



# Service Manual

## Chassis, Mast & Options

<b>FG15K</b>	AF31A-50001-up, AF31B-50001-up
<b>FG18K</b>	AF31A-50001-up, AF31B-50001-up
<b>FG20K</b>	AF17B-10001-up, AF17C-10001-up
<b>FG20K-HO</b>	AF17B-95001-up, AF17C-95001-up
<b>FG25K</b>	AF17B-10001-up, AF17C-10001-up
<b>FG25K-HO</b>	AF17B-95001-up, AF17C-95001-up
<b>FG30K</b>	AF13D-35001-up, AF13E-30001-up
<b>FG35K</b>	AF13D-55001-up, AF13E-50001-up
<b>FD20K</b>	AF18B-05001-up
<b>FD25K</b>	AF18B-05001-up
<b>FD30K</b>	AF14C-35001-up
<b>FD35K</b>	AF14C-55001-up

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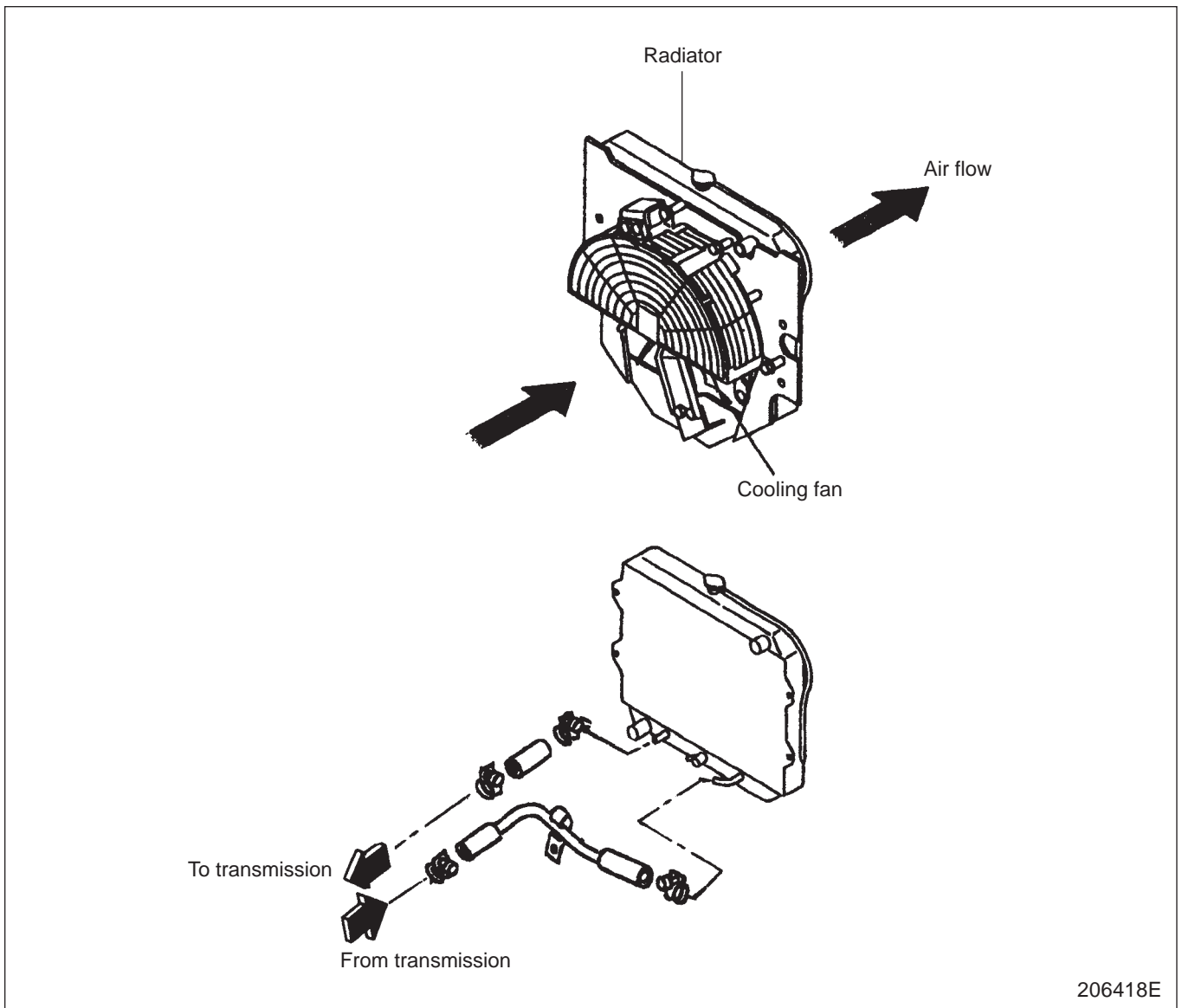
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**GENERAL INFORMATION**

Truck Model			FG15K	FG18K	FG20K, FG20K-HO	FD20K	
Ignition system (gasoline models)	Ignition coil	Type	With external resistor	With external resistor	With external resistor	–	
		Manufacturer	Mitsubishi Electric	Mitsubishi Electric	Mitsubishi Electric	–	
	Distributor	Type	Non-contact point type (C.E.I.)	Non-contact point type (C.E.I.)	Non-contact point type (C.E.I.)	–	
		Manufacturer	Mitsubishi Electric	Mitsubishi Electric	Mitsubishi Electric	–	
		Spark advancer	Centrifugal pneumatic type	Centrifugal pneumatic type	Centrifugal pneumatic type	–	
	Spark plugs	Type	W14EX-U	W14EX-U	W14EX-U	–	
		Manufacturer	Nippon Denso	Nippon Denso	Nippon Denso	–	
		Size	mm (in.)	14 × 1.25 (0.55 × 0.049)	14 × 1.25 (0.55 × 0.049)	14 × 1.25 (0.55 × 0.049)	–
		Gap		0.7 to 0.8 (0.028 to 0.031)	0.7 to 0.8 (0.028 to 0.031)	0.7 to 0.8 (0.028 to 0.031)	–
	Fuel system (gasoline models)	Carburetor	Type	Down-draft type	Down-draft type	Down-draft type	–
Manufacturer			Mikuni Kogyo	Mikuni Kogyo	Mikuni Kogyo	–	
Governor		Type	Pneumatic type	Pneumatic type	Pneumatic type	–	
		Manufacturer	Mikuni Kogyo	Mikuni Kogyo	Mikuni Kogyo	–	
Fuel pump		Type	Diaphragm type	Diaphragm type	Diaphragm type	–	
		Manufacturer	Kyosan Electric	Kyosan Electric	Kyosan Electric	–	
Air cleaner		Type × number	Cyclone-paper element × 1	Cyclone-paper element × 1	Cyclone-paper element × 1	–	
		Manufacturer	Nippon Rokaki	Nippon Rokaki	Nippon Rokaki	–	
Fuel system (diesel models)		Fuel injection pump	Type	–	–	–	Distributor type (DPK)
			Manufacturer	–	–	–	Mikuni Precision
	Plunger diam.		mm (in.)	–	–	–	7.0 (0.275)
	Cam lift (one side)			–	–	–	1.5 (0.059)
	Fuel injection nozzle	Type	–	–	–	Throttle type	
		Spray holes, diam. × number	mm (in.)	–	–	–	1.00 (0.0394) × 1
Injection pressure		kPa (kgf/cm <sup>2</sup> ) [psi]	–	–	–	13729 <sup>+1079</sup> <sub>0</sub> (140 <sup>+11</sup> <sub>+5</sub> ) [1990 <sup>+156</sup> <sub>+71</sub> ]	

## Description

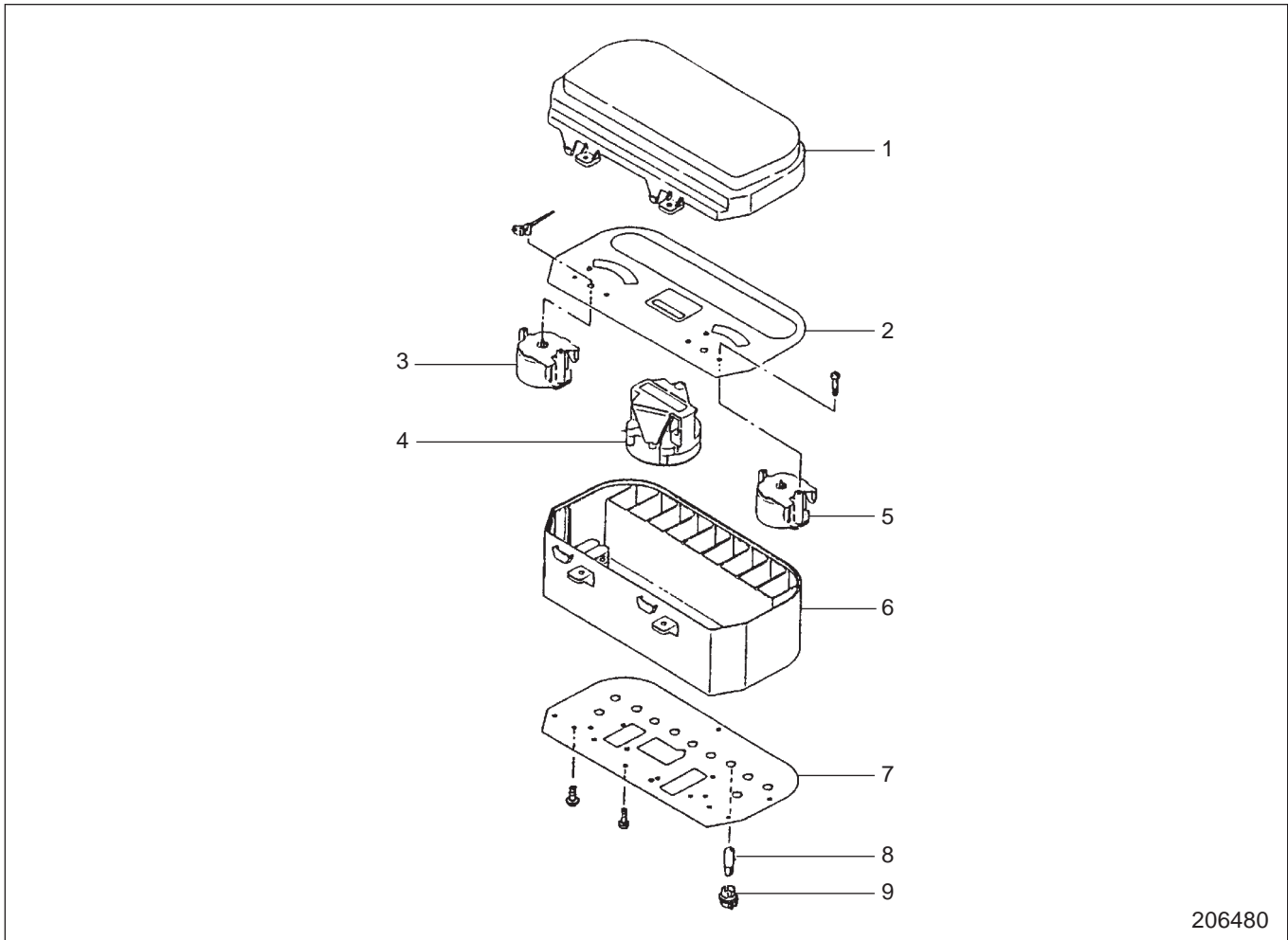


### Powershift transmission models

The cooling fan is installed inside with the radiator (in the engine compartment). This helps minimize radiator core clogging and retain high cooling efficiency even in continuous operation for hours (pusher for system). In the powershift transmission models, the radiator lower tank has a built-in transmission oil cooler.

## Combination Meter

### Disassembly



206480

### Sequence

- |                                    |                   |
|------------------------------------|-------------------|
| 1 Instrument panel                 | 6 Meter case      |
| 2 Dial                             | 7 Printed circuit |
| 3 Engine coolant temperature gauge | 8 Bulb            |
| 4 Service hour meter               | 9 Socket          |
| 5 Fuel gauge                       |                   |

**CAUTION**

Be careful not to damage the printed circuit when disassembling the combination meter.

### Reassembly

To reassemble the combination meter, follow the reverse of disassembly sequence.

### Bulb replacement

For bulb replacement, remove the socket from the printed circuit by turning it counterclockwise. For configuration of the indicator lights, refer to “OK Monitor.”

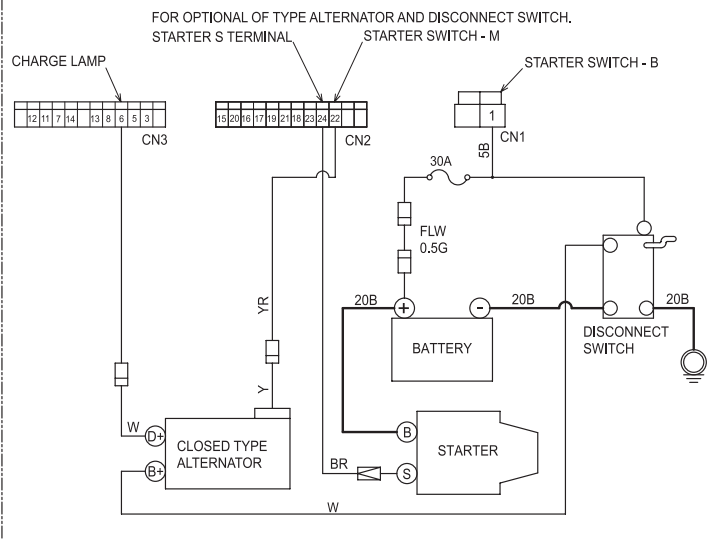
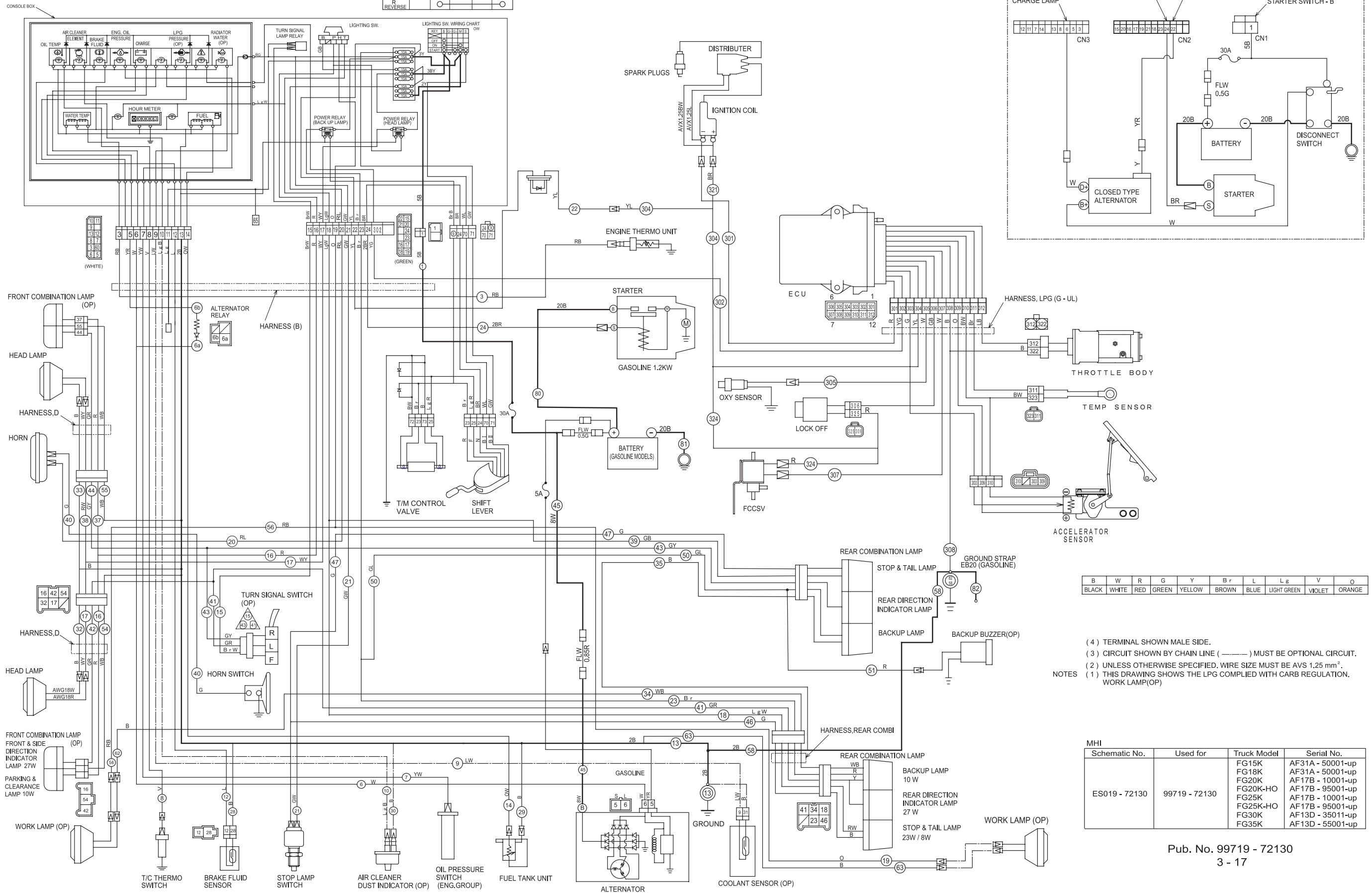
# Electrical Schematic (1/2)

LIGHTING SWITCH CONNECTION CHART

TERMINAL	CORD	OFF	1	2
B	AV1.25B			
T	#			
P	#			
(H) WORKING	AV1.25B			

F-N-R LEVER SWITCH CONNECTION CHART

POSITION	BATTERY	BATTERY	FORWARD	NEUTRAL	REVERSE
FORWARD	B	B	F	N	R
NEUTRAL					
REVERSE					

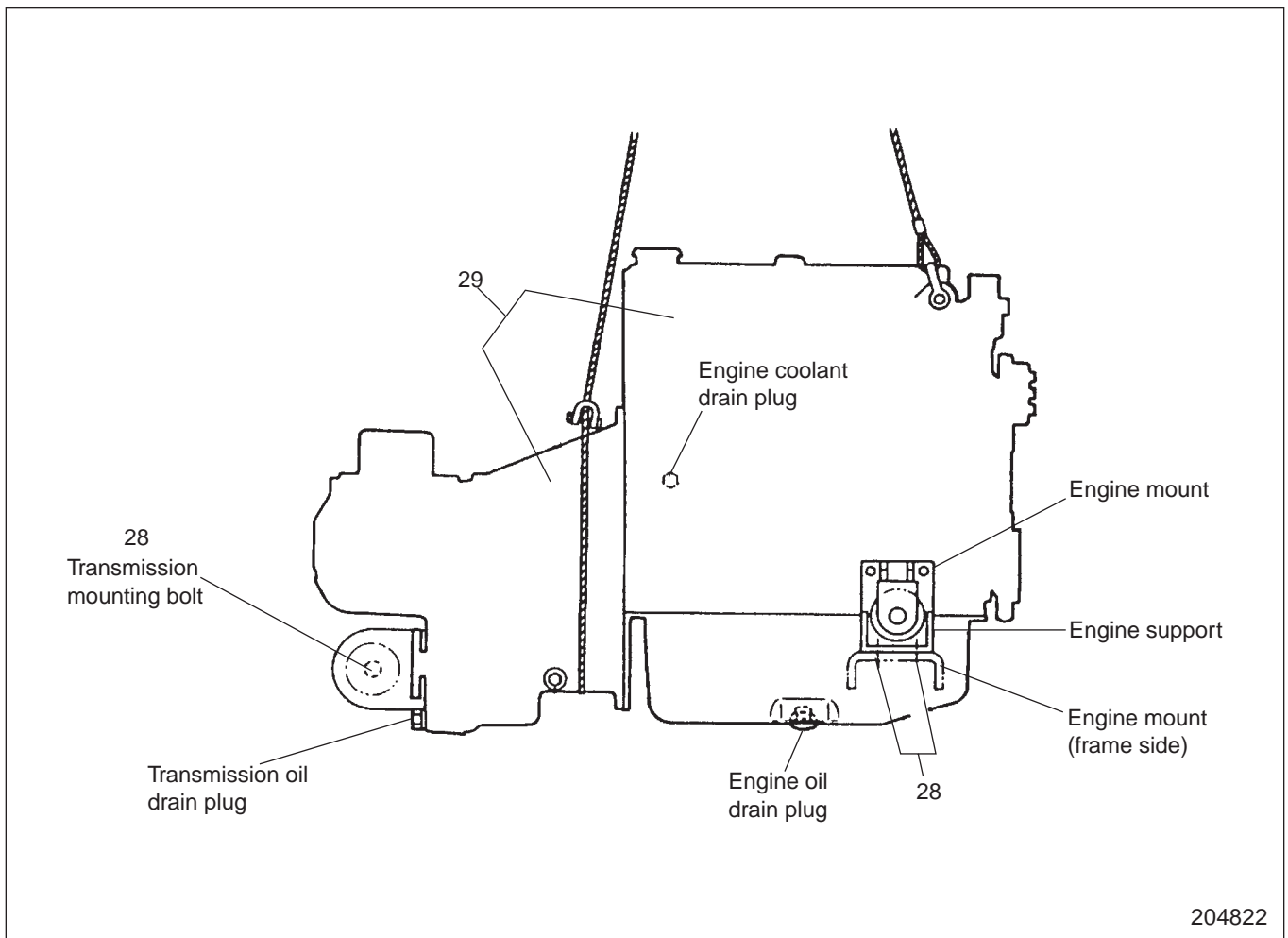


B	W	R	G	Y	Br	L	Lg	V	O
BLACK	WHITE	RED	GREEN	YELLOW	BROWN	BLUE	LIGHT GREEN	VIOLET	ORANGE

- (4) TERMINAL SHOWN MALE SIDE.
- (3) CIRCUIT SHOWN BY CHAIN LINE (——) MUST BE OPTIONAL CIRCUIT.
- (2) UNLESS OTHERWISE SPECIFIED, WIRE SIZE MUST BE AVS 1.25 mm<sup>2</sup>.
- NOTES (1) THIS DRAWING SHOWS THE LPG COMPLIED WITH CARB REGULATION. WORK LAMP(OP)

MHI Schematic No.	Used for	Truck Model	Serial No.
ES019 - 72130	99719 - 72130	FG15K FG18K FG20K FG20K-HO FG25K FG25K-HO FG30K FG35K	AF31A - 50001-up AF31A - 50001-up AF17B - 10001-up AF17B - 95001-up AF17B - 10001-up AF17B - 95001-up AF13D - 35011-up AF13D - 55001-up

## Engine and Transmission

**Sequence**

28 Bolts (for transmission and engine supports)

29 Engine and transmission assembly

**Start by:**

Lift the engine and transmission assembly by a hoist.

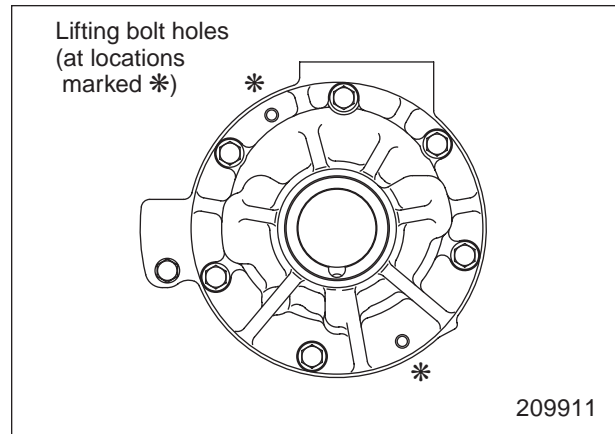
## POWERSHIFT TRANSMISSION

### 2. Removing pump assembly

Unscrew the pump mounting bolts and screw two bolts (special tool) into the M8 × 1.25 holes in the pump body to remove the pump assembly. Be sure to tighten the bolts equally, or the threads will suffer damage. Use M8 × 1.25 bolts having an effective thread length of 55 mm (2.2 in.)

Special tools needed

Bolt	91268 - 05100
------	---------------

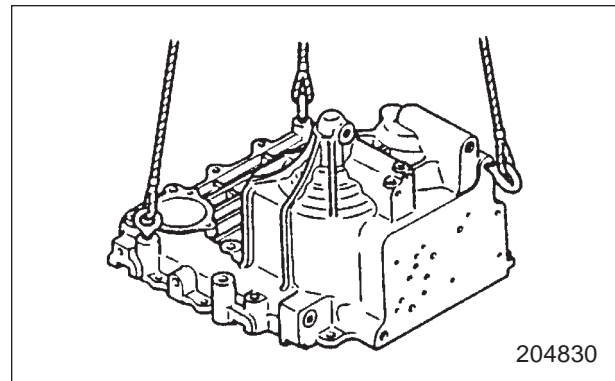


### 3. Removing transmission housing bolts

After removing the pump assembly, unscrew two transmission housing bolts (F1805 - 10025) from the torque converter housing side.

### 4. Removing transmission housing

Lay the transmission and torque converter assembly with transmission housing down. Unscrew the transmission housing bolts. Hang the transmission housing to a hoist, tap the transmission and clutch housing flanges near the dowel pins with a plastic hammer to separate the transmission housing from the torque converter housing.

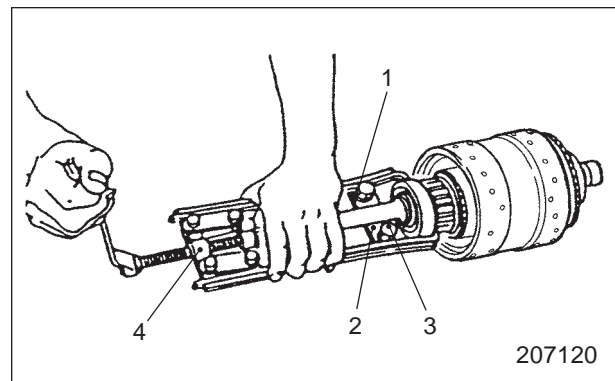


### 5. Removing input shaft ball bearing

Using a special tool, remove the ball bearing from the input shaft.

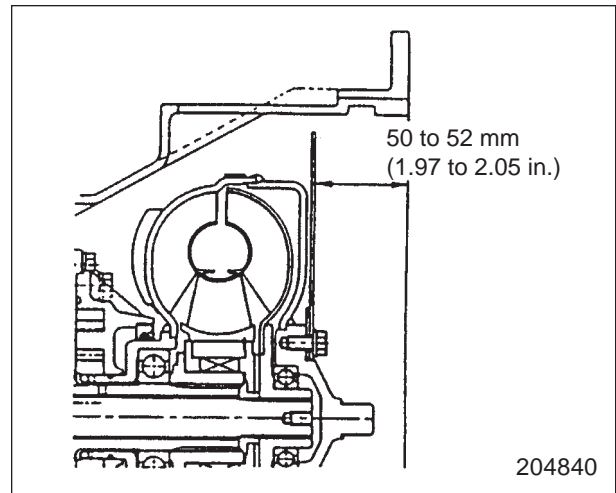
Special tools needed

Ref. No.	Tool name	Part No.	Q'ty
1	Puller	91268 - 13810	2
2	Plate	91268 - 13820	1
3	Bolt	F1035 - 10020	2
4	Gear puller T-24 (BANZAI make)	-	1



**7. Installing torque converter**

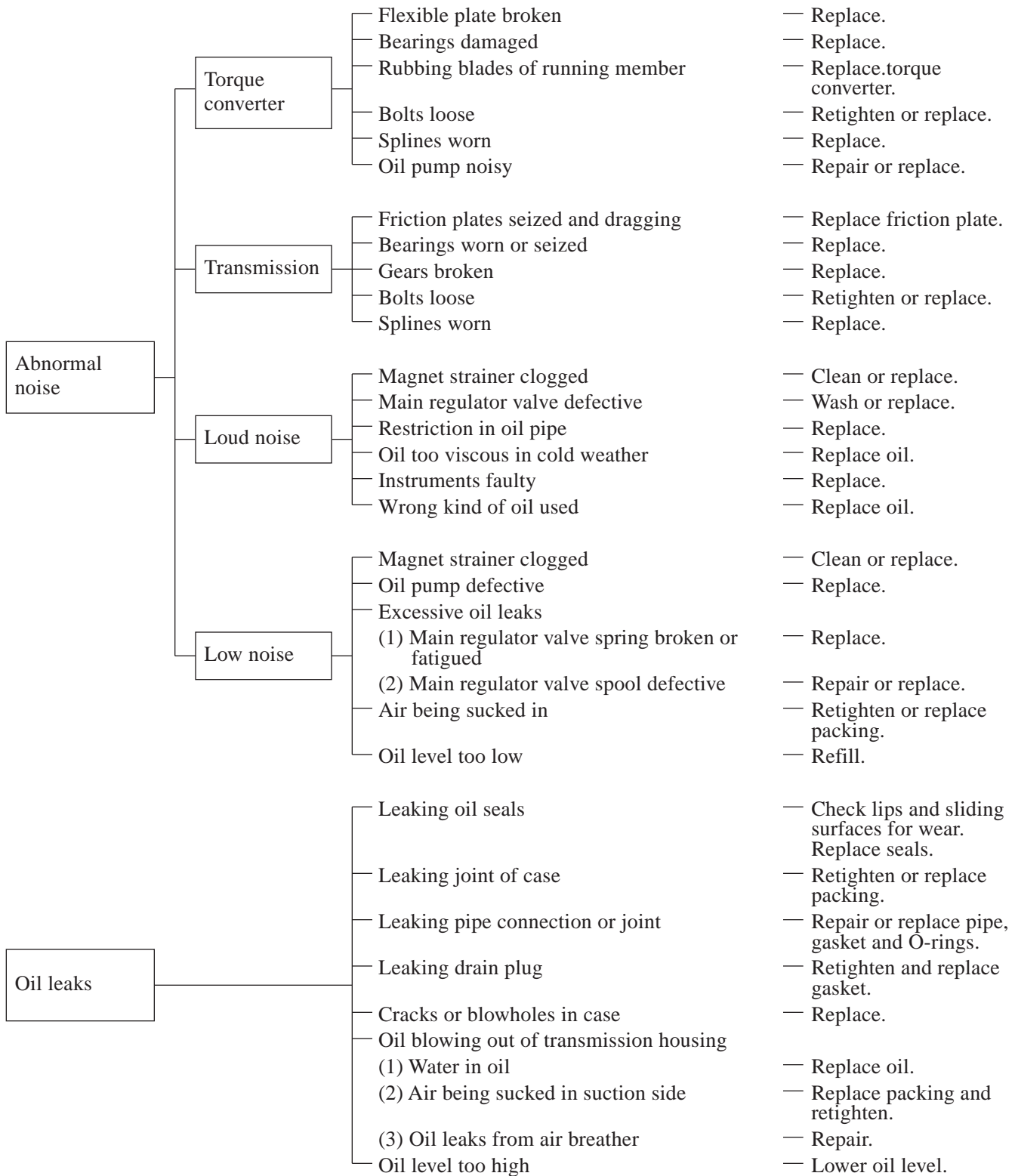
- (1) Install the torque converter in position by mating the splines of stator shaft and by positioning the groove of pump drive gear correctly.
- (2) Make sure that the distance between the end face of torque converter housing and the mating face of flexible plate is 50 to 52 mm (1.97 to 2.05 in.).
- (3) Support the flexible plate to the torque converter housing with a wire to prevent the torque converter from slipping out of position until the torque converter is coupled to the engine.



**8. Filling torque converter with AFT**

Fill the torque converter after the transmission has been mounted on the truck and the engine is ready to be started.

Run the engine at idle speed for a while. Stop the engine and, after 1 minute, check the oil level in the transmission with the oil level gauge in 15 minutes.

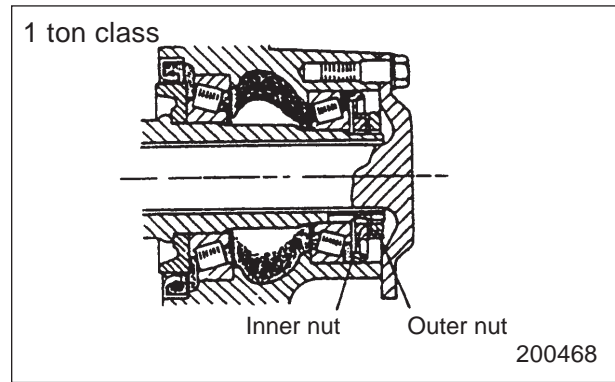




2. Hub bearing preload

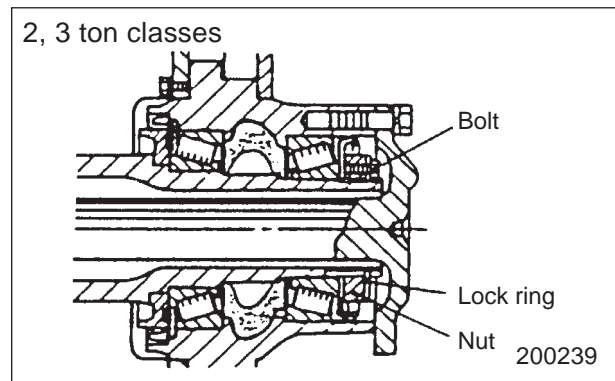
1.0 to 1.8 ton classes

Tighten the inner nut to obtain the required preload. Tighten the outer nut to the specified torque; and check the preload. Where the bearings removed in disassembly are reused, try to produce a preload in the lower side of the specified range.



2 to 3.5 ton classes

Tighten the nut to 137 N·m (14 kgf·m) [101 lbf·ft], and back it off 80° of rotation. Rotate the drum assembly more than 3 turns, and check the preload. If the preload meets the specification, put lock ring and tighten the bolts.



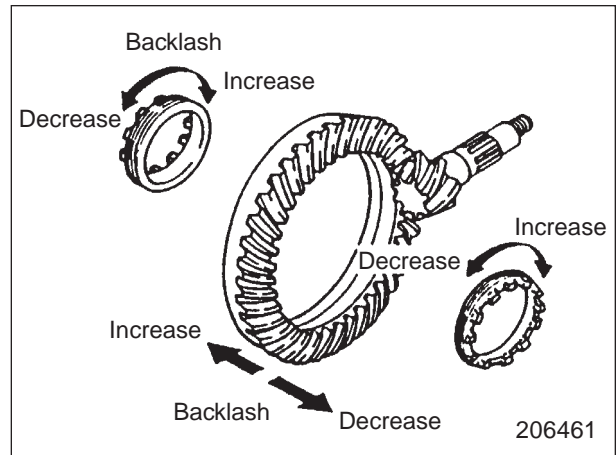
Truck Model Item	1.0 to 1.8 ton classes	2 to 3.5 ton classes
Preload for hub bearings	0.5 to 4.9 N·m (5 to 50 kgf·cm) [0.4 to 3.6 lbf·ft]	
Force applied to hub in tangential direction	5.4 to 54 N (0.55 to 5.5 kgf) [1.2 to 12 lbf]	4.4 to 44 N (0.45 to 4.5 kgf) [0.4 to 3.6 lbf]
Tightening torque for lock nuts	196 N·m (20 kgf·m) [145 lbf·ft]	—

**NOTE**

To check the preload, hook a spring balancer to the hub bolt, and measure the tangential force to rotate the wheel.

**FRONT AXLE AND REDUCTION DIFFERENTIAL**

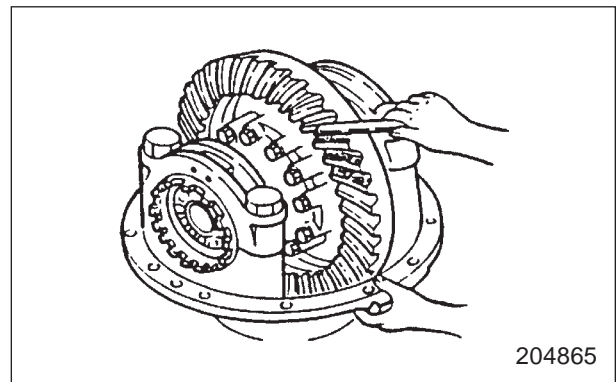
(4) To adjust the backlash, turn the adjusting screws, right and left, equally in the same direction so as not to disturb the bearing preload.



(5) Brush a light coating of coloring past on several reduction bevel gear teeth, on both the drive and coast sides. Press forward on the pinion, and rotate back and forth until a contact pattern is noted on both the drive and coast sides.

**NOTE**

Refer to Tooth Contact Patterns and Adjustment on the next page.



**14. Tightening bearing caps**

Upon checking the tooth contact, tighten the bearing cap bolts to the specified torque, and bent the lock washer.

Truck Model	1.0 to 1.8 ton classes	2 to 3.5 ton classes
Tightening torque for bearing cap bolts	123 N·m (12.5 kgf·m) [90 lbf·ft]	163 N·m (16.6 kgf·m) [120 lbf·ft]

## Removal and Installation

### Rear Wheels

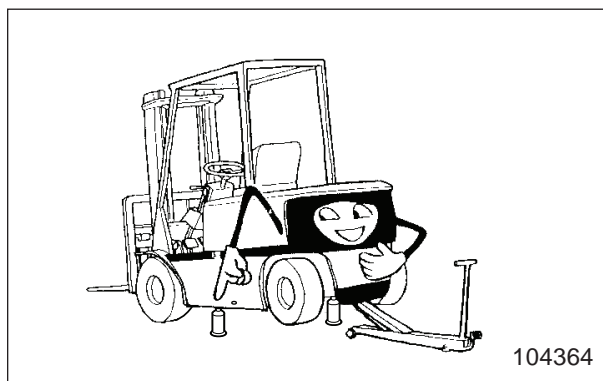
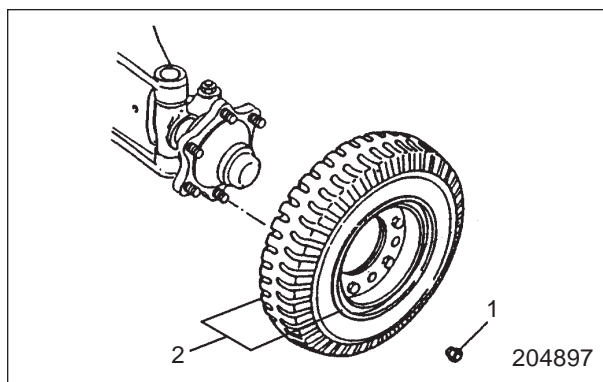
#### Removal

- 1 Wheel nuts
- 2 Rear wheel

#### Start by:

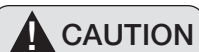
1. Set the parking brake, and block the front wheels.
2. Raise the rear end of the forklift truck with a jack or hoist.
  - (1) Method using a jack
 

Position the jack under the counterweight at the jacking point and raise the rear tire.



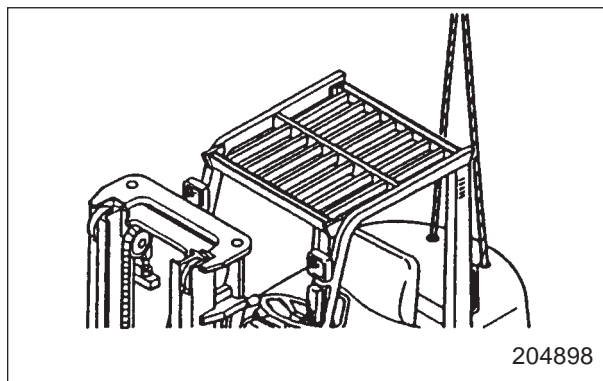
- (2) Method using a crane

Attach lifting slings to the lift holes in the counterweight, and lift it.



**CAUTION**

When the vehicle is raised, place jack stands under the side frame to support it.



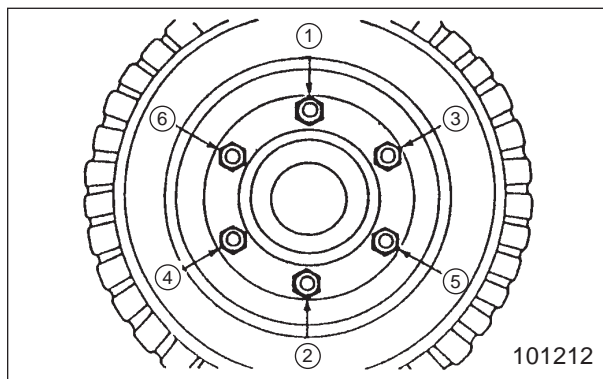
#### Installation

To install, follow the reverse of removal procedure.

#### NOTE

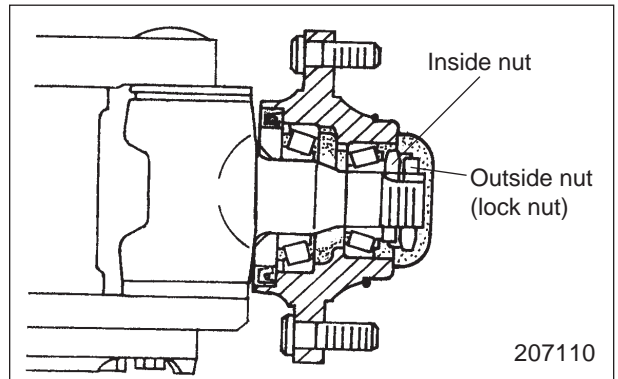
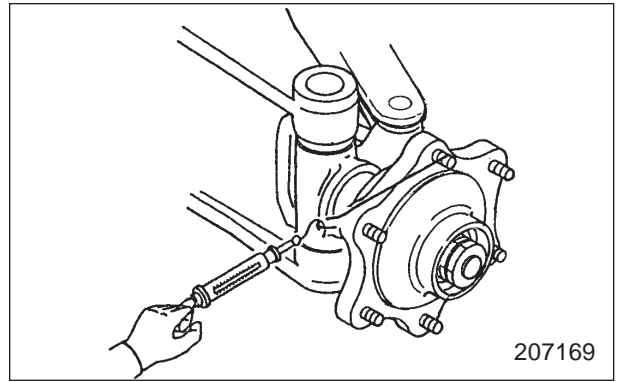
Tighten the wheel nuts to the specified torque.

Tightening torque for wheel nuts	157 N·m (16 kgf·m) [116 lbf·ft]
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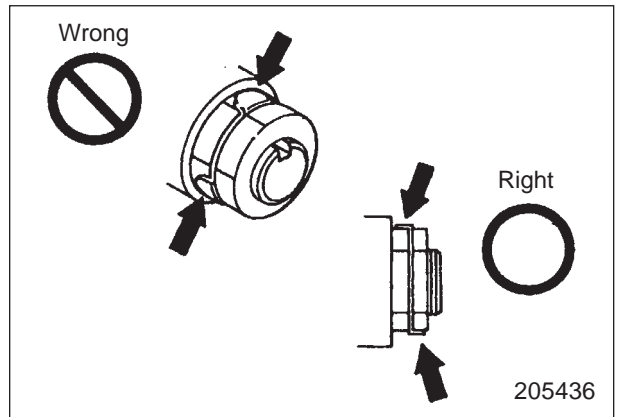


- (3) Bearing preload is specified. Tighten the inside nut first to secure the prescribed preload; after this tightening, tighten the outside nut (lock nut) to the specified torque value; and then re-check the preload. If the hub bearings (taper roller bearings) have long been in service, it is advisable to aim at a value of preload in the lower half of the specified range.

Item	Truck Model	1 ton class	2, 3 ton classes
Preload for hub bearing		0.5 to 4.9 N·m (5 to 50 kgf·cm) [0.4 to 3.6 lbf·ft]	
Tangential force for hub bearing at hub bolt N (kgf) [lbf]		6.8 to 68 (0.7 to 6.7) [1.5 to 15]	5.4 to 54 (0.55 to 5.5) [1.2 to 12]
Tightening torque for lock nut		157 N·m (16 kgf·m) [116 lbf·ft]	



- (4) Use a new lockwasher and bend it to both sides (inward and outward).
- (5) Fill the cap with grease, and install the cap.



Raise the rear end of the truck and remove the blocking from the side frames. Lower the truck until the rear wheels just touch the floor.

# BRAKE SYSTEM

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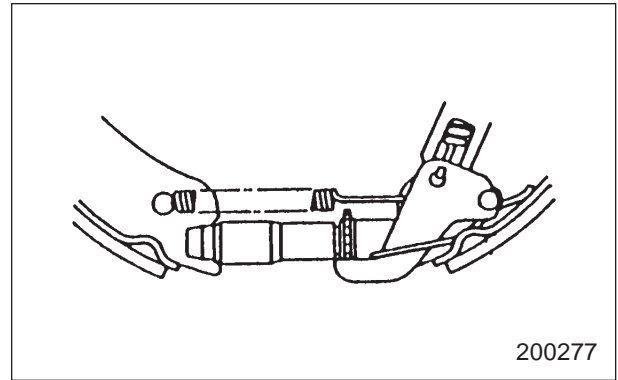
### 5. Automatic adjusting device installation

- (1) Clean the adjusting screw and associated parts and apply a thin coat of grease to the screw threads and screw socket. Check that the screw turns smoothly when rotated by hand.

If the screw is hard to turn, replace it by a new one.

- (2) Discriminate the right-hand adjusting screw and lever from the left-hand ones by the color:

Right-hand adjusting screw and lever (left-hand thread)	Yellowish color
Left-hand adjusting screw and lever (right-hand thread)	Whitish color



#### NOTE

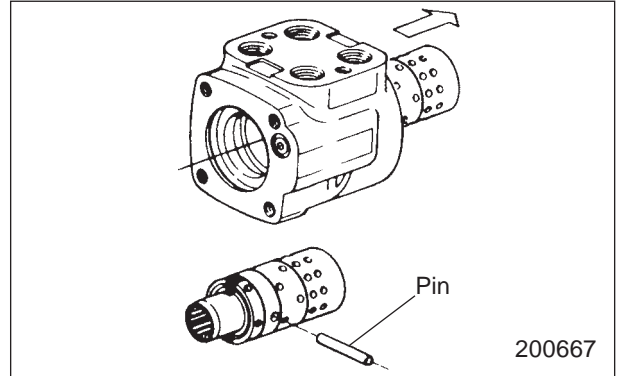
After reassembly, bleed air out of the brake fluid lines.  
(Refer to Inspection and Adjustment.)

# STEERING SYSTEM

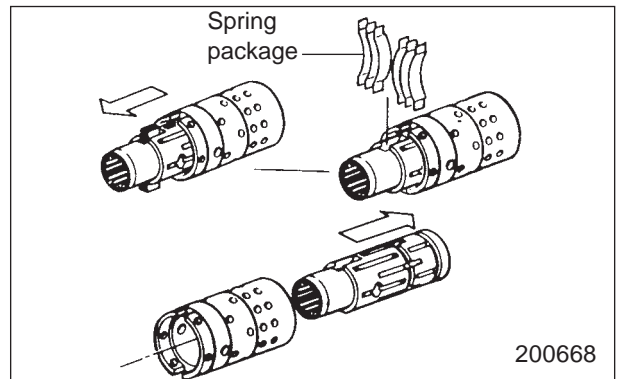
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**Removing spool and sleeve assembly**

Remove the spool and sleeve assembly from the end of the housing. Do not jam the spool and sleeve assembly. Rotate it slowly when removing it from the housing. Pull the pin from the spool and sleeve assembly.

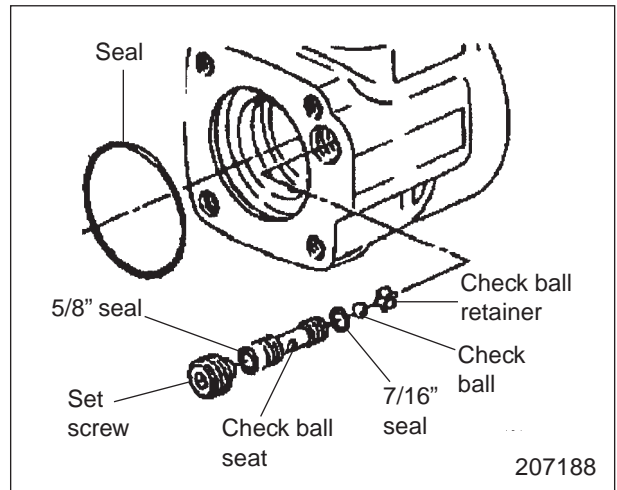


Pull the spool partially from the control end of the sleeve and carefully remove the centering springs from the spool by fingers. Push the spool back through and out of the sleeve. Rotate the spool slowly when removing it from the sleeve.



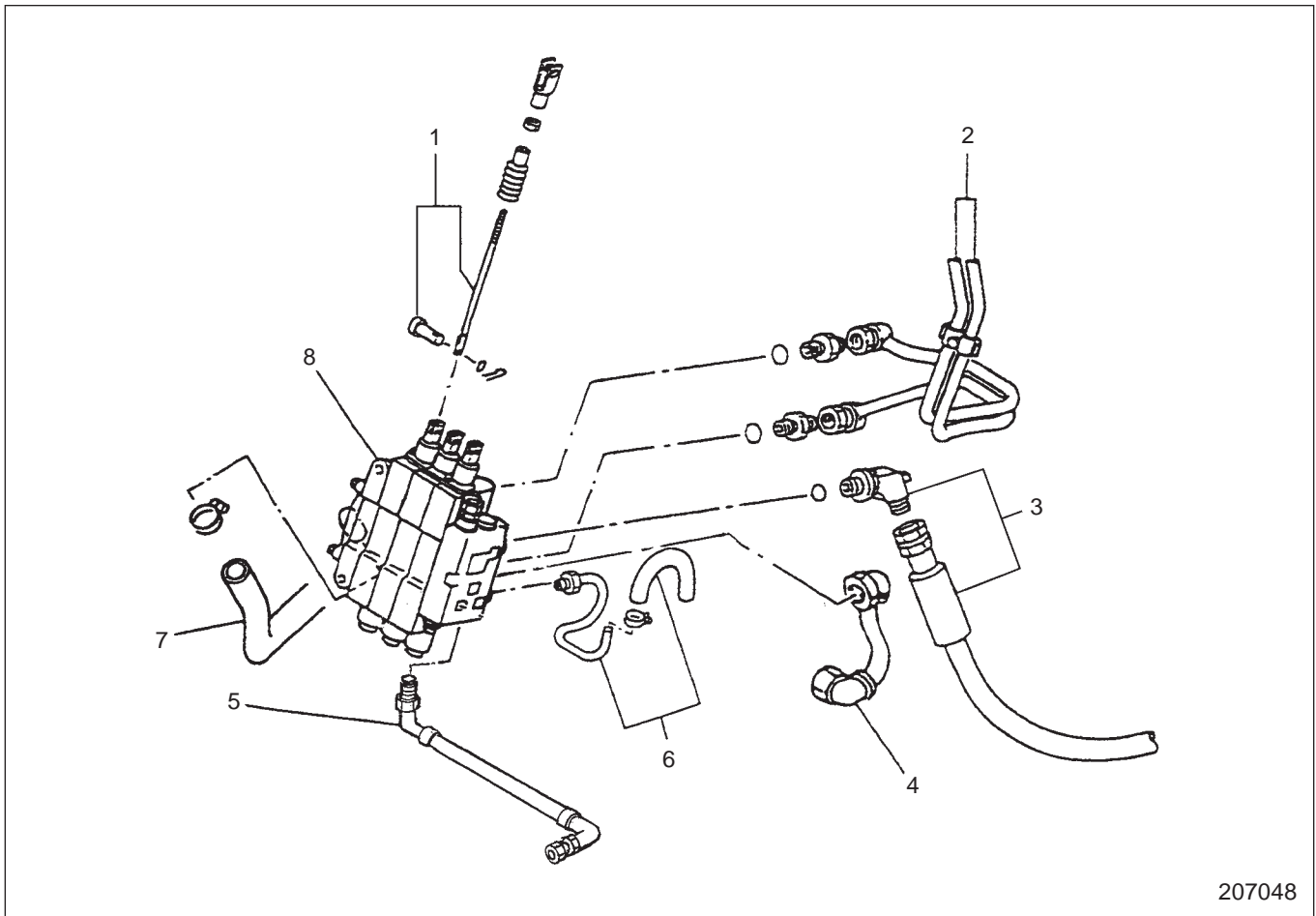
**Removing the check valve**

Remove the seal from the housing. Remove the set screw. Screw a # 10-24 machine screw into the end of the check ball seat. Then, by pulling on the screw with pliers, lift the seat out of the housing. Remove the two seals from the seat. Tip the housing to remove the check ball and check ball retainer.





Control Valve



207048

**Sequence**

- |                                     |                              |
|-------------------------------------|------------------------------|
| 1 Clevis pin, Rod                   | 5 Steering delivery pipe     |
| 2 Tilt pipe, Connector, O-ring      | 6 Steering return hose, Pipe |
| 3 Main delivery hose, Joint, O-ring | 7 Return hose                |
| 4 Lift pipe                         | 8 Control valve              |

**Start by:**

1. Remove the floor plate and dashboard cover.
2. Before disconnecting pipes, tilt the mast to vertical position, lower the forks all the way, and relieve the pressure in the pipes.

## HYDRAULIC SYSTEM

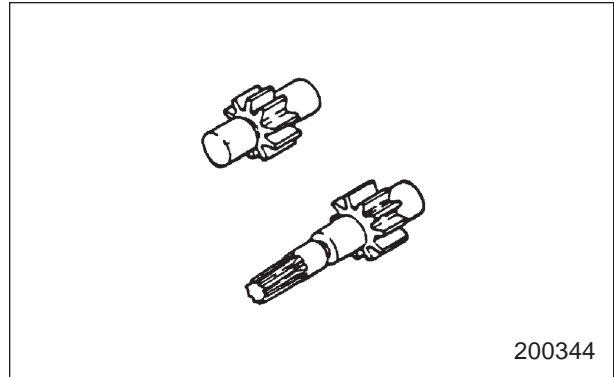
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- (5) Give a thin coat of grease to the lip of each oil seal and to the seals just before fitting them.
- (6) Tightening torque for the cover securing bolts is specified. Tighten those bolts to the specification.
- (7) The fit of the pump gears in the reassembled pump may be deemed satisfactory if the pump shaft rotates smoothly and lightly when turned over by hand with an adjustable wrench.

### Inspection after disassembly

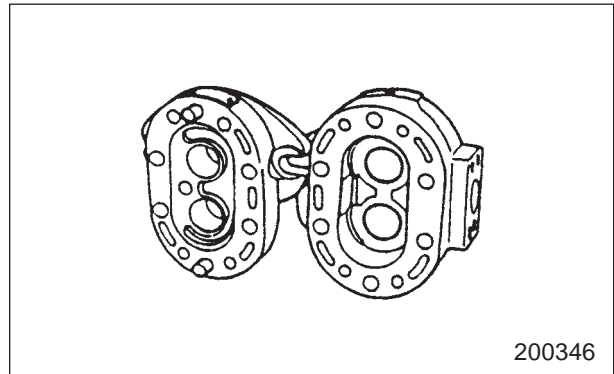
#### 1. Drive and driven gears

Inspect the gear teeth for wear and damage. Inspect the journals and splines as above.



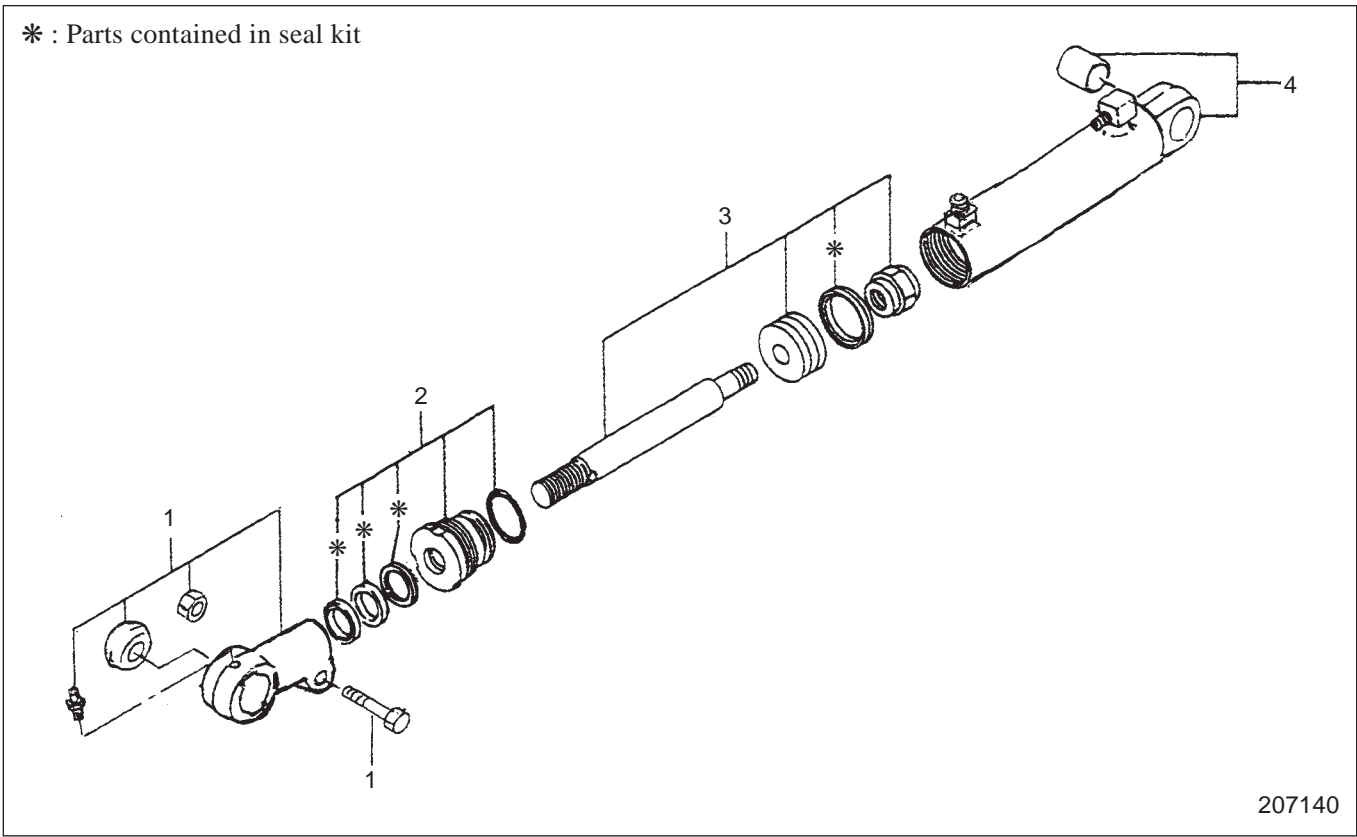
#### 2. Pump covers, body and bushings

Inspect these parts for wear and damage.



## Tilt Cylinders

\* : Parts contained in seal kit



### Sequence

- |  |  |
|--|--|
| 1 Tilt socket, Bolt, Nut, Bearing, Grease nipple         | 3 Piston rod, Piston, Piston seal, Nut |
| 2 Guide bushing, O-ring, Dust seal, Packing, Buffer ring | 4 Cylinder tube, Bushing               |

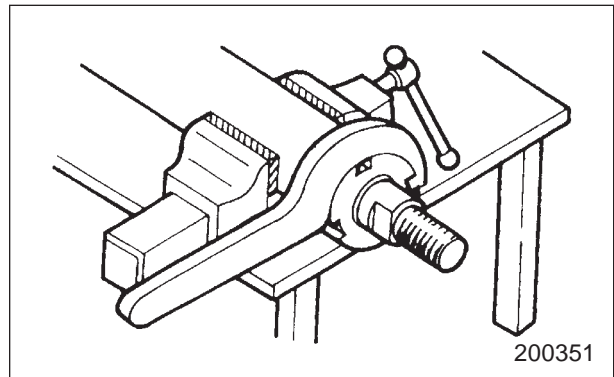
### NOTE

Do not remove the tilt socket bearing and cylinder tube bushing unless they are defective.

### Suggestions for Disassembly

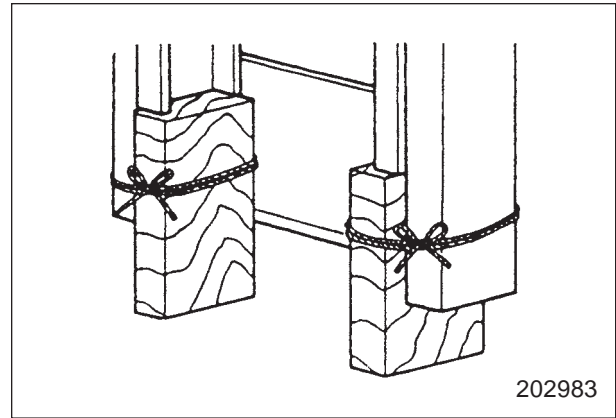
#### Removing bushing

- (1) Wrap the cylinder with a rag, and clamp it in a vise. Using a wrench, remove the bushing from the cylinder.
- (2) When removing the bushing from the piston rod, be careful not to damage the buffer ring, packing, O-ring against the threads of the piston rod.



[Adjusting method]

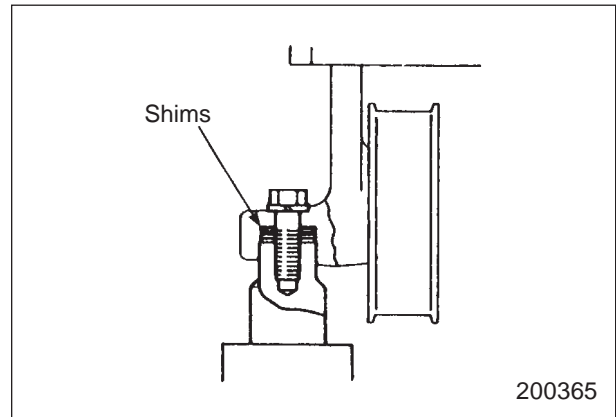
- (1) Raise the inner mast, tie blocks under the right and left sides of the mast, and lower the mast until it rests on the blocks.



- (2) Remove the stopper bolt at the top of lift cylinder which stopped first, retract the piston rod, and insert shims at the top of piston rod end.

**NOTE**

To retract the piston rod, move the lift control lever to the lowering position to let the oil escape from the lift cylinder.

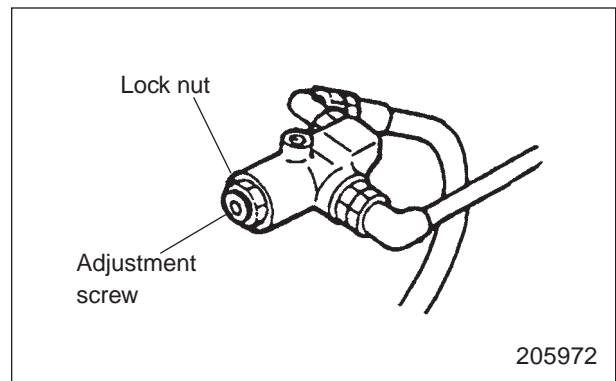


- (3) Extend the piston rod, and tighten the cylinder stopper bolt. Remove the blocks from under the inner mast.
- (4) Slowly lower the inner mast to the bottom to ensure the piston rods move smoothly.

**Flow Regulator Valve**

Measure the lowering speed with rated load. If the speed is out of specification, readjust, or replace the flow regulator valve.

Lowering speed	1 to 2.5 ton classes	500 mm/sec [98 fpm]
	3 ton class	530 mm/sec [104 fpm]
	3.5 ton class	440 mm/sec [87 fpm]

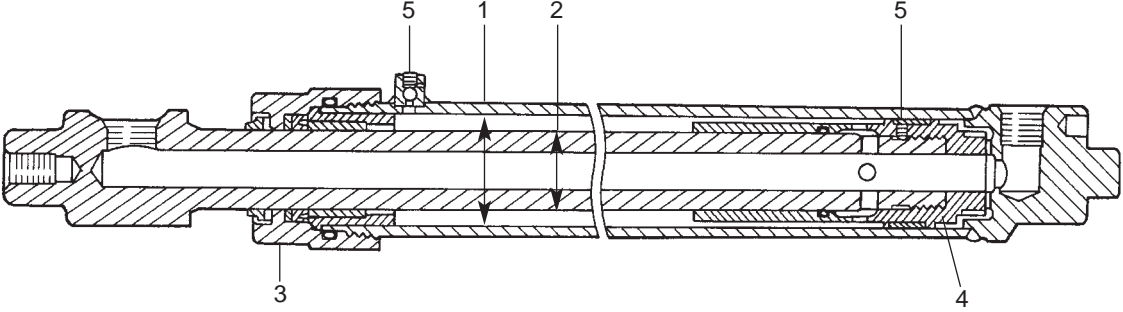


**Bleeding lift cylinder**

Air and oil remaining inside air chamber of the rod and inside rod chamber between the tubes open the check valve and flow out when they are compressed. Therefore, there is no need to bleed the lift cylinder.

A: Standard value

Unit: mm (in.)

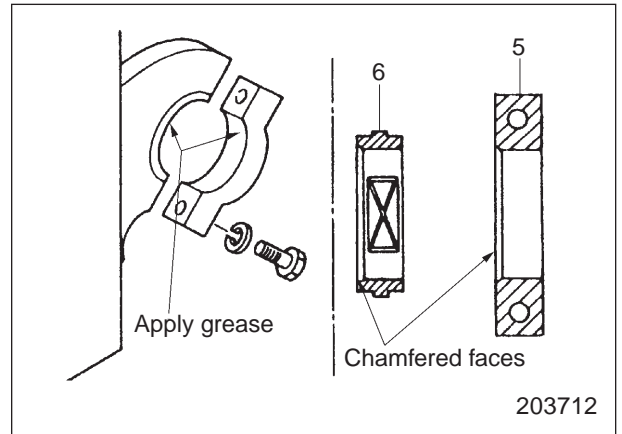
Item		Truck Model		FG15K FG18K	FG/FD20K FG20K-HO FG/FD25K FG25K-HO	FG/FD30K	FG/FD35K	
		[piston] Inside diameter of cylinder tube 1	A	45 (1.77)		50 (1.97)	55 (2.16)	
Diameter of piston rod 2	A	32 (1.26)	35 (1.38)	40 (1.57)	42 (1.65)			
Tightening torque for retainer 3 N·m (kgf·m) [lbf·ft]	A	206 ± 39.2 (21 ± 4) [152 ± 29]		235 ± 54.0 (24 ± 5.5) [174 ± 39.8]	304 ± 70.6 (31 ± 7.2) [224 ± 52]			
Holder thread diameter 3	A	M52 × 2		M57 × 2	M63 × 2			
Piston tightening torque 4 N·m (kgf·m) [lbf·ft]	A	196 ± 35 (20 ± 3.6) [145 ± 26]				245 ± 44.1 (25 ± 4.5) [180 ± 32.5]		
Set screw tightening torque 5 N·m (kgf·m) [lbf·ft]	A	3.92 ± 0.98 (0.4 ± 0.1) [2.9 ± 0.72]						
								

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**Installation**

To install, follow the removal sequence in reverse, and service as follows.

1. Procedure for mounting mast support bushings 6 and caps 6.
  - (1) Apply grease to the inner surfaces of caps and mast support bushings.
  - (2) Install mast support bushings 6 and caps 6, making sure that the sides with larger chamfered area face toward the center of the vehicle.
  - (3) Be sure to tighten the support tightening bolts securely.



Truck Model	1.0 to 1.8 ton classes	2 to 3.5 ton classes
Bolt tightening torque	74 N·m (7.5 kgf·m) [54 lbf·ft]	178 N·m (18.2 kgf·m) [132 lbf·ft]

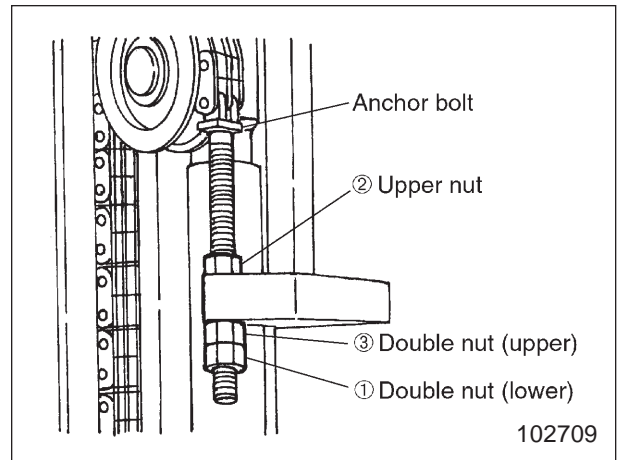
2. Adjust the chain tensions.  
(Refer to the Inspection and Adjustment section.)  
Tighten the nuts to the specified torque.

**Tightening torque**

Unit: N·m (kgf·m) [lbf·ft]

Truck Model	1.0 to 2.5 ton classes	2.8 to 3.5 ton classes
Upper nut 2	57 (5.8) [42.0]	84 (8.6) [62.2]
Double nut (lower) 1	98 (10.0) [72.3]	147 (15.0) [108.5]

3. Air bleeding of lift cylinders  
Due to internal drain type cylinder, the lift cylinders do not require air bleeding.
4. After proper operation is confirmed, check the oil level.



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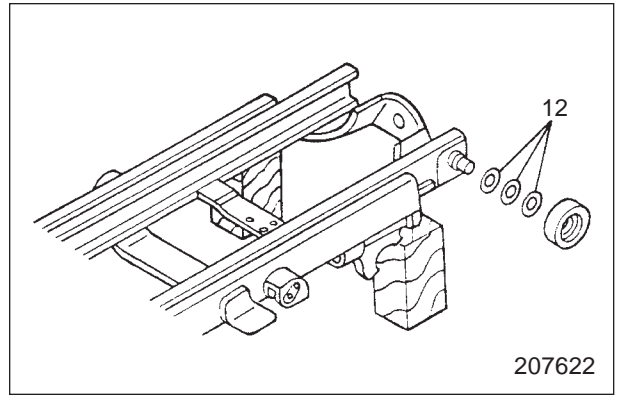
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**Reassembly**

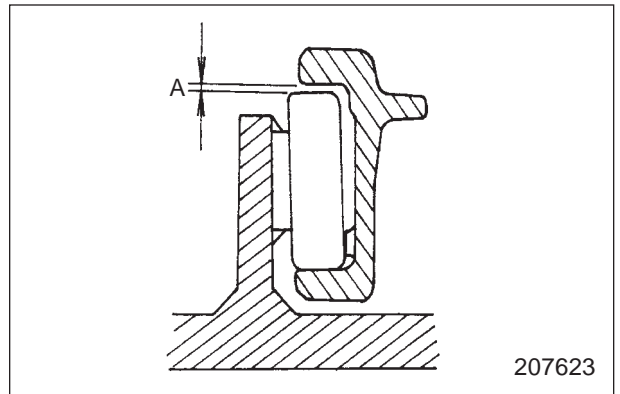
To reinstall, follow the removal sequence in reverse, and service as follows.

**1. Main rollers**

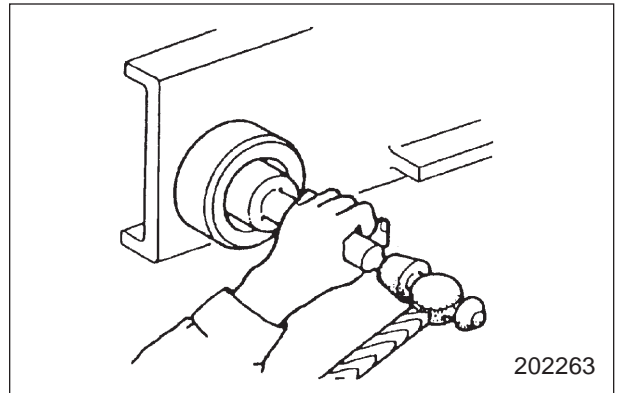
(1) Adjust the right and left clearances by increasing or decreasing the thickness of shims 12.



(2) When replacing lift bracket main rollers, make sure clearance A between each roller and mast surface is 1 mm or less.

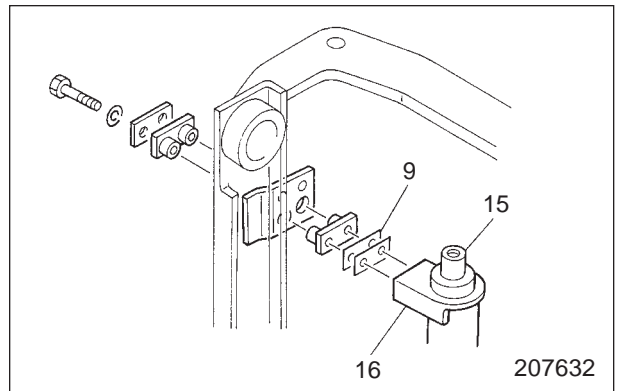


(3) To install main rollers on shafts, use a driving tool. Be careful not to accidentally strike the outer roller surface with the driving tool. The side of the roller with larger chamfered area must face toward the outside.



**2. Installing second lift cylinders**

When installing second lift cylinders 15, make sure the cylinders are parallel to the mast to prevent torsional stress on the lift cylinders when the mast is positioned at the bottom. Adjust the installation positions of lift cylinder brackets 16 with shims 9.



## Clearance Adjustment on Lift Bracket

**NOTE**

The adjustment procedure for the lift bracket is the same for the Simplex Mast, Duplex Mast and Triplex Mast.

### 1. Longitudinal clearance adjustment on lift bracket main rollers

- (1) Raise the forks a little from the floor.
- (2) Insert a bar between the upper part of lift bracket and the inner mast, and push the inner mast to one side. Using feeler gauges, measure the clearance  $F$  between the main roller and inner mast on the opposite side.

Clearance $F$	0.1 to 1.0 mm (0.004 to 0.039 in.)
---------------	---------------------------------------

- (3) If the clearance  $F$  is out of specification, use oversize rollers.

#### Roller sizes

Unit : mm (in.)

Truck Model Size (Diameter)	1 ton class	2, 3 ton classes
S	99 (3.90)	113.8 (4.48)
M	100 (3.94)	115 (4.53)
L	101 (3.98)	116 (4.57)
LL	102 (4.02)	117 (4.60)

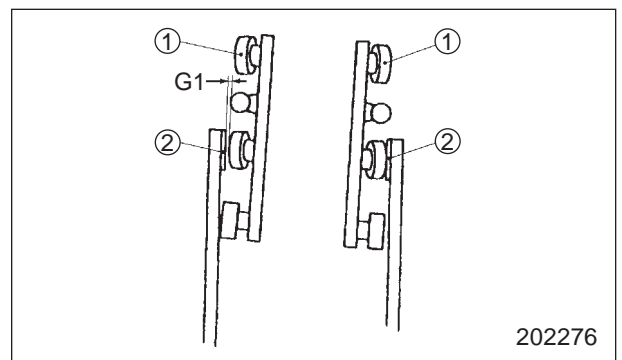
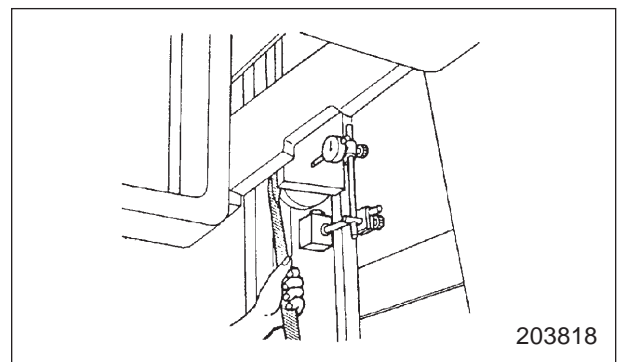
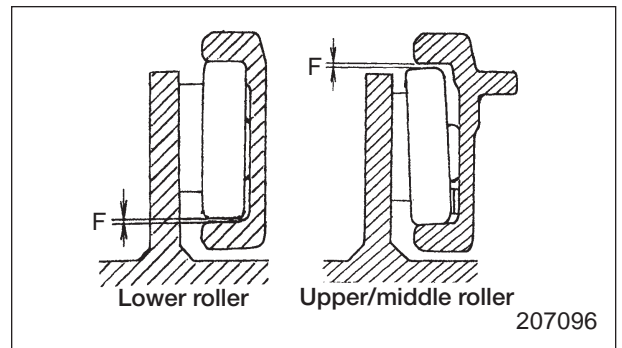
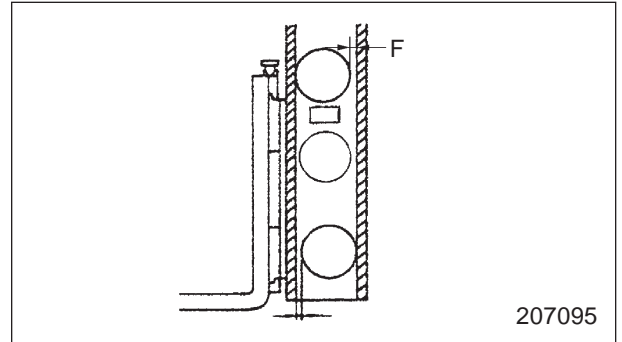
- (4) Lift bracket main rollers (upper and center rollers)  
The upper rollers should be the same in size or 1-rank larger than the center rollers.

### 2. Lateral clearance adjustment on lift bracket main rollers and side rollers

- (1) Raise the mast to the top.
- (2) Set a dial indicator on the inner mast with its contact point rested on the side of the lift bracket.
- (3) Go over to the opposite side of the mast, and push the lift bracket to one side with a bar. Set the indicator to zero.
- (4) Insert a bar between the inner mast and lift bracket on the indicator side, and push the lift bracket to the opposite side.
- (5) Read the indicator.

Clearance $G1$	0.1 to 0.5 mm (0.004 to 0.020 in.)
----------------	---------------------------------------

- (6) Adjust clearance  $G1$  between the center main roller and weld plate 2 at the maximum lift position by increasing or decreasing the thickness of the shim. Do not install a shim at upper main roller 1.

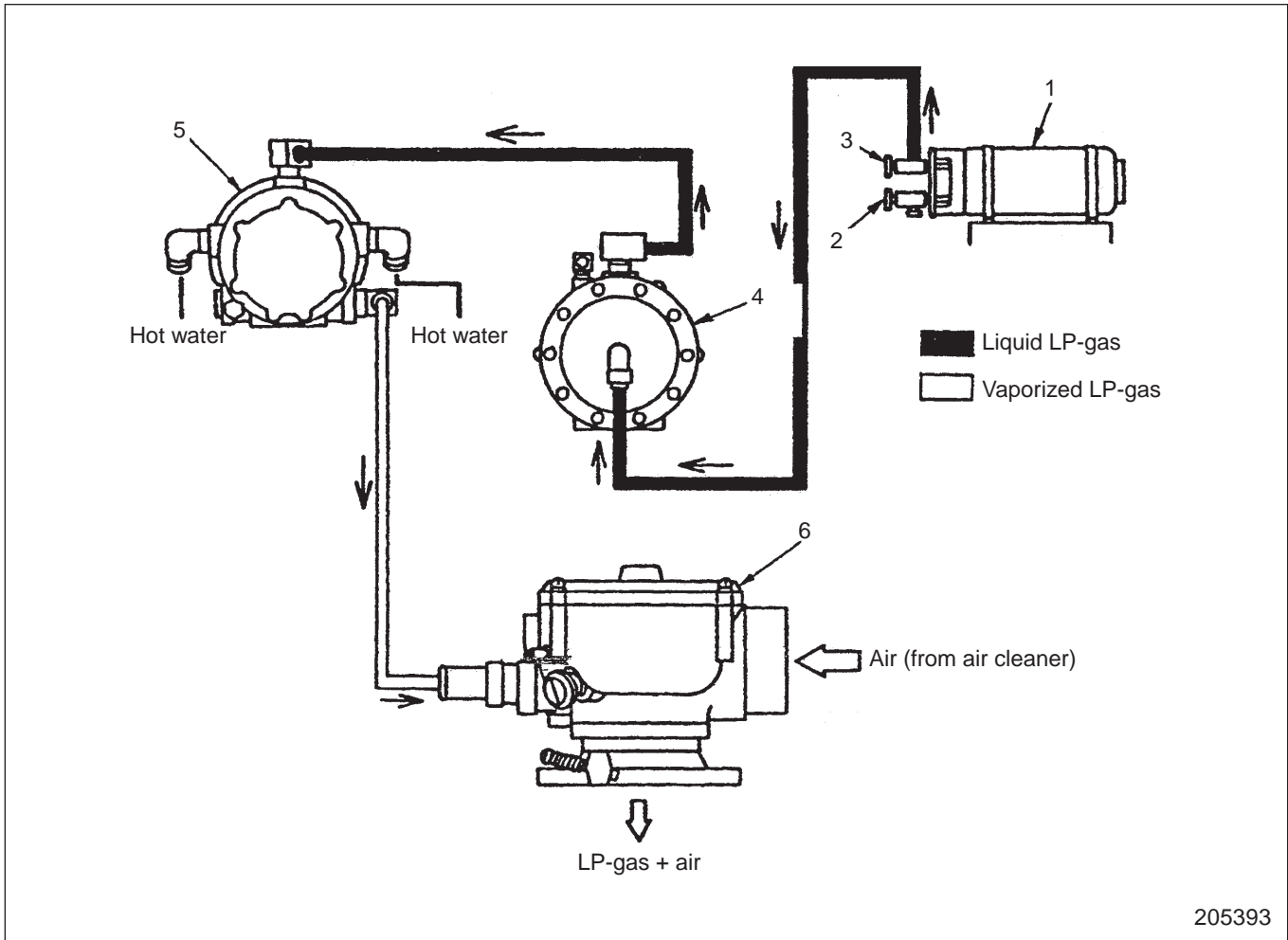


## Troubleshooting

Lift bracket, inner mast and middle mast do not rise or lower smoothly.	<ul style="list-style-type: none"> <li>— Faulty rotation of side roller</li> <li>— Faulty rotation of main rollers</li> <li>— Improper mast strip clearance</li> <li>— Improper main roller or side roller clearance</li> </ul>	<ul style="list-style-type: none"> <li>— Replace rollers.</li> <li>— Replace rollers.</li> <li>— Adjust with shims.</li> <li>— Adjust front-to-back and right-to-left clearances.</li> </ul>
Lift bracket or inner mast is out of square.	<ul style="list-style-type: none"> <li>— Uneven chain tension between right and left chains</li> <li>— Excessive side roller clearance</li> <li>— Uneven adjustment of shims between right and left lift cylinders (at maximum lift position)</li> </ul>	<ul style="list-style-type: none"> <li>— Adjust chain tension.</li> <li>— Adjust by adding shims.</li> <li>— Adjust by removing shims.</li> </ul>
Abnormal noise is generated by mast.	<ul style="list-style-type: none"> <li>— Faulty rotation of side roller</li> <li>— Faulty rotation of main rollers</li> <li>— Defective hose pulley bearing (Triplex mast system only)</li> </ul>	<ul style="list-style-type: none"> <li>— Replace rollers.</li> <li>— Replace rollers.</li> <li>— Replace.</li> </ul>
Lift cylinder drift is too large.	<ul style="list-style-type: none"> <li>— Damaged gaskets in lift cylinders</li> <li>— Internal leak of control valve</li> </ul>	<ul style="list-style-type: none"> <li>— Replace.</li> <li>— Replace.</li> </ul>
Entire mast shake	<ul style="list-style-type: none"> <li>— Worn mast support bushings and caps</li> </ul>	<ul style="list-style-type: none"> <li>— Retighten, or replace bushings and caps.</li> </ul>
Mast is deformed in shape.	<ul style="list-style-type: none"> <li>— Uneven cargo load or overload</li> </ul>	<ul style="list-style-type: none"> <li>— Replace assembly.</li> </ul>
Uneven fork end heights	<ul style="list-style-type: none"> <li>— Bent finger bars</li> <li>— Bent forks</li> <li>— Mast deformation due to uneven cargo load</li> </ul>	<ul style="list-style-type: none"> <li>— Repair or replace.</li> <li>— Replace.</li> <li>— Repair or replace.</li> </ul>
Second lift cylinders move when first lift cylinder operates (only in Duplex and Triplex masts).	<ul style="list-style-type: none"> <li>— Low oil temperature</li> <li>— No clearance for lift bracket roller surfaces</li> <li>— Clogged pipes</li> <li>— Improper air bleeding</li> </ul>	<ul style="list-style-type: none"> <li>— Increase oil temperature by raising and lowering lift bracket.</li> <li>— Readjust rollers.</li> <li>— Inspect and clean hydraulic line.</li> <li>— Bleed hydraulic system.</li> </ul>
Lift bracket is spongy when it stops in lifting operation.	<ul style="list-style-type: none"> <li>— Air is present under each lift cylinder piston due to poor air bleeding.</li> </ul>	<ul style="list-style-type: none"> <li>— Bleed hydraulic system.</li> </ul>

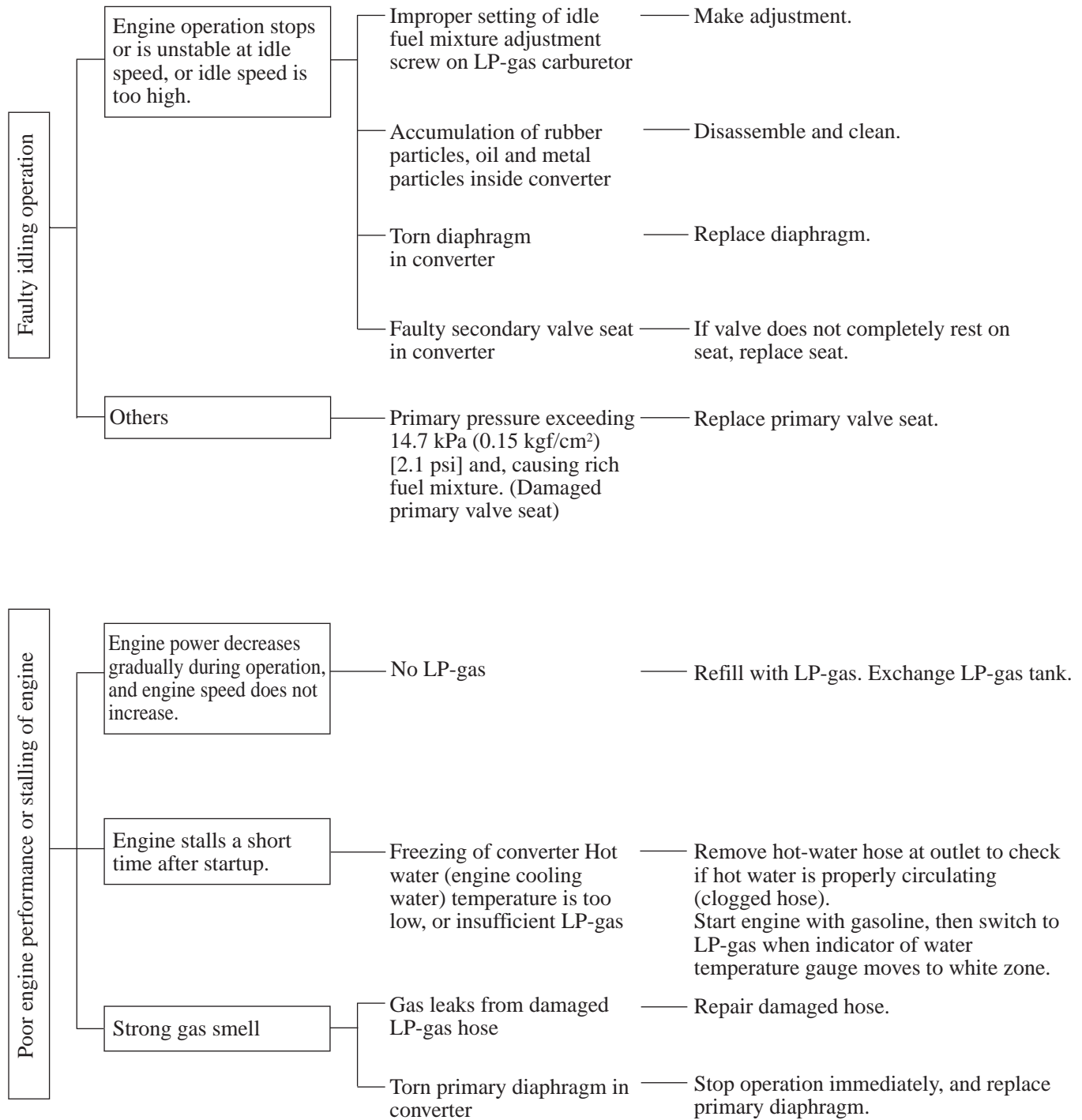
### Construction and Function

#### Outline of LP-gas Device



- 1 LP-gas tank
- 2 LP-gas filling valve
- 3 LP-gas fuel valve

- 4 Vacuum fuel lock filter
- 5 Converter
- 6 LP-gas carburetor

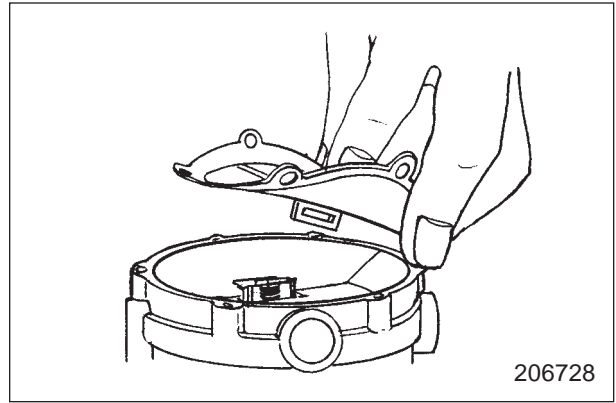


## LP-GAS SYSTEM

- (9) Align diaphragm link slot to the end section of secondary seat lever.

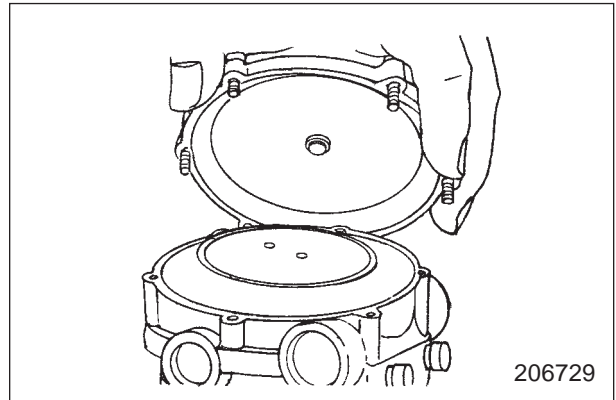
Gap from which link is punched should face gas inlet.

Refer to steps (3) and (4) of the disassembly procedure.



- (10) Position secondary diaphragm in place, and mount secondary cover with six screws.

Tighten screws until they contact secondary cover. Then, tighten screws from one side to the other until all screws are tightened evenly.



**⚠ CAUTION**

Use only brass fittings in the hot water inlet and outlet passages. Steel fittings cause casting to deteriorate due to electrolysis.

**⚠ CAUTION**

After assembly is complete, conduct a pressure test using a soapy solution or testing solution to make sure there is no leak.

## Ignition Timing Adjustment

The combustion speed is different for gasoline and LP-gas. Therefore, the optimum ignition timing also differs.

When the engine operates mostly on LP-gas, advance the ignition timing by 5° or 6° from the ignition timing for gasoline operation. This provides improved performance and better fuel economy.

## Gas Leak Check Procedure

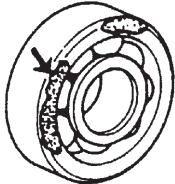

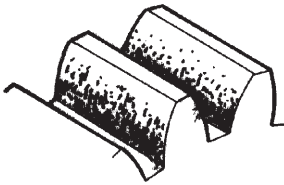
- (1) Open the gas outlet valve on the LP-gas tank.
- (2) Set the gasoline/LPG selector to the [LPG] position.
- (3) Turn the starter switch to the [START] position to start the engine.
- (4) Use a gas leak tester or soapy solution to check the pipe joints for leaks.

Inspection point		How to check	Pre-start	Intervals		Service data
				1 month	12 month	
Control valve	Oil leaks	Visual	○	○	○	
	Main relief valve setting	Pressure gauge			○	18142 kPa (185 kgf/cm <sup>2</sup> ) [2631 psi]
	Overload relief valve setting (optional)	Pressure gauge			○	
	Control levers and links — rattle	Test	○	○	○	
Lift cylinders	Cracks, distortion or other defects	Visual	○	○	○	
	Rod drift (rated load)	Visual/watch/scale				Drop test (rated load) 1 thru 3 ton classes: 50 mm (2.0 in.)/15 min 3.5 ton class: 35 mm (1.4 in.)/15 min
	Attachment					
	Mounting bolts — tightness	Wrench		○	○	
Flow regulator valve	Oil leaks	Visual	○	○	○	
	Lowering speed	Watch/scale	○	○	○	Lowering speed (rated load) 1 ton class: 520 mm/sec (102 fpm) 2 thru 2.5 ton classes: 500 mm/sec (98 fpm) 3 ton class: 530 mm/sec (104 fpm) 3.5 ton class: 440 mm/sec (87 fpm)
Tilt cylinders	Cracks, distortion or other defects	Visual	○	○	○	
	Oil leaks	Visual	○	○	○	
	Forward rod drift (rated load)	Watch/scale		○	○	20 mm (0.8 in.)/ 15 min
	Mounts — rattle or damage	Visual/free	○	○	○	
	Rod socket bolt — tightness	Torque wrench	○	○	○	127 to 152 N·m (13 to 15.5 kgf·m) [94 to 112 lbf·ft]
Piping	Oil leaks	Visual	○	○	○	
	Rubber hoses — damage	Visual		○	○	
	Hose reels and swivel joint — distortion or other defects	Visual		○	○	

**Weight of Major Components (Approximate)**

Unit: kg (lb)

Components	Truck Models					
	FG15K	FG18K	FG20K FG20K-HO FD20K	FG25K FG25K-HO FD25K	FG30K FD30K	FG35K FD35K
Counterweight	810 (1790)	970 (2140)	1180 (2600)	1510 (3330)	1920 (4230)	2210 (4870)
Engine service weight						
Gasoline models	120 (260)		150 (330)			
Diesel models	180 (400)		260 (570)			
Power train Engine, transmission (excl. reduction gear & differential)						
Gasoline models	280 (620)		290 (640)			
Diesel models	350 (770)		395 (870)			
Overhead guard	60 (130)					
Rear axle	182 (402)		210 (464)		220 (486)	
Mast (3 m Simplex mast)	505 (1110)		680 (1450)		830 (1830)	870 (1920)
Outer mast	155 (340)		220 (485)		240 (530)	250 (550)
Inner mast	130 (290)		170 (375)		180 (400)	190 (420)
Lift bracket (incl. backrest)	90 (200)		130 (290)		160 (350)	165 (360)
Forks (two)	80 (180)		100 (220)	130 (290)	165 (360)	
Lift cylinder and related parts	50 (110)		60 (130)		85 (190)	100 (220)
Mast (3.3 m Duplex mast)	550 (1210)		690 (1520)	720 (1585)	870 (1915)	905 (1995)
Mast (4.8 m Triplex mast)	720 (1585)		955 (2105)	985 (2170)	1135 (2500)	1180 (2600)

Check	For (item or defect)	How
<p>Antifriction bearings</p>	<p>k) Bad discoloration (caused by overheating due to poor lubrication)</p>  <p>l) Craters (caused by passage of electric current)</p> 	<p>Visually.</p> <p>Visually.</p>
<p>Bushings or sleeve bearings</p>	<p>This item — Fit on shaft</p> <p>These defects — Nicks, burrs or other flaws on bearing surface</p>	<p>Determine by measuring inside diameter of bushing and outside diameter of shaft.</p> <p>Hold bushing toward a light and sight through bore.</p>
<p>Fasteners</p>	<p>These defects —</p> <p>a) Stripped or otherwise damaged threads (bolts, nuts, screws, etc.)</p> <p>b) Distortion or loss of tension (spring lock washers, snap rings, etc.)</p>	<p>Visually.</p> <p>Examine by compressing.</p>
<p>Gears</p>	<p>These items —</p> <p>a) Fit on bearing, bushing, spline or key</p> <p>b) Backlash</p> <p>These defects —</p> <p>a) Excessive wear on teeth, thrust faces and end faces of hub</p> <p>b) Scratching wear (caused by large particles than those associated with abrasive wear)</p> 	<p>As stated in service manual</p> <p>As stated in service manual</p> <p>Visually.</p> <p>Visually.</p>

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## BACK BUZZER KIT

### Description

The back buzzer works when the truck is driven backward to give a warning.

### Installation

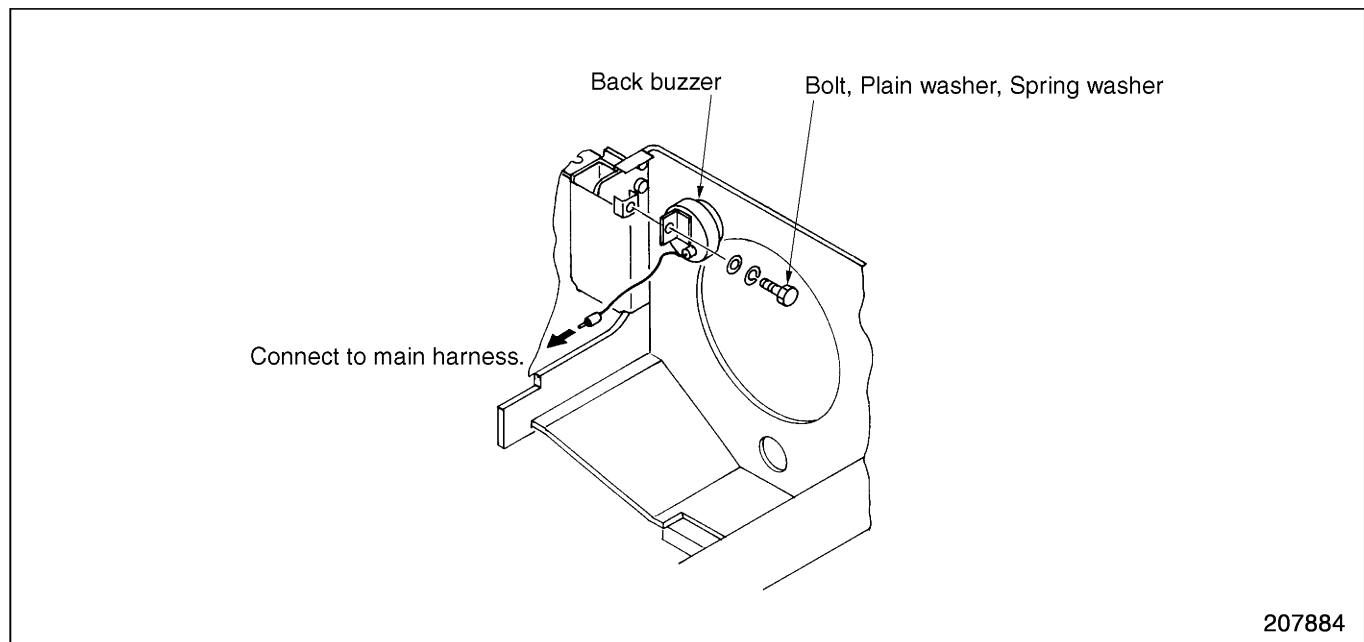
Install the back buzzer on the right-hand side of the rear cross member inside the engine compartment. (Threaded hole is provided.)

#### NOTE

The rated voltage of the back buzzer is identified by the wire color.

12 volt: Red

24 volt: Pink



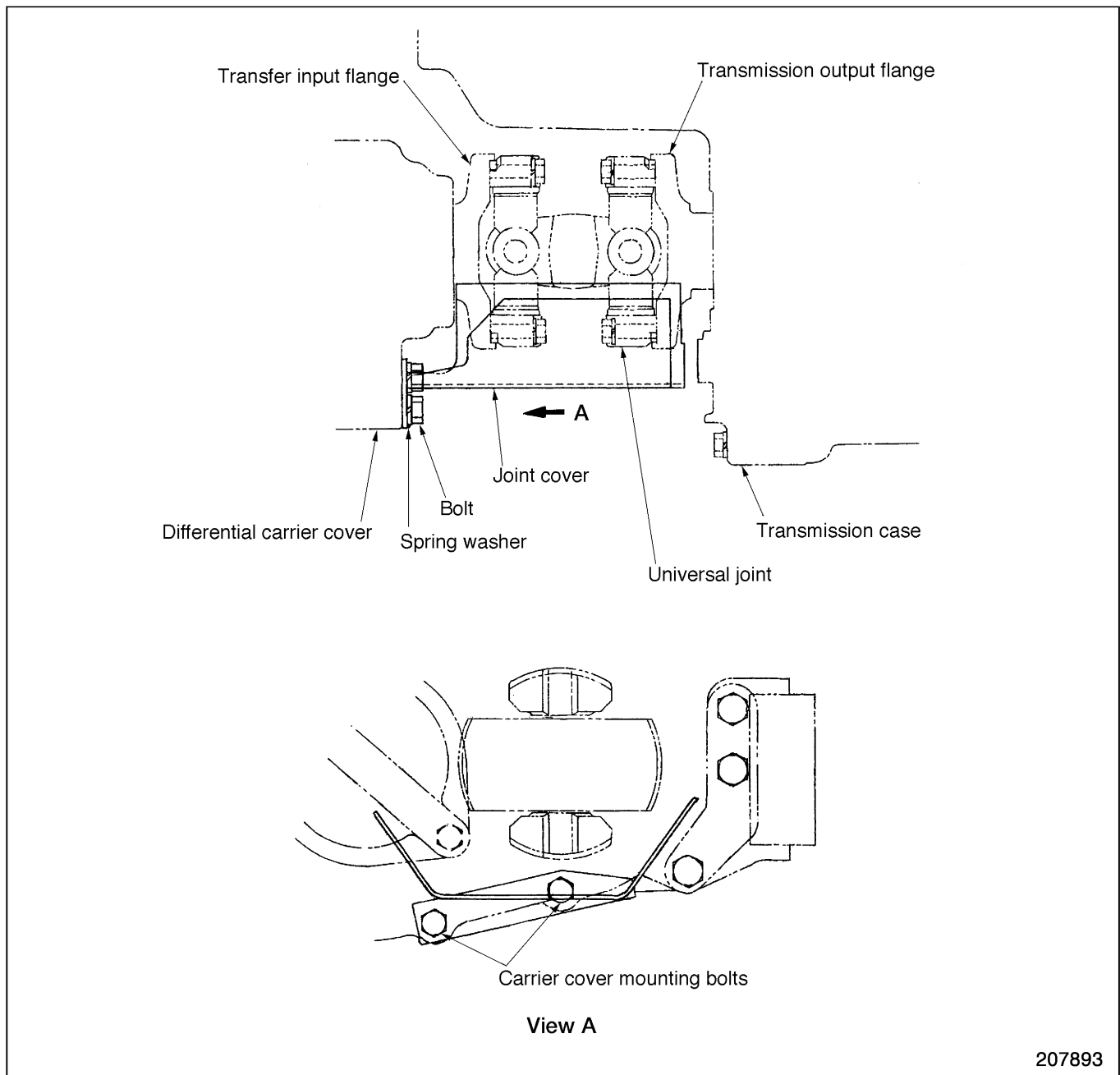
# JOINT COVER KIT

## Description

The joint cover minimizes entanglements of strings or the like around the universal joints and the transmission output flange.

## Installation

- (1) Remove the two carrier cover mounting bolts.
- (2) Install the joint cover using the bolts (F1035-10060) and the spring washers (F2512-10000) furnished, not with the removed bolts.



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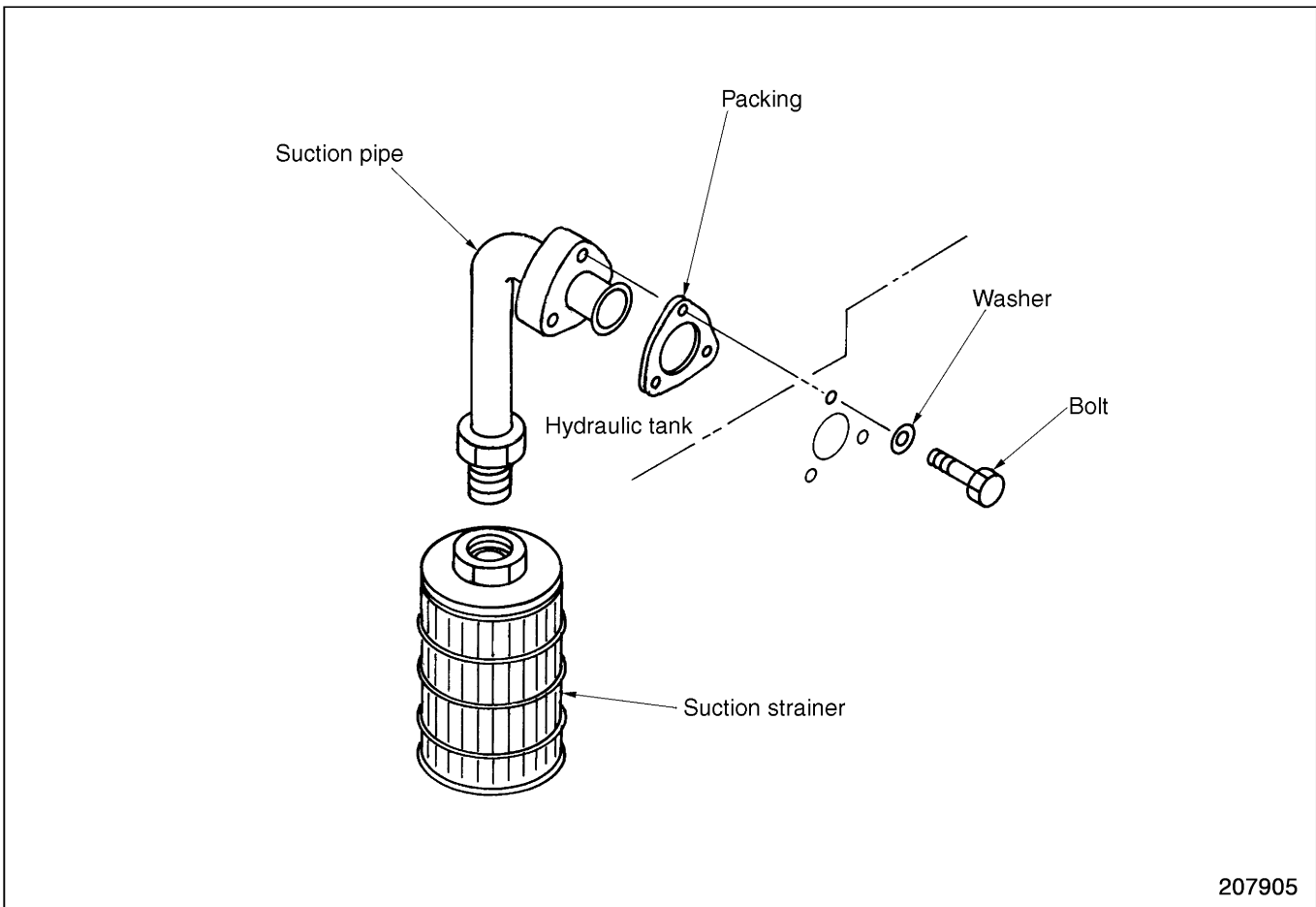
## SUCTION FILTER KIT

### Description

The kit protects the gear pump, etc. against premature wear due to foreign substances in the hydraulic oil, enhancing the reliability and the durability of the hydraulic system.

### Installation

Install this optional kit in place of the standard filter assembly.



Unit: mm (in.)

Group	Inspection Point		Nominal value	Assembly standard (standard clearance)	Repair limit (clearance)	Service limit (clearance)	Remarks	
Cylinder head	Valves	Valve sinkage	4DQ7	0.8 (0.031)	0.6 to 1.0 (0.024 to 0.039)	1.3 (0.051)	-	
			S4S	Inlet valves	0.4 (0.016)	0.2 to 0.6 (0.008 to 0.024)		1.0 (0.039)
		Exhaust valves		0.5 (0.020)	0.3 to 0.7 (0.012 to 0.028)			
		Squareness (face runout) of valve face		-	0.03 (0.0012), maximum	-		-
	Height to top of valve guide		4DQ7	18 (0.71)	17.6 to 18.3 (0.697 to 0.720)	-	-	-
			S4S	14 (0.55)	13.9 to 14.1 (0.547 to 0.562)	-	-	
	Valve seat	Angle	-	30°	-	-	-	-
		Width	4DQ7	1.2 (0.047)	1.0 to 1.4 (0.039 to 0.055)	1.6 (0.063)	-	-
			S4S	1.4 (0.055)	1.26 to 1.54 (0.050 to 0.061)	1.8 (0.071)	-	-
	Valve spring	Free length	-	48.85 (1.92)	-	-	47.60 (1.87)	-
		Test force/length under test force, kgf (lbf) [N]/mm (in.)	-	-	18 to 20 (40 to 44) [177 to 196]/ 43 (1.69)	-	15 (33) [147]/ 44 (1.73)	-
		Squareness	-	-	1.5°, maximum	-	-	-
	Valve clearance			0.25 (0.0098)	-	-	-	Cold
	Rocker	Inside diameter of rocker bushing	4DQ7	18 (0.71)	18.000 to 18.061 (0.70866 to 0.71106)	-	-	-
			S4S	19 (0.75)	19.010 to 19.030 (0.74842 to 0.74921)	-	-	
		Diameter of rocker shaft	4DQ7	18 (0.71)	17.966 to 17.984 (0.70732 to 0.70803)	-	-	-
			S4S	19 (0.75)	18.980 to 19.000 (0.74724 to 0.74803)	-	-	
		Clearance of bushing on shaft	4DQ7	-	0.016 to 0.077 (0.00063 to 0.00303)	0.10 (0.0039)	-	If repair limit is reached, replace bushings. If it is exceeded, replace shafts.
			S4S	-	0.010 to 0.050 (0.00039 to 0.00197)	0.07 (0.0028)	-	
	Main moving parts	Pushrod	Runout (bend)	4DQ7	-	0.4 (0.016), maximum	-	Runout measured with pushrod supported at centerlines of its spherical ends.
S4S				-	0.3 (0.012), maximum	-		

2.5 Tightening torques for major components

Unit: Kgf·m (lbf·ft) [N·m]

<p>Rocker shaft bracket bolts  <math>1.5 \pm 0.5</math>  <math>(11 \pm 3.6)</math>  <math>[15 \pm 5]</math></p> <p>Crankshaft pulley nut          4DQ7: <math>40 \pm 1</math>  <math>(289 \pm 7)</math>  <math>[392 \pm 10]</math></p> <p>S4S: <math>50 \pm 1</math>  <math>(362 \pm 7)</math>  <math>[490 \pm 10]</math></p> <p>Timing gear case bolts          4DQ7: <math>1.0 \pm 0.5</math>  <math>(7 \pm 3.6)</math>  <math>[10 \pm 5]</math></p> <p>S4S: <math>1.0</math> to <math>1.3</math>  <math>(7</math> to <math>9)</math>  <math>[10</math> to <math>13]</math></p>	<p>Cylinder head bolts  <math>12.0 \pm 0.5</math>  <math>(87 \pm 3.6)</math>  <math>[118 \pm 5]</math></p> <p>Flywheel bolts  <math>8.5 \pm 0.5</math>  <math>(61 \pm 3.6)</math>  <math>[83 \pm 5]</math></p>	<p>405725</p>
<p>Connecting rod cap bolts  <math>5.5 \pm 0.5</math>  <math>(40 \pm 3.6)</math>  <math>[54 \pm 5]</math></p>	<p>Main bearing cap bolts          4DQ7: <math>8.5 \pm 0.5</math>  <math>(61 \pm 3.6)</math>  <math>[83 \pm 5]</math></p> <p>S4S: <math>10.5 \pm 0.5</math>  <math>(76 \pm 3.6)</math>  <math>[103 \pm 5]</math></p>	<p>Oil pan bolts          4DQ7: <math>0.7</math> (5) [7]</p> <p>S4S: <math>1.0</math> to <math>1.3</math>  <math>(7</math> to <math>9)</math>  <math>[10</math> to <math>13]</math></p> <p>Oil drain plug  <math>4 \pm 0.5</math>  <math>(29 \pm 3.6)</math>  <math>[39 \pm 5]</math></p> <p>405726</p>

1.2 Inspection and repair

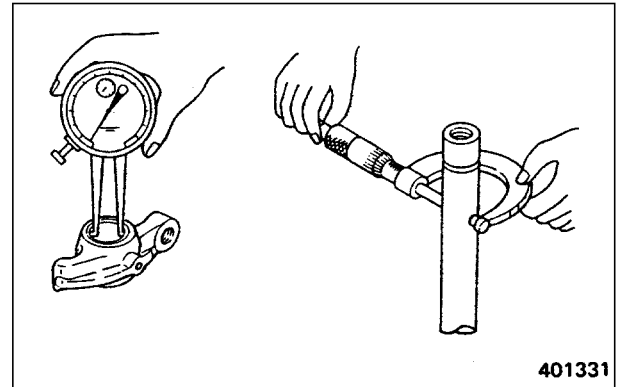
Rocker arms, rocker bushings and rocker shafts (4DQ7) or shaft (S4S)

(1) Measuring inside diameter of rocker bushing and diameter of rocker shaft

Compute the clearance of the bushing on the shaft on the basis of the measurements. If the repair limit is reached, replace the bushing. If it is exceeded, replace both bushing and shaft.

Unit: mm (in.)

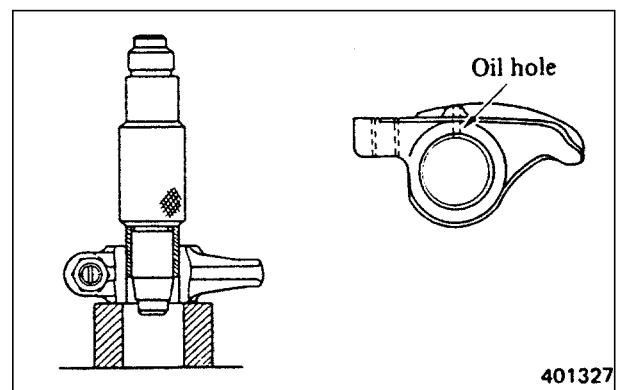
Item		Nominal value	Assembly standard	Repair limit
Inside diameter of rocker bushing	4DQ7	18 (0.71)	18.000 to 18.061 (0.70866 to 0.71106)	-
	S4S	19 (0.75)	19.010 to 19.030 (0.74842 to 0.74921)	-
Diameter of rocker shaft	4DQ7	18 (0.71)	17.966 to 17.984 (0.70732 to 0.70803)	-
	S4S	19 (0.75)	18.980 to 19.000 (0.74724 to 0.74803)	-
Clearance of rocker bushing on shaft	4DQ7	-	0.016 to 0.077 (0.00063 to 0.00303)	0.10 (0.0039)
	S4S	-	0.010 to 0.050 (0.00039 to 0.00197)	0.07 (0.0028)



Measuring rocker bushing and rocker shaft

(2) Replacing rocker bushings

When installing a replacement bushing, align the oil holes in the bushing and rocker arm.



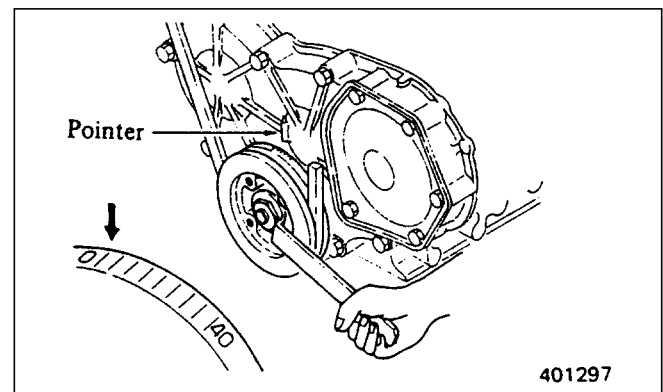
Replacing rocker bushing

## (1) Inspecting valve clearance

- (a) Check the valve clearance by the firing order, by turning the crankshaft by the specified crank angle in normal direction at a time to bring the piston to its top dead center on compression stroke.

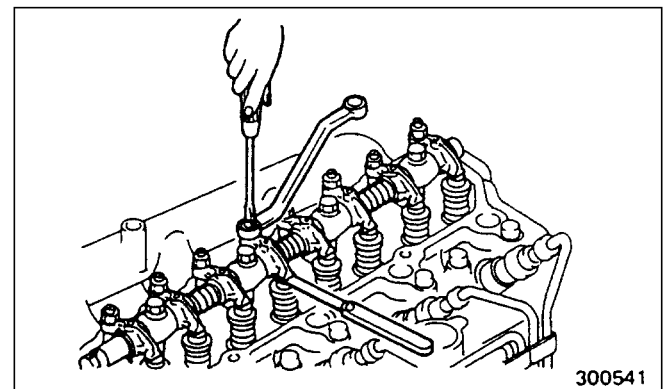
Firing order	Crank angle
1-3-4-2	180°

- (b) The top dead center on compression stroke of the piston is identified by the timing mark "0" (on the crankshaft pulley) being aligned with the pointer on the gear case. with the piston so located, the inlet and exhaust valve rocker arms are not being pushed up by their pushrods.
- (c) Insert a feeler gauge into between the rocker arm and valve cap, and check the valve clearance.



## (2) Adjusting valve clearance

- (a) Loosen the lock nut for adjusting screw on the rocker arm, and adjust the clearance by turning the screw in either direction to the extent that the gauge is slightly gripped between the rocker arm and valve cap.
- (b) After adjusting the clearance, tighten the lock nut, and again check the clearance, making sure that it is correct.

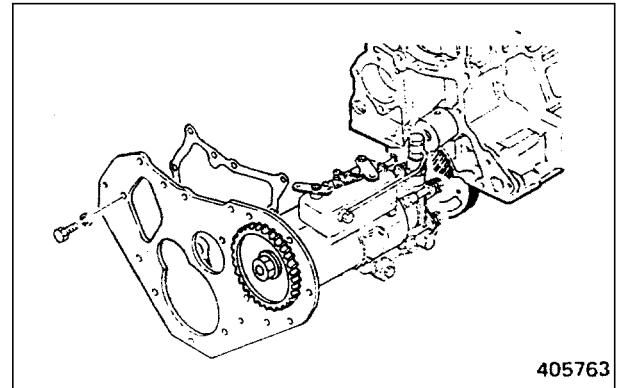


## 2.3 Reassembly

Follow the reverse of disassembly sequence.

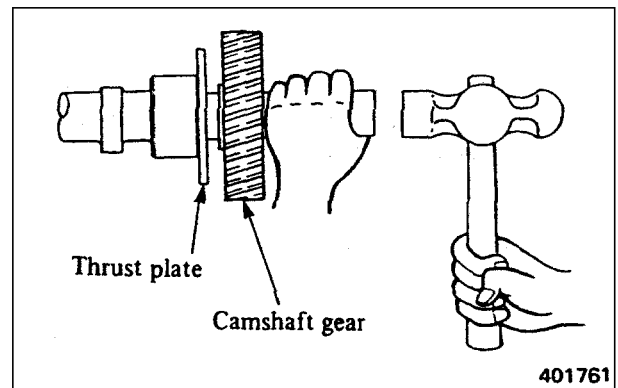
### (1) Installing front plate

- (a) Temporarily install the injection pump to the front plate.
- (b) Install the front plate to the crankcase together with packing.



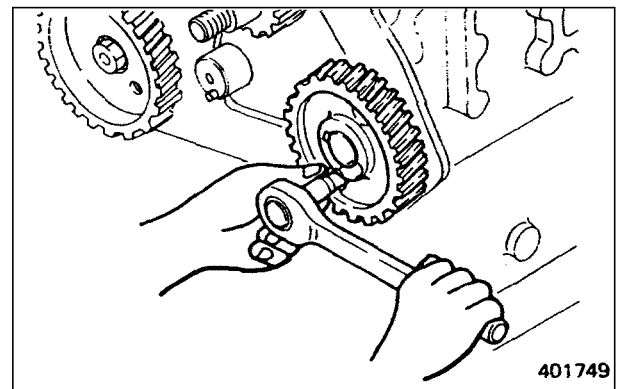
### (2) Installing camshaft gear and thrust plate

Put the thrust plate in position before installing the gear.



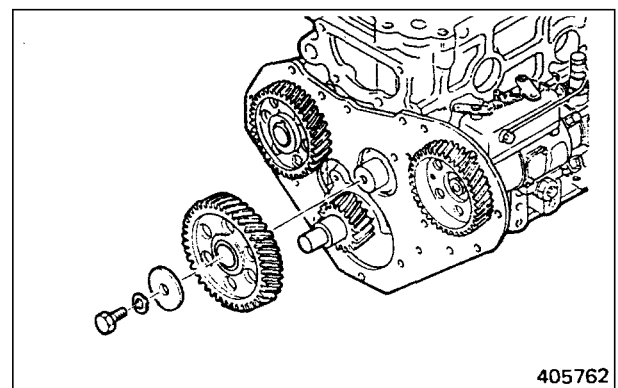
### (3) Installing camshaft

- (a) Carefully put the camshaft in the crankcase.
- (b) Tighten the thrust plate bolts to  $1.8 \pm 0.5$  kgf·m ( $13 \pm 4$  lbf·ft) [ $18 \pm 5$  N·m] (4DQ7) or  $1.0$  to  $1.3$  kgf·m (7 to 9 lbf·ft) [ $10$  to  $13$  N·m] (S4S).



### (4) Installing idle gear

- (a) Install the idle gear by aligning its mark with those on the mating gears.
- (b) Tighten the thrust plate bolts to  $3.5 \pm 0.5$  kgf·m ( $25 \pm 4$  lbf·ft) [ $34 \pm 5$  N·m].



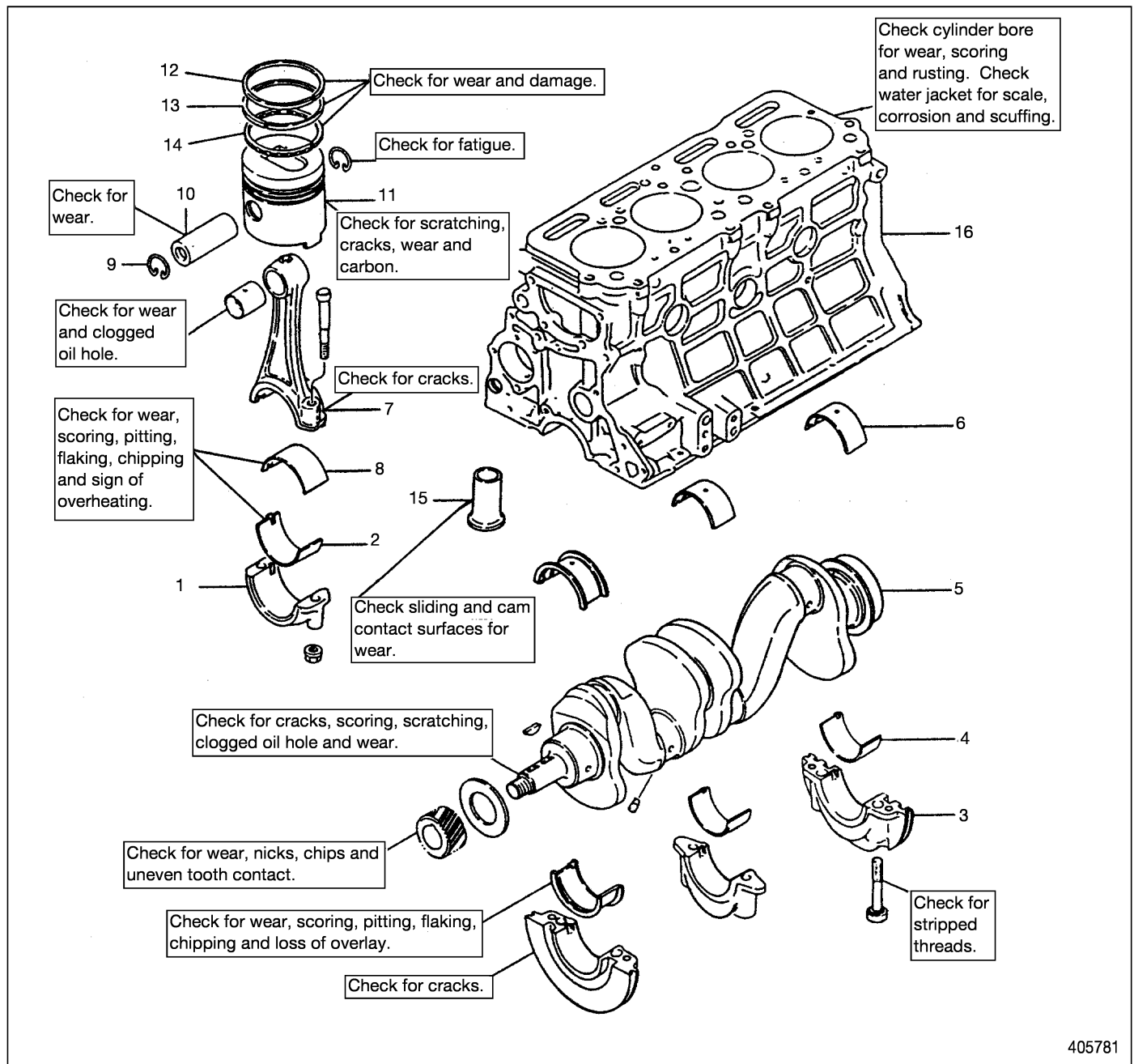
### NOTE

On the S4S engine, be sure to install the oil pump before installing the idle gear.

4. PISTONS, CONNECTING RODS, CRANKSHAFT AND CRANKCASE

4.1 Disassembly

[4DQ7]



405781

- |                          |                          |                |
|--------------------------|--------------------------|----------------|
| 1 Connecting rod cap     | 7 Connecting rod         | 13 Second ring |
| 2 Connecting rod bearing | 8 Connecting rod bearing | 14 Oil ring    |
| 3 Main bearing cap       | 9 Snap ring              | 15 Tappet      |
| 4 Main bearing           | 10 Piston pin            | 16 Crankcase   |
| 5 Crankshaft             | 11 Piston                |                |
| 6 Main bearing           | 12 Top ring              |                |

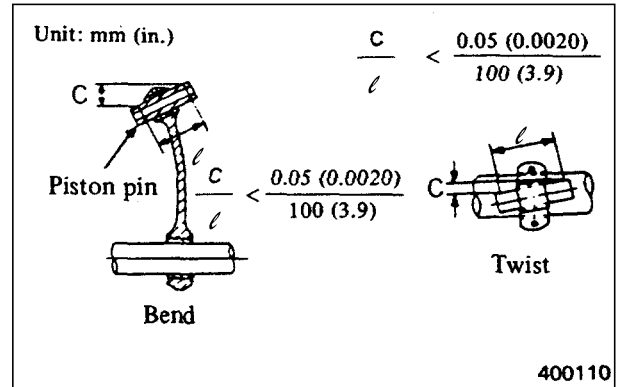
**NOTE**

When replacing the crankcase, carefully remove reusable parts (such as a relief valve) from a crankcase to be discarded.

(4) Inspecting connecting rods for bend and twist

- (a) Measure "C" and "l" If the measurement at "C" is larger than 0.05 mm (0.0020 in.) (4DQ7) or 0.10 mm (0.0039 in.) (S4S) per 100 mm (3.9 in.) of "l," straighten the rod with a press.

Item		Assembly standard	Repair limit
Connecting rod bend and twist	4DQ7	0.05/100 (0.0020/3.9), maximum	0.15 (0.0059)
	S4S	0.10/100 (0.0039/3.9), maximum	



Inspecting connecting rod

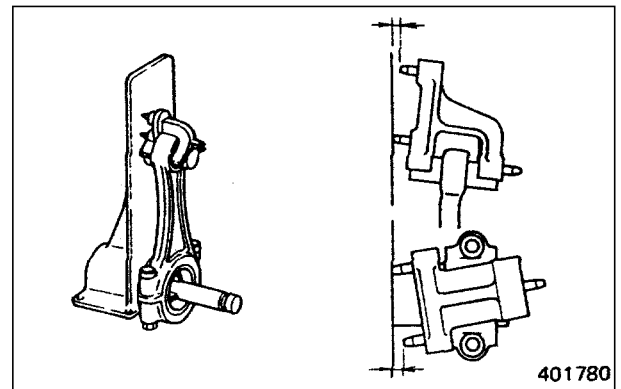
Unit: mm (in.)

- (b) For inspecting connecting rod for bend and twist, the connecting rod aligner is generally

used.

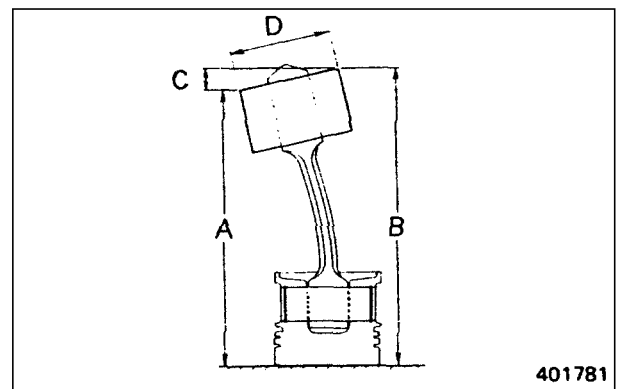
**NOTE**

To check for bend, install the bearing cap to the connecting rod, and tighten the cap bolts to  $5.5 \pm 0.5 \text{ kgf}\cdot\text{m}$  ( $40 \pm 4 \text{ lbf}\cdot\text{ft}$ ) [ $54 \pm 5 \text{ N}\cdot\text{m}$ ].



Checking connecting rod on aligner

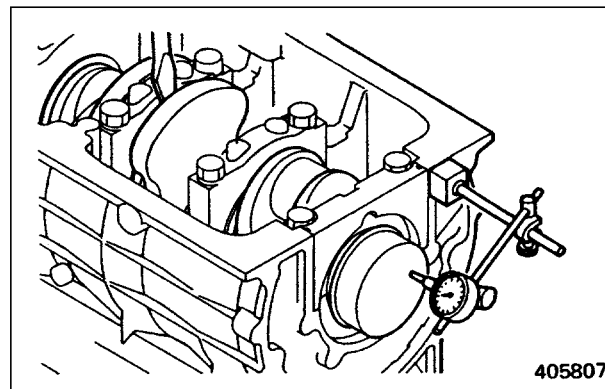
- (c) To check the rod installed to the piston, place the piston on a surface plate, insert a round bar equal to the crankpin in diameter into the big end



Inspecting connecting rod installed to piston

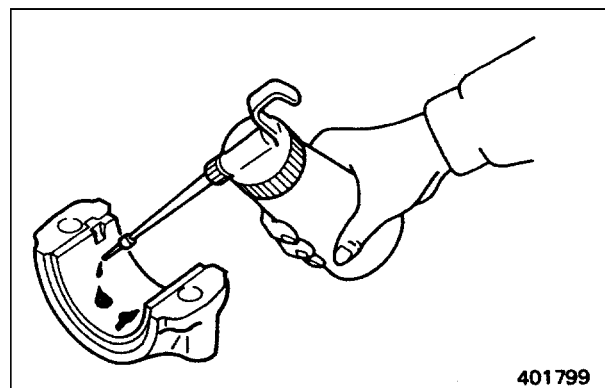
## (10) Measuring end play of crankshaft

Measure the end play of the crankshaft. If the end play is out of the assembly standard, replace the main bearings with thrust plates.



## (11) Installing connecting rod caps

- (a) Put the lower shell of the connecting rod bearings in the cap by fitting its locking lip in the groove of the cap, and apply engine oil to the inside surface of the shell.
- (b) Put the cap in place, and tighten the cap nuts to  $5.5 \pm 0.5$  kgf·m ( $40 \pm 4$  lbf·ft) [ $54 \pm 5$  N·m].

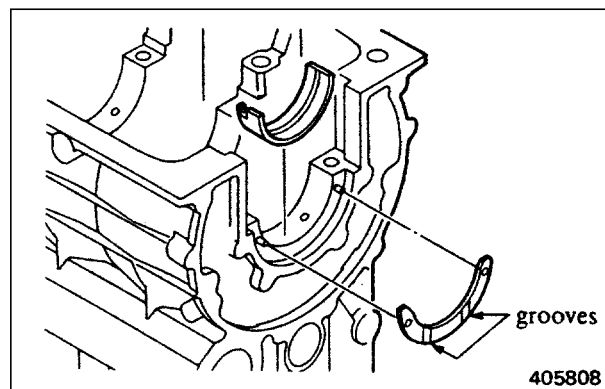
**CAUTION**

Make sure the matching marks of the cap and rod are on the same side.

[S4S]

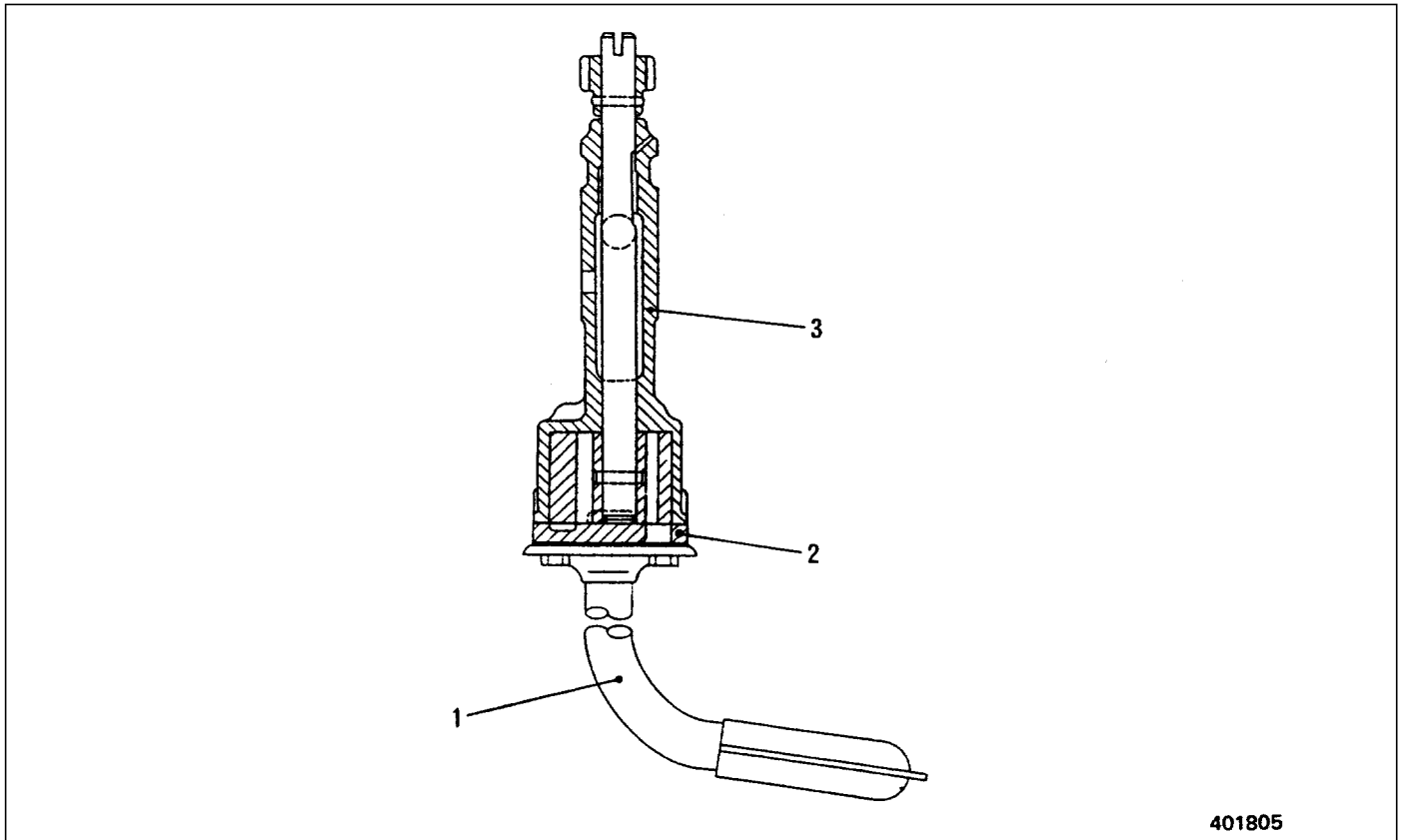
## (3) Installing main bearings

- (a) Install each upper shell in the crankcase by fitting its locking lip in the groove. The oil holes in the shell and crankcase will be aligned when the shell is so installed.
- (b) Apply a thin coat of engine oil to the inside surface of each shell.
- (c) Install the thrust plate to the rear face of crankcase with its oil groove facing outside.



## 2.3 Reassembly

[4DQ7]

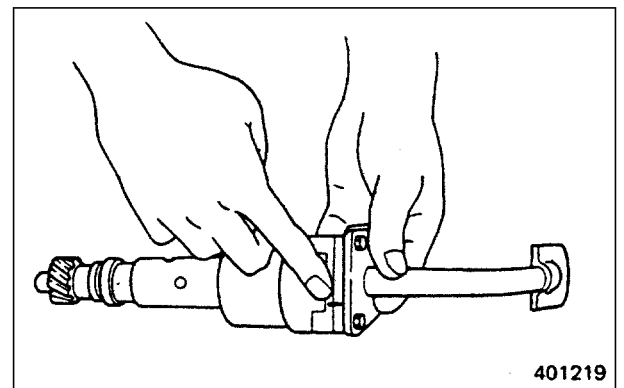


Reassembly sequence

3 → 2 → 1

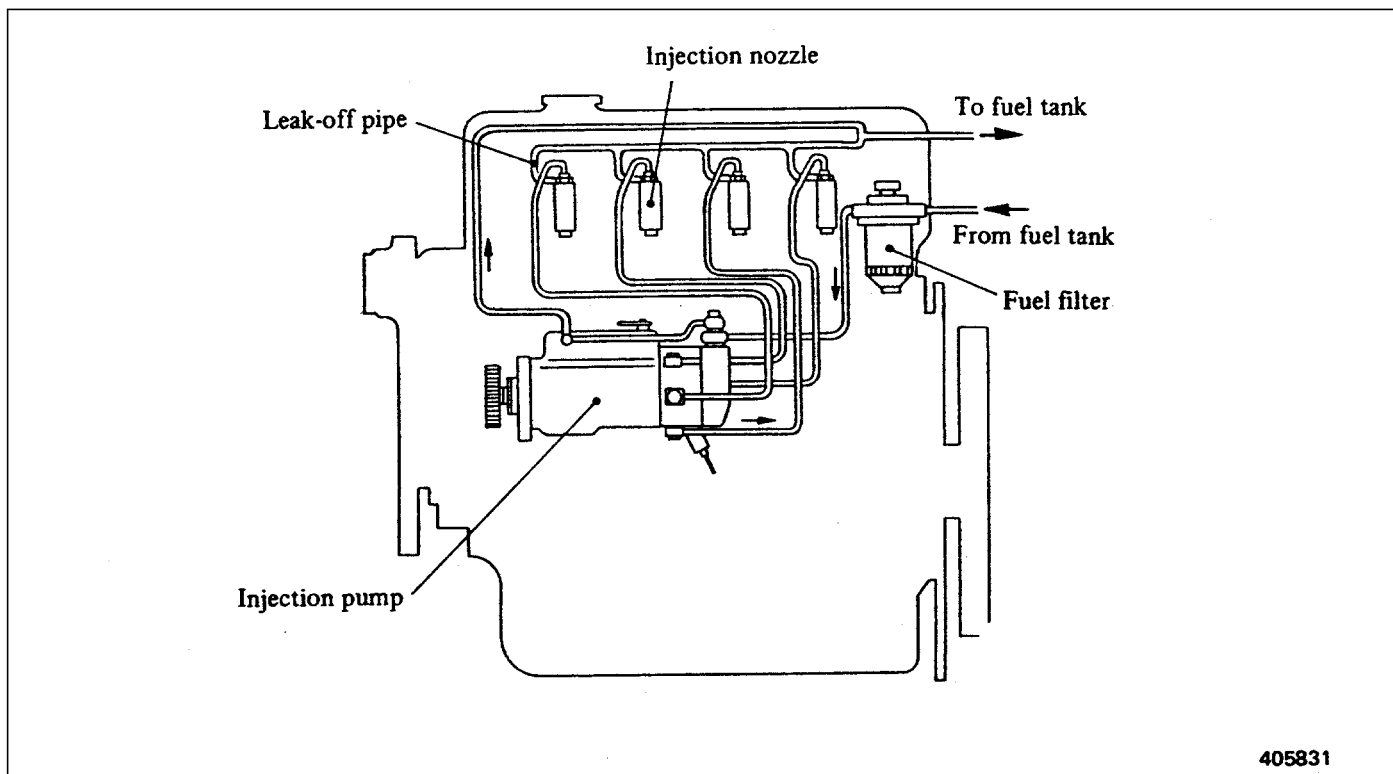
**NOTE**

Put the outer rotor in the pump case and, after making sure the matching marks on the case and cover are aligned, tighten the bolts. If the matching marks are not aligned, the oil will not be pumped.



Matching marks on pump case and cover

1. DESCRIPTION



**⚠ WARNING**

Fuel injection lines which are bent, damaged or rubbing can leak and cause a fire. Replace any lines which have damage or leaks that cannot be corrected when tightened to the correct torque.

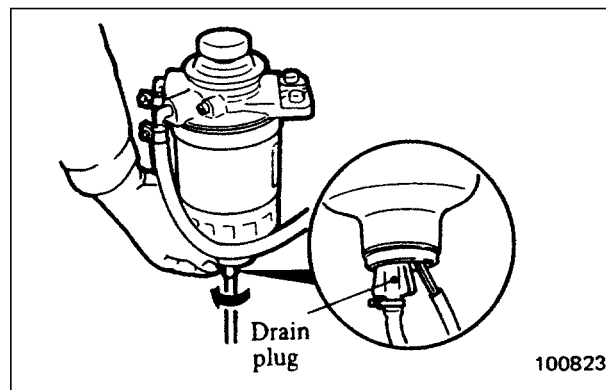
**⚠ WARNING**

When any type of service work is to be done on the fuel system, move the truck to a safe and clean work area. Be sure there is no active smoking materials in the area. Do not let fuel get on a hot engine or electrical components. Do not let fuel spray on the skin or in the eyes.

1.1 Draining (distributor type injection pump)

The fuel filter collects water and sediment that may be in the fuel. To remove the collected water and sediment, proceed as follows:

- (1) Loosen the drain plug at the bottom of the fuel filter.



### 4.3 Adjusting injection timing

The injection timing varies according to the model of the engine. Be sure to verify the timing of your engine before attempting to make an adjustment.

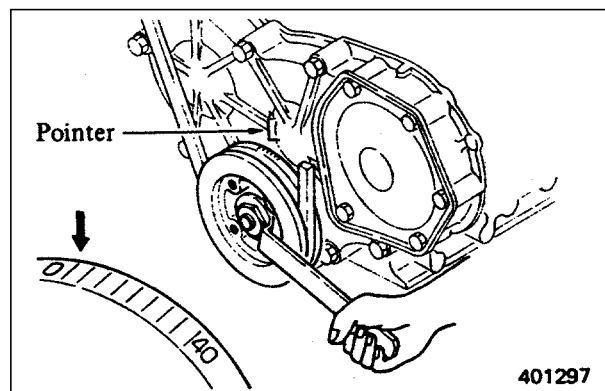
4DQ7	18° B.T.D.C.
S4S	20° B.T.D.C.

“B.T.D.C.” signifies “before top dead center on compression stroke.”

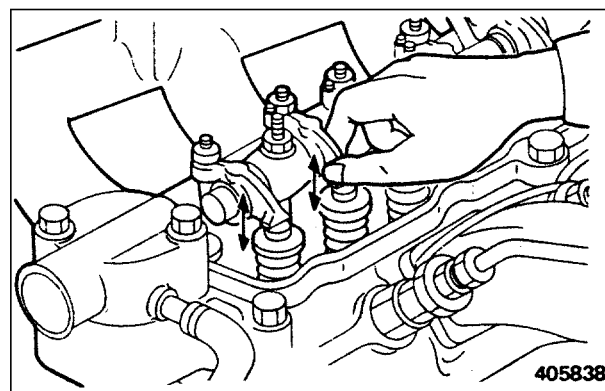
- (1) Bringing No. 1 cylinder piston to top dead center on compression stroke

**⚠ WARNING**

**Always adjust valves with engine stopped to avoid personal injury. Turn the engine by hand and not by use of the starter. Disconnect the battery.**



- (a) Put turning handle (30691-21800 for 4DQ7) or turning socket (58309-73100 for S4S) on the crankshaft pulley nut, and turn the crankshaft in normal direction (clockwise as seen from the front side of the engine).
- (b) Stop turning the crankshaft when the timing mark on the crankshaft pulley is aligned with the pointer of the timing gear case.
- (c) Attempt to move the inlet and exhaust valve rocker arms for the No. 1 cylinder up and down to make sure they are not being pushed up by their pushrods. With the piston at top dead center on compression stroke, the inlet and exhaust rocker arms are not being pushed up. If these rocker arms are being pushed up, turn the crankshaft once again.



## (3) Magnetic switch

## (a) Testing coil for open circuits

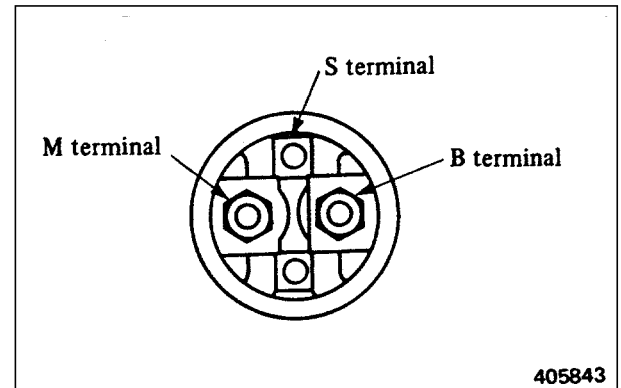
If there is no continuity between S and M terminals and between S terminal and body (ground), replace the switch.

## (b) Checking contactors for fusion

If there is continuity between B and M terminals, replace the switch.

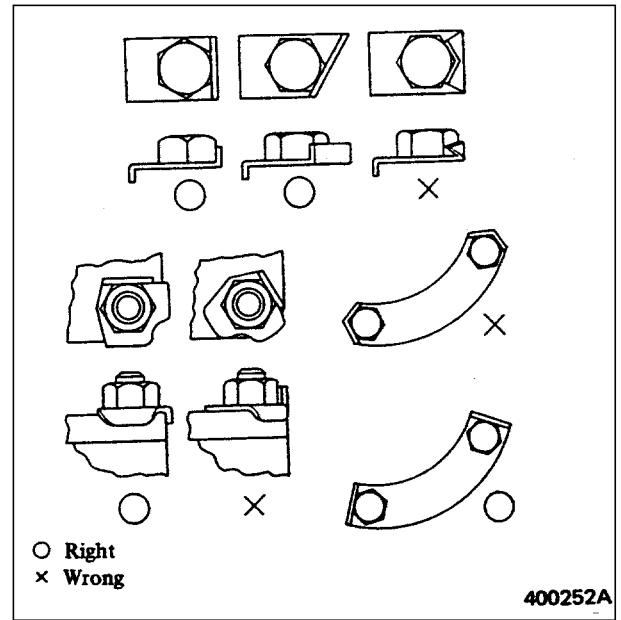
## (c) Checking contactors for poor contact

Check for voltage drop. If voltage drop is excessive, the contactors are defective.



1.4 Lock plates

Bend lock plate against one of the flats of nut or bolt head as shown.



Bending lock plates

1.5 Split pins and spring pins

Generally, split pins are to be replaced and bent properly at the time of disassembly. Drive each spring pin into position so that it may not get out of place after subsequent installation of parts has been completed.

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