



SINOTRUK

Operation and Maintenance Manual for WD615 Series Euro II Diesel Engine

CHINA NATIONAL HEAVY DUTY TRUCK GROUP CO.,LTD



Special attention

1. In order to protect legitimate right and interests of user, it is forbidden to dismantle fuel quality lead sealing of injection pump privately.
2. Once injection pump is adjusted or lead sealing is dismantled, the guarantee cease to be in effect.
3. Injection pump is precision parts, it is forbidden to dismantle by user, or the guarantee cease to be in effect.
4. Rotor shaft of turbocharger is precision high-speed rotating parts, dismantling and impacting are forbidden, or the guarantee cease to be in effect.
5. There are strict demands on torque and turned angle of main bearing bolts and connecting rod, loosening and dismantling is forbidden, or the guarantee cease to be in effect.
6. Before starting the diesel engine, check whether the coolant is full and whether the lub-oil is enough.
7. Connecting rod bolts can be used only once.



Points for attention

1. The engine has been tested strictly in accordance with the test stipulations in delivery. The throttle has been sealed, it is forbidden to dismantle the seal optionally and to enlarge the throttle. Otherwise we would not provide free service for returning product, replacement and repairment, users would better pay attention to this.
2. The engine operator must read this *Operation and Maintenance Manual* carefully to know the engine's structure, and comply with the operation and routine rules in this manual.
3. During use a new engine, 50 hours test running should be done.
4. After start cold engine, the speed should be increased slowly. It is forbidden to run the engine in high speed suddenly and in idling for a long time. After running in high load, running the engine at low speed and in no load about 5-10min, then stop the engine.
5. After stop the engine, if the ambient temp. is lower than 0°C and no antifreeze is used, the water in water tank and in diesel engine should be drained off.
6. It is forbidden that the engine works without air and unfiltered air enters into the cylinder.
7. Applied fuel and lubricating oil must be in accordance with specified trademark and filtered by strainer, and a special clean container should be used. The fuel should be settled for more than 72 hours.
8. Inspection and maintenance for electric system must be done by workers mastering electric appliance knowledge.
9. The oil seal period of the engine is one year. Inspect the engine and adopt necessary measures if beyond a year.
10. Rating and correction of power for diesel engine are in accordance with GB/T18297.
11. Feedback of engine quality.

The manufacturer has established quality files for WD615 series diesel engine. Please fill in the card and post it to us, we will contact with user according to the card.

12. Notice to repairing and replacing parts.

WD615 series diesel engine has good performance. Maintenance should be done in accordance with WD615 series diesel engine parts catalogue and specifications of maintenance manual. Purchased parts must be approved by us in order to ensure performance, reliability and service life.



Preface

WD615 series diesel engine is of high speed engine made in China by introducing foreign technology. It has compact structure and advantage of rapid starting, simple operation and easy maintenance, good reliability and economy etc. Especially the emission is advanced that it conforms to EURO 2 emission regulation (namely B stage of national emission standard). It is an ideal power for heavy-duty truck, engineering machinery, generating facilities, fishing vessel, motor boat and so on.

This manual introduces the main technical data, performance parameters, construction features, operation and maintenance methods of WD615 series diesel engine. If users operate the engine according to the stipulations of this manual, the service life of the diesel engine should be extended greatly.

During repairing, dismantling and assembling the engine, read the *Maintenance Manual for WD615 Series Diesel Engine* and purchase parts according to *WD615 Series Euro II diesel engine parts catalogue*.

WD615 series diesel engine introduced in this manual is the basic model. For engineering machinery, marine and generating diesel engines, please refer to related operation and maintenance manual. With the continuous improvement, please pay close attention to the various informations released by us. Engine structure are subjected to change without notice.

Welcome advice for improving the engine. Post the letter to Technology Development Centre of CNHTC.

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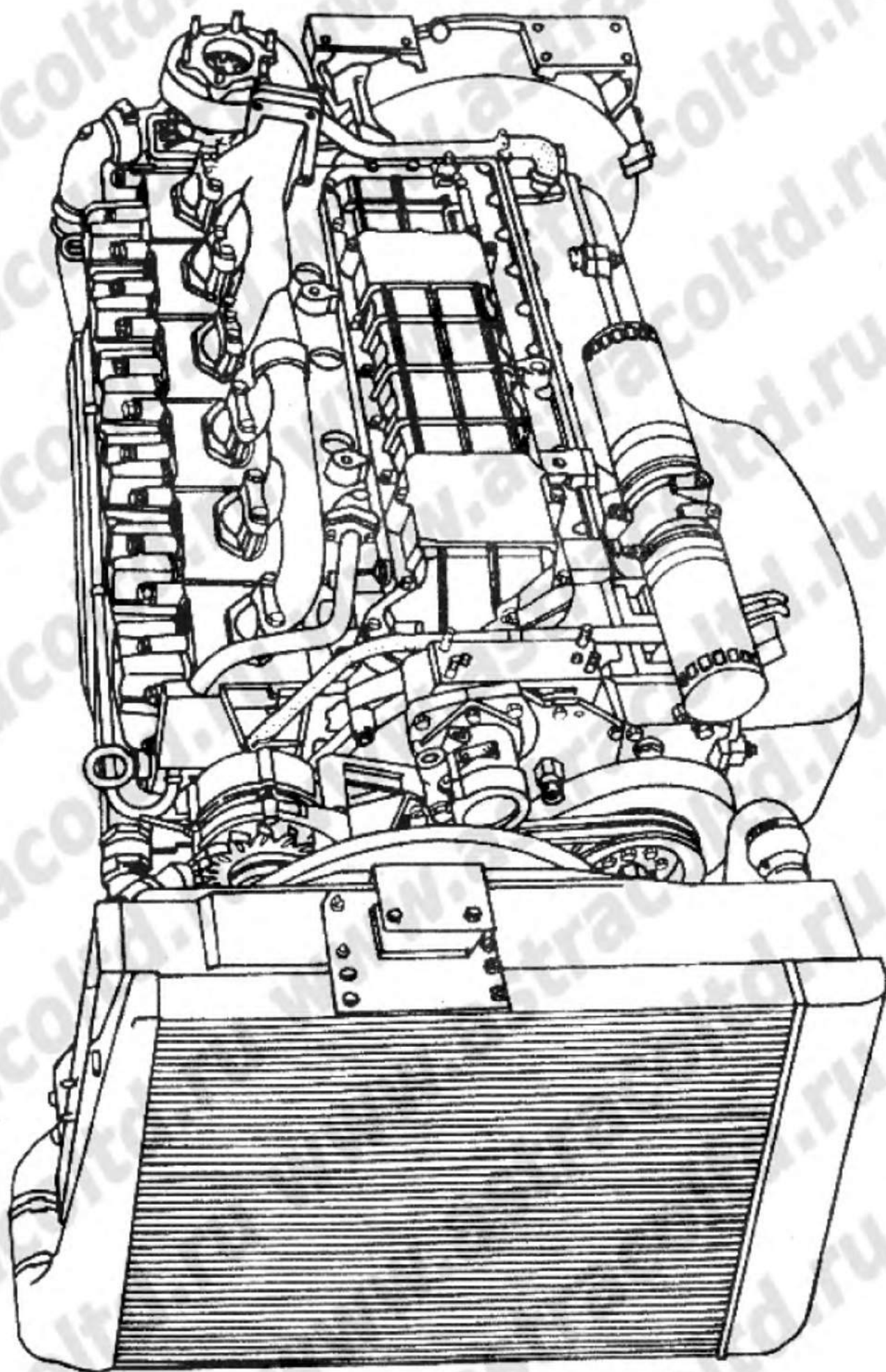


Fig.1 Outline drawing of model WD615 turbocharged and inter-cooled engine

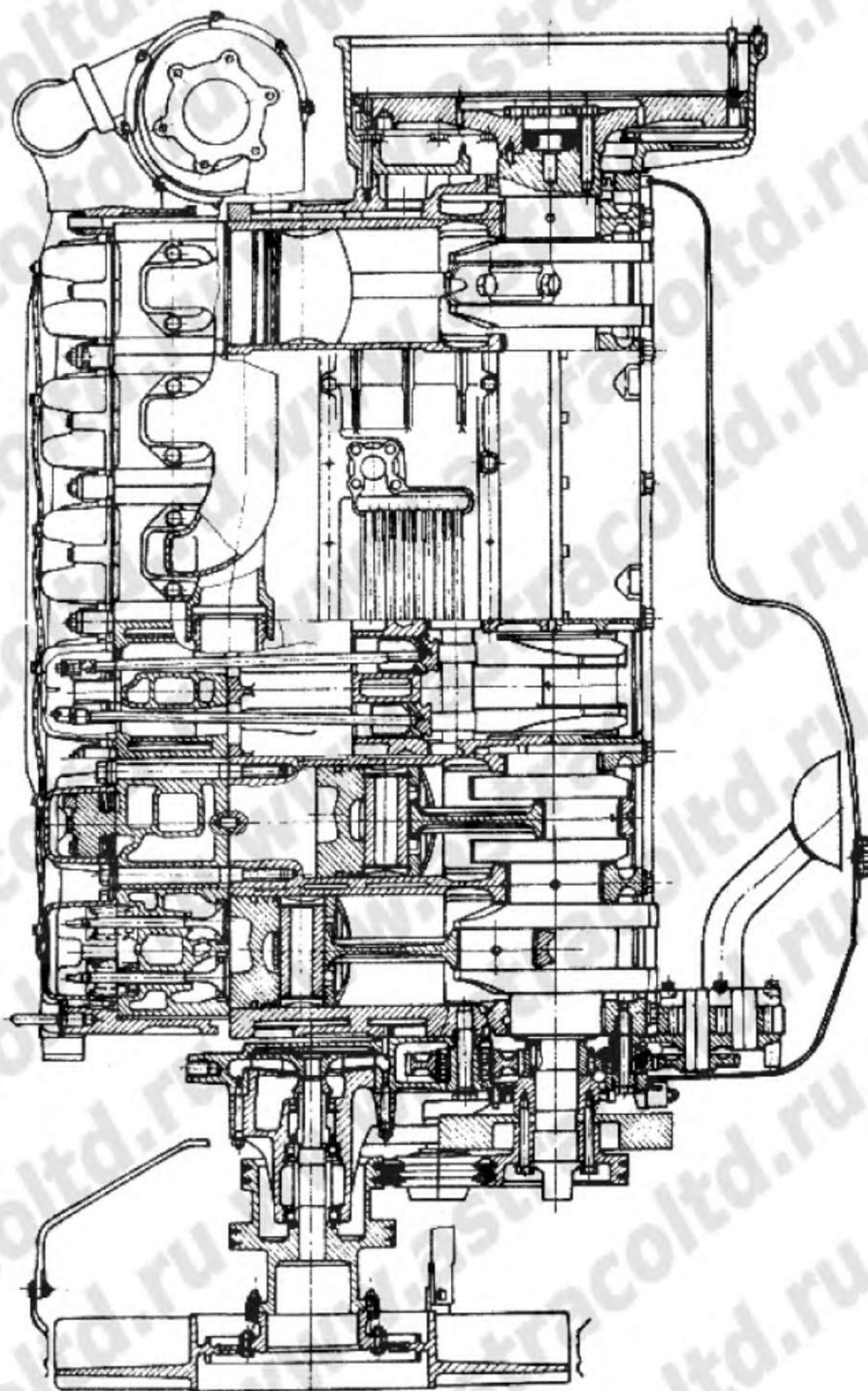


Fig.2 Longitudinal section of WD615 series diesel engine

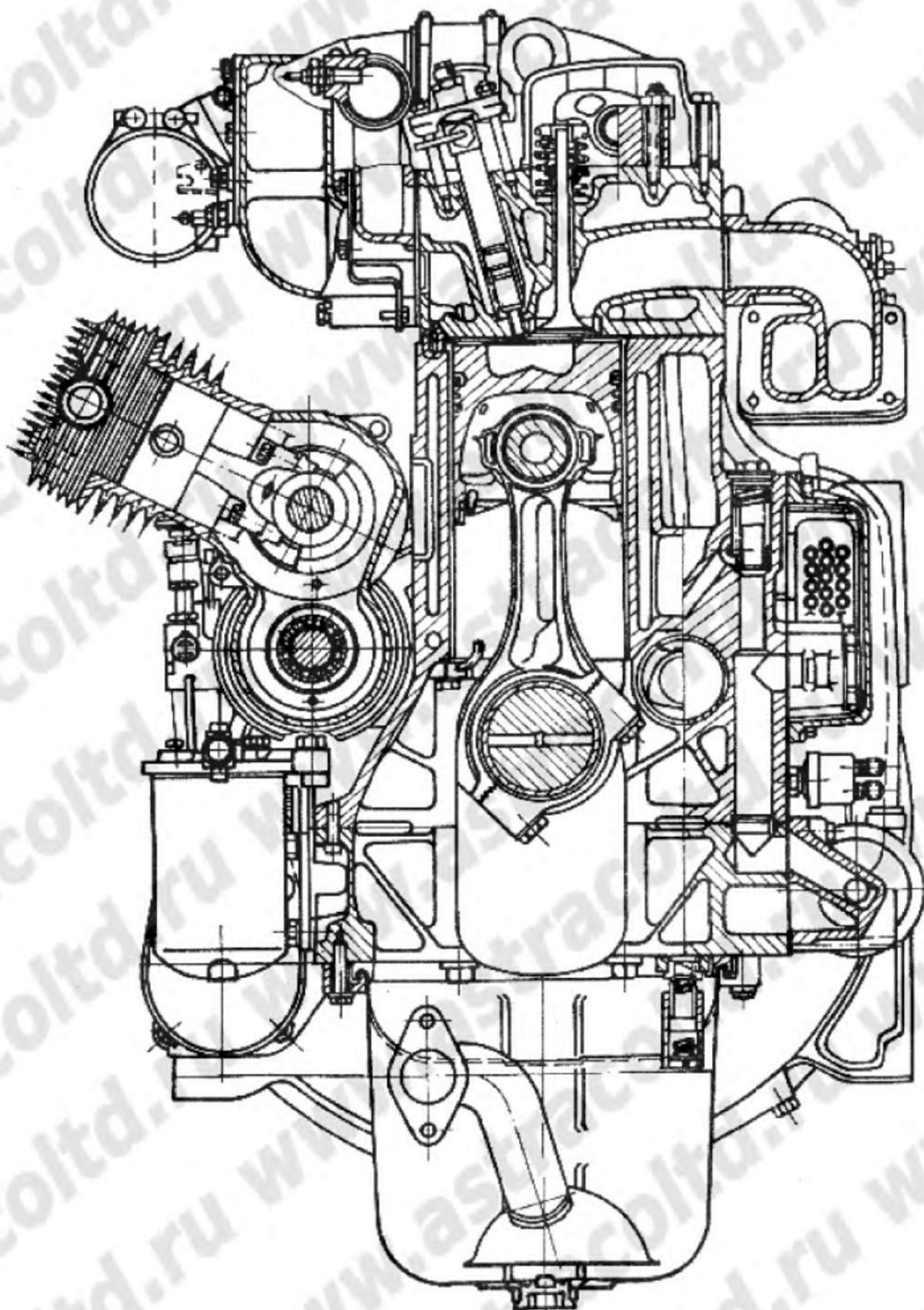
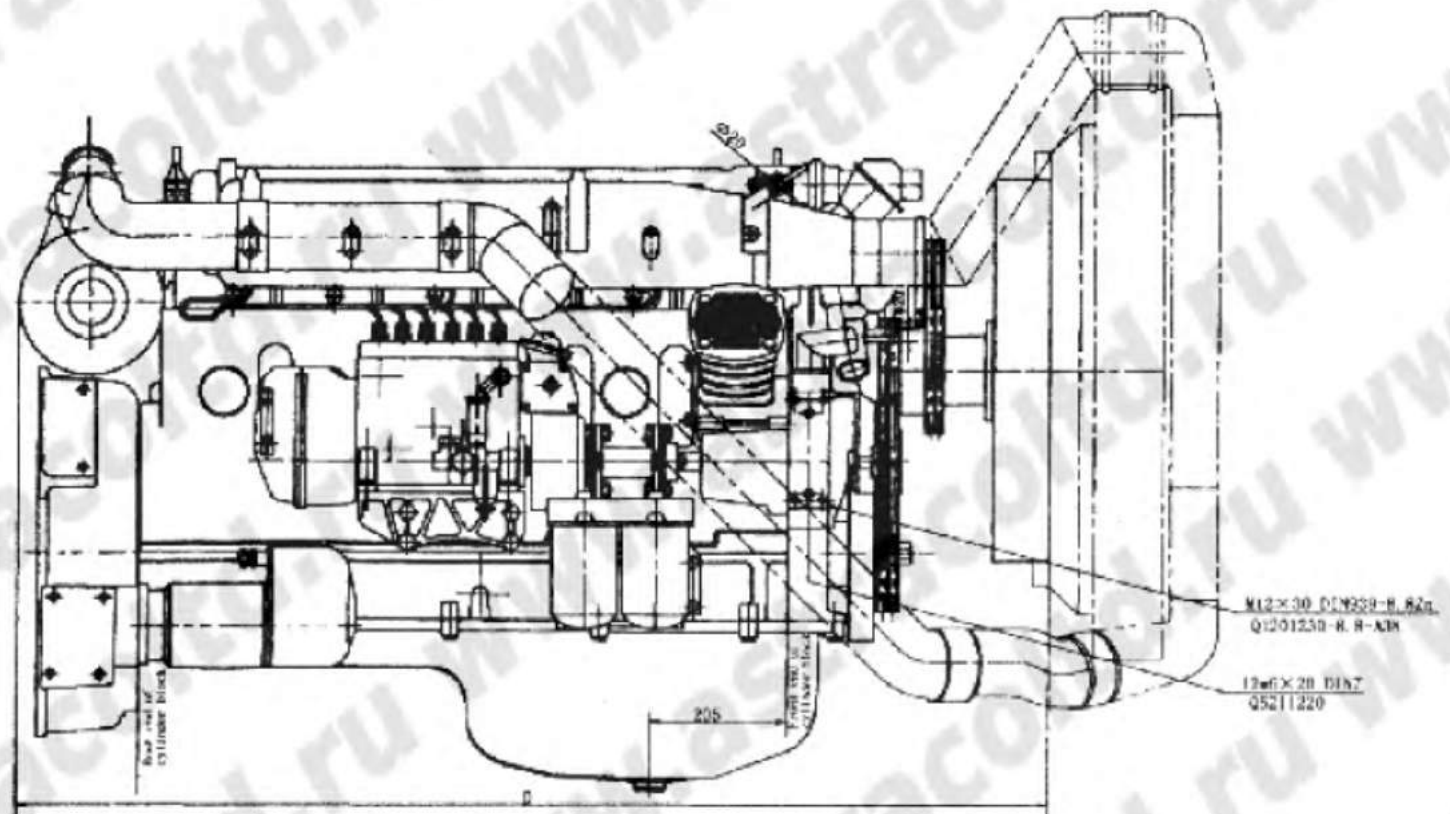
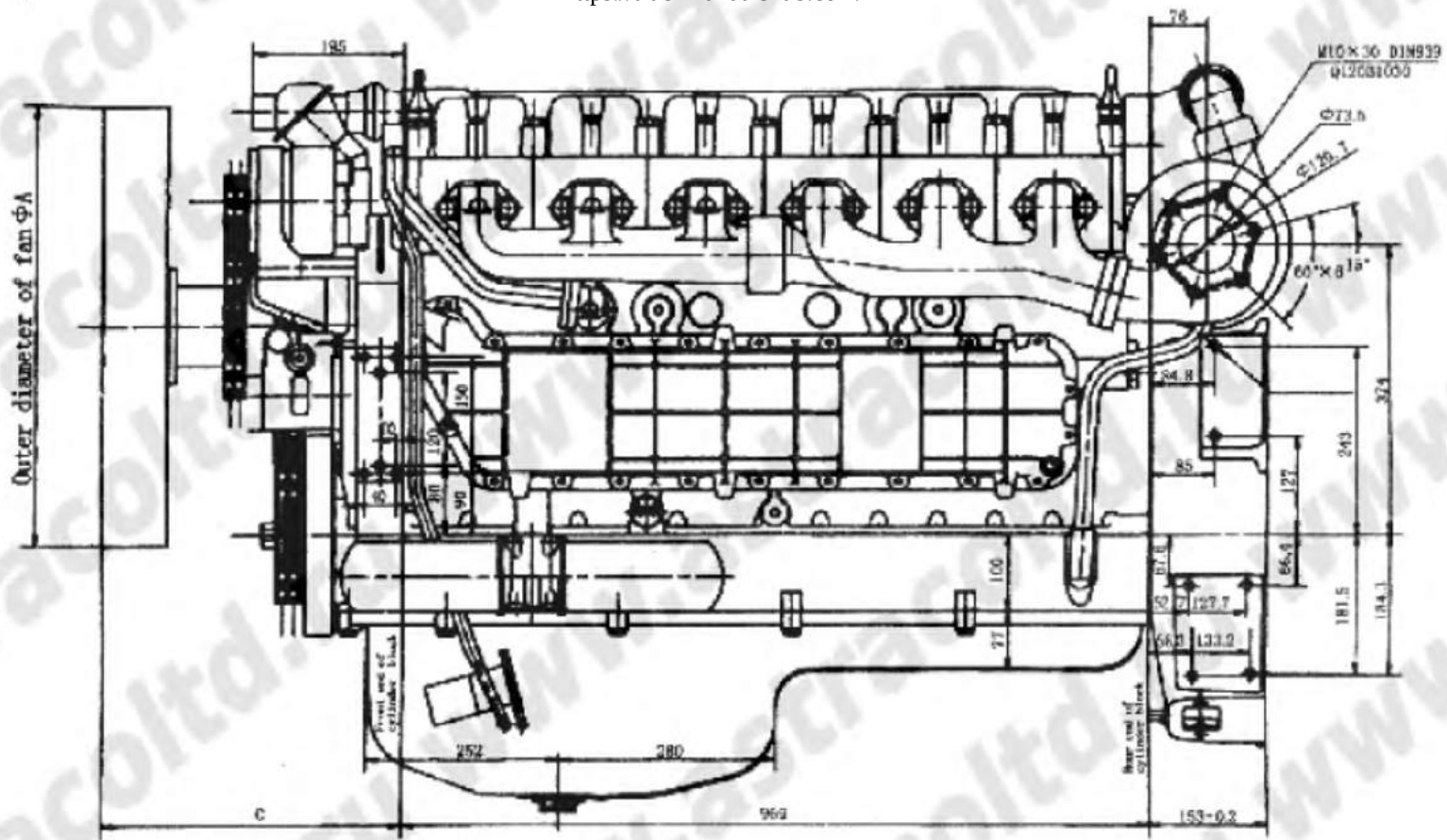
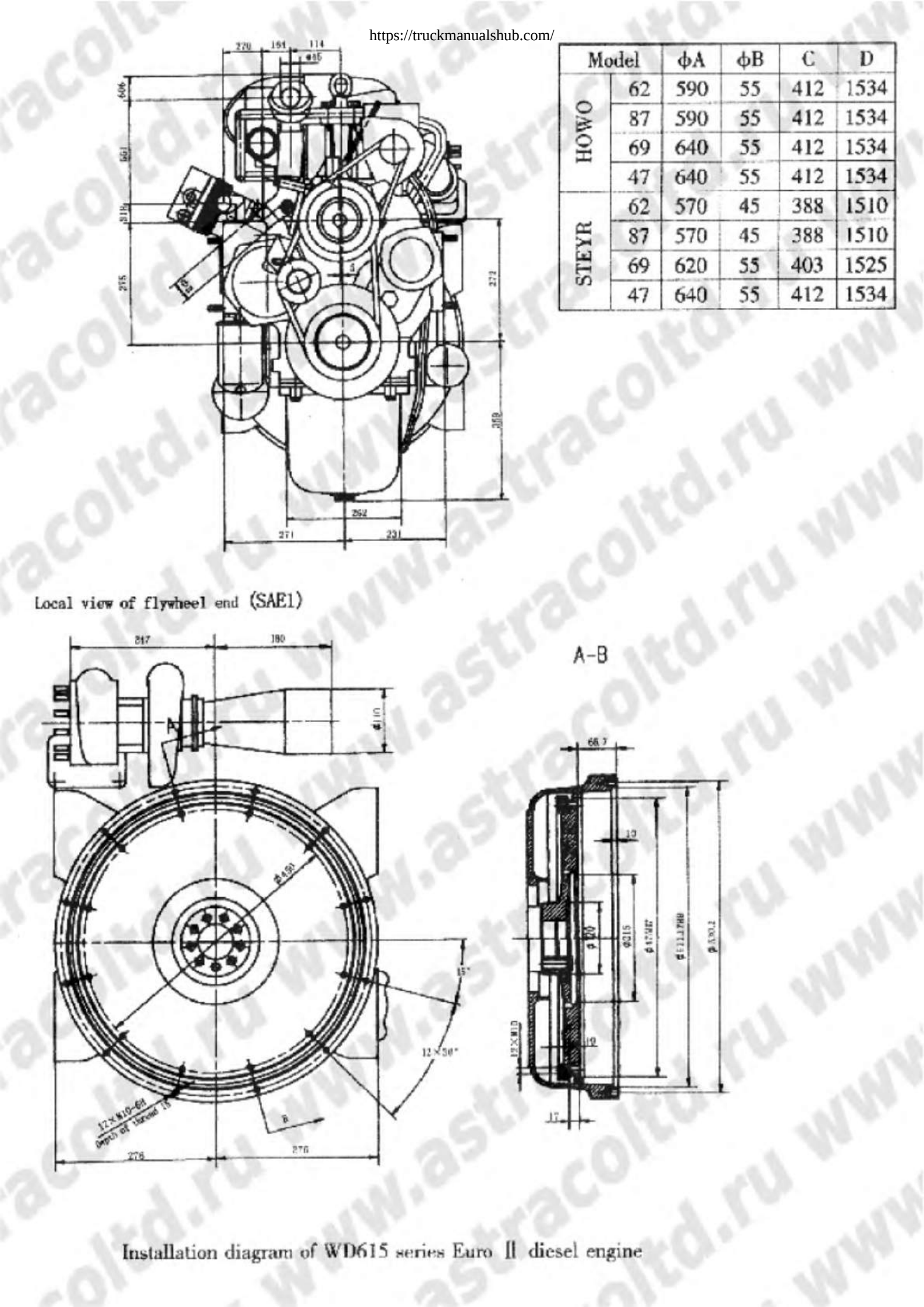


Fig.3 Cross section of WD615 series diesel engine





<https://truckmanualshub.com/>

Model		ϕA	ϕB	C	D
HOWO	62	590	55	412	1534
	87	590	55	412	1534
	69	640	55	412	1534
	47	640	55	412	1534
STEYR	62	570	45	388	1510
	87	570	45	388	1510
	69	620	55	403	1525
	47	640	55	412	1534

Local view of flywheel end (SAE1)

A-B

Installation diagram of WD615 series Euro II diesel engine

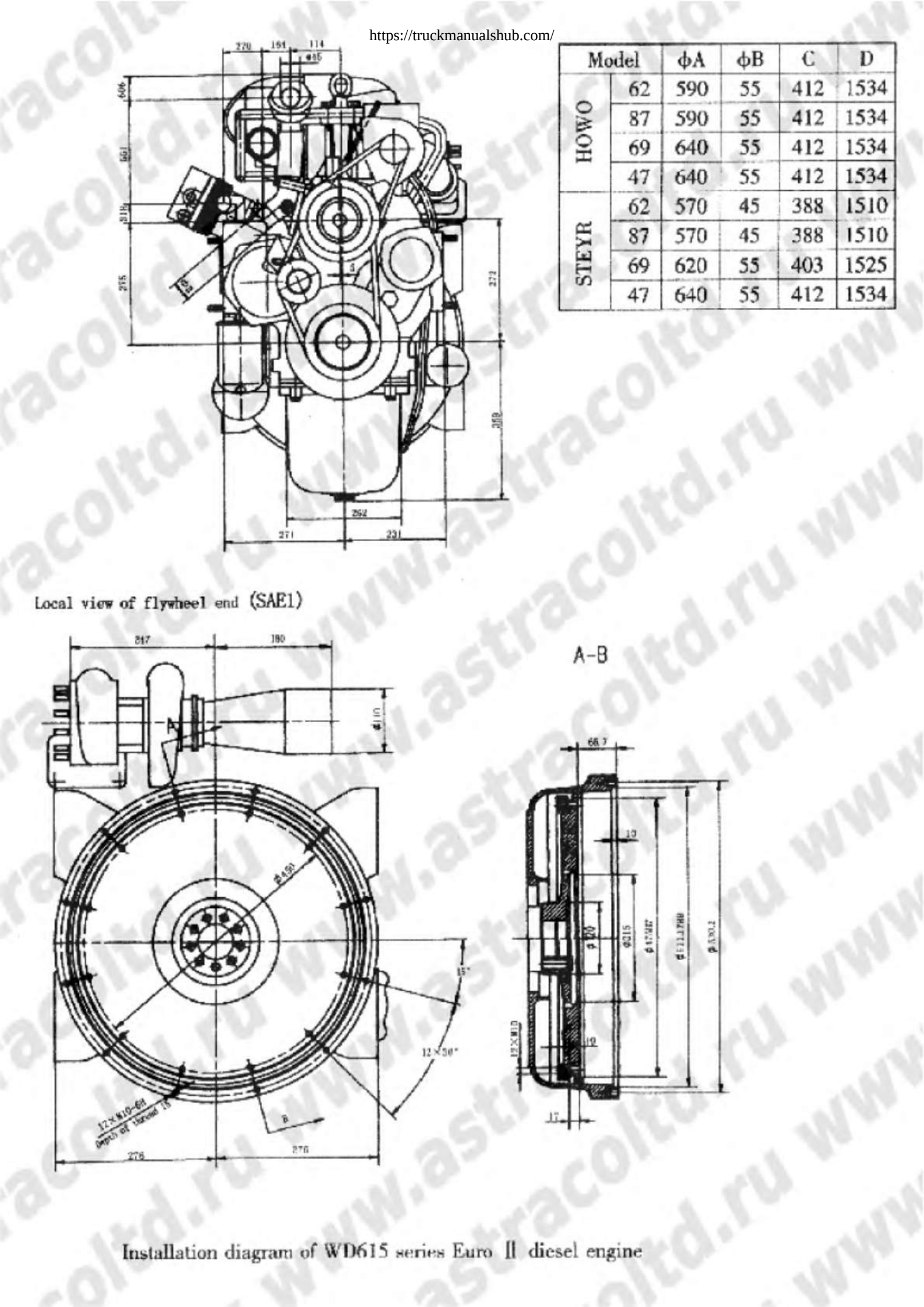
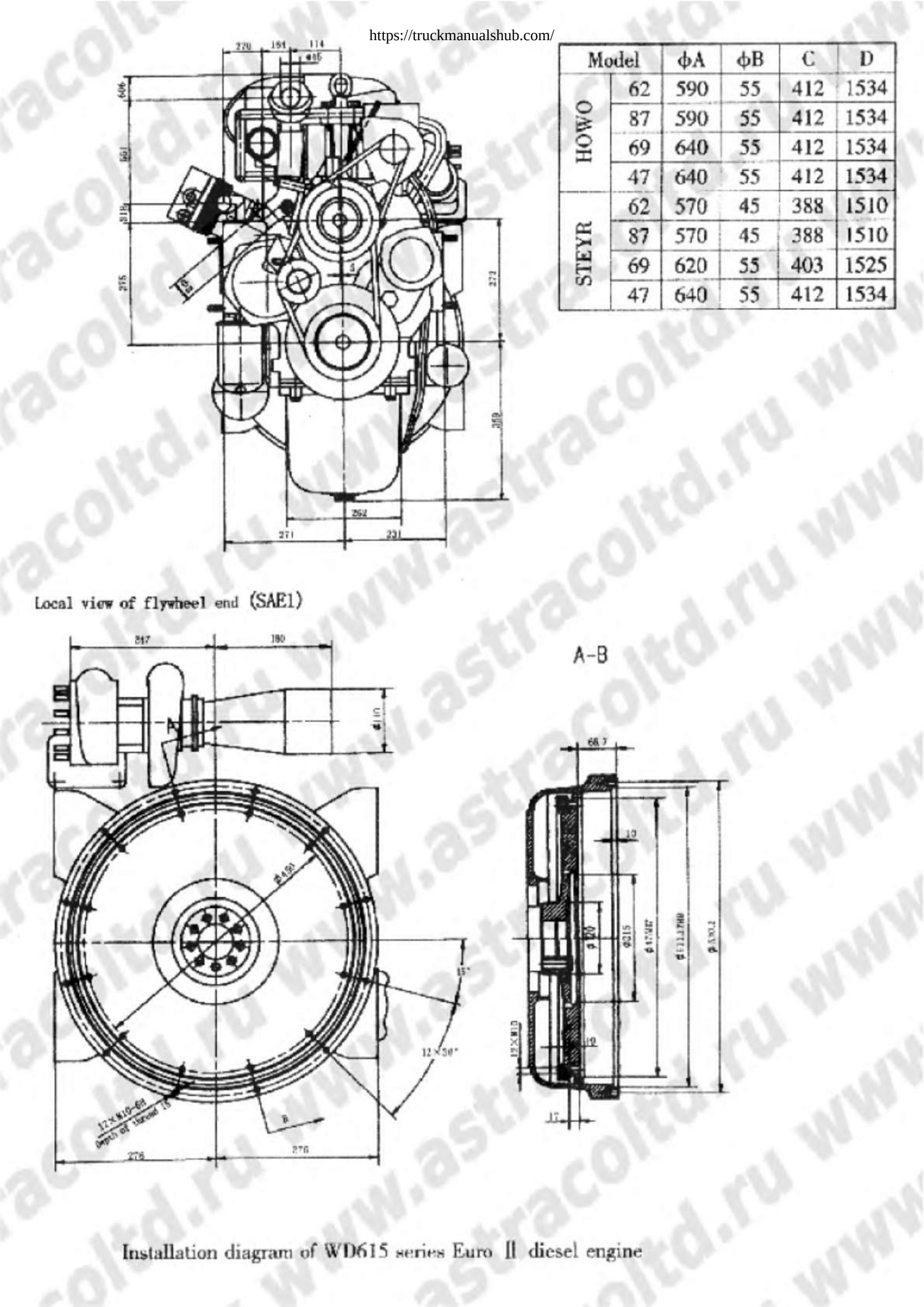
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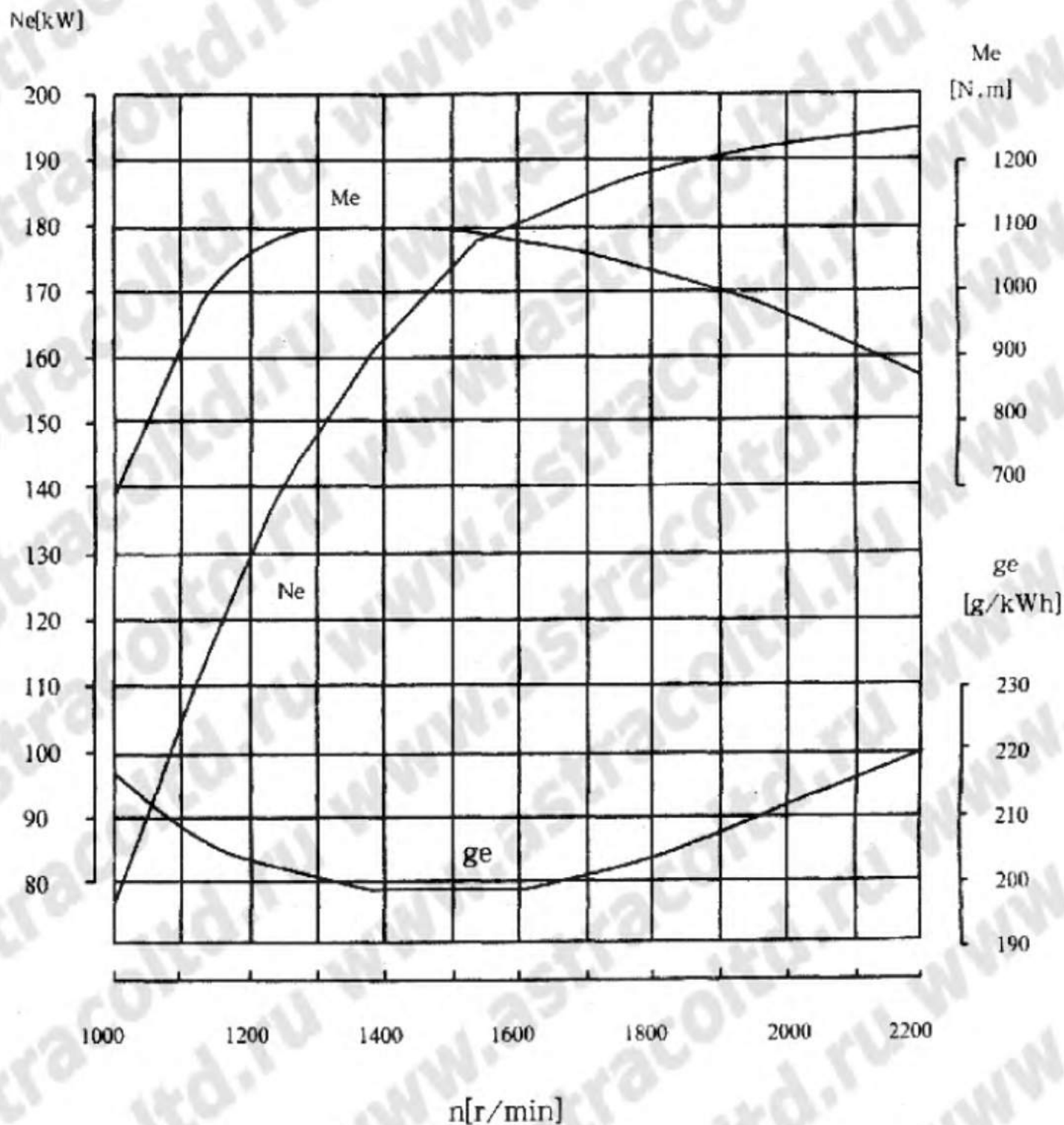
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Installation diagram of WD615 series Euro II diesel engine

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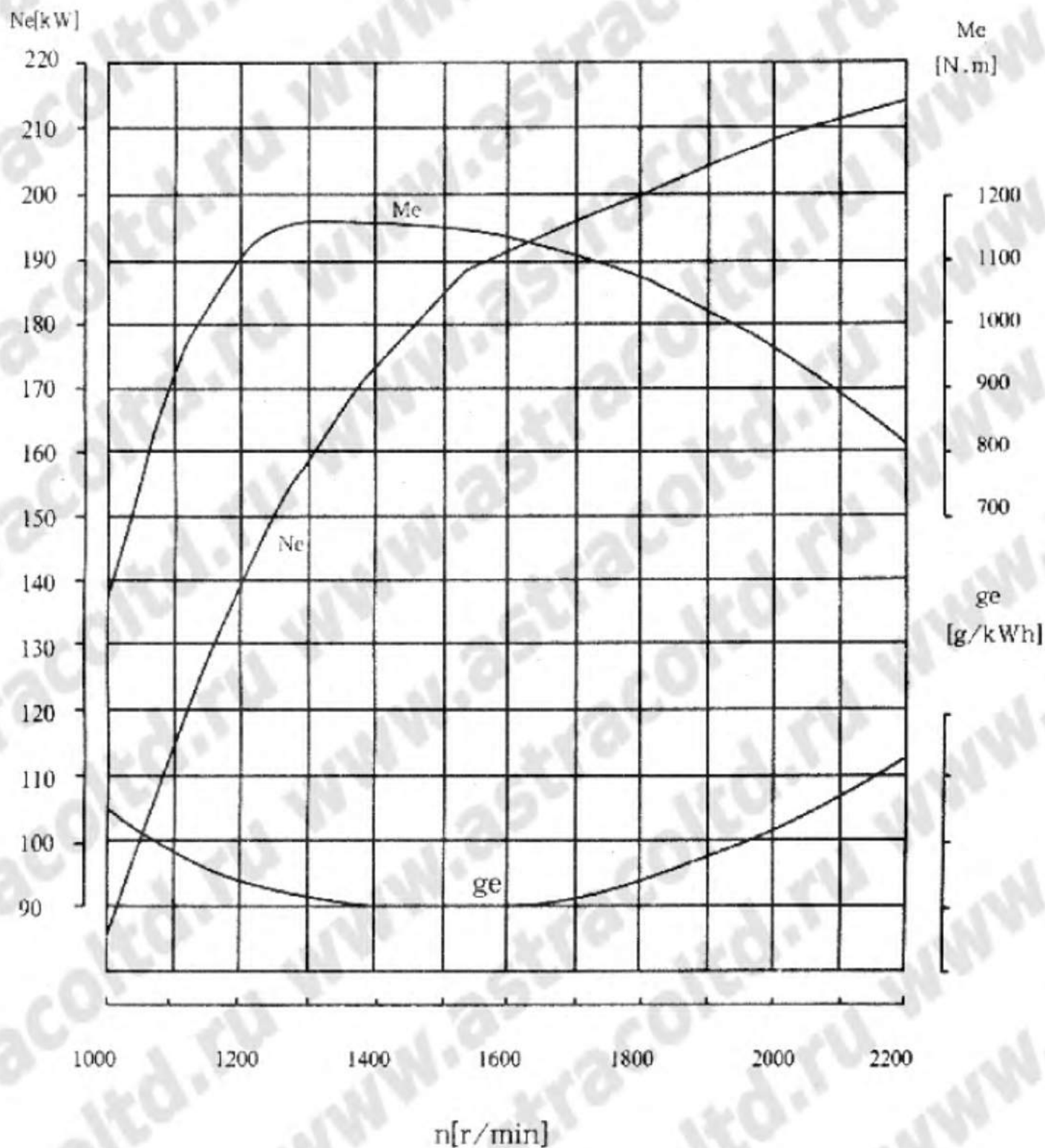
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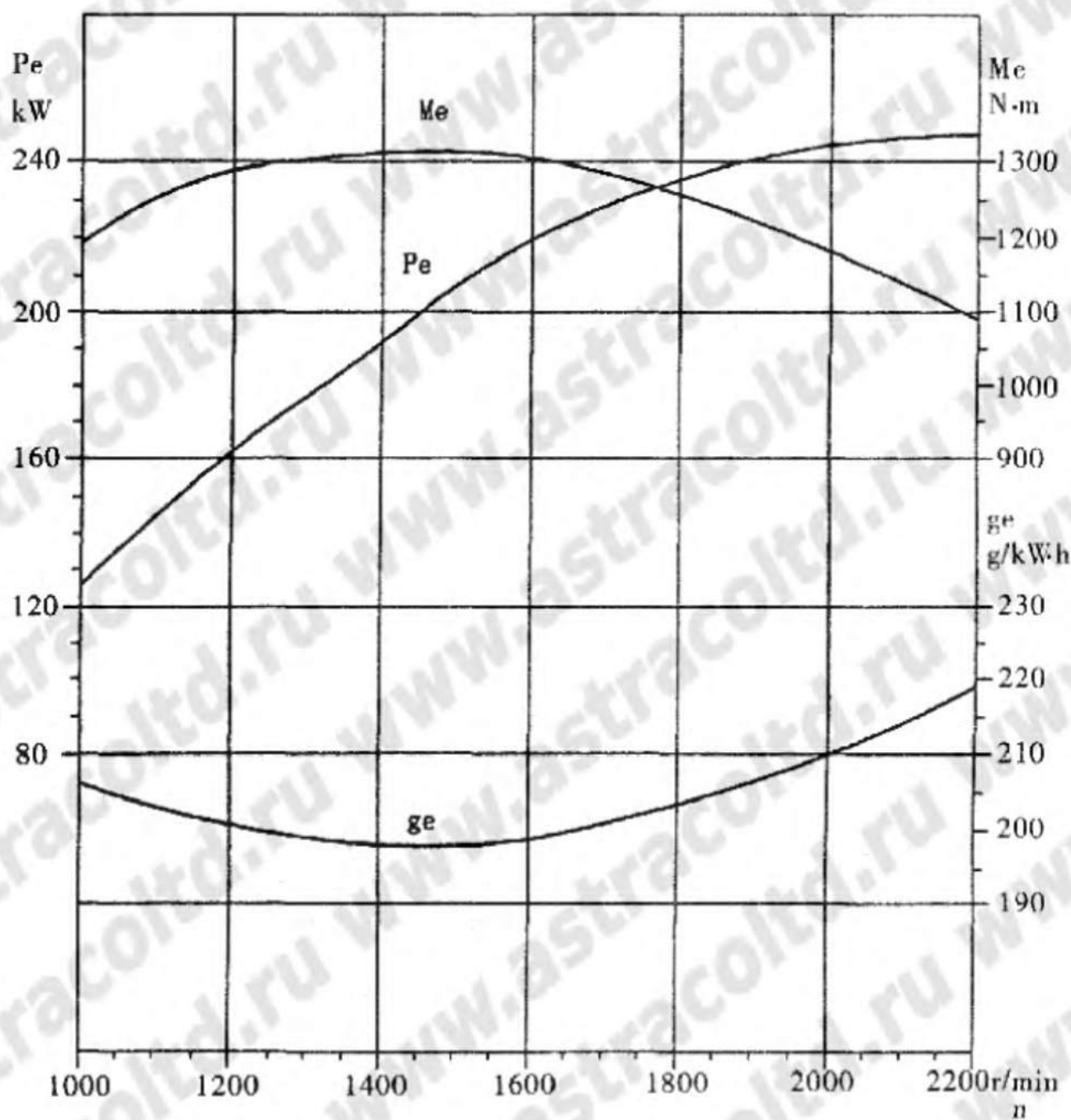
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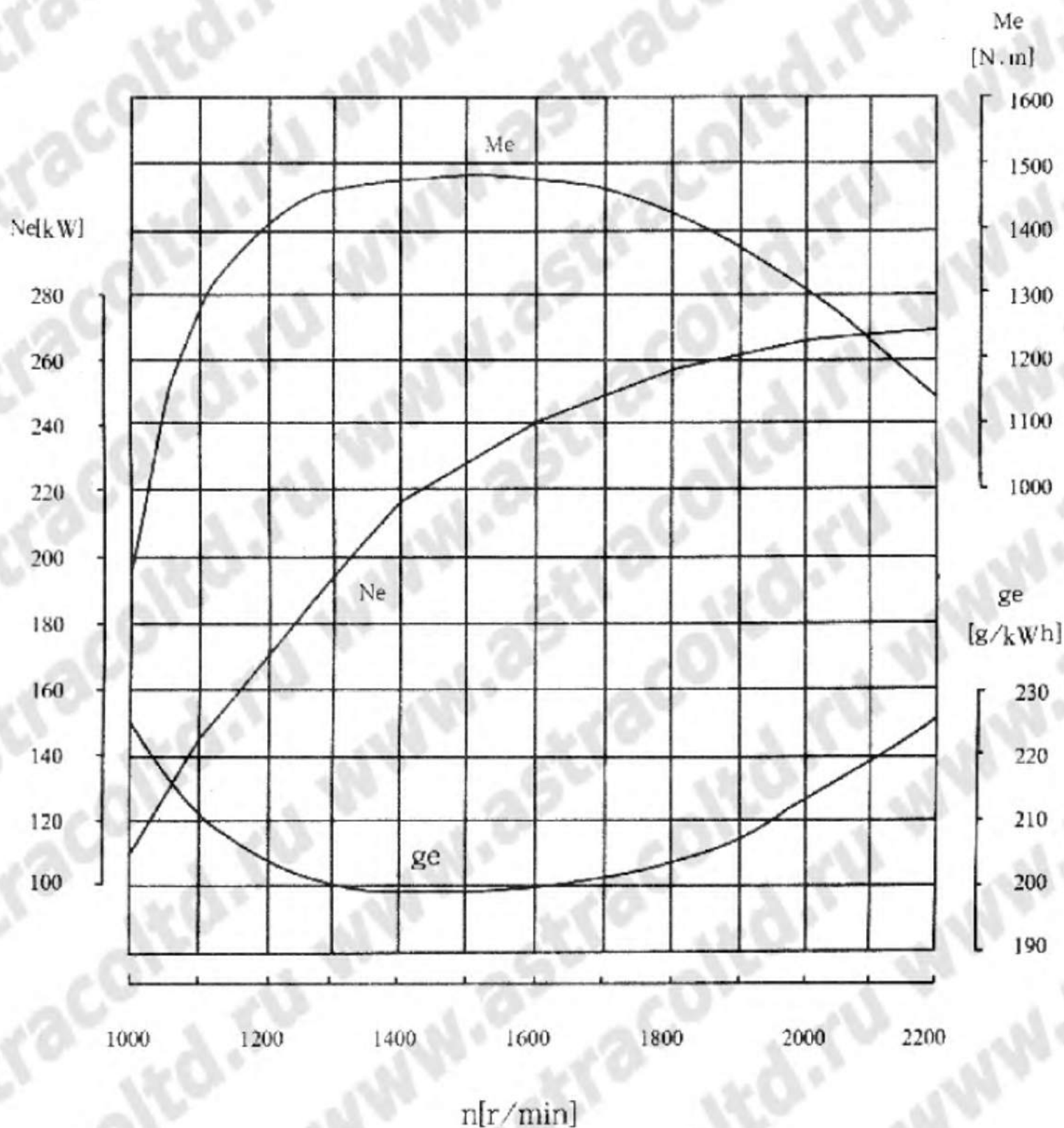
WD61569





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WD61547



1. Main performance and technical of data WD615 series diesel engine

Table1

No.	Model		WD615			
			62	87	69	47
1	Rated power kW(ps) (ISO1585)		196	213	247	273
2	Rated speed r/min		2200	2200	2200	2200
3	Max. torque N.m		1100	1160	1350	1460
4	Speed at max. torque r/min		1100-1600	1100-1600	1300-1600	1300-1600
5	Emission index		EURO II			
6	No. of cylinder		6			
7	Type		Four-cylinder, water-cooled, in-line, direct-injection, dry-liner			
8	Bore/stroke mm		126/130			
9	Displacement L		9.726			
10	Mean piston speed m/s		9.53			
11	Compression ratio		17:1			
12	Compressed pressure kPa		>2000			
13	Intake mode		Turbocharged and intercooled			
14	Firing order		1-5-3-6-2-4			
15	Valve clearance at cold state mm		Intake 0.3 Exhaust 0.4			
16	Valve phase (valve clearance Intake 0.3 Exhaust 0.4)		Intake valve open BTDC 34°-39° Intake valve close ABDC 61°-67° Exhaust valve open BBDC 76°-81° Exhaust valve close ATDC 26°-34°			
17	Thermostat opening temperature °C		80 or 71			
18	Starting method		Electric start			
19	Lubricating method		Pressure lubrication			
20	Oil sump capacity L		23(1st 25)			
21	Cooling method		Water-cooled forced circulation			
22	Oil pressure kPa		350-550			
23	Oil pressure in idling kPa		≥100kPa			
24	Exhaust temperature after turbine °C		≤550			
25	Permitted longitudinal gradient	Front/rear	Long period 10/10 Short-period 30/30			
26	Permitted cross gradient	Exhaust manifold side/ Injection pump side	Long period 45/5 Short-period 45/30			
27	Crankshaft rotating direction (view from free end)		Clockwise			
28	Overall dimensions	Length	1557	1542	1542	1542
		Width	675			
		Height	965			

2. Fuel system matching table

Table 2

Model	Injection pump model	Governor model	Injector model	Injection pres. kPa	High pres. pipe			Timing angle
					Length	Outer dia.	Inner dia.	
WD61562	CB-BHM6P120YAY170 VG2600083082	CB-TJ300-1100PFM70	VG1560080305 KBEL132P110	30000 ^{±800}	600	φ6	φ2	9~10°C
	BH6P120015 VG2600087082	TQ300/1100						
	BHT6P120R VG2600081082	TRQV-K300-1100P						
	PE6P120A720RS7283-1 VG2600082082	RQV300-1100PA1061-2K	VG1560080305 KBEL132P110					9~10°C
	PE6P120A720RS7283-1 VC1560080304	RQV300-1100PA1061-1K	VG1560080276 KBEL132P110					10~11°C
	BHT6P120R VG1560083304	RQV300-1100PA1061K	VG1560080276 KBEL132P110					10~11°C
WD61587	CB-BHM6P120YAY170 VG1560081304	TRQV-K300-1100P	VG1560080305 KBEL132P110	30000 ^{±800}	600	φ6	φ2	9~10°C
	BH6P120015 VG1560087304	CB-TJ300-1100PFM70						
WD61569	PE6P120A720RS7283 VG1560080282	TRQV-K300-1100P	VG1560080305 KBEL132P110					9~10°C
WD61547	PE6P120A720RS7283 VG1560080302	CB-TJ300-1100PFM70	VG1560080305 KBEL132P110					9~10°C

3. Main specifications of auxiliaries

Table 3

No.	Name	Specifications Model	WD615			
			62	87	69	47
1	Fuel filter	Type	Two-stage element			
2	Water pump	Type	Centrifugal (volute is casted integral with gear case)			
		Rated speed, r/min	2585			
3	Oil pump	Type	Gear pump (one-stage commonly, two-stage for specially cases)			
		Opening pressure of safety valve, kPa	1550±150			
4	Crankshaft vibration absorber	Type	Silicone oil type			
		Outer diameter	φ280			
5	Turbocharger	Type	K29、GJ90B、GT42、SJ90-2、S3A			
6	Oil filter	Type	Spiral paper element, paralleled double barrels			
		Model				
7	Thermostat	Type	Wax. type and combined core element			
		Opening temp, °C	80±2			
		Full-open temp, °C	95			
8	Oil cooler	Type	Tube type			
		Opening pressure of the bypass valve, kPa	600±36			
		Testing pressure, kPa	1500			
9	Starter	Type	DC, self-excitation			
		Model	KB-24V 5.4kW			
		Power, kW	5.4			
		Voltage, V	24			
10	Generator	Type	Rectification and voltage regulation			
		Model				
		Power, W	1000 and 1540			
		Voltage, V	28			

No.	Name	Specifications	Model	WD615			
		Items		62	87	69	47
11	Fan	Type	Enhanced polyamide whole type and silicone oil clutch type				
		Outer diameter, mm	570/590		620/640		
		Max. unbalancedness of impeller, gm	30				
12	Inter cooler	Type	Flat tube with corrugated ribbon, air cooling				
13	Clutch (optional)	Type	Spring clutch lining, dry type				
		Model	CF420				
14	Air compressor	Type	Single piston, water cooling				
		Bore, mm	90				
		Stroke, mm	46				
		Total displacement, cm ³	293				
		Operating pressure, kPa	850				
		Max. pressure, kPa	1000				
		Speed ratio to that of engine	1.25				
		Lubricating form	Pressure lubricating				
		Operating form	Continuously				
		Weight, kg	12				
15	Hydraulic (optional)	Min. speed, r/min	750				
		Max. speed, r/min	3900				
		Max. pressure, kPa	13000±1000				
		Flow(rotation direction), L/min	16(left)				
		Max. operating temp., °C	100				
		Inlet screw thread	M26×1.5				
		Outlet screw thread	M18×1.5				
		Outer dia. × Inner dia. (Inlet tube), mm	22×19				
		Outer dia. × Inner dia. (Outlet tube), mm	15×12				

4 Fuel, lubricating oil, coolant and auxiliary material

4.1 Fuel

In summer: 0[#] diesel fuel, GB252

In winter: -10[#] diesel fuel, GB252

When the ambient temperature is below -15°C or -30°C, -20°C[#] diesel fuel and -35[#] diesel fuel should be used separately.

4.2 Lubricating oil

1) CD grade oil should be used

2) Low grade oil replaced by high grade oil is permitted.

3) CD 15W/40 or 5W/20 oil should be used separately when the ambient temperature is above 15°C or below -15°C. (suggested to use oil made by China Shihua Changcheng High Grade Oil Company).

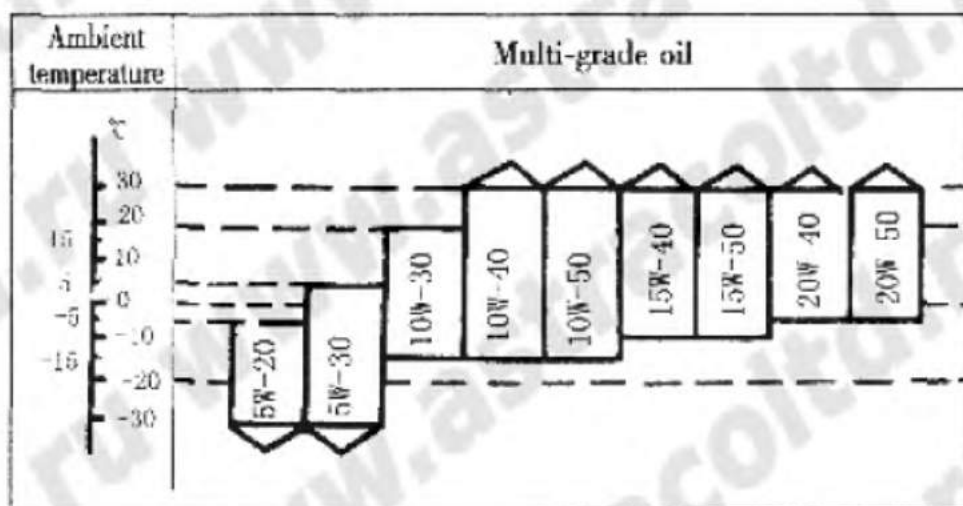
Before engine starting, check the oil level in oil sump firstly. When the oil level is at the upper limit, the oil volume is about 20L, and the lower limit is about 17L.



1. Don't check the oil level when the engine is running.

2. Don't use the oils with different grade.

Table 4 Selection of oil grade



The multi-grade oil with flat viscosity curve is possessed of good lubricating property in the ranges of lower and higher temperature.

4.3 Grease

The lubricating cup is filled with Lithium grease (GB5671-85) generally used on vehicles.

4.4 Coolant

The coolant system is filled with long-acting coolant which has the ability of rust proof and freeze proof. The mixture ratio of long-acting coolant is detailed in the "Instruction of Anti-icing Fluid".

Table 5 Long-acting anti-icing fluid (made in china)

Items	Grade	JFL318	JFL-336	JFL-345
Content of cellosolve solvent ethanediol %		33	50	56
Gravity (at 15.6°C)		1.05	1.074	1.082
Boiling point		104.5±1	108.5±1	110.0±1
Freezing point		-18±1	-36±1	-45±1
Available lowest temp.		-10	-26	-35

1) Check regularly the density of anti-icing fluid when ambient temp.is below 0°C.

2) For engine running in the region above 0°C,rust proof and dirt proof water can be used as coolant.

It's forbidden to use untreated water as coolant.

4.5 Auxiliary materials

- 1) When assembling and repairing the engine,fluid sealants and binders of type Loctite 510,242,275,648 and 277 etc must be used.
- 2) Molykote powder
- 3) Employment position of these auxiliary materials are shown in table 6.

Table 6 Auxiliary material for WD615 series diesel engine

No.	Name	Colour	Applications
1	Molykote powder	Black	Coated on smooth surfaces of metals to prevent bite each other. E.g.the outer surface of cylinder liner,etc.
2	Molykote Gu.plus	Dark grey	Used to lubricate the parts before oil pressure is established.E. g.the surface of inlet valve rod.
3	Loctite 242	Blue	Coated on the outer surface of screw thread bearing to prevent looseness,middle viscosity.e.g.the thread end of pressure-limiting valve for main oil passage.
4	Loctite 262	Red	Coated on the outer surface of screw thread for locking,sealing and looseness proofing,high viscosity.E.g. the thread end of cylinder head bolt.
5	Loctite 275	Green	Coated on the surface of pipe or connection part for fixing.E.g. the outer surface of warming device of water outlet pipe and connection for inlet pipe.
6	Loctite 510	Red(or orange)	Coated on the bright surface of metal for sealing.E.g. the mating surfaces of cylinder block and crankcase.
7	Loctite 277	Red	Sealing the hole with a core,suitable for oil cavity or passage.E. g. mating cylindrical surface of all core plug on cylinder head.
8	Loctite 648	Green	Coated on the bright surface of metal for fixing.E.g. the inner hole surface of tension pulley bearing and the shaft surface.

5. Fit clearance and wear limit of main parts

Table 7

No.	Item	Theoretic value	Wear limit	
1	Main bearing clearance	0.095~0.163	0.17	
2	Connecting rod bearing clearance	0.059~0.127	0.16	
3	Crankshaft axial clearance	0.052~0.255	0.35	
4	Clearance between connecting rod big end and crankshaft	0.15~0.35		
5	Min.clearance of piston skirt at cold state	0.143~0.182	0.35~0.4	
6	Clearance between piston pin and connecting rod small end bushing	0.045~0.066	0.1	
7	Clearance of piston pin in piston pin seat	0.003~0.013		
8	Piston ring end clearance at cold state	1 st ring	0.4~0.6	1~1.2
		2 nd ring	0.25~0.4	1~1.2
		3 rd ring	0.35~0.55	1~1.2
9	End clearance of piston ring at cold state	1 st ring		
		2 nd ring	0.07~0.12	0.28
		3 rd ring	0.05~0.085	0.26
10	Clearance between inlet valve stem and valve guide	0.05~0.086	0.15	
11	Clearance between exhaust valve stem and valve guide	0.03~0.066	0.10	
12	Height between valve bottom face and cylinder head bottom surface exhaust/inlet	1.2~1.4	1.8	
13	Height of nozzle above cylinder head face	3.2~4		
14	Height of cylinder liner above cylinder block upper face	0.05~0.10		



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No.	Item	Theoretic value	Wear limit
15	Camshaft axial clearance	0.1~0.4	
16	Camshaft bearing clearance	0.04~0.12	
17	Clearance between push rod and push rod hole	0.025~0.089	
18	Clearance between cylinder liner out dia.and cylinder bore	-0.01~0.033	
19	Clearance between rocker shaft and rocker	0.04~0.119	
20	Clearance between piston crown and the bottom of the cylinder head	1.0	
21	Valve clearance at cold state inlet/exhaust	0.3/0.4	
22	Gear side clearance	0.15~0.33	

6 Tightening torque and tightening method of main bolts and nuts

Table 8

Name		Tightening torque (N.m)+further turned angle(°)
Main bearing bolts	M18	250^{+25}_0 , the tightening order is shown in fig.4
Connecting rod bolts	M14×1.5	$120+(90^\circ\pm5^\circ)$
Cylinder head		Tightening order is shown in fig.5 and fig.6
Main bolts of cylinder head	M16	$200^{+30}_0+2\times(90^\circ\pm5^\circ)$
Minor nuts of cylinder head	M12	$90^{+10}_0+2\times(90^\circ\pm5^\circ)$
Flywheel bolts	M14×1.5	$60^{+20}_0+2\times(90^\circ\pm5^\circ)$
Flywheel housing bolts	M12	$40^{+20}_0+2\times(120^\circ\pm5^\circ)$
Bolts for oil pump intermediate gear shaft	M10	60^{+5}_0
Camshaft gear bolts	M8	32
Bolts for valve intermediate gear shaft	M10	$60^{+5}_0\text{Nm}+90^\circ$ (Reached to 100~125Nm simultaneously)
Tightening bolts for crankshaft pulley	M10	60^{+5}_0
Nuts for injector plate	M8	25
Tightening nut for injector platen	M8	15
Bolts for exhaust manifold	M10	$(50^{+5}_0)+2\times(90^\circ\pm5^\circ)$
Bolts for rocker bracket	M12	100^{+10}_0
Nuts for compressor gear	M18×1.5	200
Nuts for injection pump gear	M18×1.5	300
Bolts for tension pulley	M16	195
Bolts for oil pump drive shaft bearing plate	M8	25



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Name		Tightening torque (N.m)+further turned angle(°)
Tightening bolts for angle adjustor	M12	130 ⁺²⁰ ₀
	M14×1.5	300 ⁺²⁰ ₀
Connecting bolts for coupling connecting plate	M10	74
	M12	110

Note: The screws, nuts for different parts are not the same in strength. Don't interchange the screws and nuts with same size and different strength.

The tightening sequence for main bearing bolts see fig.4.

According to the sequence in fig.4, pre-tighten up to 50Nm, and then tighten up to 250⁺²⁵ Nm.

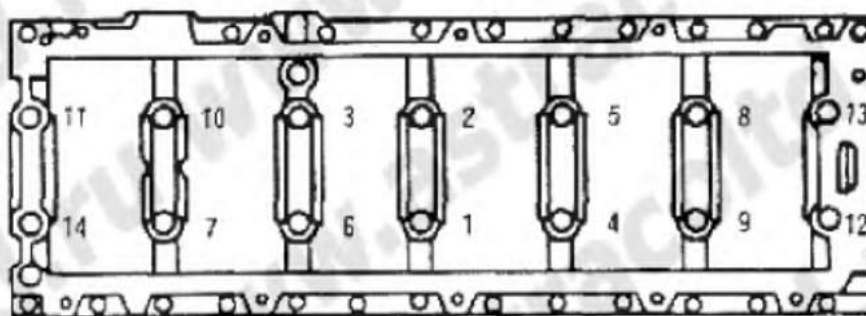
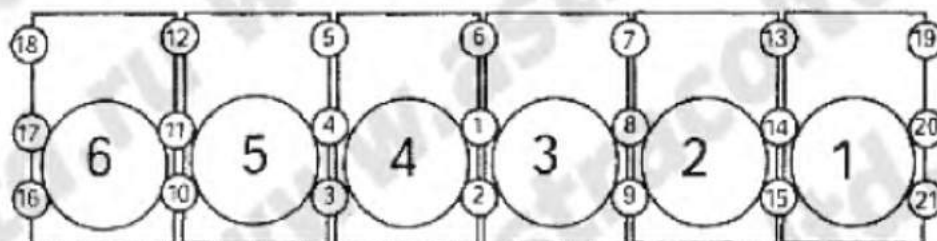


Fig.4

The tightening sequence for the main bolts and subsidiary nuts of cylinder heads see fig.5 and fig.6.

Tightening sequence

- Add some oil on the main bolts and subsidiary nuts and the bearing surface and then tighten up to 30⁺²⁰ Nm.
- According to fig.6, tighten the main bolts up to 200⁺¹⁰ Nm.
- According to fig.5, tighten the nuts to 90⁺¹⁰ Nm.
- According to fig.6, further turn the bolts an angle of 90°.
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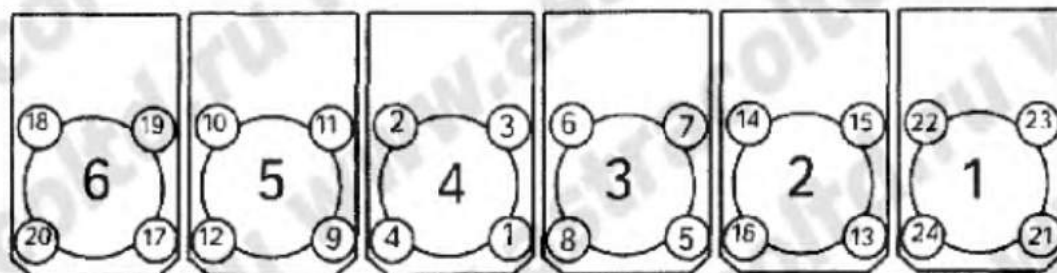


Fig.6

Table 9 Tightening parameters and stipulations for screws and nuts

Bolts and nuts	Tightening norms (manually)		Compression torque after tightened		Elongation ΔL_p (mm)	Reusable times
	Pre-tightening torque Nm	Futher turned angle	$M_{k_{min}}$ Nm	$M_{k_{max}}$ Nm		
Connecting rod bolts	120	90 ± 5	170	250	0.3 ± 0.15	0
Main bolts of cylinder head	200^{+10}_0	$2 \times (90 \pm 5)$	260	380	0.6-1.0	3
Subsidiary nuts and bolts of cylinder head	90^{+10}_0	$2 \times (90 \pm 5)$	120	160	0.4-1.0	2
Flywheel bolts	60^{+20}_0	$2 \times (90 \pm 5)$	230	280	0.2 ± 0.1	2
Flywheel housing bolts	40^{+20}_0	120 ± 5	110	140	0.1 ± 0.15	2

Note: 1) All thread parts and support faces should working with oil.

2) The parameters M_k and ΔL_p must be fulfilled after the bolts are tightened.

3) Do not use the bolts and nuts exceed the "Reusable times".

7 Design features and replacement and adjustment of main components

With compact construction, high rigidity and satisfied performance and fuel efficiency, reliable and long service time, WD615 series diesel engine is suited considerably for heavy-duty truck and engineering machinery.

Design features:

- 1) One cylinder one head, easy to disassemble.
- 2) Left set injection pump (view from the free-end of engine), convenient to arrange the vehicle with the engine.
- 3) Inner-concealed oil cooler, reliable and safe.
- 4) Rear-set turbocharger, compact arrangement and small difference in external dimensions of different engines.
- 5) All of in-line and six-cylinder engines, with high generality.

7.1 Cylinder block, crankcase and flywheel housing

1) Cylinder block and crankcase

The engine body, made of high-strength grey cast iron, is separated into two parts of cylinder block (upper) and crankcase (lower). There is no gasket between them, before mounting, clean the joint faces and coat with Loctite 510 sealant thoroughly. After the cylinder block join up with the crankcase, screw up the main bearing bolts (14×M18), (see also table 8 and fig.4) and then screw up the internal hexagon bolts (24×M8). There are seven main bearings with same width. The stop washer is set in the two sides of the 2nd main bearing seat.

The thin wall (only 2mm) and dry liner is made of wear-resisting high boron or copper-boron cast iron. And transition fit is adopted to the liner and cylinder bore. Platform net lines is specially made in the inner face of the cylinder liner for speed up wear-in and improve wearability. Before mounting, remove away the oil or grease on the surface of cylinder bore and/or the outer face of liner and coat with a layer of Molykote powder. Then push the liner into cylinder bore smoothly by hand or special tools.

The front end and rear end of cylinder block connect separately with the timing gear case and flywheel casing. Loctite 510 sealant should be coated on the joint faces before mounting. There is a main oil passage pass through in the waist of right side of cylinder block. And an auxiliary oil passage is provided at the left side to deliver oil to six nozzles. The pistons are cooled effectively with oil injected by the oil nozzles.

The seven camshaft bearing seats are located in the inner right of cylinder block. At the right side of cylinder block, a water chamber is provided for oil cooler, and six passage is designed under the water chamber for cooling water entering into the narrow space between the cylinder block and liner. There is a joint face for mounting oil filter on the crankcase (below the cylinder block), the oil filter assembly is fixed by four screws (M8) at the joint face coated with Loctite 510 sealant. (fig.1)

A joint face for injection pump support is designed at the middle left of cylinder block.

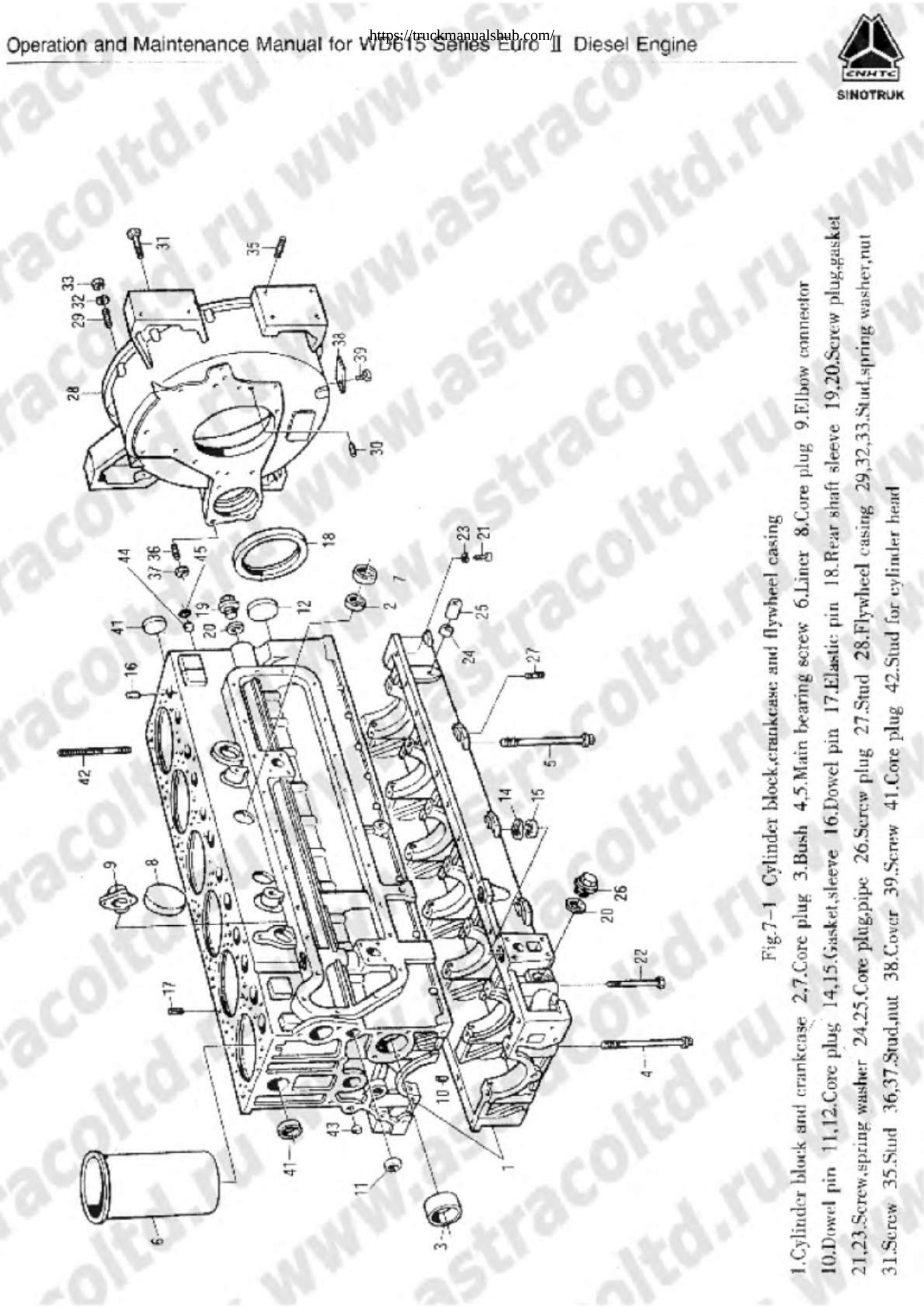


Fig.7-1 Cylinder block,crankcase and flywheel casing

- 1.Cylinder block and crankcase 2,7.Core plug 3.Bush 4,5.Main bearing screw 6.Liner 8.Core plug 9.Elbow connector
10.Dowel pin 11,12.Core plug 14,15.Gasket,sleeve 16.Dowel pin 17.Elastic pin 18.Rear shaft sleeve 19,20.Screw plug,gasket
21,23.Screw,spring washer 24,25.Core plug,pipe 26.Screw plug 27.Stud 28.Flywheel casing 29,32,33.Stud,spring washer,nut
31.Screw 35.Stud 36,37.Stud,nut 38.Cover 39.Screw 41.Core plug 42.Stud for cylinder head

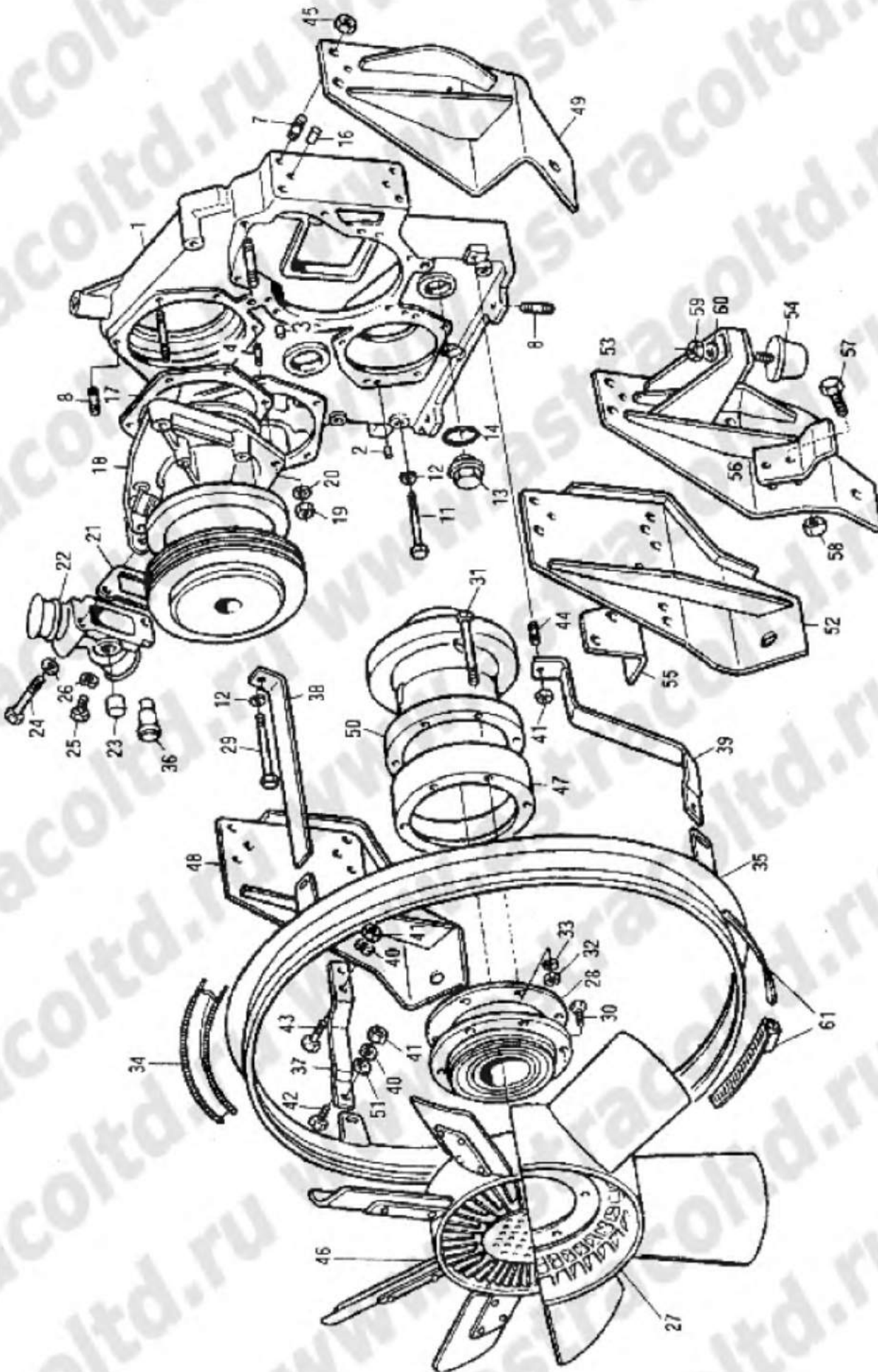


Fig.7-2 Gearcase and fan

1.Timing gear case 18.Water pump 22.Pipe connector 27.Fan 28.Hub 50,52.Support

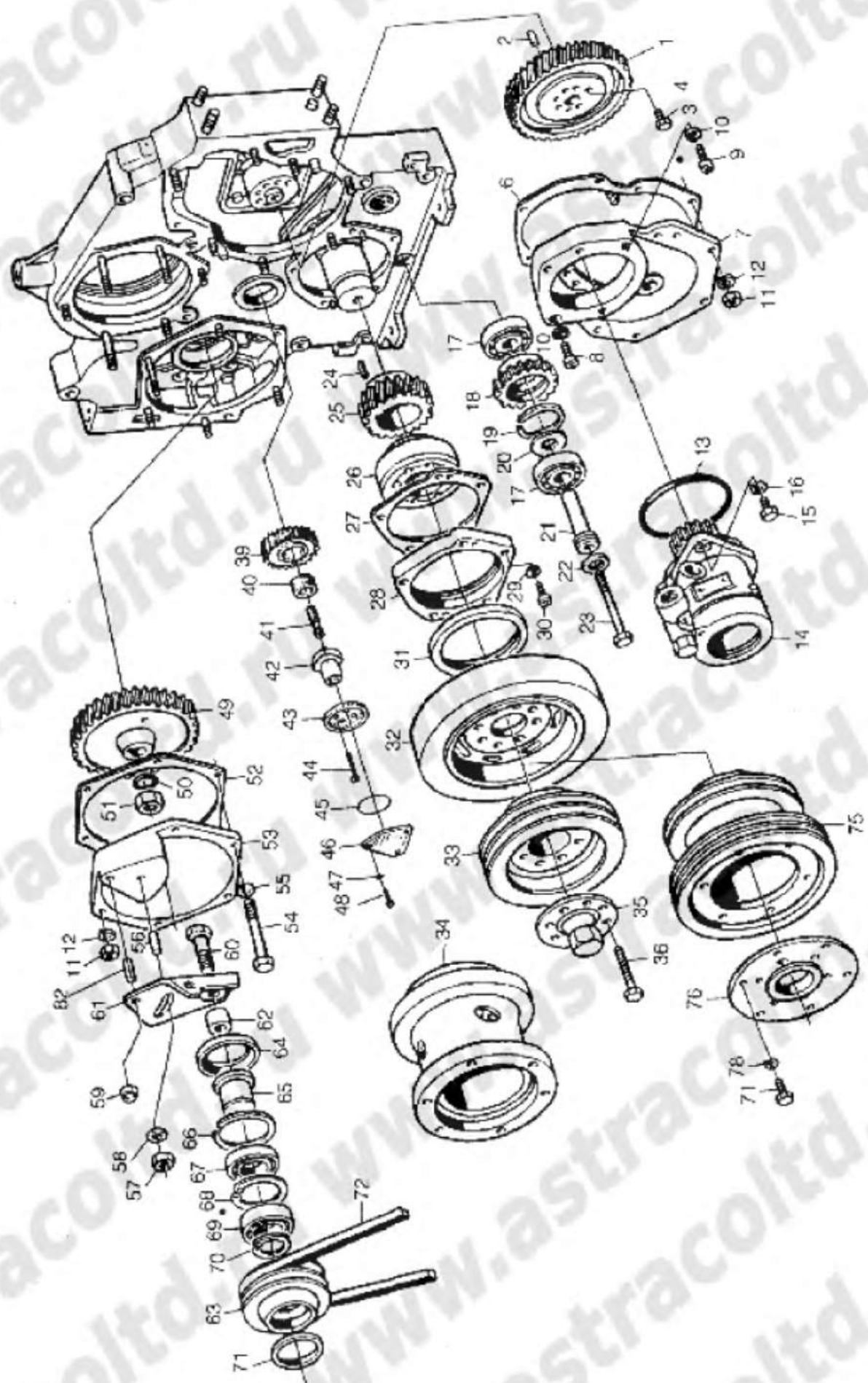


Fig.7-3 Gear train and accessories

1.Camshaft gear 7.Gear cover 14.Hydraulic steering pump 18.Idle gear 25.Crankshaft gear
28.Gasket support 31.Gasket 32.Vibration damper 39.Intermediate gear 49.Injection pump gear
42.Axle 43.Circclip 63.Tension pulley

2) Flywheel housing

SAE1 flywheel housing and flywheel (gear-ring pitch diameter is $\phi 477\text{mm}$) are used, $\phi 420\text{mm}$ clutch plate is used for this flywheel.

7.2 Timing gear case

The gear case is made of high strength grey cast iron with high rigidity. Water pump is mounted on the upside of gear case, and the pump volute is casted integral with the gear case. The outlet of water pump at the back of gear case faces the inlet at the front end of cylinder block. The front support flanges are located at the right and left side of gear case.

Air compressor is mounted at the left and back side of gear case. There are two rolling bearings on the transmission shaft of air compressor. The front bearing is located in gear case and the rear is located in the crankcase of air compressor (see the structure of air compressor for details). The hydraulic steering pump is mounted on the camshaft gear cover (Fig.7-2).

7.3 Gear train

The gear train and accessories see fig.7-3.

1) Transmission gear

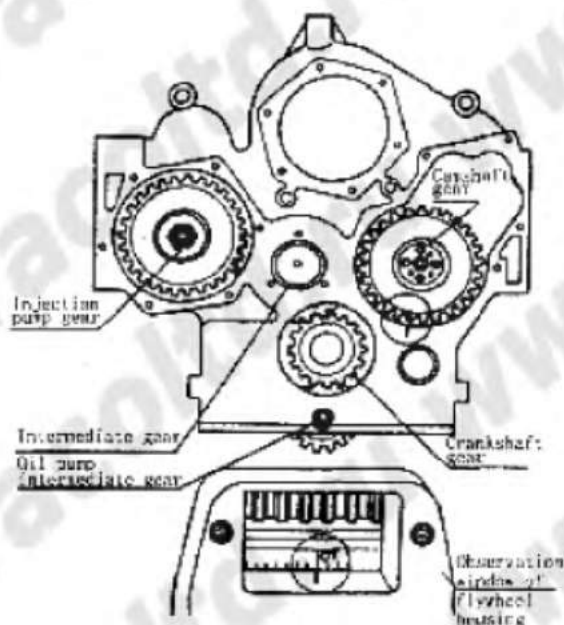
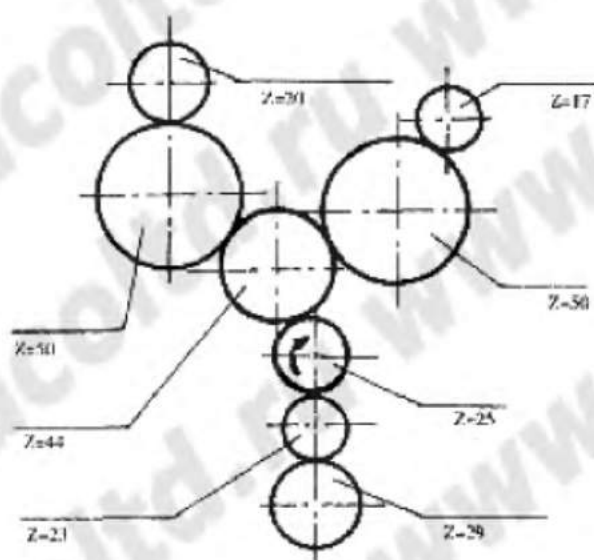


Fig.7-4 Gear train

The gear train of WD615 series diesel engine is composed of eight gears (see fig.7-4). When mounting, the mark on camshaft gear should be half tooth advanced the cut in gear case. (the 1st piston should be at TDC, i.e. the flywheel graduation is of 0°). The delivery advance angle can be adjusted only by loosen the tension screw for the angle regulating plate at the end of transmission shaft. During adjusting, align the needed graduation with the mark on flywheel casing firstly, and then loosen the tension screw and align the marks on fuel pump and advancer. When advancer is not mounted, loosen the pressure pipe of this 1st cylinder of injection pump, turn the camshaft of pump in the running direction of pump, stop turning as soon as fuel overflow from the delivery valve, and then tighten the screw to 130Nm.

When mount the cover for intermediate gear, Loctite 242 sealant must be coated at the thread of the screw, and tighten up the screw with force of 32Nm.

The air compressor gear is fitted on the compressor crankshaft, and the hydraulic steering pump gear is located at the upper-right of camshaft gear.

In order to protect the bearing from ablation, the transmission shaft should be corresponding to the drawing no. of gear case, and the oil grooves in bearing cover and bearing should be at upsides. The cover screws should be coated with Loctite 242 and tightened up with force of 32Nm to prevent looseness result from vibration.

2) Intermediate gear

The structure of intermediate gear is shown in fig.7-5. The rolling bearing is replaced by a sliding bearing which composed of gear axle (3), bushing (4), and core axle (5). Except as an oil passage, the core axle serves the function of ensure the location of gear axle (3). The gear axle (3) is fixed (through a plate 8) on gear case (2) and cylinder block (1) by four screws (6). The supporting rigidity for the intermediate gear is improved largely, and with the radial clearance of intermediate gear is limited in a small range by the sliding bearing, the mesh accuracy of gears is guaranteed. Thus the possibility of trouble is reduced and the service life of intermediate gear is increased.

At the position of intermediate gear, the gear case is sealed with a cover plate (9) and a "O"ring (7).

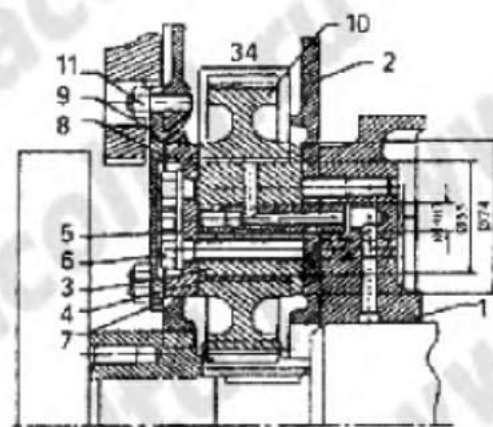


Fig.7-5 Intermediate gear

- 1. Cylinder block 2. Gear case
- 3. Gear shaft 4. Bushing 5. Core axle
- 6. Screw 7. "O"ring 8. Plate 9. Cover plate
- 10. Intermediate gear 11. Stud, nut, washer

7.4 Main moving parts

1) Crankshaft

There are two kinds of steel forging crankshaft for WD615 diesel engine according to the requirements. High-quality 45 steel crankshaft is used for the engine which rated power is lower than 220kW and 42CrMo steel crankshaft for the engines of 220kW or more than 220kW. There are twelve balance blocks on the crankshaft. The widths of main journal ($\phi 100$) and connecting rod journal ($\phi 82$) are all of 46mm. The fatigue strength and wearability of crankshaft are increased greatly by heat-treated with soft nitrogen.

There is a flange at the front end of crankshaft and the outer surface of the flange acts as the sealing face of oil seal of crankshaft. (fig.7-6)

The vibration absorber and pulley are connected with the flange through eight screwed holes (M10). Before assembling, crankshaft gear and the flange should be heated respectively to 180°C and 290°C.

The front end oil seal of crankshaft is of 95×115×12 skeleton rubber oil seal, and the rear is of 115×140×12 oil seal.

2) Vibration absorber

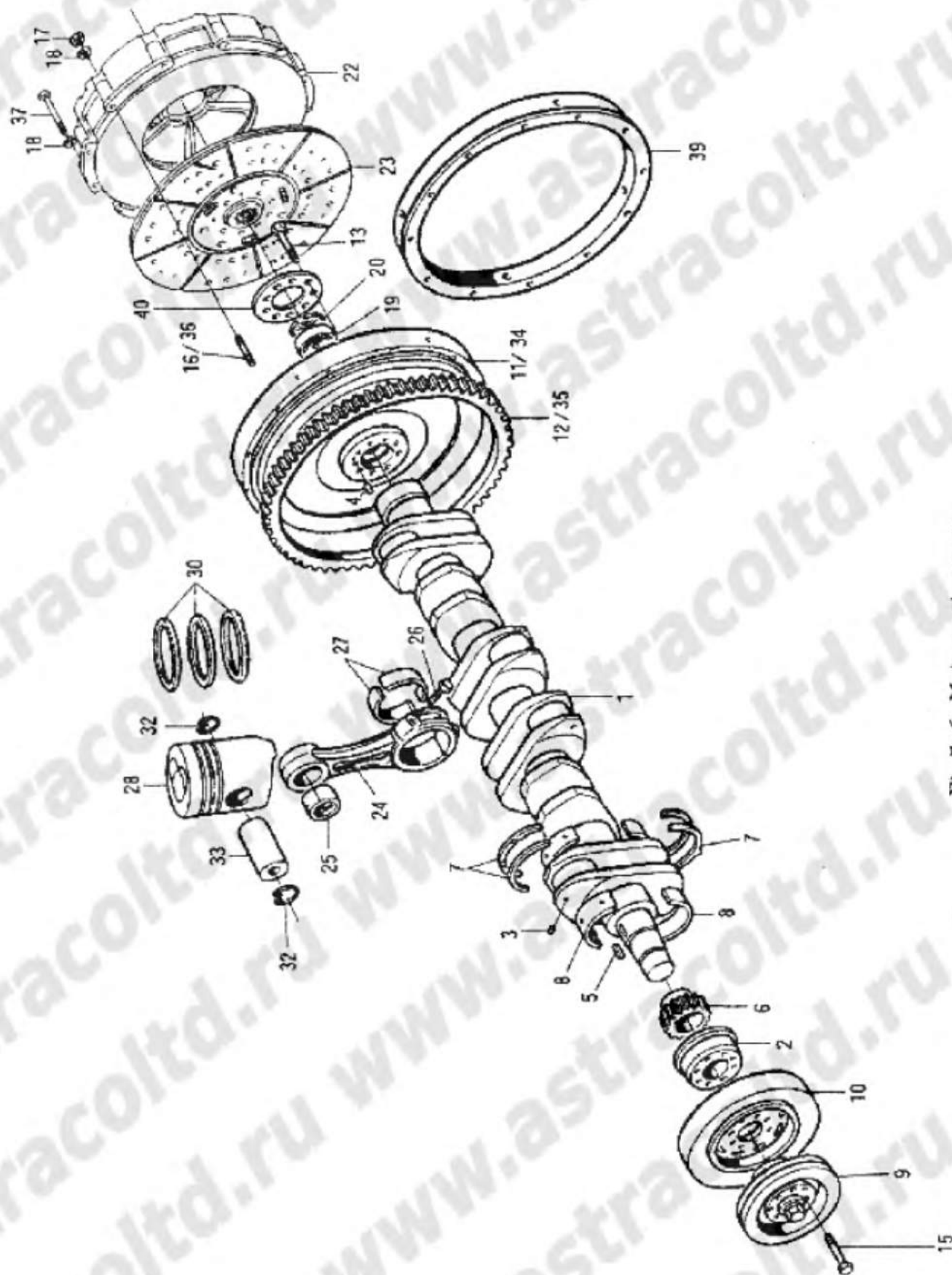


Fig.7-6 Main moving parts

- 1.Crankshaft 2.Flange 3,4.Dowel pin 5.Key 6.Gear 7.Stop washer 8.Main bearing 9.Pulley
- 10.Vibration absorber 11,34.Flywheel 12,35.Gear ring 13.Screw 15.Bolt 16.Stud 19.Sliding bearing
- 20.Circle clip 24.Connecting rod 25.Bushing 26.Bolt 27.Connecting rod bearing 28.Piston 30.Piston ring
- 32.Circle clip 33.Piston pin 39.Intermediate flange

With reliable performance and good effect, the silicon oil vibration absorber is used for WD615 series EURO II diesel engines. The diameter of vibration absorber is $\phi 280\text{mm}$.

3) Flywheel

SAE1 flywheel (with 159 gear ring teeth) is used. The mating clutch lining is of 420mm in diameter. Clearance fit is used between SAE1 flywheel and gear ring.

4) Piston

The piston for WD615 diesel engine are made of cast aluminium alloy. A cast iron ring is inlaid in the first ring groove, and is bonded well together with the piston for good heat transfer. There are three rings on one piston (two gas rings and one oil ring). The first gas ring is of double-side ladder cylindrical ring with a cut on the top end. A layer of molybdenum is sprayed on the surface of this ring for improve wear-in and scratch resistance and reduce wear and tear. The second ring is of chromium-plated cone ring. And the third ring is of a combination oil ring which is made of cast iron, the outer surfaces are chrome-plated and there is a spiral spring in it. The diameter of piston hole is 50mm. In order to improve the stress distribution on the pin seat, the pin seat is designed with a pressure reducing groove. And complex shape line skirt is effective on the fine contact of the piston and the cylinder liner. For reduce wearing, a layer of graphite is sprayed on the surface of the skirt.

For different engine models, the circular dimensions and capacities differ from each other. The clearance between cylinder head and the piston at TDC is 1mm. According to the diesel engines, the oil spray holes differ in size, the weight differences of pistons in the same group must be less than 10g.

5) Piston pin

The inner and outer surfaces of $\phi 50\text{mm}$ piston pin are surface hardened carburizing, the surface hardness is about 57-65HRC.

6) Connecting rod

The die forged connecting rod is 45° sectioned at the big end, and the mating faces is located with 60° teeth and connected with two connecting rod bolts (M14 $\times$ 1.5). Tighten up the bolts according to table 8 and 9.

The bolts are made of C2CrMo alloy, performance grade is 12.9.



The connecting rod bolts can be used only one time.

The small end bushing (thickness: 2.5mm) with a "T" oil groove is made of steel backing copper-lead-bronze alloys.

The weight differences of connecting rods in the same group must be less than 29g.

7) Connecting rod bearing

This connecting rod (unequal thickness) bearing is made of steel backing aluminium-zinc alloy with a layer of plated trimetal. For engines of more than 220kW, the upper half of connecting rod bearing is of "rillenlager" bearing with higher fatigue-resistance and bearing capabilities.

8) Main bearing

The main bearing made of high zinc-aluminium alloy is of steel backing and equal-thickness bearing. The

widths of the seven bearings are the same.

9) Thrust bearing

Material: steel backing low zinc-aluminium alloy.

7.5 Cylinder head and valve system

1) Cylinder head

The cylinder head with one inlet valve and one outlet valve is made of cast alloy, and one head for one cylinder. The intake duct and exhaust passage are designed separately at the two sides of the head. In order to improve the heat radiation and reliability of the nozzle, a copper sleeve for injector is inlaid in the head. The cooling water enters into cylinder head, then to the water cavity in the nose bridge of the head. By brush through the copper sleeve, the water gets into outlet pipe. A depression (1.5mm in depth) is machined at the nose bridge to prevent heat cracking. Valve seats made of special cast iron are inlaid at the inlet and outlet valve ports. The cone angles of inlet and outlet valve seats are 110° and 90° respectively. The sinked height of valve after fitted in the head see table 7, and sinked height after operation should be not more than 1.8mm, the structure of cylinder head assembly see fig. 7-7.

A sealing bushing is set on top end of valve guide to prevent oil get into the gas passage from the gap of the guide. Each cylinder head is pressed against the block by four bolts (M16), and the two adjacent cylinder heads are held down by three studs (M12) with help of a set of lock nuts and other parts. The main bolts and the nuts should be tightened up according to table 8, 9 and fig. 5 and 6.

The injector is set at the left side of cylinder head with a inclination of 75° from the bottom face. After mounted, the tip of injector should be 3.2-4.0mm bulge from bottom surface of cylinder head.

2) Valve

Inlet valve: high strength chromium alloyed steel, and surface chrome-plated on valve rod.

Outer valve: friction welded up with two kinds of high-temperature materials. The valve surface is built up with Stellite F(P 73), and valve rod is surface chrome plated.

3) Valving system

The camshaft of the engine is made of high-carbon steel. The lubricating oil is intaked from the main journal through the medium of the small inclined passage in the tappet hole. When the concave face of the tappet is connected with oil passage, the oil is delivered from the centre through hole and the hollow screw to the rocker bearing. And there is some oil is delivered to the top of the rocker.

Valve phase positions of WD615 diesel engine are as follow:

When the clearance between rocker arm and inlet valve is 0.3mm and rocker arm and outlet valve is 0.4mm in cold condition;

Inlet valve open: 34° - 39° CA before TDC

Inlet valve close: 61° - 67° CA after BDC

Outlet valve open: 76° - 81° CA before BDC

Outlet valve close: 26° - 34° CA after TDC

Adjusting the valve clearance according to fig. 7-8 and 7-9.

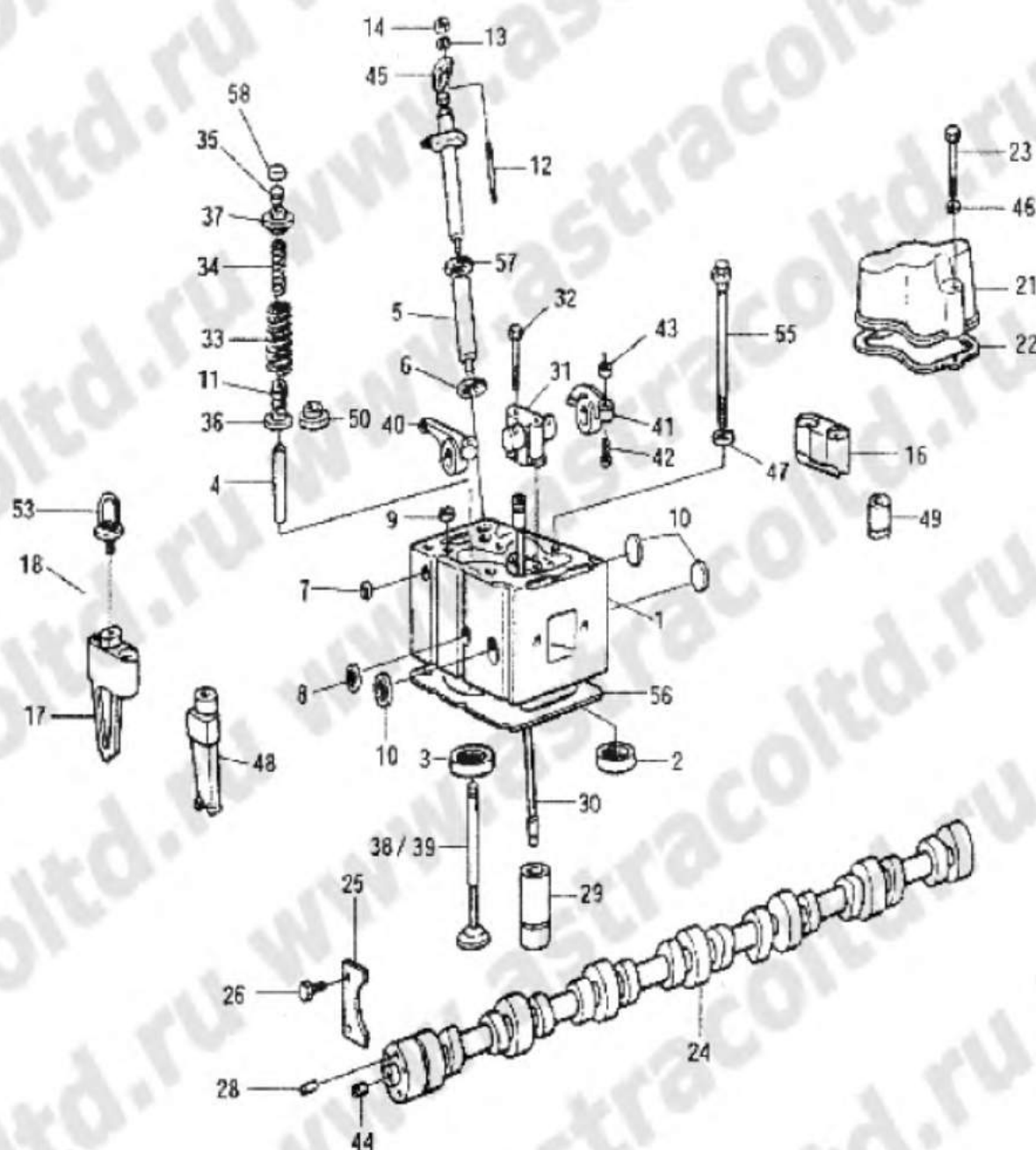


Fig.7-7 Cylinder head and valving system

- 1.Cylinder head 2.Exhaust valve seat ring 3.Inlet valve seat ring 4.Valve guide 5.Copper bushing
6.Gasket 7,8,9,10.Core plug 11.Gasket 12.Stud 13,14.Spring washer,nut 16,17.Clamp block
18.Washer 21,22.Cylinder head cover,gasket 23,46.Screw,washer 24.Camshaft 25.Thrust washer
26.Screw 28.Cylindrical pin 29.Tappet 30.Push rod 31.Rocker bracket 32.Screw 33.Outer valve spring
34.Inner valve spring 35.Valve clip 36.Spring base(inlet valve) 50.Spring base(outlet valve)
37.Spring plate 38,39.Inlet/outlet valve 40,41.Rocker arm 42,43.Screw,nut 44.Driver 45.Clip
55.Screw 49.Clamp block 53.Screw 56.Cylinder gasket 57.Gasket

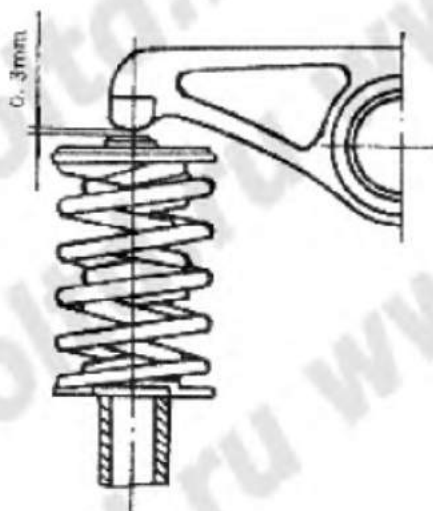


Fig.7-8 Cold valve clearance(inlet)0.3mm

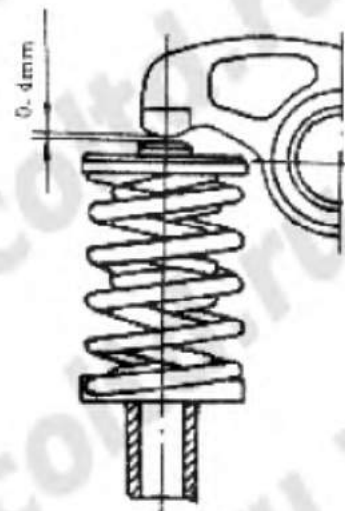


Fig.7-9 Cold valve clearance(outlet)0.4mm

The valve lash,clearance between rocker arm head "R"face and valve end or valve cap,should be adjusted by regulating the adjusting screw on rocker arm.Valve lash should be checked in second order maintenance or after reassembly,pay attention to that the valve should be in full closed status in inspection.There are two methods in checking valve lash sequence in each cylinder;First turn the crankshaft according to the engine firing order(1-5-3-6-2-4) and make this cylinder to TDC of work stroke.At this time,the intake and exhaust valves are fully closed,adjust the valve lash and rotate the crankshaft to 720° in total.Second,turn the crankshaft to 360°,adjust No.1 cylinder intake and exhaust valve lash and valve lash of No.2,4 intake valve and No.3,5 exhaust valve simultaneously when No.1 cylinder piston is at TDC of work stroke.Then adjust valve lash of No.6,3 and 5 intake valve and No.6, 2 and 4 exhaust valve after rotating crankshaft to TDC of work stroke for No.6 cylinder.

7.6 Lubricating system

The function of lubricating system is reducing wear and corrosion,washing and cooling for parts.Lubricating oil should be adopted in accordance with the factory regulations.Multi-grade oil has top priority for its better cold-start characteristics.Multi-grade oil used in all climate such as 5W30,10W40,15W40 are applied in the specified temperature range.Take proper measures to preheat oil or exchange another adaptable to temperature when low ambient temperature occurs occasionally.

Oil exchange interval should be defined according to the requirements in maintenance and service.



When exchange oil each time,replace oil filter at the same time

1) Pressure lubrication

The lubrication oil is drawn from the oil sump through the sump strainer into the oil pump,and is fed to the oil filter and oil cooler and then enters into the lubricating parts through the oil passages.Most part of oil enters into the main bearing and flows to connecting rod bearing through the oil port in crankshaft.The cylinder liner and piston pin are lubricated by oil injected from nozzle.

Valve operating system,turbocharger,high pressure pump,air compressor,intermediate gear bearing are also pressure lubricated through oil pipe and oil groove.Oil pressure in oil circulating system is adjusted by relief valve(as shown in fig.7-10a,b).

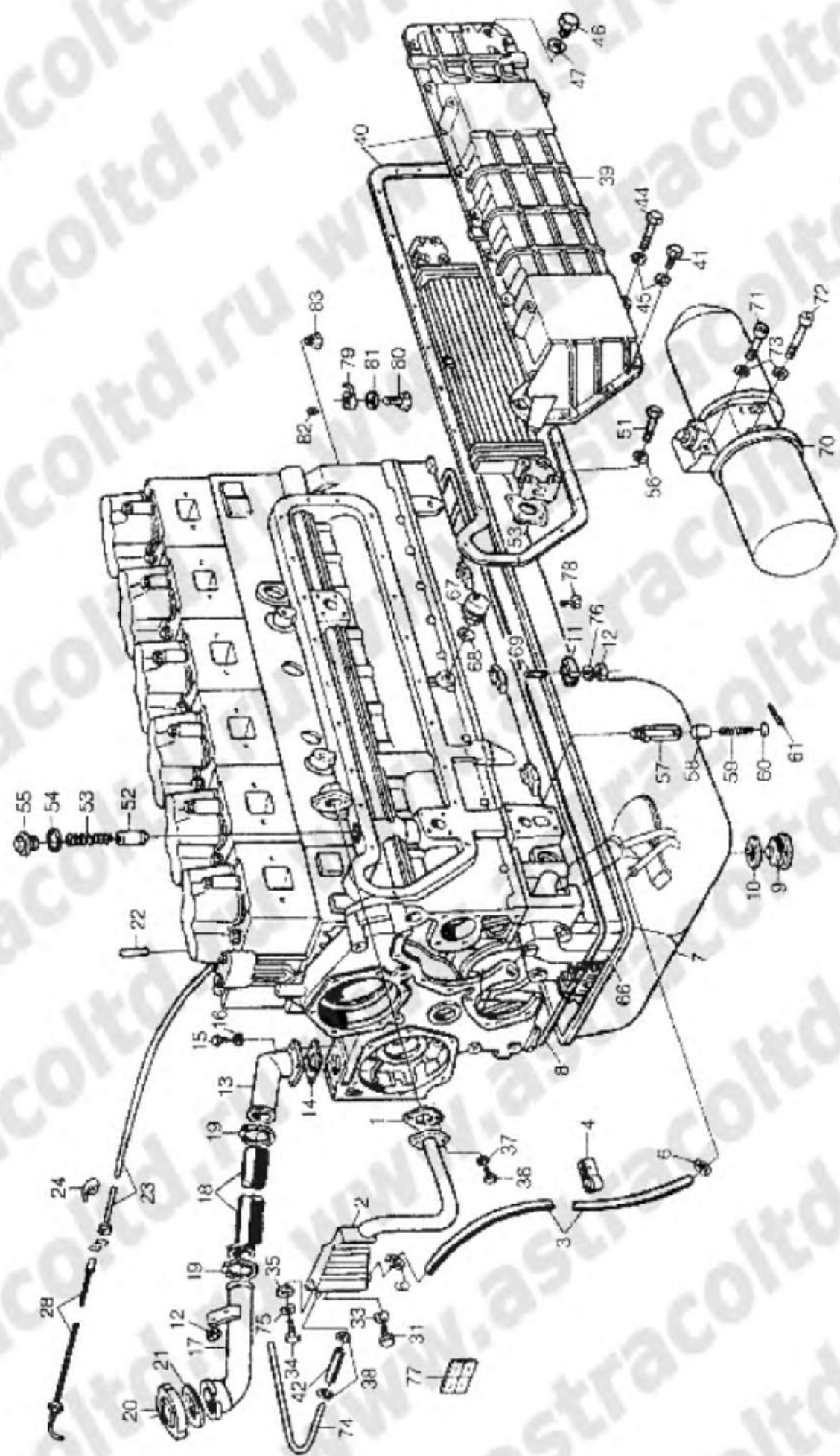


Fig.7-10a Lubricating system and the relative components

- 1,2.Oil and gas separator,gasket 3.Rubber hose 7.Oil pan 8.Gasket 9.Magnetic screw plug 11.Holding piece
13,14.Filler neck,joint 23.Oil dipstick tube 28.Oil dipstick 39,40.Oil cooler cover joint 48,49.Oil cooler,joint
52,53,54,55.Safety valve assembly for oil radiator 57,58,59,60,61.Pressure limiter in main oil passage
66.Oil pump 71.Pressure sensor 70.Oil filter 79,80,81.Oil spraying nozzle,gasket,screw

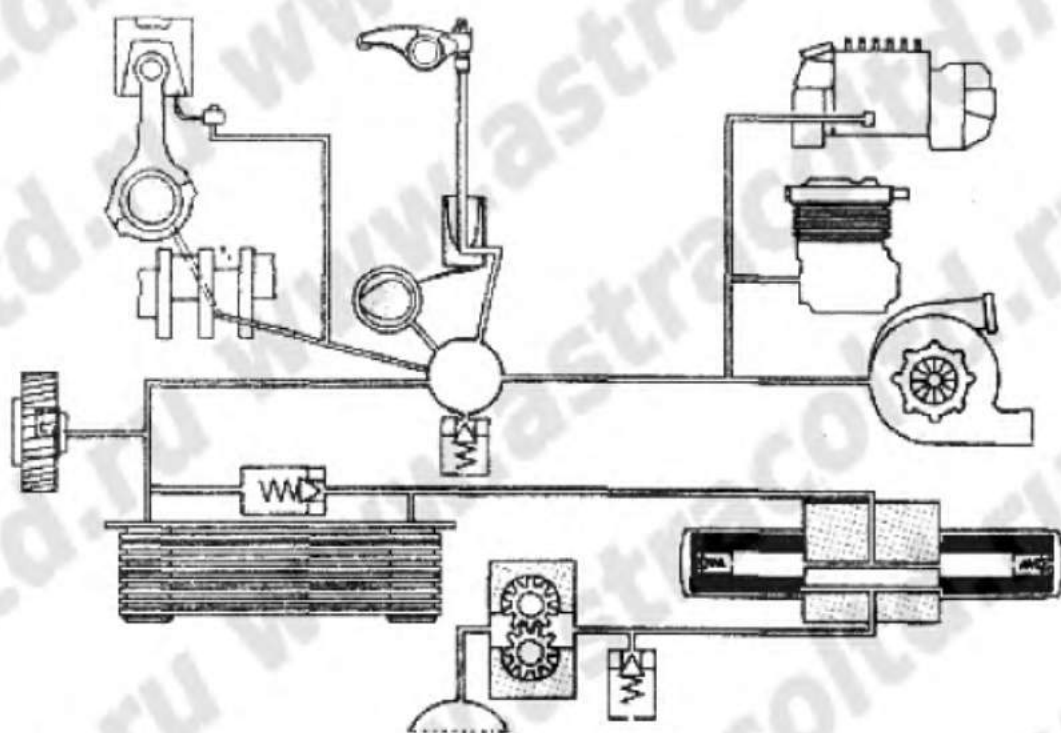


Fig.7-10b Lubricating oil circulating diagram

Min.oil pressure is 350kPa and 550kPa at normal running temperature for idling and rated speed respectively.

2) Oil sump

The oil sump is forged with steel plate,the joint face between oil sump and crankcase has deep rim and good rigidity.Fitted with concave oil sump gasket,12 brackets and M8 screws fixed to the lower joint face,it has good sealing without oil leakage.The oil sump for all series of engines are the same,except for off-road vehicle engine in which baffle is added inside the oil sump.

3) Oil cooler

The oil cooler is of tubular type,pits are punched alternatively in the pipe so as to disturb the oil flowing,as well as to improve the oil cooler radiation. The oil cooler safety valve (bypass valve) is fitted to the oil line in order to prevent oil and lack damage to the engine when oil cooler is blocked,or high resistance exists inside the oil cooler because of low oil temperature and high viscosity in winter.The opening pressure of the valve is 600 ± 36 kPa.

4) Main oil passage relief valve

The main oil passage relief valve is fitted on the right side of crankcase and projected from oil sump inner cavity,the opening pressure of the valve is 500 ± 50 kPa.The valve has been aligned in delivery,users would better not to change it.

5) Oil filter

The oil filter is of two spiral filter fitted in parallel.Dismantle the old filter element and change new one,it is easy and reliable in maintenance and replacement.

6) Oil pump

The oil pump adopts gear pump,the number of teeth is 10,the thickness of single-stage pump is 45mm.Double stage pump is used in all-axle drive vehicle while single-stage pump is adopted in other vehicles.

7.7 Fuel supply system

The fuel supply diagram is shown in fig.7-11.

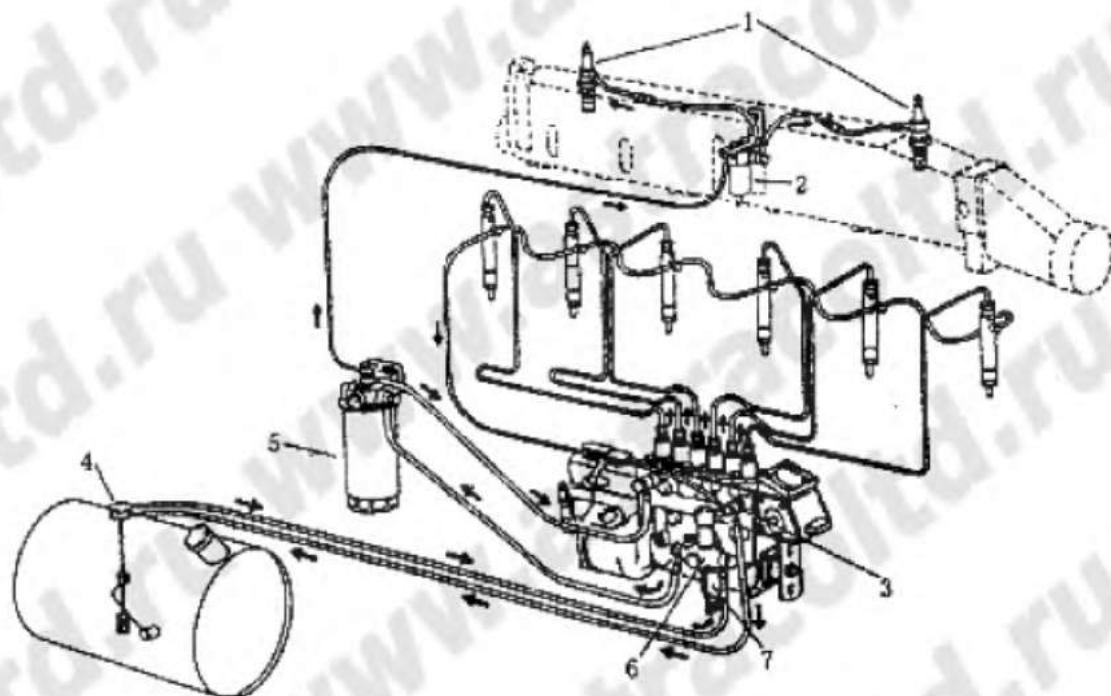


Fig.7-11 Supply system fuel circulating diagram

The fuel is drawn from the fuel tank through prefilter into the fuel pump, and is fed to the fuel filter, and then enters into the nozzle through high pressure pump.

The surplus fuel fed by supply pump flows back to fuel tank through return pipe or overflow pipe.

1) Injection pump

In-line P pump is adopted in all models of WD615 series diesel engine. Either max. and min. speed governor or variable speed governor is used according to the requirements.

The model of injection pump is shown in table 2.

Smoke limiter is fitted to the injection pump of turbocharged engine so as to improve smoke exhaust when gas turbine runs in low speed, thus outlet pressure of air compressor is low and air inlet is decreased to worsen the combustion. Pressure compensator responds to the pressure in inlet pipe through air pipe and sets a limit to fuel delivery as that smoke exhaust is not excessive even in low engine speed. The smoke limiter has been aligned in delivery, users would better not to adjust it.

2) Injector assembly

WD615 EURO 2 engine adopts the injector with P series nozzle. The injection pressure is 3.0MPa.

7.8 Cooling system

The function of cooling system is to assure that the engine works continuously in proper temperature. Forced circulating make the system reach to the running temperature rapidly. The cooling system of WD615 engine is shown in Fig.7-12.

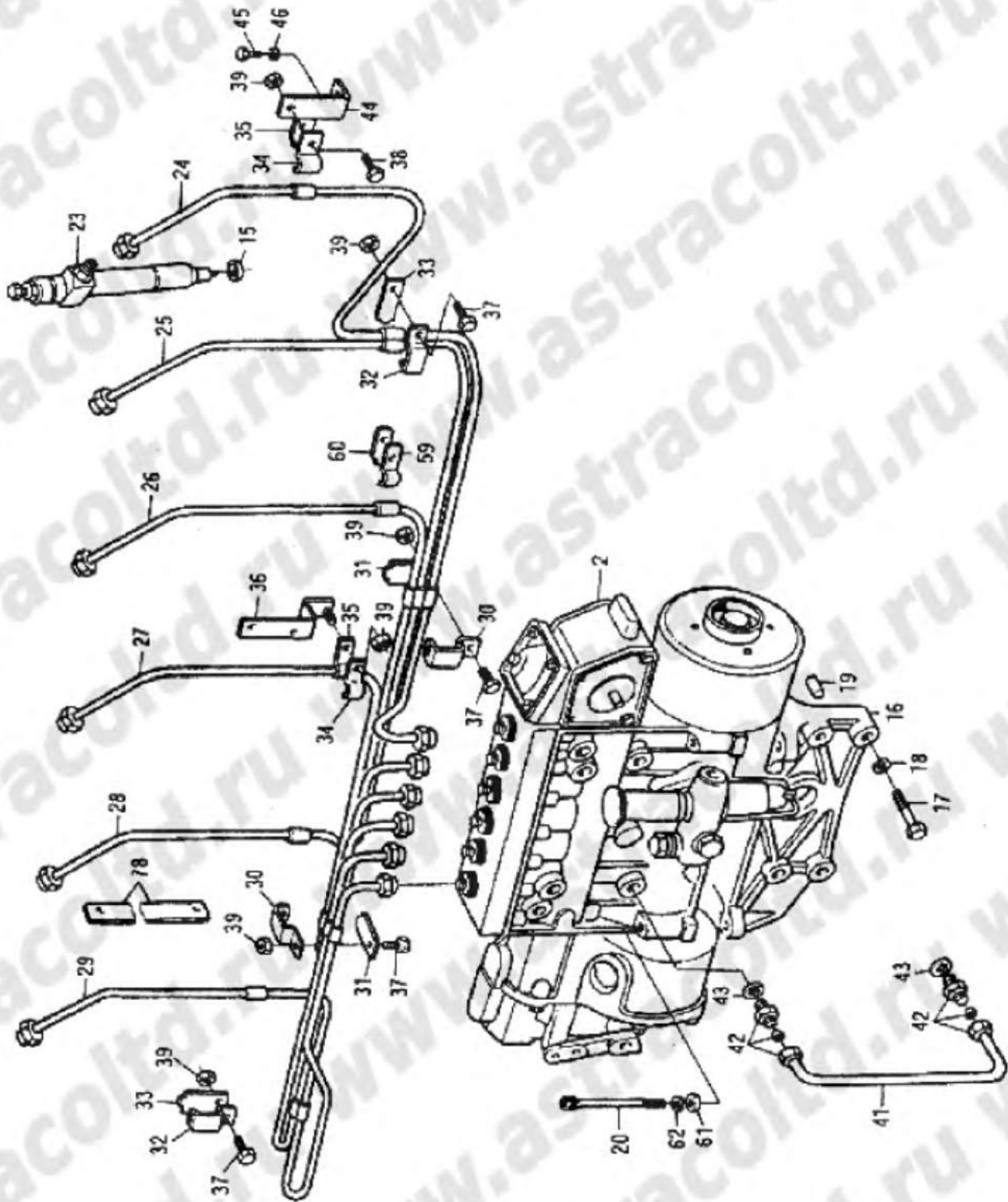


Fig.7-12 Injection pump,injector assembly and high-pressure pipe

Main parts: 2.Injection pipe 16.Pump support 23.Injector assembly 24,25,26,27,28,29.High pressure pipe 41.Oil return pipe

1) Water pump

For WD615 series diesel engine, water pump is mounted on the front of engine, water pump housing casted in one piece is fitted to the upper side of timing gear. The cooling water from pump housing comes into right water tank of the cylinder block and enters into the oil cooler, then the cooling water flows into the cylinder passage through holes on the lower right side of cylinder block to cool the cylinder liner. The water enters into the cylinder head passage through water ports and comes into the water outlet pipe through outlet port of the cylinder head. The thermostat is fitted to the end of water outlet pipe. There are two openings on the thermostat, one opening is for water to the radiator. Another is for water to inlet port of water pump, that is the "short circulation". When cooling water temperature is $80 \pm 2^\circ\text{C}$, the thermostat begins open, when cooling water temperature is 95°C , the thermostat is fully opened. All cooling water is cooled by radiator and fed to the cylinder block. When cooling water temperature is $80 \pm 2^\circ\text{C}$, the thermostat is closed, the cooling water passes through the inlet port of pump so as to make engine warm up and reach to the running status quickly and prevent low temperature wear and prolong the service life of the engine.

About 120cm^3 general lithium grease for vehicles is filled into the oil passage of water pump and it should be refilled regularly.

2) Expansion tank

The expansion tank provided by automobile factory is not fitted to the engine, its function is to remove steam in the cooling system and prevent air choke and to refill cooling water to the tank. The pressure inside the expansion tank should remain 50kPa , the position of the expansion tank is 400mm higher than that of engine and radiator (radiator is not fitted in delivery). Do not open the covers of radiator and tank should keep good and closed. The internal pressure of 50kPa is remained in the cooling system so as to improve the cooling efficiency and prevent cooling water from boiling. The cooling system and its parts are shown in Fig.7-13 and 7-14.

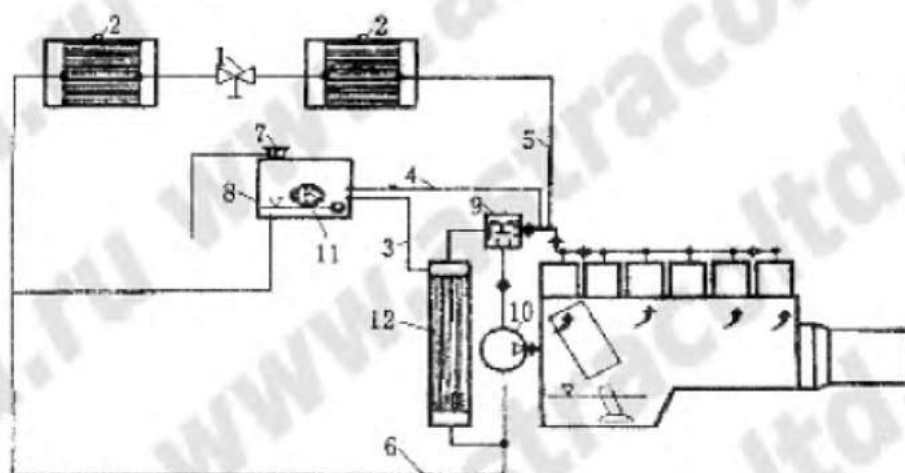


Fig.7-13 Cooling water circulating diagram

- 1.Switch 2.Water-air unit 3.Venting pipe or radiator 4.Inlet pipe of expansion tank
- 5.Inlet pipe of warm-air unit 6.Water pipe 7.Relief valve head 8.Expansion tank
- 9.Thermostat 10.Water pump 11.Water inlet cap 12.Water tank

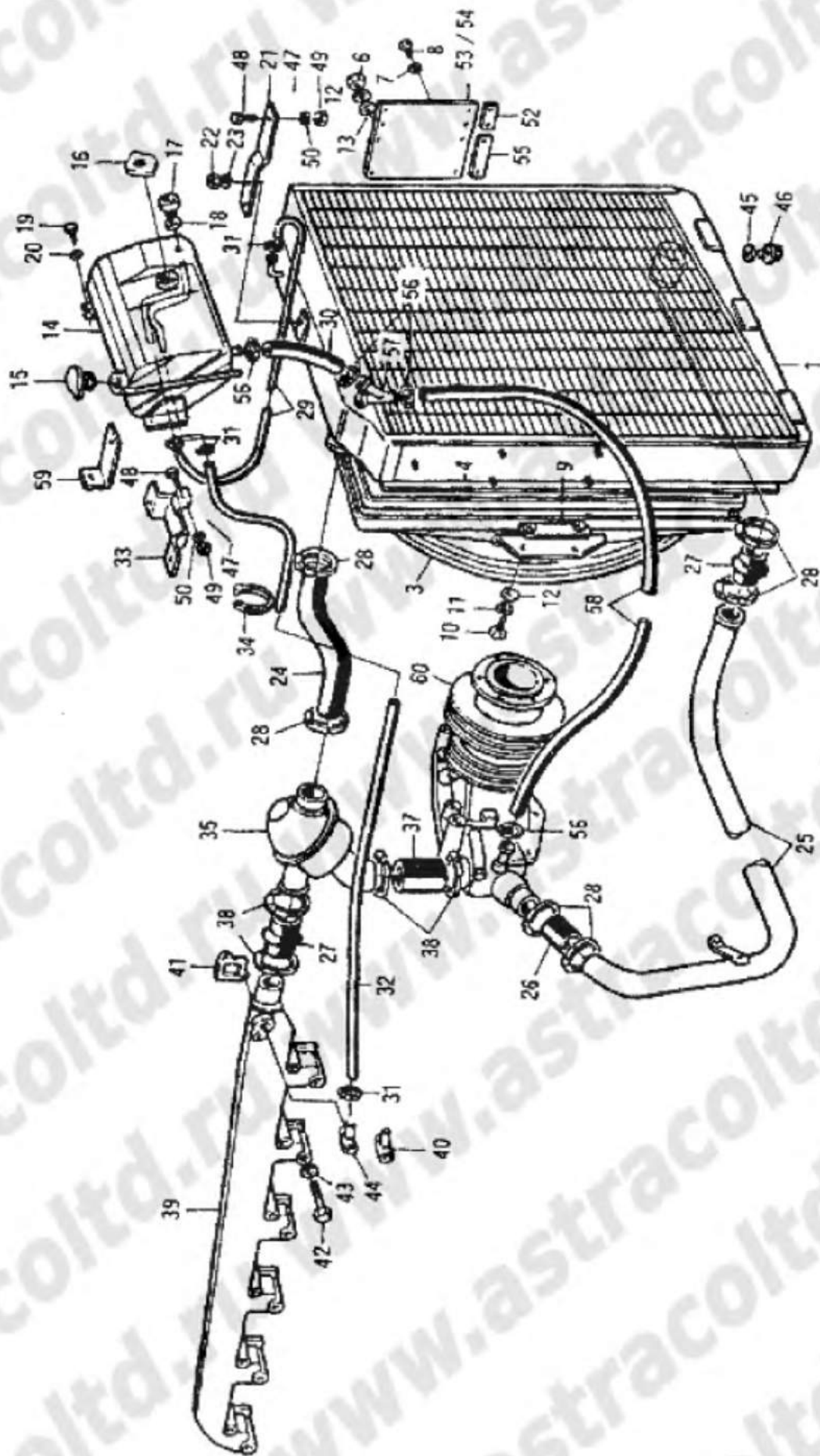


Fig.7-14 Cooling system and its parts

Main parts: 1.Radiator 3.Cowling 4.Rubber gasket 6,7,8,10,11,12,13.Screw and washer 14.Expansion tank 15.Relief valve cover 16.Filling cap of tank 17.Water level indicator 18.Gasket 19,20.Screw 25.Inlet pipe 26.Rubber pipe 35.Thermostat 39.Outlet pipe 60.Water pump

3.Fan

The plastic fan with 6 blades is pressed by reinforced plastic PA6, the diameter is $\phi 570$ and $\phi 620$. There are two kinds of transmission types, one is rigid transmission, another is silicone viscous clutch drive type.

The viscous fan is controlled by temperature through double metal sensing elements. Not only the energy saving effect is reached, but also the good running status of the engine is assured so as to guarantee the operating and service life. The principle of the fan is that the drive wheel inside the fan clutch hub is driven by the engine, the fan blades and hub housing are casted in one piece. A certain space exists in between the driven wheel and hub body, when the silicone oil is filled into the space, the drive wheel rotates the hub body, while there doesn't exist silicone oil in the space, the drive wheel rotates idly (in fact it can rotate the fan running at lower speed). A double-metal rod is the valve to control silicone oil into the space, so the fan is controlled by temperature. When the temperature before the fan is lower than 40°C , the double-metal rod makes the silicone oil valve closed, the drive wheel doesn't transmit power at this time, the fan runs in 25% speed of drive wheel. When the temperature before the fan is 60°C , the silicone oil valve is fully opened, the space is filled with oil, the fan rotates at 95% speed of the drive wheel. Pay attention to that, when using the viscous fan, it is forbidden to put the dismantled fan in level, otherwise the silicone oil will flow from sensor shaft fit clearance to make fan lose effectiveness.

7.9 Intake and exhaust system

1) Intake pipe

The intake pipe is made of cast aluminium. The position of inlet port is on the contrary, the port of the former is facing at the back (facing the flywheel) while the port of the latter is facing at the front, as shown in Fig.7-15.

2) Exhaust pipe

The exhaust pipe made of nodular cast iron consists of two parts: front exhaust manifold and rear exhaust manifold. The two manifolds are linked with each other with steel seal ring fitted to it so as to provide good sealing. The rear exhaust manifold has double ports manifold with sandwich which makes the front three cylinders and the rear three cylinders supply exhaust gas to the turbocharger separately without occurring disturbance.

3) Air cleaner

The air cleaner is of two-stage type, the first stage is spiral dust remover, the second stage is air cleaner paper element and safety element. The max. resistance of the air cleaner should be less than 5kPa . When the maintenance indicator lights, it means that it's time to maintain or replace the filter, otherwise the engine power and service life will be effected.

In choosing and mounting the air cleaner and connecting pipe, users should pay attention to its sealing and reliability. Otherwise largely increased oil consumption, crankshaft blowby, decreased engine power, black smoke exhaust and so on would occur because that the filter lose its effectiveness and is in short circuit leading early wear of the engine and could not achieve the specified service life. It even causes the serious wear of cylinder liner and piston ring, and breakage of piston ring and cylinder scuffing.

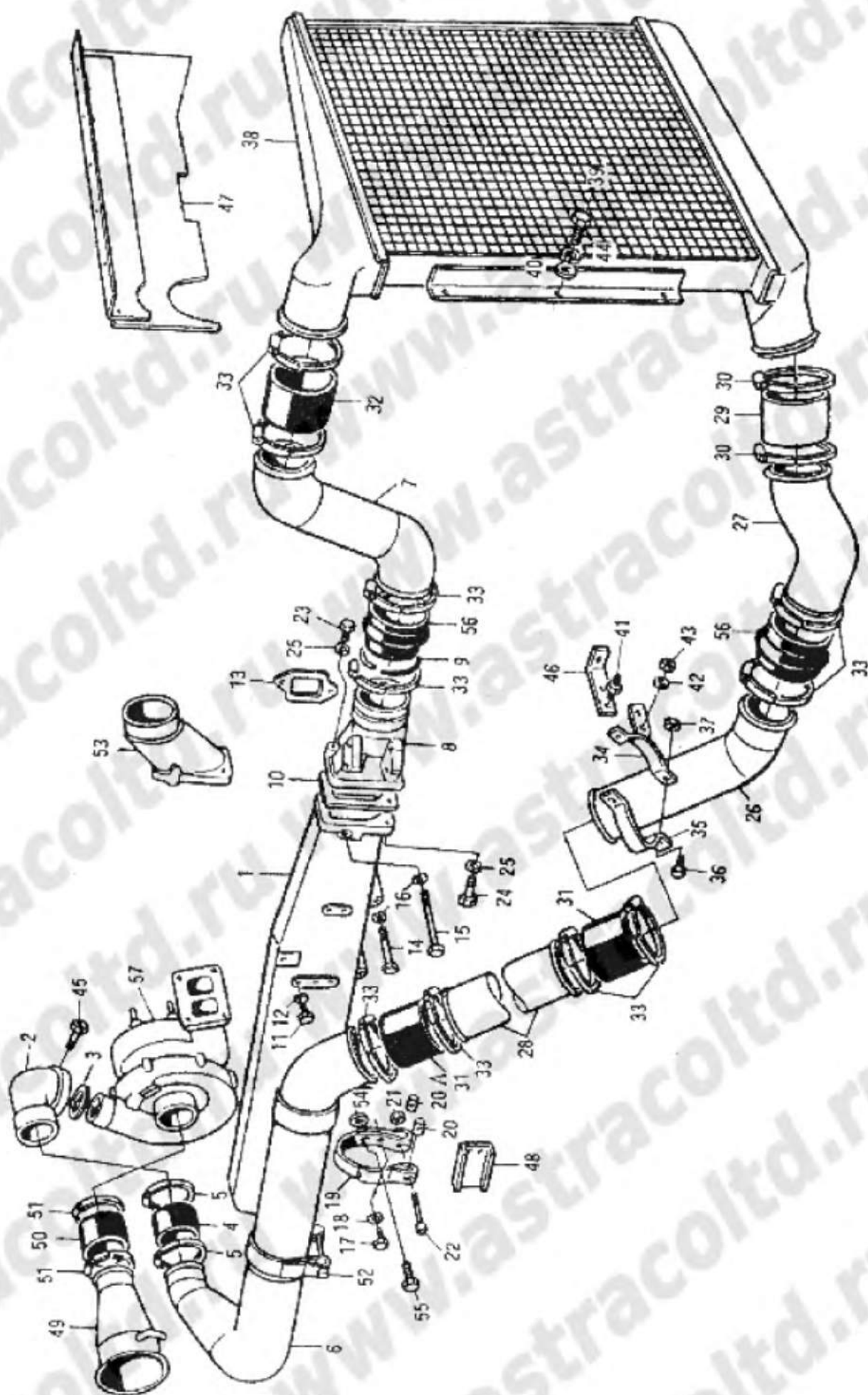


Fig.7-15 Intake system and its parts for turbocharged and turbocharged-intercooled engine

Main parts: 1.Intake pipe 2.Connecting bend pipe 6,7,26,27,28.Pipe 8.Intake connecting pipe 38.Intercooler 49.Diffuser 57.Turbocharger

The element of the air cleaner should be maintained regularly. Beat the side of the element gently to make dust fall down, or put the main element in clean cement ground horizontally and roll it to make dust shake out after dismounting the element from the air cleaner. It's better to blow the element backward (blowback from inside to outside) by compressed air.

The air cleaner is not fitted to the engine.

7.10 Turbocharged and intercooled system

1) Turbocharger

The exhaust gas turbocharger is used for turbocharged model and turbocharged-and-intercooled model of WD615 series diesel engine, the model of turbocharger is shown in table 3.

The radial turbocharger is used in all WD615 series turbocharged engine. The oil for lubricating and cooling the turbocharger is drawn from the rear end of main oil passage and enters directly into the lower part of the crankcase.

The turbocharger works in high speed (about 70000–100000r/min), so after starting the engine, run the engine idly for a short time (about 5 min, the period can also be shortened in stopping the engine for a short time) before loading. It's forbidden to stop the engine promptly at high speed and on large load. Decrease the speed and load gradually and run the engine in idling for 3–5 minutes before stopping the engine. Otherwise the turbocharger bearing would be worn and lose its effectiveness. Fill the clean oil into the inlet port in turbocharger reassembling.

2) Intercooler

The intercooler is of air-to-air cooling type. The resistance of the intercooler should be less than 10.8kPa (at rated conditions). The inlet port is at the bottom and the outlet port is at the top. The intercooler is not fitted to the engine before delivery.

Note: The sealing of the turbocharging line system and its parts and radiating capability of the intercooler should be assured.

7.11 Electrical system

The electrical system, includes generator, starter, water temperature gauge sensor, oil pressure induction plug, flame preheating unit etc.

1) Alternating generator

The rated voltage of the generator is 28V, transistor regulator is fitted to it.

The generator works in parallel with battery in vehicles and it is self-excited in working.

The electrical diagram of the generator is shown in Fig.7-16, the overall diagram of the generator is shown in Fig.7-20.

2) Starter

The starter is of direct current starter in which it adopts electromagnet control, gear moving and single acting unit for transmitting torque. The rated power of the generator is 5.4kW.

The electrical diagram of the starter is shown in Fig.7-17.

Overall diagram of the starter is shown in Fig.7-18.

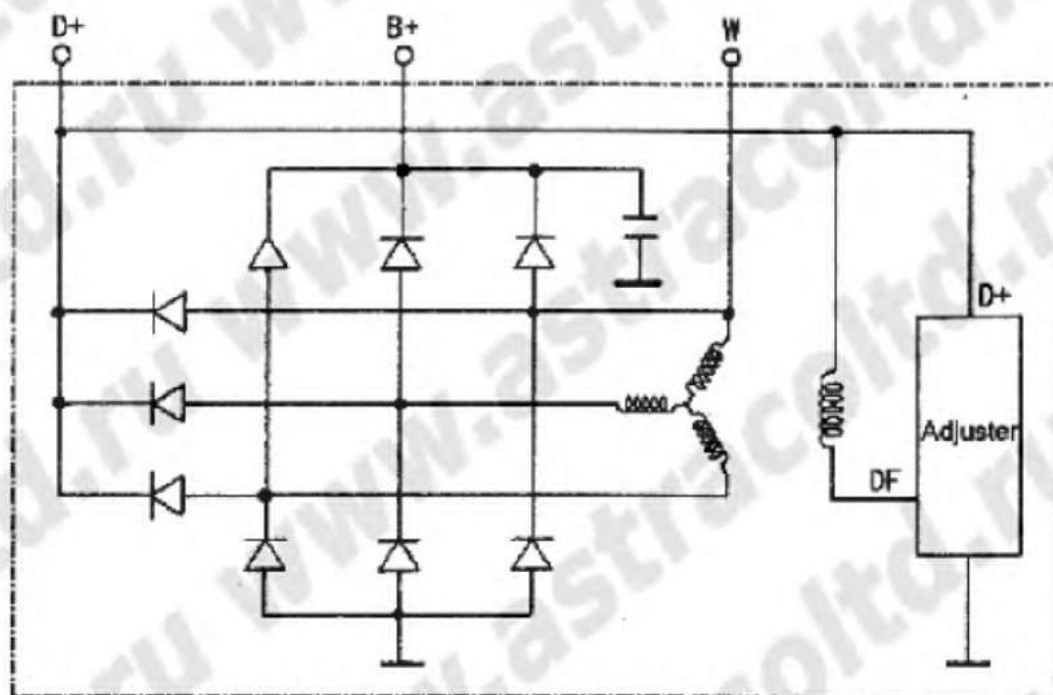


Fig.7-16 The electrical diagram of the generator

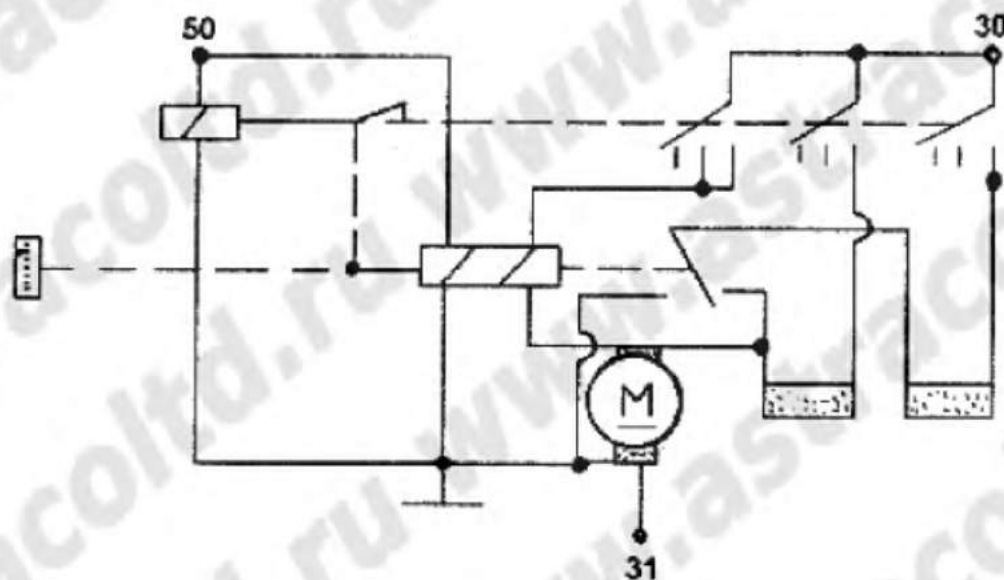


Fig.7-17 Wiring diagram of starter

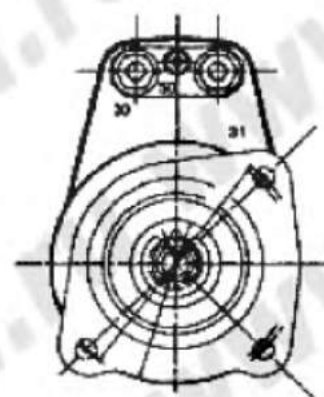


Fig.7-18 Side view of starter

7.12 Flame preheating unit

The flame preheating unit controls automatically the glowing time and flame preheating time of the glow plug which is fitted to the exhaust pipe of the engine according to the ambient temperature. The driver can start the engine after the preheating indicator giving out signal.

The principle diagram is shown in Fig.7-19.

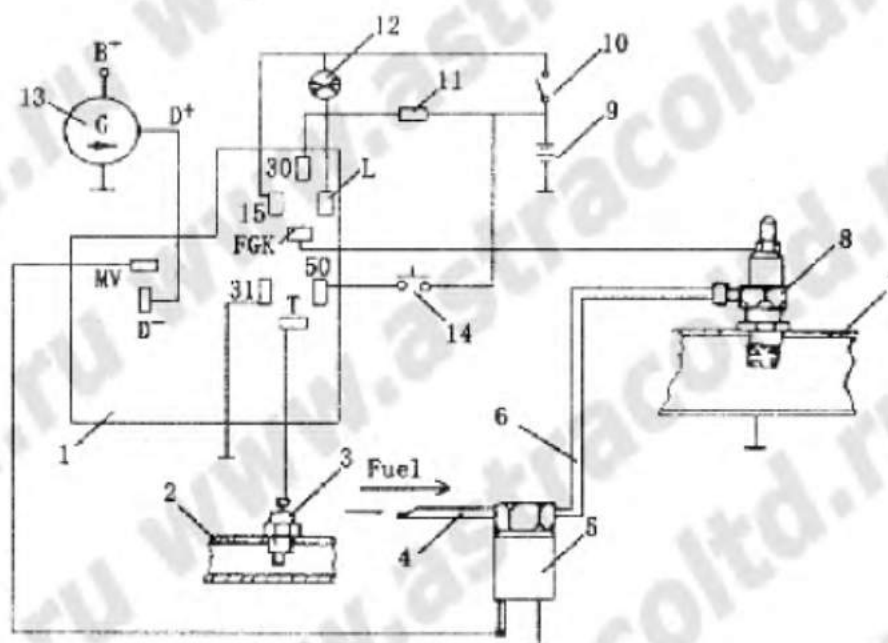


Fig.7-19 The principle diagram of flame preheating unit

- 1.Electric control unit A24 2.Cooling water pipe of the engine 3.Temp.sensor R1
- 4.Supply pipe to high pressure pump 5.Electromagnetic valve Y_{21} 6.Oil pipe
- 7.Engine inlet pipe 8.Glow plug R3 9.24V Battery 10.Electric key
- 11.Fuse 25A 12.Preheating indicator 112/29 13.Generator 14.Start button

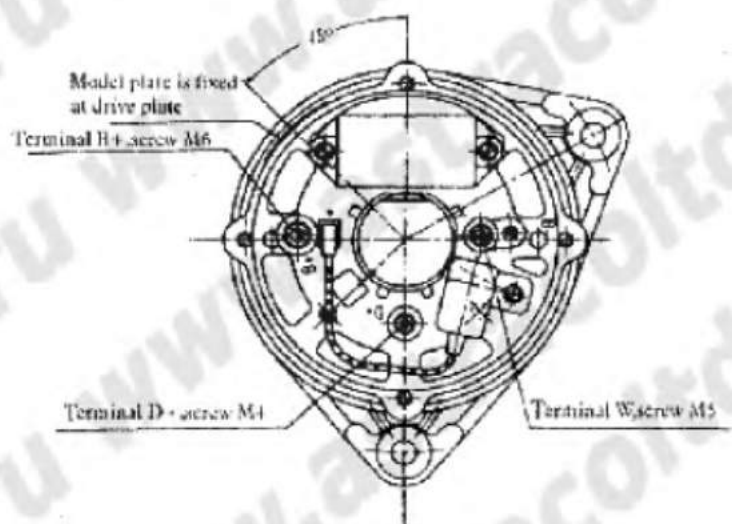


Fig.7-20 Generator overall diagram



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7.13 Air compressor

The air compressor is generally of single cylinder, reciprocating crank and connecting rod mechanism. It is fitted to the right hand of the injection pump and is driven by the gear of injection pump. The transmitting ratio is 1.25. The lubricating process is: the lubricating oil from the main oil passage passes through a pipe fitted to the cylinder block and enters into the air compressor to lubricate the bearing, then the oil flows back to the oil pump after passing through the timing gearcase.

The inlet air to the air compressor has been filtered by air cleaner. The filtered air enters into the compressor through a pipe, then it flows into the turbocharger.

The cooling method of the air compressor is: a pipe is connected between the water outlet pipe of the engine and air compressor cylinder head. The water from cylinder head is leaded to the side inlet port of the water pump.

8 Operation and Maintenance

8.1 Precautions

Check the height of the coolant, lub-oil and diesel oil level whether they conform to the requirements before starting the diesel engine.

During starting the engine, if the starting can't perform in 15s restarting after 2min.

After starting, run idly for about 2-3 min. and the oil pressure should be above 100kPa. Diesel engine can not run at high speed and on high load suddenly when the cooling water temperature is not more than 60°C, because this would have influence on the wearability and reliability of the diesel engine.

For the diesel engine with Bosch pump, while starting the engine, starting fuel thick-up device must be pulled. After starting the engine, the handle of the device should be reset. The starting fuel thick-up device need not be used during starting in thermal state. Diesel engine works in medium load in running-in period (in 3000km).

Inspection on lub-oil level should be done after stopping the engine for 5 min. Before stopping the engine, the load and speed should be decreased and the engine runs at idling speed for 5 min. at least.

8.2 Maintenance rule

Table 11 three operating conditions of the engine used for vehicle

WG1	WG2	WG3
The operating condition is very bad (e.g. cold or hot weather, high dust content, transportation in close distance, used for construction site and bus, municipal engineering vehicle, snow sweeper, fire brigade vehicle), running mileage of the vehicle with this engine is less than 2×10^4 km or operated time is less than 600h every year.	Running mileage of the vehicle with this engine is less than 6×10^4 km every year, i.e. close, middle distance transportation.	Running mileage of the vehicle with this engine is more than 6×10^4 km every year, i.e. long distance transportation.



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Table 12 The first inspection, the period of periodical inspection and maintenance

Item \ Operating condition	(WG I)	(WG II)	(WG III)
The first inspection	Running 1000–1500km or 30–50h	Running 1500–2000km	Running 1500–2000km
Periodical inspection(P)	Every 5000km or 150h	Every 1×10^4 km	Every 1.5×10^4 km
Maintenance 1(WD1)	Every 1×10^4 km or 300h	Every 2×10^4 km	Every 3×10^4 km
Maintenance 2(WD2)	Every 2×10^4 km or 600h	Every 4×10^4 km	Every 6×10^4 km
Maintenance 3(WD3)	Every 4×10^4 km or 1200h	Every 8×10^4 km	Every 12×10^4 km
Maintenance 4(WD4)8	Every 8×10^4 km or 2400h	Every 16×10^4 km	Every 24×10^4 km

Table 13 The period of renewing the lub-oil for STEYR vehicle

Item \ Operating condition	(WG I)	(WG II)	(WG III)
	Running mileage is less than 2×10^4 km every year	Running mileage is less than 6×10^4 km every year	Running mileage is more than 6×10^4 km every year
First inspection	Running 1000–1500km	Running 1000–2000km	Running 1000–2000km
P	Every 500km	Every 1×10^4 km	Every 1.5×10^4 km
WD1	Every 1×10^4 km	Every 2×10^4 km	Every 3×10^4 km
WD2	Every 2×10^4 km	Every 4×10^4 km	Every 6×10^4 km
WD3	Every 4×10^4 km	Every 8×10^4 km	Every 12×10^4 km
WD4	Every 8×10^4 km	Every 16×10^4 km	Every 24×10^4 km

Table 14 The period of renewing the lub-oil in accordance with work conditions (varies from the oil consumption)

Normal work conditions(normal oil consumption)		Bad work conditions(high oil consumption)
In normal temperature and the S content of the fuel is less than 0.5%		A; in tropics or frigid zone(the temperature is usually more than +30℃ or less than -10℃)
		B; the S content of the fuel is 0.5%~1.0%
		C; the S content of the fuel is 1.0%~1.5%
Work conditions	Operating conditions	
Normal work conditions	WG I WG II WG III	5000 Every 10000km 15000
A conditions	WG I WG II WG III	5000 Every 5000km 5000
B conditions	WG I WG II WG III	5000 Every 5000km 10000
C conditions	WG I WG II WG III	5000 Every 5000km 5000
A & B conditions	WG I WG II WG III	5000 Every 5000km 5000
A & C conditions	WG I WG II WG III	25000 Every 25000km 25000

Table 15 Maintenance rules for diesel engine

Items	First inspection	P	WD1	WD2	WD3	WD4
Renew the engine lub-oil(at least once every year)	●	●	●	●	●	●
Replace oil filter or filter element	●	While renew the oil				
Check and adjust the valve clearance	●		●	●	●	●
Check and adjust the opening pressure of nozzle					●	●



Operation and Maintenance Manual for WD615 Series Euro II Diesel Engine

Items	First inspection	P	WD1	WD2	WD3	WD4
Replace fuel filter element			●	●	●	●
Clean fuel prefilter or replace prefilter element			●	●	●	●
Check the capacity of coolant and refill it	●	●	●	●	●	●
Renew coolant	In accordance with the requirement of table 4-5					
Tighten cooling pipe clamp	●					
Tighten connecting parts of air intake pipe, hose and flange	●		●	●	●	●
Check the maintenance indicator of air cleaner			●	●	●	●
Clean the dust cup of air cleaner(not including the automatic dedusting type)		●	●	●	●	●
Clean the main filter element of air cleaner	When the indicator light					
Replace the main filter element of air cleaner	Refer to relevant stipulation of the manual					
Replace the safety filter element of air cleaner	After cleaning main filter element 5 times					
Check and tighten V-belt	●	●	●	●	●	●
Check the bearing clearance of turbocharger						●
Check and adjust injection pump on test bench					●	●
Check and adjust clutch stroke and rope	●	●	●	●	●	●
Adjust the idling speed	●					

Note: ● is the mark for needing maintenance.

8.3 Trouble shooting

8.3.1 Failure to start

Cause	Remedy
1. Fuel intake filter screen of supply pump or hose clogged	Clear away the dirt and check if the fuel is clean or not.
2. Air entered into the fuel system	Drain off the air, check the sealing of the connector and repair it.
3. Injection pump damaged	Check plunger, fuel outlet valve and repair or replace the broken parts
4. Injector damaged	Check the atomization of injector, and repair it
5. Initial angles of valve gear or fuel delivery is wrong	Check and adjust it
6. High pressure line damaged or leaked	Repair or replace
7. Insufficient pressure in cylinder	Check the sealing of the valve and cylinder gasket, the wear of the piston ring. Repair it.
8. The temperature is too low	With the addition of start-assist device

8.3.2 Stop soon after starting

Cause	Remedy
1. Fuel filter clogged	Dismantle and clean away dirt and water, replace the filter element if necessary.
2. The air entered into fuel system	Check fuel pipe and sealing of the connector, tighten air venting bolt, and drain off the air.
3. Supply pump doesn't work	Check piston and valve of supply pump, clean and repair
4. Poor quality of fuel	Clean fuel filter and renew fuel
5. Idling speed is too low	Readjust it

8.3.3 Insufficient output

Cause	Remedy
1. Air intake clogged (air cleaner choked)	Check the air cleaner and air intake pipe, clean or replace filter element
2. Exhaust back pressure is too high	Check the valve-timing and exhaust pipe, adjust and repair
3. Insufficient pressure in supercharged system	Block up the leakage of pipe's connecting
4. Faults in turbocharger	Replace the turbocharger assembly
4.1 Compressor and turbine streets choked up	Clean or replace
4.2 Floating bearing cease to be in effect	Replace
4.3 Carbon deposit in clearance of turbine and compressor back	Clean

Cause	Remedy
5. Intercooler damaged	Replace or repair
6. Leakage or choke of fuel line	Check the sealing of fuel pipe and connector,the fuel filter and fuel line.Repair, clean or replace
7. Poor quality of fuel	Clean the fuel tank,filter parts and fuel pipe.Renew the fuel
8. Excessive wear for injection pump or governor	Repair or replace
9. Smoke-limiter diaphragm of injection pump damaged	Repair or replace
10. Air pipe of smoke-limiter damaged	Replace
11. Poor atomizing	Check the injecting pressure, clean away the carbon deposit in nozzle, adjust and repair injector
12. Incorrect timing of valve gear or fuel delivery	Check and adjust it
13. High-speed of governor is adjusted too low	Check the speed-governing, and adjust
14. Oil level is too high	Check the oil-dipstick, and drain off unnecessary oil
15. Leakage in cylinder gaskets	Check the compressed pressure at hot state, replace cylinder gaskets
16. Piston ring broken, the clearance of main bearing is too large	Replace worn parts or overhaul the engine
17. Cylinder liner or piston worn, or piston scuffing	Overhaul the engine

8.3.4 Fuel consumption is too high

Cause	Remedy
1. Air intake clogged (air cleaner choked)	Check air cleaner and air intake pipe, then clean them
2. Exhaust back pressure is too high	Check exhaust pipe and brake valve, then clean them
3. Poor quality of fuel	Renew the fuel according to requirements
4. Fuel line choked	Check and repair
5. Fuel line leaked	Check and repair
6. Poor atomizing	Check, adjust and repair
7. Incorrect timing of valve gear of fuel delivery	Adjust valve clearance and injection advance angle according to requirement
8. Leakage in cylinder gasket	Check pressure
9. The clearance of main bearing is too large. Engine need to overhaul	Check and overhaul

Cause	Remedy
10. Piston scuffing	Replace cylinder liner,piston and piston ring
11. Insufficient pressure in supercharged system	Block up the leakage of pipe's connecting
12. Faults in turbocharger	Check and replace
13. Intercooler damaged or leaked	Replace or repair

8.3.5 Black smoke exhaust

Cause	Remedy
1. Air intake isn't free or exhaust back pressure is too high	Clean
2. Poor quality of fuel	Renew
3. Incorrect timing of valve gear or fuel supply	Adjust according to requirements
4. Poor atomizing	Check,repair or replace injector
5. Excessive injection quantity	Check and adjust (by manufacturer)
6. Insufficient pressure in supercharged system	Block up the leakage of pipe's connecting
7. Faults in turbocharger	Replace
8. Intercooler damaged or leaked	Replace or repair
9. Incorrect working point of smoke-limiter	Readjust (by manufacturer)

8.3.6 White,blue smoke exhaust

Cause	Remedy
1. Poor quality of fuel,contains water	Renew fuel
2. Temperature of cooling water is too low	Check working temperature of thermostat,replace if necessary
3. Incorrect timing of valve gear of fuel delivery	Check and adjust
4. Poor atomizing	Check and repair
5. Incomplete combustion,scuffing and the pressure is too low	Check piston ring,cylinder liner,cylinder gasket,and repair them
6. Wear-in between the piston rings and cylinder liners is not good	Go on wearing-in
7. The gaps of the piston rings are not staggered	Adjust,reassembly
8.Piston oil rings cease to be in effect	Replace

Cause	Remedy
9. The fit clearance between piston and cylinder liner is too large	Repair or replace
10. The sealing ring of turbocharger worn	Check and replace
11. The thrust bearing of turbocharger worn	Check and replace
12. The oil return pipe of turbocharger choked	Clean or repair

8.3.7 Lub-oil gathered in air intake port and air intake pipe of turbocharger

Cause	Remedy
1. The sealing of turbocharger cease to be in effect	Repair or replace turbocharger
2. The gas-oil separator cease to be in effect	Replace
3. Lub-oil level in oil sump is too high	Drain off unnecessary oil according to requirements

8.3.8 Uneven engine speed

Cause	Remedy
1. Poor quality of fuel,contains water or wax	Clean fuel system,and renew fuel
2. Air entered into fuel suction pipe	Check the sealing of fuel pipe and connector,drain off air
3. Faults in flyweight of governor and speed governing spring	Check and repair(by manufacturer)
4. Uneven fuel delivery	Check and adjust
5. Unstable atomizing	Check and repair
6. Surge in turbocharger	Wash compressor streets,clean away the carbon deposit from exhaust passage
7. Bearing of turbocharger damaged	Repalce it

8.3.9 Lub-oil pressue is too low

Cause	Remedy
1. Oil level in oil sump is too low	Cleck oil leakage,add oil
2. Faults in pressure regulating valve of main oil passage	Check valve,clean and repair
3. Strainer,oil pipes,connector gasket choked or broken	Check strainer and connector,repair
4. Lub-oil doesn't conform to specifications	Renew the lub-oil according to requirements
5. Oil intake pipe of oil pump leaked	Check the oil pipe and connector,repair or replace

Cause	Remedy
6. Water temperature in cooling system and oil temperature are too high	Check cooling system, and correct it
7. Excessive resistance of oil filter	Renew the filter element
8. Oil cooler choked	Check and clean
9. Main oil passage choked	Check and clean
10. The clearance of main bearing is too large or main bearing damaged	Check and replace
11. Excessive wear of parts, need to overhaul	Check the working time of the engine, overhaul

8.3.10 Cooling water temperature is too high

Cause	Remedy
1. Water level in water tank is too low	Check water leakage, add water
2. Water tank clogged	Clean or repair
3. The belt of water pump loosened	Adjust tension according to requirements
4. Water pump gasket damaged, water pump impeller worn	Check and repair, or replace
5. Faults in thermostat	Replace it
6. Water pipe damaged and air entered	Check the water pipe, connector and gasket. Renew the damaged parts
7. The oil level in oil sump is too low	Check oil leakage, repair and add oil

8.3.11 Parts wore quickly

Cause	Remedy
1. Filter element of air cleaner is unqualified or damaged	Check and replace filter element
2. Air leakage in air intake system	Check air intake pipe, gasket and connecting sleeve, repair or replace
3. Oil level in oil sump is too low	Check oil leakage, repair and add oil
4. Oil passage clogged	Clean
5. Oil doesn't conform to specifications	Renew lub-oil according to specifications
6. Piston rings broken or worn	Replace
7. Cylinder liner and piston worn or piston scuffing	Dismantle and check piston and liner, repair or replace
8. Filter element of oil filter can not be replaced in time	Replace it
9. Excessive wear of parts, need to overhaul	Check the mileage and overhaul
10. Crankshaft isn't concentric with the shaft of engine follower	Check the mounting support, repair it
11. Wrong oil grade	Adopt correct oil grade



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8.3.12 Noise is too high

Cause	Remedy
1. Poor quality of fuel	Renew fuel
2. Temp.of cooling water is too low	Check thermostat,replace it if necessary
3. Incorrect timing of valve gear or fuel delivery	Check and adjust
4. Poor atomizing	Check,repair and adjust
5. Excessive injection quantity	Check and adjust (by manufacturer)
6. Vibration damper damaged	Check connecting bolt and replace damaged parts
7. Leakage in valve or adjusted unsuitably	Dismantle and check valve,readjust it
8. Excessive gear clearance or tooth broken	
9. Cylinder liner or piston worn,or piston scuffing	Check and repair,or replace
10. Push rod bended or broken	Replace it
11. Piston rings broken or worn	Check and replace damaged parts
12. Excessive wear in main bearing	Check and replace
13. Excessive thrust clearance of crankshaft	Replace the thrust plate
14. All main bearings are not concentric	Check and repair
15. Crankshaft isn't concentric with the shaft of engine follower	Check the bolt
16. Excessive wear in parts,need to overhaul	Check the mileage and overhaul
17. Surge in turbocharger	Clean compressor streets,and clean away the carbon deposit from exhaust passage
18. Sealing ring of turbocharger sintered	Replace turbocharger assembly
19. Turbocharger bearing damaged,moving parts and fixed parts bumped each other	Replace turbocharger assembly
20. Foreign body entered turbocharger turbine or compressor impeller	Replace turbocharger assembly

8.3.13 Starting motor doesn't work

Cause	Remedy
1. Insufficient charging for battery	Check, change or replace
2. Bad contact in connecting wire	Check up circuit, tighten terminal
3. Fuse broken	Replace
4. Bad contact in brush	Clean brush surface or replace brush
5. Short circuit in starting motor	Check and repair it, or replace the motor assembly

8.3.14 Starting motor is powerless

Cause	Remedy
1. Insufficient voltage of battery	Change or replace
2. Bearing bush worn	Replace bearing assembly
3. Bad contact in brush	Clean brush surface or replace brush
4. Commutator unclean or sintered	Clean away the dirt and refurbished using sandpaper, or replace commutator assembly
5. Sealing off at wire end	Reweld
6. Bad contact for switch	Check and repair
7. Track slipped for wore clutch	Adjust working moment of clutch or replace

8.3.15 Generator doesn't work

Cause	Remedy
1. Wire connecting broken, short circuit, joint loosened	Check the connecting wire of generator or galvanometer, repair
2. Coil of rotator and stator shorted, broken	Repair or replace
3. Rectifier tube damaged	Replace
4. Insufficient of terminal damaged, wire broken	Repair
5. Voltage regulated by regulator is too low	Repair
6. Contact of regulator fused	Repair or replace

8.3.16 Insufficient charging of generator

Cause	Remedy
1. Connecting wire broken or shorted, terminal loosened	Repair
2. Coil of rotator and startor shorted or broken partially	Repair or replace
3. Belt of generator loosened	Check and adjust tension
4. Rectifier tube damaged, bad contact in brush	Repair
5. Insufficient voltage of regulator	Regulate
6. Field coil or resistance connecting pipe broken	Repair or replace
7. Insufficient electrolyte of battery or battery is too old	Add electrolyte or renew battery

8.3.17 Uneven charging current

Cause	Remedy
1. Coil of rotator or stator will short or break	Repair or replace
2. Bad contact in brush	Repair
3. Terminal loosened and bad contact	Repair
4. Voltage regulator damaged	Repair
5. Incorrect regulated voltage	Check and regulate

8.3.18 Generator over-charged

Cause	Remedy
1. Shorted in battery	Regulate
2. Voltage of regulator is too high	Repair or regulate
3. Bad contact in regulator	Repair
4. Faults in regulator contact, voltage coil or resistance connecting wire broken	Repair or replace

8.3.19 Abnormal sound in generator

Cause	Remedy
1. Incorrect mounting for generator	Repair
2. Bearing damaged	Replace
3. Moving parts bumping to fixed parts	Repair or replace
4. Rectifier shorted	Replace
5. Stator coil shorted	Repair or replace

Opinions from user

User name:		Telephone number(Area code):		
Working unit:		Cable address:		
Address:		Post code:		
Model of vehicle		Model of diesel engine and number		Ordering No.
Operating conditions	Operated milage (km or h)		Working conditions	
Failure time	Trouble	Reason	Remedy	Remarks

Opinions or advices

Note: Send to sales company of China National Heavy Duty Truck Group Co., Ltd with registered mail.

Post code: 250031