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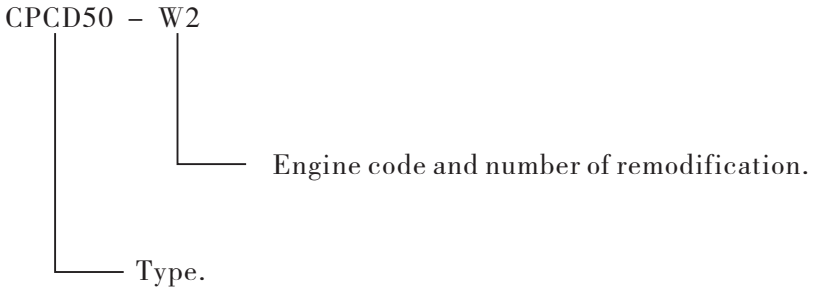
FOREWORD

This manual accounts for "HELI" Forklift Truck in H2000 series from 5t to 10t, includes its performance, constructure, safe operation and regular preventive maintenance, so that operators, mechanics and supervisors of Forklift Truck correctly operate and prevent maintenance. Read and understand this manual before operating your lift truck! This manual is your guide to safe operation and regular preventive maintenance. So as to let the Forklift Truck keep good working conditions.

If any operation or maintenance does't accord with requires in this manual, our related promises is inefficacy.

Due to continuous improvements in design, it is possible that the latest description contained herein may differ slightly from the truck delivered to you. Moreover, the specification of the forklift truck may be changed insignificantly depending on its destination.

Notice:Designations in the CATALOGUE are difference from those in product nameplates and quaulifying licenses.Designations in the CATALOGUE include engine code and number of remodification.



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Ⅰ. Safety rules for Operation and Daily Maintenance of Forklift Truck

It is important that driver and manager for forklift trucks remember the principle of the "first safety" and ensure the safety operation as the description in《OPERATION AND SERVICE MANUAL》.

1. Delivery of Forklift Truck

It must be pay attention to the following items when you delive forklift trucks with container or trucks.

(1) Apply the parking brake.

(2) Fix the mast and the balanceweight with steel wire.Wedge up all wheels.

(3) Sling points should be always at the positions specified in sling index plate when hoisting up the forklift truck.

2. Storage of Forklift Truck

(1) Drain off fuel completely. Don't drain off the cooling water containing antifreeze and rustproof agent.

(2) Apply antirust to the surface of the parts not painted. Apply lubrication oil to the lift chain.

(3) Lowing the mast to the lowest position.

(4) Apply the parking brake.

(5) Wedged up the wheels.

3. Precautions Before Operation

(1) Don't check fuel leakage and lever or instruments at the place there is open flame. Never fill the fuel tank with the engine running.

(2) Check the tire inflation pressure.

(3) The forward–reverse lever should be in neutral.

(4) Never smoke while the fuel system is under working or the battery is inspected.

(5) Check all the levers and pedals.

(6) Complete the provisions before starting.

(7) Release the parking lever.

(8) Make trying opteration of the mast for lifting, lowing and Fwd/Bwd tilting and the truck for steering and braking.

4. Operation of Forklift Truck

(1) Only trained and authorized operator shall be permitted to operate the truck.

(2) Wear all the safety guards, such as shoes, helmet, clothing and gloves while operating the truck.

(3) Check all the control and warning devices before starting the truck. If any damages or defects are found, operate it after repairing.

(4) Overload or overload operation is strictly prohibited. The fork should insert

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completely under the cargo and make the cargo placed on it evenly. Do not raise an object with one fork end.

(5) The starting, turning, driving, braking and stopping operation of the truck should be done smoothly. When steering on the humid or low friction road, the truck should be decelerated.

(6) Travel with loads as low as possible and tilted backward.

(7) Be careful when traveling on a slope. When climbing grades with a slope of more than 10%, the truck should forward travel, and when descending so grades, backward travel. Never turning on a slope. Avoid loading and unloading operation when decending.

(8) Pay attention to pedestrian, obstacle and bumpy road when driving. Pay attention to the clearance over forklift truck.

(9) Never allow any persons to stand on the forks or the truck to carry persons.

(10) Never permit anyone to stand or walk under upraised forks.

(11) Don’t operate truck and attachment of it at any position out of the drive seat.

(12) On the high lift forklift truck, when the lift high more than 3m, it is noted that the goods on it should not fall down or the protection measures must be taken if necessary.

(13) Tilt the mast of the high lift forklift truck as backward as possible while the truck working. Use minimum forward tilt angle and Min. reverse tilt when loading and unloading.

(14) Be careful and slowly driving over a dockboard or bridge-plate.

(15) Shut down the engine and don’t stay on the truck when filling fuel. Don’t ignite the engine while checking battery or fuel lever.

(16) The unloaded forklift truck with attachments should be operated as a loaded truck.

(17) Don’t handle unfixed stacked goods.Be careful to bulky goods to be handled.

(18) If leaving the truck, lower the forks on the ground and let the shift lever to neutral, shut down the engine or cut down electric supply. If parking on a slope is unavoidable, apply the parking brake and block the wheels.

(19) Don’t open the radiator cap when the engine is worm.

(20) Don’t adjust the control valve and relief valve at will to prevent the damage of hydraulic system and its components because of excessive pressure passing them.

(21) According to the measure method specified in JB/T3300,max.noise at the outboard of the truck should be not more than 89dB(A).

(22) Notice and be familiar with all kinds of decal’s function.

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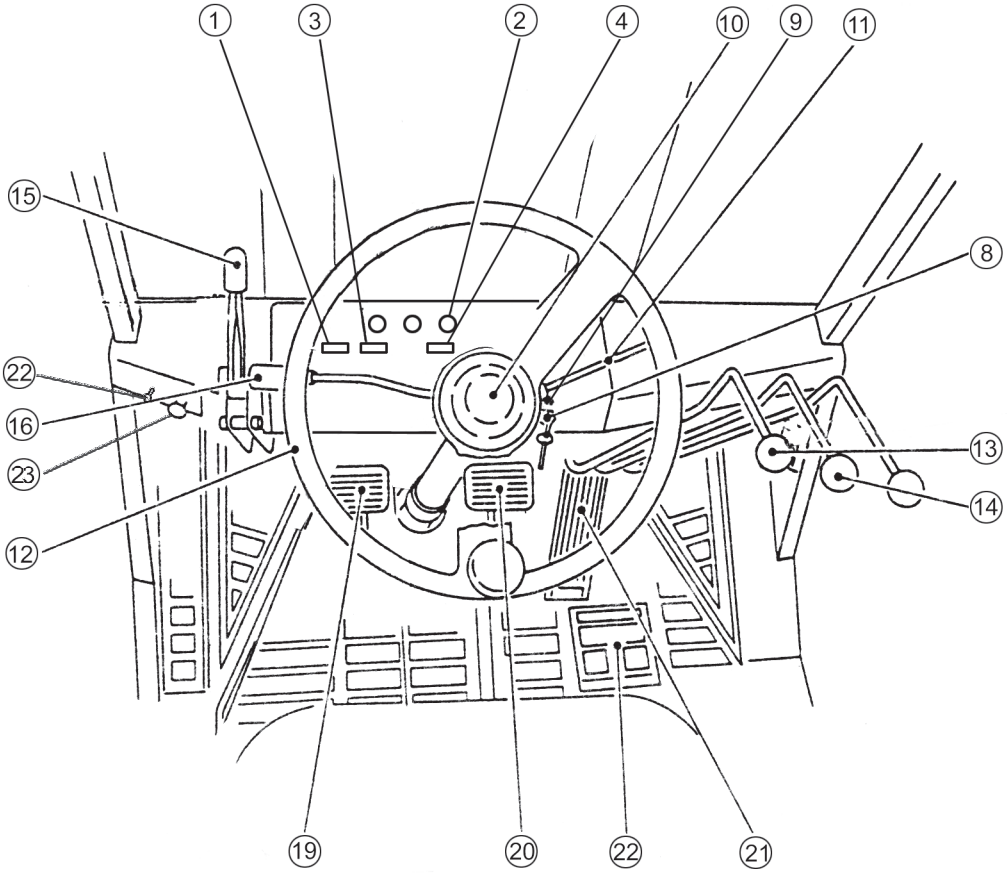
5. Arrangement sketch of instruments and controls



1. Fuel gauge
2. Monitor
3. Water temp.meter
4. Hour meter
5. Ignition switch
6. Lamp switch
7. Horn button
8. Turn signal switch
9. Steering handwheel
13. Lift lever
14. Tilt lever
15. Parking brake lever
16. Forward–reverse lever
17. Inching pedal
20. Brake pedal
21. Accelerator pedal
22. Cable of cover
23. Cable of extinguish

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6. Daily maintenance of forklift truck

6.1 Caution for starting

(1) The amount of hydraulic oil:The oil level should be at the middle position between the upper and lower scale marks of oil level meter.

(2) Check if any leak or damage found on the piping joints,pumps and valves.

(3) Check the travelling brakes:

A) The free travel of brake pedal should be within the range of 40mm.

B) The clearance between the front floor and the pedal should be bigger than 20mm.

(4) Often check the parking brake.The laden truck can park on the 20% grade ramp,when the parking lever is pulled to the bottom.

(5) Check the meters,lights,switches and electric wirings to see if they are properly in operation or not.

6.2 Fuel and lubrication used in forklift truck.

Name		Brand and temp. of using				
Gasoline		93# or 97#				
Diesel		Brand(diesel)	0#	−10#	−20#	−35#
		Temp. of using	⩾4	⩾−5	⩾−5~−14	⩾−14~−29
Gear oil (gasoline,SF) Electric injection(SG)	Chang cheng	Sticky grade	5W/30	10W/40	10W/30	15W/40
		Temp. of using	−30 ~ +30	−25~+40	−25~+30	−20~+40
Gear oil (diesel,CD)	Chang cheng	Sticky grade	5W/30	10W/30	15W/40	20W/50
		Temp.of using	−30 ~ +30	−25~+30	−20~+40	−15~+50
Hydraulic oil	Chang cheng	Sticky grade	L−HM32 wearable hydraulic oil		L−HV32 low temp. wearable oil	
		Temp. of using	⩾−5		⩾−20(cold region)	
Torque converter oil	Hai pai	6# Tor−con oil				
Brake fluid	Chong qing yi ping	4604 compound brake fluid GB12981 HZY4				
Lubricating oil	Hai pai	3# lithium base grease(−20℃~+120℃)				
Gear oil of heavy−laden vehicle	Hai pai	Sticky grade	85W/90GL−5		80W/90GL−5	
		Temp. of using	−15 ~ +49		−25~+49	
Antifreeze fluid	Jin bai	Number	FD−1	FD−2	FD−2A	FD−3
		Temp. of using	⩾−25	⩾−35	⩾−45	⩾−50

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6.3 Cautions on cooling system

(1) During operation, if the radiator of forklift "boils" or the temperature of cooling liquid is too high, do not open the cover of radiator immediately. If the cover needs to be removed to find out the cause for it, reduce the rotational speed of engine to the moderate, slowly rotate the cover and not remove it very soon so as to prevent operators from being scalded by the splashing liquid. When recovering the radiator, it must be screwed tightly, otherwise, the system may not be well enclosed and the system pressure stipulated cannot be formed.

(2) There is a compensation can on the left of engine.The letter" FULL" and "LOW" are marked on the upper and lower of the can wall.Correct antifreeze agent level should be between letters. Antifreeze liquid of same type should be replenished after the liquid leaks or evaporates. which is not changed around the year, regardless of summer or winter. Generally, after being used for one year, it should be let out for filtration and purification and then put to use again.

(3) Based on different working conditions, regularly clean the outer surface of the radiator with detergent, compressed air or high-pressure water (no high than $4kg/cm^2$).

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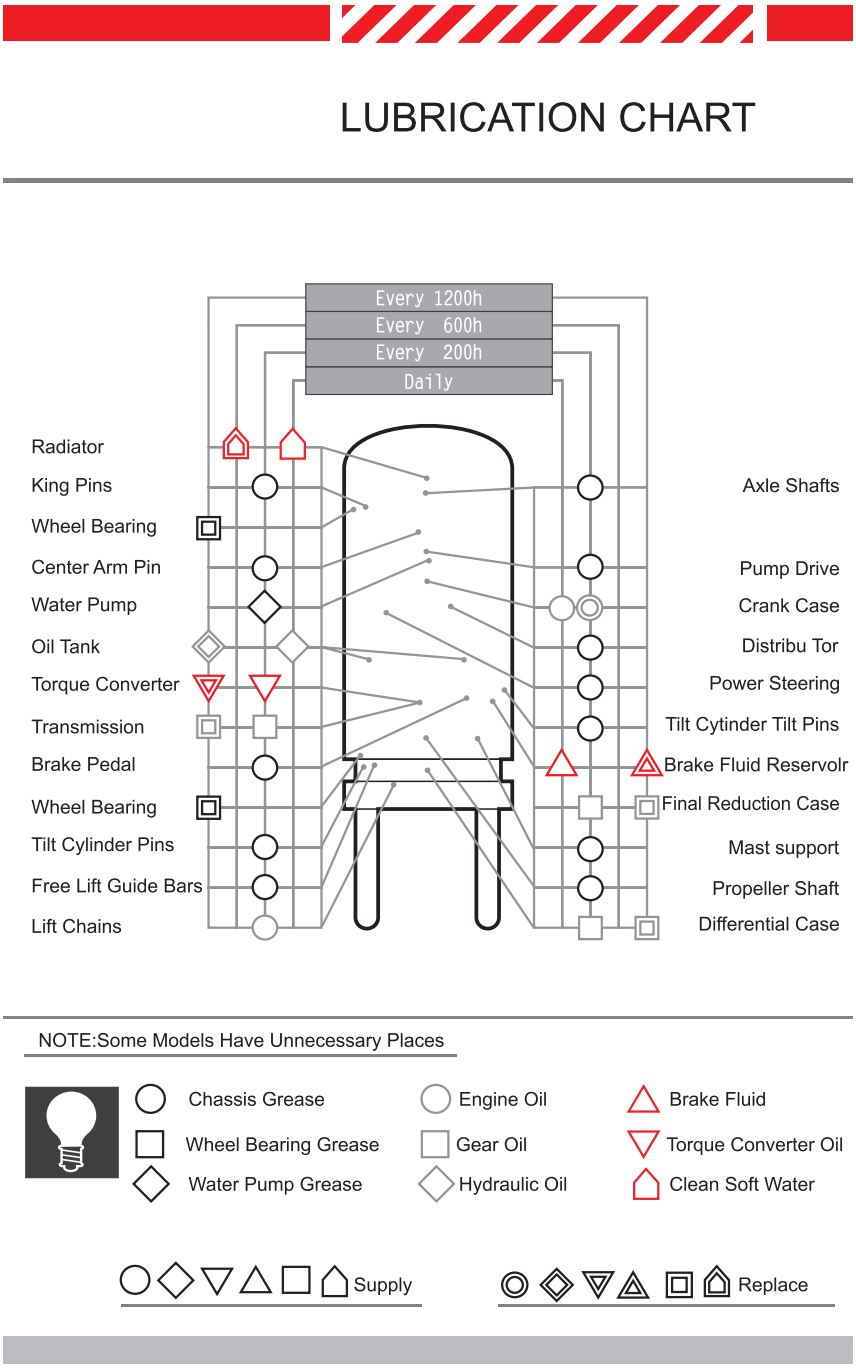
6.4 Lubrication system table



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Ⅱ. Primary Technic Parameter of Forklift

			5t	6t	7t	8t	10t
Rated load		kg	5000	6000	7000	8000	10000
Load center		mm	600				
Max.lift height(STD.)B			3000				
Free lift height(STD.)E			195	200	205	200	210
Tilt angle Y/Y			6 /12				
Min. turning radius W		mm	3250	3300	3370	3700	3900
Min.intersecting aisle X			2960	3000	3040	3310	3540
Min.under clearance G			200			250	245
Wheelbase L			2250			2500	2800
Tread Fwd/bwd S/T			1470/1700			1600/1700	
Overhang Fwd/bwd K/M			590/600	590/675	590/740	700/740	718/740
Overall length H			4660	4735	4800	5160	5480
Overall width Q			1995			2165	2245
Overall height	Mast C		2500		2625	2700	2850
	Overhead guard P		2450			2585	
Height as fork lifting (With backrest) A			4420				4330
Fork	Length J		1220				
	Width(U) thickness(F)		150X55	150X60	150X65	170X70	175X80
Fork adjustable space (outsides of fork) R			300~1700			340~1944	410~2140
Truck weight		kg	7980	8640	9350	10960	12510
Axle load	Loaden (fwd/bwd)		11660/1320	13050/1590	14570/1780	17000/1950	20380/2130
	Unloaden (fwd/bwd)		4010/3970	3880/4760	3860/5490	4840/6120	5700/6810
Tyre	Front 4		8.25–15–14PR			9.00–20–14PR	
	Rear 2		8.25–15–14PR			9.00–20–14PR	
Battery (voltage/capacity)		V/Ah	24/80				

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Item		Unit	CPCD50-WX	CPCD60-WX	CPCD70-WX	CPCD50-C10	CPCD60-C10
Max.rated		kg	5000	6000	7000	5000	6000
Load center		mm	600				
Max.lift height			3000				
Free lift height			205				
Tilt angle Fwd/Bwd		deg	6 /12				
Wheel base		mm	2250				
Tread	Front		1470				
	Rear		1700				
Truck weight (With water and oil)		kg	7980	8640	9350	8640	
Overall width		mm	1995				
Overall height	At mast		2500				
Overall length			4660	4735	4800	4802	
Min. under clearance			200				
Min. turning radius			3250	3300	3370	3250	
Max.traveling speed laden/unladen		Km/h	29/32			26/28	
Lift speed	Laden	mm/s	400	400	300	430	
	Unladen		410	410	410	500	
Max.traction force	Laden	kn	42		41	54	
	Unladen		22				
Gradeability laden			25%	22%	20%	15%	
Tyre	Front 4		8.25-15-14PR			8.25-20-14PR	
	Rear 2		8.25-15-14PR				

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Item		Unit	CPCD50–CU1	CPCD60–CU1	CPCD70–CU1	CPCD80–CU	CPCD100–CU
Max.rated		kg	5000	6000	7000	8000	10000
Load center		mm	600				
Max.lift height			3000				
Free lift height			205				
Tilt angle Fwd/Bwd		deg	6 /12				
Wheel base		mm	2250			2500	2800
Tread	Front		1470			1600	
	Rear		1700			1700	
Truck weight (With water and oil)		kg	7980	8640	9350	10960	12510
Overall width		mm	1995			2245	
Overall height	At mast		2500			2700	2850
Overall length			4660	4735	4800	5160	5480
Min. under clearance			200			245	
Min. turning radius			3250	3300	3370	3700	3900
Max.traveling speed laden/unladen		Km/h	26/30				
Lift speed	Laden	mm/s	370	350	285	440	360
	Unladen		400		300	470	380
Max.traction force	Laden	kn	42	40	40	60	58
	Unladen		22		22	27	31
Gradeability laden			23%	20%	20%	27%	22%
Tyre	Front 4		8.25–15–14PR			9.00–20–14PR	
	Rear 2		8.25–15–14PR			9.00–20–14PR	

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Item \ Model			CPCD50~70-W2	CPCD50~70-C6	CPCD50~70-Xs	CPCD50~60-WF2
Engine	Type		ISUZU (diesel) A-6BG1QC	Chaoyang (diesel) 6102BG	Komatsu(diesel) S4D95LE	Weifang (diesel) R4105G32
	Cyl.Number-Bore stroke	mm	6-105 125	6-102 118	4-95 115	4-105 125
	Rated output/speed	Kw/rpm	82.3/2000	81/2500	61/2400	59/2400
	Max.torque/speed	Nm/rpm	416/1400~1600	353/1650	291/1600	270/1400~1600
	Min.fuel consumption	G/kwh	233	231	221.5	243
2-Speed gear Fwd/Bwd			Power shift			
Brake			Power brake	Vacuum assistant or power brake	Power brake	Vacuum assistant
Lifting speed laden/unladen		mm/s	500/550 460/500	460/600 400/600	370/550 350/500 300/380	330/480
Max.travel speed laden/unladen		Km/h	26/30	26/28	24/28	26/30
Max.gradeability		%	35/19 32/19 30/19	20/15	22/20	26/23 22/20
Max.traction force(laden)		kn	54 53	53 52	42 44 41	41.45

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Item \ Model			CPCD80–W4	CPCD100–W4	CPCD80–C3	CPCD100–C3
Engine	Type		ISUZU(diesel) A–6BG1QC		Chaoyang (diesel) 6102BG	
	Cyl.Number–Bore stroke	mm	6–105 125		4–102 118	
	Rated output/speed	Kw/rpm	82.3/2000		81/2500	
	Max.torque/speed	Nm/rpm	416/1400~1600		353/1650	
	Min.fuel consumption	G/kwh	233		231	
2–Speed gear Fwd/Bwd			Power shift			
Brake			Power brake–pedal brake			
Lifting speed laden/unladen		mm/s	380/410	310/350	390/480	310/390
Max.travel speed laden/unladen		Km/h	26/30			
Max.gradeability		%	21/21		21/21	20/15
Max.traction force(laden)		kn	63.2	58	51	57

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Specification		Unit	CPCD50~70–WX	CPCD50~60–C10
Model			CA4110	6102GB–A6B
Type			In line 4–cylinder, 4–cycle, water–cooled, direct injection	In line 6–cylinder, 4–cycle,water–cooled, direct injection
Cyl.Number–Bore Stroke		mm	4–110 125	6–102 118
Total displacement		l	4.752	6.494
Compression Ratio			17:1	17
Engine	Rated speed	R/min	2300	2200
	Rated output	kw	64	73
	Max.torque	Nm/rpm	305/1400~1600	353/1650
	Max.speed (unladen)	rpm	2530	
	Min.speed(unladen)	rpm	700	
	Min.fuel consumption (laden)	G/kwh	230	

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Specification		Unit	CPCD50~70–CU1	CPCD80~100–CU
Model			B3.3–C80	4BTAA3.9–C110
Type			In line 4–cylinder,4–cycle,water–cooled, direct injection	
Cyl.Number–Bore Stroke		mm	4–95 115	4–102 120
Total displacement		l	3.26	3.9
Compression Ratio			17.5:1	18:1
Engine	Rated speed	R/min	2200	2200
	Rated output	kw	60	82
	Max.torque	Nm/rpm	291/1600	468/1500
	Max.speed (unladen)	rpm	2450	2450
	Min.speed(unladen)	rpm	800	850
	Min.fuel consumption (laden)	G/kwh	217	216

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Ⅲ. Primary Assembly of Forklift Truck

Primary Assembly of Forklift Truck

No.	Name	Contents
01	Engine System	Includes engine mounting,fuel system,exhaust system, cooling system(torque converter pipelines)etc.
02	Transmission System	Includes transmission, tor–con, transmission shaft control linkages etc.
03	Drive Axle	Includes axle house, half shafts, differential, hub reduction, brake, front wheel etc.
04	Steering System	Includes powered steering unit, redirector etc.
05	Steering Axle	Includes axle box, steering cylinder,rear wheel etc.
06	Hoist System	Includes outer & inner mast, lift bracket, backrest, fork, tilt cylinder, lift cylinder, end roller, side roller, sheave, chain etc.
07	Frame System	Includes frame, cabinet,tank in frame, hood, floor, counterweight, seat,cover of radiator etc.
08	Operation system	Includes operation series of brake & inching control, parking brake and accelerator etc.
09	Hydraulic system	Includes pump,valve,high & low pressure oil pipe, connecter,etc.
10	Electric system	Includes lights,battery,instruments harness,meter etc.
11	Overhead guard	Overhead guard(cab is option)

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Ⅳ. The structure, principle, adjustment and maintenance of forklift

1. Dynamic system

(1) Brief introduction

The dynamic system includes the engine, air inlet system, cooling system and exhaust system, etc. The engine is linked to transmission device. The holder of engine is connected with the frame of the forklift through a rubber cushion to reduce vibration. The engine is connected to the tor-con,the transmission,transmission shaft and drive axle,see following figure:

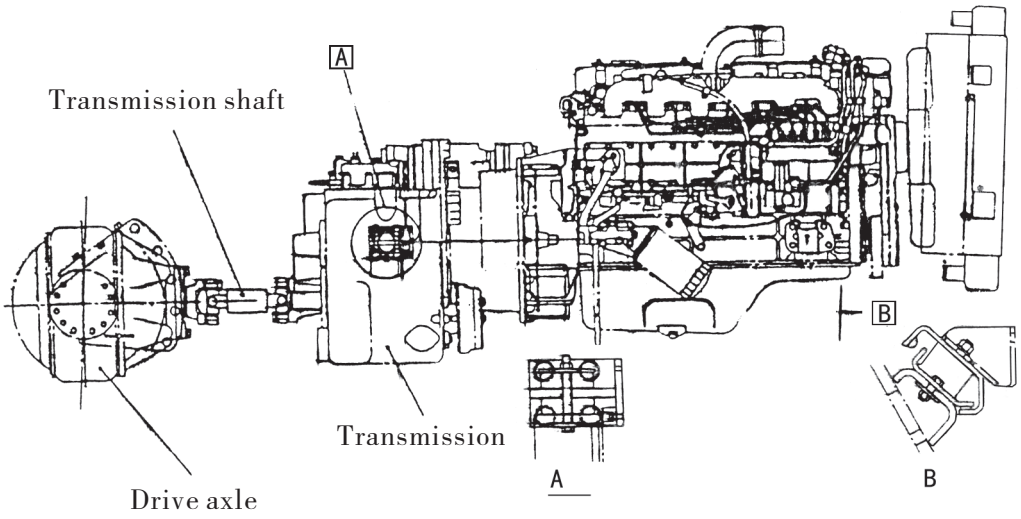

Fig.1.1 Engine mounted

(2) The engine and its accessories

The power of 5-7t forklift truck is provided by diesel engine ISUZU (6BG1),KOMATSU(S4D95LE) imported from Japan. The homeland diesel engine includes Chaoyang(6102GB7),Weifang(R4105G32).

The power of 8-10t forklift truck is provided by diesel engine ISUZU (6BG1), imported from Japan. The homeland diesel engine includes Chaoyang(6102GB7). Refer to relevant manual for the details of operation and maintenances for the engine. The structure figure of ISUZU(6BG1) engine as following:

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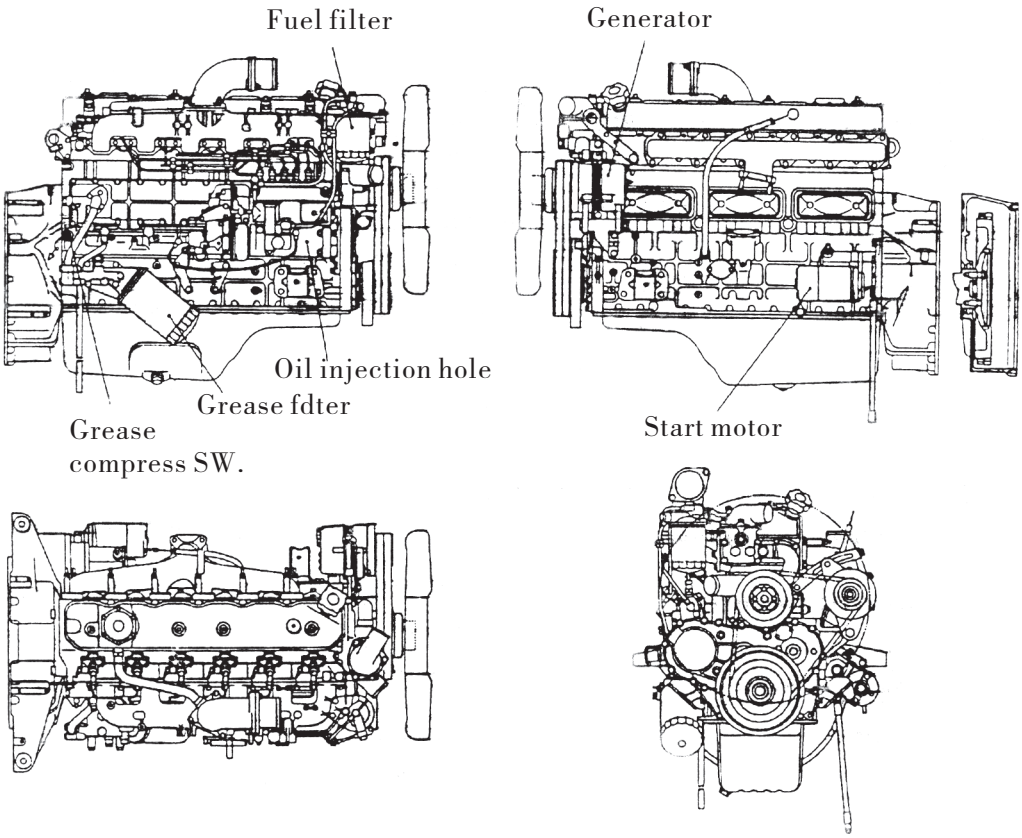

Fig.1.2 A–6BG1QC diesel engine

Name	A6BG1QC
Type	4–cycle,water–cooled, in line,overhead valve system
Cyl.number–bore stroke	6–105mm 125mm
Total displacement (L)	6.494
Compression ratio	17
Performance	
Rated speed (rpm)	2000
Rated output (kw)	82.3
Max.torque (N–m/rpm)	416/1400–1600
Full–load fuel rate (g/kwh)	233
Idle(rpm)	700
Weight(kg)	450
Measure(mm)	1129.5 672.0 860.0
Ignition order	1–5–3–6–2–4
Rotating direction	Clockwise

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Valve device	Overhead
Fuel device	
Injection pump	Boshing
Plunger piston radiu stroke	9.5mm 8mm
Injection nozzle	Porous type
Oil pump	Plunger piston type
Fuel filter	Paper filter core
Governor	
Governing method	Centrifugal,all-speed control
Lubricating method	Forced lubrication
Lubricating device	
Pump type	Gear pump
Driving method	Camshaft drive
Hydraulic regulator	Piston spring type
Oil pressure indicator	Switch type
Filting method	Full-fluid,filter-paper
Radiator	Water cooling,inner store type
Cooling device	
Cooling method	Water cooling
Cooling fan	Outside radiu 550mm,7-blade,pusher type
Drive method	Belt driving
Pump type	Vortex type
Driving method	Belt driving
Water temp.regulator	Wax pellet type
Water temp.regulator,open temp.	82℃
Water temp.regulator,full-open temp.	95℃
Start motor	
Type	Engage magnet type
Voltage	24V
Output	4.5KW
Flameout device	Fuel cut-off
Preheating device	provided
Charging generator	
Type	AC,diode commutated generator

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Voltage	24V
Output	25V
Driving method	Belt driving
Automatic charging regulator	IC type(inside engine)
Referrence data	
Oil disc oil quantity	Max:12l,Min:10l
Cooling water	12l
Valve clearance	
Suction valve	0.4mm(cold)
Exhaust valve	0.4mm(cold)
Valve opening and closing timing	
Suction valve opening	19 before T.D.C.
Suction valve closing	47 after B.D.C.
Exhaust valve opening	57 before B.D.C.
Exhaust valve closing	15 after T.D.C.
Injection timing	14 before T.D.C.
Injection starting pressure	185kg/cm^2
Compression pressure	31kg/cm^2(200rpm)

1.3 Fuel system

The fuel system is composed of fuel tank, filter and fuel sensor.

1.3.1 Fuel tank

The fuel tank of welding structure is connected into one body with frame and placed at the left side of frame. There is an oil tank cap plate on which the fuel sensor is mounted. Refer to Fig. 1.3.

1.3.2 Fuel sensor

The function of fuel sensor is to convert the oil stored in the fuel tank into current through up and down movement of float, which will be finally displayed on the fuel meter on the instrument panel so that people can directly know the quantity of oil inside the fuel tank. Refer to Fig. 1–4.

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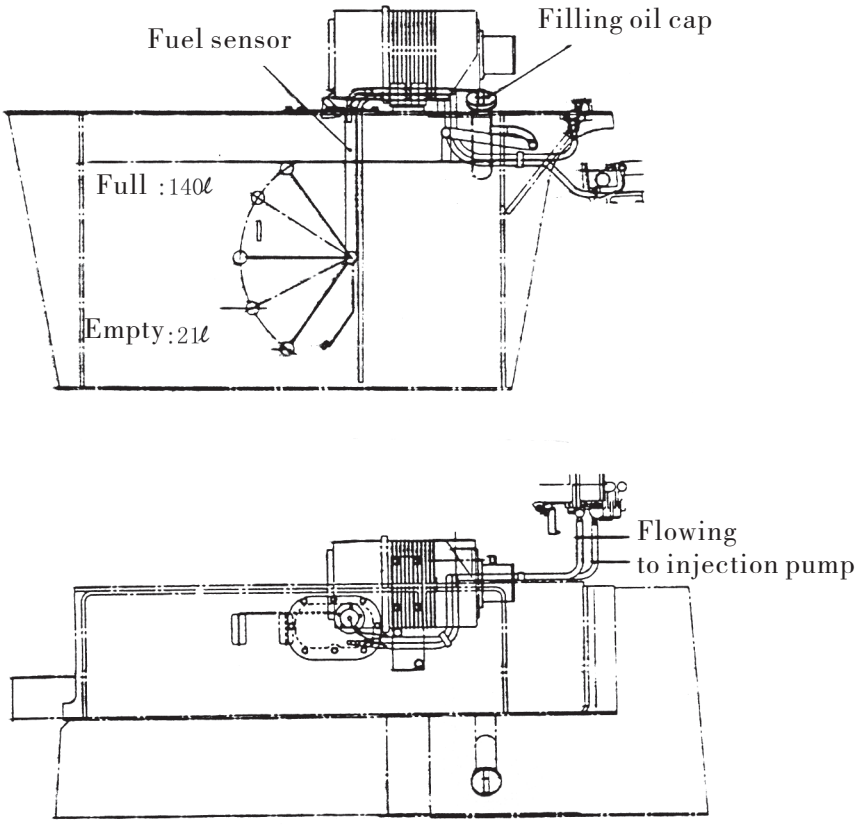

Fig.1.3 Fuel box

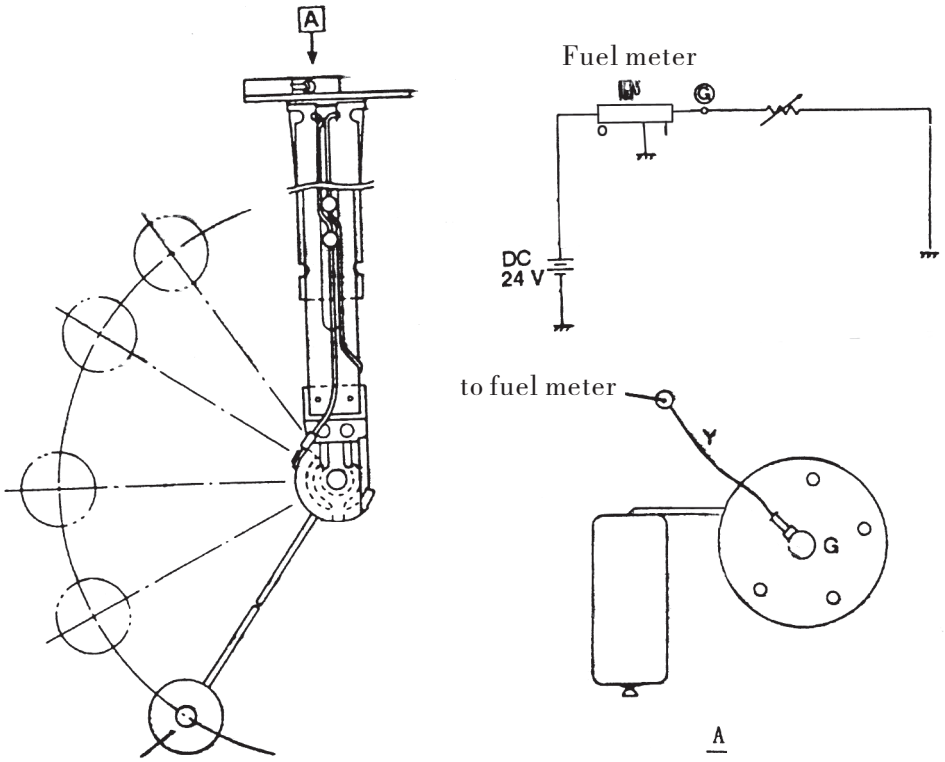

Fig.1.4 Fuel sensor unit

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1.3.3 Fuel filter

The fuel filter is mounted on the fuel–feeding manifold of engine and used to filter the fuel supplied to engine. The bypass valve is mounted inside filter , which can supply fuel to engine in case of obstruction of filter element.

1.4 Cooling system

The cooling system is made up of water pump, fan, water tank and auxiliary water tank. The water pump is mounted on the engine and crankshaft drives the work of water pump through V–shaped rubber tape.

1.5 Check and adjustment

In order to keep the engine in good working state, it is necessary to make regular check and adjustment and the main points are as follows:

1.5.1 For air filter, please See Fig. 1.5.

(1)Take out filter element

(2)Check the dust and damage state of the filter element. The lower pressure air is used to blow from inside to outside for purging and replace the filter element with a new one if it can’ t be cleaned due to serious obstruction or damaged.

(3)Clean off the dust inside the cap.

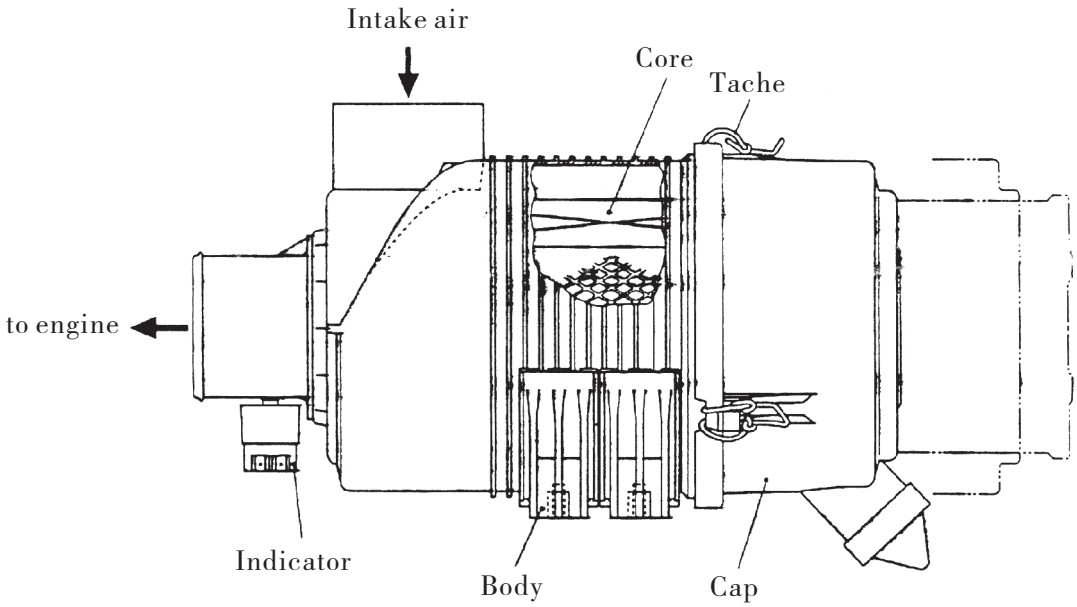

Fig.1.5 Air cleaner

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1.5.2 For fuel filter, See Fig. 1.6.

(1) Dismantle it with the spanner specially used for filter and change it if it is damaged and obstructed.

(2) Mount it after applying a few drops of fuel oil around the sealing ring of the new fuel filter and screw in 2/3 turns after the sealing ring contacts with the main body of the fuel filter.

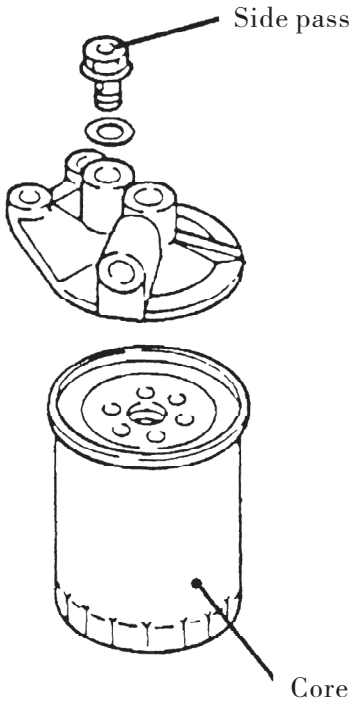

Fig. 1.6

1.5.3 For the machine oil filter, See Fig. 1.7.

(1)Dismantle it with a spanner specially used for fuel filter and change it.

(2)Mount it after applying a few drops of lubricating oil around the sealing ring of the new filter and screw in 2/3 turns after the sealing ring contacts with the machine body.

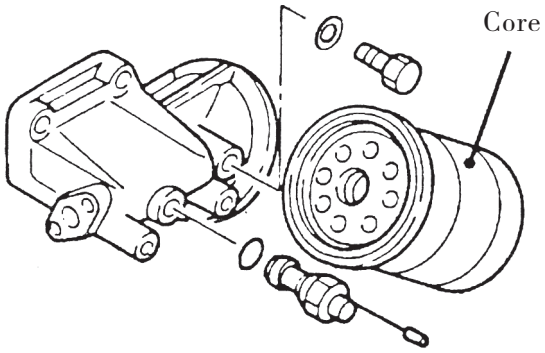

Fig. 1.7

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1.5.4 Cooling system

(1) Check the cooling liquid of auxiliary water tank

For auxiliary water tank, refer to 1.8. When the cooling liquid is lower than making line of “LOW”, it indicates that the supplementation amount of the water tank is small and the cooling liquid needs to be added. The cooling liquid should be added to the 2/3 graduation of upper and lower marking lines during cooling down.

(2) Replacing cooling liquid

A、Open the water tank cover after cooling when the machine stops for over half an hour and loosen the water drainage valve at the lower part of water tank.

B、Loosen the water drainage valve of engine and thoroughly drain dry the cooling liquid.

C、The above two water drainage valves should be tightened after drainage.

D、Fill in the specified cooling liquid and check if the level of auxiliary water tank is at 2/3 of the upper and lower graduation lines after running at slow speed.

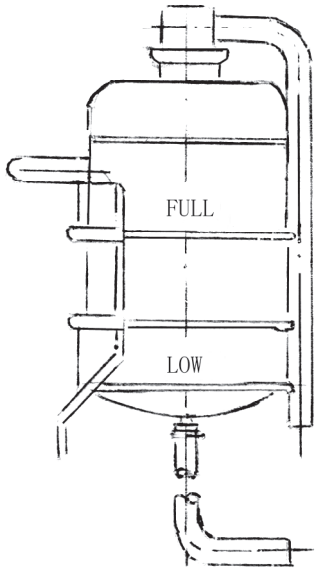

Fig. 1.8

(3) Adjust the belt of fan and tighten if it is loosened. Refer to Fig. 1.9.

Steps: Loosen the fixed bolt B and C of the generator, move it towards outside, press down the belt at place A with finger with 10kg force. Its flexibility is about 10 mm and then tighten the B and C bolts in proper order.

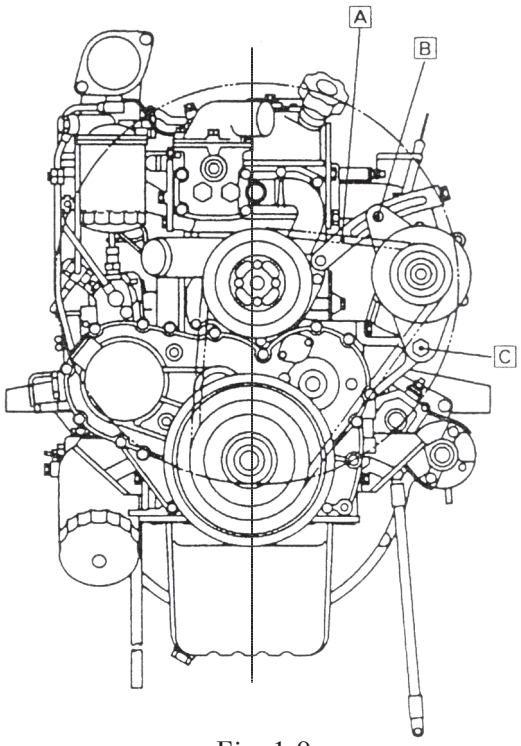

Fig. 1.9

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1.5.5 Tightening the cylinder head bolts of engine

(1) Tighten the cylinder head bolts one by one with 68 Nm moment according to the order shown in Fig. 1.10.

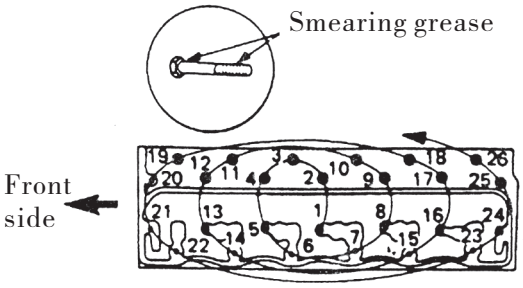

Fig. 1.10

(2)Increase the tightening moment to 93 Nm and tighten the bolts one by one.

(3) Then turn each bolt 90 and screw tightly.

1.5.6 Adjustment of clearance of air gate

(1) Turn the crankshaft clockwise and make the "TC" mark of belt wheel shock absorber coincide with the needle.

(2) Open the manhole cover and make sure the mark of the bottom plate and position of the needle. If the mark of the bottom plate coincides with the needle position, it indicates the upper dead point on the compression stroke of the first cylinder, adjust the clearances of the air gate with "△" and "※" as well. The clearance value of the air gate: 0.4mm (When it is under cooling state, the air suction and exhaustion are of the same value.)For details, please refer to Figs 1.11,1.12,1.13

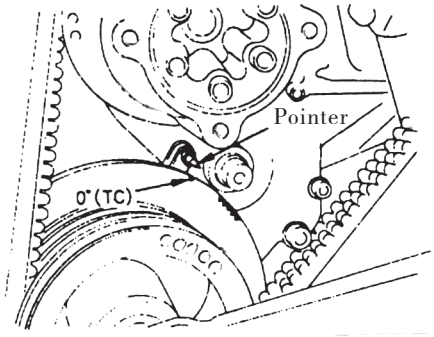

Fig. 1.11

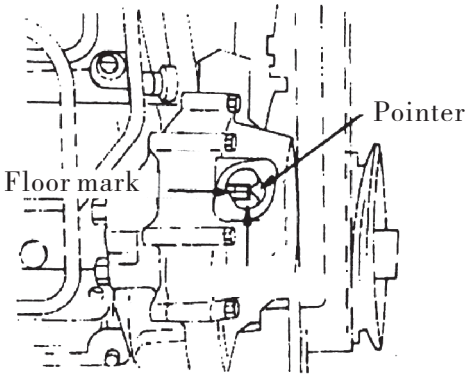

Fig. 1.12

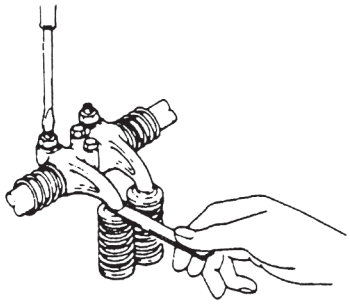

Fig. 1.13

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For the concrete adjustment table, refer to Table 1.2.

Table 1.2

Air cylinder Sequence No.	1		2		3		4		5		6	
Valve sequence No. I: Suction valve E: Exhaust valve	I	E	I	E	I	E	I	E	I	E	I	E
Dead point at compression stroke of the 1st cylinder	△	△	△			△	△			△		
Dead point at compression stroke of the 6th cylinder				※	※			※	※		※	※

1.5.7 Confirmation of the ignition time of oil injection

(1) First make sure if the "assembly marks" on the flange of oil injection pump are in conformity with each other, See Fig. 1.14.

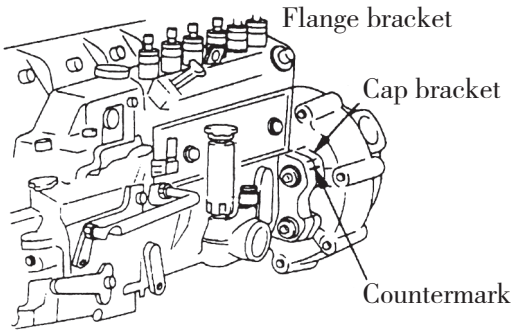

Fig. 1.14

(2)Place the first cylinder at the dead point position of compression stroke and turn the crankshaft about 30 from this position. See Fig. 1.15.

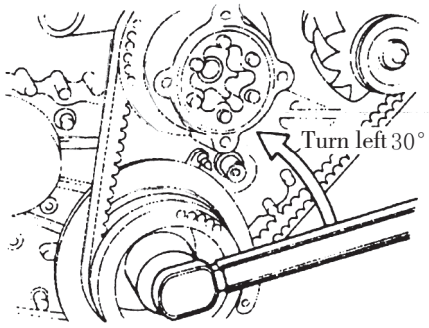

Fig. 1.15

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(3) Loosen the oil injection pipe of the first cylinder; dismantle the spring of dump valve bracket and the valve. Mount the dump valve bracket on the oil injection pump. See Fig.1.16.

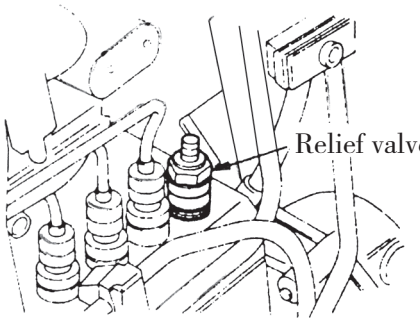

Fig. 1.16

(4)While the fuel is compressed and delivered by oil supply pump, turn slowly the crankshaft clockwise as shown in Fig.1.16 and stop turning it when the oil level of dump valve base raises to the position it stops. See Fig. 1.17 to confirm the marks of the needle.

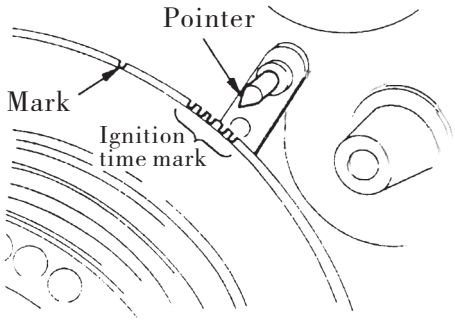

Fig. 1.17

1.5.8 Adjustment of ignition time of oil injection

(1) Dismantle the pipes mounted on the oil injection pump (fuel and lubrication oil)

(2) Loosen the mounting bolts of oil injection pump.

(3) While making sure the ignition time according to the main points of 1.6.7, adjust it in the direction far away from the engine in case of " Ahead of time" and adjust in the direction close to the engine in case of "delay".

(4) After adjustment, screw tight all the assembly bolts of oil injection pump and confirm again the ignition time.

(5) Assemble the oil discharge valve used for the first cylinder and mount each pipe on their original and respective positions.

1.5.9 Measurement of the compression pressure (See Fig.1.18)

(1) Dismantle completely the heat spark plug and oil injection pipes.

(2) Mount the manometer on the assembly positions of the heat spark plug of the first cylinder. (The nominal valve is 500N/cm^2);

(3) Start the device with battery of sufficient electrical power and measure the pressure at this time.

(4)Measurement is made with the same method to the 6th cylinder, over twice for each, then calculate their respective average values: Compressed pressure: 304N/cm^2 (Limiting value 255N/cm^2) .

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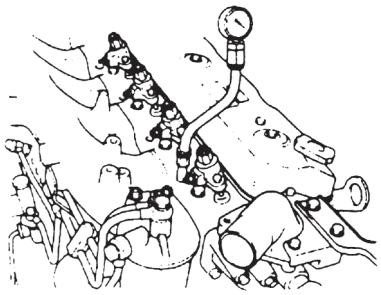

Fig. 1.18

1.5.10 Air exhaust of oil injection pump (See Fig.1.19)

(1) Loosen the exhaust plug of oil injection pump

(2)Operate slowly the manual pump till no air bulbs come from the exhaust plug

(3)Then tighten the air exhaust plug.

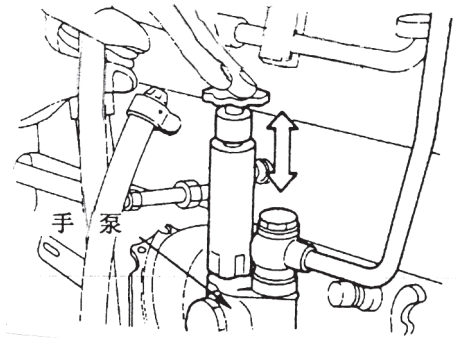

Fig. 1.19

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2. Eectric System

2.1 General

The electric system for this forklift truck is of the single-pole type, in which the frame of the truck provides the return path for the electricity. The electric system seems like "the nerve centre" of the truck and it mainly consists of the following:

2.1.1 Charging Devices

This devices contains generator, battery,charging indicator, etc. It supplies electric energy for all the electric devices.

Voltage: 24V

2.1.2 Start System

This system mainly consists of automatic pre-heating unit(only use for ISUZU and KOMATSU engine), key switch, start protection circuit, start motor, etc. The function of this system is starting the engine.

2.1.3 Stop System(use for ISUZU,IVECO and KOMATSU diesel engine)

Stop system(use for ISUZU engine) consists of key switch,flameout and automatic flameout device.Stop system(use for IVECO and KOMATSU diesel engine) consists of key switch and shut-off fuel valve.

2.1.4 Instruments

It mainly consists of hour meter, fuel meter, water temperature meter, charging indicator, oil pressure indicator, neutral indicator, warning lamp of air cleaner, water deposit(water and oil segregator)indicator(only for KOMATSU diesel engine) etc1. They are all achieve checking instruments of the forklift truck.

2.1.5 Lighting and Signal Instruments

They include all kinds of illuminating lamps, signal lamp, horn and buzzer, etc.

Headlight: 35W

Front lamp: 70W

Front combination lamp(turning/front): 21W/8W

Rear combination lamp:(turning/rear/reverse/braking): 21W(red)/8W(red)/10W(white)/21W(red)

Warning lamp:(optional)21W

Rear lamp:(optional)70W

Licenese lamp:(optional)10W

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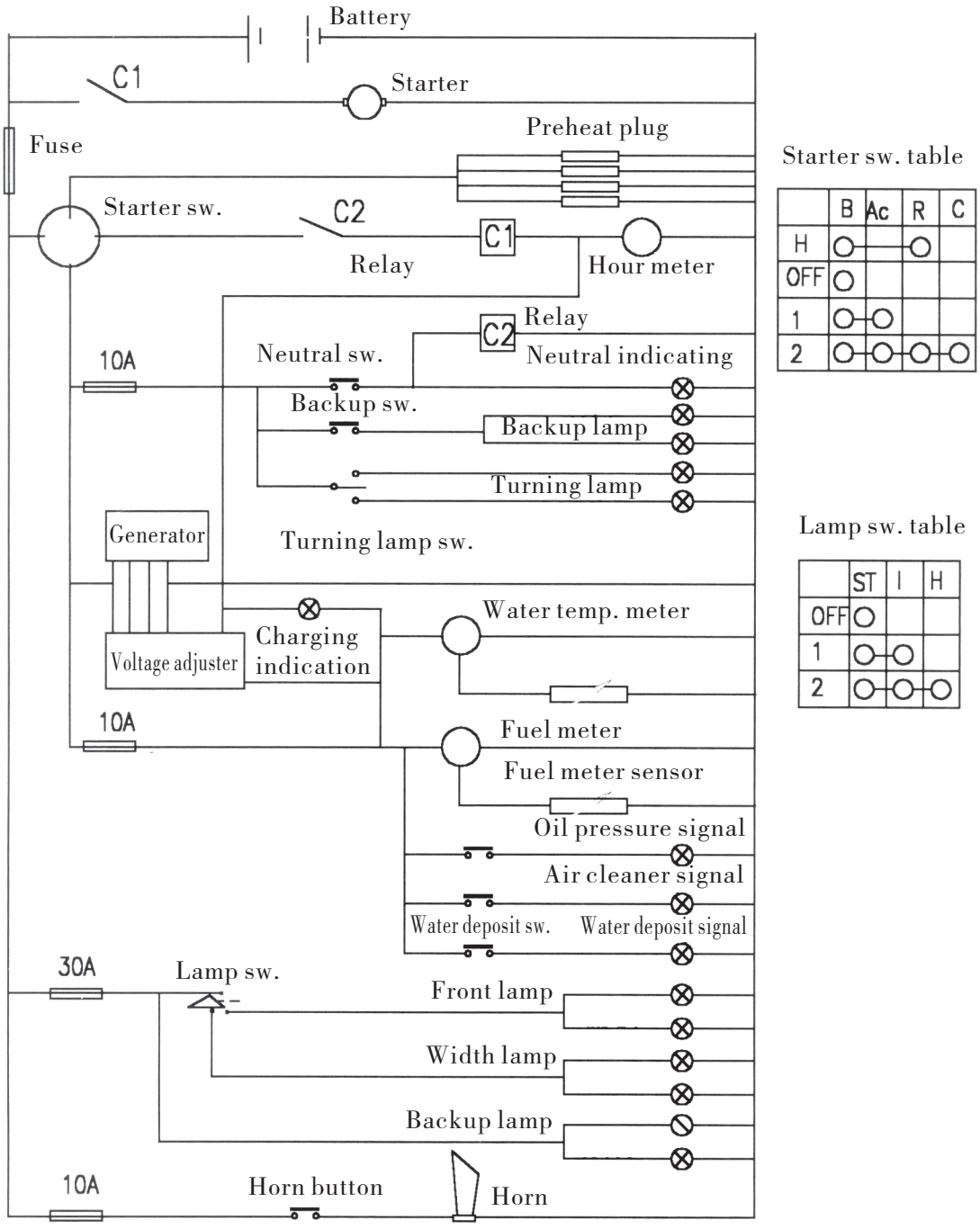

Fig.2.1 Electric principle

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(2) Brief Explanation for operation

2.1 Starting

There is a starting protection circuit in the shiftlever the forklift truck. you have to shift the shiftlever in neutral before you start the engine. Otherwise, you can not start the engine.

Turn the key switch anti-clockwise to the "H" position (pre-heating position),the air of the engine is heated to benefit for starting. Turn the key switch clockwise to the first "on" position, the instrument circuit and the ignition circuit are ready for work. The key switch as follows:

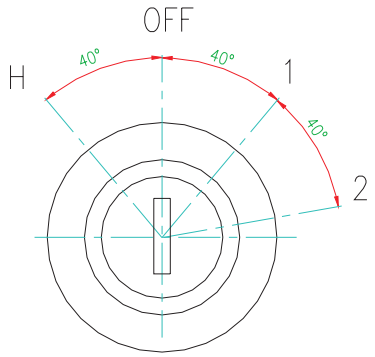

Fig.2-2 Key Switch

Turn the key switch clockwise to the second "on" position(starting position), then start the engine.

Release the brake switch before starting, Otherwise, the forklift truck can not step because the drive unit is cut off.

After engine starting, push the shiftlever forward (that is in forward shifts) , then pedal accelerator shift, the forklift truck runs faster and you can begin to work. When pull the shiftlever backward(that is in reverse shifts), the back lamp is on and the buzzer sounds.

2.2 Lamp Switch

2.2.1 Turn the lamp switch clockwise to the first "on" position ,the front lamps and rear lamps are on , turn the lamp switch to the second "on" position , the headlight on near beam are on while the front lamps and rear lamps keep on.

2.2.2 Push the turning switch backward, the left turning lamps on the front combination lamp and the rear combination lamp flash, Pull the turning switch forward, the right turning lamps on the front combination lamp and the rear combination lamp flash.

2.2.3 Brake Signal: When you pedal brake , the brake lamps (red) in the rear combination lamp are on.

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2.2.4 Reverse signal: When you need to reverse the forklift truck ,pull the shiftlever backward and the transmission is in reverse shift. Then the reverse lamps (white) in the rear combination lamps are on and the buzzer sounds.

2.2.5 Charging Signal: Before you start the engine, put the key switch to the first " on" position and the charging lamp is on. After engine starting, the charging lamp is automatically off. If the charging lamp becomes on while the engine is working , it means something is wrong with the charging circuit and you must stop working and check the charging circuit as soon as possible.

2.2.6 Oil Pressure Signal: Before you start the engine, put the key switch to the first "on" position and the oil pressure alarm lamp is on, After engine starting, the oil pressure alarm lamp is automatically off. If this lamp becomes on while the engine is working , it indicates low lubricating oil pressure and you must stop working and check the lubricating system as soon as possible.

2.2.7 Water deposit(water and oil segregator)indicator: Before you start the engine, put the key switch to the first " on" position and the water deposit(water and oil segregator)indicator is on , the alarm lamp is automatically off, if the lamp becomes on while the engine is working , it indicates water in the water deposit is over the alarming level of water, and you must drain off the water, and than the alarm lamp is automatically off.

2.2.8 Fuel meter: It indicates how much fuel is left in tank.

2.2.9 Water Temperature Meter: It indicates the temperature of the engine coolant.

2.2.10 Hour Meter: It indicates how many hours the engine has worked .

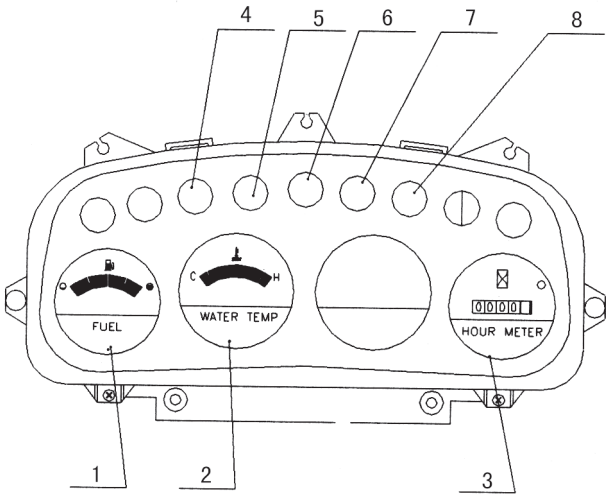

Fig.2.3-1 H2000 type combination meter

1.Fuel meter 2.Water temp. meter 3.Hour meter 4.Air cleaner indicator 5.indicator 6.Charging indicator 7.Oil pressure indicator 8 Water temp. indicator

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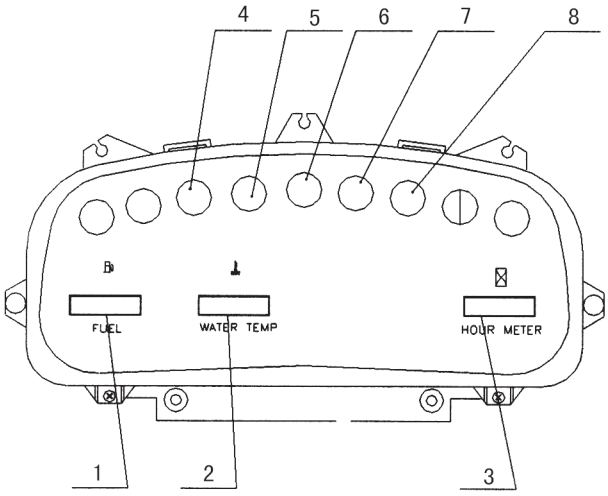

Fig.2.3–2 H2001 type combination meter

1.Fuel meter 2.Water temp. meter 3.Hour meter 4.Air cleaner indicator 5.indicator 6.Charging indicator 7.Oil pressure indicator 8 Water temp. indicator

2.3 Battery

▲! Notice:

1) The battery can produce Combustibility air, it has explosion danger, it must be forbidden short circuit, light and fireworks.

2) The electrolyte is a sparse vitriol, it is danger if skin or eye touches it. If shin touches electrolyte,it must be flush with the water immediately, While eye touches it, flush with water and see a doctor immediately.

2.4 Wire harness

1) The wire harness colour corresponding table:

B	R	G	Y	L	W	Br	Lg	P	V
black	red	green	yellow	blue	white	brown	Light green	pink	violet

The GY, GR, GW, WB, YR, RY, RB, LB etc. means two colors line, the former's quantity occupies 2/3, and the latter's quantity occupies 1/3.The number before the two colour means section area.

2) Laden current of low pressure wire harness allowing

Section area(mm^2)	0.5	0.8	1.0	1.5	2.5	3.0	4.0	5.0	6.0
Laden current(A)			11	14	20	22	25	25	35

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3) Forklift truck type and wire harness

Type / Name	50~70–W	80~100–W	50~70–C	80~100–C	50~60–WF	50~70–Xs
Cabinet cable	●	←	●	←	←	●
Engine cable	●	●	●	●	●	●
Head guard cable	All one page					

Attachment：wiring harness show in Fig. 2.4–Fig.2.13:

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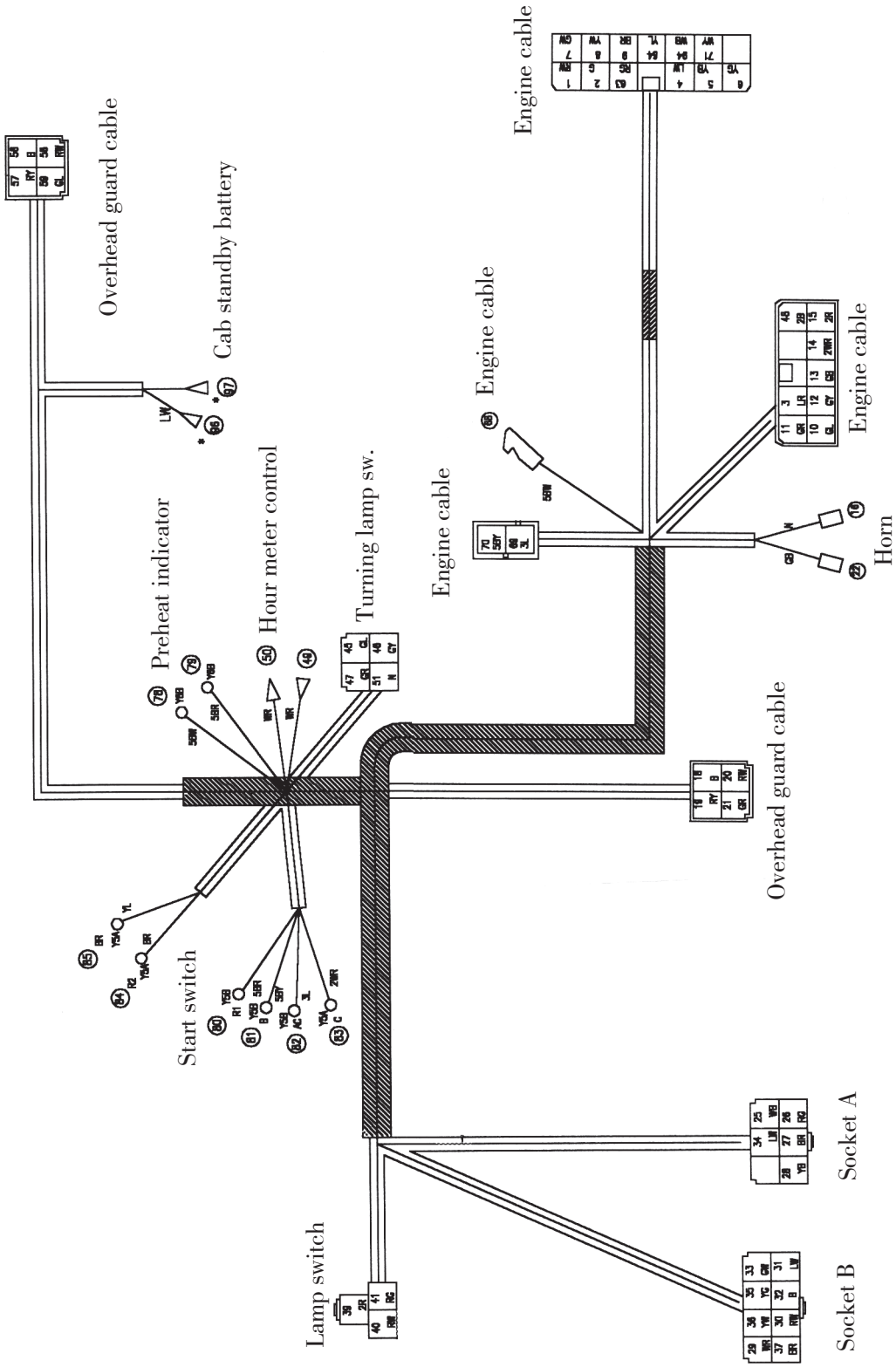

Fig. 2.4 Cabinet wire harness

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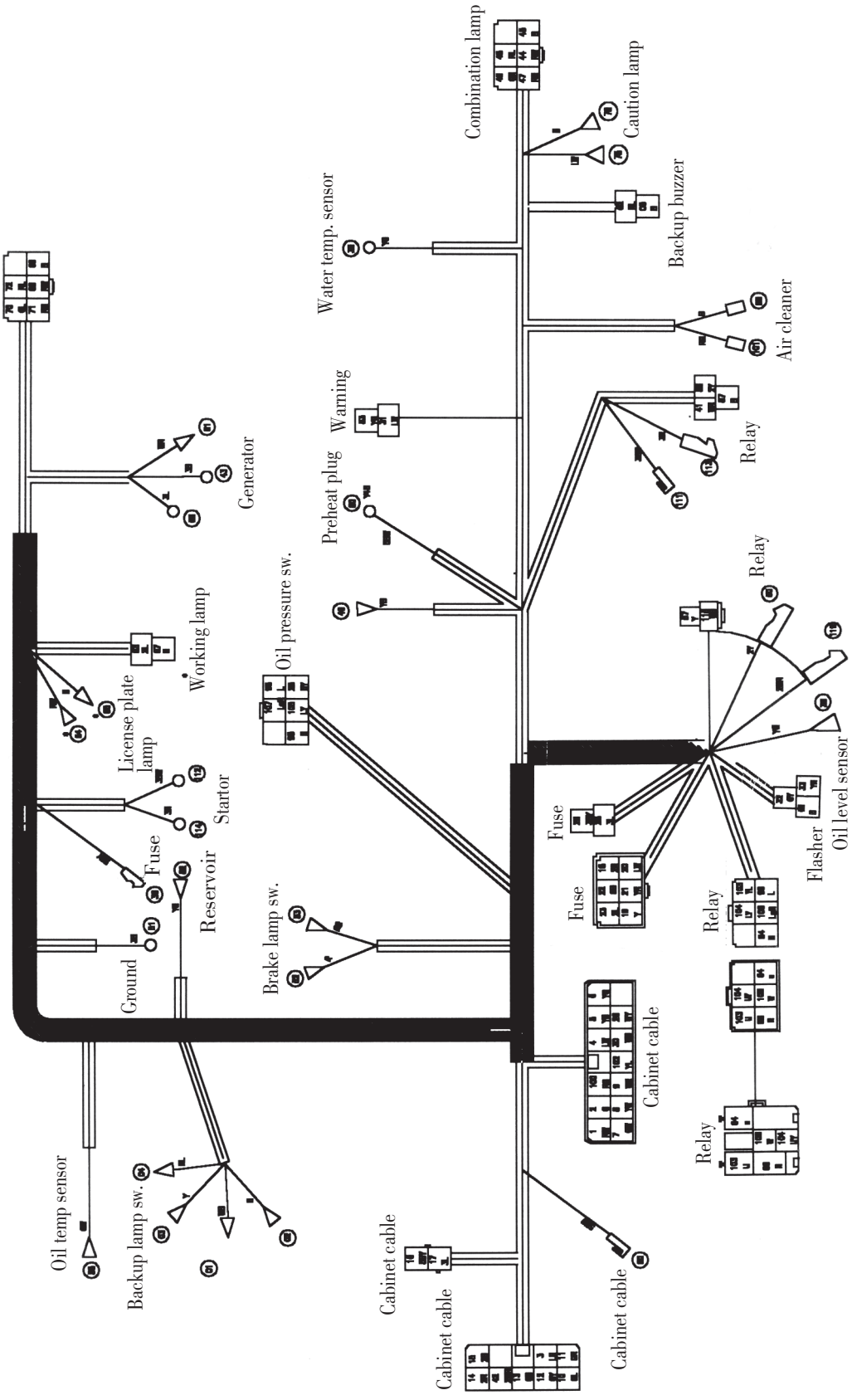

Fig. 2.5 Engine wire harness. CPCD50–70–W

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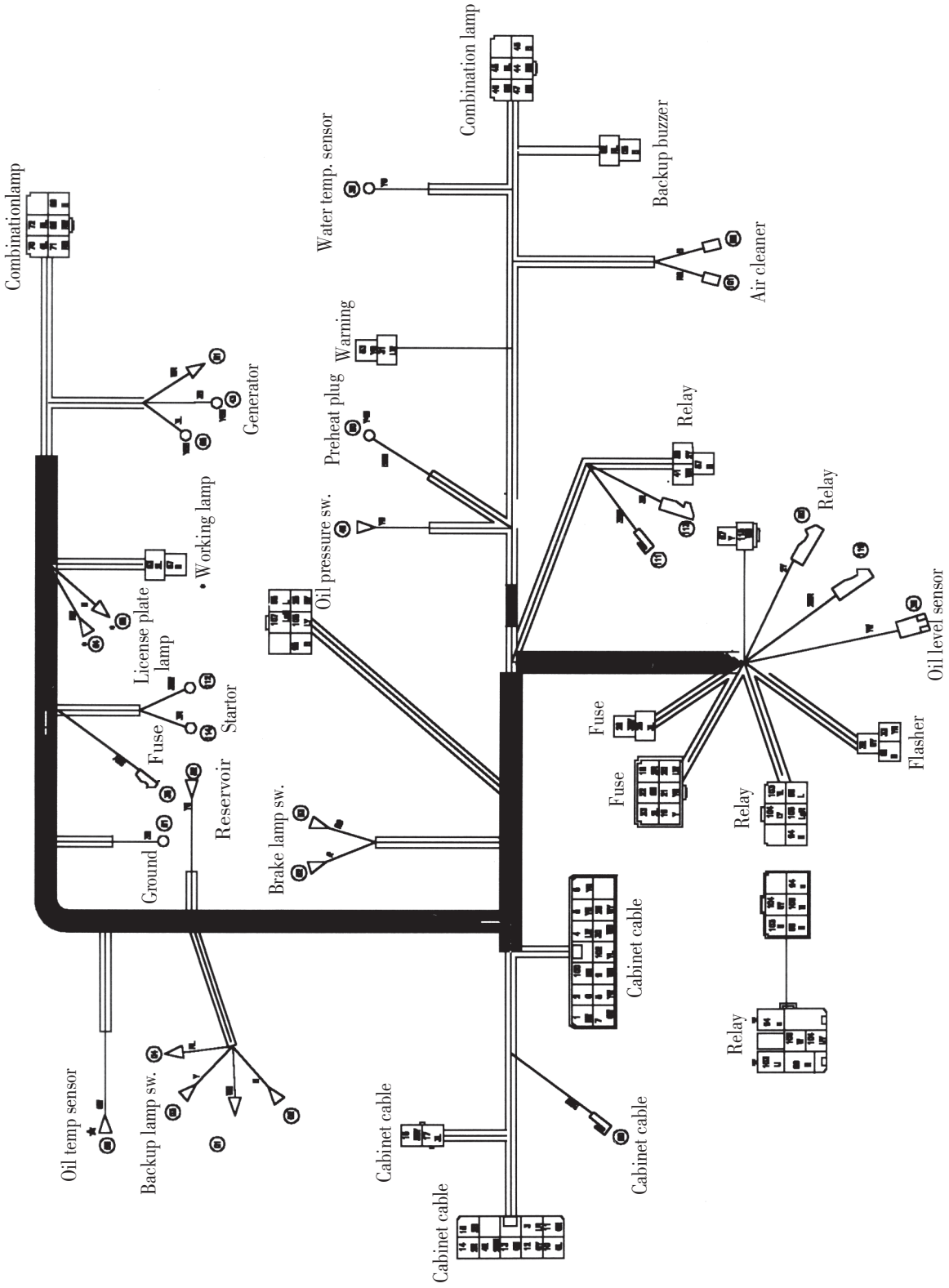

Fig. 2.6 Engine wire harness. CPCD80–100–W

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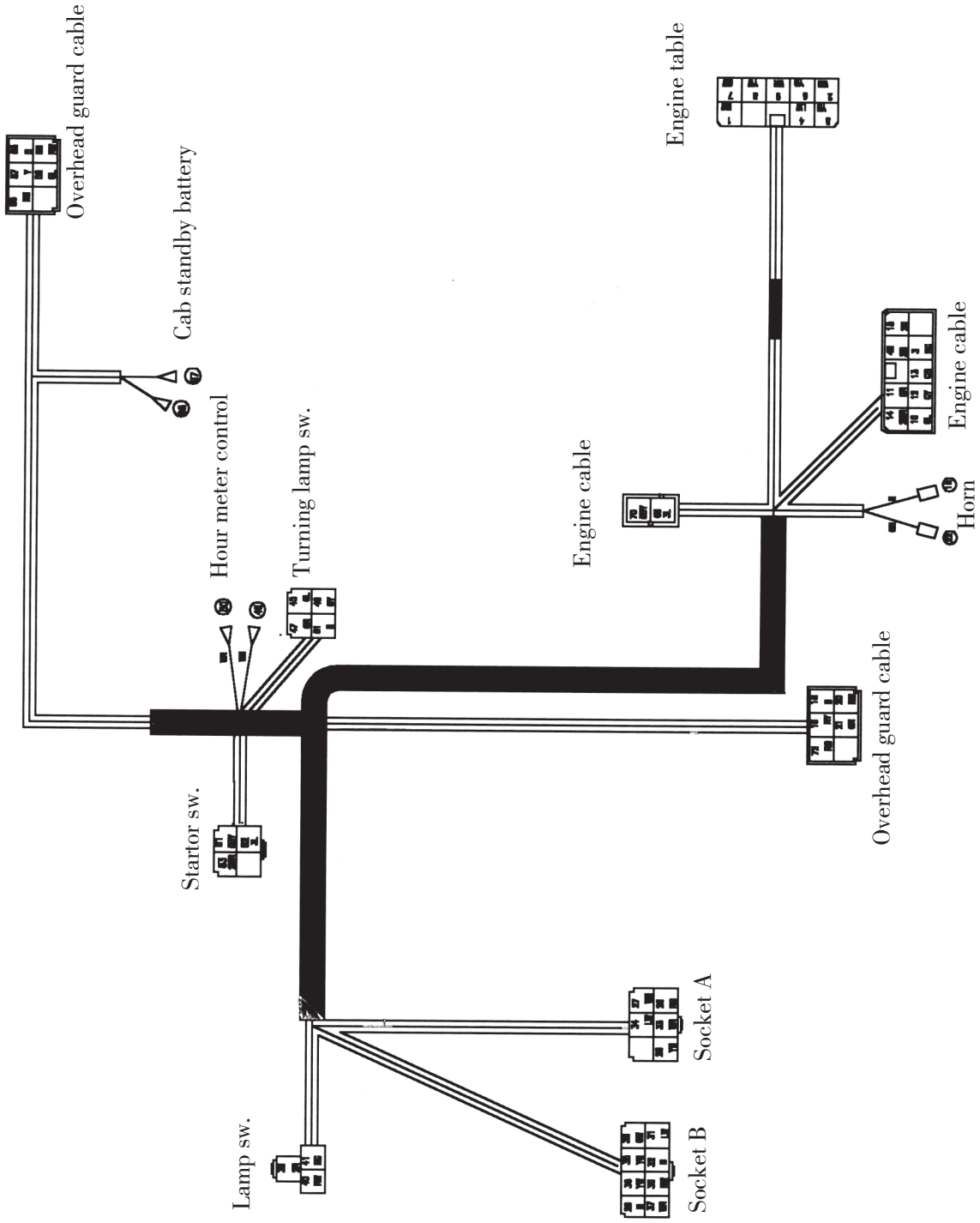

Fig. 2.7 Engine wire harness. CPCD50–70–C

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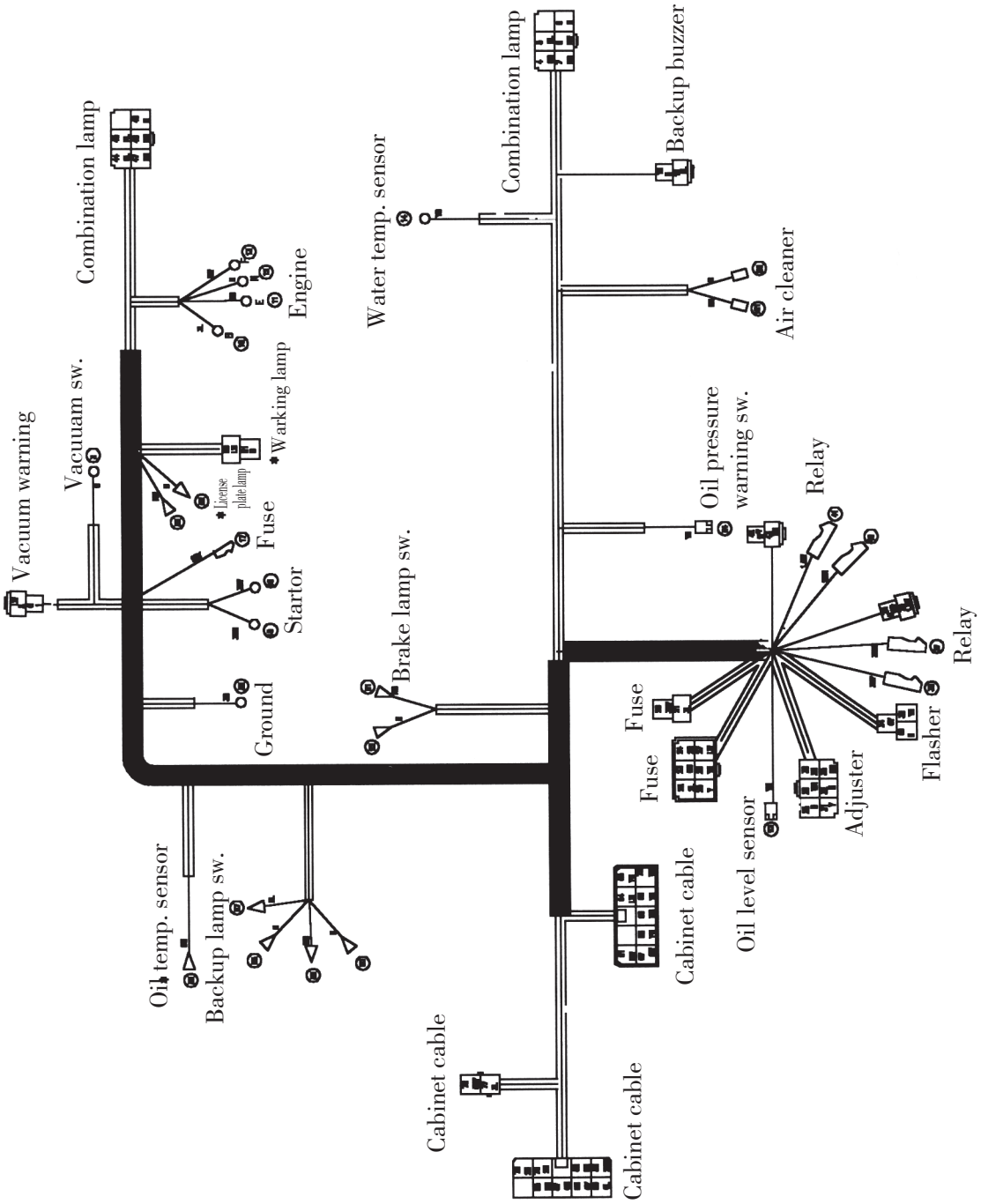

Fig. 2.8 Engine wire harness. CPCD50–70–C

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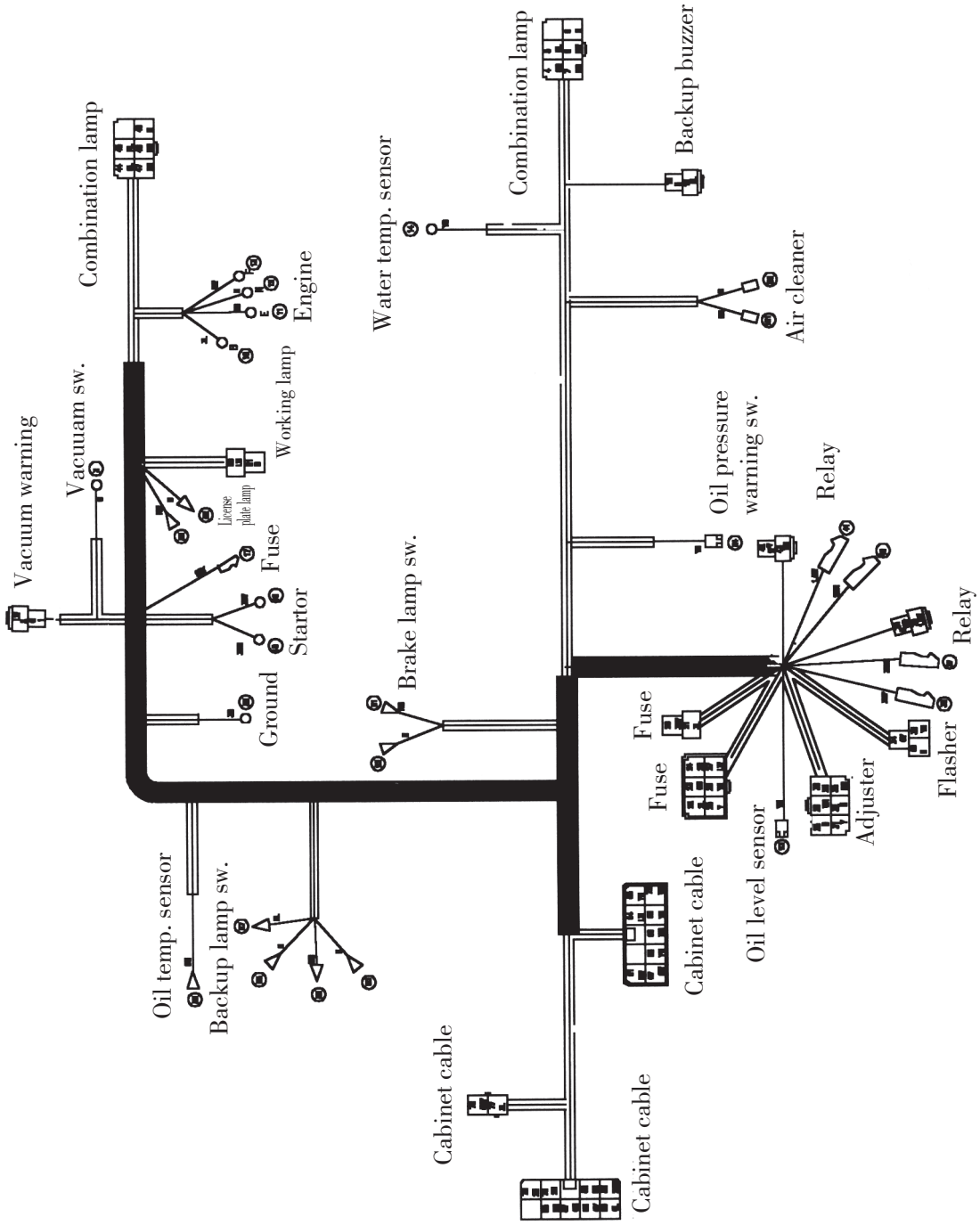

Fig. 2.9 Engine wire harness. CPCD80–100–C

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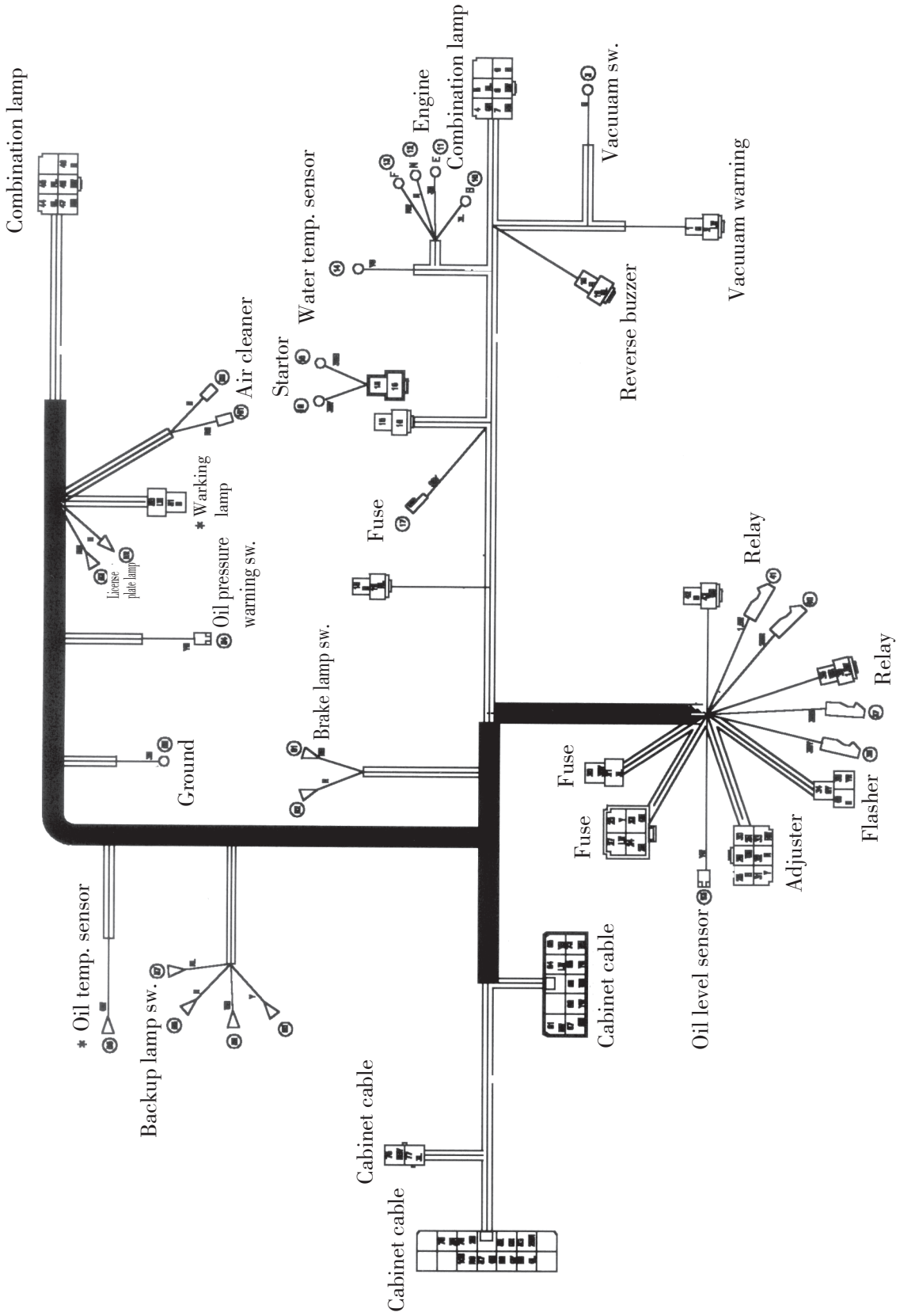

Fig. 2.10 Engine wire harness. CPCD50–60–WF

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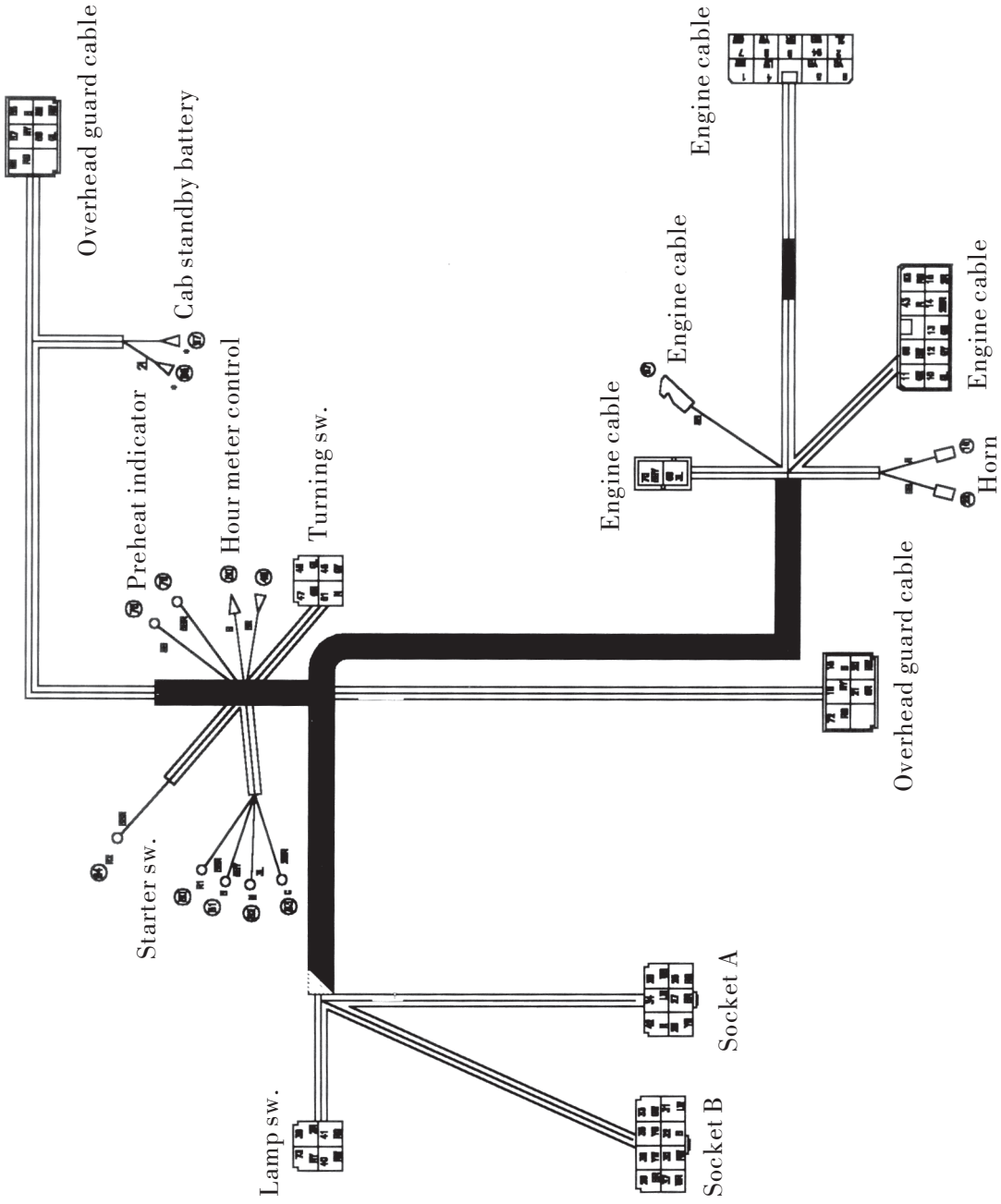

Fig. 2.11 Engine wire harness. CPCD50–70–Xs

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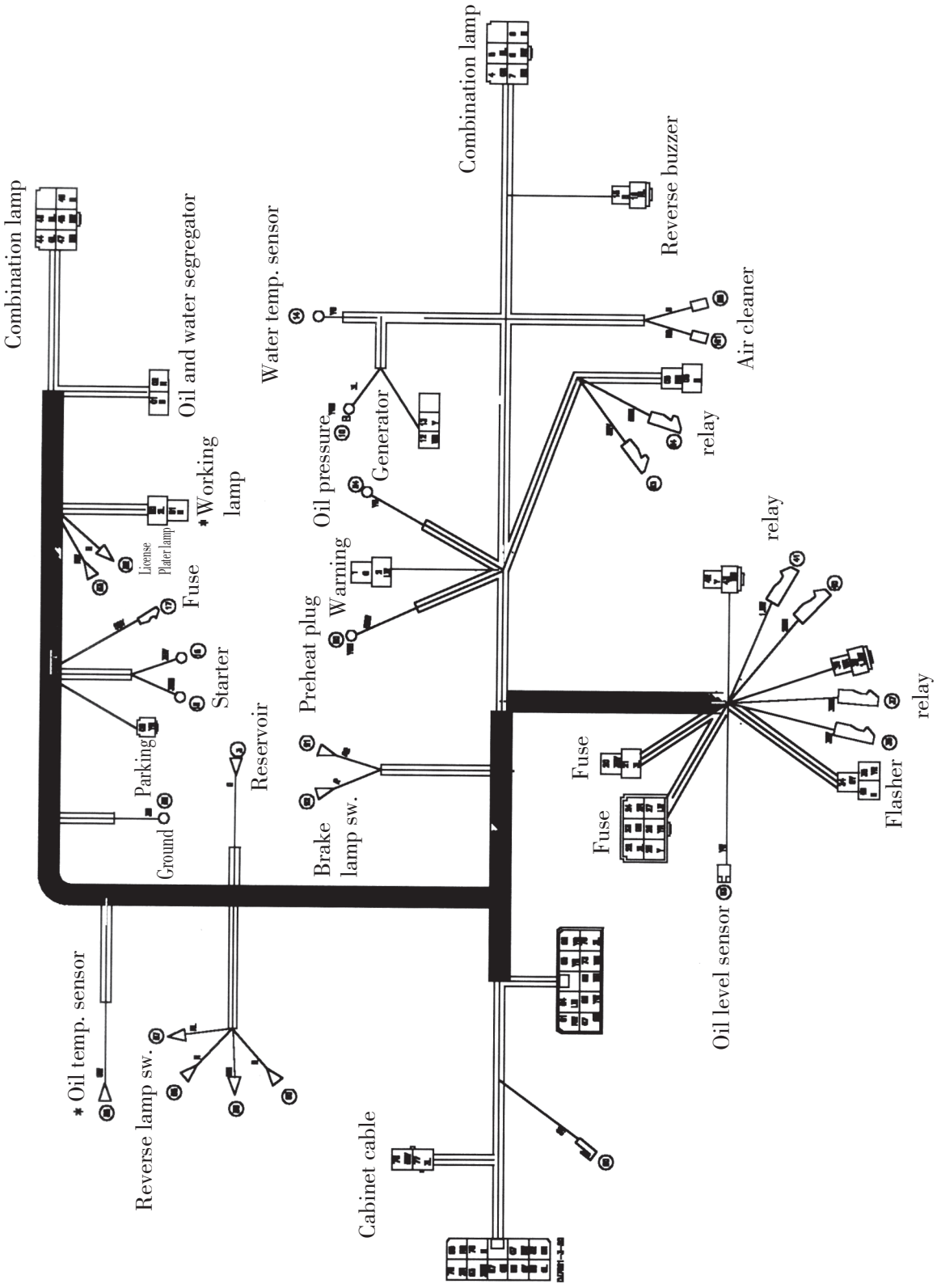

Fig. 2.12 Engine wire harness. CPCD50–70–Xs

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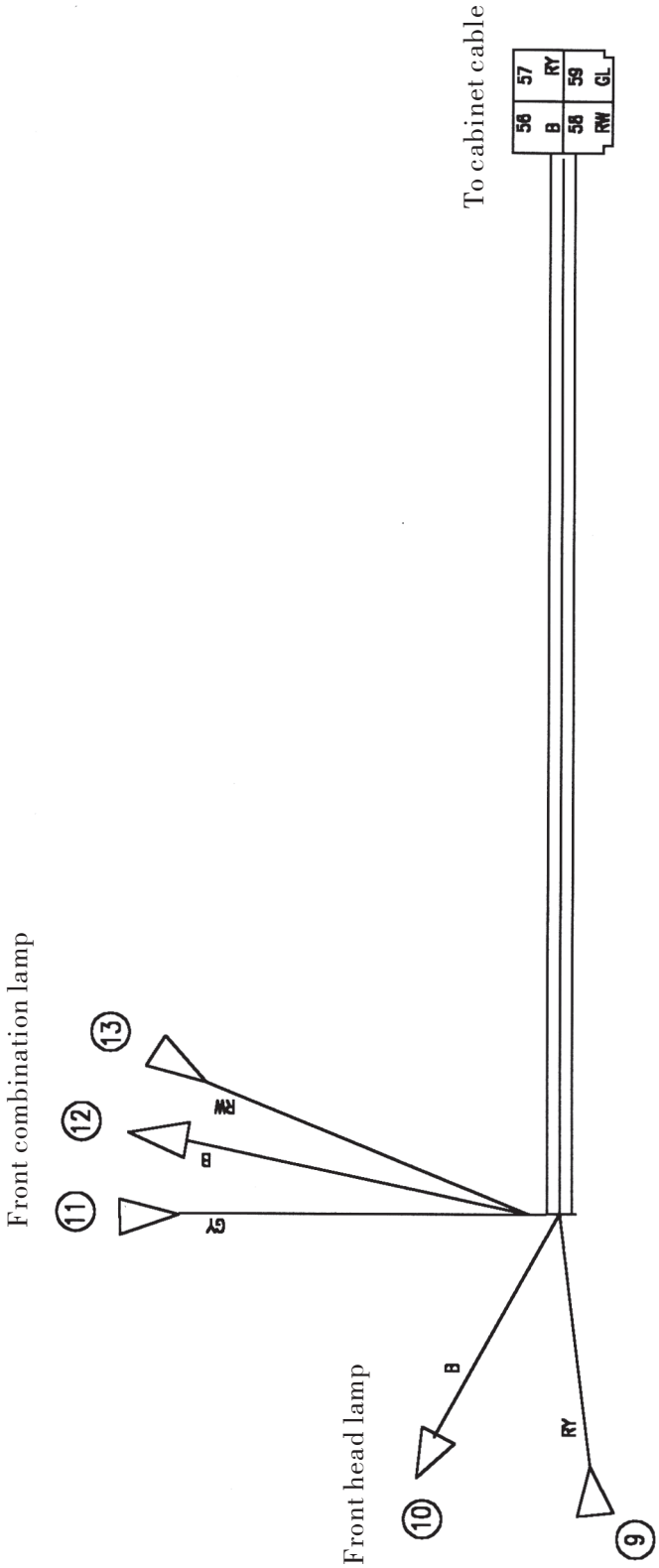

Fig. 2.13 Engine wire harness

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3. Transmission system

The transmission system consists of torque converter transmission & torque converter.

The main specifications of the system see table3.1

Item			Specifications
Torque converter	Type		3–element,1–stage,2–phase
	Circular Dia.& stall torque ratio		Dia.12.5”（ϕ315),stall torque ratio 3:1
	Pressure setting MPa		0.5~0.7
Charging pump	Type		Crescent type,gear pump, transmission output
	Discharge i/min		40(2000rpm,2MPa)
Torque Converter Transmission			Power shift type
	Gear ratio	1st(forward and backward)	1.621
		2nd(forward and backward)	0.526
	Hydraulic Clutch	Clutch outer dia. mm	134
		Clutch inner dia. mm	90
		Clutch thickness mm	2.8
		Clutch surface area cm^2	77.4(6 faces)
		Pressure setting MPa	1.2~1.50
Weight kg			About 295
Oil amount l			About 20
Oil type			Model SAE10W engine oil or No. 6 torque converter oil made in China

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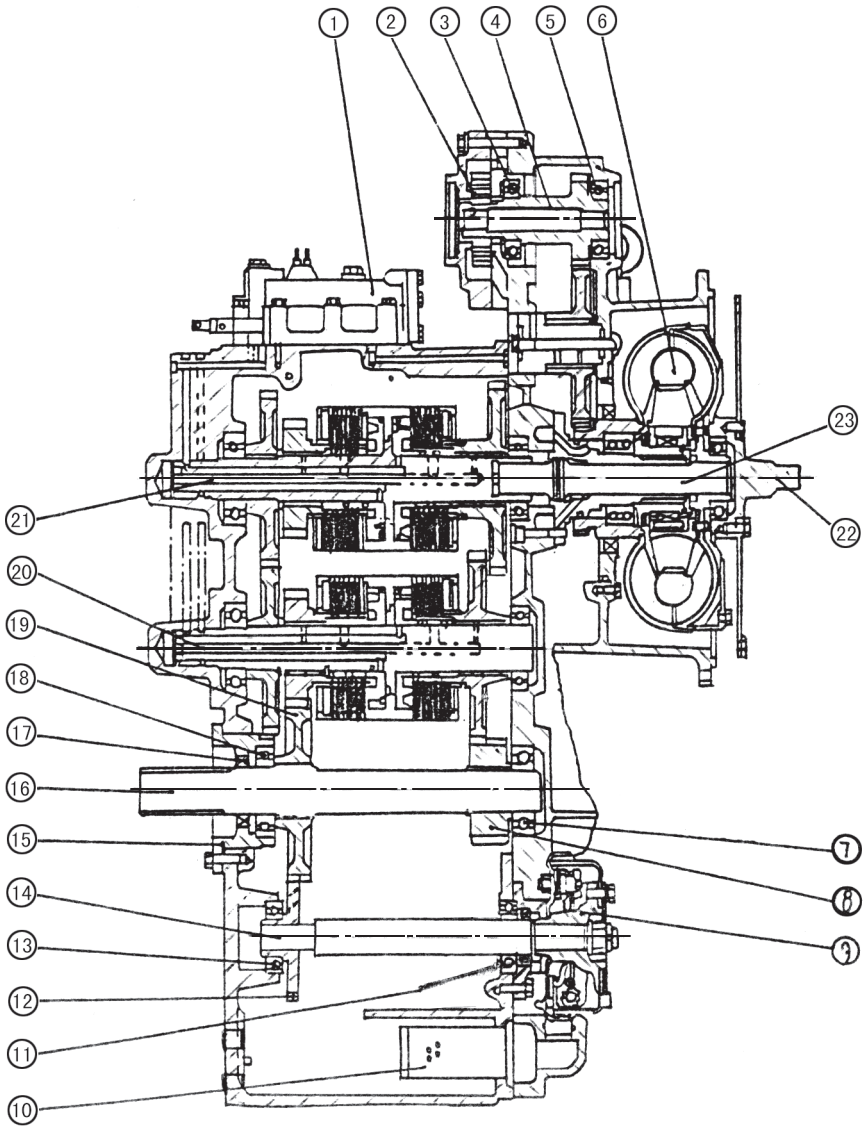

Fig.3–1 HydraulicTransmission

1.Control valve	2.Charging pump	3.Ball bearing
4.Drive shaft	5.Ball bearing	6.Torque converter
7.Ball bearing	8.Gear(30T)	9.Parking brake
10.Strainer	11.Oil seal	12.Gear(32T)
13.Ball bearing	14.Shaft	15.Bearing cage
16.Output shaft	17.Oil seal	18.Ball bearing
19.Gear(47T)	20.Reverse clutch pack	21.Forward clutch pack
22.Input plate	23.Transmission output shaft	

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3.1 General description

The transmission adopted in this machine is a rational combination of torque converter with power-shift type transmission.It has the following features.

(1) The inching valve is provided so as to improve the inching performance.Hence,the inching performance can be maintained when starting and at any rotational speed of engine.

(2) The clutch has 7 steel plates and 7 specially treated paper plates.Therefore excellent durability is ensured.

(3) The torque converter is provided with the free wheel so as to enhance the transmission efficiency(3-element,1-stage,2-phase type).

(4) The line filter is provided in the torque converter circuit so as to improve the durability.

3.2 Torque converter

Generally,the torque converter consists of pump wheel fitted to the input shaft,turbine wheel fitted to the output shaft,and stator wheel fixed to the housing(3-element,1-stage type).

The pump wheel is rotated by the drive shaft,so that the fluid in the pump forced out by the centrifugal force along the vanes of pump wheel.(At this time mechanical energy is converted to kinetic energy).

Thereby the fluid flows into the impeller of turbine wheel,transmitting torque to the output shaft.The direction of thr fluid leaving the turbine wheel is changed by the stator wheel so that it flows into the pump wheel at the best angle.At this time a reaction torque pushing the stator is generated,as a result of which the output torque becomes larger than the input torque by the valve equal to the reaction torque.

As the rotational speed of turbine wheel increases,approaching to the input rotational speed,the change of fluid flow angle reduces,and the output shaft torque also reduces.And finally the fluid begins to flow contrary to the direction of stator vanes,as a result of which the reaction torque beings to affect in the reverse direction.

In this case the output shaft torque becomes smaller than the input shaft torque.So as to prevent this phenomenon,a free wheel(one-way clutch) is provided on the stator. When the reaction torque acts in the reverse direction,the stator wheel rotates idly.In this state the input torque becomes equal to the output torque so that high performance is ensured.

As the phase of torque transmission is changed by the mechanical means (clutch),the torque converter is called the 2-phase type.It features smooth operation and enhanced efficiency.

The torque converter is fixed to the flywheel through the flex plate so that it rotates always together with the engine.

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Inside the torque converter are mounted the torque converter case,turbine wheel,pump wheel,and stator wheel,The inside of torque converter is filled with torque converter fluid.

The pump wheel has gear at its end which is engaged with the drive gear of charging pump to drive the charging pump.

The turbine wheel is spline–jointed to the main shaft.It serves to transmit power to the wet type multidisk clutch.

The construction of the torque converter see fig.3.2.

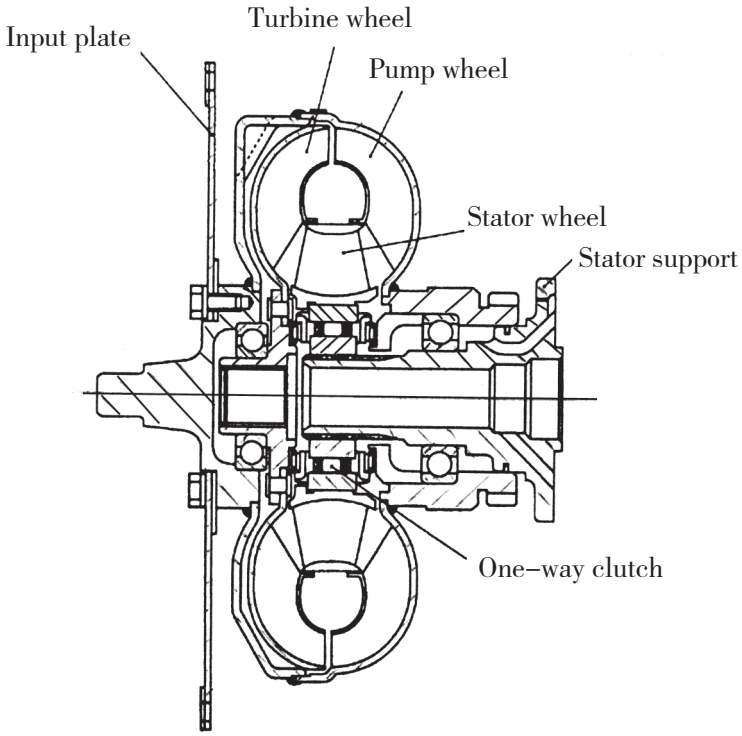

Fig.3.2 Torque converter

3.3 Charging pump

The construct of charging pump See fig.3–3.

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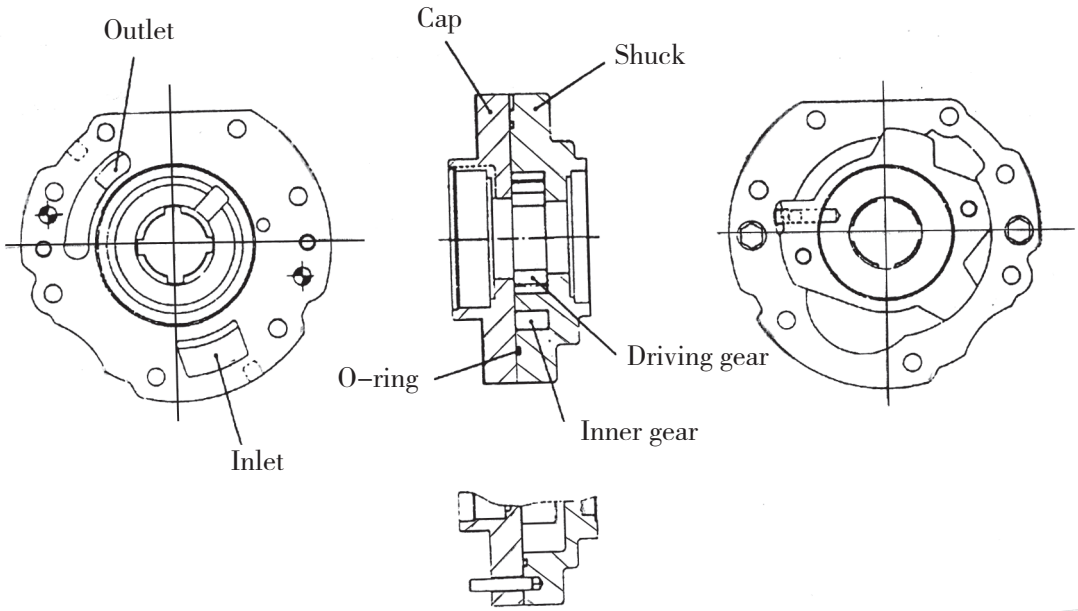

Fig.3.3 Oil pump

Charging pump consists of driving gear,inner gear(diven gear),shuck and cover,mounted on the upper end of the tor–con housing.Driving gear is driven by pump wheel,idle gear and oil pump driven gear ,the oil pump supply oil in lower half of the transmission for every area of the transmission.

3.4 The hydraulic clutch group

The hydraulic wet type multidisk clutch group is provided at the transmission side.The drive gear of forward clutch side is engaged with the driven gear whereas the counter drive gear of reverse clutch side is engaged with the counter shaft gear.

Inside one clutch group the 6 clutch disks(sintered plates) and the 7 clutch steel disks (steel plates) are alternately and assembled together with the piston.

Oiltightness of outer periphery and inner periphery of the piston is ensured with the slipper seal and "O" –ring,respectively,when it operates.In the neutral state the coil spring acts to disengage the multidisk clutch.The clutch surface is always lubricated with the oil returned from the oil cooler so that seizure and wear of the clutch surface are prevented.

When hydraulic pressure affects the piston,the alternately arranged sintered plates and steel plates are depressed so that the clutch group is made integral and transmits power from the torque converter to the drive gear.

Accordingly,power transmission route from the Tor–Co–Matic transmission is as follows:Turbine wheel→Main shaft→Clutch drum→Steel plate→Sintered plate→Forward

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or reverse gear→Output shaft.

3.5 Control valve and Inching valve

The control valve see Fig.3–5.

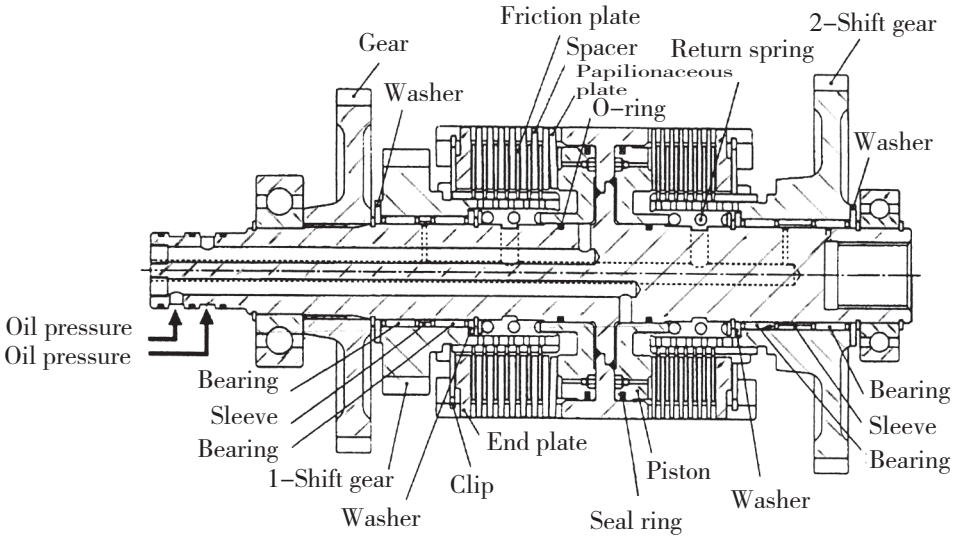

Fig.3.4 Forward Clutch

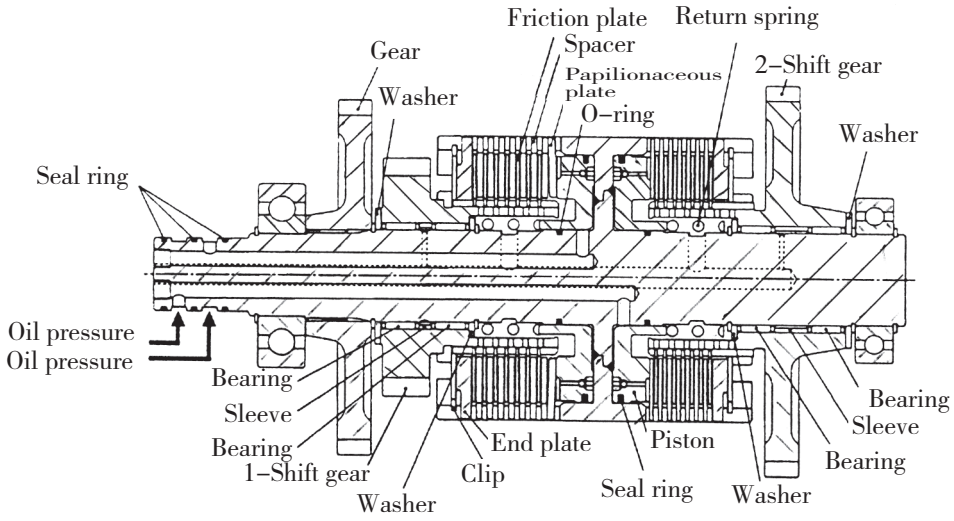

Fig.3.5 Reverse Clutch

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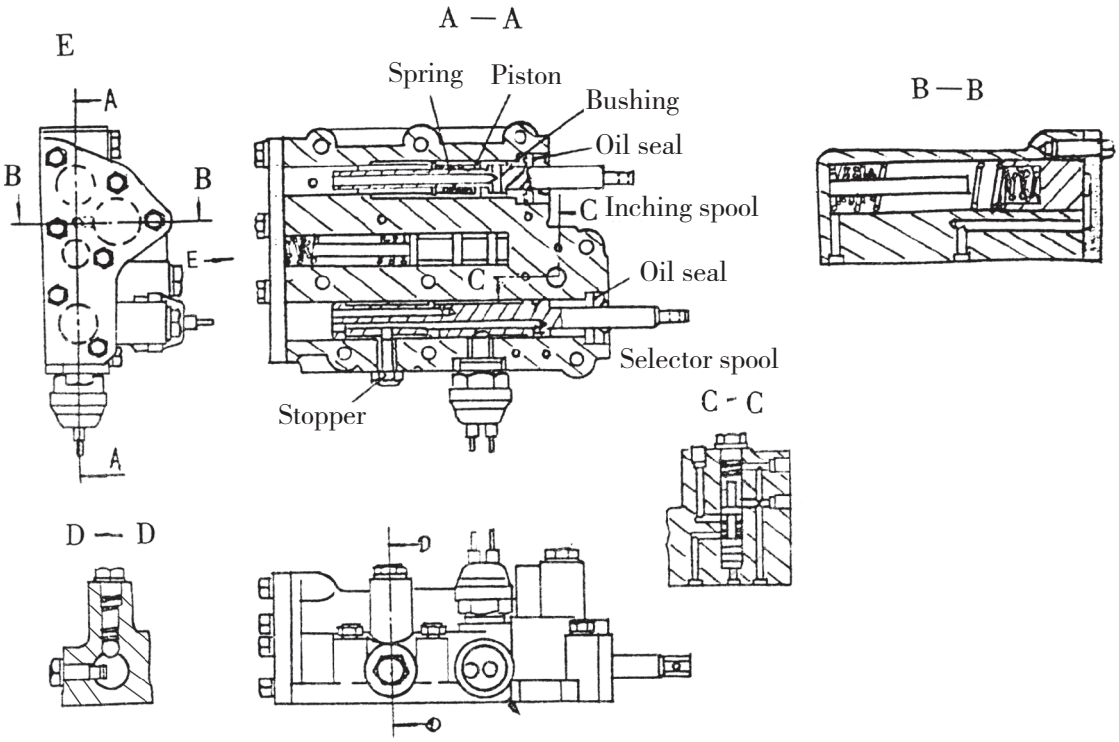

Fig.3.6 Control valve

The control valve is provided on the upper part of transmission case.The change spool and inching spool are incorporated in the valve body.

The clutch relief valve is designated to adjust the hydraulic pressure of the hydraulic pressure of the transmission clutch.The converter relief valve serves to adjust the hydraulic pressures of fluid which fills the converter.

The inching spool is connected to the link of brake pedal.When the brake pedal is depressed,the spool is forced in,so that hydraulic pressure of clutch is lowered temporarily to disengage the clutch.

3.6 Hydraulic circulation system(See fig.3−7)

When the engine is started and the charging pump is put into operation,the torque converter fluid in the oil tank (transmission case) is forcibly sent to the control valve from the pump through the strainer.

The fluid sent from the charging pump is divided to two directions in the torque converter case,one for torque converter and the other for transmission.

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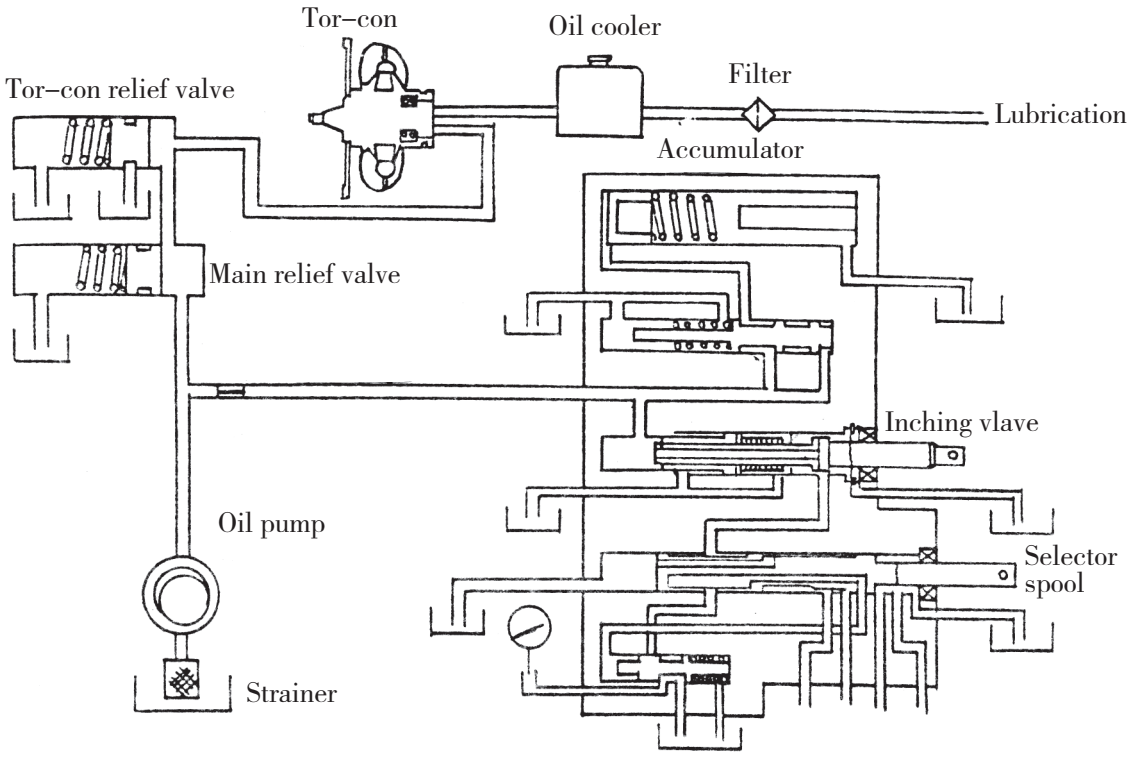

Fig.3.7 Tor–con hydraulic system

Pressur of the fluid for clutch is adjusted to 1.2 to 1.5 MPa with the relief valve.And then it is supplied to the control valve.Pressure of the fluid divided for the converter is adjusted to 0.5 to 0.7 MPa with the converter relief valve.After that this fluid reaches the wheel of torque converter.After it is cooled by the oil cooler,it lubricates the clutch group and then returns to the oil tank through the filter.

When the selector valve is in neutral position,the circuit from the selector valve to the clutch is closed.Therefore the fluid is joined with the torque converter filling fluid.

When the selector spool is set to the forward or reverse position,fluid flows into the accumulator due to action of modulate valve,so that pressure rises gradually,During this time the clutch starts to engage.

When the accumulator is filled with fluid,hydraulic preesure rises intensively so that the hydraulic clutch is completely engaged.

While the forward or reverse clutch is operating,another clutch is rotating between the sintered plates and the steel plates.Therefore this part is lubricated with oil sent from the oil cooler to prevent seizure of plates.

When the brake pedal is depressed and the inching valve is actuated,most of

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hydraulic oil supplied to the clutch is drained from the inching valve and returns to the transmission case.The fluid for the torque converter circulates in the same manner as in neutral state.

3.7 Cautions when the machine trouble occurs

When the machine with Tor-Co-Matic transmission cannot run by itself due to trouble and it must be dragged with another machine,be sure to observe the following requirements.

(1) Remove the propeller shaft between the differential and the transmission.

(2) Set the change lever in neutral position.

Since the torque converter pump does not operate,normal lubrication is not performed.Therefore,if rotation is transmitted from the front wheel to the transmission gear and clutch disk,seizure may occur.

3.8 Troubleshooting Guide

(1) Low power:see Table 3-2

(2) Abnormal rise of oil temperature:See Table 3-3

(3) Noisy transmission:see Table 3-4

(4) No power transmission:See Table 3-5

(5) Oil leakage:See table 3-6

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	Possible causes	Checking method	Remedy
Torque Converter	A.Oil pressure too low		
	(1) Low oil level	Check oil level	Add oil
	(2) Air sucked from suction side.	Check joints and pipe	Retighten and replace packing
	(3) Clogged oil filter	Disassemble and check	Clean or replace
	(4) Insufficient discharge of pump	Disassemble and check	Replace
	(5) Main relief valve coil spring deteriorated	Check spring tension	Replace
	(6) Seal ring or O–ring damaged or worn.	Disassemble,check and measure.	Replace
	B.Flywheel damaged or in contact with other parts	Drain a small quantity of oil and check for presence of foreign matter.	Replace
Transmission	A.Improper oil is used or bubbles are foamed.	Check	
	(1) Air sucked from suction side.	Check joints and pipes	Retighten or replace
	(2) Torque converter oil pressure is too low and bubbles are foamed.	Measure pressure.	Adjust pressure
	B.Clutch slips		
	(1) Low oil pressure	Measure pressure	Adjust pressure
	(2) Seal ring worn	Disassemble,check and measure	Replace
	(3) Clutch piston ring worn	Disassemble and check	Replace
	(4) Clutch disks are burned and plates deformed.	Disassemble and check,Start engine and place direction control lever in forward, reverse and neutral respec–tively.Truck runs with the lever in neutral but not in fwd.or bwd.	Replace
	C. Link lever between brake shift and valve spool is improperly positioned.	Check and measure.	Adjust
Engine	Engine power drops	Check STALL rmp.Check working sound of enginge. Check maximum rmp of engine with gears in neutral.	Adjust or repair engine

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	Possible Causes	Checking Method	Remedy
Torque Converter	1.Low oil level	Check oil level	Add oil
	2.Clogged oil filter	Disassemble and check	Clean or replace
	3.Flywheel is in contact with other parts	Drain oil from oil filter or oil tank and check for foreign matter.	Replace
	4.Air is sucked	Check joints and piping at suction side	Retighten or replace gasket
	5.Water mixed in oil	Drain and check oil	Replace oil
	6 Low flow rate of oil	Check piping for damage or bending	Repair or replace
	7. Bearings worn or seized	Disassemble and check	Repair or replace
Transmi-ssion	1.Clutch drags	Check whether the truck runs with gears in neutral.	Replace clutch plates
	2.Bearings worn or seized	Disassemble and check	Replace

	Possible Causes	Checking Method	Remedy
Torque converter	(1) input plate broken	Check rotational sound at low rmp.	Replace input plate
	(2) Bearings damaged or worn	Disassemble and check.	Replace
	(3) Gears broken	Disassemble and check.	Replace
	(4) Spline worn	Disassemble and check.	Replace
	(5) Noisy gear pump	Disassemble and check.	Repair or replace
	(6) Loose bolts	Disassemble and check.	Retighten or replace
Transmission	(1) Bearings worn or seized	Disassemble and check.	Replace
	(2) Gears broken	Disassemble and check.	Replace
	(3) Spline worn	Disassemble and check.	Replace
	(4) Loose bolts	Disassemble and check.	Retighten or replace

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	Possible Causes	Checking Method	Remedy
Torque Converter	(1) Input plate broken	Check rotational sound at low rmp and check whether front cover rotates	Replace
	(2) lack of oil	Check oil level	Add oil
	(3) Driving system of oil pump malfunctioning	Disassemble and check	Replace
	(4) Shaft is broken	Disassemble and check	Replace
	(5) Oil pressure is too low	Check whether suction pressure generates at inlet side of pump	Replace
Transmission	(1) Lack of oil	Check oil level	Add oil
	(2) Damaged seal ring	Disassemble and check	Replace
	(3) Clutch plates seized	Check clutch oil pressure	Replace
	(4) Shaft is broken	Disassemble and check	Replace
	(5) Clutch cover broken	Disassemble and check	Replace
	(6) Snap ring for clutch cover is broken.	Disassemble and check	Replace
	(7) Foreign material in clutch oil tank	Disassemble and check	Clean or replace
	(8) Spline part of shaft is worn	Disassemble and check	Replace

	Possible Causes	Checking method	Remedy
Torque Converter and transmission	(1) Damaged oil seal	Disassemble and check.Oil seal lip or its mating sliding part is worn.	Replace oil seal
	(2) Case connected improperly.	Check	Retighten or replace gasket.
	(3) Loose joints and piping	Check	Repair or replace gasket.
	(4) loose drain plug	Check	Retighten or replace gasket
	(5) Oil is ejected from breather	Drain oil and check for mixing of water. Check whether air is sucked from suction joint. Check air hole of air breather.	Replace oil. Retighten or replace packing. Repair
	(6) Excessive oil	Check oil level.	Remove excess oil.

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4.Front Axle

The main specifications of the front axle see Tale 4–1.

		5–7t	8–10t
Type		Cast–steel,full–floating type	
Main reduction	Type	Spiral bevel pinion type	
	Reduction ratio	4.75	6.33
Hub reduction	Type	Planetary gear type	
	Reduction ratio	4.25	3.75
Total reduction ratio		20.19	23.75
Oil amount	Main reduction,differential	10L	
	Hub reduction	Left and right each 8L	Left and right each 10L
Driving wheel	Tire(left and right each 2)	8.25–15–14PR	9.00–20–14PR
	Rim	6.50–15	7.0–20
	Air pressure KPa	830	760

4.1 General Description

The front axle that consists of a main reduction,differential,hub reduction and brakes as shown in fig.4–1 and fig.4–2 is bolted to the front side of the frame.The masts are installed on the axle housing.

4.2 Main reduction and Differential

The main reduction and differential consists primarily of a cross case,ring gear and drive pinions,which are all assembled on the differential carrier as shown in fig.4–3,and is fitted to the axle housing through packings.

The cross case is of the split type.The cross case,assembled with bolts,contains side gears and pinions fitted to the spider,being in mesh with each another.The drive pinions supported by two taper roller bearings are installed in the bearing cage fitted to the differential carrier through shims and packings.The ring gear is of the spiral bevel gear type.It is bolted to the cross case.Power from the transmission is reduced by the combination of the ring gear and drive pinions.

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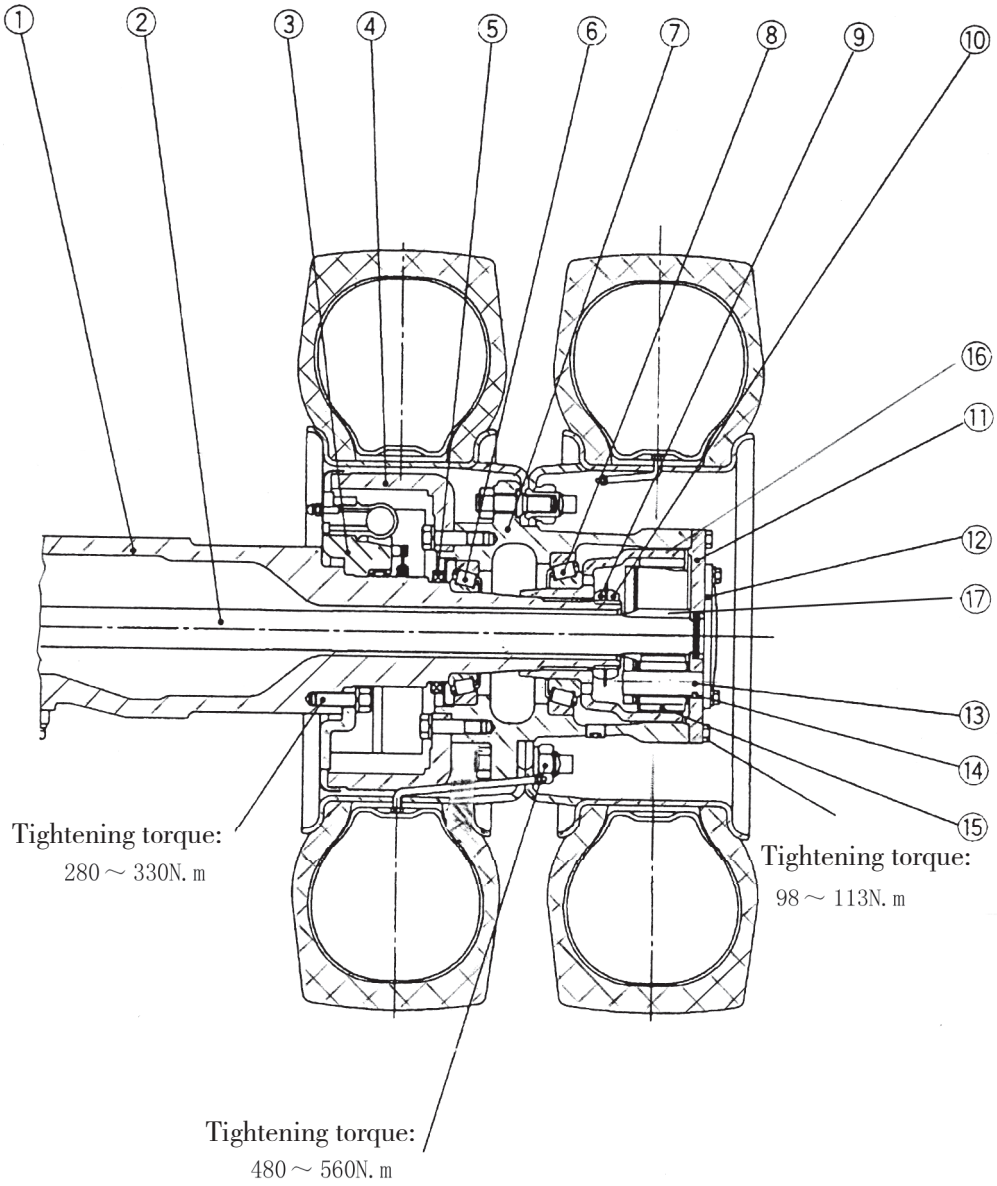

Fig.4–1 Front axle(5–7t truck)

1.Axle house	2. Half–shaft	3. Wheel brake	4.Brake drum
5.Oil seal	6.Taper roller bearing	7.Hub	
8. Taper roller bearing		9.Adjust nut	10.Lock nut
11.Planet carrier	12.Thrust cap	13.Shaft	14.Steel ball
15. Planet gear	16.Gear	17.Sun gear	

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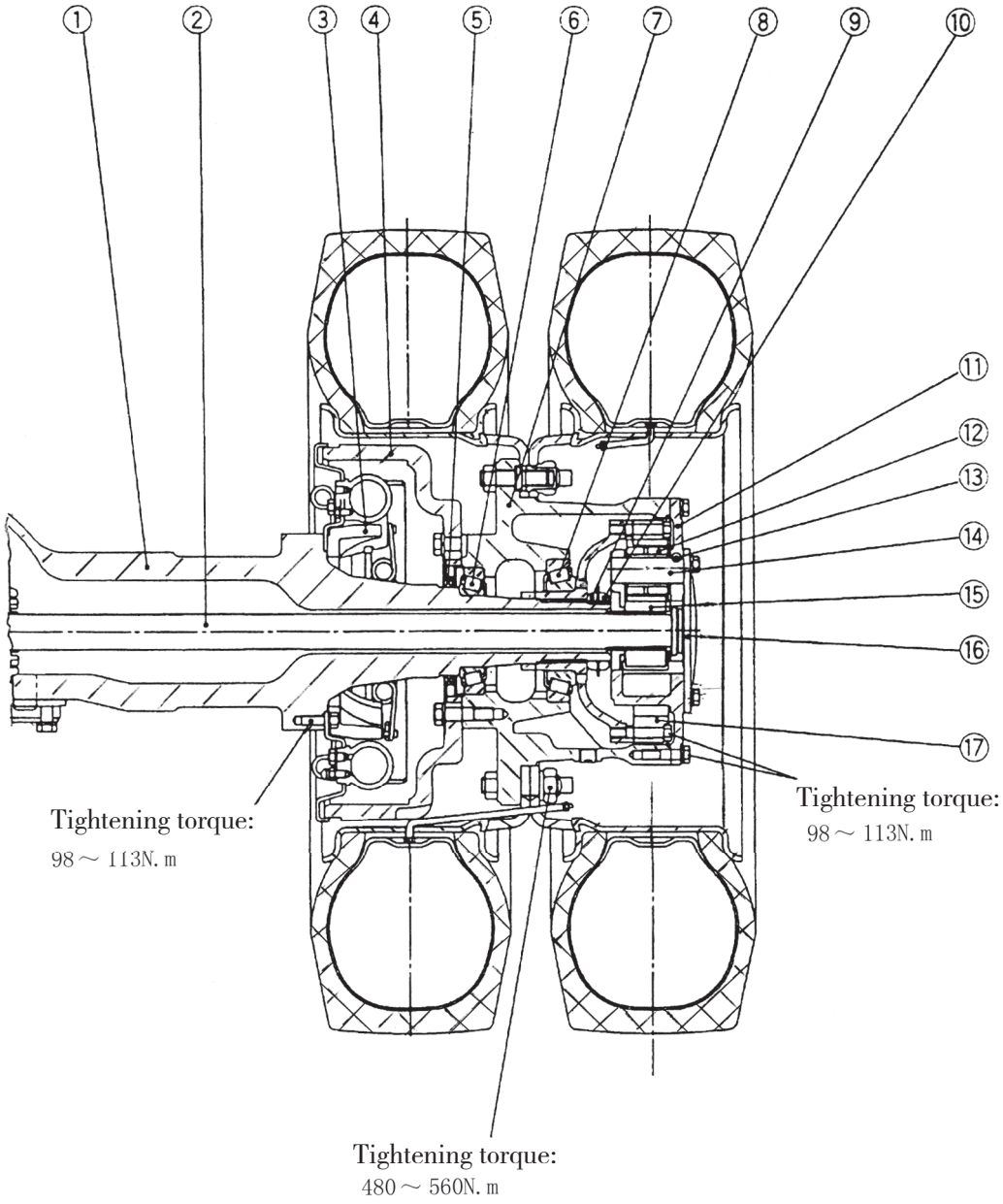

Fig.4–2 Front axle(8–10t truck)

1.Axle house	2. Half–shaft	3. Wheel brake	4.Brake drum
5.Oil seal	6.Taper roller bearing	7.Hub	
8. Taper roller bearing		9.Adjust nut	10.Lock nut
11.Planet carrier	12.Thrust cap	13.Steel ball	14.Shaft
15 Sun gear	16.Thrust cap	17.Gear	

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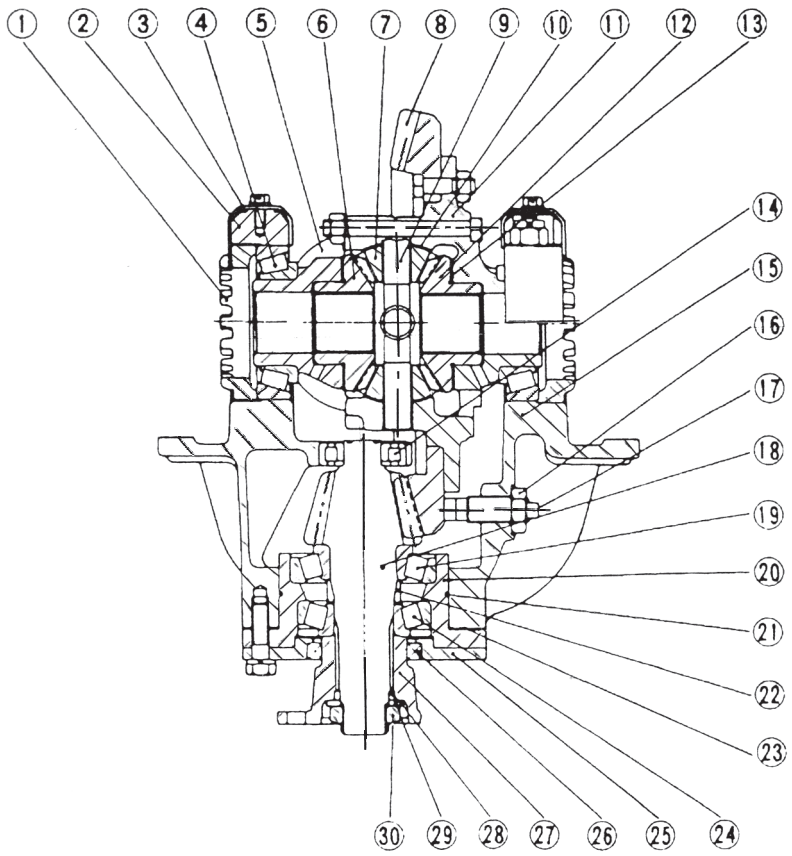

Fig.4–3 Main reduction,differential

1.Adjust nut	2.Thrust cap	3.Lock plate
4.Tapper roller bearing	5.Differential house	6.Half–shaft gear
7.Planet gear	8.Gear	9.Spider
10.Thrust washer	11.Differential house(right)	12.Half–shaft gear
13.Thrust washer	14.Needle bearing	15.Main reduction house
16.Lock nut	17.Adjust nut	18.Driving pinion
19.Taper roller bearing	20.Bearing cage	21.O–ring
22.Spacer	23.Shim	24.Taper roller bearing
25.Oil seal carrier	26.Oil seal	27.Flange
28.O–ring	29.Washer	30.Lock nut

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4.3 Hub reduction

The hub reduction is of the planet gear type consisting of a sun gear,planetary gears and an internal gear.Two hub reduction are installed on each end of the axle housing.The sun gear is splined to the axle shaft and locked with snap ring.The planetary gears are installed onto the shafts in the planet carrier which is fixed to the wheel hub.The internal gear is splined to the axle spindle through hub.

The principle of power transmission is as follows(see fig.4–4): When the sun gear turns,the rotation is transmitted to the pinion gears and ring gear.However,since the ring gear is fixed to the spindle,the pinion gears revolve around the sun gear while spining themselves.The pinion gears are installed to the carrier which is fixed to the wheel hub,therefore,power of the drive shaft causes the wheel to turn.

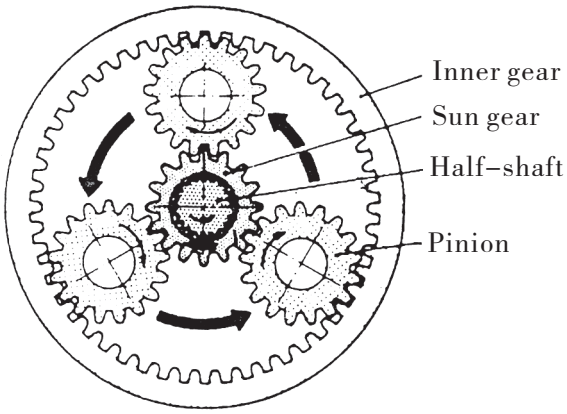

Fig.4.4 Hub reduction

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4.4 Troubleshooting Guide

See Table 4–2

Cause	Trouble	Correction
1. Oil leaks from differential carrier	Loose bolt or broken gasket of differential carrier.	Replace or retighten.
	Breather is clogged.	Clean or replace.
	Oil seal is worn or damage.	Replace.
2. Noisy differential	Gear is worn,damaged or broken.	Replace.
	Bearing is worn,damaged or broken.	Replace.
	Improper backlash	Adjust.
	Loose spline fitness of side gear to propeller shaft	Replace parts.
	Insufficient gear oil	Add as necessary.

4.5 The remedy specifications

See Table 4–3

Part	Item	STD Value
Differential	Thickness of bearing cage shim	0.1,0.2,0.5
	O.D. of oil seal sliding part of companion flange	69.95–70
	Backlash of spline part of companion flange and drive pinion.	0.036–0.067
	Backlash of drive pinion and ring gear	0.20–0.30
	Preload of drive pinion(N.m)	2.5–3.5
	Back swing of ring gear.	0.25–0.38
	Tightening torque of ring gear set bolt (N.m)	100–150
	Tightening torque of cross case set bolt(N.m)	100–150
	Thickness of pinion washers	1.562–1.613
	Backlash of spline of side gear and drive shaft	0.038–0.130
Axle housing	Tightening torque of the set bolt for axle housing and differential carrier(N.m)	150–175
	O.D. of hub bearing fitting part of spindle	89.66–89.88
	O.D. of spindle oil seal sliding part	109.913–110
	Tightening torque set bolt securing axle housing to frame(N.m)	630–946
	Tightening torque set bolt securing brake floor to axle housing	280–330
	O.D. of mast support part(N.m)	189.2–190
Hub	I.D. of hub bearing fitting part (Inside)	159.32–159.72
	I.D. of hub bearing fitting part (Outside)	179.32–179.72
	I.D. of hub Oil seal fitting part	164.6–165
	Tightening torque of set bolt securing brake drum to hub(N.m)	280–330
	Tightening torque of set bolt securing planet carrier to hub(N.m)	98–113
	Tightening torque of hub nut (N.m)	480–560

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5.Brake System

The main specifications of the brake system See Table 5–1.

			CPCD50,60,70		CPCD80,100
			Homeland engine	Import engine	
Wheel brake	Brake type		Vaccum assistant	Power brake	
	Brake model		Front wheel,internal expansion type,lining brake		
	I.D. of brake drum		Φ317.5		Φ438.15
	Wheel cylinder drum		Φ31.75		Φ47.62
	Lining size		324 1 00 1 0		489 1 00 1 2.7
	Surface area of lining cm^2		4 3 24		4 4 89
Parking brake	Type		Transmission middle shaft–mounted,internal expansion mechanical type		
	I.D. of brake drum		Φ160		
	Disk size		140 3 6 3 .5		
	Surface area of disk cm^2		50.4		
Brake pump & valve	Brake cylinder mm		Φ31.75		
	I.D. of Vaccum assistant Fwd/bwd		Φ9" /Φ10"		
	Brake valve	Type:main vale/safety valve		Open core type/Close core type	
		Move model		Spring type	
		Intake flux		27	
		Max.working oil pressure		10.5	
Reserver	Type			Spring type	
	Capacity cc			66.7	
	Piston:I.D. Stroke mm			Φ50 3 4	
	Oil pressure: Max./Working time MPa			7.2/4.9	
	Relief oil pressure			13	

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5.1 General description

The braking system consists of traveling and stopping brakes. The traveling brake is mounted inside the driving wheel, while the stopping brake is mounted on a intermediate shaft at the rear side of the gear box. The traveling brake has two modes of power brake and vacuum brake.

5.2 Power brake (For the schematic diagram of the system, refer to 5.1)

The traveling braking system that adopts the power brake mode consists of brake pedal, brake valve, energy storage and brake.

The power brake is to make use of the pressure oil transferred by pinion pump set specially for the hydraulic system of forklift, one way of oil enters into brake valve and the sub-pump of brake to produce braking, while the other way of oil enters into accumulator to store energy for spare use. Both ways of the oil are controlled by the stroke of brake pedal.

5.2.1 Brake pedal device (See Fig. 5.2)

Brake pedal and inching pedal are mounted at the left side of the frame through a bracket. The brake pedal at the right side pushes forward the piston assembly of brake valve through connecting bar and makes the pedal control the pressure oil. The inching pedal at the left side and brake pedal at the right side play the role of linkage and can manipulate the brake valve and the inching valve of gearbox as well.

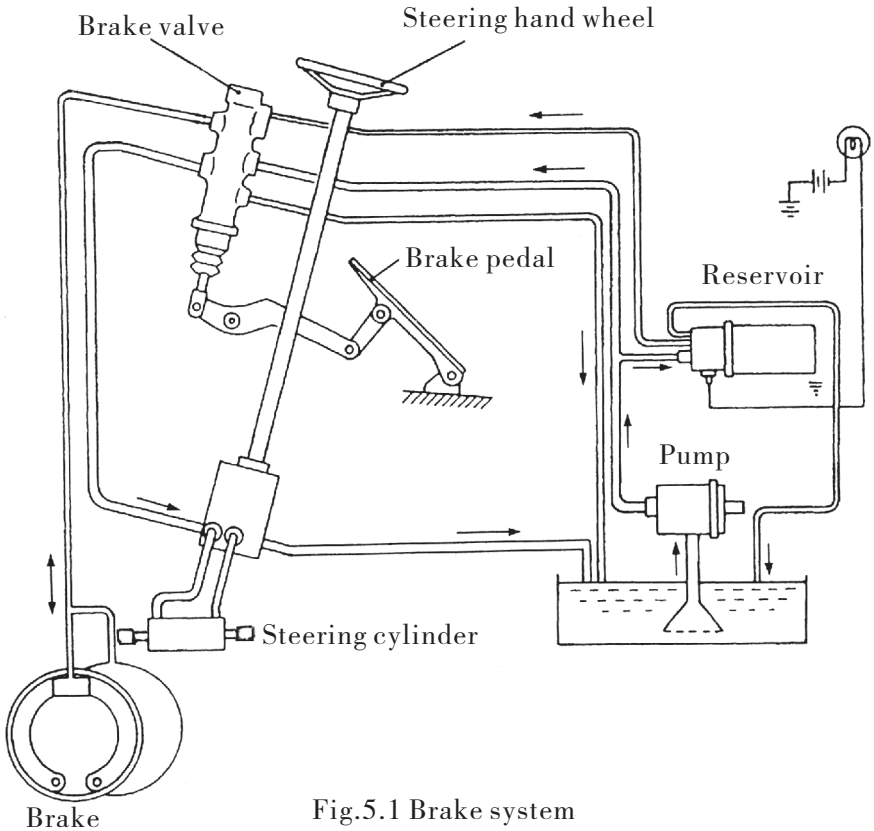

Fig.5.1 Brake system

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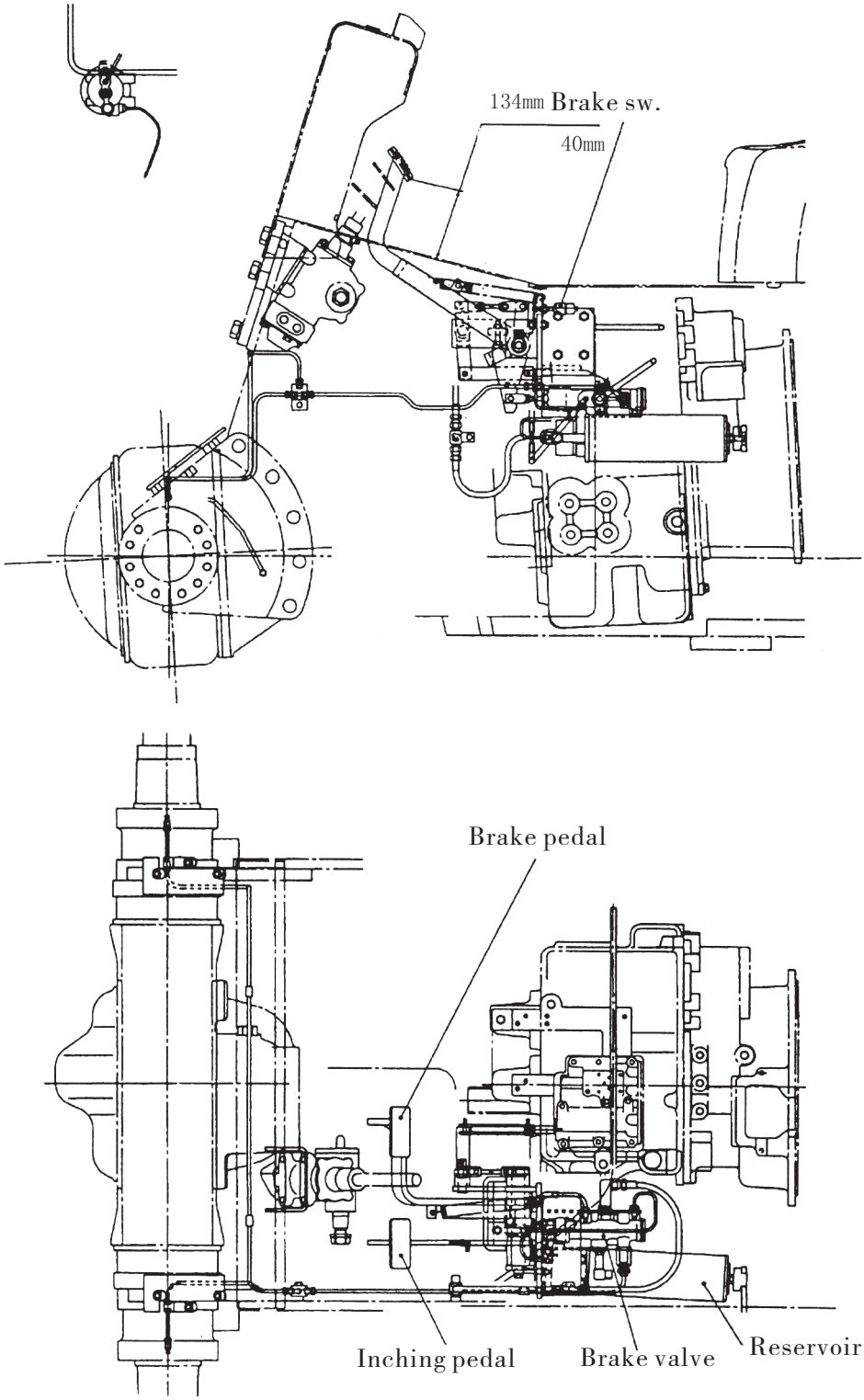

Fig.5.2 Brake pedal unit

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5.2.2 Brake valve (See Fig. 5.3)

(1) Non-brake status

In case of not-braking state and due to opening of port A of brake valve , the pump interface and the steering interface are interlinked and the steering works normally. When the brake pedal is not stepped on, even if the steering operation will not produce braking, the oil pressure of control oil pressure chamber D will not rise as the port B is closed at this time.

(2)Starting and finishing of the braking

A 、When the brake pedal is stepped on, the piston assembly (part NO.10) moves to the left , the valve sleeve (part NO.7) and backflush piston (part NO.5) are pressed to the left side by the spring set (part NO.8) and meanwhile the return spring (part NO.6) is compressed to the left side .

B、The movement of work piece (part NO.7) closes the place A, breaks the interface of D and oil return tank. B opens correspondingly and makes D chamber and pump interface connect.

C、At this time, the valve sleeve (part NO.7) moves to the left and the oil pressure that leads to the sub-pump of brake rises along with the increase of oil pressure of pump interface and chamber D due to compression. Meanwhile, the relatively higher oil pressure in chamber D moves to the right and push the backflush piston (part NO.5) and this pushing force is in balance with pedal force.

D、When the maximum pedal force is input in the right end of piston and in order that the oil pressure of D chamber will not exceed the maximum adjusting oil pressure, the bolts and pedal brackets are used for position limitation.

E 、When your foot leaves off the pedal , the counterforce of backflush piston and the spring counterforce of work pieces (part NO.6) and (part NO.8) return the valve sleeve (part NO.7) to the original position and the braking process is finished.

(3)The working process of accumulator

When the oil pump stops working, (due to engine stops) or is damaged, the accumulator needs to enter into working state.

A 、When the brake pedal is further stepped on, valve sleeve (part NO.7), back flush piston (part NO.5) and contact pin of check valve move together towards left, the contact pin will prop open the ball and chamber D and accumulator are interlinked at this time and the pressure oil of accumulator is utilized to play the braking role for brake sub-pump.

B. When your foot leaves off the pedal, the valve sleeve , back flush piston and contact pin move to the right at the same time. The ball of the check valve restores joining with valve seat under the action of spring force (check valve closes) and the contact pin stops at this position correspondingly.

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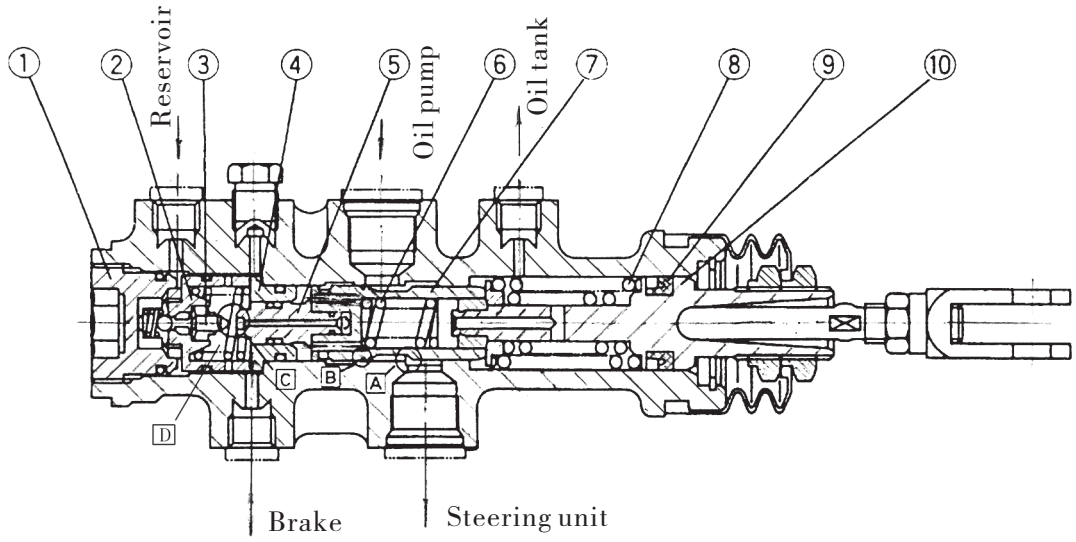
C. The backflush piston moves to the right and C open to make the oil of brake sub-pump of brake return to the fuel tank through chamber D.



1.Plug 2.1-way valve seat 3.1-way valve pin 4.Bounce-back piston seat
5. Bounce-back piston 6. Return spring 7. Valve sleeve 8.Spring
9.Oil seal 10.Piston ass'y

Fig.5.3 Brake valve

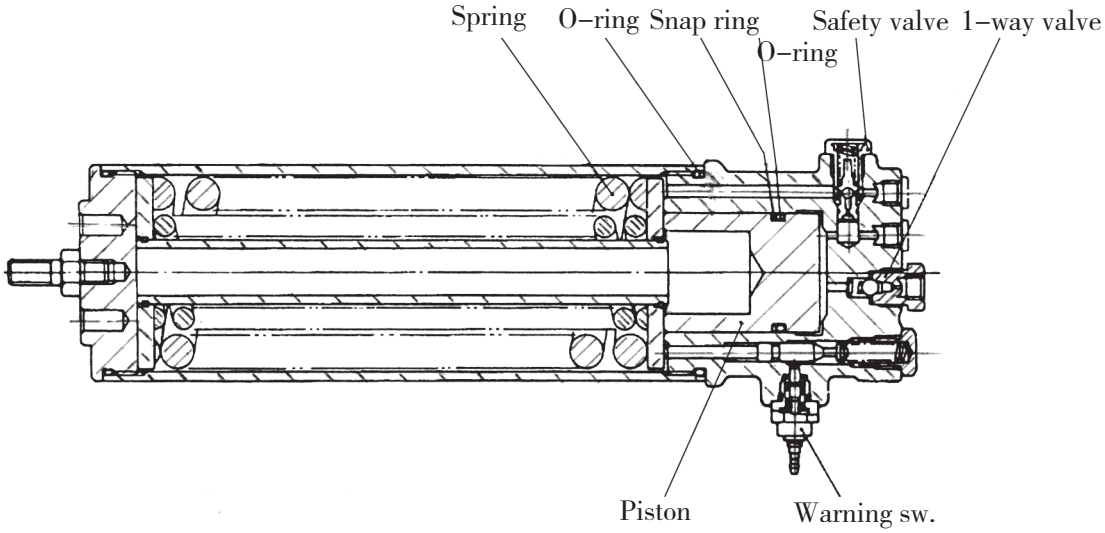


Fig.5.4 Reservior

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5.2.3 Accumulator (See fig. 5.4)

When the engine stops working or there is trouble on the oil pump, the accumulator can be used as the abnormal (extra) energy to meet the needs of braking.

The accumulating mode is of spring type.

The Fig. Shows the non–accumulating state and the buzzer of alarming switch is in normal sounding state.

When the brake pedal is operated and the oil pressure reaches over 3.9 MPa, the check valve opens and feeds the oil to the accumulator so as to push forward the piston.

Move to the left and compress the combined spring to set up oil pressure.

Meanwhile, the piston moves towards left and makes the switch control lever at alarming switch moves towards left under the action of spring pressure and the switch valve spool drop into recess of switch control lever. Now the alarm is in the silence state.

With the increase of oil pressure of the pump, the left moving stroke of the piston is restricted by the stop tube in the middle of combined spring. The accumulator stores the maximum energy at this time and the oil pressure is 13 MPa, which is controlled by safety valve.

5.3 Vacuum servo brake

5–7t forklift that matched with domestic machine adopts vacuum servo brake, i.e. vacuum booster and main brake cylinder (main pump) assembly to realize the servo brake.

The vacuum booster is to use vacuum (negative pressure) as dynamic force (use the pressure difference between vacuum pressure and atmosphere) to obtain the higher oil pressure of sub–cylinder (sub–pump) of brake under the action of light brake pedal force of operator and play the role of boosting and force saving, thus alleviating the working strength of drivers and improving the safety of traveling brake.

For main technical performances, See Table 5.2

Name		Metering unit	Value
Effective diameter of vacuum cylinder	Maximum	mm	Φ 263
	Minimum	mm	Φ 236
Maximum stroke of vacuum servo brake		mm	39
Servo ratio			7
Main brake cylinder	Diameter	mm	Φ 31.75
	Maximum stroke	mm	38
	Front cavity displacement	ml	15.8
	Rear cavity displacement	ml	14.2
Maximum outside diameter of the assembly		mm	Φ 272
Dimension of mounting plate		mm	60 80 , 4–M8 hole
Oil outlet dimension		mm	2–M10 1
Dead weight		kg	5.3

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5.3.1 Vacuum booster and main brake cylinder assembly

The outline dimension of 9″ +10″ dual-diaphragm vacuum booster and main brake cylinder assembly used for the forklift 5-7t is shown in Fig. 5.5 and the internal structure is in the Fig. 5.6. The working status of the assembly is briefed as follows:

(1) Non-working status

When the vacuum booster does not work, the big cone spring 3 pushes the push rod 1 of control valve together with piston 5 of control valve to the rear end limiting position, while control air valve 4 is pressed tightly against work piece 5 by small cone spring, thus closing the air valve port. The two cavities of air cell of booster are interconnected through channel A, control valve cavity and channel B and are isolated with the atmosphere. When the engine and vacuum pump are working, there is a certain vacuum degree in both front and rear cavities of the air cell of the booster.

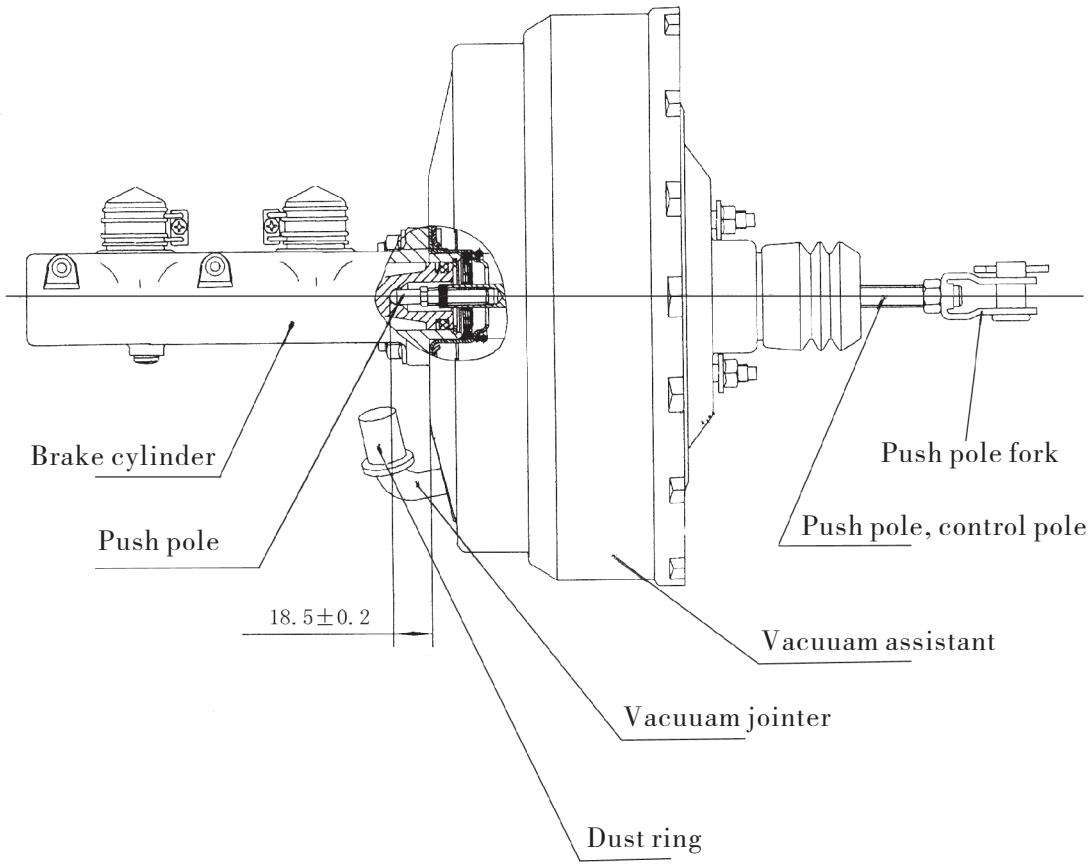

Fig.5.5 Vacuum assistant and brake cylinder

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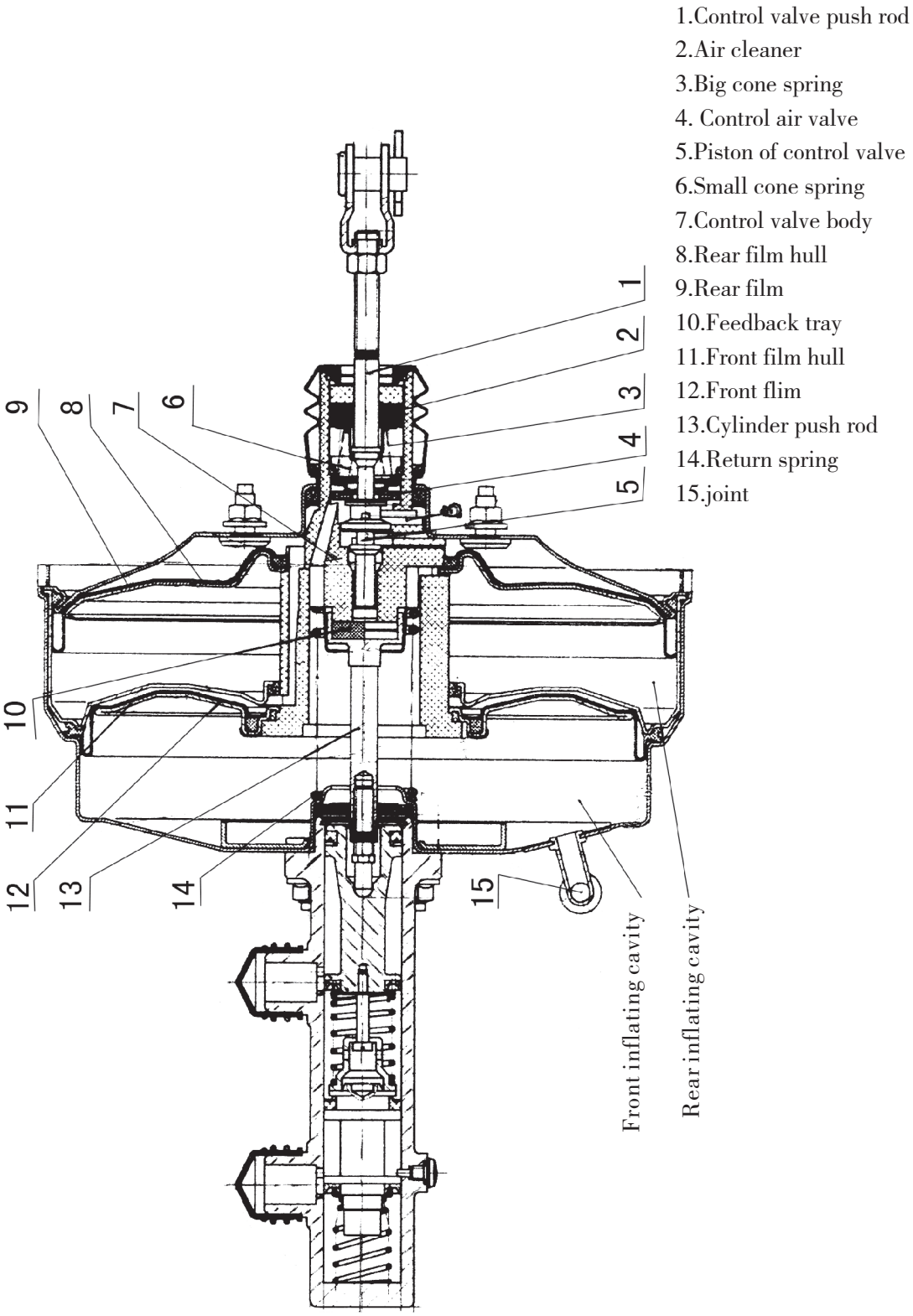

Fig.5.6 Vacuum booster and main brake cylinder constructure

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(2) Working conditions of braking

A 、As soon as the brake pedal is stepped on, the pedal acts on the control valve rod 1 after the pedal force being amplified by lever and compresses the work piece 3 and moves forward with work piece 5. Certain pressure will be produced inside main brake cylinder through the actions of feed back disc 10 and push rod 13 of main cylinder and transmitted to the sub-cylinder (sub-pump) of brake inside the braking wheel 5. Meanwhile, the control air valve 4 moves forward together with work piece 5 under the action of small cone spring 6, contacts with vacuum valve port on control valve body 7 and closes it, thus isolating the front and rear cavities of the air cell of booster. (i.e. the rear cavity of air cell of booster disconnects with vacuum source.

B 、With the continuous moving forward of the push rod 1 of the control valve , the piston 5 of control valve leaves work piece 4, the outside atmosphere fills into the rear cavity of air-cell of booster through air filter pad 2 , control valve cavity and channel B. Thus, most of the acting force caused by the two cavities of air cell of booster, except a small part of it is used to balance the acting force of big cone spring 3, acts on the feed back disc through control valve body 7 and is transmitted to the main brake cylinder, thus playing the boosting role.

(3)The braking process terminates and the non-working state resumes

A、In the course of stepping on the brake pedal(the push rod of control valve moves forwards), the air through the air valve port opened constantly enters into the front and rear cavities of air cell of booster and control valve body constantly moves forward. When the brake pedal stops being stepped on and stays at a position, the control valve body moves forward with it and stops at the position that can close the air valve port. Now, the vacuum valve port and air valve port are closed and the booster is in the balanced state, i.e. the air pressure difference of the front and rear cavities of the air cell of the booster remains balanced with the oil pressure of the oil in main brake cylinder and pushing force of push rod of control valve and the wheel brake is under the braking state.

B 、When the brake pedal is released, the push rod 1 and piston 5 of the control valve are pushed backward at once under the action of return spring 14 and big cone spring 3 and make the control air valve 4 separate with vacuum valve port, thus a braking process is finished and the original non-working state restored.

5.3.2 Installation method for vacuum booster and main brake cylinder assembly

(1) Connect the 4-8M bolt of booster with mounting bracket, then mount it on the frame of forklift, connect the adjusting fork at the end of booster with connecting bar of brake pedal, then tightened 4-M8 bolts. The tightening moment is 12N.m-18N.m.

(2) Connect the vacuum host to the vacuum pipe connector of booster and keep it sealed.

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(3) Connect the brake oil pipe with the 2–M10 1 thread at oil outlet of main cylinder of brake. The tightening moment is 12N.m–16N.m.

(4) Open the screwed cover of liquid storage tank, fill in the brake liquid (the dust or impurities are not allowed to enter) and drain off the air inside the entire braking system.

(5) When the main cylinder of brake or vacuum booster is independently changed, the tightening moment of the connecting nut between the two is 12 N.m–18N.m.

(6) Please do not easily adjust the vacuum booster and push–rod head of main brake cylinder matching surface.

5.3.3 Points of attention for users

(1) The product must use the braking liquid stipulated in the instruction.

(2) The air in the pipes must be drained completely after the assembly is added with braking liquid.

(3) Observe if the liquid level of storage tank is in the middle position after exhaust.

(4) The troubles listed in Table 5.3 must be repaired by the professional personnel with qualification and the users are not allowed to dismantle it without authorization.

5.3.4 Trouble shooting and cause analysis (See Table 5.3)

Trouble and phenomenon	Analysis
No oil pressure set up in two cavities or in one of them of the main cylinder, which is reflected by: Pedal stroke becomes bigger	1. The leather ring of main cylinder wears. 2. The oil outlet pipe is damaged.
The output oil pressure is not big and pedal force becomes heavy.	1. The vacuum of booster leaks. 2. The vacuum pipe of engine leaks
The oil storage tank often lacks oil.	1. The joint at oil cylinder leaks. 2. The leather ring of the first piston wears.
The brake pedal is low and soft.	1. There is air in the oil circuit system 2. The clearance between push rod of booster and piston of main cylinder is too big.

5.4 Travel brake

Travel brake is an internal expanding and shoe brake. There is one symmetrically on the left and right each, which are mounted respectively in the two driving wheels. Brake is composed of a pair of braking shoes (one primary and one secondary), brake sub–pump (one for 5–7t truck and two for 8–10t truck), a clearance adjuster, three or four return springs and bottom plate of brake. A friction disc is riveted on the outside of braking shoe. Clearance adjuster is used to adjust the clearance between friction disc of braking shoe

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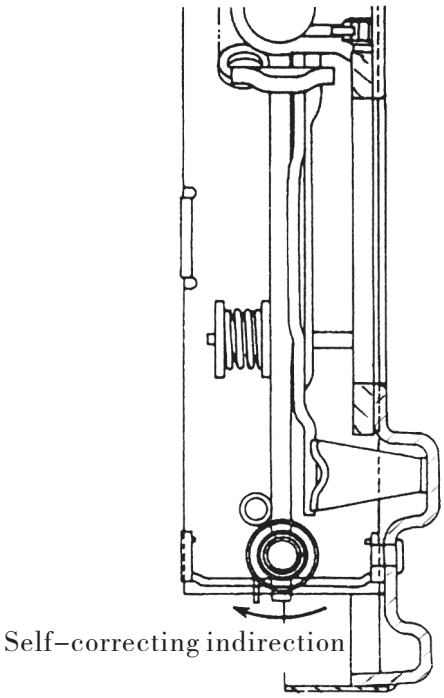
and internal wall of braking drum.



Fig, 5.7

5.4.1 Travel brake (5–7t forklift truck) (See Fig. 5.8)

There is only one brake sub–pump on travel brake of 5–7t forklift and the two ends of its piston rod contact with the upper end of primary and secondary braking shoes respectively. The lower end of primary and secondary braking shoes contact with the both ends of clearance adjuster and are pressed against the bottom plate of brake by spring and rod for setting lever spring.

The automatic clearance adjusting device generally plays the role when the forklift brakes for reversal i.e. when the adjusting lever has a large clearance, the gear on the automatic adjuster turns a tooth and makes the clearance after adjustment remain at 0.4 to 0.6mm. For the adjustment of rotation direction of the gear, See Fig. 5.7.

Because the braking of 5–7t forklift has two open–types, there are two kinds of material used for leather bowl of brake sub–pump, i.e. the leather bowl of dynamic braking type uses oil–resistant rubber and the leather bowl of vacuum assisted type is made up of leather or synthetic leather. More attention should be paid in changing parts and fittings.

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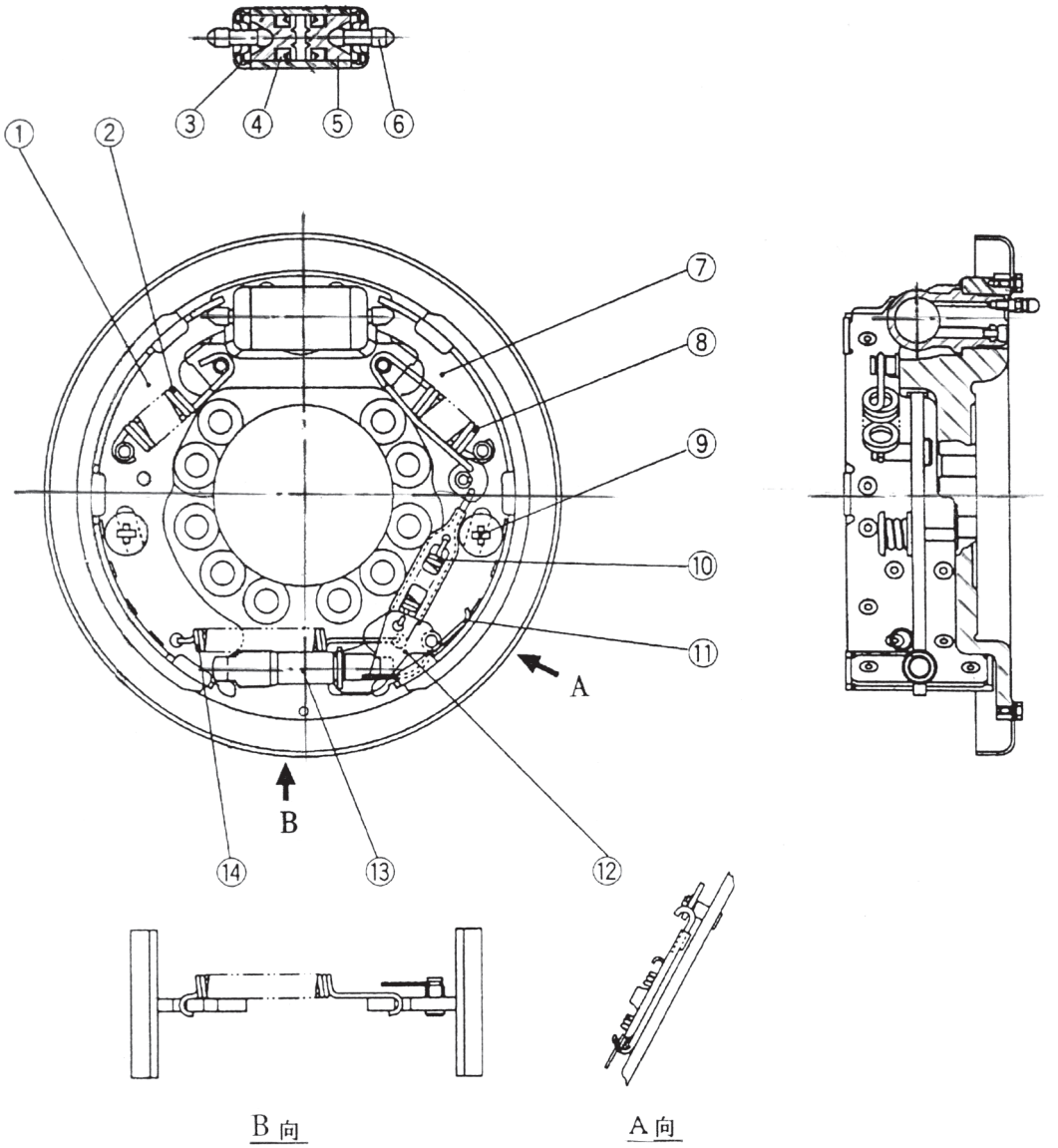

1.Brake shoe
2.Return spring
3.Dust ring
4.Boot
5.Piston
6.Push rod
7.Secondary shoe
8.Returning spring
9.Securing pin for shoe
10.Compression spring
11.Self–adjuster spring
12.Adjuster lever
13.Adjuster
14.Return spring

Fig.5.8 Brake(5–7t)

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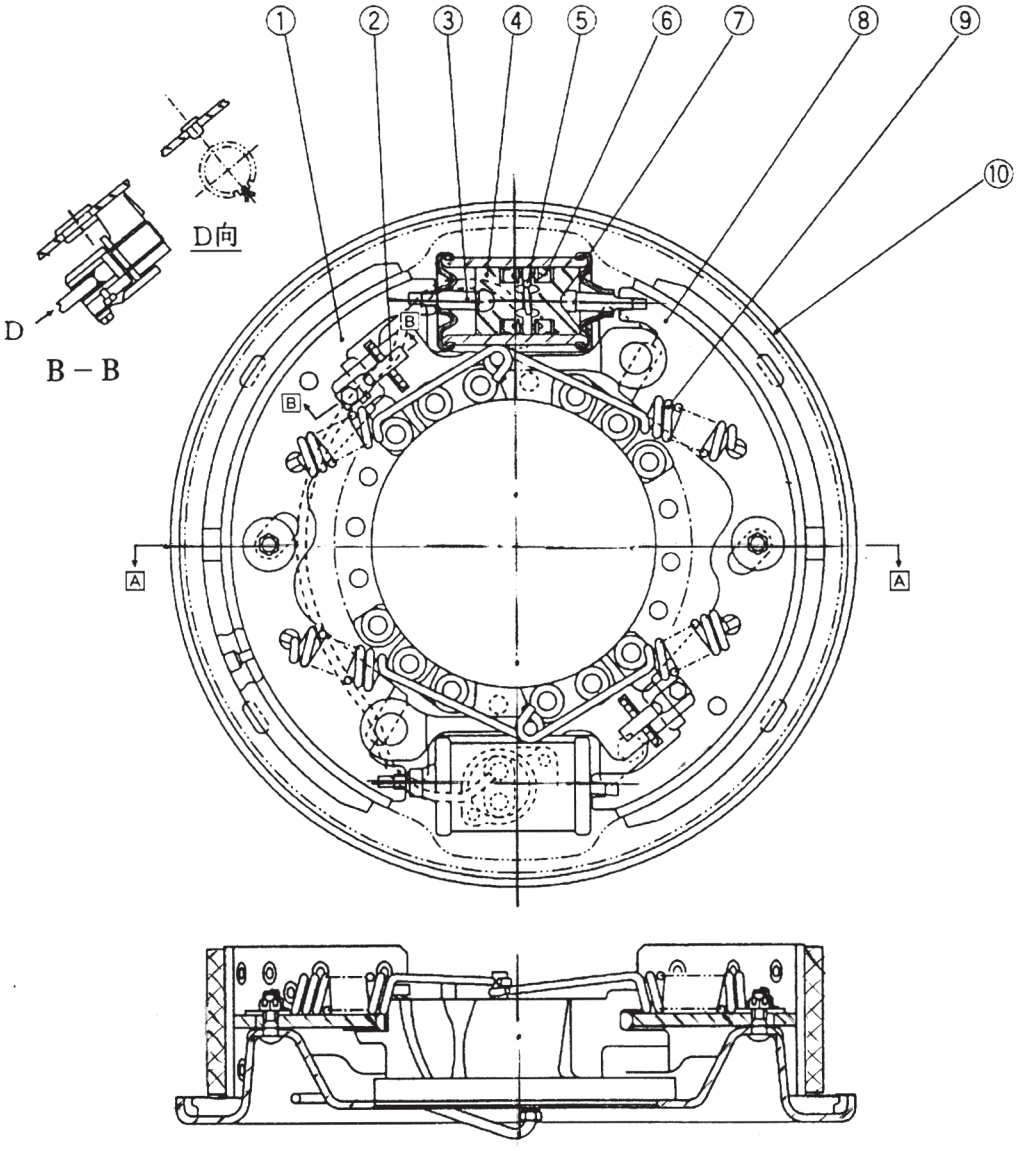

1.Brake shoe
2.Adjuster
3.Push rod
4.Piston
5.Spring
6.Boot
7.Dust hood
8.Secondary shoe
9.Return spring
10.Brake floor

Fig.5.9 Brake(8–10t)

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5.4.2 Travel brake (8–10t forklift truck) (See Fig. 5.9)

There are two brake sub– pumps for travel brake of 8–10t forklift. The upper and lower ones contact with two ends of primary and secondary braking shoes and the clearance adjuster is next to the brake sub–pump.

When the clearance is adjusted, remove the rubber cover installed at the adjuster location on the bottom plate of the brake and the tooth of the adjuster is rotated from inside to outside with screwdriver until the friction disc contacts with the inner wall of braking drum. Then the tooth of the adjuster is back rotated about 5 or 6 splines. (See Fig. 5.10)

8–10t forklift adopts dynamic braking and the material used for leather bowl of brake sub–pump is oil–resistant rubber. More attention should be paid in the replacement.

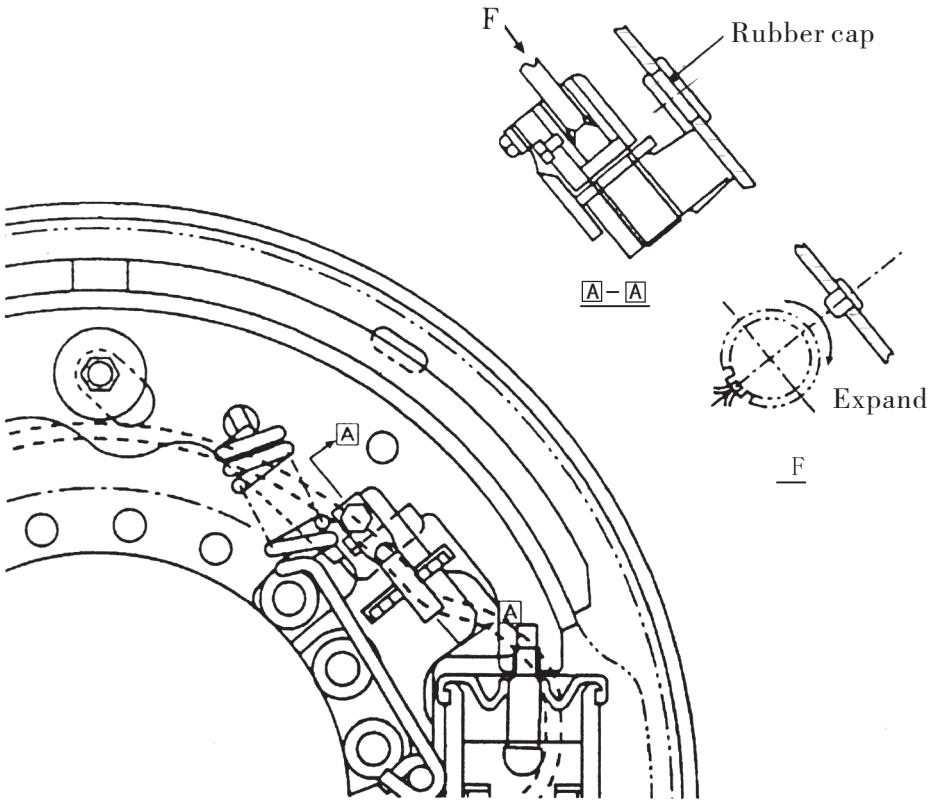

Fig.5.10

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5.5 Stop brake

Stop brake is an internal expanding and shoe type brake and is installed on the output end of one intermediary shaft at the rear side of the gearbox. (See No. 9 of Fig. 3.1) For detailed structure, See Fig. 5.12.

The operation of stop brake is shown in Fig. 5.11. When the forklift is under the standard loading state and stop brake is made on the slope, the manual operating force should be not bigger than 300N. The pulling force is adjusted according to the direction shown in the Fig and B is the force measurement point.

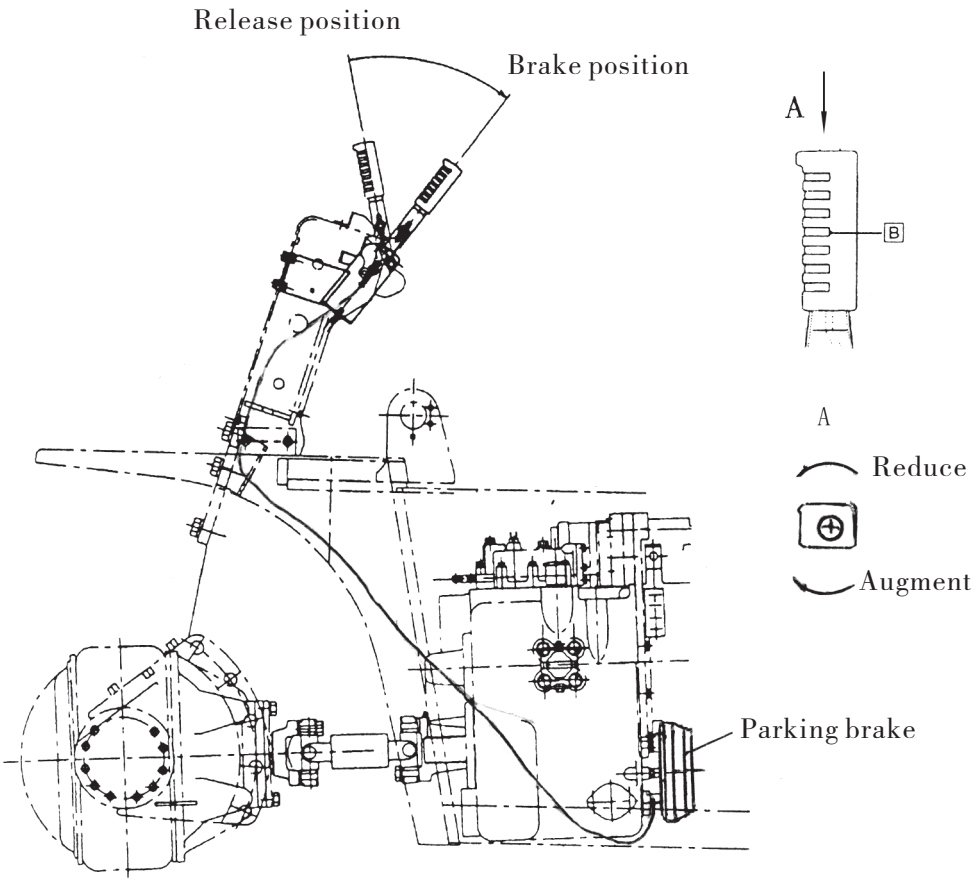

Fig.5.11 Parking brake unit

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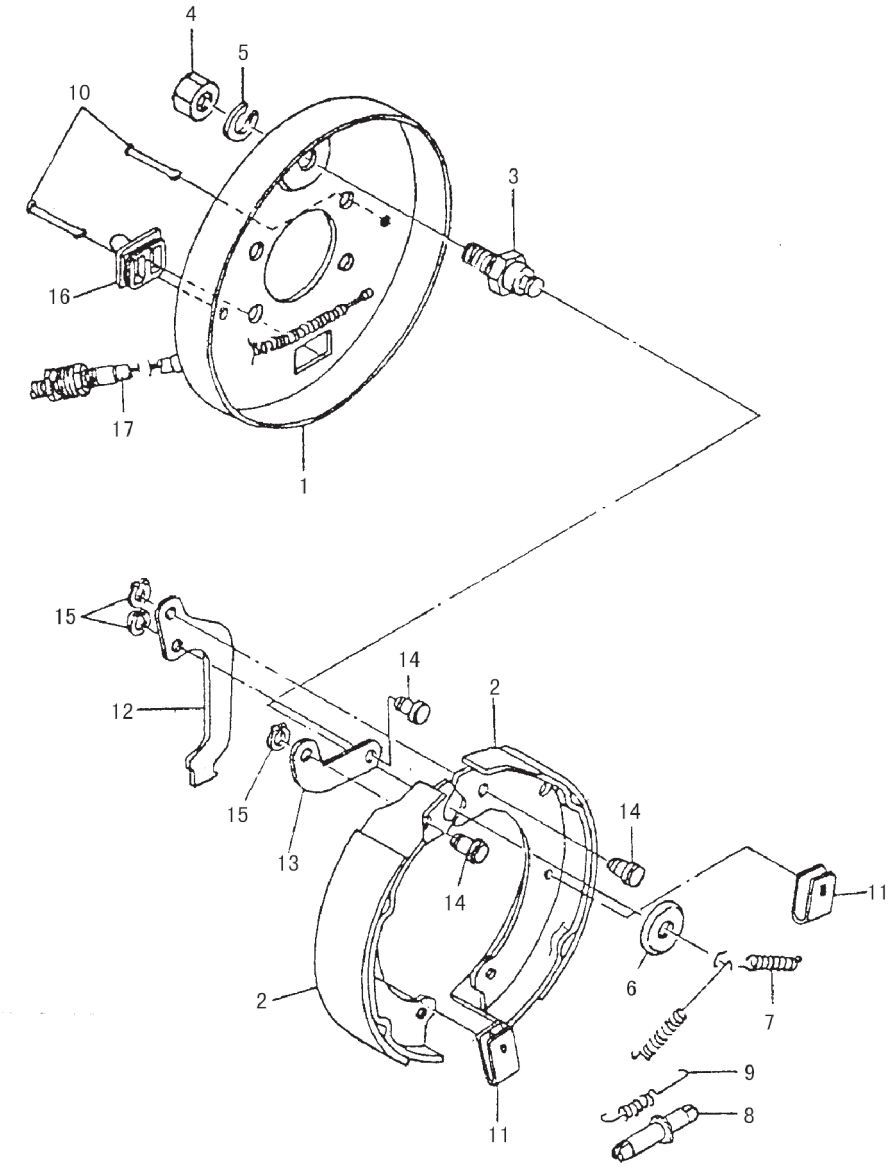

1.Floor	7.Return spring	13.Support plate
2.Brake shoe	8.Adjuster	14.Pin
3.Securing bolt	9.Adjuster spring	15.U–ring
4.Nut	10.Pin	16.Plug
5.Washer,lock	11.Spring seat	17.Parking brake cable
6.Washer	12.Lever	

Fig.5.12 Parking brake

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5.6 Troubleshooting Guide (See Table 5–3).

Problem	Possible cause	Remedy
Poor braking force	Fluid leakage from brake system	Repair
	Improper clearance of pads	Adjust
	Overheat of brake	Checking if it sliding
	Improper cantact of rotor and pads	Adjust
	Foreign material adhering to pad surface	Repair or replace
	Foreign material mixed in brake fluid	Change fluid
	Incorrect adjustment of pedal(inching valve)	Adjust
Noisy braking operation	Hardened pad surface foreign material adhered to it	Repair or replace
	Loose carrier mounting bolts,floor distortion	Repair or replace
	Deformed or incorrectly installed pad	Repair or replace
	Worn pad	Replace
	Loose ball bearing	Replace
	Bearing of wheel improper	Repair
Uneven braking	Foreign material adhering to pad surface	Repair or replace
	Auxiliary pump act improper	Repair or replace
	Drum eccentricity	Repair or replace
	Improper clearance of pads	Adjust
	Improper tire pressure	Adjust
Soft or spongey pedal	Brake fluid leakage from brake system	Repair
	Improper clearance of pads	Repair or replace
	Air mixed in brake system	Bleed air
	Incorrect pedal adjustment	Readjust

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6.Steering system

The main specifications of the steering system see table 6–1

Item		5–7t	8t	10t
Type		Rear wheel steering powered		
Dia. Of steering handwheel mm		360		
Steering unit	Type	BZZ series powered steering unit		
	Delivery rate ml/min	280		
	Rated pressure MPa	16		
Steering cylinder	Bore mm	Landscape, double function		
	Dia. Of cyl./Dia. Of piston rod mm	Φ115/Φ85		
	Stroke	2 216		2 260
Flow–divider	Setting pressure MPa	12.3		
	Rated flow l/min	25		27
Steering axle	Type	Center pin supported,landscape cylinder		
	Steering angle:Inner/Outer wheel	79 /50		
	Rear wheel:tread	1700		
	King pin:interval	1500		
Gimbal swivel radius		Φ42		
Steering wheels	Tire	8.25–15–14PR	9.00–20–14PR	
	Rim	6.50–15	7.0–20	
	Inflation pressure	830	760	

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Steering system consists of a steering handwheel, a steering column,gimal assembly, steering unit, steering axle and steering cylinder. Steering control unit see fig.6–1.

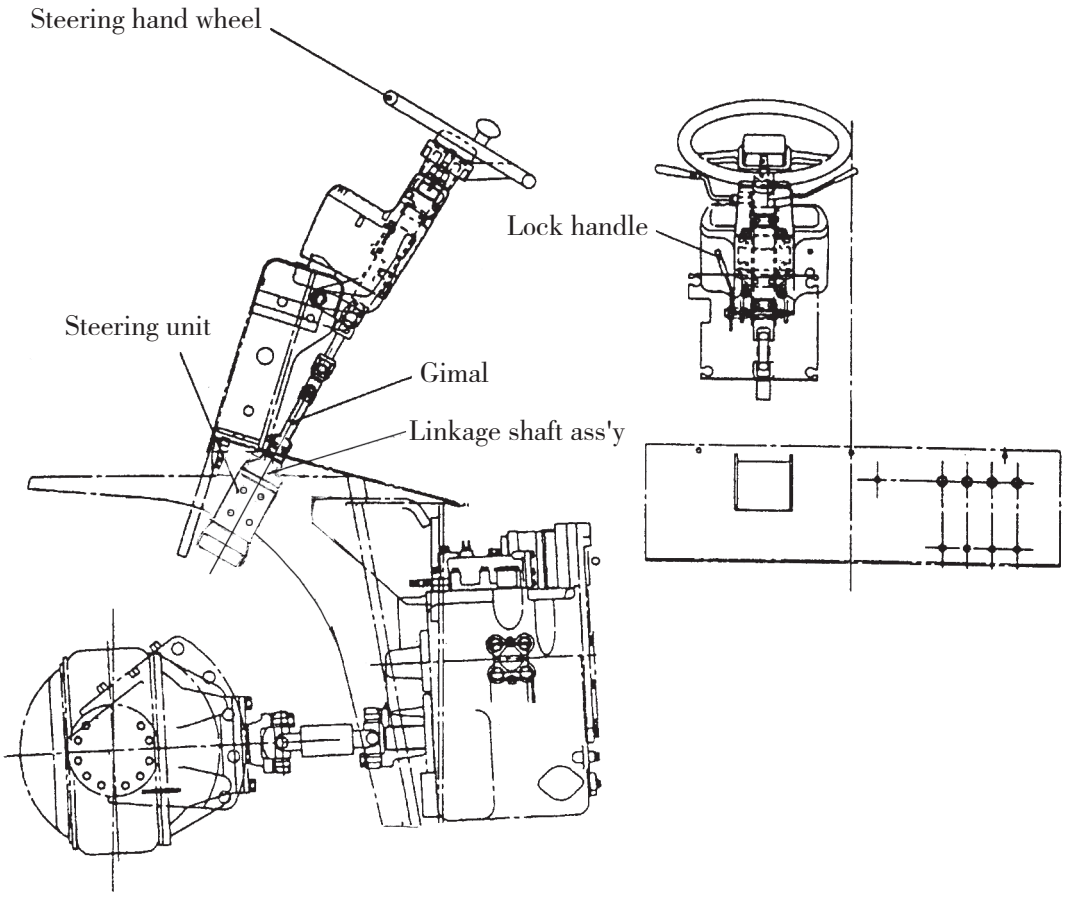

Fig.6.1 Steering control unit

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The steering shaft connects the steering unit with a gimbal,the steering handwheel turns with the steering shaft and steering column,realizes hydraulic steering. The steering column supporting steering shaft changes some tilt angle forward and backward,to adjust to a proper position ,so as to satisfy the driver's need.

6.1 Steering unit

The steering unit is a full-hydraulic steering unit,and can transmit the pressure oil from the flow-divider to steering cylinder through the oil pipe by metering.The oil volume changes as the rotation angle of the handwheel.When the engine goes out and the oil pump can not supply oil,the steering shall be done by manpower.

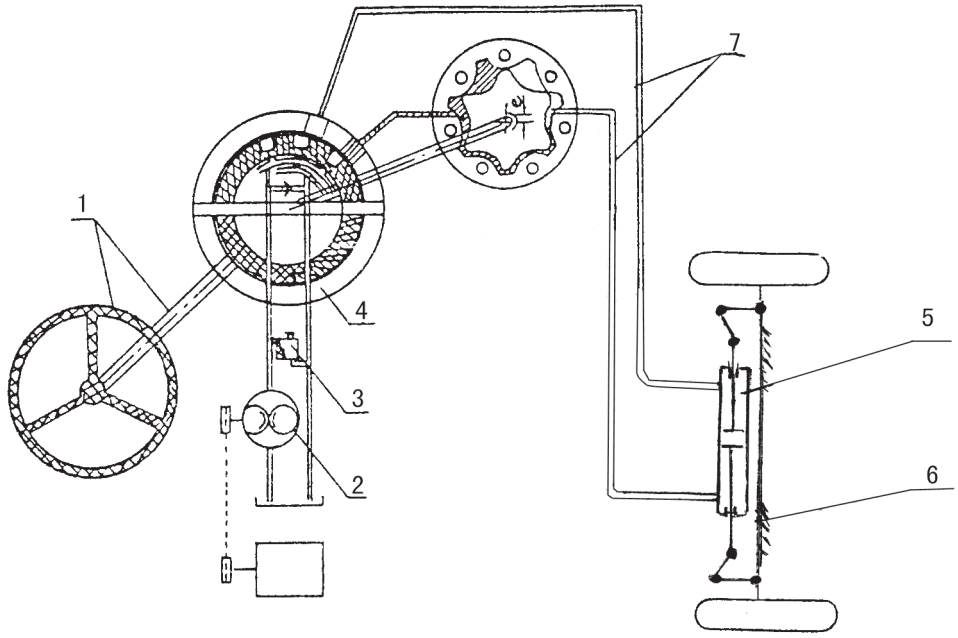

Fig.6.2 full-hydraulic steering system

1.Handwheel and steering shaft
2.pump
3.Flow-divider
4.Powered steering unit
5.Steering cylinder
6.Steering axle
7.Hose

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6.2 Checking after mounting on the machine

(1) Check the arrangement of hydraulic pipeline and turing direction of the truck for correctness.

(2) Check the forces necessary to turn the steering handwheel to right and left until it can't be turned any more to see if they are identical each other and check the operation of the steering handwheel for smoothness during above operation.

(3) After mounting on the machine,jack up the rear wheels,run the engine idly,and steer the steering wheel several times to discharge air from the piping and power steering system.Let down the rear wheels,steer the steering wheel several times to check for abnormal sound.If abnormal sound is not heard,this indicates that air has been completely discharged.Then set the engine in idling state to raise oil temperature.

(4) Measurement of steering power

Stop the machine on a flat dry paved rod,and apply its parking brake. Attach a spring balancer to the steering wheel rim to measure the steering power.The steering power must be less than approx.150N.

(5) To measure hydraulic pressure,use the pressure gauge(15–20MPa),stop valve and hoses connected as shown in fig.6.3.

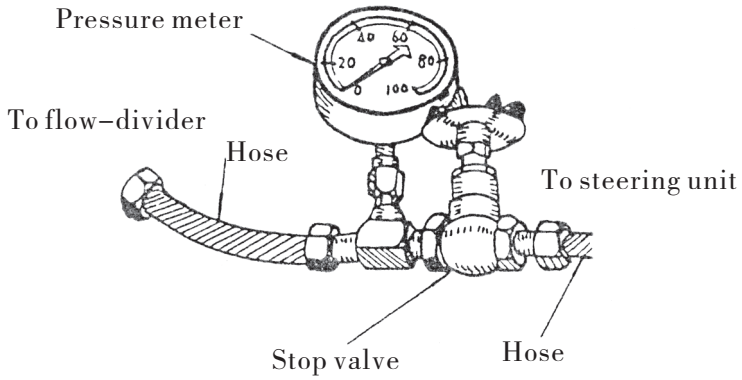

Fig.6.3 Measure pressure

Disconnect the hose which has been connected from the flow valve to the power steering,connect the hose provided with the stop valve to the power steering side,and run the engine idly.

When the steering wheel is kept in free state,the hydraulic pressure is about 0.5 to 2MPa.If the hydraulic pressure exceeds this value,check for clogging of the control valve and piping.If no abnormality is found,raise the rotational speed of engine up to about 1500rpm,and slowly close the stop valve,paying attention to preesure rise.

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The limit pressure of relief valve has been set to 12MPa.Therefore,when the stop valve is completely closed,the preeure gauge indicates its setting preesure.

If the hydraulic pressure exceeds 12MPa,this indicates that the relief valve malfunctions.If the hydraulic pressure is too low,this indicates that the oil pump malfunctions or the relief valve spring has been broken.In this case be careful not to keep the stop valve closed for more than 15 seconds.

Caution:The pump supplies the hydraulic oil to actuate the power cylinder.Its work must be considered from two different aspects,namely pressure and flow rate.

Pressure is designated to give thrust to the cylinder whereas flow rate relates to the kinetic speed of the cylinder.

Therefore,even when the hydraulic pressure is normal,say 12MPa,the power steering cannot work normally if flow rate is insufficient.This results in heavy steering.Since the flow valve and relief valve have been properly adjusted according to capacity and use conditions of the power steering,it is necessary put the match mark in the set position or measure the distance to the screw head if disassembly of valve is needed.

6.3 Troubleshooting Guide

Problem	Possible cause	Remedy
Steering wheel is caught when rapidly turned	Flow control valve spool stuck	Disassemble,repair or replace
	Flow control valve spool worn	Replace as assembly
Oil pressure does not rise	Relief valve stuck open	Replace as assembly
Oil pressure higher than relief set pressure	Relief valve stuck closed	Replace as assembly
Noisy relief valve	Relief valve vibrating	Replace as assembly
Too high oil temperature	Relief valve stuck closed	Replace as assembly
Hard steering operation while idling	Relief valve stuck open	Replace as assembly
	Flow control valve spool stuck	Disassemble and repair or replace
	Flow control valve spool worn	Replace as assembly
Varying steering force	Relief valve vibrating	Replace as assembly
	Flow control valve spool stuck	
	Flow control valve spool worn	Replace as assembly
Hard steering operation	Relief valve stuck open	Replace as assembly
	Flow control valve spool stuck	Disassemble and repair or replace
	Flow control valve spool worn	Replace as assembly

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6.4 Steering axle

5–10t forklift entirely adopts transverse steering oil cylinder. The front and rear of the center are supported by two supporting axle through sleeve on the steering axle base, the later is fixed on the forklift frame. The two supporting axle can sway a certain angle to the right and left. The structures of steering axle of 5–10t forklifts are the same in the most parts and the main structure is presented in the Fig. 6.3 and Fig. 6.4.

Steering axle is mainly made up of steering axle body, left and right steering knuckle assembly, connecting rod assembly, wheel, wheel hub and steering oil cylinder

6.4.1 Steering axle body

Steering axle body is a steel plate welding structure. On its two ends there are upper and lower bosses (holes) that connect the left and right steering knuckle assembly with the axle body by using the steering stub. The opening size of the boss for 5–8t forklift is small while that for 10t is large.

6.4.2 Left and right steering knuckle assembly

Left and right steering knuckle assembly is supported on the wheel hub through two thrust bearings and the wheel is mounted on the wheel hub. Oil seal is provided on the wheel hub in order to prevent grease from overflowing. The plane thrust bearing is mounted between the steering knuckle and the upper and lower bosses of steering axle body, under which a gasket can be used to regulate the rotation clearance. In the inner hole of upper and lower bosses, the steering stub is mounted and is supported by the upper and lower needle bearings, under which the oil seal is used. An oil nozzle is mounted on the upper extreme cover in order to lubricate all the bearings through the inner hole of stub. Users should fill in the grease on time. The locking pin is used for fixture between the steering stubs of steering knuckle assembly.

6.4.3 Wheel hub

Wheel hub is spherical iron. As the tires of 8–10t forklifts are different from those of 5–7t, the wheel hubs are also different.

6.4.4 Steering ram (oil cylinder)

The steering ram horizontally set in the middle of the axle body is of double–action type. The piston rods on two ends are connected with connecting bar assembly; the other end of the later can propel the steering knuckle arm to make the wheel change direction. On the two ends of the oil cylinder are the pilot sleeves and the steel–backed bearing , baffle plate , sealing ring and anti–dust ring are installed in the inner holes of the sleeve, which contact with piston rod. Outside the sleeve are the supporting ring and O–shaped ring, which contact with the inner wall of the cylinder. The oil cylinder of 5–8t forklift is for general use. For the structure, refer to Fig. 6.6.

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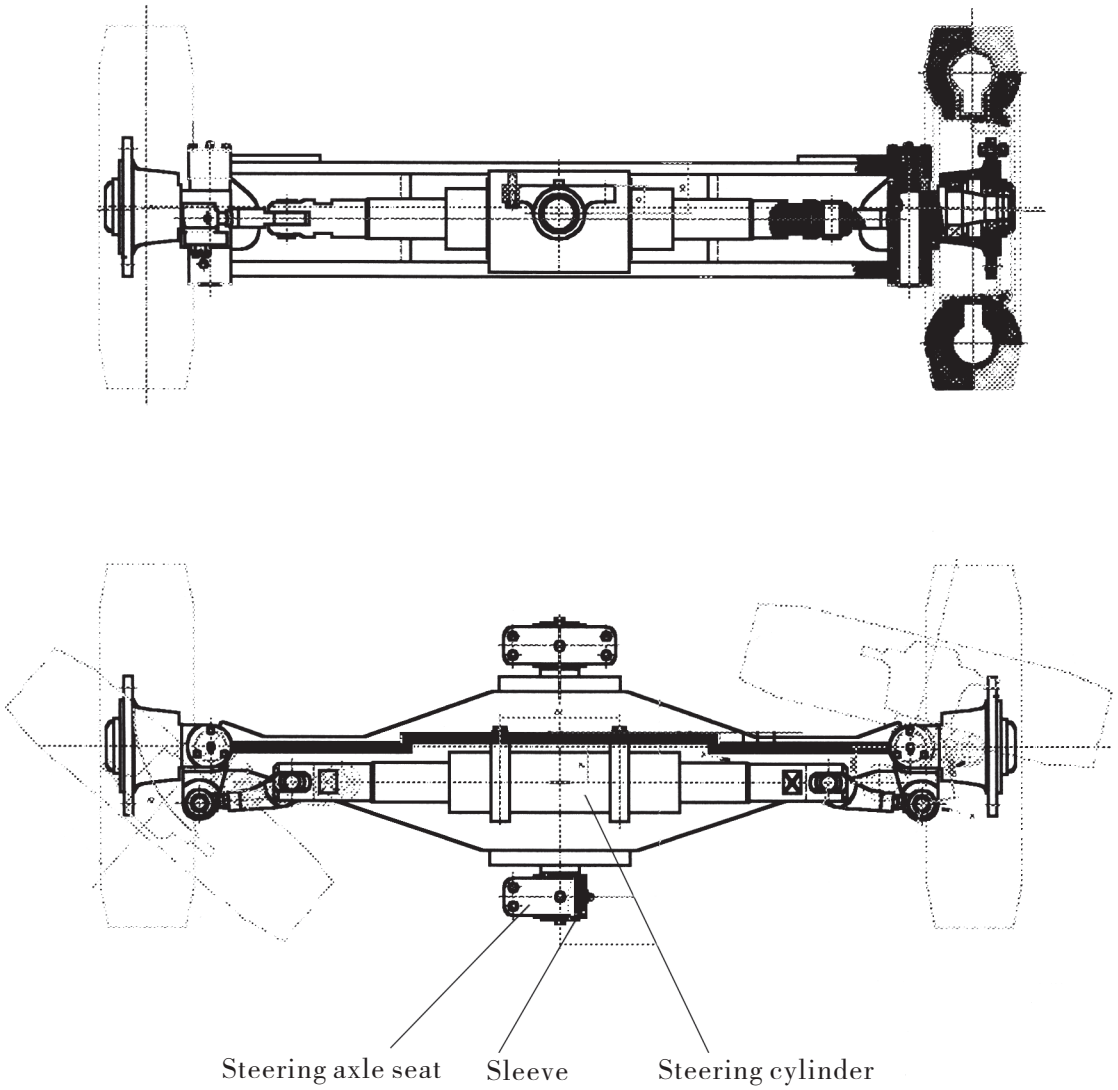

Fig.6.4 Steering axle

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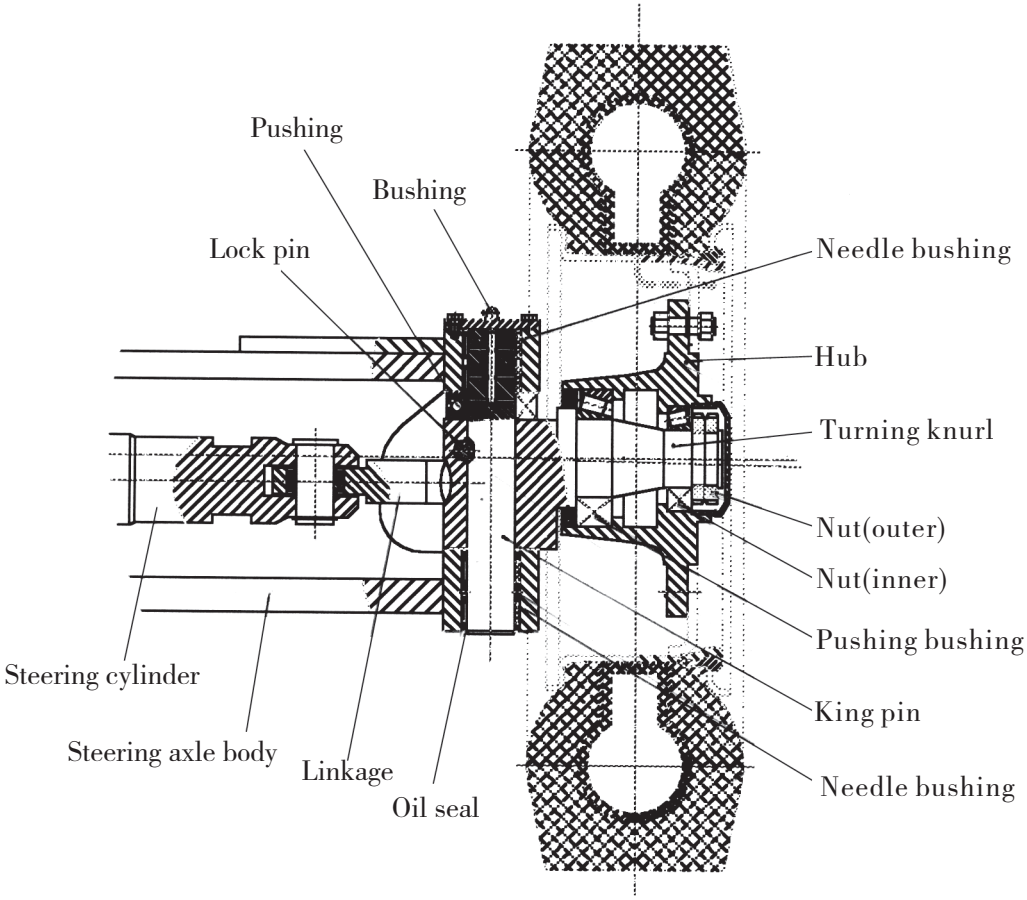

Fig.6.5 Steering axle

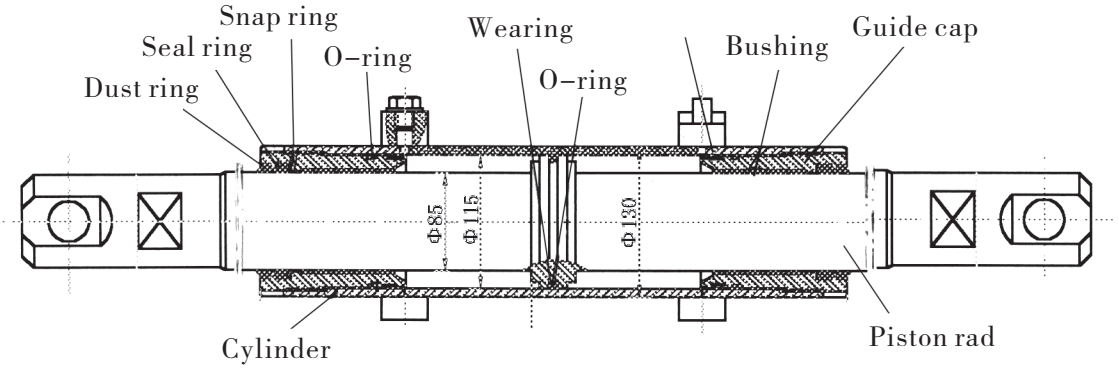

Fig.6.6 Steering cylinder

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7. Hydraulic system

			5–7t		8–10t
			Power brake	Vacuum assistant	Power brake
Oil pump	Drive type		Transmission P.T.O.		
	Rated pressure		25Mpa		
	Front pump NO.	Match Japan 6BG1	A45E7–10202 36R/4R Double–gear pump		A45E7–10202 36R/4R Double–gear pump
		Match Chaochai 6102BG	A05E7–10202 32R/3.5 Double–gear pump	H09E7–10202 32R	
		Match Komatsu S4D95LE–2	A05E7–10202 32R/3.5 Double–gear pump		
		Match Weifang R4105G32		H09E7–10202 32R(5–6t truck)	
	Rear pump NO.	Match Japan 6BG1	A45E7–10301 36L		A45E7–10301 36L
		Match Chaochai 6102BG	A05E7–10301 32L	A05E7–10301 32L	
		Match Komatsu S4D95LE–2	A05E7–10301 32L		
		Match Weifang R4105G32		A05E7–10301 32L(5–6t truck)	
Control valve	Type		Two–spool sliding type(with relief valve and tilt–lock valve)		
	Setting pressure		20Mpa		
	Part NO.	Two–throw	25787–30202G		25907–30201G
		Three–throw	25787–30212G		25907–30301G
		Four–throw	25787–30222G		25907–30401G

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7.1 General Description

The hydraulic system mainly consists of main pump,control valve,high & low pressure oil pipes and joints.The main pump is a gear type and installed on the top of the transmission.This pump is fitted to a gear to which the charging pump is also fitted.As the engine runs,the main pump is driven to draw up oil from the tank and send it to the control valve.The control valve,provided with a relief valve to keep the circuit pressure within the specified one,controls the cylinders by changing over the oil passages inside the valve body with the spools.

7.2 Main Pump

The main pump consists primarily of a drive gear,driven gear and pump body which contains the two gears and other components.The drive gear is in mesh with the driven gear.

7.3 Control valve(See fig.7-1)

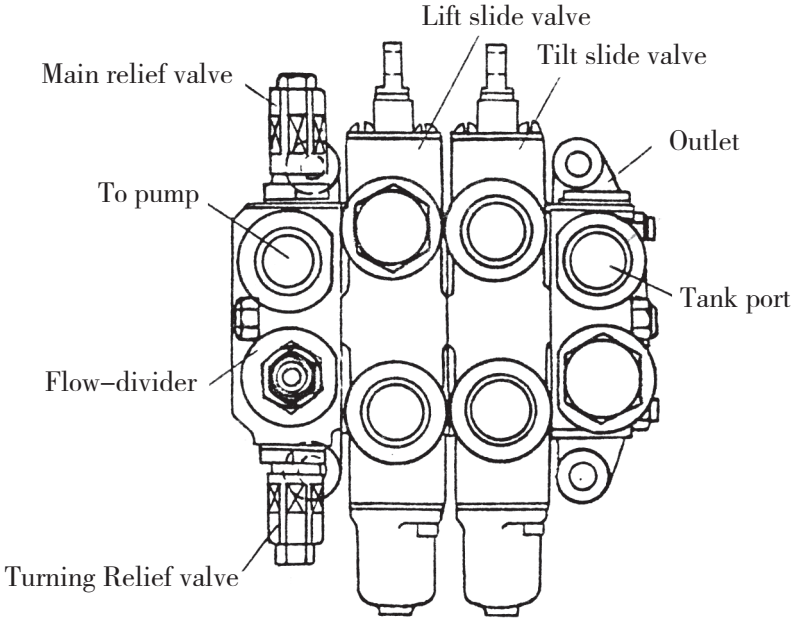

Fig.7.1 Control valve

The control valve is a sectional type consisting of the inlet section,plunger section and outlet section which are assembled with three bolts.

At the inlet section is a cartridge type relief valve to set the oil pressure in the circuit.The plunger section controls the hydraulic cylinders by changing over the flow of oil from the relief valve with plungers.The tilt cylinder plunger section is equipped with a tilt lock valve.Oil returned from the cylinders is returned to the tank through the outlet

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section.Earch section is sealed with O-ring,and the oil passage at the high pressure side is given a check valve.

7.4 Operation of control valve

(1) Neutral position (See fig.7-2)

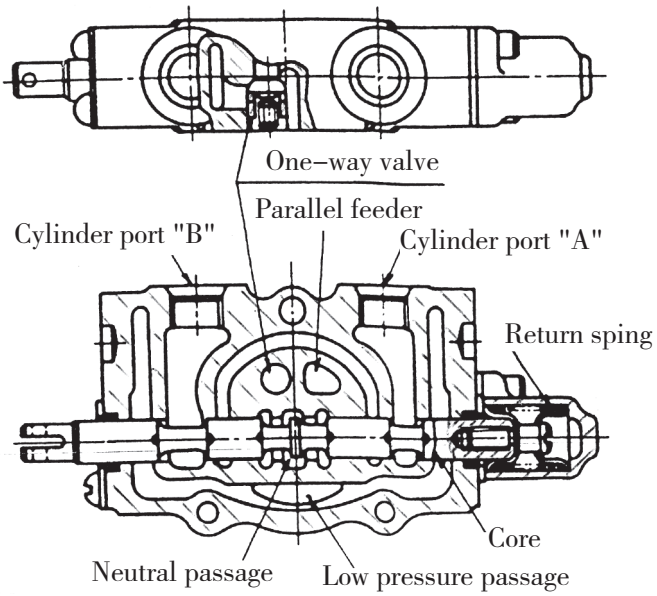

Fig.7.2 Neutral position

The oil discharged from the pump returns to the tank through the neutral passage.The cylinder ports "A" and "B" are kept closed.

(6) Pushing-in of plunger (See fig.7-3)

The neutral passage is closed,and the oil pushes up the load check valve from the parallel feeder and flows to the cylinder port "B". The returning oil from the cylinder port" A" flows through the low-pressure passage to the tank.The plunger is restored to the neutral position by thr return spring.

(7) Drawing-out of plunger(See fig.7-4)

With the neutral passage closed,the oil pushes up the load check valve from paralled feeder and flows to the cylinder port "A". The returning oil from the cylinder port "B" flows through the low-pressure passage to the tank. The plunger is restored to the neutral position by the return spring.

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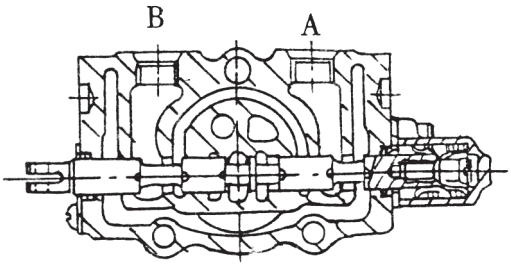

Fig.7.3 Push slide valve

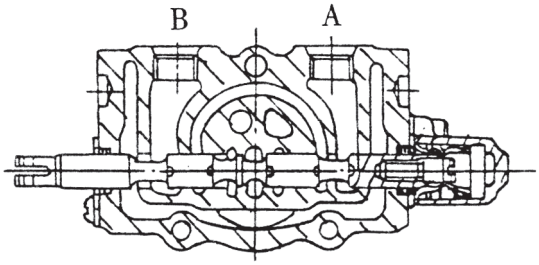

Fig.7.4 Pull slide valve

7.5 Operation of relief valve

(1) The relief valve is mounted between the cylinder port "HP" and the low-pressure passage "LP",The oil flows through the poppet" C" and affects the two areas "A" and "B" different in diameter,so that the check valve poppet "K" and the relief valve poppet "D" are securely seated.(See fig.7-5)

(2) When the pressure in the cylinder port "HP" reaches the set pressure of the pilot poppet spring force,the pilot poppet "E" opens.The oil passes around the poppet,flowing through the drilled hole to the low pressure side "LP".(See fig.7-6)

(3) As the pilot poppet "E" is opened,the preeure behind the poppet "C" drops,due to which the poppet "C" is moved to seat on the pilot poppet "E".As a result of this,the oil flowing behind the relief valve poppet," D" is shut off and the pressure at the inner side is reduced.(See fig.7-7)

(4) As compared to the pressure at the cylinder port "HP" side,the inner pressure becomes unbalanced,causing the relief valve poppet "D" to open and thereby sending the oil directly to the low-pressure passage "LP".(See fig.7-8)

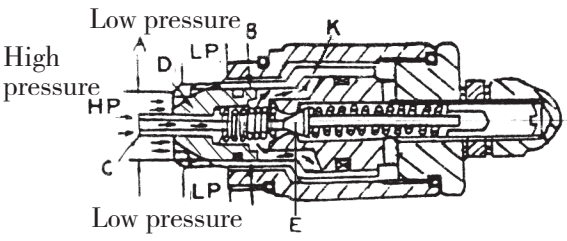

Fig.7.5

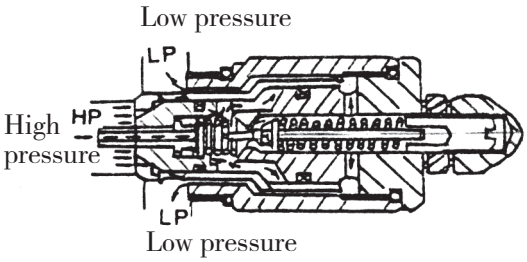

Fig.7.6

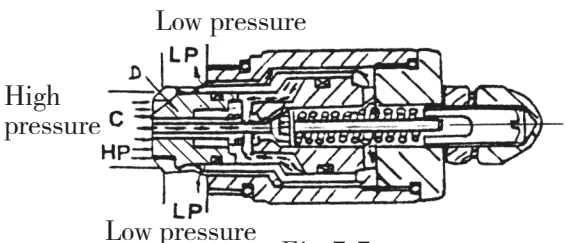

Fig.7.7

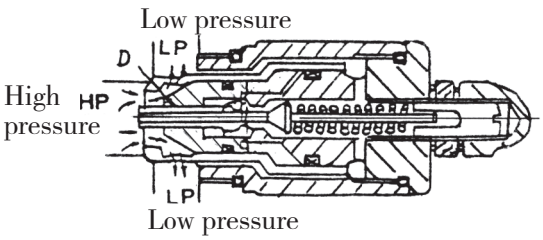

Fig.7.8

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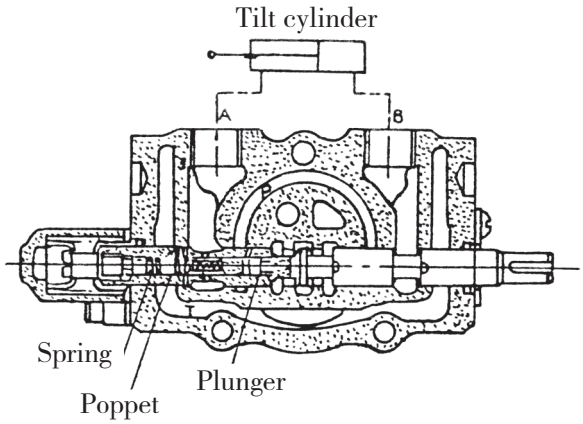
7.6 Operation of tilt lock valve

The tilt—lock valves are intended to prevent vibrations of the mast due to possible creation of internal negative pressure in the tilt cylinder and also to avoid a danger of the mast tilting due to accidental lever action when the engine is at rest.On the conventional model,even if the engine is kept at rest,the mast can be tilted forward by actuating the tiltlever.but this newly adopted tilt—lock valves does not allow the mast to tilt forward as far as the engine is at rest,even if the tilt lever is pushed with the full load.Refer to fig.7–9 for the construction of the tilt—lock valve.

The port "A" side of the plunger housing is led to the front side of the tilt cylinder,and the port "B" side to its rear side.When the tilt lever is pulled(plunger drawn out),the oil from the pump flows into the port "A" while the port "B" side oil returns to the tank,due to which the mast is tilted backward by the tilt cylinders.

When the tilt lever is pushed (plunger pressed),the oil from the pump flows into the port "B".But the port "A" side oil does not return to the tank unless the poppet installed in the plunger is moved,nor does the mast tilt forward.Hence,while the engine is being shut down,the mast never tilts forward nor does the internal pressure in the tilt cylinders get negative.



T: To tank P: To oil pump A、B: To tilt cylinder

Fig.7.9 Tilt lock valve

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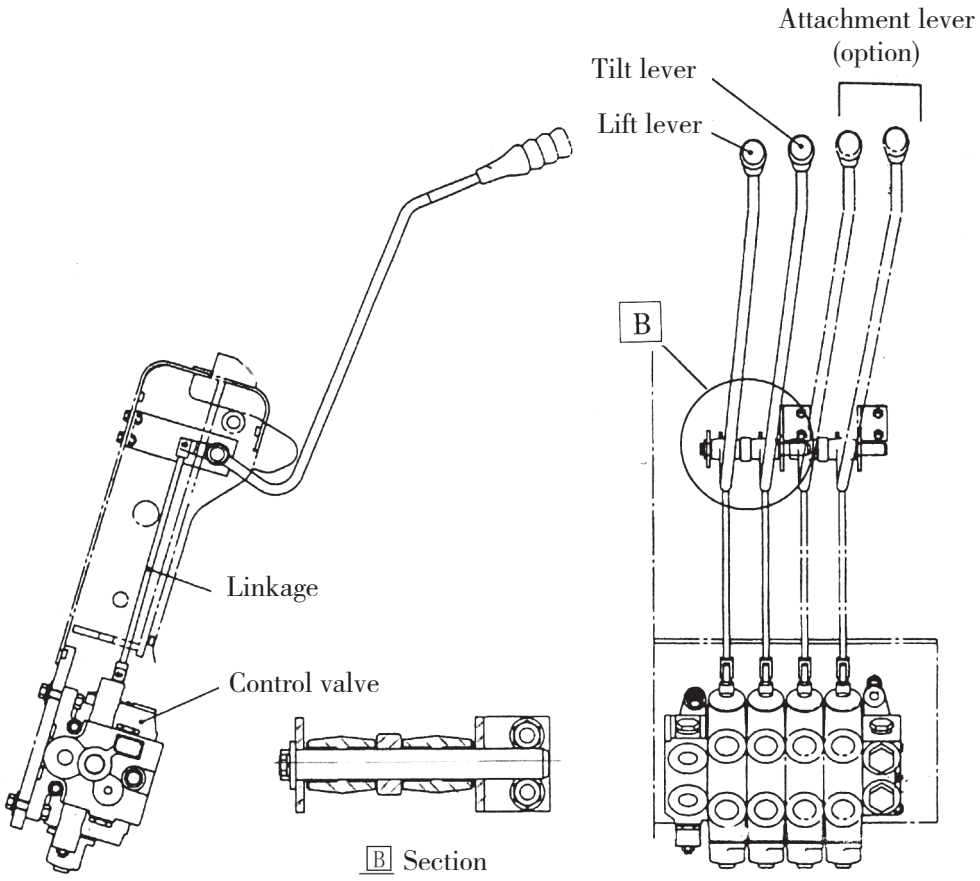

Fig.7.10 Control valve lever unit

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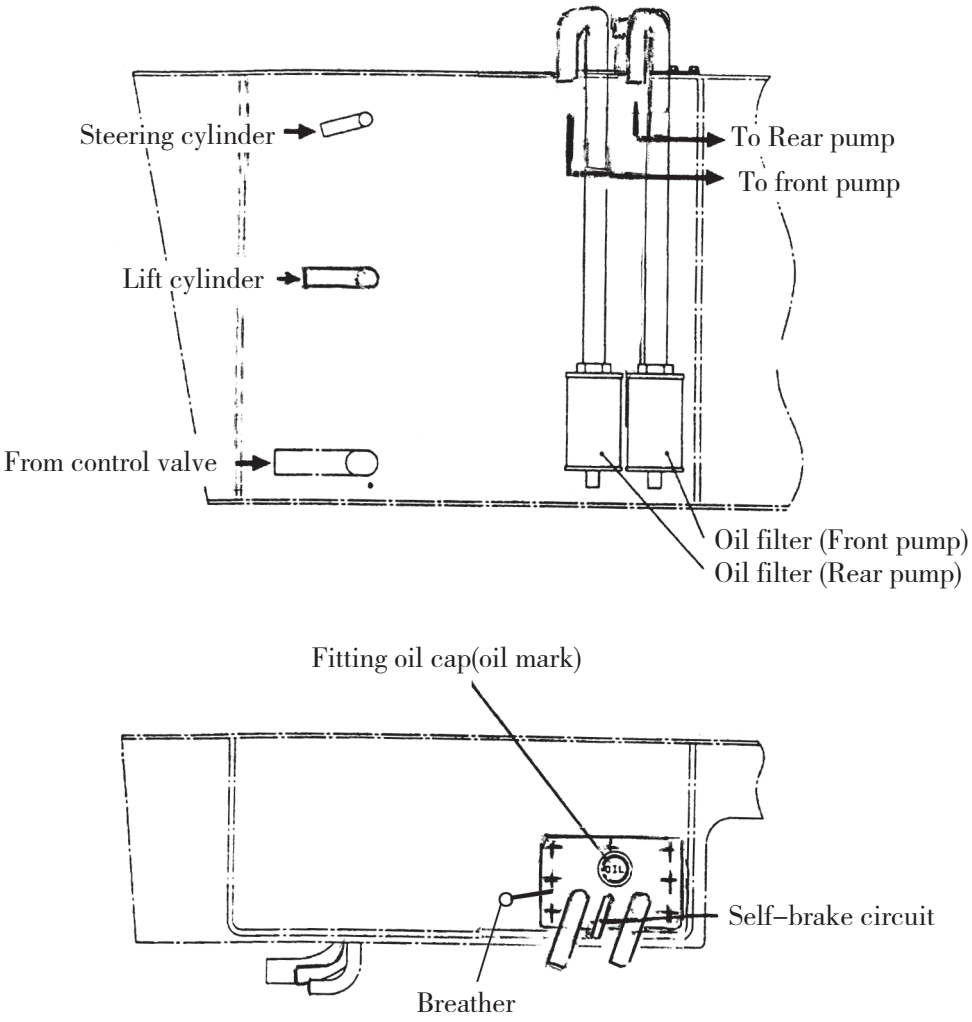

Fig.7.11 Oil tank

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7.7 Hydraulic circulation system(Main circuit)

The hydraulic system sketch see following:

The hydraulic circulation system of 5 to 8 ton forklift trucks see fig.7-12.

The hydraulic circulation system of 10 ton forklift trucks see fig.7-13

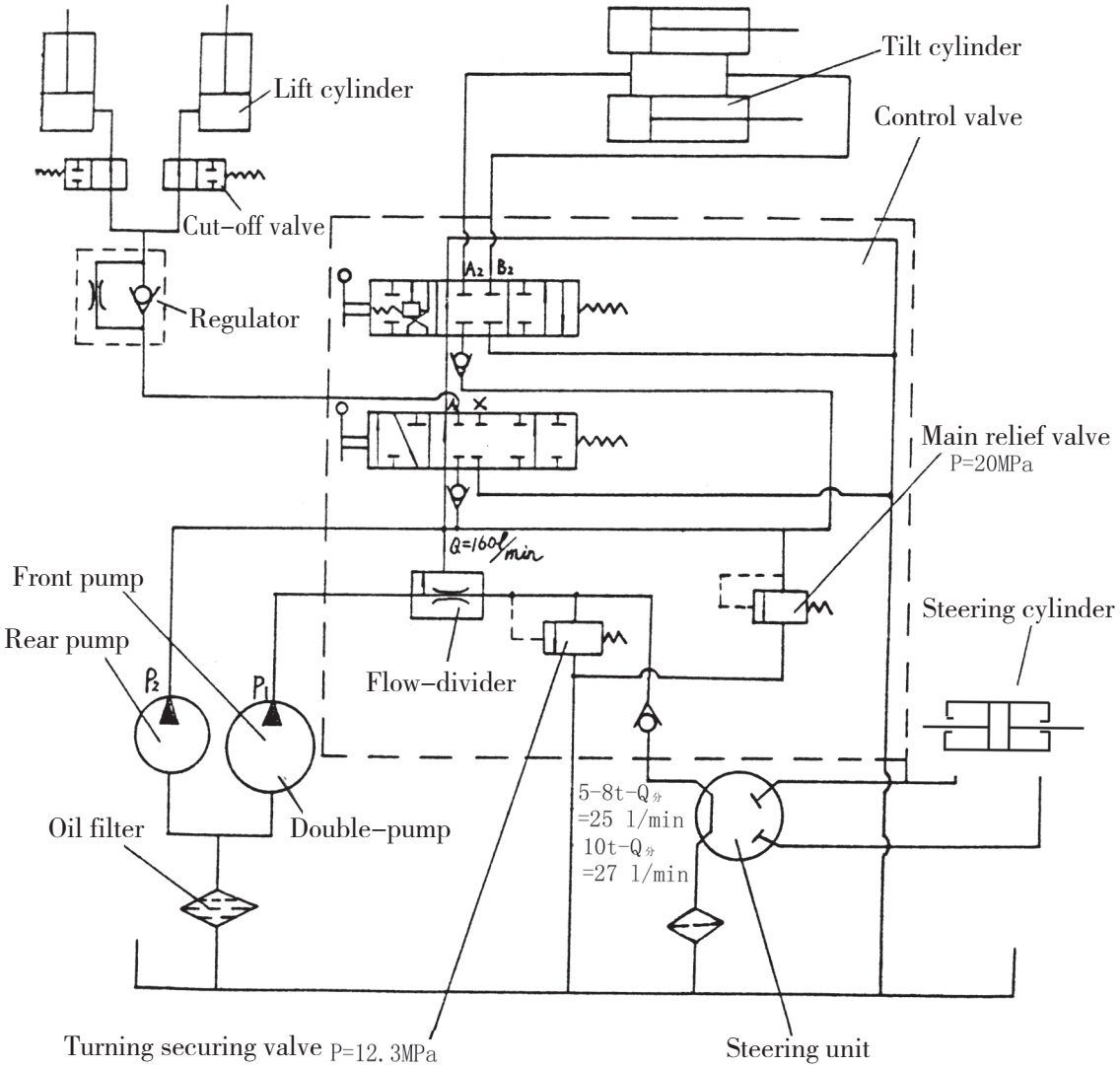

Fig.7.12 Hydraulic system

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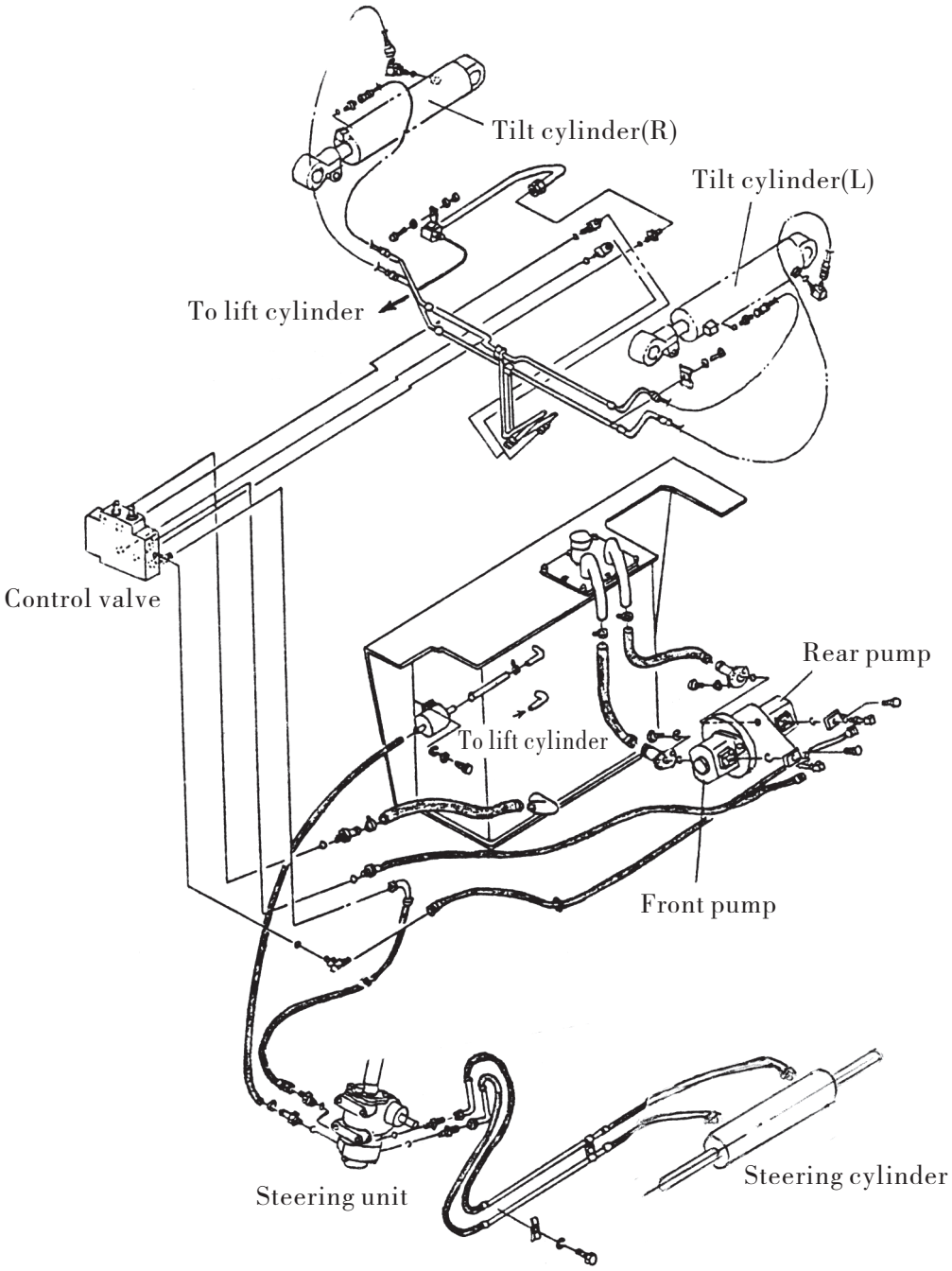

Fig.7.13 Hydraulic circuit(for 5–10t truck)

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The hydraulic circulation system of the main circuit is complicated with the hydraulic circuit for power steering.The hydraulic piping is of O-ring fitting type with excellent sealing performance,providing secure oil tightness.

The hydraulic oil sent from the rear main pump flows directly to the control valve,while the hydraulic oil sent from the front main pump is divided by the flow divider valve in two portions for steering and load handling operation.

The hydraulic oil for load handling flows into the control valve and mingles with the hydraulic oil from the rear main pump.With the control valve in neutral position,the oil returns to the oil tank,passing through the valve.

When the lift lever is pulled,the hydraulic oil from the control valve flows through the flow regulator valve and reaches the lower part of the lift cylinder piston to push up the piston rod.When the lift lever is pushed,the circuit between the lower part of the lift cylinder piston and the oil tank is opened,and the piston begins to descend due to the weight of the piston rod,lift bracket,forks,etc.In this case,the oil returning to the control valve is regulated by the flow regulator.When the tilt lever is operated,the hydraulic oil from the main pump reaches one side of the piston to push it.The oil pushed by the piston returns to the oil tank through the control valve.

7.8 maintenance

7.8.1 Disassembly of control valve

Dismount the control valve from the machine and clean exterior of it.

(1) Remove the fitting bolts and separate the control valve into each section.Don't lose the check valves and springs arranged at the joint sections.

(2) Remove the screws at the plunger head side and the bolts with hex.Groove at the cap side,and remove the wiper,O-ring and seal plate from the valve housing together with plunger.

(3) Put the plunger on the vice and remove the cap screw.And then remove the springs and spring seats.On the plunger provided with a tilt lock,remove also the spring and poppet in the plunger.

7.8.2 Reassembly of control valve

Using mineral oil,clean all the disassembled parts.Check them for burrs or nicks,and replace as necessary.The valve housing and plunger,and the plunger and poppet are assembled by wrapping.If replacement is needed,replace as assembly.

(1) Fasten the plunger with vice,and install the poppet and spring in the plunger,observing the direction of poppet.

(2) Install the O-ring,wiper,seal plate,spring seat,spring and spring seat in this order to the plunger end side,and tighten them with cap screw to the torque of 25 to 32N.m.

(3) Insert the assembled plunger into the valve housing and fit the cap by the bolt

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with hex groove.(Tightening torque:9 to 11 N.m)

(4) Fasten the O–ring and wiper to the plunger head side and tighten the seal plate with screw to the torque of 4.6 to 5.8 N.m.

(5) After assembling,install the check valve,spring and O–ring in each section and tighten them to the specified torques with three bolts.(one bolt:103N.m;the others:66N.m)

8. Lift Cylinder & Tilt Cylinder

The main specification see Table 8–1.

Table 8–1

			5–7t	8t	10t
Lift cylinder	Type		Single–acting piston type		
	Cylinder bore	mm	Φ80	Φ90	Φ100
	O.D. of piston rod		Φ60	Φ70	
	Stroke		1495		
Tilt cylinder	Type		Double–acting piston type		
	Cylinder bore	mm	Φ115		
	O.D. of piston rod		Φ50		
	Stroke		227	242	

8.1 Lift Cylinder

The two lift cylinders of single acting type are used and located behind each outer mast frame.The bottoms of the cylinders are sustained by the mast support of the outer mast frame.The bottoms of the cylinders are sustained by the mast support of the outer mast while the tops of them,or the piston rod ends are inserted into the one body construction piston head.

The lift cylinder assembly consists primarily of a cylinder body,piston,piston rod and cylinder cap.At the lower part of the cylinder body is arranged an inlet for high—pressure oil,and at the upper part there is an outlet for low—pressure oil above the piston packing,to which a return pipe is connected.The piston is fastened to the piston rod with castle nut and cotter pin together with an O–ring.A wear ring,packing and back—up ring are attached to the outside periphery of the piston which is moved along the inner surface of the cylinder by high—pressure oil.An oil seal and bushing are installed on the cylinder cap which is screwed into the cylinder body.The bushing supports the piston rod,and oil

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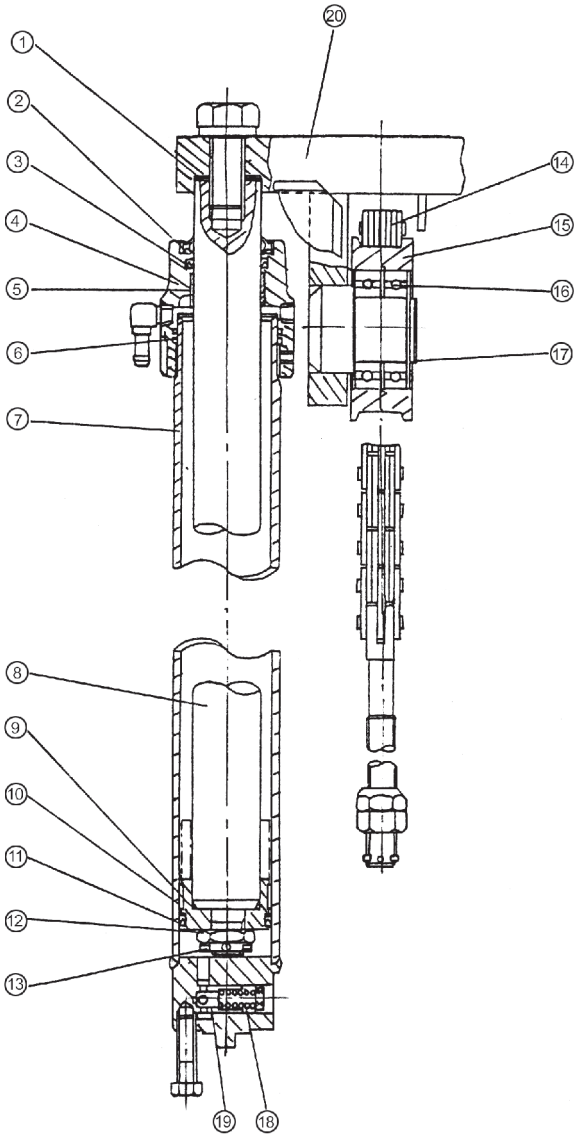
seal prevents dust from entering the cylinder.The upper end of the piston rod is locked with piston head set bolts.

When the lift lever is tilted backward,high oil pressure is sent into the lift cylinders through their inlets to push up the piston rods and the piston rods and the piston head,causing the forks to rise through chains.The height from the ground to the fork position at which the inner mast frame connecting member begins to be lifted is called "Free Lift" range.Within this range,the mast height does not vary.With the lift lever tilted forward,the pistons of the lift cylinders descend by the weights of the piston rods,lift bracket,finger bar and forks,causing oil under the piston to flow out of the cylinders.The oil discharged from the cylinders is regulated by the flow regulator and returns through the control valve to the oil tank.



1.Washer
2.Dust
3.Yx–ring
4.Guide cap
5.Ball bushing
6.O–ring
7.Cylinder body
8.Piston rod
9.O–ring
10.Wearing
11.Yx–ring
12.Groove nut
13.Cotter pin
14.Lift chain
15.Sheave
16.Ball bushing
17.Snap ring
18.Spring
19.Cut–off valve
20.Active beam

Fig.8.1 Lift cylinder(5–8t truck)

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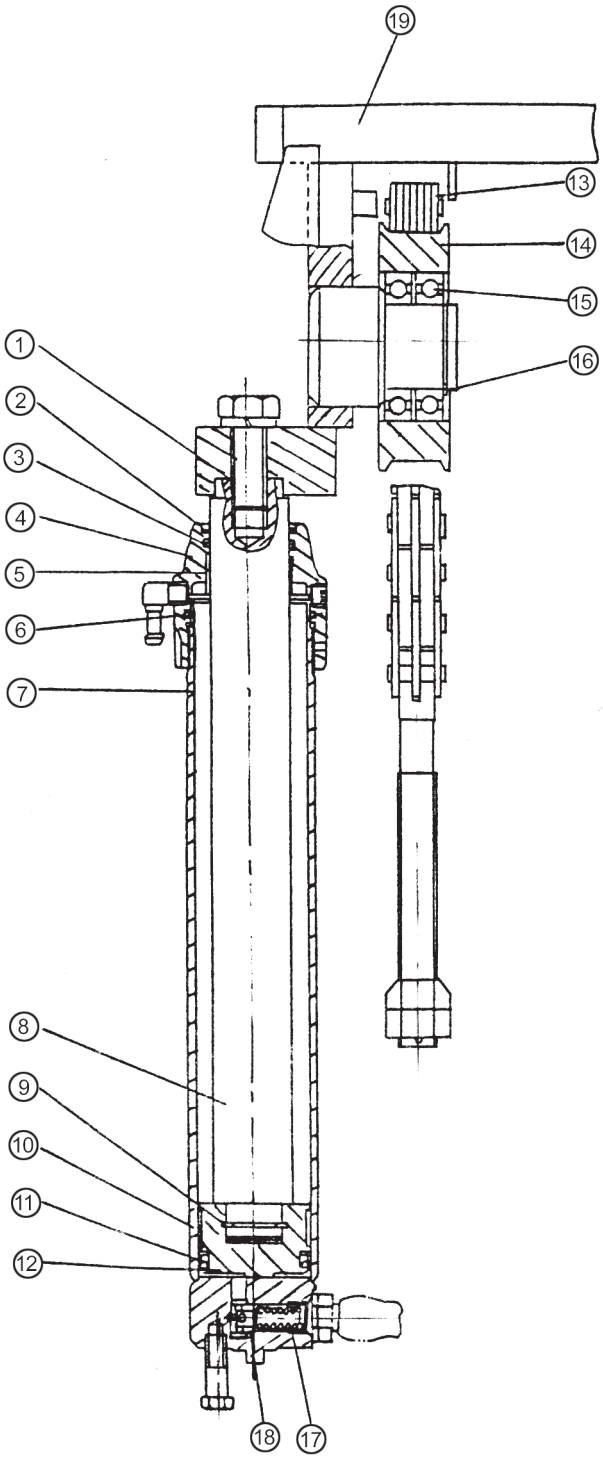

1.Washer
2.Dust
3.Yx–ring
4.Guide cap
5.Ball bushing
6.O–ring
7.Cylinder body
8.Piston rod
9.Ring
10.Wearing
11.Yx–ring
12.Piston
13.Lift chain
14.Sheave
15.Ball bushing
16.Snap ring
17.Spring
18.Cut–off valve
19.Active beam

Fig.8.2 Lift cylinder(10t truck)

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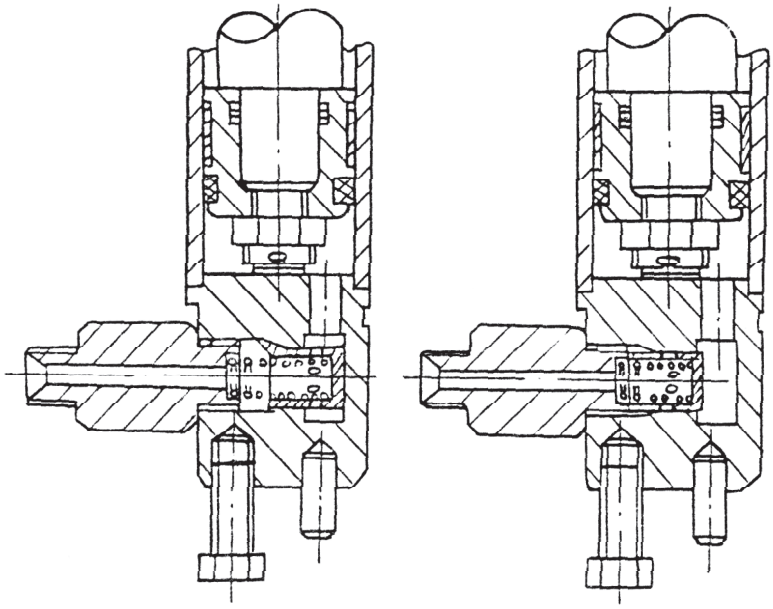
8.2 Cut—off valve

At the bottom of the two lift cylinders are two cut—off valves(See fig.8–1 No.19 or fig.8–2 No.18) which operate when the high—pressure hose bursts for any reason to prevent the load from dropping down abruptly.The oil from the lift cylinder flows through small holes in the circumference of the cut—off piston and produce a pressure difference between two chambers.As the pressure difference as result of passing the holes is smaller than the spring force so that the cut—off spool won't move.If the high—pressure hose bursts,it allows only a small amount of oil to flow through the holes in the spool head to let the forks descend at low speed.



Natural conditions Cut–off conditions

Fig.8.3 Cut–off valve

8.3 Flow regulator

The flow regulator valve is located between the control valve and the high pressure ports of the two lift cylinders,near the left cylinder (See fig.8–4).The structure of the flow regulator valve as shown in Fig.8–5.The structures of 8 ton and 10 ton forklift trucks are almost the same as 5 to 7 ton forklift trucks.No.3 in fig.8–5 is taper helical spring for 8 ton forklift trucks and is coil spring for 10 ton forklift trucks.

The flow regulator valve serving both as a flow regulating valve while forks are being lowering and a safety device if rubber hoses between the control valve and lift cylinders are damaged due to any reason.

The operation of the flow regulator valve is given below.

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See fig.8–5.With the forks upraised,high pressure oil led from the control valve flows into the chamber (A) and shifts the sleeve (2) to the left.This opens the opening (G) to allow the high pressure oil to flow along the two routes(A—B—G—D—E and A—B—C—D) and both flows of oil lead to the lift cylinders.In this case,the flows of oil is not regulated.When the forks begin to lower,oil discharged from the lift cylinders enters the chamber (E) and shifts the sleeve until it contacts the nipple.This closes the opening (G) so that oil flows through (E),(D),(H),(C),(B) and (A) to the tank.If the amount of oil discharged from the lift cylinders is rapidly increased,the pressure in the chamber (F) rises and moves the piston (5) to the right in spite of the spring force,narrowing the opening (H).So the flow of oil from the chamber (D) to the chamber (C) is decreased so that the descending speed of the forks is controlled.

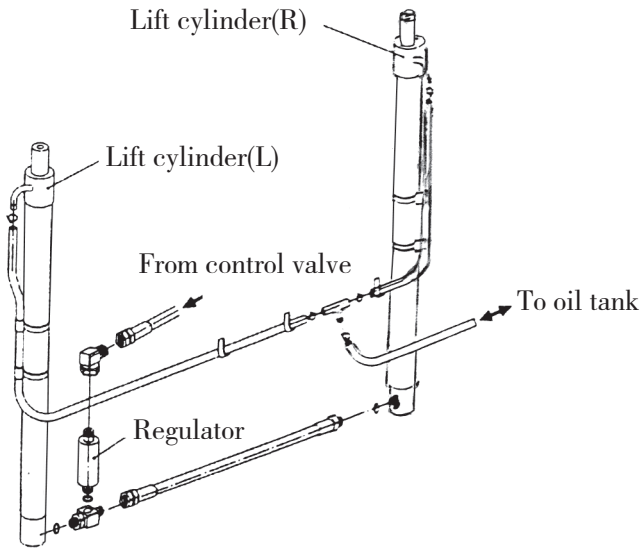

Fig.8.4 Regulator mounting position

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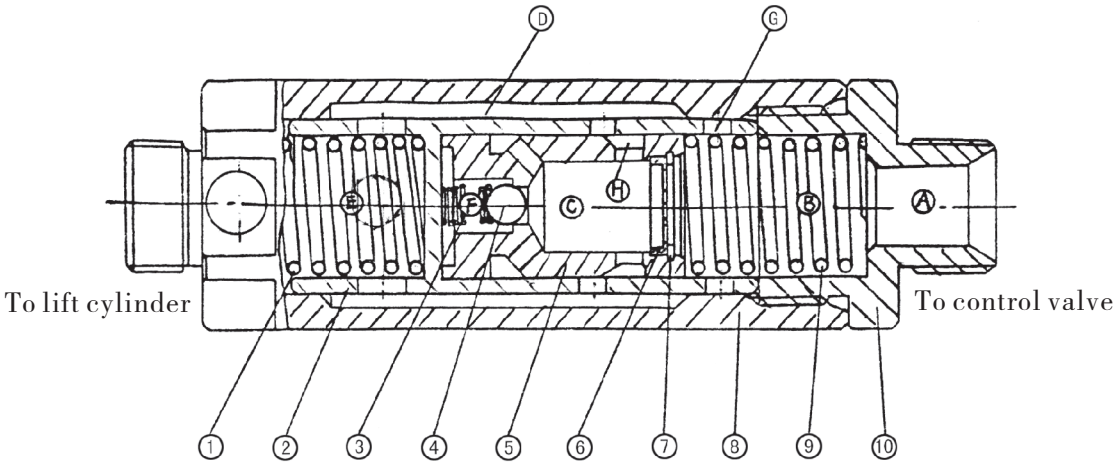
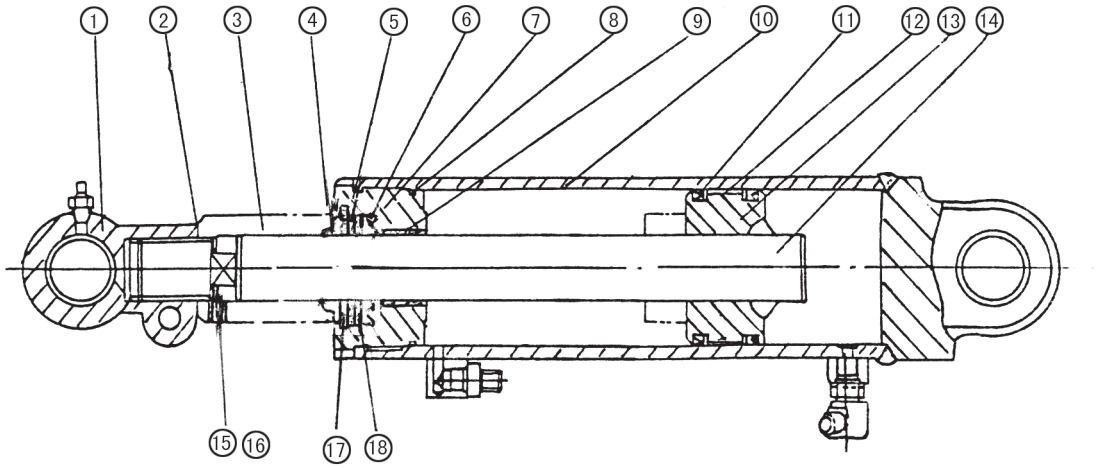


1.Spring	4.Nylon ball	7.Snap ring	10.Nipple
2.Valve sleeve	5.Valve core	8.Valve body	
3.Spring	6.Regulator plate	9.Spring	

Fig.8.5 Regulator(5–7t truck)

8.4 Tilt cylinder



1.Earring	6.Yx–ring	11.Yx–ring	16.Screw
2.Washer	7.Guide(cylinder cap)	12.Wearing	17.Snap ring
3.Adjuster sleeve	8.O–ring	13.Piston	18.Snap ring
4.Dust ring	9.Bushing	14.Piston rod	
5.Snap ring	10.Cylinder body	15.Plug	

Fig.8.6 Tilt cylinder

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Two tilt cylinders of double acting type are provided at each side of the frame.The front end of the piston rod is installed on the mast and the cylinder tail is on the frame with pins.

The tilt cylinder assembly aonsists primarily of a cylinder body,cylinder cap,piston and piston rod.The piston is welded to the piston rod.The piston,of which the outside periphery is given two packings and a wear ring,slides inside the cylinder by hydraulic oil.The inside periphery of the cylinder cap has a press—fitted bushing,packing and dust seal to keep oil tightness between the piston rod and the inside of the cylinder cap.

The cap,fitted with an O-ring on the outer periphery,is screwed into the cylinder body and fastened with a lock ring.

When the tilt lever in the drive's room is tilted forward,high pressure oil enters from the cylinder tail side to shifts the piston forward,tilting the mast forward 6 degrees.With the tilt lever tilted backward,high pressure oil enters from the cylinder cap side.This shifts the piston to the rear,causing the mast to tilt backward 12 degrees.

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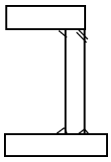
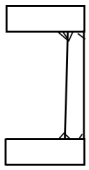
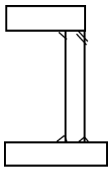
9. Hoist system

The main specifications see table 9–1.

		5–7t	8t	10t
Type		Rolling type,welded mast with free lift, 2–stage telescopic mast		
Cross section of inner mast				
Cross section of outer mast				
Max. Lift Height (S.T.D.)		3000mm		
Forward tilt (S.T.D.)		6		
Backward tilt (S.T.D.)		12		
Rollers	O.D. of end rollers mm	Φ151.5	Φ183.5	
	O.D. of side rollers mm	Φ82		
	O.D. of retaining (on bracket) mm	Φ102	Φ109.7	Φ119
Lift chain		LH2044,4 4 , P=31.75	LH2444,4 4 , P=38.1	LH2844,4 4 , P=44.5
Fork lifting method		Hydraulic		
Mast tilting method		Hydraulic		
Fork spacing adjustment		Manual		

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9.1 General

The hoist system is of the two—stage,rolling telescopic mast type.The inner mast frames have J—shaped section.The outer mast frames have J—shaped section of 10 ton forklift trucks and have C—shaped section of 5 to 8 ton forklift trucks.The masts of 5 to 10 ton forklift trucks all contain a free lift range.

9.2 Outer & inner mast

The mast assembly is of the free lift range—contained two stage telescopic type consisting of the inner and outer mast,and is sustained by mast supports.The mast supports are welded to the bottom of the outer mast,being extended from the axle housing.The outer masts are provided with brackets for lock pins of tilt cylinder connecting hardware.The mast is tilted by operation of the tilt cylinders,forward 6 and backward 12 .

The inner mast is composed of right and left mast frames which are connected with each other by upper and lower connecting members.At the upper inside of each outer mast frame an end roller is installed on the end roller shaft welded to the frame,with a snap ring.In addition,the outer mast frames are fitted with side rollers to sustain the inner mast frames.At the lower outside of each inner mast frame an end roller is installed on the end roller shaft with snap ring,which is welded to the inner mast.Under the end rollers other side rollers are located to sustain transverse load.With the aid of these rollers,the inner mast can smoothly operates.

9.3 Lift bracket

At the lift brackets,end rolers that roll along the inside of he inner mast frames are installed on the end roller shafts with snap rings.The end roller shafts are welded to the lift brackets.The side rollers that roll along on the inside of the inner mast frames are bolt fitted,being shim adjusted.To prevent the tolling of the finger bar,two retaining rollers are used,which roll along on the outside of inner mast frames.The lingitudinal load is sustained by the end rollers of which the upper ones emerge from the mast top when the forks reaches the maximum lift height.The transverse load is sustained by upper retaining rollers and lower side rollers.As we mentioned above,the mast assembly and lift brackets are designed with rigidity,stability and smooth operation in mind.Furthermore,the finger bar and lift brackets are made into one body construction using high tension steel to improve the durability.This meets the ISO Standards.

The two forks installed on the finger bar are made of special alloy steel which has been subjected to heat treatment.

9.4 Adjustment of hoist system

9.4.1 Adjustment of lift cylinder

When replace the lift cylinder,inner mast or outer mast,we shall readjust the stroke of the lift cylinder as following.

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(1) Install the piston rod in the upper beam of the inner mast without shims.

(2) Lift the mast slowly to the max, stroke of the cylinder and check the two cylinders synchronize or not.

(3) Install shims between the top of the piston rod of the cylinder which stop first and the upper beam of the inner mast.The shim are 0.2mm or 0.5mm thick.

(4) Adjust the tightness of lift chains.

The adjustment of the lift cylinder also belongs to exalted maintenance. Please be careful.

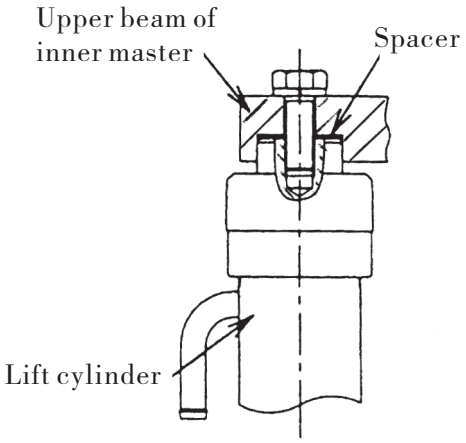

Fig.9.1

9.4.2 Carriage adjustment

(1) Let the truck parking on the horizontal ground and make the mast vertical.

(2) Let the bottom of the fork contact with the ground.Adjust the adjusting nut for the end nipple of the upper chain and make a distance A between the main roller and the carriage A. The A's value equals the 1/4–1/3 value of the main roller's radiu.

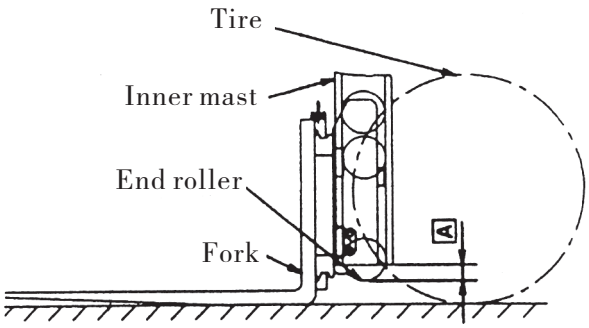

Fig.9.2

(3)Lift the fork to the max.height position,to ensure the clearance B between the stopper of bracket and the stopper of inner mast is 5–10mm.

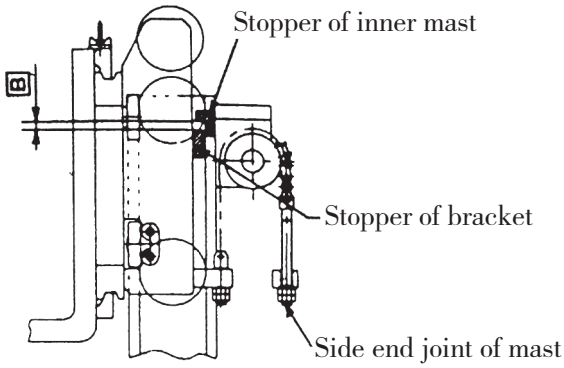

Fig.9.3

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(4) Make the fork down to the ground and tilt backward fully. Adjust the adjusting nut for the end nipple of the upper chain and make the two chains' tightness equal.

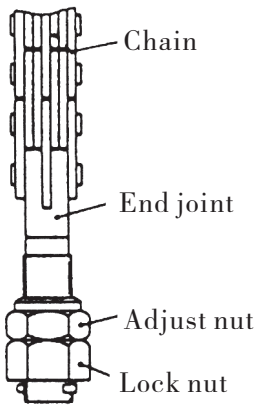

Fig.9.4

9.5 Roller disposal There are three kinds of rollers in the hoist system,main roller,side roller group,side roller.They are separately mounted on the outer mast,inner mast and carriage.Roller disposal of the trucks of 5–10t are almost similar.The main rollers sustain the loads from front and rear direction ,and generally can not be adjusted.The side rollers sustain the side loads. Usual can adjust clearance in right and left side–direction with shims,so as to outer mast,inner mast and bracket can move freely up and down.

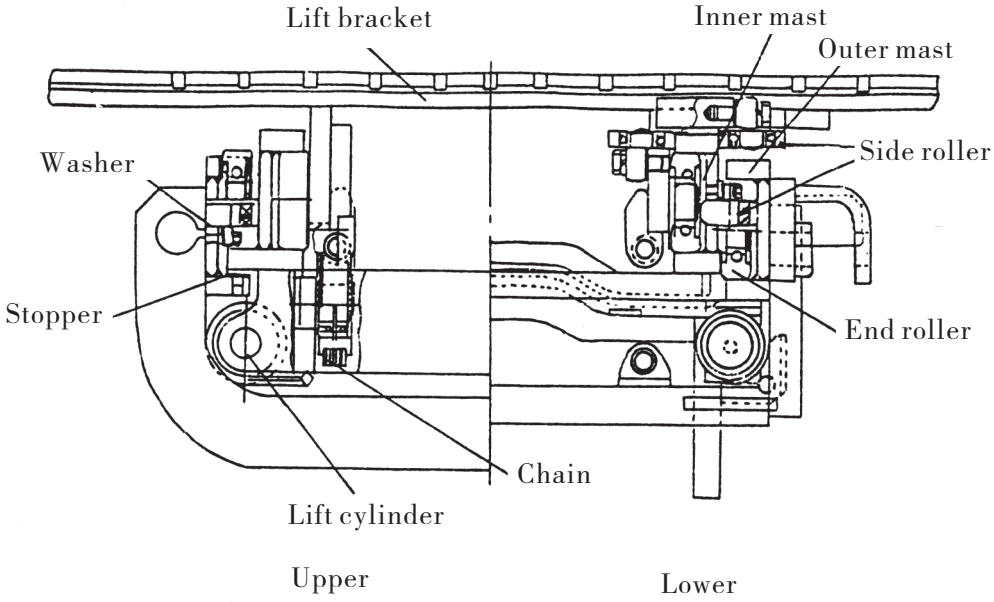

Fig.9.5 Roller lay(for 5–7t truck)

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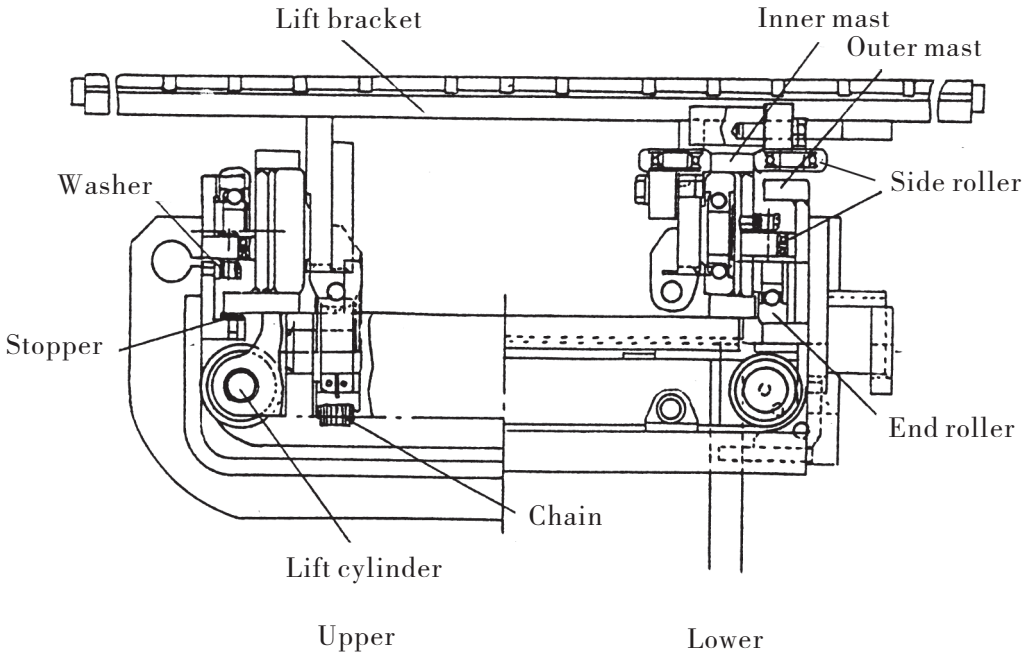

Fig.9.6 Roller lay(for 8t truck)

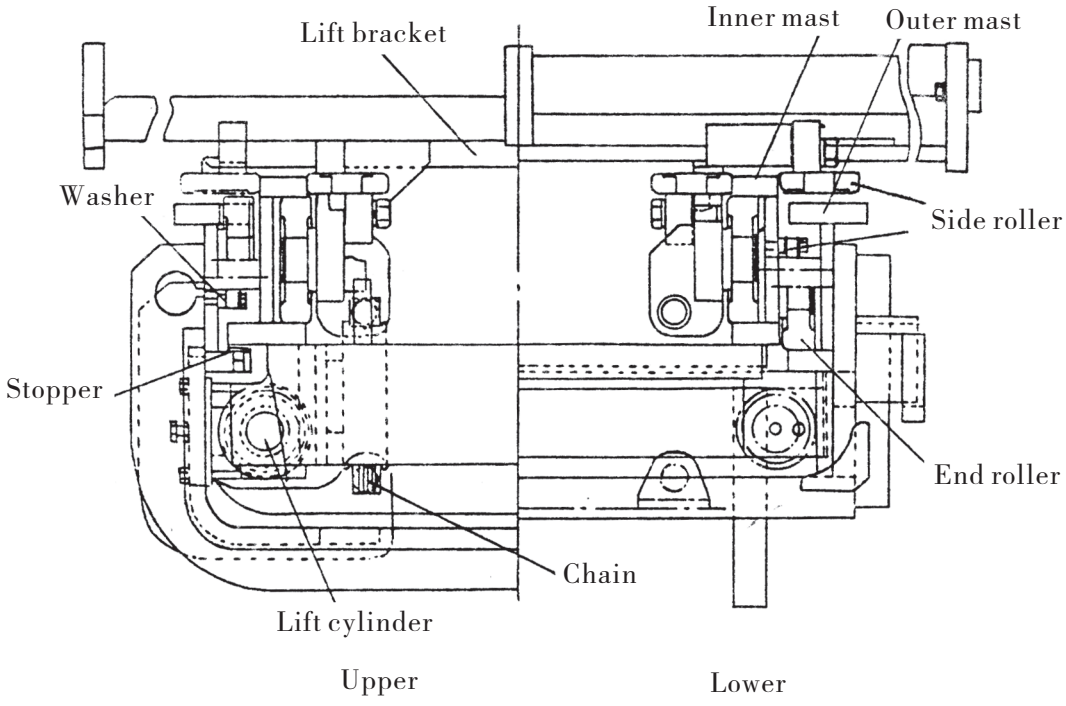

Fig.9.7 Roller lay(for 10t truck)