



Service Manual

Chassis & Mast

MC

FG20S CF54-10011-up
FG25S CF54-50011-up
FG30S CF55-10011-up

FD20HS CF50-10011-up
FD25HS CF50-50011-up
FD30HS CF51-10011-up

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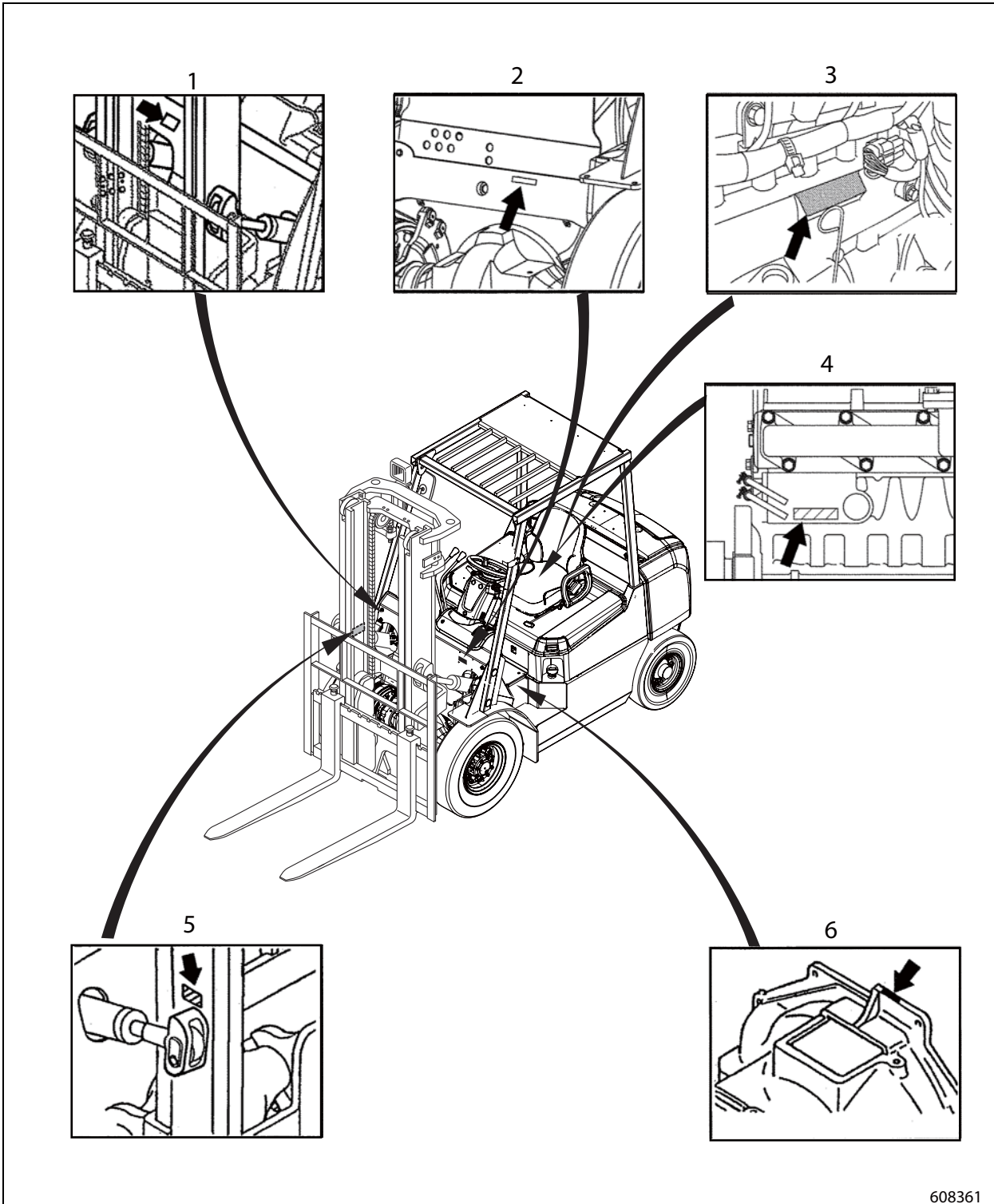
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3. Serial Number Locations



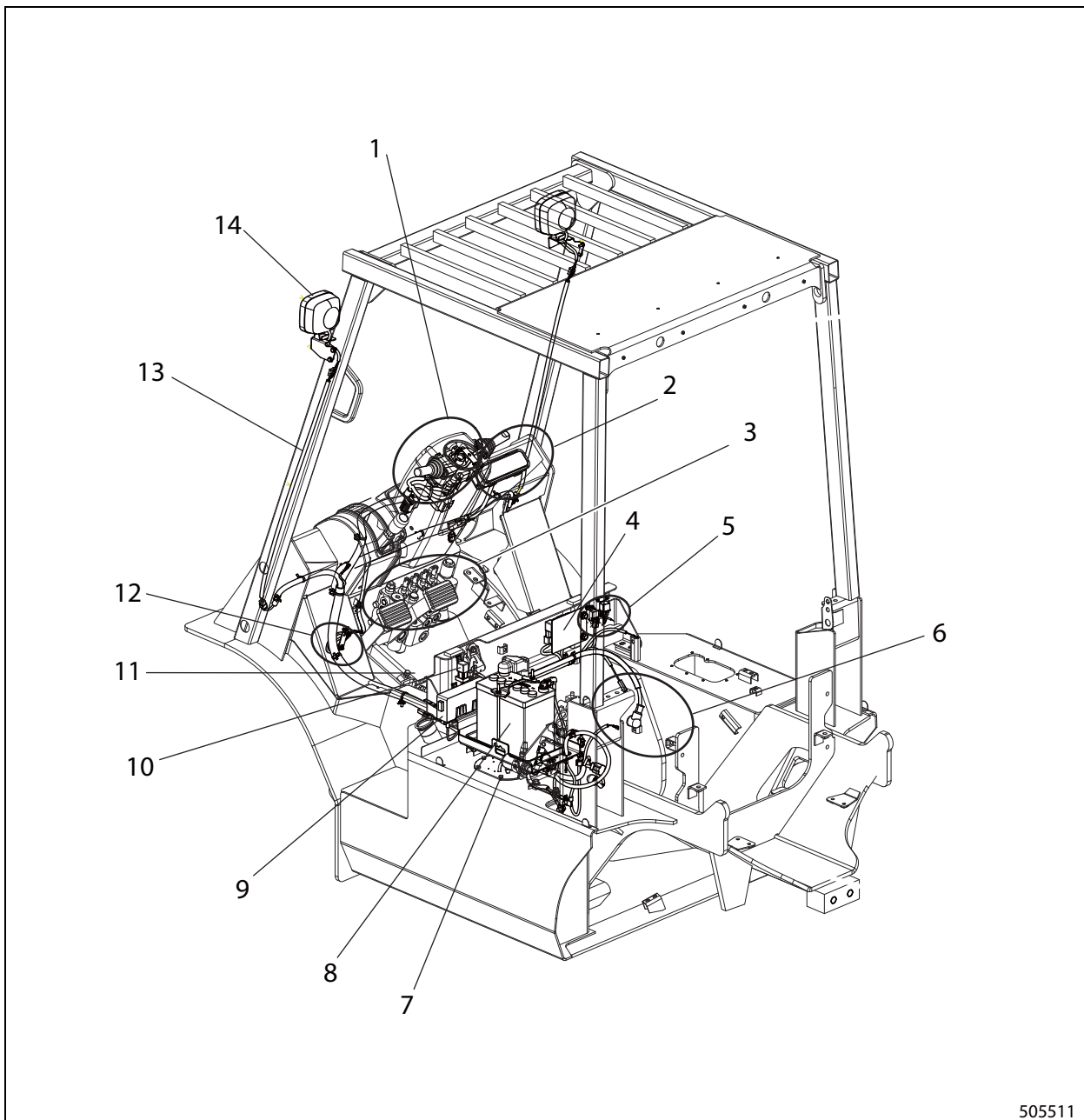
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- | | |
|--|--|
| 1. Name plate | 4. Engine number (Diesel model, S4S) |
| 2. Chassis number | 5. Mast number |
| 3. Engine number (Gasoline model, K25) | 6. Transmission serial number (Powershift) |

Chapter 3 ELECTRICAL SYSTEM

1. Electrical Components and Wiring Outline

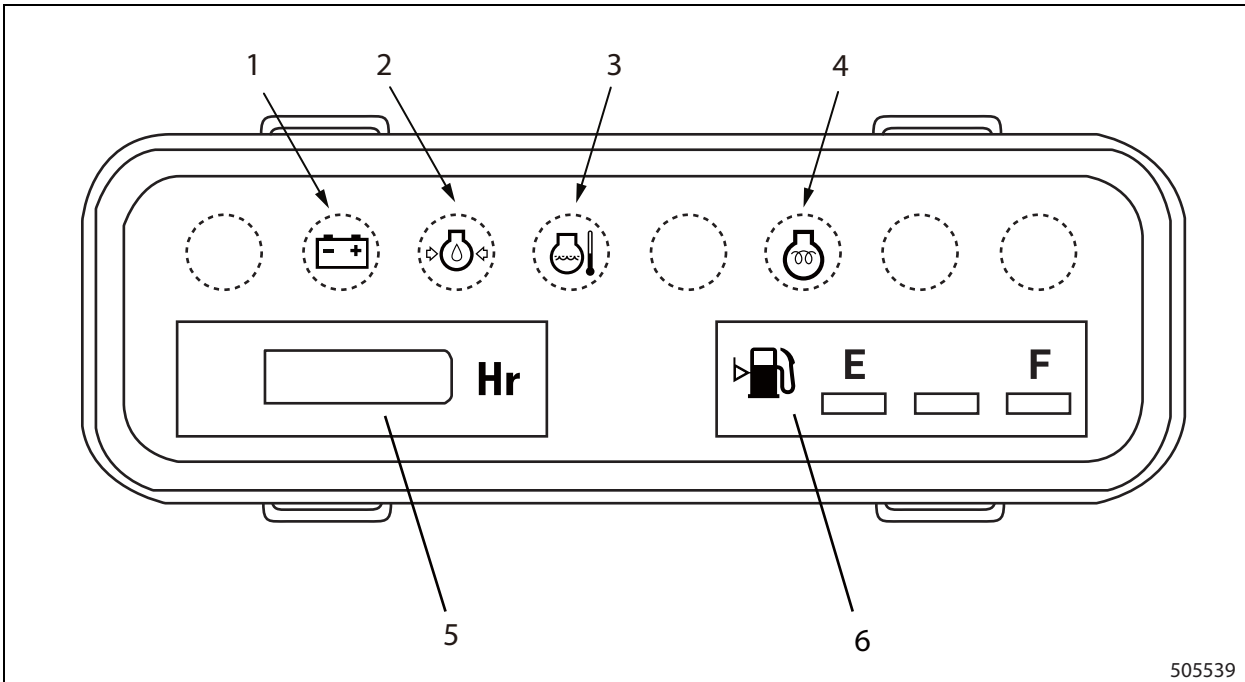
1.1 Locations of Electrical Components



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|-------------------------------------|-------------------------------|
| 1. Console box | 9. Fuse |
| 2. Meter panel | 10. T/M solenoid relay |
| 3. Control valve | 11. Stop light switch |
| 4. Relay (IGN relay, Starter relay) | 12. Horn |
| 5. Glow | 13. Front combination harness |
| 6. Engine | 14. Head light |
| 7. Tank unit | |
| 8. Battery | |

3.4 Warning Lamps and Indicators



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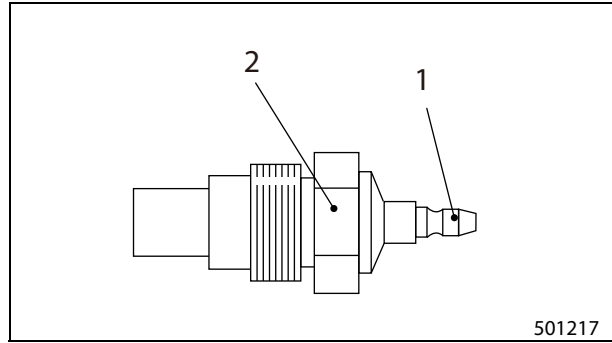
- 1. Battery charge warning light
- 2. Engine oil pressure warning light
- 3. Water temperature warning light
- 4. Glow light (Diesel model)
- 5. Hour meter
- 6. Fuel gauge

indicator light	Name	Color	Glow (ON/OFF) condition	Applicable model
	Battery charge warning light	Red	Charge is not working properly. (ON) The engine is not running. (ON)	All models (Standard)
	Engine oil pressure warning light	Red	Oil pressure switch is closed (ON) Engine is not running (ON)	All models (Standard)
	Water temperature warning light	Red	Resistance value is 11.4 ohm or less (ON) The value is 13.8 ohm or more (OFF)	Diesel model (Standard)
			Resistance value is 17.4 ohm or less (ON) The value is 21.4 ohm or more (OFF)	G/L dual model (Standard)
	Glow light	Orange	Glow timer relay is closed (ON)	Diesel model (Standard)

4.10 Thermostitch (Engine Coolant Temperature)

- (1) Apply an ohmmeter between the terminal and body of the sender unit and check for continuity (resistance value).
- (2) Replace the sender unit if there is no continuity or the measured resistance value is outside the standard resistance value.

Note: The illustration is for a dual Gas/LPG model.



1. Terminal

2. Body

Dual Gas/LPG model

Temperature [°C (°F)]	50 (122)	70 (158)	100 (212)	110 (230)	120 (248)
Standard resistance (ohm)	1.36	66	27.2	20.5	17.2

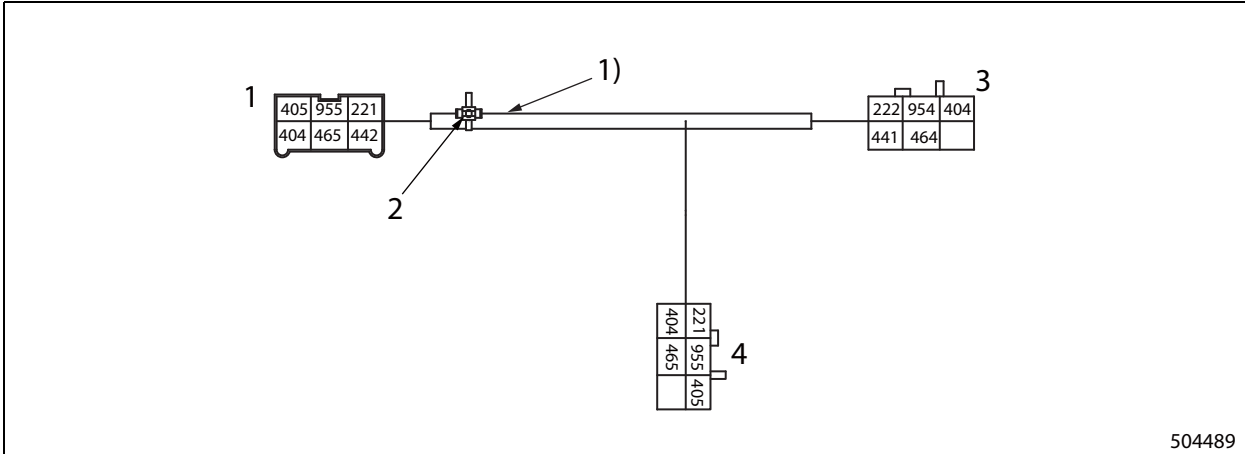
Diesel model

Temperature [°C (°F)]	50 (122)	60 (140)	80 (176)	100 (217)	106 (223)	120 (248)
Standard resistance (ohm)	80	56.3	29.5	16.5	14.3	10

- (3) When installing the thermostitch, tighten to the specified torque.

Tightening torque
19.6 to 27.4 N·m (2.0 to 2.8 kgf·m) [14.5 to 20.2 lbf·ft]

4.17 Rear Combination Harness (Option)



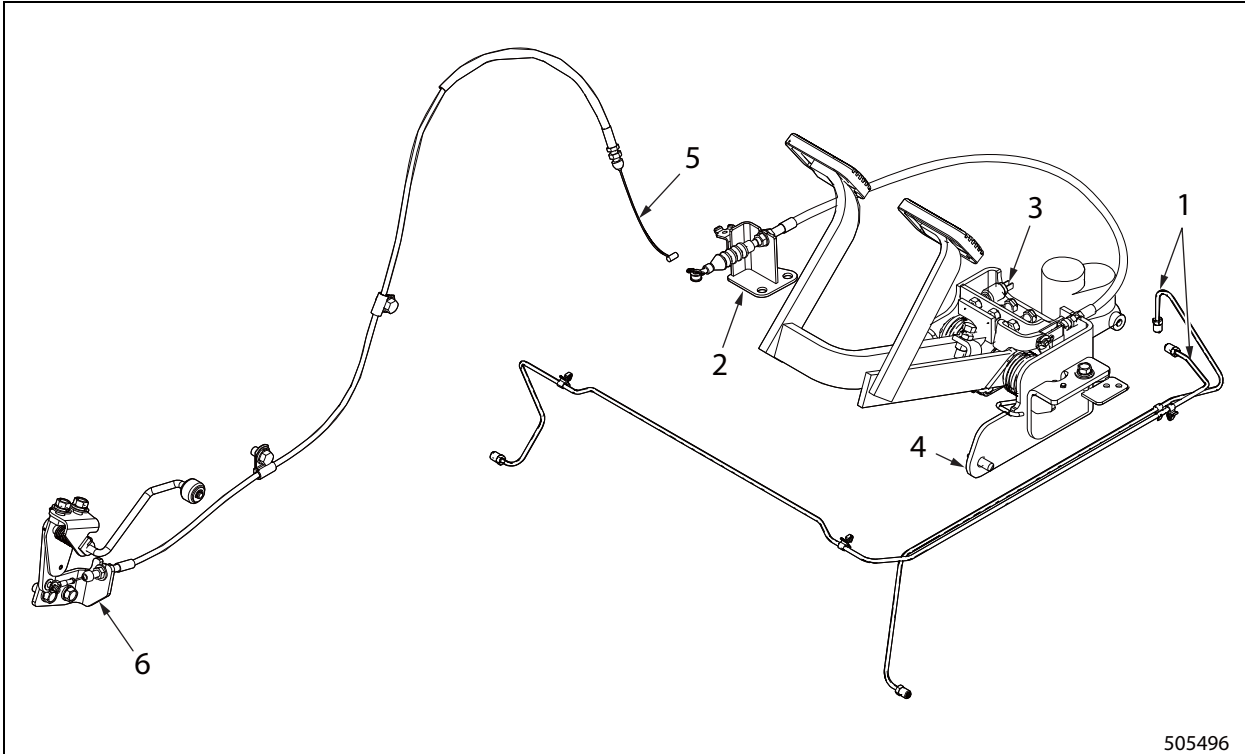
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- 1. Harness
- 2. Clip
- 3. Rear combination light (R.H.)
- 4. Rear combination light (L.H.)
- 1) Protect with corrugated tube

Note: Use AVS, CAVS or AVSS as the power source.

Circuit	Wire diameter	Wire color code	Destination
955	0.85	B	Rear combination light LH (GND) to harness
954	0.85	B	Rear combination light RH (GND) to 955
465	0.85	L/W	Rear combination light LH (backup light) to harness
464	0.85	L/W	Rear combination light RH (backup light) to 465
442	0.85	LG	Rear combination light LH (stop light) to 441
441	0.85	LG	Rear combination light RH (stop light) to harness
405	0.85	G/B	Rear combination light LH (turn signal light) to harness
404	0.85	G/B	Rear combination light RH (turn signal light) to harness
221	0.85	R/B	Rear combination light LH (tail light) to harness
222	0.85	R/B	Rear combination light RH (tail light) to 221

1.3 Removal Sequence of Controls



- | | |
|--|------------------------|
| 1. Brake pipe | 4. Pedal assembly |
| 2. Inching cable, Clevis pin, Washer, Snap pin | 5. Throttle cable |
| 3. Connector (Stop light switch) | 6. Accelerator bracket |

1.4 Suggestions for Removing Controls

- (1) To remove the inching cable, disconnect the inching pedal end and the transmission end and then loosen the locknuts.
- (2) Disconnect the throttle cable at the engine side.

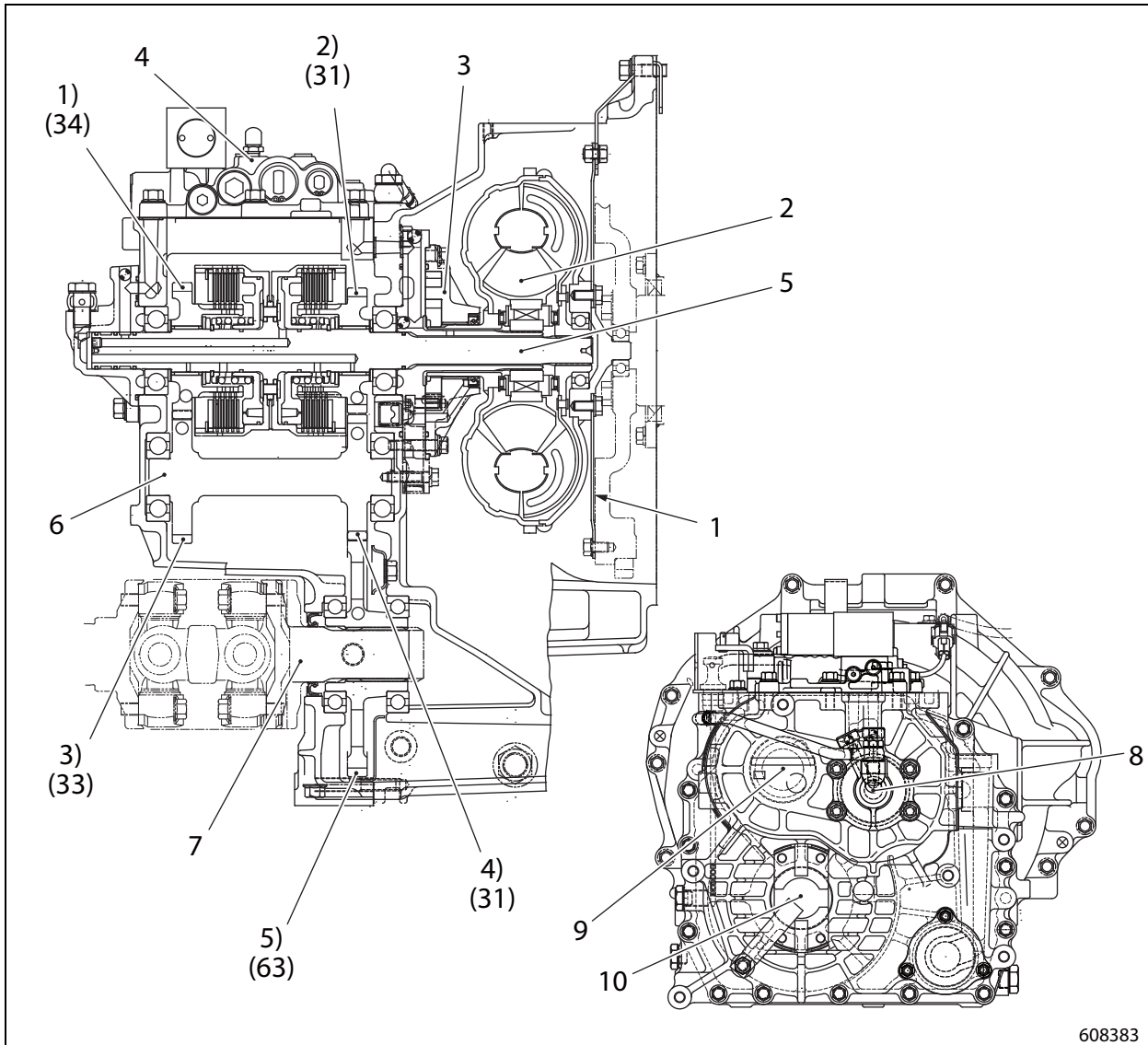
1.5 Suggestions for Installing Controls

For installation, follow the removal sequence in reverse.

For the adjustment of brake pedal, refer to the "TORQUE CONVERTER TRANSMISSION" and "BRAKE SYSTEM."

For the adjustment of inching cable, refer to the "TORQUE CONVERTER TRANSMISSION."

1.3 Transmission Components

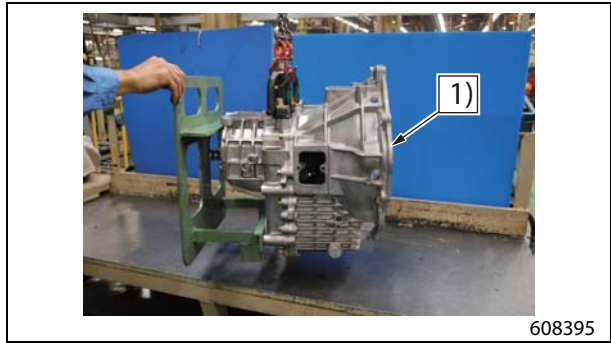


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|-------------------------------|----------------------|
| 1. Flexible plate | 1) Forward gear (34) |
| 2. Torque converter assembly | 2) Reverse gear (31) |
| 3. Oil pump assembly | 3) Idler gear (33) |
| 4. Control valve | 4) Idler gear (31) |
| 5. Input shaft (No. 1 shaft) | 5) Output gear (63) |
| 6. Idler shaft (No. 2 shaft) | |
| 7. Output shaft (No. 3 shaft) | |
| 8. No. 1 shaft | |
| 9. No. 2 shaft | |
| 10. No. 3 shaft | |

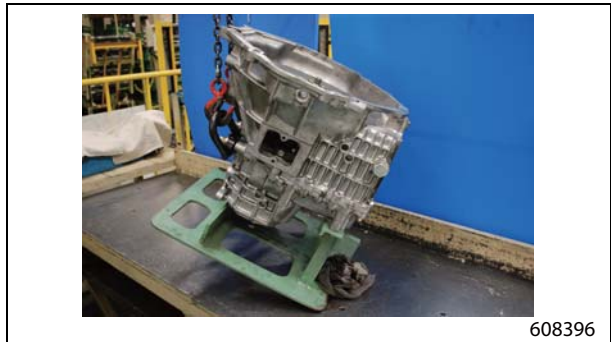
Note: Number of gear teeth is shown in the ().

- (3) Lift the transmission with the stand kit, and lay it so that the transmission housing side faces up.



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1) Housing side



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- (4) Remove two bolts from the flexible plate and install two eye bolts.
 (5) Remove the wire that is used to prevent the torque converter assembly from slipping out.
 (6) Lift the torque converter assembly with a hoist.

Note:

- The torque converter assembly cannot be disassembled.
- Oil will flow out when pulling out the torque converter assembly. Position an oil pan to catch oil.

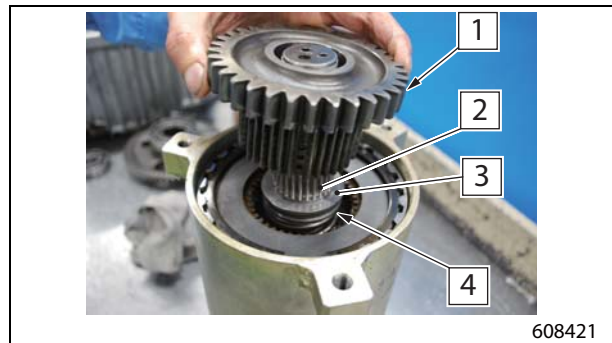


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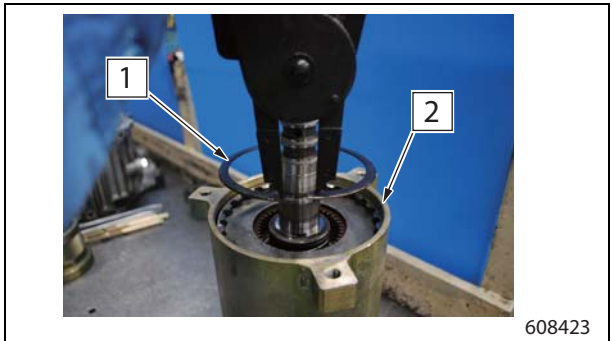
- (3) Remove forward gear.
- (4) Remove thrust washer, needle bearing and spacer.



1. Forward gear
2. Needle bearing
3. Thrust washer
4. Spacer

Disassembling forward side input shaft

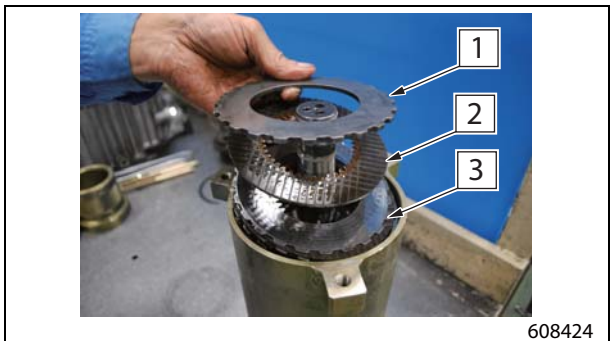
- (1) Remove snap ring.



1. Snap ring
2. Special tool (stand)

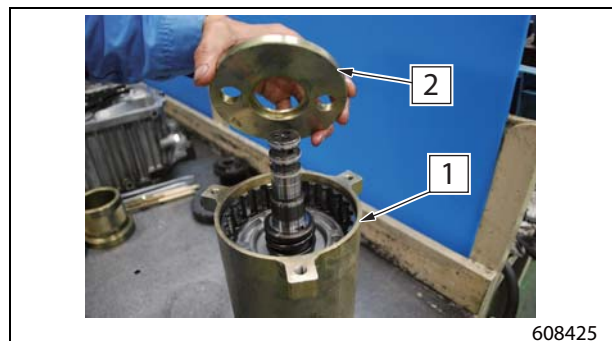
- (2) Remove one pressure plate, five mating plates and five friction plates.

Note: Take note of the sequence of all plates as you remove.



1. Pressure plate
2. Friction plate
3. Mating plate

- (3) Using clutch pack stand kit (special tool), compress clutch spring together with spring retainer and remove snap ring.

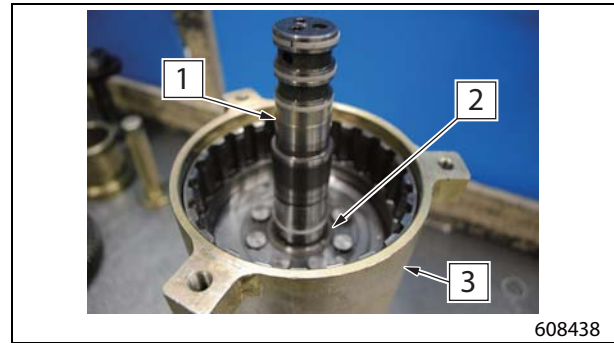


1. Stand
2. Plate 2

5.5 Assembling Forward Side Input Shaft Gear Assembly

Installing forward clutch piston

(1) Place input shaft on the stand (special tool).



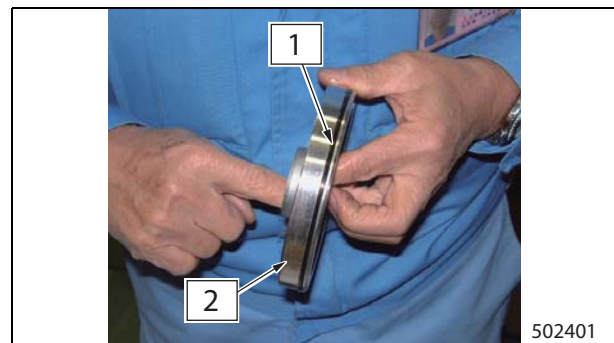
1. Input shaft
2. Seal ring
3. Special tool (Stand)

Special tool	Part number
Stand	91A68-01300

(2) Install seal ring to input shaft.

Part name	Part number	Qty
Seal ring	91B24-00600	1

(3) Install piston ring on forward clutch piston.

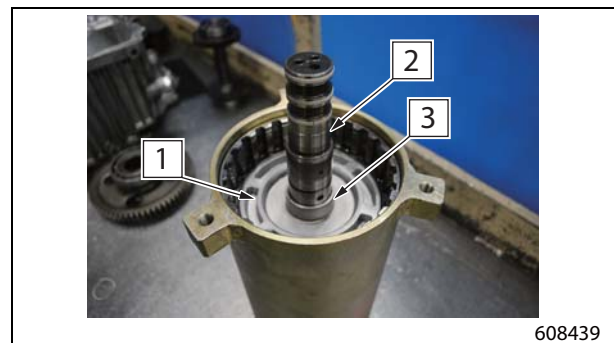


1. Clutch piston ring
2. Clutch piston

Part name	Part number	Qty
Clutch piston	91A24-21501	1
Piston ring	91B24-00700	1

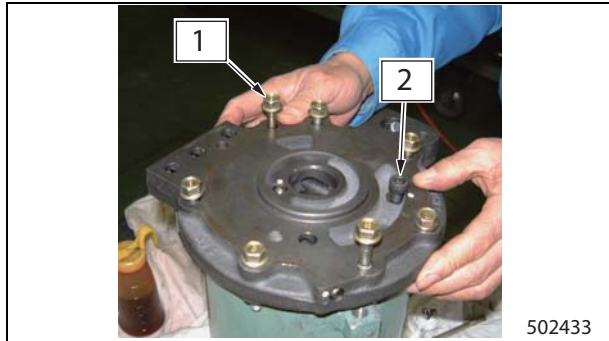
(4) Apply oil to piston ring of clutch piston and sliding area.

(5) Install clutch piston on input shaft.



1. Clutch piston
2. Input shaft
3. Boss

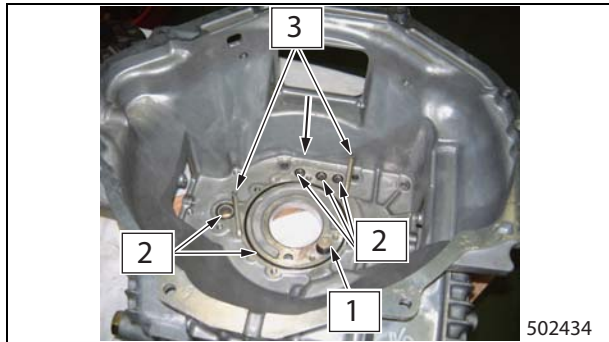
- (6) From the stator shaft side, loosely install the oil pump assembly mounting bolts and remove the guide bolt.
- (7) Tighten the hexagon socket head cap screw.
- (8) Remove the oil pump assembly mounting bolts.



1. Oil pump assembly 2. hexagon socket head cap screw

Installing oil pump assembly

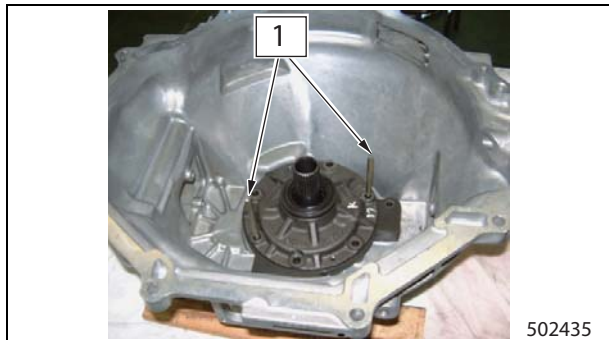
- (1) Install O-ring to transmission housing.
- (2) Install relief valve and torque converter spring.



1. Relief valve and torque converter spring 2. O-ring
3. Guide bolt

Part name	Part number	Qty
O-ring	91A24-08300	1
	05500-24022	1
	05500-24012	3

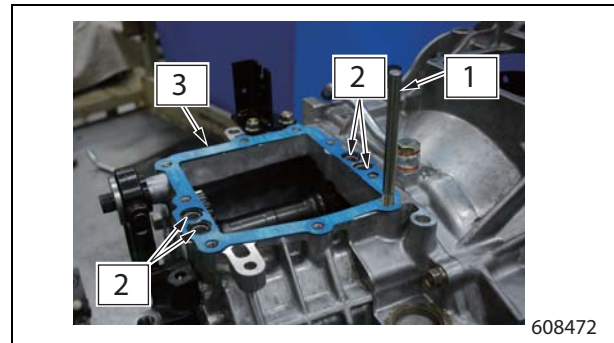
- (3) Install guide bolts.
- (4) Place the oil pump assembly in position.
- (5) Hand tighten the bolts.



1. Guide bolt

Installing control valve

- (1) Remove the stand kit (special tool) from the transmission and place the transmission on the stand (special tool).
- (2) Install guide bolts to the control valve mounting portion.
- (3) Install gasket and O-rings.

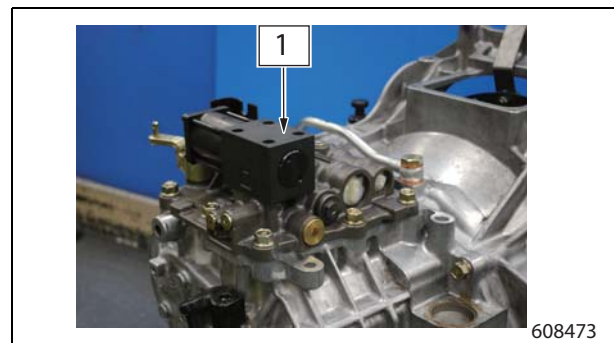


1. Guide bolt
2. O-ring
3. Gasket

Special tool	Part number
Stand	91A68-03500

Part name	Part number	Qty
Gasket	91A28-11100	1
O-ring	05500-24015	4

- (4) Install the control valve and tighten bolts to the specified torque.

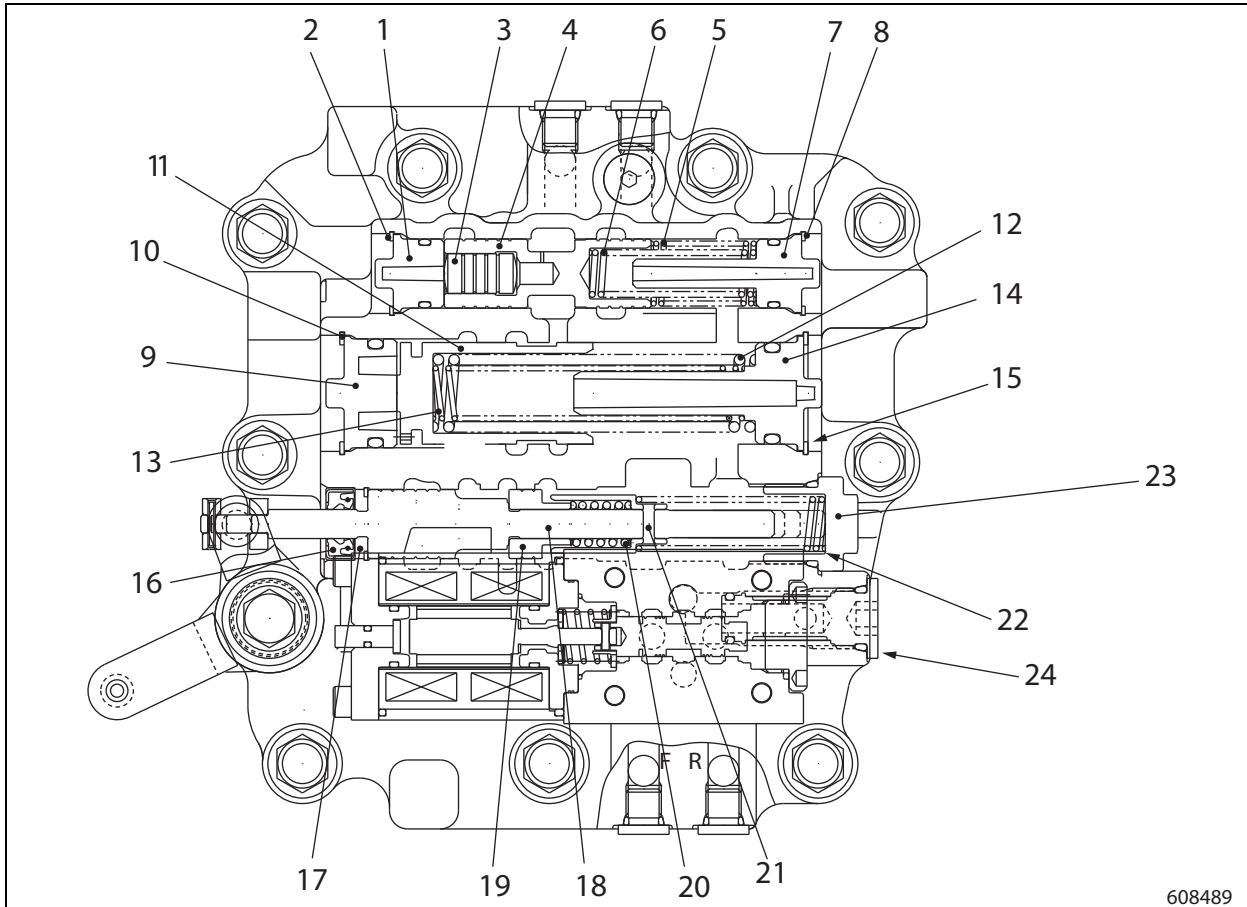


1. Control valve

Item	Tightening torque
Control valve	35.3 to 43.1 N·m (3.60 to 4.39 kgf·m) [26.036 to 31.789 lbf·ft]

7. Assembling Control Valve

7.1 Assembly Sequence of Control Valve



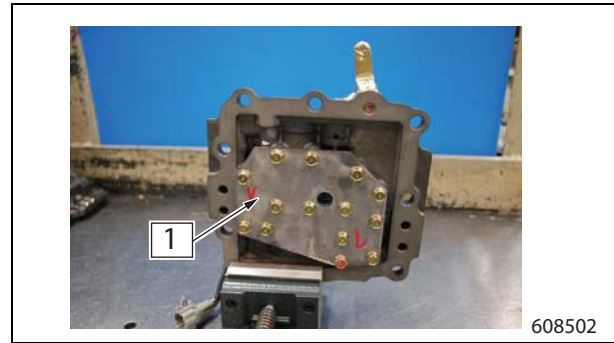
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- | | |
|-------------------------------|-------------------------------------|
| 1. Main relief plug, O-ring | 13. Inner spring |
| 2. Snap ring | 14. Accumulator spring seat, O-ring |
| 3. Slug | 15. Snap ring |
| 4. Regulator valve | 16. Oil seal |
| 5. Main relief spring (thick) | 17. Snap ring |
| 6. Main relief spring (thin) | 18. Inching rod |
| 7. Main spring seat, O-ring | 19. Inching valve |
| 8. Snap ring | 20. Inching valve spring |
| 9. Accumulator plug, O-ring | 21. Inching stopper, Spring pin |
| 10. Snap ring | 22. Inching return spring |
| 11. Accumulator piston | 23. Inching plug, O-ring |
| 12. Outer spring | 24. Strainer, O-ring |

7.10 Installing Valve Body Plate and Breather Cover

Installing valve body plate

Install valve body plate together with gasket by tightening to the specified torque.



1. Valve body plate

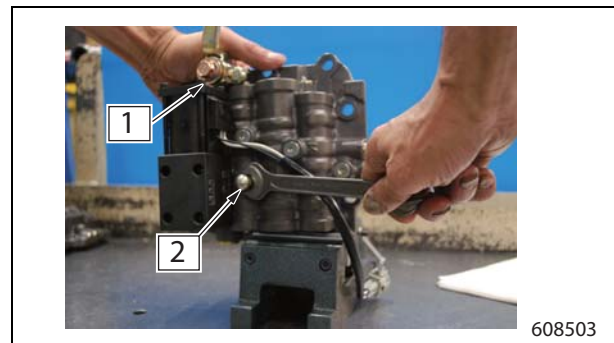
Ref.	Tightening torque
1	6 to 8 N·m (0.6 to 0.8 kgf·m) [4.43 to 5.90 lbf·ft]

7.11 Assembling Control Valve Accessories

Installing inching lever

Install inching lever together with retainer and bushing by tightening to the specified torque.

Note: Do not reuse bushings. Always install new ones.



1. Inching lever

2. Breather

Ref.	Tightening torque
1	35.5 to 43.1 N·m (3.62 to 4.39 kgf·m) [26.183 to 31.789 lbf·ft]

Installing breather

Install breather.

Condition		Possible cause		Action
Oil temperature is too high	Torque converter	Oil level too high or too low		Refill or drain
		Oil strainer clogged		Clean or replace
		Impeller rubbing		Repair or replace
		Stator freewheel malfunction		Replace stator assembly
		Air being sucked in		Retighten or replace O-ring
		Water mixed in oil		Change oil
		Restriction in oil pipe (resulting in reduced circulation flow)		Repair or replace
		Bearings worn or seized		Repair or replace
		Instrument malfunction		Replace
	Transmission	Clutches dragging		Replace clutch plate
		Bearings worn or seized		Repair or replace
		Control linkage malfunction		Repair or replace
	Miscellaneous	Truck not operated properly		Urge user to operate properly
Miscellaneous		Damaged fan belt		Replace
		Clogged oil cooler		Clean or replace
		Brake is dragging.		Check and adjust
Main oil pressure too high		Main regulator valve malfunction		Repair or replace valve assembly
		Oil viscosity too high at low temperatures		Change oil
		Improper oil		Change oil
Main oil pressure too low		Magnet strainer clogged		Clean or replace
		Oil pump malfunction		Replace
		Main regulator valve spring malfunction		Replace spring
		Main regulator valve spool malfunction		Repair or replace spool
		Air being sucked in		Tighten or replace packing
		Oil level too low		Refill
		Control linkage malfunction		Repair or replace
		Clutch valve malfunction		Repair or replace

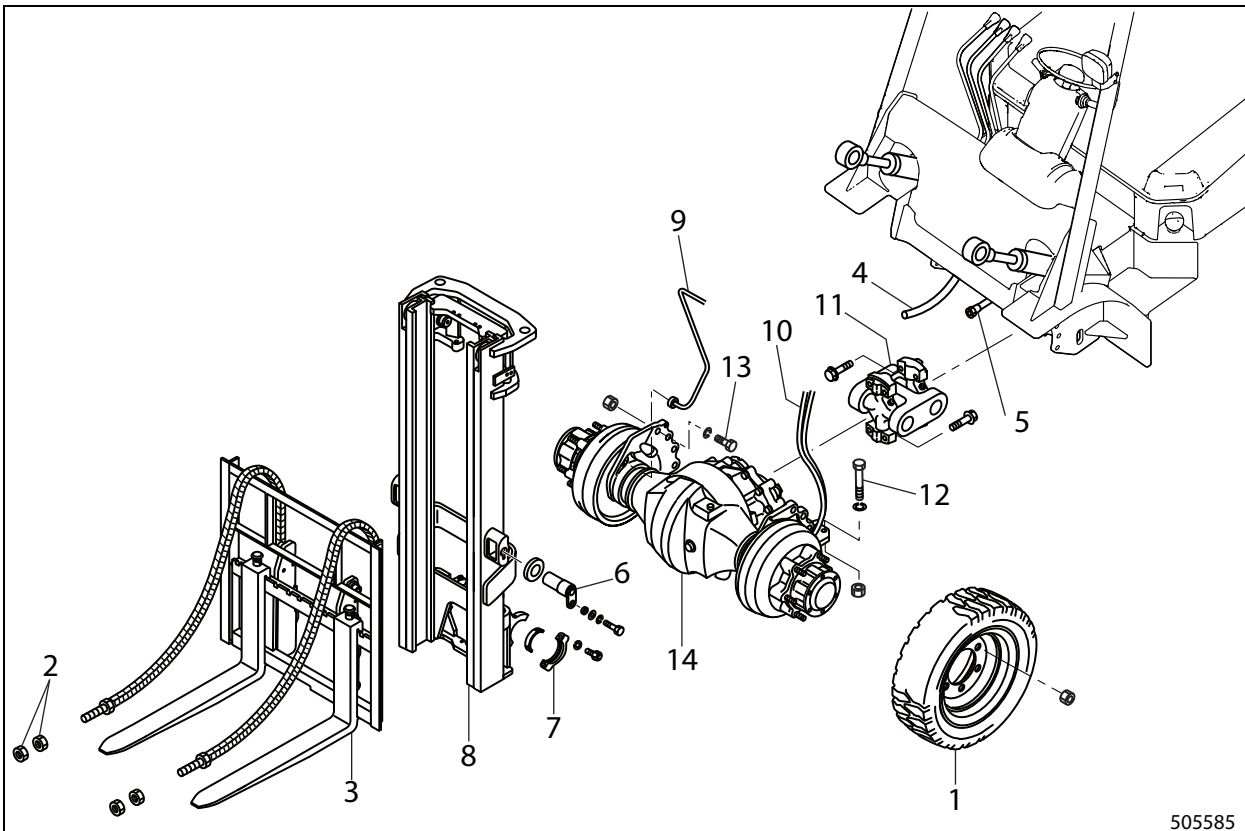
4. Removing Front Axle and Reduction Differential

4.1 Preparation

- (1) Remove the mast. For replacement of the front axle housing and disassembly of the differential, refer to "MAST AND FORKS".
- (2) Jack up the truck.
- (3) Support the front end of the truck with blocks or stands at both sides to keep the truck in the horizontal position.
- (4) Remove the front wheels.
- (5) Before removing the front axle and reduction differential, remove the front axle drain plug and drain transfer and differential oil.

Note: It is not necessary to remove the axle housing or to drain the oil for removing the axle shaft or disassembling the wheel hub.

4.2 Removal Sequence



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- | | |
|---|---|
| 1. Front wheel | 8. Mast |
| 2. Nuts | 9. Brake pipe |
| 3. Fork, Lift bracket | 10. Parking brake cable |
| 4. Return hose for lift cylinder | 11. Universal joint |
| 5. High-pressure hose for lift cylinder | 12. Bolt, Nut |
| 6. Tilt cylinder socket | 13. Bolt, Nut |
| 7. Mast support bearing cap | 14. Front axle and reduction differential |

Note:

- (1) For removal of the front wheel, refer to 6-3 "Removing Front Wheels"
- (2) For removal of mast parts 2 through 8, refer to "MAST AND FORKS."
- (3) Before removing the front axle and reduction differential, remove the front axle drain plug and drain transfer and differential oil.

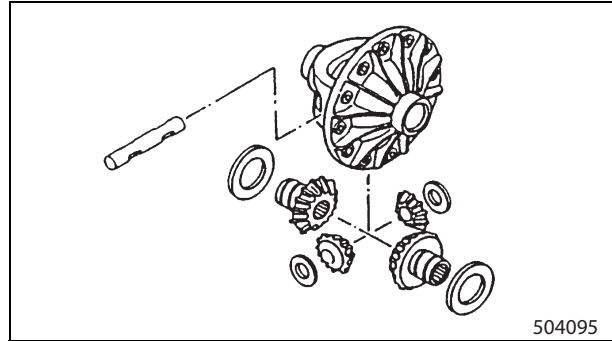
10. Inspection and Repair After Disassembling Reduction Differential

Reduction bevel gear and pinion

- Check the gear and pinion for tooth contact, wear, pitting, flaking and chipping.
- Minor flaws on the tooth surfaces can be repaired by sanding with an oil stone or sandpaper.
- If the gear and/or pinion is badly damaged, replace them as a set.

Differential

- Check the differential case and tapered roller bearing inner race to see if the seat surface is fretted.
- Check the differential case for cracks. Check the sliding contact surfaces of thrust washer and gears for wear and damage.
- Check the teeth of the differential pinions and gears for wear, pitting, chipping and galling.
- Check the pinions (inner surface) and pinion shafts (outer surface) for wear.
- Check the differential gears and axle shaft splines for wear and free play (looseness).



Item		Value	Limit
Clearance between pinions and shafts	2 ton class	0.02 to 0.09 mm (0.0008 to 0.0035 in.)	0.35 mm (0.0138 in.)
	3 ton class	0.17 to 0.27 mm (0.0067 to 0.0106 in.)	

Item	Value	Limit
Free play (looseness) of differential gear and axle shaft splines	0.07 to 0.15 mm (0.0028 to 0.0059 in.)	0.5 mm (0.020 in.)

Drive gear and driven gear

- Check the gears for tooth contact, wear, pitting, galling, and chipping.
- Replace the gears as a set if they are defective.

Note:

- The combination of drive and driven gears is different between one model of the truck and another.
- The combination can be identified by the alphabetical marks A up to F stamped on the side face of the gears.
- Before replacing the gears, always check the marks to make sure of the correct combination.

13.2 Reduction Differential

Items			Specified value	
			2 ton class	3 ton class
1	Backlash of reduction differential gear	Standard	0.15 to 0.25 mm (0.0059 to 0.0099 in.)	
		Limit	0.5 mm (0.0197 in.)	
2	Clearance between differential pinion and spider	Standard	0.02 to 0.09 mm (0.0079 to 0.0035 in.)	0.17 to 0.27 mm (0.0067 to 0.0106 in.)
		Limit	0.35 mm (0.0138 in.)	
3	Preload for differential case side bearing	Standard	14.7 to 29.4 N (1.5 to 3.0 kgf) [3.3 to 6.6 lbf]	12.8 to 24.5 N (1.3 to 2.5 kgf) [2.9 to 5.5 lbf]
4	Face runout of reduction bevel gear	Standard	0.15 mm (0.0059 in.)	
		Limit	0.15 mm (0.0059 in.)	
5	Backlash of reduction bevel gear and pinion	Standard	0.20 to 0.28 mm (0.0079 to 0.0110 in.)	0.25 to 0.33 mm (0.0098 to 0.0130 in.)
6	Free play of gear and shaft spline	Standard	0.07 to 0.15 mm (0.0028 to 0.0059 in.)	
		Limit	0.5 mm (0.020 in.)	
7	Reduction bevel gear mounting bolts	Tightening torque	226 ± 9.8 N·m (124 ± 1.0 kgf·m) [167 ± 7.2 lbf·ft]	
8	Differential case	Tightening torque	-	85 to 110 N·m (8.67 to 11.2 kgf·m) [62.7 to 81.2 lbf·ft]
9	Side bearing cap bolts	Tightening torque	235 ± 6.8 N·m (24 ± 0.7 kgf·m) [173 ± 5.0 lbf·ft]	
10	Differential carrier bolts	Tightening torque	108 ± 9.8 N·m (11 ± 1.0 kgf·m)[79.7 ± 7.2 lbf·ft]	
11	Differential carrier cover bolts	Tightening torque	39.2 ± 3.9 N·m (4.0 ± 0.4 kgf·m)[28.9 ± 2.9 lbf·ft]	
12	Locknut	Tightening torque	294 ± 19.6 N·m (30 ± 2 kgf·m)[216.8 ± 14.8 lbf·ft]	
13	Input flange bolt	Tightening torque	108 ± 9.8 N·m (11 ± 1.0 kgf·m)[79.7 ± 7.2 lbf·ft]	

7.2 Suggestions for Disassembly

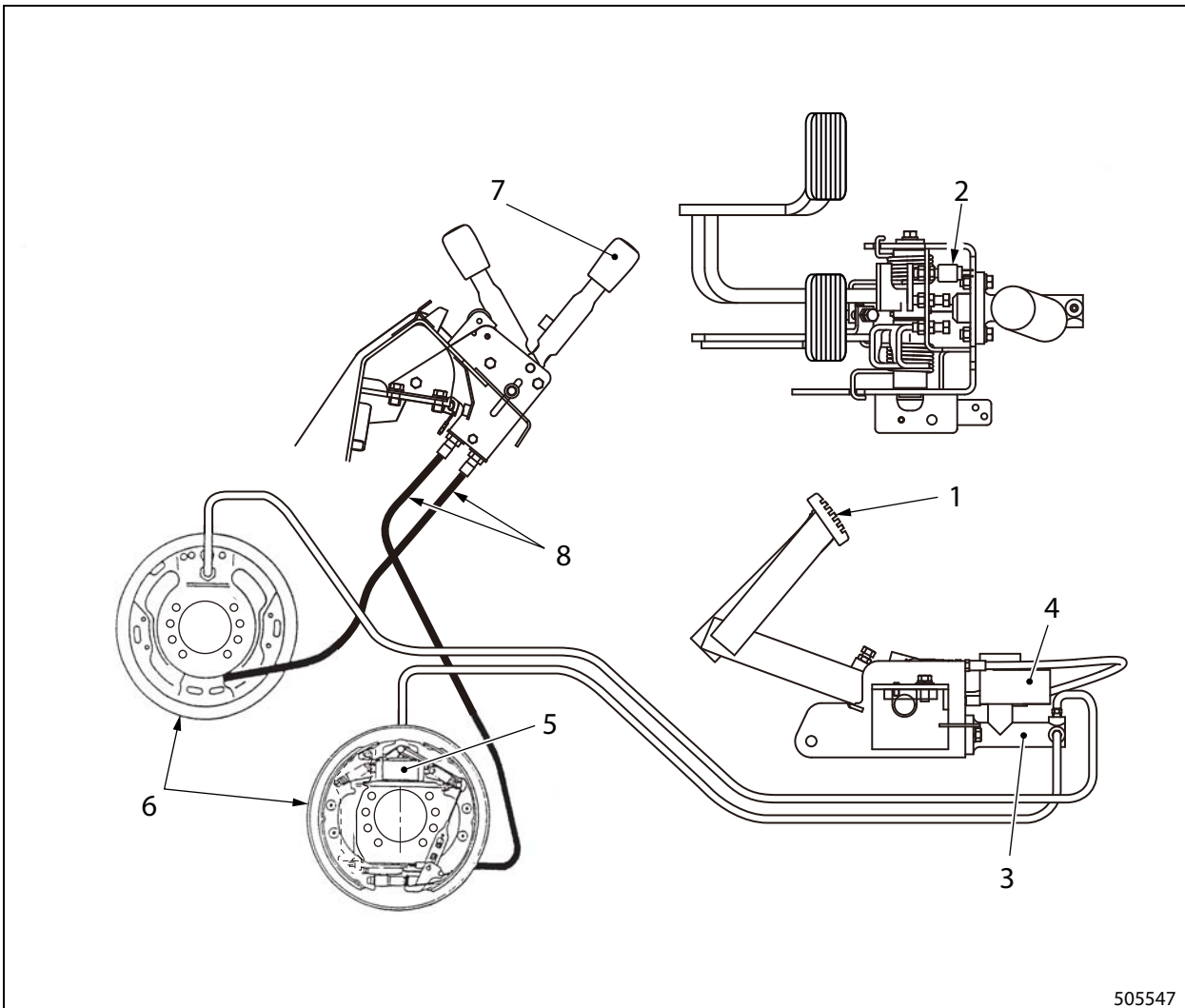
- (1) Remove the rear wheels beforehand.
- (2) Check the hub for looseness. If there is looseness, the bearing may be worn.
- (3) Do not remove the bearing if it is not damaged.
- (4) The inner and outer races of tapered roller bearing make a pair. They must be replaced as a set.
- (5) Replace oil seals once they are removed. Do not reuse it.
- (6) Remove tapered roller bearing (inner race) 7.

8. Inspection and Repair After Disassembling Wheel Hub Section

- (1) Bearing:
Replace if damage, seizure, peeling, rotational failure, or unusual noise is found.
- (2) Hub:
Replace if cracks are found by dye check.
- (3) Oil seal:
Replace if damaged or worn.

Chapter 8 BRAKE SYSTEM

1. Structure of Brake System



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- | | |
|-----------------------|------------------------|
| 1. Brake pedal | 5. Wheel cylinder |
| 2. Brake light switch | 6. Wheel brake |
| 3. Master cylinder | 7. Parking brake lever |
| 4. Reserve tank | 8. Parking brake cable |

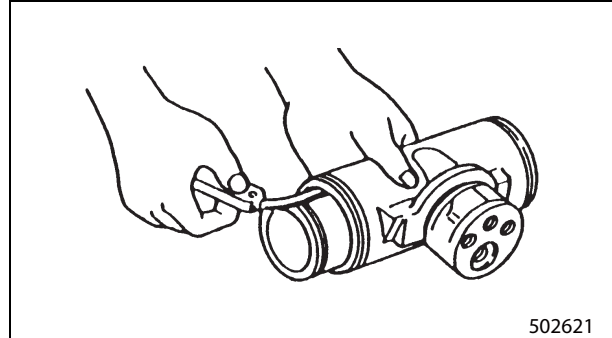
10. Inspection and Repair After Disassembling Wheel Cylinder

Cylinder body

- Inspect the cylinder bore for rusting, erosion or scoring.
- Inspect threads of both the bleeder screw and oil pipe for damage.

Piston

- Inspect sliding surfaces for rust or scratches.
- With the piston installed in the cylinder body, measure the piston-to-cylinder clearance. Replace if the clearance exceeds the service limit.



Item	Specified value	
Clearance between piston and cylinder	Standard	0.020 to 0.105 mm (0.0008 to 0.0041 in.)
	Limit	0.15 mm (0.0059 in.)

Piston cup

Check for swelling, damage, or other defects. Replace the cup if defective even slightly.

Item	Specified value	
Interference between piston cup and cylinder body	Standard	1.85 mm (0.0728 in.)
	Limit	0.65 mm (0.0256 in.)

Boot

Replace the boots if they show damage or age deterioration. Replace every 12 months or every 24000 hours.

11. Assembling Wheel Cylinder

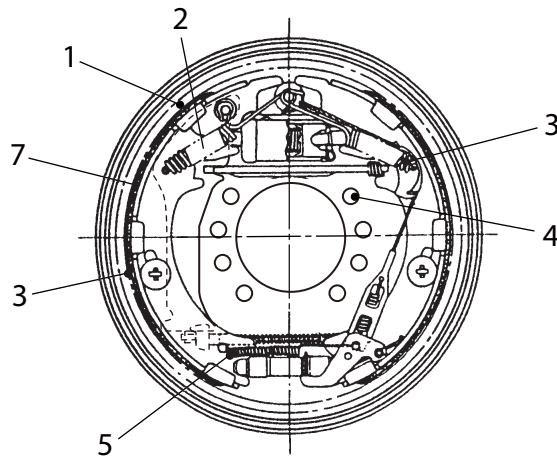
For assembly, follow the disassembly sequence in reverse and observe the instructions below:

- (1) Clean metal parts with a volatile metal cleaning fluid and blow off the fluid completely with compressed air.
- (2) Apply a thin coat of rubber grease exclusively designed for brake components or brake oil to the cylinder bore and piston cups.
- (3) Be careful not to damage the lips of the cups.
- (4) Make sure that the cups face the correct directions when assembled.
- (5) Tighten the bleeder screw to the specified torque.

Item	Tightening torque
Bleeder screw	5.9 to 8.8 N·m (0.60 to 0.90 kgf·m) [4.352 to 6.491 lbf·ft]

Wheel brake

Ref.	Item		Specified value	
1	Inside diameter of brake drum		Standard	310 mm (12.20 in.)
			Limit	312 mm (12.28 in.)
2	Return spring (primary)	Free length	Standard	120 mm (4.72 in.)
		Installed length/ installed load	Standard	134 mm (5.28 in.)/ 226 ± 23 N (23.0 ± 2.34 kgf) [50.81 ± 5.17 lbf]
3	Return spring (secondary)	Free length	Standard	139.3 mm (5.484 in.)
		Installed length/ installed load	Standard	145.4 mm (5.724 in.)/ 226 ± 23 N (23.0 ± 2.34 kgf) [50.81 ± 5.17 lbf]
4	Backing plate mounting bolt		Tightening torqued	212.7 ± 21.3 N·m (21.69 ± 2.17 kgf·m) [156.879 ± 15.71 lbf·ft]
5	Return spring (primary and secondary shoes)	Free length	Standard	126 mm (4.96 in.)
		Installed length/ installed load	Standard	145.4 mm (5.724 in.)/78 ± 8 N (8.0 ± 0.81 kgf) [17.54 ± 1.79 lbf]
6	Drum-to-lining clearance (total)		Standard	0.2 to 0.7 mm (0.008 to 0.028 in.)
7	Thickness of lining		Standard	5.7 mm (0.224 in.)
			Limit	1 mm (0.04 in.)



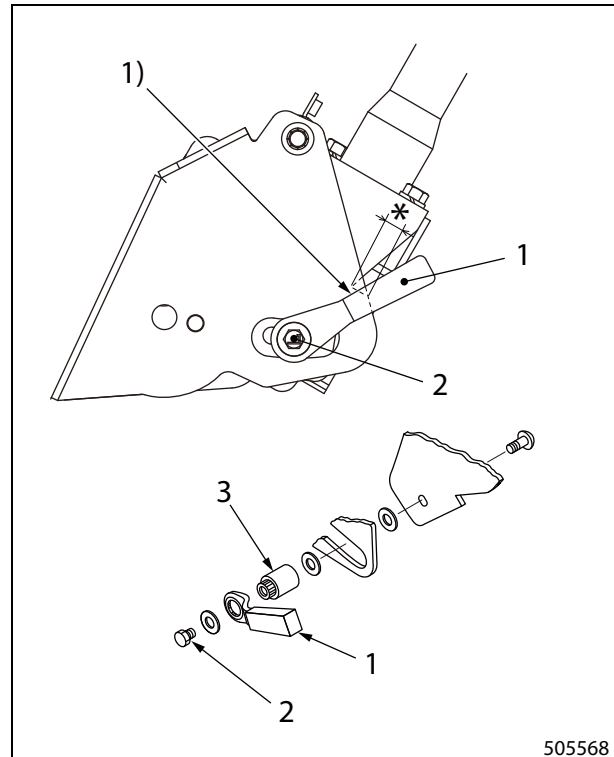
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9. Assembling Tilt Lock Lever

If the matchmark which made earlier, has disappeared, or when the lever is replaced with a new one, install the lever as instructed below:

(Figure shows relative positioning of tilt-neutral and column lock lever-lock)

- (1) Tighten nut 3 to specified torque. (This is a lever locked state.)
- (2) With the lever locked, select optimal position for the tilt lock lever and fit tilt lock lever into the serration of nut 3. The optimal position is within the range where bracket notch marked with * is crossing the upper aspect of the lever.
- (3) Tighten lever mounting bolt 2.
- (4) Loosen the tilt lock lever and make sure the bracket slides in the entire tilting area without interfering with other parts.



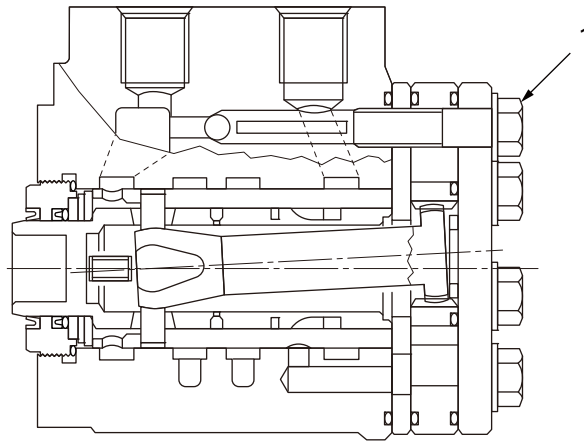
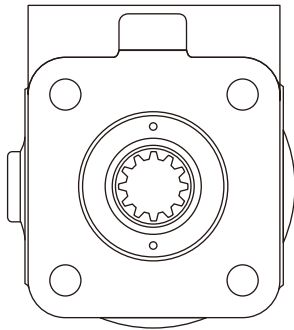
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1. Tilt lock lever
 2. Lever mounting bolt
 3. Nut
 1) Lever aspect

Ref.	Item	Tightening torque
3	Nut	11 to 15 N·m (1.1 to 1.5 kgf·m) [8.11 to 11.06 lbf·ft]

14. Service Data

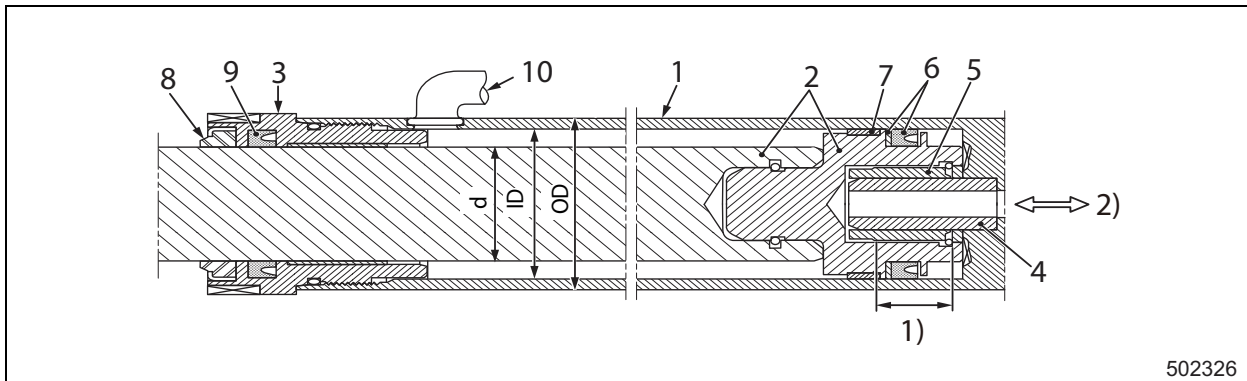
Item		Specified value	
Steering effort (at steering wheel rim)		Standard	13 N (1.3 kgf) [2.92 lbf] or less
Steering wheel mounting nut		Tightening torque	58.5 ± 5.9 N·m (0.60 kgf·m) [4.352 lbf·ft]
Steering bracket bolt		Tightening torque	33.3 ± 6.7 N·m (3.40 ± 0.68 kgf·m) [24.561 ± 4.94 lbf·ft]
Steering valve mounting bolt		Tightening torque	33.3 ± 6.7 N·m (3.40 ± 0.68 kgf·m) [24.561 ± 4.94 lbf·ft]
Steering valve	Displacement volume	Standard	100 cm ³ (6.10 cu in.)/rev
	Rotating torque in normal steering	Standard	1.5 N·m (0.15 kgf·m) [1.106 lbf·ft]
	1 End cap mounting bolt	Tightening torque	23 N·m (2.3 kgf·m) [16.96 lbf·ft]
Steering system relief valve set pressure		Standard	8.8 ^{+0.5} ₀ MPa (89.74 ^{+5.10} _{0.00} kgf/cm ²) [1276.33 ^{+72.52} _{0.00} psi]



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Main components of cylinder with a return pipe

- Simplex mast with a lift height of 3.5m (137.8 in.) or higher



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- | | |
|--|---------------------------------------|
| 1. Cylinder tube | 7. Bushing |
| 2. Piston rod assembly | 8. Wiper ring |
| 3. Cylinder head | 9. U-ring |
| 4. Pipe
(Integrated with cylinder tube) | 10. Return pipe |
| 5. Cushion bearing | 1) Cushion stroke: 2.3 mm (0.091 in.) |
| 6. U-ring, Back-up ring | 2) Oil inflow, outflow |

Cylinder dimensions (cylinder length and stroke vary depending on lift height)

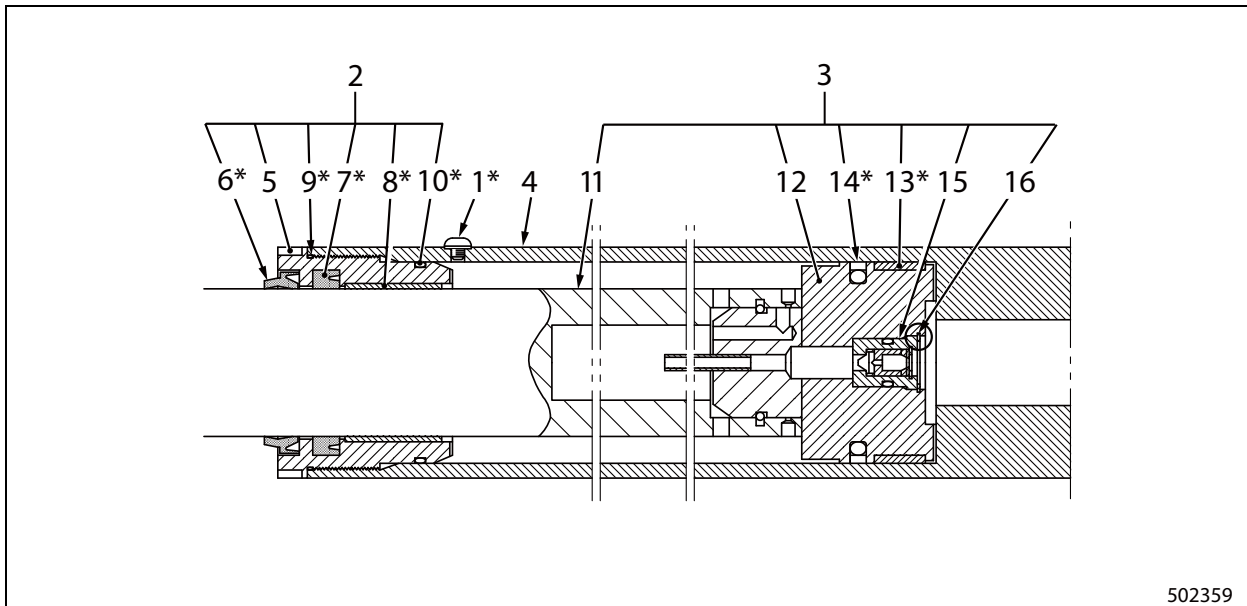
Truck class	Mast type	Height	Rod diameter (d)	Cylinder inside diameter (ID)	Cylinder outside diameter (OD)	Cushion stroke	Presence of return pipe
2 ton class	Simplex mast	3.4 m (133.9 in.) or less	40 mm (1.57 in.)	50 mm (1.97 in.)	57 mm (2.24 in.)	23 mm (0.91 in.)	No
		3.5 m (137.8 in.) or more	40 mm (1.57 in.)	50 mm (1.97 in.)	57 mm (2.24 in.)	23 mm (0.91 in.)	Yes
	Triplex mast	-	40 mm (1.57 in.)	50 mm (1.97 in.)	57 mm (2.24 in.)	23 mm (0.91 in.)	No
3 ton class	Simplex mast	3.4 m (133.9 in.) or less	45 mm (1.77 in.)	55 mm (2.17 in.)	63 mm (2.48 in.)	23 mm (0.91 in.)	No
		3.5 m (137.8 in.) or more	45 mm (1.77 in.)	55 mm (2.17 in.)	63 mm (2.48 in.)	23 mm (0.91 in.)	Yes
	Triplex mast	-	45 mm (1.77 in.)	55 mm (2.17 in.)	63 mm (2.48 in.)	23 mm (0.91 in.)	No

7. Removing Lift Cylinders

Refer to "MAST AND FORKS."

8. Disassembling Lift Cylinder (First Cylinder for Duplex and Triplex Masts)

8.1 Disassembly Sequence



- | | |
|------------------------------|-------------------------|
| 1. Plug, Gasket* | 9. O-ring* |
| 2. Cylinder head subassembly | 10. O-ring* |
| 3. Piston rod subassembly | 11. Rod |
| 4. Cylinder tube subassembly | 12. Piston |
| 5. Cylinder head | 13. Slide ring* |
| 6. Wiper ring* | 14. Seal ring assembly* |
| 7. U-ring* | 15. Check valve |
| 8. Bushing* | 16. Snapping |

Note: Parts marked with * are cylinder repair kit.

18.2 Suggestions for Assembly

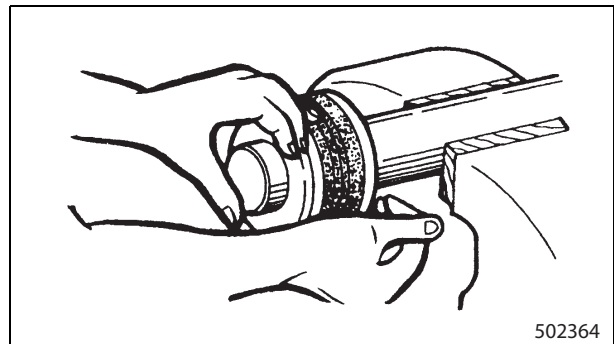
- (1) Before assembly, thoroughly clean each part and make sure that they are free from foreign materials such as dust.
- (2) Assemble the cylinder in the reverse order of the disassembly. Apply hydraulic oil to O-rings, piston seals, dust seals, packings, and the bore surface of the cylinder tube before assembly. Also, pay attention to the installation orientation.
- (3) When holding the cylinder tube in a vise, be careful not to distort the tube.
- (4) Parts marked with * are seal kit parts. Replace seal kit parts with new ones.

Installing piston seal

- (1) Before fitting the inner piston seal, softly twist it by hand five or six times to soften it.



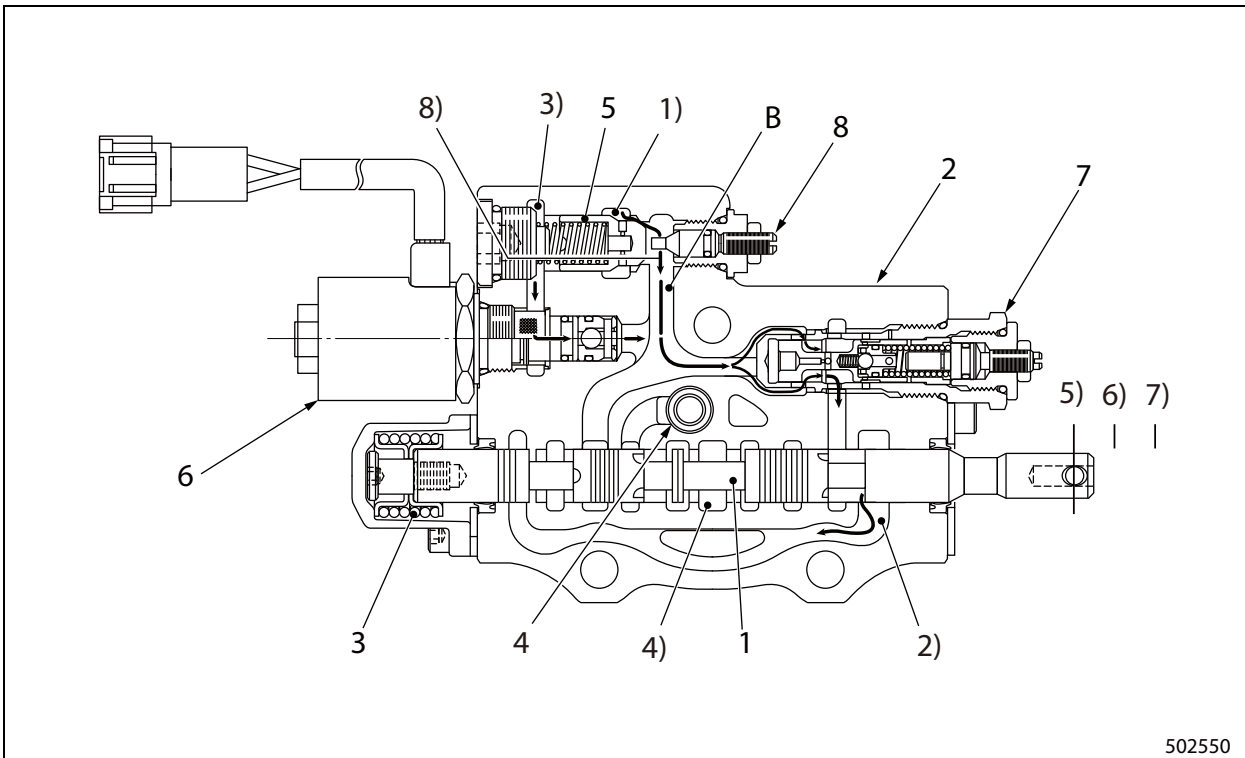
- (2) Secure the piston in a vise, while making sure not to damage any part of the piston, and then apply a thin coat of hydraulic oil to the piston seal. Fit half of the seal into the piston groove, and then press the other half into the groove.



Condition	Possible cause	Actions
Oil leaks from bushing.	Foreign particles are lodged between sealing members such as oil seals and dust seals.	Replace.
	Inner or outer diameter of oil seal or dust seal damaged.	Replace.
	O-ring damaged.	Replace O-ring.
	Cylinder is abnormally distorted.	Repair or replace.

25. Service Data

Item		Specified value
Forward tilt angle (standard model with simplex mast)	Standard	6°
Backward tilt angle (standard model with simplex mast)	Standard	10°
Lift cylinder vertical drift (at rated load) (Retracted Length of rod, oil temperature at 45°C [113 °F])	Standard	100 mm (3.94 in.)/15 min or less
Tilt cylinder forward drift (at rated load) (Extended length of rod, oil temperature at 45°C [113 °F])	Standard	20 mm (0.79 in.)/15 min or less
Main relief valve set pressure	Standard	18.1 ^{+0.5} ₀ MPa (184 ^{+5.10} ₀ kgf/cm ²) [2625 ⁺⁷² ₀ psi]
Steering system relief valve set pressure	Standard	10.3 ^{+0.5} ₀ MPa (105.0 ^{+5.10} ₀ kgf/cm ²) [1494 ⁺⁷² ₀ psi]
Return filter	Tightening torque	49 ± 9.8 N·m (5.0 ± 0.99 kgf·m) [36.14 ± 7.22 lbf·ft]
Suction strainer	Tightening torque	49 ± 9.8 N·m (5.0 ± 0.99 kgf·m) [36.14 ± 7.22 lbf·ft]
Tank cover mounting bolt	Tightening torque	5.1 ± 6.5 N·m (0.52 ± 0.66 kgf·m) [3.762 ± 4.79 lbf·ft]



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- | | |
|-------------------------|---|
| 1. Lift spool | 1) Lift cylinder port |
| 2. Valve body | 2) Tank port |
| 3. Return spring | 3) Oil passage for opening load check valve |
| 4. Check valve | 4) Center bypass port |
| 5. Load check valve | 5) Descent |
| 6. Solenoid valve | 6) Neutral |
| 7. Flow regulator valve | 7) Ascent |
| 8. Shut-off valve | 8) Pilot oil |

Descending position of lift cylinder

The figure above shows the lift control valve when spool 1 is at "descending position."

Spool 1, pushed into body 2, is at position as shown in the figure. The center bypass port is not blocked. The secondary port of flow regulator valve 7 is open to port T2 (return passage).

When the solenoid activates, pilot oil 8) behind load check valve 5 is released to passage B. Thereby, load check valve 5 moves to the left (figure) by pressure of port A1 and oil in the port A1 flows into port T2 through flow regulator valve 7.

Shut-off valve 8 forcibly opens load check valve 5 if the load check valve does not automatically activate due to malfunction of solenoid 6 or any other reason. Just loosen the locknut and push the screw in.

34. Assembling Control Valve - End Cover Section

For assembly, follow the disassembly sequence in reverse.

34.1 Suggestions for Assembly

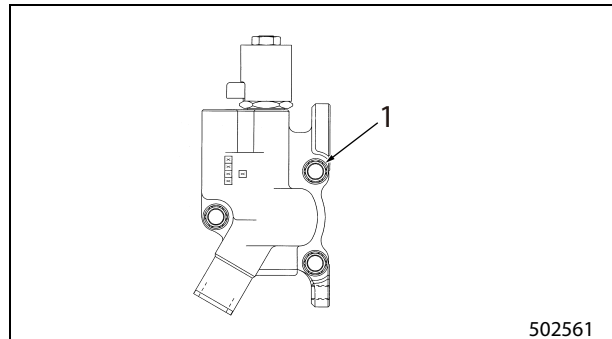
- (1) Clean parts that have been disassembled with an appropriate solvent, and apply compressed air to the parts to dry and remove foreign matter.
- (2) Apply hydraulic oil to each part.
- (3) Replace O-rings with new ones.
- (4) Tighten tie bolts.

Note: Tighten bolts evenly. Tightening them unevenly or to inadequate torque can distort the valve body, resulting in unsmooth movement of the spool.

- (5) Install component valves after appropriate valve bodies are installed with tie bolts.

- (6) Ensure the spools slide smoothly.

Note: The valve body and spool have been lapped as a set. Do not change the combination. When replacing, replace as a set of body and spool.



1. Tie bolt

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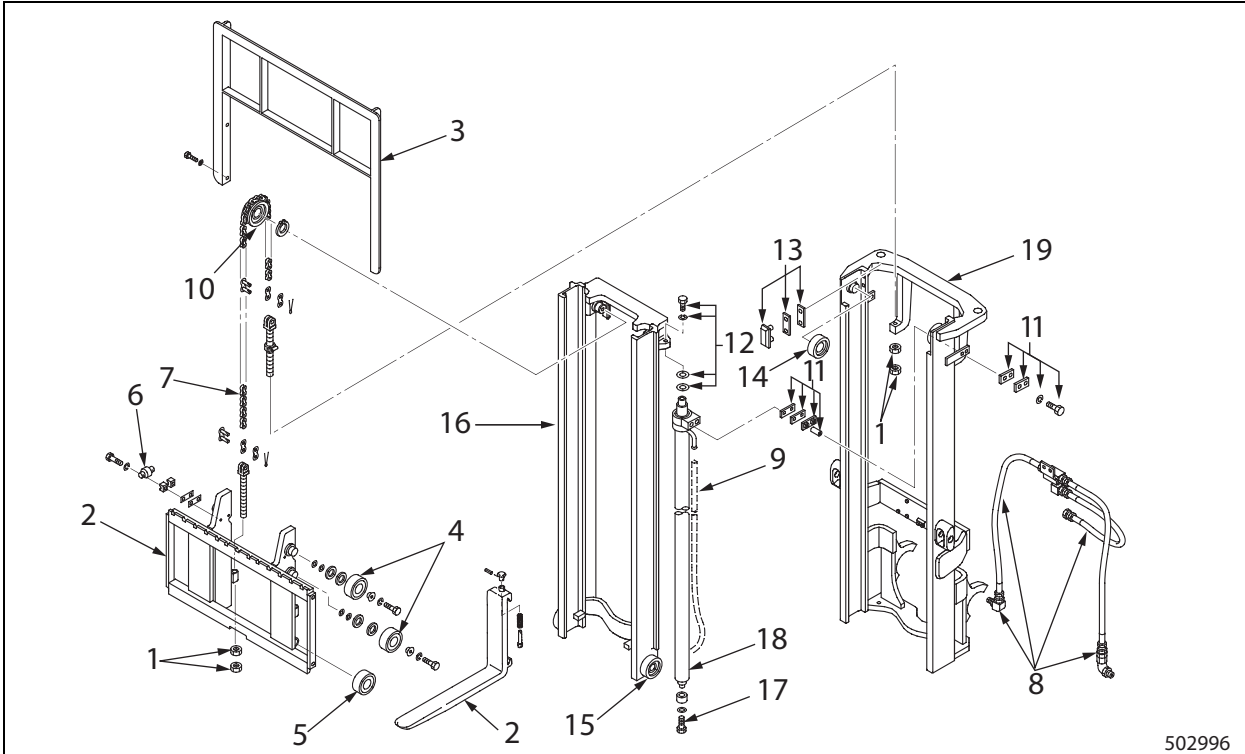
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1.6 Removal Sequence of Mast and Lift Bracket



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- | | |
|---|---|
| 1. Nut | 11. Cylinder clamps, Seats, Shims, Cushion, Collar, Bolts |
| 2. Forks, Lift bracket | 12. Set bolt, Shim |
| 3. Backrest | 13. Mast strip, Shims |
| 4. Lift bracket upper and middle roller | 14. Outer mast main rollers |
| 5. Lift bracket lower roller | 15. Inner mast main rollers |
| 6. Lift bracket side rollers | 16. Inner mast |
| 7. Chain | 17. Bolt |
| 8. Lift hose (high pressure), Rubber hose, T-joint, Down safety valve | 18. Lift cylinder |
| 9. Return hose (high-lift mast) | 19. Outer mast |
| 10. Chain wheel | |

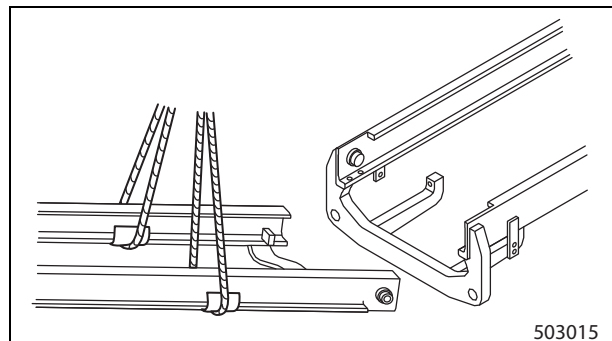
1.7 Suggestions for Disassembling Mast and Lift Bracket

Removing mast strips and main rollers

Remove clamp bolt 11, set bolt 12, and bolt 17 to free the lift cylinders, then cross the two lift cylinders at the top. Slide the inner mast down from the outer mast, and remove the main rollers and the mast strips.

Removing inner mast

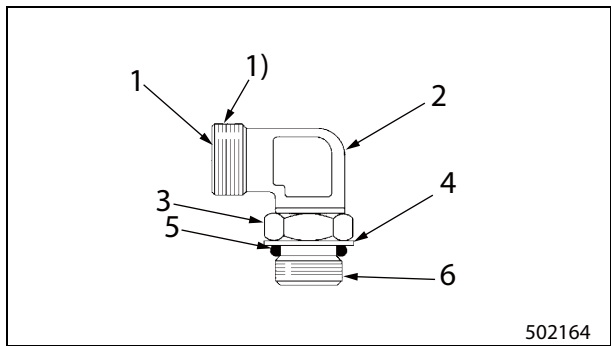
After removing the main rollers from the mast, hitch a sling to the cross-member of the inner mast and slide the inner mast upward from the outer mast. Hitch a sling to the inner mast again and gently pull out the inner mast from the outer mast by clearing the outer mast roller shafts.



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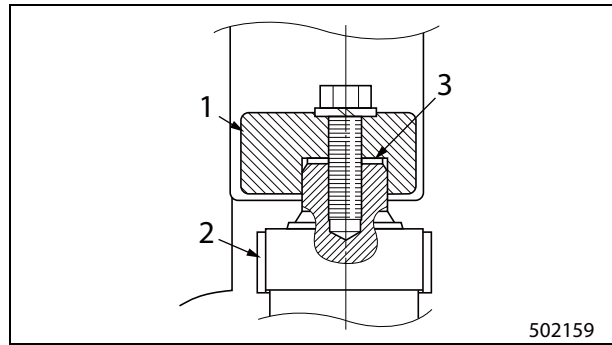
Installation of a fitting with straight threads and O-ring seal

- (1) Apply grease or hydraulic oil to O-ring and O-ring seat on the housing side.
- (2) Turn locknut so that it moves up against the body of the fitting. Move the back-up washer and O-ring seal against locknut.
- (3) Tighten the fitting by hand. Once O-ring seal is placed in the correct position of housing and the back-up washer comes in contact with the surface of housing, turn it back to adjust the mounting direction. Never loosen the body fitting more than one turn.
- (4) Tighten the locknut to the specified torque.



- | | |
|---|---------------------------------------|
| 1. End of fitting body
(for hose connection) | 5. O-ring seal |
| 2. Fitting body | 6. Threaded portion to the
housing |
| 3. Locknut | 1) Shape varies by fitting type |
| 4. Back-up washer | |

- (3) Extend the piston rod, and tighten the lift cylinder set bolt. Remove the wood blocks under the inner mast.
- (4) Check that the piston rods move smoothly throughout the stroke by slowly lowering the inner mast to the bottom. Also check that the left and right lift cylinders come to the end of stroke simultaneously at the maximum lift position of the inner mast.



1. Inner mast
2. Cylinder bracket
3. Shim (l)

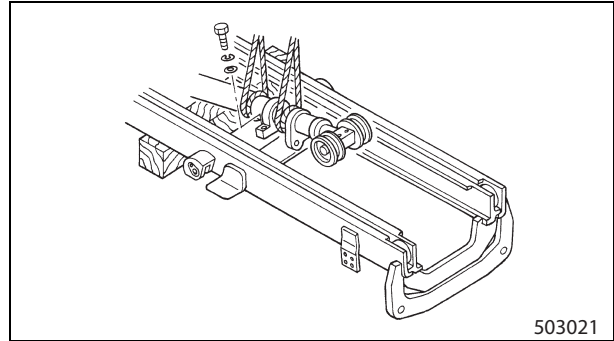
1.26 Troubleshooting

Condition	Possible cause	Action
Lift bracket and inner mast do not move smoothly	Clearance between lift rollers and side rollers is incorrect	Adjust forward/backward and right/left clearances
	Defective roller rotation	Lubricate side rollers and replace other rollers
	Incorrect clearance on mast strip	Adjust shim thickness
Lift bracket or inner mast is tilted	Excessive clearance on side roller	Increase shim stack thickness
	Uneven tension between chains on right and left side	Adjust chain tension
	Shim adjustments are unequal between left and right lift cylinders (at the maximum height)	Adjust shim stack thickness
Mast makes noise	Defective roller rotation	Adjust or replace rollers after inspection
Drift (natural descent) of lift cylinders	Lift cylinder packing is damaged	Replace
	Sliding (inside) surface of lift cylinder tube is damaged	Replace
Whole mast shakes	Mast-support bushing or metal worn	Tighten or replace bushing metal
Mast is distorted	Off-center load or overload	Replace mast assembly
Fork tips are different in height	Distortion of finger bar	Repair or replace
	Distortion of forks	
	Uneven loading	

2.8 Suggestions for Disassembling Mast and Lift Bracket

Removing first lift cylinders

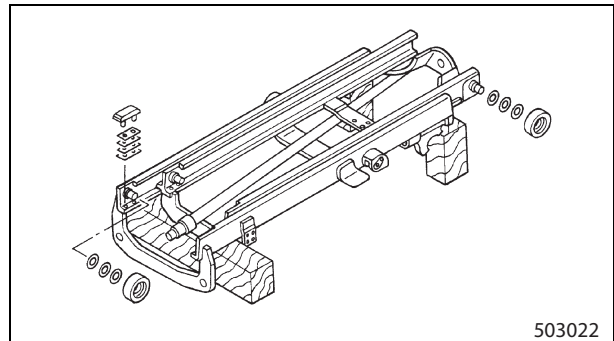
- (1) Remove the first lift cylinder mounting bolt.
- (2) Tie two slings securely to the first lift cylinder, and gently lift the cylinder.



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Removing main rollers and mast strips

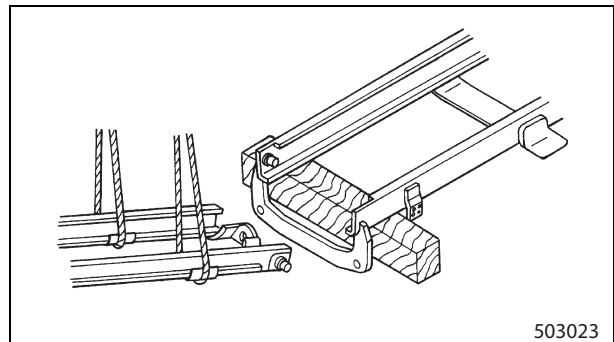
- (1) Remove the clamp bolts from the second lift cylinders.
- (2) Remove the set bolts from the top of the second lift cylinder rods. Then place the cylinder rod ends on the outer mast.
- (3) Count and record the number and thickness of shims that were installed at the top of cylinder rods.
- (4) Lower the inner mast, then remove mast strips and main rollers.



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Removing inner mast

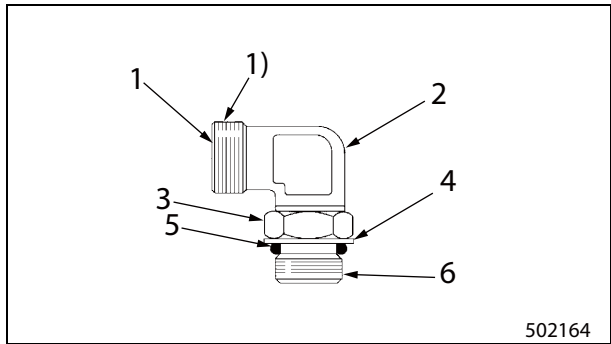
Hitch a sling to the inner mast and gently pull out the inner mast from the outer mast by clearing the outer mast roller shafts.



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Installation of a fitting with straight threads and O-ring seal

- (1) Apply grease or hydraulic oil to O-ring and O-ring seat on the housing side.
- (2) Turn locknut so that it moves up against the body of the fitting. Move the back-up washer and O-ring seal against locknut.
- (3) Tighten the fitting by hand. Once the O-ring seal is placed in the correct position of housing and the back-up washer comes in contact with the surface of housing, turn it back to adjust the mounting direction. Never loosen the body fitting more than one turn.
- (4) Tighten the locknut to the specified torque.

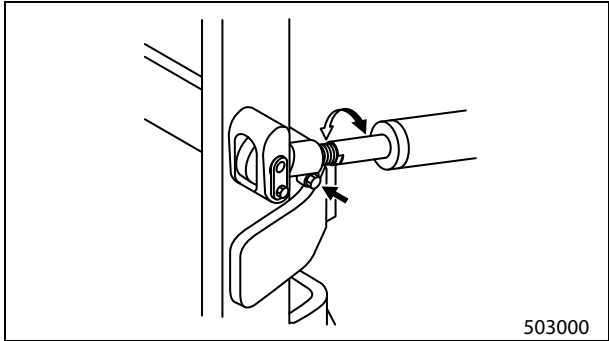


- | | |
|---|---------------------------------------|
| 1. End of fitting body
(for hose connection) | 5. O-ring seal |
| 2. Fitting body | 6. Threaded portion to the
housing |
| 3. Locknut | 1) Shape varies by fitting type |
| 4. Back-up washer | |

2.26 Adjusting Mast Tilt Angle (All Mast Models)

- (1) Adjust tire air pressure and park the truck on level ground.
- (2) Tilt the mast fully backward and turn the engine OFF.
- (3) Measure the backward tilt angle of the right and left masts.
- (4) Adjust the cylinder stroke by loosening the tilt cylinder socket bolt and then turn the tilt cylinder rod so that the backward tilt angle of the mast on each side is the same.

Note: Once the backward tilt angle has been properly adjusted, there is no need for forward tilt adjustment as it is determined by the tilt cylinder stroke.



Item	Forward tilt angle	Backward tilt angle
Standard tilt angle	6°	12°

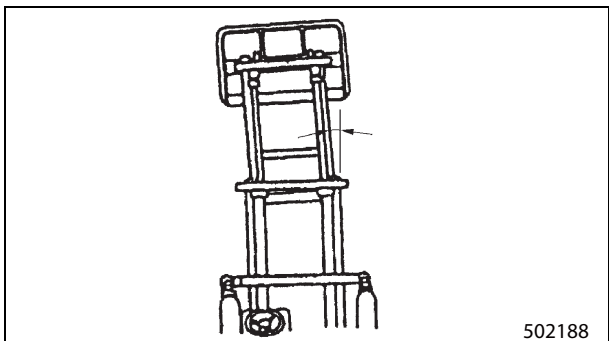
- (5) After adjustment, tighten the tilt cylinder socket bolts to the specified torque.

Item	Tightening torque
Tilt cylinder socket bolt	157 to 182 N·m (16.0 to 18.6 kgf·m) [115.80 to 134.24 lbf·ft]

2.27 Inspecting and Adjusting Right and Left Lift Cylinder Stroke (All Mast Models)

Inspection

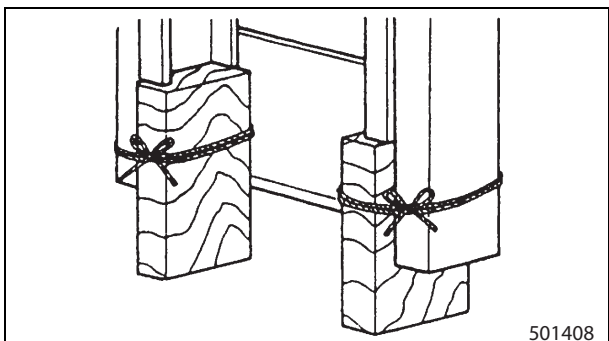
- (1) Slowly raise the inner mast, and observe how the piston rods, left and right, stop at the moment the inner mast reaches its maximum height.
- (2) If the top of the inner mast jolts at that moment, adjust shim thickness. Abnormal condition can be detected by a little time lag in stopping between the piston rods, left and right, and shaking of the rod with a longer cylinder stroke.



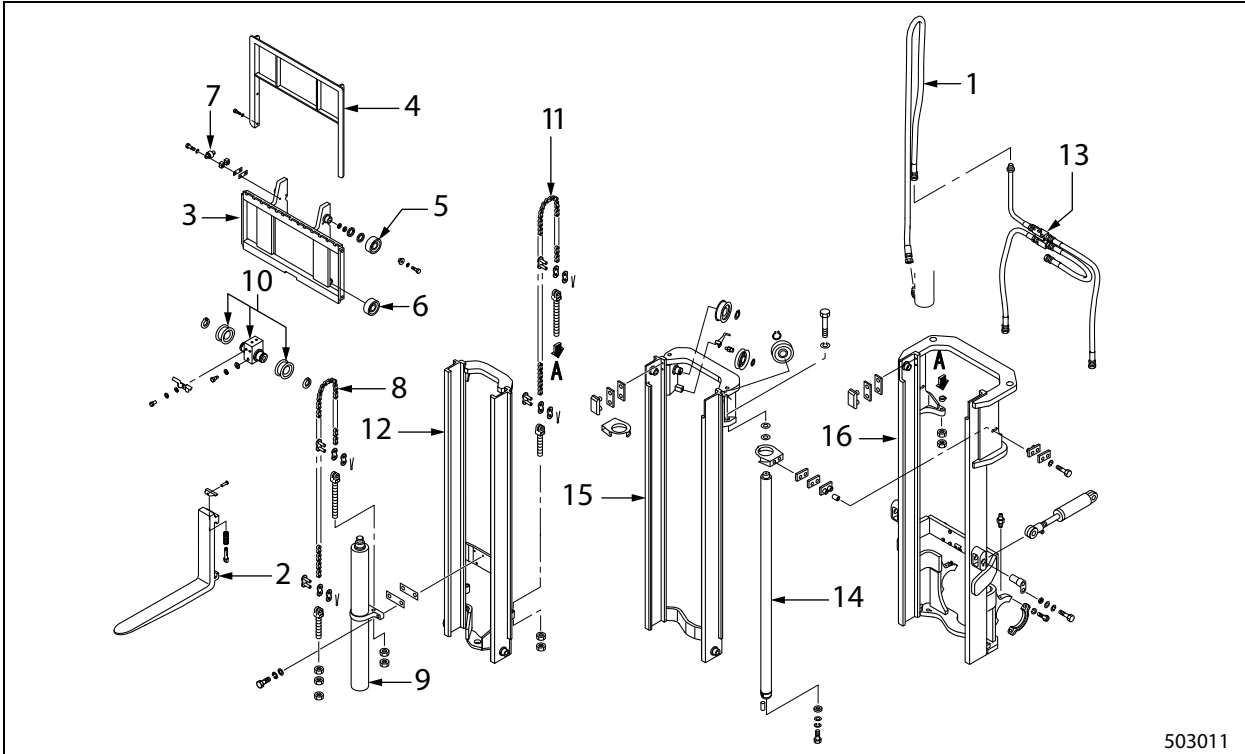
Adjustment

- (1) Raise the inner mast, place wood blocks under the right and left sides of the inner mast, and lower the mast until it rests on the wood blocks.
- (2) Remove the set bolt at the top of lift cylinder which showed earlier stroke end, retract the piston rod, and insert shims at the top of piston rod end.

Note: When retracting the piston rod, push the lift lever to lowering direction for releasing the oil in the cylinders.



3.6 Disassembly Sequence of Mast and Lift Bracket (All Mast Models)



503011

- | | |
|---|---|
| 1. First cylinder hose | 9. First lift cylinder |
| 2. Forks | 10. Chain wheel |
| 3. Lift bracket | 11. Lift chain (for second lift cylinder) |
| 4. Backrest | 12. Inner mast |
| 5. Lift bracket upper rollers, Middle rollers | 13. Hose |
| 6. Lift bracket lower roller | 14. Second lift cylinder |
| 7. Lift bracket side rollers | 15. Middle mast |
| 8. Lift chain (for first lift cylinder) | 16. Outer mast |

Note: The lift bracket disassembly procedure is the same as that of the simplex mast.

3.7 Preparation for Disassembling Mast and Lift Bracket

Lay the mast assembly horizontally on wood blocks with the lift bracket side facing up.

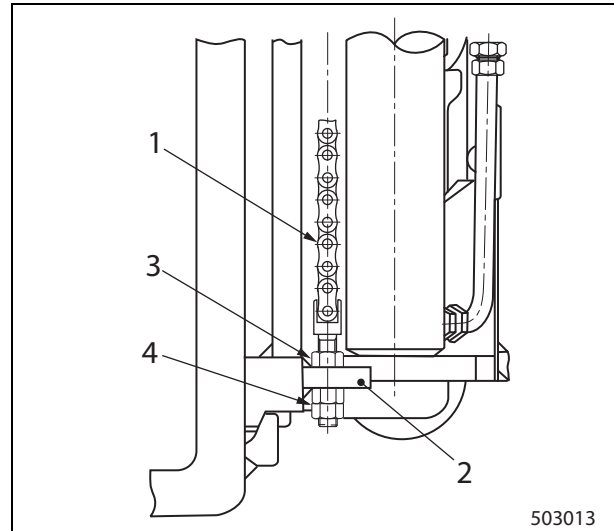
Place a wood block so that it stops the inner and middle masts from falling down.

Before disassembling the mast and fork assembly, measure and record all clearances between each lift bracket and roller and between each mast and roller. Recorded measurements will be helpful when replacing rollers or selecting shims to adjust clearances.

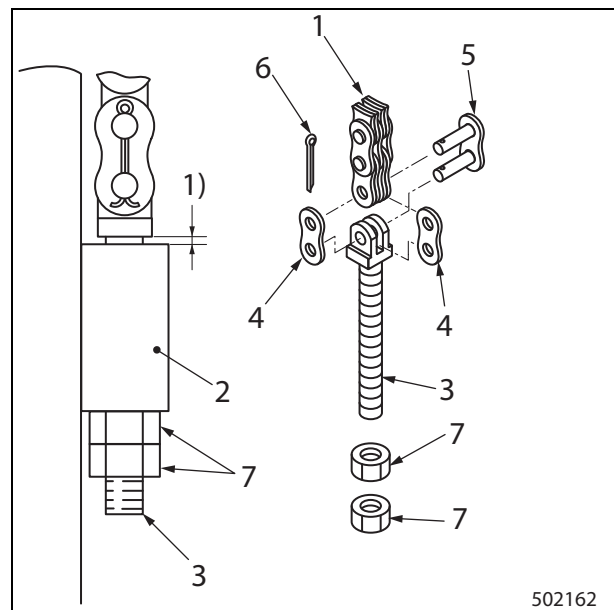
3.16 Connecting Chains

Assemble chains on the lift bracket as shown in the figure.

After assembly is completed, maintain clearance 1) between chains with locknuts to allow for chain tension.



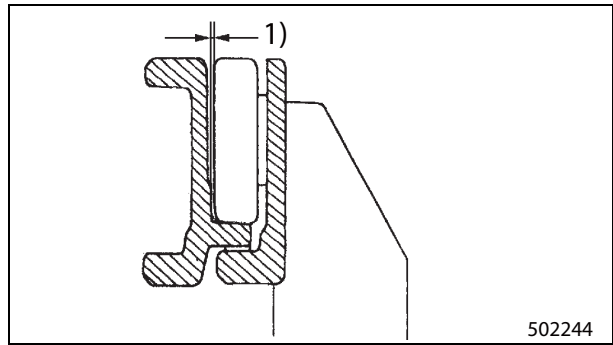
- 1. Chain
- 2. Lift bracket
- 3. Locknut (single nut side)
- 4. Locknut (double nut side)



- 1. Chain
- 2. Lift bracket
- 3. Anchor bolt
- 4. Center plate
- 5. Link
- 6. Split pin
- 7. Nut
- 1) Clearance

Item		Specified value		
		2 ton class	3 ton class	
3	Locknut (single nut side)	Tightening torque	$56.0^{+0}_{-9.8}$ N·m (5.71-1.0 kgf·m) [41.30-7.23 lbf·ft]	$84.3^{+0}_{-11.8}$ N·m (8.60-1.20 kgf·m) [62.18-8.70 lbf·ft]
4	Locknut (double nut side)		98^{+49}_{-0} N·m (9.99 ^{+5.0} ₀ kgf·m) [72.28 ^{+36.14} ₀ lbf·ft]	147^{+49}_{-0} N·m (14.99 ^{+5.0} ₀ kgf·m) [108.42 ^{+36.14} ₀ lbf·ft]

- (5) Measure the clearance between outer mast and inner mast main roller.
- (6) If clearance deviates from the specified value, adjust shim thickness.
For adjustment, refer to 11-73 "Installing Mast Rollers (All Mast Models)".

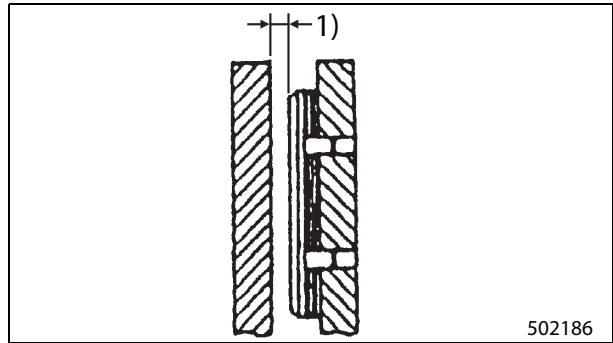


1) Clearance between main roller side face and mast

Ref.	Item	Standard
1)	Clearance between main roller side face and mast	0.1 to 0.5 mm (0.004 to 0.020 in.)

3.25 Inspecting and Adjusting Mast Strip Clearance (All Mast Models)

- (1) Measure the clearance with the clearance between the outer mast rollers and the inner mast rolling face adjusted to 0 mm (0.00 in.) at the maximum lift position.
- (2) If mast strip clearance deviates from the specified value, adjust shim thickness.
For adjustment, refer to 11-74 "Adjusting clearance between mast and mast strip".



1) Clearance between mast and mast strip

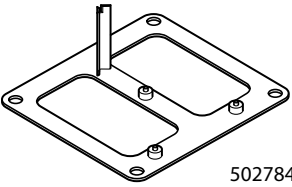
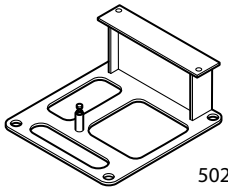
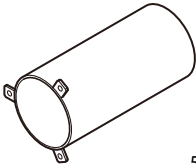
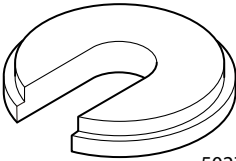
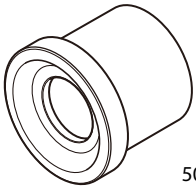
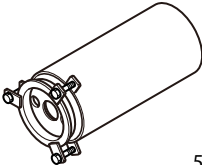
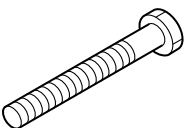
Ref.	Item	Standard
1)	Clearance between mast and mast strip	0.1 to 0.5 mm (0.004 to 0.020 in.)

- (3) After all clearances are adjusted, move the mast and lift bracket slowly, and check whether the full stroke movement is smooth.

System	Check items		Pre-start (daily/10 hours)	Every 50 hrs or weekly	1st month (200 hrs)	Every 500 hrs or 3 months	Every 1000 hrs or 6 months	Every 2000 hrs or 12 months	Others (see note 1)
			×						
Transmission Drive	Accelerator pedal	Check	×						
	Clutch	Check	×						
	Differential oil	Check			×	×			
	Inching pedal	Check	×						
	T/M gear and bearing	Check						×	
	Transmission oil (incl. torque converter oil)	Check	×						
	Last change filter (T/M control valve)	Clean					×		
	T/M strainer, cleaning	Check					×		
	Inching pedal	Check						×	
	Differential oil	Replace					×		
	Transmission oil (incl. torque converter oil)	Replace					×		
	Universal joint	Lubricate					×		
	Wheel	Tires and rims	Check	×					
Wheel and nuts		Check	×						
Knuckles		Check						×	
General	Oil, fuel, and coolant leaks (walk around)	Check	×						
	Abnormalities found at previous day	Check	×						

5. Special tools

5.1 Special Service Tools (Powershift Transmission)

No.	Name	Part number	Figure	Use	Truck classifications	
					2 ton class	3 ton class
1	Stand	91A68-03500	 502784	Transmission installation	×	×
2	Stand kit	91A68-00020	 502770	Holding transmission assembly	×	×
3	Stand (Clutch pack stand kit component)	91A68-01300	 502771	Holding idler shaft assembly Output gear stand Input shaft assembly stand	×	×
4	Stand	91A68-02100	 502778	Idler shaft assembly stand	×	×
5	Stand	91A68-01700	 502775	Forward gear assembly stand Reverse gear assembly stand Oil pump assembly stand	×	×
6	Clutch pack stand kit	91A68-00010	 502769	Disassembling and Reassembling Clutch Pack	×	×
7	Bolt (Clutch pack stand kit component)	67284-15400	 502766	Oil pump removal Idler gear bearing outer race removal	×	×

(6) Switches, control, and protective devices

Symbol	Name
	Switch (N.O)
	Switch (N.C)
	Two position switch
	Emergency switch
	Push button switch
	Switch (Auto return)

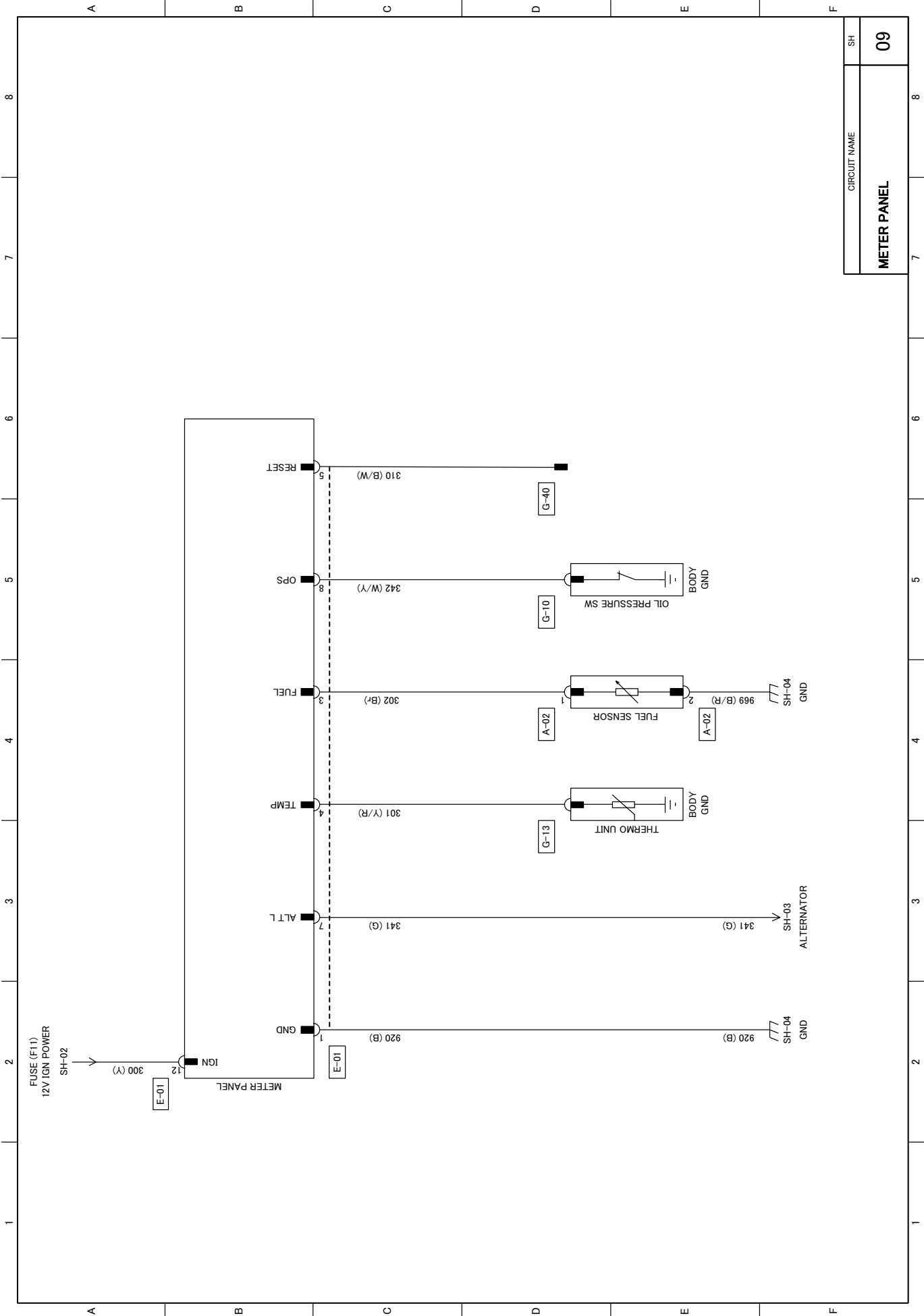
Symbol	Name
	Oil pressure switch
	Magnetic contactor
	Fuse
	Thermistor
	Magnetic coil
	Proximity sensor

(7) Indicators, lamps, and signal devices

Symbol	Name
	Lamp
	Buzzer

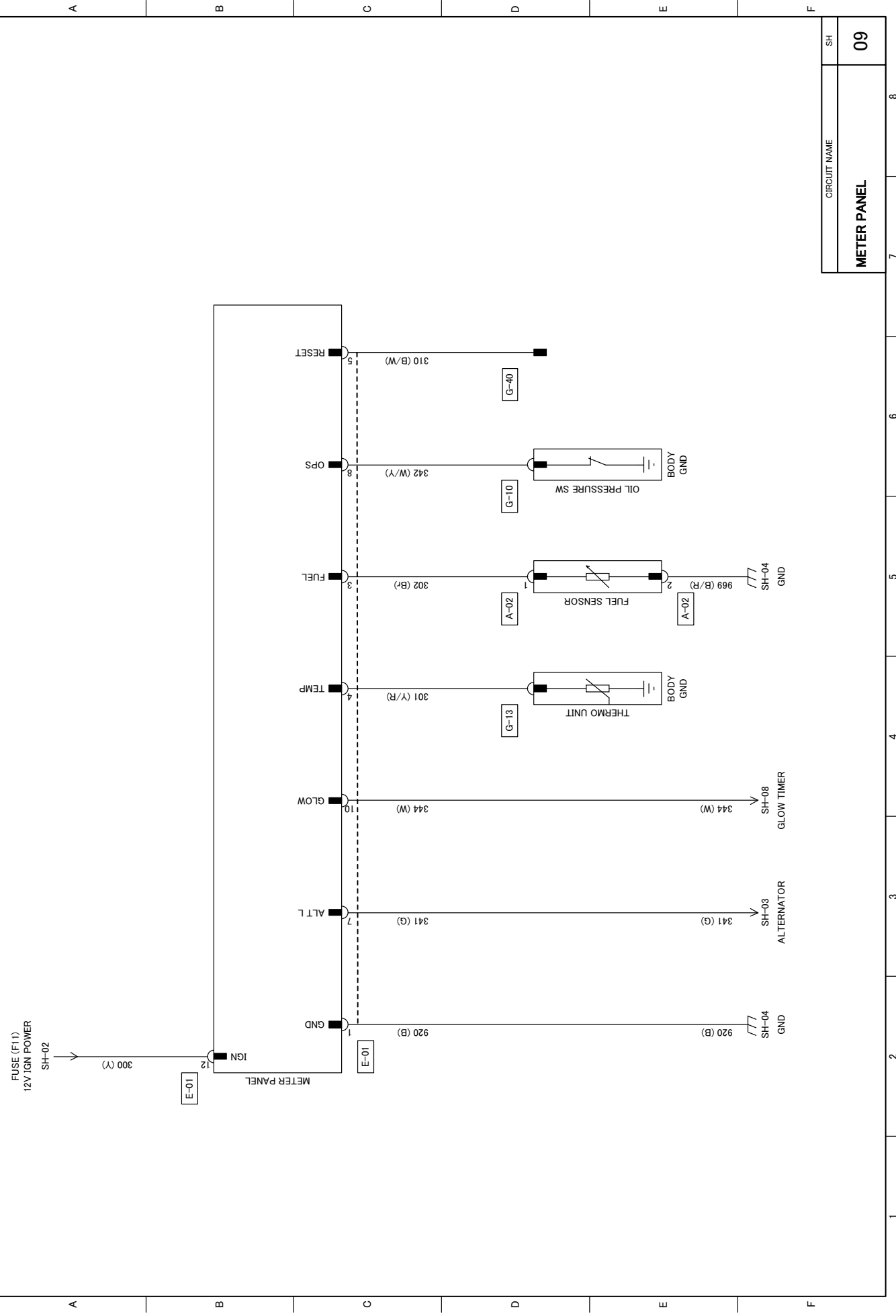
Symbol	Name
	Horn

Chapter 14 CIRCUIT DIAGRAM FOR DUAL GAS/LPG ENGINE MODELS



CIRCUIT NAME	SH
METER PANEL	09

Chapter 15 CIRCUIT DIAGRAM FOR DIESEL ENGINE MODELS



CIRCUIT NAME	SH
METER PANEL	09



Service Manual

S4S Diesel Engine (Tier 2)

Causes of Engine Problems and Remedies

Problems/Symptoms		Hard starting								Not enough power			Exhaust smoke abnormal						Engine hunts	
		Engine turns				Engine does not turn				Small amount of exhaust smoke	Large amount of white exhaust smoke	Large amount of black exhaust smoke	At idling	In operation		Engine produces loud knocking sound	Engine produces abnormal noise	Engine produces irregular combustion sound	At idling	In operation
		No exhaust smoke	Small amount of exhaust smoke	Large amount of exhaust smoke	Cranking speed low	Engine can be cranked manually	Engine cannot be cranked manually	Glow plugs do not produce red heat	Glow plugs produce red heat too fast					White	Black					
		Possible causes																		
Fuel System	No fuel to injection pump	○	○	—	—	—	—	—	—	○	—	—	—	—	—	—	—	—	—	—
	Greater variance of fuel injection quantity	—	—	○	—	—	—	—	—	—	—	○	○	—	○	○	—	○	○	○
	Injection pump oil seals defective	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Insufficient fuel injection volume	○	○	—	—	—	—	—	—	○	—	—	—	—	—	—	—	—	—	—
	Excessive fuel injection volume	—	—	—	—	—	—	—	—	—	—	—	—	○	—	—	—	—	—	—
	Injection nozzle defective	—	—	○	—	—	—	—	—	—	—	○	○	○	○	○	—	○	○	○
	Excessive fuel return from injection nozzles	—	○	—	—	—	—	—	—	○	—	—	—	—	—	—	—	○	○	—
	Injection timing is too advanced	—	—	○	—	—	—	—	—	—	○	—	—	○	○	○	—	—	—	—
	Injection timing is too retarded	—	—	○	—	—	—	—	—	—	—	○	○	—	—	—	—	○	○	—
	Engine speed is too low	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	○	—
	Failure to stop	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Improper fuel	—	—	○	—	—	—	—	—	—	○	○	○	○	○	○	—	—	—	—
	Fuel viscosity is too high	○	○	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lubrication System	Improper oil quality	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Oil viscosity is too high	—	—	—	—	○	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Oil viscosity is too low	—	—	—	—	—	—	—	—	—	—	—	○	—	—	—	—	—	—	
	Oil pressure does not rise	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Oil leaks	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	Excessive pumping up of oil	—	—	—	—	—	—	—	—	—	—	—	—	○	○	○	—	—	—	
	Clogged oil filter	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Oil pressure switch or lamp defective	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
Air Intake System	Insufficient intake air	—	—	○	—	—	—	—	—	—	—	○	—	—	○	—	—	—	—	
	Insufficient compression pressure	—	—	○	—	—	—	—	—	—	○	○	○	○	○	—	○	○	○	
	Ambient temperature is too high, or ambient pressure is too low (high altitude)	—	—	—	—	—	—	—	—	—	—	○	—	—	○	—	—	—	—	



Mitsubishi Caterpillar Forklift Asia Pte. Ltd.
RCB No.: 199203169H
No.1, Tuas West Street
Singapore 637444

Group	Inspection Point		Nominal Value	Assembly Standard (Standard Clearance)	Repair Limit (Clearance)	Service Limit (Clearance)	Remark	
Cylinder head	Cylinder head	Warpage of gasket contact surface		0.05 (0.0020) or less	0.20 (0.0079)		Regrind if warpage is minor.	
		Compressed thickness of gasket	1.2 (0.05)	±0.05 (±0.002)				
	Valve and valve guide	Diameter of valve stem	Inlet valve	8 (0.31)	7.940 to 7.955 (0.3126 to 0.3132)		7.900 (0.3110)	
			Exhaust valve		7.920 to 7.940 (0.3118 to 0.3126)		7.850 (0.3091)	
		Clearance between guide and stem	Inlet valve		(0.065 to 0.095) ([0.0026 to 0.0037])		(0.150) ([0.0059])	
			Exhaust valve		(0.080 to 0.115) ([0.0032 to 0.0045])		(0.200) ([0.0079])	
		Height to top of valve guide		14 (0.55)	13.9 to 14.1 (0.5472 to 0.5551)			
	Valve seat	Angle		30°				
		Valve sinkage	Inlet valve	0.4 (0.016)	±0.1 (±0.004)		1.0 (0.039)	
			Exhaust valve	0.5 (0.020)				
		Width		1.4 (0.055)	±0.14 (±0.0055)		1.8 (0.071)	
		Valve margin			2.13 (0.0839)		Up to 1.83 (0.0720) by refacing	
	Valve spring	Free length		48.85 (1.92)			47.60 (1.87)	
		Squareness			1.5° or less			Squareness of ends with respect to center line
		Set length			43 (1.69)			
		Set force N (kgf) [lbf]			176 to 196 (1.8 to 20) [40 to 44]		147 (15) [33]	
	Rocker arm	Inside diameter of rocker bushing	19 (0.75)		19.010 to 19.030 (0.7484 to 0.7492)			
		Diameter of rocker shaft		18.980 to 19.000 (0.7472 to 0.7480)				
		Clearance between bushing and shaft			(0.010 to 0.050) ([0.0004 to 0.0020])	(0.070) ([0.0028])		
	Valve pushrod	Deflection			0.3 (0.012) or less			1/2 of dial indicator reading
Main moving parts	Crankshaft	Deflection			0.02 (0.0008) or less	0.05 (0.0020)		
		Journal diameter	78 (3.07)	77.955 to 77.970 (3.0691 to 3.0697)	77.850 (3.0650)	77.100 (3.0354)		
		Crankpin diameter	58 (2.28)	57.955 to 57.970 (2.2817 to 2.2823)	57.800 (2.2756)			
		Center to center distance between journal and crankpin	60 (2.36)		±0.04 (±0.0016)			
		Parallelism between journal and crankpin			Runout : 0.01 (0.004) or less (over crankpin length)			

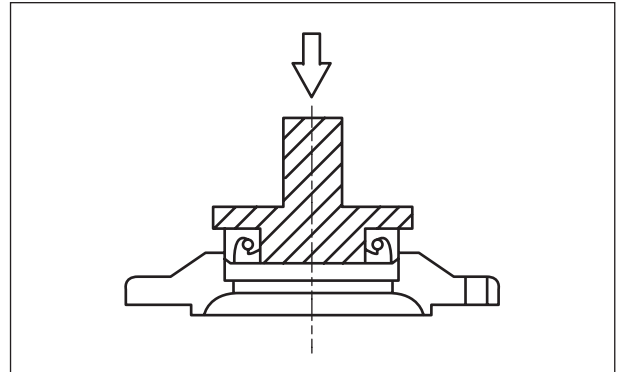
4. Precautions for Disassembly and Reassembly

4.1 Oil Seals

When installing oil seals, use care for the following points.

Driving oil seals into housings

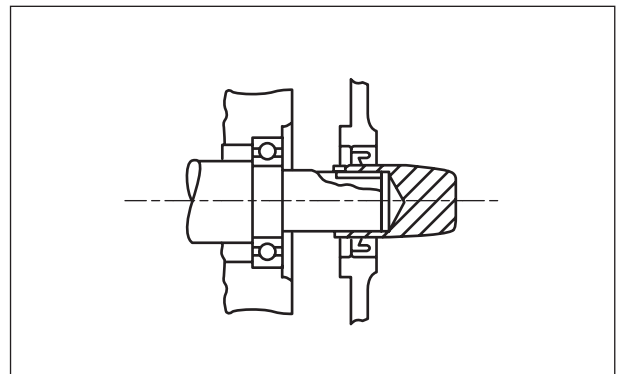
- (1) Check the seal lip for damage, and be sure to position correctly in the housing.
- (2) Apply a smear of grease to the surface of the oil seal (contact side with housing).
- (3) Using an oil seal driver as shown in the right to guide the seal lip and drive the outer diameter squarely. To avoid damage to the oil seal and leaking, never hammer on it directly.



Oil seal installer

Driving oil seals onto shafts

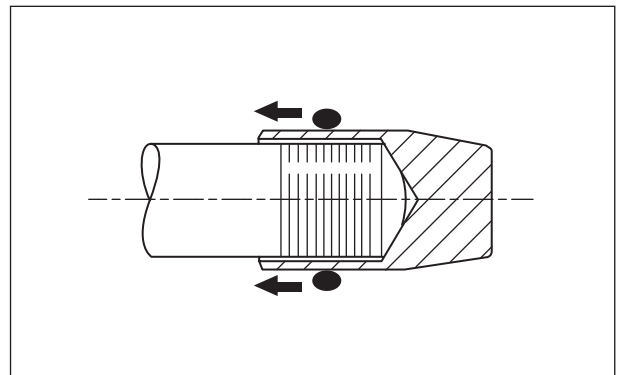
- (1) Apply a smear of grease to the oil seal lip.
- (2) Use an oil seal guide like the one shown in the right when driving the oil seal over the stepped portion, splines, threads, or key way to prevent damage to the oil seal lip.



Oil seal guide

4.2 O-rings

Use an O-ring guide to install an O-ring over stepped parts, splines, threads, or key way to prevent damage to the ring. Apply a smear of grease to the O-ring before installation.



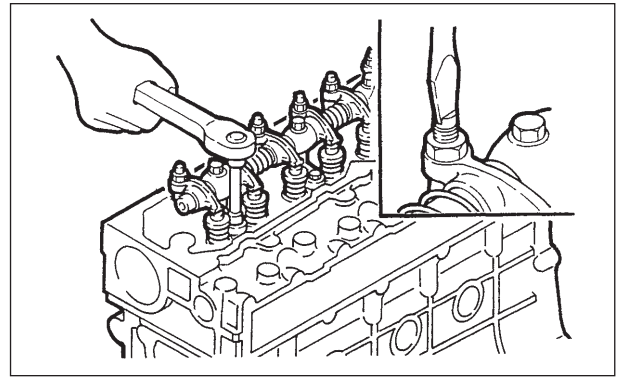
O-ring guide

7.1 Removing Rocker Shaft Assembly

- (1) Loosen the adjusting screw one turn.
- (2) Loosen the bolts, short and then long, that hold the rocker shaft bracket to the cylinder head. Be sure to loosen the short bolt first. Remove the rocker shaft assembly from the cylinder head.

CAUTION

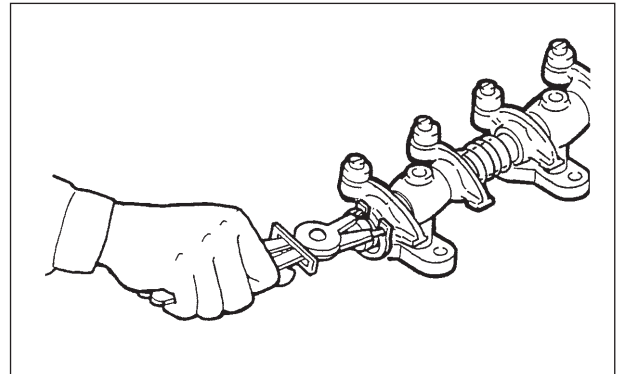
If the long bolt is loosened first, the rocker shaft bracket might suffer damage.



Removing rocker shaft assembly

7.2 Disassembling Rocker Shaft Assembly

Arrange the disassembled rockers in the order removed so that you can install them in that order at reassembly. This will ensure the same rocker shaft clearance as it was.



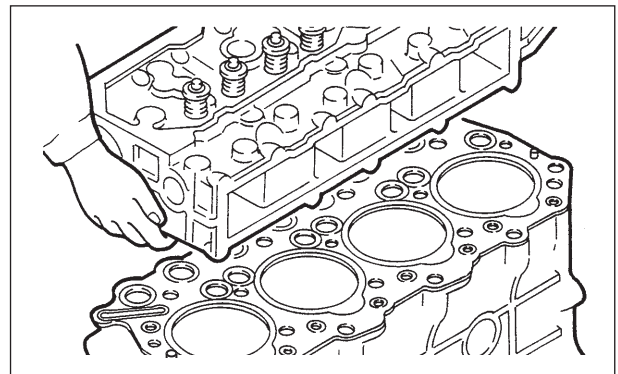
Disassembling rocker shaft assembly

7.3 Removing Cylinder Head

Remove the cylinder head bolts. Lift the head off the crankcase.

NOTE

Use care when removing gaskets from cylinder heads. Do not damage contact surfaces of cylinder and crankcase. If any parts of the cylinder head are faulty, check the cylinder head bolts for torque with a torque wrench before removing them.



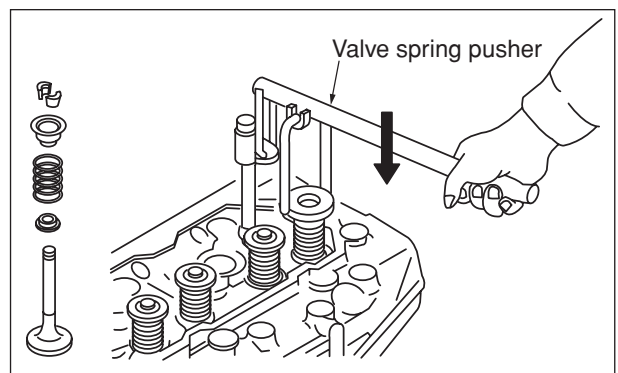
Removing cylinder head

7.4 Removing Valves and Valve Springs

Use valve spring pusher (30691-04500) to compress the valve spring squarely, then remove the valve cotters.

NOTE

If the existing valves are to be reused, put a mark on each valve for its location.



Removing valves and valve springs

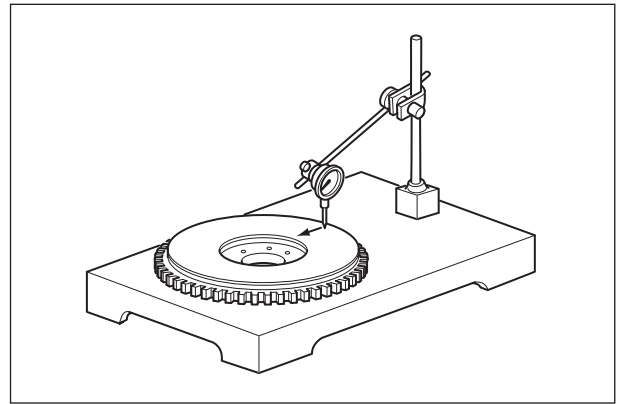
2. Inspection and Repair, Flywheel and Timing Gear

2.1 Measuring Flatness of Flywheel

Put the flywheel on the surface plate. Set a dial indicator at one side of the friction surface and move it over to the opposite side of the surface as shown in the illustration. If the friction surface is not flat within the repair limit, grind it.

Unit: mm (in.)

Item	Assembly Standard	Repair Limit
Flatness of flywheel	0.15 (0.0059) or less	0.50 (0.0197)

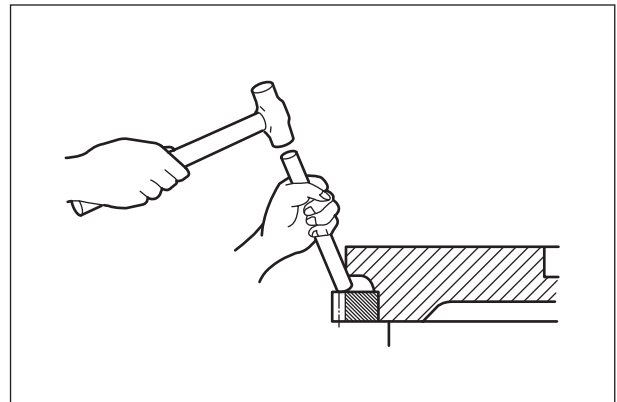


Checking flywheel

2.2 Replacing Ring Gear

Check the ring gear and replace it by the following procedure if it has missing teeth or shows evidence of abnormal abrasion on the tooth surface.

- (1) Heat the ring gear evenly with an acetylene torch.
- (2) Tap the ring gear all the way around with a bar and a hammer to remove it from the flywheel.



Removing ring gear

2.3 Installing Ring Gear

Heat a replacement ring gear up to 100°C (212°F) with a piston heater and install it to the flywheel with the unchamfered side of the gear teeth foremost.

NOTE

Do not heat ring gear excessively.

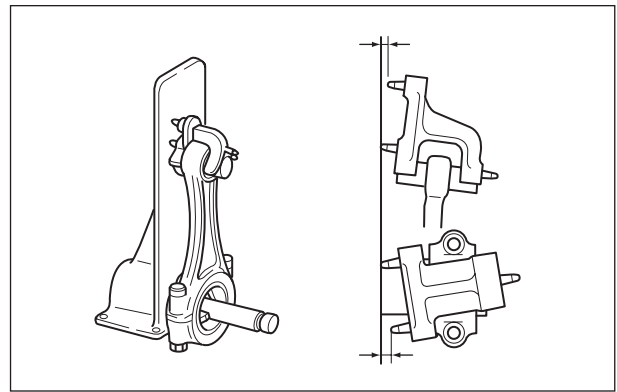
INSPECTION AND REPAIR, ENGINE MAIN PARTS

- (2) A connecting rod aligner is generally used for checking the connecting rod for twist and bend.

NOTE

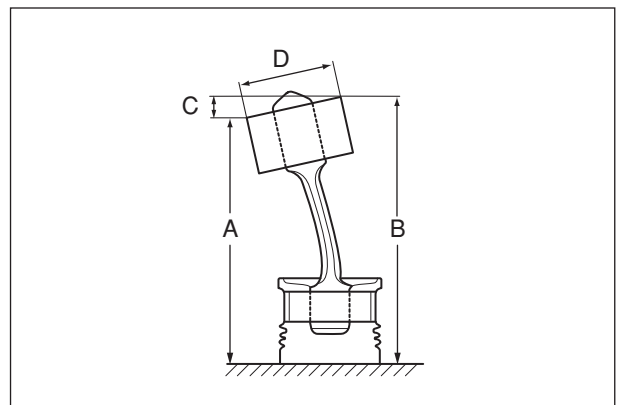
To check the connecting rod for bend, install the cap to the rod and tighten the cap nuts to the specified torque.

Tightening torque	$54 \pm 5 \text{ N}\cdot\text{m}$ ($5.5 \pm 0.5 \text{ kgf}\cdot\text{m}$) [$40 \pm 4 \text{ lbf}\cdot\text{ft}$]
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Checking connecting rod with a connecting rod aligner

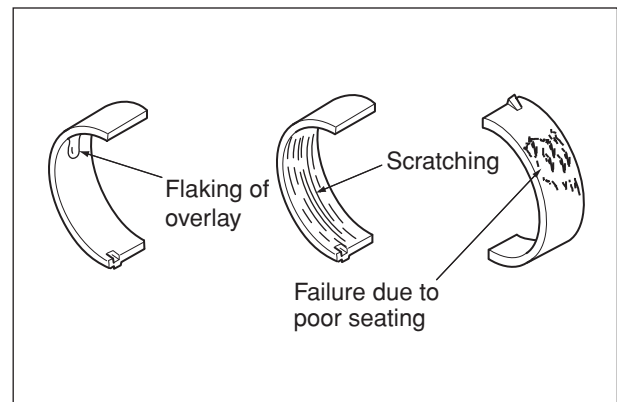
- (3) When the measurement is taken with the piston installed to the connecting rod, place the piston upside down on a surface plate, insert a round bar having the same diameter as the crank pin, and measure the height of the round bar using a dial gage.



Checking connecting rod with a dial indicator

3.12 Inspecting Connecting Rod Bearings

Check each bearing for flaking of overlay, scratching, burning, pitting or other defects. Replace defective bearings if any.

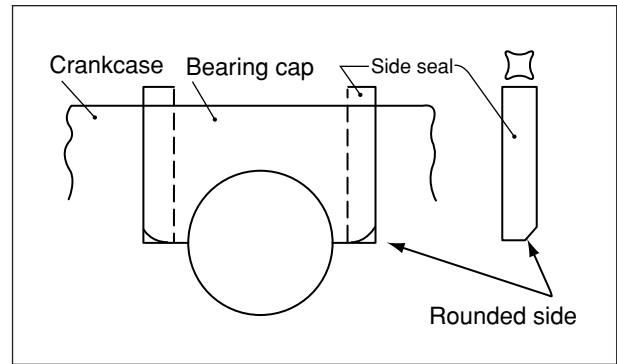


Checking connecting rod bearing

- (3) Apply soapy water to the side seals and put the seals in the groove in each bearing cap with rounded side toward outside. Push them into position with the blade of a screwdriver or the like, taking care not to bend or twist them.
- (4) Apply ThreeBond 1212 to and around the side seals.

NOTE

Install the main bearing caps in number sequence.



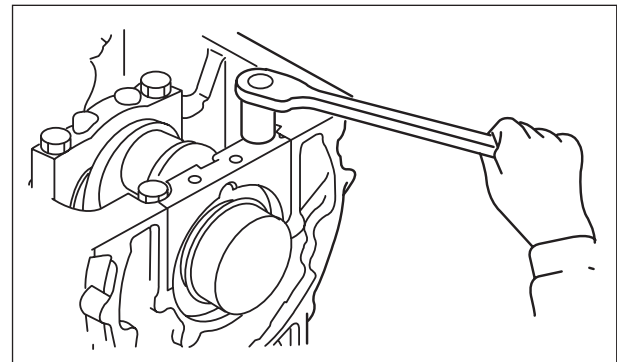
Installing side seals

1.4 Installing Main Bearing Cap Bolts

- (1) Apply engine oil to the bolts and tighten them to the specified torque.

Tightening torque for main bearing cap bolts	98 to 108 N·m (10.0 to 11.0 kgf·m) [72 to 80 lbf·ft]
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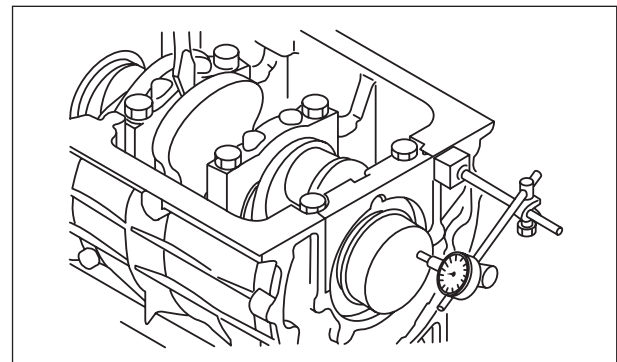
- (2) Make sure crankshaft rotates smoothly.



Installing main bearing cap bolts

1.5 Measuring Crankshaft End Play

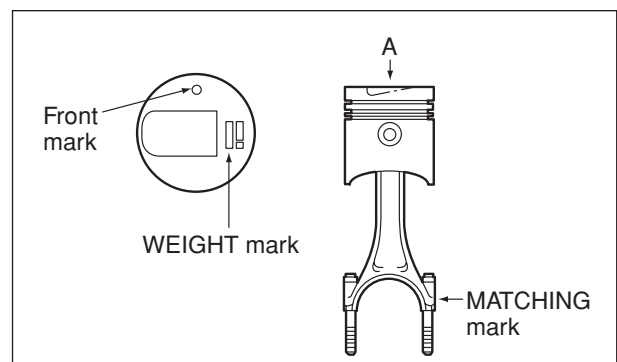
After installing the bearing caps, check the end play of the crankshaft.



Measuring crankshaft end play

1.6 Assembling Piston and Connecting Rod

- (1) Assemble the piston and the connecting rod with the WEIGHT mark of the piston and the MATCHING mark of the rod on the same side.
- (2) Apply engine oil to the piston pin and insert the pin into position.



Assembling piston and connecting rod

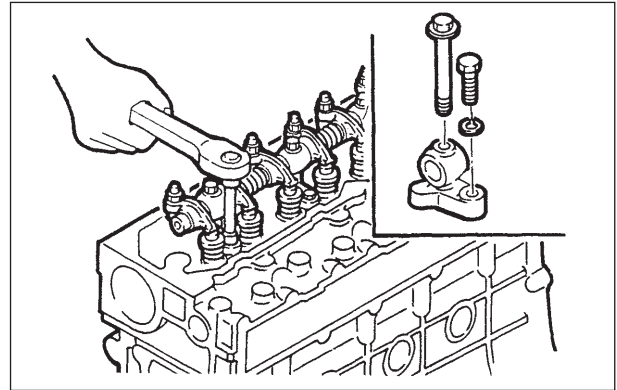
4.5 Installing Valve Pushrod

- (1) Insert the pushrod into position through the pushrod hole in the cylinder head.
- (2) Make sure the ball end of each pushrod rests securely on the curved surface (R section) of the tappet.

4.6 Installation of Rocker Shaft Assembly

- (1) Install valve caps.
- (2) When installing rocker shaft brackets, tighten the long bolts first, then tighten the short bolts (in reverse of removal sequence).

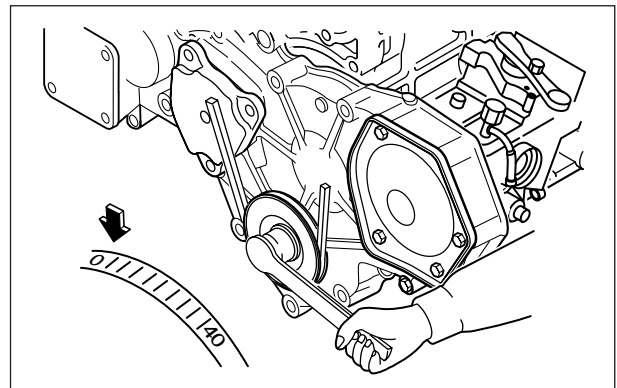
Tightening torque	$15 \pm 5 \text{ N}\cdot\text{m}$ $(1.5 \pm 0.5 \text{ kgf}\cdot\text{m})$ $[11 \pm 1 \text{ lbf}\cdot\text{ft}]$
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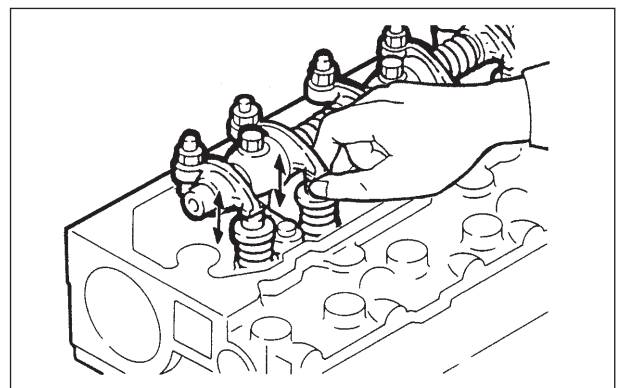
Installing rocker shaft assembly

4.7 Checking No.1 Piston Compression Top Dead Center

- (1) Find the top dead center on the compression stroke for No.1 piston as specified below:
 - (a) Using the turning socket wrench (58309-73100), turn the nut on the crankshaft pulley in the engine's forward rotating direction (clockwise when viewed from the front of the engine).
 - (b) Stop turning when the stamped "0" line on the periphery of the crankshaft pulley aligns with the pointer on the turning gear case.
 - (c) Try to move up and down the inlet and exhaust valve rocker arms of the No.1 cylinder to make sure they are not being pushed up by the pushrods. The No.1 piston is at the top dead center on the compression stroke when the rocker arms are not being pushed up by the pushrods. If the rocker arms are being pushed up, turn the crankshaft one turn.



Finding top dead center on compression stroke for No.1 piston-1

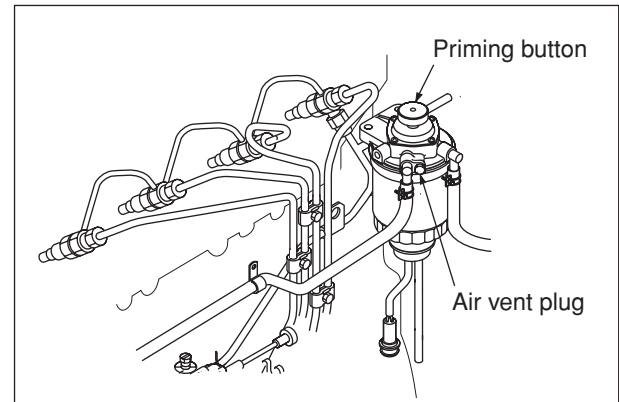


Finding top dead center on compression stroke for No.1 piston-2

4. Fuel System Bleeding

Fuel filter

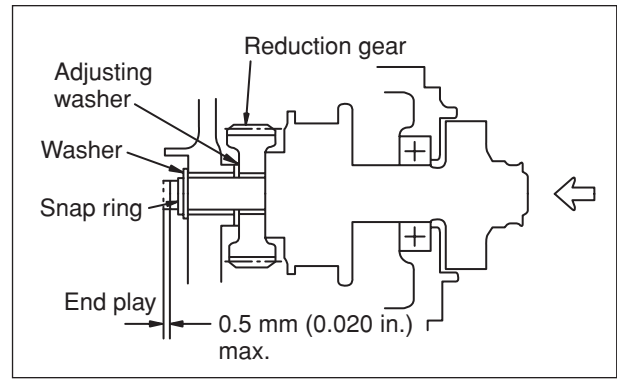
- (1) Loosen air vent plug on the fuel filter (by turning it 1.5 turns).
- (2) Pump the priming button on the fuel feed pump.
- (3) Tighten the air vent plug when the fuel flows free of bubbles.



(3) Adjusting pinion shaft end play

Using an appropriate number of adjusting washers in between the center bracket and reduction gear, adjust the end plate (thrust gap) to 0.5 mm (0.020 in.) or less.

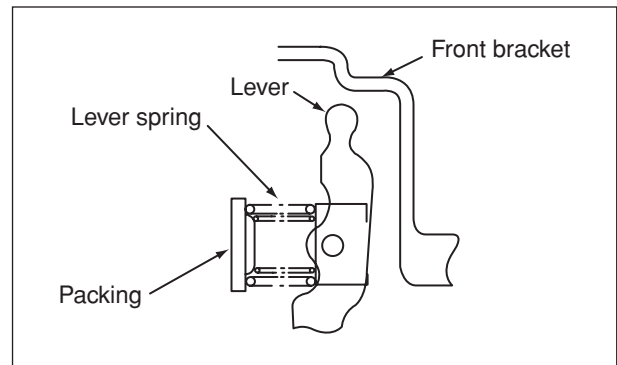
- (a) Assemble the pinion shaft, reduction gear, washer and snap ring to the center bracket.
- (b) Moving the pinion shaft in the axial direction, measure its end play. If the end play exceeds 0.5 mm (0.020 in.), increase the number of adjusting washer as required to reduce it to 0.5 mm (0.020 in.) or less.



Adjusting pinion shaft end play

(4) Installing lever

Install the lever facing in the correct direction.



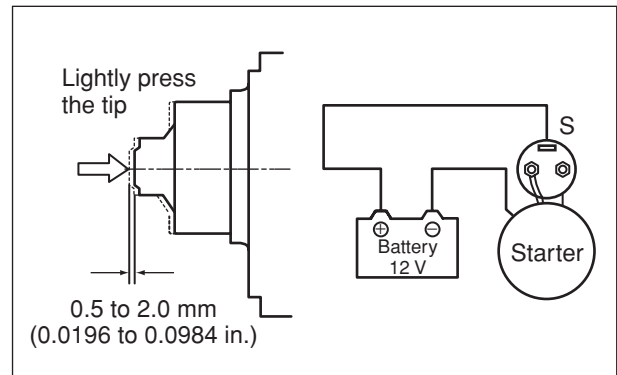
Installing lever

1.5 Inspection and Adjustment after Assembly

Following inspections and tests shall be performed after starter assembling.

(1) Checking pinion gap

With the pinion fully protruded, lightly press the pinion shaft end back with a finger. Measure the extent of shaft return to determine if the pinion gap is larger or smaller than 0.5 to 2.0 mm (0.0196 to 0.0787 in.). Make adjustment, if necessary, with the packing provided where the magnetic switch is fitted; increase the number of pieces of packing if the gap is larger and decrease otherwise.



Adjusting pinion gap

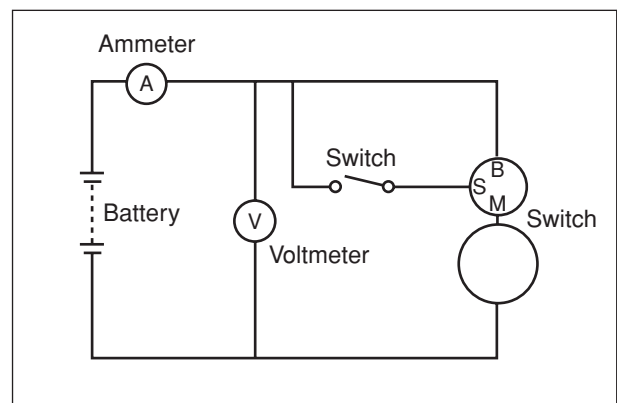
(2) No-load test

After adjusting the pinion clearance, hook up the starter as shown, and test it for no-load characteristics.



Use thick wires as much as possible and tighten each terminal securely.

Item	Voltage	Current	Speed
No-load characteristic	11 V	130 A or less	3800 min ⁻¹ or less



No-load test

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