四洋
SIYANG

N485J

MARINE DIESEL ENGINE SET

OPERATION MANUAL

East China Shipbuilding Institute Factory

FORWARD

The N485J engine is a vertical, water-cooling and four stroke marine diesel engine set with a direct injecting chamber. It is composed of N485C diesel engine and marine reduction gearbox with the advantage of compact structure, low fuel consumption, good starting ability, reliable working and convenient for maintenance and operation. The engine set is widely used as main engine of total enclosed lifeboats with keel cooling system and is found in accordance of IMO Resolution MSC.48 (66)~IMO MSC81(70) requirement and latest requirements include SOLAS 1974,1996 Amendments.

This operation manual will give you a reference to operate your engine set properly, maintain and adjust it under optimum conditions.

The information, specification, illustrations, instructions and statements contained within this publication are given with our best intentions and are believed to be correct at the time going to press. As our continued technical development, we reserve the right to amend any technical information with or without prior notice.

Users of this manual are advised that the specification details apply to N485J engine set and not to any one particular engine. In case of difficulty, consult **EAST CHINA SHIPBUILDING INSTITUTE FACTORY**, China or a local distributor for further advice and technical assistance.

The information given is subject to the company's current condition and is for the assistance of users and is based upon results obtained from tests carried out at the place of manufacture. Our company doesn't guarantee that the same results will be obtained elsewhere under different conditions.

When purchasing parts, or giving instruction for the clients' repairs, please refer to engine part catalogue and specify **EAST CHINA SHIPBUILDING INSTITUTE FACTORY**. Our company **cannot** be responsible for any damage arising from the parts that have not been supplied by our company.

East China Shipbuilding Institute Factory Technical Section

October 08, 2002

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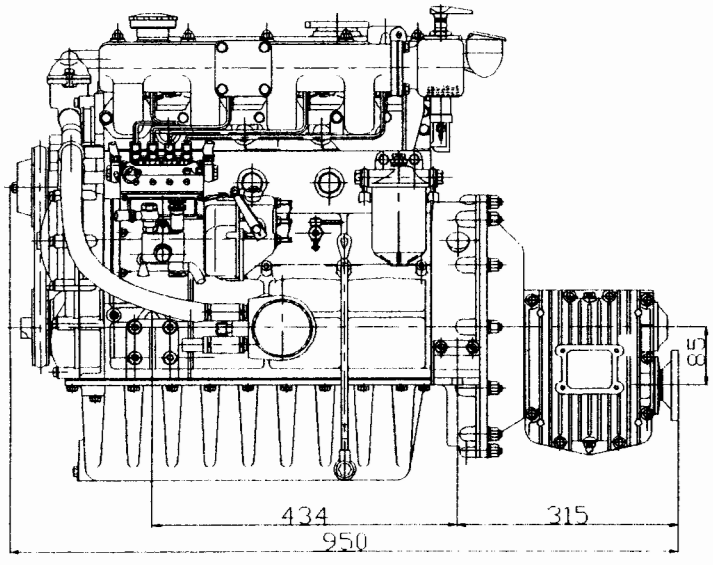
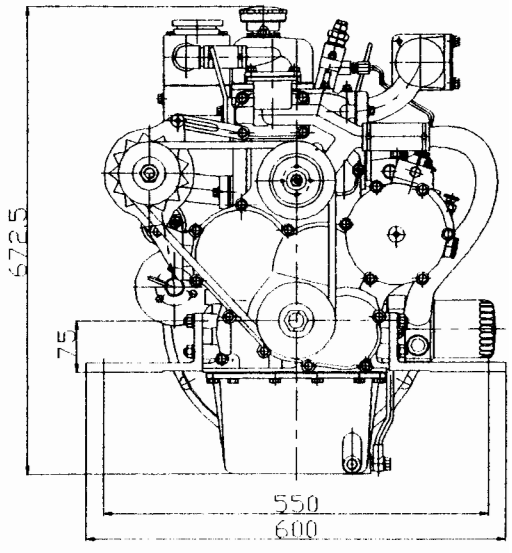
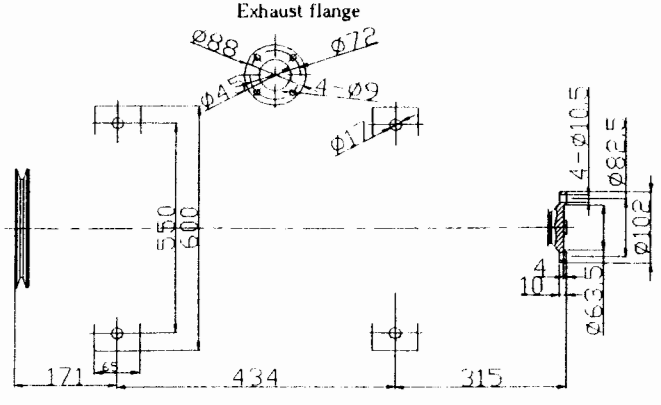




Exhaust flange



N485J Marine Diesel Engine Set Overall Dimension

SECTION I ENGINE DATA

A. Specification of the Diesel Engine **Table 1**

1	Model	N485C
2	Type	In-line、vertical、water cooled、 four stroke
3	Combustion chamber type	Direct injection
4	Number of cylinders	4
5	Bore (mm)	85
6	Stroke (mm)	95
7	Total displacement (L)	2.156
8	Compression ratio	18
9	Firing order	1→3→4→2
10	Rated output (kW (PS))	30（40.8）
11	Rated speed (r/min)	3000 or 2800
12	Specific fuel consumption at rated output rated speed (g/kW·h)	≤260
13	Lubrication oil consumption at rated output speed (g/kW·h)	≤2.45(1.80)
14	Air consumption in 10 minutes (m^3)	27.5 or 25.8
15	Direction of rotation of crankshaft (View from flywheel end)	Counterclockwise
16	Method of cooling	Forced water cooling
17	Method of lubrication	Combination of pressure and splash
18	Method of starting	Electric
19	Exhaust temperature (℃)	≤550
20	Operation method	Mechanical
21	Overall dimensions L×W×H (mm)	696×492×650
22	Net weight (kg)	≤225

Main Technical Specification of N485J Diesel Engine Set **Table 2**

Model		N485J	
Diesel Engine Model		N485C	
Gearbox	Type	SCG-025	ZF25M
	Reduction ratio	2.74(Forward)/2.67(Astern)	2.74(Forward)/2. 72(Astern)
Rated output (kW/PS)		28.8/39.2	
Rated output speed of diesel engine set	Diesel engine speed 3000rpm	1095(Forward)/1124(Astern)	1095(Forward)/1103(Astern)
	Diesel engine speed 2800rpm	1022(Forward)/1049(Astern)	1022(Forward)/1029(Astern)
Rotation direction		Clockwise (View from output end)	
Operation method		Mechanical or soft cable remote	
Cooling method		Forced water cooling with keel pipe	
Overall dimension L×W×H (mm)		950×600×672.5	
Net weight (Kg)		245	
Use		The diesel engine set can widely used for total enclosed lifeboat、rescue boat and patrol craft as propulsion power.	

B. Engine Technical Data

1. Vale timing:

Intake valve opens	12°before T.D.C
Intake valve closes	38°after B.D.C
Exhaust valve opens	50°before B.D.C
Exhaust valve closes	14°after T.D.C

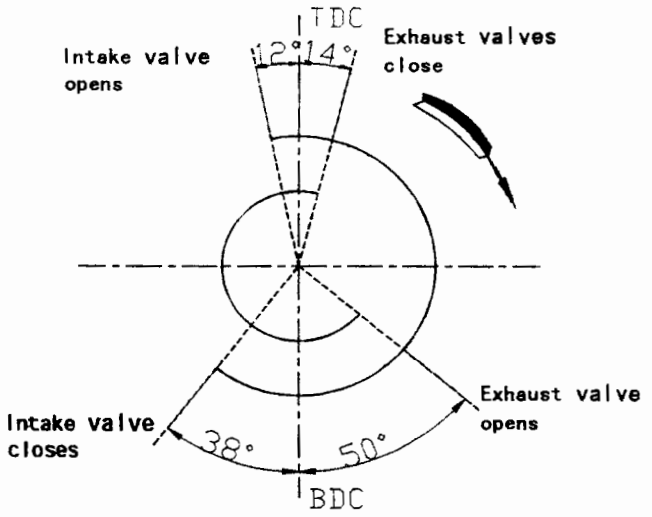


Fig. Valve Timing

Valve clearance (cold state):

Intake valve (mm)	0.25~0.30
Exhaust valve(mm)	0.25~0.30
2. Injection timing (°)	26~29
Injection Pressure [Mpa (kgf/cm^2)]	19.62 (200)
3. Various temperature and pressure	
Exhaust temperature at rated output (°C)	≤550
Lubricating oil temperature (°C)	≤105
Lubricating oil pressure [kPa (kgf/cm^2)]	200~400(2.04~4.08)
Lubricating oil pressure at idle speed [kPa(kgf/cm^2)]	>49(0.5)
Ideal outlet water temperature (°C)	78~85(Not more than 95)
4. Maximum idle speed (r/min)	≤3200
Minimum stable idle speed (r/min)	≤800
5. Torque limits of main bolts [N·m (kgf·m)]	
(1) Cylinder head bolts	118~137(12~14)

(2)Main bearing cap bolts	118~137(12~14)
(3)Connecting rod bolts	59~69(6~7)
(4)Flywheel bolts	98~118(10~12)
(5)Starting jaw	98~118(10~12)
6.Lubricating oil capacity (liter)	
Engine oil sump	6.5
Reduction gearbox	0.75

C. Accessories

Item	Description of accessories	Specifications or model
1	Injector	Model PF75Sa
2	Nozzle couple	ZCK154S425
3	Injection pump	BH 4Q75ZAY8
4	Lubricating oil pump	JZX1420 Inner and outer rotor type
5	Cooling water pump	Centrifugal type
	Speed (r/min)	3200
	Displacement (L/min)	70
	Lift (m)	6
6	Fuel filter	C0708A（CS0708B1 for Schat-harding）
7	Lubricating oil filter	JX0706P1
8	Lubrication cooler	YZ90ZH6
9	Starting motor	Model QD138
10	Charging generator	Model JFW17C3
11	Reduction gearbox	SCG025 or ZF25M

D. Propulsion Performance Curves of N485J Marine Diesel Engines Set

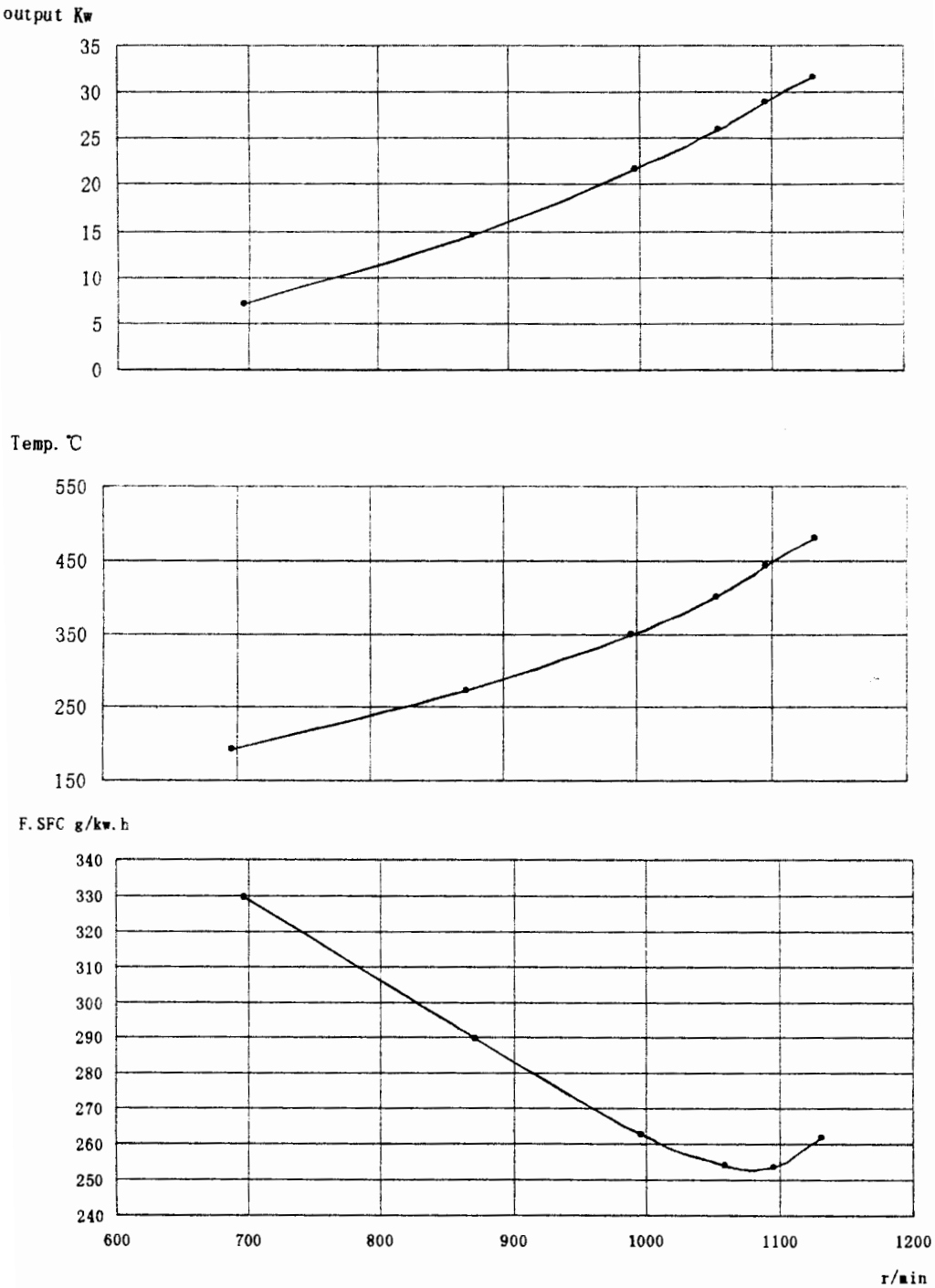


Fig1-2 Propulsion Performance Curves of N485J Marine Diesel Engine

SECTION II MAIN STRUCTURE AND ASSEMBLY OF THE ENGINE SET

A. Cylinder Block

The block is made of high strength cast iron and is of arch structure, on which 4 cylinder liners are installed. On the front side of the block is the gear case assembly.

Viewing from the front side (Fresh water pump side), on the right side of the block are assembled a fuel injection pump, an oil filter and a fuel filter; on the left side of the block are assembled a generator and a staring motor, etc; on the rear end of the block are assembled an oil seal cover and a flywheel housing; on the bottom is the oil sump. On the top of the block, besides the holes for cylinders and tapped holes for cylinder head bolts, there are water holes to the cylinder head. Near the front end of the block, there are also oil holes connected with the oil holes of the cylinder head.

The main bearings are of full support suspension type. The main bearing cap and the engine block are bored in couples. The bearing shell is separated into two sections. While assembling, attention should be paid to the 5 upper sections with semi-circular grooves that shouldn't be mixed up with lower ones.

On both sides of the rear main bearing seat and cap, two pairs (4 plates) of crankshaft thrust plates are fixed. When the crankshaft is installed on the main bearing seat, mount the main bearing cap and then tighten it with bolts. The two bolts for the same cap should be tightened in turn. Before tightening the cap, knock both the front and rear ends of the crankshaft to keep the upper and lower thrust plates in the same plane. While assembling the main bearings, main bearing caps and the thrust plates, attention should be paid to the following:

1. The main bearing caps should be assembled according to marks. No mistakes shall be made.

2. The upper and lower thrust plates are made of high tin and aluminum alloy with steel back. The surface of the alloy should face the crankshaft.

3. After assembling the upper and lower thrust plates, the axial clearance of the crankshaft shall be 0.12~0.13mm.

4. After completion of the assembling of the crankshaft, turn the crankshaft by hand at the end of flywheel to check whether it turns freely.

The rear oil seal cover is provided with oil seal SG85×110×12 for sealing the rear end of the crankshaft. While assembling, Attention should be paid not to damage the edge of the oil seal. The rear oil seal cover is positioned by two dowel pins and fixed on the rear

end surface of the cylinder block by bolts. The flywheel housing is provided with o-ring and positioned by two dowel pins and fixed on the cylinder block.

The front and rear camshaft bushings are pressed smoothly into the cylinder block by means of a special tool. While pressing, the oil hole of the bushing should coincide with that in the cylinder block for camshaft. The inner diameter of the bushing should be $\Phi 46_{0}^{+0.025}$. If the shrinkage of the bushing is too much, the bushing should be scraped to its exact size. The cylinder liner is of wet type. On the lower part of the cylinder liner, there are two circular grooves in which rubber rings are fitted for prevention of water leakage. While fitting of the rubber rings, they should not be twisted, then the cylinder liner is pressed into the cylinder block.

B. Cylinder head

The cylinder head is made of high strength cast iron, on which the inlet and exhaust ports and cooling water jacket space are cast. On the cylinder head are installed with the parts of valve mechanism, including rocker arm supports, rocker arms, rocker arm shaft, decompression device, intake and exhaust valves, valve guides, value seats and valve springs and installed with the parts for cooling system, including thermostat housing, thermostat cap and thermostat, and also cylinder head cover and fuel injector.

The cylinder head is tightened on the cylinder block with bolts. While tightening the bolts, the torque wrench should be used. The sequence of tightening should be done according to Fig.2-1. Tighten them evenly two or three wines until they reach the torque limits of 11~137N.m(12~14kg.m). After reassembling the cylinder head, let the engine run hot for a while, and then retighten the nuts again according to the required torque limits and readjust the valve clearance.

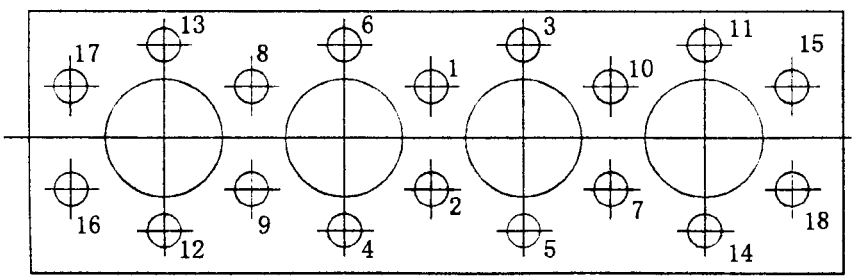


Fig.2-1 Sequence of tightening the bolts of the cylinder head

1. Intake & exhaust valves, valve seats and valve guides

The intake and exhaust valves are lapped in their respective valve seats to guarantee their air tightness. When the seat is worn or eroded by burning gases and results in

leakage, it should be relapsed. The lapping procedure should be done as follows:

Take the valve out of its seat, smear some lapping abrasive coarse, medium or fine, depending on the valve's condition along the valve seat line, put the valve back to its respective seat, lap the valve until the valve is finally lapped in its seat with an evenly lustrous sealing surface. The valve guide should be strictly prevented from being got into abrasives. After lapping, the valve seats and guides should be thoroughly cleaned of lapping abrasives and checked for leakage by purring kerosene or diesel oil into intake & exhaust ports.

When the valves and the valve seats are heavily worn, they should be renewed. While renewing the valve seat, the chamfered end should be pressed into the cylinder head and put the valve back to the seat and lap to form a seating line of about 1.5mm wide (1.2~1.7mm).

The valves and valve seats should be replaced on the following conditions:

① The width of the seating line is over 2.5mm;

② The valve is 1.5mm more below the surface of the cylinder head as shown is fig. 2-2 (For a new engine, it should be 0.55~0.85mm).

In case one of the conditions occurs, the valve and the valve seat should be replaced according to the circumstances.

The valve clearance in cold state should be 0.25~0.30mm. After a period of operation, the engine should be stopped and the valve clearance should be checked and adjusted according to the method in section Ⅳ.

The valve guides are made of materials of iron base powder metallurgy. They have an interference fit with the guiding holes of the cylinder head. While replacing the valve guide, the guide should be $13^{0}_{-0.50}$ mm above the valve spring seating surface.

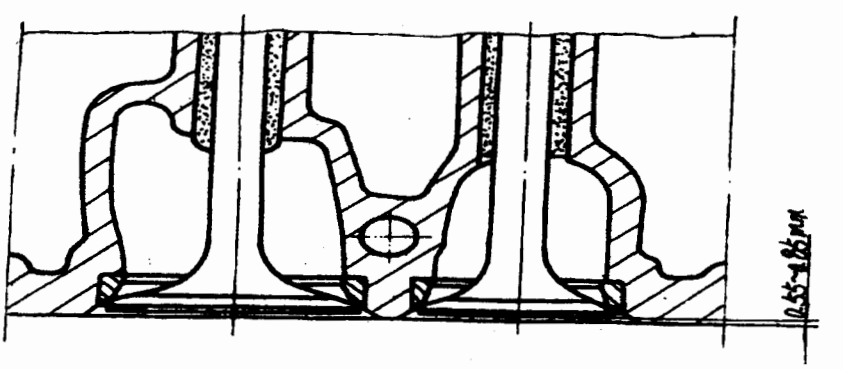


Fig2-2 Depth of valve surface below the surface of cylinder head

2. Rocker arm, rocker arm shaft and rocker arm support.

The rocker arm is assembled on the rocker arm support by rocker arm shaft, and the rocker arm support is fixed on the cylinder head. After being assembled, the rocker arm should act freely without getting stuck. The front rocker arm support has a slant oil hole connected with the oil passage of the cylinder head. It shouldn't be misused with the rear rocker arm support.

3. Cylinder head gasket

The cylinder head gasket it made of asbestos metal compound plate. The whole surface of the gasket should be smooth and even. No crackles, scars, folds and rusts should be found on it except the wrapped edges. Otherwise, it should be renewed.

The thickness of the gasket before being pressed is 1.4±0.12mm; after being pressed is 1.2±0.08mm.

C. Piston and Connecting Rod

The piston and connecting rod are composed of a piston, piston rings, piston pin, circlip, connecting rod small end bushing, large end bearing shell, connecting rod bolts, connecting rod cap and connecting rod nut. For the same engine, the weight difference among the connecting rod group (including connecting rod body, connecting rod small end bushing, connecting rod bolts, connecting rod cap and connecting rod nuts) should be less than or equal to 15 grams. The weight difference among the piston connecting rod assemblies should be less than or equal to 25 grams,

1. Piston

On the top of the piston, there is a combustion chamber. On the piston, there are two compression ring grooves and an oil ring groove.

2. Piston rings

The first compression ring is of straight edge type and porous chrome plated. The second piston ring is of tapered surface type. The oil scraping ring is of spiral spring type.

While assembling the piston rings, attention should be paid to the following points:

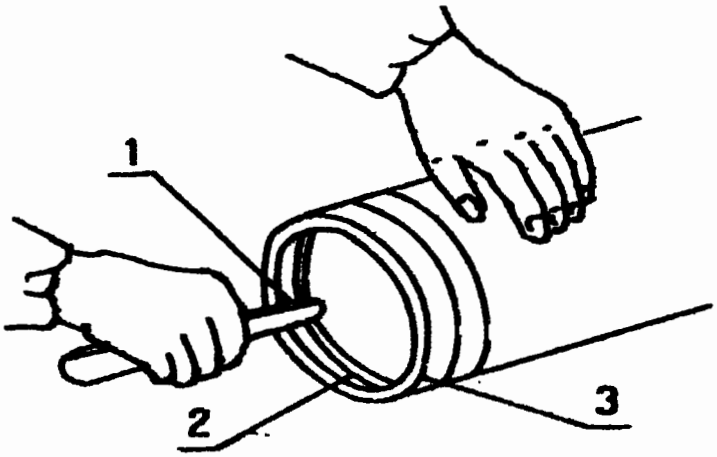
① The surface marked with "上" of the second piston ring should face the top of the piston.

② The third piston ring is of spiral spring type, its spring pin should be inserted into either end of the spiral spring not less than 16mm, and the opening of the spring should be opposite to the opening of the oil ring.

③ While assembling, the openings of the piston rings should be spaced 120° apart from one another, the opening of the first piston ring shall not be against the spraying hole of the combustion chamber. The openings of the piston rings should be avoided in the axial direction of the piston pin.

④ After the piston rings are put into the circular grooves and when the piston is in the horizontal position, turn the piston slowly, the rings should be moved smoothly in their grooves.

Before installing the rings, their gap clearances should be checked. For details, please refer to fig.2-3



1.Feeler 2.Piston ring 3.Cylinder liner

Fig. 2-3 Checking piston ring gap clearance

Place the ring into the liner about 15mm from the top of the liner. Measure it gap clearance by means of a feeler gauge. The gap clearance for the first ring should be 0.30~0.45mm; the gap clearance for the second ring should be 0.25~0.40mm; the gap clearance for the third ring should be 0.20~0.40mm. If the gap clearance is not sufficient, it could be enlarged by filing. If the gap clearance is too much, a new one could be selected.

Besides, the side clearance between the ring and its groove should also be checked by means of a feeler gauge as shown in fig.2-4.

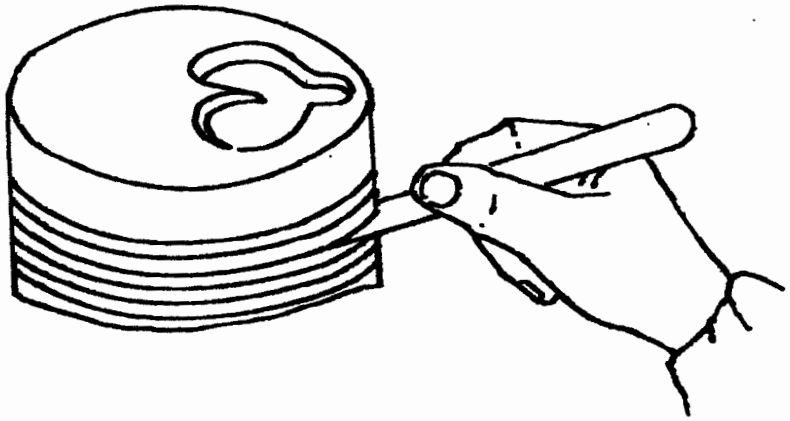


Fig 2-4 Checking the side clearance of the ring

For the first ring, it should be 0.05~0.082mm: for the second and the third ring, if should be 0.03~0.062mm. After a long period of operation, the ring may be stuck within the groove. Soak the entire piston in fuel oil, kerosene or gasoline for a period of about 24 hours, knock the ring slightly, and it would free itself and can be dismantled easily. Then clean the groove and the ring. Check the piston for damages or cracks, if any damage is found, renew the piston and also the rings.

3. Piston pin

While assembling the piston pin, first put one circlip into the piston pin bore. Heart the piston in oil until it reaches a temperature of 80~100°C (or in boiling water).Take the piston out and put the connecting rod small end in place. Then carefully and rapidly put the pin into the bore while the piston is still hot. After this, install the other circlip. While assembling, attention should be paid to that the cavity on piston crown should be in the same direction with the match marks on the connecting rod. When the piston is put into the cylinder liner, the front-end mark on the piston crown should face the front of the engine (gear case cover side).

4. Connecting rod body and large end bearing shell

The connecting rod body is of horizontal cut, its center distance is 155mm.The body and connecting rod cap are connected by two high strength bolts M10×1 with nuts. The connecting rod bolts should be tightened 2 or 3 times until they reach the specified torque 59~69 N·m (6~7kg·m).

There are oil holes on the connecting rod small end and bushing for lubrication of the piston pin and the bushing. When the bushing is renewed, two oil holes of ϕ3 should be drilled on the bushing, which should coincide with the holes on the small end. The

holes drilled should be burred. After being pressed into the small end, the inner diameter of the bushing should be $\Phi 28^{+0.02}_{+0.007}$. If the inner diameter is undersized, the bushing should be reamed.

The bore of the large end is machined after the bolts have been tightened to the specified torque limits. The body and the cap are marked so that they would not be missed up during assembly.

The large end bearing shell is made of high tin and aluminum alloy with steel back. If the clearance exceeds the limit due to the wear of bearing shell and crank pin, change the bearing shells. If any damage or crack is found, renew them.

D. Crankshaft and Flywheel

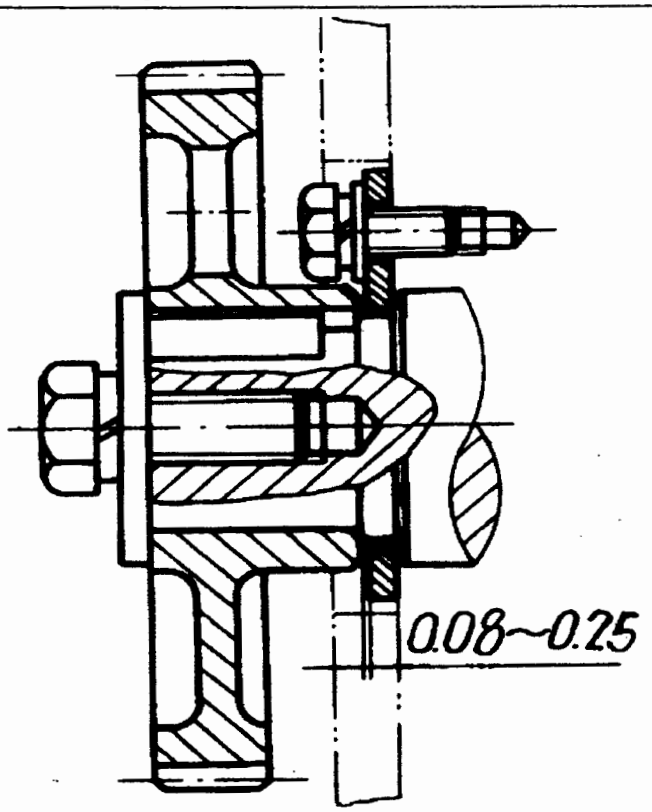
The crankshaft is of full support and entirely balance block structure. On the front of the crankshaft, the timing gear, pulley and starting jaw are assembled. The tightening torque of the starting jaw is about 98~118N·m(10~12kg·m). On the rear end of the crankshaft there is a flywheel, which is positioned by dowel pins and connected by means of 6 bolts. All the bolts should be tightened evenly with a torque wrench until the torque reaches 98~118N·m(10~12kg·m). When the 6 bolts are tightened, the flywheel should be locked with 3 locking plates. At the center of the flywheel, a bearing mode 203 is assembled to support the driving shaft of the gear case. On the peripheral of the flywheel, the flywheel ring gear is installed.

On the periphery of the flywheel there is mark line for checking the injection timing.

E. Camshaft

On the front end of the camshaft, there is a timing gear. When the camshaft is turning, the valve tappets, push rods, valve rocker arms and valves follow the movement of the cam to control the air intake and exhaust of the cylinders respectively.

On the front end of the camshaft there is a thrust collar. On the front end of the cylinder block there is a camshaft thrust plate. The clearance between the thrust plate and the timing gear is 0.08~0.25mm for controlling the axial movement (please refer to Fig .2-5).



1. Camshaft timing gear 2.Camshaft thrust plate 3.Camshaft

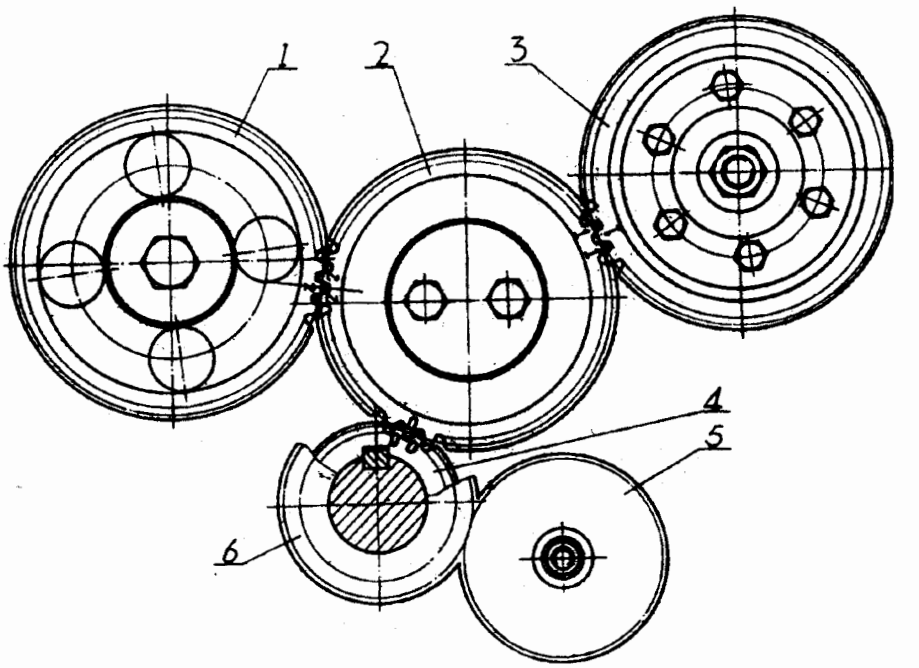
Fig.2-5 Camshaft timing gear and thrust plate

The camshaft has a long drilled hole that carries oil to lubricate the camshaft bearings. In the first bearing section there is an oil passage leading to the cylinder head and rocker arms. While assembling the camshaft bushings, check the oil holes in the bushings to make sure that they coincide with those in the cylinder block. And attention should be paid to the installation of the front and rear bushings. They should not be mixed up.

F. Gear Case

The gear case consists of gear case, gear case cover and timing gear train system. The whole assembly is installed in the front end of the cylinder block. The gear case are positioned on the cylinder block with dowel sleeves and sealed by gaskets. On the right rear end of the gear case, the injection pump and its connecting plate are fixed. On the front end of the injection pump by means of 3 bolts M8. The gear case cover and the gear case are also positioned with dowel sleeves and sealed with gaskets. The SG52×72×12 gaskets are between the gear case cover and crankshaft journal.

The timing gear system plays the role of driving and timing, which is composed of crankshaft timing gear, idle timing gear, camshaft timing gear, injection pump timing gear and oil pump gear. When the engine works, the crankshaft timing gear drives the idle timing gear, which drives the camshaft timing gear and the injection pump timing gear. And the oil pump driving gear drives the oil pump gear. All the timing gears are marked as shown in Fig. 2-6:

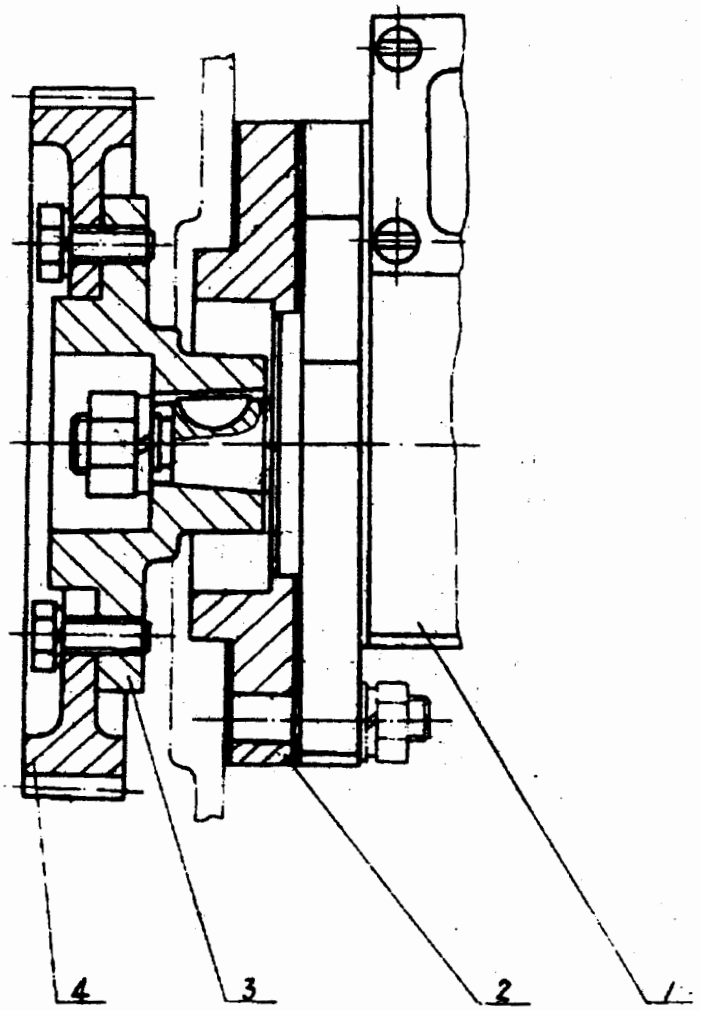


1.camshaft timing gear 2. Idle timing gear 3. Injection pump timing gear
4. Crankshaft timing gear 5. Oil pump gear 6. Oil pump drive gear

Fig2-6 Relative positions of gears during assembling

During assembling, all these marks should be correctly placed in order to obtain exact timing relative to each other.

The injection pump timing gear and the injection pump are connected with the injection timing gear adapter as shown in Fig. 2-7



1. Injection pump 2.Injection pump shim
3.Injection pump timing gear adapter 4. Injection pump timing gear

Fig.2-7 Injection pump transmission

While dismantling the injection pump timing gear, only the hexagon nut M12 wants to be loosened. The injection pump timing gear and the adapter could be taken out from the front end.

G. Fuel and Governor System

The fuel and governor system are important controlling components of the diesel engine. They are composed of injectors, fuel filter, injection pump, and high and low pressure piping and various connections.

The feed pump draws fuel from the fuel tank and delivers it to the filter. The fuel,

after passing through the filer, passes into the injection pump. The fuel, under high pressure, passes into the high-pressure pipe and thence to the injector that atomizes the fuel to fine droplets for combustion. Small amount of fuel passes through the oil return pipe into the fuel tank.

The feed pump is of roller acting structure, which consists of a hand pump, roller parts, piston, piston springs, feed pump body, non-return valves and unions.

The fuel filter is used for filtering out the mechanical impurities contained within the fuel, which is composed of the housing, filter seat and filtering element.

The injection pump is located on the right side of the engine and is of series BQ series type. The diameter of the plunger is Φ6. 5mm.

The pump consists of pump body, camshaft, plunger duple, delivery valve couple and fuel quantity control mechanism. The injection pump is also provided with the feed pump and the governor.

The injection pump is driven by the injection pump timing gear. As the camshaft rotates, the roller and tappet follow the movement of the cam thus causing the plunger to have a reciprocating motion to deliver the fuel.

The fuel quantity control mechanism is made up of a speed control lever, governor fork, regulating arm, which is close fitted into the plunger. The speed controlling lever is controlled by the governor. When the lever moves to or opposite the direction of the governor, the quantity of fuel delivered decreases or increases. The injection pump has been calibrated at the factory. Be sure not to dismantle it. If it is necessary to dismantle, repair or adjust it, it should be kept clean. The plunger couple and delivery valve couple are not interchangeable.

The governor is of mechanical full speed type, which consists of driving part (driving disk with a tapered angle of 60°), steel balls, governor spring, transmission and control sections.

The working principle of the governor is as follows:

When the speed control lever is at some position, the governor spring applies a certain pressure on the sliding sleeve. When the engine runs with a certain load and speed, the centrifugal force of the 6 steel balls in the driving disk exactly balances the force of the spring and the resistance of the entire mechanism. Therefore the governor is balanced and the engine shall run at some stable speed. The change of the position of the lever will cause the change of apply force of the spring thus resulting the change of the speed of the

engine.

On the rear cover of the governor, there are high speed and idle speed limiting screws and a fuel quantity adjusting screw, which are used to limit the maximum and minimum speed of the engine and the effective position of the calibration device respectively.

The position of the screws has been set at the factory. Don't adjust them unless absolutely necessary. The calibration device plays the role of overcoming the over load of the engine in a short time.

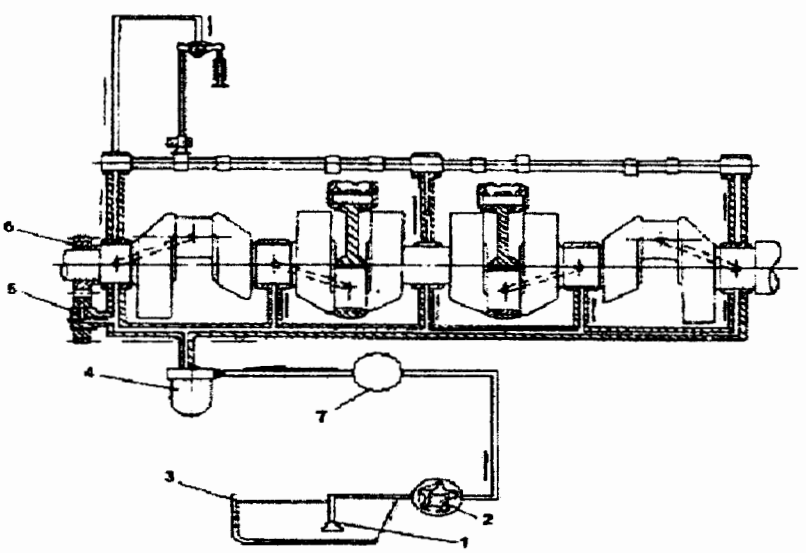
The injection pump is installed on the gear case. The fuel injection timing depends on its relative position, which has been set at the factory and shouldn't be changed unless absolutely necessary. After dismantling, the fuel injection timing should be readjusted. The model of the injector is PF75Sa.

The model of the nozzle is ZCK154S425.

The injector is composed of the injector body, lock nut, needle valve couple, spindle, spring and adjusting screw. The needle valve and barrel of the nozzle are precisely mated and lapped with each other. Therefore, they are not interchangeable and should be kept clean.

H. Lubricating System

The lubricating system is made up of an oil suction strainer, an oil pump, filters and piping as shown in Fig.2-8



1. Oil strainer 2. rotor pump 3. oil sump 4. Lube filter 5 Idle gear 6. Gear train 7.lube cooler

Fig 2-8 Schematic drawing of the lubrication system

The lubricating oil goes as follows:

Suction strainer→oil pump→filter→main oil passage→

- front sloping oil passage→crankshaft front main bearing shell→
  - crankshaft crankpin of the first cylinder→connecting rod bearing shell →sump
  - camshaft front bushing→cylinder head oil passage →front rocker arm support→rocker arm shaft→
  - rocker arms
    - valves and valve guides→combustion chamber and burning away
    - valve clearance adjusting screw and push rod
    - push rod and tappet
    - tappet and tappet hole in cylinder block

    → sump
- idle gear shaft→idle gear shaft bushing
- second sloping oil passage→crankshaft second main bearing shell→crankpin of second cylinder→ connecting rod bearing shell→sump
- third sloping oil passage
  - crankshaft third main bearing shell→crankpin of the third cylinder →connecting rod bearing shell→sump
  - camshaft middle bushing→sump
- fourth sloping oil passage →crankshaft fourth main bearing shell →crankshaft crankpin of the fourth cylinder →connecting rod bearing shell→ sump
- rear sloping oil passage→crankshaft rear main bearig shell→camshaft rear bushing→sump

Other moving parts are splash or atomized lubricated.

The lubricating oil should be added properly. If it is added too much, it would be burning; if it is added too less, the bearing shells would be burnt. It is ideal to add the oil until its level reaches between the upper and lower marks on the dipstick. When the level goes down to the lower mark, the oil should be added. Before starting the engine, the oil level should be checked.

The pressure regulator is fixed in the oil filter, which consists of pressure adjusting screw, nut, spring, valve and valve body

The working principle of the pressure regulator is as follows:

When the lubricating oil pressure is too high, the oil will overcome the spring force and push the valve down until the oil pressure cavity is connected with the oil return hole. Then, a portion of the oil returns to the sump and the oil pressure in the oil pressure cavity shall be reduced. When the engine runs, the oil pressure should be kept at 200~400Kpa. The pressure regulating valve has been adjusted at the factory. It shouldn't be adjusted unless necessary.

After a long period of operation, when the moving parts of the engine are worn, the oil leakage will increase, which will decrease the oil pressure. When the pressure decreases to lower than 1kg/cm^2, the adjusting screw should be readjusted in time to press the spring and bring the pressure back to specified limits. If the pressure can't be

increased, it my be that

① The oil pump is worn.

② The moving parts of the engine are heavily worn. For condition ①, the oil pump should be repaired or renewed. For condition ②, the moving parts should be renewed.

The oil filter is installed on the right side of the cylinder block, which is composed of filter base, housing, paper element, pressure regulating valve, relief valve and filter element shaft. Oil coming from the pump passes into the filter and passes through the paper element into the main oil passages of the cylinder block. After a long period of operation, the paper element would be blocked by dirt. Under such condition, the paper element should be taken out and cleaned in fuel oil. If the paper element is cracked, it should be renewed. The relief valve is made up of spring, steel ball and adjusting screw. When the paper element is completely blocked by oil dirt, under the pressure of the lubricating oil, the relief valve shall overcome the spring force to push the steel ball and the oil shall go directly into the main oil passage to prevent the bearing shells from severely burnt caused by the blockage. The oil filter and the cylinder block are sealed with gasket. While dismantling and reinstalling the oil filter, attention should be paid to the installation direction of the gasket. Otherwise the oil in the main oil passage shall leak into the sump. The oil pressure indicating lamp and buzzer shall be alarming.

The suction strainer is used to filter out coarse particles to prevent them from getting into the main oil passage. After a long period of operation, the screen wire shall be clogged. Therefore, the suction strainer should be cleaned regularly or renewed.

The lubricating oil pump is of rotor type, which consists of outer rotor, inner rotor, oil pump shaft, oil pump gear, pump body, and pump cover.

The oil pump is driven by the oil pump drive gear of the timing gear system.

The oil pump should run freely without getting stuck. The axial clearance of the oil pump is about 0.032~0.078, it could be adjusted with shims to 0.06~0.12mm. The opening pressure of the pressure –limiting valve is about 8.3kg/cm^2. while installing, the flat side of the oil pump gear should face outside. If shouldn't be mistaken.

The normal operation of the diesel engine depends upon the correct use and maintenance of the lubricating system, to which great attention should by paid by end users.

I. Cooling System

The cooling system is of forced circulative water cooling close type, which consists of keel pipe, lubrication oil cooler, fresh water pump and thermostat, rubber pipe and connecting hose etc. as shown in Fig. 2-10.

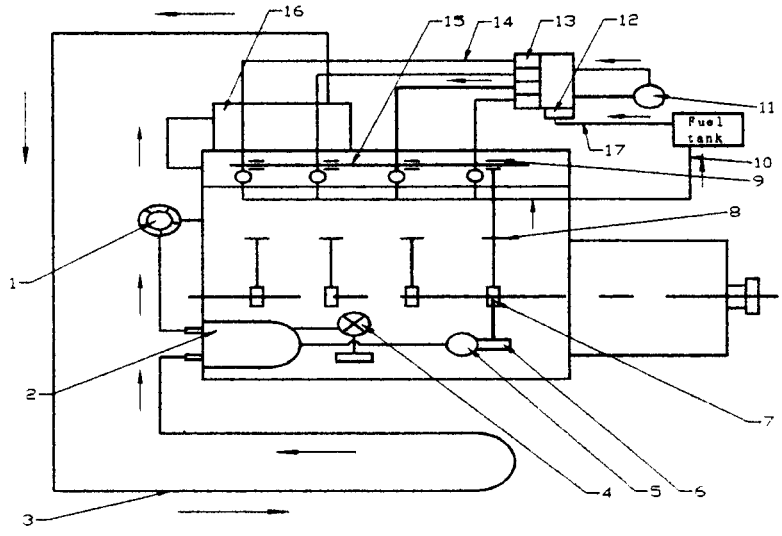


Fig 2-10 Cooling system

1.water pump 2.lube cooler 3.keel pipe 4.lube pump 5.lube filter 6.pressure regulating valve 7.main bearing 8.camshaft bearing 9.rock arm 10.overflow pipe 11 fuel deliver pump 13.fuel pump 14.high pressure pipe 15. Injector 16.exhaust pipe 17.return pipe

When the engine runs, the water pump follows the movement of the crankshaft to press the cooling water into the water jacket space of the cylinder block to cool cylinder liner, cylinder block and cylinder head, then into the thermostat. When the water temperature is lower that 75°C, the thermostat closes and the cooling water can't go into expansion tank. It will go directly into the water pump, realizing small circulation in the cylinder block. When the water temperature is higher than 75°C, the thermostat opens and the cooling water goes through the thermostat into the water tank and is cooled down by the keel pipe and pressed again by the water pump into the cylinder block, realizing great circulation. The water temperature shall be not more than 95°C otherwise indicating lamp will light and buzzer will alarm.

The water pump for the series N485J diesel engine is of centrifugal type. Its water intake cavity is attached to the front of the engine. The water pump is supported by two bearings model 60203. the water seal is of Ⅱ F-12 type, which is made of ceramics and graphite.

The water pump is driven by the pulley of the crankshaft and V belt, which consists of pump body, impeller, water pump pulley, water pump shaft, bearings and water seal. If the water outlet under the water pump drips seriously, the water seal should be renewed. In case the bearings sound irregular noise, they should be renewed. The oil cup of the water pump should be filled up with grease regularly according to the regulations of technical maintenance.

The thermostat is filled with temperature sensitive liquid to control the opening and closing of the valve. When the engine is started, the water temperature is below 70°C and there is water coming out of the outlet, or the water temperature is over 75°C and there is no water coming out of the outlet, it means the thermostat is out of order. Under such condition, the thermostat should be dismantled and checked. While checking, put the thermostat into the water and heat slowly until the water temperature reaches 70°C. At this time, the thermostat should start to open. When the temperature reaches 85°C, the thermostat should be open completely. Otherwise it should be renewed. Don't dismantle the thermostat at random. If the water temperature is too low, it would be harmful to the normal operation of the diesel engine. The V belt of the water pump should be regularly checked for its tension according to the requirements of the technical maintenance. The tension of the belt could be checked by pressing at the middle part of V belt. The belt play should be about 10~20mm. Should the tension of the belt be checked, loosen the bolt on the generator stand and make adjustment.

J. Electrical System

The electrical system of series N485J diesel engine consists of starting motor, cables, tachometer, starting switch, alarm lamp, alarm buzzer, generator and voltage regulator as shown in Fig.2-11.

The vendee can select either one of the electrical diagrams according to their uses.

The silicon controlled rectifier generator model JF11A or JFW17C3 is used as a charging generator, which should be used together with the relevant voltage regulator. The negative pole must be connected with the ground. Otherwise, the silicon rectifier components and the regulator would be burnt.

Meshing of the starting motor pinion with the ring gear on the flywheel is by means of an electro-magnet. Press the starting switch. At this instant, the pinion should engage with the ring gear of the flywheel and cranks the engine over. Under ordinary conditions, the engine will start at on starting operation. If the first start fails and it is necessary to

start the engine for a second time, let the starting motor and the ring gear of the flywheel stop rotating before pressing the starting switch again. Otherwise, the pinion will strike the ring gear and damage the gear. Each starting operation should not be over 5 seconds. The interval between two consecutive starting operations should be over 2 minutes.

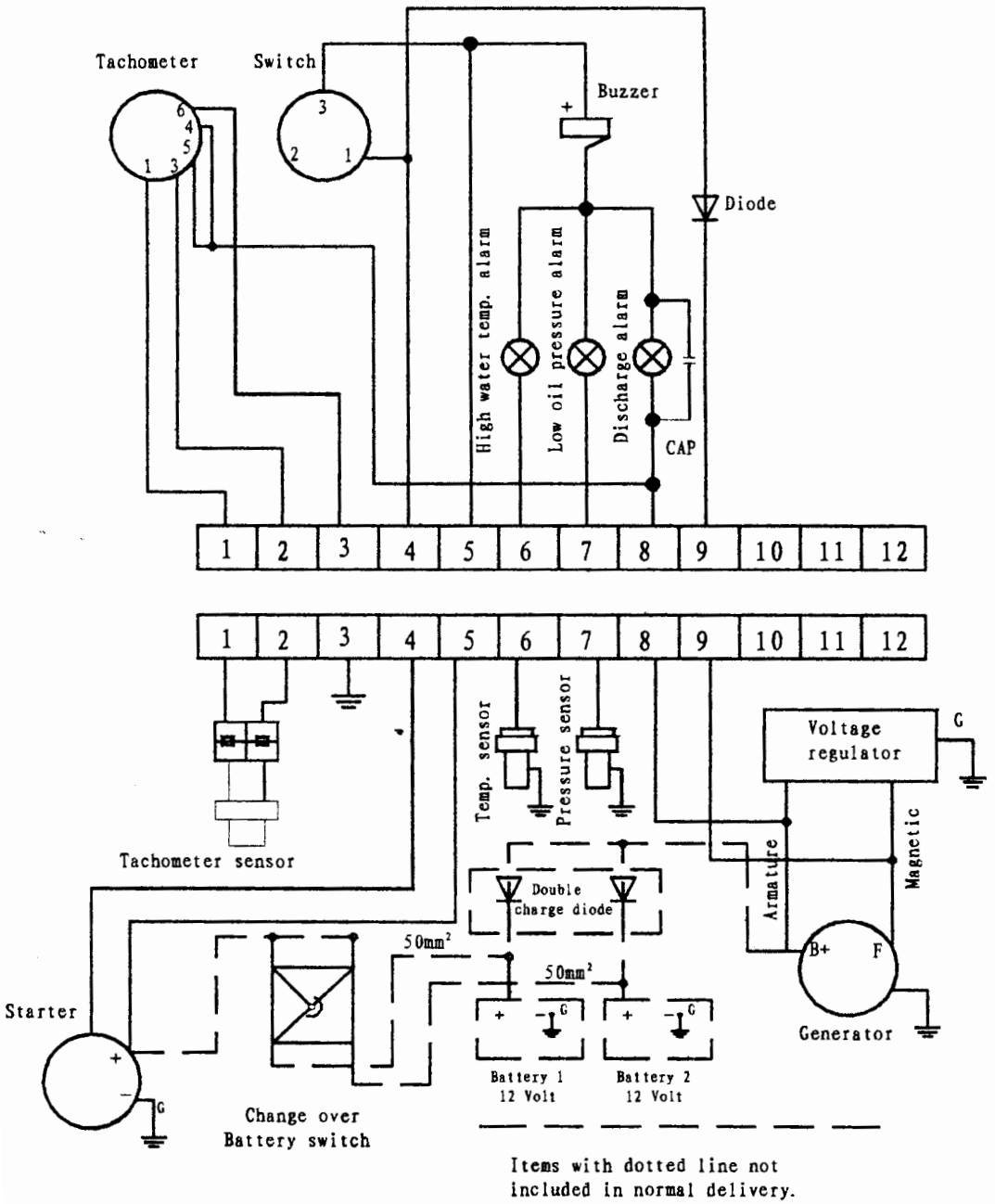


Fig 2-11 Electric diagram 1

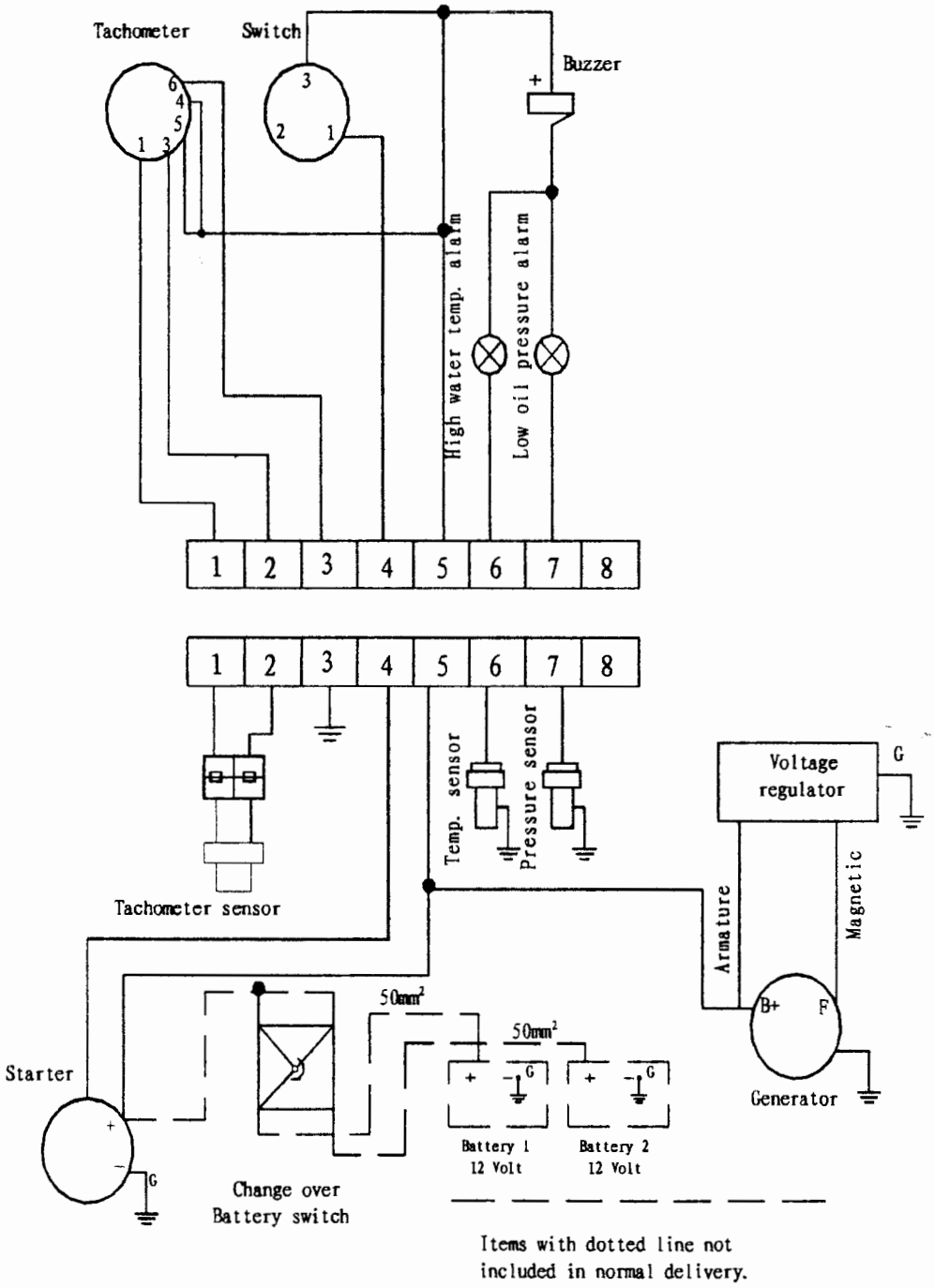


Fig 2-11 Electric diagram 2

K. Electric System Parts Description

Following parts is installed either engine side or panel side

Item	Electric diagram 1	Electric diagram 2
Tachometer	ZS12109.Y0	ZS12109.Y0
Starting switch	JK290	JK290
Buzzer	FMQ-2715	FMQ-2715
Alarm lamp (water temp.)	AD11-16	AD11-16
Alarm lamp (lube pressure)	AD11-16	AD11-16
Charge indicating lamp	AD11-16	AD11-16
Tachometer sensor	ZG912346	ZG912346
Temperature sensor	WB9311	WB9311
Lube pressure sensor	YB1011	YB1011
Starting motor	QD138	QD138
Battery voltage	12V	12V
Voltage regulator	FT111	FT111
Generator	JFW17C3	JFW17C3
Diode	IN5408	(No fitted)
Capacity	CB822 IUOJ400V	(No fitted)
Charging diode	702R	(No fitted)

L. Instruments Panel

According the choice of the buyer, the engine set is normally fitted one of the two instruments panel.

1. Tachometer 2. Alarm buzzer and lamp 3.Starting switch 4. Charging lamp (no fitted in Electric diagram 2.)

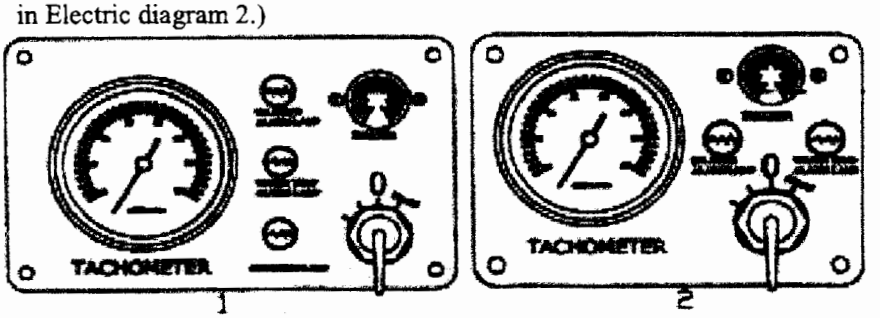


Fig. INSTRUMENT PANEL

M. Gearbox

The vendee can select either the SCG-025 or ZF25M as reduction gearbox. Its technical reduction ratio is shown as follows:

Type:	**SCG-025**	**ZF25M**
Ratio:	2.74/2.67	2.74/2.72
Rotation direction (View from output end):	Clockwise	Clockwise
Oil capacity (l):	0.75	0.75

SECTION Ⅲ OPERATION OF THE ENGINE

A. Precautions

1. Adjustment and maintenance should be made according to the procedure specified in this manual during operation of the engine.

2. Running the engine at high speed or with high load immediately after start is strictly forbidden. It is recommended to run the engine at low speed with no load first then gradually increase to high speed and full load.

3. Diesel fuel should be clean. Before use, it should be thoroughly precipitated and filtered.

4. Keep water at normal temperature of 70~80°C, Normal lubricating oil pressure at medium speed should be 200~400kPa(2.04~4.08kgf/cm^2).

5. During operation, if abnormal phenomena are found, stop the engine for check.

B. Operation

1. Fuel 、 Lubricating Oil and Cooling Water

(1) Fuel: Diesel oil conforming GB252-87 light diesel fuel grades No.0 or No.-35 or to USA specification ASTM D-975-77 Grades NO.1-D and 2-D.If the engine has to work in areas with extremely low ambient temperatures, use fuel with good clog characteristic. Clog point(CFPP) -25℃.

(2) Lubricating oil:

A. Engine lubrication oil specification

Temperature in starting	℃	Mono-grade	Multi-grade
Below	-15	5w	5w /30
Between and	-15 4	10w	10w/30
Between and	4 30	20/20 w	15w/30 10w/30
Above	30	30	15w/40 20w/40

The temperatures mentioned in the table are the ambient temperatures at the time when the engine is started.

However, if the running temperatures are much higher than the starting temperatures a compromise must be struck and a higher viscosity oil used , providing starting is satisfactory. Multi grade oils overcome the problem, provided they have a

suitable specification .

The engines must be run on heavy duty lubricating oils, meeting the requirements of API CC.DEF2101D, MIL-L-2104B or MILL-L-46152A/B

Straight mineral oils are not suitable, neither are oils of less detergency than specified.

API CD, Series 3, or MIL-L-2104C/D oils can inhibit the running in process in new or reconditioned engine but can be recommended for engines running at high load factor, particularly in conjunction with high ambient temperatures.

Mobile Delvac 1300 series
Esso lube XD3+
Fina Solna 3
BP energol DS3
Elf Disal HD3
Castrol Deusol RX super
Shell Rimula ×oil
Chevon Delco Super 3
Norol Marine TMA 300
Gulfpride Seies 3
Texaco URSA S3
Amocol New Supper ACE3

B. Gearbox oil specification

Automatic Transmission Fluid -ATF

FORD Specification M 2 C-33 G

GM Specification ATF DEXRON Ⅱ D

EXXON ATFD or ATF (or refer to its operation manual)

(3) Cooling water: It is recommended to use rain water, tap water or clean river water. Hard water (well or spring, etc.) should be softened, if they are used. Otherwise, scale, rust and sludge will form and this will affect the performance of the cooling system. Boiling up is a common practice to soften the hard water. After precipitation and removal of impurities, the softened water may be used as cooling water. When the engine operates in cold weather where the cooling water is liable to freeze, anti-freezer should be added to the cooling water. Common antifreezes are glycol or alcohol. If the engine has difficulty in starting under atmospheric temperature below 0°C, FJ-30 cold aided device can be used to start the engine successfully.

After a long period of operation, scale deposits will form on surfaces of water jacket space, which will affect heat radiation of the engine, so periodic removal of scale deposits should be made as follows :

① Smear machined surfaces with grease to prevent any corrosion. Fill water jacket space with a solution of hydrochloric aside (HCL) of 25% concentration, keep it for about 10 minutes and then drain it off. Then blow wash with fresh water. Repeat it again if not thoroughly cleaned.

③ Fill water jacket space with a solution of caustic soda (NaOH) in a ratio of 1 lira

of water to 75~80 grams of caustic soda. Then start the engine and run it at medium speed for about 10 minutes. Keep the solution in the water jacket space for 10~12 hours. Finally start and run the engine at medium speed for 10 minutes, then drain it off, blow wash with fresh water, if not thoroughly cleaned, repeat it again.

2.Preparation Before Operation

(1) Check the tightness and reliability of all connecting parts. Be sure that all control handless such as throttle control lever and stop handle.

(2) Rotate the crankshaft for several revolutions to check whether all moving parts move freely.

(3) Check to see whether oil level in the oil sump and injection pump is as specified.

(4) Check the cooling system to see whether the cooling water is full and whether there is any leakage at the joints.

(5) Check the fuel system. Make sure that the fuel tank has sufficient fuel, fuel line is through and no leakage is found. Open the fuel tank cock.

(6) Check if the battery is fully charged, and the connections of the electric system are correct and tight.

(7) Check if accessories of the engine are in good connection (injection pump, injector, fuel filter, water pump, charging generator and its bracket, V belt, starting motor, lubricating oil filter, expansion tank, etc.)

(8) Check the engine. Be sure it is unloaded when starting. It should be disengaged with the engine).

3.Starting

A. Normal Starting

(1) Set the speed control lever at medium speed position.

(2) Loosen the pipe-connecting bolt of fuel filter to vent air, if any, in the fuel system. In case there is a lot of air in the fuel system, it is necessary to loosen the vent bolt on the injection pump and repeatedly press hand-operated fuel feed pump in order to let air get out of the system.

(3) Turn the staring switch to start position, the starter engage the gear ring of flywheel to start the engine, If the engine fails to start for the first time, it is necessary to wait for two minutes, then try the second time. If the ending still fails to start after three consecutive starting operations, it is necessary to check causes. After remedy has been done, start the engine again.

(4) After the engine has been started, immediately release the starting switch and switch turn automatically back to position "0". Adjust the throttle to let the engine run at idle speed and check whether the engine is in normal operation and if there is any abnormal noise. Special attention should be paid to make sure that lubricating oil pressure is normal. Then gradually shift the speed control lever to ensure the engine to run at medium speed for warming up of the engine.

B. Cold Starting

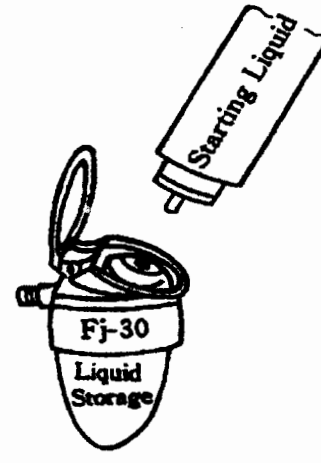
The operation method is shown as follows:

(1).Open the dust cover of the liquid storage. Insert the pouring liquid pressure can into the hole of the liquid storage. Squeeze the can to pour the liquid into liquid storage.

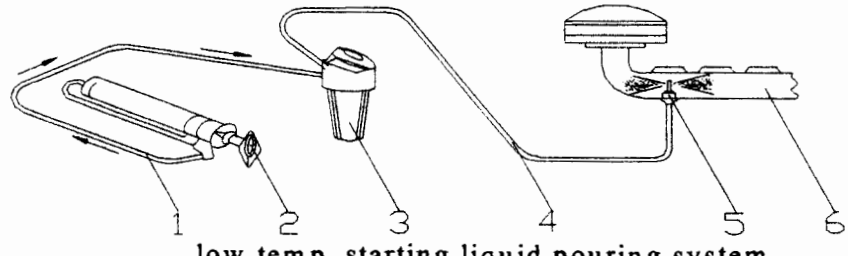
(2).Set the gearbox at idle position and put the handle of fuel rack at mid position.

(3).Start the engine. At the same time, operate the hand pump until the engine runs stably.

(4).If knocking appears while the engine is starting, the operation of hand pump must be slowed or stopped, so as to regulate the injecting liquid quantity for starting the engine stably.



CAUTION: Keep away from all heat sources (even sun light).The liquid is highly flammable.



low temp. starting liquid pouring system

1.Air pipe 2.Hand pump 3.Liquid 4.Liquid pipe 5.Injector 6.Air inlet pipe

4.Operation of The Engine

Only when temperature of cooling water reaches 50℃ and temperature of lubricating oil reaches over 40℃, the engine be loaded, However, when the engine is running at rated output. Outlet water temperature should be 80±5℃

(2) Increase the speed and load gradually. Except for special occasions, don't load or unload the engine suddenly.

(3) During operation, observe the gauges and check the operating conditions of the engine from time to time. If any abnormal exhaust smoke color and noise are noted, stop the engine for check.

(4) During operation, the charging generator should in charge operator for charge of the battery and the pointer of ampere meter should point to"+" .

5. Stopping

(1) Before stopping, reduce the load and speed gradually and let the engine run at idle speed for about 3~5 minutes.

(2) After stopping, turn the starting switch to "O" position.

(3) When the atmospheric temperature is below 5℃, after the engine has stopped, it is necessary to drain out the cooling water completely in order to prevent subsequent cracking of cylinder block because of freezing. However, if anti-freezer has added in the cooling water, it is unnecessary to drain out cooling water.

SECTION IV ADJUSTMENT OF THE ENGINE

A. Adjustment of valve Clearance

When maintaining the engine, it is necessary to check and adjust the valve clearance. The procedure of adjustment of valve clearance and valve mechanism is as follows:

1. Remove the cylinder cover to check and tighten the bolts on the rocker arm supports.

2. Rotate the crankshaft until the piston of the first cylinder reaches its top head center between the compression stroke and expansion stroke. At this position, the pointer on the inspecting window of the flywheel housing exactly points to the timing mark"0"on the flywheel.

3. Check and adjust the valve clearances of intake valve and exhaust valve by means of a feeler gauge inserted between the valve stems and the rocker arms of the first cylinder to set the valve clearance to the specified value of 0.25~0.30 mm in cold state. Then according to the firing order of cylinders (refer tot engine data of the engine), rotate the crankshaft in turn through an angle of 180° in order to adjust the valve clearances of other cylinders.

B. Adjustment of Injection Timing

For best specific fuel consumption and operating performance, injection timing should be adjusted to its specified value of 26~29° .

1. Release any air in the fuel system, and repeatedly rotate the crankshaft to make the fuel pump filled with fuel. Then disconnect the high pressure fuel pipe of first cylinder and blow off the remaining fuel in the open end of delivery valve holder. And slowly rotate the crankshaft in its rotation direction and at the same time closely observe the fuel level in the open end of delivery valve holder until the fuel just begin to flow out of it .

2. Check the mark T.D.C on the inspection window of flywheel housing to see whether it coincides with the mark on the flywheel within the specified optimum value.

3. If injection timing is too advanced or too lagging behind, it is necessary to loosen the three nut on the triangle shaped flange of the injection pump for adjustment. Viewing form the front end, turning clockwise of the injection pump will set the injection timing earlier and turning anti clockwise will set the injection timing later. After the adjustment has been done, tighten the three nuts on the flange and check the injection timing again until it meets the requirement.

C. Adjustment of Injector

The test and adjustment of the injector should be done on the injector test bench for checking and adjusting of injecting pressure and atomization quality to remedy the trouble in time.

Some troubles such as black smoke, decrease of output and speed, increase of exhaust temperature and loud cylinder knocking noise during operation of the engine may be caused by too high or too low injecting pressure, abnormal fuel injection or damaged parts.

1. Procedure of the adjustment of the injector.

(1) Operate the hand pump until the reading of pressure gauge reaches 18Mpa, (183.5kgf/cm^2), then continue to slowly and gently operate the hand pump until the pressure is up to 19.62Mpa(200kgf/cm^2), at the same time check to see whether fuel dribbling or leaking is found on the injection orifice of the injector. Fuel dribbling won't be found in normal case. If fuel dribbling still occurs, it is necessary to dismantle the nozzle for cleaning, checking or lapping before next testing.

(2) Adjustment of injecting pressure. Remove the adjusting nut of the injector, and adjust the injection pressure to 19.62Mpa(200kgf/cm^2) by screwing out or in the pressure adjusting screw. Then tighten the adjusting nut and check it again.

(3) Check the atomization quality

The atomization quality is tested at a spraying rate of about one time per second. The atomized fuel should be homogenous. Abnormal phenomena such as fuel splashing, partly uneven density and single side injecting are not acceptable. And obvious clear sound should be heard when spray off the fuel. In common eases, abnormal fuel injection is caused by the trouble of the movement of the needle valve. And fuel dribbling from the injecting orifice is caused by the failure of sealing and the form of solid jet is caused by the carbon deposit and hot deformation on the head end.

2. Maintenance of injector

Before maintaining the injector, clean its outer surface, then clamp it upwards on the bench clamp with copper lining. Screw off its nut then remove the nozzle and draw out the needle valve, immerse them in fresh fuel. Then turn the injector through an angle of 180° and clamp it, and remove the pressure adjusting nut and screw, then remove the pressure adjusting spring and spindle.

(2) In case the needle is stuck with its body or bad atomization is found, it should be

cleanly washed. Immerse the sticky needle valve and its body into fresh fuel for a while, then clamp the needle valve by means of a pair of pliers lined with cloth and gently turn and draw it out from its body. Care should be taken during this operation for prevention of scratching.

The needle valve and its body may be scraped clean by means of a piece of wood dipped in gasoline or diesel fuel. Never use metal sheet for cleaning. If the needle valve and its body is not so smooth and the movement is not so free, lapping is needed. Fresh fuel should be used for lapping. When match lapping, the needle valve must not strike against its body seat. After lapping, it is necessary to cleanly wash the needle valve and its body, be sure no metal lapping bust and dirt remain on them.

D. Adjustment of fuel pump

The fuel pump is already carefully adjusted and checked by the engine manufacturer. In case the readjustment is needed, it should be done on a special fuel pump testing bench equipped with standard injectors and high pressure fuel pipes of standard length according to the related instructions.

SECTION V MAINTENANCE

To ensure the normal and reliable operation and prolong service life, end users must execute the regulation of engine maintenance as follows:

A. Routine Maintenance

1. Check the oil level in the sump to see whether it lies between upper and lower mark lines on the dipstick but near the upper one. As for a new engine or the engine, which has been put out of service for a long time, after refilling oil up to the upper mark line, run the engine at low speed then stop the engine. And then measure the oil level again by means of the dipstick.
2. Check quantity of cooling water in the expansion radiator.
3. Check the oil level inside the governor of fuel injection pump, refill it if insufficient.
4. Check for leakage of oil, water and air.
5. Check all the components attached to the engine for correctness and rigidity.
6. Check the installation. Make sure all foundation bolts are tight and connection with the driven machine is in good order.
7. Be sure to keep the engine clean. Remove oil sludge, and dust from all parts of the engine, using dry rags or rags soaked with a little gasoline. Take special care not to foul the electrical equipment.
8. After the first 50 hours of light load running of a new engine ,replace Lubricating oil the oil sump and injection pump, and clean the element of oil filter, oil sump and oil suction strainer.
9. Remedy troubles and abnormalities found.

B. Maintenance after Every 100 Hours of Operation (First Class Maintenance)

In addition to" routine maintenance", the following should be performed:

1. Replace lubricating oil in the oil sump. Draining off lubricating oil should be done while the engine has been warmed up after running.
2. Clean or replace the lubricating oil filter.
3. Clean or replace fuel filter element after every 150 hours of operation (or accumulated 200 hours of operation).
4. Check the cylinder head bolts for tightness.
5. Check the valve clearance and adjust it to the specified value.
6. Check the V belt tension. Adjust it if necessary.

7. Add grease to the components that have oil cup.

8. Clean intake and exhaust manifolds as well.

9.Check injection pressure and atomization quality of the injector, clean it if necessary after accumulated 200 hours of operation.

10. Check the batteries. At room temperature of 15℃, the specific gravity of the battery acid should be 1.28~1.29, Ordinary, it should not be below 1.27. The level of the acid should be kept 10~15mm above the lead plates. When it is too low, add distilled water, the voltage should not be below 12V.

11. Renew cooling water after every 200 hours or according to the turbines of water. Remove the thermostat had mount back the thermostat cover (outlet pipe). Start the engine and change its speed frequently to stir the cooling water and thus wash away the sediment in the cooling system. Then drain water by opening cocks on the cylinder block. Then continuously refill the radiator with clean water after stopping of the engine. Start the engine again and run it at idle speed to make the water flow. Timely check the draining water until it is clean. Then close the draining cock and stop the engine, install back the thermostat.

12. Those parts removed for maintenance must be cleaned and located correctly while reassembling.

C. Maintenance after Every 500 Hours of Operation (Second Class Maintenance)

In addition to "First Class Maintenance", proceed as follows:

1. Check the injection pressure of the injector and the atomization of fuel spray. Clean the nozzle couple and readjust the pressure if necessary.
2. Check the injection timing, adjust it if necessary.
3. Check both intake and exhaust valves and valve seats for leakage. If necessary, lap them.
4. Check the connecting rod bolts, main bearing bolts and flywheel bolts for tightness.
5. Retighten the cylinder head bolts, adjust the valve clearance as specified.
6. According to the quantity of dust in the operation condition, this may be performed in advance after every 100 hours or shorter of operation.
7. Renew lubricating oil in the injection pump governor.
8. Clean the cooling system.(Refer to Section III)
9. Check the working condition of the thermostat.
10. Check the wiring connections of the electrical system. All contacts should be tight

and without any traces of burnout.

11. Generally check all the components of engine, repair or adjust them if necessary.

12. Check the wear on the plane of lubricating oil pump, adjust the clearance between the rotors and pump cover, and adjust oil pressure.

13. Check the opening gaps of piston rings and remove carbon deposits from the piston crown and ring grooves of piston.

14. Check both the front oil seal and rear oil seal of the crankshaft. Renew them if any hardening and damage is found.

15. In addition to periodic maintenance, end users may proceed with more detailed maintenance according to actual conditions.

D. Storage

1. If the engine is to be put out of service for a long period of time, it is necessary to drain out lubricating oil, cooling water and fuel when engine is still warm after stopping the engine.

2. Perform maintenance accordingly.

3. Dismount both intake and exhaust manifolds and pour into the cylinder liners from the air passages about 0.2kg of clean dehydrated oil(By heating the lubricating oil to 110~120℃,until all air bubbles on surface of oil disappear). And rotate the crankshaft so that the valves, cylinder liners and pistons, etc. are all covered with a layer of this oil. Then remount the intake and exhaust manifolds.

4. Remove sludge and dust from outer surfaces of the engine. Smear antirust oil on to exposed machined surfaces of parts of the engine. Rubber plastic components are prohibited to be smeared with oil.

5. Block the intake and exhaust manifolds with wooden plug, or wrap up them properly with plastic cloth in order to prevent any dust from getting in.

6. The engine so preserved should be stored in room of good ventilation and low humidity but without any dust. It is strictly forbidden to store the engine wherever there are chemicals.

The preservation according to the above procedure may be good for three months. Over this period, repeat this procedure.

SECTLON VI TROUBLE SHOOTLNG

A. Failure to Start

Cause	Remedy
1. Low starting speed (1) Battery not fully charged or loose wiring connections	(1) Charged voltage should be more than14V. Tighten the connections. Repair the connectors if necessary
(2) Bad contact between the carbon brush and the commutates	(2) Repair or renew the carbon brush
(3) Starting motor pinion fails to engage with ring gear of flywheel	(3) Turn the flywheel to another position. If necessary, check the mounting of starting motor and correct the unparallel centerlines of starting motor and ring gear.
2. Faults in the fuel system (1) Fuel tank empty or cock in fuel supply	(1) Fill and open
(2) Air in the fuel pipe line, water in fuel, leakage in connections	(2) Vent the fuel pipe line, renew fuel and tighten connections
(3) Blockage in fuel pipes	(3) Clean fuel pipelines, Renew fuel filter element. Clean inlet pipe of feed pump
(4) Feed pump not supply fuel	(4) Check inlet pipe of feed pump for leakage. Repair feed pump
(5) Injector doesn't work or insufficient fuel spray. Injection pressure too low and bad atomization. Spray holes choked. Adjusting spring of the injector broken.	(5) Repair the injector and test it on the test bench. Check injection pump for densified starting
(6) Leakage in delivery valve of injection pump, spring broken. Pump element worn.	(6) Lap, repair or renew
3. Insufficient compression (1). Valve clearance incorrect	(1) Adjust as specified
(2). Leakage in valves	(2) Lap them
(3). Leakage in cylinder head gasket	(3) Renew the cylinder head gasket and tighten the cylinder head bolts
(4). Piston rings worn, stuck, overlap of opening gap	(4) Renew, clean, adjust
4. Atmospheric temperature too low	(1) Start the engine aided by FJ-30 cold starting device

B. Abnormal Lubricating Oil Pressure

Cause	Remedy
1. No oil pressure or pressure too low	
(1) Oil level too low. Oil deteriorated or too thin	(1) Refill or renew
(2) Oil pipes broken. Leakage due to enlightened connections. Damaged pressure gauge	(2) Weed Tighten Renew
(3) Adjusting spring of oil filter deformed, broken	(3) Renew
(4) Excessive clearance of oil pump	(4)Repair or renew
(5) Oil pump shims damaged	(5) Renew
(6) Excessive fitting clearance of bearings	(6)Check, renew
2. Oil pressure too high	
(1) Relief valve of oil pump or pressure adjusting valve of oil pump out of order, unsteady flow of oil returning.	(1) Check and adjust it
(2) Ambient temperature too low. High viscosity of lube oil	(2) Use specified lube oil
3. No oil on rocker arm shaft	
(1). Blockage of oil passage of upper cylinder head and oil hole at the bottom of rocker arm shaft support	(1) Clean and make it through
(2) Incorrect fitting of camshaft bushing	(2) Check and adjust it

C. Smoky Exhaust

Cause	Remedy
1. Engine exhausts dense black smoke	
(1) Injector choked and needle valve stuck due to carbon deposits	(1) Check, repair or renew
(2) Engine overload	(2) Reduce load
(3) Injection timing too late, a Portion of fuel burns in the process of exhaust	(3) Adjust injection timing
(4) Incorrect valve clearance, bad sealing of valve	(4) Check valve clearance, valve sealing and valve spring and remedy the troubles
(5) Fuel quantity delivered by each individual pump element uneven	(5) Adjust fuel quantity delivered by each individual pump element
(6) Intake manifold and air filter choked, intake not smooth	(6) Remove and clean air filter
2. Engine exhausts white smoke	
(1) Low injection pressure, bad atomization, oil leakage	(1) Check, adjust, repair or renew the nozzle
(2) Cooling water temperature too low.	(2) Raise cooling water temperature
(3) Water gets into cylinder liner	(3) Check cylinder head gasket
3. Engine exhausts blue smoke	
(1) Oil gets into combustion chamber due to excessive wear of piston rings or insufficient elasticity due to carbon deposits of piston rings	(1) Clean or renew piston rings
(2) Oil level too high	(2) Drain surplus oil
(3) Upside-down of the second taper ring	(3) the end with mark "上" upward

D. Insufficient Output

Cause	Remedy
1.Fuel filter or inlet pipe connection of feed pump and fuel screen clogged	1. Clean or renew
2. Incorrect injection pressure or bad atomization of injector	2. Check the injector or renew nozzle
3. Excessive wear of plunger couple of injection pump	3. Adjust the quantity of fuel delivered. Renew plunger element and delivery valve
4. Low engine speed due to distorted and loose governor spring	4. Adjust high speed limiting screw and renew governor spring
5. Air in fuel system	5. Vent fuel system
6. Incorrect injection timing	6. Adjust it as specified
7. Fuel quantity delivered by each individual pump element uneven	7. Adjust fuel quantity delivered
8. Air filter choked	8. Clean or renew element
9. Leakage of valve	9. Check valve clearance, elasticity of valve spring, wear of valve guide, sticking of valve and sealing of valve. If necessary, renew or lap them.
10. Insufficient compression	10. Refer to A.3 in this section
11. Incorrect valve timing	11. Excessive wear of cam. If necessary, renew camshaft
12. Leakage of the holder of injector	12. Renew copper ring, clean surface of holder, evenly tighten the injector clamping plate
13. Loose cylinder head bolts	13. Tighten them as specified tightening torque

E. Unordinary Noise

Cause	Remedy
1. Injection timing too early. Engine detonates with a clear metallic knock	1. Readjust injection timing
2. Suddenly clatter is heard due to fuel dribbling of nozzle and seized needle valve	2. Clean, repair or renew nozzle
3. Engine runs with a clear knocking noise due to excessive valve clearance	3. Adjust valve clearance
4. Engine runs with a heavy and rhythmical noise due to the striking of piston and valve (this may be felt by touching your hand on the cylinder head cover nut)	4. Properly enlarge valve clearance, correct clearance of connecting rod bearing shell
5. Engine runs with a heavy knocking noise due to the striking of piston against the bottom of cylinder head	5. Renew cylinder head gasket
6. Valve mechanism emits slight knocking noise due to broken valve spring, deported valve push rod, wear of valve tappet	6. Renew valve spring, push rod or tappet and adjust valve clearance
7. Noise due to excessive clearance between piston and cylinder liner	7. If necessary, renew cylinder liner and piston pin
8.When engine speed suddenly drops, a heavy and powerful noise is heard, because of excessive clearance of connecting rod bearing shell	8.Renew connecting rod bearing shell
9.A slight and sharp noise is heard which is particularly clear at idle speed. This due to excessive clearance between connecting rod bushing and piston pin	9.Renew connecting rod bushing or piston pin
10.Noise from crankshaft pounding against the thrust during idle running of the engine due to worn thrust plate and excessive axial clearance	10.Renew crankshaft thrust plate

F. Serious Vibration

Cause	Remedy
1.Uneven fuel quantity delivered by individual elements of injection pump. Bad atomization of injector. Serious leakage in cylinder. Too much compression differences of cylinders	1.Check and adjust fuel quantity delivered by injection pump. Repair nozzle. Remedy leakage. Check and adjust compression of different cylinders.
2.Water and air in fuel system	2.Vent. Precipitate fuel. Renew
3.Bad installation of engine. Loose found -ation bolts	3.Correct installation. Tighten
4.Knocking of piston and rough running of engine	4.Check injection timing. Load the engine after engine has been warmed up

G. Overheating

Cause	Remedy
1.Fuel gets into crankcase or water in lubricating oil. Diluted or deteriorated oil. Insufficient or excessive oil. Low lubricating oil flow and low oil pressure. Fitting clearance of bearings too less.	1. Check and renew piston rings. Renew oil. Check level oil. Check cylinder head gasket. Check wear of inner and outer rotors. Check and adjust fitting clearance of bearings
2.Water pump impeller damaged. Thermostat out of order. Passages of cooling system blocked. Scale deposit in the water jackets too thick. Displacement of water pump insufficient. Insufficient water quantity. Cylinder head gasket damaged. Fuel gets into water passage.	2. Check and renew water pump impeller. Check tension of V belt or renew. Check the mounting of radiator. Check thermostat. Clean cooling system and water jackets. Check clearance of water pump impeller. Refill water.

H. Lubricating Oil Consumption Too High

Cause	Remedy
1. Viscosity of oil too low, its grade incorrect	1. Use oil as specified grade
2. The wear of piston and cylinder liner too much. Return holes of piston ring groove choked	2. Renew. Clean the return holes
3. Piston rings stuck. Upside down compression rings. Wear too much.	3. Renew, adjust or renew
4. Leakage in front and rear oil seals of crankshaft and in the mounting surface of oil sump.	4. Check and renew related parts
5. Steam splashes due to high oil temperature and high pressure	5. Lower temperature (see above G). Check and adjust pressure limiting valve of oil pump and pressure regulating valve of oil filter

I. Over Speeding

Cause	Remedy
1. Governor out of order, speed control lever seized in full speed position	1. Repair governor and speed control lever
2. Sliding disk bushing of governor seized	2. Repair
3. Adjusting arm gets out of fork	3. Repair
4. Oil get into cylinder too much	4. Remedy as mentioned above

J. Engine Stalls

Cause	Remedy
1. Air in fuel pipes. Fuel feed pump doesn't work. Fuel filter element choked	1. Vent. Repair fuel feed pump. Clean fuel filter
5. Piston seized. Journals seized by bearing shell	2. Incorrect fitting clearance, repair or renew. Oil interrupted or oil pressure too low. Check lubricating oil lines
3. Fuel delivery valve of injection pump seized. Plunger spring broken, sliding drive disk bushing of governor seized	3. Repair or renew

K. Uneven Running

Cause	Remedy
1. Fuel quantity delivered to different cylinders uneven. Fuel dribbling of injector. Loose screw of speed control fork.	1. Adjust fuel quantity delivered to different cylinders. Repair or renew nozzle. Tighten screw of speed control fork
2. Clearance between fork and adjusting arm too much. Serious wear of steel ball and sliding drive disk results in depression on disk.	2. Renew parts
3.Axial clearance of camshaft of injection pumps too much.	3.Adjust with copper washer
4.Sliding drives disk bushing stuck.	4. Clean, repair or renew

L. Lubricating Oil Level Too High

Cause	Remedy
1. Water seal rings for cylinder damaged	1. Renew
2. Leakage on cylinder head gasket	2. Renew gasket
3.Leakage in cylinder head or cylinder block	3. Repair or renew

APPENDIX I TABLE OF FITS AND WEAR LIMITS

NO	Designation	Standard dimensions	Type of fit	Assembly Limits (mm)	Wear limits (mm)
1	Crankpin Crankpin Connecting rod bearing	$\Phi54^{0}_{-0.019}$ $\Phi54^{+0.089}_{+0.05}$	Clearance	0.05~0.108	0.22
2	Connecting rod large end Crank fillets	$34^{-0.170}_{-0.33}$ $34^{+0.15}_{0}$	Axial clearance	0.17~0.48	0.60
3	Connecting rod small end bushing Connecting rod small end bore	$\Phi32^{+0.09}_{+0.05}$ $\Phi32^{+0.025}_{0}$	Interference	0.025~0.09	
4	Piston pin Connecting rod small end bushing	$\Phi28^{0}_{-0.009}$ $\Phi28^{+0.033}_{+0.020}$	Clearance	0.020~0.042	0.11
5	Piston pin Piston pin hole	$\Phi28^{0}_{-0.009}$ $\Phi28^{+0.009}_{0}$	Clearance	0~0.018	0.036
6	Piston skirt Cylinder liner	$\Phi84.89^{+0.01}_{-0.01}$ $\Phi85^{+0.035}_{0}$	Clearance	0.100~0.155	0.335
7	Crankshaft main journal Main bearing hole	$\Phi65^{0}_{-0.019}$ $\Phi65^{+0.099}_{-0.06}$	Clearance	0.06~0.118	0.22
8	Cylinder and thrust plate Crankshaft thrust journal	$\Phi31^{-0.12}_{-0.26}$ $\Phi31^{+0.05}_{0}$	Axial clearance	0.12~0.31	0.40
9	Main bearing cap Cylinder block bore	$\Phi110^{+0.025}_{+0.003}$ $\Phi110^{+0.035}_{0}$	Transition	0.025~0.032	
10	Camshaft bushing Cylinder block bore	$\Phi50^{+0.086}_{+0.07}$ $\Phi50^{+0.025}_{0}$	Interference	0.045~0.086	
11	Camshaft thrust plate Camshaft	$4^{-0.08}_{-0.05}$ $4^{+0.1}_{0}$	Axial clearance	0.08~0.25	
12	Tappet Cylinder block bore	$\Phi14^{-0.016}_{-0.024}$ $\Phi14^{0}_{-0.018}$	Clearance	0.016~0.052	0.10
13	Camshaft journal Camshaft bushing hole	$\Phi46^{-0.05}_{-0.075}$ $\Phi46^{0}_{-0.025}$	Clearance	0.050~0.100	0.18

NO	Designation	Standard dimensions	Type of fit	Assembly Limits (mm)	Wear limits (mm)
14	Intake valve Valve guide	$\Phi 8^{-0.025}_{-0.04}$ $\Phi 8^{+0.022}_{0}$	Clearance	0.025~0.062	0.15
15	Exhaust valve Valve guide	$\Phi 8^{-0.04}_{-0.055}$ $\Phi 8^{+0.022}_{0}$	Clearance	0.040~0.077	0.15
16	Intake valve seat Cylinder head	$\Phi 41^{+0.09}_{+0.065}$ $\Phi 41^{+0.025}_{0}$	Interference	0.04~0.09	
17	Exhaust valve seat Cylinder head bore	$\Phi 33^{+0.09}_{+0.065}$ $\Phi 33^{+0.025}_{0}$	Interference	0.04~0.09	
18	Rocker arm shaft Rocker arm bushing hole	$\Phi 18^{0}_{-0.018}$ $\Phi 18^{+0.034}_{+0.016}$	Clearance	0.016~0.052	0.15
19	Surface of valve Below surface of cylinder head		Height difference	0.55~0.85	1.5
20	Lube oil pump rotor Lube oil pump body	$20^{-0.02}_{-0.041}$ $20^{+0.041}_{+0.02}$	End clearance	0.10~0.15 (Adjusted with shims)	0.25
21	Cylinder liner flange Depth of cylinder block bore	$7^{+0.03}_{0}$ $7^{-0.04}_{-0.09}$	Height difference	0.04~0.12	
22	Inner and outer rotors of lube oil pump		Axial clearance	0.06~0.12	
23	Lash of timing gear in mesh		Clearance	0.10~0.16	
24	Gap clearance (1st ring)		Clearance	0.3~0.45	1.5
25	Gap clearance (2nd ring)		Clearance	0.25~0.40	1.5
26	Gap clearance of oil ring		Clearance	0.20~0.40	1.5
27	1st ring 1st ring groove	$2.5^{0}_{-0.012}$ $2.5^{+0.07}_{+0.05}$	Clearance	0.05~0.082	0.15
28	2nd ring 2nd ring groove	$2.5^{0}_{-0.012}$ $2.5^{+0.05}_{+0.03}$	Clearance	0.03~0.062	0.12
29	Oil ring Oil ring groove	$5^{0}_{-0.012}$ $5^{+0.05}_{+0.03}$	Clearance	0.03~0.062	0.12

APPENDIX II Delivery list of N485J marine diesel engine set

No.	Description	Unit	Qty	Remarks
1	N485J marine diesel engine set	Set	1	
2	Tools & spare parts supplied with engine	Box	1	
3	N485J marine diesel engine set operation manual	Piece	1	
4	Gearbox operation manual	Piece	1	
5	N485J-3 marine engine set parts catalogue	Piece	1	
6	Instruction for wheel house	Piece	1	
7	Classification certificate for gearbox	Piece	1	
8	N485J Classification inspecting certificate	Piece	1	
9	Product inspecting certificate	Piece	1	

APPENDIX III Tools supplied with N485J marine diesel engine set

No.	Description	Unit	Remarks
1	Valve tapping tools	1	
2	Tapping sand (140#)	1	
3	Feeler gauge	1	
4	8# screw driver	1	
5	Spanner8×10	1	
6	Spanne13×16	1	
7	Spanne18×21	1	
8	Spanne17×19	1	

Appendix IV: Spare parts supplied with N485J marine diesel engine set

No.	DWG No. or Type	Description	Qty	Remarks
1	N485QA-03013	Cylinder head gasket	1	
2	N85-02003(1)	Outer valve spring	1	
3	N85-02003(2)	Inner valve spring	1	
4	N85-02002	Valve collets	2	
5	N85Q -05005	Connecting rod bush	2	
6	N85-03006	Lower bearing shell	2	
7	N85-03008	Upper bearing shell	2	
8	N85-05002	First piston ring	2	
9	N85-05003	Second piston	2	
10	N85-05100	Oil scraping ring	2	
11	ZCK154S425	Injector nozzle	2	
12	N85QA-02008	Intake valve	1	
13	N85QA-02007	Exhaust valve	1	
14	C0708A1-1000	Fuel filter element	1	
15	C0708A2-0003	Fuel filter sealing	1	
16	DL85×110×12	Oil sealing	1	
17	DR52×72×12	Oil sealing	1	
18	15A-1020	V-Belt	1	