MAITENANCE MANUAL
4JB1 SERIES DIESEL GENERATOR

BRIEF INTRODUCTION

This manual includes the detailed main technical specifications, structure, operation, maintenance, adjustment and trouble shooting, sealing and unsealing and so on about 4JB1 diesel generator diesel engine, which is the reference for operation, maintenance and repair of 4JB1 diesel generator group.

4JB1 DIESEL GENERATOR MAINTENANCE MANUAL

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CHAPTER 1 TECHNICAL INFORMATION

1.1 Main technique parameters

Table1-1 Main technique parameters of 4JB1 series diesel generator engine

Item	Nature inspiration diesel engine		Turbocharged diesel engine	
Model	In-line、forced water cooling、4-stroke			
Cylinder number	4			
Bore diameter（mm）	93			
Piston stroke（mm）	102			
Rotary direction	Anticlockwise （look from the flywheel end）			
Fuel supply advance angle（CA°）	12±1			
Speed (r/min)	1500	1800	1500	1800
Overload power (kW)	26	31	31	37
Rated power (kW)	24	28	28	34
Dimension (mm)	885*667*788		885*687*788	
Fuel consumption (g/ Kw.h)	≤215	≤225	≤213	≤224
Net weight	225		241	
Rated voltage (V)	12			

1.2 Tightening torque of the important nuts and bolts

Tightening torque of the important nuts and bolts of 4JB1 series diesel generator is shown in Table 1-2.

Table 1-2 Tightening torque of the important nuts and bolts

Nuts and bolts	Tightening torque	Nuts and bolts	Tightening torque
Camshaft and Upper idling gear bolt	80~90 N·m	Cylinder head bolt	98~108 N·m
Rocker shaft bolt	45~59 N·m	Crankshaft pulley bolt	260~300 N·m
Main bearing cap bolt	160~180 N·m	Flywheel bolt	113~123 N·m
Connect-rod nut	80~90 N·m		

- **Note**: the important nuts and bolts of diesel engine must be tightened with special spanner.

1.3 Main adjust date

1.3.1 Valve clearance

Intake valve clearance (cold state): 0.4mm±0.05mm;

Exhaust valve clearance (cold state): 0.4mm±0.05mm.

1.3.2 Pressure of injector valve open: 18.6~19.6MPa.

1.4 The range of temperature and pressure

The range of temperature of 4JB1 series diesel generator is show in Table 1-3.

Table 1-3 Range of temperature of 4JB1 series diesel generator

Item	Temperature range	Item	Temperature range
Coolant outlet temperature	75~85 ℃	oil pressure	0.30~0.55MPa
Oil temperature	≤95 ℃		

- **Note**: The temperature of outlet of closed, high pressure water tank system is up to 100~105℃ in short time. The temperature of oil in main path is 125~130℃.

1.5 Fitting clearance and wear limits of the main component

Fitting clearance and wear limits of the main component of 4JB1 series diesel generator group.

Table 1-4 Fitting Clearance and Wear Limits of the Main Component

No.	Fitting parts	Clearance (mm)		Limits of clearance
1	Valve guide hold and inlet valve stem	0.039~0.071		0.20
2	Valve guide hold and outlet valve stem	0.064~0.096		0.25
3	Rocker arm and rocker shaft	0.010~0.050		0.20
4	Cylinder liner inner diameter and piston skirt	0.047~0.065		
5	Tappet hole and tappet outer diameter	0.010~0.041		0.10
6	1st compression ring and piston ring grove	0.090~0.125		0.15
7	2nd compression ring and piston ring grove	0.050~0.085		0.15
8	Oil ring and oil cup height	0.030~0.070		0.15
9	Width of the piston pin	Ⅰ	0.2~0.4	1.5
		Ⅱ	0.2~0.4	1.5
		Ⅲ	0.1~0.3	1.5
10	Connect-rod little end bushing hole and piston pin	0.008~0.020		0.05

11	Piston pin hole and piston pin	0.002~0.015	0.03
12	Axle clearance of connecting rod journal and big end	0.0175~0.290	0.35
13	Camshaft bearing and Camshaft journal	0.015~0.085	0.12
14	Connect-rod big end bore and crank pin journal	0.029~0.075	0.10
15	Main bearing bore and main crankshaft journal	0.033~0.079	0.11
16	Axle clearance of crankshaft	0.05~0.20	0.30
17	Clearance of timing gears	0.10~0.17	0.30

CHAPTER 2 OPERATIONS

2.1 Preparations before starting

(1) Before starting a new diesel engine, you should check tightness of all parts, accessories and control mechanism.

(2) Please check coolant level only when the diesel engine is not operating. Check oil level, oil level should between the marks “L”and “F” on the dipstick. Check oil pipe and water pipe for leakage, deterioration and tightness.

- **Note**: The mark “L” is warning level, cannot run the diesel engine on this level. Please check the oil level 5min later after adding up oil.

(3) It must eliminate air in pipe before starting for new engine and the engines that have not been used for long time or just repaired. Do as follow: First, loose exhaust coupling bolt on fuel filter, and pump fuel by hand pump until no bubbles in discharge fuel, then tighten the exhaust coupling bolt. Second, loose exhaust coupling bolt on fuel pump, and do as the same way as above until no bubbles in discharge fuel.

(4) Check the connectors of electric equipment and check electrolyte level of the battery.

2.2 Starting

(1) Step off the clutch pedal to reduce the load for staring.

(2) Turn switch key to “staring” position.

- **Note**: In order to protect the starter and battery, every time you start the diesel engine, should not be longer than 15 sec. If the first could not start the diesel engine, you should restart the diesel engine at least 2 minutes later. If you fail to start up for 3 times, you should check the fuel supply system and wiring system, check out the cause and treat them before restarting.

(3) After starting, please check the oil pressure immediately.

2.3 Running

(1) It cannot run with full load immediately after staring, the engine needs to warm up with free load. It runs with full load only after the coolant’s temperature is up to 60 ℃.

- **Note**: To the new and overhauled diesel engine, it can add with full load only after 60 hours running in.

(2) Check if the temperature of coolant is right while diesel engine is running,

(3) Check if there is abnormal noise, check if there is leakage of fuel supply, coolant system and air system while diesel engine is running, otherwise it may lead to serious trouble.

- **Note**: If the indicator of oil pressure or indicator of coolant temperature is warming while the diesel engine is running, it must stop the engine and check out the cause. It only can restart after solving the problem.

2.4 Diesel engine stopping

(1) Diesel needs to reduce load gradually before stopping. It only can stop after the engine coolant is below 70℃.

(2) It can not stop engine by the way of closing fuel tank avoid to mix air in fuel supply system that will be difficult to start next time.

2.5 Running-in

New and overhauled diesel engine (include replaced piston, piston ring, cylinder liner, main bearing and connecting-rod) must take running-in for some time before normal operation. The load should be added gradually from small. By the running-in process, friction surface of diesel engine parts will fit well to avoid abnormal wear. Experience shows that the life, reliability and economy of the diesel engine mainly depend on running-in of initial stages.

The time of running-in should be above 50h.

Table 2-1Running procedure for new diesel generator

Load (%)	Running time	Load (%)	Running time
25	10	75	30
50	15	100	5

First, running-in with 25% load in 10 hours; then running-in with 50% load in 15 hours and running-in with75% load in 30 hours; finally, running-in with 100% load in 5 hours. The load must be added gradually.

- **Note**: It is must take maintenance after running-in.

(1) Replace oil in oil pan.

(2) Replace cartridge of oil filter.

(3) Adjust the clearance of valve and fuel supply advance angle. Tighten bolts and nuts.

2.6 Sealing and maintenance

If the diesel engine would not run for a long time (over 3 months), it should

be sealed with the instruction as follow:

(1) Drain out fuel, oil and water from tank and coolant from the radiator.

(2) Remove the preheating plugs and fill 30g engine oil into cylinder and then rotate the crankshaft for 15~20 turns before reinstall the preheating plugs.

(3) Clean the surface of the engine, add industrial Vaseline to the points and contactors of electric devices, non-painting metal surface.

(4) If the engine will seal for long time, it should check it for every 2~3 months. In order to prevent engine parts rusting, the engine should run 1 hour under the direction of the request of engine starting and engine running, then seal the engine again according to the request of engine sealing.

2.7 Fuel, oil and coolant

2.7.1 Fuel

4JB1 series diesel generator group should use light fuel. According to the season and temperature, the fuel should be selected as follow:

Table 2-2 Fuel of 4JB1 series diesel generator

Temperature	Grade of diesel fuel	Temperature	Grade of diesel fuel
Above 5℃	0# light diesel fuel	Above -25℃	-35# light diesel fuel
Above -5℃	-10# light diesel fuel	Under -25℃	-50# light diesel fuel
Above -10℃	-20# light diesel fuel		

Table 2-3 Specification for light fuel oil

No.	Cetane Number Not less than	Temperature of distillation			Viscosity(20℃)		% ≤	Sulphur % ≤	Ash % ≤	Flash Point ℃ ≥	Condesation℃ ≥	Impurity %	Moisture Content % Not more than
		50% not higher than	90% not higher than	95% not higher than	° E	Kinematic Viscosity $10^{-6}m^2/s$							
10	50	300	355	365	1.2~1.67	3~8	0.4	0.2	0.025	60	10		
0	50	300	355	365	1.2~1.67	3~8	0.4	0.2	0.025	60	0		
-10	50	300	355	-	1.2~1.67	3~8	0.3	0.2	0.025	60	-10	No	Trace
-20	45	300	355	-	1.15~1.67	2.5~8	0.3	0.2	0.025	60	-20		
-30	43	300	-	350	1.15~1.67	2~7	0.3	0.2	0.025	60	-35		

To reduce trouble and prolong the life of diesel engine, the diesel fuel used by diesel engine must be clean;

Keep clean in the procedure of fuel transport and adding.

- **Note**:

(1) Fuel cannot be mixed with water and impurity.

(2) Do not fill fuel when the engine is running. Keep clear around jaws of fuel tank. Fuel cannot overflow.

2.7.2 Lubrication oil

Use only good quality lubrication oil to the relevant specification as show in the table below.

Attention: the type of lubricating oil to be used may be affected by the quality of the fuel which is available. For further details see “Fuel specification”.

Always ensure that the correct viscosity grade of lubrication oil is used for the ambient temperature range in which the engine will run as show in the chart below.

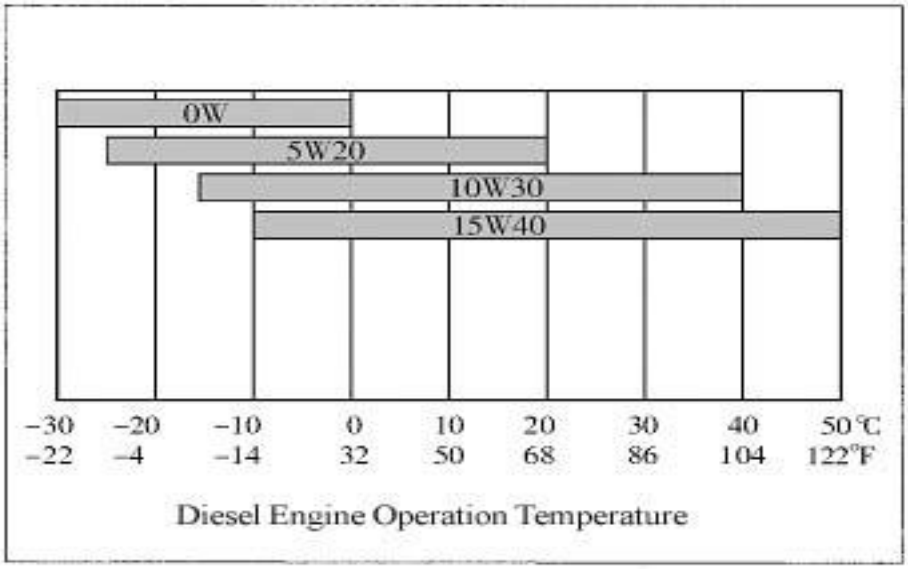

Figure 2-1 Select oil according to local temperature

- **Note**:

(1) Affirm there are no impurities and water in oil.

(2) Oil with different grade or made by different manufacturers cannot be mixed. Used oil and new filled can not be used together.

Table 2-4 Specification for lubricating oil

Engine	Specification	
	API CC/SE	API CD/SE CCMC D4
Naturally aspirated	●	● ※
Naturally aspirated engines in heavy duty earthmoving equipment		●

Turbocharged		●

※ Not recommended during the first 20/40 hours of operation, nor for light load application.

2.7.3 Coolant

Diesel engine should use antifreeze in cooling system which has the capability of antifreeze, antirust, anti-stain and high boiling point.

- **Warning**: coolant is poisonous, so it must be kept in its original container. Do not touch it by skin or splash it into eyes.

If there is a lot of mineral in water, at high temperature the mineral will change into furring, attached on water pipe and high temperature parts, make them clogged or their heat hardly be radiated, cause diesel engine overheating.

- **Note**:
  (1) Do not fill water if the coolant is not enough, it will affect performance of coolant.
  (2) If the coolant is not enough for leakage, it should be filled with the same grade coolant after the diesel is cool.
  (3) Do not mix different coolants together. Please fill the same grade coolant with high quality. Otherwise the life of diesel engine will be shorted for eroding and furring.

Table 2-4 Formula for antifreezing fluid

Description						Solidifying point ≤℃
	Ethulene	Alcohol	Glycerin	water	Unit of composition	
Ethulene antifreezing fluid	60			40		-55
	55			45		-40
	50			50		-30
	40			60		-22

2.8 Maintenance

During engine operation, engine performance will get worse due to the wear of parts. It is necessary to take maintenance. There is 4 grades maintenance:

(1) Daily maintenance: take maintenance after running 8~10h.

(2) First maintenance: take maintenance after running 100h.

(3) Second maintenance: take maintenance after running 200h.

2.8.1 Daily maintenance

(1) Check if there is oil leakage, coolant leakage and air leakage, tighten every

nuts and bolts.

(2) Check if there is enough oil in tank, refill if necessary; Check if there is enough coolant in tank, refill if necessary.

（3）Check the oil in fuel pump.

- **Note**: check if there is mixture of oil and coolant in coolant tank. If the coolant is determination.
- **Note**: it is necessary to check if there is abnormal noise, vibration, exhaust. It cannot run with trouble.

2.8.2 First grade technical maintenance

(1) Carry out daily technical maintenance

(2) Check tightness of fan belt, adjust if necessary.

2.8.3 Second grade technical maintenance

(1) Carry out First grade technical maintenance

(2) Replace oil（include the oil in fuel pump.）.

- **Note**: to lubricate every part, it is necessary to run without load some time after replace oil.

(3) Replace fuel filter cartridge.

(4) Replace oil filter cartridge.

(5) Clean air filter.

- **Note**: it is necessary to ensure the sealing of air filter. It can avoid air get into cylinder block directly.

(6) Check advance angle of fuel pump. Adjust if necessary.

(7) Check valve clearance. Adjust if necessary.

(8) Check the overflow hole of water pump. If there is leakage from overflow hole. Please replace the water pump.

(9) Check the connector of electric equipment for correct link. Burnt wire should be replaced.

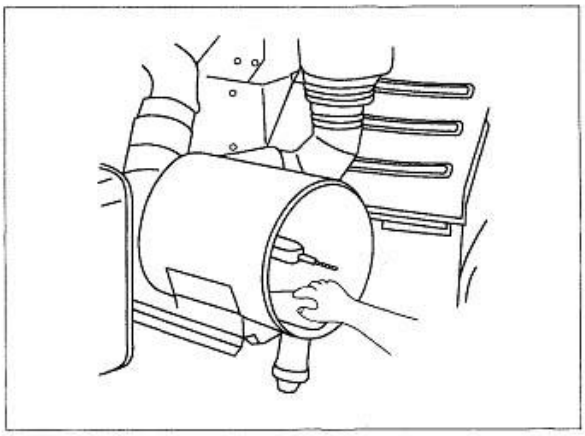

Figure 2-2 Air filter Maintenznce

Figure 2-3 Clean the Air filter Cartridge

2.8.4 Maintenance of air filter

It should be maintained after vehicle working for 200 hours. It needs to clean dust in shell and filter cartridge.

(1) Clean air filter box: wipe off the dust in air filter box and on sealing gasket surface (see Figure 2-2)

(2) Clean air filter cartridge: if the filter is in dry condition, clean it by compress air (see Figure 2-3). Turn the filter cartridge by hand, blowing off the dust by compressed air. The pressure of compressed air should be lower than 490KPa.

- **Note:** Do not clean air filter by compressed air from outside because it will make dust enter into filter.

Air filter cartridge should be replaced at the following case:

- Filter cartridge is polluted by carbon deposit and oil stain.
- Oil stain on filter is not easy to clean.
- Cartridge is distorted or damaged.

2.8.5 Maintenance of fuel filter

The Maintenance of fuel filter should be taken as follow:

(1) Clean the surface of fuel filter element. Nip the oil intake tube.

(2) Unscrew the filter box and dissemble it with spanner.

(3) To ensure the reliability of connecting, it is necessary to clean the filter seat.

(4) Lubricate sealing ring with a little fuel; Install filter box into seat by hand and then ensure that the screw connecting is reliable.

(5) Screw filter cartridge by spanner and loose oil intake tube to check if there is leakage.

(6) Exhaust air in the fuel filter.

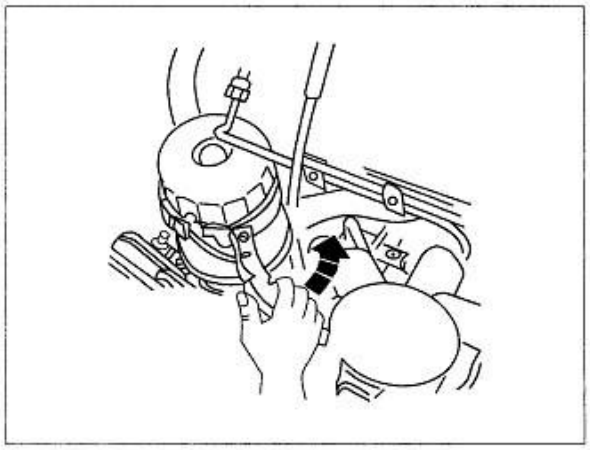

Figure 2-4 Replace Oil Filter Cartridge

2.8.6 Maintenance of oil filter (see Figure 2-4, 2-5)

(1) Put container under oil filter for the overflowed oil.

(2) Dissemble oil filter cartridge by spanner anticlockwise.

(3) Check and clean oil filter seat to ensure the connecting.

(4) Put a little oil on new filter sealing

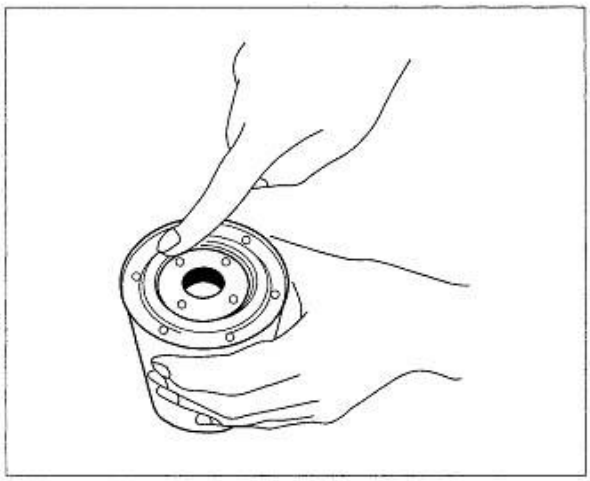

Figure 2-5 Replace Oil Filter Cartridge

ring. Screw oil filter box onto seat by hand until feeling resistance, then screw 3/4 circle by special spanner clockwise.

(5) It is necessary to ensure there is enough oil in sump tank.

(6) Start engine to check if there is leakage and then stop engine to check oil by dipstick. Add if necessary.

- **Note:** (1) Oil filter cartridge is not recyclable part.

  (2) Replace the oil filter cartridge according maintenance.

  (3) The output pressure is limited up to 0.45±0.02MPa by valve. Please do not dissemble or adjust in normal condition for it has been adjusted in manufacture.

  (4) To ensure the sealing of filter. Do take care of sealing ring. Replace if the sealing ring is damaged.

Chapter 3 TECHNICAL MAINTENANCE

3.1 The Components of the Diesel Engine

Diesel engine is a kind of complicated machine that can make the thermal energy into the mechanical energy. There are some mechanism and system in different kinds of diesel engine.

3.1.1 Cylinder head and cylinder block

The function of the cylinder head is to close the upper side of cylinder and form the combustion chamber with the upper side of the cylinder and the top piston. There are intake valve, exhaust valve, arm rocks and injectors mounted on the cylinder head. There are intake and exhaust ports and cooling jacket on the cylinder head too. The cylinder block is one of the most important parts of the diesel engine. There are a lot of mechanism and system mounted on the cylinder block.

3.1.2 Crank and connecting—rod mechanism

The crank and connecting-rod mechanism transmit reciprocating motion of piston into rotating motion of crankshaft, i.e. it can transmits push force on piston caused by burned gas into the torque of crankshaft; or it transmits rotating motion of crankshaft into reciprocating motion of piston, i.e. it transmits torque of crankshaft into push force of piston. By these motions, diesel engine finishes its working process and output energy by crankshaft. Crankshaft and connecting-rod mechanism is composed of piston, connecting-rod, crankshaft, flywheel and so on.

3.1.3 Valve mechanism and intake/exhaust system

The function of valve mechanism and intake/exhaust system is to open intake valve and close exhaust valve in time, ensure more fresh and clean air can be absorbed into cylinder in time, so that the exhaust gas can be push out of cylinder in time as much as possible. The mechanism consists of intake and exhausts valve, transmission mechanism (drive gears, camshaft, tappets, push rods, rocker shaft, rocker arm, etc) air filter, intake and exhaust pipe and so on.

3.1.4 Fuel supply system

The function of fuel supply system is to inject fuel into chamber at fixed time, fixed quantity and fixed pressure according to the condition of the diesel engine so that diesel fuel could burn completely; at the same time, fuel supply should be adjusted automatically according to the load of diesel engine ensuring the speed of the diesel constantly. Fuel supply system is mainly formed by fuel tank,

oil filter, transfer pump, fuel injection pump, and fuel injectors and so on.

3.1.5 Lubrication system

While diesel engine is working, the surfaces of crank and connecting-rod mechanism and other moving parts will cause friction and wear. So the main function of lubrication system is to lubricate moving parts' surface, reduce friction resistance and wear, and take off the heat of moving part, clean friction surface and seal surface. The lubrication system is mainly composed of engine oil strainer, oil pump, oil filter, oil radiator etc.

3.1.6 Cooling system

The function of cooling system is to take off extra heat from hot parts caused in working process and keep normal working temperature of diesel engine. Cooling system is mainly composed of water tank, water pump, fan and so on.

3.1.7 Starting system

The function of starting equipment is to rotate static crankshaft by outside power until crankshaft can move independently. It includes starting engine, battery and other equipments.

3.2 Cylinder block component

The 4JB1 series diesel generator is designed with thin wall dry liner made of steel. When the liner is worn, replace it if necessary.

- **Note**: In order to choose the right piston, it is necessary to meter the liner's diameter after replacing the liner. The clearance is controlled between (0.047~0.065mm).

There are five main bearings on cylinder block. Each is tightened by two M14 bolts onto cylinder block. Tighten torque is 160~180N.m. Tighten in three times (First 40~50N.m, then 90~100N.m, then 160~180N.m) and the tighten procedures are showed in Figure 3-1.Because main bearing cover is machined with cylinder block. It cannot be installed in opposite direction. For correct installation, it is marked with "1", "2"ect, and arrowhead on each main bearing cover, arrowhead direction

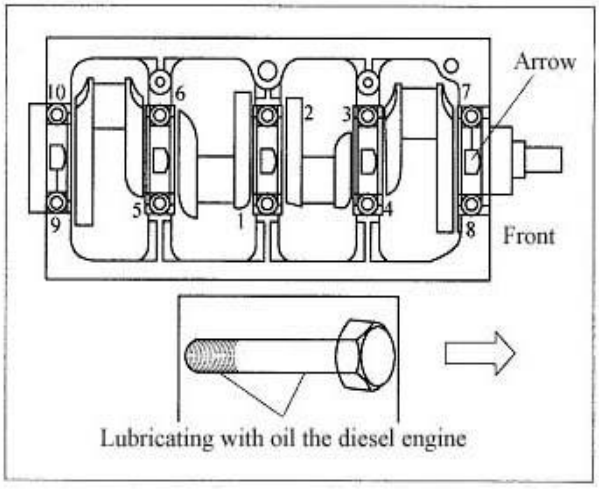

Figure3-1 Tighrening Sequence of Main Bearing Cap Bolts

points to the front of diesel (see Figure 3-1).

Third main bearing supports thrusting force of crankshaft, there are half-round thrust washers on the two sides of third main bearing. Thrust washers are made of steel-liner and aluminum-alloy layer. When install the thrust washer, you must put the surface with oil-groove towards rotative place of crankshaft (see Figure3-2).

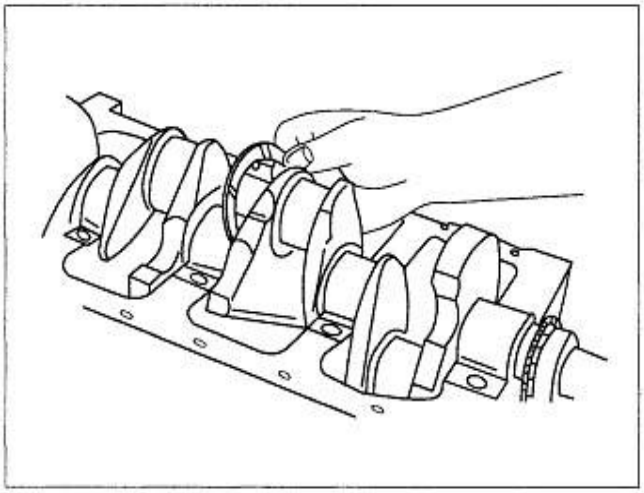

Figure 3-2 Installation of Crankshaft Thrust Washers

Thrust clearance of crankshaft is 0.05~0.02 mm.

There is an oil-groove and a hole on upper bearings (see Figure 3-3). Put upper bearings on the cylinder block and lower bearing on the cylinder block and low bearing on the main bearing cap when installation. Align the bearing claw with the claw groove of the cylinder block and the main bearing cap separately.

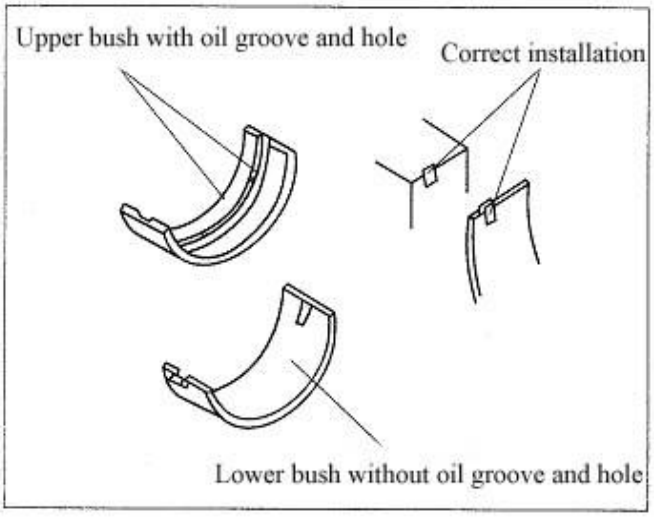

Figure 3-3 Upper and Lower Main Bearings and Installation

There is three cam bearing bores locating on the upper right side of main bearing holes. A bearing, which is made of high tin-aluminum alloy with steer liner, is pressed in each bearing bore. When reassembling camshaft bearings to oil holes on the cylinder block.

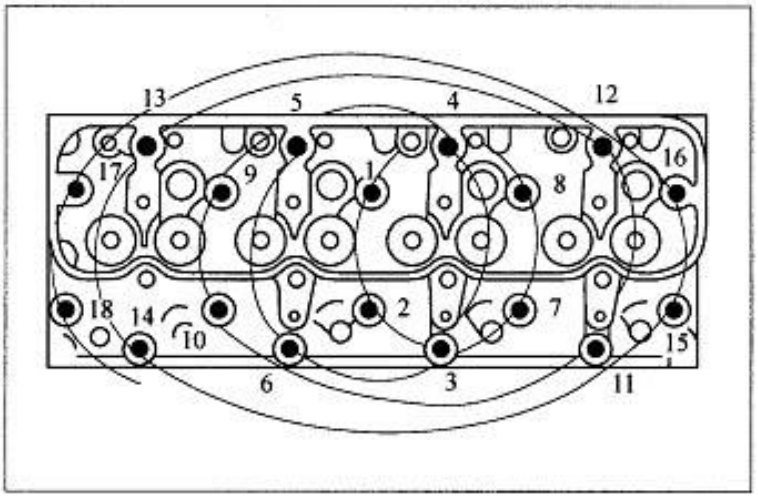

Figure 3-4 Tightening Sequence of Cylinder Head Bolts

3.3 Cylinder head

component

Cylinder head is installed on cylinder block by 18 bolts M11, tighten torque are 98~107.8N.m. First lubricate the bolts with diesel engine oil, and then tighten them at two passes in the sequence show in Figure 3-4: 1st 49~78N.m, 2nd 98~108N.m.

Valve guide that pressed in cylinder head is made of power metallurgy with iron-base or made of cast iron alloy, it has high wear-proof performance, and it cannot support lager pressure force from side direction, therefore, do not hit and press it when disassembling or assembling.

Cylinder head gasket is made of five-storey steel plate. The part of cylinder hole is warped up by tinplate, and there is a steel wire ring in it. There are special coat on around of push rod holes and water holes to seal well (Figure 3-5).

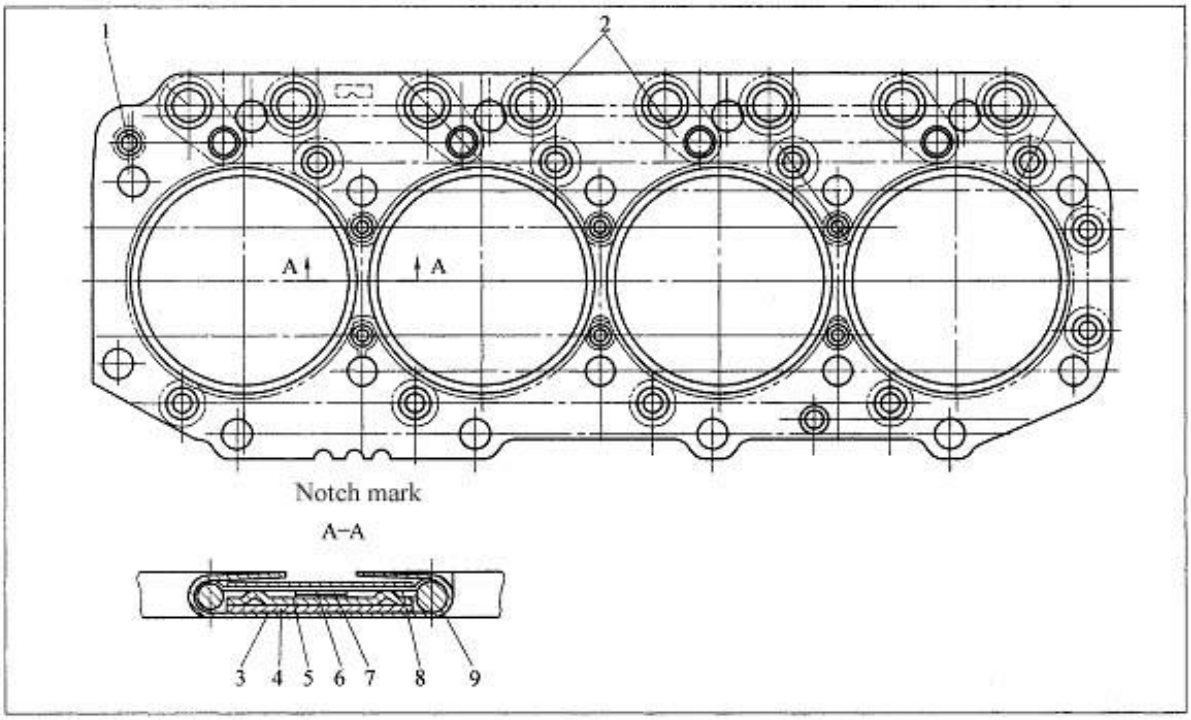

Figure 3-5 Chlinder Head Gasket Assembly

1. Oil hole; 2. Coating; 3. Bottom board; 4. Pad board; 5. Wheel circle inserting board
6. Inserting board; 7. Upper board; 8. Auxiliary board; 9. Steel wire ring gap mark

If there is leakage of air or water from the cylinder head gasket, you should check tightening torque of cylinder head bolts with torque spanner when the diesel engine is cool down fully. Tighten torque is 98~108N.m. Tighten sequence is shown in Figure3-4.

When disassembling the cylinder head for clear away carbon deposits or disassemble piston, you must drain out all coolant from cooling system first, and then disassemble other parts mounted on the cylinder head (the intake and

exhaust manifold need not disassemble), loose and remove the 18 piece of cylinder head bolts, remove the cylinder head reposefully and carefully, avoid damaging the surface of cylinder head and the cylinder block. And then check the cylinder head for cranks and warpage. check the cylinder head gasket for damage, oil leakage, gas leakage, water leakage.

Table 3-1 Thinkness of cylinder head gasket

Gap market of cylinder head gasket	Protrusion height of piston (mm)	Free thickness of cylinder head gasket (mm)
Ⓐ	0.617~0.722	1.60
Ⓑ	0.722~0.827	1.65
Ⓒ	0.827~0.933	1.70

Measure of protrusion height of piston:

(1) Clean off carbon deposition on the top of piton and gasket on the top surface of cylinder block carefully.

(2) Measure of protrusion height of piston on 1.3 spots of piston top surface and 2, 4 spots of cylinder block top surface with indicator (see Figure 3-6, 3-7). Each cylinder must be measured.

(3) Record highest value, and use this value to select the thickness of cylinder head gasket.

- **Note**: The protrusion highest of piston must be in range of 0.617~0.933mm.

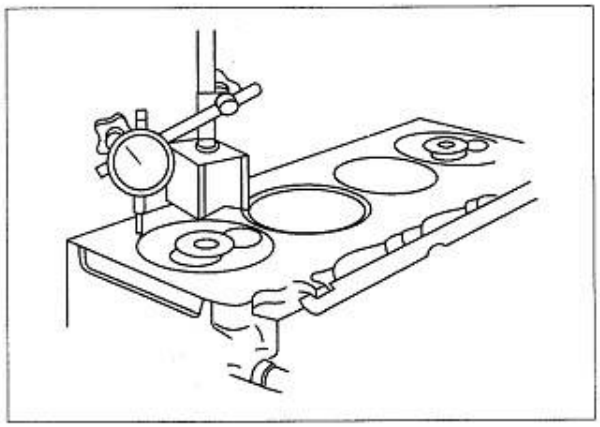

Figure 3-6 Measurement of Protrusion Height of Piston Top

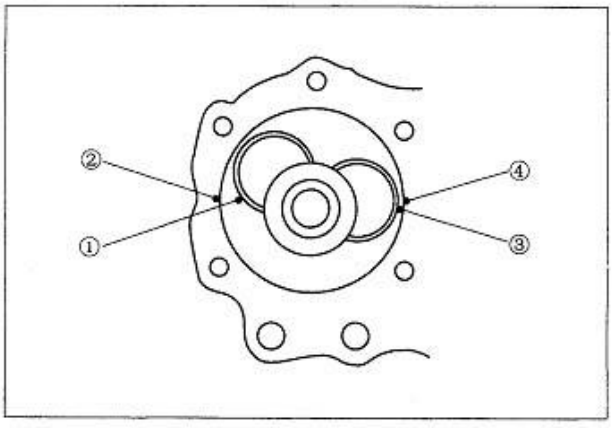

Figure 3-7 Measurement Points of Piston Surface and Cylinder Block Surface

3.4 Crank and connecting-rod mechanism

3.4.1 Piston

The piston of 4JB1 diesel engine is made of common–crystal sliming, and is coated with tin on the outside surface to improve its performance of wear-proof.

There are front-towards mark on top of the piston, so when you assemble the piston connecting-rod to the cylinder, you must make the front mark of piston towards the front of diesel engine. There also is piston diameter mark on the top of the piston such as "M, N, S, A, B, C, D, E", when you reassemble piston connecting-rod to the cylinder; you must make the piston diameter mark be same with the cylinder block (see Figure 3-8).

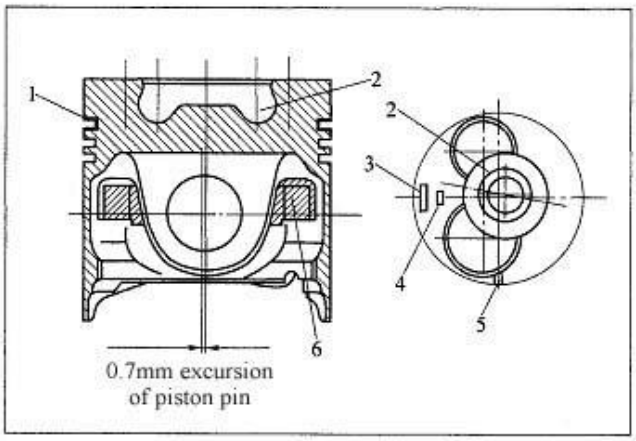

Figure 3-8 Structure of Piston
1. Inserted ring groove seat; 2. Quadrangle shape with shrinkage periphey and ω model combustion chamber; 3.Diameter mark; 4. Quantity mark; 5. Front towards mark 6.Steel supporter

- **Note:** The front mark of piston must be faced to the front of diesel engine when reassembling a piston (see Figure3-9).

  Measure the amount of wear, and change the piston if the amount over standard. It must choose the same diameter group with the old one.

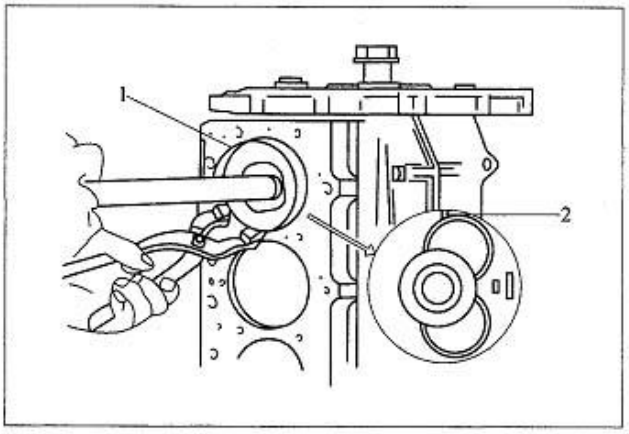

Figure 3-9 Reassembling Piston with Special Piston Rings Compressor
1. Special piston rings compressor; 2. The front towards mark of piston

- **Note:** Change piston ring while changing piston.

3.4.2 Piston ring

The piston ring includes compression ring and oil ring (see Figure 3-10). The standard of piston ring hatch clearance is: 1st compression ring 0.2~0.4mm, 2nd compression ring 0.2~0.4mm, oil ring 0.1~0.3mm.

Put the piston ring in a standard cylinder jacket and use the thickness gauge to measure the hatch clearance.

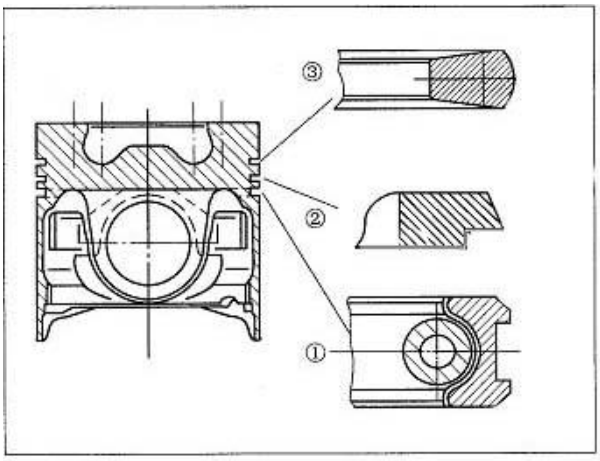

Figure 3-10 Structure of Piston Ring

The clearance will increase with the wear of piston ring, which cause air leakage gets worse. When the clearance value exceeds the standard, it should be changed.

The clearance between the piston ring and groove is side-clearance. The size of side-clearance is: first compression ring 0.090-0.125mm, second compression ring 0.050-0.085mm, and oil ring 0.030-0.070mm.

Put the piston in relevant groove and use thickness gauge measure the size of side clearance.

Must ensure the side-clearance and hatch clearance when assembling the piston ring, otherwise, it will get easy to be blocked in the groove and lose seal capability.

Reassembling three piston rings according to the number with the piston rig compressor. The mark "N" on the ring should be upwards, and ring gap should be staggered (see Figure 3-11).

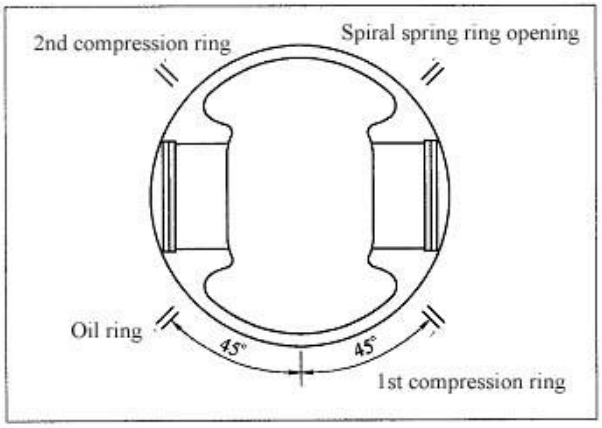

Figure 3-11 Installation Positions of Piston Ring

3.4.3 Piston pin

Piston pin is fixed by elastic ring that could be reassembled and disassembled easily with the help of pointed pincers, because there is a gap on the piston pin seat (see Figure 3-12).

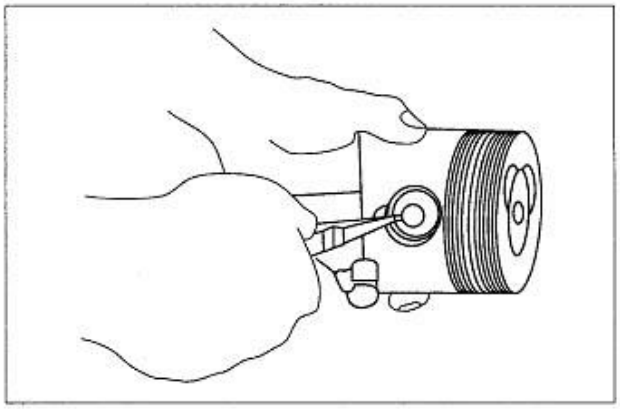

Figure 3-12 Disassembly and Reassembly of Elastic Ring with the Sharp Pincers

Check the piston pin elastic rings for crackle and scar when piston pin elastic rings are assembled, and then make the opening of piston pin ring not towards the gap of piston.

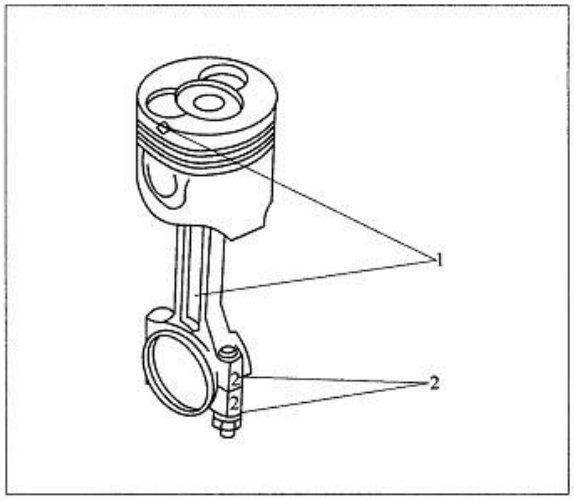

Figure 3-13 Mark of Connecting-rod
1. Front towards marks; 2. Couple marks

3.4.4 Connecting-rod and Bolts

The connecting-rod is forged by alloy structure steel. There is lead bronze alloy liner set in connecting rod small-end, with small oil groove on

connecting rod small-end for lubricating piston pin. There are bearings made of aluminum base alloy in connecting rod big end hole. In order to avoid faulty assembling, there are same mark on the right side of connecting body and the cap. There are protrusion marks on the mid-part of connecting rod and head of connecting rod cap, when reassembling keep these marks facing to the front direction of diesel engine (see Figure 3-13).

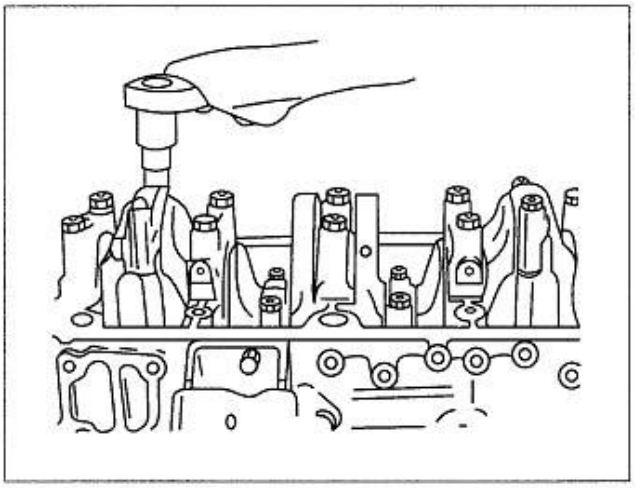

Figure 3-14 Tighten Connecting-rod Bolts

- **Note**: Do not install the connecting-rod cap in reversal direction.

Apply engine oil to the screw thread and piston face of bolts and then tighten them in two times: 1st, 40-50N.m, 2nd, 80-90N.m, (see Figure 3-14).

3.4.5 Flywheel

There is flywheel rim on the edge of the flywheel. It meshes with the rim of starter.

Flywheel is mounted to the crankshaft by 8 bolts for ensuring reliability of installation (see Figure3-15).

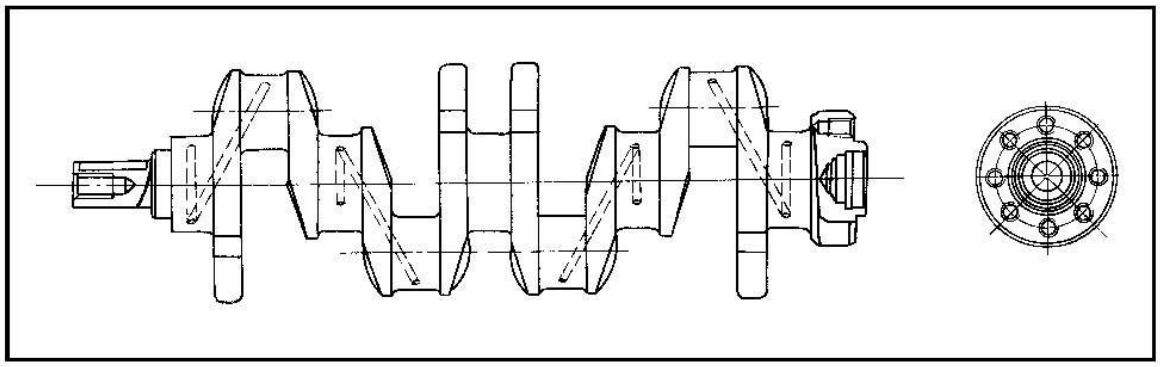

Figure 3-15 Structure of crankshaft

- **Note:**

(1) When reassembling crankshaft pulley bolt, apply engine oil to the screw thread and tighten it according to specified torque: 167-206N.m

(2) When reassembling flywheel bolts, apply engine oil to the screw thread and contact plane, and then tighten them according to the intersect order in several passes. Flywheel bolts tightening torque: 113-123N.m

High performance frame-type oil seal with screw groove is used for crankshaft, its structure and installation is shown in Figure 3-16.

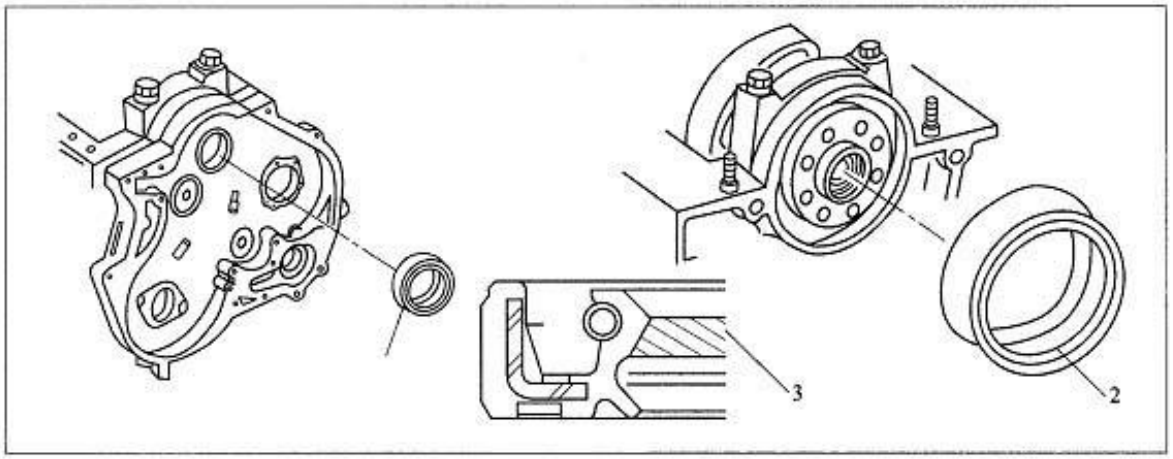

Figure 3-16 Sketch for the Structure of crankshaft

3.4.6 Crankshaft pulley

There are timing marks on the edge of pulley such as TDC and BTDC12, 14, 16 degree. (See Figure 3-17).

- Note: When check and adjust, put the timing marks right towards protrusion on gear case cover, you could determine the positions both TDC and advance angle of injection.

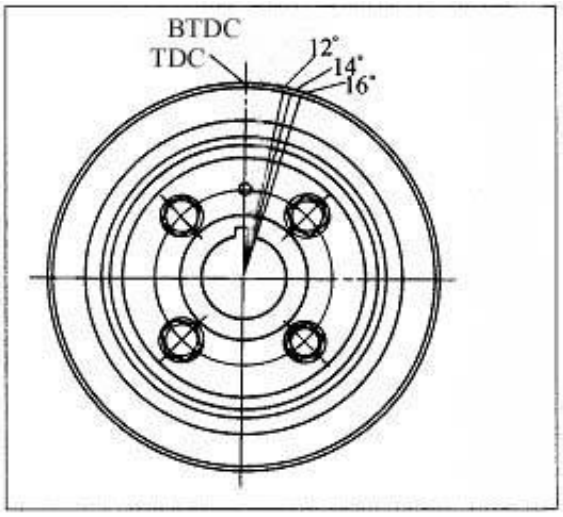

Figure3-17 Crankshaft Pully

3.5 Valve mechanism

3.5.1 Intake and exhaust valves

The valve is used to control intake and exhaust pipe (see Figure 3-18).

3.5.2 Valve spring

When reassembling the valve spring, you must put the small pitch end of spring (with paint) toward cylinder head.

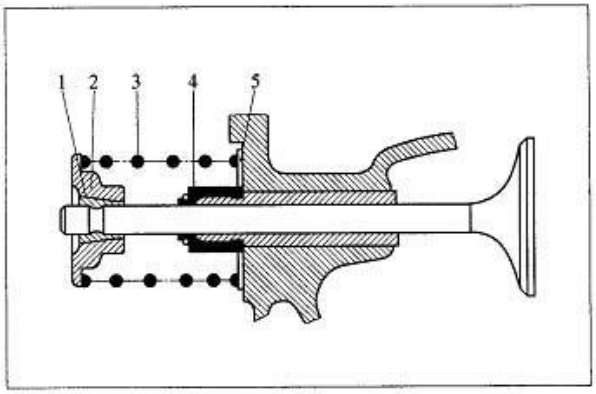

Figure 3-18 Sketch of Valve Installation
1.Valve Keepers 2.Upper seat of valve spring 3.Valve spring
4.Valve guide seal 5.Lower seat of Valve

- Note: Valve keepers must be set correctly in valve keeper groove, otherwise when they drop away, the valve will fall into cylinder and cause serious accident.

3.5.3. Arm Rocker

Screws and nuts on arm rocker can adjust valve clearance.

3.5.4. Adjustment of Valve Clearance

The clearance of intake and exhaust valves is 0.40±0.05mm at cold condition. If the valve clearance is too big, may cause serious knocking, and if it is too small, may cause that valve could not close completely and then valve burnt out with a lot of heat could not be taken away.

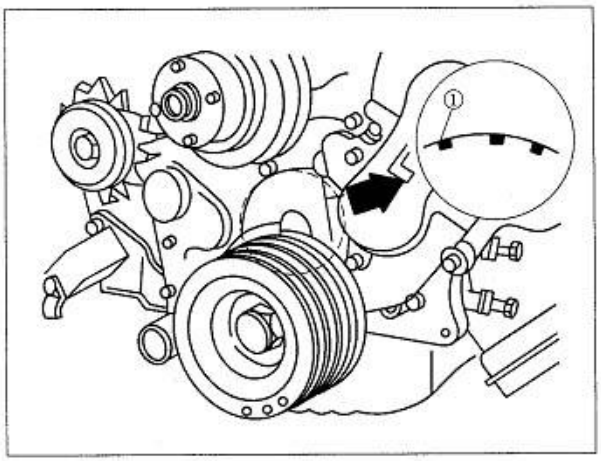

Figure 3-19 Turn Cankshaft to No.1 Piston at TDC of Compression Stroke

Methods of valve clearance adjusting

(1) Turn the crankshaft, let the piston of cylinder No.1 reach TDC piston (see Figure 3-19), "TDC" mark on edge of pulley right towards the pointer on gear case cover, in this condition adjust the 1st, 2nd, 3rd, and 6th valve clearance (see Figure 3-20).

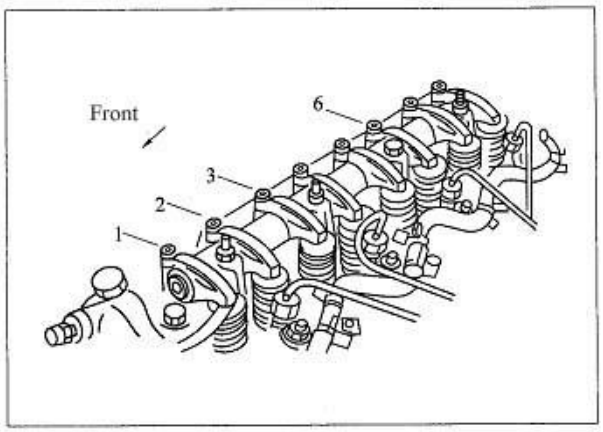

Figure 3-20 Adjust the 1st,2nd,3rd,and 6th Valve Clearances

(2) Loose the rocker arm nut, and then insert the feeler gauge between rocker arm and valve, turn the adjusting screw with the help of screwdriver to make the feeler could move a little but not smoothly, and then tighten the nut (see Figure 3-21).

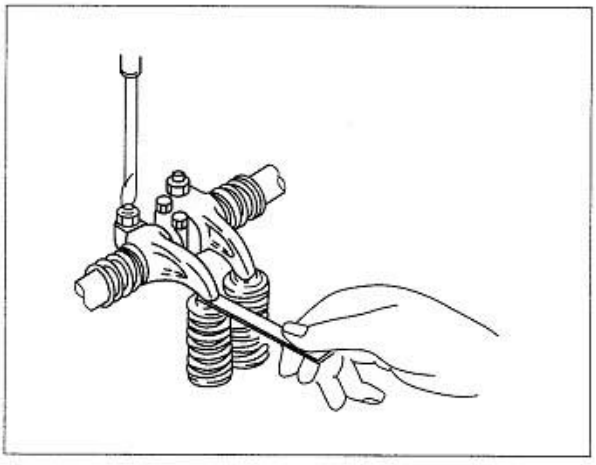

Figure 3-21 Check Valve Clearance with Feeler Gauge

(3) After adjusting 1st, 2nd, 3rd, and 6th valve clearance, turn the crankshaft one cycle to let the piston of No.4 cylinder reach TDC position, adjust the 4th, 5th, 7th and 8th valve clearance with the same way (see Figure 3-22).

3.5.5 Hand-lap the valve and check the valve for Sealing

After the diesel engine has worked for 900 hours, you should check the valve and seat for burnt or worn. If necessary, lap the valve. If the diesel engine

works at heavy load for a long time, or fuel supply system are not well, or air cleaner damaged, or air taken in are very dirty, in these cases, valve sealing will get worse, so you should check valve in short time.

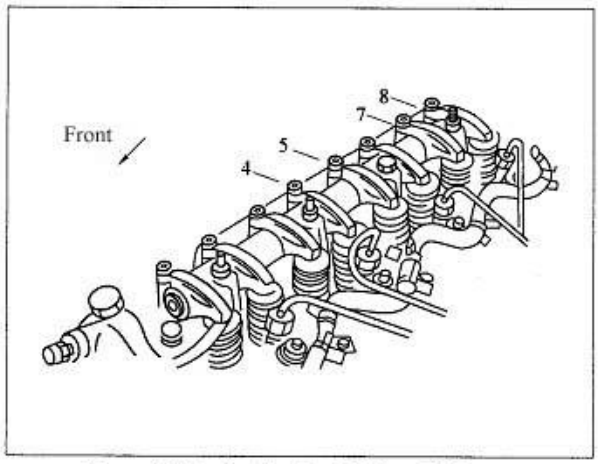

Figure 3-22 Adjust the 4th,5th,7th and 8th Valve Clearance

(1) Hand-lap valve

If the valve and seat have light worn, you may retrieve them by hand-lap the valve as follow:

First, clean the carbon on the valve and seat and guide. Then, put lap cream on the valve face. Polish it by lapping and rotating and every rotating angle is smaller than 90°. Do that until there is a ring (the width is 1.5~2mm) on valve face. If the ring is too wide, it is difficult to seal. If the ring is too thin, it is difficult to cool that will damage valve for high temperature. Please choose right lap cream according to the condition of burnt and worn. It often laps begin with grit and fine paste often use in final.

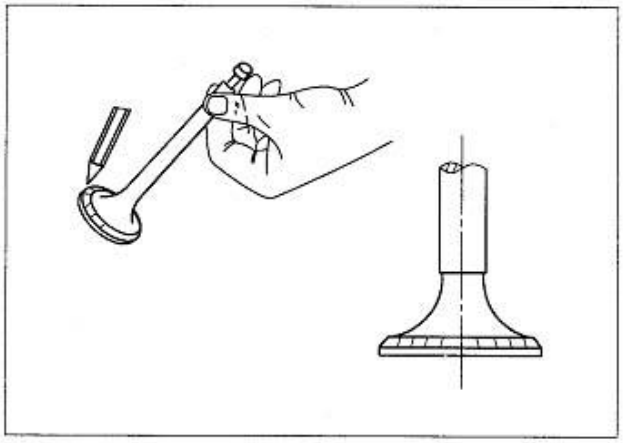

Figure 3-23 Check Valve for Sealing

After lap the valve, clean the valve face and seat and guide hole completely. Finally, check sealing capability of valve.

(2) Check Sealing capability of valve

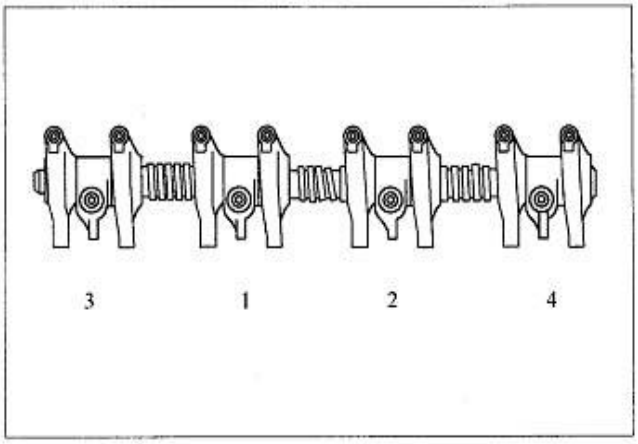

Figure 3-24 Tighten Bolts of Am Rocker Shaft According to the Order

Draw 8-12 lines with pencil on the valve face equality (see Figure 3-23). Reassembly the valve (do not rotate the valve), beat the valve plant, and then check the valve if all of the lines break off on the middle position; it shows valve sealing is well. Finally you may check by filling coal oil in intake and exhaust ports. If there is no leakage in 3~5min, sealing capability of Valve is

well.

3.5.6 Rocker shaft

When reassembling the arm rocker shaft components, tighten bolts of rocker shaft according to the order shown in Figure3-24. Tightening torque is 49-59N·m.

3.5.7 Camshaft

The clearance between camshaft journal and bearing is 0.015-0.085mm. The thrust clearance of camshaft is ensured by thickness difference between thrust washer and thrust flange of camshaft, the thrust clearance of camshaft is 0.05-0.14mm (see Figure 3-25).

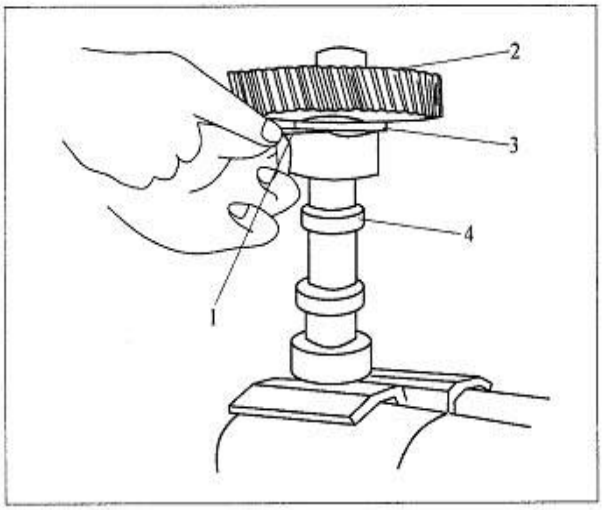

Figure 3-25 Measurement of the Thrust Clearance of Camshaft
1. Feeler gauge; 2. Camshaft gear; 3.Thrust washer; 4.CAmshaft

3.5.8 Gear case

There are 5 gears mounted in the gear case: crankshaft gear, camshaft gear, injection pump gear, upper idling and lower idling gears. There are coupling marks on each gear such as “X”, “Y”, “Z”, “V”(see Figure 3-26). When assembling you must adjust the marks for ensure correct air and fuel supply. Lower idling gear is driven by camshaft gear set mark as “X’ on both lower idling gear and crankshaft gears, camshaft gear and upper idling gear are driven by lower idling gear set marks as “Y” and “Z”, and injection pump gear is driven by upper idling gear set mark as “V”.

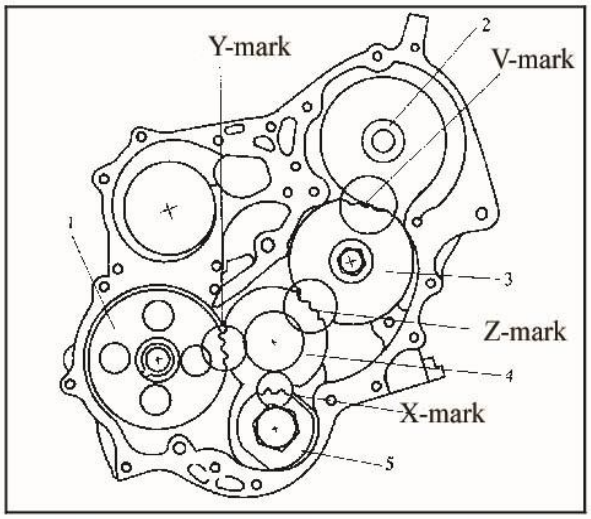

Figure 3-26 gear transmission and marks on gear
1.Gear of camshaft; 2.Gear of fuel pump;
3. Upper idling gear; 4. Lower idling gear;
5. Crankshaft

- **Note :** (1) Must check the signs of the gear without any error when assembling. Otherwise, diesel

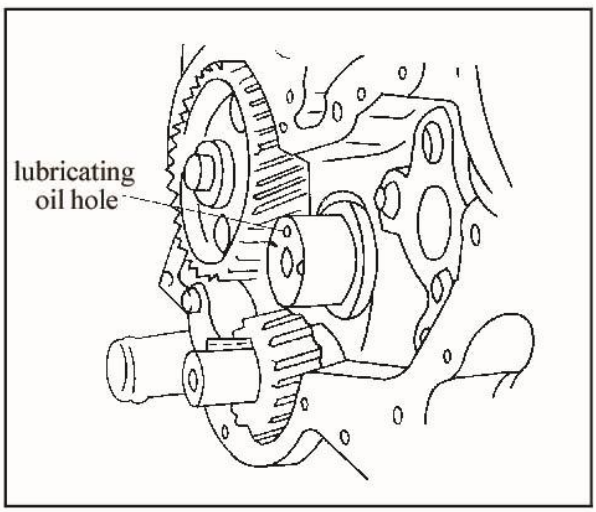

Figure 3-27 Lower idling gear assemble

engine cannot be started, or its power will decrease and oil consumption increase; moreover, the parts of valve mechanism will be damaged. If the sign of gear is not clear or gear is worn, change the gear mechanism according to its condition.

(2) Set lubricating oil hole on lower idling gear shaft upwards when reassembling (see Figure 3-27).

3.6 Lubricating system

3.6.1 Construction

See Figure (3-28, 3-29).

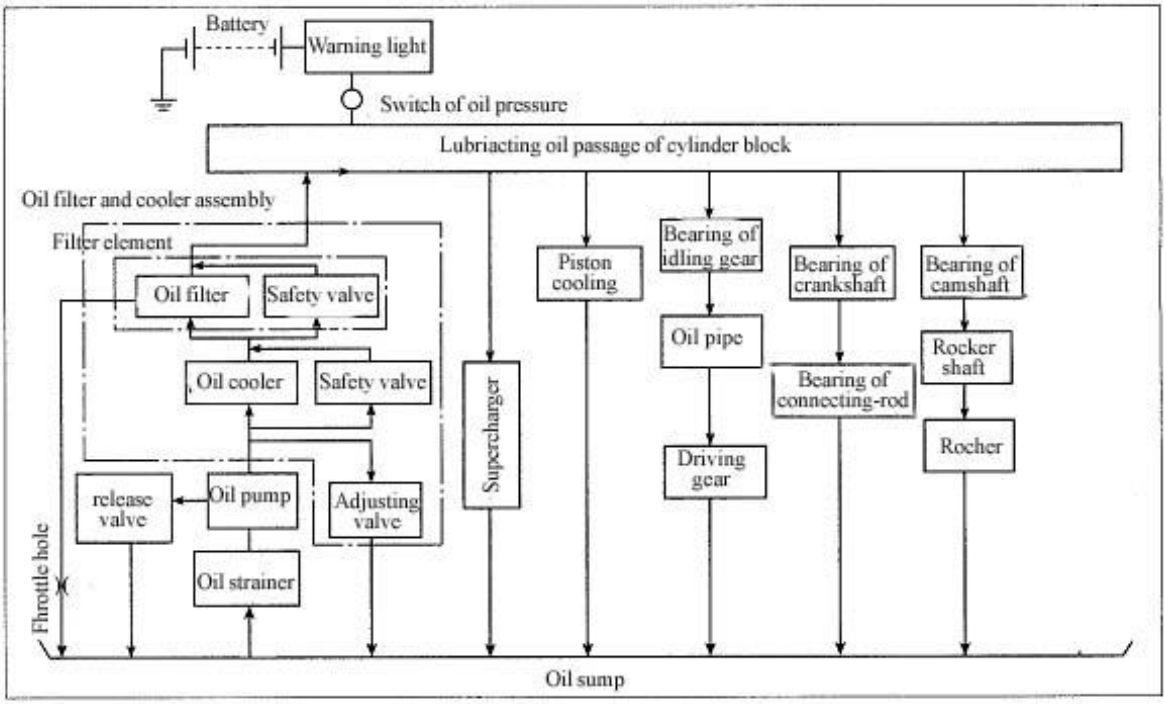

Figure 3-28 Lubricating System of the Diessl Engine

3.6.2 Oil filter

Oil filter cartridge will be replaced when engine running in accomplished. And then oil filter cartridge and oil is replaced every 200 hours (see Figure4-30).

The open pressure of relief valve on filter seat is 0.55±0.02MPa. This is properly adjusted before delivery. Please do not readjust. When reassembling the oil filter, Please put the sealing ring correctly, otherwise may cause oil leakage.

- **Note**: check the contact surface of oil filter and oil filter seat for oil leaking, check parts for damage.
- **Note**: take technical maintenance at the direction of maintenance manual. Parts will be worn and oil pipe will be jam by impurity in oil.

3.6.3 Oil pump

The technical regulations for oil pump installation:

(1) After the oil pump is assembled, it should rotate freely and smoothly without any objection.

(2) There must be no leakage between the oil pump body and the cover.

(3) Opening pressure of safety valve: 0.62~0.78MPa.

(4) Opening pressure can be adjusted by increasing or reducing adjustable gasket in the safety valve.

(5) Tightening torque of four bolts for oil pump cover is 20±5N.m

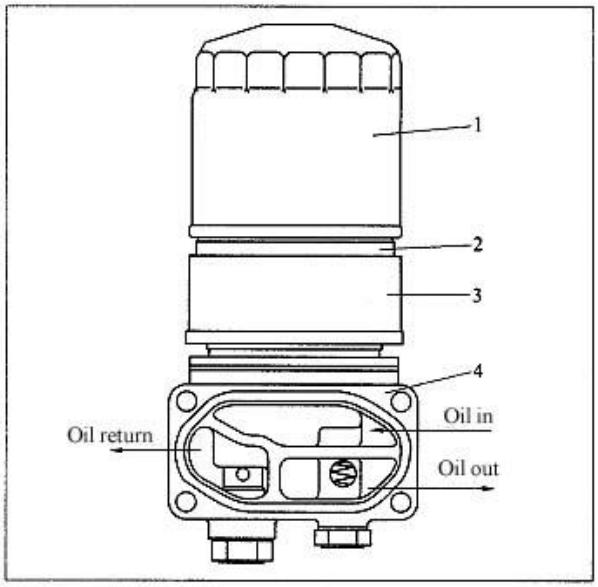

Figure 3-30 Oil Filter
1. Oil filter element; 2. Sealing ring; 3. Oil cooler
4. Oil filter seat unit

- **Note**: If oil pressure is low, pressure indicator will warm. It means trouble occurred in lubricating system and diesel engine needs checking and maintenance.

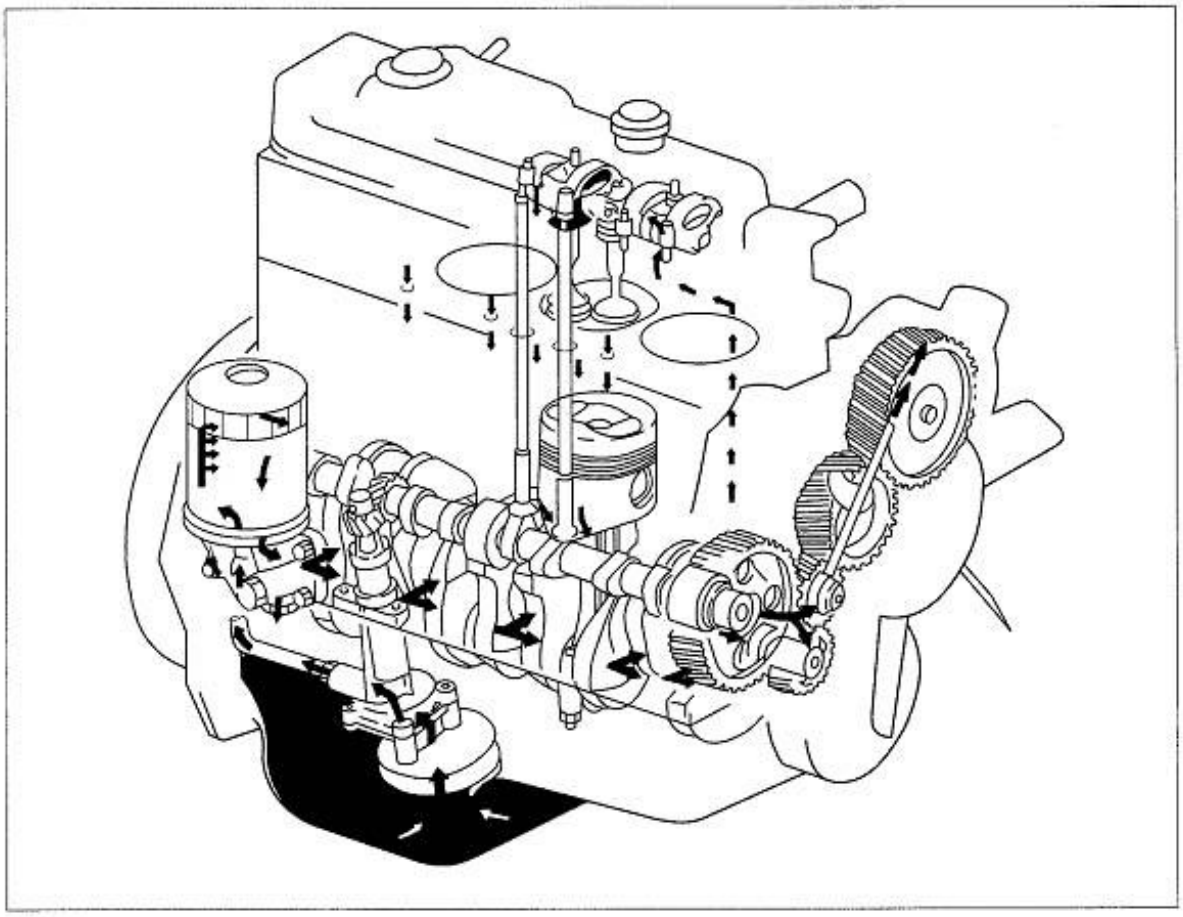

Figure 3-29 Oil Line of the Lubricating System

3.6.4 Oil pan

The function of oil pan is sealing up crankshaft case, collecting and storing oil.

After the oil pan is installed, start the diesel engine for some time, at hot condition check oil pan for oil leakage. If there is leakage, you should tighten the bolts of oil pan or replace the gasket if necessary (see Figure3-31).

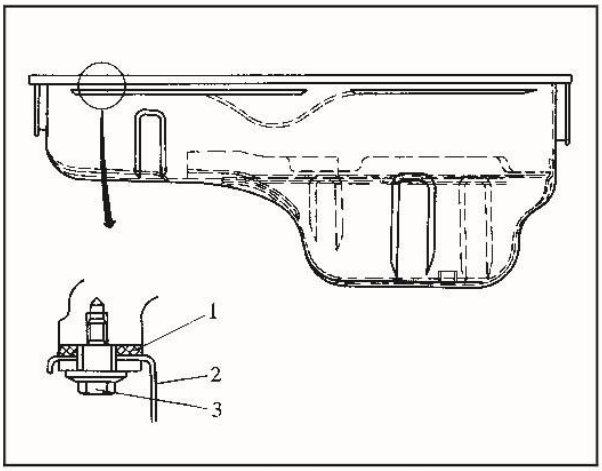

Figure 3-31 Oil pan unit
1. Sealing ring; 2. Oil pan; 3. Tightening bolt

3.6.5 Oil dipstick

Oil dipstick is a tool to check oil level of lubricating system (see Figure3-32).

There are higher and lower holes for checking oil level on the dipstick.

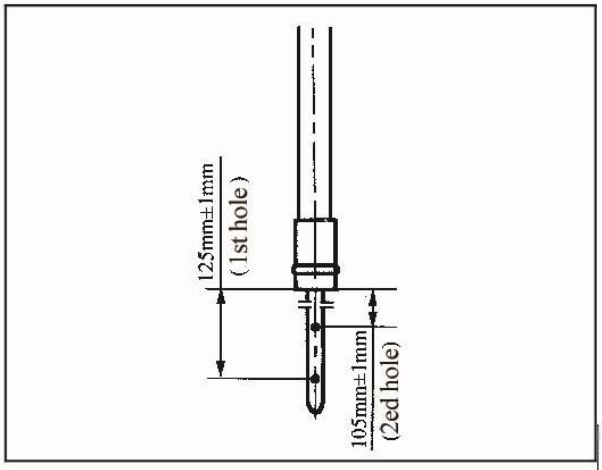

Figure 3-32 Oil dipstick

3.7 Cooling system

3.7.1Construction and operation of cooling system (see Figure3-33).

3.7.2 Water pump

Do not run the water pump when there is no water in water jacket to avoid water seal damaged because of heating. There is water spill hole in the bottom of pump housing. If water seal is damaged, coolant will overflow through spill hole. Do not block the hole avoiding water leaking into pump bearing and causing bearing damaged (see Figure3-34).

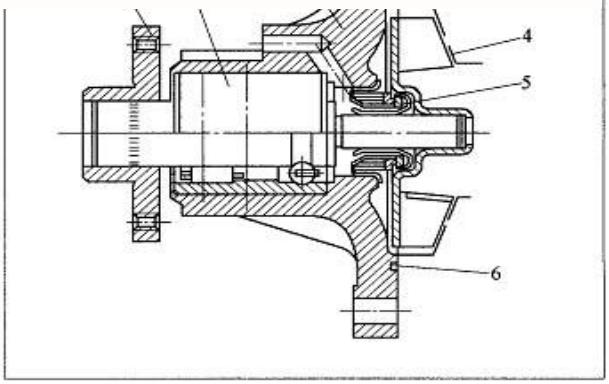

Figure 3-34 Structure of Water Pump
1. Fan pulley flange 2. Water pump shaft with bearing; 3. Pump housing; 4Water pump impeller; 5. Water sealing unit; 6. "O" -sealing ring

3.7.3 Thermostat

The initial opening temperature of the thermostat is: 8±2℃.

The full opening temperature is 95℃, full opening lift is no less than 8mm.

Thermostat inspection:

Immerse the thermostat in container with water, and heat the water gradually.

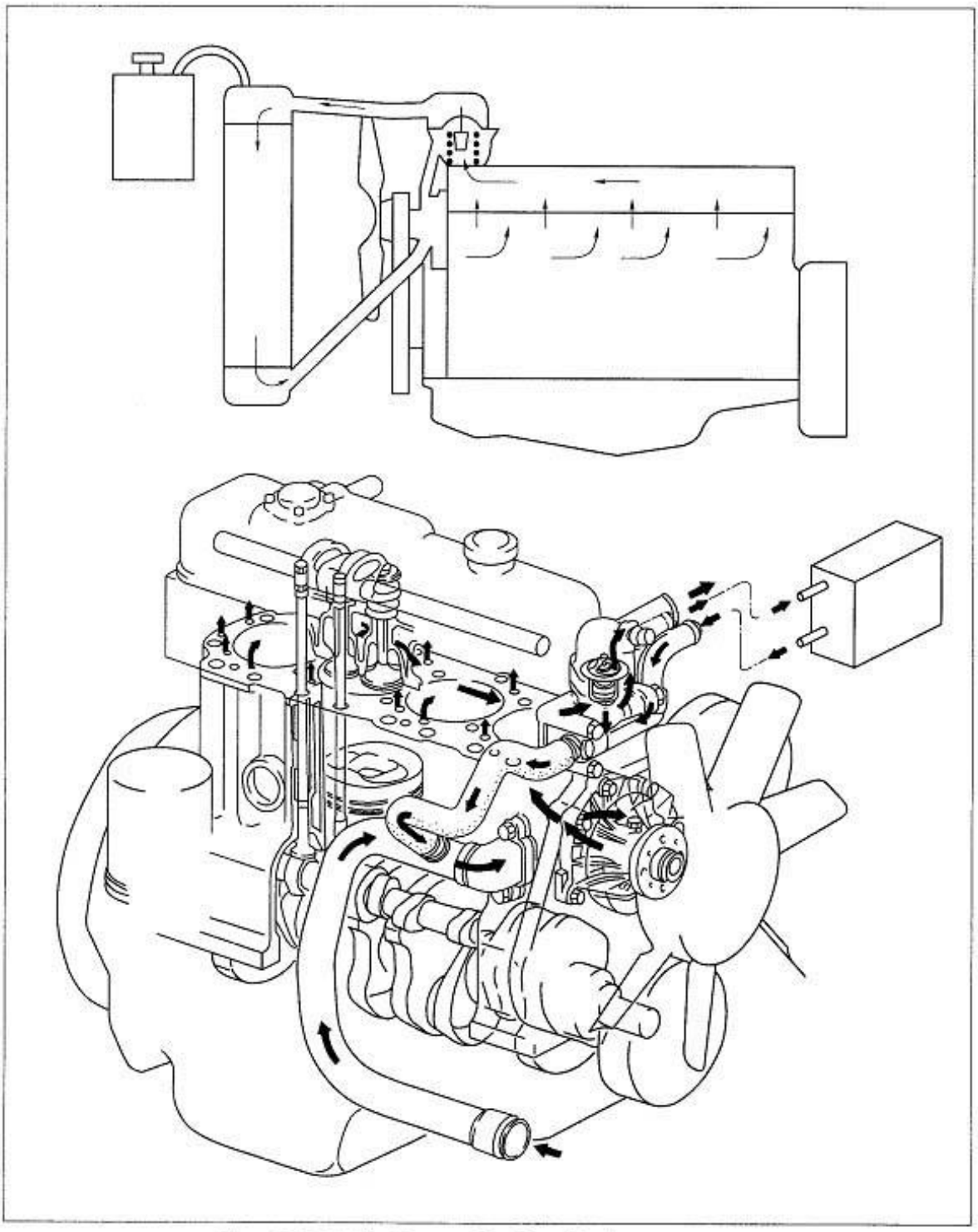

Figure 3-33 Cooling System of the Diesel Engine

Check the valve opening temperature by thermometer and valve lift (see Figure 3-35). If the valve opening temperature and valve lift are not within above specification, replace the thermostat.

3.7.4 Fan drive belt

The deflection of fan drive belt must be propriety. If the belt is too loosing, there will be slippage relatively between belt and the pulley, in this case, cooling

effect will not enough, coolant temperature will raise, and belt will worn in short time. If the belt is too tension, the bearing of water pump and belt will worn or damaged in short time. In this case, power consumption will increase too.

When installing the belt, you may first put belt into groove of generator pulley and water pump pulley, and then put it into groove of crankshaft pulley. Pry alternator with a crowbar making the belt tensioned, and then tighten the bolt.

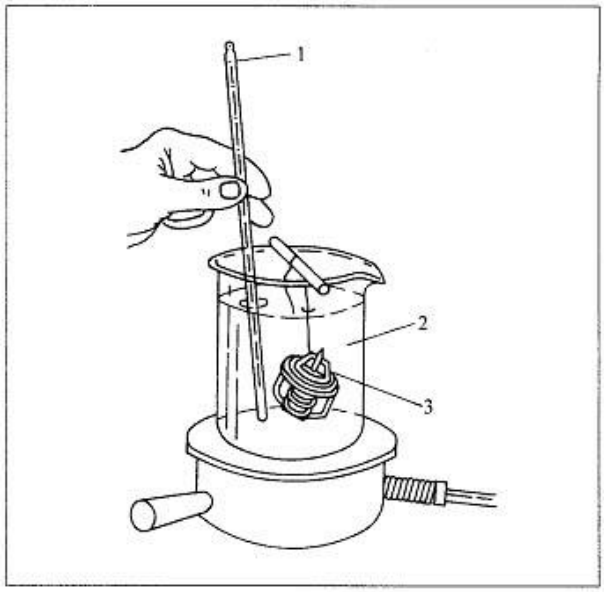

Figure 3-35 Check Thermostat
1. thermometer; 2. hot water; 3. Thermostat

Check the drive belt deflection: press the belt with the force of 68.6-98N, check belt deflection: New belt: 5~7mm; Used belt: 7~8mm.

- **Note**: must stop engine before check, adjust or change fan belt.

3.8 Fuel supply system

3.8.1 The structure of PL in-line fuel supply system (Figure 3-36)

3.8.2 PL in-line fuel injection pump

- **Note**: please take technical maintenance to fuel filter and replace fuel filter at the direction of maintenance manual.
- **Note**: take maintenance according to manual. Check oil in fuel pump timely with oil level stick. (Oil level stick is at the back of the fuel pump.)

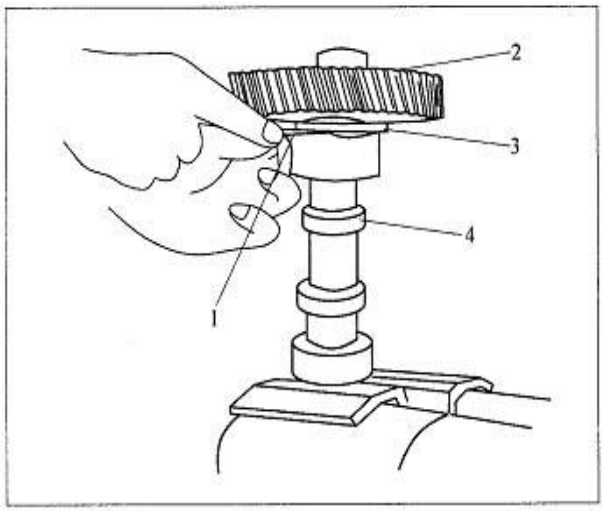

Figure 3-25 Measurement of the Thrust Clearance of Camshaft
1. Feeler gauge; 2. Camshaft gear; 3.Thrust washer; 4.CAmshaft

3.8.3 Injector

Injector is multidirectional injector. Injection open pressure is 18.6~19.6MPa.

Trouble in injector will cause diesel engine unstable operation and black smoke. In order to find the faulty injector, you should set the throttle at the most

obvious position where diesel engine is unstable. Then, loose the connecting nut of each high-pressure fuel line of pump one by one to cut off fuel-delivery to corresponding cylinder. If the speed of diesel engine dose not change obviously and smoke is less when cutting off fuel-delivery to one cylinder, it means that trouble occurred in this injector, remove it for repairing or replacement.

3.8.4 Inspection for injection spray

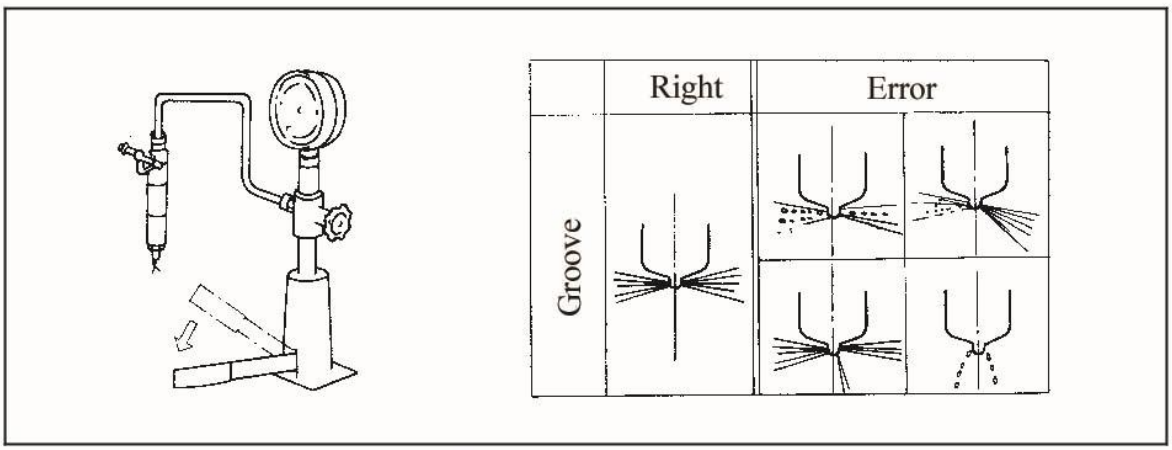

Figure 3-37 Check the injection spray of the injector

Set the injector on the test device, check the injection spray of the injector (see Figure 3-37). If there is bad atomization or fuel faggot injection or leakage or injecting sound dumb, you should clean and adjust the injector, and replace it if necessary.

The normal injection spray of an injector is: injecting fuel is small grain with injecting prick angle of 4°~12°; injecting with “peng, peng”, fuel cut completely, no fuel drop and leaking after injecting , permit wetness at end of injector.

3.8.5 Inspection and adjustment for injection timing

If the diesel engine could work normally and reliably is related to correct adjustment of injection timing. Although there is only little change of injection timing, the fuel consumption may increase and power will decrease obviously. Therefore, you must adjust injection timing carefully.

Adjust the injection timing as follow:

The best injection timing is adjusted by manufacturer, the injection timing of 4JB1 series diesel generator group is 12CA°

If the injection timing is needed to adjust, please do as follow:

(1) Check the injection timing

Loosen screw cap of high-pressure pipe of No.1 piston on pump, and then turn crankshaft clockwise until there is no fuel overflow from plunger of No.1 piston of pump. Now, the timing mark of pulley is correspond to the timing

mark of gear case cover, the value is fuel supply advance angle (see Figure3-38).

(2) Adjust the injection timing

If the fuel supply advance angle does not accord with fixed value, it should adjust the injection timing as follow:

- Loose 3 nuts of fuel pump flange
- Adjust fuel supply advance angle:

  Adjust to delay, rotate injection pump to the direction of diesel engine.

  Adjust to advance, rotate injection pump to opposite direction of diesel engine.

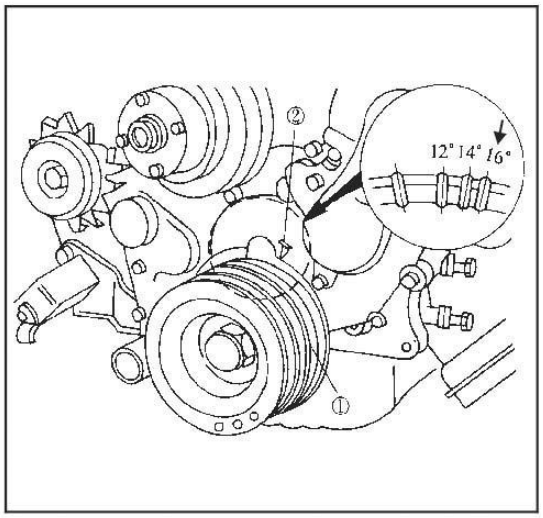

Figure 3-38 Check injection timing
1. the timing mark of pulley; 2. the timing mark of gear case cover

CHARPTER 4 TROUBLE AND TROUBLE SHOOTING

After the diesel engine has run for long time, some parts of diesel engine will wear or be damaged, which will cause its technical condition get worse. When the technical specifications are not in the limited range, it indicates the diesel engine is in trouble. The failures should be resolved in time when it appeared. If diesel engine works with malfunction, not only the power and economic capability will decrease, but also operation performance will change, even the accessories will wear quickly and diesel engine will be damaged.

For some failures, such as air existing in oil system, clog of filter, loose of belt and so on that can be resolved after maintenance or adjustment. But for other failures, such as piston ring is further worn, cylinder gasket is damaged and so on, which cannot be resolved by maintenance or adjust because of the limitation of diesel engine. The operator has to disassemble diesel engine or change accessories to resolve these failures.

- **Note**:

  (1) Usually failure is caused by inappropriate operation or missing maintenance. The operator should check if the engine is operated according to regulated operation and maintenance when failure happening.

  (2) Resolve failure in time. Firstly, check out the reason of the failure. Then go to service station if need disassemble.

  (3) For complicated failures, the technician should perform the process with professional instrument and equipment. If the clients are not qualified to adjust or maintain the engine, they should go to service station.

  (4) It is not allowed for diesel engine to work with "sickness". Engine working with "sickness" will not only damage the parts and decrease the life span of engine, but also cause accident.

The following failures and methods of eliminating are just for reference.

4.1 Diesel Engine Is Difficult to Start

Trouble shooting	Cause	Remedy the trouble
Electric system fault	Circuit connect fault or link not well	Check electric circle linkage and reconnect it if necessary
	Battery voltage is not enough	Charge the battery
	Starter fault	Repair the starter or replace it if necessary

Fuel system fault	There is air in fuel system	Check the fuel pipe link for loosing: Loose the return valve of the fuel injection pump and the air release bolt of the fuel filter, pump the fuel by the fuel-water separator pump until there is not air in the fuel. Then tighten the loosed bolt and the fuel-water separator pump
	Fuel system pipe plugged	Check the fuel pipe
	Fuel filter plugged	Replace the fuel filter
	Fuel pump could not pump fuel or fuel supply not continuous	Check the fuel intake pipe for air leakage; check the strainer of the fuel intake pipe for plug; make the switch on and off, check the fuel supply magnet valve for moving, if the magnet valve don't move, replace it
	Fuel atomization is not in good condition	Check the injector for atomization quality, remove the injector, clean the needle valve and seat, replace the injector if necessary
Chamber pressure is low	Piston ring worn or damaged	Replace the piston ring, replace the cylinder liner if necessary
	Valve leakage	Check the valve clearance, check the valve sealing performance, repair or lap the valve if necessary

4.2 Diesel Engine Does Not Work in Full Power

Trouble shooting	Cause	Remedy the trouble
Fuel system fault: power or speed dose not get higher when open the throttle largely	There is air in the fuel pipe	Drain off the air in fuel pipe as above method
	Fuel filter or fuel pipe is plugged	Replace the fuel filter or clean fuel pipe
	Fuel supply or fuel inject pump is not enough	Check the fuel injection pump, repair or replace it if necessary
	Fuel atomization is not in good condition	Check the injector
	Fuel inject pressure is low	Adjust the pressure with adjusting gasket
	Injector is damaged	Replace the injector
	Fuel injection advance angle changed	Check and adjust the fuel injection advance angle
Intake and exhaust system fault: exhaust temperature is high and exhaust gas is unusual	Air filter is plugged	Clean the filter with high pressure air, replace it if necessary
	Exhaust pipe is plugged or exhaust resistance is high	Clean the carbon in the exhaust pipe; replace the exhaust pipe with big enough section, the max. number of elbow is 3
Diesel engine	Cooling liquid	Check the cooling system, clear scale,

overheating	temperature is too high	check and adjust the deflection of the belt; check the thermostat and replace it if necessary
	Oil temperature is too high	Check the oil level, fill oil if it is not enough
	Exhaust gas temperature is too high	Check and adjust the fuel injection advance, check the injecting pressure and atomization of injector
Cylinder head unit fault: in this case, not only the power is low, but also there are air leakage, black smoke, and unusual noise	Cylinder head bolt is loosing or gasket is damaged	Tighten the cylinder head bolt with the specification or replace the gasket
	Intake and exhaust valve leakage	Check the intake and exhaust valve, lap the seal face of the valve and seat
	Valve clearance is not correct	Adjust the valve clearance with the specification
	Injector hole leakage or copper washer damaged	Disassembly the injector, repair or replace the damaged parts if necessary
Crank and connecting-rod fault	Copper bearing of connector little end clutched with piston pin	Disassembly oil pump, check if connector big end could move axial, if could not move, disassembly piston connecting-rod unit to check and repair

4.3 Diesel Engine Running with Abnormal Noise

- **Note**: If there are unusual sounds when diesel engine running, do not let diesel engine run with unusual sounds.

Trouble shooting and case	Remedy the trouble
Injecting time is very early or injector blocked, there is metal bit sound in cylinder	Adjust the inject timing (see Part3.8.5), check the injector (see Part 3.8.4)
Injecting time is very late, there is a bit sound, and for the same time there are whiff dense smoke exhaust gas	Adjust the inject timing (see Part 3.8.5), check the injector (see Part 3.8.4)
The clearance between connecting-rod little end hole and piston pin, there is little and shill sound when diesel engine running, this sound could be heard easy at idling, and get bigger when accelerating	Replace the connecting-rod little end copper bearing, make the clearance within the range of specification
The clearance between piston and cylinder liner is very big, bit sound could be heard at outer side of cylinder, and get bigger when accelerating	Replace the piston, replace the cylinder liner if necessary
The clearance between bearing and crankshaft, bit sound could be heard at crank	Check the bearing, replace it if necessary making the clearance within the range of the

case, and big bit sound could be heard at reducing speed suddenly	specification
Valve touch the piston when diesel(continue) (continue)engine running, big bit sound rhythm could be heard at cylinder head	Find the case, check the valve timing, adjust the clearance of valve (see Part 3.5.4)
Transit gear worn, clearance between gears get bigger, there is unusual sound from gear case, and bit sound could be heard when reduce speed suddenly	Check the gear clearance, replace the gear if necessary
The clearance between valve and rocker arm is very big, so bigger sound with rhythm could be heard at cylinder head	Re-adjust the clearance of valve (see Part 3.5.4)

4.4 Diesel Engine Exhaust Unusual Gas

Trouble shooting	Case	Remedy the trouble
Exhaust gas with black smoke	Diesel engine work with over load	Reduce the load of diesel engine
	Fuel supply to different cylinder is not same	Adjust the fuel pump, make fuel supply to every cylinder equally
	Valve stem clearance is not correct, so that valve could not seal, exhaust valve leakage	Adjust the valve stem clearance, check seal surface of valve(see Part 3.5.4)
	Fuel supply is too late, some fuel burn in exhaust manifold	Adjust fuel supply advance(see Part 3.8.5)
	Air intake not sufficient, air cleaner blocked or intake manifold blocked	Clear air cleaner, replace it if necessary
	Cylinder liner or piston ring worn	Replace the cylinder liner or piston ring
Exhaust gas with white smoke	Water existing in cylinder or diesel oil	Resolve
	Cylinder temperature is low at the beginning of start and oil not burn in some cylinders	2) Increase speed or load appropriately for certain time
Exhaust gas with blue smoke	Piston ring is locked, over wear or deficient flexibility; the piston cutting angle is reverse which cause engine oil enter combustion chamber	Check piston ring or replace if necessary

	Running with low load for long time, the clearance between piston and cylinder jacket is too big, which cause engine oil enter the combustion chamber	Increase load appropriately, check or repair
	Too much engine oil in oil pan	Supply engine oil according to oil dipstick hole signs

4.5 Diesel Engine Oil Over-consumption or Lower Oil Pressure

Trouble shooting	Cause	Remedy the trouble
High oil consumption	Oil not comply with the regulation	Replace oil
	Sealing gasket and oil seal out of work or leak	Replace sealing gasket and oil seal
	Worn of piston ring and groove	Replace piston ring or piston
	Worn of valve guide tube seal, valve guide tube or valve lever	Replace oil seal, valve or valve guide tube
	Worn of cylinder	Repair or replace cylinder jacket
	PCV valve leakage	Wash or replace the PCV valve
Low engine oil pressure	Engine oil not comply with the regulation	Replace engine oil
	Safety valve is locked	Replace safety valve
	Engine oil pump filter is clogged	Clean or replace filter
	Worn of driving gear and driven gear of oil pump	Replace oil pump
	Oil tube is cracked or coupling is loose	Check or replace
	Failure of oil pump	Replace oil pump assembly
	Over worn of main bearing and connecting-rod bearing	Replace main bearing or connecting-rod bearing
	Oil pressure gauge is	Repair or replace

	damaged	
Engine oil cannot reach to valve system	The oil hole on the cylinder block and cylinder head is clogged	Clean or repair
	Oil hole on rocker arm shaft is clogged	Clean or repair
	Oil hole on rocker arm bracket seat is clogged	Clean or repair
	Oil hole on rocker arm is clogged	Clean or repair

- **Note**: If there is not oil pressure in the lubrication system or oil pressure is very low, diesel engine could not work continuously. In these cases, you should first stop the diesel engine to check what happened.

4.6 Diesel Engine Cooling System with Unusual Temperature

Trouble shooting	Case	Remedy the trouble
Overheat of diesel engine	(1) Cooling fluid level is too low	(1) Supply cooling liquid, check if there is leakage, repair if necessary
	Fan belt is loose or ruptured	Adjust or replace fan belt
	Thermostat main valve cannot be opened	Replace thermostat assembly
	Failure of water pump	Replace water pump assembly
	Incorrect oil supply timing	Adjust oil supply timing
	Radiator core is clogged	Clean the radiator
Overcool of diesel engine	(1) Thermostat valve cannot be closed entirely	(1) Replace thermostat
	Water temperature instrument out of work	Gauge coolant temperature or replace water temperature instrument
Lack of water	Radiator leakage	Repair or replace the radiator
	Radiator hose coupling is loose or the hose is damaged	Tighten the coupling or replace the hose
	Water pump leakage	Replace water pump assembly
	Heater hose coupling is loose or the hose is damaged	Tighten or replace hose

- **Note** :

(1) When the diesel engine is overheat, do not stop it suddenly or supply cooling fluid immediately. The operator should keep engine run with no load for a while; after coolant temperature decrease, stop engine and check.

(2) When the diesel engine is still hot, do not touch the water inlet cover. Adding cooling fluid, the operator should be careful.

(3) If the clients cannot find the reason of overheat, they should go the professional service station immediately, otherwise, other accessories will be damaged.

4.7 Starter Can Not Run, Starts Powerless and Noise

Trouble shooting	Cause	Remedy the trouble
Starter not working	Start switch or other control circuits break	Check to make sure circuit is tight
	Bad contact of carbon brush and commutator	Adjust carbon brush spring pressure and clean commutator
	Inside circuit of starter is broken or short out	Check starter
Starter cannot drive the engine	Deficient battery capability	Charge the battery
	Bad wire connection	Tighten the wire connection
	Burning loss of commutator surface	Grinding the commutator surface or clean the stain
	Over wear of carbon brush cause bad connection with commutator	Replace carbon brush or adjust spring pressure of carbon brush
	Main contact of solenoid switch burning loss or bad contact	Use “0” nonmetal sand paper grind
	Serious worn of bearing	Replace bearing
After diesel engine start, starter still working and make noise	The copper plate stick with two contacts	Cut off power immediately, check circuit and adjust electric contact
	Starter armature axle is bent or broken	Cut off power immediately and replace starter
	Gear is locked	Cut off power immediately and adjust gear surface

4.8 Alternator Runs without Output, Charging Not Engine

Trouble shooting	Cause	Remedy the trouble
Not working	Incorrect connection, broken connection or bad connection	Check the circuit
	Rotor coil is broken	Repair or replace generator assembly
	Commute diode is damaged	Change commute diode
	Bad contact of carbon brush	Clean or replace carbon brush
	Regulator is damaged	Repair or replace regulator
Deficient charge	Pulley is loose	Adjust pulley
	Bad contact of carbon brush or stain on the ring	Adjust and clean
	Regulator is damaged	Replace regulator
	Lack of electrolyte or serious sulfidation of pole plate	Supply electrolyte to regulated level or replace battery

4.9 Battery Capacity Is Not Enough, Starts Difficultly, Self-discharges Excessively

Trouble shooting	Cause	Remedy the trouble
Electrolyte is not enough and engine is difficult to start	Electrolyte level is too low	Supply distilled water or dilute sulfuric acid with density of 1:1
	Pole plate short	Clean out the deposit or replace electrolyte
	Sulfidation of pole plate	Repeat charging and discharging the battery to clean the sulfidation
	Bad contact of circuit coupling, too much oxide on terminal and deficient charge	Tighten the contact and clean the oxide
Excessive battery discharged	Impurity existing in electrolyte	Use regulated electrolyte
	Battery wire is short	Check circuit and resolve
	Electrolyte overflowing from battery cause anode and cathode is short	Use alkali water or warm water clean the terminal end and keep battery clean

	Metal lever or tool cause anode and cathode are short	Do not place metal lever or tool on the battery
	Coming off much active substance cause the pole plate to be short; damaged clapboard cause pole plate to be short ; bended pole cause anode and cathode to be short circuit	Repair or replace battery