OPERATION AND MAINTENANCE MANUAL

FOR

MODEL 495 DIESEL ENGINE

Foreword

Model 495 diesel is a high speed engine of four—stroke, vertical, four — cylinder, water — cooled, swirl combustion chamber type. It is one of the Chinese designed 95 series products. It possesses the advanced level of its dynamic characteristic and fuel economics, and has thd proven features of simple construction, reliability, versatility to the maliti—purpose applications and higher degree of standardization, seriation and inter—changeability. 95 series diesel engine was prized by the National Science Congress in 1987.

In recent years , with the help of the technology introduced from Ricardo Consulting Engineers plc of Great Britain and the advanced design features of R series, the design of Model 495 is modified so as to improve its dynamic characteristic, economic index and its reliability.

According to the requirements of the driven equipments, various versions of Model 495 diesel engine can be developed by modifying some parts and components relevantly so as to satisfy the different applications, such as tractors, trucks, construction machineries, agricultural drainage and irrigation pumps, agricultural sideproducts processing machineries, marine propulsion, generator sets, well drilling machineries and so on, The following models of the engine are available:

1. Model 495—The basic version. (Its) rated power is taken off at the flywheel end, It can be used readily as a prime mover of the land machinery.

2. Model 495T—The version used for tractor. Provided with a flanged cast iron oil sump and a connecting plate, it is used to power wheel tractor of model 50.

3. Model 495G—The version for stationary use. Provided with a power take—off and clutch, it is suitable for driving agricultural drainage and irrigation pump, agricultural sideproducts processing machineries, and other stationary equipments.

4. Model 495Q—The version for vehicle use. Its rated power is of 70ps at 2800rpm. It is suitable for powering trucks of 2. 5—3ton capacity.

5. Model 495K—The version used for construction machinery, It can be served as the prime movers of various construction machineries such as loader or the fork lifter.

6. Model 495D—The version used for generating set. It serves as the prime mover of the 20 kw generator set.

7. Model 495ZD—The turbocharged versions. It is used as the prime mover of the 30kw generating set.

In order to keep the diesel engine in its good condition to work normally, reliably and economically as well as prolonging its service life utmostly, we are offering this manual so as to help the users to master the operation and service techniques and to run the diesel engine properly.

In this manual, the engine mentioned about is mainly the basic version of model 495, besides, the different features between the basic version and the versions for stationary and tractor uses are also described. Other versions are illustrated in Appendix Manual.

The engines will be modified and improved from time to time, therefore the users are adviced to see that the produsts supplied hereafter may be slightly different from that described in this manual which of course shall be revised periodically.

Users are hoped to give advice on this manual and the quality of the products, also to introduce the advanced experience about operation and maintenance of the diesel engine to our works.

Important Notice

1. The diesel engine operators must familiarize themselves with this manual and the engine construction, follow strictly the procedures of operation and maintenance especially the regulations for safety operation defined in this manual.

2. In any case, must keep the engine, especially the fuel system clean during their operation adjustment or repairing.

3. In any case, the engine should not be filled with any unfil—tered fuel or lubricating oil. The fuel and lubricating oil containers must be kept clean. The diesel fuel should be settled for more than 48 hrs before filled into fuel tank. The grade"R—O"light diesel fuel and the grade "HCA—14"lubricating oil of china should be used in summer, the grade 10 light diesel fuel and grade"HCA—11"lubricating oil should be used in winter, and the grade"HCA—8"lubricating oil is suitable for extremely low ambient temperature.

4. Increase its speed gradually after starting a cold engine, never let it run at high speed abruptly, and dont stop the engine instantly while its cooling water is still too hot.

5. If the ambient temperature falls below+5°C, after stopping the engine, drain the cooling water out of the radiator and the diesel engine itself completely to prevert the engine from cracking due to freeze.

6. Never run the diesel engine without an air cleaner so as to prevent the unfiltered air from entering the cylinders.

7. The inspection and repair of the components in electrical system must be carried out by the person who has a good knowledge of electricity.

8. The Running—in period is necessary for a new or an just overhauled diesel engine before the engine gets into the normal service. It is prohibited to operate the engine at full load before its running—in.

Contents

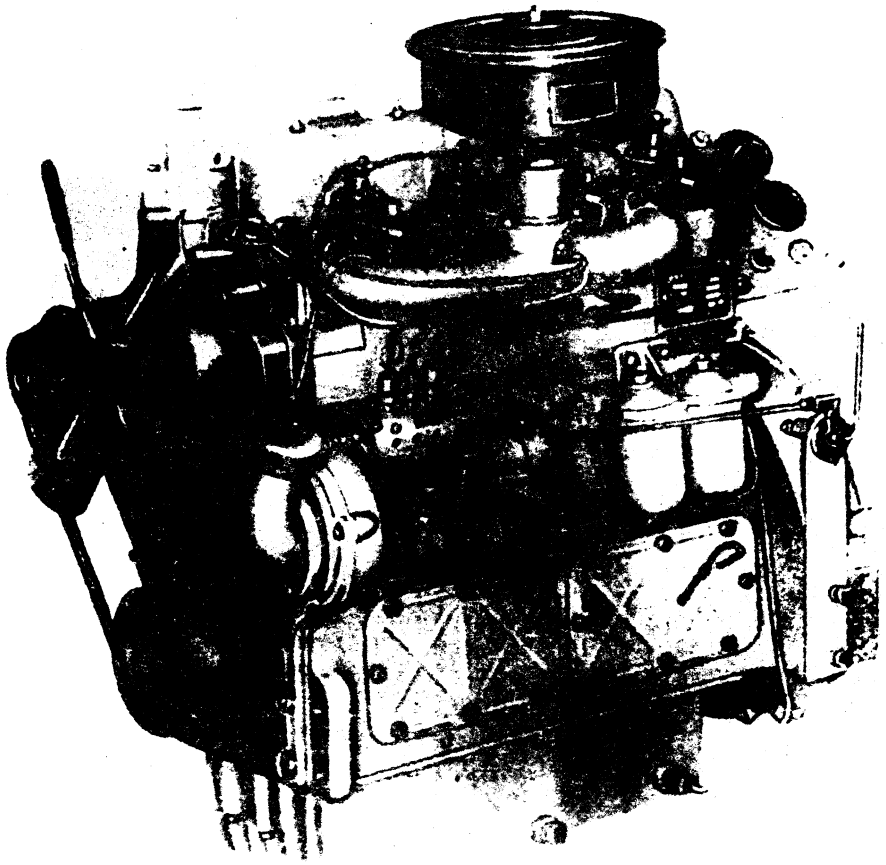


Fig.1 Right-hand view of model 495 Diesel Engine

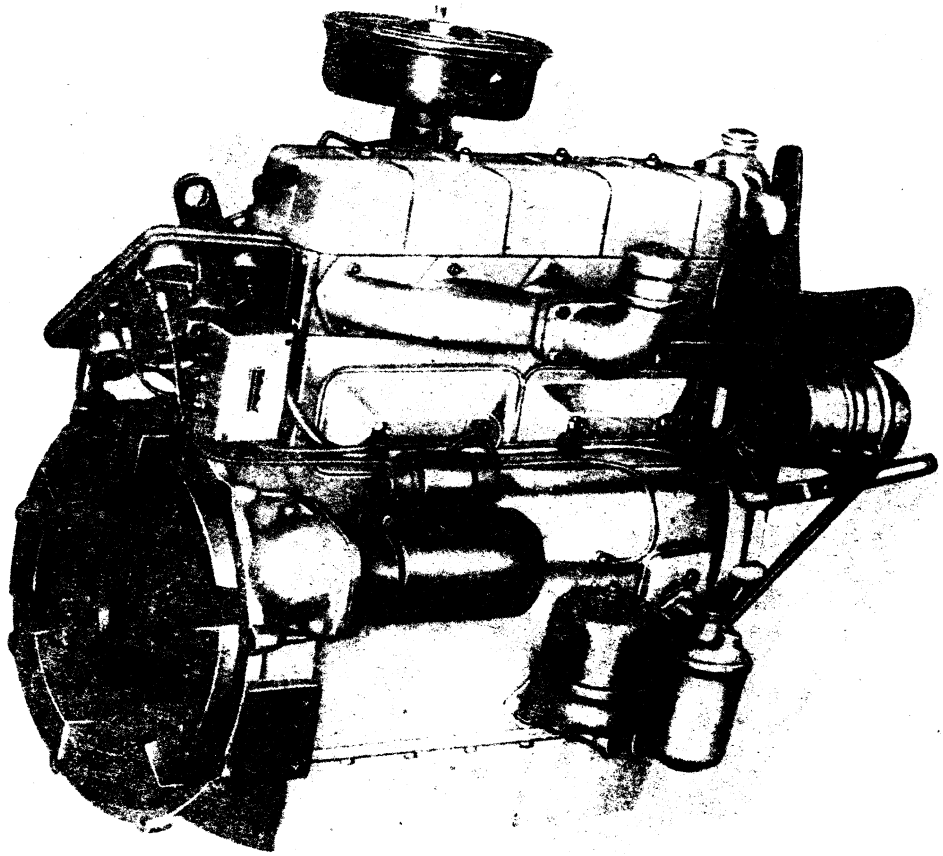


Fig. 2 Left—hand back view of model 495 Diesel Engine

Chapter Ⅶ. Maintenance of The Diesel Engine

In order to make the engine operate without trouble and damages, the maintenance regulations must be carried out strictly and attentively. The more carefully to the maintenance, the longer the service life and lower the operation cost, moreover, the work done by the engine will be accomplished successfully and efficiently.

The engine maintenance includes the daily maintenance, the first, second, third and fourth order maintenances, The maintenance intervals are stipulated as follows:

1). Daily maintenance: after every work—shift.

2). First order maintenance: after every 50 accumulated operating hours.

3). Second order maintenance: after every 250 accumulated operating hours.

4). Third order maintenance: after every 500 accumulated operating hours.

5). Fourth order maintenance: after every 1000 accumulated operating hours.

1. Daily Maintenance

1). Check rigidity and reliability of all attached components especially the injection pump, air intake manifold, air cheaner, engine foundation bolts and the connecting bolts of the driven machine, etc, and tighten them, if necessary.

2). Clean off the dust and the oil dirt on the engine parts. If there is any leakage of water, oil, fuel or air, eliminate it.

3)Check the oil sump and the injection pump for their oil lever and replenish them if necessary.

4). Remedy all the faults and abnormalities occured in the en-

gine operation.

5). The dust gathered on the air cleaner should be cleaned away every day if the engine operates under dusty conditions.

2. First Order Maintenance

Besides the work of daily maintenance, the following items should be added:

1). Clean the air cheaner and brush off the dust on the outer surface of the paper filter element with a soft brush.

2). Clean the Model J 0810 lubricating oil filter, flush and brush the paper filter element with diesel oil and a brush.

3). Clean and service the centrifugal type bypass oil filter every 150 operating hours.

4). Check the electrolyte level of the battery and see the ventilation hole on the cover of the battery is unblocked. Replenish the battery with distilled water if necessary. Wipe clean the battery with a piece of cloth and smear the terminals with grease to prevent them from corrosion.

5). Check and adjust the tension of the fan belt.

6). Fill the water pump bearing with grease.

3. Second Order Maintenance

Besides the work of first order maintenance, the following items should be added:

1). Replace the lubricating oil in the sump, flush the oil sump, sump strainer and the filter screen of the oil filter.

2). Clean the lubricating oil filter or replace the paper filter element.

3). Wash the air cleaner or replace the filter element.

4). Wash the fuel filter or replace the filter element.

5). Check and adjust the valve lash and the decompressor's

travel.

4. Third Order Maintenance

Besides the work of second order maintenance, the following items should be added:

1). Check the injection pressure and nozzle spray. Wash the nozzle assembly and readjust the injection pressure if necessary. Repalce it if it is in vain.

2). Check and adjust the delivery advance angle of the injection pump, and replace the lubricating oil in it.

3). Wash the fuel tank and fuel pipes.

4). Check the connecting rod bolts , main bearing nuts and cylinder head nuts for their tightness.

5). Flush the outer surface of the battery with hot water. Check the specific gravity of the electrolyte; it should be within 1. 24—1. 27 when the ambient temperature is of 15°C. Replenish the battery with electrolyte and charge it if the specific gravity is lower than 1. 24.

5. Fourth Order Maintenance

Besides the work of third order maintenance, the following items should be added:

1). During the last shift before the engine going to be serviced for the fourth order maintenance, the water scale in the cooling system should be removed first and the cooling system should be washed cleaning.

2). Inspect the water pump for leakage, replace the water seal or other parts if necessary and renew the grease in the bearing of the water pump.

3). Dismantle the cylinder head, check the valves for gas tightness, clean off the deposited carbon, and see if lapping the valves

and reaming the valve seats are necessary.

4). Clean off the deposited carbon on the upper parts of cylinder liners and pistons. Dismantle the piston — connecting rod assembiles, inspect the wear conditions of the cylinder liners, pistons and piston rings. Replace the piston rings if necessary.

5). Dismantle the sump, inspect the wear conditions of the crankshaft, main bearings, thrust bearings and connecting rod bearings.

6). Dismantle the lubricating oil pump and adjust the end play of the rotor if necessary.

7). Inspect the dynamo and starting motor, renew the grease in the bearings.

8). Inspect, adjust and test the injection pump and the governor (if it is necessary).

Chapter Ⅷ. Engine Troubles and Their Remedies

In order to enable the users to identify and remedy the engine common troubles, the general faults, probable causes and their remedies are listed as follows:

1. Engine Fails to Start

Abnormality and Cause	Remedy
1) The starting motor fails to rotate the engine.	
(1) Insufficient battery voltage or bad connection in starting electrical system.	(1) Recharge the battery or eliminate the fault in connection.
(2) The pinion of the starting motor fails in meshing with the flywheel ring rear.	(2) Adjust the stroke of the electromagnetic switch core.
2) A dense white smoke emits from the exhaust manifold.	
(1) Air trapped in the fuel passage	(1) Vent the air according to the maintenance procedure of the fuel system.
(2) Decompression mechanism fails to return	(2) Check and adjust it.

(3) Insufficient preheating of the engine.	(3)In winter, the engine cooling system should be filled with hot water before starting and preheat the air intake manifold with the preheater.
(4) The fuel spray is not well atomized.	(4)Inspect and adjust the injector or replace the nozzle assembly if necessary.
(5) Incorrect fuel delivery advance angle (Owing to reinstalling the injection pump)	(5) Chech and adjust the fuel delivery advance angle. It should be of 17°± 2° before T. D. C.
(6) Water trapped in the cylinders.	(6) Inspect the cylinder head whether there is a crack on it and check the cylinder head gasket for gas tightness.
(7) Insufficient compression pressure in cylinders.	(7) Remedy it according to the procedure specified in the section of "Insufficient compression pressure in cylinders" later.
(8)The starting hole on the swil chamber inserts are blocked.	(8)Clean off the deposited dirt to make them unblocked.
3) No smoke (or only a little black smoke) comes out from the exhaust manifold.	
(1)No fuel in the fuel tank	(1)Replenish it and vent the air from the fuel passage.

(2)The stop lever of the governor fails to return.	(2) Push it forward to its end position.
(3)Fuel passage is blocked	(3) Inspect the fuel passage from fuel tank to the injection pump (The screen inside the banjo connection bolt of the feed pump should be checked first). Eliminated it.
(4)Control rod of the injection pump is stuck.	(4) Dismantle the inspection window cover to inspect the control rod. If it is stuck, send the injection pump to a service workshop for remedy.
(5)The feed pump fails to supply fuel.	(5)Check whether the piston is stuck and inspect whether the valve and the spring are in good conditions.

2. Unsteady Running of The Engine

Abnormality & Cause	Remedy
1). Engine running intermittently.	
(1)Poor qualitty of the fuel or the fuel contains water.	(1)Check the fuel quality and renew it if necessary.
(2)Air trapped in fuel system.	(2)Vent the air.

(3)Uneven fuel delivery to each cylinder.	(3)Check and adjust the injection pump on a special test stand.
(4)Fuel injection pipe cracks or pipe connection gets loosen.	(4) Replace the fuel injection pipe, or tighten the connection nut to eliminate the leakage.
(5)Water enters into cylinder.	(5) Tighten the cylinder head nuts first. If it is in vain, the cylinder head, cylinder liners should be inspected.
(6)Plunger spring breaks.	(6)Replace the spring.
(7)Fuel spray of one or two injectors is not well atomized.	(7)Check, adjust or repalce the nozzle assembly.
(8) Insufficient compression pressure in ont or the cylinder.	(8)Remeby it according to the procedure specified in the section of "Insufficient compresion pressure in cylinders" later.
(9) Plunger control arm loosens.	(9)Replace the plunger.
2). Rough runing of the engin.	
(1) Fuel injecting pressure of the injector varies.	(1)Check and adjust the fuel injecting pressure.
(2) The nozzle assembly gets strck.	(2)Wash, inspect and lap it with lubricating oil, or replace it if necessary.
(3)The control fork on control rod of injection pump gets loosen.	(3)Dismantle check and adjust the injection pump (on a special test bench).

3). The engine emits dense black smoke to — gether with shrill pounding noise. The nozzle assembly is stuck seriously.	Replace the nozzle assembly
4). A hiss comes from the intake manifold (It can be heard clearly in the engine running at idling). The valve leaks.	Adjust valve lash or lap the valve.
5). Engine runs unsteadily. The governor is not so sensitive.	Send it to a service workshop for check and repair.

3. Insufficient Engine Output

Abnormality & Cause	Remedy
1). Insufficient Compression pressure in cylinders	
(1)Valve spring breaks.	(1)Crank the engine to let the piston reach its T. D. C., and then replace the spring
(2) Valve lash is too small or even becomes to zero.	(2)Adjust the valve lash
(3)The valves leak.	(3)Lap the valves.

(4)The piston rings are stuk by carbon deposits or are worn out.	(4) Clean off the carbon deposits or replace the rings.
2). Abnormal operation of the fuel system.	
(1)The fuel delivery timing is incorrect.	(1) Readjust the fuel delivery timing.
(2) The plungers of injection pump are worn out.	(2)Replace the plungers (do it in a service workshop).
(3)Fuel spray of injector is not well atomized.	(3)Wash cleaning or replace the nozzle assembly.
(4)Insufficient fuel supply.	(4)Check whether the fuel passage is blocked.
3). Air cleaner is choked.	3). Clean or replace the fillter element.

4. Abnormal Exhaust Smoke

Abnormality & Cause	Remedy
1). Black smoke.	
(1)Engine is over—loaded.	(1)Reduce the load.
(2)Fuel spray is not well atomized.	(2)Clean or replace the nozzle assembly.
(3)Injection timing is too late.	(3) Check and adjust the fuel delivery advance angle, it should be of $16\pm\frac{1}{2}^{\circ}$.

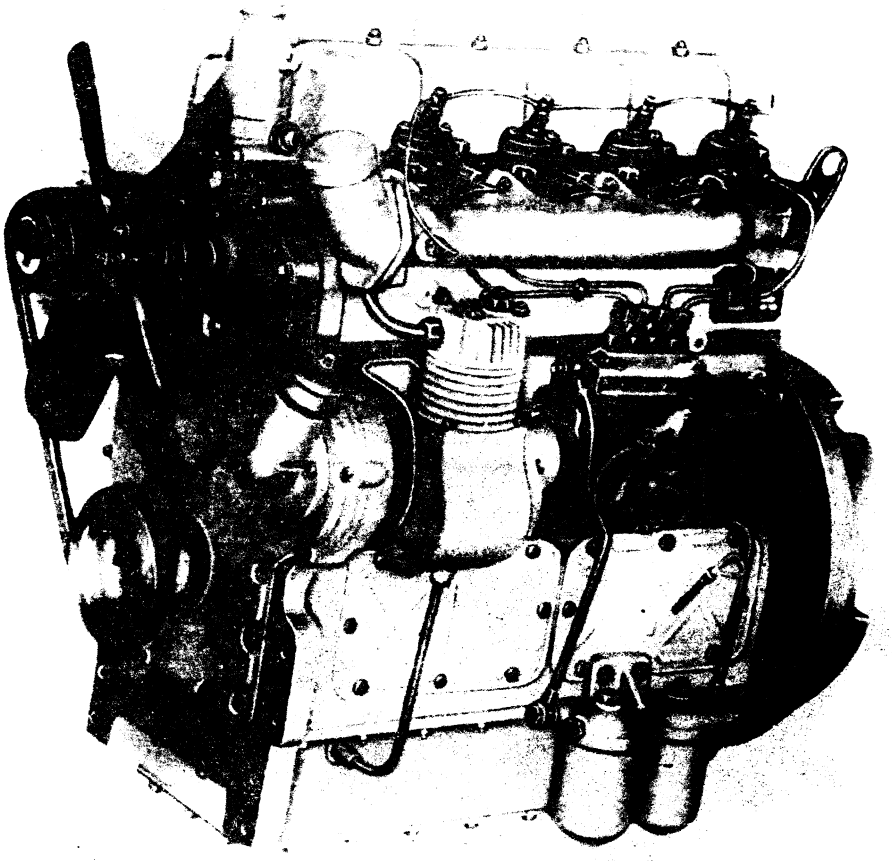


Fig. 3 Right—hand front view of
model 495T Diesel Engine

(4)Air cleaner is choked.	(4)Clean or replace the filter element.
2). White smoke	
(1) Insufficient compression pressure.	(1)Remedy it according to the procedure specified in the section of "Insufficient compression pressure in cylinders" above.
(2)Temperature of cooling water is too low.	(2) Increase the cooling water temperature.
(3)Injection timing is too late.	(3)Adjust the injection timing.
(4)Water trapped in fuel.	(4) Inspect the fuel quality and renew it if necessary.
3). Grey blue smoke	
(1)Oil level in oil sump is too high.	(1)Check the oil level and drain out the excessive oil.
(2) The piston rings are stuck by carbon deposits or are worn out.	(2) Clean off the carbon deposits or replace the rings.
(3) The clearance between piston and cylinder liner is too large.	(3)Replace the cylinder liner.

5. Unusual pounding noise

Abonrmality & Cause	Remedy

1). Injection timing is too early (The rhythmic pounding noise can be heard clearly during the engine running at idling).	Check and adjust the fuel injection timing.
2). Clearance between piston pin and connecting rod small end bushing is too large (A clear metallic pounding noise emits from the upper portion of the cylinder when engine runs at low speed or when engine speed or suddenly drops to the idling).	Replace the connecting rod small end bushing.
3). Valve pounds the piston top. A dull cilcking noise emits from joint surface of cylinder and cylinder head, it will be even louder if the valve lash is reduced.	Inspect the valve lashes and check the valve timing.
4). Connecting rod bearing or main rearing clearance is too large or one of these bearing is damaged. (The dull pounding noise emits from the lower portion of cylinder block).	Replace the connecting rod bearing or main bearing.
5). Valve lashes are too large (The rhythmic cilcking noise can be heard clearly above the cylinder head).	Adjust the valve lashes.

6. Engine Overheated

Abnormality & Cause	Remedy
1). Engine is overloaded for a long period.	Reduce the load.
2). Cooling water is insufficient	Replenish the cooling water.
3). Fan belt is too loose.	Adjust the tension of the belt.
4). Thermostat is out of order.	Replace it.
5). Radiator is clogged up.	Clean and repair it.
6)Injection timing is incorrect.	Adjust the injection timing.
7). Oil level in oil sump is too high so that the oil overheated.	Keep the oil level in oil sump normal.

7. Abnormal Lubricating Oil Pressure in Main Oil Passage

Abnormality & Cause	Remedy
1). Oil pressure suddenly drops to zero in operation.	
(1) Lubricating oil pump gear has come off.	(1)Inspect and repair.
(2)Lock pin of the inner rotor of oil pump breaks.	(2)Replace the inner and outer rotors.

(3)Oil pressure gauge is out of order or an oil pipe breaks.	(3)Inspect and replace.
2). There is no oil pressure in a new engine or unsteadiness of the oil pressure of a engine whose sump strainer is just washed.	
Oil suction pipe leaks.	Tighten the bolts or replace the gasket.
3). Oil pressure cann't be lifted up by the adjustment.	
(1) Oil fillter element is clogged.	(1)Replace the filter element.
(2) Pressure regulating valve spring of oil filter breaks or pressure regulating valve leaks.	(2) Inspect and replace the spring or lap the valve.
(3) Crank shaft or camshaft bearing clearances are too large.	(3)Replace the bearings.
(4) Lubricating oil pump rotor is worn out or its end play is too large.	(4)Replace the rotor assembly or adjust the end play.

8. Engine running away (overspeed Suddenly)

Abnormality & Cause	Remedy

1). Oil level in the governor is too high.	Drain off the excessive oil.
2). Some parts of governor are stuck.	Send it to a service
3). Adjusting arm of injection pump plunger gets loose.	——ditto——
4). Control rod of injection pump is stuck.	——ditto——
5). Preheater needle valve leaks.	Replace the preheater.

Chapter Ⅸ. Model 495G Stationary Diesel Engine

1. Constructional Features

Model 495G diesel engine is formed by adding the clutch and power take—off assembly to the basic version of model 495. It is an independent diesel power unit provided with the baseframe, fuel tank, instruments and control mechanism, etc. According to the user's request the cooling fan and the radiator are available for different service sites.

Model 495G diesel engine adopts a single plate constantly meshed dry type clutch. The majority of the clutch parts are common with those of the main clutch on Taishan—50 tractor.

The clutch and power take—off assembly consists mainly of the support plate, clutch disc, pressure plate, pressure plate spring, release lever, power take—off shaft, release bearing, release fork, clutch housing and control lever, etc. as shown in Fig. 34.

The engine power is transmitted to the pulley through the fly wheel, support plate, pressure plate, clutch disc and power take—off shaft. The front end of the power take—off shaft is supported on the flywheel bearings while its rear end is supported on the two bearings in the clutch housing. The release bearing and its seat are fitted on the front bearing cap and are able to slide axially. On the pressure plate, there are three pulling brackets protruding from the support plate, on which three release levers are installed. When the control lever is shifted forward, the release fork pushes the release bearing seat forward, the release bearing will touch and force the release levers to make the pressure plate overcome the spring pressure and depart from the clutch disc, then the power take—off will be cut—off.

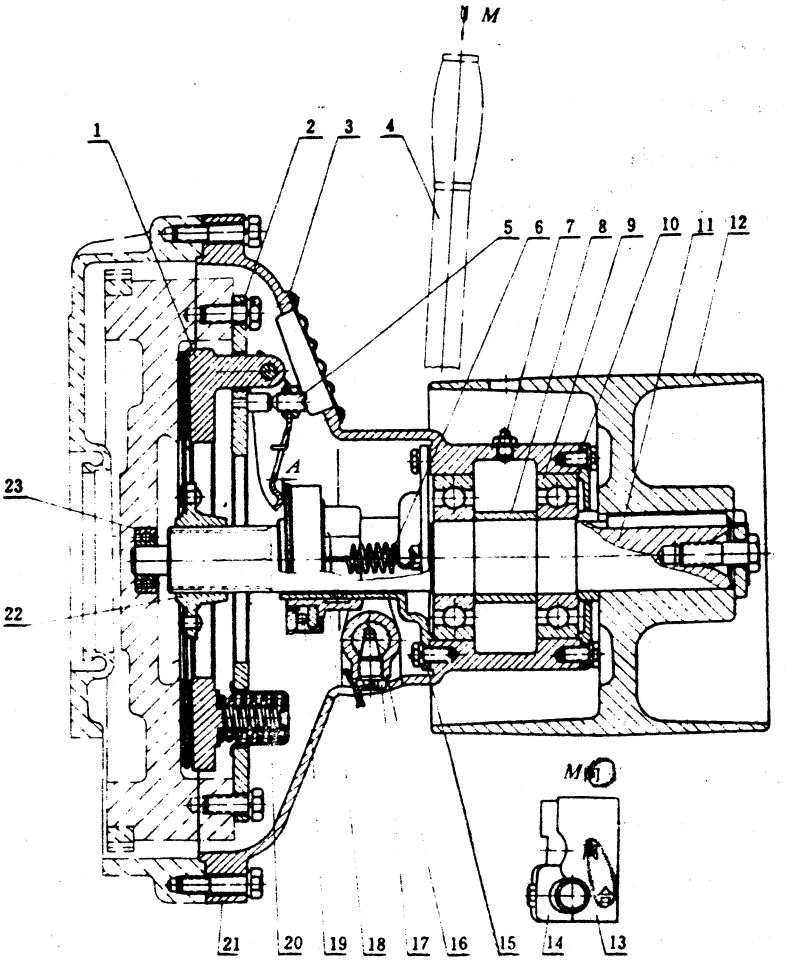


Fig. 34 Clutch and power take—off assembly

1—— Pressure plate; 2—— Support plate; 3—— Window cover of adjustment; 4—— Control lever; 5—— Adjusting screw and pressure plate spring of release lever; 6—— Return spring; 7—— Grease nipple; 8—— Spacer; 9—— Ball bearing; 10—— Rear bearing cap; 11—— Power take—off shaft; 12—— Pulley; 13—— On—off positioning plate; 14—— Forked connection; 15—— Front bearing cap; 16—— Release fork and shaft; 17—— Lock screw; 18—— Release bearing seat; 19—— Release bearing; 20—— Pressure plate outer and inner springs; 21—— Clutch housing; 22—— Clutch lining assembly; 23—Ball bearing.

2. Operation and Maintenance of The Clutch

1). The clutch should be engaged only when the engine speed is not higher than 1500 rpm. The act of engagement should be moderate, otherwise the engine may emit dense smoke or even stall because of being loaded suddenly. The act of disengagement should be prompt without hesitation so as to prevent the clutch disc from premature damage because of sliding each other.

2). During the engine operating, it is not permitted to disengage the clutch for more than 15 minutes in order to prevent the release bearing from premature damage. Therefore, the engine should be disconnected with the driven equipment and shift the clutch to the "on" position when the engine is being warmed up in winter.

3)Pay close attention to prevent the engaged surfaces of the clutch disc, flywheel and pressure plate from grease or dirt when the clutch is dismantled or installed. When install the clutch on to the engine, the centering mandrel (a tool provided with the engine) should be used to make the center line of the clutch disc spline hole coincide with the center line of the flywheel bearing as shown in Fig. 35. Then, fix the support plate onto the flywheel. After the clutch disc has been fastened, take out the centering mandrel and install the clutch housing.

4). Check and maintenance of the clutch

(1)Fill the grease nipple on the clutch housing with sodium base grease through the hole on the pulley every 150 operating hours. Don't use the common calcium base grease.

(2)Fill grease into the two grease nipples on the release fork shaft every 250 operating hours (Second order maintenance).

(3)The clearance "A" between the release lever and the re-

lease bearing should be checked and adjusted every 500 operating hours (Third order maintenance). The procedure is as follows:

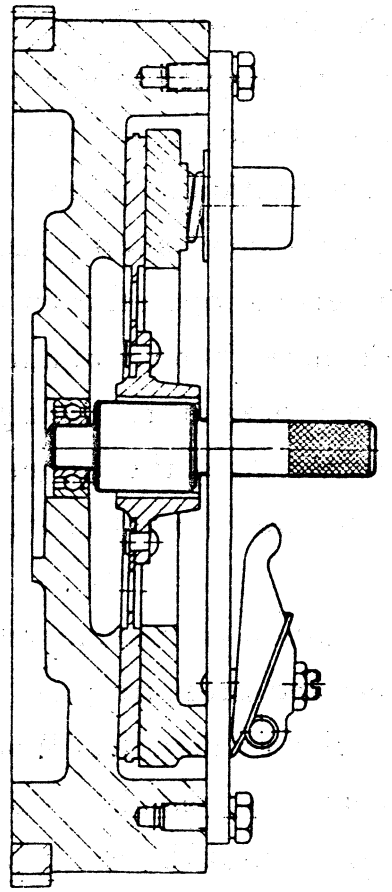


Fig. 35 Usage of the centering mandrel.

Remove the adjusting window cover, loosen the nuts to adjust the adjusting screws, When the clutch control lever is shifted to the differences among three clearances should not be more than 0. 2mm.

(4) The clutch and the power take—off shaft should be dismantled and checked once every 1000 operating hours (Fourth order maintenance). Clean off the deposited dust and greasy dirts, inspect and replace the damaged parts. If the thickness of the clutch lining has been reduced to less than 7. 2 mm by wear, the lining

should be replaced. Dismantle the release bearing, immerse it into meltiing sodium base grease and boil it for 10 minutes, then wipe it clean and reinstall it.

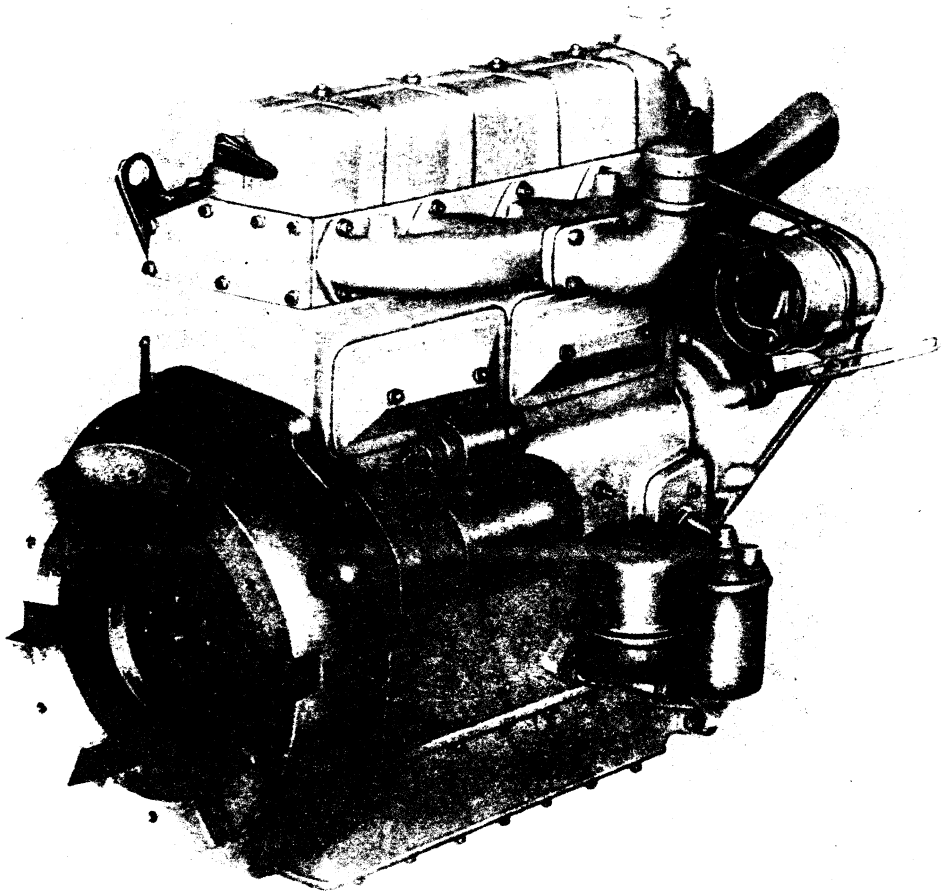


Fig.4 Left—hand back view of
model 495T Diesel Engine

Chapter X. Model 495T Diesel Engine for Tractor

1. Constructional Features

Being served as the power of the tractor, model 495T diesel is a version of the model 495 engine. The main specification, construction, adjustments and maintenances of this version are the same as those of model 495 diesel engine. Hence only its constructional features and the relevant affairs in operation and maintenance which differs from other versions will be described in this chapter.

Model 495T diesel engine is provided with a model K1317A air cleaner of two—stage dry type. It consists mainly of upper casing, guide vanes, paper filter element and lower casing, etc, as shown in Fig. 36.

The air cleaner is fitted on the air intake manifold which intakes air from one of its ends.

Being provided with a dry type cyclone, this air cleaner is good in performace of rough filtering. It is especially suitable to be used in the dusty and dry working ambient.

While the engine is in operation, the air entering into the upper casing through its inlet port along the tangential direction froms a swirl movement, which grows very strong and flows downwards after passing through the guide vanes. The dust particles contained in the air are separated out under the action of the centrifugal force and fall into the bottom of the lower casing. At this time, the air stream changes its moving direction, and enters into the inner space of the filter element from its outside to complete its further filtration.

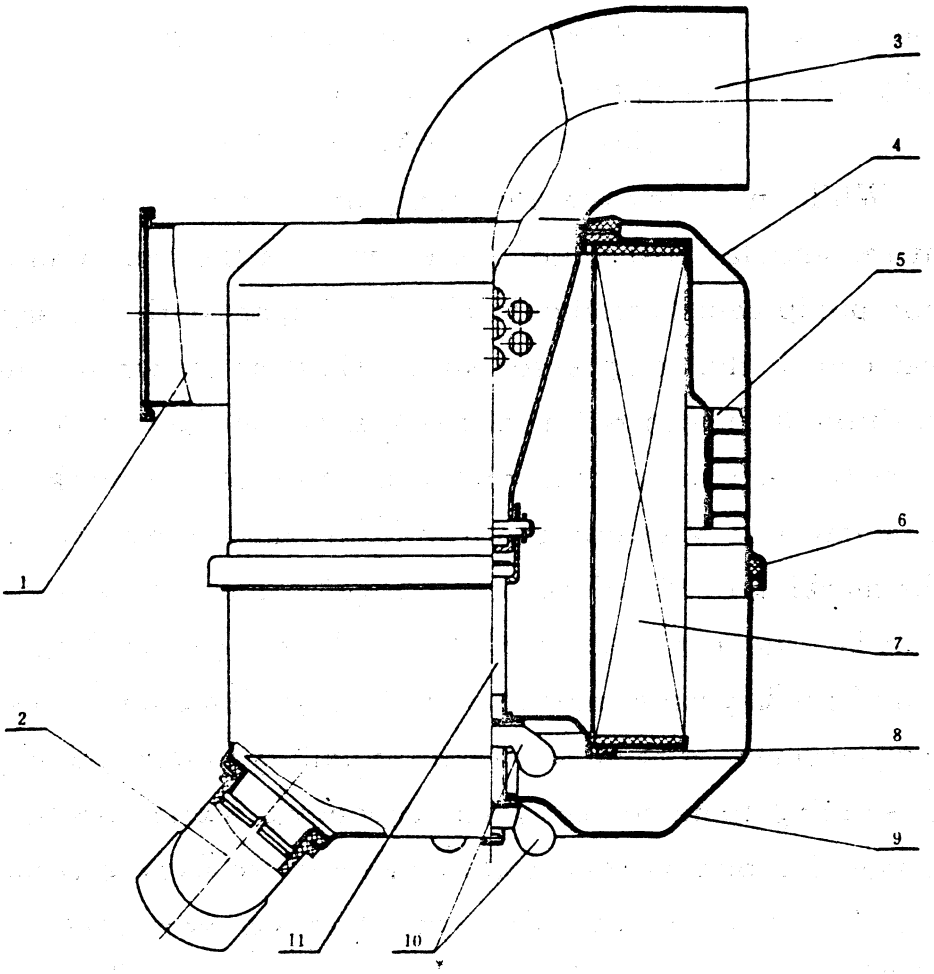


Fig. 36 K1317A Air cleaner

1——Inlet port; 2——Rubber dust discharger; 3——Outlet port; 4——Upper casing; 5——Guide Vanes; 6——Ring seal; 7——Filter element; 8——Filter element ring seals; 9——Lover casing; 10——Winged nut; 11——Center bolt.

In order to prevent the unfiltered air from entering the inner space of the filter element, the element is sealed at its ends by the rubber seals, which are tightened together with the element by a center bolt and a winged nut. A rubber dust discharger is provided at the bottom of the lower casing. The dust inside the lower casing

is gathered in this discharger. A duck bill shaped opening is provided at the lower end of the discharger to discharge the dust automatically while the engine is in operation.

2. Adjustment and Maintenance

1). While installing the injection pump, attention must be paid to that the angular position of the keyway on the front end of the injection pump camshaft should be of 90° apart with the same on the rear end of the compressor spline shaft as shown in Fig. 37. The position of the centre line of the keyway on the rear end of the spline shaft is corresponding to the position of the mark on the flanged connector. Viewing from the front end of the tractor, if rotate the marking on the rim of the flanged connector for 90° counterclockwise, the new position of the marking is just at the angular position of the keyway centre line on the injection pump camshaft. Any misplacement of them will result in failing to start the engine. After installing them correctly, corresponding marks can be made on the injection pump connecting flange and the flanged connector respectively to prevent them from misalignment next time.

2). If it is necessary, the two bolts fastening the flanged connector and the flanged disc may be loosened for adjusting the fuel delivery advance of the injection pump. Viewing from the front end of the tractor, rotate the flanged disc clockwise in respect to the flanged connector, the fuel delivery advance increases, vise verse. Stagger the corresponding markings on the flanged connector and the flanged disc by one divesion, the fuel delivery advance will increase or decrease by 8° (crank angle).

Appendixes

List of Rolling Bearing

Model of bearing (ball)	Name of Assembly on which bearings (balls) mounted	Bearing Quantity		
		495	495G	495T
60203	495 — 06100 Water pump and fan	2	2	2
60204	495G — 15000 Clutch and power take—off		1	
310	495G — 15000 Clutch and power take—off		2	
9688213 (JB85—58)	495G — 15000 Clutch and power take—off		1	
E7203	495—13000 Injection pump	2	2	2
Steel ballΦ3	495—13000 Injection pump	12	12	12
Steel ballΦ6	495—13000 Injection pump	1	1	1
Steel ballΦ8	495—09300 oil pump	1	1	1
Stell ballΦ10	J 0810 — 2000 oil Filter head	1	1	1
Stell ballΦ12	J 0810 — 20000 oil Filter head	1	1	1
Steel ball 1″	495—13000 Injection pump	6	6	6

List of Oil Seals

Code NO.	Specification	Name of assembly on which oil seals used	Quantity 495	495G	495T
HG_4—692—67	Oil seals				
	PG 55 X 85 X 12	495—01000 Cylinder block	1	1	1
	PG 100 X 125 X 12	495—01000 Cylinder block	1	1	1
	PG 17 X 35 X 10	495—13000 Injection pump	1	1	1
GB1235—76	"O" ring seals				
	10 X 1.9	495—03300 Rocker arm shaft bracket	2	2	2
		495—13000 Injection pump	3	3	3
	14 X 2.4	495—03200 Cylinder head cover	1	1	1
	18X 2.4	495—09500A Oil filter bracket	1	1	1
	240 X 5.7	495T—01000 Cylinder block			1
C 0708—0001	Ring seals				
	33 X 3.5	C0708—0000 Fuel filter	2	2	2
C 0708—0003	73 X 81 X 2.5	C0708—0000 Fuel filter	1	1	1
J 0810—0007	37.5 X 3.5	J0810—0000 Oil filter	2	2	2
J0810—0008	94 X 87 X 3	J0810—0000 Oil filter	1	1	1
FL 85—0002	113.5 X 4.6	FL 85—0000 Centrifugal bypass oil filter	1	1	1
FL 85—01004	79.4 X 3.1	FL 85—0000 Centrifugal bypass oil filter	1	1	1
495—01504	Breather diaphragm 40 X 3.5	495—01500 Breather and oil filter	1	1	1
495—03010A	Cylinder head cover gasket	495—03000 Cylinder head	1	1	1

List of water Seals

Code NO.	Specification	Name of assembly on which water seals used	Quantity 495	495G	495T
95—0102	Cylinder liner seal 81 X 4	495--01000 Cylinder block	8	8	8
495—03018	"O" ring seal 50 X 2	495—03000 Cylinder head	1	1	1

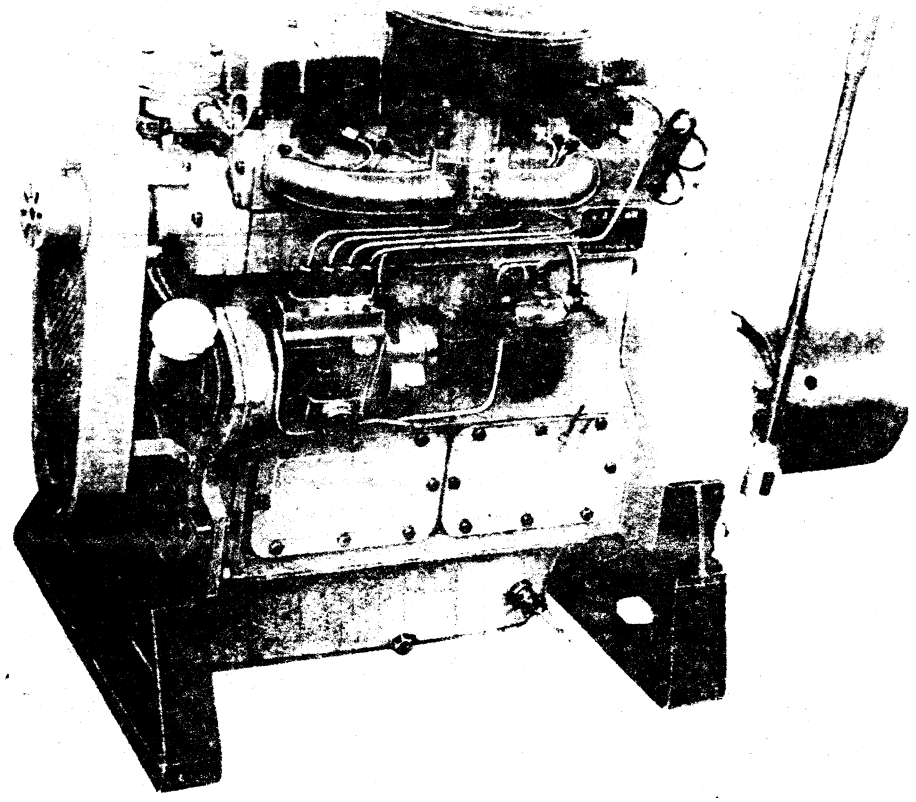


Fig. 5 Right—hand front view of
model 495G Diesel Engine

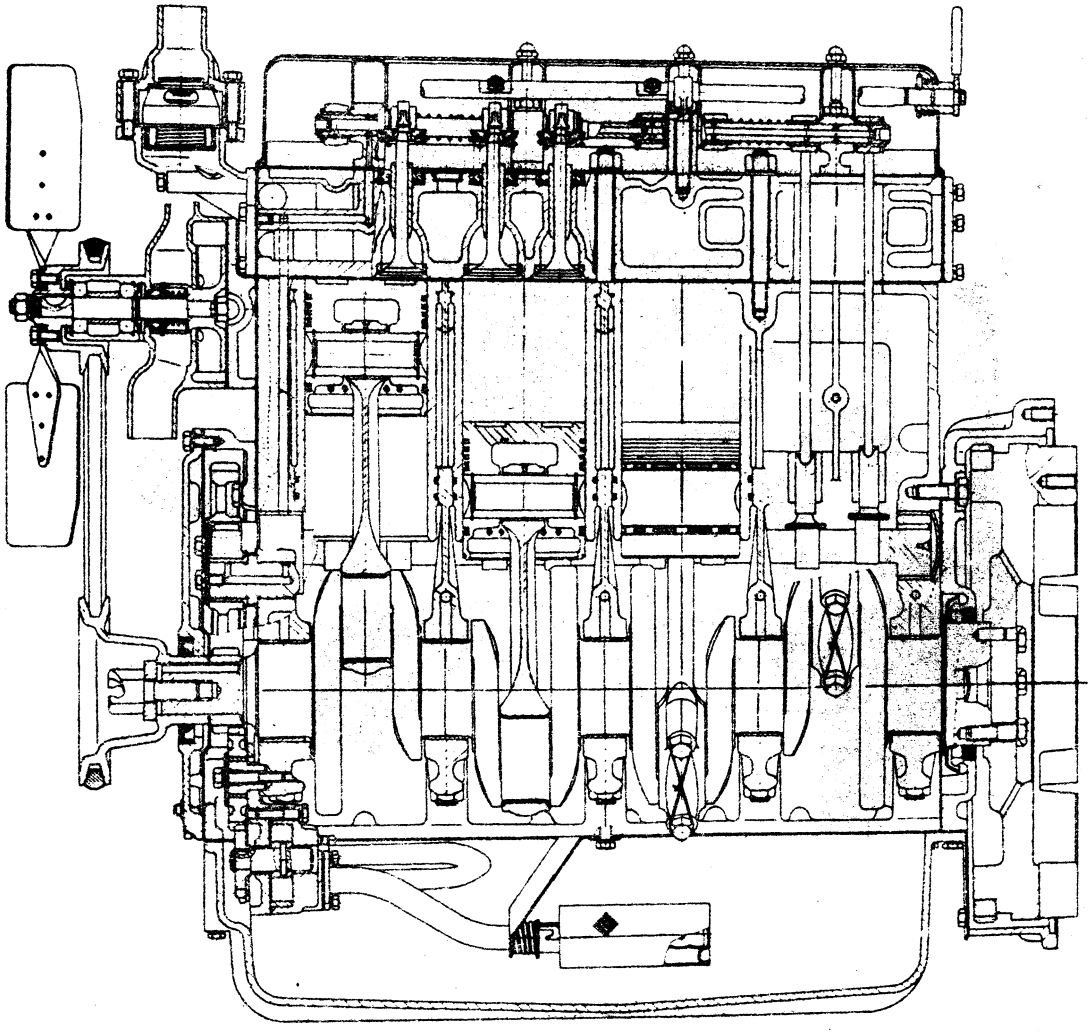


Fig. 6 Longitudinal and cross section drawings of model 495 Diesel Engine

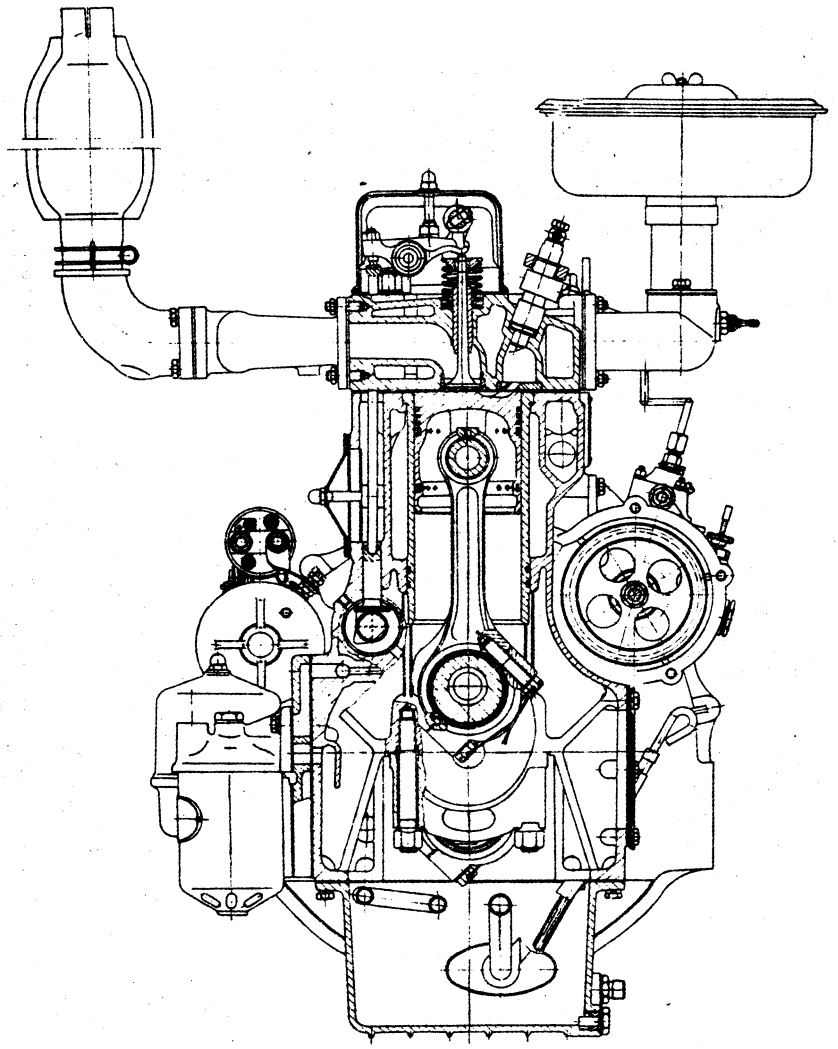


Fig. 6 Longitudinal and cross section drawings of model 495 Diesel Engine

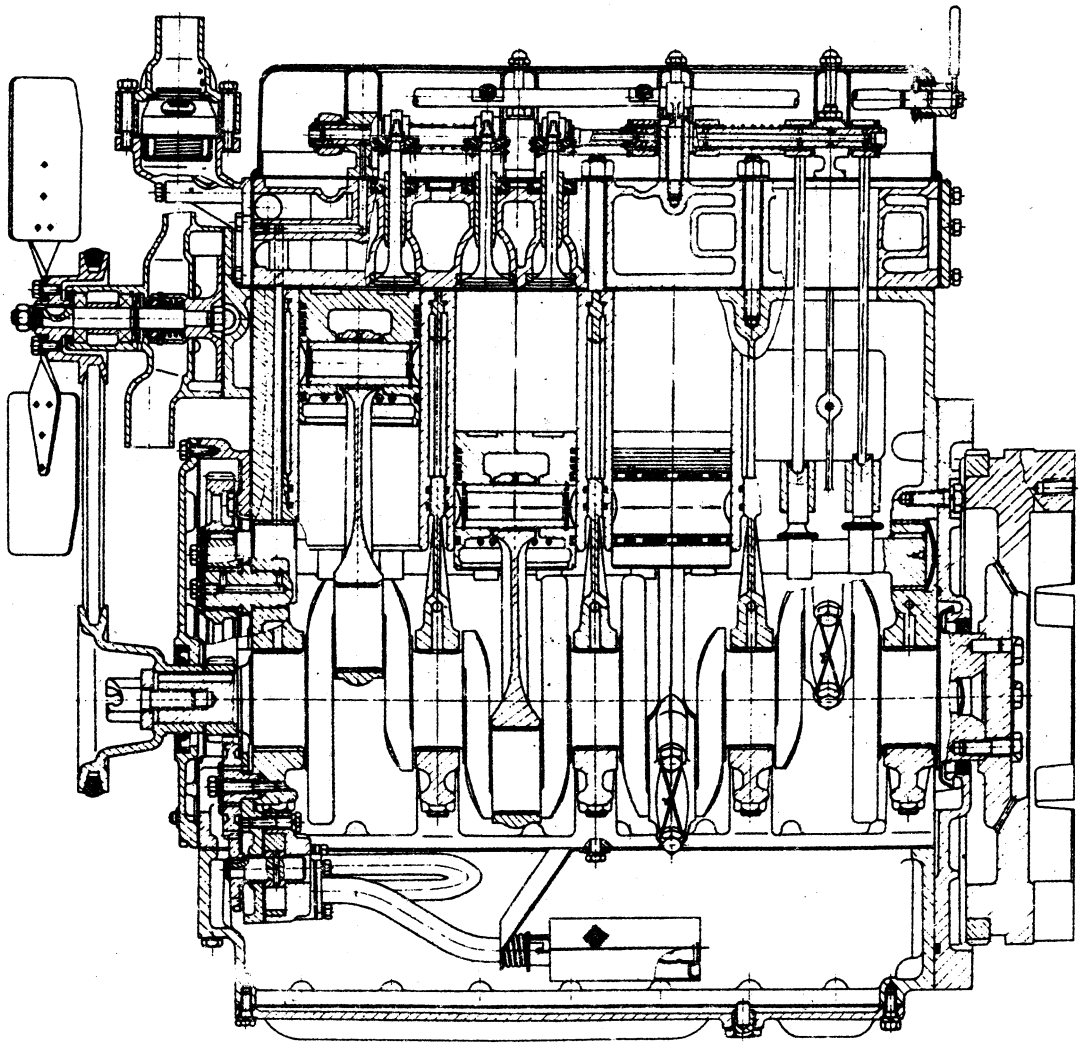


Fig.7 Longitudinal and cross section drawings of model 495 T Diesel Engine

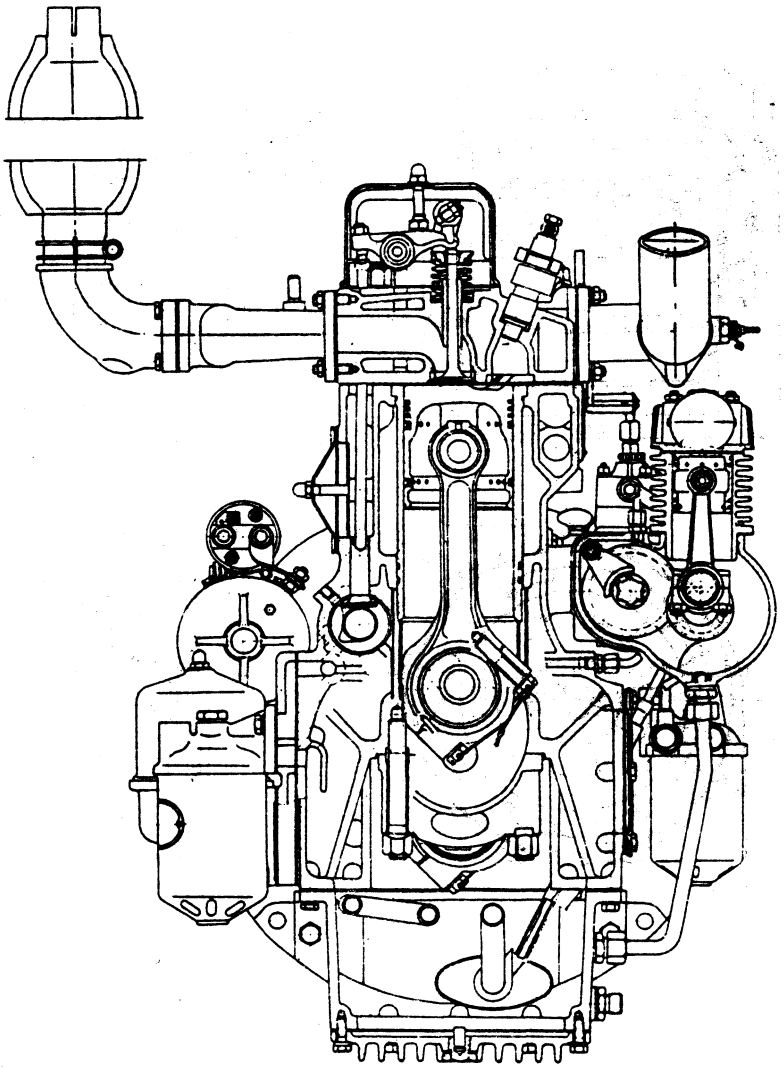
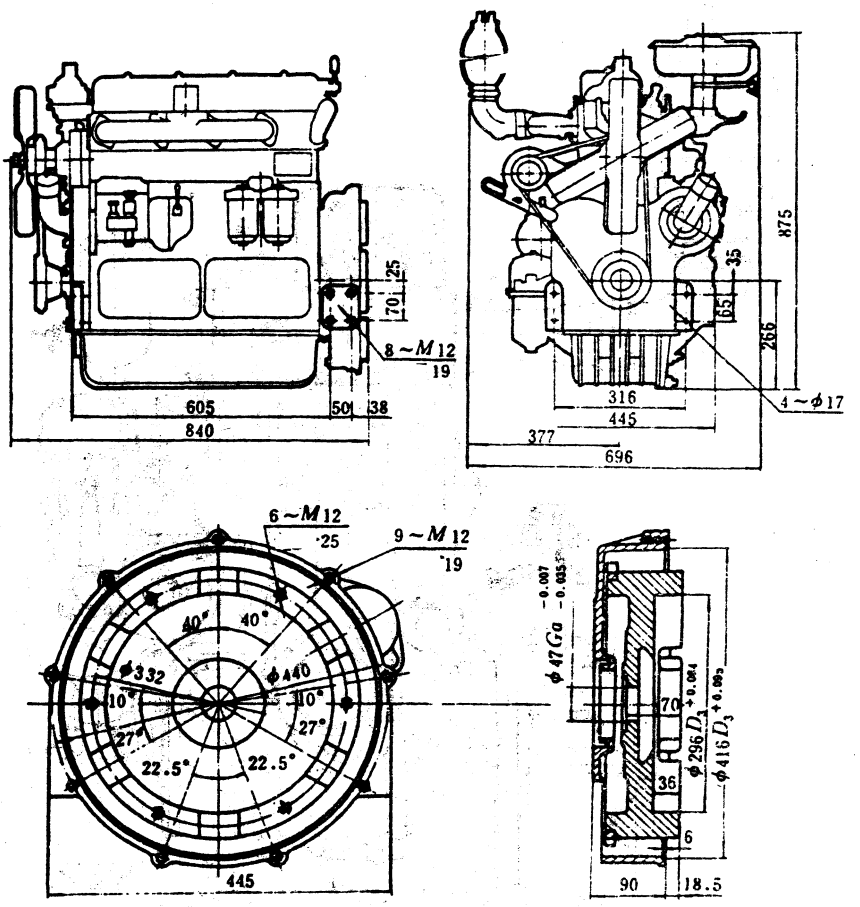


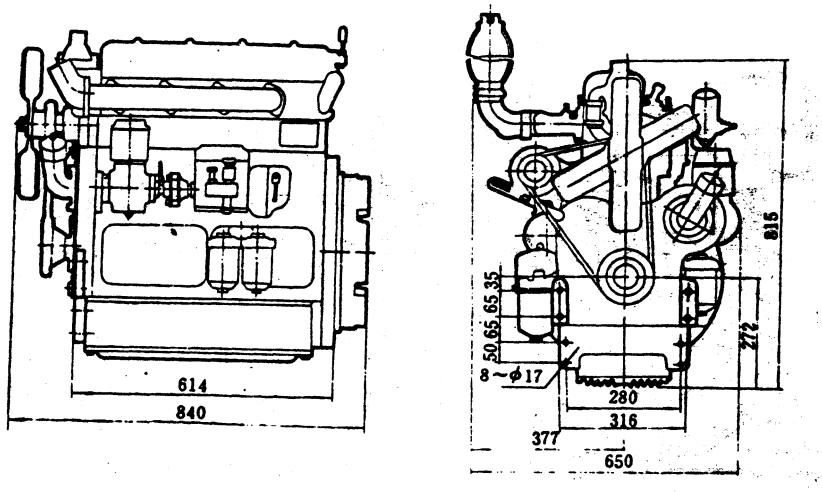
Fig. 7 Longitudinal and cross section drawings of model 495 T Diesel Engine

8 tapped holes of M12,19 deep



9 tapped holes of M12, 19 deep

Fig. 8 Overall and Mounting Dimensions of model 495 Diesel Engine



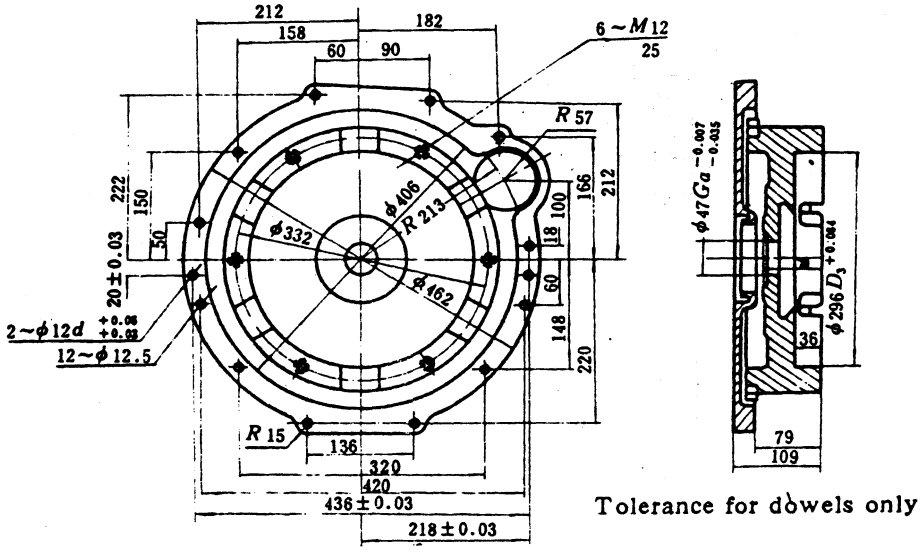
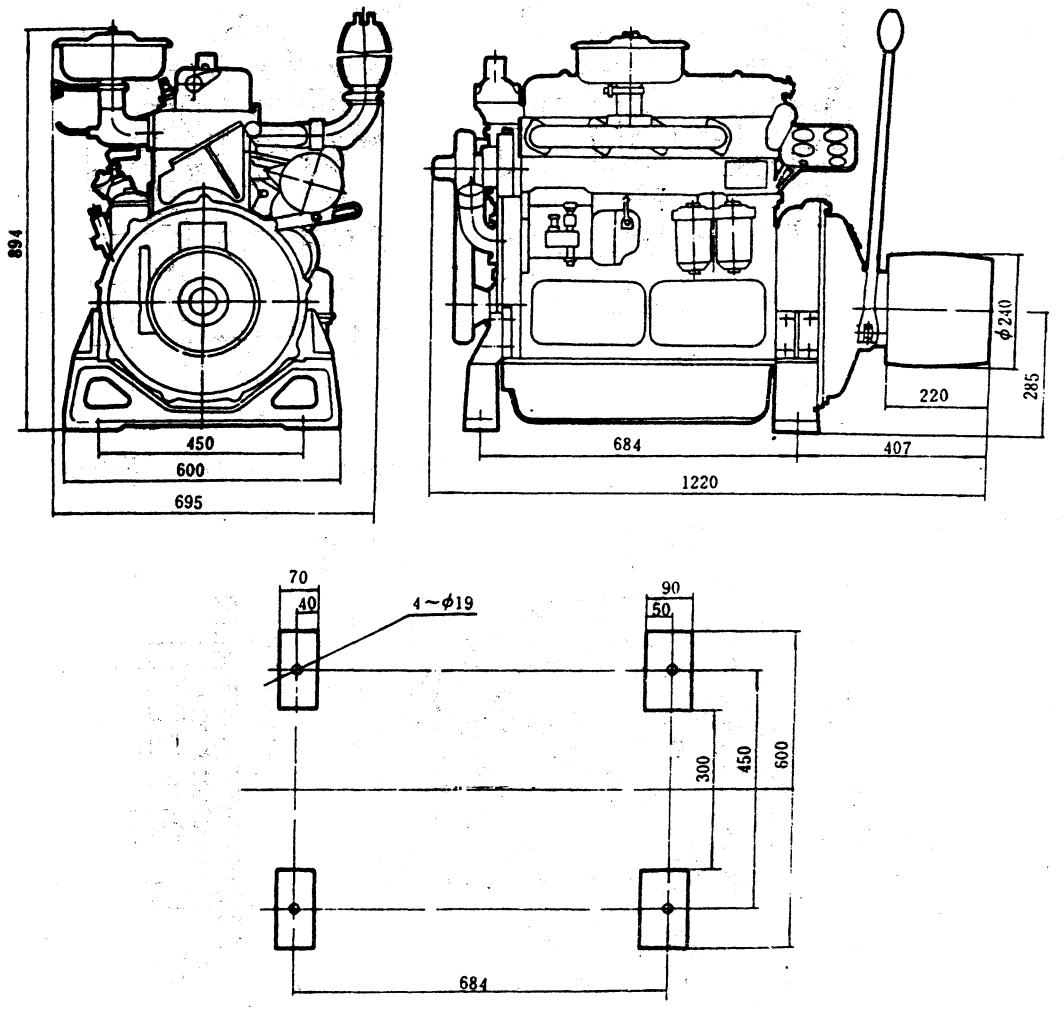
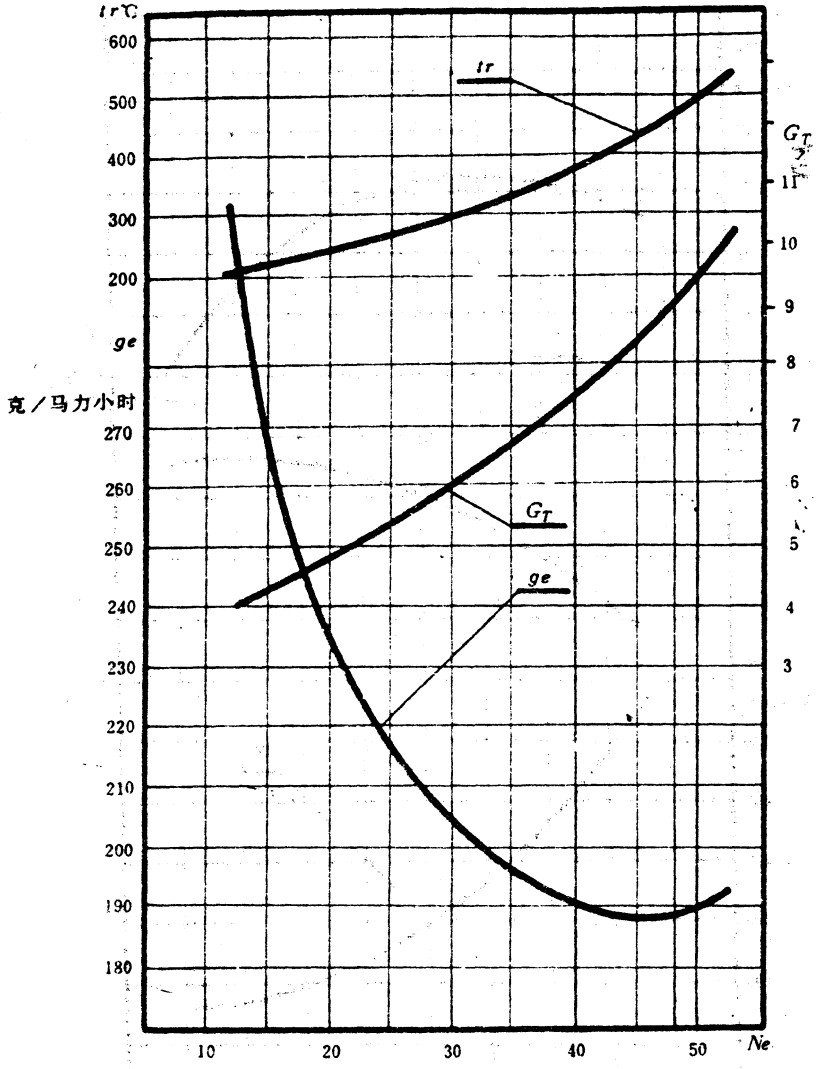


Fig. 9 Overall and mounting dimensions of model 495 T Diesel Engine



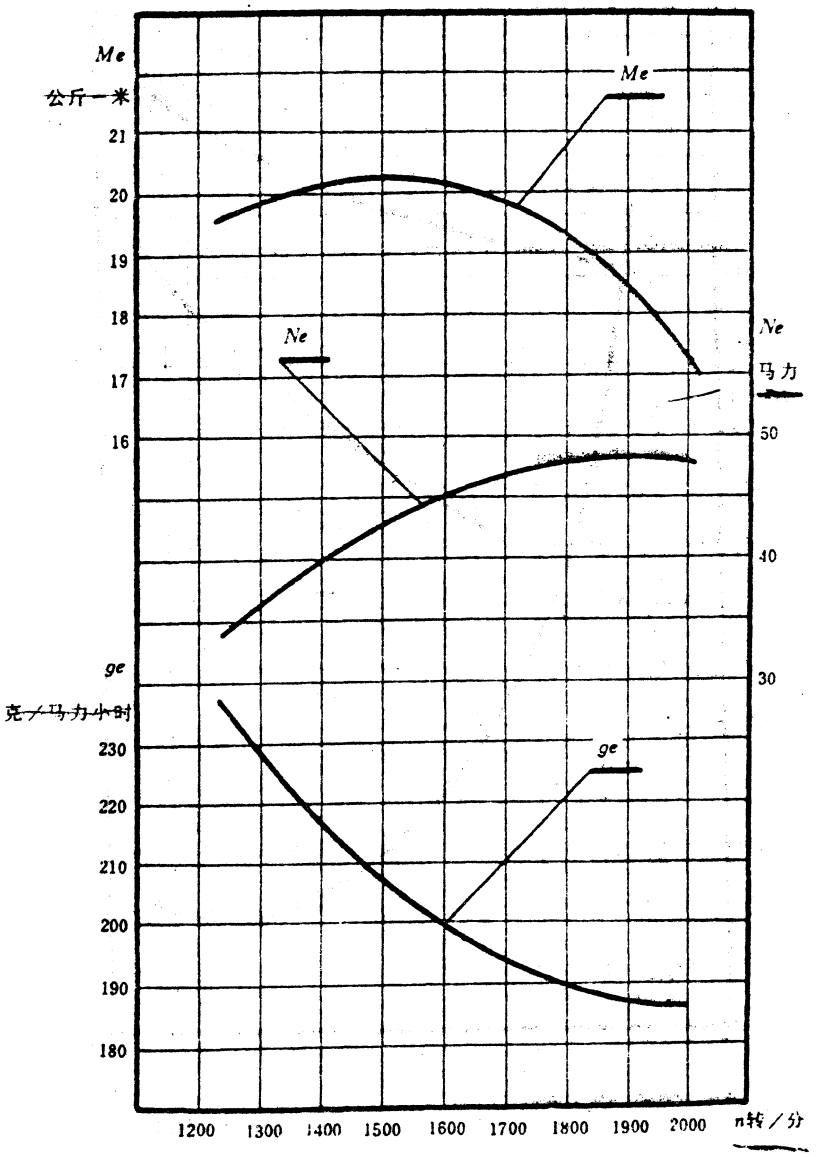
Crankshaft Center Line

Fig. 10 Overall and mounting dimensions of model 495 G Diesel Engine



12 hr. Power Rating at 2000 rpm

Fig. 11 Load characteristic curve of model 495 Diesel Engine



12 hr. Power Rating

Fig. Speed characteristic curve of model 495 Diesel Engine

Chapter I. Main Specifications and Technical Data of The Diesel Engine

1. Main Specifications

Model	495
Type	Vertical, in-line, water-cooled, four-stroke
Number of Cylinders	4
Cylinder bore	95mm
Piston stroke	115mm
Type of combustion chamber	Swirl chamber
Compression ratio	18—20
Firing order	1—3—4—2
Mean piston speed	7.67m/s
rated output and speed	
1 hour power rating	38.8kw/2000rpm
12 hour power rating	35.3kw/2000rpm
Continuous power rating	31.8kw/2000rpm
Max. idle speed	≤2200rpm
Min. Idling steady speed	≤550rpm
Max. torque and its related speed	≥196N—m/1500rpm
At 12 hour power rating:	
Mean effective pressure	650kpa
Specific fuel consumption	≤251.6g/kw—hr
Specific lube oil consumption	≤2.04g/kw—hr
Lubricating oil pressure	196Kpa—392Kpa
	49Kpa at idling speed
Lubricating oil temperature	≤368K

Outlet water temperature	343—363K
Exhaust gas temperature	≤743K (at manifold branch)
Direction of crankshaft rotation	Counter — clockwise (viewed from flywheel end)
Cooling method	Forced circulation water cooling
Lubricating method	Mixed type, pressure and splash lubrication
Starting method	Electric motor starting
Lubricating oil capacity	11.5 liter (approx. 9.5 kg)
Engine overall dimensions (L W H)	
Model 495	840 696 875 mm
Model 495T	840 650 815 mm
Model 495G	1310 695 394 mm
Engine net weight	
Model 495	320—340 kg
Model 495T	360 kg
Model 495G	450 kg

2. Specifications of Main Accessories

Lubricating oil pump	
Type	Inner and outer rotor type (JZ 2518—412—8 left)
Speed	2350 rpm
Capacity	>35 liter/min
Cooling water pump	
Type	Centrifugal type
Speed	3000 rpm
Capacity	>100 liter/min
Discharge head	6 m

Fuel injection pump	
Type	4—cylinder No. 1 pump (right)
plunger helix	Left—hand
Plunger dia.	8 mm
Injection quantity per Pump element	$22cm^3$/400 times
Governor	Mechnical Centrifugal variable Speed type
Injector	Model ZS_4S_1
Fuel filter	Model CO708, single stage paper element type
Lubricating oil filter	Model JO810, single stage paper element type
Centrifugal oil filter	Model FL 85, Centrifugal by-pass type
Air cleaner:	
For model 495 and 495G	Model K2007, single stage paper element type
For model 495T	Model 1317A, paper element with dry type cyclone
Thermostat	Model 144A or model 141, Opening temperature: 343K fully opening temperature: 358K
Preheater	Model 201, 12V, 190W
Starting motor	Model ST95 (11 teeth) fully enclosed series excitation type, 12V, 1.5KW
Dynamo	Model 2JF—200, fully enclosed silicon rectifier type 14V, 180W

Regulator	Model FT70D*
Battery	Type 6—Q—140

The model FT8ID regulator should be used if the F29B 12V, 150W, d. c. dynamo is applied.

3. Tightening Torques of Main bolts and Nuts

Cylinder head nuts	118—137N—m
Cylinder head studs	59—69N—m
Main bearing nuts	137—157N—m
Main bearing studs	69—78N—m
Connecting rod bolts	98—118N—m
Flywheel bolts	98—118N—m
Gear case bolts	29—39N—m
Flywheel housing (connecting plate)bolts	49—59N—m

4. Main Adjustment Data

Valve timing(in crank angle)	
Intake valve opens	Before TDC12°
Intake valve closes	After BDC 36°
Exhaust valve opens	Befor BDC 56°
Exhaust valve closes	After TDC 12°
Valve lash:	
Intake valve	0. 35—0. 45mm
Exhaust valve	0. 35—0. 45mm
Decompression travel	1—1. 5mm
Fuel delivery advance angle	Before TDC 16°$\pm\frac{1}{2}$°CA
Injection pressure	11768+980Kpa

5. Clearances and wear Limits of the Main Parts

The clearances and wear limits of the main parts are listed in tabel 1.

Table 1

No.	Description	Standard dimensions (mm)	Clearances (mm)	Wear limits (mm)
1	Main journal and bearing	Shaft $\varnothing 75_{-0.019}$ Hole $\varnothing 75^{+0.135}_{+0.070}$	0.07—0.154	0.300
2	Crank thrust surface and thrust ring		Axial play 0.07—0.27	0.500
3	Connecting rod journal and bearing	Shaft $\varnothing 65_{-0.019}$ Hole $\varnothing 65^{+0.089}_{+0.04}$	0.040—0.108	0.300
4	Connecting rod large end and crank fillet surfaces	Shaft $38^{-0.17}_{-0.33}$ Hole $38^{+0.\overline{10}}$	Axial clearance 0.17—0.43	0.700
5	Piston skirt and cylinder liner	Shaft $95^{-0.160}_{-0.196}$ Hole $\varnothing 95^{+0.035}$	0.160—0.225	0.500
6	Piston pin and connecting rod small end bushing	Shatf $\varnothing 35_{-0.011}$ Hole $\varnothing 35^{+0.035}_{+0.010}$	0.010—0.046	0.150
7	First compression ring and ring groove	Shaft $3_{-0.012}$ Hole $3^{+0.075}_{+0.050}$	0.050—0.087	0.400
8	Second and third compression rings and ring grooves	Shaft $3_{-0.012}$ Hole $3^{+0.050}_{+0.030}$	0.030—0.062	0.300
9	Oil ring and ring groove	Shaft $6_{-0.012}$ Hole $6^{+0.050}_{+0.030}$	0.030—0.062	0.250
10	Gap of first compression ring in the cylinder	gauge $\varnothing 95^{+0.035}$	0.30—0.45	3.00
11	Gaps of second and third compression rings in the cylinder	gauge $\varnothing 95^{+0.035}$	0.25—0.40	3.00
12	Gap of oil ring in the cylinder	Gauge $\varnothing 95^{+0.035}$	0.25—0.40	3.00
13	Camshaft journal and bushing	Shaft $\varnothing 50^{-0.08}_{-0.119}$ Hole $\varnothing 50^{+0.025}$	0.08—0.144	0.250
14	Camshaft thrust plate and camshaft journal thrust surface	Shaft $12^{-0.060}_{-0.120}$ Hole $12^{+0.100}$	Axial play 0.060—0.220	0.400
15	Cylinder liner locating flange and cylinder block counterbore	Shaft $10^{+0.'050}$ Hole $10^{-0.060}_{-0.110}$	Protruding 0.060—0.160	
16	Valve tappet and cylinder block tappet hole	Shaft $\varnothing 16^{-0.016}_{-0.031}$ Hole $\varnothing 16^{+0.018}$	0.016—0.052	0.200
17	Idling gear shaft and bushing	Shaft $\varnothing 26^{-0.020}_{-0.04}$ Hole $\varnothing 26^{+0.02}$	0.020—0.063	0.200
18	Idling gear and shaft		Axial clearance 0.100—0.350	
19	Backlash of all timing gears		0.130—0.170	0.600
20	Valve stem and valve guide	Shaft $\varnothing 9^{-0.050}_{-0.070}$ Hole $\varnothing 9^{+0.030}$	0.050—0.100	0.250
21	Rocker arm shaft and bushing	Shaft $\varnothing 16^{-0.016}_{-0.034}$ Hole $\varnothing 16^{+0.018}$	0.052	0.250
22	Lubricating oil pump outer rotor and pump body	Shaft $\varnothing 67^{-0.10}_{-0.146}$ Hole $\varnothing 67^{+0.030}$	0.10—0.176	0.300
23	Lubricating oil pump shaft and bushing	Shaft $\varnothing 18_{-0.011}$ Hole $\varnothing 18^{+0.043}_{+0.016}$	0.016—0.054	0.200
24	Lubricating oil pump rotors and pump body end surfaces		Adjusting clearance 0.03—0.100	
25	Backlash between inner and outer rotors of lubricating oil pump		0.080—0.210	0.500
26	Water pump impeller and pump housing		Back clearance 0.200—0.700	
27	Water pump impeller and bed plate		Adjusting clearance 0.400—0.800	

Chaprer Ⅱ

Main Constructions, Adjustments and Maintenances of The Diesel Engine

1. Cylinder Block Assembly

The cylinder block assembly is shown in Fig. 1.

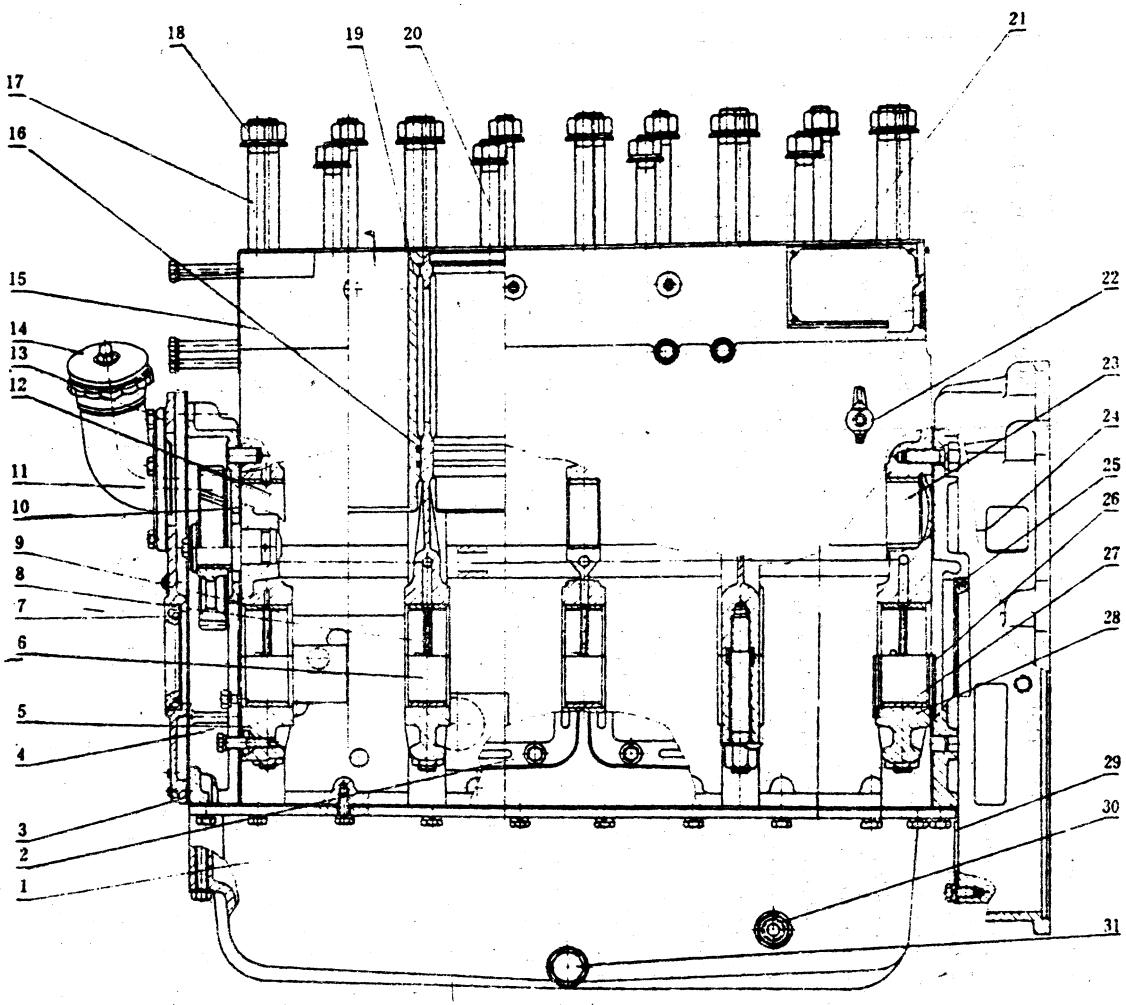


Fig. 1 Cylinder block assembly

1——oil sump; 2——Lower side cover; 3——Gear case cover gasket; 4——Gear case; 5——Front main bearing cap; 6——Middle main bearing and its lower half; 7——Crankshaft front oil seal; 8——Middle main bearing upper half; 9——Front and rear main bearing upper half; 10——Gear case gasket; 11——Idling gear and shaft; 12——Camshaft front bushing; 13——Gear case cover; 14——Breather and oil filler sub——assembly; 15——Cylinder block; 16——Cylinder liner water seal; 17——Cylinder head stud 135; 18——Cylinder head nut; 19——Cylinder liner; 20——Cylinder head stud 116; 21——Cylinder head gasket; 22——Drain cock; 23——Camshaft middle and rear bushing; 24——Flywheel housing with inspecting hole and TDC mark ; 25——Crankshaft rear oil seal; 26——Crankshaft thrust ring; 27——Front and rear main bearing lower half; 28——Rear main bearing cap; 29——Cover; 30——oil temperature gauge adapter; 31——Oil drain plug.

"A"——The distance between the top surfaces of cylinder liner and cylinder block: 0. 06—0. 16mm.

The crankcase and the cylinder block are cast integrally with reinforced ribs inside. The distance from the centre line of the crankshaft to the bottom of the cylinder block is 120 mm. Cylinder liners of wet type are fitted in the cylinder block and rested at its upper shoulders. The top surface of the liners are higher than the top suface of the block by 0. 06—0. 16 mm on account of fastening the liners positively and its difference in height between any two liners on the same engine should be no more than 0. 05 mm. There are two rubber seal rings installed on the lower seal belt of the cylinder to prevent cooling water from entering the crankcase.

Five main bearings are distributed in the crankcase. The main bearing caps are located by locating sleeves and machined in pair with the corresponding bearing seats on the crankcase, so that the caps cannt be interchanged or turned inside out. There fore, both the bearing seat and cap are marked with number respectively to prevent them from mixing up in assembly.

The timing gear case and the flywheel housing are fixed onto

the front and rear ends of the cylinder block respectively by screws with a fiber gasket of 0. 5 mm thick between both jointing surfaces, and two cylindrical dowel pins are employed both ends to secure their assembling accuracy. An oil filling elbow with a breather is installed on the gear case cover for lubricating oil inlet and crankcase ventilation. There is an opening on the side of the flywheel housing for observing the marks on the flywheel rim in behalf of adjusting the fuel delivery advance angle.

The oil sump is fixed on the bottom of the cylinder block, The oil strainer with its suction pipe is installed inside.

2. Cylinder Head Assembly, Valve gear and Their Maintenance

1). Constructions and Features

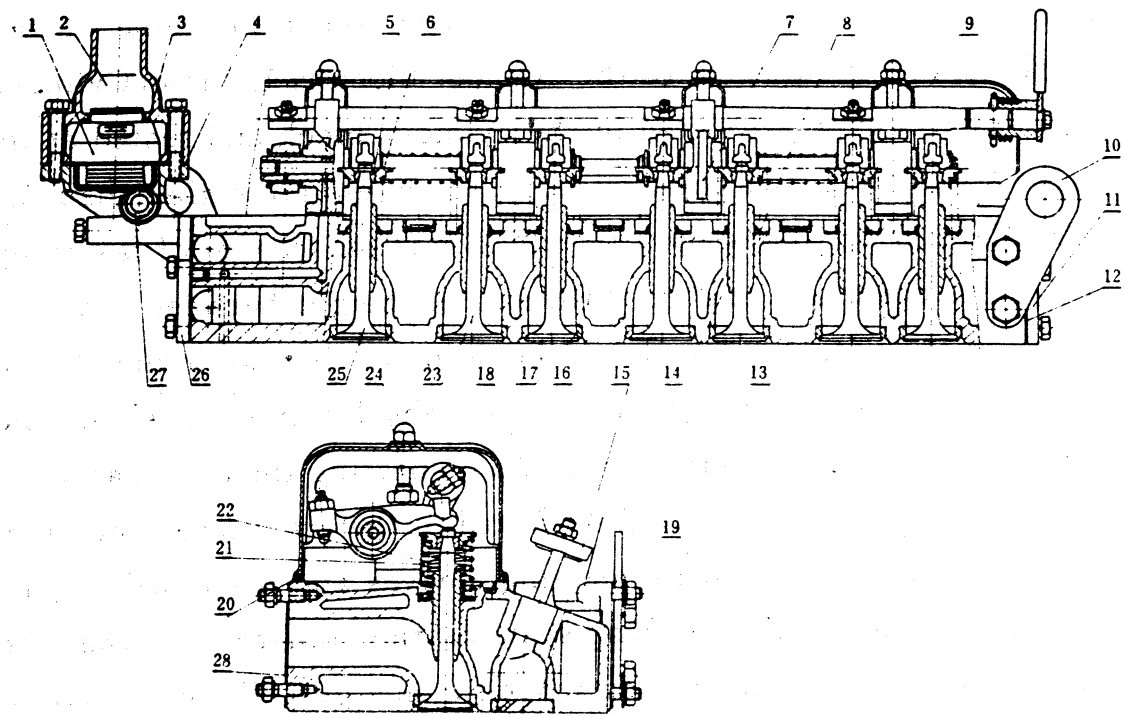


Fig. 2 Cylinder head assembly

1—— Thermostat; 2—— Therm stat housing; 3—— "O" ring seal; 4—— Thermostat gasket; 5—— Valve collet, halves, 6—— Valve spring seat; 7—— Rocker arm shaft bracket sub—— assembly; 8—— Valve spring lower seat; 9—— Cylinder head cover sub—— assembly; 10—— Lifting bracket; 11—— Cylinder head rear cover; 12—— Cylinder head front and rear cover gasket; 13—— Cylinder head; 14—— Valve guide; 15—— Swirl combustion chamber insert; 16—— Intake valve seat insert; 17—— Exhaust valve seat insert; 18—— Injector clamp; 19—— Intake manifold gasket; 20—— Cylinder head cover gasket; 21—— Outer valve spring; 22—— Inner valve spring; 23—— Intake valve; 24—— Rocker arm shaft bracket stud; 25—— Exhaust valve; 26—— Cylinder head front cover; 27—— Temperature gauge adapter; 28—— Exhaust manifold gasket;

Cylinder head is an one piece casting (Fig. 2). The independent intake and exhaust manifolds are installed on each side of the cylinder head respectively. A thermostat is installed on the cylinder head front cover to regulate the outlet water temperature. The insert, with a slant throat of kidney shape cross — section and a small conical hole inside, is pressed into the bottom of the swirl chamber. The small conical hole should be aligned with the nozzle center line in installation of the insert so as to make the engine easy to start. The valve guides and seats, made by powder metallurgy and of alloy cast iron respectively to increase their wear resistance, are all pressed into the cylinder head with interference fit.

Intake and exhaust valves are made of alloy steel and heatresisted alloysteel respectively. The head of the intake valve is bigger than that of the exhaust valve. There is a strict dimensional requirement for the distance from the valve head to the cylinder head bottom surface in order to keep the engine compression ratio exactly and to avoid the valve impact against the piston. The valve is fitted with inner and outer valve springs and positioned by the upper spring seat and the collet halves.

The rocker arm mechanism is housed in the cylinder head cov-

er. The rocker arm shaft is made of two separated sections jointed together by a connecting shaft, and each section is supported by two brackets. The "O" ring seal is used between the connecting shaft andthe rocker arm shaft rear section to prevent the lubricating oil from leakage. The rocker arm is provided with an renewable bushing made by powder metallurgy. The adjusting screw is fitted on the head of the rocker arm for valve lash adjustment.

The decompressor shaft is supported by two rocker arm shaft brackets. There are four decompression screws fitted on the shaft, Turning the shaft, the decompression screws will depress the intake valves to reduce the pressure inside the cylinders in behalf of the engine starting easy.

A copper—asbestos gasket is fitted between the cylinder head and the cylinder block. The cylinder head is fastened on the cylinder block by 18 studs which should be tightened in the specified sequence (as Fig. 3 shown) with the specified torque in order to prevent the two parts from deformation as well as to maitain the gas tightness between them.

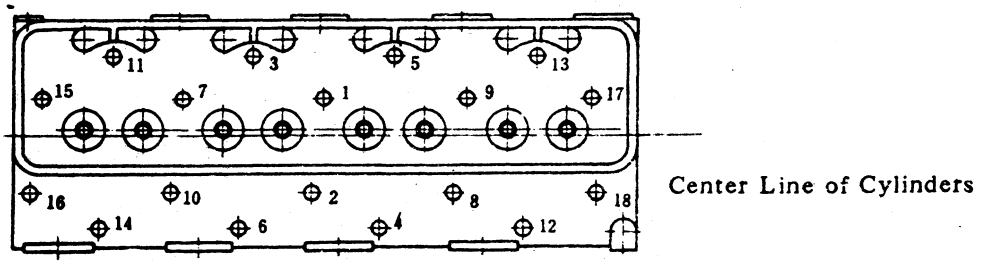


Fig. 3 Diagram showing the sequence of tightening the cylinder head nuts.

The valve gear consists of camshaft, Camshaft timing gear, tappets, push rods, rocker arms and valves as shown in Fig. 4.

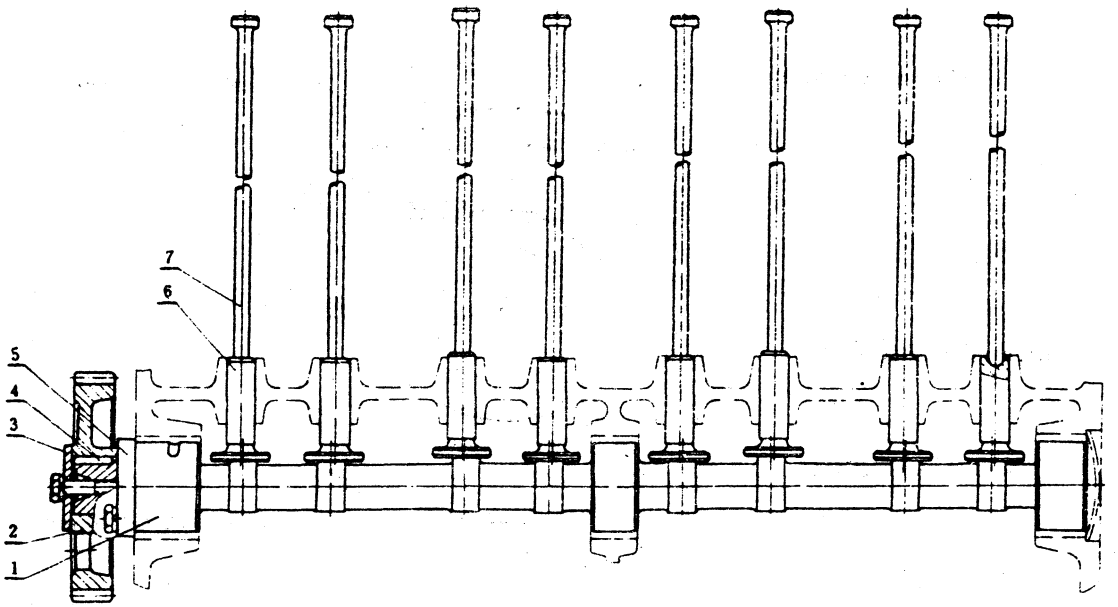


Fig. 4 Camshaft assembly

1—— Camshaft; 2—— Camshaft timing gear; 3—— Gear washer; 4—— Key; 5—— Camshaft thrust plate; 6—— Valve tappet; 7—— Push rod.

The camshaft is supported by three bushings of same diameter and driven by the crankshaft timing gear through the idling gear and camshaft timing gear. Between the camshaft timing gear and the camshaft shoulder, a thrust plate is provided to control the axial play. The camshaft can be drawn out together with the gear by removing the two fastening screws of the thrust plate through the round hole on the camshaft timing gear.

There is an offset of 1. 5mm between the center lines of the mushroom—shaped tappet and the cam, which makes the tappet to rotate around its own centre line in operation for evening the wear on its bottom surface.

The valve timing of the diesel engine is shown in Fig. 5. In or-

der to keep the valve timing as required, the valve lashes should be adjusted to the prescribed valve.

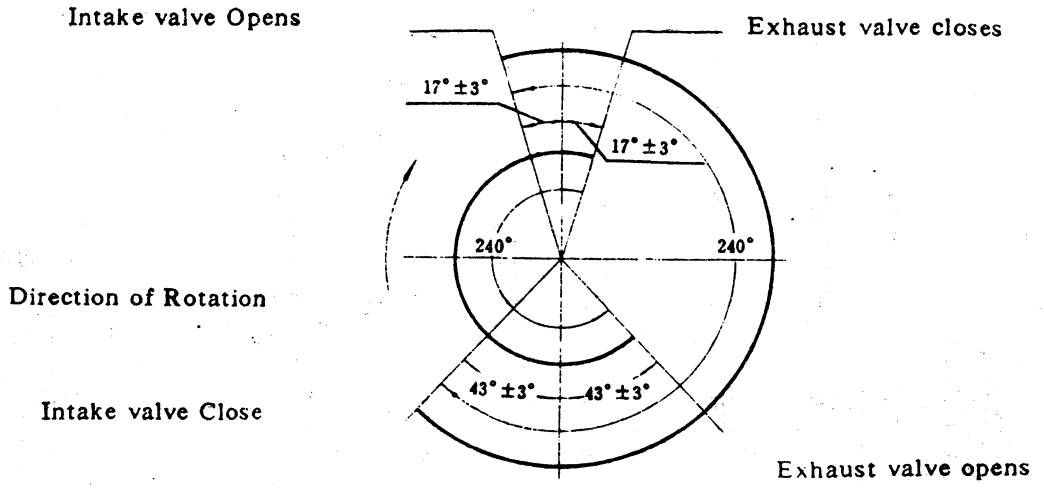


Fig. 5 Valve timing Diagram

2). Maintenance of Cylinder Head and Valve Gear

(1)Adjusting Valve Lash

Adjusting method: Turning the flywheel to let the piston of the first cylinder moving up to the top dead centre in its compression stroke. (When the top dead centre mark "O" on the flywheel in aligned with the line marked at the side of the opening on the flywheel housing, the pistons of the first and fourth cylinders are at their top dead centre positions. If the exhaust valve of the second cylinder opens, the piston of the first cylinder is in the meantime just at top dead centre in its compression stroke.) Loosen the locking nuts of adjusting screws on the rocker arms of both the intake and exhaust valves on the first cylinder of the intake valve on the second cylinder and of the exhaust valve on the third cylinder,

insert the feeler gauge in turn between the stem end and the rocker arm head of each valve mentioned, and turn the adjusting screw until the gauge feels nipped very slightly, then hold the adjusting screw with a screwdriver and tighten the locking nut one after another. Slide the feeler gauge slowly to check the lashes again until the requirement is fulfilled. After this, turn the flywheel for just one revolution to keep the piston of the fourth cylinder being at the top dead centre in its compression stroke and adjust the valve lashes of the exhaust valve on the second cylinder, of the intake valve on the third cylinder and of both the intake and exhaust valves on the fourth cylinder with the same method mentioned above as shown in Fig. 6.

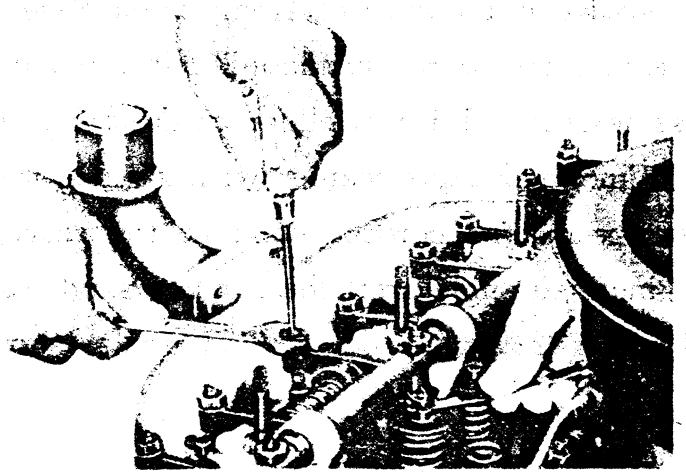


Fig. 6 Adjusting valve lash

(2) Inspecting and Lapping Valve

During the fourth order maintenance of the diesel engine or when the valve leakage has been discovered, the valves should be dismounted to remove the carbon deposits and to check their air

tightness. If the wear, corrossion and out—of —roundness of the valve and seat are not serious and their contact band width is less than 2. 5 mm, then the contact band can be lapped with lapping compound, It is important to prevent the lapping compound from getting into the valve guide when lapping the contact band. Well lapped contact band of valve and valve seat should be even, continuous and in greyish white colour without pitting, scrape and briliant line. After lapping, both the valve and valve seat must be carefully cleaned with kerosine or diesel fuel; then, put the related side of cylinder head upward after the lapped valve is mounted with its springs, and fill some kerosine into the port. After 2—3 minutes, if there is no leakage, the contact surfaces are proven in good air tightness.

(3)Reaming and Replacing Valve Seat

The valve seat can be reconditioned if it is burnt out or out—of—roundness seriously. First of all, ream the valve seat by means of a 15° and 75°inclined angle reamer with a guide rod of 9 mm in diameter. Next, ream the contact band of the valve seat with a reamer of 45° inclined angle until the contact band is rounded. The contact band width should be of 1. 3—1. 5 mm as shown in Fig. 7.

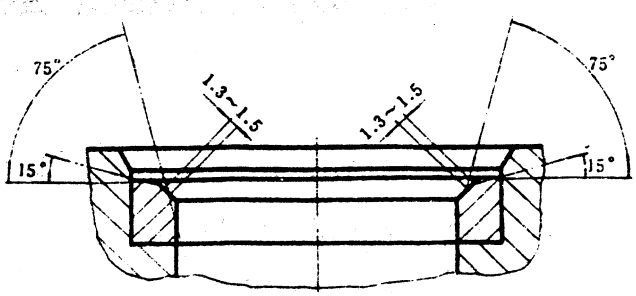


Fig. 7 Diagram of reconditioning valve seat

The valve seat must be renewed if the level of the valve head is lower than that of the cylinder head bottom surface by more than 3. 5 mm after the valve seat being reconditioned. Before a new valve seat is pressed into the cylinder head, a interference of 0. 086 — 0. 150 mm in diameter should be kept, and the cylinder head should be heated integrally to about 200°C.

After pressing the valve seat in, ream its contact band again accurately to ensure the valve seat being concentric with the valve guide, and meanwhile, measure the distance from the cylinder head bottom surface down to the valve head which should be within 1. 2 — 1. 60 mm. If it is too small, the accident of valve impacting piston may occur.

(4)Mounting Cylinder Head onto cylinder Block

Before mounting the cylinder head, check the flatness of its bottom surface first. The allowable deviation of the flatness is within 0. 05 mm. If it is greater than 0. 25 mm (in longitudinal direction), the bottom surface should be reconditioned by means of scraping. When mounting the cylinder head onto the cylinder block, the nuts should be tightened according to the sequence shown in the fig. 3. Tighten them gradually and evenly in several times with a torque wrench until the specified torque limit of 12—14 Kg — m is reached; otherwise the cylinder head may be deformed, the cylinder head gasket may be burnt out and even the cylinder liner may be broken and some other important parts may be damaged.

(5)Adjusting Decompressor's Travel

Turn the flywheel to lift the piston of the first cylinder up to the top dead centre in its compression stroke, while the intake valves on the first and second cylinder are closed. Turn the

decompressor's shaft to the decompressing position, loosen the locking nuts of adjusting screws on the first and second cylinder and turn the adjusting screws to make them just touching the rocker arm heads of the intake valves. Turn the screws for 1—1.5 turns further to make the intake valves open by 1—1.5 mm, and then lock the screws with their nuts. After completing the adjustment of the first and second cylinders, turn the flywheel for one more revolution to lift the piston of the fourth cylinder up to the top dead center in its compression stroke, Adjust the valve decompressor travels on the third and fourth cylinders by the same method as shown in Fig. 8.

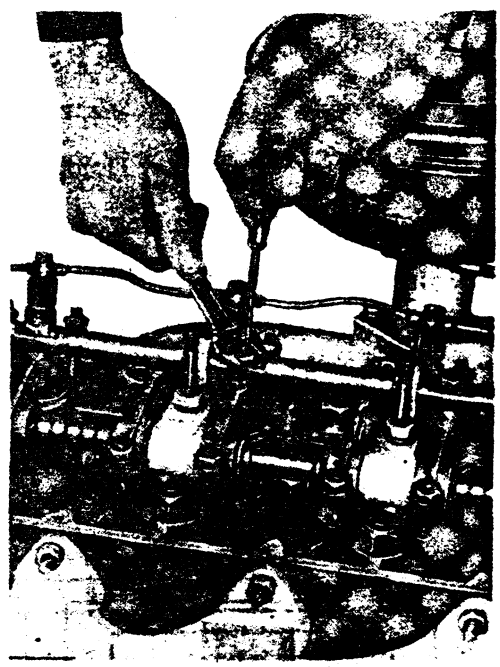


Fig. 8 Adjusting decompressor's travel

(6)Mounting Timing Gears

During mounting the timing gears, it is important that the marks on each pair of the meshing gears should be aligned with one another to ensure the correct valve timing and injection timing.

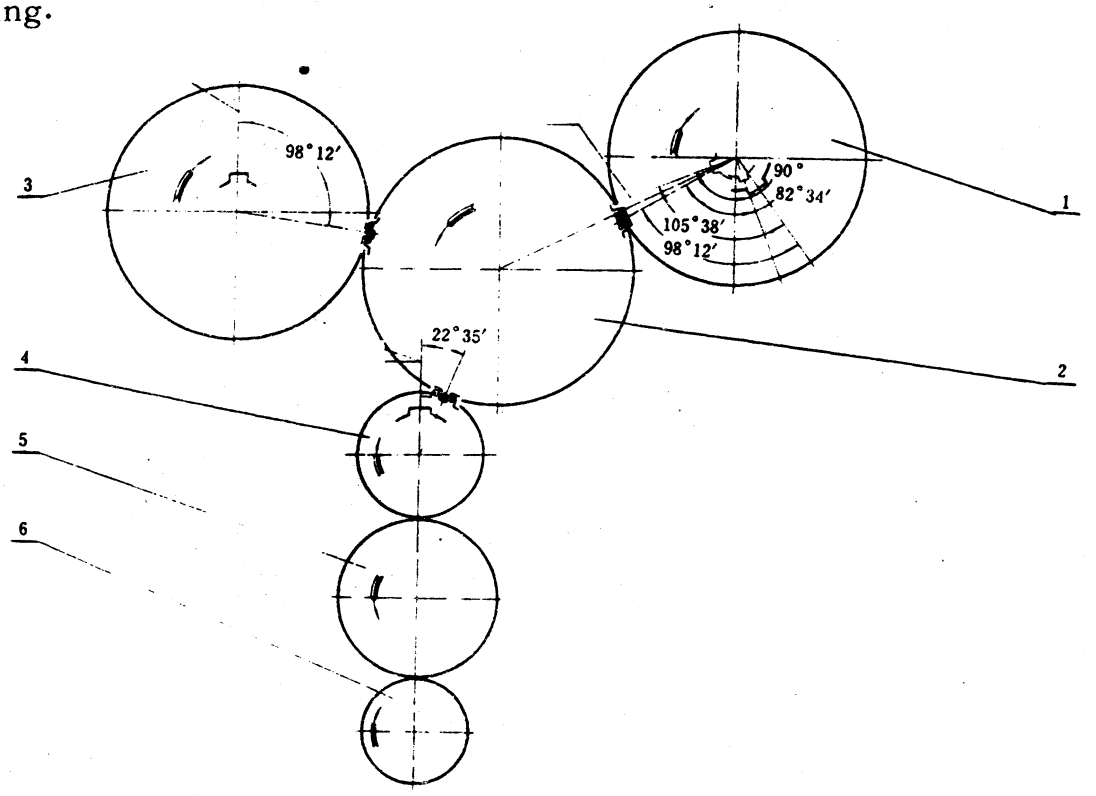


Fig. 9 Layout of the gear train

1——Injection pump gear (Z=40); 2——Idling gear (Z=41); 3——Camshaft timing gear (Z=40); 4——Crankshaft timing gear (Z=20); 5——Lubricating oil pump intermediate gear (Z=25); 6——Lubricating oil pump gear (Z=17)

3. Crankshaft—Connecting Rod Mechanism and Its Maintenance

1)Construction and Features

The crankshaft and connecting rod mechanism consists of the piston connecting rod assembly (Fig. 10) and the crankshaft flywheel assembly (Fig. 11)

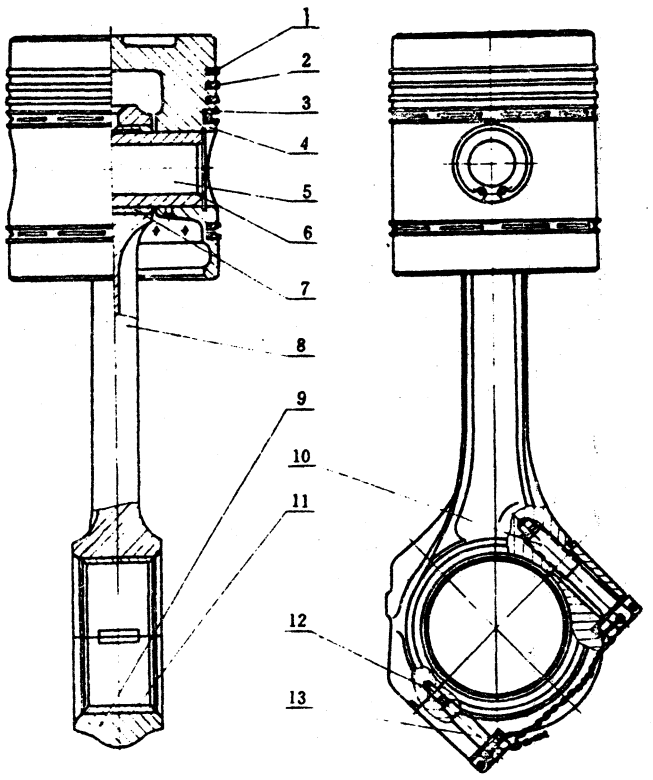


Fig. 10 Piston——Connecting rod assembly

1——Top compression ring; 2——Second and third compression ring; 3——Oil ring (or composite oil ring); 4——Piston; 5——Piston pin; 6——Snap ring 35 7——Connecting rod small end bushing; 8——Connecting rod; 9——Connecting rod cap; 10——Connecting rod bolt; 11——Connecting rod bearing shell; 12——Dowel pin 4d4 X10; 13——Lock wire.

The crankshaft is made of rare—earth nodular cast iron. It has four connecting rod journals and five main journals. All of them are case—hardened in order to improve their wear resistance.

Thin—wall plain bearing shells made of steel back lined with tin—aluminium alloy are used for main bearings and connecting rod bearings. The clearance between the journal and the plain bearing is unadjustable, whenever a bearing shell is worn beyond

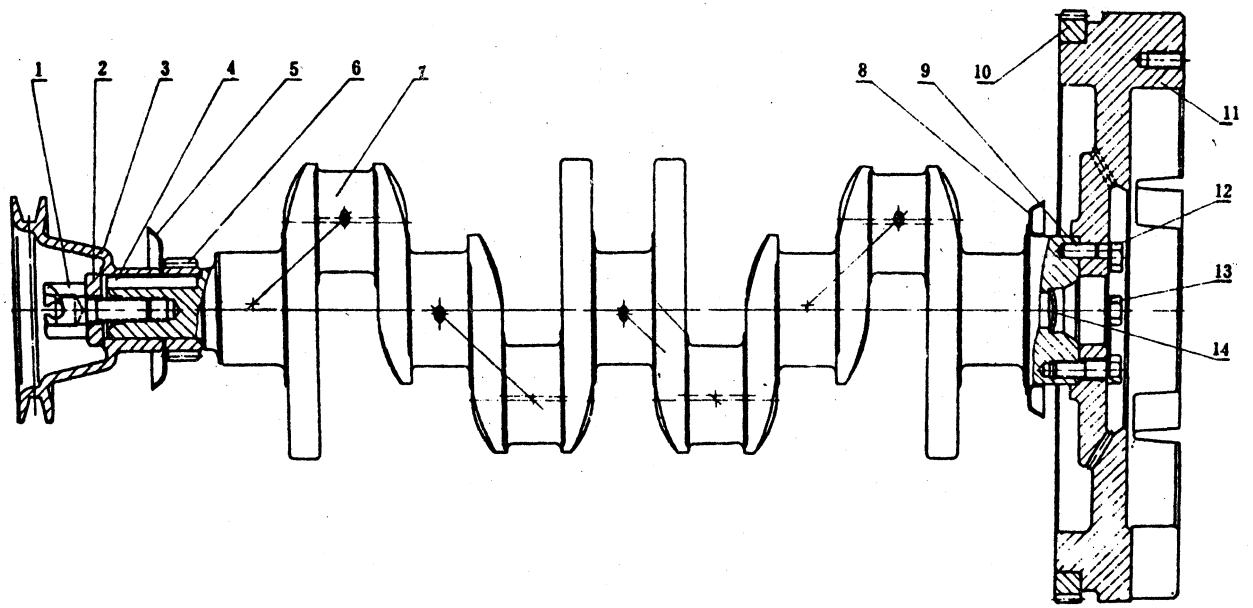


Fig. 11 Crankshaft and figwheel assembly

1——Starting dog; 2——Starting dog washer; 3——Crankshaft pulley; 4——Key A 10 X 60; 5——Front oil slinger; 6——Crankshaft timing gear; 7——Crankshaft; 8——Rear oil slinger; 9——Dowel pin; 10——Flywheel ring gear; 11——Flywheel; 12——Flywheel bolt; 13——Lock plate; 14——Plug.

the per—missible limit, it should be renewed.

On the joint face of each bearing half, there is sheared locating lug which is just to be set into the locating slot on the bearing housing to prevent the shell from axial movement.

The main bearings can be classified into two groups according to their width. The first and the fifth main bearing are wider while the second, the third and the fourth main bearings are narrower. The main bearing upper halves are also different from the lower halves. The one provided with an oil hole is the upper half.

All the connecting rod bearing halves are the same in structure and size.

In order to let the crankshaft taking axial load, the thrust rings are fitted on both sides of the fifth main bearing housing. There are two oil grooves on the side of alloy layer of each thrust ring, which should face to the crankshaft shoulder and never put the inside surface outward.

The main bearing caps and connecting rod caps are fastened by high strength bolts tightened with specified torque and locked by lock tab and lock wires respectively.

Both the front and rear ends of the crankshaft are sealed by means of two rubber seals. In order to make the sealing more reliable, an oil slinger is mounted in the front of the rubber seal.

The flywheel is tightened onto the flange at the crankshaft rear end by six high strength bolts and located angularly by a dowel pin.

There are graduation lines of 2° crank angle each marked on the outer rim of the flywheel, presenting the top dead centre and the advance angles from 10° to 30° for the pistons of the first and fourth cylinders.

These lines are used together with the pointer marked on the flywheel housing to check and adjust the injection advance angle.

Each aluminium alloy piston is fitted with three compression rings and two oil rings. The top compression ring is chrome plated to improve its wear resistance under high temperature. The chamfer on the outer periphery of the oil ring, used to improve its oil scraping capability. Should be upward in mounting the oil rings on the piston, never put them upside down.

The piston pin is of the full—floating type, when the certain working temperature of the piston is reached, the piston pin may rotate in its bore to even its wear. But at the cold state, it fits in the bore with interference fit, therefore the piston should be preheated before the pin remounted or dismounted from it.

The connecting rod big end is split along the 45° inclined diametrical line. After machinning both the connecting rod, shanks and caps are all marked in couples with numbers and it is forbidden to mix them up.

A bronze bushing used in the small end of the connecting rod. The oil hole on the bushing should be aligned with the oil hole on the small end of the connecting rod so as to facilitate lubricating the bushing and the piston pin.

2). Maintenance of Crankshaft and Connecting rod Mechanism

(1) Dismantling and Inspecting Crankshaft—Connecting Rod Mechanism

A. The following points should be noted when dismantling and inspecting the crankshaft—connecting rod mechanism.

a. The dismantlement and inspection should be carried out in a clean room.

b. Check all fixing and locking parts for their tightness. Note

whether the pistons, connecting rods and main bearing caps are marked with numbers and whether there are chips in the oil sump. Check the relative positions of the piston ring gaps.

c. Before taking out the piston, remove the carbon deposits on the upper portion of the liner by a scraper and be care not to damage the piston and piston ring.

d. The dismantled bearing shells should be reassembled in time to prevent them from confusion.

e. Before dismantling the piston pin, the piston should be put into lubricating oil and heated to 100—120°C.

f. Check the wear of these parts according to the table of the clearances and wear limits of the main parts. If the clearance has not exceeded the wear limit and the surface is in good condition, the part may be used again; otherwise; it should be repaired or replaced.

B. Check the bearing clearance. If there is no suitable checking instrument, the following method may be taken:

a. Remove the bearing cap, put a piece of fuse onto the crankshaft journal.

b. Remount the bearing cap and tighten the bolts with the specified torque.

c. Dismantle the bearing cap again. Take out the deformed fuse and measure with a micrometer its thickness which is just equal to the bearing clearance.

(2) Repairing and Installing Crankshaft — Connecting Rod Mechanism.

A. If the ovality of the crankshaft journal exceeds 0. 06mm, the crankshaft should be reconditioned on a special grinding machine. The dimensions after every recondition are list in the follow-

ing table:

Journal Diameter(mm)			Bearing Shell Thickness(mm)		
Dimensional calss symbol	Main journal	Connecting rod joural	Dimensional class Symbol	Main bearing	Connecting rod bearing
O	$75_{-0.019}$	$65_{-0.019}$	0	$3^{-0.035}_{-0.050}$	$2.5^{-0.020}_{-0.035}$
P_1	$74.75_{-0.019}$	$64.75_{-0.019}$	−0.25	$3.125^{-0.035}_{-0.050}$	$2.625^{-0.020}_{-0.035}$
P_2	$74.5^{-0.019}$	$64.5_{-0.019}$	−0.50	$3.25^{-0.035}_{-0.050}$	$2.75^{-0.020}_{-0.035}$
P_3	$74.25_{-0.019}$	$64.25_{-0.019}$	−0.75	$3.375^{-0.035}_{-0.050}$	$2.875^{-0.020}_{-0.035}$
P_4	$74_{-0.019}$	$64_{-0.019}$	−1.00	$3.5^{-0.035}_{-0.050}$	$3^{-0.020}_{-0.035}$
P_5	$73.5_{-0.019}$	$63.5_{-0.019}$	−1.50	$3.75^{-0.035}_{-0.050}$	$3.25^{-0.020}_{-0.035}$
Clearance: Main journal and bearing 0.070～0.154; Connecting rod journal and bearing 0.040～0.108					

B. After reconditioning the crankshaft, the crank radius should be kept in 57.5 ± 0.05mm, the fillet radius of the crankshaft journal should be of 5 mm, the ovality and the taper of the crank−shaft journal should be within 0.015 mm. It is permitted that the dimensional class of reconditioning of the main journals may be different from that of the connecting rod journals. But the reconditioned dimensions of all the main journals or connecting rod journals must be unified in the same class respectively.

C. It is strictly forbidden to recover the bearing clearance by means of filing or shimming the bearing.

D. When the axial play of the crankshaft exceeds the wear limit, a thickened thrust ring should be adopted to meet the specified value of 0.07−0.23mm.

E. When the connecting rod is corrected by means of a corrector, the relative unparallelism between the centre lines of both connecting rod and bores in any direction should be less than 0.05/100

mm.

F. Should a piston or a connecting rod be renewed, the weight differences among the four piston connecting rod assemblies should be less than 0.05 kg.

G. A new piston ring should be able to slide freely along the ring groove due to its own weight. The ring gap should be measured with a feeler while the ring is placed into the liner (Fig. 12). If it doesn't conform with the specified value (for the first compression ring is 0.30—0.45 mm. for the others are 0.25—0.40 mm), it can be filed with a fine file.

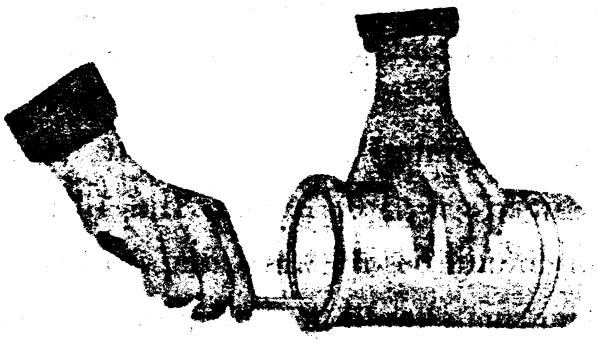
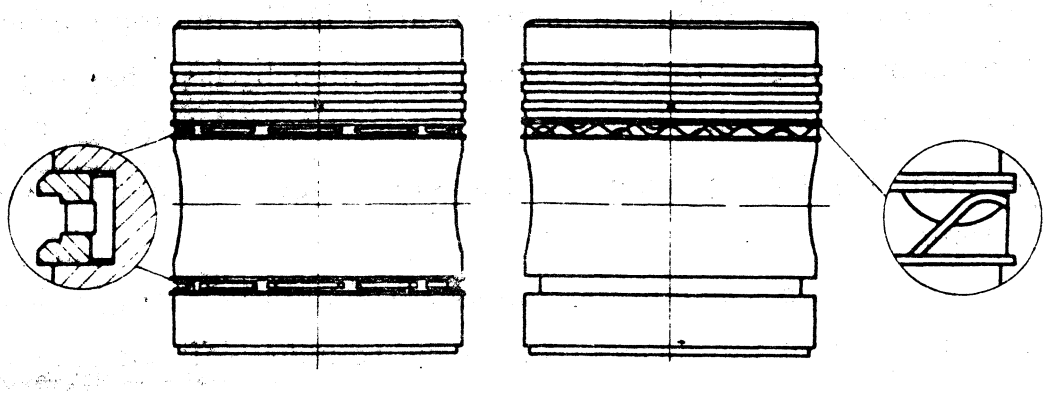


Fig. 12 Checking the piston ring gap

While installing piston rings, pay attention to that the first compression ring is chrome plated, the three compression ring gaps should be offset 120° one after the other in sequence, the chamfers of the two oil rings should face to the piston top, the two oil ring gaps should be offset 180° one after another and the positions of all gaps should not be on the center line of the piston pin bore as shown in the Fig. 13 and Fig. 14.

If the Duaflex oil ring is used, the backing expander ( ) should be fitted firstly into the ring groove with its ends just in touch with each other but without overlapping, then slip on the

chrone plated rails and crimped spring ( ) outside the radial backing expander. Among them, a pair of rails are laid on the upper side of the ring groove, the other one is laid on the lower side of the ring groove and the crimped spring is fitted between them to maintain them in firm contact with both sides of the groove as shown in Fig. 13.



(a)Oil ring (b)Duaflex oil irng

Fig. 13 Installing the oil ring or Duaflex oil ring

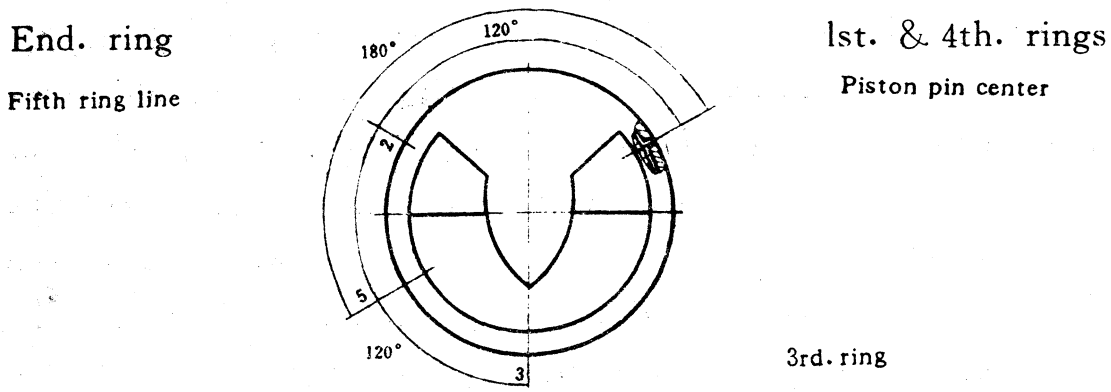


Fig. 14 Positions of the piston rings inside the cylinder liner

H. Before installing piston pin, the piston should be heated to

100—120°C in hot oil. It is forbidden to insert the pin with any heavy blow in cold condition to prevent the pin bore from damage. When reassembling the piston with connecting rod, the combustion chamber cavity on the piston crown should be on the same side with the 45° splitting plane of the connecting rod shank. During installing the piston and connecting rod into the liner, the combustion chamber cavity on the piston crown should be in the same side with the injector. When the piston is at T. D. C., the top surface of the piston is higher than the same of the liner by less than 0. 5 mm and the difference in elevation of the piston top surface at T. D. C between any two cylinders on the same engine should be within 0. 15mm.

I. The oil passage in the crankshaft should be carfully cleaned and the edge of the oil hole should be rounded off and smoothed with a fine oil stone.

New bearings should be tested turning before installing formally; The connecting rod bearing can be turned freely around the journal by hand after tightening the connecting rod bolts. Installing the crankshaft with main bearings, tightening all of the nuts, the crankshaft can be turned freely by hand. It is permissible to remove the individual hard spot on the joint face of the shell by means of a scraper.

J. It is important to tighten the connecting rod bolts and the main bearing nuts evenly with the specified torque of 98—118N • m. respectively and locking them with wires. Otherwise, an accident may occurs due to looseness or breakage of any bolt.

K. The flywheel bolts should be tightened evenly in sequence as shown in Fig. 15 and locked with lock plates after the specified torque of 98—118N • m has been reached.

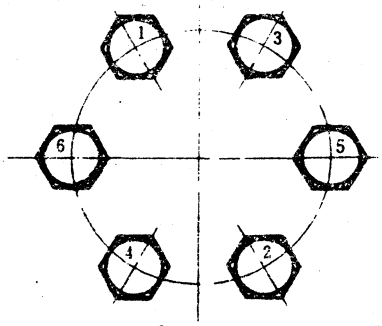


Fig. 15 Sequerxe of tightig the flywheel bolts

4. Supply System

The supply system of the diesel engine consists of air cleaner, fuel tank, fuel filter, feed pump, injection pump, governor, injector, fuel delivery and injection piping subassemblies and so on as shown in Fig, 16.

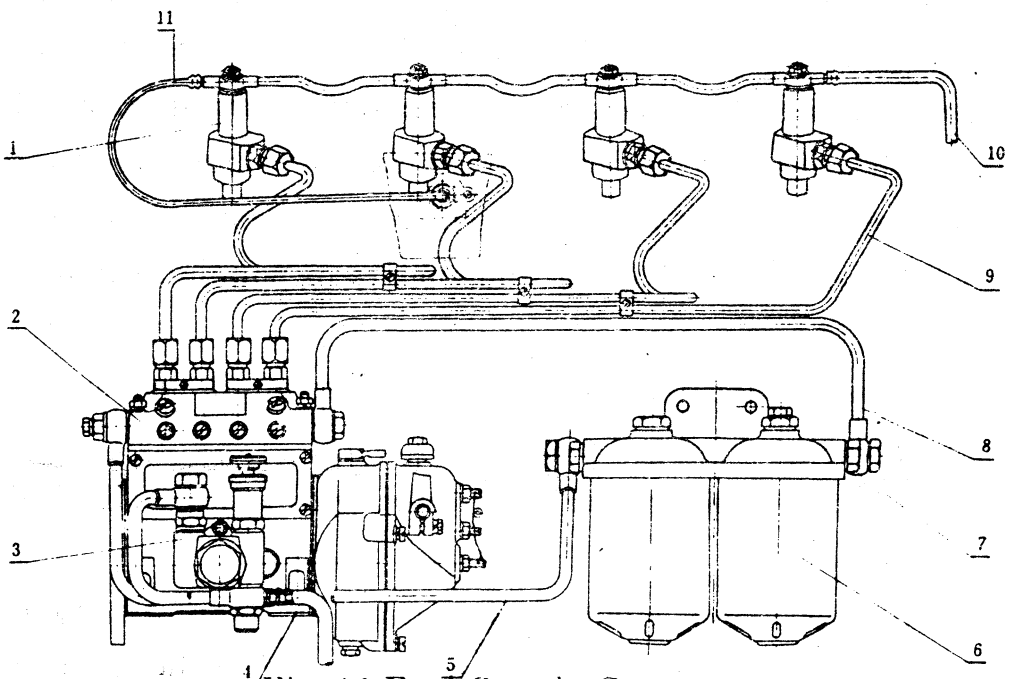


Fig. 16 Fuel Supply System

1—— Injector; 2—— Injection pump governor assembly; 3—— feed pump; 4—— Feed pump inlet pipe; 5—— Fuel filter inlet pipe; 6—— Fuel filter; 7—— Threaded plug; 8—— Injection pump pipe; 9—— Fuel injection pipe; 10—— Injector leak—off pipe; 11—— Pre-heater fuel delivery hose.

During the operation, the feed pump draws fuel from fuel tank through the cock and fuel inlet pipe and delivers it into the fuel filter. After being filtered, the fuel flows into the upper housing of the injection pump. Then, depending on the load of the engine, the pump element controlled by the pump control rod delivers a certain quantity of fuel through the delivery valve and fuel injection pipe to the injector. When the pressure of 11768KPa inside the injection system is built up, the needle velve will be lifted opening and the fuel will be atomized and injected into the combustion chamber to burn with the charged air. The fuel leaking out from the clearance between the needle valve and nozzle—body will return to the fuel tank through the leak—off pipe on the top of the injector.

The amount of fuel fed into the injection pump by the feed pump is greater than that needed by the engine in operation, The surplus fuel will flow back to the feed pump through the check valve so that the fuel will circulate in the upper housing of the injection pump constantly to prevent it from air trapped inside.

1). Construction of Main Components in Supply System

(1)Air Cleaner

The diesel engine is provided with different air cleaner according to the various applications.

Model 495 diesel engine is provided with a model K 2007 air cleaner (Fig. 17)

Model 495 diesel engine draws in air of 200m^3 per hour approximately. If the dust in air is permitted entering the cylinder together with the air, then the piston ring, the piston and the cylinder liner will be worn out in a short time, The function of an air cleaner is just to filter the air before it enters the intake manifold.

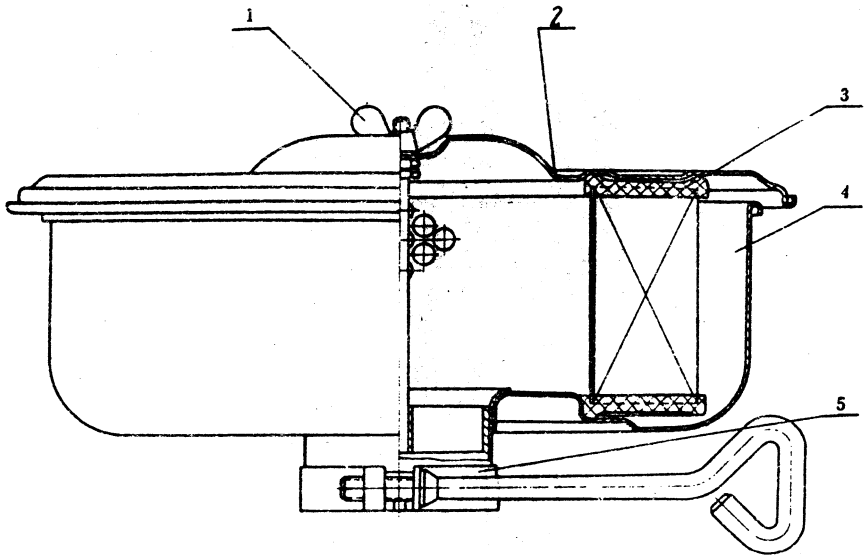


Fig. 17 K2007 Air cleaner

1——Winged nut; 2——Filter cover; 3——Filter element; 4——Filter casing; 5——Clamp.

Model K 2007 air cleaner is of single stage dry type. It consists mainly of a filter cover, an element, a filter casing and a clamp. The element is made of special filter paper and stiffened with sheet iron frame inside. On account of enlarging the filtering area, the element paper is made in the folding shape, At first, air enters into the outside space of the element throug the clearance between the filter cover and the casing; after being filtered, the air enters into the inner space of the element then to the intake manifold while dust remains on the outer surface of the paper element.

(2)Feed Pump

The plunger type feed pump consists of pump housing, piston, piston spring, check valve and hand pump, etc. As shown in Fig. 18. The feed pump is driven by an eccentric lobe on the injection pump camshaft through the push rod.

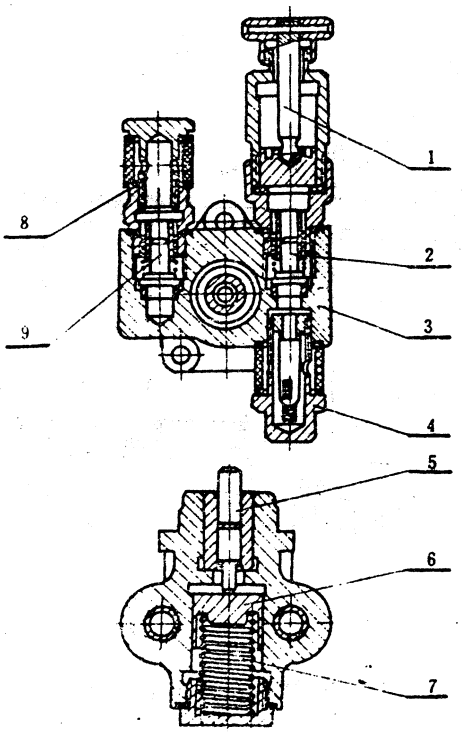


Fig. 18 Feed Pump

1——Hand pump; 2——Check valve; 3——Pump housing; 4——Inlet banjo connection bolt; 5——Push rod; 6——Piston; 7——Piston spring; 8——Outlet banjo connection bolt; 9——Check valve.

The main function of the feed pump is to keep the low pressure fuel passage full of fuel with certain pressure.

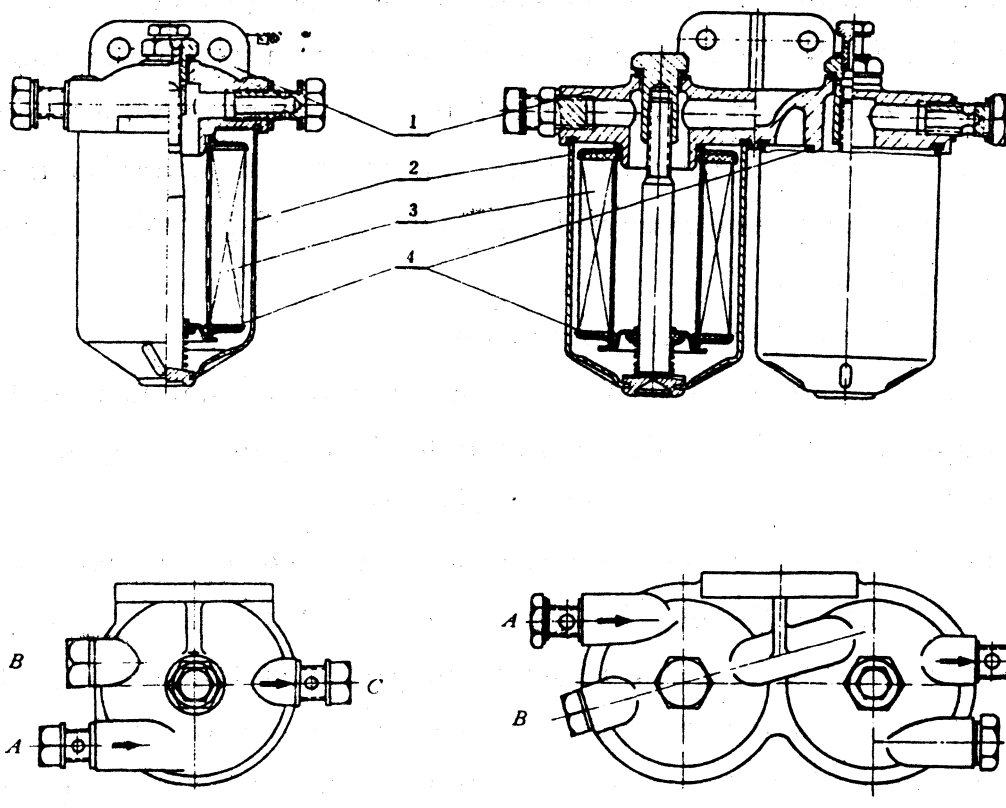
The feed pump is of automatic pressure regulated type to ensure the fuel pressure steady, When the fuel pressure within the low pressure fuel passage exceeds 49KPa, the fuel pressure will compress the resilient spring through the piston to make the piston apart from the push rod gradually and as a result, the fuel delivery will be reduced or stopped.

The hand pump is used to make the fuel delivery system expelling the trapped air out and being full of fuel before the engine starting. When it isn't in use, the hand pump piston should be depressed down and the knob should be tightened, so that the oil pas-

sage will be sealed by the hand pump piston to prevent the air from getting into the fuel system.

(3)Fuel filter

Model C 0708 Fuel filter consists of the filter shell, filter head, paper element and ring seals, etc. as shown in Fig, 19.



Single stage Double stage

Fig. 19 C 0708 fuel filter assembly

1——Fuel filter head; 2——Fuel filter shell; 3——Paper filter element; 4——Ring seal.

There are three (single stage) or four (double stage) fuel pipe connectors on the top of the filter head. Connector (A) is used to connect the outlet pipe of the feed pump, connector (B) is blocked

by a threaded plug and connector (C)is used to connect the inlet pipe of the injection pump upper housing.

The function of the fuel filter is to filter off the mechanical impurities from the fuel to reduce the wear of the precise elements of the injection pump and the injector.

After the fuel being filtered through the filter element, the mechanical impurities are remained on the outer surface of the element. The filter element is made of diesel oil filter paper and is good in strength and permeability. But the element may be broken when it is chocked up with dirts. Therefore, the filter element should be cleaned and renewed regularly according to the maintenance regulations.

(4)Injection Pump and Governor

For the sake of delivering a certain amount of fuel accurately, the engine is provided with the 4 cylinder No. I pump using the left —hand pump elements of 8 mm in diameter.

The front end of the injection pump is fixed on the gear case with a triangular flange and the pump is driven by the crank — shaft gear through the idling gear and the injection pump gear. Meshing marks are marked on the gears to ensure the correct injection timing. The accurate adjustment of injection timing is obtained by means of turning the injection pump in the clockwise or counterclockwise direction.

The injection pump camshaft rotates in a pair of roller bearings inside the lower housing of the injection pump. The four cam lobes on the camshaft are in phase with the firing order 1—3—4—2 of the engine respectively. The reciprocating tappets transmit the motion of the camshaft to the pump plunger as shown Fig. 20.

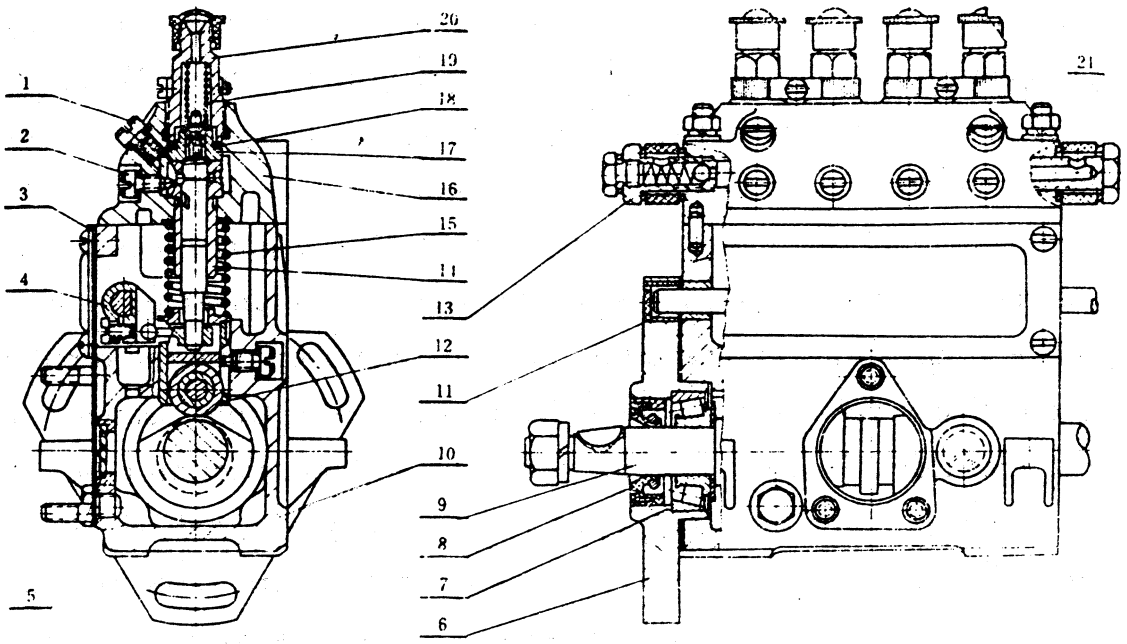


Fig. 20 Injection pump

1——Air venting screw; 2——Locating screw; 3——Inspection window cover; 4——Control fork; 5——Oil lever indicating palte; 6——Triangular flange; 7——Roller bearing; 8——oil seal; 9——Camshaft; 10——Injection pump lower housing; 11——Control rod; 12——Tappet and adjusting pad; 13——Check valve; 14——Pump element; 15——Plunger spring; 16——Injection pump upper housing; 17——Delivery valve; 18——Delivery valve gasket; 19——Delivery velve spring; 20——Delivery velve holder; 21——Inlet banjo connection blot.

The pump element, delivery valve, plunger spring and delivery valve holder are all installed in the upper housing of the injection pump. The barrel and the delivery valve seat are pressed tighgtly together within the upper housing by the delivery valve holder. The locating screws are used to prevent the barrels from rotation. The air trapped in the upper housing can be vented by loosening the vent screw. The upper housing together with all parts on it are fastened on the lower housing with bolts.

The fuel from the feed pump flows, after being filtered, into the upper housing of the injection pump through the inlet banjo connection bolt and fills up the space above the plunger. When the fuel pressure reaches 49kpa, the check valve opens and the excessive fuel flows back to the delivery pump via return pipe.

As the plunger moves upward to cover the port holes on the barrel thouroghly, the fuel is compressed. The plunger goes on to move up until the increased fuel pressure can overcome the force of the delivery valve spring, the delivery valve lifts from its seat and the fuel flows into the injector through the fuel injection pipe.

The plunger moves upward continuously, the helical groove on it is connected with the spill—port on the bareel, the residual compressed fuel above the plunger top flows back to the low pressure chamber within the pump housing along the vertical passage and helical groove on the plunger and through the apill—port on the barrel. Thus, fuel pressure within the space above the plunger drops, the delivery valve returns to its seat under the action of its spring and the fuel delivery ceases.

During the end of the fuel injection, the relief piston of the delivery valve makes the fuel pressure within the injection pipe drop rapidly to make the nozzle terminate the fuel injection instantaneously and thereby avoid "dribbling" after injection of the fuel.

The quantity of fuel delivered by the pump varies with the engine load and its variation is carried out by turning the plunger of the pump which is achieved by the movement of the control rod, control fork and the adjucting arm. The axial movement of the control rod is governed by the governor.

The injection pump is provided with a centrifugal variable speed type governor (Fig. 21) mounted on pump's rear end. The

function of the governor is to ensure reliable engine operation at specified speed while engine load varies, and define the maximum and the idling speed.

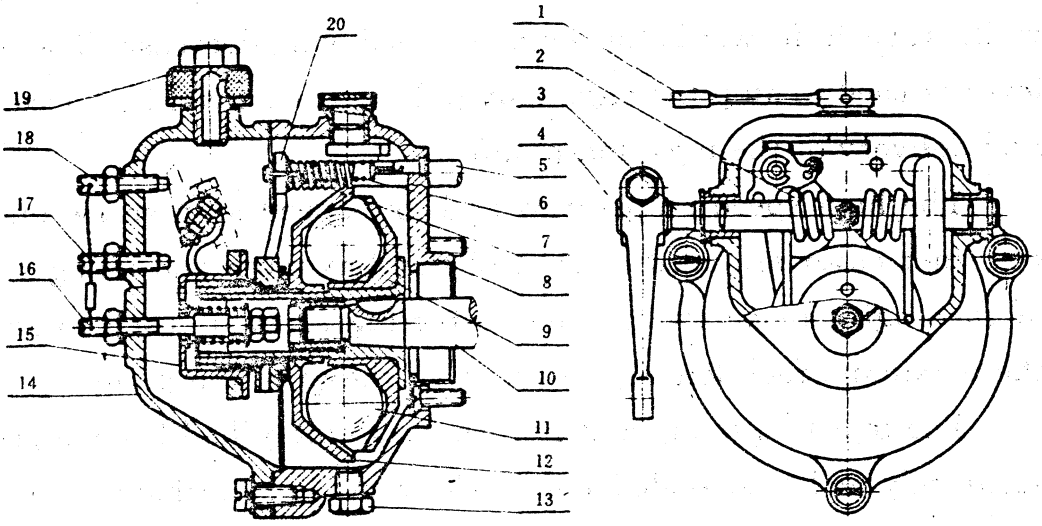


Fig. 21 Governor

1——Stop lever; 2——Governor spring; 3——Governor control shaft; 4——Governor control lever; 5——Control rod; 6——Start spring; 7——Stop spring; 8——Governor housing; 9——Driving plate and connecting sleeve; 10——Camshaft; 11——Steel ball; 12——Driven plate; 13——Drain plug; 14——Governor cover; 15——Push cup; 16——Correcting screw and spring; 17——Low speed stop screw; 18——High speed stop screw; 19——Breather and filler; 20——Linking plate.

The Driving plate and the connecting sleeve are fixed on the camshaft of the injection pump. There are six steel balls which can slide along their radial races in the driving plate. When engine load drops and speed rises, the steel balls slide further apart under the action of centrifugal force. This makes the driven plate to overcome the force of the governor spring and move backward, so that the control rod of the pump is pulled backward through the linking plate and the quantity of fuel delivered by the plunger decreases and the engine speed drops correspondingly, and vice versa; there-

fore the engine speed can eventually maintain the specified value.

The governor cover is provided with governor control lever and stop lever. The governor control lever is used to control the engine speed. The torque of the governor spring can be changed by turing the lever. Turn it backward, the engine speed will increases, while turn it forward, the engine speed will decrease. The stop lever is used to stop the engine by pulling it backward to cease the fuel delivery of the injection pump.

The high speed stop screw and low speed stop screw on the governor cover are used to control the maximum and idling speed of the engine respectively. The correcting screw is used to adjust the maximum fuel delidery quantity of the injection pump.

The injection pump and governor assembly had been adjusted accurately and lead sealed before delivery. It is forbidden for the users to dismantle and readjust it optionally. If there is any trouble with it, it must be adjusted on a pump test bench by a skillful worker.

(5)Injector

The injector consists of nozzle holder, nozzle cap nut, nozzle, spindle, injector spring, adjusting screw, and protecting cap nut, etc., as shown in Fig, 22.

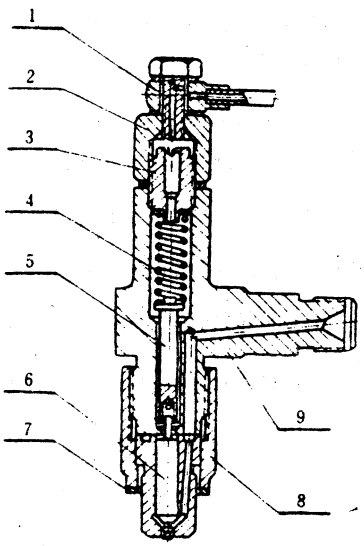


Fig. 22 Injector

1—— Leak off pipe connection; 2—— Protecting cap; 3—— Adjusting screw; 4—— Injector spring; 5—— Spindle; 6—— Nozzle; 7—— Cooper washer; 8—— Nozzle cap nut; 9—— Nozzle holder.

Model ZS4SI nozzle is of single—hole pintle type (The spray hole diameter is 1 mm, and the spray angle is 4°). The high pressure fuel delivered by the injection pump enters through the mozzle holder and the annular chamber in the nozzle body. When the fuel pressure reaches to 11768KPa, the spring pressure will be overcomed and the needle valve will be lifted. At this time, a certain amount of fuel will be atomized and injected into the combustion chamber through the spray hole. After injection, the fuel pressure drops and the spray hole is plugged again by the needle valve under the action of the spring. The fuel leaking out from the clearance between the needle valve and nozzle body will return to the fuel tank through the top of the injector, the banjo connection bolt and the leak off pipe.

The injector assembly is fixed on the cylinder head with two studs. The two nuts should be tightened evenly with specified torque of 15—20N—n. In order to ensure its air tightness, a copper washer is used on the bottom of the nozzle cap nut.

2). Maintenance of the Supply System

(1)Maintenance of Air Cleaner

A. When the engine operates in the atmosphere full of strawchips and dusts , a linen hood should be used to cover the inlet port of the air cleaner. The dust remained on the linen hood and the cleaner should be cleaned off after every shift.

B. Check frequently the air tightness of every air passage connection. It is forbidden to operate the engine unless all the connections are well air—tight; otherwise, the cylinder liners will be worn

out rapidly.

C. It is forbidden to flush the paper element with oil. The dust on the outside surface can be brushed off tenderly with a soft brush as shown in Fig. 23 or blown away by compressed air from the inside outward.

If the element is found broken or dust has entered into the inner space, it must be replaced. When installing a new element, pay special attention to its ends for air tightness.

Fig. 23 Remove the dust on the outer surface of the element with a soft brush.

(2)Maintenance of Fuel System

The engine's power output and economics in operation is directly affected by the working condition of its fuel system. Therefore, the fuel system should be carefully and regularly maintained according to the service manual specified. The stipulated fuel should be used to ensure the fuel system working satisfactorily, Before being filled up the fuel tank of the engine, the fuel should be settled at least for 48 hours and filtered with double layers of silkfabric during its filling. It should be noted that the precise elements (plunger, delivery valve and nozzle assemblies) will be worn out early or get stuck if the fuel having not been settled or having

been mixed with some water respectively.

In order to prevent dirt and water from entering the fuel passage, the level of the fuel tank outlet cock must be higher enough than that of the tank bottom.

A. maintenance of Fuel Filter

a. The paper element of the fuel filter should be flushed in clean diesel oil after every 250 working hours. Its service life closely relating to the fuel cleanliness is about 500 hours. If the outer surface is too dirty or the filter paper has been deformed, the element should be replaced before the due time. When flushing the element, a soft brush may be used to clean off the dirt on the outer surface tenderly. To avoid dirt entering the inner space of the element, the holes on blth ends of the element should be choked up with rubber or cork plugs in advance.

b. When installing the element, it must be carefuel that its end surfaces must be oil tighted and the inlet and outlet pipes on the filter head must be connected correctly, otherwise the filter will lose its effectiveness.

B. Calibration of the Fuel Delivery Timing

The fuel delivery timing should be calibrated in the 3rd order maintenance or after reassembling the engine, the procedure is as follows:

a. Mount an overflow tube on the first cylinder delivery valve holder of the injection pump (Fig. 24). The overflow tube consists of a high pressure fuel pipe of 45—60 mm in length, a plastic (or rubber) hose and a glass tube of 1.5—2 mm in inner diameter.

b. Place the governor control lever at the maximum fuel delivery position and expel up the air from the fuel passage with the hand pump. Then turn the crankshaft to let the fuel level stay still

at certain position in the glass tube.

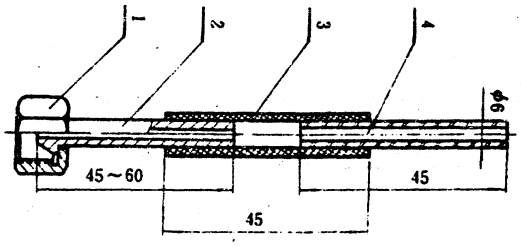


Fig. 24 Overflow tube

1——Fuel pipe lock nut; 2——High pressure fuel pipe; 3——Plastic hose; 4——Glass tube.

c. Turn the flywheel slowly. At the same time observe the fuel level in the glass tube. When fuel level just starts to rise, stop turning the flywheel immediately. The graduation mark on the rim of the flywheel aimed by the line marke on the inspecting window of the flywheel housing should be of $16\pm\frac{1}{2}^{\circ}$.

d. The fuel delivery advance can be adjusted by means of loosening the nuts of the three studs on the injection pump flange and turning the pump both directions by hand. Viewing from the end of the governor, if rotate the injection pump in clockwise direction, the delivery timing will be advance, while in the contrary, it will be retarded, After tightening the nuts on the flange, the delivery advance angle should be checked again.

e. If the delivery advance angle is still beyond the limit after rotating the injection pump to its extreme position, the gear case cover should be dismantled, the injection pump timing gear and the

idling gear should be staggered relatively by one tooth. Viewing from the front end of the injection pump, rotate the injection pump timing gear in clockwise direction, the delivery advance angle will be enlarged, while in the contrary, it will be reduced. Staggering the gears by one tooth, the fuel delivery timing will be changed by 18°.

C. Inspection and Adjustment of Injection pump and Governor

The injection pump and the governor are the important components of the engine fuel system, whose working condition will directly affect the performance and service life of the engine, therefore, it is not allowed to dismantle them optionally in normal case. The inspecting flushing, replacing and repairing as well as testing and adjusting the injection pump and the governor may be done only when they are out of order.

Inspecting and adjusting the injection pump and the governor should be undergone on a special test bench and done by a well—trained skillful worker.

a. Notice on dismantling and assembling the injection pump and the govenor.

a). These work should be taken in the certain sequence.

b). The important components should be dismantled and assembled with special tools.

c). All the parts, especially the plunger, delivery valve assemblies and other precise parts must be washed thoroughly in clean diesel fuel before reassembly. The primary and secondly washes are taken in the different containers. The precise parts should not be placed together with the other parts or wiped cotton waste.

d). The precise mating parts are selectively assembled in couple and the part of one are not interchangeable with that of anoth-

er.

e). In order to ensure the evenness of fuel delivery to every cylinder, the parts for each cylinder should not be interchanged each other optionally.

f). The end play of the pump camshaft should be adjusted to 0. 05 — 0. 15 mm by shims so that the camshaft can be rotated freely after the adjustment.

g). The barrel is installed in the upper housing of the injection pump, and should not be able to rotate after the locating screw is fastened, but it is able to move up and down slightly before the delivery valve assembly is installed.

h). When the plunger reaches top end of its stroke, the clearance between the top surfaces of the plunger and the barrel must be larger than 0. 3 mm to prevent the plunger from damage.

i). The specified torque for tightening the delivery valve holder is 49—59N. m.

j). Make the opening of the circlip on the control rod closer to aviod any accident due to its dropping off in operation.

k). In the whole process of assembling, check and see all moving parts are able to move smoothly especially the control rod, which should be able to slide freely while the cam is in any position.

l). The same lubricating oil as that used in the engine should be filled into the governer.

b. The adjustment of Injection Pump and Governor

a). Check the fuel delivery timing interval

(i). Mount an overflow tube of 2mm in inner diameter on the delivery valve holder of the first cylinder and keep the plunger stay at the position of delivering the maximum fuel quantity.

(ii) Rotate the pump camshaft clockwisely (viewed from the end of the pump flange) and watch the fuel level inside the glass tube until it starts to rise, record the fuel delivery advance angle of the first cylinder. The other cylinders should be checked in the same way in the sequence of 1 — 3 — 4 — 2. The timing interval should be 90° each and the tolerance in respect to the first cylinder should be less than ±1°.

(iii) The adjusting tappet pad should be replaced and the fuel delivery timing intervals should be readjusted if the tolerance exceeds the specified limit.

b). Adjusting control fork position on control rod

Adjust the staring amount of fuel delivery of the first cylinder to 17±1 cm^3/200 strokes when the camshaft speed is at 100—150 rpm. Then fix this control fork and set the remaining control forks in equal distances apart in general by means of a vernier calliper.

c. Adjusting rated amount of fuel delivery and fixing the high speed stop screw.

(i) Adjusting rated amount of fuel delivery; Let the camshaft running at a speed of 1000 rpm and set the governor control lever to the position on which the governor spring exerts a heavier pretension, then turn the correcting screw to obtain the amount of fuel delivery of the first cylinder being 22±0. 3 cm^3/400 stroks. Adjust the amount of fuel delivery of the remaining cylinders to be within this limit (The unevenness of them should not exceeds 3%). Finally, tighten the screws of the ramaining control forks.

The unevernness of the fuel delivery can be calculated according to the following equation:

$$H = \frac{Qmax - Qmin}{Qaverage} \times 100\%$$

Where: H = The unevenness of fuel delivery %;

Qmax —— Miximum amount of fuel delivery, cm^3/400 times;

Qmin —— Miximum amount of fuel delivery, cm^3/400 times;

Qaverage —— Average amount of fuel delivery of four cylinder cm^3/400 times.

(ii) Fixing the high speed stop screw: Keep the camshaft running at a speed of 1000 rpm and screw in the correcting screw to make itself out of function. Operate the governor control handle to reduce the pretension of the governor spring until the amount of fuel delivery to every cylinder is reduced to its rated value. Then hold the governor control lever still and screw in the high speed stop screw until it touches the upper lug on the governor control shaft. Finally, tighten the lock nut on the high speed stop screw.

d). Fixing the position of the correcting screw.

Keep the injection pump running at a speed of 700 rpm and set the governor control lever at the position on which the high speed stop screw touches the upper lug. Then turn the correcting screw to make the amount of fuel delivery to each cylinder be of $13 \pm 0.4 cm^3$/200 times. Finally, tighten the lock nut on the correcting screw.

e). Checking the governor Performance

Set the governor control lever at the position on which the high speed stop screw touches the upper lug, and then check:

(i) Rated amount of fuel delivery: Keep the camshaft turnning at a speed of 1000 rpm, the amount of fuel delivery to every cylinder should be of $22 \pm 0.3 cm^3$/400 times, its unevenness should not exceeds 3%.

(ii) Fuel delivery shutoff speed: Increase the camshaft speed gradually until the injector shuts down injecting fuel and at that

time the speed of the camshaft should not exceeds 1100 rpm.

f). Fixing the low speed stop screw.

Keep the camshaft running at a speed of 250—300 rpm. (275 rpm for example) Operate the governor control lever to make the amount of fuel delivery to each cylinder be of 2—3cm^3/200 times i. e. to keep the engine running idly, then screw in the low speed stop screw until it touches the lower lug on the governor control shaft. Set the governor control lever on the iding limit position and readjust the amount of fuel delivery until it reaches the specified value of the engine running idle, then tighten the lock nut.

D. Inspection and adjustment of Injector

a. Dismantle the injector and wash its parts in clean kerosene or diesel fuel. The primary and secondly washes should be done in different containers. The part of the nozzle assembly should not be confused with that of other nozzle assembly and the dirt and carbon deposit on their surfaces should be scraped off with a piece of wood or brass sheet, and then wiped cleaning with a piece of soft cloth.

b. a well cleaned needle valve should be able to slide down into its nozzle body by its own gravity. If the conical seating surfaces of the needle valve and nozzle body are not good enough to be oil—tighted, they can be lapped each other with a fine lapping compound such as # 500 green chromium oxide paste. Both the needle valve and the nozzle body must be washed cleaning thoroughly after lapping.

c. Install nozzle assembly onto injector and check injection pressure as well as the spray pattern on an injector test bench. The injection pressure should be set within 11768 + 980KPa. A good nozzle should be able to atomize the fuel finely without fuel

droplets which can be seen by naked eyes in the spray, and terminate the fuel injection instantaneously and also, there should be no "dribbling" or leakge after injection.

5. Lubricating System

The engine is lubricated by pressure oil combined with splash oil.

The layout of lubricating system is shown in Fig. 25. The lubricating oil is drawn from the oil sump through the sump strainer and the oil suction pipe into the lubricating oil pump. A portion of

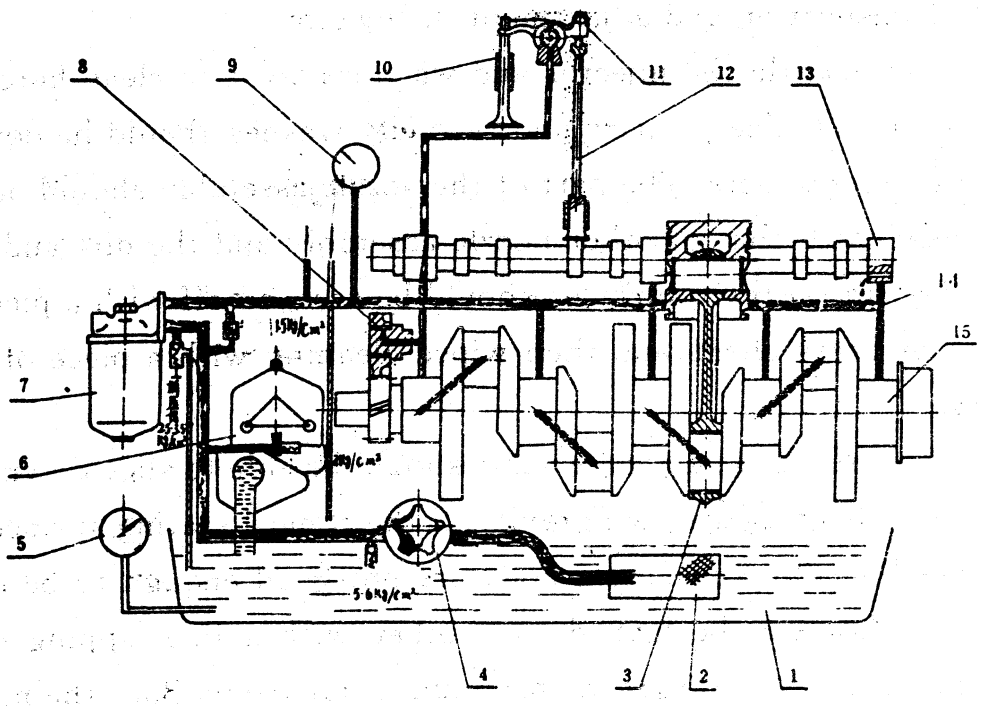


Fig. 25 Layout of lubricating system

1——Oil sump; 2——Sump strainer and oil suction pipe; 3——Piston and connecting rod assembly; 4——Lubricating oil pump; 5——Oil temperature gauge; 6——Centrifugal bypass type oil filter; 7——Oil filter; 8——Idling gear shaft and bushing; 9——Oil pressure gauge; 10——Valve and valve guide; 11——Rocker arm and its shaft; 12——Push rod; velve tappet and tappet bore on cylinder block; 13——Camshaft and bushing; 14——Main oil passage; 15——Crankshaft and bearing.

the oil is fed to the oil filter and then enters into the main oil passage after being filtered while another portion of the oil enters into the centrifugal bypass oil filter and flows back to the oil sump after being filtered. The oil in the main oil passage of the cylinder block is fed to the main bearings, connecting rod bearings, camshaft bushings and the idling gear shaft, The oil passing through the first camshaft bushing flows through the oil passage in cylinder block and cylinder head to lubricate the valve mechanism. The piston, piston pin, cylinder liner and timing gears are all splash—lubricated by the oil spilled from the bearings.

1). Construction of Main Components in Lubricating System

(1)Lubricating oil pump

The lubricating oil pump is of inner and outer rotor type as shown in Fig. 26.

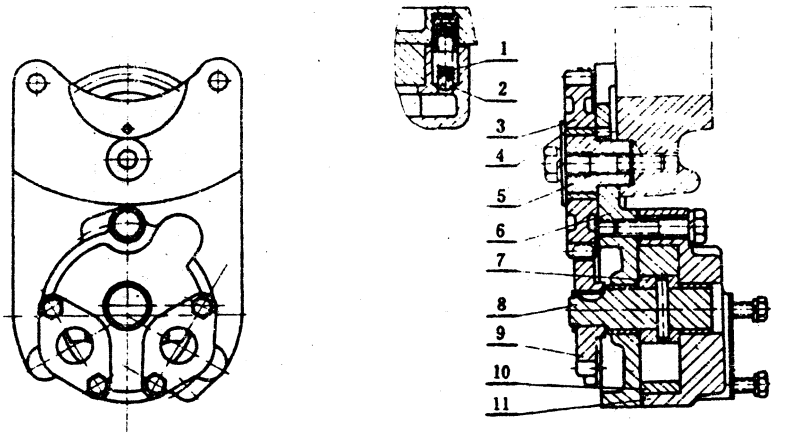


Fig. 26 Lubricating oil Pump

1—— Pressure regulating valve spring; 2—— Steel ball; 3—— Intermediate gear; 4——Gear washer; 5—— Intermediate gear shaft; 6——Oil pump cover; 7——Inner rotor; 8——Oil pump shaft; 9——Oil pump gear; 10——Outer rotor; 11——Oil pump body.

The lubricting oil pump is driven by the crankshaft timing

gear through the intermediate gear. When the pump speed is 2350 rpm, the oil pressure is 294KPa and the oil temperature is 85°C, the normal oil supply should not be less than 35 liters/min.

The axial clearance between the inner and outer roter and the pump body is within 0. 03—0. 10mm. If the end play is enlarged due to the wear, it can be adjusted by varying the thickness of the pump gasket.

(2)Lubricating oil Filter

Model J 0810 lubricating oil filter whose construction shown in Fig. 27 is used in the engine. It consists mainly of paper filter element, filter shell, filter head, pressure regulating valve and relief valve.

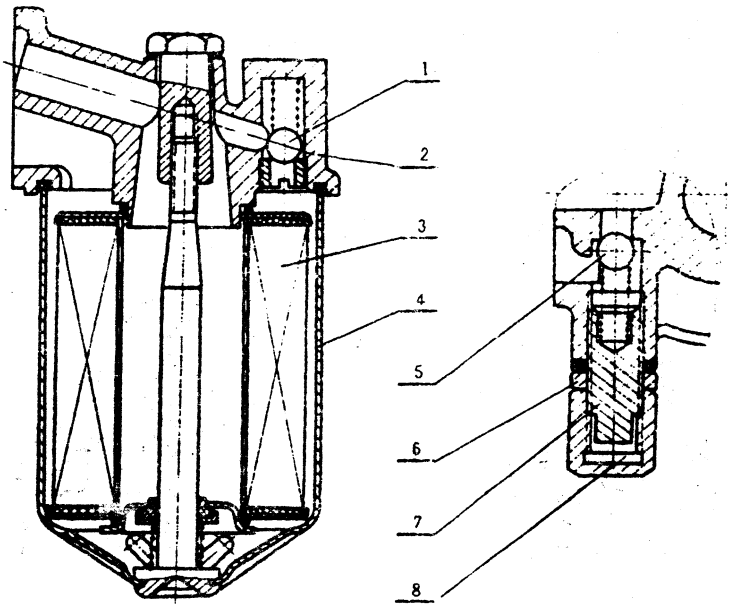


Fig. 27 J0810 Lubricating oil filter

1—— Relief valve; 2—— Filter head; 3—— Paper filter element; 4—— Filter shell; 5——Pressure regulating valve; 6——Lock nut; 7——Pressure reglating screw; 8——Protecting cap.

The oil fed by the lubricating oil pump enters into the filter shell through the oil inlet port on the filter head. After being fil-

tered, the oil is forced into the main oil passage of the cylinder block through the oil outlet port on the filter head from the inner space of the filter element. A pressure regulating valve provided for regulating the oil pressure inside the main oil passage is installed on the side of the filter head. The protecting cap should be removed and the lock nut should be loosened before adjusting. The oil pressure can be increased or decreased by turning in or out the adjusting screw. The adjustment can be made only when the oil temperature reaches about 80°C. The oil pressure should be within 196—392KPa at this time.

When the filter element is seriously chocked or the viscosity of the oil is too high. the amount of oil fed into the main oil passage will be reduced greatly and the relief valve will open, then the oil will enter into the main oil passage without being filtered to ensure the engine running safely. The relief valve had been adjusted on a special instrument in the factory before its delivery, so it should not be dismantled and adjusted under normal condition.

(3 Centrifugal type Bypass Oil Filter

Model F L 85 centrifugal bypass oil filter which consists mainly of rotor assembly, filter head, filter casing and rotor shaft, etc. is shown in Fig. 28.

The working principle of the centrifugal type bypass oil filter is : The pressurized oil fed by lubricating oil pump enters into the inner space of the rotor through the inlet port on the filter head and central oil passages of pressure regulating valve and the rotor shaft. There are two nozzles with an orifice on the bottom of the rotor. After flowing into the inner space of the rotor, the pressurized oil is injected out at high speed from the two nozzles. The reaction force of the oil jets drives the rotor to rotate at high speed.

Under the action of the centrifugal force, the dirts and impuritmies in the oil are thrown to the inner wall of the rotor to form a deposit layer, then the oil free of dirts and impurities injected out through the nozzles and flows back to the oil sump through the inner space of the filter head.

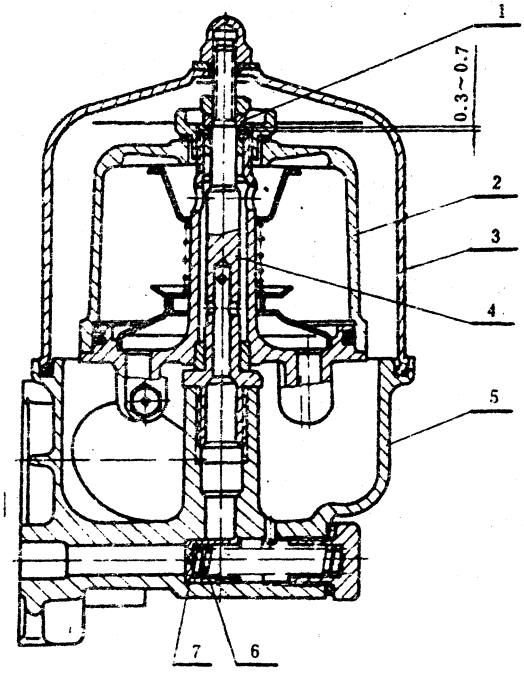


Fig. 28 Model FL 85 Centrifugal type bypass oil filter

1——Thrust washer; 2——Rotor assembly; 3——Filter casing; 4——Rotor shaft; 5——Filter head; 6——Pressure regulating spring; 7——Pressure regualting valve.

The rotor assembly is housed in the filter casing to prevent dirts from getting in.

The standard working specification of the rotor is: The rotor speed should not be lower than 5500 rpm while the oil pressure is of 343KPa and the oil viscosity is within 3 — 4 Engler degree (which is equivalent to the viscosity of the grade "HC—11" lubricating oil at 80±2°C).

In order to ensure the necessary pressure in the main oil passage and prevent the rotor from being out of normal operation be-

cause of too low inlet oil pressure, a pressure regulating valve is installed in the oil inlet passage of the filter head. When the oil pressure is too low to operate the rotor normally, the pressure regulating valve shuts down and the rotor will stop to work. The pressure regulating valve had been adjusted in the factory before its delivery to its opening pressure of 196±49KPa.

2). Maintenance of Lubricating System

In order to ensure the service life of all moving parts of the engine, it is important to maintain the lubricating system consciously.

(1)Notice on Maintenance

A. Only the stipulated lubricating oil is allowed to be used (refer to chapter 5 of this manual).

B. The lubricating oil should be stored in a clean and fully enclosed container and filled into the engine with a clean vessel. It is best to filter the oil with a piece of silk cloth just before filling it into the oil sump.

C. Follow the procedure of maintenance strictly in maintaining the lubricating system regularly. Special attention should be paid to replenish or renew the oil as well as to clean the sump strainer and replace the oil filter element regularly.

D. During the engine operating, the oil pressure in its main oil passage should be kept within 196—392KPa. When a cold engine is just started, its oil pressure should not be higher than 490KPa. The oil pressure should not be lower than 49KPa during the engine running at idling speed. If the oil pressure is too low, the pressure regulating valve on the filter should be adjusted first and if this adjustment is vain, the components of the lubricating system should be inspected ont after another as follows:

a. The oil pressure gauge and its connecting pipe;

b. The screen of the sump strainer;

c. The oil filter element and pressure regulating valve;

d. The oil inlet and outlet pipes of the lubricating oil pump.

The clearances of the crankshaft bearings are to be checked only when the components mentioned above are proven without being choked and getting loosened or other troubles.

e. The engine should be stopped immediately to inspect the lubricating system if no oil pressure is found in its main oil passage.

2). Cleaning, Inspection and Adjustment of the Components

(A)Inspection and Adjustment of Lubricating Oil Pump

After installing the rotors into oil pump body, the axial play of the rotors which can be adjusted by changing the thickness of gasket between the pump body and the cover, should be within 0. 03—0. 10 mm. The backlash between the inner and outer rotors should be within 0. 08—0. 21mm which may be measured by feeler gauge after installing the rotors and shaft into the casing and it is not adjustable. If this backlash is enlarged up to 0. 5mm. due to wear or the amount of oil supply is not sufficient, the inner and outer rotors should be replaced in couple.

Special attention should be paid to that the dowel pin fitted in the inner rotor and te pump shaft should not be loosen. Rivet the dowel pin's both ends after pressing it into the pin hole so as to prevent it from displacement to damage the rotor.

A renewed rotor couple should be able to rotate freely in the pump body, otherwise they should be checked for some high spots on their contact surfaces which may be eliminated carefully by a fine abrasive stick.

The lubricating oil pump should be tested on a special test

bench after reassembling. The delivering capacity of the pump should not be less than 35 liters/min. when the pump speed is at 2350 rpm, the oil temperature is of 80°—85°C and the oil pressure is of 294KPa.

The opening pressure of the pressure regulating valve should be adjusted to 490—588KPa.

Only a slight amout of oil leaked from the pump bushings is allowed during testing.

(B)Cleaning of Lubricating Oil Fliter

The method of cleaning the lubricating oil filter's paper element is the same as that of the fuel filter eiement.

(C)Cleaning of Centrifugal type Bypass Oil Filter

a. Remove the cap nut and dismantle the filter casing.

b. Remove the nut on the thrust washer, and the washer itself, take out the rotor assembly from the rotor shaft.

c. Remove the lock nut on the rotor cover and the cover itself.

d. Scrape away the dirt deposited in the inner space of the rotors with a wood scraper and wash the rotors with diesel oil. Clean the nozzle orifice with a brass wire if necessary, but don't dismantle the orifice plug.

e. Reassmble the rotor in the reversed sequence. The "O" ring seal beneath the rotor cover and the gasket beneath the hollow lock nut should be checked whether they are in good condition or not. The hollow lock nut should not be over tightened to prevent the rotor cover from damage.

f. After being installed onto the rotor shaft, the rotor assembly should be able to be rotated freely by hand, and then put on the thrust washer and tighten the nut. The rotor's end play should be within 0. 3—0. 7 mm.

g. Install the filter casing. Because there is no oil pressure within it, the cap nut should not be over tightened.

If the oil inlet pressure is normal, a correctly assembled rotor should be able to rotate by itself for 1—2 minutes under the action of its inertia. Therefore, after the engine stops, a special and even sound can be heard if sound or it lasts for very short time, that indicates the rotor assembly working abnormally either not running or running at very low speed.

6. Cooling System

The cooling system consists of the radiator (or cooling pool), water pump, fan, thermostat, cowling, water inlet and outlet hose, etc. as shown in Fig. 29.

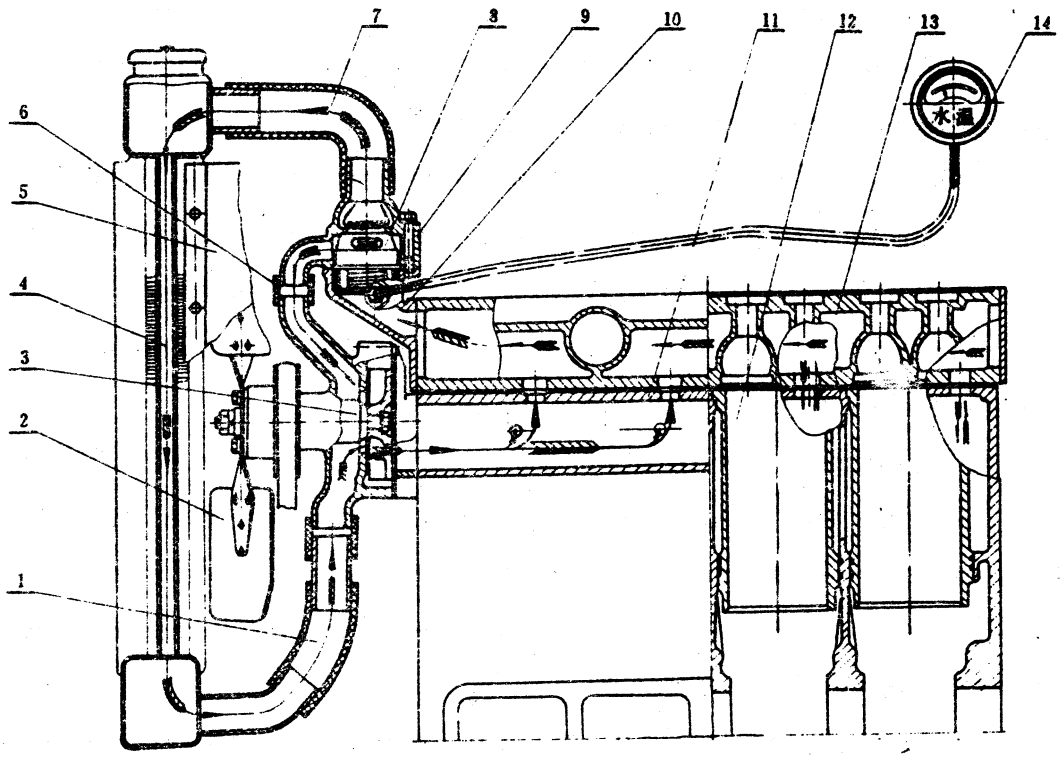


Fig. 29 Layout of cooling system

1——Water pump inlet rubber hose; 2——Fan; 3——Water pump; 4——Radiator; 5——Cowling; 6——Bypass rubber hose; 7——Engine water outlet rubber hose; 8——

Thermostat; 9——Thermostat housing; 10——Cylinder head front cover; 11——Cylinder block; 12——Cylinder liner; 13——Cylinder head; 14——Water temperature gauge.

1). Construction and Features

The close type (or open type) forced circulation water cooling system is adopted in the engine.

The cooling water is sucked in through the water pump inlet hose of the radiator and forced by the water pump into the main water passage located at the upper side of the cylinder block. A portion of the water enters into the cylinder block through four small holes to cool the cylinder liners. The remains passes through four holes of different diameter and enters into the cylinder head. The guide plates provided within the cylinder head make the water coolant flow concentrately through the triangular zones among the swirl chamber, the air intake port and the exhaust port. The heated water flows through the upper portion of the cylinder head and the engine water outlet hose back to the upper tank of the radiator. Then the water passing through the thin wall cooling tubes of the radiator element is cooled by the cooling fan and finally returns to the lower tank of the radiator to complete a "long circulation".

In order to control the water temperature, a thermostat is provided on the cylinder head front cover. When cylinder head outlet water temperature reaches 70±2°C, the thermostat starts to open, and when the temperature reaches 85°C, the thermostat opens fully.

When the water temperature is below the lower limit, the thermostat remains closed and the cooling water can't flow to the upper tank of the radiator, but flows back to the water pump through the small bypass pipe beneath the thermostat. Thus, the cooling water directly pumped back to the cylinder block and head

without being cooled by the radiator. This is so—called "short circulation".

The water pump used on the engine is of centrifugal type. The pump and the fan are assembled into an independent unit installed on the front end of the cylinder block with a bed plate and driven by the crankshaft pulley through a V—belt. The pump capacity should be greater than 100 liters/min. while the pump speed is 3000 rpm and the discharge head is 6 m.

The water pump consists mainly of pump housing, impeller, pulley, pump shaft and water seal etc as shown in Fig 30.

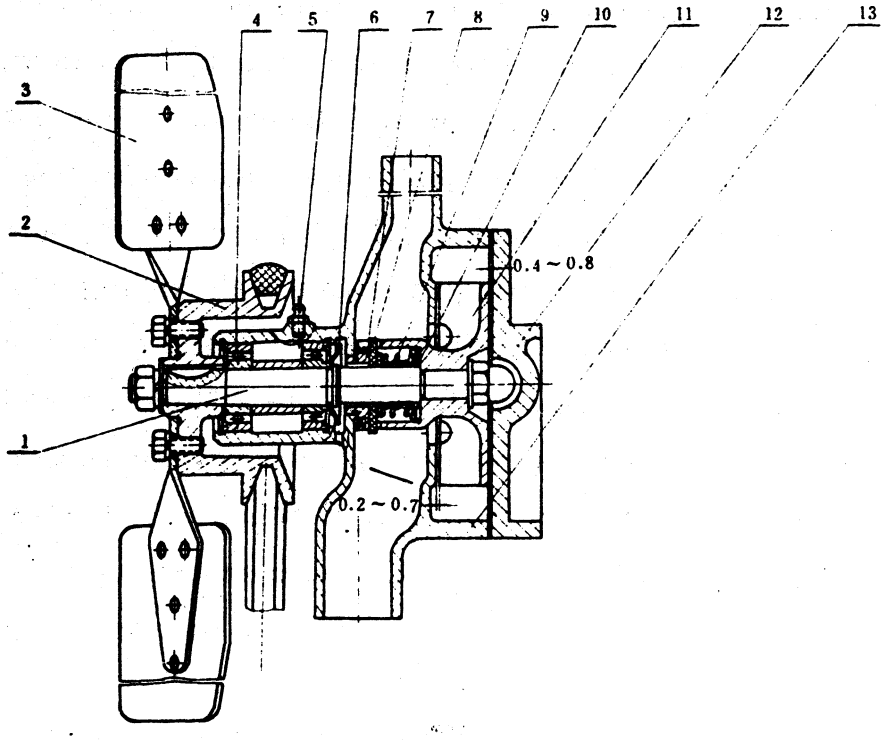


Fig. 30 Water pump and fan assembly

1——Water pump shaft; 2——Pulley; 3——Fan sub—assembly; 4——"60203"bearing; 5——Grease nipple; 6——Water slinger; 7——Seal sleeve; 8——Water seal gasket; 9——Water seal spring; 10——Water seal; 11——Water pump impeller; 12——Bed plate; 13——Water pump housing.

The pump shaft rotating in the pump housing is supported by two dust—proof rolling bearings. The impeller is installed on the rear end of the shaft and tightened with a nut. Inside the neck of the impeller, a water seal and a water seal gasket are fitted to prevent the water from leakage by means of the pressure of the water seal spring which presses the gasket onto the end and makes the gasket rotate together with the shaft.

In order to prevent the water leaking from the water seal gasket and entering the ball bearings, a water slinger is fitted in front of the bearings and a small weep holeis drilled at the bottom of the bearing housing end to drain off the water go into the bearing housing.

Should the engine operated in North China, the fan can be provided with or without hub in construction and both of them are 380 mm in diameter; in South China, the "Yue Jin" type four—blade hubless fan of 450 mm in diameter may be used.

2). Maintenance of Cooling System

(1)In order to prevent the water jacket from scale deposit, the cooling water should be the clean soft water. If there is no soft water, the hard water should be treated in the manner recommended in Chapter 5.

(2)The water temperature should be maintained within 80—90°C during the engine operating. The engine is not allowed to run continuously for a long period of time while the water temperature is too high or too low.

(3)The scale deposit in the cooling system should be removed in the fourth order maintenance of the engine. According to the following recommended procedures:

a. Put either 750—800 grams of sodium hydroxide (caustic

sods) plus 250 grams of kerosene or 1 kg. of sodium carbonate (soda) plus 0.5 liter of kerosene into every 10 liters of clean water to form a descaling solution (the full capacity of the engine cooling system is about 14 liters)

b. Drain off the water within the cooling system and fill the system with either one of the above mentioned solutions.

c. Start the engine and set it running at medium speed (800—1500 rpm) for 5—10 minutes.

d. Stop the engine and let the solution remain in the cooling system for 10—20 hours. Then, operate the engine again for 5—10 minutes to heat up the solution.

e. Stop the engine, drain off the solution immediately and flush the engine cooling system with clean water after the engine cools down.

(4) The V—belt of model B 1143 (GB 1171—74) is adopted to drive the fan of the engine. The belt tension should be maintained with in certain limit. To check whether the tension of 3—5kg at midway between the fan and dynamo pulleys, the belt should slope down 15—25 mm as shown in Fig. 31.

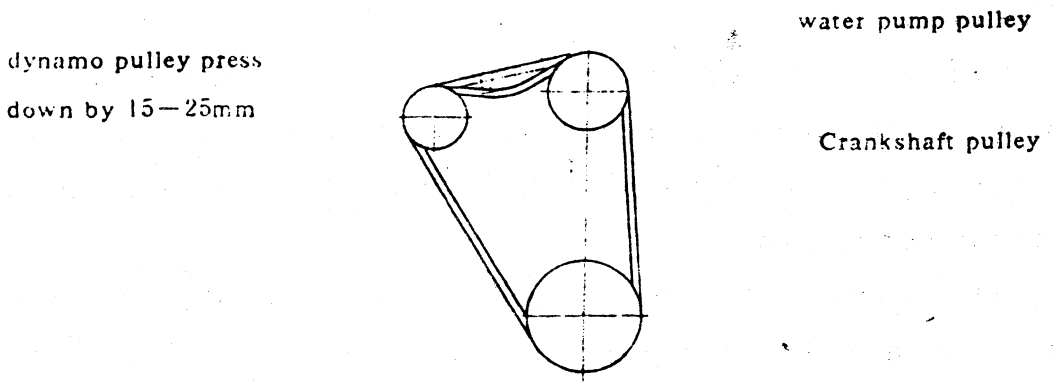


Fig. 31 Checking the correct tension of the belt

If the belt is too tight, it will cause excessive wear of the

pump bearings and the belt itself, whereas if it is too loose, it will cause slippage which can decrease the cooling efficiency and eventually cause the engine overheated.

(5) A slight leakage of not move than 3 drops of water per minute from the drain hole of the water pump is permitted. The leakage may take place more seriously for a new pump because the seal gasket has not got fitted yet. nevertheless the pump should be dismantled for remedy if the leakage gets more and more.

The disassembly and inspection of the water pump should be carried out according to the following steps:

a. Loosen off the bed plate fastening screws and remove the bed plate.

b. Loosen off the impeller fastening cap nut and make use of the two M6 tapped holes on the impeller to pull out the impeller itself with two bolts.

c. Remove the water seal lock ring inside the neck of the impeller and take out the seal gasket and the water seal, then inspect them or replace them if necessary (the water seal is the same as that of the "Jie Fan" or of the "Yue Jin" truck).

d. Loosen off the pulley fastening nut and take off the fan together with the pulley.

e. Take off the snap ring with a pair of pliers, press out the pump shaft together with the bearings from the front end, then inspect them and replace the bearings if necessary or clean them and renew the grease.

The reassemble steps is just the reverse of that mentioned above.

During installing, the bearing should be fully filled with new clean grease. The axial clearance between the front end of impeller

and the pump housing should be of 0. 2—0. 7mm, while the clearance between the back end of the impeller and the bedplate should be of 0. 4—0. 8mm.

7. Electrical System

The electrical system of the model 495 diesel engine includes mainly the bettery, staring motor, generator, regulator, instruments and switches, etc. The cable is of single wire system with one pole grounded as shown in Fig. 32.

1). Construction Features of The Electrical System

(1)Battery

The battery is of Model 6—Q—140, its rated voltage is 12 volts. Each cell of the battery is fitted with 21 pieces of pole plant. The battery capacity is 140 amperes.

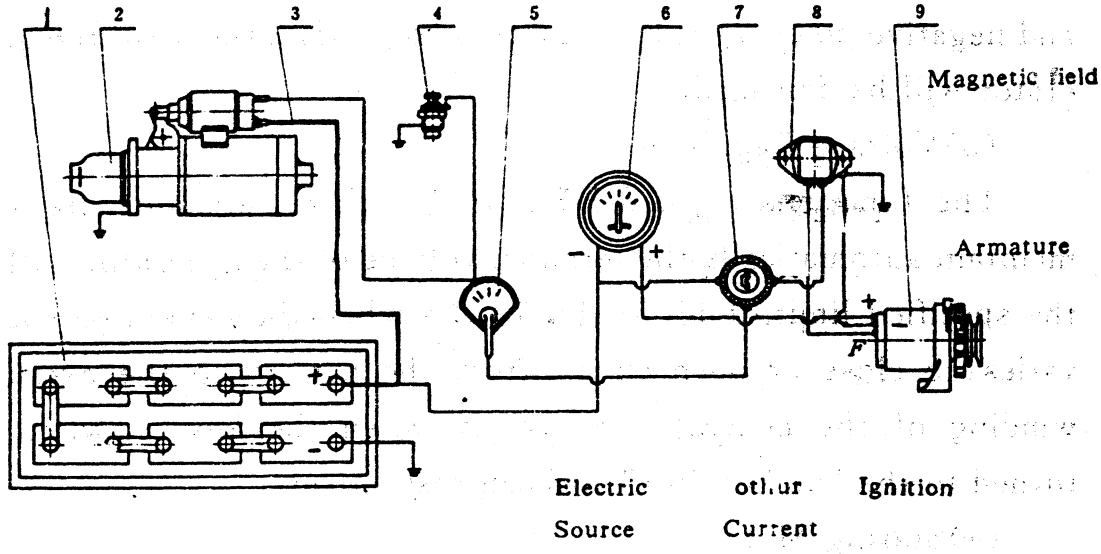
The condition of battery, which affects the engine staring directly, should always be kept will through regular maintenance as specified.

(2)Dynamo

The model of 2JF—200 silicon rectified dynamo of completely enclosed type is adopted in the engine. The operating voltage is 14 volts, the output current is 13 amperes and the rated capacity is 180 watts. The silicon rectified generator is a set of small size, simple construction and good charging performance at low speed, etc.

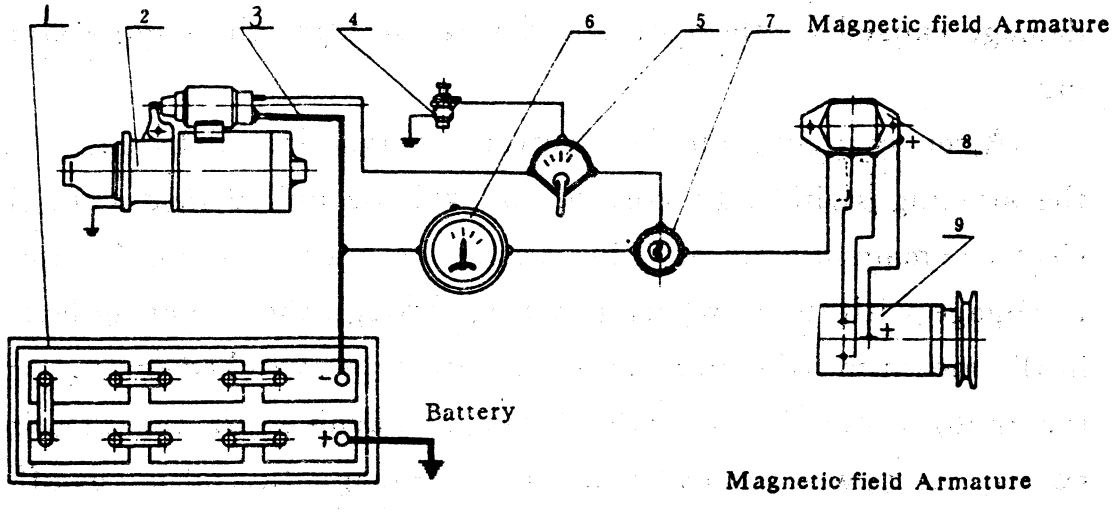
The magnetic poles of the generator are located on the rotor and the exciting current is conducted to the magnetic field coil through two slip rings.

The 3—phase windings are located on the stator and the current from the windings is turned into DC and conducted out after being rectified by two groups of silicon diodes (there are 3 diodes in each group) in the rectifying device.



(a)Electrical system with AC generator

1—— Battery; 2—— Starting motor; 3—— Cable; 4—— Preheater; 5—— Preheating starting switch; 6—— Ammeter; 7—— Key switch; 8—— Voltage regulator; 9—— Silicon rectified generator.



(b)Electrical system with DC generator

1—— Battery; 2—— Starting motor; 3—— Cable; 4—— Preheater; 5—— Preheating starting switch; 6—— Ammeter; 7—— Key switch; 8—— Voltage; 9—— DC generator.

Fig. 32 Layout of the electrical system

Model 2JF — 200 silicon rectified dynamo should be used in conjunction with model FT 70 D regulator and with the positive and negative poles must be connected correctly, otherwise the generator will be damaged.

(3)Voltage Regulator

The functions of model FT 70 D volage regulator are : to maintain automatically the terminal voltage of the generator within the specified limit of 13. 8—14. 5 volts when the generator speed varies; to close or open circuit from the battery to the exciting winding of the generator relevantly when the key — switch is turned to the "on" or "off" position respectively.

(4)Staring Motor

The staring motor is of model ST95, DC series exciting type with a voltage of 12volts and a maximum power output of 1. 47kw. It is provided with an electro — magnetic engagement mechanism and a one — way rolling ball clutch to prevent the armature from damage caused by the high speed rotation after the engine starting.

After switching on the electron — magnetic coil by means of the starting switch, the core of coil will be pulled in due to the electro — magentic action. This drives the starting motor's pinion to engage with the flywheel gear ring through the actuating lever; in the meantime, the starting motor circuit is switched on, causing the motor, then the fly wheel rotate. Turning off the starting switch, the power supply of the electro — magnetic coil is cut off , the magnetic force disappears, the core will return to its original position. This causes the starting motor's pinion to disengage with the flywheel gear ring. At the same time, the power supply will be cut off to stop the starting motor rotating.

(5)Preheater

The preheater installed on the main air intake manifold is of 20ltype. Its construction is shown in Fig. 33.

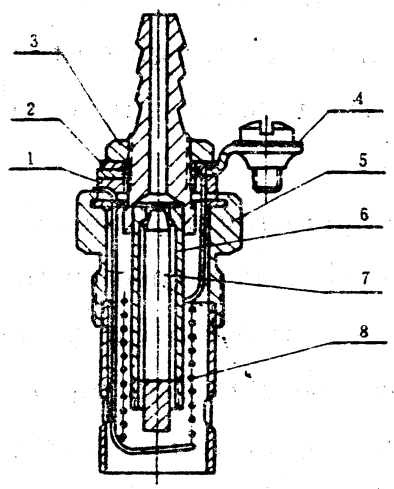


Fig. 33 Preheater

1——Metal gasket and isolate gasket; 2——Metal gasket and isolate gasket; 3——Nut; 4——Terminal; 5——Adapter; 6——Valve body; 7——Needle valve; 8——Resistance wire

After turning on the preheating—starting switch, the valve body of the preheater heated by the resistance wire will elongate to form a clearance between the conical sealing bands of the valve body and its needle valve. Coming from the fuel tank, the fuel flowing into the valve body through the injector return pipe is heated and carburated. The carburated fuel will be ignited by the red—hot resistance wire during it leaving the valve body. The flame of ignited fuel heats the air inside the air intake manifold to make the engine start easily. After turning off the switch, the valve body contracts and the needle valve colses down automatically.

After the circuit is switched on for 15 seconds, the prdheater begins to spurt flame. It is notpermitted to switch on the circuit for

more than 30 seconds each time.

During the installation of the preheater, it is forbidden to wrench the nut "3", but wrench the adapter "5" instead, in order to prevent the terminal "4" from getting damaged.

If the preheater drops fuel in cold state, switch on the preheater for 5—6 senconds , then tighten the needle valve with a pair of sharp nose pliers, the trouble will get remedied accordingly.

(6)Key Switch:

There are three operating positions on the key switch of model JK—405. When the key is turned to the intermediate position, the whole circuit is cut off. Both the preheating—starting switch and the regulator will be switched on by turning the key clockwise. At this time, the engine can be started. As soon as the engine is started, the key should be turned counterclockwise to the end immediately. Now, only the regulator is swiched on so that the generator can charge the battery but the starting motor can't be started so as to avoid accident.

(7)Preheating—Starting Switch

There are four operating positions on the preheating—starting switch of model JK—290. When the switch is turned to the preheating "position" the preheater will be switched on only; when the switch is turned to the "starting" position, the starting motor will be switched on lnly while the switch is turned to the "preheating and starting" position, both the preheater and the starting motor will be switched on, turning the switch to the "O" position, the whole circuit will be switched off.

2)Maintenance of Electrical System

(1)Maintenance of Battery

A. The batteries delivered with the engine have not been

charged. Therefore, they should charged before using according to the charging practice. If the engine user has no facility for charging the new battery, it should be sent to a shop possessing such facility to do so.

B. The top surfaces of the batteries should be always kept clean and dry, the covers and terminals should be wiped clean on time and should never let ventilating holes on the covers get clogged up.

C. Check the battery electrolyte regularly. Under normal conditions, its specified gravity should be within 1. 240—1. 270. If it is less than the specified valve, fill the battery with the electrolyte whose specific gravity is of 1. 280.

D. In the cource of operation, water inside the battery electrolyte will evaporate gradually, so it should be checked and replenished on time. In general conditions, check once every 10—15 days in winter and every 5—6 days in summer. The solution lever should be 10—15 mm above the paltes. If it is too low, replenish is with distilled water; other kinds of water is prohibited to use.

To prevent the solution from chemical reaction, it is forbidden to check the solution lever with a metal rod, It is recommended to use a glass tube of 3—5 mm in inner diameter. Dip it vertically into the solution through the filler while its upper end is pressed on by the thumb. Remove the thumb and repress it with the thump while the tube is dipped into the solution, then take it out. The height of the solution lever in the glass tupe is just the same above the plates inside the battery.

E. If the non—charged batteries are key idly for a long time, they should be stored at a dry and well ventilated place where the ambient temperature should not less then 6°C. And the period of

storage should not exceed two years since their delivery.

The used batteries should be wiped clean fully charged before being put aside separately. Moreover, they should be checked and recharged once a month.

If the used batteries are taken out of service for a long period of time, (more than 6 months), they should be stored without electrolyte. Therefore, it is necessary to discharge them with one twentieth of rated current until the voltage of each cell is lower than 1. 7 volts, and then drain off the electorlyte, and flush them with distilled water (once enery 3 hours) until the water is free of acidity. Finally, dry them up and store them as the new batteries.

F. Safety operation: The place where the batteries are charged should be well ventilated and free of fire. When the electrolyte is being made, it is important that pure sulphuric acid should be added into distilled water, and never add the water to the acid.

(2)Maintenance of the generator

A. During inspecting and servicing the generator, never test its insulation with a megaohm meter (hand winding meter) of with the 220 volts A. C. power source. Only a multimeter with high internal resistance can be used such purpose.

B. The generator should be inspected once every 750 operating hours (It is allowed according to the operating condition, that the generator may not be serviced until the fourth order maintenance).

(3)Miantenance of Starting Motor

A. Check regularly to see whether its connctions of the fastening parts and the conducting cables are firmly connected and clean the gathered dirts off.

B. The staring motor should be thoroughly checked during the

fourth order maintenance. The service interval may be shortened or prolonged properly according to the operating conditions.

C. Check the wear condition of the electric brushes of model TS 103, replace the worn out ones. Check the pressure of their springs with a spring weigher. The pressure should be within 0. 9 —1. 3kg. If it isn's within this limit, the spring should be replaced.

D. Check the wear conditions of the pinion, the front cover, the intermediate cover and the bushing on the rear cover, repalce them if they are worn out badly.

E. Test the insulations between the armature and the shaft, the magentic pole coil and the housing as well as the brush insulation frame and the rear cover with a multimeter.

F. Check the attraction force of the magnetic switch with the storage battery . If the attraction force is weak but the soldering connection on the copper sheet-is still perfect, the magnetic switch should be sent to the service shop for remedy or renew. If its contact found poor in the course of use, them melt away the soldering tin on the copper sheet of the bakelite casing, turn off the two bolts and take down the bakelite casing to check and polish the contacts with No. o sandpaper (the spring inside the bakelite casing should be cared during reassembling the switch).

Chapter Ⅲ. Transporting, Installing and Unpacking the Diesel Engine.

The front and rear lifting bracket provided on the cylinder head should be used to hang up the engine in haulage. Close attention should be paid to prevent the engine exterior appearance, accessories and pipes, etc. from damage or deformation.

If the engine is employed for stationary application, the foundation should be kept strong and rigid, the mounting surface of the foundation surface should be kept horizontal, the driven equipment should be conformed to the regulation and the working place should be spacious, dustproof, rainproof and well ventilated.

When a new engine is unpacked before using, wipe off firstly the rust proof grease from its exposed parts , turn crankshaft slowly with the staring handle; then drive the engine for 15 seconds each time by means of the starting motor under decompression condition. Repeat this operation for several times and stop the engine for 2 minutes after each operation. Eventually, start the engine and run it according to the regulation for the running—in operation.

Chapter Ⅳ. Test Running and Running—in of The Engine

Though the new and the overhauled engines had been tested running in the factory before delivery, the working surfaces of the engine parts still have not won the perfect fitness; therefore, it is forbidden to let the engine parts run under full load right away; otherwise, the parts will wear rapidly and the engine service life becomes much shorter.

The duration of the test working and running — in period should not be less than 50 hours. It is recommended to adopt the following procedure:

1. No—load running (for 15 minutes), referred to Table 3

Table 3

Speed(rpm)	800—1000	1400—1600	1800—2000
Time duration(min)	5	5	5

(1)Start the engine according to the procedures stipulated in this manual.

(2)During the engine in no—load running, observe the operating condition and listen to the noises carefully of all engine parts. The engine is allowed to run—in under load only if the engine is normal for sure in its test working.

2. Loaded running—in(for 50 hours), referred to Table 4

Table 4

No	Speed (rpm)	Percentage of full load(%)	Load (PS)	Duration (hr)
1	2000	25	12	10
2	2000	50	24	15
3	2000	75	36	20
4	2000	100	48	5

(1)If the actual load of the driven equipment is difficult to be

determined exactly, the users may estimate the horsepower consumed according to the actual operating conditions and increase the load gradually to carry out the running—in procedures.

(2)The engine should be run steadily and evenly with load. It is not permitted to load and unload the engine abruptly.

(3)In every running—in stage, pay close attention to the operating conditions of the engine; the running—in duration may be prolonged properly if necessary.

3. Inspecting and cleaning the engine after running—in

After running—in, the engine should be inspected and cleaned so as to remove metallic particles in the lubricating oil due to the slight wear of the parts in the course of running—in.

(1)Renew the lubricating oil in the oil sump and injection pump; wash cleaning the oil sump and the sump strainer.

(2)Clean the lubricating oil filter.

(3)Check and adjust the valve lashes.

Chapter V Engine Operation

1. Fuel, Lubricating Oil and Cooling Water

1) Fuel

If the engine runs in summer, the Chinese grade o light diesel fuel (GB252—81) is to be used, and in winter, the 10 light diesel fuel is to be used.

The fuel to be used must be clean and settled for a period of time (generally not less than 48 hours). A further filtering is necessary during the fuel being filled into the engine (filtrate the fuel by means of putting two layers of silk cloth on the filler).

2) Lubricating oil

If the engine runs in summer or in hot climate areas, use Chinese grade HCA—14 diesel engine lubricating oil (SYB1152—79); and in winter or in cold climate areas, use HCA—11 diesel engine lubricating oil; while in the extreme low ambient temperature the HCA—8 diesel engine lubricating oil must be used. The lubricating oil to be used should be detergent. When filling the lubricating oil into the engine, it shluld be filtered with a screen. It is forbidden to adopt other grades of lubricating oil to prevent the bearings, piston rings and other grades of lubrcating oil to prevent the bearings, piston rings and other grades of lubricating oil to prevent the bearings, piston rings and other parts from premature wear or damage.

3) Cooling Water

It is recommended to use soft water such as clean river water, rain water and snow water, etc. for engine cooling. The soft water containing less minerals will or less scales after heating so that the cooling system will not clogged up easily. If the hard water containing much minerals is often used, the cylinder head will be over-

heated and damaged.

Well water, spring water or other hard water of containing much minerals should be softened before using. Any one of the following methods may be adopted for this purpose.

(1)Boiling and settling it.

(2)Put 6. 6 grams of caustic soda (NAOH) into every 10 litres of water, then settle and filtrate the water before using.

(3)Add 2 grams of lime (CaO) and then 10 grams of soda Na_2CO_3 to every to every 100 litres of water to or a water solution (The lime should be previously soaked thoroughly and filtrated before being poured into the hard water).

2. Preparations Before Starting The Engine

1)The engine should be thoroughly checked before starting. Pay close attention to see whether the foundation bolts and the connection with the driven equipment are rigid and reliable, and whether all the transmission parts and the control systems are sensitive and so on. The engine should not be started unless everything is all right.

2)Check and replenish the oil sump and injection pump with lubricating oil; fill up cooling water and diesel fuel, open the cock of the fuel tank to check the fuel system for leakage and eliminate it if there is any.

3) Vent the air out of fuel system step by step, It is recommened to adopt the following procedure:

At first, loosen the venting plug on the fuel filter, pump the fuel with the priming hand pump to expel the trapped air out of the fuel passage between the fuel tank and the filter, and then slacken the venting screw on the injection pump until the fuel flows out without bubbles.

4)Connect the battery and check the circuit to see whether it is connected correctly and firmly.

5)Crank the crankshaft with starting handle to lubricate the parts inside the engine and see whether every component moves normally.

3. Engine Starting

1)Set the governor control lever to the position where the fuel will be delivered rather more.

2)Push down the decompressor lever to reduce the pressure inside the cylinder (The engine may be started without decompression in summer or after stopping & for a short duration only).

3)Switch on the circuit, turn the preheating—starting switch to the "Starting" position, release the decompression lever after the crankshaft has been speeded up (approximate 300—400rpm) by the starting motor, the engine will be able to be stared then. As soon as the engine has been start, turn the starting switch back to "0" and set the governor control lever to the idling speed position immediately.

When the ambient temperature is not less than 5°C and the engine is in normal condition, it should be started successfully within about 4 seconds. If the engine still fails to start after it has been driven by the starting motor for 15 seconds, stop and wait for 1—2 after 3 attempts, check the cause and remedy the fault.

4)When the ambient temperature is lower than 5°C, the engine can be started with the help of the preheater after the cooling water and the lubricating oil having been heated up to 80—90°C previously. For this purpose, turn the preheating—starting switch to the "preheating" position first, and wait for 10—20 seconds, then turn it to the "starting" position. After the crankshaft speed

up, release the decompressor lever, the engine will be able to be started. If the engine still fails to srart afte releasing the decompressor lever, pause for 1—2 minutes and preheat again. If it still fails to start after 3 attempts, check the cause and remedy the fault.

5) After the engine has been started, pay close attention to observe whether it is running normally and whether the reading of every gauge is correct. If there is no oil pressure or other abnormal condition occurs, stop the engine, check the cause and remedy the fault, It is not permitted to go on operating the abnormal engine.

4. Operating The Engine

1) After being started, the engine should be warmed up with the medium speeds (incresing the speed gradually from 600—700 rpm up to 1000—1200 rpm). Aviod to run a cold engine at idling speed for a long period of time. The engine can be operated at maximum speed and full load only after its cooling water temperature has reached above 60°C.

2) Engine speed and load should be increased or decreased gradually. Aviod to load unload or to speed—up and speed—down the engine rapidly.

3) When the engine operating at full load, it is best to maintained the temperature of the cooling water within 80—90°C. The wear of the cylinder liners will speed up if the engine often operating with the water temperature below 70°C. The temperature of the lubricating oil should not exceed 95°C in general.

4) While the engine is running, pay attention frequently to the oil pressure, oil and water temperature and the charging current, etc., the readings of the gauges must be within the specified limits; observe the colour of the exhaust smoke and listen attentively

to the operating sound inside, If any trouble such as overheating, smoking, knocking or the other abnormal condition occurs, the engine should be stopped for check and remedy. It is forbidden to let the engine operate with trouble so as to prevent the engine parts from getting damaged.

5. Stopping The Engine

1)Before stopping the engine, take off the load first, and then decrease engine speed to idling gradually. After the water temperature falls below 70°C, push the stop lever backward to stop the engine.

2)It is forbidden to stop the engine suddenly while the water temperature is too high so as to prevent the cylinder head, combustion chamber inserts, and nozzle assemblies from getting damaged due to the overheat of the cylinder head locally.

3)It is not permitted to stop the engine by shutting off the cock of the fuel tank in order to prevent air from entering into the fuel passage. Don't stop the engine through decompression in general so as to prevent the valves from damage.

4) In winter, the cooling water inside the radiator and the cylinder block should be drained off in time after engine stops, and turn the crankshaft for several turns to prevent the water pump from freezing.

5)When the engine is going to be laid up for a long period, it should be preserved and stored according to the methods set forth by this manual.

6)Procedure of Safety Operation

1)One who is not familiar with the operation instructions is not allowed to operate the engine.

2)The engine is not permitted to be started unless all prepara-

tion work for the engine starting has been done.

3)Pay attention to fire prevention, no open fire is permitted to get access to the operating engine and flammable oil.

4)While the engine is operating, it is not permitted to be dismantled, checked and adjusted. The operator is not allowed to get away from the engine.

5)It is forbidden to let the engine operate with trouble for a long period. It is strictly porhibited to let the engine operate while the oil pressure is too low or even falls to zero, or with abnormal sound inside. The engine should be stopped running in emergency if any case as above mentioned happens.

6)When the engine drives a thrashing machine on a threshing ground, the exhaust manifold should be provided with a fire prevention device.

7)A safety shield should be fitted on the transmission device between the engine and driven machine.

8)Once the engine overspeeds suddenly due to out of control, push the stop lever immediately to stop the engine, then check the cause and remedy the fault. If the stop lever is out of order, push down the decompression lever or block up the air inlet port to stop the engine.

Chaper Ⅵ. Preservation and storage of The Engine

If the engine is to be laid up for a relatively long period of time, it should be preserved and stored according to the following procedure:

1. Drain off the fuel oil, lubricating oil and cooling water.

2. Remove the injector assembly, fill each cylinder with 200g clean dehydrated lubricating oil (i. e. heat the oil to 100—120°C, wait until no bubble appears). Turn the crankshaft to let the lubricating oil coat evenly on the surfaces of the parts such as the valve, the cylinder liner and the piston, etc., then clean the outer surface of the nozzle assembly, smear some lubricating oil on it and re—install it onto the engine.

3. Wrap up the air cleaner with plastic film, dismantle the silencer and choke up the exhaust manifole with a wooden plug.

4. Wipe off the oil dirt, dust and rust from the outer surface of the engine, smear the unpainted parts surfaces with a thin layer of anti—rusting agent (or grease) and cover them with paper.

5. Wrap up the engine with plastic cloth.

6. The preserved engine should be stored in a clean, dry and good ventilated engine room. It is strictly forbidden to put the engine together with corrosive substances.

The preservation according to the above procedure holds good for three months. It is advisable to repeat the procedure when the preservation period is overdue.