395A
DIESEL ENGINE

OPERATION MANUAL

NEW HOLLAND

Operation Manual For Model

395A Diesel Engine

FORWARD

The Model 395A Diesel engine adopts spherical combustion chamber dry cylinder liner and is a left set high speed diesel engine. This machine features compact construction, good staring – performance, low fuel consumption, reliable operation and convenient maintenance.

This engine could match and install an air compressor for braking and two hydraulic pumps for steering, lifting or other uses according to requirements of users.

This engine features high standardization and universalization and belongs to the same series – products with Model 495A that has won National Golden Medal and could be developed to various versions which are used as a power unit for tractor, farm car, farm by – product processing, irrigation, small boats, engineering machinery, generating set, etc.

This manual briefly describes the principal technical specifications and data, construction characteristic, adjusting procedures, as well as requirements of operation and maintenance for Model 395A Diesel.

In order to prolong operation life and lower operation cost and make engine having reliable running with good work condition, please read this manual carefully before operator and overhauler use the engine and operate seriously according to specified operation – maintenance procedures.

When using this machine must pay special attention as follows:

a. **Allow a new or overhauled engine to operate under loaded condition after running – in 60 hours.**
b. **Don't seriously allow engine to run without water, or oil, or air filter.**
c. **After starting a cold engine, could not immediately run under high speed or run under idling speed for a long time. When water temperature is higher, could not suddenly stop.**
d. **If the engine isn't operated in winter for a long time, must be drain water inside.**
e. **Fuel and oil must be kept clear at any time and used only after filtering and fuel must be used after depositing for two days.**

Because of continuous improvement and development of our products the concerned items in this manual could not conform with recent product and we could not inform every user. Please pay attention and excuse.

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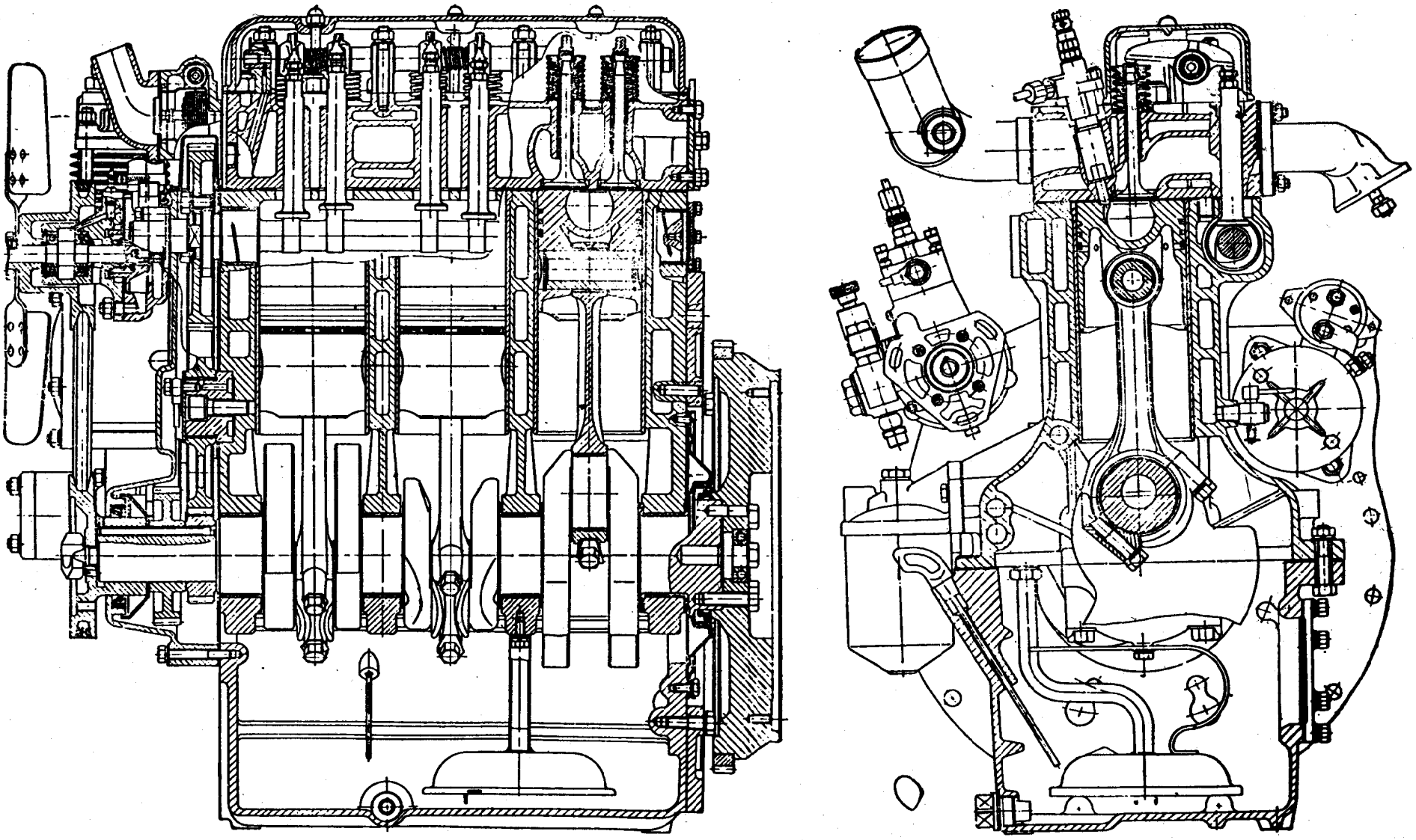
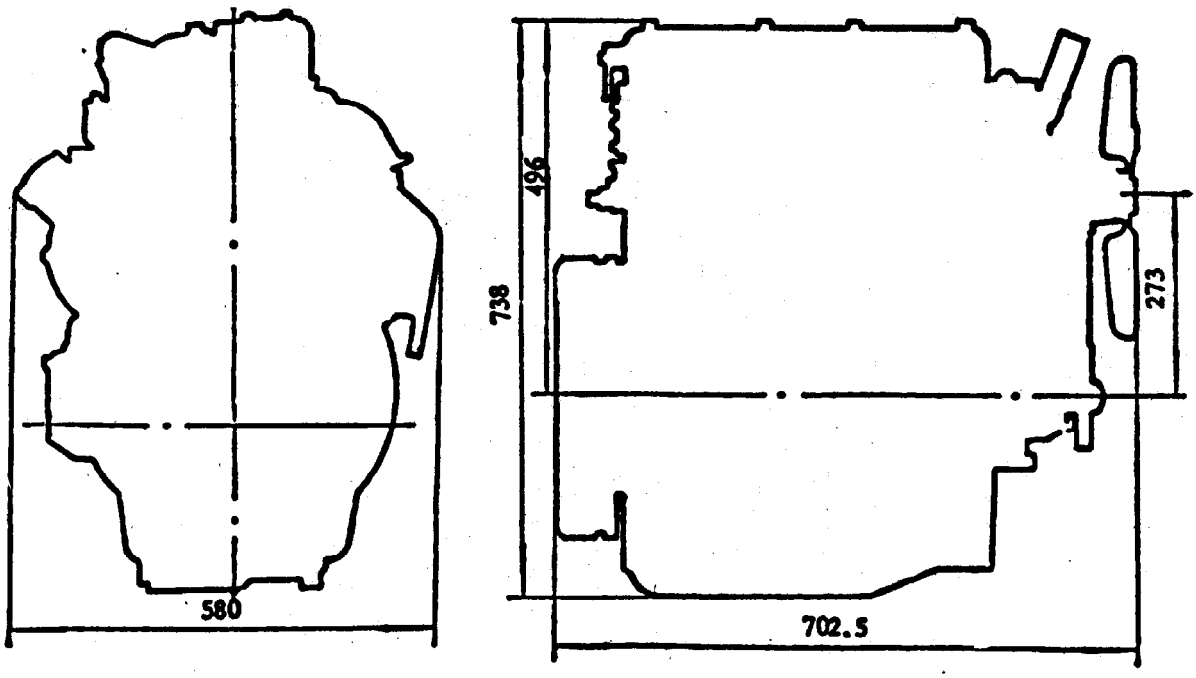
Comprehensive Table of Contents

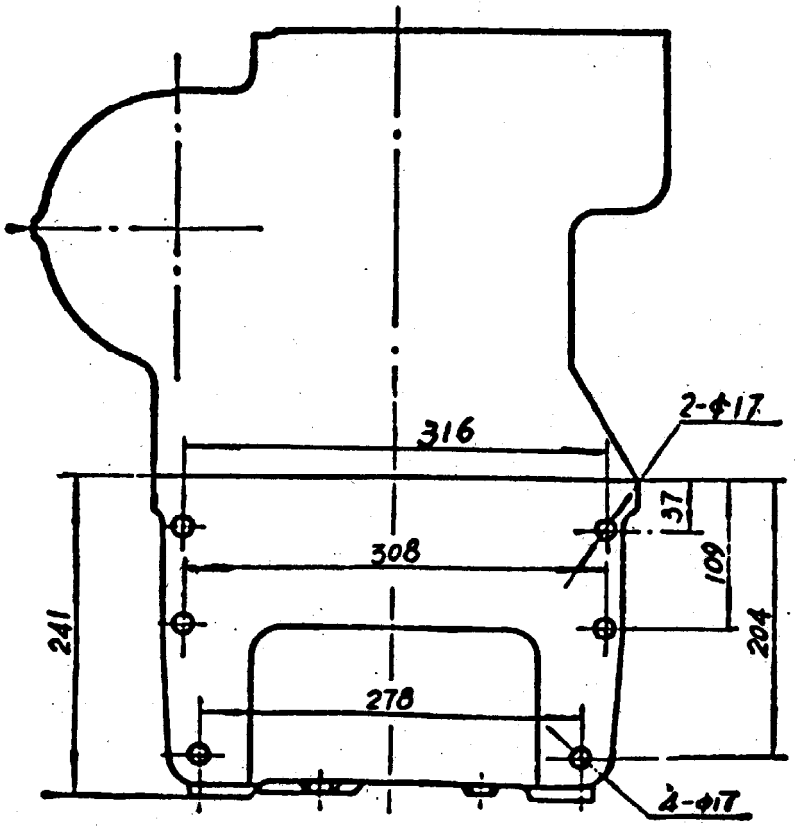


· I · Longitudinal and cross sectiondrawings of diesel engine

Ⅱ. Overall and mounting dimensions of model 395A diesel engine

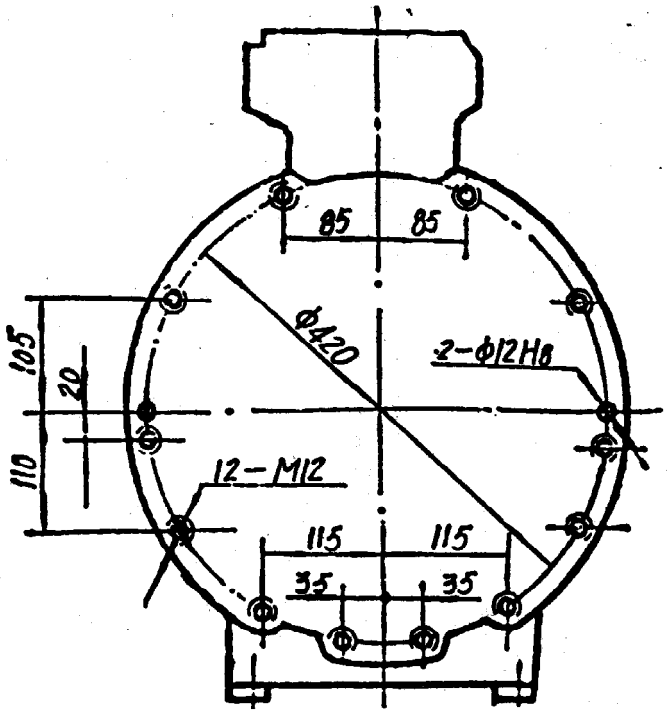


Ⅱ－1. Overall dimensions of diesel engine

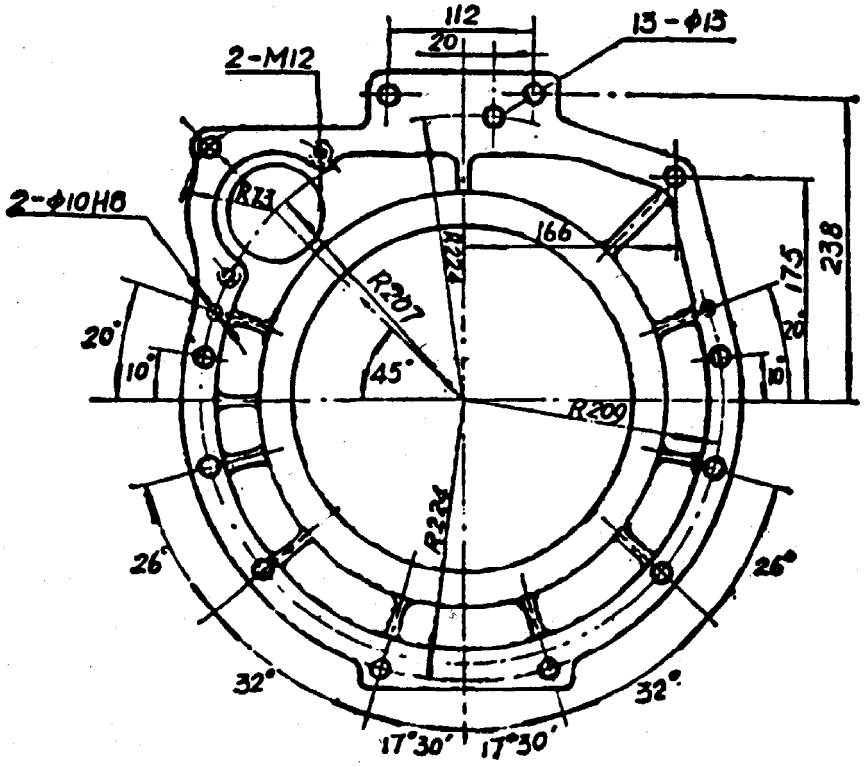


Ⅱ－2. The connecting size of engine frout end

The rear end surface
(connect with flywheel casing)

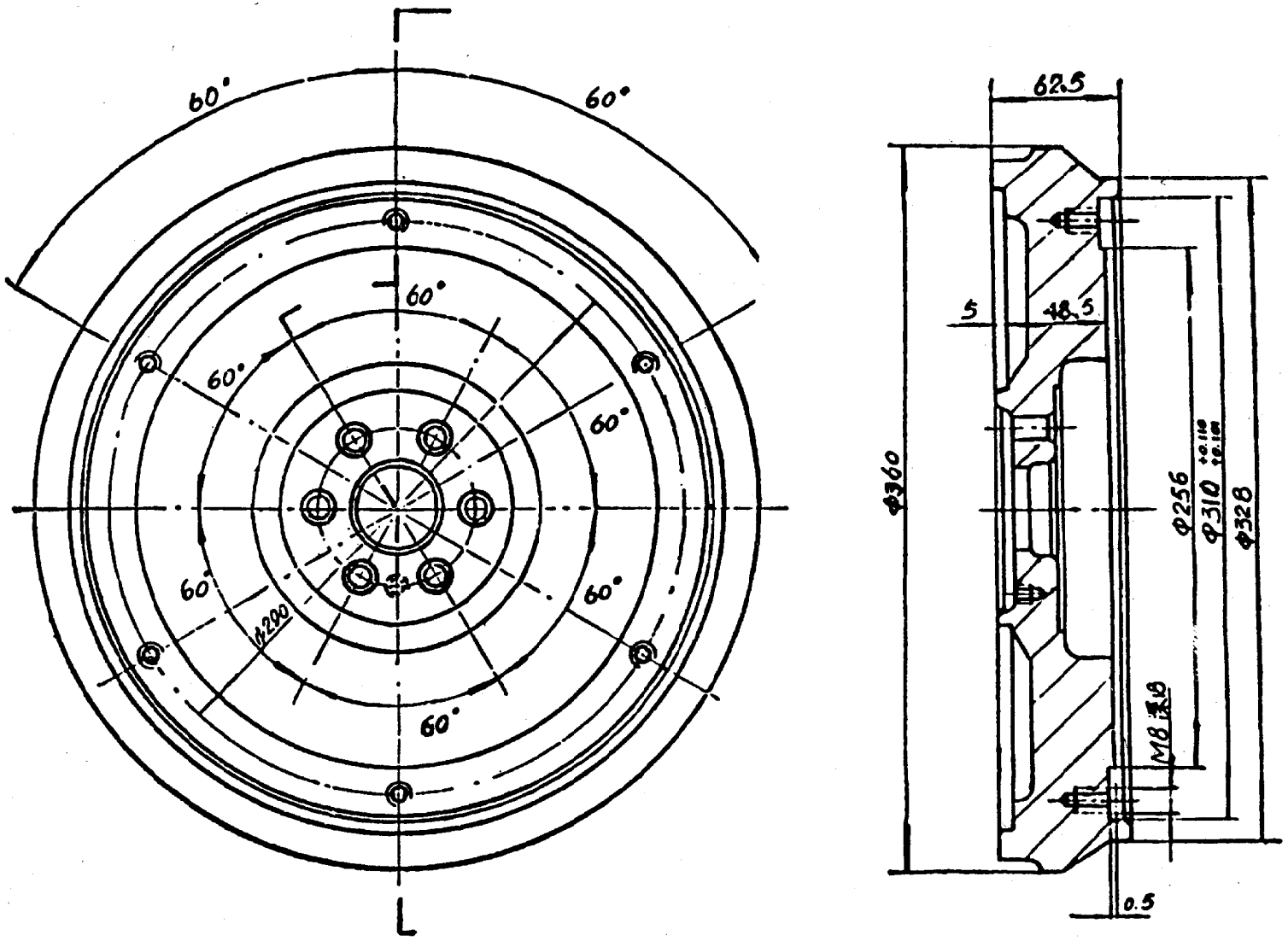


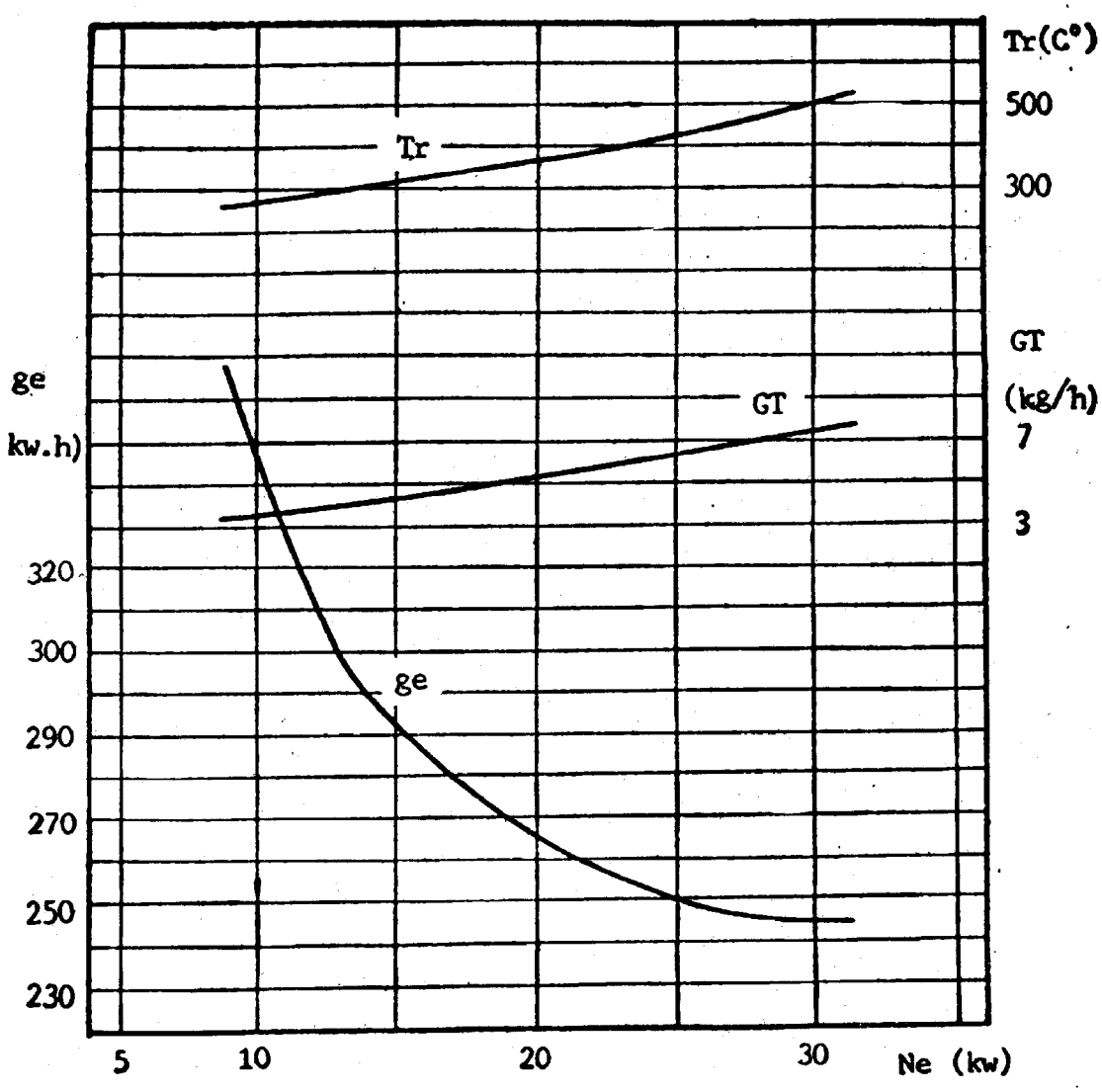
The rear end surface
(connect with connecting plate)



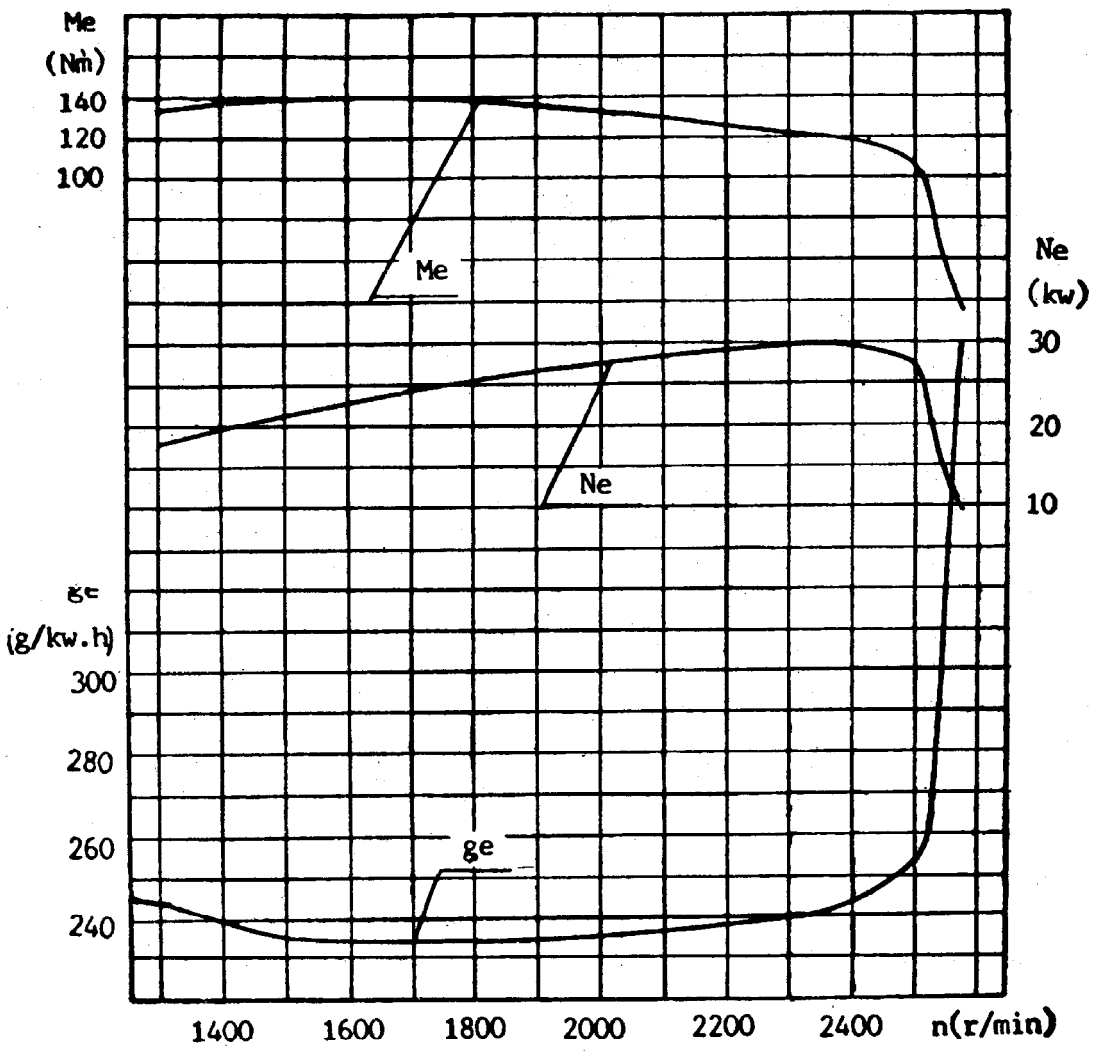
II－3. The connecting size of engine rear surface

Ⅱ－4. The flywheel connecting size





·Ⅲ· Load characteristic curve of diesel engine



· Ⅳ · 12hr power rating speed characteristic curve of diesel engine
(after sixty hours runningin)

Chapter I principal Technical Specifications and Technical Data of the Engine

A. Principal Technical Specifications

1. Model: 395A
2. Type: Three－cylinder, vertical, in－line, four－stroke, water coolng, spherical chamber, left set engine.
3. Type of liners: dry
4. Cylinder bore: 95mm
5. Piston stroke: 115mm
6. Piston total displacement: 2.45 l
7. Firing order: 1－3－2
8. 12hr rated power and speed: 29.4kw(40 PS) / 2400 r/min.
9. Idling speed: 600 r/min.
10. Max. torque and speed: ≤134 N.m (13.7kgf.m) / 1600－1700 r/min.
11. At 12 hr rating:
    Specific fuel consumption: ≤251.6 g/kw h(185 g/ps·h)
    Specific lubricating oil consumption: ≤2.04 g/kw h(1.5 g/ps·h)
    Mean piston speed: 9.2 m/s
    Mean effective pressure: 600 kpa(6.12 kgf/cm^2)
    Steady speed regulation: ≤8%
    Fluctuation of rated speed: ≤1.5%
12. Rotating direction of crankshaft: counter clockwise (facing the power output end)
13. Type of cooling: forced water cooling
14. Type of lubrication: force－feed splash type
15. Type of starting: by starting motor
16. Overall dimensions: (L×W×H) 702.5×580×738
17. Net weight: ≤ 320kg

B. Specifications of Main Accessories

1. Injection Pump
    Type: three－cylinder No. I plunger pump (for left set engine)
    Specification of plunger: diameter ϕ 7mm (right handed)
2. Governor: steel－ball, all－speed centrifugal type
3. Fuel supply pump
    Type: single acting piston
    Fuel pressure: 98－196 kpa (1－2 kgf/cm^2)
    Output: 750 cm^3/min (750 r/min)

4. Fuel injector

Type: long - neck closed single hole

Injection pressure: 17.64.Mpa (180 kgf/cm^2)

5. Fuel filter

Type: two - stage composite, paper cartridge

Model of cartridge: C 0708 (fine)

6. Oil filter

Type: paper filter cartridge full - flow pressure

Model: J 0810

7. Lubricating oil pump

Type: inner and outer rotor

Specifications of rotor: $\phi 50 \times 30$mm

Oil output: 23 l/min, Rotating speed: 1650r/min

Oil temperature: 85℃, Oil pressure: 390 kpa

8. Water pump

Type: flat - plate cast iron impeller centrifugal pump

Output $\geqslant$75 l/min, Speed: 3000~3100 r/min.

9 Thermostat

Model: Feng - Shou 35

Type: corrugated pipe single valve

Open temperature: 70℃ ±2℃, begins to open, 83℃ ±3℃, fully open

10. Electrothermic plug

Type: resistance coil heating, free - flow oil supply

Voltage: 12V, Power: 200w (operating time: no longer than 40 seconds)

11. Starting motor

Model: 2Q2C

Type: series excited d.c. starting motor

Voltage: 12V

Power: 1.84 kw (2.5 PS)

12. Dynamo

Model: JFZ1317Y

Type: entirety, alternating current

Operating valtage: 14v

Rated power: 350w

Mode of earthing: negative pole

13. Battery

Type: lead - plate(thin)

Voltage / current: 12V / 470A

Capacity: 100 Ah

14. Hydraulic gear pump

Model of output: spline shaft

Type: CBN－E308 (left) / CBN－E314 (right)

Rated speed: 2000 r/min

Output: 8 ml/r / 14ml/r

Rated pressure: 16 MPa (160kgf/cm^2)

15. Radiator

Model: 235 A

Type: air cooled, flat－tube core, closed type cover.

Total heat dissipating area: 6.2m^2

Capacity: 5.5 l

C. Principal Technical Data of the Engine

1. Temperature ranges at 12 hr rated power:

Temperature of cooling water at outlet: ≤98℃

Exhaust temperature in the main pipe: ≤550℃

Temperature of lubricating oil in oil sump: ≤100℃

2. Pressure range in the main oil passage:

At 12 hr rating: 294－490 kpa (3－5 kgf/cm^2)

At idling speed: ≥49 kpa (0.5 kgf/cm^2)

3. Tightening torque for principal bolts and nuts

Cylinder head nuts: 176－196 N.m (18－20 kgf. m)

Main bearing bolt: 157－176 N.m(16－18 kgf. m)

Connecting－rod bolt: 98－118 N.m (10－12 kgf. m)

Flywheel bolt: 98－118 N.m (10－12 kgf. m)

Injector nut: 58－78 N. m (6－8 kgf. m)

4. Principal adjusting data

(1) Valve timing: according to angle of rotation of crankshaft

Inlet valve opens: 8°±3° in advance of T. D. C.

Inlet valve closes: 48°±3° behind B. D. C.

Exhaust valve opens: 48°±3° in advance of B. D. C.

Exhaust valve closes: 8°±2° behind T. D. C.

(2) Clearance of valves: (cold engine)

Inlet valve: 0.25～0.30 mm

Exhaust valve: 0.30～0.35 mm

(3) Theoretical valve lift: 11.4 mm

(4) Fuel supply advance angle: 28°±2° in advance of T. D. C

5. Filling capacity for principal containers:

Coolant capacity of radiator: 5.5 l

Oil capacity of sump: 7.5 l

Oil capacity in injection pump－governor: 0.4 l

Chapter Ⅱ principal Components and Maintenance of Diesel Engine

1. Cylinder Head Assembly and Air Distribution Machanism

Mounted on cylinder head, there are inlet and exhaust valves, inner and outer valve springs, rocker armshaft brackets, rocker arms, rocker armshafts and other parts.

The thermostat of cooling system is installed in the front cover of cylinder head and a M18 × 1.5thread connector of water temperature thermometer is mounted on the front cover. On cylinder head, the heating water pipe connector is installed on the other side facing the water thermometer connector. The connecting thread is M22 × 1.5 (if not installed, this end should be blocked.)

At the front end of the cylinder head there is an oil hole linking up oil circuit from the cylinder block via first rocker armshaft bracket to the rocker armshaft. A cooling water jacket is cast inside the cylinder head. The cylinder head is fastened to the cylinder block by 14nuts, and a cylinder head gasket is fitted for sealing. These nuts should be evenly tightened 2～3 times according to the sequence shown on Fig 2－1, until they reach the specified torque limit.

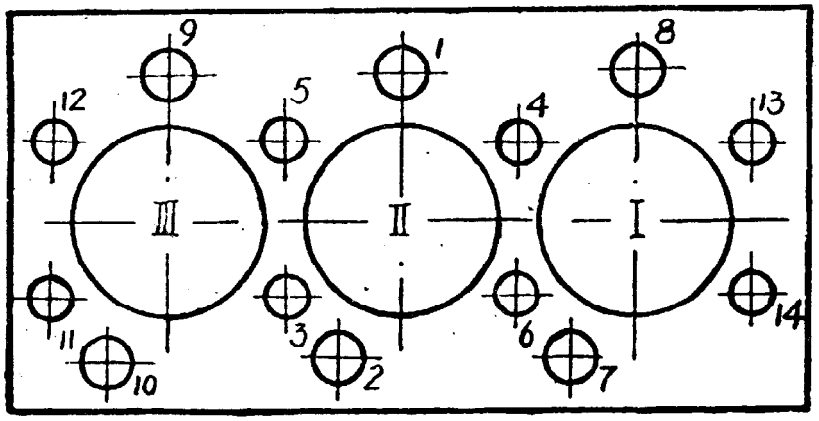


Fig 2－1 Tightening sequence of the cylirder head nuts

2. Cylinder Block and Oil Sump

On the front part of the cylinder block, lubricating oil pump, transmission gears, water pump, hydraulic pumps, tachometer transmitter, air compressor, fan and other parts are installed.

On the right side of the cylinder block the plunger pump, fuel filter and lubricating oil filter are mounted.

On the left side of the cylinder block the starting motor, dynamo and drain cock are fitted.

On the rear part of the cylinder block the rear oil seal and connecting－plate are mounted.

The main bearing has four steps. The notches on both the main bearing seat and the main bearing cap are milled for setting bearing shells. When the bearing cap is assembled the said notches should be set on the same side.

Each set of bearing and cap has matching marks and should not be interchanged and is fixed by bearing sleeves. Beginning from middle step, the bearing bolts on the main bearings should be evenly tightened 2～3 time in a sequence with a torsion spanner, until they reach the specified torque value. (157～196N. m). After knocking main bearing cap with a rubber hammer and reaching the tightenning torque, the bolts are locked up with bearing bolt lock plates.

The upper main bearing shell with oil groove and hole should be assembled in the main bearing seat of the cylinder block. Pay attention to that the quantity covered on oil hole is not allowed to be more than fifth of the hole diameter.

The fixing tongues on the back of upper and lower bearing shells should be inserted in the respective matching notches of the seat and cap. On both sides of the forth step of main bearing, two crankshaft thrust plates are mounted serving as thrust bearing for crankshaft. The axial clearance is 0.11～0.26mm. The earings of the lower thrust plates should be inserted into the notches on both sides of bearing cap. The side of the plate with oil groove on it should face outward.

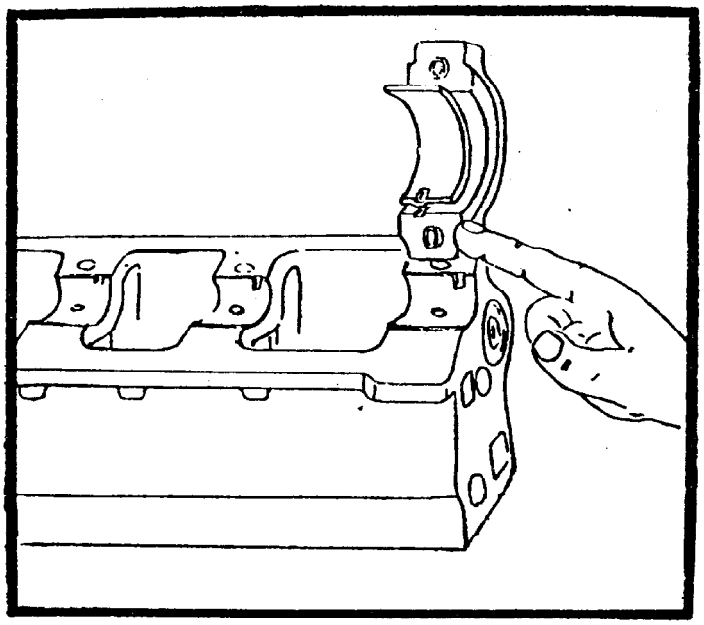


Fig 2－2 Assembling the Bearing Cap

The cylinder liner may be fitted into the hole of the cylinder block by slightly pressing and revolving. Before assembling, clean the cylinder linear and the cylinder bore first and do not apply any lubricating oil, otherwise, it will effect their contact and heat transfer.

The lower flat surface of the cylinder block connects with oil sump, sealed by cylinder body gasket of rubber asbestos, with two fixing sleeves for positioning and fastened by bolts and nuts.

The oil sump is used as a container for lubricating oil. An oil stick with two scaled marks is attached on the right side of the sump. The oil level should be maintained between those two marks. On the lower side of the oil sump an oil drain plug with a magnet in it provided for catching iron scraps from the lubricating oil.

3. Crankshaft Connecting－rod Mechanism

The crankshaft connecting－rod mechanism consists of crankshaft, flywheel, connecting－

rod, piston, etc. The function of this mechanism is to change the reciprocal movement of the piston to the rotational movement of flywheel.

The crankshaft has 4 main journals and 3 connecting－rod journals with inclined oil holes on them to provide the lubricating. The crankshaft must be subjected to dynamic balancing test, and its balance should not exceed 50 gf.·cm

The keys in the front end of the crankshaft are used for transmitting the timing gear, the oil pump driving gear and crankshaft pulley respectively. They are fastened by threaded starting pawl with starting pawl lock piece. The journal for crankshaft pulley is sleeved with a framed rubber oil seal. The oil seal is fitted in the corresponding hole of gear cover. The flywheel is mounted on the rear end of crankshaft by flywheel bolts. The bolts should be evenly tightened by torsion spanner 2－3 times in sequence until reaching the specified torque. The flywheel should be subjected to static balancing and its balance should not exceed 50 gf. cm. The rear end of crankshaft is sleeved with rubber oil seal, installing in the rear oil seal cover. Do not allow to turn the bolts too tight. Stop tightening as soon as the rubber oil seal has a little expansion.

The splitting surface between the large end of connecting－rod and connecting－rod cap makes a 45°with respect to the centre line of the connecting－rod. The splitting surface of the connecting－rod is towards the oil window of oil sump. The Construction of Connecting－rod large end bearing is similar to the main bearing. The weight differences among the large ends and among the small ends of connecting－rod of the same engine should not exceed 5 gf and 10gf respectively. The tightening torque of connecting－rods bolts must reach 98－118 N. m. (10－12kgf. m).

When installing the piston and connecting－rod assembly into the cylinder liner, the guide bush shown in Fig 2－3 must be used by putting it on the top of cylinder liner. The gap of piston combustion chamber must be kept on the same side of engine with fuel injector, that is to say, make the 45° incline surface of connecting－rod large end facing the oil window of oil sump.

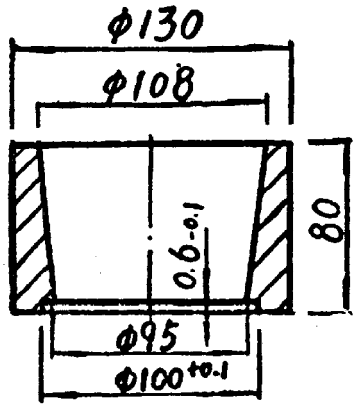


Fig 2－3 Guide Bush

When dismantling the piston and connecting－rod assembly, just unscrew the connecting－rod bolts through the oil window of oil sump, take out the connecting－rod cap and bearing shell, and then the rest parts of the assembly can be pulled out.

On reassembling the mentioned assembly, every component part should be installed at its

orignial location to favour the run－in of the engine.

4. Transmission Mechanism

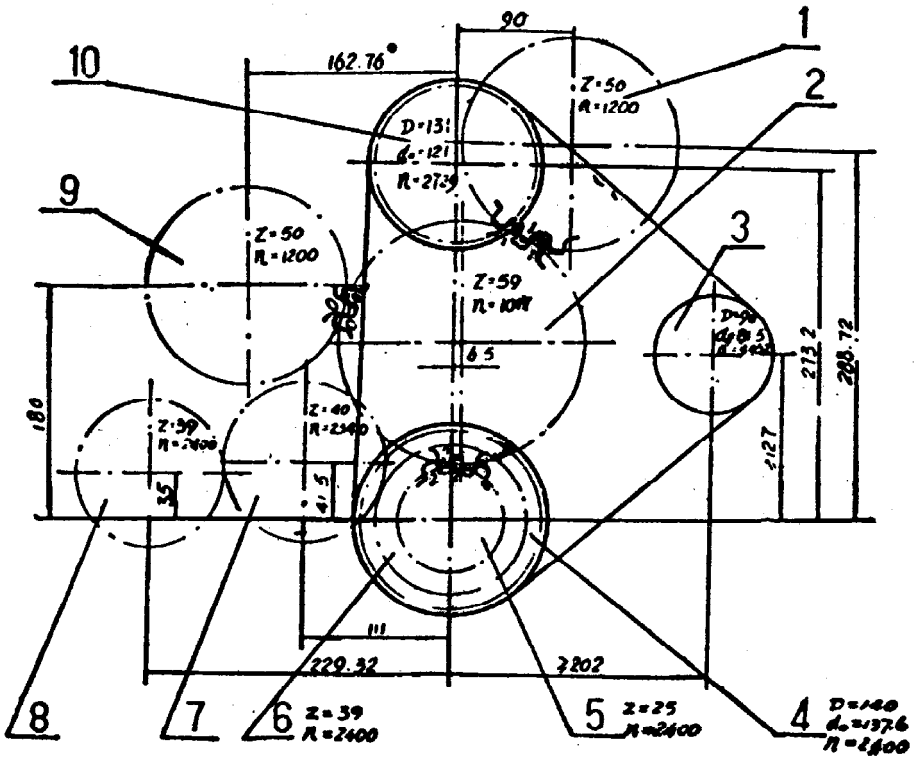
The transmission mechanism is shown in Fig. 2－4. At the front end of the crankshaft, the timing gear, the lubricating oil pump driving gear and crankshaft pulley are mounted. The idle gear driven by the timing gear drives the camshaft gear and the fuel pump gear. The lubricating oil pump drivig gear drives the lubricating oil pump gear and the oil pump gear drives hydraulic pump gear. The crankshaft pulley drives dynamo and water pump pulley through the fan belt. The rear end of the crankshaft with a flywheel is the power output end of the engine. When starting the engine, the gear on the starting motor is engaged with the flywheel gear ring to drive the crankshaft.

The idle gear is loosely mounted on its shaft which is fixed on the cylinder block. The oil outlet must be towards left up 45° direction.

The fuel pump gear is loosely mounted on its shaft which is also fixed on the cylinder block. installing the fuel pump gear shaft, the oil goove with a triangular section on it should face upward so that the splashed lubricating oil can be collected to lubricate the shaft.

The fuel pump gear is connected to the camshaft of plunger pump through the fuel pump gear connection disc and plunger pump connection shaft. The connection shaft is mounted on the taper extending portion of the camshaft of plunger pump with a woodruff key. Two rectangular teeth of the connection shaft should be inserted in the relative groove of the connection disc, and fixed by a pin. The connection disc is fixed on the pump gear by bolts.

Marks are made on the end surfaces of the timing gear , idle gear , camshaft gear and fuel



1. Camshaft gear 2. Idle gear 3. Dynamo pulley 4. Crankshaft pulley 5. Timing gear 6. Lubricating oil pump driving gear 7. Idle gear 8. Hydraulic pump gear 9. Fuel pump gear 10. Water pump pulley

Fig 2－4 Transmission mechanism

pump gear. The relative position of the camshaft and the camshaft gear is marked with arrow signs on their end surfaces. When the piston of the lst cylinder is operating at top – dead centre of the exhaust stroke, the relative position of engaging gears as shown as Fig 2 – 4. Do not allow to turn the crankshaft or camshaft after removing idle gear to avoid damaging the valve, rocker, piston, etc.

The tension of the fan belt can be adjusted by turning the supporting stand of dynamo.

At the right upper front end of the cylinder block is mounted a tachometer transmission which is driven by the camshaft. The square shaft head of the tachometer flexible axle is inserted in a square hole on the front end of driven shaft. The size of square hole is 2.7mm and the joint thread is M18 × 1.5. The rotating direction of square hole is counter – clock wise facing the front end.

5. Fuel supply system

The fuel supply system is mainly composed of fuel tank, precipitation cup, fuel pump, fuel filter, plunger pump, injector, etc. as shown as Fig 2 – 5. Fuel flows from the tank through the precipitation cup to the fuel filter.

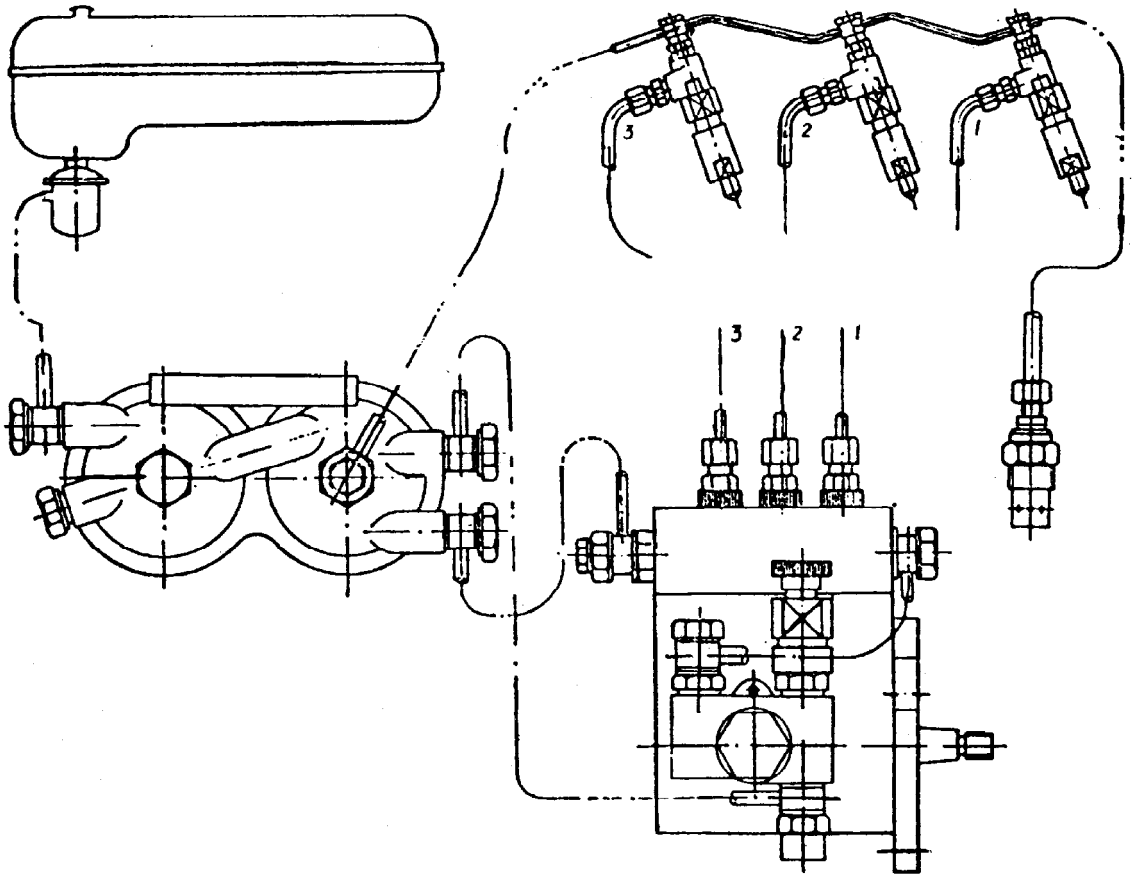


Fig 2 – 5 Fuel flow diagram

After being filtered it is pumped by fuel pump to the plunge pump where the hihg pressure fuel is injected into the combustion chamber by the injector. The low pressure fuel from plunger pump and the fuel leaked from injector needle valve will flow back to the fuel filter respectively. When preheat – starting, the fuel from leak – pipe of injector atomatically enter the air intake pipe through electrothermic plug and then is ignited by electrothermic plug. Air can be preheated to be convinience for starting engine.

The fuel tank is made of thin steel plate. On the fuel tank cover there is filler vent unit opened to the atmosphere to avoid any pressure or negative pressure appearing in the fuel tank. A filler unit is provided, the impurities on the filter screen should be cleaned in time. The site of the fuel tank of diesel engine for tractor is in general higher than the injector.

As the fuel flows through the precipitation cup, the clean fuel on the upper part of the cup will flow out by passing through filter screen, while the water and dirt will gradually deposit on the bottom of the cup. The precipitation cup should be periodically cleaned by pouring the water and dirt out of it.

The single – acting piston – type fuel supply pump is mounted on the lower body of the plunger pump and driven by the middle eccentric cam of plunger pump camshaft. When the eccentric cam pushes the piston, the inlet check valve closes, the outlet check valve will be opened and the fuel in front of the piston will be sent to the back space of the piston. When the piston returns to its original position by the elastic action of the spring, the inlet check valve will be drawn to open. Then the fuel passes through the filter copper screen to the fuel inlet pipe and enters in the front space of the piston. Meanwhile the outlet check valve closes and the fuel in the back space of the piston will be pressed out of the fuel supply pump.

The fuel supply pump is provided with a hand pump. To pump fuel by hand is to fill up the fuel pipe line full with fuel and to dispel air from the pipe line. When the hand pump is not in use, its handle should be turned tightly to prevent any leakage of fuel.

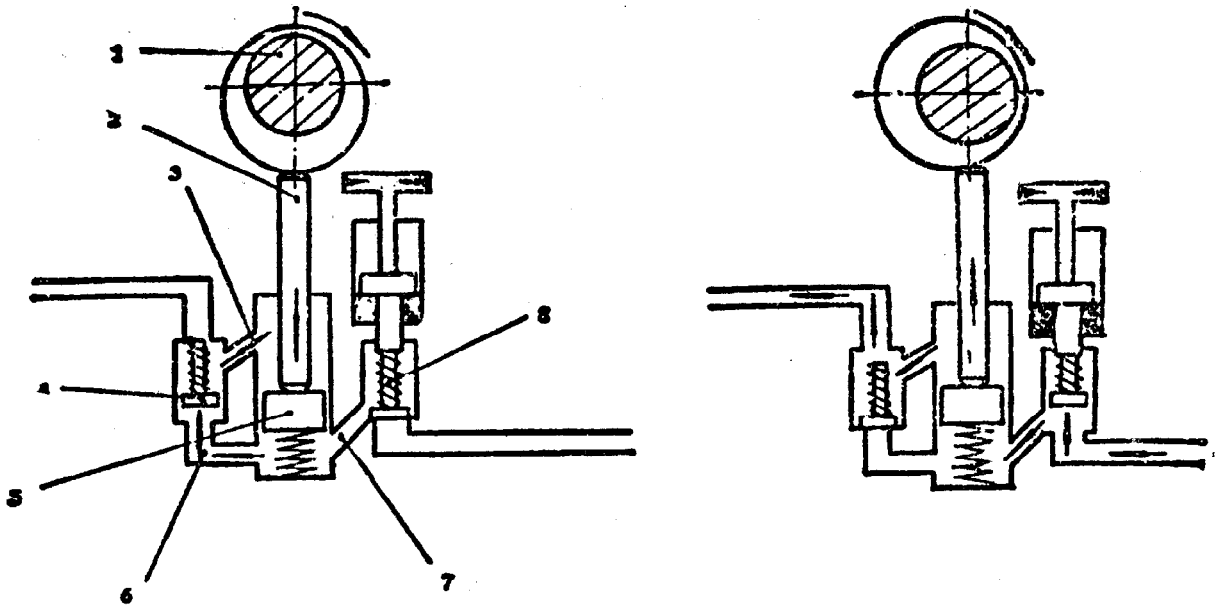
The fuel filter has two paper cartridges in series for separating the mechanical impurities in the fuel to lessen the wear of plunger and plunger barrel and needle valve set of the injector.

If the cartridges are blocked or damaged, clean them in time or replace them with new cartridges.

The cartridge of filter must be cleaned for every 250h. When cleaning, the holes on two ends of cartridge must be blocked with rubber or cork and then brush out surface lightly with soft-brush. When installing cartridge, please pay special attention to seal realibility on the ends. The replaced period is adout 500 – 1000 hrs.

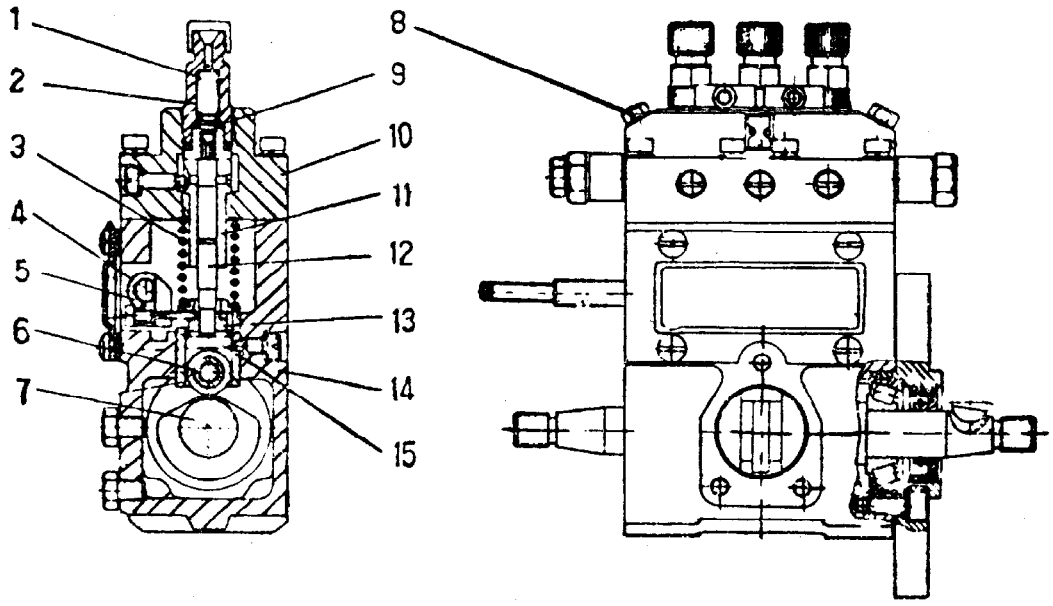
The sealing between the upper and lower pump bodies of plunger pump depends upon the close contact of their plane surfaces. Tappets, camshaft, control rod, etc. are provided in the lower body. The plunger barrel sets, delivery valve sets and delivery valve fastening seat are provided in the upper body.

The operating process of plunger pump is shown as Fig 2 – 8. When the plunger moving downward under the action of spring, the hole on the plunger barrel will open and let the pressure fuel enter in the plunger barrel. As the cam pushes the plunger upward through low tapper, the hole are closed, the fuel in the top part of the plunger barrel will be compressed to high pressure. The high pressure fuel will overcome the pressure of the delivery spring and open the delivery valve. The plunger moves upward continuously to force the high pressure fuel feeding in the injection pipe. When the inclined slot on the plunger comes in connection with the hole on the plunger barrel, the fuel pressure in the top part will drop suddenly. The delivery valve will fall back to its seat by the action of delivery valve spring, then the fuel supply will be cut off.



1. Camshaft 2. Tappet 3. Upper fuel outlet pipe 4. Check valve(outlet) 5. Piston 6. Lower fuel outlet pipe 7. Fuel inlet pipe 8. Check valve(inlet)

Fig 2－6 The operating process of fuel supply pump



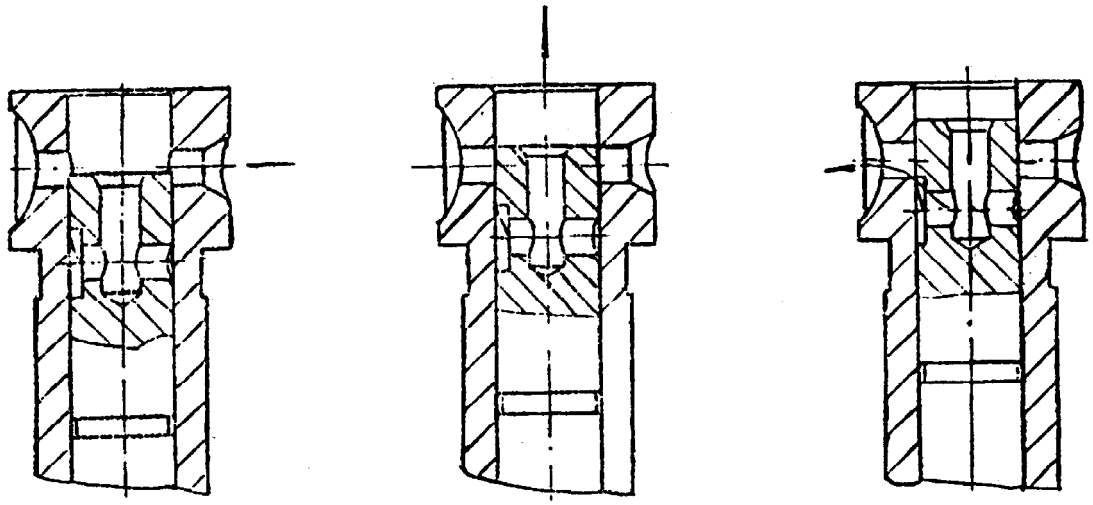
1. Delivery valve spring 2. Delivery valve fastening seat 3. Plunger spring 4. Control rod 5. Shift fork 6. Roller 7. Camshaft 8. Air relief screw 9. Delivery valve 10. Upper pump body 11. Plunger barrel 12. Plunger 13. Adjusting arm sleeve 14. Lower pump body 15. Adjusting blodk

Fig 2－7 The construction of plunger pump

The meshing mark "0" on the fuel pump gear is for ensurance the rough position of supply fuel advanced angle. The accuracy adjusting is carried out by turning plunger pump left or right making relative rotation of camshaft of plunger pump to crankshaft.

The plunger barrel set and delivery valve set are precise sets, so that they could not be interchanged, and must be kept clean during assembling.

The supply output of fuel of plunger pump is changed with the load. It is carried out by turning the plunger. The plunger turning is depend on linking of control rod with shift fork and adjusting arm. The axial moving of control rod is controlled by a governor. The diesel engine will operate steadly under every specified kind of engine speeds positioned by speed governing handle, and the min. and max. speed will be confined. Unscrew fastening screw, adjust relative position of the shift fork and the control rod (i.e changing the relative position of plunger and plunger barrel), so the feed amount of fuel to the cylinder may be changed. For the plunger pump of the right turn screw groove, moving the shift fork towark the shaft stretching end, the fuel supply would increase and the fuel supply would decrease by moving the shift fork toward the end of the governor. The adjustment must be carried out on the plunger pump test bench.

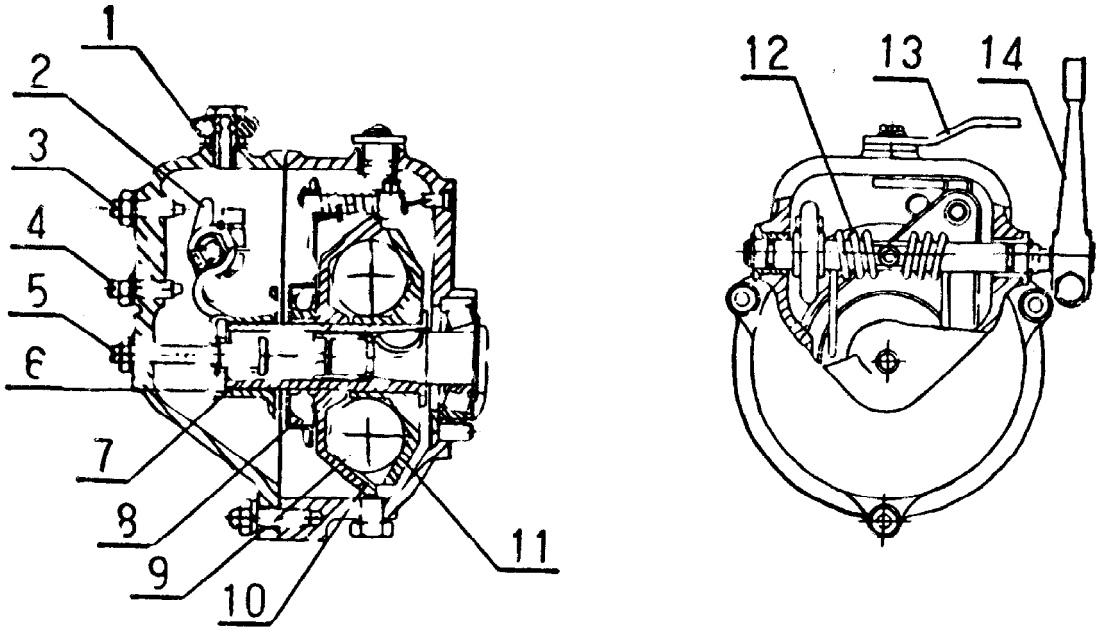


a. sucking b. Beginning of pressing fuel c. End of pressing fuel

Fig 2－8 The operating process of the plunger pump

At the rear end of the plunger pump a steel－ball all speed centrifugal governor is mounted. When the speed governing handle is fixed and diesel engine load is under steady state, the governor will stand in a balancing state. Within the range of function of governing, when the load decrease, the speed of engine will increase, then the centrifugal force of steel ball will increase. In the meantime, the sliding pan via the control rod driving plate will force the control rod to move backward, to decrease the fuel supply in each cycle of the plunger pump and hence the enging speed will drop. Should the load increase, then the control rod will forward, the engine speed can likewise be kept in steady state. Changing the position of speed governing handle can make the diesel engine running in various speed. When the high speed set screw being set against the speed governing set block, the injection pump will supply rated amount of fuel at rated speed. At this time, the correcting spring just touches the sliding sleeve. When the idling speed set screw being set against the speed governing set block, the injection pump will supply specified amount of fuel for idling speed. At starting speed, the starting spring may overcome the centrifugal force of the steel ball and enable the conrtol rod standing in a position, where the ample amount of fuel supply

is obtainable. Change the position of shift fork, the ample amount fuel for starting may be adjusted. When the stop handle is pulled backward, the fuel supply will quickly decrease and lead the engine to stop.



1. Connecting screw 2. Speed governing set block 3. Set screw (high speed) 4. Set screw (idling speed)
5. Correcting screw 6. Sliding sleeve 7. Correcting spring 8. Ball bearing 9. Steel ball 10. Sliding pan
11. Driving pan 12. Speed governing spring 13. Stop handle 14. Speed governing handle

Fig 2 – 9 Governor

The fuel injection pipe connectors on the plunger pump should be connected according to the sequence with the inlet joints of the injector.

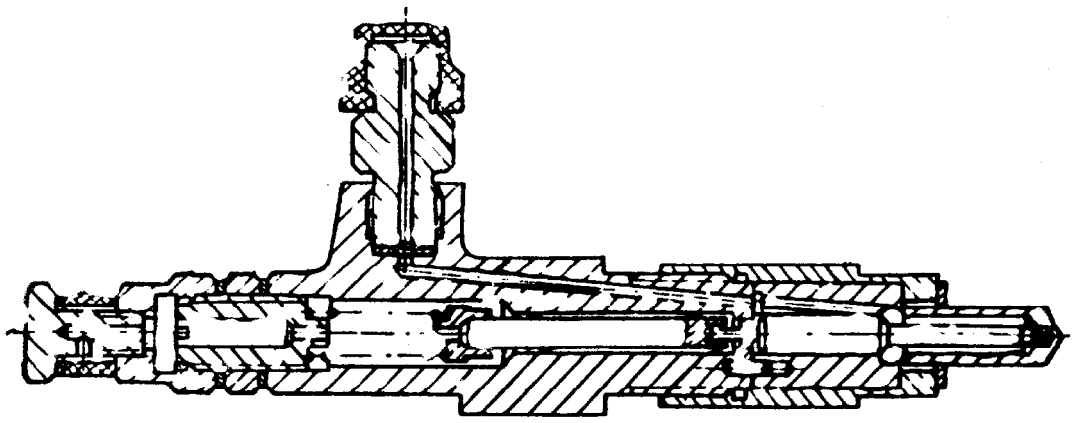


Fig 2 – 10 Injector

Fig 2 – 10 shows the structure of the fuel injector. The high pressure fuel from the plunger pump flows in the ring frame fuel containing groove of the needle valve body, overcomes the elastic force of injector spring, enables the needle valve to open, and inject fuel into the combustion chamber from the nozzle.

The needle valve and needle valve body are selected and ground fit as a set, so that they

should not be interchanged. There are two cylindrical pins to fix the needle valve body and the injector body. The torsion of the fastening nut is 59 – 78N.m (6 – 8kgf.m), when in dismantling it, unscrew the adjusting screw and loosen the injector spring first.

The injecting fuel pressure of the injector should be 17.16M Pa (175kgf/cm^2). The sprayed fuel should be well atomized, and any dripping of fuel is not permitted.

6. Lubricating system

The lubricating system is composed of strainer, lubricating oil pump and lubricating oil filter. The lubricating oil pump sucks oil from the oil sump through the strainer, and feeds lubricating oil to the main oil line through the lubricating oil filter. One path of the lubricating oil lubricates the main bearing and connecting – rod bearing. The lubricating oil leaked out of bearing clearancc is splashed onto the inner wall of cylinder liner. Other path of the oil passing through the first rocker arm shaft bracket and rocker arm shaft lubricates the rocker arm shaft bearings. The lubricating oil leaked out of the small holes on rocker arms lubricates the friction pairs such as rocker arm and valve, rocker arm and tappet, and camshaft. The third path of the oil leading through the idle gear shaft lubricates the gear train by the casting oil of the idle gear.

The inner rotor of rotor type lubricating oil pump has four teeth, while the outer rotor has five teeth. Both rotors are out of concentricity by 3.5mm. If the clearances existing between the rotors, between the outer rotor and pump body and between the oil pump shaft and the bushings are too excessive, the oil output will drop down. In this case, adjustment should be made or new parts should be replaced.

The paper cartridge provided in the lubricating oil filter may be flushed in the gasoline or diesel oil, or wiped by a soft brush. Hardened or broken filter cartridge must be replaced. Generally, a filter cartridge will last for 100 – 200 hours. A pressure in the outlet of lubricating oil too high (exceed 490Kpa), the pressure relief valve will open allowing the lubricating oil to return directly to the oil sump. the opening pressure of the pressure relief valve may be adjusted with the adjusting screw. In the filter head, there is another by – pass valve by which the lubricating oil may directly flow into the main oil line without passing through the filter cartridge in case of block.

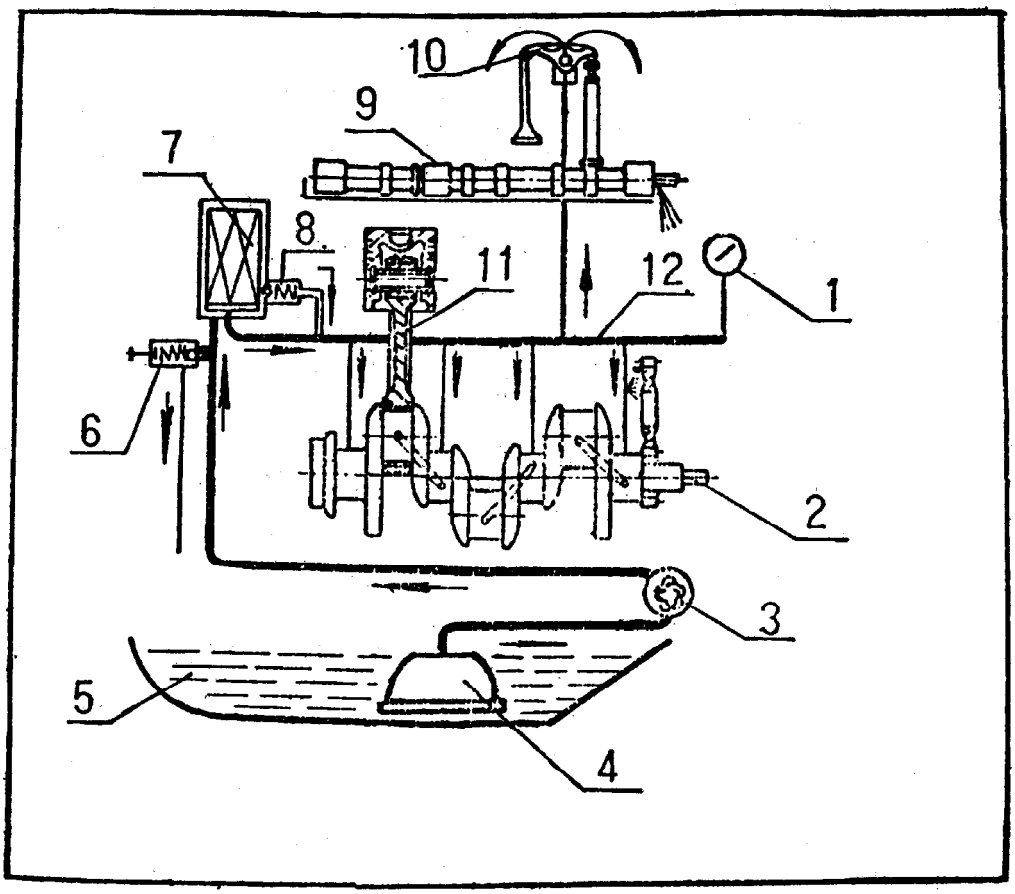
When the engine is operated, the oil pressure in main oil passage must keep in range of 294 – 490kpa(3 – 5kgf/cm^2). At the just moment of starting, the oil of cooled engine must not be bigger than 490kpa. The oil pressure at idling speed must not be lower than 49kpa. If it is found that there is not oil pressure in main passage, must stop immediately to check and eliminate faults in lubricating system.

The strainer is hung beside the third step main bearing seat of cylinder block. The oil suction pipe joint must be tightened, any leakage at the tapered surface will affect the sucking function of the lubricating oil pump. The screen of strainer must be cleaned in time.

7. Cooling system

The diesel engine adopts a forced – cycle water cooling system, which consists of water pump, thermostat, radiator, fan, etc, with an antomatic adjusting function of the cooling water temperature.

A corrugated pipe single – valve type thermostat is provided in the front cover of cylinder head.



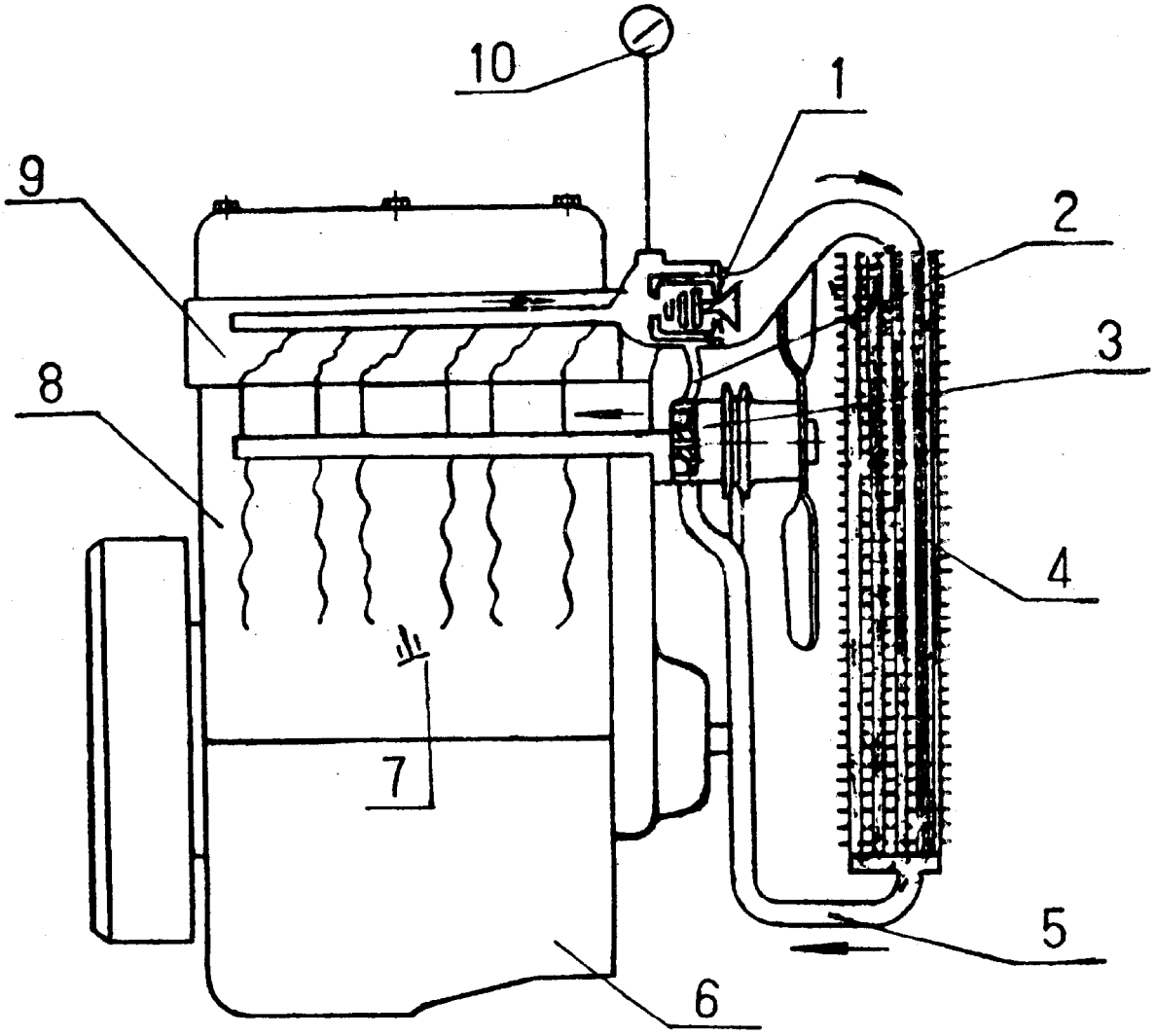
1. Oil pressure gauge 2. Crankshaft 3. Lubricating oil pump 4. Strainer 5. Oil sump 6. pressure regulating valve 7. Lubricating oil filter 8. By－pass valve 9. Camshaft 10. Rocker arm 11. Piston connecting－rod 12. Main oil line

Fig 2－11 The circulating circuit of the lubricating oil

When the temperature of cooling water passed by the thermostat is lower than 70℃, the thermostat will close and the cooling water directly enter into the water pump through the branch inlet water pipe. When the cooling water temperature is above 70℃, the thermostat will open. If the water temperature rises up 85℃, the thermostat will full open. At these time, most part of cooling water will flow into the water pump after passing through the radiator. When the water is added, the air in the water passages of diesel engine will went out from the radiator cap by way of the small hole. on the valve of thermostat. The thermostat may be dismantled in hot summer time.

The water pump is a single side flat plate iron impeller centrifugal pump. The inlet water pipe is connected to the outlet pipe of radiator, while the branch inlet water pipe directly connects with the front cover of the cylinder head. The outlet of the water pump is opposite to the water passage of the cylinder block. The water leaked from the water seal may drip out from a drain hole at the bottom of the pump cover. In case of abnormal leakage, the water seal should be checked. The user should fill lubricating grease into the grease nipple on the pump cover for lubricating the bearings(60203).

The fan is four－impeller axial flow suction type. The fan pulley is installed at the front end of the water pump shaft. Any slack of fan belt will affect the efficiency of the fan and the water pump output, hence the tensity of the fan belt should be checked frequently.



1. Thermostat 2. Branch inlet water pipe 3. Water pump 4. Radiator 5. Maininlet water pipe 6. Oil sump
7. Drain cock 8. Cylinder block 9. Cylinder head 10. Thermometer

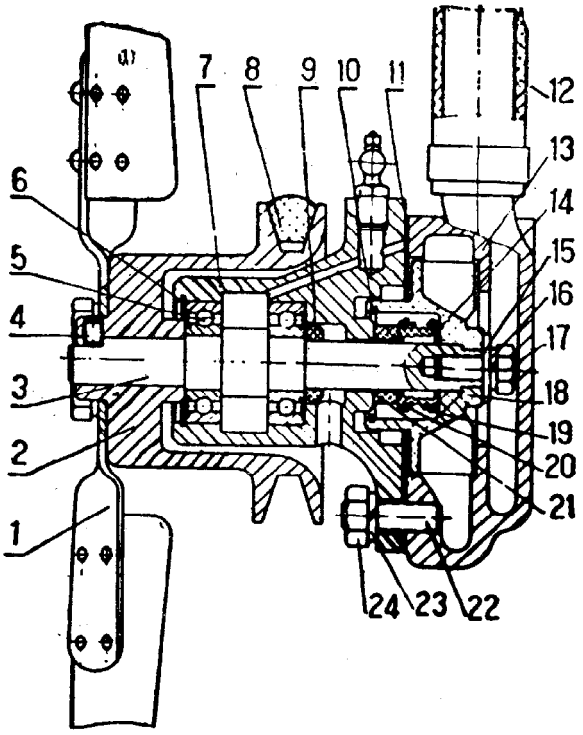
Fig 2 – 12 The circulating circuit of the cooling water

A vapour pressure relief valve and an air pressure relief valve are provided on the cover of The radiator. the vapour valve will not open until the vapour pressure in the radiator is higher than the atmosphere by 20 – 29kpa, hence the boiling poit of water will be slightly higher than 100℃ in the radiator, when the pressure in the radiator is lower than the atmosphere. As the radiator core is of very thin flat – tube, care should be taken to avoid any collision with it.

8. Electric system

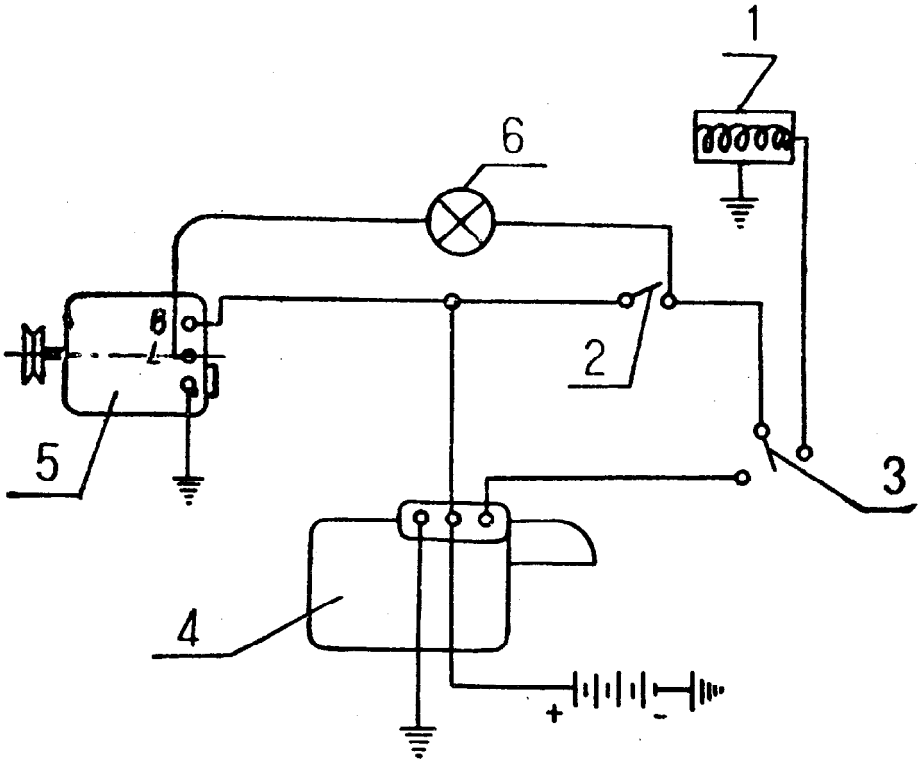
The electric system is composed of starting motor, dynamo, electrothermic plug, battery, motor, and switches, etc. Adopted the whole – body dynamo JFZ1317Y the electric system is negative pole grounded, shown on Fig2 – 14, the cross sectional area of copper, conductor used for connection with the battery should not be smaller than 50mm^2 and that used for connection with the on – and – off switch should not be smaller than 4mm^2.

The starting motor is 2Q2C type, four – pole. four – brush, series excited d. c. motor. The rated voltage is 12 volts and the rated power is 2.5 ps. It revolves clockwise facing the output end.



1. Fan 2. Fan pulley 3. Water pump shaft 4. Screw 5. Ball bearing 6. Snap ring 7. Water pump cover 8. Fan belt 9. Water pump shaft watar seal 10. Lock ring 11. Pump cover gasket 12. Connecting pipe 13. Water pump body 14. Rubber water seal 15. Wesher 16. Spring washer 17. Bolt 18. Impeller 19. Water seal protection rign 20. Water seal spring 21. Water seal 22. Stud 23. Spring washer 24. Nut

Fih 2 – 13 Water pump



1. Electrothermic plug 2. Electric key 3. Preheating and starting switch 4. Starting motor 5. Dynamo 6. Galvanometer

Fig 2 – 14 Electric system adopting JFZ1317Y dynamo

The starting motor is equipped with an electromagnetic cluch. When the power line is connected, the electromagnetic switch functions to push out the gear of the motor and make it to mesh with the flywheel gear ring of the engine. After the engine speed rises, the gear can automatically disengage with the gear ring.

The continuous working time of the starting motor should not exceed 10 seconds, and the interval between two starting operations should not be less than two minuts. When the flywheel gear ring has disengaged with the gear of the motor and the engine still revolving, restarting is not permitted.

The type JFZ1317Y silicon rectifying with 14 volts rated voltage and 350 watts rated power and covers regulator in themself.

At each end of the dynamo armature shaft, a ball bearing is fitted. The lubricating grease (calcium base complex grease or No. 4 high temperature lubricating grease) should be renewed for every 1000 hrs operation. In general, the grease is recommended to fill 2/3 full of the bearing space.

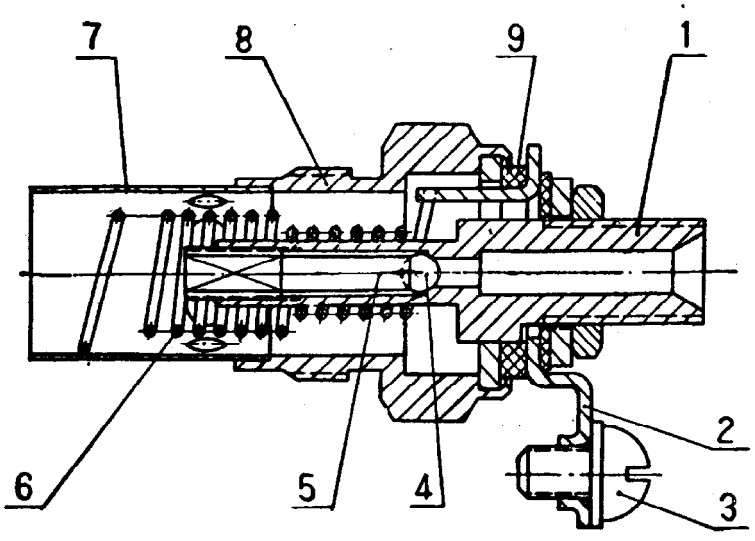
If the brush wears out too much, the pressure of the brush spring will reduce. It should be checked for every 1000 hrs operation, and replace the brush if necessary.

The storage battery is of lead plate type , with 12 volts rated voltags , and not less than 100 A－hr capacity.

Two poles of the battery are marked with " + " and " － " signs respectively. The electrothermic plug is fitted at the air entrance of the diesel inlet pipe. In cold winter it is used to preheat the air to aid the starting of the engine. When the power line is connected, the electric resistance wire is heated to make he thread lever elongated and pushing the ball valve to open. Then the fuel flows out and gets ignited. If the circuit is cut off. the ball valve will close itself.

The electrothermic plug should not be continually used over 40 seconds.

When installing electrothermic plug, please pay attention to allowing a spenner to be used for screwing the union nut. Do not allow to screw the nut to avoid breaking insulated seat of connecting fixing support.



1. Thread lever 2. Fixing support 3. Screw 4. Steel ball 5. Lever body 6. Electric resistance wire 7. Steel plate cover 8. Union nut 9. Limiting plate

Fig 2－15 Electrothermic plug

Chapter Ⅲ Check and Adjustment of Diesel Engine

A. Adjustment of Valve Clearance and Air Distribution Phase

1. Adjustment of Valve Clearance

Valve clearance means the clearance between the valve and the rocker arm. For cold engine, the inlet valve clearance is 0.25 – 0.30 mm and exhaust valve clearance is 0.30 – 0.35 mm.

Continual engine operations may cause the bolts and nuts to become loose, therefore, it is necessary to check the valve clearance periodically every 240 hours performance.

Methods for adjusting the valve clearance of the first cylinder:

(1) Turn the flywheel counter clockwise. After the exhaust tappet of the second cylinder begins to move, then turn counter clockwise the flywheel about 180° and make the index line "1" on the flywheel align with the index line on the connecting plate. At this moment, the piston of the first cylinder is at T. D. C. of the compression stroke. Since the inlet and exhaust tappets are on the base circle of the cam, it is possible to adjust the clearance of the inlet and exhaust valves at the same time.

(2) Loosen the adjusting nut, slip a feeler gauge (0.25 mm thick for the in let valve and 0.30 mm thick for the exhaust valve) between the rocker arm and valve, adjust the adjusting screw till the

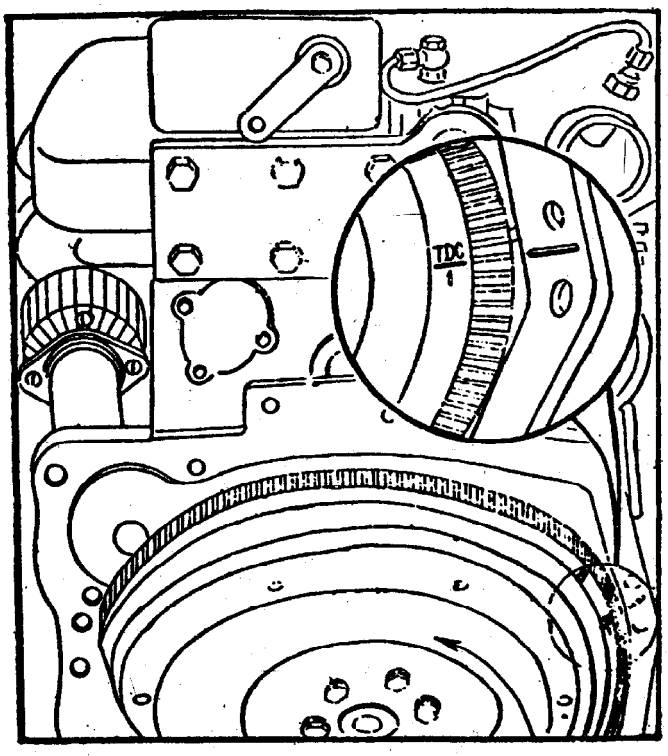


Fig 3 – 1 T. D. C. of the first piston

feeler gauge can slip slightly, then tighten the nut to fix the adjusting screw (see Fig3－2), and check once again.

Method for adjusting the valve clearance of the rest cylinders:

(3) When the piston of the first cylinder is at T. D. C. of the compression stroke, adjust the inlet valve clearance of the second cylinder and the exhaust valve clearance of the third cylinder at the same time. Turn counter－clockwise the crankshaft 240° (two third turn) making the third cylinder piston at the T. D. C. compression stroke, the index line "3" on flywheel align the base line on connecting－rod and adjust the exhaust valve clearance of second and third cylinders and the inlet valve clearance of the second cylinder.

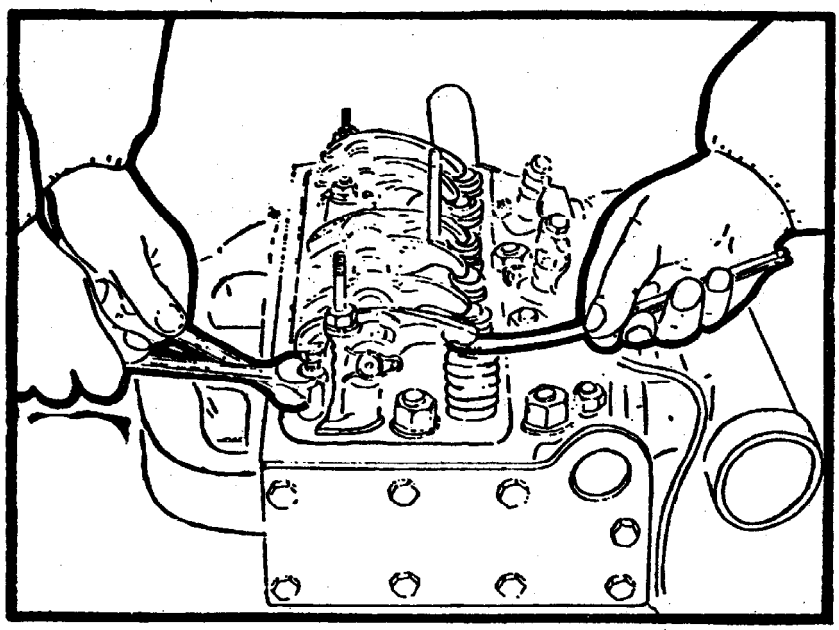
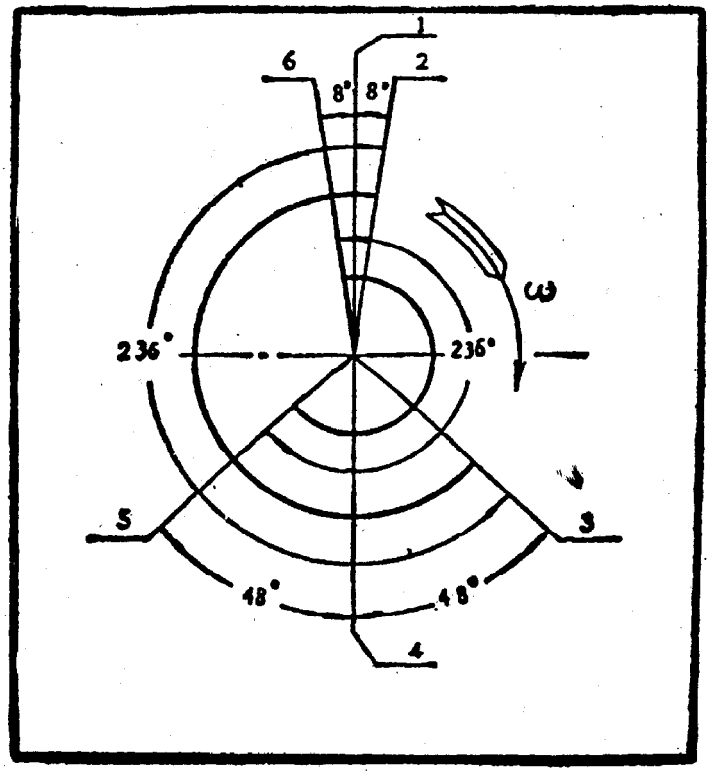


Fig 3　2 Adjusting the valve clearance



1. T. D. C. 2. Exhaust valve closes
3. Exhaust valve opens　4. B. D. C.
5. Inlet valve closes　6. Inlet valve opens.

Fig 3－3 Timing the air distribution

2. **Adjustment of the Air Distribution phase Angle:**

For cold engine, the air distribution phase angle means the turn angles of the inlet and exhaust valves

The air distribution phase angles are shown in Fig 3－3.

The air distribution phase angles have been set up by the manufacturer, nad the relative positions of the camshaft and the camshaft gear have been marked by lines and arrows on their end surfaces (see Fig 3－4).

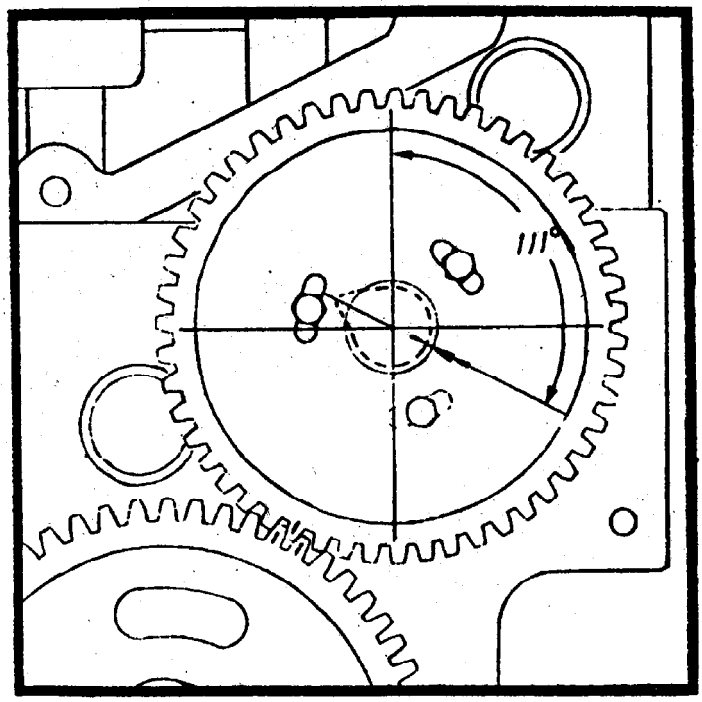


Fig 3－4 The mark of camshaft gear end surface

The relative positions of all the cams on the camshaft are fixed, therefore, it is necessary only to check the phase angle of one cam. In general, adjust the inlet cam of the first cylinder as a sample.

Before checking the air distribution phase angle, it is necessary to check and adjust the valve clearance, and then go on the following procedures.

(1) Turn the flywheel counterclockwise till the second cylinder begins to inject fuel.

(2) Put a dial gauge with support on the cylinder head, make the measuring probe in contact with the inlet valve spring upper seat, press it down slightly (see Fig 3－5).

(3) Change to retuurn slowly the flywheel clockwise about 106°, when the pointer of the dial gauge stop moving, and then over turn slightly: and then begins to return counterclockwise, till the pointer is movement of 0.17 mm, it signifies the opening of valve. At this mement, the index line "I" on the flywheel should be at the right side of index line on the cylinder block, with a distance of 2.5－3 teeth (see Fig 3－5). In this time the first cylinder piston is 8° before. T. D. C. of exhaust stroke.

During the overhaul, there are three ways of assembling the camshaft gear. with respect to the different conditions of the dismantlement of the engine.

(1) If the idling gear need not be reset, and the fuel pump gear has been fitted on, turn the

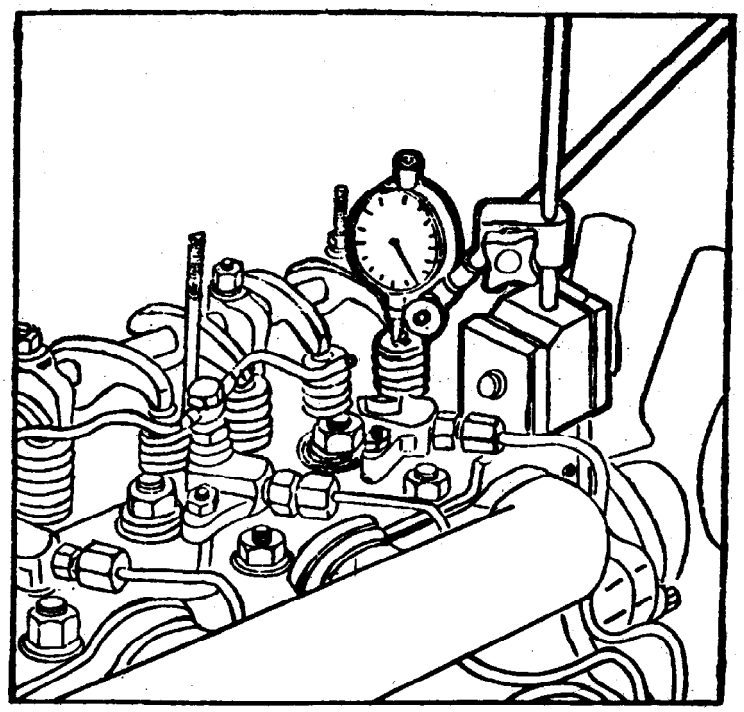


Fig 3 – 5 checking the air distribution phase

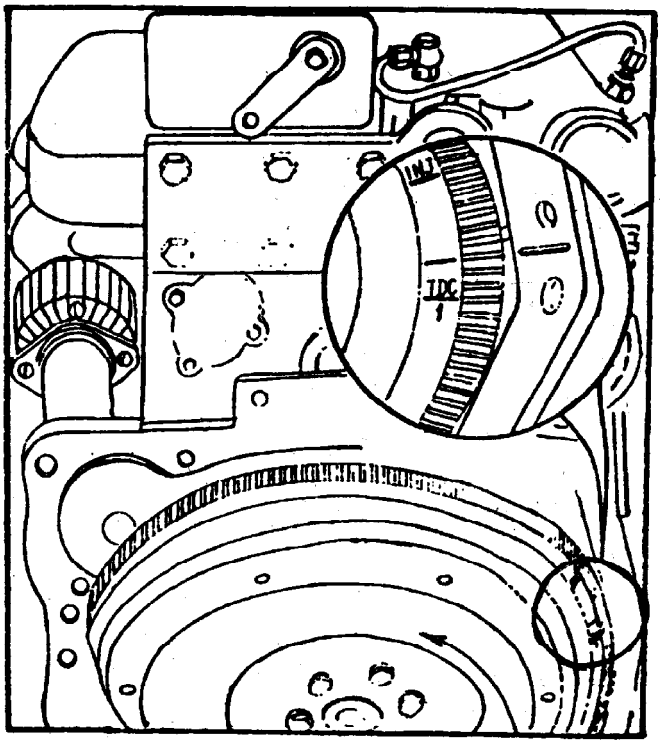


Fig 3 – 6 The flywheel position at the just opening of first

crankshaft counterclockwise. After the second cylinder begins to inject fuel, turn the piston of the first cylinder to 8° in advance of T. D. C. (about 2.5 – 3 teeth on the gearring, meanwhile, the distance between the piston of the first cylinder and T. D. C. is 0.72 mm). Adjust the index line on the end surface of camshaft to an angle of about 111° with the vertical line on the surface of the connecting plate (see Fig 3 – 4, 3 – 6), and then mount the camshaft gear on the camshaft,

keeping the reference marks in aligment at this position.

(2) If the idling gear need not be reset, and the gear of the fuel pump has not been fitted on, turn the crankshaft until the piston of the first cylinder are positioned at 8° in advance of T. D. C.. Mount the camshaft gear on the camshaft previously mentioned.

(3) If reset the idling gear, determine the relative positions of the gears according to Fig 3－4.

B. Adjustment of Fuel Supply Advance Angle

The fuel supply advance angle means the turning angle of the crankshaft, begins from the delivery valve of the plunger pump being lifted up till the piston reaches T. D. C.

As the relative positions of all the cams on the crankshaft of the plunger pump are fixed, it is necessary only to check the advance angle of one cam. Generally, the cam which is concerned with the first cylinder may serve as sample.

The methods for adjusting fuel supply advance angle are as follows:

(1) Removing the high pressure pipes of first cylinder of fuel pump, and setting the handle on the maximum supply fuel position, eliminate the air with hand pump, and then turn the crankshaft counterclockwise. Soon after the exhaust tappet of the second cylinder starts to rise, keep on turning the crankshaft slowly till the fuel surface at the delivery port of the delivery valve connector of the plunger pump appears rippling, it means the beginning of fuel supply. This time, the index line "1" on the flywheel should be at the right side of the index line on the connecting plate, the distance between them is 28° ± 1°(about 9.8 teeth on the gear ring) (see Fig 3－7).

When it is necessary to adjust the fuel supply advance angle, loosen the three fastening nuts on the plunger pump turn the plunger pump counterclockwise (view from the free end of the engine).

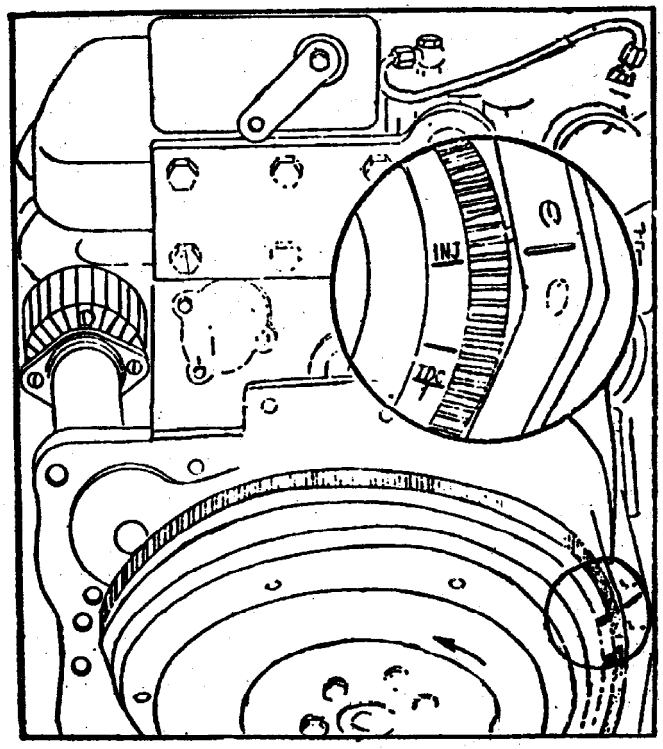


Fig 3－7 The flywheel position at the beginning fuel supply of lst cylinder

to enlarge the fuel supply advance angle and vice versa.

C. Adjusting of Plunger Pump and Governor:

They must Be Made by Workers Acquainted with Them on Fuel Pump Testing Bench.

(1) Check for supply interval of each cylinder

Remove the connector of supply fuel valve of plunger pump and set the regulating handle on the Max. supply fuel position. Turn the camshaft clockwise (see from fuel pump flange) till fuel surface of supply valve beginning to fluctuate, and write down the supplying fuel angle of first cylinder. Then check starting supply fuel angle of other every cylinder according to sequence 1 – 3 – 2, and the interval angle 120° between every cylinder must allow the tolerance of less than ± 1°. Adjusting exceeded tolerance adopts exchanging adjusting shim on tapper.

(2) Adjusting the starting fuel for each cylinder:

Adjusting the position of shift fork on control rod. When the camshaft speed is 100 – 150r/min adjust first cylinder starting fuel to 23cc ± 1cc/200 cycle, and lock up the shift fork. Then measure every interval distance of other cylinders with a slide gauge and make them equal with each other

(3) Adjusting of rated fuel supply

When the camshaft speed is 1200r/min, under bigger prefastening force of governor handle turn correct screw till first cylinder fuel reach 19cc ± 0.3cc/400 cycle and then regulate supply fuel of other cylinder. After shift fork and control rod, the unequalance of every cylinder not exceed 3% and then lock shift fork screw. The unequalance supply fuel.

$$H = \frac{Q_{max} - Q_{min}}{Qmean} \times 100\%$$

(4) Setting of high speed limiter screw

When the fuel pump speed is 1200 r/min, it is useless to turn into the correct screw, loosen the governor handle and reset to rated position of every cylinder supply fuel. Then set the adjusting handle, turn – in the high speed limiter screw till it contact with the adjusting set block and lock the nut on high speed limiter screw.

(5) Set the position of correct screw:

When the speed of fuel pump is 800 r/min, set the governor handle to the position of high speed set screw, then turn – in the correct screw till supply fuel of each cylinder is 23cc ± 0.4cc 400 cycle, and then lock the nut of correct screw.

(6) Check for speed regulating performance

Check when the prefastening force governor handle set on position of limiter screw.

1. Rated fuel: When pump speed is 1200r/min, supply fuel of each cylinder is about 19cc ± 0.3 cc/400 cycle. unequalness is less than 3%.
2. Stop supplying fuel speed: Rise the speed slowly until the injector stop supplying. The shut full speed is less than 1320 r/min.

(7) Set for low speed limiter screw:

When the pump speed is 250 – 300 r/min, control handle make the supply reach 2 – 3 cc/200

cycle (idling fuel supply). Then turn in limiter screw till contact with adjusting block. Then reset governor handle on idling limiter position. Recheck idling fuel supply lock nut when reach specified range.

D. Adjusting of Injection Fuel Pressure

When the atomization of injector is not good, nad valve needle hole leak fule, it is necessary to check fuel pressure and atomization on fuel tests bench. Continually turn – back the fuel handle and read the date of fuel pressure on the pressure gauge. The date range is 175 – 195 kgf/cm^2, and automization is equivalent and hear "Gu – Gu" sound. If not required, it must be to loosen the top nut of fuel injector, turn regulating pressure screw with a screw – driver. After adjusting, tighten the nut and check again the fuel pressure.

E. Adjusting of Tension of Fan Belt

Because of that tension of fan belt influences the speed of water pump and dynamo and life of water pump shaft and belt and normal operation of diesel, it must be to pay attention to check and regulate the tension of fan belt. When diesel is stop to run, press with force 3 – 4 kg – f by thumb on middle of belt, if the drop is range of 10 – 15 mm, it is normal. If not normal, it must be regulated, it is made by loosening bracket set screw of dynamo, move position of dynamo and make belt tension is sufficient.

F. Adjusting of Oil Pressure

Adjusting of oil pressure must be made after diesel run – in (oil temperature reaches about 80℃), remove the seal oil nut cap on oil filter and loosen the lock nut and turn regulating pressure screw, and change the oil pressure in main passage, turn – in screw the oil pressure will rise.

Chapter IV Trial Operation and Running－in of Diesel Engine

New and over repaired diesel engine is not allowed to operated under big load and must at first run－in for 60hrs. After small repairing, it must run－in for 10hrs and make the contact surface reaches the idling matching. Otherwise, the operating life of diesel will be shorten fast.

A. Preparation before Running－in

Clean the dirty, oil and wash with diesel fuel and check and tighten outside fasten bolts and nuts, fill oil into sump, pump－governor and air compressor (when running－in, use lubricating oil SY1152－79, HC－8 high speed diesel oil), grease the water pump bearing, fill fuel to tank and water to radiator and check electric circuit.

B. Running－in Procedures

(1) Unloaded running－in for 15 min: Starting according to rules and then make unloaded running as following specification:

Speed (r/min)	800－900	1600－1700	2400－2500
Time (minute)	5	5	5

When unloaded run－in pay attention to check the operation of diesel whether there are leaking oil, abnormal sound and the smoke and gauge reading is normal and adjust and remove faults and keep normal operation.

(2) Running－in under load for 60h:

Load(kw)	7	15	24	29.44
Time(hrs)	10	15	30	5

The warning items at load run－in as mentioned before

C. Check after Running－in

1. Stop and drain the oil in oil sump when the oil is heating and clean sump and filter with diesel fuel and refill new oil.
2. Clean and replace elements of oil filter
3. Check and adjust the valve clearance
4. Check tightening and locking condition of connecting－rod and outside fastening bolts and nuts.
5. Check and remove every kinds of faults.
6. Lubricating maintenance for every lubricating place

7. Operate only after checkig and adjusting

Ð. Run－in for Ioh Procedures

After every small repair (replace piston ring, main bearing shell, and connecting－rod, etc.) must run－in at short period as following:

(1) Unload run－in for 15 minutes (as mentioned before)

(2) Loaded run－in for 10hrs

Load(kw)	7	15	24	29.44
Time(hours)	2	3	4	1

Warning items and maintenance as mentioned before. After running－in drain lubricating oil in sump when heating and clean lubricating circuit and refill new oil.

Chapter Ⅴ. Operation of Diesel Engine

A. Fuel, Oil and Cooling Water

1. Fuel

Only Nos, -25, -20, -10 and 0 light diesel oils and agricultural diesel oil in conformity with National Standard (GB252-81) should be used in this engine. The freezing of the diesel oil selected for use should be about 10℃ lower than the ambient temperature, Before using, the diesel oil should be subjected to precipetation treatment for several days, and take the upper portion of the oil being filtered by fine cloth as fuel.

Specification of diesel oils (excerpt from GB252-81, Sy 1077-77)

Description \ Grade	0	-10	-20	-35	Agricultural diesel oil
Centre number	≥50	≥50	≥45	≥43	≥40
Distillation temp. ℃					
a. 50%	≤300	≤300	≤300	≤300	-
b. 80%	-	-	-	-	≤350
c. 90%	≤355	≤300	≤350	-	-
Kinematic viscosity at 20℃, centistoke	3-8	3-8	2.5-8	2.5-7	≤6(at 50℃)
Pour point, ℃	0	-10	-20	-35	20

2. Lubricating oil

The lubricating oil containing the requisite additive in confirmity with the National Standard (SYB 1152-79) suitable for high-speed diesel engines should be used. Generally, HG-14 oil is used in summer and HC-11 or HC-8 oil in winter. If the ambient temperature is very low, the lubricating oil should be heated up to 80℃-90℃ before filled into the oil sump. No. 20 machine oil is used for lubricating oil on the plunger pump.

Specifications of lubricating oils (excerpt from SY115－79, GB443－64)

Description \ Grade	HC－8	HC－11	HC－14	HJ－20
Kinematic viscosity at 100℃ centistoke	8－9	10.0－11.5	13.5－14.5	17－23(at 50℃)
Kinematic viscosity ratio, ν50/ν100℃	≤6	≤6.5	≤7	—
Acidity mg KOH/g	≤0.1	≤0.1	≤0.1	≤0.16
Flash point ℃ (open gap method)	≥195	≥205	≥210	≥170
Pour point, ℃	≤－15	≤－15	≤0	≤－15

3. Cooling water

The use of clean soft water, such as rain water or river water, is desired. If hard water, such as well water or mineral water, is to be used, it should be treated by softening process, in order to prevent it from producing scales which are unfavourable to heat dissipation. The softening process involves boiling, or adding 0.67 gram of caustic soda to 1 litre of water, and collecting the clear water after precipitation. If the ambient temperature is below 0℃, antifreezing agent may be added, The anti－freezing agents commonly used are as follows:

Antifreezing agents	Proportion %				
	Ethylene glycol	Alcohol	Glycerin	Water	Freezing temp.
Ethylene glycol	55			45	－40
Alcoholic glycerin		30	10	60	－17
		40	15	45	－26
		42	15	43	－32

B. Starting

1. Preparations before starting:

(1) Check and see if the radiator has been fulled up with water, and if there are sufficient amounts of lubricating oil in the oil sump and the plunger pump, and the requisite diesel oil in the fuel tank respectively. Check whether all pipe joints are secured, battery is adequately charged, and circuits are in order.

(2) Turn on the switch of the precipitation cup and loose the stopping handle.

(3) Discharge air from the fuel system for starting a cold engine. As the position of the fuel tank is rather high, to loose the respective joint will discharge the air in the pipe in front of the fuel pump. Loosen the respective joints and the air relief screw of the plunger pump, to press the handle of the fuel pump, then the air in the pipe between fuel pump and plunger pump will be dischargee. Loosen the fuel inlet joints of the fuel injectors and turn the crankshaft, will discharge the air in the fuel injection pipes. All screws and nuts should be tightened after air is discharged from all parts.

(4) place the fuel throttle control lever in the middle position.

2. Starting the engine

At ambient temperature above 5℃, turn on the electric key. Turn preheating switch to "start" position, the engine will start. After starting turn the starting switch back to "0" position. immediately. Governor handle will be set at idling position.

Turning for 15 sec. as crankshaft speed is too low (lower than 150r/min) it can not be started, auxiliary device must be used for starting. At ambient temperature below 5℃, start the engine with preheating procedure. Turn the starting switch to "preheating" position, allow the preheating plug to work for 30 – 40 seconds. Start the engine by turning the starting switch to "preheating – start" position. If necessary, pour into hot water until the temperature of water flowing out after drain valve is about 30℃ or heat oil temperature to 80° – 90℃ and manufally turn the crankshaft several rounds by means of a hand lever engaging with the starting pawl.

The starting motor should not be continually operated exceeding 10 seconds. If the engine fails to start within this interval, it should be left to stand for about two minutes before started again. If it fails more than three times, a thorough check should be performed.

C. Running

After starting the engine, adjust the throttle to its idling running at about 800 – 1000 rpm for five minutes. Avoid cold engine from idling operating at long time as far as possible and watch whether the engine operates normally and reading data on every gauge is within specified range. If there is not oil pressure or there are another abnormal conditions, the engine must be stopped and checked and must remove faults. When the oil pressure is normal, the engine speed can be risen gradually and preheat – operated till moter temperature reaches above 60℃ and allow operate under loaded.

Full – load operation is allowed only when the water temperature is keeped to 80 – 90℃ if water temperature is lower than 70℃, engine operates at long time under this condition, the liner will speed – up to wear. Oil temperature is not exceed 98℃.

D. Stopping

Stopping should be effected after take off the load, decrease speed gradually to about 800 rpm, and then let the engine idle for a few minutes and under steady water temperature 70℃. In case of run – away or other emergencies, the engine can be forced to stop by decompression or blocking up the air inlet of the air filter of loosenging connecting nuts of high fuel pressure pipes.

When the engine is stopped , the electric key should be turned "off," in order to prevent any current from the battery dischanging and flowing back to the excitation winding of silicon rectifying dynamo.

If the engine is to be left long out of operation in a place where the ambient temperature is below 0℃, open the drain valve to drain out the water completely and turn the crankshaft in

order to avoid freezing, cylinder block, water pump and radiator. Draining is unneceessary if anti – freezing agents are used.

E. Engine Safety Operation Procedures

1. Do not allow the man who do not understand operating technique to operate the diesel engine.
2. Do not allow starting diesel if not be ready before starting.
3. Warning to preventing fire, the fire is not placed near the operated engine oil or easy fired goods.
4. Do not allow to disassemble the engine under operting, Do not allow to leave when the diesel engine is working.
5. Do not allow diesel engine operating with faults at long time, surely avoid diesel engine to operate under loss pressure, oil pressure too low and operates with abnormal sounds inside the engine. If mentioned occures, must stop engine immediately.
6. If diesel rotating speed is suddenly risen, must turn the stop handle at time for stopping and checking and remove faults. If the function of stop handle fails, must adopt the methods such as block inlet port for stopping engine or loosening connecting nuts of high fuel pressure pipes.
7. If there are easy – fire goods round the operation place of diesel must be added the misfire device on exhaust pipe.
8. When the diesel transmit drive device of working machinery, it must be installed using prevent guide.

Chapter Ⅵ. Technical Maintenance

In order to ensure normal and reliable operption, the engine should be properly maintained. The specific technical instructions of the engine maintenance are as follow:

1. Daily maintenance
2. Maintenance after 125 accumulated hours of operation
3. Maintenance after 500 accumulated hours of operation
4. Maintenance after 1000 accumulated hours of operation

A. Daily maintenance

1. Check the oil level in oil sump, injection pump and an compressor, and if there is sufficient cooling water in radiator.
2. Check if there are any dirt and water in the precipitation cup of the fuel tank. Disassemble and wash it, if required.
3. All dirt and foreign particles in the filtering element of the air filter, and air duct should be cleaned away.
4. Leakage of oil or water should be checked.
5. Check and see whether all connections and joints are secured and kept intact.
6. Clean the dirt at the surface of the engine, keep the engine thoroughly clean (with special attention to the electrical equipments). If it is cleaned by water flushing, care should be taken to prevent any water from flowing into the engine through air duct of inlet pipe filler vent unit, etc.
7. Apply grease to the grease nipple of the water pump, periodically.
8. Check the electrolyte level of the storage battery (10 – 20 mm above the protective cover) and gradivity of electrolyte. Add distilled water is necessary and charge in time.
9. After a new engine has been used for 30 hours, the lubricating oil in the oil sump should be changed with fresh oil, and the filtering element of the oil filter should be cleaned.
10. Remove faults.

B. Maintenace after 125 Accumulated Hours of Operation

In addition to the "Daily Maintenance" procedures, the following procedures are supplemented.

1. Clean the oil strainer, oil filter and the filtering screen of the fuel pump.
2. Replace the oil filtering cartridge and seal ring (for every 250 hours).
3. Renew the lubricating oil in the oil sump.
4. Check the tension of the fan driving belt.

5. Check the clearance of inlet and exhaust valves (henceforth, check once every 250 hours).
6. Clean fuel filter and its cartridge (for every 250 hours).
7. Clean carbon deposit of exhaust pipe and silencer.
8. Check seal of air compressor valve, grinder is necessary.

C. Maintenance after 500 Accumulated Hours of Operation

In addition to the procedures for "Maintenance after 125 Accumulated Hours of Operation", the following procedures are supplemented.

1. Check the injection preessure of the fuel injector and its performance. Dismantle the fuel injector and needle valve set, and clean them, if necessary.
2. Check the fuel supply advance angle, and adjust it, if required.
3. Check the drainage hole and the performance of the water pump. Replace the water seal, if necessary.
4. Check the electrothermic plug, and see if there is leakage of fuel its insulation is in good order.
5. Check the working condition of the thermostat.
6. Check the working pressure of the pressure regulating valve and the by－pass valve, and make adjustments if necessary.
7. Clean the fuel tank, Fuel pump and fuel pipelines.
8. Check electric device and connector of electric circuit, clean up the firing surface.
9. Replace oil in fuel pump governor and air compressor.
10. Replace seal ring and cartridge on fuel filter.

D. Maintenance after 1000 Accumulated HOurs of Operation

In addition to the procedures for "Maintenance after 500 Accumulated Hours of Operation" the following procedures are supplemented.

1. Check and see if the bolts on the connecting－rods and main bearing are securely tightened in place.
2. Check the sealing condition of the inlet and exhaust valves. If necessary, the engine surfaces should be remedied and polished.
3. After disassembling the starting motor and dynamo, check them and apply grease to all the bearings.
4. Thoroughtly check all parts of the engine.
5. All units and parts, disassembled and removed from the engine for performing the maintenance work, should be carefully and properly reset, ensuring correct positions and specified clearances. Start the engine for a test run and check if there is any trouble. The engine should be proved perfect performance before it is put into normal operation.
6. Replace element of air filter.
7. Remove scale gathered of cooling system.

Chapter Ⅶ. Transportation, Openning of Sealing, Storage

Lifting single engine must use lifting ears on two sides of cylinder head. At transportation and storing, diesel engine in not allowed collision or too big inclination, make attention to protect wetness.

When open sealing of the engine, at first clean the anticorrosion oil on surface of outside parts slowly turn crankshaft for several turns, then use starter to turn the engine running in about 15 seconds. Stop two minute, then start and operate intervally for several times, the operattion is according to tri－running specification.

In order to advoid damage because corrosion, diesel engine must be seal－storing before stopping for a long time.

1. Drain oil, cooling water and fuel.
2. Clean crankshaft case, fuel sump and filter strainer.
3. Fill cleaning dehydrated T8 oil into oil sump and then turn crankshaft, make oil into full of lubricating system.
4. Disassemble injector assembly, full 0.3kg dehydrated oil into every injector, install hole and then turn crankshaft and make the oil reaching to piston liner and connecting place of valve seats.
5. Outside precessing surface is covered with a thin lay of corrosion resistant oil and covered with paper.
6. Must assemble engine after cleaning the valve needle of injector and coating with oil.
7. Fill corrosion resistant oil into intake and exhaust pipes.
8. Made of rubber, or plastic parts do not be covered with oil.
9. Disassembly silencer, exhaust pipe port is blocked with cock.
10. Enclose air cleaner surely with thin plastic lay.
11. Enclose diesel with plastic cover.
12. After seal－storing, the diesel must be placed and stored in dry and clean room and cover severely. Do not place with corrosion goods together.
13. Effective periods of oil sealing is 3 monthes. When exceeding the time limits, must check, maintenance and oil seal again.