
MITSUBISHI DIESEL ENGINE

SHOP MANUAL

MODEL DR

(FOR INDUSTRIAL USE)

4DR5-744591

6DR5-131569

and up



Mar. 1983 97811-04010

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1. GENERAL

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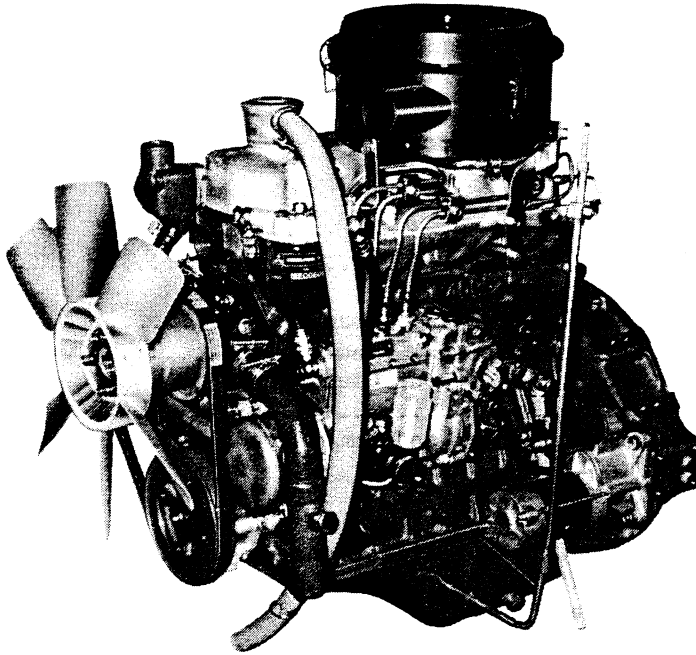
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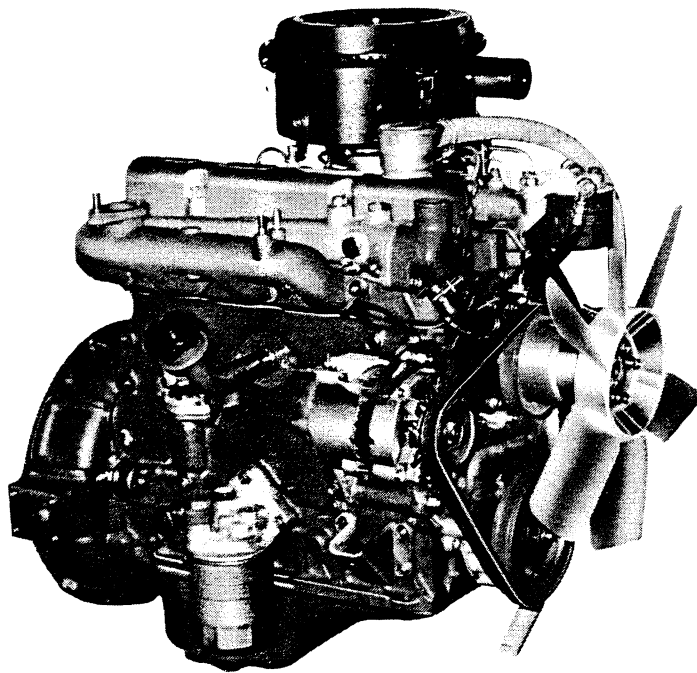
1-1 GENERAL DESCRIPTION

1-1-1 Outside View Photographs

(1) 〈4DR5〉

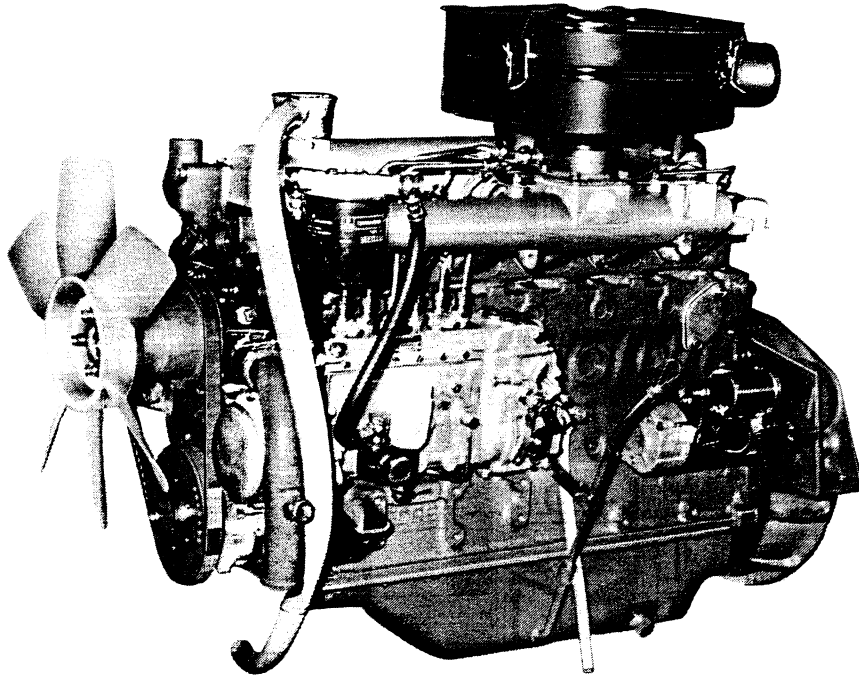


PE2057

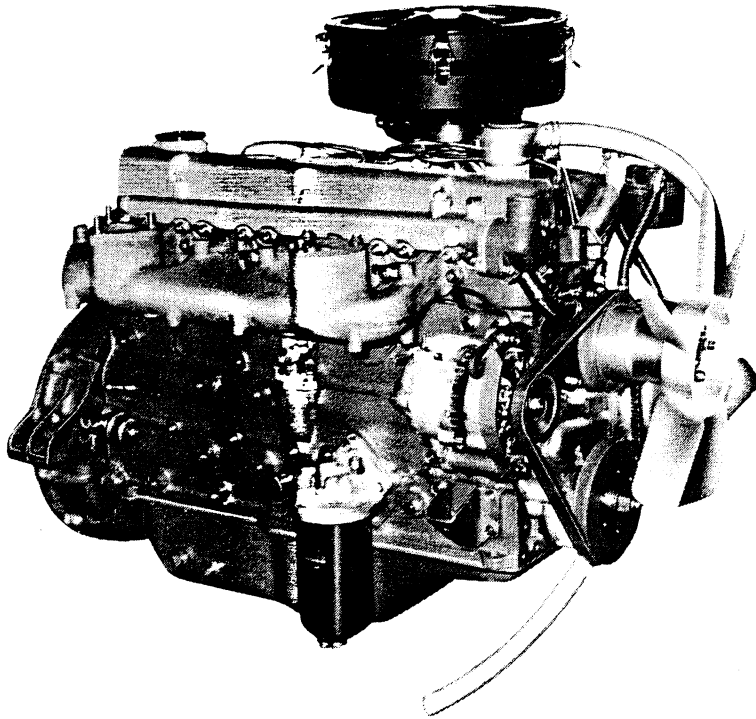


PE2058

(2) 〈6DR5〉



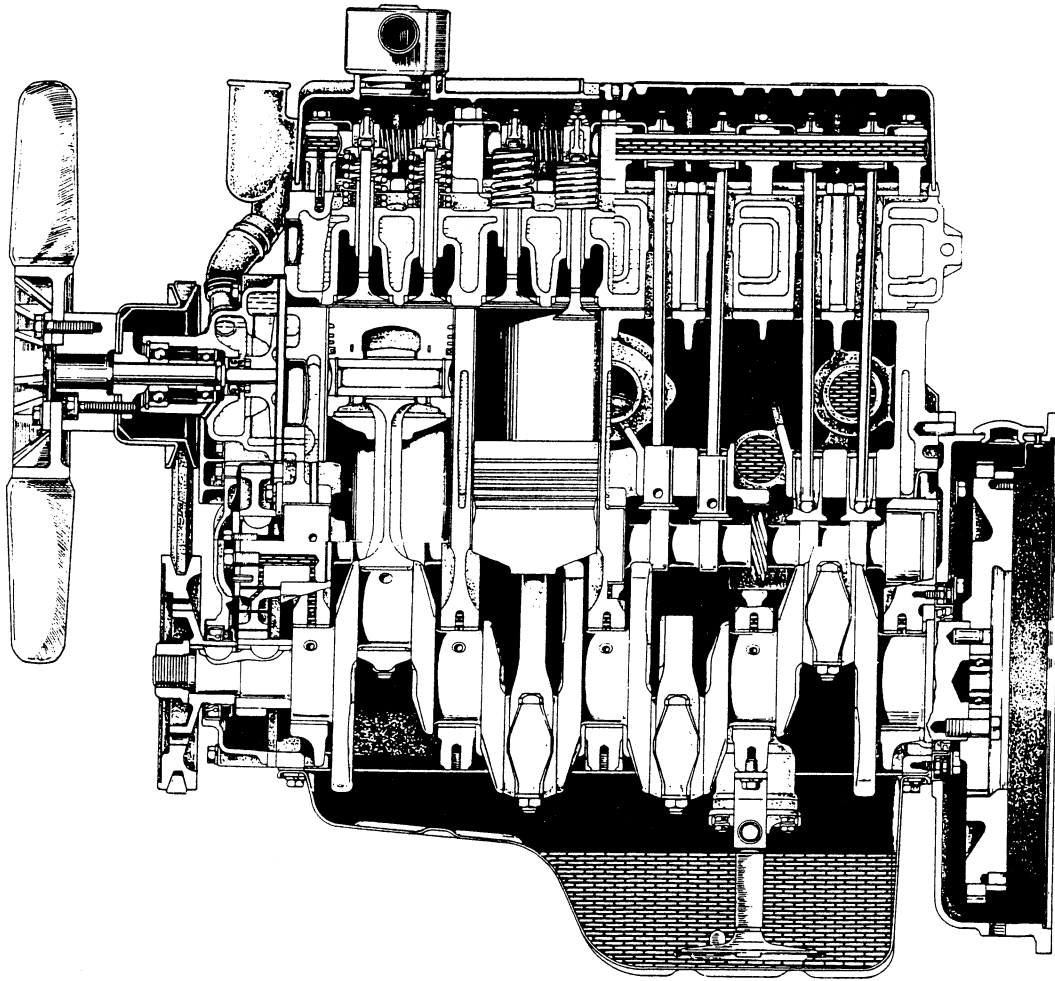
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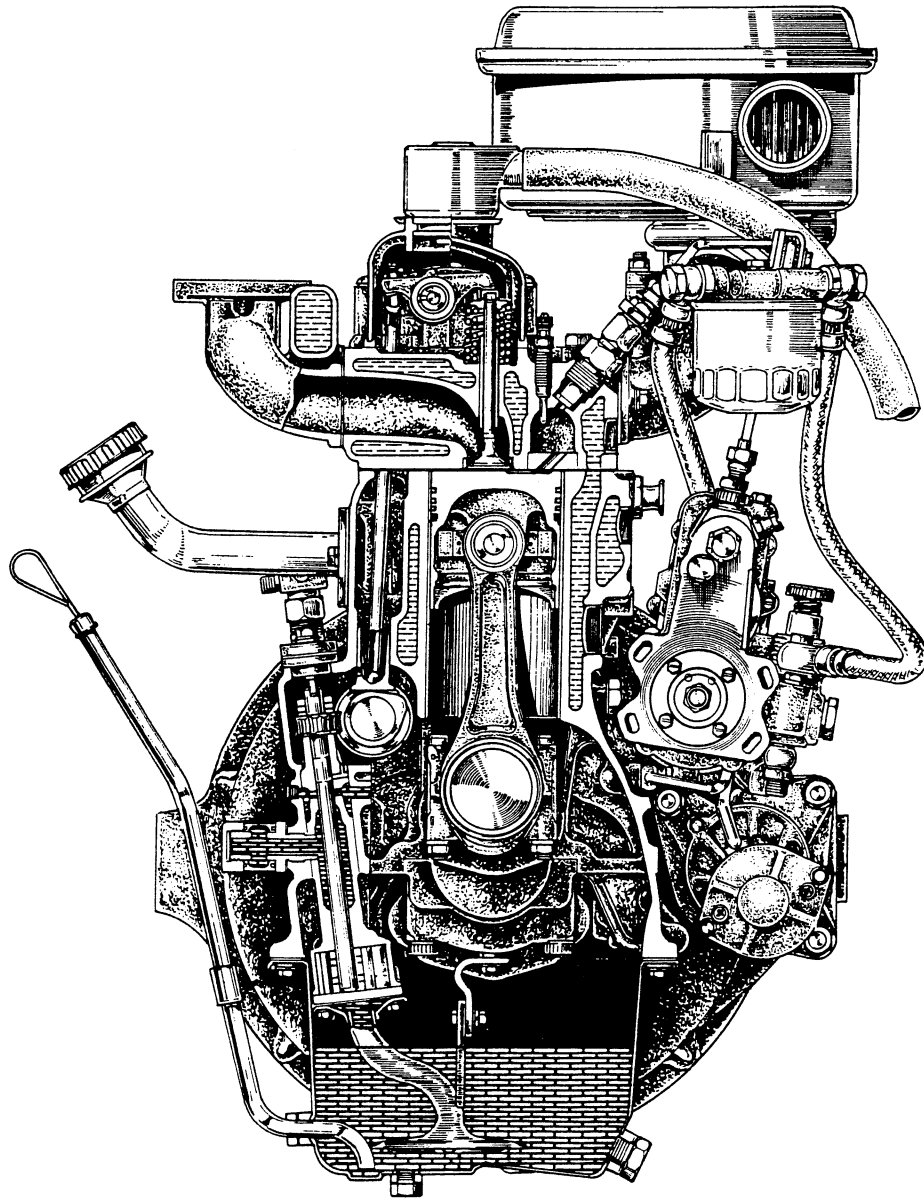
PE2060

1-1-2 Engine Sectional View

(1) <4DR5>

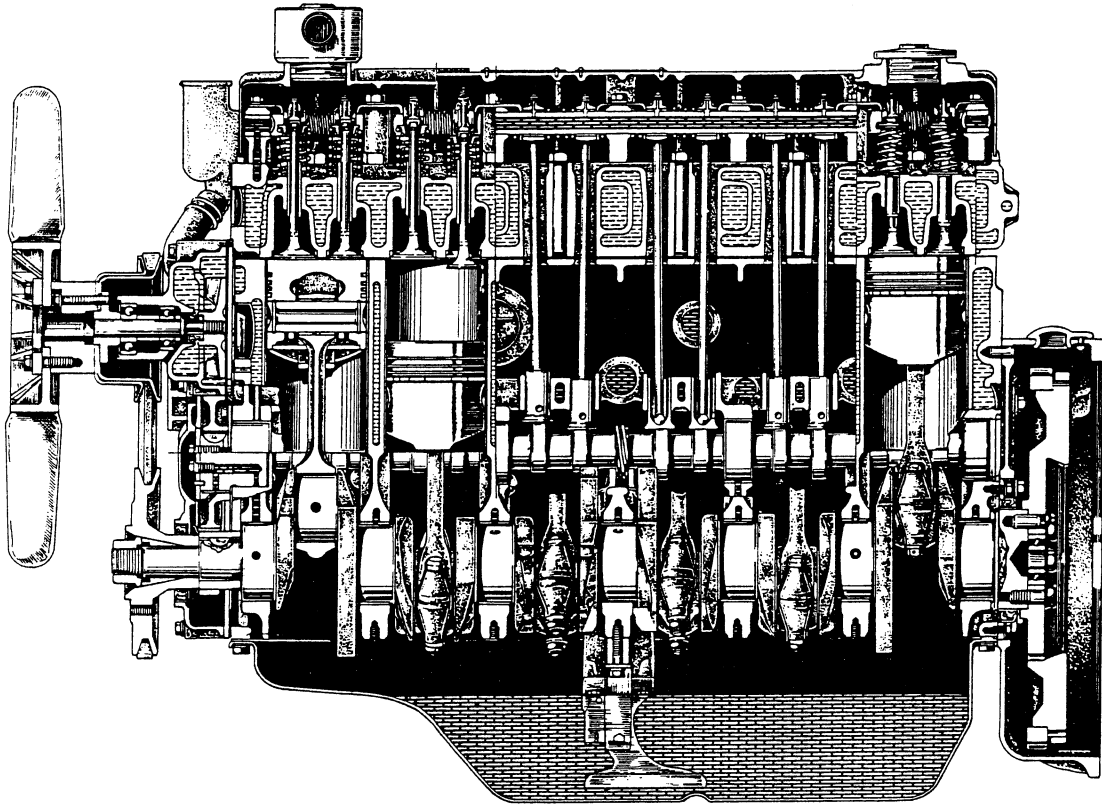


PE7453

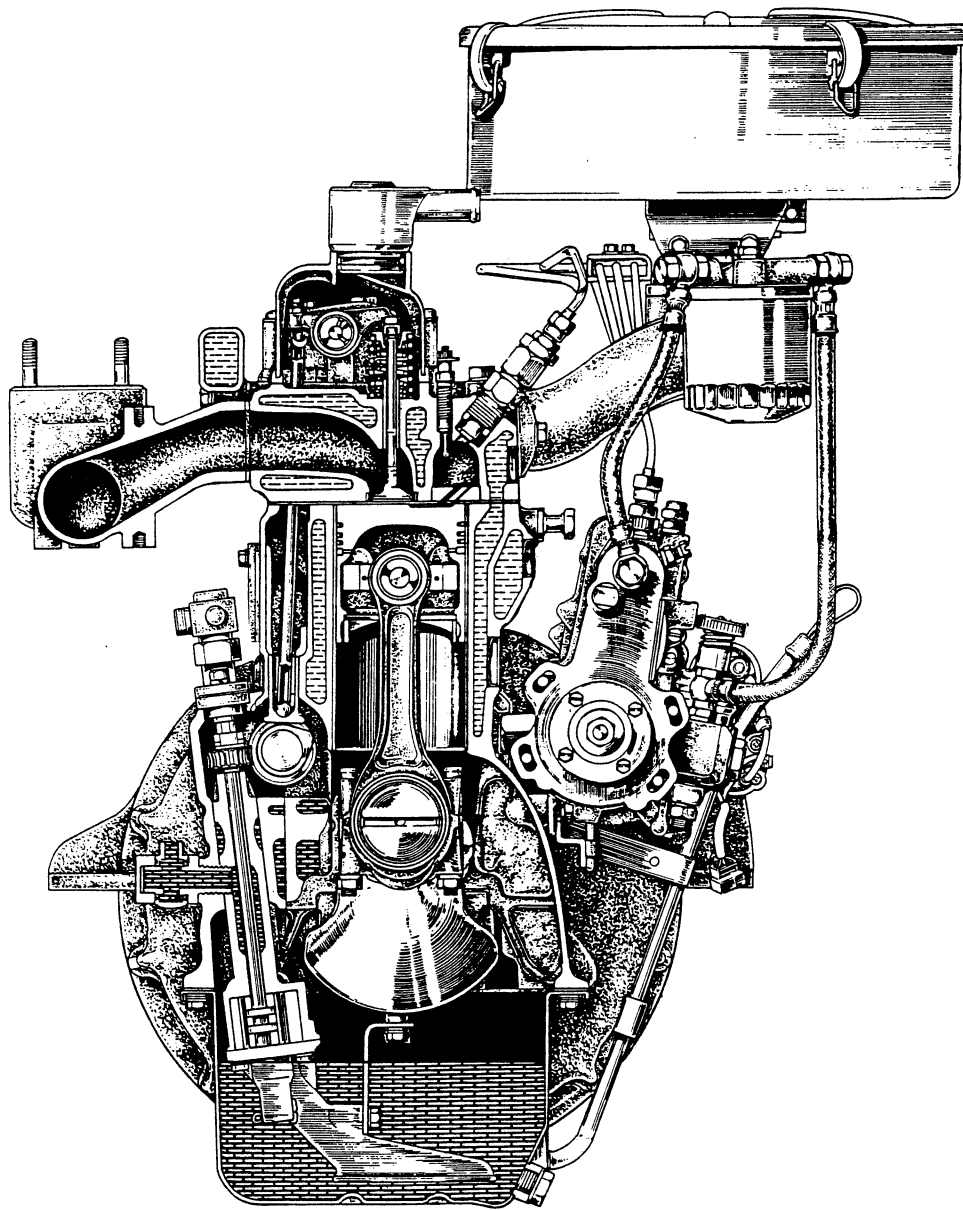


PE7454

(2) 〈6DR5〉



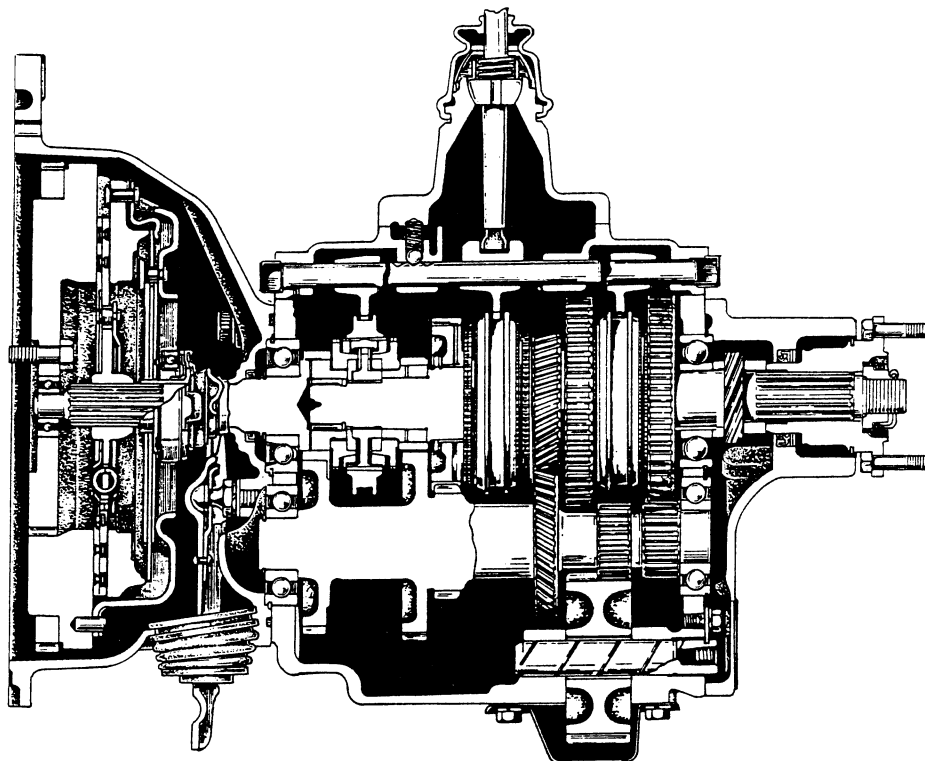
PE7455



PE7456

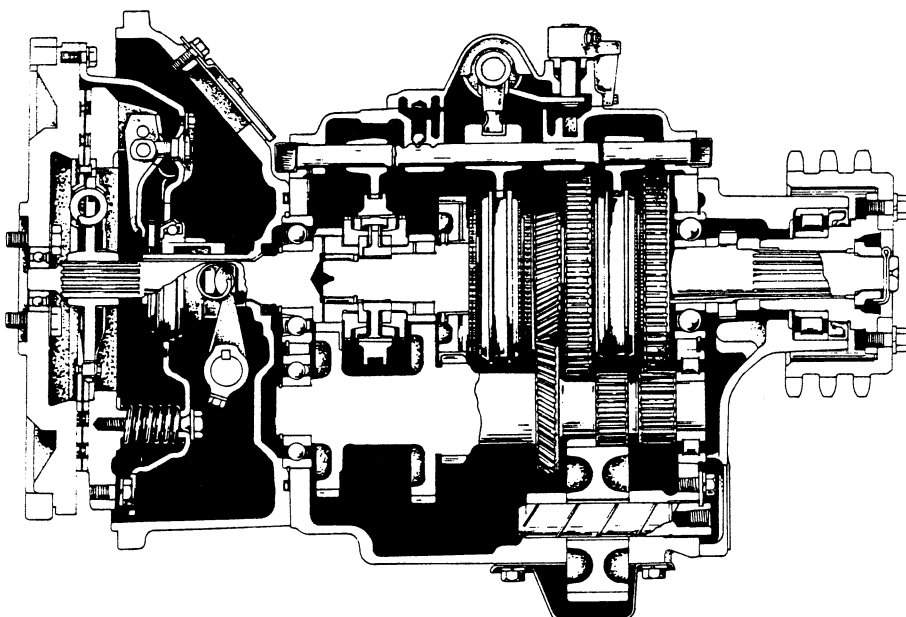
1-1-3 Sectional View of Clutch and Transmission

(1) <4DR5>



PE7457

(2) <6DR5>



PE7190

1-1-4 Engine Number and Nameplate

(1) Engine Number

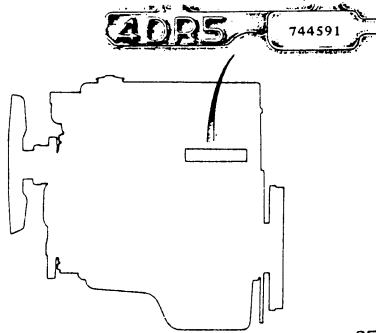
The engine number is stamped on the left side of the crankcase as shown below.

E.g. Model Engine No.

4DR5 - 744591

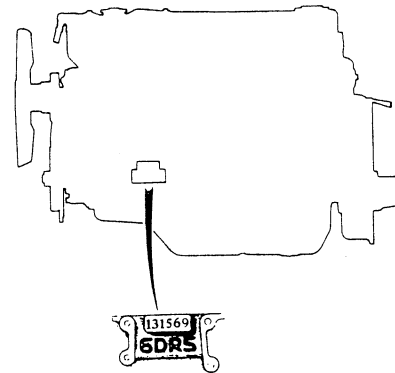
The engine number is an important number in learning the history of the engine.

<4DR5>



SE5004

<6DR5>

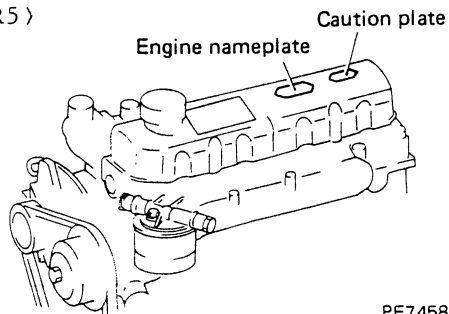


SE5372

(2) Engine Nameplate

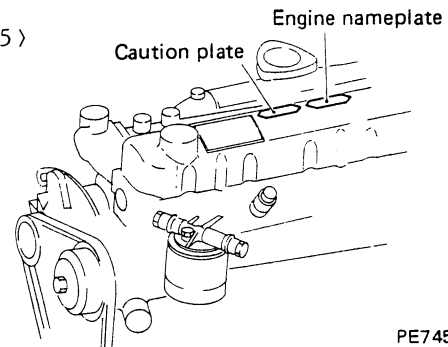
The nameplate is located at the position shown in illustration below. The nameplate shows the engine model, application symbol, total displacement, and rated output/engine speed. The caution plate shows valve clearance, firing order and fuel injection timing.

<4DR5>



PE7458

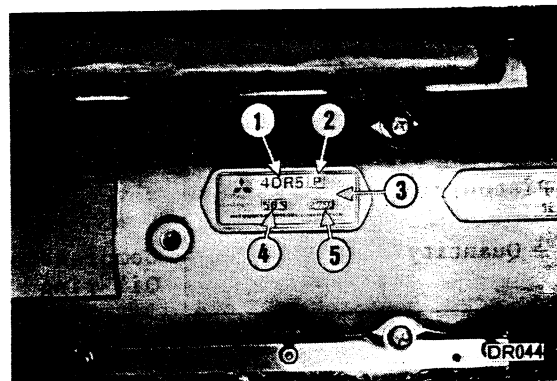
<6DR5>



PE7459

Indication on Nameplate

- 1 Engine model
- 2 Application symbol
C: For construction machinery
P: For power generator and
general power plant
- 3 Total displacement
- 4 Rated output
- 5 Engine speed



1-2 SPECIFICATIONS

1-2-1 Principal Specifications

Item	Specification	
Engine model	4DR5	6DR5
Type	Water cooled, 4-cycle diesel	←
Number of cylinders- arrangement	4 - in-line	6 - in-line
Valve mechanism	Overhead valve	←
Combustion chamber	Swirl chamber type	←
Cylinder bore x stroke	92 x 100 mm	←
Total displacement	2 659 lit.	3 988 lit.
Compression ratio	20	←
Firing order	1-3-4-2	1-5-3-6-2-4
Engine dimensions		
Overall length	773 mm	1 003.5 mm
Overall width	648 mm	695 mm
Overall height	857.5 mm	853.5 mm
Weight	255 kg	370 kg

The weight and dimensions of engine built to standard specifications are shown.

1-2-2 Specifications of Each Device

ENGINE PROPER

Item	Specification
Cylinder sleeve	
Type	Dry type
Piston type	Trunk, slipper - skirt type
Piston ring	
Quantity	Compression ring: 3 Oil ring : 1

INLET AND EXHAUST

Item	Specification	
Air cleaner Element type	〈Standard〉 (Nippon Rokaki Co., Ltd. product)	〈Option〉 (Nippon Donaldson Ltd. product)
	Flat type filter paper element	Cyclone type filter paper element

LUBRICATION

Item	Specification		
	〈4DR5〉		〈6DR5〉
Engine oil			
Quality	API classification Grade CC or better		←
Quantity	Approx. 5 lit (oil pan only)		Approx. 8.5 lit (oil pan only)
	Approx. 0.8 lit (oil filter only)		Approx. 1.5 lit (oil filter only)
Lubrication system	Forced lubrication by oil pump		←
Oil pump			
Type	Trochoid type		←
Relief valve			
Type	—		Ball valve type
Oil filter	〈Standard〉 〈Option〉		
Type	Throw-away filter paper type (built-in bypass valve)	Center bolt filter paper type	Center bolt filter paper type
Relief valve			
Type	Piston valve type	←	←
Oil bypass alarm			
Type	—	Piston valve containing electric contact	←

Item	Specification		
Oil cooler (4DR5: 2 500 rpm or more) (6DR5: 2 200 rpm or more)			
Type	Shell and plate type		←
Bypass valve			
Type	Piston valve type		←
Oil pressure unit	〈Standard〉	〈Option〉	
Type	Bimetal type	Variable resist- ance type	Bimetal type
Oil pressure switch	〈Option〉		〈Option〉
Type	Diaphragm type with built-in electric contacts		←

COOLING

Item	Specification			
	<4DR5>		<6DR5>	
Cooling system	Water-cooled, forced circulation type		←	
Cooling water quantity (engine proper)	Approx. 5 lit.		Approx. 7.7 lit.	
Water pump				
Type	Centrifugal type		←	
Drive system	V-belt drive		←	
V-belt	<Standard>	<Option>	<Standard>	<Option>
Type	Low edge cog B type	Low edge plain A type	Low edge cog B type	Low edge plain A type
Quantity	1	←	←	←
Thermostat				
Type	Wax pellet side bypass type		←	
Valve opening temperature	76.5°C		←	
Fan	<Standard>	<Option>	<Standard>	<Option>
Type	Polypropylene blow-out type	Polypropylene suction type	Polypropylene blow-out type	Polypropylene suction type or steel blow-out type
Radiator				
Type	Tube and plate fin type		←	
Radiator cap				
Type	Pressure type		←	
Boiling temperature	110°C		←	

FUEL

Item	Specification			
	(Nippondenso Co., Ltd. product)			
	〈4DR5〉		〈6DR5〉	
Injection pump proper				
Type	Bosch A	←		
Model	ND-PES4A65	ND-PES6A65		
Turning direction (as viewed from drive side)	Clockwise	←		
Plunger				
Diameter	6.5 mm	←		
Lead	RH lead	←		
Governor	〈Standard〉	〈Option〉		
Type	RSV type mechanical all-speed governor	RU type minimum-maximum mechanical governor, MZ type all-speed pneumatic governor	RSV type mechanical all-speed governor	
Feed pump				
Model	ND-FP/KS22AC		←	
Automatic timer (2 500 rpm or more)				
Type	SCZ type mechanical automatic timer		←	
Injection nozzle				
Type	Throttle type		←	
Model	ND-DN4SDND62		←	
Injection orifice diameter	1.00 mm		←	
Spray angle	4°		←	
Injection pressure	11.8 MPa (120 kgf/cm ²)		←	
Fuel filter	〈Standard〉	〈Option〉	〈Standard〉	〈Option〉
Type	Throw-away filter paper type	Auto clean type (for fuel oil A)	Throw-away filter paper type	Auto clean type (for fuel oil A)

ELECTRICAL

Item	Specification				
Voltage - Polarity	〈Standard〉 24 V (-) earth		〈Option〉 12 V (-) earth		
	(Mitsubishi Electric Corp. product)				
Starter	〈4DR5〉		〈6DR5〉		
	〈Standard〉	〈Option〉	〈Option〉	〈Standard〉	〈Option〉
Type	Overhang electromag- netic push-in type reduc- tion starter	←	←	←	←
Model	M2T64272	M2T54272	M2T56871	M3T57371	M3T66871
Output	24 V - 3.2 kW	12 V - 2 kW	←	24 V - 5 kW	12 V - 2.2 kW
Reduction mechanism	Single exter- nal spur gear	←	←	←	←
Starter relay					
Model	U001T06072			U001T06076 (add-on starter)	U001T06272 (←)
Alternator	〈Standard〉		〈Option〉		〈Option〉
Type	Alternator with built- in IC regulator		←	←	
Model	A2T71683		A2T70776	A2T13083	
Output	24 V - 25 A		24 V - 30 A	12 V - 40 A	
	〈Option, for 4DR5〉	〈Option, for 4DR5〉	〈Option, for 6DR5〉	〈Option, for 6DR5〉	
Type	Alternator with built-in IC regulator (with vacuum pump)	←	←	Alternator with built-in IC regulator	
Model	A2T12978	A2T71483	A2T71583	A2T71678	
Output	12 V - 40 A	24 V - 25 A	←	←	
Vacuum pump					
Type	Rotary pump with 4 vanes, direct- ly coupled with alternator	←	←	←	

Item	Specification		
Safety relay	< Standard >	< Option, for 6DR5, 12 V >	
Type	Tirril type	←	
Model	RX-Q30	RX-Q25	
Glow plug	< Standard >	< Option, for 12 V >	< Option >
Type	Sheathed type (body earth type)	←	Sheathed type (earth float type)
Voltage - Current	20.5 V - 6 A	10.5 V - 8.3 A	24 V - 5.3 A
Oil pan heater < Option >			
Type	Electric heating type		
Capacity	AC100 V - 80 W		
Water heater < Option >			
Type	Electric heating type		
Capacity	AC100 V - 300 W		

AUTOMATIC STOP SYSTEM < OPTION >

Item	Specification	
	< 4DR5 >	< 6DR5 >
Stop solenoid	(Nippondenso Co., Ltd. product)	←
Model	053400-1011	053400-1861
Solenoid relay	(Nikko Denki product)	←
Model	0 - 25000 - 5591	←
Oil pressure switch		
Type	Diaphragm, built-in electric contact	←
Thermo switch		
Type	Wax type	←

CLUTCH (OPTION)

Item	Specification	
	<4DR5>	<6DR5>
Clutch		
Type	Dry single disc diaphragm spring hydraulically operated	Dry single disc coil spring type
Model	C2W26-D C2M26-D	C3W28
Facing		
Material	Woven Cerametallic	Woven
O.D. x I.D.	260 x 170 mm 260 x 174 mm	275 x 175 mm
Power cylinder		
I.D. x stroke	22.22 (7/8") x 28.6 mm	←
Master cylinder		
I.D. x stroke	22.22 (7/8") x 30 mm	←
Bearing case		
Type	Direct drive type or belt drive type	←
Model	PC2	PC3

TRANSMISSION (OPTION)

Item	Specification	
	<4DR5>	<6DR5>
Type	Full-synchromesh 5 forward speeds	←
Model	M2S5	M3S5
Gear ratio		
1st speed	5.866	←
2nd speed	3.028	←
3rd speed	1.700	←
4th speed	1.000	←
5th speed	0.797	←
Reverse	5.866	←

Item	Specification	
	(4DR5)	(6DR5)
Weight	85 kg	89 kg
Gear oil		
Quality	API classification GL-3, SAE80	←
Quantity	Approx. 4.4 lit.	←

1-2-3 Engine Outputs Classified by Application

Application \ Engine model	4DR5	6DR5
P engines for power generator Rated output kW/min ⁻¹ (PS/rpm)	22.8/1 500 (31/1 500) 28.3/1 800 (38.5/1 800)	34.6/1 500 (47/1 500) 41.9/1 800 (57/1 800)
P engines for general power plant Rated output kW/min ⁻¹ (PS/rpm)	20.6/1 500 (28/1 500) 25.7/1 800 (35/1 800) 28.7/2 000 (39/2 000) 35.3/2 500 (48/2 500) 39.7/3 000 (54/3 000)	31.6/1 500 (43/1 500) 38.2/1 800 (52/1 800) 42.6/2 000 (58/2 000) 52.6/2 500 (71.5/2 500) 60.3/3 000 (82/3 000)
C engines for construction machinery Rated output kW/min ⁻¹ (PS/rpm)	22.8/1 500 (31/1 500) 28.3/1 800 (38.5/1 800) 31.6/2 000 (43/2 000) 39.0/2 500 (53/2 500) 44.1/3 000 (60/3 000)	34.6/1 500 (47/1 500) 41.9/1 800 (57/1 800) 47.1/2 000 (64/2 000) 57.7/2 500 (78.5/2 500) 66.2/3 000 (90/3 000)

- NOTE:**
1. The above performance values are obtained in the standard conditions (atmospheric pressure of 760 mmHg, atmospheric temperature of 20°C and humidity of 65%) specified by JIS D1005.
 2. As for the rated outputs of the engines for general power plant, 10-hour continuous ratings are shown. Overload shall be limited to 10% over the rated output, and the overload period shall not exceed one hour.
 3. As for the rated output for power generator, 1-hour rating is shown.

1-3 CONSTRUCTION AND OPERATION

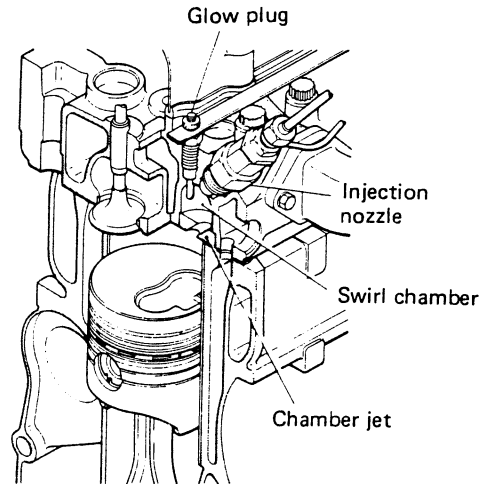
1-3-1 Engine Proper

(1) Combustion Chamber

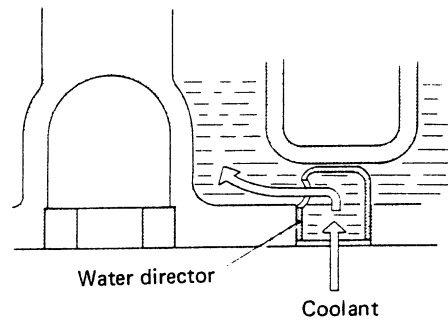
The combustion chamber is a swirl chamber. In the cylinder head, a bell shaped swirl chamber is provided, in which the air drawn in is made to swirl on the compression stroke to thoroughly mix the compressed air and fresh fuel before combustion, thus assuring instant ignition of the airfuel mixture.

An injection nozzle and glow plug are mounted to the swirl chamber, and a chamber jet made of materials featuring minimum thermal expansion is provided at the bottom of the swirl chamber.

At the coolant inlet through which coolant is driven from the crankcase, a water director is provided which directs flow of coolant for more efficient cooling of the areas between the intake and exhaust ports and valves and the swirl chamber.



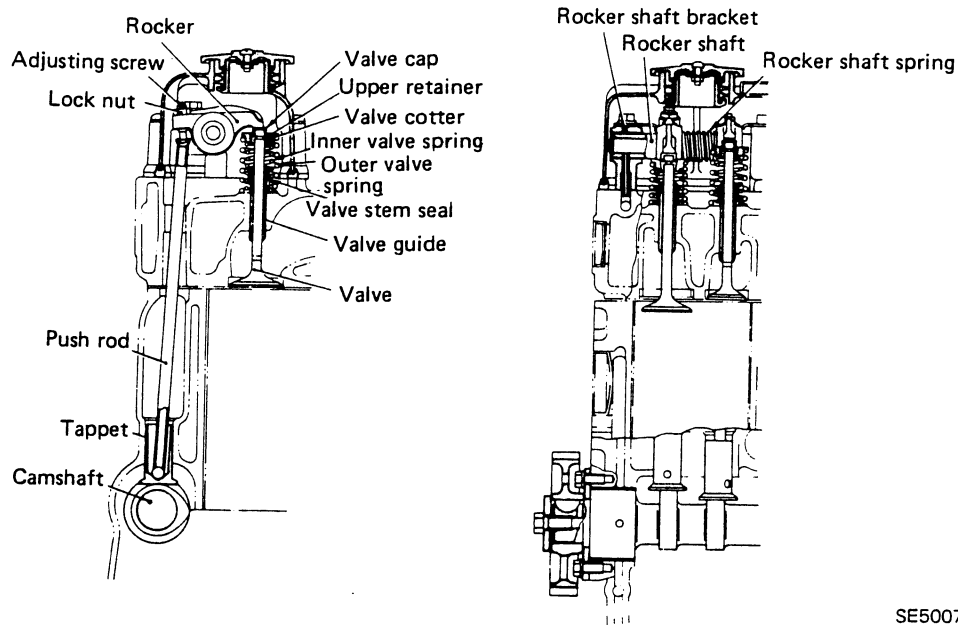
SE5005



SE5006

(2) Valve Mechanism

The valve mechanism is an overhead valve system and is constructed as shown.



SE5007

- (a) Both inlet and exhaust valves are made of heat-resistant steel given surface treatment. The valve seat angle is 45° .

A valve stem seal is provided on the stem of the valve to control the quantity of oil that lubricates the sliding portions of the valve and valve guide.

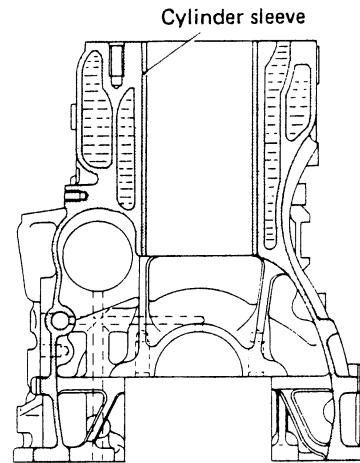
The exhaust side valve guide is one with a carbon cutter.

- (b) As valve springs, two inequally pitched springs are provided; the inner and outer ones which are different in winding direction.
- (c) The rocker end surface making contact with the valve cap is induction-hardened and a bushing installed in the rocker shaft fitting hole to improve wear resistance.
- (d) The rocker shaft is a hollow round rod sealed off with expansion plugs at both ends and provides a passage for engine oil.
- (e) The push rod is a hollow round rod. A steel ball is welded to the bottom end and a spherical concave piece welded to the top end. Both ends are case-hardened.
- (f) The tappet is shaped like a mushroom and the camshaft contacting surface spherical. The tappet has an oil hole for lubrication of the tappet and crankshaft.
- (g) The camshaft is supported by the crankcase at three points (four points on the 6DR5) and the journal and cam surfaces induction-hardened. A screw gear is provided on the camshaft for driving the oil pump.

(3) Crankcase and Cylinder Sleeve

The crankcase is made of cast iron and the cylinder portions of one-piece construction. It is light-weight and has effective ribs for higher rigidity, featuring a construction relatively free from stress concentration and deformation.

A dry type cylinder sleeve resistant to wear is installed in the cylinder.

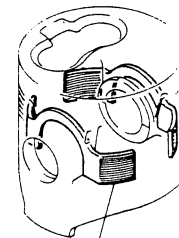
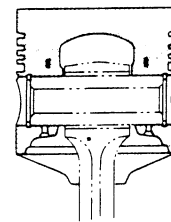
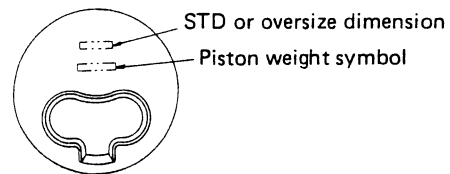


(4) Piston and Piston Ring

(a) Piston

The piston is an aluminum alloy casting. Inside the piston a strut is provided which has made it possible to reduce the thickness of the piston and maintain the proper spacing between the piston and cylinder sleeve.

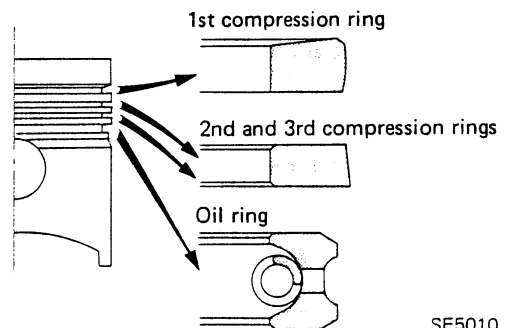
A piston weight symbol and "STD" (standard piston) or an oversize dimension (oversize piston) are stamped on the top surface of the piston.



The piston pin is mounted in a full floating style, and snap rings provided at both ends to prevent the piston pin from slipping out of position.

(b) Piston ring

The piston rings include three compression rings and one oil ring, making up the total of four. The sliding surfaces of the 1st compression ring and oil ring are hard chrome plated, whereas the entire surfaces of the other compression rings are phosphated.



As for the shapes of the piston rings, the 1st compression ring is a barrel face semi-keystone type, the 2nd and 3rd compression rings a taper face type, and the oil ring a dual type with an expander spring.



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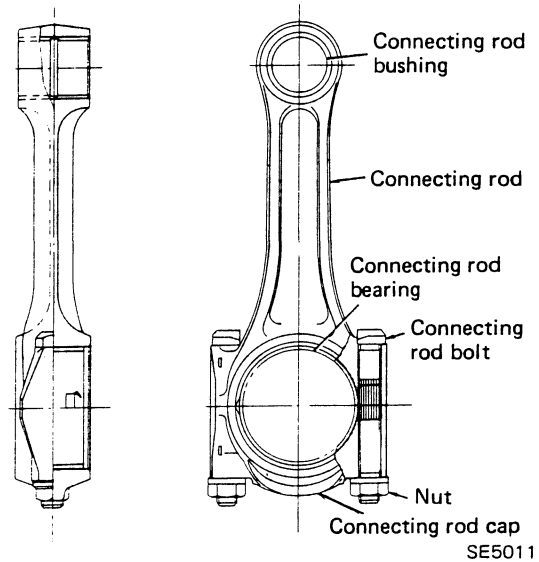
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(5) Connecting Rod and Connecting Rod Bearing

The connecting rod is an I-section die forging providing high rigidity. A lead bronze bushing is installed in the small end. The connecting rod bearings at the big end are split type plain bearings.

The connecting rod and connecting rod cap are coupled together by knurled connecting rod bolts.



(6) Crankshaft and Main Bearing

(a) Crankshaft

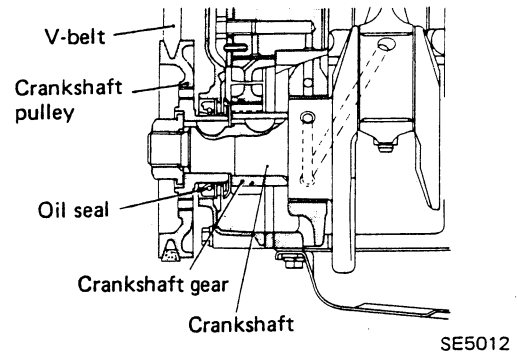
The crankshaft is designed to provide high rigidity and is a die forging integral with the balance weight.

The pin and journal are induction-hardened for higher wear resistance.

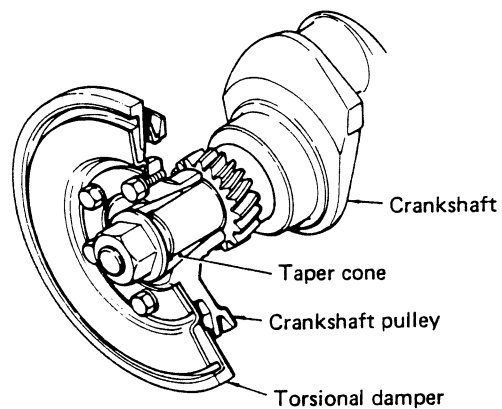
By the through oil hole of the journal and pin, some of the main bearing lubricating oil is fed to the pin for lubrication of the connecting rod bearing.

The crankshaft pulley and crankshaft gear are mounted to the front of the crankshaft with a nut. The crankshaft pulley is driven by a V-belt to drive the alternator and water pump.

The crankshaft gear drives the camshaft and injection pump.

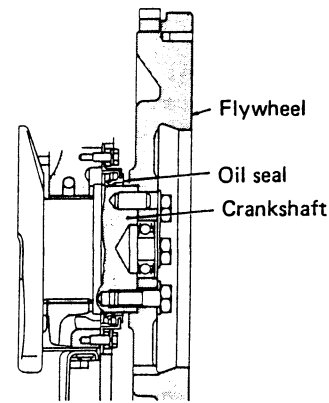


As an option on the 6DR5, a torsional damper is provided at the front end of the crankshaft. The torsional damper accomplishes the function of absorbing the torsional vibration of the crankshaft.



The flywheel is mounted to the rear of the crankshaft.

Oil seals are provided at the front and rear of the crankshaft.



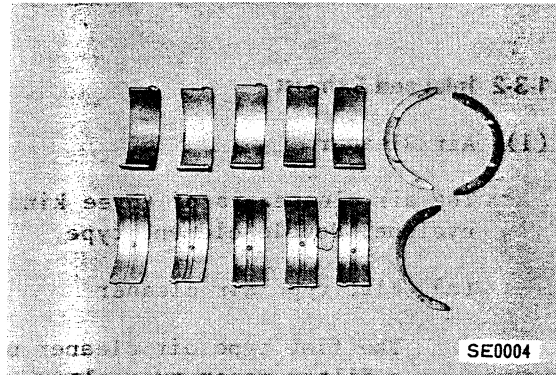
(b) Main bearing

SE5013

The main bearings are special alloy deposited split type plain bearings.

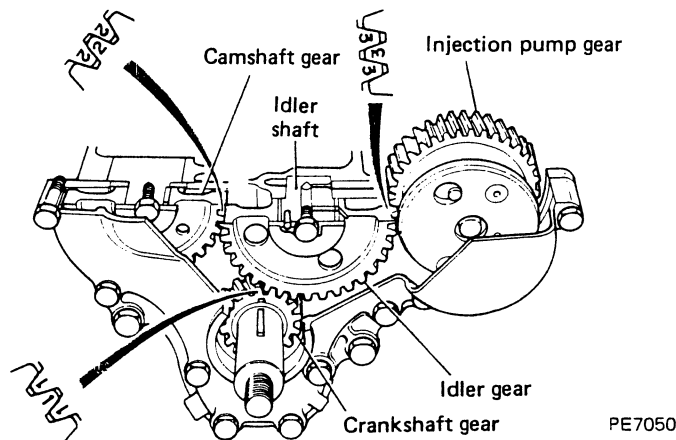
An oil groove and oil hole are provided in the inside surface of the upper main bearing.

Five pairs of main bearings are provided on the 4DR engine and seven pairs on the 6DR. At the rearmost end, split type thrust plates are mounted which support the thrust of the crankshaft.



(7) Timing Gear

The timing gear is housed in the timing gear case at the front of the engine. The gear train is shown below.



All of the gears are high precision gears produced by shaving helical gears.

A timing mark is stamped on each gear. Correct mesh can be achieved by aligning the timing marks at reassembly.

The crankshaft gear is exactly located by a key and is installed to the crankshaft. This gear is the drive source for all of the gears.

The idler gear has a pressed-in bushing and turns on the idler shaft. The idler shaft and idler gear have an oil hole which is an oil passage for lubrication of the idler gear bushing and each timing gear.

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