



Service Manual

Chassis & Mast

FC/LC

FD100NM1	F15E-90011-99999
FD100NM1S	F15E-90011-99999
FD120NM1	F15E-90011-99999
FD120NM1S	F15E-90011-99999
FD135NM1	F15E-90011-99999
FD135NM1S	F15E-90011-99999
FD150ANM1	F24C-20011-39999
FD150ANM1S	F24C-20011-39999

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4.3	VCM Battery Voltage Warning (F02)	4-23
4.4	VCM Communication Warning (F03)	4-25
4.5	Meter Panel Communication Warning (F07)	4-27
4.6	Lift Lever Neutral Warning (F10)	4-28
4.7	Tilt Lever Neutral Warning (F11)	4-30
4.8	Attachment 1 Lever Neutral Warning (F12)	4-32
4.9	Attachment 2 Lever Neutral Warning (F13)	4-34
4.10	Attachment 3 Lever Neutral Warning (F14)	4-36
4.11	Direction Lever Warning (F16)	4-38
4.12	Vehicle Speed Warning (F17)	4-39
4.13	Lift Lever Warning (F20)	4-40
4.14	Tilt Lever Warning (F22)	4-42
4.15	Attachment 1 Lever Warning (F24)	4-44
4.16	Attachment 2 Lever Warning (F26)	4-46
4.17	Attachment 3 Lever Warning (F28)	4-48
4.18	Joystick Duplicate Warning (F29)	4-50
4.19	Vehicle Speed Sensor Warning (F34)	4-52
4.20	Output Unit Warning (F41)	4-53
4.21	Output Unit Supply Voltage Warning (F44)	4-54
4.22	Output Unit Communication Warning (F45)	4-56
4.23	Input Unit Warning (F46)	4-58
4.24	Input Unit Communication Warning (F49)	4-59
4.25	Lift up Solenoid Warning (F50)	4-61
4.26	Lift Down Solenoid Warning (F52)	4-63
4.27	Lift Solenoid Leak (F54)	4-65
4.28	Tilt Forward Solenoid Warning (F55)	4-68
4.29	Tilt Backward Solenoid Warning (F57)	4-70
4.30	Tilt Solenoid Leak (F59)	4-72
4.31	Attachment 1A Solenoid Warning (F60)	4-75
4.32	Attachment 1B Solenoid Warning (F62)	4-77
4.33	Attachment 1 Solenoid Leak (F64)	4-79
4.34	Attachment 2A Solenoid Warning (F65)	4-82
4.35	Attachment 2B Solenoid Warning (F67)	4-84
4.36	Attachment 2 Solenoid Leak (F69)	4-86
4.37	Attachment 3A Solenoid Warning (F70)	4-89
4.38	Attachment 3B Solenoid Warning (F72)	4-91
4.39	Hour Meter Gap Warning (F73)	4-93
4.40	Attachment 3 Solenoid Leak (F74)	4-94
4.41	Unload Solenoid Warning (F75)	4-97
4.42	Unload Solenoid Leak (F79)	4-99
4.43	Transmission Forward Solenoid Warning (F85)	4-101
4.44	Transmission Reverse Solenoid Warning (F87)	4-103
4.45	Transmission Solenoid Leak (F89)	4-105
4.46	VCM Speed Change Solenoid 1 Warning (F93)	4-107
4.47	VCM Setting Warning (F96)	4-109

Chapter 5 POWER TRAIN

1.	Specifications	5-1
2.	Structure	5-2

8.2	Suggestions for Assembly	13-10
9.	Inspecting and Adjusting Side Shifter Cylinder	13-10
10.	Troubleshooting	13-11

Chapter 14 FORK POSITIONER

1.	Applicable Attachment Models	14-1
2.	Specifications	14-2
2.1	Fork Positioner	14-2
2.2	Applicable Fork Blades	14-2
3.	Structure	14-3
4.	Removing Fork Positioner	14-4
4.1	Preparation	14-4
4.2	Removal Sequence of Fork Positioner (Simultaneous Move Type)	14-4
4.3	Removal Sequence of Fork Positioner (Independent Move Type)	14-5
4.4	Suggestions for Removing Fork Positioner	14-6
5.	Inspecting and Repairing Fork Positioner	14-7
6.	Installing Fork Positioner	14-7
6.1	Suggestions for Installation	14-7
7.	Disassembling Fork Positioner Cylinder	14-9
7.1	Disassembly Sequence	14-9
7.2	Suggestions for Disassembly	14-10
8.	Inspecting and Repairing Fork Positioner Cylinder	14-11
9.	Assembling Fork Positioner Cylinder	14-13
9.1	Assembly Sequence	14-13
9.2	Suggestions for Assembly	14-13
10.	Inspection and Adjustment After Assembling Fork Positioner ...	14-14
11.	Troubleshooting	14-15
12.	Service Data	14-16

Chapter 15 SERVICE DATA

1.	Maintenance Schedule.....	15-1
2.	Tightening Torques for Standard Bolts and Nuts	15-6
2.1	Metric Fine Thread	15-6
2.2	Metric Coarse Thread	15-8
3.	Periodic Replacement Parts	15-10
3.1	Location of Periodic Replacement Parts	15-10
4.	Lubrication Schedule	15-11
4.1	Lubrication Chart	15-11
4.2	Fuel and Lubricant Specifications	15-12
4.3	Adjustment Value and Oil Capacity	15-13
5.	Weight of Major Devices	15-14
6.	Special Tools	15-15

3. Removing Radiator and Intercooler

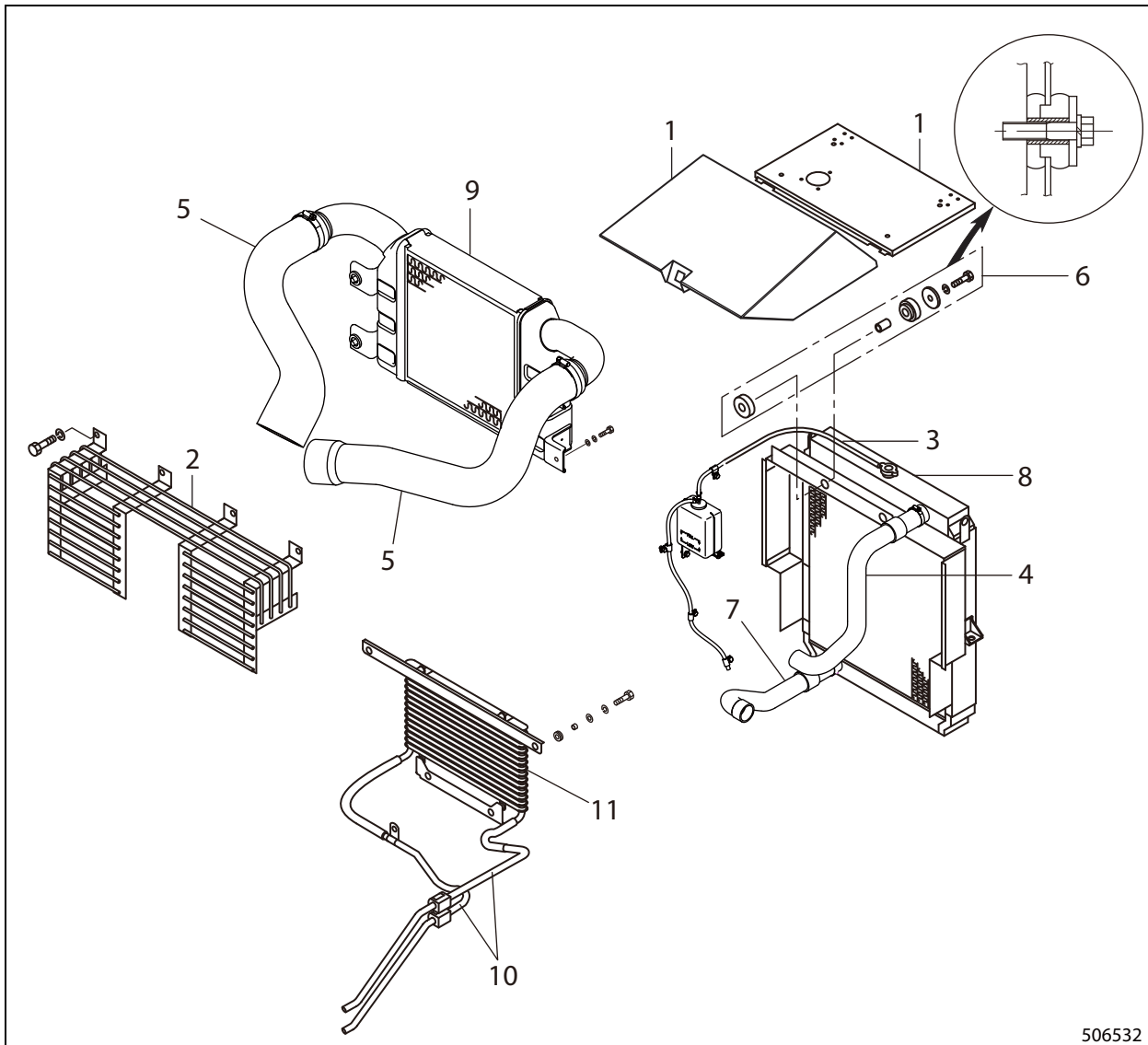
3.1 Preparation

Drain the coolant from the radiator by loosening the drain cock.

⚠ WARNING

Check the cooling water temperature is lowered enough before opening the drain cock.

3.2 Removal Sequence of Radiator and Intercooler

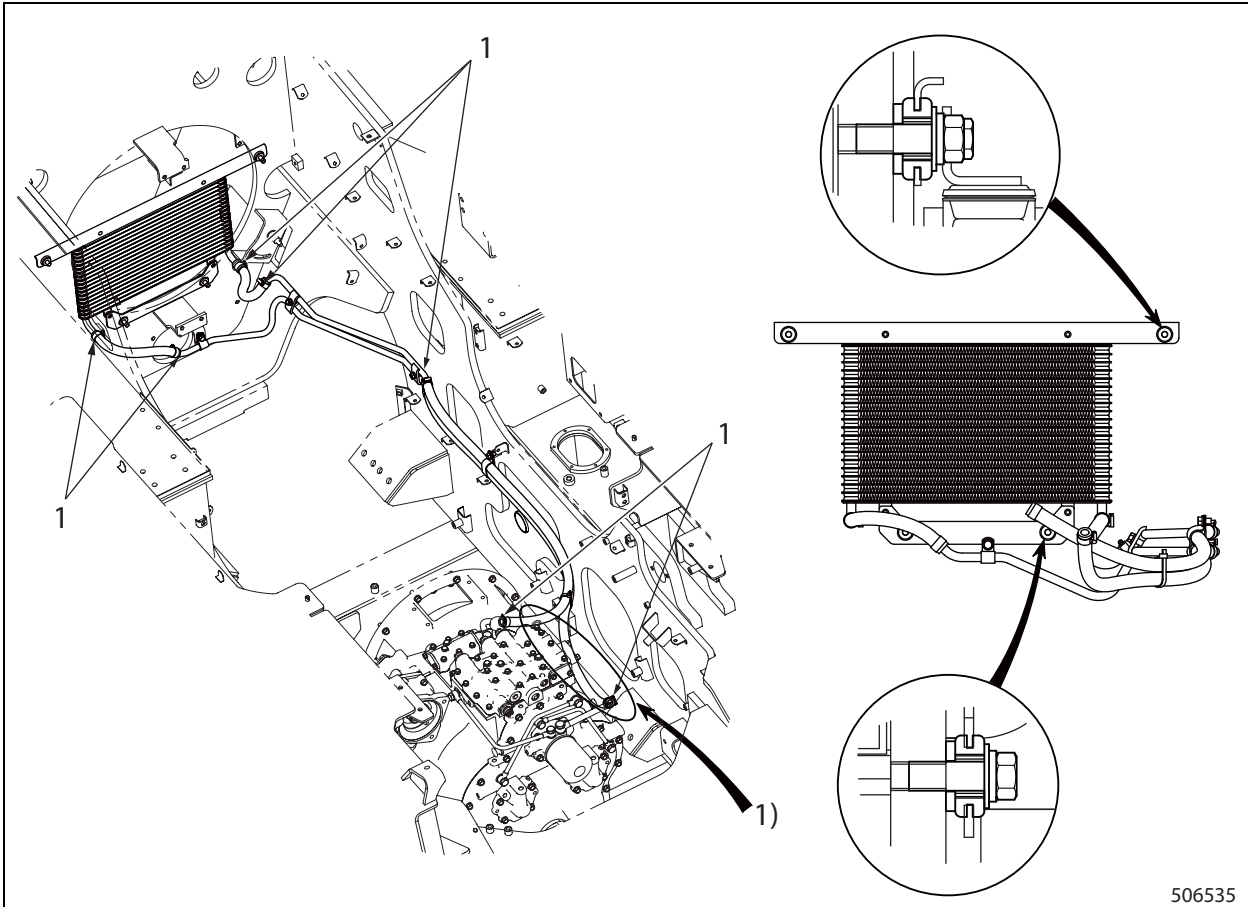


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- | | |
|----------------------------------|---------------------|
| 1. Engine cover, Radiator cover | 7. Radiator hose |
| 2. Fan guard | 8. Radiator |
| 3. Reserve tank hose | 9. Intercooler |
| 4. Radiator hose | 10. Oil cooler pipe |
| 5. Intercooler hose | 11. Oil cooler |
| 6. Grommet, Spacer, Washer, Bolt | |

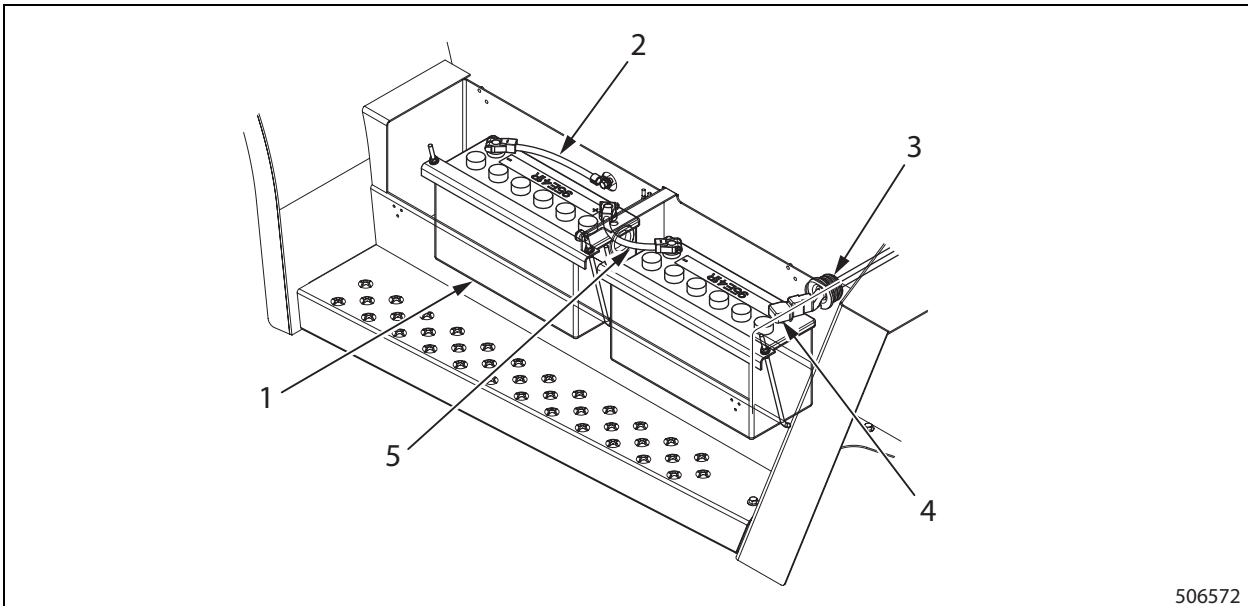
7.4 Oil Cooler

Ref.	Item	Specifications
1	Clamp	Tightening torque 5.0 to 6.8 N·m (0.51 to 0.69 kgf·m) [3.688 to 5.015 lbf·ft]



- 1) Clearance between rubber hose and transmission must be more than 10 mm (0.39 in.).

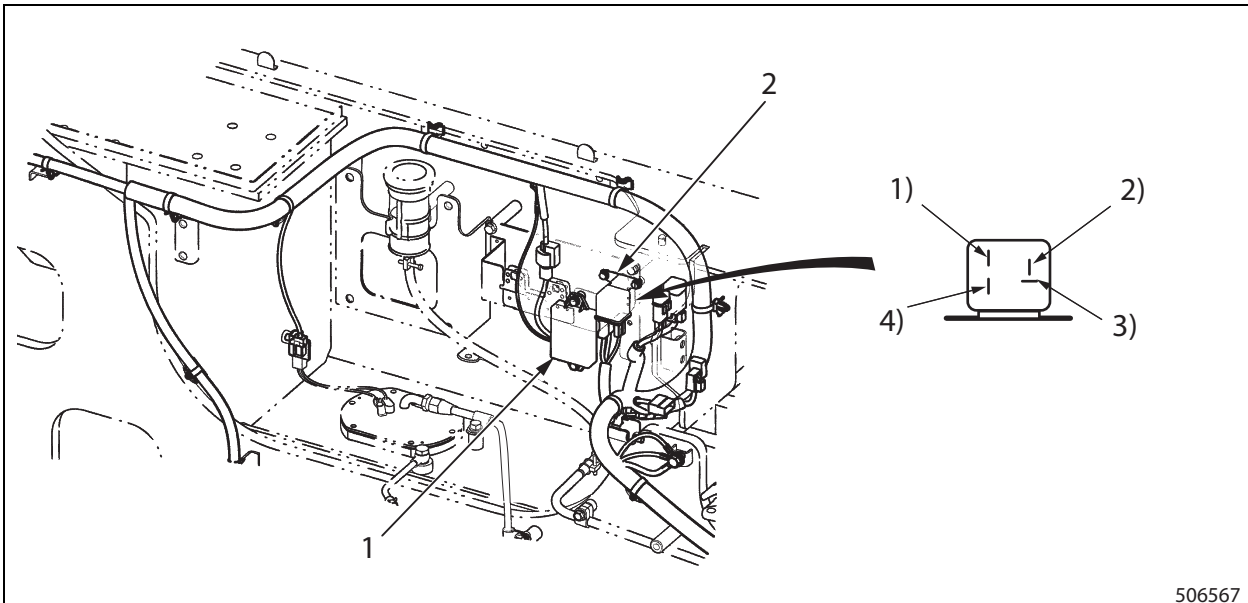
Battery



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|---|--|
| <p>1. Battery (12V)</p> <p>2. Battery cable (negative)
Tightening torque: 3.4 ± 0.3 N·m (0.35 ± 0.03 kgf·m)
[2.508 ± 0.221 lbf·ft]</p> <p>3. Grommet</p> | <p>4. Battery cable (positive)
Tightening torque: 2.5 ± 0.3 N·m (0.25 ± 0.03 kgf·m)
[1.844 to 0.221 lbf·ft]</p> <p>5. Battery cable
Tightening torque: 3.4 ± 0.3 N·m (0.35 ± 0.03 kgf·m)
[2.508 ± 0.221 lbf·ft]</p> |
|---|--|

Engine stop timer



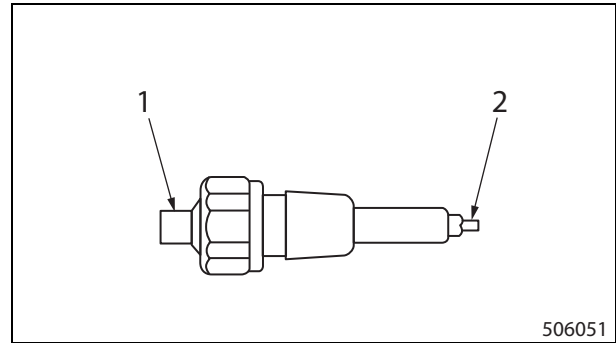
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- | | |
|--|---|
| <p>1. Engine stop timer</p> <p>2. Glow relay</p> | <p>1) Color: R/W</p> <p>2) Color: Y</p> <p>3) Color: G/W</p> <p>4) Color: R</p> |
|--|---|

Turn signal switch connection table

Lever position	Terminal	T-1	T-2	T-3
	Destination	Flash unit	Turn signal light (R side)	Turn signal light (L side)
R (RIGHT turn)		○-----	-----○	
N (NEUTRAL)				
L (LEFT turn)		○-----	-----	-----○

3.16 Low Air Pressure Switch



1. Case

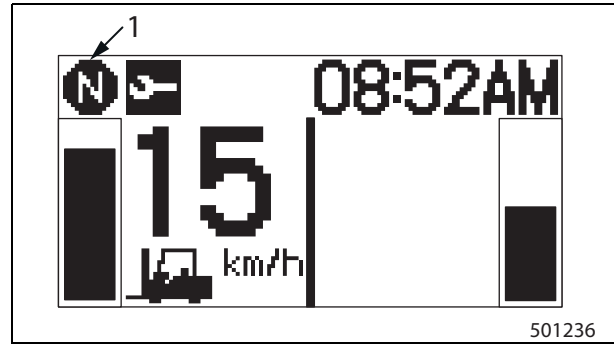
2. Terminal

Specification	
Rated load	24V
Insulation resistance	Resistance between terminal and case must be 1 M or above when pressurized at 785 kPa or above. (normal temperature and humidity)

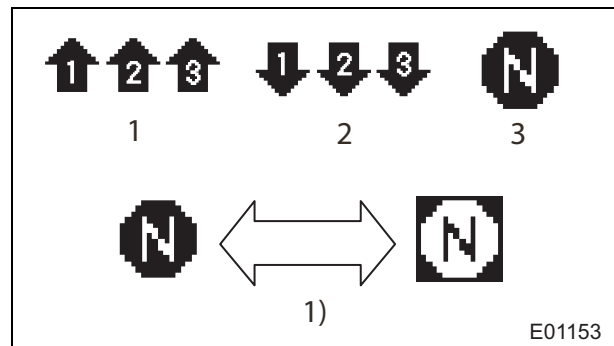
Travel direction display

The travel direction is displayed. If the direction lever is not in the NEUTRAL position when starting the engine, the symbol "N" blinks and the engine will not start. If the operator leaves the seat while the engine is running and the direction lever is not in the NEUTRAL position, the symbol "N" blinks and the transmission is electrically shifted to the NEUTRAL position.

Note: Travel direction display is switched by the signal from the direction lever.



1. Truck direction indicator

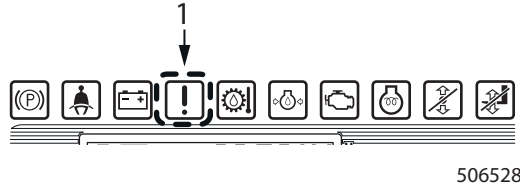
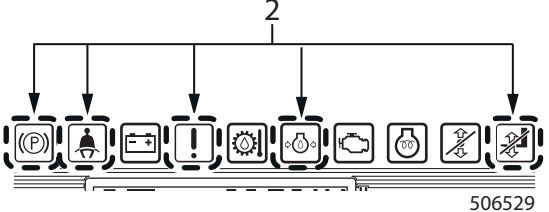


- 1. FORWARD indicator
- 2. REVERSE indicator
- 3. NEUTRAL indicator

1) Driving interlock indicator icon blinks when the direction lever is not in the NEUTRAL position

Note: Driving interlock display changes every 0.5 second.

Warning display according to fault level

<p>Minor warning</p>	<p>Multi-purpose warning icon 1 glows</p>	 <p>506528</p>
<p>Serious warning</p>	<p>All of the five warning icons 2 blink</p>	 <p>506529</p>

7. Troubleshooting

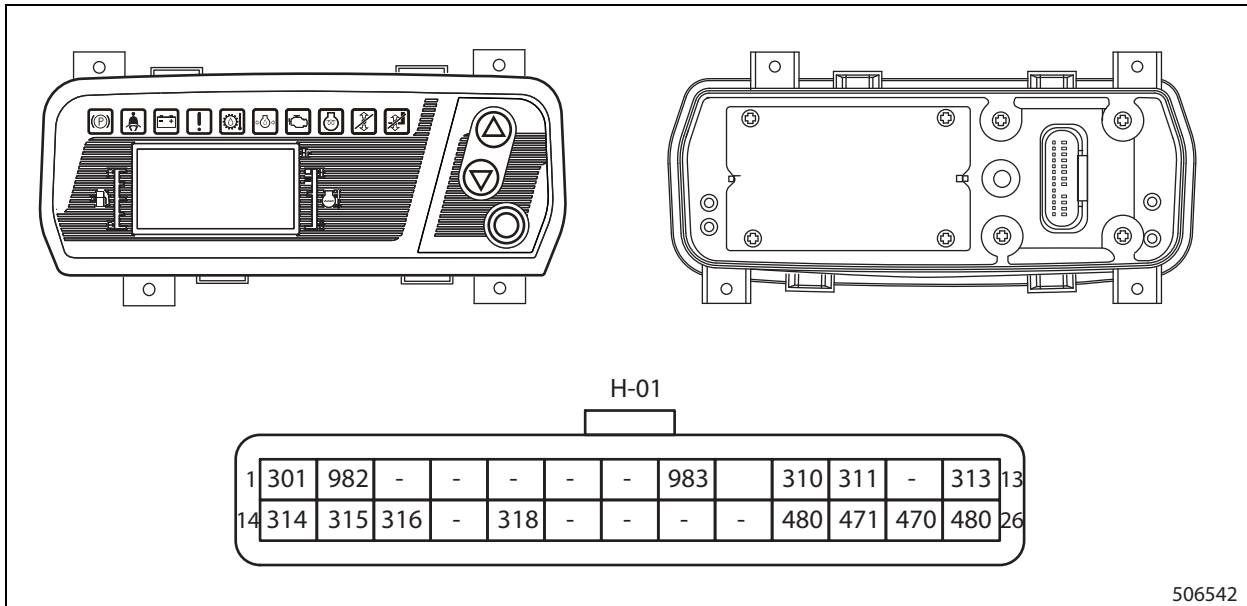
7.1 Engine Startup Problem

Condition		Possible cause	Action
Key switch	Starter won't crank the engine when the key switch is turned ON	Battery is discharged	Charge or replace battery
		Disconnection or poor connection	Repair or replace
		Key switch continuity failure	Replace
		Defect in starter or starter relay	Replace direction
		Direction lever not in the NEUTRAL position	Place the transmission shift lever to the NEUTRAL position
Engine won't stop when the key switch is turned OFF	Disconnection or poor connection	Repair or replace	
	Stop solenoid defective	Replace or adjust	
	Control linkage defective	Replace	

7.2 Gauge-Related Problems

Condition		Possible cause	Action
Coolant temperature gauge	Gauge reading is low	Disconnection between meter panel and water temperature gauge	Make sure the connector is firmly inserted
			Check continuity
			Check the display by heating the water temperature sensor
			Replace water temperature sensor
			Replace meter panel
Gauge reading is inaccurate	Check the part number	Make sure the specified part is used	
		Make sure the connector is firmly inserted	
		Replace water temperature sensor	
Fuel gauge	Gauge reading is not displayed	Setting is incorrect	Incorrect VCM setting
	Gauge reading is inaccurate	Check the part number	Make sure the specified part is used
			Make sure the connector is firmly inserted
			Replace water temperature sensor
			Remove fuel tank cap assembly and check if the float is free of bends
Gauge reading blinks	Short circuit between meter panel and fuel gauge	Correct the short circuit	
		Remove fuel tank cap assembly and check the wiring inside the tank	

Meter panel



Pin No.	Circuit No.	Signal name	Wire diameter/ color
1	301	12V power supply	0.5 R/W
2	982	GND	2 B
3	-	-	-
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	983	GND	0.5 B
9	-	-	-
10	310	Charge light (ALTL)	0.5 G
11	311	Glow	0.5 G/R
12	-	-	-
13	313	12V IGN	0.5 R/B

Pin No.	Circuit No.	Signal name	Wire diameter/ color
14	314	Engine thermo unit	0.5 G/Y
15	315	Fuel sensor	0.5 G/W
16	316	Oil pressure SW	0.5 L/R
17	-	-	-
18	318	Parking brake	0.5 L
19	-	-	-
20	-	-	-
21	-	-	-
22	-	-	-
23	480	CANTER1	0.5 P/B
24	471	CAN_L	0.5 P/G
25	470	CAN_H	0.5 P
26	480	CANTER2	0.5 P/B

4.5 Meter Panel Communication Warning (F07)

Diagnostic code: F07	
Situation	"F07" blinks. All traveling operations disabled.
Possible cause	Faulty meter panel, faulty VCM, or faulty harness
How the code is triggered	When CAN communication from meter panel to VCM is interrupted.
Recovery	Auto recovery
Action	Activates with default values of meter panel incoming data.

Checks

(1) Check continuity of CAN communication cables.

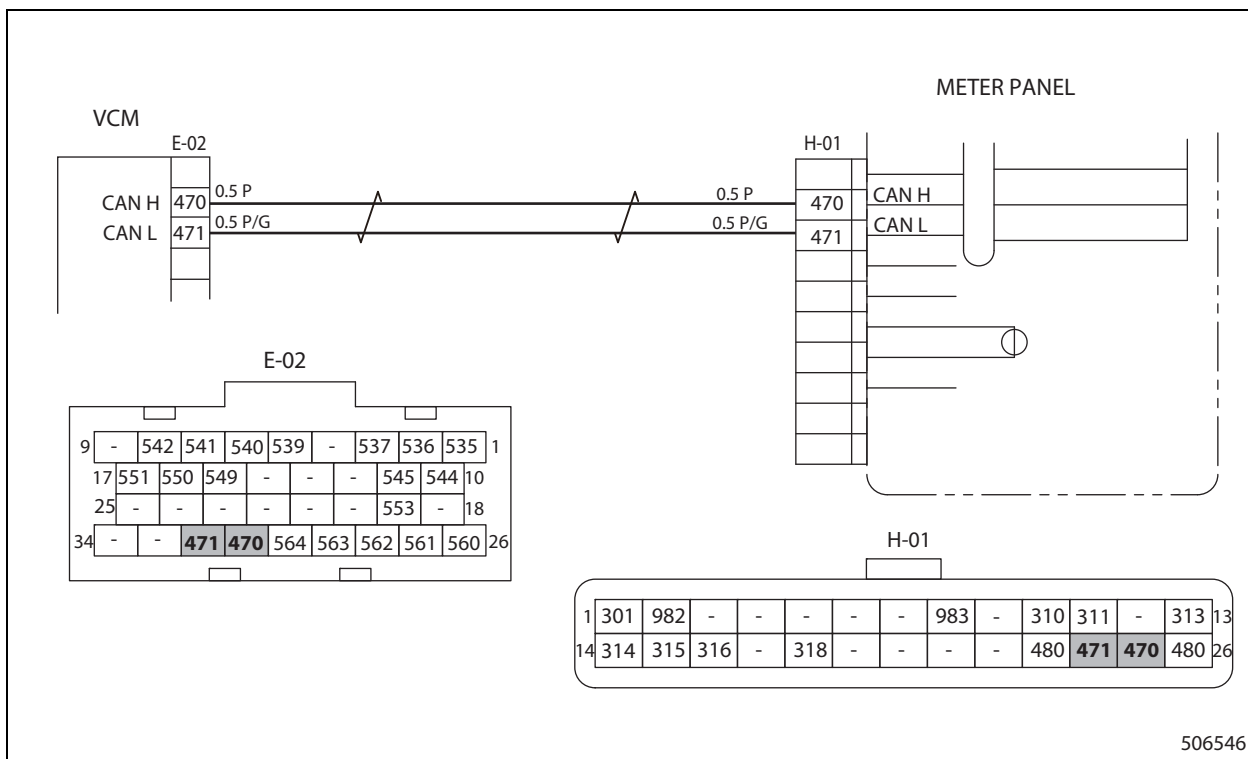
VCM to meter panel	Between 470 (VCM: E-02-31) and 470 (MP: H-01-25) and between 471 (VCM: E-02-32) and 471 (MP: H-01-24)
Continuity	No continuity

(2) Replace meter panel.

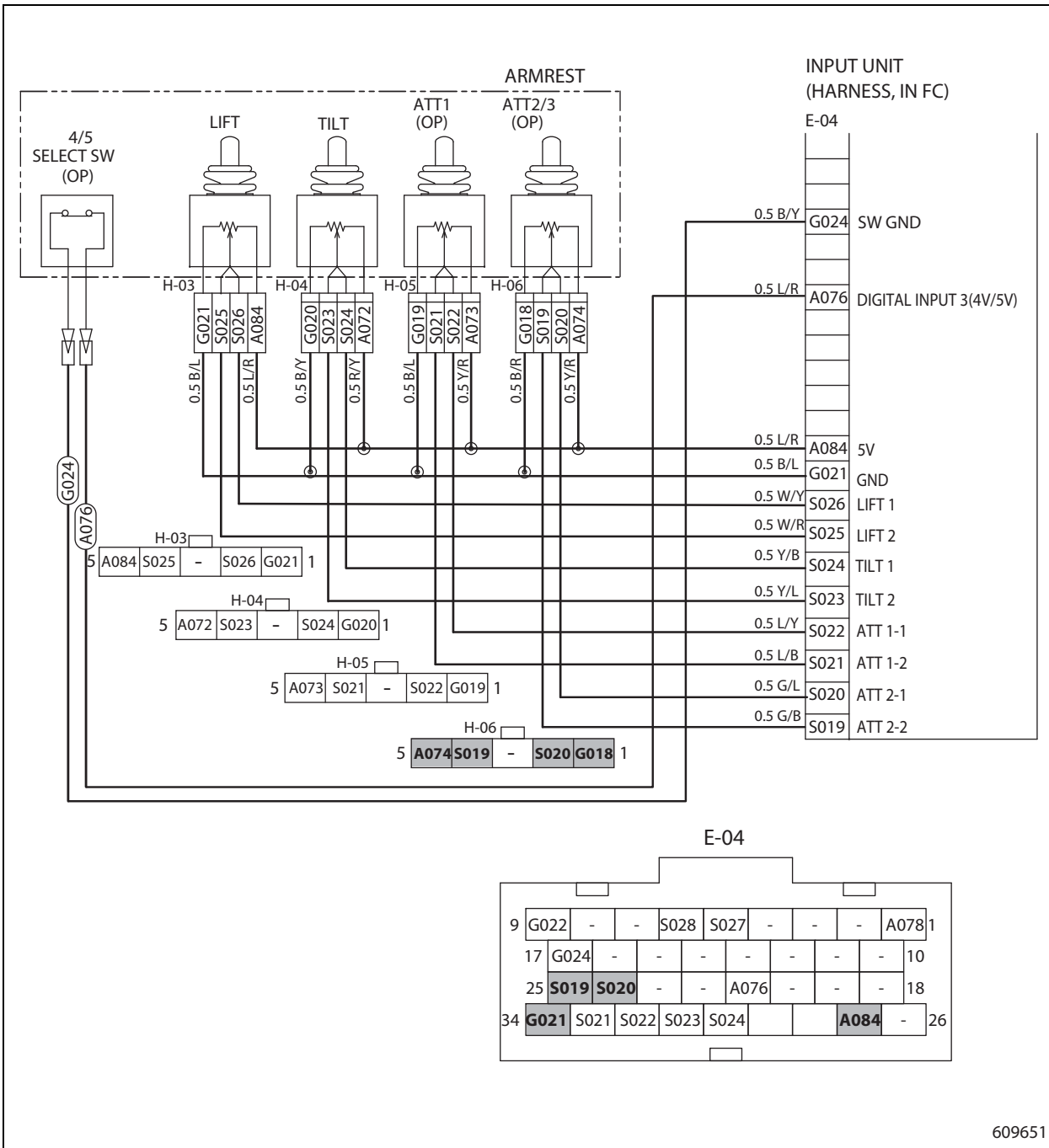
(3) Replace harness.

Warning remains

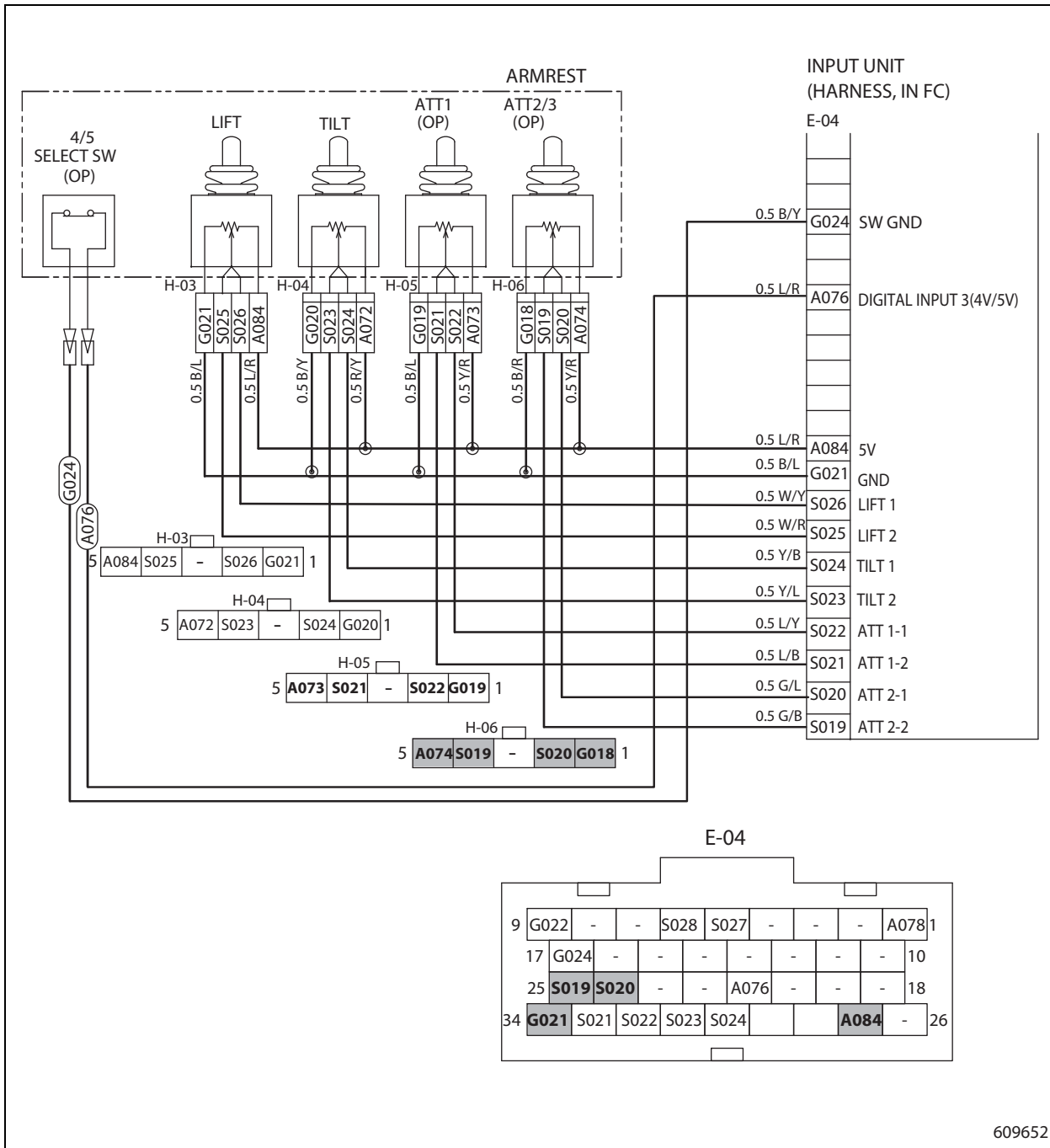
(4) Replace VCM controller.



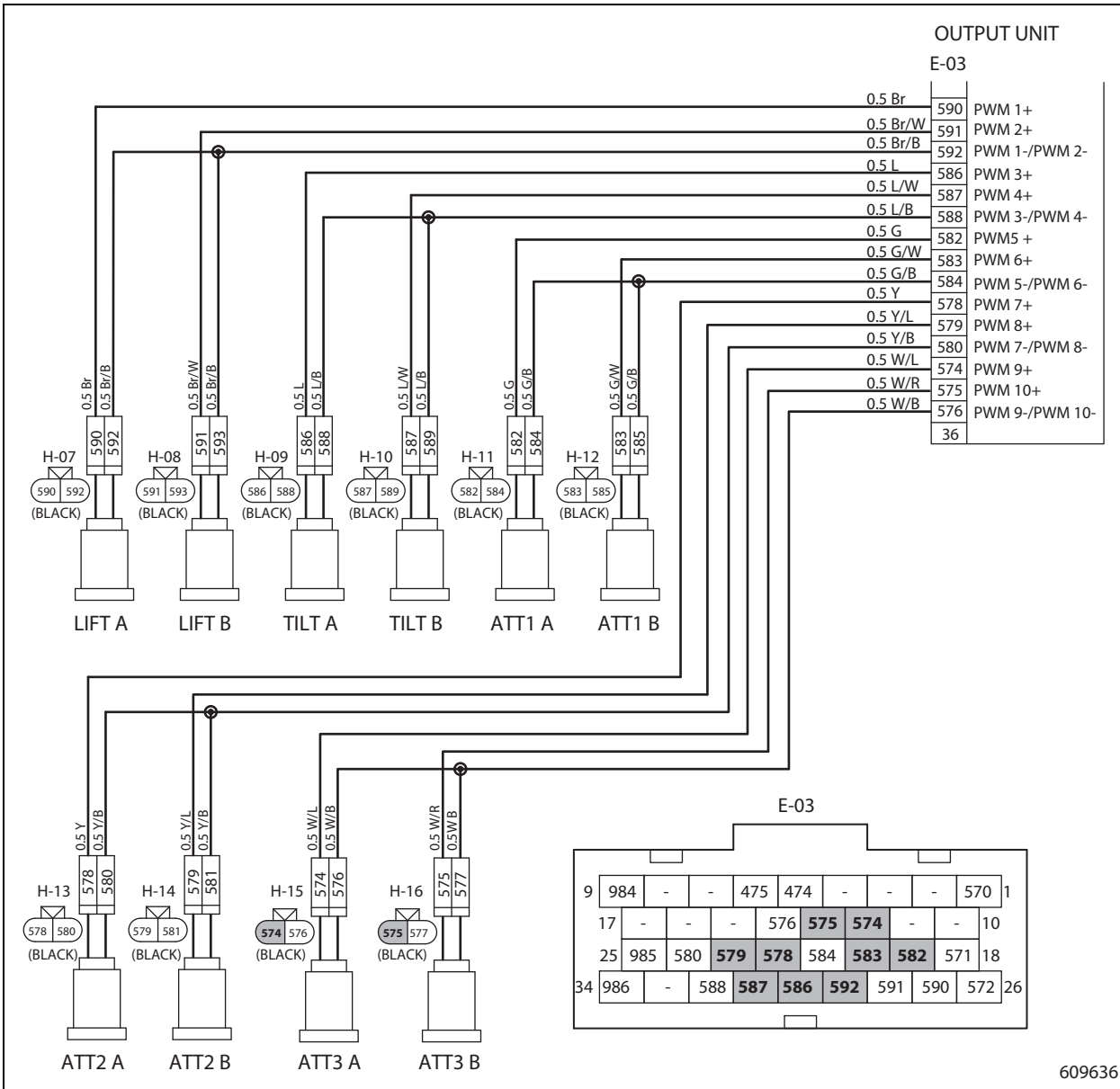
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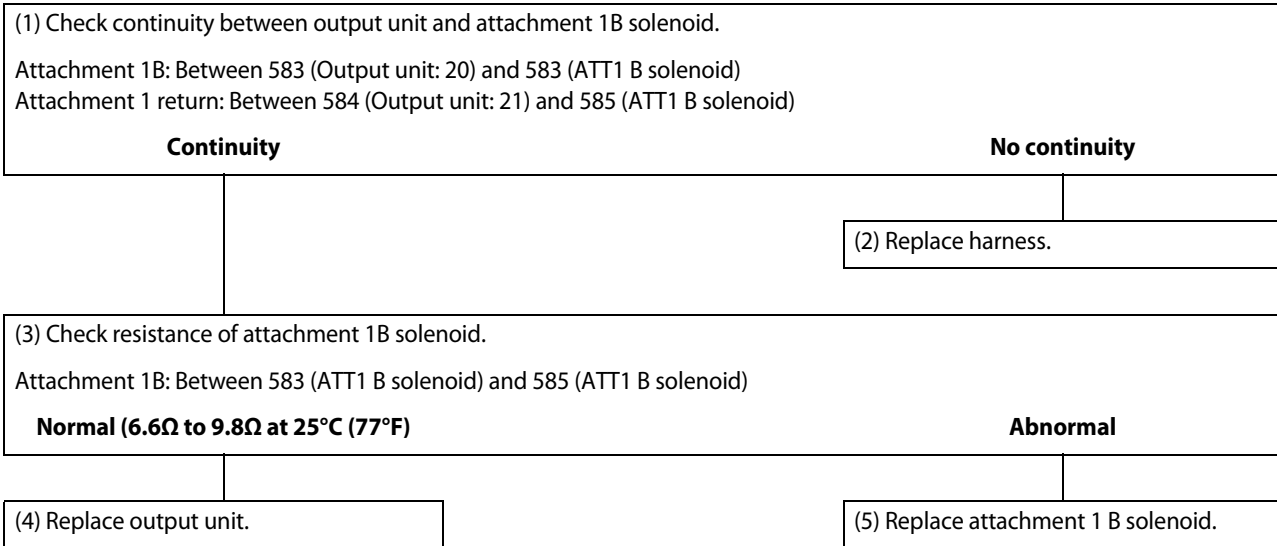


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4.32 Attachment 1B Solenoid Warning (F62)

Diagnostic code: F62	
Situation	"F62" blinks. Attachment operation disabled.
Possible cause	Faulty output unit, faulty attachment 1B solenoid, or faulty harness.
How the code is triggered	Current is 0.16A or less, or 1.9A or more, when attachment 1B solenoid signal is output.
Recovery	Key OFF/ON.
Action	Turns OFF attachment (1A/1B) solenoid output.

Checks





4.41 Unload Solenoid Warning (F75)

Diagnostic code: F75	
Situation	"F75" blinks. All load handling operations disabled.
Possible cause	Faulty VCM controller, faulty unload solenoid, or faulty harness.
How the code is triggered	Current is 0.16A or less, or 2.4A or more, when unload solenoid signal is output.
Recovery	Key OFF/ON.
Action	Turns OFF unload and operating function solenoids.

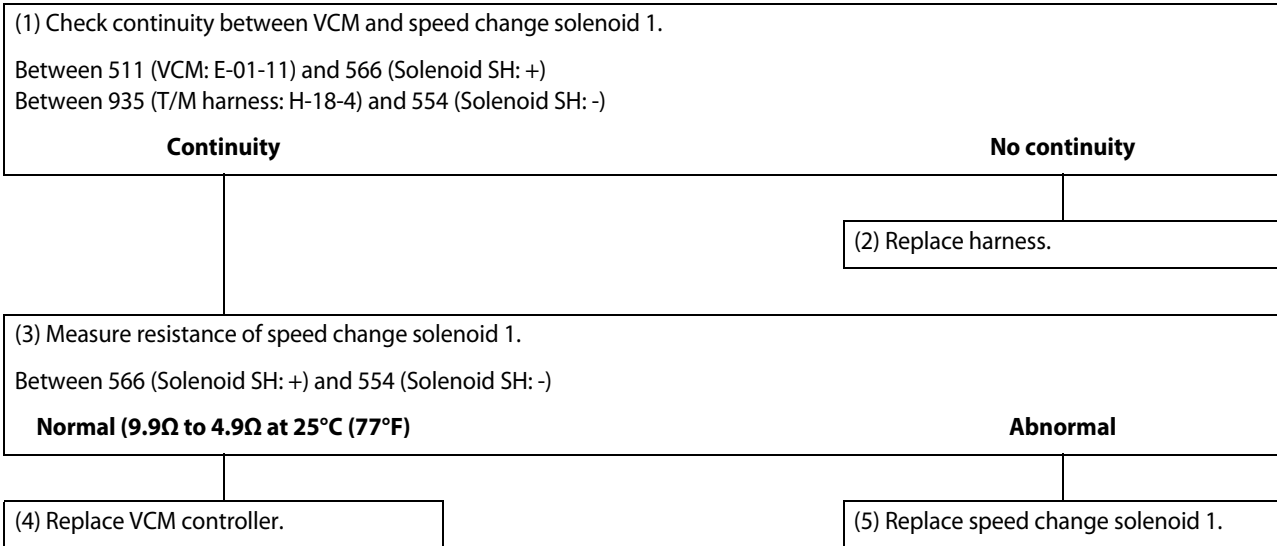
Checks

(1) Check continuity between VCM and unload solenoid. Between 530 (VCM:30) and 530 (Unload solenoid: B-08-1) Between 532 (VCM:32) and 532 (Unload solenoid: B-08-2)	
Continuity	No continuity
	(2) Replace harness.
(3) Measure resistance of unload solenoid. Between 530 (Unload solenoid) and 532 (Unload solenoid)	
Normal (6.9Ω to 10.3Ω at 25°C (77°F))	Abnormal
(4) Replace VCM controller.	(5) Replace unload solenoid.

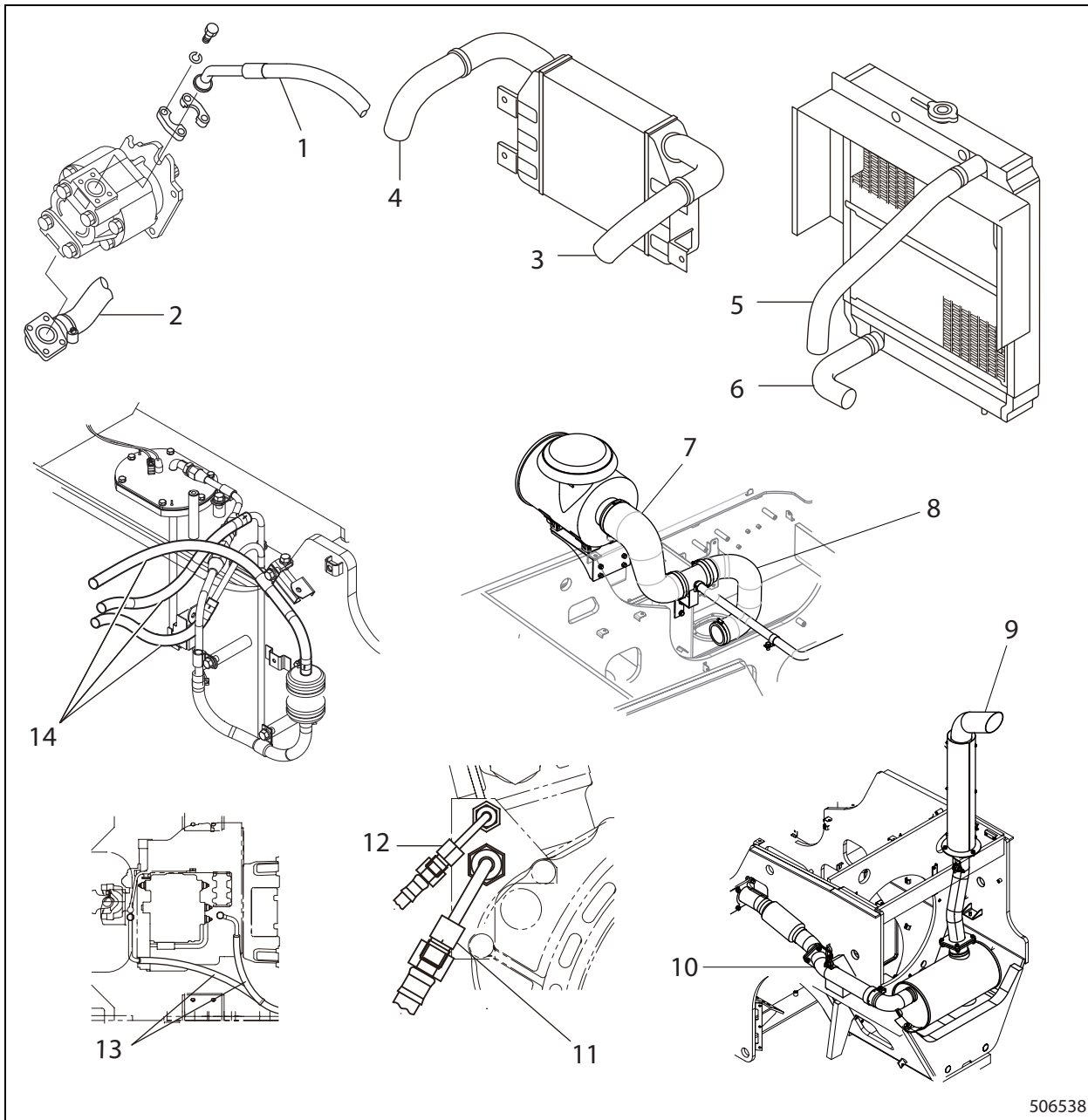
4.46 VCM Speed Change Solenoid 1 Warning (F93)

Diagnostic code: F93	
Situation	"F93" blinks. Speed change control disabled (gear fixed and will not move to another gear).
Possible cause	Faulty VCM, faulty speed change solenoid 1, or faulty harness.
How the code is triggered	Current is 0.6A or less, when speed change solenoid 1 signal is output.
Recovery	Key OFF/ON.
Action	Turns OFF speed change solenoid 1 outputs.

Checks



4.4 Disconnecting Pipes and Hoses



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- | | |
|------------------------------------|-----------------------------------|
| 1. Delivery hose of hydraulic pump | 8. Air intake hose |
| 2. Suction hose of hydraulic pump | 9. Tail pipe |
| 3. Inlet hose of intercooler | 10. Exhaust pipe |
| 4. Outlet hose of intercooler | 11. Inlet hose of air compressor |
| 5. Upper hose of radiator | 12. Outlet hose of air compressor |
| 6. Lower hose of radiator | 13. Oil cooler hose |
| 7. Air intake hose and pipe | 14. Fuel hose |

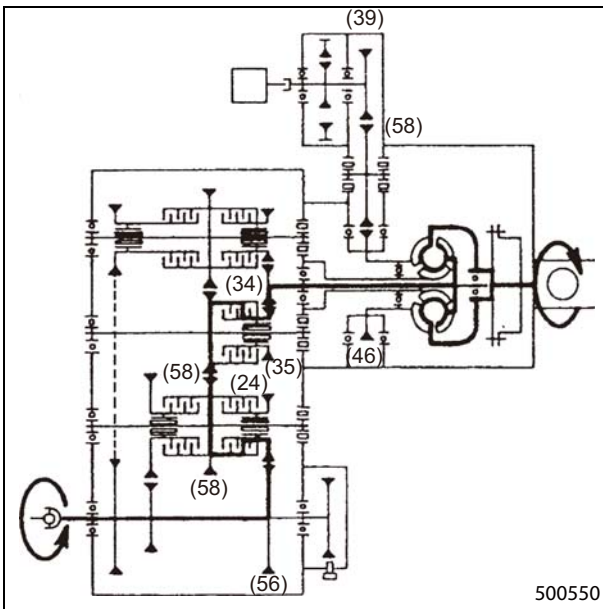
Suggestions for removal

- (1) Disconnect the engine left side fuel hose. Leave other intermediate pipes and right side hoses connected to the engine.
- (2) Disconnect the oil cooler hoses at the transmission side and tack the hoses along the frame.

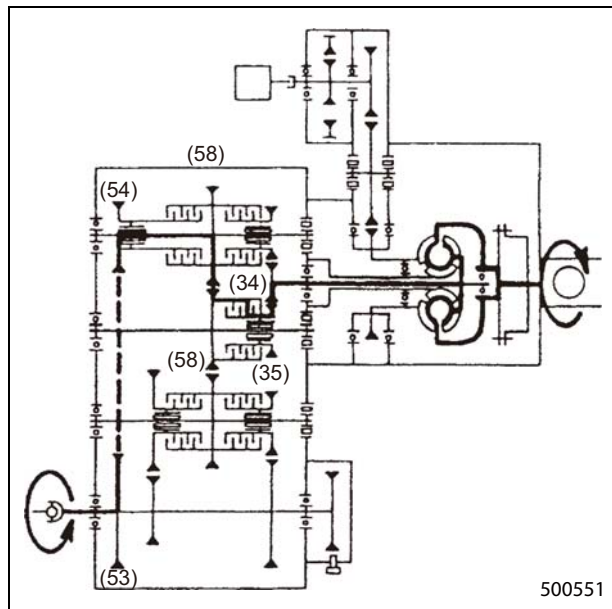
2.4 Power Flow - Reverse

Gear position	Gear engagement	Reduction ratio
1st speed	35/34x58/58x56/24	2.402
2nd speed	35/34x58/58x53/54	1.010
3rd speed	35/34x58/58x32/59	0.558
PTO	58/46x39/58	0.848

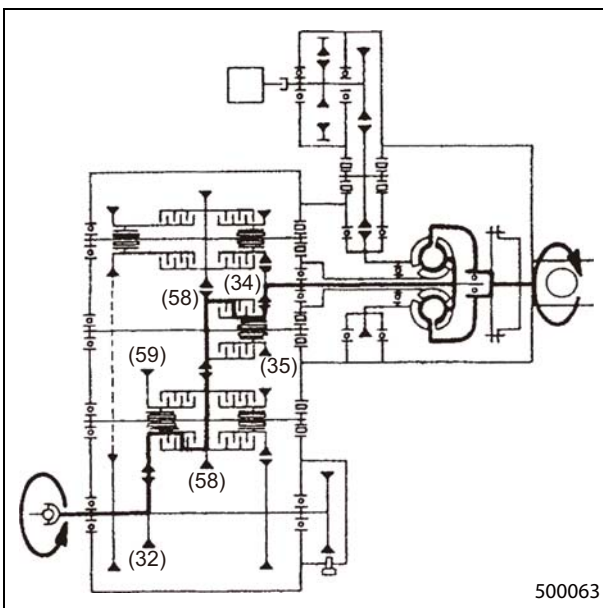
Reverse 1st speed



Reverse 2nd speed

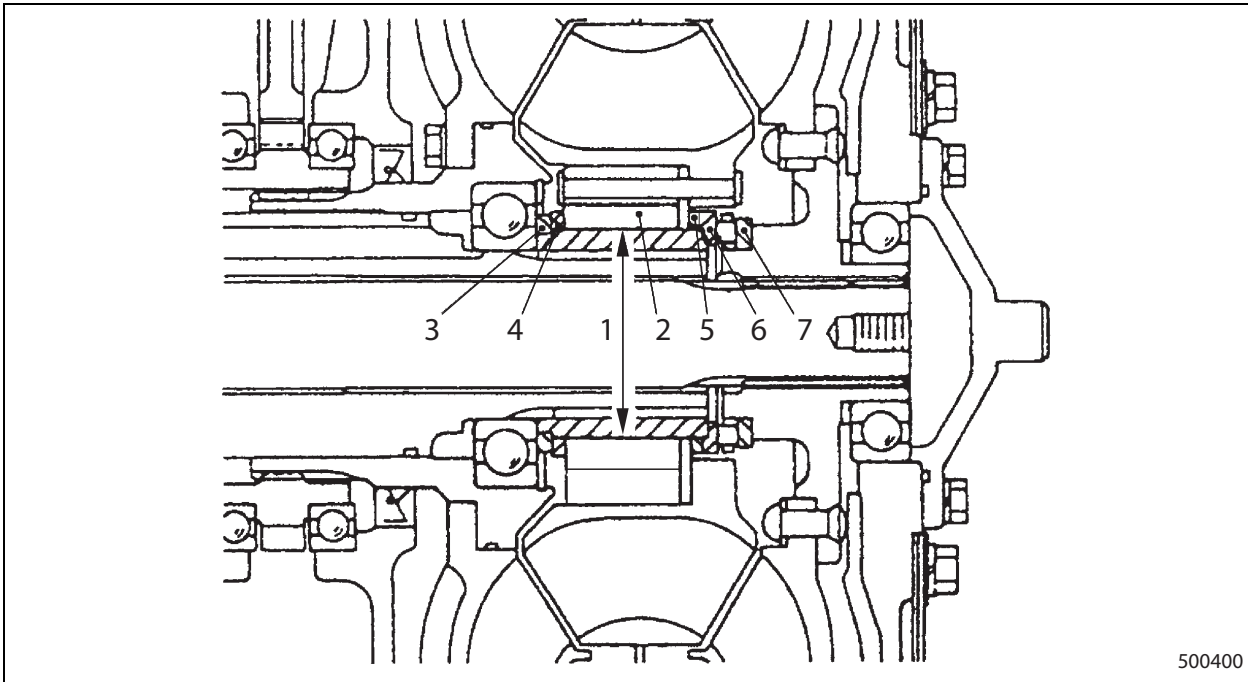


Reverse 3rd speed



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

Ref.	Item	Standard	Limit
1	Outside diameter of clutch hub	67.951 to 67.97 mm (2.6752 to 2.6760 in.)	67.8 mm (2.669 in.)
2	Outside diameter of clutch roller	10.185 to 10.2 mm (0.4010 to 0.402 in.)	10.1 mm (0.398 in.)
3	Thickness of thrust washer	4.95 to 5 mm (0.1949 to 0.20 in.)	4.8 mm (0.189 in.)
4	Thickness of thrust washer	3.95 to 4 mm (0.1555 to 0.16 in.)	3.8 mm (0.150 in.)
5	Thickness of thrust washer	2.9 to 3 mm (0.114 to 0.12 in.)	2.8 mm (0.110 in.)
6	Thickness of thrust washer	4.9 to 5 mm (0.193 to 0.20 in.)	4.8 mm (0.189 in.)
7	Thickness of thrust washer	4.95 to 5 mm (0.1949 to 0.20 in.)	4.8 mm (0.189 in.)



Removing stator shaft

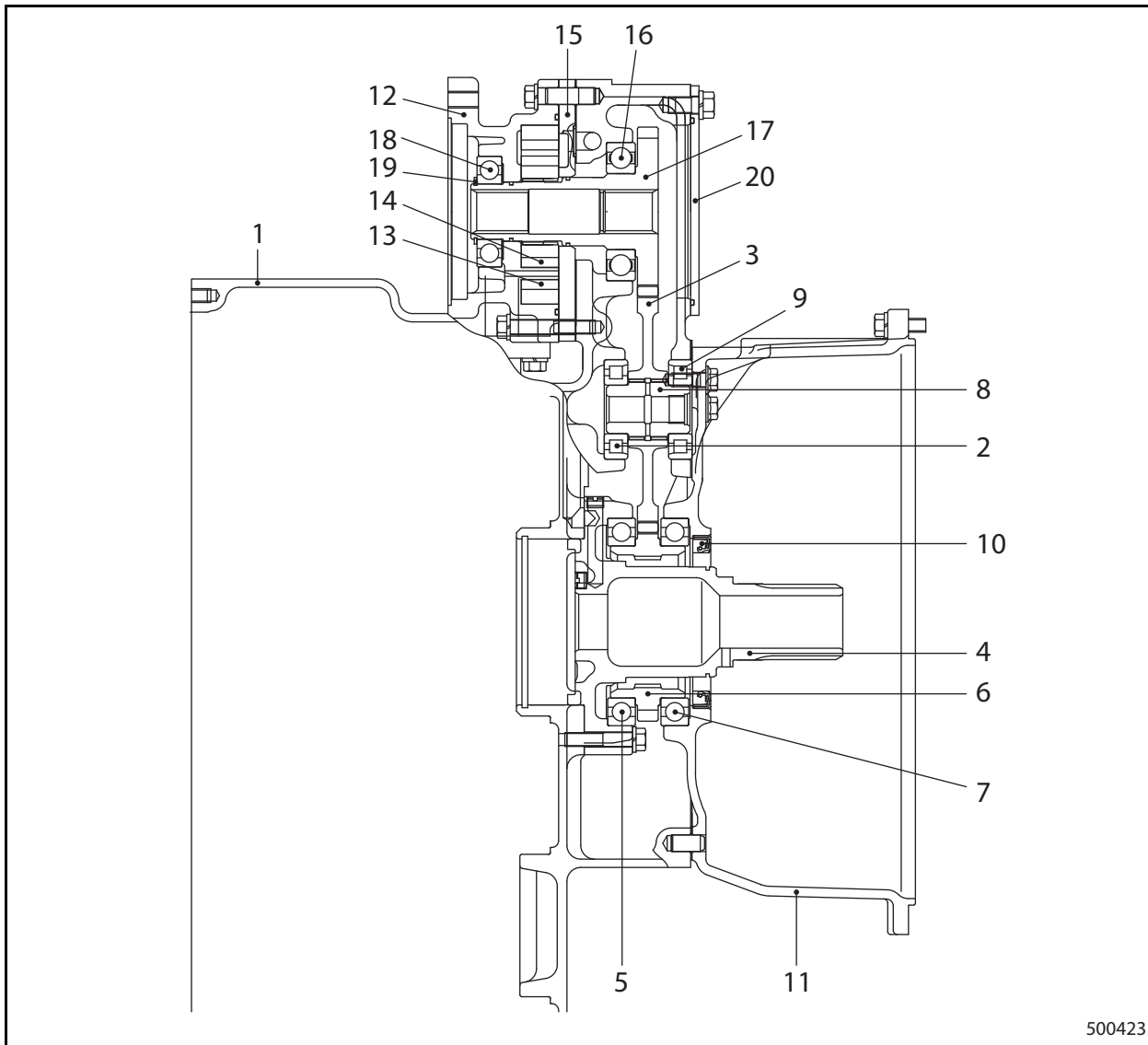
Screw in the two special tool bolts evenly into the stator shaft M10 x 1.25 jack bolt holes, and remove the stator shaft. Or place a metal piece and tap out.

Special tool name	Part number
Bolt	67284-15400

Roller bearing outer race

Do not remove the roller bearing outer race installed in the transmission case, unless it is defective. Also, maintain the roller bearing outer race of idler gear in the same way.

10.3 Assembly Sequence of Stator Shaft and Oil Pump



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- | | |
|---|---|
| 1. Transmission case, Dowel pins | 11. Torque converter housing, Gasket, Flange bolts |
| 2. Roller bearing | 12. Pump case, O-ring, Bolts, Spring washer |
| 3. Idler gear | 13. Internal gear |
| 4. Stator shaft, Seal ring, Bolts, Spring washers | 14. Pump gear |
| 5. Ball bearing | 15. Pump plate, O-ring, Gasket, Bolts, Spring washers |
| 6. PTO drive gear | 16. Ball bearing |
| 7. Ball bearing | 17. Pump drive gear, Seal rings |
| 8. Idler shaft | 18. Ball bearing |
| 9. Roller bearing | 19. Snapring |
| 10. Oil seal | 20. PTO cover, O-ring, Bolts, Spring washers |

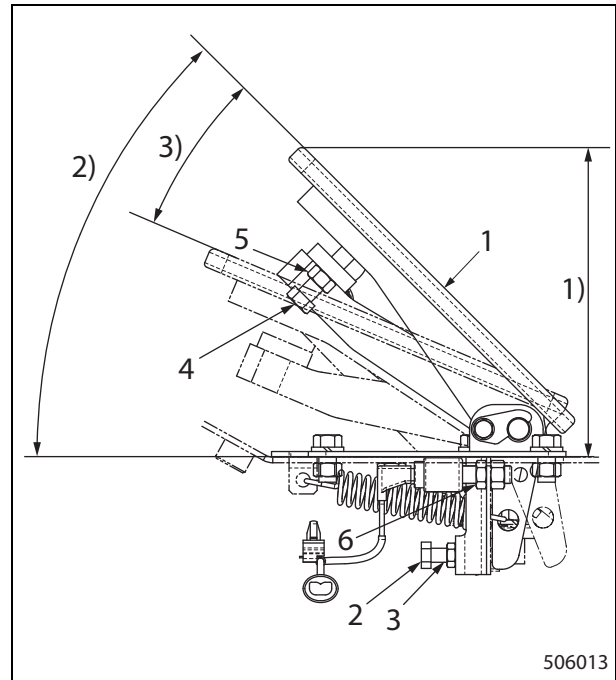
Note: Do not remove the dowel pins installed in the transmission case.

(Dowel pins are used to retain the pump case, torque converter housing, transmission cover subassembly, etc.)

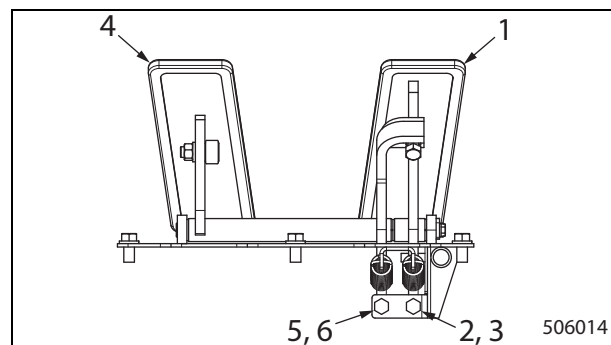
17. Adjustment

17.1 Adjusting Brake Pedal and Inching Pedal

- (1) Set the inching pedal height to 178 mm (7.01 in.) by adjusting the bolt and nut.
The inching pedal will be set at an angle of $45^{\circ} \pm 1.0^{\circ}$.
- (2) Set the height of the brake pedal equal to the height of the inching pedal by adjusting the bolt and nut.
- (3) Set the clearance between the inching pedal and the brake pedal to zero (0) by adjusting the bolt and nut.



- | | |
|------------------|--|
| 1. Inching pedal | 6. Nut |
| 2. Bolt | 1) 178 mm (7.01 in.) (Pedal height) |
| 3. Nut | 2) $45^{\circ} \pm 1.0^{\circ}$
(Pedal set angle) |
| 4. Bolt | 3) 22° (Stroke) |
| 5. Nut | |

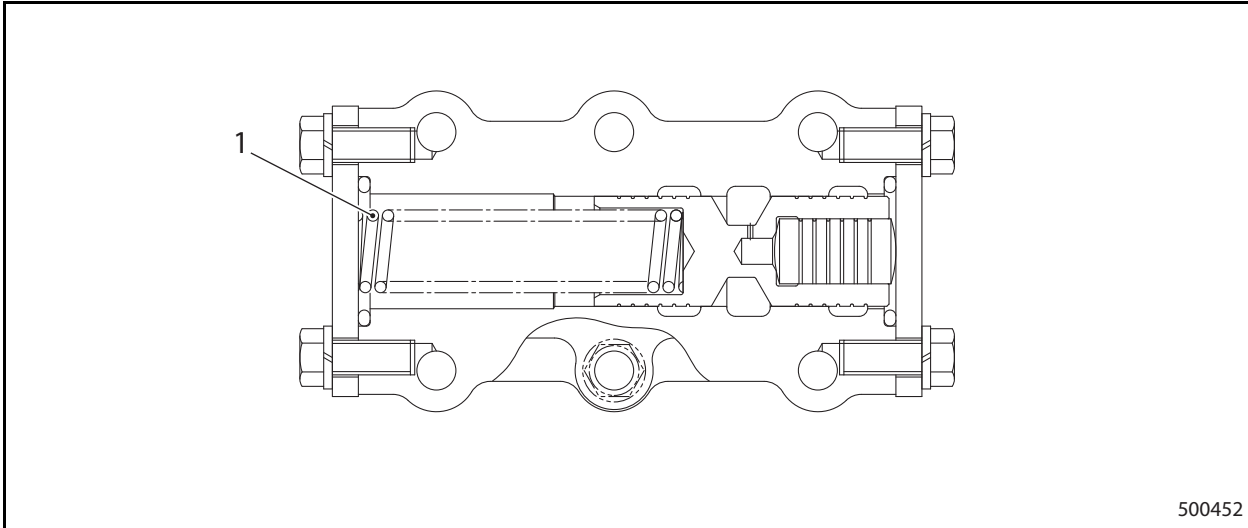


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|------------------|----------------|
| 1. Inching pedal | 4. Brake pedal |
| 2. Bolt | 5. Bolt |
| 3. Nut | 6. Nut |

Condition		Possible cause	Action	
Oil temperature too high	Torque converter	Incorrect oil level	Add or drain oil	
		Oil strainer clogged	Wash or replace	
		Stator rubbing	Correct or replace stator	
		Stator malfunction	Replace stator assembly	
		Air sucking	Retighten or replace O-ring	
		Water mixed in oil	Change oil	
		Restriction in oil pipe	Repair or replace	
		Bearing worn out or seized	Repair or replace	
		Instrument malfunction	Replace	
	Transmission	Clutches dragging	Replace clutch plates	
		Bearing worn out or seized	Repair or replace	
	Body	Incorrect operation of lift truck		Operate the lift truck properly
		Body Failure	Damaged fan belt	Replace
Clogged oil cooler			Wash or replace	
Brake is dragging			Inspect or adjust	
Main oil pressure too high		Damaged main regulator valve	Repair or replace valve assembly	
		Cold climate	See "12. SERVICE DATA" and replace	
		Incorrect oil	See "12. SERVICE DATA" and replace	
Main oil pressure too low		Magnet strainer clogged	Wash or replace	
		Oil pump malfunction	Replace	
		Main regulator valve spring malfunction	Replace spring	
		Main regulator valve spool malfunction	Repair or replace spool	
		Air sucking	Tighten or replace packing	
		Oil level too low	Add oil	
		Clutch valve malfunction	Repair or replace	
Clutch oil pressure too low		Magnet strainer clogged	Wash or replace	
		Oil pump malfunction (worn out)	Replace	
		Main regulator valve spring malfunction	Replace spring	
		Main regulator valve spool malfunction	Repair or replace spool	
		Air sucking	Tighten or replace packing	
		Oil level too low	Add oil	
		Clutch valve malfunction	Repair or replace	
		Broken seal ring in servo case	Replace	
		Broken clutch seal ring	Replace	

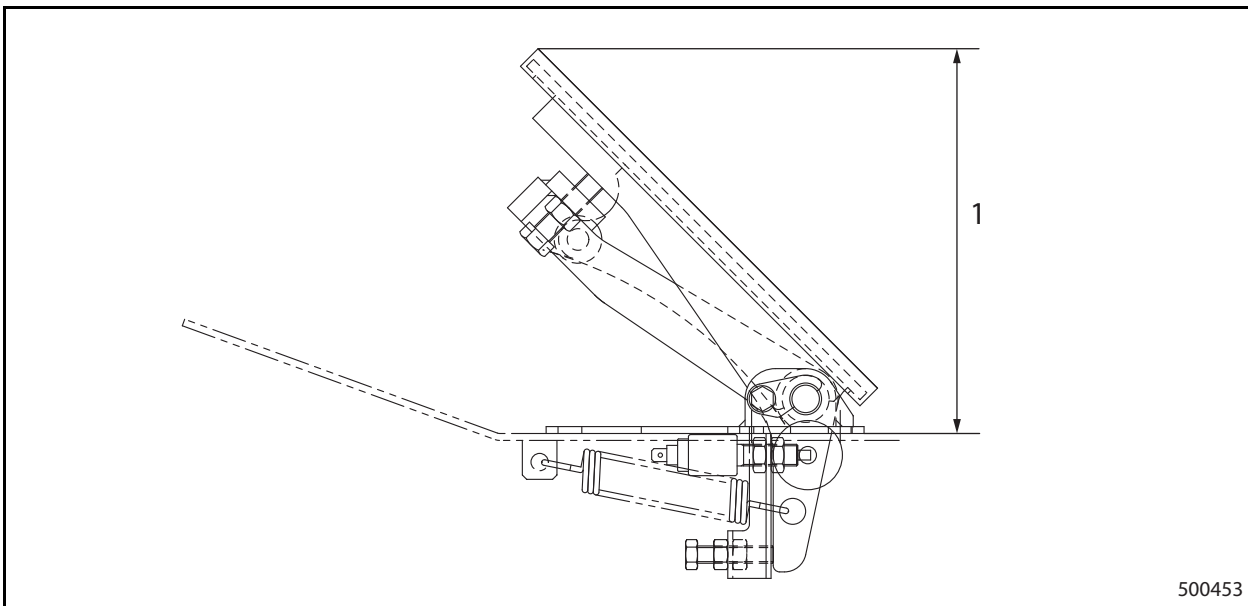
19.11 Main Regulator Valve

Ref.	Item		Value
1	Main regulator valve Free length of inner spring Spring constant: $k = N/m$	Standard	112 mm (4.41 in.) $k = 4.99 (0.51 \text{ kgf/mm}) [28.49 \text{ lbf/in.}]$
		Limit	109 mm (4.29 in.)



19.12 Inching Pedal Control

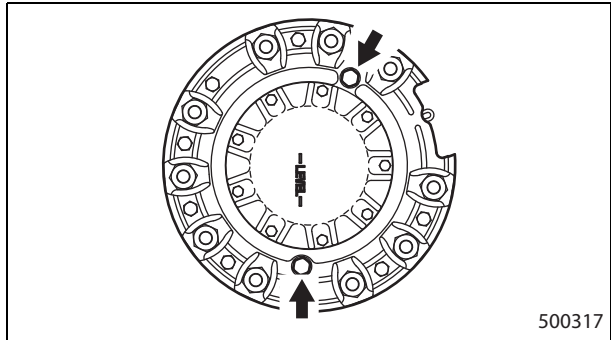
Ref.	Item		Value
1	Inching pedal height (from the top of pedal pad to the frame)	Standard	178 mm (7.01 in.)



5. Removing Front Axle and Reduction Differential

5.1 Preparation

- (1) Block the rear wheels.
- (2) For removal of the mast assembly, see "12. Mast and Forks".
- (3) Remove the front wheels, referring to 7-4 "Removing Front Wheels".
- (4) Place jack stands under the frame to prevent the forklift truck from falling.
- (5) Drain the front axle oil as instructed below:
Place containers sufficient for the quantity of oil under each drain, then drain the oil by removing the drain plugs of the axle housings and wheel hub covers.
To drain oil from the wheel cover, turn the wheel axle to bring the drain plug (right or left) of wheel hub cover to the lowest position. Remove the plug positioned above the wheel center line to drain air.



Capacity
Approximately 25 L (6.61 US gal.)

- Check the thrust washer for wear or damage.

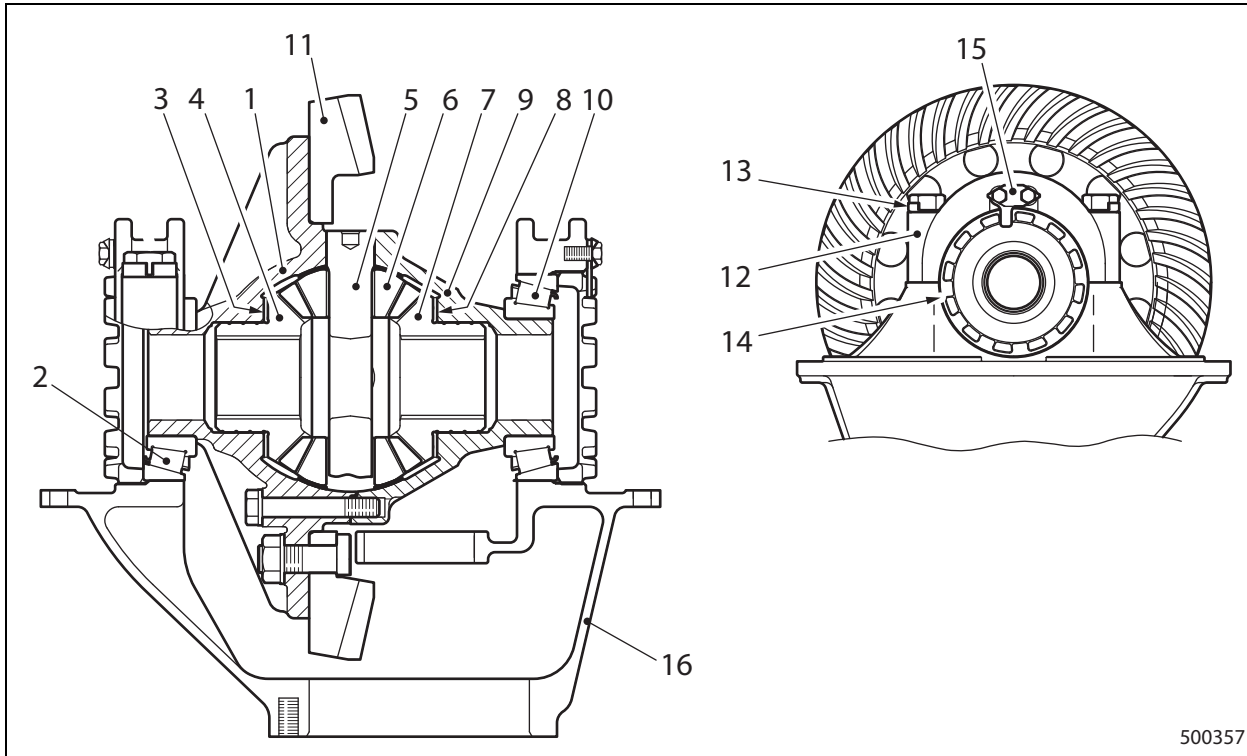
Item	Standard	limit
Thickness of trust washer	1.2 ± 0.06 mm (0.047 ± 0.0024 in.)	0.8 mm (0.032 in.)

Others

- Check the outer periphery of oil seal retainer for wear or damage.
- Check the tapered roller bearing (inner race) for wear or damage.

12. Assembling Reduction Differential

12.1 Assembly Sequence of Differential Gear Assembly



- | | |
|--------------------------------|-----------------------------|
| 1. Differential case (Left) | 9. Deferential case (Right) |
| 2. Tapered roller bearing | 10. Tapered roller bearing |
| 3. Thrust washer | 11. Reduction gear |
| 4. Differential gear | 12. Bearing cap |
| 5. Spider | 13. Lockwasher |
| 6. Differential pinion, Washer | 14. Side bearing nut |
| 7. Differential gear | 15. Lockplate |
| 8. Thrust washer | 16. Differential carrier |

12.6 Assembling Reduction and Parking Brake Assembly

O-ring and oil separator for each part

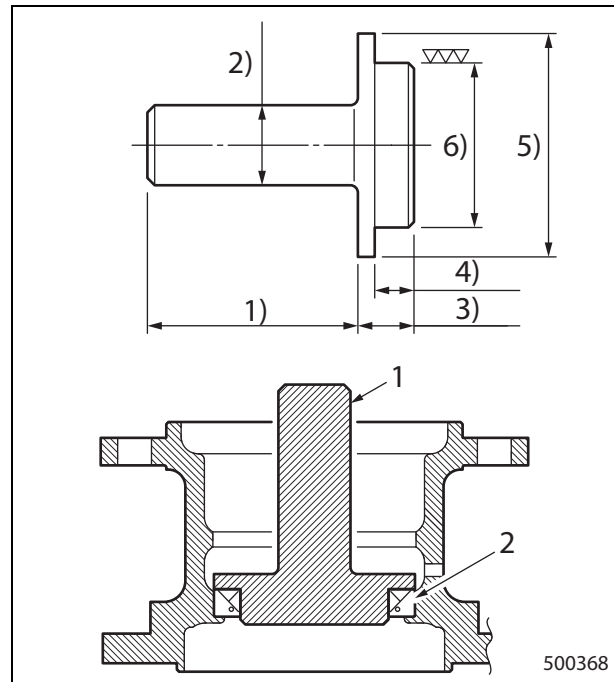
Apply the service oil before assembly.

Oil seal

Prepare the following special tool.

Installer: To be made by dealer (for the dimensions, see the illustration on the right).

- Place the main lip of oil seals inward and apply grease and oil between the lips.
- Put the oil seal on the installer and insert it into the parking brake bracket.



- | | |
|-------------------------------|---|
| 1. Installer | 3) 23 mm (0.91 in.) |
| 2. Oil seal | 4) 15 mm (0.59 in.) |
| 1) 130 mm (5.12 in.) | 5) $\text{Ø}95 \begin{smallmatrix} 0 \\ -0.1 \end{smallmatrix}$ mm (3.74 $\begin{smallmatrix} 0 \\ -0.004 \end{smallmatrix}$ in.) |
| 2) $\text{Ø}35$ mm (1.38 in.) | 6) $\text{Ø}68.5 \pm 0.1$ mm (2.7 ± 0.004 in.) |

Parking brake assembly

- (1) Exercise care for the direction of the parking brake lever when assembling.
- (2) Tighten the mounting bolts to the specified torque.

Tightening torque
145 ± 22 N·m (14.8 ± 2.2 kgf·m) [106.95 ± 16.23 lbf·ft]

Parking brake drum

Tighten the mounting nuts to the specified torque.

Tightening torque
96 ± 15 N·m (9.8 ± 1.5 kgf·m) [70.81 ± 11.06 lbf·ft]

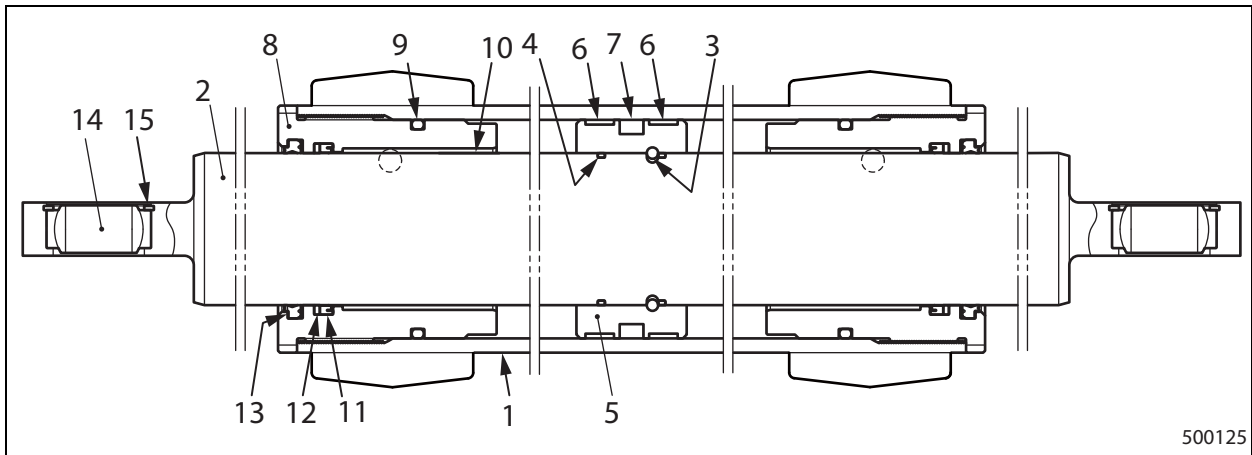
Self-locking nut

- (1) Apply LOCTITE[®] 271 to the self-locking nut and tighten it to the specified torque.

Tightening torque
294.2 ± 29.4 N·m (30.00 ± 3.00 kgf·m) [216.991 ± 21.684 lbf·ft]

- (2) Torque caulk the nut with a punch after tightening.

2.2 Power Steering Cylinder

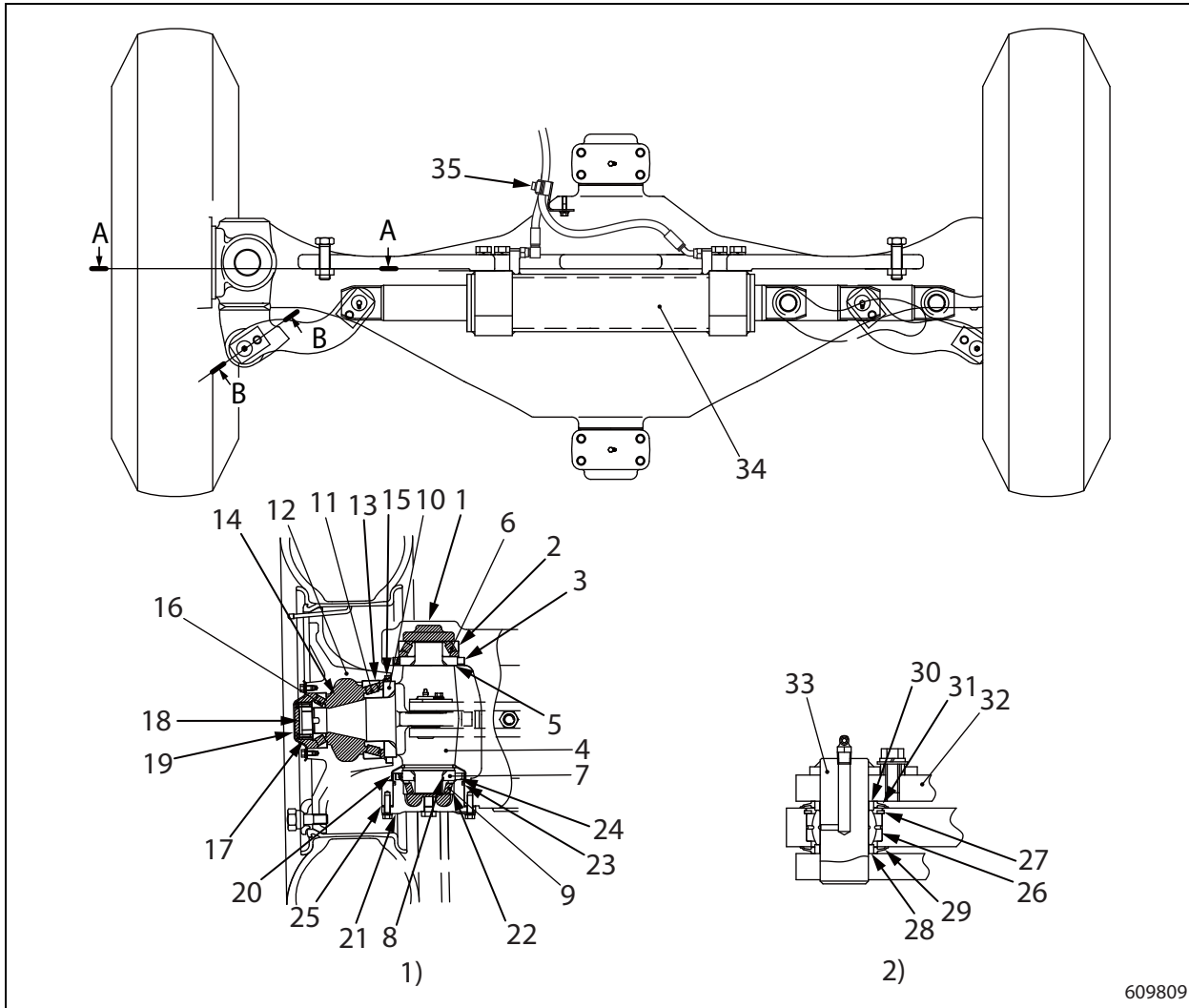


500125

- | | |
|------------------|------------------|
| 1. Cylinder | 9. O-ring |
| 2. Rod | 10. Bushing |
| 3. Snapring | 11. Seal |
| 4. O-ring | 12. Backup ring |
| 5. Piston | 13. Dust seal |
| 6. Wear rings | 14. Bearing |
| 7. Piston seal | 15. Stopper ring |
| 8. Cylinder head | |

8. Assembling Rear Axle

8.1 Assembly Sequence



- | | |
|---|---|
| 1. Rear axle housing | 19. Hub cap, Gasket |
| 2. Tapered roller bearing (outer race) | 20. Lower dust cover |
| 3. Oil seal | 21. Cover |
| 4. Steering knuckle | 22. Tapered roller bearing (outer race) |
| 5. Oil seal retainer | 23. O-ring |
| 6. Tapered roller bearing (inner race) | 24. Oil seal |
| 7. Oil seal retainer | 25. Shim |
| 8. O-ring | 26. Spherical bearing |
| 9. Tapered roller bearing (inner race) | 27. Stopper ring |
| 10. Oil seal retainer | 28. Spacer |
| 11. Tapered roller bearing (inner race) | 29. Dust seal |
| 12. Rear axle hub | 30. Spacer |
| 13. Tapered roller bearing (outer race) | 31. Dust seal |
| 14. Tapered roller bearing (outer race) | 32. Tie rod |
| 15. Oil seal | 33. Tie rod pin |
| 16. Tapered roller bearing (inner race) | 34. Power Steering Cylinder |
| 17. Locknut | 35. Clamp |
| 18. Lockplate | 1) Section A-A |
| | 2) Section B-B |

12. Adjustment

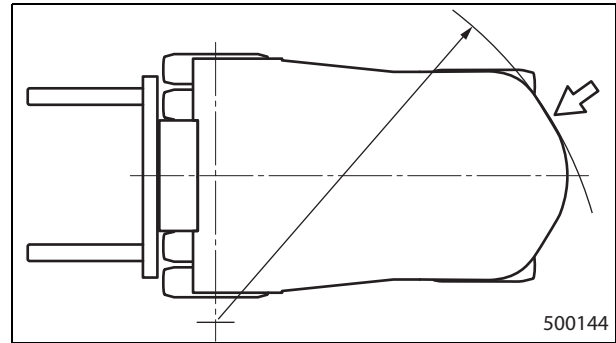
12.1 Measuring Minimum Turning Radius

- (1) Secure level ground of 20 by 20 meters (21.9 by 21.9 yd) or more.

⚠ WARNING

The area where the measurement to be taken must be surrounded by a fence, etc. or assigned with a watchman so that no unauthorized persons gain access to the area.

- (2) Attach a piece of chalk on the end of a thread, and hang it down from a position of the counterweight to the ground as shown in the illustration.
- (3) Turn the steering wheel fully and drive the forklift truck at a low speed. At this point, make sure that the chalk draws a line (circle) on the ground.
- (4) Measure the diameter of the circle drawn on the ground. The radius of this circle is assumed to be the minimum turning radius (R).

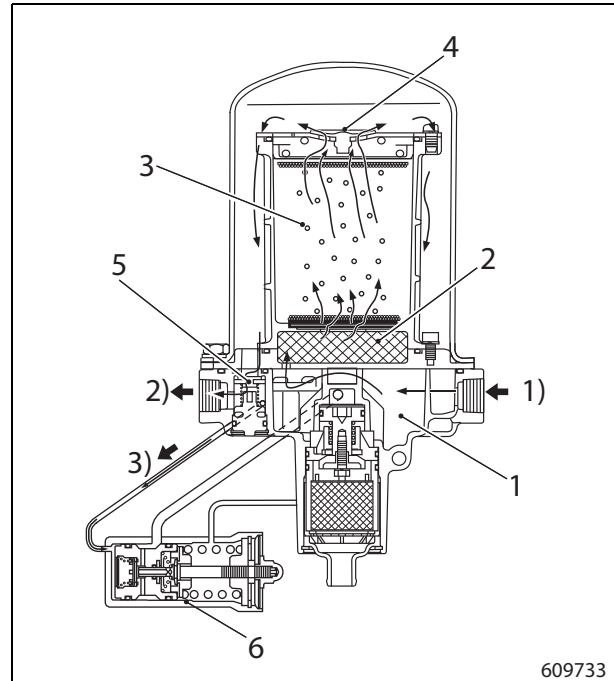


Truck model	Minimum turning radius
FD100NM1 FD100NM1S	4000 ⁺³⁰⁰ ₋₅₀ mm (157.48 ^{+11.8} ₋₂ in.)
FD120NM1 FD120NM1S	4060 ⁺³⁰⁰ ₋₅₀ mm (159.84 ^{+11.8} ₋₂ in.)
FD135NM1 FD135NM1S	4160 ⁺³⁰⁰ ₋₅₀ mm (163.78 ^{+11.8} ₋₂ in.)
FD150ANM1 FD150ANM1S	4550 ⁺³⁰⁰ ₋₅₀ mm (179.13 ^{+11.8} ₋₂ in.)

Dehumidification effect

The pressurized air A from the compressor enters the air dryer supply port. The water and oil are separated in the body, and accumulated at the bottom during the air charging to air tank. The air goes through the air filter, and tiny oil droplet and dust are removed. Then the air is sent to the casing inside. Water content in the air is removed with desiccant.

As the air moves from the bottom to the top, it contacts with dryer desiccant, and the water content is reduced. At the top position in the case, the air becomes dry, and is supplied from the exhaust port through check valve A, purge chamber and check valve B to the air tank. Also, the air pressure is applied to the piston in air pressure governor.



- | | |
|----------------------|--------------------------|
| 1. Body | 6. Air pressure governor |
| 2. Oil filter | 1) Supply side |
| 3. Desiccating agent | 2) Discharge side |
| 4. Check valve A | 3) Air pressure A |
| 5. Check valve B | |

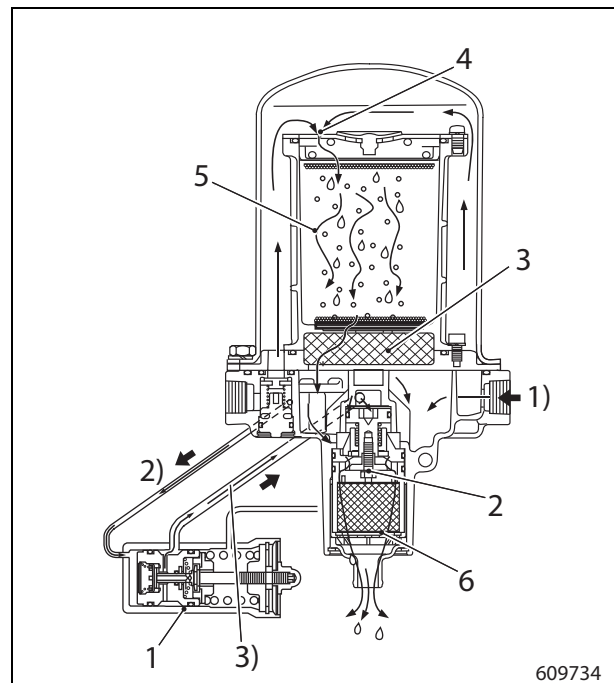
Regeneration of desiccant

When the air pressure in air tank becomes the specified high-pressure by the supplied air from compressor, the valve B at the control port in air dryer is opened by the commanding pressure from air pressure governor. Thus, oil filter is cleaned by the pressure in case, and condensed water and oil are released to the atmosphere.

After a sudden depressurizing, the dry air in purge chamber expands in decompression, and becomes super-dry air. The air flows back inside of the case, removes water content from the desiccant, and is discharged to the atmosphere. Thus, the regeneration of desiccant is completed.

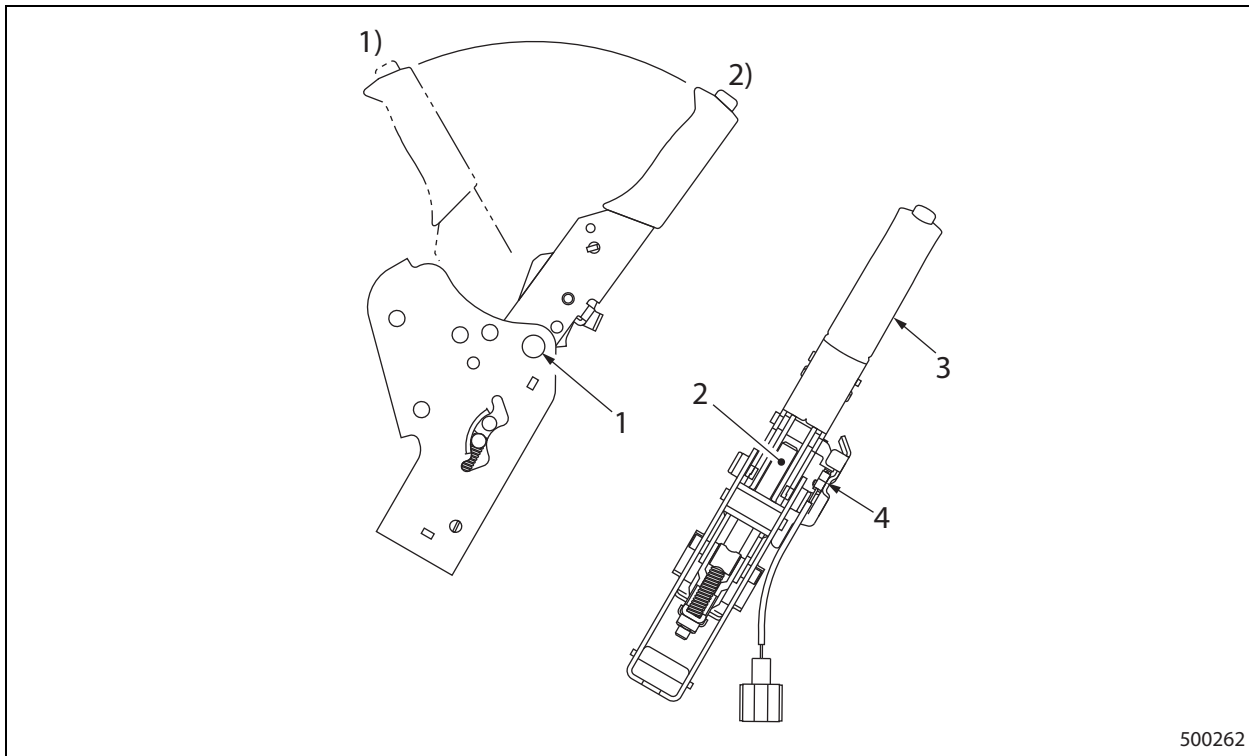
In this occasion, the check valve is closed, and the commanding pressure from air pressure governor is applied to the control port. The air from air compressor goes through the valve B, sound absorbed with silencer, and released to atmosphere.

This condition continues until the air pressure in tank becomes the specified low-pressure of governor by air consuming.



- | | |
|--------------------------|-----------------------|
| 1. Air pressure governor | 6. Silencer |
| 2. Valve B | 1) Supply side |
| 3. Oil filter | 2) Air pressure A |
| 4. Orifice | 3) Indicated pressure |
| 5. Desiccating agent | |

2.9 Parking Brake Lever



- | | |
|---------------------------------|-------------------------|
| 1. Lever support pin | 4. Parking brake switch |
| 2. Adjusting screw | 1) Released state |
| 3. Parking brake lever assembly | 2) Activated state |

Inspection and repair

- (1) If the lever pin or lever pin hole is seriously damaged, replace the lever assembly.
- (2) If the parking brake cable is stretched, damaged, or rusted, replace the cable.

Assembly

Connect the wire to the lever, then inspect whether or not the operating effort is within the standard.

Item	Standard
Lever operating effort	235 ± 9.8 N (23.96 ± 1.00 kgf) [55.83 ± 2.20 lbf]

7.2 Suggestions for Assembly

Applying grease

Apply a thin coat of specified brake grease on the following parts:

- Apply grease on the fitting area of the adjusting cam and wheel cylinder to the anchor bracket before assembling.
- Apply grease on the fitting area of the anchor pin to the anchor bracket and the inside faces of shoe bushing before assembling.

Note: Do not allow grease to protrude into the drum.

Installing wheel cylinder

- (1) Apply a thin coat of liquid gasket on the mounting surface of cylinder.
- (2) Align the oil filler port surface on the cylinder with the dust cover side face of anchor bracket, and tighten the bolt to the specified torque.

Tightening torque
45 to 69 N·m (4.6 to 7.0 kgf·m) [33.19 to 50.89 lbf·ft]

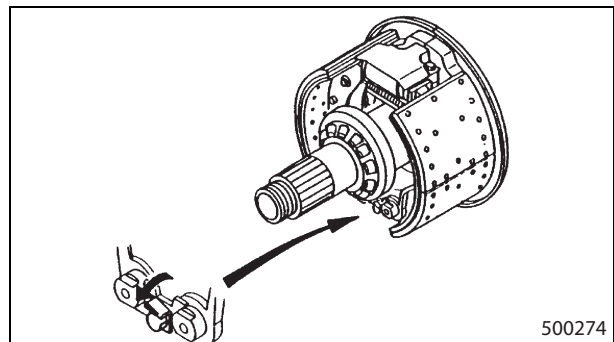
Installing brake shoe

- (1) Minimize the eccentricity of the right and left adjusting cams.
- (2) Verify that each push rod of the wheel cylinder is correctly inserted into the shoe web.

Installing lockplate and lockwasher

- (1) Tighten the mounting bolts to the specified torque.
- (2) After installing, bend the lockplate without fail.

Tightening torque
15.7 to 23.6 N·m (1.60 to 2.41 kgf·m) [11.580 to 17.406 lbf·ft]



19. Assembling Brake Control Valve

Follow the disassembly sequence in reverse to assemble.

19.1 Suggestions for Assembly

Replacing seal kit parts

Replace the seal kit parts whenever disassembled.

Cleaning parts

- Clean metal parts with a clean metal cleaner.
- Wipe off surface deposits of rubber parts with alcohol or diesel oil soaked cloth.

CAUTION

DO NOT dip the rubber parts in a metal cleaning fluid.

Applying grease

Apply grease on O-rings and the sliding surfaces contacting with O-rings.

Fill grease grooves with grease.

24.2 Parking Brake

Condition	Possible cause	Action
Brake lever stroke is short	Small drum-to lining clearance	Adjust
Noise	Small drum-to lining clearance	Adjust
	Distorted brake drum	Replace
Brake cannot be applied	Worn lining	Replace
	Small drum-to lining clearance	Adjust
	Improper adjustment of brake lever effort	Adjust to 245 to 249 N (25.0 to 25.4 kgf) [55.08 to 55.98 lbf]

24.3 Air Dryer

Condition	Possible cause	Action
Brake lever stroke is short	Takes a long time to dry saturated air	Drain daily at the end of operation until air line is completely dehydrated
Noise	Excessive air consumption and continuous air compressor operation	Operate the forklift truck to allow compressor in loaded-unloaded cycle operation Or check air dryer installation
	Desiccant is not replaced periodically	Replace desiccant kit periodically

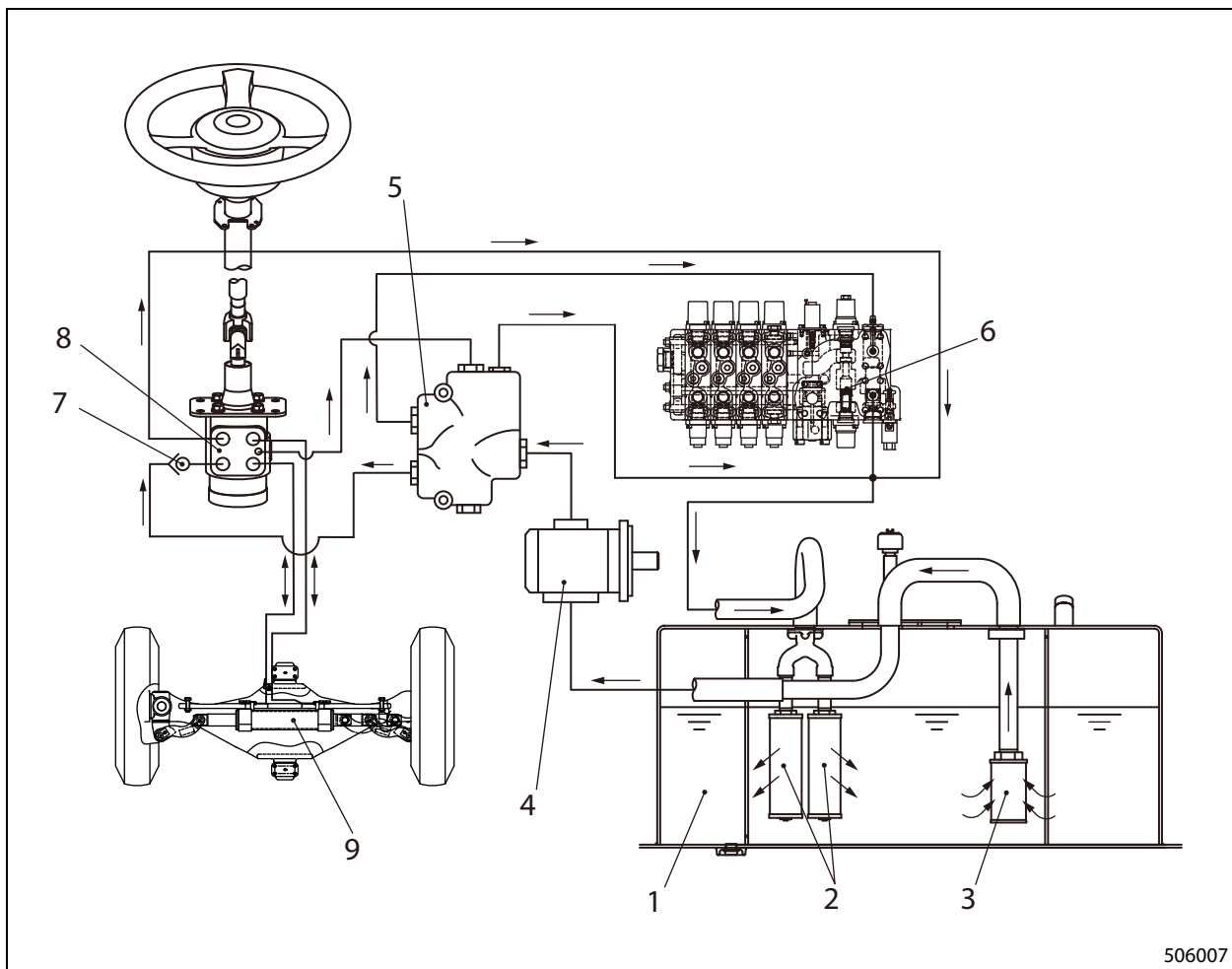
Chapter 10 STEERING SYSTEM

1. Specifications

Item		Specification
Steering type		Full-hydraulic power steering
Steering control valve	Displacement volume	369 cm ³ (22.5 in. ³) /rev
	Rated flow	45.4 L (11.995 US gal.)/min
	Max pressure	17.2 MPa (175.4 kgf/cm ²) [2494.7 psi]
Steering wheel outside diameter		320 mm (12.60 in.)

2. Structure

2.1 Steering System



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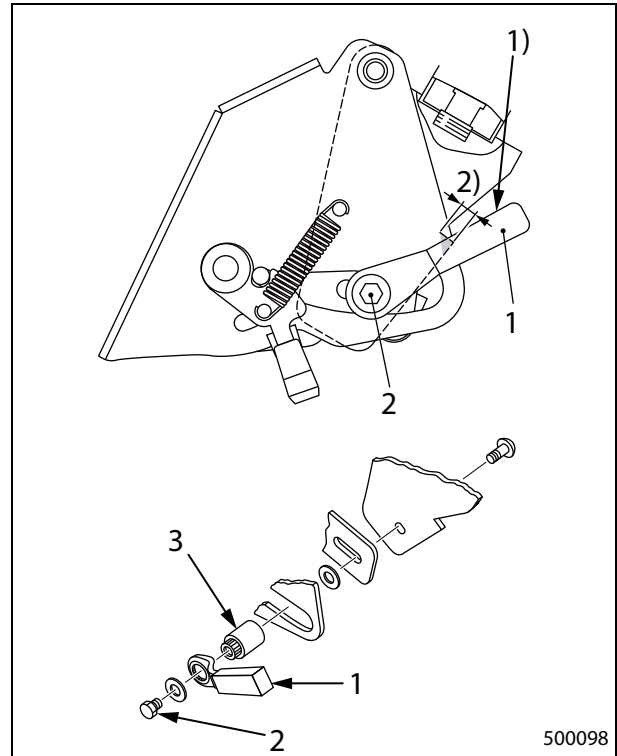
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|-------------------------|--|
| 1. Hydraulic tank | 6. Control valve for other operation devices |
| 2. Return filter | 7. Check valve |
| 3. Suction strainer | 8. Steering valve |
| 4. Gear pump (Oil pump) | 9. Power steering cylinder |
| 5. Priority valve | |

4.7 Assembling Tilt Lock Lever

If the matchmarks which were made earlier, have disappeared, or when the lever is replaced with a new one, install the lever as instructed below.

(The illustration on the right shows the relation of the parts when the tilt position is in NEUTRAL and the column lock lever is locked.)

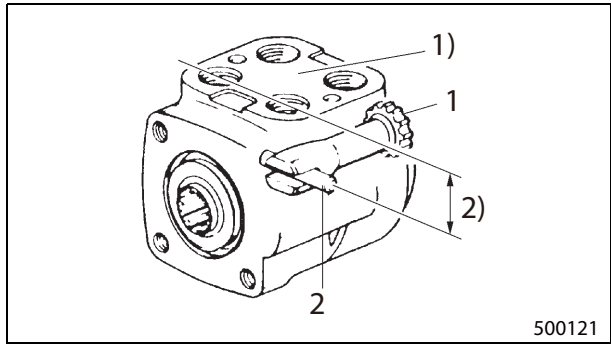
- (1) Tighten nut **3** to the tightening torque of 11 to 15 N·m (1.1 to 1.5 kgf·m) [8.11 to 11.06 lbf·ft]. (This is a lever locked state).
- (2) Select the optimal locked position for the tilt lock lever **1** and fit the tilt lock lever **1** into the serration of nut **3**. The optimal position is within the range which formed by the intersection of the notched section **2** of the bracket and the upper aspect of the lever.
- (3) Tighten bolt **2**.
- (4) Loosen the tilt lock lever **1**, and make sure that the bracket slides in the entire tilting range without interfering with other parts.



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

Installing drive shaft

- (1) Rotate the spool and sleeve assembly to make the port surface of the housing parallel with the pin.
- (2) Insert drive shaft **1**, and engage the pin **2** with the yoke of drive shaft.
- (3) Draw an alignment mark like the line B in the next illustration on the end face of drive shaft spline with a felt-tip pen to ensure the proper positioning during the following process.

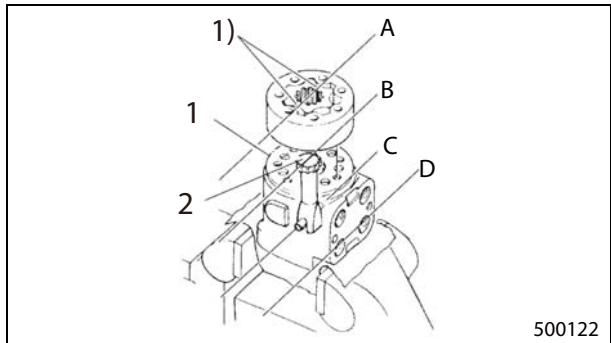


- | | |
|----------------|----------------------------------|
| 1. Drive shaft | 1) Port face |
| 2. Pin | 2) Pin is parallel to port face. |

Installing gerotor set

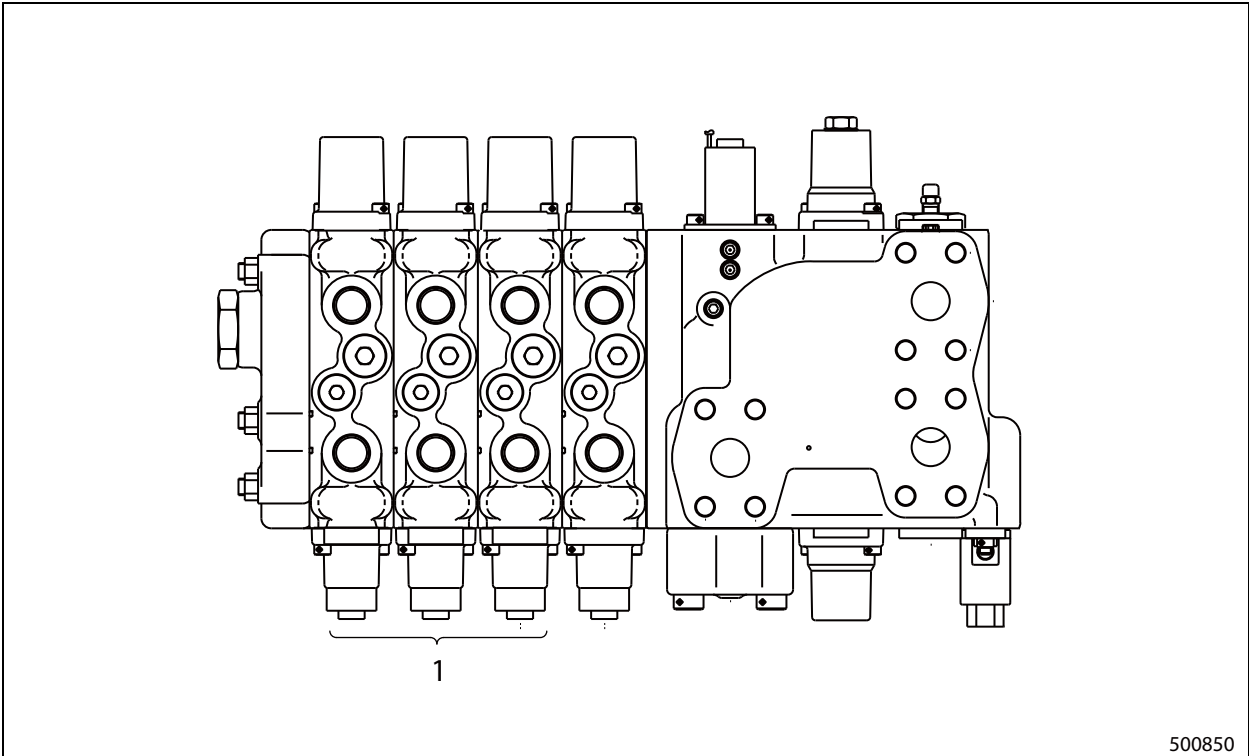
- (1) Install the O-ring on the gerotor. Place the gerotor O-ring side to the spacer plate **1** side. Align the roots of gerotor rotor set **1** (Line **A**) to the line **B** of drive shaft **2** and assemble them.
- (2) Check that lines **A**, **B**, **C**, and **D** are in parallel with each other.
- (3) Keep the engagement of the drive shaft **2** and rotor, and align the bolt holes of the gerotor set.

Note: This procedure is important as it determines the valve timing of this unit.



- | | |
|-----------------------------------|-----------------------------|
| 1. Spacer plate | 1) Gerotor set, star valley |
| 2. Drive shaft (with marked line) | |

Five-way valve



500850

- 1. Attachment valve

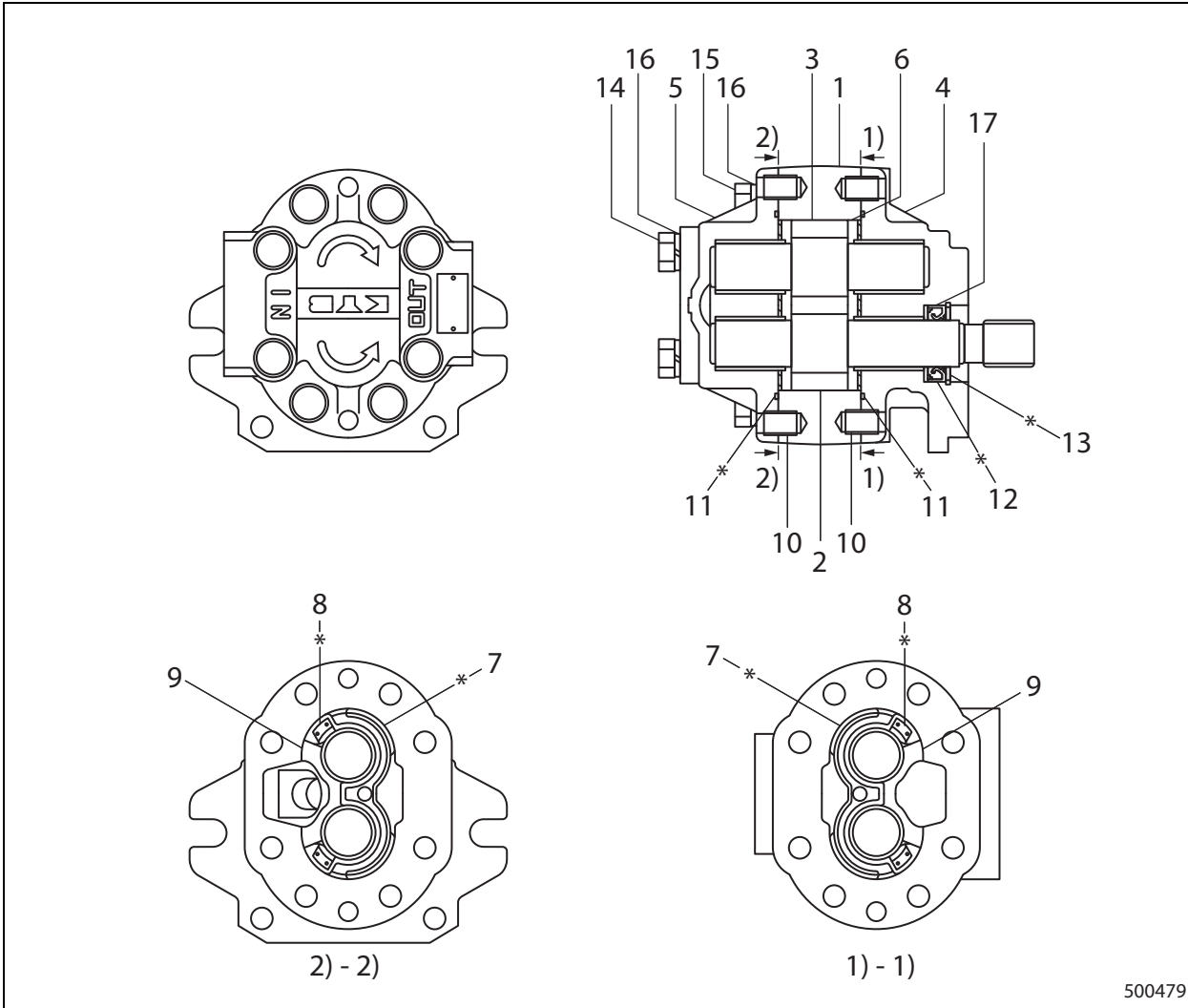
Attachment valves can be added to the standard control valves to form a three-way, four-way, or five-way valve.

8. Disassembling Gear Pump

8.1 Preparation

- (1) Clean the pump exterior.
- (2) Prepare paper or close to place disassembled parts.

8.2 Disassembly Sequence



500479

- | | |
|--------------------|-------------------|
| 1. Gear plate | 10. Dowel |
| 2. Drive gear | 11. O-ring |
| 3. Driven gear | 12. Oil seal |
| 4. Cover A | 13. Snaprings |
| 5. Cover B | 14. Bolt |
| 6. Pressure plates | 15. Bolt |
| 7. Plate seal | 16. Spring washer |
| 8. Backup | 17. Washer |
| 9. Isolation plate | 1) Section A-A |
| | 2) Section B-B |

Note: The part marked with * is included in the seal kit.

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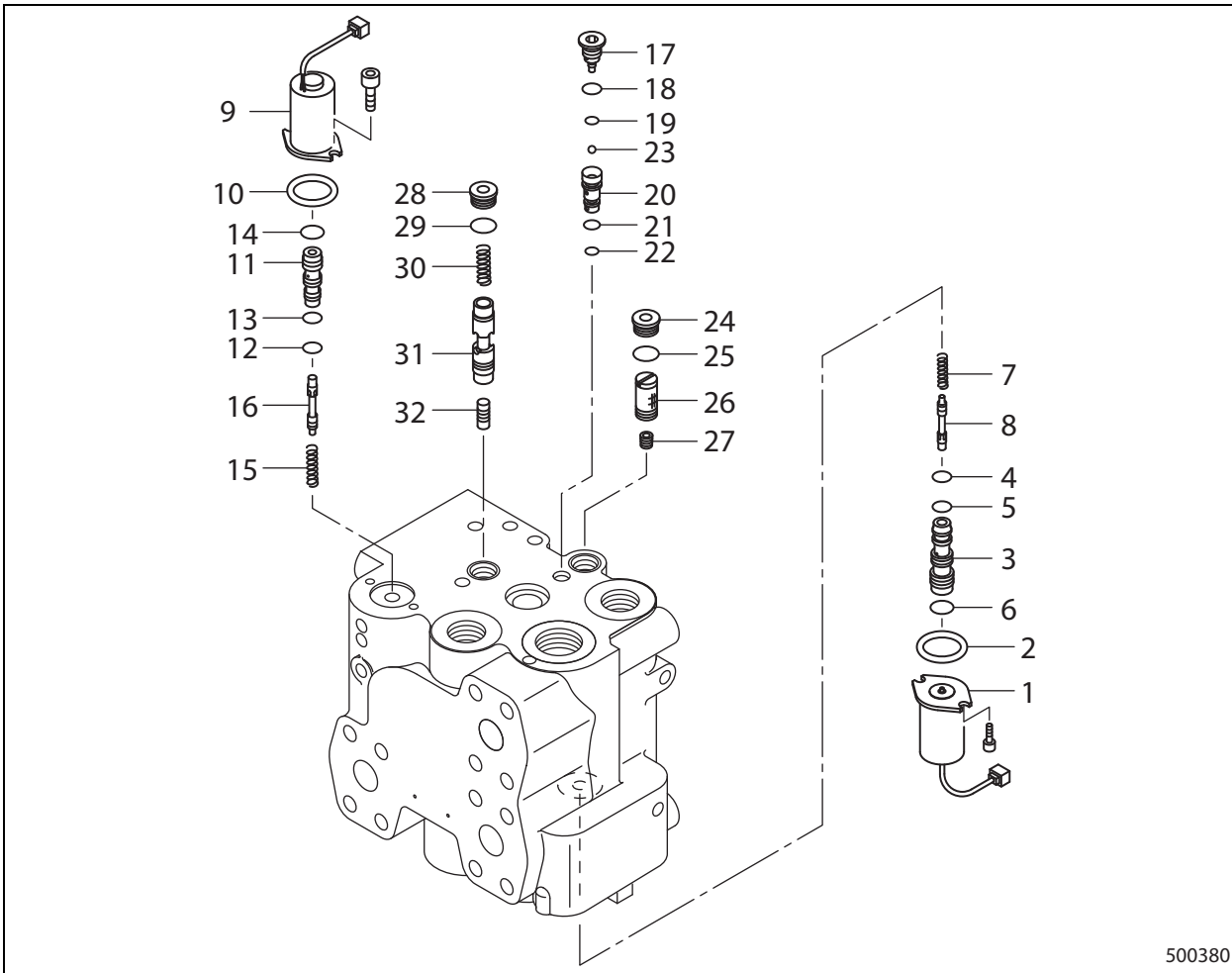
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Disassembly sequence of inlet valve assembly (part 3)



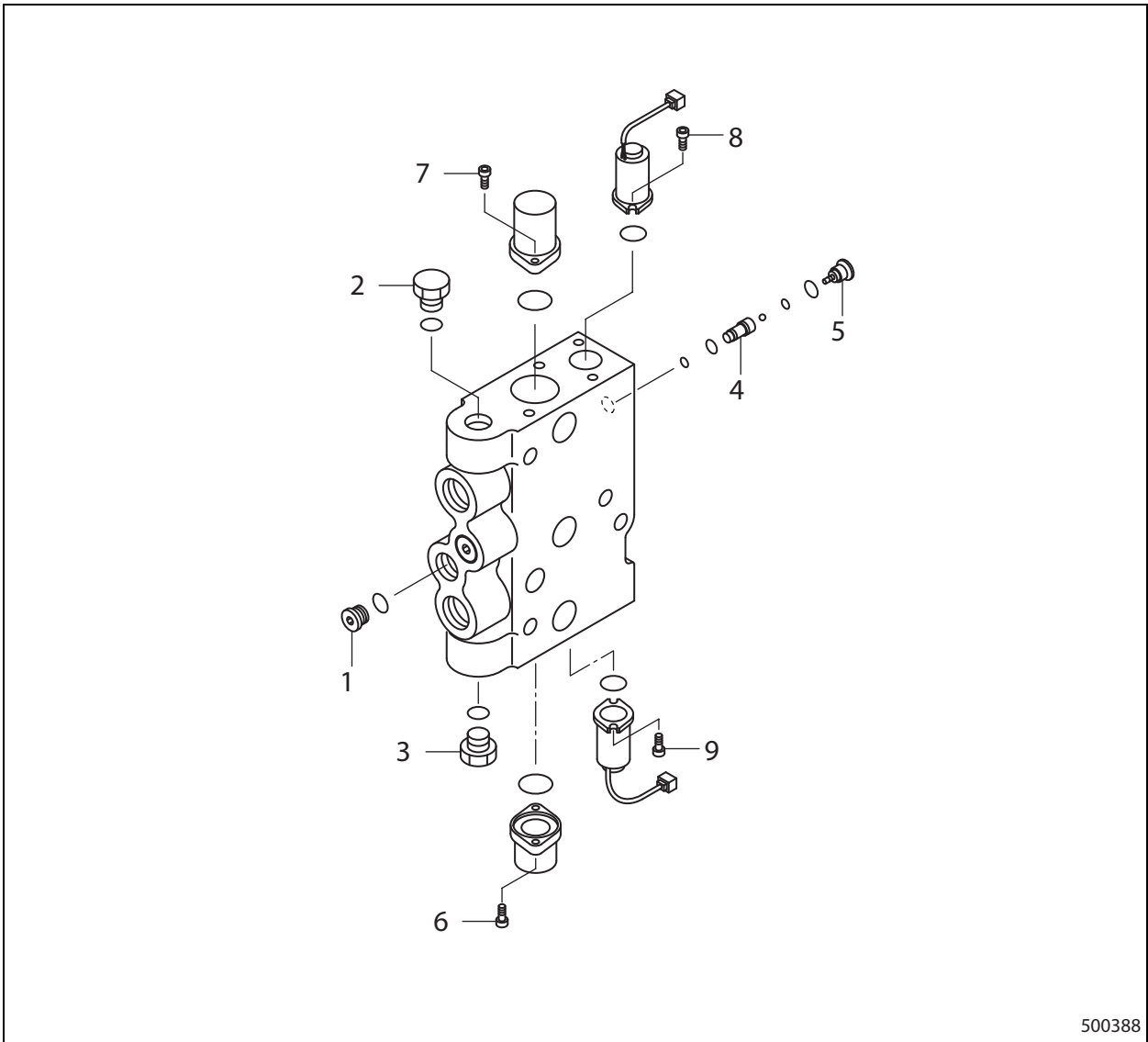
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- | | |
|-----------------------------|------------------|
| 1. Solenoid valve (Descent) | 17. Tapered plug |
| 2. O-ring | 18. O-ring |
| 3. Sleeve | 19. O-ring |
| 4. O-ring | 20. Plug |
| 5. O-ring | 21. O-ring |
| 6. O-ring | 22. O-ring |
| 7. Spring | 23. Steel ball |
| 8. Spool (Pilot) | 24. Plug |
| 9. Solenoid valve (Ascent) | 25. O-ring |
| 10. O-ring | 26. Strainer |
| 11. Sleeve | 27. Orifice |
| 12. O-ring | 28. Plug |
| 13. O-ring | 29. O-ring |
| 14. O-ring | 30. Spring |
| 15. Spring | 31. Spool |
| 16. Spool | 32. Slug |

Suggestions for disassembly

Arrange parts in the order of disassembling to ensure the correct combination of sleeves **3** and **11** to spools **8** and **16**.

(3) Tightening torque for parts

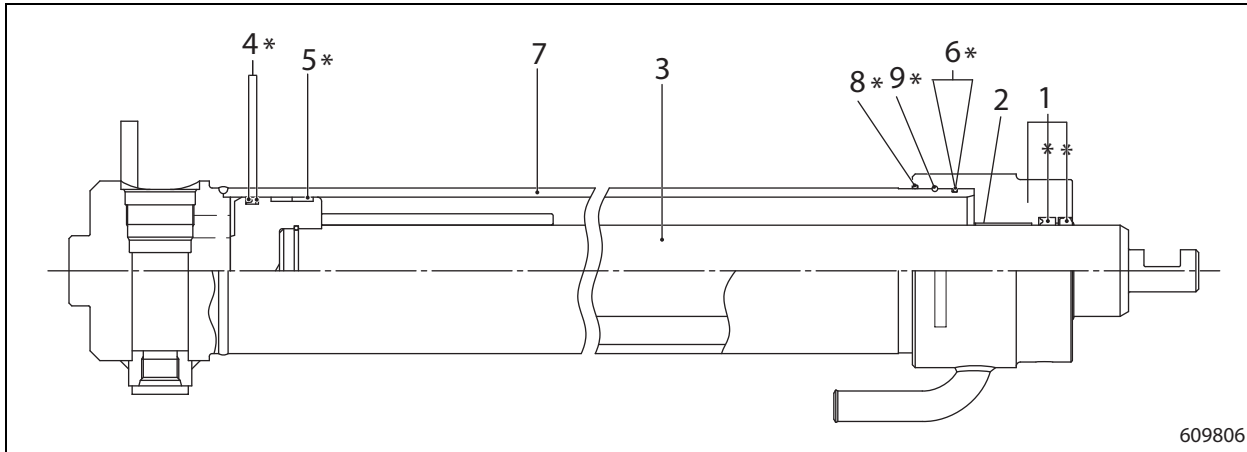


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Ref.	Item	Tightening torque
1	Plug	34.3± 3.4 N·m (3.5 ± 0.35 kgf·m) [25.3 ± 2.51 lbf·ft]
2	Plug	34.3± 3.4 N·m (3.5 ± 0.35 kgf·m) [25.3 ± 2.51 lbf·ft]
3	Plug	34.3± 3.4 N·m (3.5 ± 0.35 kgf·m) [25.3 ± 2.51 lbf·ft]
4	Plug	1.5 ± 0.1 N·m (0.15 ± 0.01 kgf·m) [1.106 ± 0.074 lbf·ft]
5	Plug	14.7 ± 1.5 N·m (1.50 ± 0.15 kgf·m) [10.842 ± 1.106 lbf·ft]
6	Mounting bolt	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.580 ± 1.180 lbf·ft]
7	Mounting bolt	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.580 ± 1.180 lbf·ft]
8	Mounting bolt	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.580 ± 1.180 lbf·ft]
9	Mounting bolt	15.7 ± 1.6 N·m (1.60 ± 0.16 kgf·m) [11.580 ± 1.180 lbf·ft]

20. Assembling Lift Cylinders

20.1 Assembly Sequence



- | | |
|--|--------------------------|
| 1. Rod cover, Rod packing*, Dust seal* | 6. Backup ring*, O-ring* |
| 2. Bushing | 7. Cylinder |
| 3. Piston rod assembly | 8. O-ring* |
| 4. Backup ring*, Piston packing* | 9. Wire* |
| 5. Wear ring* | |

Note: Parts marked with * are seal kit parts.

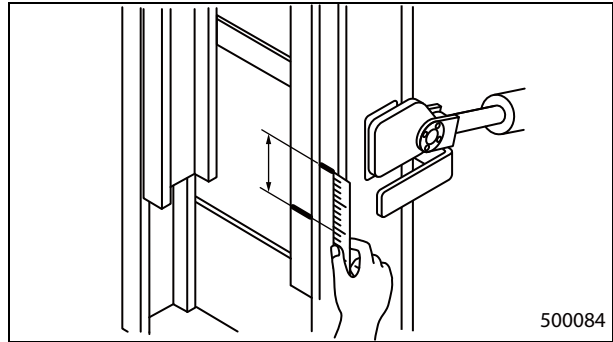
20.2 Suggestions for Assembly

- (1) Replace the * marked seal kit parts to new ones when assembling.
- (2) Thoroughly clean all parts before assembly making sure they are completely free from dirt or dust.
- (3) Install the rod packing on the groove.
- (4) Apply LOCTITE®638 or equivalent to the dust seal groove in the housing, then install the dust seal.
- (5) Install the piston packing and backup ring on the groove.
- (6) Apply a thin coat of grease on the rod cover inside, then install on the rod.
- (7) Make V-shaped dents at the center of both ring gap ends by using nippers for better fitting of the ring.
- (8) Place the cylinder horizontally.
- (9) Set the backup spring, apply grease on the O-ring, then install.
- (10) Apply working fluid to the inside face of the cylinder bore and piston periphery.
- (11) Insert the rod aligning with the cylinder axle.

25. Drift Test

25.1 Loaded Drift Test

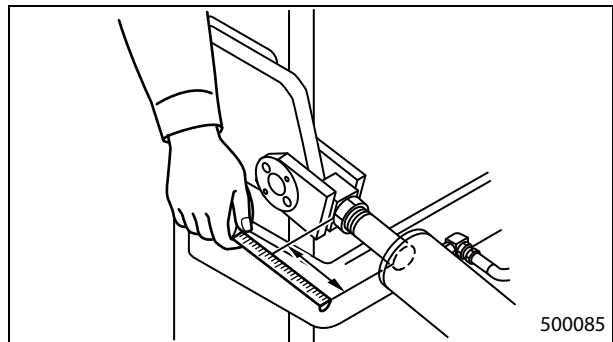
- (1) Pick up a load equal to the rated capacity, place the mast in a vertical position, lift the forks about 1 to 1.5 m (1.1 to 1.64 yd), and turn OFF the engine.
- (2) Mark a reference line on the mast, and measure the amount of descent (retraction of the piston rods) in 15 minutes.



Item	Model	Standard
Rod retraction stroke in the vertical drift test (at the rated load) Oil temperature: 40 to 50 °C (104 to 122 °F)	FD100NM1 FD100NM1S	68 mm (2.68 in.) / 15 min
	FD120NM1 FD120NM1S	78 mm (3.07 in.) / 15 min
	FD135NM1 FD135NM1S	61 mm (2.40 in.) / 15 min
	FD150ANM1 FD150ANM1S	66 mm (2.60 in.) / 15 min

25.2 Tilt Drift Test

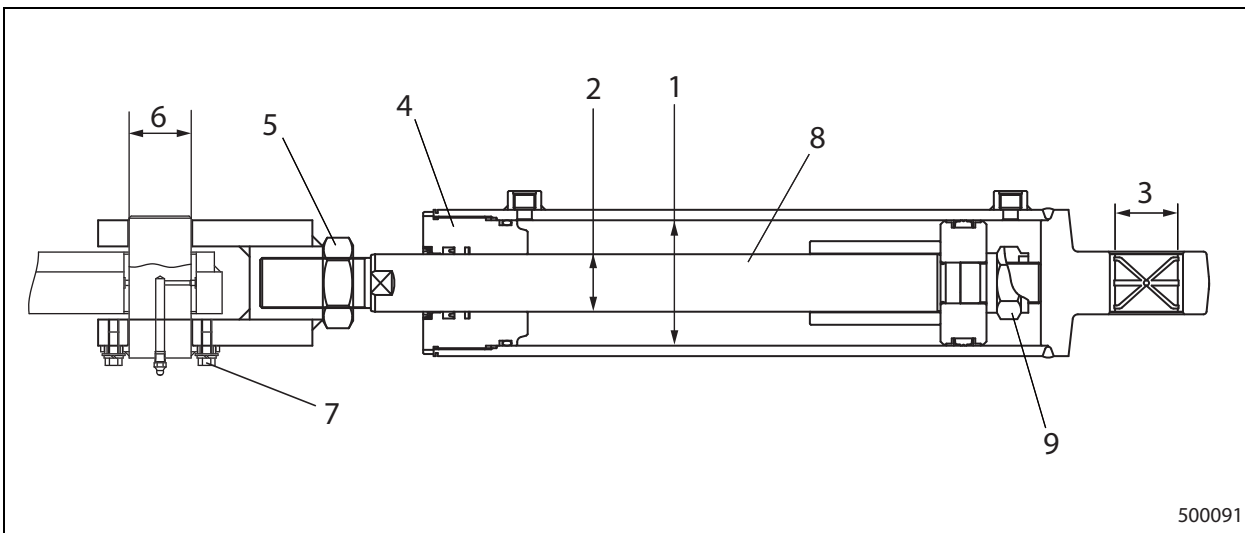
- (1) Pick up a load equal to the rated capacity, place the mast to a vertical position, lift the forks about 500 mm (19.69 in.), and turn OFF the engine.
- (2) Measure the extension of tilt cylinder piston rod for 15 minutes.



Item	Model	Standard
Rod retraction stroke in the tilt drift test (at the rated load) (Oil temperature: 40 to 50 °C (104 to 122°F))	FD100NM1 FD100NM1S	35 mm (1.38 in.) / 15 min
	FD120NM1 FD120NM1S	41 mm (1.61 in.) / 15 min
	FD135NM1 FD135NM1S	32 mm (1.26 in.) / 15 min
	FD150ANM1 FD150ANM1S	35 mm (1.38 in.) / 15 min

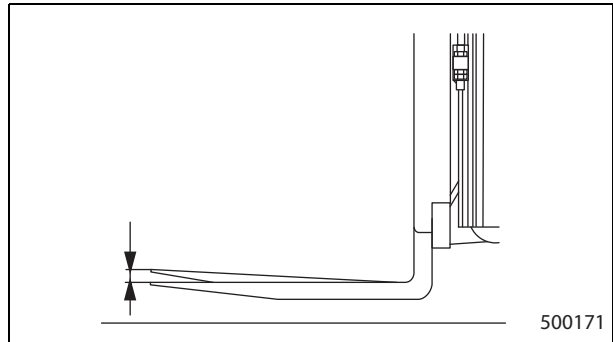
27.7 Tilt Cylinder

Ref.	Item		FD100NM1 FD100NM1S	FD120NM1 FD120NM1S	FD135NM1 FD135NM1S	FD150ANM1 FD150ANM1S
1	Cylinder inside diameter		Standard	120 mm (4.72 in.)		130 mm (5.12 in.)
			Limit	120.12 mm (4.7291 in.)		130.12 mm (5.1228 in.)
2	Guide bushing	Outside diameter of piston rod	Standard	55 mm (2.17 in.)		
		Clearance between rod and guide bushing	Standard	0.1 mm (0.004 in.)		
			Limit	0.2 mm (0.008 in.)		
3	Inside diameter of bushing (under press-fit condition)		Standard	60 ^{+0.100} _{+0.070} mm (2.36 ^{+0.0039} _{+0.0028} in.)		
			Limit	60.6 mm (2.386 in.)		
4	Guide bushing		Tightening torque	637.7 ± 64 N·m (65.03 ± 6.5 kgf·m) [470.343 ± 47.20 lbf·ft]	696.5 ± 69 N·m (71.02 ± 7.0 kgf·m) [513.712 ± 50.89 lbf·ft]	
5	Socket nut		Tightening torque	1334 to 1468 N·m (136.0 to 149.7 kgf·m) [983.91 to 1082.74 lbf·ft]	1618 to 1780 N·m (165.0 to 181.5 kgf·m) [1193.38 to 1312.86 lbf·ft]	
6	Outside diameter of tilt socket pin		Standard	60 ^{+0.010} _{-0.029} mm (2.36 ^{+0.0004} _{-0.0011} in.)		
			Limit	59 mm (2.32 in.)		
7	Tilt socket pin mounting bolt		Tightening torque	33 N·m (3.4 kgf·m) [24.34 lbf·ft]		
8	Piston rod deflection (1/2 TIR)		Standard	1.0 mm (0.039 in.)		
9	Self-locking nut		Tightening torque	1471 ⁺¹⁴⁷ ₀ N·m (150.0 ^{+15.0} ₀ kgf·m) [1084.95 ^{+108.42} ₀ lbf·ft]	1765 ⁺¹⁷⁷ ₀ N·m (180.0 ^{+18.0} ₀ kgf·m) [1301.80 ^{+130.55} ₀ lbf·ft]	



Forks

Check the fork blade for bend, cracks, and uneven height of the blade ends.



Item	Standard
Difference of height at blade tips	5 mm (0.20 in.) or less

- Check the fork blades for wear. If it exceeds the limit, replace with new ones.

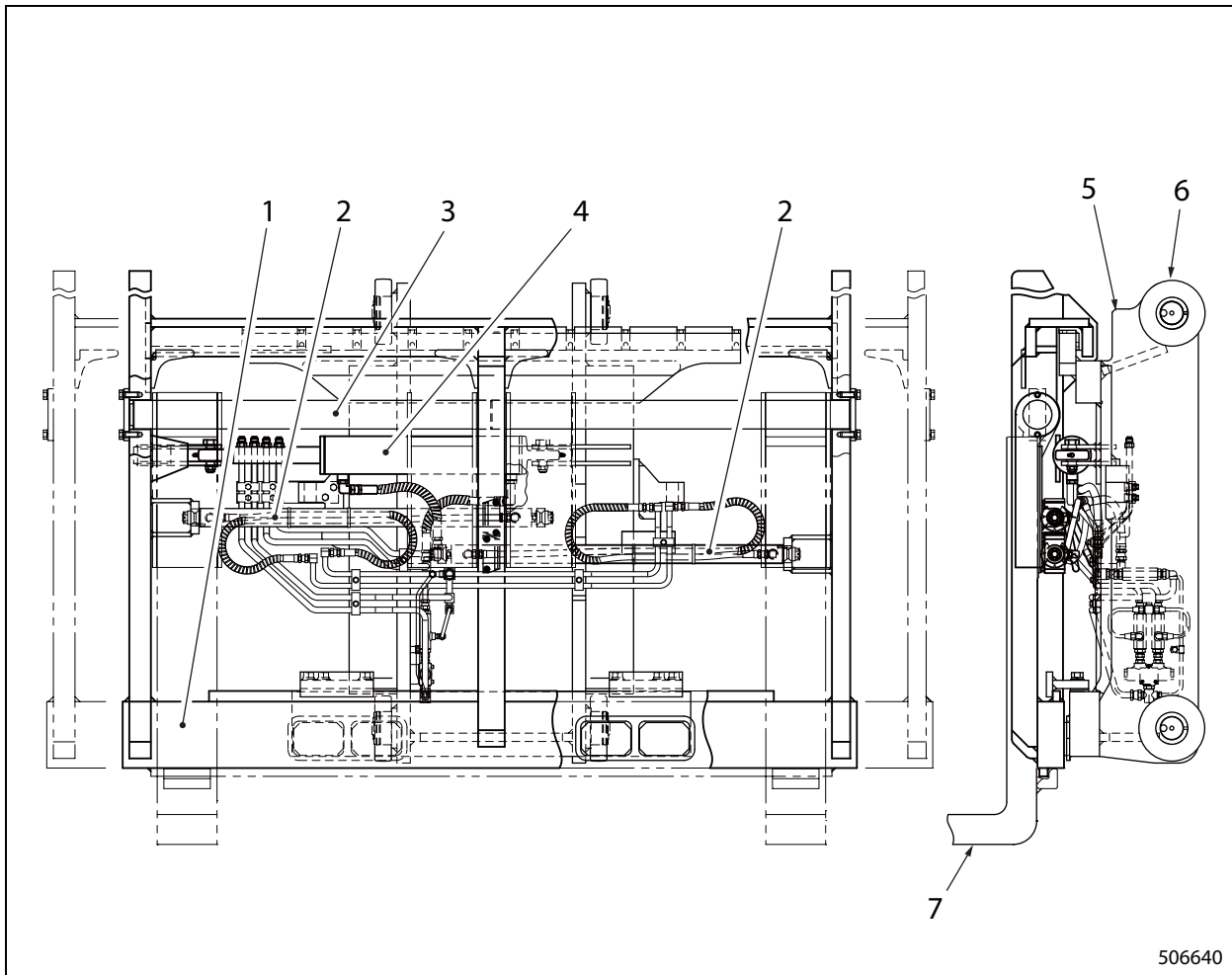
Item	Truck model	Standard	Limit
Blade thickness	FD100NM1 FD100NM1S	72 mm (2.83 in.)	65 mm (2.56 in.)
	FD120NM1 FD120NM1S	79 mm (3.11 in.)	71 mm(2.80 in.)
	FD135NM1 FD135NM1S	88 mm (3.46 in.)	76 mm (2.99 in.)
	FD150ANM1 FD150ANM1S	88 mm (3.46 in.)	80 mm (3.15 in.)

Note: The values herein are for standard specification, thus, they differ depending on the specification.

8. Troubleshooting

Condition	Possible cause	Action
Lift bracket, inner mast and outer masts do not move smoothly	Incorrect clearance between main rollers and side rollers	Adjust back/front and right/left clearances
	Defective roller rotation	Lubricate or replace
	Sluggish chain movement	Lubricate or replace
	Incorrect clearance on mast strip	Adjust with shims
Lift bracket or inner mast is tilted	Excessive clearance on side roller	Adjust by adding shim(s)
	Uneven tension between chains on right and left side	Adjust chain tension
	Uneven shim adjustments between left and right lift cylinders (at the maximum height)	Adjust with shim(s)
Mast makes noise	Defective roller rotation	Adjust or replace rollers after inspection
Drift (natural descent) of lift cylinders	Damaged lift cylinder packing	Replace
	Flaws on sliding (inside) surface of lift cylinder tube	Replace
Whole mast jolts	Worn mast support bushing	Retighten or replace bushing
Deformed mast	Off-center load or overload	Replace mast assembly
Fork blade tips are not aligned	Distortion of finger bar	Repair or replace
	Distortion of forks	Repair or replace
	Mast distortion by off-center load	Repair or replace

4SFS135AM, 4SF135AM, 5FS160AM, SF160AM



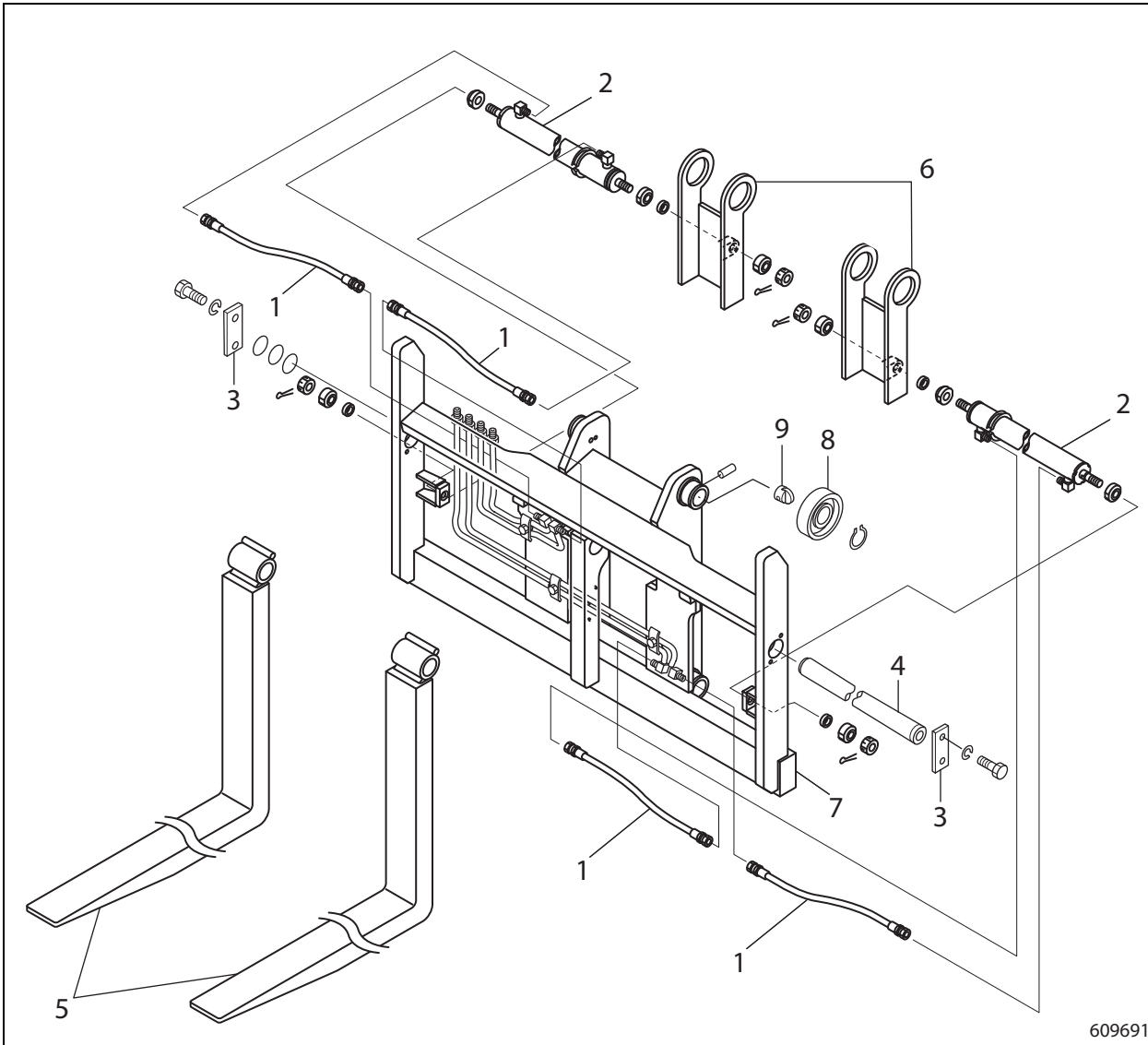
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- | | |
|-----------------------------|-----------------|
| 1. Carriage | 5. Lift bracket |
| 2. Fork positioner cylinder | 6. Main roller |
| 3. Fork guide bar | 7. Fork |
| 4. Side shifter cylinder | |

A hydraulic cylinder is attached to the carriage in front of the lift bracket. The carriage moves from side to side by extension and contraction of the cylinder.

It is difficult to bring a large forklift truck in the proper position for loading and unloading operation. When the forklift truck is equipped with the side shifter, efficiency of loading and unloading operations can be improved because you do not have to move the forklift truck, as the carriage with loads moves from side to side.

4.3 Removal Sequence of Fork Positioner (Independent Move Type)






609691

- | | |
|------------------------------------|---|
| 1. Hose (4 pieces) | 6. Fork bracket |
| 2. Fork positioner cylinders, Pins | 7. Lift bracket |
| 3. Stopper plates, Shims | 8. Main roller (Do not remove unless defective) |
| 4. Guide bar | 9. Side roller (Do not remove unless defective) |
| 5. Forks | |

11. Troubleshooting

Condition	Possible cause	Action	
Shifting speed of right and left blades is slow, or the shift movement is abnormal	Hydraulic tank oil level is too low	Add hydraulic oil	
	Gear pump delivery rate low	Replace pump assembly	
	Overload relief valve malfunction	Valve opening pressure setting is too low	Adjust overload relief valve
		Pilot valve seat face defect or foreign matter inclusion	Replace overload relief valve assembly, or disassembly the valve and clean
		O-ring in valve case damaged	Replace O-ring
		Pilot valve spring fatigued	Replace overload relief valve assembly
	Cylinder defects	Foreign particles in packing	Replace rod packing
		Scratches on bore of rod packing	Replace rod packing
		Piston O-ring damaged	Replace piston O-ring
		Abnormal distortion	Replace
Shift movement is not smooth (jamming or rattling)	Rust or scratches on guide bar	Repair and apply grease	
	Scars on lift bracket surface to contact with fork blade	Repair and apply grease	
	Scars on fork guide bar	Repair and apply grease	
Fork tips are different in height	Distortion of forks	Replace	
	Off-center loading	Instruct operator to handle loads within capacity	

Nominal size mm	Pitch mm	Without spring washer								
		 500247			 500248			 500249		
		N-m	kgf-m	lbf-ft	N-m	kgf-m	lbf-ft	N-m	kgf-m	lbf-ft
10	1.5	39.2	4.00	28.91	51.0	5.20	37.62	79.4	8.10	58.56
12	1.75	69.6	7.10	51.33	90.2	9.20	66.53	135.3	13.80	99.79
14	2	112.8	11.50	83.20	146.1	14.90	107.76	215.7	21.99	159.09
16	2	172.6	17.60	127.30	224.6	22.90	165.65	323.6	33.00	238.67
18	2.5	239.3	24.40	176.50	311.9	31.80	230.04	451.1	46.00	332.71
20	2.5	336.4	34.30	248.11	437.4	44.60	322.60	630.6	64.30	465.10
22	2.5	392.3	40.00	289.34	587.4	59.90	433.24	842.4	85.90	621.31
24	3	578.6	59.00	426.75	753.2	76.80	555.52	1088.5	110.99	802.82
27	3	852.2	86.90	628.54	1108.2	113.00	817.35	1588.7	162.00	1171.75
30	3.5	1140.5	116.30	841.18	1481.8	151.10	1092.90	2168.3	221.10	1599.23
33	3.5	1563.2	159.40	1152.94	2031.9	207.19	1498.63	2915.5	297.29	2150.33
36	4	1972.1	201.10	1454.52	2564.4	261.49	1891.37	3765.8	384.00	2777.47
39	4	2610.5	266.19	1925.37	3393.1	345.99	2502.58	4845.5	494.10	3573.80
42	4.5	3241.1	330.49	2390.47	4212.9	429.59	3107.22	6044.8	616.39	4458.34

Chapter 16 HOW TO READ CIRCUIT DIAGRAMS

1. Description of Circuit Diagrams

The circuit diagrams consist of the schematic diagrams and connector diagrams.

1.1 Circuit Diagrams

All circuits including the power supply and ground are divided into the power circuit, GND circuit and system circuits.

Power circuit diagram

The power circuit diagram indicates the power circuit including the battery, fuse, ignition switch, etc.

GND circuit diagram

The GND circuit diagram indicates the circuits from each electric component to the body ground or from each component to the battery negative terminal.

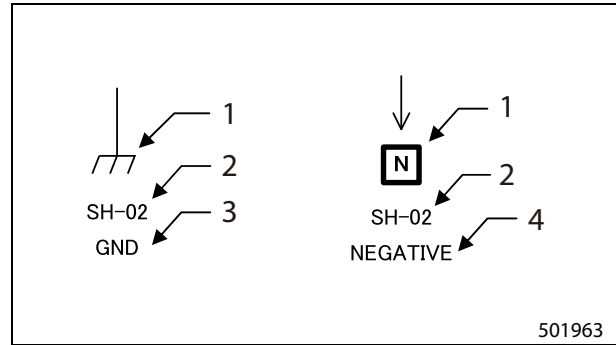
System circuit diagrams

The system circuit diagrams indicate the circuits of each system from fuse to GND (earth) excluding the above power supply and GND circuit portions.

1.2 Connector Diagrams

The connector shapes, terminal shapes and terminal arrangements of all connectors in the circuit diagrams are indicated.

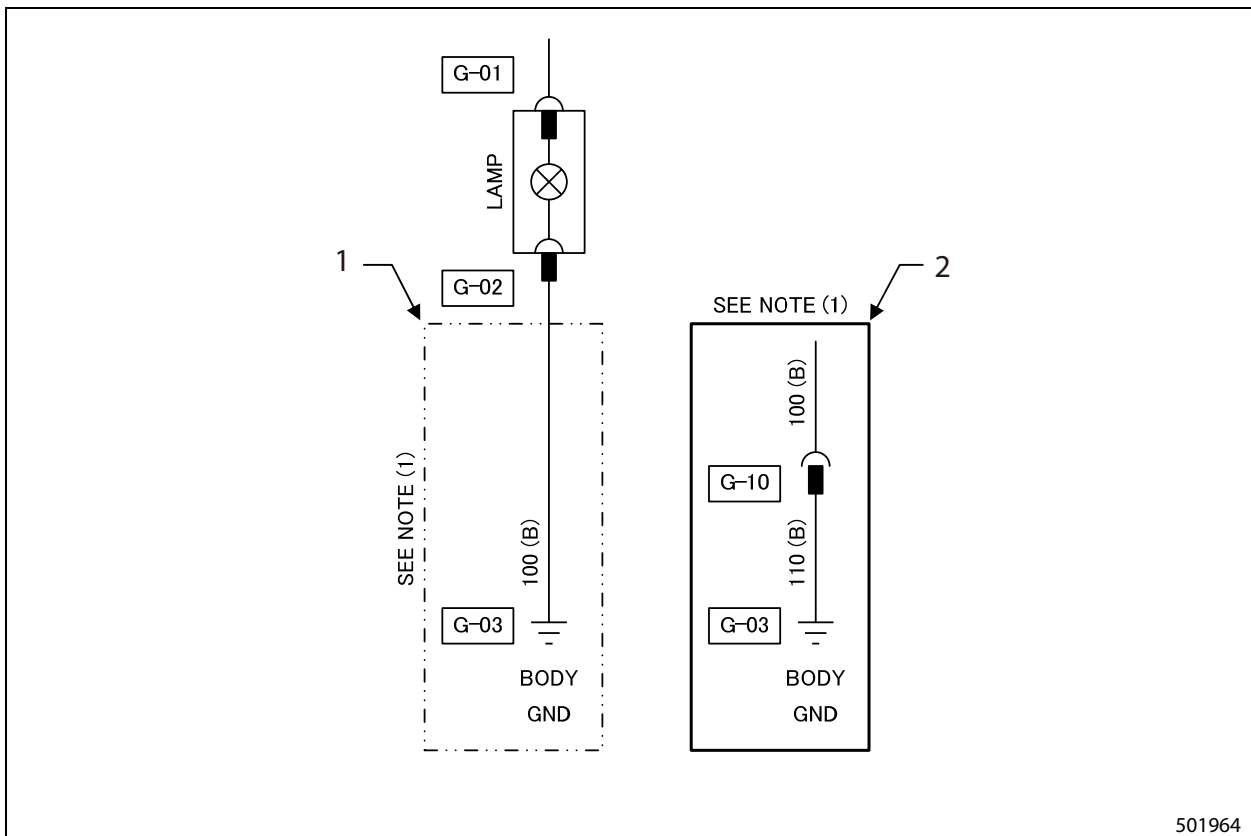
- (2) When connecting to body or battery negative terminal through GND circuit and negative circuit.



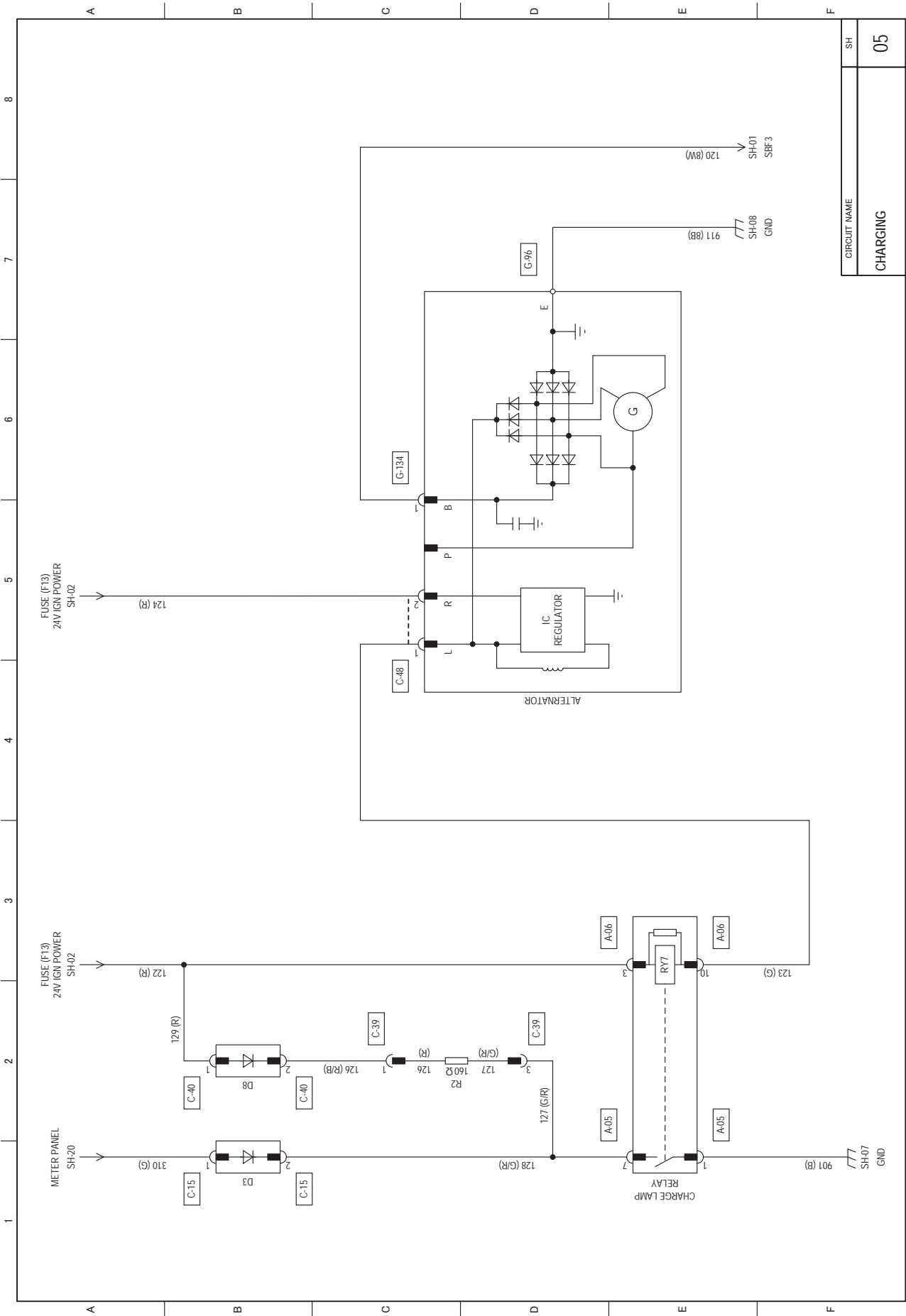
1. Graphic symbol
2. Destination sheet symbol
3. This indicates the connection to GND circuit
4. This indicates the connection to negative circuit.

2.9 Indication of Another Specification

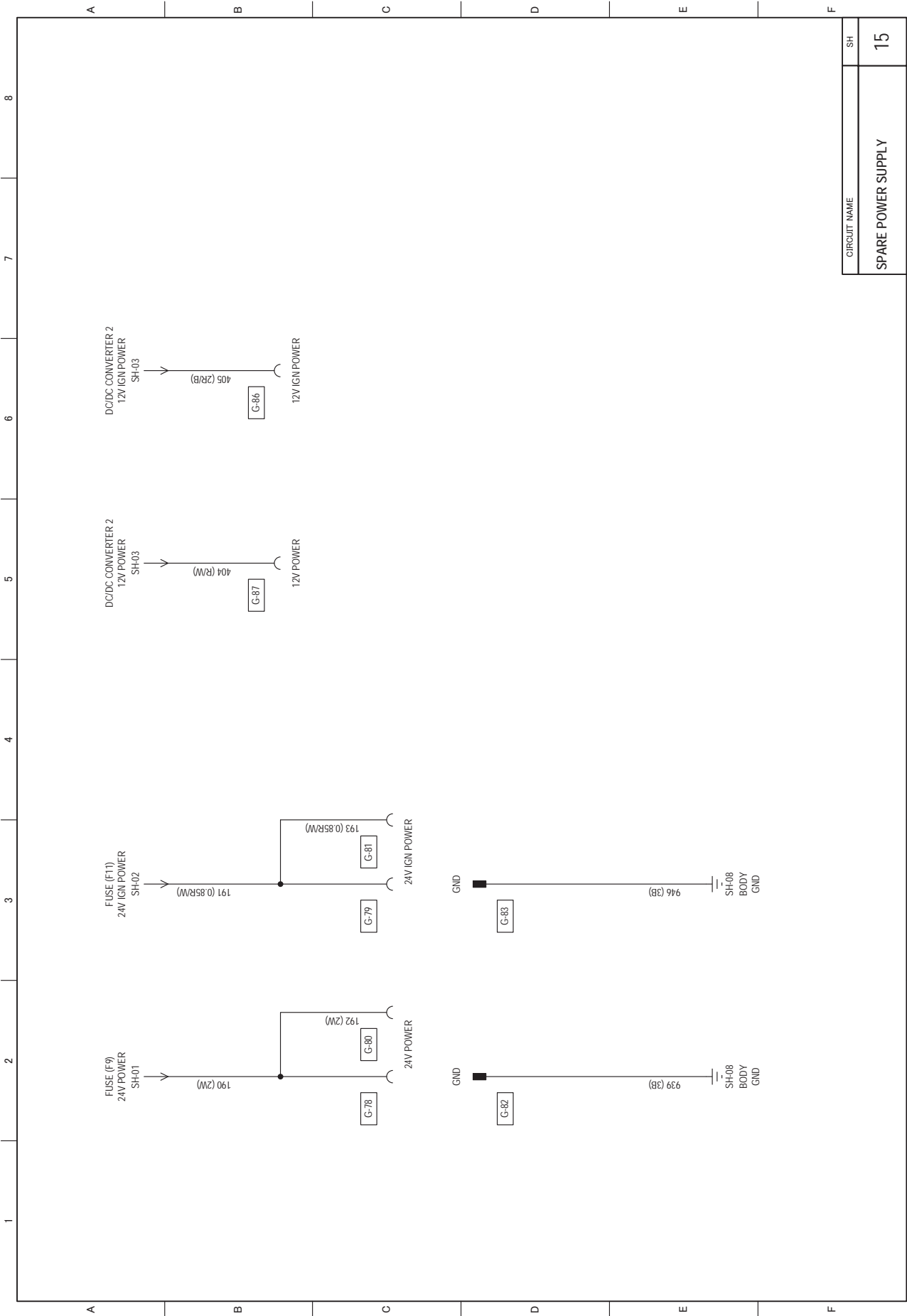
When there is another specification, the portion of circuit, for which another specification is available, is enclosed with an alternate long and two short dashes line, and the circuit of another specification is enclosed by a thick solid line.



1. The circuit portion which differs depending on the specification
2. The circuit of another specification

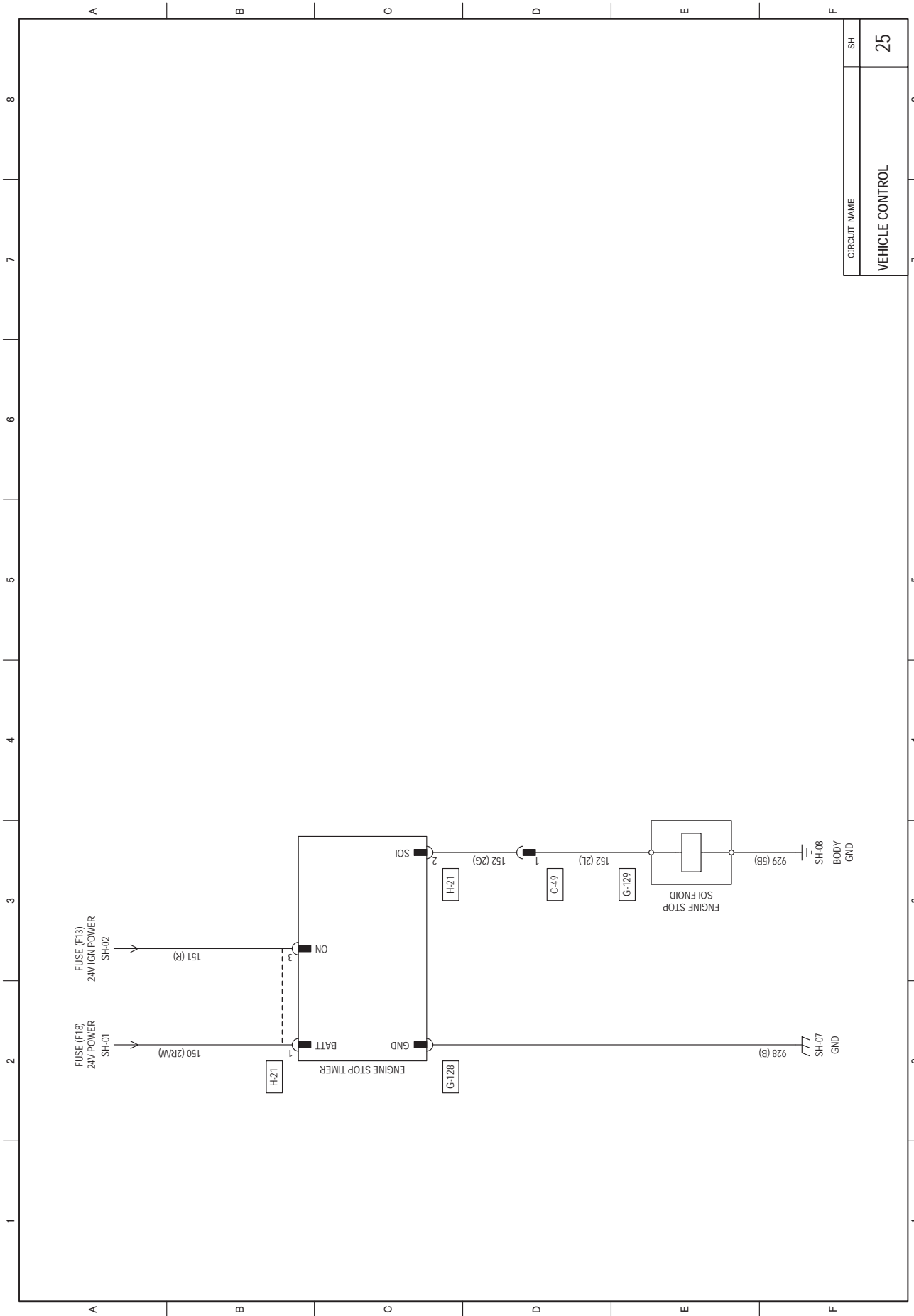


CIRCUIT NAME	SH
CHARGING	05



CIRCUIT NAME SH

SPARE POWER SUPPLY 15



CIRCUIT NAME	SH
VEHICLE CONTROL	25

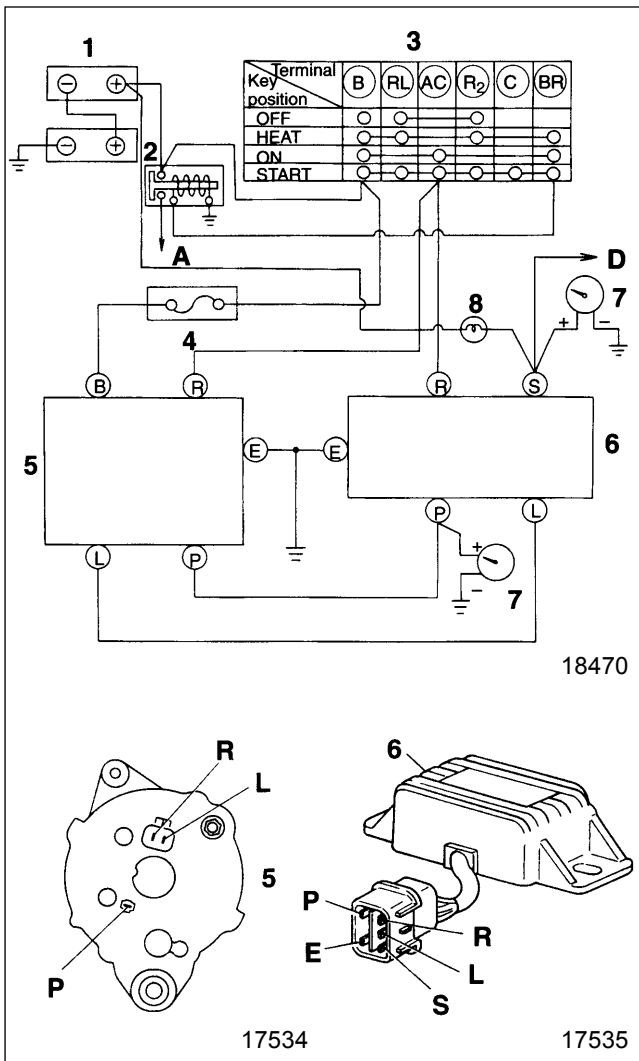
GROUP 14 COOLING

SPECIFICATIONS.....	14-2
STRUCTURE AND OPERATION.....	14-3
1. Cooling System (Water Flow).....	14-3
2. Water Pump.....	14-3
3. Thermostat.....	14-4
TROUBLESHOOTING	14-5
ON-VEHICLE INSPECTION AND ADJUSTMENT.....	14-6
1. Replacing Coolant and Cleaning Coolant System.....	14-6
2. Air Bleeding of Cooling System	14-8
3. Gas Leak Testing.....	14-8
RADIATOR.....	14-10
COOLING FAN AND V-BELT	14-12
WATER PUMP	14-14
THERMOSTAT	14-18

M E M O

GROUP 54 ELECTRICAL SYSTEM

SPECIFICATIONS.....	54-2
STRUCTURE AND OPERATION.....	54-3
1. Circuit Diagram.....	54-3
2. Alternator.....	54-5
3. Charging Circuit.....	54-10
4. Starter.....	54-12
5. Preheating Circuit.....	54-13
6. Engine Starter Circuit.....	54-14
7. Safety Relay.....	54-15
TROUBLESHOOTING	54-16
ON-VEHICLE INSPECTION AND ADJUSTMENT.....	54-18
1. Inspection of Preheater System.....	54-18
2. Inspection of Safety Relay	54-18
ALTERNATOR.....	54-24
<24V-40A> (with vacuum pump).....	54-24
<24V-40A> (without vacuum pump).....	54-32
<24V-50A>	54-38
STARTER.....	54-44
<24V-5kW>	54-44
PREHEATER CIRCUIT	54-56
ENGINE STARTER CIRCUIT	54-59



(3) Checking output voltage at terminal S

- Connect the voltmeter 7 and lamp 8 as shown.
- Set the starter switch 3 to the START position and measure the voltage between the safety relay 6 (terminal S) and the earth in the cranking state.
- If the reading is out of the standard value, the following points are likely to be defective. Check all the parts and replace if defective.
 - When the reading is close to the battery voltage, the safety relay 6 is defective.
 - When the reading is 0V, the following problems are suspected.
 - Defective wiring
 - Incorrectly connected connector
 - Defective starter relay
 - Defective starter switch
- Start the engine and let it run at idle (600 rpm or more).
- Measure the voltage at terminal P.
- If the reading is out of the standard value, replace the alternator 5.
- In the idling state, check to ensure that the lamp 8 does not come on. When the voltage at terminal P is normal and the lamp comes on, replace the safety relay 6.

M E M O

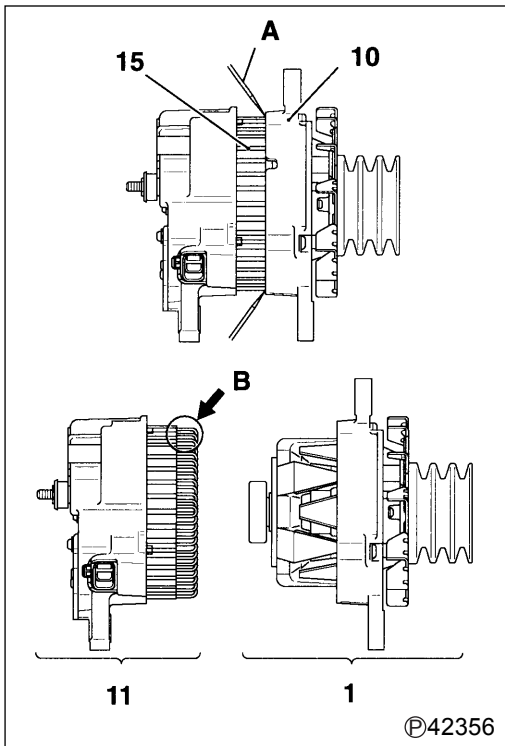
Service standards

Location	Maintenance item	Standard value	Limit	Remedy
14	Field coil resistance [at 20°C (68°F)]	5.1 to 6.0 Ω	–	Replace

ⓘ Tightening torques

Unit: N·m (kgf·m) [lbf·ft]

Location	Parts to be tightened	Tightening torque	Remarks
2	Nut (to mount pulley)	132 to 162 (13.5 to 16.5) [97.4 to 119]	–



◆ Service procedure

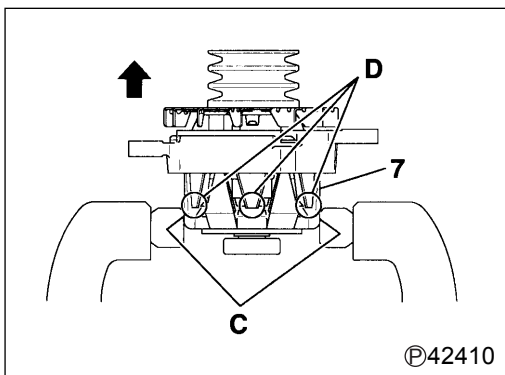
1 Rotor & front bracket assembly

[Removal]

- Insert a plain screwdriver A between the front bracket 10 and stator assembly 15.
- While wrenching the plain screwdriver A, remove the rotor & front bracket assembly 1 from the stator & rear bracket assembly 11.

CAUTION ⚠

If the plain screwdriver A is inserted too far, the coil B of the stator assembly 15 might be damaged and short-circuited.

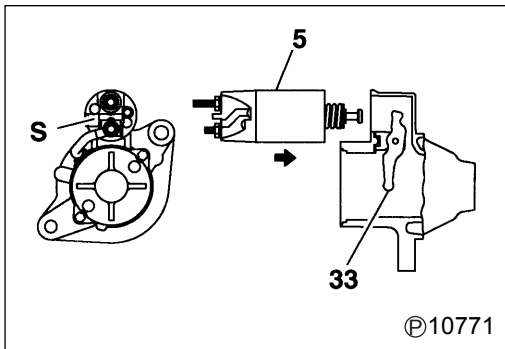


[Disassembly]

CAUTION ⚠

When the rotor assembly 7 is held in a vice, make sure that the base C of the lugs of the core is held.

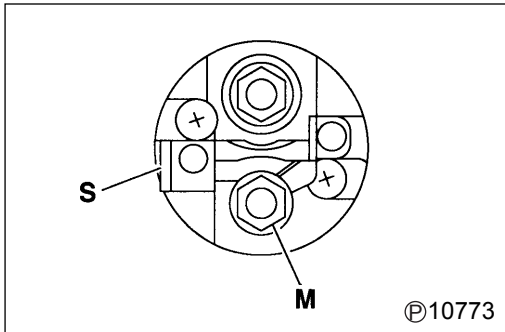
If the lugs D of the core are held, they could be broken or damaged.



5 Magnet switch

[Installation]

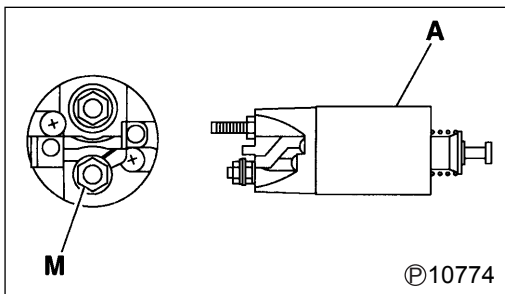
Install the magnet switch 5 on the lever assembly 33 with terminal S in the direction shown.



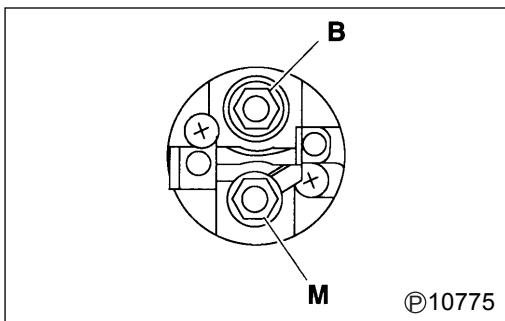
[Inspection]

(1) Open circuit test on coil

- Check to ensure that there is continuity between terminals S and M.
- If there is no continuity, replace the magnet switch 5.

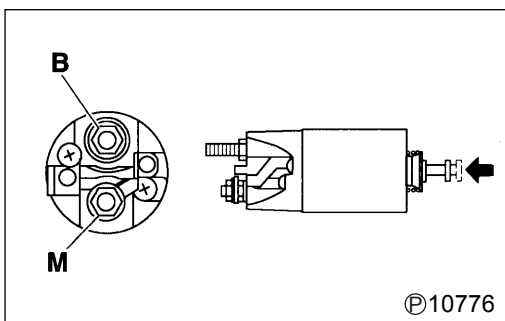


- Check to ensure that there is continuity between terminal M and body A.
- If there is no continuity, replace the magnet switch 5.



(2) Contact fusion check

- Check to ensure that there is no continuity between terminals B and M.
- If there is continuity, replace the magnet switch 5.



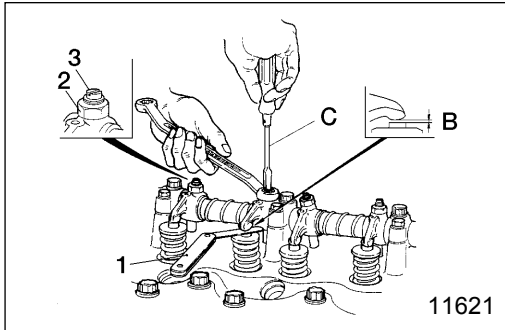
(3) Contact contacting check

- Push the end of the magnet switch 5 in to close the internal contact. In this state, check to ensure that there is continuity between terminals B and M.
- If there is no continuity, replace the magnet switch 5.

GROUP 11 ENGINE

SPECIFICATIONS.....	11-2
STRUCTURE AND OPERATION.....	11-3
1. Cylinder Head and Crankcase.....	11-3
2. Valve Mechanism.....	11-4
3. Connecting Rods.....	11-4
4. Pistons	11-5
5. Timing Gears	11-5
6. Flywheel.....	11-5
TROUBLESHOOTING	11-6
ON-VEHICLE INSPECTION AND ADJUSTMENT	11-8
1. Measuring Compression Pressure.....	11-8
2. Inspecting and Adjusting Valve Clearances.....	11-10
CYLINDER HEAD AND VALVE MECHANISM.....	11-12
PISTONS, CONNECTING RODS, AND CYLINDER LINERS	11-30
FLYWHEEL	11-46
TIMING GEARS	11-52
CAMSHAFT	11-58
CRANKSHAFT AND CRANKCASE.....	11-66

- If any measurement is out of specification, make adjustments as follows:



[Adjustment]

- To adjust the valve clearance **B**, loosen the locknut **2** and turn the adjusting screw **3** until the feeler gauge **1** moves more stiffly in the gap.
- After adjusting the clearance, tighten the locknut **2**. At this time, use a screwdriver **C** to stop the adjusting screw **3** from turning. Next, insert the feeler gauge **1** once more to confirm that the clearance **B** is correct.

Service standards

Unit: mm (in.)

Location	Maintenance item		Standard value	Limit	Remedy	
4	Outer valve spring	Free length	6D16	67.0 (2.64)	64.0 (2.52)	Replace
			6D16-TLE	68.3 (2.689)	65.3 (2.571)	
		Installed load [at 47.8 mm (1.88 in.) installed length]	6D16	330 N (33.5 kgf) [74.5 lbf]	290 N (29.7 kgf) [65.2 lbf]	Replace
			6D16-TLE	390 N (40.0 kgf) [87.7 lbf]	350 N (35.5 kgf) [65.2 lbf]	
	Squareness		–	2.5 (0.0984)	Replace	
5	Inner valve spring	Free length	6D16	55.1 (2.17)	52.1 (2.05)	Replace
			6D16-TLE	65.1 (2.563)	61.5 (2.421)	
		Installed load [at 40.5 mm (1.59 in.) installed length]	6D16	92 N (94 kgf) [20.7 lbf]	78 N (8.0 kgf) [17.5 lbf]	Replace
			6D16-TLE	155 N (15.8 kgf) [34.9 lbf]	130 N (13.4 kgf) [29.3 lbf]	
	Squareness		6D16	–	2.0 (0.0787)	Replace
		6D16-TLE	–	2.5 (0.0984)	Replace	
7	Exhaust valve	Stem outside diameter		$\phi 8.93$ to 8.94 ($\phi 0.3516$ to 0.3520)	$\phi 8.85$ ($\phi 0.348$)	Replace
		Sinkage from cylinder head bottom surface		1.3 to 1.7 (0.0512 to 0.0670)	2.0 (0.0787)	Inspect every location
		Valve margin		1.5 (0.0591)	1.2 (0.0472)	Reface or replace
8	Inlet valve	Seat angle		45°	–	Correct
		Stem outside diameter		$\phi 8.96$ to 8.97 ($\phi 0.3528$ to 0.3531)	$\phi 8.85$ ($\phi 0.348$)	Replace
		Sinkage from cylinder head bottom surface		1.1 to 1.5 (0.0433 to 0.0591)	1.8 (0.0709)	Inspect every location
		Valve margin		1.5 (0.0591)	1.2 (0.0472)	Reface or replace
		Seat angle		45° ± 15'	–	Correct
7, 15	Exhaust valve stem-to valve guide clearance [Basic diameter: 9 mm (0.354 in.)]		0.07 to 0.10 (0.00276 to 0.00394)	0.2 (0.00787)	Replace	
8, 16	Inlet valve stem-to-valve guide clearance [Basic diameter: 9 mm (0.354 in.)]		0.04 to 0.06 (0.00157 to 0.00236)	0.15 (0.00591)	Replace	
17	Exhaust valve seat width		1.8 to 2.2 (0.0709 to 0.0866)	2.8 (0.110)	Correct or replace	
18	Inlet valve seat width		1.8 to 2.2 (0.0709 to 0.0866)	2.8 (0.110)	Correct or replace	
20	Cylinder head	Bottom surface distortion		0.08 (0.00315) or less	0.2 (0.00787)	Correct or replace
		Height from top to bottom surface		94.9 to 95.1 (3.736 to 3.744)	94.5 (3.72)	Replace

Tightening torques

Unit: N·m (kgf·m) [lbf·ft]

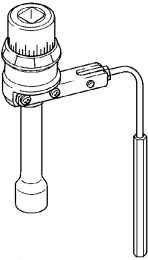
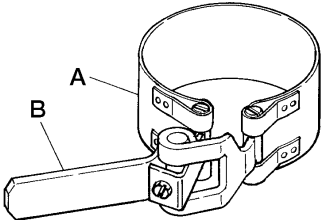
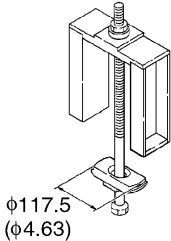
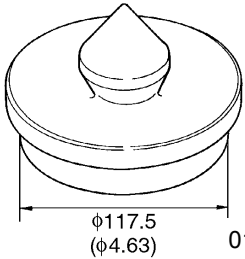
Location	Parts to be tightened	Tightening torque	Remarks
1	Bolt (connecting rod installation)	29 (3) [21.4] + 90° ± 5°	Wet

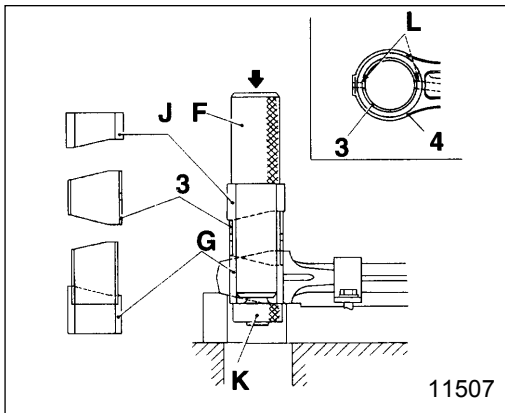
Lubricant

Location	Points of application	Specified lubricant	Quantity
1	Both threads	Engine oil	As required
2, 4	Connecting rod bearing inside surface	Engine oil	As required
6	Cylinder liner outside surface	Engine oil	As required

Special tools

Unit: mm (in.)

Location	Tool name and shape	Part No.	Application
5	Socket Wrench 	MH061560	Installing piston and connecting rod assembly
5	A: Piston Guide Clamp B: Piston Guide Lever 	A: MH061760 B: MH061658	Installing piston and connecting rod assembly
6	Cylinder Liner Extractor 	MH061761	Removing cylinder liners
6	Cylinder Liner Installer 	MH061771	Installing cylinder liners (dry type)

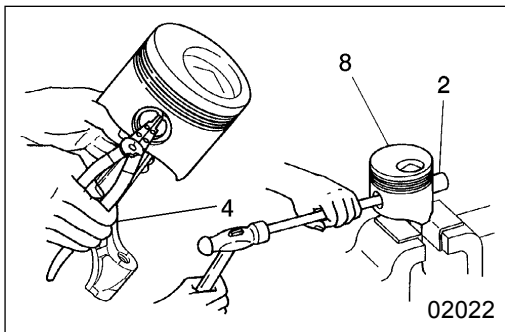


[Installation]

- Apply engine oil to the small end of the connecting rod 4 and to the outer surface of the connecting rod bushing 3.
- Fit the collar J over the puller F, position the connecting rod bushing 3 and collar G as shown in the illustration, and lock this arrangement together with the nut K.
- Align the oil holes L in the small end of the connecting rod bushing 3 and connecting rod 4. Then, use a press to slowly apply pressure of approximately 49 kN (5,000 kgf) until the bushing is pressed into place.
- After press-fitting the connecting rod bushing 3, ream it to achieve the specified nominal clearance between the bushing and piston pin 2.

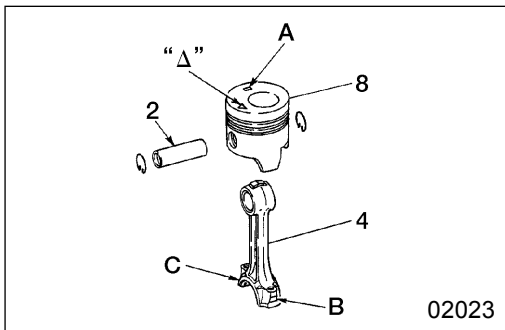
NOTE

After installing the connecting rod bushing 3, insert the piston pin 2 and check that it turns smoothly and without play.

**2 4 8** Piston pin, connecting rod, and piston

[Removal]

- Tap out the piston pin 2 using a rod and hammer.
- If the piston pin 2 is difficult to remove, heat the piston 8 in hot water or using a piston heater.



[Installation]

- Apply engine oil to the piston pin 2. With the connecting rod 4 and piston 8 aligned as illustrated, insert the piston pin to hold these components together.

A: Weight mark

B: Weight mark (A, B, C, D, E, F, G, H, I, V, W, X, Y, Z)

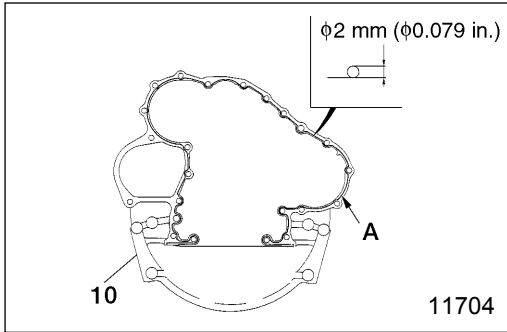
C: Alignment mark for connecting rod cap

Δ: Front mark

- If the piston pin 2 is difficult to insert, heat the piston 4 in hot water or using a piston heater.

CAUTION ⚠

- No piston should differ from any other piston by a weight of more than 10g.
- The connecting rods must all have the same weight mark.
- After inserting the piston pin 2, check that it turns smoothly and without play.



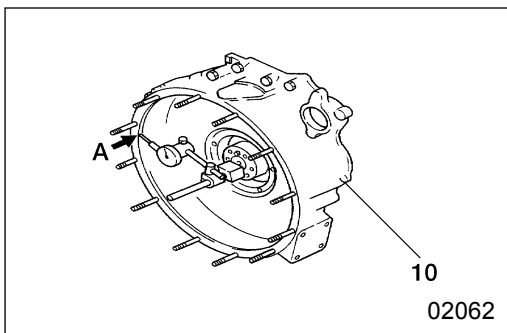
10 Flywheel housing

[Installation]

- Apply an even, unbroken bead of sealant A to the crankcase mounting surface of the flywheel housing 10.
- Fit the flywheel housing 10 onto the crankcase within 3 minutes of applying the sealant A.

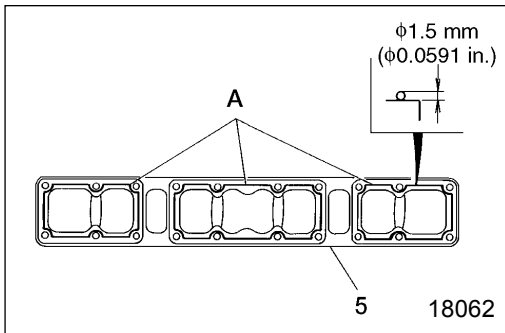
CAUTION

- Ensure that the sealant application position on the flywheel housing 10 is clean before applying sealant.
- When fitting the flywheel housing 10, hold it firmly in position to prevent spreading the sealant.
- After fitting the flywheel housing 10, wait at least an hour before starting the engine.
- Apply a new bead of sealant A whenever the mounting bolts of the flywheel housing 10 have been loosened.



[Inspection]

- Rotate the crankshaft and check the extent of eccentricity at the joint A of the flywheel housing 10.
- If eccentricity exceeds the specified limit, carry out reassembly.
- If eccentricity still exceeds the specified limit after reassembly, replace the defective part(s).

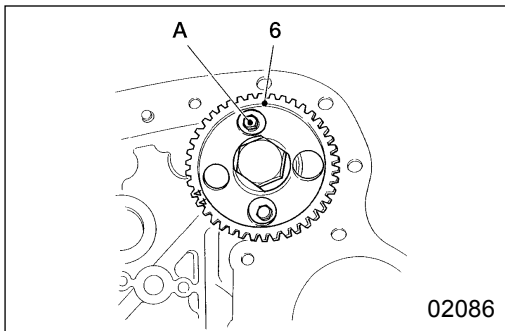


5 Fitting side cover

- Apply an even, unbroken bead of sealant A to the side cover 5.
- Fit the side cover 5 onto the crankcase within 3 minutes of applying the sealant A.

CAUTION

- Ensure that the sealant application surface of the side cover 5 is clean before applying sealant.
- When fitting the side cover 5, hold it firmly in position to prevent spreading the sealant.
- After fitting the side cover 5, wait at least an hour before starting the engine.
- Apply a new bead of sealant A whenever the mounting bolts of the side cover 5 have been loosened.



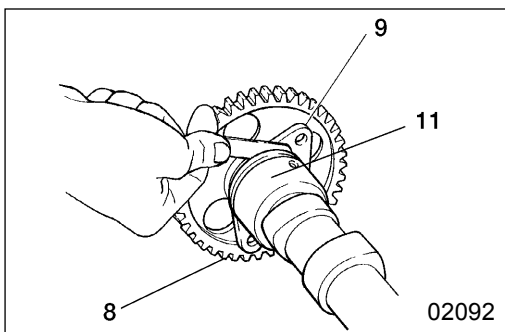
6 Camshaft assembly

[Removal]

- When removing the camshaft assembly 6, take off the side cover 5 and support the camshaft by hand.
- Remove the bolts A from the camshaft gear holes, then slowly remove the camshaft assembly 6.

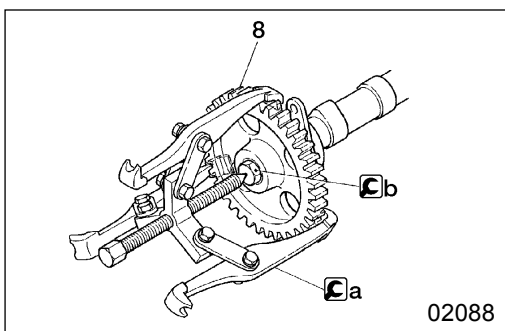
CAUTION

Take care not to damage the camshaft bushings 12 to 15 when removing the camshaft assembly 6.



[Installation]

- Before installing the camshaft assembly 6, measure the end play between the thrust plate 9 and camshaft 11.
- If the measurement exceeds the specified limit, replace the defective part(s).
- With the alignment marks lined up on the camshaft gear 8 and No. 2 idler gear, fit the camshaft assembly.



8 Camshaft gear

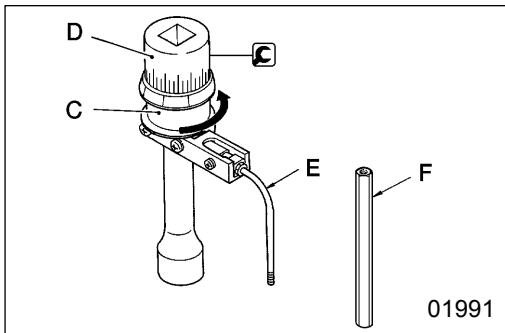
[Removal]


CAUTION

The camshaft gear 8 must be removed with the appropriate special tools. Do not tap off the camshaft gear since this would damage it.

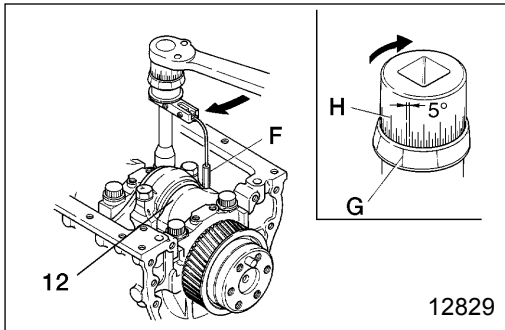
a : Gear Puller

b : Plug



- Tighten the bolts **8** to the specified torque. Then, turn the bolts further in accordance with the following procedure:
- Turn the holder **C** of the  Socket Wrench counter-clockwise to tension the built-in spring.

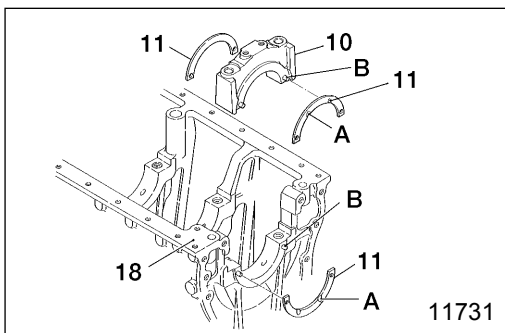
D: Socket
E: Rod
F: Rod (extension)



- Set the socket wrench such that the built-in spring force forces the rod **F** against the crankshaft assembly **12**.
- On the holder **C**, select the inscribed line **G** that is easiest to see.
- Using the selected line as a reference, turn the socket **D** 90° clockwise. (One gradation on the scale **H** represents 5°.)

CAUTION

Since the bolts utilize the plastic region tightening method, they must not be tightened further after this procedure.



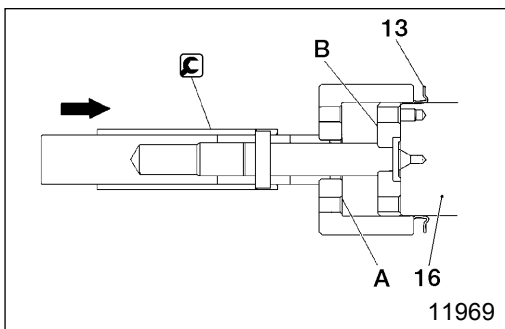
11 Installing thrust plates

Fit a thrust plate **11** on each side of the main bearing caps **10** and at the rear end of the crankcase **18** such that the oil grooves **A** are on the outside.


B: Locating pin

NOTE

If oversize thrust plates **11** are used, they must be fitted on both sides of the bearing caps **10**. Ensure that the bearing cap rear thrust plates and the rearmost thrust plate in the crankcase **18** are the same size. Note, however, that the front and rear thrust plates on each bearing cap may be of different sizes.



13 Installing front oil seal slinger

Using the  Front Oil Seal Slinger Installer, drive the front oil seal slinger **13** onto the crankshaft **16** until the tool's end face **A** is pressed firmly against the guide **B**.

General Explanation of This Manual

● Specifications

Particulars relative to maintenance service are made.

● Structure and operation

(1) Regarding conventional equipment, descriptions are made in brief.

(2) Regarding new equipment, descriptions of system and operating condition are made in detail.

● Troubleshooting

Symptoms of troubles and possible causes are described comparatively.

● Inspection and adjustment mounted in vehicle

Descriptions are made regarding inspection and adjustment of units mounted in vehicle.

● Service procedure

In principle, an explanation is given at the spread title page so that the service procedure can be understood.

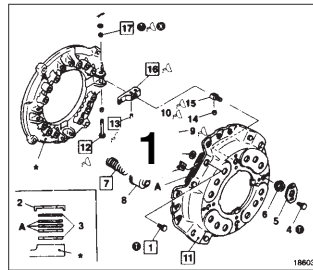
Servicing points are explained as a supplementary explanation.

Regarding the design of this manual

CLUTCH BODY

21

Pressure Plate and Lever Assembly



◆ Disassembly sequence

- 1 Bolt
- 2 Washer
- 3 Washer
- 4 Bolt
- 5 Lo
- 6 Su
- 7 Pin
- 8 Pressure spring cap
- 9 Return spring
- 10 Release lever plate
- 11 Clutch cover
- 12 Release lever pin
- 13 Support lever pin
- 14 Bushing
- 15 Support lever
- 16 Release lever
- 17 Bushing

2 Pressure plate & lever assembly

3 Clutch disc

- Flywheel
- ▲ Positioning pin (at 2 places)
- Non-reusable part

◆ Assembly sequence

15 → 17 → 1 14 → 15 → 13 7 → 6 → 5 → 4 → 3 → 2 → 1

Repair kit: clutch release

Service standards

Unit: mm

Location	Maintenance item	Standard value (Basic diameter in [])	Limit	Remedy
1, A	Clearance between strap bolt and strap plate	0.01 to 0.16	0.3	Replace
7	Pressure spring Installed load (installed length 49.1)	8650 N (90.2 kgf)	750 N (16.7 kgf)	Replace
2	Clearance between pin and bushing	2.9 or less	5.0	Replace
10	Clearance between support lever pin and bushing	[10] 0.06 to 0.16	0.4	Replace
10	Release lever	53.8 ± 0.7	Mutual difference 0.5 or less	Adjust

◆ Tightening torque

Unit: N · m (kgf · m)

Location	Parts to be	Tightening torque	Remarks
1	Strap bolt (securing str)	39 to 59 (4 to 6)	—
4	Bolt (securing lock plate)	5.9 to 7.8 (0.6 to 0.8)	Wet

▲ Lubricants

Location	Points of application	Kinds	Quantity
1	Threads of strap bolt	LOCTITE 212	As required
10, 16	Sliding surfaces of release bushing	Molybdenum disulfide grease	As required
12, 17	Sliding surfaces of support bushing	Molybdenum disulfide grease	As required
13, 14	Sliding surfaces of support release lever	Molybdenum disulfide grease [NLGI No. 2 (L soap)]	As required

◆ Special tools

Unit: mm

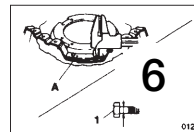
Location	Tool name and shape	Part No.	Application
11	Clutch Installer	MH061051	Removal and installation of clutch cover
5	Clutch Master Plate	MH062291	Release lever plate height adjustment

◆ Service procedure

1 A Clearance between strap bolt and strap plate

If the measurement exceeds the limit, replace the defective part.

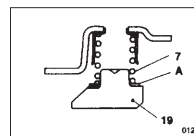
A: Strap plate



7 Installation of pressure spring

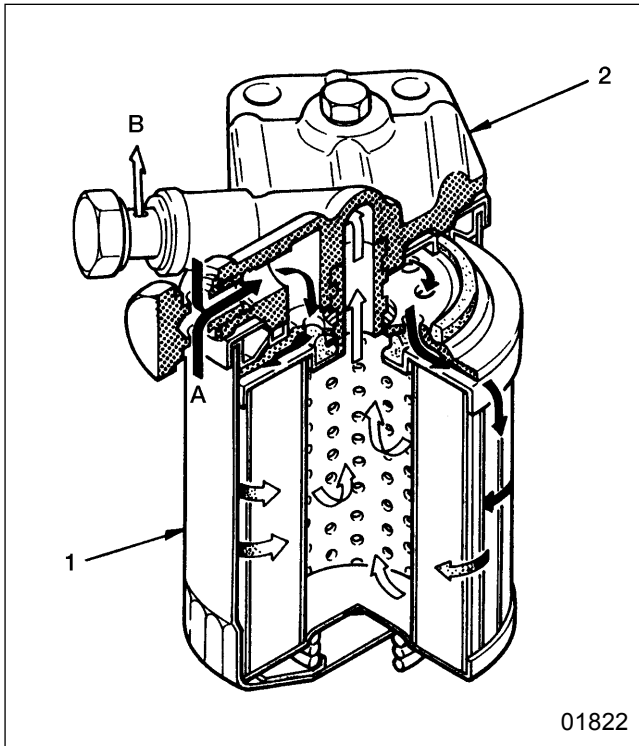
If pressure plate 19 has been reground, insert adjusting washer A corresponding to the amount of reground in the space between the pressure plate and pressure spring 7.

Regrind amount	Type and no. of washers
Less than 1 mm	Not required
1 mm or more to less than 2 mm	One 1.2-mm
2 mm or more to less than 3 mm	Two 1.2-mm or one 2.3-mm



1. Illustration for disassembly and assembly or removal and installation: 3-D exploded view of component parts is displayed.
 - 1a. Names of parts show an example of the disassembly (removal) sequence.
 - 1b. When the assembly (installation) sequence differs from the disassembly (removal) sequence, an example of the assembly (installation) sequence is shown.
2. Service standards are shown collectively, classified by location.
3. Tightening torques are shown collectively, classified by location.
4. Points of lubricant, fluid and sealant application are shown collectively, classified by location.
5. Special tools to be used are shown collectively, classified by location.
6. When it is considered hard to understand the service procedure, just by the foregoing description, a supplementary description of the service procedure is given.

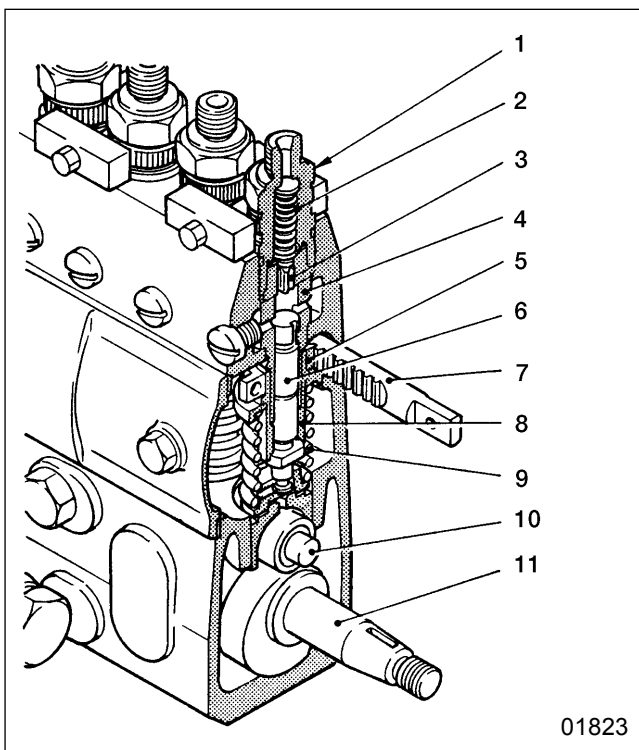
2. Fuel Filter



- 1 Fuel filter
 - 2 Fuel filter head
- A: From feed pump
B: To injection pump

The fuel filter separates any water content out of fuel fed from the injection pump's feed pump, and its element removes any impurities.

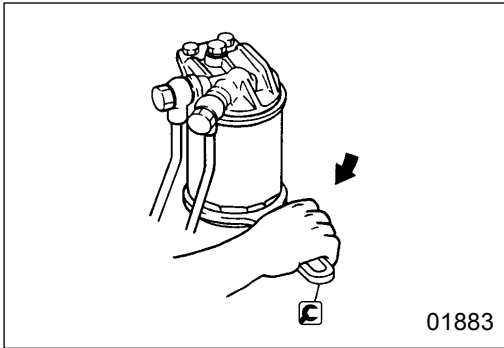
3. Injection Pump



- 1 Delivery valve holder
- 2 Delivery valve spring
- 3 Delivery valve
- 4 Plunger barrel
- 5 Control pinion
- 6 Plunger
- 7 Control rack
- 8 Control sleeve
- 9 Plunger spring
- 10 Tappet
- 11 Camshaft

The injection pump feeds fuel to the injection nozzles under high pressure and incorporates a mechanism for increasing and decreasing the fuel flow.

Possible causes		Symptoms												
		Engine will not start	Engine difficult to start	Engine knocks	Unstable engine output	Insufficient engine output	Engine maximum speed too high	Unstable engine idling	Engine stops soon after starting	Engine does not reach maximum speed	Engine will not stop	Accelerator pedal too stiff	Defective fuel supply	
Governor	Insufficient full-load stopper position					<input type="radio"/>								
	Weak governor spring					<input type="radio"/>				<input type="radio"/>				
	Incorrectly adjusted control lever				<input type="radio"/>	<input type="radio"/>				<input type="radio"/>				
	Flyweights not operating effectively						<input type="radio"/>							
	Weak idling spring							<input type="radio"/>						
	Bent links							<input type="radio"/>						
	Excessive friction or play in links							<input type="radio"/>						
	Loose round nut							<input type="radio"/>						
	Poorly adjusted idling set bolt							<input type="radio"/>						
	Defective sliding action in control lever											<input type="radio"/>		
	Stop mechanism damaged										<input type="radio"/>			
Automatic timer	Defective advancing action					<input type="radio"/>		<input type="radio"/>						
Injection nozzles	Sticky needle valve	<input type="radio"/>												
	Valve opening pressure too low	<input type="radio"/>								<input type="radio"/>				
	Blocked injection orifice	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>		<input type="radio"/>		<input type="radio"/>				
	Poor airtightness in nozzle	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>		<input type="radio"/>		<input type="radio"/>				
	Valve opening pressure too high			<input type="radio"/>										
	Broken spring				<input type="radio"/>	<input type="radio"/>								
	Defective sliding action in needle valve				<input type="radio"/>									
	Defective valve opening pressure				<input type="radio"/>									
Fuel filter	Filter (and/or secondary filter) clogged	<input type="radio"/>			<input type="radio"/>			<input type="radio"/>	<input type="radio"/>					
Fuel tank empty		<input type="radio"/>												
Fuel pipes blocked and/or fuel leaking from connections		<input type="radio"/>												
Air or water in fuel system		<input type="radio"/>			<input type="radio"/>			<input type="radio"/>	<input type="radio"/>					
Low-quality fuel in use			<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>						
Cracked fuel pipe														<input type="radio"/>
Leaky fuel tank														<input type="radio"/>

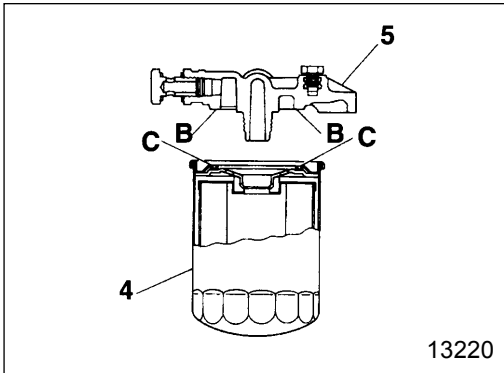


◆ Service procedure

4 Fuel filter [Removal]

WARNING

- Fuel is highly flammable; keep it away from flames and sources of heat.
- To minimize the risk of fire, wipe up any spilled fuel.



[Installation]

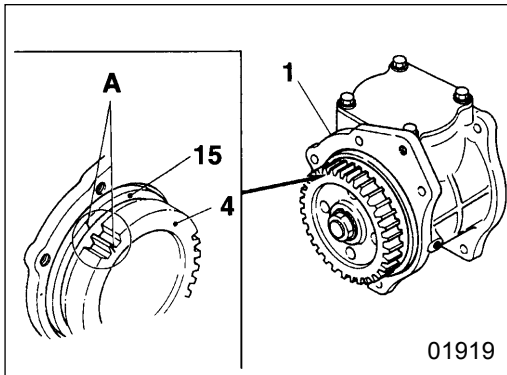
WARNING

Use of an unsuitable fuel filter 4 can lead to fuel leaks and fires. Be sure to use a genuine Mitsubishi filter.

- To fit the fuel filter 4, turn it until the gasket C touches surface B of the fuel filter head 5. Then, tighten the filter by 3/4 to 1 turn. Be sure to turn the filter by hand.
- Start the engine and check for fuel leaks.


 Lubricant

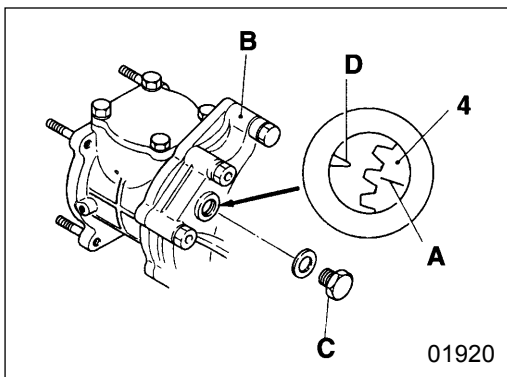
Location	Points of application	Specified lubricant	Quantity
16	O-ring	Engine oil	As required



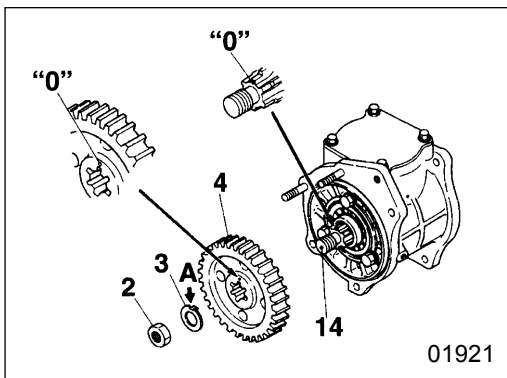
◆ Service procedure

1 Installing injection pump drive assembly

- Bring cylinder No. 1 of the engine to the TDC position of its compression stroke.  Gr 11
- Align the inscribed line A on the drive gear 4 of the injection pump drive assembly 1 with the inscribed line A on the pump drive case 15.

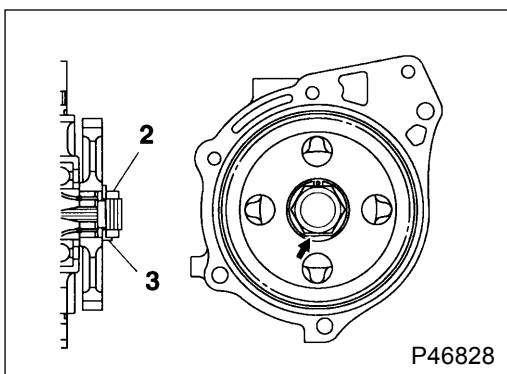


- Remove the plug C from the flywheel housing B, then check that the inscribed line A on the drive gear 4 is aligned with the pointer D. If the line and pointer are not aligned, remove and refit the injection pump drive assembly.

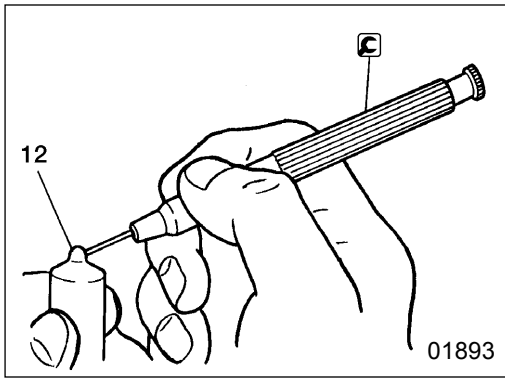



4 Installing drive gear

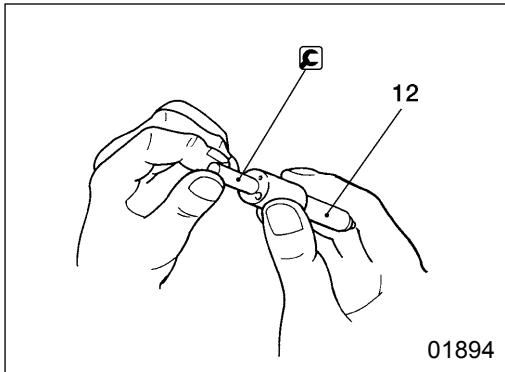
- Fit the drive gear 4 such that its "0" alignment mark is aligned with the "0" alignment mark on the pump drive shaft 14. Then, fit the lockwasher 3 such that its notch A is aligned with the drive gear alignment mark, and tighten the nut 2 to the specified torque.




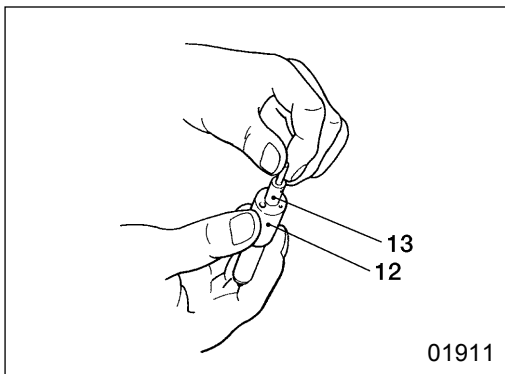
- When the assembly is complete, bend the lockwasher 3 down onto the nut 2.



- Remove carbon from the injection orifice of the nozzle 12 using the Needle Cleaner of the  Cleaning Tool Set. Insert the Needle Cleaner and rotate it to dislodge the carbon.



- Clean the seat of the nozzle 12 using the Cleaning Scraper of the  Cleaning Tool Set.
- To remove burned and hardened carbon, use FUSO[®] Carbon Remover or generic carbon remover.

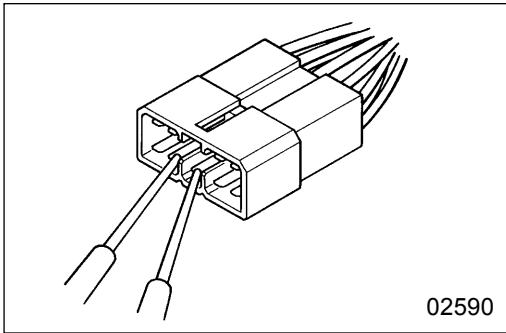


[Inspection]

- Wash the needle valve 13 and nozzle 12 in fuel oil, then fit them together.
- Pull up the needle valve 13 by approximately 1/3 of its entire stroke, then check that it drops under its own weight. Repeat this test several times, turning the needle valve each time.
- If the needle valve 13 does not drop as required, wash it in gas oil and carry out this test again. If the needle valve is still defective, replace the needle valve and nozzle 12 as a set.

NOTE

Whenever a nozzle 12 is replaced, the nozzle and needle valve 13 must be replaced as a set using Nozzle Service Kit. (This applies to genuine Mitsubishi forklift truck products only.)



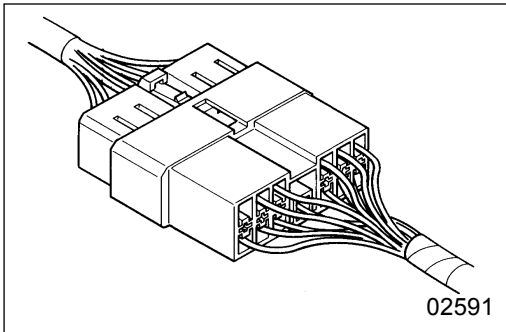
Using male pins

Touch the pins directly using test probes.

CAUTION ⚠

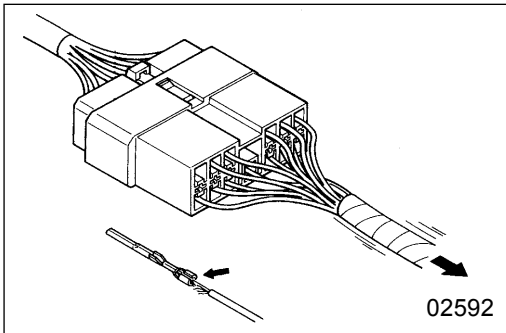
Be sure that you do not short circuit the connector pins when you use the test probe because this could damage the internal circuit of the electronic control unit.

Connector Inspection Procedures

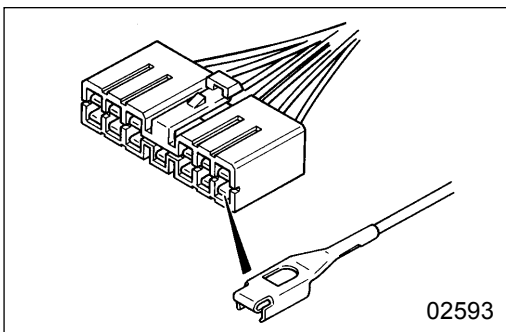


Visual inspection

Check for loose connection and poor engagement.



Check if harnesses are broken by pulling gently around the terminals.



Check for a decrease in contact pressure between the male and female terminals.

Check for poor contact caused by connector pins having fallen out, rusted terminals or foreign particles.

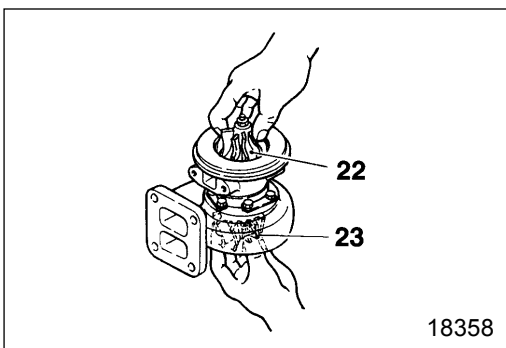
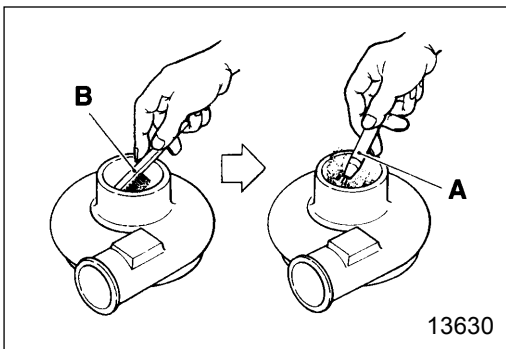
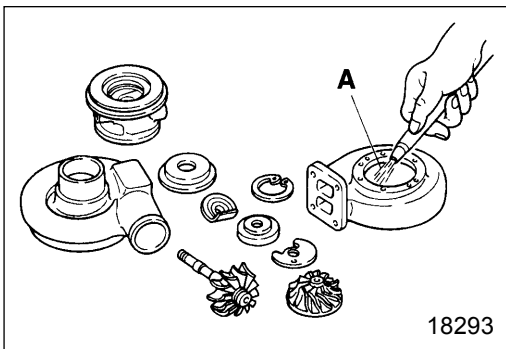
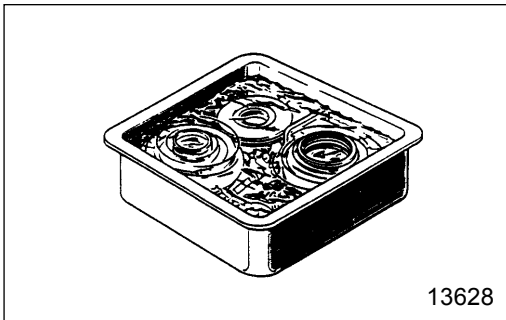
MEMO

● **Cleaning after disassembly**

- Before cleaning, visually check the individual parts for burns, rubbed stains, etc. which might disappear after cleaning. If there is anything wrong, replace.

CAUTION ⚠

Do not immerse the actuator assembly 6 in the solvent. Clean it with a cloth dipped in kerosene.



- Immerse the disassembled parts in a non-combustible solvent.

- Take out the parts from the solvent and blow compressed air A against them.

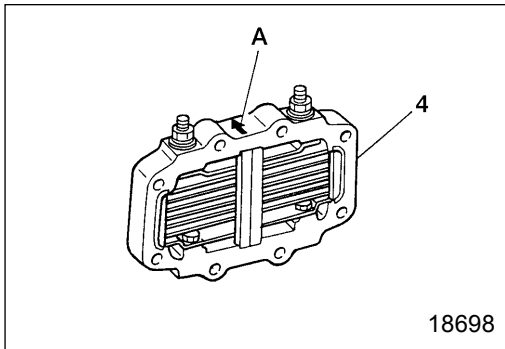
- Scrape off deposits.

B: Plastic scraper or stiff brush

- Re-immerses in the solvent.
- Blow compressed air A.

● **Inspection after reassembly**

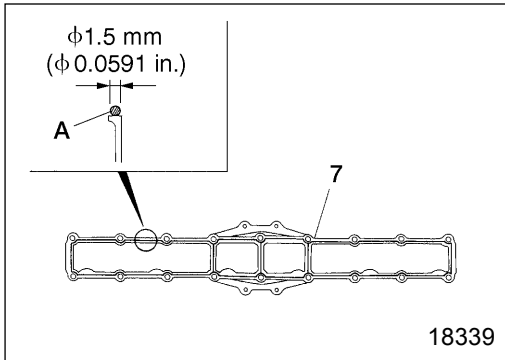
- (1) Manually rotate the compressor wheel 22 and turbine wheel 23 to check whether they rotate smoothly.



◆ Service procedure

4 Installation of air heater

The air heater 4 should be installed with its arrow mark A directed toward the intake manifold 7.



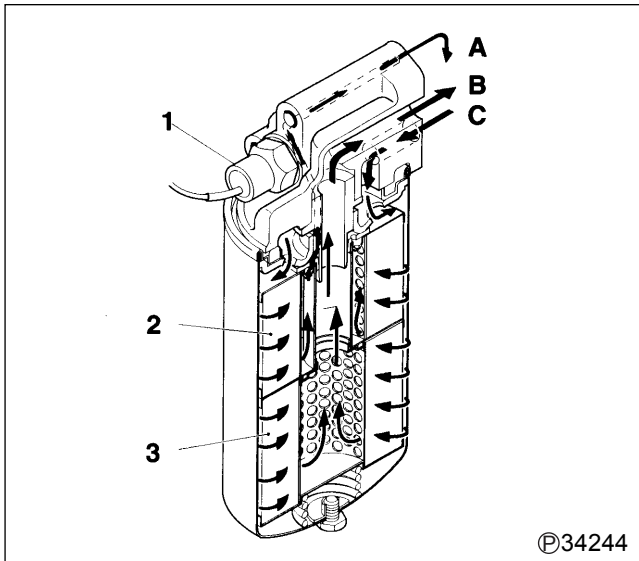
7 Installation of intake manifold

- The intake manifold is installed by use of either a seat gasket or sealant. This section describes the procedures for installation by use of a sealant.
- Apply sealant A evenly without a break to the cylinder head mounting surface of the intake manifold 7.
- Install the intake manifold on the cylinder head in less than three minutes after application of sealant A.

CAUTION

- Thoroughly clean the sealant surface of the intake manifold 7 beforehand.
- When the intake manifold 7 is installed, make sure that it is not out of alignment.
- When the manifold mounting bolt 6 was loosened, be sure to re-apply sealant A to the intake manifold 7.
- Wait one hour after installation before starting engine.

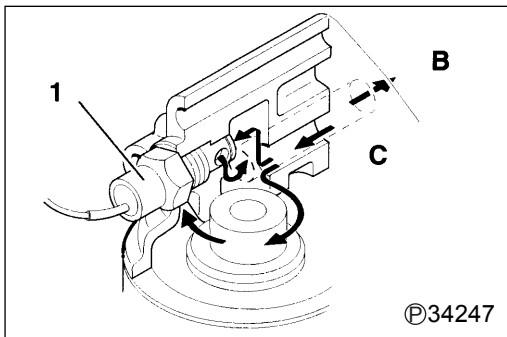
<Spin-on type (C type)>



- 1 Engine oil bypass alarm switch
- 2 Bypass filter element
- 3 Full-flow filter element

- A: To oil pan
- B: To oil cooler
- C: From oil pump

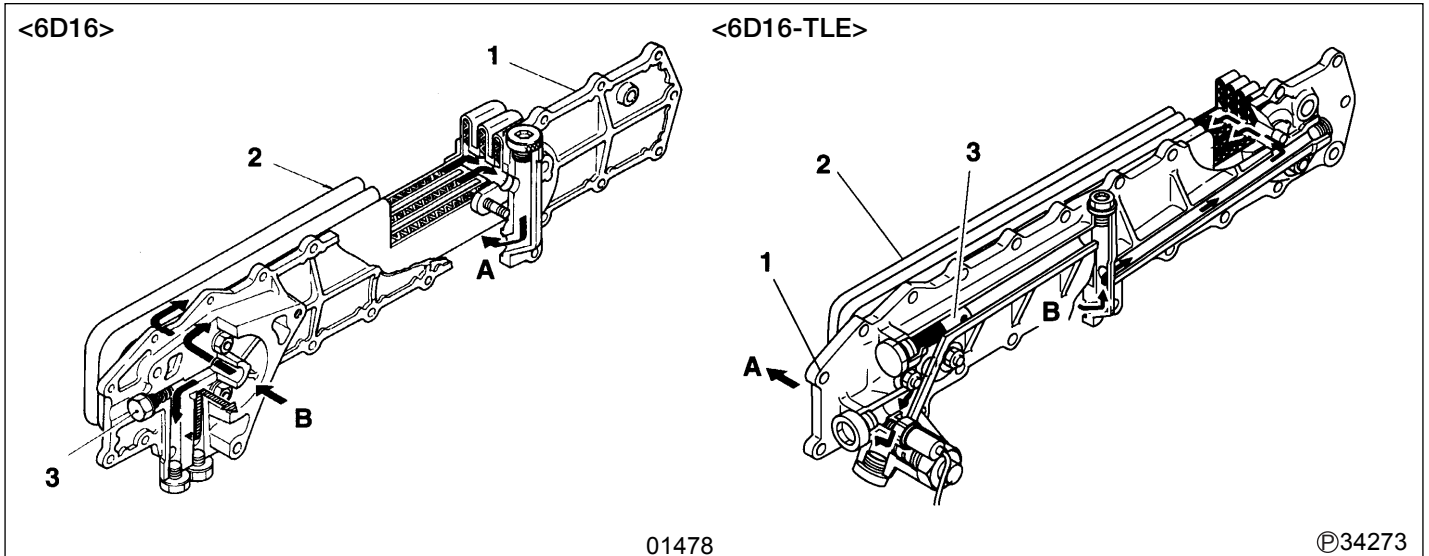
This oil filter is a paper-filter type incorporating full-flow filter element 3 and bypass filter element 2.



● Engine oil bypass alarm switch

- If the oil filter element becomes clogged, the flow of engine oil is restricted, causing engine parts to seize. To prevent this, engine oil bypass alarm switch 1 is fitted to the spin-on filter.
- When the oil filter element becomes clogged, engine oil bypass alarm switch 1 is activated. As a result, engine oil is allowed to flow directly to the oil cooler, bypassing full-flow filter element 3. When the engine oil bypass alarm switch is activated, a warning lamp illuminates to notify the operator of the clogged oil filter element.

4. Oil Cooler



- 1 Oil cooler cover
- 2 Oil cooler element
- 3 Bypass valve

- A: To main oil gallery
- B: From oil filter

2. Engine Oil Replacement

① Tightening torques

Unit: N·m (kgf·m) [lbf·ft]

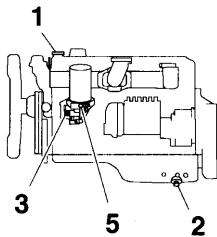
Location	Parts to be tightened	Tightening torque	Remarks
2	Oil pan drain plug	69 (7) [50.9]	–
3	Oil filter drain valve	29 ± 4.9 (3 ± 0.5) [22.1 ± 3.6]	–
4	Oil filter drain plug	7.8 ± 2.0 (0.8 ± 0.2) [5.89 ± 1.44]	–

🛢 Lubricants

Unit: L (U.S.gal.)

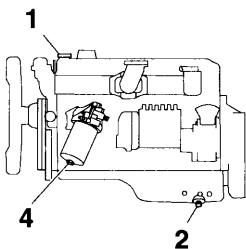
Location	Points of application	Kinds	Quantity
–	Oil pan	General power applications	Non-turbocharged engines: API CC or above Approx. 9.5 (2.51)
	Construction machinery applications	Turbocharged engines: API CD or above Approx. 16 (4.23)	
–	Oil filter	Spin-on type: A, B type	Non-turbocharged engines: API CC or above Approx. 2.1 (0.555)
	Spin-on type: C type	Turbocharged engines: API CD or above Approx. 2.3 (0.608)	

<Spin-on type: A type>



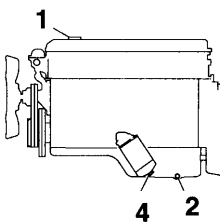
©16770

<Spin-on type: B type>



©47034

<Spin-on type: C type>



©47096

⚠ WARNING

- Wipe up any spilled engine oil since it could cause a fire.
- Do not touch oil when the engine is hot since it can inflict severe burns.

⚠ CAUTION

When pouring oil into the engine, take care not to spill any on the V-belts. Contact with oil could make the V-belts slip, rendering the cooling system less effective.

[Draining]

- Warm up the engine, then remove oil filler cap 1.
- Remove oil pan drain plug 2, oil filter drain valve 3, and air plug 4. Then, drain the engine oil.

[Filling]

Tighten oil pan drain plug 2 and oil filter drain valve 3 or oil filter drain plug 4 to their specified torques, then pour the specified quantity of engine oil into the engine.

WARNING 

- Wipe up any spilled engine oil since it can cause a fire.
- Do not touch oil when the engine is hot since it can inflict severe burns.

CAUTION 

When pouring oil into the engine, take care not to spill any on the V-belts. Contact with oil could make the V-belts slip, rendering the cooling system less effective.

Service standardsUnit: MPa (kgf/cm²) [psi]


Location	Maintenance item	Standard value	Limit	Remedy
4	Engine oil bypass alarm switch valve opening pressure	$0.19 \begin{smallmatrix} +0.05 \\ -0 \end{smallmatrix}$ ($1.9 \begin{smallmatrix} +0.5 \\ -0 \end{smallmatrix}$) [$27.6 \begin{smallmatrix} +7.3 \\ -0 \end{smallmatrix}$]	–	Replace

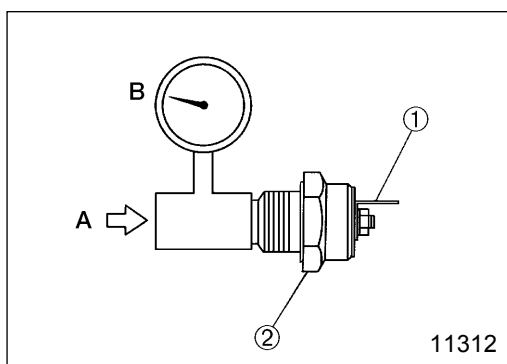
Tightening torques

Unit: N·m (kgf·m) [lbf·ft]

Location	Parts to be tightened	Tightening torque	Remarks
1	Oil filter drain valve <A, B type>	29 ± 4.9 (3.0 ± 0.5) [22.1 ± 3.6]	–
2	Oil filter drain plug	7.8 ± 2.0 (0.8 ± 0.2) [5.89 ± 1.44]	–
4	Engine oil bypass alarm switch	49 ± 4.9 (5.0 ± 0.5) [36.1 ± 3.6]	–

Lubricant

Location	Points of application	Specified lubricant	Quantity
3	Apply thin film to oil filter gasket area  P.12-12	Engine oil	As required
9	Apply to O-rings	Engine oil	As required

**Service procedure****4** Inspection of engine oil bypass alarm switch

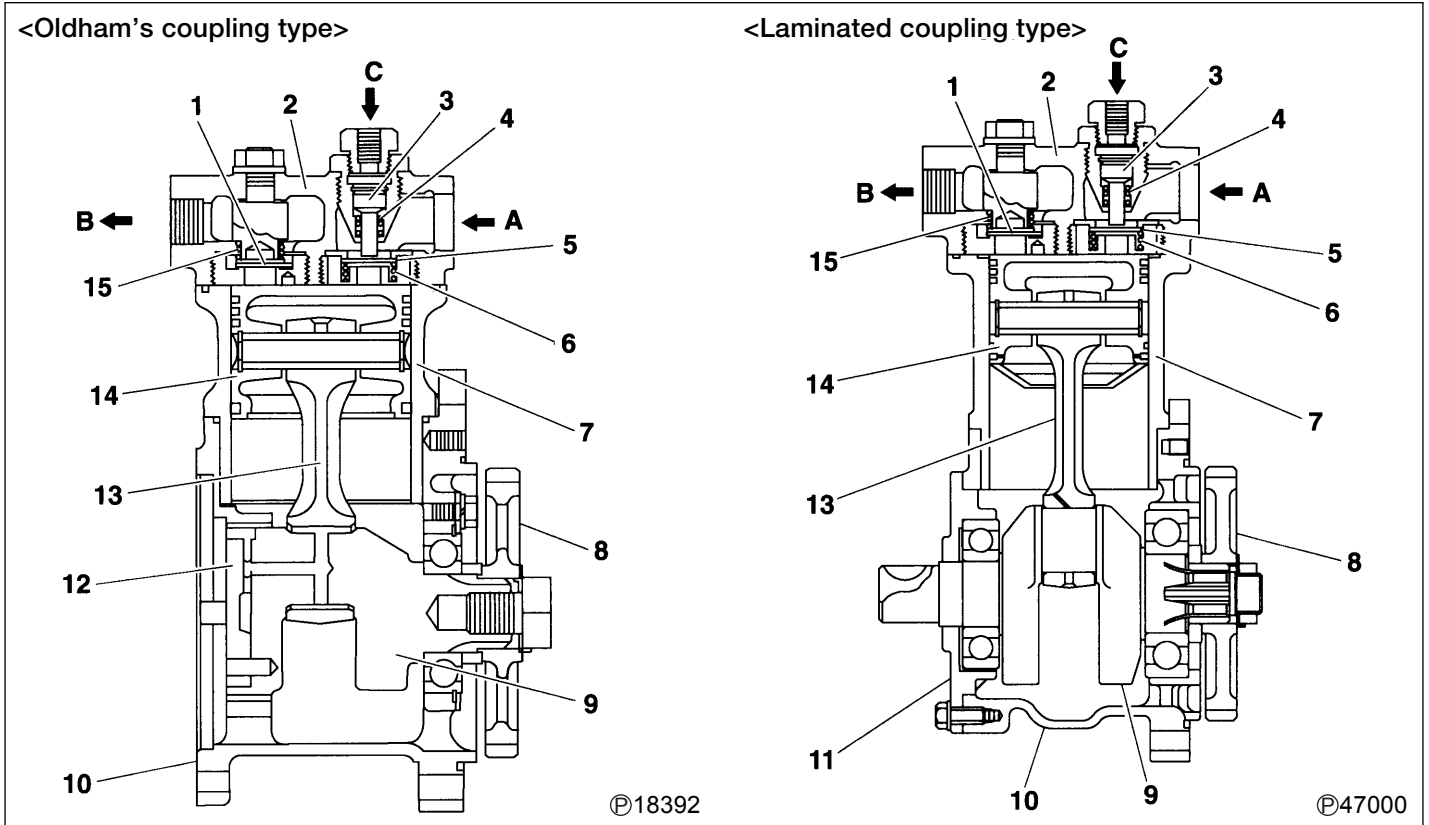
Carry out the following inspections and replace the engine oil bypass alarm switch 4 if the results are unsatisfactory:

- With no air pressure A applied to engine oil bypass alarm switch 4, check that there is no electrical continuity between the terminal ① and body ② of the engine oil bypass alarm switch.
- Starting with pressure of 0 kPa (0 kgf/cm²) [0 lbf/in.²], gradually increase the air pressure A on engine oil bypass alarm switch 4. Note the air pressure when electrical continuity appears between the terminal ① and body ②. Verify that this pressure conforms with the specified standard value.

B: Air pressure gauge

Air Compressor

<Air-cooled type>

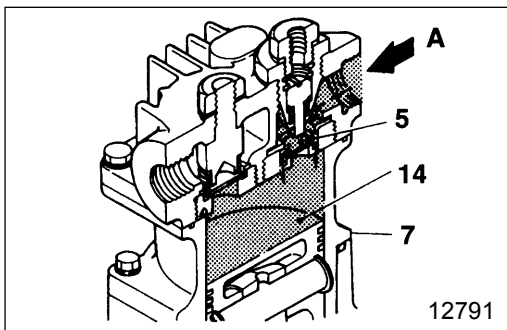


- 1 Delivery valve
- 2 Cylinder head
- 3 Unloader valve
- 4 Unloader valve spring
- 5 Suction valve
- 6 Suction valve spring
- 7 Cylinder liner
- 8 Compressor gear
- 9 Crankshaft
- 10 Crankcase

- 11 Bearing holder <Laminated coupling type>
- 12 Coupling <Oldham's coupling type>
- 13 Connecting rod
- 14 Piston
- 15 Delivery valve spring

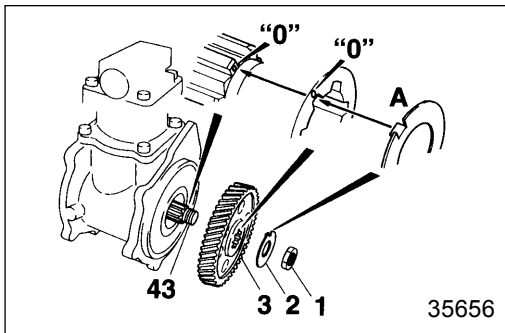
A: From air cleaner
 B: To air tank
 C: From air pressure governor

- The air compressor is driven by compressor gear 8 which is in mesh with the timing gear of the engine.
- Cylinder head 2 is provided with fins that prevent it from being overheated by the compression heat generated by the air compressor.



When air is taken in

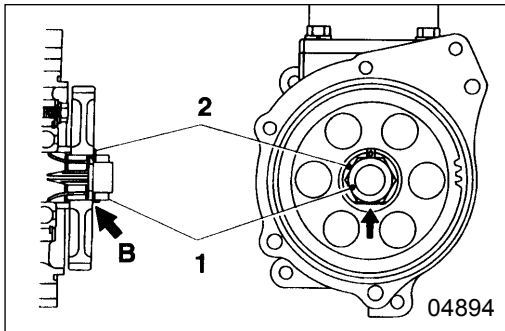
- When compressor gear 8 is turned, crankshaft 9 in mesh with the compressor gear lowers piston 14.
- The vacuum generated at this time opens suction valve 5, allowing air A from the air cleaner to be drawn into cylinder liner 7.



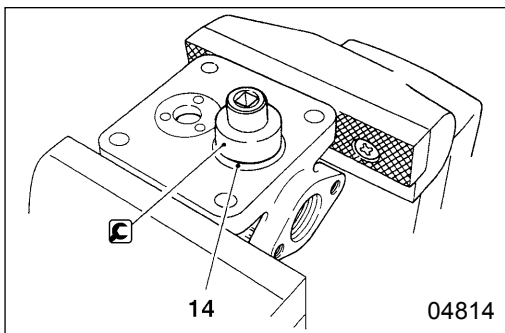
◆ Service procedure

3 Installation of compressor gear

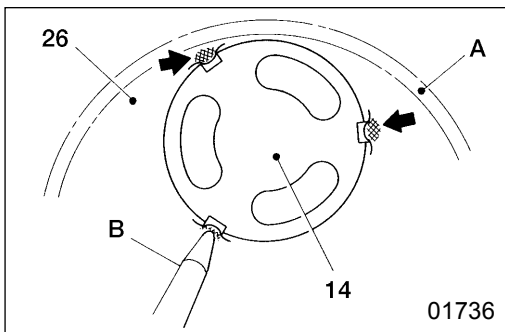
- Install compressor gear 3 to crankshaft 43, ensuring that the "0" mark on the gear is aligned with the "0" mark on the crankshaft.
- Insert tab A of lockwasher 2 such that the "0" mark on compressor gear 3 remains exposed.



- Tighten nut 1 to the specified torque. Lock the nut by bending bottom portion B of lockwasher 2 over the nut.



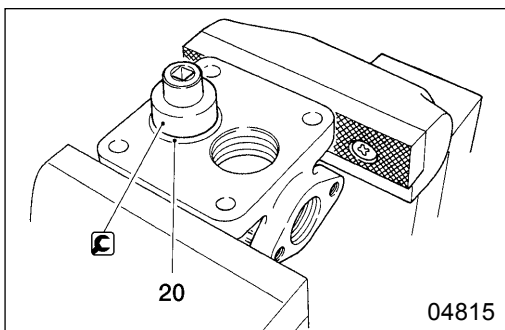
14 Suction valve holder [Removal and Installation]



[Staking]

Stake cylinder head 26 at points not corresponding to O-ring's sealing surface A.

B: Punch



20 Removal and installation of delivery valve holder

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