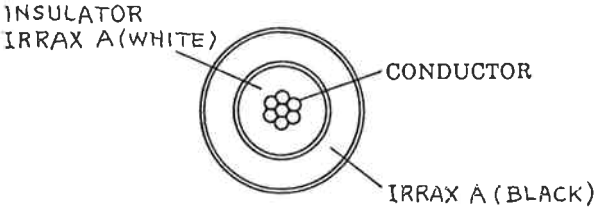
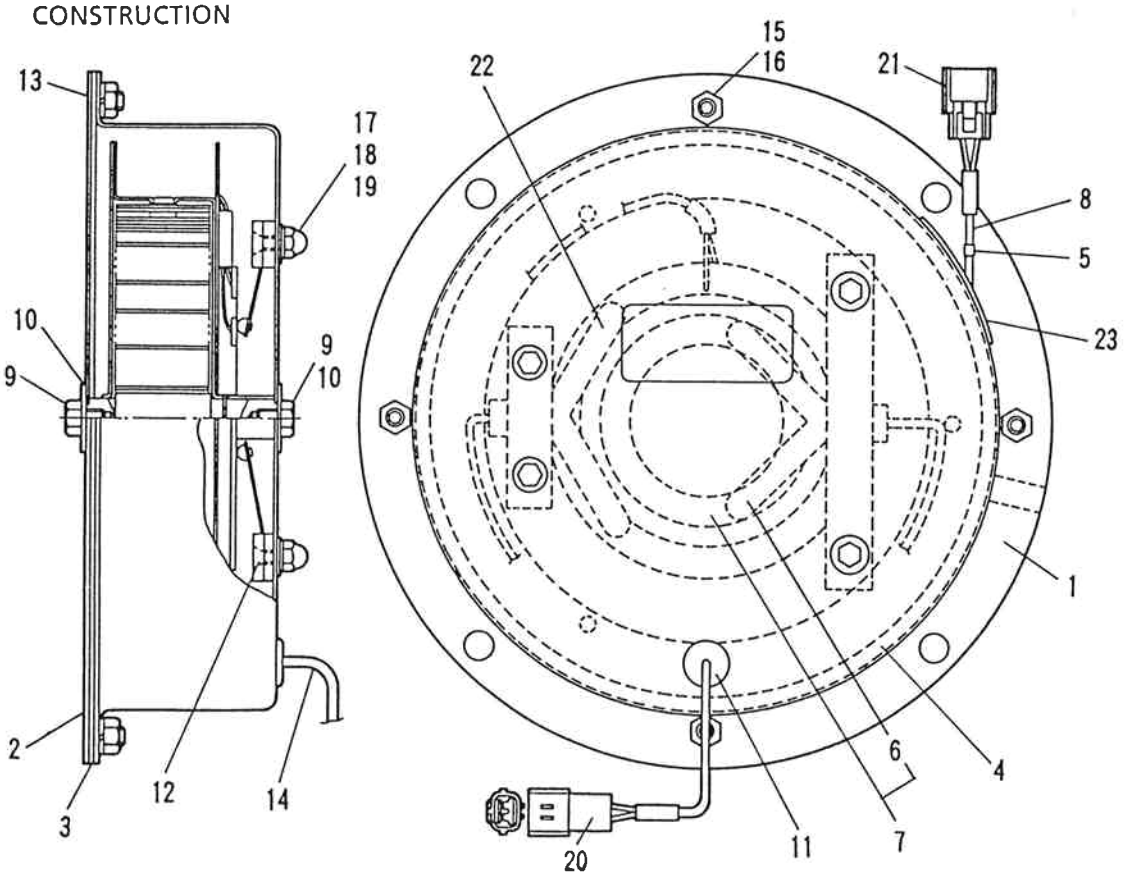


Fig. 3-2 Section of Cord

https://truckmanualshub.com/

3. DISASSEMBLY AND ASSEMBLY

3.1 CONSTRUCTION



1. CASE	9. CAPSCREW	17. WASHER
2. BASE PLATE	10. WASHER	18. LOCKWASHER
3. PACKING	11. RUBBER BUSHING	19. CAP NUT
4. DRUM	12. MACHINE SCREW	20. CAP
5. TUBE	13. MACHINE SCREW	21. CAP
6. CONTACTOR	14. SUB-CORD	22. CONTACTOR ASSEMBLY
7. CONTACTOR ASSEMBLY	15. LOCKWASHER	23 CORD GUIDE
8. MAIN CORD	16. NUT	

Fig. 3-1

3.2 REPLACEMENT OF MAIN CORD

The cord is one called shied wire woven with insulator Irrax A , and the conductor is reinforced with galvanized steel wires.

If the cord should be injured or cut off, replace the cord as follows :

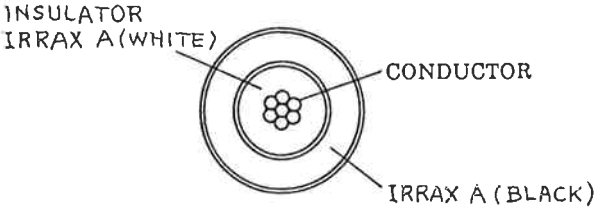


Fig. 3-2 Section of Cord

https://truckmanualshub.com/

3.2.1 Removal of Cord

(1) Remove the four capscrews which secure base plate (2) and capscrew (9), then remove the base plate.

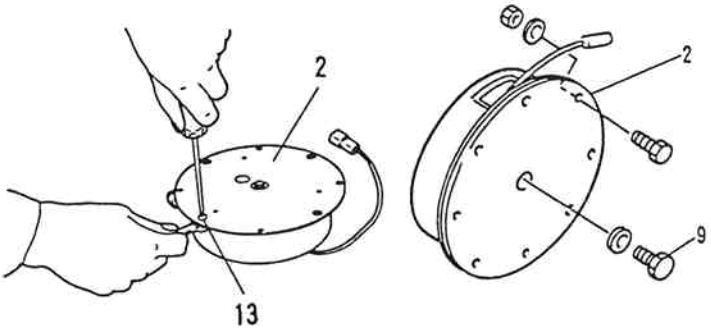


Fig. 3-3

(2) Remove capscrew (9) from case (1), and draw drum (4) out from the case.

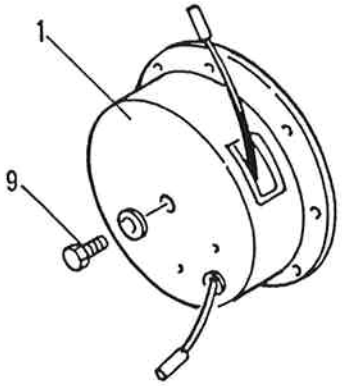


Fig. 3-4

(3) After the case has been removed, remove the contact ring assembly attached to the drum assembly. (Using a screwdriver or cutter knife, carefully work not to break the contact ring assembly.)

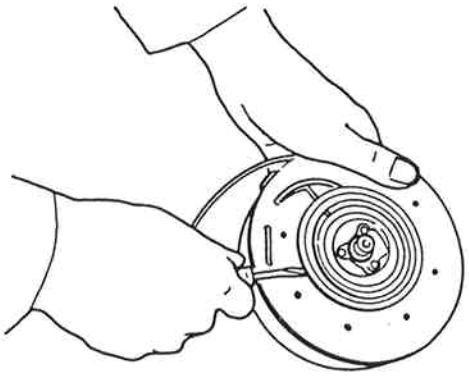


Fig. 3-5

(4) Move the vinyl tube sideways. Using a soldering iron, melt the soldered section between the lead wire and main cord (8) to remove.

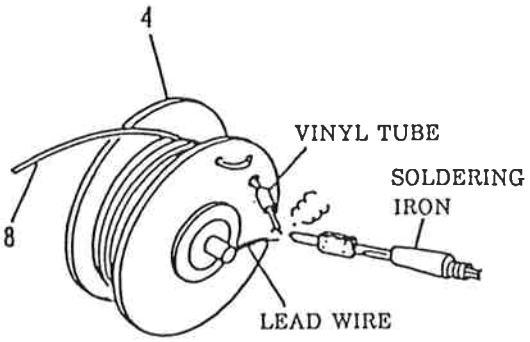


Fig. 3-6

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3.2.2 Installation of Cord

(1) Cut the main cord precisely at the specified length from the coil or reel, and attach the rubber tape as the mark. Measure the specified length (position) from this end, and attach the yellow colored tape (0 point mark).

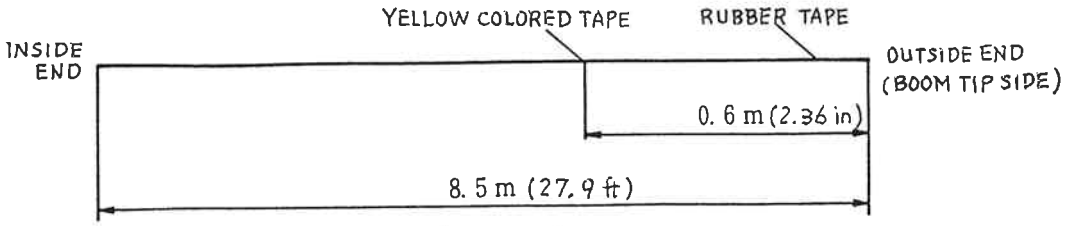


Fig. 3-7

Securely attach the yellow colored tape (0 point mark) not to allow the position to move during handling the cord.

(2) Pass the inside end of the new main cord through the vinyl tube (4mm dia. x 1mm thickness), and pass it through the hole of the drum assembly.

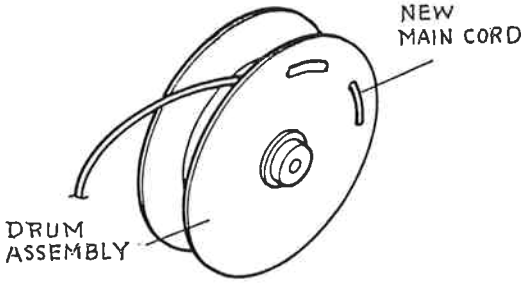


Fig. 3-8

(3) Strip off the inside end of the new main cord, and solder it to the contact ring assembly.

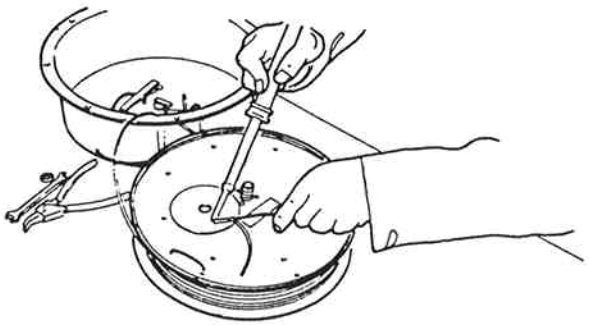


Fig. 3-9

(4) Fix the contact ring assembly to the drum with sealing agent (equivalent to Toyo Rayon Silicon Sealant SH780).

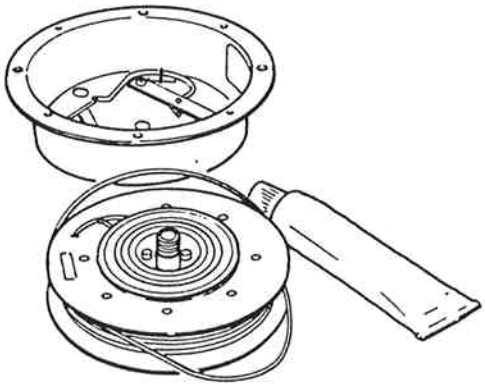


Fig. 3-10

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(5) Tie the auxiliary string to the outside end of the new main cord.

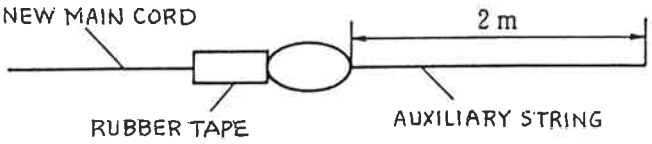


Fig. 3-11

(6) Wind the cord onto the drum in the specified direction. When the yellow colored tape comes onto the drum, wind 4 turns more as the extra winding of the spiral spring. Attach the rubber tape (approximately 100 mm (4 inches) long) at the position to lock the cord and auxiliary string not to be loosened.
This cord winding direction is counterclockwise looking from the contact ring assembly.

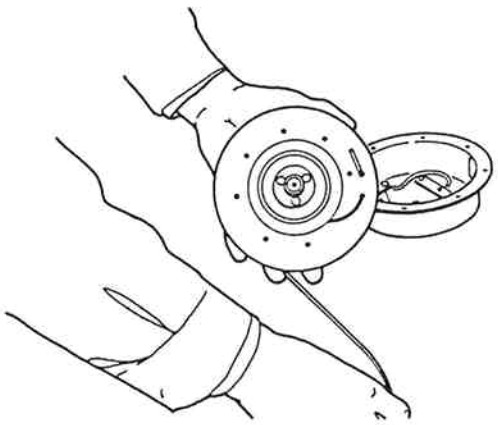


Fig. 3-12

3.2.3 Installation of Case

(1) Proceed in the reverse order of the Removal.
Caution points:

1) Align the hole form of the shaft and case, and tighten carefully not to injure the threads.
2) When tightening, fix the shaft not to turn with a pair of cutting pliers or like.

(2) Solder the connector assembly (Japan AMP Economy Seal Mark II (+)) to the new main cord tip.

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(5) Tie the auxiliary string to the outside end of the new main cord.

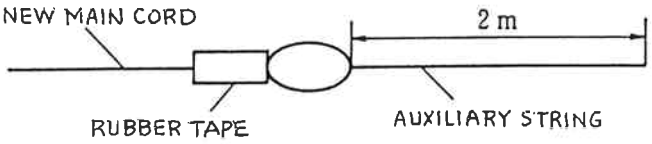


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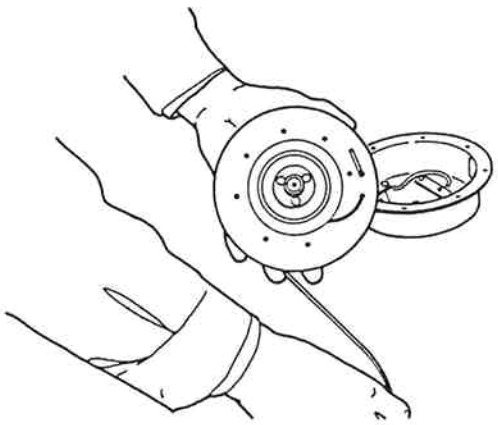


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3.2.3 Installation of Case

(1) Proceed in the reverse order of the Removal.
Caution points:

1) Align the hole form of the shaft and case, and tighten carefully not to injure the threads.
2) When tightening, fix the shaft not to turn with a pair of cutting pliers or like.

(2) Solder the connector assembly (Japan AMP Economy Seal Mark II (+)) to the new main cord tip.

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3.3 REPLACEMENT OF CONTACTOR ASSEMBLY

3.3.1 Removal

(1) Proceed steps (1) to (4) of topic 3.2.1 Removal of Cord.

(2) Remove machine screw (12) which secures assembly (7), strip the subcord which is attached to rubber bushing (11), then push the cord into the case.

- Be careful not to injure the cord.

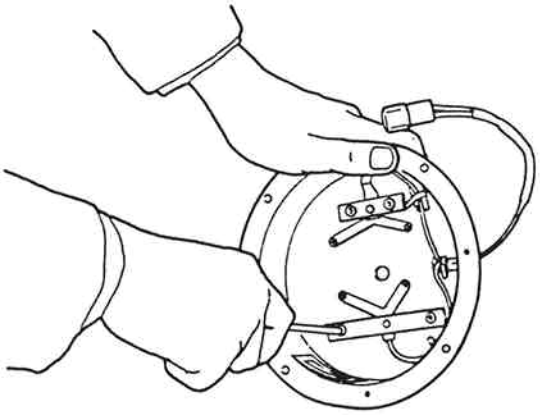


Fig. 3 - 13

(3) Melt solder, and remove the contactor assembly.

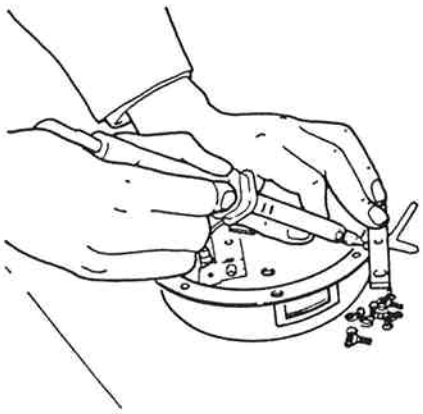


Fig. 3 - 14

3.3.2 Installation

(1) Solder a new contactor assembly to the subcord. At this time, insert the cord into the hole of the contact point, and turn the solder one turn.

(2) Draw out the subcord a little, and install the contactor assembly with machine screw (12).

(3) For installation of case (1) and etc., refer to topic Installation of Main Cord.

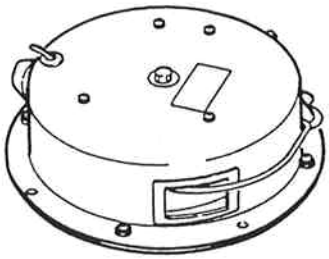


Fig. 3 - 15

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3.3 REPLACEMENT OF CONTACTOR ASSEMBLY

3.3.1 Removal

(1) Proceed steps (1) to (4) of topic 3.2.1 Removal of Cord.

(2) Remove machine screw (12) which secures assembly (7), strip the subcord which is attached to rubber bushing (11), then push the cord into the case.

- Be careful not to injure the cord.

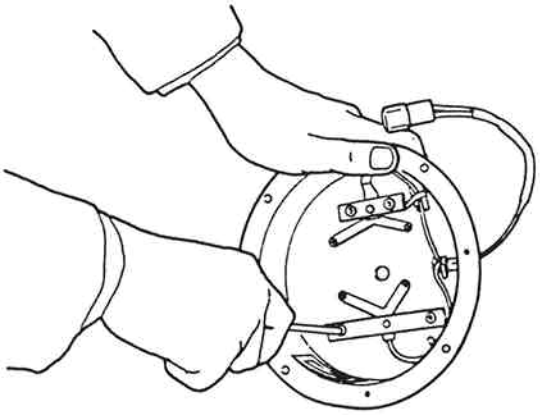


Fig. 3 - 13

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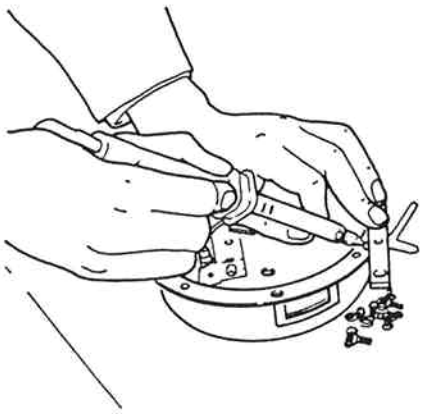


Fig. 3 - 14

3.3.2 Installation

(1) Solder a new contactor assembly to the subcord. At this time, insert the cord into the hole of the contact point, and turn the solder one turn.

(2) Draw out the subcord a little, and install the contactor assembly with machine screw (12).

(3) For installation of case (1) and etc., refer to topic Installation of Main Cord.

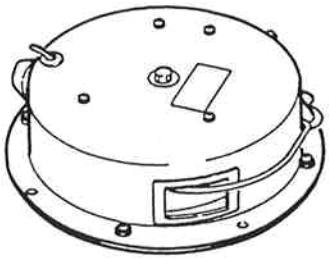


Fig. 3 - 15

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1. OUTLINE

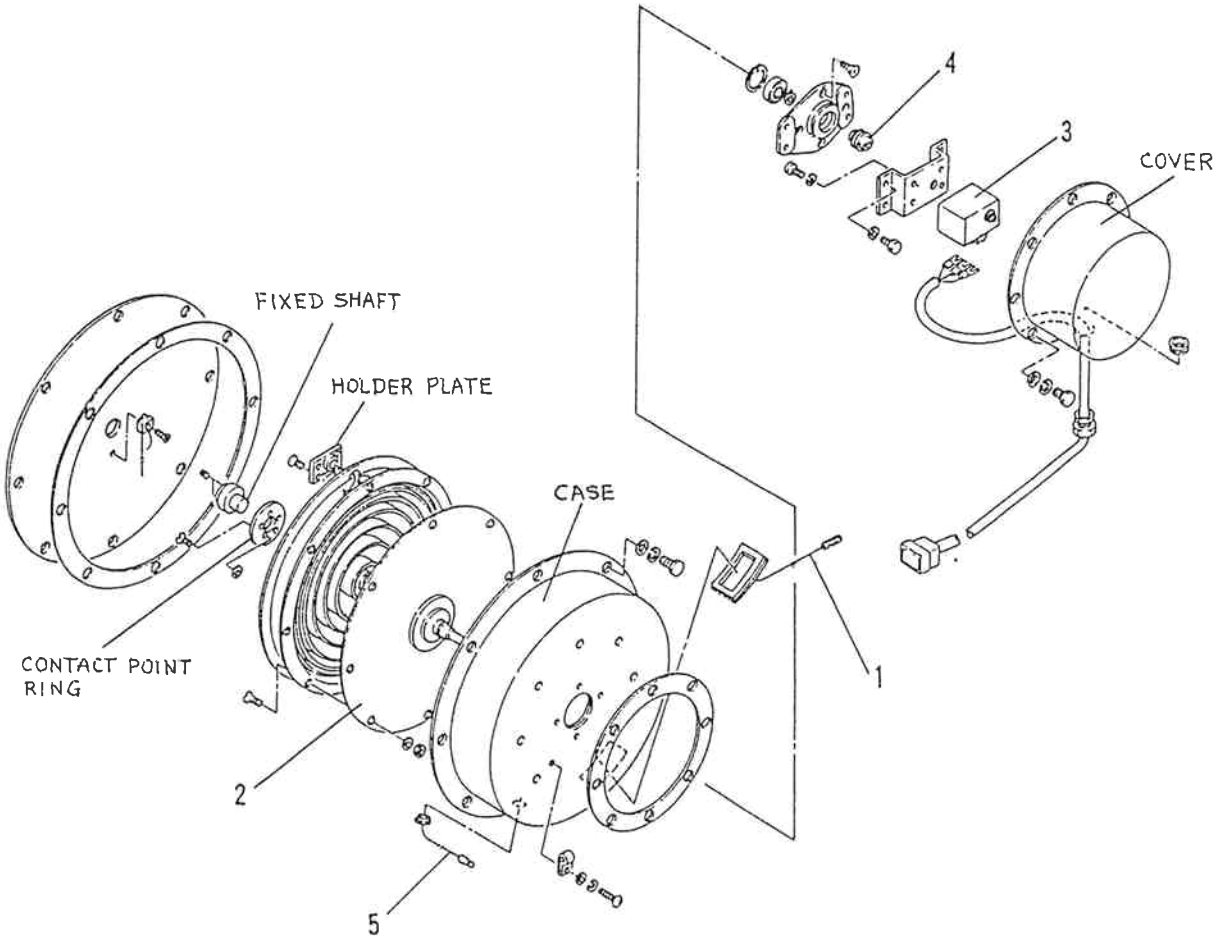


Fig. 1-1 Main Components of Cord Reel

1.1 MAIN COMPONENT PARTS

		RK250-3	RK350	RK450-2
1	Main cord Outside diameter: 1.4mm (0.055 in)	36 m (118.1 ft)	37m (121.4 ft)	43m (141.1 ft)
2	Cord winding drum	Drum diameter: 280mm (11.02in)		
3	Potentiometer	Nominal resistance value: 2kΩ, reduction ratio 1/52		
4	Coupling	For connection of reduction unit and potentiometer.		
5	Sub-cord	For overhoist alarm		

1.2 FUNCTION

The cord, wound onto the drum, is paid out or wound back as the boom is telescoped, and the number of rotation of the drum shaft transmitted at that time is reduced to 1/52 with the potential assembly, and is transmitted to the potentiometer to vary electrical resistance value in the potentiometer.

It is also taken out to the outside as variation of the electrical voltage of the cable connected to the potentiometer, and is put into the computer of the load safety device to indicate the boom length.

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1. OUTLINE

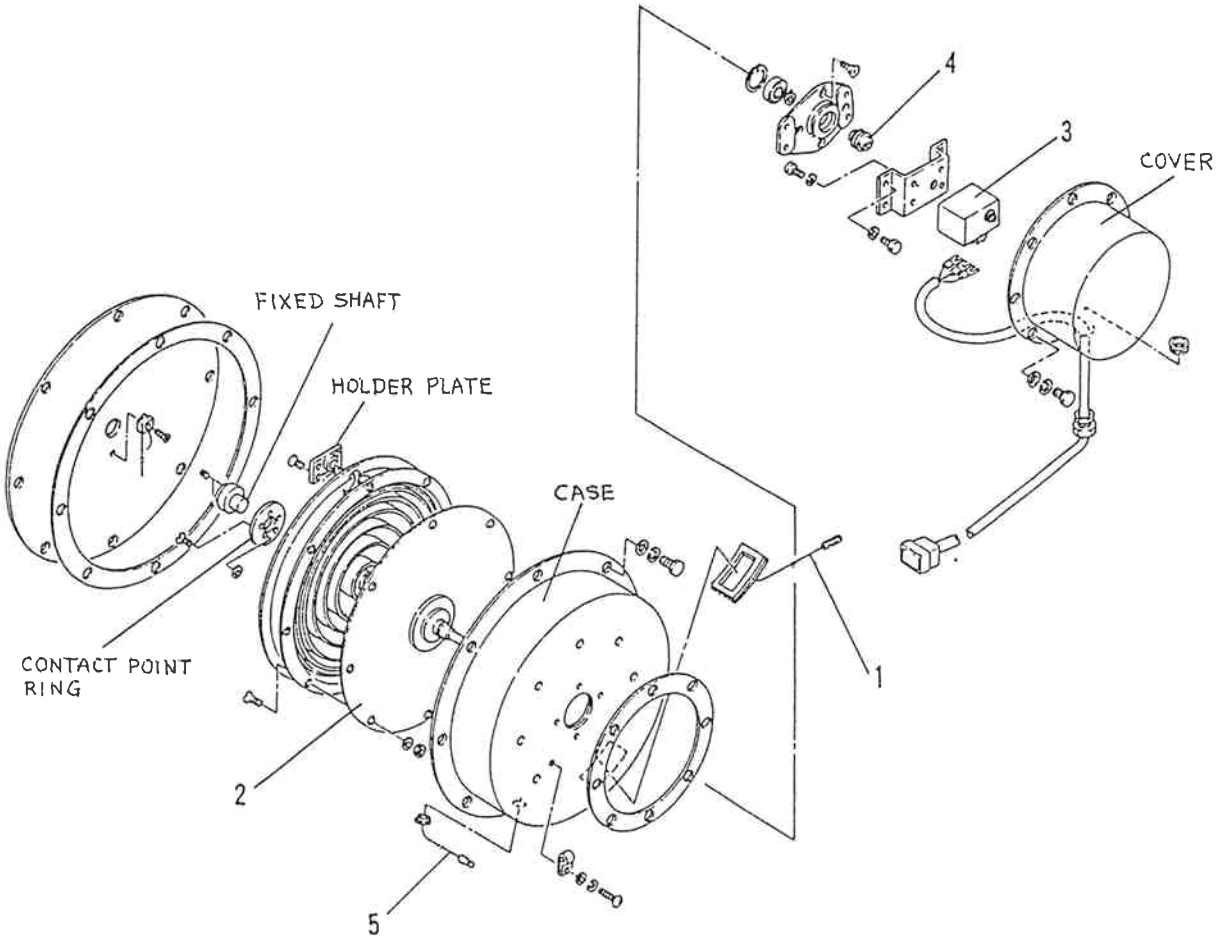


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It is also taken out to the outside as variation of the electrical voltage of the cable connected to the potentiometer, and is put into the computer of the load safety device to indicate the boom length.

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2. CAUTIONS FOR MAINTENANCE/SERVICE

2.1 GENERAL POINTS (FOR REFERENCE)

(1) 0 (zero) Point Indication of Main Cord.
Stick a red color tape on the position of the specified length from the main cord tip, and regard the position as the 0 (zero) point. (RK250-3 : 10 m (32.8 ft), and RK350/RK450-2 : 9 m (29.5 ft).)

(2) 0 (zero) Point Adjustment of Potentiometer.
When the 0 point (red tape) of the main cord is in the center of the cord guide (outlet of the cable), adjust so that the voltage of the output terminal (between the white and the black) is 300 mv. (Energize between the white and the red of the output terminal with d.c. 12 v.)

(3) Number of Pre-coiling of Spiral Spring.
When the 0 point (red tape) of the main cord is in the cord guide section, adjust so that the number of the pre-coiling is seven turns. (Wind the cord onto the drum by extra seven turns.)

2.2 MATTERS THAT DEMAND CAUTION

(1) The drum assembly and the potentiometer shall not be sub-disassembled.

1) Since the drum assembly is provided with the spiral spring in it and the spring will jump out by opening the cover carelessly, it is dangerous. Besides, since the spring is secured by rivetting, it cannot be replaced.

(2) Handle the main cord in the condition that the cord is always loaded with tension.

1) When the tension of the cord becomes 0 (zero) or approaches 0, winding of the cord onto the drum comes loose to allow the cord to get out of the drum, and the cord could enter the gap between the drum and the case to make the rotation impossible.

2) When the cord is wound in by approx. 9 m (29.5 ft) from the 0 point (red tape), the tension comes near zero.

3) Do not wind the cord in more than 3 m (9.84 ft) from the 0 point (red tape).

4) If the cord reel is shaken during transport, the drum could turn idle to loosen the cord, and the cord could enter between the drum and the case. Insert a rubber pipe through the cord guide to brake the drum not to turn idle.

(3) Keeping method of main cord during storage.
The follow is the presented method when the manufacturer shipped the main cord.

1) After winding the main cord to the rubber pipe in the position where the cord is wound in approx. 3 m (9.84 ft) from the 0 point (red tape), bind that part with a different cord so that the cord and the rubber pipe do not come loose, and insert the one end of the rubber pipe through the cord guide to prevent the cord from loosening and the drum from turning idle. (Fig. 2-1)

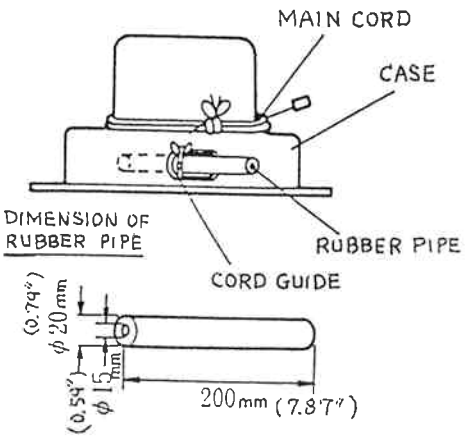


Fig. 2-1 Preventive Measure of Drum Idling

2) Regarding the actual working method, see page 3-8.

(4) Do not loosen the set screw for the coupling carelessly.

1) Since the position is set so that the voltage of the potentiometer is 300 mv when the 0 point of the main cord is in the cord guide position, loosening the set screw carelessly could allow the mutual position to get out of order, and re-adjustment will be required.

(5) Since the coat of the main cord is for insulation, be careful not to damage the coat when handling the cord.

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2. CAUTIONS FOR MAINTENANCE/SERVICE

2.1 GENERAL POINTS (FOR REFERENCE)

(1) 0 (zero) Point Indication of Main Cord.
Stick a red color tape on the position of the specified length from the main cord tip, and regard the position as the 0 (zero) point. (RK250-3 : 10 m (32.8 ft), and RK350/RK450-2 : 9 m (29.5 ft).)

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When the 0 point (red tape) of the main cord is in the center of the cord guide (outlet of the cable), adjust so that the voltage of the output terminal (between the white and the black) is 300 mv. (Energize between the white and the red of the output terminal with d.c. 12 v.)

(3) Number of Pre-coiling of Spiral Spring.
When the 0 point (red tape) of the main cord is in the cord guide section, adjust so that the number of the pre-coiling is seven turns. (Wind the cord onto the drum by extra seven turns.)

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1) Since the drum assembly is provided with the spiral spring in it and the spring will jump out by opening the cover carelessly, it is dangerous. Besides, since the spring is secured by rivetting, it cannot be replaced.

(2) Handle the main cord in the condition that the cord is always loaded with tension.

1) When the tension of the cord becomes 0 (zero) or approaches 0, winding of the cord onto the drum comes loose to allow the cord to get out of the drum, and the cord could enter the gap between the drum and the case to make the rotation impossible.

2) When the cord is wound in by approx. 9 m (29.5 ft) from the 0 point (red tape), the tension comes near zero.

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The follow is the presented method when the manufacturer shipped the main cord.

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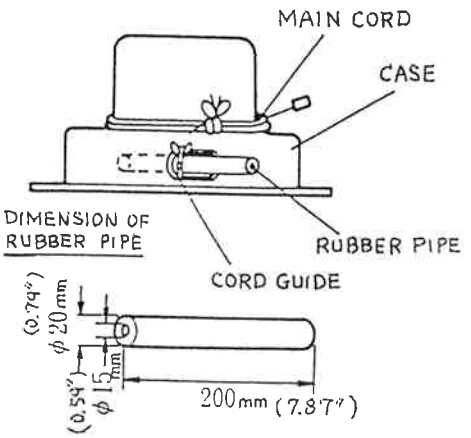


Fig. 2-1 Preventive Measure of Drum Idling

2) Regarding the actual working method, see page 3-8.

(4) Do not loosen the set screw for the coupling carelessly.

1) Since the position is set so that the voltage of the potentiometer is 300 mv when the 0 point of the main cord is in the cord guide position, loosening the set screw carelessly could allow the mutual position to get out of order, and re-adjustment will be required.

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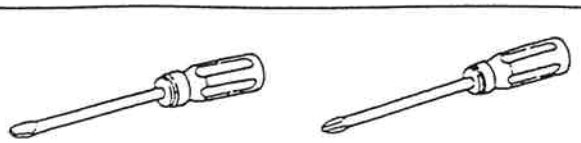
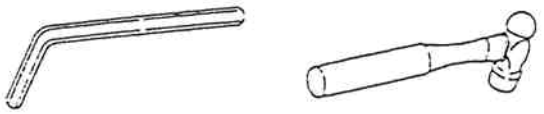
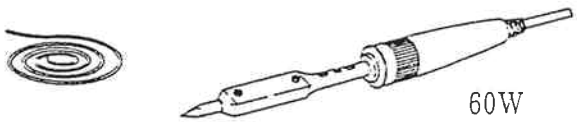
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3. REPLACEMENT OF MAIN CORD (WORKING PROCEDURE)

3.1 PREPARATION FOR WORKING

(1) NECESSARY TOOLS

The tools required for disassembly and assembly are as follows :

1	Screwdrivers (+ and −)	
2	Spanners (one each for M4 and M6)	
3	Hexagon bar wrenches (one each for 2mm and 2.5mm of width across flats) and hammer	
4	Solder and soldering iron	
5	Snap ring pliers (one each for shaft and hole)	
6	Silicon sealant KE45 (transparent)	Shinetsu Chemistry-made or equivalent

(2) DISPOSAL OF CORD AND REMOVAL OF DETECTOR UNIT

1) Remove the tip of the cord from the boom. While holding the cord with hand, slowly wind the cord in. If the cord is released completely, it will be wound in at a high speed to cause troubles such as damage of the spiral spring.
2) When the winding force becomes zero, while holding the cord and the drum, stick a rubber tape on the cord, which has been wound in onto the drum, not to allow the cord to loosen freely more. After the winding force becomes zero, do not push the cord into the cord reel. This could allow the cord to loosen in the reel and to get out of the drum.
3) After removing the length/angle detector unit from the boom, remove the length detector drum assembly from the unit mounting plate.

NOTE

a. In case that the cord has been cut and that it has been wound into the cord reel, this item is unnecessary.
b. The procedure to remove the whole cord reel from the crane basic machine is omitted.

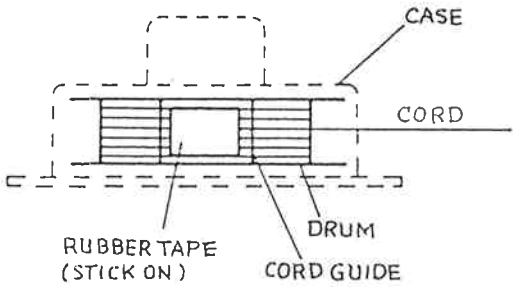


Fig. 3-1 Preventive Method of Cord Loosening

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3.2 DISASSEMBLY OF LENGTH DETECTOR DRUM ASSEMLY

(1) REMOVAL OF BASE PLATE

1) Remove two set screws (M5) which secure the fixing shaft and the base plate (Fig.3-2).

> NOTE
>
> Although the fixing shaft and the base plate are stamped with the match marks for positioning at assembly, if the marks are indistinct, stamp again, then disassemble them

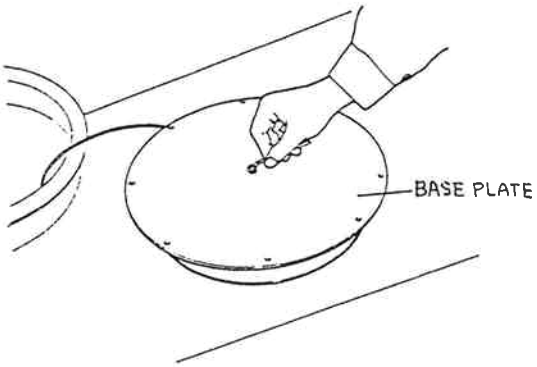


Fig. 3-2

2) Remove four bolts (M6) which tighten the base plate and the case.

> NOTE
>
> Mark the match marks to the case and the base plate, too. (Even rubber tapes will do.)

3) Remove the base plate (Fig.3-3).

> CAUTION
>
> a. When removing the base plate, be careful not to damage the rubber packing.
> b. Be careful so that the sub-cord is not pulled together with the base plate.

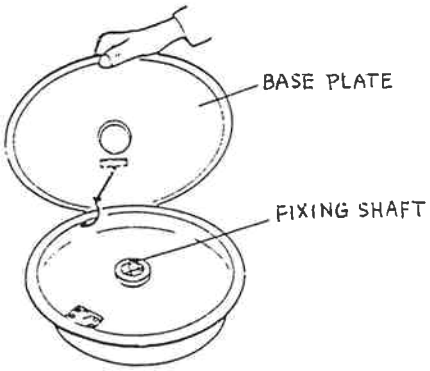


Fig. 3-3

(2) REMOVAL OF POTENTIOMETER ASSEMBLY

1) Turn the whole cord reel upside down, and remove the bolts which secure the cover.
2) While being careful not to pull the output cable, hold up and remove the cover (Fig. 3-4).

> NOTE
>
> a. Stick a cellophane tape and so on to the shaft of the potentiometer assembly not to allow the shaft to rotate.
> b. Mark the potentiometer shaft with a match mark using a felt pen and so on. Since the shaft of the potentiometer is not provided with a stopper inside, the shaft can be rotated freely. But, by marking, worrying about the number of rotation is unnecessary.

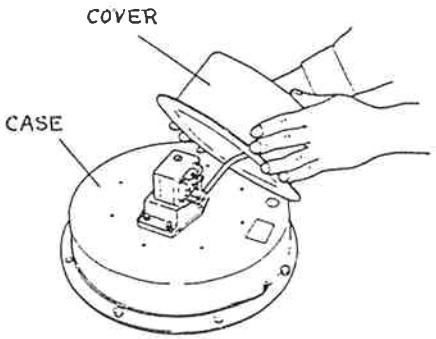


Fig. 3-4

https://truckmanualshub.com/

3) Remove the bracket mounting bolts, and remove the bracket together with the potentiometer (Fig. 3-5).

CAUTION

a. Do not turn the removed potentiometer shaft. Since turning shaft carelessly allows the internal brush to move, re-adjustment is required when assembling.
b. Turning the potentiometer shaft counter-clockwise enlarges the output.

(3) REMOVAL OF DRUM (Figs. 3-6 through 3-8)

1) After removing the coupling, remove the snap ring for the rotating shaft, using the snap ring pliers for shaft (Fig. 3-6).
2) Holding the case upward, separate it from the drum assembly (Figs. 3-7 and 3-8).

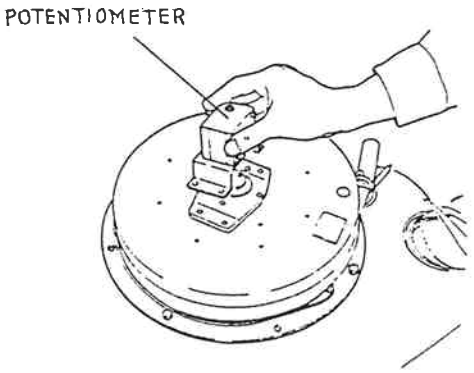


Fig. 3-5

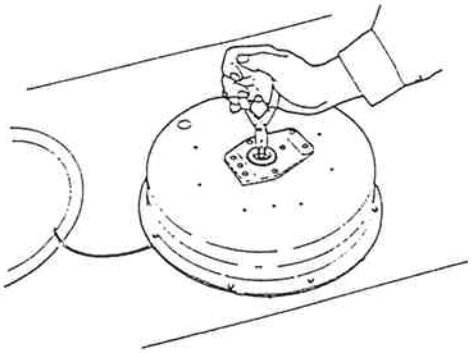


Fig. 3-6

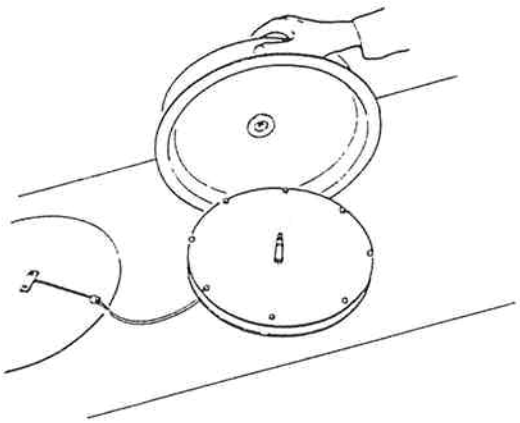


Fig. 3-7

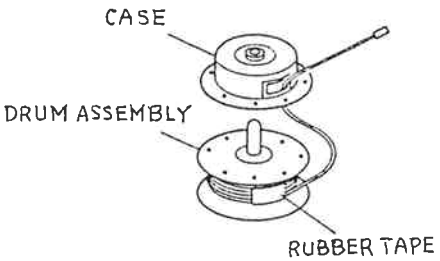


Fig. 3-9

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3.3 REPLACEMENT/INSTALLATION OF MAIN CORD

(1) REMOVAL OF OLD CORD

1) Remove the contact point ring in the center of the base plate side of the drum assembly and the wire holder plate in the external edge of the drum (Fig. 3-9).

2) Removing the cord soldered to the contact point, draw out the cord from the cord retainer and the wire holder, and remove the whole cord.

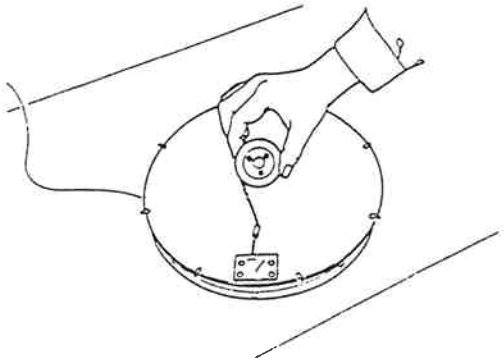


Fig. 3-9

(2) INSTALLATION OF NEW CORD

1) Prepare a new cord for replacement (Fig. 3-9).

> NOTE
>
> If the cord only is to be replaced, install the terminal and red tape, etc. beforehand as shown in Fig. 3-10.

2) Pass the inside end of the cord through the inside of the drum flange, the outside, wire holder plate and cord retainer in this order.

> CAUTION
>
> Cover the cord with a vinyl tube so that the cord does not directly touch the cord retainer

3) Strip off the coat of the cord tip which comes out from the cord retainer, and solder the tip to the place where the old cord of the contact point ring was removed (Fig. 3-11).

> NOTE
>
> Since the core wire of the cord is made of stainless steel, it cannot be soldered with an ordinary solder.
> Use the paste prepared in paragraph 3.1.

4) Install the contact point ring and the wire holder plate to the specified position of the drum, and secure them with the screws.

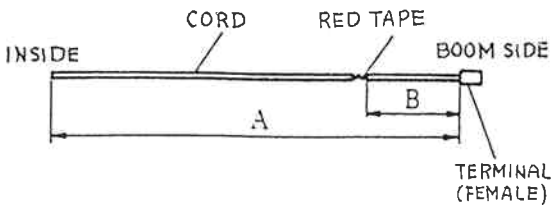


Fig. 3-10 Specification of Cord

Model	Main cord length (A)	Red tape position (B)
RK250-3	36m (118.1 ft)	10m (32.8 ft)
RK350	37m (121.4 ft)	9m (29.5 ft)
RK450-2	43m (141.1 ft)	9m (29.5 ft)

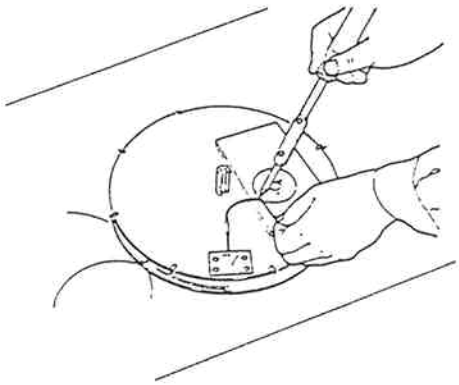


Fig. 3-11

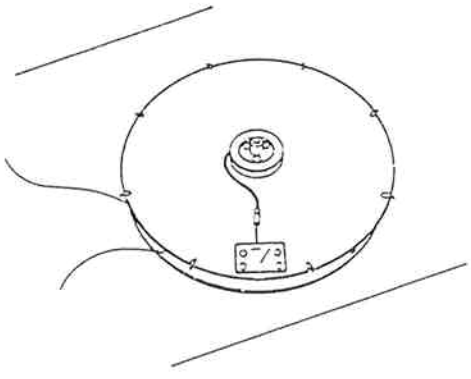


Fig. 3-12

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CAUTION

a. Pass the vinyl tube through the inside of the cord retainer, and push the cord retainer not to allow the tube to move.
b. Stretch the cord between the contact point ring and the wire holder plate to an extent that the cord does not slacken.
c. Tighten the cord in the wire holder plate section so that the protrusion of the cord is small as far as possible (Fig. 3-13).
d. When the grease on the sliding surface of the contact point ring is gone, apply grease for lubrication.

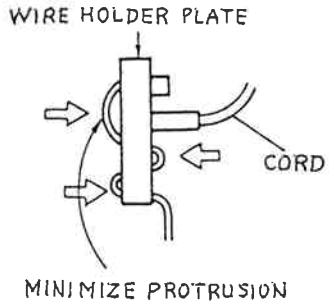


Fig. 3-13 Fixing Cord in Holder Plate Section

(3) WINDING OF MAIN CORD ONTO DRUM

1) Wind the main cord onto the drum upto the red tape position, and wind seven extra turns more. This is the initial winding (for initial tension) (Fig. 3-14).

NOTE

While pulling the cord a little strongly (3 to 4 kgs), wind the cord not to allow the cord to slacken.

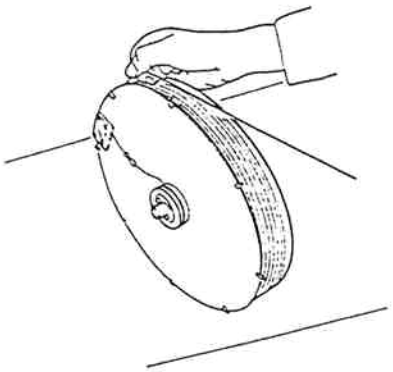


Fig. 3-14

2) After winding is finished, stick a rubber tape onto the section where winding has finished not to allow the cord to slacken.

NOTE

Stick the rubber tape onto the cord of the drum only. If the drum flange section also is stuck with the tape, removal of the tape later will be difficult (Fig. 3-16).

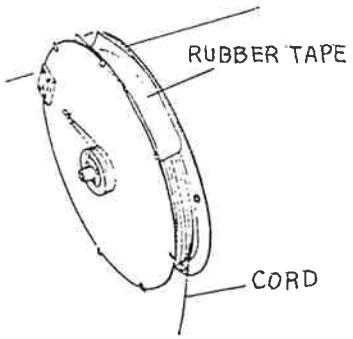


Fig. 3-15

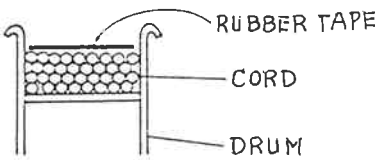


Fig. 3-16 Temporarily Retaining Wound Cord

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3.4 ASSEMBLING PROCEDURE OF LENGTH DETECTOR DRUM ASSEMBLY

3.4.1 INSTALLATION OF DRUM AND BASE PLATE

☐ COMBINATION OF DRUM AND BASE PLATE

(1) Place the drum assembly with the contact point ring side up. Align the base plate hole with the fixing shaft, put the base plate onto the drum assembly, and secure with the set screws (Fig.3-17).

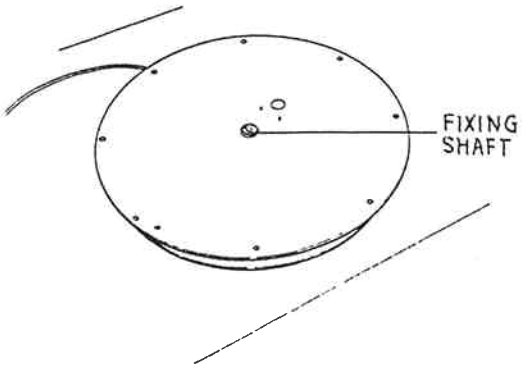


Fig. 3-17

CAUTION

a. Align the match marks of the drum fixing shaft and base plate. When aligning is difficult, it may do to insert the tips of the radio cutting pliers into the tapped hole and to turn it, but be careful not to damage the threads.

b. Do not damage the threads by screwing the set screw in forcibly.

c. When placing the drum assembly, place it on a suitable bench not to injure the rotating shaft.

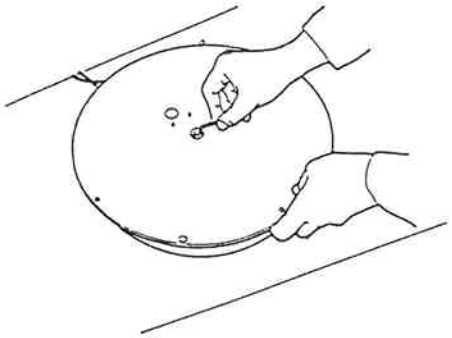


Fig. 3-18

☐ COMBINATION OF CASE AND BASE PLATE

(1) Pass the remaining section of the main cord from the inside to the outside of the cord guide of the case. Be careful not to strip the rubber tape by pulling the cord excessively.

(2) Pass the sub-cord (for overhoist alarm) from the inside to the outside through the bushing hole of the case.

(3) Align the match marks of the case and the base plate. While pulling the main cord and sub-cord to an extent that the cords do not slacken in the case, put the case onto the drum assembly

(4) Apply thread lock (Locktite, etc.) to the four bolts (M6), and install the case to the base plate.

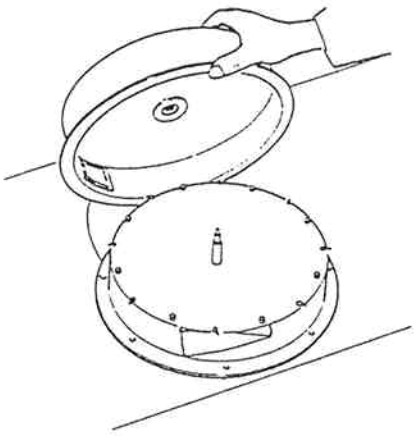


Fig. 3-19

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(5) Install the snap ring to the rotating shaft of the drum which protrudes from the top face of the case (Fig. 3-20).

CAUTION

a. If the rotating shaft does not protrude sufficiently, lightly tap with a hammer through a wooden protector. Strongly tapping has possibility to damage the bearing.

b. Arrange so that the water draining cut section of the rubber packing comes nearly right under the outlet of the sub-cord.

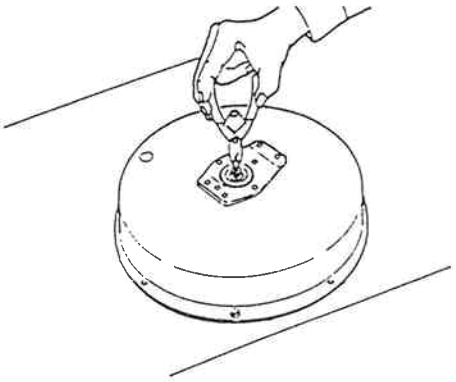


Fig. 3-20

3.4.2 INSTALLATION OF POTENTIOMETER

(1) INSTALLATION OF POTENTIOMETER ASSEMBLY

1) Aligning the match marks, install the coupling.

2) Install the potentiometer with the hexagon head bolts.

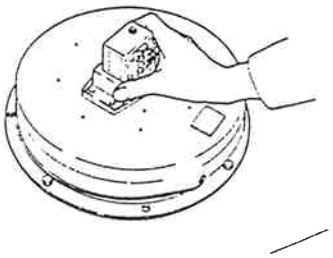


Fig. 3-21

Adjusting Method

(1) In order to remove the slack of the main cord, draw out the whole winding capacity.

(2) While giving tension to the main cord, allow the cord to be wound until the specified point (red tape) comes to the cord guide position, and hold the cord at the position.

(3) Remove the cover in the potentiometer side of the cord reel.

(4) Connect the measuring instrument to a.c. 100 volts of power supply.

(5) Connect the lead wire (red) to the power supply of the measuring instrument, the lead wire (white) to GND, and the lead wire (black) to the output.

(6) Turn the electric voltage knob to adjust so that the voltage becomes 12 volts.

(7) At this time, if the measured voltage is not 300 mv, remove the potentiometer assembly, temporarily adjust to 300 mv, then install it again.

(8) Move the red tape position of the cord as much as the cord was moved by connecting the coupling to adjust to 300 mv.

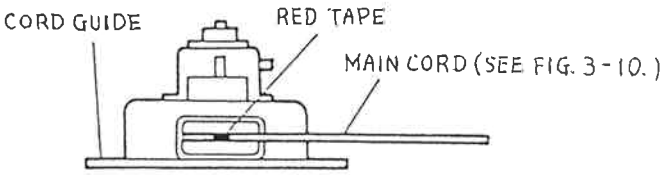


Fig. 3-22 Specified Point Position of Cord

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(5) Install the snap ring to the rotating shaft of the drum which protrudes from the top face of the case (Fig. 3-20).

CAUTION

a. If the rotating shaft does not protrude sufficiently, lightly tap with a hammer through a wooden protector. Strongly tapping has possibility to damage the bearing.

b. Arrange so that the water draining cut section of the rubber packing comes nearly right under the outlet of the sub-cord.

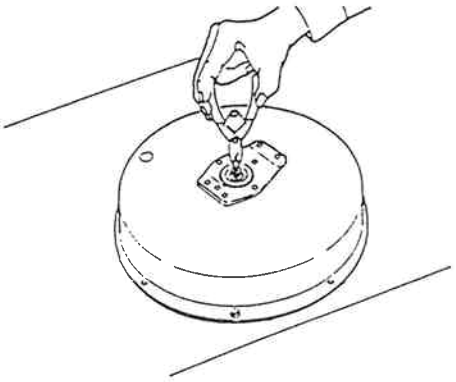


Fig. 3-20

3.4.2 INSTALLATION OF POTENTIOMETER

(1) INSTALLATION OF POTENTIOMETER ASSEMBLY

1) Aligning the match marks, install the coupling.

2) Install the potentiometer with the hexagon head bolts.

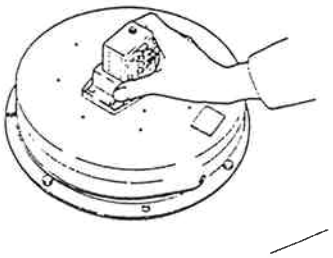


Fig. 3-21

Adjusting Method

(1) In order to remove the slack of the main cord, draw out the whole winding capacity.

(2) While giving tension to the main cord, allow the cord to be wound until the specified point (red tape) comes to the cord guide position, and hold the cord at the position.

(3) Remove the cover in the potentiometer side of the cord reel.

(4) Connect the measuring instrument to a.c. 100 volts of power supply.

(5) Connect the lead wire (red) to the power supply of the measuring instrument, the lead wire (white) to GND, and the lead wire (black) to the output.

(6) Turn the electric voltage knob to adjust so that the voltage becomes 12 volts.

(7) At this time, if the measured voltage is not 300 mv, remove the potentiometer assembly, temporarily adjust to 300 mv, then install it again.

(8) Move the red tape position of the cord as much as the cord was moved by connecting the coupling to adjust to 300 mv.

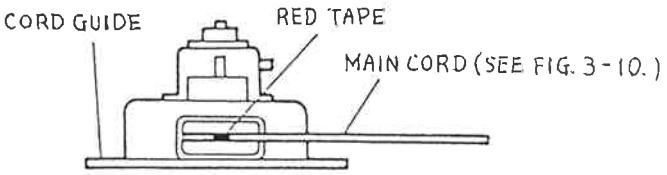


Fig. 3-22 Specified Point Position of Cord

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(2) INSTALLATION OF COVER

Arrange the cover so that the output cable drawing out outlet comes between the main cord guide and the sub-cord drawing out outlet, put the cover on, and secure the cover with the bolts.

NOTE

Draw out the output cable to an extent that the cable does not slacken.

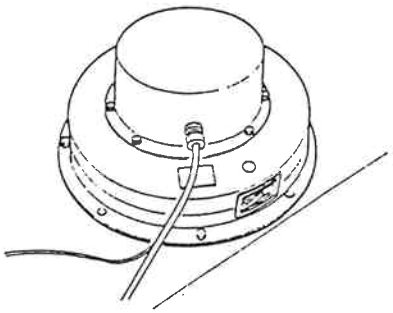


Fig. 3-23

3.4.3 HOLDING DISPOSAL OF MAIN CORD

This work shall be done in order to prevent the cord from slackening and getting out of the drum by rotating idle of the drum due to some cause during handling of the cord reel.

(1) Slowly pull the main cord so that the rubber tape stuck on the drum comes to the position of the cord guide. While giving tension to the main cord, remove the rubber tape.

CAUTION

After removing the rubber tape, do not release the tension from the cord.

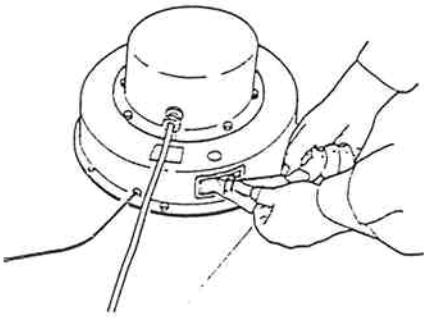


Fig. 3-24

(2) Wind the main cord onto the rubber pipe prepared beforehand two or three turns (Fig. 3-25).

(3) Further, bind the cord with a different cord not to allow the cord to slacken (Fig. 3-26).

(4) Push the one end of the rubber pipe into the drum, and brake drum to prevent the cord from being loosened and getting out of the drum by unexpected rotation of the drum as the cord is wound freely.

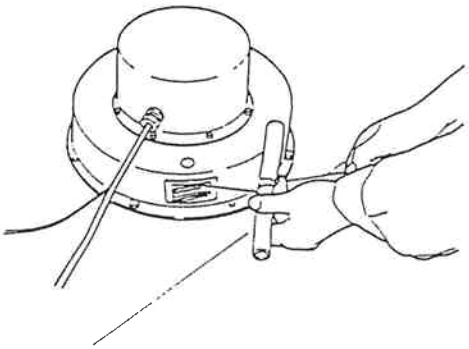


Fig. 3-25

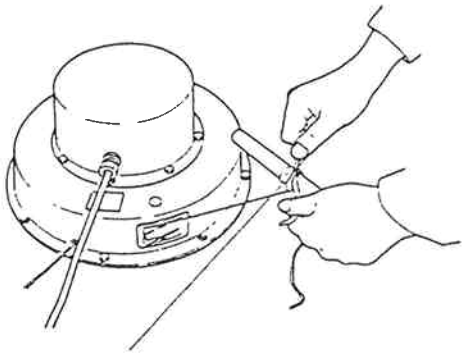


Fig. 3-26

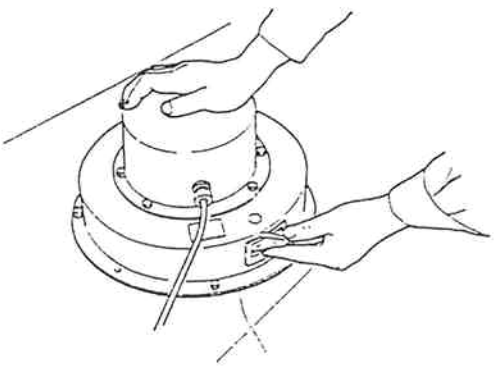


Fig. 3-27

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(2) INSTALLATION OF COVER

Arrange the cover so that the output cable drawing out outlet comes between the main cord guide and the sub-cord drawing out outlet, put the cover on, and secure the cover with the bolts.

NOTE

Draw out the output cable to an extent that the cable does not slacken.

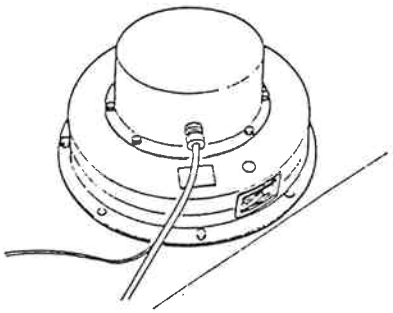


Fig. 3-23

3.4.3 HOLDING DISPOSAL OF MAIN CORD

This work shall be done in order to prevent the cord from slackening and getting out of the drum by rotating idle of the drum due to some cause during handling of the cord reel.

(1) Slowly pull the main cord so that the rubber tape stuck on the drum comes to the position of the cord guide. While giving tension to the main cord, remove the rubber tape.

CAUTION

After removing the rubber tape, do not release the tension from the cord.

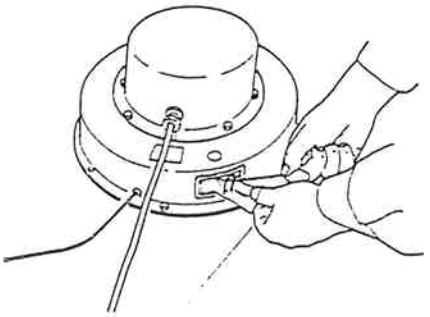


Fig. 3-24

(2) Wind the main cord onto the rubber pipe prepared beforehand two or three turns (Fig. 3-25).

(3) Further, bind the cord with a different cord not to allow the cord to slacken (Fig. 3-26).

(4) Push the one end of the rubber pipe into the drum, and brake drum to prevent the cord from being loosened and getting out of the drum by unexpected rotation of the drum as the cord is wound freely.

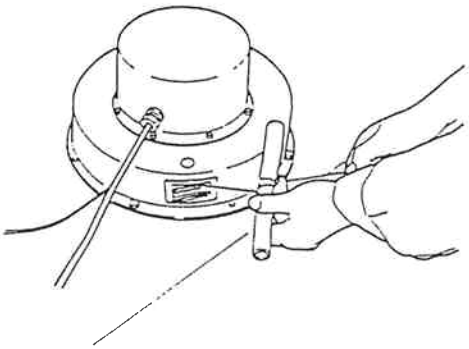


Fig. 3-25

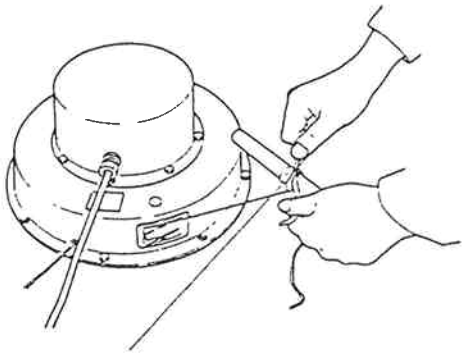


Fig. 3-26

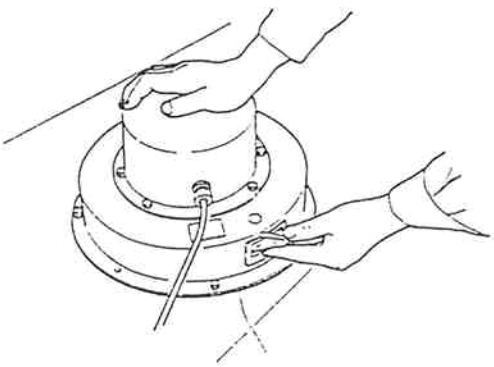
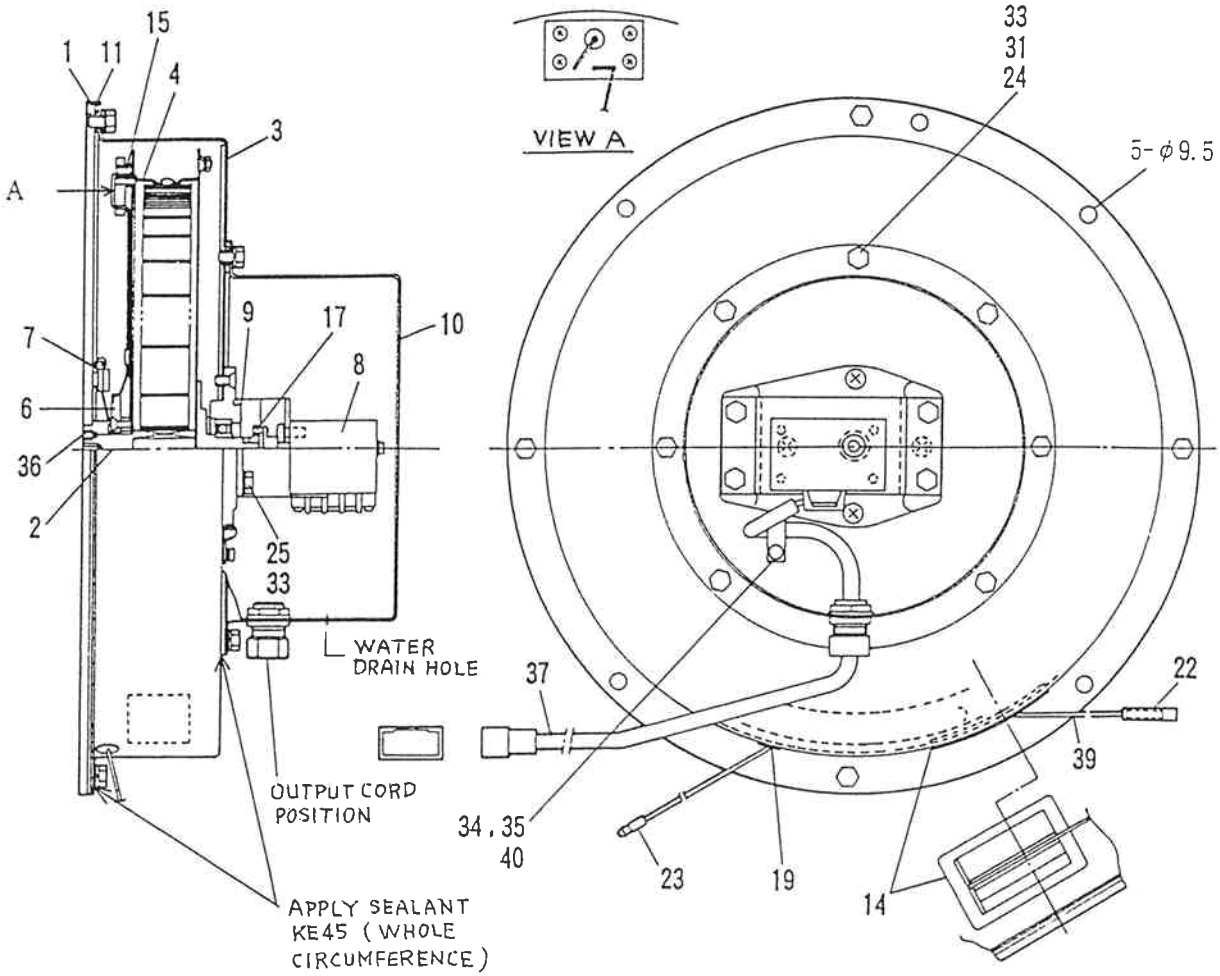


Fig. 3-27

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4. TERMINOLOGY OF CORD REEL PARTS



1. BASE PLATE
2. FIXING SHAFT
3. CASE
4. DRUM ASSEMBLY
6. CONTACT POINT RING ASSEMBLY
7. CONTACT POINT ASSEMBLY
8. POTENTIOMETER ASSEMBLY
9. BRACKET
10. COVER
11. PACKING
14. CORD GUIDE
15. HOLDER PLATE
17. COUPLING
19. RUBBER BUSHING
22. TERMINAL (FEMALE)
23. TERMINAL (MALE)
24. BOLT (M6×10)
25. BOLT (M6×16)
31. WASHER (6)
33. LOCKWASHER
34. LOCKWASHER
35. WASHER
36. SOCKET HEAD SET SCREW
37. CORD
39. CORD
40 ROUND HEAD SCREW

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1. SPECIFICATIONS AND CONSTRUCTION

1.1 SPECIFICATIONS

Item	Description
Rating	DC 15 volts, 20 milliamperes
Specification of cable (cord)	Nominal sectional area : 0.3 mm² (0.012 in²) × 3 cores Outside diameter of shield wires : Approx. 5.7 mm (0.224 in.) Conductor : 16 tinned soft copper wires / 0.12 mm (0.005 in.) dia. Insulation : 0.3 mm (0.012 in.) thickness Coat : Polyethylene (black), 0.3 mm (0.012 in.) thickness
Range of working temperature	-30°C to 75°C (-22°F to 167°F)
Max. effective stroke	21 meters (68.9 feet)
Cabe winding method	Clockwork spring type
Grease	Clockwork spring section : Molybdenum speed grease No. 0 Ring section : CRS grease 701
Weight	Approx. 17.3 kgs (38.14 lbs)

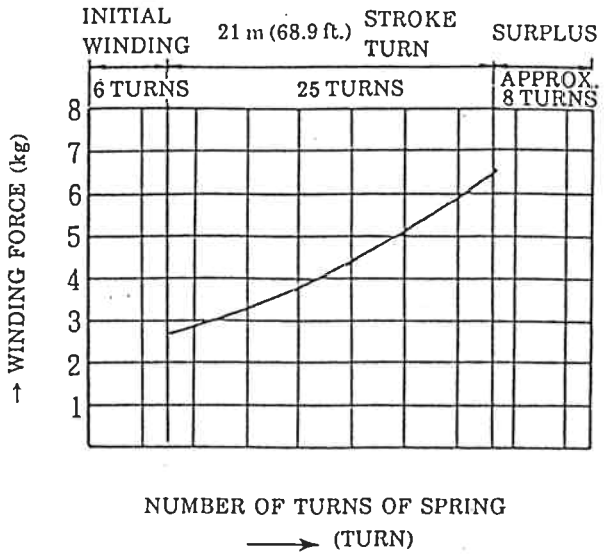
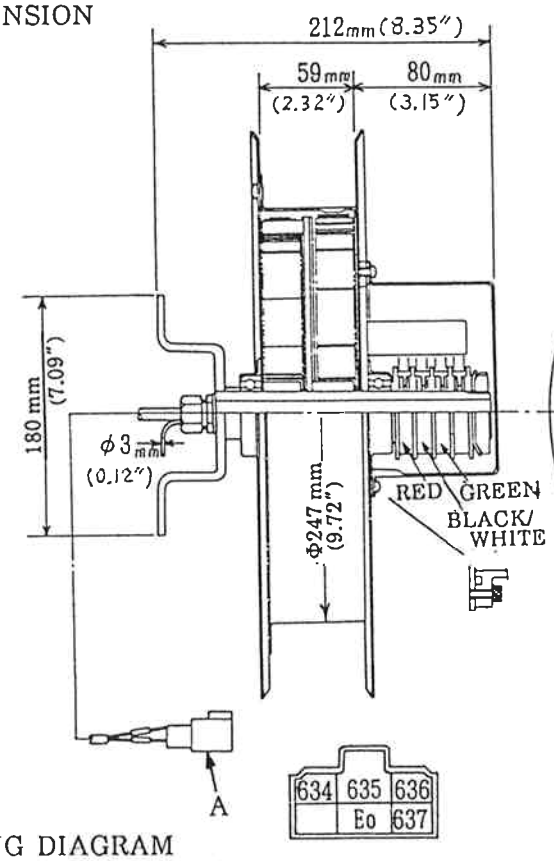
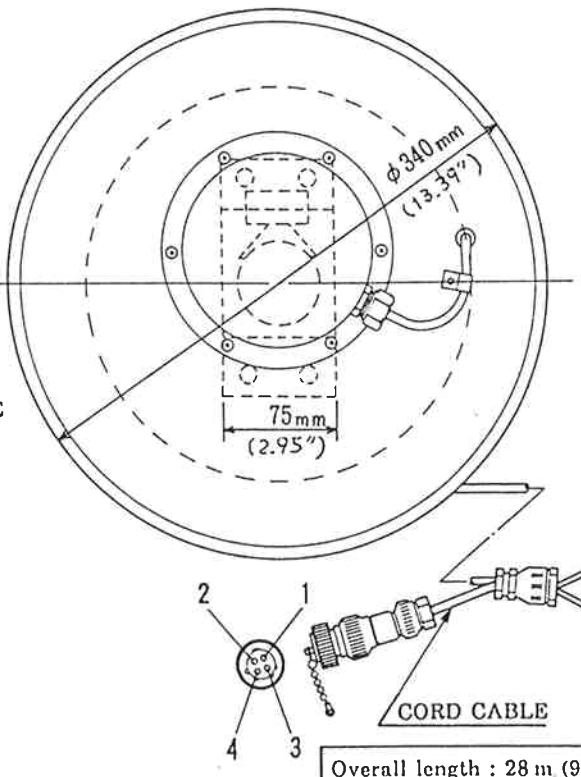


Fig. 1-1

- DIMENSION





WIRING DIAGRAM

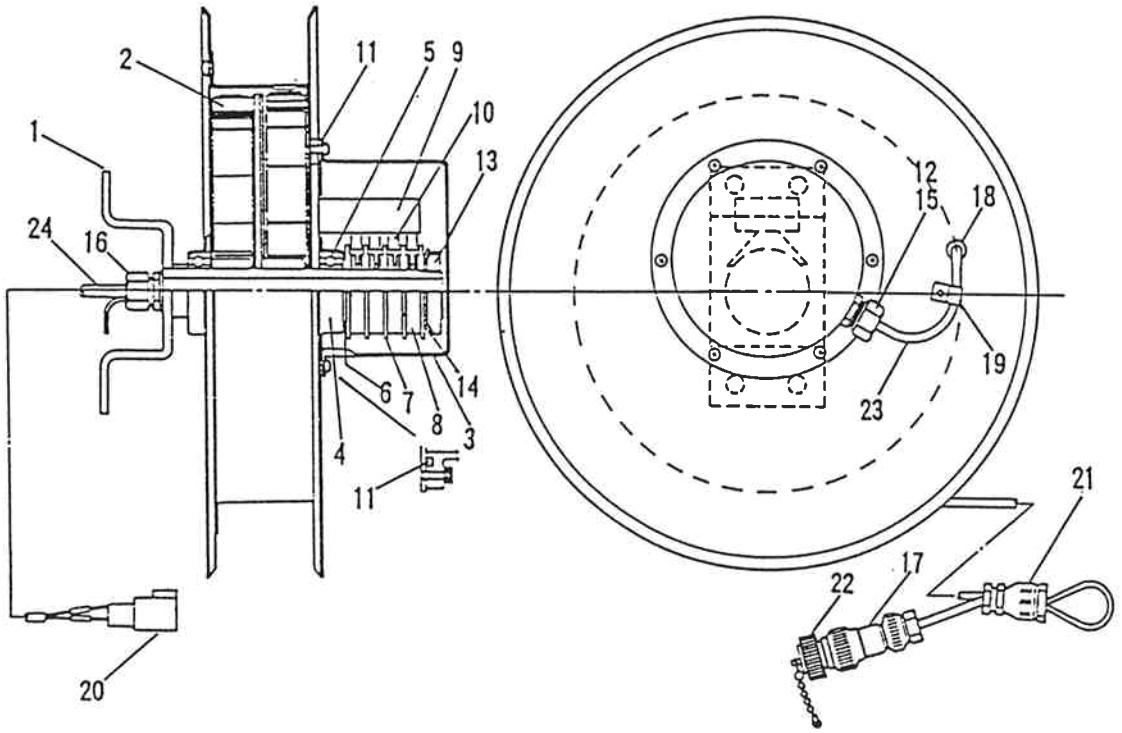
1	RED	— 634 RED
2	WHITE	— 635 GREEN
3	BLACK	— 636 BLACK, 637 WHITE
4	SHIELD	— Eo YELLOW

Fig. 1-2

Overall length : 28 m (91.86 ft.)
Mounting length : 5.6 m (18.37 ft.)
Stroke length : 21 m (68.90 ft.)
Idle winding : 1.4 m (4.59 ft.)

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1.2 CONSTRUCTION



1. FRAME
2. DRUM
3. COVER
4. BEARING CASE
5. BEARING
6. COLLAR (A)
7. COLLAR (B)
8. RING
9. PLATE
10. BRUSH (CONTACT POINT)
11. PACKING (O-RING)
12. CONNECTOR WITH O-RING
13. NUT (FOR BEARING)
14. WASHER
15. CLAMP
16. CLAMP
17. CONNECTOR (TERMINAL)
18. BUSHING (RUBBER)
19. CLIP
20. CONNECTOR
21. LOCK
22. CAP
23. CABLE (28 m)
24. CABLE
25. SNAP RING (NOT SHOWN)
26. SCREW
27. SCREW

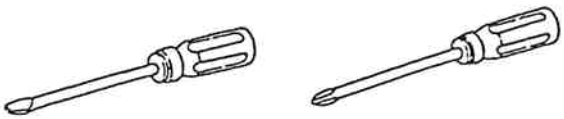
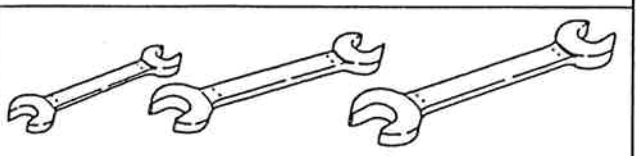
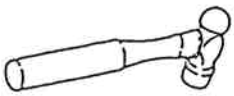
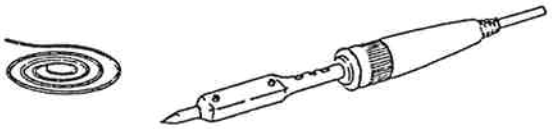
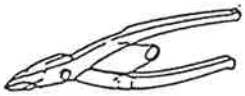
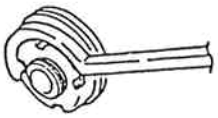
Fig. 1-3

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2. DISASSEMBLY

2.1 NECESSARY TOOLS

The tools required for disassembly and assembly are shown below.

1	Screwdriver (+ and −)	
2	Spanner (wrench) (Nominal sizes : 7, 21 and 22)	
3	Hexagon bar wrench	
4	Hammer	
5	Solder and soldering iron	
6	Snap ring pliers (for shaft)	
7	Silicon sealant KE45 (transparent)	Shinetsu Chemistry Co.
8	Wrench for bearing nut	
9	Grease	CRS Grease 701 for coating ring
		Molybdenum speed grease No.2 for coating spiral spring.

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2.2 DISASSEMBLY

(1) Remove the output cable assembly wound onto the cable reel.

(2) Removing screw (26) for nylon clip (19) which secures the cable to the drum plate, remove the nylon clip from the cable.

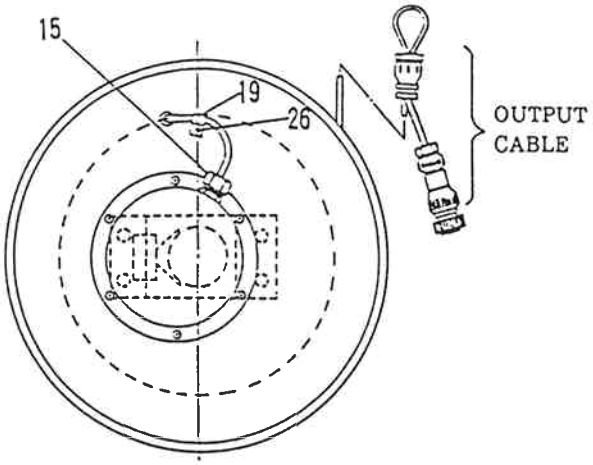


Fig. 2-1

(3) Removing the nut for cable clamp (15) installed to cover (3), release clamping condition for the cable of the inside rubber bushing.

(4) Remove six screws (27) which secure cover (3) and packing or O-ring (11).

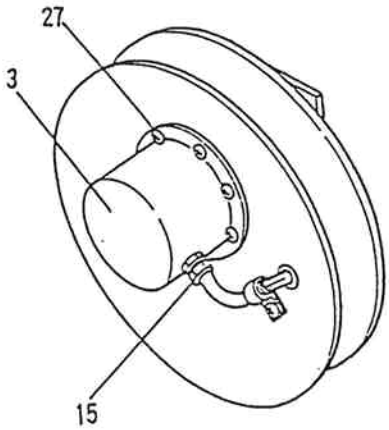


Fig. 2-2

(5) Remove the cover. Remove the hexagon nut fixing the terminal (connector) of the cord cable, and remove the connector.

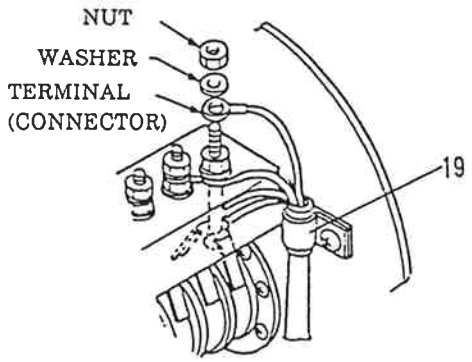


Fig. 2-3

(6) Removing the screw for nylon clip (19) which secures the cable to the drum plate, remove the clip from the cable, and pull out the cable from the drum plate.

(7) Remove two screws (M6), which secure holder plate (9), from the holder plate.

(8) Remove the screw (M4) which secures brush (10) to the holder plate, and remove the brush.

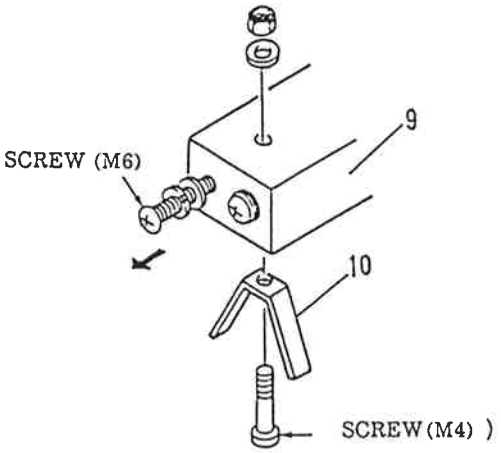


Fig. 2-4

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(9) With the use of the screwdriver (−), raise the nail of washer (14) for bearing nut (13) which is screwed onto the thread section (M25) of the shaft, and remove the bearing nut together with the washer from the shaft.

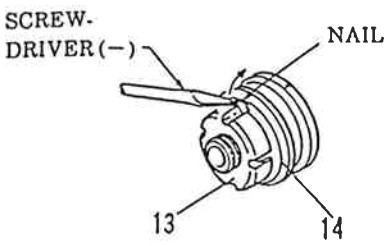


Fig. 2-5

(10) Removing the nut for cable clamp (16) which is screwed in to frame (1), release clamping condition of the inside rubber bushing to the cable. At this time, remove the pipe also at the same time.

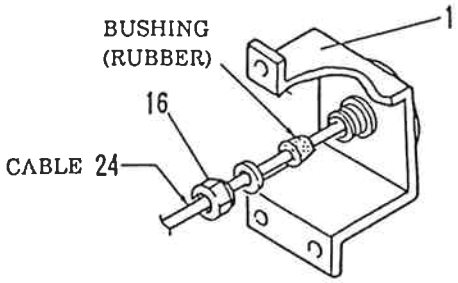


Fig. 2-6

(11) Using the soldering iron, remove the lead wire soldered to ring (8), and remove all of collar (7), ring (8) and collar (6) which are passed through the shaft.

(12) Pull out input cable assembly (24) from the shaft.

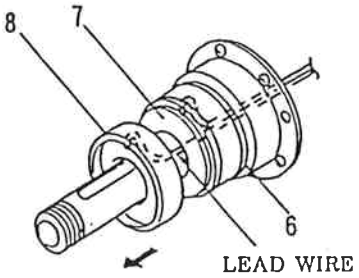


Fig. 2-7

(13) Remove four screws (M4) which secure bearing case (4), and remove the bearing case and bearing (5).

(14) Using the pliers, remove C-shape snap ring (25) from the shaft.

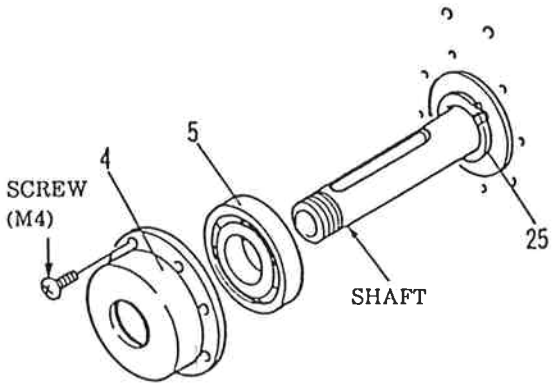


Fig. 2-8

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(15) Place the main body in the condition as shown in Fig. 2-9. Remove the six screws (M4) which secure the drum plate and drum of drum assembly (2), in which the spiral spring is built. Insert the screwdriver (−) into the several places of the drum flange surface which is adhesive condition with sealant, and separate the drum plate from the drum.

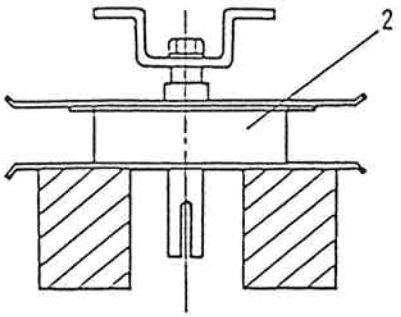


Fig. 2-9

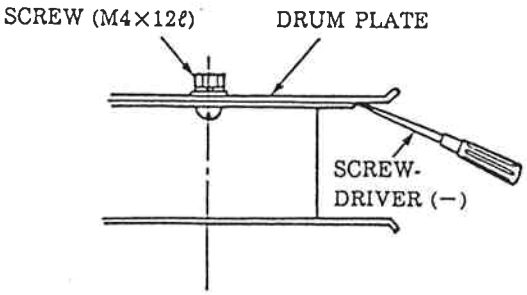


Fig. 2-10

(16) Since frame complete (1), the drum plate which has been separated from the drum in step 15 and the spiral spring fixing shaft in the drum are in one body, pull out them in the direction shown in Fig. 2-11 at the same time.

CAUTION

Since sometimes the spiral spring in the drum may be raised together with the spiral spring fixing shaft, be careful for this condition. If the spring is raised, hold the spiral spring with a tool or so, and pull the shaft up from the spring.

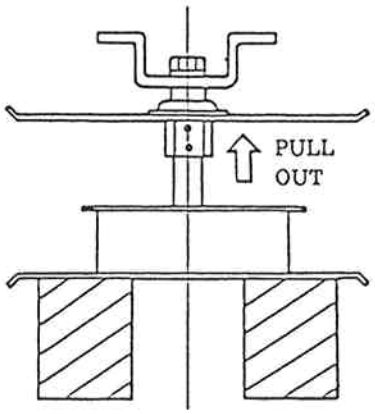


Fig. 2-11

(17) Loosen the two hexagon socket head setscrews (M5) for the spiral spring fixing shaft, and pull out spiral spring fixing shaft bearing (5), the drum plate and the collar from the shaft.

(18) Remove the cable clamps installed to the frame and the cover.

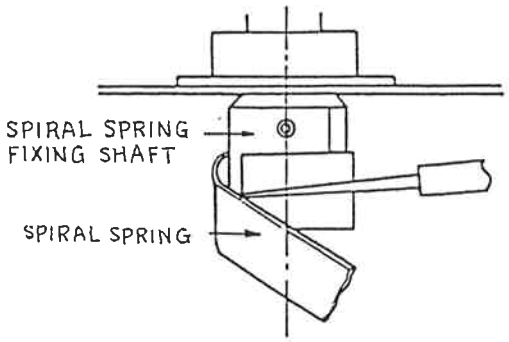


Fig. 2-12

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3. ASSEMBLY

(1) Install the cable clamps to frame (1) and cover (3) as shown in Fig. 3-1, and apply sealant for waterproof.

(2) Install the collar to the shaft of frame (1).

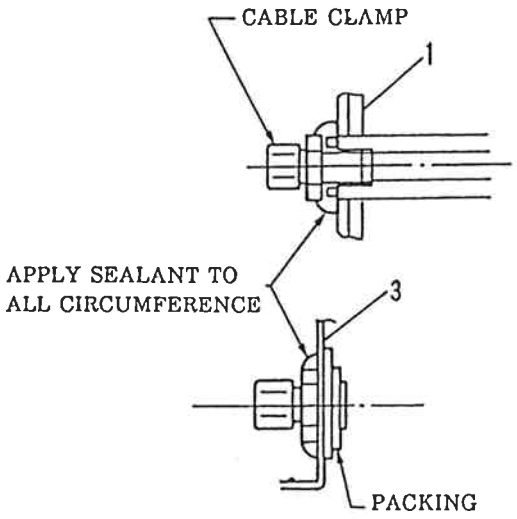


Fig. 3-1

(3) Tap bearing (5) into the drum plate in the side where the drum plate and the bearing case are in one body.

(4) Pass the shaft through the drum plate and the spiral spring fixing shaft, and secure the spiral spring fixing shaft to the shaft securely with the two hexagon socket head setscrews (M5).

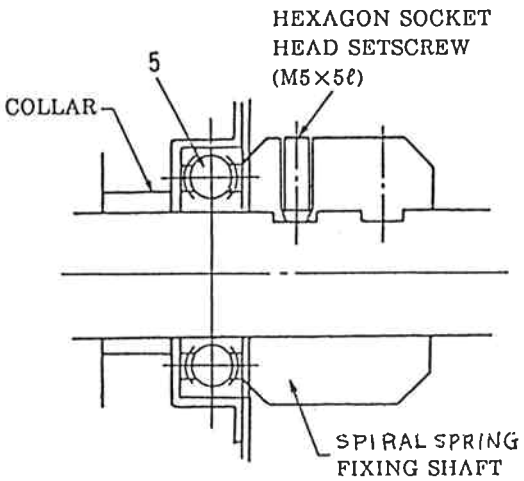


Fig. 3-2

CAUTION

Install the spiral spring fixing shaft as shown in Fig. 3-2. Fig. 3-3 is a view looking at the frame side from the tip of the shaft.

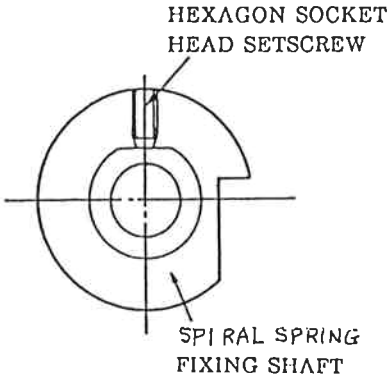


Fig. 3-3

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(5) Place drum assembly (2) with the built-in spiral spring down as shown in Fig. 3-4. Apply sealant to the all circumference of the drum flange surface for waterproof. Then, insert the spiral spring fixing shaft which was installed to the shaft in step 4 mentioned above into the spiral spring , aligning the shaft with the shape of the inside end of the spring.

NOTE

Set the drum plate so that the protrusions provided on the left and right drum plates are apart by 180° from each other.

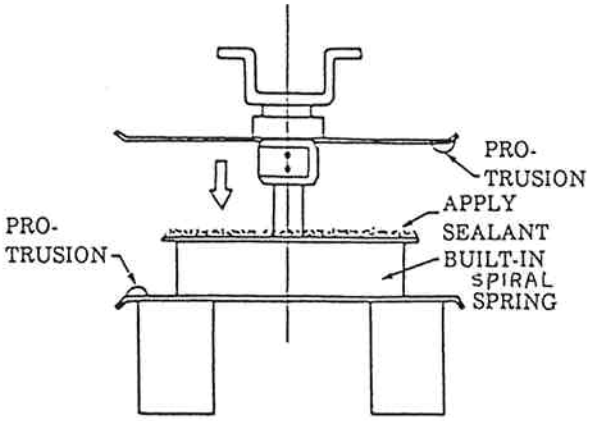


Fig. 3-4

(6) Secure the drum plate to the drum with six screws (M4).

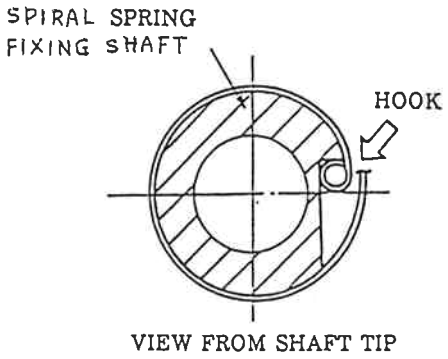


Fig. 3-5

(7) Install the C-shape snap ring (for shaft) into the groove of the shaft with the snap ring pliers.

(8) Tapping bearing (5) into bearing case (4), secure the bearing case to drum assembly (2) with the four screws (M4).

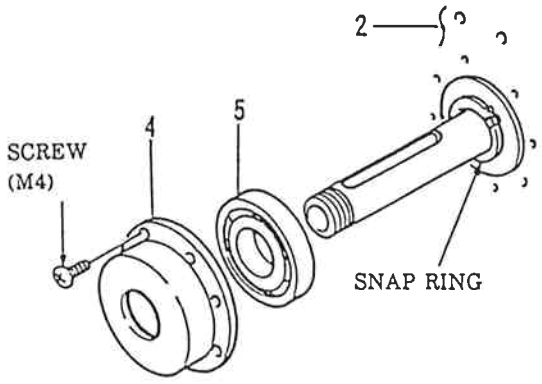


Fig. 3-6

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(9) Pass the nut, washer and bushing of cable clamp (16) through input cable assembly (24), then pass them through the shaft.

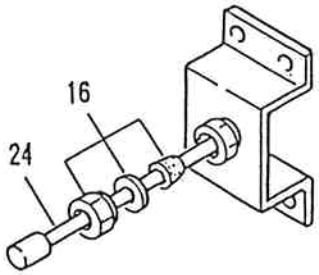


Fig. 3-7

(10) Pass collar (A) (6) and ring (8) through the shaft. Cut 1 (red) of input cable assembly (24) to a suitable length, strip off and solder it.
Then, arrange collar (B) (7) and the ring in order. For wiring, arrange 1 (red), 2 (black/white), 3 (green) and 4 (yellow) (soldered with the yellow lead wire to the shield wire) in order, cut to the suitable length and solder them.

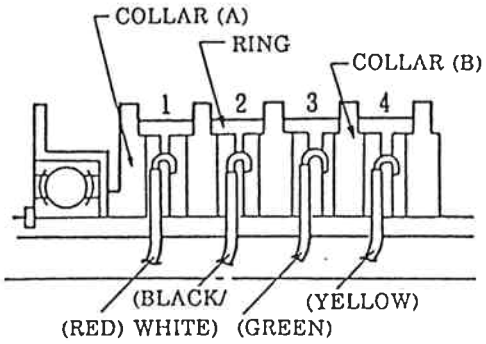


Fig. 3-8

(11) Aligning bearing washer (14) with the lock groove of the shaft, and install the washer to the shaft. Turn bearing nut (13) with the hand until the nut cannot be turned, then use the exclusive tool. Tighten the nut (approximately 1/2 to 3/4 turn) until the ring cannot be turned with the hand. Fold the nail of the washer into the groove of the nut.

CAUTION

When tightening the bearing nut, while holding the ring not to allow the corner sections of the shaft groove to injure the lead wire, proceed the work. Apply a thin coat of grease to the surface of the ring.

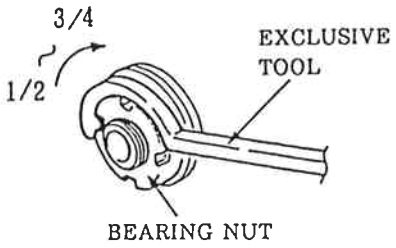


Fig. 3-9

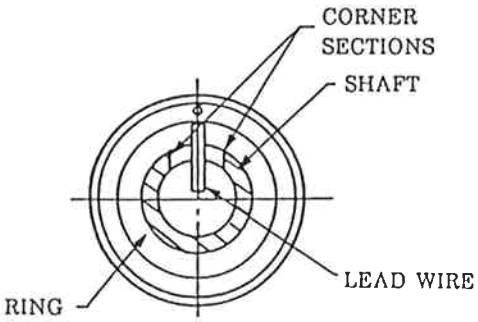


Fig. 3-10

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(12) Install brush (10) to holder plate (9) with the screws (M4×35) (four places).

(13) Install holder plate (9) to drum assembly (2) with the two screw (M6).

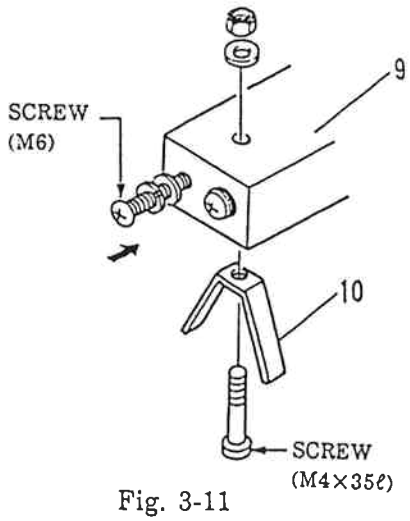


Fig. 3-11

(14) Apply sealant to the flange surface of cover (3), and stick packing (11) on the surface. In case of an O-ring instead of the packing, insert the O-ring into the cover.

(15) Pass output cable assembly (23) through drum assembly (2), cord clamp (15) and cover (3) in this order.

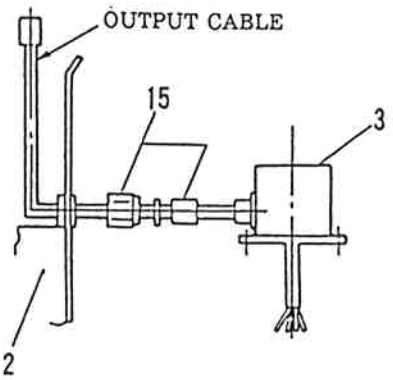


Fig. 3-12

(16) Install output cable assembly (23) to drum assembly (2) with nylon clip (19) and the screw (M4). Wrap a vinyl tape onto the position of the output cable, where the nylon clip is installed, to remove the gap between the nylon clip and the cable.

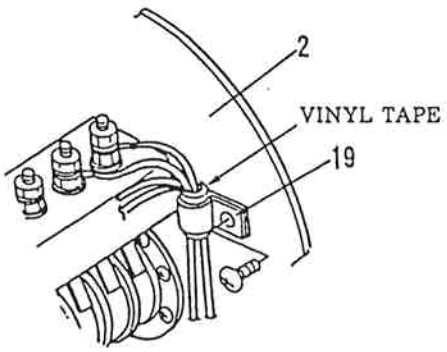


Fig. 3-13

(17) Cut the lead wires of output cable assembly (23) in accordance with the length to the screw thread position for the terminal installation, strip off the lead wires, and calk connector (17) with a pressure connecting tool. Next, install the calked connector to the lead wires to the screw thread position for the connector installation.
The order of wiring is order of 1 (red), 2 (black), 3 (white) and 4 (yellow) from the drum plate side.
(Yellow lead wire is soldered to the shield wire.)

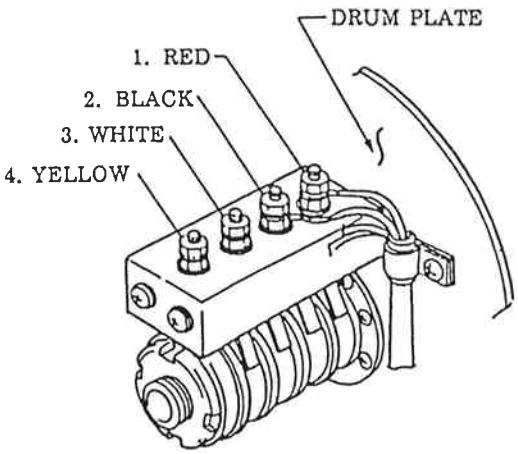


Fig. 3-14

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(18) Insert the pipe (3 mm diameter) (0.12 in.) into the nut of input cable (24). Tighten the nut, and coat sealant. Measure conductance between the each connector and insulation to the main body to confirm for normality.

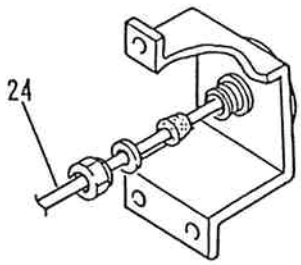


Fig. 3-15

(19) Apply sealant to the flange surface of cover (3) which was attached with the packing in step 14, and install the cover to drum assembly (2) with six screws (M4).

NOTE

In case of O-ring, install the O-ring to the cover.

(20) Secure the nut for cord clamp (15), and install output cable assembly (23) to drum assembly (2) with nylon clip (19) and the screw (M4). Wrap a vinyl tape onto the nylon clip installing position of the output cable to remove the gap between the nylon clip and the cable.

Now, assembly is completed.

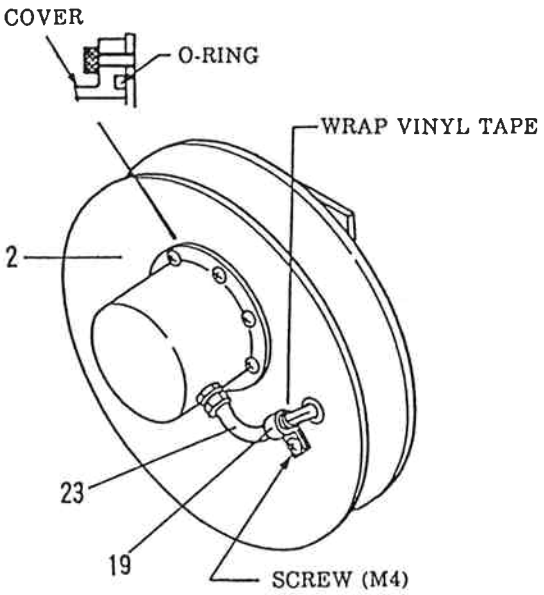
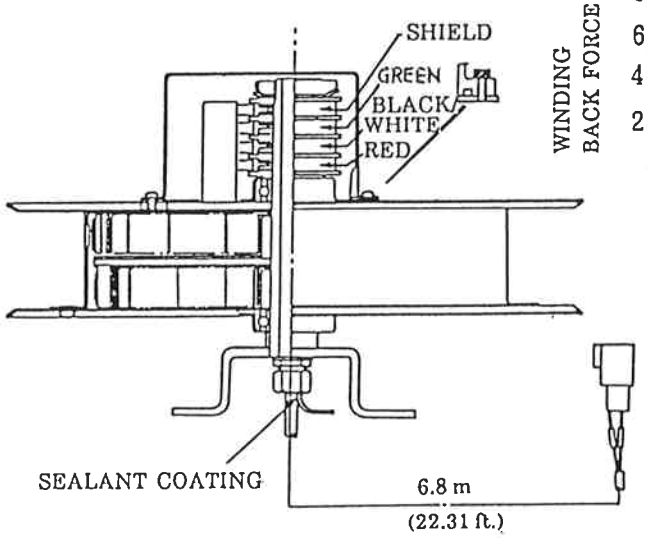
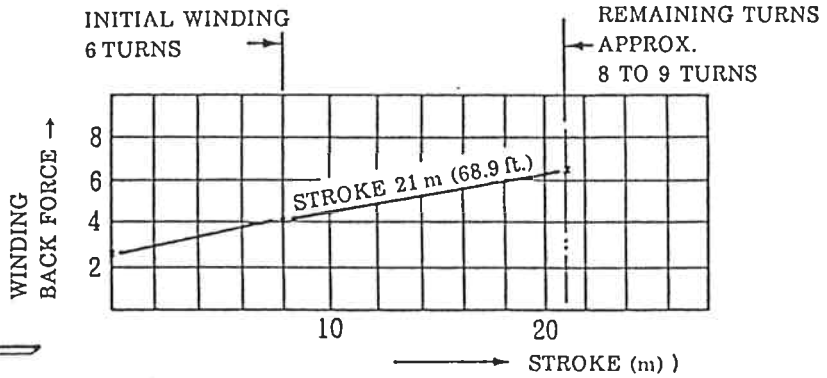


Fig. 3-16

■ The following figure is for reference.





WINDING BACK FORCE DIAGRAM

Fig. 3-17