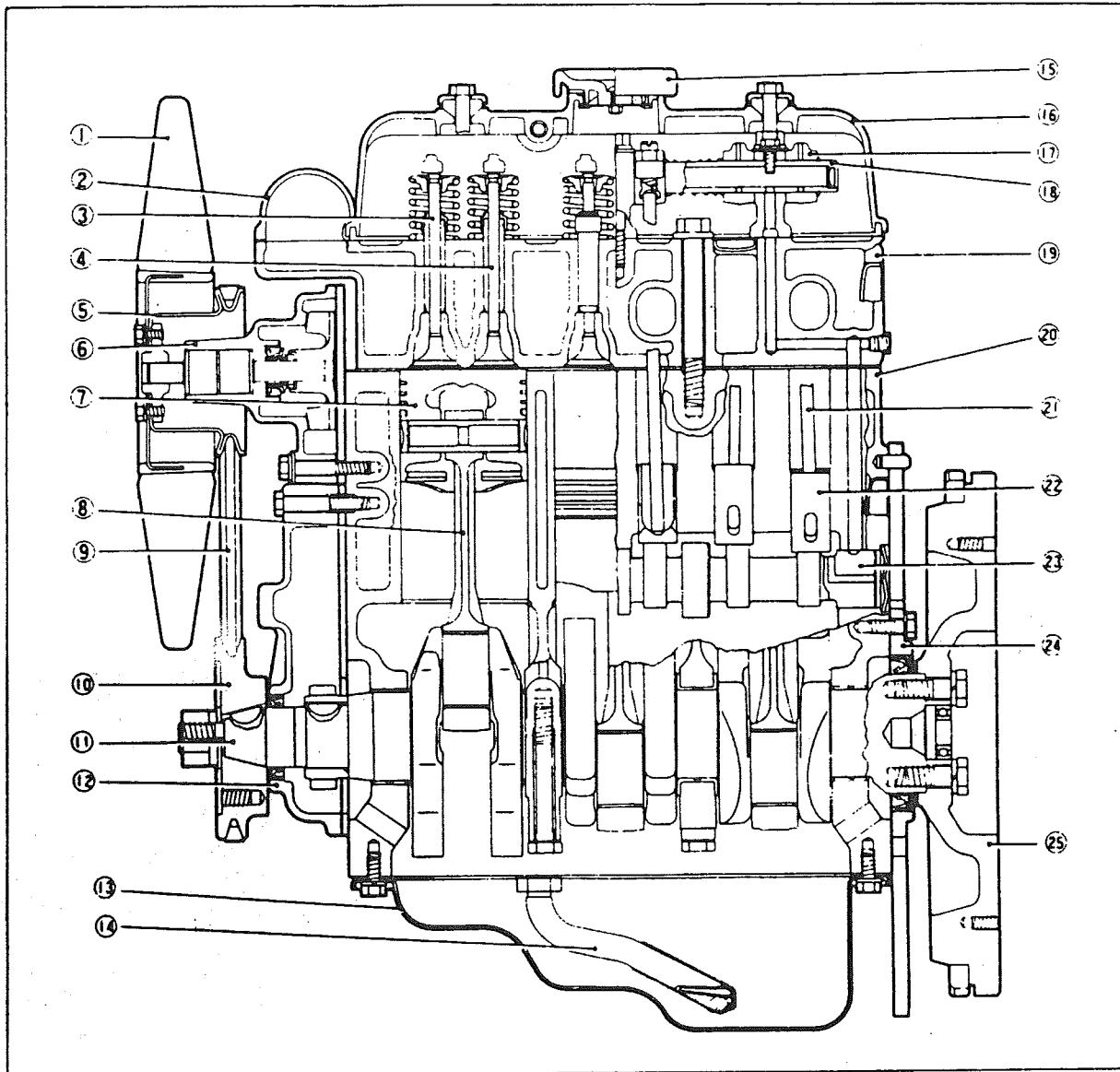


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2. Sectional View of Engine

2-1 Longitudinal Sectional View

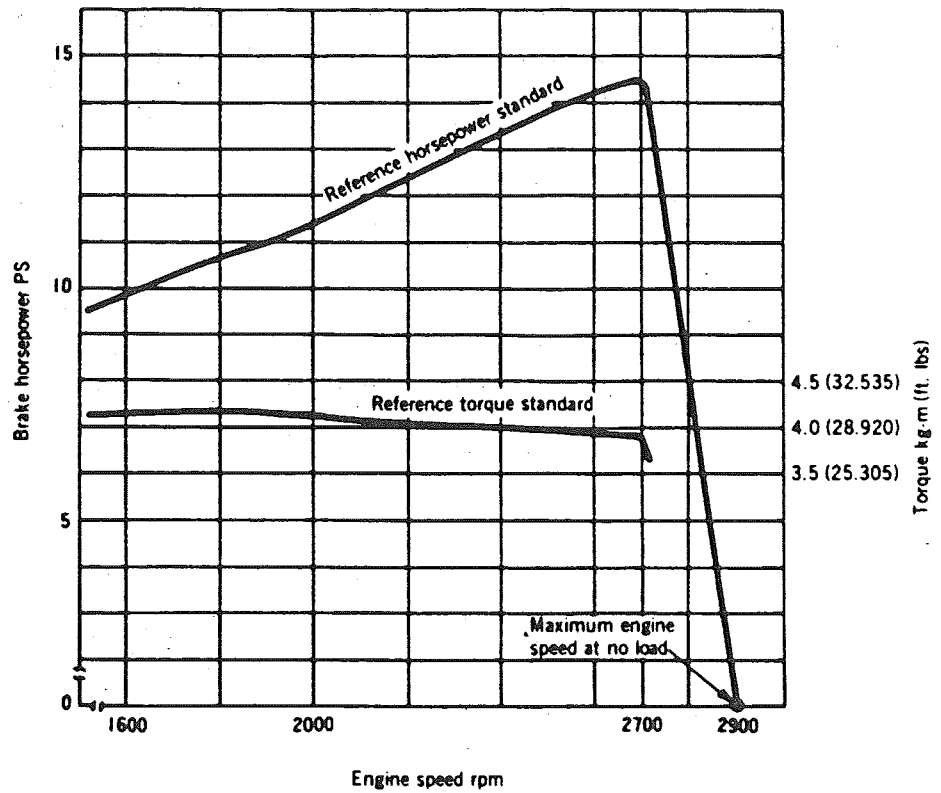


- | | | |
|--------------------------|---------------------|-------------------------|
| (1) Cooling fan | (10) Crank pulley | (19) Cylinder head |
| (2) Water outlet fitting | (11) Crankshaft | (20) Cylinder block |
| (3) Intake valve | (12) Gear case | (21) Push rod |
| (4) Exhaust valve | (13) Oil pan | (22) Tappet |
| (5) Water pump pulley | (14) Oil screen | (23) Camshaft |
| (6) Water pump | (15) Oil filler cap | (24) Rear oil seal case |
| (7) Piston | (16) Rocker cover | (25) Flywheel |
| (8) Connecting rod | (17) Rocker arm | |
| (9) Fan belt | (18) Rocker shaft | |

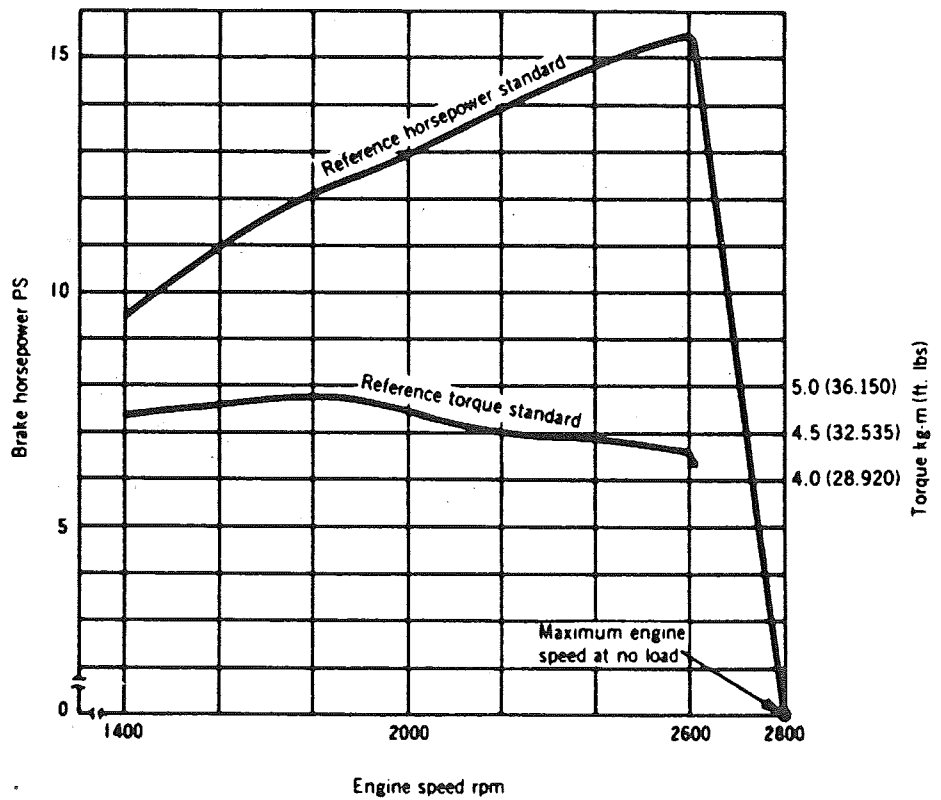
4. Performance Curves

4-1 Engines for Agricultural Use

K3A-11 Models for Tractor



K3B-11 Models for Tractor



6-2 Adjustment of Injection Timing

1. Incorrect fuel injection timing will result in hard engine starting and poor engine performance. Adjust the injection timing in the following manner. First remove No. 1 delivery valve holder. Pull off the delivery valve and spring. Install the delivery valve holder only. Subsequently turn the crankshaft, and find an instant when the fuel flowing out of the outlet port of the holder stops. This instant is the injection timing to be obtained. The injection timing differs with engine specifications; be sure to adjust the timing to specification.
2. When the specified injection timing cannot be obtained, adjust by increasing or decreasing the thickness of the injection pump mounting shim. Changing the shim thickness by 0.1 mm changes the injection timing by about 1°. If this adjustment cannot be made, adjust by the following method without removing the delivery valve and spring. First disconnect No. 1 injection pipe at the nozzle holder side. Then, using a wrench on the crankshaft pulley nut, gradually turn the nut. The instant the fuel in the forward end of the pipe expands is the injection timing. In this case, the injection timing takes place about 1° later than the specified.

CAUTION:

- When the delivery valve is removed, use special care to prevent entry of foreign matter.
- Do not crank the engine with the delivery valve holder removed.

6-3 Adjustment of High Speed

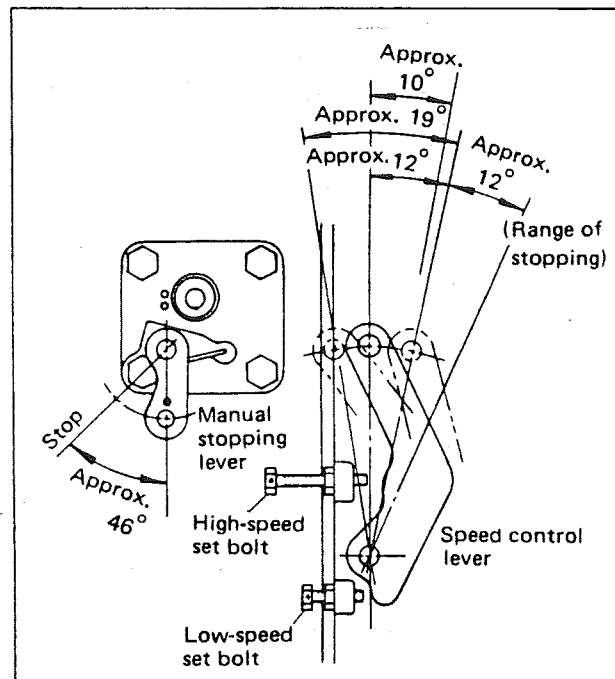
CAUTION:

Prior to adjustment operations, warm up the engine fully.

1. Engine without Damper Spring

Set to a no-load high speed by the HIGH-SPEED set bolt and lock the set bolt. In engines of other models than the following, the set speed is otherwise specified in accordance with respective specifications.

Model	Injection timing
K3A-11, K3B-11, K3C-11, K3B-13	19° BTDC
K3D-11, K3B-31, K3B-61, K3D-31, K3D-61, K3D-13, K3E-13	23° BTDC



High-Speed Adjustment

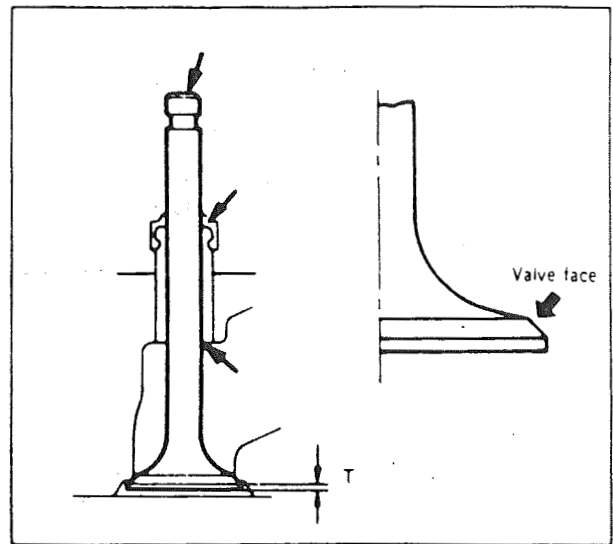
Model	Set speed (no-load)
K3A-11, K3B-11, K3C-11, K3D-11	2,750 $\begin{smallmatrix} +30 \\ -10 \end{smallmatrix}$ rpm
K3D-61WM	3,150 $\begin{smallmatrix} +30 \\ -10 \end{smallmatrix}$ rpm

5. Valve Spring

- a. Check for cracks and damage.
- b. Measure the free length and load of the spring. Replace if the spring is too much deteriorated.
- c. Check the squareness of the spring. Replace if it tilts too much.

6. Rocker Arm and Rocker Shaft

- a. Check the rocker arm face for wear and damage. Replace the rocker arm if excessively worn or damaged. Also check the adjusting screw. If its push rod contact surface is worn or damaged, replace.
- b. Measure the rocker arm I.D. and shaft O.D. In the event of excessive clearance, replace the rocker arm.



Checking Valve

1-2-3 Reassembly

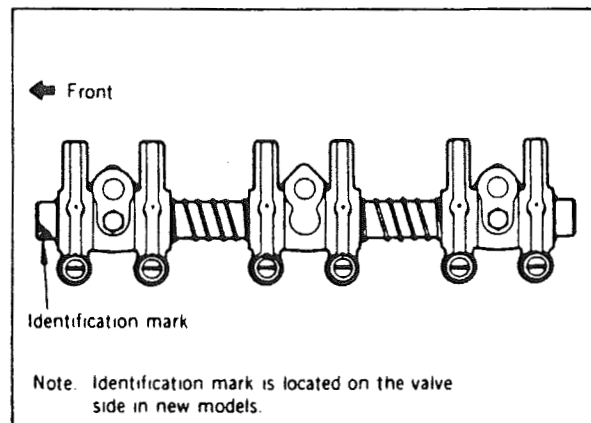
Reassembly can be done by reversing the order of disassembly. When reassembling keep in mind the following items.

1. Partial Assembly of Cylinder Head Assembly

- a. Press in the valve guide to the specified height. (For installation, see 2. Valve Guide in 1-2-2 Inspection.)
- b. Install the valve stem seal properly in the valve guide.
- c. Apply oil to the valve stem and insert the valve stem into the valve guide. Install the spring, retainer, and retainer lock in order of mention.
- d. To assemble rockers to the rocker shaft, first place the rocker shaft front stay with the attaching hole on the right (nozzle side). Install the shaft to this stay in such a manner that the identification mark ($\phi 3$ mm hole) at the front end of the shaft may come on the left front side (or on the right front side in new models) as shown. Install the front outside rocker arm, and retain it with a snap ring. In the similar manner, install other rocker arms in order backward. Install the rear snap ring. Then install to the cylinder head. When tightening the front and rear stays, be sure to install seat washers for bolts.

- e. Tighten the glow plug to a specified torque.
- f. Install the nozzle holder, then tighten the bolt evenly to a specified torque.

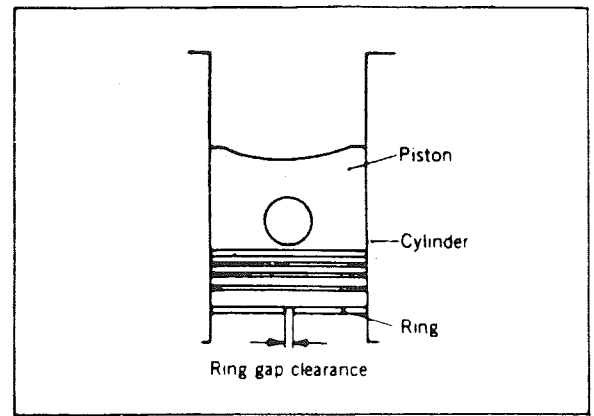
Description	Standard value	Service limit
Valve spring free length	43 mm (1.6929 in.)	41.7 mm (1.6417 in.)
Squariness of valve spring	1.5°	3.0°



Assembling Rocker Arms to Rocker Shaft

Description	Service limit
Rocker arm to rocker shaft clearance	0.2 mm (0.0079 in.)

Description		Standard value	Service limit
Piston ring side clearance	No. 1 compression ring	0.06 to 0.12 mm (0.0024 to 0.0047 in.)	0.3 mm (0.0118 in.)
	No. 2 compression ring	0.05 to 0.09 mm (0.0020 to 0.0035 in.)	0.2 mm (0.0079 in.)
	No. 3 compression ring	0.04 to 0.08 mm (0.0016 to 0.0031 in.)	0.2 mm (0.0079 in.)
	Oil ring	0.03 to 0.07 mm (0.0012 to 0.0028 in.)	0.2 mm (0.0079 in.)



Measuring Piston Ring Gap Clearance

Description	Standard value	Service limit
Piston ring gap clearance	0.15 to 0.4 mm (0.0059 to 0.157 in.)	1.5 mm (0.0590 in.)

- d. Measure the piston ring gap clearance. Replace the ring if the gap is too large.

To measure, insert the ring into the least worn place of the cylinder bore (skirt) using a piston as shown, and measure the gap with a feeler gauge.

3. Connecting Rod

- Using a connecting rod aligner, check bend and distortion of the rod. If excessive, correct or replace.
- Measure the connecting rod thrust clearance with the rod assembled on the crankshaft. If the clearance is excessive, replace the rod assembly.

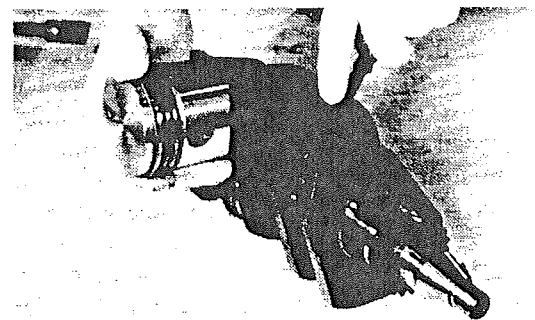
4. Crankshaft

- Measure crankshaft bend. If excessive, repair or replace the crankshaft.
- Check the journals and pins for damage, seizure and other faults. If the journals and pins are seriously worn or damaged, correct them to undersize.

CAUTION:

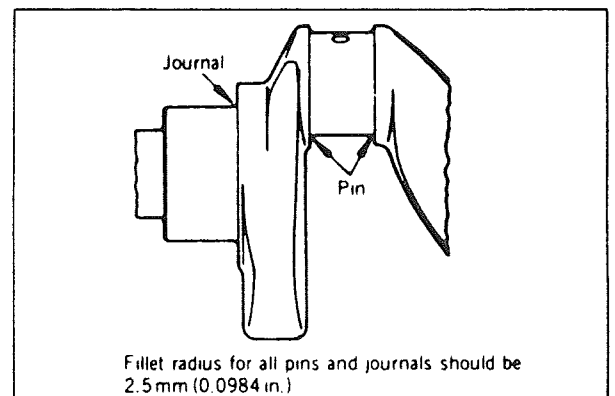
- Undersizes for correcting journals and pins are shown in the table of Specifications and Service Standard in Section 7.
- Finish each fillet of journal or pin to the radius of 2.5 mm (0.0984 in.).

Worldwide Parts Source LLC
Source for hard to find
Engine Gasket Sets
Engine ReRing Kits
Engine Overhaul Kits with Pistons
Phone: 269 673 2313
email: Parts@WwPartsSource.com



Measuring Connecting Rod Thrust Clearance

Description	Standard value	Service limit
Bend of connecting rod	0.05 mm (0.002 in.) max.	
Thrust clearance of connecting rod	0.1 to 0.35 mm (0.0039 to 0.0138 in.)	0.5 mm (0.0197 in.)



Fillet radius for all pins and journals should be 2.5 mm (0.0984 in.)

Fillet Radius

SECTION 2. LUBRICATION SYSTEM

1. Construction

The lubrication system is a full-force type using a trochoid gear pump fitted with a full-flow oil filter. The oil pump is driven through the Oldham's coupling at the rear end of the fuel injection pump camshaft. The oil from the oil pump flows into the cartridge type oil filter via the check valve. After being filtered by this filter, the oil passes through the oil hole in the cylinder block, being delivered to each part of the engine.

1. Engine Oil

a. Engine Oil

Use a heavy-duty (HD) engine oil of API Classification CC or better quality. Change the oil after the first 50 hours of operation and thereafter change every 100 hours of operation. Recommended oil viscosity is as shown at right bottom.

b. Changing Engine Oil

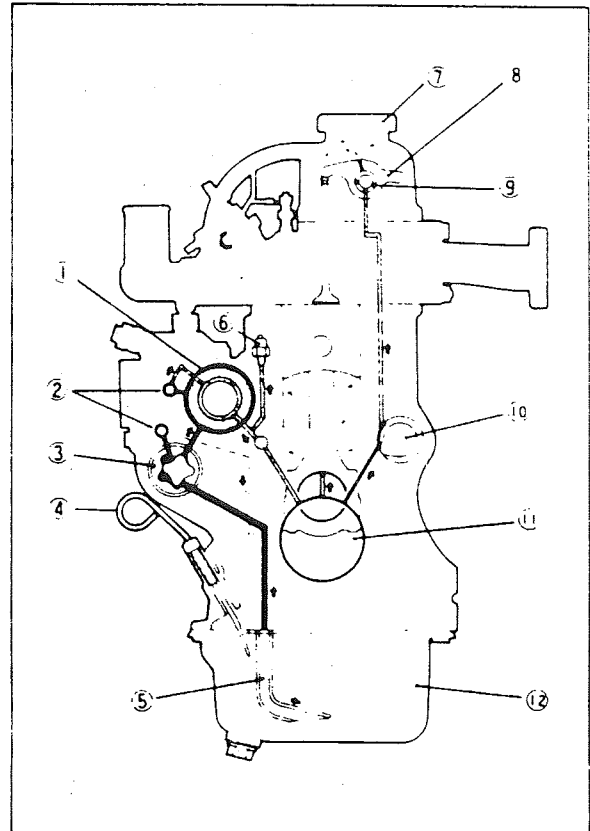
To change the engine oil, first warm up the engine and remove the oil pan bottom drain plug to let oil drain. Tighten the plug and put in new oil at the oil filler port located in the top of the rocker cover.

c. Checking and Refilling Engine Oil

Check the oil pan oil level. Refill up to the upper mark on the oil level gauge.

CAUTION:

- When the oil has been added, wait for about one minute and check the oil level again by the level gauge.



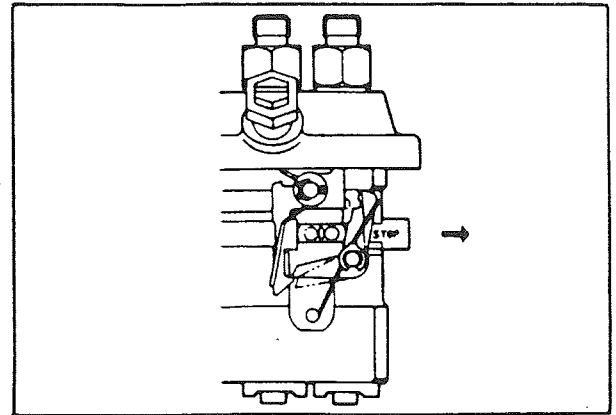
- | | |
|-------------------------|--------------------|
| (1) Oil filter | (7) Oil filler cap |
| (2) Check valve | (8) Rocker arm |
| (3) Oil pump | (9) Rocker shaft |
| (4) Oil level gauge | (10) Camshaft |
| (5) Oil screen | (11) Crankshaft |
| (6) Oil pressure switch | (12) Oil pan |

Lubricating System

Description	Recommended oil viscosity	
Atmospheric temperature	Above 20°C (68°F)	SAE30 or 10W-30
	5 to 20°C (41 to 68°F)	SAE20 or 10W-30
	Below 5°C (41°F)	SAE10W-30

d. Resetting Ungleich Device and Starting Engine

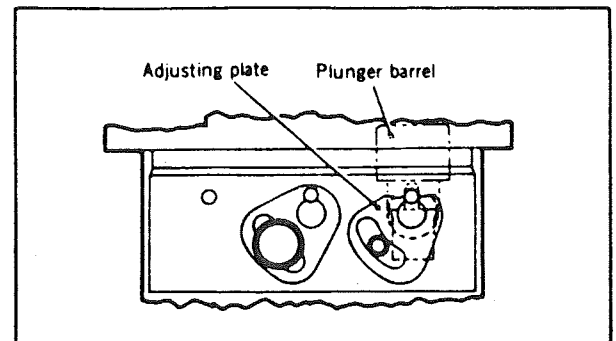
To start the engine, push the speed control lever in all the way in the stop direction and then move it to the fully opened position, and the ungleich set plate will be reset and an excessive injection state created.



Resetting Ungleich Device

e. Inter-cylinder Injection Control

Fuel injection control among three cylinders is performed by the adjusting plates (in two places) having a cam mechanism. These adjusting plates are located on the opposite side of the control rack and as these plates are turned, the plunger barrel is also turned, thus controlling the fuel injection.

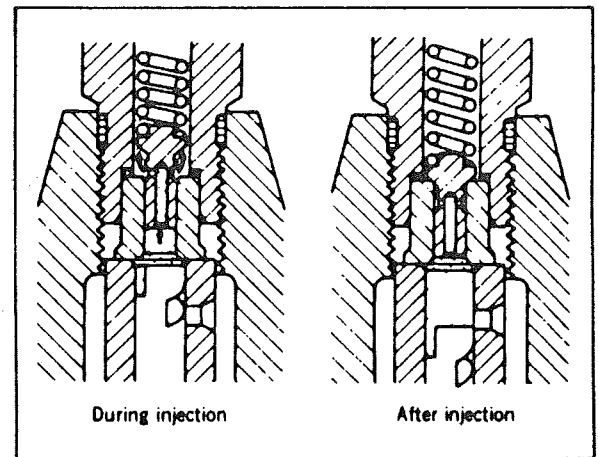


Adjustment of Injection Among Cylinders

f. Delivery Valve Operation

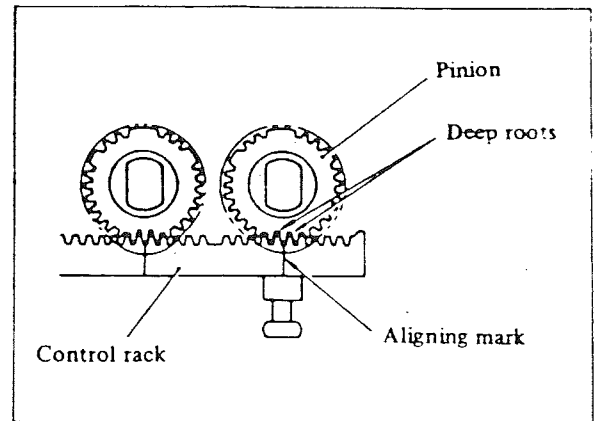
The delivery valve functions to deliver the fuel to the injection pipe after the fuel pressure has increased sufficiently high and also to prevent "after-drip" from the nozzle.

When the fuel pressure above the plunger has decreased after injection, the delivery valve closes the valve seat. At this time the compressed fuel remaining in the injection pipe drips from the nozzle. To prevent this "after-drip", the delivery valve bottom piston makes a stroke to draw back the fuel before the delivery valve reaches the seat, reducing the fuel pressure in the injection pipe to nearly zero. A standard type delivery valve is a Silt type while a special-specification delivery valve for use in a high-speed range is a Bosch type (having a flower petal type notch).



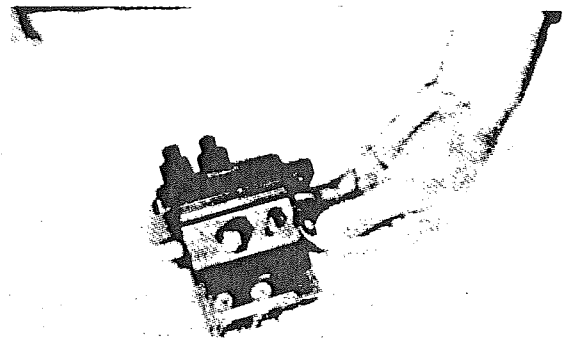
Operation of Delivery Valve

- d. Install the spring seat gasket, and valve assembly to the holder, then tighten it to the pump housing. In this case, make certain the O-ring has been properly installed.
- e. Install the pinion with its deep-root tooth aligned with an aligning mark on the rack.
- f. Install the spring upper seat and spring.
- g. Assemble the spring lower seat to the plunger. Insert the mark "L" area of the plunger collar into the control rack side.



Assembling Rack and Pinion

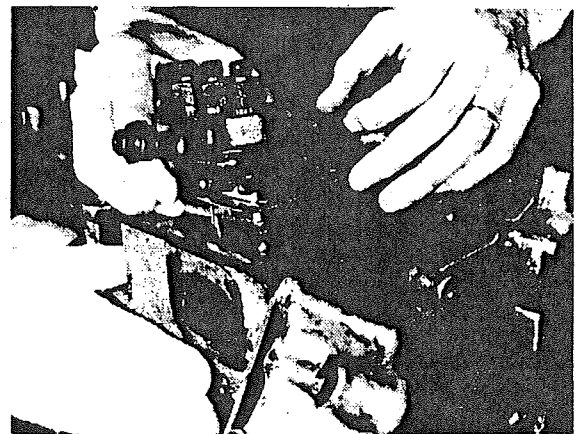
- h. Insert the tappet, using care not to drop the shim. Align the tappet guide hole with the dowel pin hole of the housing to insert the tappet guide pin. Before inserting the tappet guide pin, install the lock plate and insert the guide pin. Lock the pin by bending the plate.
- i. For other cylinders, use the same procedures as above for reassembly.



Assembling Tappet

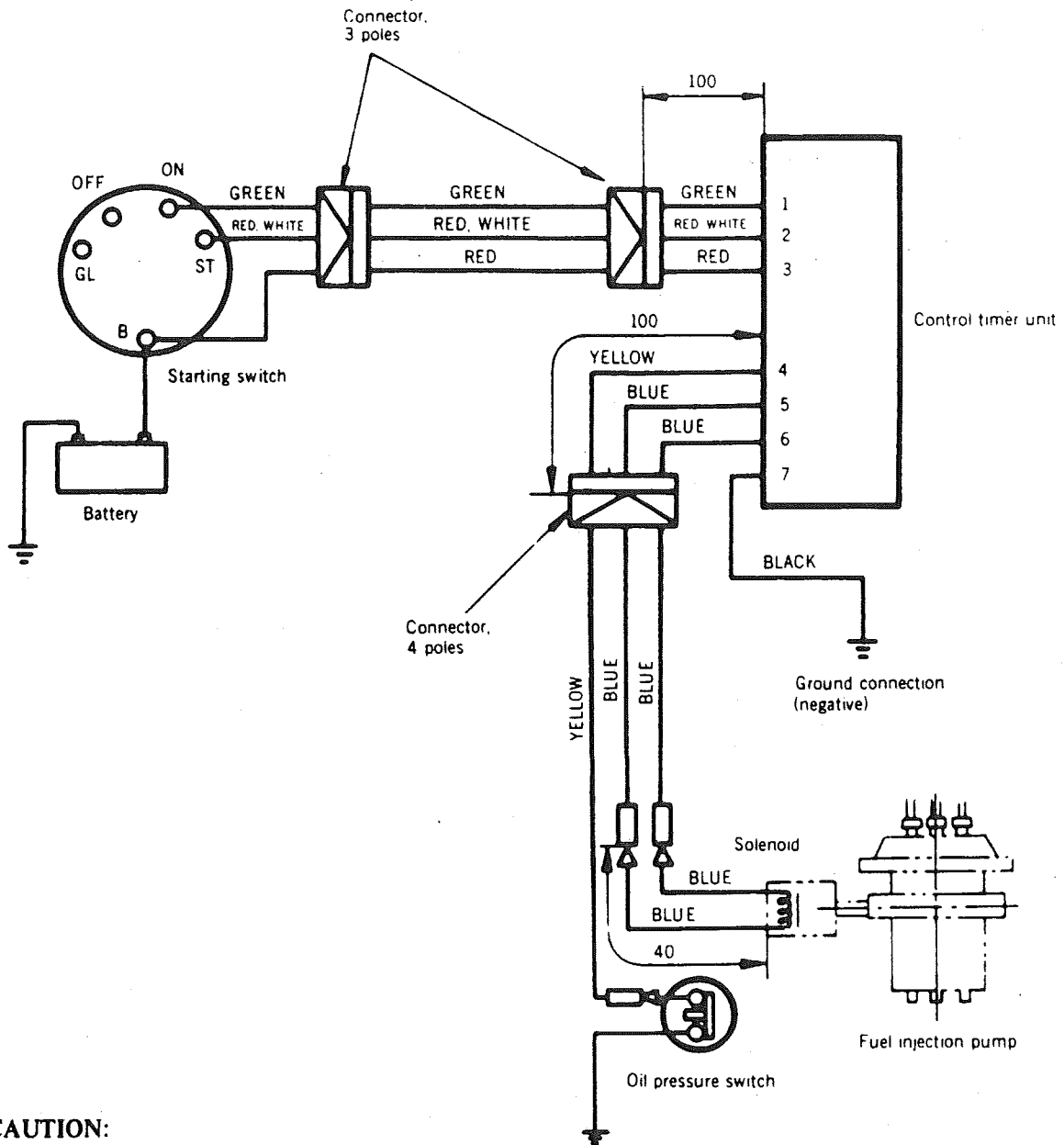
4. Installation and Adjustment of Fuel Injection Pump

- a. When installing the pump assembly, select and install the adjusting shim. After installing the pump, tightly fit the tie rod connected with the governor lever and the tie rod spring to the control rack. There are nine types (thicknesses) of shims in 0.1 mm (0.0039 in.) increments from 0.2 mm (0.0079 in.) to 1.0 mm (0.039 in.).



Installing Pump Assembly

1-2. Wiring Diagram of Electric Shut-off System (option)



CAUTION:

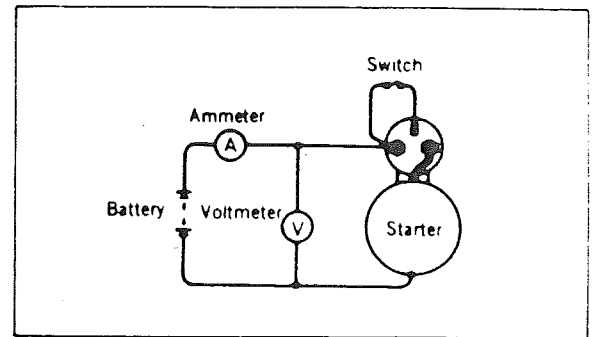
Description	Control timer unit and oil pressure switch
Ambient temperature	-30 to 80°C (-22 to 176°F)
Acceleration of VIB	10G (at 3,000 rpm)

2-2 Inspection and Servicing

2.2.1 Starter

CAUTION:

- Hard engine starting is not necessarily caused by a starter trouble. A cause of trouble will sometimes exist in other part, for example in the starter switch or engine. In the event of hard starting, check the starter circuit with the starter left on the engine. If no abnormality has been found with the circuit, remove the starter from the engine and test it.



No-load Test

(1) Starter Circuit

- Charged condition of battery
- Tightened condition of battery terminals
- Tightened condition of starter terminals
- Condition of wiring (Grounded or broken)
- Grounded condition of starter

(2) No-load Test

Connect the starter with the battery as illustrated and close the switch to turn the starter.

The starter must turn lightly at the current and speed shown at the right when the battery voltage is 11.5V.

If any abnormality has been found, make the following inspections.

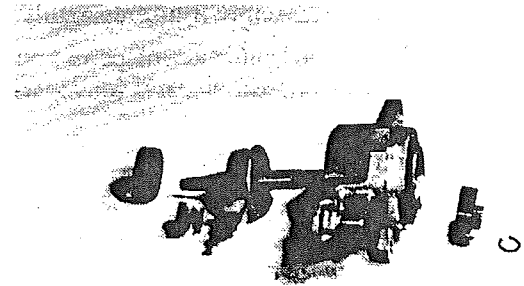
(3) Brushes and Brush Holders

- Check brushes. If the brushes are worn over the service limit, replace. (See "Service Standards.")
- With the brush holders assembled to the commutator, check brush spring tension. If the spring tension has decreased over the service limit, replace.
- Check continuity between the positive brush holder and the brush holder base. In case of continuity, replace the holder assembly.
- Check the brush holder caulk.

(4) Armature

- Check the armature coil using a growler tester. If the armature is shorted, replace. Also check for continuity between the armature and the commutator shaft. Replace if defective.

Description	Standard value		
	Current	Speed	
No-load characteristics of starter (Battery voltage: 11.5V)	1.6 kW	100A or less	3,000 rpm or more
	2.0 kW	180A or less	3,300 rpm or more



Disassembling Overrunning Clutch

Description	Standard value	Service limit	
Brush spring tension	1.6 kW	1.5 kg (3.31 lbs.)	0.7 kg (1.54 lbs.)
	2.0 kW	3.0 kg (6.62 lbs.)	1.8 kg (3.97 lbs.)

Description	Standard value	Service limit
Brush length	1.7 mm (0.67 in.)	11.5 mm (0.45 in.)

(3) Testing procedures

No.	Check item	Sketch	Criterion	Testing tool
1	Voltage at terminal B (Lead wire: red)	<p>3P coupler "ST" "ON" "B"</p>	Approx. 12V DC	Circuit tester
2	Voltage at terminal ON (Lead wire: green)	<p>"ON" Timer circuit</p>	ON: Approx. 12V DC OFF: 0V	Circuit tester
3	Voltage at terminal ST (Lead wire: red/white)	<p>"ST"</p>	ON: Approx. 12V DC OFF: 0V	Circuit tester
4	Voltage at terminal OL (Lead wire: yellow)	<p>"OL" "S" "S"</p>	When stopped: 0V When operated: Approx. 12V	Circuit tester
5	Output of solenoid (Lead wire: blue)	<p>4P coupler "OL" "S" "S" Lamp</p>	Lamp lights for 7 to 15 seconds.	A lamp of 3W or lower rating
6	Action of solenoid	<p>Solenoid 12V Fuse 10A</p>	It is normal if plunger of solenoid is attracted.	Battery Fuse (10A)
7	Wiring to solenoid (Lead wire : blue)	<p>"OL" "S" "S"</p>	Approx. 1.7 Ω Resistance to body: ∞	Circuit tester

2. Periodic Service Chart

○ ... Check, adjust or replenish □ ... Clean ● ... Replace △ ... Drain

Check and service point	Time to check or adjust						Remarks
	Before operation (on delivery)	After first 50 hours	Every 100 hours	Every 400 hours	Every 800 hours	Long-period storage	
Engine proper							
Loose, damaged and leaky points	○						
Exhaust fume, noise, and vibration	○						
Additional tightening of engine parts		○			○		
Valve clearance		○		○			
Engine idle speed		○	○				
Engine compression pressure					○		
Lubrication system							
Engine oil	○	●	●				
Oil filter		●	●				
Fuel system							
Fuel	○					△	
Fuel tank				□		□	
Fuel filter			□	●			Replace only the element for the type with cock
Fuel pump		□	□				Filter
Injection pump					○		Adjustment of fuel injection rate
Nozzle				○			
Intake system							
Air cleaner (filter paper type)			□	●			
Cooling system							
Cooling water	○	●			●	△	Unless anti-freeze is mixed, drain after each operation
Fan belt	○						
Electrical system							
Check of each instrument (pilot lamp)	○						
Starter motor, alternator, regulator				○	○*		* Adjustment of voltage and current
Glow plug				○			

3-4 Governor System

Description	Type	Standard value	Repair limit	Service limit
Governor				
Engine stopping solenoid	Centrifugal weight type Electromagnetic pull-out type			
Rated voltage [20°C (68°F)]		12V		
Current [20°C (68°F)]		7A max.		
Stroke		13.5 ± 0.5 (0.53 ± 0.02)		

3-5 Cooling System

Description	Type	Standard value	Repair limit	Service limit
Cooling fan				
K3A, B-11, 13R	4.N.S.	φ290mm (φ11.42 in.)		
K3B, D-61A	6.N.S.	φ325mm (φ12.80 in.)		
K3D-61TG; K3D, E-13R	5.N.S.	φ340mm (φ13.39 in.)		
Fan belt	HM type	939 (36.97)		
Water pump	Centrifugal impeller type			
Thermostat (Models equipped with thermostat only)	Wax type			
Valve opening temperature		82 ± 1.5°C (180 ± 2.7°F)		
Valve full-opening temperature		95°C (203°F)		
Valve lift		Approx. 8 (0.3)		
Thermoswitch	Bimetal switch type			
Contact closing temperature		108 to 114°C (227 to 238°F) 105 to 111°C (221 to 232°F)		

3-6 Electrical System

Description	Type	Standard value	Repair limit	Service limit
Starter (1.6 kW)				
Output-voltage	Electromagnetic push-in type M002T50381	1.6 kW-12V		
Rotating direction		Clockwise as viewed from pinion side		
No-load characteristics [20°C (68°F)]				
Terminal voltage		11.5V		
Current		100A or less		
Speed		3,000 rpm or more		

SECTION O. GENERAL

4. Performance Curves (5)

