YANMAR

SERVICE MANUAL

CRAWLER CARRIER

MODEL C12R(EP)

131103

1. GENERAL CAUTIONS FOR MAINTENANCE WORK

1. General Cautions for Maintenance Work

1-1 Correct Work

Correct work means the quickest possible completion of according to the correct procedures and the specified standards.

It is important when conducting certain operations always to bear in mind the equipment, tools, gauges, materials, oil and grease, etc. that you must have ready, as well as items to be checked, adjusted, or disassembled, and cautions to watch out for.

1-2 Safety Precautions

(1) Never attempt servicing while engine is running or immediately after stopping operation.
(2) Wear work cloths, safety shoes and helmet.
(3) Check the equipment and tools before use. Especially, be sure to check the crane, lifting equipment and tools.
(4) When working together with other persons, allocate everyone's share of job, arrange the signals and act in concert with the other persons.
(5) The operation of the crane and slinging work must be performed by qualified persons.
(6) Do not enter or pass under the raised load.
(7) Lift and support the massive parts by crane before removing the installation bolts.
(8) Disconnect cables from battery before repairing the electric system.
(9) Remove the battery when welding the machine.

1-3 Preparations

(1) Check the service record of the machine. (That is, check how many months or hours the machine has been used since the preceding overhaul, what was the trouble then and what parts were replaced.)
(2) Have all servicing tools ready, i.e., tools, measuring devices (which have received periodic maintenance), containers, oil & grease, etc.
(3) Have the service literature (operation manual, parts catalog, etc.) ready.

1-4 Cautions for Disassembly and Reassembly

(1) Clean the machine before disassembly.
(2) Check and record the condition of the machine before disassembly :
  • Model, machine number, operation hours
  • Reasons for repair, history of repair
  • Contamination of filters
  • Fuel and oil condition
  • Damage to parts, etc.
(3) Place alignment marks on the necessary parts to facilitate reassembly.
(4) Clean all the removed parts and new replacement parts and put them in order.
(5) Use new seals, split pins, etc. for reassembly.

1-10 Air Release Procedure for H.S.T. System

1. Air Release Procedure for H.S.T. System

When hydraulic oil is put into the H.S.T. after replacing or repairing the H.S.T., release air according to the following procedure.

If any excessive wear is found in disassembly, be sure to replace the hydraulic oil and the return filter.

(1) Remove the return hose on the top of the H.S.T. to fill the inside of the H.S.T. with hydraulic oil.
  • If there is no hydraulic oil in the H.S.T. pump, put 0.6 L of hydraulic oil into the pump.

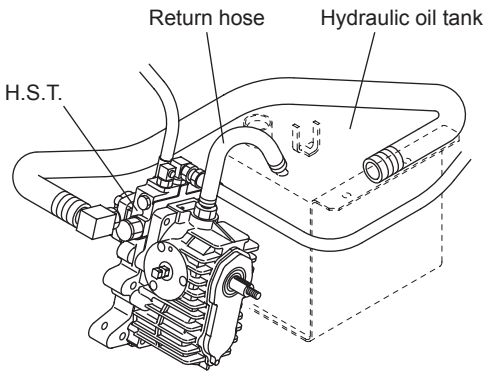
(2) Install the return hose on the H.S.T.

(3) After starting the engine, idle it for about 5 minutes.

(4) Stop the engine, and check for oil leak and the oil level in the hydraulic oil tank.

(5) Restart the engine, and travel the vehicle forward and backward at medium speed 3 or 4 times.

(6) Stop the engine after running it at the rated speed for a while, and check the oil level in the hydraulic oil tank.



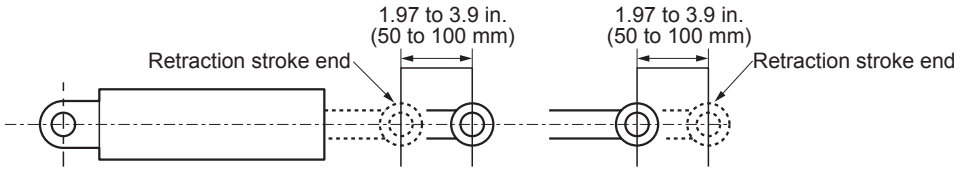
2. Air-Venting of Each Hydraulic Component

Operate engine at medium speed and activate the respective circuit for about 10 to 15 minutes.

3. Air-Venting of Hydraulic Cylinders

(1) Set the engine speed at low idling range.

(2) Extend and retract the cylinder up to 1.97 to 3.9 in. (50 to 100 mm) from each stroke end slowly 4 or 5 times.



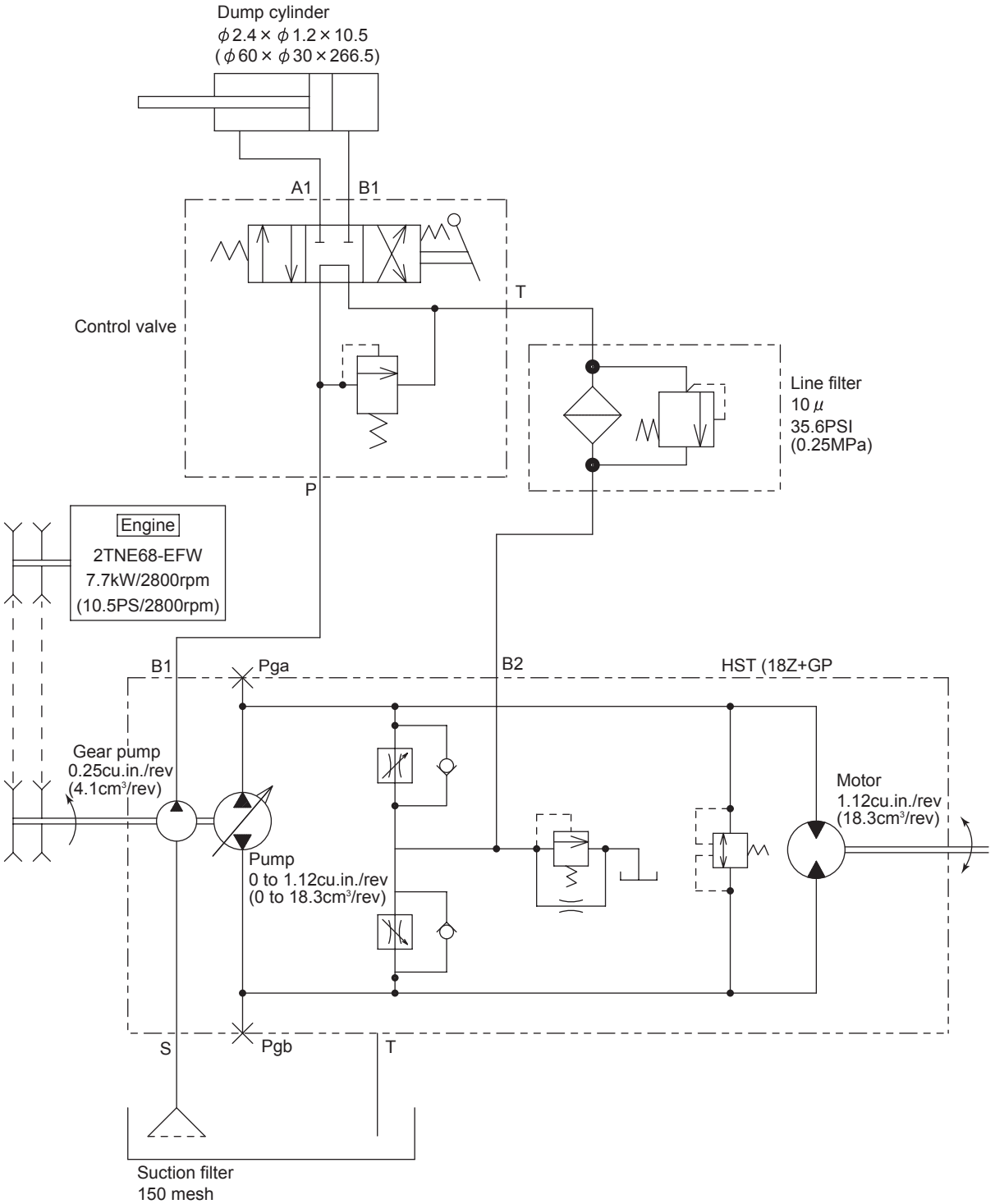
Note :

The extension and retraction stroke is up to 1.97 in. (50 mm) from each stroke end for the blade cylinder.

(3) Then, fully extend and retract the cylinder 3 or 4 times.

2-3 Hydraulic Circuit Schematic

Dump speed (sec.)	Up	3.9
	Down	2.8
Relief pressure (PSI (MPa))	Control valve	2233 to 2318 (15.4 to 16.0)
	HST (High)	3959 to 4002 (27.4 to 27.7)
	HST (Low)	58 to 87 (0.4 to 6.0)



Applicable model				2TNE68-EFW	
Item			Unit	Standard	Wear limit
Piston ring					
	Oil ring	Ring groove width	in. (mm)	0.1185 to 0.1191 (3.010 to 3.025)	–
		Ring width (B)		0.1169 to 0.1177 (2.970 to 2.990)	–
		Clearance between groove and ring		0.0008 to 0.0022 (0.020 to 0.055)	–
		End gap		0.0059 to 0.0138 (0.150 to 0.350)	0.0591 (1.5)
Connecting rod					
	Crank pin side	Crank pin metal inside dia.	in. (mm)	Ø1.5354 to 1.5361 (Ø39.000 to 39.016)	–
		Crank pin metal thickness		0.0585 to 0.0591 (1.487 to 1.500)	–
		Crank pin outside dia.		Ø1.4161 to 1.4165 (Ø35.970 to 35.980)	Ø1.4138 (Ø35.91)
		Oil clearance		0.0013 to 0.0023 (0.033 to 0.059)	0.0059 (0.15)
	Piston pin side	Bush hole inside dia.		Ø0.7884 to 0.7889 (Ø20.025 to 20.038)	Ø0.7913 (Ø20.10)
		Piston pin outside dia.		Ø0.7870 to 0.7874 (Ø19.991 to 20.000)	Ø0.7835 (Ø19.90)
		Oil clearance		0.0010 to 0.0019 (0.025 to 0.047)	0.0079 (0.2)
	Distortion			0.0012 (0.03) or less for 0.39370 (100)	0.0031 (0.08)
Cam					
	Gear side	Cam shaft outside dia.	in. (mm)	Ø1.4150 to 1.4157 (Ø35.940 to 35.960)	Ø1.4114 (Ø35.85)
		Oil clearance		0.0016 to 0.0033 (0.040 to 0.085)	–
	Intermediate	Cam shaft outside dia.		Ø1.4138 to 1.4148 (Ø35.910 to 35.935)	Ø1.4114 (Ø35.85)
		Oil clearance		0.0026 to 0.0045 (0.065 to 0.115)	–
	Flywheel side	Cam shaft outside dia.		Ø1.4150 to 1.4157 (Ø35.940 to 35.960)	Ø1.4114 (Ø35.85)
		Oil clearance		0.0016 to 0.0049 (0.040 to 0.125)	–
	Cam shaft bend			0.0008 (0.02) or less	0.0020 (0.05)
	Cam height	Intake		1.1799 to 1.1823 (29.970 to 30.030)	1.1723 (29.75)
		Exhaust		1.1799 to 1.1823 (29.970 to 30.030)	1.1723 (29.75)

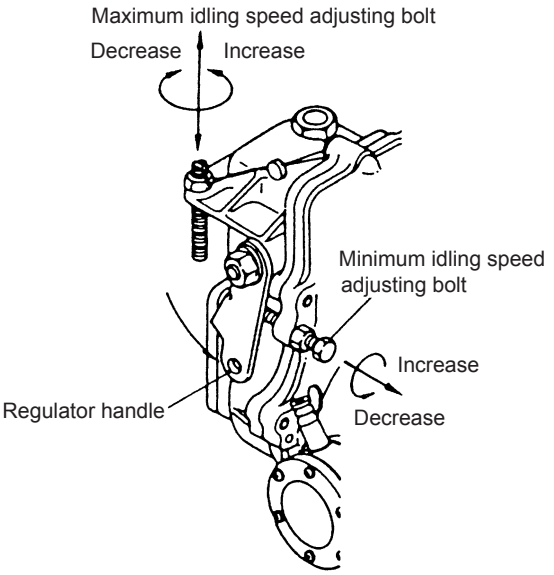
CHAPTER 4

ENGINE

4-1-6 Adjusting the Maximum (or Minimum) Idling Speed

(1) First warm up the engine. Then, gradually increase the engine speed up to the maximum idling speed. (Refer to Section "2-1 Specifications".)
(2) If the maximum idling speed differs from the specified one, adjust the maximum idling speed using the maximum idling speed adjusting bolt.
(3) Set the minimum idling speed to the specified value, (Refer to Section "2-1 Specifications") by turning the minimum idling speed adjusting bolt.

Note :
The illustration shows the partial perspective view of the governor for the direct injection system.

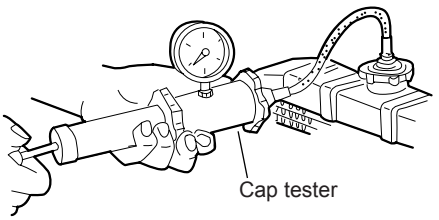


4-1-7 Checking the Cooling Water System and Radiator for Water Leakage

1) Checking the Cooling Water System for Water Leakage

Note :
The cooling water system can be checked effectively while the engine is warm.

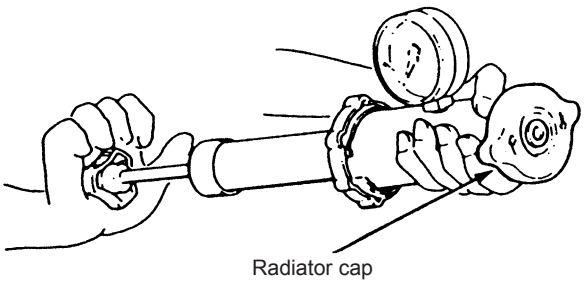
(1) Supply cooling water up to the normal water level in the radiator. Attach the cap tester body to the radiator.
(2) Start operating the cooling water pump, and set the pressure of the tester to 13.05 to 15.95 PSI (0.09 to 0.11 MPa). Any lower reading of the pressure gauge on the cap tester indicates water leakage from the cooling water system. Then, find out the portion of the cooling water system from which cooling water leaks.



(Checking the cooling water system for water leakage)

2) Checking the Radiator Cap

Attach the radiator cap to a cap tester. Set the pressure of the tester to 13.05 to 15.95 PSI (0.09 to 0.11 MPa). Check if the cap is opened at the set pressure. If not, replace the cap, because it is defective.

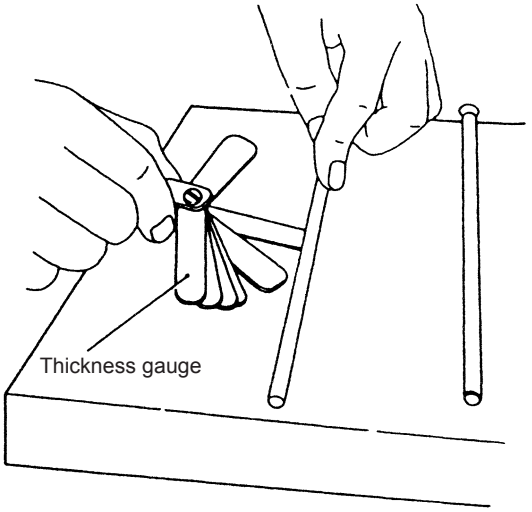


(Checking the radiator cap)

2) Checking the Push Rod Bend, Measuring the Tappet Stem Outside Diameter and Checking the Tappet Contact Surface

Put the push rod on the surface plate to check that there is no clearance between the push rod and the surface plate. Measure the tappet stem outside diameter with a micrometer.

		Standard	Wear limit
Push rod bend		Refer to Section "3-2 Engine"	
Tappet	Stem outside diameter		
	Guide hole inside diameter		
	Oil clearance		



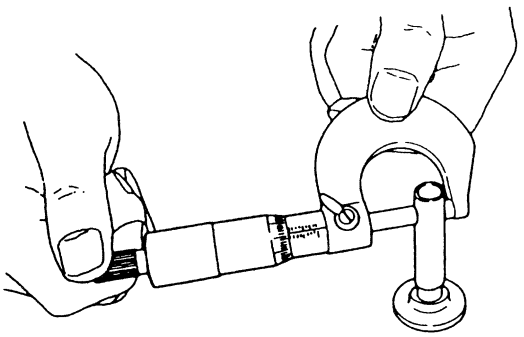
(Measuring the push rod bend)

3) Other Inspections

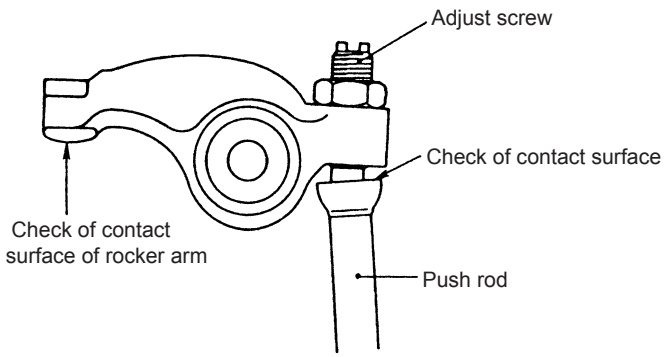
(1) Valve rocker arm shaft spring
Check if the rocker arm shaft spring is free from corrosion and wear. If not, replace it with a new one.

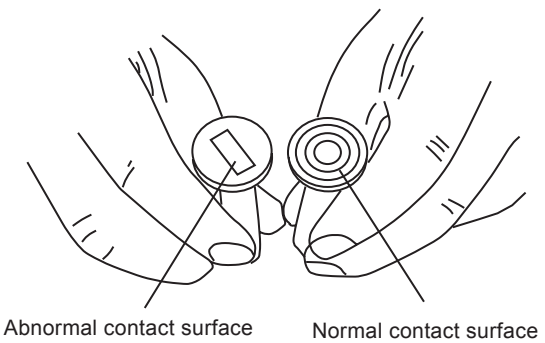
(2) Wear of intake/exhaust valve rocker arm and valve cap
Check the intake / exhaust valve rocker arm for the contact surface with the valve cap. If any of them is excessively worn or partially flaked, replace it.

(3) Check the portion where the valve clearance adjust screw is in contact with the push rod. If the portion is worn or flaked, replace the push rod or the adjust screw.



(Measuring the tappet stem outside diameter)



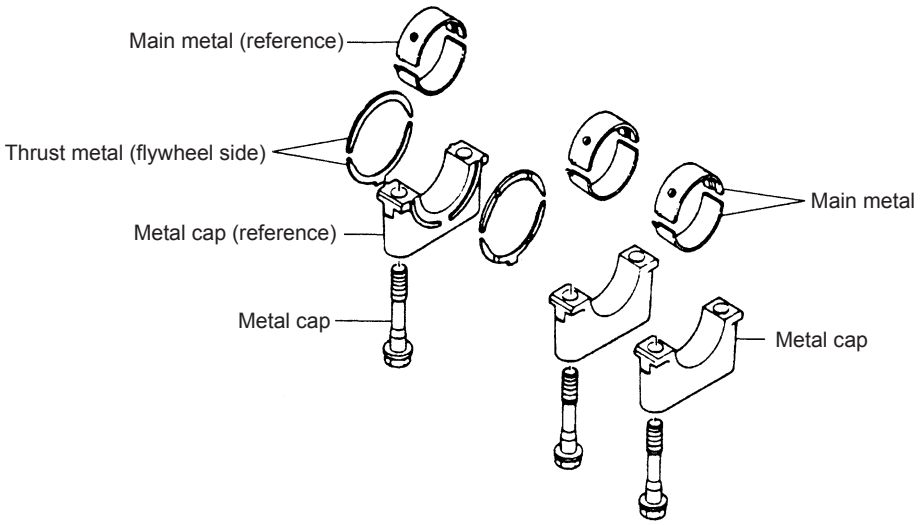


(Checking the tappet contact surface)

		Standard	Wear limit
Crank pin	Crank pin outside dia.	Refer to Section "3-2 Engine"	
Crank journal	Outside dia.		
	Main metal thickness		
	Oil clearance		

6) Precautions for Installation of the Metal Caps

(1) The lower half of the metal on the cap side has no oil groove.
(2) The upper half of the metal on the cylinder block side has an oil groove.
(3) Check the cylinder block alignment No.
(4) Place the embossed mark "FW" of the cap on the flywheel side.
(5) Place the main metal as a reference one on the flywheel side.



7) Undersized Main Metal by 0.0098 in. (0.25 mm) and Oversized Thrust Metal by 0.0098 in. (0.25 mm)

Main metal		Thrust metal	
Part code No.	Metal thickness in. (mm)	Part code No.	Metal thickness in. (mm)
	Standard		Standard
719260-02870	0.064 (1.625)	119260-02940	0.084 (2.125)

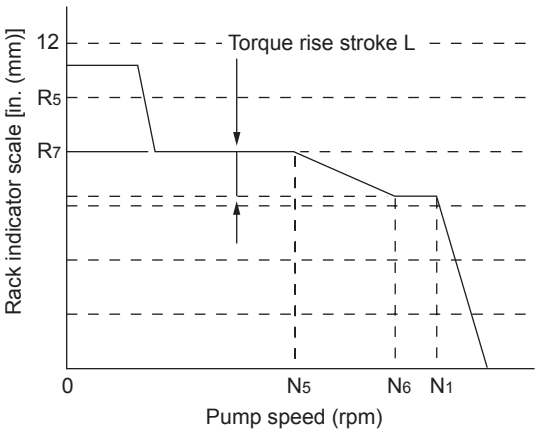
4) Adjusting the torque rise

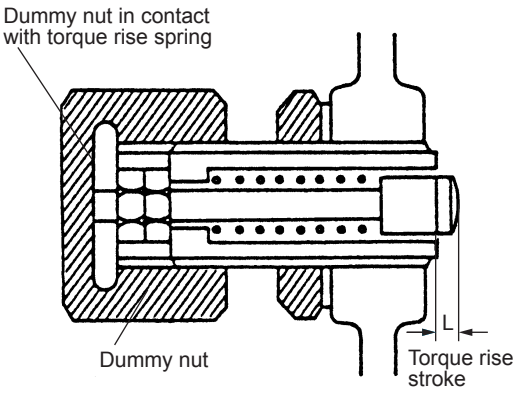
For the injection pump provided with a torque rise spring as an injection quantity increasing mechanism, make the following torque rise adjustment for increasing the fuel injection quantity.

(1) The torque rise spring is incorporated in the fuel limit bolt (the full load stopper bolt).
Use a dummy nut for the adjustment, as shown in the figure, with no torque rise stroke during the adjustment.
Remove the dummy nut after the adjustment to shift the torque rise stroke. Adjust the torque rise spring after adjusting the fuel limit bolt and the maximum idling speed.

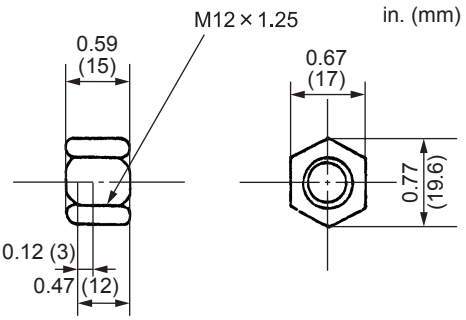
[1] Set the governor control lever to the full load position and lower the pump speed gradually from the rated RPM to check that the control rack shifts the torque rise stroke L smoothly.

[2] Keep the injection pump at the maximum RPM N_5 to check that the injection quantity is within the specified range.





Dummy nut



Part code No.	158090-51520

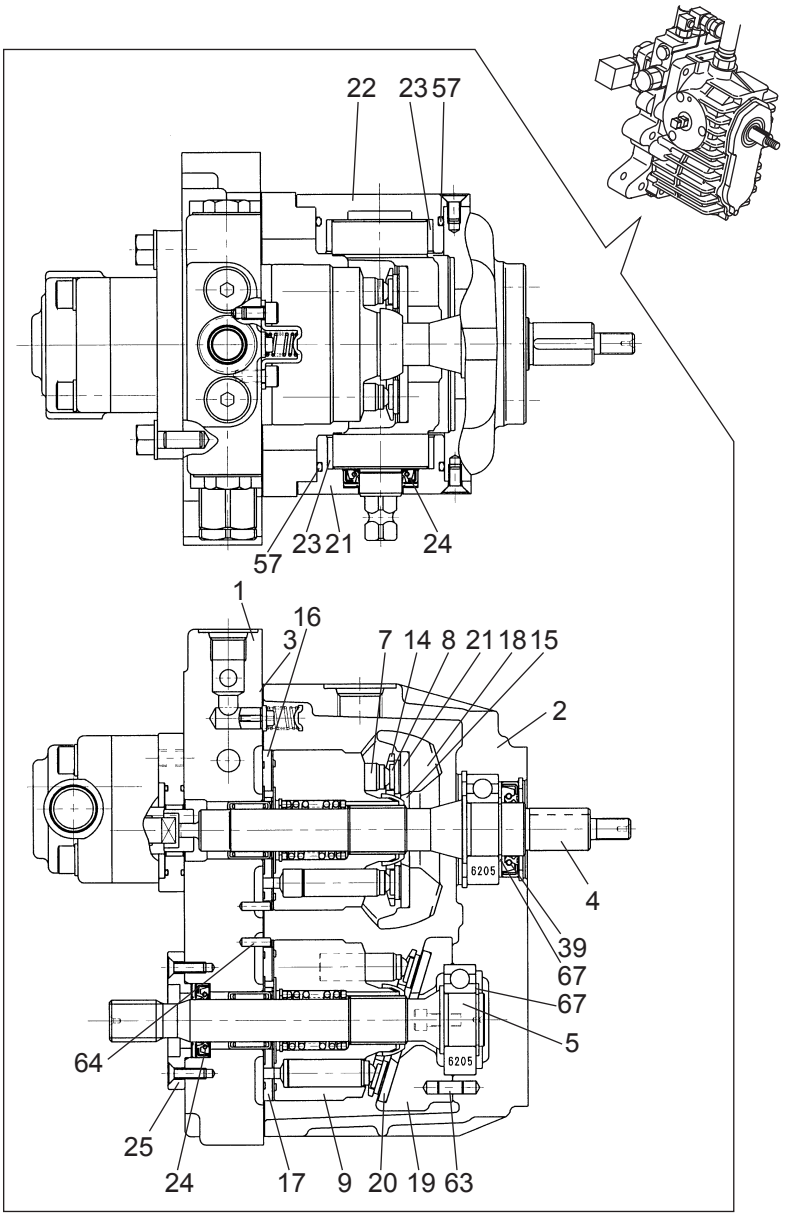
5-3 Power Transmission

5-3-1 Outline of H.S.T.

H.S.T. is an acronym of Hydro Static Transmission.

5-3-2 Features of H.S.T.

1) The H.S.T. provides smooth changes between forward travel, backward travel and neutral by using travel pedal and F/R lever.
2) When the travel pedal and F/R lever are set in the neutral position, the braking function (dynamic brake) works, so that the vehicle can be stopped without using the mechanical brake.
3) The H.S.T. has a high pressure relief valve which operates in an overload state to protect the H.S.T. itself from damage.
4) The H.S.T. also has a valve for keeping the travel pedal in neutral, which provides a wide neutral position to ensure that the vehicle is stopped.



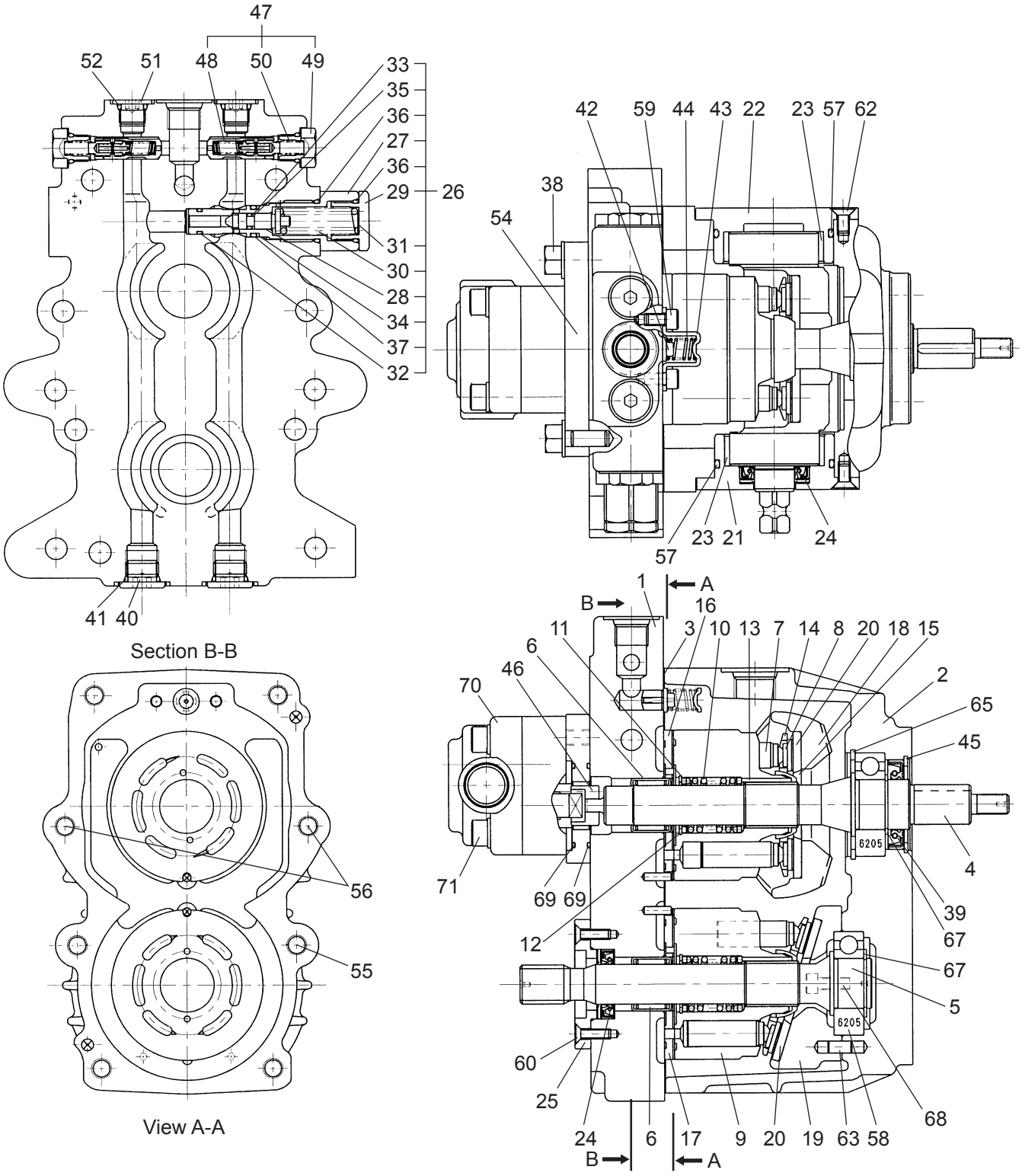
No.	Part
1	Center section
2	Housing
3	Gasket (for housing)
4	Input shaft
5	Output shaft
7	Plunger
8	Shoe
9	Plunger block
14	Retainer
15	Retainer holder
16	Valve plate (for pump)
17	Valve plate (for motor)
18	Movable swash plate
19	Fixed swash plate
20	Thrust plate
21	Trunnion cover (A)
22	Trunnion cover (B)
23	Bushing (DD)
24	Oil seal 20 × 35 × 8
25	Seal cover
39	Oil seal 25 × 45 × 8
57	O-ring 1A G55
63	Parallel pin 6 × 12
64	Parallel pin 4 × 14
67	External snap ring C 25

CHAPTER 6

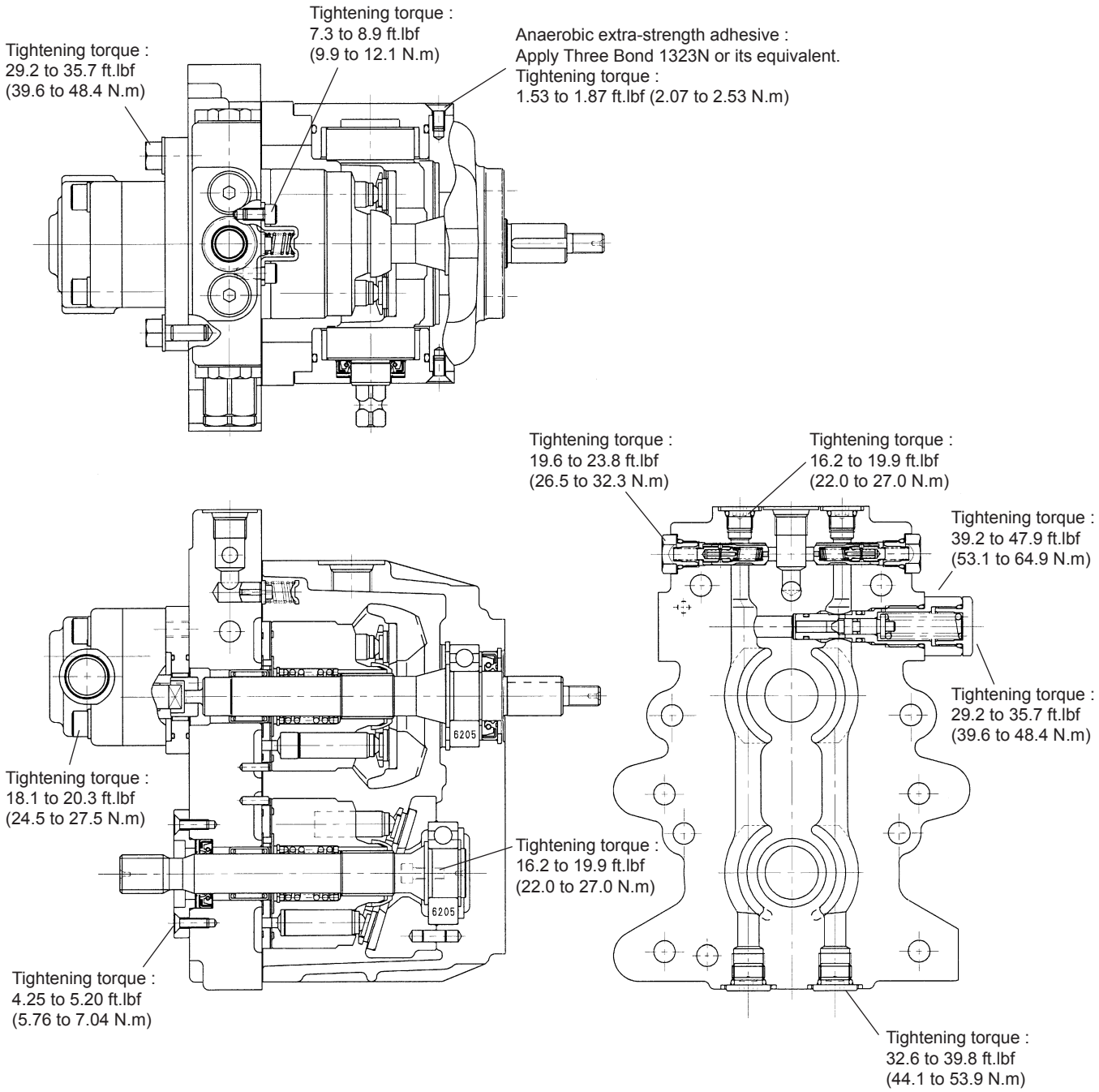
HYDRAULIC EQUIPMENT

4. Disassembly and Reassembly

1) Exploded View and Parts



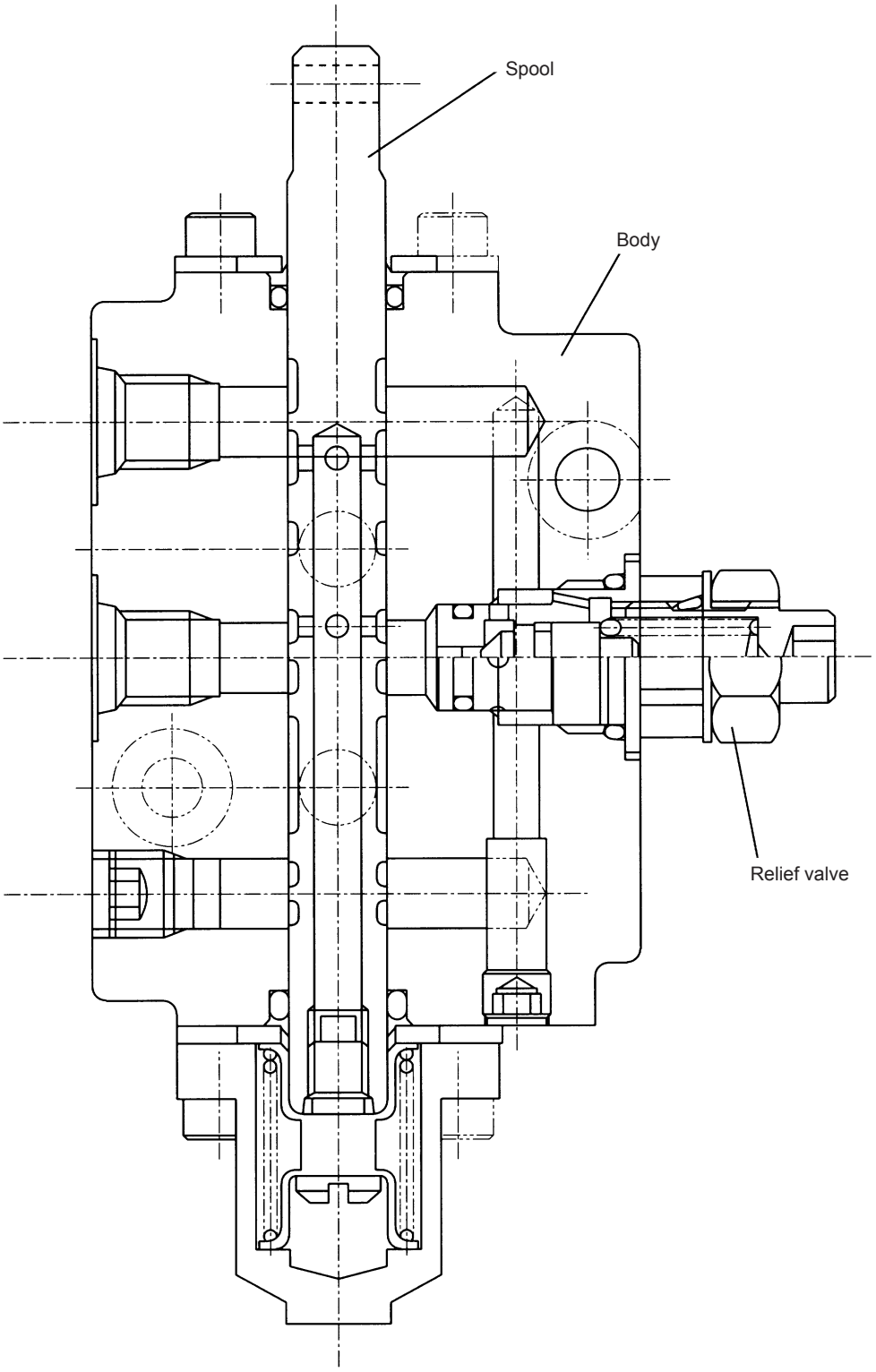
3) Reassembly



6-3 Control Valve

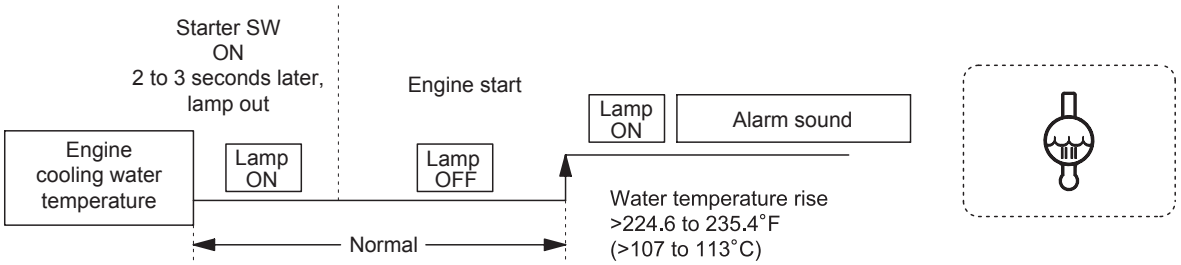
1. Outline

The control valve comprises the combination of a directional control circuit for changing the oil flow direction and a relief valve for controlling the oil pressure so that it is a set value or less.

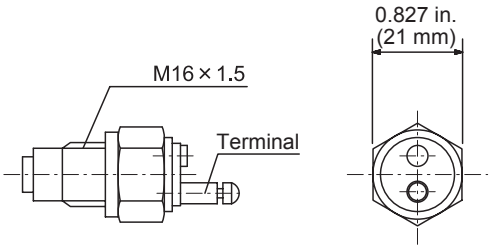


When the alarm buzzer sounds, check the following items.
[1] Degeneration of engine oil.
[2] Clogging of oil filter element.
[3] Malfunction of engine oil pressure switch.
Refer to Section 4-1-8 in the chapter "4. Engine" for the checking procedure of the engine oil pressure switch.
[4] Malfunction of pressure control valve.
[5] Wear or breakage of lube oil pump.

(2) Overheating sensor (Water temperature switch)
The water temp. meter indicates the engine cooling water temperature.
If the pointer goes up to the set water temperature of the water temperature switch while the engine is running, the engine is overheating.

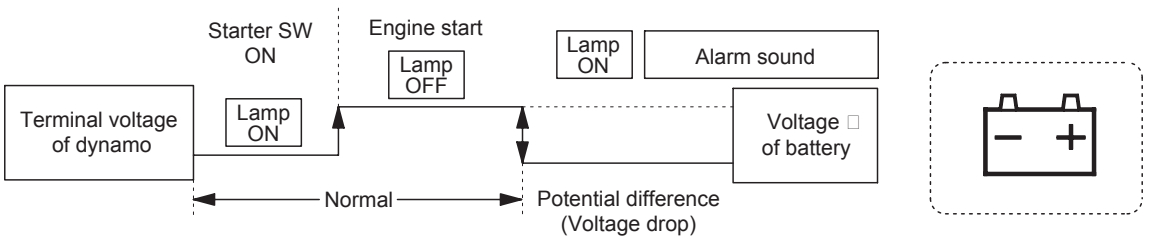


Turned on : Set water temp. : 224.6 to 235.4°F (107 to 113°C)
Turned off : Set water temp. : 212°F (100°C) or less
Installation position : Cooling water pump on engine



When the alarm buzzer sounds, check the following items.
[1] Refer to Section 4-1-7 in the chapter "4. Engine" and the chapter "10. Troubleshooting".

(3) Battery charge
When there occurs a potential difference between the output voltage of the dynamo and the voltage of the battery, the lamp goes on and the buzzer sounds.



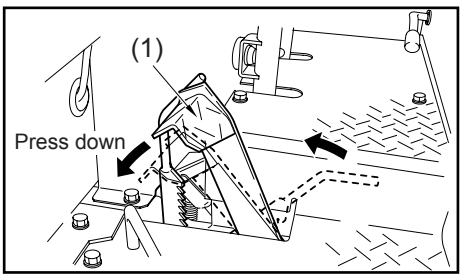
When the alarm buzzer sounds, check the following items.
[1] Degeneration or malfunction of battery.
[2] Refer to Section "7-1-4 Circuit Description of Engine Start and Stop" and the Section "7-1-5 Circuit Description of Battery Charging".

No.	Part	No.	Part	No.	Part
1	Washer 10	17	Damper	33	Cotter pin 2.0 × 16
2	Spring	18	F/R H.S.T. lever	34	Cotter pin 4.0 × 35
3	Return spring	19	Pin 14 × 75	35	Grease nipple B
4	F/R link stopper	20	Plate A	36	Nut M10
5	F/R return pipe	21	F/R stopper	37	Bolt M8 × 25 plated
6	Spring 18 × 88	22	Spring	38	Bolt M8 × 30 plated
7	F/R link rod	23	Bolt M10 × 30	39	Bolt M8 × 40 plated
8	F/R link stopper	24	Spring	40	Nut M8
9	Circlip 24	25	Rod-end 10	41	Nut M8
10	Lock nut M10 plated	26	Rod-end 10	42	Nut M10
11	F/R pedal	27	Knob	43	Rod M10 × 120
12	Bush 14 × 15	28	Polished washer 8	44	Rod M10 × 100
13	F/R pedal link	29	Polished washer 10	45	Turnbuckle M10 × 40
14	Bush 14 × 15	30	Polished washer 10	46	Spring washer 10
15	F/R pedal rod	31	Spring washer 10	47	Nut 10
16	Nut M10	32	Spring pin 3.5 × 25		

7-3-3 Checking and Adjusting the Brake Pedal

1) Checking the Brake Pedal

[1] Depress the brake pedal (1) with your hand and check that the play of the pedal is no more than 3.5 in. (90 mm).



[2] If the play exceeds 3.5 in. (90 mm), ask your dealer to check the brake pedal and replace the brake friction plates and steel plates if necessary.

2) Adjusting the Brake Pedal

[1] Loosen the lock nuts on both sides of each rod.

[2] Turn both rods counterclockwise to bring the arm out of contact with the stopper 1. Adjust both rods so that they are of the same length. (For S/N 20501 to 20709)

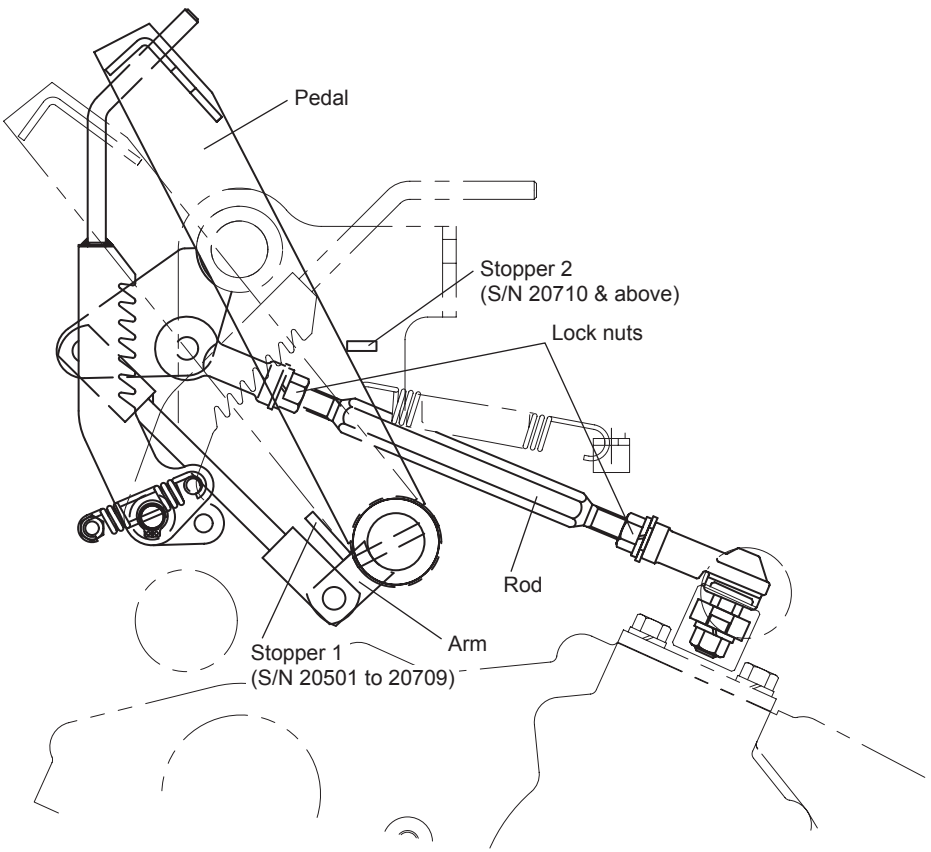
[3] Turn both rods counterclockwise to bring the pedal out of contact with the stopper 2. Adjust both rods so that they are of the same length. (For S/N 20710 & above)

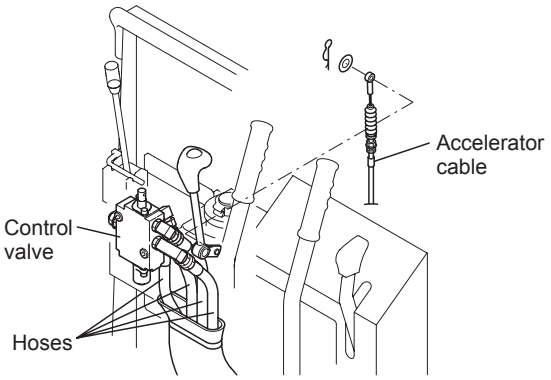
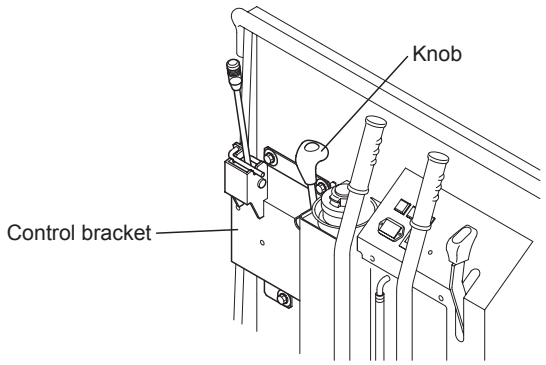
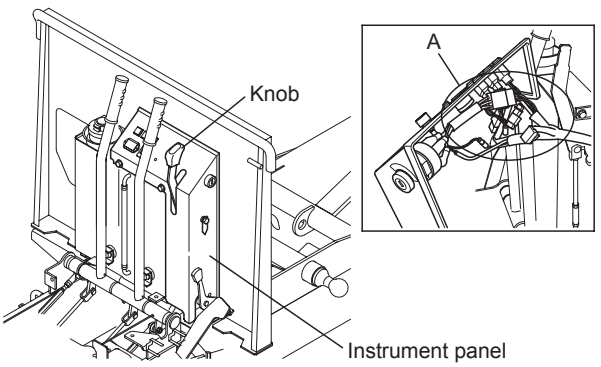
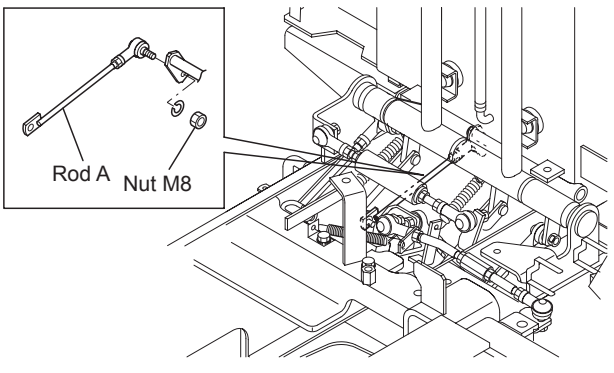
[4] Equally turn both rods clockwise by hand as far as possible, to extend them. (Do not use a tool for turning the rods.)
Check that the arm are in contact with the stopper 1. (For S/N 20501 to 20709)
Check that the pedal are in contact with the stopper 2. (For S/N 20710 & above)

[5] Give each rod a turn to the left to reduce the length of the rod.

[6] Depress the pedal with a pressing force of 55 lbs. (25 kg) to check that the pedal does not touch the frame.

[7] Be sure to tighten the lock nuts securely.



Procedure	
(8) Disconnect the four hoses from the control valve. (9) Disconnect the accelerator cable.	
(10) Remove the knob from the accelerator lever and remove the control bracket (with the control valve).	
(11) Remove the knob from the F/R lever. (12) Remove the instrument panel and disconnect the connectors A of the electrical equipment.	
(13) Remove the nut M8 from the rod A.	

2. Disassembly and Reassembly of Hydraulic Cylinder

1) Precautions for Disassembly and Reassembly

(1) Parts are high precision-made. Be careful not to damage any parts by dropping them or knocking them together when handling them.
(2) If there are any burrs on the surface of seal mounting areas or O-ring grooves, remove them.
(3) Replace once removed seals and O-rings with new ones.
(4) Clean all the parts and dry them by air blow.

2) Disassembly

(1) Remove the PWL bearings **7** and then the RGU gasket **8** from the piston **6**.
(2) Push the backup ring **5** and the O-ring **4** at two places with your fingers, and remove them together from the cylinder head **1** by catching the raised part of the O-ring with the other hand.
(3) Remove the ISI gasket **2** and the DKB dust seal **3** from the cylinder head **1**, taking care not to damage the mounting areas.

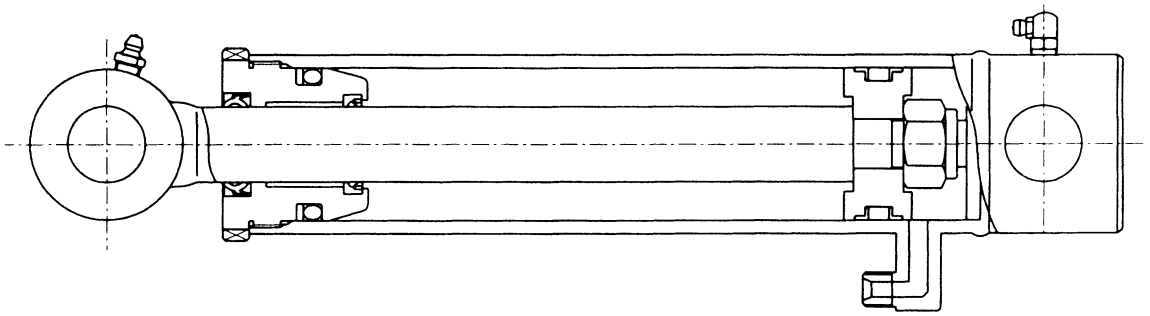
3) Reassembly

(1) For the cylinder head, install the parts **2** to **5** in numerical order.

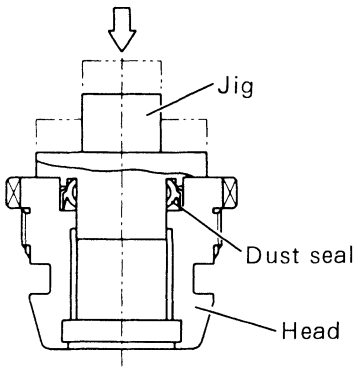
Notes :

- *Press-fit the DKB dust seal **3** using a jig.*
- *Be sure to install the backup ring **5** and the O-ring **4** in position.*
- *Do not extend the O-ring **4** excessively.*

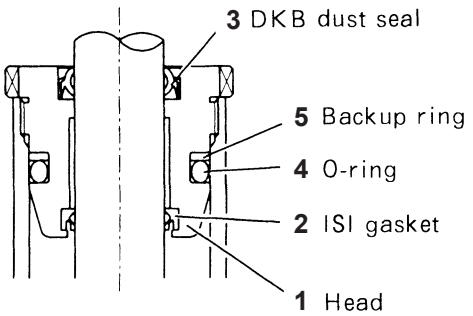
(2) For the piston seals, install the RGU gasket **8** and then the PWL bearings **7** onto the piston **6**.
Tightening torque for nut: 217 to 253 ft•lbf (294 to 343 N•m)



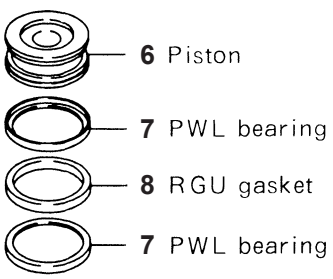
How to press fit dust seal



Cylinder head section



Piston section



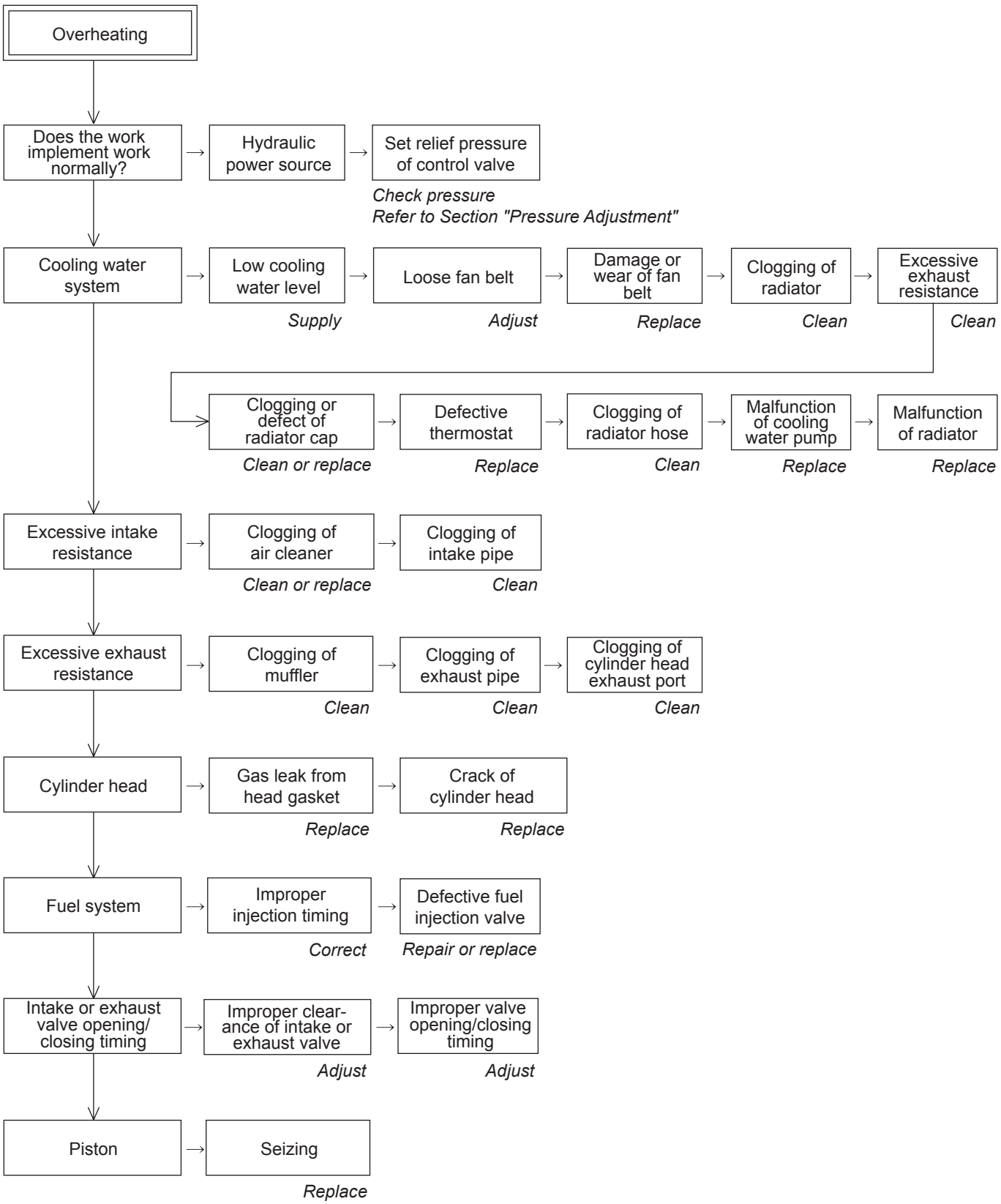
8. PERIODIC INSPECTION AND SERVICING

8. Periodic Inspection and Servicing

8-1 List of Periodic Inspection and Servicing

◇ : Check ○ : Supply ● : Replace □ : Adjust (clean) ■ : Oil & grease

Check & service items			Daily	Every 50	Every 100	Every 250	Every 500	Every 1000 hrs
General	Check falling off, breakage of parts		◇					
	Check loose bolts & nuts, retighten		◇					
	Check engine condition		◇					
	Check drive belt tension			◇/□				
	Clean		□					
Lube oil	*Swing gear case oil	Check, resupply				○		
		Replace			●1st time			●
	*Travel reduction gear oil	Check, resupply				○		
		Replace			●1st time			●
	*Transmission oil	Check, resupply	◇					
		Replace			●1st time			●
	*Differential gear oil	Check, resupply			◇			
		Replace			●1st time			●
Hydraulic system	Hydraulic oil	Check, resupply	◇					
		Replace						●
	Clean suction filter					□1st time		□
	Replace return filter					● 1st time	●	
	Check for abnormality of hydraulic pump		◇					
Grease	Check grease-up positions, grease		■					
	*Greasing swing gears and swing bearings			■				
	*Greasing track gauge change cylinder and link fulcrum			■				
Undercarriage	Check, adjust crawler tension		◇					
	*Check air pressure, wear, flaw in tyres		◇					
Steering equipment	Check performance, play of steering levers		◇					
	Check performance, play of travel pedal		◇					
	*Check performance of speed change lever		◇					
	Check performance of forward/reverse lever		◇					
	*Check performance, play of steering wheel		◇					
	Brake pedal	Stroke	◇					
		Performance	◇					
	*Parking brake	Stroke	◇					
		Performance	◇					
	Check performance of accel. lever		◇					
Electric equipment	*Check head light, horn		◇					
	Check hourmeter function		◇					
	Check function of charge, oil and pilot lamps		◇					
	Check wire breakage, short-circuits, loose terminals, retighten		◇					
	Check, resupply battery electrolyte		◇					
	Check specific gravity of electrolyte						□As required	
	Check function of monitor		◇					


Overheating
Does the work implement work normally?
Hydraulic power source
Set relief pressure of control valve
Check pressure
Refer to Section "Pressure Adjustment"
Cooling water system
Low cooling water level
Supply
Loose fan belt
Adjust
Damage or wear of fan belt
Replace
Clogging of radiator
Clean
Excessive exhaust resistance
Clean
Clogging or defect of radiator cap
Clean or replace
Defective thermostat
Replace
Clogging of radiator hose
Clean
Malfunction of cooling water pump
Replace
Malfunction of radiator
Replace
Excessive intake resistance
Clogging of air cleaner
Clean or replace
Clogging of intake pipe
Clean
Excessive exhaust resistance
Clogging of muffler
Clean
Clogging of exhaust pipe
Clean
Clogging of cylinder head exhaust port
Clean
Cylinder head
Gas leak from head gasket
Replace
Crack of cylinder head
Replace
Fuel system
Improper injection timing
Correct
Defective fuel injection valve
Repair or replace
Intake or exhaust valve opening/ closing timing
Improper clear-ance of intake or exhaust valve
Adjust
Improper valve opening/closing timing
Adjust
Piston
Seizing
Replace