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No. SEW-655DE

TCM®

SERVICE MANUAL

WHEEL LOADER

L27-3
(Serial No. 02101 and after)

L32-3
(Serial No. 02101 and after)

L35-3
(Serial No. 07101 and after)

L40-3
(Serial No. 05101 and after)

TCM CORPORATION

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No. SEW-655DE

FOREWORD

TCM offers a wide variety of wheel loaders which have been enthusiastically welcomed by users all over the world. TCM Models L27-3, L32-3, L35-3, and L40-3 articulated type wheel loaders, are the latest products developed from years of research and experience. To get the most of the loader, it is required that you become familiar with its features, construction, operating and maintenance procedures.

This Service Manual explains the structure of the above loaders for service personnel and shop workers. We hope it will be your reference guide during servicing jobs.

For the standard service values and the procedure for inspection, see the Inspection Manual and for the procedure for maintaining each component unit, see the Shop Manual of their respective components.

The descriptions and specifications described in this manual are subject to change without notice.

July, 2004

TCM CORPORATION

This Service Manual applies to the following loaders:

L27-3 : #02101 and after
L32-3 : #02101 and after
L35-3 : #07101 and after
L40-3 : #05101 and after

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0. SPECIFICATIONS

0.1 OUTER VIEWS

(L27-3, LX130-7)

Unit: mm [in.]

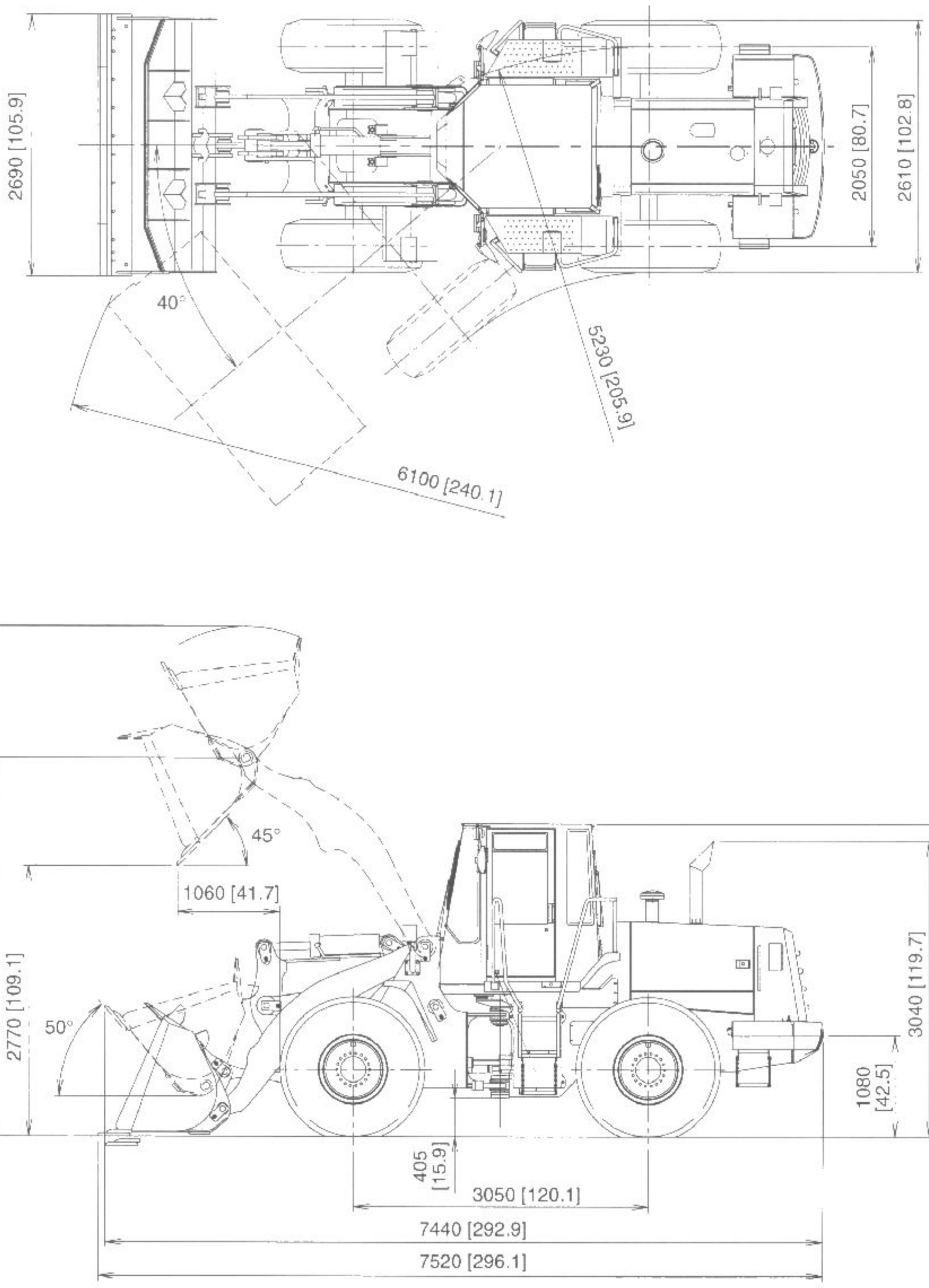


Fig. 0.1 Outer Views (L27-3, LX130-7)

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(L32-3, LX160-7)

Unit: mm [in.]

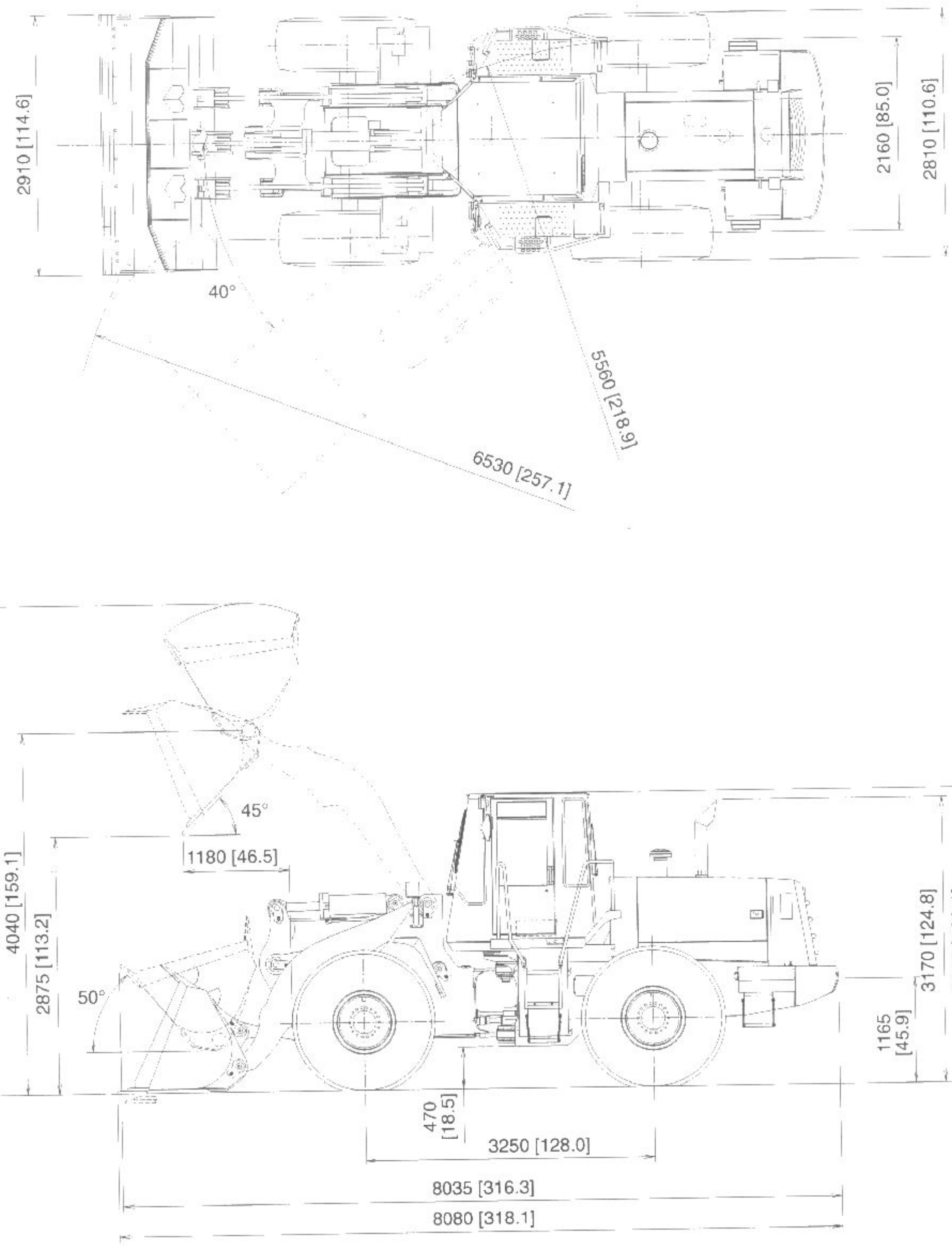


Fig. 0.2 Outer Views (L32-3, LX160-7)

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(L35-3, LX190-7)

Unit: mm [in.]

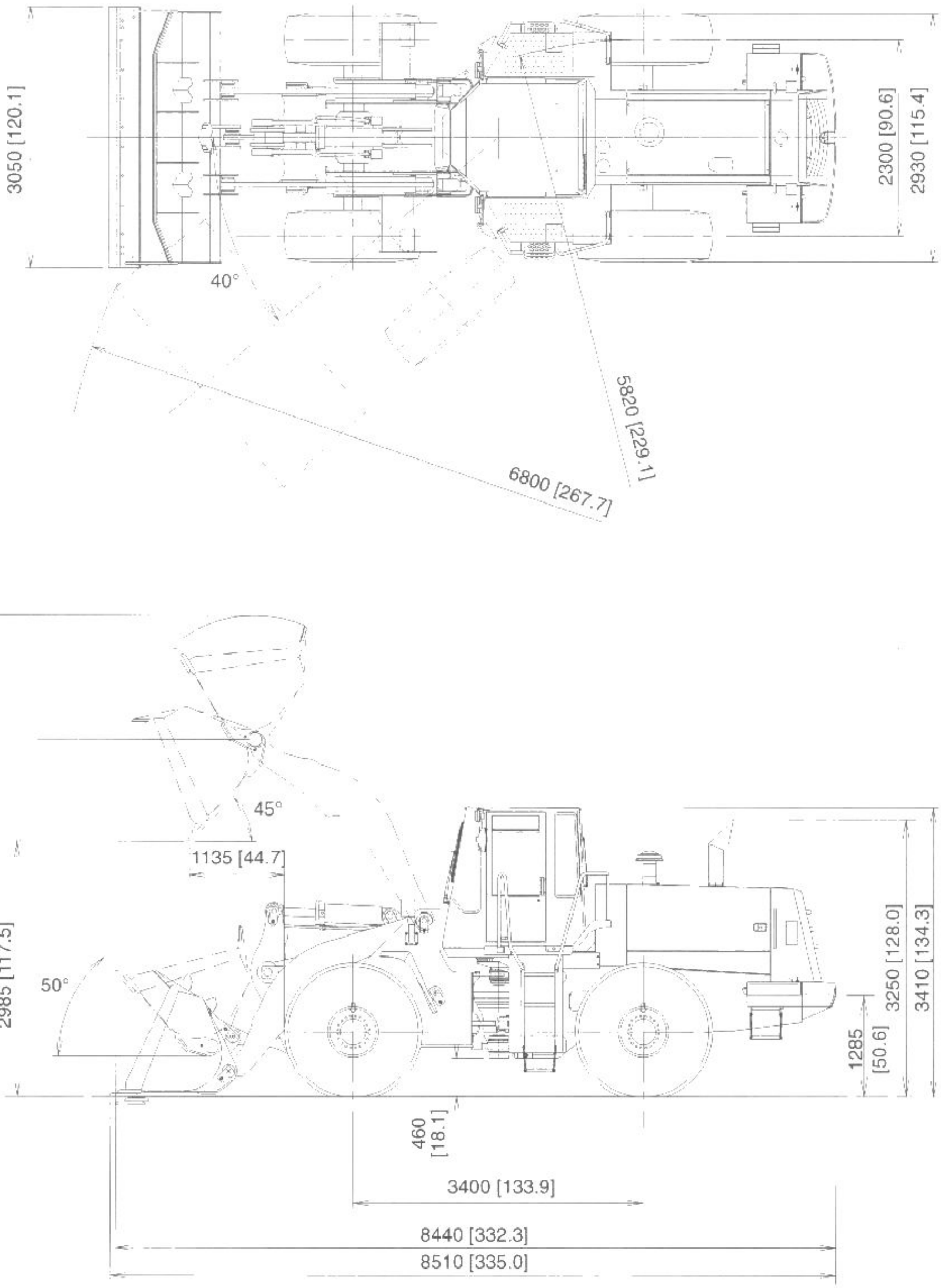


Fig. 0.3 Outer Views (L35-3, LX190-7)

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(L40-3, LX230-7)

Unit: mm [in.]

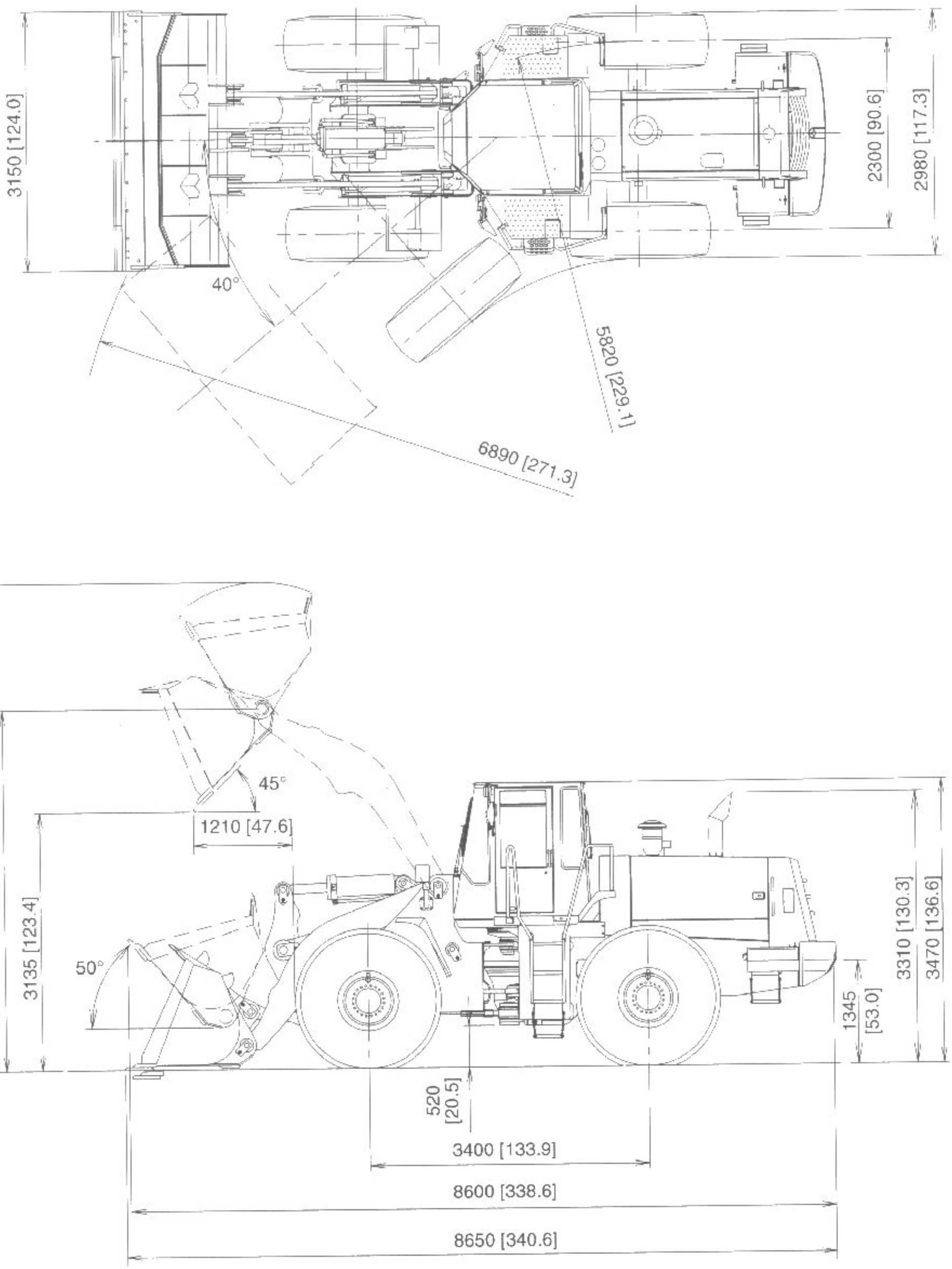


Fig. 0.4 Outer Views (L40-3, LX230-7)

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0.2 SPECIFICATIONS

Loader Models			L27-3, LX130-7	L32-3 , LX160-7	L35-3, LX190-7	L40-3, LX230-7
Type			Front-end articulated loader with diesel engine			
Bucket Type			DEB	DEB	DEB	DEB
Performance	Bucket capacity, heaped	m^3 [y^3]	2.7 [3.5]	3.2 [4.2]	3.5 [4.6]	4.0 [5.2]
	Breakout force, bucket cylinder	kN {kgf} [lbf]	124.5 {12700} [28000]	153.9 {15700} [34620]	165.6 {16900} [37260]	198.0 {20200} [44540]
	SAE rated operating load, full turn	kg [lbs]	4320 [9530]	5120 [11290]	5600 [12350]	6400 [14112]
	Rising time, full load	s	5.8	6.0	6.2	6.4
	Lowering time	s	3.3	3.3	3.3	3.6
	Bucket dumping time	s	1.4	1.4	1.4	1.5
	Travel speed, fwd 1st	km/h [mph]	7.5 [4.7]	7.5 [4.7]	7.5 [4.7]	7.5 [4.7]
	fwd 2nd	km/h [mph]	12.0 [7.5]	12.5 [7.8]	13.0 [8.1]	13.0 [8.1]
	fwd 3rd	km/h [mph]	22.0 [13.7]	22.5 [14.0]	21.0 [13.0]	21.0 [13.0]
	fwd 4th	km/h [mph]	34.5 [21.4]	34.5 [21.4]	34.5 [21.4]	34.5 [21.4]
	rev 1st	km/h [mph]	8.0 [5.0]	8.5 [5.3]	8.5 [5.3]	8.5 [5.3]
	rev 2nd	km/h [mph]	13.5 [8.4]	14.0 [8.7]	14.5 [9.0]	14.5 [9.0]
	rev 3rd	km/h [mph]	24.0 [14.9]	24.5 [15.2]	23.0 [14.3]	23.0 [14.3]
	rev 4th	km/h [mph]	37.0 [23.0]	37.0 [23.0]	37.0 [23.0]	36.5 [22.7]
	Max. traction force	kN {kgf} [lbf]	125.4 {12800} [28220]	156.8 {16000} [35280]	179.3 {18300} [40350]	192.1 {19600} [43220]
	Gradeability, fwd 1st		25° tilt	25° tilt	25° tilt	25° tilt
	Minimum turning radius					
	outermost part of bucket	mm [in.]	6100 [240.2]	6530 [257.1]	6800 [267.7]	6890 [271.3]
	center of outermost wheel	mm [in.]	5230 [205.9]	5560 [218.9]	5820 [229.1]	5820 [229.1]
Dimensions	Overall length, bucket on ground	mm [in.]	7520 [296.1]	8080 [318.1]	8510 [335.0]	8650 [340.6]
	in carry position	mm [in.]	7440 [292.9]	8035 [316.3]	8440 [332.3]	8600 [338.6]
	Overall width, loader body	mm [in.]	2610 [102.8]	2810 [110.6]	2930 [115.4]	2980 [117.3]
	bucket	mm [in.]	2690 [105.9]	2910 [114.6]	3050 [120.1]	3150 [124.0]
	Overall height, bucket on ground, top of cab	mm [in.]	3240 [127.6]	3305 [130.1]	3410 [134.3]	3470 [136.6]
	Overall operating height, bucket fully raised	mm [in.]	5250 [206.7]	5460 [215.0]	5640 [222.0]	5925 [233.3]
	Wheelbase	mm [in.]	3050 [120.1]	3250 [128.0]	3400 [133.9]	3400 [133.9]
	Tread, front wheels	mm [in.]	2050 [80.7]	2160 [85.0]	2300 [90.6]	2300 [90.6]
	rear wheels	mm [in.]	2050 [80.7]	2160 [85.0]	2300 [90.6]	2300 [90.6]

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			L27-3, LX130-7	L32-3 , LX160-7	L35-3, LX190-7	L40-3, LX230-7
Dimensions	Front overhang, in carry position	mm [in.]	2550 [100.4]	2720 [107.1]	2790 [109.8]	2900 [114.2]
	Rear overhang angle	°	32	31	29	31
	Min. ground clearance, center hinge pin	mm [in.]	405 [15.9]	470 [18.5]	460 [18.1]	520 [20.5]
	Bucket hinge pin height	mm [in.]	3890 [153.1]	4040 [159.1]	4180 [164.6]	4385 [172.6]
	Dumping height, at 45° discharge angle	mm [in.]	2770 [109.1]	2875 [113.2]	2985 [117.5]	3135 [123.4]
	Reach, at 45° discharge angle	mm [in.]	1060 [41.7]	1180 [46.5]	1135 [44.7]	1210 [47.6]
	Bucket roll-back angle, in carry position	°	50	50	50	50
	Bucket dumping angle, bucket fully raised	°	50	50	50	50
	Digging depth, bucket tilted forward 10°	mm [in.]	320 [12.6]	330 [13.0]	335 [13.2]	350 [13.8]
	Towing pin height	mm [in.]	1080 [42.5]	1165 [45.9]	1285 [50.6]	1345 [53.0]
Weight	Weight of loader	kg [lbs]	13700 [30210]	17000 [37490]	19700 [43440]	21700 [47850]

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1. ENGINE AND RELATED COMPONENTS

1.1 ENGINE

1. General Description

The engine mounted on this loader is a 4-cycle, water-cooled, in-line direct-injection type diesel engine. Each engine is equipped with a turbocharger.

The engine is mounted at the rear of the loader and its power is transmitted through the flywheel, coupling gear, and the torque converter, into the transmission.

On the Models L27-3 and LX130-7, the flywheel and torque converter are connected through the input plate instead of the coupling gear.

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(1) L27-3, LX130-7 · L32-3, LX160-7 (ISUZU "6HK1T" Diesel Engine)

Name	ISUZU "BB-6HK1T" Diesel Engine
Type	4-cycle, water-cooled, in-line vertical, direct-injection type with turbocharger
Number of cylinders – bore x stroke	6 – 115 mm [4.53 in.] x 125 mm [4.9 in.]
Total displacement	7.790 L [475.4 $in.^3$]
Compression ratio	17.3
Engine performance	
Rated speed	2300 rpm for L27-3, LX130-7, 2200 rpm for L32-3, LX160-7
Rated output	129 kW {175 ps} for L27-3, LX130-7 143 kW {195 ps} for L32-3, LX160-7
Maximum torque	599 N-m {61 kgf-m} [441 lbf-ft] (at approx. 1600 rpm) for L27-3, LX130-7 735 N-m {75 kgf-m} {542 lbf-ft] (at approx. 1500 rpm) for L32-3, LX160-7
Full-load min. fuel consumption ratio	208 g/kWh {153 g/psh} (at approx. 1500 rpm) for L27-3, LX130-7 214 g/kWh {157 g/psh} (at approx. 1600 rpm) for L32-3, LX160-7
Dry weight	About 650 kg [1433 lbs]
Dimensions (overall length x overall width x overall height)	1330.5 mm x 846.5 mm x 1403.0 mm [52.38 in. x 33.33 in. x 55.24 in.]
Firing order	1 – 5 – 3 – 6 – 2 – 4
Rotational direction	Clockwise when viewed from cooling fan
Unloaded max. speed (when separately measured)	2600 rpm or less for L27-3, LX130-7 2440 rpm or less for L32-3, LX160-7
Unloaded min. speed (when separately measured)	850 ± 25 rpm
Allowable tilting angle	30° in four directions when viewed from flywheel
Maintenance data	
Valve opening and closing time	Intake valve (open): 15° before TDC Intake valve (closed): 44° after BDC Exhaust valve (open): 58° before BDC Exhaust valve (closed): 11° after TDC
Valve clearance	Intake valve (cold): 0.4 mm [0.016 in.] Exhaust valve (cold): 0.4 mm [0.016 in.]
Injection timing	7° before TDC
Injection start pressure	18.1 MPa {185 kgf/cm^2} [2631 psi]
Compression pressure	3.2 MPa {33 kgf/cm^2} [469 psi] (at 200 rpm)

Note: For the maintenance of the engine proper, see the Model BB-6HK1 Engine Workshop Manual (No. IDE-2380) published by Isuzu Motors LTD.

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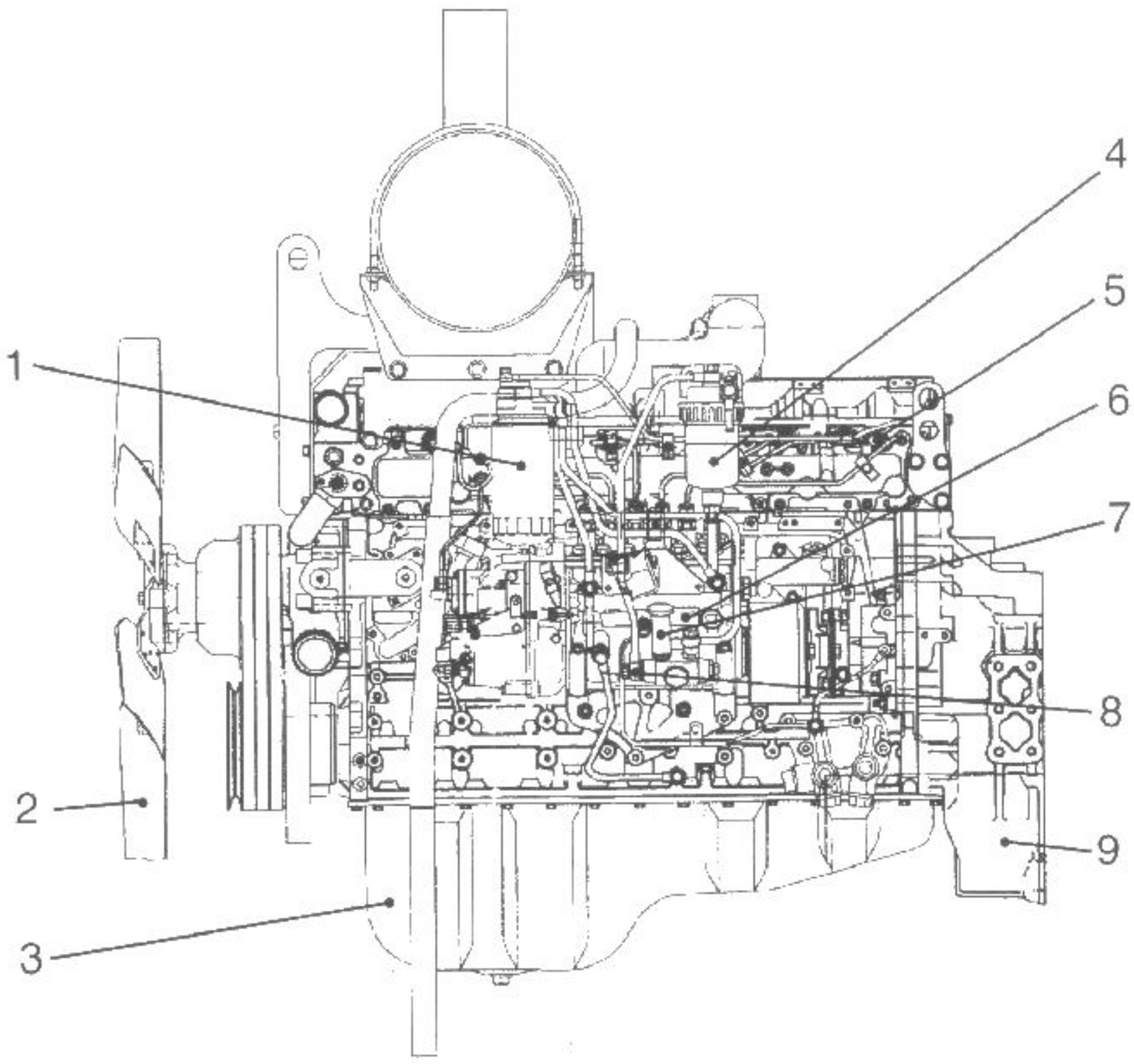
(2) L35-3, LX190-7 · L40-3, LX230-7 (MITSUBISHI "6D24-TL" Diesel Engine)

Name	MITSUBISHI "6D24-TL" Diesel Engine
Type	4-cycle, water-cooled, in-line vertical, direct-injection type with turbocharger and inter-cooler
Number of cylinders – bore x stroke	6 – 130 mm [5.1 in.] x 150 mm [5.9 in.]
Total displacement	11.94 L [727.1 in.^{3}]
Compression ratio	17.5
Engine performance	
Rated speed	2100 rpm
Rated output	165 kW {225 ps} (at 2100 rpm) for L35-3, LX190-7 198 kW {270 ps} (at 2100 rpm) for L40-3, LX230-7
Maximum torque	980 N-m {100 kgf-m} [723 lbf-ft] (at approx. 1400 rpm) for L35-3, LX190-7 1176 N-m {120 kgf-m} [868 lbf-ft] (at approx. 1400 rpm) for L40-3, LX230-7
Full-load min. consumption ratio	212 g/kWh {156 g/psh} (at 1300 to 1400 rpm)
Dry weight	About 1020 kg [2249 lbs]
Dimensions (overall length x overall width x overall height)	1497 mm x 931 mm x 1511 mm [58.9 in. x 36.7 in. x 59.5 in.]
Firing order	1 – 5 – 3 – 6 – 2 – 4
Rotational direction	Clockwise when viewed from cooling fan
Unloaded max. speed (when separately measured)	2250 ± 20 rpm
Unloaded min. speed (when separately measured)	800 ± 30 rpm
Allowable tilting angle	30° in four directions when viewed from flywheel
Maintenance data	
Valve opening and closing time	Intake valve (open): 18° before TDC Intake valve (closed): 50° after BDC Exhaust valve (open): 50° before BDC Exhaust valve (closed): 18° after TDC
Valve clearance	Intake valve (cold): 0.4 mm [0.016 in.] Exhaust valve (cold): 0.6 mm [0.024 in.]
Injection timing	Electronic control
Injection start pressure	15.7 MPa {160 kgf/cm^2} [2276 psi]
Compression pressure	2.7 MPa {28 kgf/cm^2} [398 psi] (at 200 rpm)

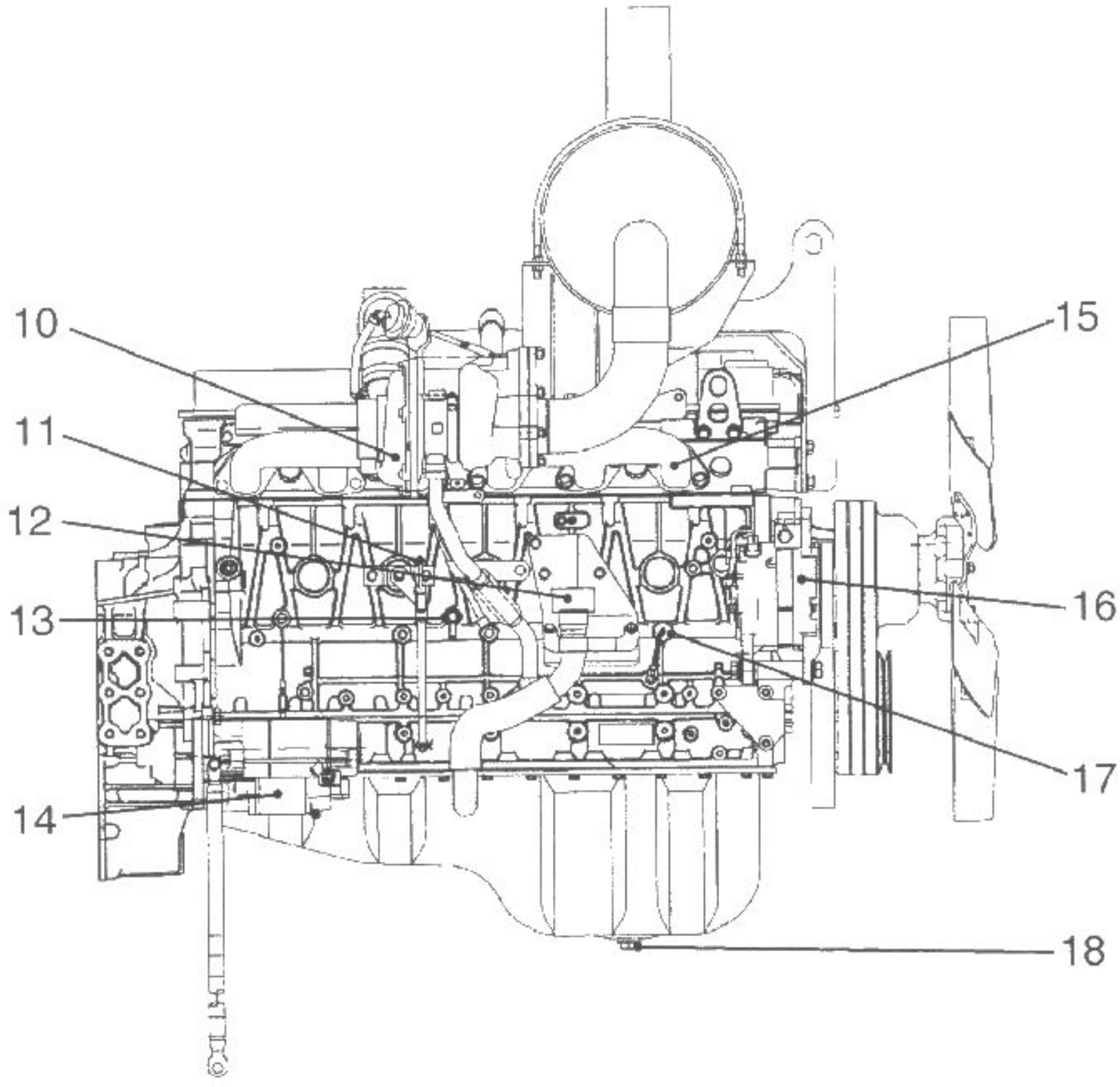
Note: For the maintenance of the engine proper, see the Model 6D2 Engine Shop Manual (No. 97841-02021) published by Mitsubushi Fuso Truck & Bus Co.

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2. Outer Views



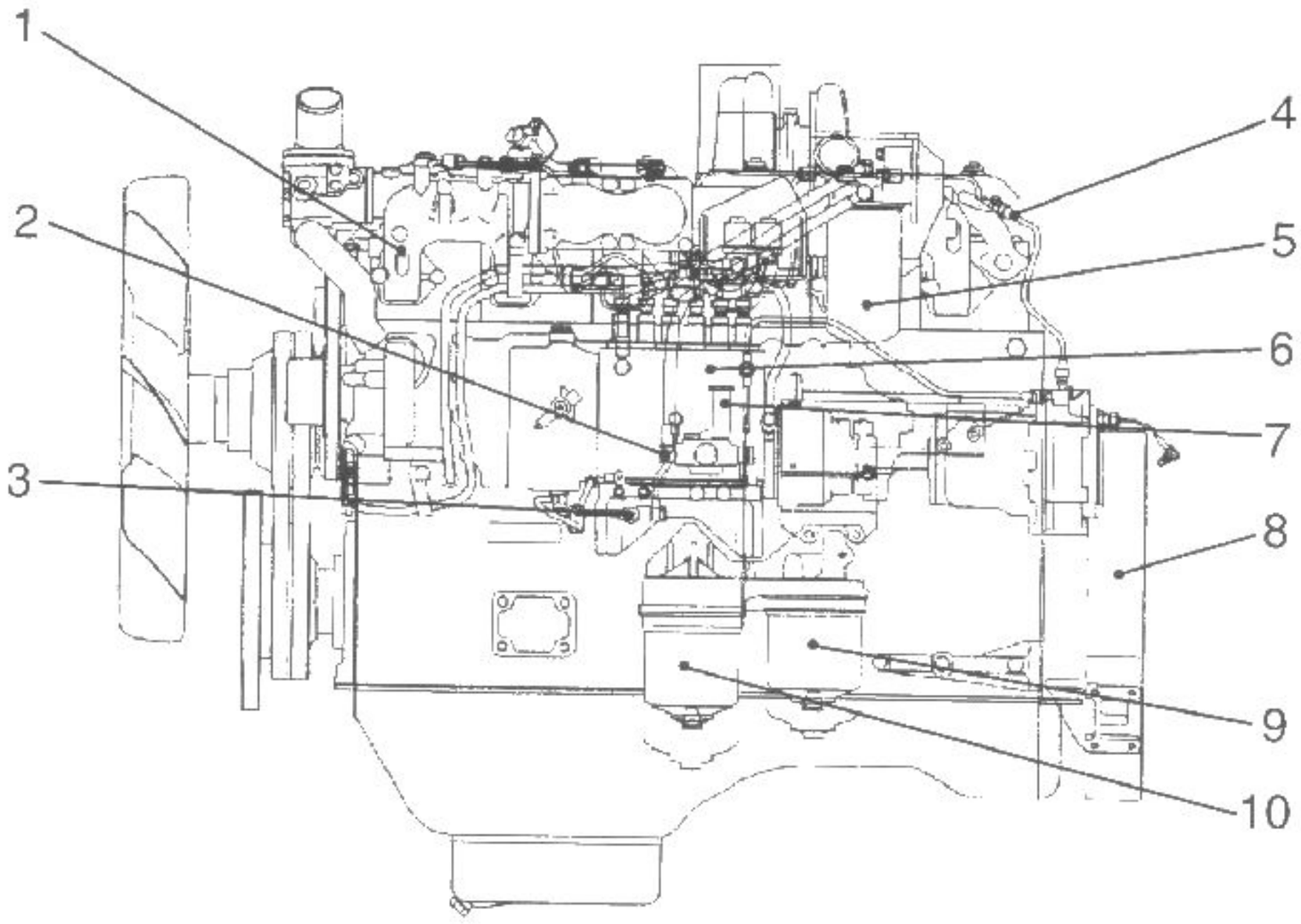
1. FUEL FILTER
2. COOLING FAN
3. OIL PAN
4. WATER SEDIMENTER
5. NOZZLE HOLDER
6. INJECTION PUMP
7. PRIMING PUMP
8. GAUZE FILTER
9. FLYWHEEL HOUSING



10. TURBOCHARGER
11. OIL LEVEL GAUGE
12. OIL FILLER CAP
13. WATER DRAIN COCK
14. STARTER MOTOR
15. EXHAUST MANIFOLD
16. ALTERNATOR
17. OIL PRESSURE SWITCH
18. DRAIN PLUG

Fig. 1.1 6HK1T Diesel Engine (L27-3, LX130-7 · L32-3, LX160-7)

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1. INLET MANIFOLD
2. GAUZE FILTER
3. OIL PRESSURE SWITCH
4. NOZZLE HOLDER
5. FUEL FILTER
6. INJECTION PUMP
7. PRIMING PUMP
8. FLYWHEEL HOUSING
9. OIL FILTER (DIVIDED FLOW)
10. OIL FILTER (FULL FLOW)

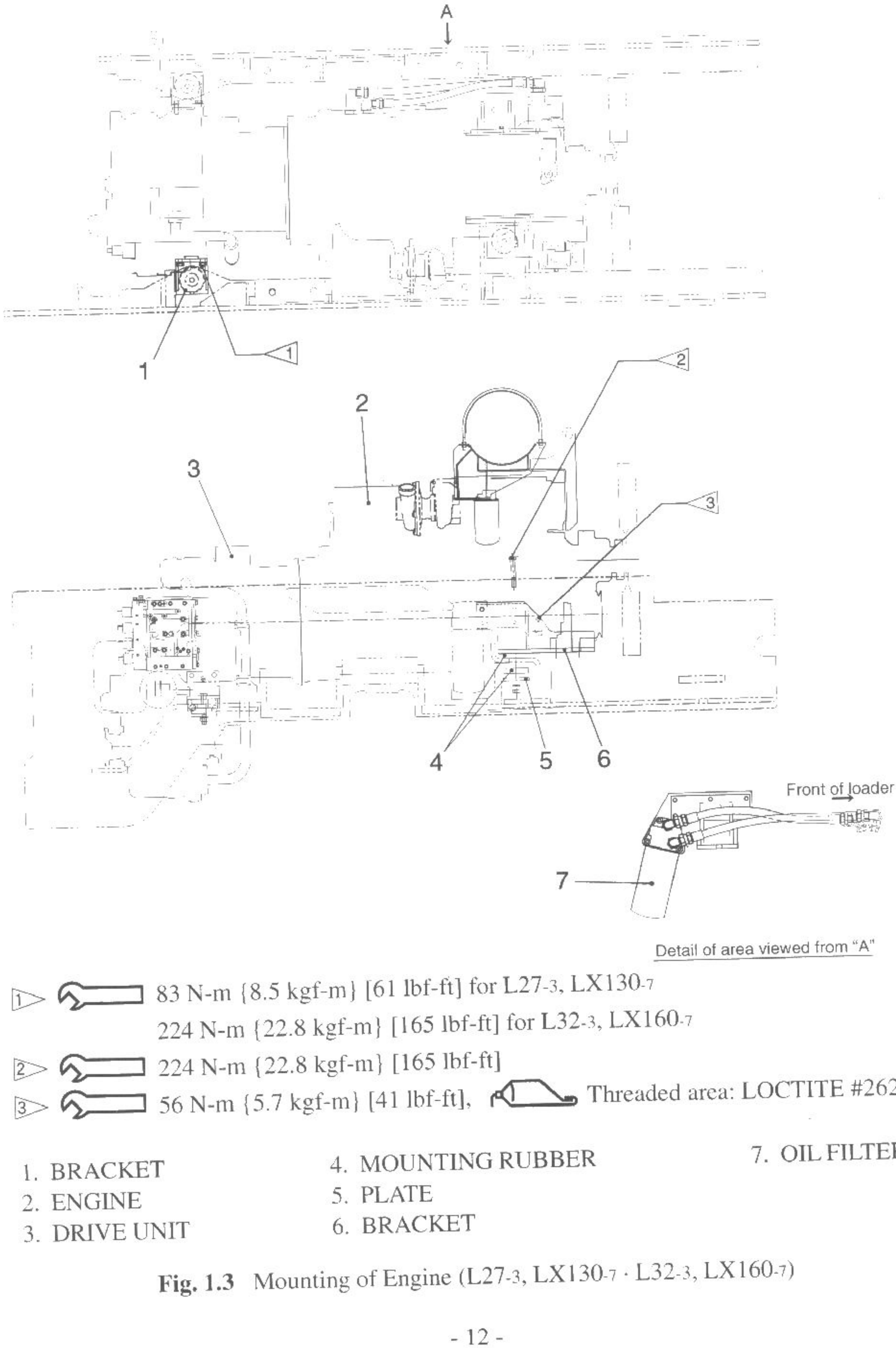
11. TURBOCHARGER
12. EXHAUST MANIFOLD
13. WATER DRAIN COCK
14. OIL LEVEL GAUGE
15. STARTER MOTOR
16. OIL FILLER CAP
17. COOLING FAN
18. ALTERNATOR
19. OIL PAN
20. DRAIN PLUG

Fig. 1.2 6D24-TL Engine (L35-3, LX190-7 · L40-3, LX230-7)

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3. Engine Mounting

The engine is connected to the drive unit and supported to the rear frame at 4 points on the right and left sides, with mounting rubbers at both sides of the cylinder body.

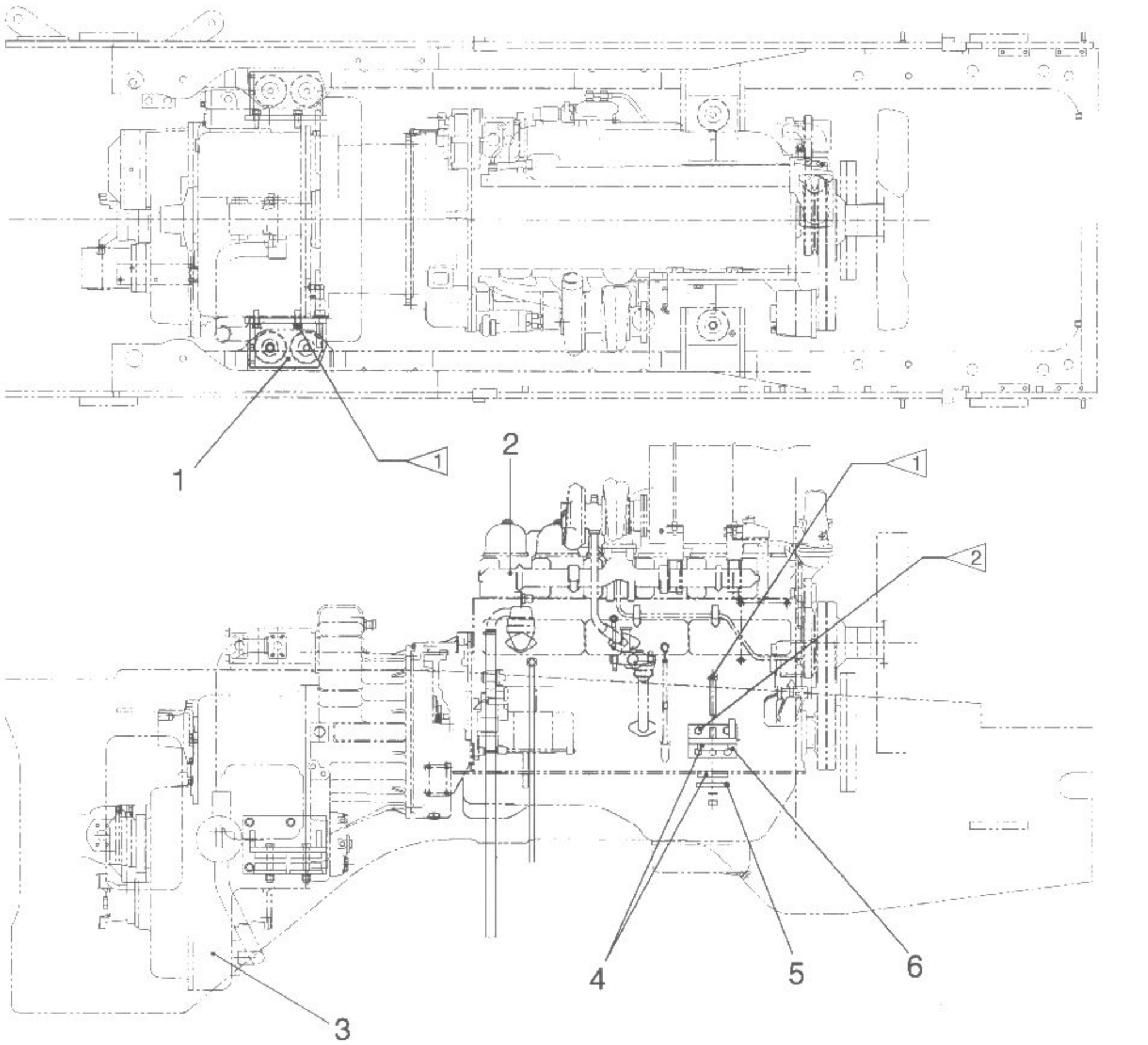


Note: 1▷ 83 N-m {8.5 kgf-m} [61 lbf-ft] for L27-3, LX130-7
224 N-m {22.8 kgf-m} [165 lbf-ft] for L32-3, LX160-7
2▷ 224 N-m {22.8 kgf-m} [165 lbf-ft]
3▷ 56 N-m {5.7 kgf-m} [41 lbf-ft], Threaded area: LOCTITE #262

1. BRACKET
2. ENGINE
3. DRIVE UNIT
4. MOUNTING RUBBER
5. PLATE
6. BRACKET
7. OIL FILTER

Fig. 1.3 Mounting of Engine (L27-3, LX130-7 · L32-3, LX160-7)

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Note: 1 ▷ 224 N-m {22.8 kgf-m} [165 lbf-ft]
2 ▷ 88 N-m {9 kgf-m} [65 lbf-ft]

1. BRACKET
2. ENGINE
3. DRIVE UNIT
4. MOUNTING RUBBER
5. PLATE
6. BRACKET

Fig. 1.4 Mounting of Engine (L35-3, LX190-7 · L40-3, LX230-7)

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1.2 LUBRICATING SYSTEM

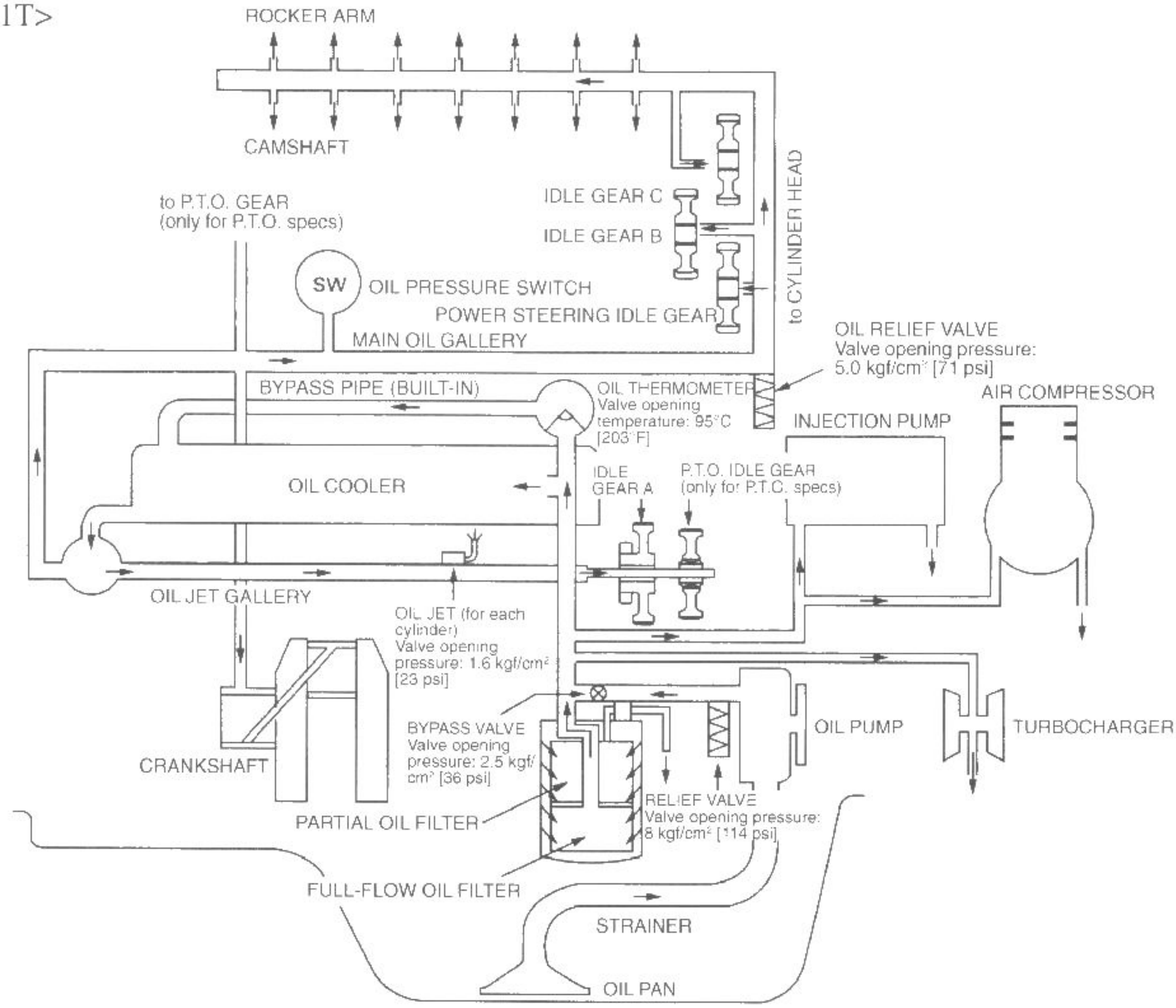
	L27-3, LX130-7 · L32-3, LX160-7 (6HK1T)	L35-3, LX190-7 · L40-3, LX230-7 (6D24-TL)
Lubrication	Forced circulation method by oil pump	←
Lubricating pump	Gear pump, crankshaft driven	Gear pump, gear driven
Filtration	Full-flow and divided-flow paper, cartridge type	Combination of full-flow paper type and bypass flow type, center bolt type
Cooling	Water-cooling type	←
Oil pressure adjuster	Regulator valve	←
Lubricating oil capacity	Max. 19 L [5.0 U.S. gal.] Min. 14 L [3.7 U.S. gal.]	Max. 38 L [10.0 U.S. gal.] Min. 25 L [6.6 U.S. gal.]

The engine parts are lubricated by forced circulation method by the oil pump. The engine oil is picked up from the oil pan by the oil pump and directed under pressure, through the oil filter and the oil cooler, to the oil gallery from which the engine oil is delivered to each section for lubrication, before returning back into the oil pan.

The occurrence of an abnormal engine oil pressure is monitored by the oil pressure switch and displayed by way of the "engine oil pressure" warning light of the cluster meter on the dashboard.

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<6HK1T>



<6D24-TL>

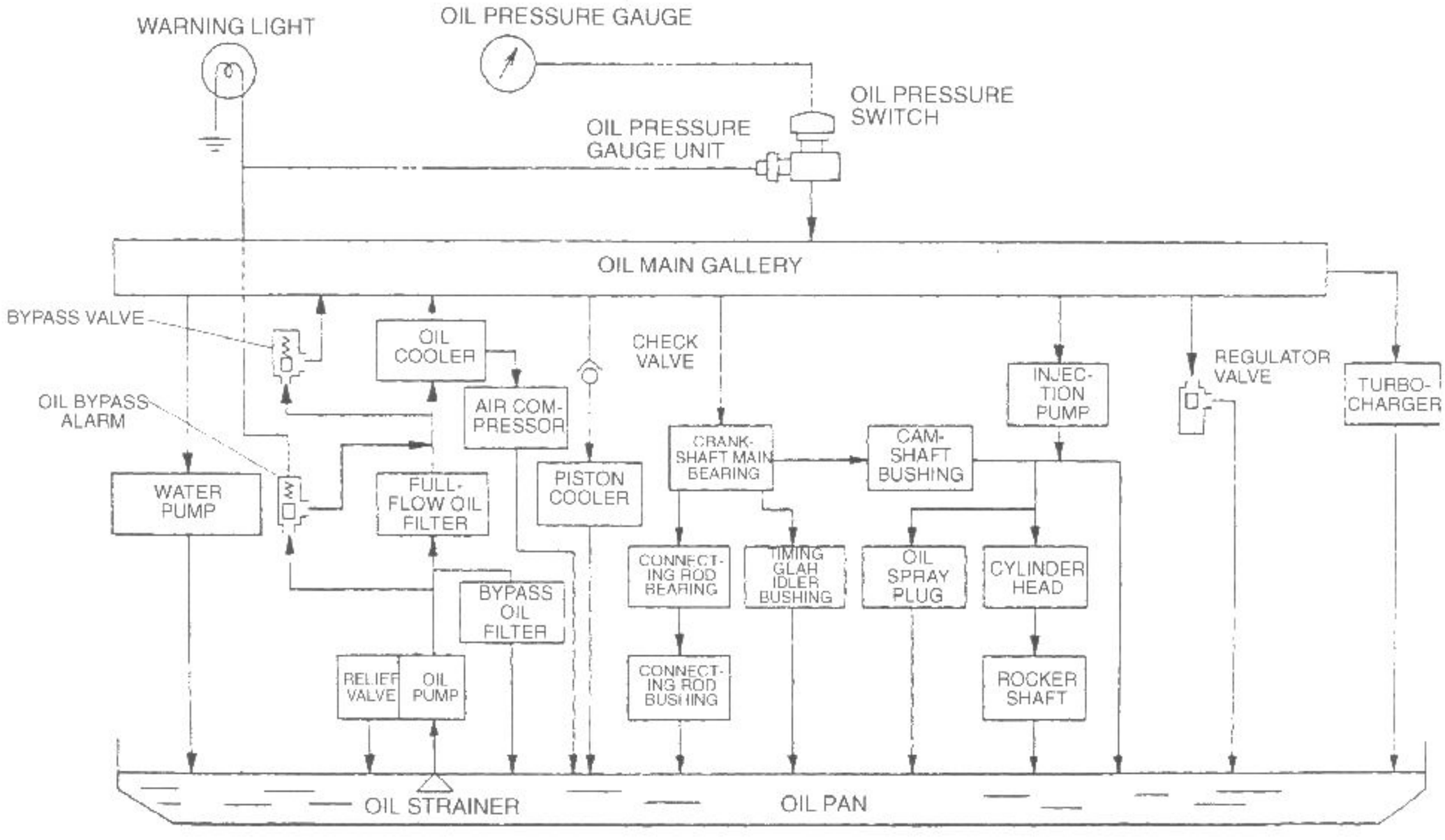


Fig. 1.5 Schematic Diagram of Engine Lubricating System

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1.3 COOLING SYSTEM

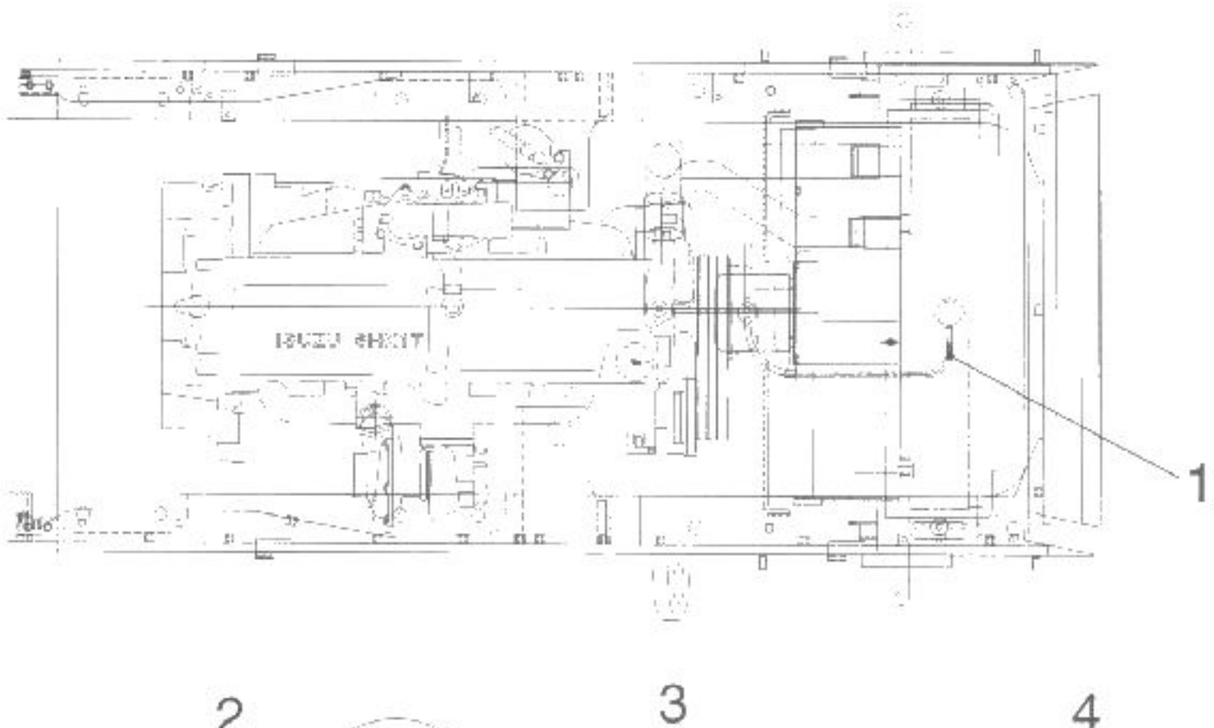
	L27-3, LX130-7 (6HK1T)	L32-3, LX160-7 (6HK1T)	L35-3, LX190-7 · L40-3, LX230-7 (6D24 – TL)
Cooling	Water-cooled forced circulation type	←	←
Cooling fan			
Type	Plate type, discharge,	←	←
	750 mm [29.5 in.] dia. 6-bladed	←	680 mm [26.8 in.] dia. 8-bladed
Driving	Belt driven	←	←
Water pump	Belt driven, spiral type	←	←
Water thermostat			
Type	Wax type, 1 unit	←	Wax type, 2 units
Temp. at which valve starts opening	82°C [180°F]	←	76.5°C [170°F]
Temp. at which valve fully opens	95°C [203°F]	←	90°C [194°F]
Radiator			
for engine	Plate fin & tube, F-T	Plate fin & tube, PF2-6	Plate fin & tube, PF2-7
for torque converter oil	Multiple plate, P-T	Multiple plate, PTO-OL	←
for hydraulic oil	Corrugated fin & tube, T-CW	Aluminum corrugated fin & tube, CF40-1	←
for inter-cooler	–	–	Corrugated fin type
Dry weight	Approx. 109 kg [240 lbs]	Approx. 180 kg [397 lbs]	Approx. 300 kg [662 lbs]
Cooling water capacity (total capacity)	47.5 L [12.5 U.S. gal.]	63.0 L [16.6 U.S. gal.]	80.0 L [21.1 U.S. gal.]

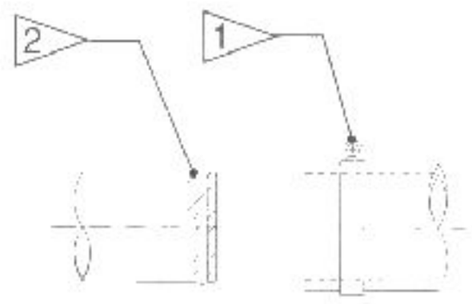
The engine cooling system is a water-cooled forced-circulation type by means of the water pump.

The cooling water is drawn up by the water pump and is sent to each part of the engine for cooling. When the cooling water temperature rises enough to open the thermostat, the cooling water is sent into the radiator for cooling down before flowing into the water pump.

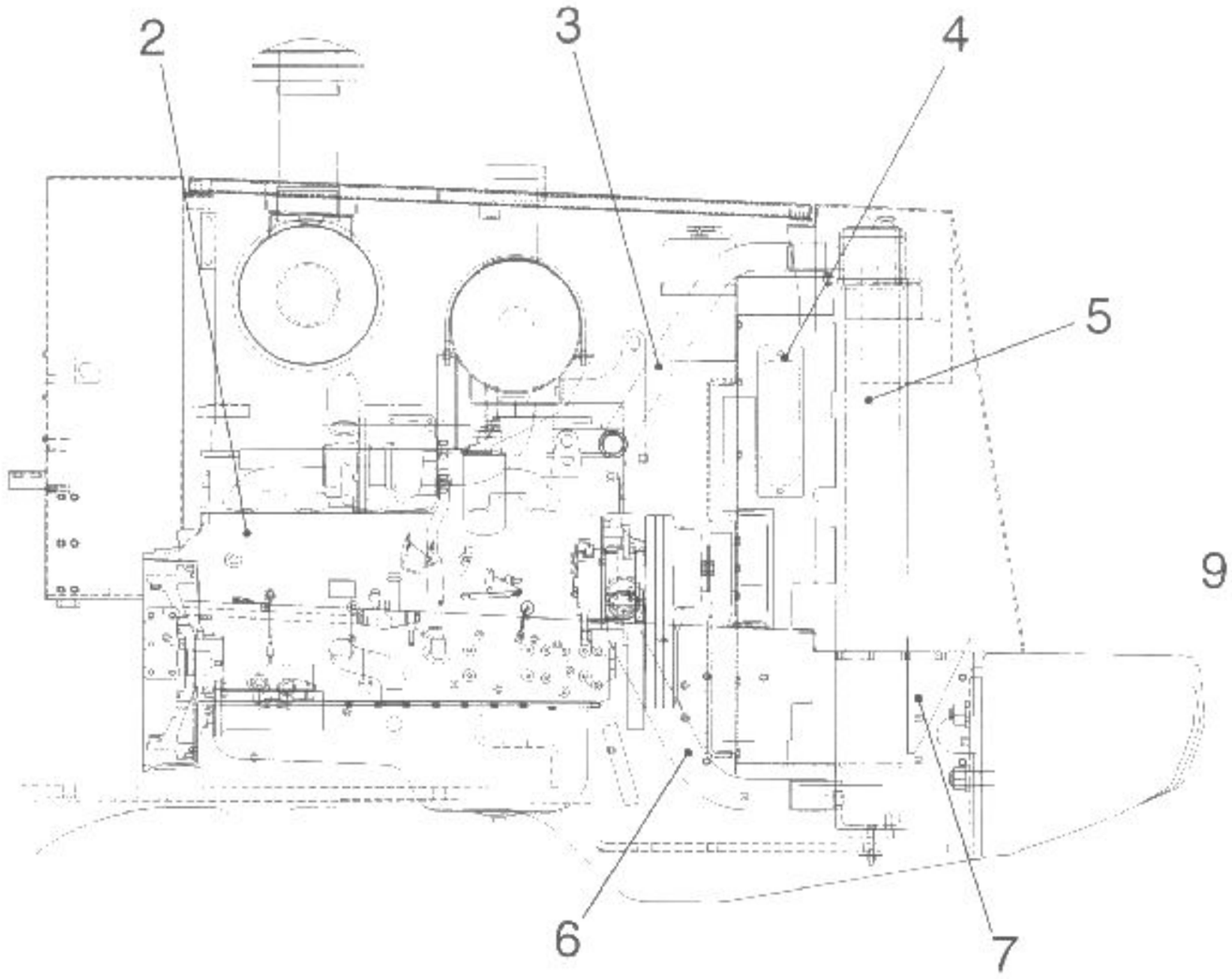
The cooling water temperature is always monitored by the thermosensor and indicated by way of the "engine water temperature gauge" of the cluster meter on the dashboard.

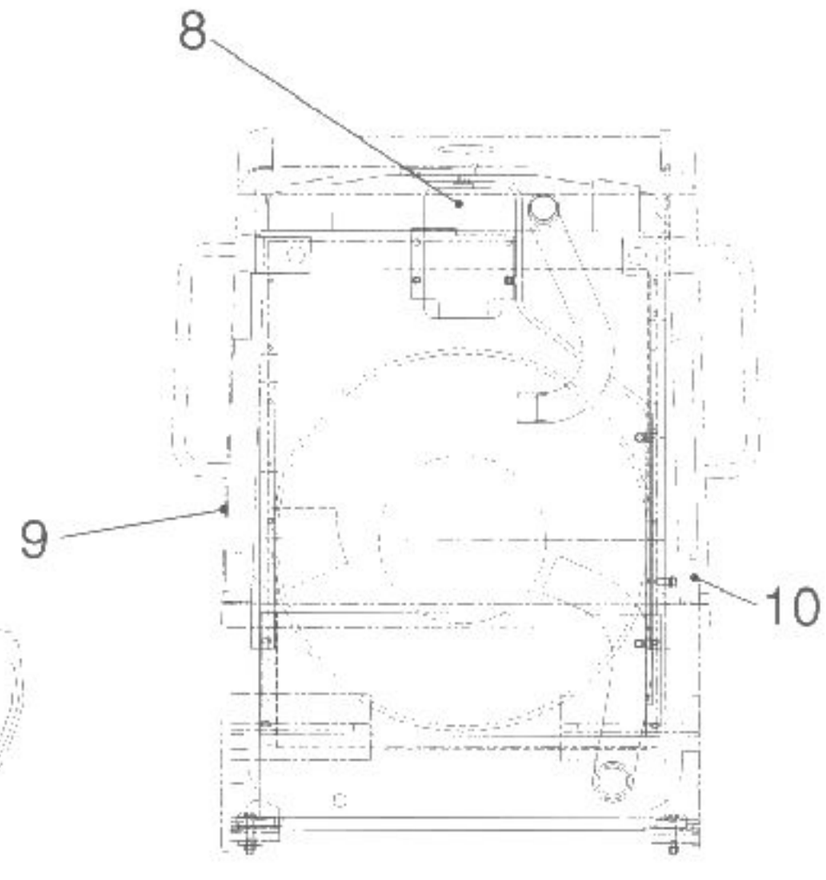
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Installation of radiator hose





Note: The sketches show the cooling system of the L32-3 and LX160-7.

Note: ▷1 5.9 N-m {0.6 kgf-m} [4.3 lbf-ft]

▷2 Tube end: Sealing agent (Japan Hermetic Co., Ltd. Herme-seal SS-80); it should not be applied to the inner side of the hose.

1. HOSE
2. ENGINE
3. RADIATOR UPPER HOSE
4. SIDE COVER
5. RADIATOR
6. RADIATOR LOWER HOSE
7. SHROUD
8. RESERVOIR TANK
9. SHROUD
10. SHROUD

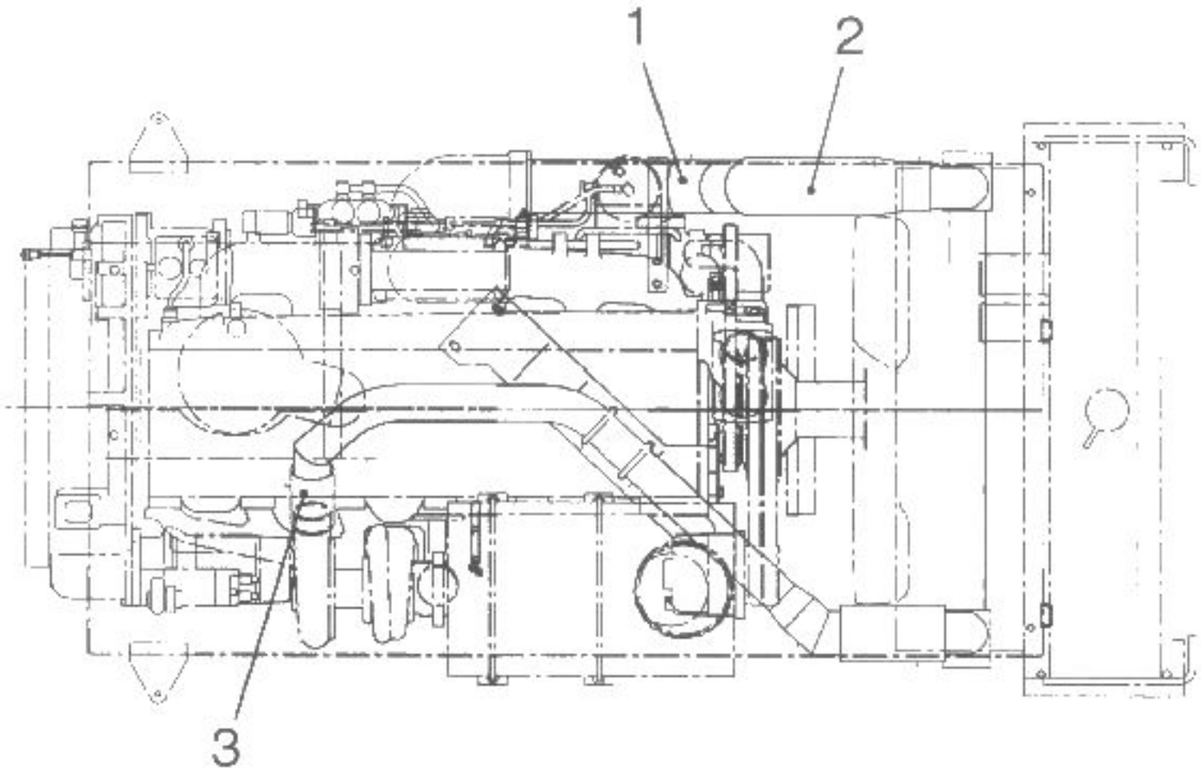
Fig. 1.6 Engine Cooling System

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Inter-cooler (L35-3, LX190-7 · L40-3, LX230-7)

The air compressed by the turbocharger increases in temperature as its pressure rises. If the temperature rises too much, the rate of increase in air will density decrease to lower the efficiency of the turbocharger or cause knocking. To prevent this, an inter-cooler is provided between the turbocharger and the intake manifold to lower the intake air temperature.

The inter-cooler is an air-cooled type which is located in front of the radiator and cooled with the cooling fan.



1. TUBE
2. HOSE
3. HOSE
4. TUBE
5. HOSE
6. INTER-COOLER

Fig. 1.7 Piping of Inter-cooler (L35-3, LX190-7 · L40-3, LX230-7)

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1.4 FUEL SYSTEM

	L27-3, LX130-7 (6HK1T)	L32-3 , LX160-7 (6HK1T)	L35-3, LX190-7 · L40-3, LX230-7 (6D24-TL)
Injection pump	Bosh type (line)	←	Bosh type
Injection nozzle	Porous type	←	←
Fuel feed pump	Plunger type	←	←
Fuel filter	Paper type	←	←
Water sedimenter	Provided	←	←
Governor			
Governing	Centrifugal (mechanical), all-speed control	←	Electronic
Lubrication	Forced circulation type	←	←
Fuel tank			
Capacity	230 L [60.7 U.S. gal.]	265 L [70.0 U.S. gal.]	320 L [84.5 U.S. gal.] for L35-3, LX190-7 345 L [91.2 U.S. gal.] for L40-3, LX230-7
Dry weight	160 kg [353 lbs]	178 kg [392 lbs]	200 kg [441 lbs] for L35-3, LX190-7 210 kg [463 lbs] for L40-3, LX230-7

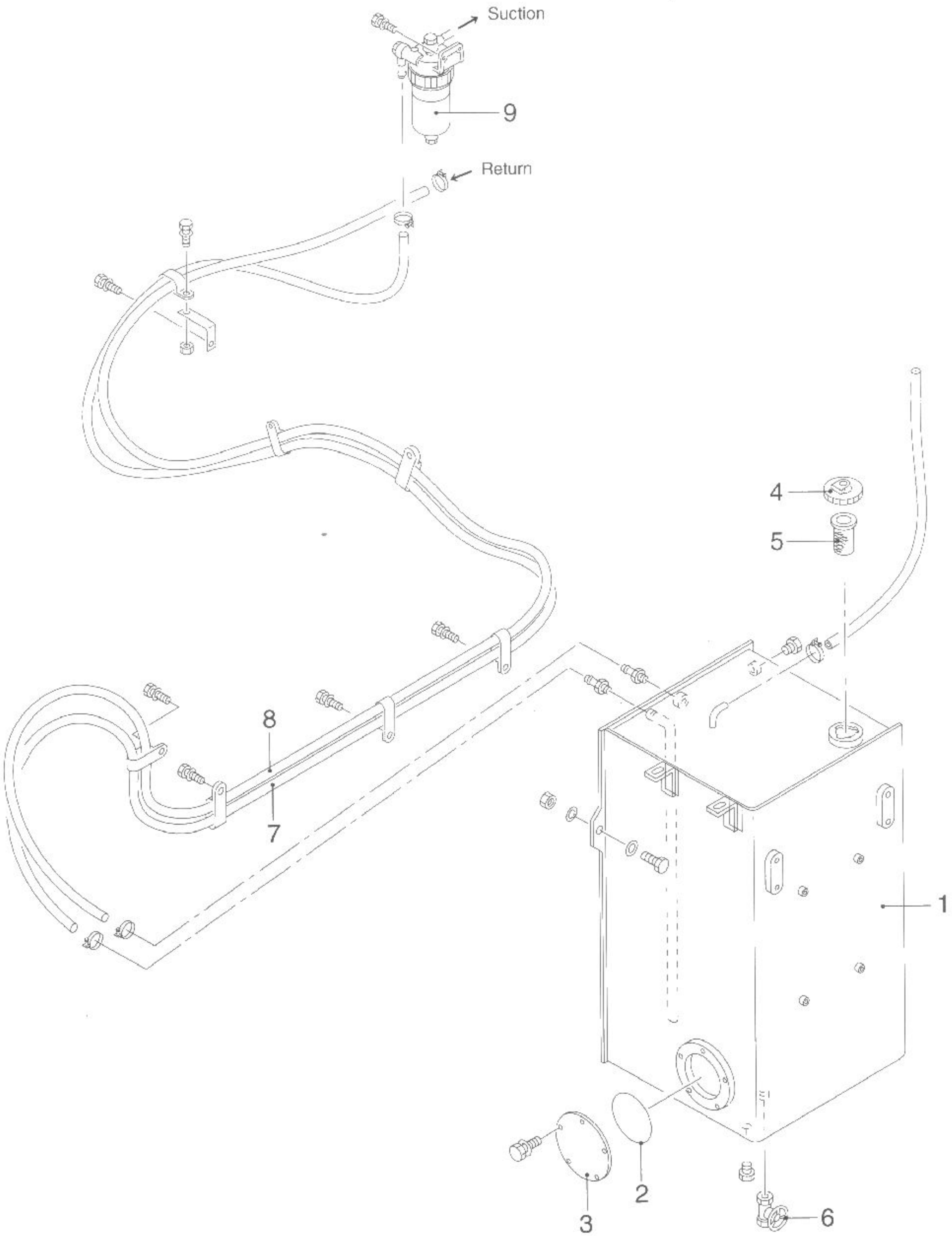
The fuel pump draws fuel from the fuel tank and forces it under pressure through the fuel filter into the injection pump. The fuel is then distributed to the injection nozzle and injected into the combustion chamber.

Fuel tank

The fuel tank is installed on the left side of the rear frame with 3 bolts, with its fuel hoses (suction and return) connected to the engine.

The fuel tank is equipped with a fuel level sender unit linked to the fuel meter on the dashboard, which displays the remaining amount of fuel in the fuel tank.

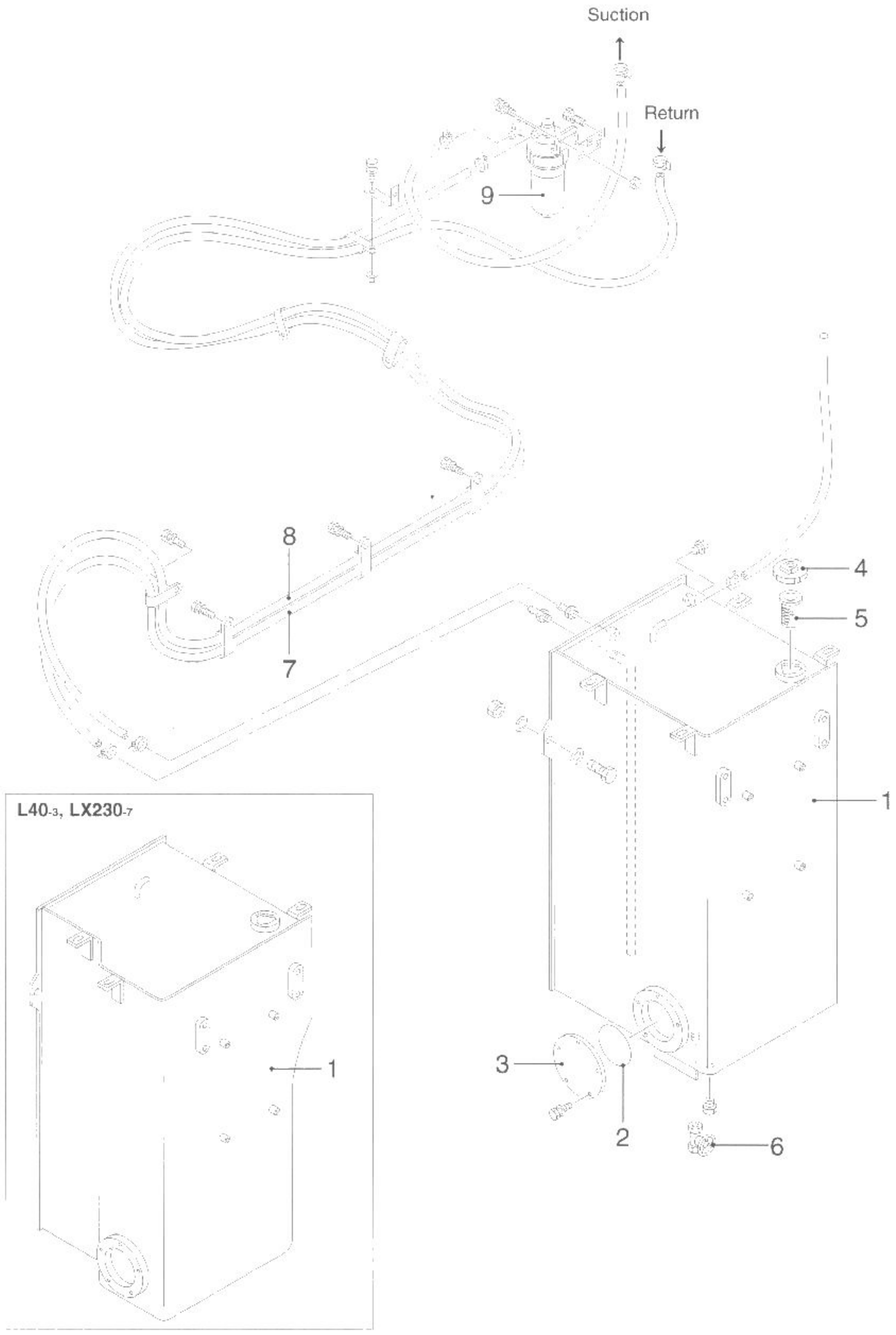
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1. FUEL TANK
2. "O"-RING
3. COVER
4. CAP
5. STRAINER
6. DRAIN COCK
7. SUCTION HOSE
8. RETURN HOSE
9. WATER SEDIMENTER

Fig. 1.8 Fuel System (L27-3, LX130-7 · L32-3, LX160-7)

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1. FUEL TANK
2. "O"-RING
3. COVER
4. CAP
5. STRAINER
6. DRAIN COCK
7. SUCTION HOSE
8. RETURN HOSE
9. WATER SEDIMENTER

Fig. 1.9 Fuel System (L35-3, LX190-7 · L40-3, LX230-7)

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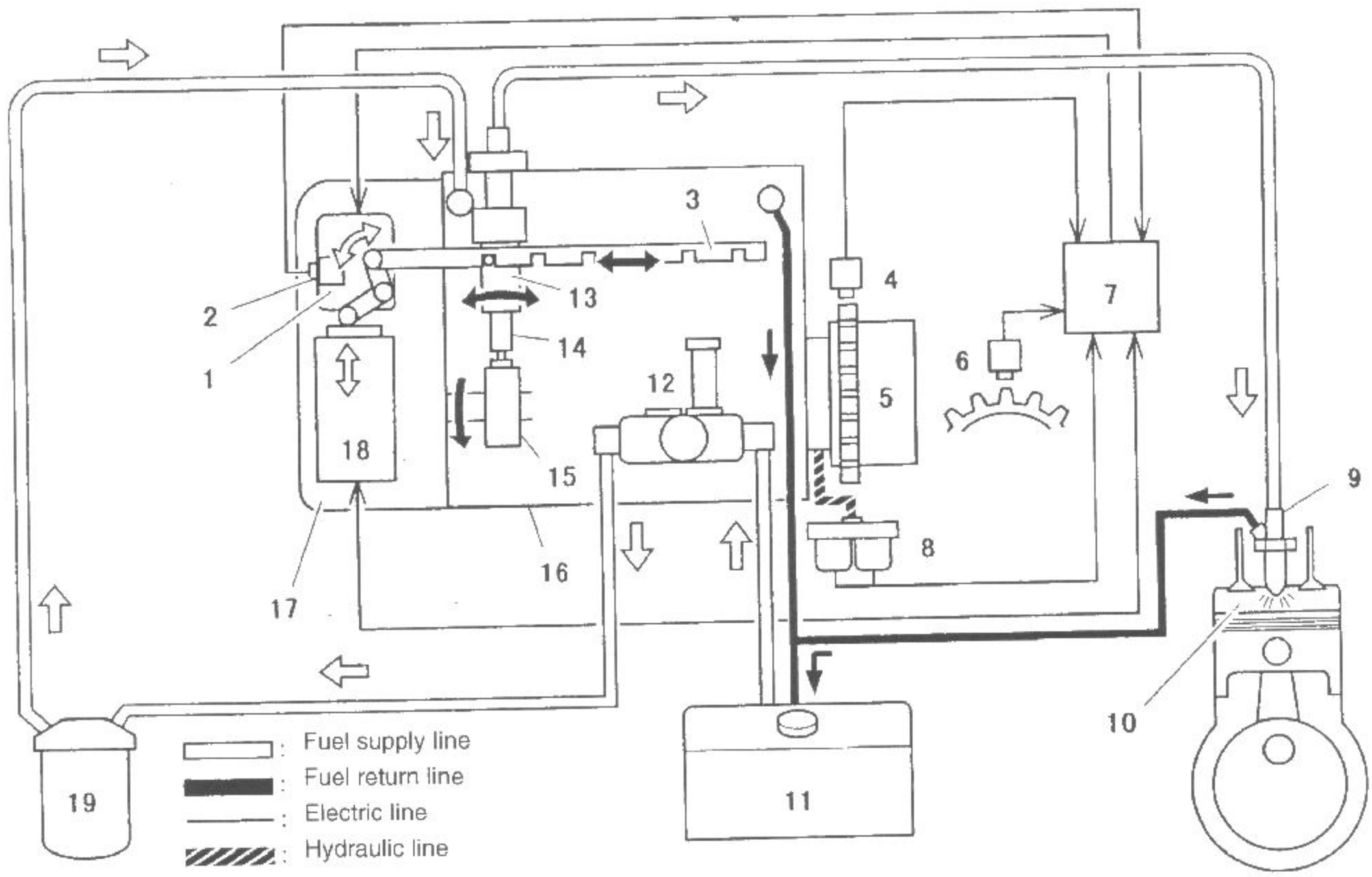
Electronically controlled fuel system (L35-3, LX190-7 · L40-3, LX230-7)

With the electronically controlled injection pump system, electronic control is applied to the governor and timer (the components of the injection pump assembly) to realize the optimum fuel injection timing and fuel injection rate.

The electronic governor electronic control unit optimally controls the governor and timer in accordance with data signals from sensors mounted on the engine and other parts of the vehicle.

● Principle of operation

- The extent of operation of the linear DC motor (17) and timer control valve (8) are determined by signals from the engine electronic control unit (7).
- The linear motor DC (17) moves the control rack (3), thereby changing the fuel injection quantity.
- The timer control valve (8) controls the hydraulic pressure applied to the electronic timer (5), thus adjusting the fuel injection timing.
- The RED-4 internal circuit (1) is incorporated into the electronic governor actuator (18). It contains a control rack position sensor processing circuit and a linear DC motor drive circuit, which are conventionally incorporated into the engine electronic control unit. This arrangement eliminates noise in the harness and thus prevents erroneous electronic control unit operation.
- More accurate electronic control is possible as a result. The engine speed is sensed by engine speed sensor 1 (6) and engine speed sensor 2 (4). Each of these sensors acts as a backup if the other fails.



1. RED-4 INTERNAL CIRCUIT
2. CONTROL RACK POSITION SENSOR
3. CONTROL RACK
4. ENGINE SPEED SENSOR 2
5. ELECTRONIC TIMER
6. ENGINE SPEED SENSOR 1
7. ENGINE ELECTRONIC CONTROL UNIT
8. TIMER CONTROL VALVE
9. INJECTION NOZZLE
10. COMBUSTION CHAMBER
11. FUEL TANK
12. FEED PUMP
13. CONTROL SLEEVE
14. PLUNGER
15. CAMSHAFT
16. INJECTION PUMP
17. LINEAR DC MOTOR
18. ELECTRONIC GOVERNOR ACTUATOR
19. FUEL FILTER

Fig. 1.10 Electronically Controlled Fuel System

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1.5 INTAKE AND EXHAUST SYSTEM

	L27-3, LX130-7 · L32-3, LX160-7 (6HK1T)	L35-3, LX190-7 · L40-3, LX230-7 (6D24-TL)
Air cleaner	Dry filter paper type (FHG12")	Dry filter paper type (L35-3, LX190-7: FHG14") (L40-3, LX230-7: EGB14")
Muffler	Porous separators	←
Turbocharger		
Name	Exhaust-gas turbocharger	←
Turbocharging	Exhaust gas	←
Lubrication	Forced lubrication	←

The intake system of the engine is designed so that the outside open air is drawn through the air cleaner into the intake manifold. The air cleaner is equipped with the dust indicator which leads to the "air cleaner" warning light of the cluster meter on the dashboard. The air cleaner element should be cleaned according to the indication of the warning light.

The exhaust system is designed so that the exhaust gas from the exhaust manifold is discharged through the muffler where the pressure and temperature of the exhaust gas are lowered, and tail pipe into the atmosphere.

⚠ Be careful not to touch the muffler or exhaust manifold since they are hot when the engine is running and for a while after it is shut off; otherwise, you might burn your hand.

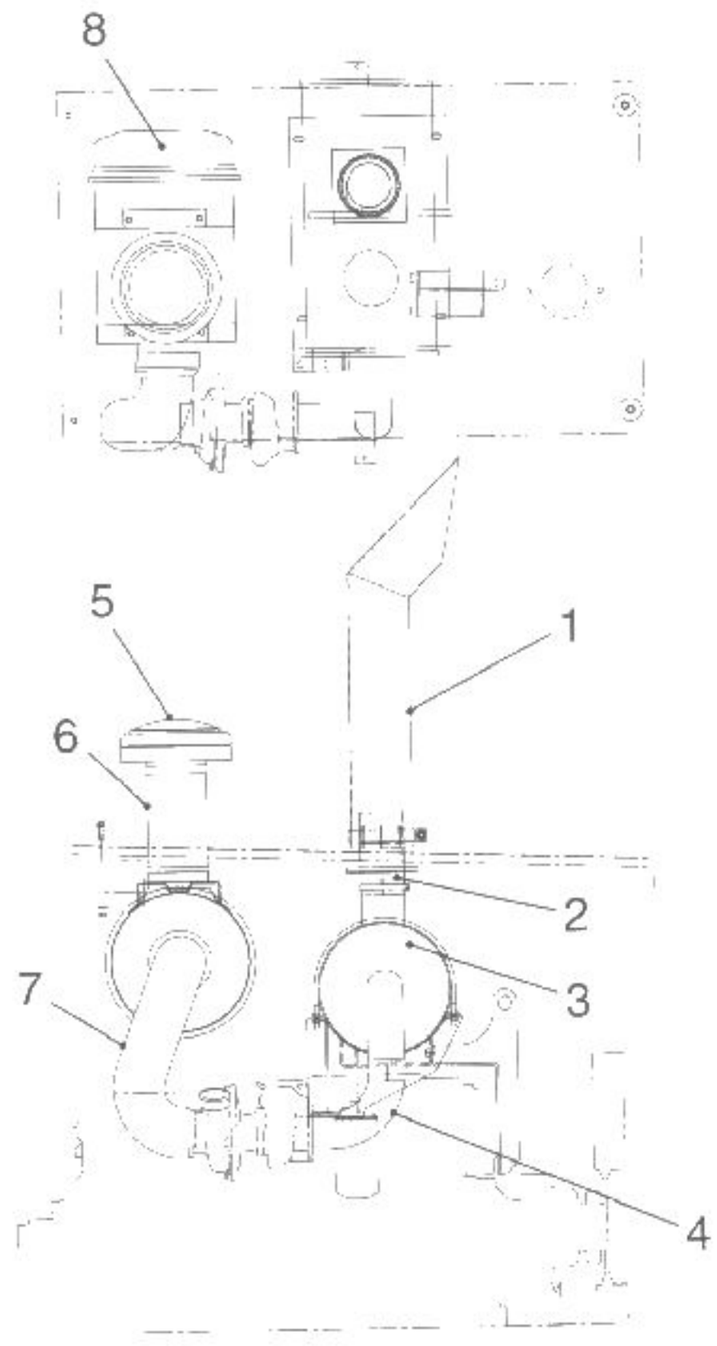
Turbocharger

It is possible to attain high engine output by sending highly compressed air into the cylinders on the intake stroke to increase air supply, thus increasing the quantity of fuel to be injected. To achieve this purpose, the loaders are equipped with an exhaust-gas-driven turbocharger.

The turbocharger's exhaust gas inlet is connected to the exhaust manifold. The exhaust gas rotates the turbine wheel at a high speed, before being routed through the exhaust gas outlet into the muffler.

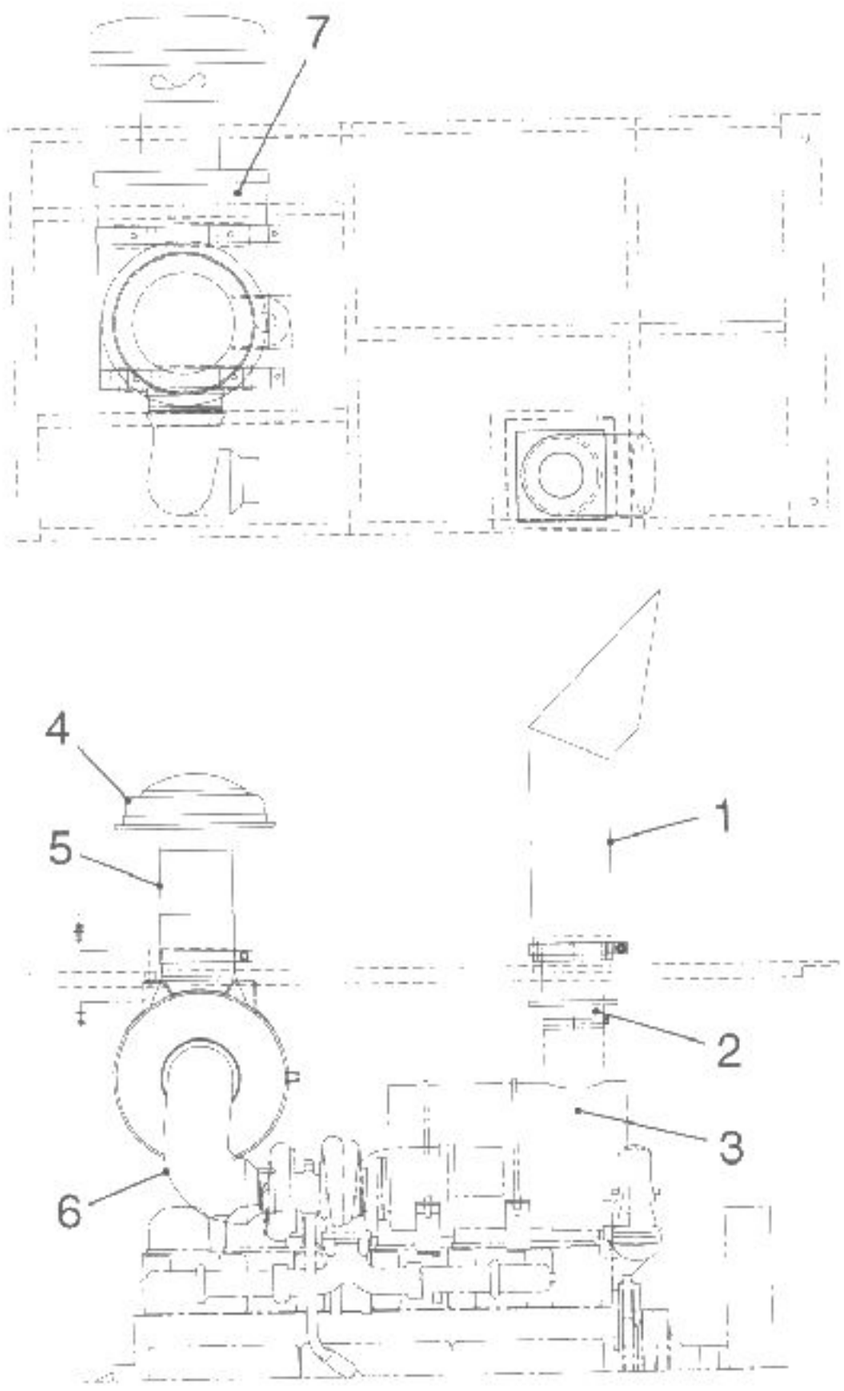
Therefore, the impeller, mounted on the opposite end of the same shaft as the turbine, also rotates at a high speed to compress the air drawn through the air cleaner and send it to the intake manifold.

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1. TAIL PIPE
2. PLATE
3. MUFFLER
4. EXEHAUST PIPE
5. RAIN CAP
6. EXTENSION
7. AIR CLEANER HOSE
8. AIR CLEANER

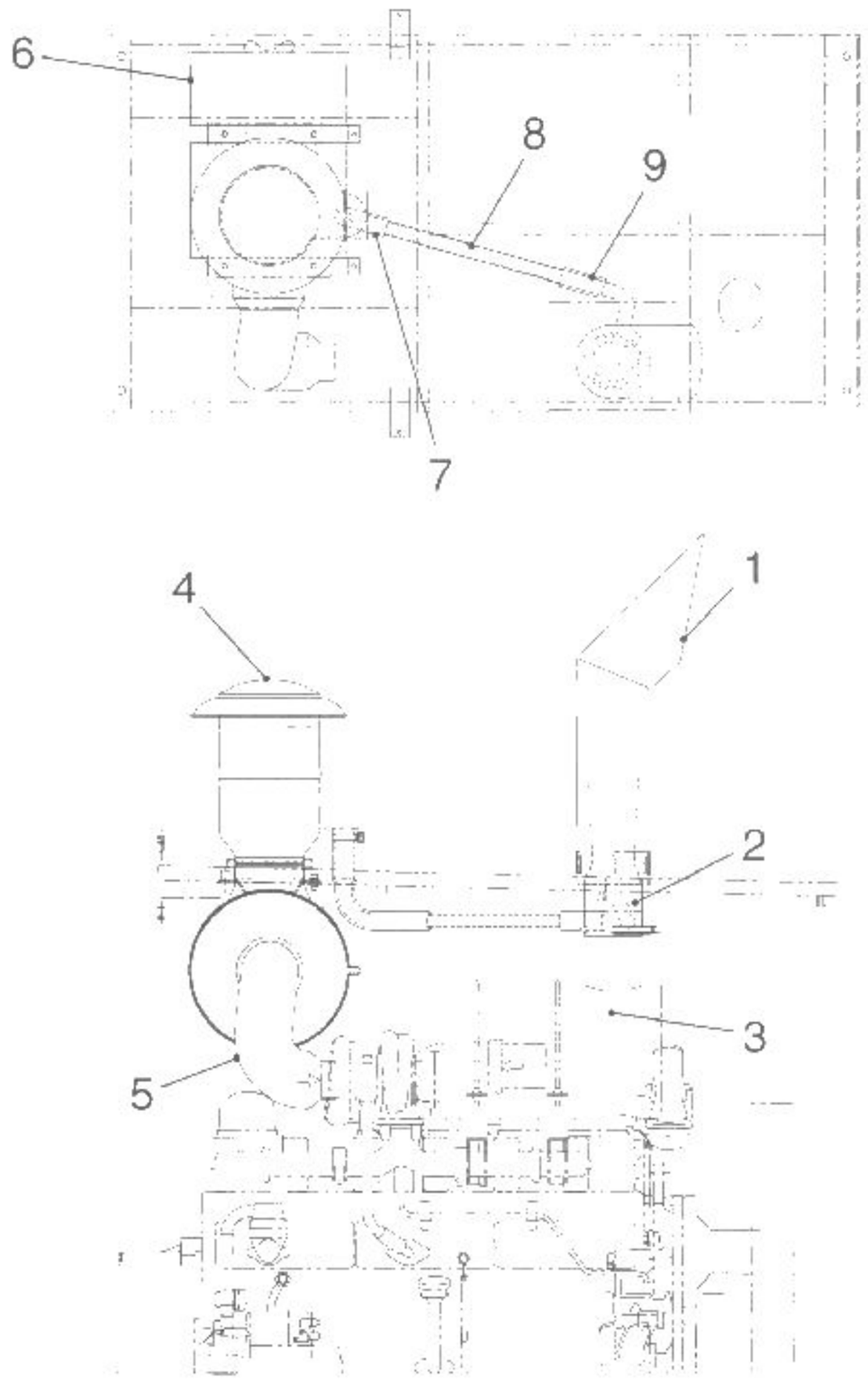
Fig. 1.11 Intake and Exhaust System (L27-3, LX130-7 · L32-3, LX160-7)



1. TAIL PIPE
2. PLATE
3. MUFFLER
4. RAIN CAP
5. EXTENSION
6. AIR CLEANER HOSE
7. AIR CLEANER

Fig. 1.12 Intake and Exhaust System (L35-3, LX190-7)

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1. TAIL PIPE
2. EJECTOR
3. MUFFLER
4. PRECLEANER
5. AIR CLEANER HOSE
6. AIR CLEANER
7. HOSE
8. PIPE
9. HOSE

Fig. 1.13 Intake and Exhaust System (L40-3, LX230-7)

Strut precleaner in operation (L40-3, LX230-7)

The air from the screen hood is sucked into the strut tube where dust is separated from the air by centrifugal force. Then, the dust removed air is sent to the air cleaner.

The dust in the strut tube is sent through the scavenging pipe and hose into the ejector in the tilt pipe. The dust is then automatically discharged with the engine exhaust gas from the tilt pipe to the outside open air.

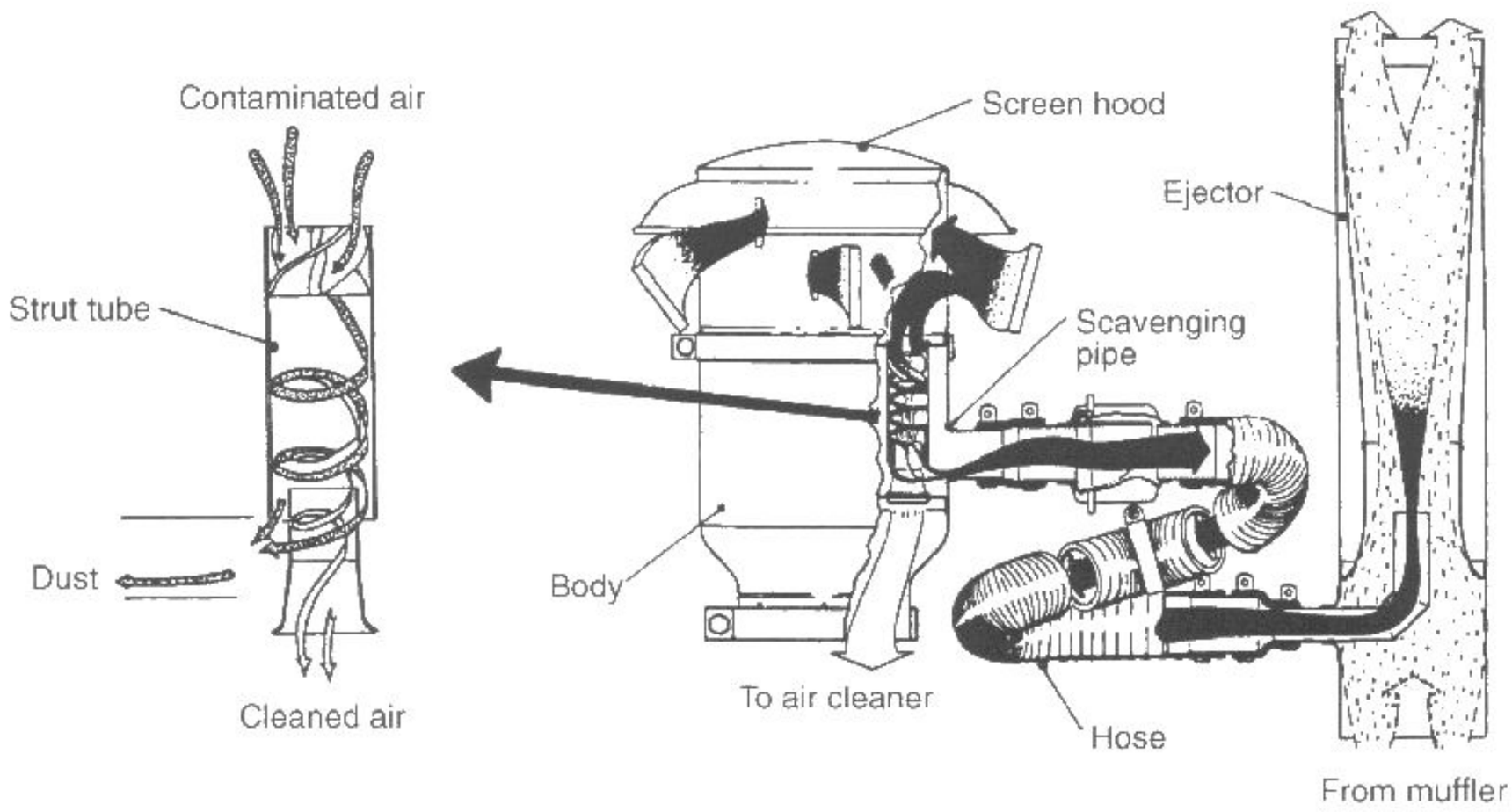


Fig. 1.14 Strut precleaner in operation

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1.6 ELECTRICAL SYSTEM

	L27-3, LX130-7 · L32-3, LX160-7 (6HK1T)	L35-3, LX190-7 · L40-3, LX230-7 (6D24-TL)
Battery		
Voltage and capacity	12 V, 108 Ah (5-hour rate)	←
Quantity	2	←
Weight (per case)	About 35.5 kg [78.3 lbs]	←
Starter motor		
Type	Dry (L27-3, LX130-7) or wet (L32-3, LX160-7), gear reduction type	Wet, gear reduction type
Voltage and output	24 V, 5.0 kW	24 V, 7.0 kW
Start method	Pinion-shift type	←
Alternator		
Type	A/C semiconductor commutation type	←
Voltage and output	24 V, 50 A	←
Driving	Belt-drive	←
Automatic charging regulator	IC regulator (integrated in alternator)	←
Cold start aid	Glow plug	Electric air heater
Stopping device	Key switch type	←

1. Battery

Two batteries are installed inside the battery boxex at the right and left sides of the rear frame. When inspection of the battery unit is needed, open the battery box cover.

⚠ Danger! Use due caution when handling the battery unit.

1. **No fire. No spark. Never smoke or use fire or naked flame near the battery unit since flammable gas is always released from the battery box cover.**
2. **The battery electrolyte is dilute sulfuric acid. It will cause painful and serious burns if it gets on the skin. It can cause blindness if it gets into eyes. If electrolyte gets onto your skin, flush off with copious amount of water and get medical help. If electrolyte gets into your eyes, flush your eyes out with copious amount of water and get to a doctor.**

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2. Electric Circuit

For the electric circuit diagram of the engine, refer to "8.4 Electric Circuit Diagram."

(1) General description

① The engine's cold start aid is a glow plug for the L27-3, LX130-7, L32-3 and LX160-7, and an electric air heater for the L35-3, LX190-7, L40-3 and LX230-7. If a cold engine won't start, turn the starter switch to the ON position to energize the glow plug or the air heater, thus preheating the engine. The engine can be usually preheated by turning the starter switch to ON except when L35-3, LX190-7, L40-3 and LX230-7 have the mechanical governor type engine which can be preheated by turning the starter switch to PREHEAT. Then, turn the starter switch to the START position to crank the engine. For the electronic governor engine of the L35-3, LX190-7, L40-3 and LX230-7, crank it after the engine preheating lamp goes out.

The glow plug is installed on the intake side of the cylinder block. The air heater is installed on the air inlet in the intake manifold.

② The engine shut-off device is a key switch type. Turning the starter switch to OFF will actuate the stop motor (wire motor), the stop solenoid or the governor control servomotor to shut off the engine. (Engine Shut-off Device) For more information on the engine key switch device, refer to "1.7 ENGINE CONTROL UNIT."

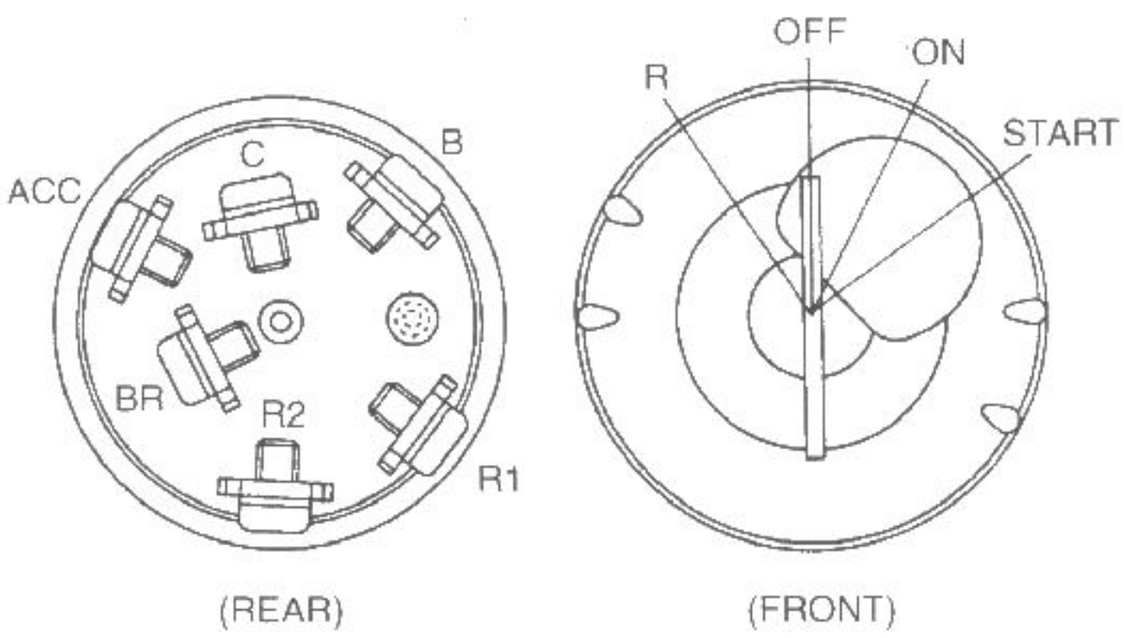
(2) Starter switch

The starter switch has 4 positions: R (Not used), OFF, ON and START.

⚠ Engine Neutral Start

Unless the transmission control switch (shift lever) is in neutral, the engine won't start. (Refer to "2.3.4 TRANSMISSION CONTROL.")

This prevents the loader from moving unexpectedly when the starter switch is turned on.



TERMINAL / POSITION	B	BR	ACC	R1	R2	C
R	○	○	○	○		
OFF						
ON	○	○	○			
START	○	○	○		○	○

Fig. 1.15 Starter Switch

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1.7 ENGINE CONTROL UNIT

1. Accelerator Pedal

The engine speed is controlled by operating the accelerator pedal.

When the accelerator pedal is pressed, the governor control lever of the engine is mechanically actuated through the control cable (L27-3, LX130-7 · L32-3, LX160-7) or the engine governor control servomotor is actuated by the electric signal through the potentiometer and the engine control unit (L35-3, LX190-7 · L40-3, LX230-7), so that an engine speed most suited to the working condition is obtained.

1. ACCELERATOR PEDAL ASSEMBLY
2. CABLE
3. BRACKET
4. ENGINE
5. ACCELERATOR SWITCH

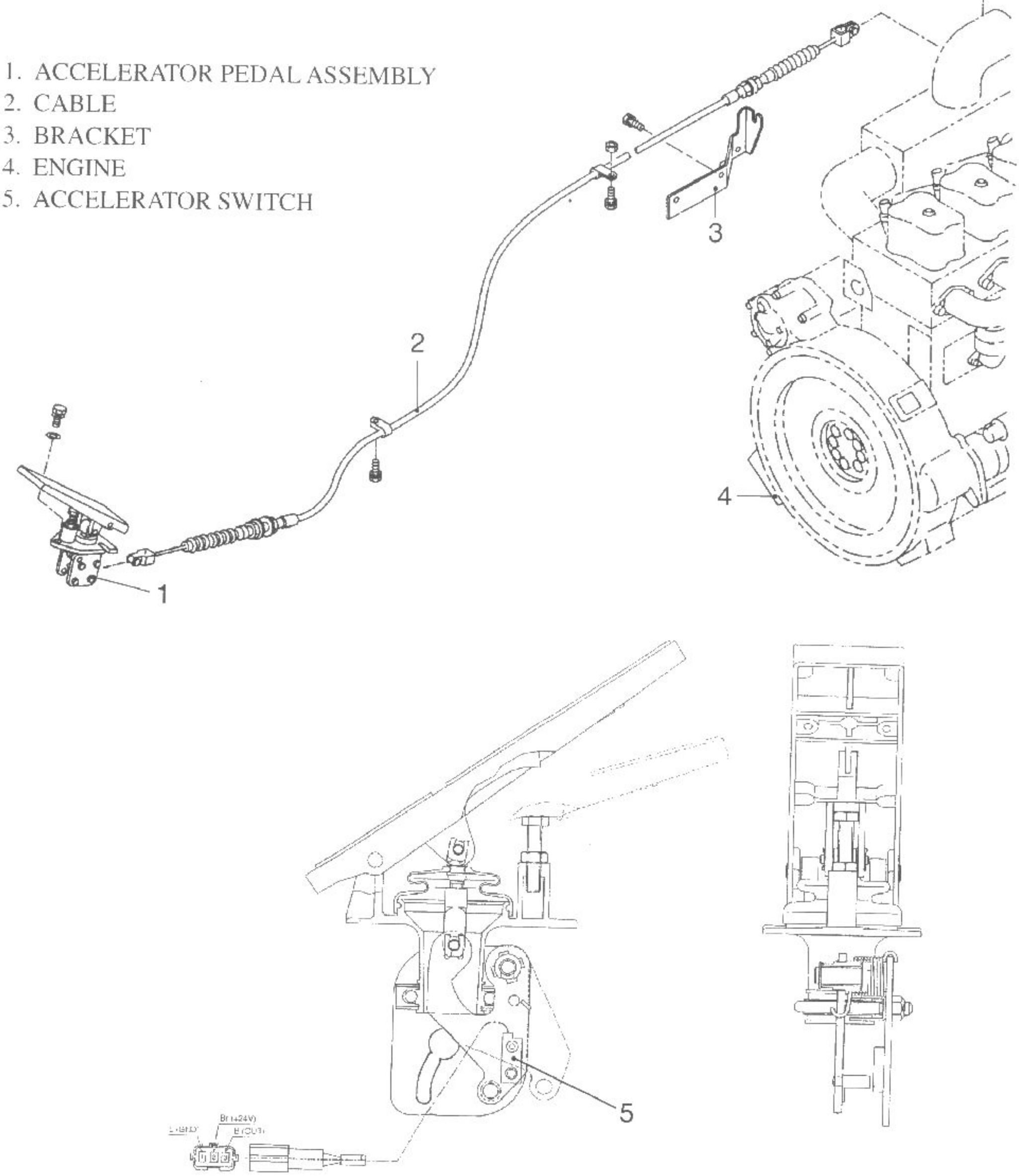
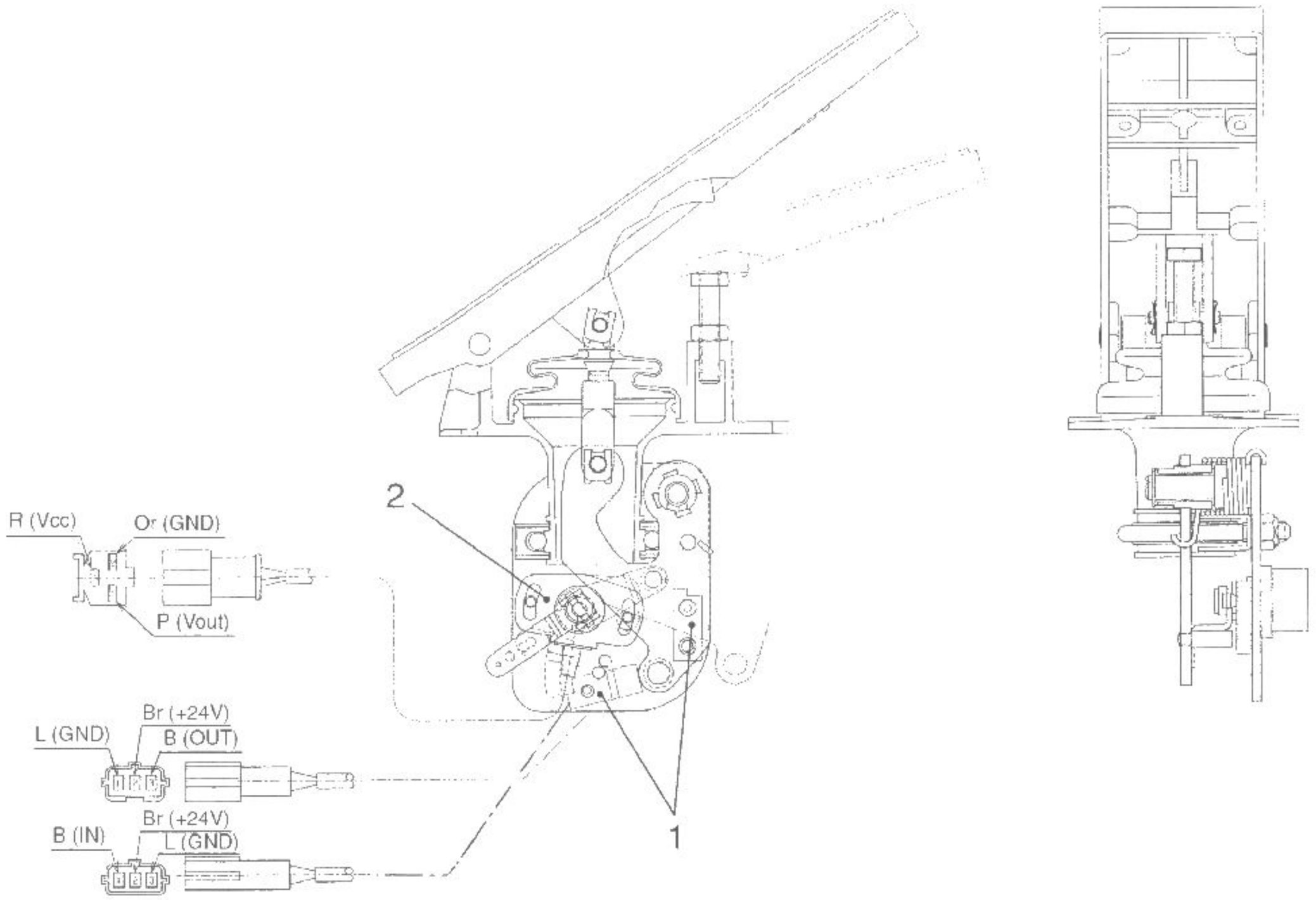


Fig. 1.16 Accelerator Control and Accelerator Pedal (L27-3, LX130-7 · L32-3, LX160-7)

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1. ACCELERATOR SWITCH
2. ACCELERATOR SENSOR (POTENTIOMETER)

Note: On the L35-3, LX190-7 · L40-3, LX230-7, the accelerator pedal has only a wire harness attached (without accelerator cable).

Fig. 1.17 Accelerator Pedal (L35-3, LX190-7 · L40-3, LX230-7)

2. Engine Shut-off Device

A diesel engine does not have any electric ignition device like a gasoline engine, so it cannot usually be shut off simply by turning the main switch (starter switch) off. For this reason, the wheel loaders have an engine shut-off device using a wire motor (engine stop motor) or a governor control servomotor.

When the starter switch is turned OFF, the wire motor (L27-3, LX130-7 · L32-3, LX160-7) or the governor control motor (L35-3, LX190-7 · L40-3, LX230-7) operates in the non-injection direction. This reduces the quantity of fuel injected from the injection pump to zero, thus shutting off the engine.

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NOTE

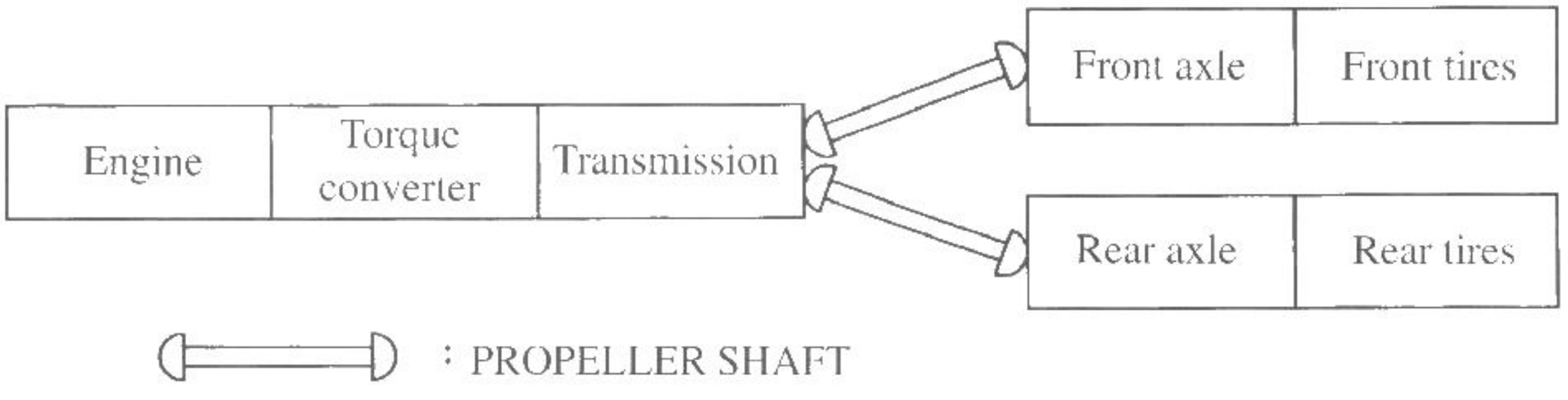
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2. POWER TRAIN

The power train consists of the drive unit (torque converter and transmission), propeller shafts, front and rear axles, and tires.

Power from the engine is transmitted to the drive unit where it is converted in both rotational speed and direction and distributed through the propeller shafts to the front and rear axles. The power transmitted to each axle is further sent through the wheel to the tire so that the loader moves.

The schematic diagram of the power transmission of the loader is given below.



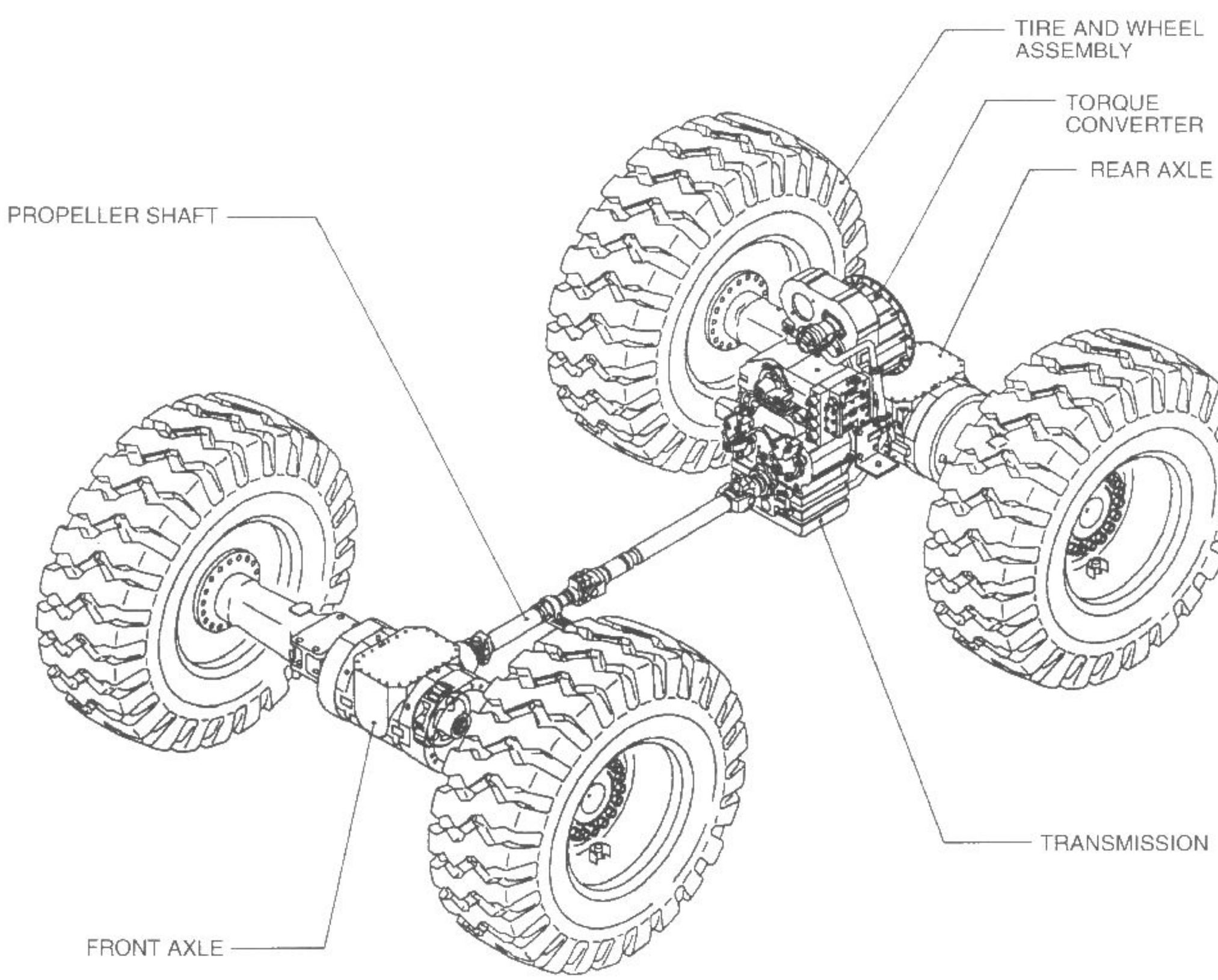


Fig. 2.1 Power Train

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2.1 DRIVE UNIT

	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7 · L40-3, LX230-7
Name	TCM656-25	TCM667-25	TCM679-25
Torque converter			
Name	12.5" (MS370) Niigata Converter	13.5" (MS330) Niigata Converter	13.5" (MS400) Niigata Converter
Type	3-element, 1-stage, single-phase type	←	←
Oil cooler	See "1.3 COOLING SYSTEM."	←	←
Pressure setting	0.27 MPa {2.8 kgf/cm²} [40 psi]	←	←
Charging pump	See "6.2 PUMP"	←	←
Transmission			
Name	Solenoid, full power-shift, constant-mesh type, full-modulation	←	←
Speeds	4 fwd/ 4 rev	←	←
Clutch (transmission)			
Type	Wet multiple-disk type	←	←
Operation	Hydraulic	←	←
Pressure setting	2.06 to 2.35 MPa {21 to 24 kgf/cm²} [299 to 341 psi]	←	2.06 to 2.45 MPa {21 to 25 kgf/cm²} [299 to 356 psi]
Oil capacity	20 L [5.3 U.S. gal.]	35 L [9.2 U.S. gal.]	←
Weight	547 kg [1206 lbs]	792 kg [1746 lbs]	862 kg [1901 lbs]

General Description

The drive unit consists of a combination of a torque converter and a transmission, forming a compact one-piece body, with the converter housing connected to the transmission case.

The drive unit is connected to the engine and is mounted in the rear frame with mounting rubbers.

Power from the engine is transmitted through the engine flywheel and torque converter to the transmission.

The engine and the drive unit are connected to each other by linking the engine flywheel to the converter's front cover with an input plate (L27-3, LX130-7) or a coupling gear (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7).

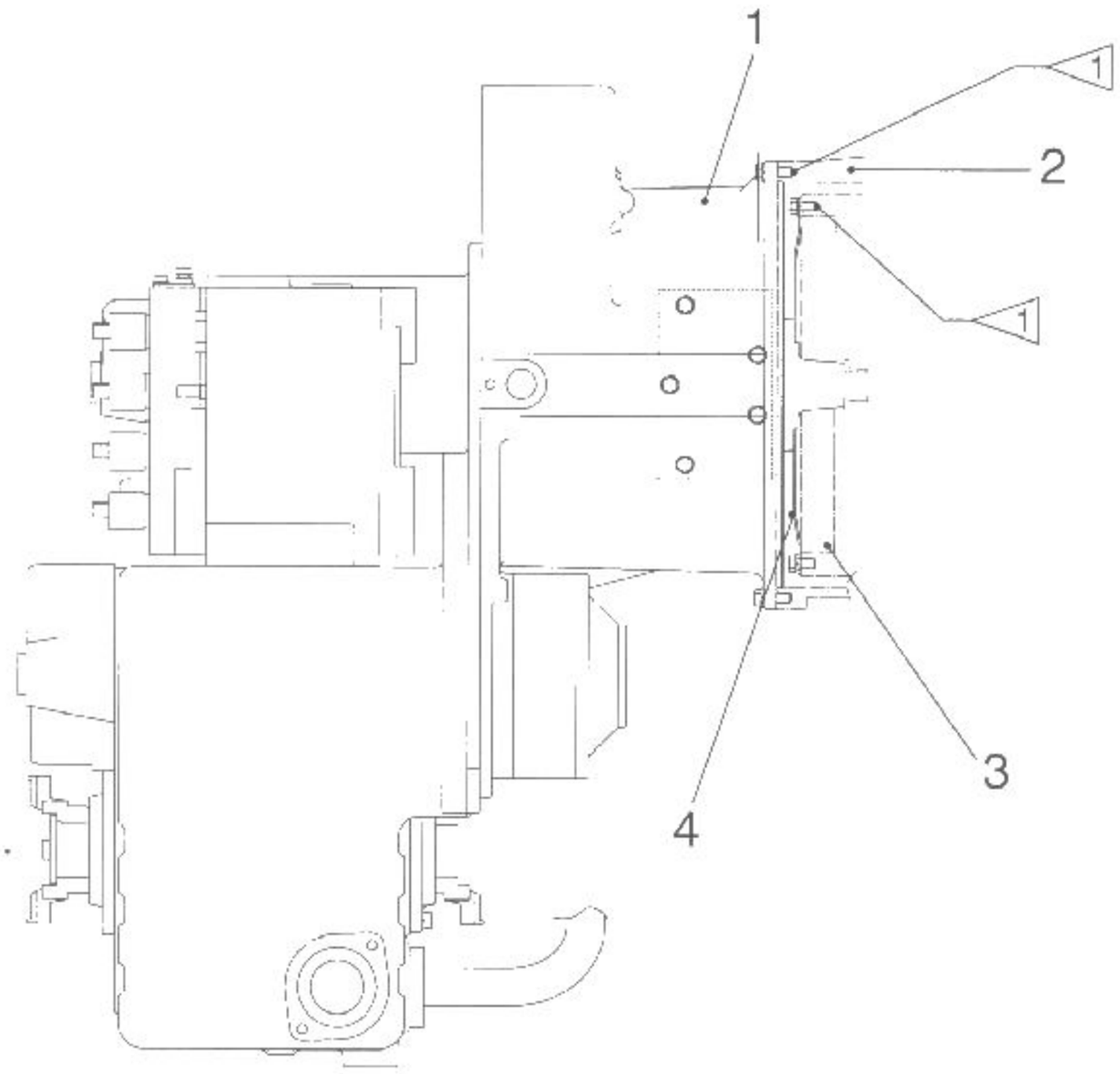
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(L27-3, LX130-7)

Note: 1 ▷ 42 to 48 N-m {4.3 to 4.9 kgf-m} [31 to 35 lbf-ft]

Threaded area: LOCTITE #262

1. TORQUE CONVERTER HOUSING
2. FLYWHEEL HOUSING
3. FLYWHEEL
4. INPUT PLATE



(L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

Note: 1 ▷ 41.0 N-m {4.2 kgf-m} [30.4 lbf-ft]

2 ▷ 31 to 46 N-m {3.1 to 4.7 kgf-m} [22 to 34 lbf-ft]

Threaded area: LOCTITE #262

1. TORQUE CONVERTER HOUSING
2. FLYWHEEL HOUSING
3. FLYWHEEL
4. COUPLING GEAR
5. SPACER

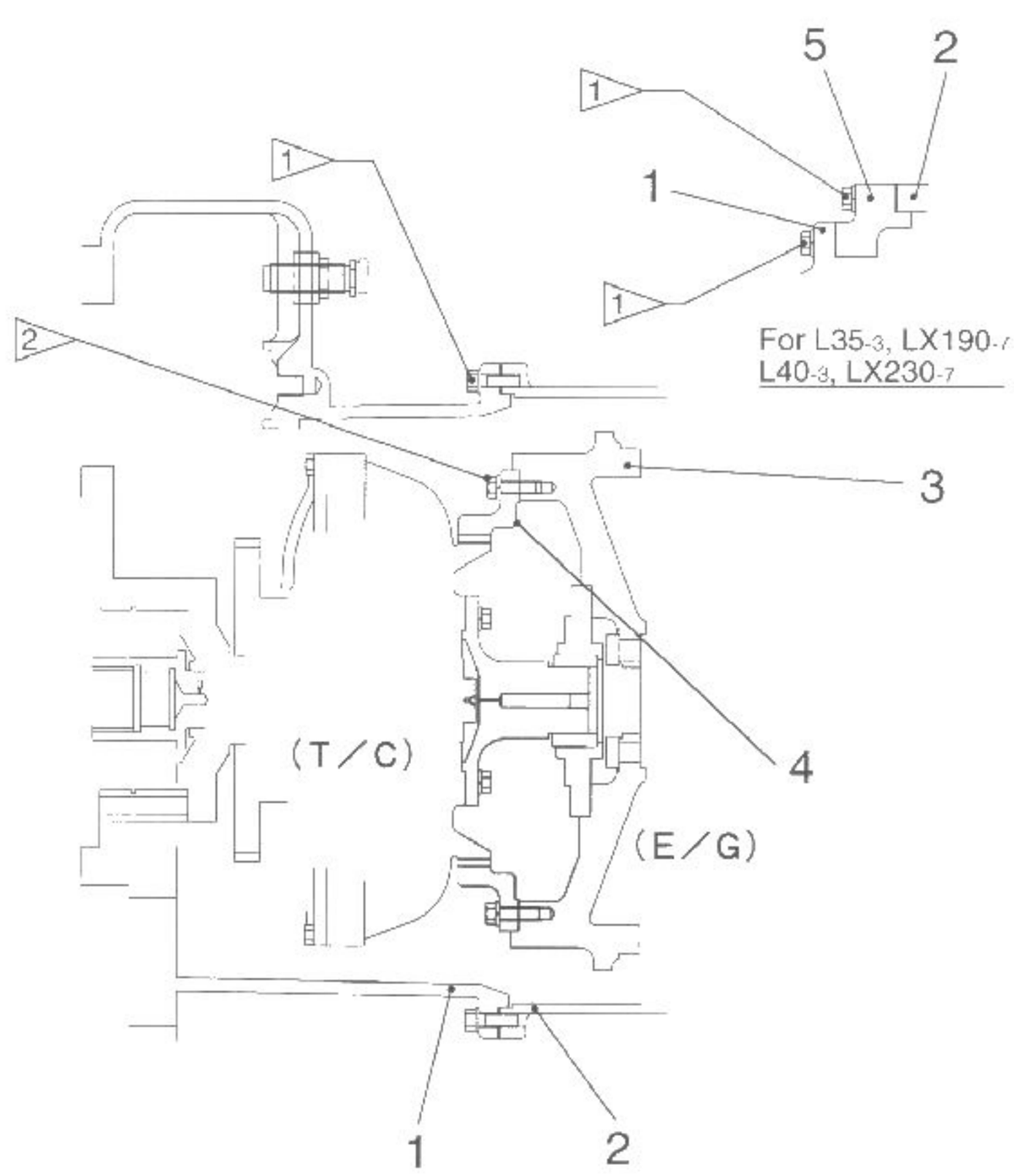


Fig. 2.2 Drive Unit Mount

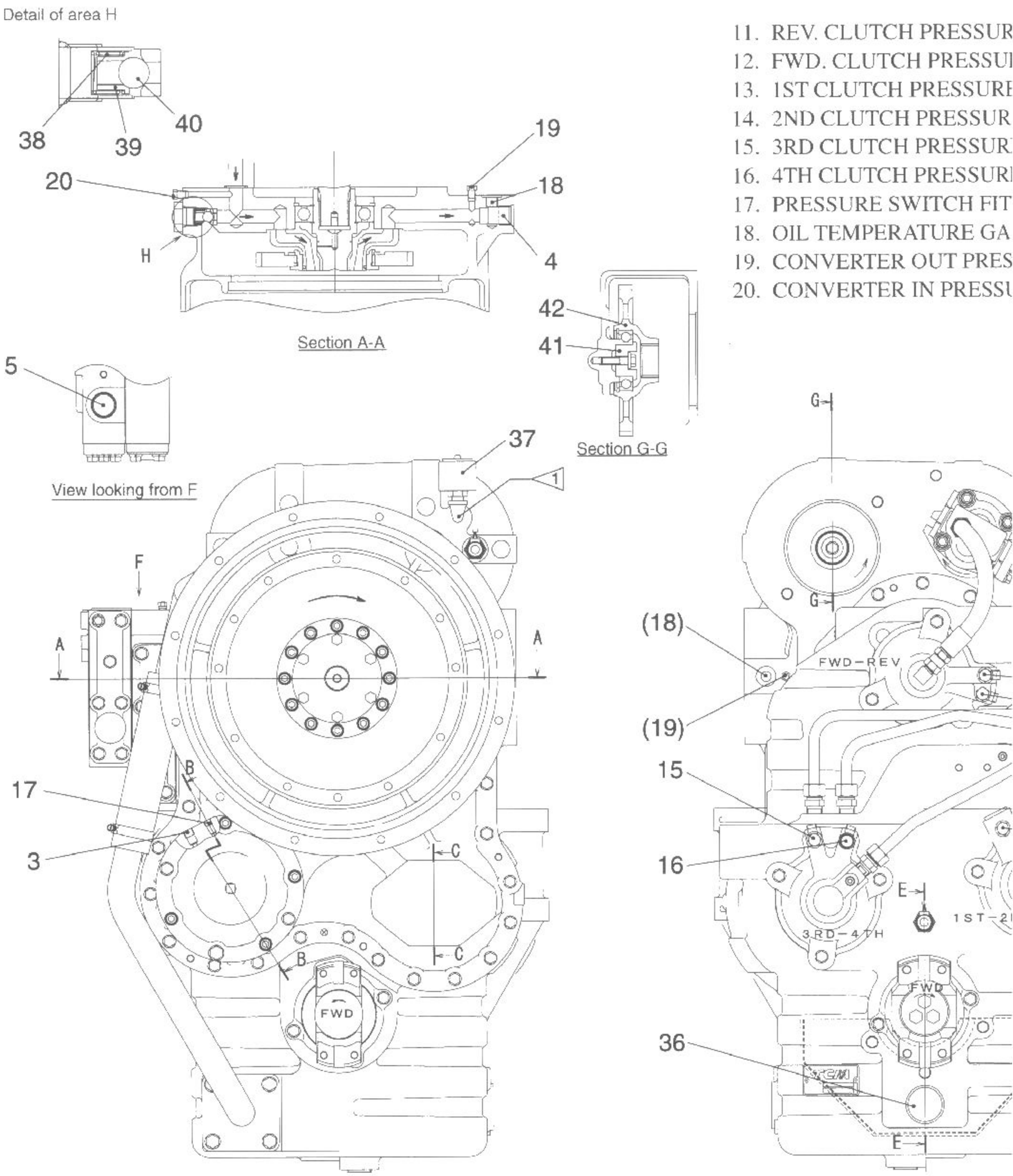
https://truckmanualshub.com/

(Empty page)

Clutch oil pressure:	2.1 to 2.4 MPa {21 to 24 kgf/cm²} [299 to 341 psi]
Safety valve relief pressure:	0.71 MPa {7.2 kgf/cm²} [102 psi]

1. from OIL COOLER
2. OIL FILL PORT
3. PARKING BRAKE RELE
4. to OIL COOLER
5. from FILTER

11. REV. CLUTCH PRESSUR
12. FWD. CLUTCH PRESSUI
13. 1ST CLUTCH PRESSURE
14. 2ND CLUTCH PRESSUR
15. 3RD CLUTCH PRESSUR
16. 4TH CLUTCH PRESSURI
17. PRESSURE SWITCH FIT
18. OIL TEMPERATURE GA
19. CONVERTER OUT PRES
20. CONVERTER IN PRESSU



Note: For the sections B-B, C-C and E-E, refer to the next page.

Fig. 2.3 Drive U

https://truckmanualshub.com/

E PRESSURE

CHECK PORT
CHECK PORT
HECK PORT
CHECK PORT
CHECK PORT
CHECK PORT
NG PORT
GE FITTING PORT
RE CHECK PORT
E CHECK PORT

31. CHARGING PUMP
32. SUCTION TUBE
33. STRAINER
34. CONTROL VALVE
35. OIL GAUGE
36. PLUG
37. BREATHER
38. SPRING
39. SPRING SEAT
40. BALL
41. BEARING SUPPORT
42. GEAR

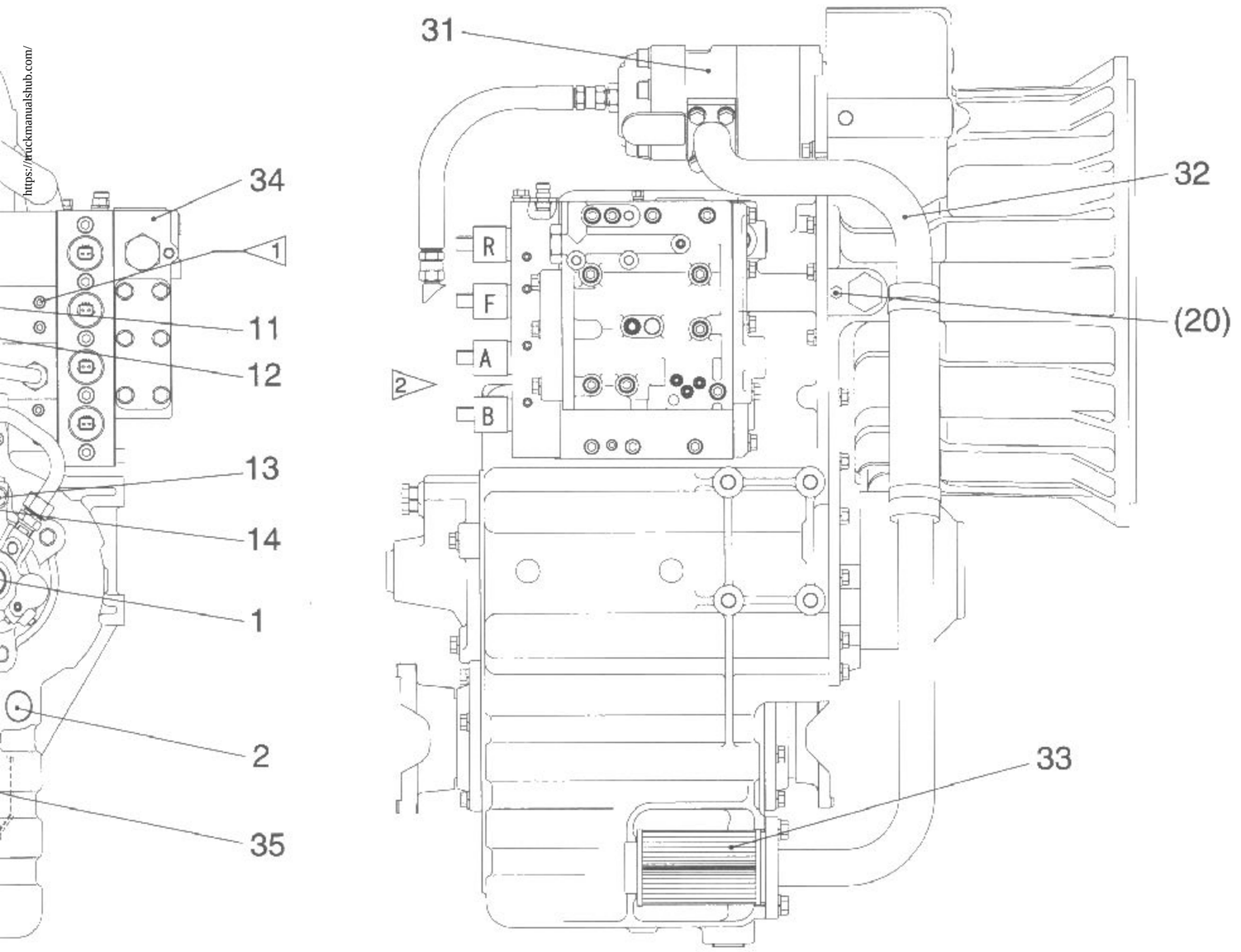
Note: 1 Threaded area: LOCTITE#572

2 Control valve solenoid operation table

● : ON

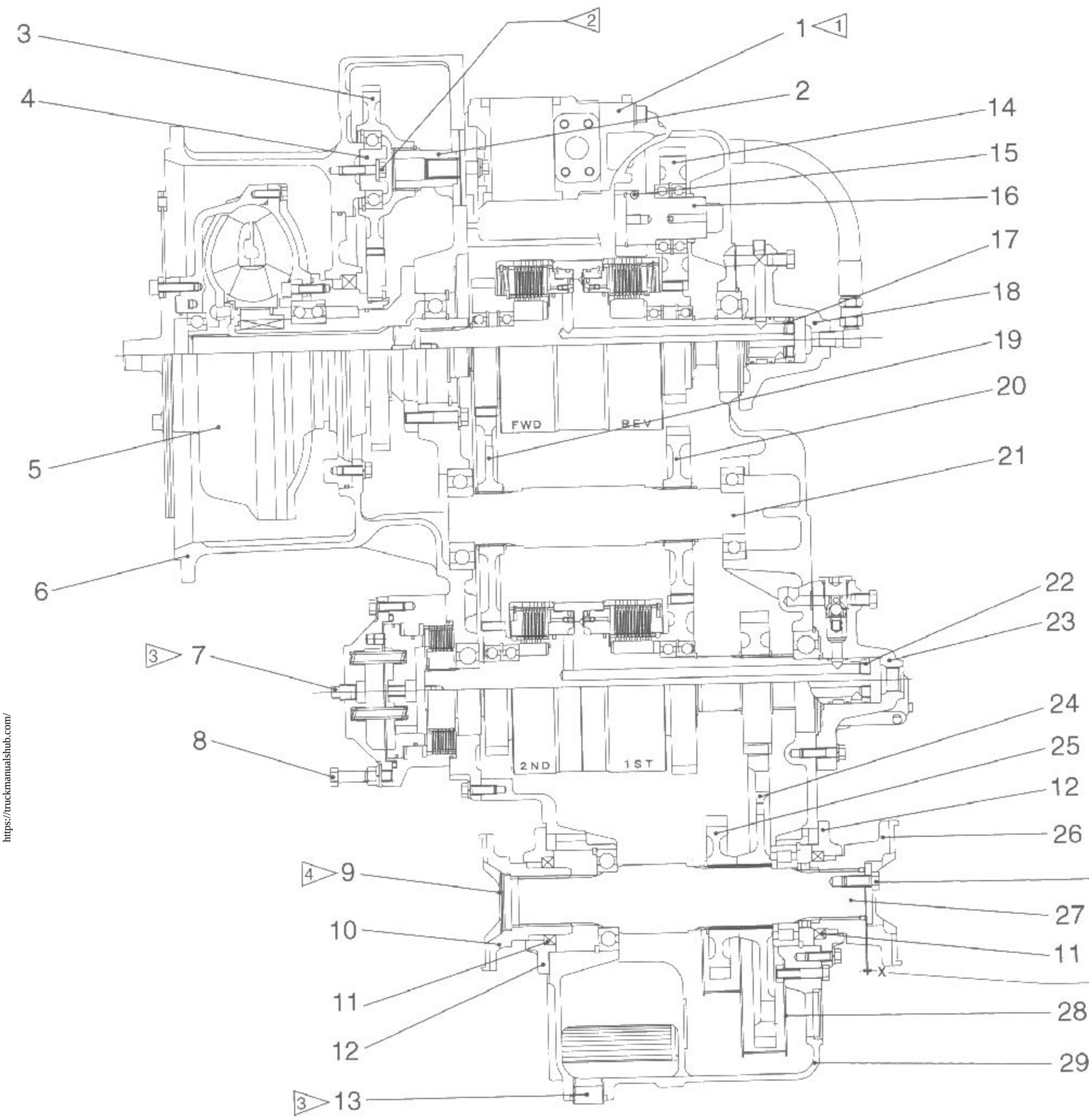
	F sol	R sol	A sol	B sol
F4	●			●
F3	●			
F2	●		●	●
F1	●		●	
N				
R1		●	●	
R2		●	●	●
R3		●		
R4		●		●

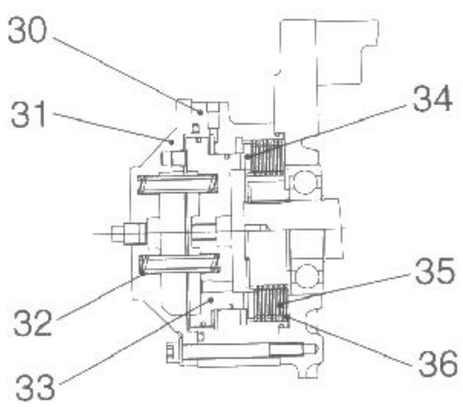
Note: Threaded areas of plug and tube: LOCTITE#572



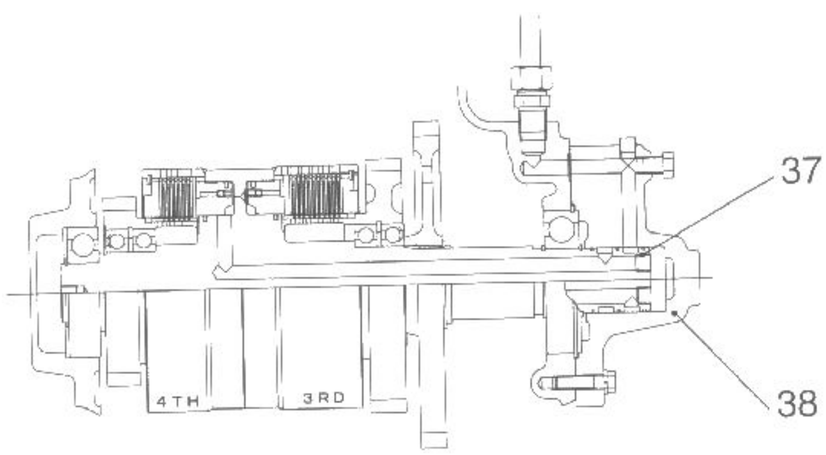
t of the L27-3, LX130-7 (1)

https://truckmanualshub.com/

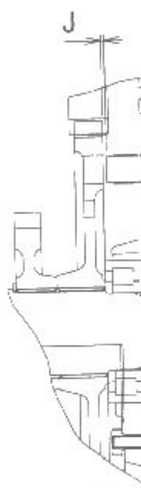




Section B-B



Section C-C



Section E-E

1. CHA
2. PUM
3. GEA
4. BEA
5. CO
6. CO
7. PLU
8. BO
PA
9. PLU
10. FL
11. OIL
12. BE
13. DR

Note:

Fig. 2.4 Drive Unit of the

https://truckmanualshub.com/

CHARGING PUMP
PUMP SLEEVE
GEAR
BEARING SUPPORT
CONVERTER WHEEL
CONVERTER HOUSING
PLUG
BOLT (FOR RELEASING PARKING BRAKE)
PLUG
FLANGE
OIL SEAL
BEARING CAP
DRAIN PLUG
14. BACK GEAR
15. BALL
16. SHAFT
17. FWD/REV SHAFT
18. DISTRIBUTOR CAP
19. GEAR
20. GEAR
21. IDLER SHAFT
22. 1ST/2ND SPEED SHAFT
23. DISTRIBUTOR CAP
24. GEAR
25. GEAR
26. FLANGE
27. OUTPUT SHAFT
28. OIL BAFFLE
29. TRANSMISSION CASE
30. BRAKE HOUSING
31. CAP
32. SPRING
33. PISTON
34. END PLATE
35. DISK
36. PLATE

:  Mating area with converter housing: LOCTITE FMD-127

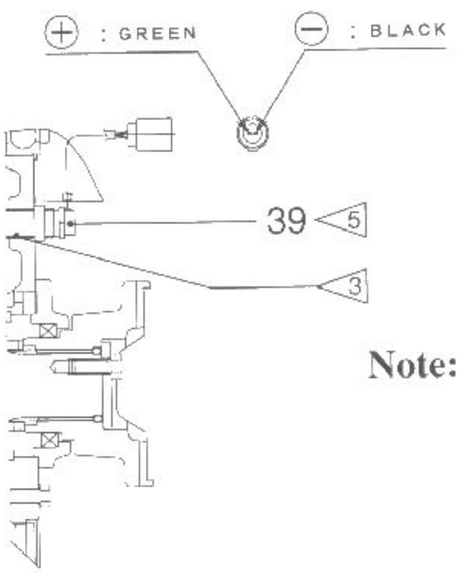
 Threaded area: LOCTITE#262

 Threaded area: LOCTITE#572

 Outer diameter: LOCTITE#572

5> Procedure for adjusting gap J: After the sensor touches the gear, back it off by 2 turns.

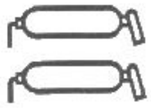
6> Measure the difference in height X between flange and shaft without shims, and select and install appropriate shims so that the difference in height is $X^{+0.05}_{-0.1}$ mm.



Note: Oil seal assembling procedure

 Oil seal outer diameter (metal): LOCTITE#262

 Area between lips of lip type oil seal: Grease

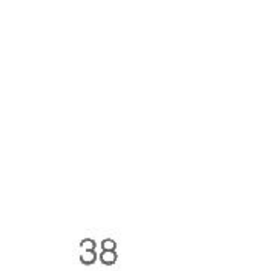
 Chamfered area and sliding area of companion flange: Grease

https://truckmanualshub.com/

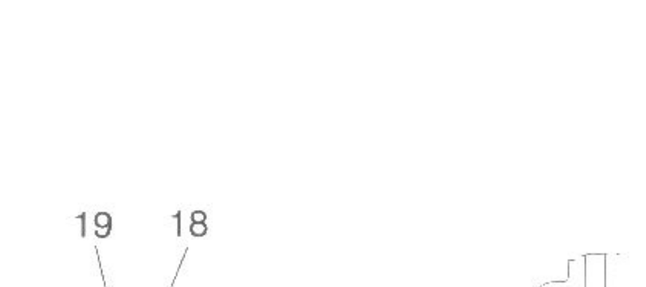
Clutch oil pressure:	2.1 to 2.4 MPa {21 to 24 kgf/cm²} [299 to 341 psi]
Safety valve relief pressure:	0.92 MPa {9.4 kgf/cm²} [134 psi]

1. fr
2. O
3. P
PH
4. to
5. fr

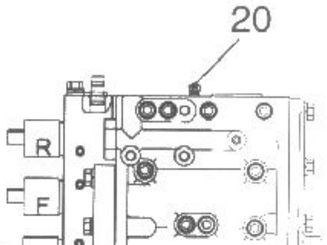
11. RE
PO
12. FW
PO
13. 1S
PO
14. 2N
PO
15. 3R
PO
16. 4T
PO
17. PR



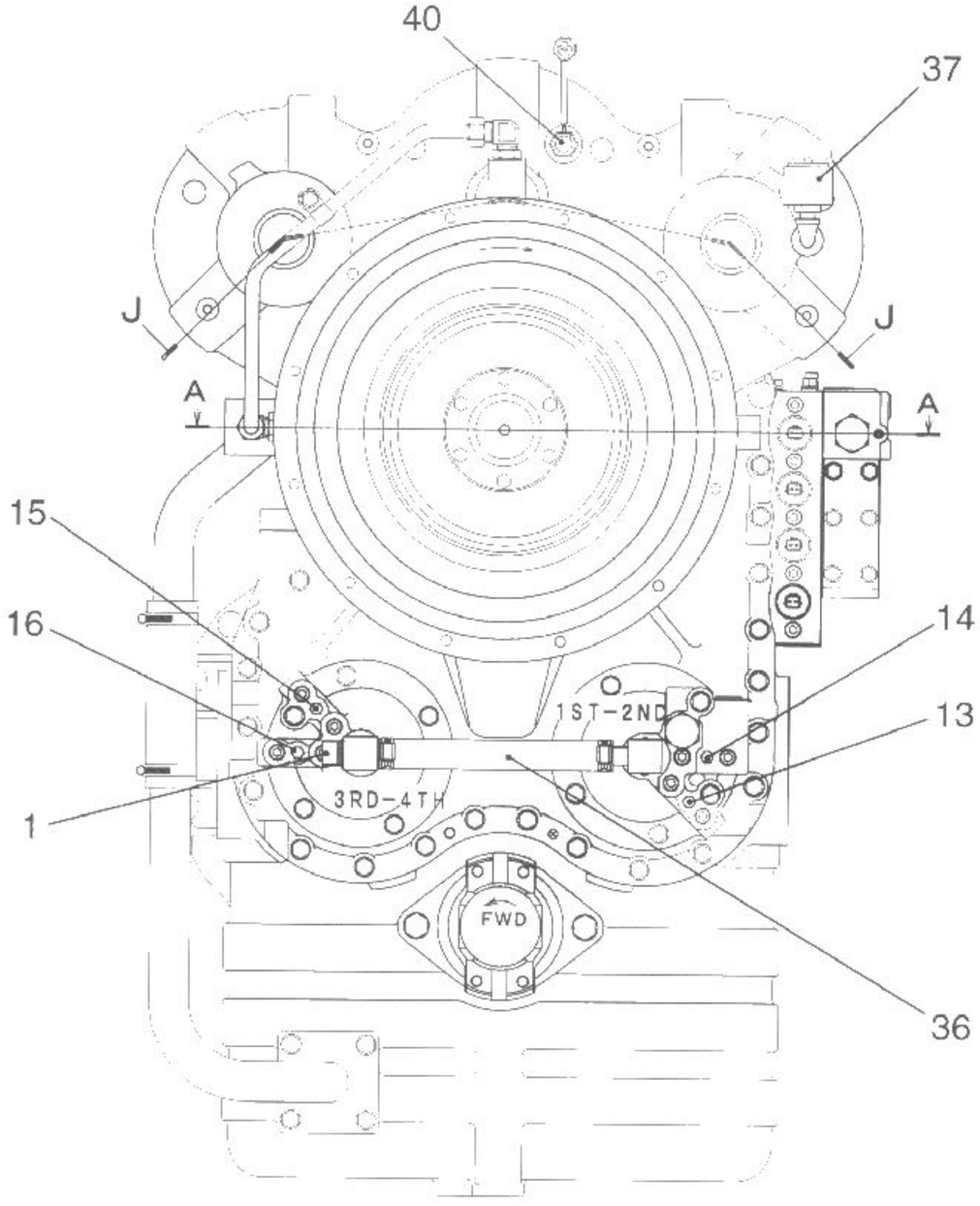
Detail of area H

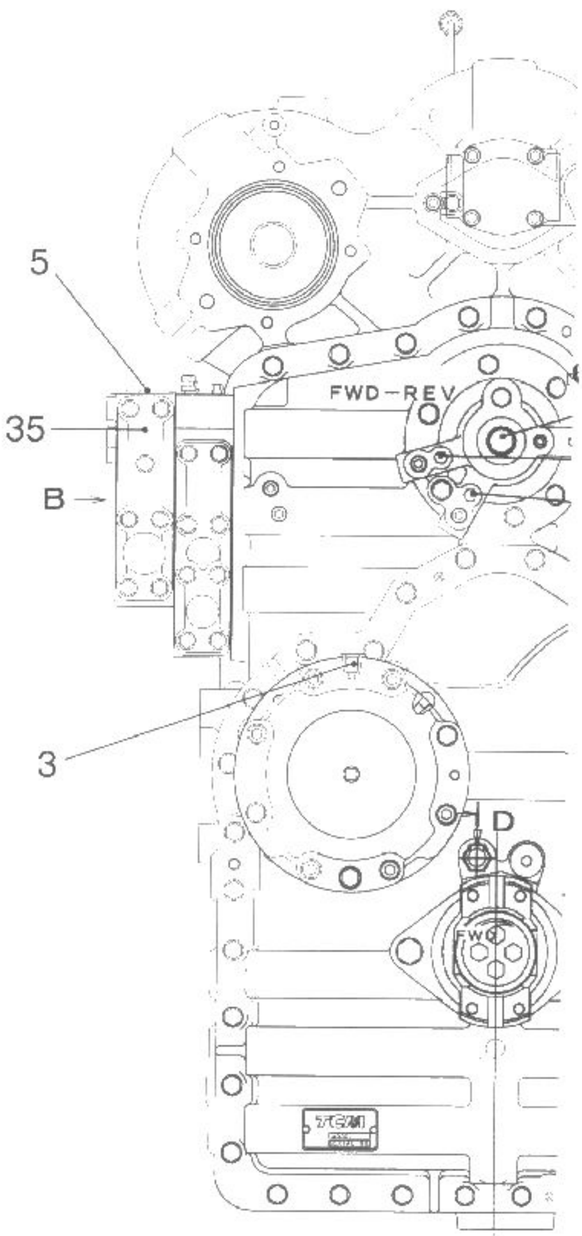


Section A-A



View looking from B





Note: For the sections D-D, E-E and J-J, refer to the next page.

Fig. 2.5 Drive Ur

https://truckmanualshub.com/

L COOLER
L PORT
G BRAKE RELEASE
URE
COOLER
LTER

LUTCH PRESSURE CHECK

LLUTCH PRESSURE CHECK

UTCH PRESSURE CHECK

LUTCH PRESSURE CHECK

LUTCH PRESSURE CHECK

LUTCH PRESSURE CHECK

URE SWITCH FITTING PORT

18. OIL TEMPERATURE GAUGE FITTING PORT
19. CONVERTER OUT PRESSURE CHECK PORT
20. CONVERTER IN PRESSURE CHECK PORT

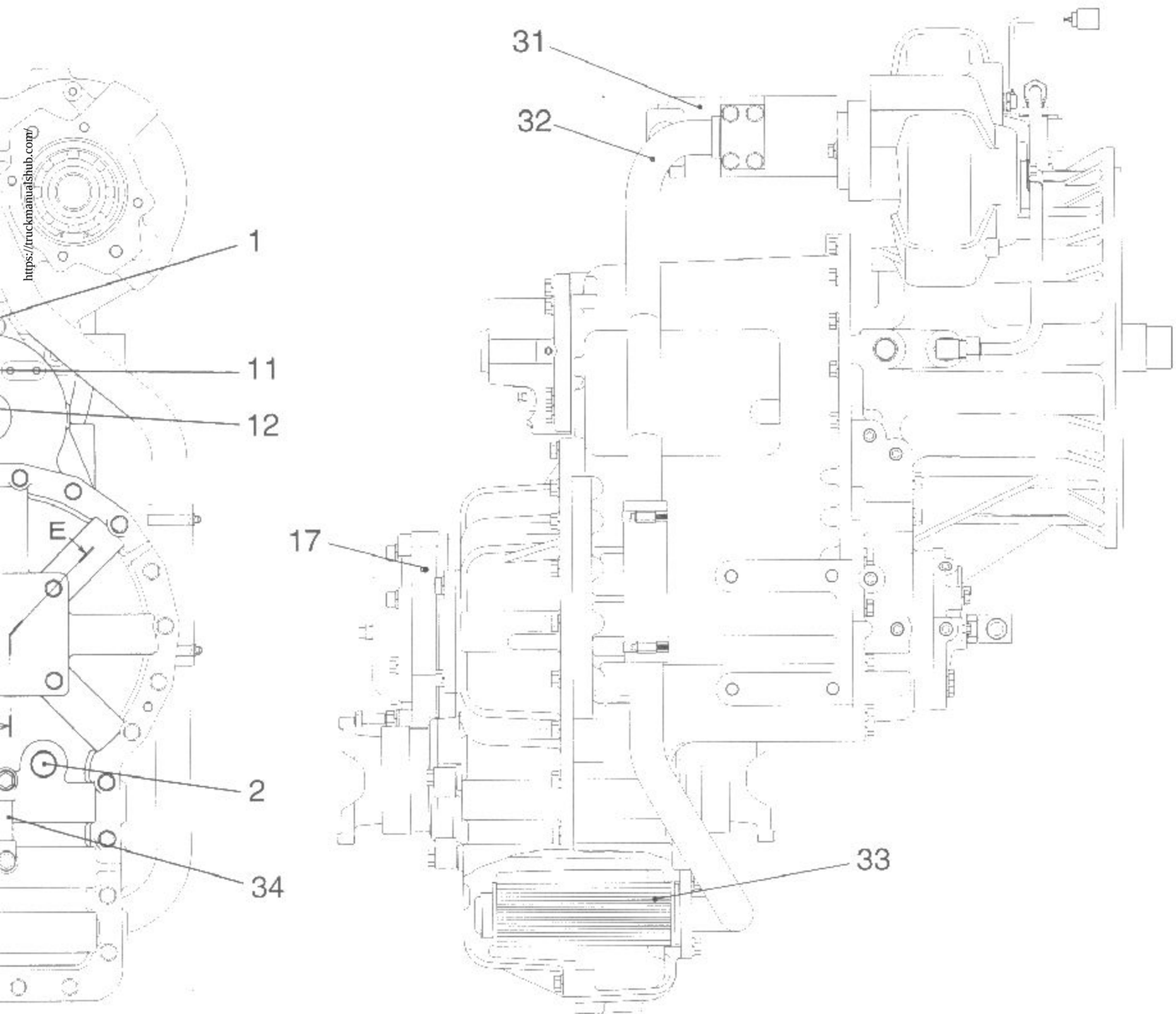
31. CHARGING PUMP
32. SUCTION TUBE
33. STRAINER
34. OIL GAUGE
35. CONTROL VALVE
36. HOSE
37. BREATHER
38. SPRING
39. PLUNGER (SAFETY VALVE)
40. SENSOR

Note: 1.  Threaded area of plug: LOCTITE#572

2. Control valve solenoid operation table

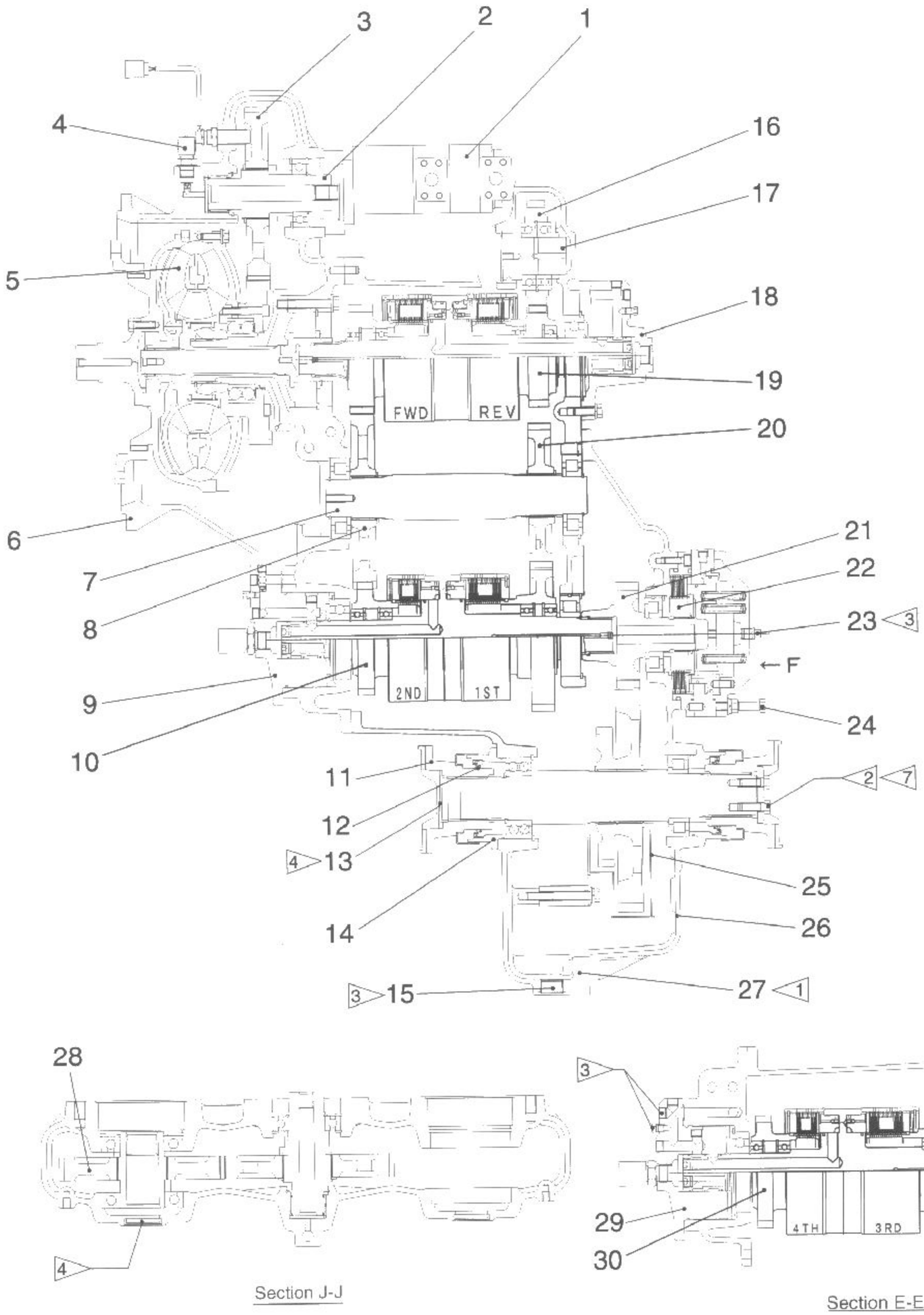
(● : ON)

	F sol	R sol	A sol	B sol
F4	●			●
F3	●			
F2	●		●	●
F1	●		●	
N				
R1		●	●	
R2		●	●	●
R3		●		
R4		●		●



https://truckmanualshub.com/

f the L32-3, LX160-7 (1)



Section J-J

Section E-E

Fig. 2.6 Drive Unit of th

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CHARGING PUMP
PUMP SLEEVE
GEAR
ELBOW
CONVERTER WHEEL
CONVERTER HOUSING
IDLER SHAFT
GEAR
CAP ASSEMBLY
(REFER TO FIG. 2.32)
1ST/2ND SPEED SHAFT
FLANGE
OIL SEAL
PLUG

14. SEAL RETAINER
15. DRAIN PLUG
16. BACK GEAR
17. SHAFT
18. DISTRIBUTOR CAP
19. FWD/REV SHAFT
20. GEAR
21. LOW RANGE GEAR
22. DISK HUB
23. PLUG
24. BOLT (FOR RELEASING PARKING BRAKE)
25. OIL BAFFLE
26. REAR CASE
27. TRANSMISSION CASE
28. GEAR
29. DISTRIBUTOR CAP
30. 3RD/4TH SPEED SHAFT
31. HIGH RANGE GEAR
32. PLATE
33. ROTARY SENSOR (FOR SPEEDOMETER)
34. PISTON HOUSING
35. BRAKE HOUSING
36. DISK
37. PLATE
38. CAP
39. PISTON
40. SPRING
41. END PLATE

:  Mating area with converter housing: LOCTITE FMD-127

 Threaded area: LOCTITE#262

 Threaded area: LOCTITE#572

 Outer diameter: LOCTITE#572

5> Adjusting of gap C: After the sensor touches the gear, back it off by 2 turns.

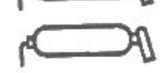
6> Measure the difference in height X between flange and shaft without shims, and select and install appropriate shims so that the difference in height is $X^{-0.05}_{-0.1}$ mm.

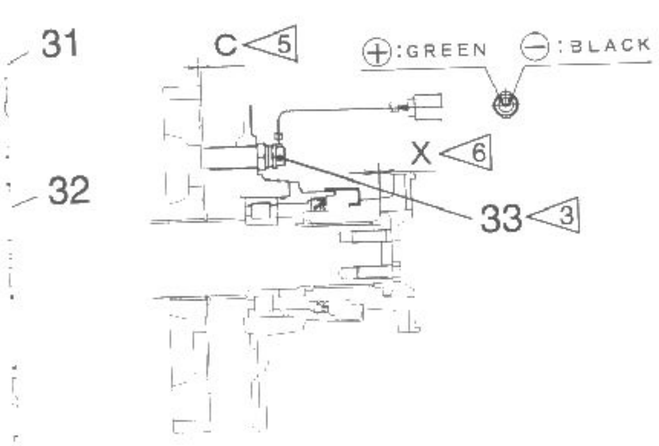
 88 N-m {9 kgf-m} [65 lbf-ft]

: Oil seal assembling procedure

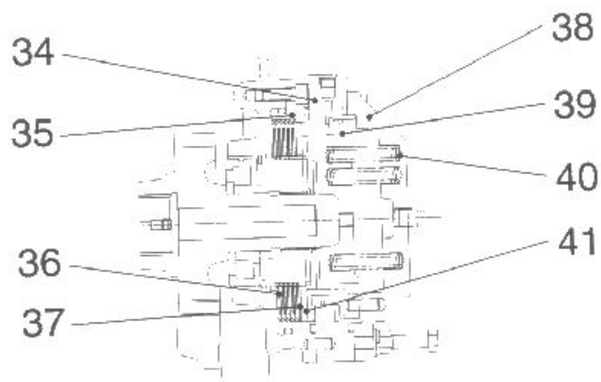
 Oil seal outer diameter (metal): LOCTITE#262

 Area between lips of lip type oil seal: Grease

 Chamfered area and sliding area of companion flange: Grease



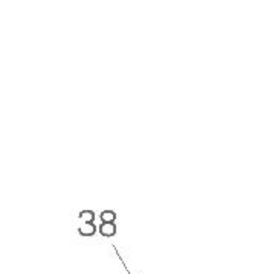
Section D-D



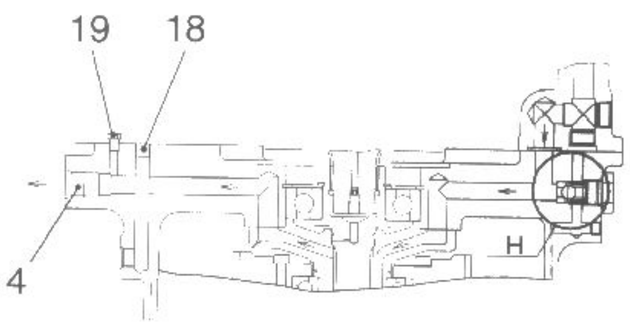
Detail of area F

https://truckmanualshub.com/

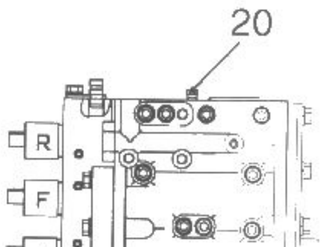
Clutch oil pressure:	2.1 to 2.5 MPa {21 to 25 kgf/cm²} [299 to 356 psi]
Safety valve relief pressure:	0.92 MPa {9.4 kgf/cm²} [134 psi]



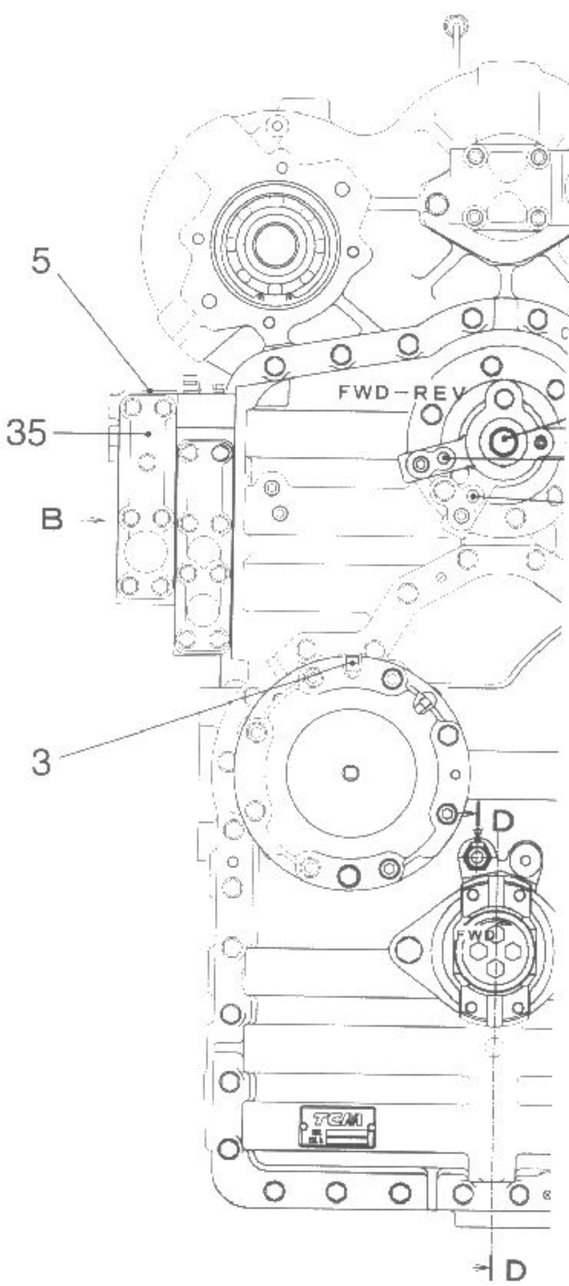
Detail of area "H"



Section A-A



View looking from B



Note: For the sections D-D, E-E and J-J, refer to the next page.

Fig. 2.7 Drive Unit of the

https://truckmanualshub.com/

n OIL COOLER
L FILL PORT
RKING BRAKE RELEASE
ESSURE
IL COOLER
n FILTER

V. CLUTCH PRESSURE CHECK
RT
D. CLUTCH PRESSURE CHECK
RT
F CLUTCH PRESSURE CHECK
RT
D CLUTCH PRESSURE CHECK
RT
D CLUTCH PRESSURE CHECK
RT
H CLUTCH PRESSURE CHECK
RT
ESSURE SWITCH FITTING PORT

18. OIL TEMPERATURE GAUGE FITTING PORT
19. CONVERTER OUT PRESSURE CHECK PORT
20. CONVERTER IN PRESSURE CHECK PORT

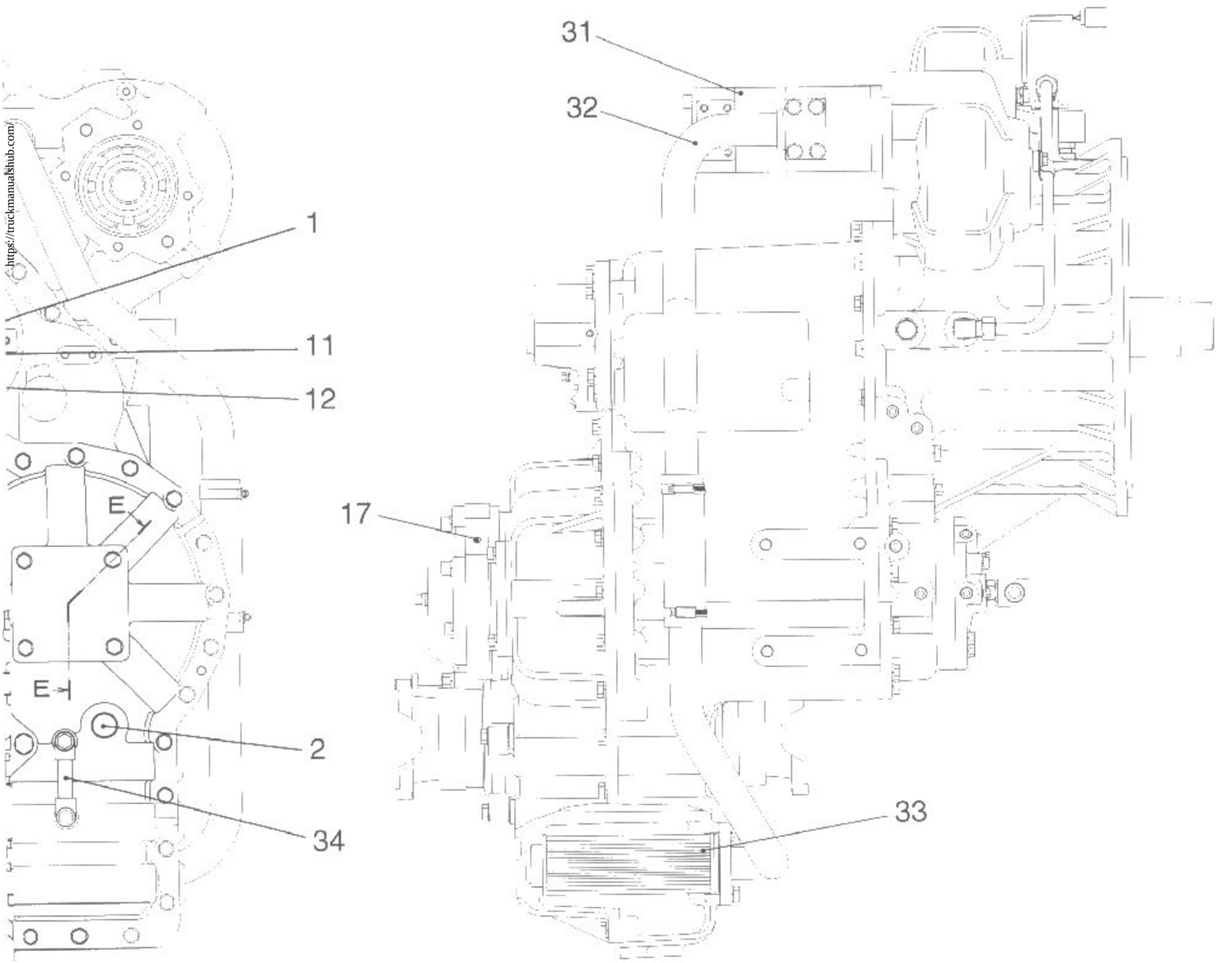
31. CHARGING PUMP
32. SUCTION TUBE
33. STRAINER
34. OIL GAUGE
35. CONTROL VALVE
36. HOSE
37. BREATHER
38. SPRING
39. PLUNGER (SAFETY VALVE)
40. SENSOR

Note: 1. Threaded area of plug: LOCTITE#572

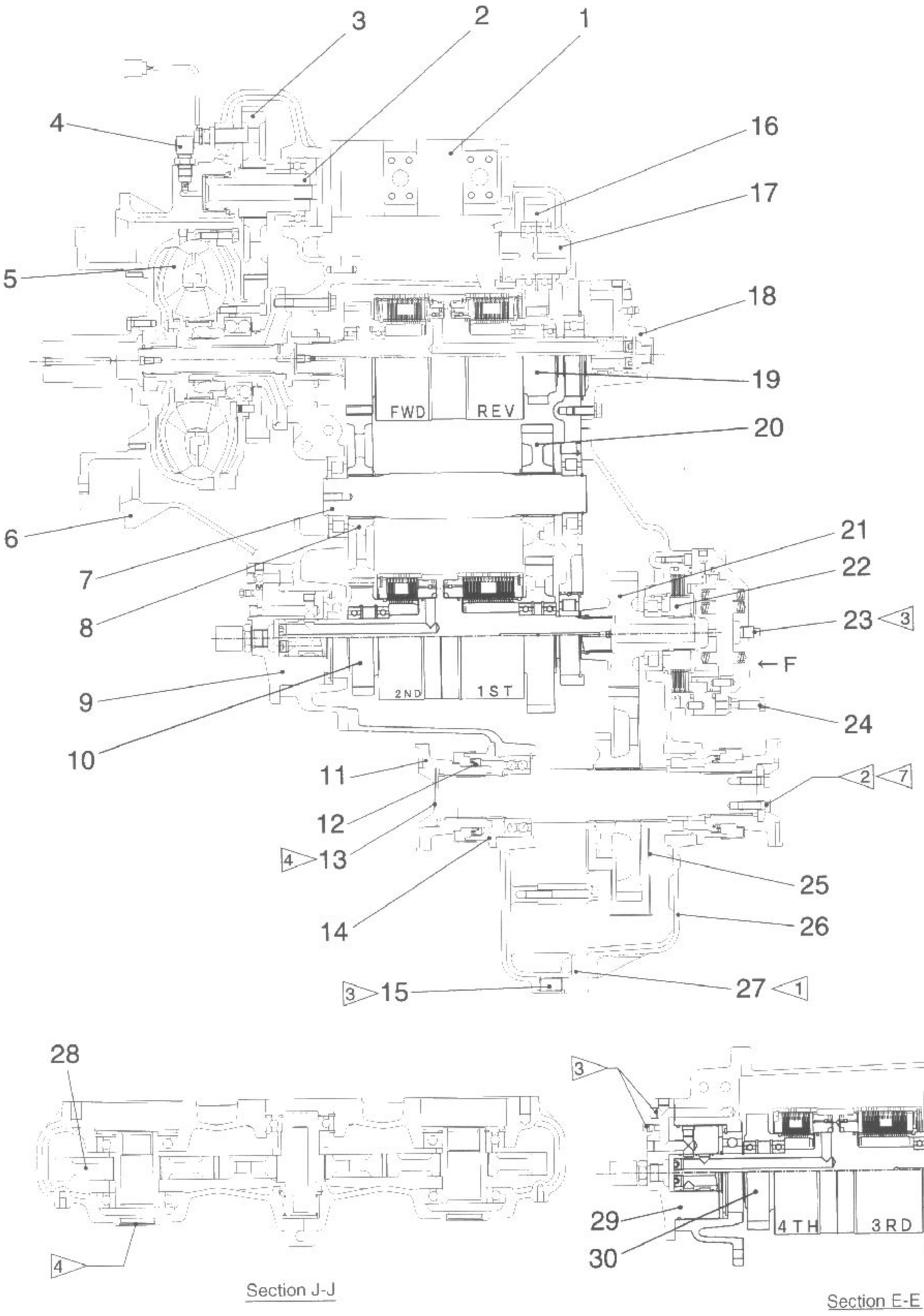
2. Control valve solenoid operation table

(● : ON)

	F sol	R sol	A sol	B sol
F4	●			●
F3	●			
F2	●		●	●
F1	●		●	
N				
R1		●	●	
R2		●	●	●
R3		●		
R4		●		●



https://truckmanualshub.com/



1. CHA
2. SHA
3. GEA
4. ELB
5. CON
6. CON
7. IDLI
8. GEA
9. CAP (REI
10. 1ST/
11. FLA
12. OIL
13. PLU

Note:

Note:

Fig. 2.8 Drive Unit of the L35-3, LX1

https://truckmanualshub.com/

CHARGING PUMP
SHAFT
GEAR
ELBOW
CONVERTER WHEEL
CONVERTER HOUSING
IDLER SHAFT
GEAR
CAP ASSEMBLY
(REFER TO FIG. 2.32)
1ST/2ND SPEED SHAFT
FLANGE
OIL SEAL
PLUG
14. SEAL RETAINER
15. DRAIN PLUG
16. BACK GEAR
17. SHAFT
18. DISTRIBUTOR CAP
19. FWD/REV SHAFT
20. GEAR
21. LOW RANGE GEAR
22. DISK HUB
23. PLUG
24. BOLT (FOR RELEASING PARKING BRAKE)
25. OIL BAFFLE
26. REAR CASE
27. TRANSMISSION CASE
28. GEAR
29. DISTRIBUTOR CAP
30. 3RD/4TH SPEED SHAFT
31. HIGH RANGE GEAR
32. PLATE
33. ROTARY SENSOR (FOR SPEEDOMETER)
34. PISTON HOUSING
35. BRAKE HOUSING
36. DISK
37. PLATE
38. CAP
39. PISTON
40. SPRING
41. END PLATE

: 1 Mating area with converter housing: LOCTITE FMD-127

2 Threaded area: LOCTITE#262

3 Threaded area: LOCTITE#572

4 Outer diameter: LOCTITE#572

5 Adjusting of gap C: After the sensor touches the gear, back it off by 2 turns.

6 Measure the difference in height X between flange and shaft without shims, and select and install appropriate shims so that the difference in height is $X^{-0.05}_{-0.1}$ mm.

7 88 N-m {9 kgf-m} [65 lbf-ft]

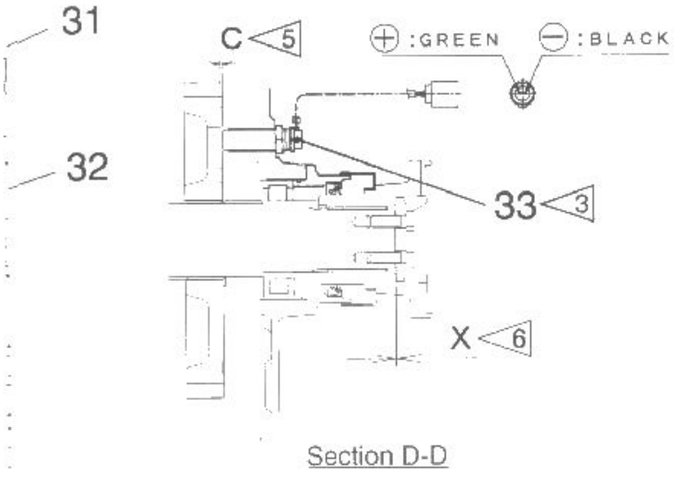
https://truckmanualshub.com/

: Oil seal assembling procedure

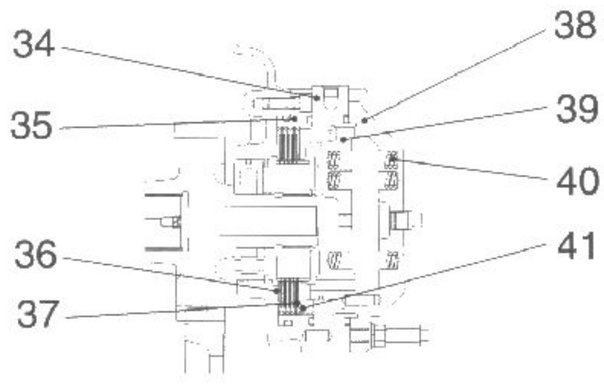
Oil seal outer diameter (metal): LOCTITE#262

Area between lips of lip type oil seal: Grease

Chamfered area and sliding area of companion flange: Grease



Section D-D



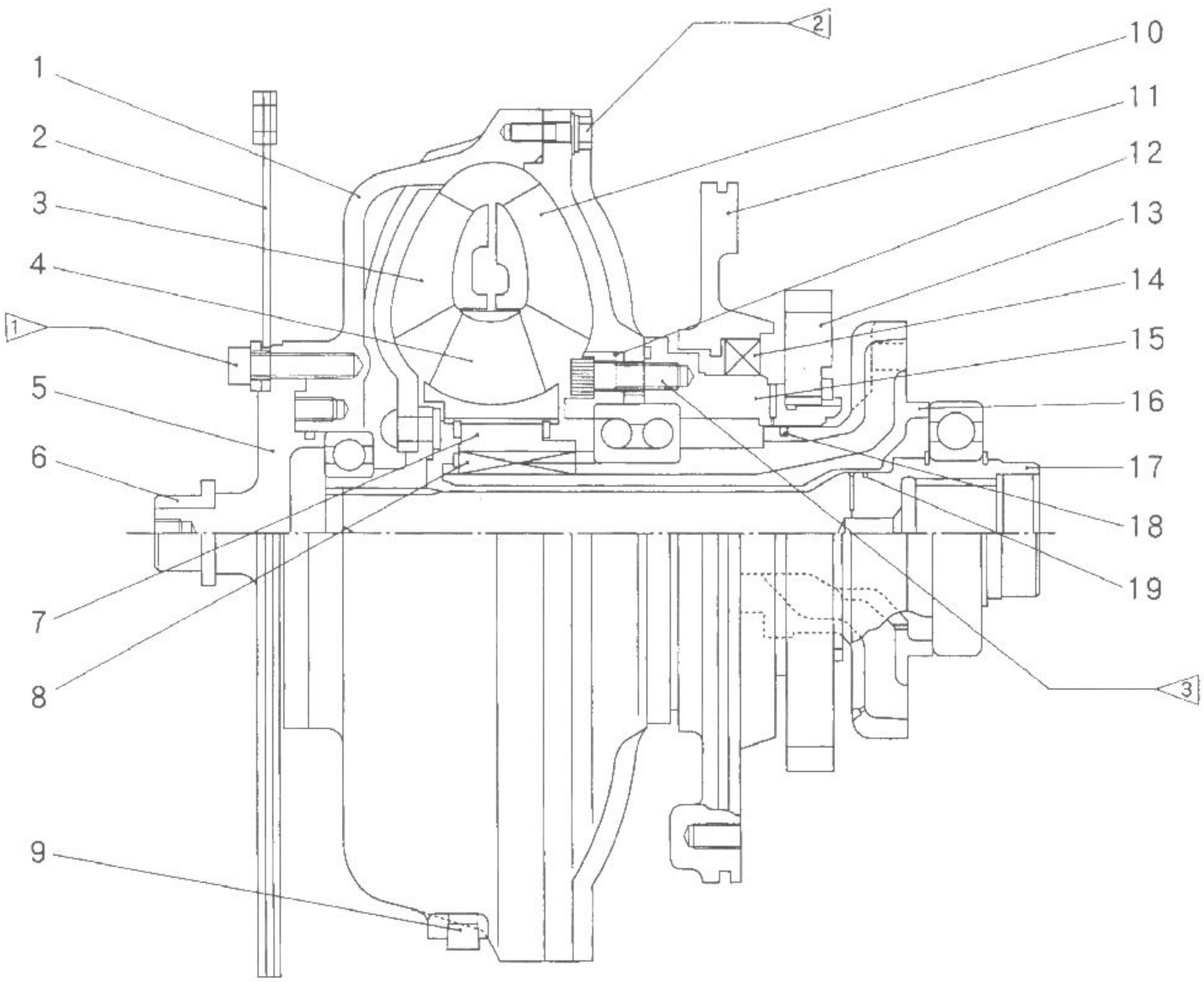
Detail of area "F"

https://truckmanualshub.com/

2.2 TORQUE CONVERTER

The torque converter consists of a converter wheel assembly, a pump drive, and a turbine shaft. The converter wheel assembly consists of an impeller and a turbine located opposite to each other, with a stator wheel in between, and housed in the torque converter case filled with oil.

The pump drive drives the charging pump, the main pump and the steering pump through the pump drive gear installed onto the impeller hub.

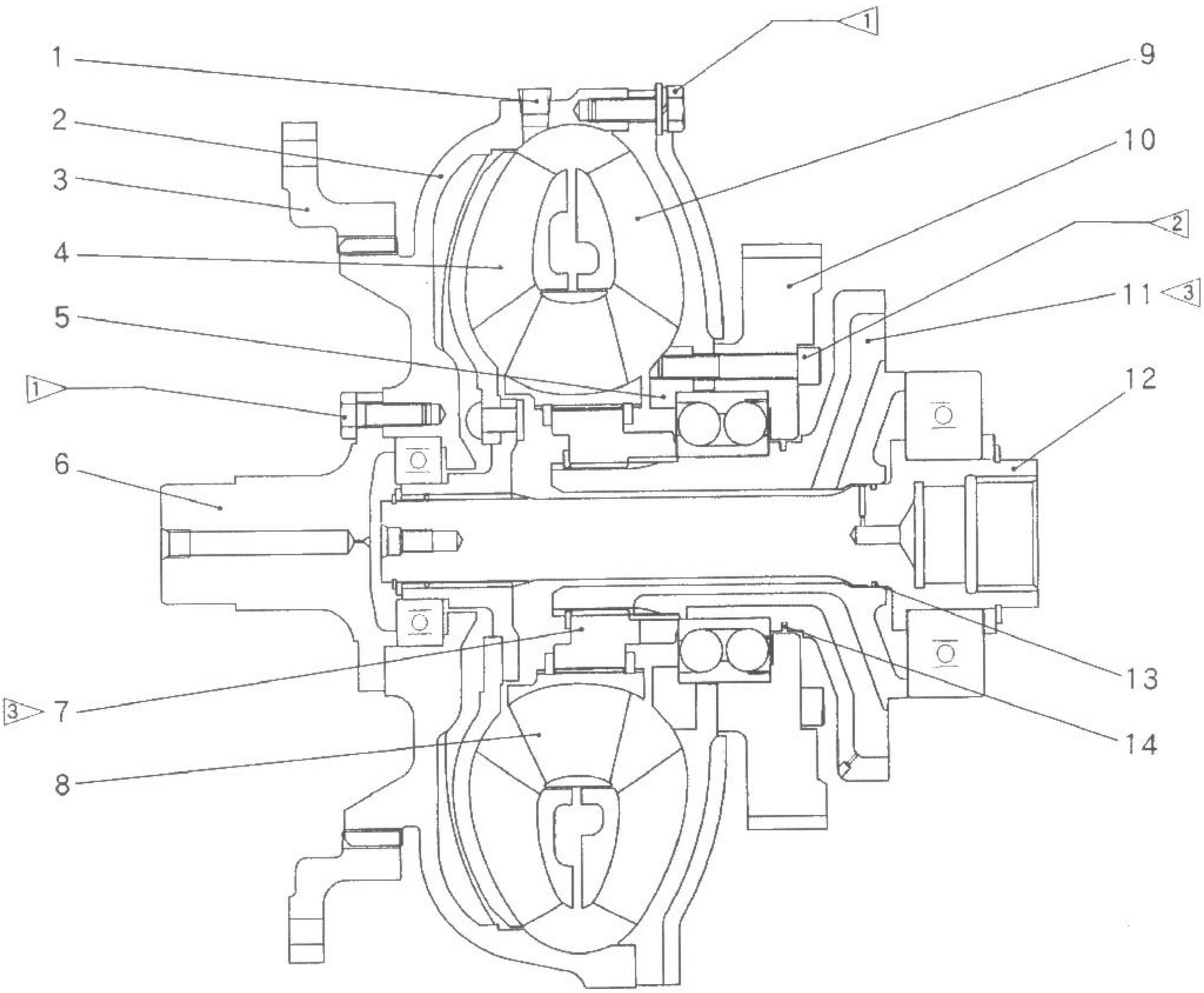


Note: 1 54 to 61 N-m {5.5 to 6.2 kgf-m} [40 to 45 lbf-ft]
2 39 to 44 N-m {4.0 to 4.5 kgf-m} [29 to 33 lbf-ft]
3 51 to 58 N-m {5.2 to 5.9 kgf-m} [38 to 43 lbf-ft]

1. COVER WHEEL
2. INPUT PLATE
3. TURBINE WHEEL
4. STATOR WHEEL
5. INPUT GUIDE
6. BUSHING
7. STATOR HUB
8. KEY
9. TAPER PLUG
10. IMPELLER WHEEL
11. SEAL CARRIER (OIL BAFFLE)
12. IMPELLER HUB
13. PUMP DRIVE GEAR
14. OIL SEAL
15. PUMP DRIVE SLEEVE
16. GUIDE CARRIER (STATOR SUPPORT)
17. TURBINE SHAFT
18. OIL SEAL RING
19. OIL SEAL RING

Fig. 2.9 Converter Wheel Assembly (L27-3, LX130-7)

https://truckmanualshub.com/



Note: 1▷ 39 to 45 N-m {4.0 to 4.6 kgf-m} [29 to 33 lbf-ft]

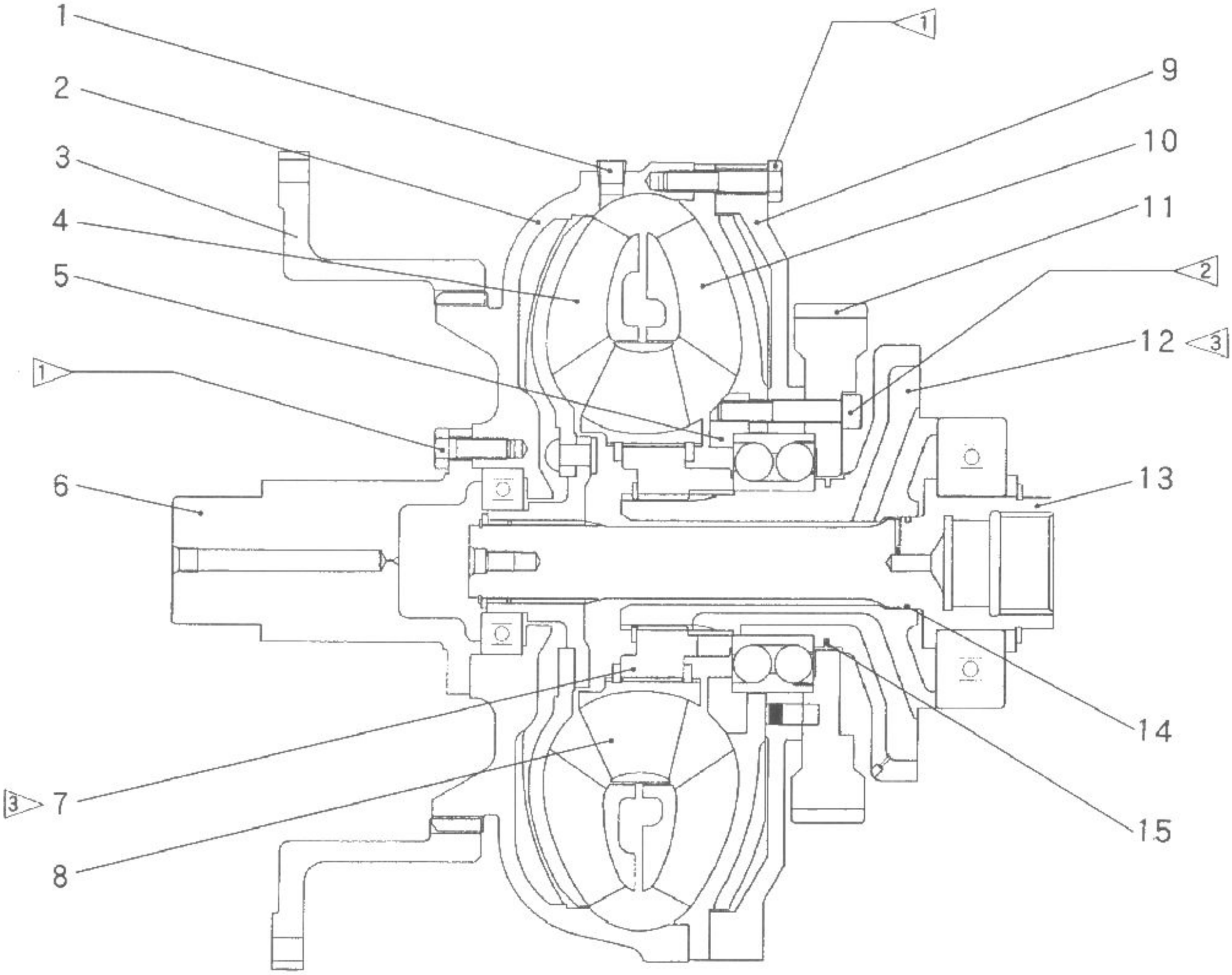
2▷ 51 to 58 N-m {5.2 to 6.0 kgf-m} [38 to 43 lbf-ft]

3▷ Align the arrows of the oil outlet grooves in the stator holder and stator hub.

1. TAPER PLUG
2. COVER WHEEL
3. COUPLING GEAR (DRIVE RING)
4. TURBINE WHEEL
5. IMPELLER HUB
6. INPUT GUIDE
7. STATOR HUB
8. STATOR WHEEL
9. IMPELLER WHEEL
10. PUMP DRIVE GEAR
11. STATOR HOLDER
12. TURBINE SHAFT
13. OIL SEAL RING
14. OIL SEAL RING

Fig. 2.10 Converter Wheel Assembly (L32-3, LX160-7)

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Note: 1 ▷ 39 to 45 N-m {4.0 to 4.6 kgf-m} [29 to 33 lbf-ft]

2 ▷ 51 to 58 N-m {5.2 to 6.0 kgf-m} [38 to 43 lbf-ft]

3 ▷ Align the arrows of the oil outlet grooves in the stator holder and stator hub.

1. TAPER PLUG
2. COVER WHEEL
3. COUPLING GEAR (DRIVE RING)
4. TURBINE WHEEL
5. IMPELLER HUB
6. INPUT GUIDE
7. STATOR HUB
8. STATOR WHEEL
9. IMPELLER WHEEL PLATE
10. IMPELLER WHEEL
11. PUMP DRIVE GEAR
12. STATOR HOLDER
13. TURBINE SHAFT
14. OIL SEAL RING
15. OIL SEAL RING

Fig. 2.11 Converter Wheel Assembly (L35-3, LX190-7 · L40-3, LX230-7)

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Power transmission

Power from the engine is transmitted through the flywheel, input plate or coupling gear, front cover, impeller, turbine, turbine shaft, and to the transmission.

Oil flow route (See Fig. 2.3, 2.5 or Fig. 2.7)

The torque converter oil delivered from the transmission control valve passes through the oil passage in the stator support into the converter wheel.

As the engine is started and the impeller rotates, the oil between the vanes of the impeller is thrown out by centrifugal force, flowing into the vanes of the turbine. It hits the vanes of the turbine at an angle which in turn rotate the turbine shaft. The reaction torque or the oil produced by the oil flow hitting the vanes of the turbine becomes the output torque of the turbine shaft.

The stator controls the oil flow leaving the vanes of the turbine in a certain direction, directing it into the impeller, thus increasing the torque.

Part of the oil inside the converter wheel passes through the oil passage in the stator support to the oil cooler. A safety valve is installed at the torque converter oil inlet port, to release excess oil into the converter housing.

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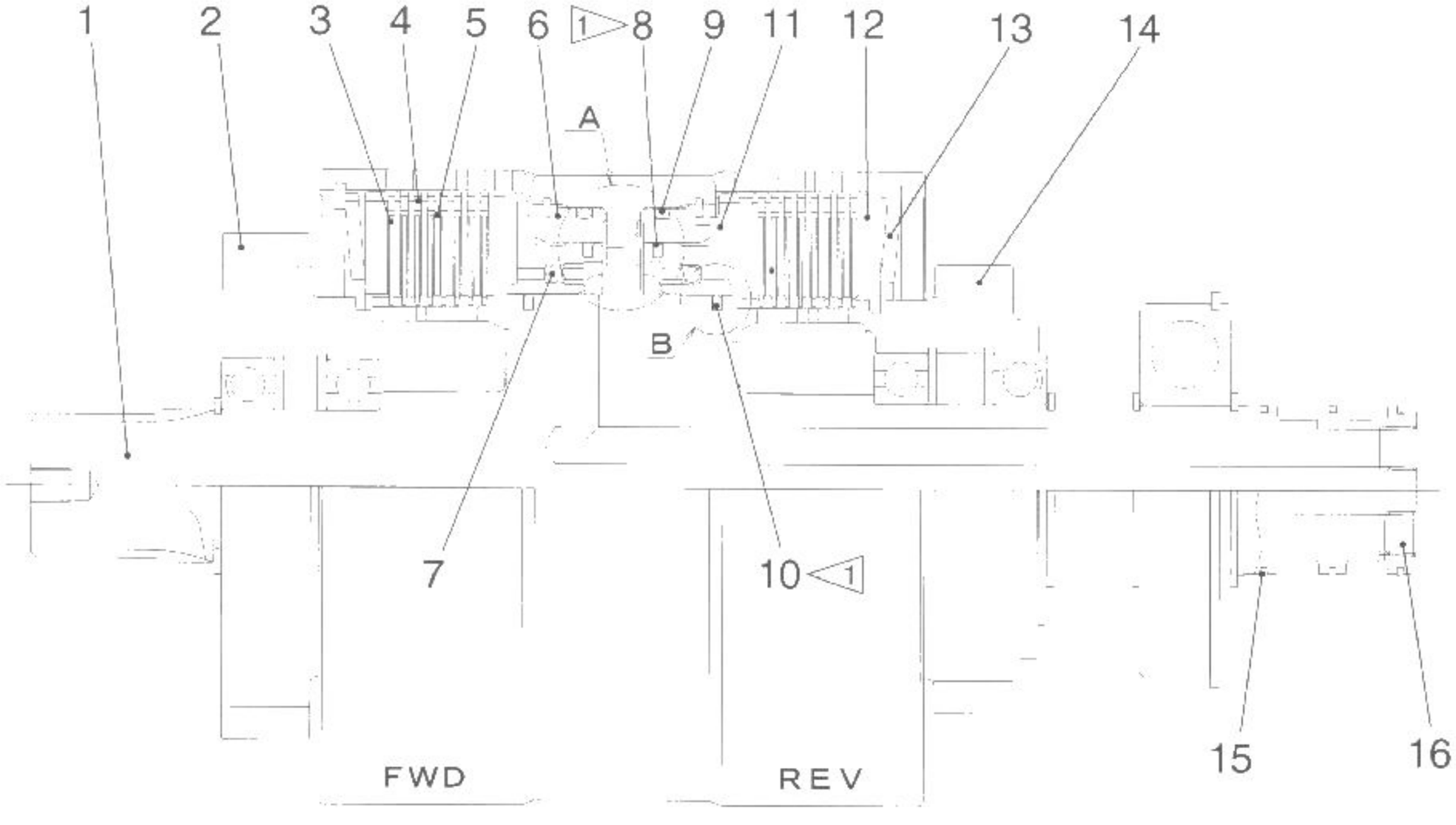
2.3 TRANSMISSION

The transmission converts the speed and direction of power transmitted from the torque converter.

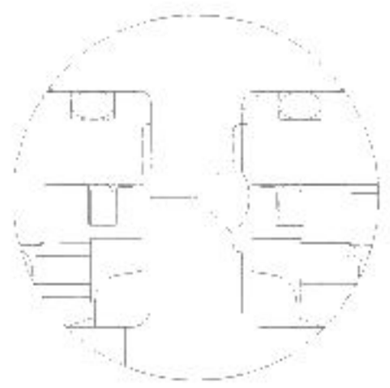
The transmission consists of three clutch shaft assemblies, a back gear, an output shaft, a parking brake, and a control valve.

2.3.1 CLUTCH SHAFT

The clutch shaft assembly has clutch disks for each speed, and turns power transmission on and off.



Note: 1▷ Sliding surfaces: Grease
(Pay attention to the direction of assembly.
See the enlarged views on the right.)



Detail of area A



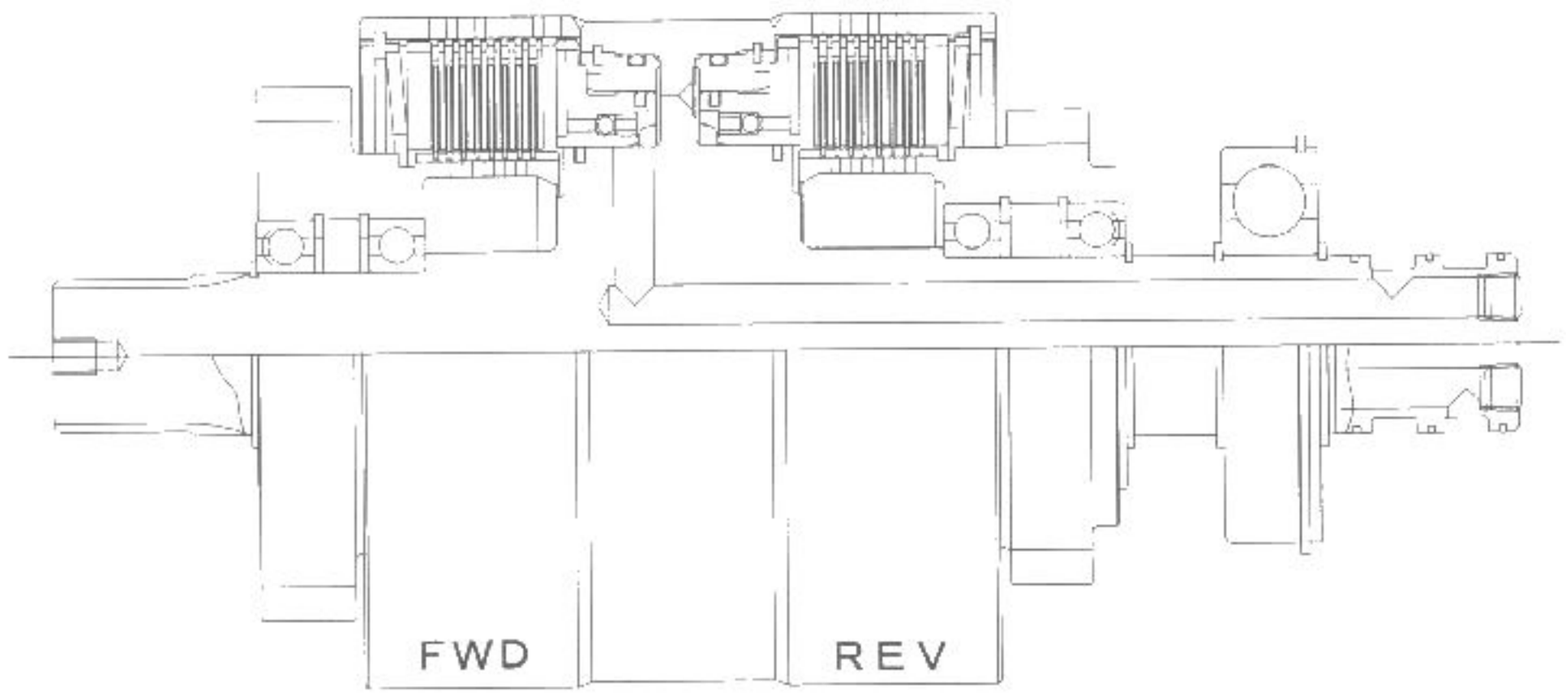
Detail of area B

1. SHAFT & DRUM
2. GEAR
3. DISK
4. RETURN SPRING
5. PLATE
6. SPACER
7. BLEED VALVE
8. SEAL RING (OUTER)
9. "O"-RING
10. SEAL RING (INNER)
11. PISTON
12. END PLATE
13. BELLEVILLE SPRING
14. GEAR
15. SEAL RING
16. PLUG

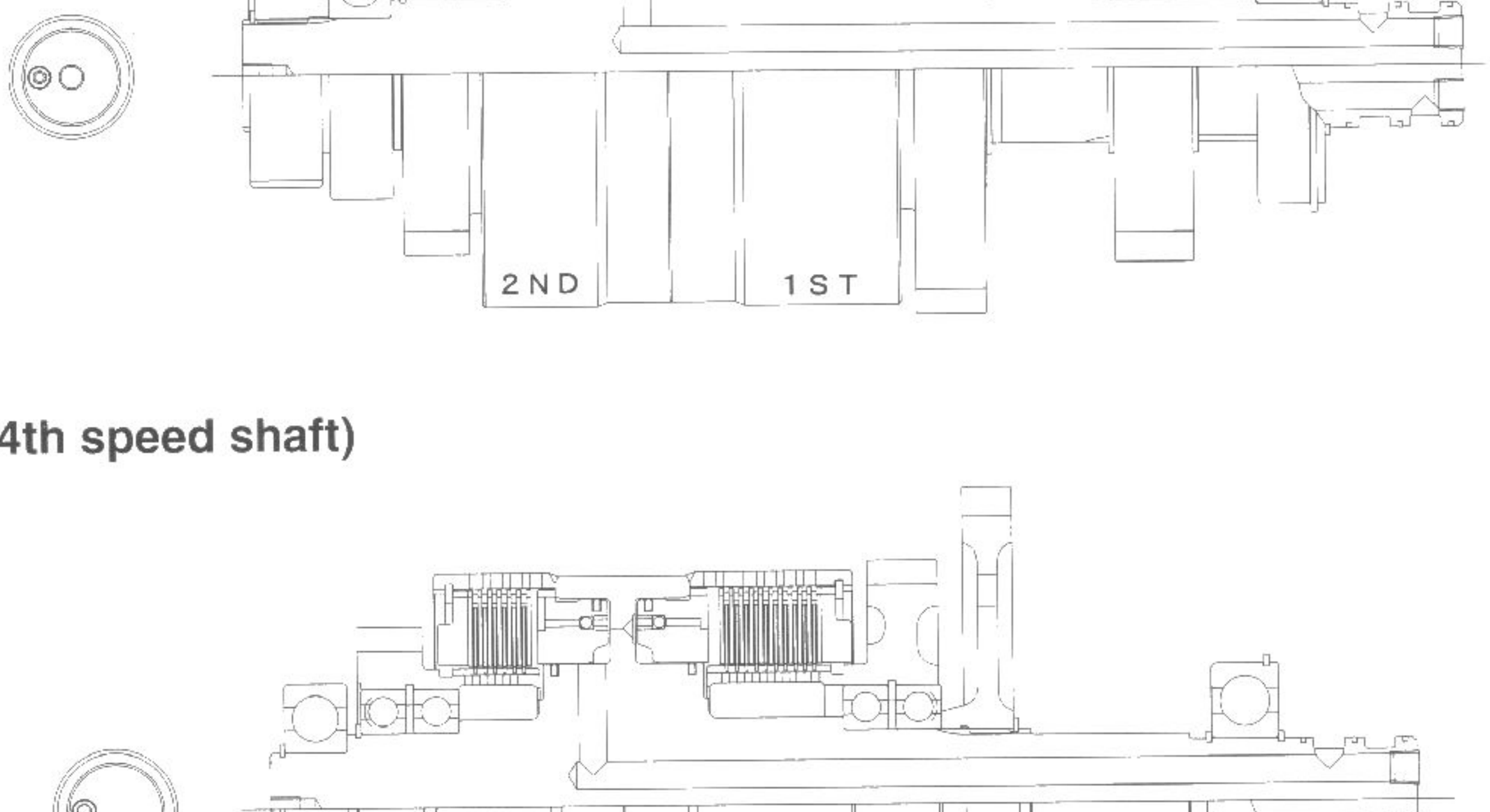
Fig. 2.12 Typical Clutch Shaft Structure

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(Fwd/Rev shaft)



(1st/2nd speed shaft)



(3rd/4th speed shaft)

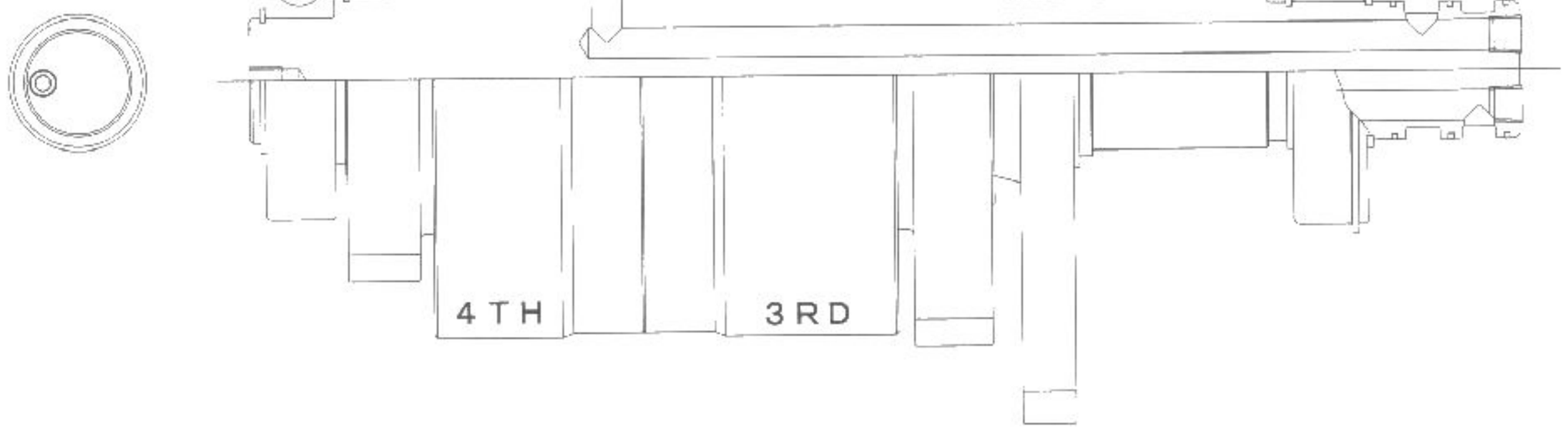
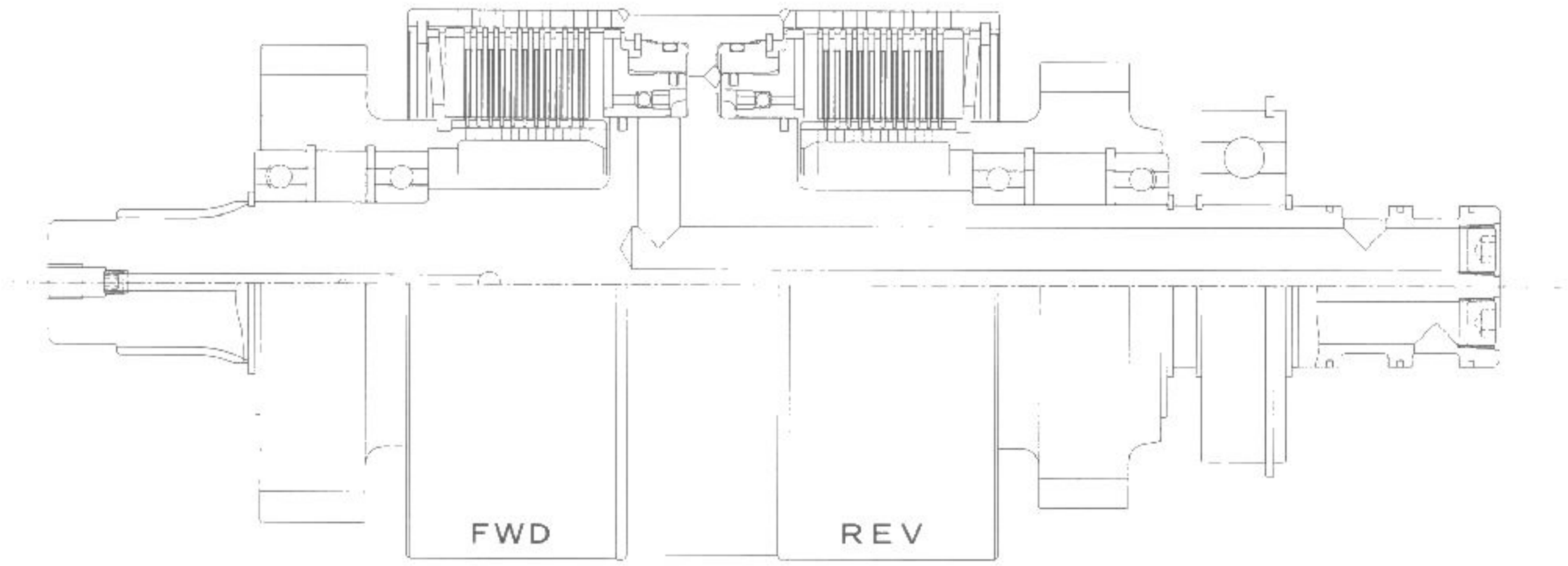


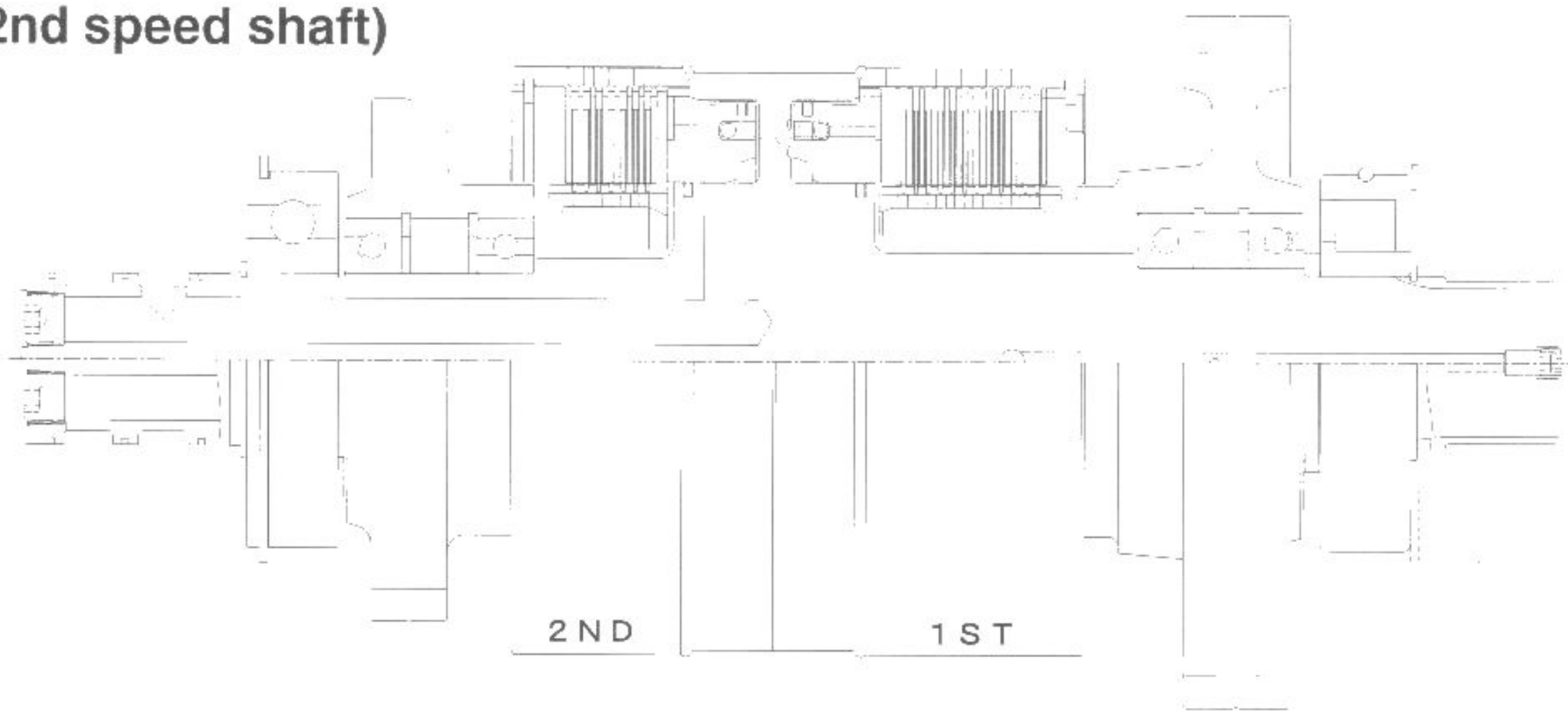
Fig. 2.13 Clutch Shaft (L27-3, LX130-7)

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(Fwd/Rev shaft)



(1st/2nd speed shaft)



(3rd/4th speed shaft)

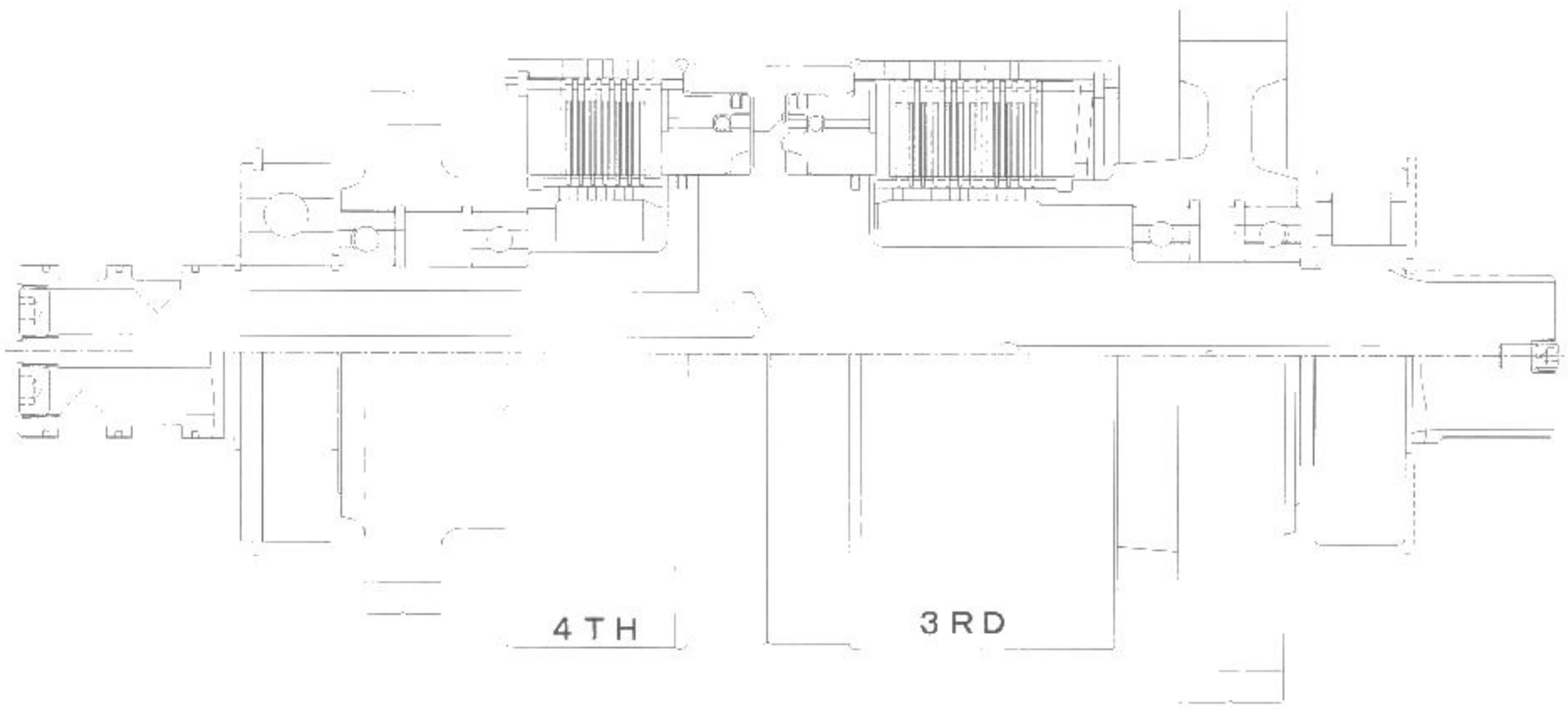
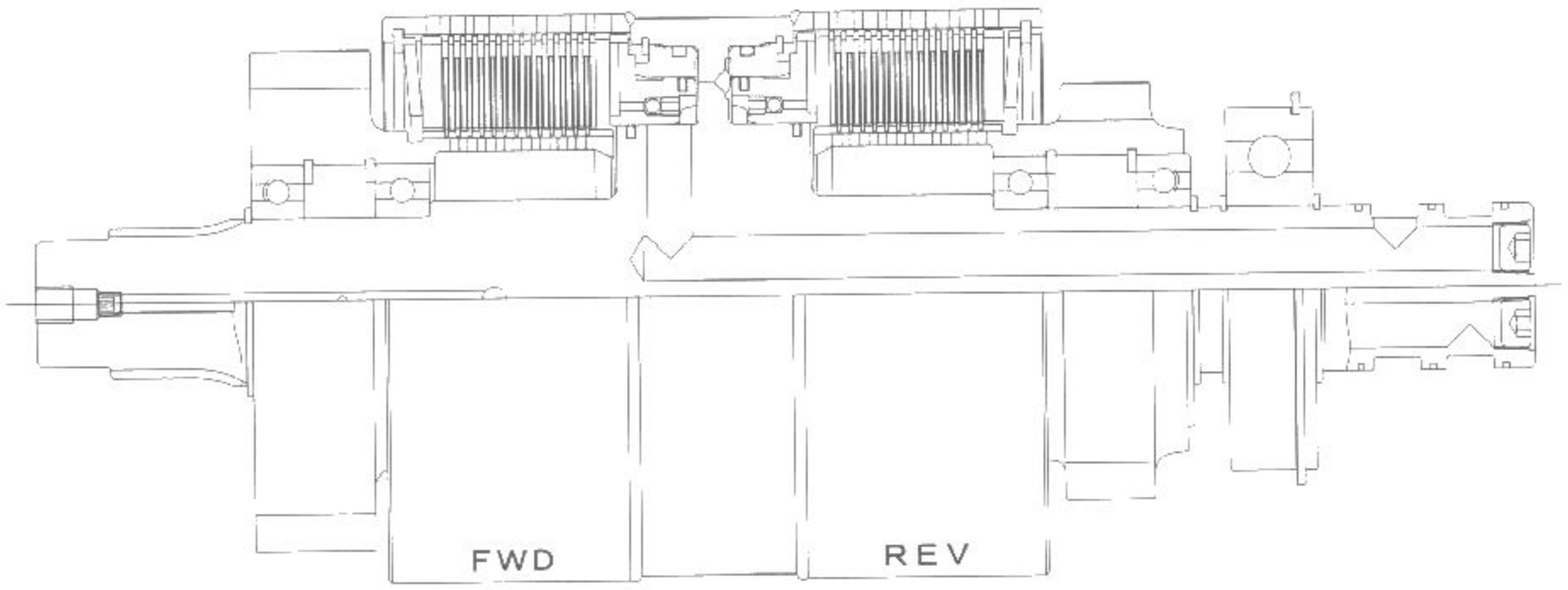


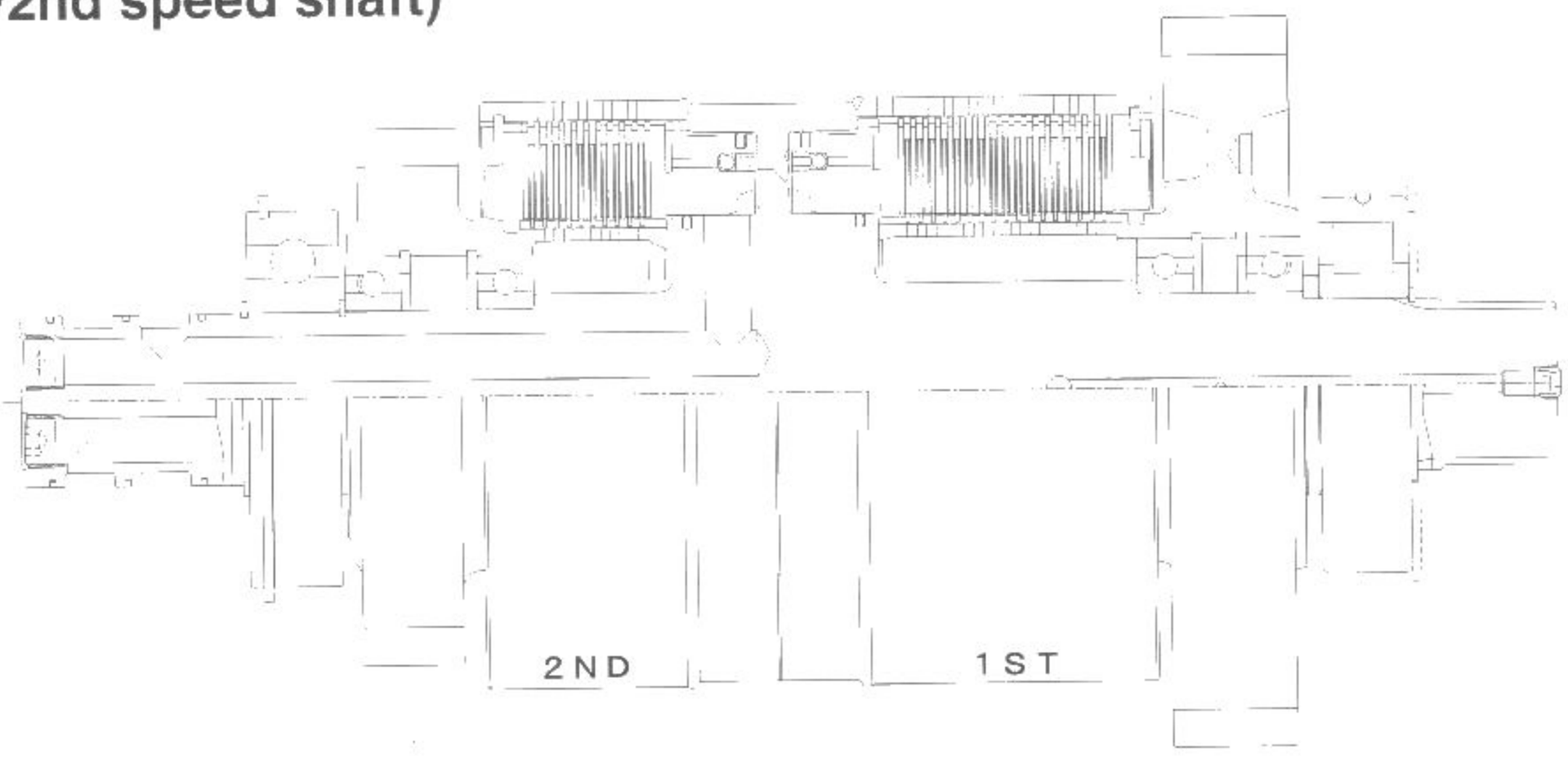
Fig. 2.14 Clutch Shaft (L32-3, LX160-7)

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(Fwd/Rev shaft)



(1st/2nd speed shaft)



(3rd/4th speed shaft)

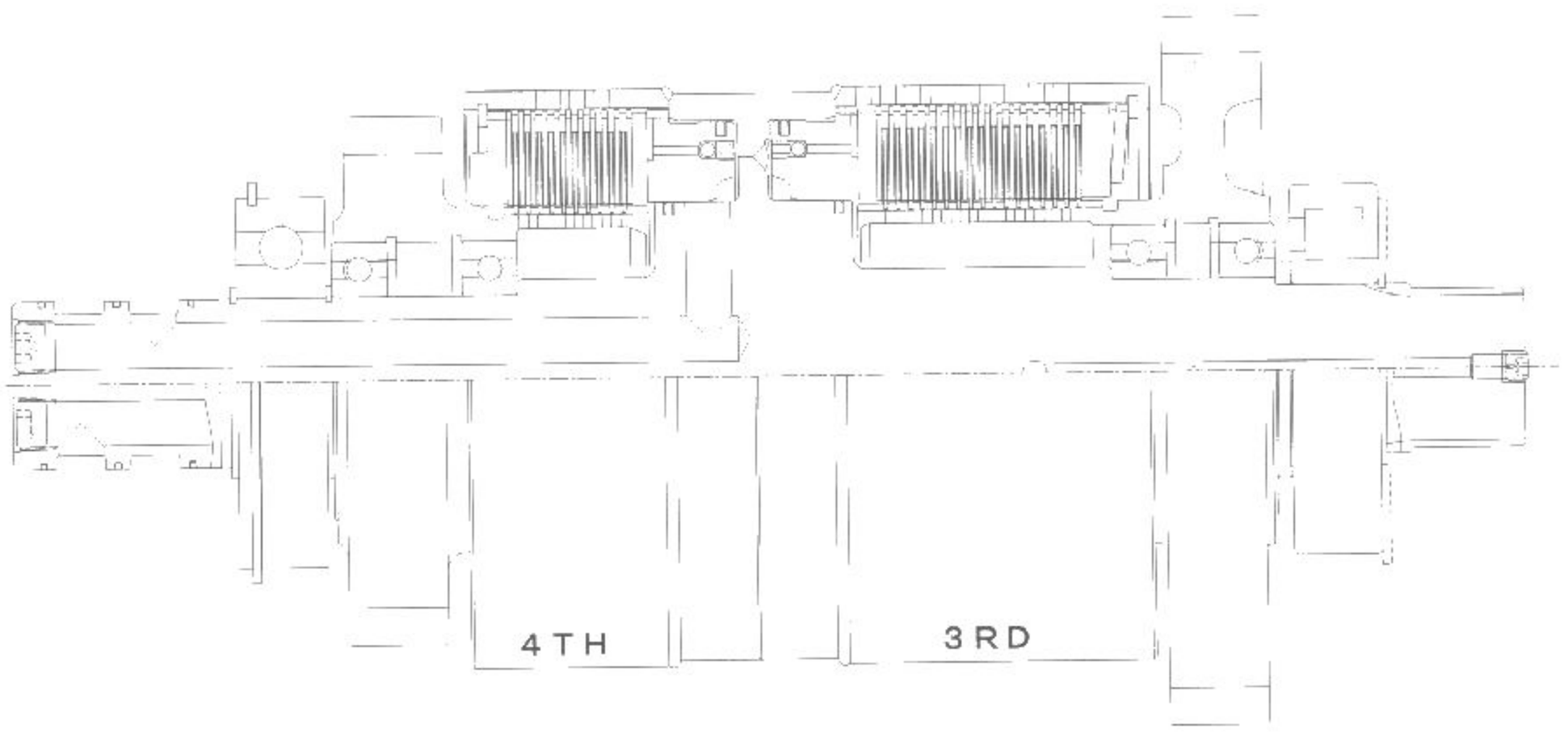


Fig. 2.15 Clutch Shaft (L35-3, LX190-7 · L40-3, LX230-7)

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Operation

The clutch is operated by pressurized oil from the transmission control valve. The pressurized oil from the control valve flows, passing through the distributor cap and the oil passages in the clutch shaft, to the back of the clutch piston to move the clutch piston. The clutch piston then locks up the clutch disks and clutch plates, thus engaging the clutch shaft and clutch hub together to transmit the power to the drive shaft.

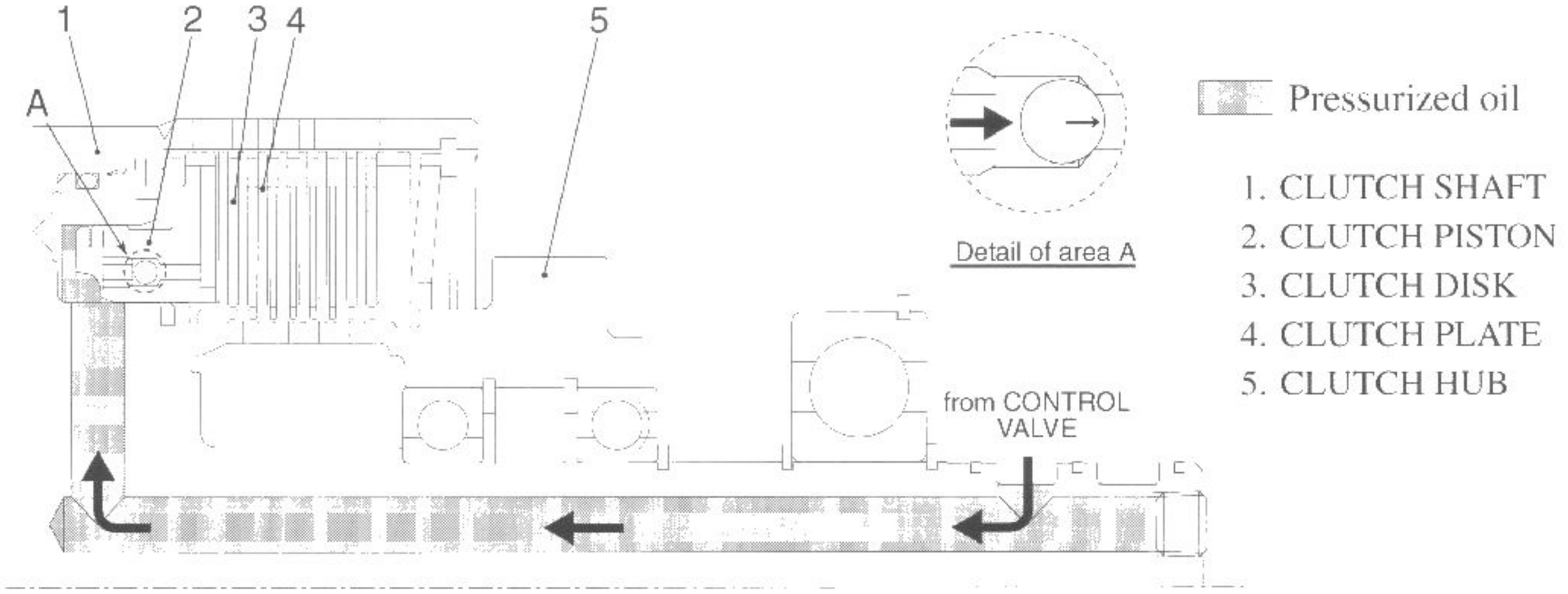


Fig. 2.16 Clutch in Engagement

With no pressurized oil delivered from the control valve, the oil in the piston is discharged from the bleed valve so that the clutch piston is pushed back by the return spring between the clutch plates. This unlocks the clutch disks and clutch plates to allow the clutch shaft and clutch hub to rotate independently, so that no power is transmitted to the drive shaft.

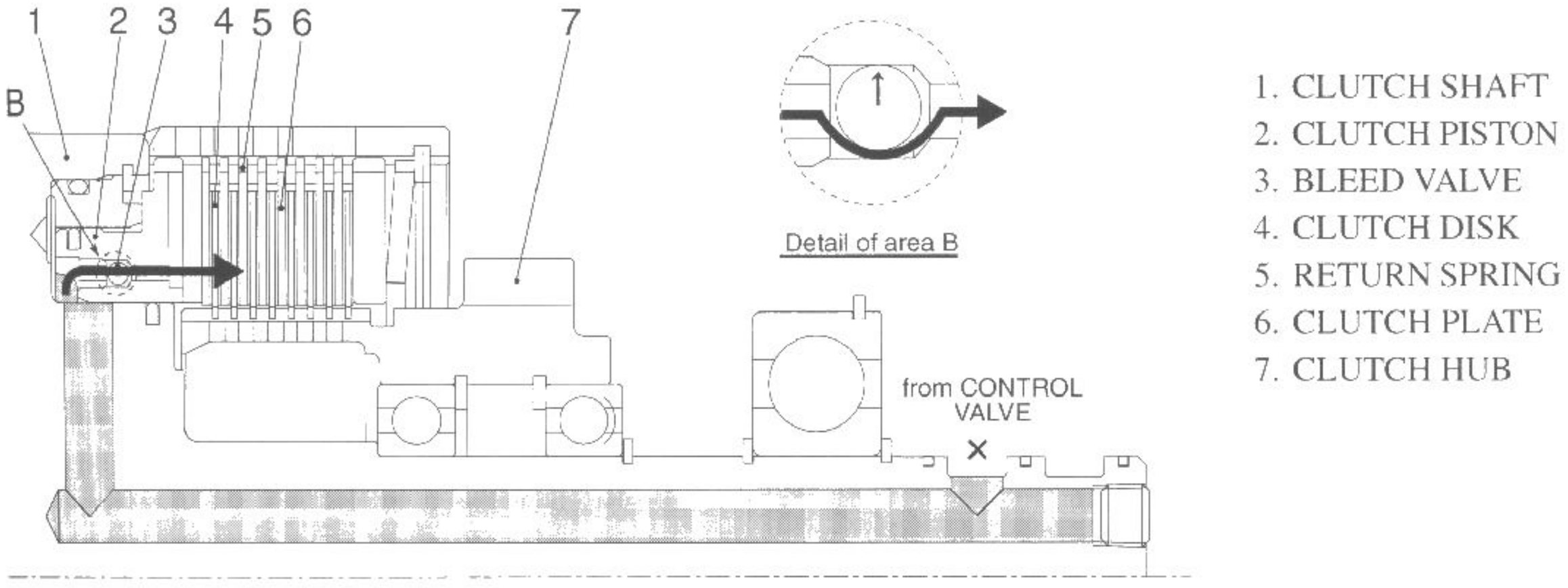


Fig. 2.17 Clutch in Disengagement

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2.3.2 POWER FLOW

(1) Shift lever in neutral

With neither the forward nor the reverse clutch engaged, the power from the torque converter rotates the forward and reverse shaft, but is not transmitted any further.

(2) Shift lever in forward

When the shift lever is put into one of the four forward speeds, the power from the torque converter is transmitted through the forward clutch and the selected speed clutch to the output shaft.

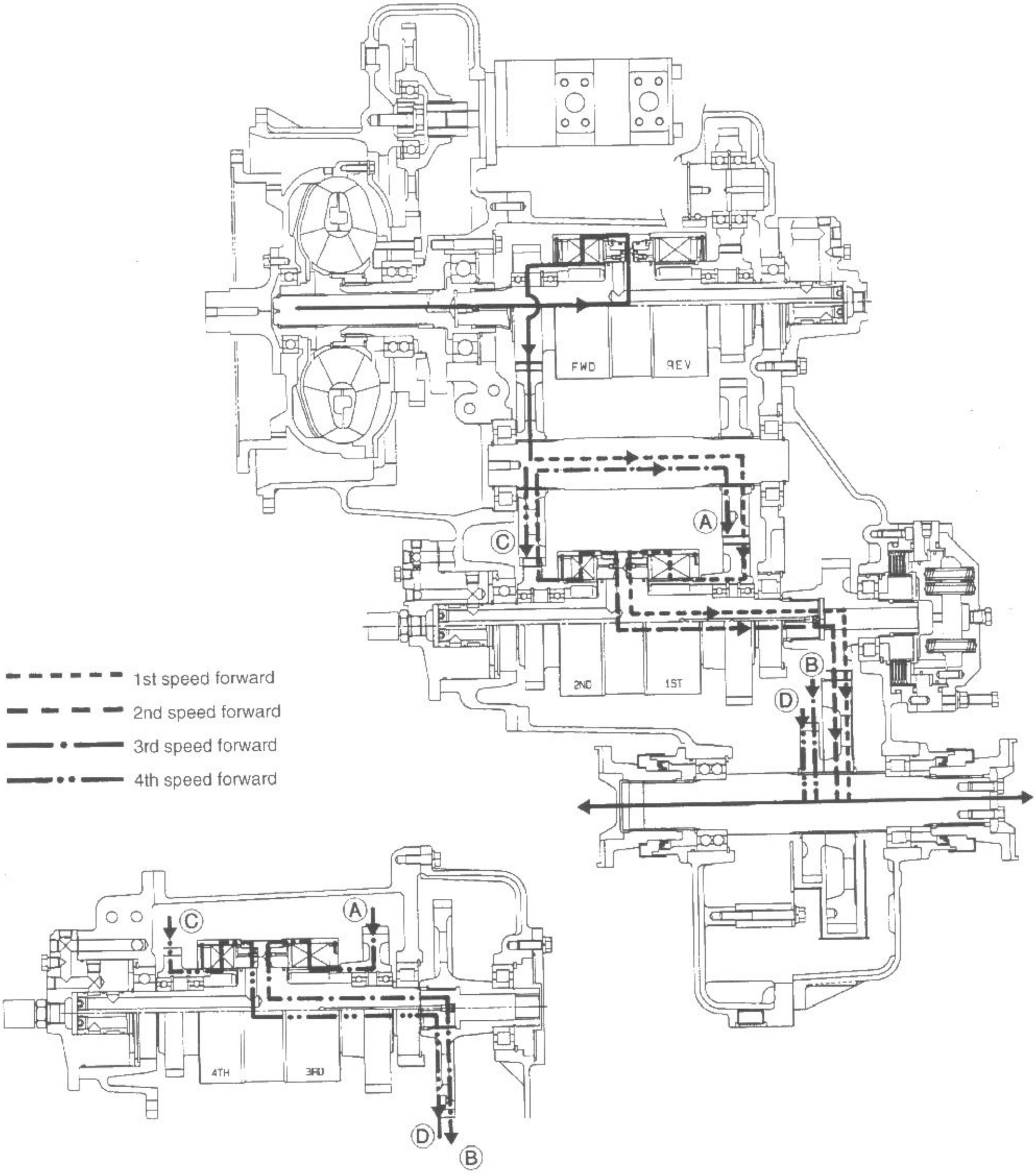


Fig. 2.18 Power Flow in Forward

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(3) Shift lever in reverse

When the shift lever is put into one of the four reverse speeds, the power from the torque converter is transmitted through the reverse clutch, the back gear and the selected speed clutch to the output shaft.

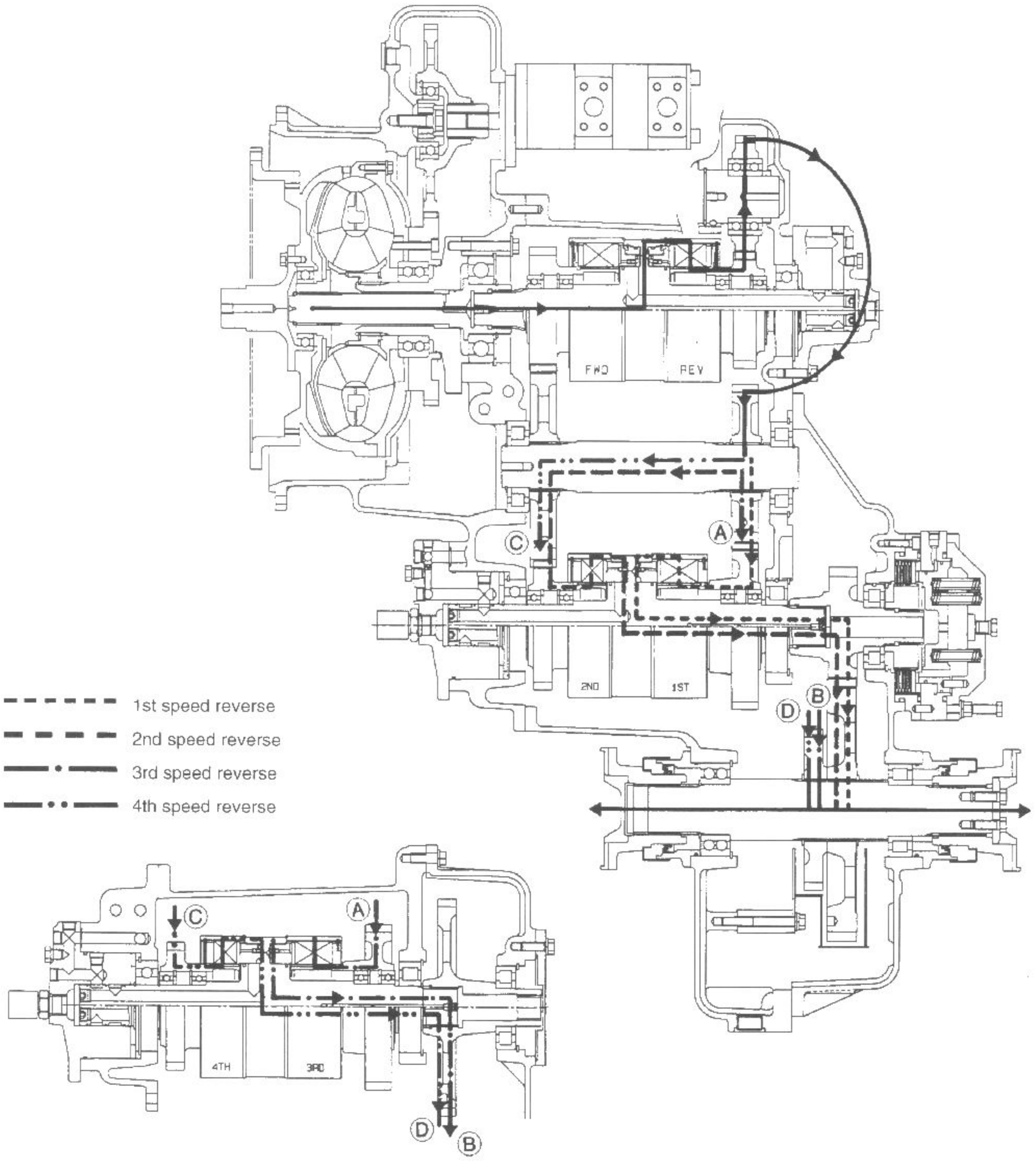


Fig. 2.19 Power Flow in Reverse

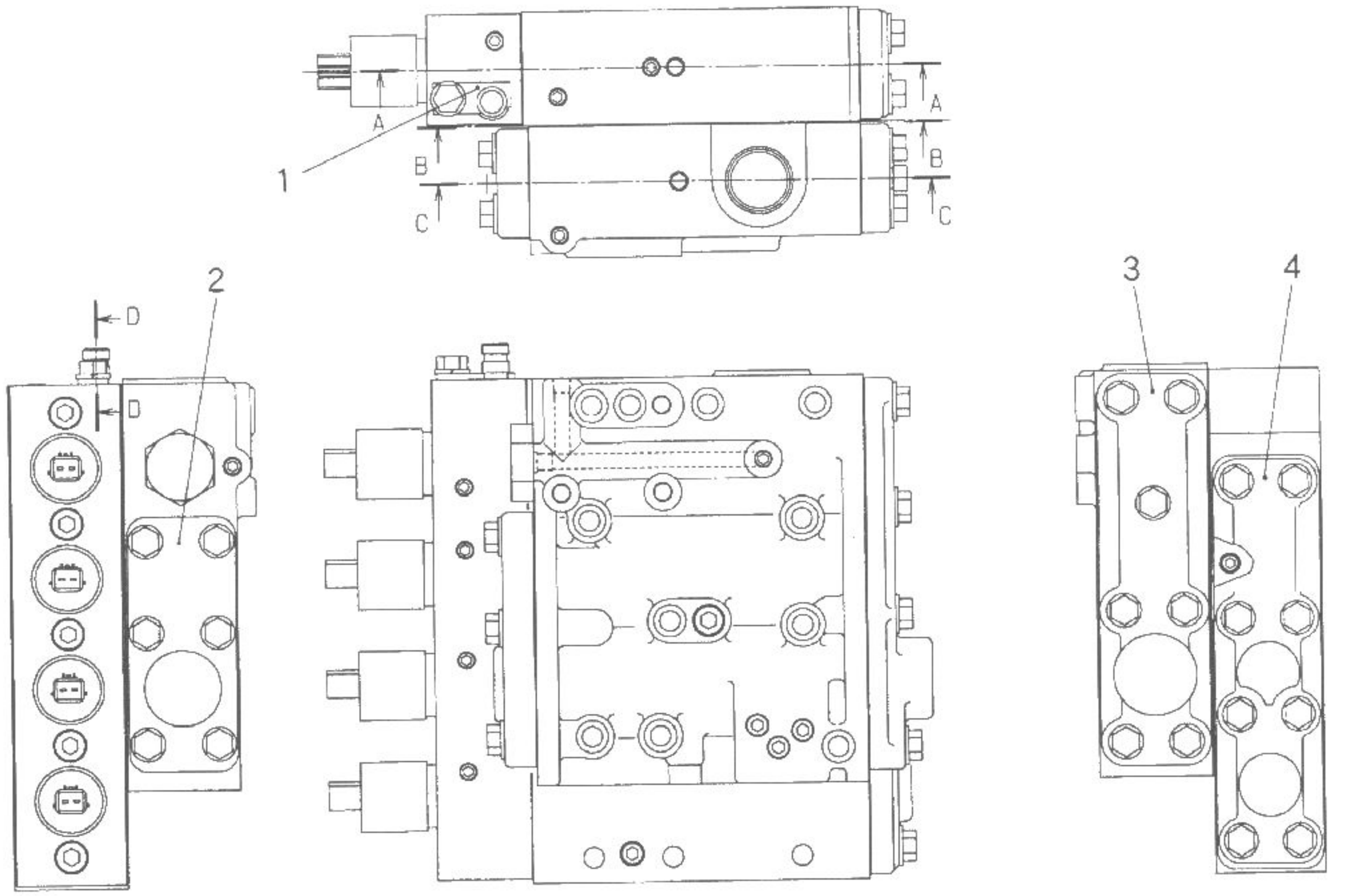
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2.3.3 TRANSMISSION CONTROL VALVE

The transmission control valve selectively sends oil to each clutch so as to change over the directions an speeds of the loader.

The control valve consists of a valve body and 4 solenoid valves. The solenoid valves are engaged an disengaged by the transmission control switch (shift lever), to shift the spool in the valve to control the clutc lock-up oil.

The control valve also has a modulation mechanism which operates differently according to the spee ranges. It is possible to operate the control valve manually if the electric system fails to operate normally.



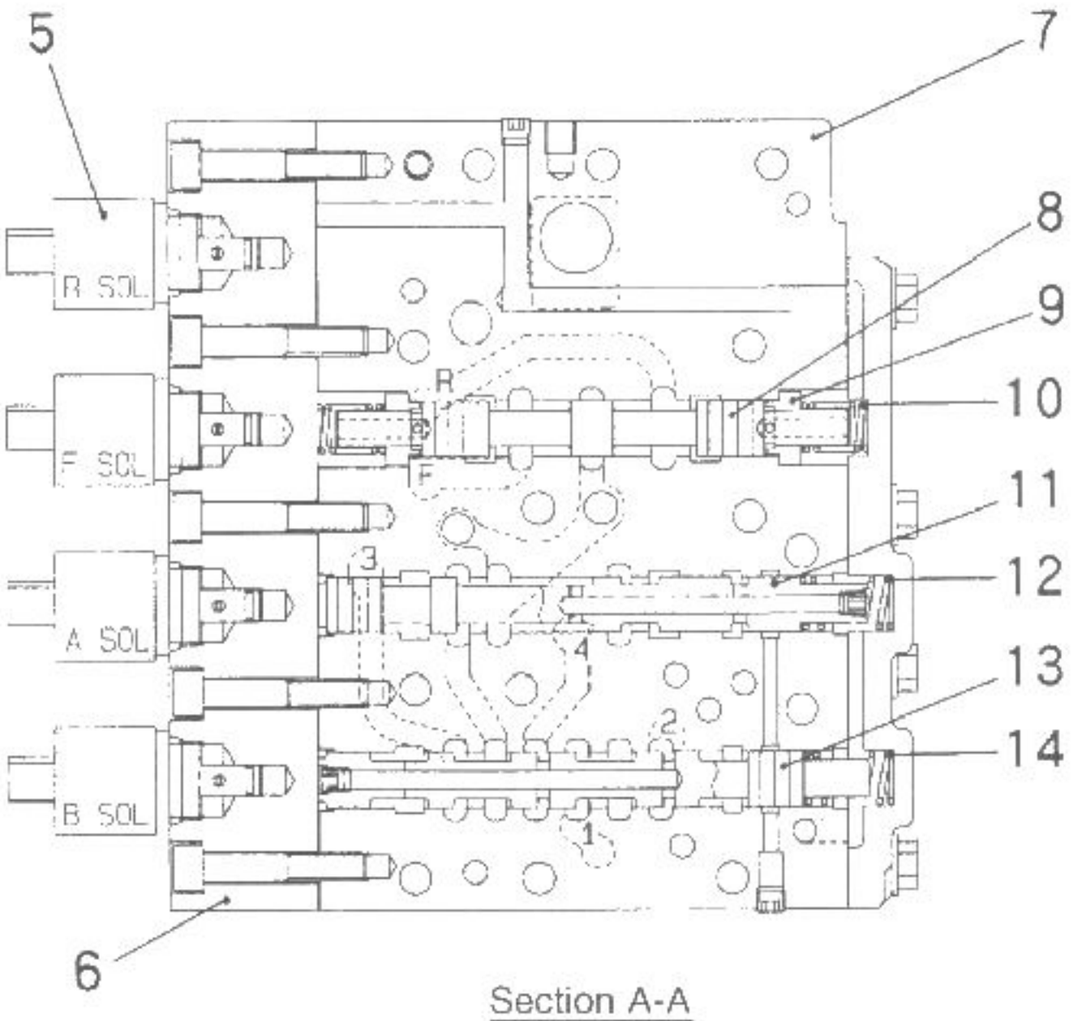
1. PLATE (FOR MANUAL OPERATION)
2. COVER
3. COVER
4. COVER
5. SOLENOID VALVE
6. ADAPTER
7. VALVE BODY (LOWER)
8. F/R SELECTOR SPOOL
9. ADAPTER
10. SPRING
11. SPOOL A
12. SELECTOR SPRING
13. SPOOL B
14. SELECTOR SPRING
15. ORIFICE, 0.8 mm [0.031 in.] dia. (FOR SOLENOID VALVE)
16. ORIFICE (W)
17. ORIFICE (Z)
18. ORIFICE (Y)
19. ORIFICE (X)

(16–19: See Note.)

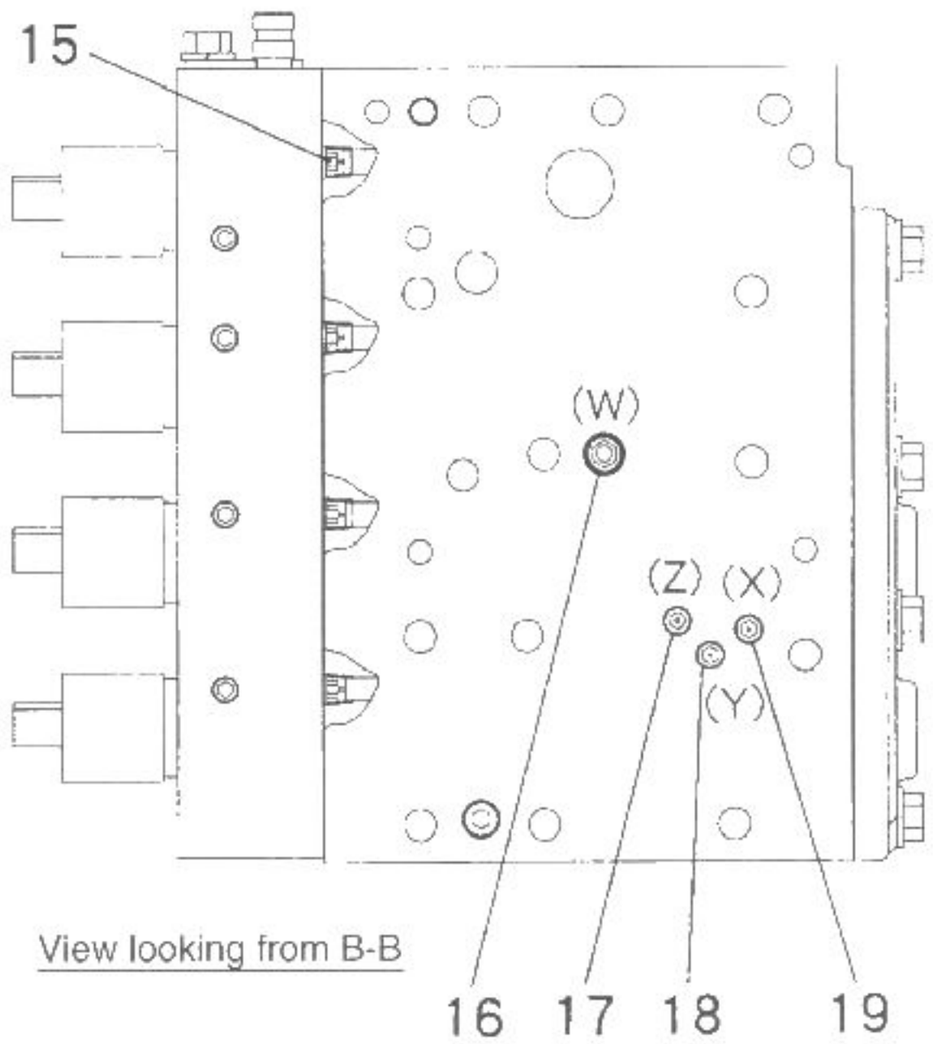
20. VALVE BODY (UPPER)
21. SPRING
22. FLOW SENSING SPOOL
23. SPRING
24. PIN
25. ROD
26. SPRING, INNER
27. SPRING, CENTER
28. SPRING, OUTER
29. LOAD PISTON H
30. REGULATOR SPOOL
31. PISTON

Fig. 2.20 Transmission Control Valve (1)

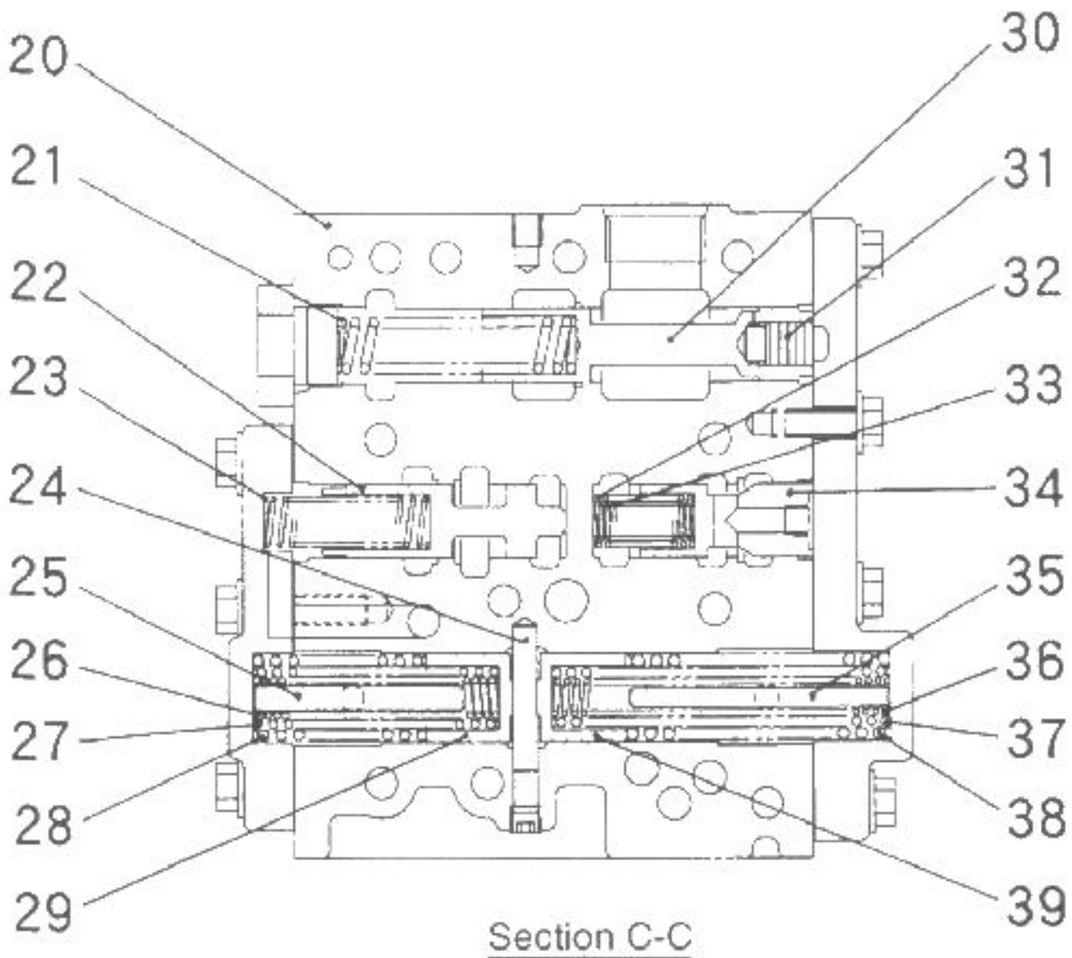
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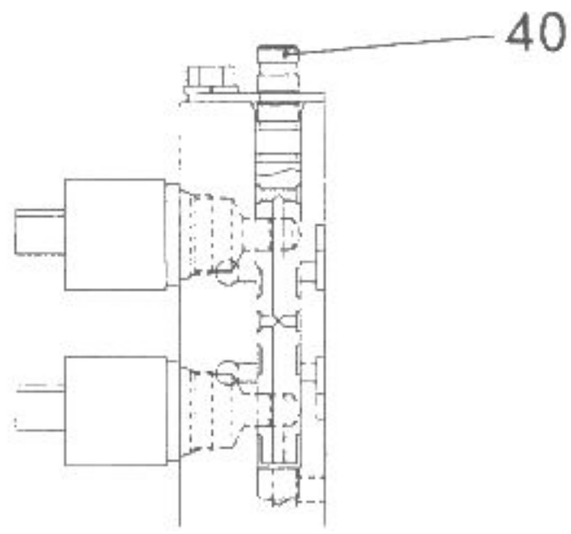
Section A-A



View looking from B-B



Section C-C



Section D-D

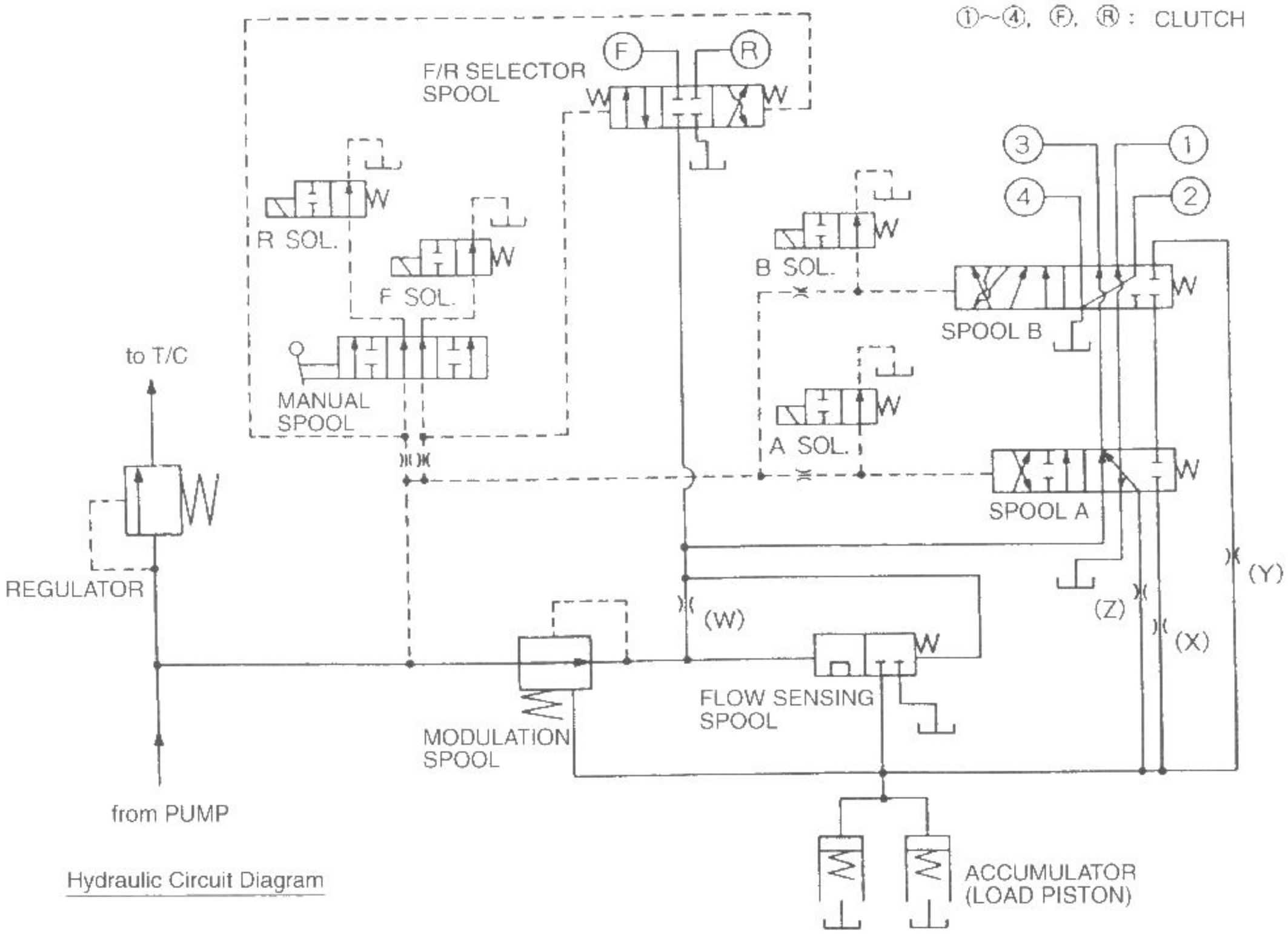
Note: Orifice diameter, mm [in.]

	Orifice (W) for main	Orifice (X) for 1st/2nd gears	Orifice (Y) for 2nd gear	Orifice (Z) for 3rd/4th gears
L27-3, LX130-7 L32-3, LX160-7	6.0 [0.24]	0.9 [0.035]	0.9 [0.035]	1.5 [0.059]
L35-3, LX190-7 L40-3, LX230-7	6.0 [0.24]	1.1 [0.043]	1.1 [0.043]	1.8 [0.071]

32. SPRING, OUTER
33. SPRING, INNER
34. MODULATION SPOOL
35. ROD
36. SPRING, INNER
37. SPRING, CENTER
38. SPRING, OUTER
39. LOAD PISTON L
40. MANUAL SPOOL (FOR EMERGENCY TRAVEL SPOOL)

Fig. 2.21 Transmission Control Valve (2)

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Hydraulic Circuit Diagram

Fig. 2.22 Transmission Control Valve (3)

Operation

The modulation mechanism of this control valve changes the time the clutch lock-up oil takes to build up, or the clutch oil pressure waveform, according to the speed ranges, thus making gear shifting smoother.

The operation of the modulation mechanism is explained on points A to E. In addition, the operation of the solenoid valves and manual spool (emergency travel spool) is also explained in pages that follow.

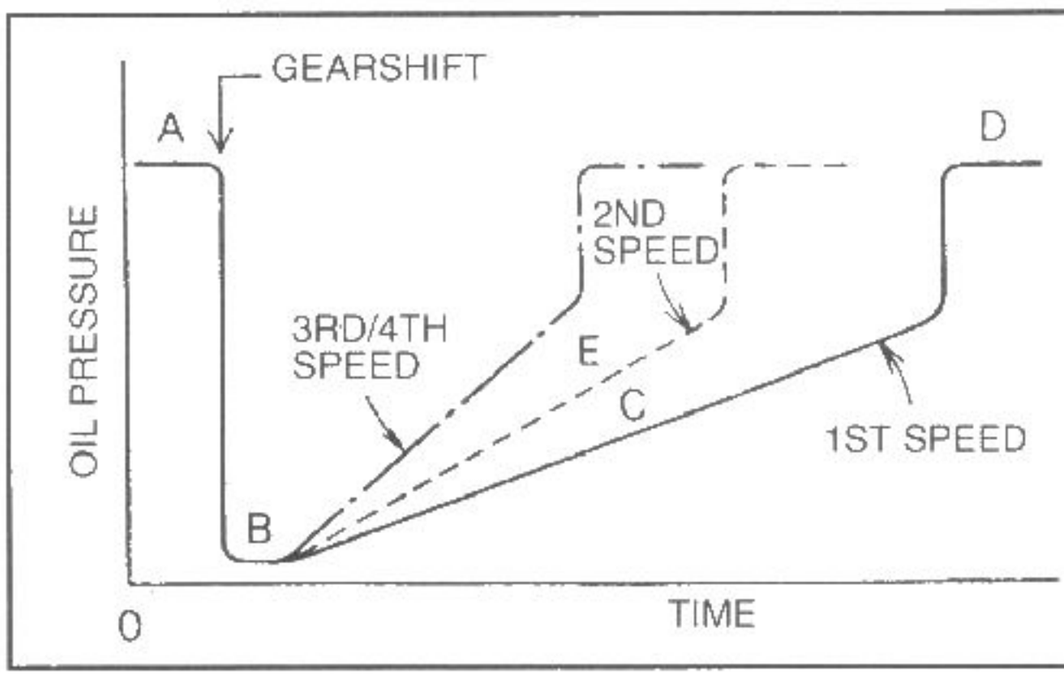


Fig. 2.23 Clutch Oil Pressure Waveform

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(1) Neutral, 3rd speed in Neutral (Point A in Fig. 2.23)

① The oil which has entered the inlet port (1) of the control valve, flows through the small hole "a" in the regulator spool into the chamber (2) at the back of the spool, to shift the spool to the left in the figure. The oil whose pressure has been regulated to the clutch lock-up pressure, flows through the circuit (3) into the modulation spool circuit (5). Excess oil flows, passing through the circuit (4), to the torque converter.

② The oil which has reached the circuit (5) flows through the tapered oil passage in the modulation spool circuit (6), which leads through the main orifice (W), to the circuits (8, 9, 12).

③ The oil which has been delivered to the circuit (8) flows through (8), (16), (17), (18) and to the 3rd speed clutch chamber. The clutch ports other than that of the 3rd speed clutch are connected with the drain.

④ The oil which has reached the circuit (8) flows through the drilled hole in the spool A to the circuit (19). The oil then passes through the throttle (Z) to the load piston chamber (20). There are two load pistons: low-pressure and high-pressure ones. After the low-pressure load piston moves to the stopper, the high-pressure load piston starts moving.

⑤ The oil which has flowed into the circuit (12) is stopped by the F/R selector spool. Both the forward and the reverse clutches are disengaged (neutral).

⑥ The solenoid valves are in the "OFF" state so that the oil which has reached through the orifice to each solenoid valve is drained.

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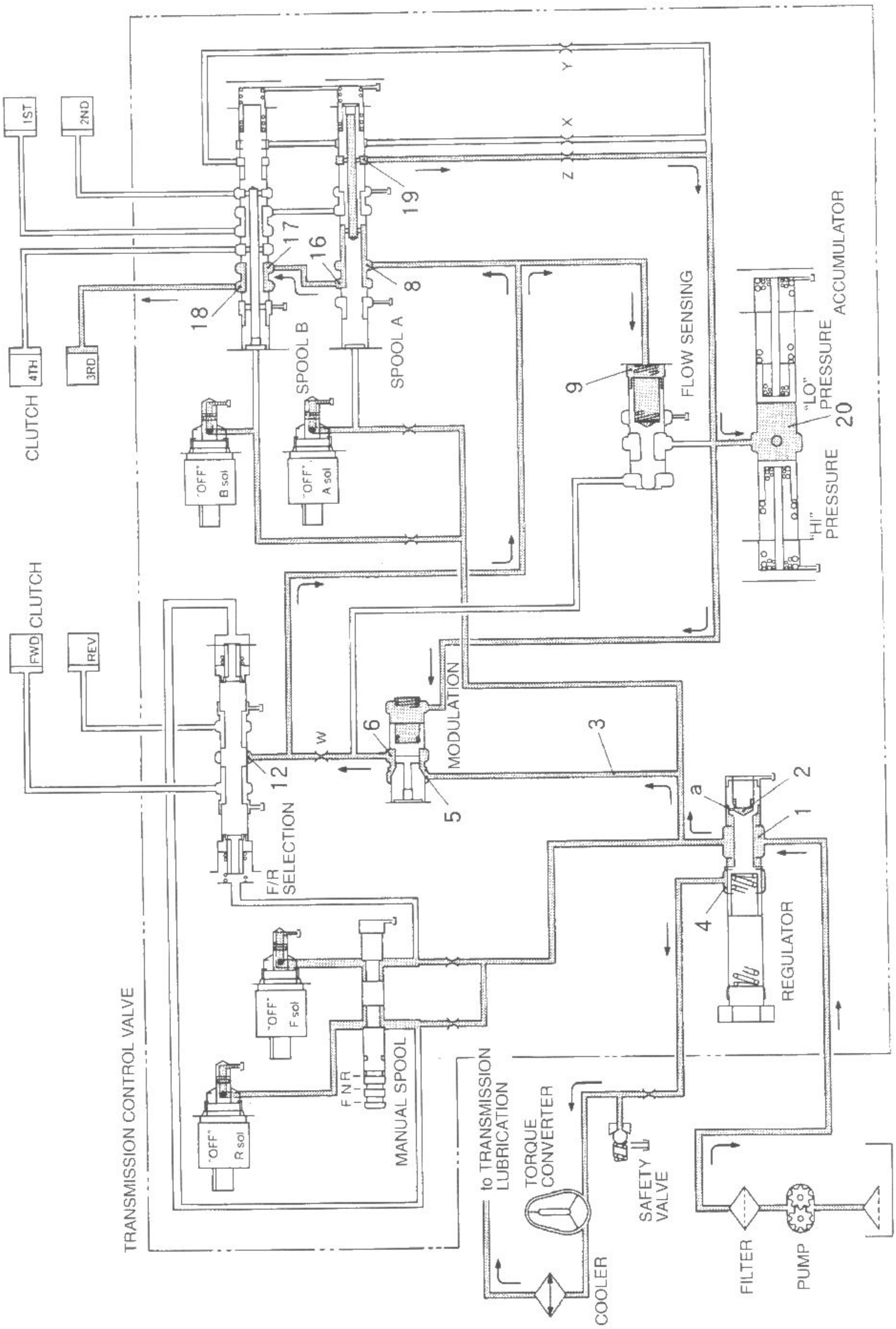


Fig. 2.24 Neutral (3rd Speed in Neutral)

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(2) Shifting into 1st forward (Point B in Fig. 2.23)

① Solenoid valves F and A are turned "ON."

② With the solenoid F turned ON, the oil flow is stopped by the solenoid valve F so that the oil sent from the oil passage (1) flows to the circuit (26) where the F/R selector spool is then shifted, due to the oil pressure, to the right in the figure.

③ On the other hand, as the solenoid A is turned ON, the spool A moves to the right in the figure.

④ As the F/R selector spool moves, the oil in the circuit (12) flows to the circuit (21) where the fwd clutch is located. As the empty fwd clutch chamber is filled with oil, a difference in pressure between the preceding circuits (6, 22) and the subsequent circuits (8, 9, 12) of the main orifice (W) is created. (The preceding circuits have a higher oil pressure.)

⑤ The pressure differential between the circuit (9) and the circuit (22) moves the flow sensing spool to the right in the figure, with the oil in the circuit (20) being drained.

⑥ The modulation spool moves to the right in the figure because the oil pressure in the circuit (25) drops, to control the oil flow from the circuit (5) to the circuit (6), thus delivering only the necessary amount of oil.

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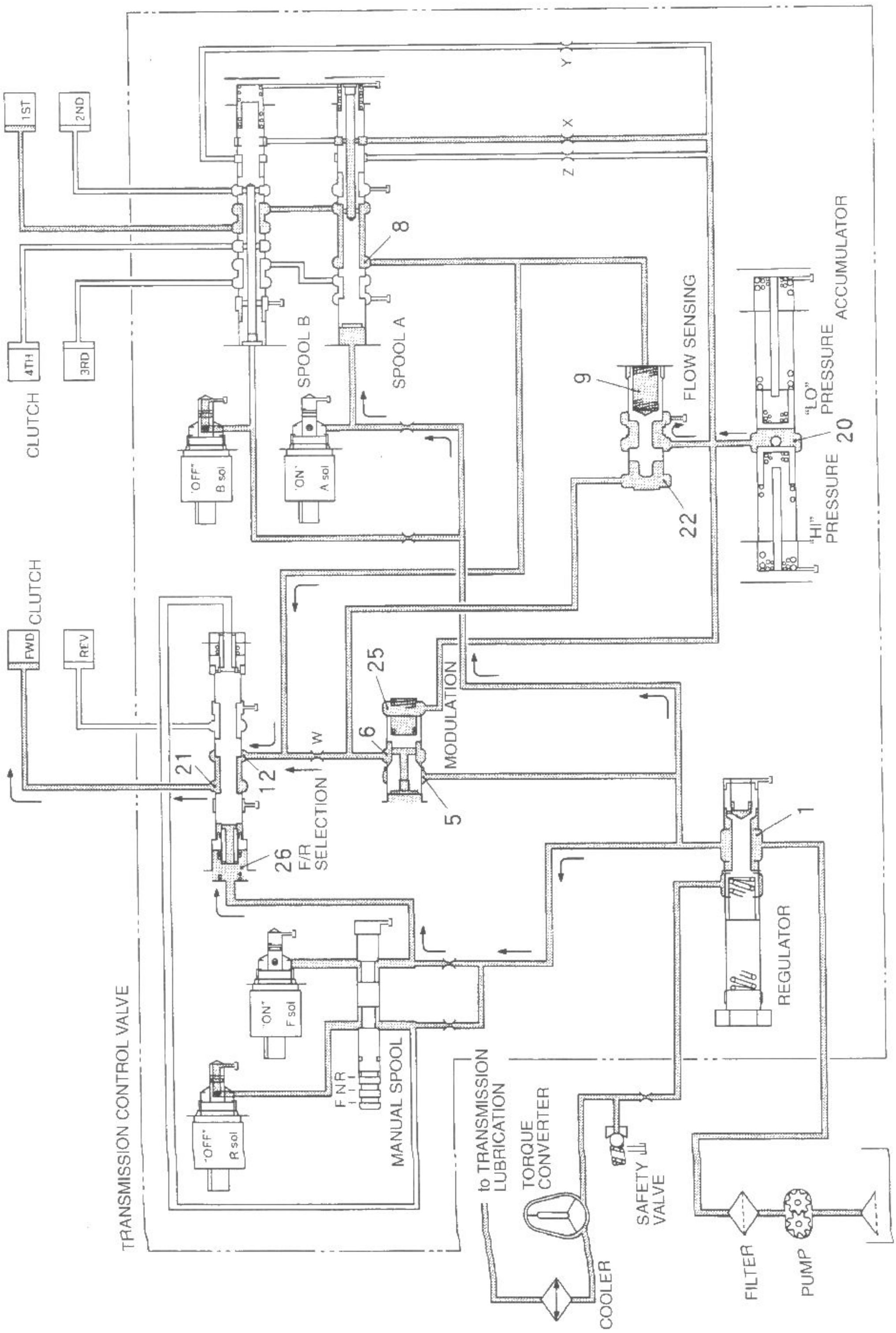


Fig. 2.25 Shifting into 1st Forward

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(3) Clutch in engagement (Point C in Fig. 2.23)

① When the selected clutches are filled with oil, the pressure differential across the main orifice (W) drops so that the flow sensing spool is moved to the left in the figure by spring tension, thus closing the drain circuit.

The oil in the circuit (23) flows through the drilled holes in the spool A to the circuit (24), then passing through the orifice (X), to the load piston chamber (20).

② On the other hand, the oil flows from the modulation spool, passing through the oil passages (5,6) and the drilled holes in the spool, to the chamber (7) at the back of the spool. Therefore, the modulation spool moves due to the oil pressure in the chambers (7) and (25) or that in the load piston chamber (20), gradually increasing the clutch oil pressure.

③ When the clutch oil pressure reaches the specified value, the load piston stops at the stopper position.

(4) After clutch engaement (Point D in Fig. 2.23)

① As soon as both the fwd clutch and 1st speed clutch are locked up, the load piston moves to the stopper to increase the oil pressure in the load piston chamber (20) rapidly up to the regulator pressure.

② The modulation spool circuits (7) and (25) have the same oil pressure, but the circuit (25) has a spring. For this reason, the modulation spool moves to the left in the figure.

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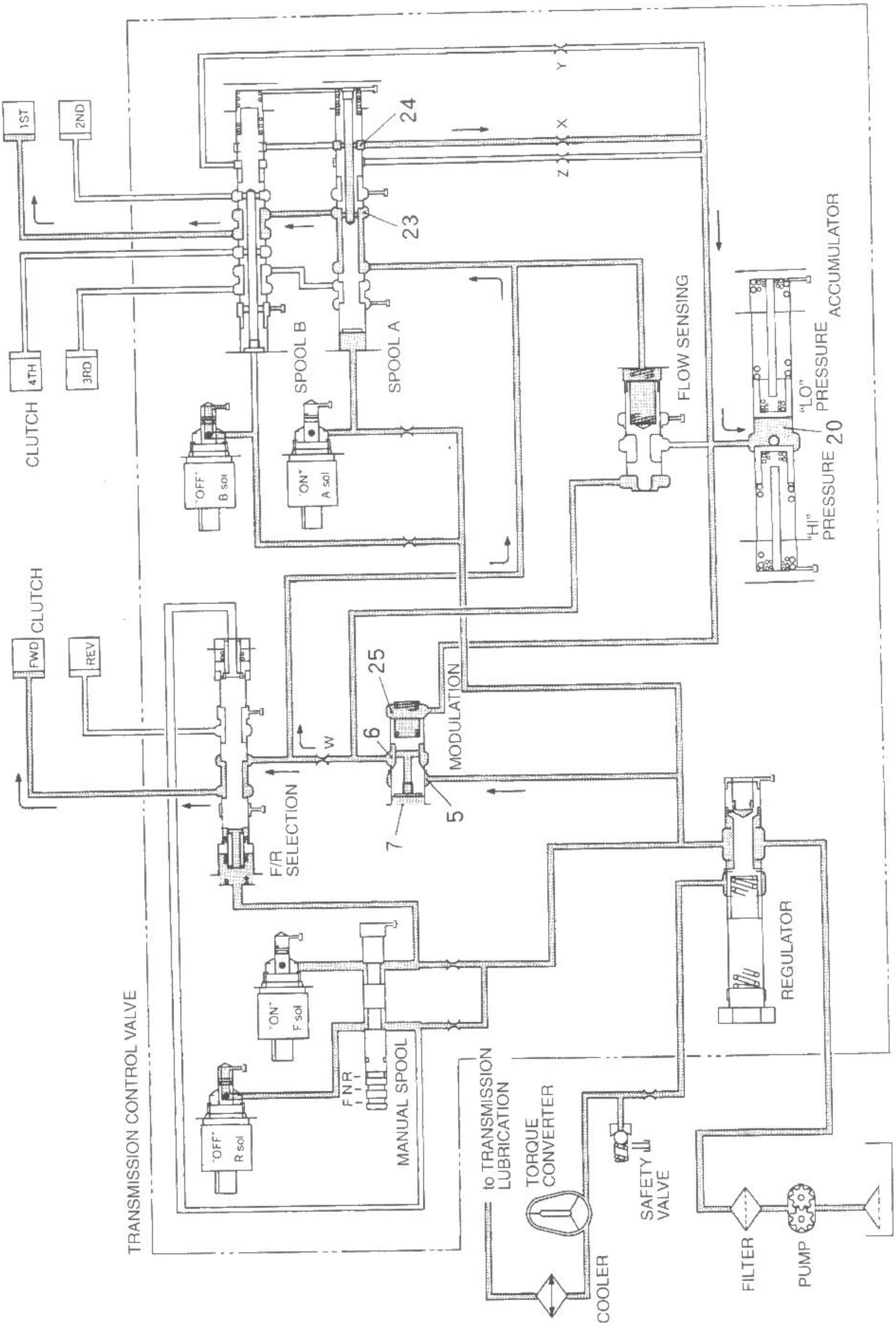


Fig. 2.26 Clutches in Engagement (1st Speed Forward)

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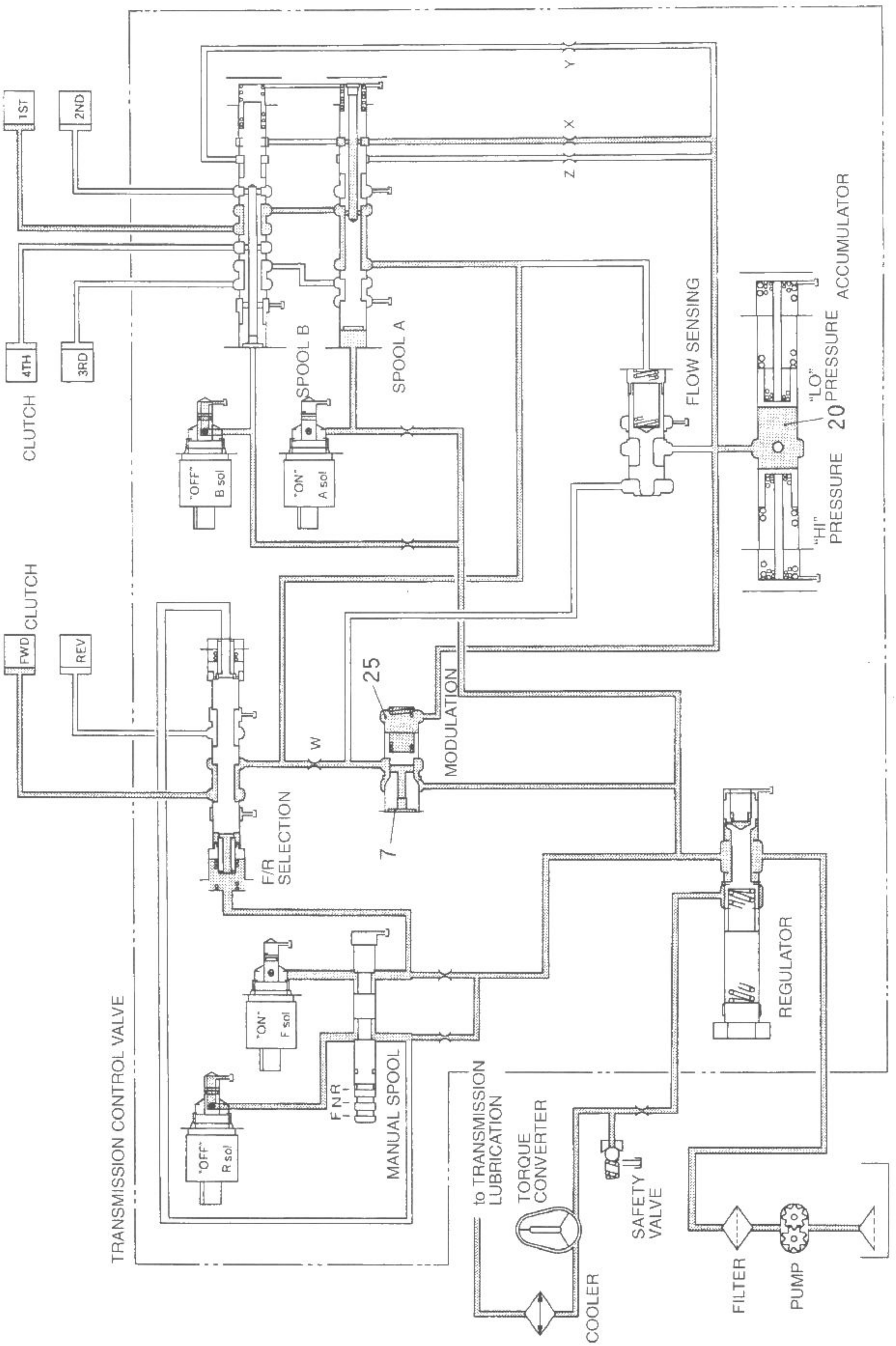


Fig. 2.27 After Clutch Engagement (1st Speed Forward)

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(5) Fwd and 2nd speed clutches in engagement (Point E in Fig. 2.23)

① Since the solenoids A and B are in the ON state, the speed spools A and B move to the right in the figure.

② The oil which entered circuit (8) flows into circuit (23). It then passes through the drilled holes in the spool, to circuit (24) , from which some of the oil passes orifice (X) into the load piston chamber (20). At the same time, the other flows from circuit (24) into circuit (27) of the spool B. The oil leaving the circuit (27) flows through the circuit (28) and orifice (Y) if circuit (29), into the load piston chamber (20).

In other words, when the shift lever is put in 2nd speed, the oil flows through orifices (X, Y), so that the time needed for the clutch oil pressure to build up is shorter than when the 1st speed clutch (the oil passes through orifice (X) alone) is selected.

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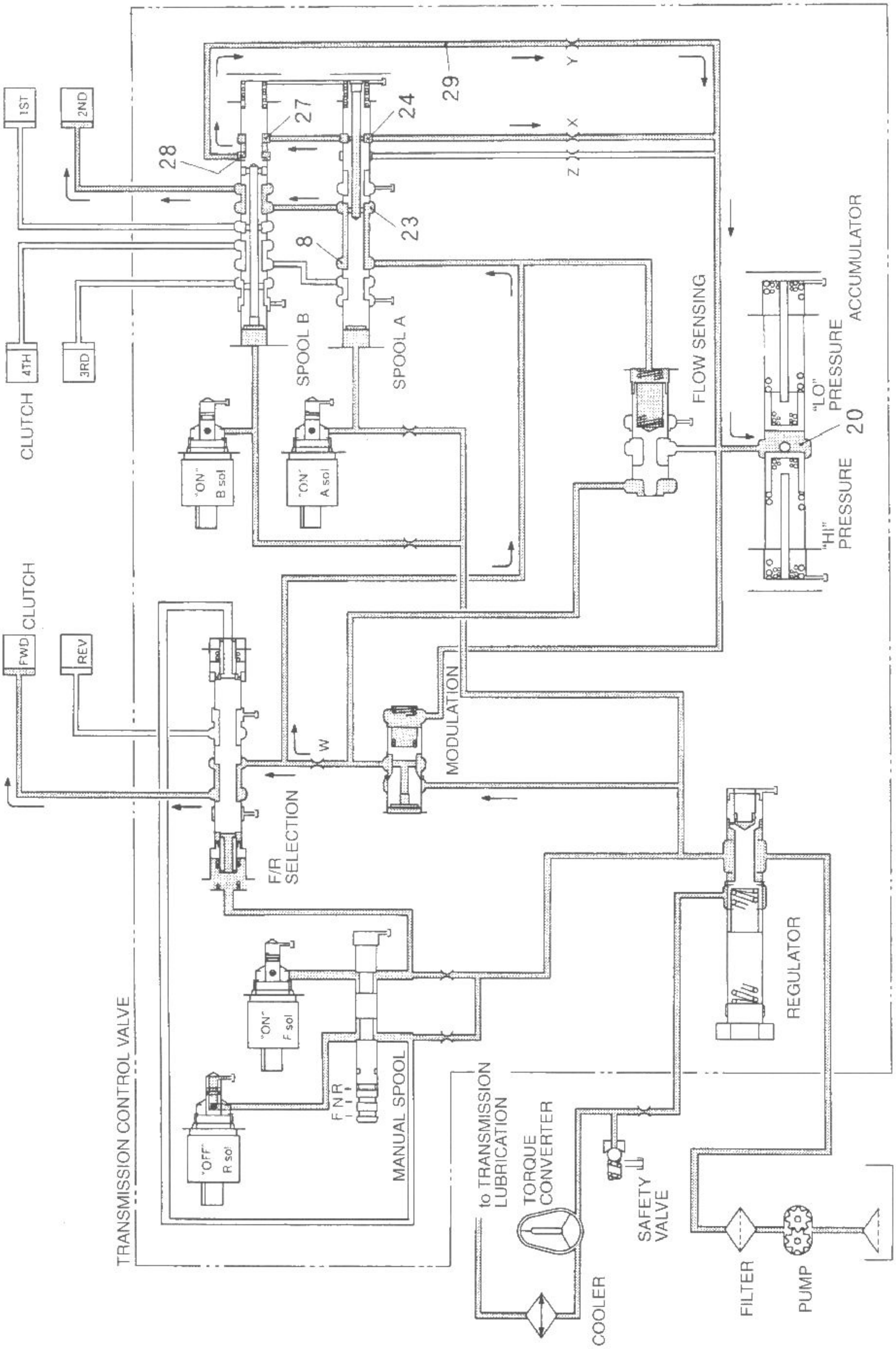


Fig. 2.28 Clutches in Engagement (2nd Speed Forward)

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(6) Solenoid valve operation

Four solenoid valves are installed on the lower valve body.

The solenoid valves are operated by shifting the shift lever in the operator's compartment, to control the F/R selector spool and speed spools A and B.

The table on the right shows the relationships in operation between each speed range and the solenoids. (● : solenoid in ON.)

		F sol	R sol	A sol	B sol
Fwd	4th	●			●
	3rd	●			
	2nd	●		●	●
	1st	●		●	
Neutral					
Rev	1st		●	●	
	2nd		●	●	●
	3rd		●		
	4th		●		●

a. Solenoid in OFF state

The oil whose pressure has been controlled by the regulator is always flowing through the orifice into the solenoid valve. When the solenoid is in the OFF state, the oil passes through inside the solenoid valve and is drained. The oil pressure at the point P is 0 MPa {0 kgf/cm^2} [0 psi].

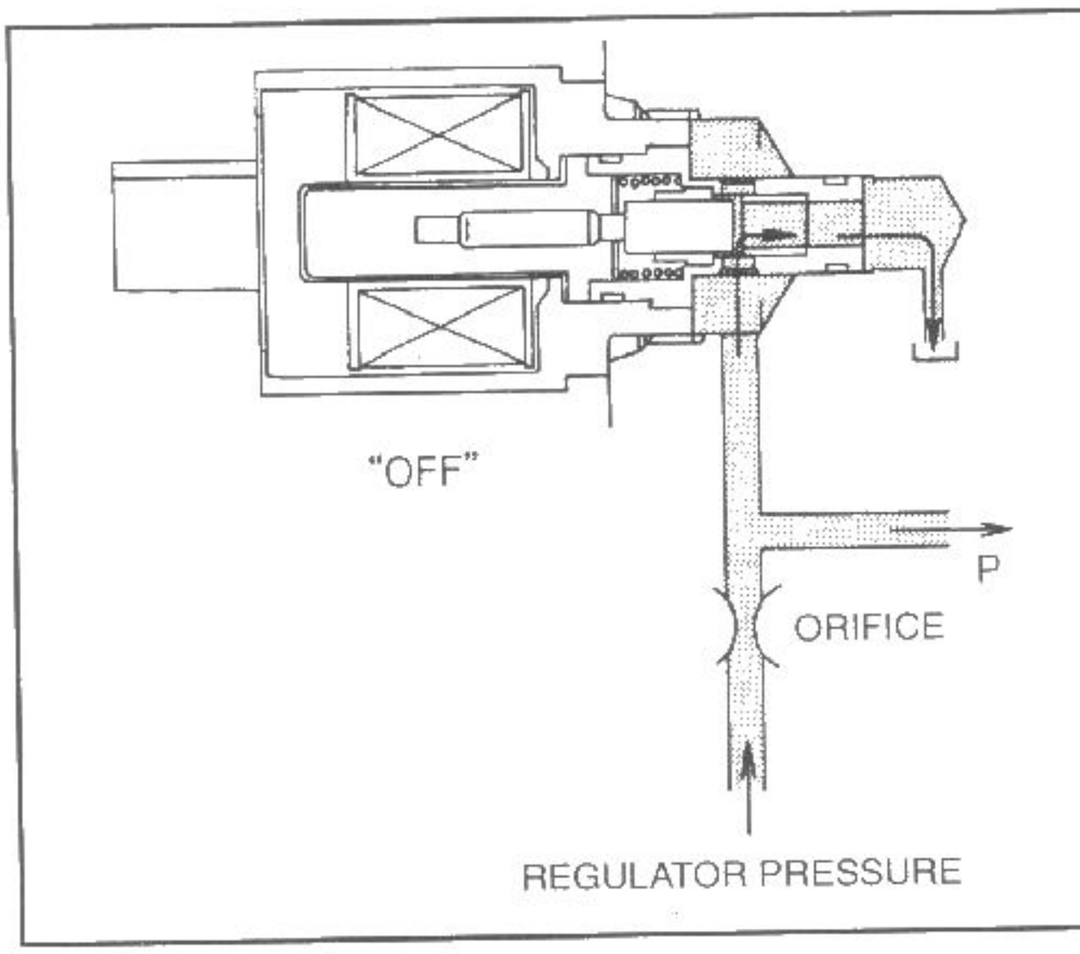


Fig. 2.29

b. Solenoid in ON state

When the solenoid is excited, the inside of the valve is blocked to oil flow. The oil is no longer drained. The oil pressure at the point P becomes equal to the regulator pressure. The transmission speed is switched over by the F/R selector spool and the speed spools A and B using this oil pressure.

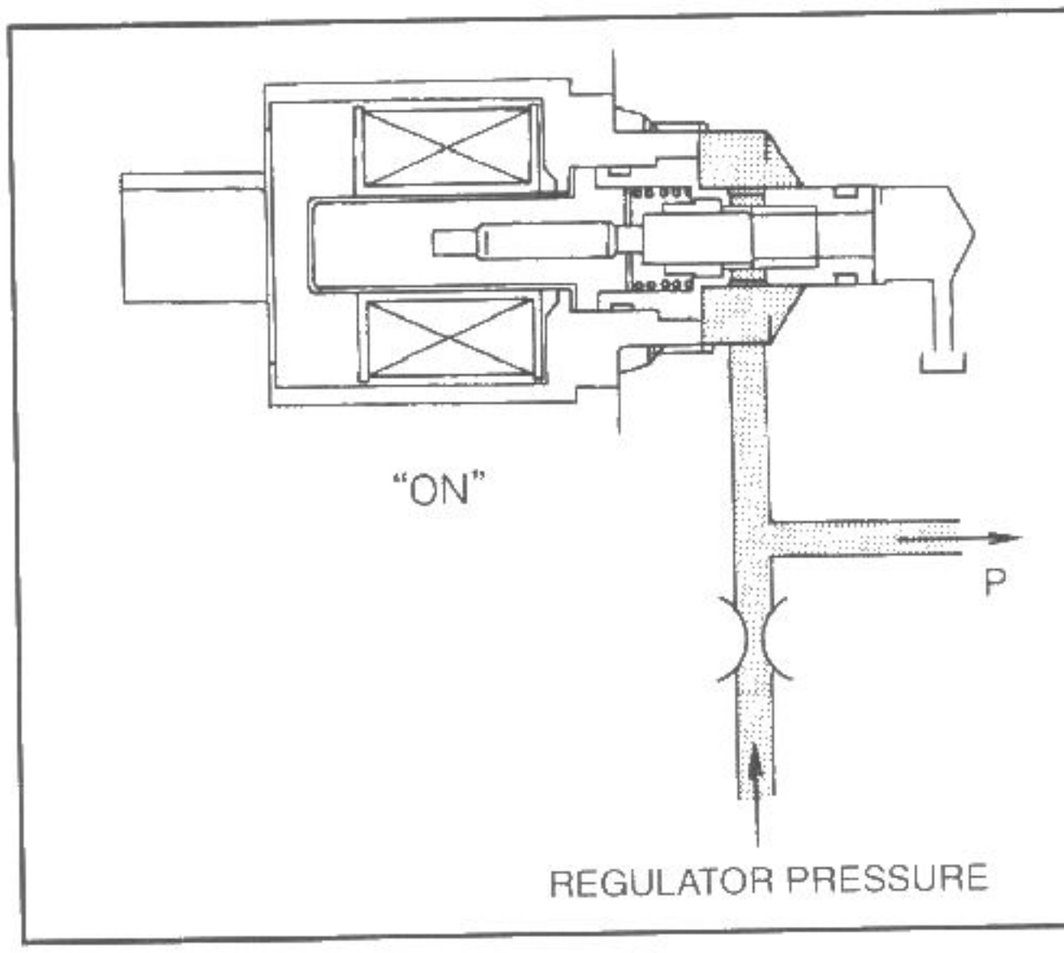


Fig. 2.30

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(7) Manual (emergency travel) spool operation

If the solenoid valves fail to operate properly due to a broken wire or any other electrical failure, it is possible to mechanically switch the control valve to 3rd forward or reverse with this spool. It is advisable to use this spool when the loader needs to be moved to an out-of-traffic area for repair.

⚠ Make sure the engine is shut off before trying to use the manual spool. If the manual spool is operated with the engine running, the loader can jerk, causing an accident.

a. Switching to 3rd fwd.

To switch to 3rd fwd, pull the manual spool out about 10 mm [0.4 in.].

① The oil whose pressure has been controlled by the regulator flows through the orifice into the manual spool circuits (31, 32). Since the circuit (31) is blocked by the spool, the oil is routed from the circuit (33) to the F/R selector spool circuit (26), thus shifting the spool to the right in the figure so that the fwd clutch oil pressure increases.

② The oil in the circuit (32) flows through the spool and the R solenoid valve to drain.

③ Since both the solenoids A and B of the speed spools are OFF, the 3rd clutch pressure increases, (See Fig. 2.24) thus making it possible to travel in forward 3rd speed.

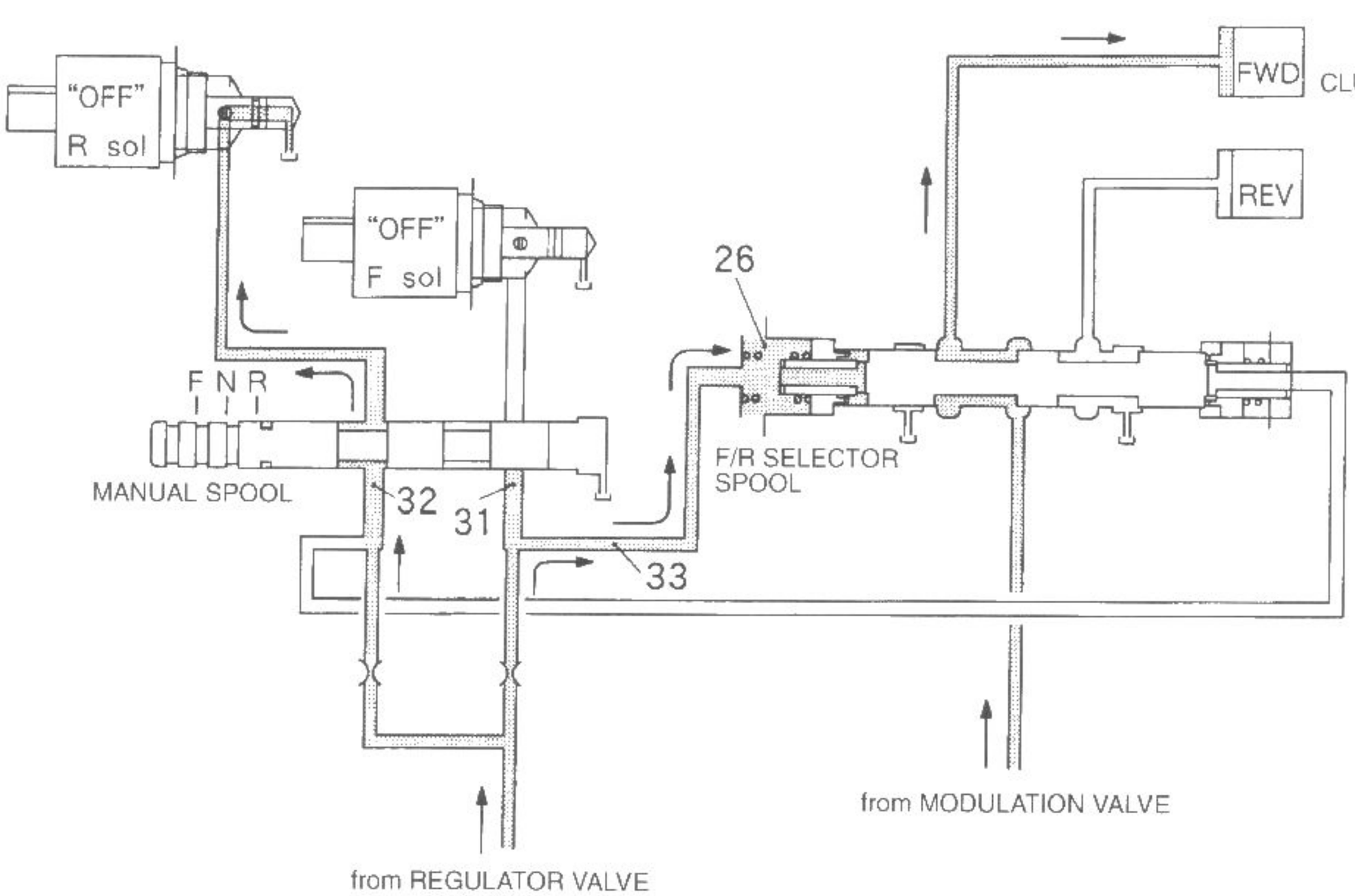


Fig. 2.31 Manual Spool Operation (Fwd)

b. Switching to 3rd rev.

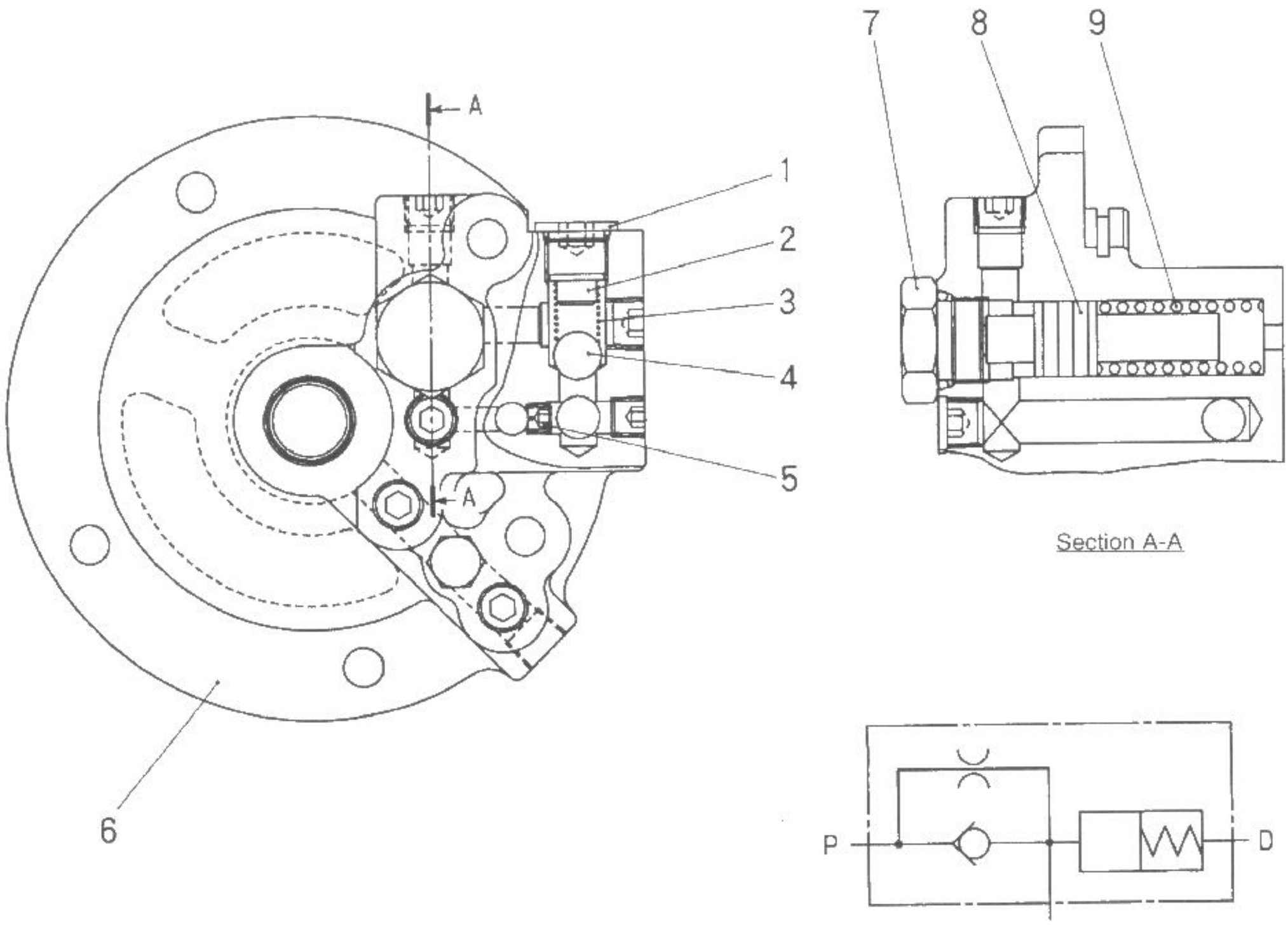
To switch to 3rd reverse, push the manual spool in about 10 mm [0.4 in.].
The operating principle is the same as in the case of 3rd forward.

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(8) Accumulator for 2nd speed clutch (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

On L32-3, LX160-7, L35-3, LX190-7, L40-3 and LX230-7, an accumulator is attached to the distributor ca on the 1st/2nd speed shaft of the transmission.

The accumulator is built in the hydraulic circuit of the 2nd speed clutch.



1. PLUG
2. ADAPTER
3. SPRING
4. BALL
5. ORIFICE, 3.6 mm [0.142 in.] DIA.
6. DISTRIBUTOR CAP
7. PLUG
8. SPOOL
9. SPRING

Fig. 2.32 Cap Assembly

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When the gear is shifted from 2nd to 1st by the DSS in scooping or digging operation, the accumulator stops oil flow to the 2nd clutch slowly enough to overlap it with the rise of the oil pressure of the 1st clutch. Therefore, it takes a longer timer (t1) for the driving force of the loader to shut off when no accumulator is provided; when the loader is equipped with an accumulator, the shut-off time (t2) becomes shorter, thus preventing the loader from rolling back.

The accumulator also operates as described above, when the gear is shifted without using DSS (2nd to 1st or 2nd to 3rd).

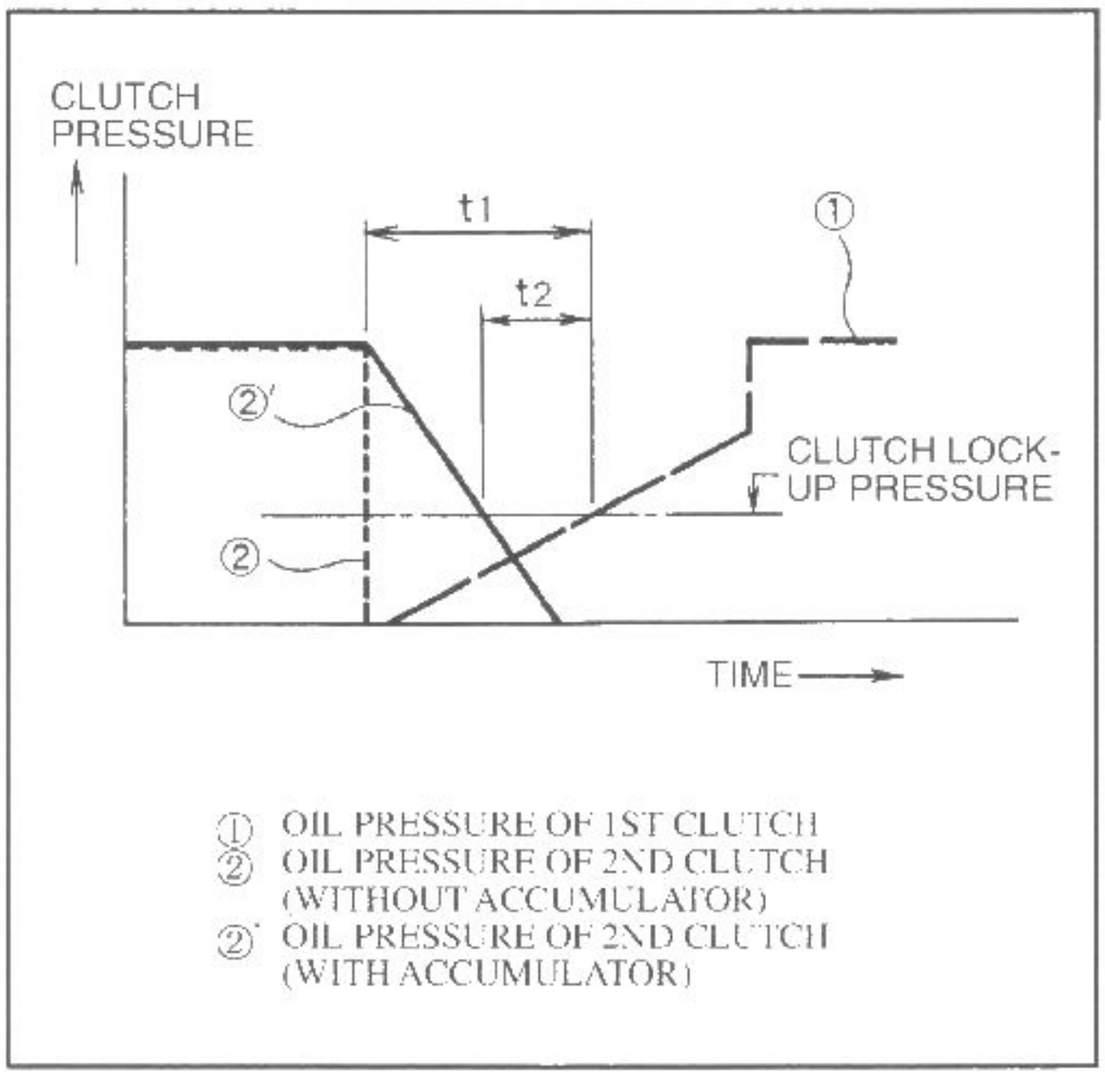


Fig. 2.33 Speed Change (2nd to 1st)

Operation

① When the gear is changed to the 2nd gear, the pressurized oil from the control valve flows through the check valve into the 2nd speed clutch and also into the accumulator.

② When the 2nd speed clutch is changed to another speed clutch, the pressurized oil in the accumulator drains through the throttle so that the oil pressure of the 2nd speed clutch drops slowly.

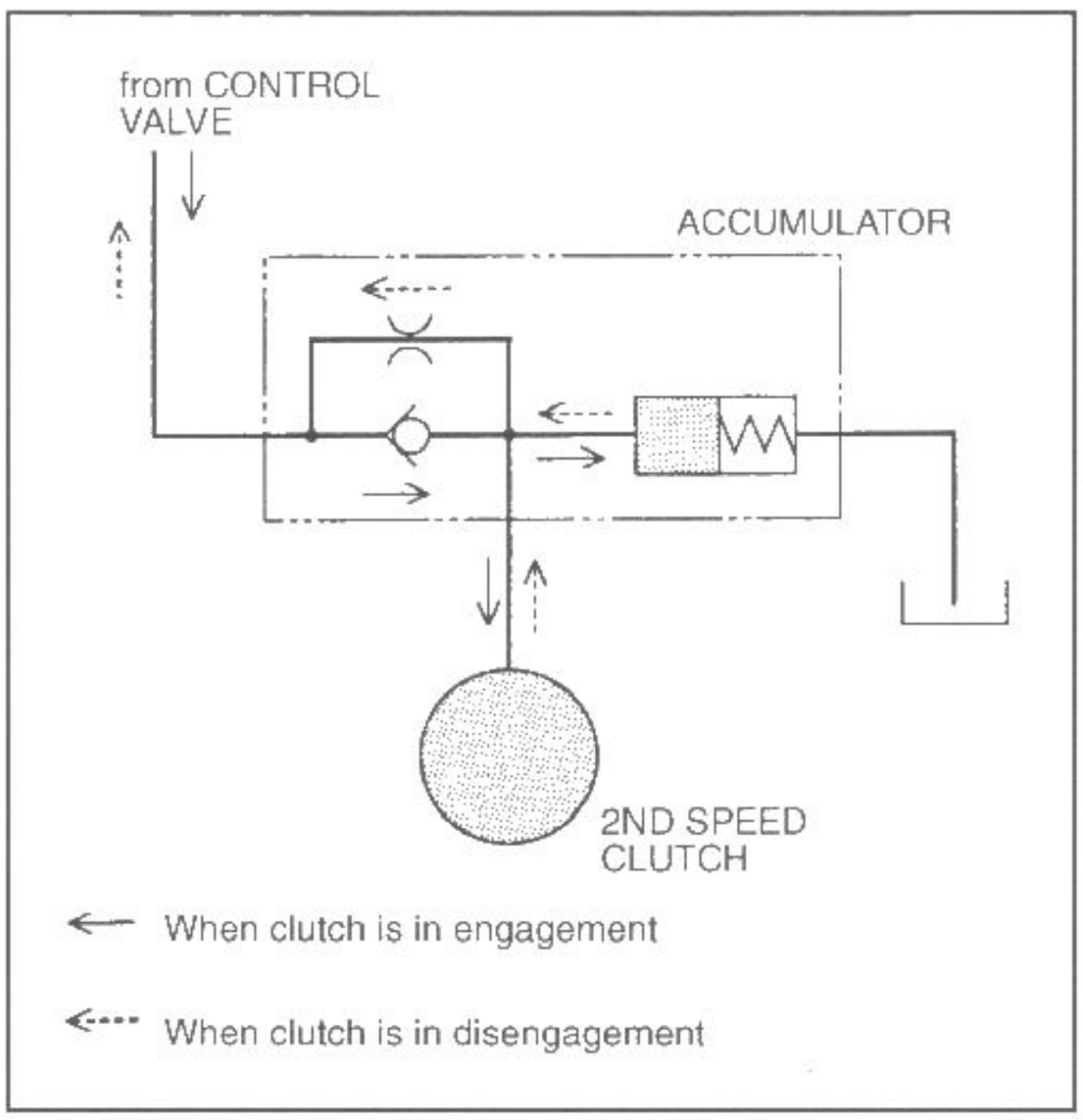


Fig. 2.34 Accumulator Operation

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2.3.4 TRANSMISSION CONTROL

The transmission control system is an electric type which turns on and off the solenoid valve of the transmission control valve by the operation of the shift lever (transmission control switch), to switch over the passages of the clutch oil, thus controlling the traveling speed of the loader.

The transmission control system consists of a shift lever, an ATC (automatic transmission controller) unit, a downshift switch (DSS), a clutch cut-off switch and a sensor.

The transmission control system has an engine neutral-start safety system, a DSS (downshift switch), inching mechanism and a mode selection switch.

Note: For the inching mechanism and transmission cut-off mechanism, refer to "3. BRAKE SYSTEM."

⚠ Engine Neutral Start Safety System

The neutral-start safety system prevents the engine from being started unless the shift lever is in neutral. This prevents the loader from moving unexpectedly when the starter switch is turned to START.

Make sure the shift lever is neutral before cranking the engine.

The engine neutral-start safety system (neutral relay) is incorporated in the engine starting circuit.

Operation (See "8.4 ELECTRIC CIRCUIT DIAGRAM.")

① When the starter switch is turned to START with the shift lever in neutral, the neutral relay is closed to allow an electric current to flow through the safety relay, thus starting the starter motor (engine).

② When the starter switch is turned to START with the shift lever not in neutral, the neutral relay remains open, so that no current flows through the safety relay. Consequently, the engine won't start.

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1. *Shift* Lever (Transmission Control Switch)

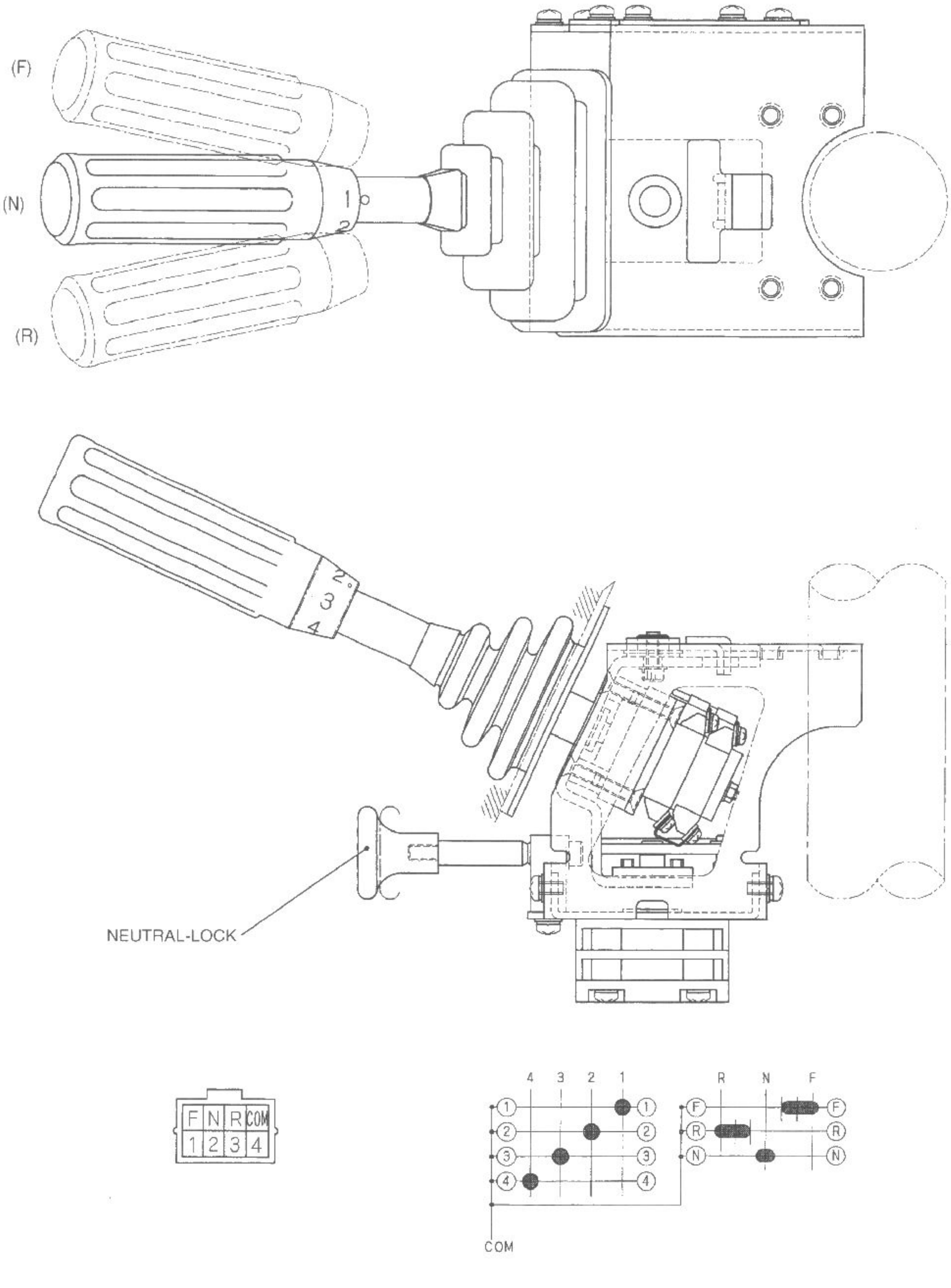


Fig. 2.35 Shift Lever

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2. DSS (Down Shift Switch) Mechanism

With the downshift switch pressed, the DSS mechanism provides speedier, more efficient load handling without having to operate the shift lever.

The DSS mechanism consists of a downshift switch built in the boom lever knob and an ATC unit.

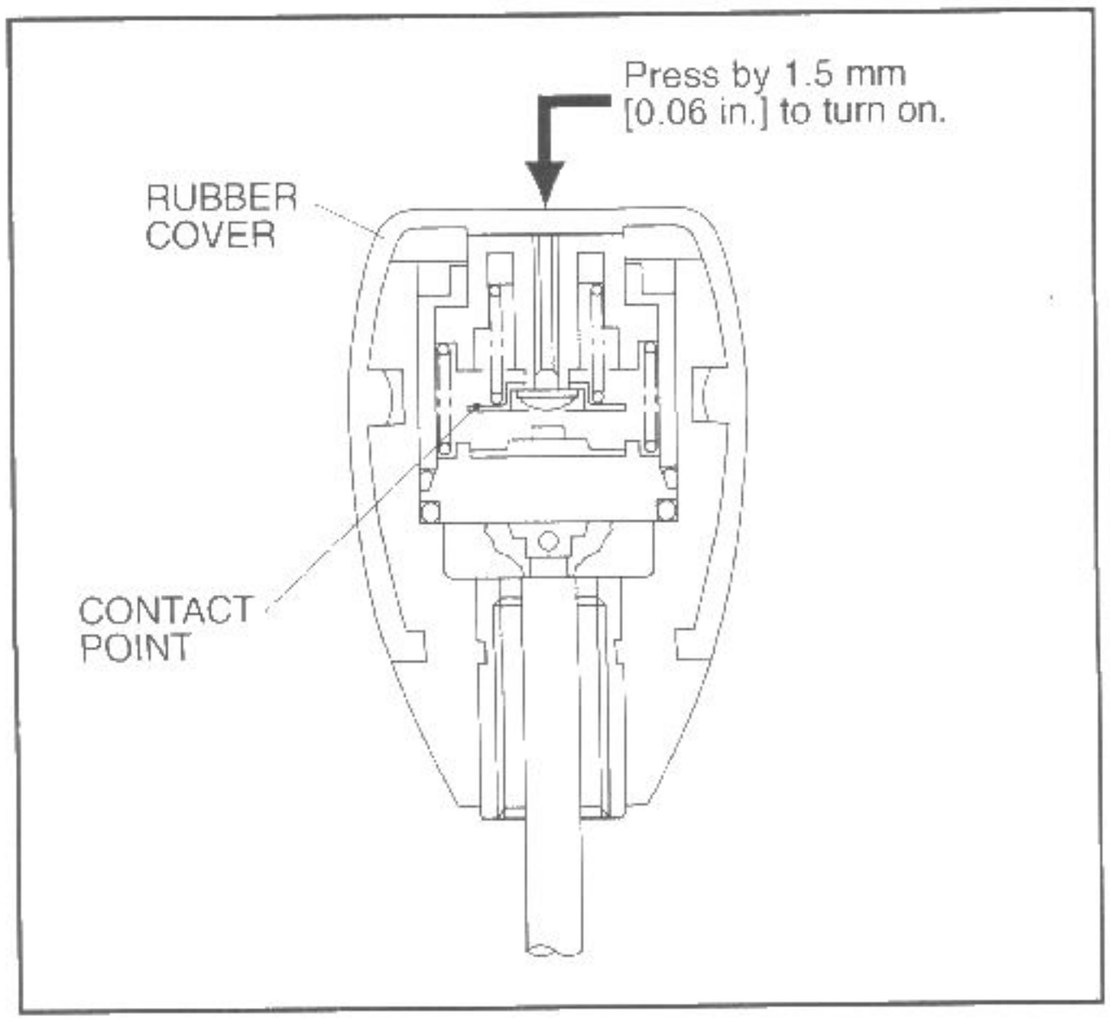


Fig. 2.36 Down Shift Switch

Operation

When the DSS is pressed in 2nd gear forward, the transmission is automatically shifted into the 1st gear position by the operation of the ATC unit, allowing more horse power to be concentrated on loading operation.

When the shift lever is placed in the reverse gear after scooping or digging, the speed range is automatically shifted into 2nd gear for quicker driving back.

That is, using the DSS, it is possible to control both the bucket thrusting force and the travel speed of the loader by operating the boom lever (downshift switch) alone, with the shift lever kept in 2nd gear, during scooping or digging operation.

3. USS (Up Shift Switch) Mechanism

When the up-shift switch is pressed, the USS mechanism changes the loader's traveling speed without having to operate the shift lever.

The USS mechanism consists of an up-shift switch built in the boom lever knob and an ATC unit.

Note: The structure of the up-shift switch is the same as that of the downshift switch.

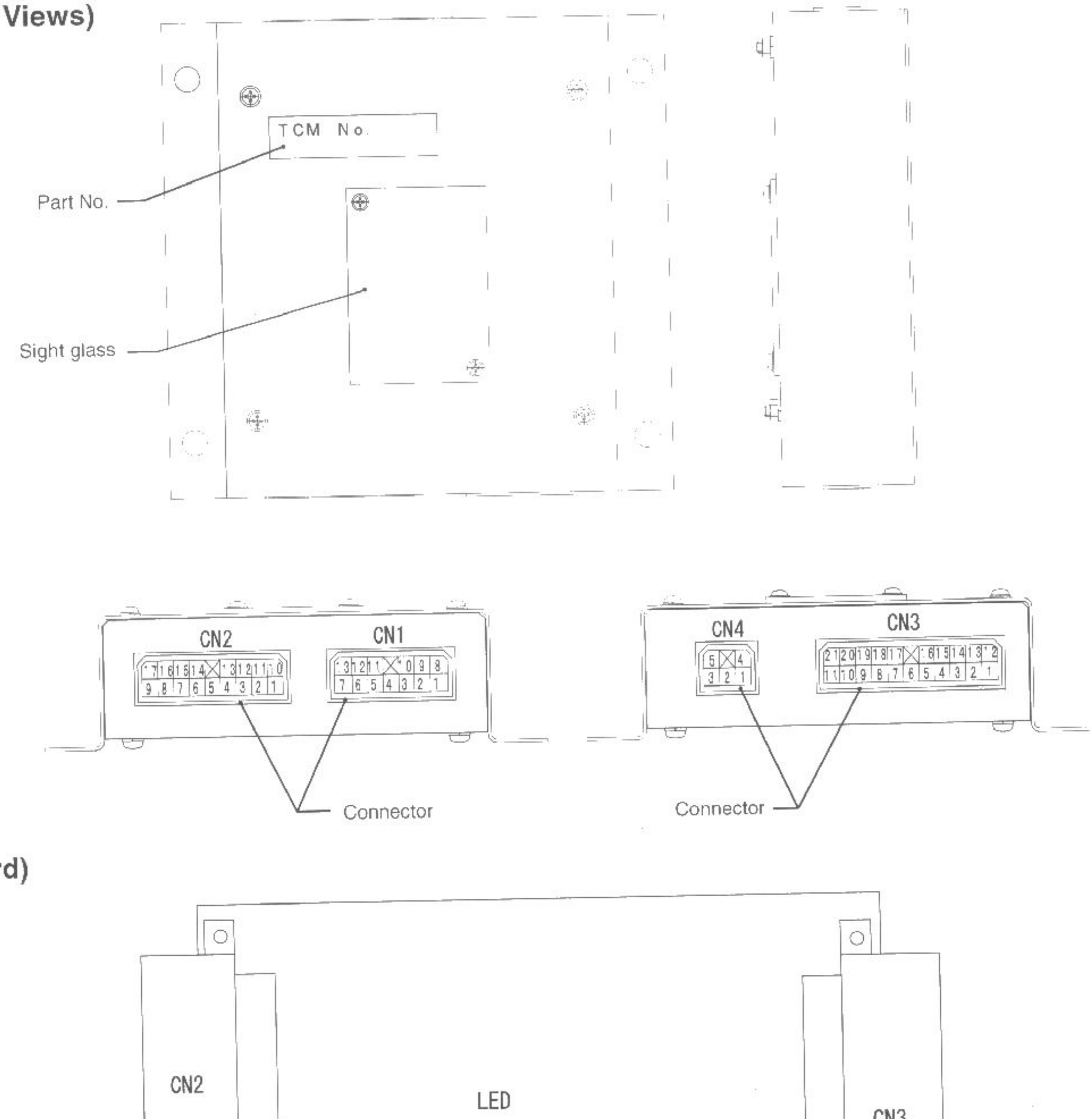
Operation

The reverse operation of the DSS mechanism is carried out here. With the up-shift switch pressed, the transmission reaches higher gear by the operation of the ATC unit. With the fwd/rev lever operated, the speed returns to the specified gear.

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2.3.5 ATC (AUTOMATIC TRANSMISSION CONTROLLER)

(Outer Views)



(Board)

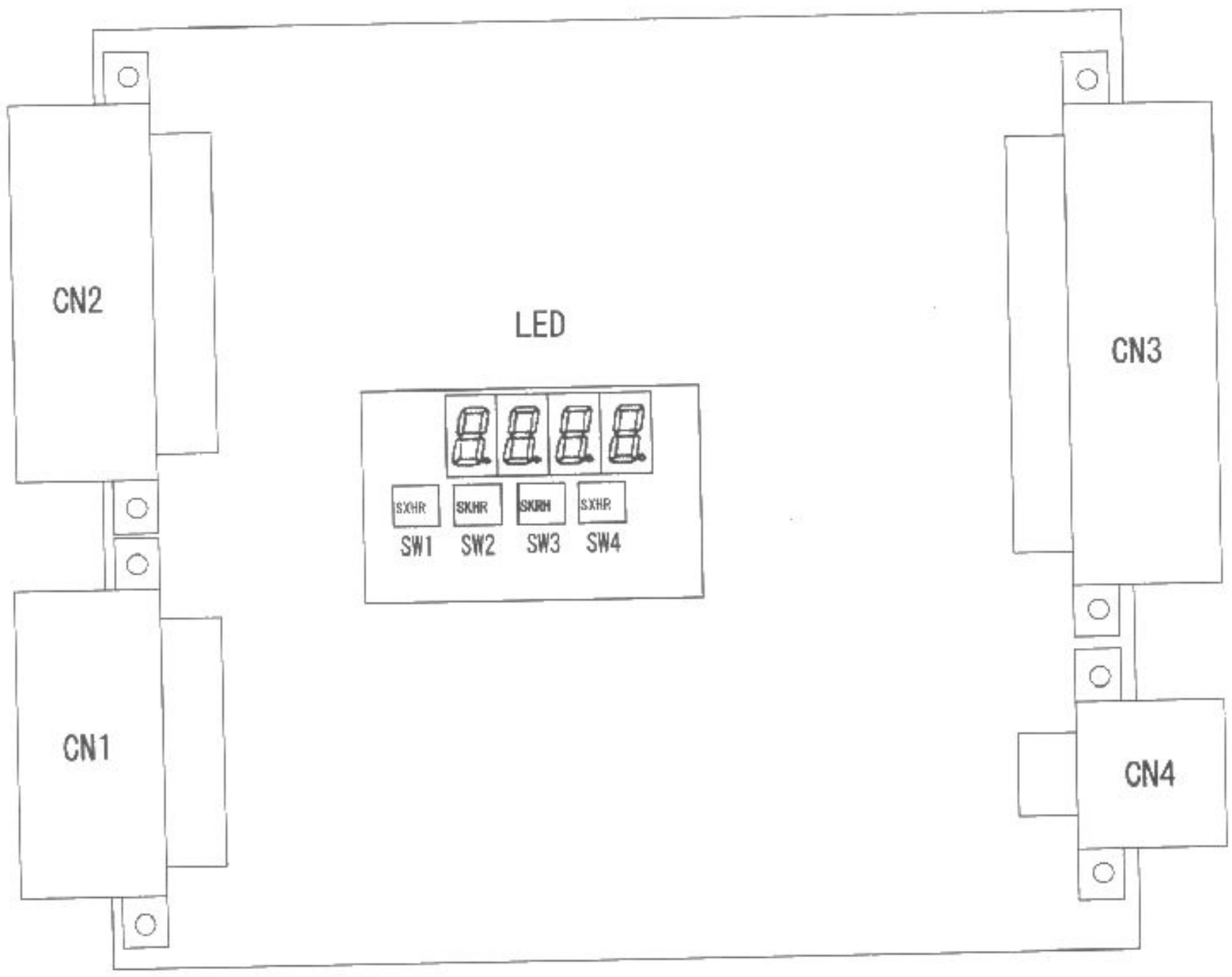


Fig. 2.37 ATC Unit

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1. ATC functions

The ATC (Automatic Transmission Controller) unit has the following functions:

- Automatic speed-range change of the transmission according to the traveling speed of the loader (switching of automatic and manual transmission modes)
- Speed-range change by switches
- Output of the signal to the speedometer and tachometer
- Sensing of errors and output of warning about the transmission solenoid

Figure 2.38 shows the relationship between the ATC unit and other devices.

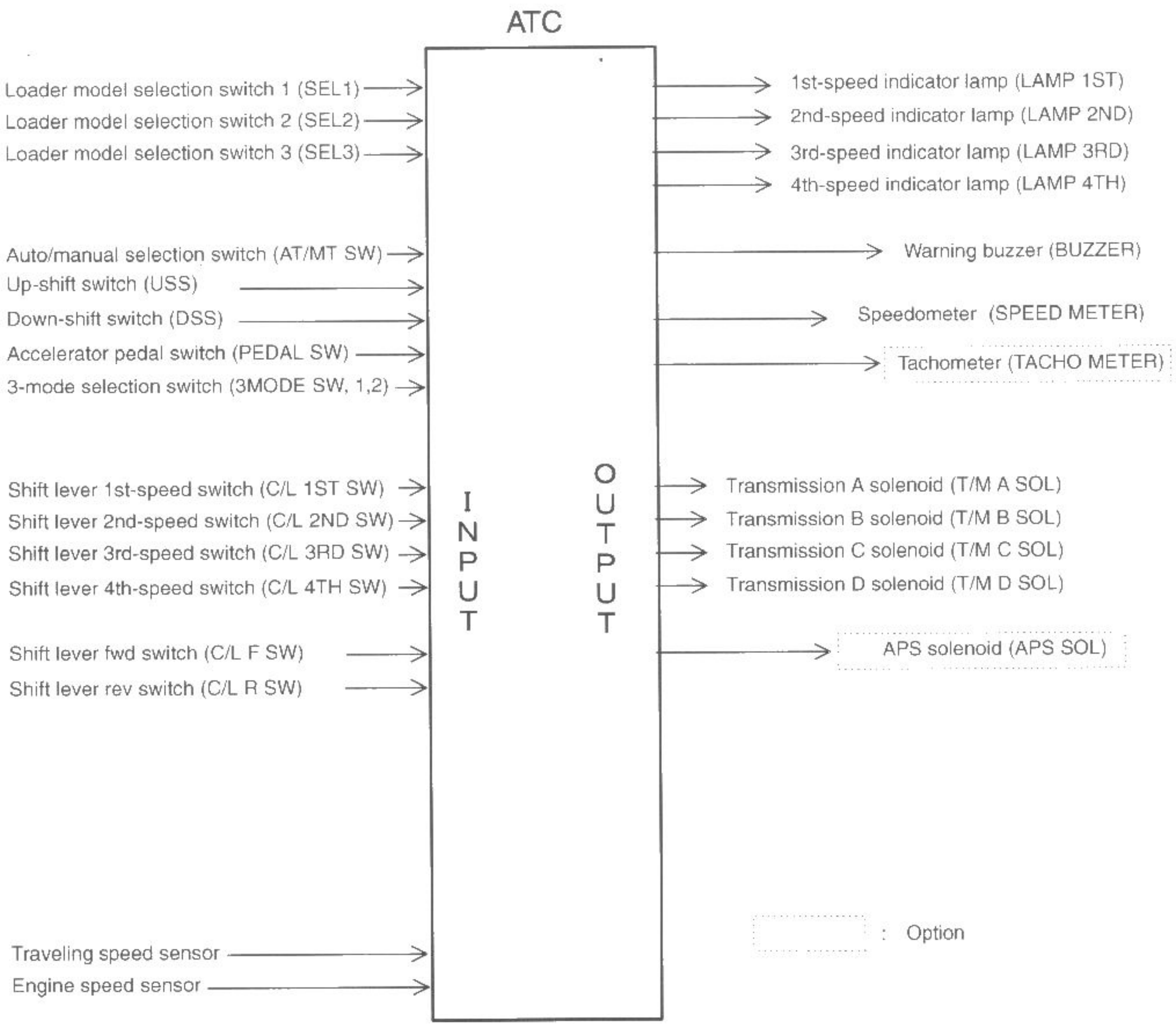


Fig. 2.38 I/O Relationship of ATC

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2. Relationship between shift lever positions and gearshift patterns

The ATC (Automatic Transmission Controller) unit automatically controls the speed range of the transmission based on the truck's traveling speed and engine rpm. The ATC functions as follows:

(1) Gearshift patterns

A. Relationship with the shift lever positions

Usually, the 2nd-speed gear is selected for digging and scooping, 3rd-speed gear for load & carry operation, and 4th-speed gear for traveling and moving. The automatic speed-range is changed according to the shift lever positions. (See Fig. 2.39.)

		Speed range				Applicable work
		1st	2nd	3rd	4th	
Shift lever position	1ST	←○→				Work using 1st-speed range
	2ND	←----←○→				Digging and scooping
	3RD	←----←---○→				Load & carry work
	4TH	←----←------○→				Traveling

○: Speed range in manual mode.

Fig. 2.39 Relationship between shift lever position and gearshift patterns

B. DSS (Downshift switch) operation (both for AT and MT)

① When the DSS is pressed with the gears in the 4th speed, the transmission shifts from 4th speed to 3rd speed (Press DSS once).

② When the DSS is pressed with the gears in the 3rd speed, the transmission shifts from 3rd speed to 2nd speed (Press DSS once).

③ When the DSS is pressed with the gears in the 2nd speed, the transmission shifts from 2nd speed to 1st speed (Press DSS once).

④ When the DSS is pressed and held down with the gears in the 4th speed, the transmission shifts from 4th speed to 3rd and then to 2nd. (For the 1st speed, release the DSS switch and then press it once.)

When the transmission has been shifted into the 1st speed by the DSS, you can release the DSS 1st speed using either of the following two methods:

- Use the shift lever.
- More than 3 seconds after the transmission is shifted into the 1st speed by pressing the DSS switch, the transmission automatically shifts up to the 2nd speed when the traveling speed exceeds 6 km/h [3.7 mph] (common to all models).

C. USS (Upshift switch) operation (both for AT and MT)

① When the USS is pressed with the gears in the 2nd speed, the transmission shifts from 2nd speed to 3rd speed (Press USS once).

② When the USS is pressed with the gears in the 3rd speed, the transmission shifts from 3rd speed to 4th speed (Press USS once).

③ When the USS is pressed with the loader shifted into the 1st speed by DSS operation, the transmission is shifted from 1st speed to 2nd speed.
The transmission won't shift up from 2nd to 3rd and to 4th even if the USS is pressed and held down.
In addition, the transmission won't be shifted up beyond the speed range of the shift lever with the USS.

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(2) Relationship between engine speed and gearshift patterns

Shifting down is quickened when engine speed is high in climbing a slope (kickdown function). In addit the transmission is designed not to shift up when descending a downhill to allow the use of engine brak

Figure 2.40 shows the relationship between engine speed, traveling speed and gearshift patterns. engine speed is detected by the engine speed sensor when the engine runs at high rpm and it is detected switch attached to the accelerator pedal when the loader descends a downhill. (The transmission won't up when this switch is not turned on or when the pedal is not pressed.)

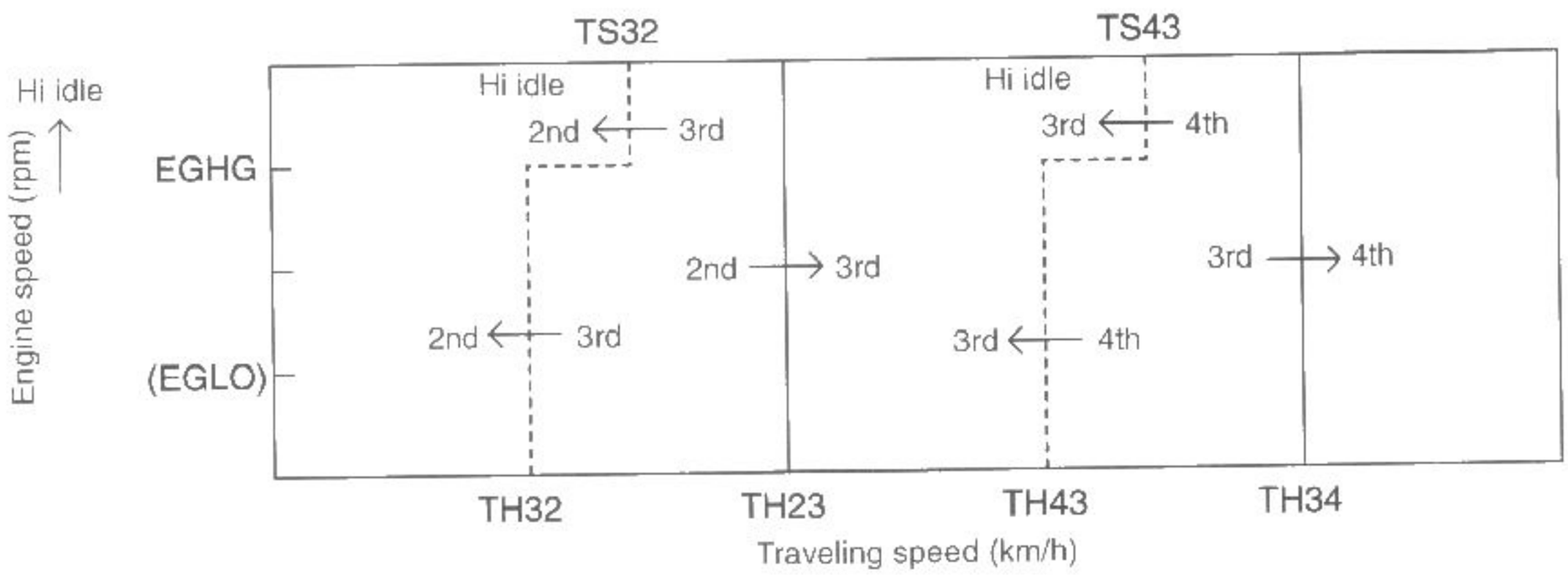


Fig. 2.40 Relationship Between Engine Speed, Traveling Speed and Gearshift Patterns

(3) 3-mode selection

The transmission operation mode can be switched among traveling, load handling and intermediate m

In the "Traveling mode", the gearshift points in 2nd to 3rd and 3rd to 4th speed are quickened to a smooth acceleration.

In the "Load handling mode", the gearshift points in 2nd to 3rd speed is delayed to suppress shifting the transmission when performing V cycle work or others.

The "Intermediate mode" represents the intermediate setting between the above two settings.

Specifically, the above functions are performed by switching over the values TH23, TH34, TH43, T and TS32 for each operation mode. The respective values for each operation mode area shown below

		L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
		km/h [mph]	km/h [mph]	km/h [mph]	km/h [mph]
TH23	Load handling mode	9.8 [6.1]	10.2 [6.3]	9.6 [6.0]	10.3 [6.4]
	Intermediate mode	9.0 [5.6]	9.4 [5.8]	8.8 [5.5]	9.5 [5.9]
	Traveling mode	8.2 [5.1]	8.6 [5.3]	8.1 [5.0]	8.7 [5.4]
TH34	Load handling mode	16.5 [10.3]	17.3 [10.8]	17.4 [10.8]	16.1 [10.0]
	Intermediate mode	15.2 [9.4]	15.9 [9.9]	16.0 [9.9]	14.8 [9.2]
	Traveling mode	13.9 [8.6]	14.5 [9.0]	14.6 [9.1]	13.5 [8.4]
TH43	Load handling mode	12.0 [7.5]	12.8 [8.0]	12.9 [8.0]	11.6 [7.2]
	Intermediate mode	10.7 [6.6]	11.4 [7.1]	11.5 [7.1]	10.3 [6.4]
	Traveling mode	9.4 [5.8]	10.0 [6.2]	10.1 [6.3]	9.0 [5.6]
TH32	Load handling mode	6.8 [4.2]	7.2 [4.5]	6.6 [4.1]	7.3 [4.5]
	Intermediate mode	6.0 [3.7]	6.4 [4.0]	5.8 [3.6]	6.5 [4.0]
	Traveling mode	5.2 [3.2]	5.6 [3.5]	5.1 [3.2]	5.7 [3.5]
TS43	Load handling mode	13.5 [8.4]	14.3 [8.9]	13.1 [8.1]	13.1 [8.1]
	Intermediate mode	12.2 [7.6]	12.9 [8.0]	11.8 [7.3]	11.8 [7.3]
	Traveling mode	10.9 [6.8]	11.5 [7.1]	10.5 [6.5]	10.5 [6.5]
TS32	Load handling mode	8.3 [5.2]	8.7 [5.4]	8.8 [5.5]	8.8 [5.5]
	Intermediate mode	7.5 [4.7]	7.9 [4.9]	8.0 [5.0]	8.0 [5.0]
	Traveling mode	6.7 [4.2]	7.1 [4.4]	7.2 [4.5]	7.2 [4.5]

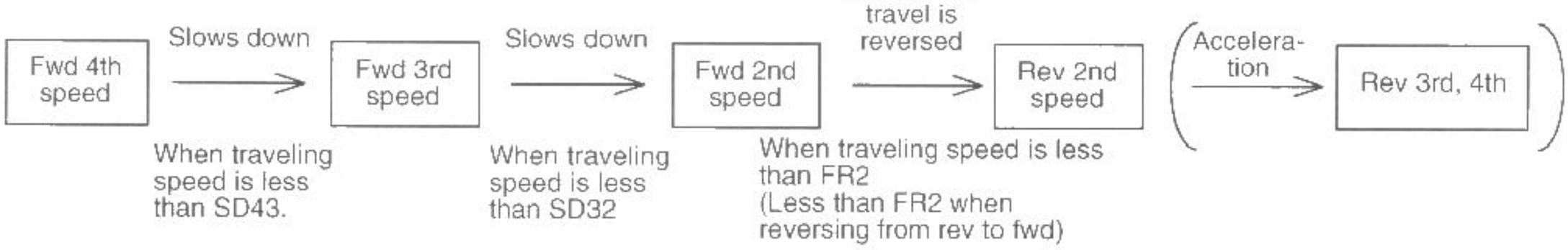
Table 2.1 Gearshift points in 3 operation modes

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(4) Gearshift patterns from F to R or vice versa

When the operator tries to reverse the direction of travel while the loading is running at 3rd speed or 4th speed, the warning buzzer sounds and 4th-speed indicator comes on. The direction of travel cannot be reversed when the loader is running at 4th or 3rd speed. It is not until the transmission automatically shifts down to 2nd speed and the loader slows down to a speed which makes it possible to switch over the direction of travel that the direction of travel of the loader can be performed.

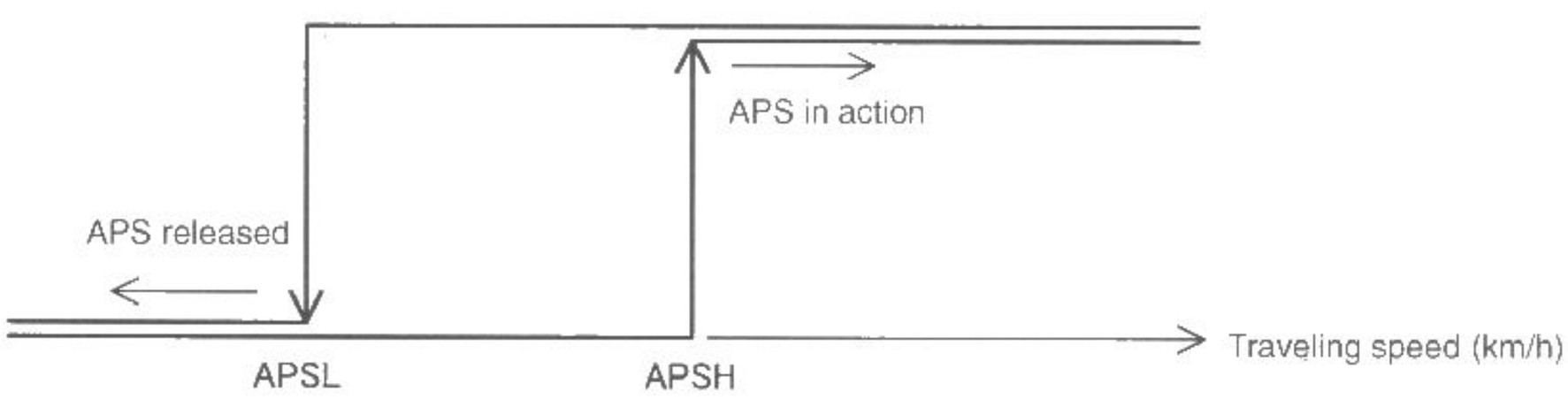
If the direction of travel is tried when the loader is running in forward at 4th speed with the shift lever in the 4th speed position:



Loader model		L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
SD43	km/h [mph]	86.2 [53.6]	49.8 [30.9]	98.4 [61.1]	98.9 [61.5]
SD32	km/h [mph]	37.3 [23.2]	37.7 [23.4]	47.4 [29.5]	47.6 [29.6]
FR2	km/h [mph]	12.4 [7.7]	12.8 [8.0]	13.6 [8.5]	13.3 [8.3]
RF2	km/h [mph]	13.5 [8.4]	14.1 [8.8]	14.8 [9.2]	14.5 [9.0]

Table 2.2 Gearshift point in reversing direction of travel

(5) APS (Anti-pitching system) operation (option)



APSH (Traveling speed at which APS is activated): 7 km/h [4.3 mph]
APSL (Traveling speed at which APS is released): 5 km/h [3.1 mph]
} Common to all loader models

Fig. 2.41 Traveling Speeds at which APS is Activated and Released

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2.4 OIL CIRCULATION ROUTE

1. General Description (L27-3, LX130-7)

The oil used for the drive unit is supplied from the transmission sump tank.

As the engine starts, the charging pump unit (double pumps) picks up oil from the transmission sump tank through the strainer and sends it under pressure. The oil discharged from the front pump passes through the oil filter to the transmission control valve. The control valve divides the oil into one for torque converter operation and one for transmission clutch operation.

The oil sent into the converter, after leaving the converter, flows into the oil cooler to get cooled down. After leaving the oil cooler, it lubricates and cools 1st/2nd and 3rd/4th speed clutch shaft assemblies, before returning into the transmission sump tank.

The oil sent from the rear pump flows into the fwd/rev clutch shaft of the transmission to cool the clutch shaft assembly.

Notes: For the specifications and construction of the charging pump, refer to "6.2 PUMP."
The oil cooler is incorporated in the lower tank of the radiator. Refer to "1.3 COOLING SYSTEM" for the oil cooler.

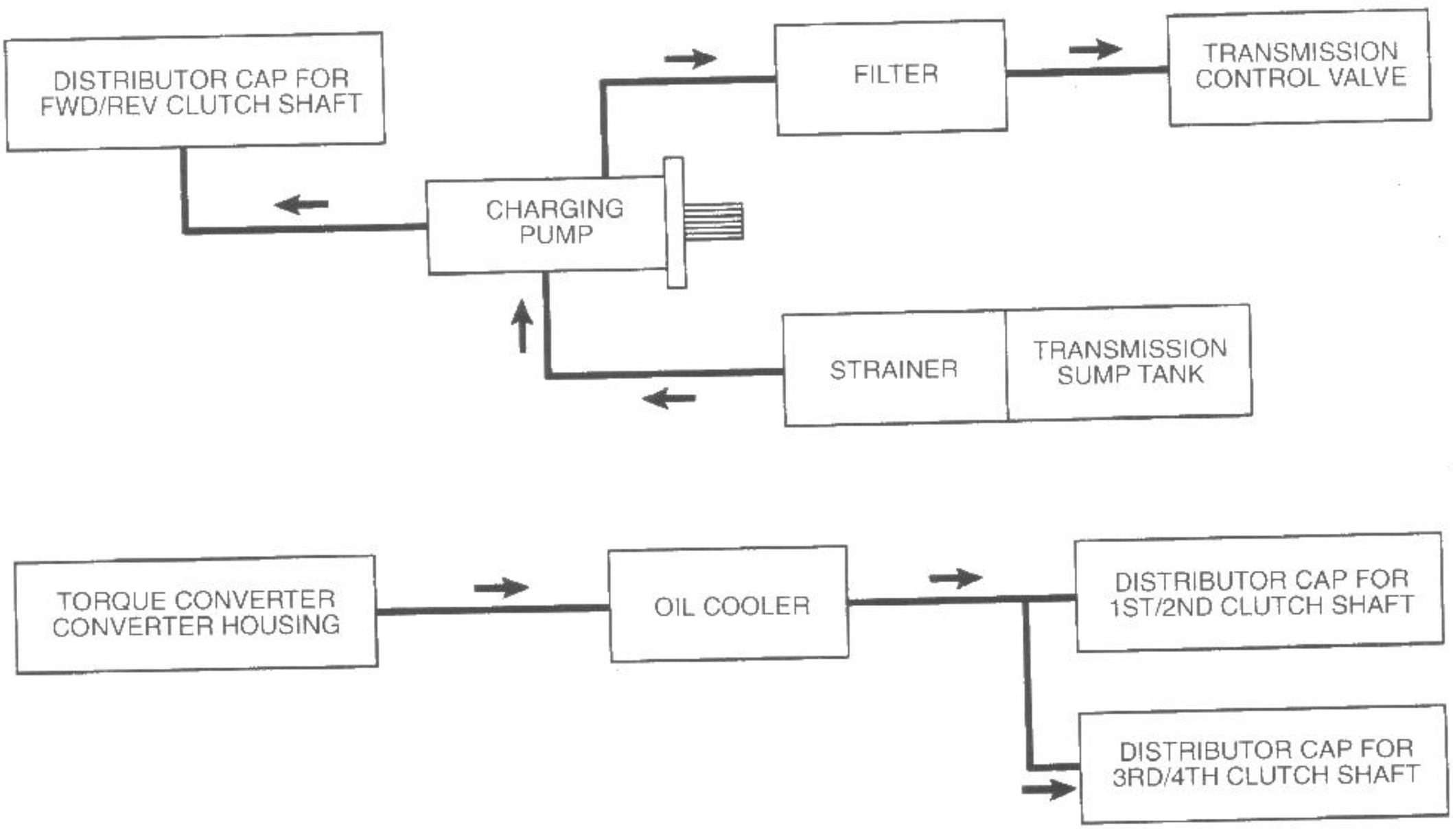


Fig. 2.42 Oil Circulation Route (L27-3, LX130-7)

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2. General Description (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

The oil used for the drive unit is supplied from the transmission sump tank.

As the engine starts, the charging pump unit (double pumps) picks up oil from the transmission sump tank through the strainer and sends it under pressure. The oil discharged from the front pump passes through the oil filter to the transmission control valve. The control valve divides the oil into one for torque converter operation and one for transmission clutch operation.

The oil sent from the rear pump and the hydraulic oil sent from the converter housing flow together into the oil cooler to get cooled down.

After leaving the oil cooler, it lubricates and cools each clutch shaft assembly, before returning into the transmission sump tank.

Notes: For the specifications and construction of the charging pump, refer to "6.2 PUMP."
The oil cooler is incorporated in the lower tank of the radiator. Refer to "1.3 COOLING SYSTEM" for the oil cooler.

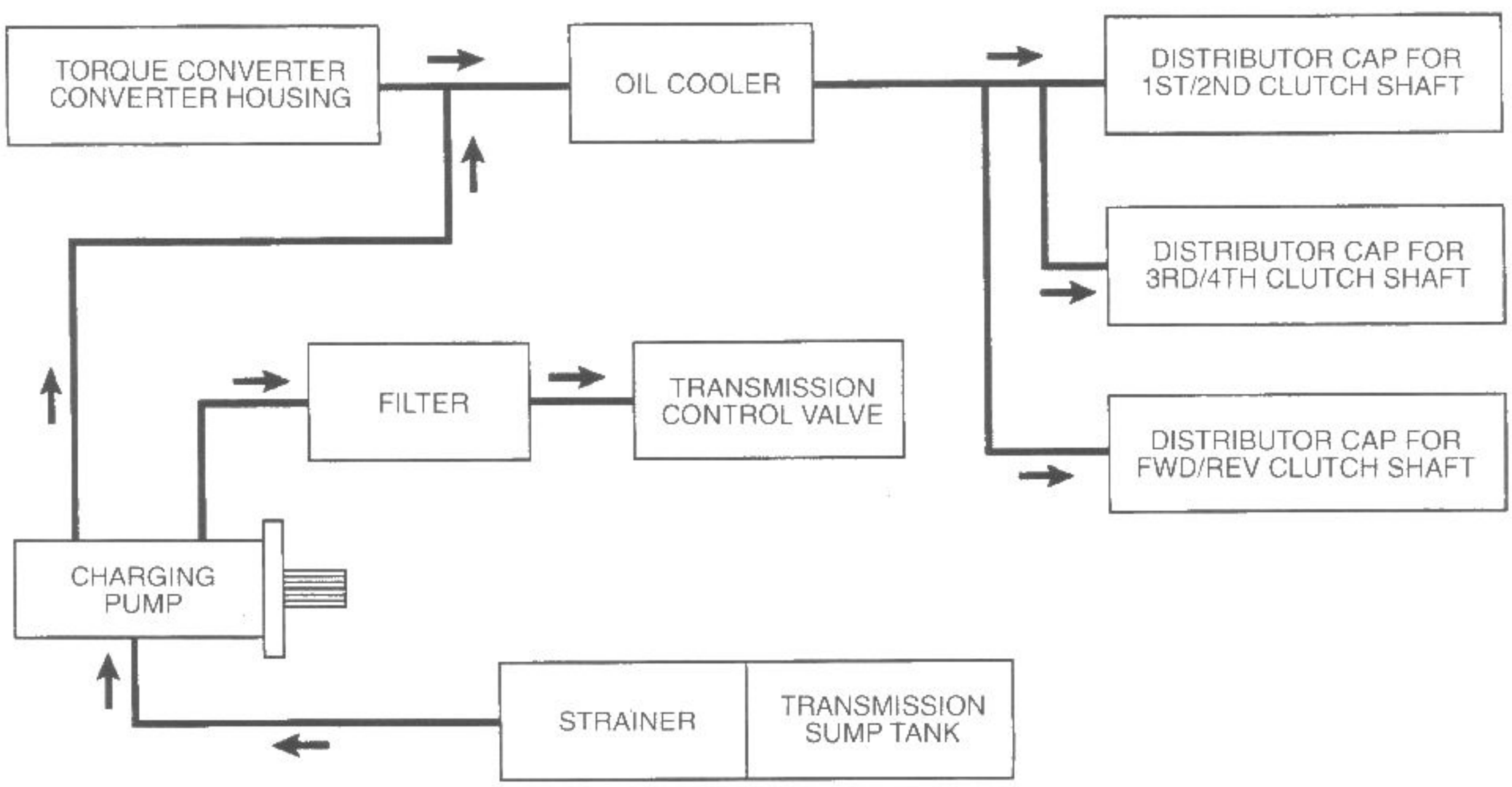


Fig. 2.43 Oil Circulation Route (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

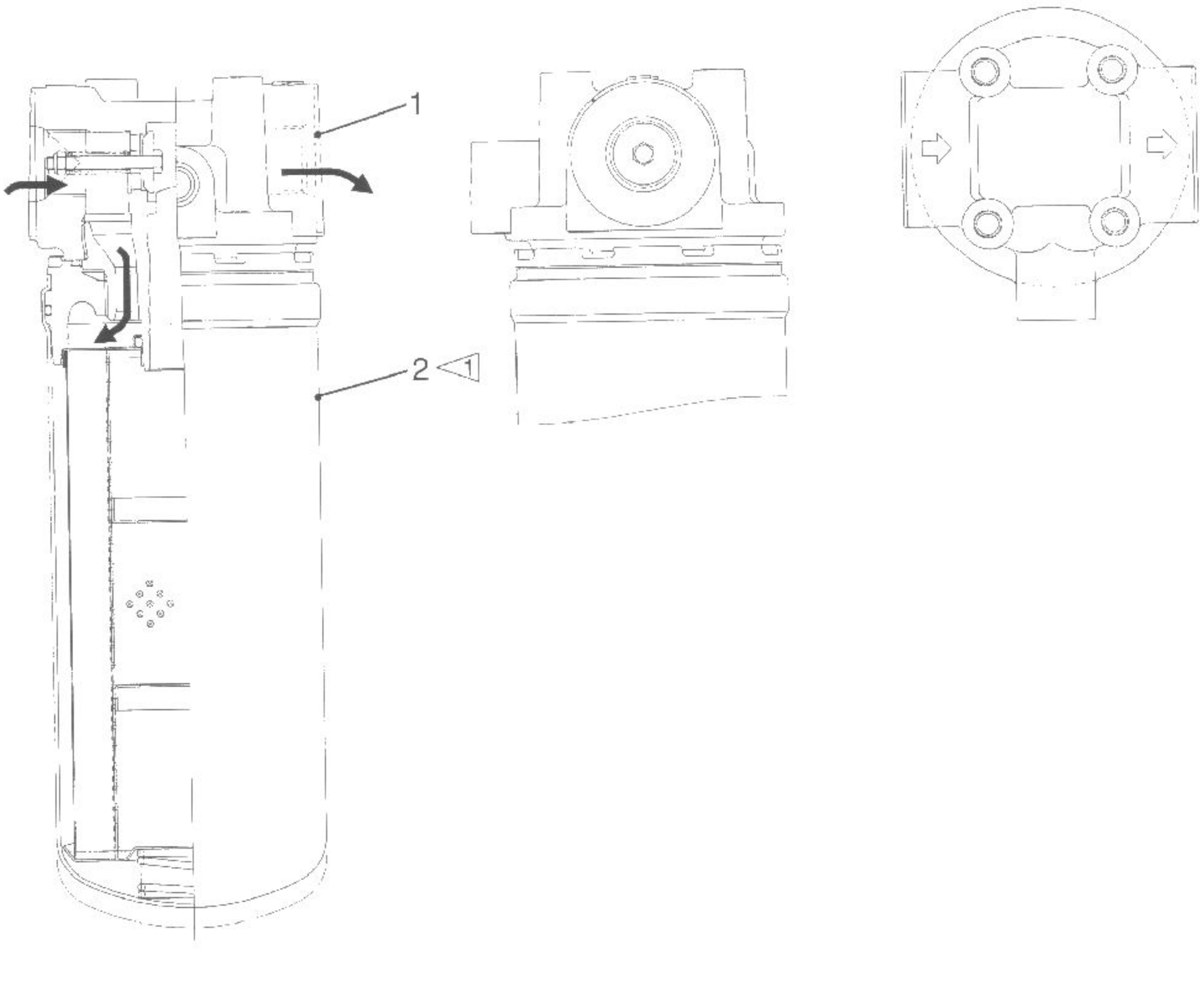
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3. Filter

The filter is provided in the supply line of the drive unit oil circulation route. The oil flows through the filter element from outside to inside and the filtered oil is directed to the transmission control valve.

When the oil filter element becomes clogged, the pressure at the inlet port side increases so that the oil bypasses the clogged filter element and forces open the bypass valve to flow directly to the outlet port side.

Bypass valve operating pressure: 343 ± 24.5 kPa {3.5 ± 0.25 kgf/cm^2} [49.8 ± 3.6 psi]



Note: 1 ▷ 49 to 45 N-m {5.0 to 6.0 kgf-m} [36 to 43 lbf-ft]

1. HEAD ASSEMBLY
2. CARTRIDGE ASSEMBLY

Fig. 2.44 Filter

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2.5 PROPELLER SHAFTS

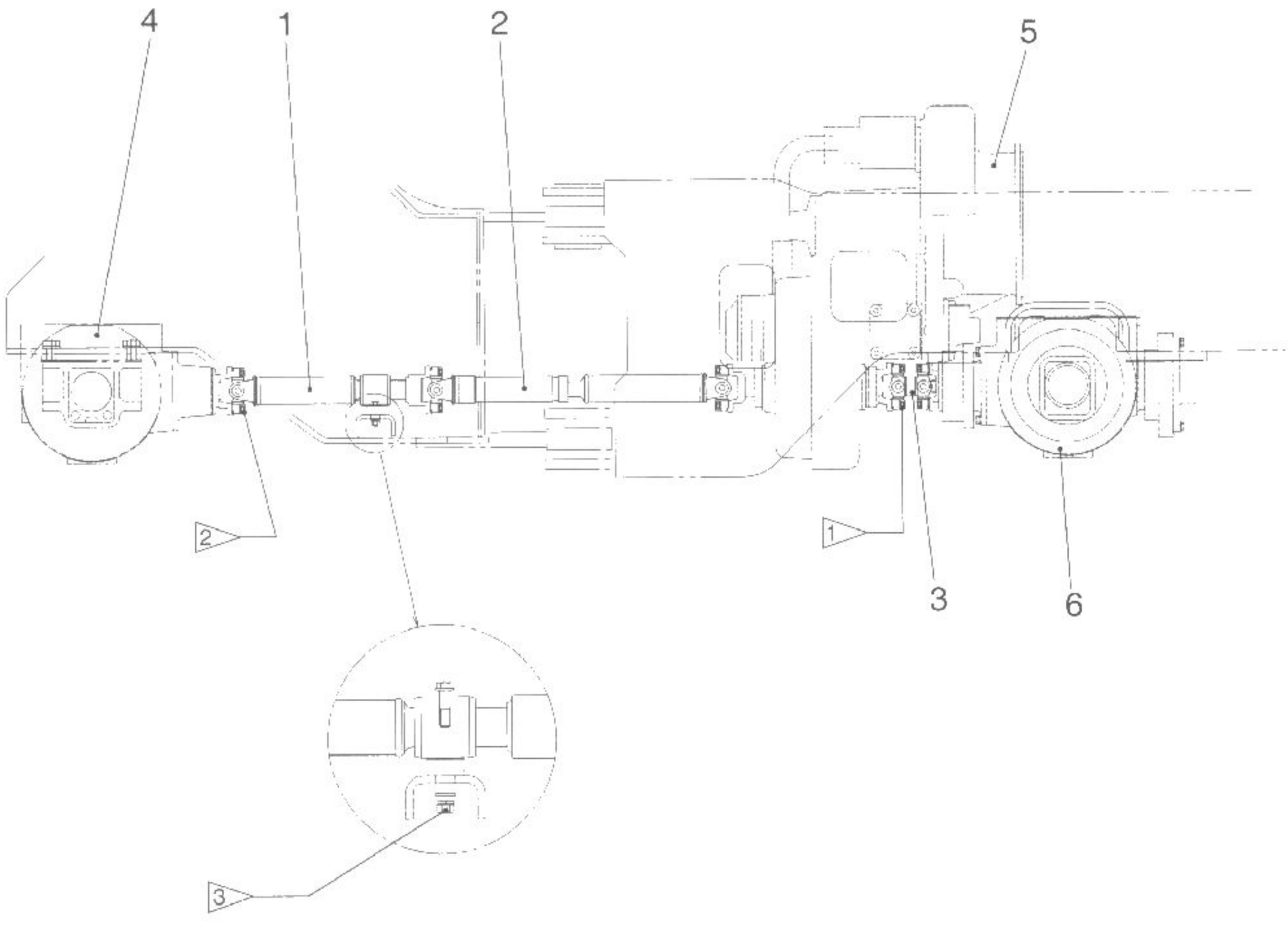
	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7 · L40-3, LX230-7
Universal joint type	Cross joint	←	←
Length (inter-pin length)			
Front	698 mm [27.5 in.]	703 mm [27.7 in.]	755 mm [29.7 in.]
Center	835 mm [32.9 in.]	843 mm [33.2 in.]	865 mm [34.1 in.]
Rear	210 mm [8.3 in.]	180 mm [7.1 in.]	211 mm [8.3 in.]

The propeller shafts, located between the transmission and the front axle and between the transmission and the rear axle, transmit the power from the transmission to the front and rear axles.

The propeller shaft at the front axle side is equipped with a center bearing which is attached to the front frame to serve as a stopper when the loader is articulated.

The propeller shafts absorb the change in drive angle and the change in length when the loader travels, ensuring smooth flow of power from the transmission to the axles.

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Note: 1 74 N-m {7.6 kgf-m} [55 lbf-ft] for L27-3, LX130-7
143 N-m {14.6 kgf-m} [106 lbf-ft] for L32-3, LX160-7 to L40-3, LX230-7
Threaded area: LOCTITE#262
2 143 N-m {14.6 kgf-m} [106 lbf-ft] (12 points)
Threaded area: LOCTITE#262
3 206 N-m {21 kgf-m} [152 lbf-ft]

1. PROPELLER SHAFT (FRONT)
2. PROPELLER SHAFT (CENTER)
3. PROPELLER SHAFT (REAR)
4. FRONT AXLE
5. DRIVE UNIT
6. REAR AXLE

Fig. 2.45 Propeller Shaft Assembly

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2.6 AXLES (FRONT AND REAR)

	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
Driving	4-wheel drive	←	←	←
Front axle	Frame-fixed, semi-floating type	←	←	←
Rear axle	Trunnion, semi-floating type	←	←	←
Reduction gear and differential				
Model	TCM656-30	TCM667-30	TCM671-30	TCM679-30
Type	Ordinary, 2-stage reduction type	←	←	←
Differential gear box	One-piece type	←	←	←
Differential limiter	Torque proportional differential	←	←	←
Final reduction gear assembly				
Model	TCM656-30	TCM667-30	TCM671-30	TCM679-30
Type	Planetary gear	←	←	←
Oil quantity to be used				
Front	28 L [7.4 U.S. gal.]	32 L [8.5 U.S. gal.]	48 L [12.7 U.S. gal.]	←
Rear	28 L [7.4 U.S. gal.]	32 L [8.5 U.S. gal.]	48 L [12.7 U.S. gal.]	←
Weight				
Front	680 kg [1499 lbs]	973 kg [2145 lbs]	1278 kg [2818 lbs]	←
Rear	653 kg [1440 lbs]	927 kg [2044 lbs]	1214 kg [2677 lbs]	←

2.6.1 DRIVE AXLE

The drive axle consists of the differential, final reduction gear assembly, wet type hydraulic disk brake unit, and axle shafts to which wheels are attached.

The power from the drive unit is transmitted through the propeller shafts to the front and rear drive axles. The power is then transmitted to the differential where it is divided into the right and left axle shafts to the final reduction gear assembly on each shaft end, thus driving the wheels.

The wet type hydraulic disk brake is installed in front of the final reduction gear assembly and serves as a service brake. For the operation of the service brake, refer to "3. BRAKE SYSTEM."

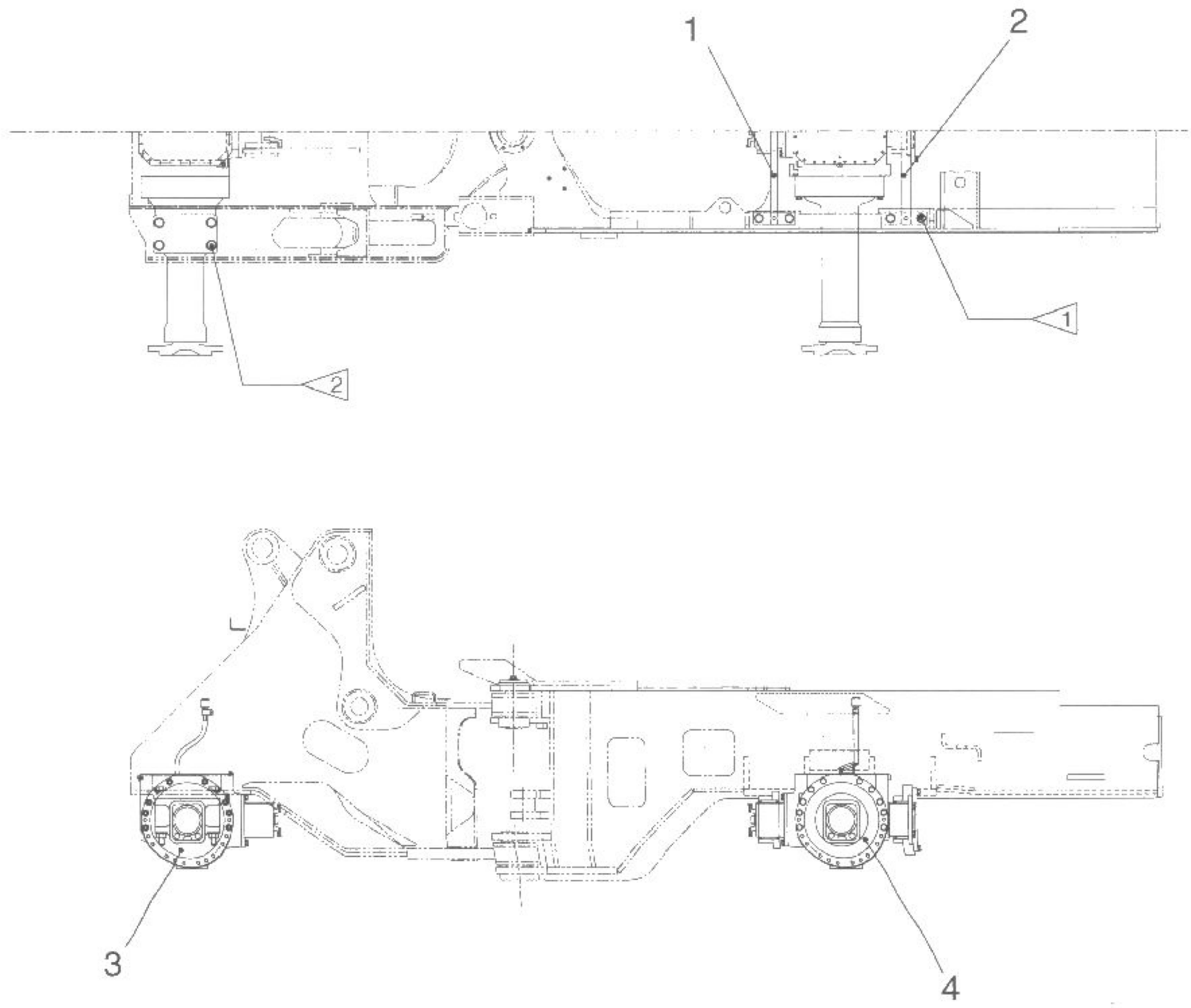
Axle Mount

The front axle is bolted directly to the front frame.

The rear axle is supported by the trunnion method in which axle supports are installed across the rear axle and bolted to the rear frame. Consequently, the rear axle is cradled up and down around the center line of the differential according to the ground condition the loader travels.

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The trunnion-mounted drive axle helps improve operator comfort because loaders with a trunnion-mounted drive axle jolt less than those with the conventional cradle-supported drive axle, when they travel on a bad ground condition.



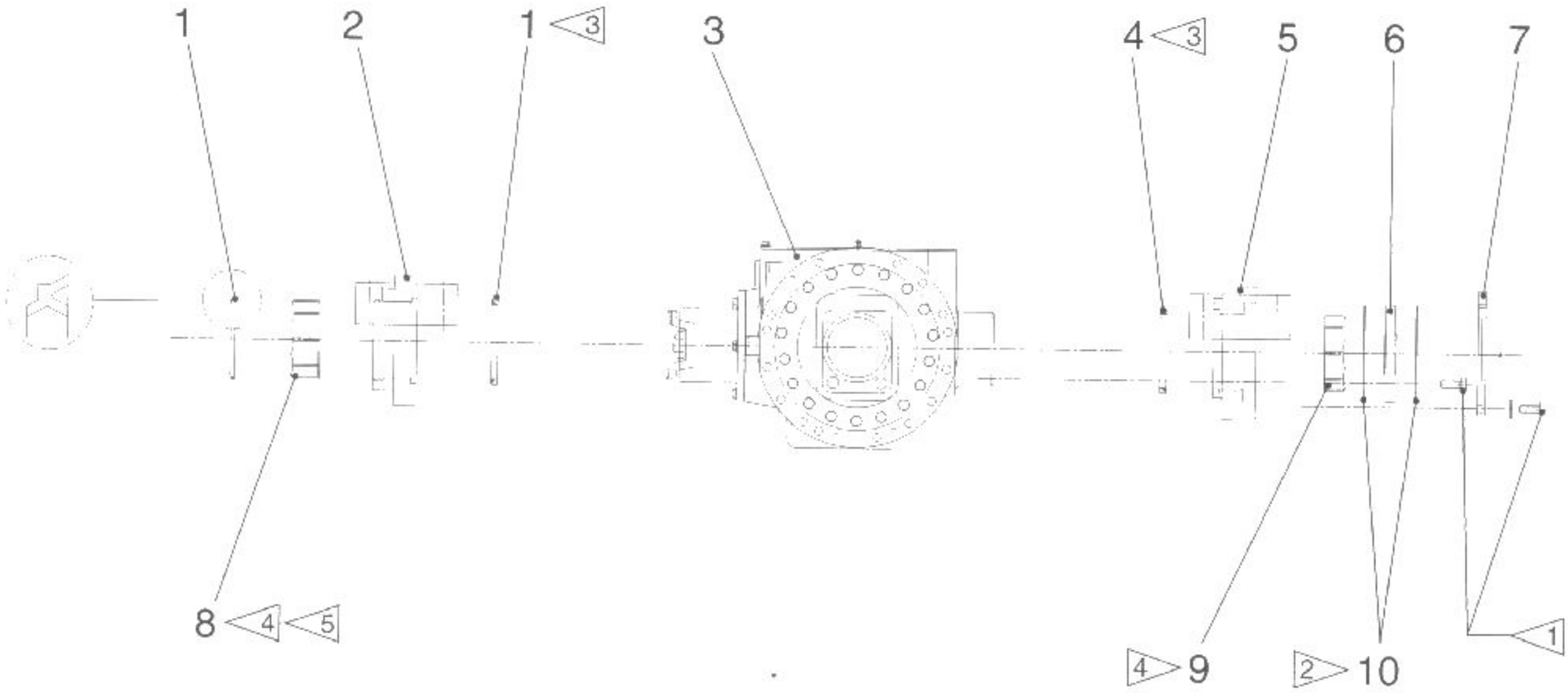
Note: 1▷ 773 N-m {78.8 kgf-m} [570 lbf-ft]

2▷ 785 N-m {80 kgf-m} [579 lbf-ft] for L27-3, LX130-7,
1128 N-m {115 kgf-m} [832 lbf-ft] for L32-3, LX160-7,
1579 N-m {161 kgf-m} [1165 lbf-ft] for L35-3, LX190-7 · L40-3, LX230-7

1. AXLE SUPPORT, FRONT
2. AXLE SUPPORT, REAR
3. FRONT AXLE
4. REAR AXLE

Fig. 2.46 Drive Axle Assembly (1/2)

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Detail of trunnion

Note: 1> 223 N-m {22.7 kgf-m} [164 lbf-ft], Threaded area: LOCTITE#262

2> Assemble with groove pointing toward part 6.

3> Assemble with lip pointing outward.

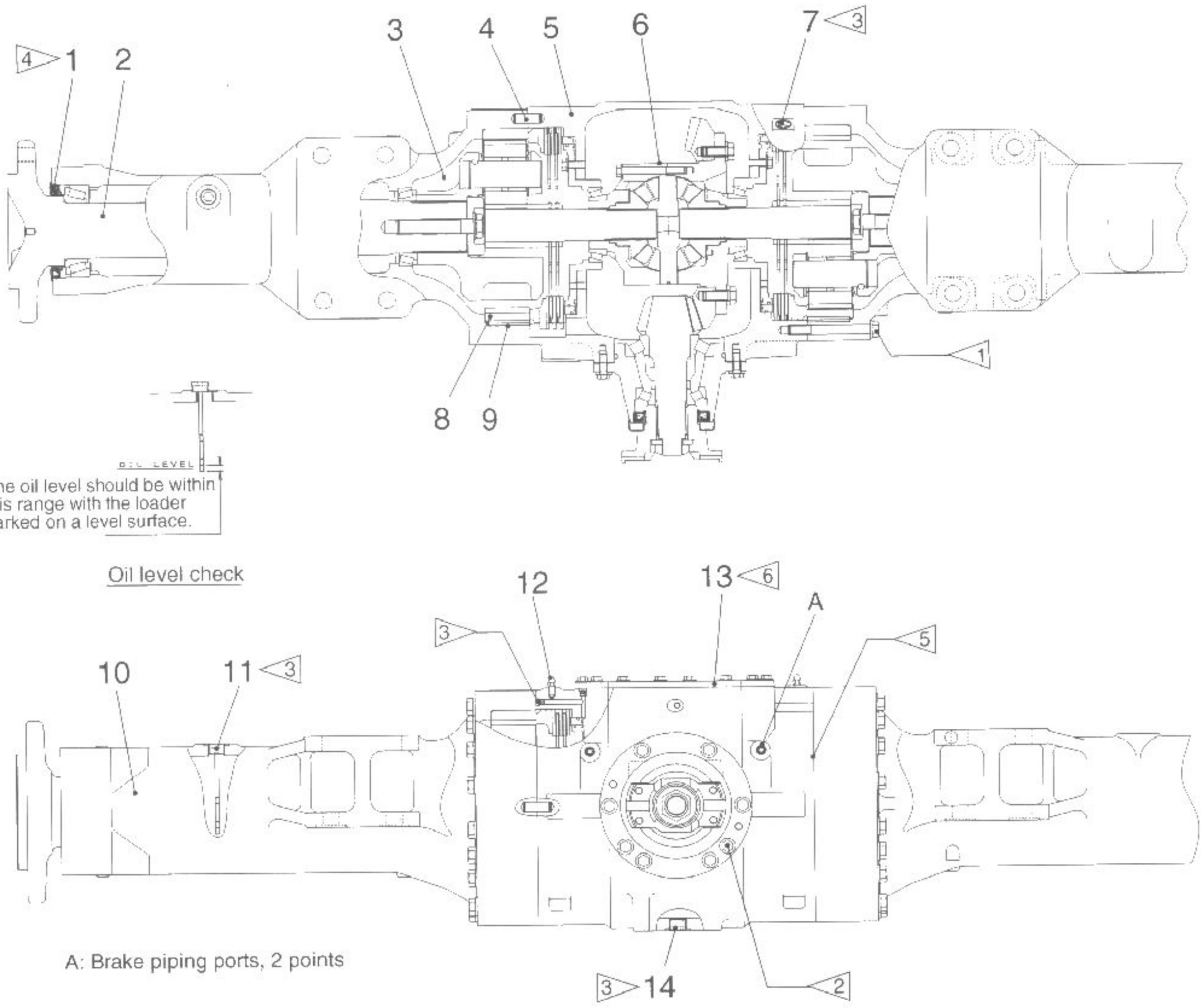
4> Bushing inner surface: Grease, assemble with groove pointed to the opposite side of axle. Assemble with slit pointed up.

5> Align grease holes with groove. Supply grease till it overflows from the opposite side.

1. DUST SEAL
2. AXLE SUPPORT, FRONT
3. REAR AXLE
4. DUST SEAL
5. AXLE SUPPORT, REAR
6. THRUST PLATE
7. COVER
8. BUSHING
9. BUSHING
10. THRUST WASHER

Fig. 2.47 Drive Axle Assembly (2/2)

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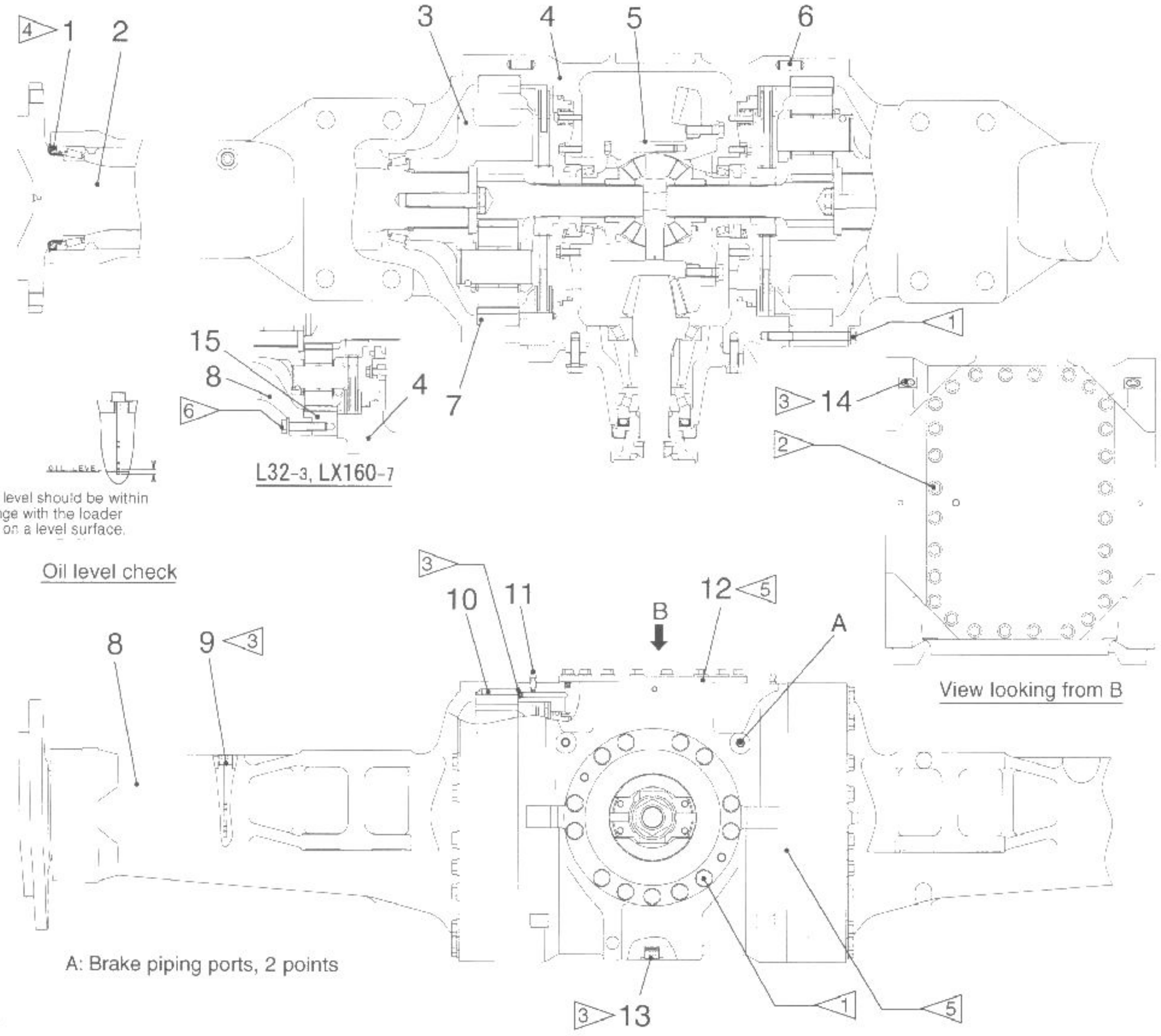
Note:
- 1 ▷ 205 N-m {21 kgf-m} [152 lbf-ft]
- 2 ▷ 98 N-m {10 kgf-m} [72 lbf-ft]
- 3 ▷ Threaded area: LOCTITE#572
- 4 ▷ Lip: Grease
- 5 ▷ Mating surface: LOCTITE FMD-127
- 6 ▷ 49 N-m {5 kgf-m} [36 lbf-ft]

1. OIL SEAL
2. AXLE SHAFT
3. FINAL ASSEMBLY
4. PIN
5. DIFFERENTIAL BODY
6. DIFFERENTIAL
7. PLUG (CHECK PORT)
8. RING GEAR
9. PIN
10. AXLE TUBE
11. LEVEL GAUG
12. BLEEDER
13. COVER
14. DRAIN PLUG

Note: Threaded area not specified: LOCTITE#262

Fig. 2.48 Front Axle (L27-3, LX130-7)

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Note: 1> 225 N-m {23 kgf-m} [166 lbf-ft]

2> 98 N-m {10 kgf-m} [72 lbf-ft]

3> Threaded area: LOCTITE#572

4> Lip: Grease

5> Mating surface: LOCTITE FMD-127

6> 206 N-m {21 kgf-m} [152 lbf-ft] for L32-3, LX160-7

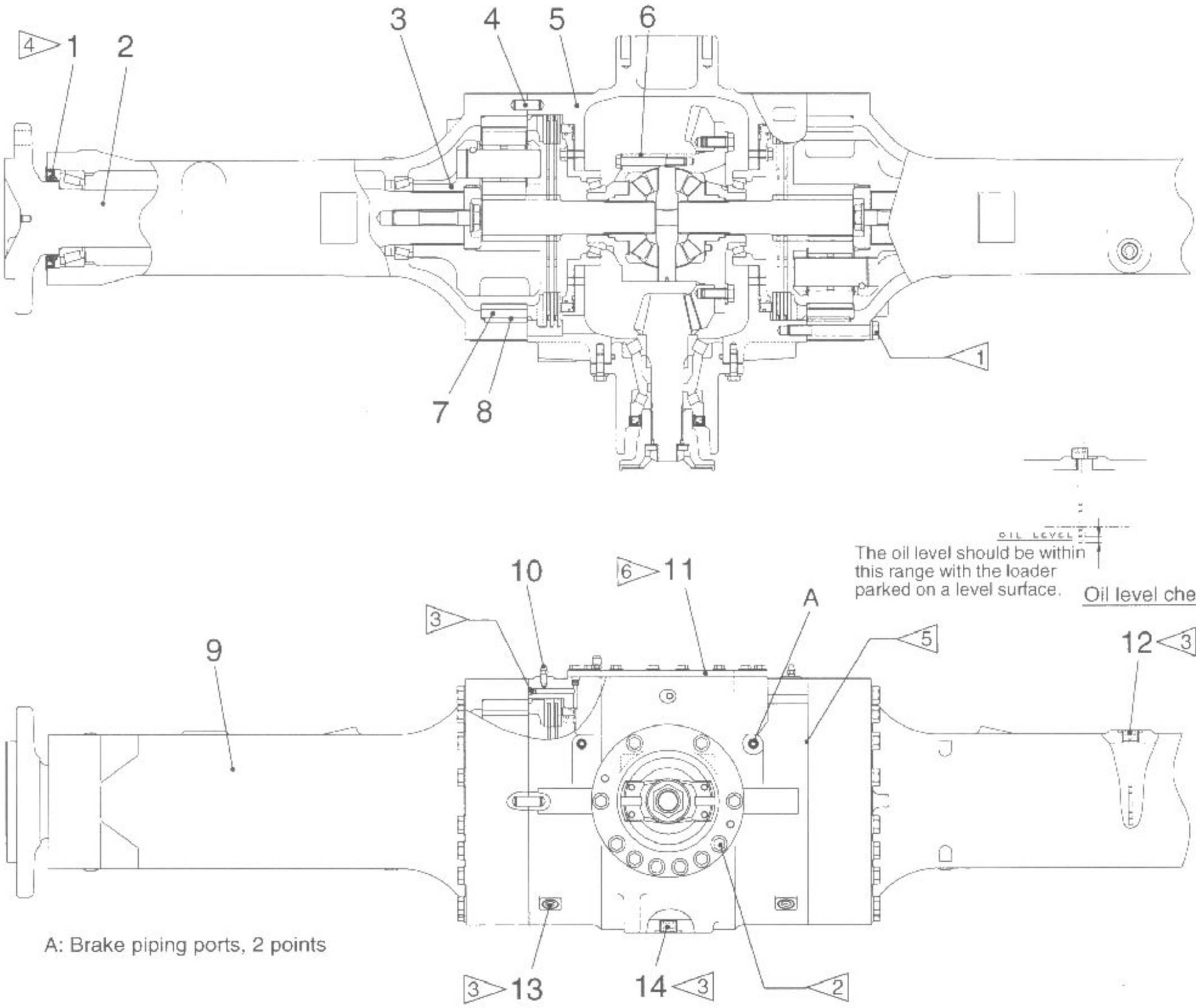
1. OIL SEAL
2. AXLE SHAFT
3. FINAL ASSEMBLY
4. DIFFERENTIAL BODY
5. DIFFERENTIAL
6. PIN
7. RING GEAR
8. AXLE TUBE
9. LEVEL GAUGE
10. PIN
11. BLEEDER
12. COVER
13. DRAIN PLUG
14. PLUG (CHECKING PORT)
15. INTERNAL RING GEAR (for L32-3, LX160-7)

Note: Threaded area not specified: LOCTITE#262

This sketches shos the front axle of the model L40-3, LX230-7. On the other models, the construction of the front axle is the same.

Fig. 2.49 Front Axle (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

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Note: 1 205 N-m {21 kgf-m} [152 lbf-ft]

2 98 N-m {10 kgf-m} [72 lbf-ft]

3 Threaded area: LOCTITE#572

4 Lip: Grease

5 Mating surface: LOCTITE FMD-127

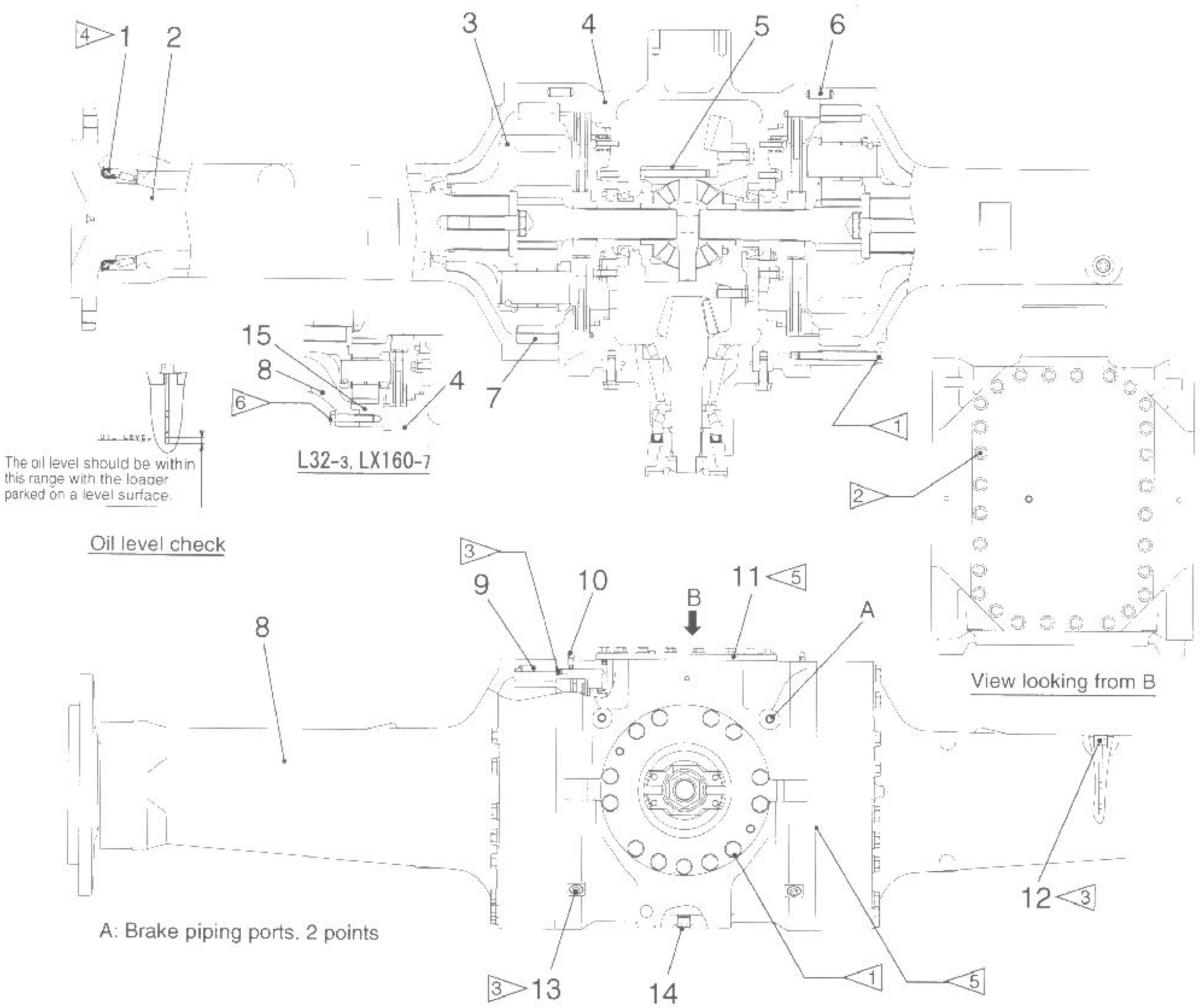
6 49 N-m {5 kgf-m} [36 lbf-ft]

1. OIL SEAL
2. AXLE SHAFT
3. FINAL ASSEMBLY
4. PIN
5. DIFFERENTIAL BODY
6. DIFFERENTIAL
7. RING GEAR
8. PIN
9. AXLE TUBE
10. BLEEDER
11. COVER
12. LEVEL GAUGE
13. PLUG (CHECK PORT)
14. DRAIN PLUG

Note: Threaded area not specified: LOCTITE#262

Fig. 2.50 Rear Axle (L27-3, LX130-7)

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Note: 1 ▷ 225 N-m {23 kgf-m} [166 lbf-ft]

2 ▷ 98 N-m {10 kgf-m} [72 lbf-ft]

3 ▷ Threaded area: LOCTITE#572

4 ▷ Lip: Grease

5 ▷ Mating surface: LOCTITE FMD-127

6 ▷ 206 N-m {21 kgf-m} [152 lbf-ft] for L32-3, LX160-7

1. OIL SEAL
2. AXLE SHAFT
3. FINAL ASSEMBLY
4. DIFFERENTIAL BODY
5. DIFFERENTIAL
6. PIN
7. RING GEAR
8. AXLE TUBE
9. PIN
10. BLEEDER
11. COVER
12. LEVEL GAUGE
13. DRAIN PLUG
14. PLUG (CHECKING PORT)
15. INTERNAL RING GEAR (for L32-3, LX160-7)

Note: Threaded area not specified: LOCTITE#262

This sketches shos the front axle of the model L40-3, LX230-7. On the other models, the construction of the front axle is the same.

Fig. 2.51 Rear Axle (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

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2.6.2 DIFFERENTIAL

The differential is integral with the reduction gear.

The power from the propeller shaft is transmitted through the drive pinion and the ring gear to the differentia gear case. It is then sent through the right and left side gears to the final reduction gear assembly. The spee reduction of the power is accomplished by the drive pinion and the ring gear.

The differential operates as follows:

While the loader travels straight, the ring gear, differential gear case, and side gears rotate together, wit the pinion gears inside the differential gear case not rotating. The power of the same speed is thus transmitte from the right and left side gears through the axle shafts to the wheels. When the loader makes a turn, th right and left wheels rotate at different speeds; the pinion gears in the differential gear case rotate around the own axes according to the difference in speed between the right and left side gears.

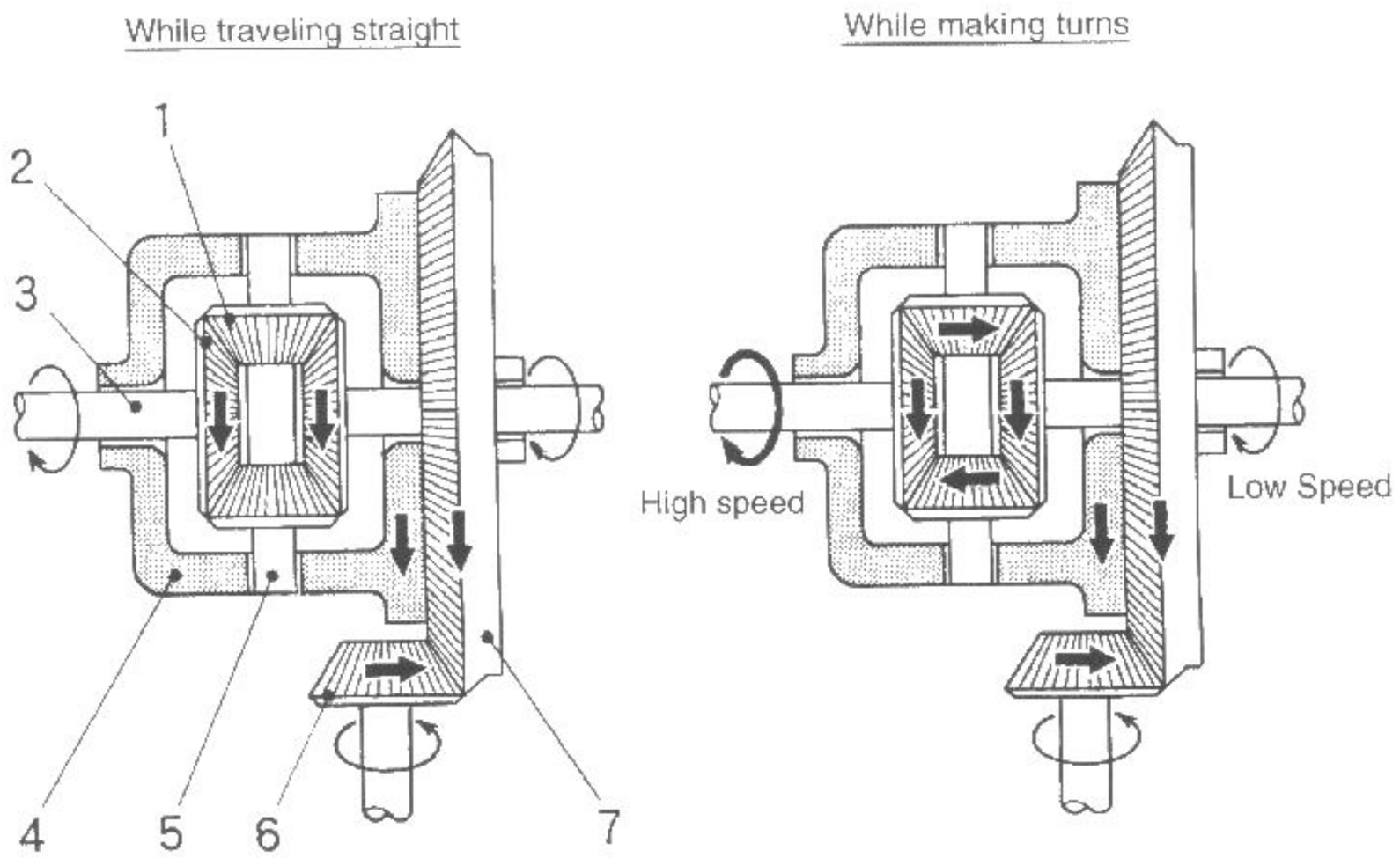


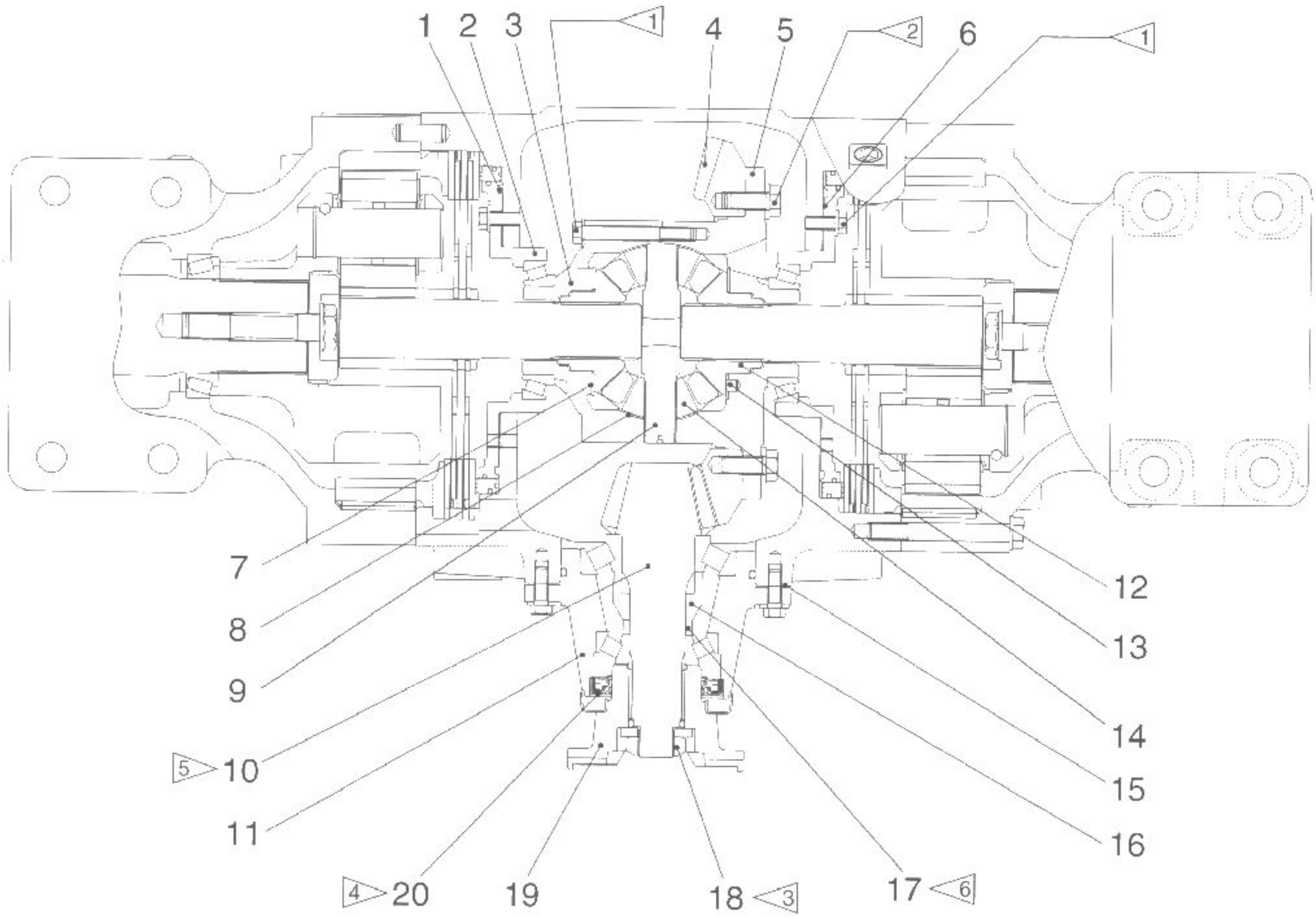
Fig. 2.52 Differential Gear Operation

Torque proportional differential

Wheel loaders often need to work on a bad ground condition such as on sand or in a swampy place. such a bad ground condition, a loader with the conventional differential can skid, thus making it difficul deliver its performance. In addition, the tires will also wear out prematurely. To prevent this from happeni some models may come equipped with a torque proportional differential which limits differential action

The torque proportional differential has almost the same construction as the standard differential assem except that the differential pinion gears have an odd number of teeth of a special contour. When the tires about to skid on soft ground, the pinion gears continue to transmit power to both side gears without idl until the difference in road resistance between the right and left tires reaches a certain point, thus prevent the tires from skidding.

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Note: 1> 98 N-m {10 kgf-m} [72 lbf-ft]

2> 225 N-m {23 kgf-m} [166 lbf-ft]

3> 540 N-m {55 kgf-m} [398 lbf-ft]

4> Outer diameter: LOCTITE#262, Lip: Grease

5> Backlash between ring gear and pinion gear: 0.25 to 0.36 mm [0.0098 to 0.0142 in.]

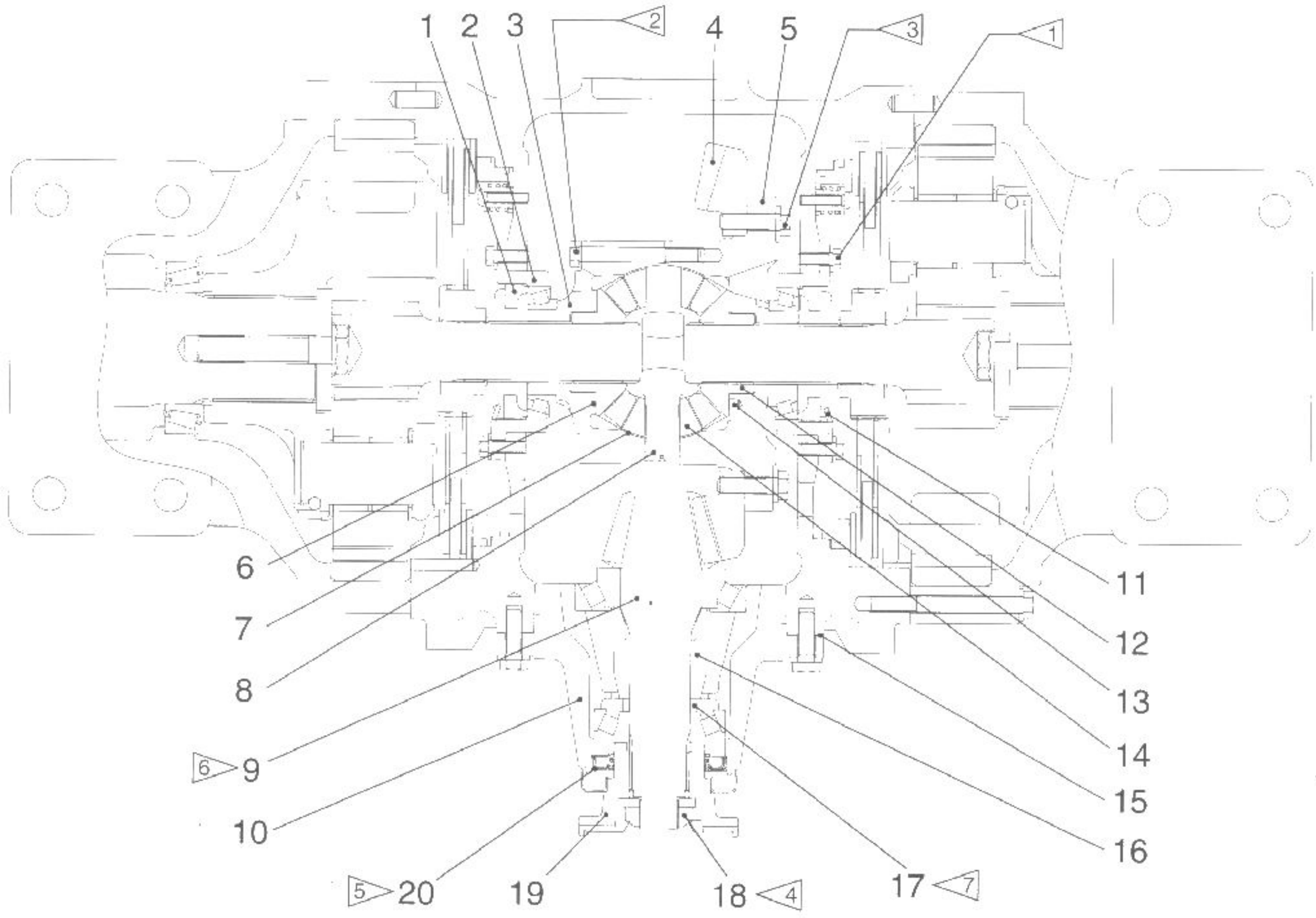
6> The spacer should be machined so as to acquire the rotating torque of 1.5 to 2.5 N-m {0.15 to 0.25 kgf-m} [1.1 to 1.8 lbf-ft] (without oil seal).

1. OIL SEAL
2. BEARING RETAINER
3. CASE B
4. RING GEAR
5. CASE A
6. SHIM
7. THRUST WASHER
8. THRUST WASHER
9. SPIDER
10. PINION GEAR
11. BEARING CAGE
12. SIDE GEAR
13. DOWEL PIN
14. PINION GEAR
15. SHIM
16. SPACER
17. SPACER
18. NUT
19. FLANGE
20. OIL SEAL

Note: Threaded area not specified: LOCTITE#262

Fig. 2.53 Differential (L27-3, LX130-7)

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Note: 1 98 N-m {10 kgf-m} [72 lbf-ft] for L32-3, LX160-7
88 N-m {9 kgf-m} [65 lbf-ft] for L35-3, LX190-7 · L40-3, LX230-7

2 147 N-m {15 kgf-m} [108 lbf-ft]

3 225 N-m {23 kgf-m} [166 lbf-ft]

4 657 N-m {67 kgf-m} [485 lbf-ft], Threaded area: LOCTITE#262

5 Outer diameter: LOCTITE#262, Lip: Grease

6 Backlash between ring gear and pinion gear: 0.25 to 0.36 mm [0.0098 to 0.0142 in.]

7 The spacer should be machined so as to acquire the rotating torque of 1.5 to 2.5 N-m {0.15 to 0.25 kgf-m} [1.1 to 1.8 lbf-ft] (without oil seal).

1. OIL SEAL
2. BEARING RETAINER
3. CASE B
4. RING GEAR
5. CASE A
6. SHIM
7. THRUST WASHER
8. SPIDER
9. PINION GEAR
10. BEARING CAGE
11. LOCK PLATE
12. SIDE GEAR
13. DOWEL PIN
14. PINION GEAR
15. SHIM
16. SPACER
17. SPACER
18. NUT
19. FLANGE
20. OIL SEAL

Note: Threaded area not specified: LOCTITE#262

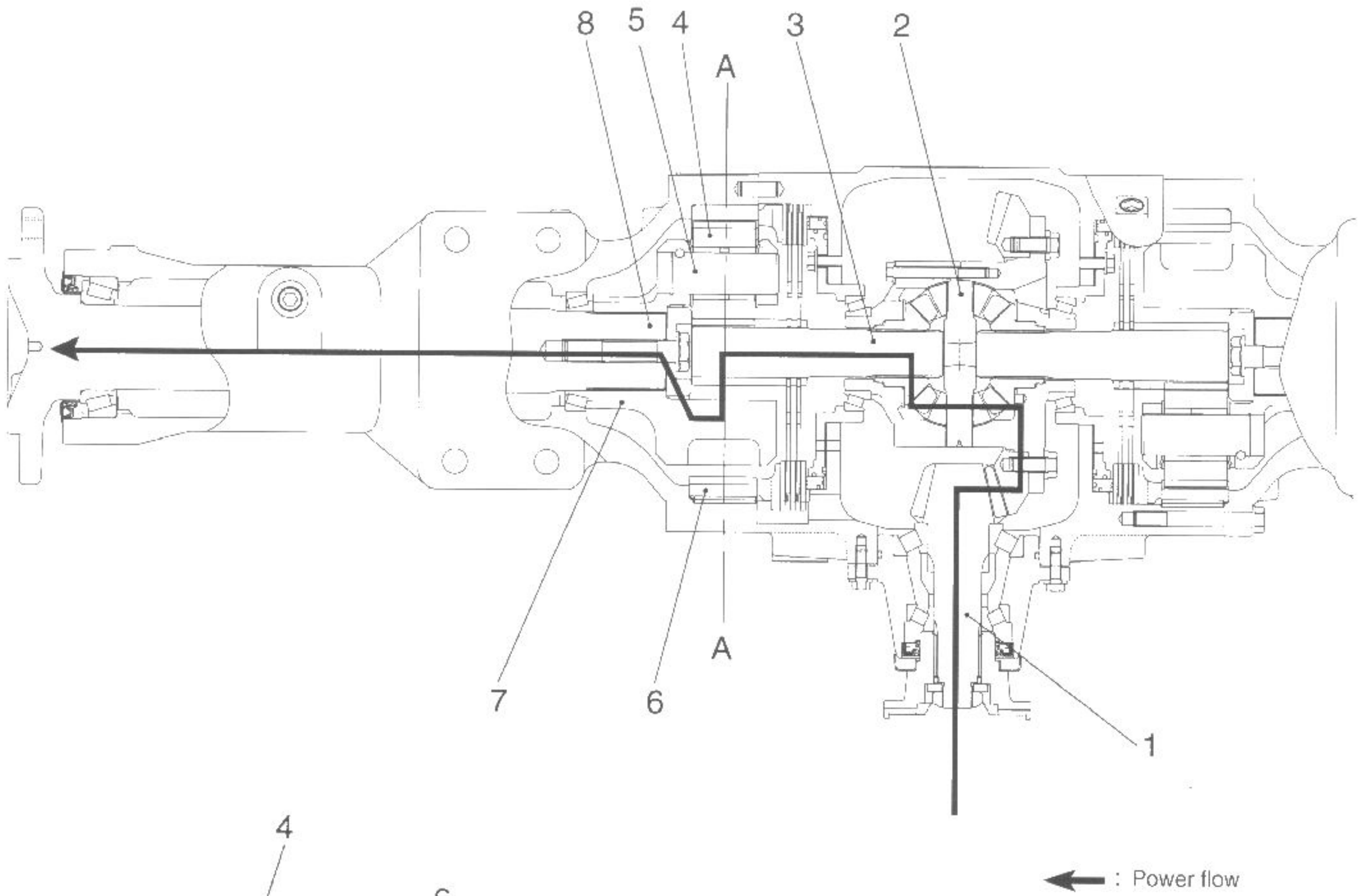
Fig. 2.54 Differential (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

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2.6.3 FINAL REDUCTION GEAR

The final reduction gear assembly is a planetary type and provides final speed reduction of the power from the engine in the power transmission line.

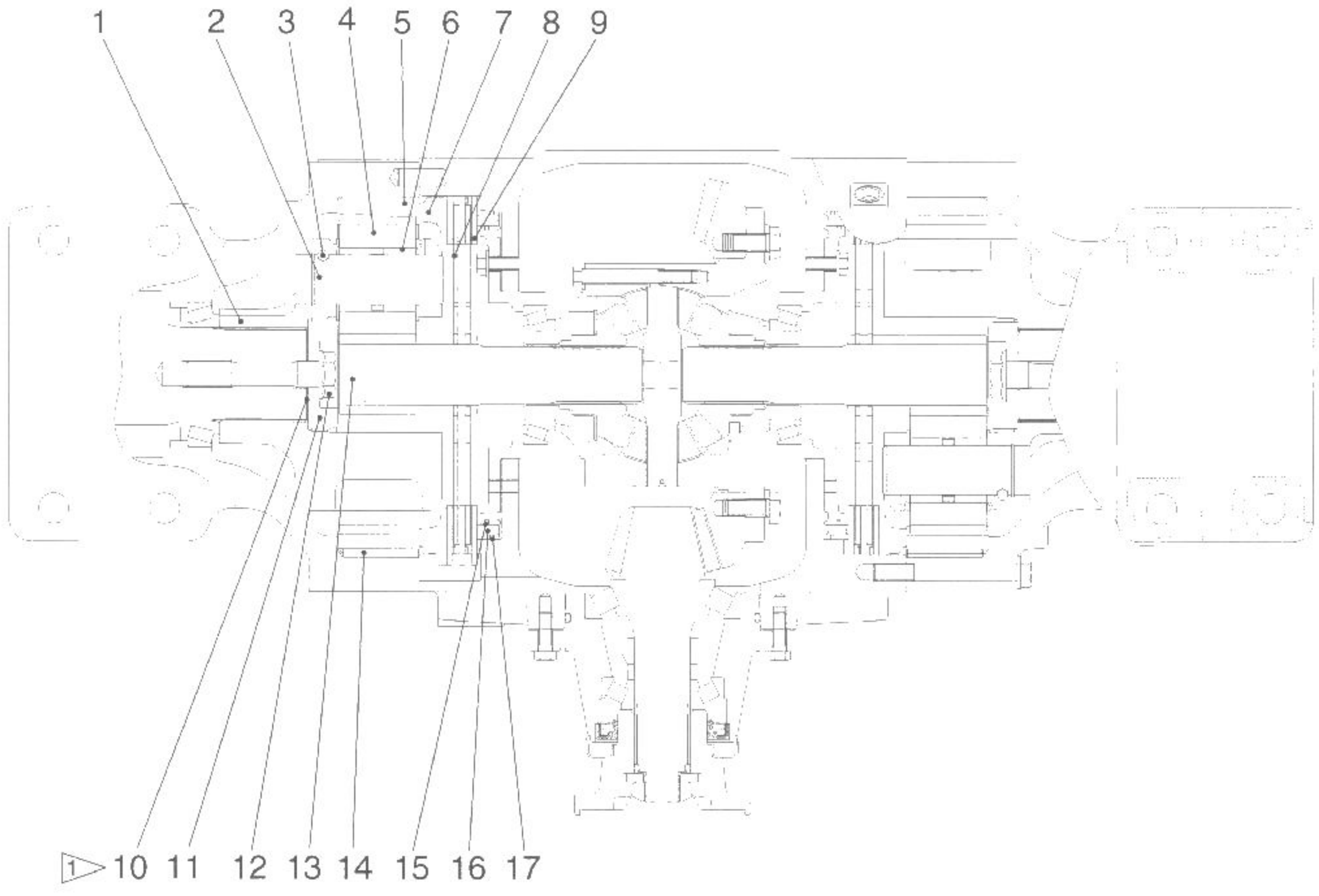
The power from the differential gear rotates the shaft and the three planet gears inside the ring gear. The rotation of the planet gear is transmitted to the planet carrier and the axle shaft.



1. DRIVE PINION
2. DIFFERENTIAL
3. GEAR & SHAFT
4. PLANET SHAFT
5. PLANET GEAR
6. RING GEAR (Fixed)
7. PLANET CARRIER
8. AXLE SHAFT

Fig. 2.55 Power Flow

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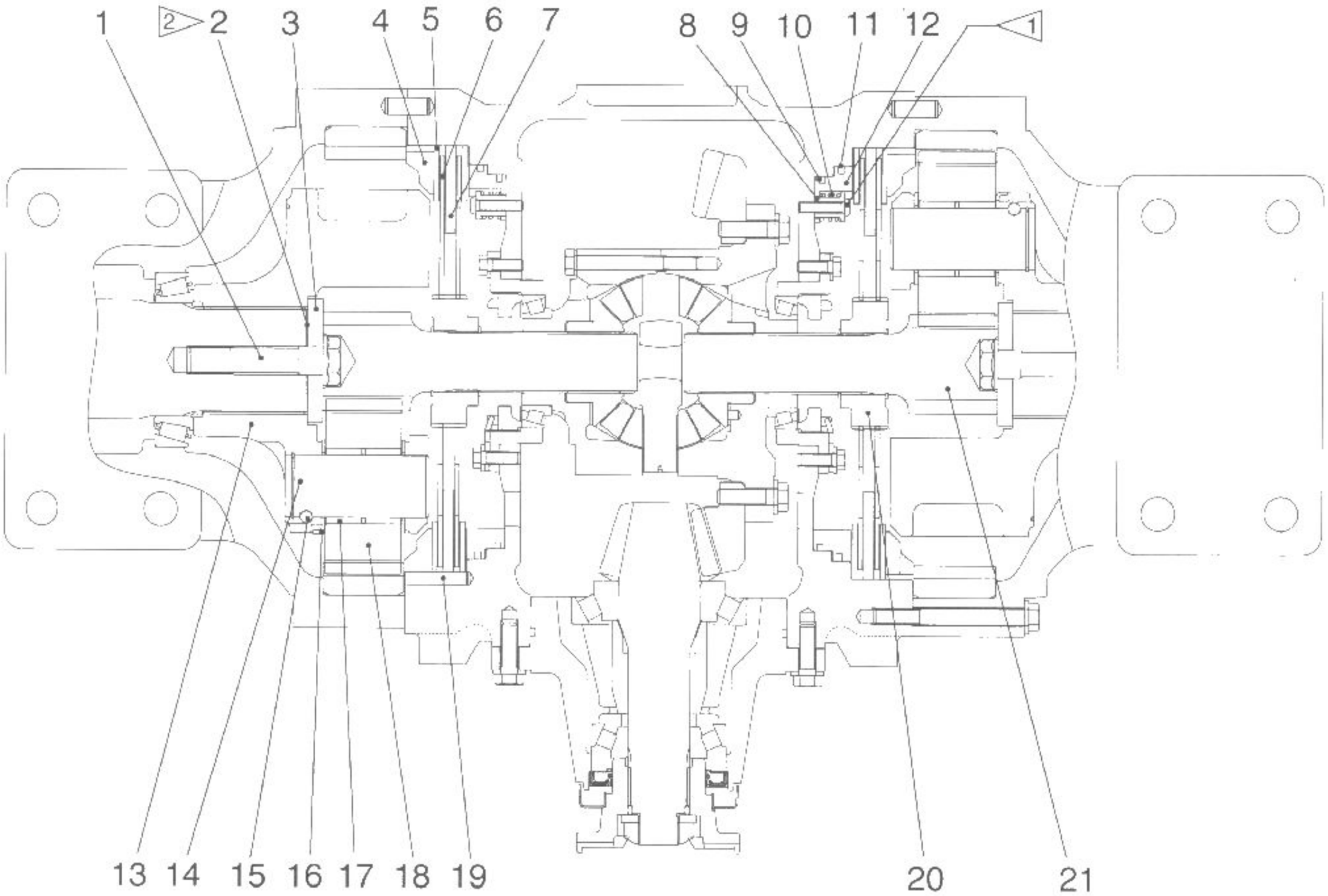
Note: 1 Shim adjustment procedure

1) Tighten the bolt (12) to the tightening torque of 49 N-m {5 kgf-m} [36 lbf-ft] and push in axle shaft bearing cone, turning axle shaft.
2) Measure spacing between retainer plate (11) and axle shaft. Measured value = Y.
3) Choose shims whose thickness is 0.03 to 0.10 mm [0.0012 to 0.0039 in.] greater than the value Y.
4) Install shims and install retainer plate and bolt.
   1090 N-m {111 kgf-m} [803 lbf-ft], Threaded area: LOCTITE#262
   The bearing's rotational resistance is 19.6 to 39.2 N {2 to 4 kgf} [4.4 to 8.8 lbf] on the tube fitting bolt pitch circle.

1. PLATE CARRIER
2. SHAFT
3. BALL
4. PLANET GEAR
5. RING GEAR
6. NEEDLE ROLLER
7. END PLATE
8. BRAKE DISK
9. BRAKE RING
10. SHIM
11. RETAINER PLATE
12. BOLT
13. GEAR & SHAFT
14. PIN
15. D-RING
16. PISTON
17. D-RING

Fig. 2.56 Final Reduction Gear Assembly (L27-3, LX130-7)

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Note: 1 ▷ 49 N-m {15 kgf-m} [36 lbf-ft], Threaded area: LOCTITE#262

1) Tighten the bolt (1) to the tightening torque of 49 N-m {5 kgf-m} [36 lbf-ft] and push in axle shaft bearing cone, turning axle shaft.
2) Measure spacing between retainer plate (3) and axle shaft. Measured value = Y.
3) Choose shims whose thickness is 0.03 to 0.10 mm [0.0012 to 0.0039 in.] greater than the value Y.
4) Install shims and install retainer plate and bolt.

   1088 N-m {111 kgf-m} [803 lbf-ft] for L32-3, LX160-7
   1588 N-m {162 kgf-m} [1172 lbf-ft] for L35-3, LX190-7 · L40-3, LX230-7

   Threaded area: LOCTITE#262

   The bearing's rotational resistance is 19.6 to 39.2 N {2 to 4 kgf} [4.4 to 8.8 lbf] on the tube fitting bolt pitch circle.

1. BOLT
2. SHIM
3. RETAINER PLATE
4. END PLATE
5. BRAKE RING
6. BRAKE DISK
7. BRAKE RING
8. ADAPTER
9. D-RING
10. RETURN SPRING
11. D-RING
12. PISTON
13. PLANET CARRIER
14. SHAFT
15. BALL
16. THRUST WASHER
17. NEEDLE ROLLER
18. PLANET GEAR
19. PIN
20. DISK HUB
21. GEAR & SHAFT

Fig. 2.57 Final Reduction Gear Assembly (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

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2.7 WHEEL ASSEMBLY (TIRE AND WHEEL)

	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
Tire	20.5-25-12PR, Tubeless, L-3	23.5-25-16PR Tubeless, L-3	23.5-25-16PR, Tubeless, L-3	26.5-25-16PR, Tubeless, L-3
Wheel (rim)	25 x 17.00/1.7-0-22FTL	19.5 x 25WTB-0-19DTL	19.50 x 25 WTB-0-25FTL	22.00 x 25 WTB-0-25FTL
Weight (per piece)				
Tire	178 kg [392 lbs] (Toyo Rubber)	282 kg [622 lbs] (Toyo Rubber)	282 kg [622 lbs] (Toyo Rubber)	286 kg [631 lbs] (Toyo Rubber)
Rim	132 kg [291 lbs]	228 [503 lbs]	234 kg [516 lbs]	265 [584 lbs]
Inflation pressure	330 kPa {3.30 kgf/cm^2} [46.9 psi]	375 kPa {3.75 kgf/cm^2} [53.3 psi]	375 kPa {3.75 kgf/cm^2} [53.3 psi]	330 kPa {3.30 kgf/cm^2} [46.9 psi]

2.7.1 TIRE

The standard model is provided with lock-type L-3 tires which feature damage resistance and abrasion resistance. Select appropriate tires since there are a variety of tires available according to the application and purpose of work.

The tire size is expressed in inches. The strength of tires are expressed in ply rating (PR): for example, 10PR means a strength corresponding to that of 10 pieces of cotton cords. (PR does not necessarily stand for the number of cord plies in tire.)

Example: 20.5 – 25 – 12PR

- 20.5: Tire width (in.)
- 25: Rim diameter (in.)
- 12PR: Tire strength

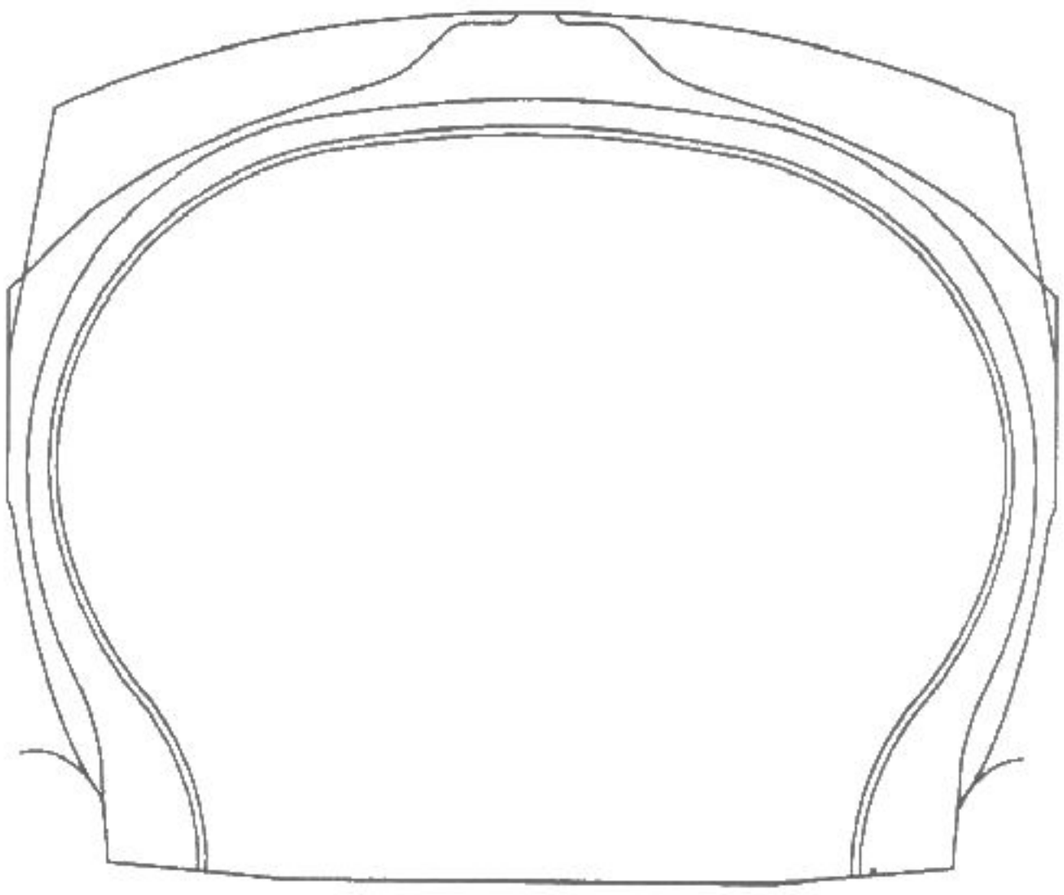
2.7.2 WHEEL

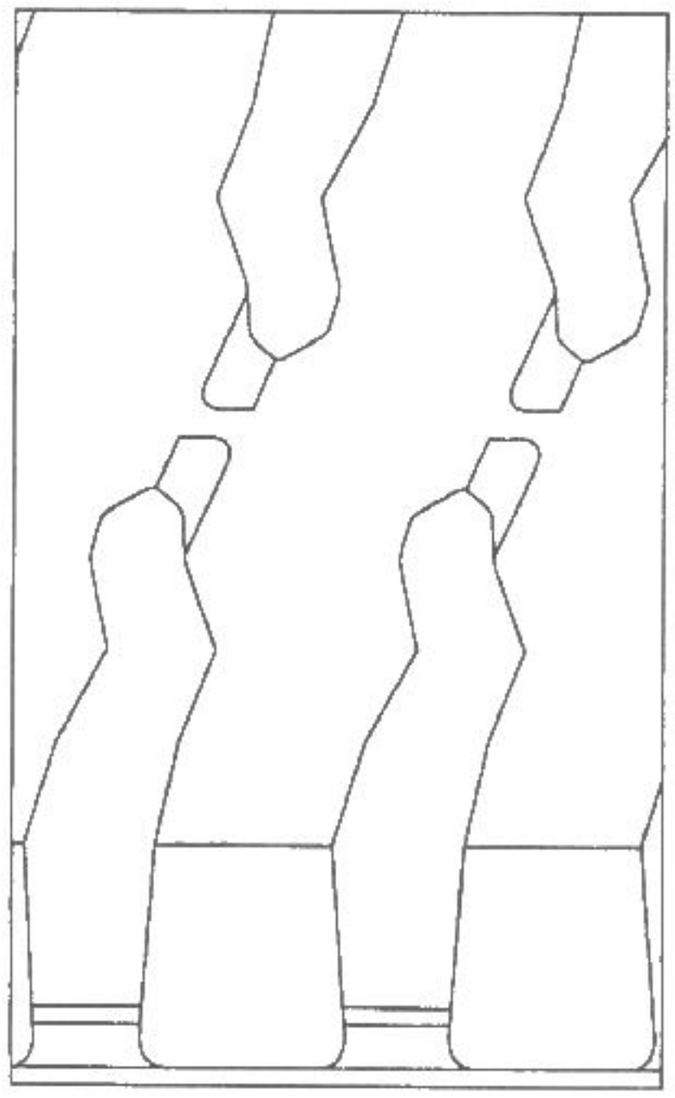
The wheel consists of the rim and disk. The disk is bolted to the axle shaft.

The tire is installed on the rim and both serve as one piece. It is thus very important to use an appropriate rim when installing a tire on the rim. The use of an inappropriate rim may result in a short life of the tire and in the worst case might lead to a serious accident. The rim size is also expressed in inches. The first number stands for the rim diameter and the next one the rim width.

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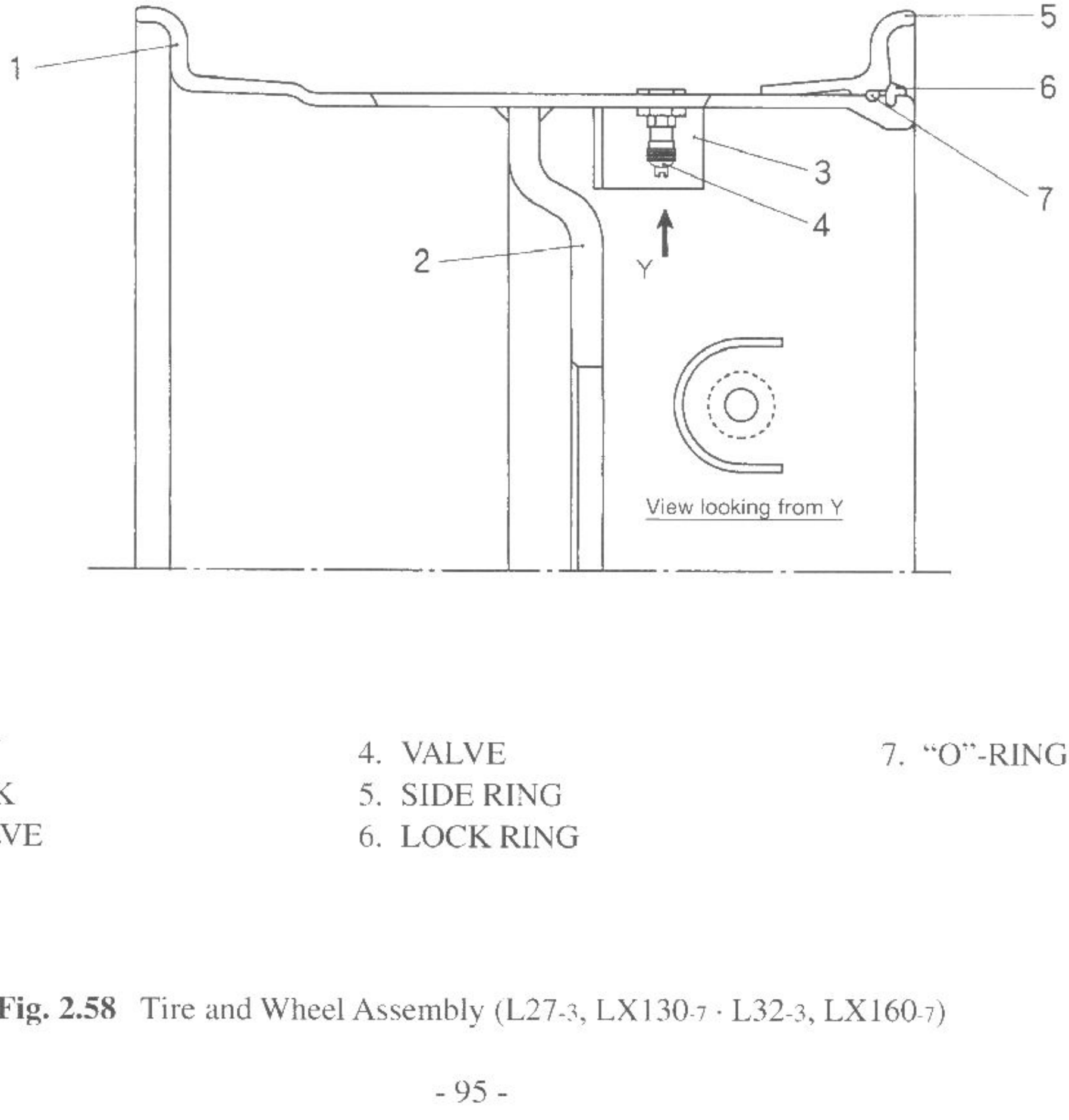
(Tire)





(Tread Pattern)

(Wheel)

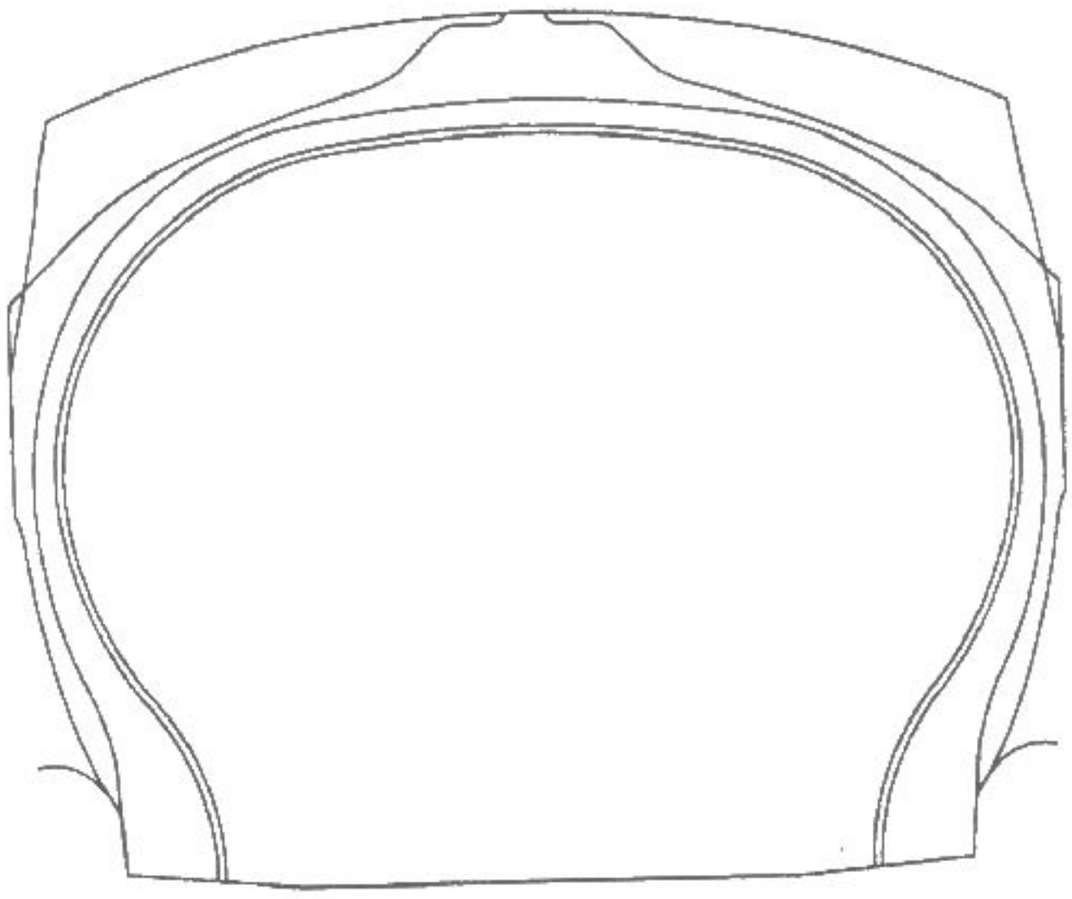


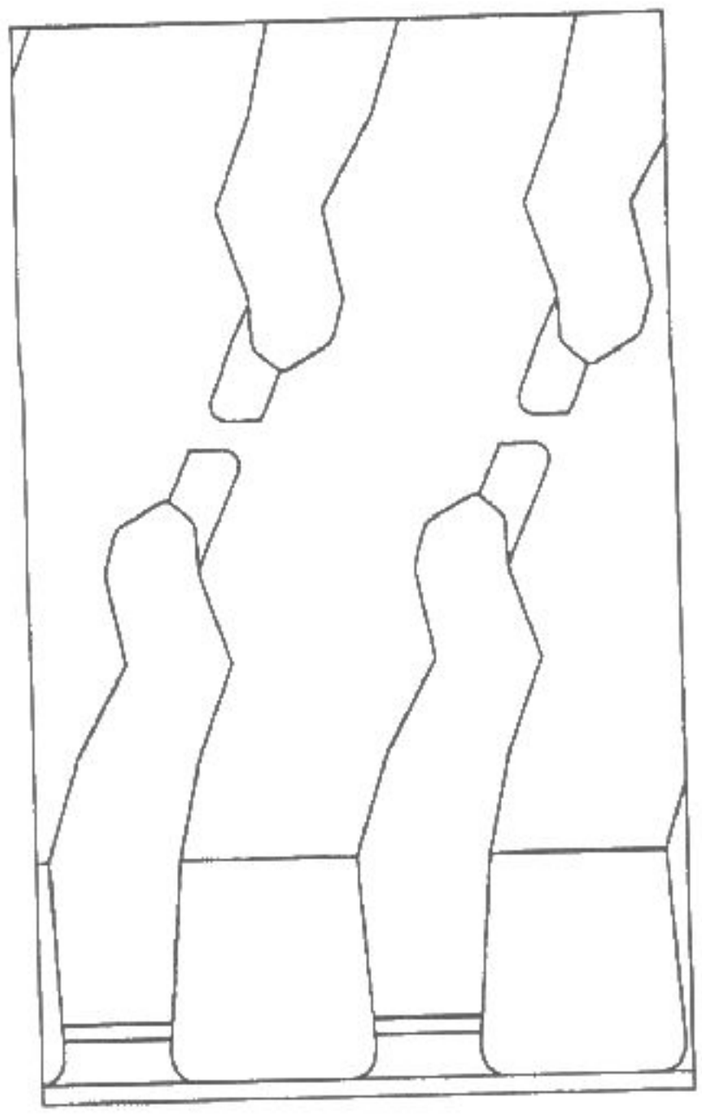
1. RIM
2. DISK
3. VALVE
4. VALVE
5. SIDE RING
6. LOCK RING
7. "O"-RING

Fig. 2.58 Tire and Wheel Assembly (L27-3, LX130-7 · L32-3, LX160-7)

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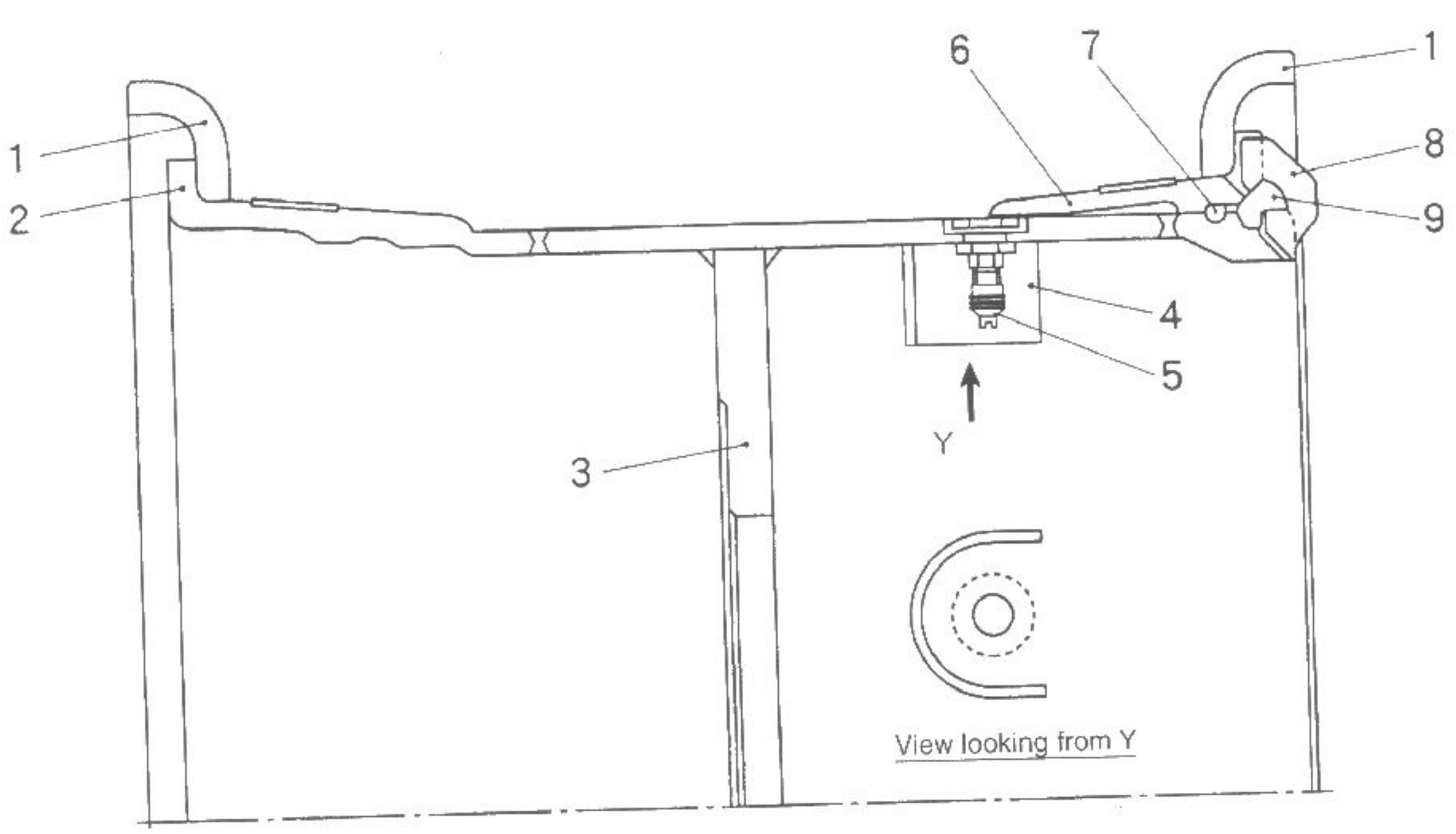
(Tire)





(Tread Pattern)

(Wheel)

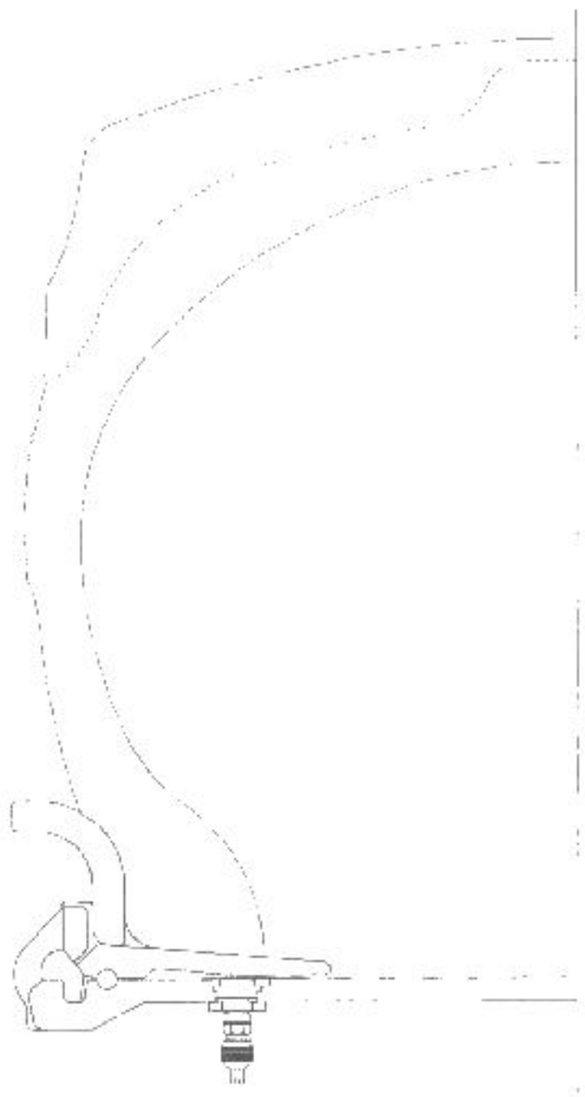


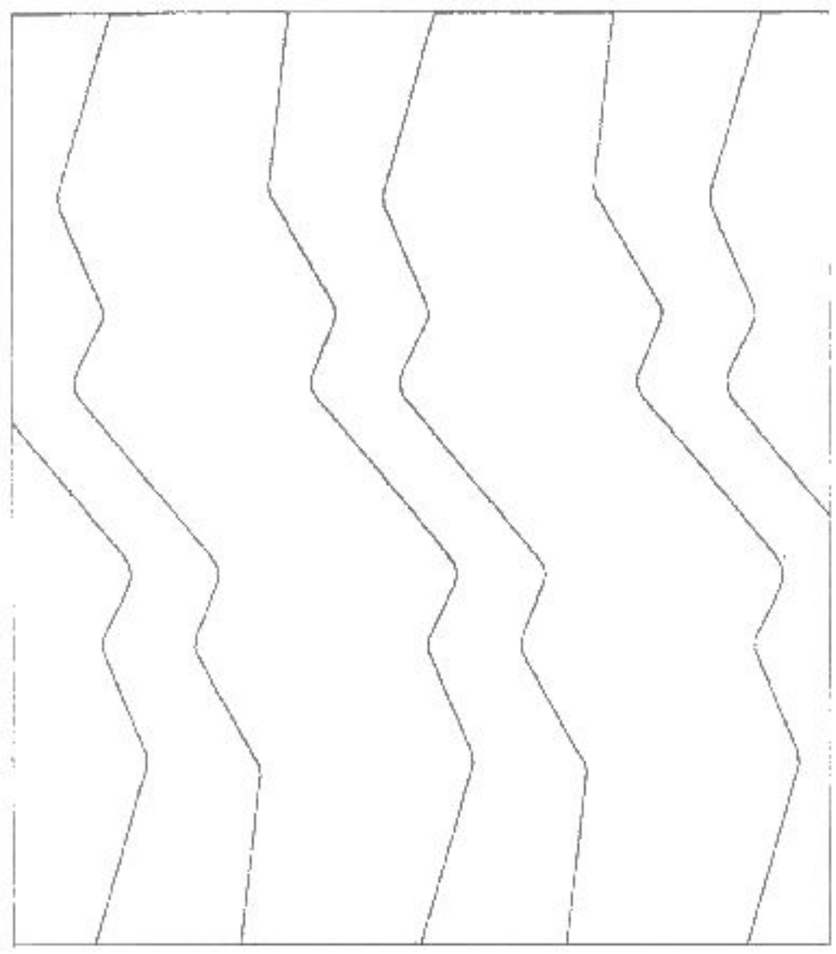
1. SIDE RING
2. RIM
3. DISK
4. VALVE GUARD
5. VALVE
6. BEAD SHEET BAND
7. "O"-RING
8. LOCK RING DRIVER
9. LOCK RING

Fig. 2.59 Tire and Wheel Assembly (L35-3, LX190-7)

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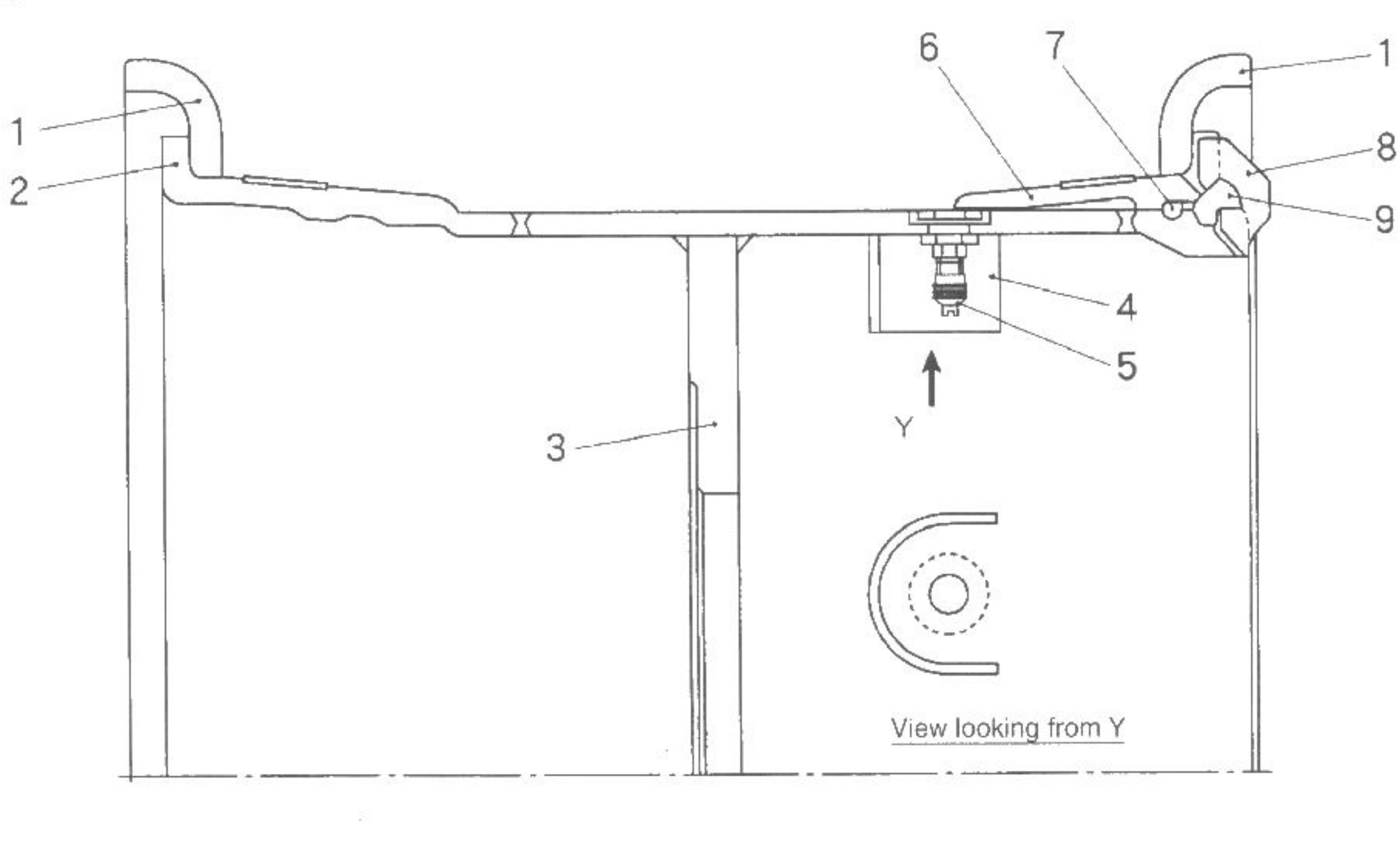
(Tire)





(Tread Pattern)

(Wheel)



1. SIDE RING
2. RIM
3. DISK
4. VALVE GUARD
5. VALVE
6. BEAD SHEET BAND
7. "O"-RING
8. LOCK RING DRIVER
9. LOCK RING

Fig. 2.60 Tire and Wheel Assembly (L40-3, LX230-7)

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NOTE

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3. BRAKE SYSTEM

Service brake	
Type	Front and rear wheel independent braking, wet disk hydraulic, full-power brake
Number of fluid lines	Independent 2 lines
Brake valve	Dual brake valve
Disk brake	4-wheel wet type multidisk brake
Brake pump	See "6.2 PUMP."
Accumulator	Accumulator (0.7 L [43 $in.^3$] x 3 pcs.)
Brake oil pressure setting	3.27 MPa {33.4 kgf/cm^2} [475 psi] for L27-3, LX130-7
	4.18 MPa {42.7 kgf/cm^2} [607 psi] for L32-3, LX160-7 to L40-3, LX230-7
Alarm system	Warning lamp and buzzer
Parking and emergency brake	
Type	Wet multiple-plate disk mechanical brake
Installation	Inside transmission

⚠ If the engine stalls while the loader is running, the brake may become inoperative. Do not shut off the engine while the loader is running.

⚠ Except in an emergency situation, do not apply the parking brake while the loader is moving. Abusing emergency braking function might cause malfunction of the parking brake.

⚠ Caution to be taken when servicing accumulator and its piping.

- **The accumulator is filled with high-pressure nitrogen gas. Use due caution when servicing the accumulator.**
- **Servicing of the accumulator such as filling of nitrogen gas, should be performed only by qualified personnel.**
- **Do not try to machine or weld the accumulator directly.**
- **The accumulator piping has pressurized hydraulic oil inside it. Before working on the accumulator piping, release any residual pressure from the piping.**
- **When releasing residual pressure from the accumulator piping, park the loader ona level surface, shut off the engine and lower the booms and bucket on the ground.**

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3.1 SERVICE BRAKE

3.1.1 GENERAL DESCRIPTION (BRAKE LINE)

(1) Service brake line

The service brake is a 4-wheel wet type disk brake and uses the full power brake system.

The hydraulic brake line has an independent 2-line system for the front and rear wheels. If one of the two lines is damaged, another line will operate properly to brake the loader.

The brake pump picks up the oil from the oil tank and accumulates it in the accumulator. When the brake pedal is pressed, the disk brake is operated by the accumulator oil pressure.

The brake pump is also used as an assist pump. For the specifications and construction of the pump, refer to "6.2 PUMP."

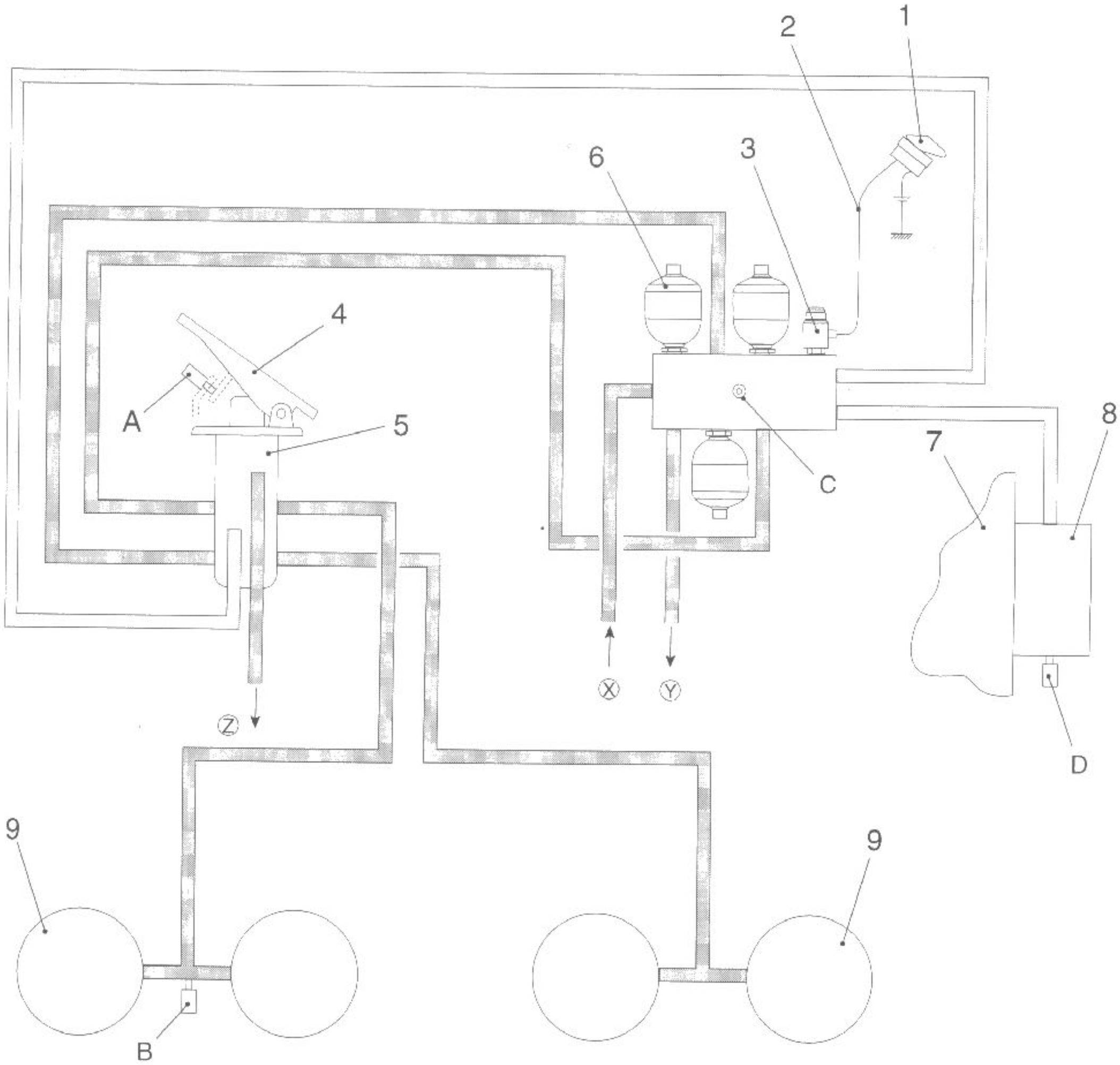
(2) Safety system and alarm system

- An emergency brake is installed as a safety device for the service brake line. If oil pressure in the hydraulic line of the brake (accumulator) drops to zero, the emergency brake is actuated. The emergency brake is also used as parking brake.
- The accumulator is equipped with a pressure switch. If the accumulator oil pressure drops to a certain level, the operator will notice it immediately by way of the buzzer and the "brake oil pressure" warning lamp on the dashboard.

Note: Specifications and applications of switches (Fig.3.1)

Position	Name	Application	Specification
A	Stop lamp switch	Stop lamp	OFF when push rod is pushed ON when push rod is released
B	Pressure switch (Clutch cut-off switch)	Transmission clutch cut-off (inching)	Operating state: 1.5 MPa {15 kgf/cm^2} [210 psi], Reset: 1.0 MPa {10 kgf/cm^2} [140 psi] (Turns ON at atmospheric pressure)
C	Pressure switch	"Brake oil pressure" warning lamp and buzzer	Operating state: 3.4 MPa {35 kgf/cm^2} [500 psi], Reset: 2.5 MPa {25 kgf/cm^2} [360 psi] (Turns ON at atmospheric pressure)
D	Pressure switch (Parking switch)	"Parking brake" indicator lamp and transmission clutch cut-off	

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Ⓧ : from CHARGING VALVE

Ⓨ : to STOP VALVE IN PILOT HYDRAULIC CIRCUIT

Ⓩ : to MAIN PUMP SUCTION TUBE (DRAIN)

SERVICE BRAKE LINE

PARKING BRAKE LINE

1. PARKING BRAKE SWITCH
2. WIRE HARNESS
3. PARKING BRAKE VALVE (SOLENOID VALVE)
4. BRAKE PEDAL
5. BRAKE VALVE
6. ACCUMULATOR
7. TRANSMISSION
8. PARKING BRAKE
9. WET TYPE DISK BRAKE (built in AXLE)

Fig. 3.1 Brake Line

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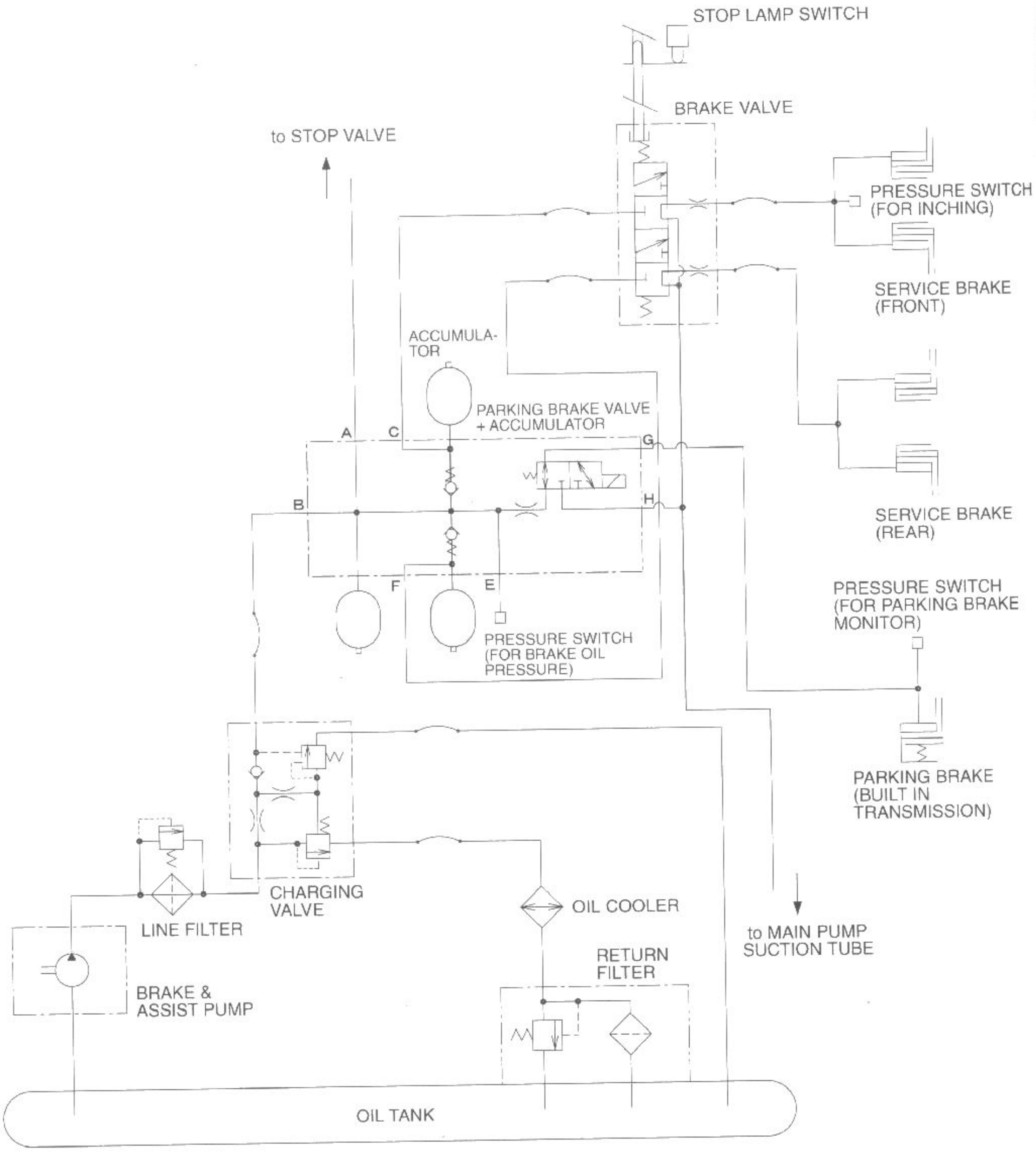


Fig. 3.2 Brake Oil Pressure Circuit Diagram

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(3) Inching mechanism

The mode inching, interlocked to the brake system, stops power transmission temporarily by placing the transmission in neutral.

When the inching mechanism is activated, the driving power is concentrated in the load-handling system.

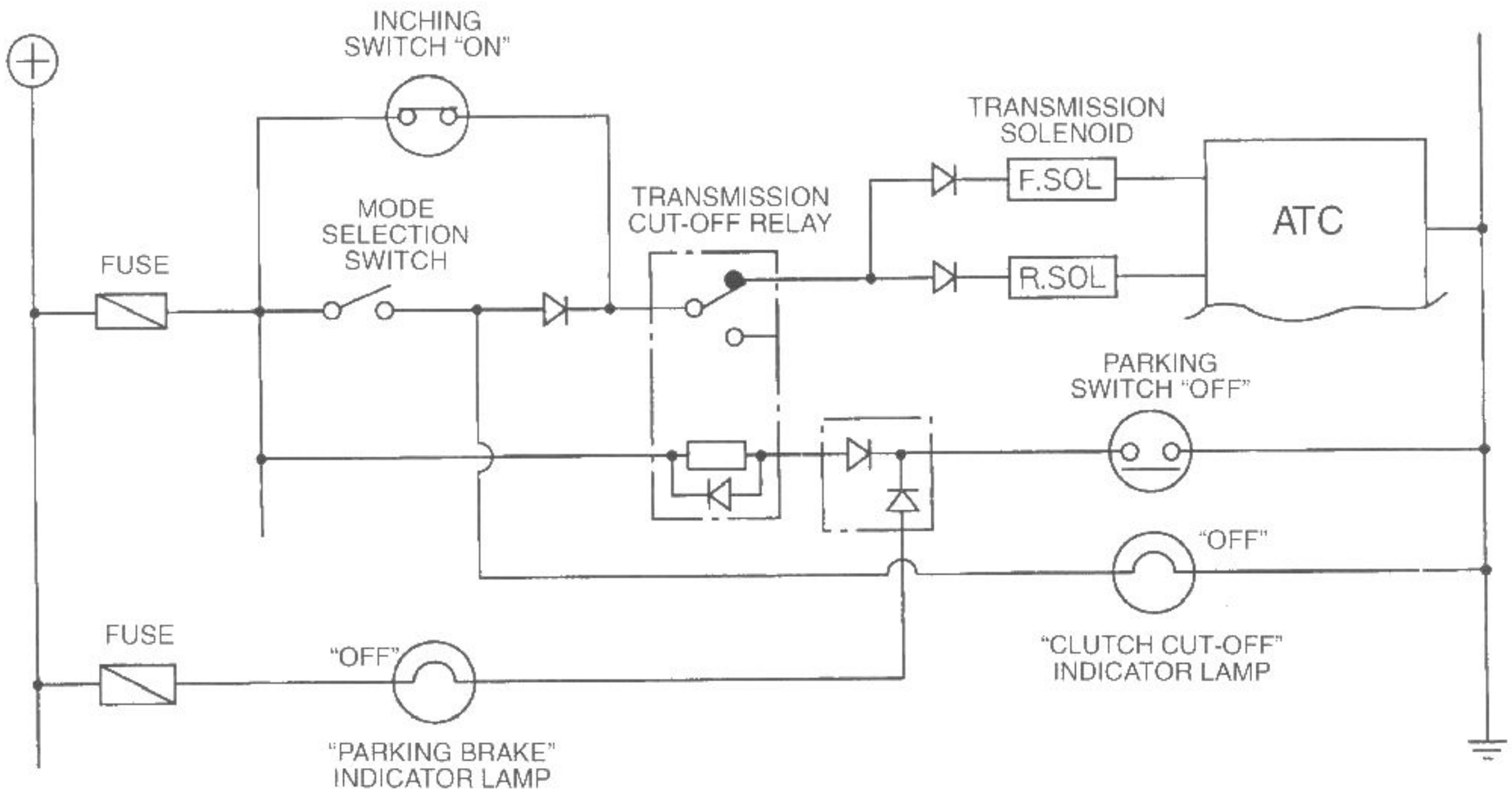
- When the brake is applied, the inching switch is turned off to stop the power supply to the forward and reverse solenoids of the transmission control valve, thus putting the transmission in neutral.
- The loader is equipped with a mode selection switch in the operator's compartment. The inching mechanism (clutch cut-off) is switched over to Traveling or Load handling by operating the switch.

a. Load handling mode with mode selection switch "OFF"

The "clutch cut-off" indicator lamp goes out, indicating that the inching mechanism is in activation. When the brake pedal is pressed, the brake is applied and the inching switch is turned off to put the transmission in neutral. When the brake pedal is released, the inching switch is turned on to link the transmission line again.

b. Traveling mode with mode selection switch "ON"

The "clutch cut-off" indicator lamp turns on, indicating that the inching mechanism is not working. The power supply to the forward and reverse solenoids of the transmission control valve is supplied through the clutch cut-off switch regardless of the inching switch operation. Therefore, when the brake pedal is pressed, the transmission won't shift into neutral.



Note: This diagram shows a circuit with the service brake and the parking brake released.

Fig. 3.3 Inching Circuit Diagram

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Operation

(1) Brake pedal in neutral

① The oil sent from the brake & assist pump is accumulated in the accumulator (1).

② The oil in the accumulator (1) flows through the brake piping to the accumulator port of the brake valve (2).

③ When the brake pedal (3) is in the release state, the brake valve (2) is not in operation. The accumulator port is shut off with a spool in the valve.

④ The brake port to the disk brake (4) is connected to the tank port in the brake valve.
The disk brake is in the release state.

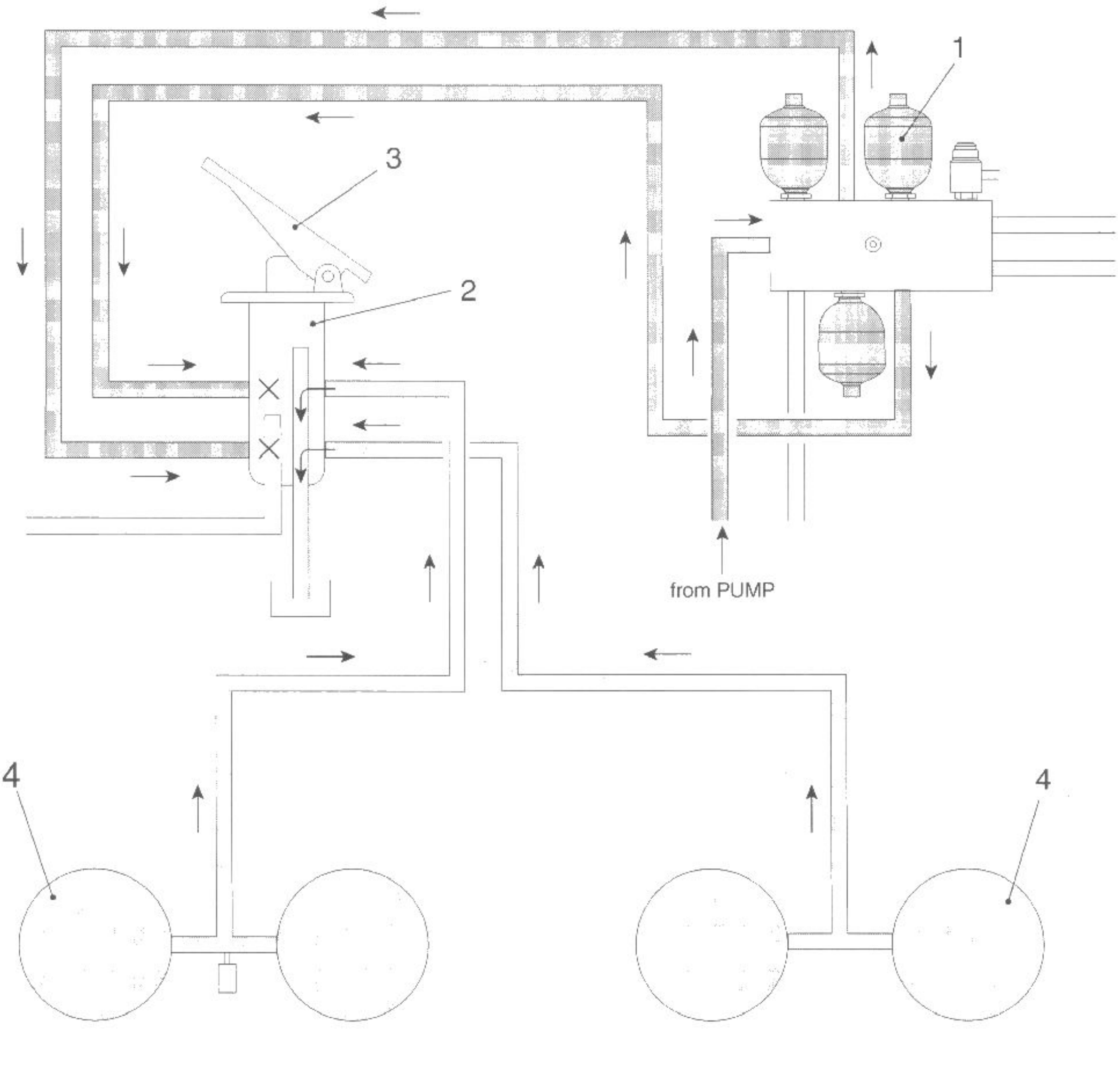


Fig. 3.4 Brake Pedal in Neutral (Release State)

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(2) Brake pedal in operation

① When the brake pedal (3) is depressed, the brake valve (2) is operated to shut off the brake port and the tank port.

Then, the brake port is connected to the accumulator port. The pressurized oil in the accumulator (1) is sent to the disk brake (4) to apply the brake.

② When the brake pedal (3) is released, the brake valve (2) returns in the neutral position. The pressurized oil sent to the disk brake (4) flows through the brake valve (2) and is drained from the tank port. The disk brake gets in the release state. (See. Fig. 3.4)

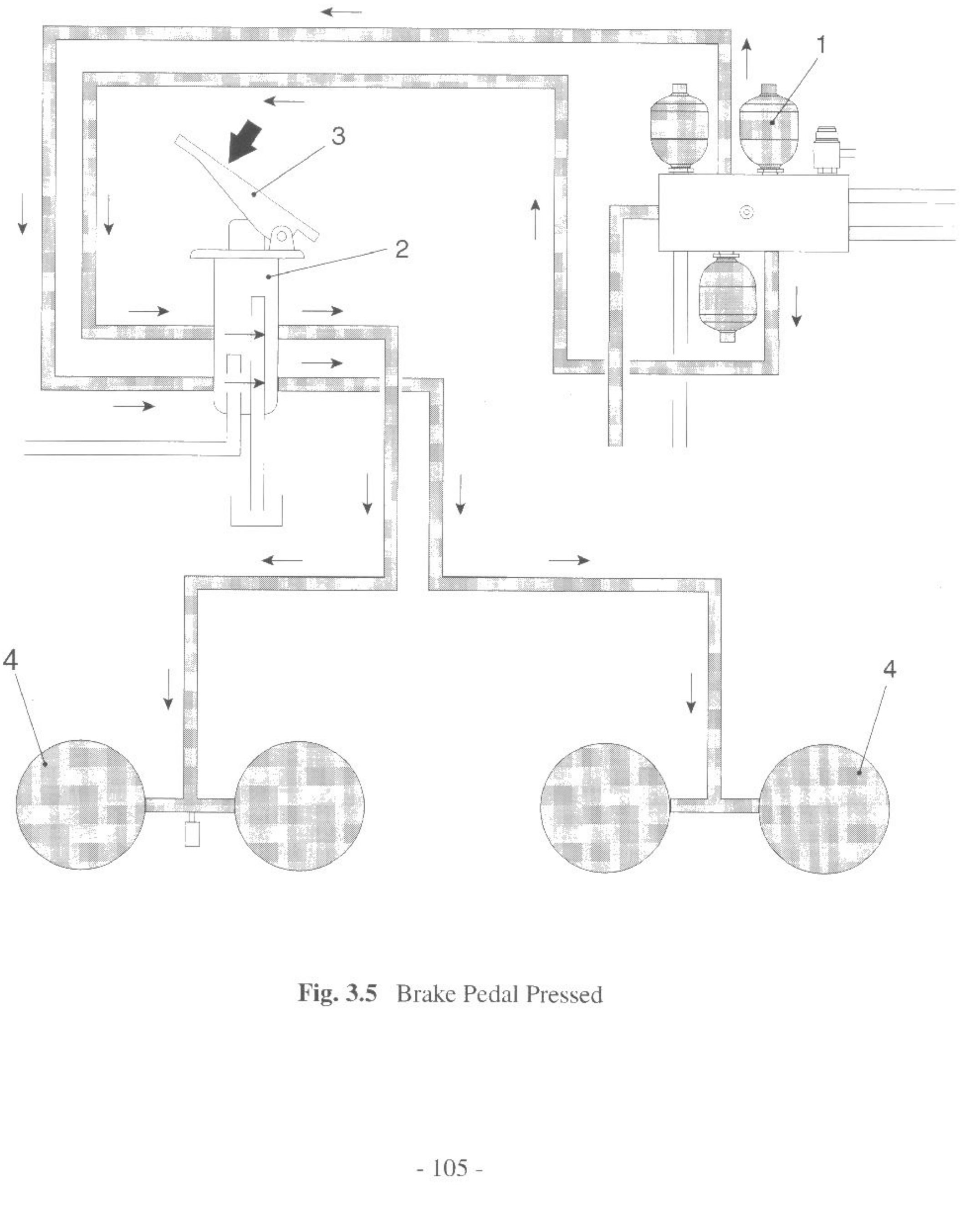


Fig. 3.5 Brake Pedal Pressed

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3.1.2 BRAKE VALVE

The brake valve is a dual type consisting of two independent brake lines: front and rear.

The brake valve has two spools provided in series at the center of the valve body, with each spool having a plunger built in to feed back the brake control oil pressure. In addition, a spring is installed between the spool input and each spool to transmit operation load and stroke to the brake pedal.

Operation

(1) Brake in release state (For the identification numbers of the parts, see Fig. 3.6)

When the brake valve is not actuated, the spools (8, 17) are returned to the release position by the spring (19) and the brake port (B) is connected to the tank port (T).

The accumulator port (A) and the brake port (B) are shut off by the spools so that the oil pressure in the accumulator is kept high.

(2) Brake in operation

① When the brake pedal is pressed, the spool input (14) is pushed through the roller (22). The spool input moves the spools (8, 17) forward through the spring (16).

② When the spools are moved forward, the brake port (B) is blocked off from the tank port (T). When the spools are farther moved forward, the brake port (B) is connected to the accumulator port (A) and the high pressure oil in the accumulator flows from the brake port to start braking operation.

③ The pressurized oil at the brake port side flows through the orifices in the spools and actuates the plungers built in the spools, generating the force pushing back the spools (hydraulic counterforce). The total force of the hydraulic counterforce and the spring (19) load is balanced with the spring (16) load to control the brake oil pressure at the brake port side.

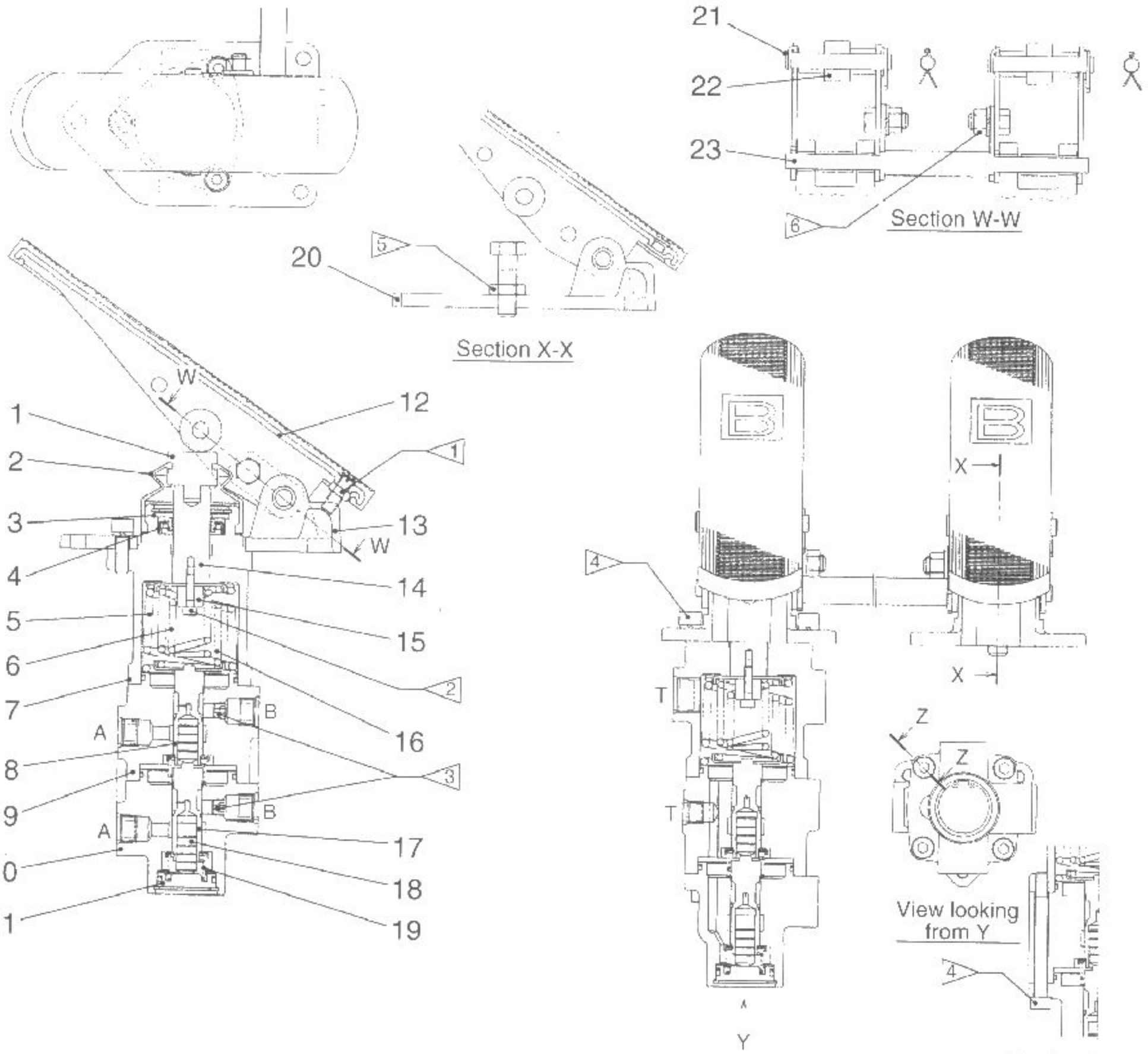
④ The compression and load of the spring (16) are fed back as the stroke and operating force of the brake pedal to give the operator the operating feel of the brake pedal.

(3) When brake is released

① When the operating force of the brake pedal is released, the spool input is pushed back by the spring (5).

② When the compressed spring (16) is released, the spools are returned to the release state by the total force of the counterforce acting on the plunger and the spring (19) force. The brake port (B) and the accumulator port (A) are shut off by the spools, and the brake port is released to the tank port (T). The pressurized oil at the brake port side is drained into the tank port to release the brake operation.

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Note:
1. 7.85 to 11.8 N-m {0.8 to 1.2 kgf-m} [5.8 to 8.7 lbf-ft]
2. 6.86 to 8.83 N-m {0.7 to 0.9 kgf-m} [5.1 to 6.5 lbf-ft]
3. 9.81 to 14.7 N-m {1.0 to 1.5 kgf-m} [7.2 to 10.8 lbf-ft]
4. 19.6 to 25.5 N-m {2.0 to 2.6 kgf-m} [14.4 to 18.8 lbf-ft]
5. 44.1 to 58.8 N-m {4.5 to 6.0 kgf-m} [32.5 to 43.4 lbf-ft]
6. 29.4 to 34.3 N-m {3.0 to 3.5 kgf-m} [21.7 to 25.3 lbf-ft]

A. OIL FEED PORT
B. DISCHARGE PORT
T. TANK PORT

1. SEAT
2. DUST COVER
3. PLATE
4. OIL SEAL
5. SPRING
6. SPRING
7. COVER
8. SPOOL
9. BODY
10. BODY
11. PLUG
12. PEDAL
13. MOUNTING PLATE
14. SPOOL INPUT
15. RETAINER
16. SPRING
17. SPOOL
18. PLUNGER
19. SPRING
20. MOUNTING PLATE
21. PEDAL PIN
22. ROLLER
23. SHAFT

Fig. 3.6 Brake Valve

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3.1.3 DISK BRAKE

The disk brake is wet multiple-plate disk brake and built in the differential body of the drive axle. On the loader, four disk brake units are installed on the 4 wheels, one for each.

For the structure of the disk brake, refer to "2.6 DRIVE AXLE."

Operation

● L27-3, LX130-7

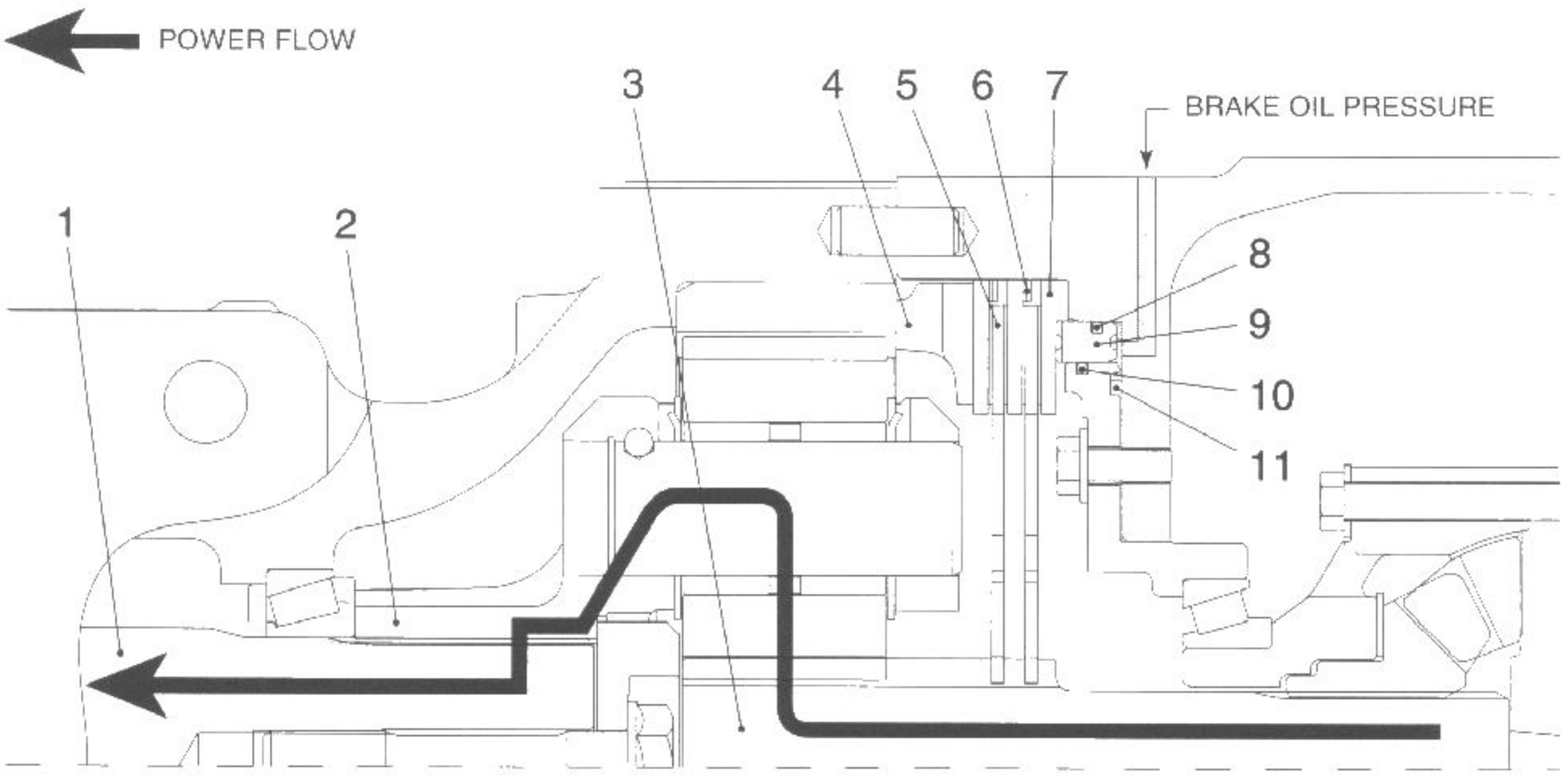
(1) Brake in operation

The brake oil pressure acts on the back of the brake piston, moves the brake piston and locks up the brake disks with the brake rings.

The inner periphery of each brake disk is splined through the disk hub to the shaft in the power transmission line. The outer peripheries of the brake rings are secured to the differential body by pins so that the locked-up brake disks stop rotating to brake the loader.

(2) Brake released

When the brake oil pressure acting on the brake piston is released, the brake piston is returned by the return spring to make the brake disks free, thus releasing the braking force.



1. AXLE SHAFT
2. PLANET CARRIER
3. GEAR & SHAFT
4. END PLATE
5. BRAKE DISK
6. RETURN SPRING
7. BRAKE RING
8. D-RING
9. PISTON
10. D-RING
11. SEAL

Fig. 3.7 Disk Brake Operation (L27-3, LX130-7)

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● L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7

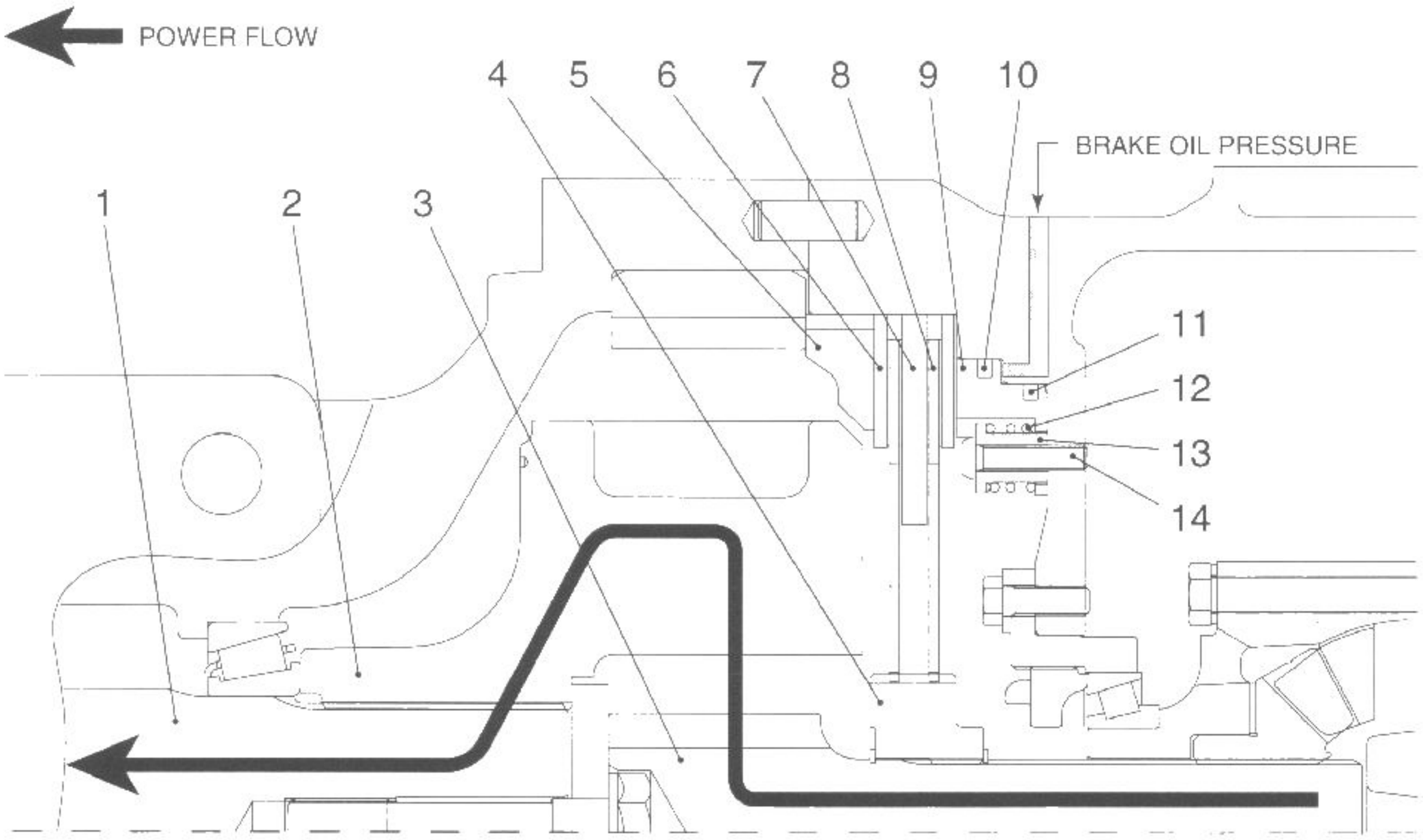
(1) Brake in operation

The brake oil pressure acts on the back of the brake piston, moves the brake piston and locks up the brake disks with the brake rings.

The inner periphery of each brake disk is splined through the disk hub to the shaft in the power transmission line. The outer peripheries of the brake rings are secured to the differential body by pins so that the locked-up brake disks stop rotating to brake the loader.

(2) Brake released

When the brake oil pressure acting on the brake piston is released, the brake piston is returned by the return spring to make the brake disks free, thus releasing the braking force.



1. AXLE SHAFT
2. PLANET CARRIER
3. GEAR & SHAFT
4. DISK HUB
5. END PLATE
6. BRAKE RING
7. BRAKE RING
8. BRAKE DISK
9. PISTON
10. D-RING
11. D-RING
12. RETURN SPRING
13. ADAPTER
14. BOLT

Fig. 3.8 Disk Brake Operation (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

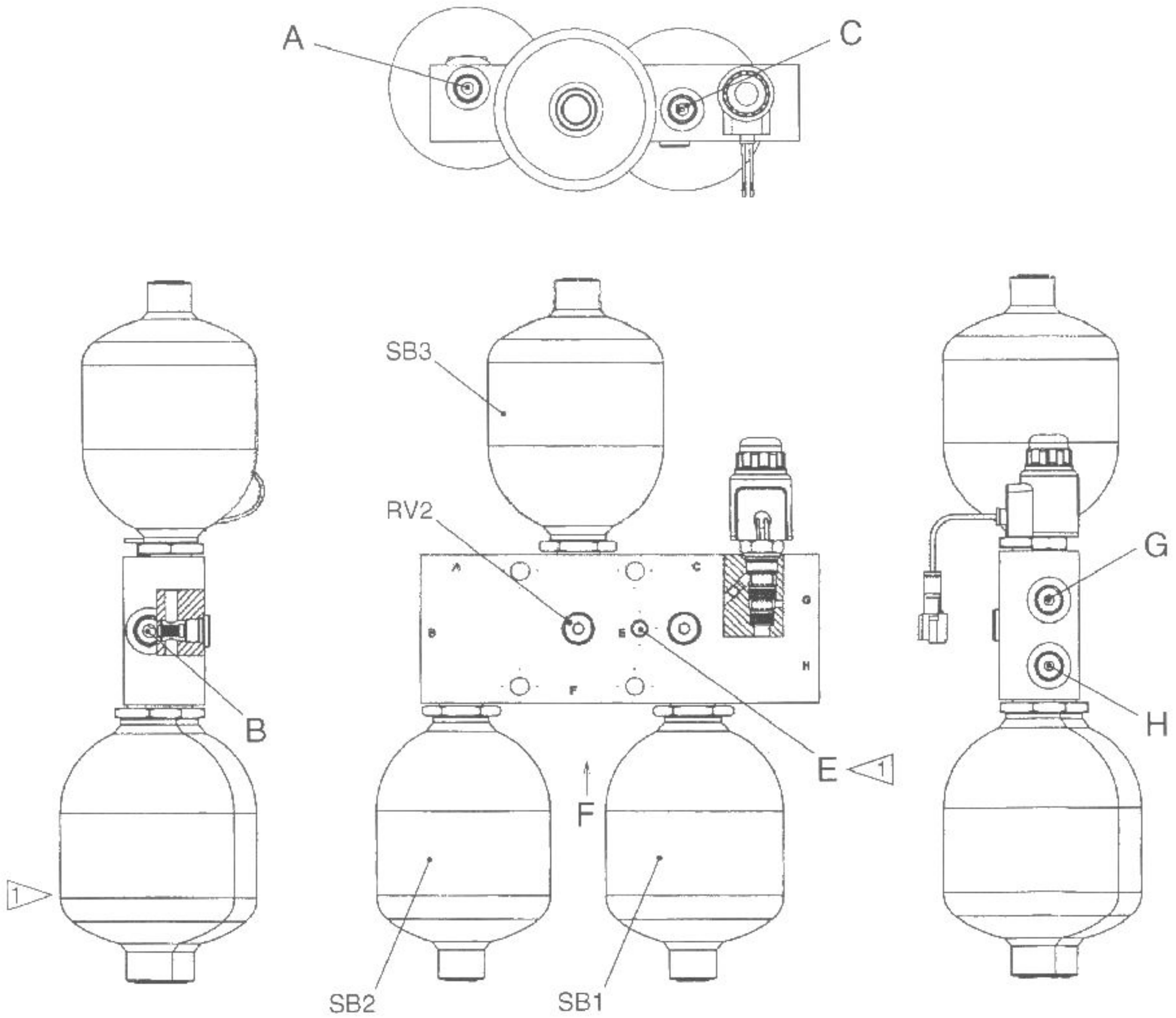
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3.1.4 ACCUMULATOR

The accumulator is installed in order to accumulate the oil pressure for actuating the brake and pilot valve.

Oil sent from the brake and assist pump flows through the line filter. Its oil pressure is adjusted by the charging valve and accumulated in the accumulator.

In addition, the parking brake is incorporated in the accumulator body, and the solenoid valve controls the pressure oil supply to the disk brake.



Note: 1 The parking and pilot pressure should be measured at the pressure switch port. (Make sure to release the brake line pressure before removing the pressure switch.)

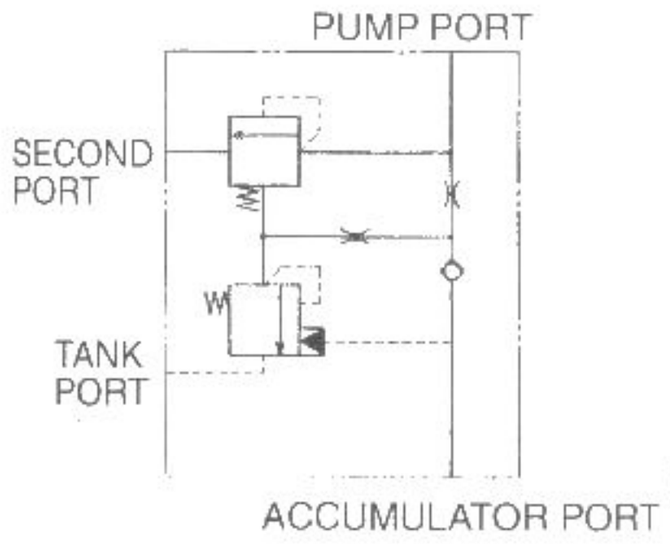
A. DISCHARGE PORT (to STOP VALVE)
B. OIL SUPPLY PORT (from CHARGING PUMP)
C. BRAKE VALVE PORT
E. PRESSURE SWITCH PORT
F. BRAKE VALVE PORT
G. DISCHARGE PORT (to PARKING BRAKE)
H. DISCHARGE PORT (to OIL TANK)

Fig. 3.9 Accumulator

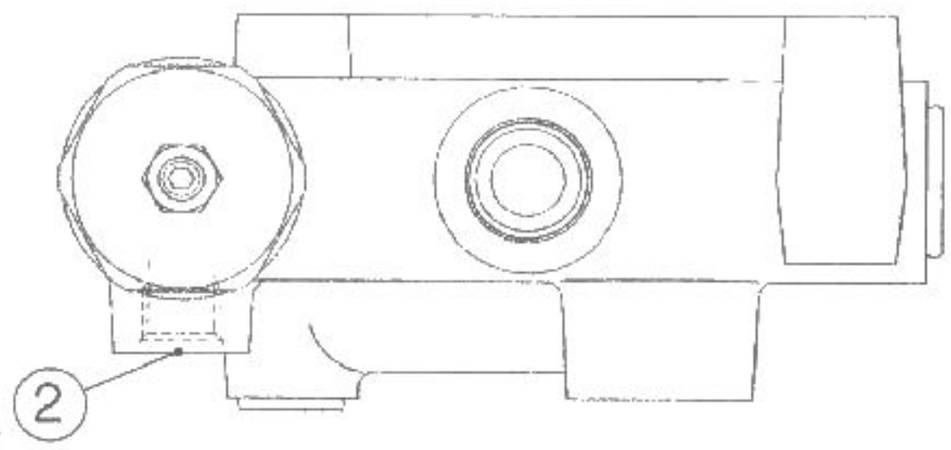
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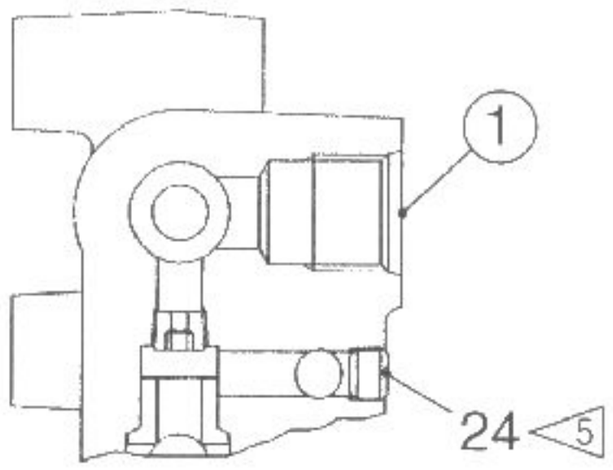
3.1.5 CHARGING VALVE

The service brake line is equipped with the charging valve which controls the flow rate and pressure of oil sent from the pump to the accumulator.

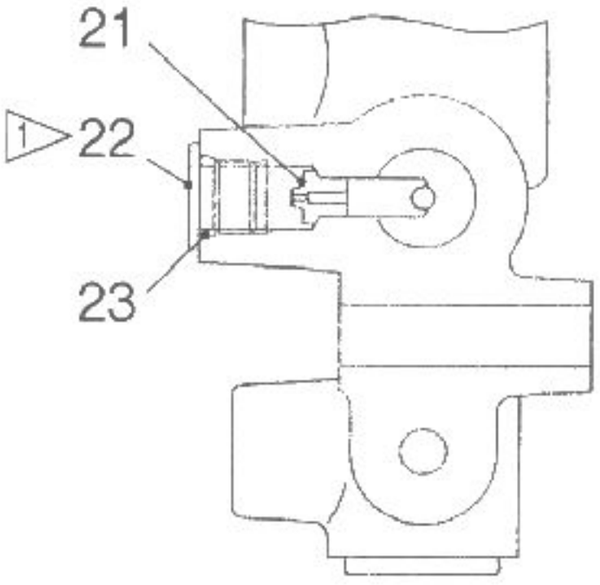


OIL PRESSURE CIRCUIT DIAGRAM

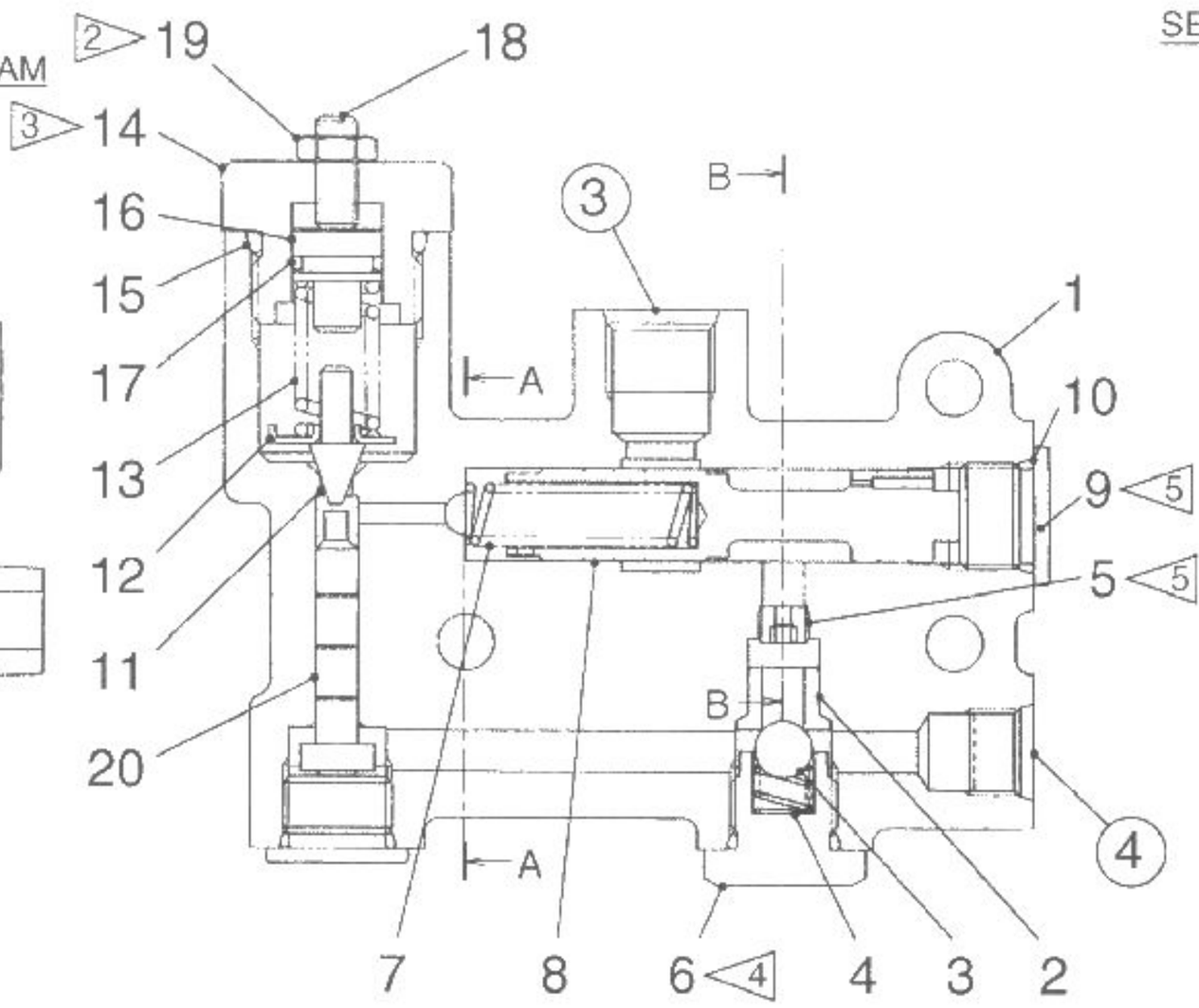


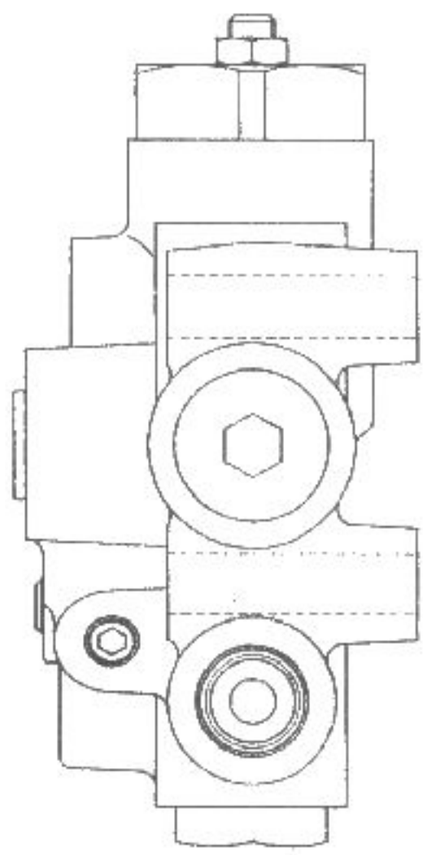


SECTION B-B



SECTION A-A





Note: 1 29.4 to 39.2 N-m {3 to 4 kgf-m} [21.7 to 28.9 lbf-ft]
2 11.8 to 16.7 N-m {1.2 to 1.7 kgf-m} {8.7 to 12.3 lbf-ft]
3 118 to 137 N-m {12 to 14 kgf-m} [87 to 101 lbf-ft]
4 49 to 83.4 N-m {5 to 8.5 kgf-m} [36 to 61 lbf-ft]
5 9.8 to 14.7 N-m {1 to 1.5 kgf-m} [7.2 to 10.8 lbf-ft]

1. VALVE BODY
2. VALVE SEAT
3. STEEL BALL
4. SPRING
5. ORIFICE
6. PLUG
7. SPRING
8. SPOOL
9. PLUG
10. "O"-RING
11. PILOT VALVE
12. SPRING SEAT
13. SPRING
14. PLUG
15. "O"-RING
16. SEAT
17. "O"-RING
18. SCREW
19. NUT
20. PLUNGER
21. ORIFICE
22. PLUG
23. "O"-RING
24. PLUG

① from PUMP
② to TANK
③ to OIL COOLER (SECOND PORT)
④ to ACCUMULATOR

Fig. 3.10 Charging Valve

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Structure

The charging valve has a pump port, second port (leading to the oil cooler), accumulator port and drain port. It also incorporates the spool (8) that controls the pump port and the second port, the orifice (5) that prioritizes the flow rate of oil to the accumulator, check valve, and the pressure governing mechanism that controls the oil pressure at the check valve and the accumulator port side.

Operating principle

When the charging valve is not in operation, the spool (8) is kept in its home position by the spring (7) to block the pump port and the second port.

The oil that flows through the pump port passes through the orifice (5) to the accumulator port, thus increasing the oil pressure at the accumulator port.

Any excess oil flow moves the spool (8) toward the second port side to be drained through the second port.

The pressurized oil at the accumulator port flows, passing through the orifice (21), into the pressure governor. When the oil pressure at the accumulator increases enough to overcome the spring (13) force acting on the pilot valve (11), the pilot valve (11) opens to stop the pressure increase at the accumulator port (cut-out pressure).

At this time, the oil pressure at the accumulator port is maintained by the check valve. In addition, the oil pressure at the accumulator port pushes up to plunger governor (20) to keep the pilot valve (11) open. When the oil pressure at the accumulator port drops, the plunger governor (20) is pushed back by the spring (13) force action on the pilot valve (11), to close the pilot valve (11). This allows the oil pressure at the accumulator port to increase again (cut-in pressure).

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3.2 PARKING BRAKE

Manual releasing of parking brake (as an emergency measure) ⚠

If the parking brake cannot be released with the parking brake knob due to a defective pump or for any other reason, manually move the brake piston by using the parking brake release bolt to release the parking brake.

⚠ **Manually releasing the parking brake should not be abused. It should be limited to a disabled loader needing to be moved to an out-of-traffic area. If the parking brake needs to be released with the loader parked on a slope, be sure to block the wheels.**

Manually releasing the parking brake

① Remove the parking brake release bolt (1) from the parking brake cap of the transmission.
② Remove the plug (2) from the center of the cap.

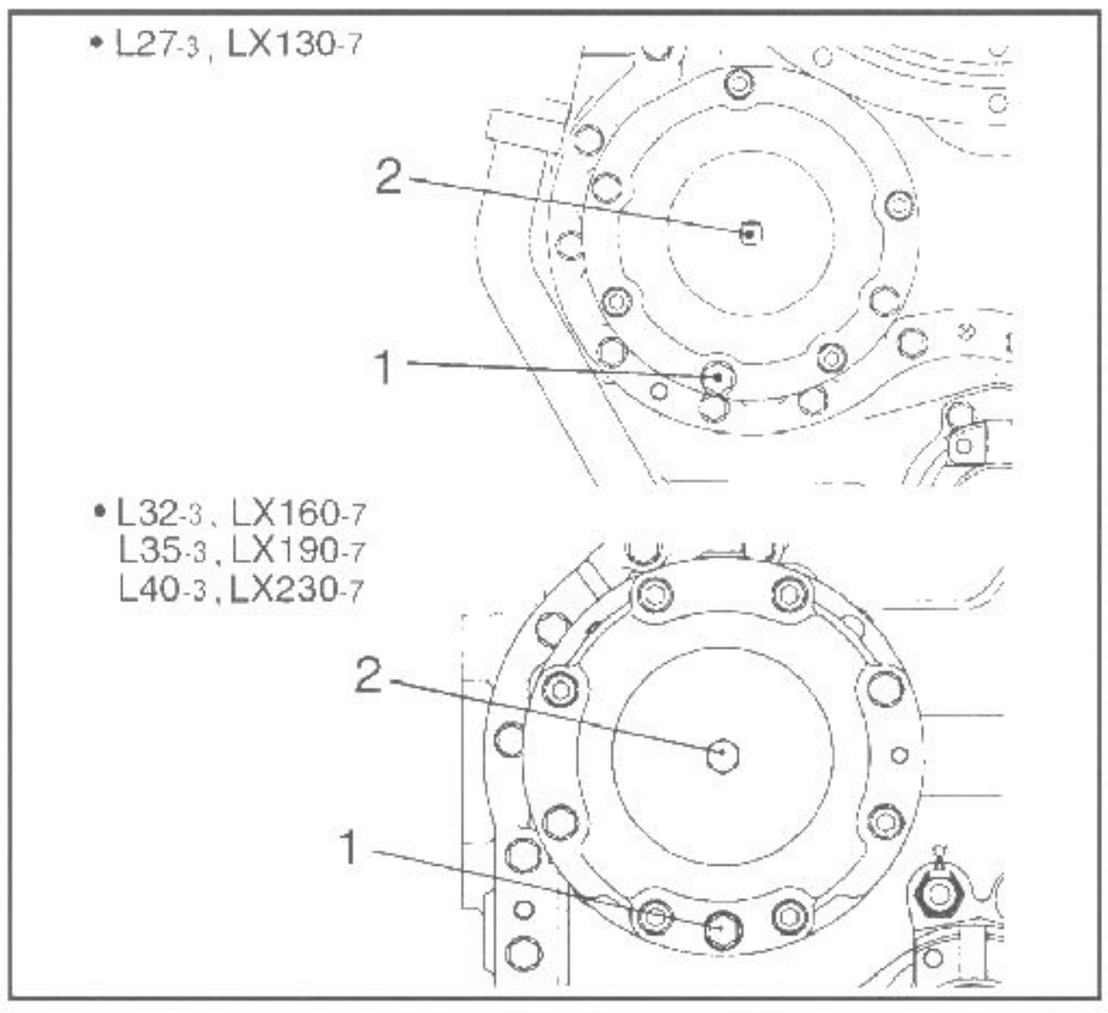


Fig. 3.11

③ Insert the removed bolt (1) through the plug hole from where the plug was removed in step ②, into the screw hole at the center of the brake piston (3) as shown in Fig. 3.12.
④ Tighten the release bolt (1) to withdraw the brake piston (3), thus releasing the disk brake.

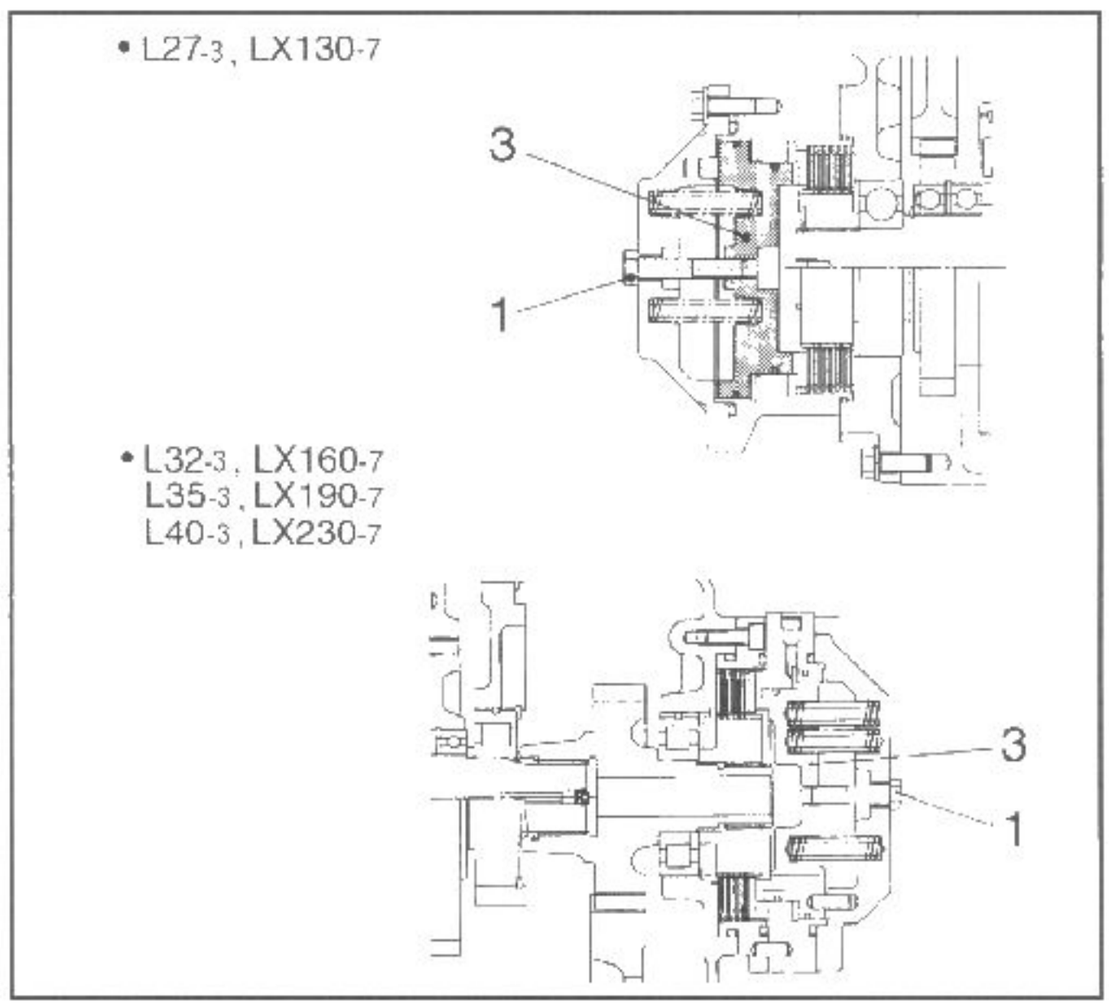


Fig. 3.12

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3.2.1 GENERAL DESCRIPTION (BRAKE LINE)

The parking brake is a mechanical (spring), wet multiple-plate disk brake and installed on the 1st/2nd clutch shaft of the transmission.

The parking brake is operated with the parking brake switch in the operator's compartment.

Operation

(1) Releasing parking brake

① When the parking brake switch (1) is turned OFF, the pressure oil from the accumulator (4) flows through the parking brake valve (3) into the front chamber (A) of the brake piston (8).

② The brake piston moves against the spring (7) by oil pressure to release the disk brake (9).

Note: The parking brake cannot be released unless an adequate pressure oil is stored in the accumulator. If the main switch is turned off during travelling, the parking brake will be applied. Do not turn OFF the main switch during traveling except in an emergency situation. Abusing the emergency brake might cause the malfunction of the parking brake.

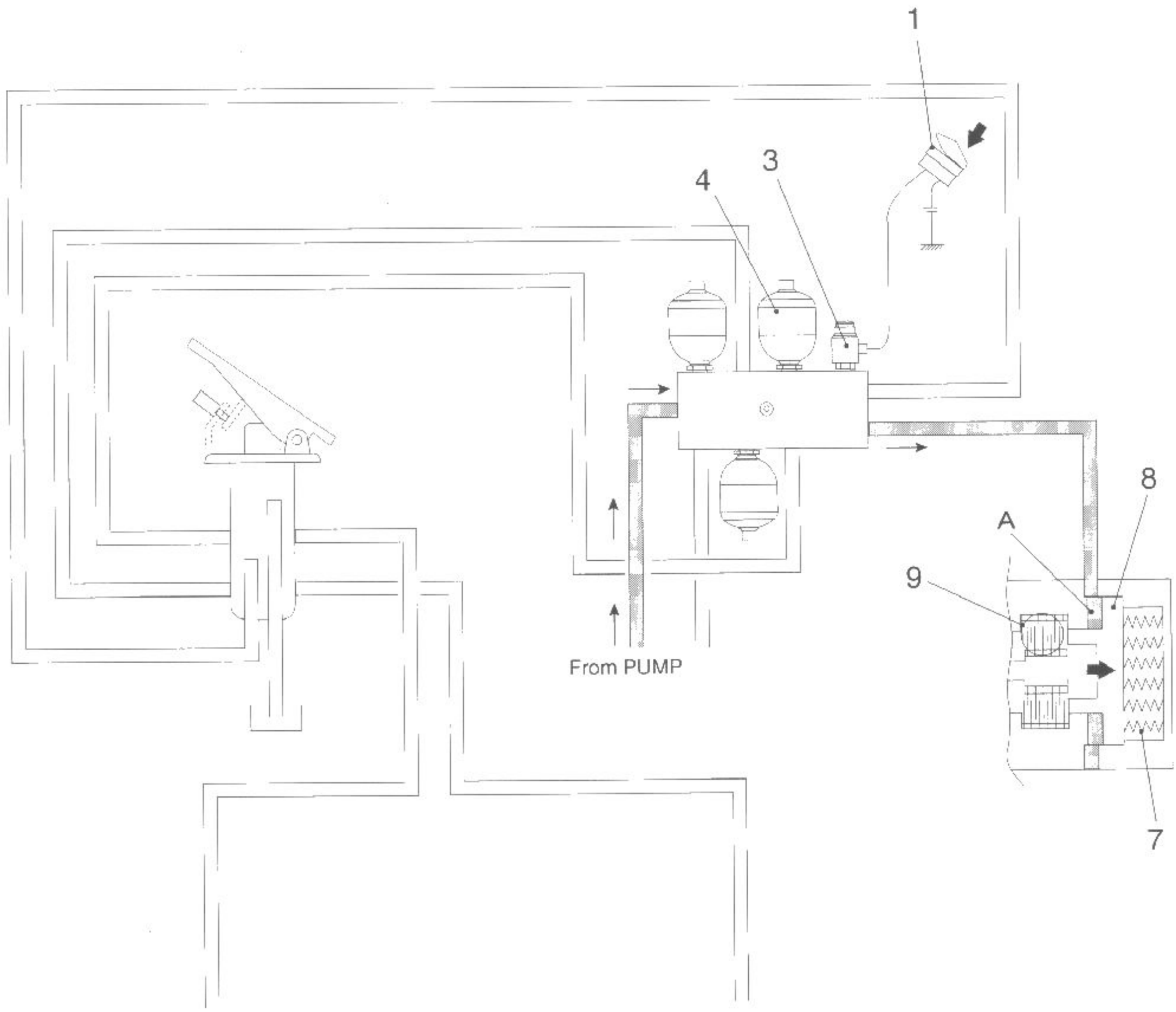


Fig. 3.13 Releasing Parking Brake

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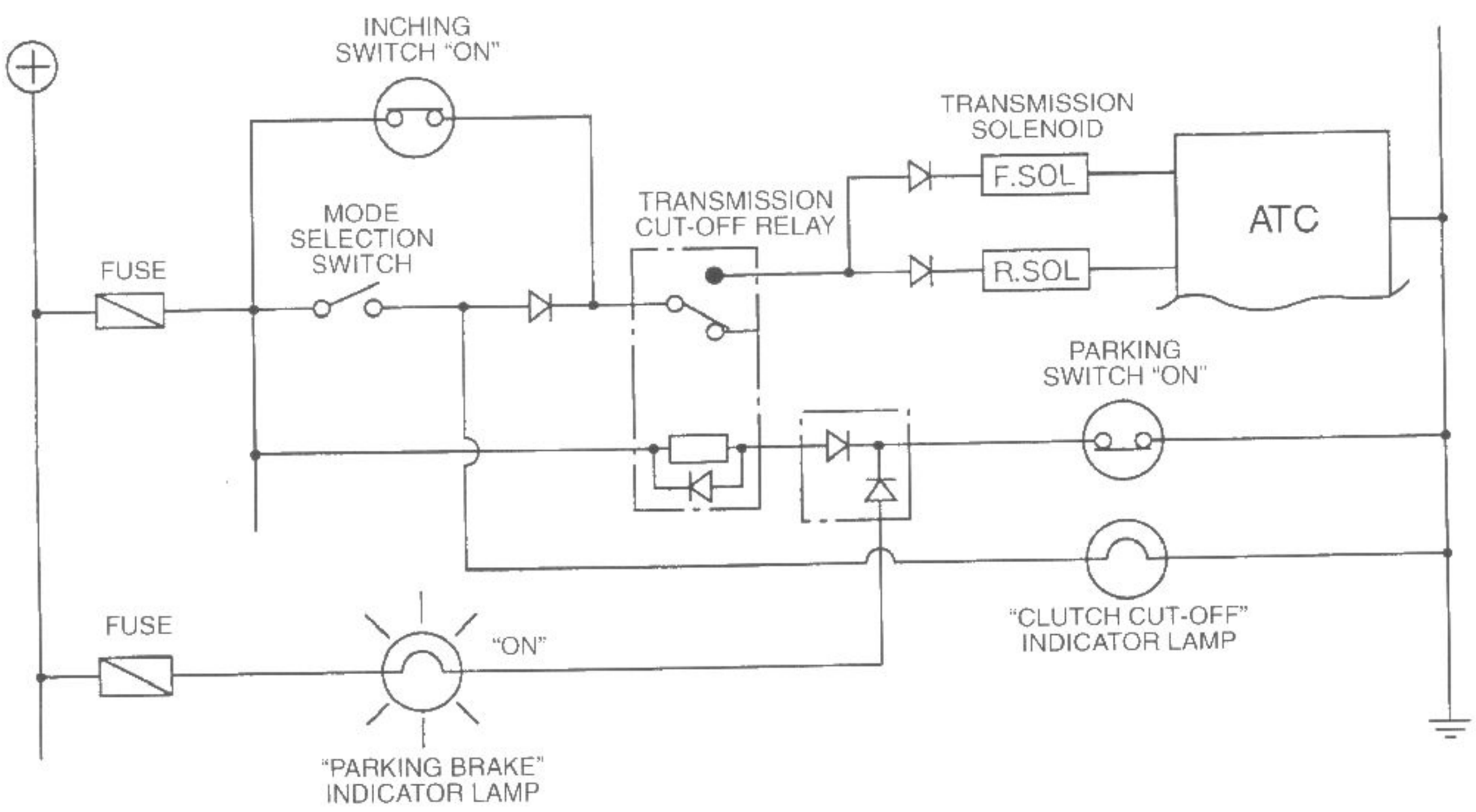
(3) Transmission clutch cut-off

a. When parking brake is applied:

① When the parking brake is applied, the oil pressure acting on the brake piston is drained. The pressure switch (parking switch) installed on the piston housing turns on to change over the transmission cut-off relays.

② The power supply to the forward and reverse solenoids of the transmission control valve is cut off so that the transmission is put in neutral. (transmission clutch cut-off)

③ The "parking brake" indicator lamp circuit is closed and the lamp comes on.



Note: This diagram shows a circuit with the service brake released and the parking brake applied.

Fig. 3.15 Electric Circuit Diagram

b. When parking brake is released:

① When the parking brake is released, the oil pressure is produced to act on the brake piston. The parking switch is turned off and the transmission cut-off relay returns to the original condition.

② The power supply to the forward and reverse solenoids of the transmission control valve is restored to make it possible to shift the transmission.
The "parking brake" warning lamp goes out.

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3.2.2 DISK BRAKE

The disk brake is a wet multiple-plate type and installed on the 1st/2nd clutch shaft of the transmission. The disk brake is actuated by the built-in spring and released by the pressure oil from the parking brake valve.

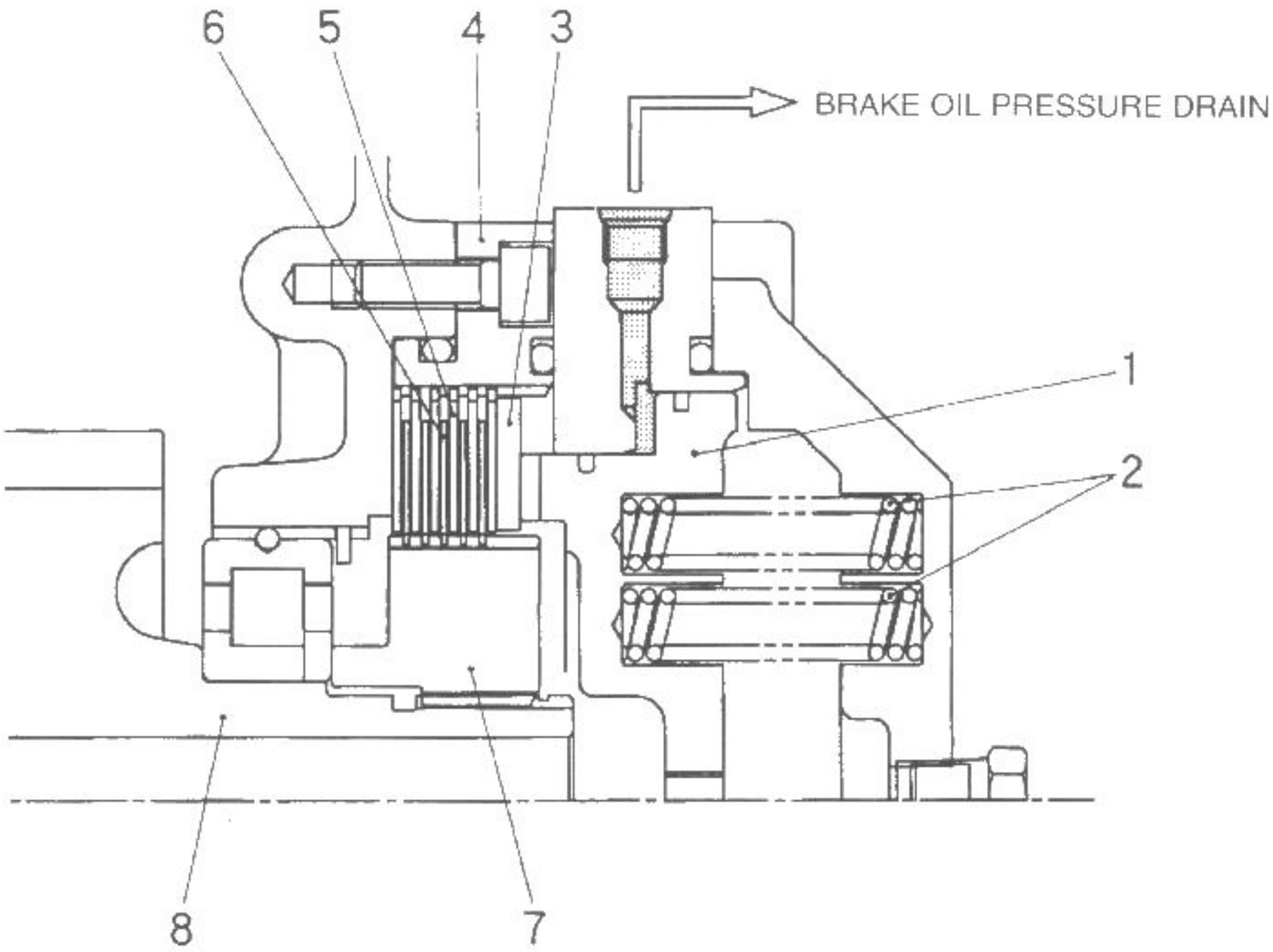
For the structure of the disk brake, refer to "2.1 DRIVE UNIT."

Operation

(1) Disk brake in operation

① When the pressure oil acting on the brake pistons is drained, the brake piston is moved by the spring force to lock up the brake disks with the brake plates.

② The inner diameters of the brake disks are meshed with the transmission shaft through the disk hub. The outer diameters of the brake plates are meshed with the brake housing. As the brake disks are forced against the brake plates, they stop rotating. This in turn stops the rotation of the transmission shaft through the disk hub, thus braking the loader.



1. BRAKE PISTON
2. SPRING
3. END PLATE
4. BRAKE HOUSING
5. BRAKE PLATE
6. BRAKE DISK
7. DISK HUB
8. 1ST/2ND SHAFT

Note: The sketch shows the disk brake of the L32-3, LX160-7 to L40-3, LX230-7.

Fig. 3.16 Disk Brake in Operation

(2) Releasing Brake

① When the pressure oil is sent to the back of the brake piston, the brake piston overcomes the spring force and shifts its position.

② A clearance is created between each brake disk and brake plate to make the brake disks free, thus releasing the brake.

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NOTE

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4A. STEERING SYSTEM

(L27-3, LX130-7 · L32-3, LX160-7)

Type	Frame-articulating type
Mechanism	Orbitrol type
Frame articulating angle	40° to right and left
Number of rotations of steering wheel	4.8
Power steering	
Model	Orbitrol (LUAUHSD)
Type	Separate type
Pressure setting	22.6 MPa {230 kgf/ cm^2} [3271 psi]
Steering pump	Used also as main pump[1]
Steering cylinder	
Type	Double-acting piston
Quantity	2
Cylinder stroke	422 mm [16.6 in.]
Weight (per cylinder)	33 kg [72.8 lbs]

Note: 1) For the specifications and structure of the main pump, refer to "6.2 PUMP."

4A.1 GENERAL DESCRIPTION

The steering system is a frame-articulating type which steers the loader by operating the two steering cylinders between the front and rear frames.

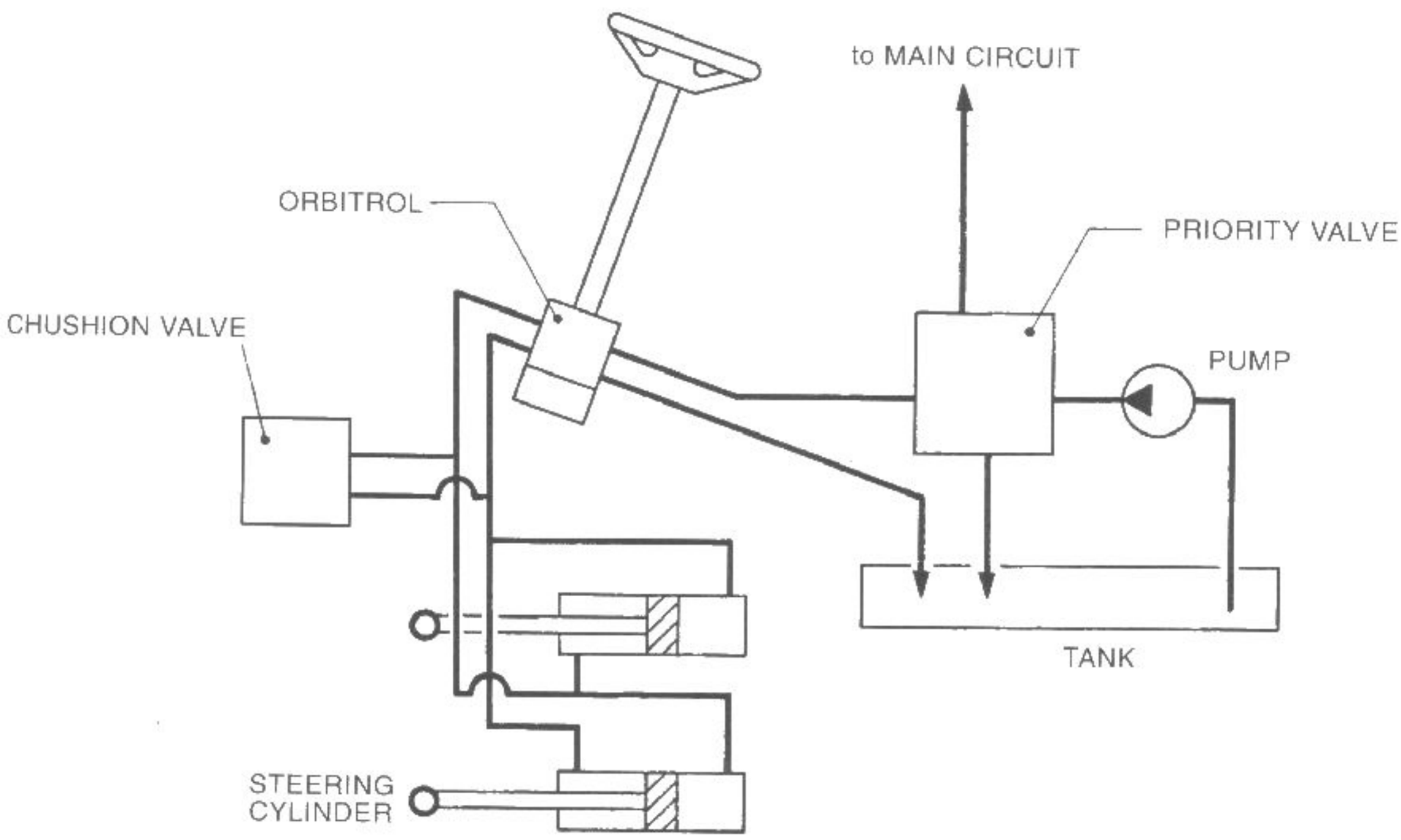


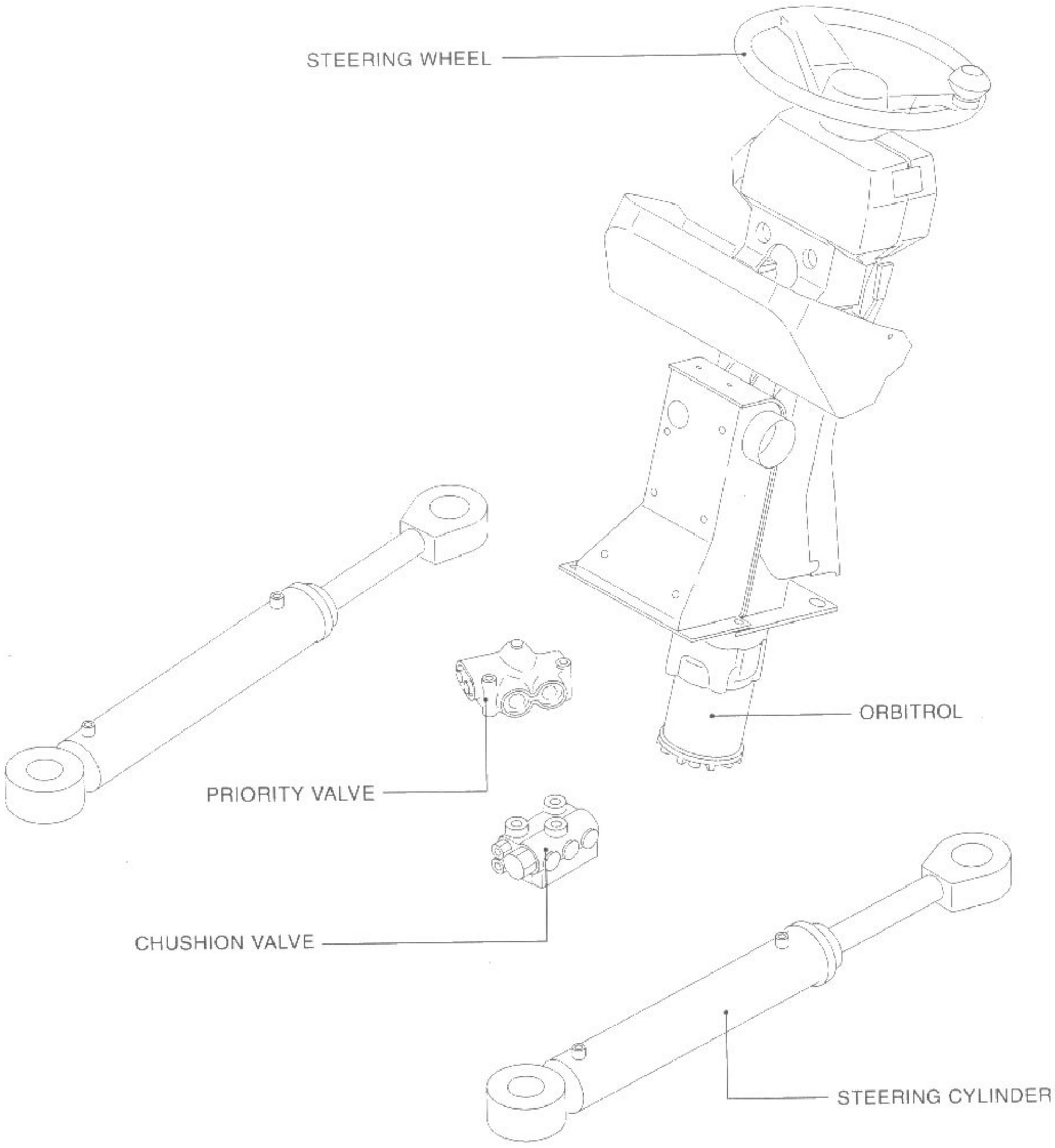
Fig. 4A.1 Orbitrol Type Steering System

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The steering mechanism is orbitrol type (full-hydraulic power steering) which does not use any linkage mechanism, but operates on hydraulic power alone.

The steering system consists of the steering wheel unit, orbitrol, priority valve, chushion valve, steering cylinders and hydraulic piping.

⚠ If the pressure oil is not supplied from the pump for any reason such as when the engine stalls, the orbitrol acts as a manual steering system, thus making it possible to steer the loader. However, note that steering operation is considerably harder than usual.



Note: The above sketch does not illustrate the hydraulic piping.
For the hydraulic piping, refer to "6. HYDRAULIC SYSTEM."

Fig. 4A.2 Steering System

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4A.2 OIL CIRCULATION ROUTES

The oil picked up from the oil tank by the steering pump is sent under pressure to the priority valve where it is divided into two portions: one for the main hydraulic circuit and one for the steering hydraulic circuit.

The steering hydraulic circuit uses the load sensing system which lets the steering hydraulic circuit take priority over the main circuit so that the orbitrol receives the necessary amount of oil from the priority valve, with the residual amount of oil being sent to the main circuit.

When the steering wheel is turned, the oil is sent into one steering cylinder. The oil discharged from the other steering cylinder returns into the orbitrol from which it returns into the oil tank.

Note: For the operation of the load sensing system, refer to "4A.5 PRIORITY VALVE."

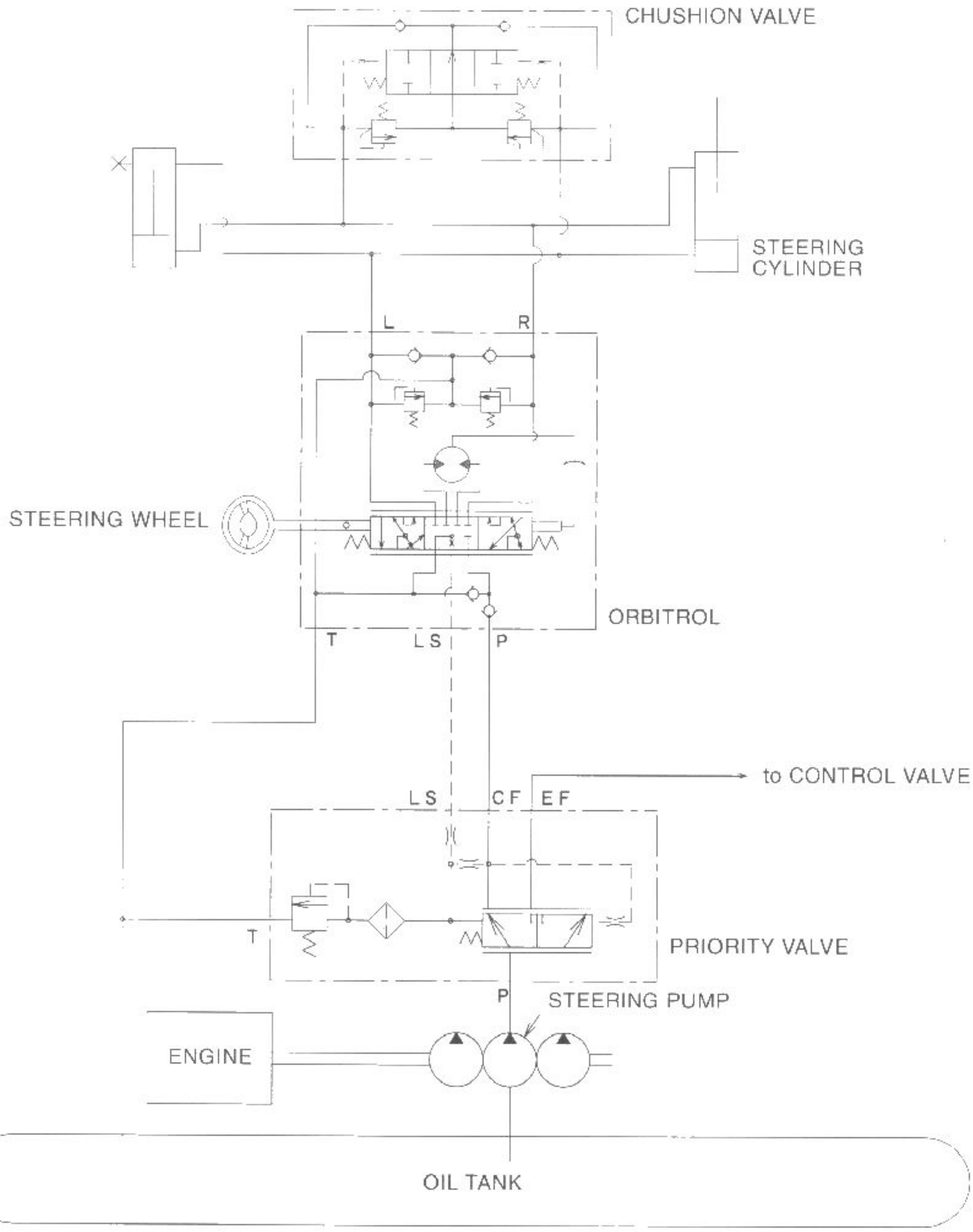


Fig. 4A.3 Hydraulic Circuit Diagram

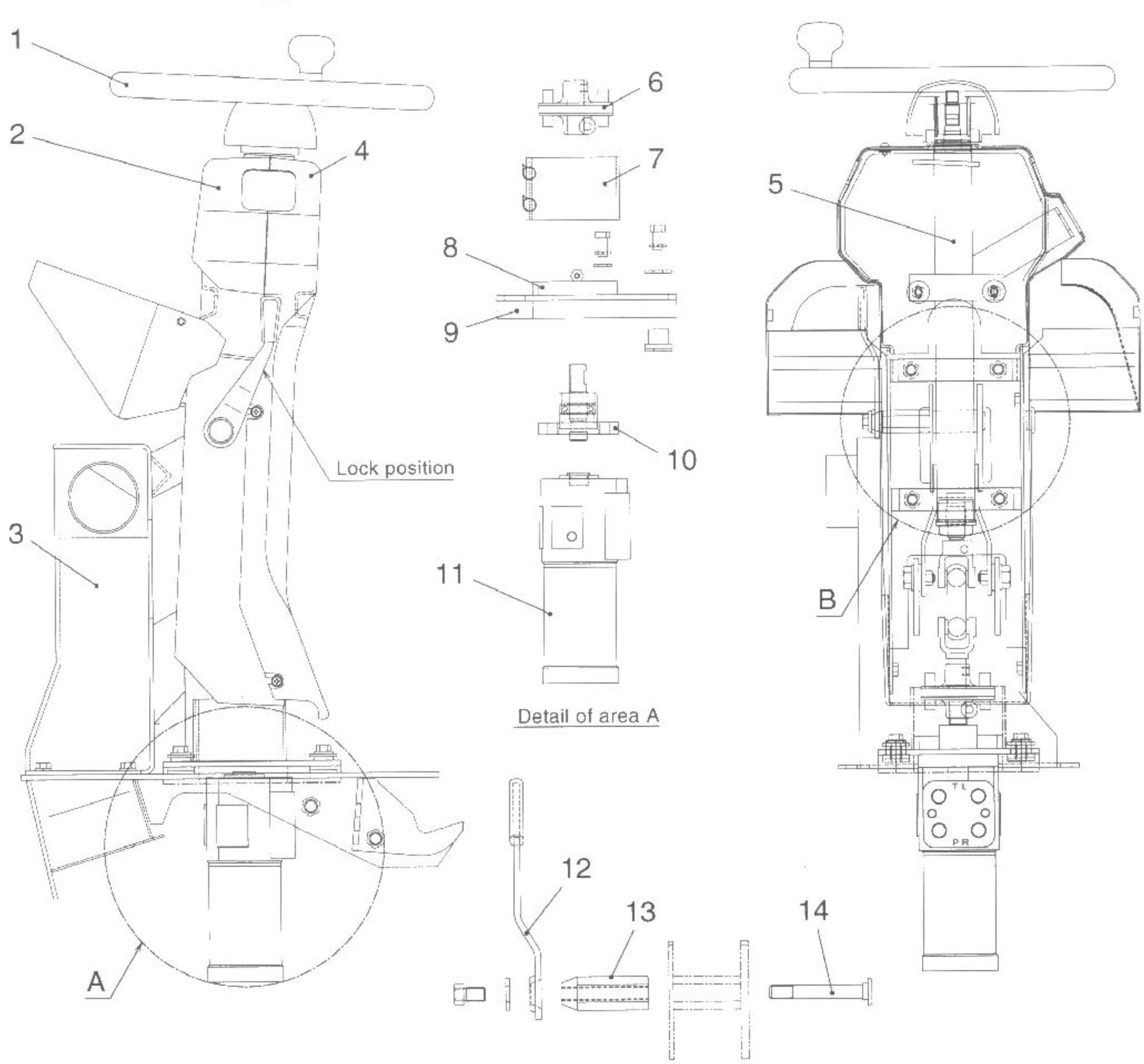
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4A.3 STEERING WHEEL UNIT

The steering wheel unit consists of the steering wheel, steering column assembly, and steering valve (orbitrol).

When the steering wheel is turned, the rotation of the steering wheel is transmitted through the steering column assembly to actuate the orbitrol.

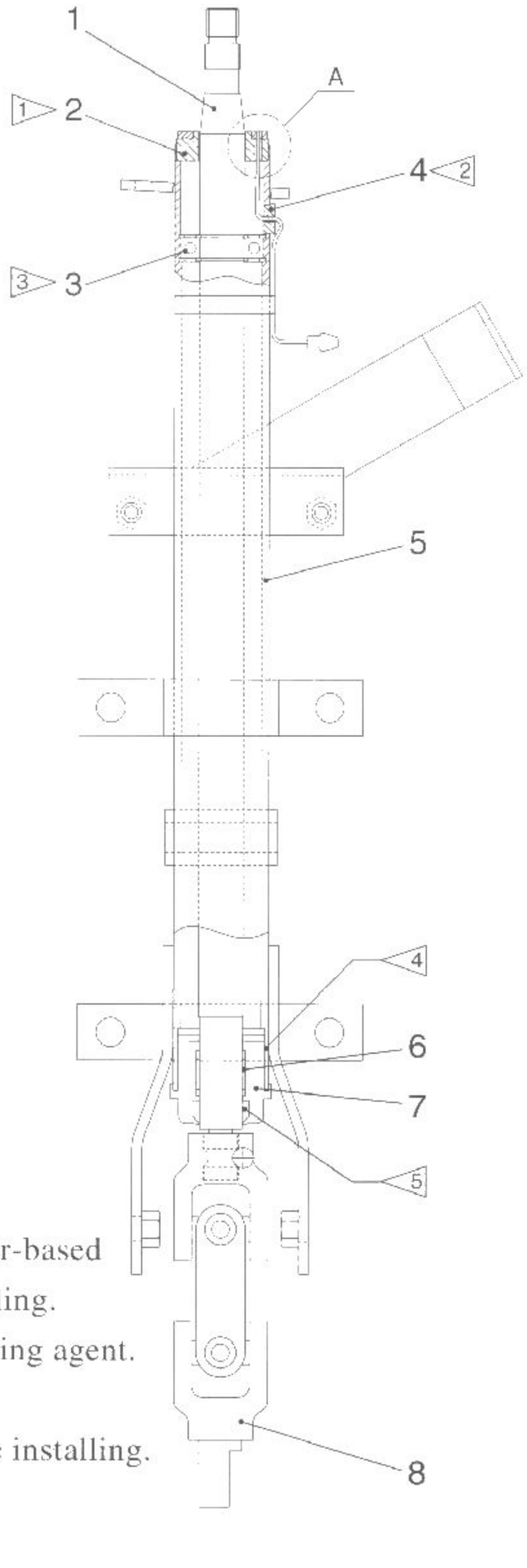
The steering wheel is a tiltable type which can be tilted back and forth.

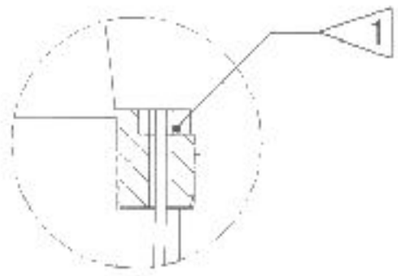


1. STEERING WHEEL
2. STEERING COLUMN POST COVER
3. STEERING COLUMN SUPPORT
4. STEERING COLUMN POST COVER
5. STEERING COLUMN ASSEMBLY
6. NOISE ISOLATOR
7. RUBBER
8. BRACKET
9. MAT
10. COLUMN ASSEMBLY
11. ORBITROL
12. TILT LEVER
13. NUT
14. LOCK BOLT

Fig. 4A.4 Steering Wheel Unit

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Detail of area A

Note:
1. Apply synthetic-rubber-based adhesive before installing.
2. Apply waterproof sealing agent.
3. Apply grease.
4. Apply adhesive before installing.
5. Fill grease.

1. SHAFT
2. BUSHING
3. BEARING
4. GROMMET
5. COLUMN
6. BUSHING
7. COLUMN BUSHING
8. JOINT

Fig. 4A.5 Steering Column

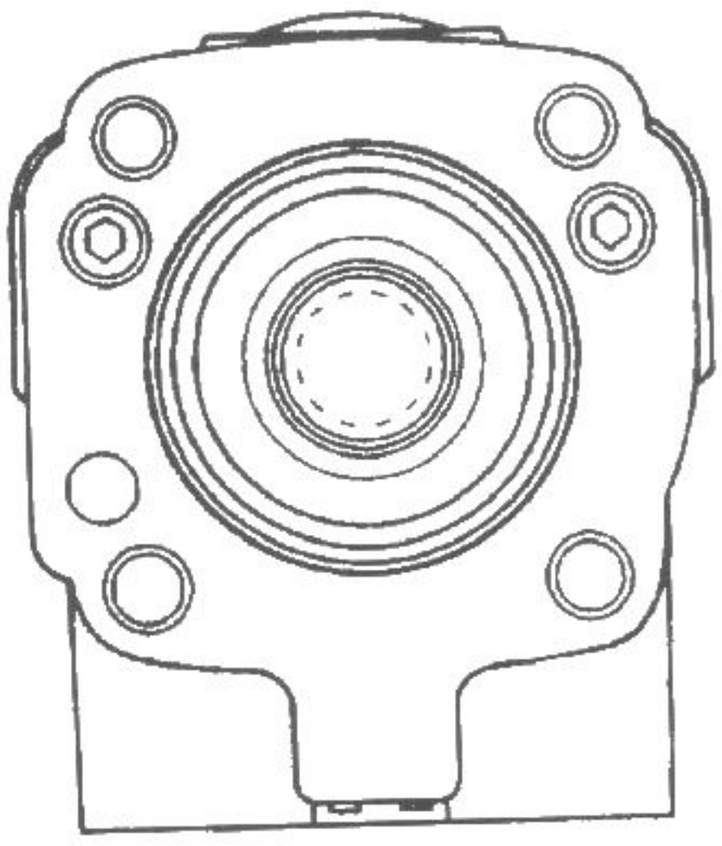
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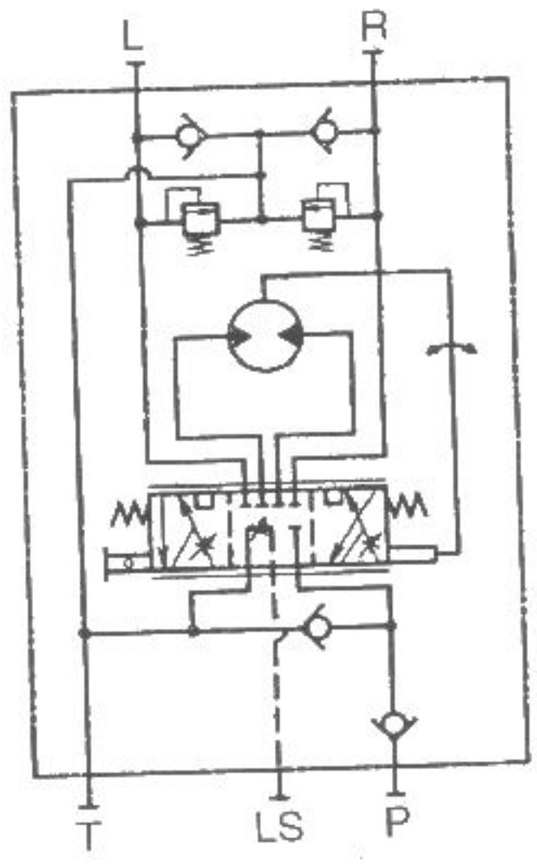
4A.4 STEERING VALVE (ORBITROL)

The orbitrol consists of the control valve section and the rotor set section.

The control valve is a rotary valve type which changes over the oil passages by rotating itself, to steering cylinders.

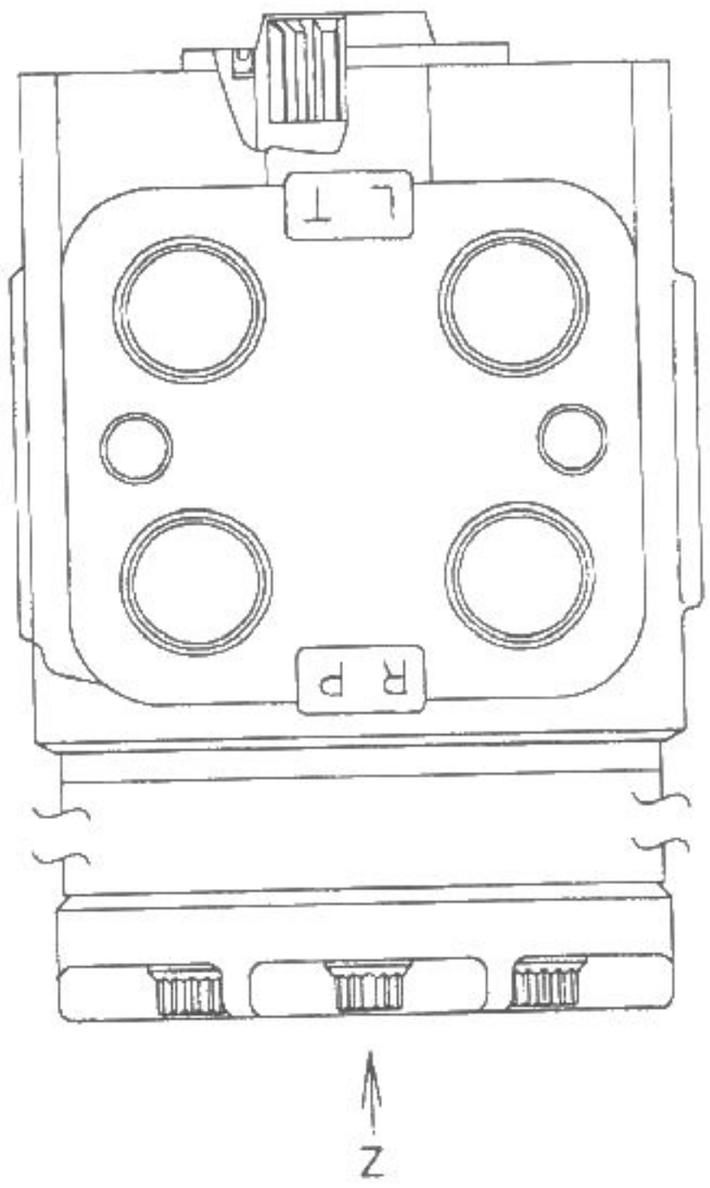
The rotor set is located under the control valve. Usually, it acts as an oil motor to perform metering function. In an emergency, it is used as a hand pump and acts as a manual steering unit.

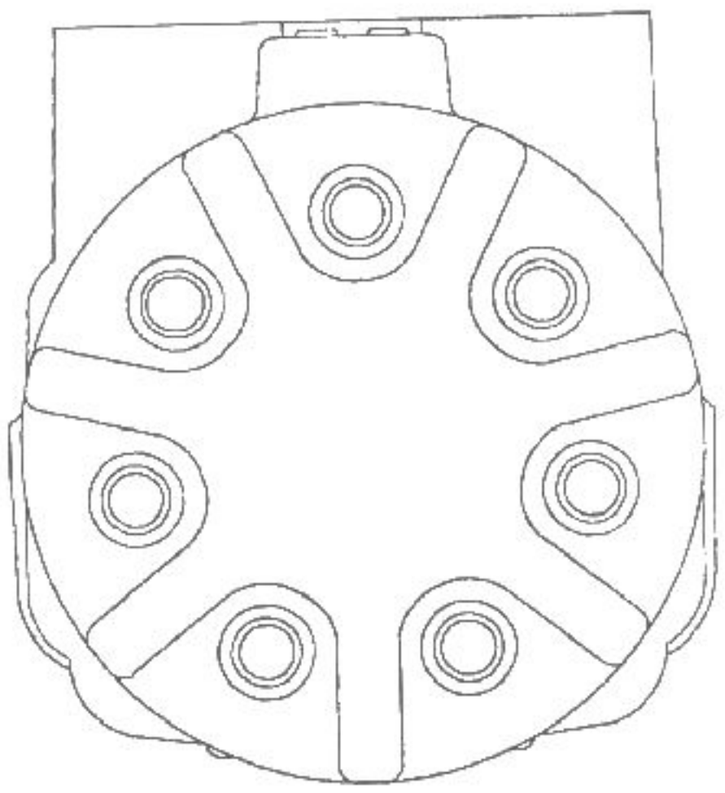




(Circuit diagram)

L,R: CYLINDER PORT
P : PUMP PORT
T : TANK PORT
LS : LOAD SENSING PORT

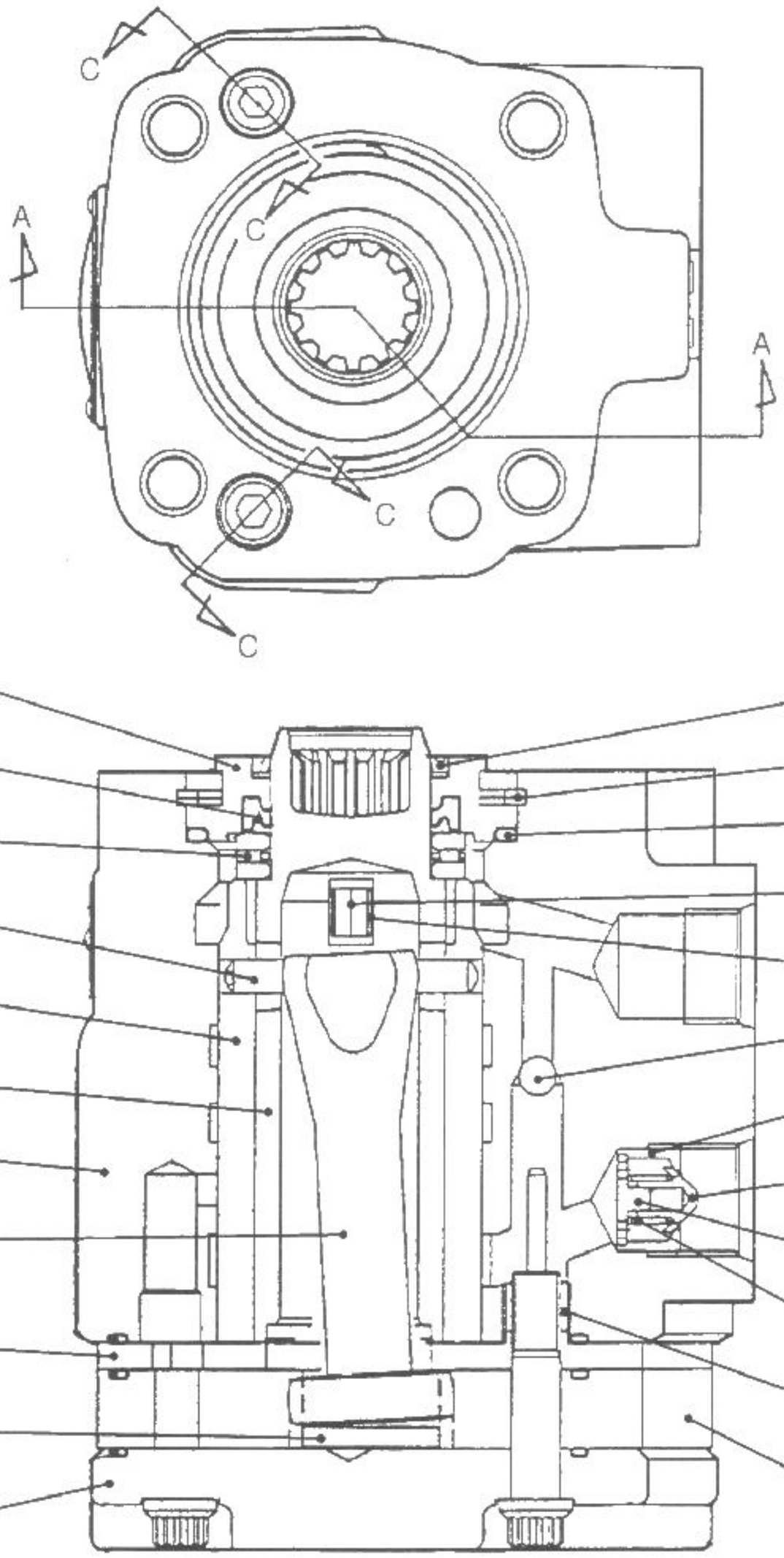




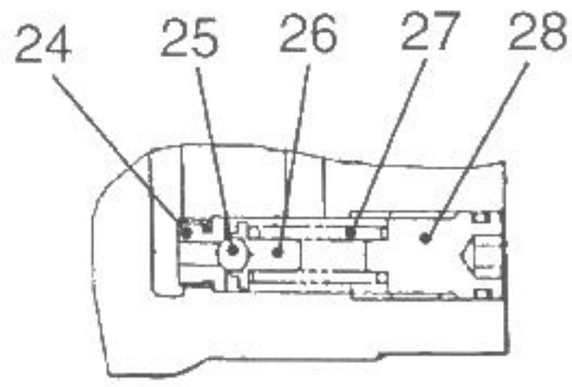
View looking from Z

Fig. 4A.6 Orbitrol

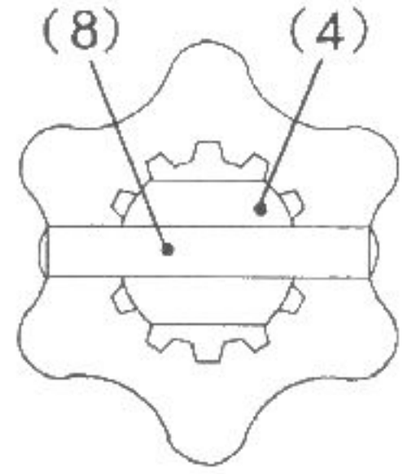
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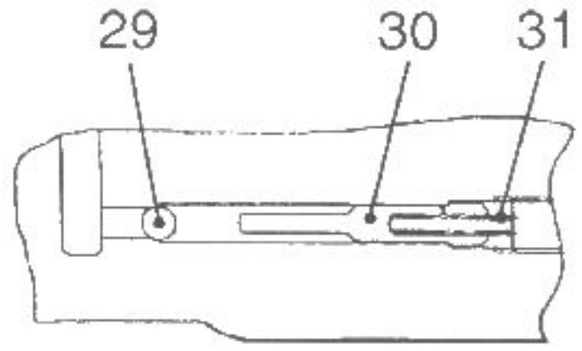
Section A-A



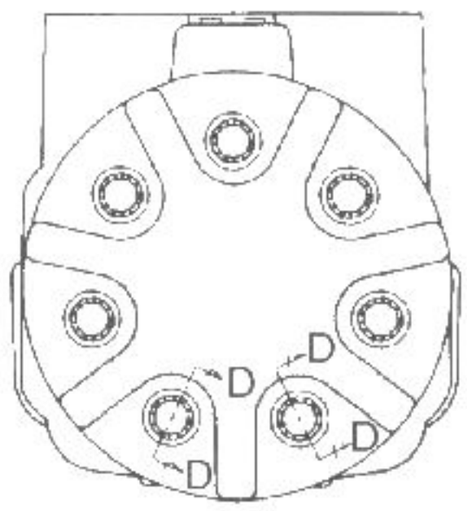
Section C-C



Detail of area B
(Gerotor star mounting position)



Section D-D



1. END CAP
2. SPACER
3. SPACER PLATE
4. DRIVE
5. HOUSING
6. SPOOL
7. SLEEVE
8. PIN
9. NEEDLE BEARING
10. OIL SEAL
11. SEAL GLAND BUSHING
12. DUST SEAL
13. RETAINING RING
14. "O"-RING
15. FLAT SPRING
16. CENTERING SPRING
17. BALL
18. CHECK VALVE BODY
19. CHECK VALVE POPPET
20. GUIDE
21. SPRING
22. ADAPTER SCREW
23. GEROTOR
24. VALVE SEAT
25. BALL
26. HOLDER
27. SPRING
28. PLUG
29. BALL
30. RETAINER PLUG
31. SPRING

Fig. 4A.7 Orbitrol Structure

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ORBITROL OPERATION

(1) Steering Wheel in Neutral

The oil from P port flows into the cavity between the spool (2) and drive shaft (3) through the small openings of the sleeve (1) and the spool (2). The oil in the cavity flows out from the T port through the upper part of the drive shaft, and notch groove of the spool and sleeve. The R and L ports (cylinder ports) are closed by the spool.

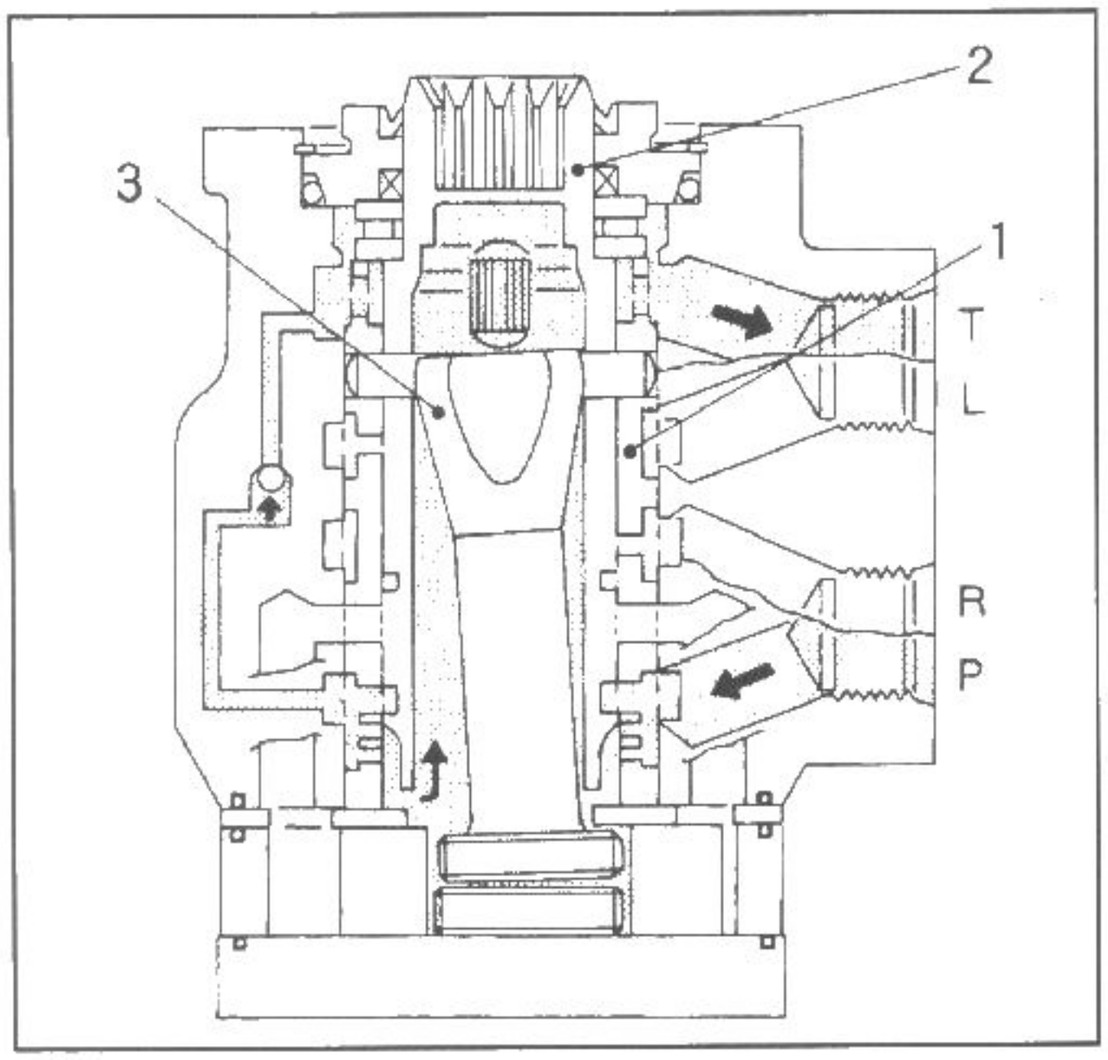


Fig. 4A.8 Neutral State

(2) Turning Steering Wheel Counterclockwise

When the steering wheel is turned, counterclockwise, the spool (2) is rotated with respect to the sleeve (1) to close the neutral flow passage (small openings).

The oil from the P port passes through the changed over sleeve openings, spool groove and sleeve openings and is sent to the rotor set section through the oil passage of the housing (4) to rotate the rotor (5).

The oil discharged by rotation of the rotor is sent to the control valve section and then flows from the L port into the steering cylinder through the sleeve and spool.

The oil discharged from the steering cylinder returns to the R port and flows out from the T port through the sleeve and spool.

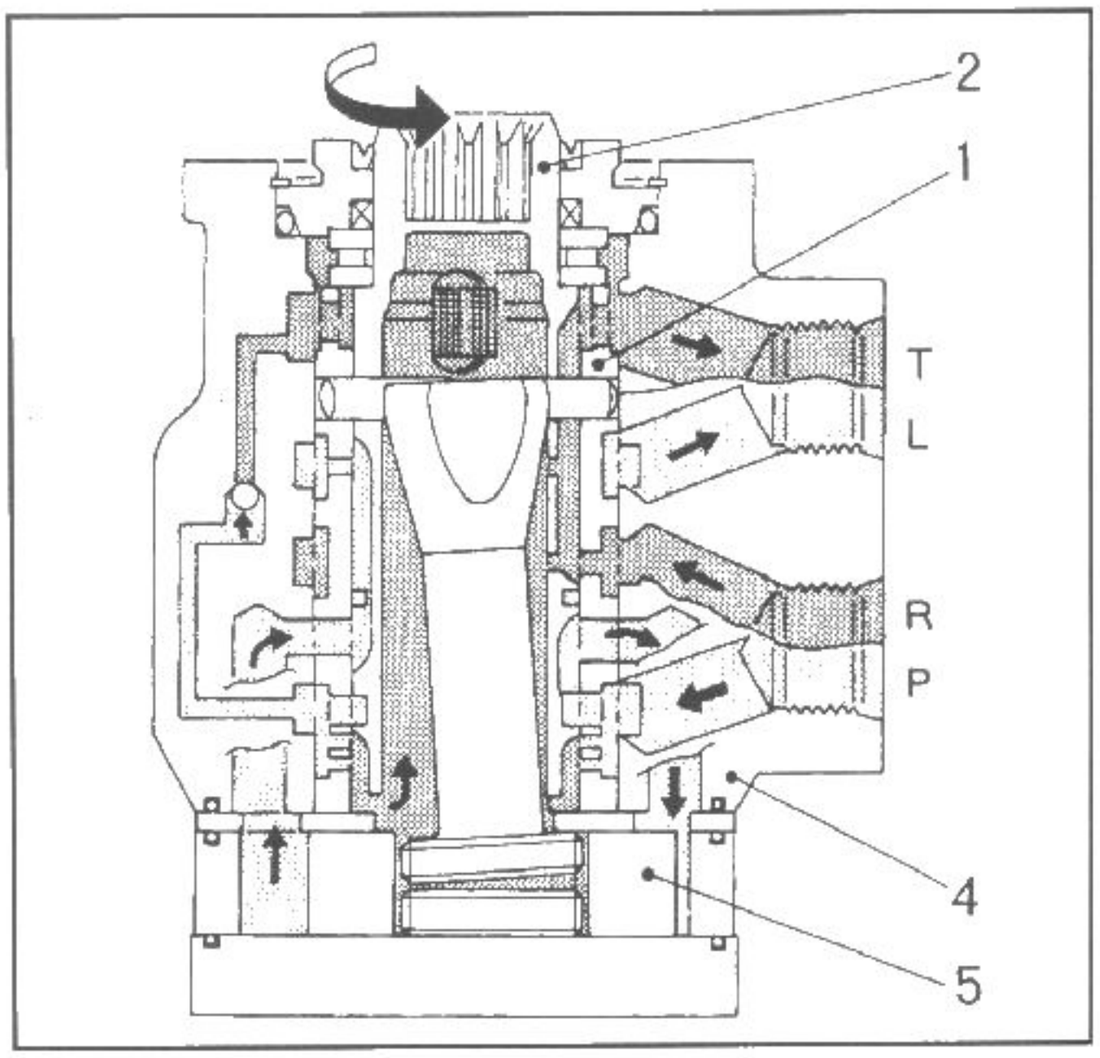


Fig. 4A.9 Counterclockwise Rotation

Note: When the rotor rotates, the drive shaft and the sleeve rotate together. Namely, if the steering wheel is turned to rotate the spool, the sleeve is also rotated equally, thereby nullifying spool displacement. Consequently, the rotor is rotated, corresponding to the rotation angle of the steering wheel, and the oil displaced by the rotor is sent to the steering cylinder. In actual steering the following motion of rotor to steering wheel is executed continuously.

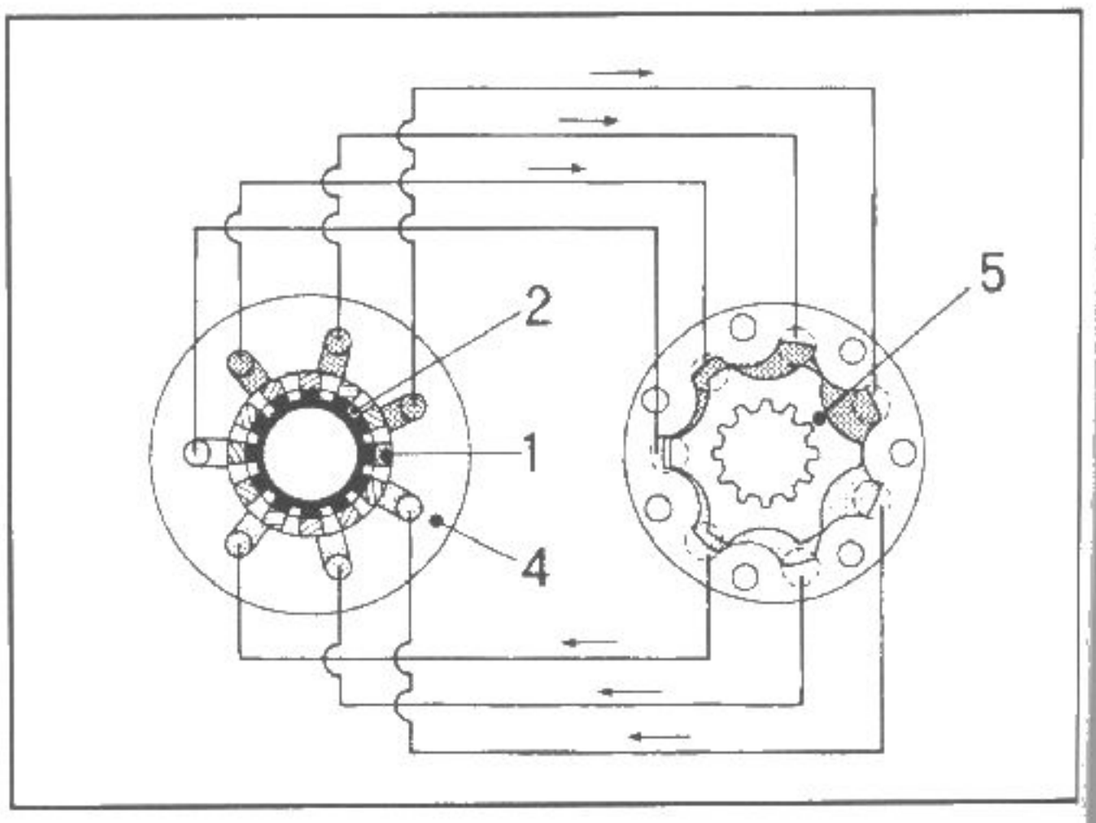


Fig. 4A.10 Rotor Set Section in Operation

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(3) Turning Steering Wheel Clockwise

When the steering wheel is turned clockwise, the rotor rotates in a direction opposite to direction of rotor rotated when the steering wheel is turned counterclockwise, thereby inversing oil intake and discharge by the rotor.

The oil flows from the R port into the steering cylinders, and the oil discharged from the steering cylinder returns to the L port.

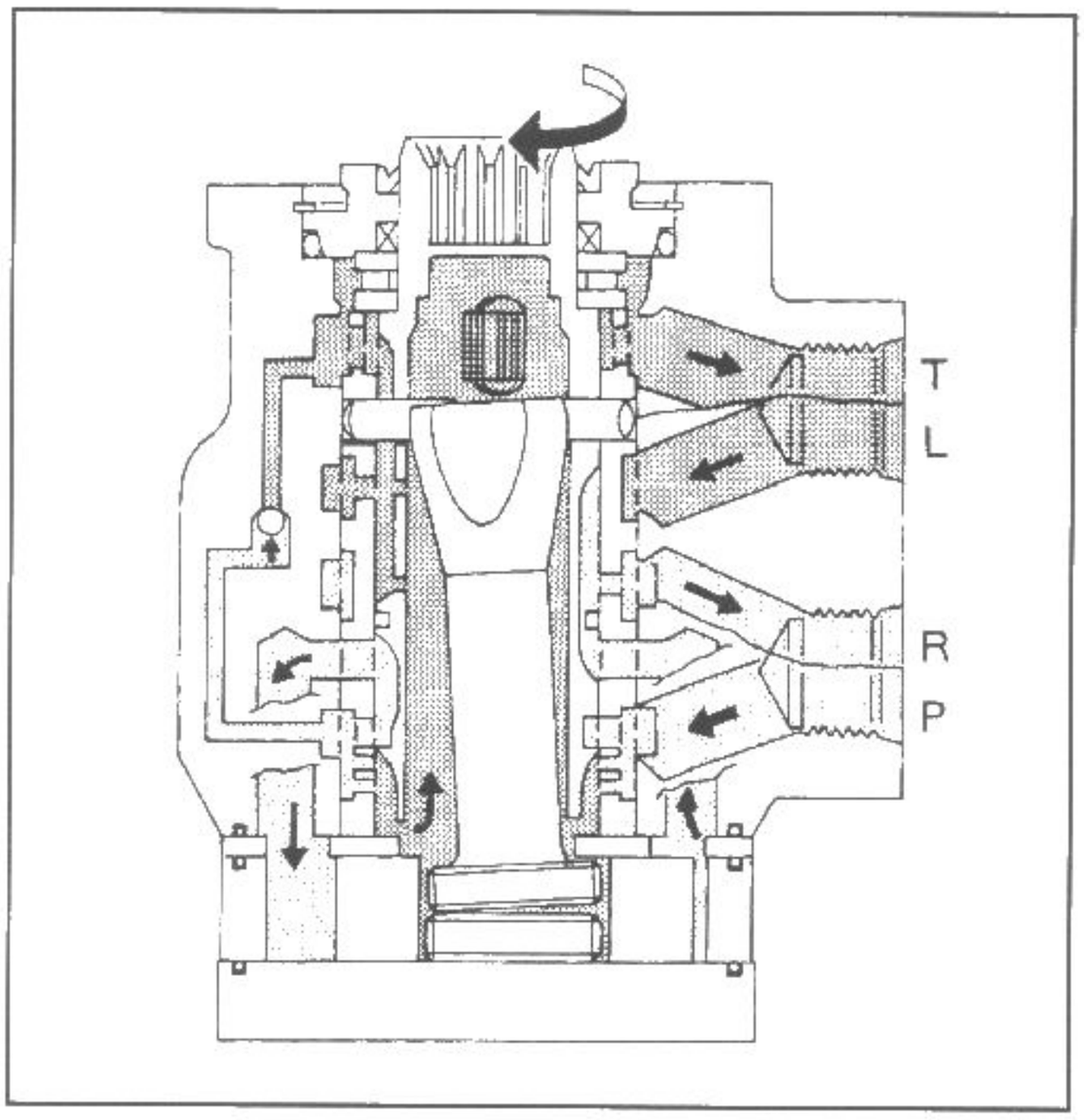


Fig. 4A.11 Clockwise Rotation

(4) Emergency Operation

When the hydraulic oil is not supplied from the pump due to engine stop, the orbitrol serves as an emergency steering unit.

When the steering wheel is turned, rotation is transmitted to the drive shaft (3) and the rotor (5) through the spool (2) and cross pin (6).

The rotor, put into rotation, draws in oil. Negative pressure is created in the oil passage, so that the check valve (7) is opened to draw in oil from the T port.

The oil discharged from the rotor is sent to the steering cylinder through the cylinder port to change the direction of the loader.

The oil discharged from the steering cylinder returns to another cylinder port and is drawn into the rotor through the check valve (7).

Note: In case of emergency operation, the steering wheel is harder to turn than in normal operation.

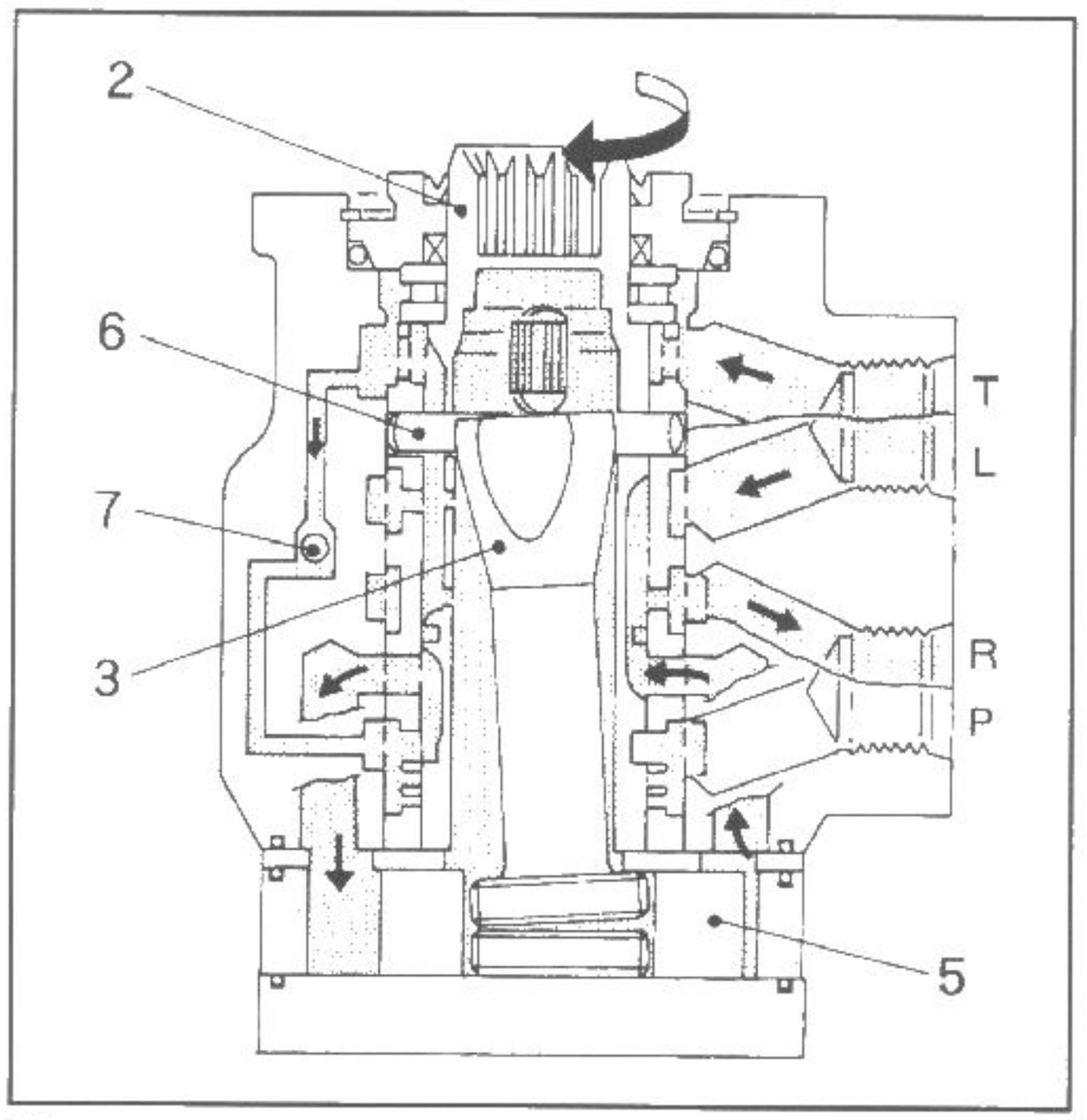


Fig. 4A.12 Emergency Operation (Clockwise Rotation)

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(5) Center spring operation

When the steering wheel is turned, the centering spring is compressed corresponding to the clearance between the cross pin and spool. When the steering wheel is released or locked, the sleeve is rotated by the centering spring tension to return the steering wheel to neutral. The loader continues to turn at its turning angle until the steering wheel is operated again. Thus, the centering spring tension acts as feedback of the steering mechanism.

(6) P port check valve operation

The orbitrol's P port has a check valve installed.

The check valve operates as follows:

When the steering wheel is turned clockwise and the steering cylinder reaches its stroke end, the pressure at the R port of the orbitrol rises to the setting value. When your hand is released from the steering wheel at this point, the entire system returns to neutral, but high pressure oil remains at the R port because the cylinder port side is blocked.

When the steering wheel is then turned slowly to the clockwise direction, the R port of the orbitrol is connected through the rotor to the P port. The rotor turns momentarily due to the residual pressure at the R port to let the oil flow back to the P port.

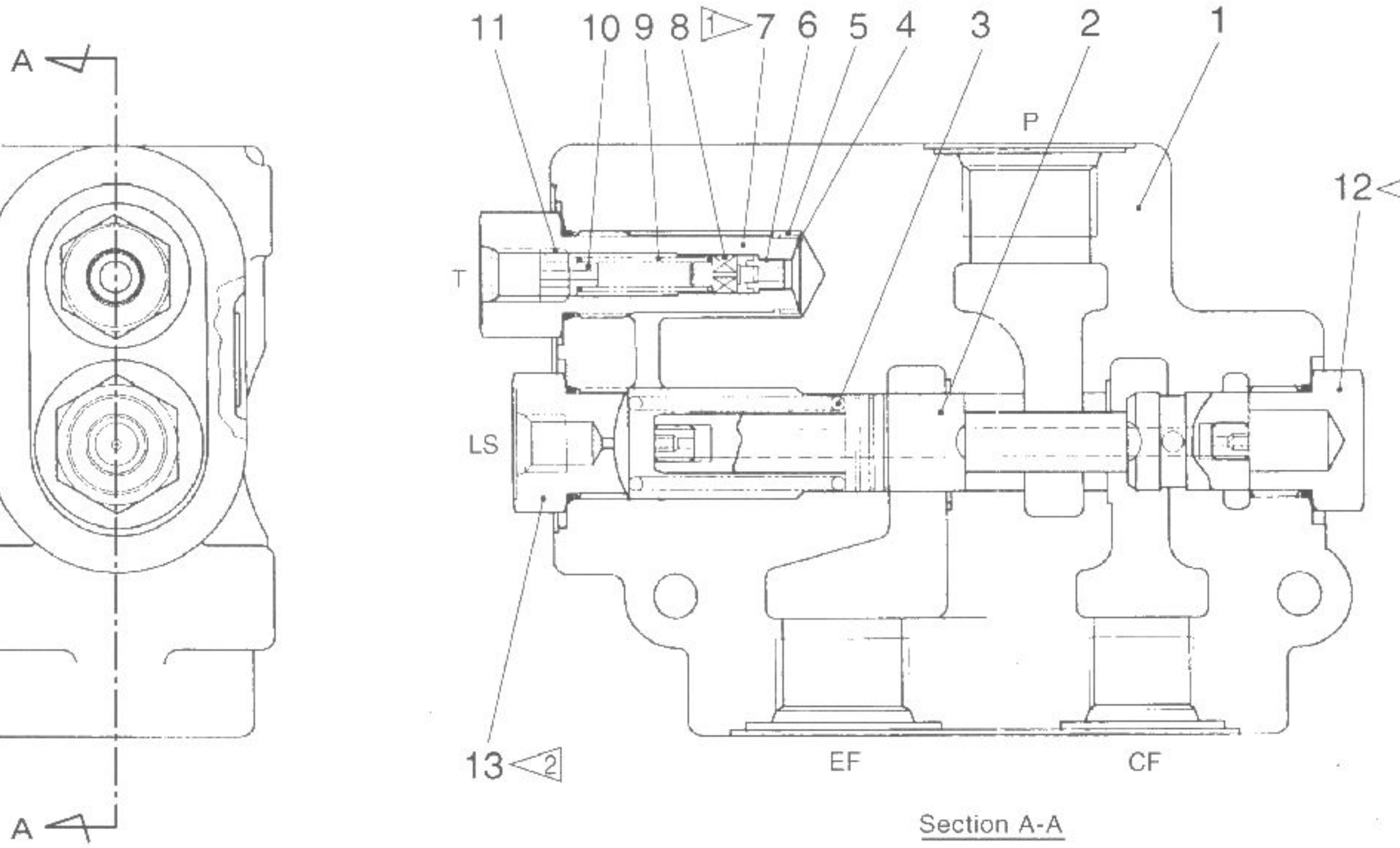
The rotor is mechanically linked to the steering wheel and thus the steering wheel tries to turn in the direction (counterclockwise) opposite to the direction you want to turn. To prevent this from happening, a check valve is installed at the P port of the orbitrol.

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4A.5 PRIORITY VALVE

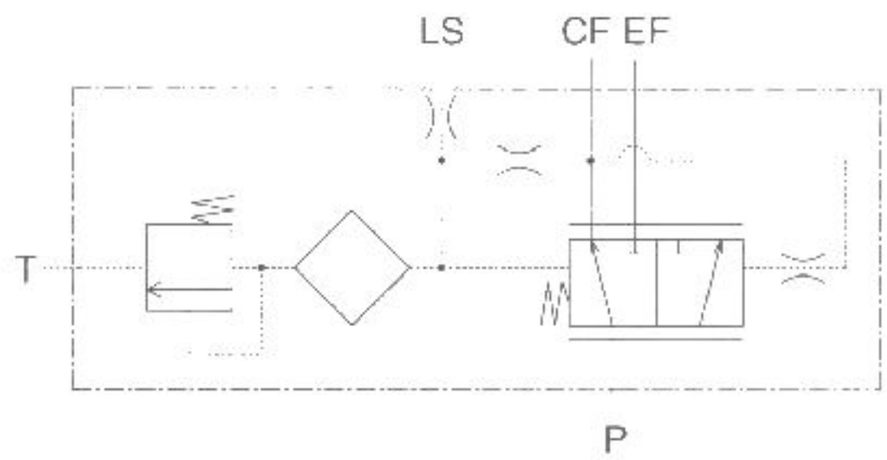
The priority valve combines with the orbitrol to form the load sensing system in which both the steering system and the hydraulic system can be efficiently driven by a single pump.

The priority valve is provided with a relief valve for the steering hydraulic circuit.



Note: 1 20.6 N-m {2.1 kgf-m} [15.2 lbf-ft]

2 44.1 N-m {4.5 kgf-m} [32.5 lbf-ft]



P : PUMP PORT (from MAIN PUMP)
T : TANK PORT (to OIL TANK)
LS : LOAD SENSING PORT (from ORBITROL)
EF : MAIN CIRCUIT PORT (to CONTROL VALVE)
CF : STEERING CIRCUIT PORT (to ORBITROL)

1. HOUSING
2. SPOOL
3. SPRING
4 to 11. RELIEF VALVE
4. SCREEN
5. RING
6. VALVE SEAT
7. BODY
8. POPPET
9. SPRING
10. SPRING GUIDE
11. ADJUSTMENT SCREW
12. PLUG
13. PLUG

Fig. 4A.13 Priority Valve

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Load sensing valve operation

The load sensing system lets only the amount of oil (out of the discharged from the main pump) necessary for steering operation flow into the orbitrol, while letting all the remaining oil flow into the load handling system (control valve).

For example, when the steering wheel is in neutral, most of the oil discharged from the main pump is directed to the control valve for the operation of the load handling system.

This allows efficient use of the oil discharged from the main pump, thus making the hydraulic system more energy-saving.

(1) Steering wheel in neutral (engine not running)

When the engine is not running, the priority valve spool (1) is pressed to the left in the figure by control spring (2) tension, thus keeping the CF port fully open and the EF port fully closed.

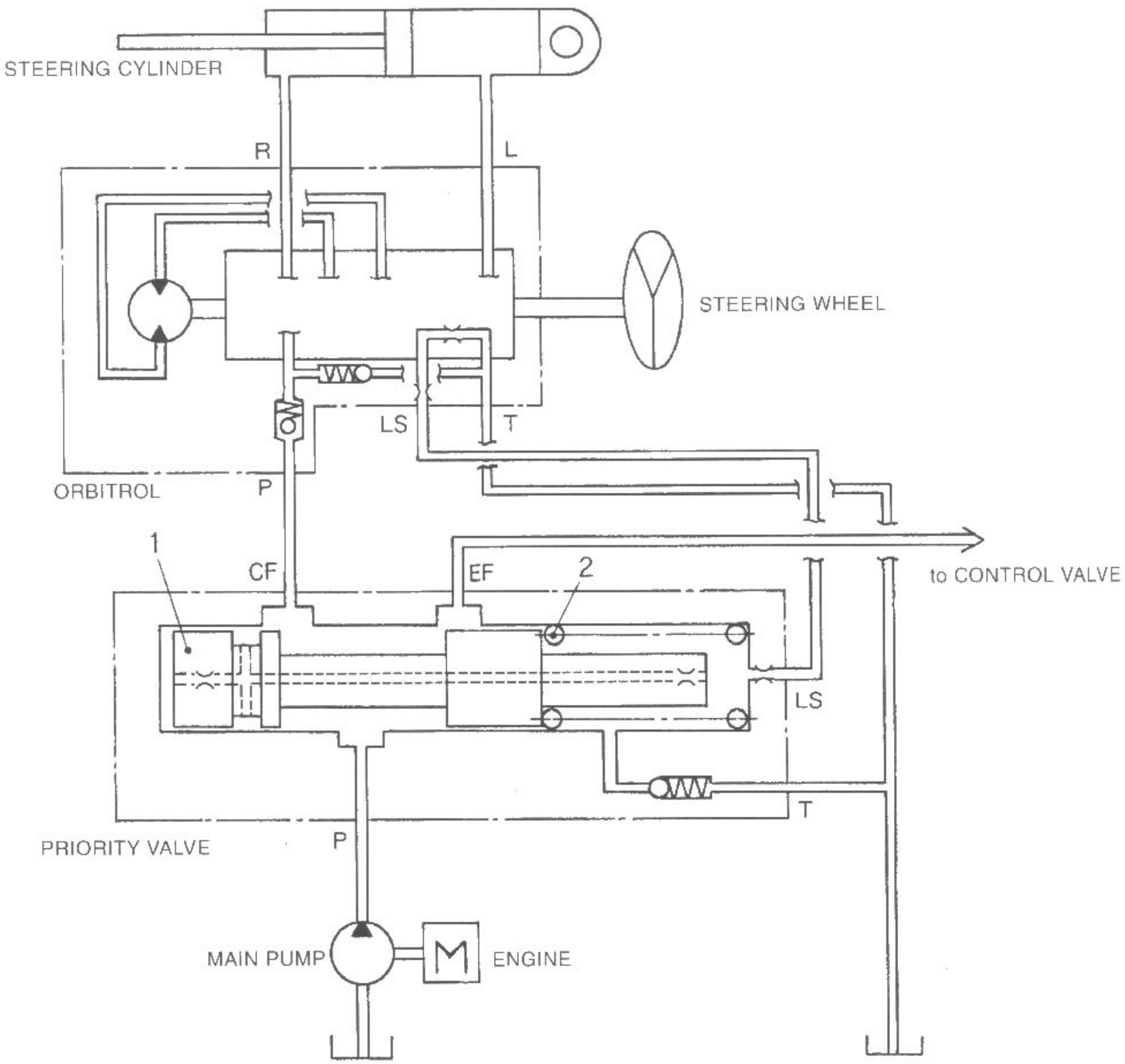


Fig. 4A.14 Steering Wheel in Neutral (engine not running)

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(2) Steering wheel in neutral (engine running)

① The pressure oil from the main pump flows through the P port of the priority valve and then branches.

② The pressure oil from the CF port is blocked off by the orbitrol and thus flows through the throttles C_1 and C_2 to the chambers A and B.

③ The pressure oil in the chamber B flows, passing through the LS port and orbitrol, to the hydraulic oil tank so that the oil pressure in the chamber B becomes lower than the oil pressure in the chamber A thanks to the throttle C_2. If the pressure differential exceeds the control spring pressure of the spring (2), the spool (1) moves to the right.

④ The EF port of the priority valve opens fully while the CF port opens slightly. For this reason, almost all the oil discharged from the main pump flows to the control valve for driving the load handling means.

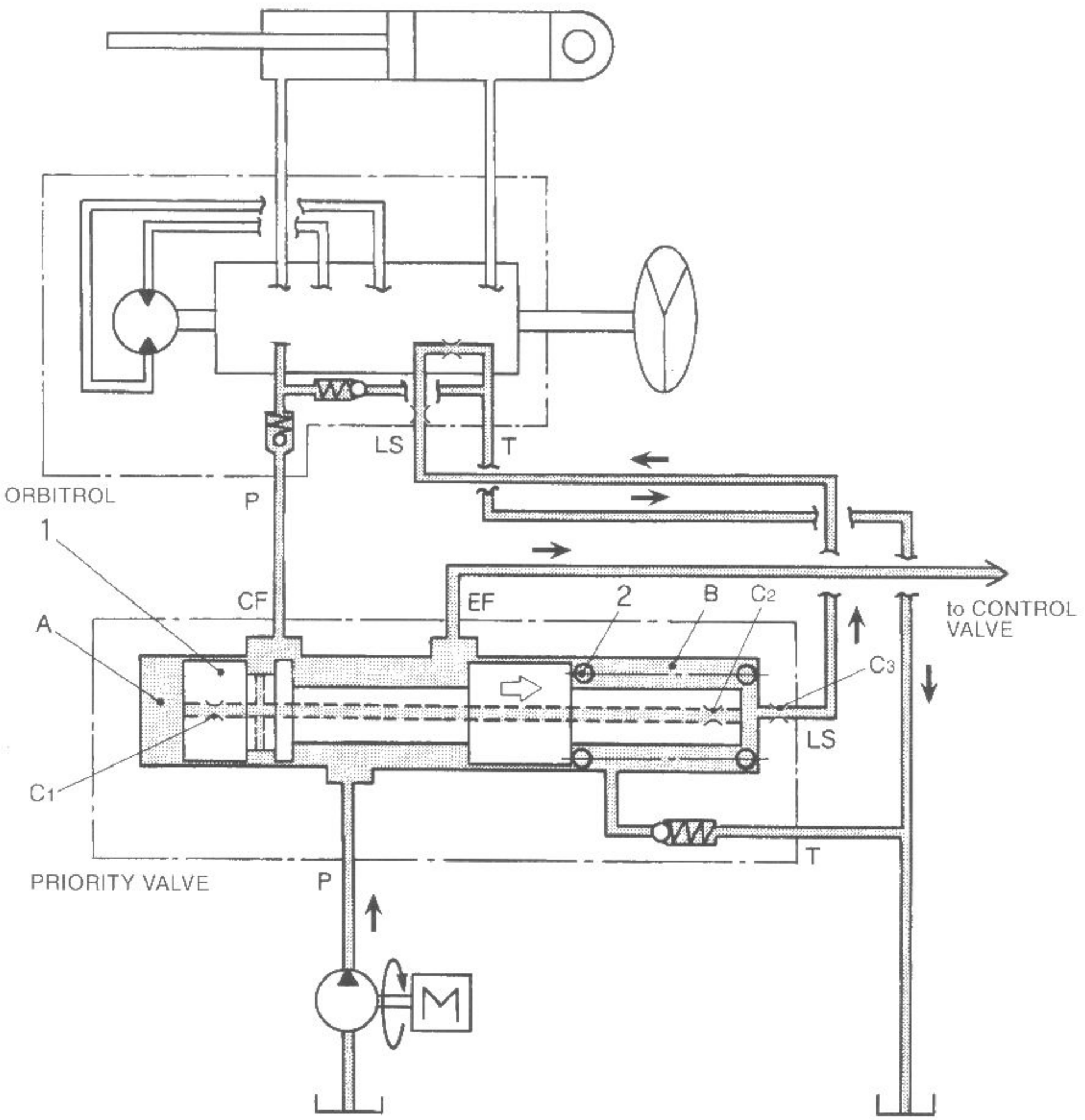


Fig. 4A.15 Steering Wheel in Neutral (engine running)

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(3) Steering wheel in rotation

① When the steering wheel is turned from neutral state, the oil passages in the orbitrol are changed over so that the pressure oil in the chamber A and CF port of the priority valve passes through throttle C_4 into the Gerotor.

② The oil pressure in the chamber A drops as the pressure oil enters the Gerotor and thus the spool (1) of the priority valve moves to a position which attain a balance between the pressure differential between the chambers A and B and the control spring (2) force. This determines the flow ratio of oil discharged from the main pump between the CF port and the EF port.

③ The opening of the throttle C_4 inside the orbitrol is determined by the rotating speed of the steering wheel. That is, the quicker the steering wheel is turned, the larger the opening becomes; the slower the steering wheel is turned, the smaller the opening results. Therefore, when the steering wheel is turned quickly, more oil is directed to the CF port, thus quickening steering speed.

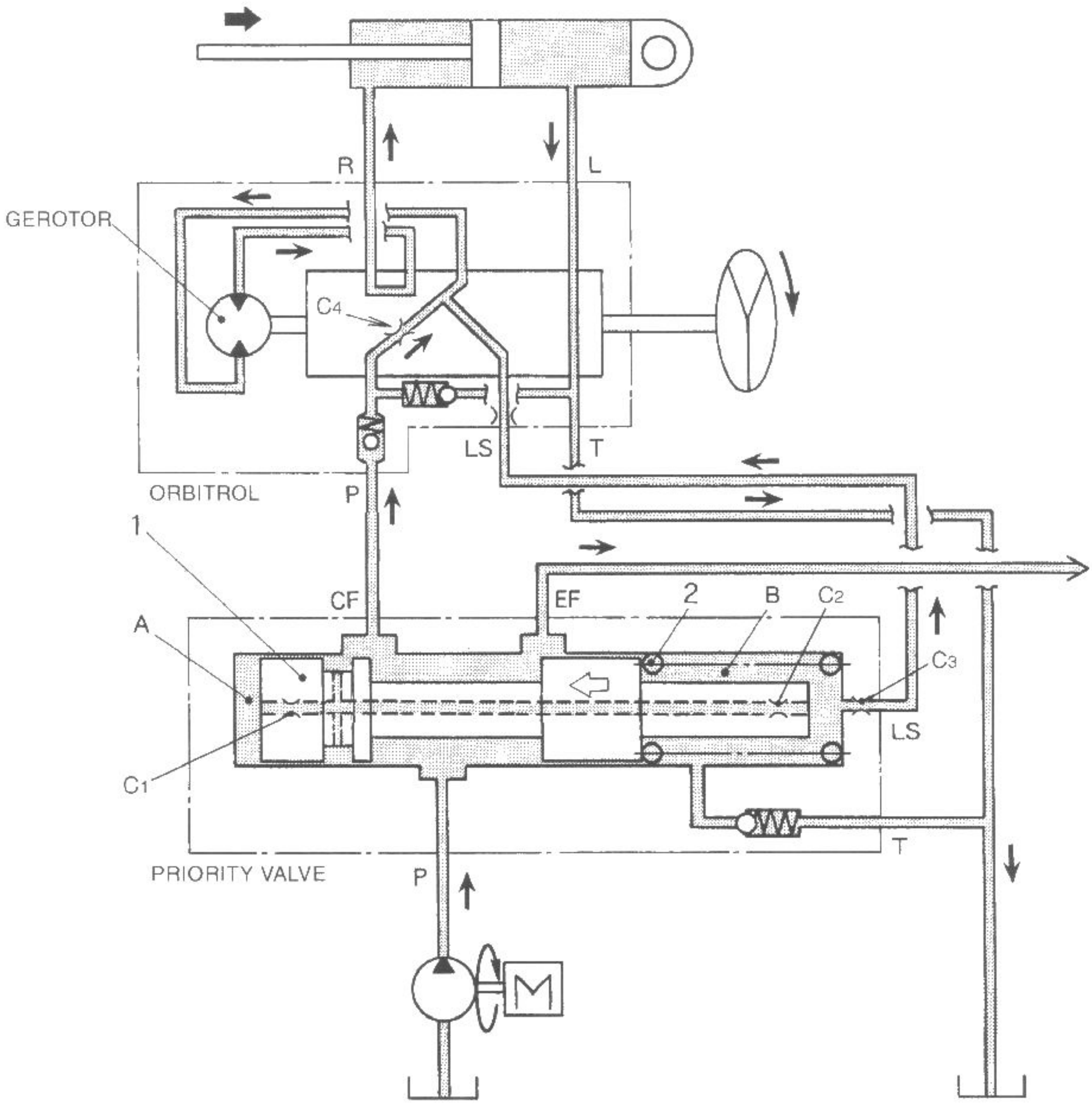


Fig. 4A.16 Steering Wheel in Rotation

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(4) Steering wheel at stroke end

① The pressure oil that reached the Gerotor flows, passing through the LS port and throttle C_3 of the priority valve, into the chamber B.

② When the steering wheel is further turned and the steering cylinder reaches its stroke end, the oil pressure in the chamber B of the priority valve rises together with the circuit pressure. When the oil pressure in the chamber B reaches 17.2 MPa [175 kgf/cm^2] {2 495 psi}, the relief valve (3) of the priority valve operates to reduce the oil pressure in the chamber B.

③ When the oil pressure in the chamber B drops, a pressure differential is produced between the chambers A and B by the throttle C_2. When the pressure differential overcomes the control spring pressure of the spring (2), the spool (1) of the priority valve moves to the right.

④ Therefore, the EF port of the priority valve opens fully while the CF port opens slightly and thus almost all the oil discharged from the main pump flows to the control valve.

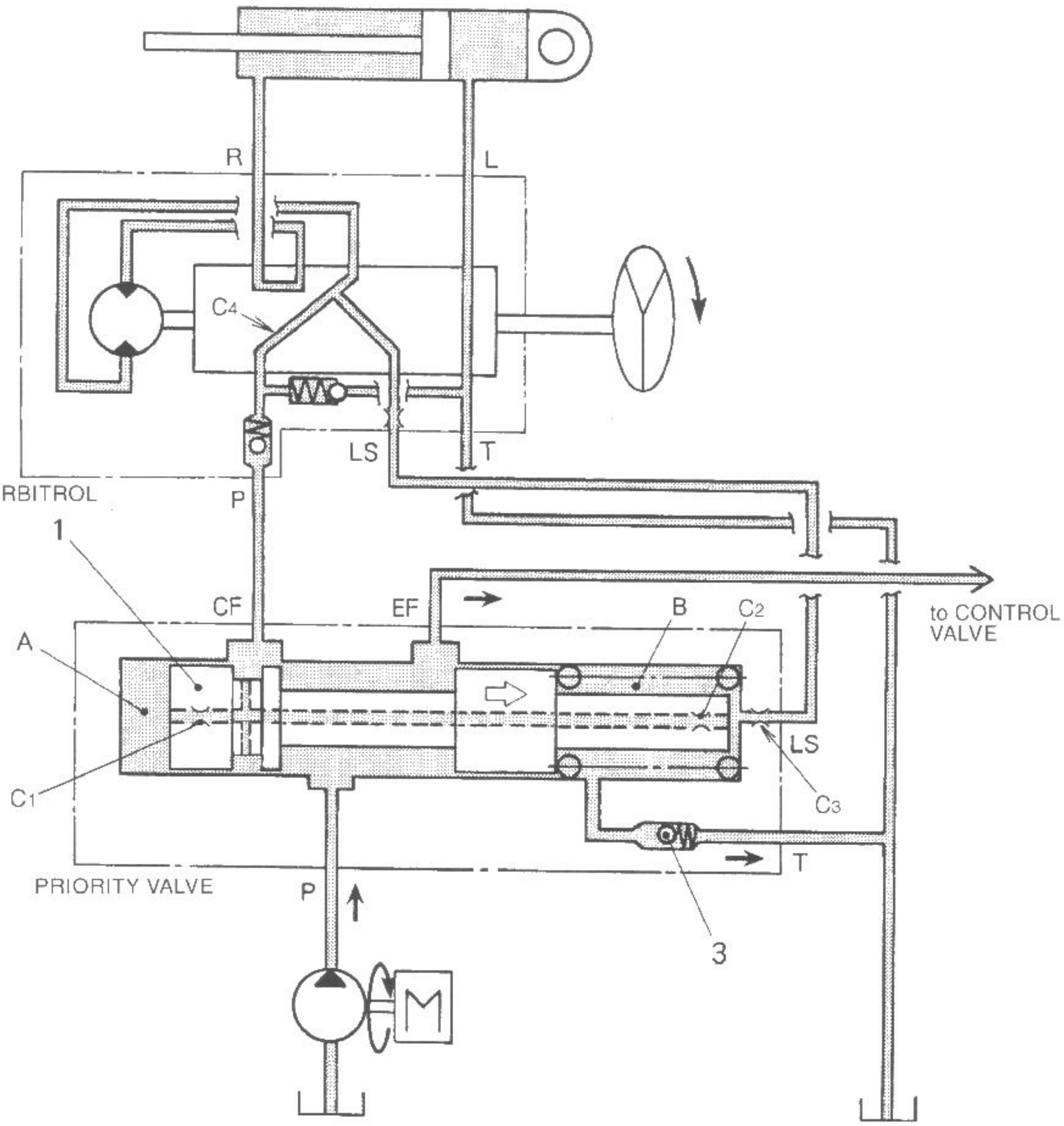
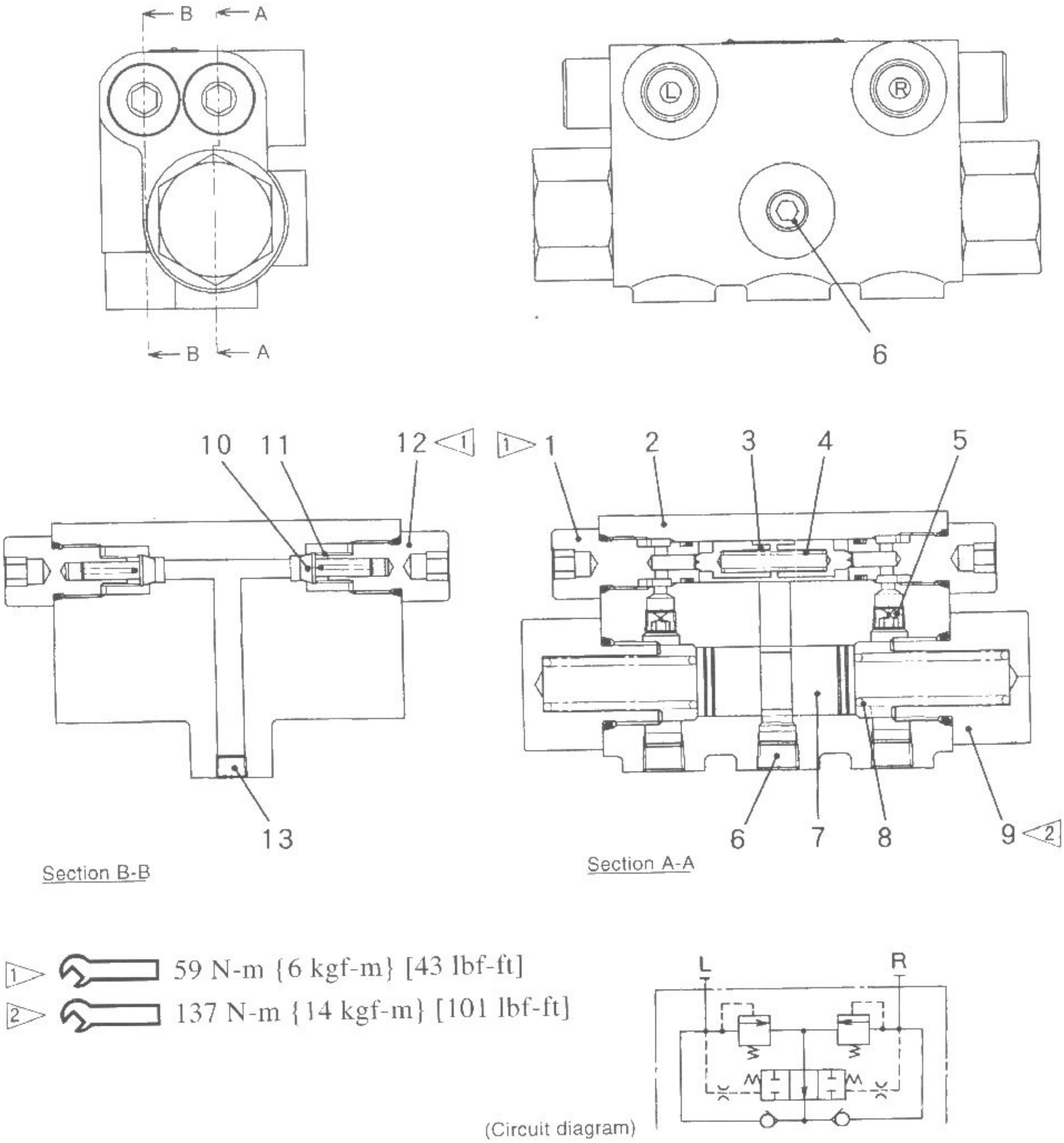


Fig. 4A.17 Steering Cylinder at Stroke End

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4A.6 CUSHION VALVE

When the steering operation is started or stopped, oil pressure in the steering circuit rapidly increases. The cushion valve is used to release this steep oil pressure temporarily at the low-pressure area into the tank line and smoothen the steering operation of the loader.



Note: 1 ▷ 59 N-m {6 kgf-m} [43 lbf-ft]

2 ▷ 137 N-m {14 kgf-m} [101 lbf-ft]

(Circuit diagram)

1. VALVE SEAT
2. HOUSING
3. POPPET
4. SPRING
5. ORIFICE (1.2 mm or 0.047 in. dia.)
6. PLUG
7. SPOOL
8. SPRING
9. PLUG
10. POPPET
11. SPRING
12. PLUG
13. PLUG

Fig. 4A.18 Cushion Valve

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Operation

① The high-pressure oil rapidly sent from the R port overcomes the spring (2) force to open the poppet (1).

② The high-pressure oil passes through the poppet (1), the center groove of the spool (3) and the check valve (4) at the L port side and flows out from the L port.

Note: The check valve (5) at the R port side is closed by the high-pressure oil at the R port.

③ At the same time, the high-pressure oil at the R port flows through the orifice (6) into the pressure chamber of the plug (7), and shifts the spool (3) overcoming the pressure at the L port and the spring (8) force. Consequently, the high-pressure oil at the R port passes through the poppet (1) to shut off the oil flow from the L port.

④ The temporary oil flow above causes a cushioning effect. After that, this cushion valve won't operate to give no effect to the normal steering operation.

⑤ If the pressure reaction is slow and needs no cushion effect, the spool (3) closes earlier than the poppet (1) opens, causing no cushioning function.

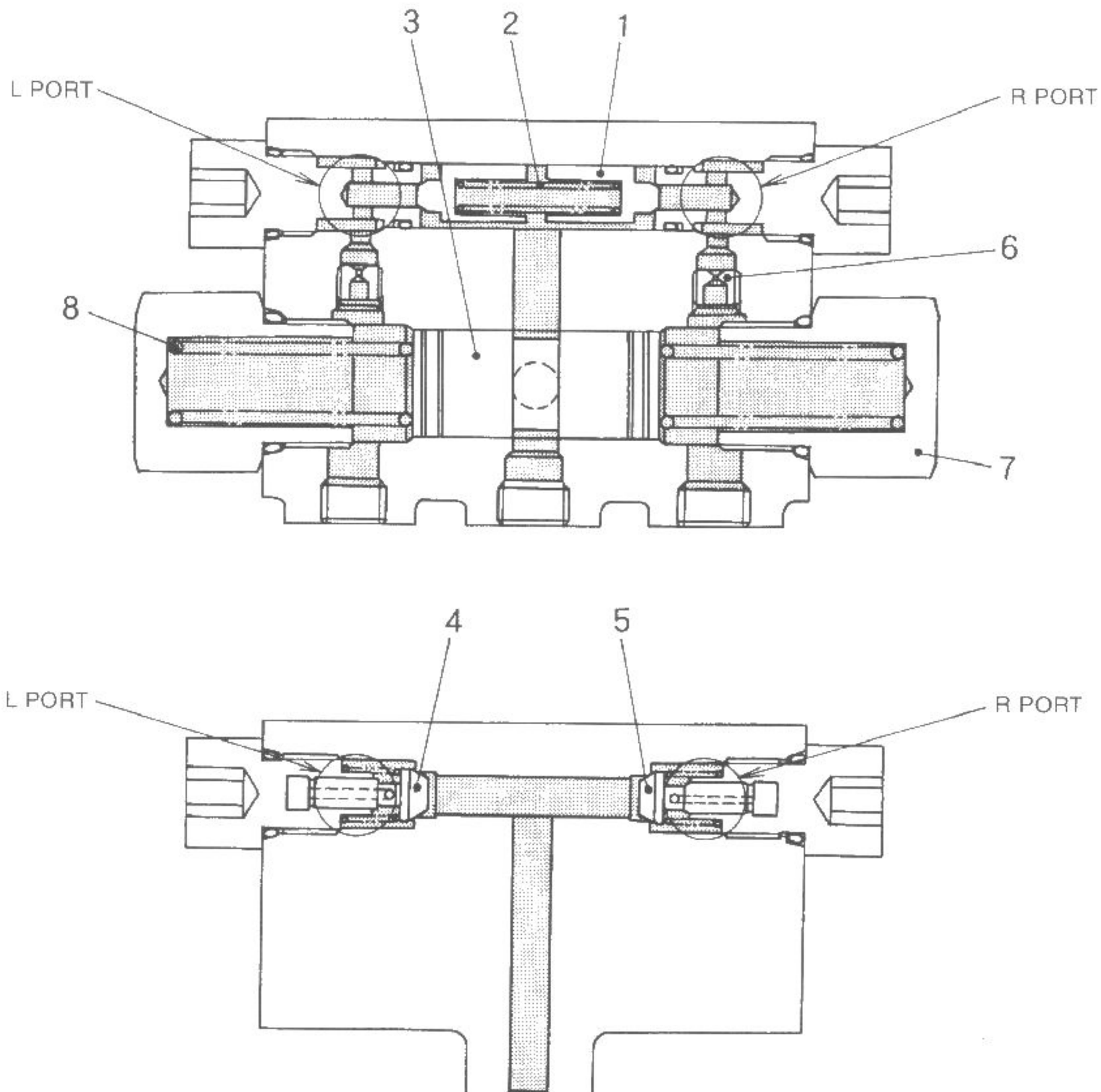
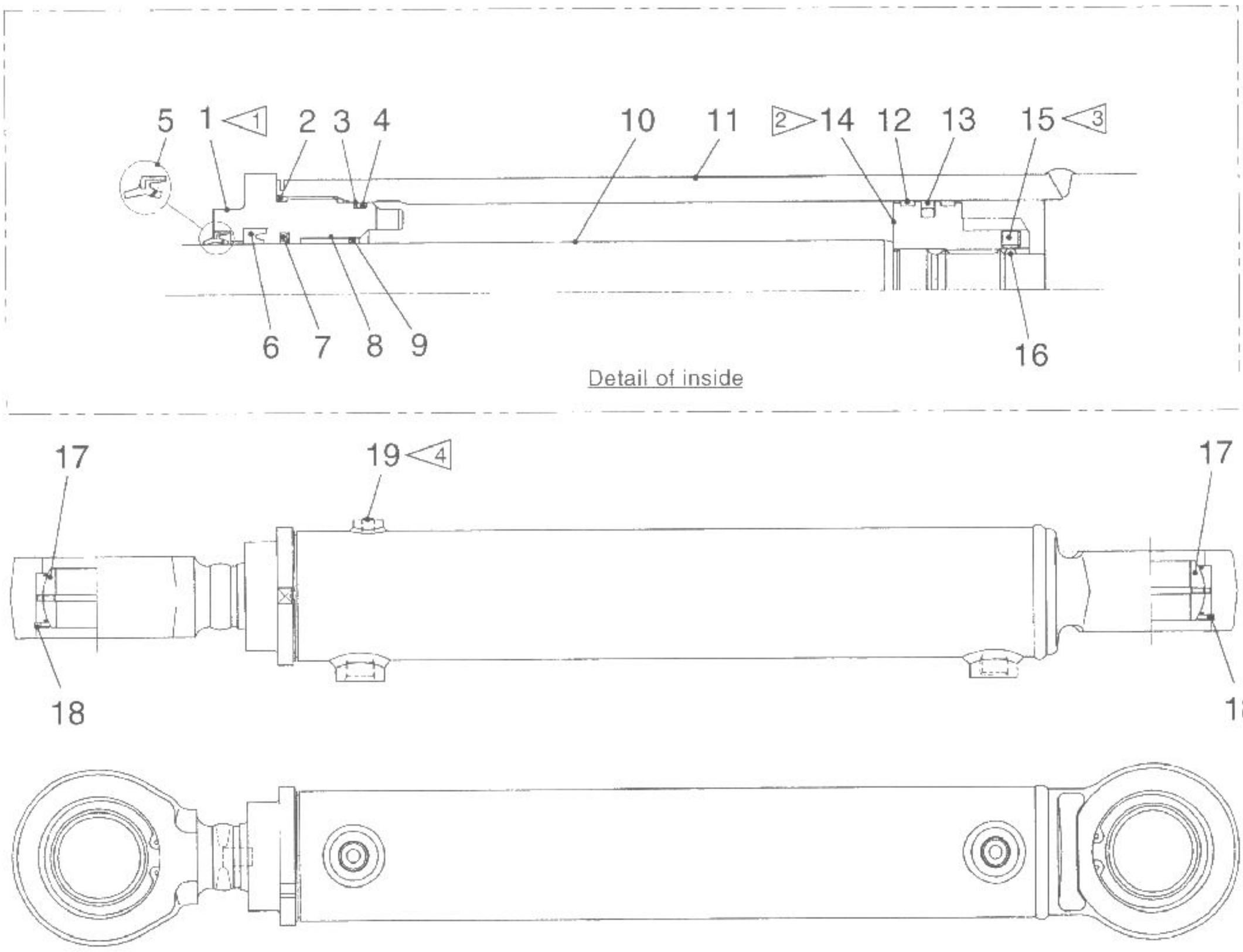


Fig. 4A.19 Operation

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4A.7 STEERING CYLINDER

Two double-acting steering cylinders are used. Each cylinder tube and piston rod are connected to the front frame and rear frame, respectively. The loader is steered by the piston rod extending and retracting.



Note: 1 450 N-m {46 kgf-m} [333 lbf-ft], Threaded area: Three Bond #1901

2 890 N-m {91 kgf-m} [658 lbf-ft]

3 16.2 N-m {1.65 kgf-m} [11.9 lbf-ft] (After tightening, calk two parts.)

4 Pressure check port (PT1/8)

1. CYLINDER HEAD
2. "O"-RING
3. BACK-UP RING
4. "O"-RING
5. WIPER RING
6. "U"-RING
7. BUFFER RING
8. BUSHING
9. SNAP RING
10. PISTON ROD
11. CYLINDER TUBE
12. SLIDE RING
13. SEAL RING, "O"-RING
14. PISTON
15. SET SCREW
16. STEEL BALL
17. SPHERICAL BEARING
18. SNAP RING
19. PLUG

Fig. 4A.20 Steering Cylinder

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4B. STEERING SYSTEM

(L35-3, LX190-7 · L40-3, LX230-7)

Type	Frame-articulating
Mechanism	Follow-up linkage
Frame articulating angle	40° to right and left
No. of rotations of steering wheel	4.0
Steering wheel reduction gear	Ball nut type
Pressure setting	18.6 MPa {190 kgf/cm^2} [2702 psi]
Flow setting	100 L/min [26.4 gpm]
Steering pump	See "6.2 PUMP."
Steering cylinder	
Type	Double-acting piston
Q'ty	2
Cylinder stroke	542 mm [21.3 in.]
Weight (per piece)	37 kg [81.6 lbs]

4B.1 GENERAL DESCRIPTION

The loader is a frame-articulating type. Its steering system is steered by operating cylinders installed between the front and rear frames.

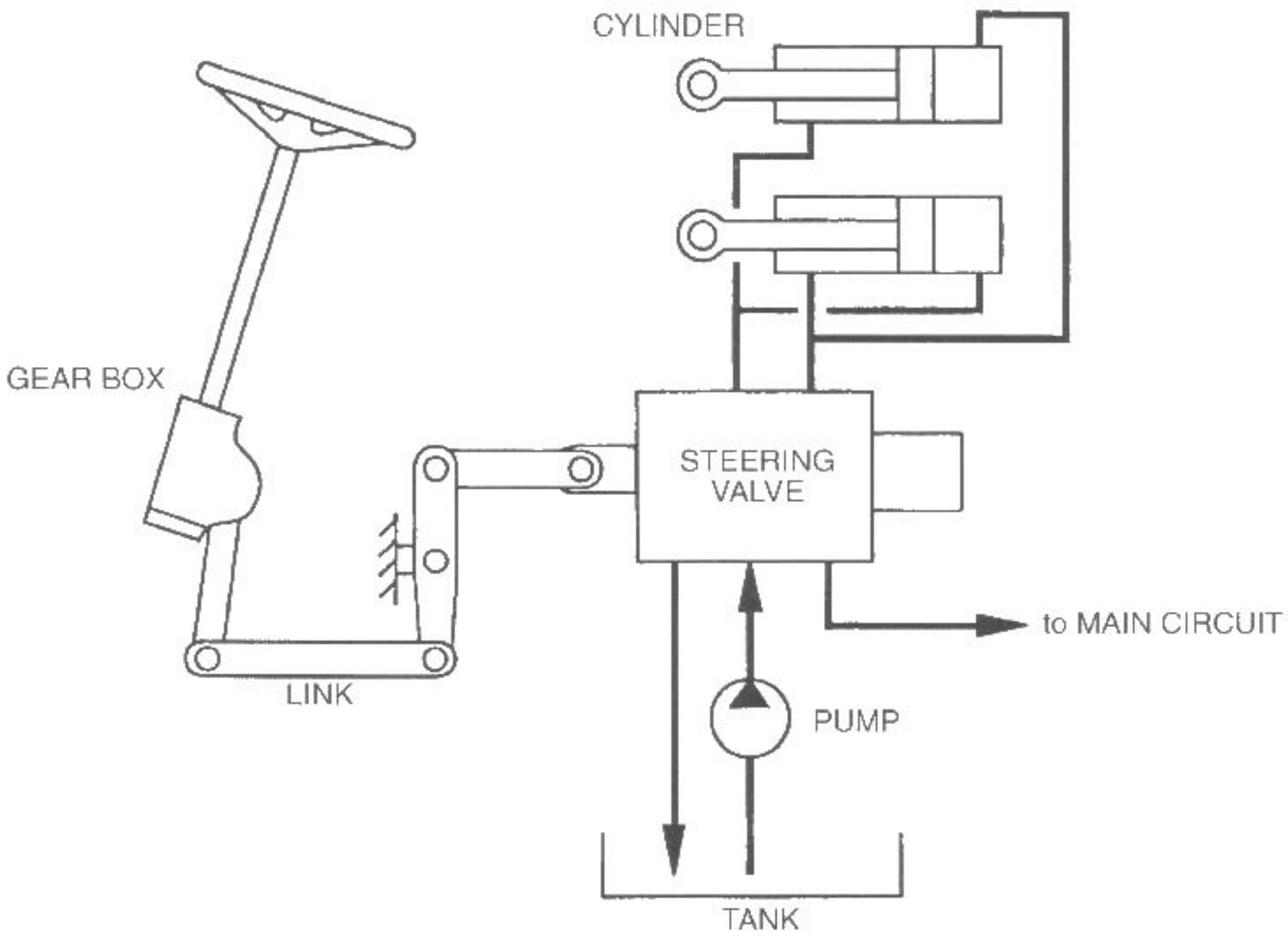
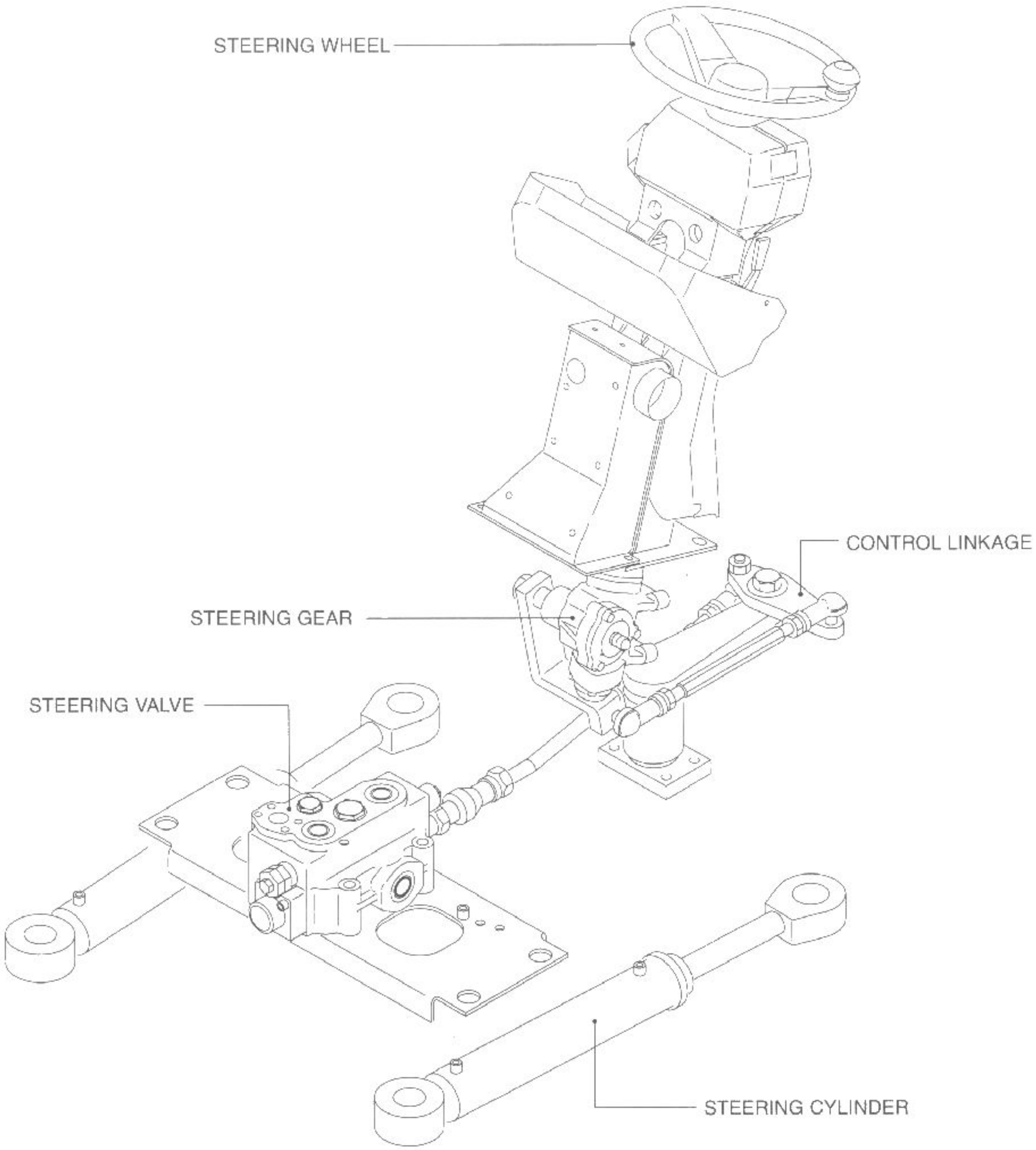


Fig. 4B.1 Follow-up Linkage System

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The mechanism of the steering system adopts the follow-up linkage which operates the steering valve spools.

The steering system consists of the steering gear, steering valve, steering cylinder, steering pump and hydraulic tubing.



Note: The above sketch does not illustrate the tubing.

Fig. 4B.2 Steering System

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4B.2 OIL CIRCULATION ROUTES

The oil picked up from the oil tank by the steering pump is sent under pressure to the steering valve.

The steering valve adjusts the pressure and flow of the pressurized oil to steer the loader. It has a priority system where the steering circuit takes priority over the other circuits to send excess pressure oil to the main circuit. When the steering wheel is operated, the steering valve is actuated to send the pressurized oil from the pump to the steering cylinders, steering the loader. The oil returning from the steering cylinder flows through the steering valve back to the oil tank.

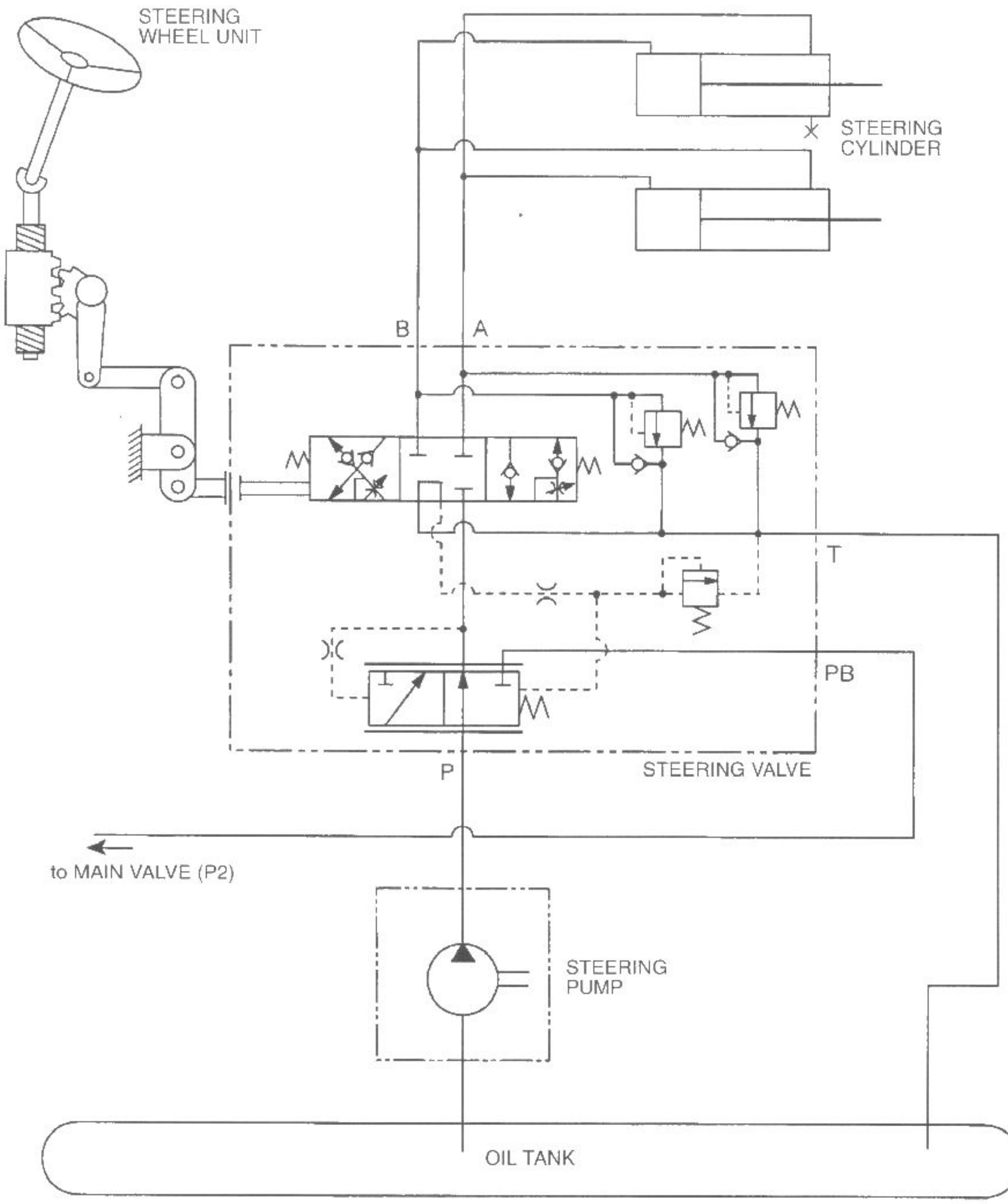


Fig. 4B.3 Hydraulic Circuit Diagram

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4B.3 STEERING WHEEL UNIT

The steering wheel unit consists of a steering wheel, steering column assembly and steering gear.

The steering wheel unit is a tilt type so that the tilt of the steering wheel post can be adjusted.

The steering gear is a ball nut type. It is also called a recirculating ball type or ball circulating type and features light steering operation. In the ball nut steering gear, steel balls are installed between the worm and ball nut so that the worm rotation is converted to the axial movement of the ball nut by the rolling contact of the balls.

Operation

① When the steering wheel is turned, the rotation is transmitted through the steering column which in turn rotates the worm of the steering gear.

② The outer rack of the ball nut which is engaged with the worm is also engaged with the teeth of the bevel gear whose sector shaft is tilted. Therefore, the ball nut does not turn and moves to the axial direction.

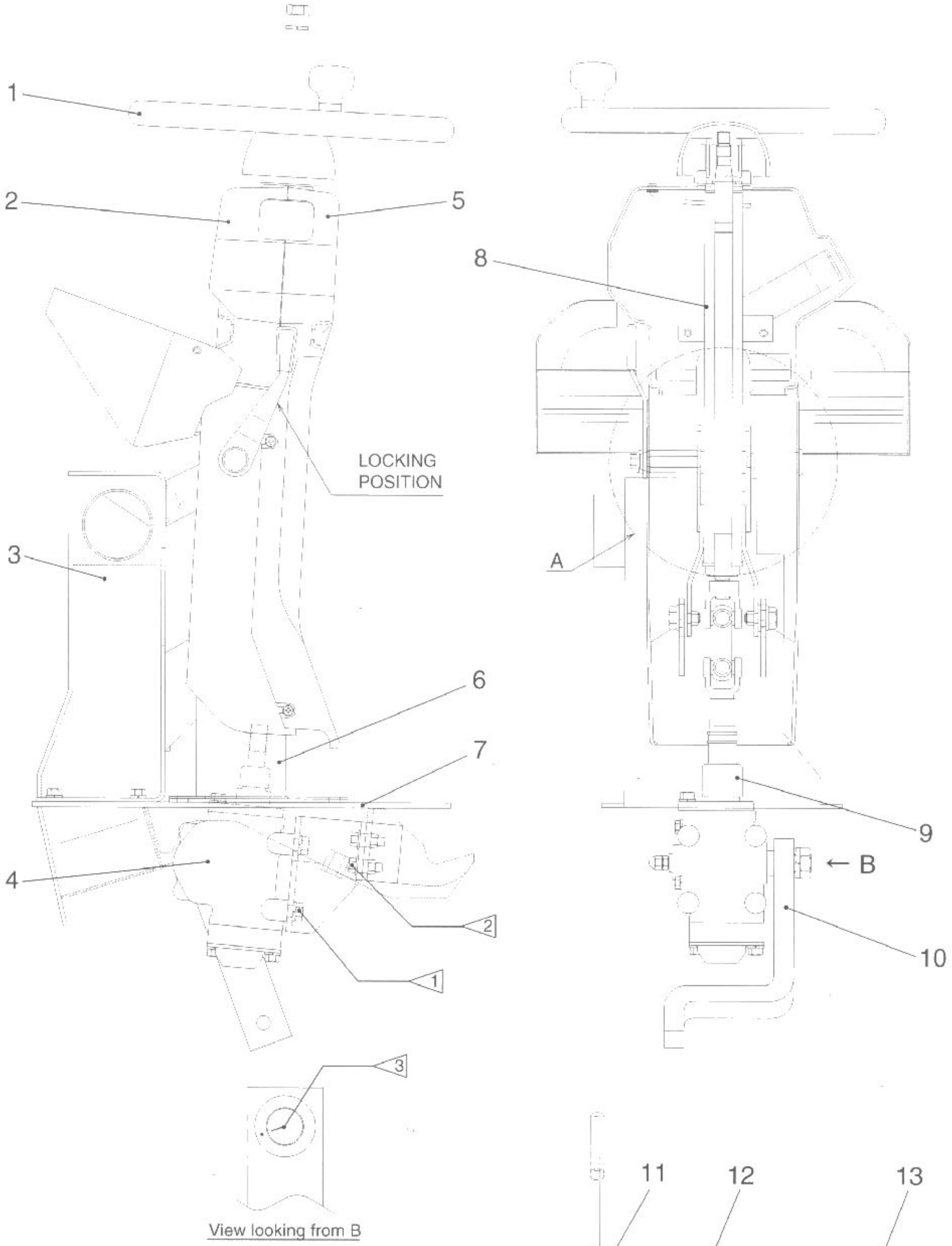
③ The axial movement of the ball nut is converted into the rotation of the sector shaft by means of the outer rack.

④ The rotation of the sector shaft actuates the steering valve through the pitman arm and linkage.

(Parts names shown in Fig. 4B.4 Steering Wheel Unit)

1. STEERING WHEEL UNIT
2. STEERING WHEEL POST COVER
3. STEERING WHEEL SUPPORT
4. STEERING GEAR
5. STEERING WHEEL POST COVER
6. BRACKET
7. SEAT
8. STEERING COLUMN ASSEMBLY
9. BOOT
10. PITMAN ARM
11. TILT LEVER
12. NUT
13. LOCK BOLT

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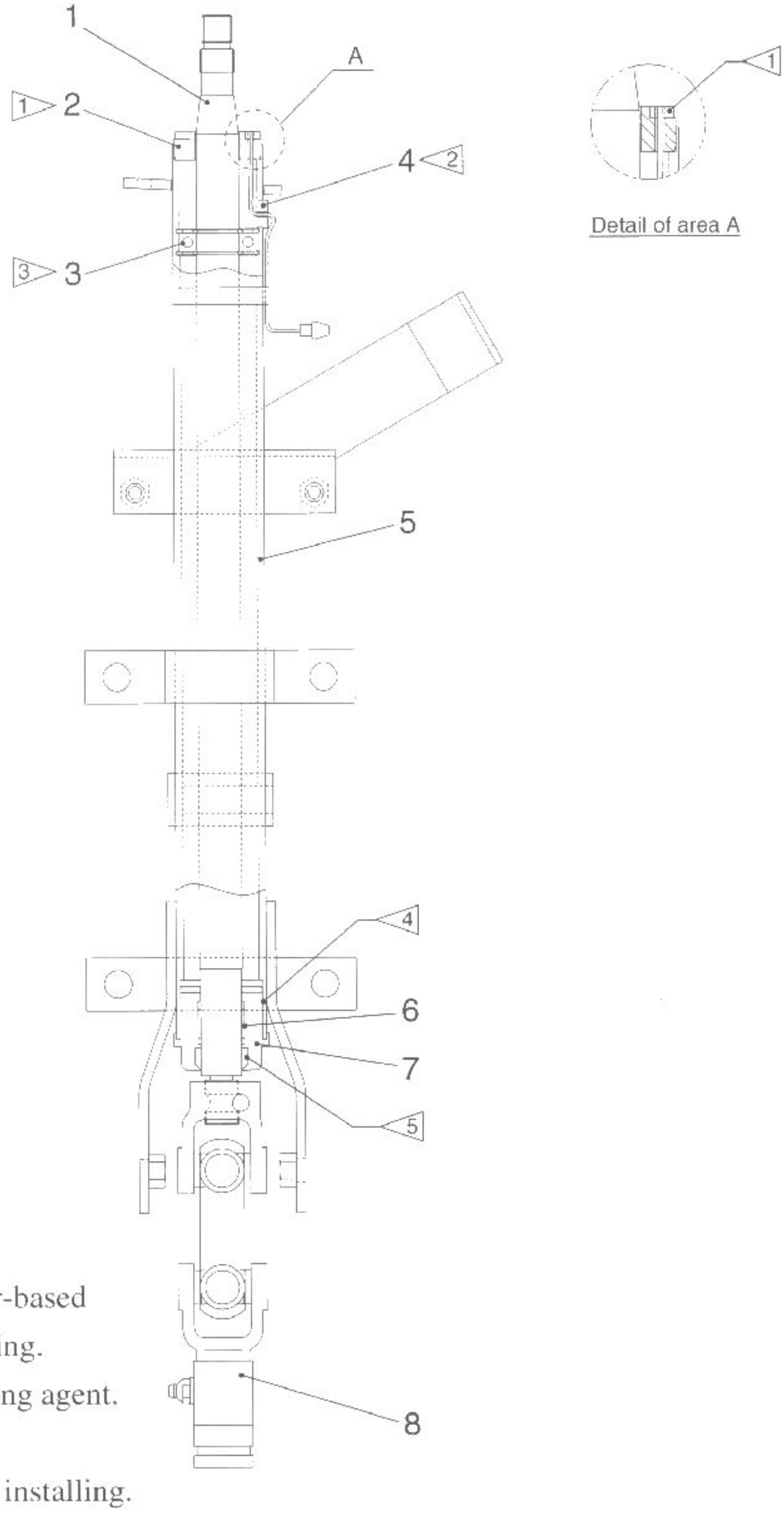
Note: 1▷ 104 N-m {10.6 kgf-m} [77 lbf-ft]

2▷ 101 N-m {10.3 kgf-m} [74 lbf-ft]

3▷ Install aligning the slit in the steering gear shaft with the punched hole in the pitman arm.

Fig. 4B.4 Steering Wheel Unit

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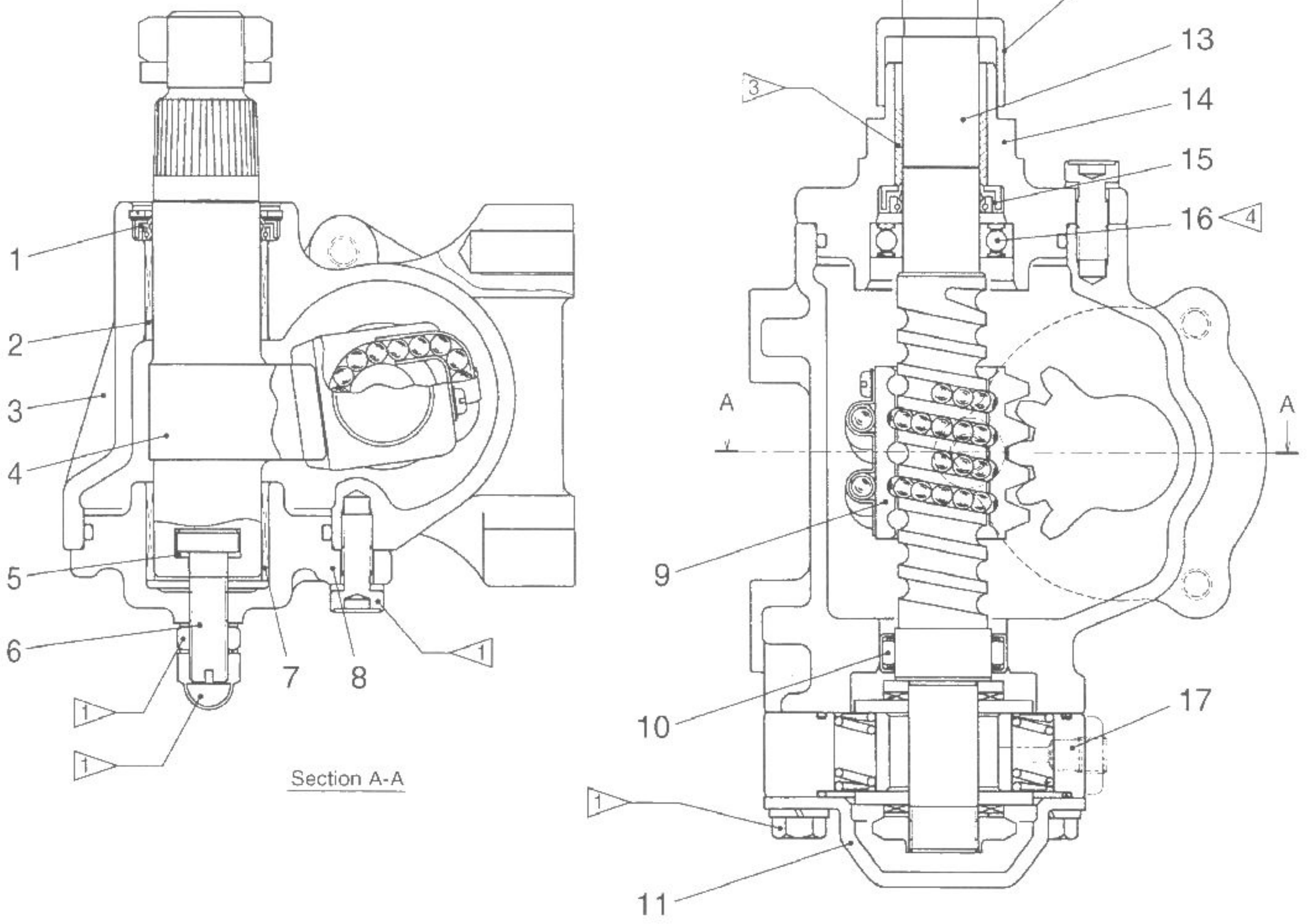


Note: 1 Apply synthetic-rubber-based adhesive before installing.
2 Apply waterproof sealing agent.
3 Apply grease.
4 Apply adhesive before installing.
5 Fill grease.

1. SHAFT
2. BUSHING
3. BEARING
4. GROMMET
5. COLUMN
6. BUSHING
7. COLUMN BUSHING
8. JOINT

Fig. 4B.5 Steering Column

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Note: 1 20 to 29 N-m {2 to 3 kgf-m} [14 to 22 lbf-ft]
2 Inside of dust cover: Fill grease
3 Shaded area: Fill grease
4 Bearing: Fill grease

1. OIL SEAL
2. BUSHING
3. GEAR CASE
4. SECTOR SHAFT
5. SHIM
6. ADJUSTMENT SCREW
7. BUSHING
8. SIDE COVER
9. BALL NUT
10. BUSHING
11. END COVER
12. DUST COVER
13. WORM
14. TOP COVER
15. OIL SEAL
16. BEARING
17. VALVE CASE

Fig. 4B.6 Steering Gear

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4B.4 STEERING VALVE

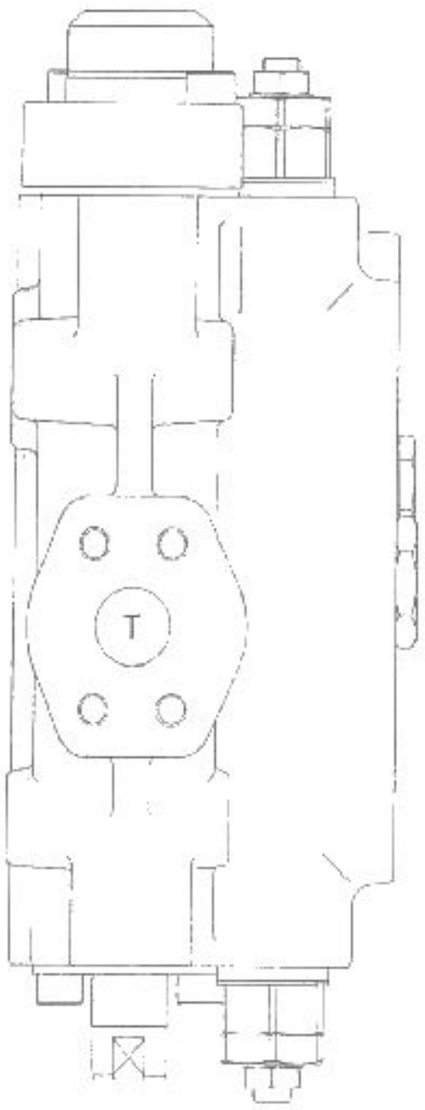
Name	KVMT-200L
Type	Control valve with pressure compensating mechanism
Max. control flow	200 L/min [52.8 gpm]
Main relief pressure setting	18.6 MPa {190 kgf/cm^2} [2700 psi]
Port relief pressure setting	24.5 MPa {250 kgf/cm^2} [3560 psi]
Weight	22.5 kg [40.6 lbs]

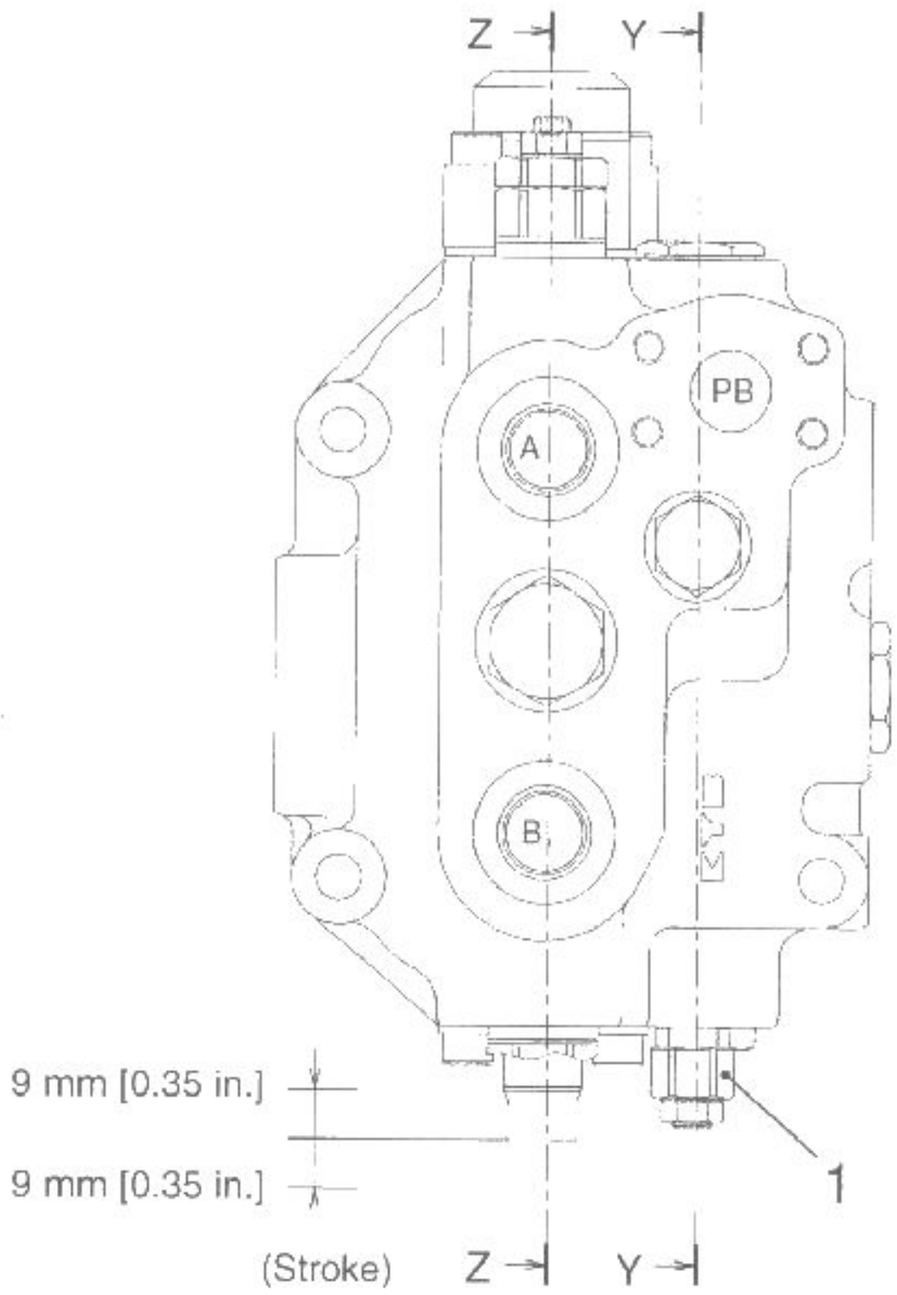
The steering valve is a control valve with a pressure compensating mechanism which supplies flow in proportion to the displacement of the steering spool valve, regardless of load pressure (steering cylinder pressure) change.

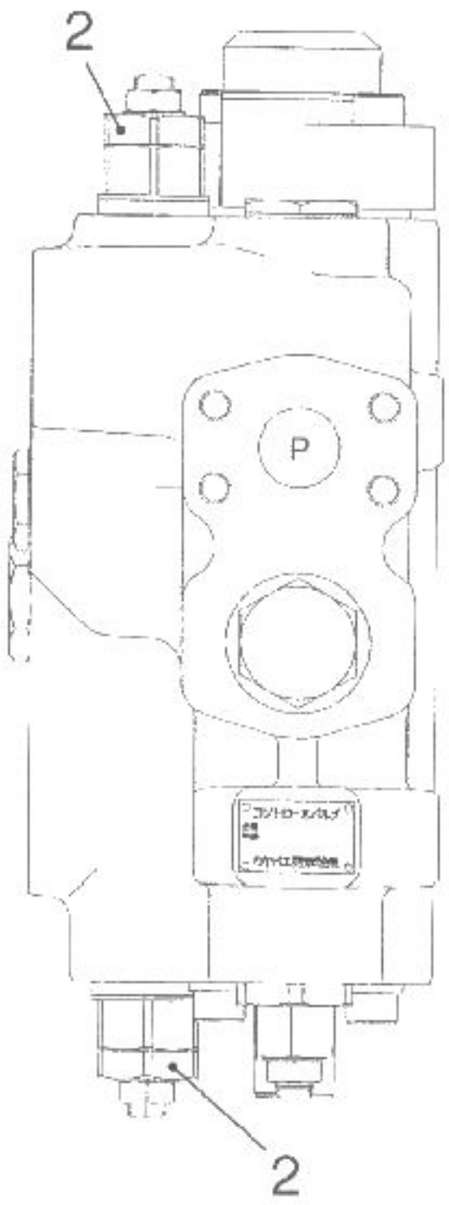
The steering valve is also equipped with a carry over port so that the excess pressurized oil which is not used for the steering circuit, flows to the main circuit. When no steering operation is carried out, the entire amount of oil discharged from the pump flows to the main circuit.

The steering valve consists of the valve housing, steering spool, carry over plunger, main relief valve and two port relief valves. The main relief valve adjusts the hydraulic oil pressure in the steering circuit. When the hydraulic oil pressure exceeds the pressure setting, the main relief valve operates to direct the pressurized oil to the oil tank. The port relief valve, installed on each cylinder port, protects the circuit to the steering cylinder from overload.

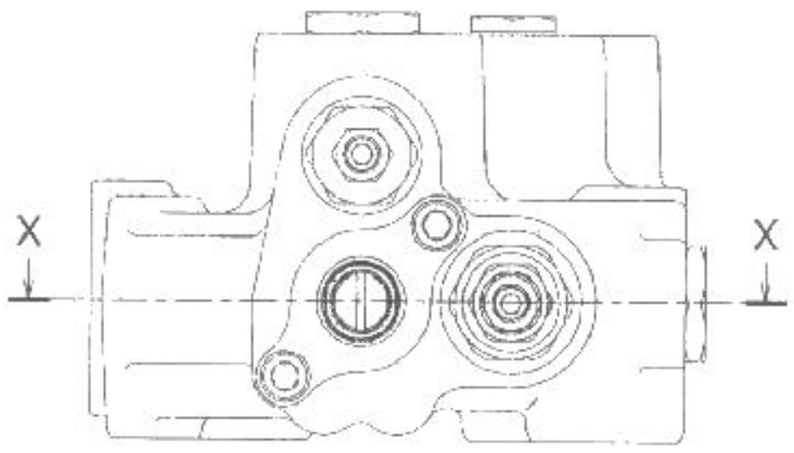
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1. MAIN RELIEF VALVE
2. PORT RELIEF VALVE



A : CYLINDER PORT
B : CYLINDER PORT
P : PUMP PORT
PB : CARRY OVER PORT
(to MAIN CIRCUIT)
T : TANK PORT

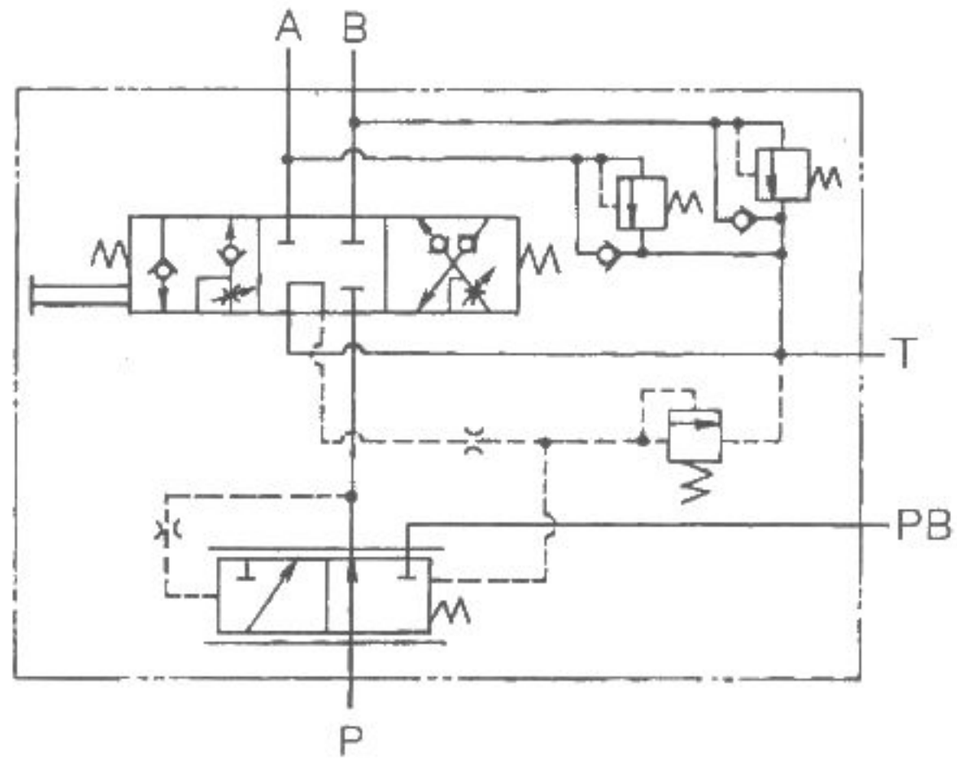
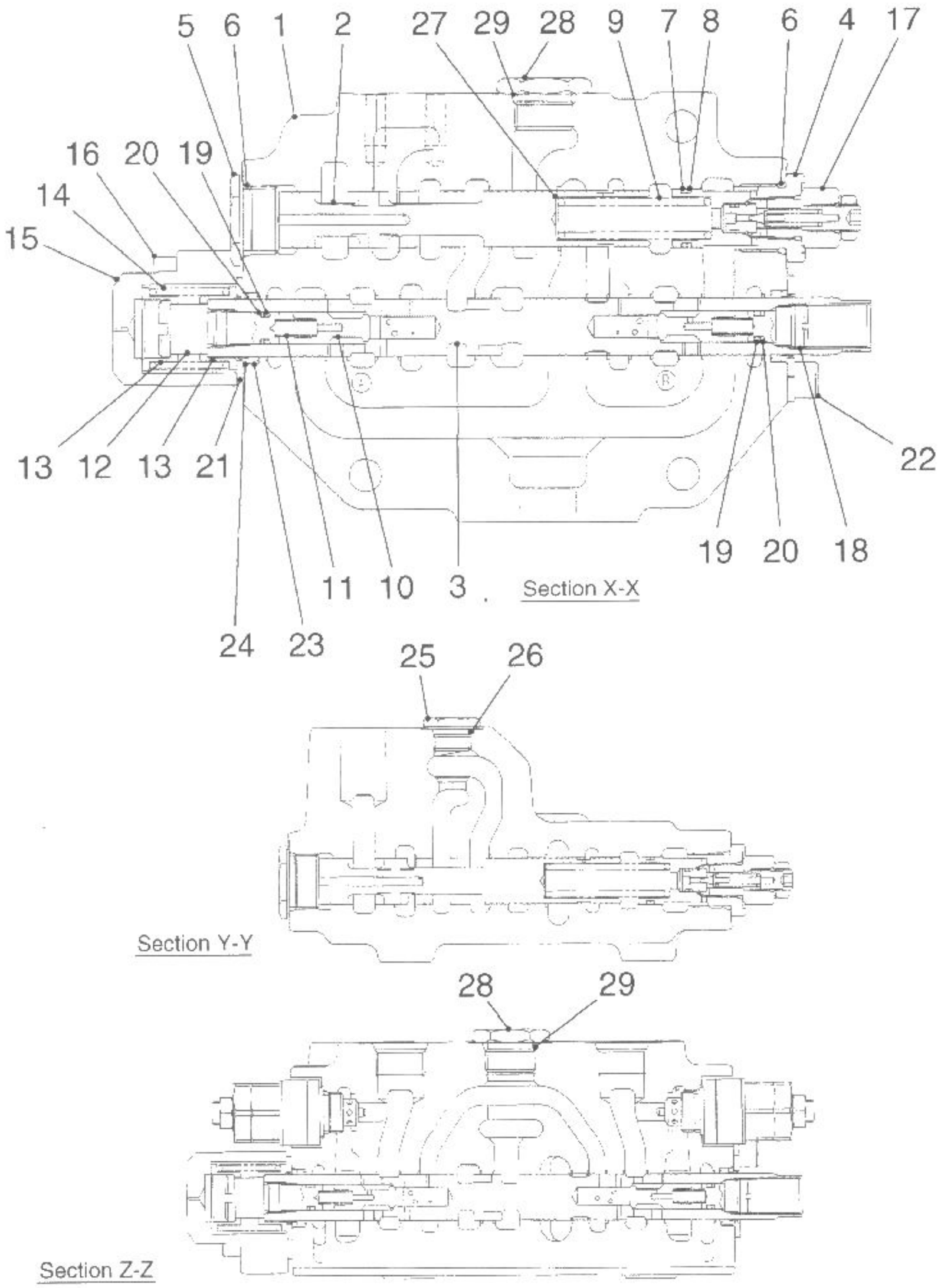


Fig. 4B.7 Steering Valve

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1. HOUSING
2. SPOOL
3. SPOOL
4. PLUG
5. PLUG
6. "O"-RING
7. "O"-RING
8. BACK-UP RING
9. SPRING
10. POPPET
11. SPRING
12. CAP SCREW
13. SPRING SEAT
14. SPRING
15. CAP
16. SOCKET HEAD BOLT
17. RELIEF
18. PLUG
19. "O"-RING
20. BACK-UP RING
21. SEAL PLATE
22. SOCKET HEAD BOLT
23. SEAL
24. WIPER
25. PLUG
26. "O"-RING
27. SHIM
28. PLUG
29. "O"-RING

Fig. 4B.8 Steering Valve Construction

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Operation

Note: The sketches of the steering valve that will be shown in the following pages are given for reference purposes. They may be somewhat different from that used for your loader.

1. Neutral

① With the steering spool (1) in neutral, the ports A and B leading to the steering cylinders are closed.
② The pressurized oil from the pump flows from the port P, passing through the orifice (3) in the carry-over plunger (2), into the chamber "b."
③ The chamber "a" on the opposite side leads through a small hole to the load check valve (4) of the steering spool (1). When the oil pressure in the chamber "a" rises, the load check valve is opened and the chamber "a" is connected to the low-pressure passage (T).
④ This puts the chamber "b" into the pump pressure state and the chamber "a" in a low- pressure state so that the carry-over plunger (2) moves to the right side all the way to open the carry-over port (PB).
⑤ All the pressurized oil from the pump flows from the port P to the port PB.

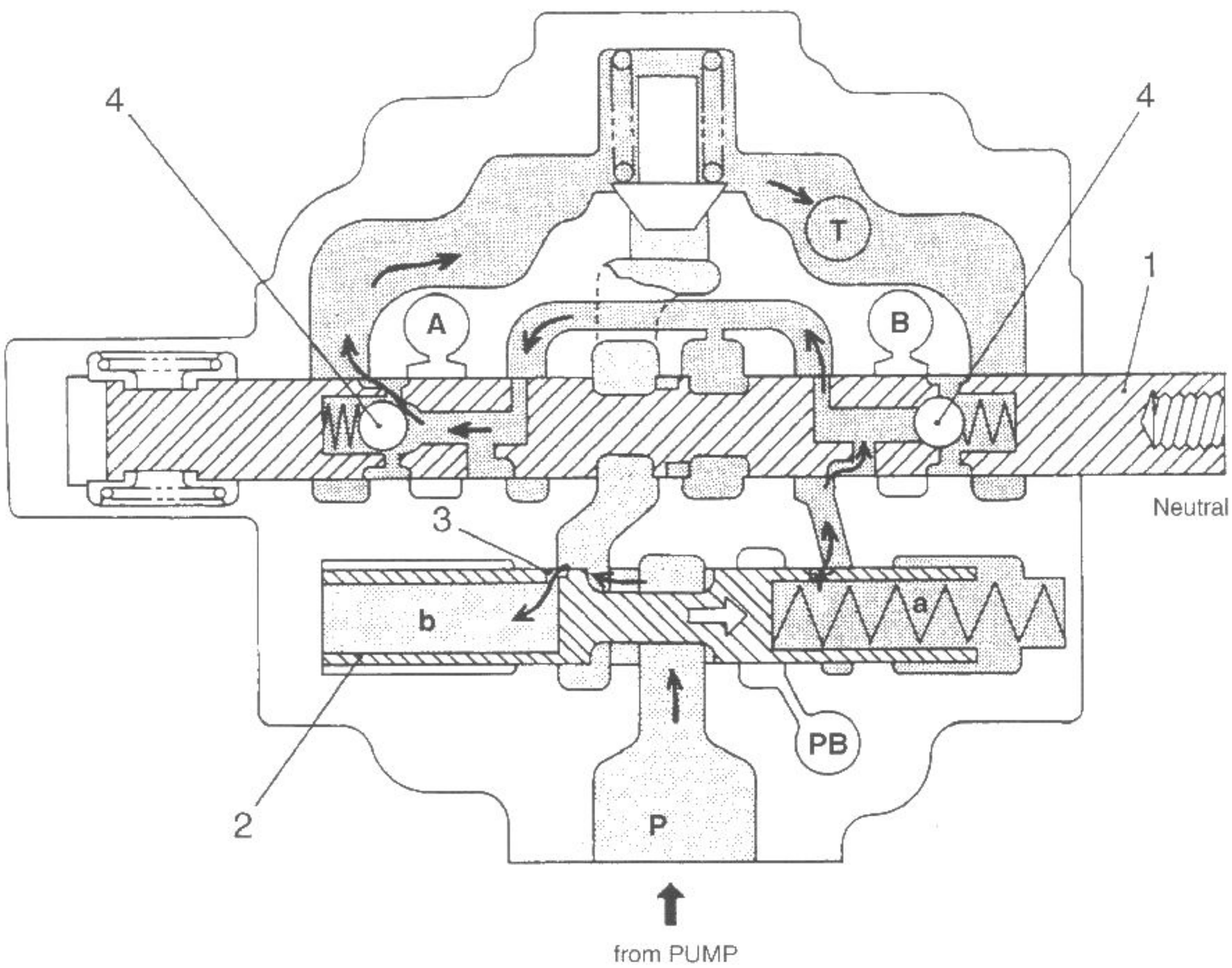


Fig. 4B.9 Neutral

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2. When the steering wheel is turned clockwise

(1) Beginning of rotation

① When the steering wheel is turned clockwise, the steering spool (1) is pushed in by the control linkage.

② The pressurized oil from the port P enters the steering spool (1), passes through the variable orifice (6) and fixed orifice (5) to open the load check valve (4) inside the steering spool, and then flows, passing through the cylinder port B to the steering cylinder.

③ At this time, the opening area of the variable orifice (5) varies proportionately with the movement of steering spool (1). In addition, the pressurized oil (port B) downstream from the variable orifice is directed into the chamber "a" of the carry-over plunger (2) while the pressurized oil upstream from the variable orifice is directed to the chamber "b."

④ The carry-over plunger (2) moves according to the pressure differential between the chambers "a" and "b." This keeps the pressure differential across the variable orifice (5) always constant so that the amount of oil proportional to the movement of the steering spool (1) always flows to port B regardless of the load pressure on the cylinder port.

⑤ Excess oil not used for the steering circuit flows out of the carry-over port (PB).

⑥ The oil returning from the steering cylinder passes through the port A to open the load check valve (4') of the steering spool (1) and then flows, passing through the low-pressurized oil passage and tank port (T), into the oil tank.

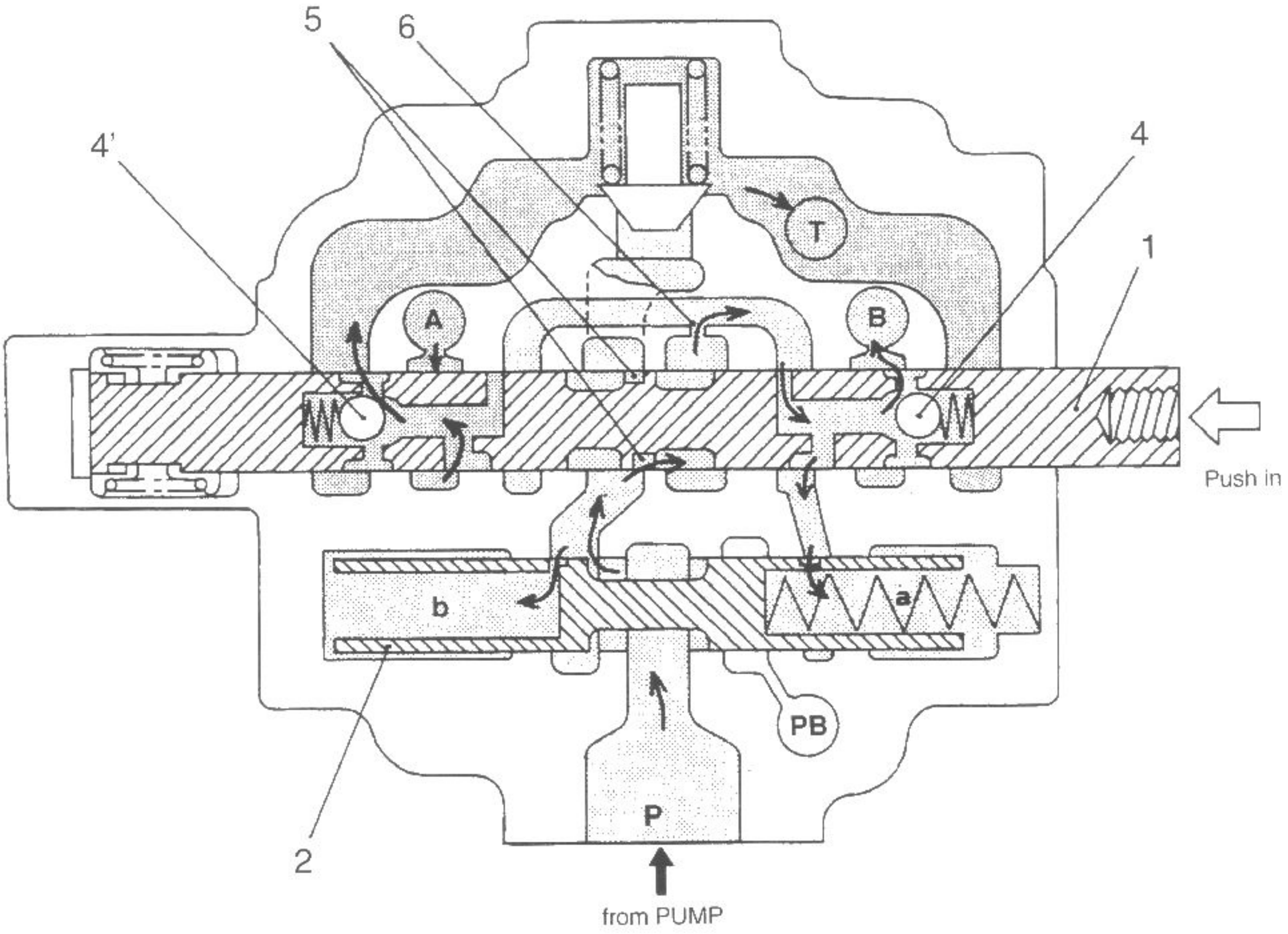


Fig. 4B.10 When Steering Wheel is Turned Clockwise

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(2) When steering wheel is turned clockwise to the full

① When the steering spool is pushed in to the full, the opening area of the variable orifice (5) becomes the maximum to increase the flow rate. This also increases the flow rate of oil sent from the cylinder port B to the steering cylinder. (The steering speed becomes faster.)

Note: The fixed orifice (6) keeps the flow rate of oil from the port P to the cylinder port constant when the steering spool is at the stroke end.

② When the steering wheel is turned further until the front frame comes in contact with the rear frame, the oil pressure in the steering circuit rises to actuate the high-pressure relief valve (7) to let the pressurized oil escape from the low-pressurized oil passage to the tank port (T).

③ The cylinder port is blocked by the load check valve (4) of the steering spool (1).

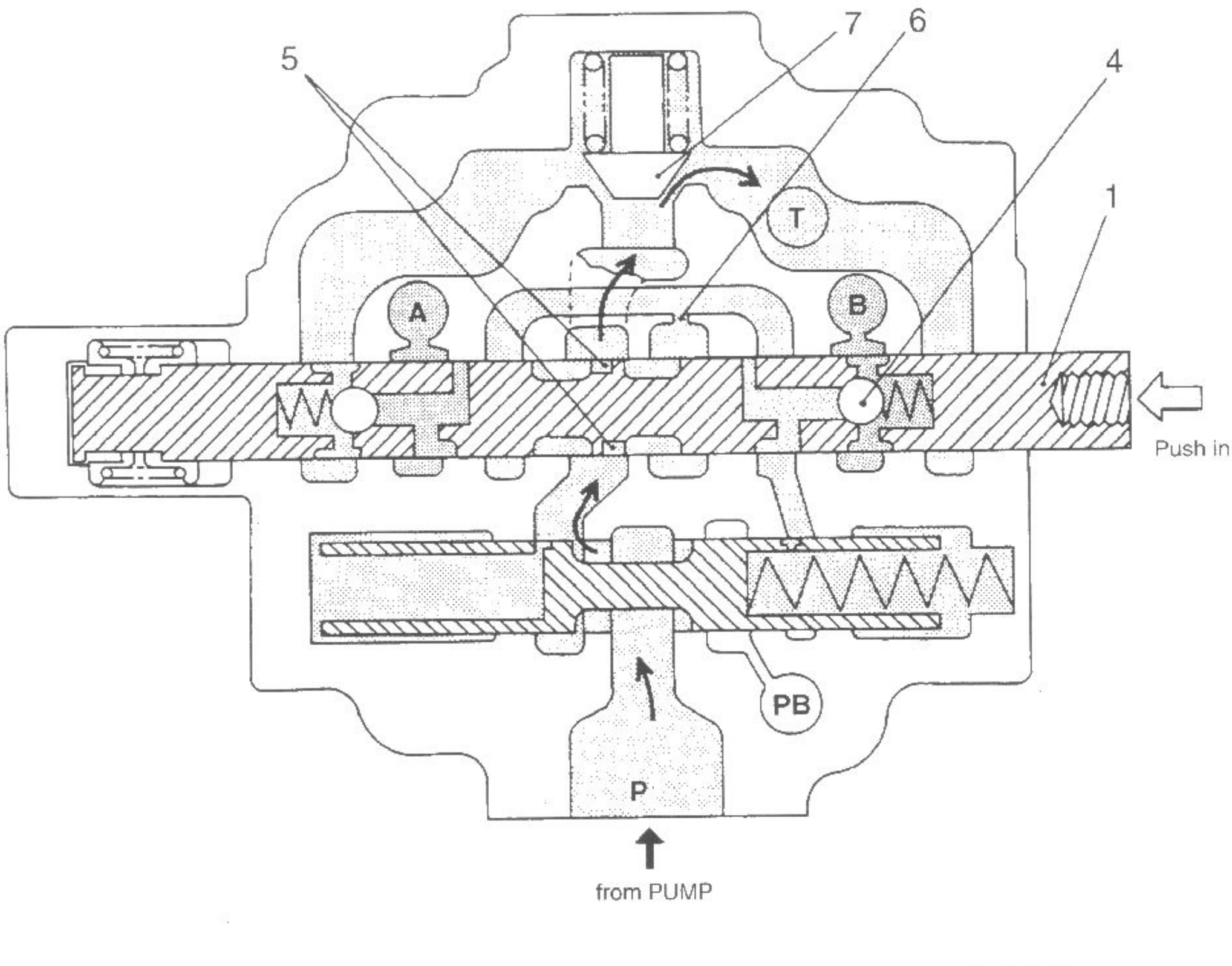


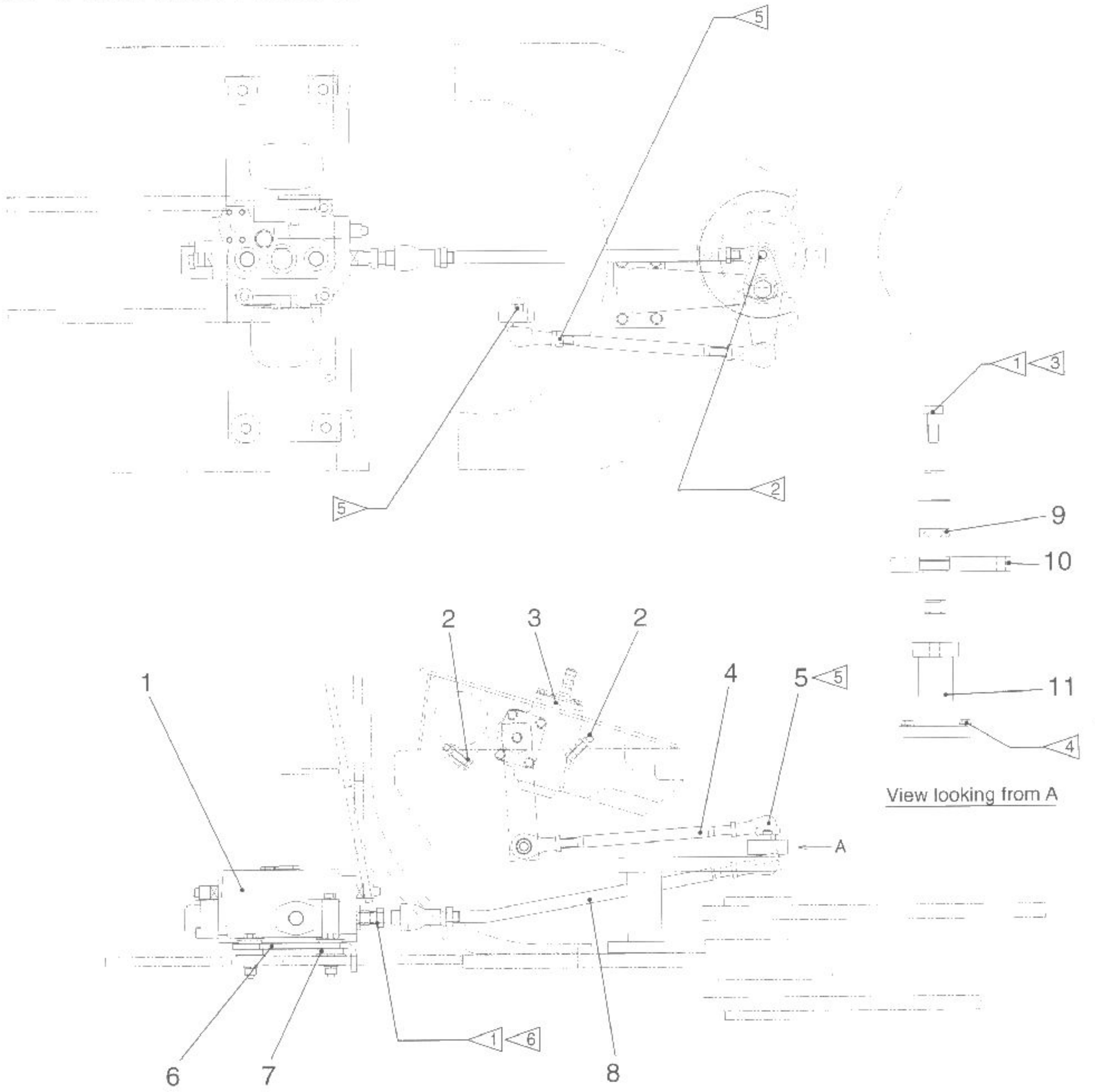
Fig. 4B.11 When Steering Wheel is Turned Clockwise to the Full
(High-pressure relief valve in operation)

3. When steering wheel is turned counterclockwise

When the steering wheel is turned counterclockwise, the steering spool is pulled out. The oil inside the steering valve flows as follows: The pressurized oil from the pump port flows into the cylinder port A while the oil returning from the steering cylinder flows, passing through the cylinder port B and low-pressurized oil passage, and tank port, into the oil tank.

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4B.5 CONTROL LINKAGE



Note: 1▷ Threaded area: LOCTITE#262

2▷ Align with the center of the center hinge pin

3▷ 246 N-m {25.1 kgf-m} [181 lbf-ft]

4▷ 34 N-m {3.5 kgf-m} [25 lbf-ft]

5▷ 87 N-m {8.9 kgf-m} [64 lbf-ft]

6▷ 150 N-m {15.3 kgf-m} [111 lbf-ft]

1. STEERING VALVE
2. STOPPER
3. (STEERING GEAR)
4. ROD
5. BALL JOINT
6. PLATE
7. MOUNTING RUBBER
8. ROD
9. BEARING
10. LINK
11. PIVOT

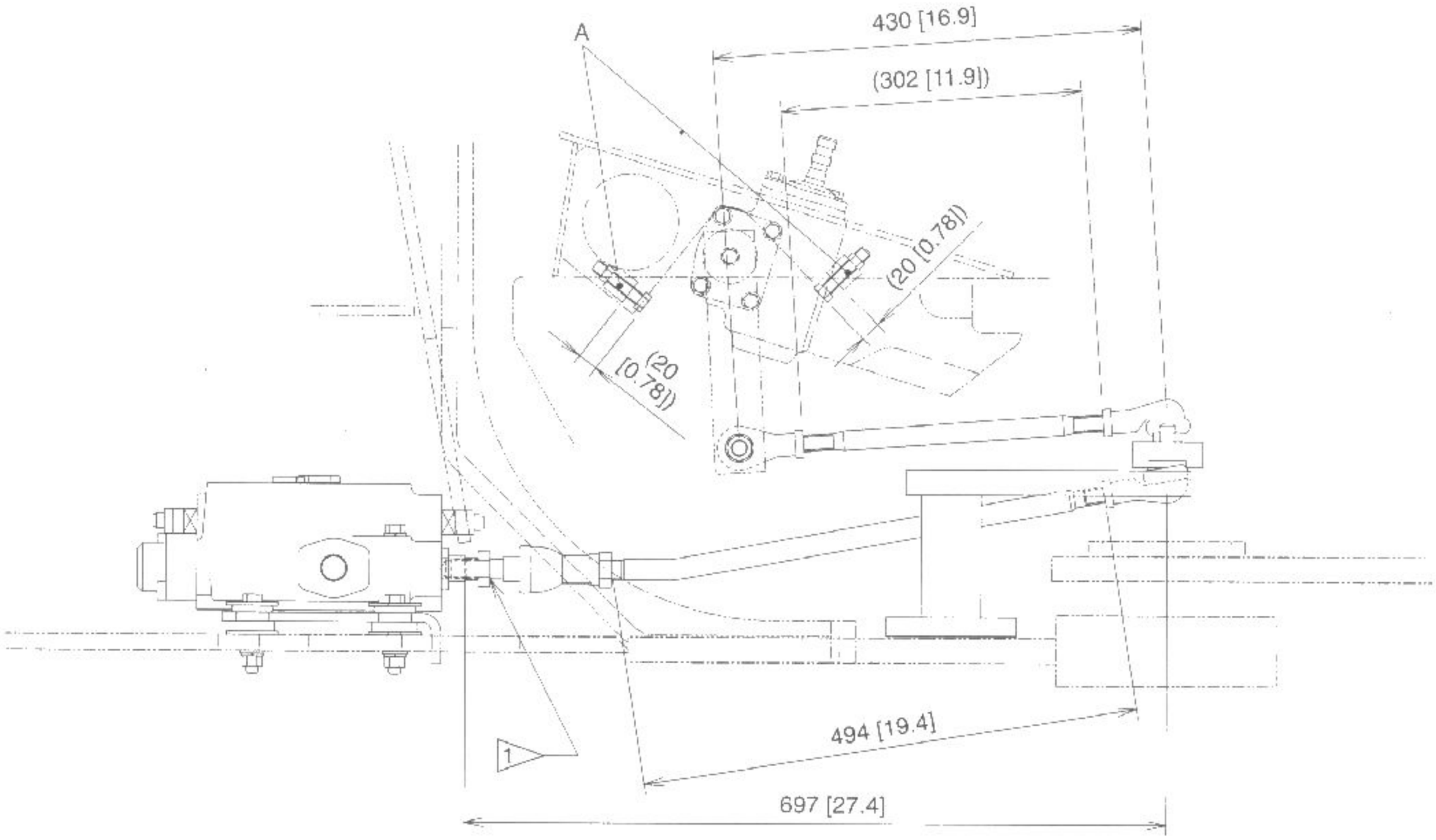
Fig. 4B.12 Control Linkage

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The control linkage of the steering system is connected through the pitman arm attached to the steering gear sector shaft, rod and link, to the steering valve spool. The link of the control linkage is supported by the pivot which is installed on the front frame. The steering valve is installed on the front frame and the steering gear is on the cockpit (rear frame) respectively, so that the steering valve and gear move as each frame does in steering the loader.

As the steering wheel is turned, the control linkage operates the steering valve while feeding back the operation to the steering valve through articulation of the frame.

Unit: mm [in.]



Note: 1 Tighten the screw to the root of the threaded area

<Assembling linkage>

① Adjust the rod length to the value shown on the sketch before assembling the linkage.
② Set the length of the stopper bolt (A) attached to the cockpit to 14 mm [0.55 in.].
③ Turn the loader on the spot and adjust the length of the stopper bolt (A) so that the gap between the front and rear frames becomes 25 mm [0.98 in.].

Fig. 4B.13 Assembling Linkage

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Operation

1. Steering valve in neutral

When the steering wheel is not turned, the steering valve is in neutral. The cylinder ports of the steering valve are closed and no oil flows into the steering cylinders. The loader continues to travel.

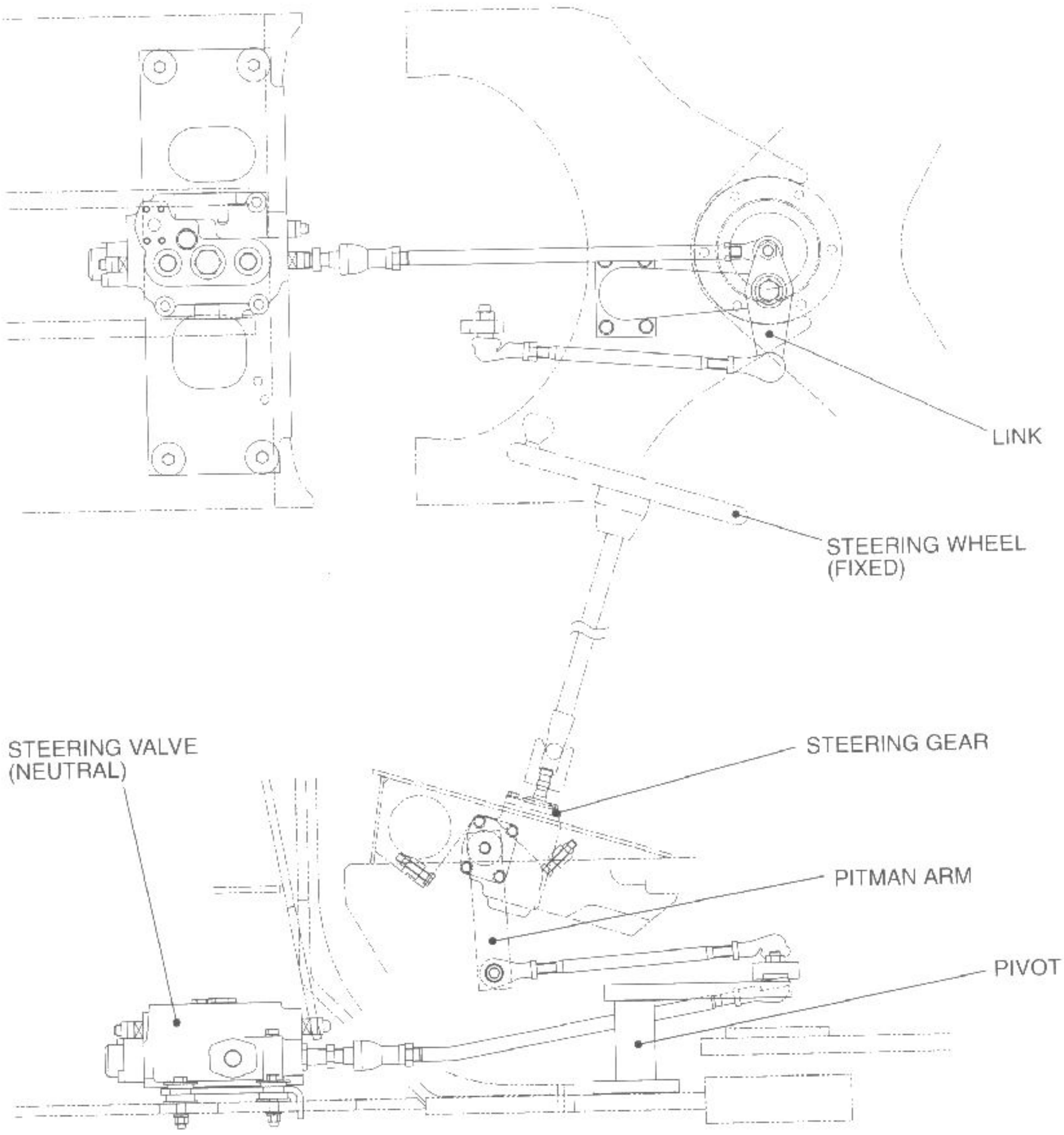


Fig. 4B.14 Steering Valve in Neutral

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2. Turning steering wheel clockwise

(1) Linkage operation

① When turning the steering wheel clockwise, the sector shaft of the steering gear rotates to turn the pitman arm in the direction of the loader rear side.

② The movement of the pitman arm turns the link through the rod, pushing in the steering valve spool.

③ When the steering valve is actuated, the pressurized oil from the steering pump is sent to the steering cylinders, which flexes the front frame in the right direction to turn the loader clockwise.

④ The rotation angle of the steering wheel controls the angles of the sector shaft and pitman arm, i.e. the changing amount of the link position. Therefore, the turning radius of the loader varies with the rotation angle of the steering wheel.

⑤ The operation speed of the linkage is determined by the rotation speed of the steering wheel, and changes the opening of the oil passage to the cylinder port. The steering speed becomes slow by turning the steering wheel slowly and it becomes fast by turning it fast.

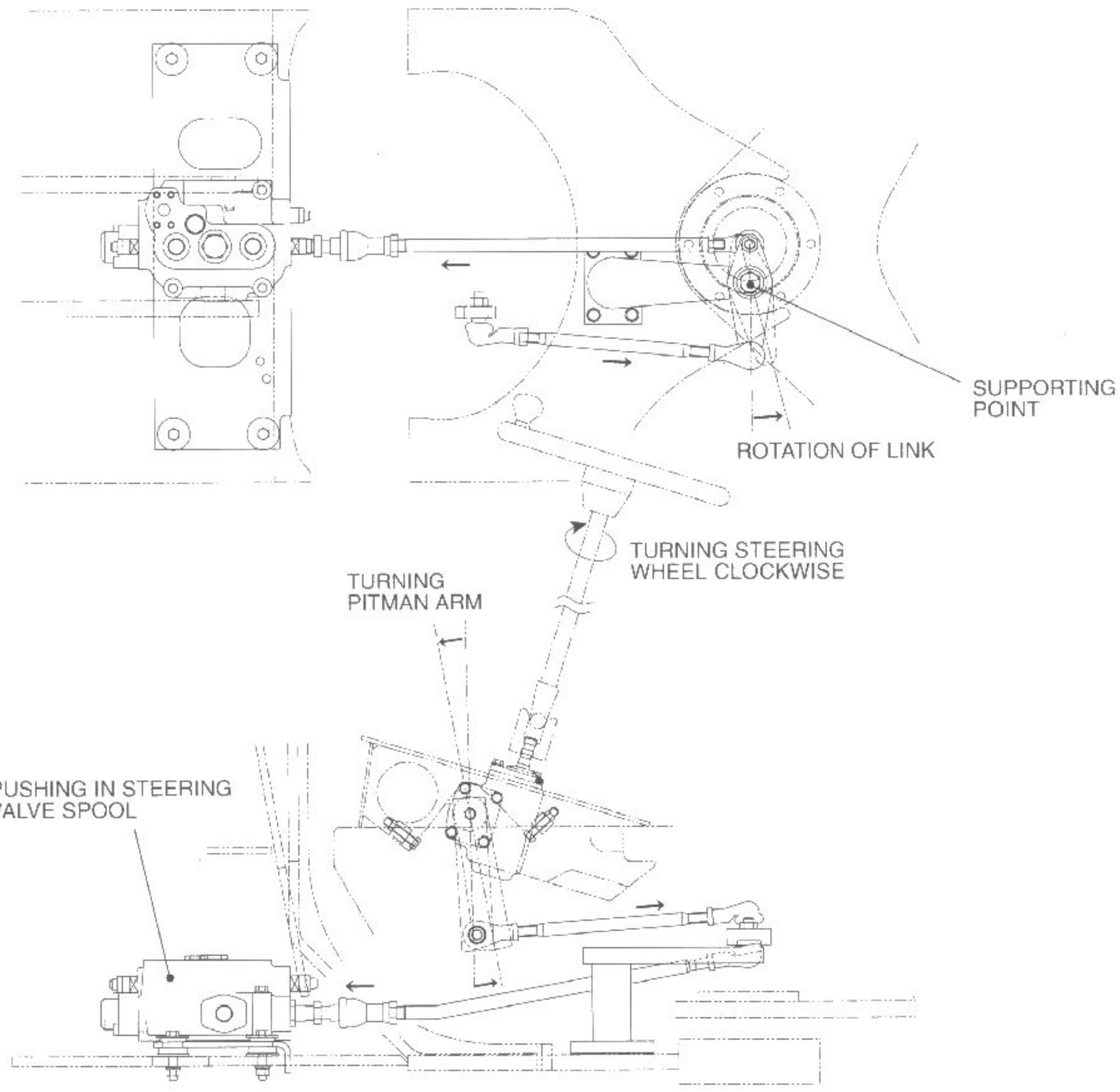


Fig. 4B.15 Turning Steering Wheel Clockwise

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(2) Feedback operation of linkage

① After turning the steering wheel clockwise, stop and keep it as it is. Then the steering linkage stops.
② The steering valve spool is inserted, the steering cylinder operation continues, and the front frame is bent in the right direction.
③ The link is turned through the pivot by flexing the front frame, and the steering valve spool is pulled in the neutral position.
④ Then, the front frame stops flexing and the loader continues to rotate with its steering angle. Flexing radius according to the rotation angle of the steering wheel.

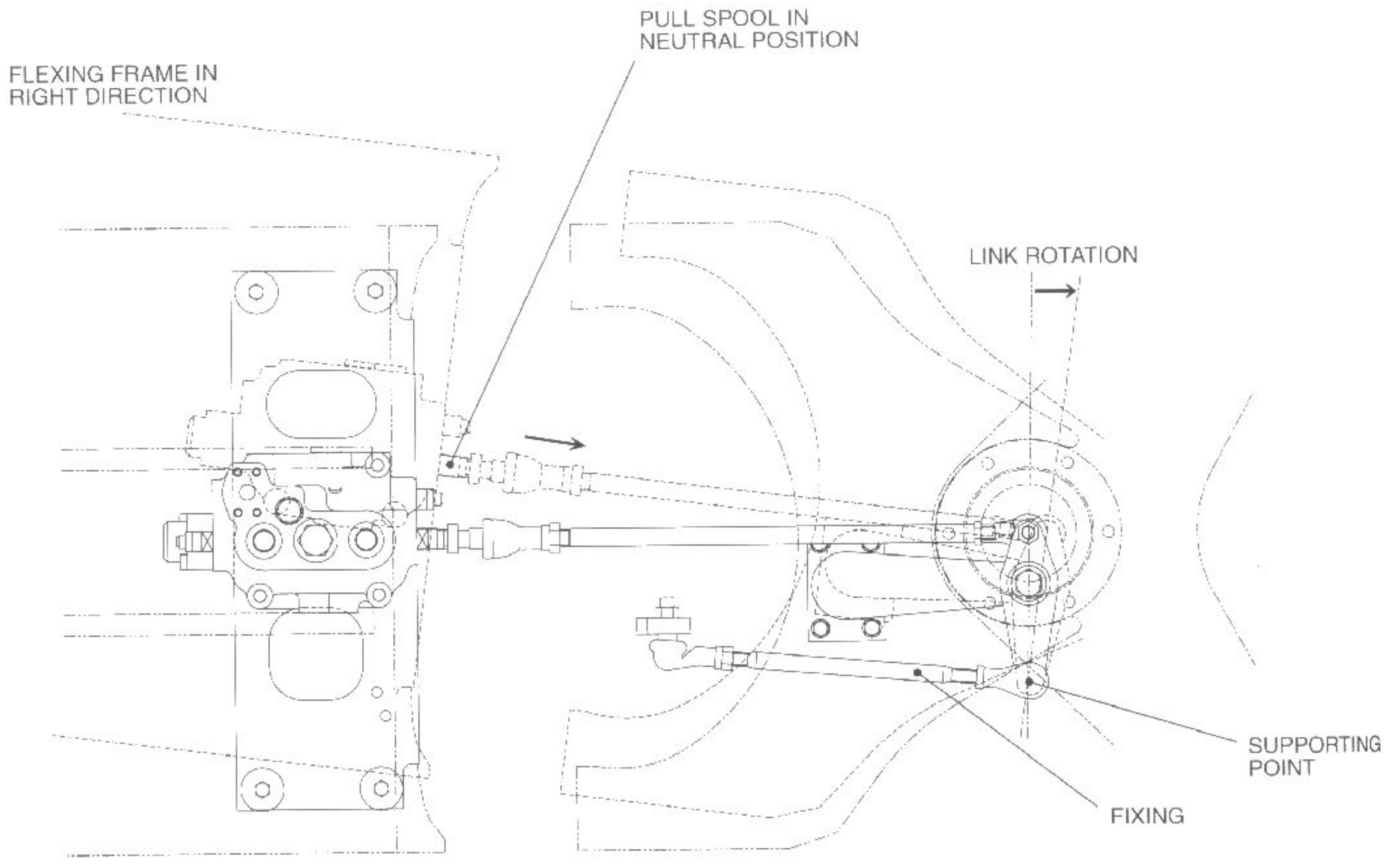


Fig. 4B.16 Feedback Operation of Linkage

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3. Turning steering wheel counterclockwise

When the steering wheel is turned counterclockwise, the steering valve spool is pulled out. The pressurized oil flows in the direction opposite to the one that the oil flows when the steering wheel is turned clockwise, thus articulating the front frame to the left to turn the loader to the left.

The feedback motion of the linkage is also opposite to the one achieved when the steering wheel is turned clockwise, thus returning the steering valve spool to neutral.

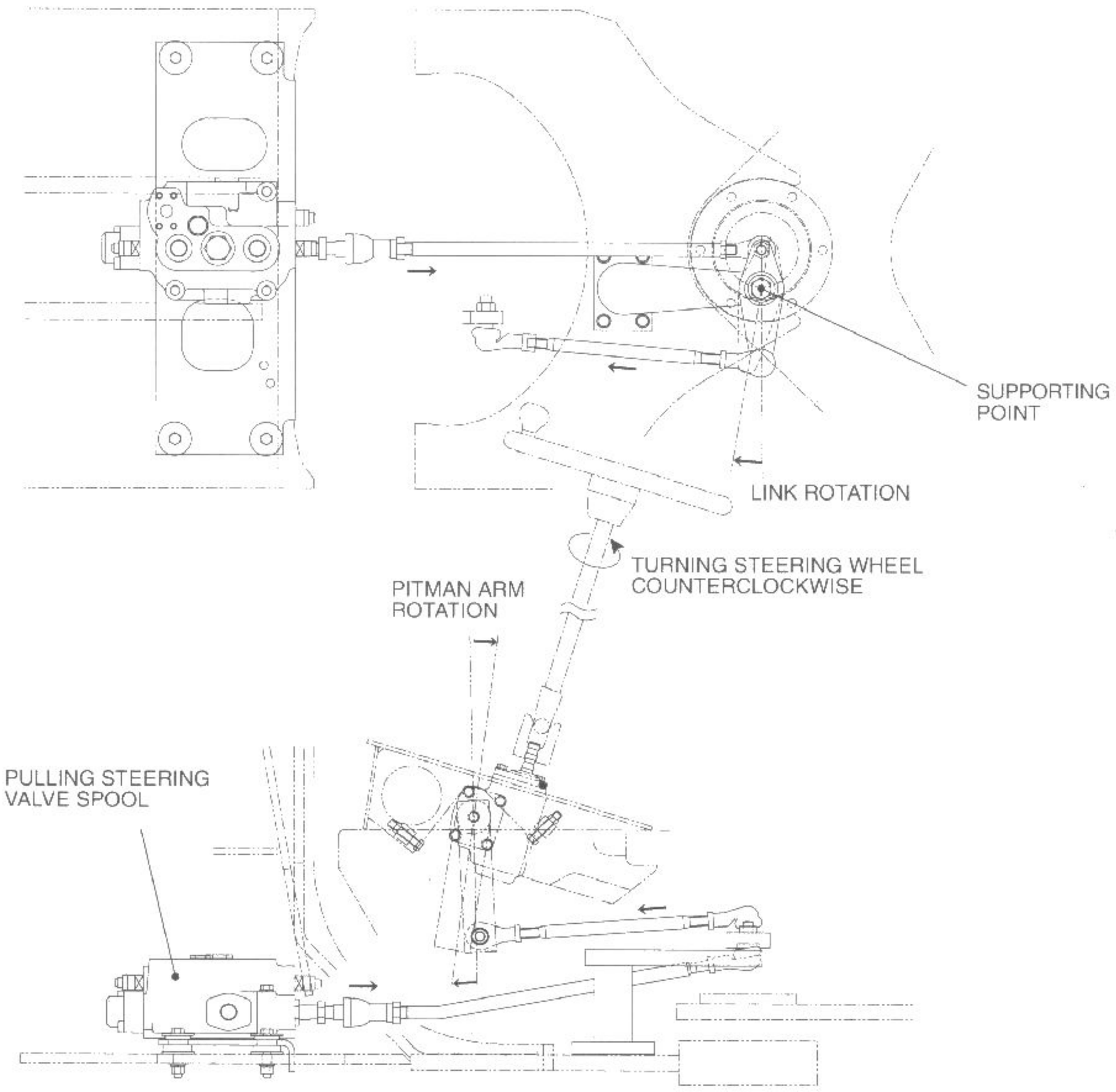
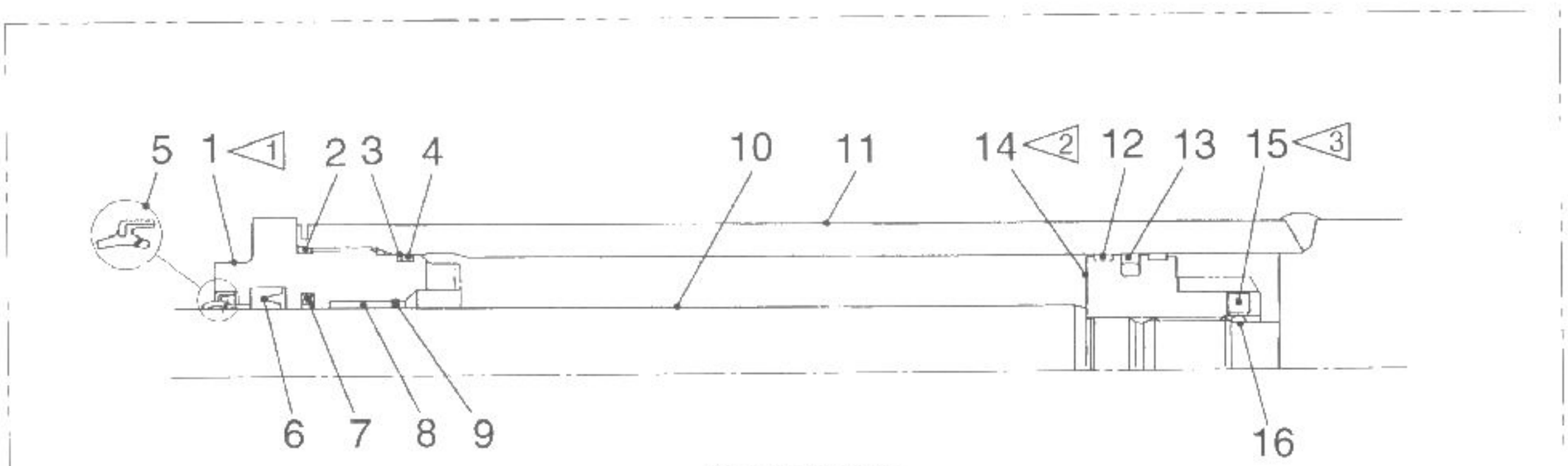


Fig. 4B.17 Turning Steering Wheel Counterclockwise

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4B.6 STEERING CYLINDER

Two steering cylinders of double acting piston type are used, with the cylinder tube and piston rod connected to the front and rear frame respectively. The steering cylinders are operated by the pressurized oil from the steering valve, and when one cylinder extends, the other retracts. The loader is steered in the direction of the retracting cylinder.





Note: 1 450 N-m {46 kgf-m} [332 lbf-ft], Threaded area: THREEBOND#1901
2 890 N-m {91 kgf-m} [657 lbf-ft]
3 16.2 N-m {1.65 kgf-m} [11.9 lbf-ft] (After tightening, calk 2 parts around the bolt.)
4 Pressure check port (PT 1/8)

1. CYLINDER HEAD
2. "O"-RING
3. BACK-UP RING
4. "O"-RING
5. WIPER RING
6. U-RING
7. BUFFER RING
8. BUSHING
9. SNAP RING
10. PISTON ROD
11. CYLINDER TUBE
12. SLIDE RING
13. SEAL RING/"O"-RING
14. PISTON
15. SET SCREW
16. STEEL BALL
17. SPHERICAL BEARING
18. SNAP RING
19. PLUG

Fig. 4B.18 Steering Cylinder

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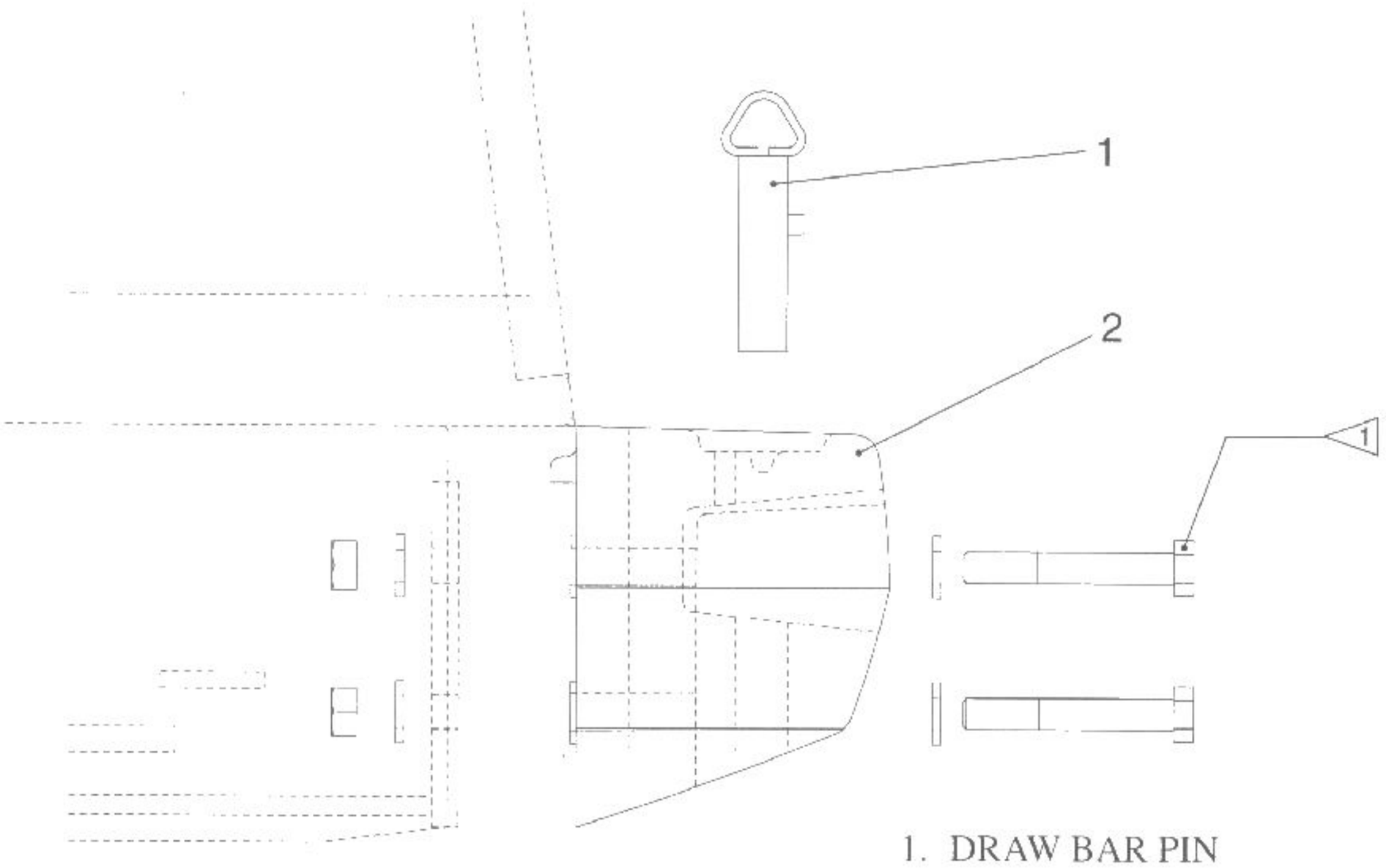
5. FRAME AND COCKPIT

5.1 FRAME

The frame is a steel-plate welded type and divided into two parts: front and rear frames. The cockpit and operator's seat are mounted on the rear frame.

⚠ Do not try to modify the ROPS (Roll-over protection structure), if mounted, without prior permission from the manufacturer. If the ROPS should get damaged or deformed due to turning over or collision, it is advisable to replace it with a new one, because a damaged or deformed ROPS has a low structural strength.

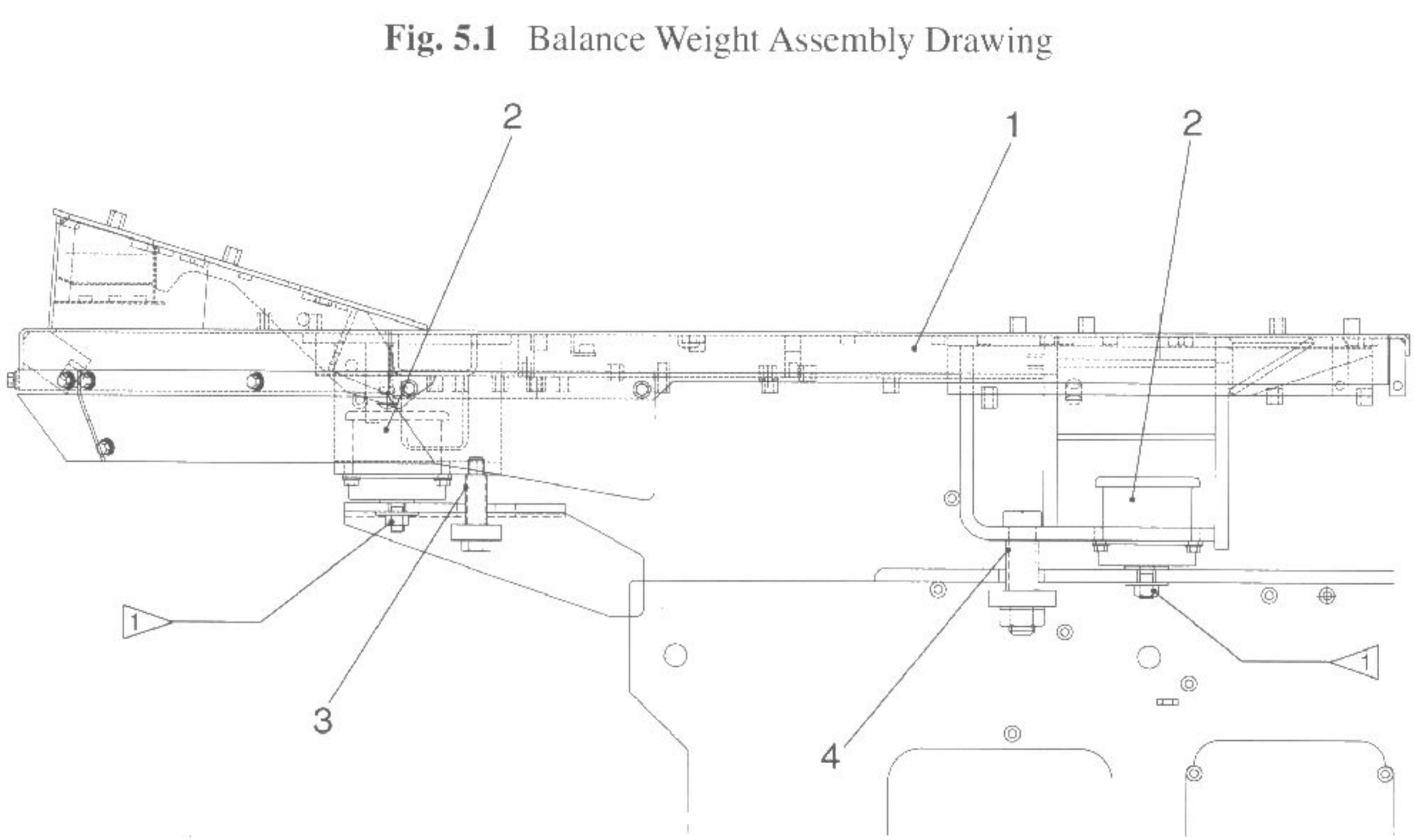
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Note: 1 ▷ 1510 N-m {154 kgf-m} [1110 lbf-ft]

1. DRAW BAR PIN
2. BALANCE WEIGHT
   1100 kg [2430 lbs] for L27-3, LX130-7
   1860 kg [4100 lbs] for L32-3, LX160-7
   1360 kg [3000 lbs] for L35-3, LX190-7
   2320 kg [5110 lbs] for L40-3, LX230-7

Fig. 5.1 Balance Weight Assembly Drawing

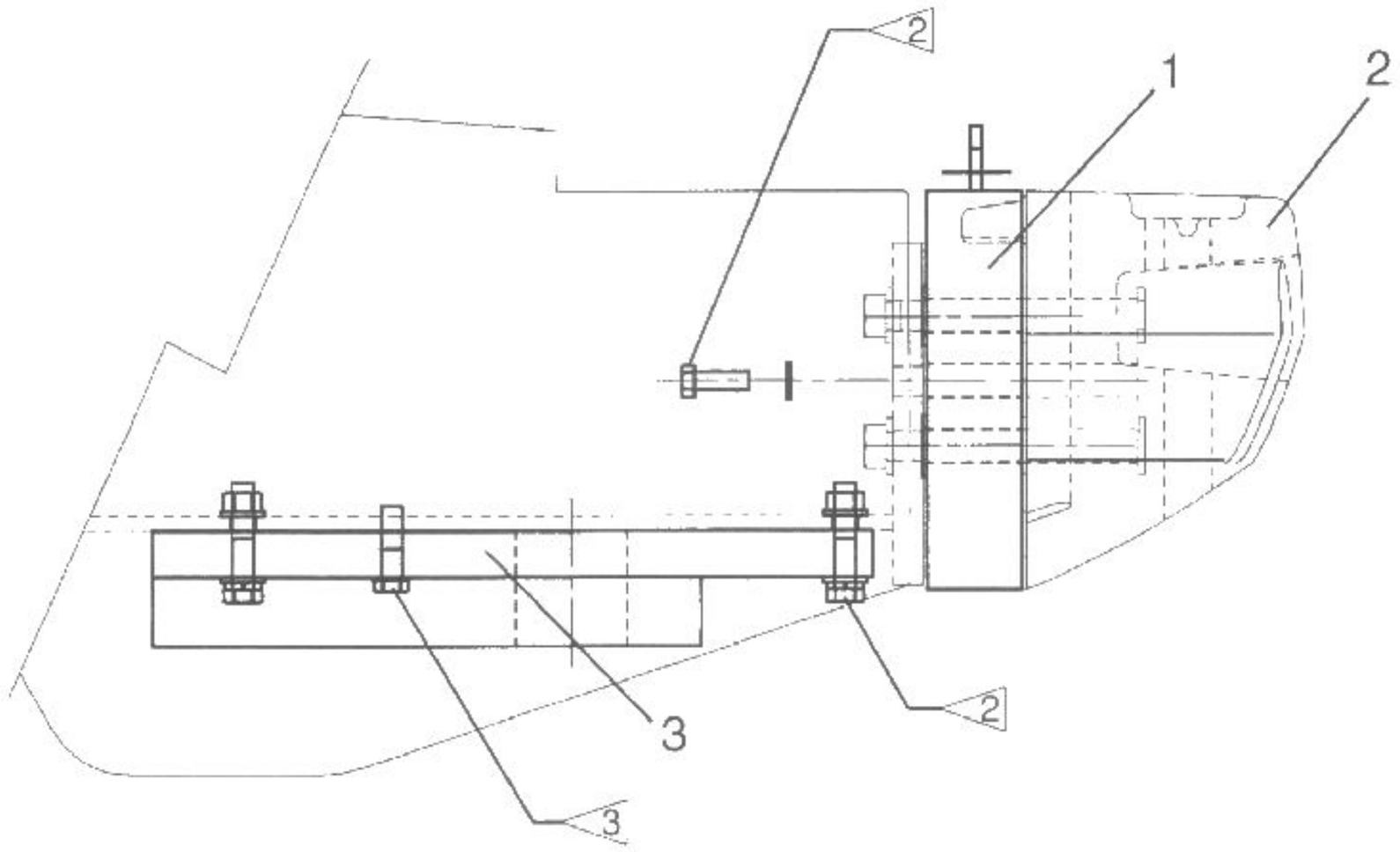


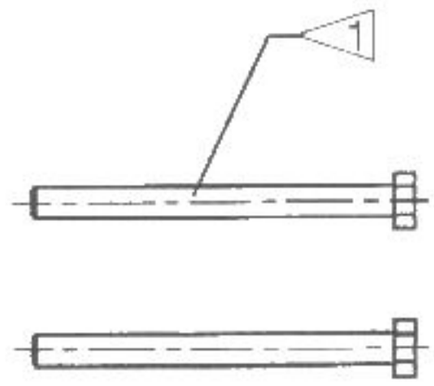
Note: 1 ▷ 224 N-m {22.8 kgf-m} [165 lbf-ft]
Threaded area: LOCTITE#262

1. COCKPIT
2. RUBBER MOUNT
3. SPACER
4. SPACER

Fig. 5.2 Cockpit Assembly Drawing

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1. Additional weight A
2. Standard weight
3. Additional weight B

Weight mass

	Additional weight A	Additional weight B
L27-3, LX130-7	565 kg [1246 lbs]	448 kg [988 lbs]
L32-3, LX160-7	282 kg [622 lbs]	448 kg [988 lbs]
L35-3, LX190-7	2320 kg (*) [5116 lbs]	240 kg [529 lbs]
L40-3, LX230-7	318 kg [701 lbs]	931 kg [2053 lbs]

(*) On the L35-3 and LX190-7, replace the standard weight.

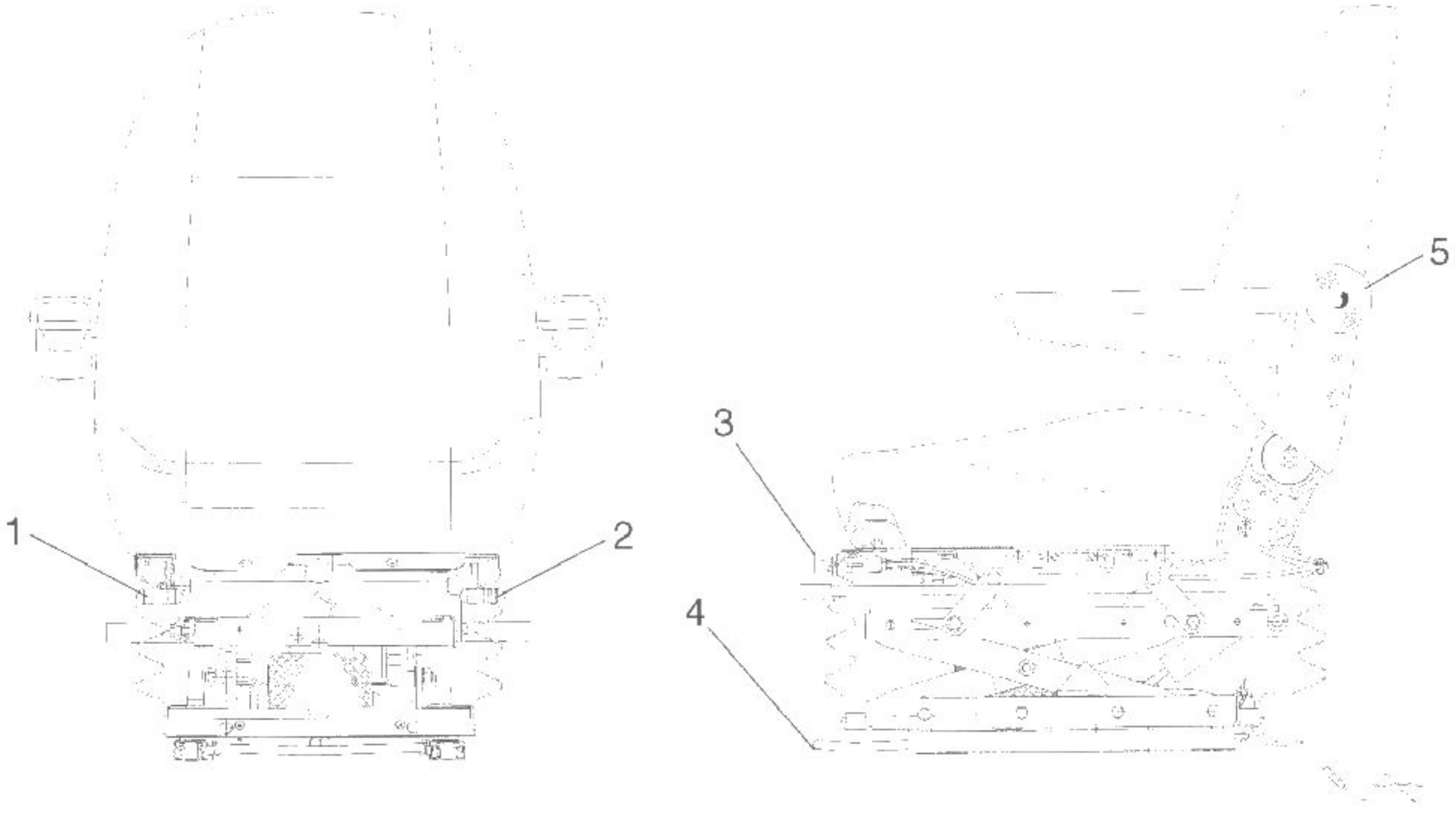
Note: 1 1510 N-m {154 kgf-m} [1113 lbf-ft]
2 171 N-m {17.4 kgf-m} [126 lbf-ft]
3 782 N-m {79.7 kgf-m} [576 lbf-ft]

Fig. 5.3 Assembling Additional Weight (option)

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Air suspension seat (option)

The air suspension seat can be adjusted regarding the hardness (height) of the seat pan by using the air valve control lever at the front part of the seat. The adjustment of the seat pan is performed by the air compressor built in the seat.



1. RECLINING SEAT LEVER
2. SEAT ANGLE AND HEIGHT CONTROL LEVER
3. AIR VALVE CONTROL LEVER
4. SLIDE LEVER
5. LUMBAR SUPPORT

Fig. 5.4 Air Suspension Seat

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5.2 CENTER HINGE PIN

The loader is a frame-articulated type: the front frame is joined to the rear frame with two hinge pins around which the loader pivots for steering.

⚠ When the loader is steered, the area near the center hinge pins becomes so narrow that you might get caught between the front and rear frames. Before trying to service the loader, make sure to set the safety link.

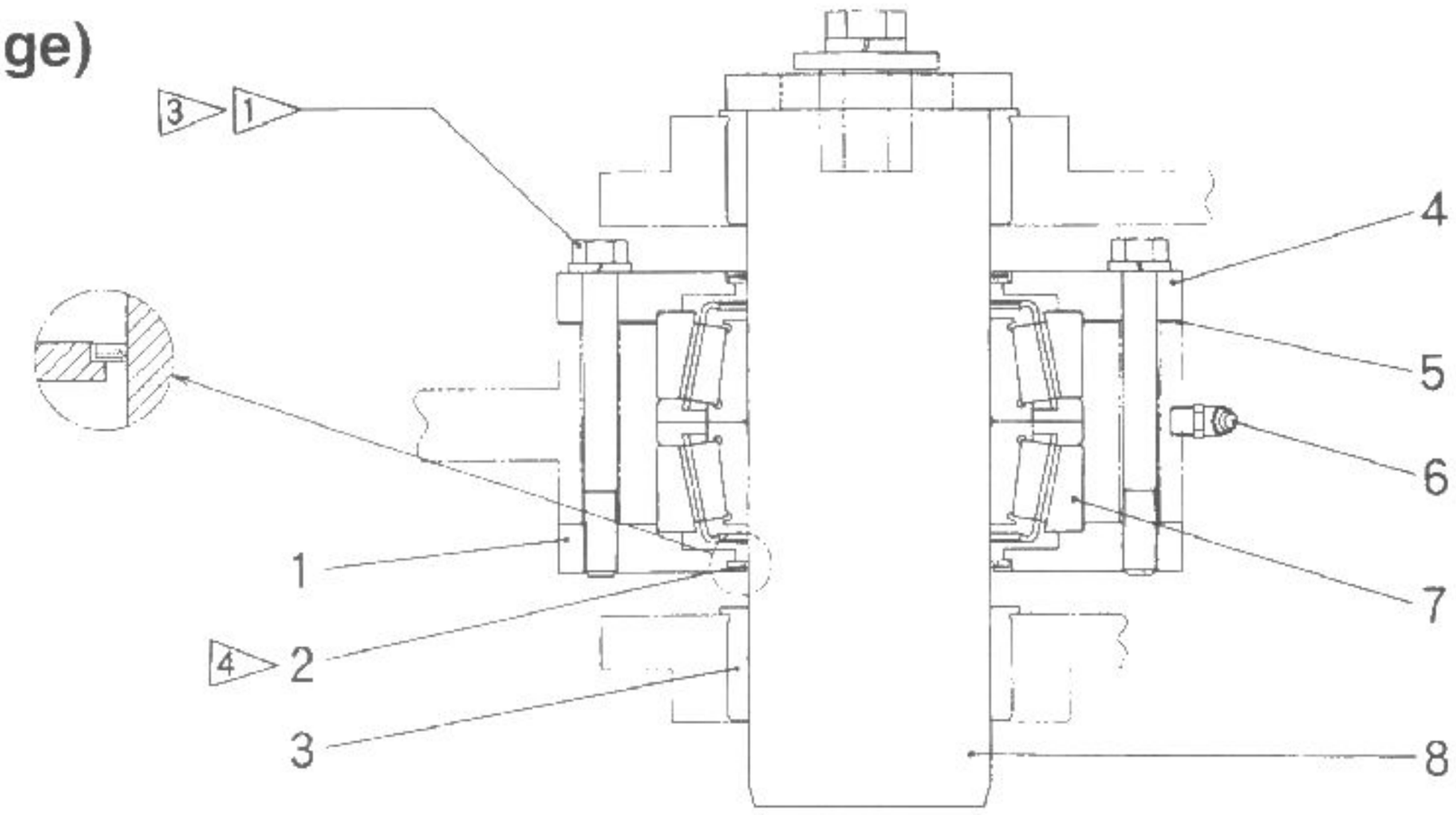
Prior to moving (traveling) the loader, make sure the safety link is set at the original position.

(When servicing the loader)

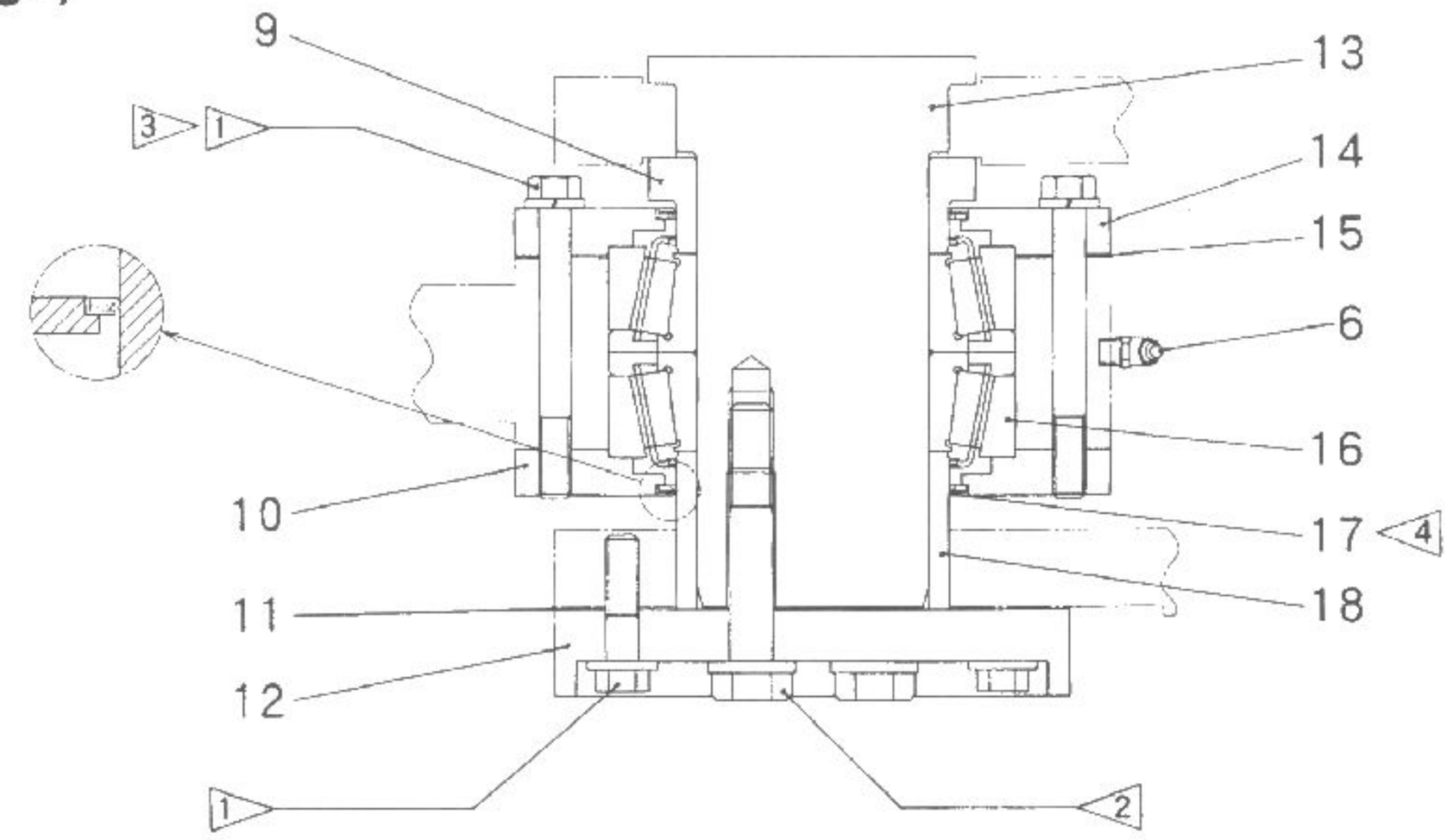
Fig. 5.5 Safety Link

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(Upper hinge)



(Lower hinge)



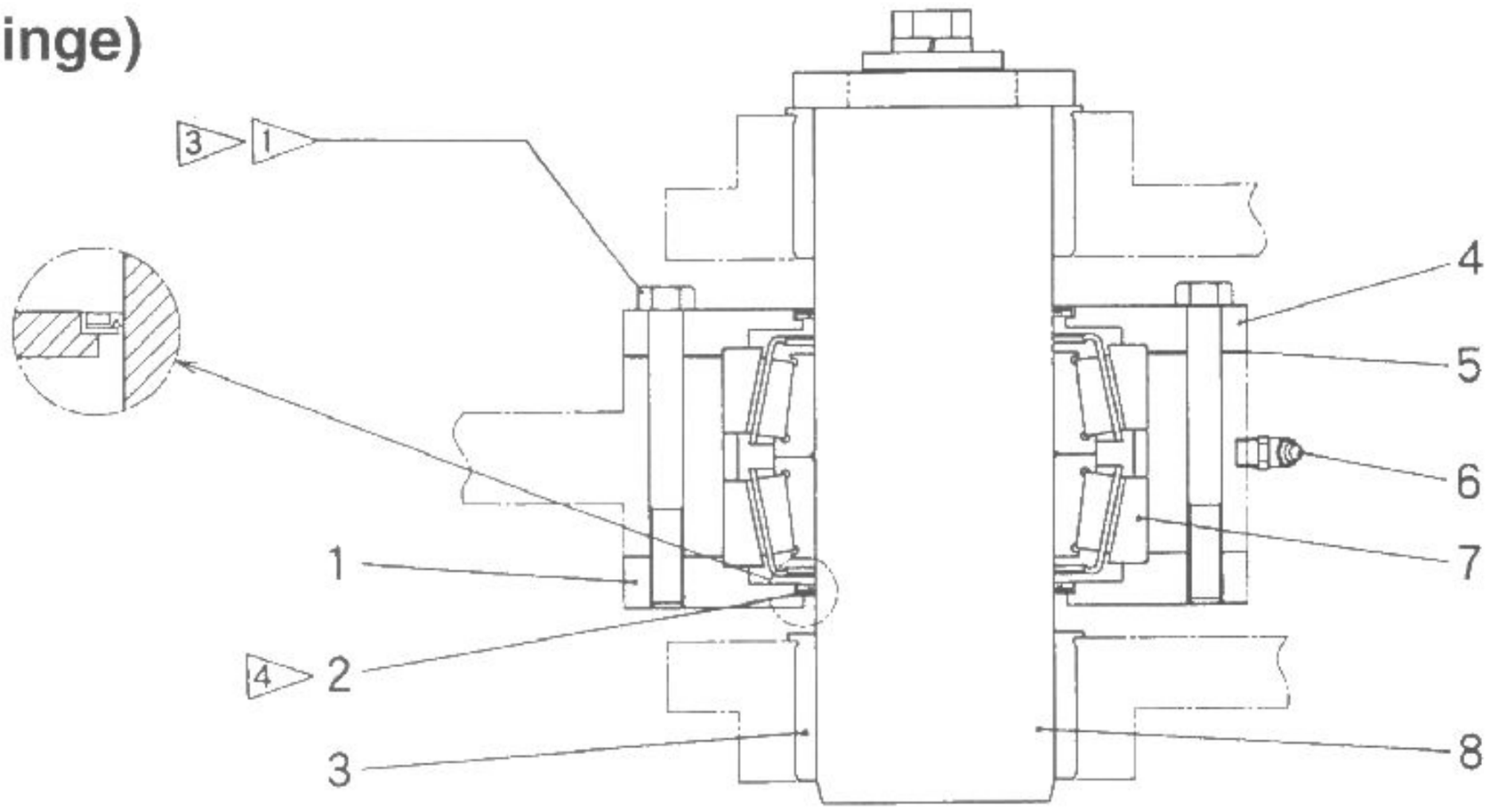
Note: 1 88 N-m {9.0 kgf-m} [65 lbf-ft]
2 224 N-m {22.8 kgf-m} [165 lbf-ft]
3 Threaded area: LOCTITE#262
4 Outer ring area: LOCTITE#262

1. CAP
2. DUST SEAL
3. BUSHING
4. CAP
5. SHIM
6. GREASE FITTING
7. BEARING
8. PIN
9. BUSHING
10. CAP
11. SHIM
12. WASHER
13. PIN
14. CAP
15. SHIM
16. BEARING
17. DUST SEAL
18. BUSHING

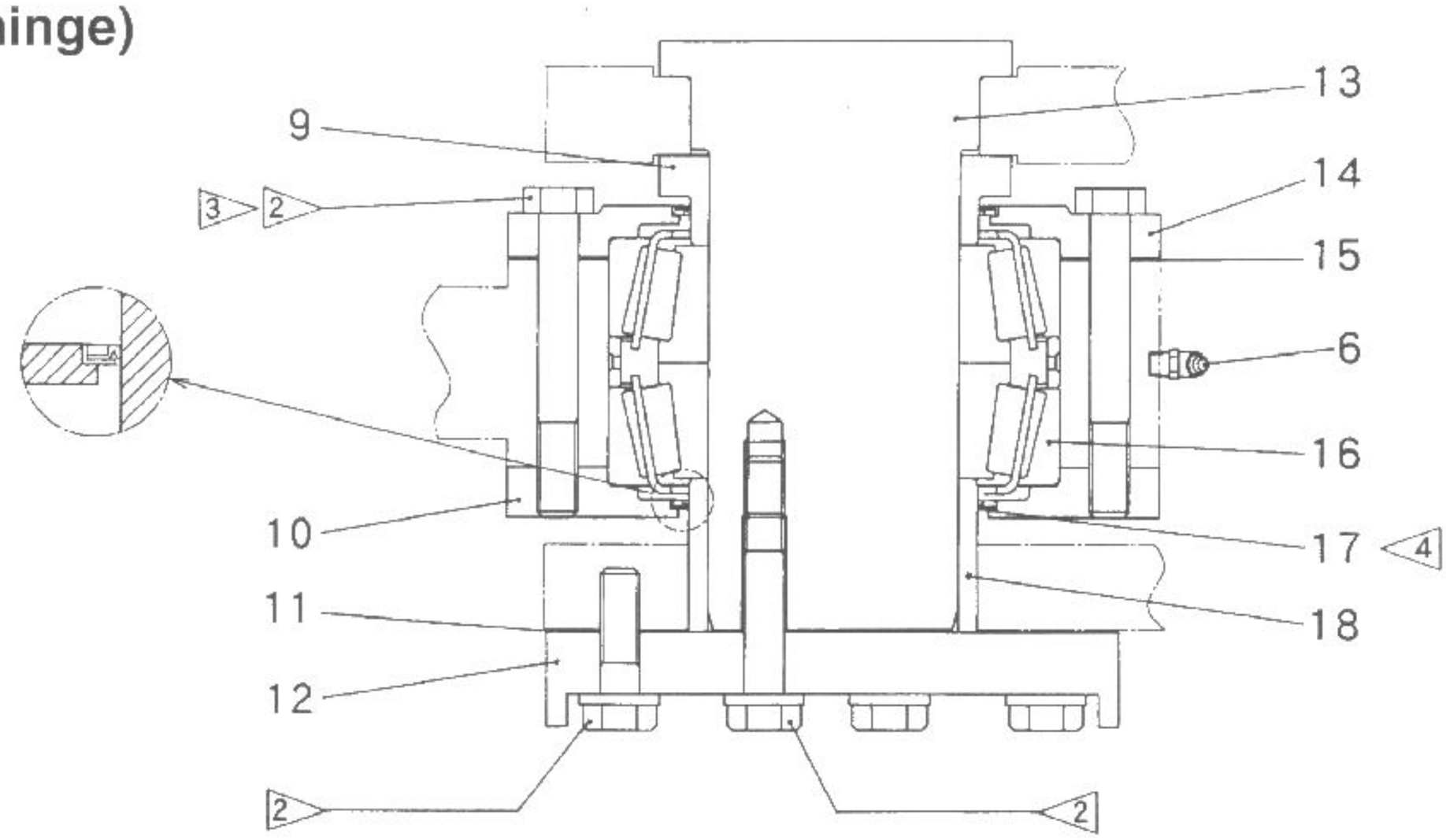
Fig. 5.6 Center Hinge (L27-3, LX130-7 · L32-3, LX160-7)

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(Upper hinge)



(Lower hinge)



Note: 1 88 N-m {9.0 kgf-m} [65 lbf-ft] 2 224 N-m {22.8 kgf-m} [165 lbf-ft]
3 Threaded area: LOCTITE#262 4 Outer ring area: LOCTITE#262

1. CAP
2. DUST SEAL
3. BUSHING
4. CAP
5. SHIM
6. GREASE FITTING
7. BEARING
8. PIN
9. BUSHING
10. CAP
11. SHIM
12. WASHER
13. PIN
14. CAP
15. SHIM
16. BEARING
17. DUST SEAL
18. BUSHING

Fig. 5.7 Center Hinge (L35-3, LX190-7 · L40-3, LX230-7)

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NOTE

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6. HYDRAULIC SYSTEM

The hydraulic system uses the main pump as its power source and directs oil flow with the main valve according to the work you want to do.

The hydraulic system uses the pilot operation control method that combines the pilot valve with the main valve to reduce the valve operating force.

The hydraulic system consists of the main pump, valves, valve controls, oil tank and hydraulic piping.

6.1 OIL CIRCULATION ROUTES (HYDRAULIC CIRCUIT DIAGRAM)

The hydraulic circuit of the loader consists of the main hydraulic circuit, pilot hydraulic circuit, steering hydraulic circuit and brake hydraulic circuit.

For the steering hydraulic circuit, refer to "4A.2, 4B.2 OIL CIRCULATION ROUTES."

For the brake hydraulic circuit, refer to "3. BRAKE SYSTEM."

1. Main hydraulic circuit

The oil picked up from the oil tank by the main pump is sent under pressure to the main valve. The pressurized oil which is not used for the steering circuit is sent from the steering valve to the main valve.

When the main valve is in neutral, the pressurized oil passes through the main valve back into the oil tank.

When the main valve is changed over, the pressurized oil is sent to the boom cylinders or the bucket cylinder to operate the cylinder. The oil discharged from the cylinder returns into the main valve which in turn sends the oil into the oil tank.

Unloading system

The main pump uses the unloading system.

When the oil pressure in the main circuit is lower than the specified pressure, the oil discharged from the main and steering pumps is used.

When the oil pressure in the main circuit becomes higher than the specified pressure, the main pump stops discharging oil and starts unloading operation.

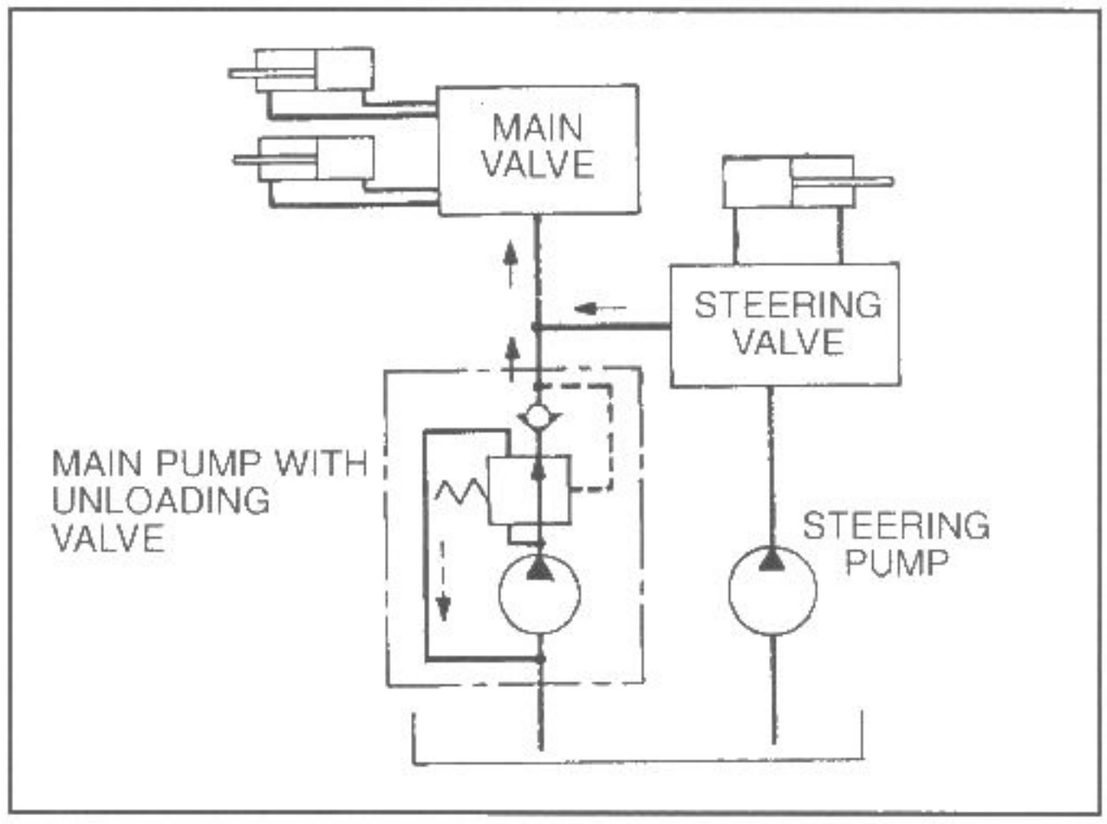


Fig. 6.1 Unloading System

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2. Pilot hydraulic circuit

The oil picked up from the oil tank by the brake & assist pump is adjusted as to the pressure by using the charging valve and accumulated in the accumulator. The oil drained off by the charging valve is cooled by the oil cooler and returned into the oil tank. The oil cooler is integrated with the radiator. For its structure, refer to "1.3 COOLING SYSTEM."

The pressurized oil in the accumulator passes through the stop valve to the pilot valve.

When the pilot valve is changed over by actuating the load handling lever, the pressurized oil is sent to the pilot port of the main valve to move the main valve spool. The oil discharged from the opposite side of the spool returns into the pilot valve which in turn sends the oil into the oil tank.

The pressurized oil in the accumulator is used for both the pilot hydraulic circuit and the brake hydraulic circuit. (See "3. BRAKE SYSTEM.")

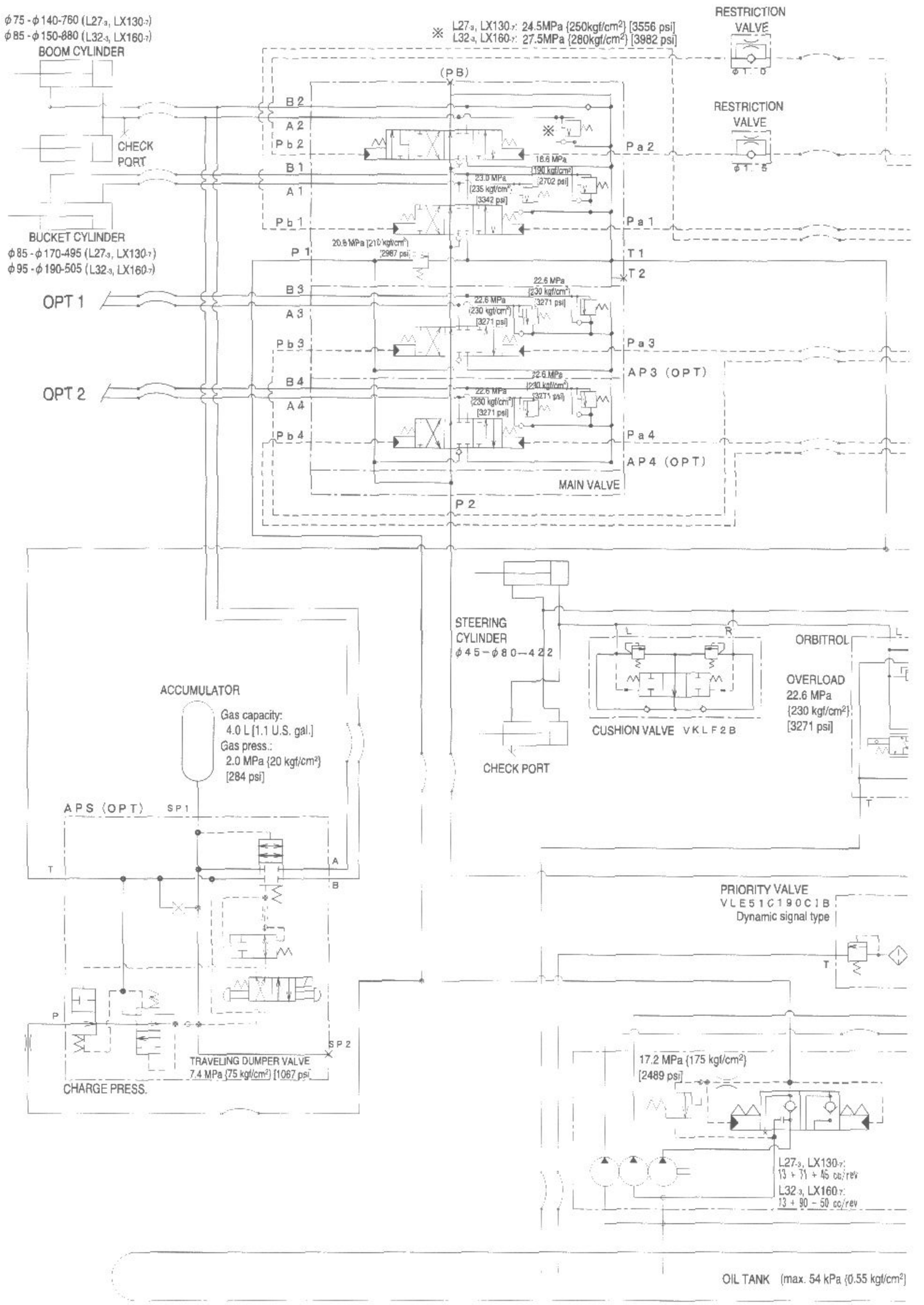
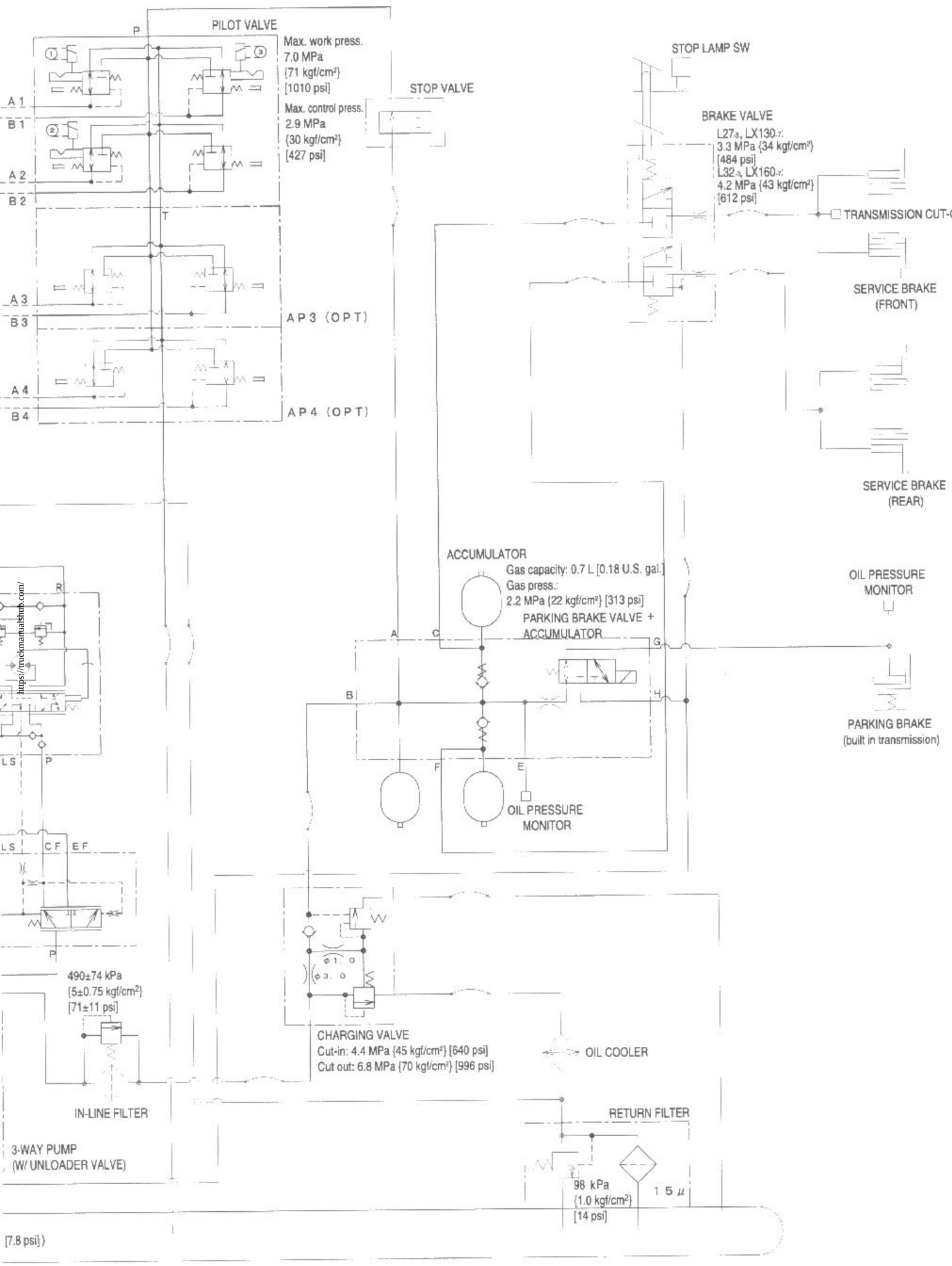


Fig. 6.2 Hydraulic Circuit Di

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ıgram (L27-3, LX130-7 · L32-3, LX160-7)

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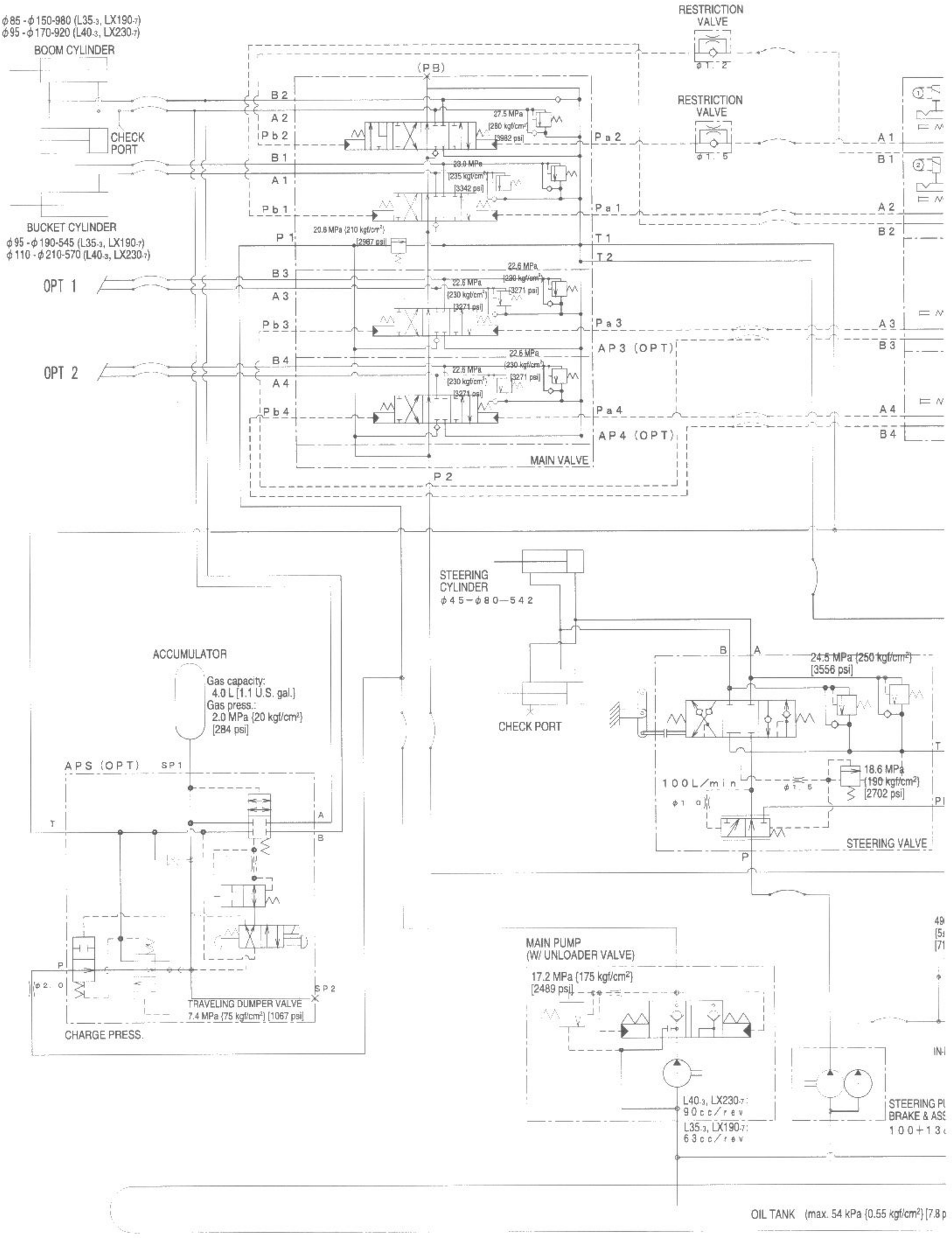
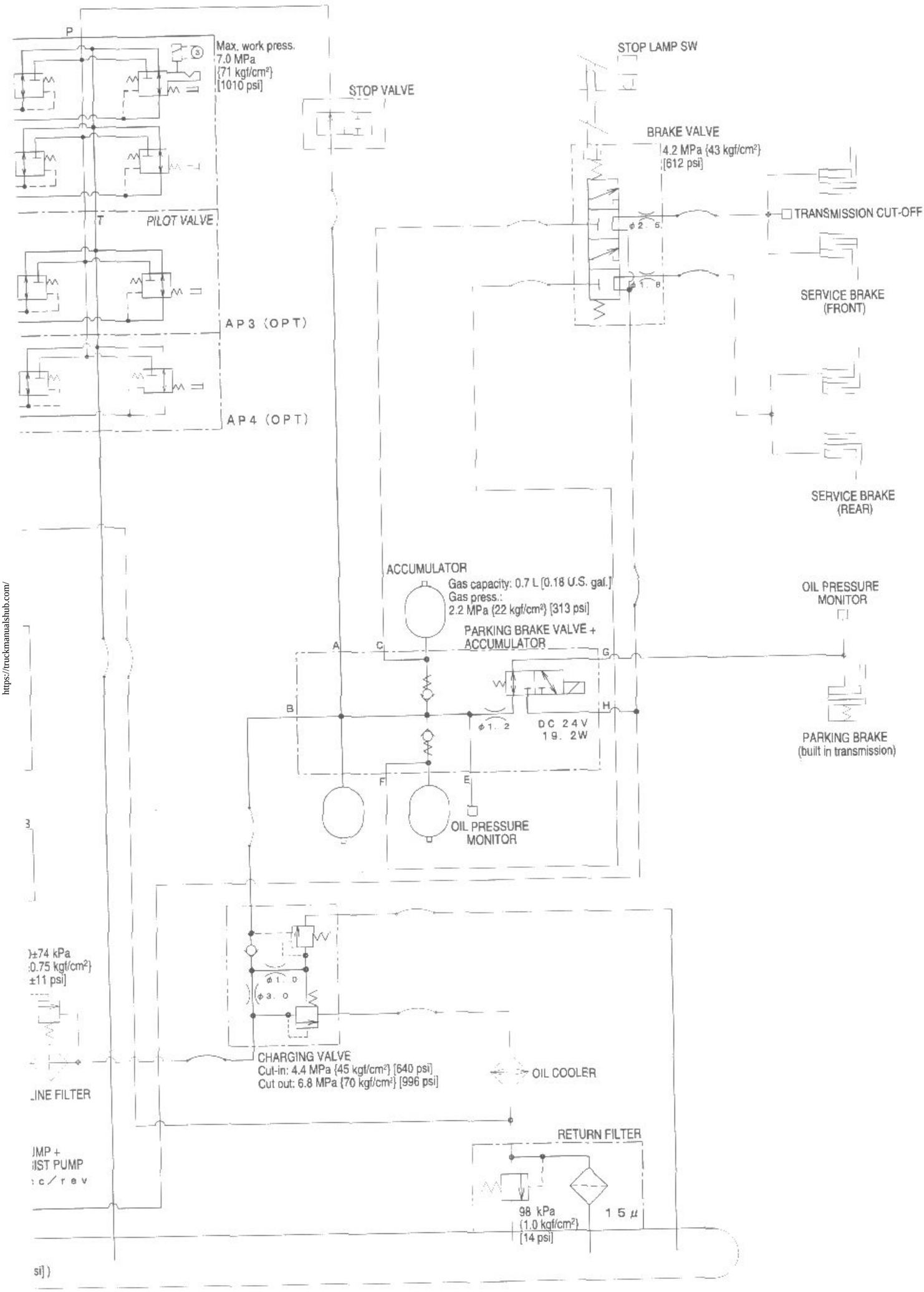


Fig. 6.3 Hydraulic Circuit Diagram (L3

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6.2 PUMP

	L27-3, LX130-7	L32-3, LX160-7
Main pump		
Model	KFP5145	KFP5150
Type	Gear type, with unloading valve	Gear type, with unloading valve
Drive	Gear type	Gear type
Discharge	100 L/min [26.4 gpm] (2300 rpm, 17.2 MPa {175 kgf/cm²} [2489 psi])	107 L/min [28.3 gpm] (2200 rpm, 17.2 MPa {175 kgf/cm²} [2489 psi])
Weight	61.1 kg [134.7 lbs] (including steering pump and brake & assist pump)	61.5 kg [135.6 lbs] (including steering pump and brake & assist pump)
Steering pump		
Model	KFP5163	KFP5190
Type	Gear type	Gear type
Drive	(Attached on main pump)	Gear type
Discharge	141 L/min [37.3 gpm] (2300 rpm, 20.6 MPa {210 kgf/cm²} [2987 psi])	192 L/min [50.7 gpm] (2200 rpm, 20.6 MPa {210 kgf/cm²} [2987 psi])
Weight	-	-
Brake & assist pump		
Model	KP1013C	KP1013C
Type	Gear type	Gear type
Drive	(Attached on steering pump)	(Attached on steering pump)
Discharge	29 L/min [7.7 gpm] (2300 rpm, 6.4 MPa {65 kgf/cm²} [924 psi])	28 L/min [7.4 gpm] (2200 rpm, 6.4 MPa {65 kgf/cm²} [924 psi])
Charging pump		
Model	SDY1A3616	SD1B4023
Type	Gear type, two-throw pump	Gear type, two-throw pump
Drive	Gear type	Gear type
Discharge	Front: 86 L/min [22.7 gpm] (2300 rpm, 2.5 MPa {25 kgf/cm²} [356 psi]) Rear: 40 L/min [10.6 gpm] (2300 rpm, 0.5 MPa {5 kgf/cm²} [71.1 psi])	Front: 84 L/min [22.2 gpm] (2200 rpm, 2.5 MPa {25 kgf/cm²} [356 psi]) Rear: 50 L/min [13.2 gpm] (2200 rpm, 0.5 MPa {5 kgf/cm²} [71.1 psi])
Weight	6.8 kg [15.0 lbs]	8.4 kg [18.5 lbs]

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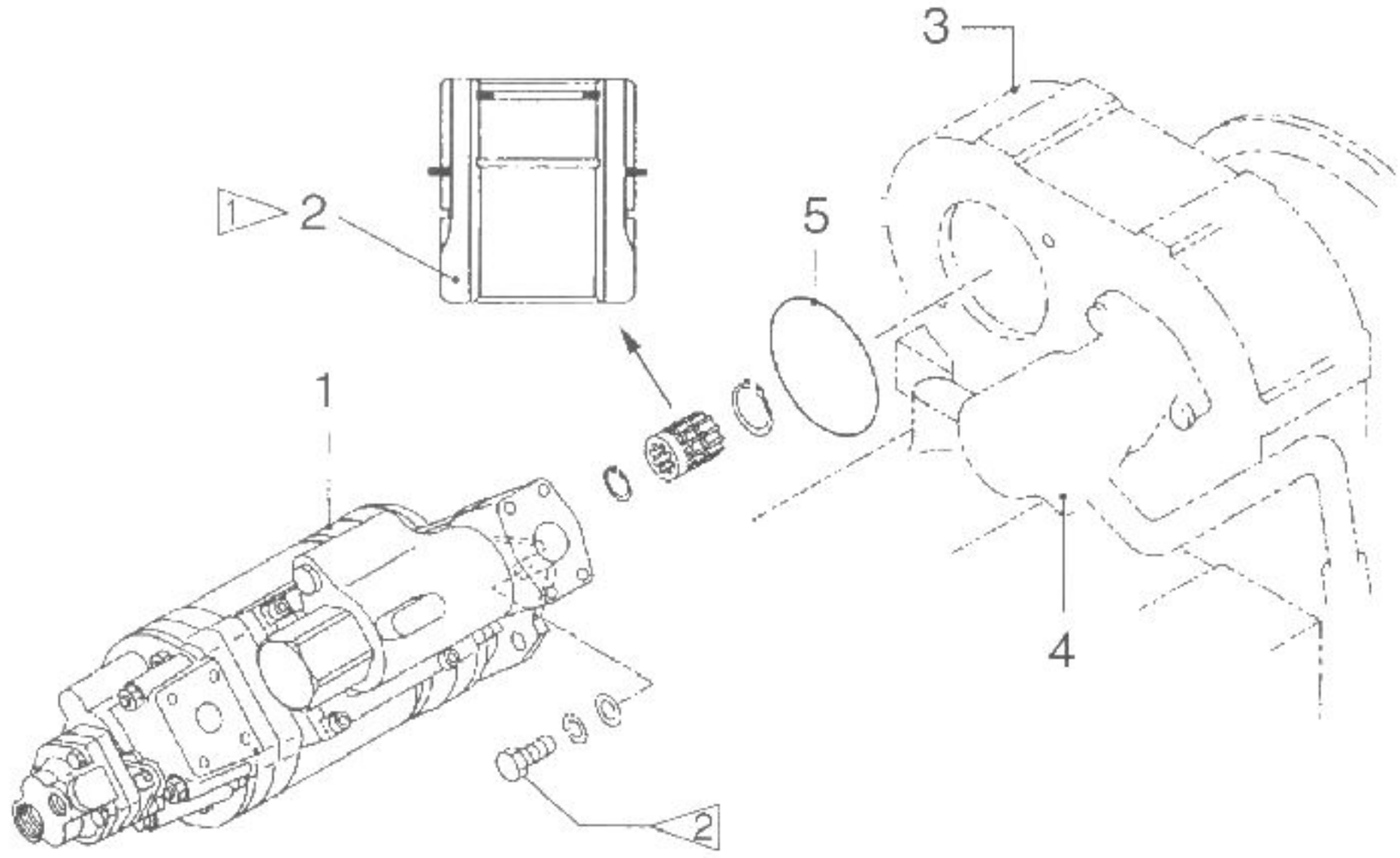
	L35-3, LX190-7	L40-3, LX230-7
Main pump		
Model	KFP5163CYR-SPNH	KFP5191CY-SPNH
Type	Gear type, with unloading valve	Gear type, with unloading valve
Drive	Gear type	Gear type
Discharge	129 L/min [34.1 gpm] (2100 rpm, 17.2 MPa {175 kgf/cm²} [2489 psi])	185 L/min [48.9 gpm] (2100 rpm, 17.2 MPa {175 kgf/cm²} [2489 psi])
Weight	27.8 kg [61.3 lbs]	30.5 kg [67.3 lbs]
Steering pump		
Model	KFP51100	←
Type	Gear type	←
Drive	Gear type	←
Discharge	205 L/min [54.1 gpm] (2100 rpm, 20.6 MPa {210 kgf/cm²} [2987 psi])	←
Weight	27 kg [60 lbs] (including brake & assist pump)	←
Brake & assist pump		
Model	KP1013C	←
Type	Gear type	←
Drive	(Attached on steering pump)	←
Discharge	27 L/min [7.1 gpm] (2100 rpm, 6.4 MPa {65 kgf/cm²} [924 psi])	←
Charging pump		
Model	SDB4044	←
Type	Gear type, two-throw pump	←
Drive	Gear type	←
Discharge	Front: 81 L/min [21.4 gpm] (2100 rpm, 2.5 MPa {25 kgf/cm²} [356 psi])	←
	Rear: 91 L/min [24.0 gpm] (2100 rpm, 0.5 MPa {5 kgf/cm²} [71.1 psi])	←
Weight	12.4 kg [27.3 lbs]	←

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All pumps are installed in the converter housing and driven with the pump drive of the torque converter. Therefore, each pump always rotates with engine running. For the installation of the charging pump, refer to "2.1 DRIVE UNIT."

(L27-3, LX130-7)

1. PUMP
2. DRIVE SLEEVE
3. (TORQUE CONVERTER)
4. (CHARGING PUMP)
5. "O"-RING

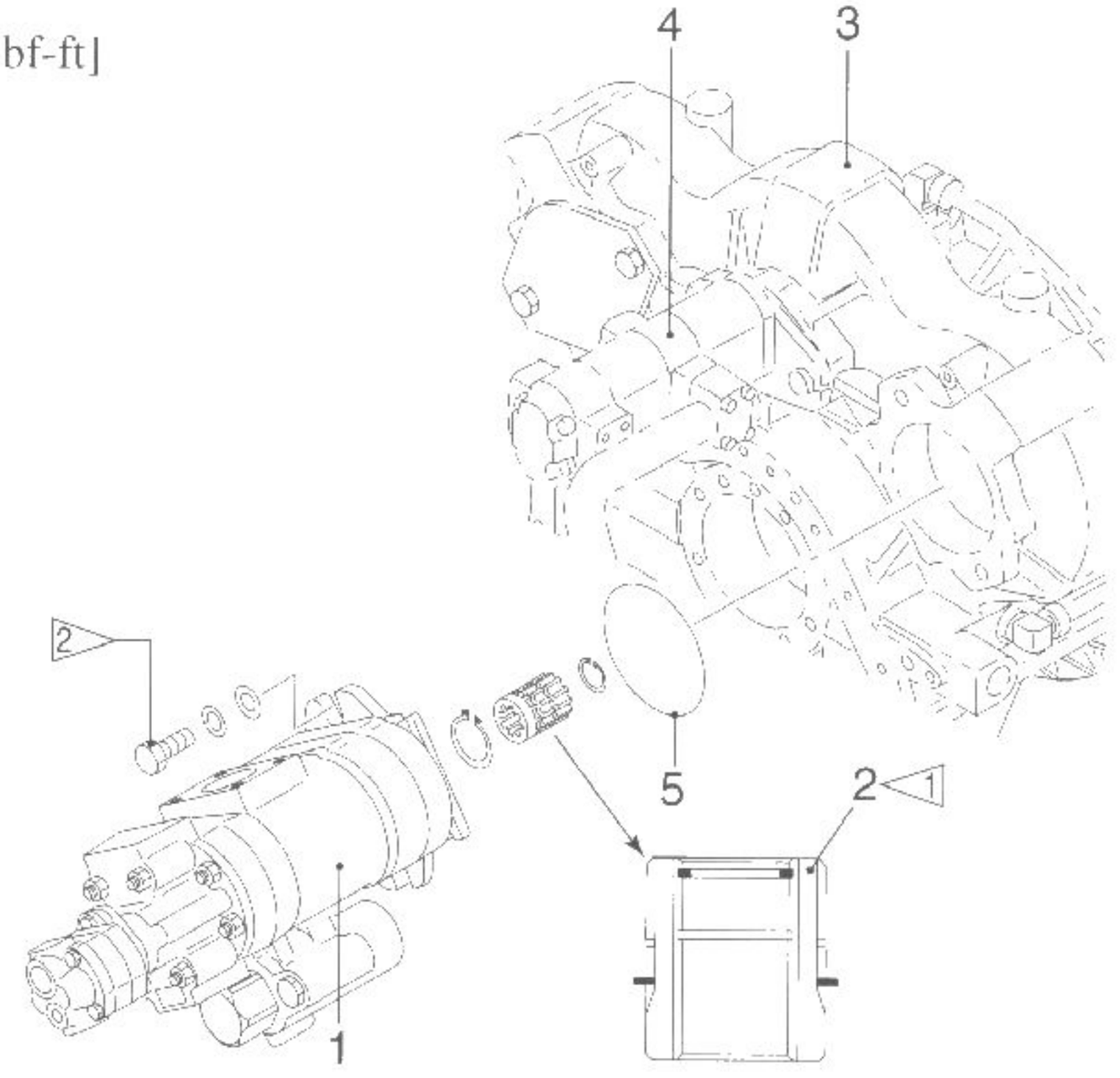


Note: 1▷ Pay attention to the installation position of the snap ring.

2▷ 88 N-m {9.0 kgf-m} [65 lbf-ft]

(L32-3, LX160-7)

1. PUMP
2. DRIVE SLEEVE
3. (TORQUE CONVERTER)
4. (CHARGING PUMP)
5 "O"-RING



Note: 1▷ Pay attention to the installation position of the snap ring.

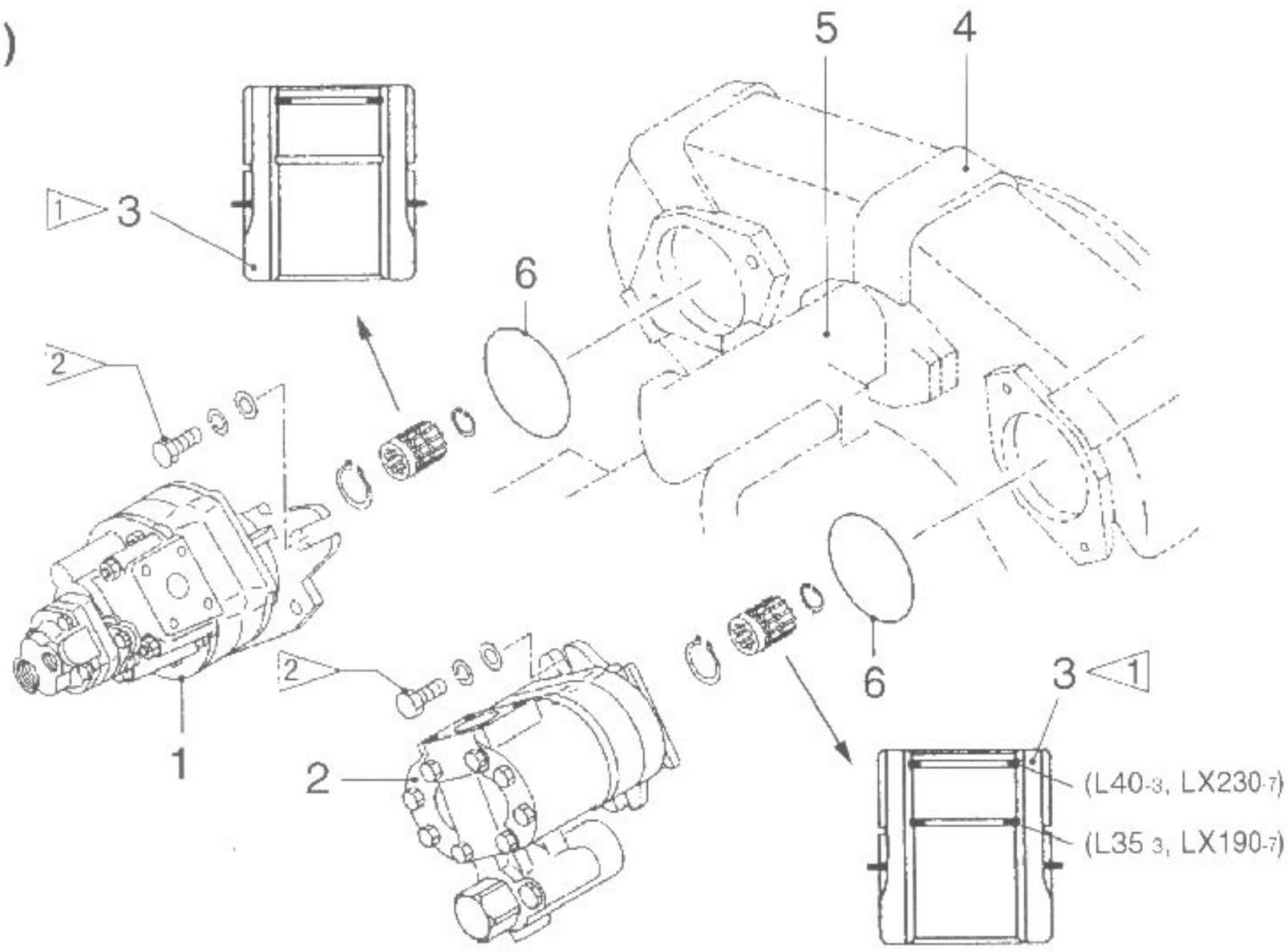
2▷ 88 N-m {9.0 kgf-m} [65 lbf-ft]

Fig. 6.4 Pumps Installed on Converter Housing (1)

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(L35-3, LX190-7 · L40-3, LX230-7)

1. STEERING PUMP, BRAKE & ASSIST PUMP
2. MAIN PUMP
3. DRIVE SLEEVE
4. (TORQUE CONVERTER)
5. (CHARGING PUMP)
6 "O"-RING



Note: 1 Pay attention to the installation position of the snap ring.

2 224 N-m {22.8 kgf-m} [165 lbf-ft]

Fig. 6.5 Pumps Installed on Converter Housing (2)

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1. L27-3, LX130-7 · L32-3, LX160-7

The loader uses a three-way pump and a two-way pump.

The three-way pump uses its front pump as a main pump, the center pump as a steering pump and the rear pump as a brake & assist pump.

Each pump picks up hydraulic oil from the oil tank and sends it under pressure to each actuator.

The two-way pump serves as a charging pump. The charging pump picks up oil from the transmission sump tank and sends it under pressure to the transmission line filter through the front pump, and to the radiator oil cooler through the rear pump.

2. L35-3, LX190-7 · L40-3, LX230-7

The main pump, steering pump (with brake & assist pump) and charging pump are used. The brake & assist pump is installed at the rear side of the steering pump.

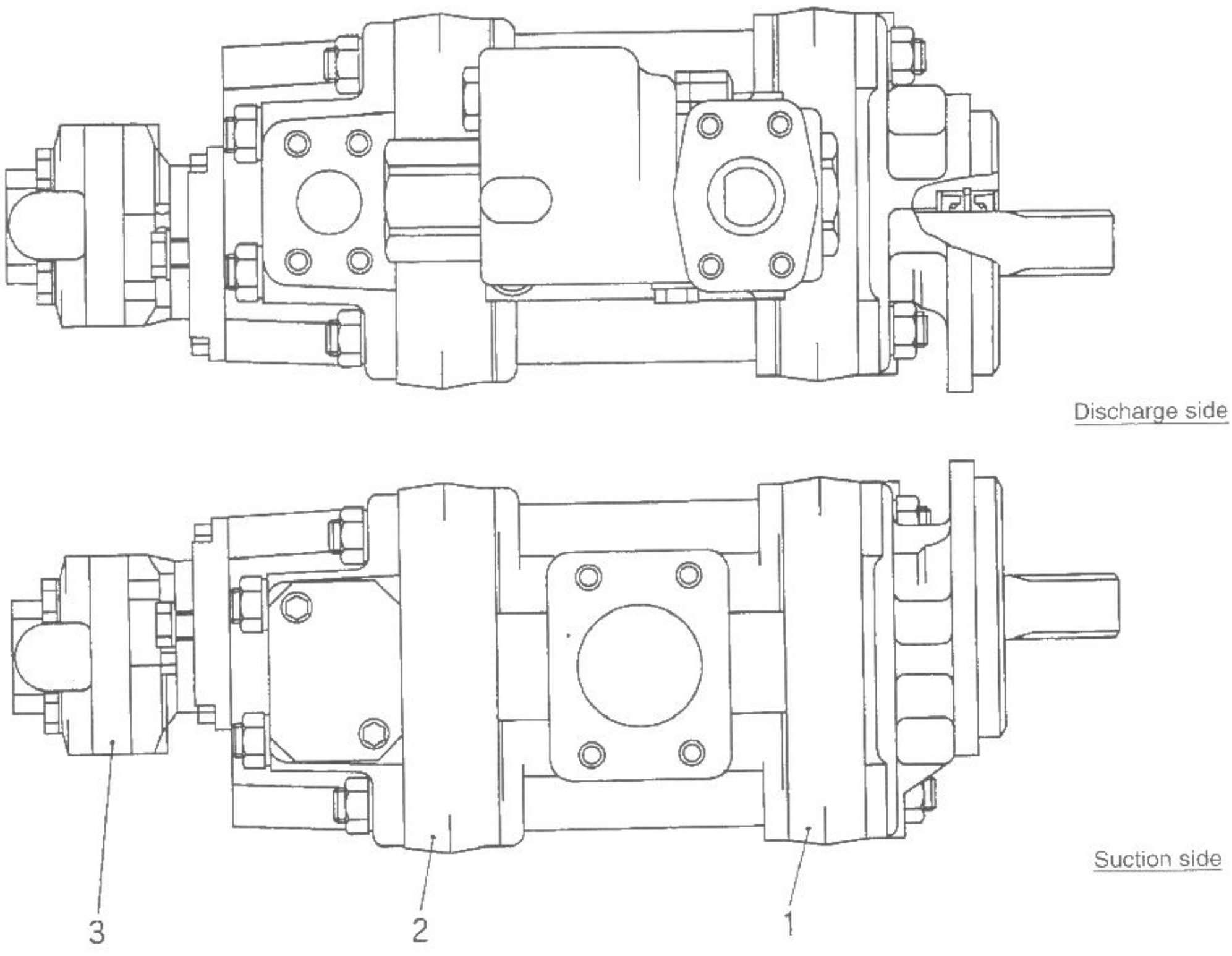
The main pump, steering pump and the brake & assist pump pick up hydraulic oil from the oil tank, and send it under pressure to each actuator.

The charging pump is a two-way pump type. The charging pump picks up oil from the transmission sump tank and sends it under pressure to the transmission line filter through the front pump, and to the radiator oil cooler through the rear pump.

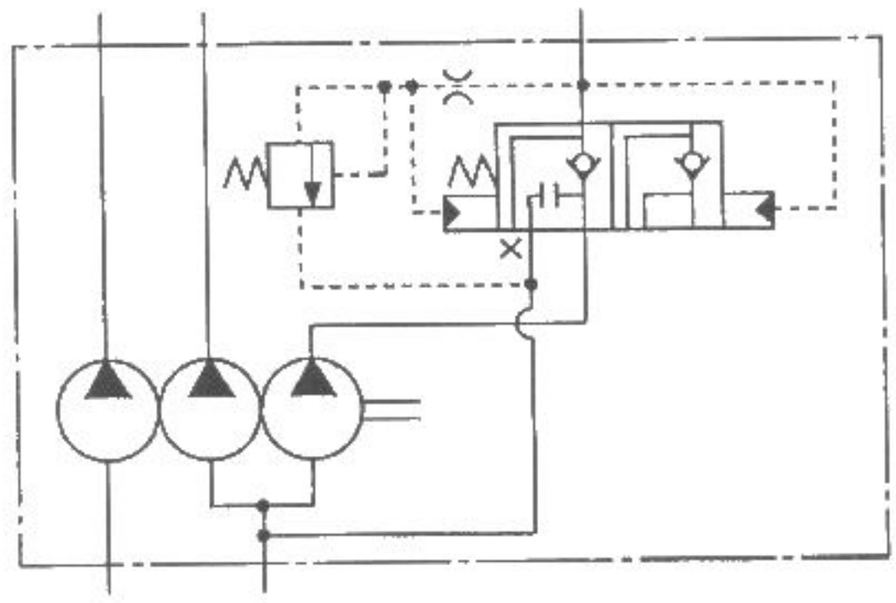
Main pump

The main pump is equipped with the unloading valve (SH valve). When the pressure in the main hydraulic circuit (pump discharge side) increases higher than the specified pressure, the unloading valve actuates to return the oil discharged from the main pump into the pump suction side. Therefore, the pump starts unloading operation (idling) so that the engine output can effectively be used.

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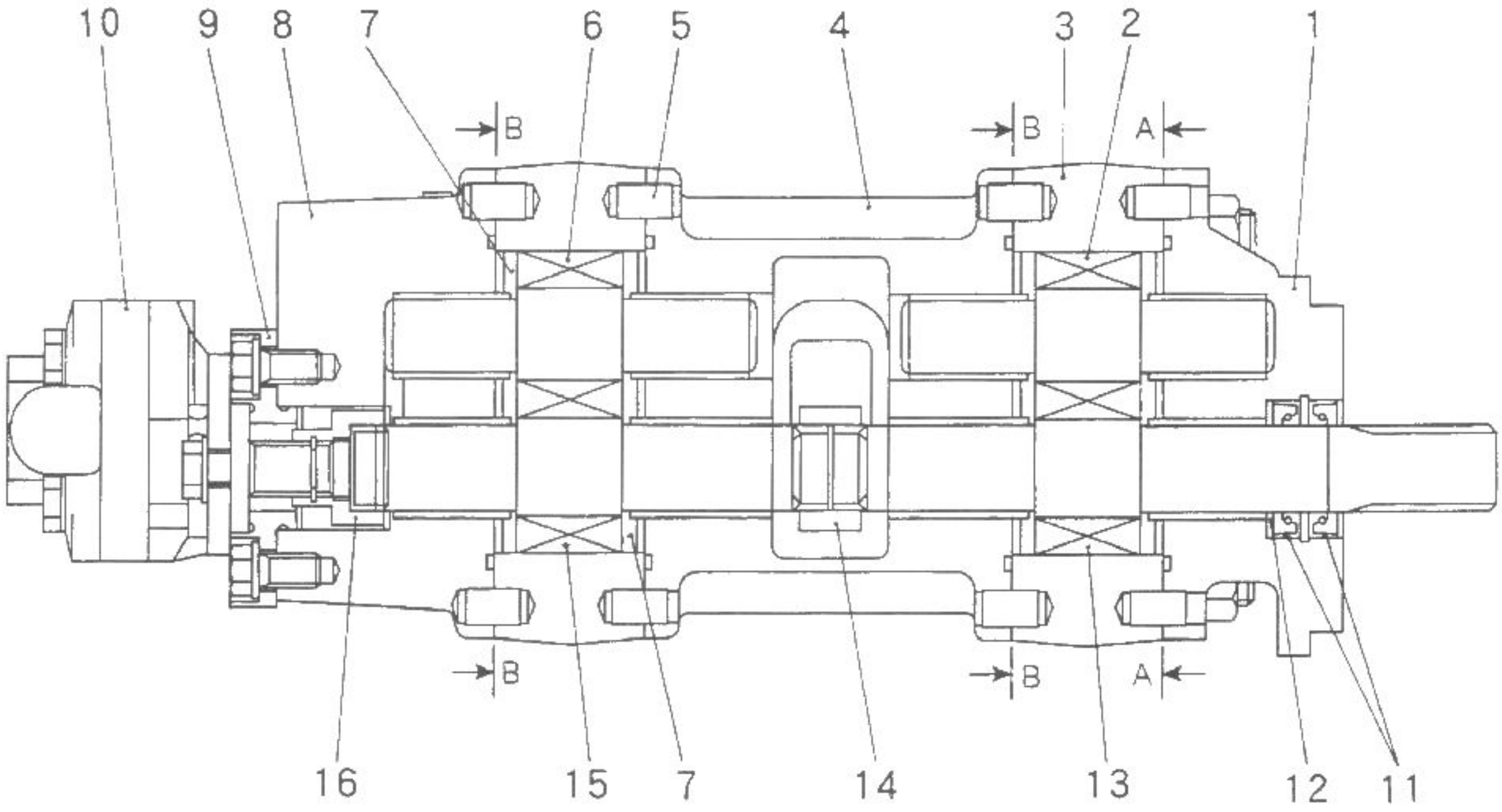
SH VALVE
UNLOADING PRESSURE:
17.2 MPa {175 kgf/cm^2} [2486 psi]

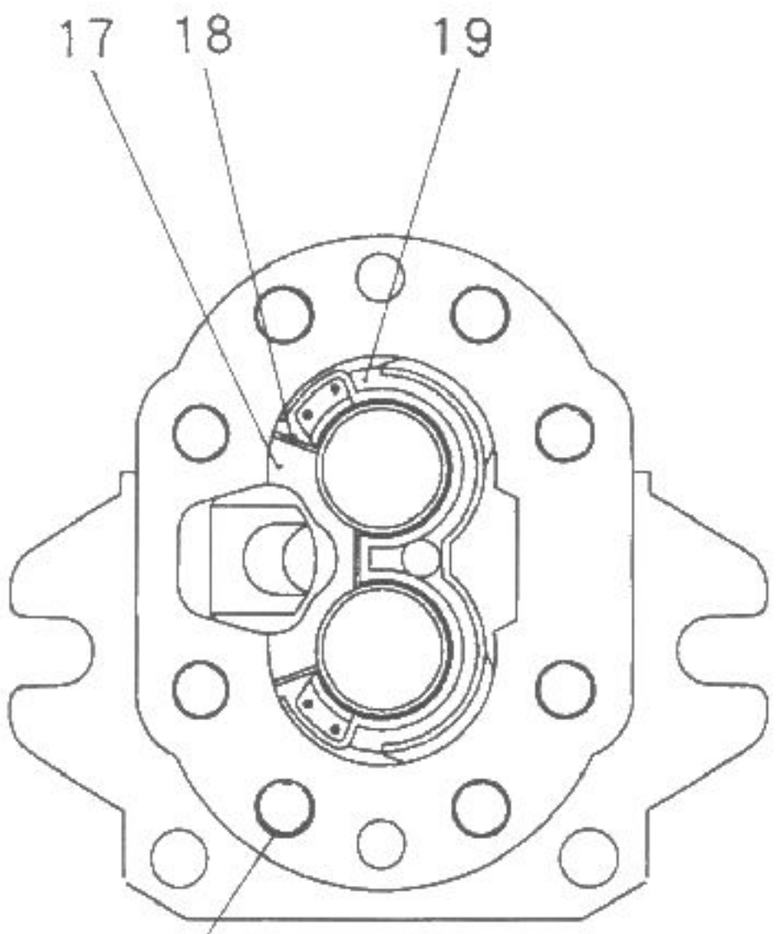


1. FRONT PUMP (MAIN PUMP)
2. CENTER PUMP (STEERING PUMP)
3. REAR PUMP (BRAKE & ASSIST PUMP)
4. SH VALVE

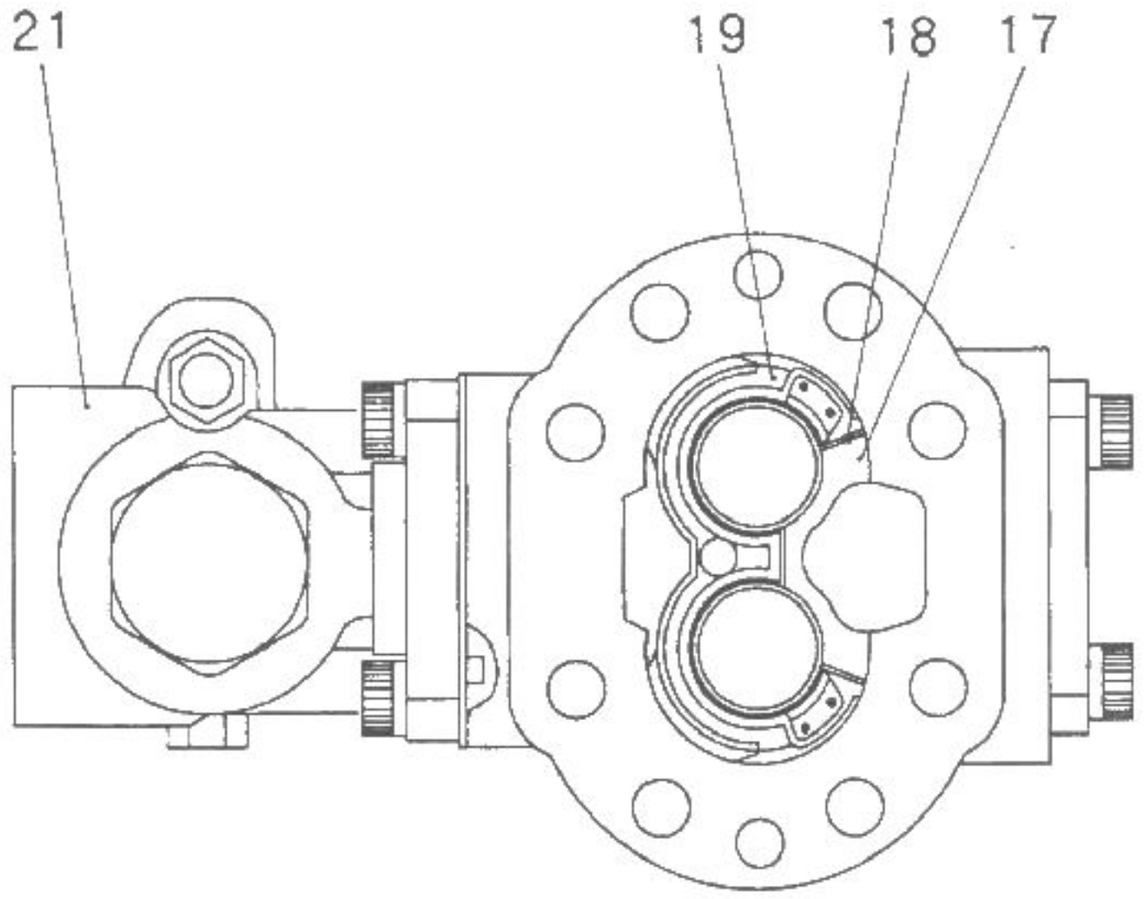
Fig. 6.6 Three-Way Pump (L27-3, LX130-7 · L32-3, LX160-7)

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Section B-B

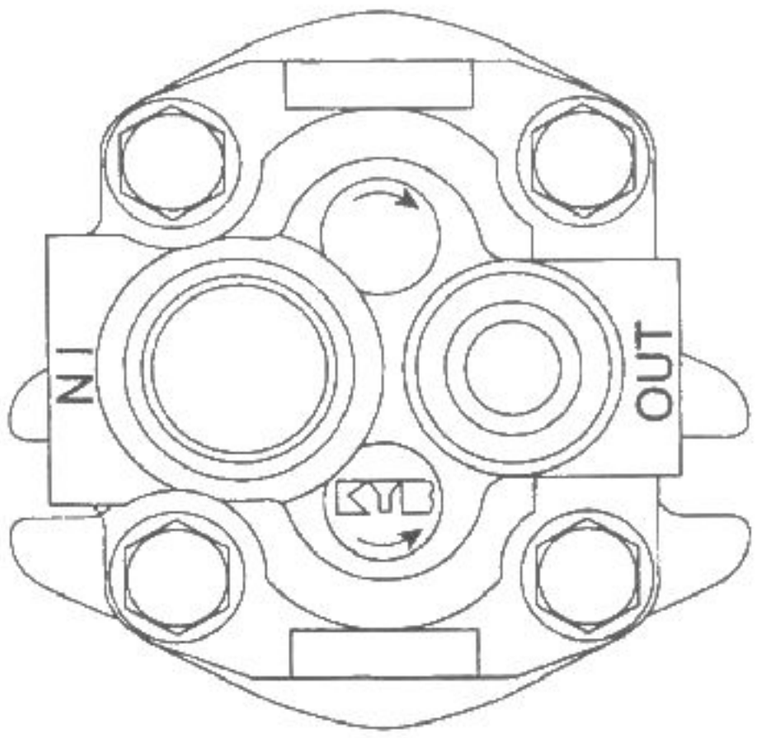


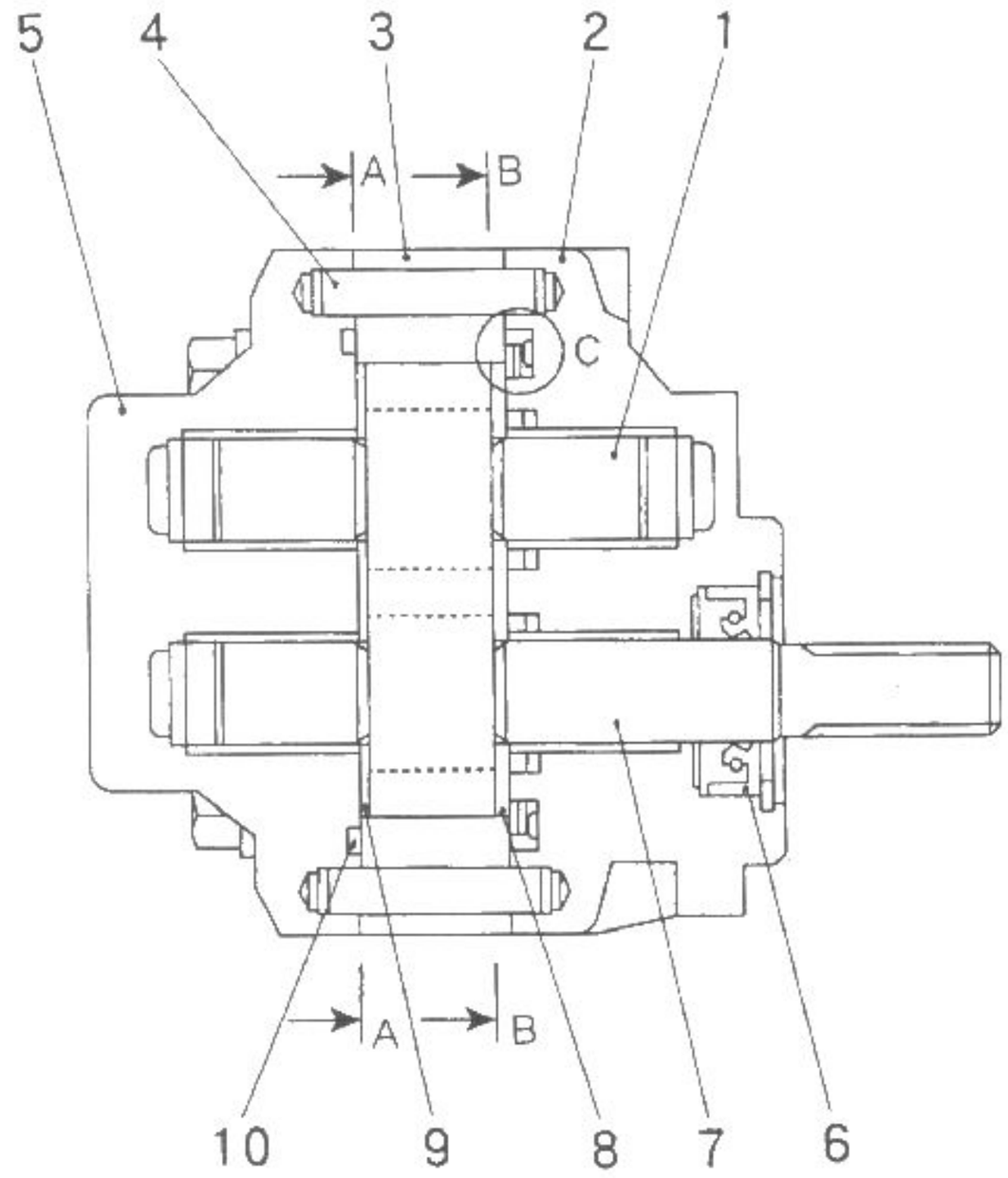
Section A-A

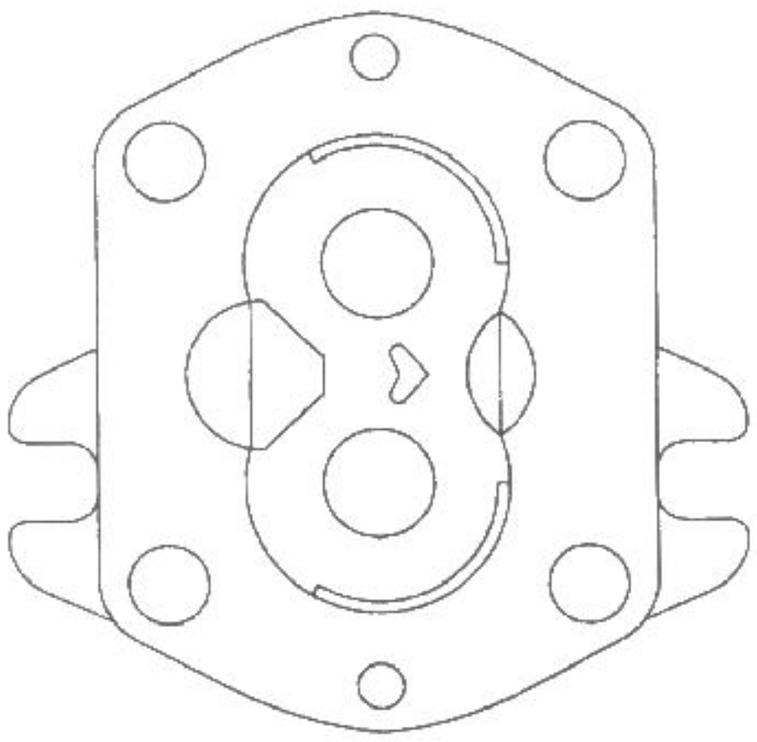
1. MOUNTING FLANGE
2. DRIVEN GEAR
3. GEAR PLATE
4. CENTER PLATE
5. DOWEL
6. DRIVEN GEAR
7. PRESSURE PLATE
8. COVER PLATE
9. ADAPTER PLATE
10. KP1013 (See Fig. 6.8)
11 OIL SEAL
12. SPECIAL WASHER
13. FRONT DRIVE GEAR
14. SPLINE COUPLING
15. CENTER DRIVE GEAR
16. SPLINE COUPLING
17. ISOLATION PLATE
18. BACK-UP
19. PLATE SEAL
20. STABILIZER
21. SH VALVE

Fig. 6.7 Construction of Three-Way Pump (L27-3, LX130-7 · L32-3, LX160-7)

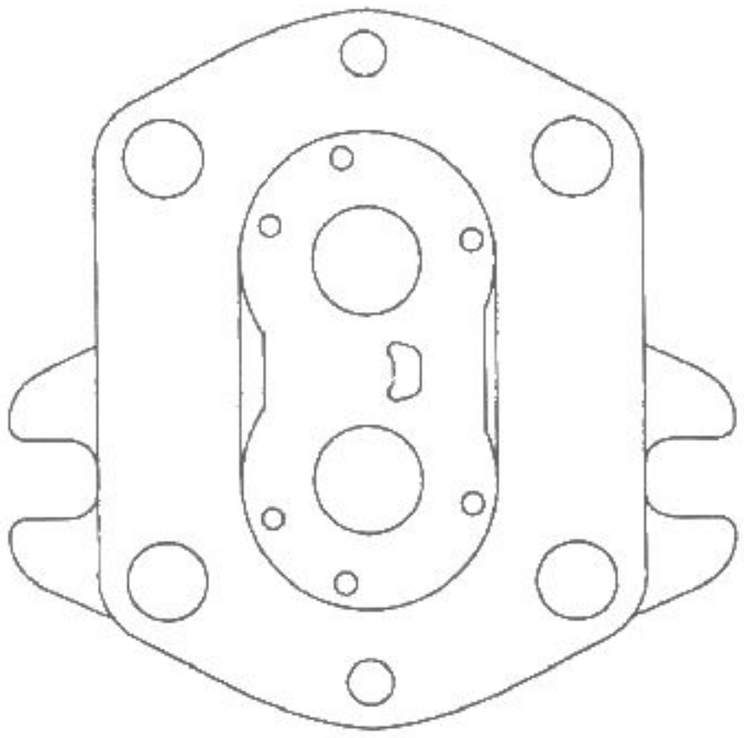
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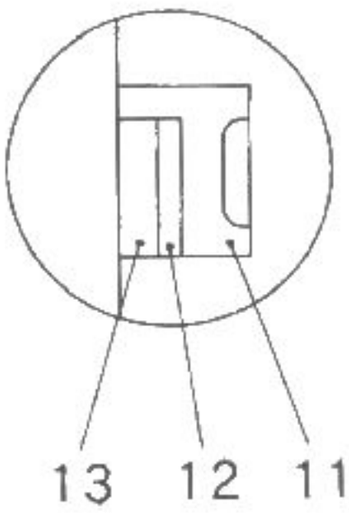


Section A-A



Section B-B

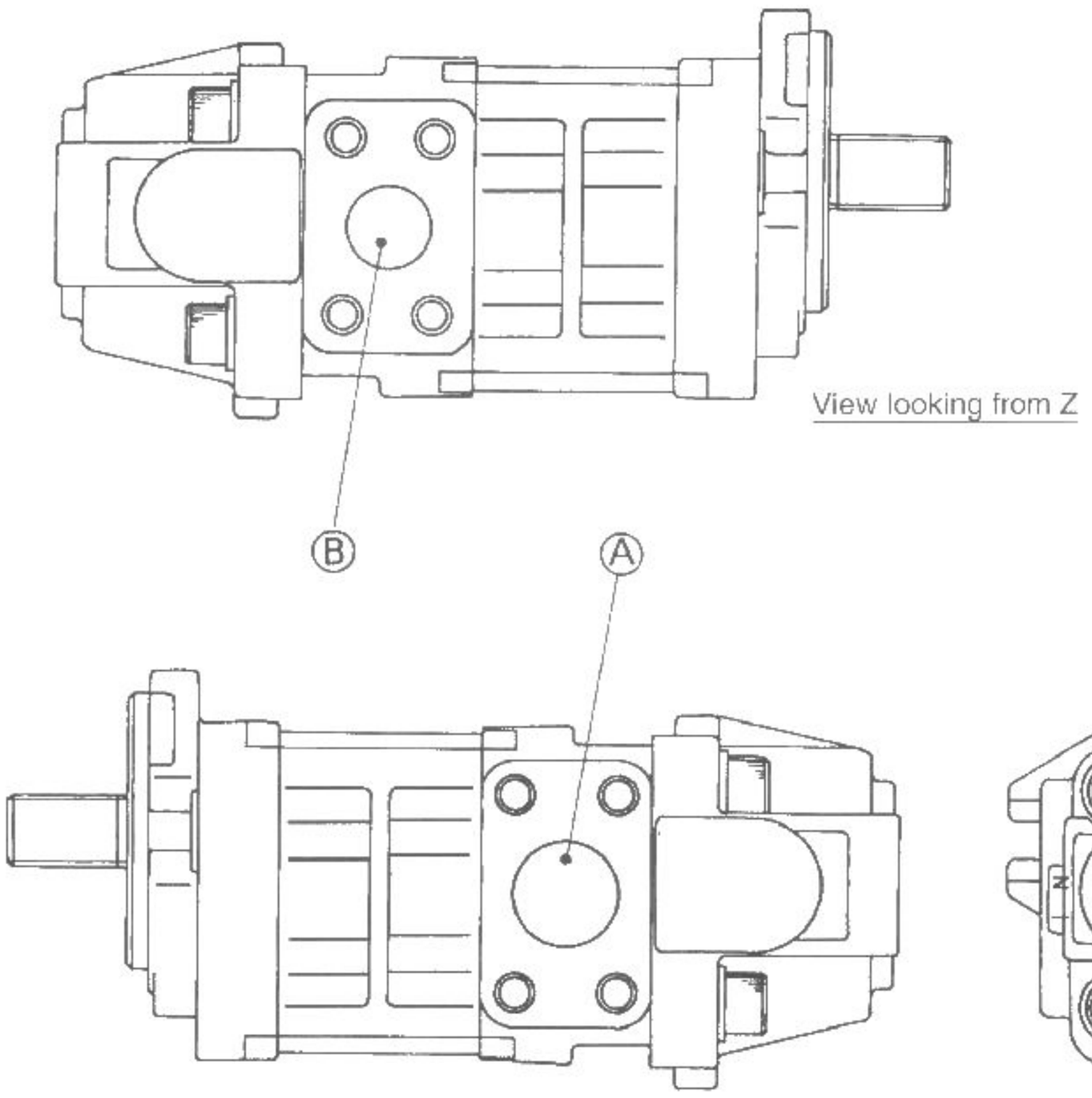
Details of Area C



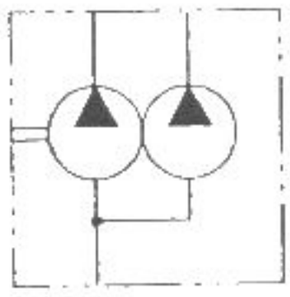
1. DRIVEN GEAR
2. MOUNTING FLANGE
3. GEAR PLATE
4. DOWEL PIN
5. COVER
6. OIL SEAL
7. DRIVE GEAR
8. SIDE PLATE A
9. SIDE PLATE B
10. "O"-RING
11. BALANCE SEAL
12. GASKET B
13. GASKET A

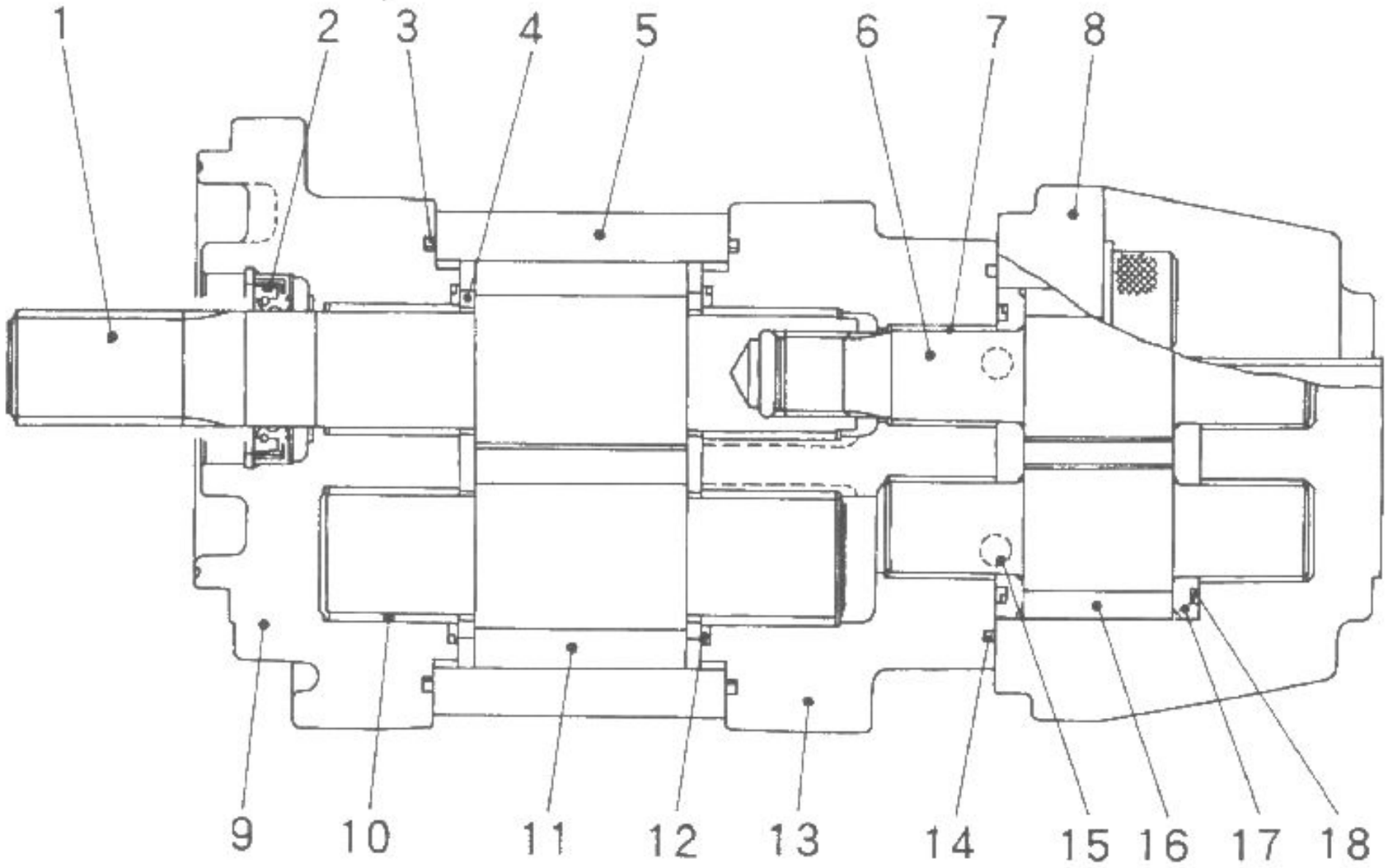
Fig. 6.8 Construction of KP1013 (Brake & Assist Pump)

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Ⓐ : SUCTION PORT
Ⓑ : FRONT PUMP DISCHARGE PORT
Ⓒ : REAR PUMP DISCHARGE PORT



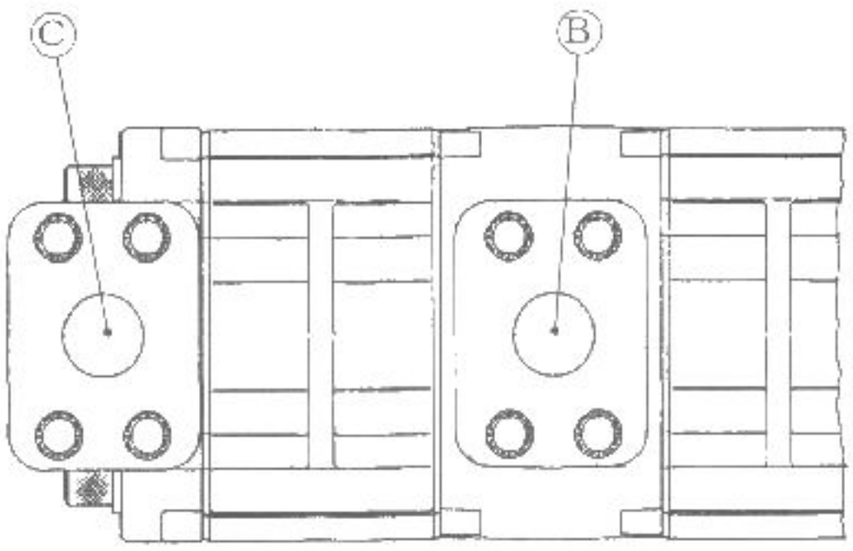


Inside construction

1. DRIVE GEAR (No.1)
2. OIL SEAL
3. GASKET
4. SIDE PLATE
5. BODY
6. DRIVE GEAR (No. 2)
7. BUSHING
8. BODY
9. FRONT COVER
10. BUSHING
11. DRIVEN GEAR (No. 1)
12. GASKET
13. ADAPTER PLATE
14. GASKET
15. STEEL BALL
16. DRIVEN GEAR (No. 2)
17. SIDE PLATE
18. GASKET

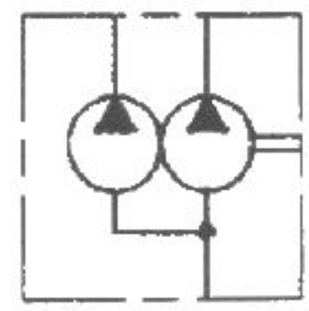
Fig. 6.9 Charging Pump (L27-3, LX130-7)

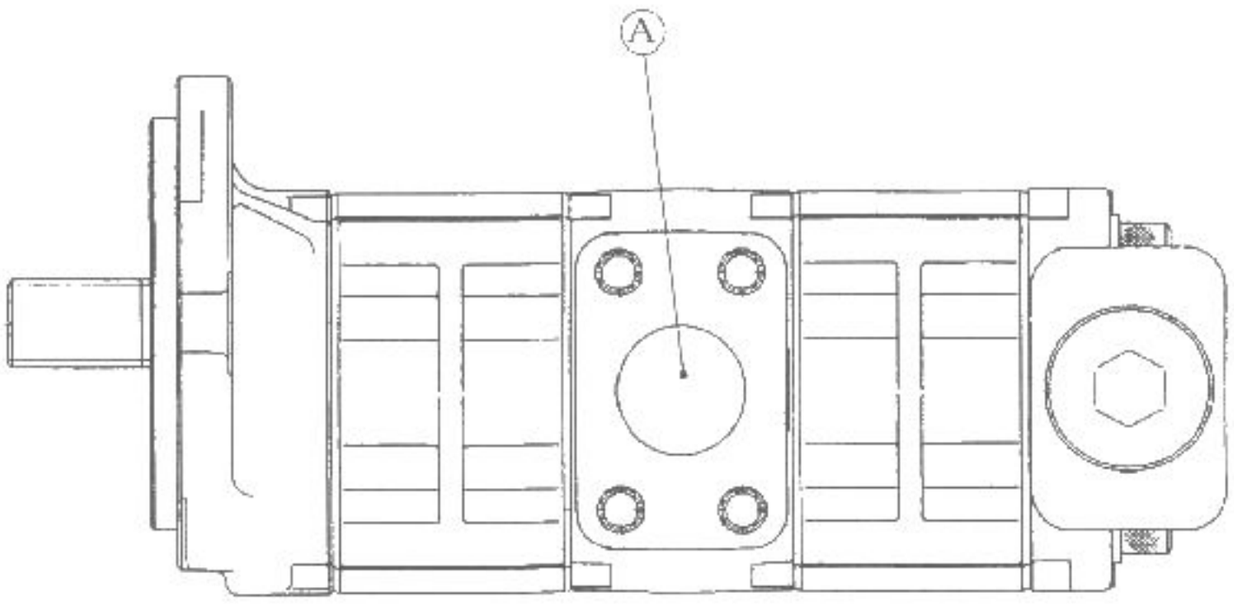
https://truckmanualshub.com/

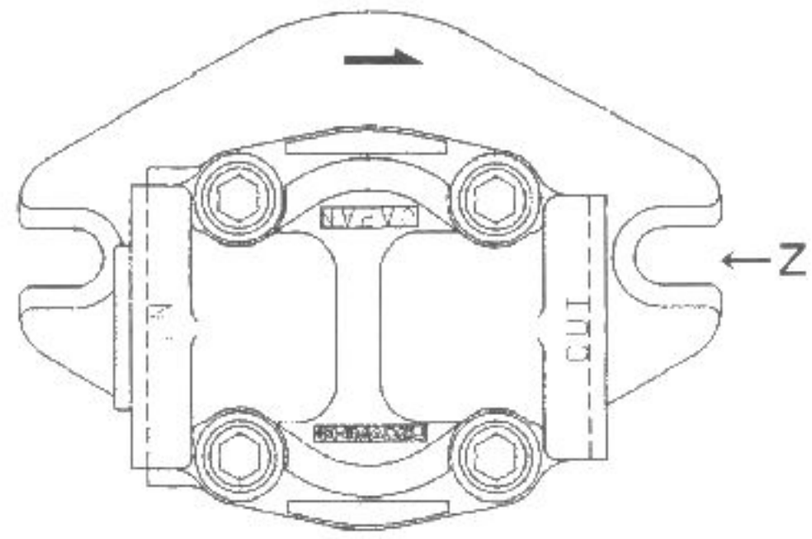


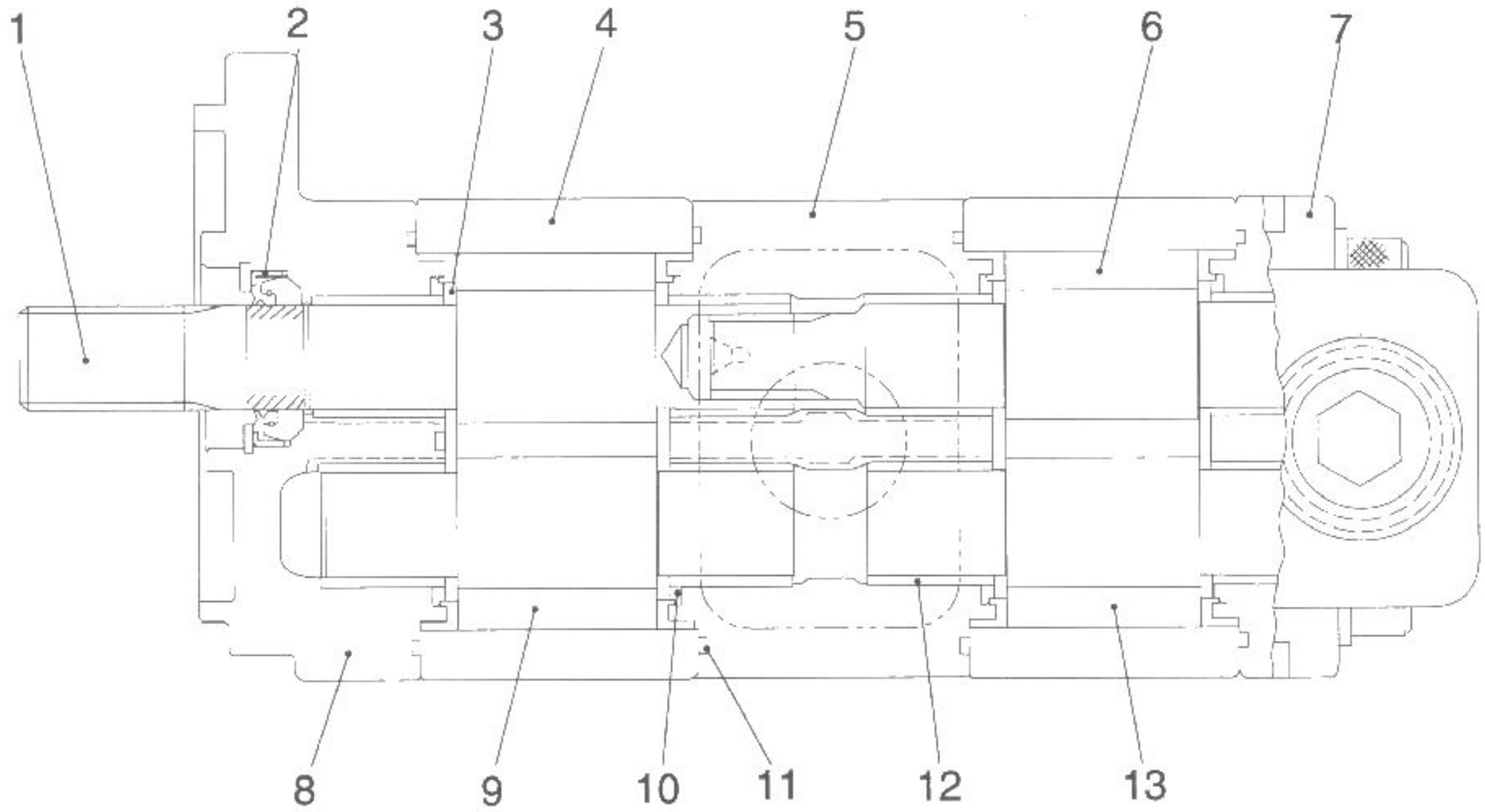
View looking from Z

Ⓐ : SUCTION PORT
Ⓑ : FRONT PUMP DISCHARGE PORT
Ⓒ : REAR PUMP DISCHARGE PORT





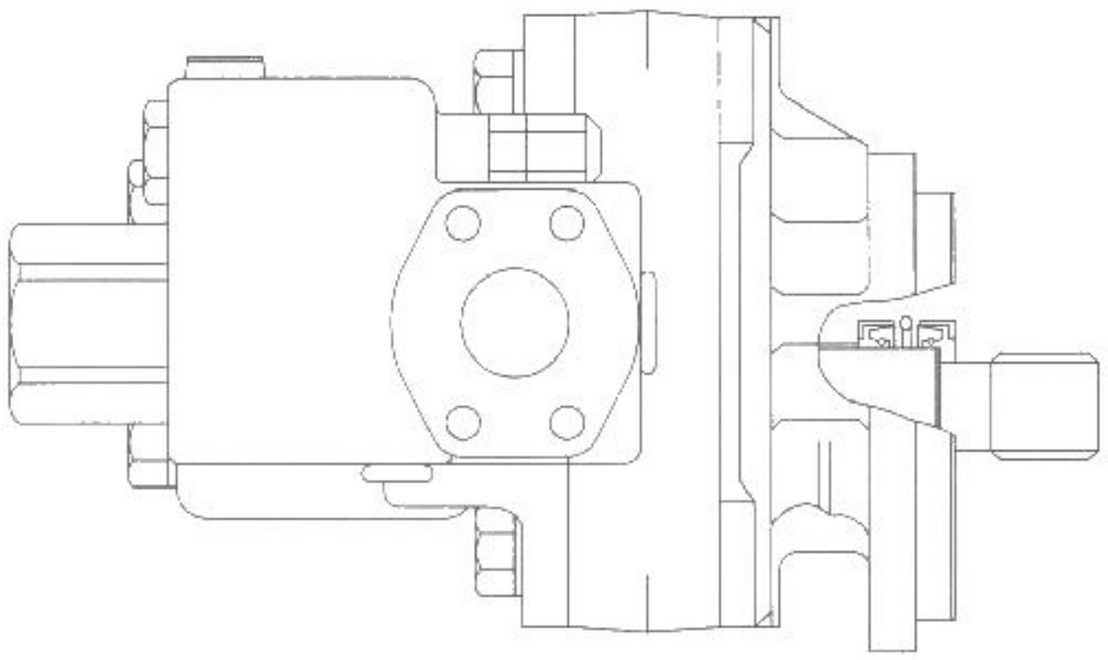




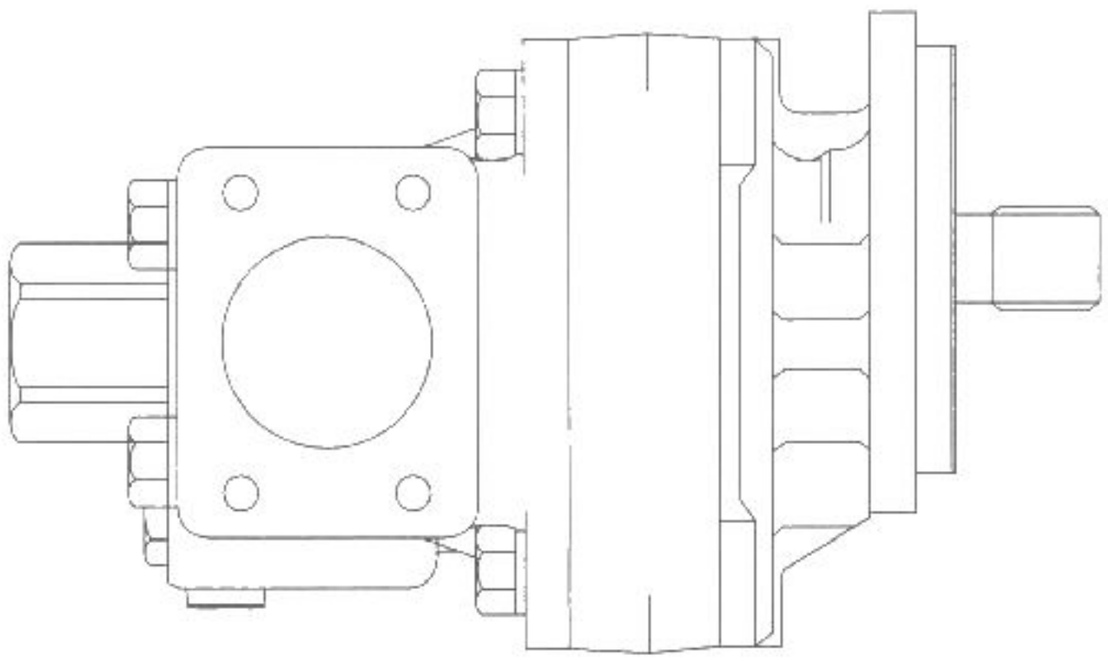
1. DRIVE GEAR
2. OIL SEAL
3. SIDE PLATE
4. BODY
5. ADAPTER PLATE
6. DRIVE GEAR
7. REAR COVER
8. FRONT COVER
9. DRIVEN GEAR
10. GASKET
11. GASKET
12. BUSHING
13. DRIVEN GEAR

Fig. 6.10 Charging Pump (L32-3, LX160-7)

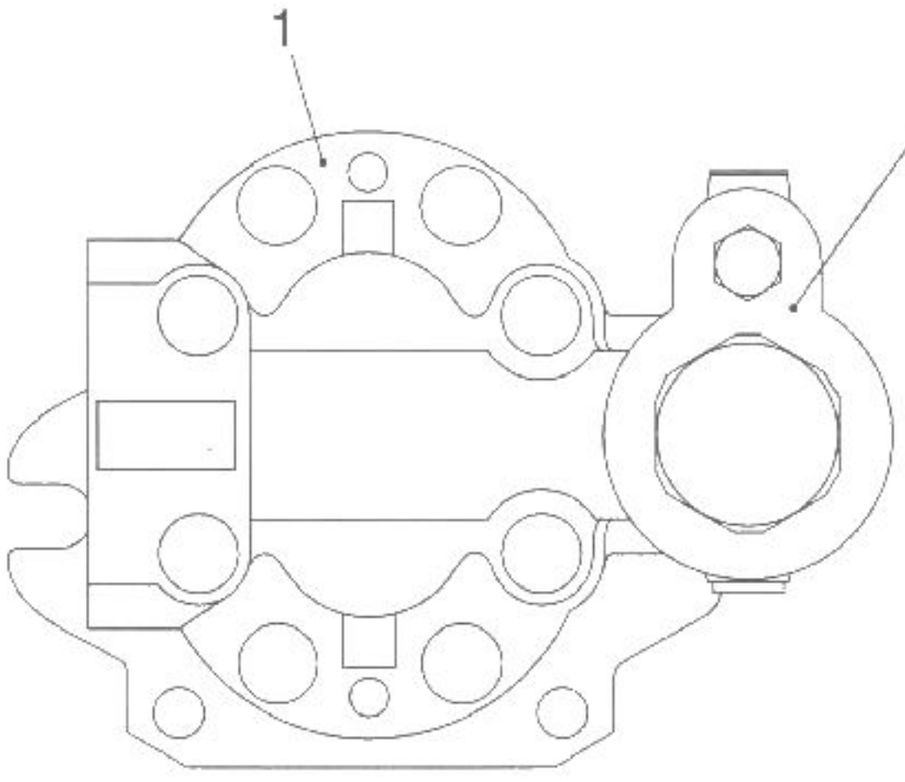
https://truckmanualshub.com/

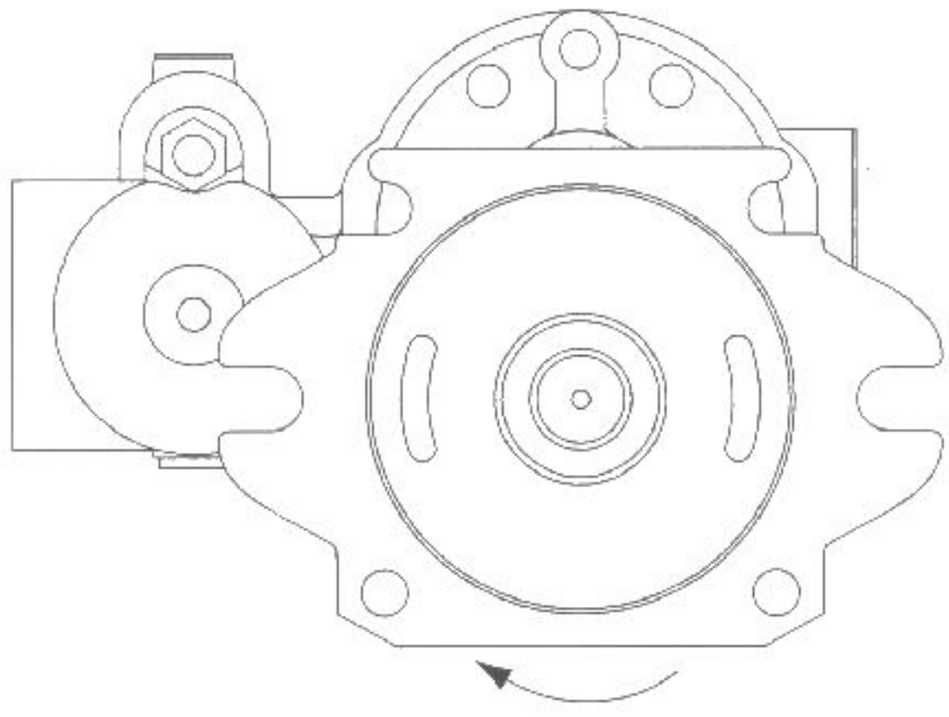


Discharge side



Suction side





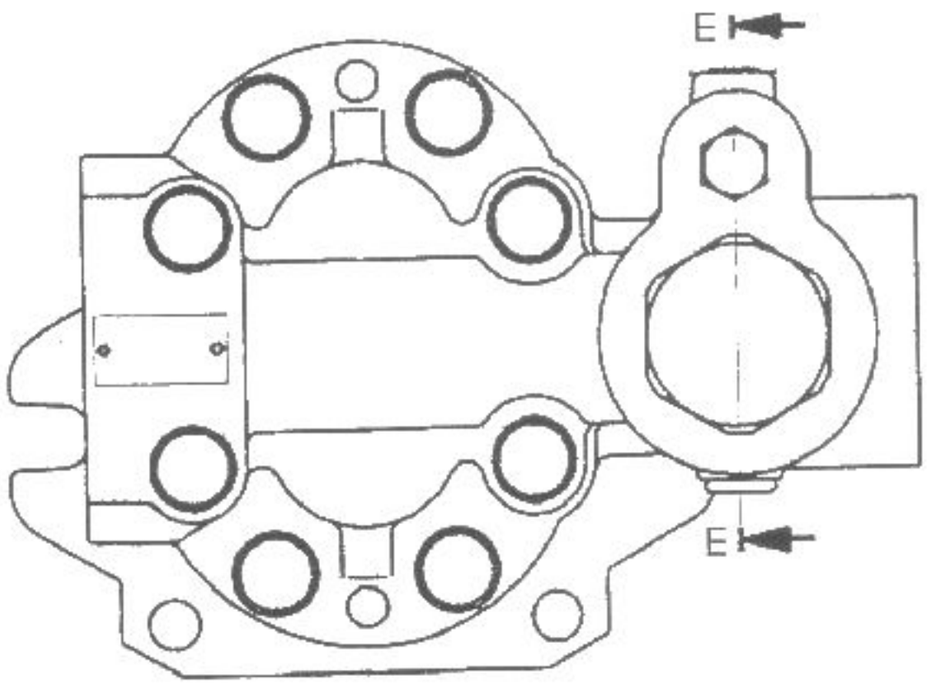
Turning direction

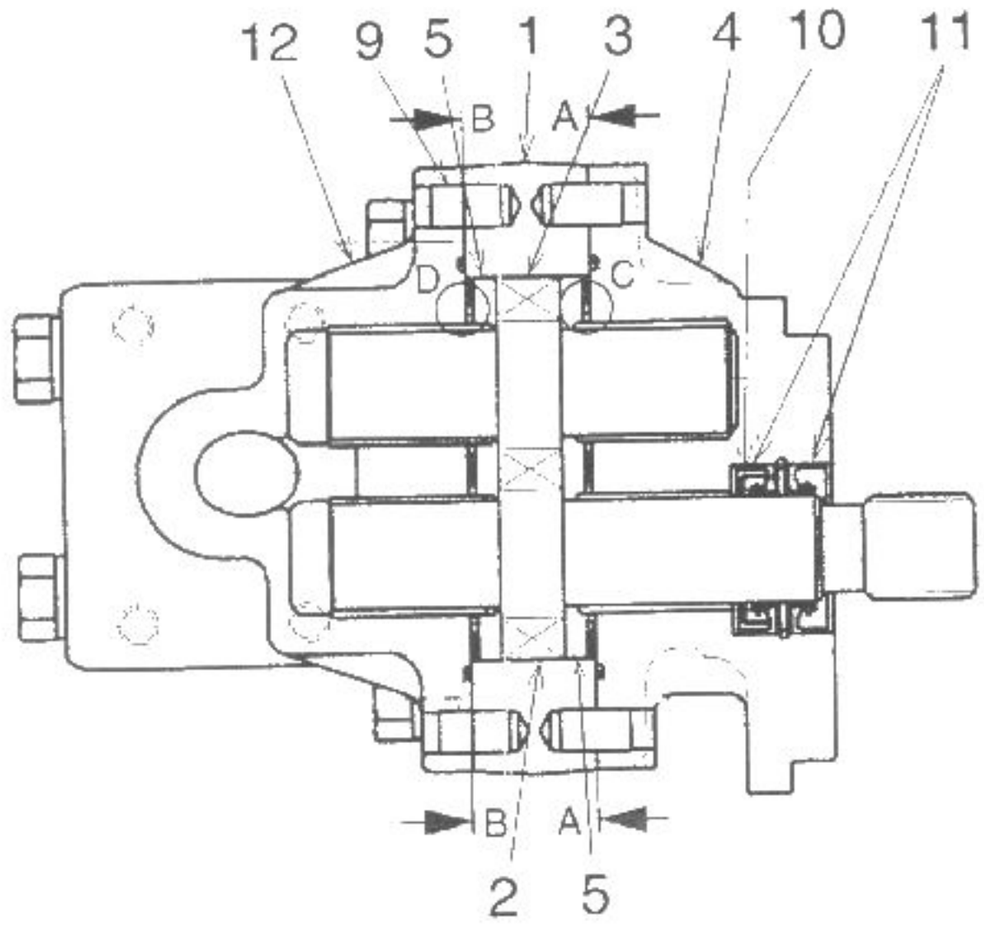
SH VALVE
UNLOADING PRESSURE:
17.2 MPa {175 kgf/cm^2} [2489 psi]

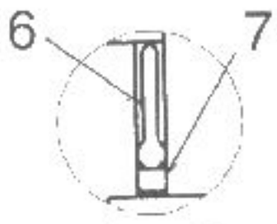
1. PUMP
2. SH VALVE

Fig. 6.11 Main Pump (L35-3, LX190-7 · L40-3, LX230-7)

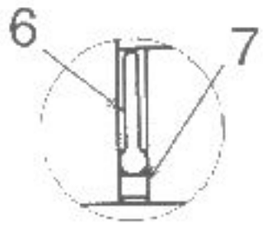
https://truckmanualshub.com/



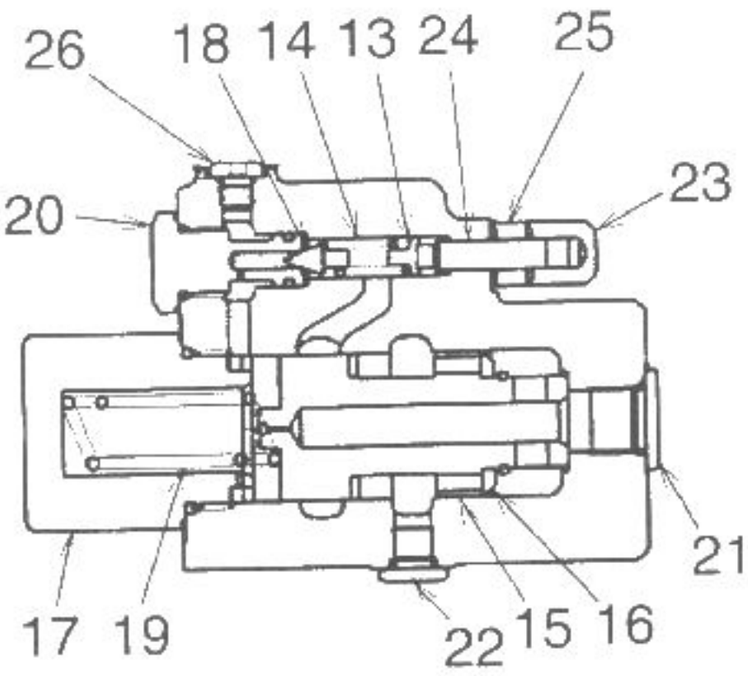




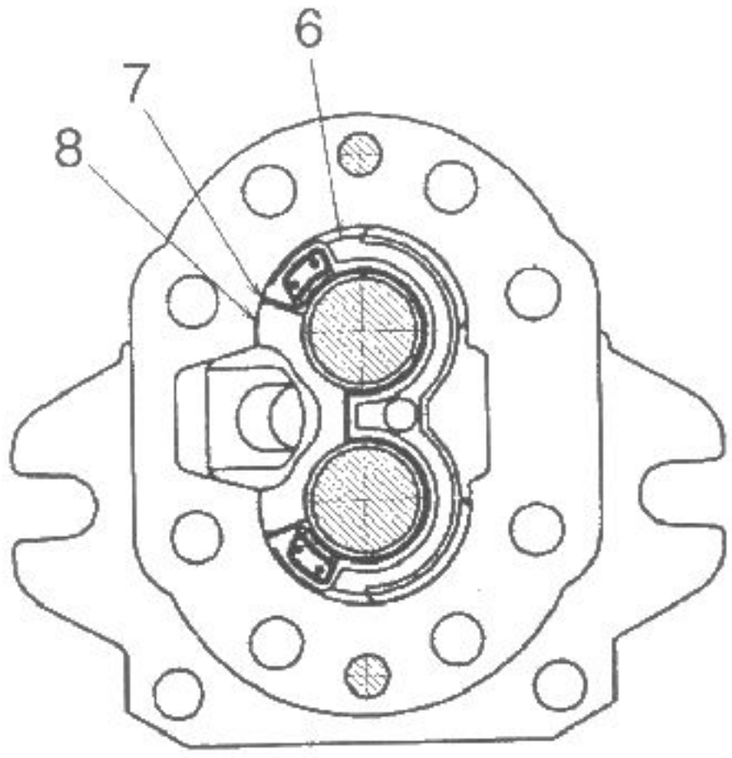
Area C



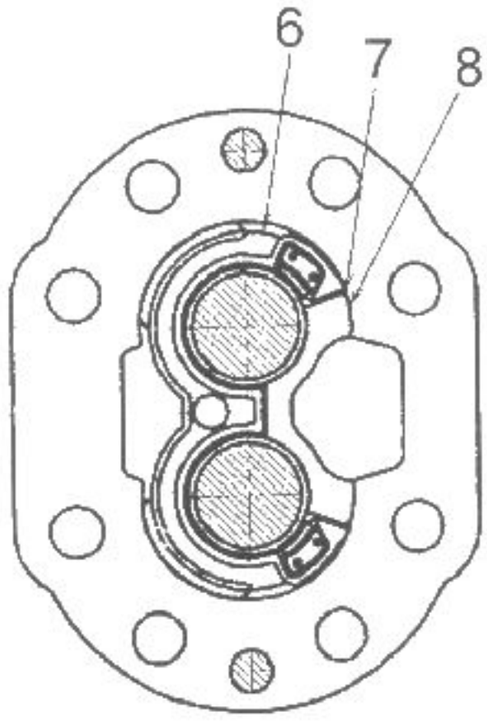
Area D



Section E-E



Section B-B

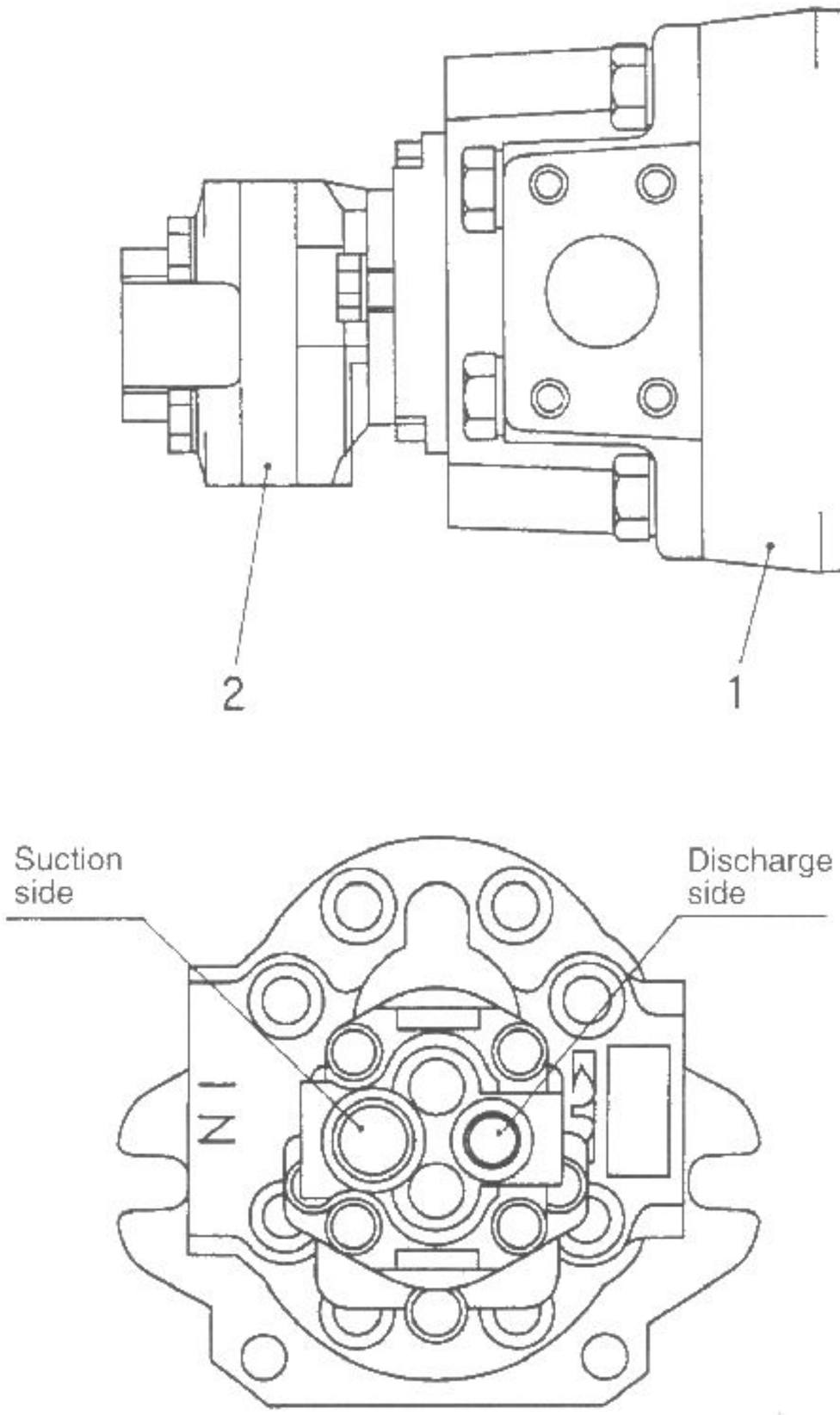


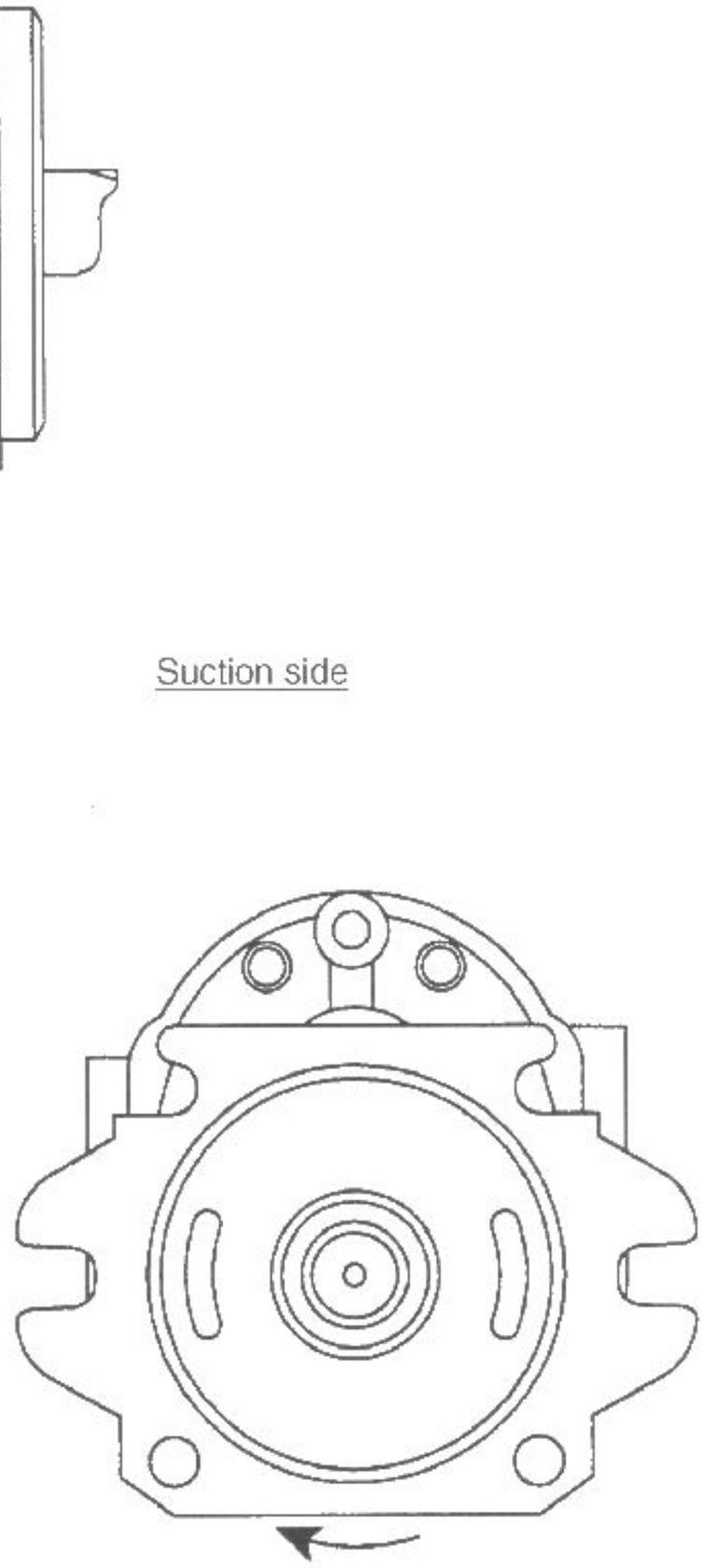
Section A-A

1. GEAR PLATE
2. DRIVE GEAR
3. DRIVEN GEAR
4. MOUNTING FLANGE
5. PRESSURE PLATE
6. PLATE SEAL
7. BACK-UP RING
8. ISOLATION PLATE
9. DOWEL PIN
10. SPECIAL WASHER
11. OIL SEAL
12. SH ONE-PIECE COVER
13. SPRING GUIDE
14. SPRING
15. SPOOL
16. CHECK VALVE
17. PLUG
18. CONE
19. SPRING
20. PLUG
21. PLUG
22. PLUG
23. NUT
24. SET SCREW
25. NUT
26. PLUG

Fig. 6.12 Construction of Main Pump (L35-3, LX190-7 · L40-3, LX230-7)

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1. FRONT PUMP (STEERING PUMP)
2. REAR PUMP (BRAKE & ASSIST PUMP)

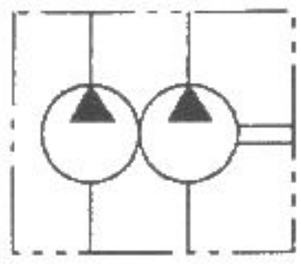
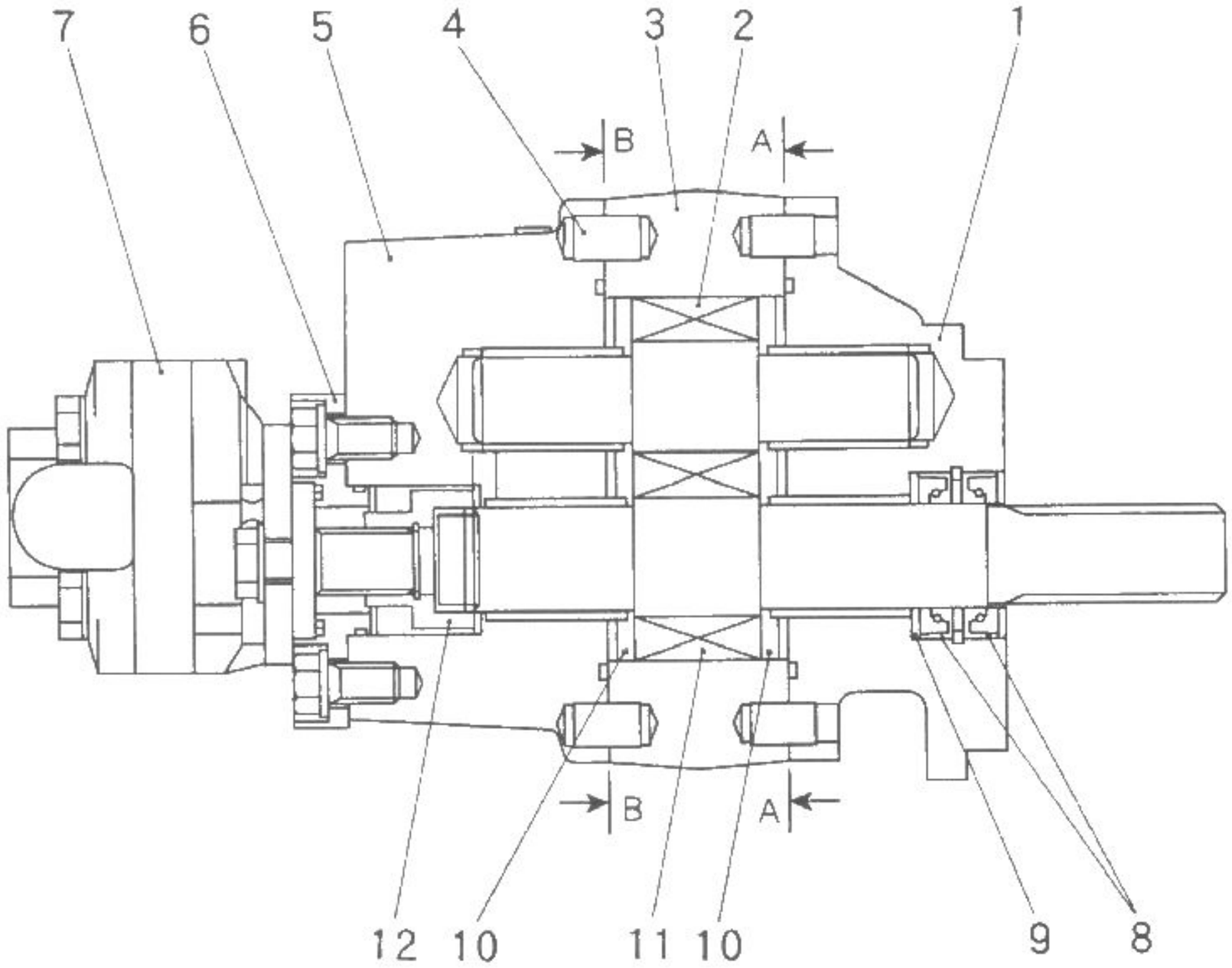
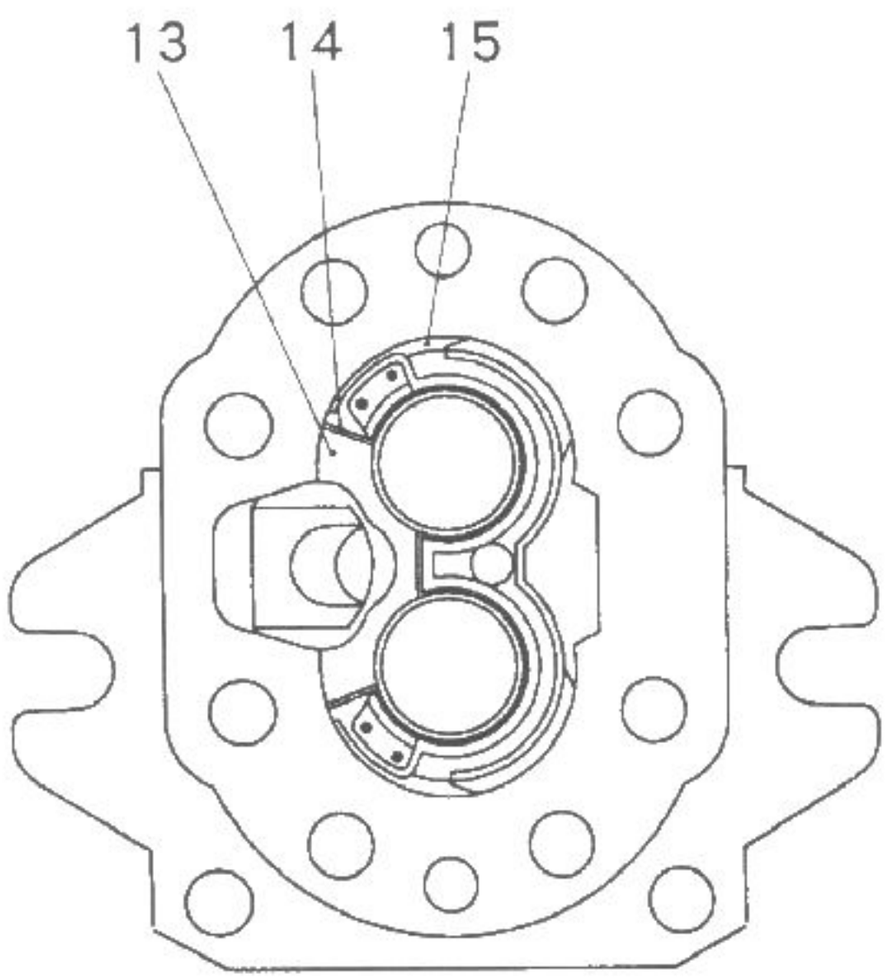


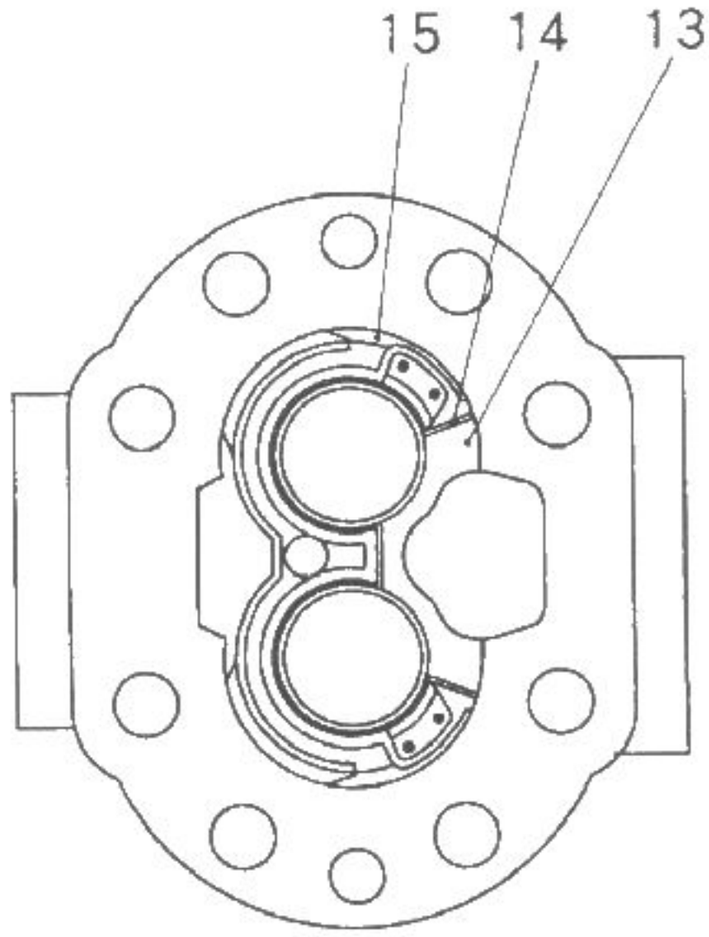
Fig. 6.13 Steering, Brake & Assist Pump (L35-3, LX190-7 · L40-3, LX230-7)

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Section B-B



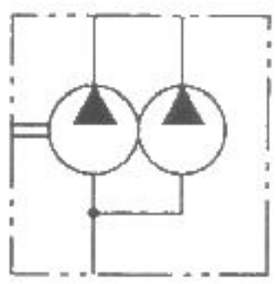
Section A-A

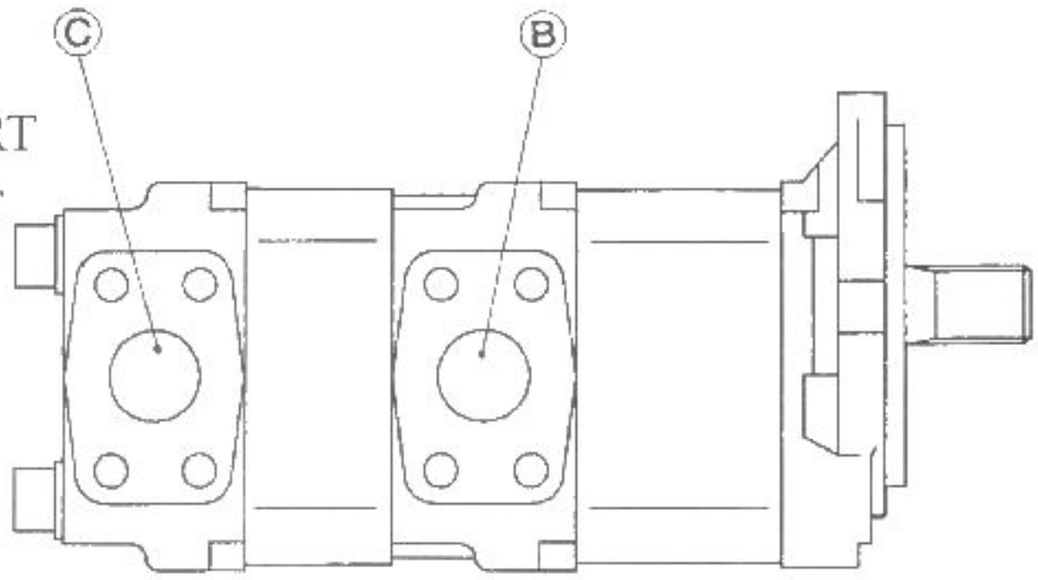
1. MOUNTING FLANGE
2. DRIVEN GEAR
3. GEAR PLATE
4. DOWEL
5. COVER PLATE
6. ADAPTER PLATE
7. KP1013 (See. Fig. 6.8)
8. OIL SEAL
9. SPECIAL WASHER
10. PRESSURE PLATE
11. FRONT DRIVE GEAR
12. SPLINE COUPLING
13. ISOLATION PLATE
14. BACK-UP
15. PLATE SEAL

Fig. 6.14 Construction of Steering, Brake & Assist pump (L35-3, LX190-7 · L40-3, LX230-7)

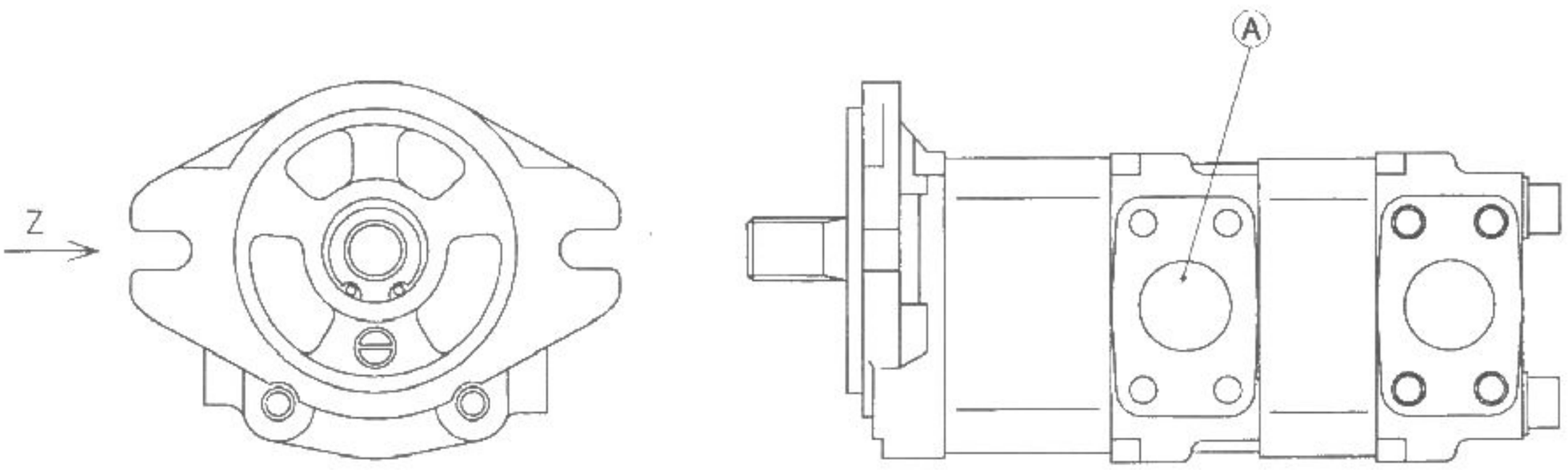
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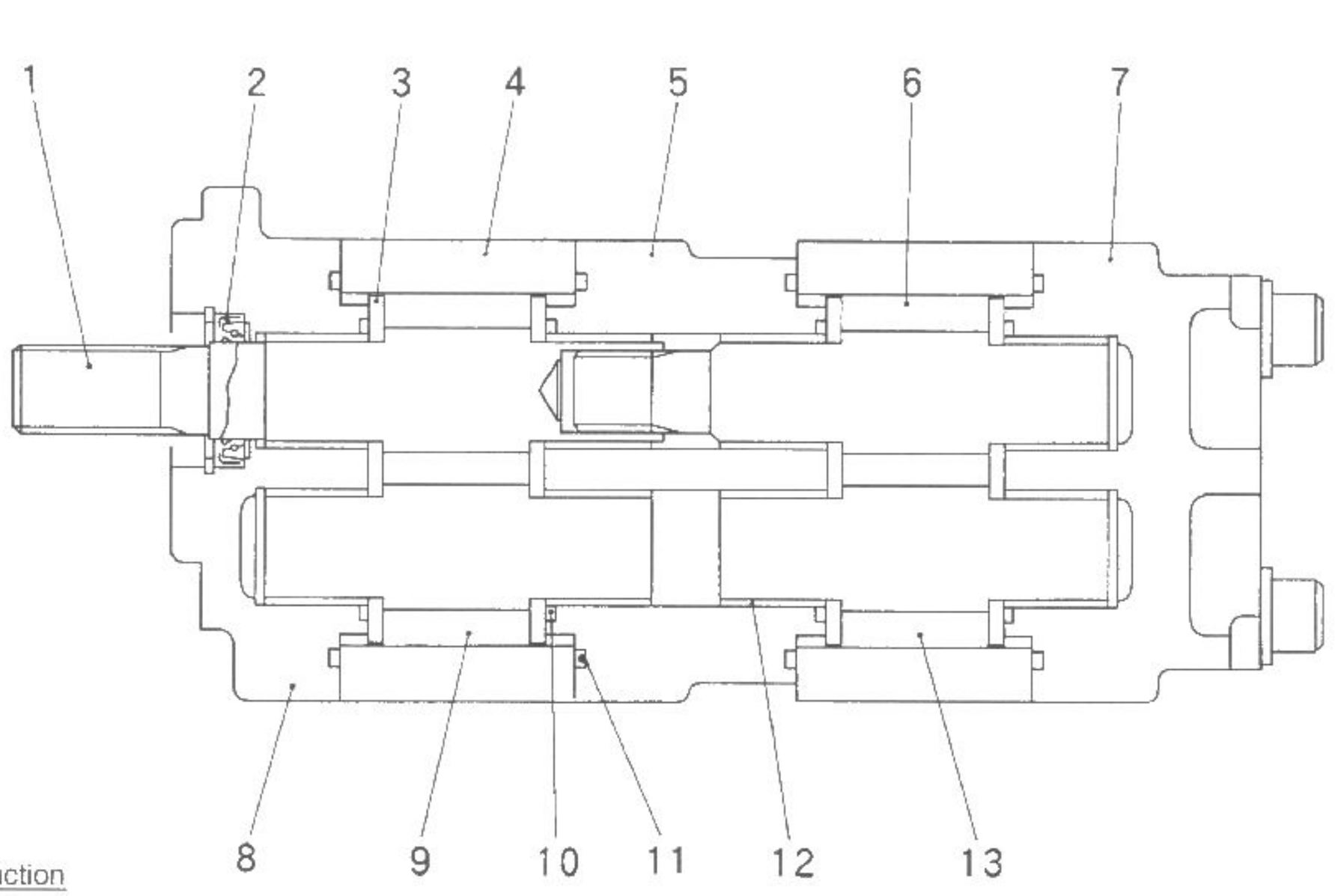
Ⓐ : SUCTION PORT
Ⓑ : FRONT PUMP DISCHARGE PORT
Ⓒ : REAR PUMP DISCHARGE PORT





View looking from Z





Inside construction

1. DRIVE GEAR
2. OIL SEAL
3. SIDE PLATE
4. BODY
5. ADAPTER PLATE
6. DRIVE GEAR
7. REAR COVER
8. FRONT COVER
9. DRIVEN GEAR
10. BACK-UP STRIP/GASKET
11. GASKET
12. BUSHING
13. DRIVEN GEAR

Fig. 6.15 Charging Pump (L35-3, LX190-7 · L40-3, LX230-7)

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6.3 VALVE

	L27-3, LX130-7	L32-3, LX160-7· L35-3, LX190-7 · L40-3, LX230-7
Main valve		
Model	KVML-200-2	KML28/2T601
Type	2-spool sliding type, pilot operation control	←
Main relief pressure setting	20.6 MPa {210 kgf/cm²} [2987 psi]	←
A1 port relief pressure setting	23.0 MPa {235 kgf/cm²} [3342 psi]	←
B1 port relief pressure setting	18.6 MPa {190 kgf/cm²} [2702 psi]	←
A2 port relief pressure setting	24.5 MPa {250 kgf/cm²} [3556 psi]	27.4 MPa {280 kgf/cm²} [3982 psi]
Weight	35 kg [77 lbs]	54 kg [119 lbs]
Pilot valve		
Model	MPPC-MD	←
Type	2-spool sliding type	←
Weight	7.5 kg [16.5 lbs]	←

6.3.1 MAIN VALVE

The main valve is a mono-blocked, 2-spool sliding type. The oil passages inside the valve are of the tandem type in which the bucket oil passage has priority over the boom oil passage so that the pressure oil is supplied to the boom circuit only when the bucket spool is in neutral.

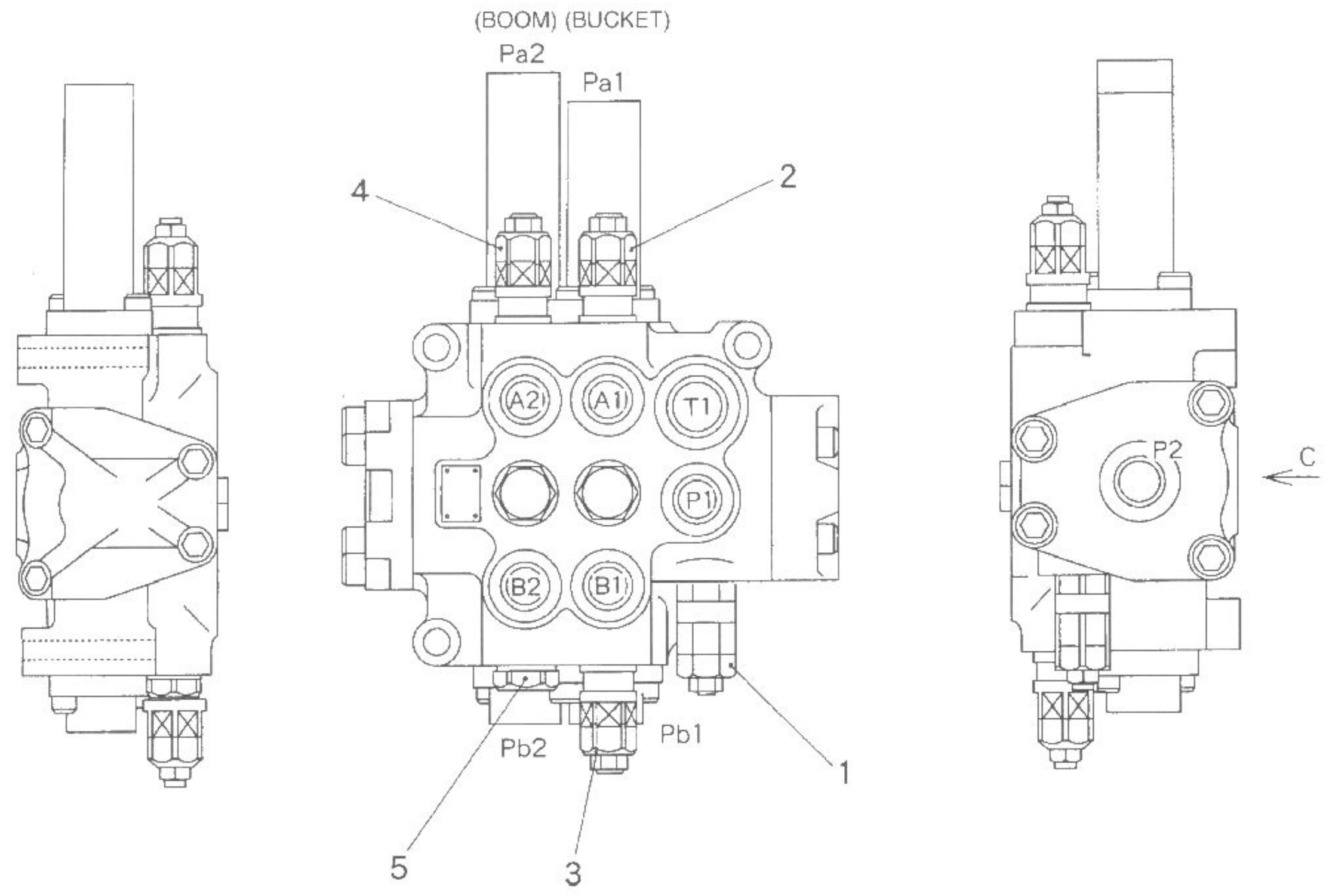
This priority circuit has a following feature: When the boom lever is placed in the working (moving up or down) position, the cylinders of both the bucket and the booms can be operated by operating only the bucket lever.

The main valve is changed over with the pilot operation control using oil flow through the pilot valve. For details, see "6.4 VALVE CONTROLS."

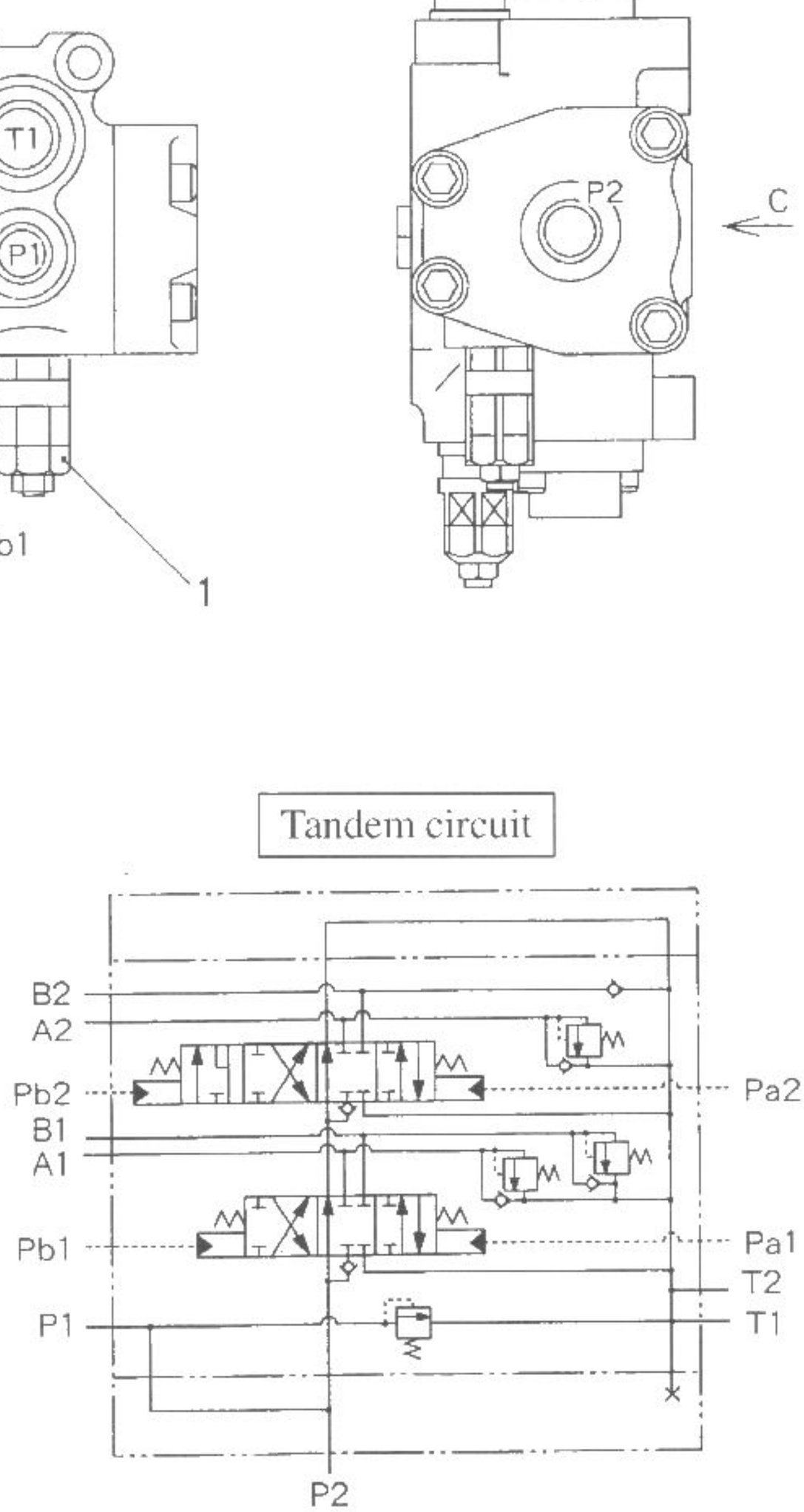
The main valve is provided with a main relief valve and three port relief valves. The main relief valve serves to protect the entire hydraulic circuit of the load handling system while controlling the operating pressure. When the pressure in the hydraulic circuit exceeds the main relief pressure setting, the main relief valve sends the oil pressure into the return passage to protect the cylinders and the piping.

Each port relief valve sends the oil pressure into the return passage when the cylinder receives a load heavy enough to cause the pressure at the cylinder port to rise beyond the port relief pressure setting, thus protecting the cylinder and the piping.

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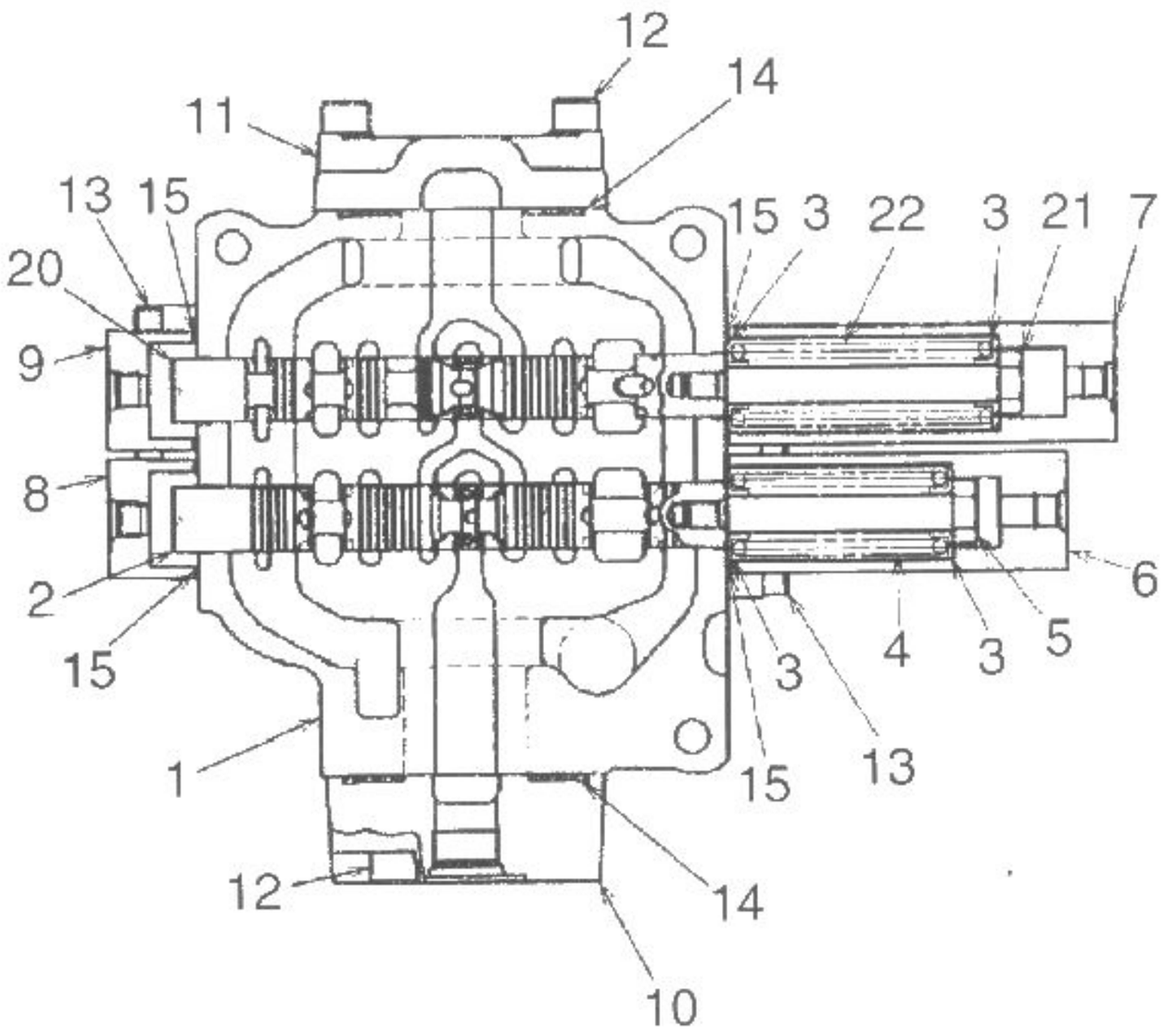
View looking from C

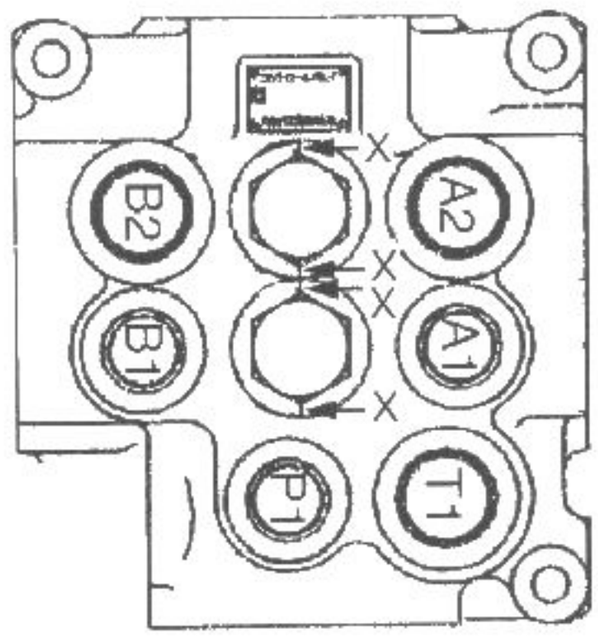


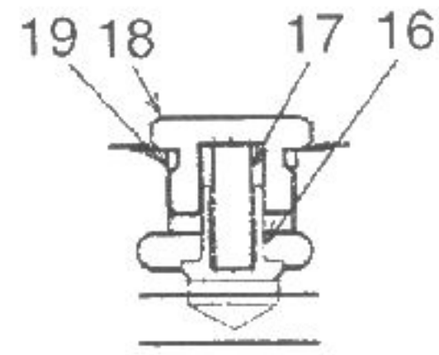
1. MAIN RELIEF VALVE
2. PORT RELIEF VALVE (A1)
3. PORT RELIEF VALVE (B1)
4. PORT RELIEF VALVE (A2)
5. ANTI-VOID VALVE

Fig. 6.16 Main Valve (L27-3, LX130-7)

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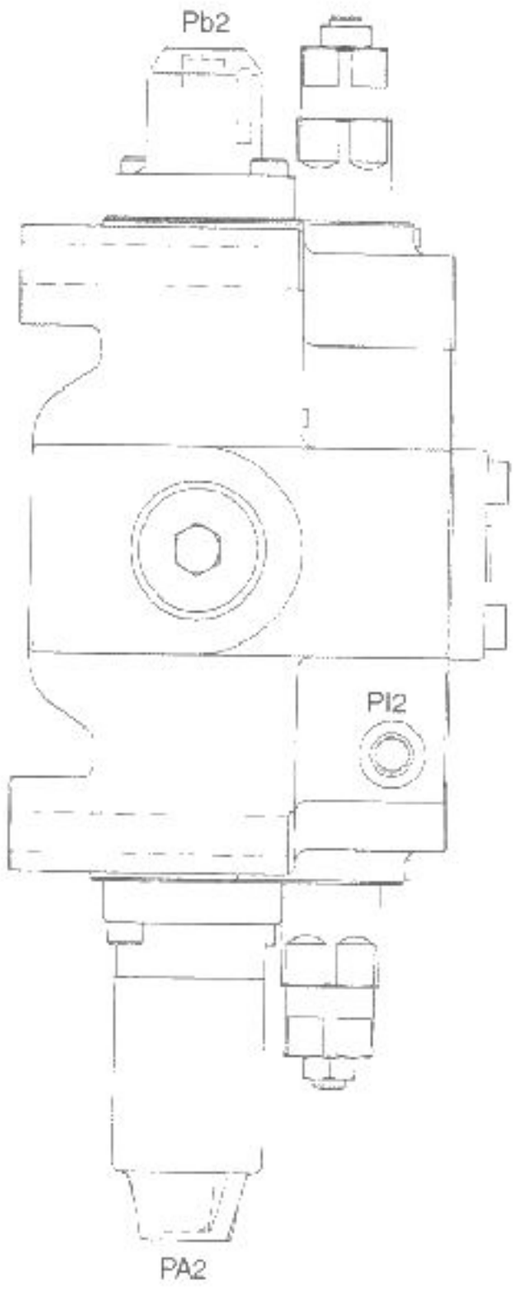


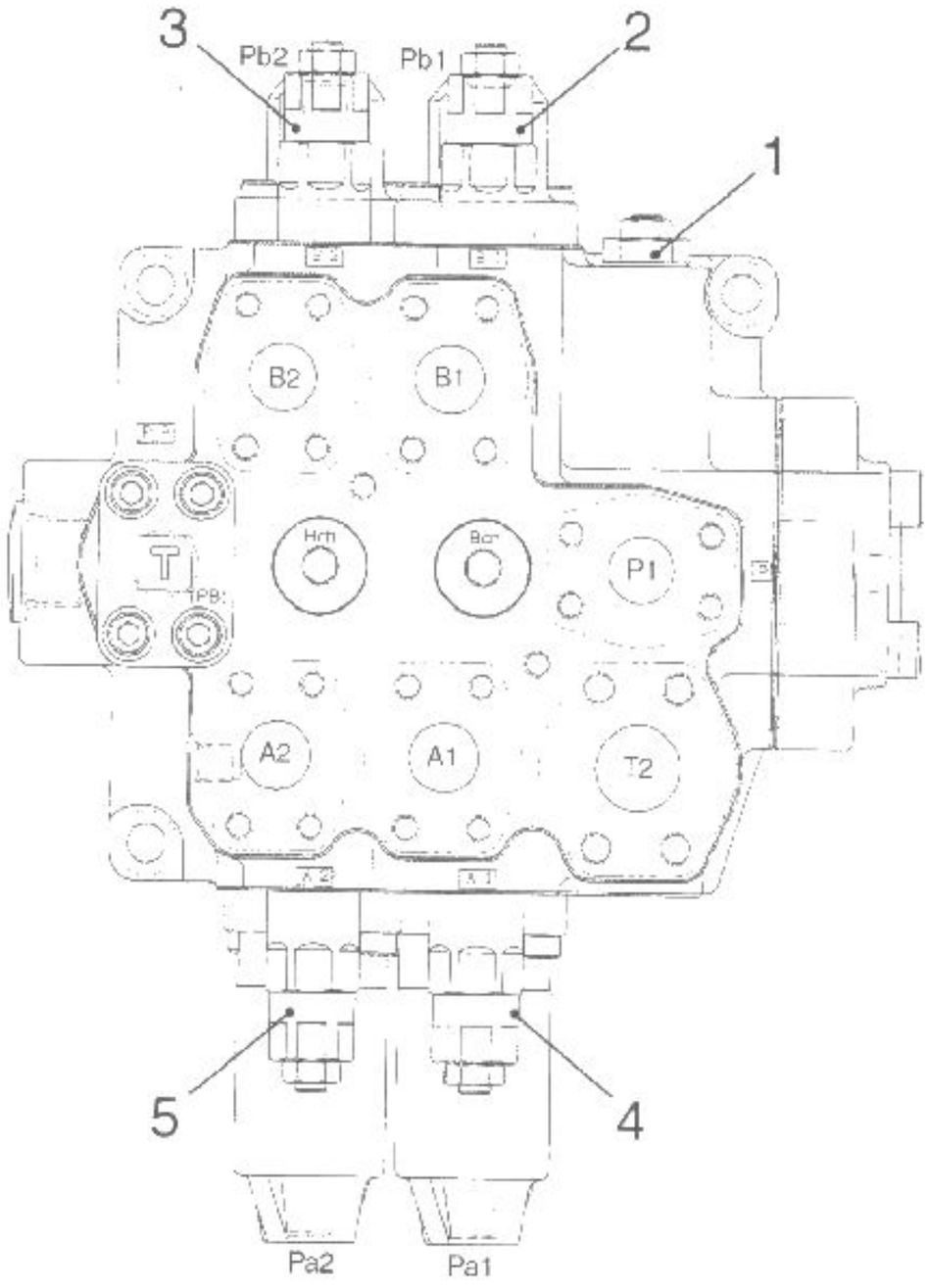
Section X-X

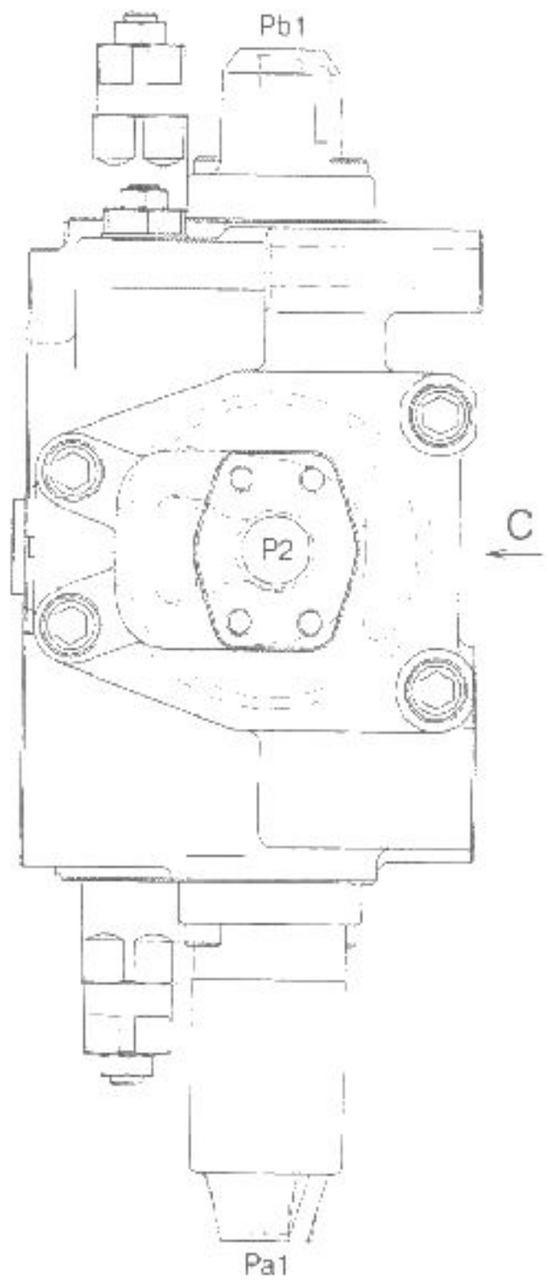
1. HOUSING
2. SPOOL
3. SPRING SEAT
4. SPRING
5. SPOOL END
6. CAP
7. CAP
8. CAP
9. CAP
10. COVER
11. COVER
12. SOCKET HEAD BOLT
13. SOCKET HEAD BOLT
14. "O"-RING
15. "O"-RING
16. POPPET
17. SPRING
18. PLUG
19. "O"-RING
20. SPOOL
21. SPOOL END
22. SPRING

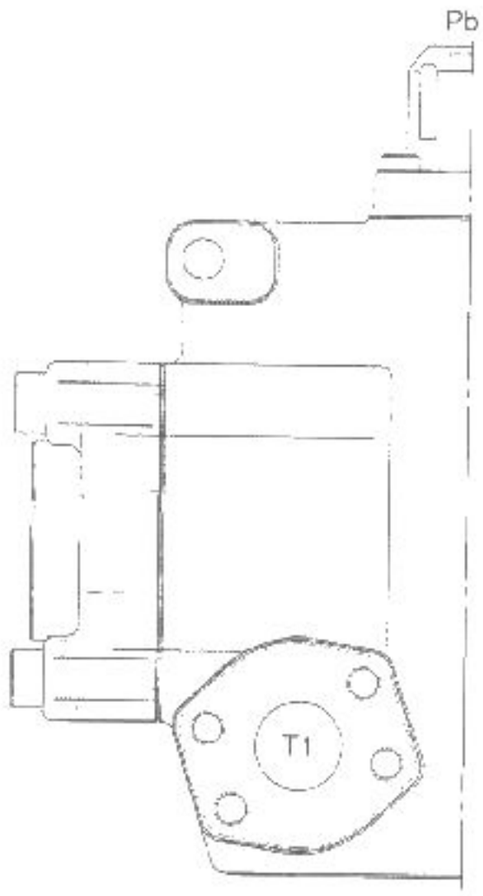
Fig. 6.17 Construction of Main Valve (L27-3, LX130-7)

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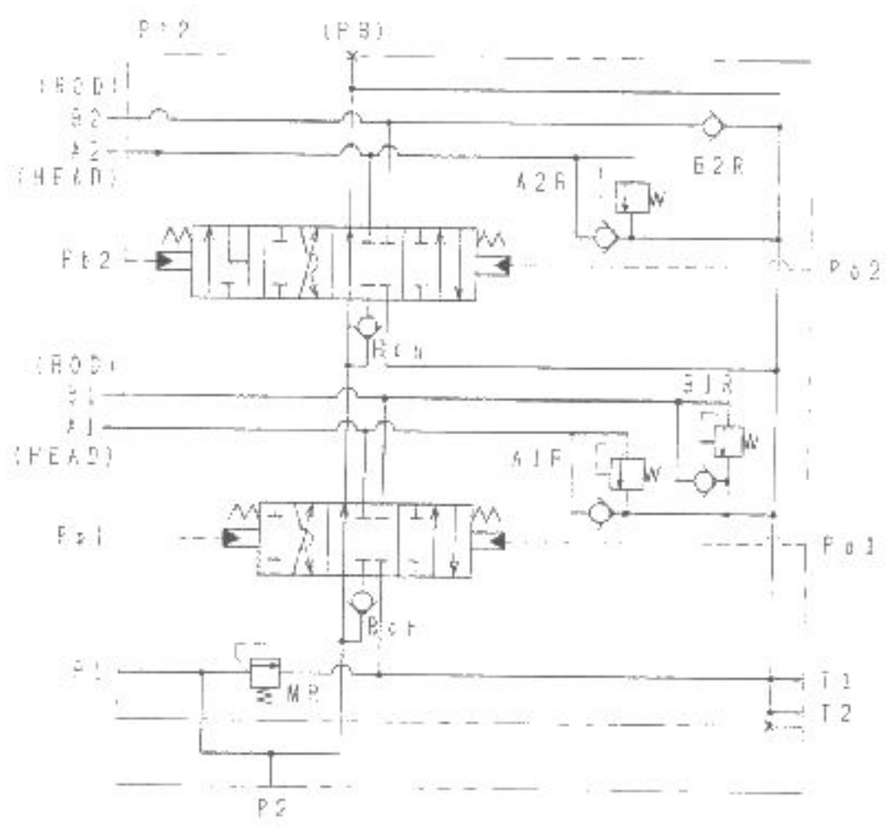






View looking from C

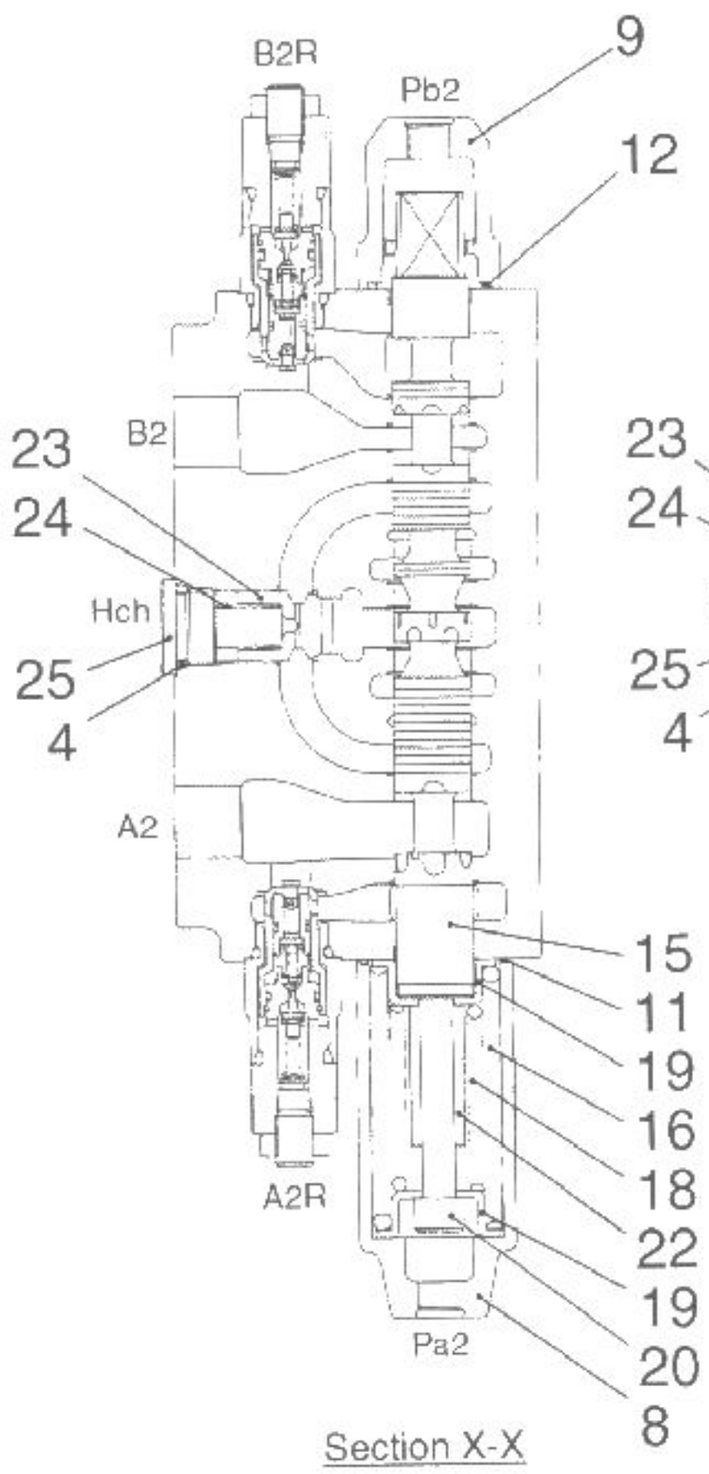
Tandem circuit



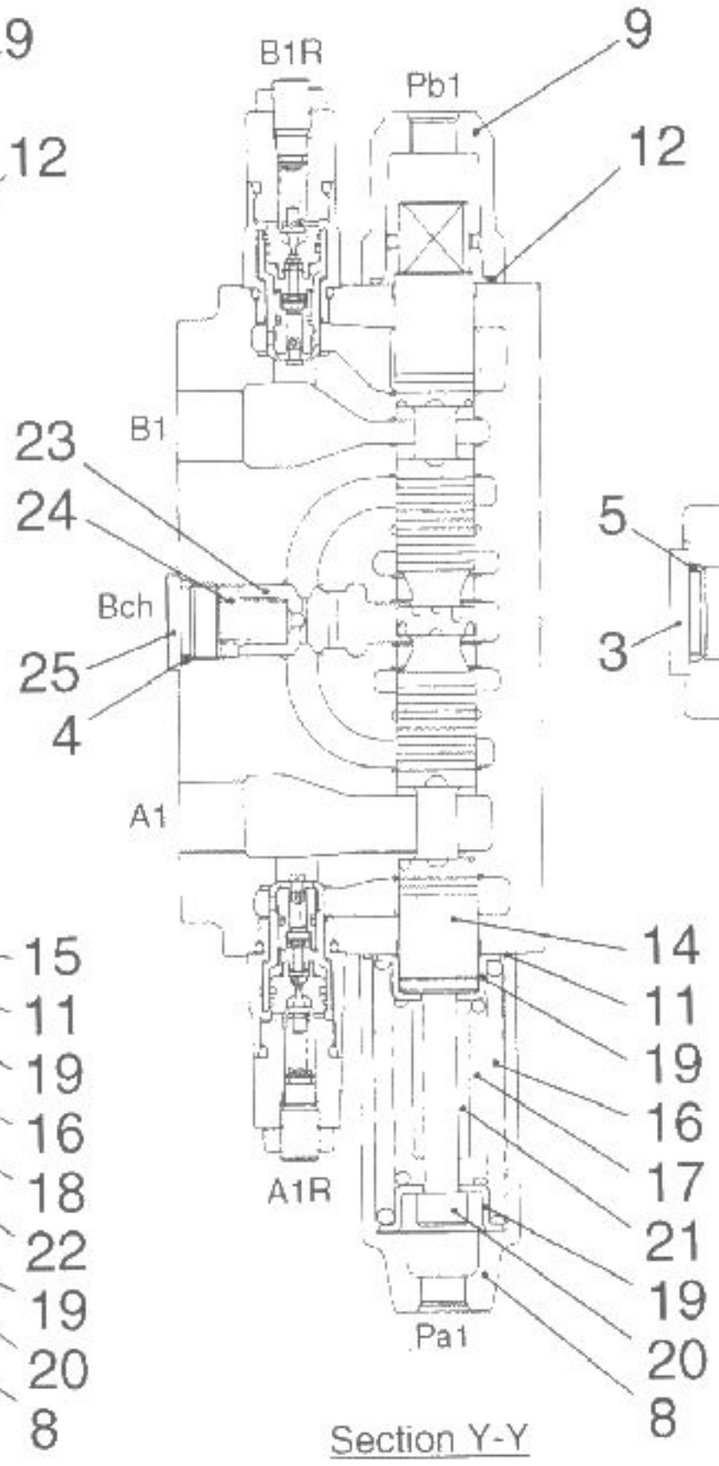
1. MAIN RELIEF VALVE
2. PORT RELIEF VALVE (B1)
3. PORT RELIEF VALVE (B2)
4. PORT RELIEF VALVE (A1)
5. PORT RELIEF VALVE (A2)

Fig. 6.18 Main Valve (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

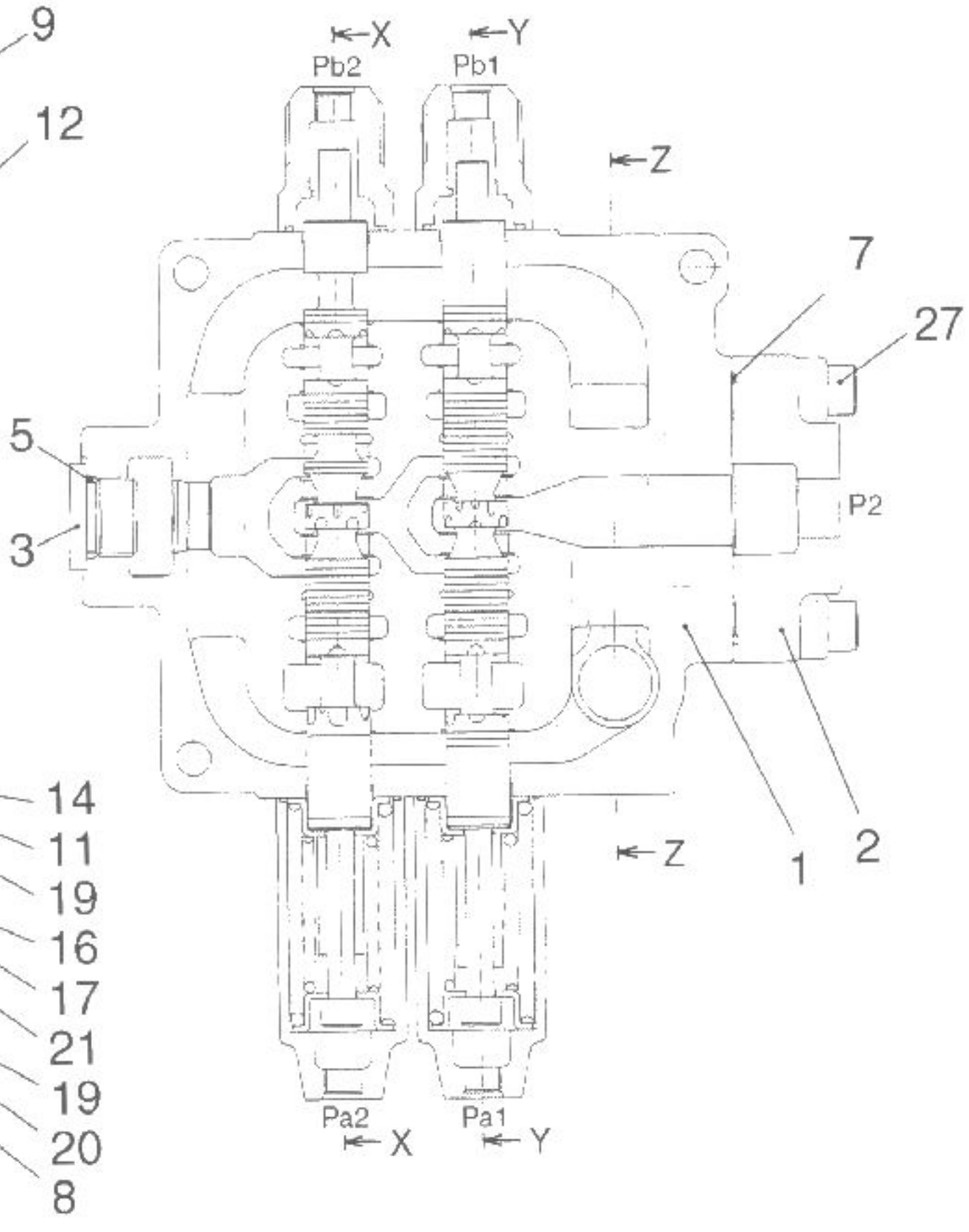
https://truckmanualshub.com/

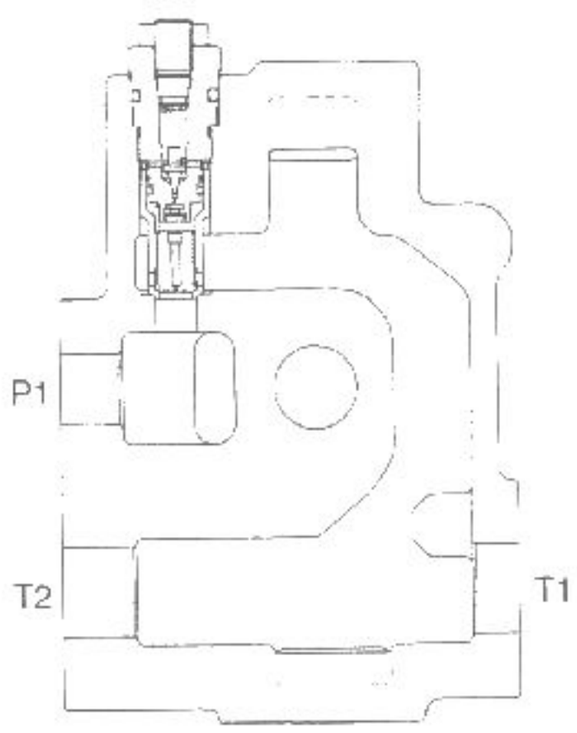


Section X-X

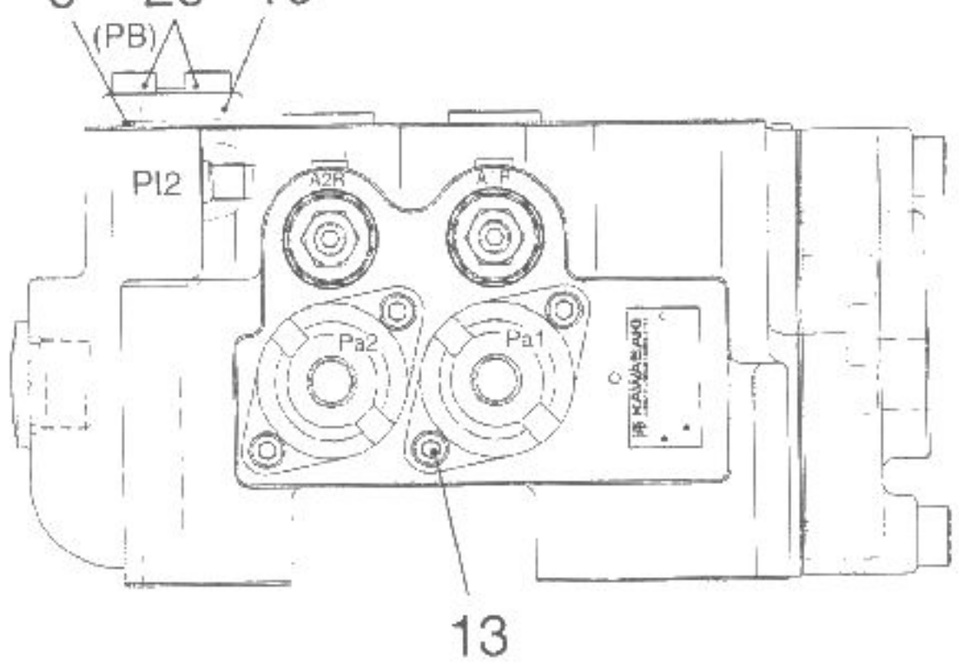


Section Y-Y





Section Z-Z



1. HOUSING
2. COVER
3. PLUG
4. "O"-RING
5. "O"-RING
6. "O"-RING
7. "O"-RING
8. SPRING COVER
9. SPOOL COVER
10. FLANGE
11. "O"-RING
12. "O"-RING
13. SOCKET HEAD BOLT
14. SPOOL
15. SPOOL
16. SPRING
17. SPRING
18. SPRING
19. SPRING SEAT
20. SPACER BOLT
21. STOPPER
22. STOPPER
23. POPPET
24. SPRING
25. PLUG
26. SOCKET HEAD BOLT
27. SOCKET HEAD BOLT

Fig. 6.19 Construction of Main Valve (L32-3, LX160-7 · L35-3, LX190-7 · L40-3, LX230-7)

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Operation

The control valve switches over the oil passages with their respective spools using the pilot pressure from the pilot valve to send the pressurized oil directed from the main pump, priority valve or the steering valve to the bucket cylinders or boom cylinders selectively.

1. Control valve in neutral

① With the spools of both the bucket spool section and the boom spool section in neutral, the cylinder ports A1 (tail side) and B1 (rod side) are closed by the spools.

② The pressurized oil which has reached the control valve flows, passing through the center bypass circuit, to the low-pressure oil passage and then leaves the control valve through the ports T1 and T2.

Note: The sketch shows the control valve of the L32-3, LX160-7, L35-3, LX190-7, L40-3, LX230-7, and LX230-7.
The operation of the control valve of the L27-3, LX130-7 is the same.

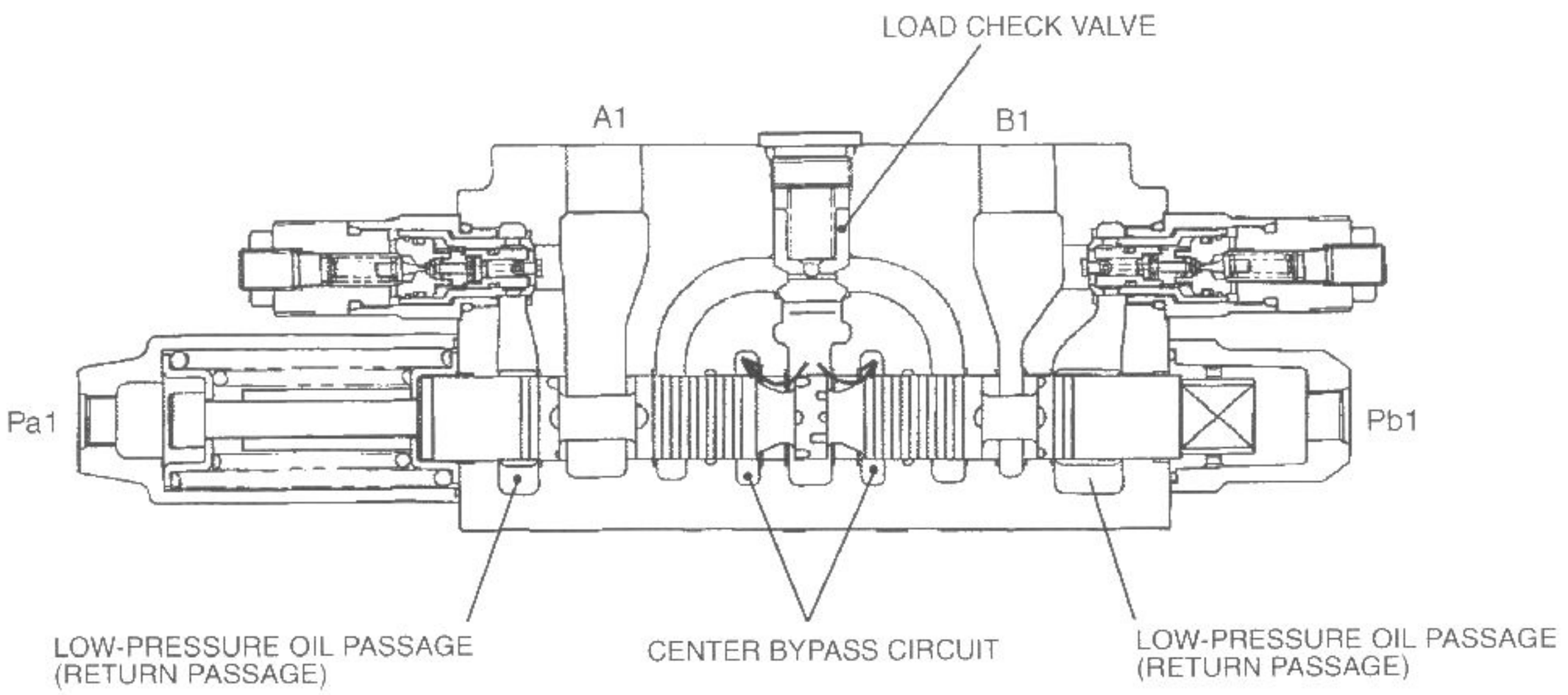


Fig. 6.20 Control Valve in Neutral (Bucket Spool Section)

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2. Bucket spool operation

(1) Roll-back

When the control lever is placed in the "roll-back" position, the pilot pressure is applied to the port Pa1 to shift the spool to the right so that the center bypass circuit is blocked by the spool's shoulder C. Oil from the pump opens the load check valve D and flows through the port A1 into the tail side of the bucket cylinder to roll back the bucket. On the other hand, the oil at the bucket cylinder rod side flows through port B1 back into the tank.

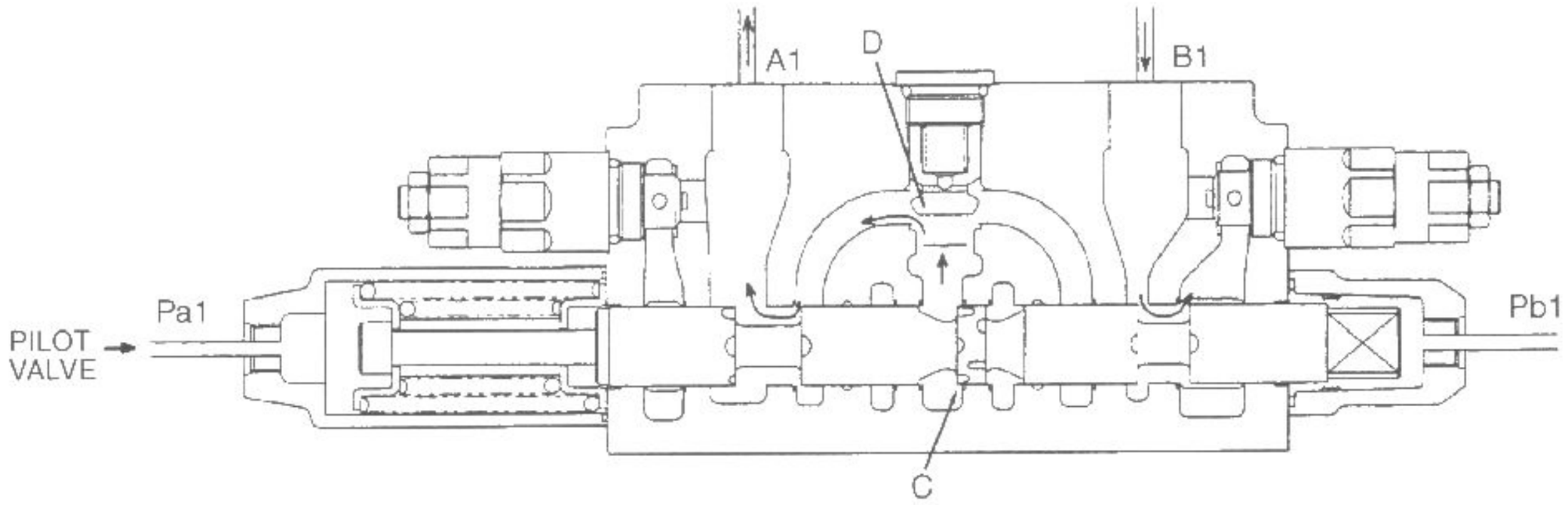


Fig. 6.21 Bucket in Roll-back

(2) Dump

When the control valve is placed in the "dump" position, the pilot pressure is applied to the port Pa1 to shift the spool to the left so that the center bypass circuit is blocked by the spool's shoulder C. Oil from the pump opens the load check valve D and flows through the port B1 into the rod side of the bucket cylinder to tilt the bucket forward. On the other hand, the oil at the bucket cylinder tail side flows through the port A1 back into the tank.

If a sudden dump operation is made, the make-up valve (Part E) of the overload relief valve opens to let oil at the tank port flow into the cylinder rod side, thus preventing negative pressure from building up at the rod side.

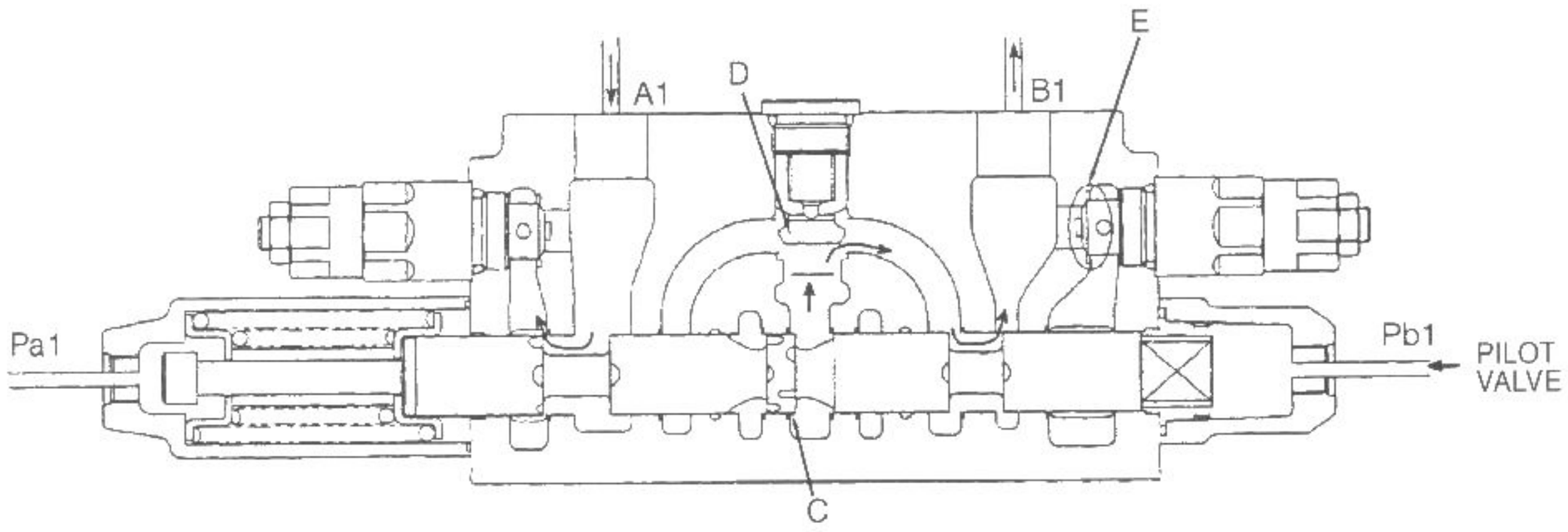


Fig. 6.22 Bucket in Dump

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3. Boom spool operation

(1) Raise and down

The oil passage in the boom spool section is identical with that of the bucket spool section. Therefore, boom raising operation is the same as bucket roll-back operation whereas boom lowering operation is the same as bucket dump operation.

For the details of boom operations, see the pertinent paragraphs of bucket operations.

Note: The oil passages inside the control valve are tandem type and the bucket oil passage has priority over the boom oil passage so that the pressure oil is supplied to the boom section only when the bucket spool is in neutral.

(2) Float

① When the control lever is further pushed down from the "down" position to the "float" position, the boom spool moves as indicated in the illustration.

② Due to this motion, pressurized oil flows as in neutral phase.

③ The cylinder ports A2 and B2 are connected to the low-pressure oil passage. As a result, the booms float over the ground surface according to its irregularities. Oil discharged from the boom cylinder rod side flows to the tail side and oil forced out of the tail side flows to the rod side, respectively through the low-pressure oil passage inside the control valve.

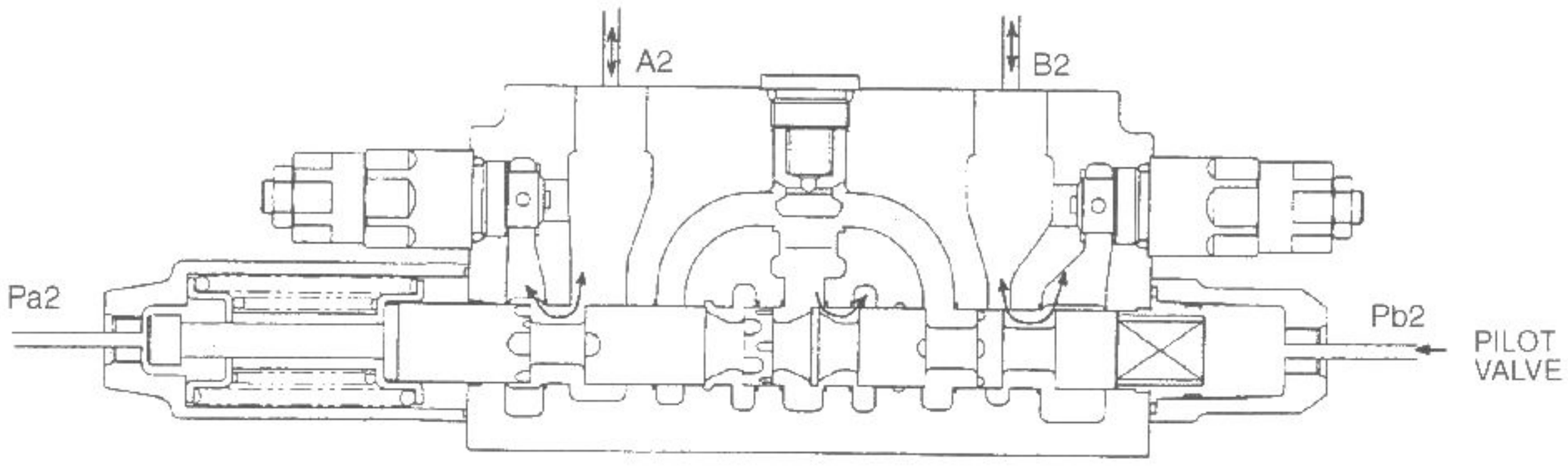


Fig. 6.23 Booms in Floating Phase

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Relief valve

1. Main relief valve

The main relief valve is located between the pump and the control valve spool and it lets oil pressure escape into the tank to prevent damage to piping and hydraulic devices when high pressure builds up, such as when the cylinder is at the stroke end.

Operation

(1) When oil pressure is less than relief pressure setting

Pressurized oil from the pump flows through the orifice in the main plunger C into the chamber D. The main plunber C is forced against the seat E due to the difference in area and spring force. In addition, the seat E also closely seats to the pump port owing to the difference in area between the pump port side and the chamber D.

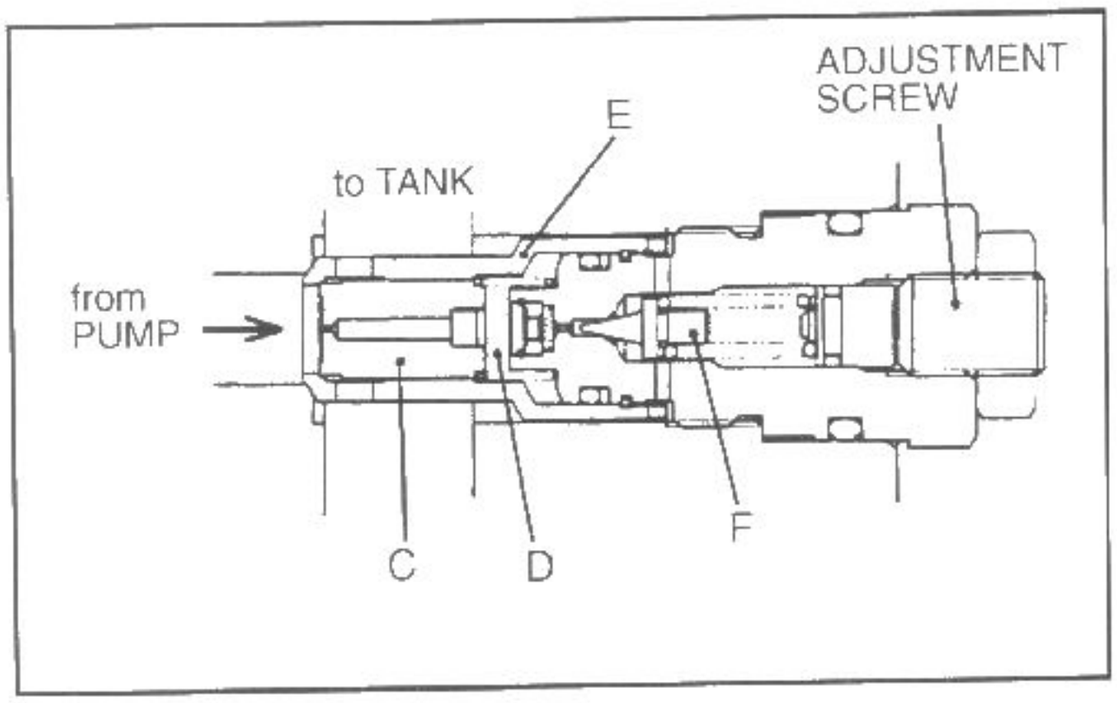


Fig. 6.24

(2) When oil pressure is higher than relief pressure setting

When the oil pressure that acts on the poppet F rises beyond the spring pressure setting, the poppet F is forced to the right to open so that the oil escapes, passing around the seat E, into the tank. As a result, the pressure in the chamber D drops to let the main plunger move to the right to open the oil passage to the tank port. This lets the pressurized oil at the pump port escape to the tank port.

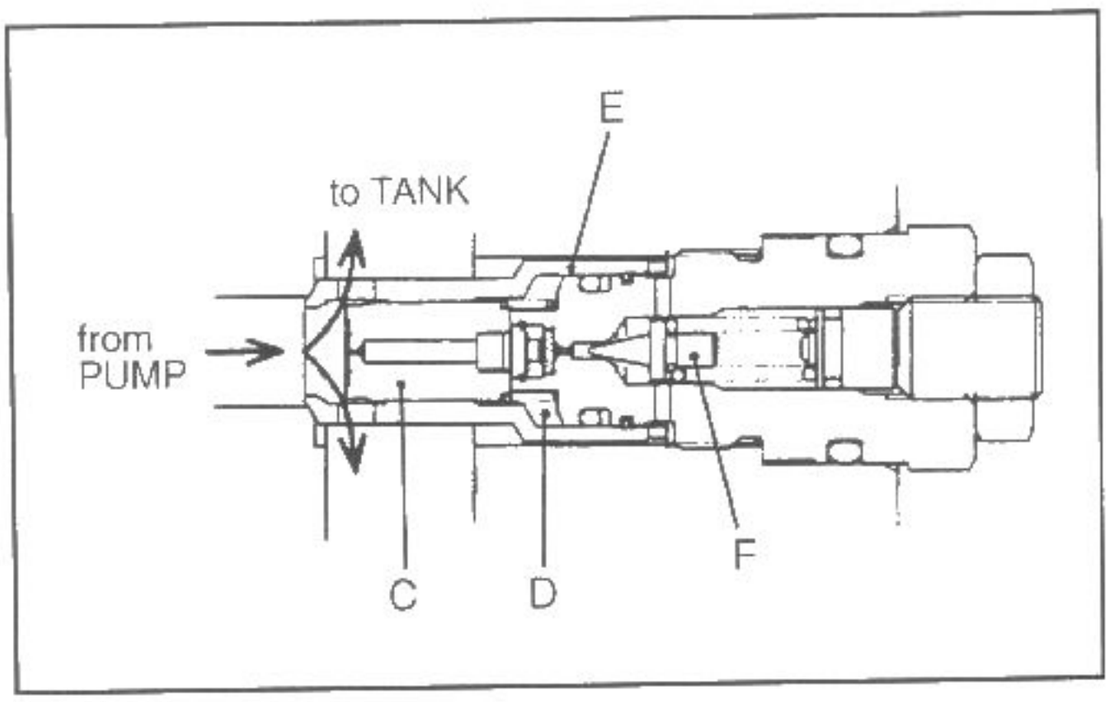


Fig. 6.25

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2. Port relief valve

The port relief valve is located between the cylinder and control valve spool. If abnormally high oil pressure build up in the hydraulic circuit due to the application of external force to the cylinder, the port relief valve escapes the oil pressure to prevent damage to the cylinder or piping.

Operation

(1) Operation as an overload relief valve

- When oil pressure is less than relief pressure setting
  Pressurized oil at the cylinder port flows through the oil hole in the piston C into the chamber X. The main plunger D is forced against the spool due to the difference in area and spring force. In addition, the seat K also closely seats to the cylinder port owing to the difference in area between the cylinder side and the chamber X.

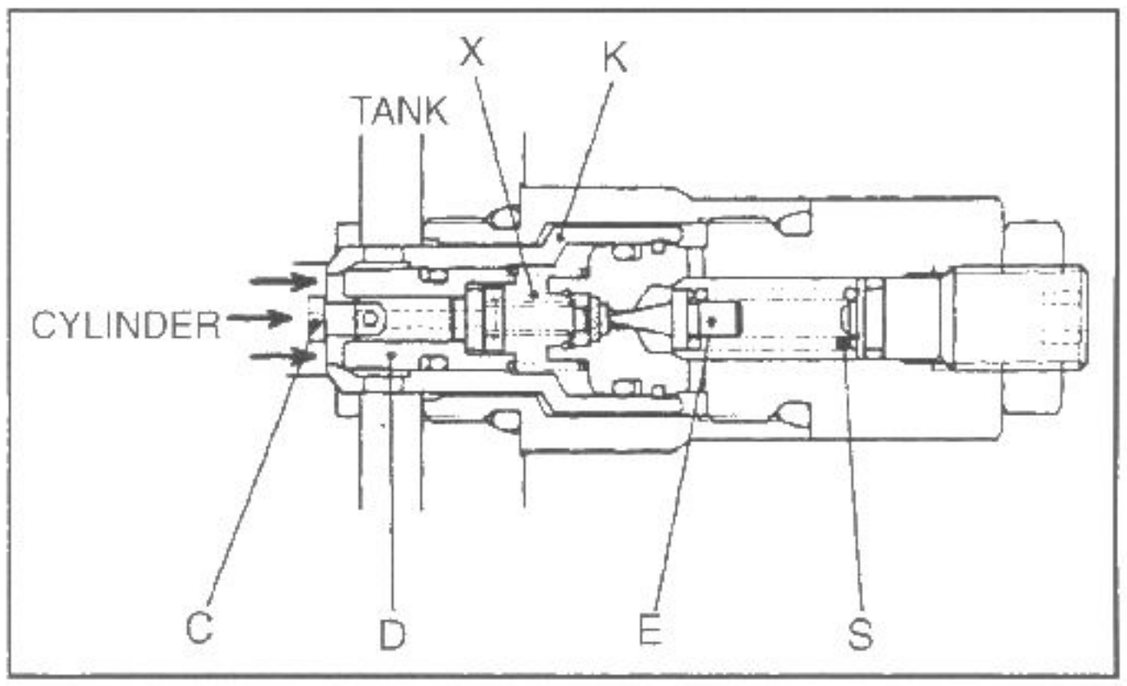


Fig. 6.26

- When oil pressure is higher than relief pressure setting
  If an abnormally high pressure builds up in the cylinder circuit and exceeds the spring force setting, the poppet E is moved to the right to open. The oil inside the chamber X flows, passing around the seat K, into the tank. As a result, the oil pressure inside the chamber X drops so that the plunger D moves to the right to open the hydraulic circuit to the tank port to let the pressurized oil at the cylinder port escape into the tank port.

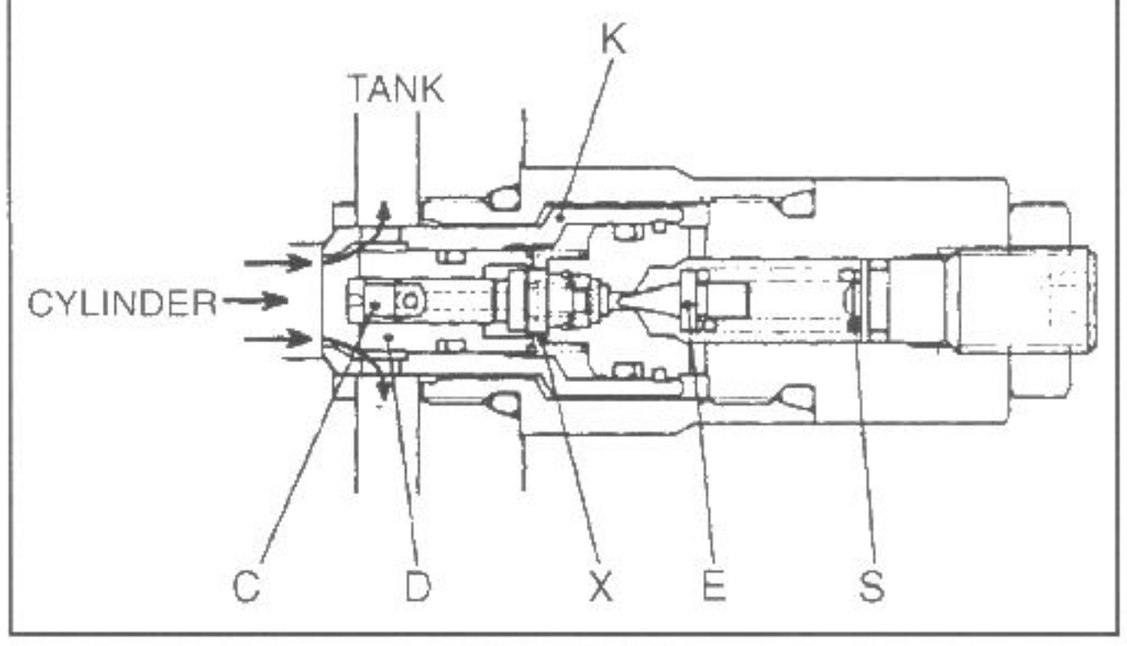


Fig. 6.27

(2) Operation as a make-up valve

If negative pressure builds up in the cylinder, the seat K moves to the right owning to the difference in area on which hydraulic pressure acts at the right and left sides of the seat K, to open the oil passage to the cylinder port. The oil thus flows to the cylinder port to make up for negative pressure.

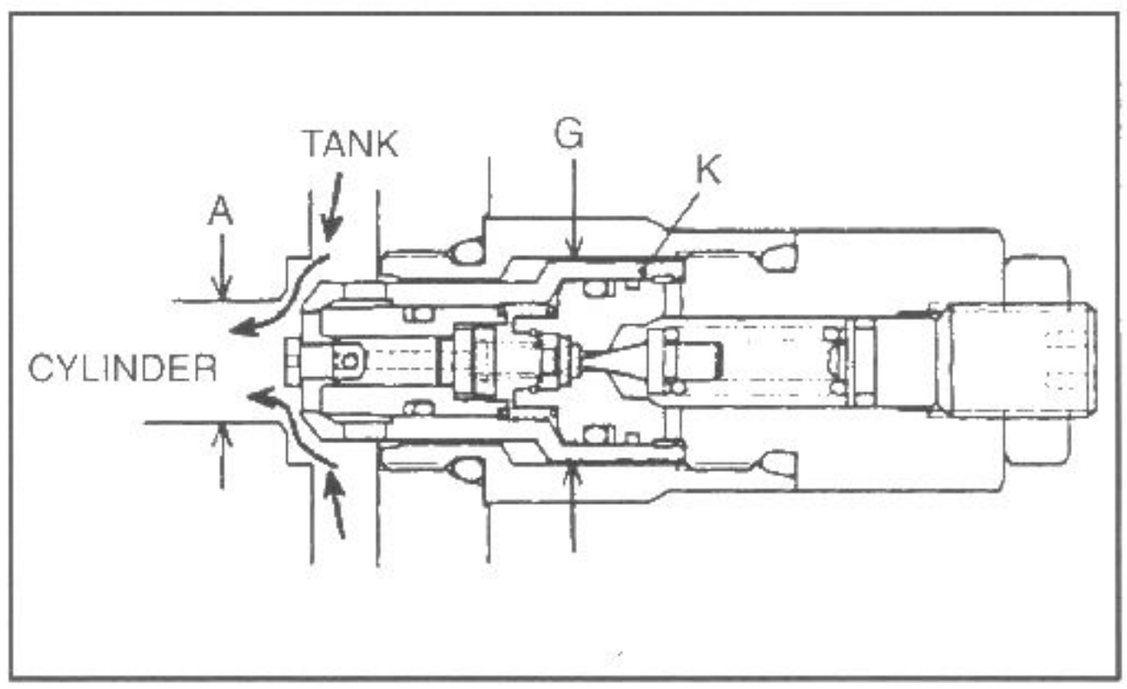


Fig. 6.28

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6.3.2 PILOT VALVE

The pilot valve is a stacked, 2-spool sliding type. Each plunger of the pilot valve has a solenoid detent mechanism. When the boom plunger is moved to the "Lift" or "Float" position and the bucket plunger is moved to "Roll-back" position, the detent mechanisms automatically hold the positions, keeping the load handling lever from returning to neutral when the operator removes his hand from the lever. The load handling lever automatically returns to neutral from operating positions other than the "Lift", "Float" and "Roll-back."

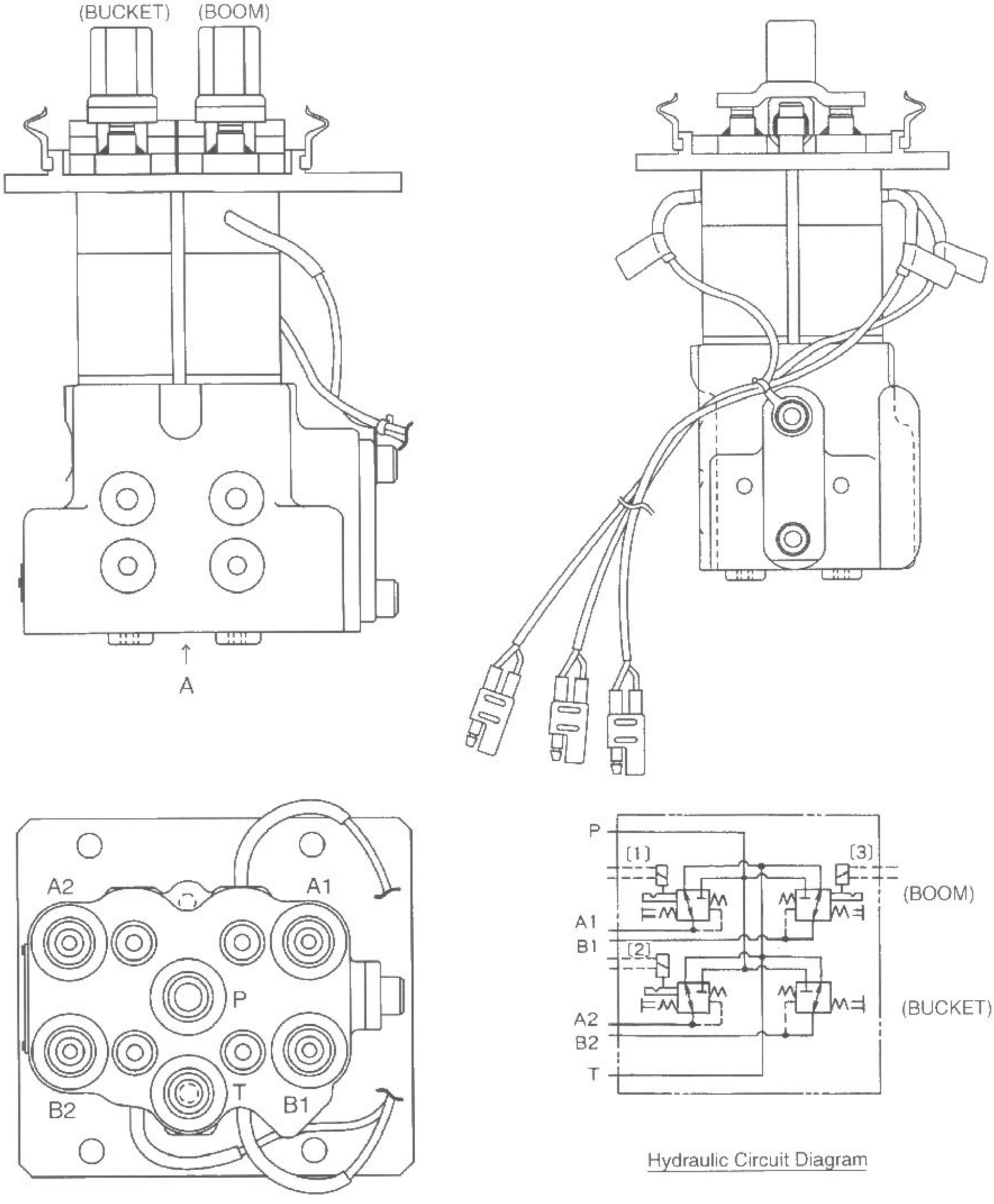
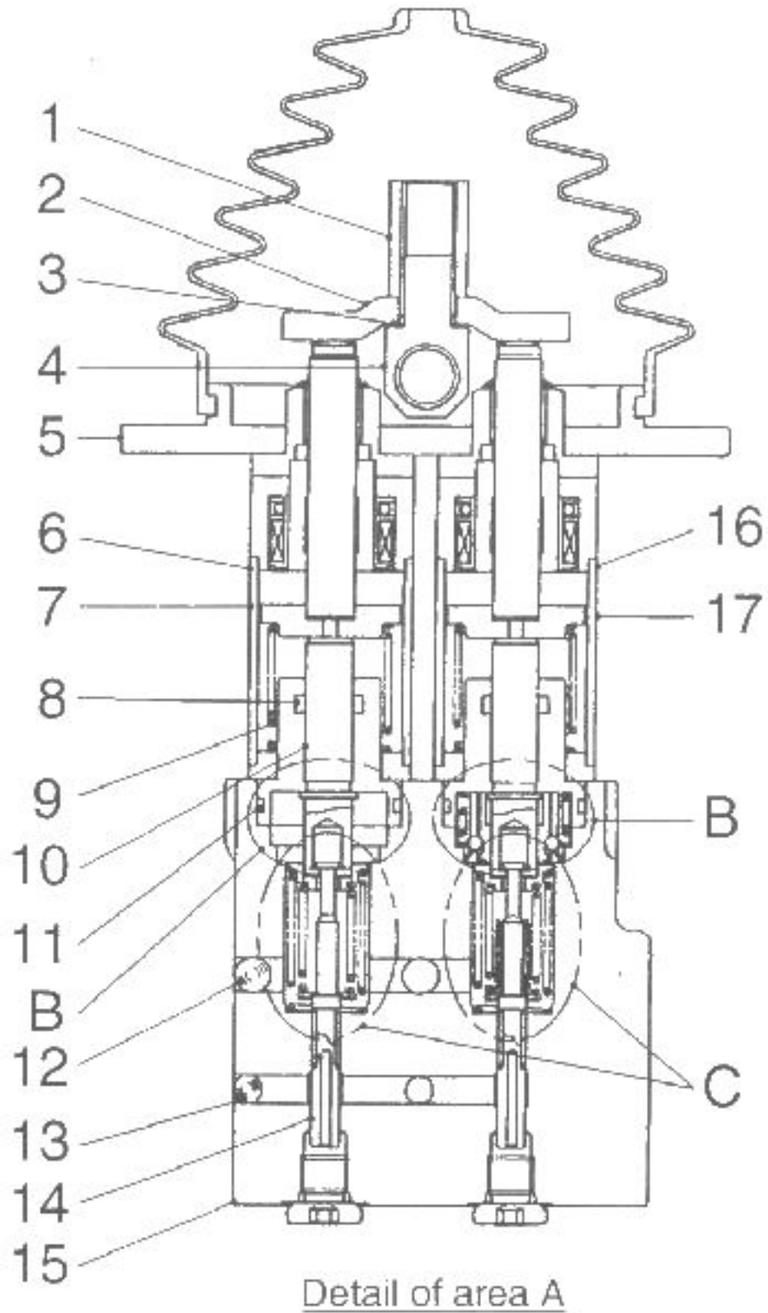
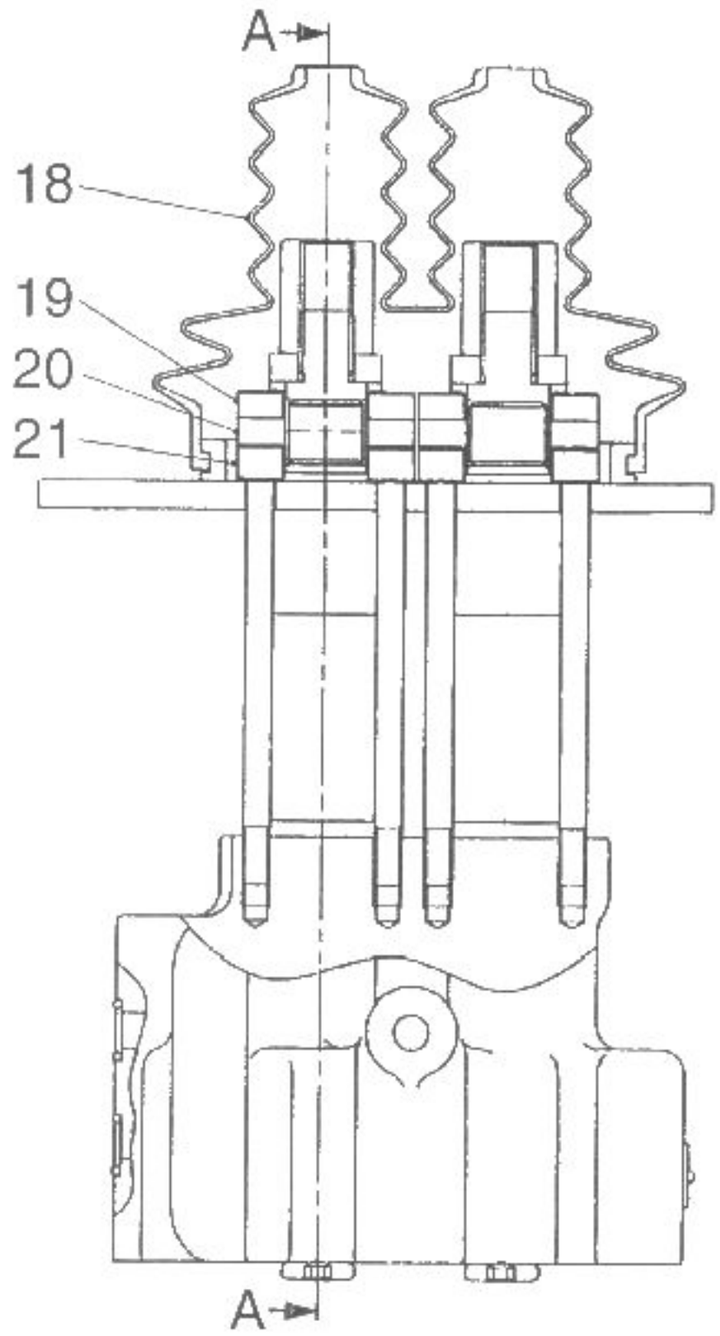


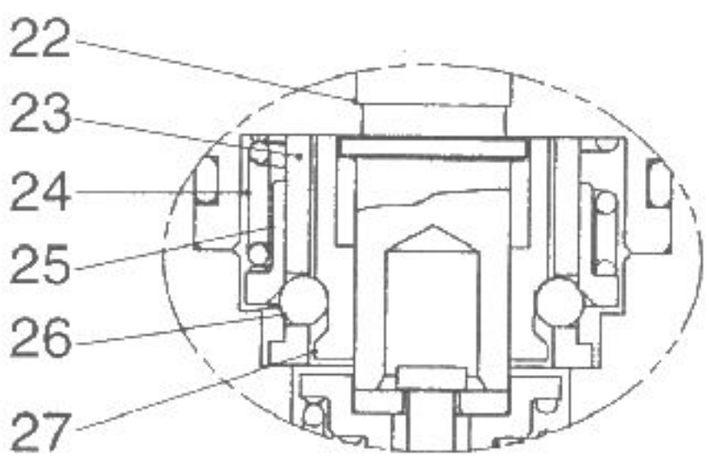
Fig. 6.29 Pilot Valve

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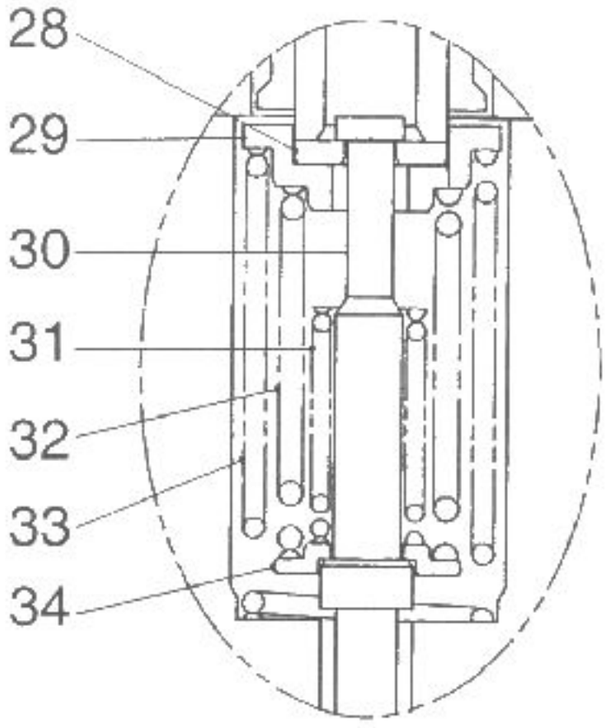


Detail of area A





Detail of area B



Detail of area C

1. LOCK NUT
2. PLATE
3. SPACER
4. LINK ASSEMBLY
5. PLATE
6. TUBE ASSEMBLY (A2)
7. COIL TUBE ASSEMBLY (A1)
8. SEAL
9. CAP
10. PUSH ROD
11. "O"-RING
12. STEEL BALL
13. STEEL BALL
14. SPOOL
15. VALVE BODY
16. COIL TUBE ASSEMBLY (B2)
17. COIL TUBE ASSEMBLY (B1)
18. BOOT
19. BOLT
20. PIN
21. SPACER
22. PUSH ROD
23. SLEEVE
24. SPRING
25. SPRING SEAT
26. STEEL BALL
27. CAM
28. WASHER
29. SPRING SEAT
30. SPOOL
31. SPRING
32. SPRING
33. SPRING
34. SPRING SEAT

Fig. 6.30 Pilot Valve

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6.4 VALVE CONTROLS

The valve control system is a pilot operation control type.

As the loader becomes larger, the hydraulic systems to be used will be bigger, the oil flow through the valve will increase (i.e. some hundreds liter per minute), the spool changing over the oil passages will be larger and the stronger operation force for moving the spool will be required.

To reduce the valve operation force, the pilot operation control is used.

The pilot operation control combines the main and pilot valves and moves the main valve spool by the oil pressure from the pilot valve, thus changing over the main valve.

⚠ As the safety device for the valve control system, a stop valve is provided. The main valve won't be actuated (is fixed in neutral) by operating the load handling lever accidentally, which prevents the loading system from operating by misoperation.

⚠ Cautions to be taken before servicing the pilot hydraulic line
The pilot valve is operated by the pressurized oil accumulated in the accumulator. Before servicing the pipings, stop the engine and press the brake pedal from 20 to 40 times to release the pressure from the accumulator. If the pipings are removed without releasing the pressure, high-pressure oil will spout out, causing an accident.

6.4.1 SYSTEM IN OPERATION

The pilot ports (Pa1, Pa2, Pb1 and Pb2) are provided with the both ends of each spool section of the main valve. The ports are connected with the discharge ports (A2, B1, B2 and A1) of the pilot valve respectively.

The oil passage in the pilot valve is changed over by operating the load handling lever, and the pressurized oil is sent from the discharge port to be selected to the pilot port of the main valve to move the main valve spool. The oil discharged from the opposite side of the pilot port by the movement of the main valve spool flows back through the pilot valve into the oil tank.

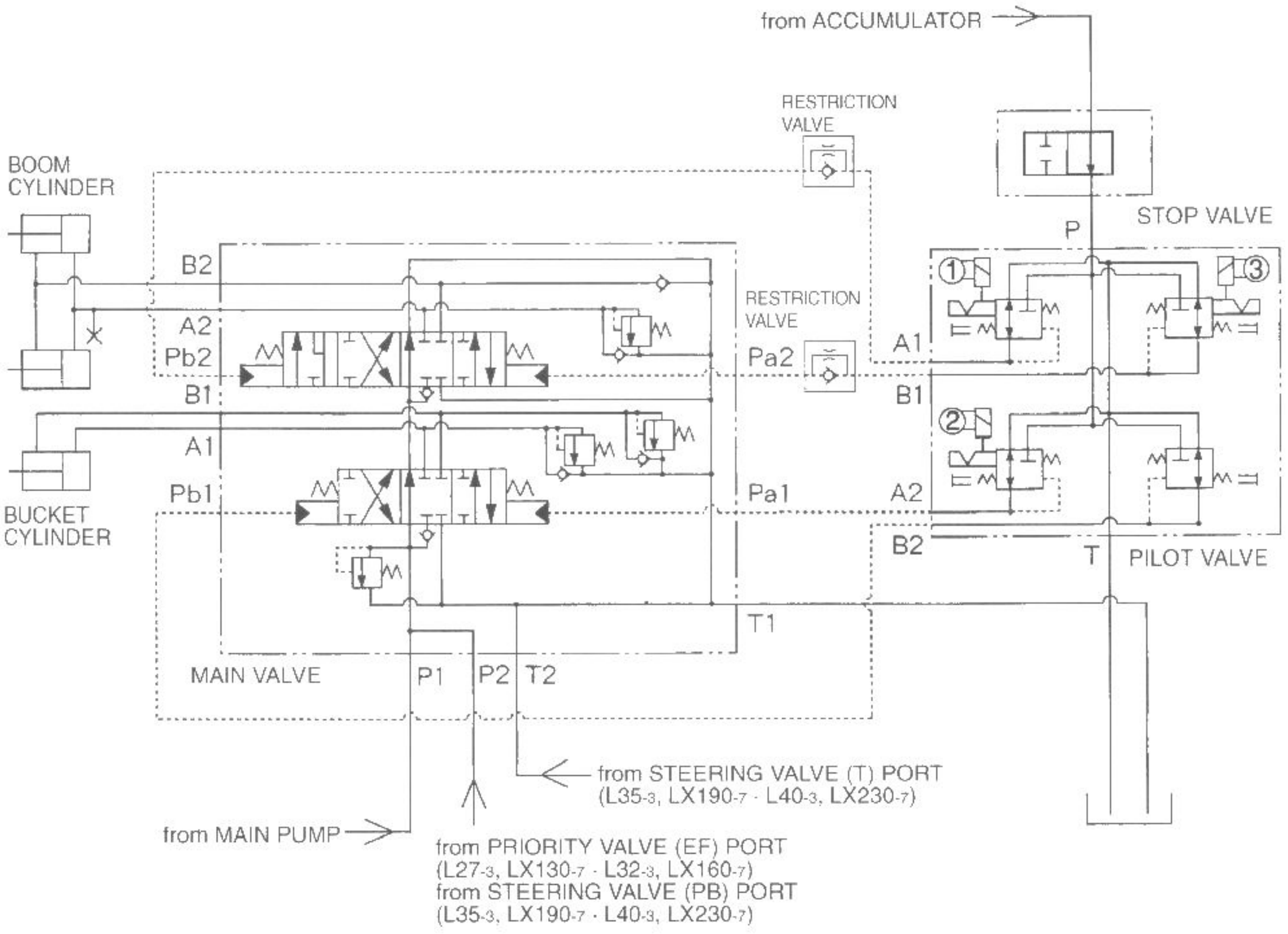
Note: If the accumulator has oil with engine stopped, the boom can be lowered by operating the boom lever.

Hydraulic control type

The pilot operation control of the loader is a hydraulic control type.

As the operation angle of the load handling lever increases, oil pressure at the discharge port of the pilot valve rises. As the oil pressure of the pilot valve rises, the movement of the main valve spool increases. Therefore, the whole system acquires the operation speed of the load handling system in proportion with the operation angle of the load handling lever.

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[Typical Operation] When boom lever is at "Lift" position:

① When the boom lever is moved to the "Lift" position, A1 and B1 ports of the pilot valve are connected to the T and P ports, respectively.

② The pressurized oil in the accumulator is sent through the stop valve to the P port of the pilot valve.

③ The pressurized oil at the P port of the pilot valve flows through the B1 port to the Pa2 port of the main valve, moving the main valve spool. Then, the pressurized oil at the P port of the main valve is discharged from the A2 port to extend the boom cylinder, raising thus the boom.

④ The oil discharged from the Pb2 port by movement of the main valve spool flows into the A1 port of the pilot valve, and returns through the T port into the oil tank.
The oil pressure at the port Pb2 of the main valve flows through the orifice in the restriction valve to the port A1 of the pilot valve to gradually drop the pilot oil pressure, thus moving the boom spool slowly.

Fig. 6.31 Hydraulic Circuit Diagram of Valve Control System

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6.4.2 STOP VALVE

The stop valve controls the oil supply to the pilot valve.

When the lever of the stop valve is pulled, the oil passage inside the valve is closed, supplying no oil to the pilot valve. (The load handling system doesn't operate.)

When the lever of the stop valve is pushed in, the oil passage inside the valve opens to supply the oil to the pilot valve (in load handling operation).

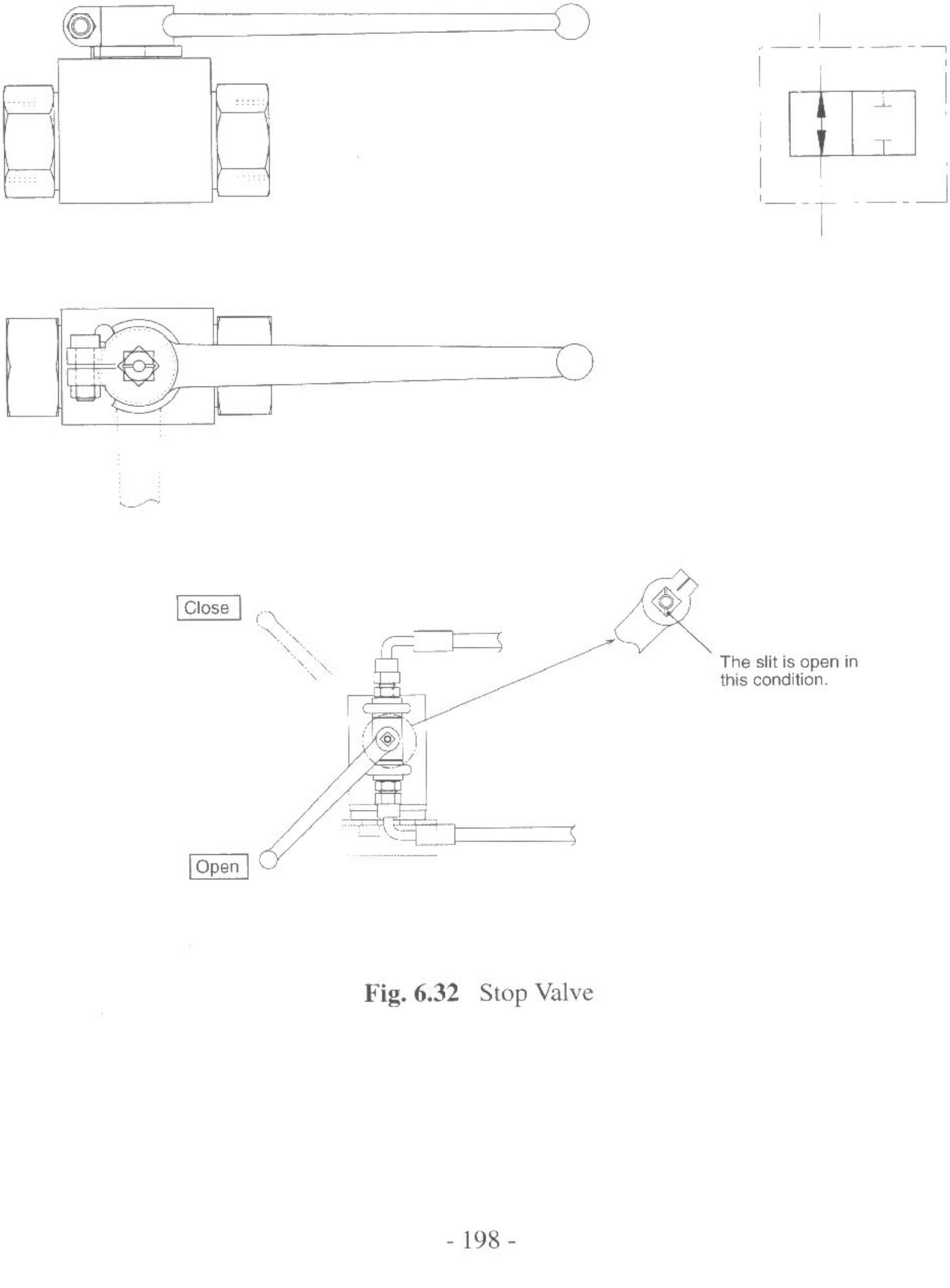
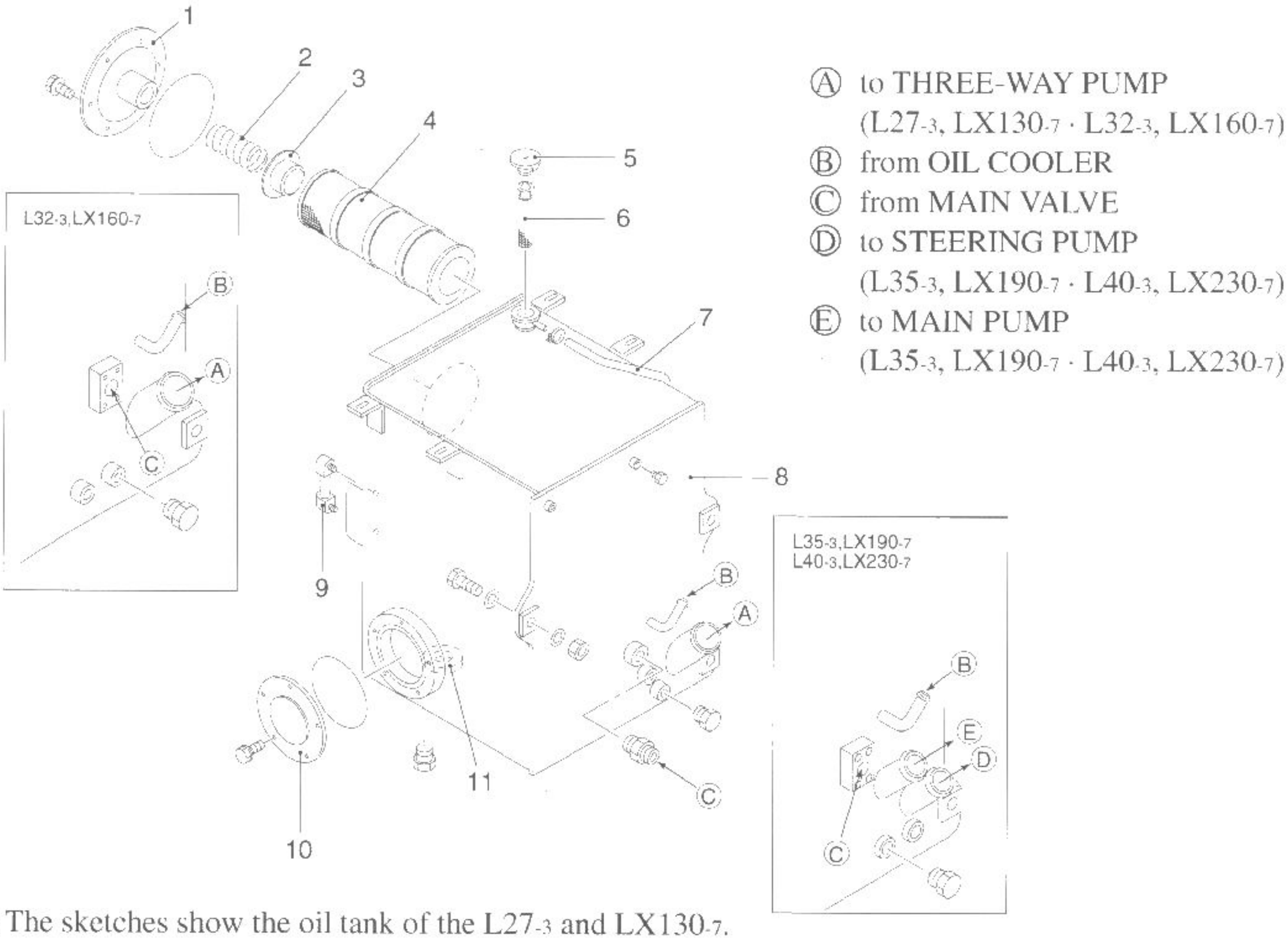


Fig. 6.32 Stop Valve

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6.5 OIL TANK

	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7 · L40-3, LX230-7
Type	Pressurized, enclosed type	←	←
Cap operating pressure	Positive pressure: 44.1 to 53.9 kPa {0.45 to 0.55 kgf/cm²} [6.4 to 7.8 psi]	←	←
	Negative pressure: 3.9 to 4.9 kPa {0.04 to 0.05 kgf/cm²} [0.6 to 0.7 psi]	←	←
Return filter	1pc., 15 µ	←	←
Tank capacity	80 L [21.1 U.S. gal.]	97 L [25.6 U.S. gal.]	124 L [32.8 U.S. gal.]
Tank weight (dry)	133 kg [293 lbs]	152 kg [335 lbs]	173 kg [381 lbs]



Ⓐ to THREE-WAY PUMP (L27-3, LX130-7 · L32-3, LX160-7)
Ⓑ from OIL COOLER
Ⓒ from MAIN VALVE
Ⓓ to STEERING PUMP (L35-3, LX190-7 · L40-3, LX230-7)
Ⓔ to MAIN PUMP (L35-3, LX190-7 · L40-3, LX230-7)

Note: The sketches show the oil tank of the L27-3 and LX130-7.

1. SUPPORT PLATE
2. SPRING
3. RETAINER
4. FILTER
5. CAP
6. FILTER
7. HOSE
8. OIL TANK
9. LEVEL GAUGE
10. COVER
11. MAGNET

Fig. 6.33 Oil Tank

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NOTE

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7. LOAD HANDLING SYSTEM

The load handling system is operated by hydraulic cylinders and is used to dig, load and unload, and transport loads. The linkage employed for the loading system is a Z-shaped type which is simpler in design and produces more powerful bucket break-out force than the duplex or other types.

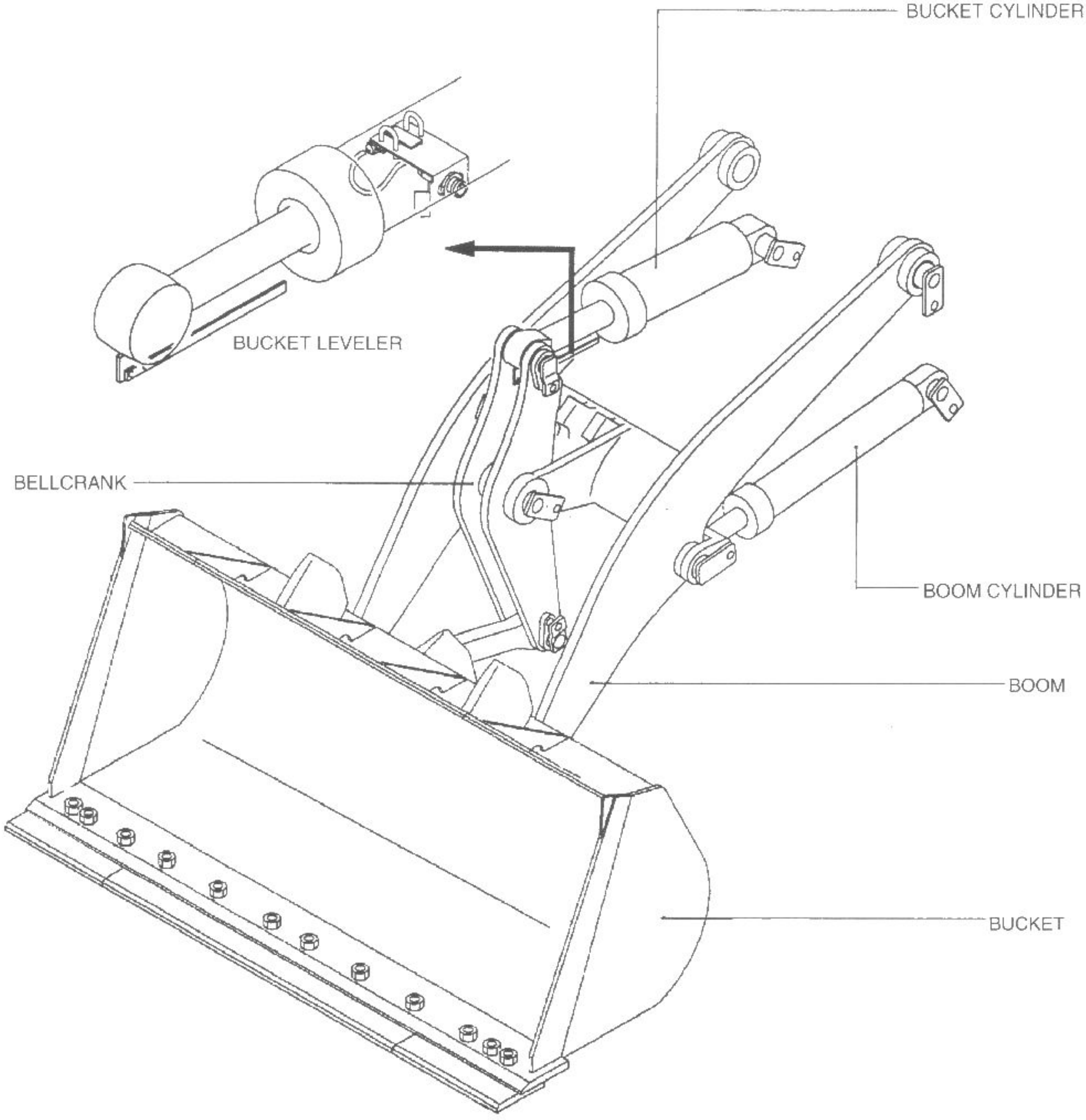


Fig. 7.1 Load Handling System

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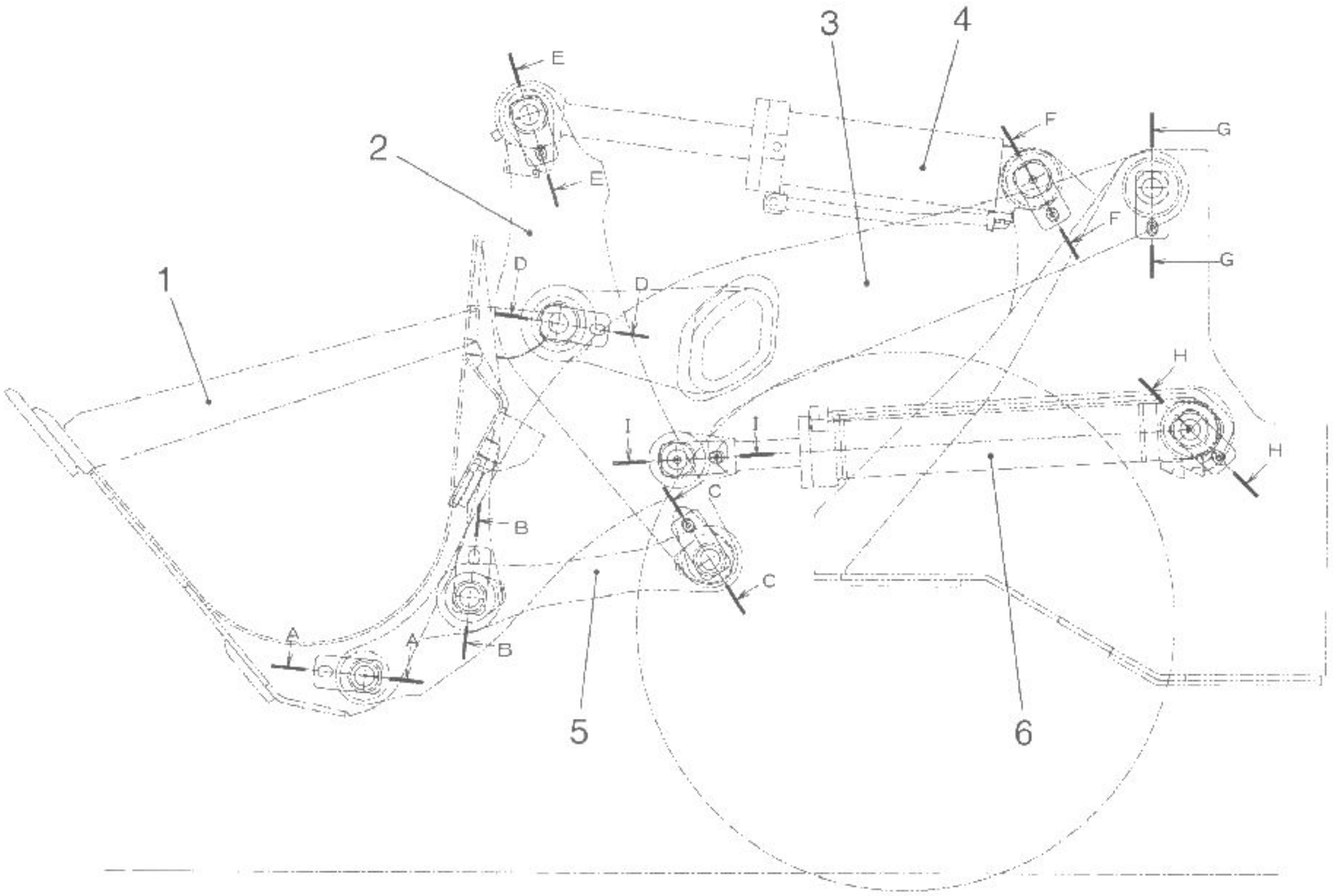
7.1 BOOM, BELLCRANK AND BUCKET

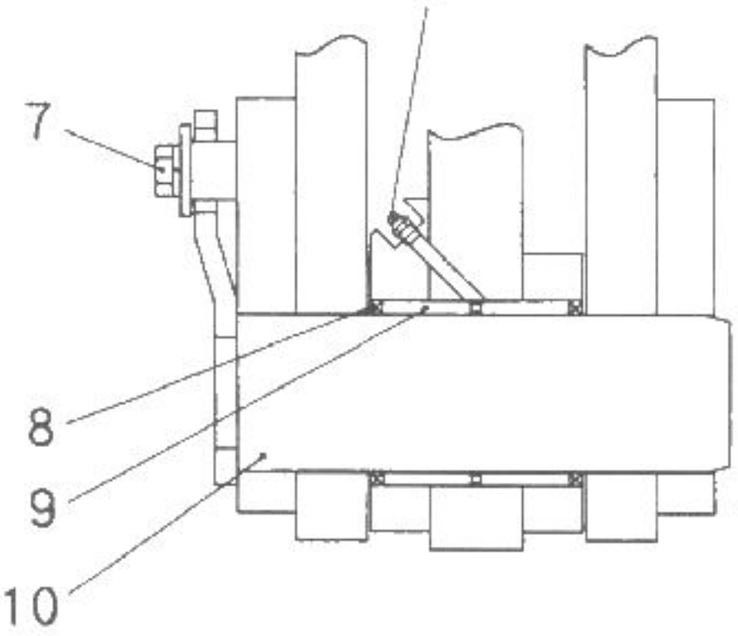
	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
Linkage	Z-shape	←	←	←
Bucket shape	DEB Type 1	←	←	←
Bucket capacity				
Heaped	2.7 m³ [3.5 yd³]	3.2 m³ [4.2 yd³]	3.5 m³ [4.6 yd³]	4.0 m³ [5.2 yd³]
Bucket leveler	Provided (non-contact type)	←	←	←
Boom kickout	Provided (non-contact type)	←	←	←
Weight				
Boom	916 kg [2020 lbs]	1146 kg [2527 lbs]	1325 kg [2922 lbs]	1509 kg [3327 lbs]
Bellcrank	252 kg [556 lbs]	297 kg [655 lbs]	350 kg [772 lbs]	420 kg [926 lbs]
Push rod	43 kg [95 lbs]	55 kg [121 lbs]	68 kg [150 lbs]	70 kg [154 lbs]
Bucket (with double edge)	1315 kg [2900 lbs]	1540 kg [3396 lbs]	1790 kg [3947 lbs]	2070 kg [4564 lbs]

7.1.1 GENERAL DESCRIPTION

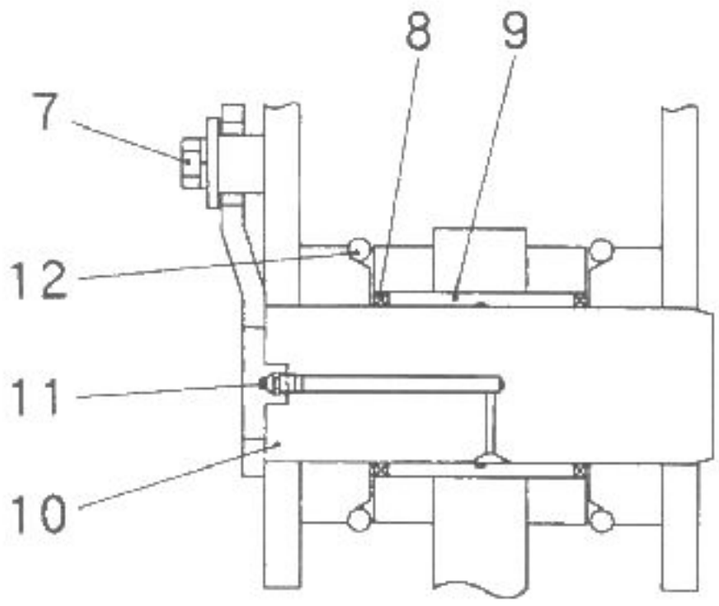
The load handling system consists of booms, bellcrank, push rod, bucket, bucket cylinder, boom cylinders, and pins. The bucket leveler and boom kickout helps provide efficient load handling operation. All connecting pins of the load handling system have dust seals to prevent the entrance of water, mud or dust into the system. The three connecting pins of the bucket are provided with "O"-rings. All the connecting pins are secured with lock bolts.

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Detail of typical pin



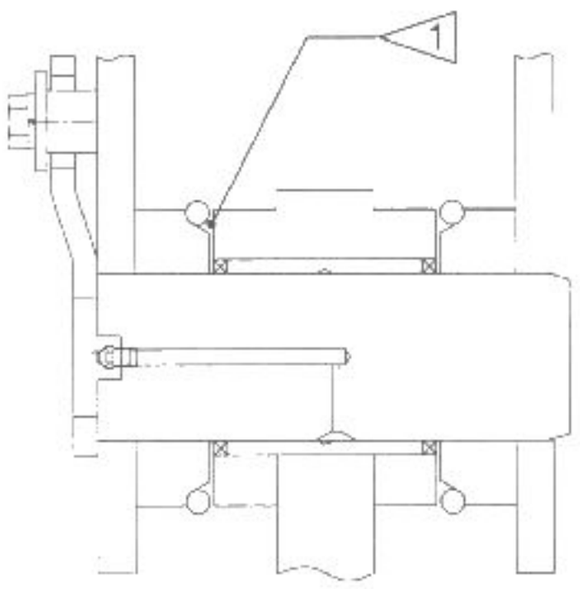
(Pins on bucket)

Note: Apply grease to the inner surface of the bushings and dust seals before inserting pins. Apply antirust oil to the inner surfaces of the bosses.

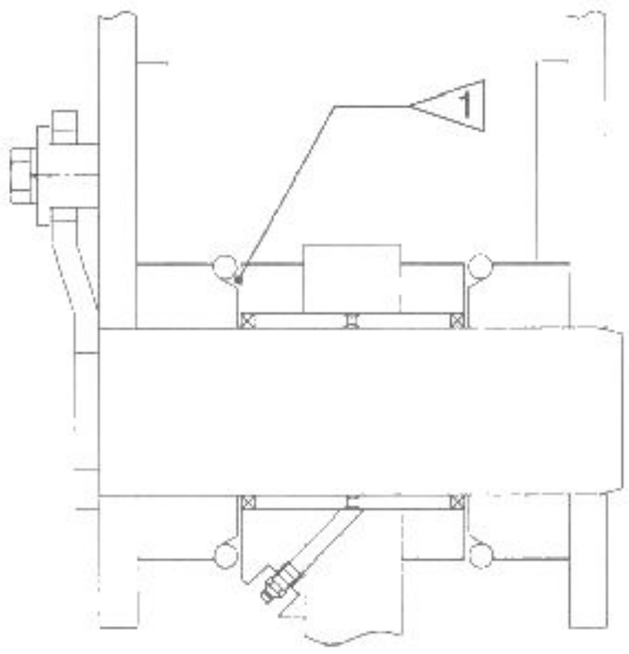
1. BUCKET
2. BELLCRANK
3. BOOM
4. BUCKET CYLINDER
5. PUSH ROD
6. BOOM CYLINDER
7. LOCK BOLT
8. DUST SEAL
9. BUSHING
10. PIN
11. GREASE FITTING
12. "O"-RING

Fig. 7.2 Boom, Bellcrank and Bucket (1)

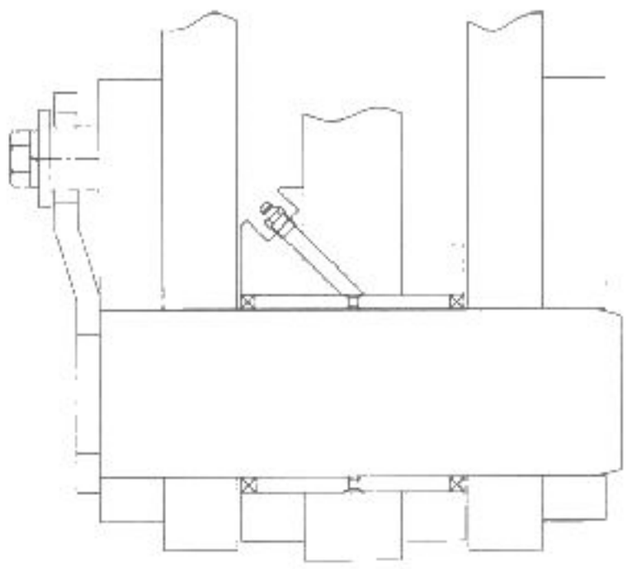
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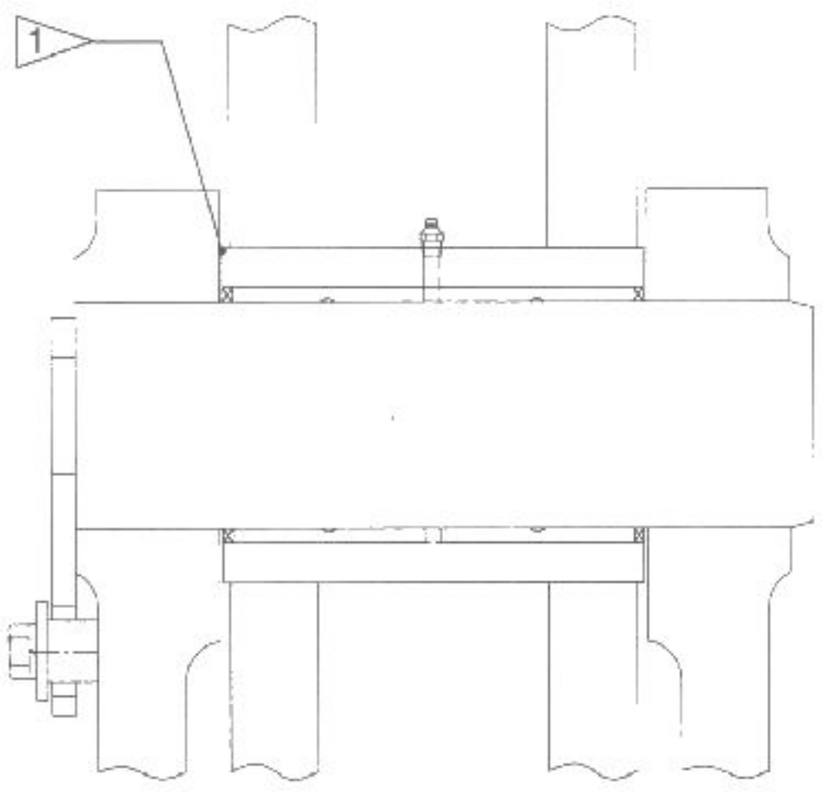
Section A-A



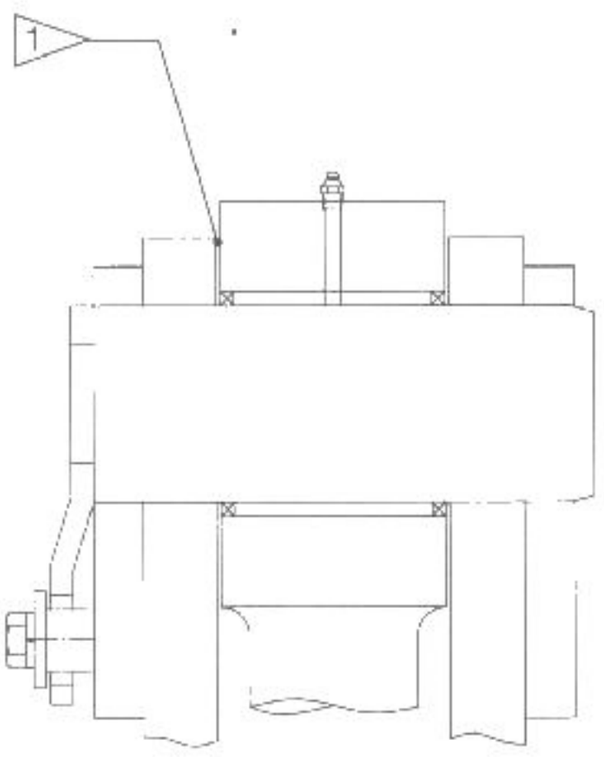
Section B-B



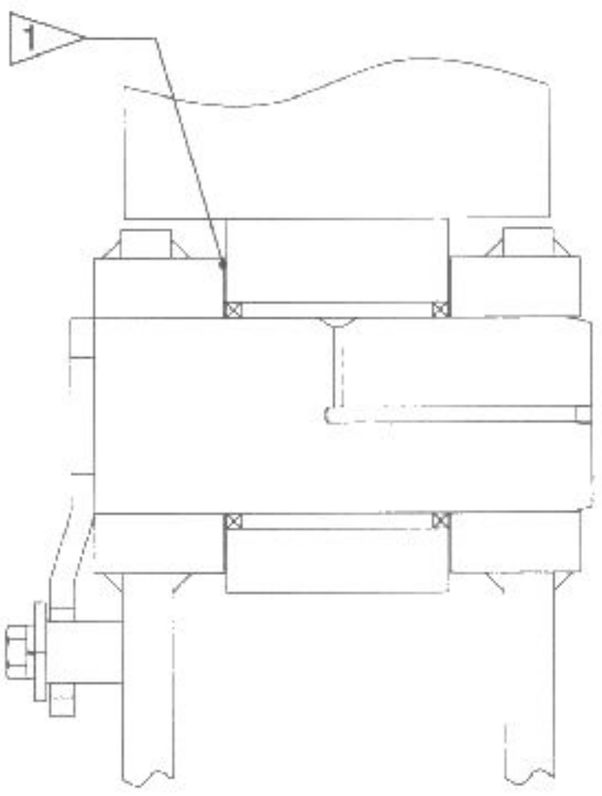
Section C-C



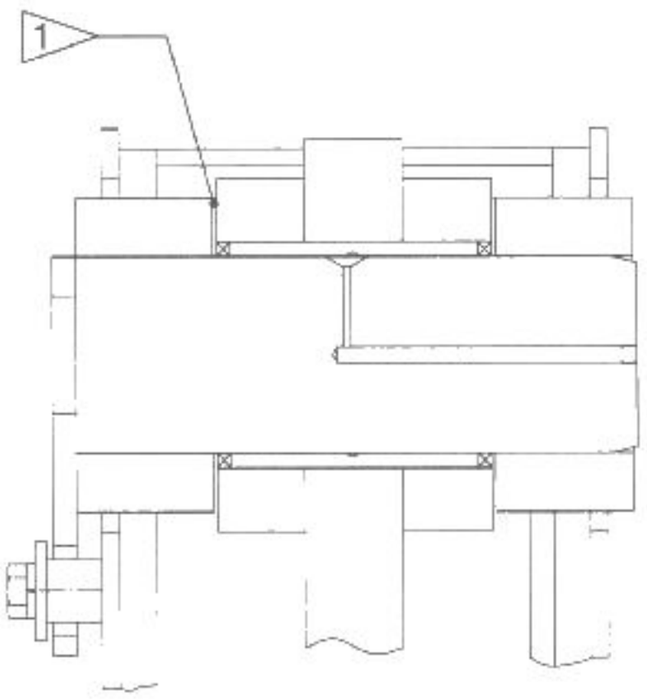
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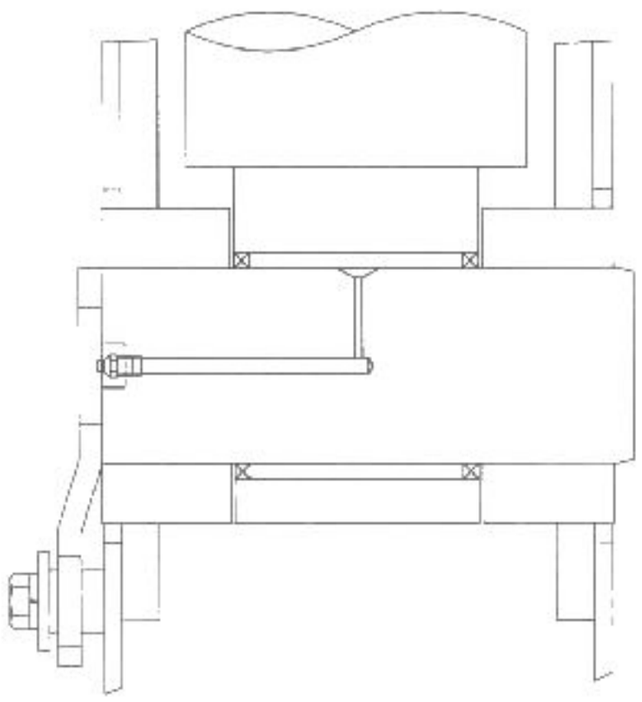
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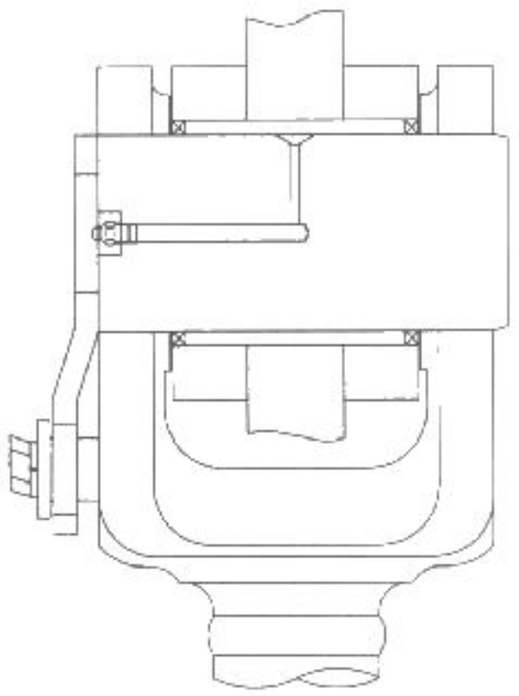
Section F-F



Section G-G



Section H-H



Section I-I

Note: 1 Adjust the maximum clearance to 1.5 mm [0.059 in.] or less using shims.

Fig. 7.3 Boom, Bellcrank and Bucket (2)

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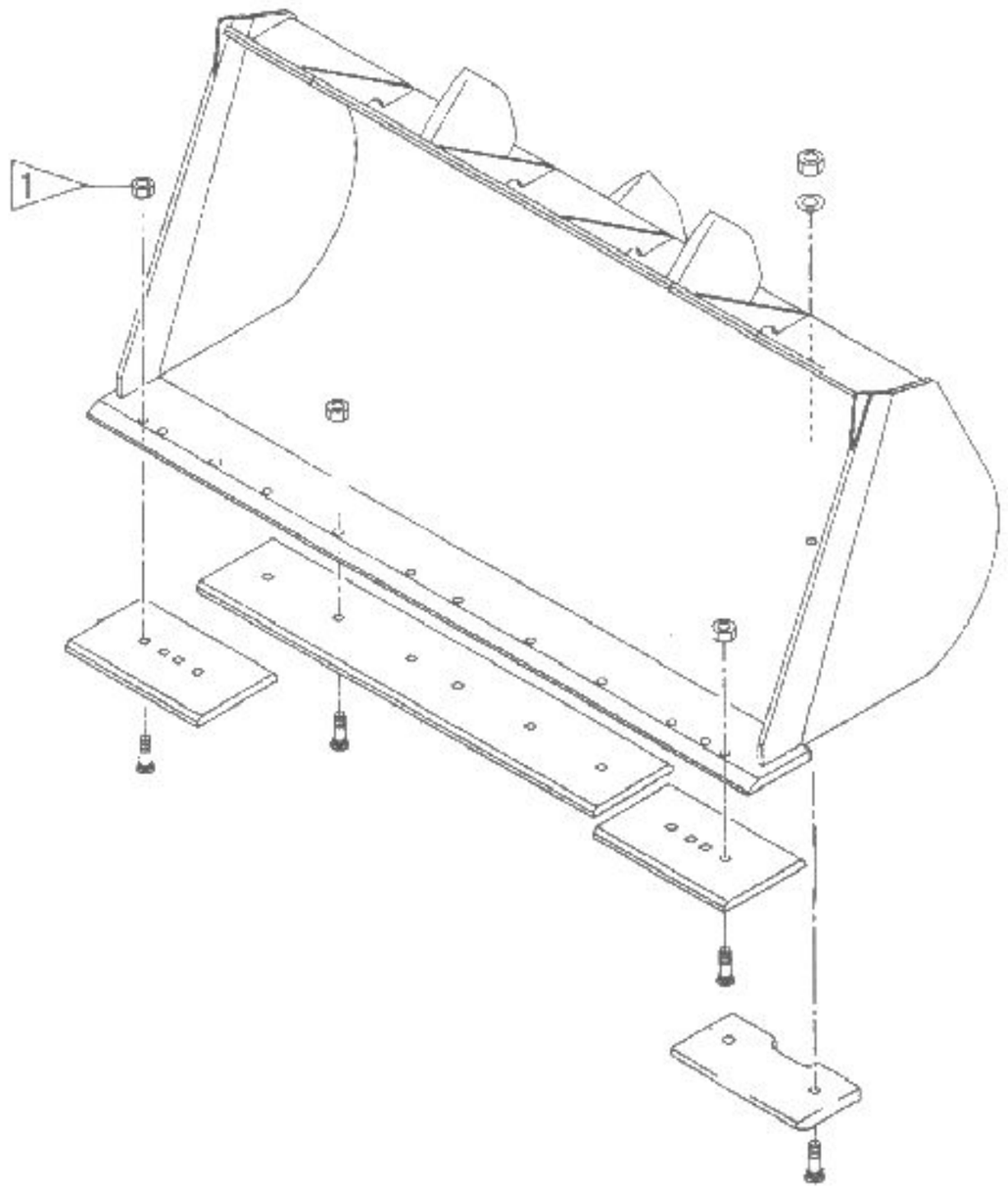
7.1.2 BUCKET

The general-purpose bucket with a bolt-on reversible cutting edge (DEB) is standard. The light-material bucket with welded cutting edge (Type 1) and the general-purpose bucket with bolt-on teeth (Type 3) are optionally available.

The bucket should be selected with due care, considering the condition of job sites, the nature of loads to be handled, and the operating conditions. A wrong bucket will cause an inefficient operation and may cause the malfunction of the load handling system as well.

(General-purpose bucket with reversible cutting edge, DEB)

Note: 1 1068 N-m {109 kgf-m} [788 lbf-ft]



(Type 3 bucket [w/ space edge])

Note: 1 1940 N-m {198 kgf-m} [1432 lbf-ft]
2 1068 N-m {109 kgf-m} [788 lbf-ft]

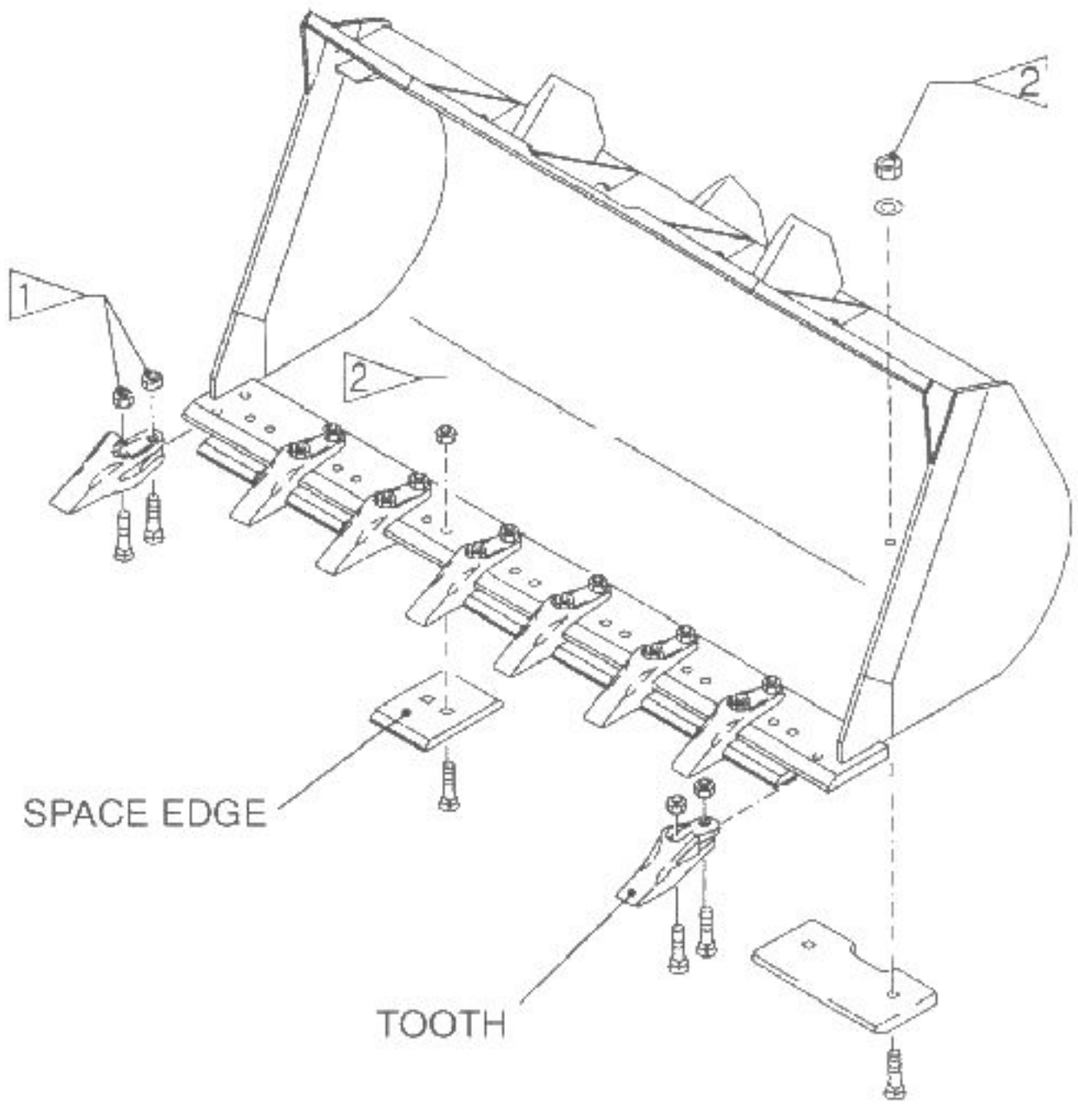


Fig. 7.4 Bucket

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7.1.3 BUCKET LEVELER

With the bucket leveler put in the Roll-back position after dumping the bucket, the bucket levele automatically returns the bucket lever to neutral when the bucket is put in horizontal position.

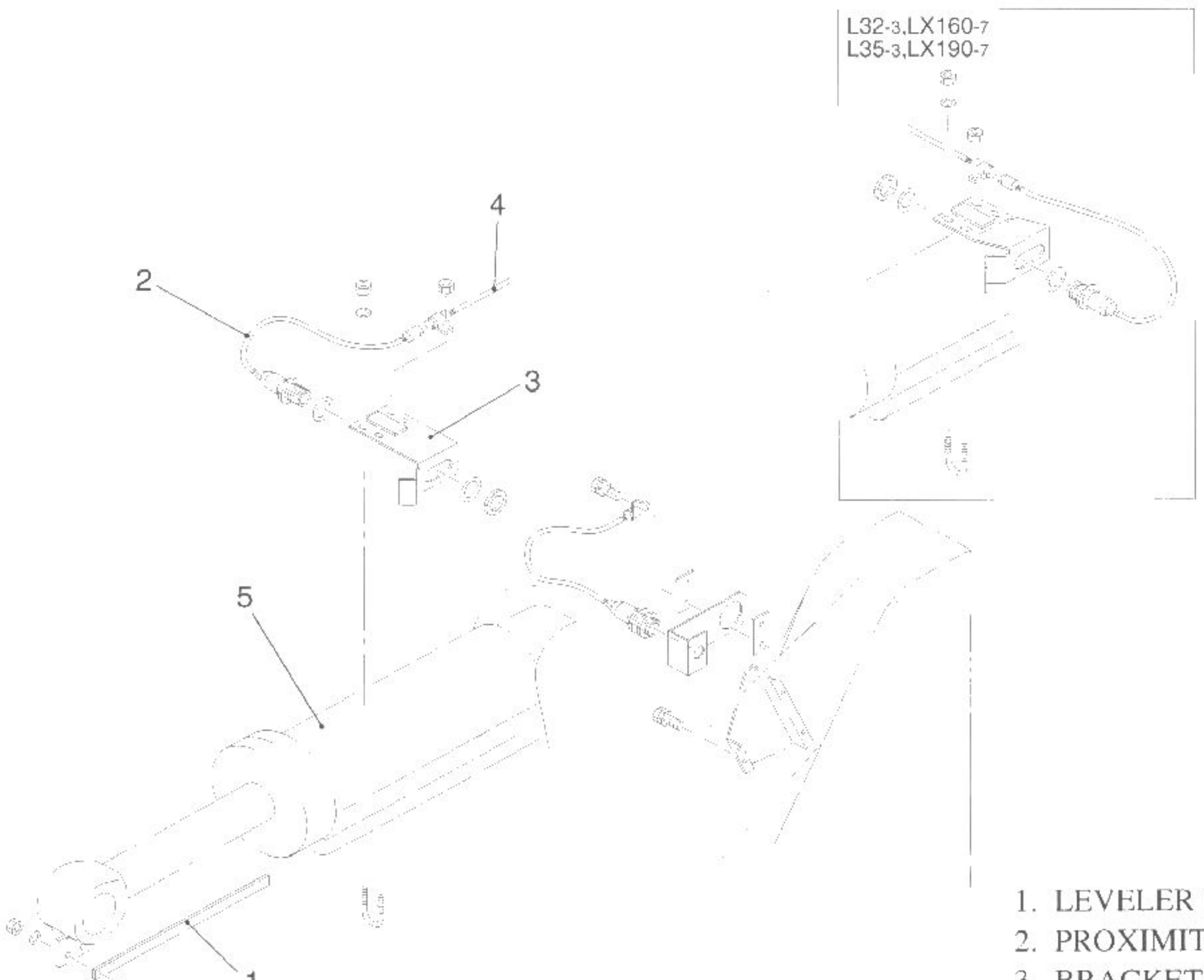
Operation

① With the bucket dumped from the horizontal position, the sensing surface of the proximity switch for the bucket leveler is close to the leveler bar so that the switch stays ON.
When the bucket lever is put in the Roll-bucket position, the bucket leveler solenoid of the pilot valve holds the position of the bucket lever.

② As the bucket is rolled back, the bucket cylinder piston rod extends to put the bucket in horizontal position, which allows the leveler bar to leave the sensing surface of the proximity switch, thus turning the switch OFF.

③ When the bucket leveler solenoid of the pilot valve is de-energized, the detent comes off to return the bucket lever to neutral, stopping the rolling back operation of the bucket. Then, the bucket stopped in horizontal position.

Note: With the bucket rolled back beyond the horizontal line, the proximity switch of the bucket lever stays OFF so that the bucket lever detent mechanism in the roll-back phase won't work.



1. LEVELER BAR
2. PROXIMITY SWITCH
3. BRACKET
4. WIRE HARNESS
5. BUCKET CYLINDER

Note: For the electric circuit diagram, see Fig. 7.6.

Fig. 7.5 Bucket Leveler Assembly Drawing

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7.1.4 BOOM KICKOUT

The boom kickout device stops the booms at a preset height during the lifting phase. With the boom lever in the RAISE position, the boom kickout device automatically returns the boom lever into neutral when the booms are raised to a preset height, thus stopping the lifting operation of the booms.

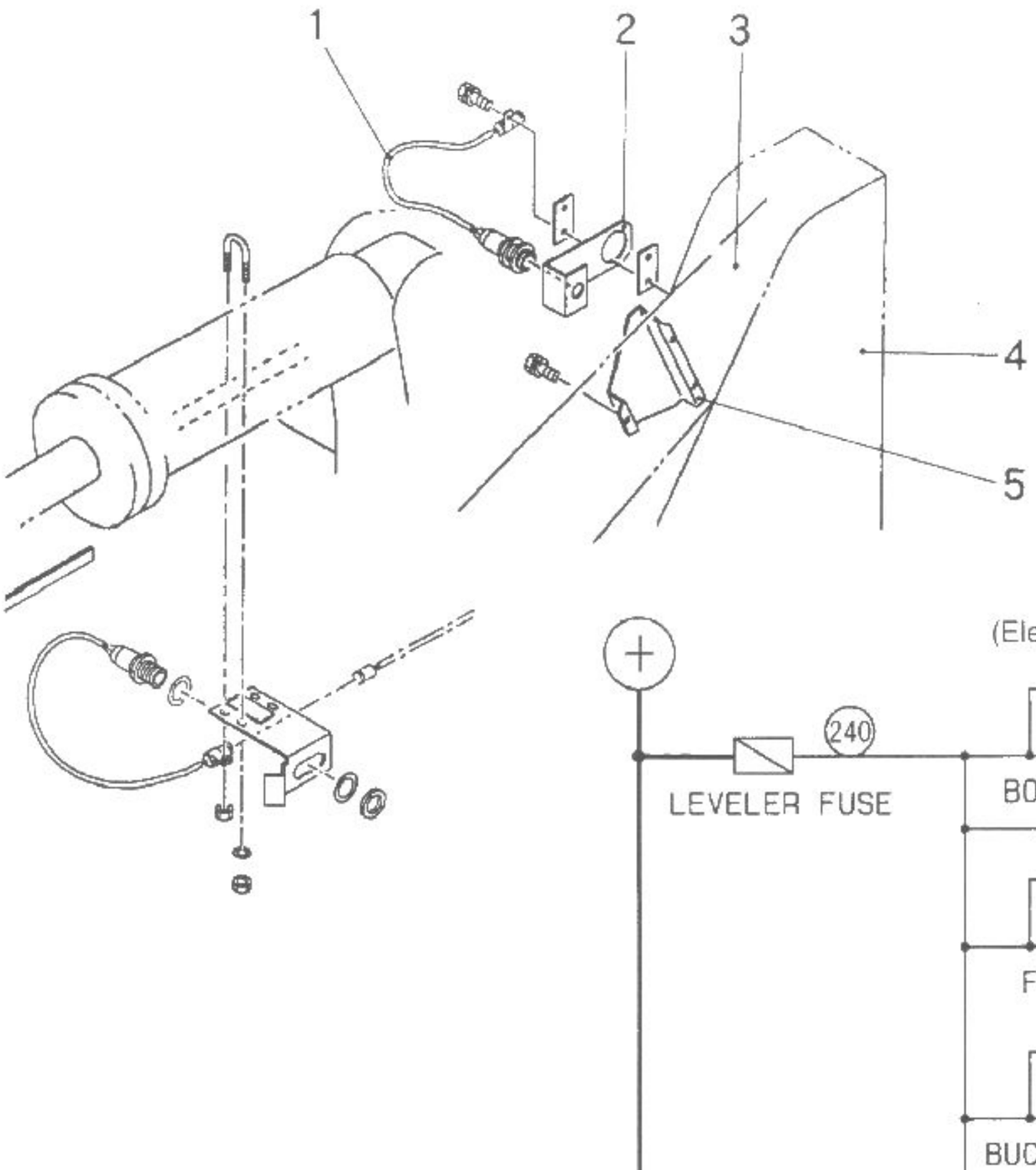
Operation

① When the booms are in the lower position than the preset boom kickout height, the sensing surface of the proximity switch for the boom kickout is close to the level plate and the switch stays OFF. When the boom lever is put in the RAISE position, the boom kickout solenoid of the pilot valve holds the position of the boom lever.

② When the booms are raised to a preset boom kickout height, the level plate leaves the sensing surface of the proximity switch, thus turning off the switch.

③ When the boom kickout solenoid of the pilot valve is de-energized, the detent comes off to return the boom lever to neutral, stopping the lifting operation of the booms. Then, the booms stop in the preset height.

Note: With the booms beyond the preset boom kickout height, the proximity switch of the boom kickout stays OFF so that the boom lever detent mechanism in the RAISE position won't work.



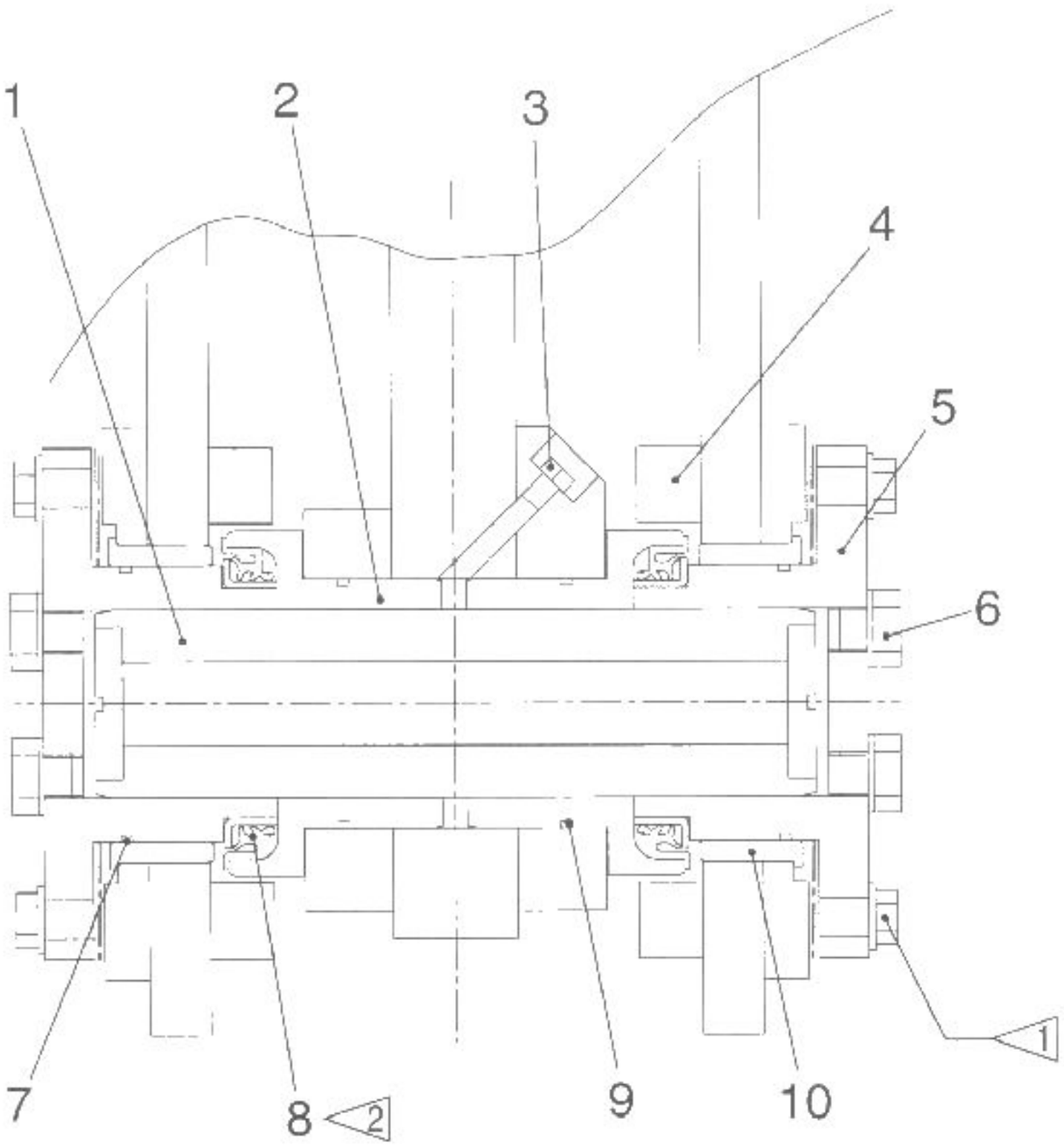
1. PROXIMITY SWITCH
2. BRACKET
3. BOOM
4. FRONT FRAME
5. LEVEL PLATE

Fig. 7.6 Boom Kickout Device Assembly Drawing

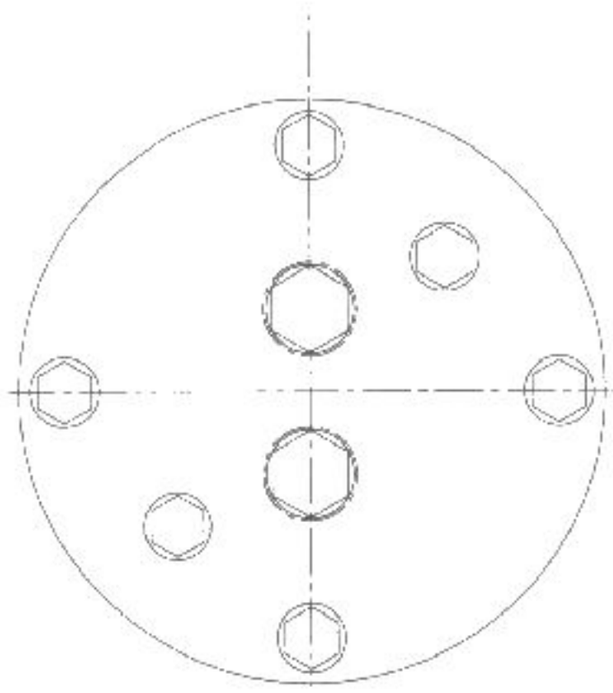
https://truckmanualshub.com/

7.1.5 FLOATING PINS (OPTION)

You can improve the maintenability (such as longer lubrication interval) of the load handling system by using optional oil-filled floating pins for the bucket connecting pins.



Note: The sketch shows the floating pins for the L27-3, LX130-7 and L32-3, LX160-7 but their design is the same for the L35-3, LX190-7 and L40-3, LX230-7.



Note: 1. The bushing should be expansion-fitted using dry ice at -60°C to -70°C [-76°F to -94°F] for about 1 hour.
2. The oil seal should not be removed when reassembling.
3. After reassembly, fill pin oil.

Note: 1 ▷ M12: 88 N-m {9.0 kgf-m} [65 lbf-ft] for L27-3, LX130-7 · L32-3, LX160-7
M16: 223 N-m {22.8 kgf-m} [165 lbf-ft] for L35-3, LX190-7 · L40-3, LX230-7

2 ▷ Inside oil seal: Fill grease generously.

1. PIN
2. BUSHING
3. PLUG
4. FLANGE
5. CAP
6. PLUG
7. "O"-RING
8. OIL SEAL
9. "O"-RING
10. BUSHING

Fig. 7.7 Floating Pin

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7.2 CYLINDER

	L27-3, LX130-7	L32-3, LX160-7	L35-3, LX190-7	L40-3, LX230-7
Boom Cylinder				
Type	Double-acting piston	←	←	←
Q'ty	2	←	←	←
Cylinder bore	140 mm [5.5 in.]	150 mm [5.9 in.]	150 mm [5.9 in.]	170 mm [6.7 in.]
Cylinder rod outer diameter	75 mm [3.0 in.]	85 mm [3.3 in.]	85 mm [3.3 in.]	95 mm [3.7 in.]
Cylinder stroke	760 mm [29.9 in.]	880 mm [34.6 in.]	980 mm [38.6 in.]	920 mm [36.2 in.]
Weight (per cylinder)	128 kg [282 lbs]	161 kg [355 lbs]	170 kg [375 lbs]	200 kg [441 lbs]
Bucket Cylinder				
Type	Double-acting piston	←	←	←
Q'ty	1	←	←	←
Cylinder bore	170 mm [6.7 in.]	190 mm [7.5 in.]	190 mm [7.5 in.]	210 mm [8.3 in.]
Cylinder rod outer diameter	85 mm [3.3 in.]	95 mm [3.7 in.]	95 mm [3.7 in.]	110 mm [4.3 in.]
Cylinder stroke	495 mm [19.5 in.]	505 mm [19.9 in.]	545 mm [21.5 in.]	570 mm [22.4 in.]
Weight (per cylinder)	135 kg [298 lbs]	189 kg [417 lbs]	192 kg [423 lbs]	241 kg [531 lbs]

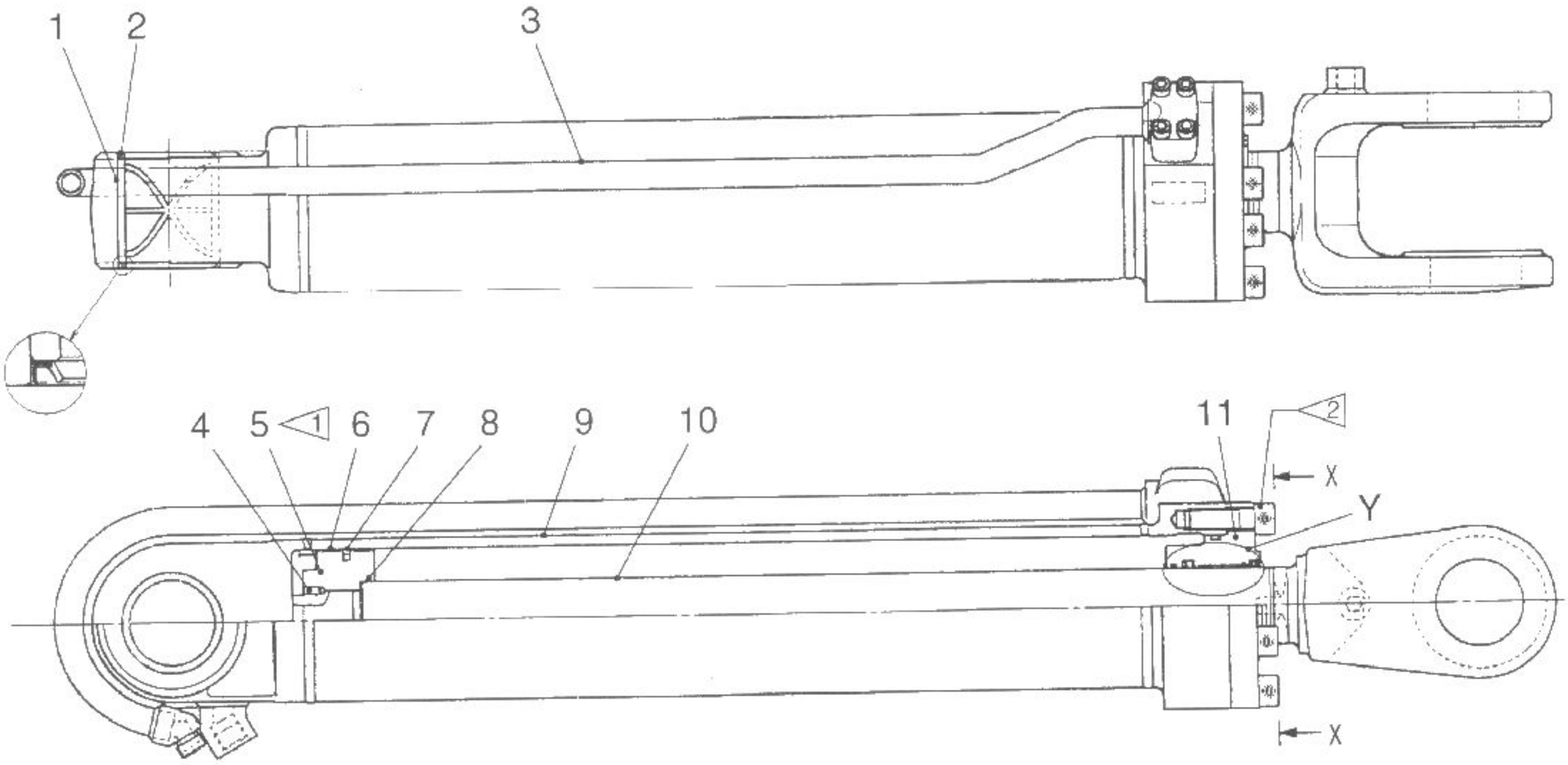
7.2.1 BOOM CYLINDER

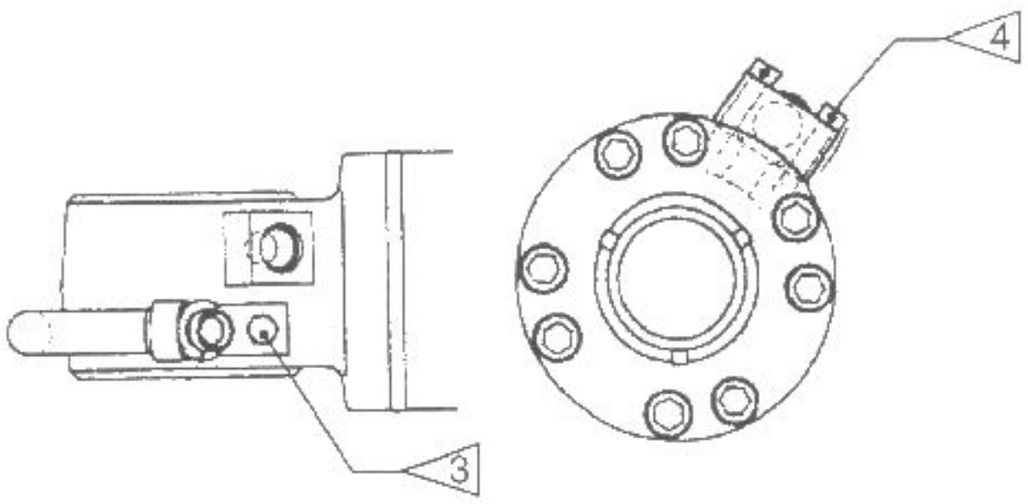
The two boom cylinders are of the double-acting piston type. When the boom cylinders are extended or retracted, the booms are raised or lowered respectively. The boom cylinder consists of a cylinder tube, cylinder head, piston rod, and packings.

7.2.2 BUCKET CYLINDER

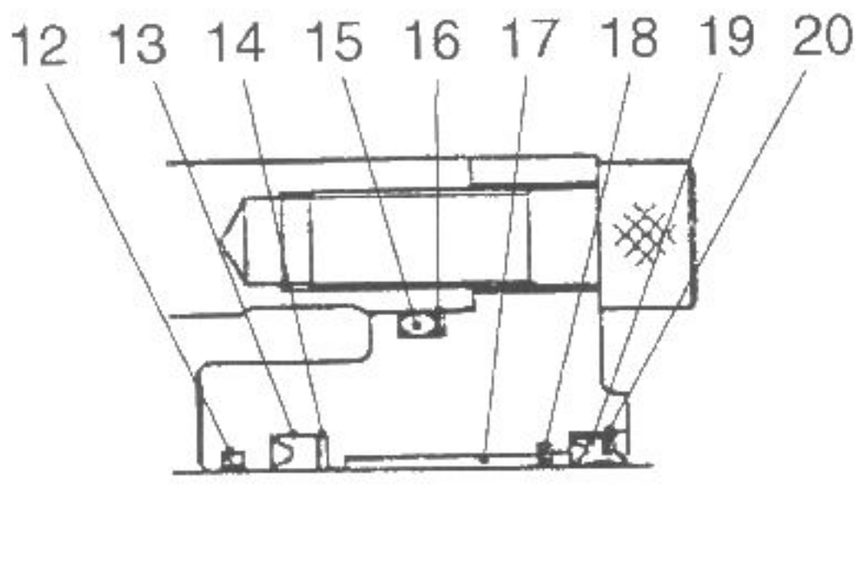
The bucket cylinder is a double-acting piston type. As the bucket cylinder is extended or retracted, the bucket is dumped or rolled back through the bellcrank and push rod mechanism. The bucket cylinder consists of the cylinder tube, cylinder head, piston rod, piston and packings.

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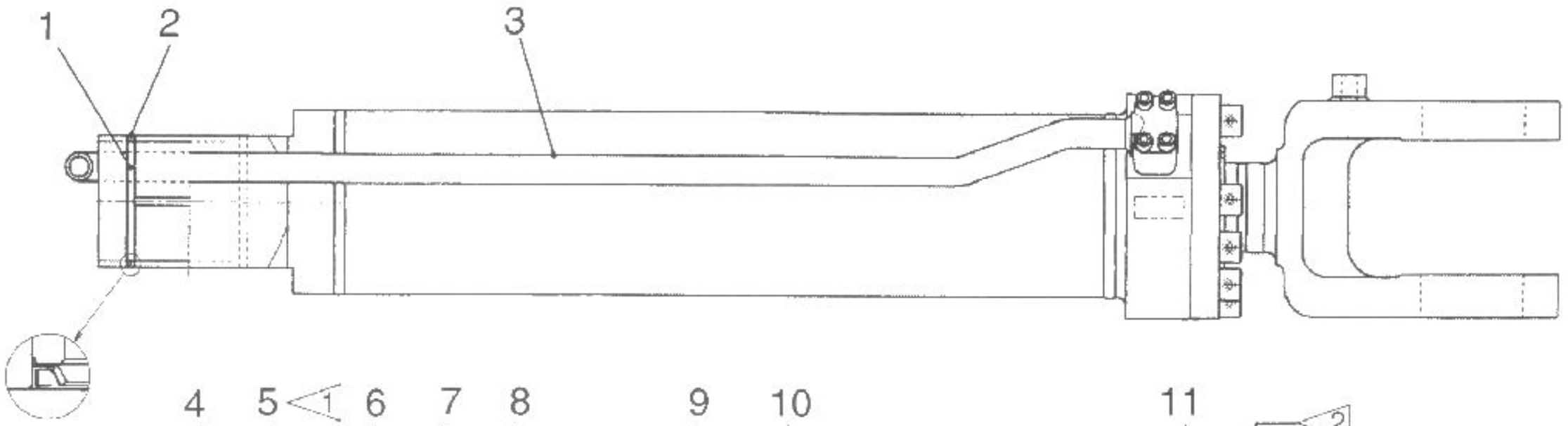
Detail of area Y

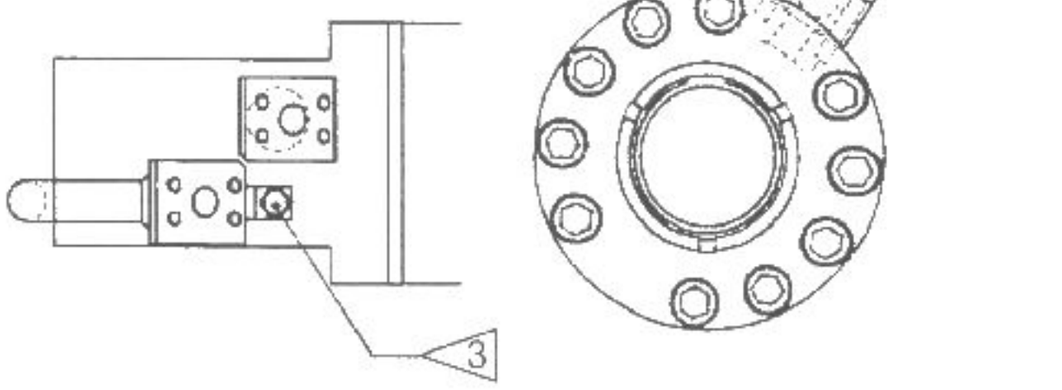
Note: 1 1400 N-m {143 kgf-m} [1034 lbf-ft]
2 458 N-m {46.7 kgf-m} [338 lbf-ft]
3 38 N-m {3.9 kgf-m} [28 lbf-ft]
4 49 N-m {5.0 kgf-m} [36 lbf-ft]

1. BUSHING
2. DUST SEAL
3. PIPE
4. HEX. SOCKET HEAD SCREW
5. PISTON
6. WEAR RING
7. SEAL RING, "O"-RING
8. "O"-RING
9. CYLINDER TUBE
10. PISTON ROD
11. CYLINDER HEAD
12. BUFFER RING
13. U-RING
14. BACK-UP RING
15. "O"-RING
16. BACK-UP RING
17. BUSHING
18. CIRCLIP
19. WIPER RING
20. SNAP RING

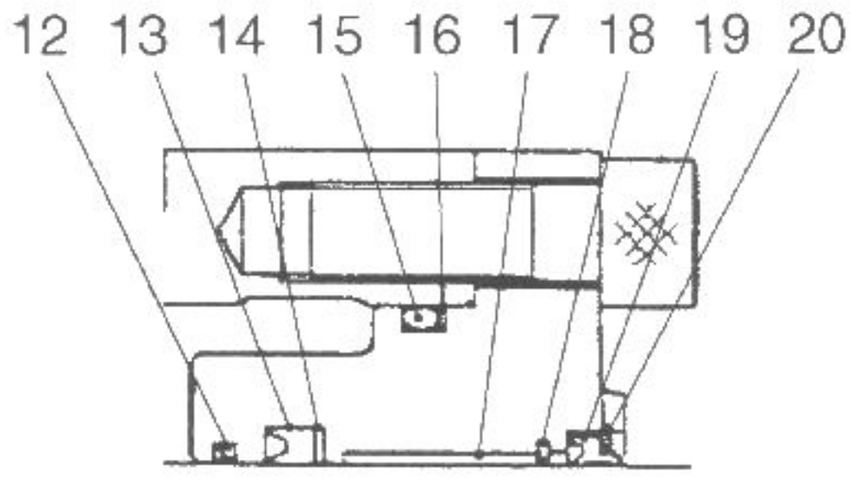
Fig. 7.8 Boom Cylinder (L27-3, LX130-7)

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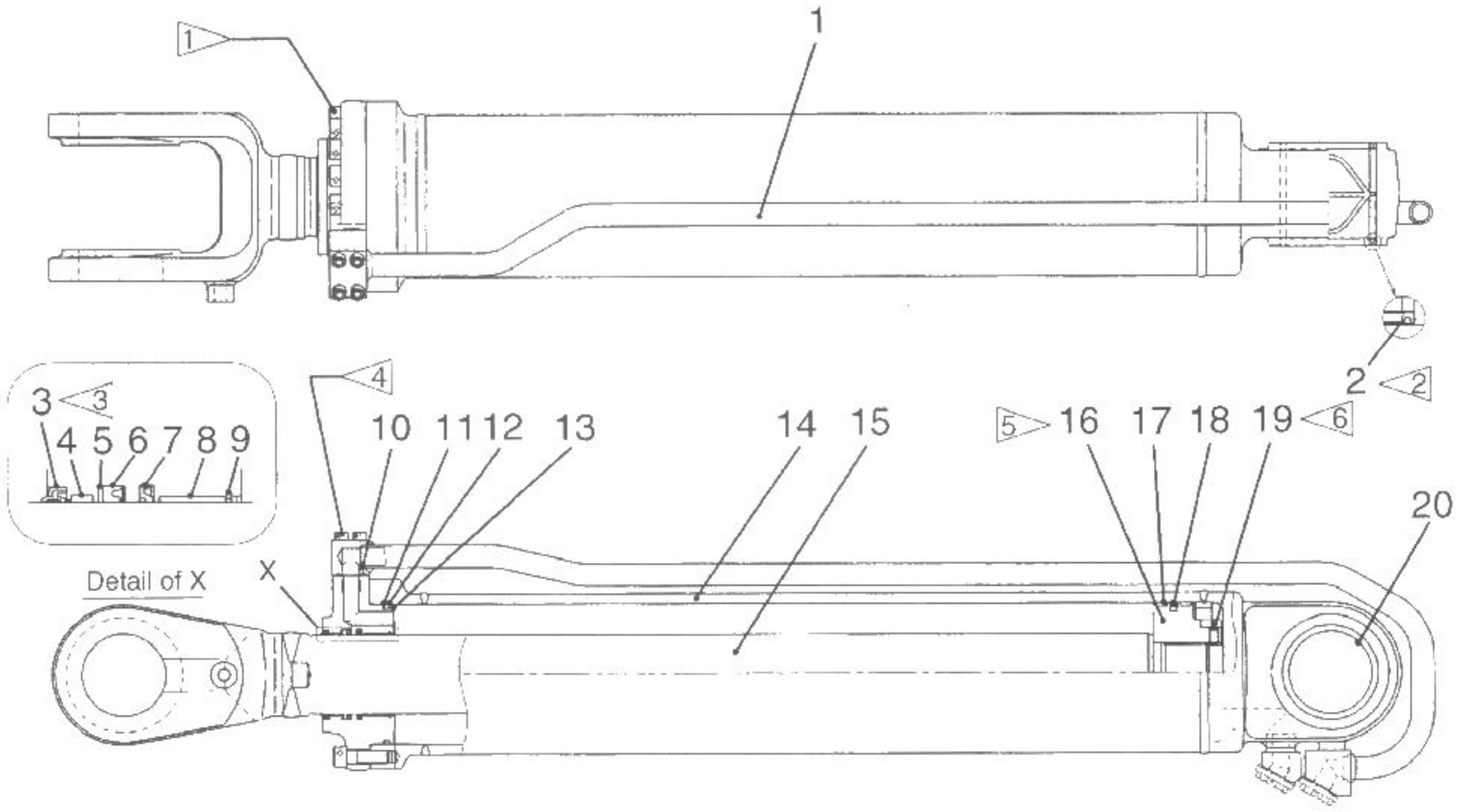
Detail of area Y

Note: 1 ▷ 1400 N-m {143 kgf-m} [1034 lbf-ft]
2 ▷ 458 N-m {46.7 kgf-m} [338 lbf-ft]
3 ▷ 38 N-m {3.9 kgf-m} [28 lbf-ft]
4 ▷ 58 N-m {5.9 kgf-m} [43 lbf-ft]

1. BUSHING
2. DUST SEAL
3. PIPE
4. HEX.SOCKET HEAD SCREW
5. PISTON
6. WEAR RING
7. SEAL RING, "O"-RING
8. "O"-RING
9. CYLINDER TUBE
10. PISTON ROD
11. CYLINDER HEAD
12. BUFFER RING
13. U-RING
14. BACK-UP RING
15. "O"-RING
16. BACK-UP RING
17. BUSHING
18. CIRCLIP
19. WIPER RING
20. SNAP RING

Fig. 7.9 Boom Cylinder (L32-3, LX160-7 · L35-3, LX190-7)

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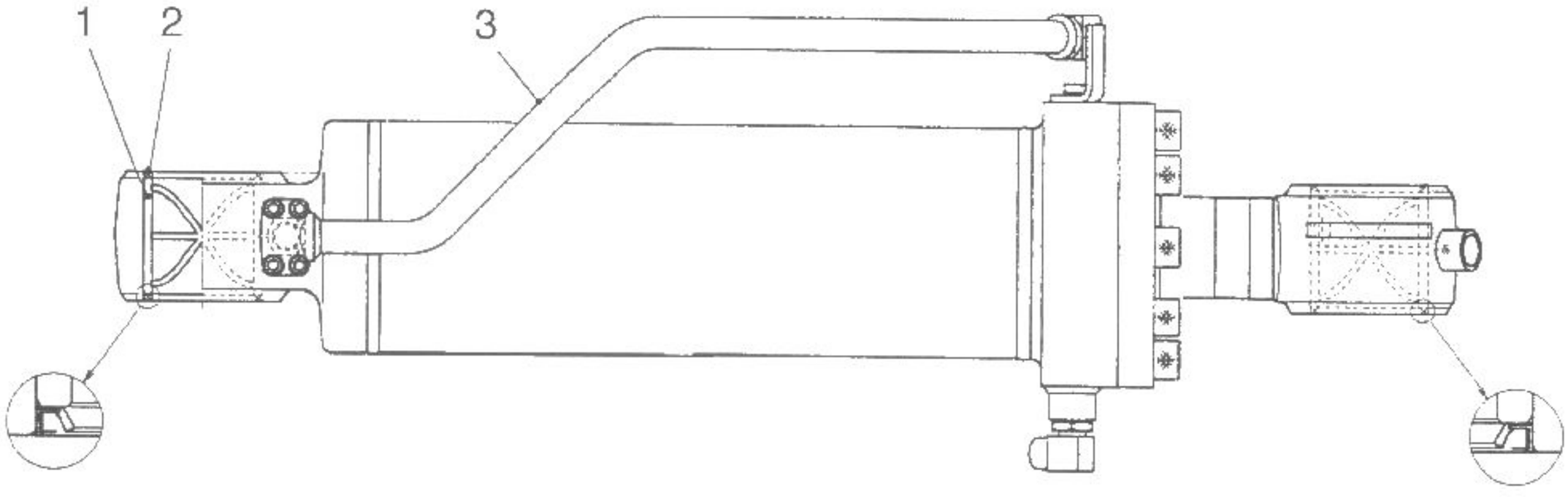


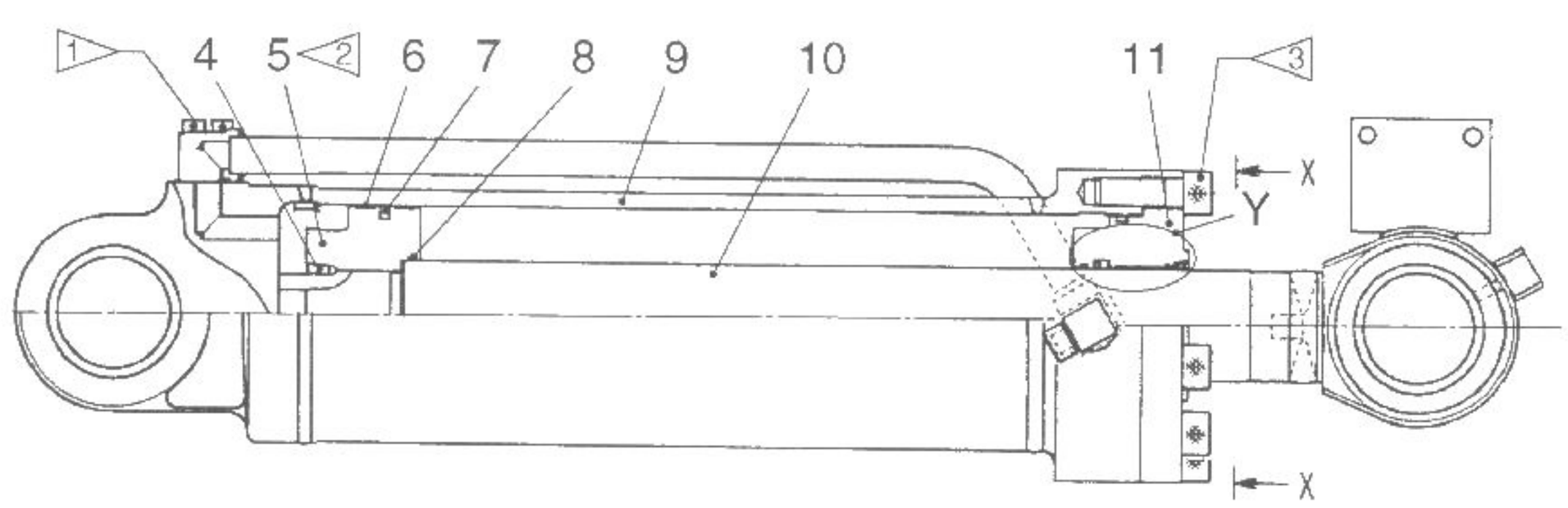
Note: 1> 225 N-m {26 kgf-m} [188 lbf-ft] 2> Outer periphery: LOCTITE#638
3> Outer periphery: Three Bond#1102 4> 58 N-m {5.9 kgf-m} [43 lbf-ft]
5> 8.83 kN-m {900 kgf-m} [6510 lbf-ft]
6> 37 N-m {3.8 kgf-m} [27 lbf-ft], Threaded area: LOCTITE#242
After tightening, caulk two parts.

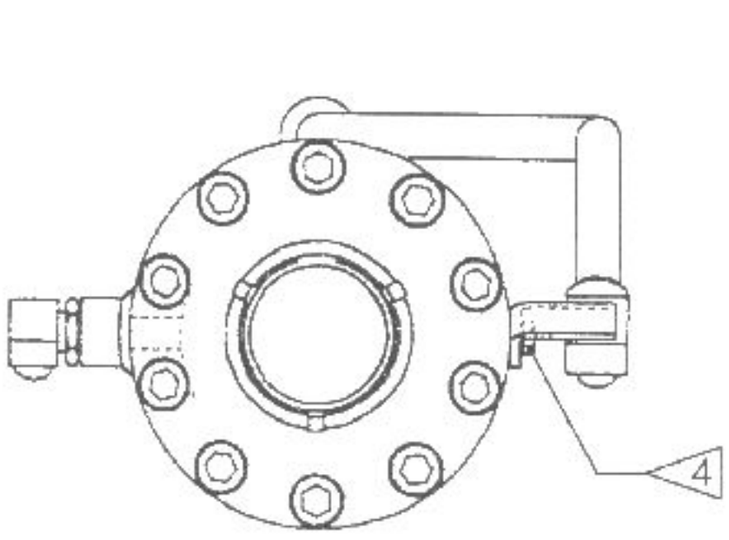
1. PIPE
2. DUST SEAL
3. WIPER RING
4. WEAR RING
5. BACK-UP RING
6. U-RING
7. BUFFER RING
8. BUSHING
9. CIRCLIP
10. "O"-RING
11. BACK-UP RING
12. "O"-RING
13. CYLINDER HEAD
14. CYLINDER TUBE
15. PISTON ROD
16. PISTON
17. WEAR RING
18. SEAL RING, "O"-RING
19. SCREW
20. BUSHING

Fig. 7.10 Boom Cylinder (L40-3, LX230-7)

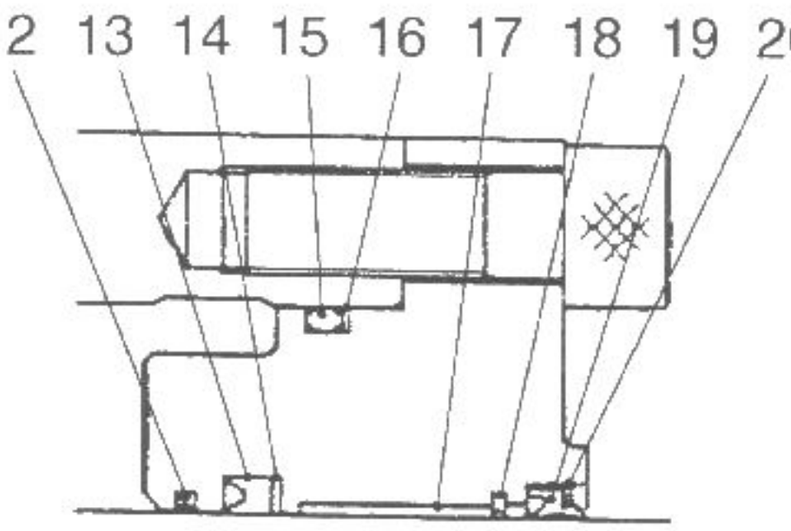
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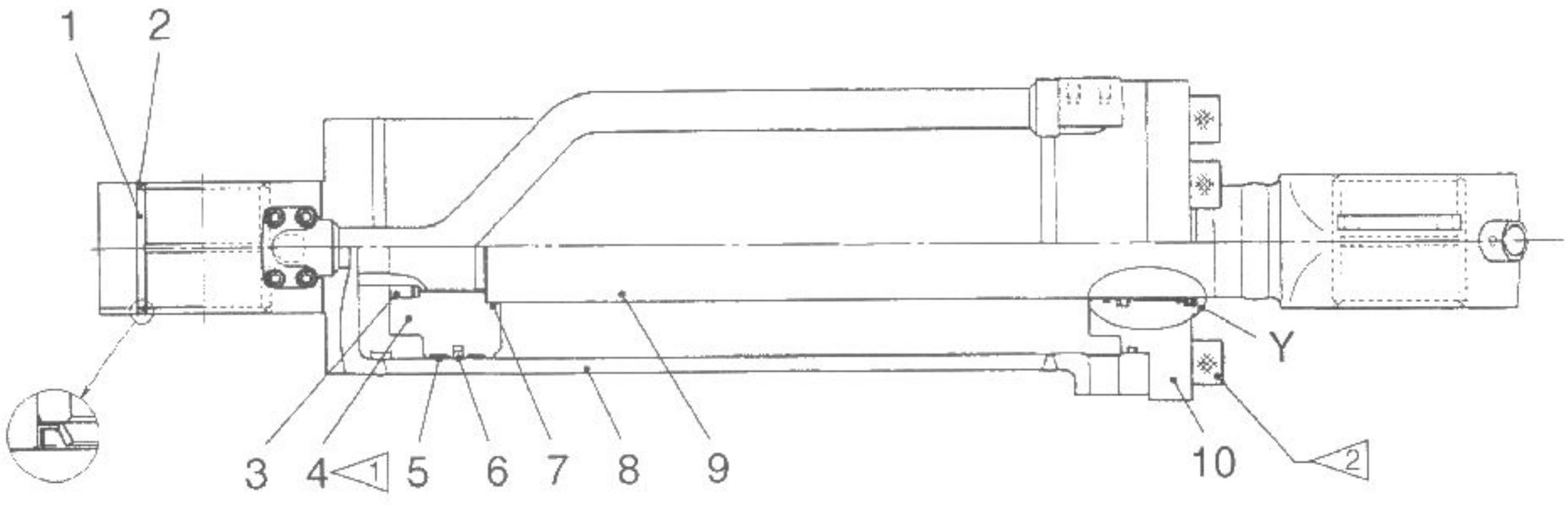
Detail of area Y

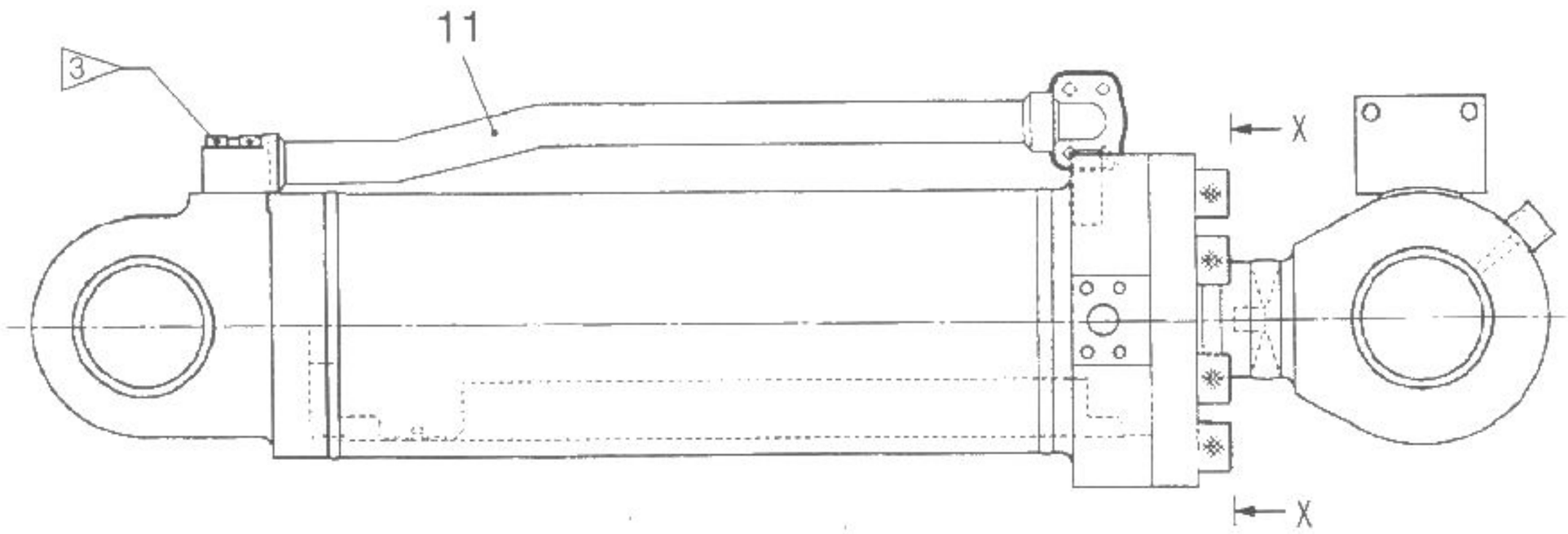
Note: 1▷ 49 N-m {5 kgf-m} [36 lbf-ft]
2▷ 1400 N-m {143 kgf-m} [1034 lbf-ft]
3▷ 610 N-m {62.2 kgf-m} [450 lbf-ft]
4▷ 45 N-m {4.6 kgf-m} [33 lbf-ft]

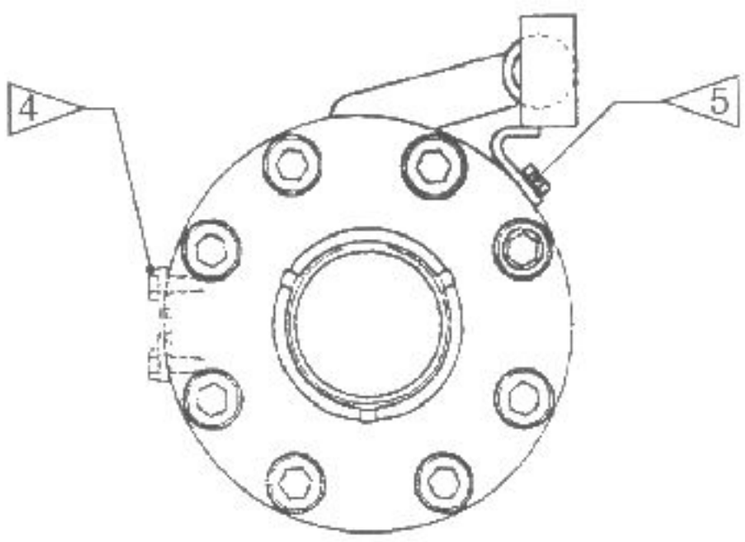
1. BUSHING
2. DUST SEAL
3. PIPE
4. HEX. SOCKET HEAD SET SCREW
5. PISTON
6. WEAR RING
7. SEAL RING, "O"-RING
8. "O"-RING
9. CYLINDER TUBE
10. PISTON ROD
11. CYLINDER HEAD
12. BUFFER RING
13. U-RING
14. BACK-UP RING
15. "O"-RING
16. BUFFER RING
17. BUSHING
18. CIRCLIP
19. WIPER RING
20. SNAP RING

Fig. 7.11 Bucket Cylinder (L27-3, LX130-7)

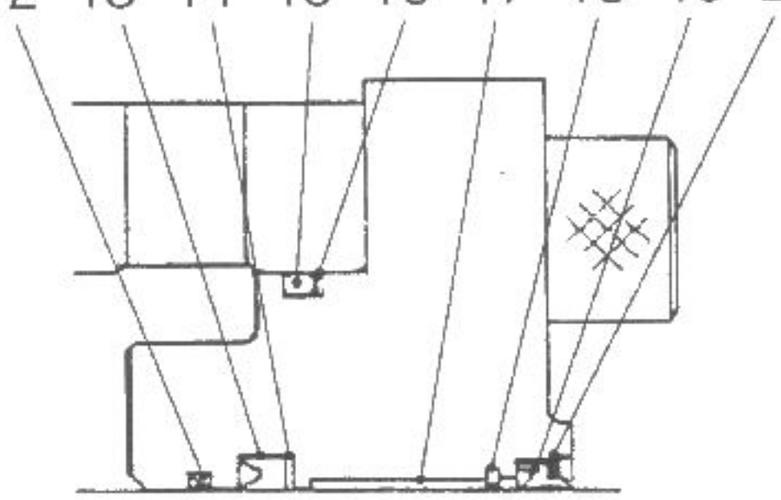
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Section X-X



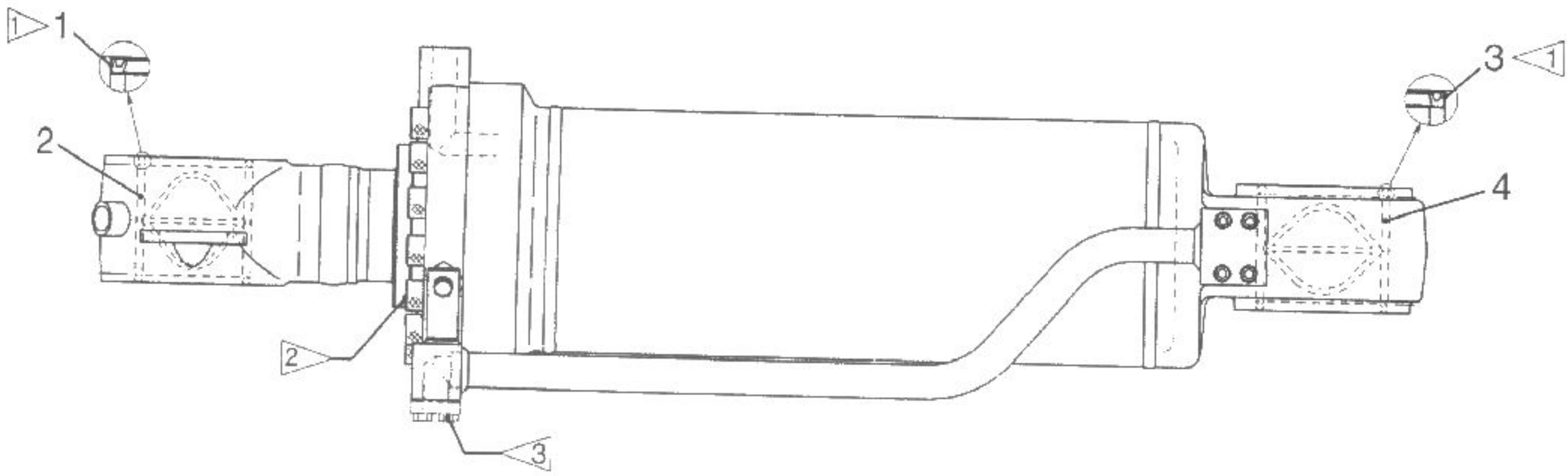
Detail of area Y

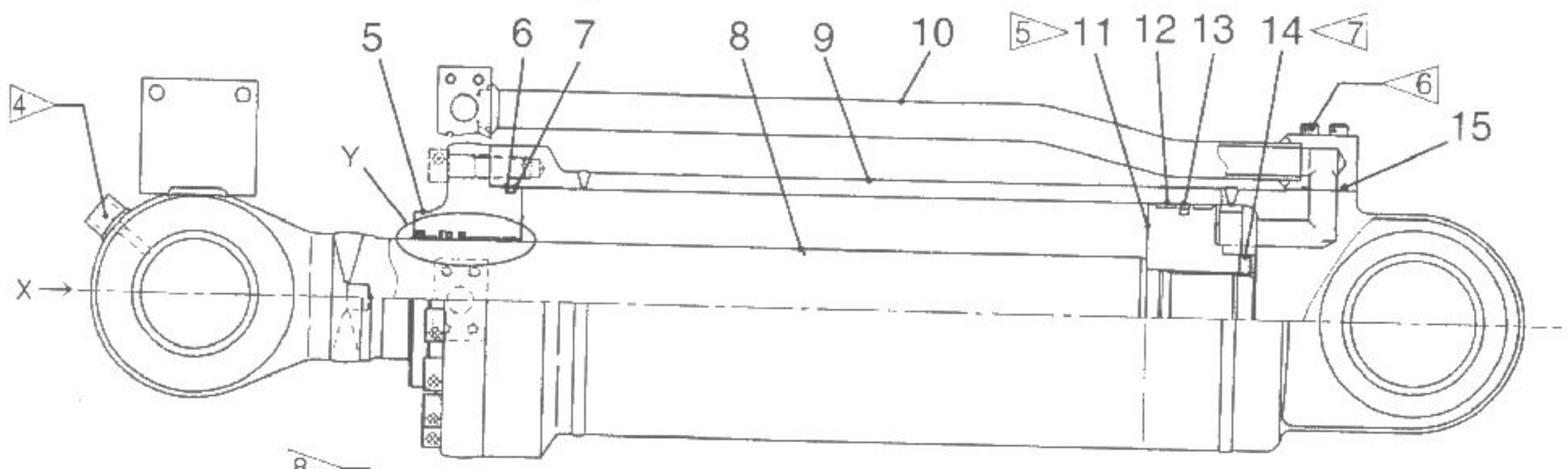
Note: 1 1400 N-m {143 kgf-m} [1034 lbf-ft] 2 1140 N-m {116 kgf-m} [839 lbf-ft]
3 63 N-m {6.4 kgf-m} [46 lbf-ft] for L32-3, LX160-7
49 N-m {5.0 kgf-m} [36 lbf-ft] for L35-3, LX190-7
4 20 N-m {2.0 kgf-m} [14 lbf-ft] 5 45 N-m {4.6 kgf-m} [33 lbf-ft]

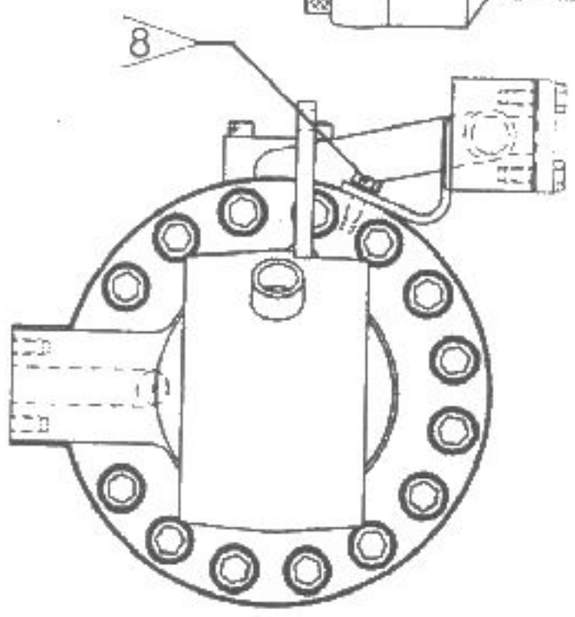
1. BUSHING
2. DUST SEAL
3. HEX. SOCKET HEAD SET SCREW
4. PISTON
5. WEAR RING
6. SEAL RING, "O"-RING
7. "O"-RING
8. CYLINDER TUBE
9. PISTON ROD
10. CYLINDER HEAD
11. PIPE
12. BUFFER RING
13. U-RING
14. BACK-UP RING
15. "O"-RING
16. BACK-UP RING
17. BUSHING
18. CIRCLIP
19. WIPER RING
20. SNAP RING

Fig. 7.12 Bucket Cylinder (L32-3, LX160-7 · L35-3, LX190-7)

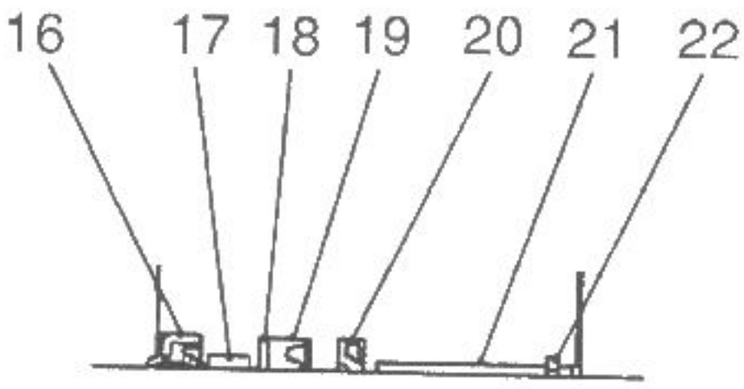
https://truckmanualshub.com/







View looking from X



Detail of area Y

Note:
- 1 Outer periphery: LOCTITE#638
- 2 471 N-m {48 kgf-m} [347 lbf-ft]
- 3 20 N-m {2.0 kgf-m} [14 lbf-ft]
- 4 5.9 N-m {0.6 kgf-m} [4.3 lbf-ft]
- 5 15.0 kN-m {1530 kgf-m} [11100 lbf-ft]
- 6 58 N-m {5.9 kgf-m} [43 lbf-ft]
- 7 37 N-m {3.8 kgf-m} [27 lbf-ft]

Threaded area: LOCTITE#242. After tightening, caulk two parts.

- 8 34 N-m {3.5 kgf-m} [25 lbf-ft],

Threaded area: LOCTITE#242

1. DUST SEAL
2. BUSHING
3. DUST SEAL
4. BUSHING
5. CYLINDER HEAD
6. BACK-UP RING
7. "O"-RING
8. PISTON ROD
9. CYLINDER TUBE
10. PIPE
11. PISTON
12. WEAR RING
13. SEAL RING, "O"-RING
14. SCREW
15. "O"-RING
16. WIPER RING
17. WEAR RING
18. BACK-UP RING
19. U-RING
20. BUFFER RING
21. BUSHING
22. CIRCLIP

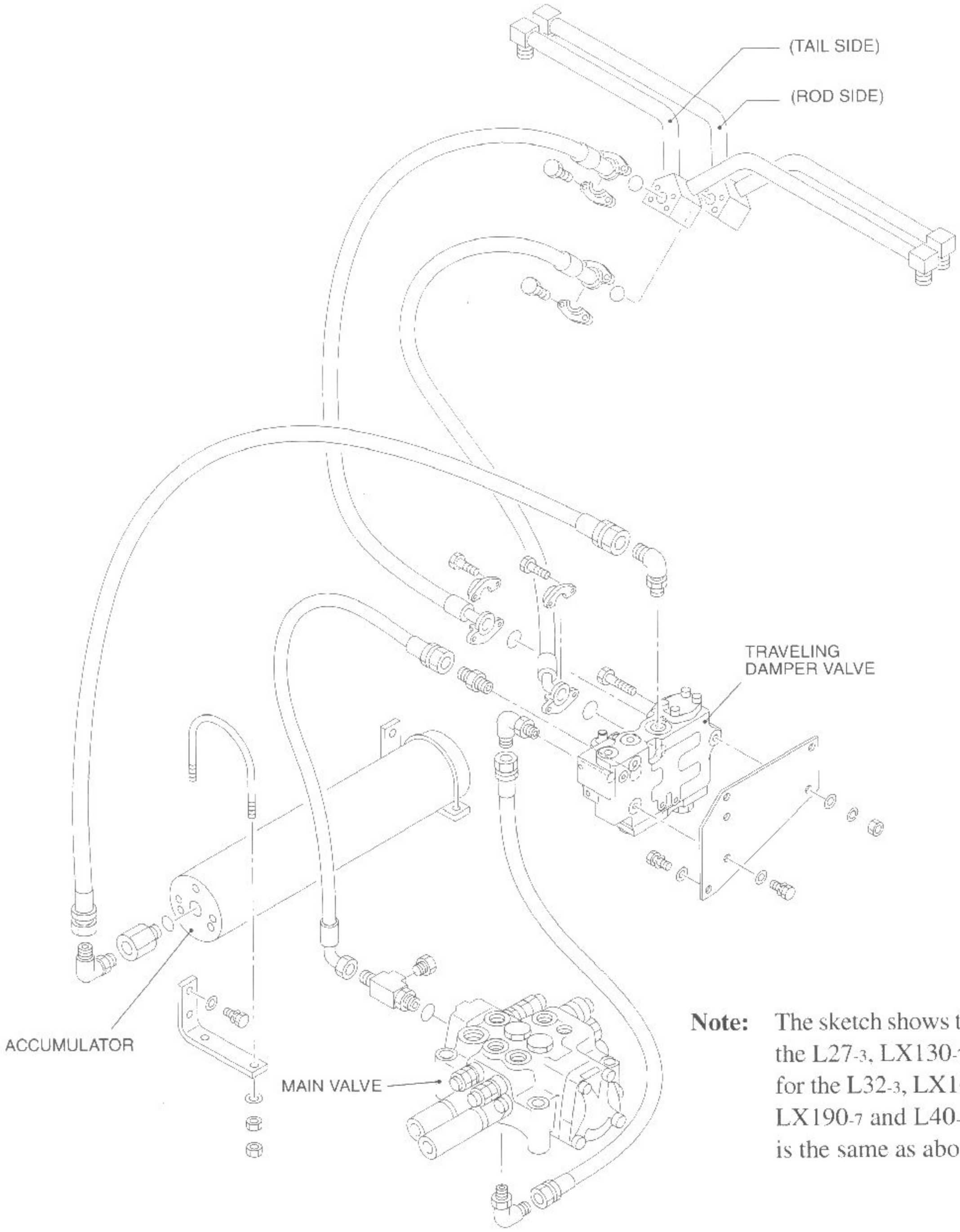
Fig. 7.13 Bucket Cylinder (L40-3, LX230-7)

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7.3 ANTI-PITCHING SYSTEM (APS) [OPTION]

When traveling at high speed on bad roads, pitching or bouncing might occur and usually there is need to slow down.

The APS suppresses pitching and bouncing of the loader body to make it possible to travel in a safe and stable manner.



Note: The sketch shows the APS for the L27-3, LX130-7. The APS for the L32-3, LX160-7, L35-3, LX190-7 and L40-3, LX230-7 is the same as above.

Fig. 7.14 Anti-pitching System (APS)

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1. General description

The APS consists basically of an accumulator which is connected to the tail side of the boom cylinders with hydraulic piping, and a solenoid valve which is located at the piping to control the oil passage.

The APS is activated by turning the APS switch ON and deactivated by turning the APS switch OFF. When the APS is activated, the gas filled in the accumulator works as a spring to allow the load handling system and the loader body to move independently. This relative motion of the loader body and the load handling system dissipates vibration energy to suppress pitching or bouncing of the loader body, making it possible to travel in a stable manner on bad roads.

The electric and hydraulic circuits of this mechanism consist principally of the boom cylinders, accumulator, traveling damper valve, APS switch, controller (ATC unit), and traveling speed sensor.

2. Operation

① When the APS switch is turned ON, the traveling speed sensor and controller function and the monitor lamp comes on.

② When the traveling speed exceeds 7 km/h [4.3 mph], the solenoid valve inside the traveling damper valve is switched by the signal from the controller, to complete the circuit between the tail side of the boom cylinder and the accumulator, thus activating the APS.

③ If the traveling speed drops below 5 km/h [3.1 mph] while the APS is in operation, APS will be deactivated.

④ While the APS switch is in OFF, the APS is in deactivated state.

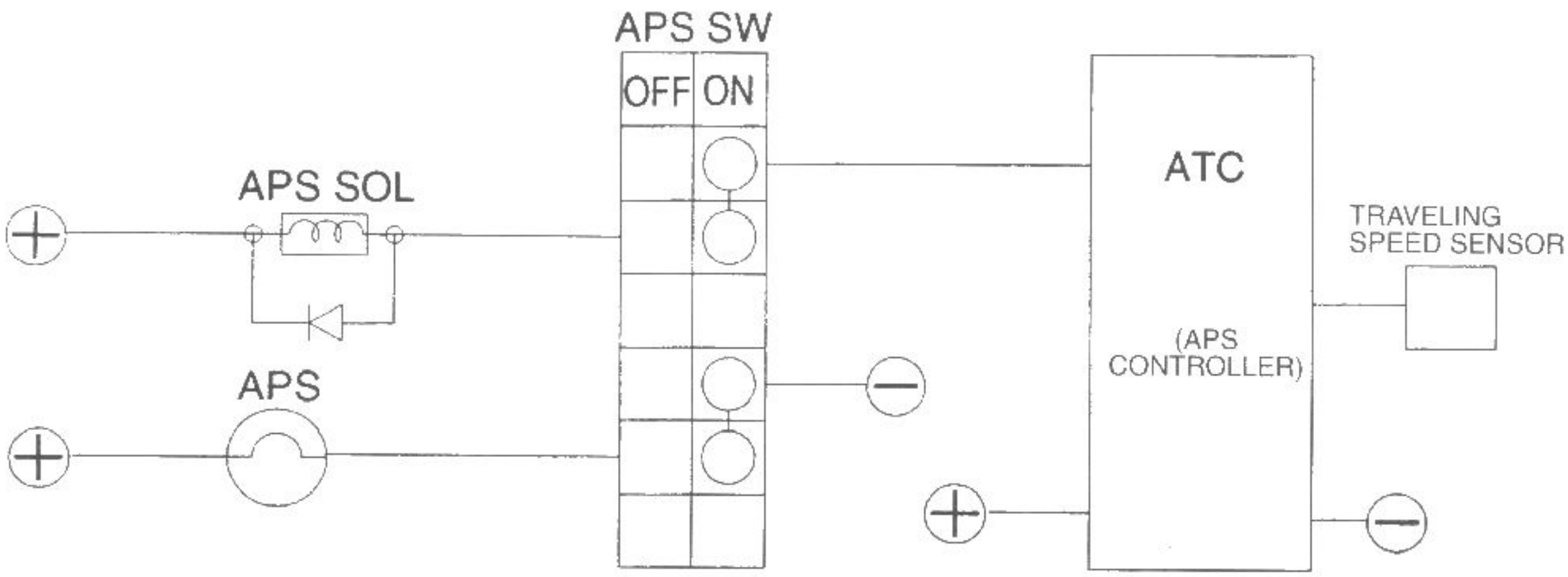


Fig. 7.15 APS Electric Circuit

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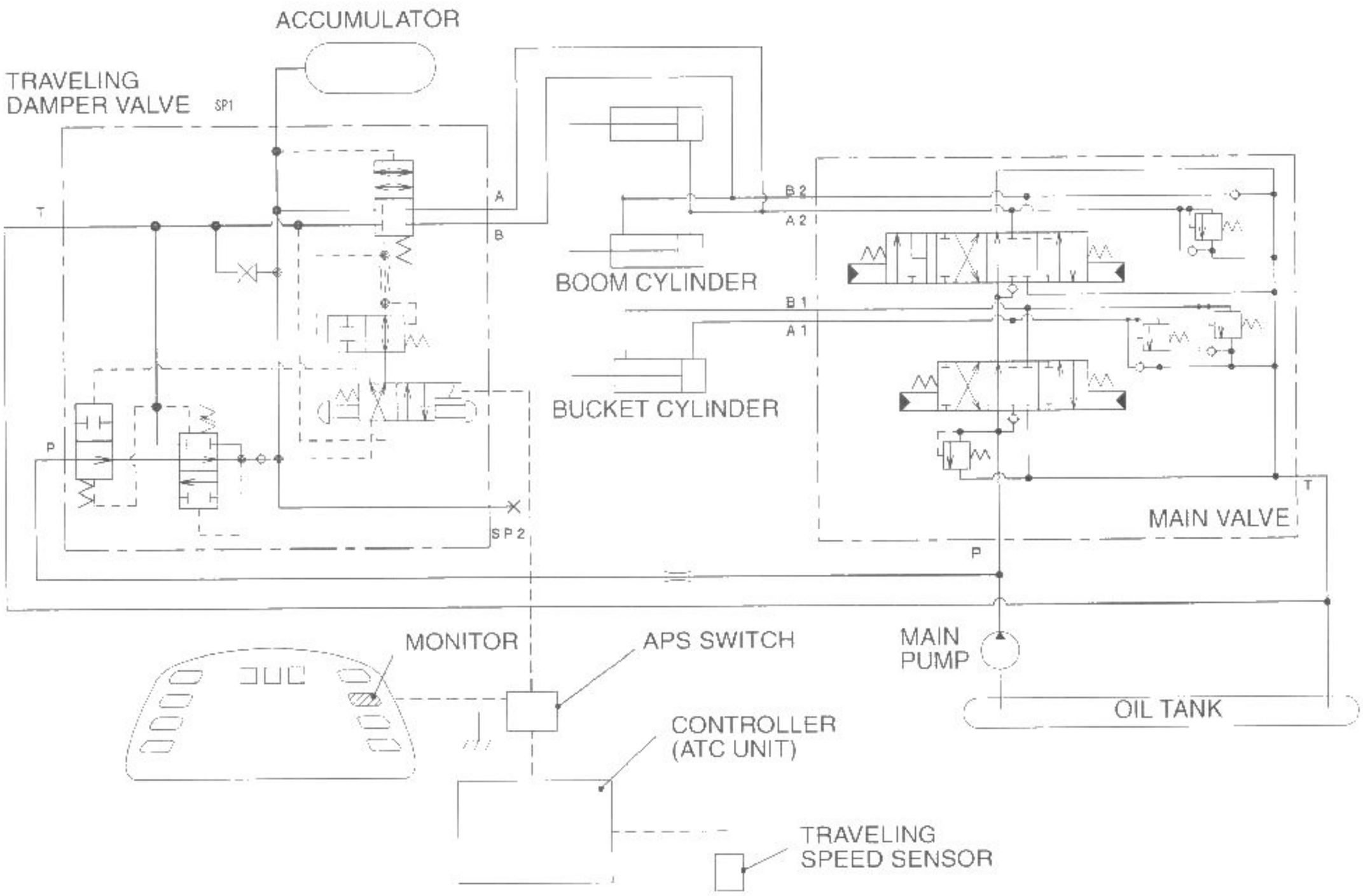
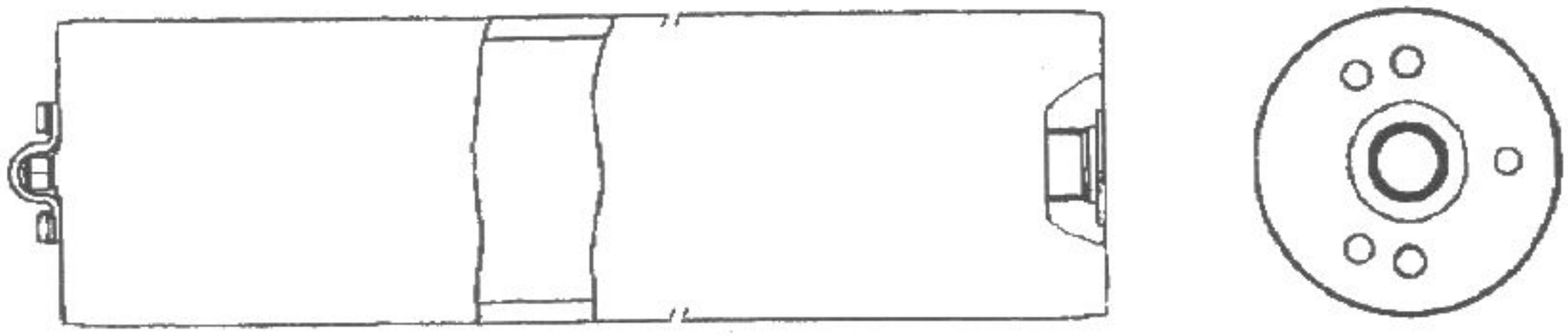


Fig. 7.16 APS Hydraulic Circuit and Electric Unit

3. Accumulator



Gas capacity: 4 liters [244 in.^{3}]
Gas charge pressure: 2.0 ±0.1 MPa {20 ±1.0 kgf/cm^2} [290.1 ±14.5 psi] at 20 ±5°C [68 ±9°F].

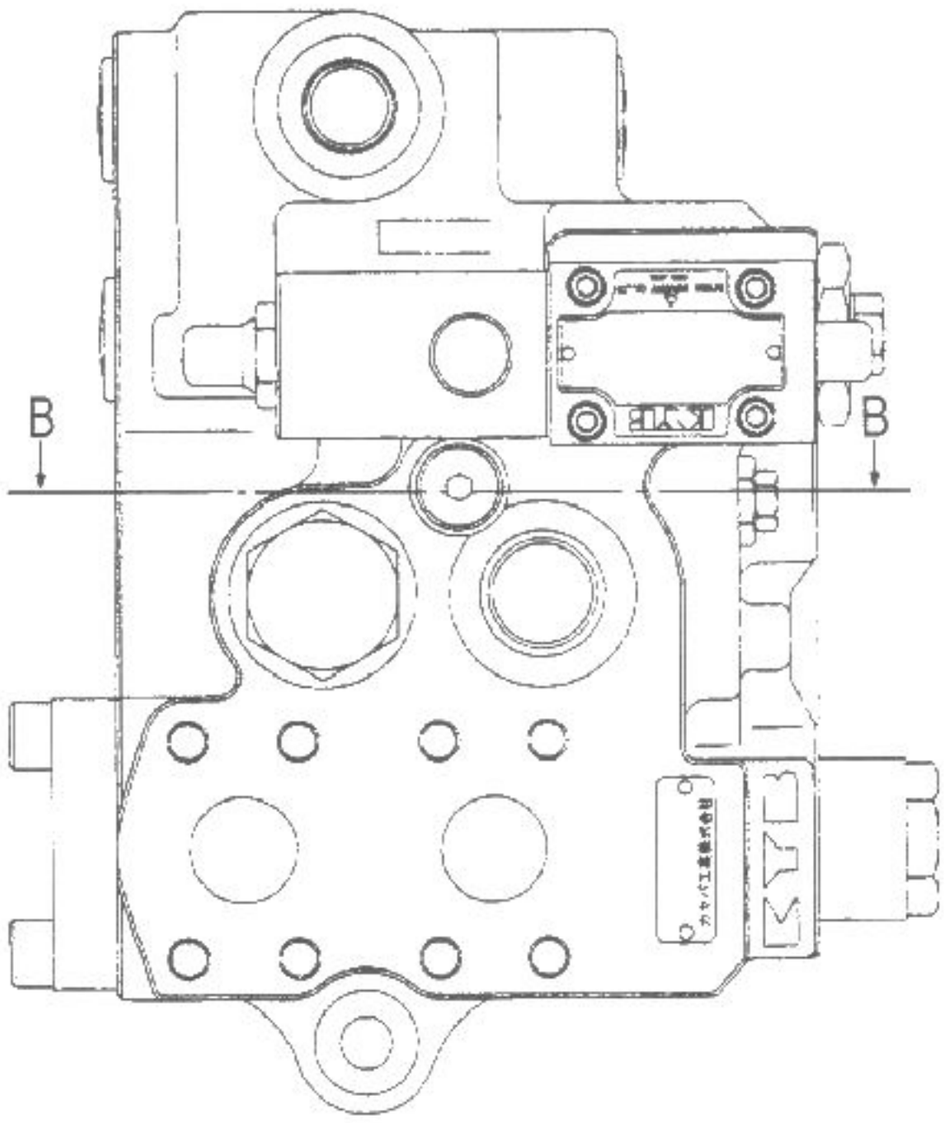
Fig. 7.17 Accumulator

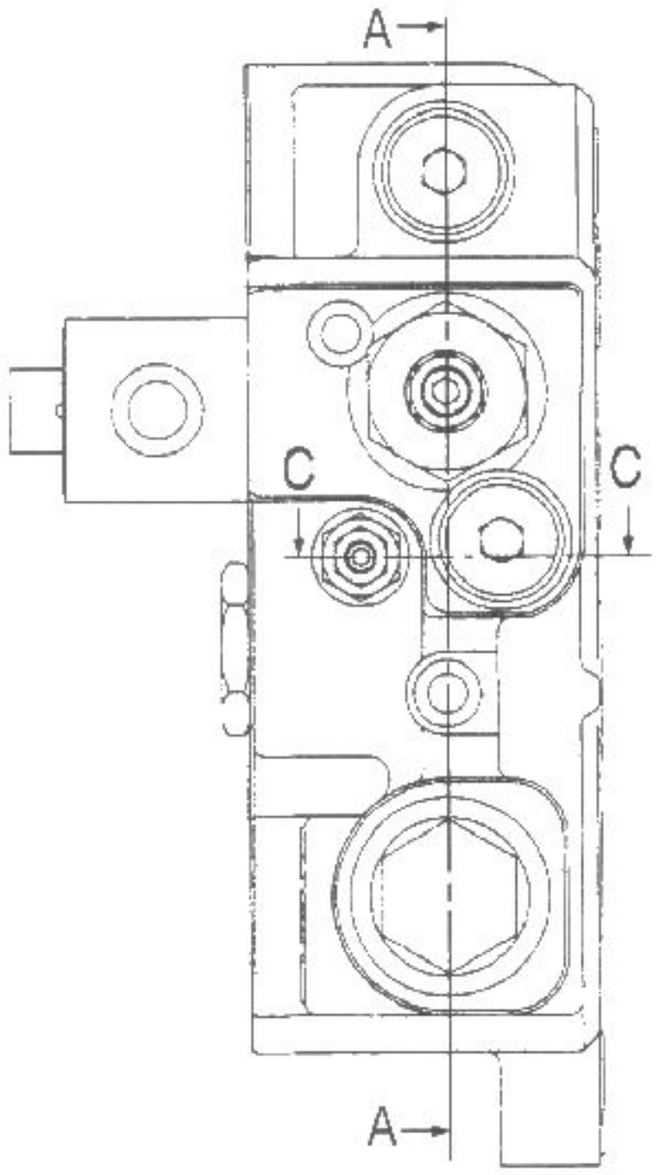
⚠ Caution to be taken when servicing accumulator and piping

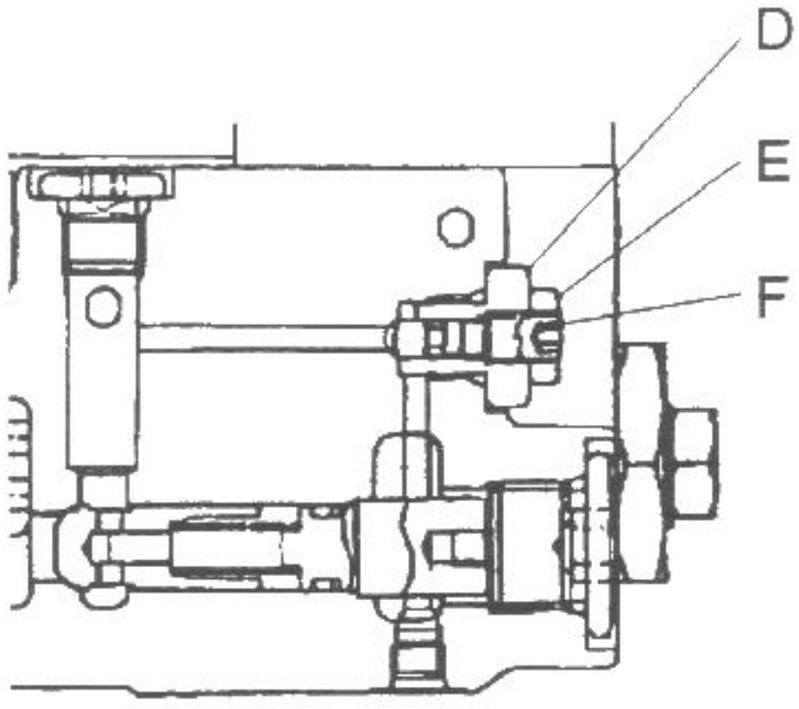
- **Use caution when handling the accumulator and piping because the accumulator has high-pressure nitrogen gas charged.**
- **Filling nitrogen gas into the accumulator should be performed only by qualified personnel.**
- **Do not modify or weld the accumulator.**
- **Before trying to service the piping, make sure to remove the pressure from inside the accumulator using traveling damper valve, because hydraulic oil remains in the piping. (For the procedure, see "4. Traveling damper valve".**
- **When removing the pressure from inside the accumulator, park the loader on a level surface, shut down the engine, and lower the booms and bucket on the ground.**
- **Check the gas pressure every 2000 hours of operation or one year whichever comes first.**

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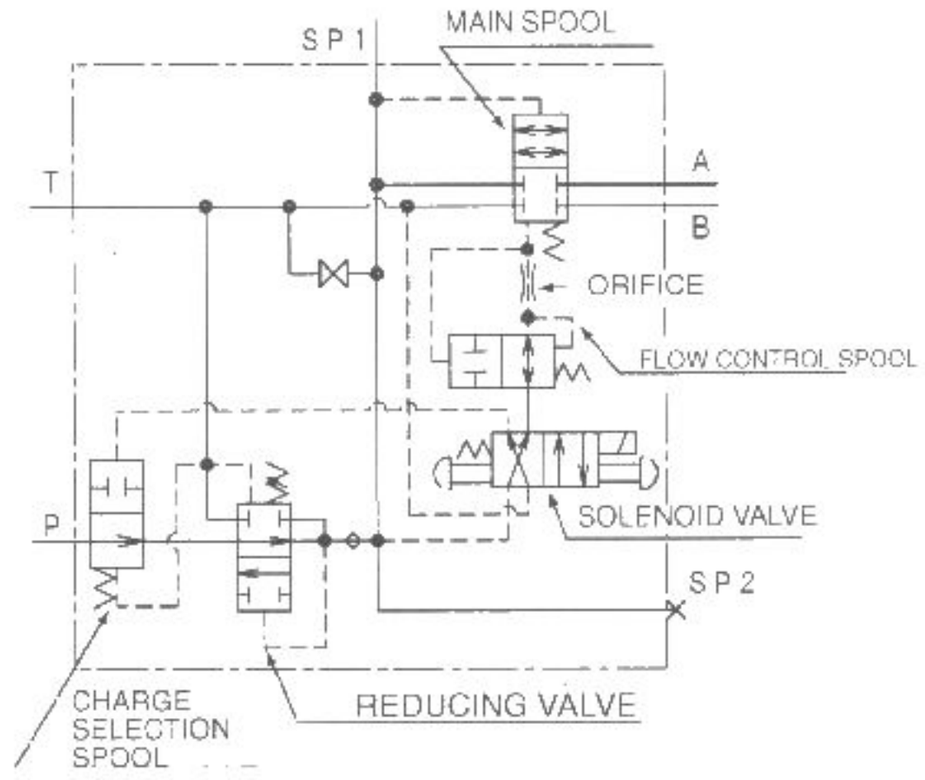
4. Traveling damper valve







Section C-C



Circuit diagram

Note: D: 29 ±1.0 N-m {3.0 ±0.1 kgf-m} [21.7 ±0.7 lbf-ft]
E: 13 ±0.6 N-m {1.3 ±0.06 kgf-m} [9.4 ±0.4 lbf-ft]
F: 6.9 ±0.6 N-m {0.70 ±0.06 kgf-m} [5.1 ±0.4 lbf-ft]

Fig. 7.18 Traveling Damper Valve (1)

[Removing pressure]

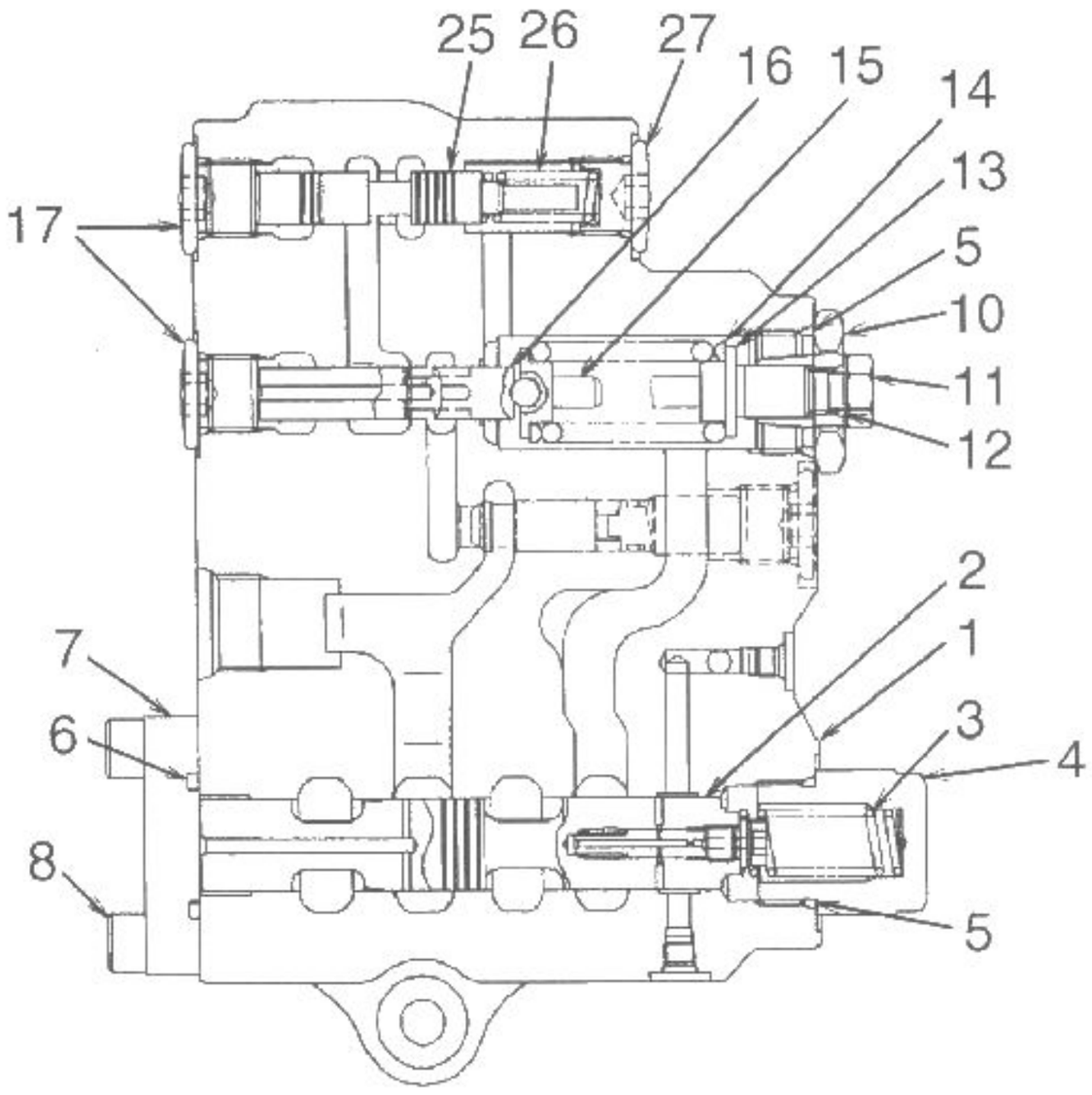
Loosen the lock nut (E) and then loosen the poppet (F) to release the pressure.

Do not plug (D) as much as possible to prevent damage to the "O"-ring. If the plug (D) was loosened, replace the "O"-ring with a new one.

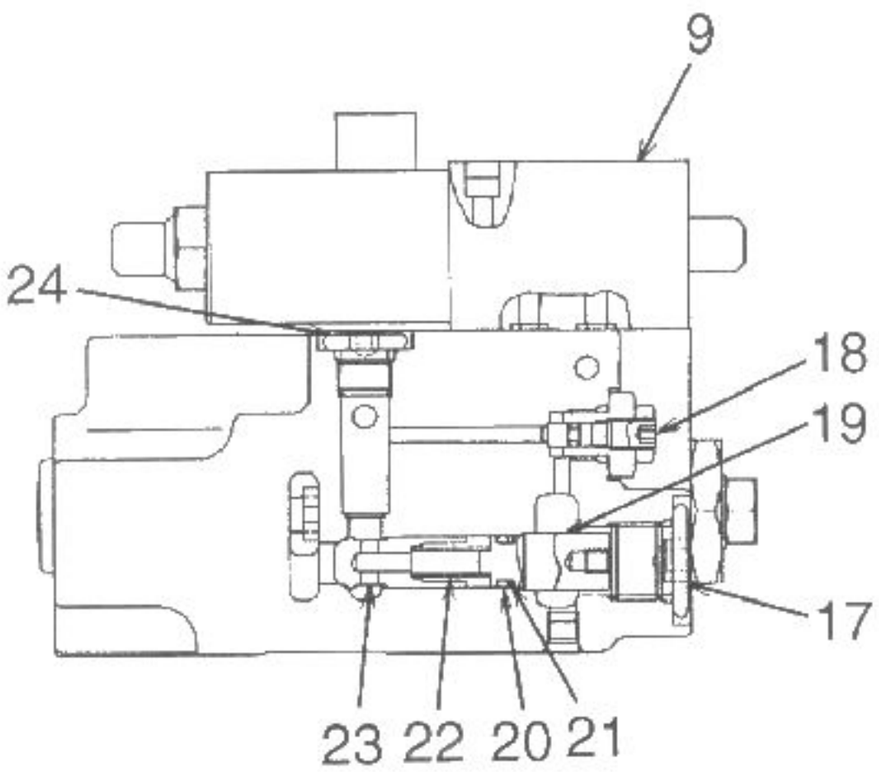
[Installing]

① Tighten the plug (D) to the specified torque.
② Tighten the poppet (F) to the specified torque to seat it to the valve housing securely.
③ Tighten the lock nut (E) to secure the poppet (F).

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Section A-A



Section B-B

1. HOUSING
2. SPOOL
3. SPRING
4. PLUG
5. "O"-RING
6. "O"-RING
7. CAP
8. SOCKET HEAD BOLT
9. SOLENOID VALVE
10. PLUG
11. ADJUSTER
12. "O"-RING
13. PLUNGER
14. SPRING
15. SPOOL SEAT
16. SPOOL
17. PLUG
18. VALVE
19. SPACER
20. "O"-RING
21. BACK-UP RING
22. SPRING
23. POPPET
24. PLUG
25. SPOOL
26. SPRING
27. PLUG

Fig. 7.19 Traveling Damper Valve (2)

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8. ELECTRIC SYSTEM

8.1 LIGHTING EQUIPMENT

Name	Specification	Q'ty	Remarks
Head lights	27 V 75/70 W	2	Halogen
Width lamps	24 V 5 W	2	Front combination lamp
Turn signals (front)	24 V 25 W		
Brake lamps	24 V 25/10 W	2	Rear combination lamp
Tail lamps			
Back-up lamps	24 V 12 W		
Turn signals (rear)	24 V 25W		
Rear work lights	24 V 70 W	2	Halogen
Auxiliary head lights	24 V 70 W	2	Upper side of the cab, halogen
Compartment lights	24 V 10 W	2	

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8.2 METERS AND SWITCHES

8.2.1 MONITOR LAMPS (CLUSTER GAUGE UNIT)

The operating status monitor system monitors the loader operating status by means of the sensors and switches installed on the loader and displays the information on the cluster gauge unit in the operator's compartment to inform the operator of the current operating status of the loader.

The cluster gauge unit consists of meters including the speedometer, monitor lamps (warning lamps) which indicate whether or not each system is operating properly, and indicator lamps.

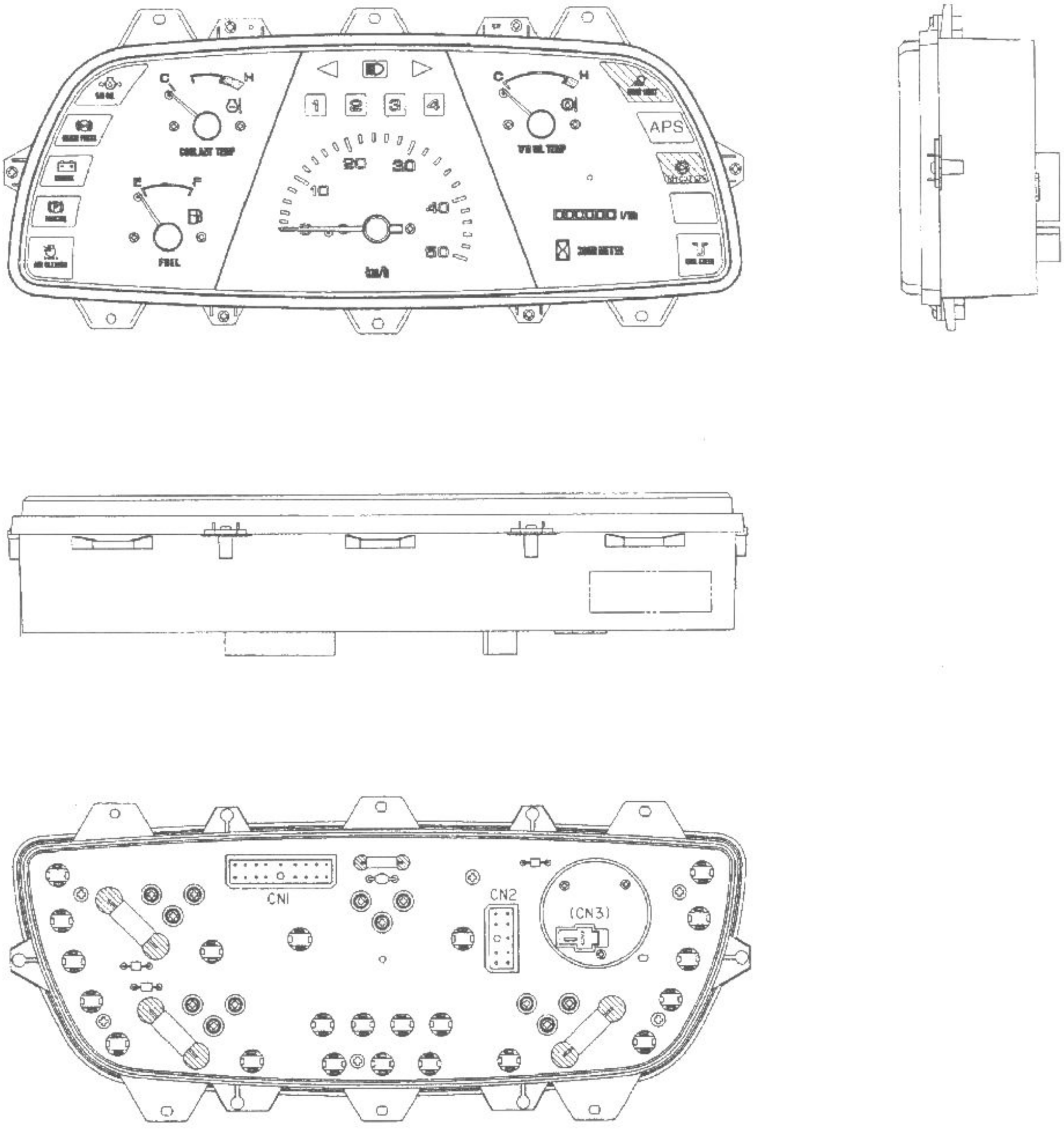
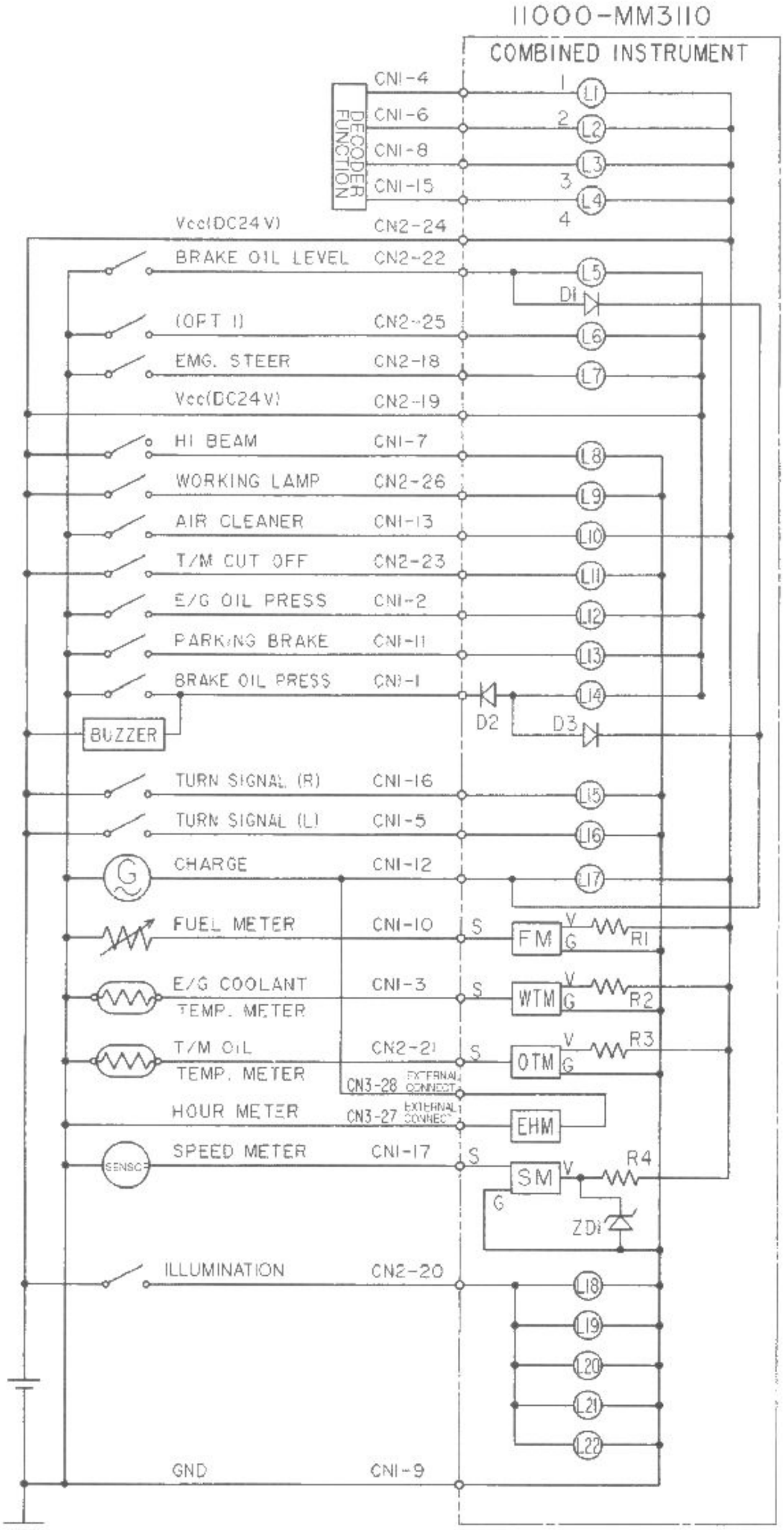


Fig. 8.1 Cluster Gauge Unit (1)

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● Meter circuit diagram



CONN.	No.	Connected to
CN1	1	Brake oil pressure
	2	Engine oil pressure
	3	Water temperature sensor
	4	Shift indicator 1
	5	Turn signal (L)
	6	Shift indicator 2
	7	Main lamp
	8	Shift indicator 3
	9	Ground
	10	Fuel sensor
	11	Parking brake
	12	Charge
	13	Air cleaner
	14	Not connected
	15	Shift indicator 4
	16	Turn signal (R)
	17	Speed sensor
CN2	18	Emergency steering
	19	Power source (24 V DC)
	20	Instrument lamp
	21	Oil temperature sensor
	22	Brake oil level
	23	Transmission cut-off
	24	Power source (24 V DC)
	25	OPT-1
	26	Working light
CN3	27	Hour meter GND
	28	Hour meter power source

● Connector

〔CN1〕

8	7	6	5		4	3	2	1
17	16	15	14	13	12	11	10	9

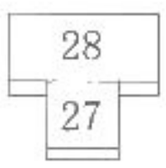
(Connector at cluster gauge unit side)

〔CN2〕

21	20		19	18
26	25	24	23	22

(Connector at cluster gauge unit side)

〔CN3〕

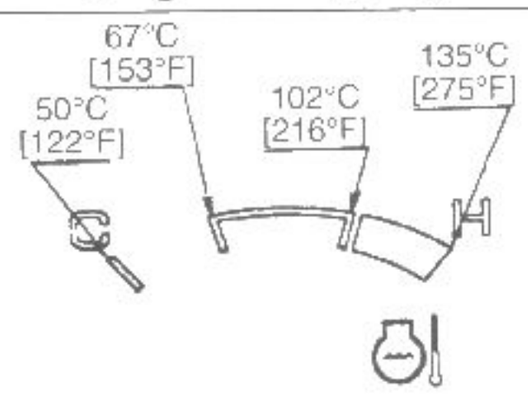
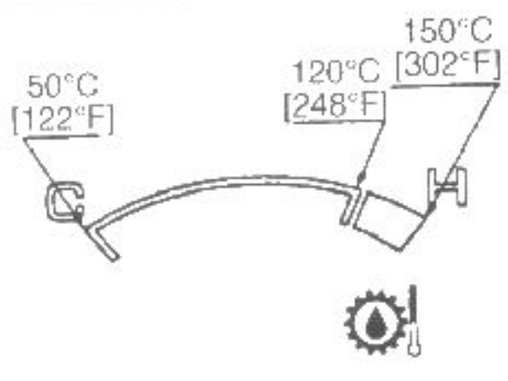
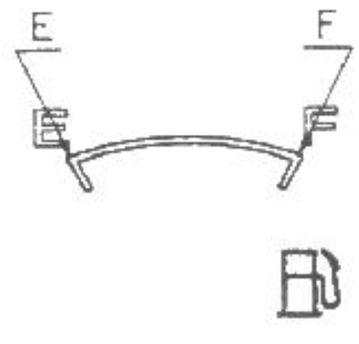


(Connector at loader side)

Fig. 8.2 Cluster Gauge Unit (2)

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1. Meters

Meter	Engine water temperature gauge		Transmission oil temperature gauge		Fuel meter	
Scale						
Measurement point	67°C[153°F]↗	102°C[216°F]↗	50°C[122°F]↗	120°C[248°F]↗	E↙	F↗
Standard resistance value	49.8 Ω	16.8 Ω	91.7 Ω	10.4 Ω	80 Ω	10 Ω

Sensor	Application	Specification				Location
Fuel level sender unit	Fuel meter	Float	E	1/2	F	Inside fuel tank
		Resistance Ω	80	32	10	
Thermosensor	Engine water temperature gauge	Temperature °C [°F]	50 [122]	80[176]	120 [248]	Upper front of engine (cooling fan side)
Thermosensor	Transmission oil temperature gauge	Resistance Ω	80	30	10	Torque converter

2. Monitor Lamps (Warning lamps)

The loader is provided with a total of 7 monitor lamps: 3 warning lamps (Nos. 1, 2 and 3) and 4 indicator lamps (Nos. 4,5,6 and 7). (Nine monitor lamps are installed when an optional lamp is included.)

The 3 warning lamps come on when the starter switch is turned to the ON position. If any warning lamp doesn't come on, it is suspected that the bulb is blown out.

No.	Name	Description (when it comes on)
1	Engine oil pressure	Oil pressure below specified value
2	Brake oil pressure	Oil pressure below specified value
3	Battery voltage	Battery undercharged
4	Parking brake	Parking brake applied
5	Work light	Light is on
6	Clutch cut-off	Clutch cut-off is ON (non-inching)
7	Air cleaner	Clogged
8	Emergency steering (option)	Emergency steering is operated.
9	APS (option)	Activated

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(Specifications and locations of switches)

Name	Application	Specifications	Location
Oil pressure switch	Engine oil pressure	Operating pressure: 49 kPa {0.5 kgf/cm^2} [7.1 psi] (Turns ON at atmospheric pressure)	Right side of engine
Pressure switch	Brake oil pressure	Operating pressure: 3.4 MPa {35 kgf/cm^2} [498 psi] Returning pressure: 2.5 MPa {25kgf/cm^2} [356 psi] (Turns ON at atmospheric pressure)	Accumulator
Pressure switch	Parking brake		Transmission disk brake
Indicator	Air cleaner	Operating resistance: 6.37 kPa {635 mmH_2O} (Turns OFF at atmospheric pressure)	Air cleaner

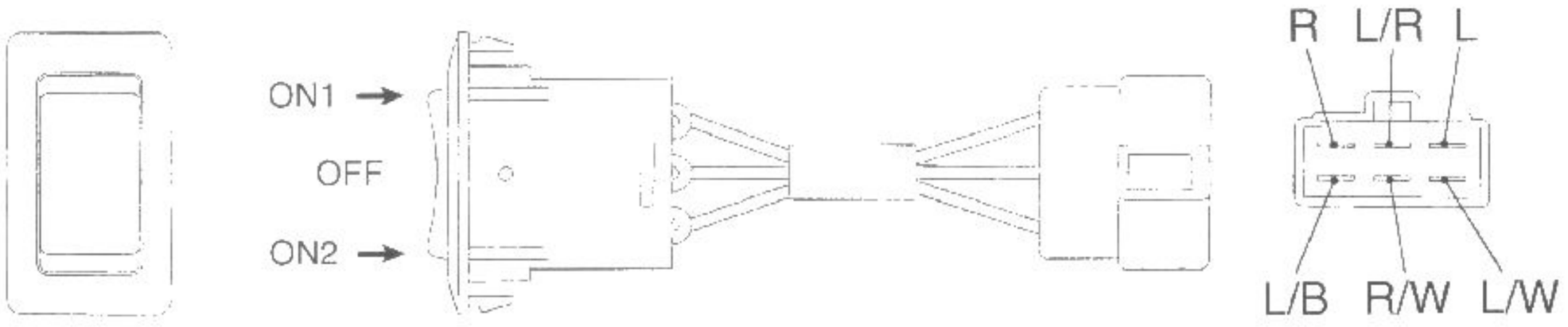
8.2.2 MONITOR LAMPS (EXCEPT CLUSTER GAUGE UNIT)

The loaders have one confirmation lamp (No.10) and two warning lights (L35-3, LX190-7 · L40-3, LX230-7) in addition to the cluster gauge unit.

No.	Name	Light comes on when:
10	Engine heater glow lamp	The engine preheater is activated.
11	(red) Engine diagnostic lamp (L35-3, LX190-7 · L40-3, LX230-7)	An error occurs in the engine (load handling or traveling error)
12	(orange) Engine diagnostic lamp (L35-3, LX190-7 · L40-3, LX230-7)	An error occurs in the engine (load handling or traveling error)

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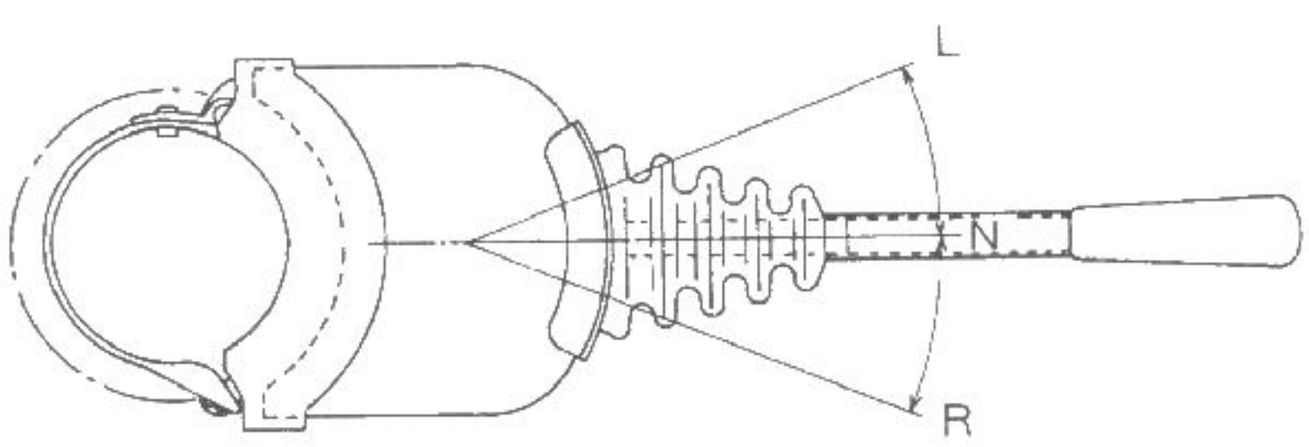
8.2.3 LIGHTING SWITCH



	L/R	L	R	R/W	L/W	L/B
ON-1	○	○		○	○	
OFF						
ON-2	○		○	○		○

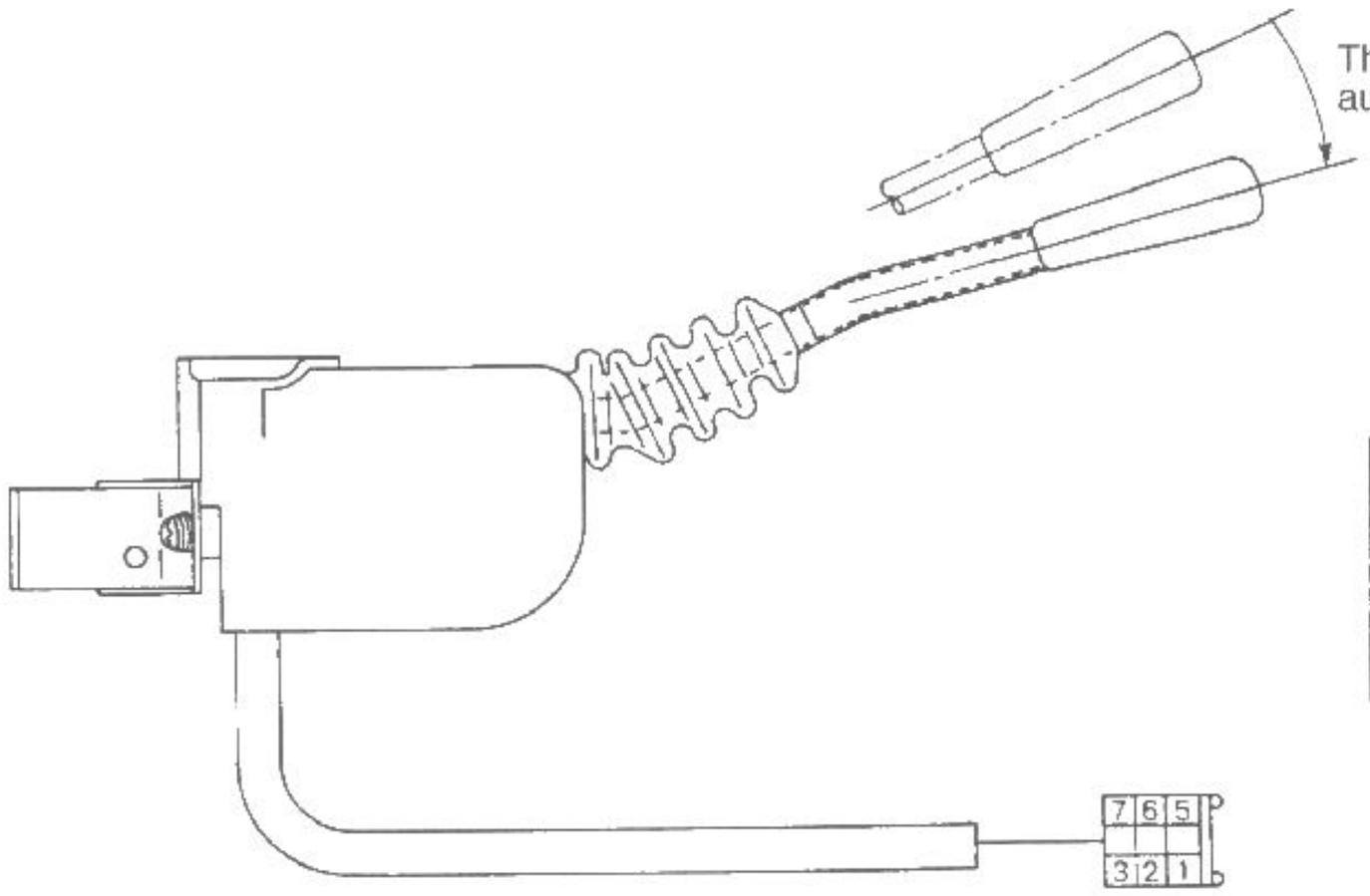
Fig. 8.3 Lighting Switch

8.2.4 TURN SIGNAL SWITCH



(Turn signal switch connection table)

Connected to	Flasher unit	Left	Right
Terminal No.	6	5	1
L	TF ○	○ TL	
N			
R	TF ○		○ TL



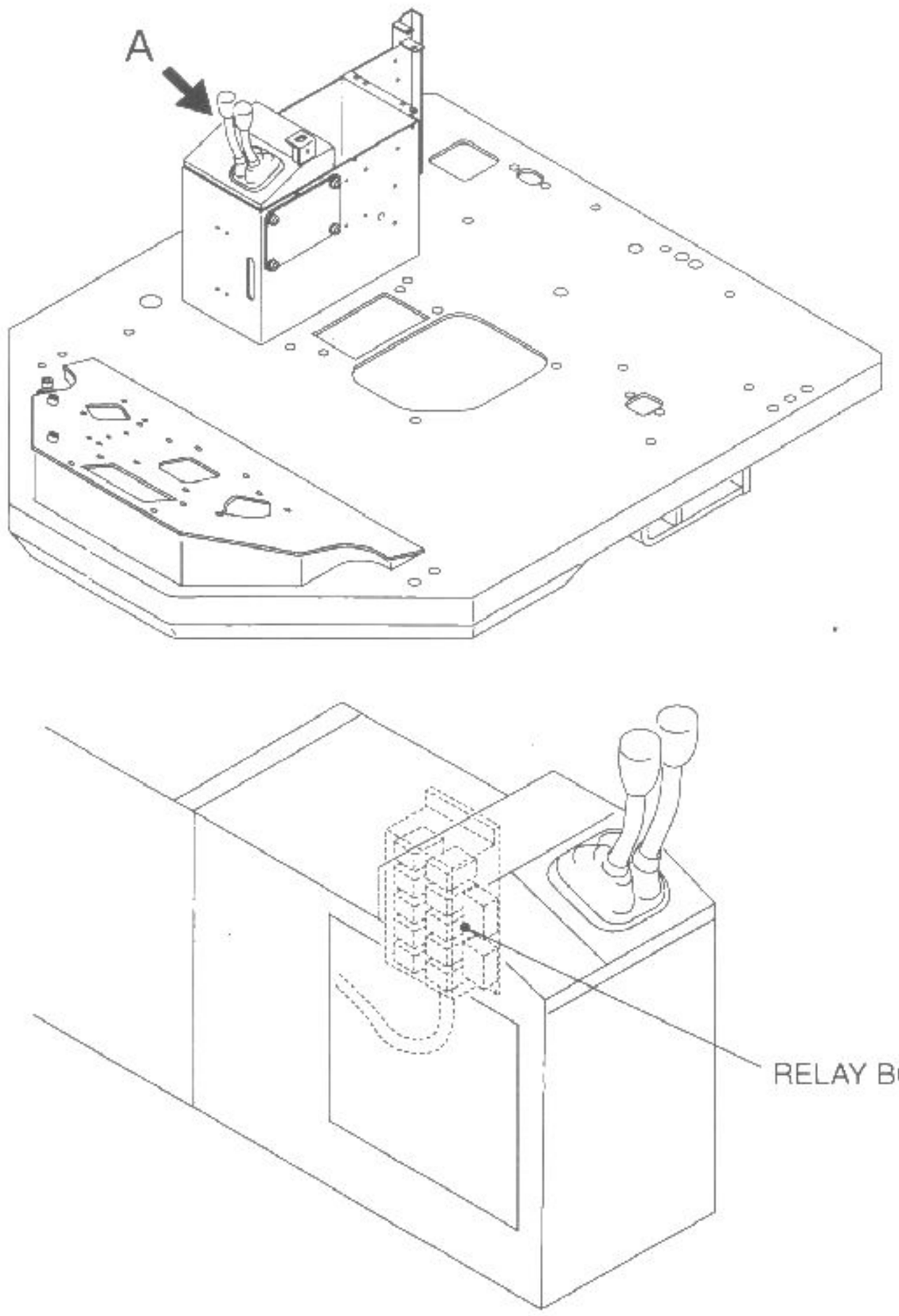
(Dimmer switch connection table)

Connected to	MAIN	DIMMER	BATT
Terminal No.	7	3	2
DIMMER		○	○
MAIN	○		○

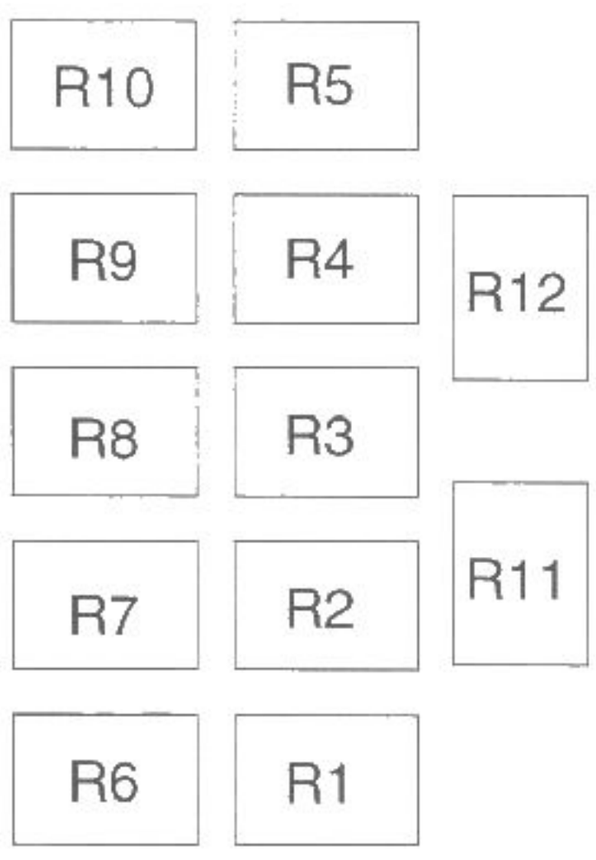
Fig. 8.4 Turn Signal Switch

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8.3 LOCATION OF RELAYS



View looking from A



Relay arrangement

R1 : NEUTRAL RELAY
R2 : EMERGENCY RELAY
R3 : PARKING BRAKE RELAY (1)
R4 : PARKING BRAKE RELAY (2)
R5 : TRANSMISSION CUT-OFF RELAY
R6 : BUZZER RELAY
R7 : HORN RELAY
R8 : STOP RELAY
R9 : BACK-UP LIGHT RELAY
R10 : ECU RELAY (L35-3, LX190-7 · L40-3, LX230-7)
R11 : HEATER RELAY (L35-3, LX190-7 · L40-3, LX230-7)
R12 : CONDENSER RELAY (L35-3, LX190-7 · L40-3, LX230-7)

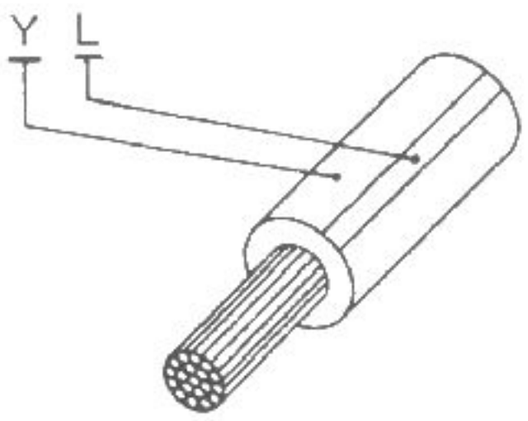
Fig. 8.5 Location of Relays

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8.4 ELECTRIC CIRCUIT DIAGRAM

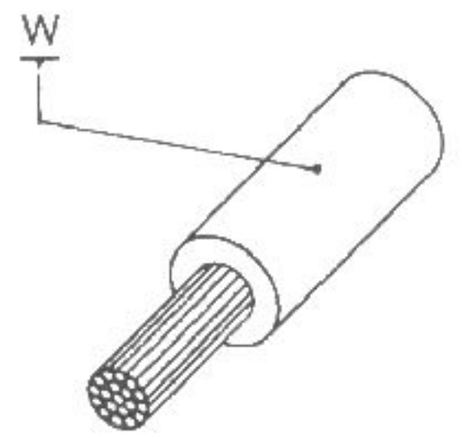
Note: Wire colors:

The wires are classified by color. The first symbol shows the insulation color and the 2nd the marking color.



Example: Yellow coating in blue

B	Black	W	White
R	Red	G	Green
Y	Yellow	Br	Brown
L	Blue	Lg	Light Green
P	Pink	O	Orange
Gr	Gray		



Example: White coating without marking

(Wire No. and Wire Color)

● L27-3, LX130-7 · L32-3, LX160-7

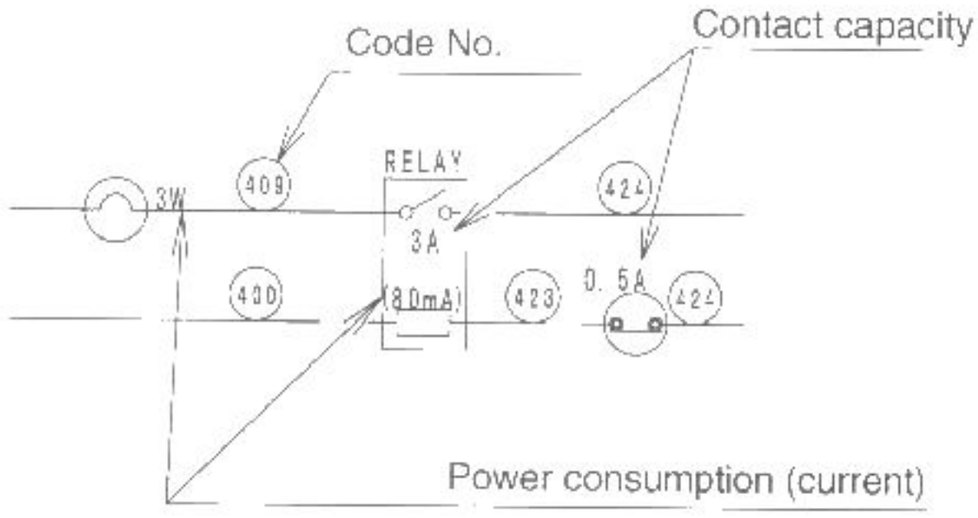
No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL	No	COL
0	B	10	YL	20	W	30	–	40	–	100	P	110	G	120	YL	130	RY	140	GL	150	LY	160	–	200	RW	210	RB	220	WR	230	WR	240	R	250	RG	300	GR	310	YG	400	Br	410	GW	500	Y	510	LG	520	WB
1	R	11	L	21	RW	31	–	41	–	101	G	111	WG	121	YB	131	RW	141	G	151	LR	161	–	201	WG	211	RG	221	LW	231	Br	241	–	251	O	301	–	311	RW	401	BL	411	GB	501	WG	511	YW	521	Br
2	R	12	LW	22	YR	32	–	42	–	102	G	112	WY	122	YG	132	WG	142	O	152	–	162	–	202	BL	212	L	222	RB	232	WY	242	–	252	LG	302	Br	312	L	402	RY	412	BL	502	O	512	YB		
3	R	13	LY	23	–	33	–	43	–	103	O	113	W	123	LG	133	GL	143	GR	153	–	163	–	203	GB	213	LR	223	–	233	–	243	–	253	WR	303	BW	313	–	403	GB	413	YB	503	GW	513	YL		
4	R	14	O	24	YW	34	–	44	–	104	L	114	GL	124	LW	134	Br	144	–	154	–	164	–	204	–	214	WB	224	–	234	–	244	–	254	Br	304	RG	314	–	404	L	414	WL	504	GL	514	YG		
5	R	15	–	25	YB	35	–	45	–	105	WL	115	BW	125	YB	135	BL	145	–	155	G	165	–	205	–	215	–	225	–	235	–	245	YG	255	LY	305	YW	315	–	405	BG	415	LY	505	BL	515	GR	550	Br
6	–	16	RB	26	–	36	–	46	–	106	G	116	BL	126	RG	136	RB	146	–	156	Br	166	–	206	–	216	–	226	–	236	–	246	W	256	–	306	BL	316	–	406	G	416	WG	506	YB	516	O		
7	Y	17	LY	27	–	37	–	47	–	107	W	117	LW	127	WG	137	Y	147	–	157	–	167	–	207	–	217	–	227	–	237	–	247	YL	257	–	307	–	317	–	407	–	417	GL	507	P	517	GL		
8	YG	18	WB	28	–	38	–	48	–	108	WR	118	Y	128	YR	138	WG	148	LY	158	–	168	–	208	–	218	–	228	–	238	–	248	–	258	–	308	YR	318	–	408	–	418	BW	508	LR	518	RB	600	YR
9	B	19	–	29	–	39	–	49	–	109	WB	119	GB	129	RB	139	YB	149	YW	159	–	169	–	209	–	219	–	229	–	239	–	249	–	259	–	309	LG	319	–	409	–	419	–	509	LW	519	GB	610	O

● L35-3, LX190-7 · L40-3, LX230-7

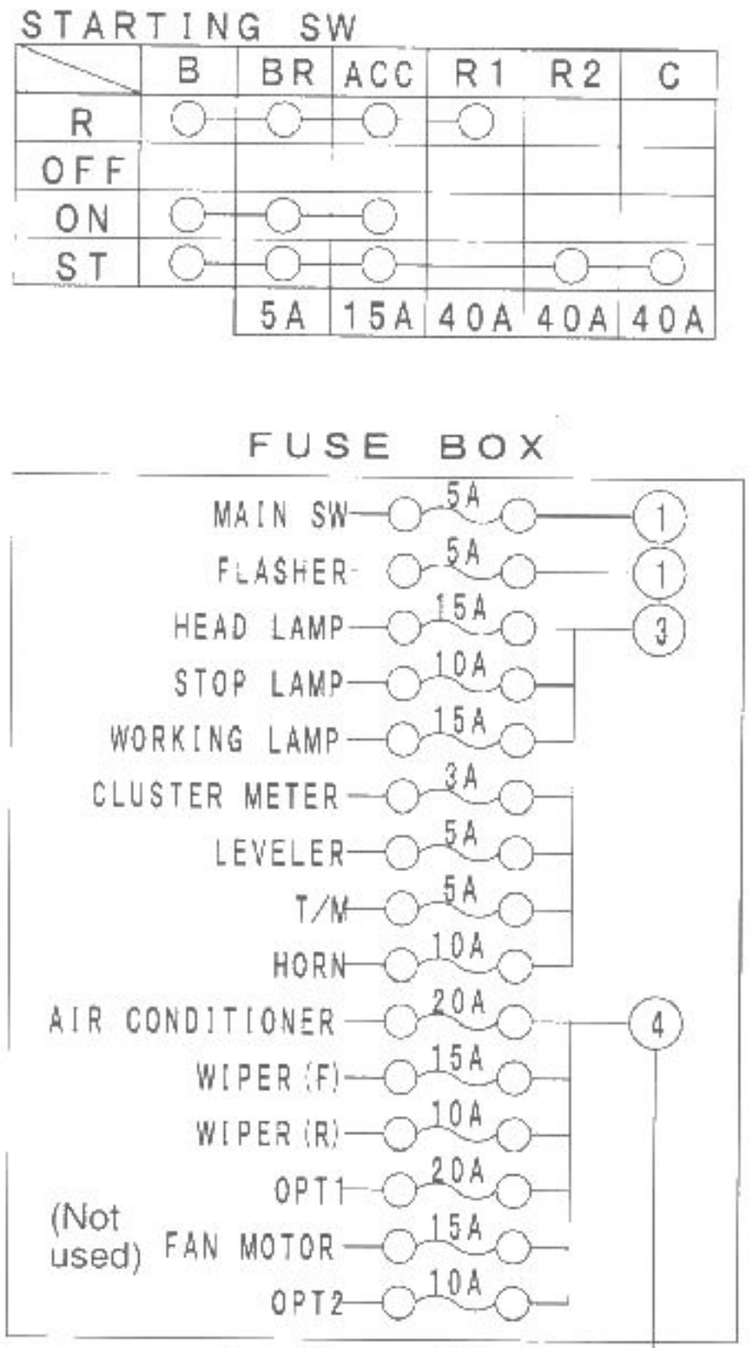
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0	B	10	YL	20	W	30	–	40	Y	50	RY	60	R	70	LR	80	LB	90	O	100	P	110	G	120	YL	130	RY	140	GL	150	LY	160	–	200	RW	210	RB	220	WR	230	WR	240	R	250	RG	300	GR	310	YG	400	Br	410	GW	500	Y	510	LG	520	WB
1	R	11	–	21	RW	31	–	41	P	51	YB	61	W	71	WL	81	GR	91	L	101	G	111	WG	121	YB	131	RW	141	G	151	LR	161	–	201	WG	211	RG	221	LW	231	Br	241	–	251	O	301	–	311	RW	401	BL	411	GB	501	WG	511	YW	521	Br
2	R	12	–	22	YR	32	–	42	YB	52	YR	62	B	72	LB	82	GW	92	–	102	GL	112	WY	122	YG	132	WG	142	O	152	–	162	–	202	BL	212	L	222	RB	232	WY	242	–	252	LG	302	Br	312	L	402	RY	412	BL	502	O	512	YB		
3	R	13	–	23	–	33	–	43	YR	53	WR	63	G	73	–	83	GB	93	–	103	O	113	W	123	LG	133	GL	143	GR	153	–	163	–	203	GB	213	LR	223	–	233	–	243	–	253	WR	303	BW	313	–	403	GB	413	YB	503	GW	513	YL	625	WR
4	R	14	O	24		34	–	44	YG	54	WB	64	BL	74	–	84	–	94	–	104	L	114	GL	124	LW	134	Br	144	–	154	–	164	–	204	–	214	WB	224	–	234	–	244	–	254	Br	304	RG	314	–	404	L	414	WL	504	GL	514	YG	530	Br
5	R	15	BW	25		35	–	45	Y3	55	WR	65	GR	75	–	85	–	95	–	105	WL	115	BW	125	YB	135	BL	145	–	155	G	165	–	205	–	215	–	225	–	235	–	245	YG	255	LY	305	YW	315	–	405	BG	415	LY	505	BL	515	GR	550	Br
6	–	16	RB	26	–	36	–	46	O	56	WL	66	LG	76	L	86	W	96	–	106	G	116	BL	126	RG	136	RB	146	–	156	Br	166	–	206	–	216	–	226	–	236	–	246	W	256	–	306	BL	316	–	406	G	416	WG	506	YB	516	O		
7	Y	17	LY	27	–	37	–	47	Br	57	WG	67	GB	77	B	87	B	97	–	107	W	117	LW	127	WG	137	Y	147	–	157	–	167	–	207	–	217	–	227	–	237	–	247	YL	257	–	307	–	317	–	407	–	417	GL	507	P	517	GL		
8	YG	18	WB	28	–	38	–	48	BrR	58	WB	68	B	78	Y	88	W	98	–	108	WR	118	Y	128	YR	138	WG	148	LY	158	–	168	–	208	–	218	–	228	–	238	–	248	–	258	–	308	YR	318	–	408	–	418	BW	508	LR	518	RB	600	YR
9	B	19	BL	29	–	39	–	49	YR	59	WY	69	–	79	O	89	–	99	–	109	WB	119	GB	129	RB	139	YB	149	YW	159	–	169	–	209	–	219	–	229	–	239	–	249	–	259	–	309	LG	319	–	409	–	419	–	509	LW	519	GB	610	O

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⚠ Before trying to work on the electric system or replace parts, make sure to disconnect the battery connectors. When disconnecting the battery connectors, first disconnect the grounding side (-) terminal and then remove the other terminal.



Notes: 1. The wire diameter is 0.85 mm² unless otherwise specified.
2. The contact capacities of the switches and sensors are given under the condition which the engine is shut down, pressure is 0 (atmospheric pressure), and the oil level is proper.
3. The marking * shows an optional specification.



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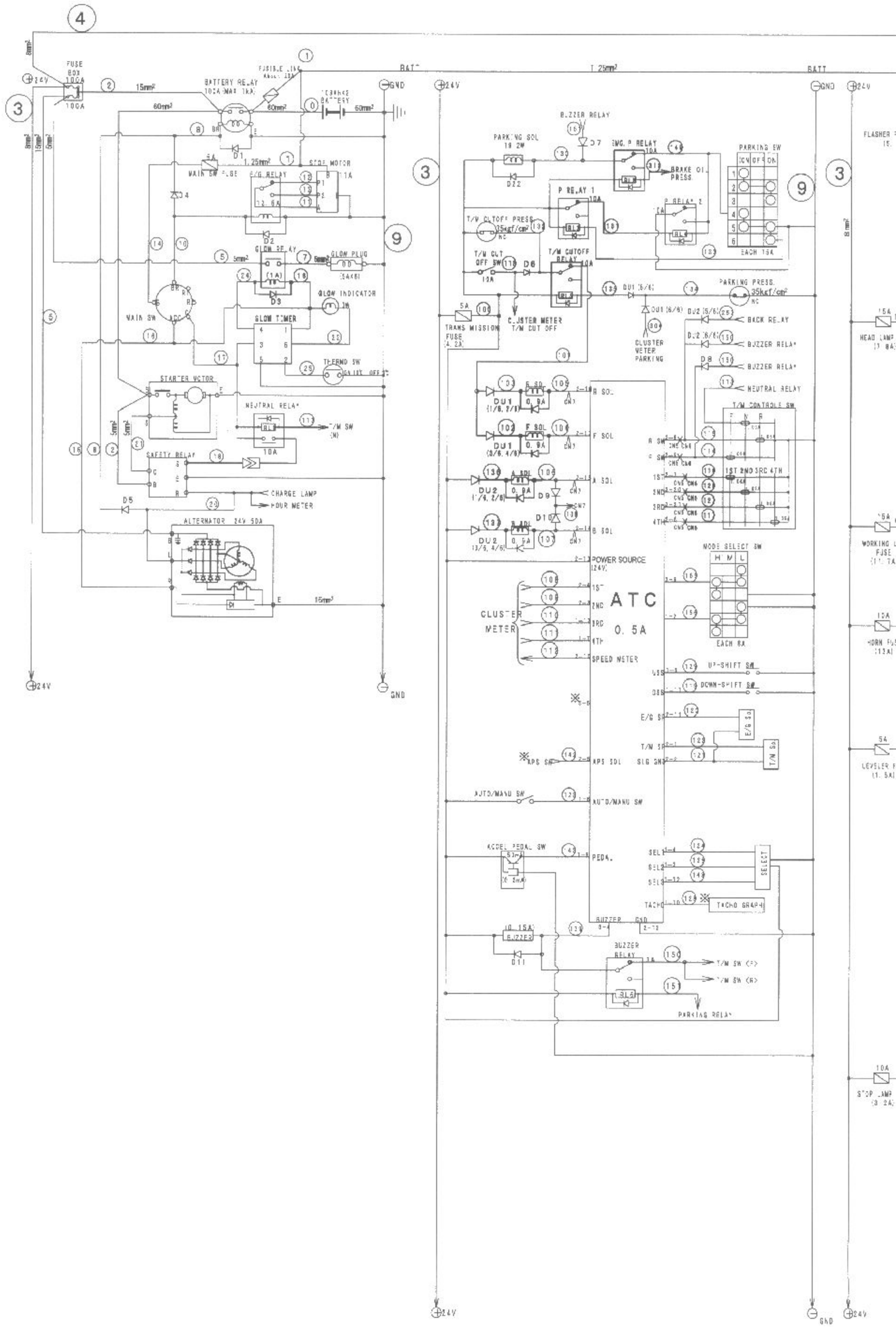
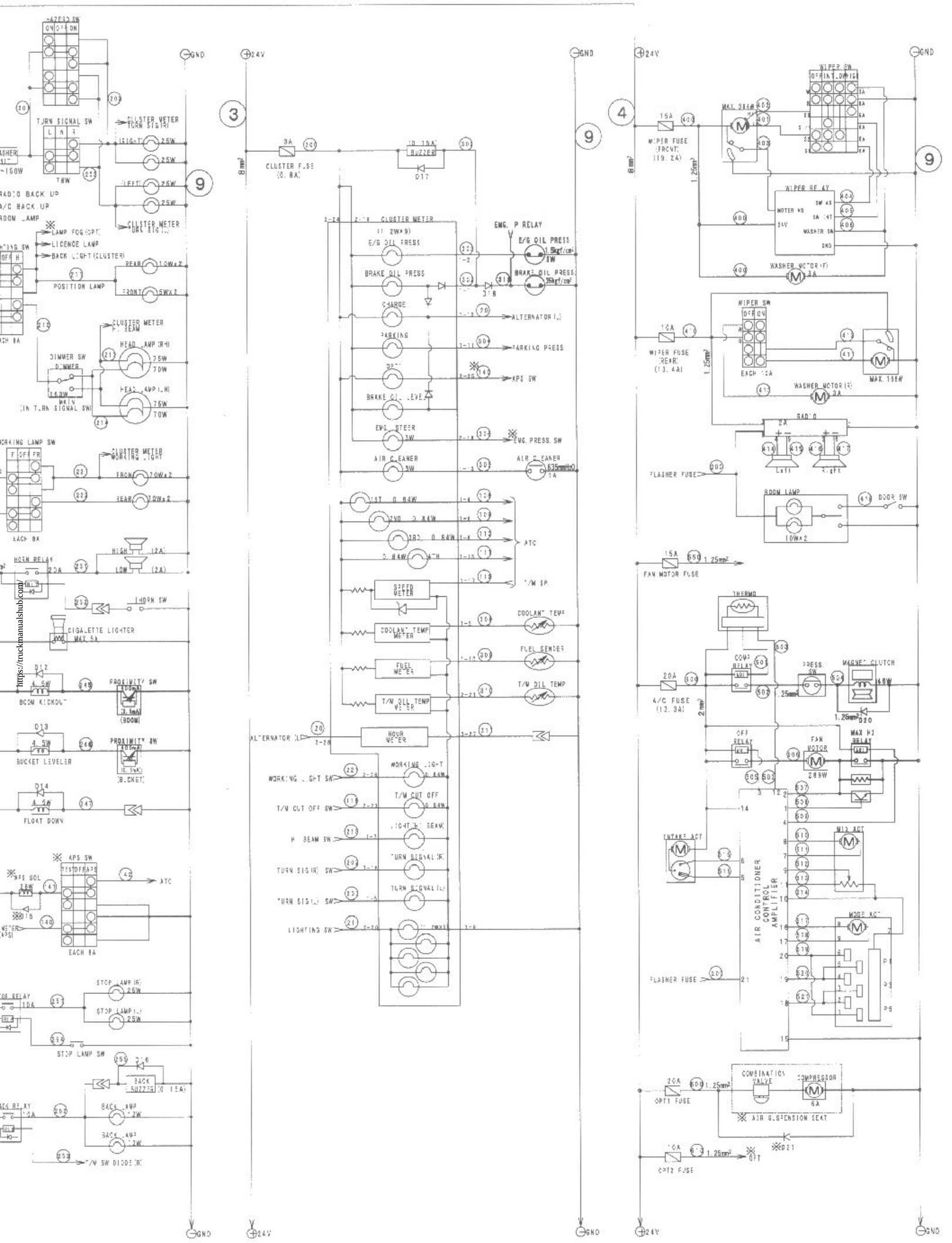


Fig. 8.6 Wiring Diag

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(L27-3, LX130-7 · L32-3, LX160-7)

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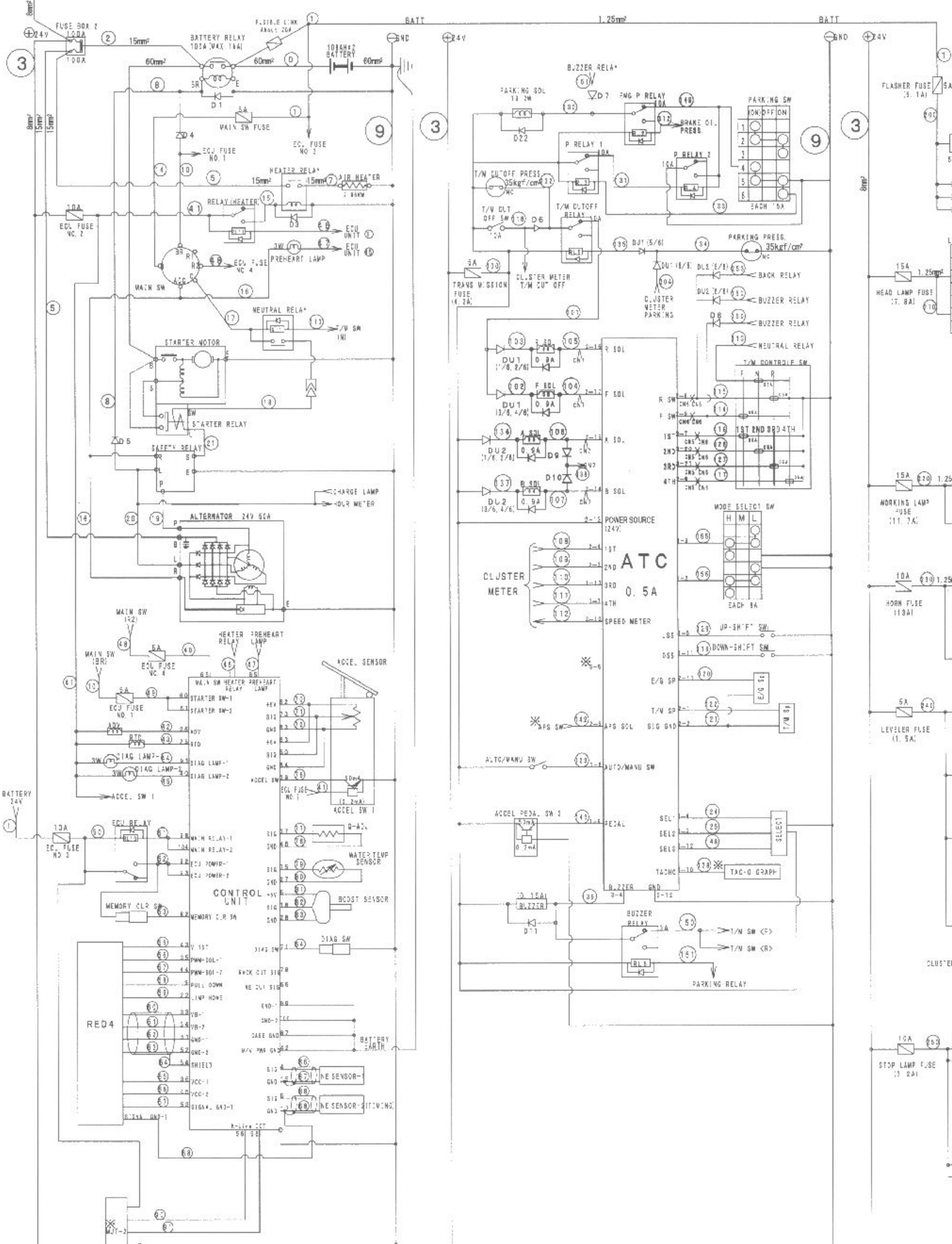
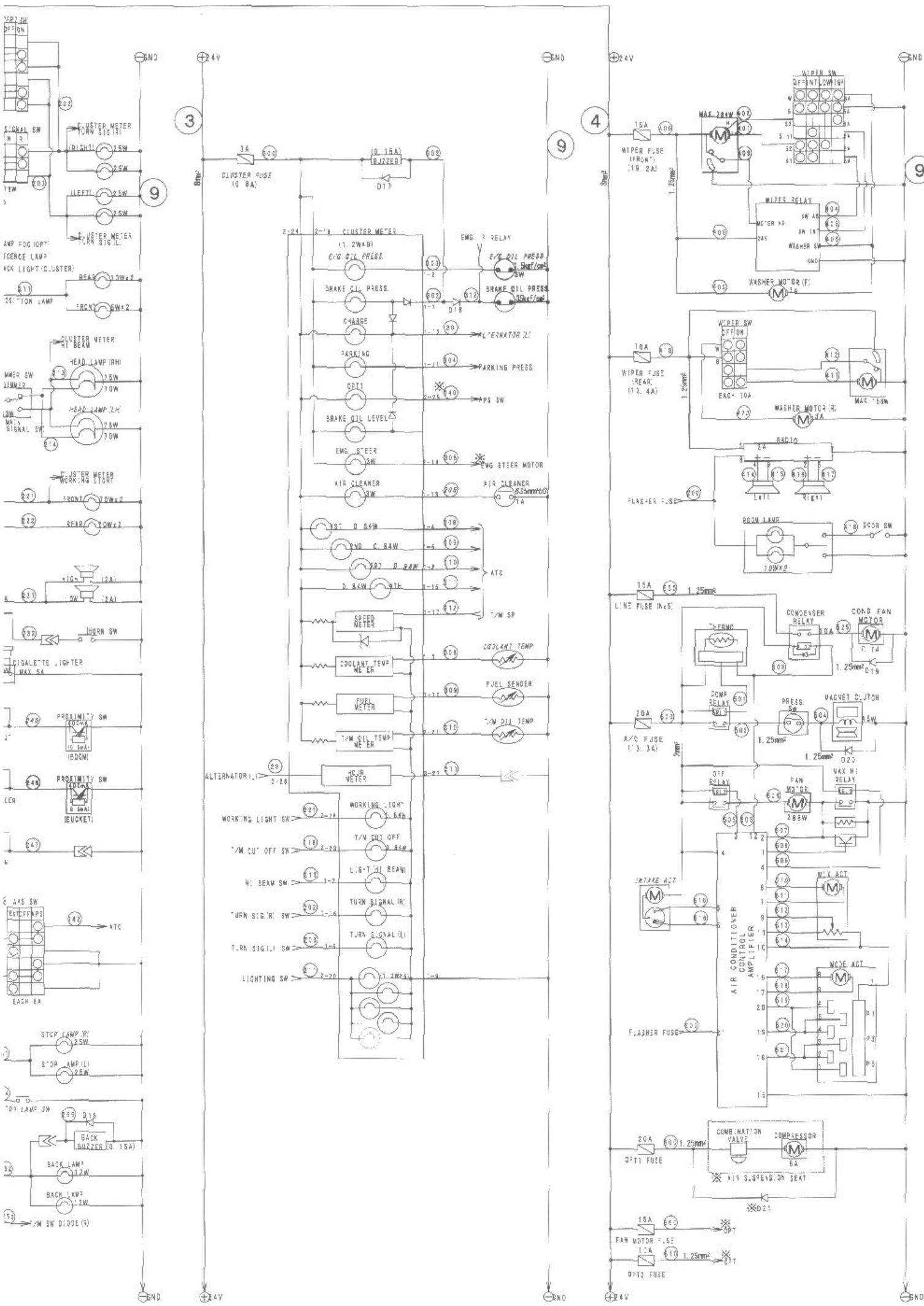


Fig. 8.7 Wiring Diagram (L35-

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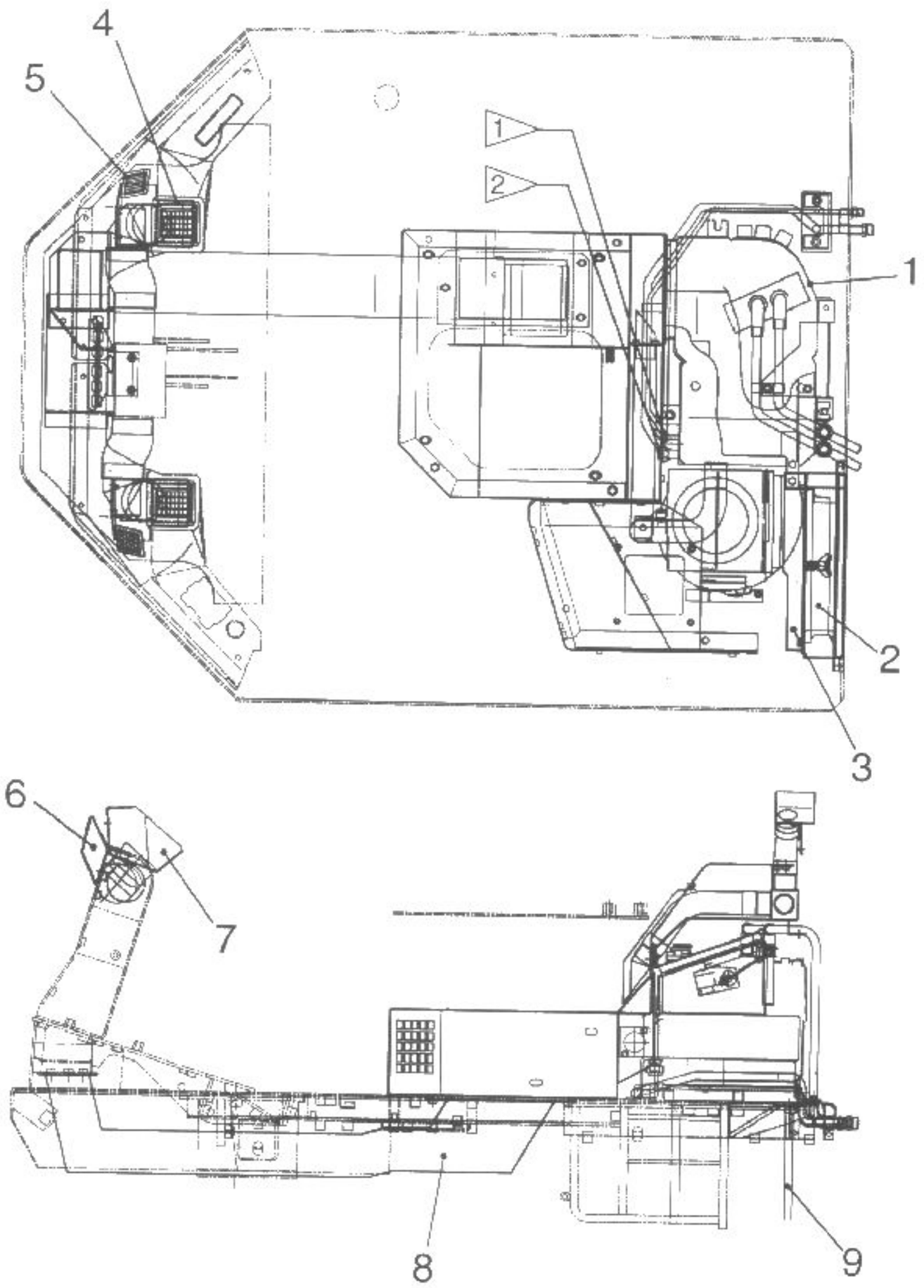


X190-7 · L40-3, LX230-7)

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9. AIR CONDITIONER

Model	AIR CON: WHEEL LOADER (R134a can be used)
Heater	
Heat dissipation	5.49 kW {4725 kcal/h}
Blast volume	400 m^3/h [14126 ft^3/h]
Power consumption	205 W
Cooler	
Cooling capacity	5.35 kW {4600 kcal/h}
Circulation air volume	550 m^3/h [19423 ft^3/h]
Power consumption	325 W
Compressor	
Model	DKS-16H with magnet clutch
Discharge	167 cm^3/ rev [10.2 $in.^3$/rev]



Note: ▷1 15 N-m {1.5 kgf-m} [11 lbf-ft]

▷2 25 N-m {2.5 kgf-m} [18 lbf-ft]

1. AIR CONDITIONER UNIT
2. FILTER
3. DUCT
4. GRILLE
5. GRILLE
6. DUCT
7. DUCT
8. DUCT
9. DRAIN HOSE

Fig. 9.1 Air Conditioner (installed inside the cockpit)

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9.1 GENERAL DESCRIPTION

9.1.1 OPERATING PRINCIPLE

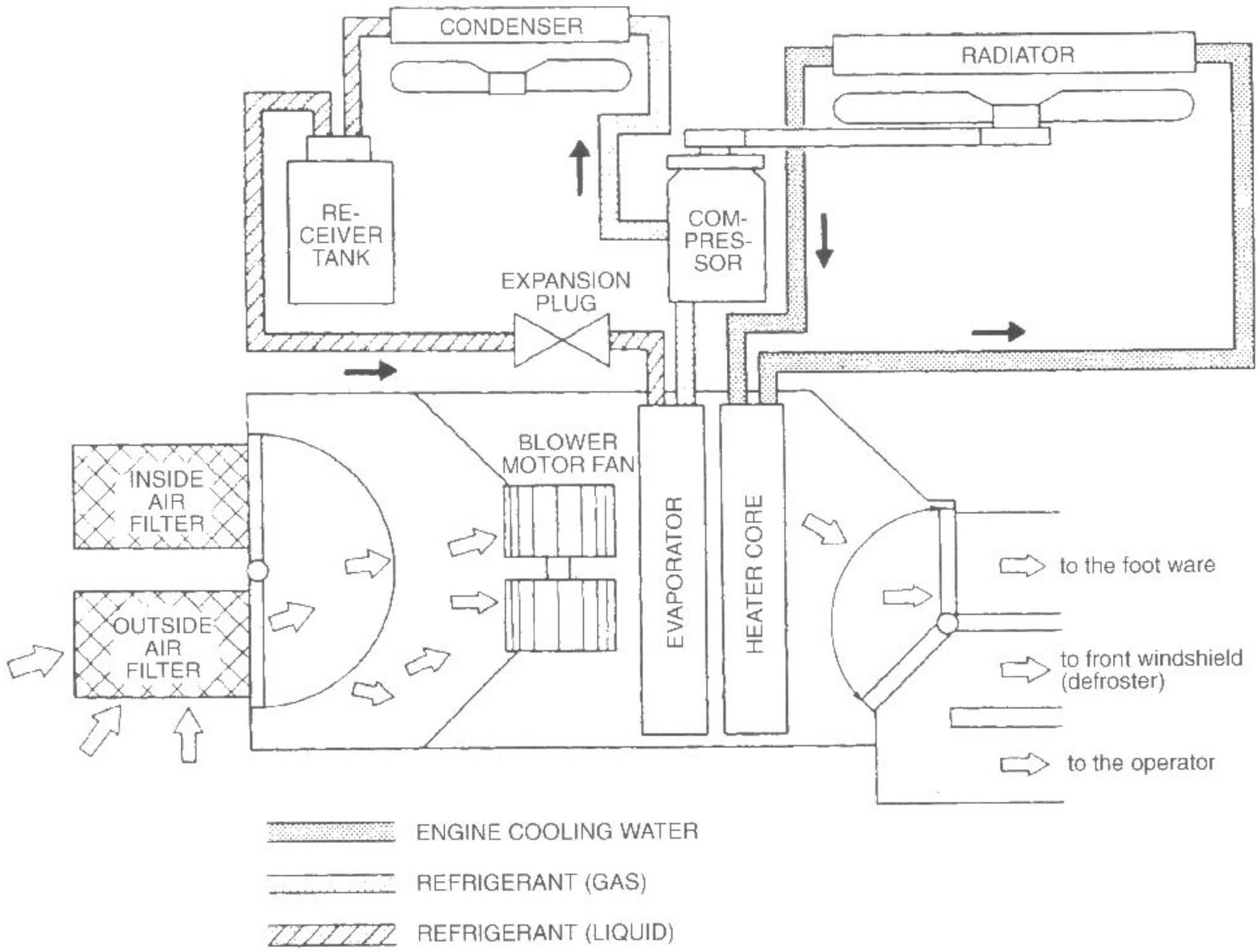


Fig. 9.2 Operating Principle

1. Functional components

(1) Compressor

The compressor re-circulates the refrigerant in the cooling cycle for repeated use and compresses the refrigerant to facilitate liquefaction.

(2) Condenser

The condenser converts the high-temperature, high-pressure gaseous refrigerant which has been compressed by the compressor, into liquid refrigerant through heat exchange with the open air, using the cooling fan.

(3) Receiver tank

The receiver tank temporarily stores the refrigerant liquefied by the condenser in it.

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(4) Expansion plug

The expansion plug injects the high-temperature, high-pressure liquid refrigerant sent from the receiver tank, through small holes to expand it rapidly and make into low-temperature, low-pressure, misty refrigerant. In addition, the expansion plug also adjusts the quantity of the refrigerant to be supplied to the evaporator according to the cooling load.

(5) Evaporator

The evaporator exchanges heat between the misty refrigerant and the air inside the operator's compartment. The misty refrigerant thus vaporizes to cool the air in the operator's compartment.

(6) Heater core

The heater core exchanges heat between heated engine cooling water and the air inside the operator's compartment to heat the air inside the operator's compartment.

2. Heating cycle

The heating cycle is achieved by using the engine cooling water.

High-temperature cooling water is passed into the heater core and hot air is blown out by the fan.

3. Cooling cycle

The cooling cycle is achieved as follows: The refrigerant is recirculated in the cycle to transfer the heat from the low-heat source (the air inside the operator's compartment) to the high-heat source (open air). This method is called the vapor refrigerating system.

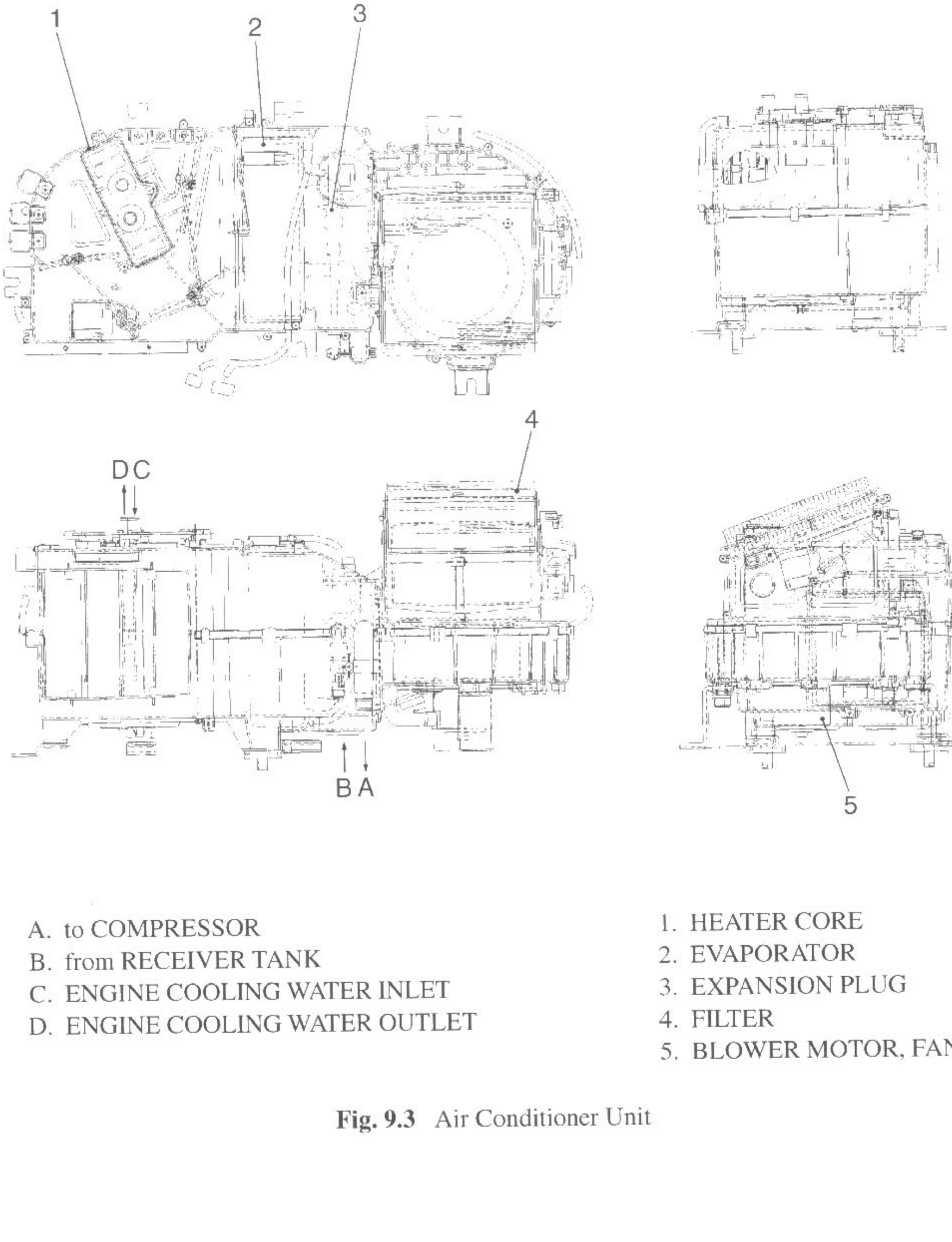
Flow of the refrigerant

① The refrigerant (gas) evaporated by the evaporator is sucked into the compressor where it is compressed into a high-temperature, high-pressure gas.
② The gaseous refrigerant discharged from the compressor flows into the condenser where it is cooled forcefully and liquefied by the condenser.
③ The liquid refrigerant then enters the receiver tank where it is cleared of water content and dust before being sent to the expansion plug.
④ The high-pressure liquid refrigerant is injected through the small holes of the expansion plug so that it expands rapidly to become low-temperature, low-pressure, misty refrigerant before flowing into the evaporator.
⑤ The misty refrigerant deprives the surface of the evaporator pipe of heat to evaporate. At this time, as the air is supplied by the fan, the air is deprived of heat and blown out as cool air. Since the air is cooled rapidly, the water content in the air is condensed to dehumidify the air inside the operator's compartment.
⑥ The refrigerant leaving the evaporator changes into the gas and sucked into the compressor.

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9.1.2 AIR CONDITIONER UNIT

The air conditioner unit consists of the evaporator, heat core, expansion plug, blower motor, and fan.



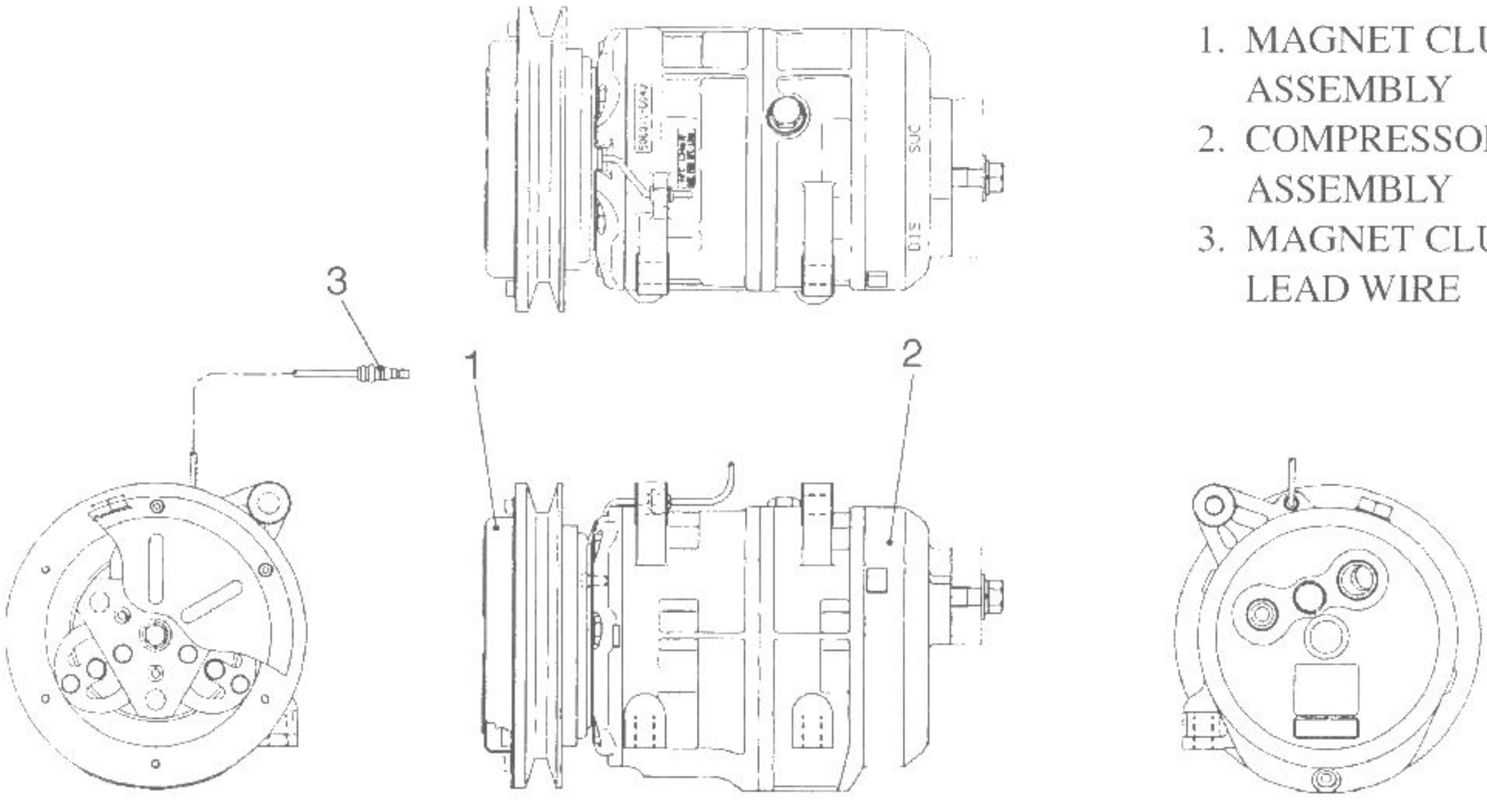
A. to COMPRESSOR
B. from RECEIVER TANK
C. ENGINE COOLING WATER INLET
D. ENGINE COOLING WATER OUTLET

1. HEATER CORE
2. EVAPORATOR
3. EXPANSION PLUG
4. FILTER
5. BLOWER MOTOR, FAN

Fig. 9.3 Air Conditioner Unit

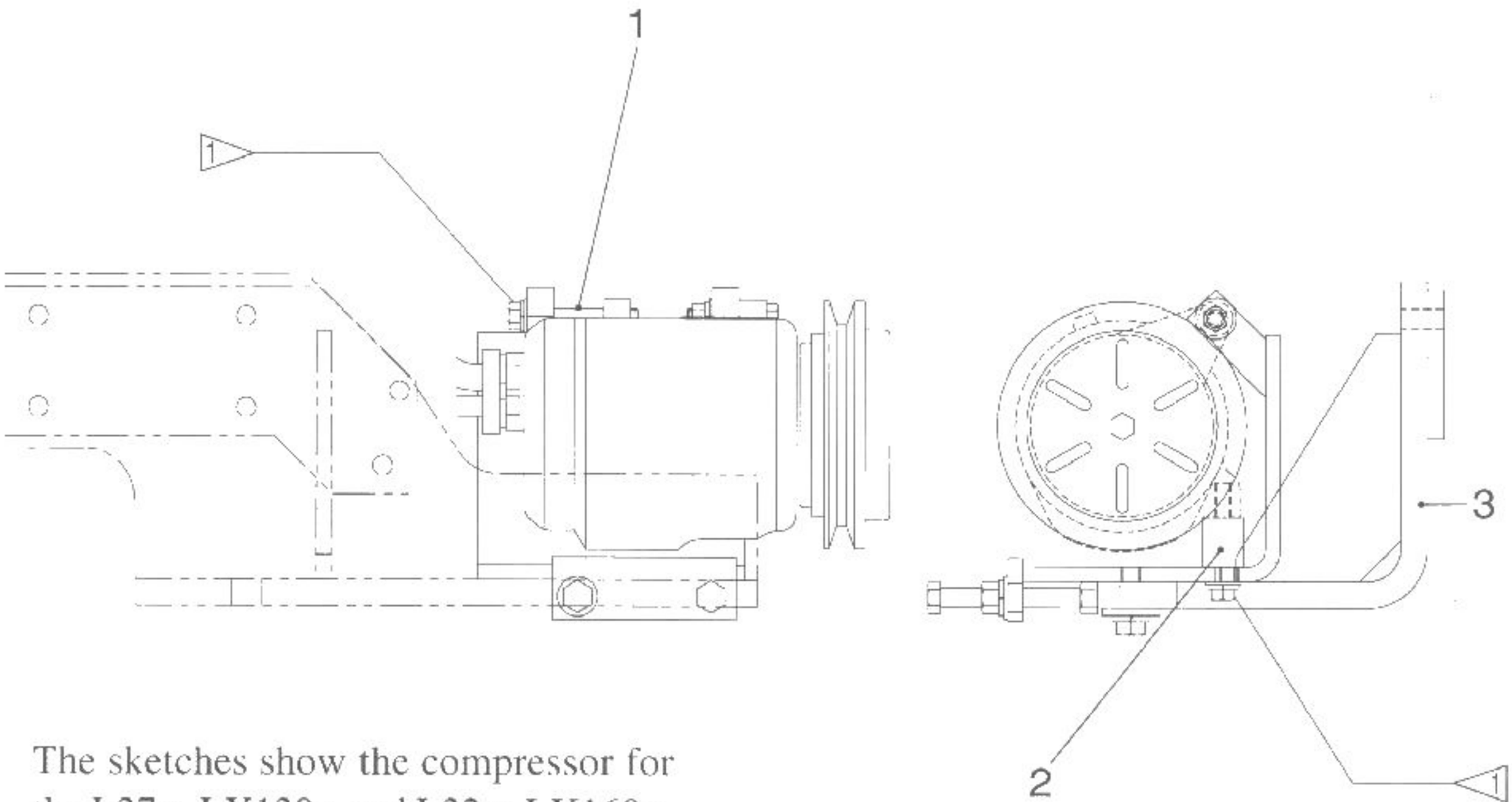
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9.1.3 COMPRESSOR



1. MAGNET CLUTCH ASSEMBLY
2. COMPRESSOR ASSEMBLY
3. MAGNET CLUTCH LEAD WIRE

Fig. 9.4 Compressor



Note: The sketches show the compressor for the L27-3, LX130-7 and L32-3, LX160-7.

Note: 1▷ 27 N-m {2.8 kgf-m} [20 lbf-ft]

1. COLLAR
2. COLLAR
3. BRACKET

Fig. 9.5 Compressor Installation

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9.1.4 RECEIVER TANK

The receiver tank has a strainer and desiccant inside it, to remove dust and water content from the refrigerant during cooling cycle.

The fuse bolt consists of a bolt with a hole at its center and a special type of solder filled in the hole, and acts as a fuse for the electric circuit. If the condenser fails to disperse heat for any reason, the solder will melt in the fuse bolt to discharge the refrigerant into the atmosphere.

The sight glass is used to check the status of the refrigerant.

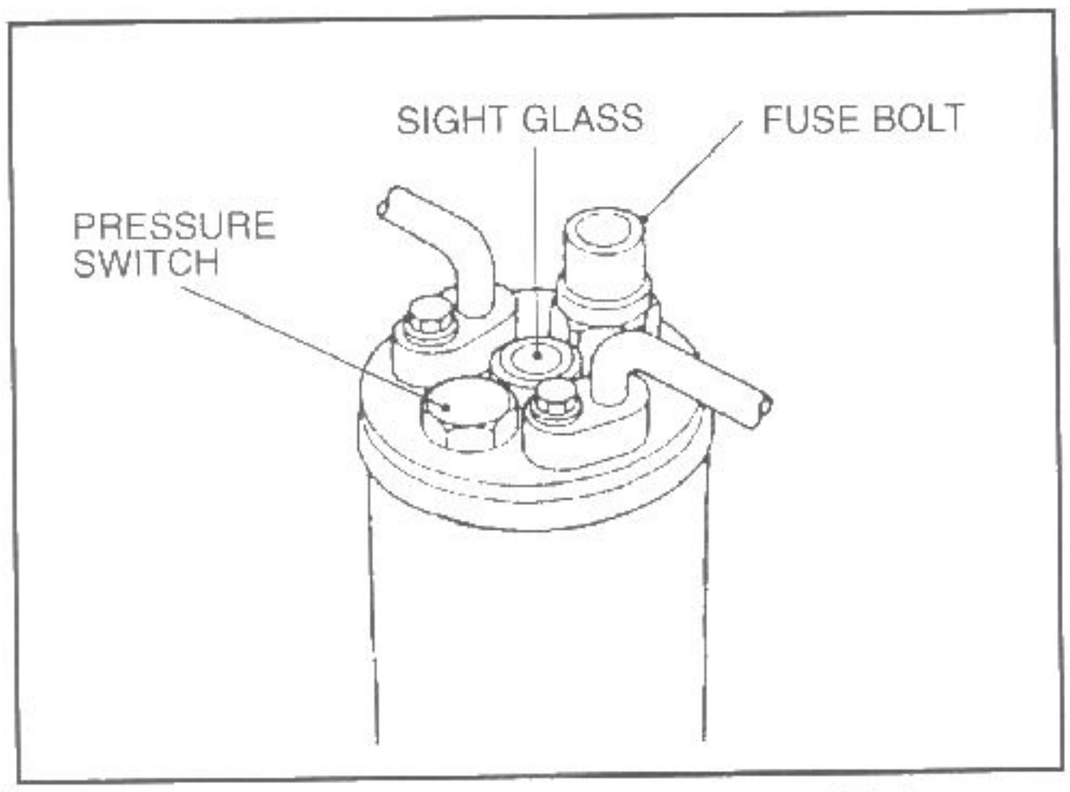
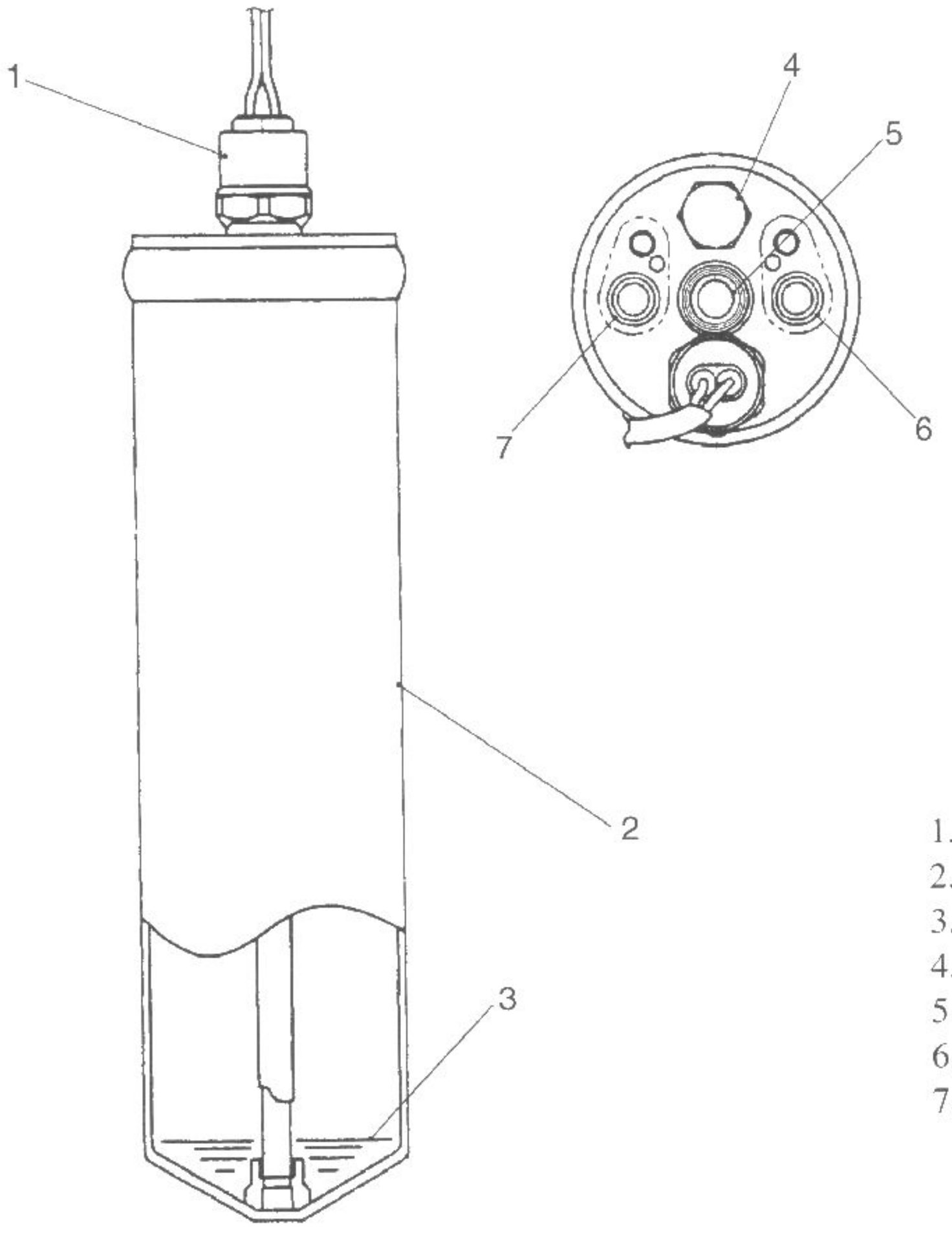


Fig. 9.6 Sight Glass and Fuse Bolt



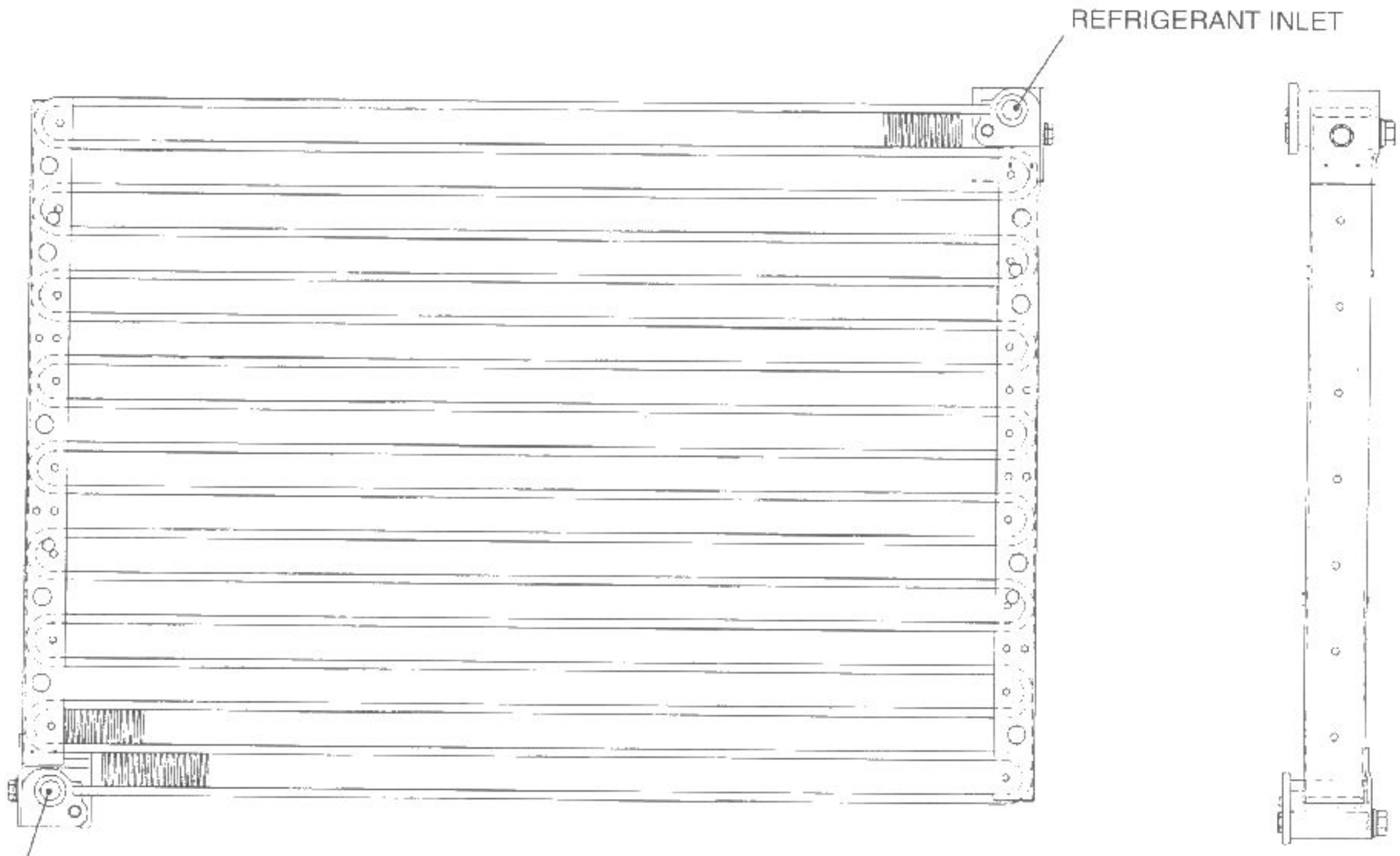
1. PRESSURE SWITCH
2. DRIER
3. OIL
4. FUSE BOLT
5. SIGHT GLASS
6. REFRIGERANT INLET
7. REFRIGERANT OUTLET

Fig. 9.7 Receiver Tank

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9.1.5 CONDENSER

● L27-3, LX130-7 · L32-3, LX160-7



● L35-3, LX190-7 · L40-3, LX230-7

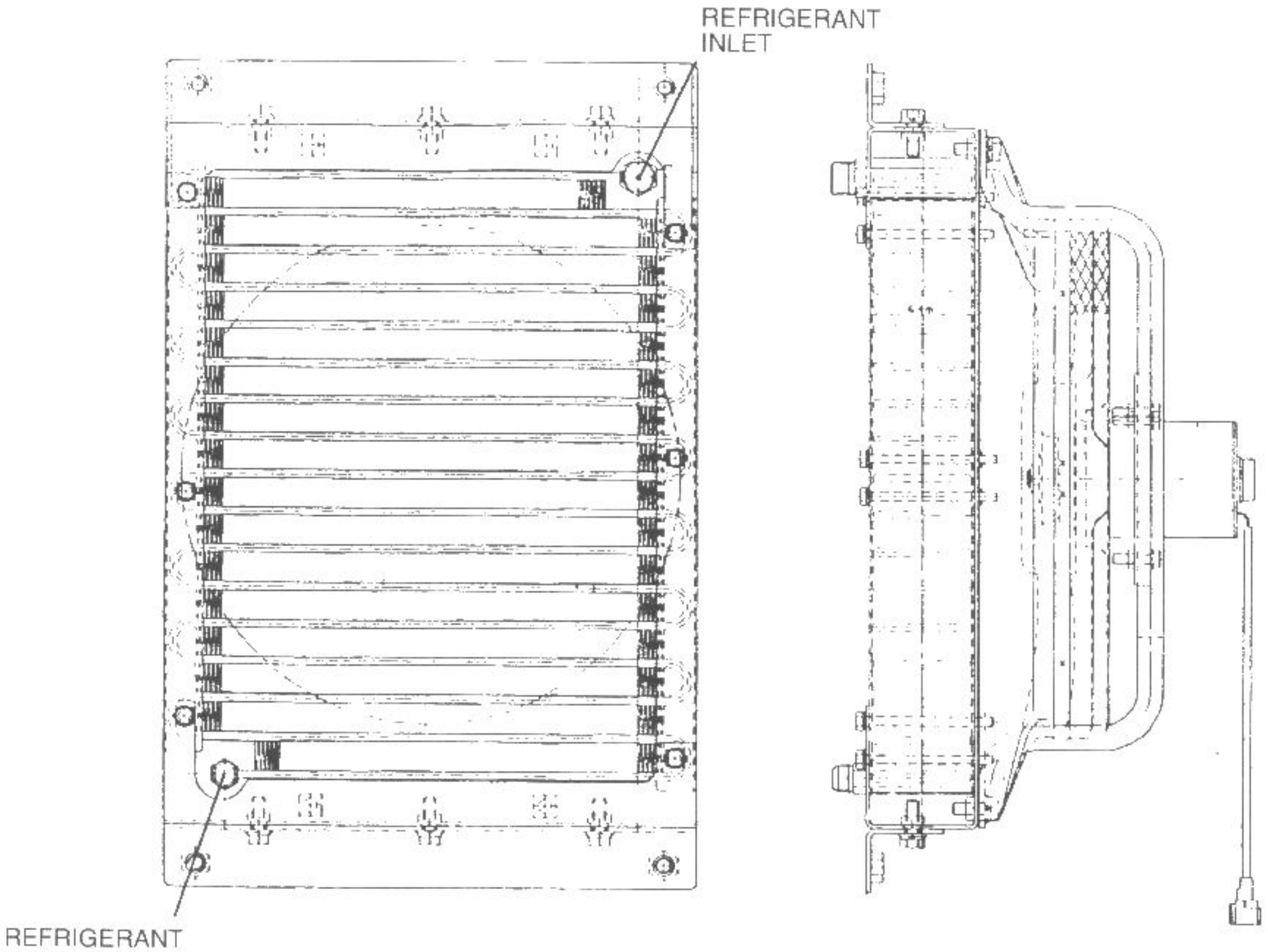
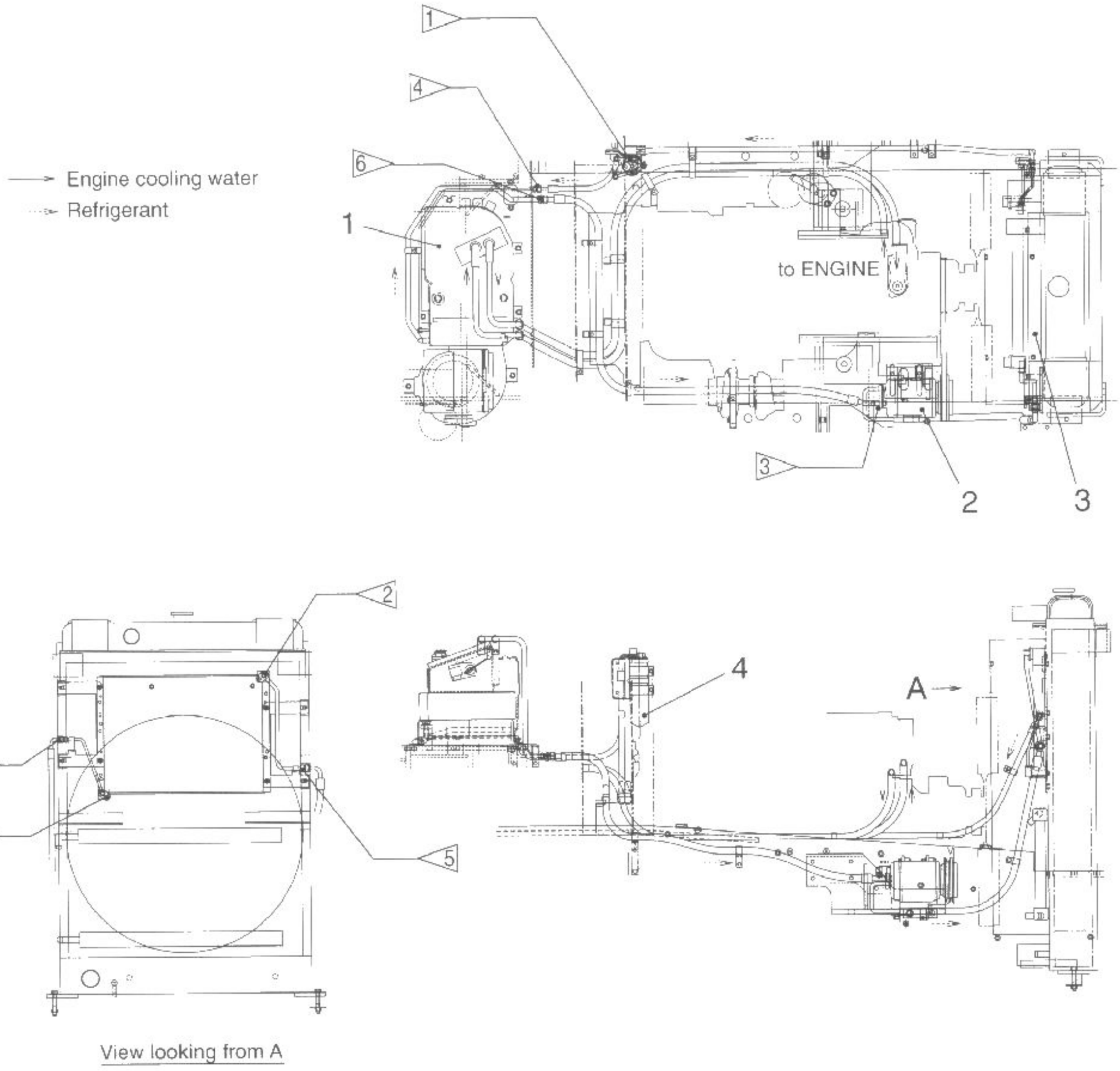


Fig. 9.8 Condenser

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9.1.6 AIR CONDITIONER PIPING

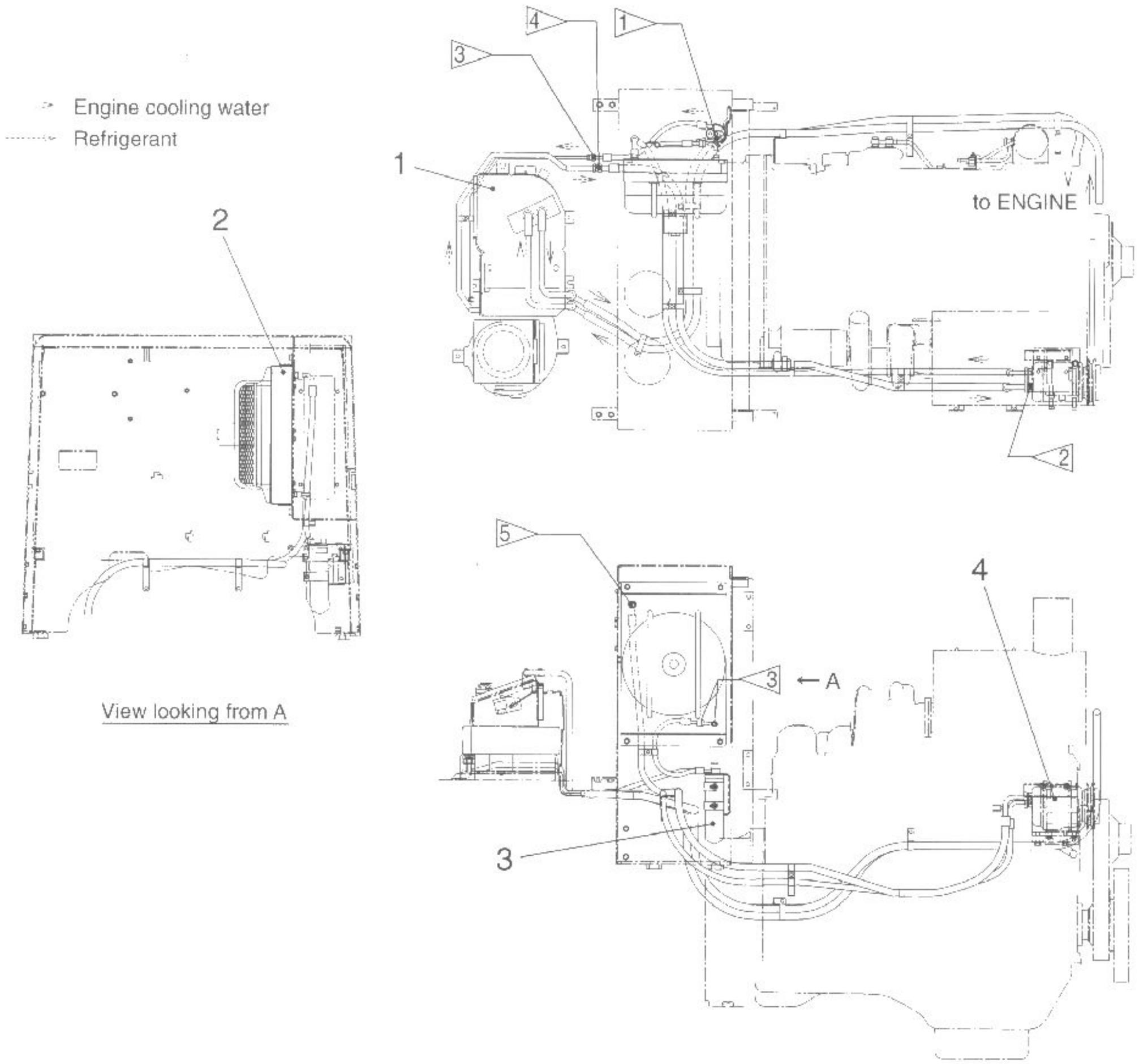


Note:
1. 5.9 N-m {0.6 kgf-m} [4.3 lbf-ft]
2. 13 N-m {1.3 kgf-m} [9.4 lbf-ft]
3. 27 N-m {2.8 kgf-m} [20 lbf-ft]
4. 15 N-m {1.5 kgf-m} [11 lbf-ft]
5. 20 N-m {2.0 kgf-m} [14 lbf-ft]
6. 25 N-m {2.5 kgf-m} [18 lbf-ft]

1. AIR CONDITIONER UNIT
2. COMPRESSOR
3. CONDENSER
4. RECEIVER TANK

Fig. 9.9 Air Conditioner Piping (L27-3, LX130-7 · L32-3, LX160-7)

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Note:
- 1 ▷ 5.9 N-m {0.6 kgf-m} [4.3 lbf-ft]
- 2 ▷ 27 N-m {2.8 kgf-m} [20 lbf-ft]
- 3 ▷ 15 N-m {1.5 kgf-m} [11 lbf-ft]
- 4 ▷ 25 N-m {2.5 kgf-m} [18 lbf-ft]
- 5 ▷ 20 N-m {2.0 kgf-m} [14 lbf-ft]

1. AIR CONDITIONER UNIT
2. CONDENSER
3. RECEIVER TANK
4. COMPRESSOR

Fig. 9.10 Air Conditioner Piping (L35-3, LX190-7 · L40-3, LX230-7)

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NOTE

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INTERNATIONAL MARKETING DIVISION: 1-15-5, Nishi-shimbashi, Minato-ku, Tokyo
105-0003, Japan
FAX: JAPAN +81-3-35918152, 3-35918153

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