CEBMW17020

SHOP MANUAL

KOMATSU

WA180-1LC

WHEEL LOADER

MACHINE MODEL	SERIAL NUMBERS
WA180-1LC	75001 and up

MAR 92

HOW TO READ THE SERVICE MANUAL

VOLUMES

Service manuals are issued as a guide to carrying out repairs. They are two manuals for each machine, **Chassis volume** and **Engine volume**.

These volumes are designed to avoid duplication of information. Therefore to deal with all repairs for any model, both chassis and engine volumes are needed.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to your distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number:

   Example 1 (Chassis volume):

   11 - 3

   - 11: Section and sub-section number (11. Engine Structure and Function)
   - 3: Consecutive page number for each sub-section

   Example 2 (Engine volume):
   Refer to the pertinent engine manual.

3. Additional pages: Additional pages are indicated by a hyphen (-) and numbered after the page number. File as in the example.

   Example:

   21-4
   21-4-1 Added pages
   21-4-2
   21-5

REVISED EDITION MARK ([1] [2] [3] ....)

When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

Revised pages are shown on a LIST OF REVISED PAGES which is located between the section contents page and SAFETY pages.

SYMBOLS

So that the service manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel water must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

excessive amounts of chlorides and should not be used.

NOTE: *Never use water alone in the cooling system because corrosion will occur.*

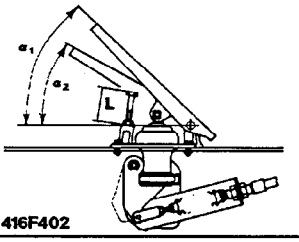
Maintain supplemental coolant additive levels at 1 unit DCA4 per 1 U.S. gal (3.8 liters) of coolant.

Use antifreeze during all seasons to protect the cooling system from corrosion as well as freezing damage.

A mixture of 50% water and 50% ethylene glycol base antifreeze is required for operation of the engine in temperature environments above -34.6°F (-37°C). A mixture of 40% water and 60% antifreeze is recommended for temperatures below -34.6°F (-37°C).

In tropical climates where antifreeze availability may be limited, use a corrosion inhibitor (Cummins liquid DCA), or an equivalent to protect the engine cooling system.

Do not operate the engine without a thermostat.

Cooling system - Continued	Fan belt tension	Deflection at longest span when pushed with a force of 6 kg	mm	9.5 - 12.7	Max. 12.7
		Gauge value at longest span when using Cummins belt tension gauge, ST-1293	N	267 - 578	Min. 267
Accelerator pedal	Operating force	 416F402	kg	7 - 10	Max. 15
	Operating angle α		Degree	α_1 = 45 α_2 = 31	-- 29 - 33
	Stopper bolt height L		mm	47	42 - 52

NOTE: The values given in the Testing and Adjusting data are NOT for adjustment of the output. Do not use these values as a guide to change the setting of the fuel injection pump.

ALTERNATOR

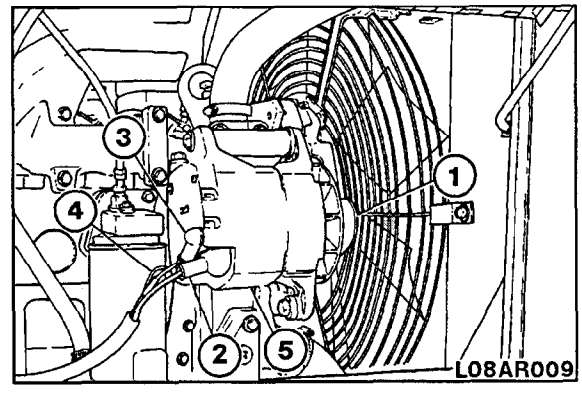
REMOVAL

WARNING! Disconnect the cable from the negative (-) terminal of the battery.

1. Open the engine side access door on the left side of the machine and lock it in the open position.
2. Remove drive belt (1) from the alternator pulley.
3. Disconnect electrical wires (2), (3) and (4) from the alternator.

   ★ Identify each electrical wire with a tag for ease of correct installation.

4. Remove alternator (5).

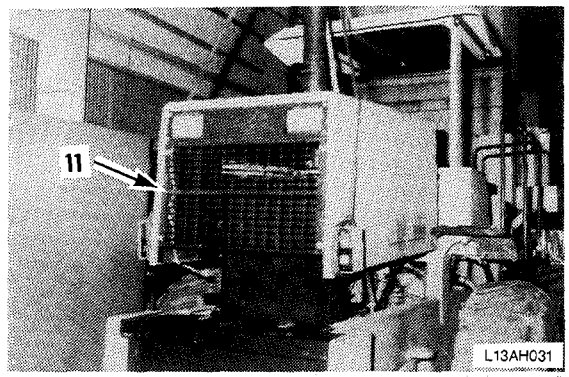


INSTALLATION

1. Install alternator (5) with the mounting hardware.
2. Connect electrical wires (4), (3) and (2) to the alternator.
3. Install drive belt (1) on the alternator pulley.
4. Unlock and close the engine side access door on the left side of the machine.
5. Connect the cable to the negative (-) terminal of the battery.

7) Hoist and sling hood (11), remove mounting bolts and lift off the hood.

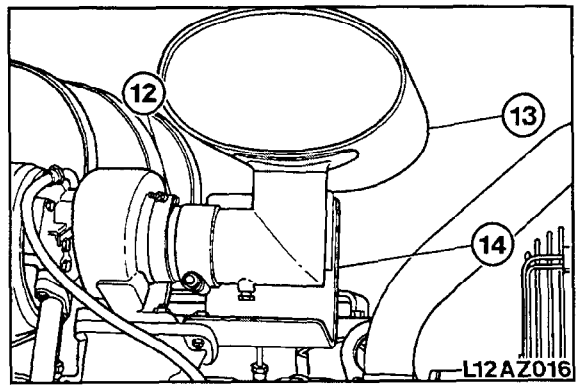
kg Hood: 135 kg



2. Exhaust muffler

1) Loosen muffler clamp (12).

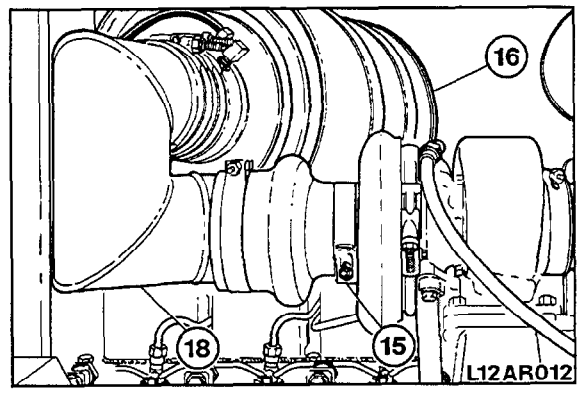
2) Remove muffler mounting bracket hardware and remove muffler (13) and mounting bracket (14) as an assembly.



3. Air Cleaner

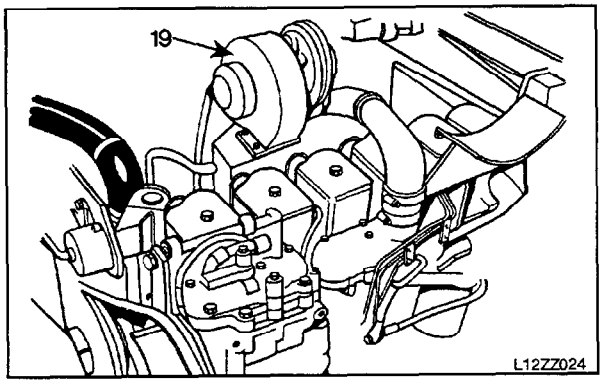
1) Loosen air cleaner hose clamp (15).

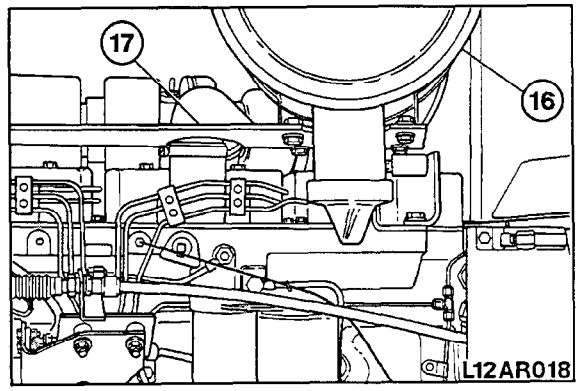
2) Remove air cleaner mounting bracket hardware and remove air cleaner (16), mounting bracket (17) and tube (18) and hoses as an assembly.



4. Turbocharger

Remove turbocharger (19) from the engine as described in the engine service manual.





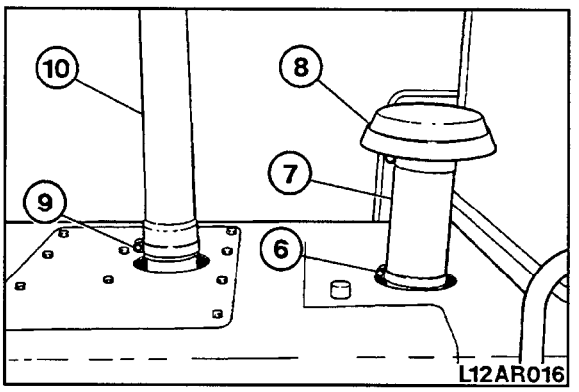
3) Loosen air inlet tube clamp (6) and remove air inlet tube (7) and hood (8) as an assembly.

4) MACHINES WITH STANDARD EXHAUST PIPE ONLY: Loosen exhaust pipe clamp (9) and remove exhaust pipe (10).

5) Remove two mounting bolts (11) at the exhaust pipe cover plate or mounting bracket and replace them with eye bolts (12).

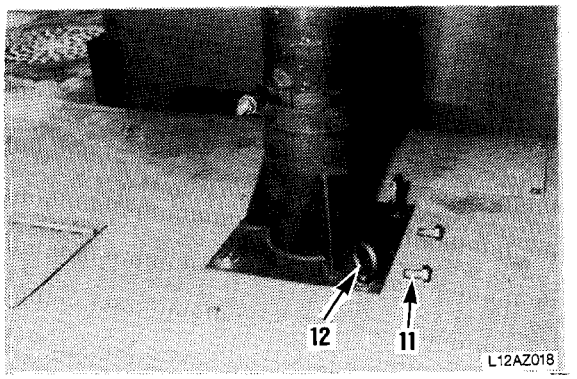
6) Hoist and sling hood (13), remove mounting bolts and lift off the hood.

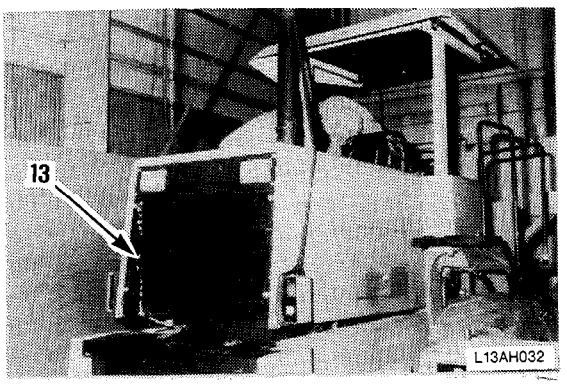
kg Hood: 135 kg

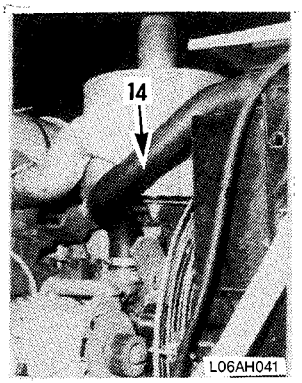


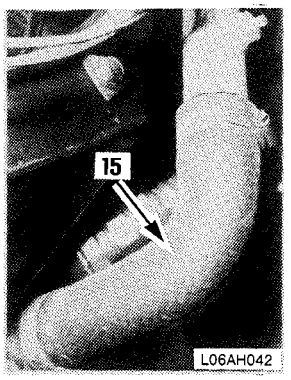
4. Radiator hoses

Remove radiator inlet hoses and tube (14) and disconnect outlet hose (15) at the radiator.









- Disconnect harness connector (30) for parking brake switch and service brake fluid level sensor.
- Disconnect harness connector (31) for cab work lights, if so equipped.

9. Accelerator control cable

Disconnect accelerator control cable (32) from the fuel injection pump and mounting bracket.

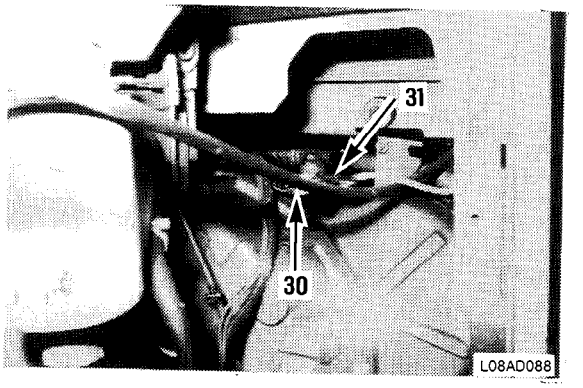
10. Fuel hoses

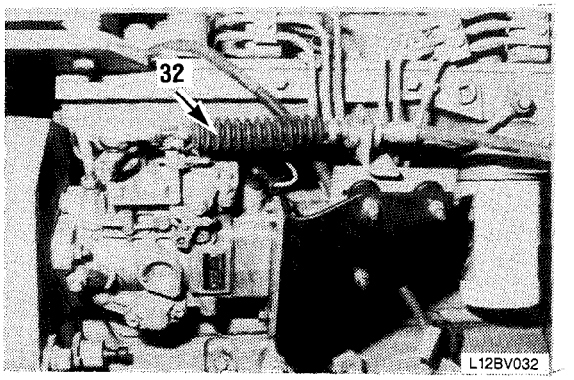
1) Disconnect fuel supply hose (33) at fuel transfer pump.

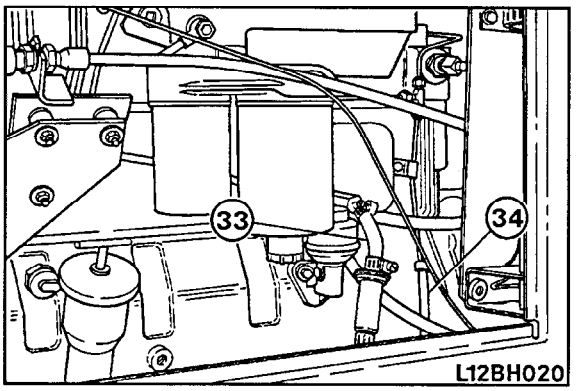
2) Disconnect fuel return hose (34) from the fuel return tube.

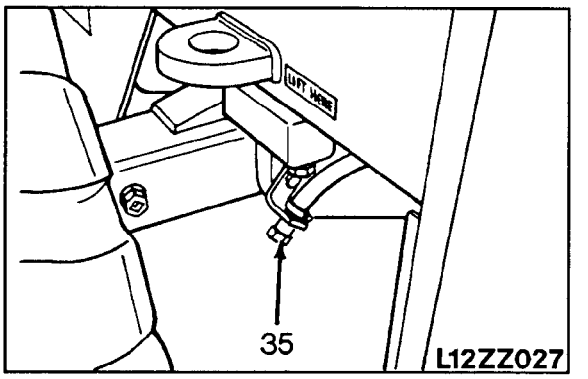
11. Engine oil drain valve

Remove engine oil drain valve (35) from the rear drive axle pivot area.









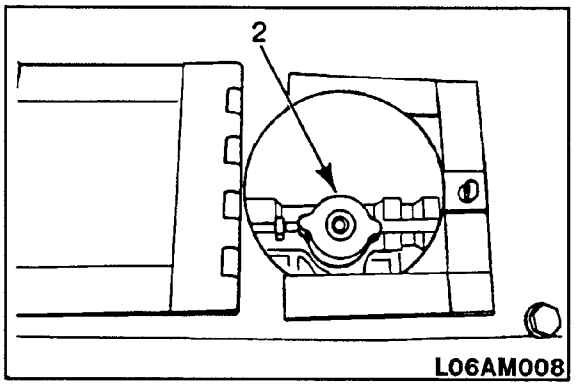
3) Remove the transmission oil cap and add transmission oil through filler opening to specified level.

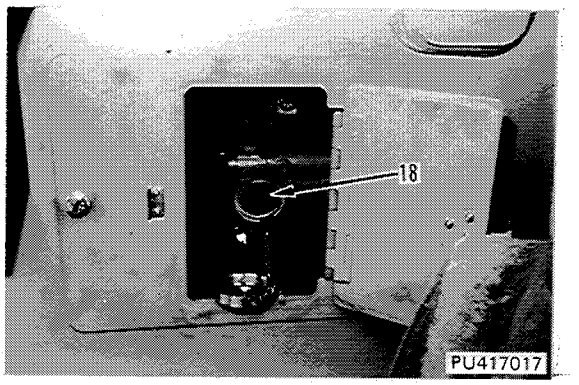
4) Run the engine to circulate the coolant and transmission oil through the system.

5) Stop the engine and check the coolant and transmission oil levels.

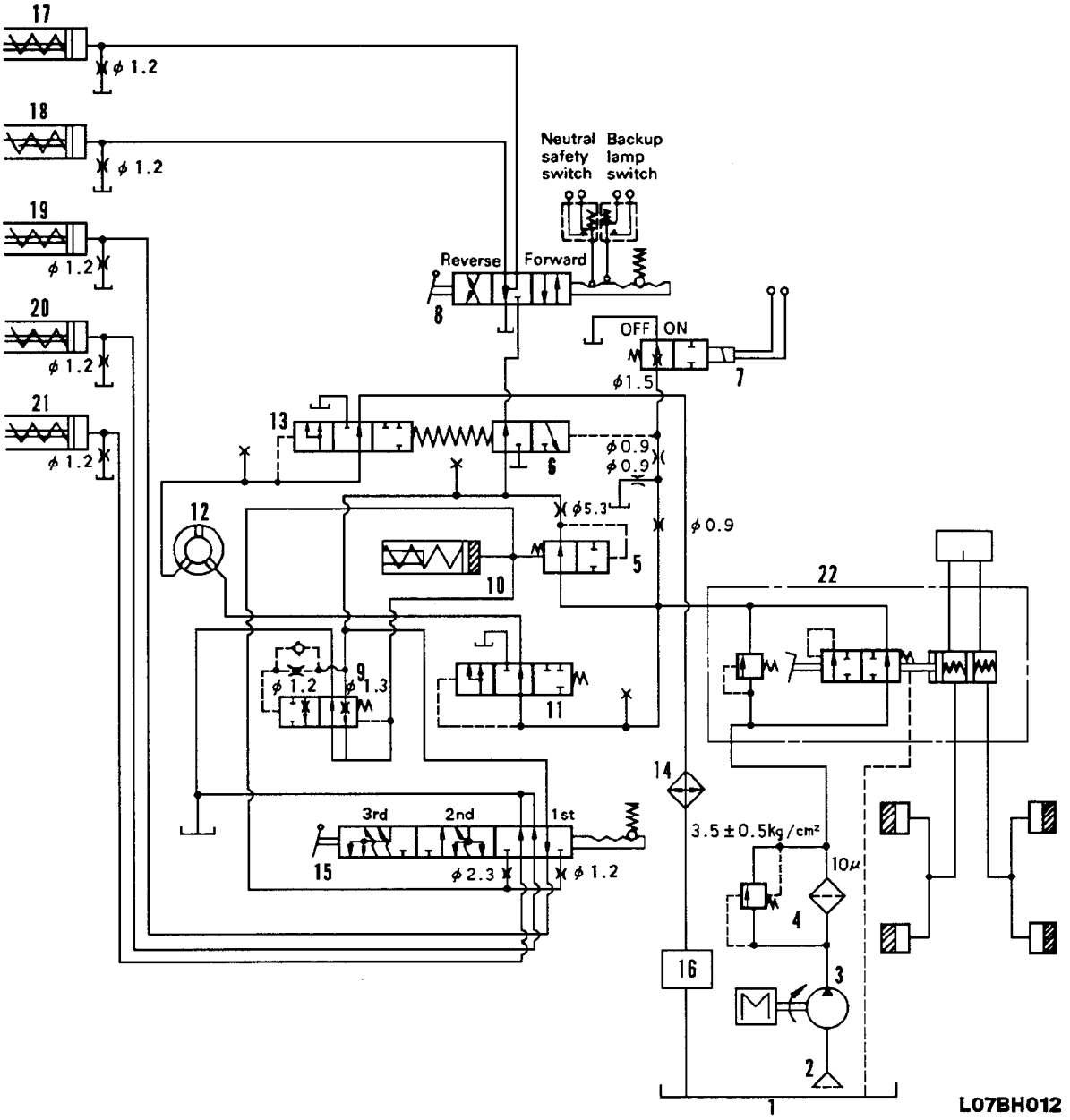
6) Install radiator filler cap (2).

17. Unlock and close the engine side access door on the left side of the machine.



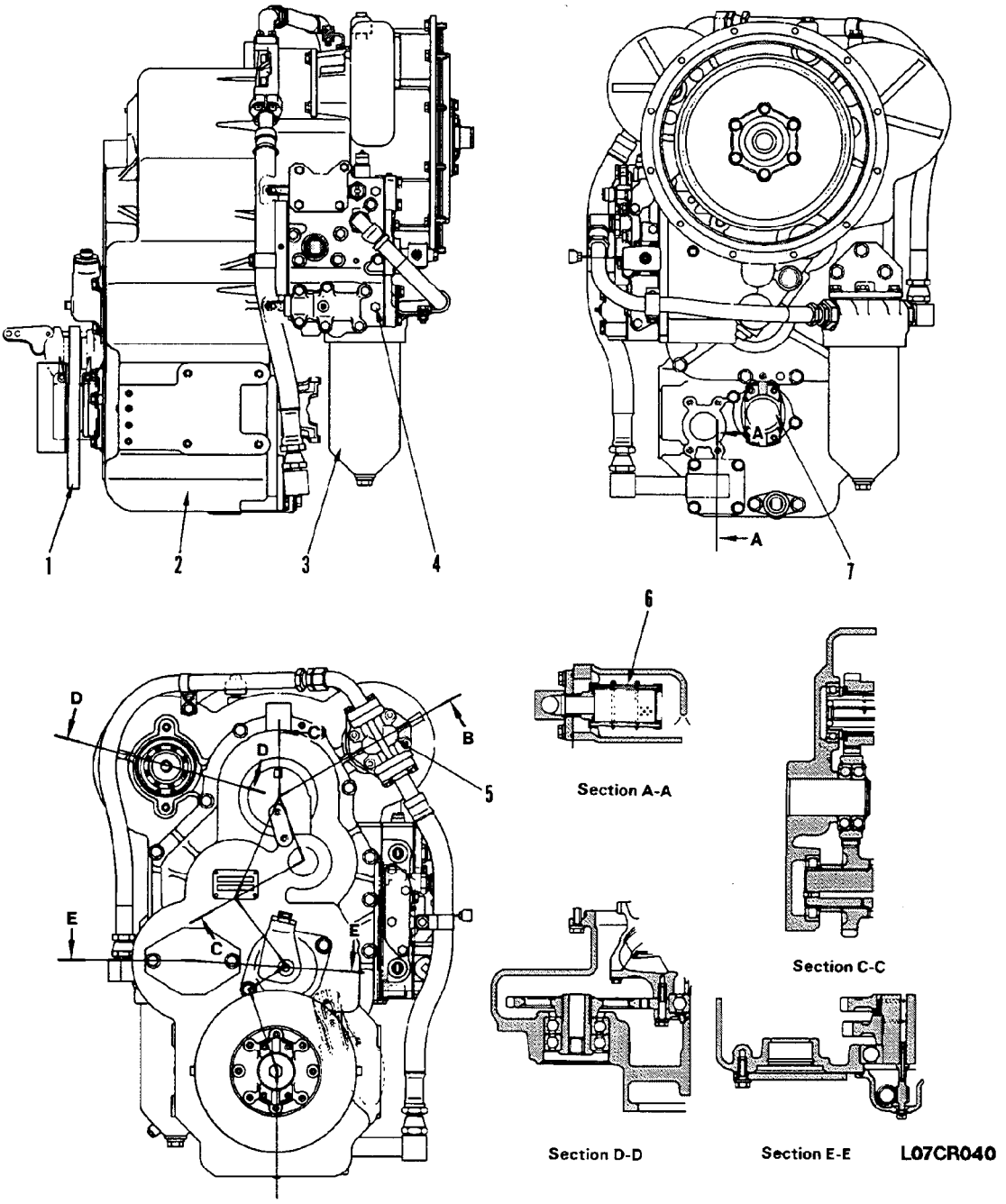


HYDRAULIC CIRCUIT DIAGRAM FOR POWER TRAIN

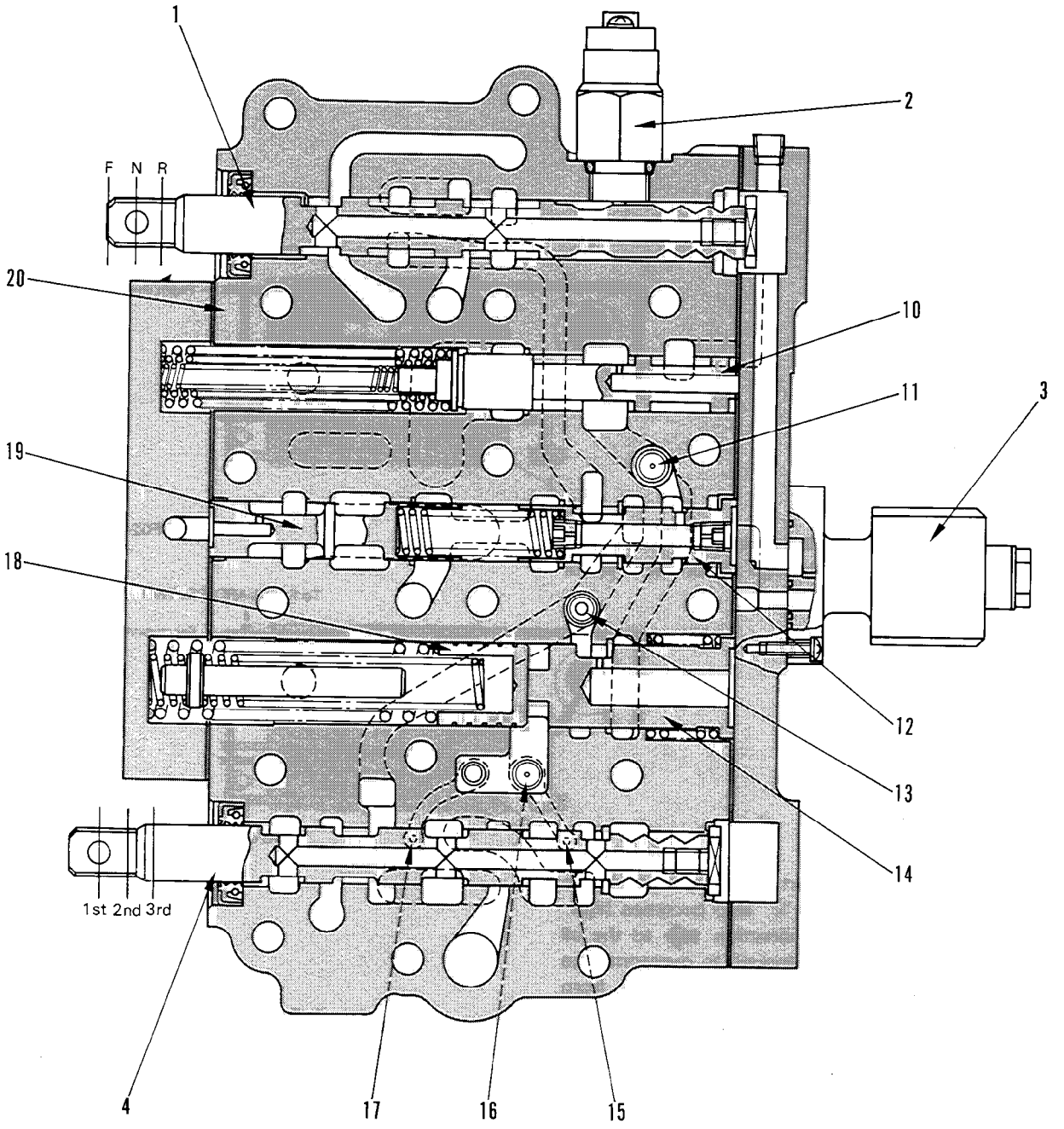


1. Transmission sump
2. Oil strainer
3. Torque converter charging pump
4. Torque converter oil filter
5. Throttle poppet
6. Clutch cut-off valve
7. Neutral solenoid valve
8. Forward reverse spool
9. Quick return valve
10. Accumulator
11. Main regulator valve
12. Torque converter
13. Torque converter outlet valve
14. Oil cooler
15. Speed control spool
16. Lubrication for transmission
17. Forward clutch
18. Reverse clutch
19. First gear clutch
20. Second gear clutch
21. Third gear clutch
22. Wheel brake power master cylinder

TRANSMISSION



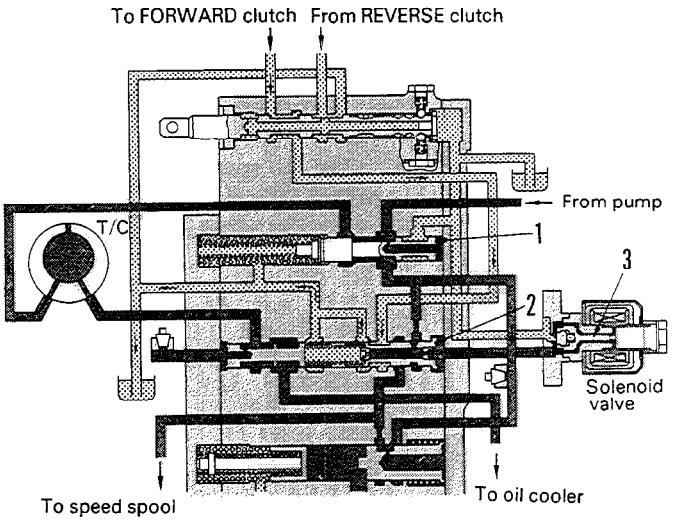
1. Parking brake
2. Transmission case
3. Torque converter oil filter
4. Transmission control valve
5. Torque converter charging pump
6. Oil strainer
7. Output flange
8. Reverse clutch



Section F—F

10. Main regulator valve
11. Orifice
12. Cut-off valve
13. Main orifice
14. Modulating valve
15. Orifice
16. Orifice
17. Orifice
18. Accumulator
19. Torque converter outlet regulator valve
20. Valve body

- The movement of clutch cut-off (2) to the left causes the port from main regulator valve (1) to be closed. Since the forward reverse clutch apply port is open to the drain circuit, the pressurized forward reverse clutch apply oil runs out, causing the machine to stop.



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- When the left brake pedal is released, the electrical current flowing to solenoid valve (3) is cut-off. This opens the drain circuit, which allows the oil pressure in chamber (A) to lower and causes the clutch cut-off valve to move to the right. For this reason, at the same time when the drain circuit is closed, the main regulator valve port and the clutch apply circuit are connected together.

  Thus oil is supplied to the clutch again. A rise in clutch apply pressure gives the same effect as encountered when shifting gears.

MEMORANDA

MEMORANDA

5. **Carry out troubleshooting using the troubleshooting charts.**
   There are the following two types of troubleshooting charts.
   1. TROUBLESHOOTING TABLE..... 22 POWER TRAIN
      42 STEERING SYSTEM
      52 BRAKE SYSTEM
      62 WORK EQUIPMENT SYSTEM
   2. TROUBLESHOOTING FLOW CHART.....
      The troubleshooting flow charts consist of:
      1) Items which can be checked easily.
      2) Items which are likely to be the cause of such failures.
      Follow these charts to carry out troubleshooting.
      At the same time, do not forget the following points.
      - Check related items.
      - Check that there are no other failures or breakdowns.

   ★ For details of the troubleshooting tables, see the following pages.

6. **Investigate causes of breakdown.**
   - Even if the breakdown is repaired, if the original cause of the problem is not removed, the same breakdown will occur again. To investigate and remove the original cause, see " Actions to take to prevent failures from occurring again".

3. PRECAUTIONS WHEN REMOVING, INSTALLING, DISASSEMBLING OR ASSEMBLING PARTS DURING TROUBLESHOOTING

If it is necessary to remove, install, disassemble or assemble parts for troubleshooting, remember the following points.

- Carry out the various testing and adjusting while observing the items on quality control given in "Testing and Adjusting".
- When removing parts, check their condition of mounting and distinguish between front and rear, left and right and top and bottom.
- Check the match marks or make match marks to prevent mistakes when installing.
- If a part can not be removed even when the mounting hardware has been removed, do not use excessive force to remove it. Check the part to see if there is any problem with it and correct the problem before trying to disassemble the part.
- When installing or assembling, clean off dust and dirt and repair any scratches or dents. Remove all grease and/or oil before coating with gasket sealant.

4. Large time lag when moving off or changing gear.

Check the following items with the operator.
- If the time lag is large and also the machine speed, thrust force and gradeability are abnormal, refer to item 2. "Machine speed is low, thrust is weak, gradeability falls off".

Checks before troubleshooting.
- Is quantity and type of oil in transmission correct?
- Is there any leakage of oil from valve or pipe connections?

Fault check
- Determine whether or not the time lag is large by means of the judgement criterion table.

No.	Problems \ Remedy / Cause	C △	△ X	△ X	△ X	△ X	△ X
					Transmission control valve		Transmission
					a: Blocked orifice of transmission control valve	b: Faulty quick return transmission control valve	c: Oil leakage due to wear of piston spool or bore of transmission control valve with modulator
					d: Oil leakage from transmission clutch pack and piston seal	e: Oil leakage from transmission clutch pack and shaft seal ring	f: Oil leakage from O-ring between transmission housing and valve
1	Large time lag at all speed positions.	○	○	○			
2	Large timg lag at a particular speed position.				○		
3	Low clutch pressure at all speed positions.	○		○			
4	Clutch oil pressure is low at speed stages having a large time lag.			○	○		

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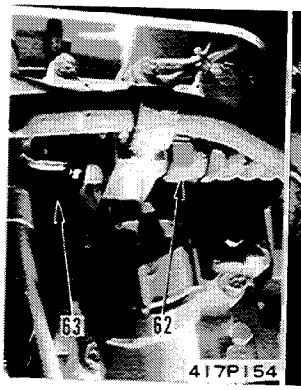
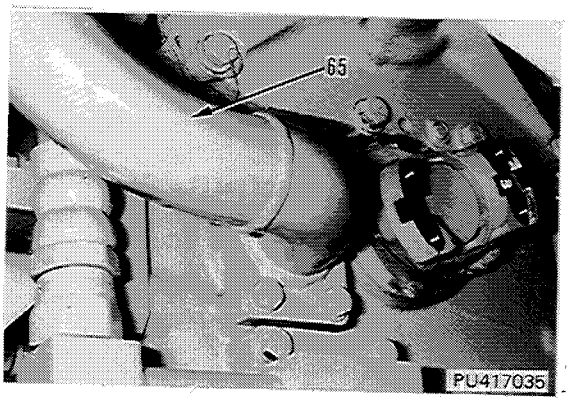
The following symbols are used to indicate the action to be taken when a cause of failure is located:

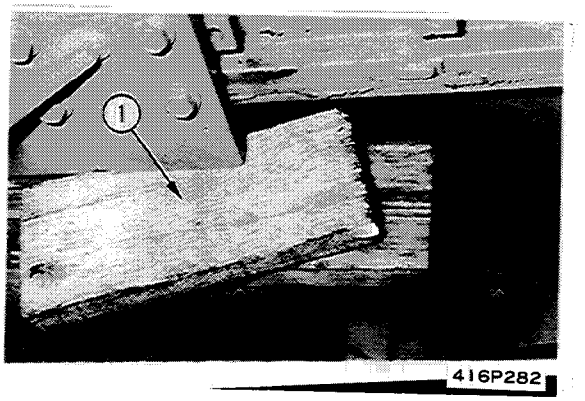
X: Replace △: Repair
A: Adjust C: Clean

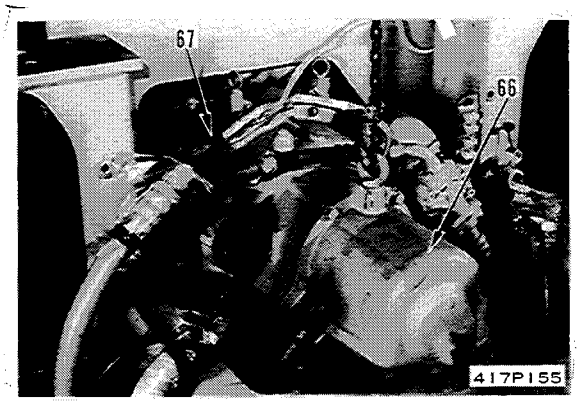
16. Torque converter transmission and piping

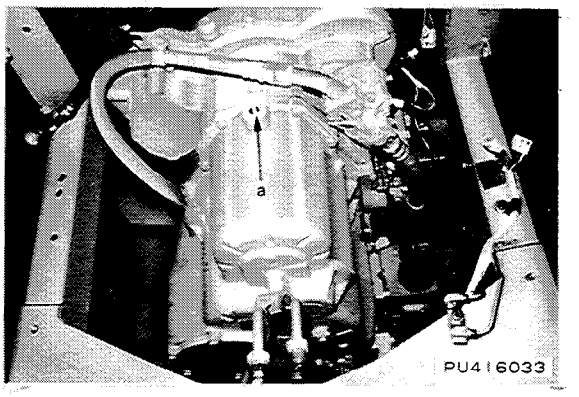
1) Disconnect hose (62) between the transmission control valve and the oil cooler from control valve (63).
2) Disconnect hose (64) between the transmission and the oil cooler from the transmission.
   ★ Remove the mounting bolts of the mounting bracket for the two-way wrist lifter and pull it to the front to move it.
   ★ Remove hose clamp
3) Remove oil supply tube (65) from the transmission.
4) Place block ① under the engine.
   ★ Adjust the height correctly.
5) Install eye bolt (a).
   ★ Adjust the height correctly.
6) Hoist and sling torque converter transmission (66) and remove the mounting bolts connecting the torque converter to engine (67).



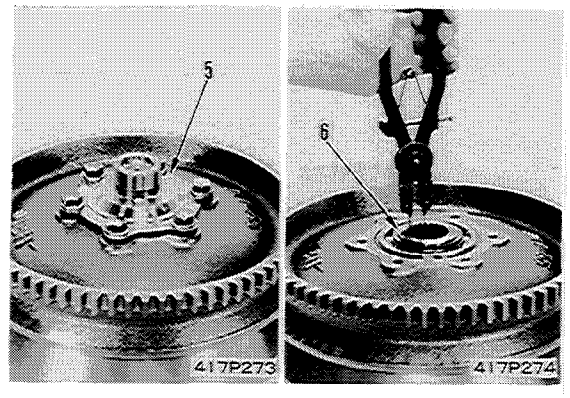




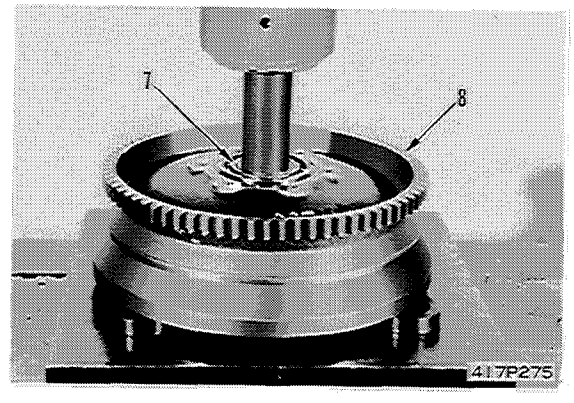


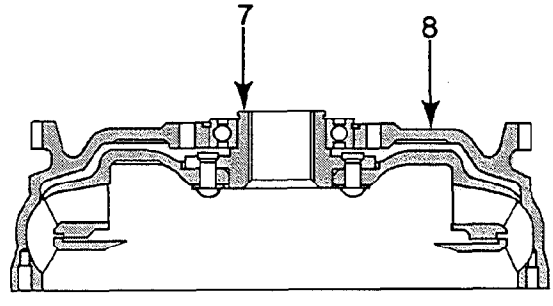


3) Disassemble turbine and case assembly as follows:
   i) Remove pilot (5).
   ii) Remove snap ring (6).
   iii) Push boss of turbine (7) and remove from case (8).



3. Stator
   Remove snap ring (9), then remove stator (10).





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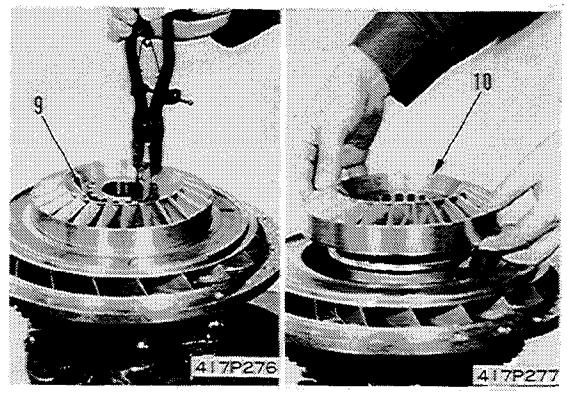
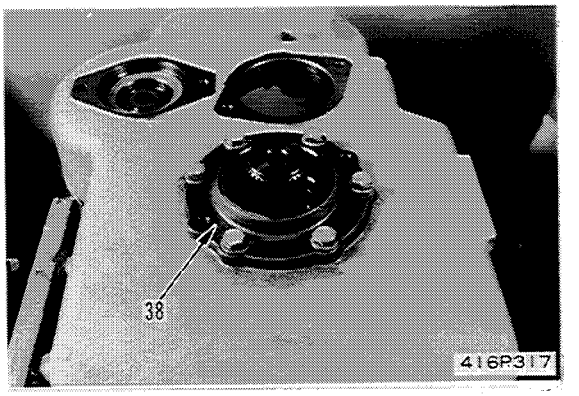
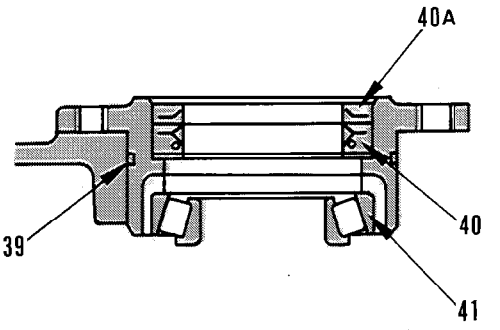


16. Front bearing retainer

1) Remove the mounting bolts, then using forcing screws, remove bearing retainer (38) and shims.
   ★ Record the number and thicknesses of the shims and keep them in a safe place.



2) Remove O-ring (39), oil seal (40) and bearing cup (41) from retainer.
3) Remove dirt seal (40A).



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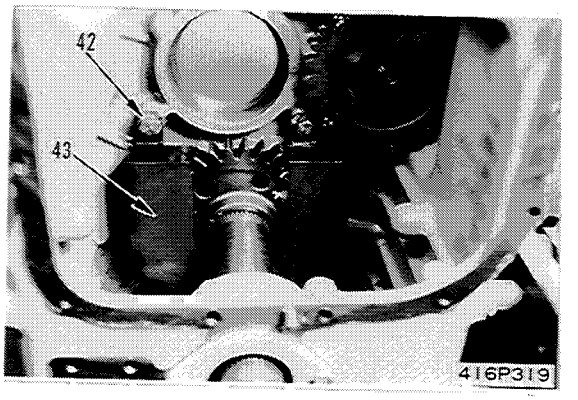
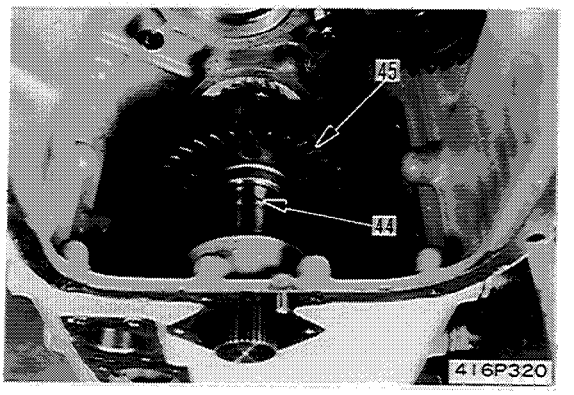
17. Output shaft and gear

1) Remove lock plate (42), then remove shroud (43).

WARNING! Be careful not to cut your hand with the edge of the shroud.



2) Remove ring (44) from groove, move it to the center, then move gear (45) to same position as the ring.



11. Rear housing

1) Using tool A, raise housing (16), and assemble to front housing (60).
   - ★ Be sure contact surfaces of housing are clean of deposited matter and grease. Apply a 2-4 mm wide x 1-2 mm high bead of liquid gasket to the contact surface of one of the housings. Be careful not to let the gasket sealant get inside the case. Assemble the housings within 5 minutes of applying the bead of liquid gasket.
   - ★ Wait for at least one hour after assembling before filling with oil.
   - ★ Remove pilot (61) of the torque converter, then align the spline of the input shaft correctly.
   - ★ Be careful not to damage the seal rings on the shafts.

   Housing contact surface: Liquid gasket: Part no. 419-15-18131

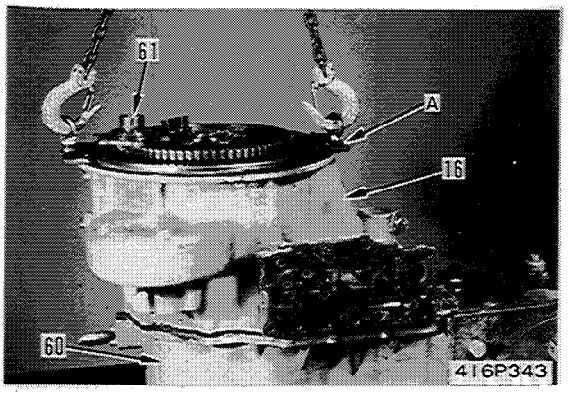
   Housing mounting bolts: 11.5 ± 1.0 kgm

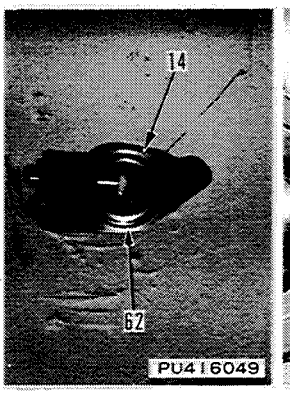
   kg Rear housing: 65 kg

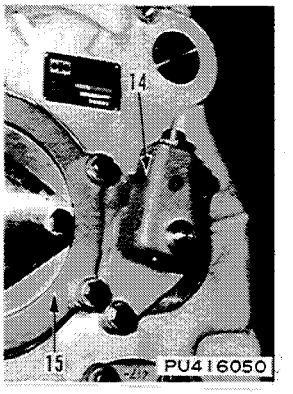
2) Install torque converter pilot (61).

   Pilot mounting bolt threads: Gasket sealant (LT-2)

   Pilot mounting bolts: 6.8 ± 0.8 kgm







12. Housing cover and speedometer drive

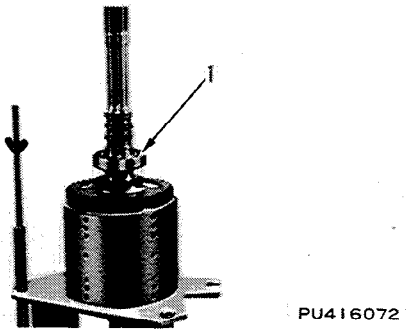
1) Fit a new O-ring (62) and install speedometer drive (14) at the end of the second and third speed clutch shaft.
   - ★ When installing the speedometer drive, be sure that the speedometer worm gear is properly meshed.
2) If so equipped, fit a new O-ring and install housing cover (15) adjacent to the second and third speed clutch shaft.
   - ★ Be careful not to let the O-rings come out of place.

   O-ring: Transmission oil

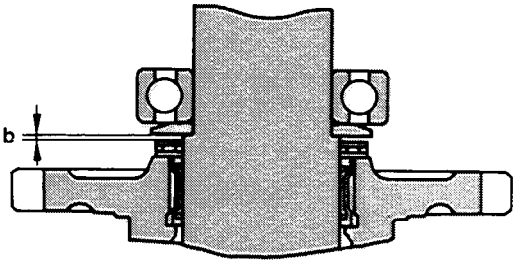
16. Bearing

Press fit bearing (1).

★ Press fit the bearing completely so that spacer (3) is in close contact with the stepped part of the shaft and bearing (1).



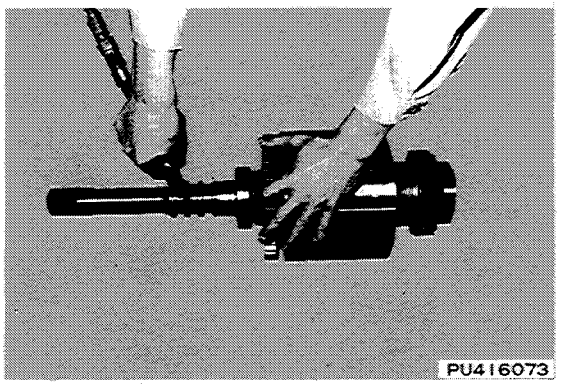
★ After press fitting the bearing, check that clearance 'b' between the thrust bearing and spacer is within the specified range.
'b' = 0.092 - 1.222 mm



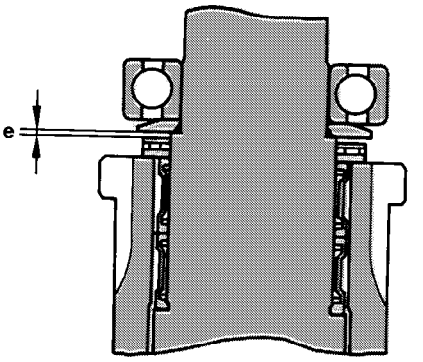
17. Clutch pack operational test

Blow in compressed air through the clutch apply oil holes in the shaft and check the operation of each clutch pack.

★ If the gear on the side where the air is blown in is held in place, the clutch is working normally.



★ After press fitting the bearing, check that clearance 'e' between the thrust bearing and spacer is within the specified range.
'e' = 0.001 - 1.131 mm



416F238

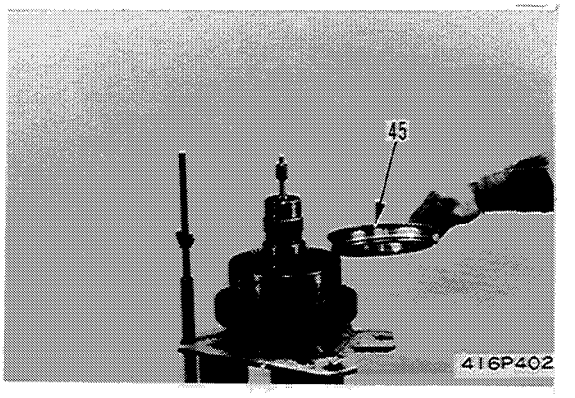
9. Second speed piston

1) Turn over clutch pack.

WARNING! When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

2) Install new piston seal rings. Install second speed piston (45).
★ Be careful not to damage the piston seals.
★ Check that the spring pin is not protruding from the outside circumference.

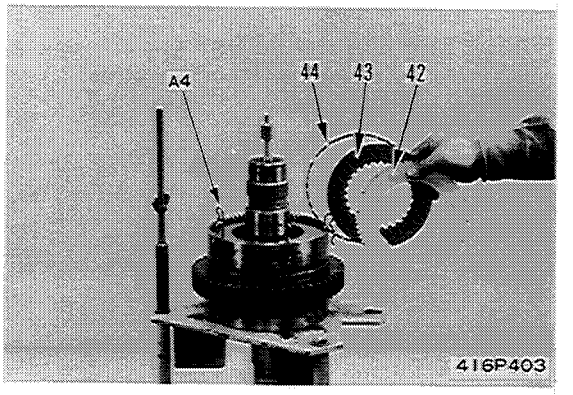
Sliding surface of piston seals: Transmission oil



416P402

10. Clutch plates

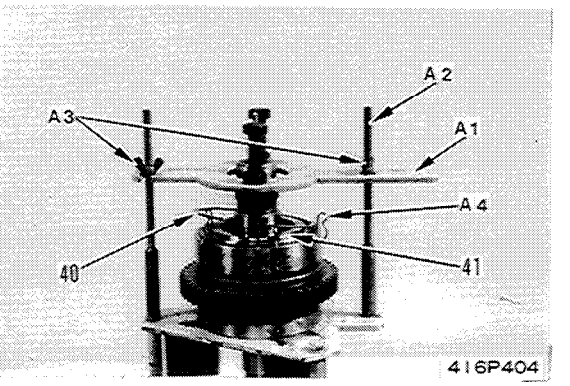
Insert tool A_4 in housing, then assemble plates (42), and discs (43) and springs (44) in turn.
★ Assemble in the same way as for the third speed side.



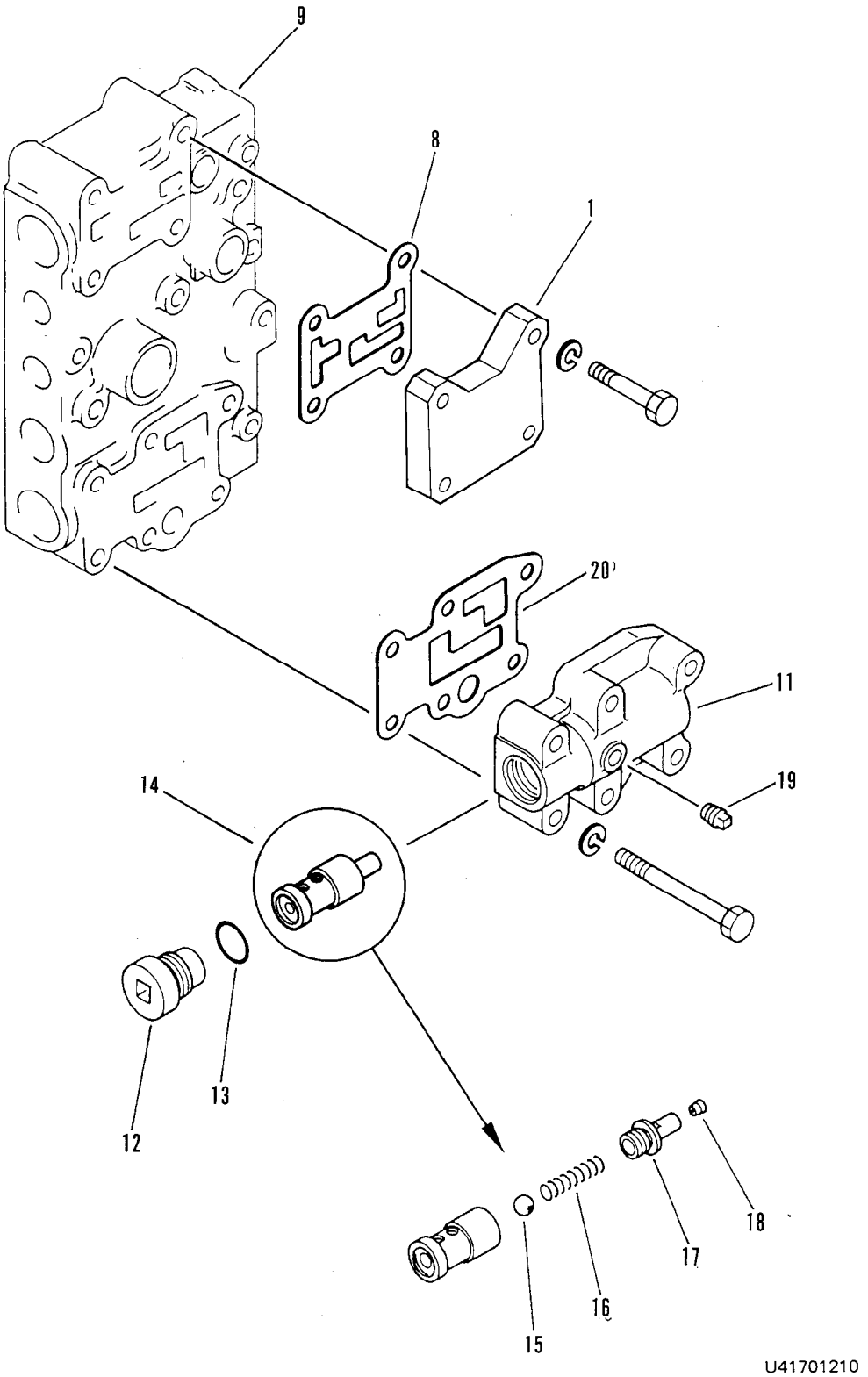
416P403

11. End plate

1) Install tools A_1 and A_2. Tighten tool A_3 to push in end plate (41). Remove tool A_4.
2) Assemble ring (40), then remove tools A_1, A_2 and A_3.
★ Assemble in the same way as for the third speed side.



416P404


9
8
1
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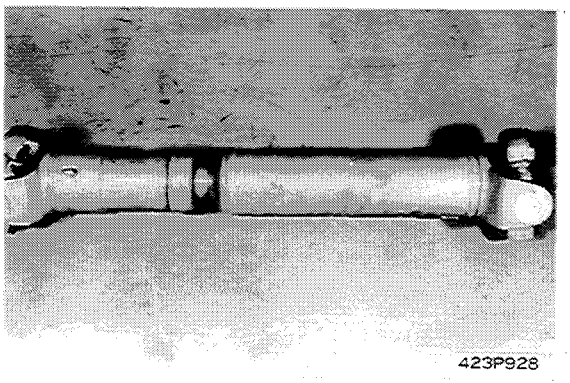
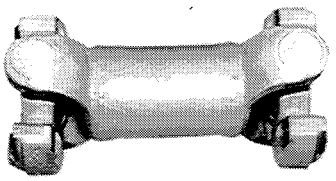
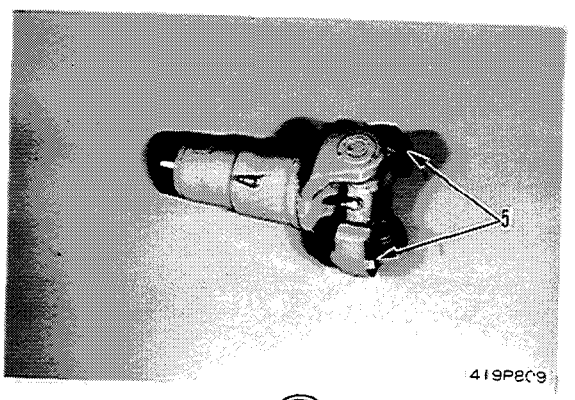
U41701210

2. **Center drive shaft, rear drive shaft**
   ★ Follow the procedure in **1. Front drive shaft** Step 1).


423P928

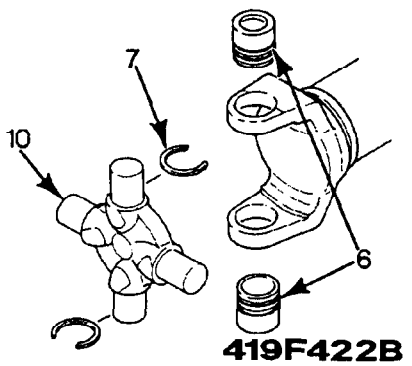

417P176

3. **Spider, bearing**
   1) Remove seal and bearing caps (5).



419P809

   2) Remove ring (7) of spider (10) and bearing (6), then tap with plastic hammer to remove spider and bearing.
      ★ Repeat the same procedure for the front, center and rear drive shafts.

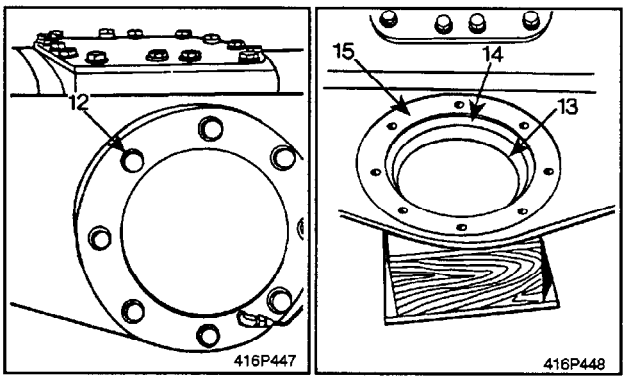


419F422B

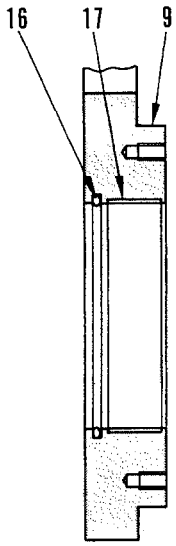
7. Rear pivot

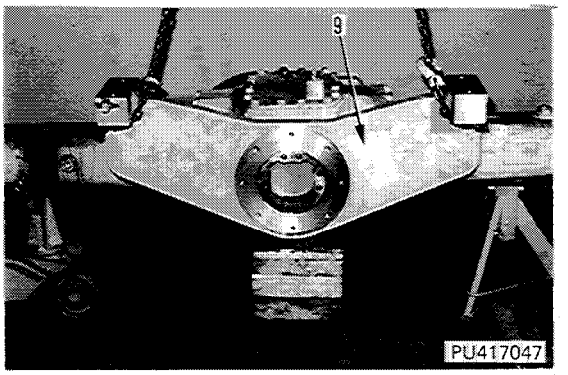
1) Remove trunnion cap (12).
   - ★ Before removing the cap, remove the grease tube.
   - ★ There are shims inserted, check the number and thickness of the shims, and keep in a safe place.
2) Remove thrust washer (13), thrust plate (14), and thrust washer (15).
3) Lift off rear pivot.
   - ★ Be careful not to let the lifting tool slip when lifting off the pivot.

kg Rear pivot: 87 kg



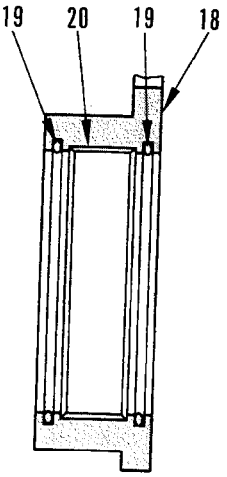
4) Remove O-ring (16) and bushing (17) from pivot (9).

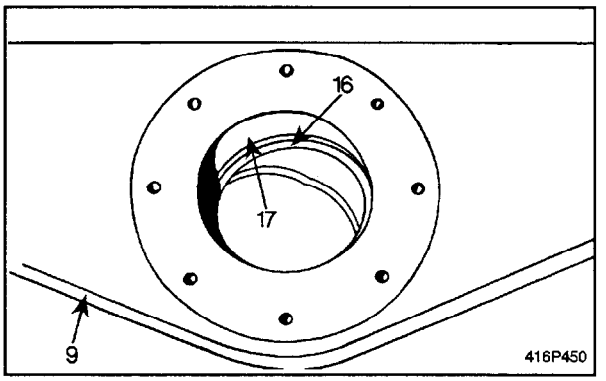


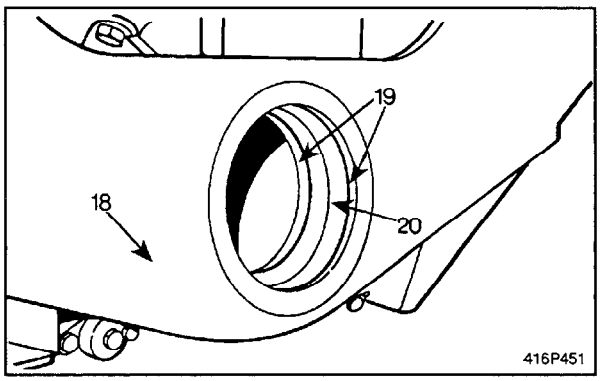


8. Front pivot

Remove O-ring (19) and bushing (20) from pivot (18).



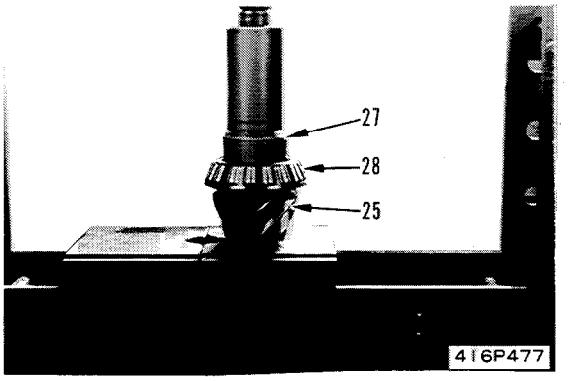




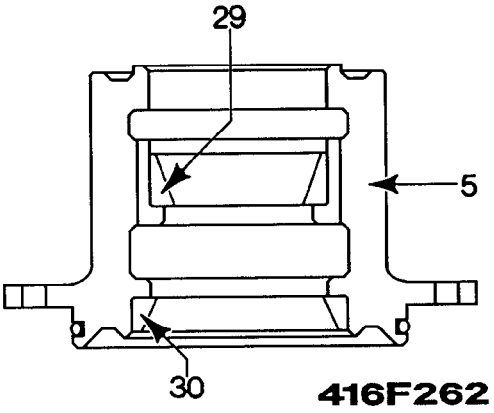
ASSEMBLY

Special tools

	Part number	Part name	Qty.
A	793-510-1600	Mandrel	1
B	793-520-2200	Installer	3
C	793-605-1001	Brake tester	1



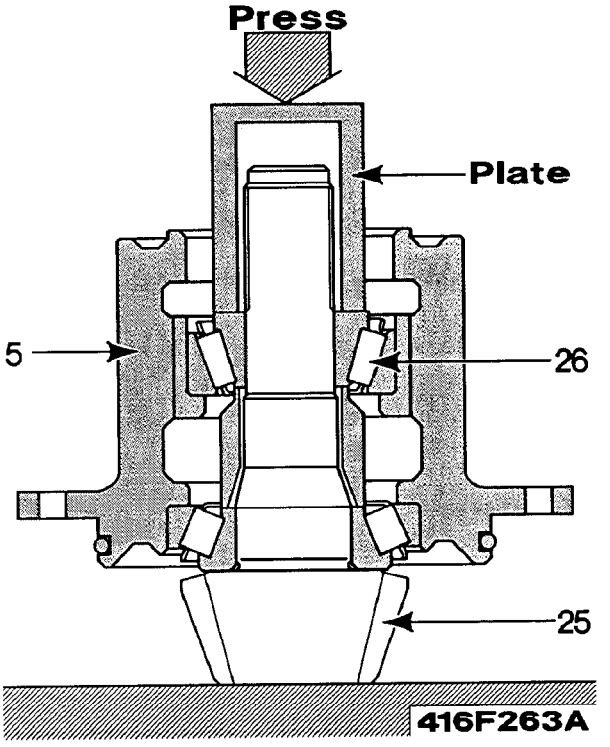
1. **Pinion gear**
   1) Press fit bearing cone (28) in pinion gear (25), then assemble spacer (27).
      ★ There must be no clearance at the contact surface of any parts.
   2) Press fit bearing cups (29 and 30) in cage (5).



   3) Assemble pinion gear (25) in cage (5), then press fit bearing cone (26).
      ★ Apply pressure to the bearing at the specified load, and rotate the cage to settle the bearing.
      Press load: 5 ton

      Bearing: Oil (axle oil)

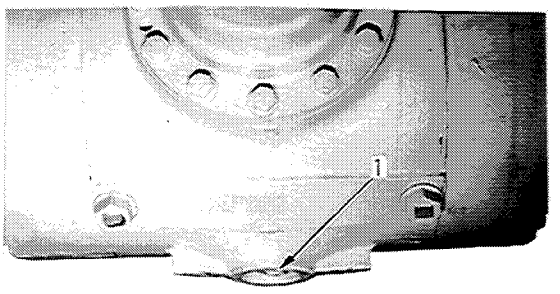
      ★ When rotating the cage at the specified load, rotate lightly by hand.
      (Front axial play = Max. 0.145 mm)
      (Rear axial play = Max. 0.172 mm)
      If the rotation is not smooth, replace the bearing and spacer, and check that rotate lightly by hand again.



AXLE HOUSING
DISASSEMBLY

Special tools

	Part number	Part name	Qty
A	790-101-3100	Puller	1
A_1	790-101-3110	Puller	1 Set
A_2	790-101-3120	Bolt	2
A_3	790-101-3130	Nut	2

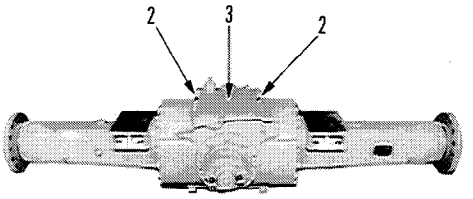


419P882

1. Draining oil

Loosen drain plug (1) and drain oil from axle.

Axle: 16ℓ



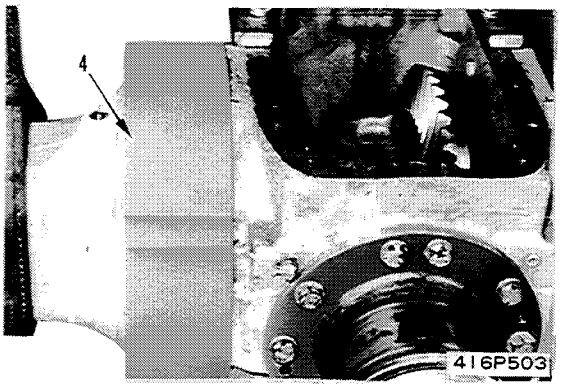
419P883

2. Differential cover

1) Remove bleeder screw (2), then remove differential cover (3).
2) Install axle on stand.

3. Axle housing

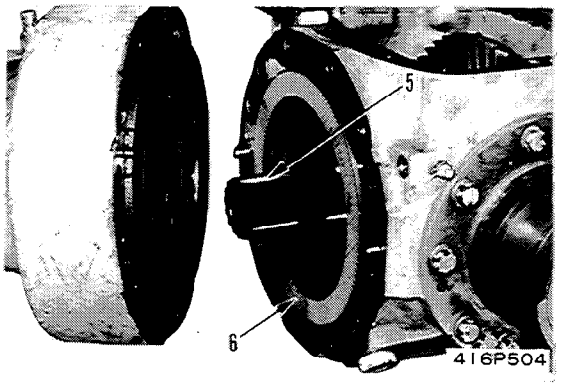
1) Sling axle housing (4), remove mounting bolts, then lift off.
   ★ Mark the housings to distinguish the left and right axle housings.



416P503

2) Disconnect axle housing, then remove sun gear shaft (5), brake disc (6), and brake ring.
   ★ Be careful not to damage the face of the brake disc.

kg Axle housing: 130 kg

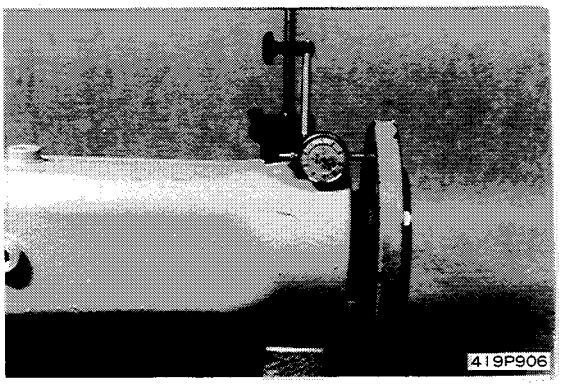


416P504

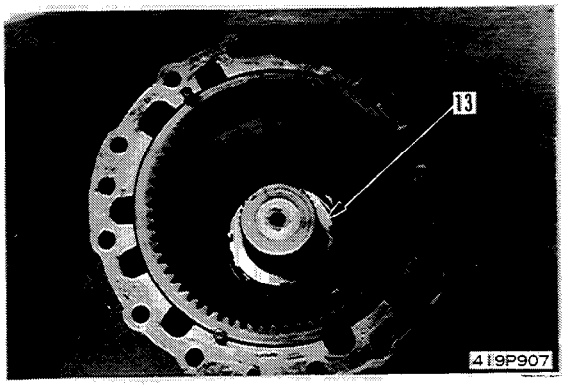
4) Rotate shaft and tighten lock nut until standard value is reached for axial play.

End play: 0.025 - 0.200 mm.

★ Put the axle housing on its side. Install a dial gauge to the housing and put the probe in contact with the wheel mounting surface.



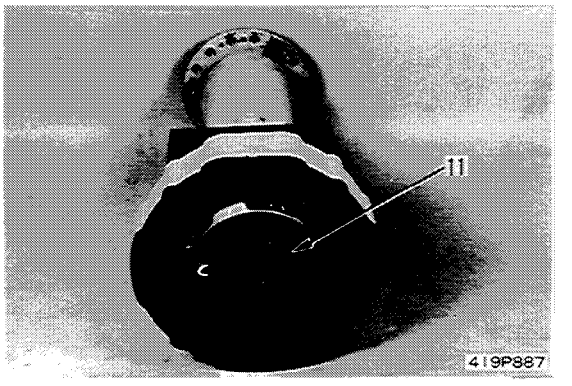
5) After deciding the axial play, bend tab of lock washer (14) and fit in groove of lock nut (13).
★ Bend the tab of the lock washer and fit it securely in the groove of the lock nut.



7. Planetary carrier

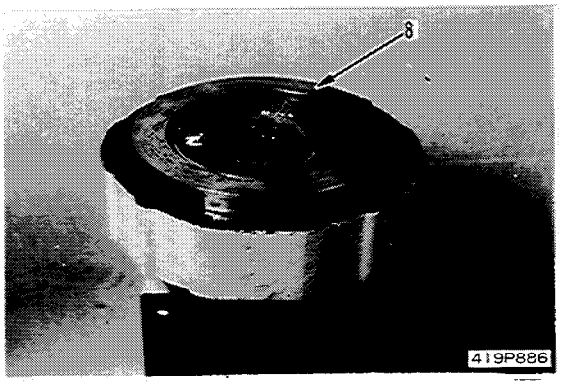
Align spline of axle shaft, install planetary carrier (11), then secure with ring.
★ Clean the shaft and planetary carrier spline before assembling.
★ Install the ring securely in the groove of the shaft.

When assembling the planetary carrier, be careful not to get your fingers caught in the gear.



8. Brake outer ring

Install brake outer ring (8) in axle housing.
★ Align the pin and the outer ring pin hole when installing.
★ Be careful not to damage the surface of the brake outer ring.



Unit: mm

No	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between piston and cylinder (F-R) Inside	110	-0.27 -0.32	+0.06 -0.07	0.20-0.38	0.43	
	(F-R) Outside	139	-0.27 -0.32	+0.06 -0.07	0.20-0.38	0.43	
2	Clearance between piston and cylinder (1st, 2nd, 3rd) Inside	110	-0.27 -0.32	+0.06 -0.07	0.20-0.38	0.43	
	(1st, 2nd, 3rd) Outside	165	-0.27 -0.32	+0.06 -0.07	0.20-0.38	0.43	
3	Clearance between F-R clutch shaft and bearing inner race (R)	50	+0.013 -0.002	bearing 0 -0.012	-0.025 -0.002		
4	Clearance between F-R clutch shaft and bearing inner race (F)	50	+0.030 -0.015	bearing 0 -0.012	-0.042 -0.015		Replace
5	Clearance between 1st clutch shaft and bearing inner race (R)	55	+0.015 +0.002	bearing 0 -0.015	-0.030 0.002		
6	Clearance between 1st clutch shaft and bearing inner race (F)	55	+0.030 +0.015	bearing 0 -0.015	-0.045 -0.015		
7	Clearance between 2nd-3rd clutch shaft and bearing inner race (R)	50	+0.013 +0.002	bearing 0 -0.012	-0.025 -0.002		
8	Clearance between 2nd-3rd clutch shaft and bearing inner race (F)	60	+0.015 +0.002	bearing 0 -0.015	-0.030 -0.002		

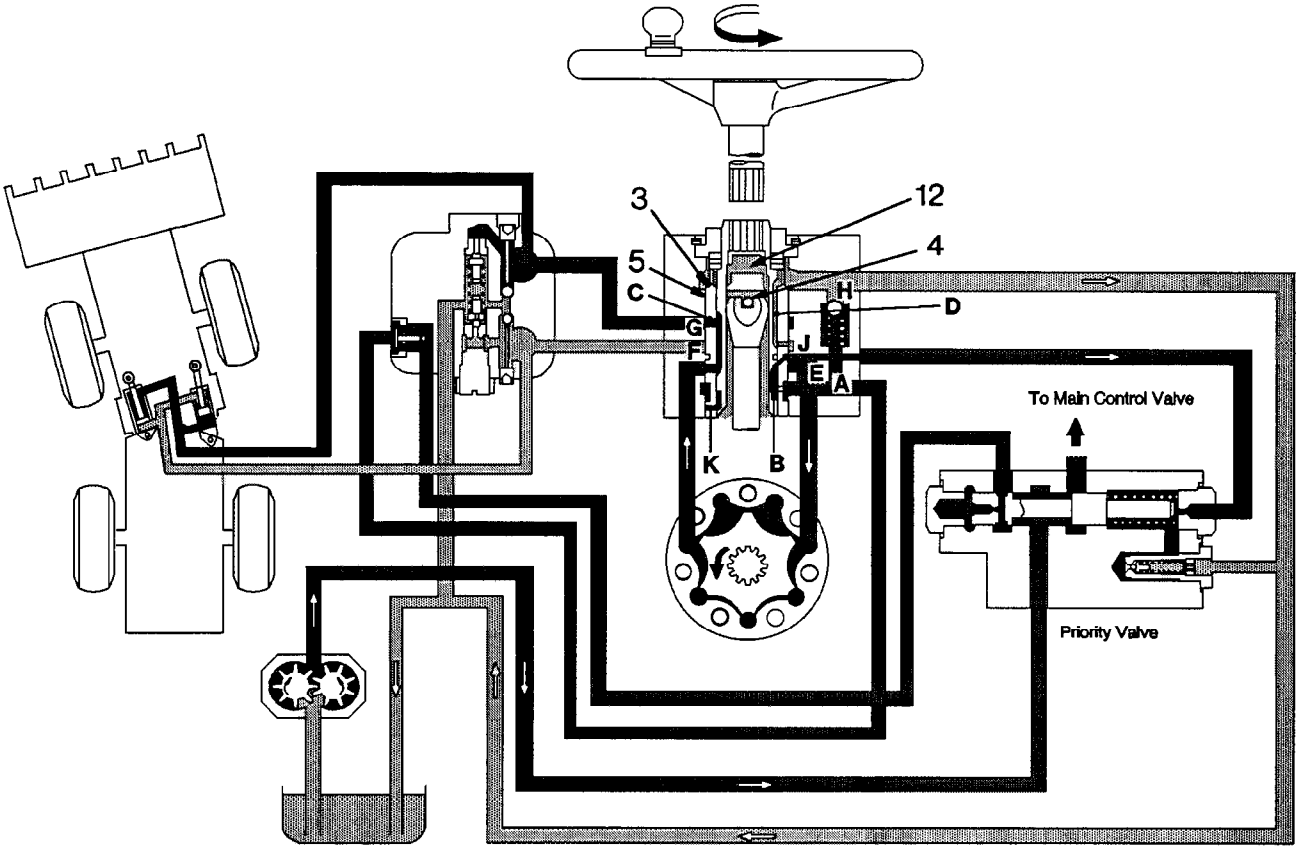
		Standard size	Tolerance	Repair limit	
9	Thickness of separator plate	1.7	±0.05	1.5	
	Deformation of wear surface of separator plate		0.08	0.15	
10	Thickness of friction plate	2.2	±0.08	1.9	
	Deformation of wear surface of friction plate		0.13	0.25	
11	Load of wave spring	103 (kg) (at height 2.2 mm)	±10.0 (kg)	83 (kg)	Replace
12	Thickness of F-R clutch spacer	5	±0.05		
13	1st clutch spacer length	34.3	±0.1		
14	Thickness of 1st clutch thrust washer	3.18	±0.05	2.7	

		Standard size	Repair limit	
15	End play of forward gear	0.092 - 1.222		
16	End play of reverse gear	0.022 - 0.692		
17	End play of 1st gear	0.21 - 1.07	1.47	Replace
18	End play of 2nd gear	0.04 - 0.71		
19	End play of 3rd gear	0.001 - 1.131		

UNIT: mm

No.	Check item	Criteria					Remedy
1	Thickness of thrust plate	Standard size	Repair limit				Replace
		15.9	-				
2	Clearance between shaft and hole at front support side	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		170	-0.043 -0.106	+0.550 +0.050	-0.093 -0.656	-	
3	Clearance between shaft and hole at rear support side	170	-0.043 -0.106	+0.550 +0.050	-0.093 -0.656	-	
4	Thickness of axle mount shim	0.2 (standard shim thickness)					-
5	Tightening torque of mounting bolt	11.5 ± 1.0 kgm					Retighten
6	Tightening torque of mounting bolt	11.5 ± 1.0 kgm					
7	Tightening torque of mounting bolt	56 ± 6.0 kgm					
8	Tightening torque of axle mounting bolt	69 ± 7.0 kgm					

2. Steering wheel turned to the left



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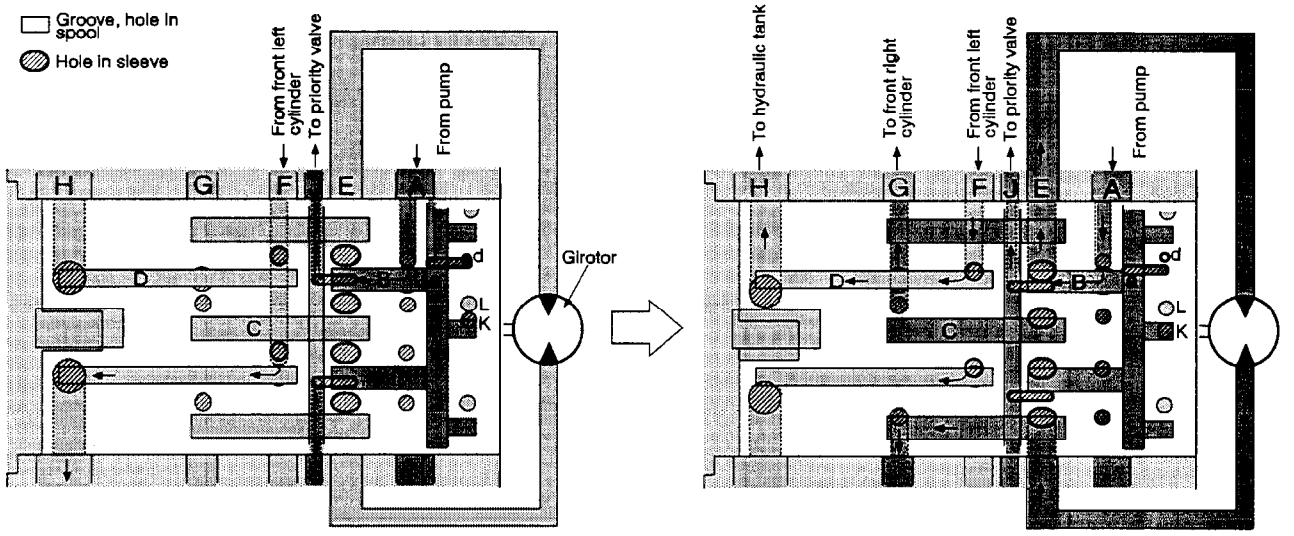
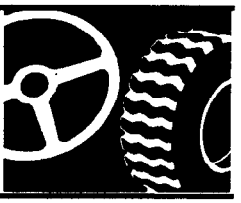


22WF833

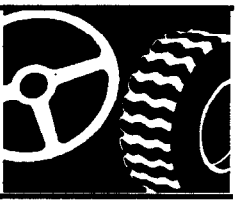
STEERING SYSTEM

42 TESTING AND ADJUSTING



STEERING SYSTEM

43 DISASSEMBLY AND ASSEMBLY



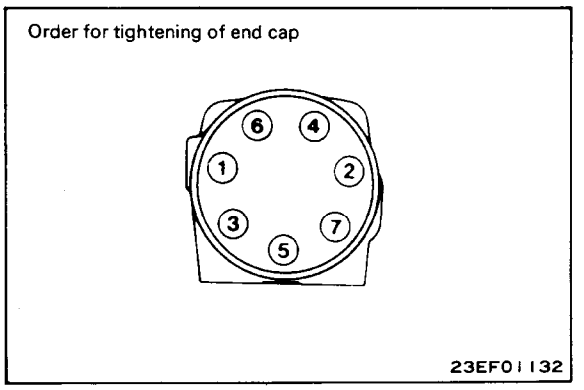
★ Use the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and piping.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 - 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 - 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

NOTE: After long storage, same procedure is required.

23. Coat thread of screw with grease, and tighten end cap.
    ★ Install the handle to the spool, and check that the spool rotates.

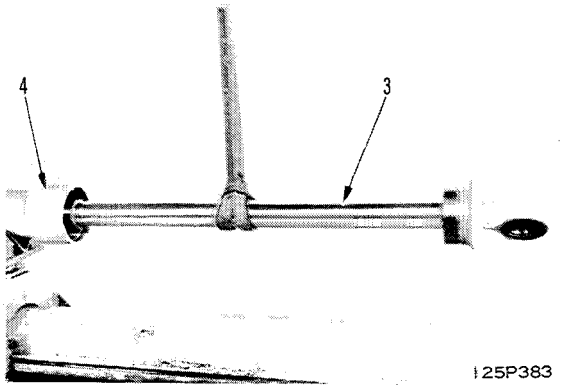
    End cap mounting screw
    First step: 1.5 kgm
    Second step: 2.75±0.15 kgm



6. Remove piston rod and cylinder head assembly from tool **A**.

7. Set cylinder (4) in tool **A**.

8. Sling piston rod and cylinder head assembly (3) and install in cylinder (4).

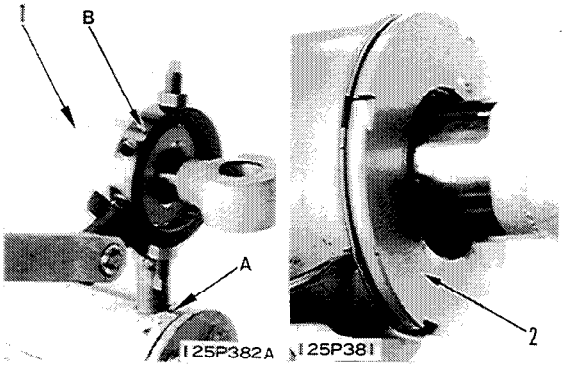


9. Using tool **B**, tighten cylinder head nut (2).

Cylinder head nut: 45 ±4.5 kgm

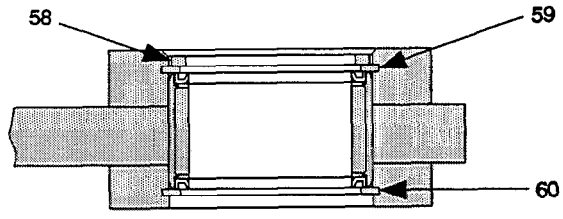
10. Bend lock into notch on cylinder.

11. Remove cylinder assembly (1) from tool **A**.



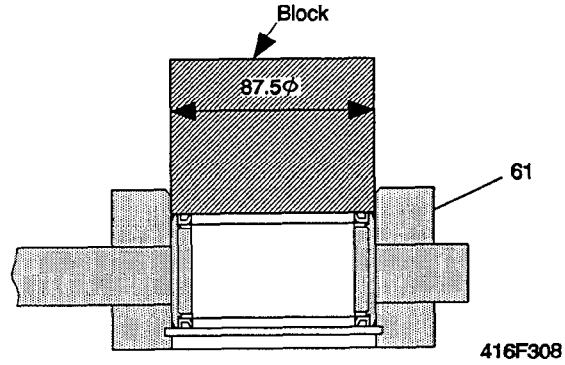
2. Lower hinge pin

1) Install snap ring (60), and press fit bearing (61).



416F307

2) Install snap ring (59), and install washer (58).



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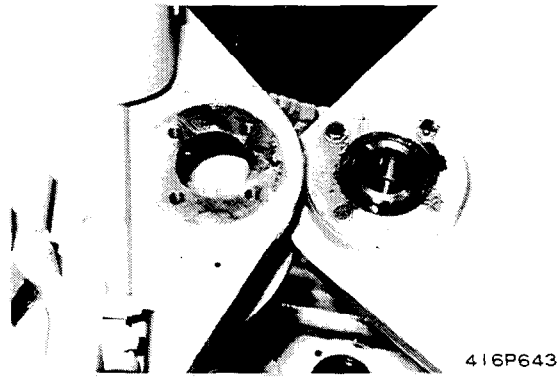
3. Connecting frame

Jack up front differential, move front frame towards rear frame and align pin holes.

WARNING! Use a bar to align the pin holes. Never use your fingers.

★ Be careful not to bite into the lower spacer of the upper hinge when connecting the frames.



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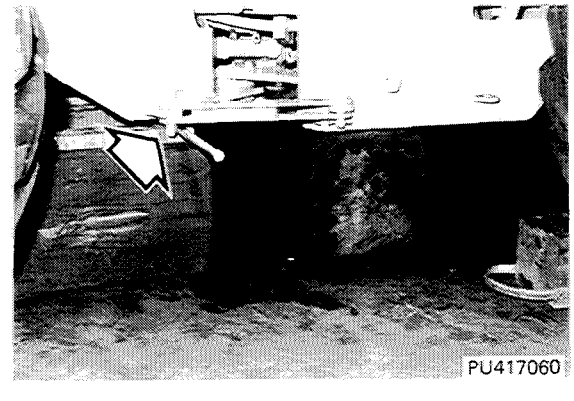
★ Install the safety bar



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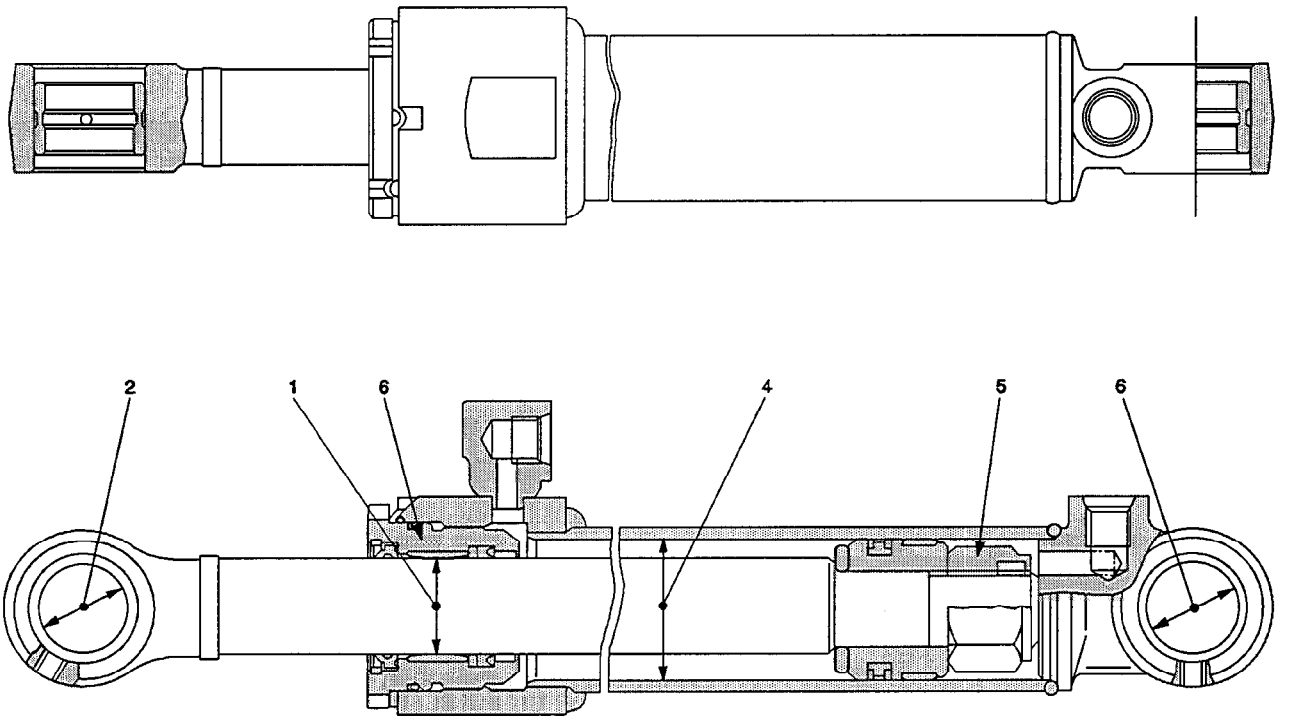
STEERING CYLINDER

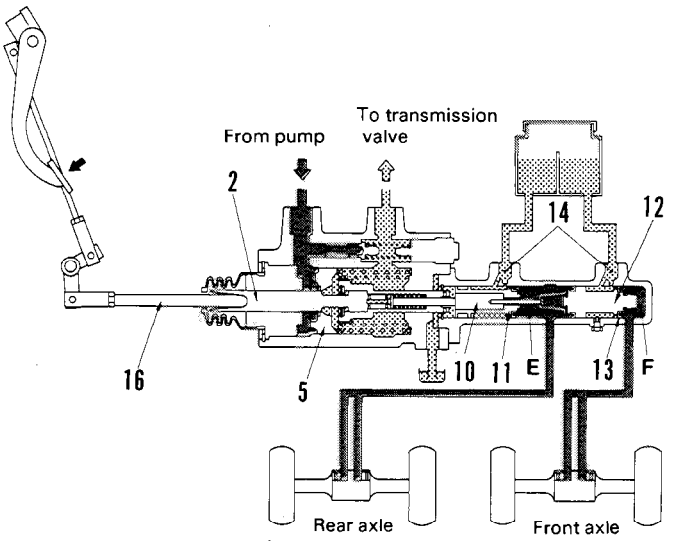


416F126

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between rod and bushing	45	-0.080 -0.142	+0.152 +0.007	0.087- 0.294	0.574	Replace bushing
2	Clearance between piston rod mounting pin and bushing	40	0 -0.025	+0.142 +0.080	0.08- 0.167	1.0	Replace
3	Clearance between cylinder bottom mounting pin and bushing	40	0 -0.025	+0.142 +0.080	0.08- 0.167	1.0	
4	Cylinder bore	70	0 -0.206	+0.25 0	0- 0.456	-	
5	Tightening torque of piston nut	110 ± 11 kgm (width across flats 46 mm)					Retighten
6	Tightening torque of cylinder head	55 ± 5.5 kgm					

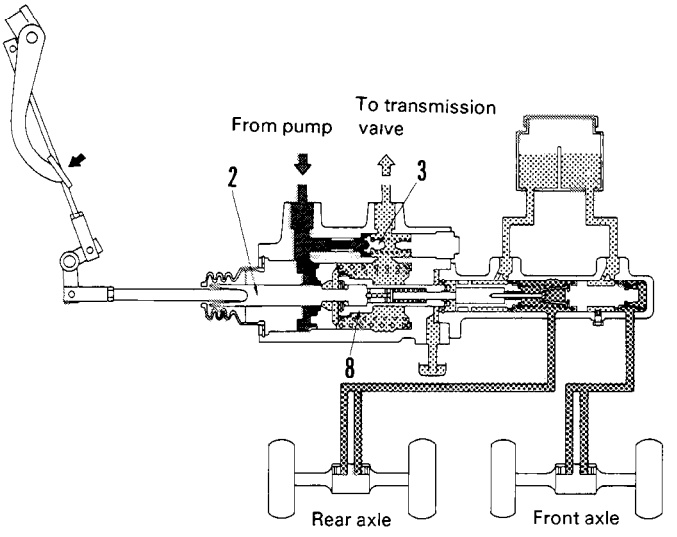
Hydraulic force rising



417F310

- When secondary piston (11) moves forward and primary cup (13) closes relief port (14), pressure is generated in chamber E. Reaction piston (10) (piston with small diameter) built into secondary piston (11) moves to the rear and is in continuous contact with the tip of the spool. The pressure generated in the master cylinder and bearing on the area of reaction piston (10) passes through push rod (16) and is transmitted to the pedal as the operating force.
- The pressure generated at chamber E of secondary piston (11) of the master cylinder is also generated at the same time in chamber F of the primary piston (12).
- In addition, when the brake pedal is depressed, power piston (5) moves to the right, and the pressure of the oil in chamber E and chamber F rises, so the braking force of the front brake and rear brake is also increased.

Relief valve



417F311

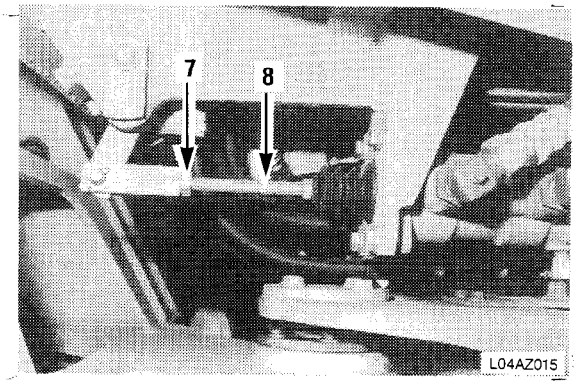
- When the brake is being operated, if the pressure inside the power cylinder (port A) goes above the specified level, relief valve (3) is actuated. The oil is relieved to the transmission circuit to prevent abnormal pressure in the brake system.
- If there should be any failure in the hydraulic pump sending oil to the power cylinder, the operating force of the pedal is transmitted through spool (2) and connector (8), so the piston in the master cylinder can be actuated. However, when this happens, the operating force of the brake pedal is heavier than usual.

BRAKE PEDAL LINKAGE

★ Testing conditions
● Engine water temperature: Inside operating range

Unit: mm

Item	Standard value (new machine)	Permissible value
Length of link X_1	464	
Length of rod X_2	254.5	
Clearance a	0.5-1.5	
Clearance b	1.02-1.90	



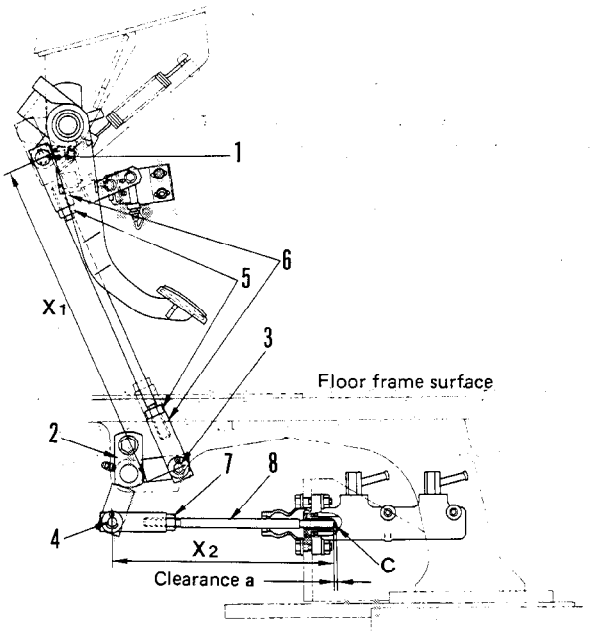
★ Remove the cover.

Testing procedure

1. Check the play of linkage mounting pin (1), pin hole of lever (2), and lever bushing.

2. Measure length X_1 of link, and check that it is within the standard value.
   ★ Measure the distance between the center of pin (1) and the center of pin (3).

3. Remove rod pin (4), and measure the movement of hole. Check that clearance "a" is within the standard range.
   ★ When carrying out this check, make sure that the brake pedal is in contact with the stopper.



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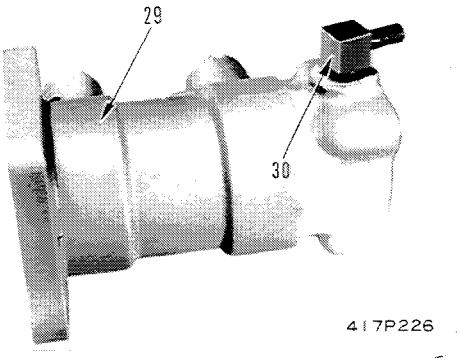
Adjusting procedure

1. **Adjusting link X_1**
   1) Remove pins (1 and 3), then remove the rod. Loosen lock nut (5), and adjust the length of the link X_1 by turning yokes (6).
   2) After adjusting the length of link X_1, connect it to the brake pedal.

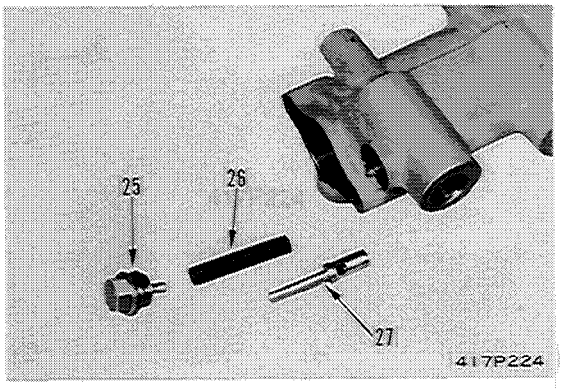
TROUBLESHOOTING

ASSEMBLY

1. **Elbow**
   Install elbow (30) to power cylinder body (29).

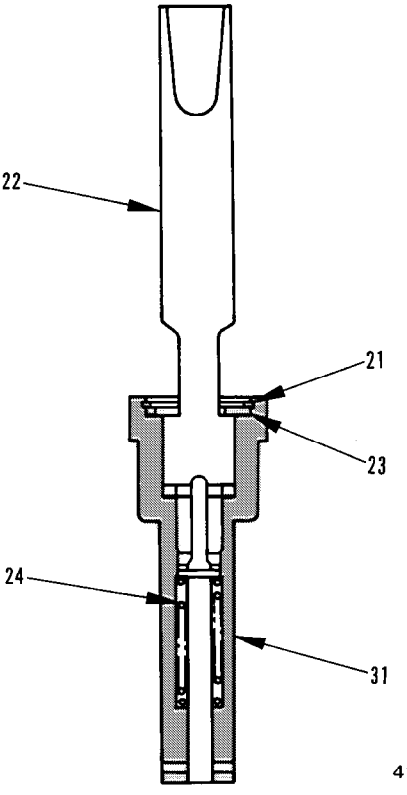


2. **Relief valve**
   Insert spring (26) in spool (27), assemble in power body, then install plug (25).

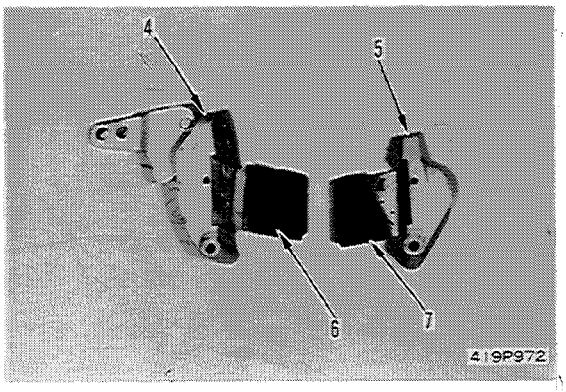


3. **Fine assembly of power cylinder**
   1) Assemble spring (24) in connector (31).

   2) Insert spool (22) in connector (31), assemble thrust washer (23), then secure with snap ring (21).



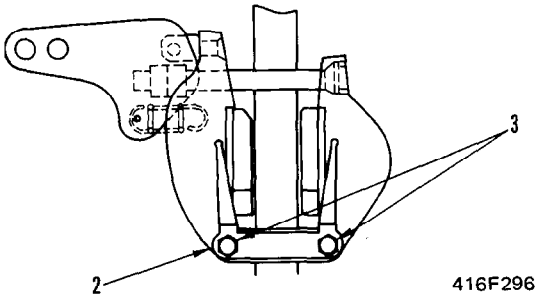
INSTALLATION



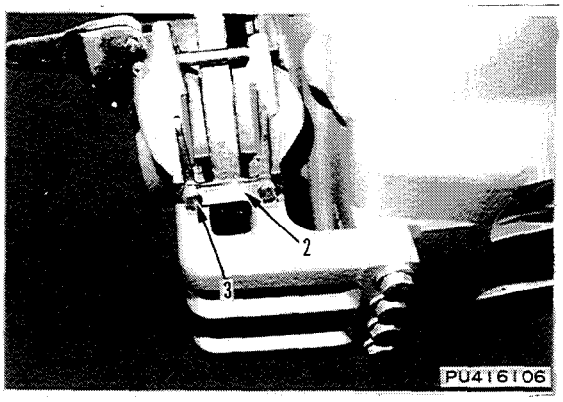
1. **Pads**
   1) Set pads (6 and 7) in mounting position, then secure with nut.
   2) Set calipers (4 and 5) in mounting position, install lock plate (2), then tighten mounting bolts.

   3) Install lock plate (2), then tighten mounting bolts.
      ★ Knock the tip of the lock plate into the caliper mount hole up to the root.

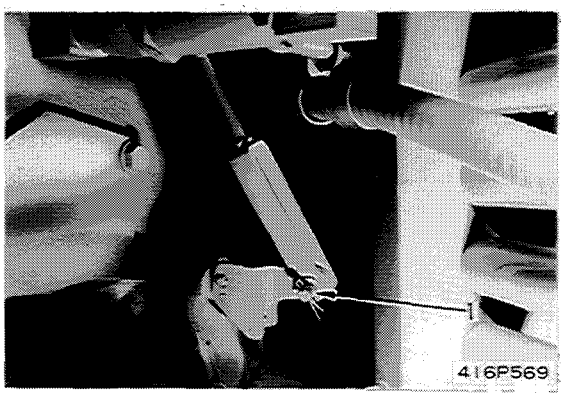
      Mounting bolt: 1.2±0.1 kgm



   4) Bend lock plate (2) with a chisel to lock bolt (3).

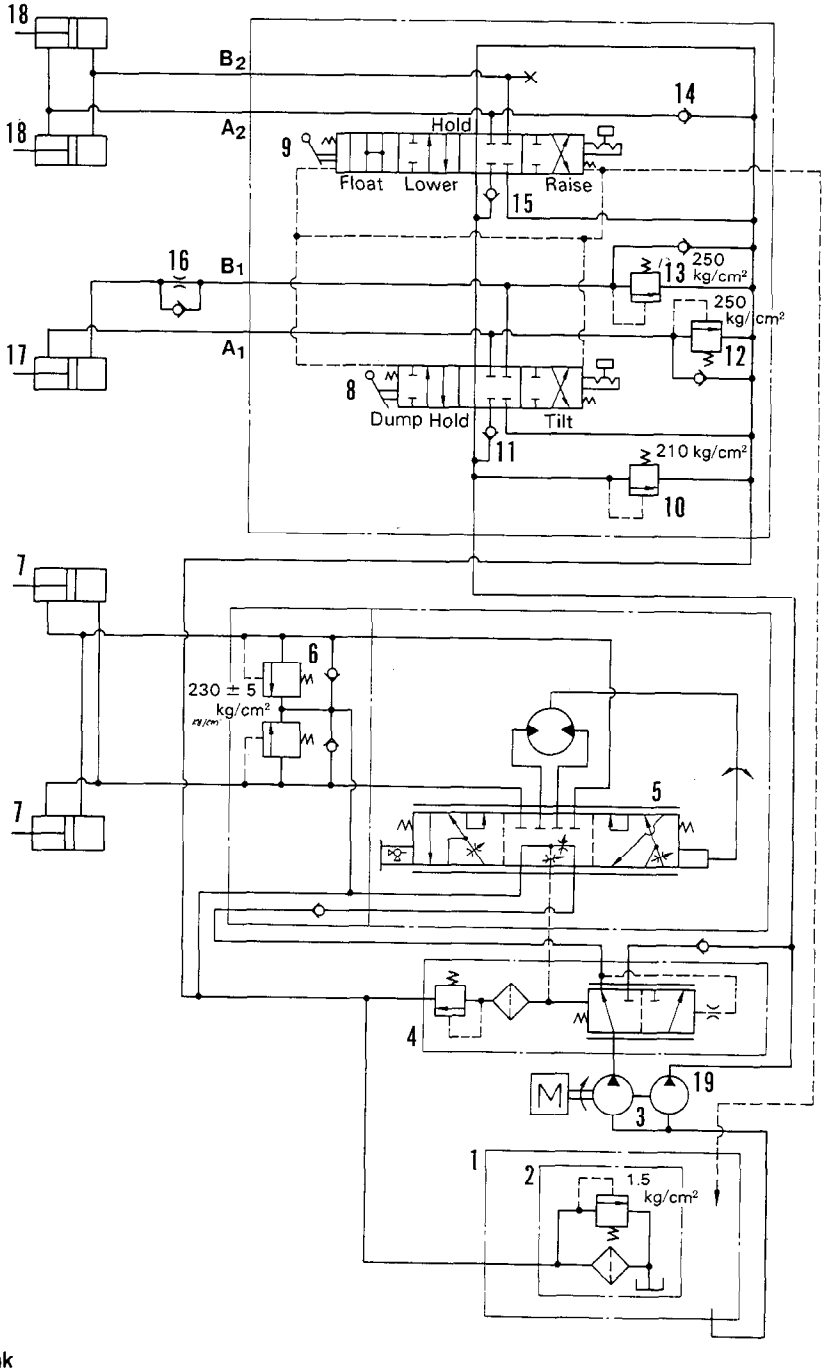


2. **Linkage**
   Install pin (1).
   ★ Bend the cotter pin securely.



3. **Adjusting linkage**
   ★ For details of adjusting the linkage, see SECTION 52, TESTING AND ADJUSTING.

HYDRAULIC CIRCUIT DIAGRAM



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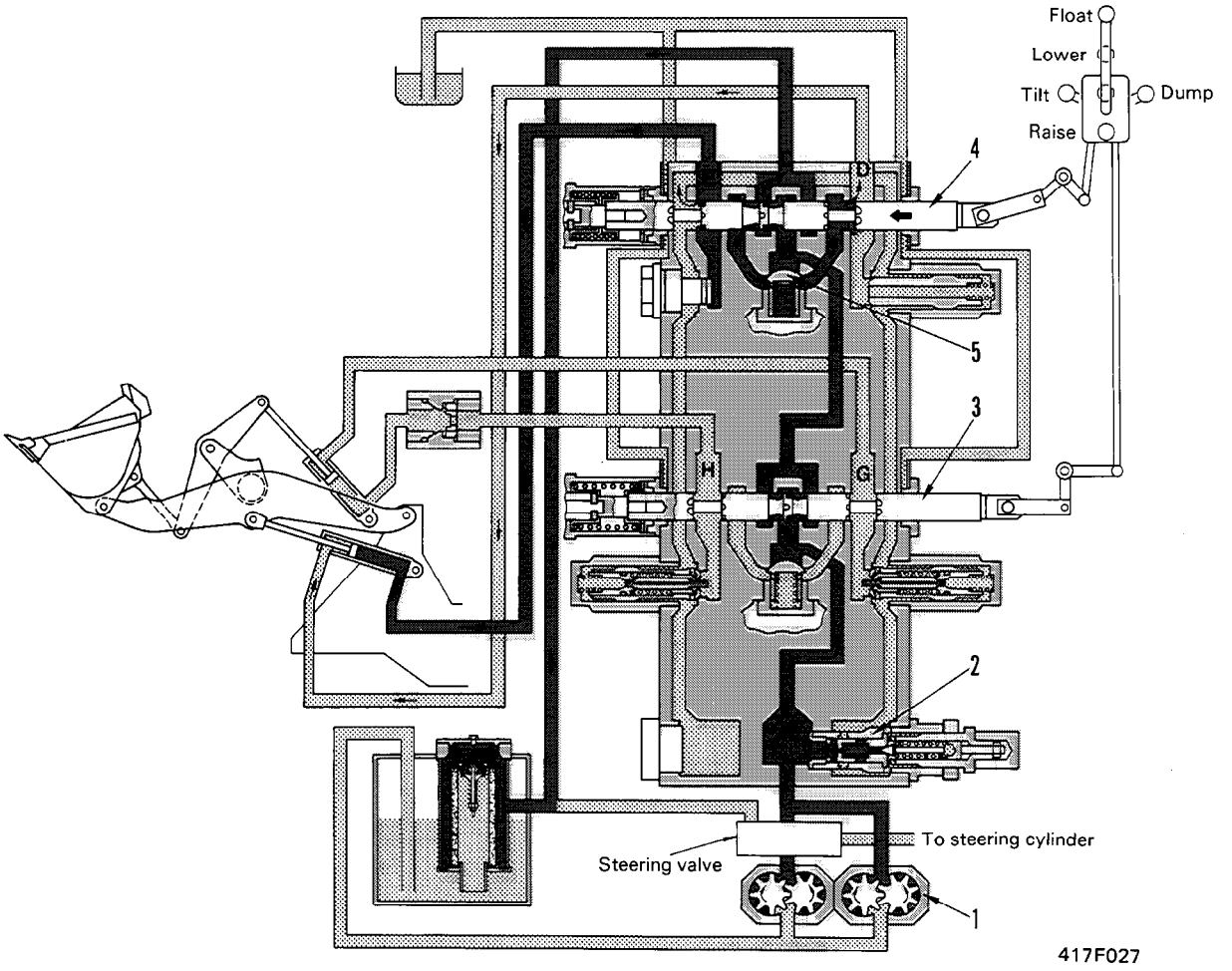
1. Hydraulic tank
2. Oil filter
3. Steering pump
4. Priority valve
5. Steering valve
6. Check valve
7. Steering cylinder
8. Dump spool
9. Lift spool
10. Relief valve
11. Check valve
12. Safety valve with suction valve
13. Safety valve with suction valve
14. Suction valve
15. Check valve
16. Slow down valve
17. Lift cylinder
18. Dump cylinder
19. Hydraulic pump

LIFT SPOOL AT "FLOAT POSITION"



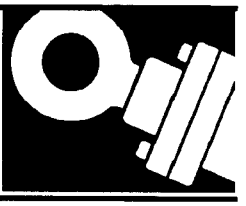
Operation

- When the lift control lever is pushed down further from the LOWER position, the lift spool (4) is pushed into the FLOAT position.
- The oil flows from the pump through the steering valve. It then flows around the bypass circuit of the dump spool (3) to the lift spool bypass circuit. The oil in the bypass circuit flows to the drain circuit because of the spool, but it cannot push open the check valve (5).

In addition, RAISE circuit **E** and LOWER circuit **D** of the lift cylinder are connected to the drain circuit, so the lift arm goes down under its own weight.

- When the bucket is in contact with the ground, it shape of the ground.

WORK EQUIPMENT SYSTEM
62 TESTING AND ADJUSTING



HYDRAULIC PRESSURE

★ • Measurement condition
• Coolant temperature: Inside operating range
• Hydraulic oil temperature: 45 - 55°C
• Engine speed: High idling

Unit: kg/cm²

Item	Standard value	Permissible value
Main relief pressure	210 +8 0	210 +8 -15

Special tool

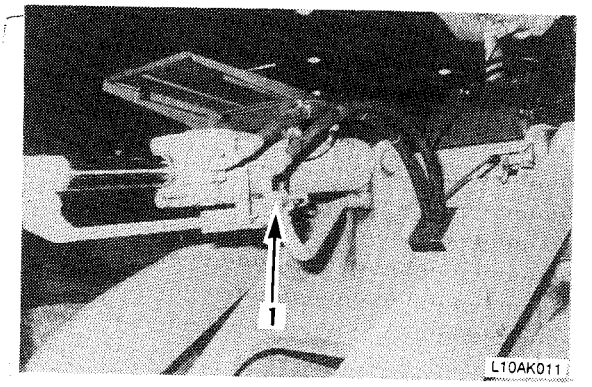
	Part number	Part name	Q'ty
A	799-101-5000	Hydraulic tester	1

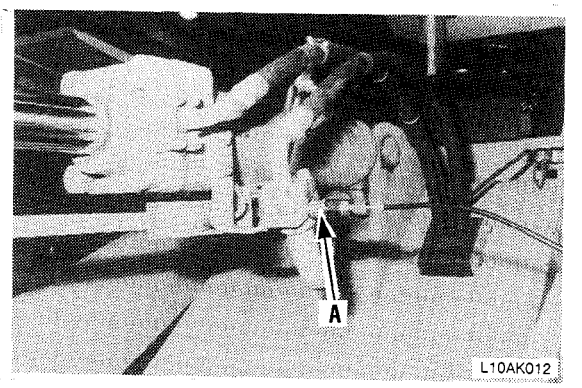
1. MEASURING PROCEDURE (Main relief valve)

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

1) Remove plug (1) for measuring pressure of dump cylinder circuit.
2) Install hydraulic tester A to the measuring port.
   ★ Check that there is no oil leakage from any connection.
   ★ Use a hose which is long enough to reach the operator's compartment.
3) Start the engine, raise the lift arm 400 mm from the ground and operate the dump control lever (TILT). Measure the pressure when the relief valve is actuated.
   ★ Be careful not to apply any sudden pressure to the pressure gauge.

When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when installing





2. Lift arm moves slowly or does not have sufficient lifting power.

Checks before troubleshooting
- Is the amount of oil in the hydraulic tank and also the type of oil correct?
- Is the stroke of the lift arm control lever and also the spool of the main control valve correct?
- Seizure of work equipment linkage bushing.

Fault check
There is a strong relationship between faults involving lifting force and lifting speed. Such faults appear initially in the form of insufficient lifting speed. Measure the lifting speed of the lift arm when loaded and refer to the judgement criterion table to determine whether or not there is a fault.

No.	Problems \ Remedy	C △	△ X	△ X	A X	X	X
	Cause	Tank to pump: a	Tank to pump: b	Priority valve: c	Control valve: d	Control valve: e	Cylinder: f
1	Bucket tilt back and speed are abnormal and lift arm lifting speed is low.	○	○	○	○		
2	Bucket tilt back and speed are normal but lift arm lifting speed is low.					○	○
3	Same as item 1 except that lift arm lifting speed becomes particularly low when oil temperature rises.		○				
4	Hydraulic pump emits unusual noise.	○	○				
5	When the engine is at high idling, steering action is heavy and slow.	○	○				
6	Lift cylinder has a large amount of hydraulic drift.					○	○
7	The relief pressure of maine relief valve is low when the engine is at high idling.				○	○	○

Blockage in strainer on suction side of pump or excessive amount of air contained in oil
Faulty work equipment pump · steering pump
Faulty priority valve
Faulty or improperly adjusted main relief valve
Worn or damaged valve body (lift arm spool)
Damaged lift cylinder piston seal

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The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace △: Repair
A: Adjust C: Clean

HYDRAULIC FILTER

REMOVAL

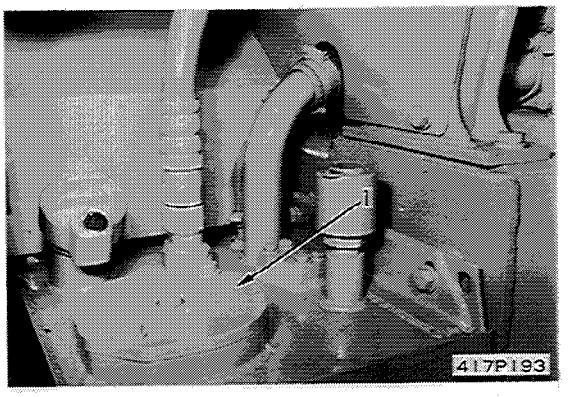
⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

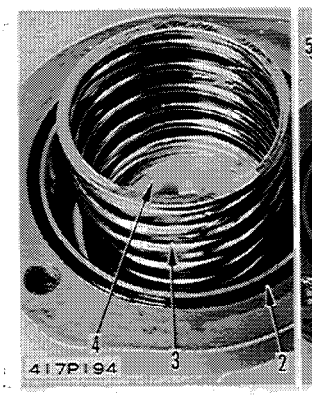
1. **Cover**
   Remove mounting bolts, then remove cover (1).

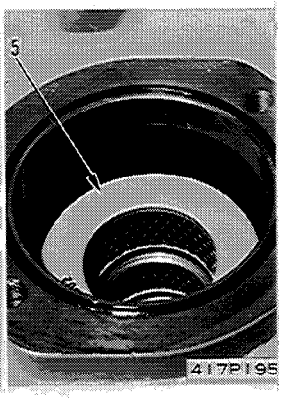
⚠ The tension of the spring is pushing the cover, so be careful when removing.

★ Be careful not to damage the O-ring (2) and the contact faces of the cover and tank.

2. **Filter**
   Remove spring (3) and bypass valve (4), then remove filter (5).

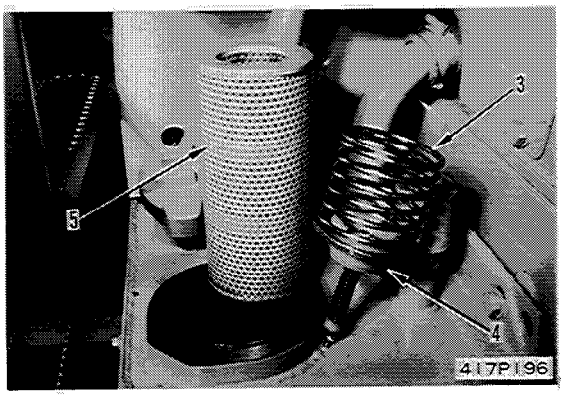




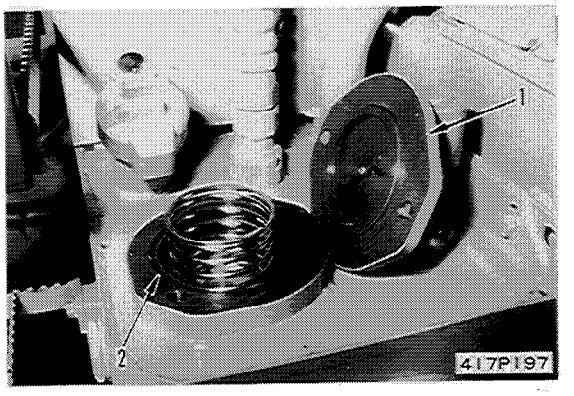


INSTALLATION

1. **Filter**
   Install filter (5), then install bypass valve (4) and spring (3).



2. **Cover**
   Fit O-ring (2) in groove of cover, then install cover (1) to tank.
   ★ Replace the O-ring with a new part.
   ★ Fit the O-ring securely in the groove, and make sure that it is not caught when installing.



ASSEMBLY

1. Assembly valve (28) and spring (27) in body (29), then fit O-ring and tighten plug (26).

   Plug: 11±1.5 kgm

2. Fit O-ring and install suction valve assembly (24) and safety valve assembly (25) with suction valve.

   Safety valve: 14.5±2 kgm

   Suction valve: 14.5±2 kgm

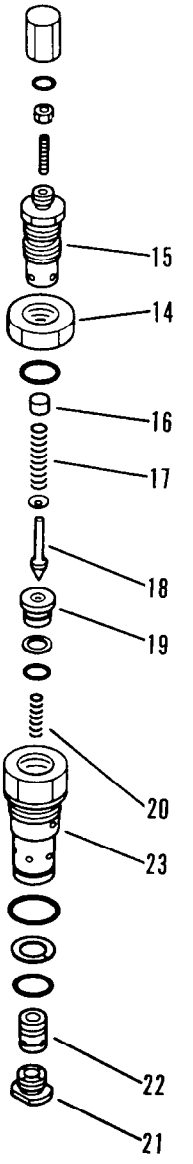
3. **Main relief valve assembly**
   1) Assemble valve (22) in sleeve (23), then tighten plug (21).
   2) Assemble spring (20), seat (19), poppet (18), spring (17) and retainer (16) in sleeve.
   3) Screw nut (14) into holder (15), fit O-ring on holder, then install the holder into sleeve (23) and tighten nut (14).
   4) Fit O-ring and back-up ring and install main relief valve assembly (13).

   Main relief valve: 8.5±1.5 kgm

4. **Spool assembly**
   1) Assemble spool (4) in body, then install oil seal (10) and retainer (12).
   2) Pull out spool slightly, then assemble retainer (11), oil seal (10), retainer (9), spring (8), and retainer (7).
   3) Hold spool from moving, turn bolt inside detent assembly (1), and install joint (6) to spool (4).

   Joint: 1.5±0.5 kgm

   4) Tighten bolt (5), then install detent assembly (1).



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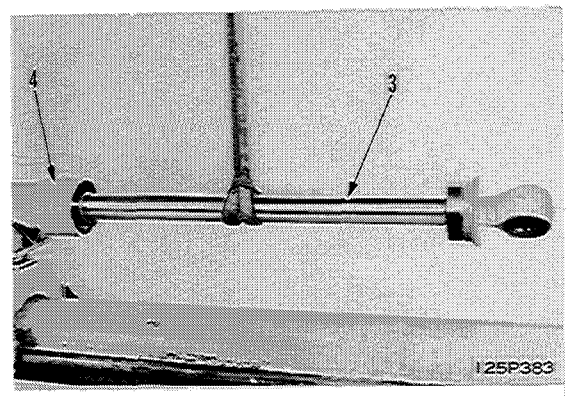
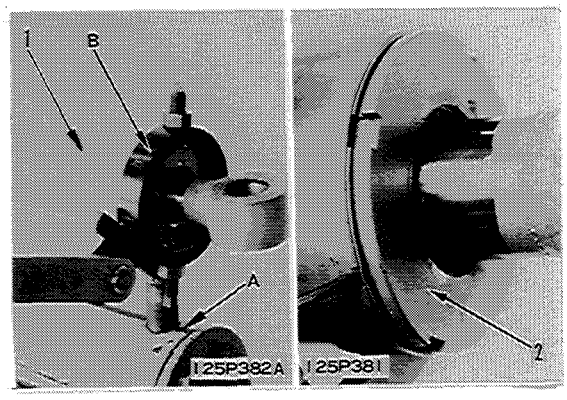
6. Remove piston rod and cylinder head assembly from tool A.
7. Set cylinder (4) in tool A.
8. Sling piston rod and cylinder head assembly (3) and install in cylinder (4).

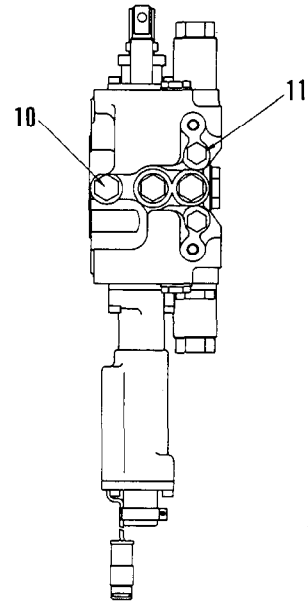


9. Using tool B, tighten cylinder head nut (2).

Cylinder head nut:
Lift and dump: 85±10 kgm

10. Bend lock into notch on cylinder.
11. Remove cylinder assembly (1) from tool A.





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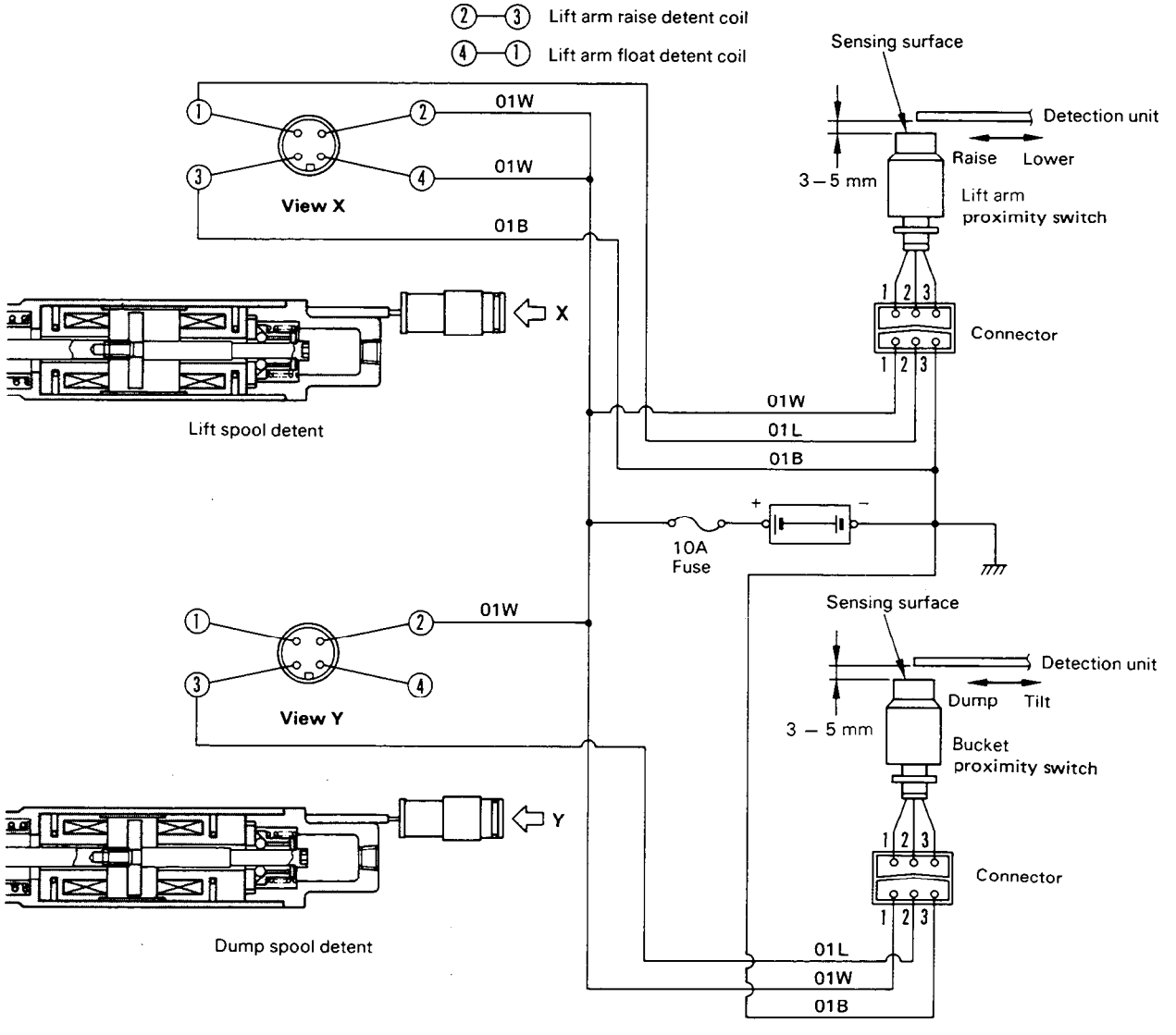
Unit: mm

No	Check item	Criteria					Remedy
		Standard size			Repair limit		Replace Possible to use again if no damage or deformation
		Free length	Installation length	Installation load	Free length	Installation load	
1	Poppet spring of main relief valve	41.1	32.6	26.4	Max 39.4	Max 21.1	
2 3	Tightening torque of joint at end of spool	1.5±0.5 kgm					Retighten
4	Tightening torque of main relief valve	8.5±1.5 kgm					
5	Tightening torque of adjustment screw lock nut	7.0±1.0 kgm					
6	Tightening torque of safety valve with suction valve	14.0±2.0 kgm					
7	Tightening torque of plug check valve	10.5±1.5 kgm					
8	Tightening torque of suction valve	14.0±2.0 kgm					
9	Tightening torque of plug	14±2 kgm					
10	Tightening torque of bolt	17±1 kgm					
11		6±1 kgm					
12	Tightening torque of plug	7±1 kgm					
13	Tightening torque of plug	5.5±0.5 kgm					

PROXIMITY SWITCH

- Proximity switches are installed by a support to the lift and dump cylinders. The lift arm RAISE position and the TILT BACK position can be selected to match the operating conditions. When these position are reached, a pulse is generated from the switch, the electric current flows to a magnet and the lift or dump lever is returned to the neutral position. When this happens, the main control valve is also returned to neutral and the movement of the lift arm or bucket stops.

When the starting switch is turned ON, the float detent solenoid will be energized, and if the lift arm lever is set to the FLOAT position, it will be held in that position.



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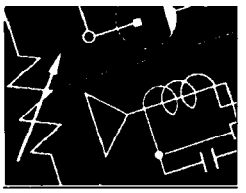
ELECTRIC AND ELECTRONIC SYSTEM



83 DISASSEMBLY AND ASSEMBLY

Line - engine to air conditioner

1. Air conditioner assembly
2. Hose, elbow at air conditioner
3. Connector, at air conditioner
4. Hose, Engine to air conditioner
5. Elbow, at engine

Line - air conditioner to radiator

6. Hose, elbow at air conditioner
7. Connector, at air conditioner
8. Hose, air conditioner to radiator
9. Elbow, at radiator water tube
10. Tube, radiator to water pump

Line - air conditioner drain

11. Hose, air conditioner drain

PRINCIPLE OF OPERATION

- MECHANISM FOR DELIVERING OIL

The drawing at right shows the operational principle of an external gear pump in which two gears are rotating in mesh.

The oil entering through the suction port is trapped in the space between two gear teeth, and is delivered to the discharge port as the gear rotates.

Except for the oil at the bottom of the gear teeth, the oil trapped between the gear teeth is prevented from returning to the suction side with the gears in mesh.

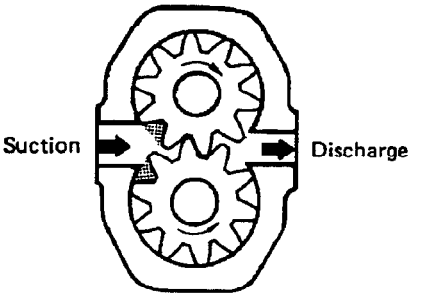
Since the gears are constantly delivering oil, the oil delivered to the discharge port is forced out of the port.

The amount of discharge increases with the speed of rotation of the gear.

If there is no resistance in the oil passage into which the discharged oil flows, the oil merely flows through the passage, producing no increase in pressure.

If, however, the oil passage is blocked with some thing like a hydraulic cylinder, there will be no other place for the oil to flow, so the oil pressure will rise. But the pressure which rises in this way will never go higher, once the hydraulic cylinder piston starts moving because of the oil pressure.

As described earlier, the pump produces the oil flow, but not the oil pressure. We can therefore conclude that pressure is a consequence of load. In other words, the pressure depends on a counterpart.



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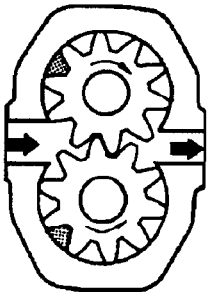

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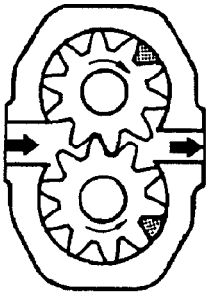

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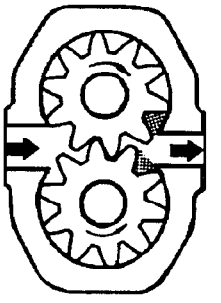

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TESTING AND ADJUSTING

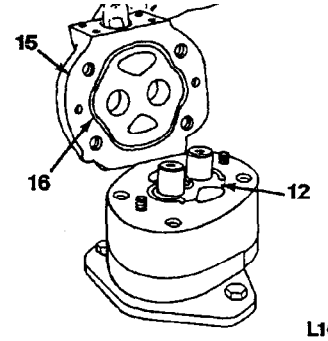
Measure the pump delivery with a bench or flow meter kit (790-303-1001).

For SA pumps operating at a service pressure of 50 kg/cm² or less, see the standard and the repair limit in Table No. 2. (Examples: Pumps for power trains and servo-hydraulic pumps for excavators)

* See Notes on page following table 1 & 2. The capacity codes marked ★ are for triple pumps.

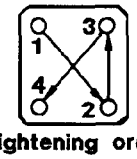
No	Check item	Series No	Capacity Code	Delivery pressure (kg/cm²)	Standard		Repair limit	
					Rotation (rpm)	Delivery (liters/min)	Rotation (rpm)	Delivery (liters/min)
1	Performance Hydraulic oil: EO10-CD Oil temperture: 50°C	1	008	210	3500	25	3500	23
			010			32		29
			012			38		34
			014			47		43
			016			52		48
			020			66		61
			025			83		76
		2	★016	210	3000	44	3000	40
			★020			55		50
			★025			67		62
			028			77		71
			032			88		82
			036			100		92
			040			111		103
			045			121		111
			050			138		128
		3	★020	210	2500	45	2500	42
			★025			55		51
			★040			90		82
			★050			112		102
			056			129		119
			063			145		134
			071			158		146
			080			184		170
			100			231		214
			112	140	2000	212	2000	192
			125			236		213
		4	112	210	2200	233	2200	215
			125			253		234
			140			287		266
			160			328		303
					---	---	---	---
			180		2000	336	2000	310
			200			373		345
			224			411		385
			250			460		425

11) Remove the cover (15) and install O-ring (16).
12) Install backup ring and seal ring to side plate (12) in the manner described in item 6.
13) Install cover (15).
★ Align the match marks when installing the cover.
★ Before installing the cover, make sure backup ring and seal ring are properly installed according to the precautions given in item 6.
★ Make sure O-ring (16) is fit properly.

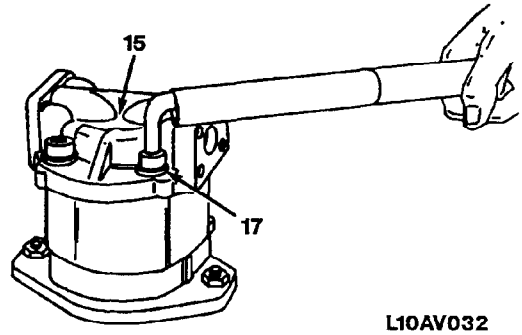


L10AV035

14) Tighten mounting bolts (17).
★ Use a torque wrench and tighten the bolts to the specified torque in the order shown in the drawing.
For the tightening torque, see the Maintenance Standard Table, this section.



Tightening order
L10AV026



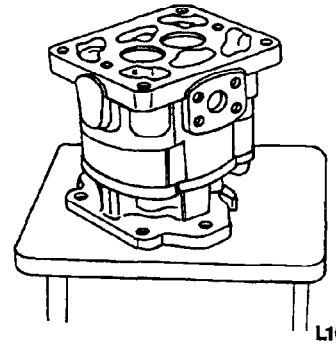
L10AV032

15) After assembly, check the rotational torque of the pump shaft to see if it conforms to the value given in the table.
★ After the pump is assembled, carry out the performance test (measure the pump delivery) with a test bench or flow meter kit (790-303-1001). Confirm that the performance is with the repair limits.

Series	Rotational torque
1	0.2 - 0.5 kgm
2	0.3 - 0.7 kgm
3	0.7 - 1.2 kgm
4	1.0 - 1.5 kgm

2. Tandem pump

1) For the assembly of individual units of the front and rear pump, follow the same assembly procedure as for the single pump.
2) Put the front pump on a work bench.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