495 / 4100 Series Engines

OPERATION MANUAL

NEW HOLLAND

Preface

NEW HOLLAND brand **495** series diesel engine is a four－stroke, vertical, water－cooled, swirl combustion chamber, four－cylinder diesel engine. In **1980**′, our company adopted the comet V combustion system and diesel design technique of Ricardo Consulting Engineers Company and have make great improvement in design. Thus, the power, economy and liability reached a advanced level among the same kind products all over the world.

NEW HOLLAND brand **495** series diesel engine was prized by the National Science Congress and it′s easy to adapt. According to the different application, some parts are changed accordingly. It can be matched with middle－sized tractors, engineering machinery, middle－sized vehicles, generating sets, irrigating machines and agricultural products process machines etc. The output range of various version of **495** series diesel engine is **26.5－51.5**KW, and its rated speed is **1500－2800**r/min. Model K**4100** is developed from Model **495** through cylinder expansion. As a result, the output range has been enlarged. ZH**4100** is developed from K**4100**. It adopts the direct injecting combustion chamber, and improved its economy further. The model, its make－up rule and the meaning of the symbol for every type is as follows:

ZH 4 100 □ □ □—□
K 4 100 □ □ □—□
4 95 □ □ □—□

⑦ ⑥ ⑤ ④ ③ ② ①

①: distinguish symbol, Expressed with number sequence
②: Version symbol, expressed with number sequence
③: application featrue symbol, expressed with alphabet
no alphabet: for common use; T: for tractor; G: for engineering machinery; Q: for vehicle; D: for generating set;
C: for marine use; P: for power take-off unit; Y: for transporting vehicle use.
④: construction feature symbol, expressed with alphabet; no alphabet: for natural aspirated model;
Z: for turbocharged model.
⑤: cylingder bore(mm)
⑥: cylinder number
⑦: cylinder expanded (ZH: Direct injecting combustion chamber)

In order to keep the diesel engine in good condition in most time, prolong the guarantee period maximally, reduce the cost of usage, we compiled this manual on the basis of the " National Rated **495** Diesel Engine Manual" and the change and improvement of the products to introduce the operation and maintenance knowledge to the customers.

This operation manual mainly introduces common usage type. For the products is changing and improving continually, there may be some slight difference between the produces and that described in this manual and the users are advised to notice it kindly.

Attention

1. The diesel engine operators must familiarize themselves with this manual as well as engine construction and strictly follow the procedures of operation and maintenance especially the regulations for safety operation described in this manual.
2. Before operating an engine at full load, the **60** hours running in should be carried out as specified in the manual.
3. Increase its speed gradually after stating a cold engine, never let it run at highs speed abruptly, and don't stop the engine instantly while its cooling water is still hot, also don't let the engine running long time without load.
4. If the ambient temperature falls below **+5**℃, drain the cooling water out of the radiator, the lubricating oil cooler and the diesel engine itself completely after stopping the engine. Continuous keeping the water in the oil cooler should be forbidden.
5. Never run the diesel engine without and air cleaner so as to prevent the unfiltered air from entering the cylinders.
6. The engine must be filled with specified grade fuel and lubricating oil, and a special and clean container for each oil should be used. The fuel oil should be settled for **72** hours and filtered before using.
7. The inspection and repair of the components in electrical system must be carried out by the person who has a good knowledge of electricity.
8. The working environment of the diesel engine should be well ventilated to avoid being polluted by waste gas or smoke.
9. The power rating and amending of the diesel engine is according to GB**6072.1 – 2000** the first section of reciprocating internal combustion engine: standard basic condition, the rating and testing method of power, fuel consumption and engine oil consumption.
10. The manufacturing of the diesel engine is according to the common technical requirement for low and middle level powered diesel engine in JB/T**8895 – 1999** and Q/WCG**004**

-2004 495 series diesel engine enterprise standard.

11. The No. of production license of this series diesel engine is: XK**06 - 205 - 00160**, XK**06 - 205 - 00161**, XK**06 - 205 - 00279**.

12. The position of safety warning marks:

(**1**) There's a guard against burning mark at the end of the cylinder cover which is beside the exhaust manifold of the diesel engine.

(**2**) There's a guard against fire mark at the oil filler.

(**3**) There's a guard against twinning mark on the inlet manifold.

(**4**) There's a flywheel rotating direction mark on the flywheel housing.

Contents

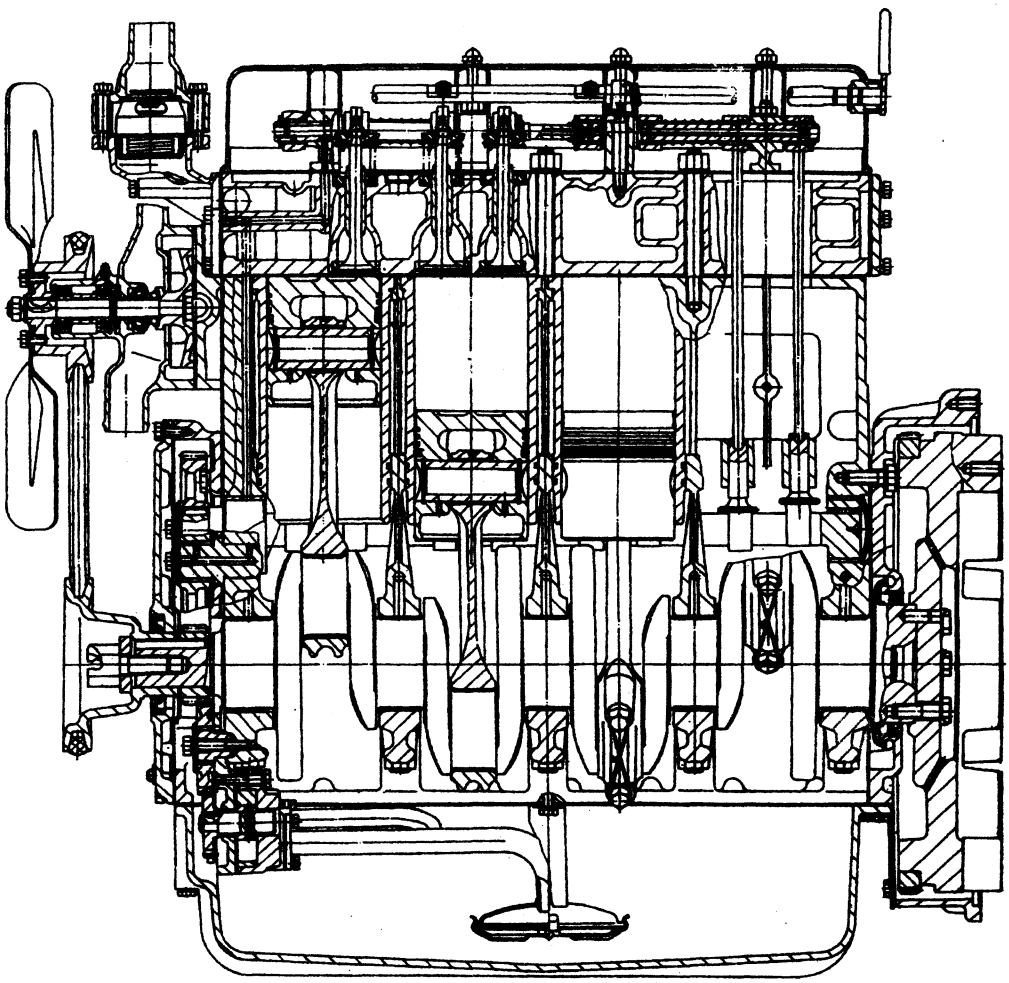


Fig. 1a Longitudinal sectional drawing for 495 diesel engine

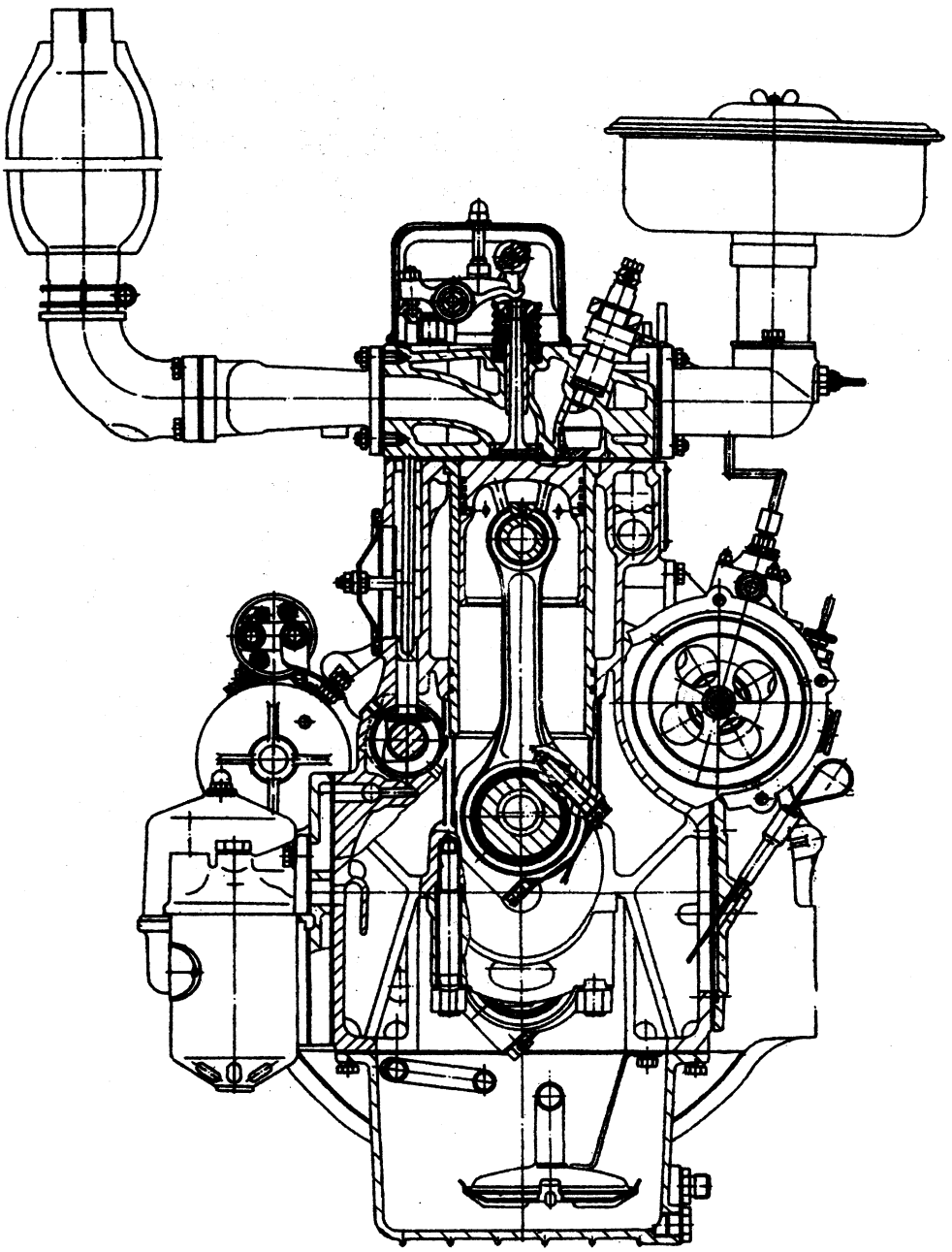


Fig. 1b Cross sectional drawing for 495 diesel engine

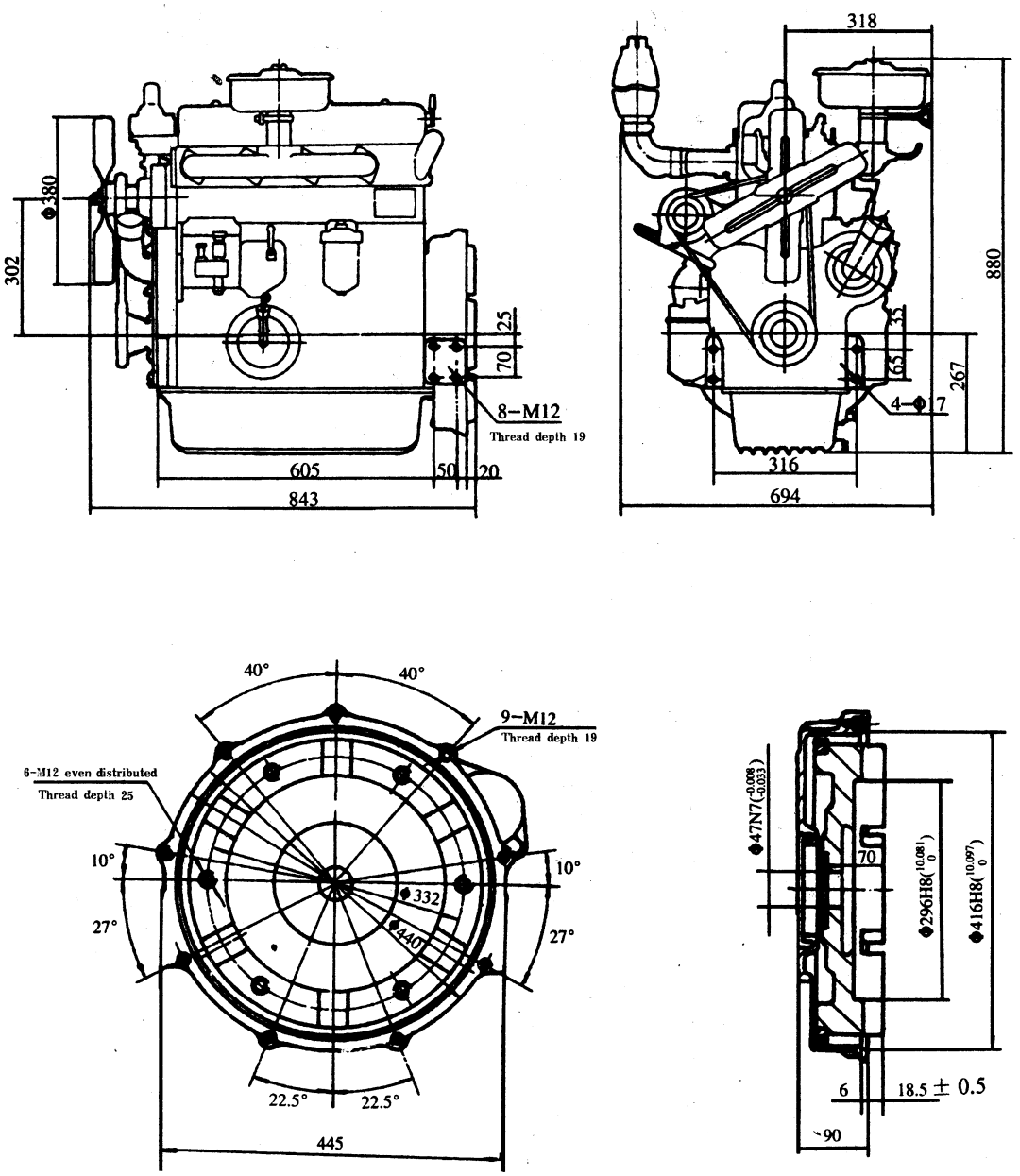


Fig. 2 Outline drawing for 495, 495G, K4100 diesel engine

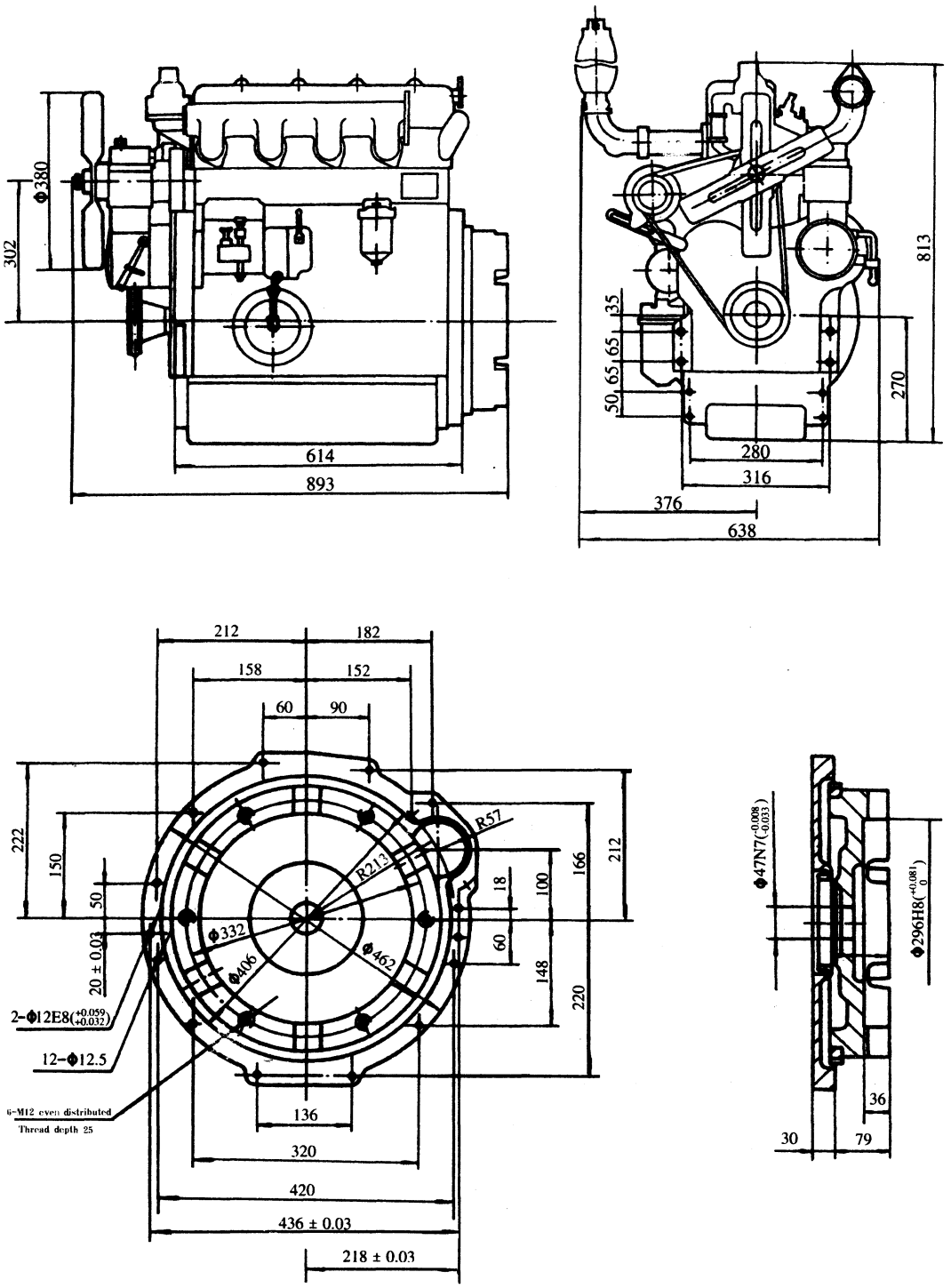


Fig. 3 Outline drawing for 495T diesel engine

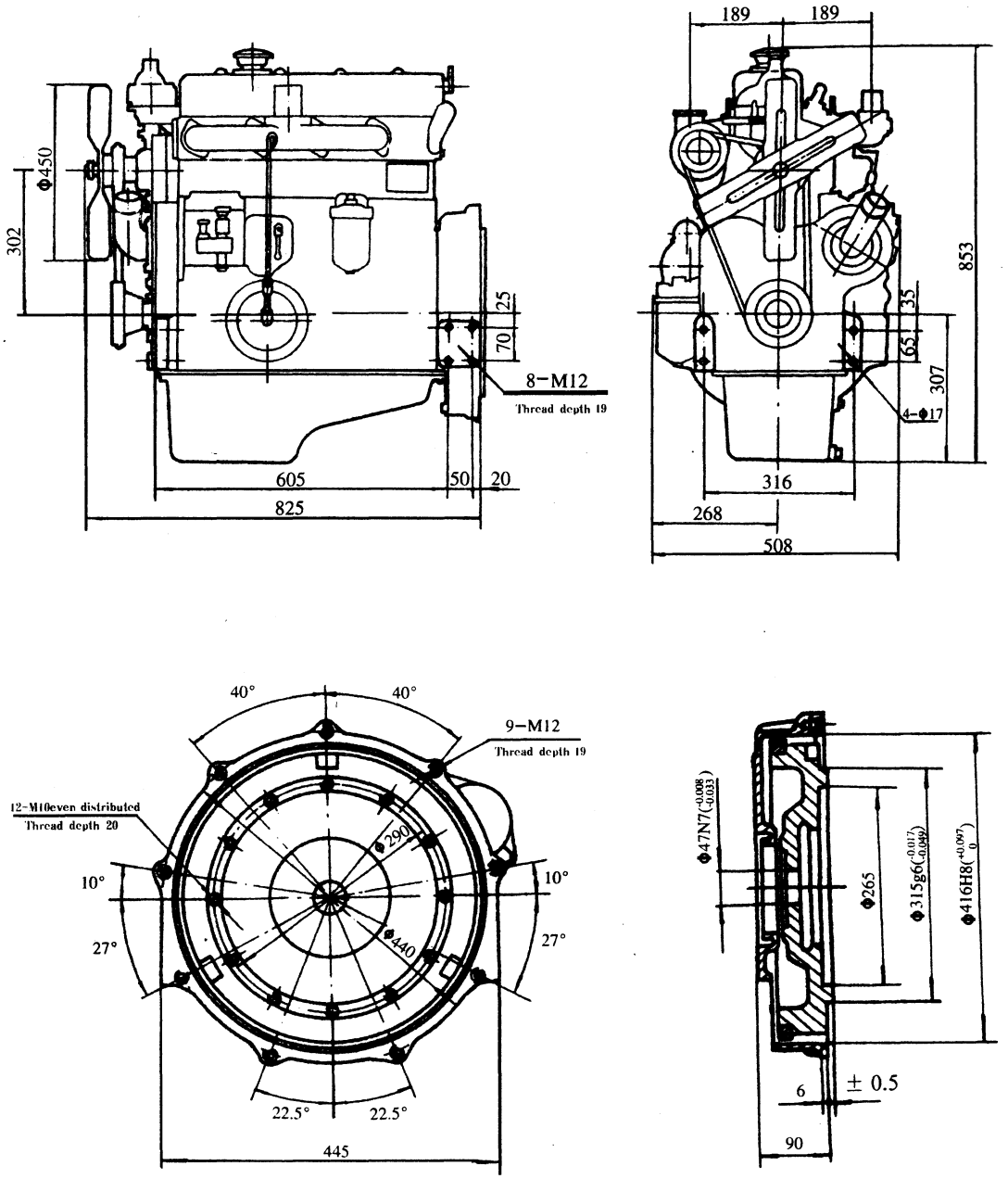


Fig. 4 Outline drawing for 495G1, 495G9, K4100G1 diesel engine

* The air cleaner, exhaust manifold & oil gauge of 495G9 are the same as those of 495 (see Fig. 2)

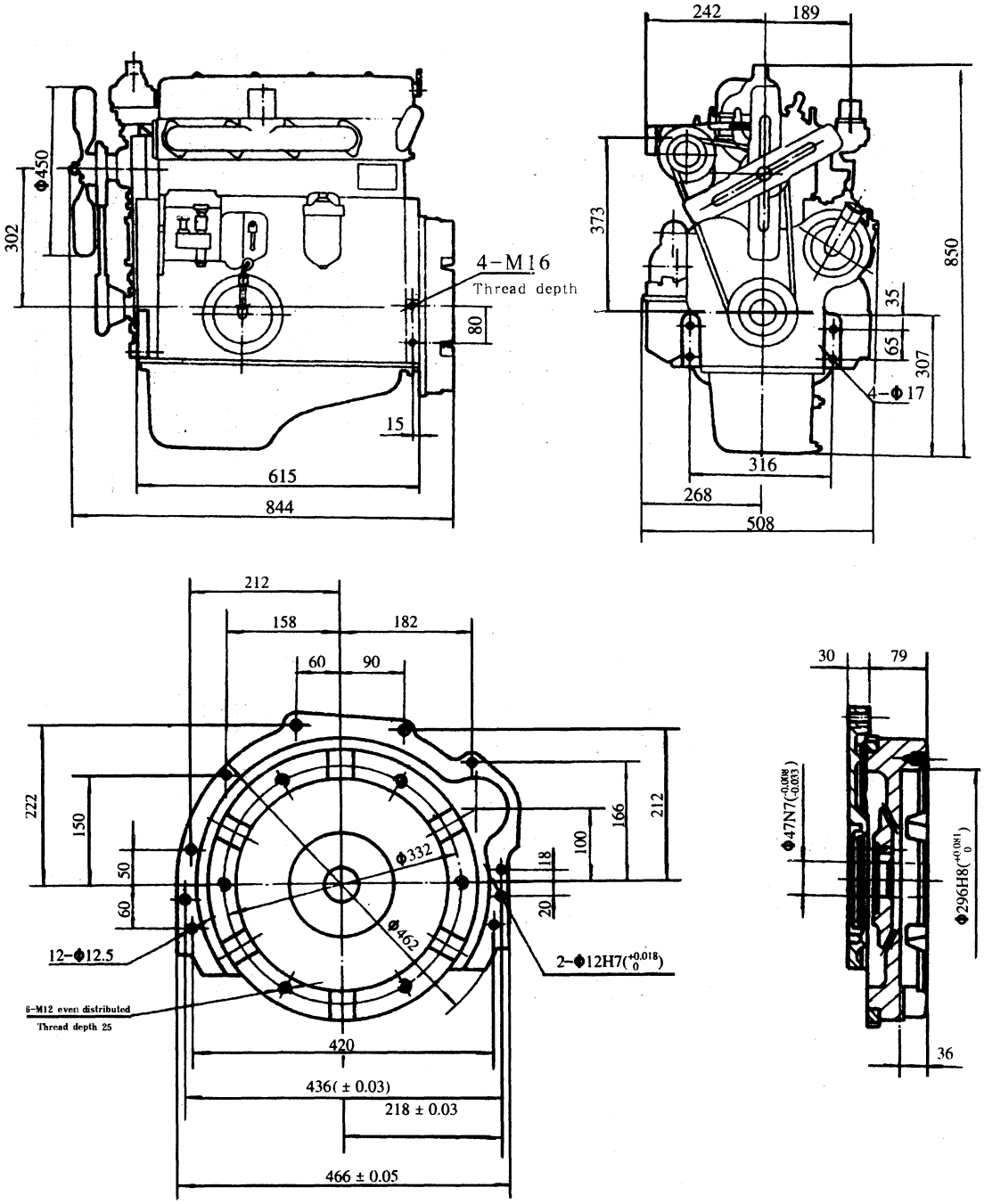


Fig. 5 Outline drawing for 495G3 diesel engine

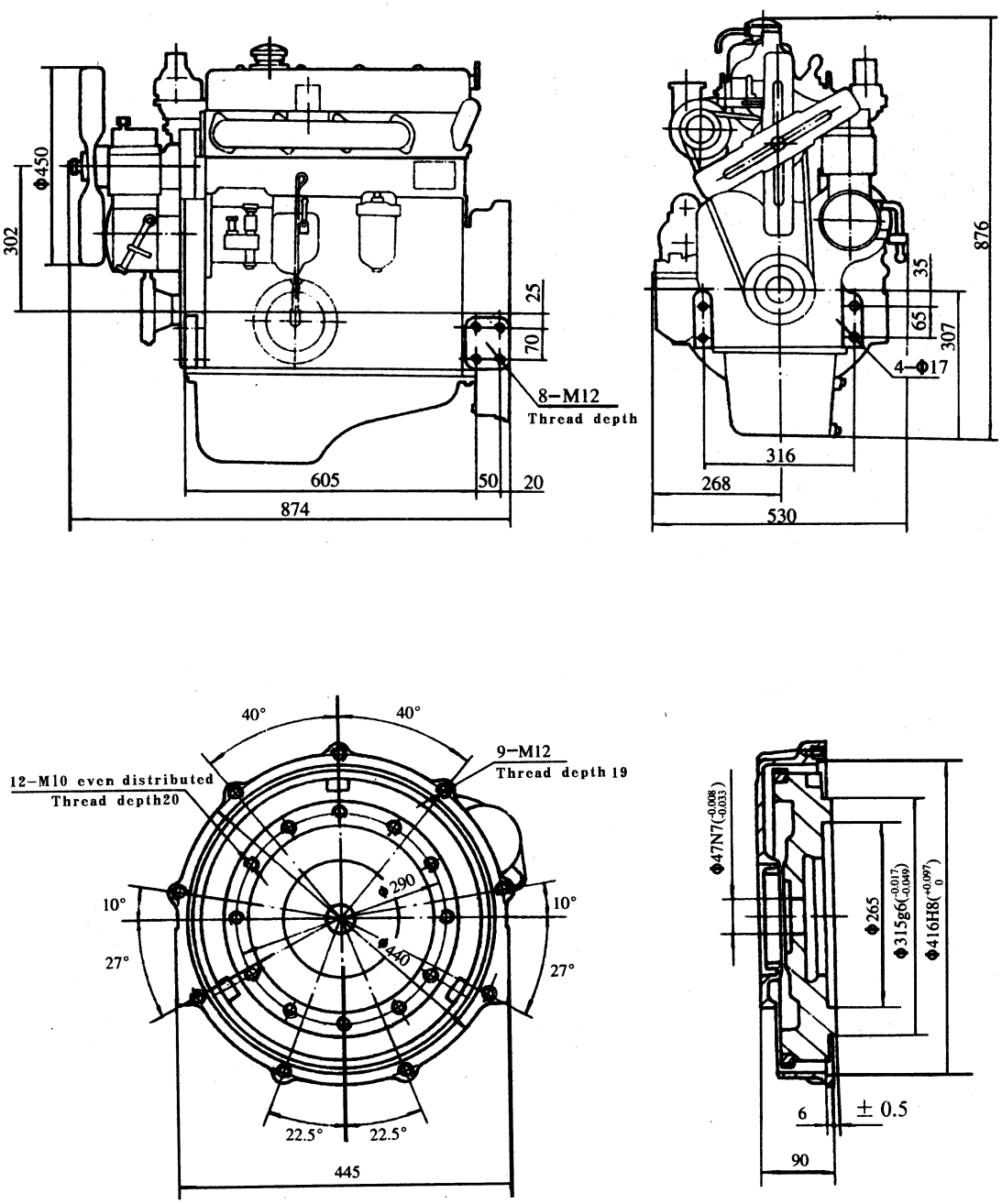
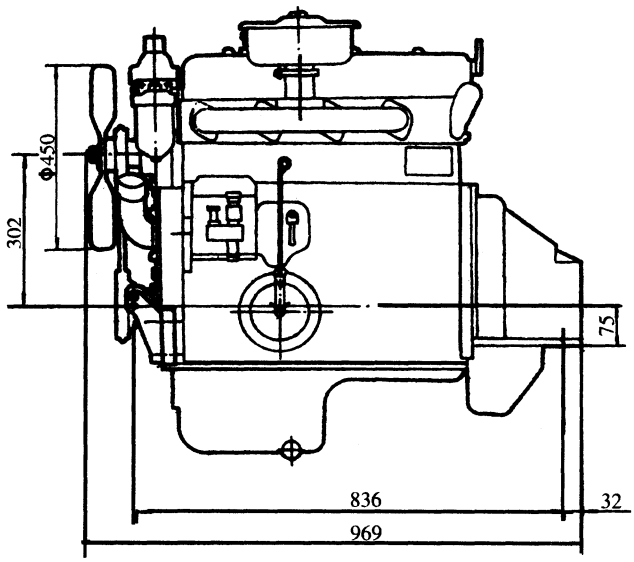
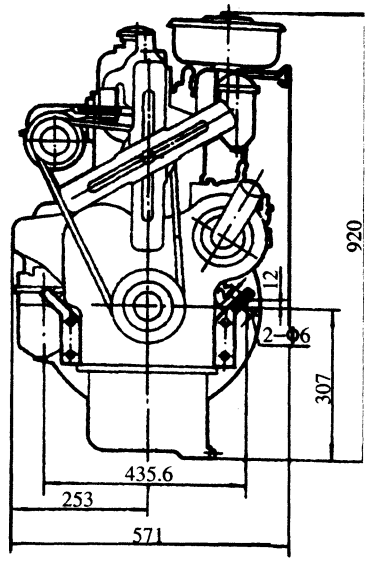


Fig. 6 Outline drawing for 495G10, 495G14 diesel engine

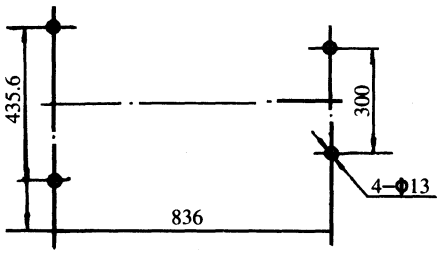
* The length dimension of 495G14 is the same as 495G1 (see Fig. 4)



The connecting dimension of the diesel engine



The connecting dimension of the clutch shell



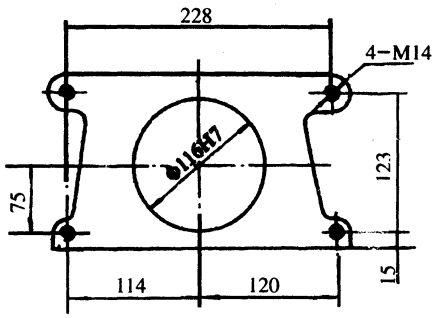


Fig. 7 Outline drawing for 495G11 diesel engine

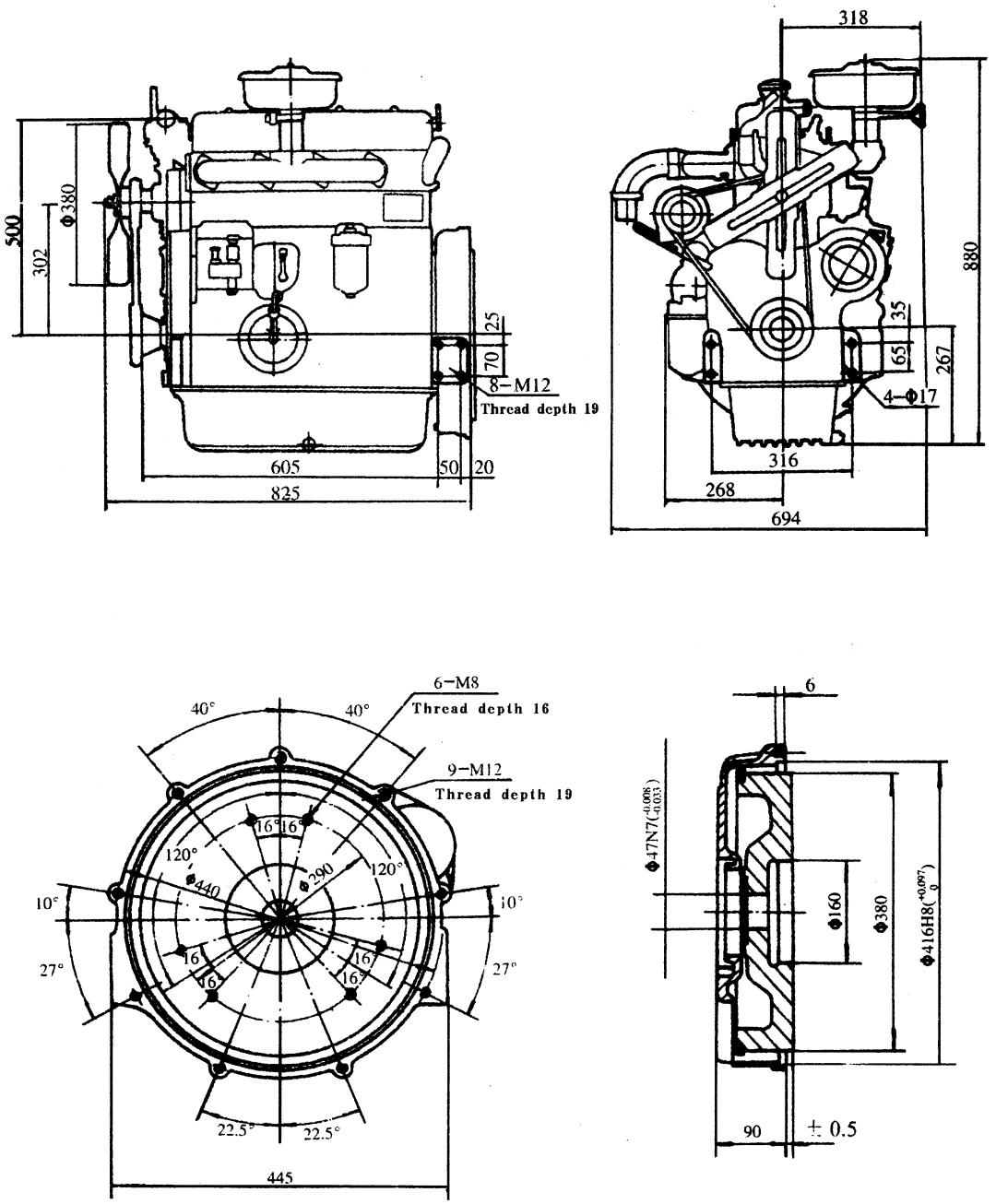
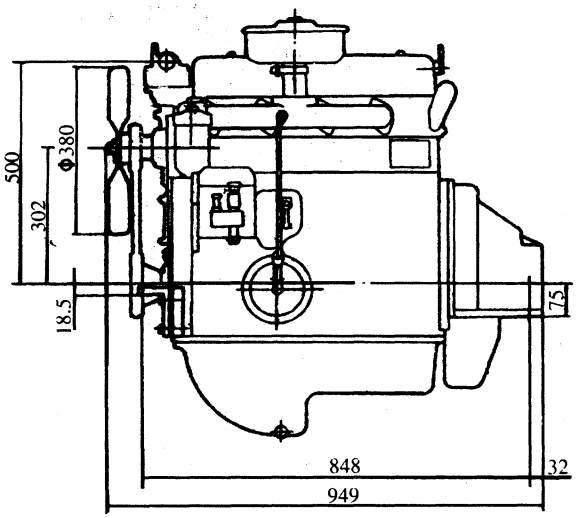
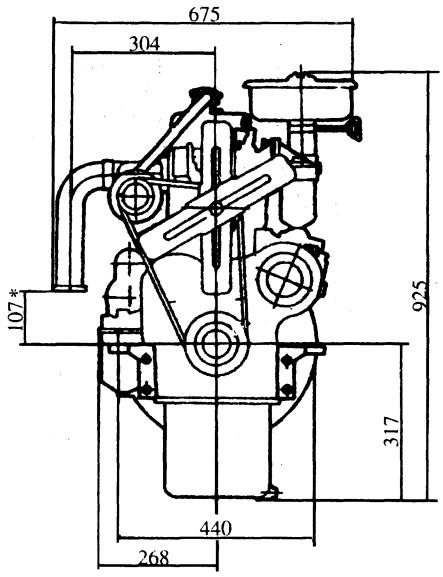


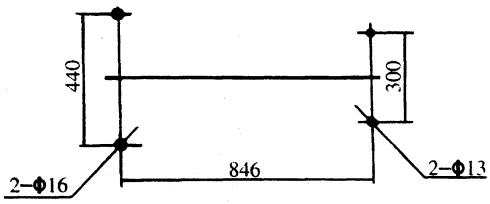
Fig. 8 Outline drawing for 495Q diesel engine



The installing dimension of the diesel engine



The connecting dimension of the clutch shell



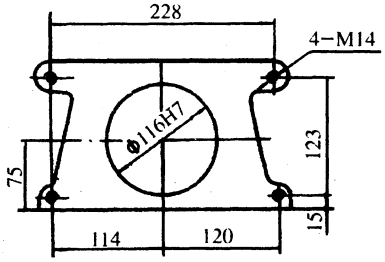
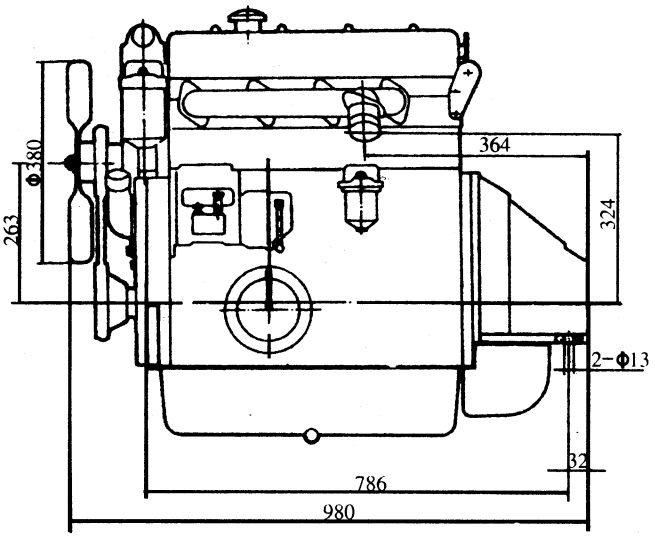


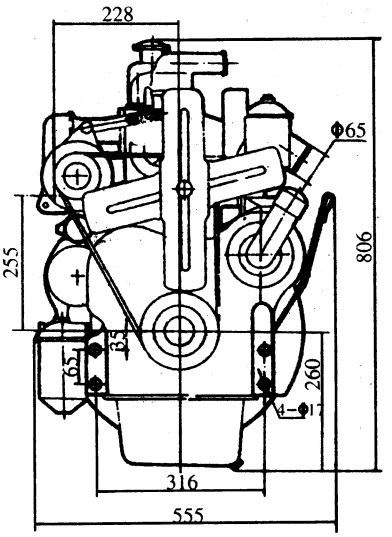
Fig. 9 Outline drawing for 495Q1, 495Y1 – 1, 495G6 diesel engine

* The exhaust manifold height 107 of 495Y1 – 1 is 255

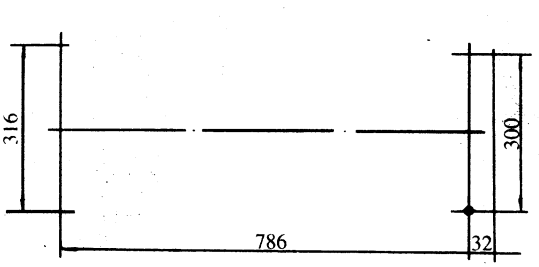
* * The inlet & exhaust manifold and air cleaner of 495G6 are the same as 495G2



The installing dimension of the diesel engine



The connecting dimension of the clutch shell



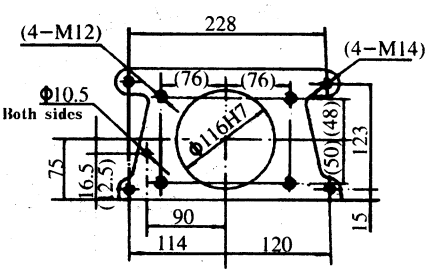
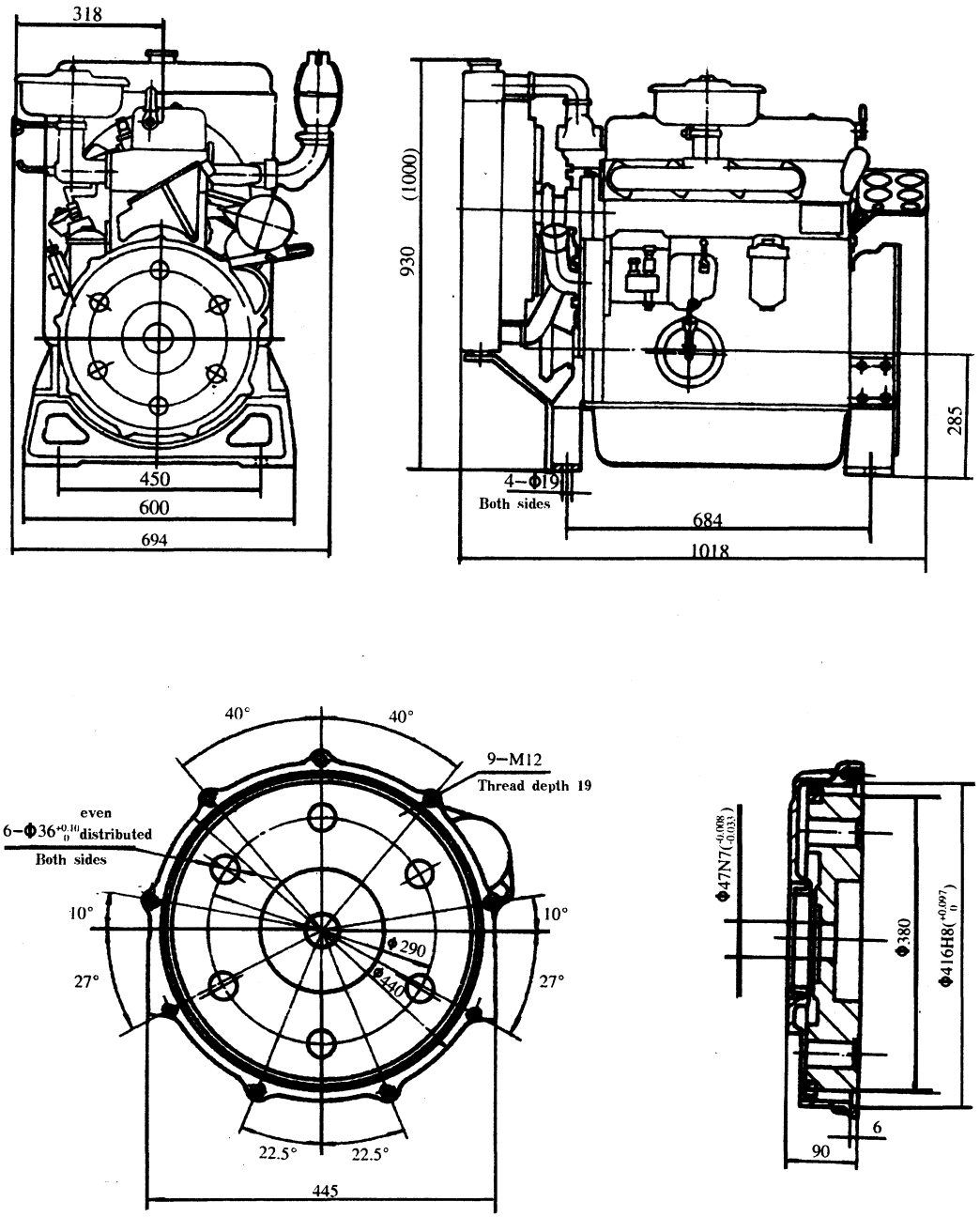


Fig. 10 Outline drawing for 495Y - 1, 495Y4 diesel engine



Note: The dimension in the brackets is the length of 4100D

Fig. 11 Outline drawing for 495D, 495D1, 495D2, K4100D diesel engine

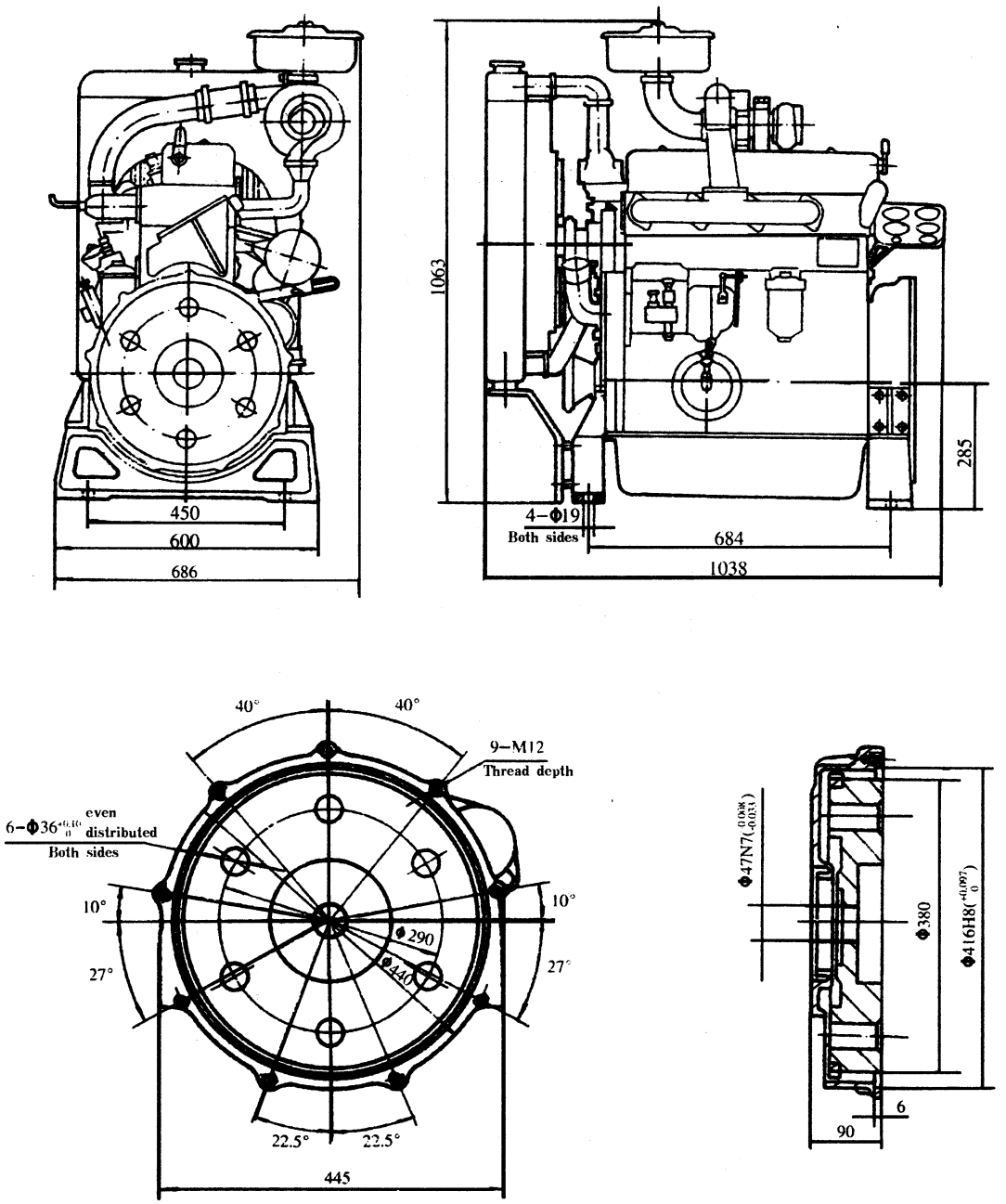


Fig. 12 Outline drawing for 495ZD – 1, 495ZD1 – 1, 495ZD2, 495ZD3 diesel engine

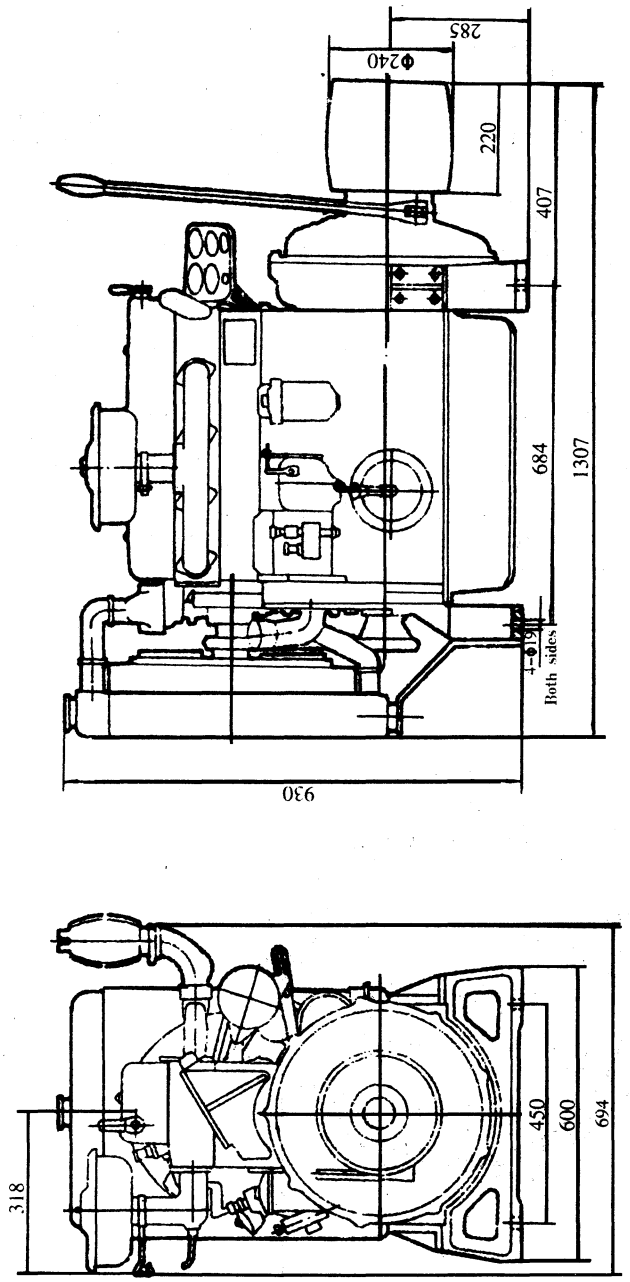


Fig. 13 Outline drawing of 495P diesel engine

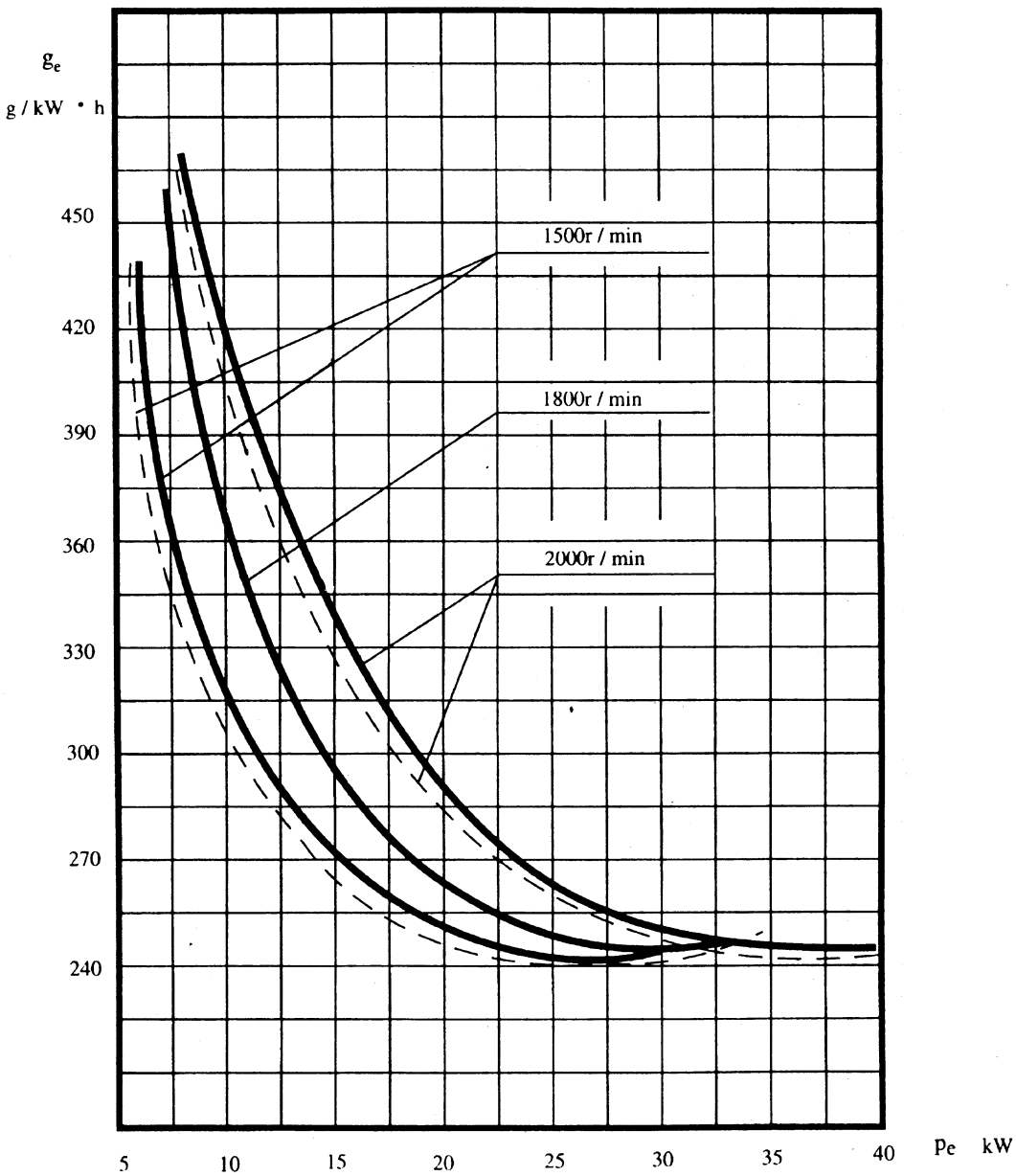


Fig. 14 Load characteristic curve for
1500, 1800, 2000r/min diesel engine

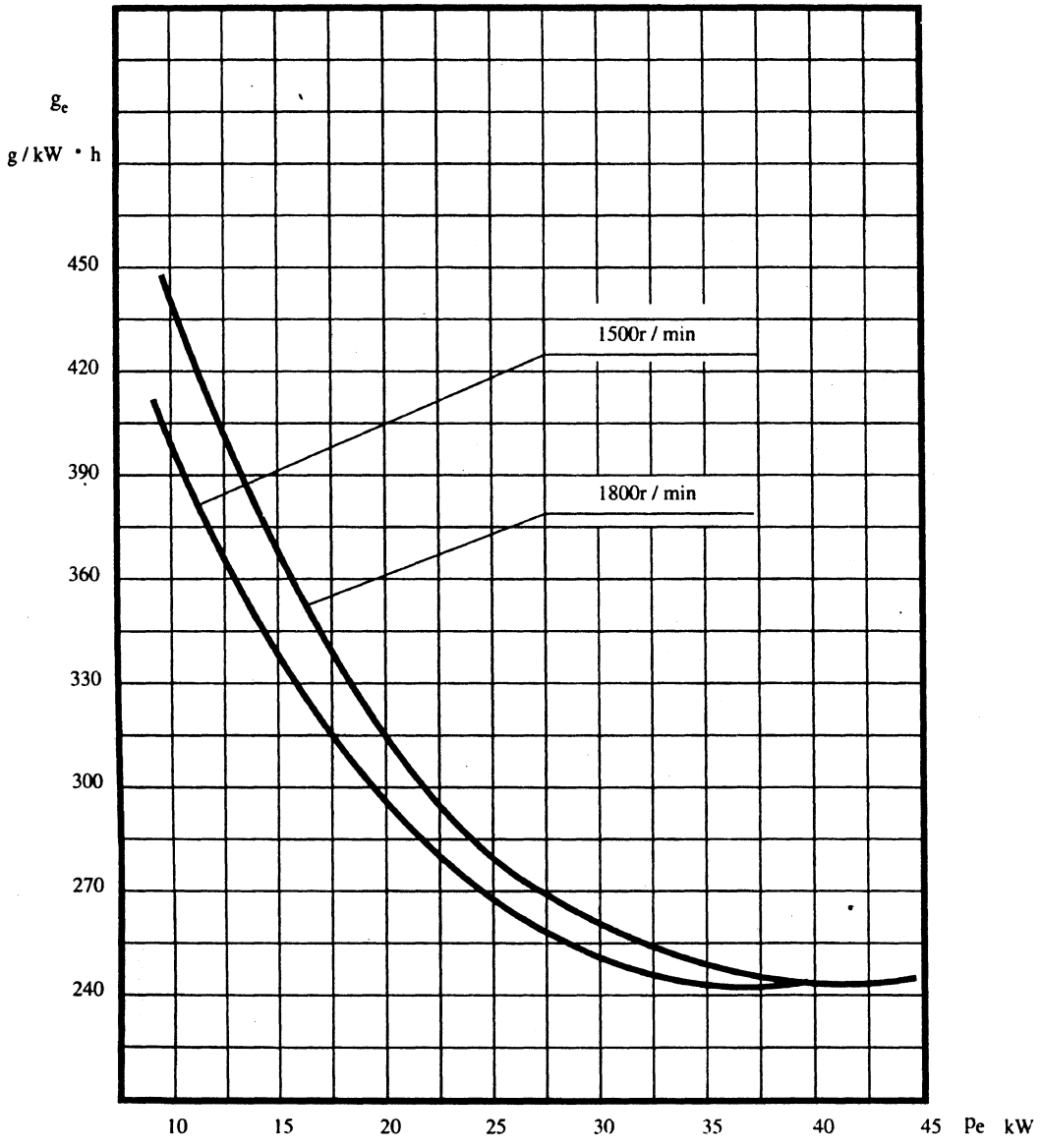


Fig. 15 Load characteristic curve for
1500, 1800r/min turbocharged diesel engine

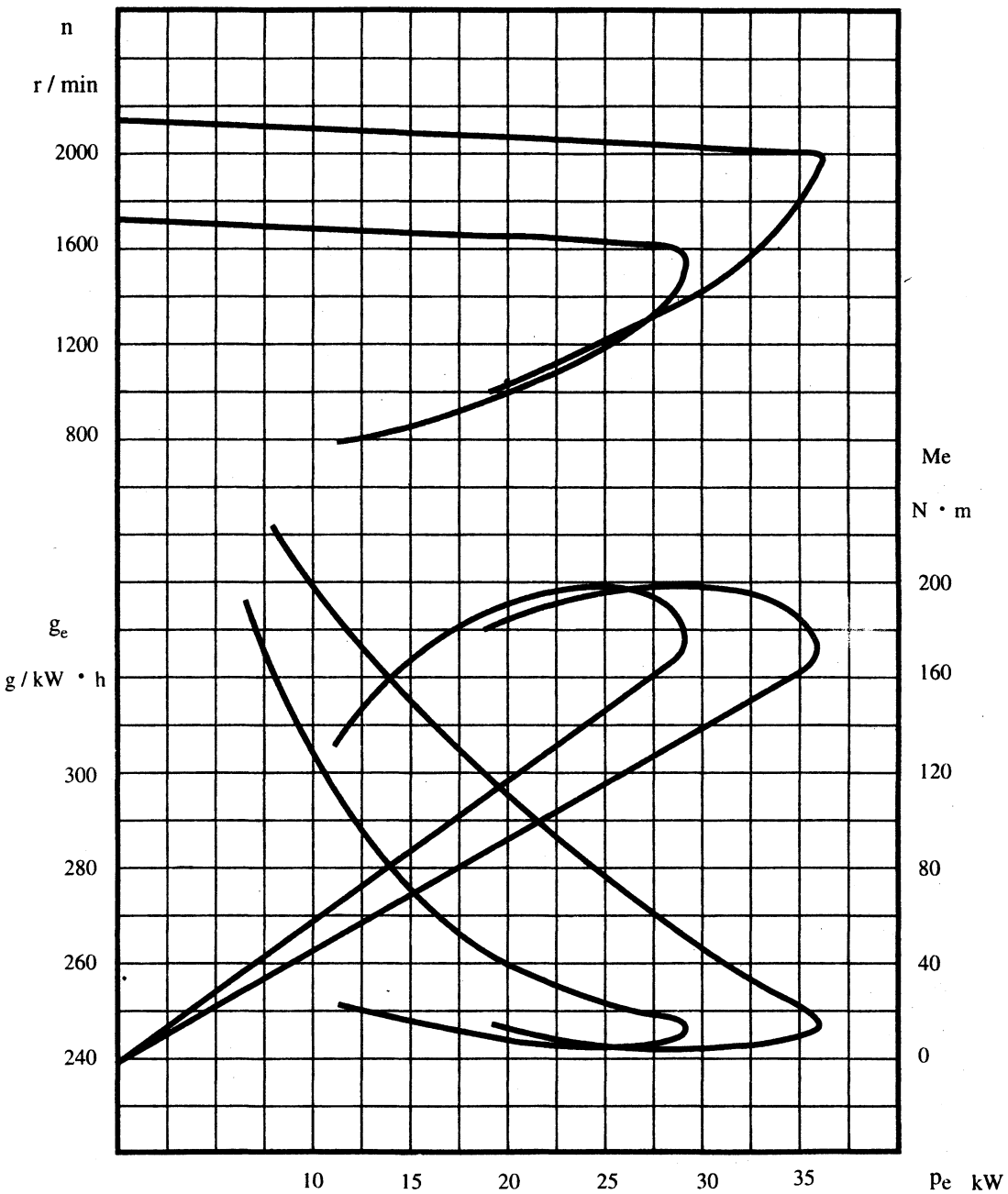


Fig. 16 Speed adjusted characteristic curve for 1600, 2000r/min diesel engine used for tractors

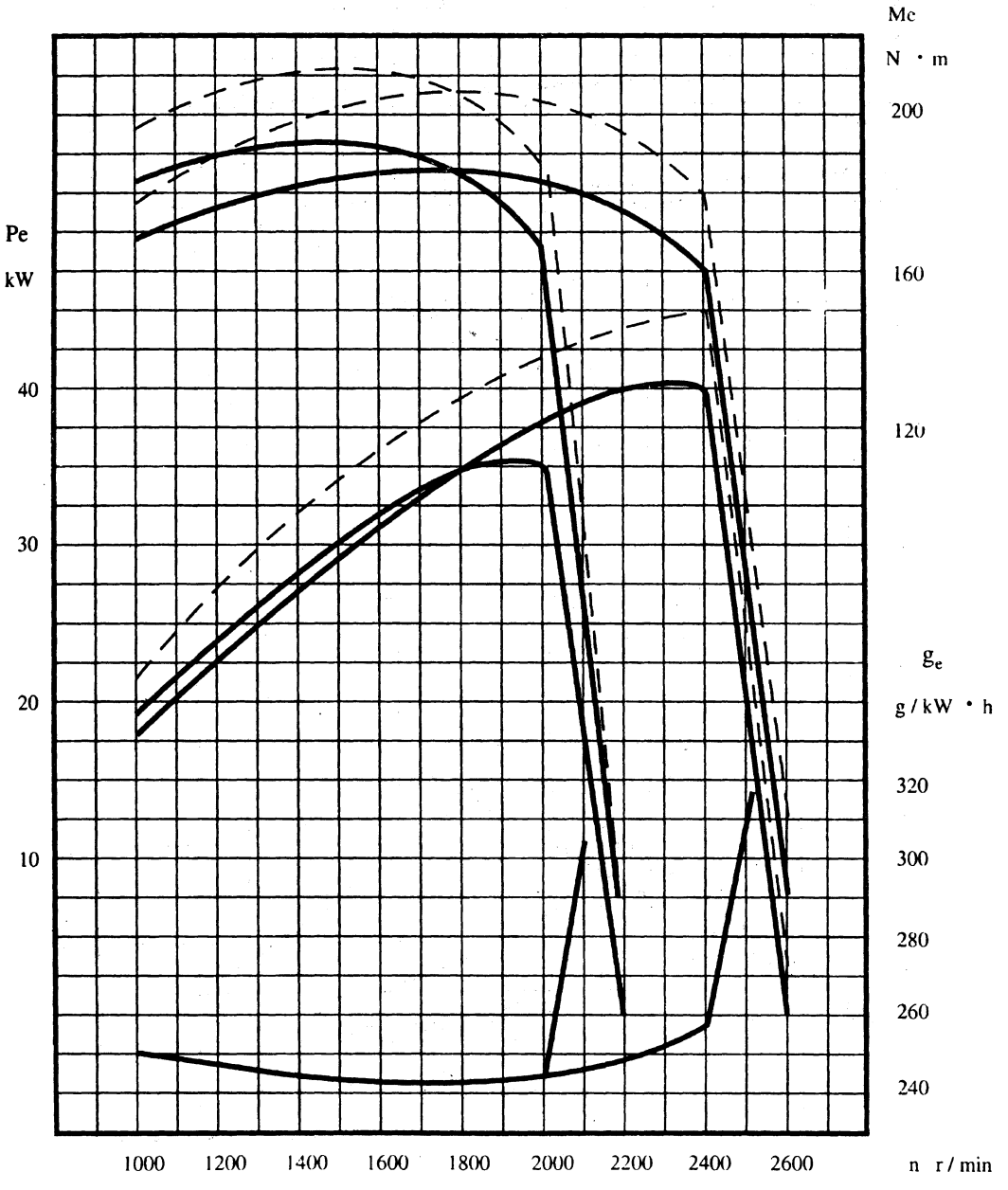


Fig. 17 Speed and speed adjusted characteristic curve for 2000, 2400r/min diesel engine used for engineering machines

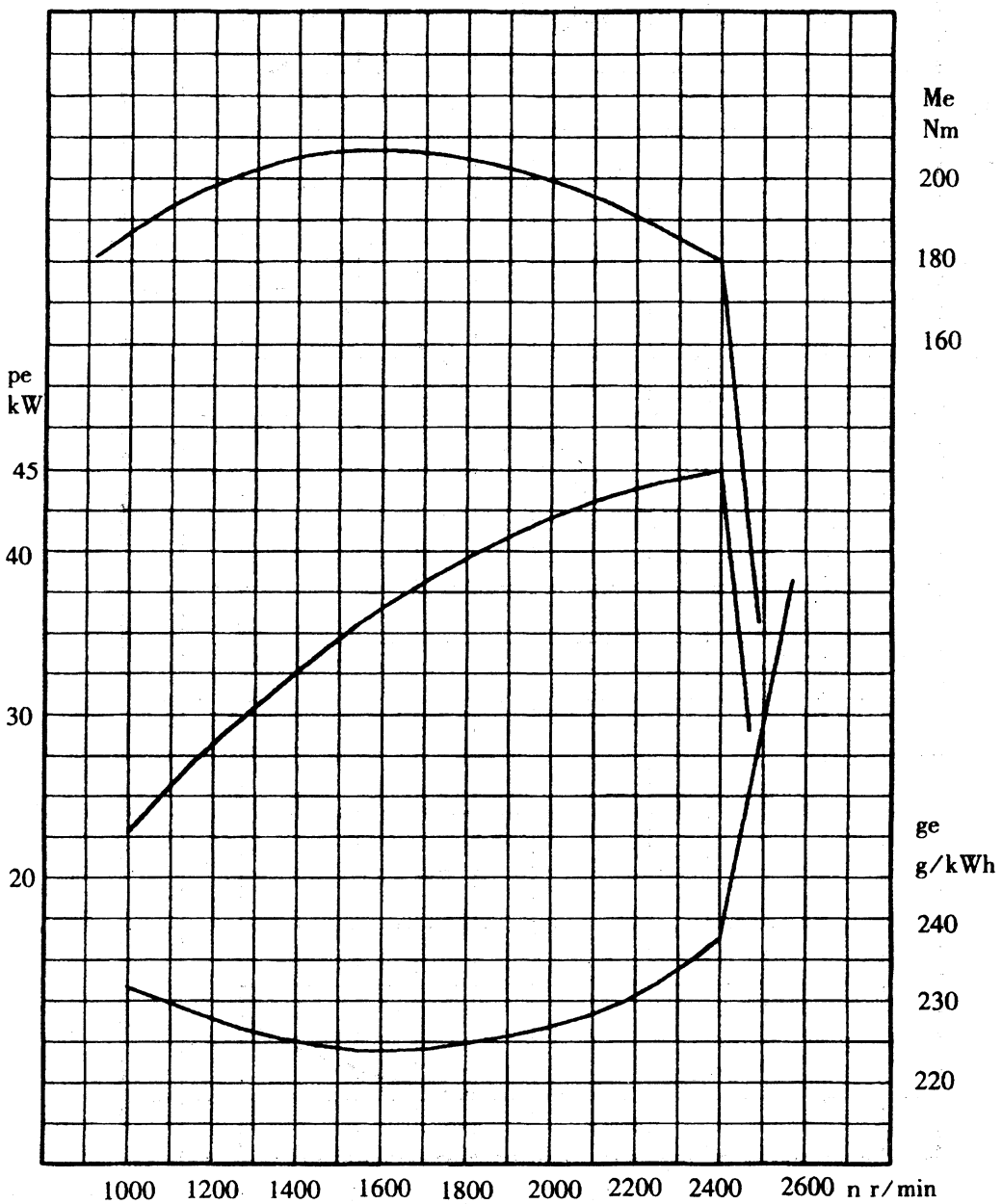


Fig. 18 Speed and speed adjusted characteristic curve for 2400r/min Model ZH4100 diesel engine used for engineering machines

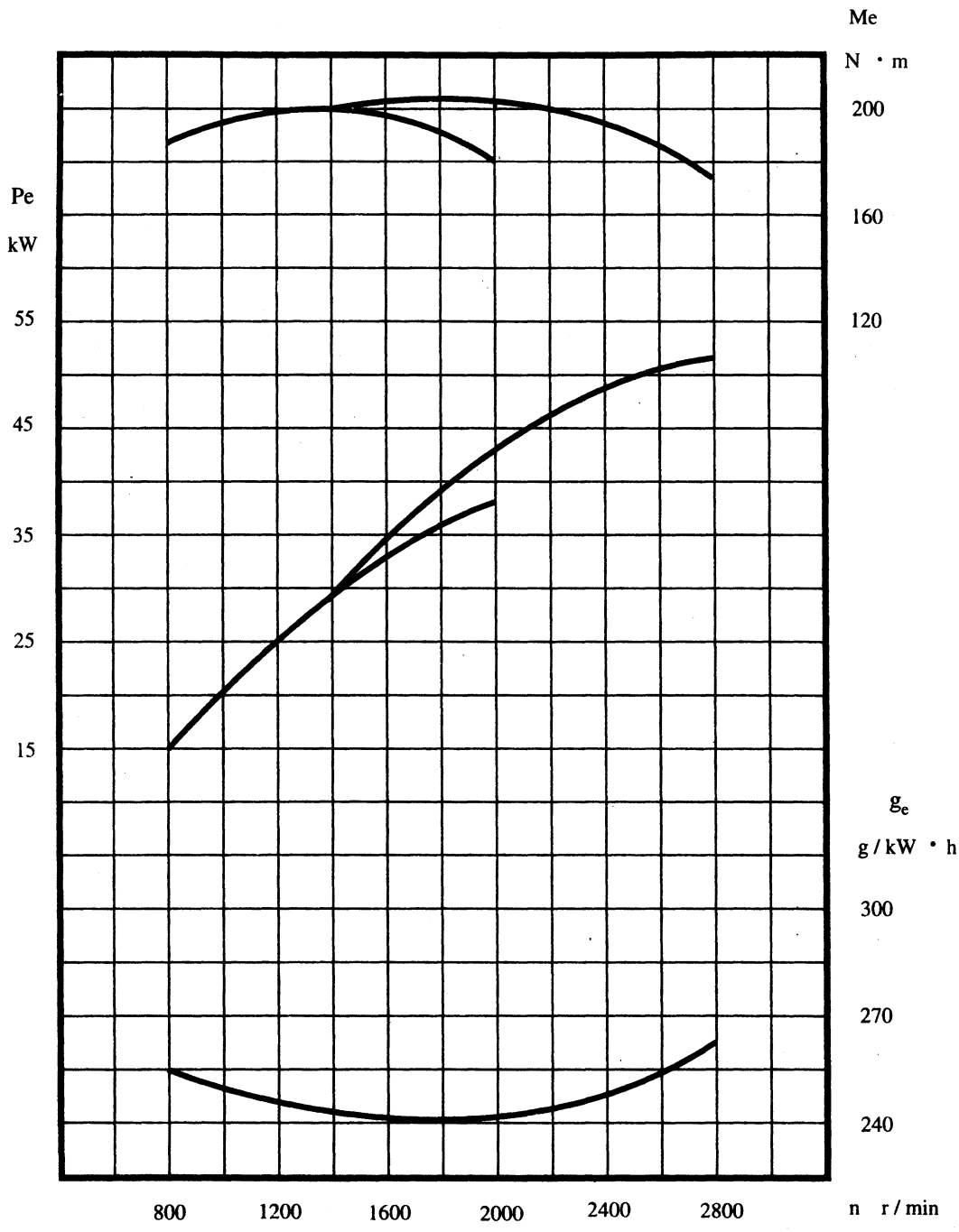


Fig. 19 Total output test curve for 2000, 2800r/min diesel engine used for vehicles

CHAPTER 1 Main Technical Specifications and Data of Diesel Engine

1 Main Technical Specifications

No.	Item \ Model		495	495T	495T3
1	Type		Four strokes, Water Cooling, Inline, Swirl combustion chamber		
2	Cylinder No. —Bore × Stroke(mm)		4—95 × 115		
3	Total Displacement of Piston(L)		3.26		
4	Pressure Ratio		19:1		
5	Firing Order		1—3—4—2		
6	Air Intake Mode		Naturally Aspirated		
7	Rated Working Condition	15min Output/Speed(KW/r/min)			
		1h Output/Speed(KW/r/min)	38.8/2000		
		12H Output/Speed(KW/r/min)	35.3/2000	35.3/2000	29/1600
8	Highest Idling Speed(r/min)		≤2160		≤1728
9	Lowest Idling Stable SPeed(r/min)		≤550		
10	Max Torque/Speed(N.m/r/min)		194/1500		199/1200
11	Rated Working Condition	Average Effective Pressure(Kpa)	650		667
12		Fuel Consumption Rate(g/KW*h)	≤258.4		
13		Oil Consumption Rate(g/Kw*h)	≤2.04		
14		Exhaust temperature(℃)	≤470		
15	Crankshaft Ratating Direction		ounter clockwise(Facing to the power output end)		
16	Cooling Mode		Forced Water Cooling		
17	Lubricating Mode		Compound type with pressure and splash		
18	Starting Mode		Electric starting		
19	Net Mass(kg)		320	360	370

495T4	495T5	495G	495G1 495G10 495G14	495G2	495G3	495G5 495G9	No.
Four strokes, Water Cooling, Inline, Swirl combustion chamber							1
4—95 x 115							2
3.26							3
19:1							
1—3—4—2							5
Naturally Aspirated							6
							7
			40.4/2400				
36/2000		26.5/1500		35.3/2000			
≤2160		≤1650	≤2640	≤2200			8
≤550							9
198/1500			186/1680	194/1500			10
662		650	620	650			11
≤258.4			≤266.6	≤258.4			12
≤2.04							13
≤470			≤540	≤470			14
ounter clockwise(Facing to the power output end)							15
Forced Water Cooling							16
Compound type with pressure and splash							17
Electric starting							18
360	370	340					19

No.	Item \ Model		495G6	495G7	495G11
1	Type		Four strokes, Water Cooling, Inline, Swirl combustion chamber		
2	Cylinder No. —Bore × Stroke(mm)		4—95 × 115		
3	Total Displacement of Piston(L)		3.26		
4	Pressure Ratio		19:1		
5	Firing Order		1—3—4—2		
6	Air Intake Mode		Naturally Aspirated		
7	Rated Working Condition	15min Output/Speed(KW/r/min)			51.5/2800
		1h Output/Speed(KW/r/min)			
		12H Output/Speed(KW/r/min)	35.3/2000	30/1800	
8	Highest Idling Speed(r/min)		≤2200	≤1980	≤3080
9	Lowest Idling Stable SPeed(r/min)		≤550		
10	Max Torque/Speed(N * m/r/min)		194/1500		197/1960
11	Rated Working Condition	Average Effective Pressure(Kpa)	650	614	677
12		Fuel Consumption Rate(g/KW.h)	≤258.4		≤253.0 *
13		Oil Consumption Rate(g/Kw.h)	≤2.04		
14		Exhaust temperature(℃)	≤470		≤650
15	Crankshaft Ratating Direction		ounter clockwise(Facing to the power output end)		
16	Cooling Mode		Forced Water Cooling		
17	Lubricating Mode		Compound type with pressure and splash		
18	Starting Mode		Electric starting		
19	Net Mass(kg)		340	480	320

* This volume is minimum fuel consumption of external characteristic.

495Q	495Q1	495Q5	495Y－1 495Y1－1 495Y4	495D 495D2	495D1	495ZD	No.
Four strokes, Water Cooling, Inline, Swirl combustion chamber							1
4—95 x 115							2
3.26							3
19:1						17:1	4
1—3—4—2							5
Naturally Aspirated						Turbocharged	6
37.5/2000	51.5/2800						7
			40.4/2400	29/1500	33/1800	39.6/1500	
				26.5/1500	30/1800	36/1500	
≤2200	≤3080		≤2640	≤1575	≤1890	≤1575	8
≤550				≤500	≤550	≤500	9
197/1400	197/1960	201/1960	186/1680				10
690	677	677	620	650	613	903	11
≤253.0 *			266.6	≤258.4		≤251.6	12
≤2.04							13
≤650			≤540	≤470		≤540	14
ounter clockwise(Facing to the power output end)							15
Forced Water Cooling							16
Compound type with pressure and splash							17
Electric starting							18
340	320			380		390	19

* This volume is minimum fuel consumption of external characteristic.

No.	Item \ Model		49ZD－1 495ZD2 495ZD3	495ZD1	495ZD1－1	495P
1	Type		Four strokes, Water Cooling, Inline, Swirl combustion chamber			
2	Cylinder No.—Bore ×Stroke(mm)		4—95×115			
3	Total Displacement of Piston(L)		3.26			
4	Pressure Ratio		17:1			19:1
5	Firing Order		1—3—4—2			
6	Air Intake Mode		Turbocharged			Naturally Aspirated
7	Rated Working Condition	15min Output/Speed(KW/r/min)				
		1h Output/Speed(KW/r/min)	39.6/1500	44/1800		38.8/2000
		12H Output/Speed(KW/r/min)	36/1500	40/1800		35.2/2000
8	Highest Idling Speed(r/min)		≤1575	≤1890		≤2160
9	Lowest Idling Stable SPeed(r/min)		≤500	≤550		
10	Max Torque/Speed(N.m/r/min)					
11	Rated Working Condition	Average Effective Pressure(Kpa)	903	817		650
12		Fuel Consumption Rate(g/KW.h)	≤251.6			≤258.4
13		Oil Consumption Rate(g/Kw.h)	≤2.04			
14		Exhaust temperature(℃)	≤540			≤470
15	Crankshaft Ratating Direction		ounter clockwise(Facing to the power output end)			
16	Cooling Mode		Forced Water Cooling			
17	Lubricating Mode		Compound type with pressure and splash			
18	Starting Mode		Electric starting			
19	Net Mass(kg)		390			450

K4100	K4100D	K4100G1	ZH4100	ZH4100D	ZH4100G1	ZH4100L	No.
Four strokes, Water Cooling, Inline, Swirl combustion chamber			Four strokes, Water Cooling, Inline, Direct injecting combustion chamber				1
4—100 x 115							2
3.61							3
19:1			17:1				4
1—3—4—2							5
Naturally Aspirated							6
							7
43/2000	33/1500	45/2400	44/2000		45/2400		
39/2000	30.1/1500		40/2000	31/1500		43/2200	
≤2160	≤1575	≤2640	≤2160	≤1575	≤2640	≤2380	8
≤550							9
215/1500		206/1680	220/1500		206/1680	210/1600	10
650	650	620	660	680	620	650	11
≤258.4		≤266.6	≤248.8		≤251.6	≤248.8	12
≤2.04							13
≤470		≤540	≤500		≤580	≤580	14
ounter clockwise (Facing to the power output end)							15
Forced Water Cooling							16
Compound type with pressure and splash							17
Electric starting							18
320	340	380	320	380	340	360	19

2 Various temperature and pressure range

Lub oil temperature	≤95℃(the TC Engine≤100℃)
Outlet cooling water temperature	≤90℃(the TC Engine≤98℃)
Lub oil pressure	0.20 ~ 0.40MPa ≥0.5MPa,when at idling speed
Fuel injection pressure	12 + 1.0MPa

3 Main bolts tightening torque

Cylinder head bolt	120 ~ 140N. m
Main bearing bolt	140 ~ 160N. m
Flywheel tightening bolt	100 ~ 120N. m
Connecting rod bolt	100 ~ 120N. m
Gear case bolt	30 ~ 40N. m
Flywheel housing bolt	50 ~ 60N. m

4 Main adjusting data

Valve lash(cold state)	
Air intake & exhaust valve	0.35 ~ 0.45mm
Valve timing:(crankshaft rotating angle) Air intake valve open Air intake valve close Exhaust valve open Exhaust valve close	 12° ±3°before top dead center 36° ±3°after bottom dead center 56° ±3°before bottom dead center 12° ±3°after top dead center
Compression Clearance	1—1.2mm
Fuel delivery advance angle: 1500 ~ 1600 r/min 1800 ~ 2000 r/min 2400 r/min 2800 r/min	 15° ±2°before top dead center 17° ±2°before top dead center 18° ±2°before top dead center 20° ±2°before top dead center

5 Matched clearances and wear limit of main parts

No	Matched parts	Standard size	Matched clearance	Wear limit
1	Crankshaft main journal neck and main bearing	Shaft $\Phi75^{0}_{-0.019}$ Hole $\Phi75^{+0.135}_{+0.070}$	0.070 ~ 0.154	0.30
2	Crankshaftr thrust ring and crankshaft		0.08 ~ 0.23	0.50
3	Crankshaft & connecting rod journal neck and connecting bearing	Shaft $\Phi65^{0}_{-0.019}$ Hole $\Phi65^{+0.093}_{+0.050}$	0.050 ~ 0.112	0.30
4	Connecting rod big end and crankshaft	Shaft $\Phi38^{-0.17}_{-0.33}$ Hole $\Phi38^{+0.10}_{0}$	axile clearance 0.17 ~ 0.43	0.70
5	Piston skirt and cylinder liner	Shaft $\Phi95^{-0.160}_{-0.190}$ Hole $\Phi95^{+0.035}_{0}$	0.160 ~ 0.225	0.50
6	Piston pin and connecting rod bushing	Shaft $\Phi35^{0}_{-0.011}$ Hole $\Phi35^{+0.034}_{+0.009}$	0.009 ~ 0.045	0.15
7	The first compression ring and ring grave	Shaft $\Phi3^{0}_{-0.012}$ Hole $\Phi3^{+0.075}_{+0.050}$	0.050 ~ 0.087	0.40
8	the second compression ring and ring grave	Shaft $\Phi3^{0}_{-0.012}$ Hole $\Phi3^{+0.075}_{+0.030}$	0.030 ~ 0.062	0.30
9	oil ring and ring grave	Shaft $\Phi6^{0}_{-0.012}$ Hole $\Phi6^{+0.050}_{+0.030}$	0.030 ~ 0.062	0.25
10	Gap of first compression ring in cylinder	Gauge within$\Phi95.00$	0.20 ~ 0.40	3.00
11	Gap of the second & third compression ring in cylinder	Gauge within$\Phi95.00$	0.15 ~ 0.35	3.00
12	Gap of oill compression ring in cylinder	Gauge within$\Phi95.00$	0.15 ~ 0.35	3.00
13	Camshaft journal neck and bushing	Shaft $\Phi50^{-0.080}_{-0.105}$ Hole $\Phi50^{+0.025}_{0}$	0.080 ~ 0.130	0.25
14	Camshaft thrust plate and camshaft	Shaft $\Phi12^{-0.050}_{-0.120}$ Hole $\Phi12^{+0.100}_{0}$	0.050 ~ 0.220	0.40
15	Cylinder liner over the cylinder block surface	Shaft $\Phi10^{+0.050}_{0}$ Hole $\Phi10^{0}_{-0.050}$	(selective fitted) 0.030 ~ 0.080	
16	Valve push rod and push rod hole	Shaft $\Phi16^{-0.016}_{-0.034}$ Holet $\Phi16^{+0.018}_{0}$	0.016 ~ 0.052	0.20

No	Matched parts	Standard size	Matched clearance	Wear limit
17	Idler shaft and idler shaft bushing	Shaft $\Phi 26^{-0.020}_{-0.041}$ Holet $\Phi 26_{0}^{+0.021}$	0.020 ~ 0.062	0.20
18	Air intake valve and valve guide	Shaft $\Phi 9^{-0.030}_{-0.050}$ Holet $\Phi 9_{0}^{+0.022}$	0.030 ~ 0.072	0.25
19	Exhaust valve and valve guide	Shaft $\Phi 9^{-0.040}_{-0.060}$ Holet $\Phi 9_{0}^{+0.022}$	0.040 ~ 0.082	0.25
20	Rocker arm shaft and bushing	Shaft $\Phi 16^{-0.016}_{-0.034}$ Holet $\Phi 16_{0}^{+0.018}$	0.016 ~ 0.052	0.25
21	Idler and idler shaft		axial clearance 0.10 ~ 0.35	
22	Contacting clearance of various timing gear		clearance of tooth flank 0.130 ~ 0.170	
23	Oil pump rotor and pump block surface		Adjusting clearance 0.050 ~ 0.100	
24	Contacting clearance between the internal and external rotor of the oil pump		0.060 ~ 0.188	0.50
25	Water pump impeller and pump body		back clearance 0.20 ~ 0.70	
26	Water pump impeller and packing block		Adjusting clearance 0.40 ~ 0.80	

6. ZH4100, K4100 matched clearances and wear limit of main parts

No.	Matched parts	Standard size	Matched clearance	Wearlimit
1	Piston skirt and cylinder liner	Shaft $\Phi100^{-0.140}_{-0.170}$ Holet $\Phi100_{0}^{+0.035}$	0.140 – –0.205	0.50
2	The first compression ring and ring grave	Shaft $\Phi2.5^{0}_{-0.012}$ Holet $\Phi2.5^{+0.07}_{+0.05}$	0.050 – –0.082	0.40
3	The second, third compression ring and ring grave	Shaft $\Phi2.5^{0}_{-0.012}$ Holet $\Phi2.5^{+0.05}_{+0.03}$	0.030 – –0.062	0.30
4	Oil ring and ring grave	Shaft $\Phi5^{0}_{-0.012}$ Holet $\Phi5^{+0.05}_{+0.03}$	0.030 – –0.062	0.25
5	Gap of the first, second and third compression ring in cylinder	Gauge within $\Phi100.00$	0.35 – –0.50	3.00
6	Gap of oil compression ring in cylinder	Gauge within $\Phi100.00$	3.00	
Except these listed in the above table, all the others are the same as Model 495.				

7. The main adjusted specification of ZH4100

No.	Accessary \ Model		ZH4100	ZH4100D	ZH4100G1
1	Fuel pump	Type	4 – cylinder NO. I strengthening pump		
		Plunger diameter(mm)	8.5		
		Rated quantity of fuel delivered * (ml/cyc)	9.6/200	10.2/200	9.6/200
		Rated speed * * (r/min)	1000	750	1200
2	Injector	Model	PF68S		
		Starting pressure(Mpa)	18 + 1.0		
3	Nozzle mate model		ZCK155S529		

The tightening torque of cylinder head bolts: 170 – 190N. m

Fuel delivery advance angle:

1500 – 2000r/min Type: Befor top dead center 15° ±2°

2400 r/min Type: Befor top dead center 18° ±2°

Note: the others are the same as 495

Chapter II Main Construction, Adjustment and Maintenance of the Diesel Engine

1. Cylinder Block Assembly

Cylinder block is of a rectangle gantry type. Cylinder liners of wet type are fitted in the cylinder block and rested at its upper shoulder. The top surface of the liners should be higher than the top surface of the block 0.03 – 0.08mm.

The main bearing caps are located by locating sleeves and machined in pair with the corresponding bearing seats on the crankcase, so that the caps can't be interchanged or turned inside out. Therefore, the bearing cap is marked with number and arrowhead, and the direction of the arrowhead is forward. The main rod bearing is made of steel – backed aluminum alloy which is very thin, so it can't be lapped. Before installing, we should apply adequate clean engine oil on the crankshaft.

There are two bolts on one main bearing cap, so they should be tightened evenly by many times one by one in regulated torque, and should use tightening gaskets to lock it.

In the process of using, you shouldn't make the crankshaft receive additional power.

2. Cylinder Head Assembly

Cylinder head is a single piece casting structure, with independent intake and exhaust ports on both sides. The combustion chamber is whirl chamber. The insert, with a slant throat of kidney shape cross – section and a small comical hole inside, is pressed into the bottom of the swirl chamber. The small conical hole should be aligned with the nozzle center line in installation of the insert so as to make the engine easy to start. Intake & exhaust valve and valve seat have been run – in when using, so remember the number of cylinder when disassembly and assembly. When sealing condition between valve and valve seat is not good, lapping is necessary, and should be cleaned before assembly. After long time operation, the width of valve seat contacting area may be over 2.5mm, we can ream the valve seat by means of a 15°and 75°special reamer with a guide rod of 9mm in diameter (Please refer to Fig. 1.) and 45°reamer articulated contact area when necessary (ZH4100 intake valve seat ring should adopt 60°reamer) . The valve seat must be renewed if the level of the valve head is lower than that of the cylinder head bottom surface by more than 3.5mm after the valve seat being reconditioned. Before a new valve seat is pressed into the cylinder head, a interference of 0.086 – 0.150mm in diameter

should be kept, and the cylinder head should be heated integrally to about 200℃ when assembly. Then the valve seat can be in – laid, and ream and lap it at the contact area to make it at 1.3 – 1.5mm in width, valve setting value is 0.6 – 1.0mm down.

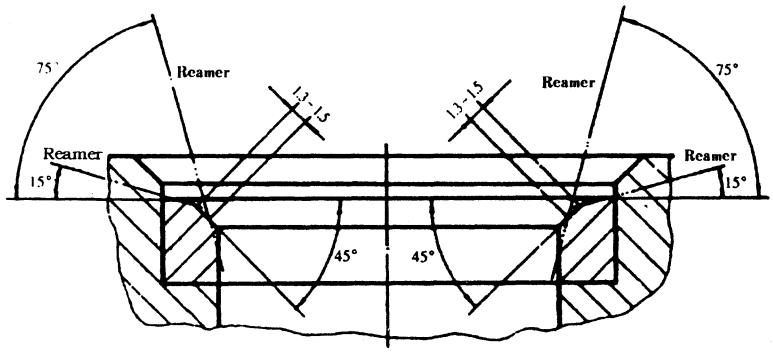


Fig. 1 Diagram of reconditioning valve seat

There are cylinder heat gaskets between the cylinder and the cylinder block. And the cylinder head is fastened to the cylinder block by 18 bolts. The cylinder head bolts should be tightened evenly by three times one by one in regulated order and torque. (Fig. 2)

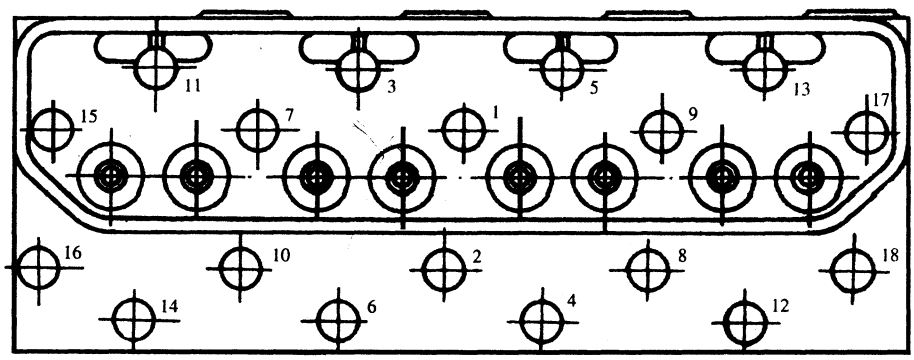


Fig. 2 The sequence of tightening cylinder head bolts

3. Piston and Connecting Rod Assembly

The piston and connecting rod assembly are constituted by piston, piston ring, pis-

ton pin, connecting rod, connecting rod bearing and connecting rod screw.

Each piston of diesel engine has three compression rings and one scraper ring. The first compression ring is barrel chrome – plate ring of modular cast iron, to improve the abrasive resistance under high temperature. The second ring is taper – face ring with the word " top" on the side which should be upward when assembled. The third compression ring is distorting ring. The side with distorting groove should be faced downward. The scraper ring is a component with inner spiral spring. As assembling scraper ring, the opening of the inner spiral spring maintaining reed should be at the opposite side of the opening of scraper ring. As assembling piston ring, first it should be put in cylinder liner, then be checked with clearance gauge to find out if the opening clearance is in the specified scope. If clearance is too small, repair with file. The three piston rings should be staggered 120℃ with each other, and meanwhile avoid the direction of piston pin hole. See to Fig. 3.

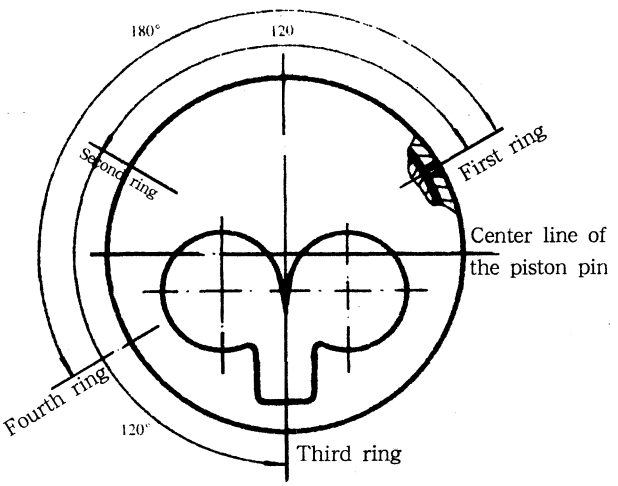


Fig. 3 The opening clearance of piston rings in cylinder liner

The piston pin is full floating type, and can be rotate in piston pin hole as it getting to certain working temperature, to make wearing evenly. But it is cool, it is interference fit between piston pin and the piston pin hole. So when assemble and disassemble the piston pin, the piston should be preheated to 100 – 120°. Assemble piston pin by force at cool temperature is prohibited, otherwise the pinhole may be ruined.

The big end of connecting rod has a 45°inclined cut. Connecting rod body and connecting rod cap have marking numbers at same side. When assembled, the number must be registered. The small end of connecting rod has a copper bushing. The oil

hole on the bushing should be right aligned to the oil gathering hole at the top of connecting rod small end, to lubricate piston pin and bushing. Connecting rod bolts are self – locked by friction force. The mass difference of connecting rod for one same diesel engine is less than 20g, and that of piston and connecting rod assembly for one same diesel engine is not bigger than 30g.

The connecting rod bearing is usually made of thin steel – backed aluminum alloy material, so it can't be lapped.

When we assembling the connecting rod, the short side on the 45° inclined face should be at the same side with the groove of the combustion chamber on the top of the piston. When the piston is installed in the cylinder liner, the combustion chamber should be at the same side with the nozzle.

4. Crankshaft And Flywheel Assembly

The crankshaft and the flywheel assembly is constituted by crankshaft, flywheel, crankshaft timing gear, crankshaft pulley and starting dog etc. The crankshaft is made of modular cast iron and has four connecting rod shaft neck and five main shaft necks. All the surface of shaft necks is quenched or intruded, to improve the wearing resistance.

The front and rear end are sealed by skeleton structure rubber oil seal. There's a retainer ring installed in front of the oil seal to assure the seal liability.

Flywheel is positioned by dowel pin, and fastened on the rear end of crankshaft by six high strength bolts. Flywheel bolts should be tightened gradually according to the sequence shown in Fig. 4.

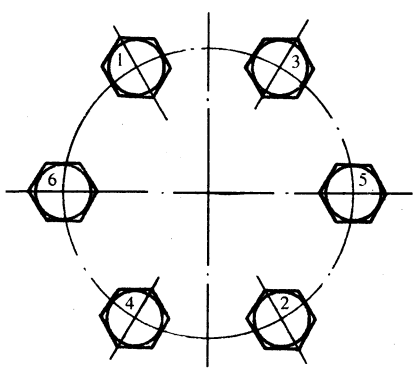


Fig. 4 The tighten sequence of flywheel

The outside of flywheel is marked TDC point, and also the scale range of 10 – 30°advanced. Each scale means 2°crankshaft angle of turn.

5. Intake & Exhaust System and Turbocharger

The turbocharger is of H1A, H2B or J65 type. In the process of using, the whirl shell and the vane groove of the turbocharger are easy to accumulate greasy dirt and charcoal, so we should clean them regularly.

According to the requirements of application, the air cleaner has K2007, K1317, KW1532, KW2410 and oil showering (Shanghai 495A) type etc. In the process of using, you mustn't discharge the air cleaner and air cleaner wick to avoid the early damage to the cylinder liner and other parts. The air cleaner should be maintained regularly.

According to the customers' requirements, we can install exhaust silencer before delivery.

1. The air cleaner wick must be changed when damaged.
2. When maintaining, can't pollute the inside of the air cleaner wick.
3. Mustn't operating the engine when the air cleaner or air cleaner wick.

6. Fuel System

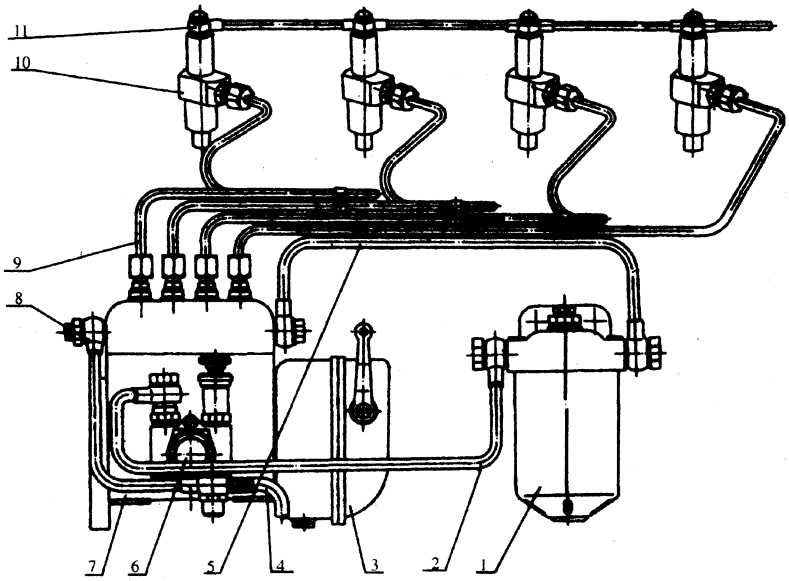
The fuel system consists of oil tank, fuel delivery pump, fuel filter, fuel injection pump, governor, high pressure fuel pipe, injector and low pressure pipe etc. (Fig. 5).

According to the requirements of application, two kinds of fuel system have been designed: One is the extra fuel of the fuel pump enters into the inlet pipe through the fuel return valve and then the fuel delivery pump, and the fuel that the injector needle valve mate leaks flows back to the fuel tank through the fuel return pipe; the other is the extra fuel passes the fuel filter return valve with the fuel that the needle valve mate leaks flow back to the fuel tank together.

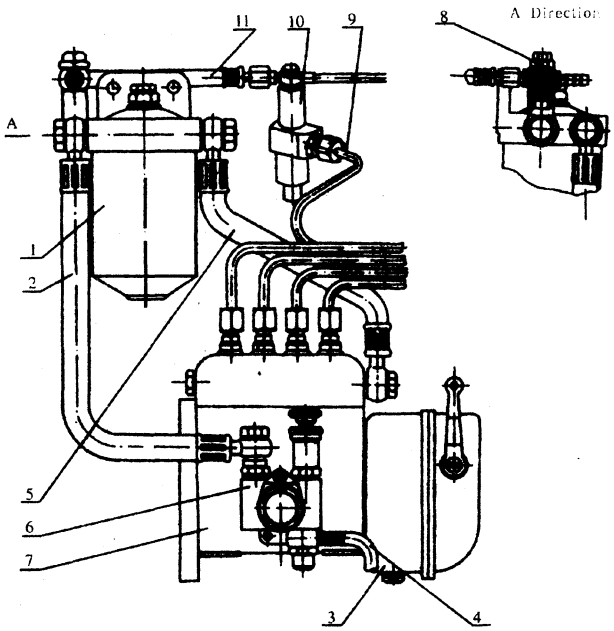
Fuel delivery pump is of a piston type. Use the hand press to make the fuel delivery system full of fuel and wipe off air before the engine starts. When the engine is not at working situation, the handle nut should be tightened.

The fuel filter is Model C0708. It has two types: single class and double class, which can be chosen according to the requirements of application. The filter wick should be maintained regularly.

The fuel injection pump is of a four cylinder No. 1 plunger mate pump. The governor is of a full range type. The governor has been adjusted to the best condition and lead



a. Fuel injection pump fuel returning



b. Fuel filter fuel returning

Fig. 5 Fuel System

1. Fuel filter 2. Fuel filter inlet pipe 3. Governor 4. Fuel delivery pump inlet pipe
5. Fuel injection pump 6. Fuel delivery pump 7. Fuel injection pump 8. Return pipe
9. High pressure fuel pipe 10. Injector 11. Injector fuel return pipe
12. Fuel ring 13. Fuel supply 14. Pre – heater

sealed before delivery. The customers shouldn't adjust it privately.
The injector is Model PB35S and of a single hole shaft needle type. The fuel should be atomized evenly after being sprayed, and the fuel stopping should be functioned at once, no fuel late drops of leakage. When the fuel atomized not well, the injector should be tested and adjusted on the injector test bench.
The needle valve mate is matched mate, never exchanged when dismantled.
When the injector is installed on the cylinder head, there is a copper washer on the front, this can assure the tightness.

7. Lubricating System

The engine is lubricated by pressure oil combined with splash oil, the layout of lubricating system is shown in Fig. 6. the fuel injection pump, air compressor, power take - out equipment should be added engine oil separately.
When changing the engine oil, the oil filter wick or oil filter should be changed at the same time.

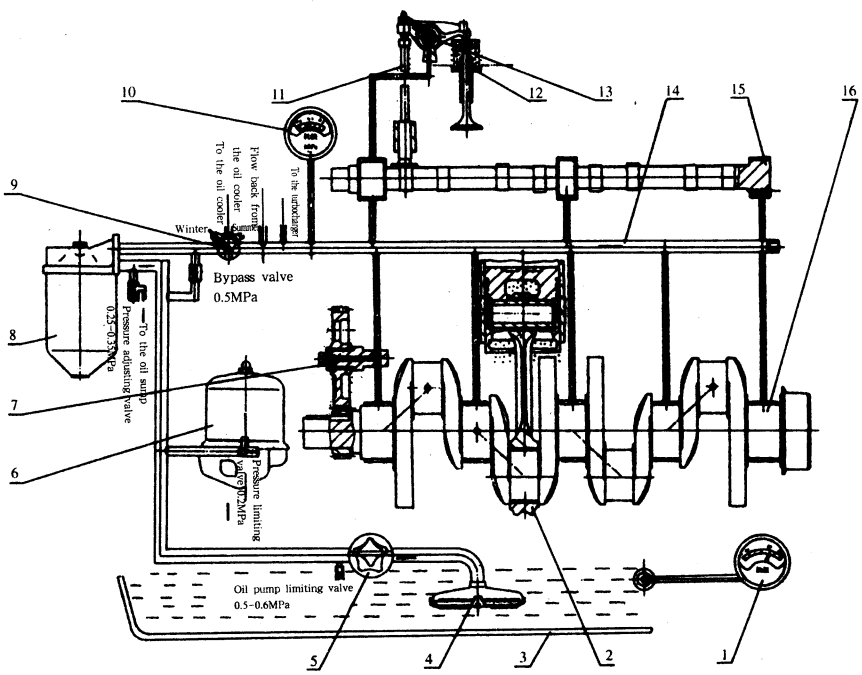


Fig. 6 Layout of lubricating system

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

To low down the oil temperature, an engine oil radiator or cooler can be added to the diesel engine. There's a " Winter & Summer" valve on the connecting panel of the oil filter. When the oil temperature goes too high, we should turn the valve to " Summer" end, and when the oil temperature is normal, we should turn it to " Winter" end. The engine oil enters into the main oil passage through the oil filter without cooling.

The oil pump is of a internal and external rotor type, JZ x 2578 Model. There's a pressure limiting valve installed on the oil pump to control the oil pressure.

The oil filter is Model J0801, J0812 on which a pressure adjusting valve is installed to adjusted the oil pressure.

There's also a bypass valve in the oil filter. When the oil filter or viscosity of the oil is too high, the bypass valve will open, and the oil will enters into the main oil passage without being filtered through oil cooler or filter to ensure the engine without authorization.

Turbocharged diesel engine has a model J0506 oil filter to filter the oil lubricating the turbocharger.

The oil filter wick should be maintained regularly.

8. Cooling System

The engine adopts close (or open) type forced circulation water cooling system, which consists of the radiator (or cooling pool), water pump, fan thermostat, cowling, water inlet and outlet hose etc. The diesel engine adopts centrifugal water pump which is installed at the front of the engine block and driven by the crankshaft belt wheel through the V belt. If find the water – relief hole dripping water seriously, you should change the water seal.

9. Electric System

The electric system of the 495, K4100 series diesel engine has two types: 12V and 24V, both of which are single wire system with negative pole grounded. The rated voltage of the motor and other electrical equipment must meet the voltage requirement of the electric system.

The battery for starting is a power device of the diesel engine, its performance influence the start of the diesel engine directly, suitable capacity battery should be chosen according to the starting motor's specific property. The battery should be installed near the starting motor so as to shorten the length of the cable between the

battery and the starting motor to avoid the voltage drop too hard when the engine starting, the section area 36mm2 low voltage connecting cable should be adopted. When the staring current is highest, for 12V and 24V starting motor, the voltage drop should be less than 0.5V and 1V respectively.

The battery with the diesel engine hasn't been charged before delivery, it should be first charged as the battery's requirement before used. When the diesel engine is working, the amount of the charging current should often be noticed. When the needle of the ammeter is reaching to zero, or shows that the battery has been fully charged and the charging circuit can be switched off.

The diesel engine adopts the JF series silicon rectified dynamo which has the characteristics of small volume, simple structure, low speed electrification etc.

The use of voltage regulator is to keep the voltage at the range of 13.5 – 14.5V or 27 – 29V respectively when the speed of the 14V or 28V generators adopt FT111 or FT211 voltage regulator respectively. If the charging indicator is needed, the generators should adopt FT126 or FT226 voltage regulator. When the FT111 type and FT211 type regulators are used, the key switch should be turned off as soon as the engine stops in case the battery discharge to the magnetic coil and make the battery insufficient, this will influence the next starting.

The regulator is a precise instrument and not be dismantled and regulated at will, if it is necessary to be adjusted, it should be done at special equipment.

The starting motor is full closed direct current series excitation motor. The working current of the starting motor is very large, it can only works within a short time, and every starting time can't exceeds 10s. if it's necessary to continuously start, the break shouldn't less than 2 minutes and shouldn't exceed 10 times in case the starting motor and the battery be damaged.

The key switch has three working positions, at the center position, the whole circuit will be turned off, turning the key clockwise, the preheating – starting switch, Voltage regulator and other electric equipment will all be switched on and the diesel engine will start. After the engine starts, the switch should be turned anticlockwise to the end to turn off the preheating – starting switch and in case of any trouble.

If the pre – heater is used, a preheating – starting switch should be adopted. The preheating – starting switch has four working positions. At the " Preheat" position, only the pre – heater or electric plunger will be turned on. At the " Preheat – start" position, both the pre – heater and the starting motor will be turned on. At the " start" position, only starting motor will be turned on. To loose the switch, it will automatically moves back to the " O" position and the whole circuit will be cut off.

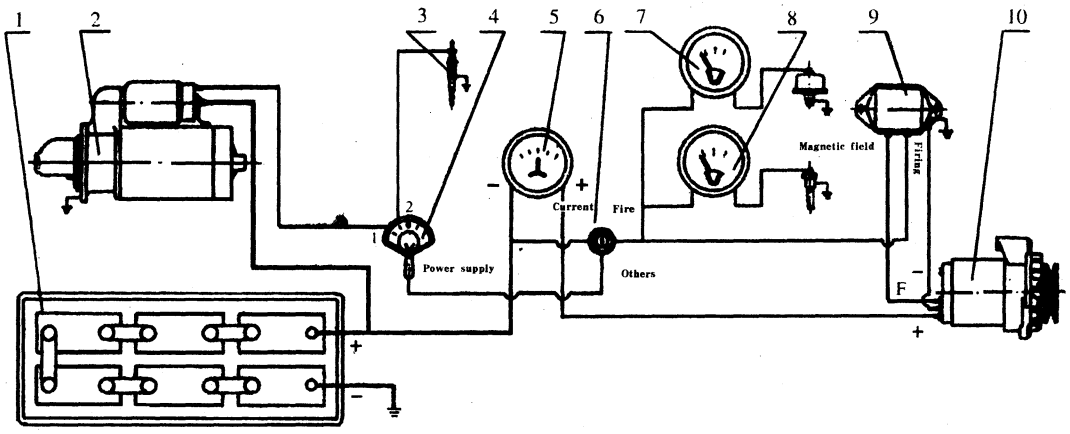


Fig. 7 Electric System

1. Battery 2. Starting motor 3. Electric plunger 4. Preheating – starting switch
5. Ammeter 6. Key switch 7. Pressure gauge 8. Temperature gauge
9. Voltage regulator 10. Silicon rectified generator

10. Transmission System

The transmission system includes the common V belt transmission and the gear transmission in the gear housing. The crankshaft belt pulley drives the water pump belt pulley and the alternator belt pulley through the " B" type V belt. There are three different specification of belt length: B1168, B1143 and B1080 according to the different positions of the water pump and the alternator. The belt is tightened by the alternator adjusting frame. When we press the middle part of the V belt using the finger, 10 – 15mm should be pressed down.

The transmission gears are all slanted gears in which the crankshaft timing gear, camshaft timing gear, fuel pump gear and idling gear have timing mark. We should align the mark when installing, otherwise, it will affect the normal operation seriously for the incorrectness of fuel advance angle, and even cant start the engine.

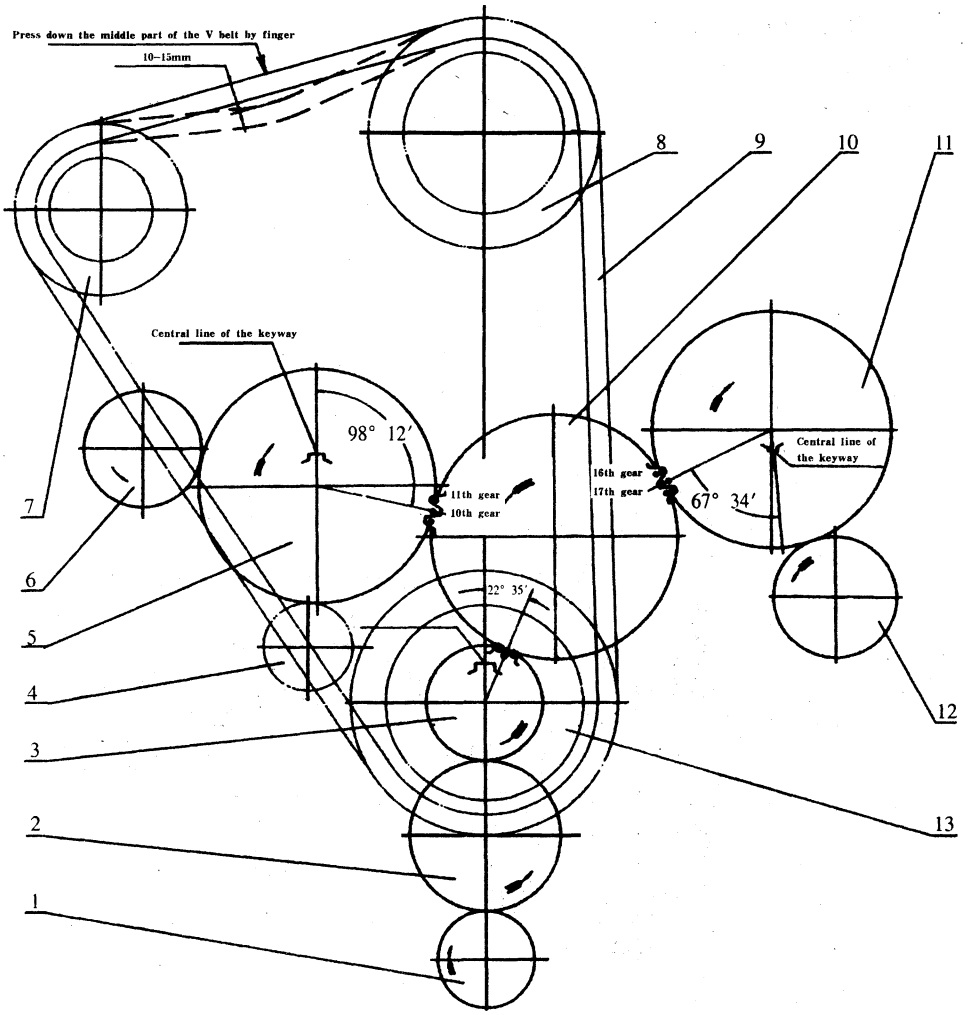


Fig. 8 Transmission system

1. Oil pump transmission gear (Z = 17) 2. Oil pump middle gear (Z = 25)
3. Crankshaft timing gear (Z = 20) 4. Oil pump gear (Z = 16)
5. Camshaft timing gear (Z = 40) 6. Hydraulic pump gear (Z = 20)
7. Alternator belt pulley 8. Water pump belt pulley 9. Common V belt
10. Idling gear 11. Fuel pump gear 12. Timing gear 13. Crankshaft belt pulley

11. Power Take Out Equipment

The diesel engine takes out power through the flywheel and clutch or spring coupler. We can't adopt the steel connection of belt pulley and flywheel in case the crankshaft inherits additional pressure and the crankshaft break.

495, K4100 adopt the dry, one piece and close type clutch, which is shown in Fig 9.

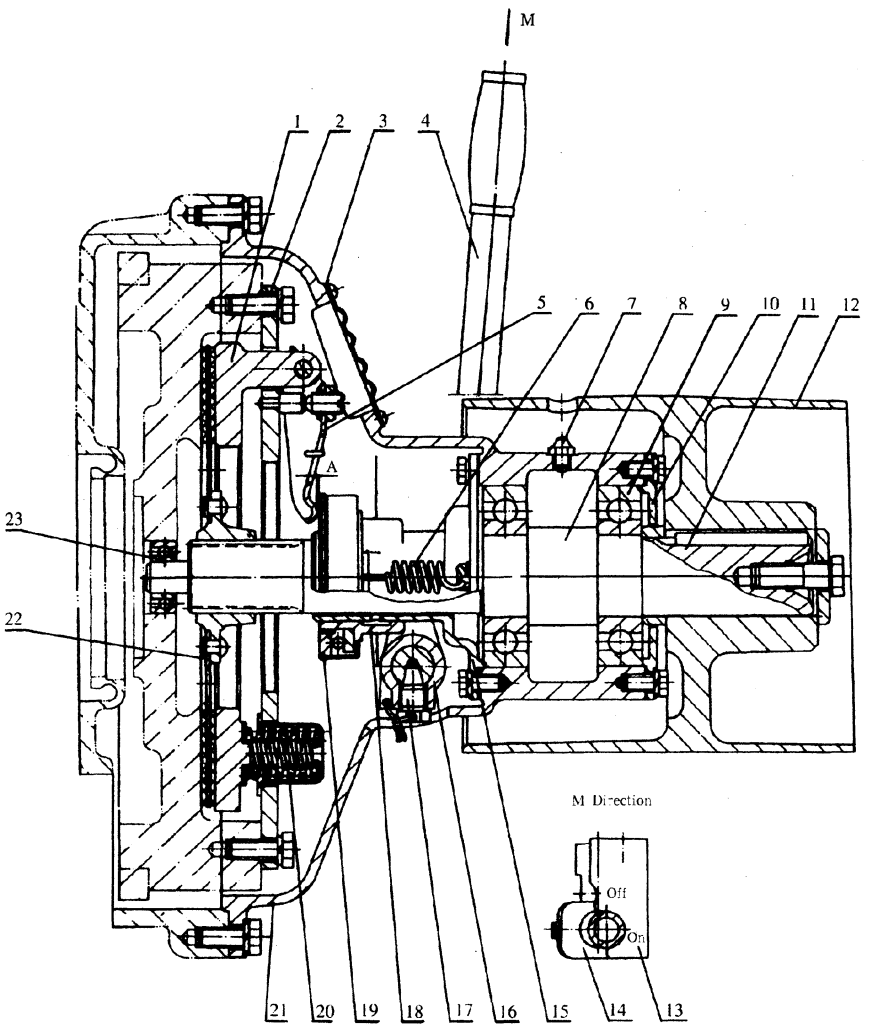


Fig. 9 Clutch assembly

1. Pressure disc 2. Supporting disc 3. Adjusting hole cover 4. Control lever 5. Release lever & adjusting bolt 6. Return spring 7. Adding oil lever 8. Bushing 9. Rotating shaft 10. Rear shaft cover 11. Take – out shaft 12. Belt pulley 13. Clutch board 14. Adaptor 15. Front shaft cover 16. Release yoke 17. Tightening bolt 18. Release shaft seat 19. Release bearing 20. Pressure big spring & pressure small spring 21. Clutch housing 22. Driven plate subassembly 23. Rotating shaft

A. The clearance between the release lever and the release shaft should be 3mm.
The diesel engine takes out power through flywheel, supporting disc, pressure disc and driven plate putout shaft. A flat belt pulley, V – belt pulley or a coupler can be installed at the output shaft end.
The front end of the clutch output shaft is supported on the flywheel bearing, the rear end is supported on the two bearings inside the clutch housing. The release bearing and the seat are installed on the front bearing cover. There are three pulling ears on the pressure disc stretched out of the supporting disc, on which installed three release lever. When the control lever is moved forward, the release yoke pushes the release bearing move forward, the release bearing contacts the release lever, and press the lever to overcome the pressure of the spring and leave the driven plate, finally cut the power.

12. The Main Changed Parts of K4100 Diesel Engine

K4100 diesel engine is developed on the basis of 495 through cylinder expansion. The cylinder block, cylinder liner, water seal ring, cylinder cover gasket, piston and piston ring are newly designed. They can be in common use with 495 diesel engine.

13. The Main Changed Parts of ZH4100 Diesel Engine

ZH4100 diesel engine is developed on the basis of K4100 by the changing of direct injection. The main changed parts are cylinder head, fuel pump, injector, high pressure pipe, inlet pipe, piston and piston ring etc.

CHAPTER Ⅲ OPERATION OF THE DIESEL ENGINE

1. Transportation & installation

When the diesel engine is transported, the front and rear lifting bracket should be used to lift the engine and close attention should be paid to protect the appearance, accessories and oil pipes of the diesel engine from being damaged.

If the diesel engine will be transported for a long distance, the air filter and silencer should be dismantled, use plugs and plastics to seal the air intake and exhaust hole, water pump inlet and outlet hole, fuel inlet and outlet hole. If necessary, use plastic cover and wooden case to pack the diesel engine.

If the diesel engine is used for stationary application, the foundation must be firm, the mounting surface must be kept horizontal, the driving equipment should conform to the requirement of stipulation, the working place should be spacious, well wentilated, clean and rain - proof.

2. Fuel, lubricationg oil and cooling water

2.1 Fuel

The diesel engine should adopts diffeent brand of light diesel oil according to the atmospheric temperature(GB252 - 1994)

Atmospheric temperature(℃):	>0	0 ~ -10	-10 ~ -20	-20 ~35
Brand of diesel oil:	0	-10	-20	-35

The fuel oil must be kept very clean, befor filling it into the fuel tank, you should clear the fuel oil for over 3 days so as to make the dust and water inside the oil precipitated to the bottom, then pich up the top clean fuel oil. the fuel oil must be strictly filtered when filled to the fuel tank.

2.2 Lubricationg oil

The diesel engine should adopt different brand CC or DD diesel lubricating oil according to different area and atmospheric temperature.

AREA	Winter In Cold Area	All Year In Common Area	Summer In The South
TEMPERATURE(℃)	-5 ~ -15	0 ~30	>30
OIL BRAND	20W/40	30	40

The lubricating oil must be filtered before it is filled into diesel engine, other brand lubricating oil is forbidden to be used for engine so as to protect the parts such as bearing and piston ring from being darmaged.

2.3 Cooling Water

The diesel engine should adopt clear soft water such as tap water, rain water and river water , etc. . If hard water is adopted such as well water and spring water which contains much more minerals, the hard water should be softened, of there will be scale on the water passage of the engine and block the water, weaken the cooling effect and recult in the engine too hot.

One of below methods can be used to soften water:

(1) boiled, precipitated and filtered before used.

(2) Fill 20g Na_3PO_3 on each 10kg water, precipitated and piston ring fom being damaged.

When the temperature is below 0℃, antifreeze mixture can be used for cooling medium. The antifreeze mixture can be mixed with water and alcohol according to the below ratio.

Volume ratio of antifreeze mixture(%)		Ice point of antifreeze mixture℃	
water	alcohol	denatured alcohol	water alcohol
90	10	-3	-5
80	20	-7	-12
70	30	-12	-19
60	40	-19	-29
50	50	-28	-50

When compound and fill the antifreeze mixtrue, pay attention to:
(1) The antifrezed mixture is poisonous, never drink it.

(2) When the engine is working, the temperature of the antifreeze mixture doesn't exceed 90℃ so as to avoid the alcohol volatilize.

(3) test the volume of the antifreeze mixture each 25 – 30hrs, compensate it if not enough.

(4) the volume of antifreeze nixture should be 6% less than the water, because the antifreeze mixture preventive liquid will exqands at high temperature.

3. Preparation for starting

3.1 The diesel engine should be thoroughly checked before starting. Closed attention should be paid to see whether foundation bolts and the connection with the driven equipment is rigid and reliable, and whether the transmission parts and control systems are sensitive and so on. The engine won't be started unless everything is all right.

3.2 Check and replenish the oil sump to keep the oil surface between the top and bottom carved line, fill up cooling water and fuel oil, open the switch of the fuel tank, check the fuel system for leakage and eliminate it if there is any.

3.3 It is recommend to vent the air out of fuel system step by step as follows:

At first loosen the venting screw on the filter, pump the fuel with priming hand pump, vent out the air from the fuel passage between the fuel tank and the filter, then loosen the venting screw on the injection pump until the fuel flows out without bubbles.

3.4 Check the battery be sufficien or not, connect the battery to the circuit and see whether it is electrified.

4. starting

The diesel engine shouldn't be started until the preparation is completed and meets the requirement. When starting, the clutch should be apart, operate as following steps:

4.1 Set the control handle of the fuel valve to the position where the fuel will be delivered rather more.

4.2 Turn the circuit switch clockwise and close the circuit.

4.3 Turn the starting switch to the "starting position", after the crankshaft is speeded up by the starting motor, the engine is started then.

4.4 For the protection of the starting motor and battery, the starting time shouldn't exceed 10s. If need to start continucously, the interval time should be more than 2min. If can't start for continuous 3 times, then don't start until the trouble is found out and elininated.

4.5 As soon as the engine starts, turn the starting switch back to the previous position. Set the control handle of the fuel valve to the idel speed position, turn the circuit key switch counterclockwise to the charging position.

4.6 Check the oil pressure after the engine starts, the oil pressure in ilde speed never be lower than 0.1mpa. After the engine starts for 5min, stop it and wait for 15 min, check the surface of the oil when the oil flows back to the oil sump, if necessary, add oil to the required level.

5. running

5.1 After being started, the engine shouldn't operater at full load immediately. It should be warmed up at low speed without load, only after the temperature of the cooling water reaches to 60℃, it can be speeded up to the highest speed and operates at full load.

5.2 When operating, the engine's speed and load should be increased and decreased gradually. In general, shouldn't increase or decrease rapidly.

5.3 When the engine is working, should often pay attention to oil pressure, oil tmeperature, cooling water temperature, charging current, should also observe the color of the exhaust smoke, listen attentively to the voice inside. If any trouble such as overheating, black smoking, knock and others, should stop the engine to check and remedy immediately. It is forbidden to let the engine operate with trouble so as to preveant the engine parts from being damaged.

5.4 When the engine working, often pay attention to the oil passage, water passage and union joint, if any leakage, should remedy it at once so as to avoid waste and pollution to the envkronment.

5.5 For new or just overhauled engine, it is permitted to run af full olad only after it has workde for over 60h.

5.6 It is forbidden to let the engine running at idle speed for a long time.

5.7 The injection pump has been adjusted rightly before leaving factory, it is forbidden for users to change it at will. If necessary, it should be adjusted at the injection pump equipment.

6. Stopping

6.1 Before stopping the engine, unload first, decrease the engine to the idling speed gradually, when the water temperature falls down below 70℃, turn the stopping lever to stop. After the engine stops, take out the switch key and close the fuel thak valve.

6.2 It is forbidden to stop the engine suddenly at high water temperature.

6.3 It is not permitted to stop the engine by shutting off the valve of the fuel tank so as to preventiong the air from entering into the oil passage.

6.4 When it is below5℃, if the antifreeze mizture is not used, should drain off the cooling water so as to avoid the cylinder block and water pump being frost crack.

6.5 The found trouble should be remedied after every stopping, and should often check the engine.

7. Safe and technical operating instruction

7.1 It' forbidden to let the person who don't know the operating technique to operate the engine.

7.2 The engine can be started only after all the starting preparation has been completed.

7.3 Pay close attention to prevent fire, it's forbidden to let the naked flame near the working engine. If the engine is working beside inflammable substance, a fire extinguisher system should be installed on the exhaust manifold.

7.4 When the engine is working, never to dismantle or adjust, the operator don't leave the working site.

7.5 It/s forbidden to let the engine working under no oil pressure, low oil pressure or whith abnormal noise inside. If you meet with these cases, the engine should be stopped urgently.

7.6 If the engine happens to be overspeed, you should turn the stopping hanlde to stop it to have a test. If the stopping handle malfunctions, you can stop the engine with the methoud of plugging up the air inlet hole.

CHAPTER IV Technique maintenance of the diesel engine

Periodic technique maintenance is an important content of using engine normally, in order to remain the engine in good technique state and to prolong it's service life, the technique maintenance system must be seriously performed as standard.

The maintenance of the engine is classified as follows:

1) Working day maintenance (per 8 – 10h)
2) First grade technique maintenance (accumulative working hous: 50h; or for the cargo vehicle, traveling distance over 2500km)
3) Second grade technique maintenance (accumulative working hours: 250h; or for the cargo vehicle, traveling distance over 12500km)
4) Third grade technique maintenance (accumulative working hours: 1000h; or for the cargo vehicle, traveling distance over 50000km)
5) Technique maintenance on winter use.

1. Working day maintenance

1.1 Check the oil surface in the oil sump, oil bath type air filter and the power output gear box, if the oil surface is higher, find out the trouble and eliminate it; if the oil is insufficient, the refill it to the required amount.

1.2 Check the cooling water surface in the water tank, if insufficient, fill it up . If the air temperature will be under +5℃, then drain off the cooling water after stopping.

1.3 Check and fasten the shown bolt and nut, eliminate the leak of oil, water and air.

1.4 During working at the dusty place, use the compressed air to clean the air filter element.

1.5 Clean the mud, dust and oil dirt on the appearance of the engine.

1.6 When the engine is working, listen to the voice, observe the smoke color and eliminate the troule and abnormal appearance.

2. First grade technique maintenance

2.1 Perform the items on the "working day maintenance"

2.2 Clean the oil filter element with clear fuel. Clean the centrifugal oil filter once on

two – maintenance period.

2.3 Clean the dust on the air filter element and inside the dust deposit set. Replace the oil inside the oilbath type air filter.

2.4 Check and adjust the tension of the fan belt.

2.5 Fill the lubricating grease into the weater pump bearing.

2.6 Check all parts of the engine, to do the necessary adjustment if need.

2.7 when the maintenance is finished, start the engine and test it's working appearance, eliminate the trouble and abnormal appearance.

3. Second grade technique maintenance

3.1 Perform the items on the "first grade technique maintenance"

3.2 Replace the oil, clean the oil sump and the oil strainer.

3.3 Clean the oil filter, replace the element.

3.4 Replace the oil in the air compressor.

3.5 Clean the fuel tank, oil delivery pump screen and pipe.
clean the fuel filter element with clear fuel.

3.6 If the engine is supercharged type, then clean the cave and propeller impeller of the turbocharger air pump, and also test the moving and fasten parts.

3.7 Blow off the dust inside the dynamo with wompressed air. Check all parts, eliminate and abnormal parts.

3.8 Check and adjust the valve gap.

3.9 Check the injecting open pressure and it's spray quality of the injector, if need, to adjust it.

3.10 Fill the lubricating grease to the filling boles of the clutch, test the gap between the releasing lever and the releasing bearing.

3.11 Check and adjust the contack working gap and iron core gap every two maintenance period

4. Third grade technique maintenance

4.1 Perform the full items on the "second grade technique maintenance"

4.2 Clean the cooling system, wipe off the scale.

4.3 Clean the oil cooler.

4.4 Replace the air filter element and fuel filter element.

4.5 Dismantle and check the cylinder head. Test the valve seal, wipe off the carbon deposit, burnish the valve according the conditions.

4.6 Check the fasten situation of the cylinder head bolt, main bearing bolt, connecting rod bolt. For the bolts which tightening torque is insufficient, then tighten it to the set point value.

4.7 Check the water pump, replace the lubricating grease, if necessary, replace the water seal.

4.8 Check the dynamo, starting motor, clean, repair and fill new lubricationg grease.

4.9 Check the injection pump, adjust the fuel lead angle, and adjust the injection pump according the conditions.

4.10 Test the air compressor, burnish the valve according the situation, and clean the carbon deposit.

4.11 Check the clutch, clean the inside dust deposit, oil dirt, and replace the lubricating grease.

4.12 Check the turbocharger, clean the parts, wipe off the cabon deposit, and test the rotor freedom allowance.

5. Technique maintenance on winter using

If the temperature maybe lower than5℃, the engine must be maintained specially.

5.1 Must use the winter used oil and fuel, note the damp in the fuel so as to protect the fuel passage from being jammed.

5.2 It's better to fill the antifreeze fluid to the cooling system, or must drain off the cooling water after its lemperature is lower than 40 – 50℃.

5.3 On the cold dseason or area, it's better to prevent the diesel engine(or vehicle from being deposit in the open air, or when starting, it's need to heat the cooling water to preheat the engine body.

CHAPTER V Troubleshooting

1. Start failures

Touble cause and its feature	Remedy
1.1 Troubles in fuel system	1.1
(1) Jammed in the fuel s	(1) Dismantle and clean

(2) Air trapped in the fuel system	(2) Vent the air from the system withe the fuel delivery pump, check whether t-her is leakage of fuel and air in the fuel pipes
(3) Delivery pump fails in delivering fuel or delivers brokienly	(3) Check and repair
(4) Injector sprays abnormally	(4) Check and adjust or replace the nee-dle valve mate
1.2 insufficient compress pressure	1.2
(1) Piston ring and cylinder liner wear	(1) Check and replace worn parts
(2) Piston ring gumming	(2) clear off gumming
(3) Valve leaks	(3) Vave spring broken or elasticity weakens, valve lash is incorrect, valve seal is not good, eliminate the ault
(4) Temperature is low after end of compression	(4) Environmental temperature is low, use preheat starting method
1.3 Trouble in electric devices	1.3
(1) Battery is insufficient	(1) Recharging the battery to the speci-fied point
(2) Connecting of electric devices is not good	(2) Check the tighten of the connection
(3) Starting motor on rotate or rotates in-sufficiently	(3) Check the starting motor
(4) Clutch of starting motor skids	(4) Check and repair the clutch of the starting motor
(5) Gear of starting motor cnt't inlay the flywheel gear – rim	(5) Find out the fault and eliminate it
2. Unsteady running of the engine	Remedy
Trouble cause and its feature	(1) Handle according to the (1), (2) (3), (4) in the 1.1
(1) Fault in fuel system	(2) check the dampness in the fuel
(2) Too much water in fuel	(3) Check and eliminate the fault
(3) Leakage in fuel passage	(4) Governor works abnormally

(5) Cylinder blows by
(6) Uneven fuel delivery to each cylinder
①Uneven fuel delivery to each cylinder in injection pump
②Injector sprays not well or the mate be choked
③The plunger of the injection pump worn out or the spring broken

(4) Check and adjust the governor
(5) Check the tightening torque of the cylinder head bolt and the seal of thecylinder head gasket
(6)①Check and adjust
②check the spray quality of the injector, replace the mate if necessary
③Check and replace

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3. Output is insufficient or drops suddenly

Trouble cause and its feature	Remedy
(1) Air filter choked	1. Clean or replace filter element
(2) Valve spring or push rod broken	2. Check and replace
(3) Valve lash is incorrect	3. Check and adjust
(4) Compress pressure is insufficient	4. Handle according to 1.2 5. Check and adjust
(5) Fuel delivery advance angle is incorrect	6. Handle a ccoyding to (1), (2), (3) in 1.1
(6) Air trapped in the fuel system or thd system is choked	7. Check the plunger of the injection pump and fuel outlet valve
(7) Fueldelivery is insufficient	8. Check, clean and adjust the pressure
(8) Injector spray not well	9. Test and repair the governor
(9) Governotr works abnormally	10. Test and repair thd cooling sys – tem, wipe off the scale
(10) Engine overbeated	11. Clean off the carbon deposit
(11) Too much carbon deposited inside the engine	12. Find out the fault and eliminate it.
(12) Exhaust manifold not expedite	

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4. Abnormal noise during engine operation

Trouble cause and its featre	Remedy
(1) Injecting time is too early to	1. Adjust the fuel delivery advance

cause the rhythmic and clear metallic pounding noise be heard inside the cylinder.	angle
(2) Injecting time is too late to cause the grave and unclear noise is heard inside the cylinder.	2. adjust the fjel delivery advance angle
(3) Pounding noise can be heard inside the cylinder after the engine starts because of too large gap between the piston and cylinder liner, this noise gets lower along mith the warming of the engine.	3. Check the cylinder clearance, replace the piston or cylinder liner
(4) Too large clearance between the piston pin and pinhole, clear and sharp sound, especialy when idling.	4. Replace the parts, ass ure the stipulated gap
(5) Too large clearance between the main bearing and the con – rod bearing, parts pounding sound is heard when the engine speed drops suddenly, grave and strong sound when at low speed.	5. Replace the parts, assure the stipulated gap
(6) The axile gap of the crankshaft is too large, pounding noise when idling.	6. Replace the thrust plate, assure stipulated gap
(7) Valve spring broken, push rod bent, valve clearance too large and so on, disorderly sound or lignt and rhythmic pounding sound be heard inside the cylinder head cover.	7. Replace the parts, adjust valve gap
(8) Piston touches valve, metallic pounding sound can be heard beside the cylinder head	8. Check valve clearance and transmitting gear mark
(9) Too large gear clearance, pounding sound is heard at the gear case when the speed	9. Test the gear back lash, replace gear according to the situation

5. Abnormal exhaust smoke

When the engine works normally, the smoke color is light grey, when the load is higher at low time, it color is onlt dark grey, when the exhaust smoke is blue, white or black, then the smoke color is abnormal. Blue means burning oil; white means fuel fog no burns thoroughly inside the cylinder or water trapped inside the cylinder; black means injecting fuel too much to burns thoroughly. Thouble cause and its feature

5.1

Blue smoke	Remedy
(1) Lubricating oil flees, piston ring installed inversely, choked or worn out to badly	(1) Check piston ring and eliminate the fault
(2) Clearance between valve and pipe hole too large	(2) Replace the parts and assure the stipulated lash

5.2

White smoke	Remedy
(1) Fuel spray be atomized not well, fuel drips	(1) Check the injection pressure and the seal of the mate, adjust and clean or replace
(2) too much water trapped in the fuel	(2) Test the fuel quality
(3) Water trapped in the cylinder	(3) Inspect the seal of the cylinder gasket, check the water leakage of the cylinder head and cylinder liner, repair or replace

5.3

Black smoke	Remedy
(1) Engine is ouer – loaded	(1) Adjust to the stipulated load

(2) Fuel sprays too much	(2) Adjust the fuel delivery amount of the fuel injection pump
(3) Injecting time is too late, late burning is heavyp	(3) Adjust the fuel delivery advance angle
(4) Valve lash is incorrect or valve seal is not good	(4) Adjust the valve lash and seal, eliminate the foult
(5) Air filter choked	(5) Clean the filter element

6. Insufficient oil pressure

Trouble cause and its feature	Remedy
1. Oil pressure gauge is in trouble or the connecting pipe choked	1. Replace the pressure gauge or dredge the passage
2. Too little oil in the sump	2. Fill oil to the stipulated level
3. Too thin oil	3. Inspect oil grade, check whether the oil be thinned out with fuel or oil temperature too high, eliminate it
4. Oil pump driving and driven gear worn out	4. Replace driveing and driven gear
5. Strainer screen and oil filter element blocked	5. Clean or replace
6. Pressure limiting valve and pressure regulating valve spring broken	6. Inspect and replace
7. Oil passage choked or oil leaks	7. Checkand eliminate
8. Lash between the bearings too large	8. Test the matching lash

7. Oil temperature too high

Trouble cause and its feature	Remedy
1. Engine is over – loaded	1. Adjust the load
2. oil is insufficient or overmuch	2. Add or reduce the oil according the stipulation
3. Piston ring leaks heavily	3. Replace piston ring or cylinder liner
4. Oil cooler choked inside, dirt	4. Check and clean

deposited outside, influence the heat radiating efficiency

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8. The temperature of used cooling water too high

Trouble cause and its feature	Remedy
1. Water temperature gauge or inductor be in trouble	1. Inspect and replace
2. Cooling water is not enough	2. Fill cooling water and get rid of the air from the water passage
3. Flow of cooling water is too small	3.
(1) Flow of water pump is too small	(1) Check the lash of the water impellers , adjust the tension of the fan belt
(2) Too much scale deposit inside the engine	(2) Wipe off the scale deposit
4. The efficiency of radiator is not well	4. Clean off the dirt and ecale deposit
5. Engine is over – loadedp	5. Adjust to the stipulated load

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9. Trouble in the injection pump

Trouble cause and its featurep	Remedy
1. No fuel delivery	1.
(1) Fuel deliver pump is out of order	(1) Process according 10.
(2) Fuel filter or fuel passage is choked	(2) Clean or peplace
(3) Air trapped in fuel passage	(3) Wipe off air
(4) Fuel outletyp Valve Spring broken	(4) Replace spring
2. Fuel delivery uneven	2.
(1) Air trapped in fuel passage	(1) Wipe off air
(2) Fuel outlet valve spring broken	(2) Replace spring
(3) Seal face and outer face worn out	(3) Repair or replace
(4) Plunger mate worn out or spring broken	(4) Replace parts
(5) Plunger choked with impurityp	(5) Clean

(6) Pressure of inlet fuel is uneven	(6) Inspect fuel delivery pump and filter
3. Insuficient fuel delivery	3. (1) Replace parts
(1) Fuel cock leaks	(2) Tighten the connector
(2) Connector of fuel pipe leaks	(3) Replace parts
(3) Plunger worn out	

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10. Insufficient fuel supply of the fuel delivery pump

1. Non – return spring broken or seal of the valve seat is not good	1. Replace spring or repair no – return valve
2. Piston worn out	2. Replace piston
3. Fuel inlet pipe leaks or choked	3. Check the seal of the pipes, tighten the screw, dredge the pipes

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11. Injector malfunction

Trouble cause and its feature	Remedy
1. Spray less or no spray	1.
(1) Air trapped in the fuel passage	(1) Blow off air
(2) Neeldle is blocked	(2) Repaing or realace
(3) Loose combination of the needle valve	(3) Replace
(4) Heavy leakage in fuel system	(4) Tighten connctor or replace parts
(5) Abnormal fuel supply of the injection pump	(5) Inspect fuel supply of the injection
2. Injecting pressure is low Pressure adjustion washer worn out	2. Add suitable thick washer
3. Too high injecting pressure	3.
(1) Needle valve blocked	(1) Clean or replace
(2) Injecting hole choked	(2) Clean
(3) Pressure adjusting washer is too thick	(3) Adjust the pressure adjusted washer
4. Too much of fuel leakage	4.
(1) Needle valve blocked	(1) Repair or peplace
(2) Needle valve blocked	(2) Clean or replace
(3) Pressing cap is loose or distorted	(3) Tighten, replace parts

(4) Fuel inlet and outlet connector screw is loose	(4) Tighten, replace parts
5. Fuel atomized not well	5.
(1) Needle valve is distorted or worn out	(1) Replace
(2) Bad seal of the needle valve	(2) Repair or replace
(4) Needle valve blocked	(4) Clean or replace

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12. Governor malfunction

Trouble cause and its feature	Remedy
1. Unsteady speed	1.
(1) Too large of camshaft axile lash	(1) Readjust
(2) Cylinders fuel supply uneven to much	(2) Readjust
(3) Fly – weight assembly installed improperly , too large stagger of fly hammer bracket shaft	(3) Recheck and assemble
(4) Fuel cock worn out or bad seal	(4) Repair or replace
2. Too high idling speed	2.
(1) Operating handle lever no rea – ches its positon	(1) Inspect and adjust
(2) Tooth rod is not flexible	(2) Readjust or repair
3. Speed floating	3.
(1) Speed adjusted spring distorted	(1) Replace the speed adjusted sping Check and tighten
(2) Fly hammer assembly loosen	(3) Repair and eliminate
(3) Too large friction resistance inside the governor	
(4) Too Large axile lash of the injection pump camshaft	(4) Readjust
4. Overrunning of the engine	4.
(1) Toothe rod is not flexible	(1) Readjust and repair
(2) Lubricated not well, shaft sleeve of the governor burned out.	(2) Check and repair
(3) Fly hammer assembly loosened	(3) check and tighten
(4) High speed limit screw loosened	(4) Readjust

13. Engine stops suddenly

Trouble cause and its feat	Remedy
1. Crankshaft can't be rotated after the engine shtops	1.
(1) Crankshaft jammed with bushing	(1) Inspect, replace parts
(2) Piston jammed with cylinder liner	(2) Inspect, replace parts
2. Crankshaft can be rotated easily	2.
(1) Air trapped in fuel systemp	(1) Blow out air
(2) Fuel system choked	(2) Clean
(3) Air filter choked	(3) Maintenance the air filter

14. Charged dynamo out of order

Trouble cause and its feature	Remedy
1. Can't be charged at all	1.
(1) Open circuit or short circuit, , circuit cnnecting wrong	(1) Check the circuit connecting
(2) Dynamo claw loosened, rotor circuit opened, brus contacted badly	(2) Repair or check
(3) Dynamo silicon parts out of order	
2. Insufficient charging or charging unsteadily	(3) Replace
	2.
(1) Brush contacts badly, insufficient spring pressure, oil dirt on slip ring	(1) Check and repair
(2) Transmitting V – belt loosened	
(3) Some silicon parts open circuited	
3. Abnormal sound when working	(2) Adjust the tension of V – belt
(1) Dynamo bearing worn out	(3) Replace
(2) Installed improperly	3.
(3) Shout circuit inside the stator coil or parts shout circuited	(1) Replace
	(2) Adjust
	(3) Repair

15. Starting motor malfunction

Trouble cause and its feature	Remedy
1. Starting motor no works	1.
(1) Vonnecting electric wire con – tacts badly	(1) Clean and tighten the contacting point
(2) Insufficient charging of the bet – tery	(2) Recharging
(3) Brush contacts badly	(3) Clean the contacting surface of the commutator
(4) Open circuited inside the start – ing motor itselt	(4) Repair
2. Starting motor rotates weakly	2.
(1) Bearing bush worn out	(1) Replace bearing bush
(2) Brush contacted badly	(2) Clean the contacting surface of the commutator
(3) Connecting electric wire con – tacted badly	(3) Clean and tighten the contocting point
(4) Switch contacted badly	(4) Inspect switch
(5) Insufficient charging of the bat – tery or its capacity is too small	(5) Recharging or replace large capacity battery
(6) Clutch clips	(6) Repair clutch
3. Gear returns hardly	3.
(1) Switch contacting slice burning – out and cemented	(1) Repair switch

16. Governor in trouble

Trouble cause and its feature	Remedy
1. No generating electricity at all	1.
(1) Too low of regulating voltage	(1) Inspect and adjust
(2) Connecting wrong	(2) Inspect the connecting
(3) Relay coil worn out, conntacting point contacted badly	(3) Repair
2. Charging insufficiently or unsteadily	2.

(1) Too low of adjusting voltage	(1) Inspect and adjust
(2) Too dirty of contacting point	(2) Clean
3. Overchargine	3.
(1) Adjusting voltage too high or unadjusted, uncontrolled	(1) Inspect and adjust

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17. Turbocharger in trouble

Trouble cause and its feature	Remedy
1. Engine output drops	1.
(1) Passage of air filter or air pump dirty	(1) Clean
(2) Leakage at the connector of the air pump body	(2) tighten
(3) Leakage at the air inlet connector	(3) Tighten
(4) Air inlet passage of the turbine be choked or dirrty	(4) Clean
(5) Floating bearing worn out	(5) Replace
2. Black or blue smoke	2.
(1) Passage of air filter or air pump dirty	(1) Clean
(2) Altitude or temperature too high	(2) Adjust output
(3) Fuel return pipe of the turbocharger choked	(3) Wipe out
3. Abnormal noise insde the turbocharger	3.
(1) Pounding sound	(1) Check and repair
(2) Foreign matter enters into impeller or impeller be worn out	(2) Dismantle, inspect and repair
(3) Seal ring burned out	(3) Replace
4. Rotor rotates not flexibly	4.
(1) Leakage of turbocharger causes carbon deposited	(1) Clean
(2) Floating bearing worn out	(2) Replace

(3) Over – heating causes parts be transmuted	(3) Replace
(4) Precision of running balance too low	(4) Replace

18. Air compressor in trouble

Trouble cause and its feature	Remedy
1. Efficiency gets worse because of carbondepositedonexhaustvalve, valvespringbrokenorcylinderliner worn out	1. Clean off carbon deposit, replace parts
2. Oil mixes because of piston ring broken, cylinderlinerwornoutoroil return pipe choked	2. Clean and repair, replace parts
3. Abnormalsoundcanbeheardwhen working because of thaft and bearingwornoutorpistontouches cylinder head	3. Check and repair, clean off corbon deposit, replace parts.

19. Clutch in trouble

Trouble cause and its feature	Remedy
1. Clutch slips	1.
(1) Friction disc worn out or burn out	(1) Replace friction dise
(2) Oil dirt on friction disc	(2) Clean off oil dirt on the friction disc, pressing plate and flywheel
2. Clutch disconnects not completely	2.
(1) Pressing lever worn out	(1) Replace in time
(2) Adjusting plate worn out	(2) Replace in time
(3) Connecting plate worn out	(3) Replace in time
(4) Disconnecting bushing pin hole and tree lever shaft pin worn out	(4) Replace in time

APPENDIX:

The wearing in of the diesel engine

The time of wearing in should not less than 60 hours. The load and time of wearing in is as follows:

Load	Operation time	
Idling speed	10 minutes	Check the pressure of lubricating oil and whether there is abnormal noise etc.
25%	2 h	
50%	15 h	
75%	30 h	
100%	15 h	

During the period of wearing in, the throttle should be fully opened. The load numeral value can be gained according to the load estimation of the matched belt, however, we must obey the principle of increasing load gradually from low load.

Due to the different fitting machines, such as tractors, vehicles, engineering machines, generating sets and harvesters etc., the wearing in should meet the different requirements for the usage. The diesel engine used for agricultural machines, for example, the diesel engine used for water pump, thresher and grinder etc., which have power take out equipment have already wearied in preliminarily, so customers can reduce the wearing in time properly.