CHAPTER I ENGINE INTRIDUCTION

1. MAIN SPECIFCATIONS

MODEL	Y380BD	Y380BD2	Y380BD3	Y385BD	Y385BD2	Y480BD	Y480BD2	Y480BD3	N485AD	N485AD2	N485AD3	N490BD	N490BZD	N485AZD
Typer	in – line, water – cooling, direct injection													pressure boost
No. of Cylinder	3					4								
Cylinder bore(mm)	80			85		80			85			90		85
Piston stroke(mm)	90								95			100		95
Compression(mm)	18:1													
Displacement(L)	1.36			1.53		1.81			2.16			2.54		2.16
Cylinder working sequence	1 –3 –2					1 –3 –4 –2								
Rated power(Kw)	10	12	20	12	14	14	17	28	17	20	34	20	27	23
Rated speed (r/ min)	1500	1800	3000	1500	1800	1500	1800	3000	1500	1800	3000	1500	1500	1500
Full consumption (g/kW.h)	247												234	
Oil consumption(g/ kW.h)	≤2.72													
Exhaust pipe(℃)	≤900													
Injection advance angel(°CA)	17 ± 2													
Ciankshaft rotating direction	counterclockwise													
Cooling method	water – cooling													
Starting method	electric starting													
Net weight(kg)	165			175		195			210			220	230	220
Overall dimension (mm)	570 ×525 ×605					675 ×525 ×605			820 ×590 ×638					

2. MAIN ACCESSORIES SPECIFICATIONS

Model	No. I or BQ
Type	Plunger
Plunger diameter(mm)	φ7
Injector nozzle No. & type	ZCK155S425 or ZCK154S423
STARTER	
Type	QD1383or QD1332
Power	1.8－2.5kW
Voltage	12V
ALTERNATOR	
Type	FJ11A orJFWB13A1
Power	350W
Voltage	14V
Oil pump	
Type	gear or rotary
Flow rate	≥22L/min
Water pump	
Type	centrifugal
Flow rate	≥68L/min
Fuel filter	
Type	C0506C
Oil filter	
Type	J0708

3、MAIN BOLTS TIGHTENING TORQUE

Cylinder head bolts	135－150N. m
Connecting rod bolts	50－60N. m
Bearing cover bolts	115－130N. m
Flywheel bolts	50－60N. m

4. FITTING CLEARANCES AND WEAR LIMITS OF THE MAIN MOVING PARTS

No	NAME	FITTING	NEW ENGINE FITTING CLEARANCE	LIMIT ALLOWANCE
1	main journal and main bearing hole	clearance fit	0.05 ~0.118	0.25
2	axial clearance of crankshaft	clearance fit	0.075 ~0.265	0.50
3	crankshaft journal and connecting rod bearing hole	clearance fit	0.04 ~0.101	0.20
4	connecting rod big end facing clearance	clearance fit	0.10 ~0.30	
5	piston pin &and connecting rod small end bushing hole	clearance fit	0.025 ~0.044	0.10
6	piston pin & piston pin seat hole	clearance fit	−0.0045 ~0.0105	
7	piston skirt & cylinder liner	clearance fit	0.016 ~0.160	0.40
8	piston ring opening clearance		0.25 ~0.40	2.20
9	first ring and itsslot	clearance fit	0.06 ~0.092	0.20
10	second & third ring and its slot	clearance fit	0.04 ~0.072	0.18

No	NAME	FITTING	NEW ENGINE FITTING CLEARANCE	LIMIT ALLOWAN
11	oil scraper ring and its slot	clearance fit	0.03 ~ 0.67	0.18
12	camshaft and its bushing hole	clearance fit	0.08 ~ 0.130	0.20
13	camshaft axial clearance	clearance fit	0.07 ~ 0.245	0.60
14	valve tappet and its hole	clearance fit	0.016 ~ 0.045	0.25
15	rocker arm shaft and shaft hole	clearance fit	0.016 ~ 0.054	0.20
16	intake valve and valve guide hole	clearance fit	0.025 ~ 0.069	0.15
17	exhaust valve and valve guide hole	clearance fit	0.040 ~ 0.077	0.15
18	idle gear shaft journal and bushing hole	clearance fit	0.025 ~ 0.075	0.20
19	idle gear end facing clearance	clearance fit	0.19 ~ 0.276	
20	gears engaging side clearance	clearance fit	0.11 ~ 0.18	0.30

CHAPTER II
ENGINE OPERATION AND PRECAUTIONS

1. ENGINE OPERATION

Fuel ,oil and cooling water

1) Fuel and oil :

Fuel and oil selected subject to local ambient temperature . According to the atmospheric temperature, choose the CD 、CE or higher grade lub. Oil ,and its viscosity grade is 5W/50 (243K ~ 313K) , 10W/30 (248K ~ 313K) , 15W/30 (256K ~ 313K) , 20W/30 (261K ~ 313K) . Remove the oil filler cap of cylinder cover ,then can add the oil ;remove the oil drain screw bolt of oil pan ,then can drain the oil .

2) Cooling water :

Water of rain or clear river water is always preferably selected as cooling water. You are always suggested to fill some anti – frozen liquid in cooling system in cold winter . Heat the cooling water up to 80℃ before filling it into the water tank ,if the engine is hard to start , when the ambient temperature is below 0℃ .

Inspection and preparation before starting.

1) Check each connections for tightness , check operation levers such as fuel supply lever, engine stop lever whether they are running freely.

2) Running the crankshaft several turns , check each part for running smoothly.

3) Check the oil level in oil sump and injection pump to ensure that the oil level is at the upper side of the oil dipstick mark.

4) Check water tank for full of cooling water and whether there is any leakage on water pipe connections.

5) Check fuel tank for full of fuel and fuel pipes for smooth flowing and its leakage.

6) Check each attached parts for correct connection as injection pump ,fuel filter oil filter, water pump ,fan ,generator and its bracket ,fan belt ,starter and water tank ect.

7) Check each connector of electrical system for correctness, tightness .

Check accumulator for sufficient voltage.

Check alternator for negative electrode bonding and the accumulator for negative electrode bonding .

Engine starting

1) Set the speed adjusting level at middle position.

2) Loosen the air exhaust screw on fuel filter ,continuously press the hand – operated fuel

delivery pump to discharge the air inside fuel system, especially for new engine or engi stocked for long time .

3) To start the engine first turn the switch to "pre – heat" position. Then turn to "preh – start " position to start the engine .

4) After staring , immediately adjust fuel supply to make the engine running at idle sp . Care should be taken to ensure that the oil pressure is upto 49kpa , then gradually incre speed to warm up the engine without load.

Engine running

1) Engine is only allowed working with load when the cooling water temperature is a 80℃ when running at rated power.

2) Increasing or decreasing the load and speed should be smoothly and gradually ca out . Normally it is not allowed to increase or decrease the load suddenly.

3) During engine operation , care must be taken to see whether the meter is normal colour of exhaust air and the sound of running . Should any abnormals appear , stop the en and check.

Engine stopping

1) Before stopping the engine , lower the speed to the idle condition and gradually charge the load until the water temperature comes down below 70℃ , then the engine ca stopped by stop – lever.

2) After the engine stopped , turn the switch to middle position.

3) After the engine stopped , draining the cooling water by opening the water cock on cylinder block and water tank while the colling water temperature comes down below 6 when ambient temperature below 5℃ . Drainaging is not necessary when antifrozen liq filled.

2. PRECAUTIONS WHEN OPERATION

Engine should be maintained and adjusted according to the stipulation in the ope manual.

Full speed and full load operation is not allowed for the new or repaired engine wearing – in should be carried out for 45 hours in low speed and load . Then the engine be put in normal load operation.

Engine fuel should be precipitated and filtered clean.

Keep normal water temperature at 80℃ –90℃ , normal oil pressure at 200 – 400

3. ASSEMBLING AIR FILTER

Air filter should be correctly , reasonably and tightly assembled at a suitable p

back or front of the chassis or cabin ,and connected to intake pipe by rubber wave pipe which both ends should be tightened with clips . The dirt discharge port should be downwards . The type of air filter is K1317A.

4. The using and maintenance of the fuel injection pump

Often keep the fuel system and fuel filter (including the filting net of the delivery pump) clean and to be in good performance.

Use the light diesel fuel by the national standard (GB252 -94) stipulation ,No. 0 in summer ,No. 10 in winter.

The pump has been adjusted to be in good order according to the engine's requirement by ex - works and locked and sealed ,any random dismounting is forbidden.

Before using ,shall take out the rubber sleeve on the balancing pipe for the pump type I.

When the pump need to be inspected and repaired , it shall be operated in the clean place. Before assembling , its components must be washed and cleaned by gasoline firstly , then washed by diesel fuel and adjust it on the pump testing stand by the engine technical stipulation. If there is not special equipment shall send it to be adjusted in the professional words or repairing center ,it is certified and may be used.

Before every day starting the engine ,must inspect the oil level of the speed controller.

After running 100 hours ,shall replace the lub. Oil for the pump and clean the fuel filter.

When the pump has been run 2000 hours in the rated speed , it shall be completely inspected ,washed, cleaned, replaced or repaired for the damaged parts , and readjust it by technical requirement.

5. The using and maintenance of the alternator.

The alternator belt - pulley center shall point at its driving wheel. The belt - pulley tension can't be too tightened or loosened ,Otherwise it will affect using life and reliability of the alternator .

The alternator must be parallel connected with the accumulator and match to use with the proper regulator. The connecting wire should be fixed ,the wire connection method is shown as Fig 1.

The alternator and accumulator's negative should be earthed , otherwise the alternator and regulator may be burnt out.

Use the avomenter to inspect if the alternator is generating ,the wrong testing method by striking arc on earth is forbidden.

Timely clean the dust and oil dirty of the alternator, keep the wire connection is ok.

When alternator has run every 1000 hours ,one completely maintenance shall be done , check if the electric brush is worn out ,clean the bearing and fill some lub. oil ,which of the oil

volume shall be 2/3 of the bearing chamber. The double – face seal bearing need not to maintained.

During alternator working ,any wire dismounting or connecting is forbidden ,otherwis may cause to be short circuit and burn out the silicon rectifying element.

When the silicon rectifying element connect with the stator coil ,it is forbidden to ins ting the alternator' insulation by megger or alternating current (220V) ,otherwise the di may be bornt out and damaged.

While the alternator occur troubles, you' d better to repair it by the professional m bers.

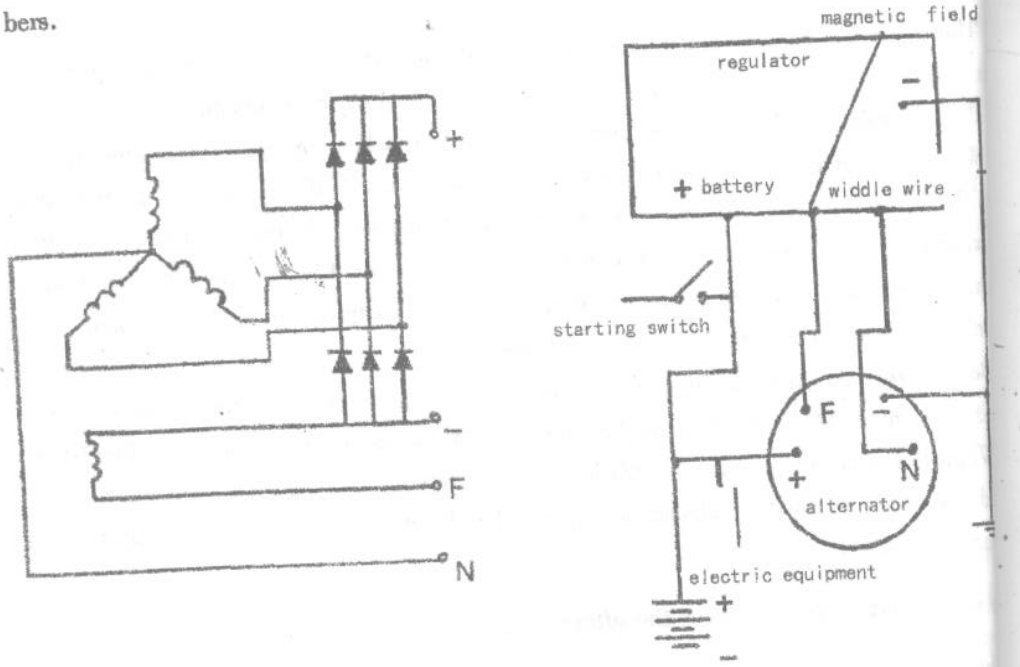


Fig. 1 alternator schematic and wire connecting diagram

6. The using and maintenance of vacuum pump

Ensure the connecting of the compressing oil with oil inlet joint ,vacuum pump w exhauster joint and oil return joint with the cylinder block. The above connecting plac be strictly sealed.

Check if there are cracks on the vacuum pump body and seat, if connecting place pump core with the alternator main shaft spline and its inner working surface is serious out and scraped, otherwise ,it shall be replace in time.

The pump leaf width must be ⩾13mm,which can be sure the air exhausting chara it is worn out and shall be replaced in time.

If there is oil leakage of the pump ,shall firstly find out the leaking place and t

place the damaged components. Ensure the lub. oil cleaning and proper viscosity, working in no – oil condition is forbidden ,otherwise the vacuum pump will be damaged.

7. The using and maintenance of the starter

Before starting the engine ,check firstly if the engine is in good order and then start the starter.

The starter wire connecting diagram is shown an Fig. 2. The section of the copper wire of connecting the accumulator shall be≥25(mm)2,The section of the copper wire of connecting button shall be≥4(mm)2, which shall be as short as possible. Before starting ,shall check if the wire connecting is ok, the accumulator has recharged sufficiently . After finishing the prepare working ,may start the engine ,it shall be succeeded one time in normal condition. If the first time is not ok, please restart it after a while when the starter armature and gears is completely stopped ,otherwise the starter will knock the engine gear ring and be damaged. In addition ,the starter can be started when the engine has been preheated in winter.

The starter every continuous working time shall not over 5 seconds, restart it after 2 minutes to avoid the starter is overheated and being damaged.

If the starter can't be started by 3 times yet, shall check the starter, electric – magnetic switch, engine, accumulator and connecting wire etc, resolve the troubles and the restart it.

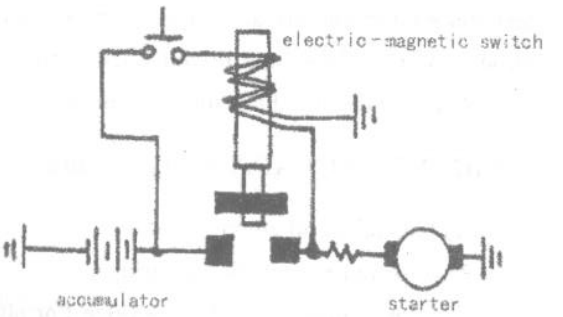


Fig. 2 Starter wire connecting diagram

After starting, shall loose the switch button immediately ,let the starter gear return from the meshing position and stop to work, otherwise, the starter may be damaged.

Often check if the starting fixed element is firmed, the wire connection is tightened,and shall clean the deposited dirty, smear some Vaseline for rustproof.

Often check if the wire insulation is damaged.

Timely dismount the dustproof belt, check if the commutator surface is clear, the electric brush is blocked in the frame, the spring pressure is ok and clean the deposited dust. If find out the electric brush has been seriously worn out, the commutator surface is burned out and other troubles, shall dismount and repair it immediately. The starter shall have one heavy repair every year.

CHAPTER III ENGINE MAINTENANCE

To ensure a longer service life, the engine should e maintained according to the follo procedure.

1. DAILY MAINTENANCE

Check the oil level in oil sump, to ensure the oil level be between the two marks o oil dipstick.

Check water quantity in water tank.

Check the oil level in injection pump and speed adjustor, refill to specified position insufficient.

Check and remove any oil, fuel water and gas leakage.

Check for the tightness of each attached parts.

Check for the tightness of engine bracket.

Keep the engine clean, remove dirt and mud. Special care must be taken to ensure lectrical equipments dry and clean. After 45 hours wearing – in of new engine with light oil should be replaced and the oil filter cartridge should be cleaned in time.

Remove other troubles and abnormals

2. MAINTENANCE AFTER 100 HOURS

Replace oil in oil sump

Clean or replace oil filter cartridge.

Clean or replace fuel filter cartridge (or after 200 hours)

Check for tightness of cylinder head bolts.

Check valve clearance and adjust when necessary.

Check fan belt tightness and adjust when necessary.

Remove dirt in intake pipe and air filter.

Check injection and injection pressure after 200 hours Clean and adjust when nec

Check the accumulator voltage. The specific gravity of electrolyte should be 1.2 29, when air temperature at 15℃ It is normally not lower than1.27.

Check whether the electrolyte level is 10to 15mm higher than polar plates, other in vaporised water.

Replace cooling water when not clean

Take out thermostat, assemble water outlet pipe, start the engine and change the speed alternatively so as to change the water flow speed to wash out sediment. Then engine and open the water cock both on cylinder block and water tank to drain water fill clean water into the water tank. Restart the engine and run in idle to make wat

Close the water cocks as soon as the drainaged water is clean. Stop the engine and reassemble the thermostat.

To ensure the parts disassembled for maintenance be reassembled correctly.

3. MAINTENANCE AFTER 500 HOURS

Carry out the follow procedure besides item 2.

Check full injection pressure and automization quality. Clean and adjust when necessary.

Check injection advance angle and adjust when necessary.

Dismount cylinder head, remove carbon deposit. Check valve sealing and lap when necessary.

Check connecting rod bolts, main bearing bolts and fly wheel bolts for tightness.

Re – tighten the cylinder head bolts according to the sequence shown in Fig. 1, adjust the valve clearance.

Clean or replace air filter cartridge (may proceed earlier according to working condition)

Replace oil in injection pump and speed adjustor.

Clean cooling system. Cleaning fluid is mixture of 150g NaOH and 1 liter water completely.

Drain out the cooling water before cleaning, then fill in cleaning fluid and run the engine after 8 – 12 hours. Stop the engine when working water temperature is achieved, drain out cooling fluid immediately to prevent the in fluid scale depositing, finally clean the cooling system with clean water.

Check thermostat working.

Check each electrical starting equipment to ensure all tigheness and wiring Connections are tighten. Replace those burned out.

Check all engine parts, repair or adjust when necessary.

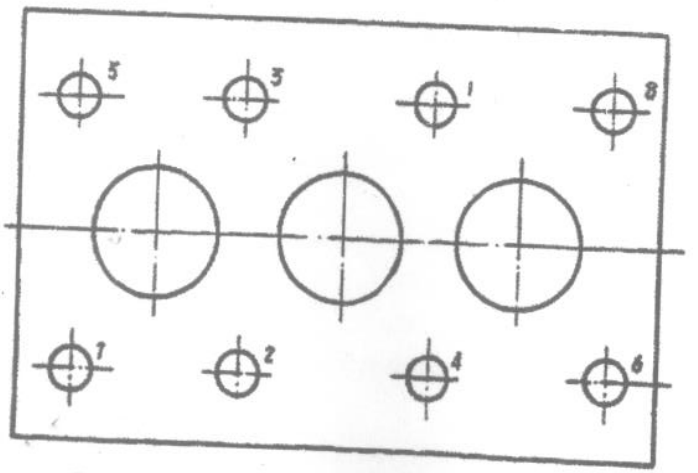


Fig. 1 cylinder head bolts tighten sequence

Besides the above mentioned procedures, you may carry out more detail maintenance accor ing to your own condition

4. ENGINE PRESERVATION AND STORAGE

To store the engine for long time, immediately drain out oil, cooling water and fuel af engine stops.

Clean oil sump and oil filter cartridge. Carry out maintenance procedure accordingly.

Disassemble intake and exhaust pipes. Fill 50g dewatered clean oil into air port and tu crankshaft to make the oil smoothly covet the valves, cylinder head, cylinder liner, piston a piston rings etc.

Remove all dirt from engine surface; brush the unpainted parts with butter except rubb and plastic parts.

Cover the mouths of air filter and silencer, wraped in plastic paper.

Engine should be stored in place of dry, clean and good ventilation.

Chemical medicine is strictly prohibited nearby.

The above preservation method could store the engine for 3 months, if the preservation is ov due; the engine should be preserved as above again

CHAPTER IV THE STRUCTURE OF ENGINE

1. CYLINDER BLOCK ASSEMBLY

The cylinder block is planer – type with the full supporting bearing and dry cylinder liner which the shoulder is 0. 02 – 0. 10mm higher than the cylinder block upper surface. The height difference of adjacent liner is not more than 0. 03mm.

Dismounting cylinder liners must use the special tools and should keep the cylinder bore inner surface and the cylinder liner outer suface dry and clean, coating grease is prohibited.

The water cavity of cylinder block is tested by 400kpa water pressure for 2 minutes. The oil channel should be tested by 600kpa oil pressure for 1 minute, Leskage is not allowed.

Cylinder block have valve tappet cavity opener, a connecting pipe on the cover plate connects with breather. The oil filter and water drain cock is assembled on the cylinder block – by the side of injection pump.

2. CYLINDER HEAD ASSEMBLY

Cylinder head water cavity is tested by 400kpa water pressure for 3 minutes. No leakage is allowed.

Valve guide is pressed into cylinder head leaving a protruding of 10mm, shown as Fig. 2.

The cone angle of intake and exhaust valve are 90°. The width of contacting surface is 1. 2 – 1. 6mm. The sinkage of intake and exhaust valve is 0. 7 – 0. 9mm, shown as Fig. 2, 3.

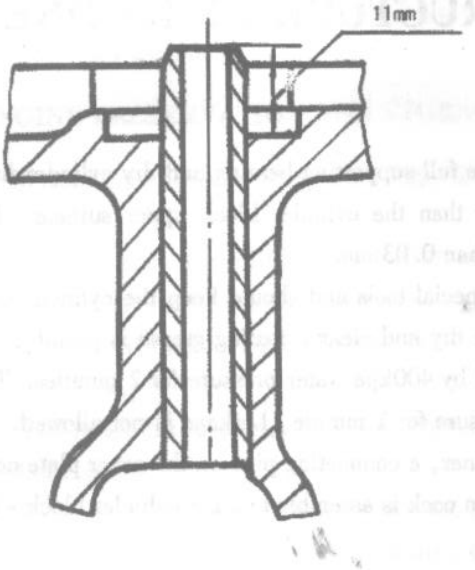


Fig. 2 Valve guide mounting dimension

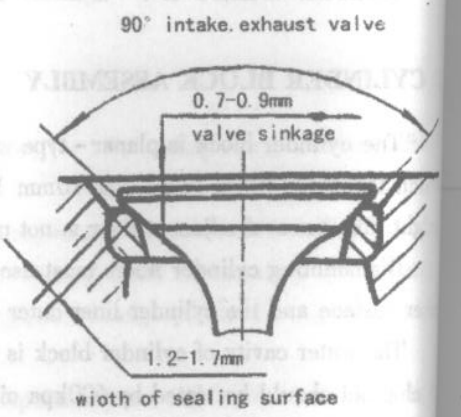


Fig. 3 Valve sinkage diagram

There is an oil hole on the cylinder head cover which is designed for filling in oil. Wh mounting cylinder head gasket, pay attention to the position of oil hole, water hole and scr hole, Incorrectly mounting is not allowed. Before mounting cylinder head, pour 20g lub. into each cylinder liner surface.

Cylinder head is positioned on block by positioning bushing and tightened by cylin head bolts. tightening torpue is 135 ~ 150N. m which should be effected twice.

CRANKSHAFT AND FLYWHEEL ASSEMBLY

Crankshaft is made of nodular cast iron. Main bearing is made of steel back 20% a with high tin and aluminium which can't adhere oil while mounting to avoid affecting its ra ting efficiency and damaging bearings. The thrust plate is of the same material as main b ing. They are mounting on two sides of the last main bearing and positioned by the convex of the lower thrust plate.

When mounting, the oil channel of thrust plate should face to crankshaft thrust surfa Reverse mounting is not allowed.

Main bearing cover is machined in couple with cylinder block. Cylinder block No. sequence No are engaraved on main bearing cover. The forth main bearing cover is positi by positioning bushing when mounting, the top arrow on main bearing should back – fac the side of camshaft and compile the number from front end.

Reverse mounting is not allowed

Tightening torque of main bearing bolts is 115 ~ 130N. m, when tightening, firstly tighten the central one, then the two sides alternatively. After tightened, the crank haft should run freely

Fly wheel is positioned by pin and tightened by bolts on the crankshaft rear end. Bolts are tightened at a torque of 50 – 60 N. m alternatively on diagonal line. The belt pulley is positioned by starting paw, tightened at a torque of 160 – 170 N. m on the crankshaft front end.

Pouding or bearing is strictly prohibited when mounting or dismounting.

Crankshaft, fly wheel and belt pulley have been balanced, Care must be taken of ensuring its balance when replacing parts, Both fly wheel housing and gear case cover are mounted with oil seal. Do not damage them when mounting or dismounting

4. PISTON AND CONNECTING ROD ASSEMBLY

The piston is made of aluminium alloy ZL109 which has tow air – compression rings and one oil scraper ring.

The first compression ring is of chrome – plated barrel shape, the second one is of tapper shapes. The oil scraper ring is spiral spring expanding ring with the inner cylinder face, inner round face and outer cylinder edge face plated by chrome. Pay attention that the spring connecting point should space out 180° apart from the oil scraper ring gap.

It is advised to install the piston ring with special expander, excessive expanding is not allowed to avoid breaking. The ring should turn easily in the slot and can fall into the slot supporting face by itself the piston concave should be poured lub. oil

The piston ring shape and its opening direction, please refer to Fig. 4 and Fig. 5

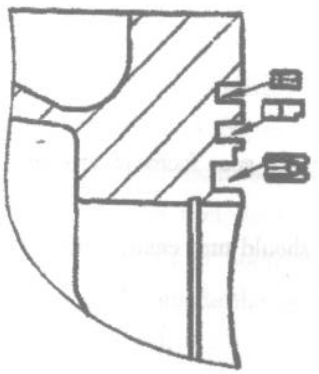


Fig. 4 Pistor ring shape

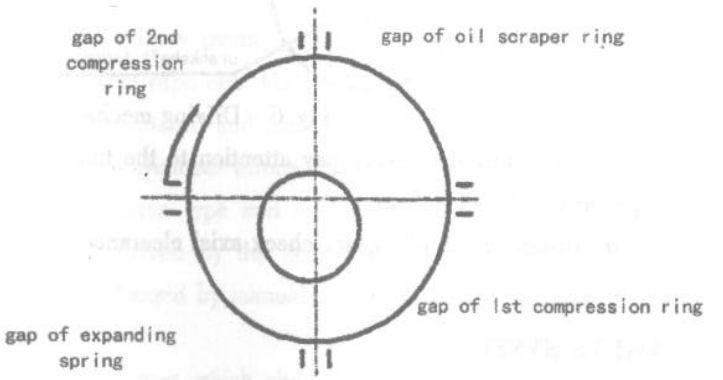


Fig. 5 Piston ring opening direction

The connecting rod is made of No. 45 steel. There is coupling mark on the body and cap You must install according to the mark, wrong installing should be avoided.

The tightening torque of the connecting rod bolts is 50 – 60N. m

The conneting rod bearing is made of 20% high tin – aluminum alloy.

While mounting the piston pin, the piston should be heated to 100℃, while mounting th connecting rod, the piston top face to the installer, the tub concave is on the upper side, an the bearing positioning slot in the connecting rod big end hole should also be on the upp side.

The weight of connecting rod big end & small end has a strict distribution portion, th weight difference of piston and connecting rod assembly of each engine should be limited to b low 20g.

5. DRIVING MECHANISM

The gear driving system of the engine, please refer to Fig. 6

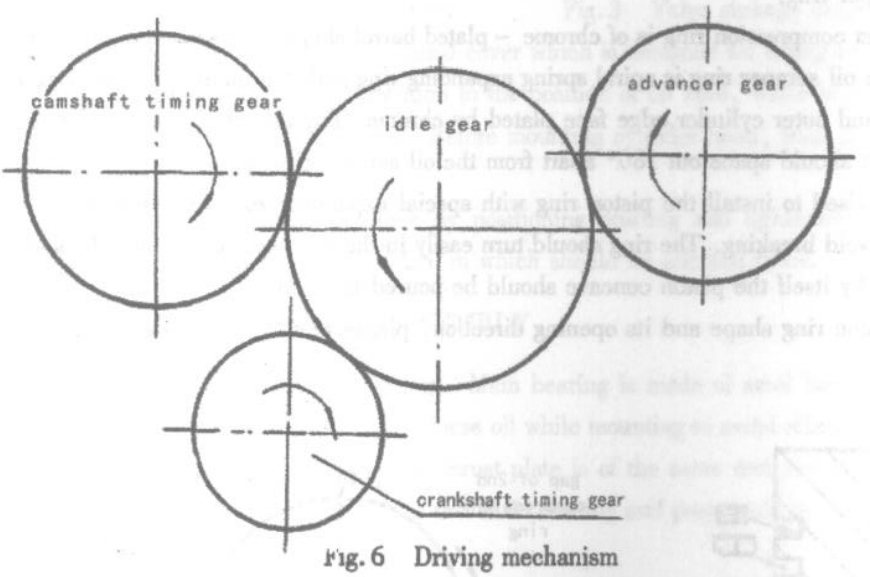


Fig. 6 Driving mechanism

When installing the gears, pay attention to the timing mark on the gear faces to ensu good phasing and fuel delivery.

After installing the idle gear, check axial clearance. Each gear should turn easily with clicking.

6. VALVE SYSTEM

Valve mechanism:

The mechanism is top – mounted valve type. The surfaces of camshaft and gear are h frequency quenched. There is a thrust plate in front of first shaft journal. Axial clearance

camshaft is 0.07 – 0.245mm.

Valve tapper is made of chilled casting iron. There is a position deviation between tappet center and cam center, so that the tappet could continuously turn for smooth wearing during operation to prevent seizing. Push – rod is made of steel, one end is ball structure, the other end is of bowl structure. Rocker arm shaft is fully supported for high rigidity . Rock arm and shaft are lubricated by pressed oil from cylinder head.

Valve and valve seat are made of alloy steel and alloy cast iron and lapped to fit. To check its fitting, pour kerosene into air port and wait for 2 minutes, no leakage is allowed. Air leakage of the valve may affect engine technical performance or even burn to damage valve and seat. So leakage check should be carried out according to technical requirement when in operation . Lap it when necessary.

A chamfer is designed on valve guide to prevent oil flowing back into cylinder liner and burning.

Valve clearance adjustment:

Valve clearance shall affect engine performance. It should be checked and adjusted according to technical maintaining stipulation; The intake valve cooling clearance is of 0.20 – 0.25mm, the exhaust valve cooling clearance is of 0.25 – 0.30mm. The adjusting procedure as following:

Make the first cylinder piston stop at T. D. C position when the "O" mark on crankshaft pulley is aligned with the arrow mark on gear case cover, then check and adjust valve clearance of the first valve(count from the engine front end) by inserting a valve clearance gauge. Turn the crankshaft 180°subject to the cylinder working order1 – 3 – 4 – 2 to adjust every valve clearance.

7. FUEL SUPPLY SYSTEM

The fuel supply system consist of delivery pump, injection pump, speed adjustor, fuel filter, injector, delivery pipe and injection pipe etc. Fuel is delivered to fuel filter from fuel tank by delivery pump where the fuel is filtered and transfered to injection pump by a high pressure and atomised, then injected into chamber through injection pipe.

1) The fuel delivery pump is of piston type and assembled on the side, of injection pump. When in normal operation it is driven by the eccentric cam shaft gear of injection pump. Air inside the system can be discharged by manual pump when necessary after the engine stopped.

2) Fuel filter cartridge is made of paper which should be mounted correctly to ensure completely sealing. To keep fuel clean, replace and clean the cartridge as instruction, other wise some elements might be choked or worn out to cause trouble or shorten service life.

3) The plunger diameter of injection pump is 6.5mm. Lubrication oil is filled into in jec-

tion pump from right upper side until oil drop out from side pipe for complete lubrication. Oi refilling should be darried out periodicaily.

Injcetion pump disassenbling:

Try not to turn rhe crankshaft after fhe pump is disassenbled so that to ensure the fue supply timing . Otherwise the marks on idle gear and pump gear should be aligned again by turning the crankshaft.

Adjust fuel supply timing:

Fuel supply advance angle is 17 ±2℃A before the T. D. C. To ajust the angle, firstly dis charge air in fuel system, crank the crankshaft to let injection pump fill fuel. Dismounting in jection pipe on first cylinder. Blow off the ruel in the hole of delivery valve seat connector then crank the crankshaft slowly and inspect the fuel level in delivery valve seat connector stop cranking immediately when fuel level waves. Check the mark on crankshaft belt pulley t see whether the advance angle is in comply with the above mentioned specification. Larger smaller advance angle can be adjusted by loosening three bolts on pump connecting plate. the angle is larger, turn the gear seat counter clock wise a proper angle. If the angle is sma ler, turn it clockwise for a proper angle, then tighten three bolts and check the angle again.

Adjust injection pump:

Injection pump was already adjusted, checked and lead sealed before ex – works. If n adjustment is necessary, it should be made on special testing machine at repairing worksho

Injection diameter × outside diameter × length = $\varphi 1.5 \times \varphi 6 \times 380$mm

Injector:

Open pressure:20000KPa

Plunger and barrel are couple parts and can't be changed with each other. To assemb the injector, never forget to adjust the head of the injector 30°to the cylinder head.

Higher or lower injection pressure shall affect normal injection. When the part is dam aged, the engine shall exhaust black smoke, loss power and speed, raise exhaust temperatu or knock the cylinder. To check the trouble injector, loosen injection pipes one by one, st injection, and inspect the colour of exhaust smoke. Only the trouble injector stop injection c make the engine no smoke, crank the crankshaft slowly to check injection sound of each inje tor, the trouble injector shall be no sound.

Injector adjustment:

Set injector on testing machine, slowly increase pressure from 18000 to 20000 KP Check to ensure no fuel drops or leakage, otherwise clean or lap the nozzle and try aga Then check atomization at a speed of one injection per second. Atomized injection should smooth and fog shape without split, drops, uneven or partial injection but with obvious melodious sound when fuel supply is cut off. Generally speaking, an abnormal imjection caused by unsmooth movement of plunger and barrel. While fuel drops in injection hol

caued by damaged sealing surface ,and uneven injection is caused by heat deflection due to carbon deposit on head.

Injector dismountiong:

When dismounting injector, firstly clean outside surface. Clamp it on bench vice with nozzle toward upside. Note that the vice mouth should be covered with copper plates. Screw out the tightening nut, pull out plunger and barrel and put in clean diesel. Turn the injector upside down and clamp again. Screw out pressure adjusting screw and nut ,then take out pressure adjusting spring and push rod. Clean the plunger and barrel when they are seized or effect poor atomization. Sink it in diesel for a while when seized, clamp it with cloth covered clipper and lightly turn out the plunger. To clean plunger and barrel, scrap with wooden sheet dip in gasoline or diesel. metal sheet is strictly prohibited. If plunger can't move smoothly in barrel. lap it with clean diesel, then clean to remove all dirty and metal chips.

Speed adjustor:

Speed adjustor is well adjusted and lead sealed when ex – works. Don't adjust it unless necessary.

Adjust speed controller only on pump testing bench to prevent damaging.

8. Fuel injection Pump

The engines shall select the fuel injection pump type BQ or type I by the engine's rated speed and matched purpose, we will mainly describe the pump type BQ as following;

A. The Characteristics of the injection pump type BQ

The injection pump type BQ is especially adapted to the high spedd and little cylinder bore diesel engine. It have the characters of full – closed type structure, high rigidity, compacted and light weight, which of weight is less than 6kg and the highest speed can reach 4200r/min. The speed controller is full – stroke type with the automatic fuel economizer and fuel rectifier during starting.

B. The structural drawing (refer to see Fig. 7)

C. Dismounting of the fuel injection pump type BQ

The dismounting ,inspecting and repairing of the injection pump shall be done at indoor and clean place by the skilled technical members, firstly shall wash and clean the outer of the pump carefully before dismounting . You'd better to use the special tools to dismount the pump and prepare one plastic plate for laying the componenets. While dismounting, you shall firstly dismount the lower cover of the pump (refer to see Fig. 7) drain out the oil ,then respectively dismount from the speed controller end (refer to see the dismounting of the speed controller) to the injection pump. (A). The injection pump dismounting procedure(refer to see Fig. 7):

a. Screw out the two fixed nuts of the flanged sleeve, then lightly shock the flanged sleeve

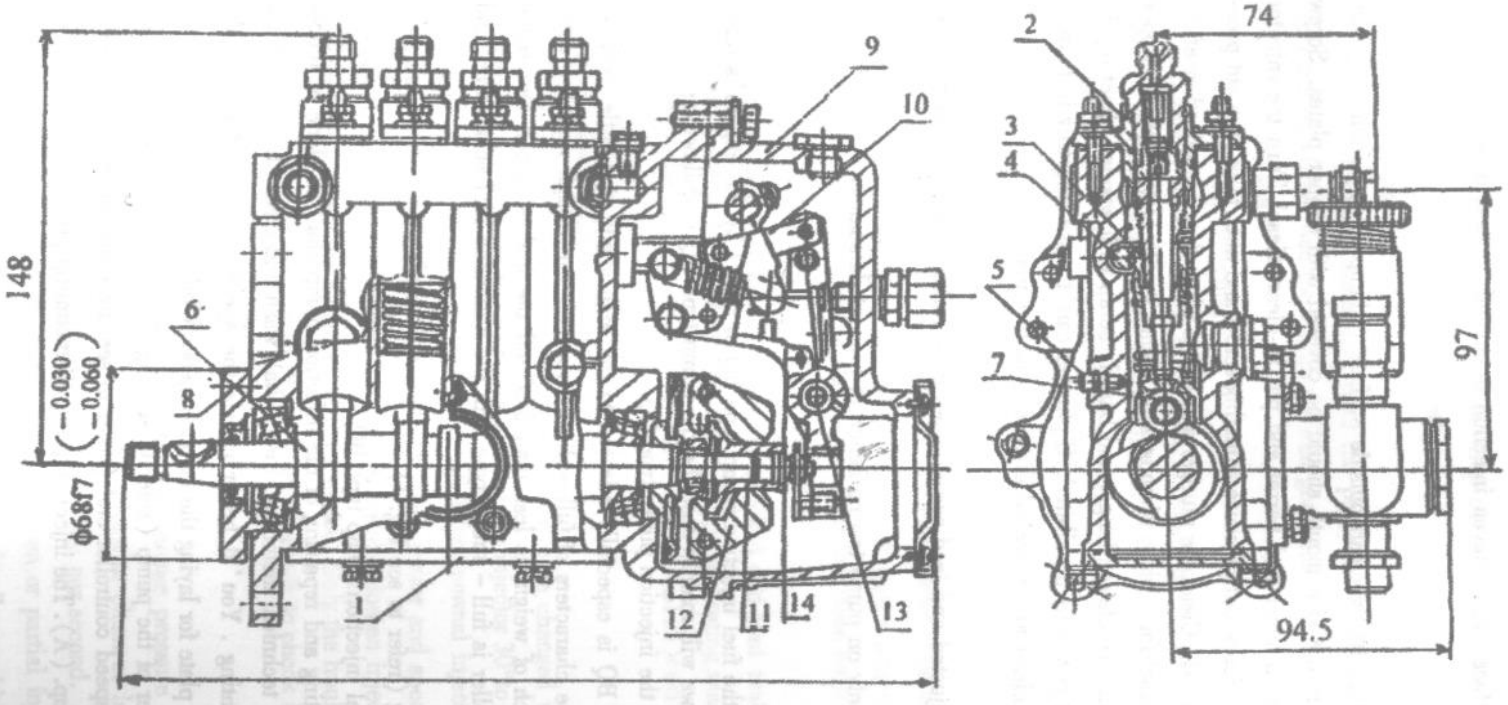


Fig 7 The structural drawing of the injection pump type BQ

1. injection pump lower cover 2. flanged sleeve 3. adjusting gear bushing 4. gear stem 5. tappet body positioning screw 6. camshaft 7. Pulley 8. front bearing cover 9. speed controller rear cover 10. connecting bar assembly 11. speed controller sliding sleeve 12. fly weight element 13. circlip 14. speed controlling support 15. speed rectifier

element by wood stick or copper hammer, respectively take out each slave pump's flanged sleeve element after little loosing.

b. Carefully take out the adjusting gear bushing by the nipper.

c. Clamp the plunger top by the nipper with plastic sleeve, then turn 60°and take out the plunger upward.

d. Screw out the gear stem fixed screw, then draw out the gear stem from the speed controller end.

e. The flanged sleeve elements dismounting procedures (refer to Fig. 8):

(a). Screw out the fuel delivery valve fixed seat.

(b). Take out the fuel delivery valve with seat.

(c). Lightly knock the plunger bushing lower part by copper stick, take out up – ward the plunger bushing from the flanged sleeve element, take the dismounted plunger back the matched plunger bushing.

While dismounting, shall take especially care of the partnership of each cylin – der's plunger and delivery valve with seat, any error is prohibited, and the other parts must be respectively laid by each slave pump.

f. Screw out the three fixed nuts of the delivery pump, dismounts the delivery pump.

g. After dismounting the positioning screw of tappet body, turn the camshaft to make the tappet body on the T. D. C. position, then screw in the tappet body element, the other cylinders dismounting shall do as same procedure.

h. Dismount the front bearing cover, take out the axial clearance adjusting pack – ing of the camshaft at the same

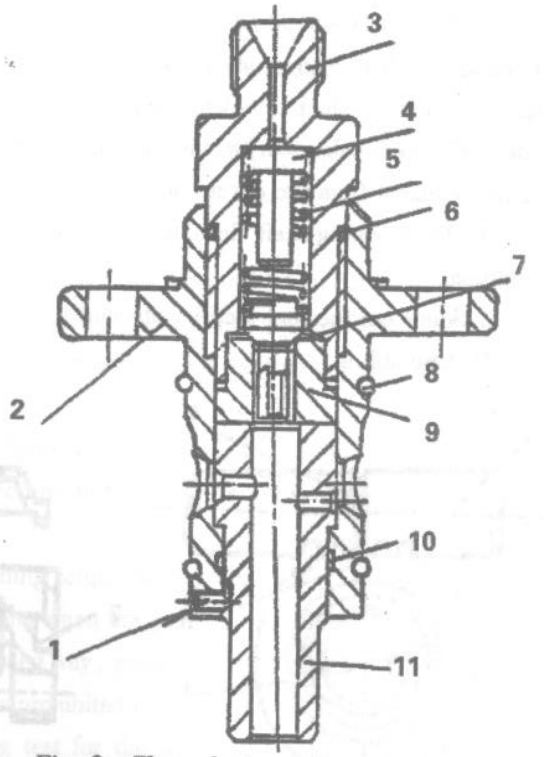


Fig. 8 Flanged sleeve element

1, plunger positioning pin 2, flanged sleeve
3, fuel delivery valve fixed seat 4, reducing volume body 5, delivery valve seat 6, "O" ring
7, delivery valve washer 8, "O" seal ring
9, fuel delivery valve with seat 10, "O" seal ring
11, plunger bushing

time, then draw out the camshaft from the front bearing hole.

i. Prop up the tappet body element by copper stick, screw out the tappet body's special installing and dismounting screw, take out the tappet body element, plunger spring lower seat and upper seat from the lower part of the pump body which shall be solely laid by each slave pump.

(B) The dismounting procedures of the speed controller (refer to see Fig. 7):

a. Screw out the 7fixed screws of the speed controller rear cover, properly pull out – ward the speed controller rear cover, take out the cotter pin from its inner, then take out the speed controller's connecting bar element from the gear stem, dismount the speed controller rear cover body element.

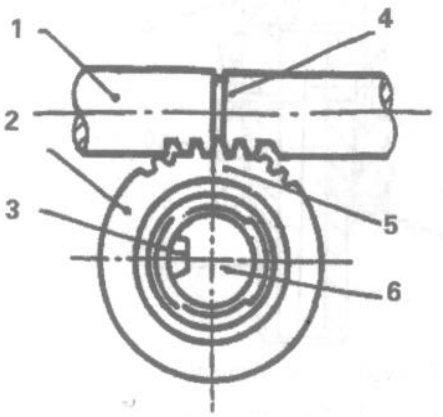
b. Take out the speed controller sliding bushing element from the camshaft, then pull out the fly weight element from the camshaft by special tool, any beating is forbid – den.

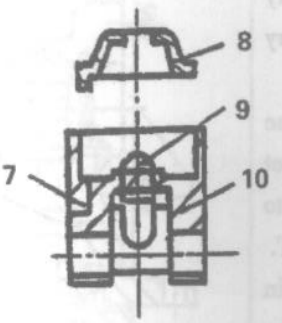
c. Take out the right and left side circlip of middle of the speed controller, beat in – ward its middle shaft by copper stick (adjacent of the stopping shaft) to make the "O" ring of the other side middle shaft completely reveal out of the cover, take out the "O" ring, the another side "O" ring is taken out by the same means, take out the middle shaft and speed controlling support element from the cover body.

d. The stopping shaft element is not easy to damaging, so need not to dismount in normal condition.

e. Screw out the fuel rectifier element

D. Assembling





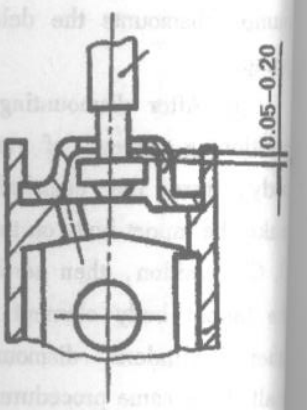


Fig. 9 plunger gear ring and gear stem Fig. 10 Fig. 11

1. gear team 2. gear ring 3. plunger 4. gear stem assembly mark 5. gear ring as – sembly mark 6. plunger assembly 7. plunger spring lorer seat pesitioning slot 8. plunger spring lower seat 9. tappet body positioning slot 10. tappet body

Before assembling, you shall wash and clean all of the components carefully with clear diesel fuel, exchange all of the "O" rings and seal packing, normally assemble the pump by the reverse dismounting procedures, but shall also especially pay attention to the followings:

a. While assembling, the plunger lower flat part shall aim at the spring lower seat plat part and insert, turn it 90 °by the nipper to make the plunger top frank slot direct to the side of its gear stem , then assemble the gear ring. Lightly Pull out it by the nipper to make the mark ". "of gear ring point to the gear stem mark (refer to the Fig. 9).

b. While assembling the flanged sleeve element , firstly turn the camshaft to make the plunger on the T. D. C. position , then assemble it carefully and pay attention the flanged sleeve's mark "F"to point to the gear stem.

c. The protruding tongue of the plunger spring lower seat shall take into the tappet body side surface's short slot (refer to see Fig. 10). Pay attention that there are two positioning slots on the tappet body, in which one of the longer positioning slot is used to positioning another shorter slot of the tappet body to prevent the plunger lower seat from turning, wrong assembly is prohibited.

d. The precision of the plunger axial altering clearance has been guaranteed and control in the range of 0.05 – 0.20mm, in spite of that, it shall be also inspected before assembling (refer to see the Fig. 11).

e. The camshaft axial clearance shall be controlled in the range of 0.02 – 0.05mm, if it is not reach the standard, shall exchange the adjusting packing and guarantee that the symmetry between the camshaft eccentric wheel and the delivery pump assembling hole of the pump body is not over 1mm.

f. The fuel delivery valve fixed seat 's tightening torque is 34 – 39Nm. After tightening the fuel delivery valve fixed seat, shall inspect the sliding flexibility of the plunger in its bushing, any blocking is prohibited.

g. The flanged sleeve fixed bolts' tightening torque is 9.3 – 12.3Nm. After assembling, shall inspect there is not blocking and clamping when the gear stem is sliding in full – stroke.

h. Seal all of the fuel cavity's outer revealed way, press 0.49MPa(5kg/cm2) compressing air from the fuel inlet adaptor, any bladder is prohibited to occurring within 15 seconds during immerging the diesel fuel. Have the sealing test for the other inner cavity by pressing 0.049MPa(0.5kg/cm2) compressing air by the same means.

i. Ensure the dimension between sleeve working surface and pump body connecting surface to be 25 ±0.5 by exchanging the height of peed controlling sleeve, if the dimension is too less (<25.5) ,it will cause the speed controlling sleeve to occur hollow stroke, the fuel stop delivery stroke may be insufficient and not to stop delivery fuel; if the dimension is too bigger, it will cause the stroke to be insufficient and the starting fuel volume may be not enough.

j. Inspect all of the moving components if they can run smoothly and no any blocking.

E. Two points operating mode fuel volume adjustment on the fuel injection pump testing stand.

The adjustment in the rated operating mode

Raise the pump speed to the rated speed and adjust the high speed positioning screw and measure the fuel volume to top limit of the rated fuel volume, then screw in the fuel rectifier (the fuel rectifier shall have some pre – tighten strength) to make the odometer run from 0. 1mm to 0. 3mm (pre – pressure volume), inspect the rated fuel volume and working speed, adjust them by exchanging the pre – pressure volume.

a. The adjustment in the rectifying operating mode

(a). The adjustment for the rectifying working speed

Refer to see Fig. 12: Firstly set out the rectifying stroke adjusting screw bushing outward a bigger distance, then reduce the pump speed to the rectifying speed lower limit of the technical documents stipulation, adjust the pre – tighten strength adjusting screw bushing, till the odometer pointer run to 0. 05mm, finally lock the pre – tighten strength adjusting bushing.

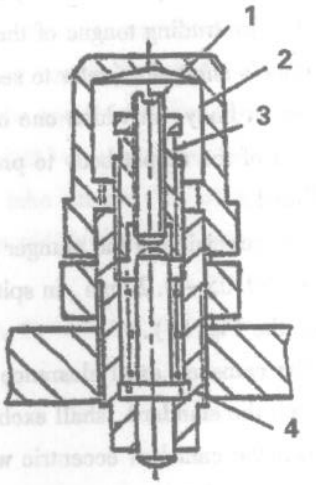


Fig. 12

1. rectifying stroke screw 2. protecting cap 3. pre – tighten strength adjuting screw bushing 4. rectifying screw bushing

(b). Rectifying fuel volume adjustment

Continue to reduce the pump speed to the Max. torque speed; inspect the fuel volume value in that condition. If the fuel volume value is little lower or higher than the stipulation, lightly adjust the pre – tighten strength adjusting screw bushing to reach the stipulated value; If the value difference is larger, need to exchange rectifying spring. Finally screw inward the rectifying stroke adjusting screw to contact the rectifying push rod justly and lock it.

F. Two – point operating mode fuel volume adjustment on the engine's testing stand.

a. The inspection and adjustment in the rectifying operating mode

After wearing and running by the engine's adjusting stipulation, pull the speed adjusting handle to the top position and run in the rated operating mode, inspect if the pump fuel volume can meet the rated requirement. If the inspection result can not meet the requirement:

(a). While increasing the fuel volume, shall screw out the high speed limiting screw a little and lightly screw outward the rectifying screw busing at the same time . pull the speed adjusting handle to reach the requirement of the rated operating mode, finally lock it.

(b). While reducing the fuel volume, shall screw in the high speed limiting screw a little, and reduce the engine speed to rated speed over 10 – 20r/min, lightly screw inward the rectifying screw bushing till it meet the requirement of rated operating mode and lock it.

b. Rectifying operating mode fuel volume inspection and adjustment.

Reduce the engine speed to run in rectifying operating mode, inspect if the fuel volume can meet the requirement of rectifying operating mode, otherwise shall have the following procedures:

(a). While increasing the fuel volume, shall screw out the protecting cap of the fuel rectifier and screw outward the rectifying stroke screw a little till it reach the requirement in rectifying operating mode and lock it.

(b). While reducing the fuel volume, shall screw inward the rectifying stroke screw a little till it reach the requirement in rectifying operating mode and lock it.

(c). If it need to exchange the rectifying speed, shall adjust the pre – tighten strength adjusting screw bushing: while increasing the speed, screw outward the adjusting screw bushing; While reducing the speed, screw inward the adjusting screw bushing.

G. The fuel volume specification of injection pump type BQ for diesel engine model LL380B

Speed(r/min)	Rated fuel volume (ml/r/min /600times)	Fuel volume in Max. torque point (ml/r/min/600times)
2800	17/1400	15/980

9. LUBRICATTION SYSTEM

Lubrication system which effect pressure and splash lubrication consists of oil pump. oil filter and oil channel. Oil pump is of gear or rotor type and is driven by camshaft gear . The gear shaft and camshaft gear are lubricated by splashed oil. Oil filter is of paper cartridge type which should have g good sealing. While installing the cartridge, care must be taken to prevent leakage or short – way. The system working pressure is 200 – 400kpa, to ensure a longer service life, maintain the lubrication system completely and in time.

10. COOLING SYSTEM

Cooling system is of a closed, forced water cooling which consists of water pump, thermostat, fan, connecting pipe and radiator etc.

The cooling water in radiator is pumped into cylinder block water cavity, then to cylinder head. Some water directly flows up to cylinder head and accumulated near thermostat. Some

water holes in cylinder block and head are very small, so care must be taken not to block them especially those holes between cylinder bores and the trangle area where injection nozzle located to prevent trouble caused by overheating. Water pump is centrifugal type. If there is trouble in water seal, water may leak out from overflowing hole, repair it in time . After long time operation, some deposit shall be left in cooling system which can be removed by the following procedure:

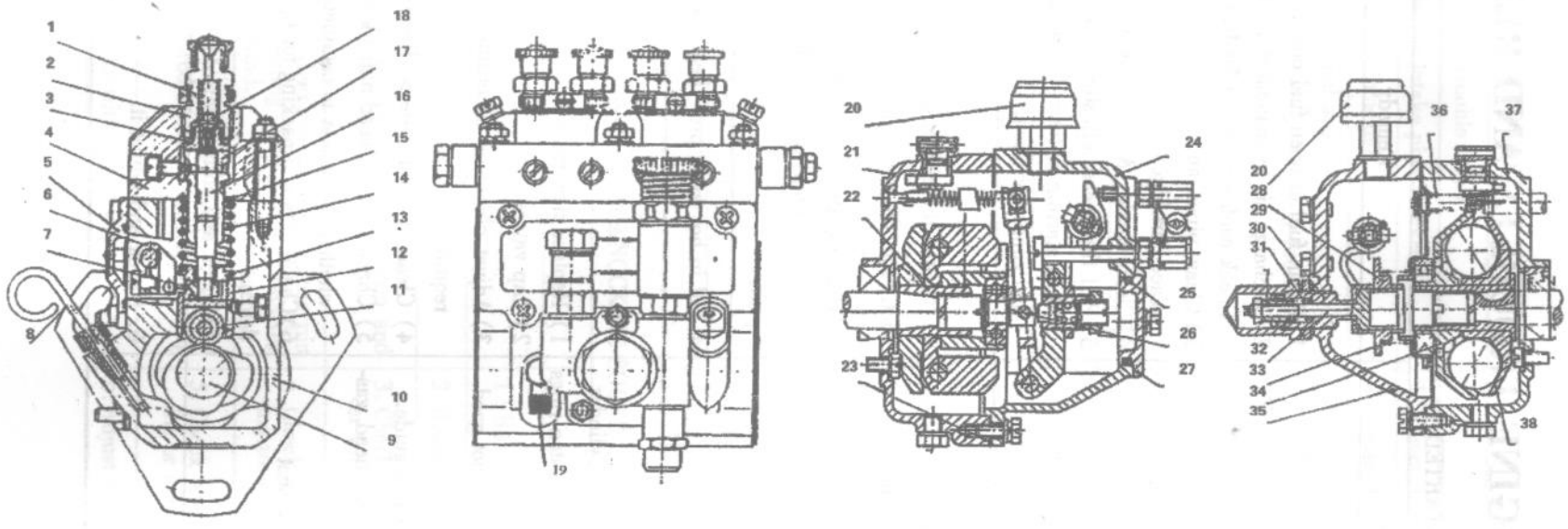
Pour the mixture of 700 – 800g Noah and 150g kerosene into water cooling system. Run the engine for 5 – 10 minutes, then stop for 10 – 12 hours. Restart the engine for 10 – 15 minutes, drain out the mixture and clean cooling system with clear water.

11. ELECTRIC SYSTEM

Electric system consist of generator, starting motor, regulator, accumulator, oil pressure senser, glow plug and connecting wire etc . Engine normal voltage is 12v.

The negative pole of accumulator and generator should be earthened, positive and negative pole can't be short circuit to prevent damage .

Appendix: structural drawings of the injection pump type I and speed controller



Fuel injection pump type I　　Speed controller type T110　　Speed controller type T71B

1. Fuel delivery valve spring 2. Fuel delivery valve adapter 3. fuel delivery valve washer 4. Upper body 5. window cover 6. shifting fork 7. adjusting arm 8. oil dipstick 9. camshaft 10. lower body 11. pulley 12. tappet body 13. spring lower seat 14. plunger spring 15. spring upper seat 16. plunger 17. plunger bushing 18. fuel delivery valve 19. balancing pipe 20. breather 21. speed controller seat 22. fly weight element 23. speed controller washer 24. speed controller housing 25 "O" seal ring 26. adjusting packing 27. rear cover 28. sliding bushing 29. screw bushing 30. rectifying spring 31. adjusting screw bushing 32. fuel volume limiting screw 33. starting spring 34. sliding plate element 35. speed controller cover 36. Stopping spring 37. speed controller seat 38. drive element.

CHAPTER V ENGINE TROUBLES AND REMEDY

A: ENGINE CAN NOT BE STARTED

Trouble Cause	Remedy
1. Fuel System 1) No fuel in fuel tank or fuel cock not opens. 2) Air in fuel system 3) Fuel pipes or fuel filterblocked. 4) Poor atomization 5) Levers not return to max. fuel supply position	1) Fill in fuel or open fuel cock. 2) Discharge air by manual delivery pump. Check each connection for leakage. 3) Clean pipes and filter cartridge or replace cartridge. 4) Clean nozzle; Adjust injection pressure. 5) Pull the speed adjustor lever with force when starting to force the lever to max. fuel supply position.
2. Electrical System 1) Improper circuit contact 2) Lower voltage of accumulater	1) Tighten the circuit connecting screw. 2) Charge the accumulater.
3. Large oil viscosity to lower the engine starting speed	3. Cranking the crankshaft for several turns with cranking handle, fill in preheated oil.
4. Ambient tempreture too low	4. Fill in hot water pre – heat starting
5. Lower Compression PressureIn Cylinder 1) Cylinder liner, piston and piston rings worn out. 2) Valve and valve seat fitting not good. 3) No valve clearance 4) Valve stem blocked in valve guide. 5) Air leakage from cylinder head gasket. 6) Air leakage from injector seat 7) Valve timing incorrect.	1) Replace new parts. 2) Lap valves. 3) Adjust clearance according to technical requirement. 4) Clean it in kerosene or diesel. 5) Check cylinder head nuts torque. Check whether the gasket is complete. 6) Check nuts and packing for tightness and damage 7) Check and adjust
6. Fuel supply advance angle not correct	6. Check and adjust it.

B: ENGINE POWER DECLINE

Trouble Cause	Remedy
1. Air filter or intake pipe blocked	1. Clean it.
2. Exhaust pipe blocked	2. Clean it.
3. Insufficient fuel supply 1) Delivery pipe & fuel filter blocked. 2) Nozzle tip worn out.	1) Clean it. 2) Replace nozzle tip or injector
4. Water in fuel	4. Replace fuel
5. Incorrect fuel supply advance angle.	5. Adjust
6. Too much carbon deposit in chamer	6. Disasemble cylinder head and Remove carbon deposit

C: ENGINE STOP SUDDENLY

Trouble Cause	Remedy
1. No fuel supply. 1) No fuel in tank. 2) Air in fuel system 3) Fuel filter blocked 4) Water in fuel	1) Fill in fuel. 2) Discharge air 3) Clean it. 4) Replace fuel
2. Piston blocked	2. Replace it.
3. Air filter blocked.	3. Replace filter cartridge.

D: ENGINE RUNNING WITH KNOCKING SOUND

Trouble Cause	Remedy
1. Fuel supply too early or too late.	1. Readjust fuel supply advance angle.
2. Valve clearance to large	2. Readjust valve clearance
3. Too Large clearance between piston and cylinder liner	3. Check and replace piston or cylinder liner when necessary.
4. Too large clearance between piston pin and connecting rod bushing, having beating sound.	4. Check and replace connecting rod bushing when necessary.
5. Too large clearance of main bearing or connecting rod bearing, having ramming sound.	5. Check and replace connecting rod bearing or main bearing when necessary
6. Vavle knocks with piston top.	6. Adjust timing phase

E: OIL PRESURE TOO LOW.

Trouble Cause	Remedy
1. Insufficient oil in sump.	1. Fill in oil.
2. Oil pipes or oil filter Cartridge blocked.	2. Clean and replace when necessary
3. Oil viscosity too low.	3. Replace oil according to technical requirement.
4. Cylinder head gasket, water Pump packing or gear case cover packing damaged to Induce water into oil.	4. Replace damaged gasket, packing and oil
5. Sution fuel pipe connector leakage	5. Check and repair it
6. Oil pumps rotors seriously worn out.	6. Replace rotors and adjust clearance.
7. Too large clearance between main bearing and connecting rod bearing.	7. Check and replace when necessary.
8. Improper adjustment of pressure adjusting valve on oil filter	8. Readjust it
9. Oil pressure gauge damaged	9. Replace it
10. Wrong assembling of oil filter seat packing	10. Reassemble it

F: ENGINE OVER HEAT

Trouble Cause	Remedy
1. Cooling system out of order 1) No water in radiator 2) Too much deposit in water passage. 3) Fan and water pump belt too loose. 4) Space between radiater and ran is not suitable. 5) Water inlet and outlet pipe deformed or blocked	1) Fill in water 2) Add alkaline solution (750g alkaline in 10 L water). Operating 4 – 8 hours and discharged, then use clean water to clean the passage. 3) Adjust the tension of belts or Change belt when necessary. 4) Adjust it. 5) Replace it.
2. Fuel injection delayed or Nozzle leaks fuel.	2. Adjust the fuel delivery advance angle or repair nozzle.
3. Oil insufficient causes oil pressure too low and temperature too high.	3. Add oil.
4. Valve phasing is incorrect.	4. Adjust it.
5. Thermostat out of order.	5. Replace it.
6. Engine running overload for a long period.	6. Reduce load.

G: ENGINE EXHAUST ABNORMAL SMOKE.

Trouble Cause	Remedy
1. Exhaust blue smoke(oil in cylinder) 1) Piston rings, cylinder liner worn out or piston rings jammed. 2) Intake or exhaust valve guide hoke worn out. 3) Too much oil in oil sump.	1) Repair or replace it. 2) Replace it. 3) Drain out some oil.
2. Exhaust white smoke (Engine in cold condition with bad fuel atomization in low load condition.) 1) Fuel injection pump delivery too much fuel. 2) With bad fuel atomization, fuel pressure is too low 3) Fuel delivery too late 4) Cylinder compressing pressure is low. 5) Fuel with water	1) Adjust fuel delivery. 2) Inspect injection pressure or replace fuel injector when necessary. 3) Adjust fuel advance angle 4) Refer to a – 5 5) Replace fuel
3. Exhaust black smoke(bad combustion) 1) Engine overloaded 2) Nozzle with bad atomization or leak fuel 3) Fuel delivery too late 4) Air filter blocked 5) Too much fuel delivery	1) Reduce the load. 2) Adjust or replace the nozzle. 3) Adjust the fuel delivery advance angle. 4) Clean air filter and air intake pipe or replace filter cartridge. 5) Adjust the fuel delivery.

H: FUEL INJECTION PUMP OUT OF ORDER

Trouble Cause	Remedy
1. No fuel delivery 1) Delivery valve burn out or with dirt 2) Delivery valve spring or plunger spring deformed or broken. 3) Adjusting arm broken down. 4) Adjusting arm and fork jammed 5) Delivery pump stem jammed	1) Replace or clean delivery valve. 2) Replace it. 3) Tighten the adjusting arm. 4) Inspect and repair it. 5) Inspect and repair it.
2. Fuel injection pump supply fuel all the time causes running away of the engine. 1) Adjusting arm and fork jammed 2) Adjusting arm come down. 3) Governor sleeve burn out because of bad lubrication. 4) Puling bar stroke not enough. 5) Flyweight loosen 6) Pulling bar spring come down.	1) Inspect and repair it. 2) Replace or tighten it. 3) Inspect and repair it. 4) Adjust its stroke. 5) Tighten it. 6) Adjust it.
3. Speed governing rate too high 1) Governing spring deformed or worn out. 2) Calibrator works too early.	1) Replace the spring 2) Adjust it.
4. Unsteady fuel delivery. 1) Air or water in fuel 2) Delivery pump damaged. 3) Plunger spring broken.	1) Discharge air or water. 2) Repair or replace it. 3) Replace plunger spring.
5. Unsteady operating of the engine 1) Governor internal friction too large. 2) Camshaft axial clearance too big 3) Governing spring deformed or rigidity too small 4) Flyweight loose 5) Too much lub. oil	1) Inspect and solve it. 2) Adjust the clearance. 3) Replace it. 4) Tighten it. 5) Add lub. Oil as requirement
6. Insufficient fuel supply. 1) Pump element or delivery valve worn out. 2) Calibrator out of order. 3) High speed limit abnormal	1) Replace it. 2) Adjust it. 3) Adjust it.
7. Uneven fuel delivery of each cylinder 1) Adjusting arm loosen. 2) Flunger spring broken. 3) Delivery valve or nozzle with dirt.	1) Tighten it. 2) Replace it. 3) Clean it.
8. Engine unsteady in low speed. 1) Idle speed screw not correct. 2) Uneven fuel supply in low speed.	1) Adjust it. 2) Adjust it.

I. Troubles and remedies of the injection pump type I

Trouble Cause	remedy
1. The running speed is unstable and occur a larger fluctuation 1) Sliding plate taper surface is worn out. 2) The cylinder surface of the drive element hole (6) is over worn out. 3) The moving parts sliding character is bad. 4) The speed adjusting spring is deformed or its rigidity is lower.	1) Replace it. 2) Replace it. 3) Repair and readjust it. 4) Replace it.
2. The engine stop suddenly. 1) The pull bar is blocked. 2) The speed controller moving parts is blocked	1) Repair it. 2) Replace it.
3. The engine is running away. 1) There are burrs in the drive elements hole mouth (6). 2) The moving parts are blocked	1) Repair it. 2) Repair it.
4. The engine idle speed can not meet the requirement. 1) The adjustment is not suitable. 2) The parts sliding character is bad.	1) Readjust it. 2) Clean and repair it.

J. The troubles and remedies of the injection pump type BQ

Trouble Cause	Remedies
1. It is difficulty of starting. 1) The fuel pump is not delivery fuel a. There is air in the fuel way. b. The hand pump can not pump fuel c. The gear stem is blocked d. The stopping handle can't return its position 2). Fuel volume is insufficient. a. The plunger is seriously worn out.	a. Exhaust out air b. Repair hand pump c. Replace or repair it. d. Shift back the handle. a. Replace it
2. The engine is unsteadily running in idle speed. 1) The gear stem sliding character is bad. 2) The speed controller's moving parts connecting clearance is bigger. 3) The centering of the speed controller and pump body is bad. 4) The friction of slide bushing working surface is bigger. 5) Fuel delivery's inhomogeneous degree is bad 6) There is air in the fuel way.	1) Readjust and repair it. 2) Repair and readjust it 3) Repair it 4) Repair it 5) Repair and adjust it 6) Exhaust out the air.
3. There are inner leakage 1) The seal ring of fuel volume adjusting busing is damaged. 2) The plunger is leakage 3) The fuel delivery pump leaks fuel.	1) Replace the ring. 2) Replace it 3) Repair of replace it
4. The engine exhausts black smoke. 1) The fuel delivery interval angle is bigger 2) Fuel delivery's inhomogeneous degree is bad 3) The washer of fuel delivery is dirty.	1) Adjust it 2) Adjust it 3) Clean or replace it

K. STARTER IS OUT OF ORDER

Trouble Cause	Remedy
1. The starter can't work 1) Connecting wire is broken or bad connection. 2) The fuss is broken 3) The accumulator is no power or insufficient power. 4) The electric brush can't connect with the commutator 5) The starter is short 6) The bearing sleeve is worn out 7) The clutch is sliding	1) Weld it or replace new wire. 2) Replace it 3) Recharge or replace it 4) Adjust brush and spring pressure 5) Check and resolve the short 6) Replace it 7) Adjust it
2. The starter can run in empty load, but not start the engine 1) The shaft bushing is worn out, the armature rub with the magnetic pole. 2) The electric brush badly connect with the commutator. 3) The surface of commulator is burnt out or has oil dirty 4) The armature coil seal off with the commulator. 5) The wire connection is bad. 6) The electric – magnetic switch's connection spot is burnt out and cause a bad connection 7) The accumulator is insufficiently recharged or the voltage is not in conformity with the requirement.	1) Replace new bushing 2) Clean brush and commutator surface 3) Clean oil dirty and polish it 4) Weld it 5) Screw down the nuts 6) Check the switch connecting spot and polish it 7) Recharge or replace the accumulator.
3. Loosen the switch, but the starter continue to run. 1) The electric – magnetic switch connecting spot has been melted together. 2) The eccentric screw is not adjusted in proper position	15) Check and polish the connecting spot. 16) Adjust eccentric screw (frontward)
4. The starter's gear badly mesh with the flywheel gear ring	4. Adjust eccentric screw (rearward)

L. ALTERNATOR IS OUT ORDER

Trouble Cause	Remedy
1. The alternator can not generating power. 1) The wires is broken or short and bad or wrong connection 2) The stator and rotor coil is broken or short 3) Silicon rectifier damage to cause broken or short circuit 4) Electric brush is bad connection, sliding ring is dirty and ternator v – belt is too loosened. 5) The regulator's regulating voltage is lower, its connecting spot is burnt out or oxygenated, the relay coil is burnt out.	1) Check and repair it 2) Repair or replace it 3) Replace it 4) Clean and repair it 5) Repair and replace it
2. The charged power is insufficient 1) Some of alternator's silicon elements is broken circuit 2) The alternator's electric brush is bad connection, spring pressure is lower, the sliding ring is dirty. 3) The regulator's regulating voltage is lower, its connecting spot is burnt out 4) The accumulator's electrolyte is less or it is older.	1) Repair or replace it 2) Clean and replace it 3) Repair or replace it 4) Fill the electrolyte or replace it
3. The charged current is unstable 1) The stator and rotor coil will be short or broken circuit. 2) The alternator electric brush is bad connection, spring pressure is lower, the sliding ring is dirty 3) The alternator v – belt is loosened 4) The regulator's connecting spot is dirty 5) The regulator is out of order	1) Repair or replace it 2) Clean, repair or replace it 3) Adjust or replace it 4) Clean it 5) Repair or replace it
4. There are abnormal sound in the alternator 1) The alternator installing is not correct, bearing is damaged. 2) The alternator's stator coil or silicon elements are short 3) The alternator's moving parts knock or rub with the fixed parts	1) Repair or replace it 2) Repair or replace it 3) Repair it
5. the charged power it too excessive 1) The regulator's regulating voltage is higher or it is out of order.	1) Repair or replace the regulator
6. The alternator is burnt out and damaged 1) The alternator's silicon elements is short circuit or its stator knock the rotor 2) The regulator's coil is burnt out and damaged or the connecting spot is burnt out and melted together cause it is out of order. 3) The regulator's voltage coil or resistance wire is broken	1) Repair it 2) Repair or replace it 3) Repair it