FOREWORD

This shop manual contains the specifications, construction, operation, adjustment and service procedures of the Model D6A diesel engine for service mechanics engaged in servicing of the Hyundai diesel engines.

Please make the most of this shop manual to perform correct servicing and wasteless operations.

Note that some of the contents of this shop manual are subject to change owing to improvements, etc. that may be introduced after publication of the shop manual.

HYUNDAI MOTOR COMPANY
COMMERCIAL ENGINE DEP'T
Printed in Korea

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HYUNDAI MOTOR COMPANY

COMPILATION OF THIS MANUAL

1. The contents of this shop manual are divided as shown below when edited.

Group No	Group Name	Contents
1	General	General description, outside view photograph and cross section view of engine, specifications, construction and operations
2	Service standards	Engine service standards, service standards table, tightening torque table, sealant and grease table
3	Special tools	Shapes and usages of special tools
4	Determining time to overhaul	Decision on time to overhaul, measurement of compression pressure, troubleshooting
5	Engine adjustment and break—in operation	Inspection and adjustment of valve clearance, inspection and adjustment of fuel injection start timing, engine speed adjustment
6	Removal and installation of auxiliaries	Removal and installation of auxiliaries such as injection pump, starter, alternator, injection pump drive
7	Engine proper	Disassembly, inspection and reassembly of engine proper, including cylinder head, valve mechanism, camshaft, piston, crankshaft, timing gear, flywheel, etc.
8	Inlet and exhaust	Disassembly, inspection and reassembly of air cleaner, turbocharger, etc.
9	Lubrication	Disassembly inspection and reassembly of lubrication system, including oil pump, oil filter, oil cooler, etc.
10	Cooling	Disassembly, inspection and reassembly of cooling system, including water pump, thermostat, etc.
11	Fuel	Disassembly, inspection and reassembly of fuel system, including injection pump, injection nozzle, fuel filter, etc.
12	Electrical	Inspection of starter, starter relay, alternator, etc.
13	Other equipment	Disassembly, inspection and reassembly of infection pump drive.

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2. How to read disassembly and reassembly drawings

(a) The part names and numbers in the drawings correspond to those in the text. The parts are numbered in the order of disassembly.

(b) The inspection items to be performed during disassembly operations are shown in the disassembly drawings.

(c) All tightening torque specifications in the reassembly drawings may be considered "dry" unless "wet" is specified.

3. Definition of terms

(a) Nominal Value(Abbr. : NV)

Shows dimension of single part, mutual clearance between parts or standard performance. Values, however, are rounded off within limits necessary for inspection.

(b) Repair Limit(Abbr. : RL)

Shows that when specified value is reached, repair is necessary, Repair means adjustment, grinding, replacement of bushings, metals and the like, selection of oversize, selection of shim thickness, etc.

(c) Service Limit(Abbr. : SL)

Shows that when specified value is reached, replacement of the parts with new one is necessary.

(d) Basic Diameter(Abbr : BD)

Shows nominal diameter of part to be measured.

4. Unit

The SI unit(International System of Units) is used. Metric notation is jointly shown in parentheses.

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5. Table of Conversion Rate for Foot-pound Units into SI Units

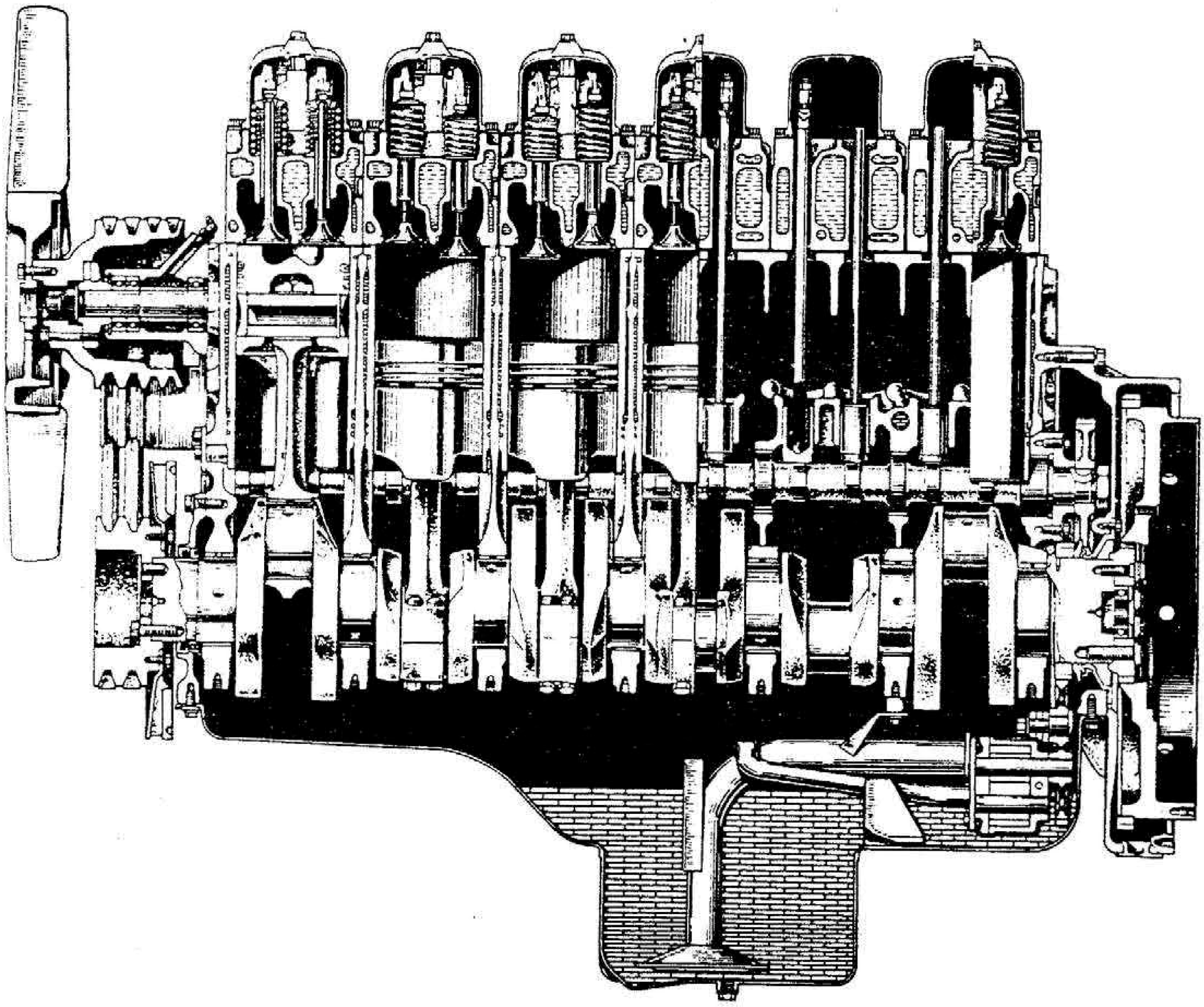
Unit	Sign of SI unit	Sign of foot-pound unit	Conversion rate
Mass quantity of matter	kg g	lb oz	1kg=2.2046 1b 1g=0.035274 oz
Dimension	m mm	ft. in.	1m=3.2808 ft. 1mm=0.03937 in.
Capacity	lit. cc	gal. oz	1 lit.=0.2642 gal.(U.S.) 0.220 gal.(Imp.) 1 cc=0.033814 oz(U.S.) 0.035195 oz(Imp,)
Force	N(Newton)	lbf	1 N=0.2248 lbf
Pressure	kpa(Kilopascal)	lbf/in.^{2}	1 kpa=0.145 lbf/in.^{2} 1 kpa=0.2953 in. Hg
Stress	N/cm^2	lbf/in.^{2}	1 N/cm^2=1.45 lbf/in.^{2}
Moment of force	N/m	ft.lbf	1 N/m=0.7375 ft.lbf
Output	kw(kilowatt)	HP	1 kw=1.34 HP
Temperature	℃	°F	t℃=(1.8t℃+32)°F

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1-1 GENERAL DESCRIPTION

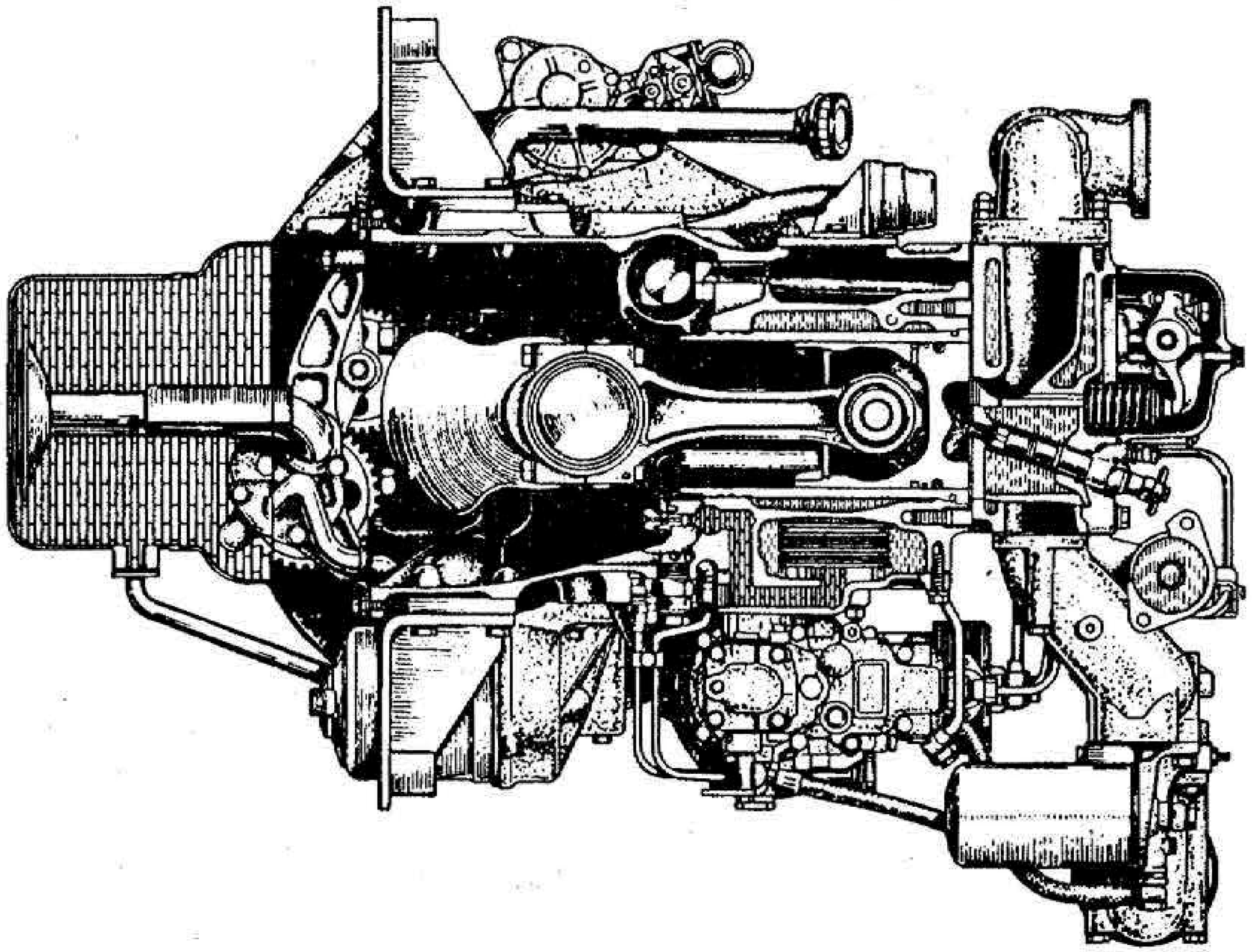
1-1-1 Engine Section Views

(1) D6AU

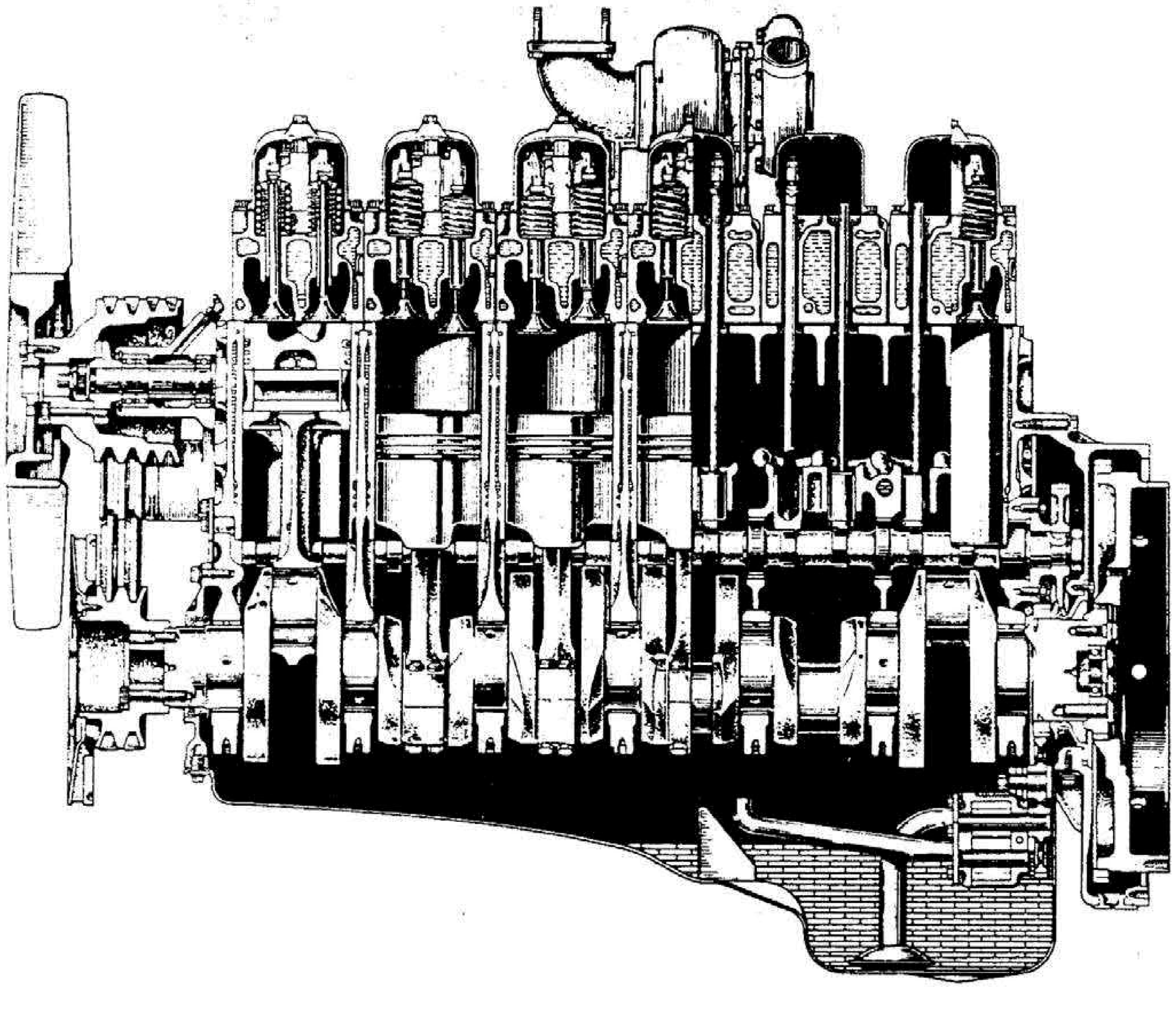


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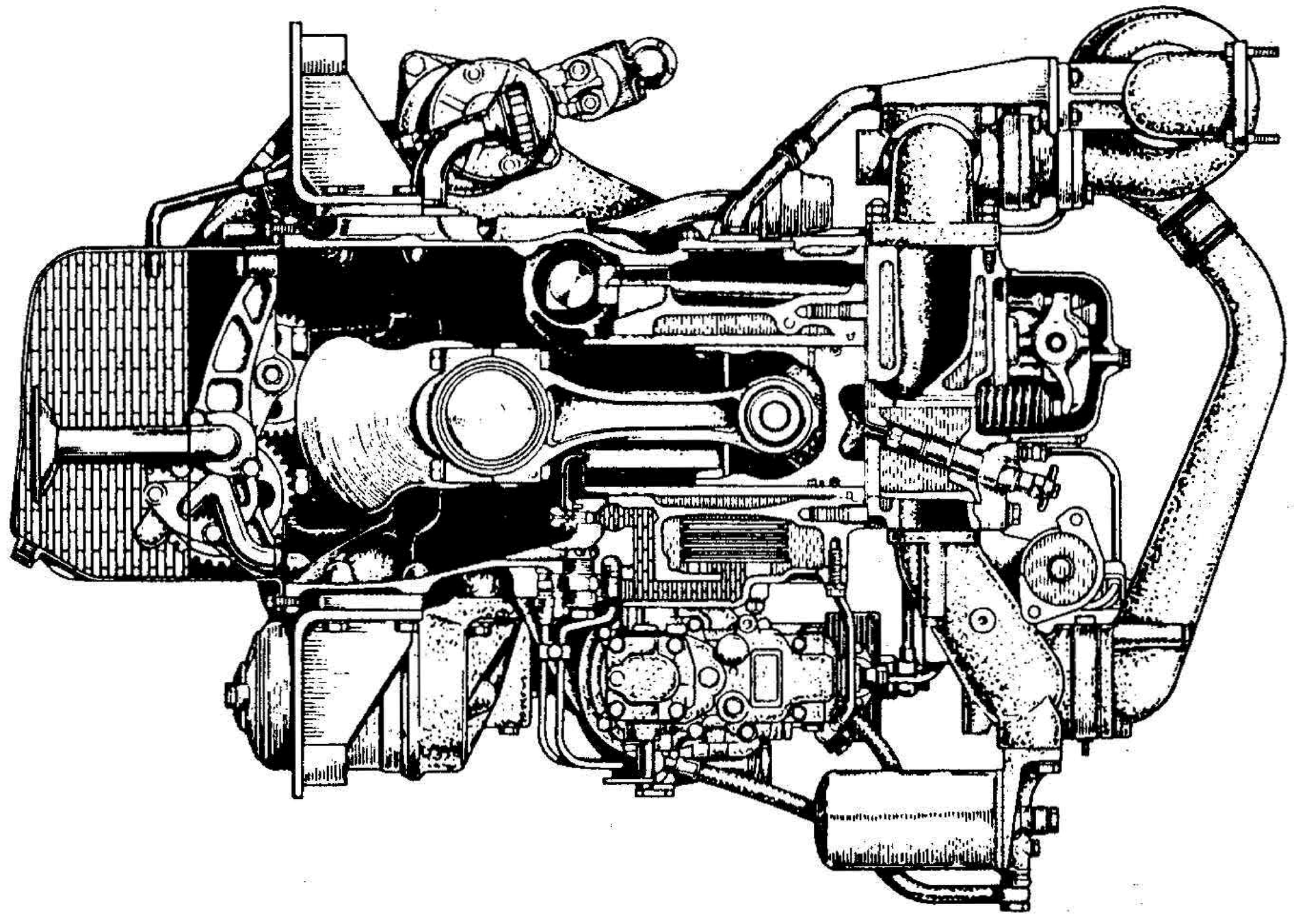


(2) D6AZ



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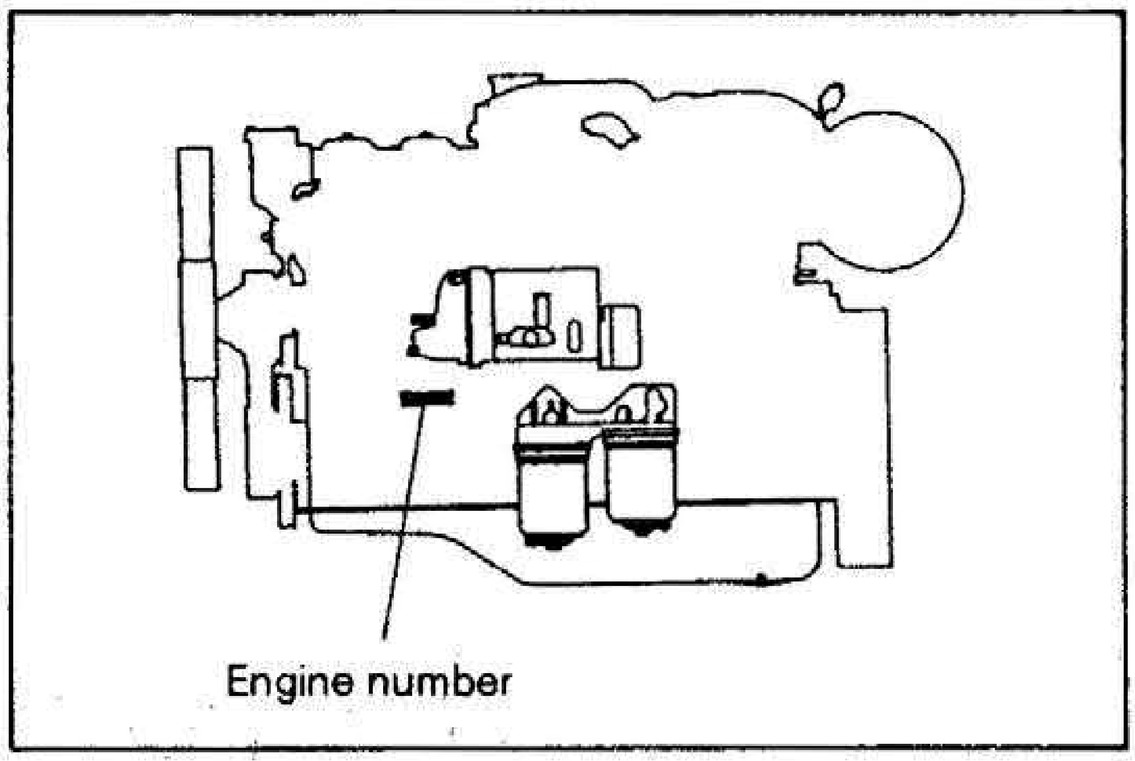


1-1-3 Engine Number, Nameplate

(1) Engine Number

The engine number is stamped on the left side of the crankcase, near the front portion, as shown.

Ex : Model ↓ D6AU Production year ↓ W Engine No. ↓ 123456

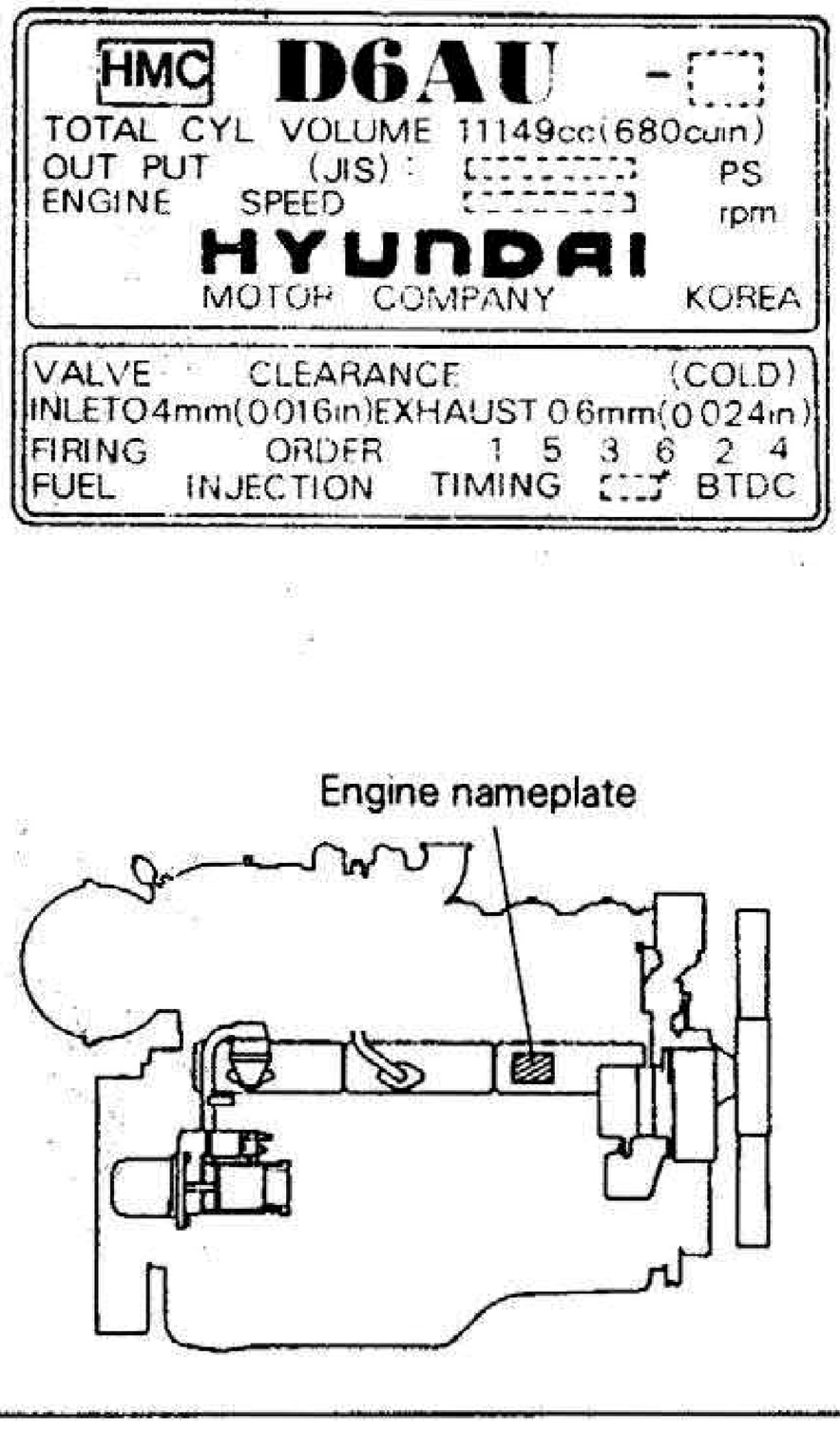


The engine number is important in knowing the history of the engine.

(2) Name plate

The nameplate is bonded to the side cover on the right side of the engine and shows the following.

- Engine Model
- Total Displacement
- Output
- Valve Clearance
- Firing Order
- Fuel Injection Timing



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1-2 SPECIFICATIONS

1-2-1 Principal Specifications

Item		Specification		
Engine model		D6AU	D6AZ	D6AC
Type		Water cooled, 4-cycle diesel	Water cooled, 4-cycle diesel	← ←
Number of cylinders-arrangement		6-in-line	6-in-line	←
Valve mechanism		Overhead Value	Overhead Value	←
Combustion chamber		Direct injection type.	Direct injection type.	←
Cylinder bore × stroke	mm	130 × 140	130 × 140	←
Total displacement	cc	11149	11149	←
Compression ratio		17	16	16.5
Firing order		1-5-3-6-2-4	1-5-3-6-2-4	←
Engine dimensions				
Overall length		1612	1607	1289.6
Overall width	mm	924	907	847.5
Overall height	mm	1248	1392	1018
Weight	kg	930	970	970

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1-2-2 Specifications of Each Device

Engine proper

Item		Specifications
Cylinder liner	Type	Wet type
Piston	Type	Trunk-shaped, slipper skirt type
Piston rings	Q'ty	Two compression rings One oil ring

Inlet and Exhaust

Item		Specifications
Air cleaner		
Element	Type	Cyclone filter paper type
Turbocharger		D6AZ
	Type	Turbocharger
	Model	Mitsubishi Schwitzer 3LM

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Lubrication

Item		Specification			
Engine oil	Quality	[D6AU] API classification "FOR SERVICE CC" or better		[D6AZ(AC)] API classification "FOR SERVICE CD" or better	
		For generators	For construction machinery	For generators	For construction machinery
Oil pan oil quantity		Approx. 20 lit.	Approx. 23.3 lit.	Approx. 20 lit.	Approx. 23.3 lit.
Oil filter oil quantity		Approx. 3 lit.		Approx. 3 lit.	
Lubricationg system		Oil pump forced feed system			
Oil pump	Type	Gear Pump forced feed system			
Relief valve	Type	Ball valve type			
Oil filter					
Full flow filter element type		Filter paper type			
By pass filter element type		Filter paper type			
Oil bypass alarm type		Piston valve type with electric contacts			
Oil cooler	Type	Shell and plate type(multi-plate type)			
Bypass valve	Type	Piston valve type			
Regulator valve	Type	Piston valve type			
Oil jet					
Check valve	Type	Piston valve type			

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Cooling

Item		Specification
Cooling system		Water-cooled, forced circulation system
Cooling water quantity		24 lit.
(Engine proper)		
Water pump	Type	Centrifugal type
	Drive system	V-belt drive
V-belt	Type×quantity	(With fan)
		Low edge cog Type B×1(for water pump)
		Low edge cog Type C×2(for fan drive)
		(Without fan)
		Low edge cog Type C×1(for water pump)
Thermostat	Type	Wax pellet type bottom bypass system
	Valve opening temperature×q' ty	71℃×2
Fan	Type	Made of polypropylene, blow-off type

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Fuel

Item		Specification		
		[D6AU]	[D6AZ]	[D6AC]
Injection pump proper				
	Type	Boash Type AD	Boash Type P	←
	Model	NP-PE6AD 105	NP-PE6P 120	←
Turing direction (as viewed from drive side)		Counter Clockwise	Counter Clockwise	←
Plunger				
	Diameter	10.5mm	12mm	←
Governor				
	Type	All speed governor	All speed governor	←
	Model	RSV	Electric Gov.	←
Feed pump				
	Model	NP-FP/KE22ACB	NP-FP/KE-PS	←
Automatic timer				
	Type	Mechanical automatic timer	Mechanical automatic timer	←
	Model	SA	SP	←
Injection nozzle				
	Type	Hole type (1-spring nozzle)	Hole type (2-spring nozzle)	←
	No. of orifices	5	5	←
	Orifices diameter	0.33mm	0.34mm	←
	Orifices angle	154°	150°	←
	Injection pressure	220kgf/cm²	220kgf/cm²	←
Fuel filter				
	type	Cartridge type		

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Electrical

Item		Specifications
Voltage-Polarity		24V-(-) ground
Starter		
	Type	Solenoid shift Type Reduction starter
	Output	24V-5.5kW
	Reduction mechanism	Single stage reduction by internal spur gear
Starter relay		
	Model	M72S3006
Alternator		
	Type	Alternator with built-in IC regulator
	Output	24V-40A
Intake air heater		
	Type	Electric heating type
	Capacity	2.86kW
Heater relay		
	Fuse capacity	127A

Automatic stop system (For generators)

Item		Specifications
Stop solenoid		
	Type	Solenoid type
Oil pressure switch	Type	Diaphragm type with built-in electric contacts
Water temp unit	Type	Wax type with built-in electric contacts

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1-3 CONSTRUCTION AND OPERATION

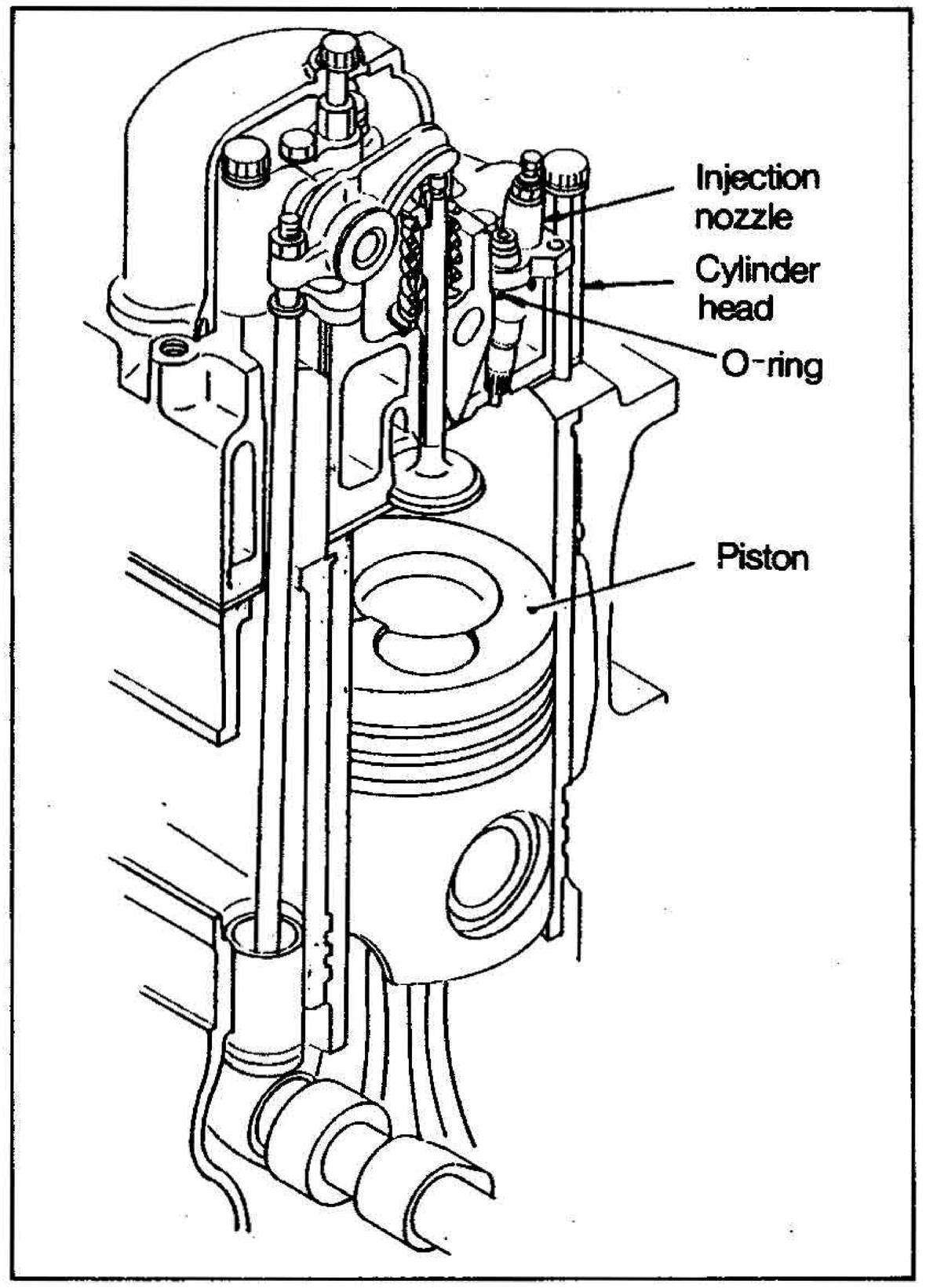
1-3-1 Engine Proper

(1) Combustion Chamber

The combustion chamber is formed by the cylinder head and pistion top.

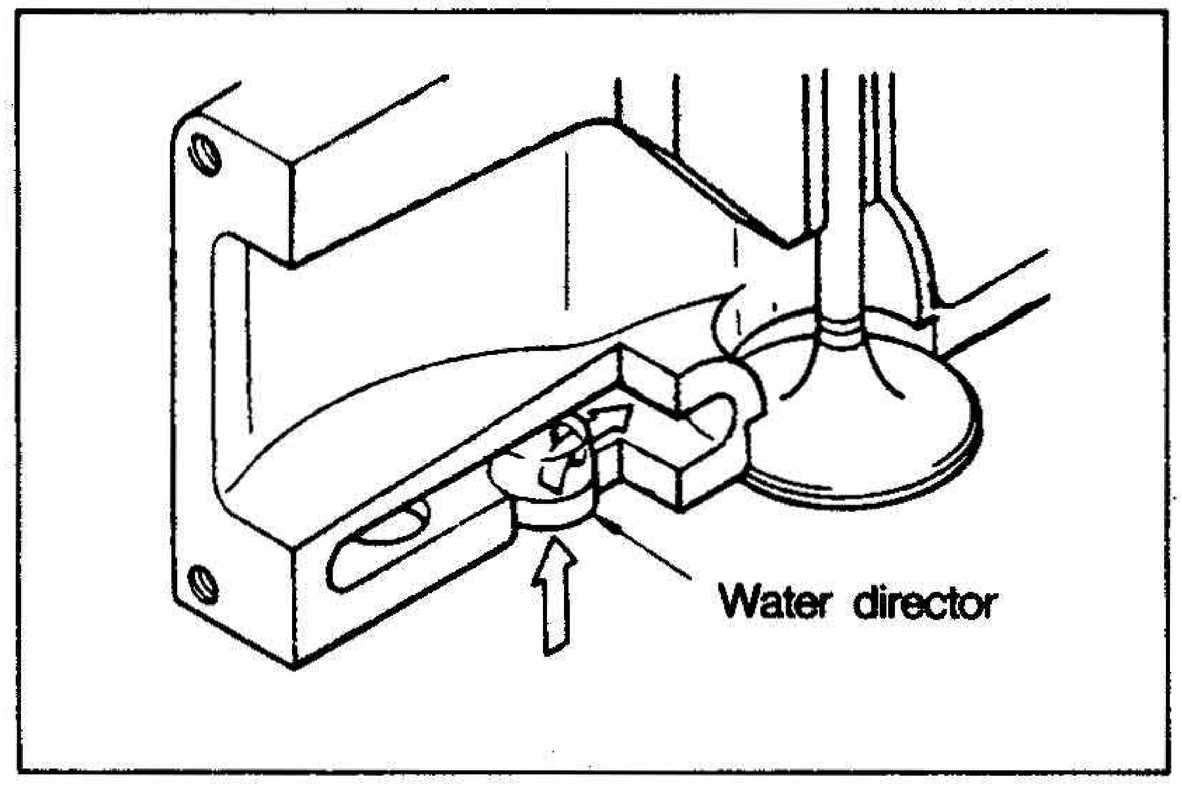
The injection nozzle and nozzle tube are mounted to the cylinder head.

The nozzle tube not only holds the nozzle in position but also cools it. Since the outside of the nozzle tube is exposed to the water jacket, the top end of the tube is sealed with an O-ring and the bottom end staked to prevent water leakage.



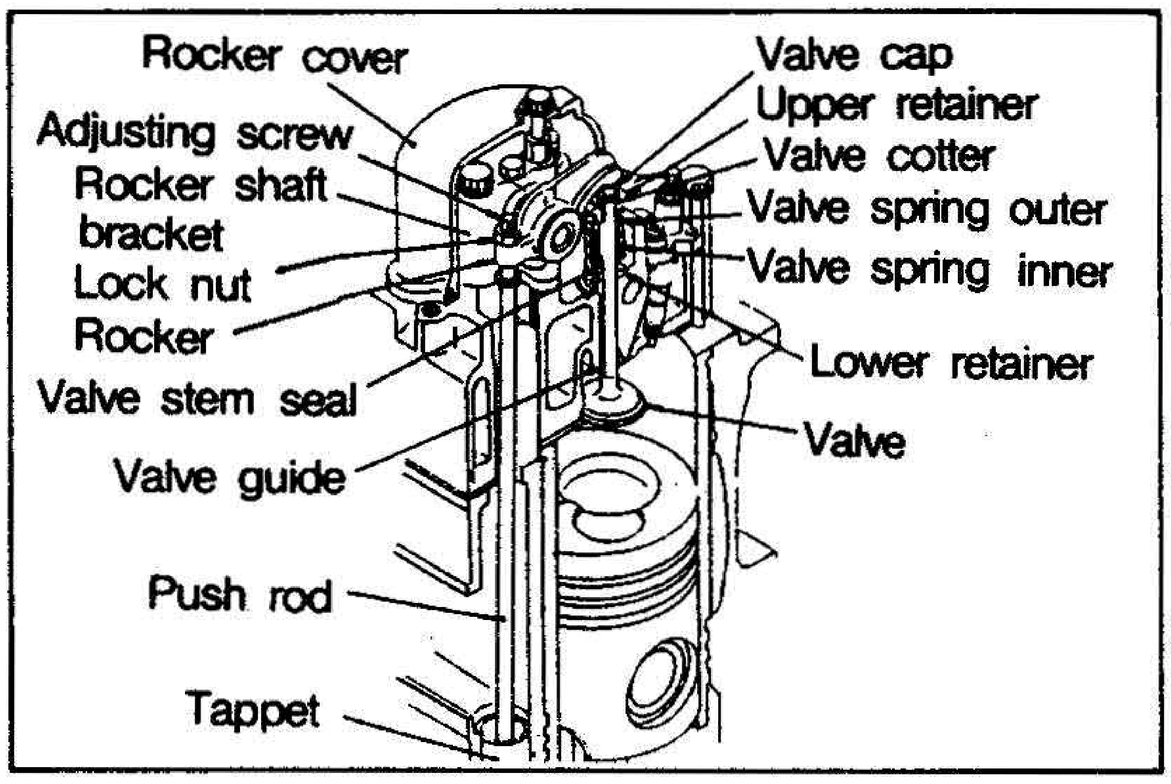
Fuel is directly injected into the combustion chamber where combustion takes place.

Water directors which direct the flow of coolant are installed at the bottom of the cylinder head to provide more effective cooling around the combustion chamber.



(2) Valve Mechanism

The valve mechanism is an overhead valve (OHV) type and is constructed as shown in illustration at right.

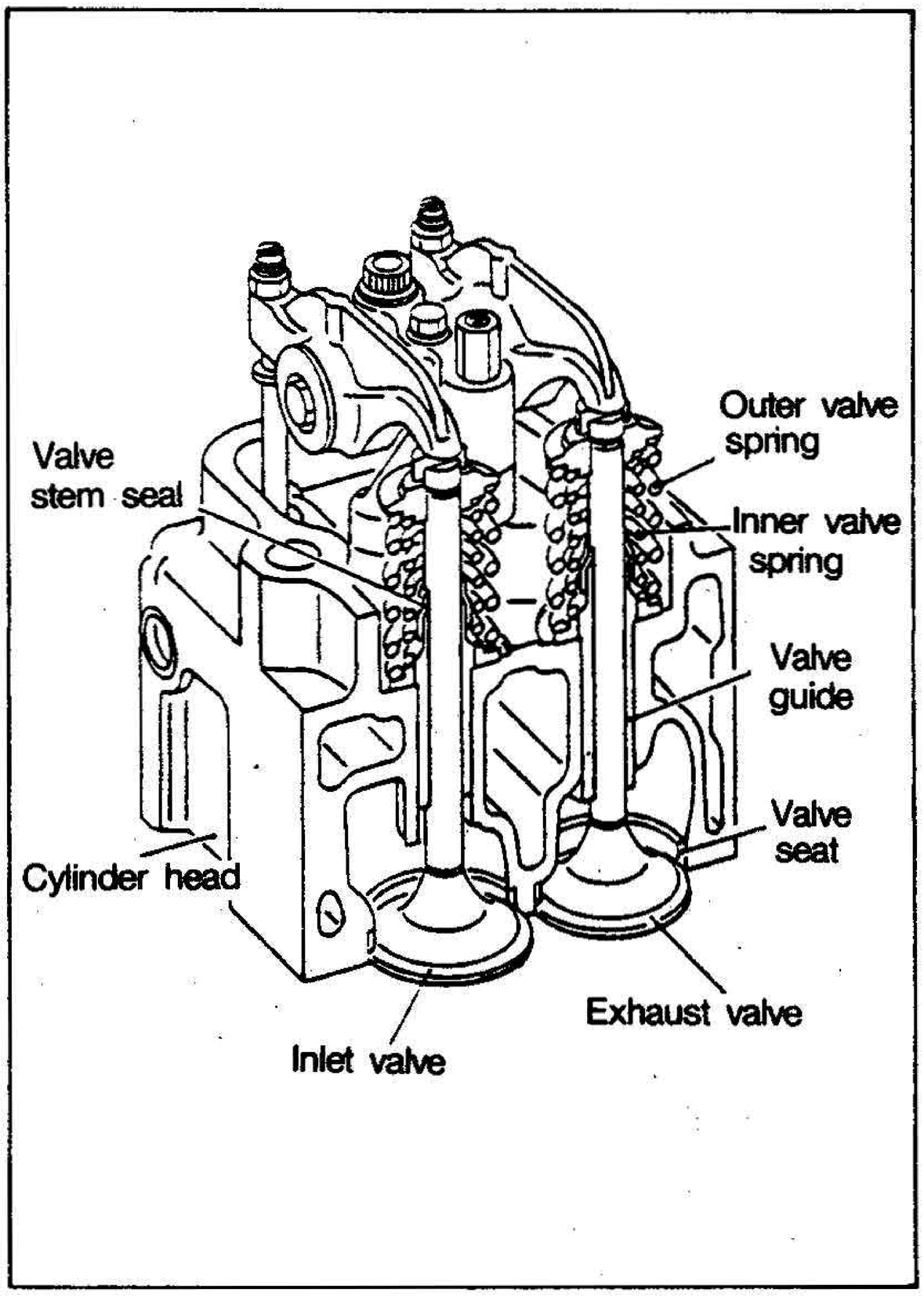


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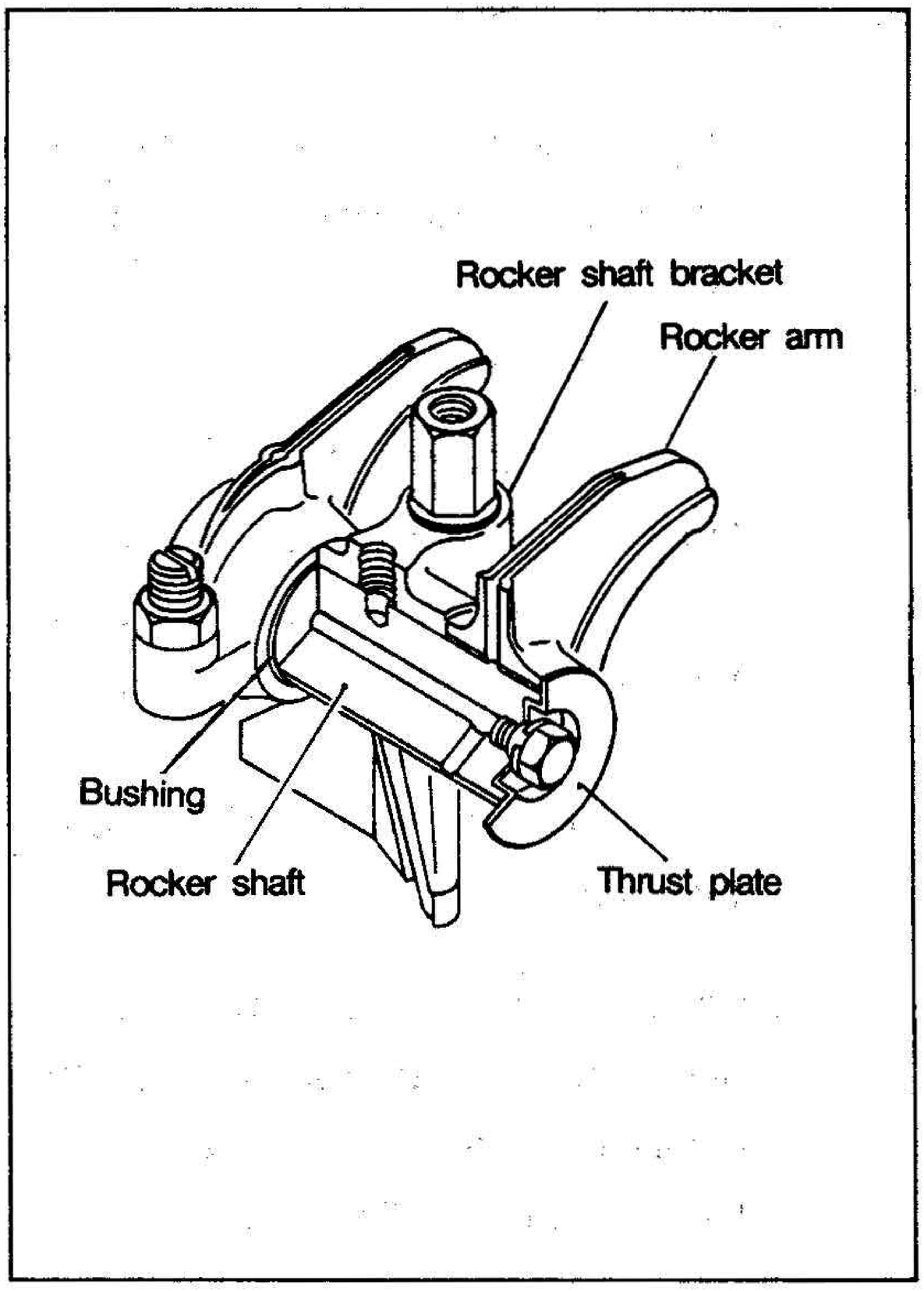
(a) Both inlet and exhaust valves are made of surface-treated heat-resisting steel. The valve seat angle is 45°.

The valve stem has a valve stem seal which controls the quantity of lubricating oil on the sliding surfaces of valve and valve guide.

(b) The valve springs are unequally pitched springs. Two springs, inner and outer, diferent in coiled direction are installed.



(c) The rocker and rocker shaft are supported on the rocker shaft bracket and are independently installed for each cylinder. The inlet and exhaust rockers are common parts, and the end sliding portions are quenched. The rocker shaft is a hollow round rod sealed off by thrust plates at both ends. The hollow inside of the shaft constitutes an engine oil passage.

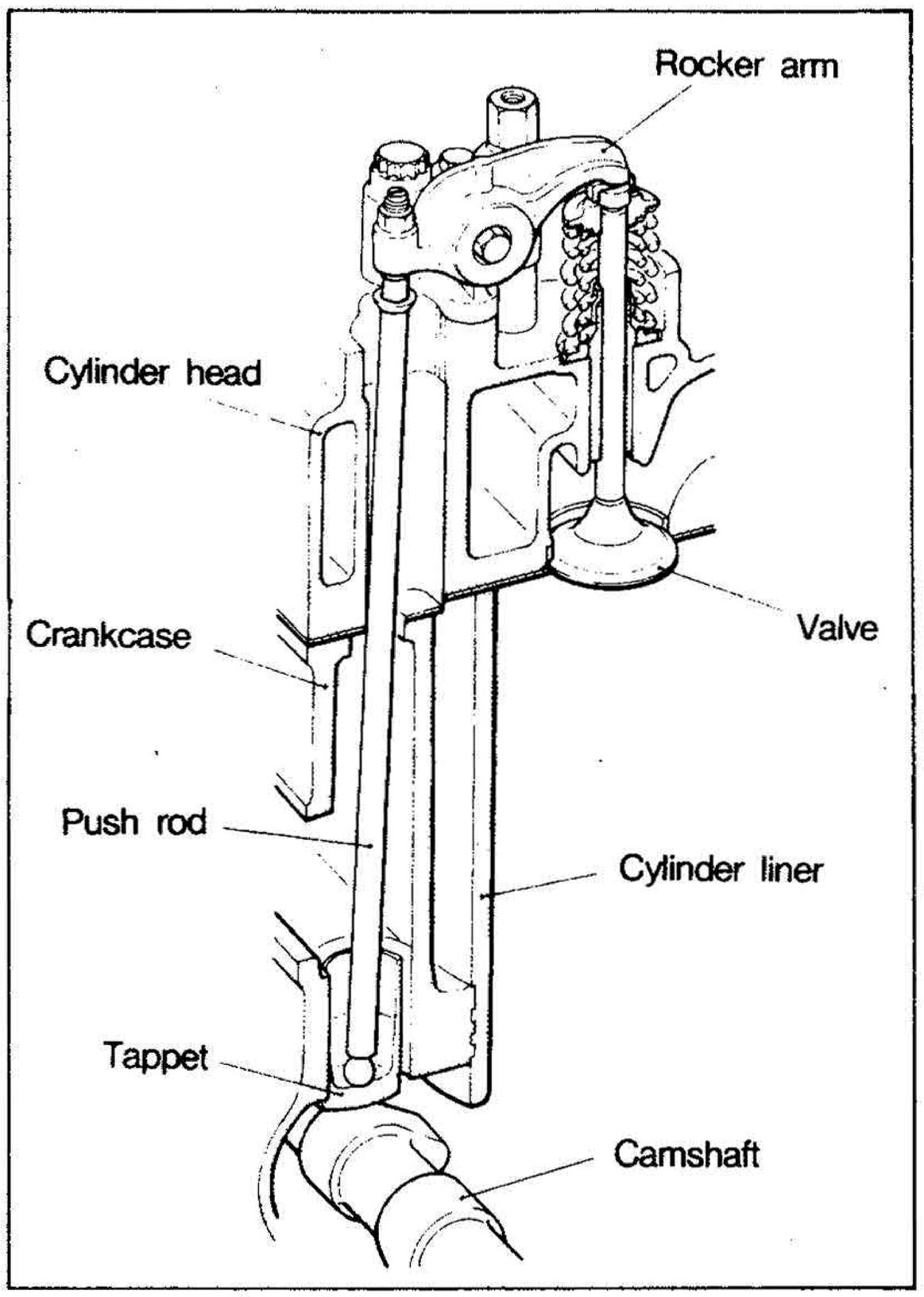


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(d) A steel ball is welded to the bottom end of the push rod and a spherical concave-shaped cup welded to the top end. Both ends are case-hardened.

(e) The tappet is a cylindrical type, and the portion making contact with the camshaft has a spherical surface. The tappet is removable through the side of the crankcase.

(f) The cam profile of the camshaft has a special curve. The surface is induction-hardened to improve the performance of the valve mechanism at high speeds and to improve wear resistance.

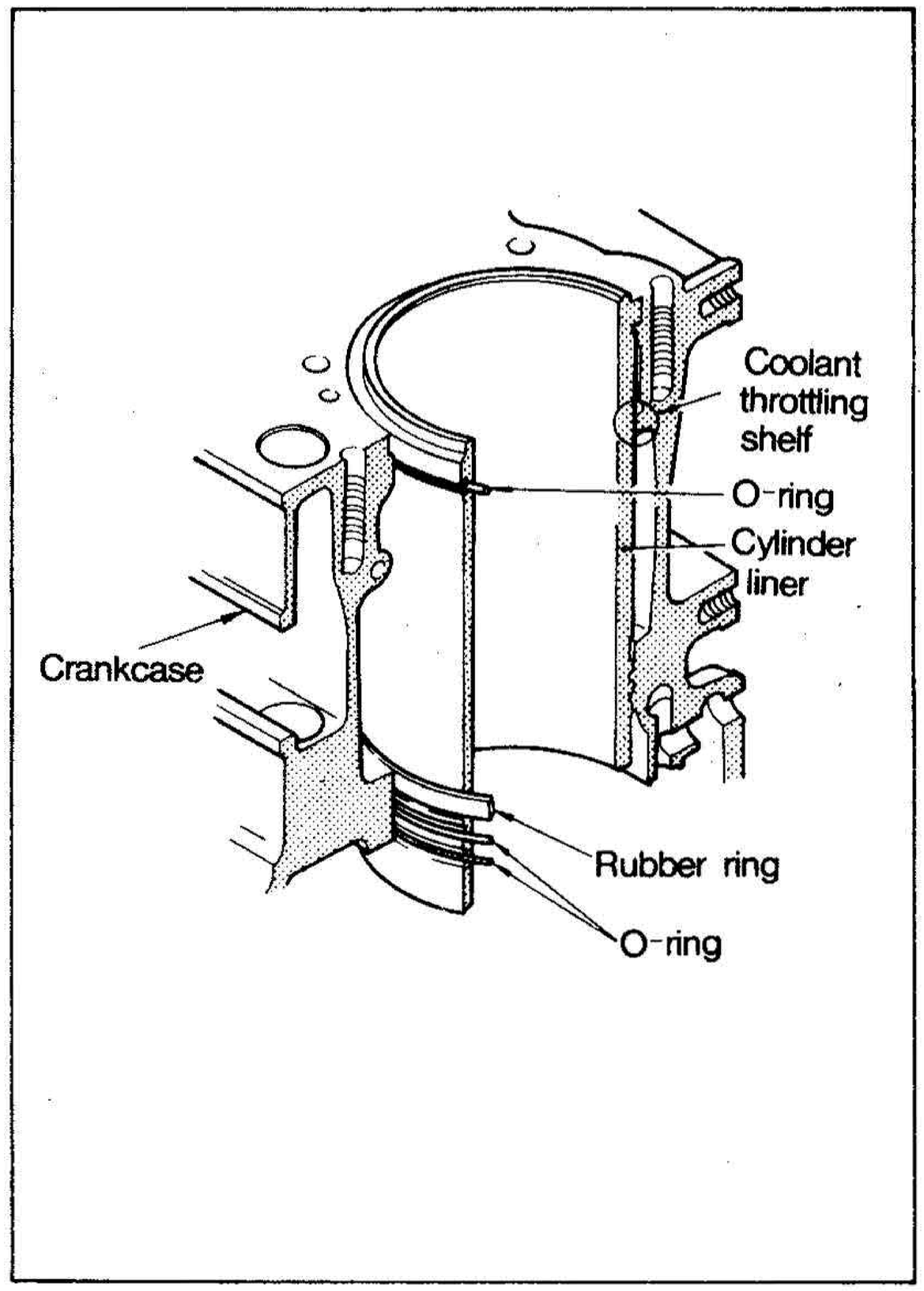


(3) Crankcase and Cylinder Liner

(a) The crankcase is made of cast iron, has a high rigidity and is so constructed as to minimize stress concentration and deformation.

(b) Seven camshaft bushings are installed in the camshaft bearing portions of the crankcase. To facilitate insertion and removal of the camshaft from the rear end of the case, the bearing I.D. is made smaller toward the front.

(c) Coolant is forced in from the water pump at the left front end of the crankcase. after cooling the oil cooler, the coolant flows through the



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water jacket holes to around all cylinders. After cooling the cylinders, the coolant reaches the cylinder head

(d) The cylinder liner is a removable wet type and is press-fitted in the crankcase at the top of the crankcase and at the bottom of the water jacket.
Rubber rings and O-rings are provided at the top and bottom of the cylinder liner to prevent entry of coolant. The water jacket has a throat for higher cooling performance.

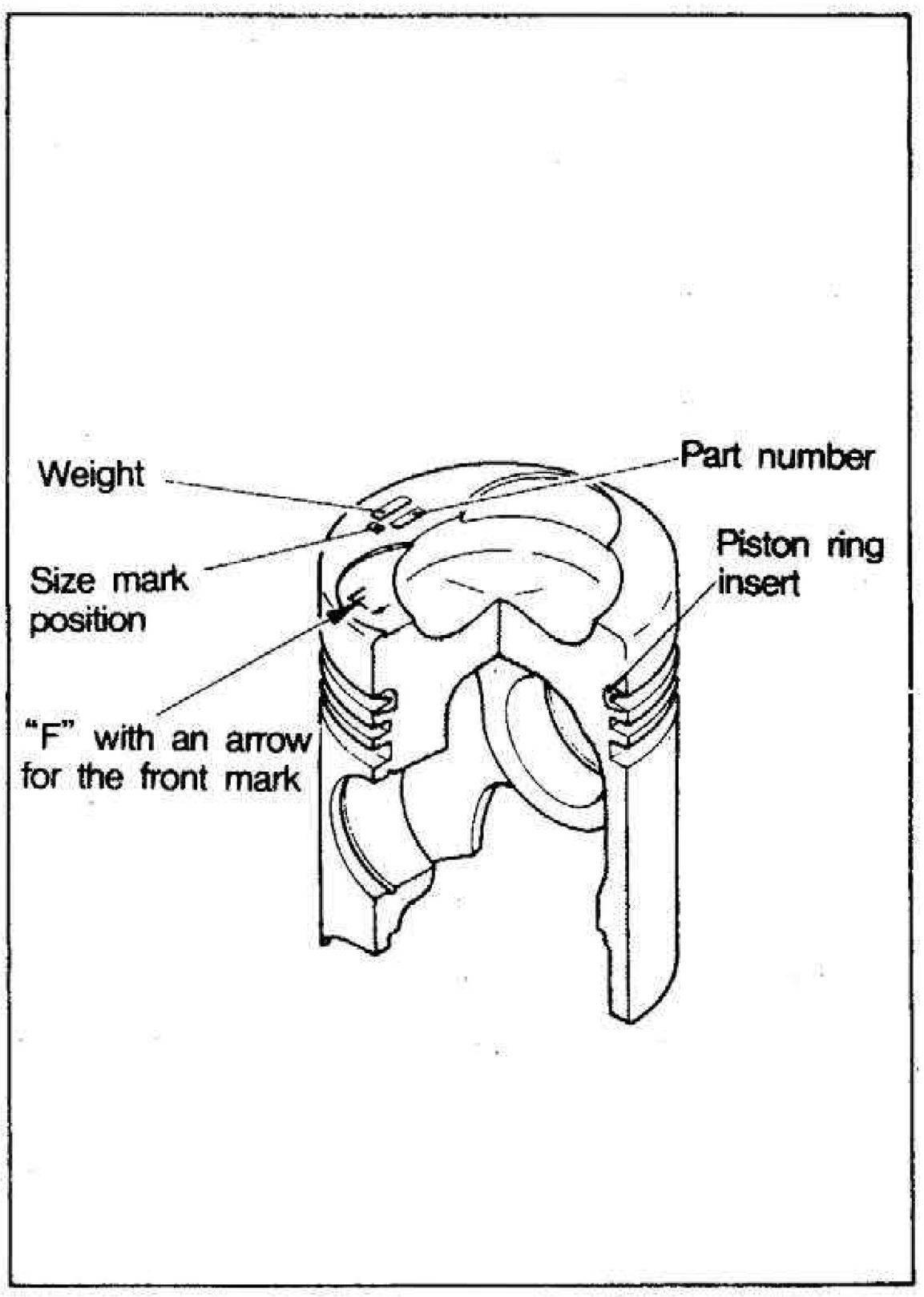
(4) Piston and Piston Ring

(a) Piston

The piston is an aluminum alloy casting. The one for the D6AU has a re-entrant type combustion chamber at the top, whereas the one for the D6AZ has a toroidal type combustion chamber.

A Niresist piston ring insert is cast into the 1st piston ring groove to increase durability.

A size classification mark(oversize dimension on oversize pistons) for selection fit with the cylinder liner, a piston weight and part No., and a front mark "F" and arrow indicating the piston installing direction are stamped on the top surface of the piston.



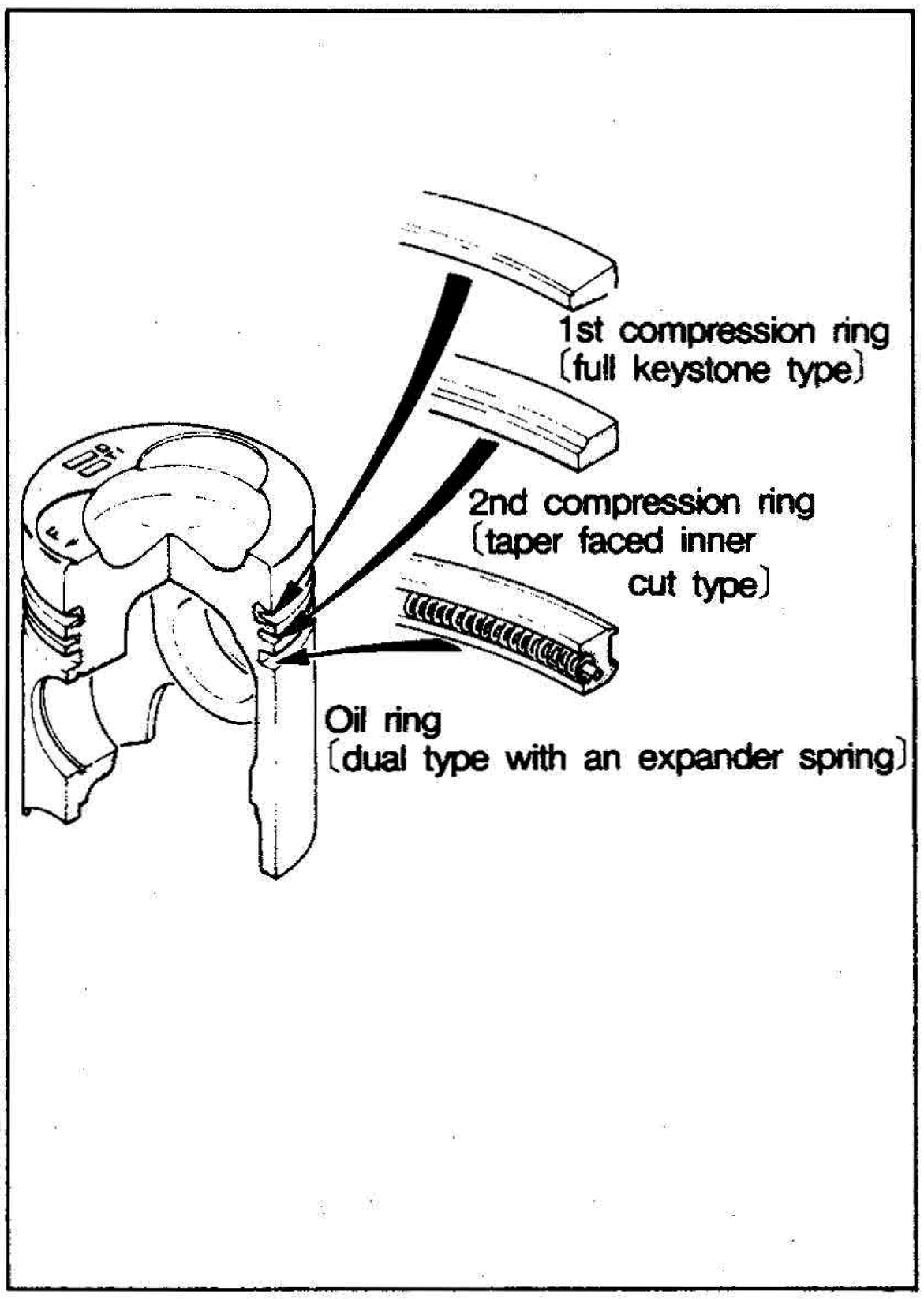
The piston pin is fitted in the piston and connecting rod in fullfloating style with the snap rings fitted at both ends of the piston pin to prevent the pin from slipping off.

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(b) Piston ring

The piston rings are three in total ; two compression rings and one oil ring. The sliding surface of each ring is hard chrome plated to improve durability.

The piston rings are shaped as shown. The 1st compression ring is a barrel-faced full keystone type, the 2nd compression ring is a taper faced inner cut type, and the oil ring is a dual type with an expander spring.

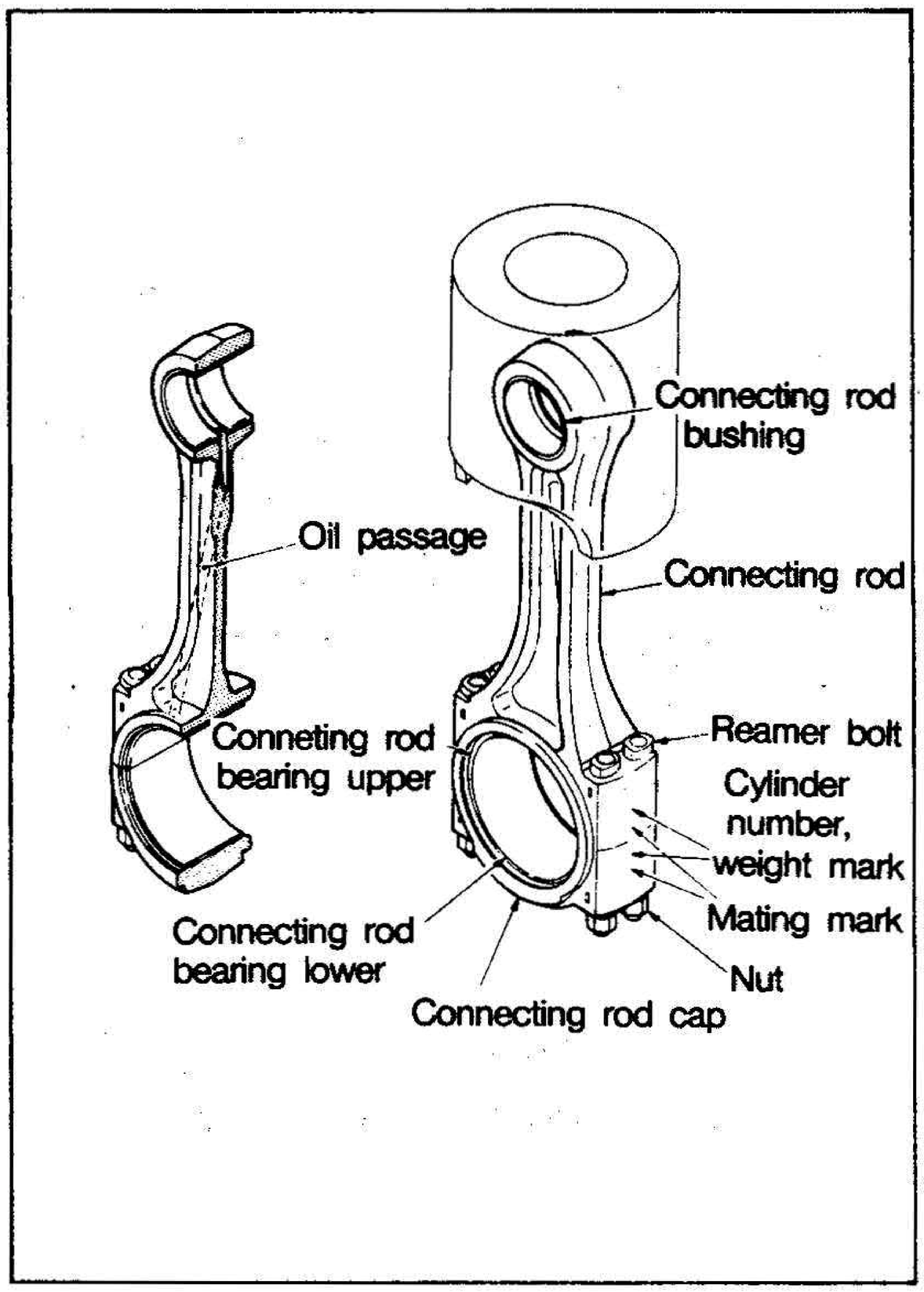


(5) Connecting Rod and Connecting Rod Bearing

The connecting rod is I-section die forging and has a high rigidity. A lead bronze bushing is installed in the small end and a split type plain bearing used in the big end.

An oblique oil passage is provided in the stem portion for lubrication of the small end bushing.

The connecting rod and connecting rod cap are coupled by four bolts.

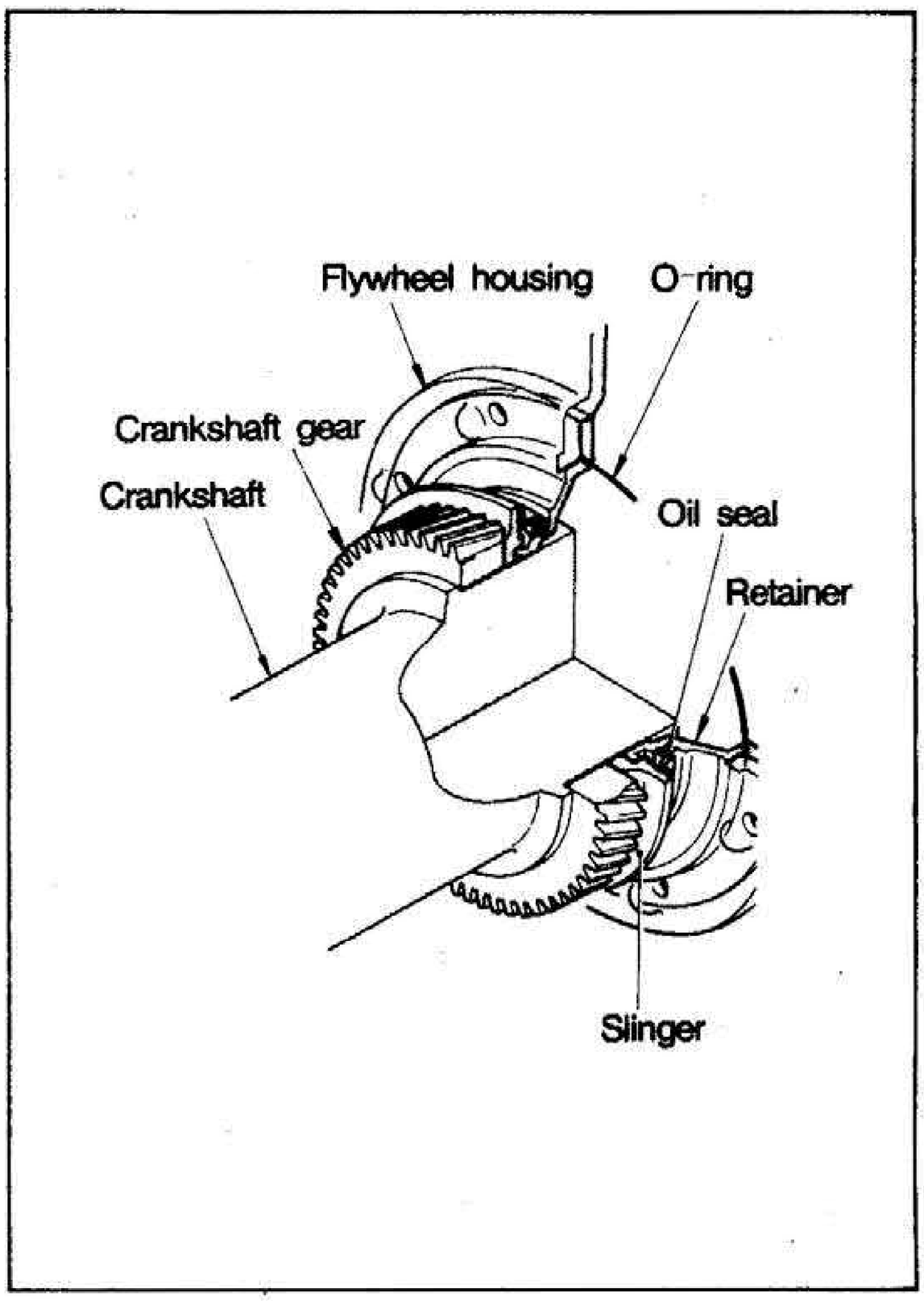


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(6) Crankshaft and Main Bearing

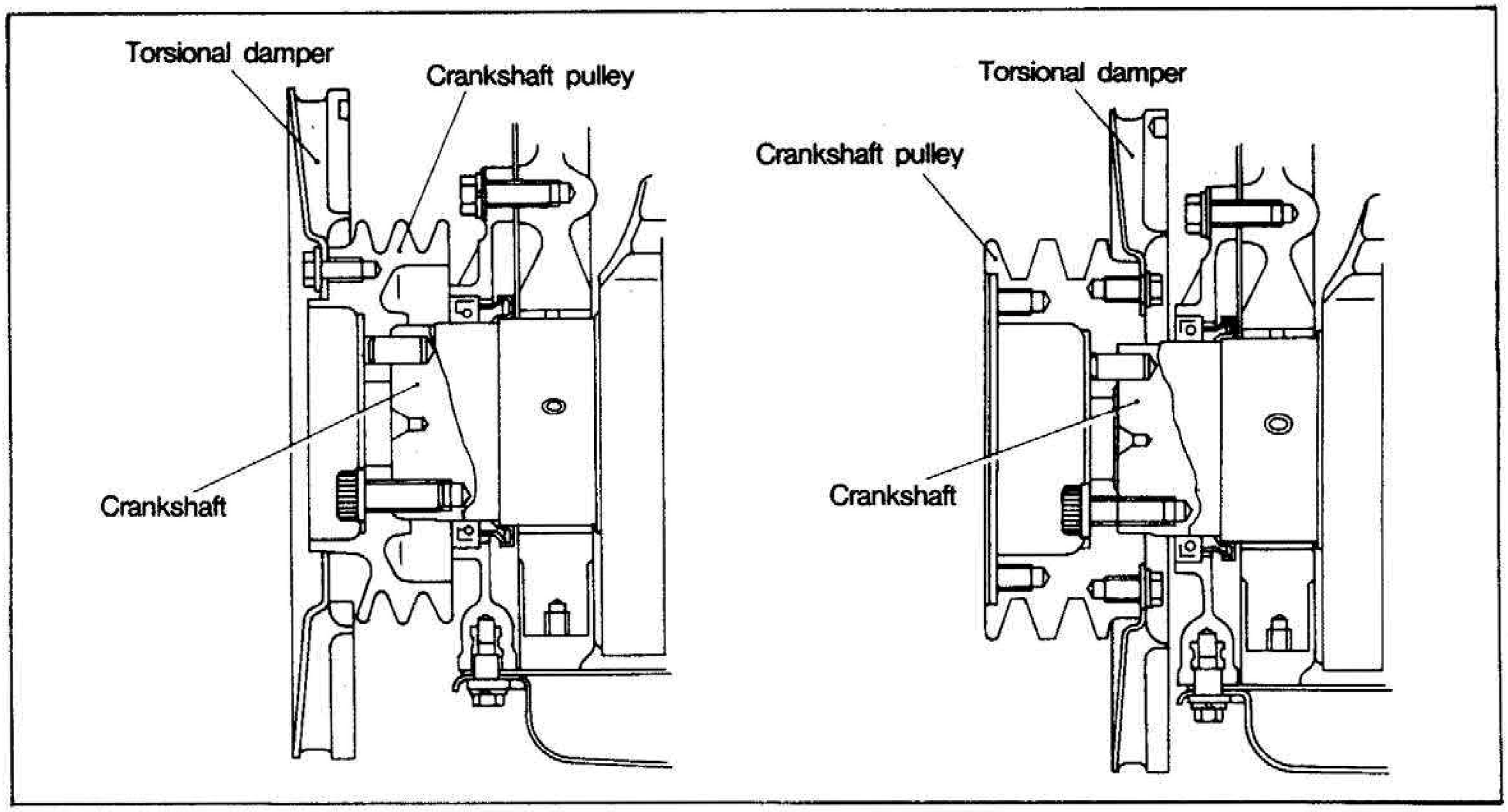
(a) The crankshaft is a high rigidity die forging with integrally forged balance weights.

The pin and journal are induction hardened for higher wear resistance. An oil hole is provided between each journal and pin, allowing some of the main bearing lubricating oil to be fed to the pin to lubricate the connecting rod bearing. At the rear of the crankshaft, the crankshaft gear which drives the timing gear is fitted.



An oil seal is provided at the front of the crankshaft and an axial lip type oil seal provided at the rear.

The front portion of the crankshaft is a flange type to which the crankshaft pulley is mounted with bolts. A torsional damper mounted to the pulley absorbs the torsional vibration of the crankshaft.



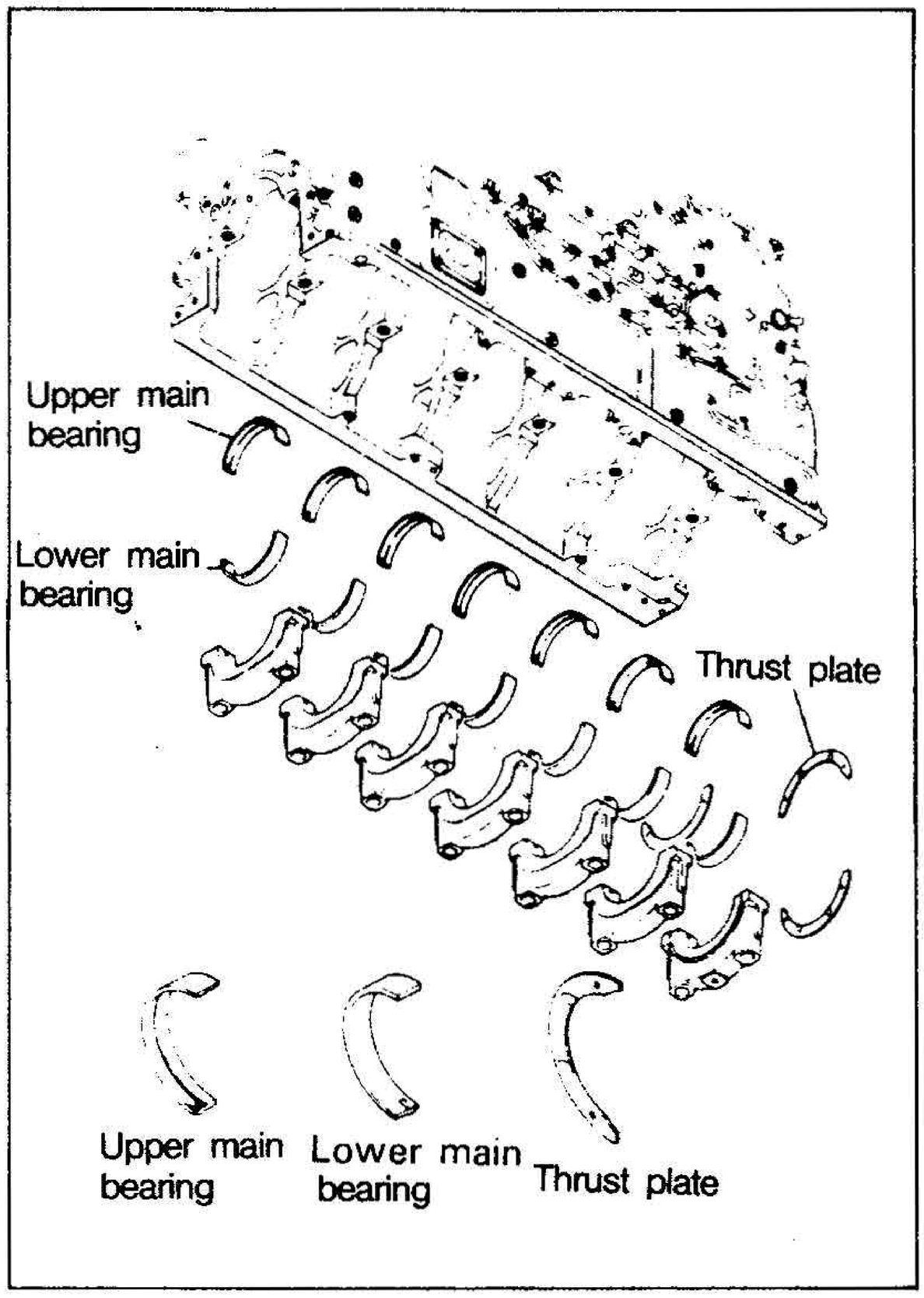
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(b) Main bearing

The main bearing is a split type plain bearing consisting of special alloy plating and kelmet metal with backing metal.

The inside surface of upper main bearing has an oil groove and oil hole which is in alignment with the oil hole in the crankshaft.

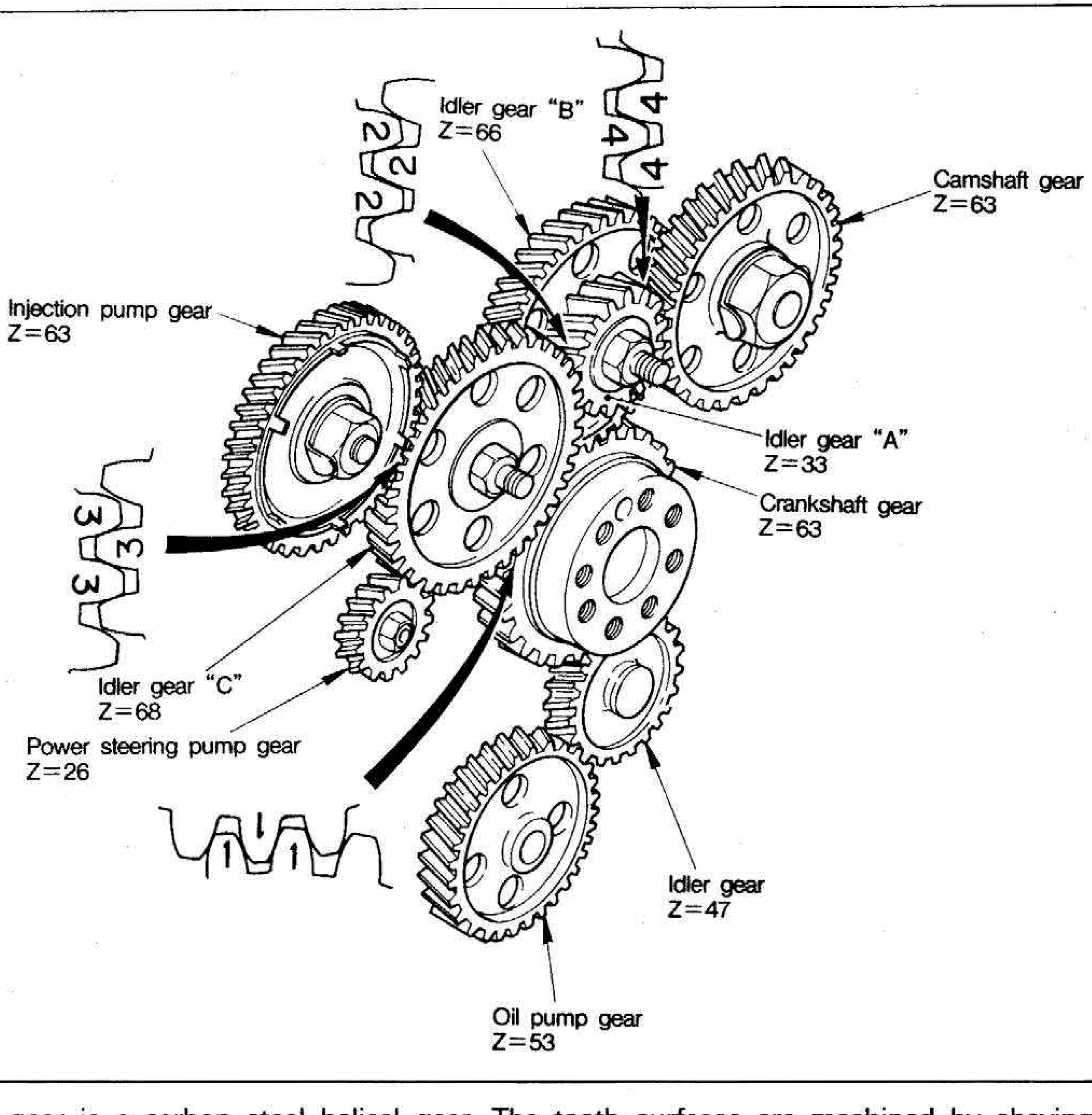
Seven pairs of main bearings are provided. Halved thrust plates are mounted at the rearmost bearing cap.



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(7) Timing Gear

The timing gears are accommodated in the flywheel housing at the rear of the engine. The gear train is as shown below.



Each gear is a carbon steel helical gear. The tooth surfaces are machined by shaving to form close-tolerance tooth profile, and are given surface treatment to offer improved durability.

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

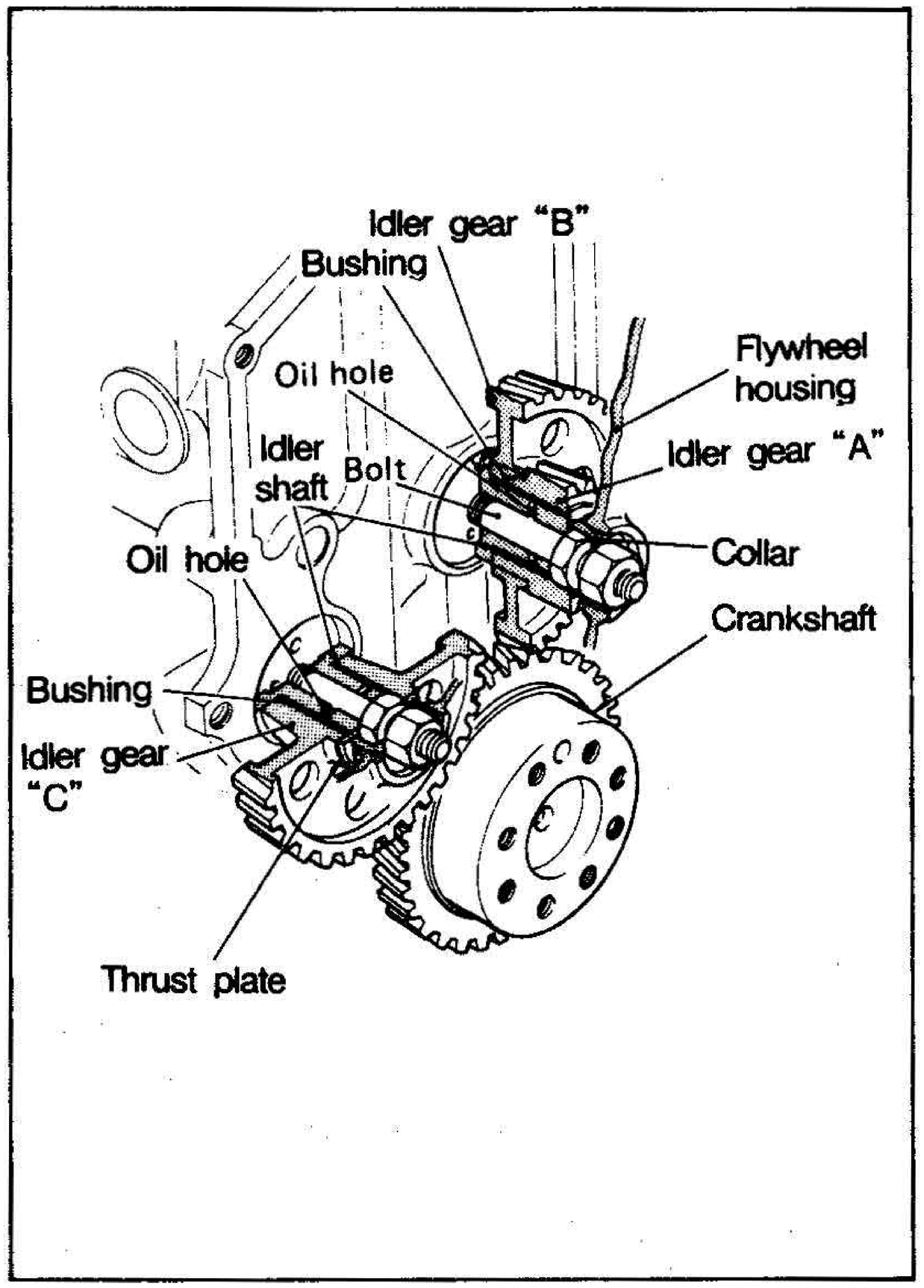
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The crankshaft gear, installed on the crankshaft and positioned by a dowel pin drives all the gears.

The idler gear is mounted to the crankcase with the idler shaft bolt and is supported by the flywheel housing at the other end.

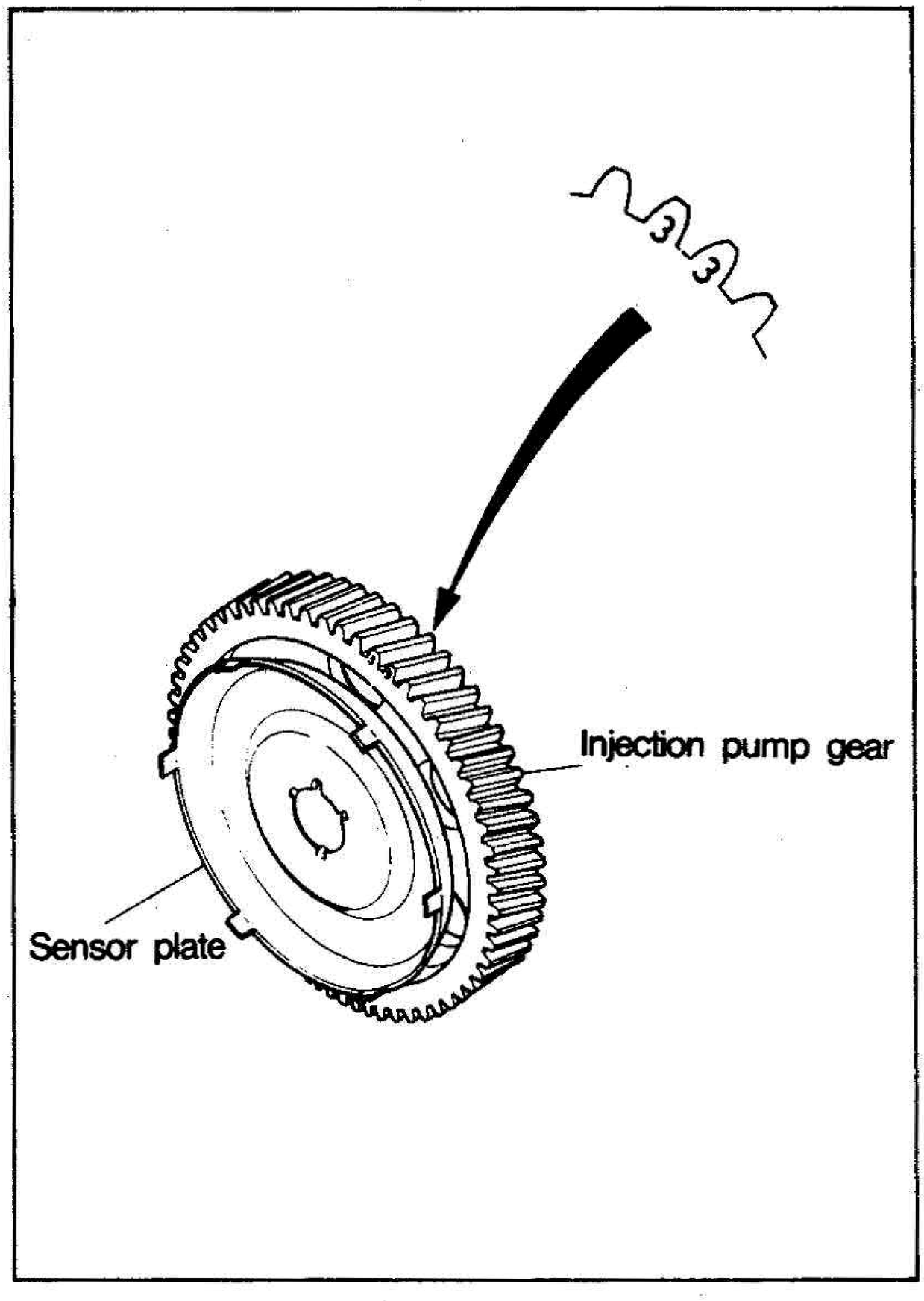
A bushing is installed on the inside circumference of the idler gear and turns on the idler shaft.

The bushing is lubricated by the oil which flows through the inside of the idler shaft from the crankcase oil hole.



A sensor plate is mounted on the injection pump gear.

The sensor plate is smaller than the injection pump gear to facilitate removal of the air compressor, etc. Therefore, the air compressor, etc. can be easily removed with the gear at any position, When they are reinstalled, however, make sure that the timing marks are in alignment.



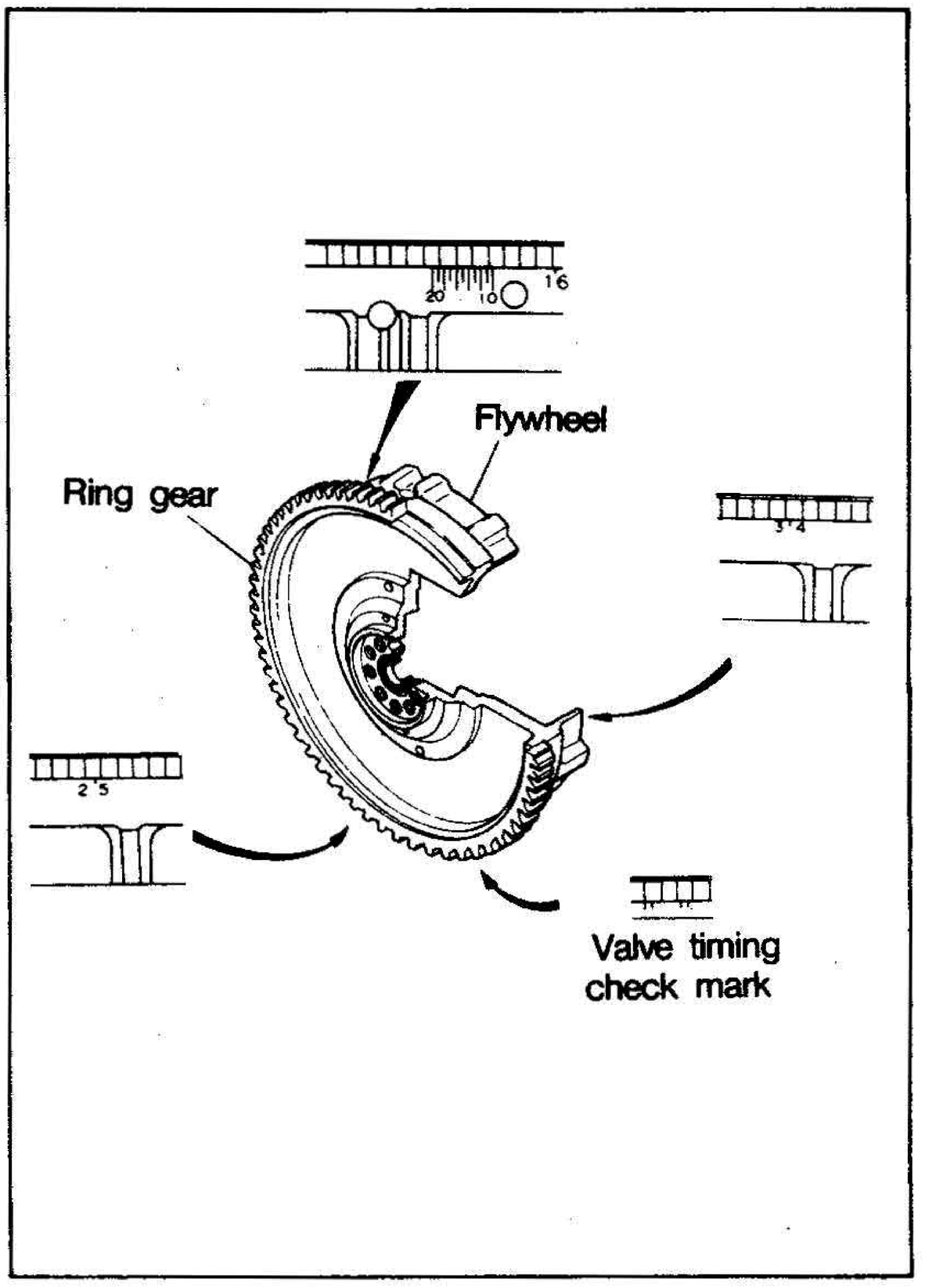
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(8) Flywheel

The flywheel is made of cast iron. The pilot bearing of the transmission drive pinion is installed at the center. The ring gear which meshes with the pinion of the starter is shrinkage-fitted on the circumference of the flywheel.

The ring gear teeth are induction-hardened for higher durability and one side of the teeth is chamfered for easier engagement with the pinion of the starter.

The cylinder Nos. and angle scales are stamped on the circumference of the flywheel as shown.



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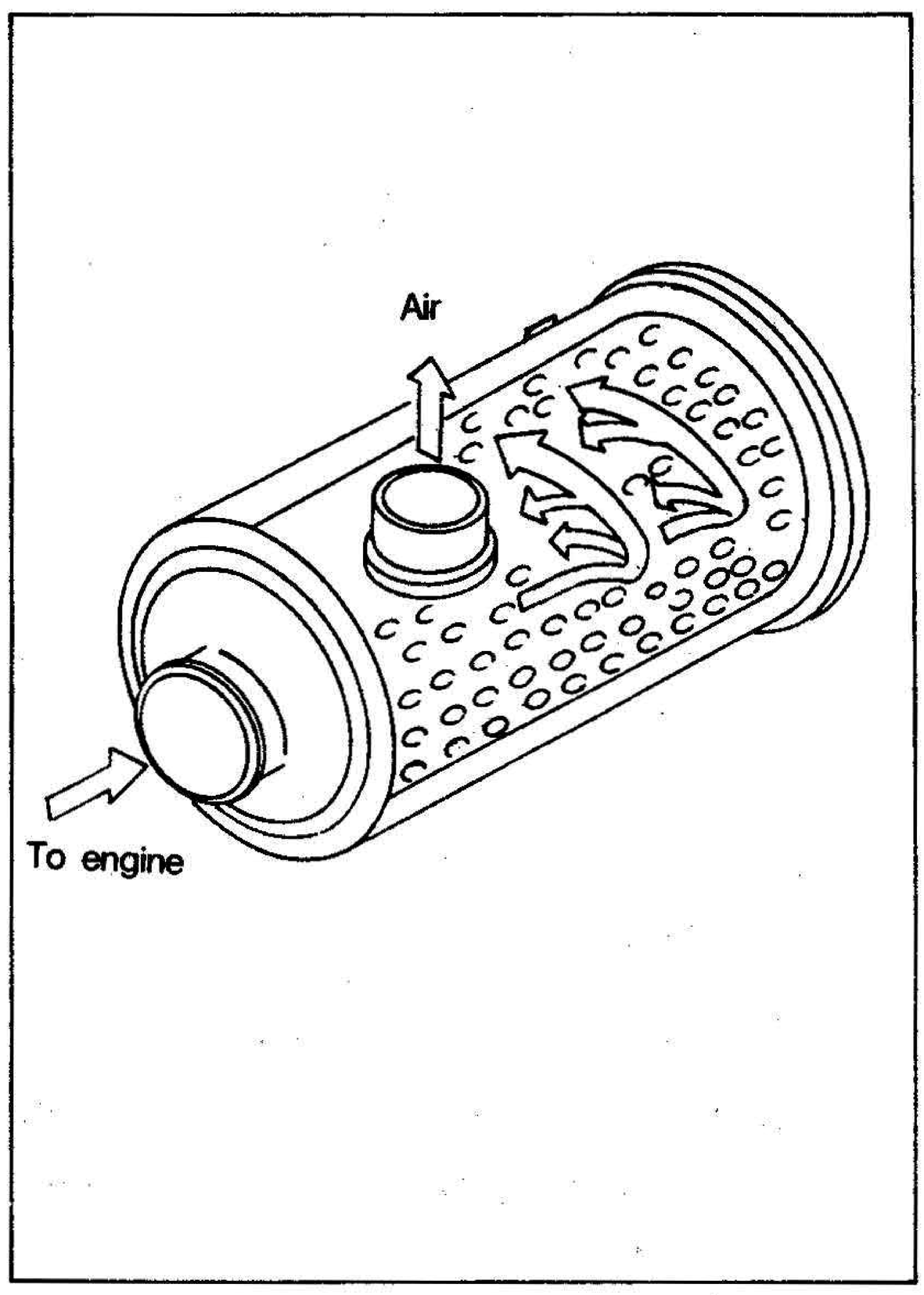
1-3-2- Inlet and Exhaust

(1) Air Cleaner

(a) Cyclone type air cleaner

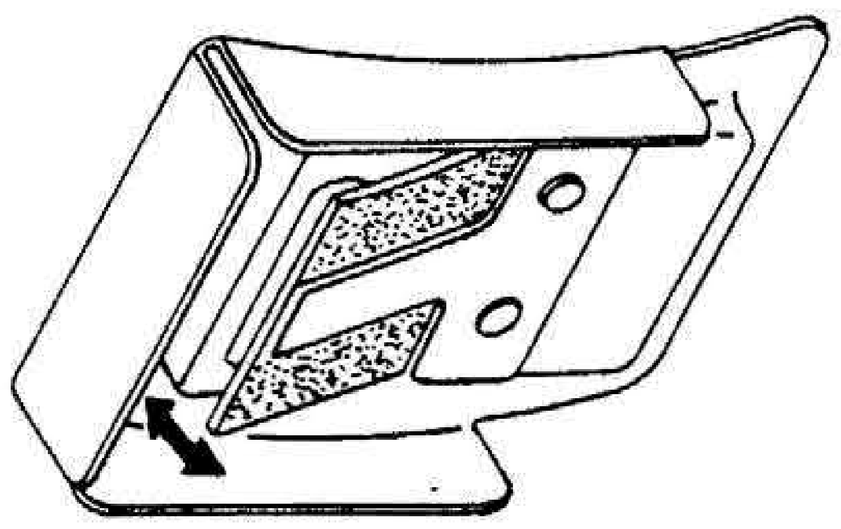
The element is a plastic-coated and heat-treated filter paper type and is resistant to water and oil. Even if it is contaminated with oil or water, it can be restored to normal by washing.

The air drawn into the element is made to spin at high speed by the vanes on the element, so large particles of dust are centrifugally separated(cyclone function). Small particles of dust are removed by the filter paper element, so clean air is drawn into the engine.



(b) Read Valve

The centrifugally separated particles of dust and dirt are collected at the bottm of the air cleaner. The collected particles of dust and dirt are discharged outside by pulsations of the rubber read valve mounted in the air cleaner. If the engine speed increases(to 800 rpm or more), the read valve will be closed by a high negative pressure in the air cleaner, so no outside air will be drawn in.

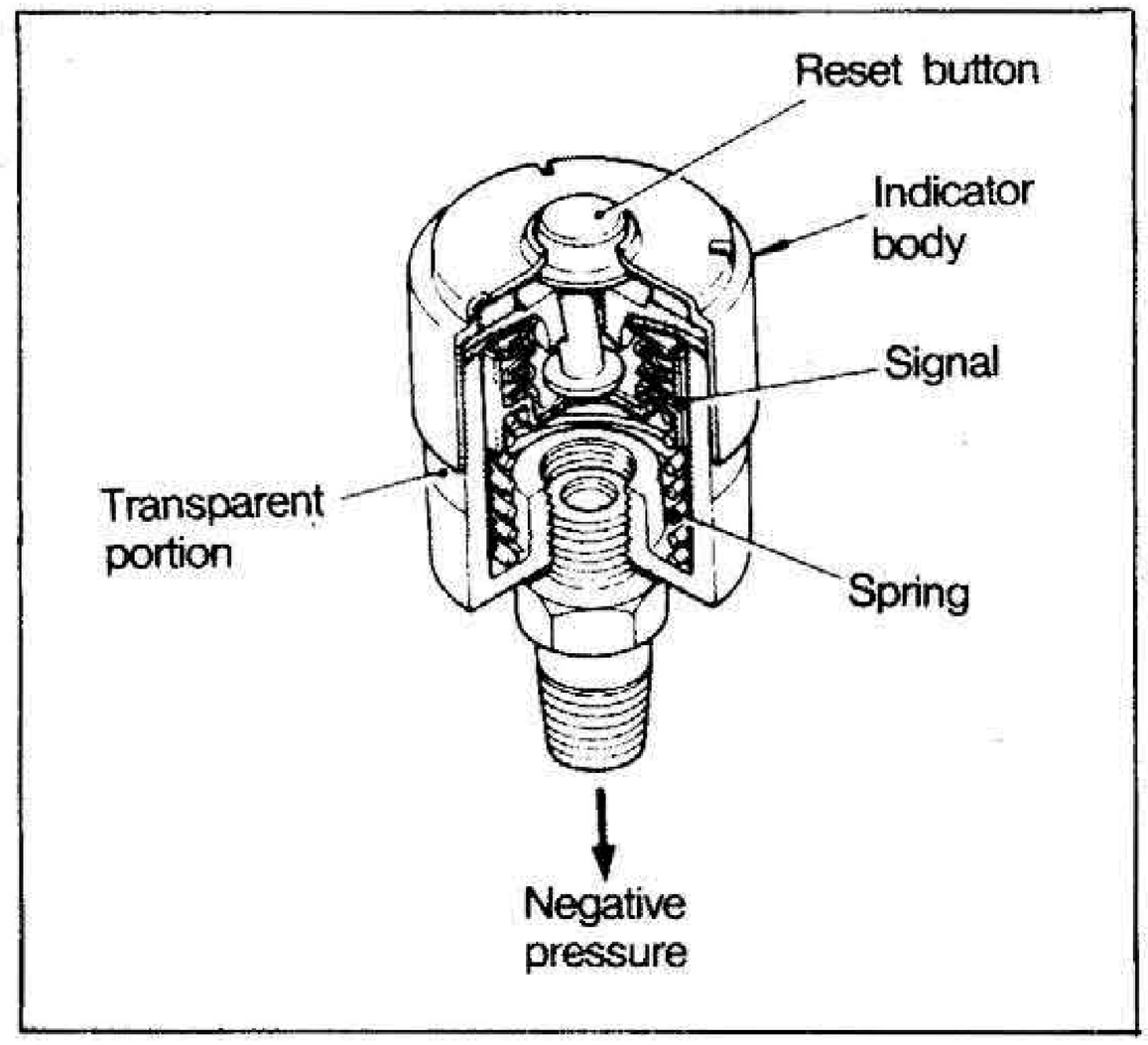


(2) Dust Indicator

The dust indicator, mounted near the outlet of a paper element type air cleaner, operates on the negative pressure of the air drawn into the engine, performing the function of indicating, the time to clean or replace the element.

If dust is collected in the element, the suction resistance increases. When the negative pressure reaches 700mmAq, the signal is pulled down against the pressure of the spring, and the transparent portion of the body changes to red, indication the time to clean or replace the element.

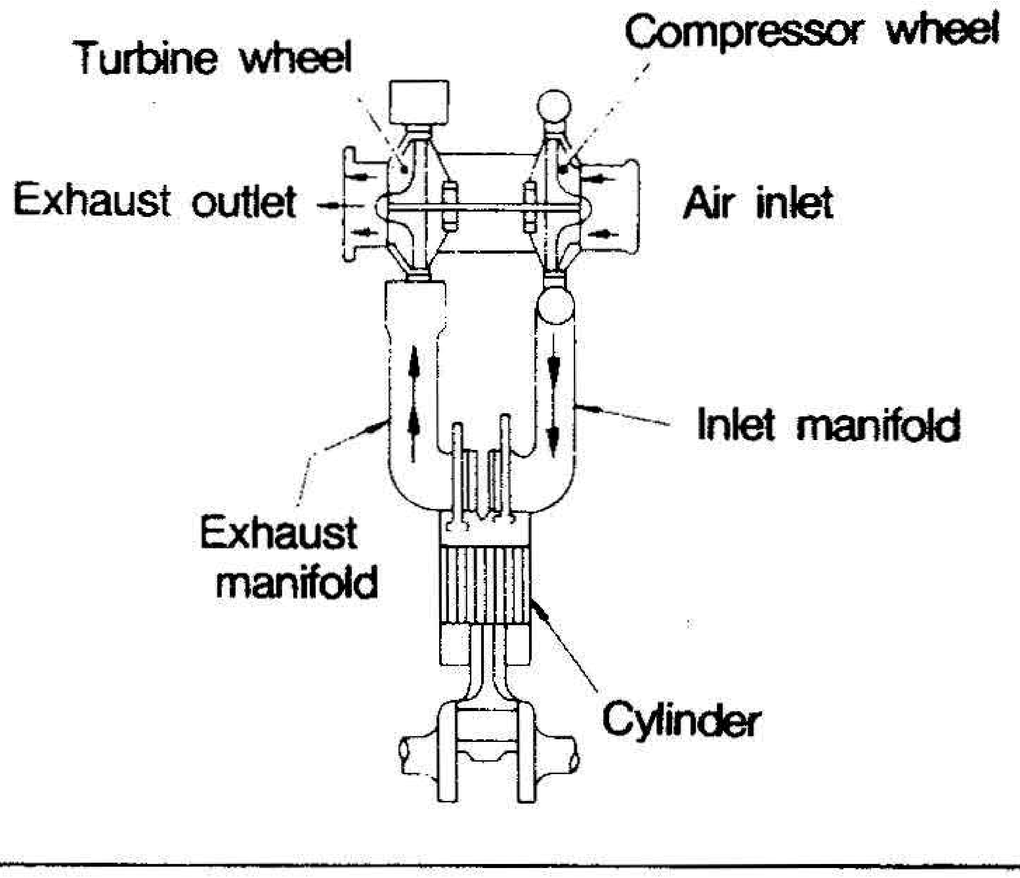
After the element has been cleaned or replaced, depress the reset button on the top, and the signal will return to its original position.



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(3) Turbocharger

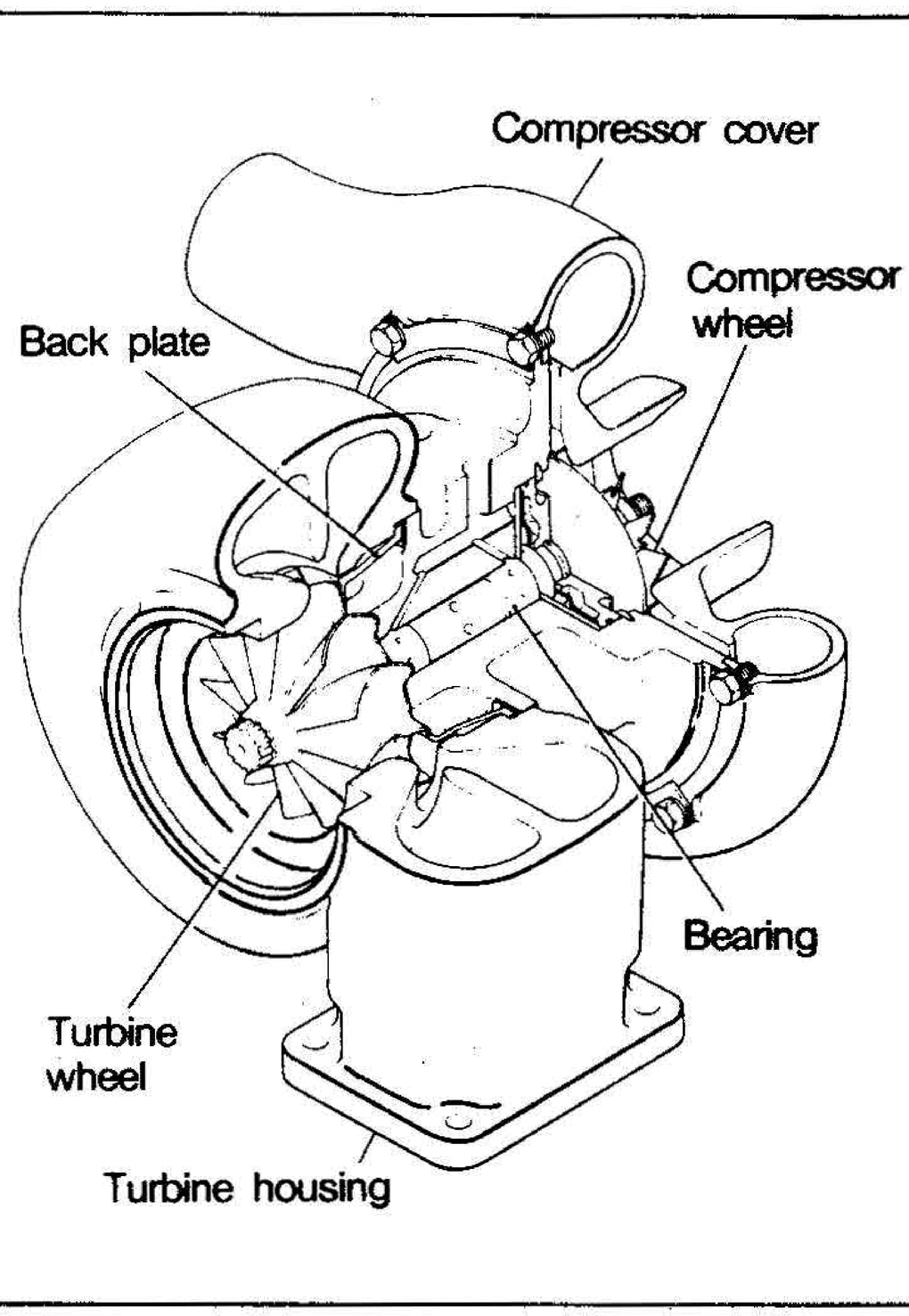
The turbocharger utilizes the energy of the exhaust gases from the engine to feed more air into the engine, thereby offering the advantages of increased engine out put, greater saving in fuel consumption, lower engine noise, etc.



The exhaust gases discharged from the cylinder of the engine are led through the exhaust manifold into the turbocharger and are accelerated in the turbine housing and are blown against the turbine wheel. Accordingly, the turbine is made to rotate at a speed of scores of thousands of revolutions per minute, and turns the compressor wheel mounted on the same shaft as the turbine wheel. By rotation of the compressor wheel, a larger amount of air than that supplied when no turbocharger is provided is forced into the cylinder of the engine, so a correspondingly larger amount of fuel can be burnt. This increases the effective pressure during combustion(the pressure forcing the piston down) and thus increases the output.

Structurally, the turbocharger may be divided into two broad sections ; the turbine wheel section which is driven by exhaust gases and the compressor wheel section which forces inlet air.

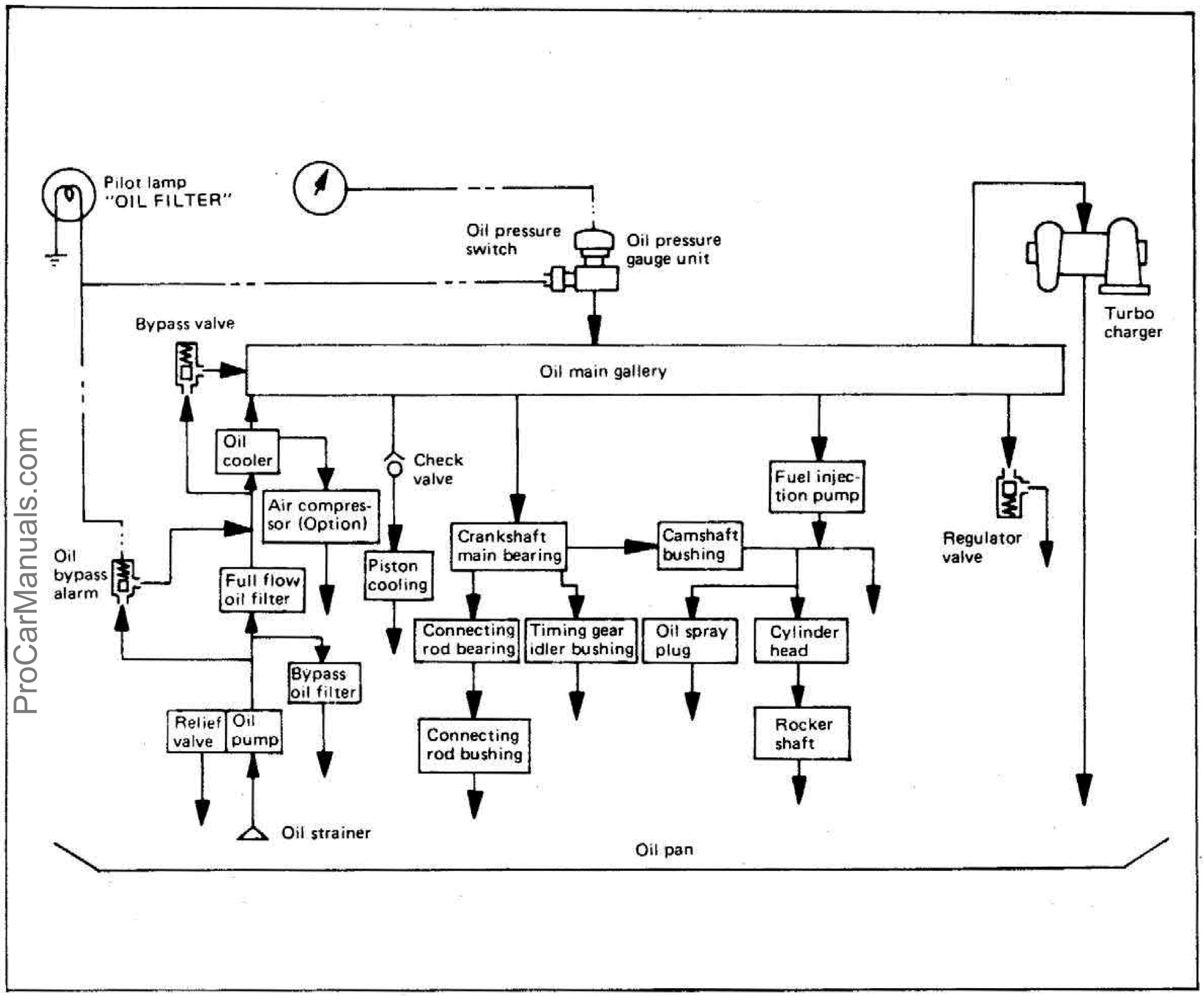
The turbine wheel and compressor wheel are supported by bearings. A thrust bearing is mounted on the compressor side. The lubricating oil is derived from the main oil gallery at the front end of the engine and routed through the oil hole provided in the bearing housing. After lubrication of the bearings, the oil is returned to the engine oil pan through the drain port provided at the bottom of the bearing housing.



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1-3-3 Lubrication

Engine lubrication is accomplished by forced lubrication system using gear pump. The engine oil in the pan is drawn up through the oil strainer by the oil pump and force-fed to the oil filter and oil cooler to lubricate all parts.



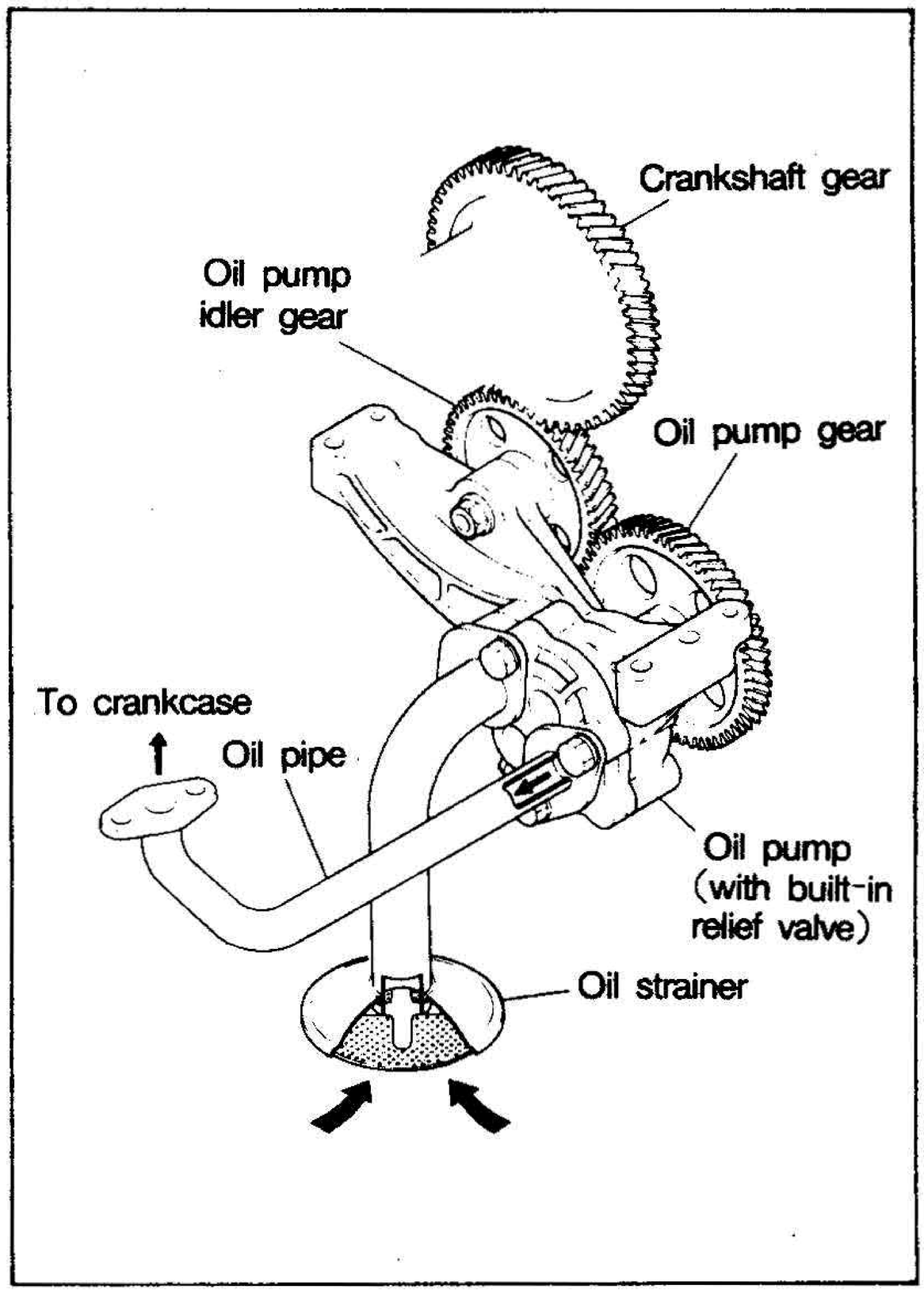
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(1) Oil pump

The oil pump is a gear pump. It is mounted on the rear bottom surface of the crankcase and is driven by the crankshaft gear.

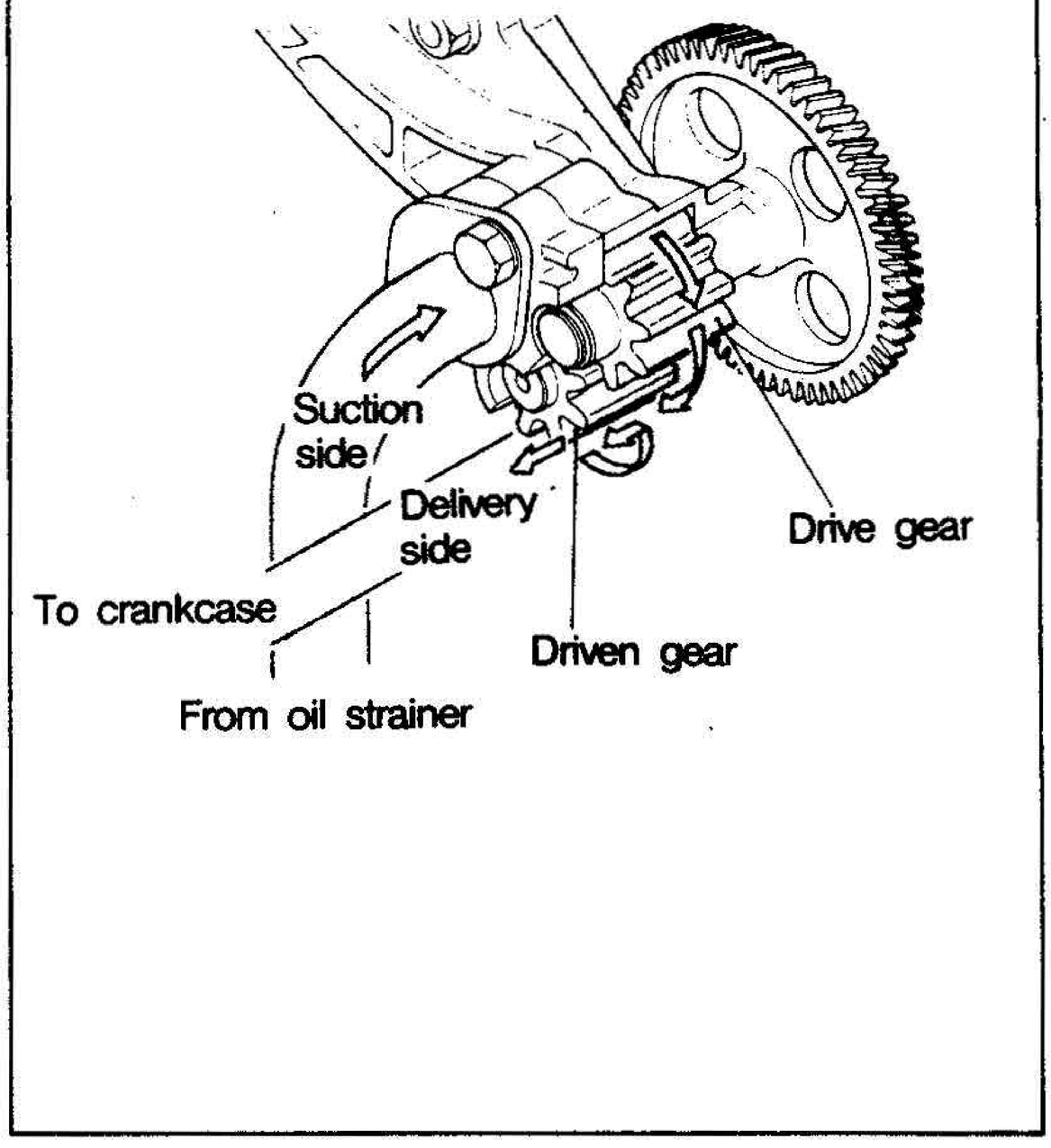
An oil strainer is mounted to the suction port of oil pump and an oil pipe mounted to the delivery port.

The crankshaft gear drives the oil pump idler gear and oil pump gear to transmit the rotation to the oil pump drive gear, In the oil pump, the oil pump drive gear is in mesh with the oil pump driven gear. When the oil pump drive gear is driven, the oil pump driven gear is turned in the opposite direction.



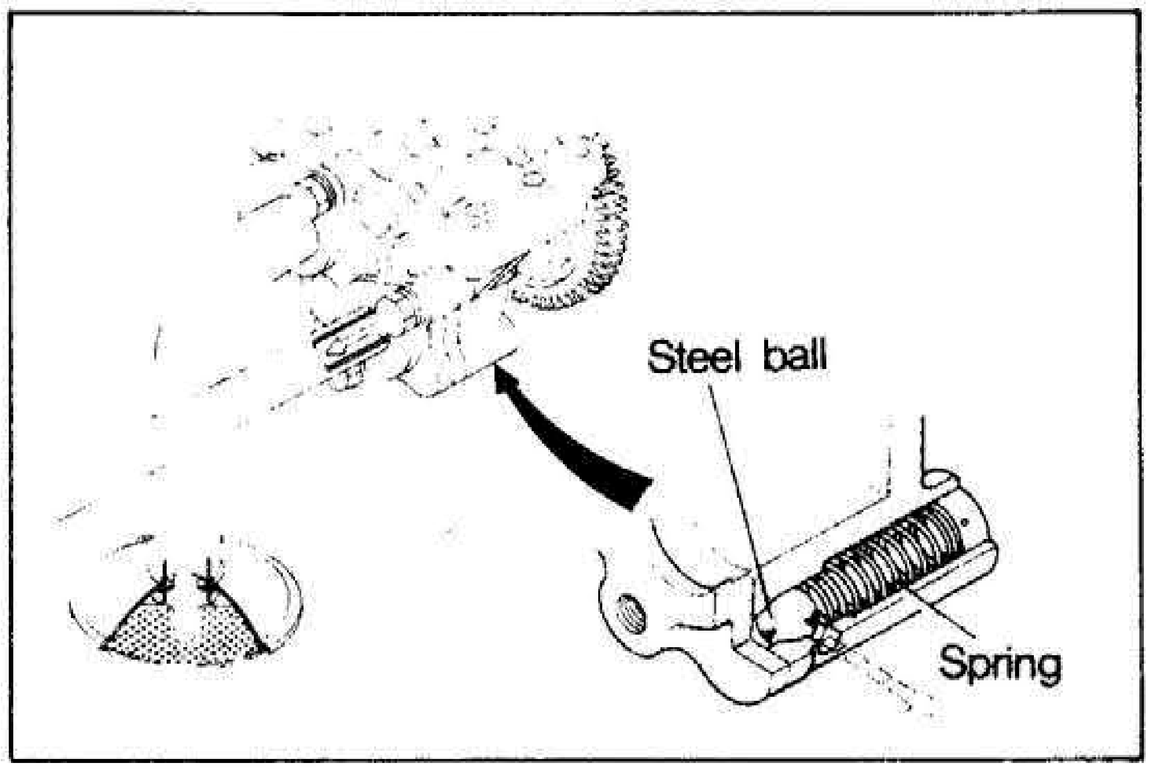
At this time, the engine oil is drawn in by the negative pressure produced when the gears turn along the inside of the pump case, and is forced out from the suction side to the delivery side along the gears and case inside wall.

An oil strainer is mounted to the suction port of the oil pump to prevent suction of foreign substances and air from inside the oil pan. The oil pipe mounted to the delivery port sends the ensine oil to the crankcase.



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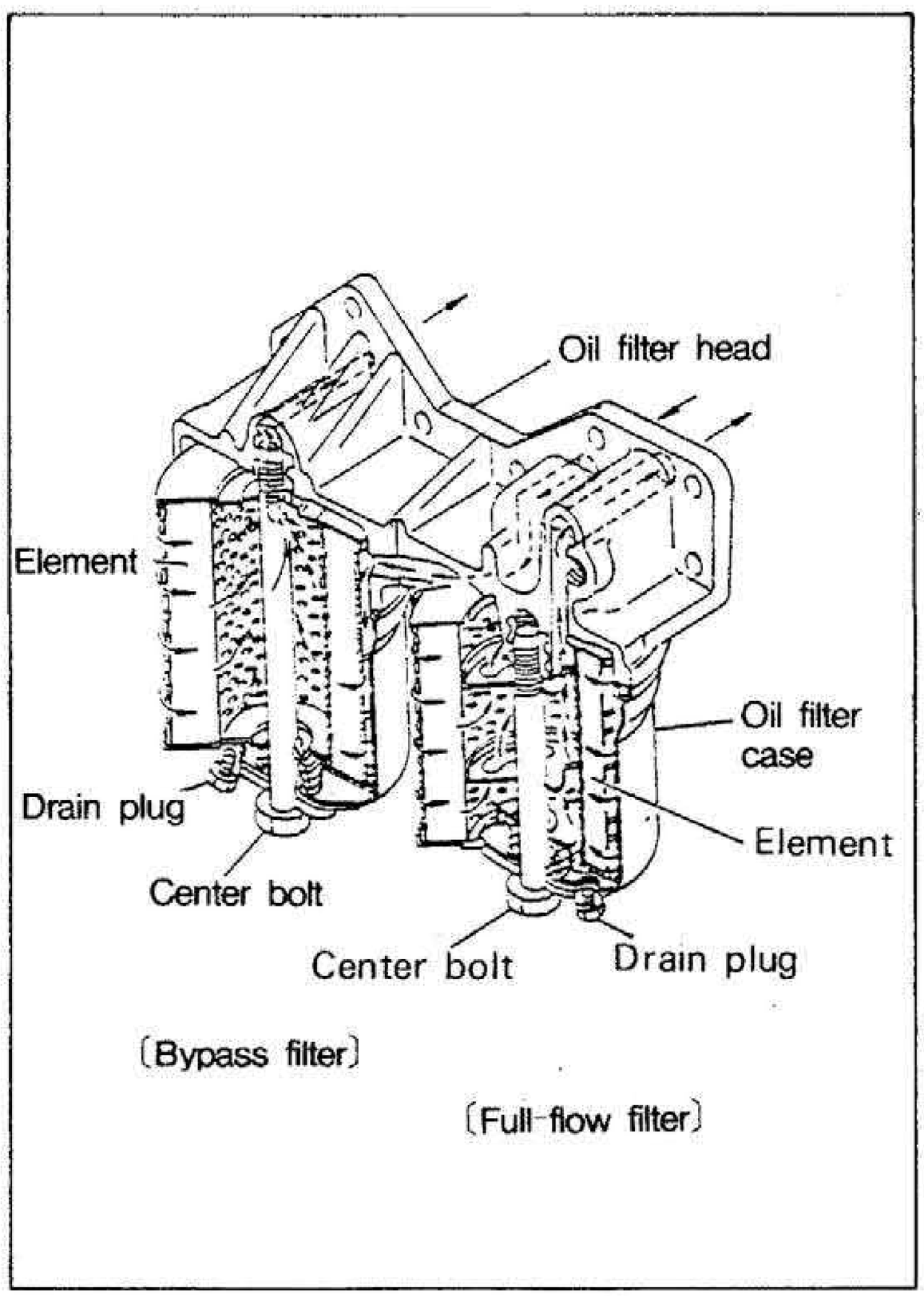
Since the oil pump is driven at speed proportional to the engine speed, the delivery pressure of the oil pump might rise excessively and overload the lubrication system during cold starting, etc. To prevent overloading the lubricating system, the oil pump has a built-in relief valve.



(2) Oil Filter

The oil fileter is a double type oil filter consisting of a full flow filter and bypass filter put together as a single assemly. It comes in two types ; the vertical and horizontal types. The element is a filter paper element.

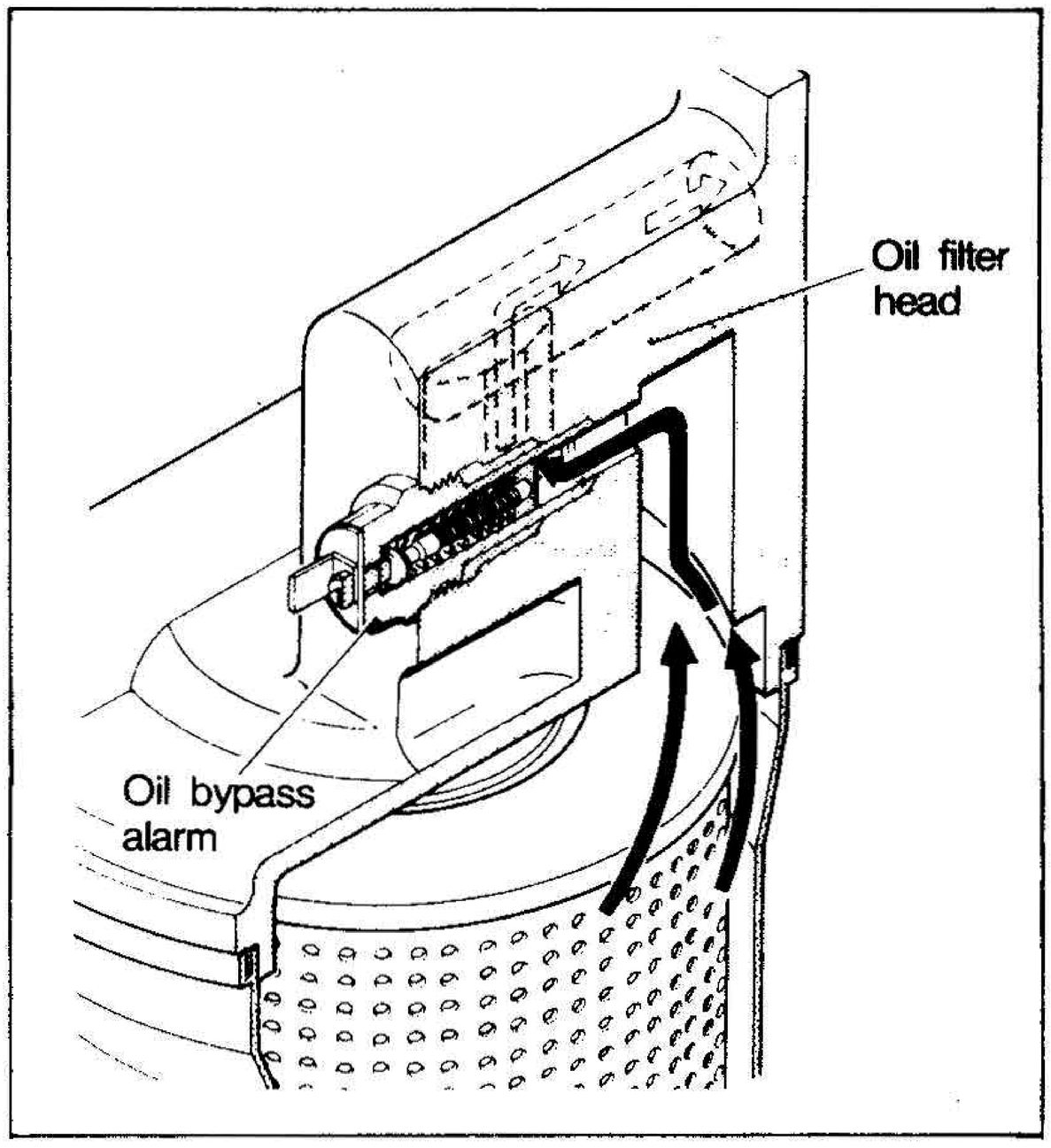
The engine oil forced by the oil pump passes through the oil hole of the crankcase and flows from the oil filter head into the full flow filter and bypass filter. The engine oil filtered by the full flow filter is routed from the oil filter head through the crankcase oil hole to the oil cooler. The engine oil filtered by the bypass filter returns to the oil pan. An oil bypass alarm is provided on the oil filter head.



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When the oil filter element is clogged and the difference between the filtered and unfiltered oil pressures increases beyond specification, the valve in the oil bypass alarm moves against the spring force, allowing the unfiltered oil to flow to the filtered oil path.

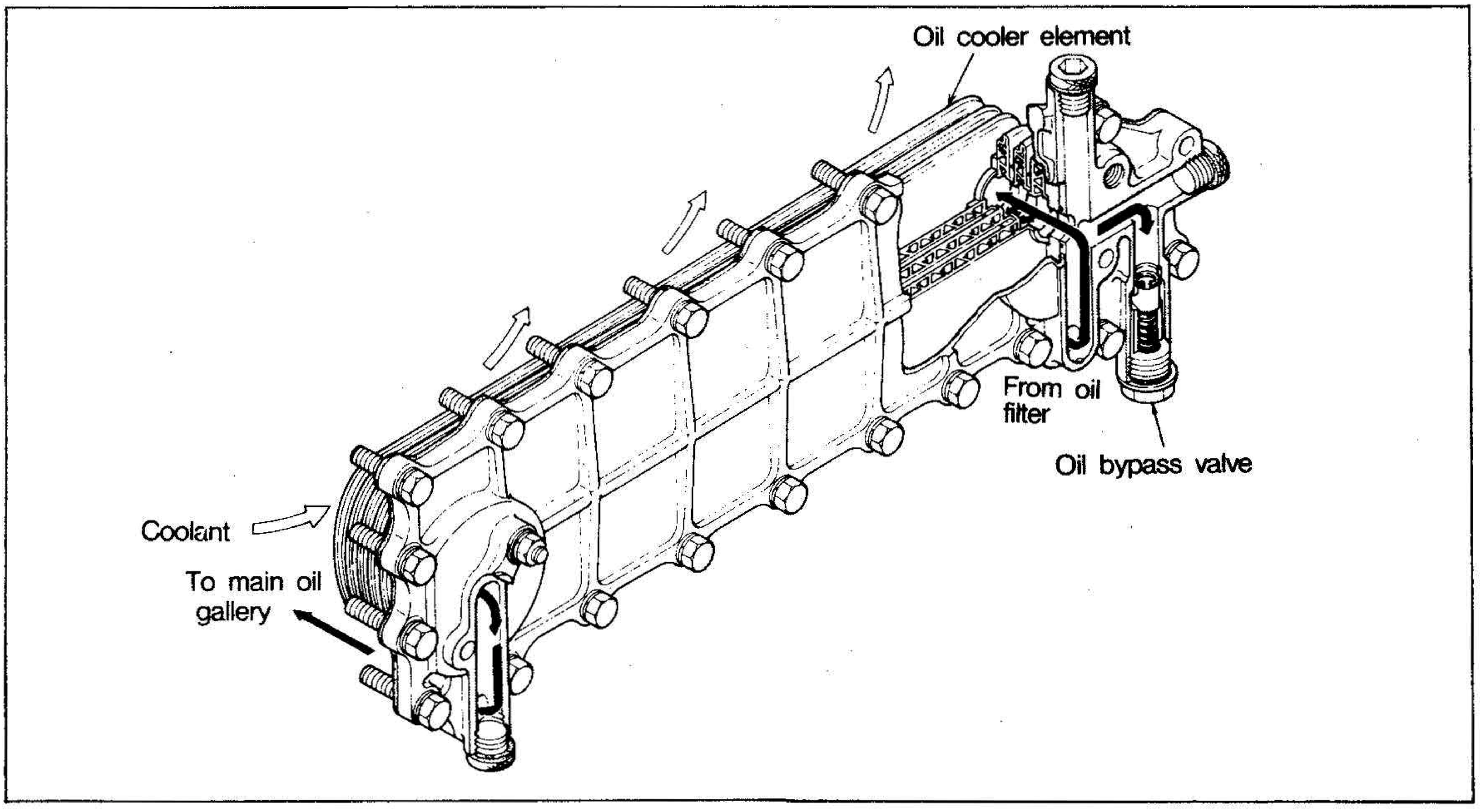
The oil bypass alarm has electric contacts. When the valve opens, the contacts close and the meter cluster pilot lamp of the cab lights to warn the driver.



(3) Oil Cooler

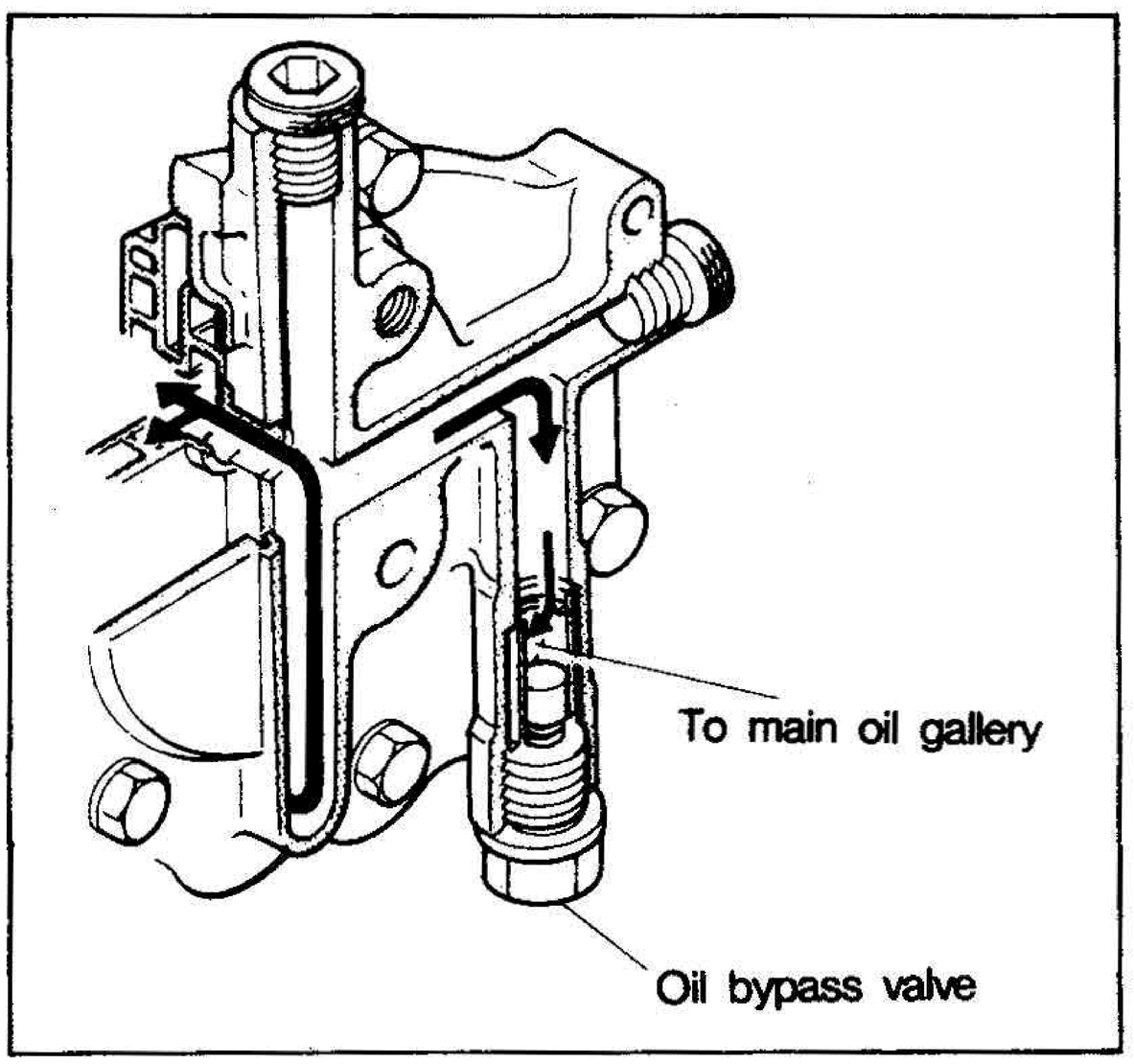
The oil cooler is a shell and plate type(multi-plate type) and is mounted to the coolant path on the left side of the crankcase.

The engine oil forced through the oil filter flows through the inside of the oil cooler element, whereas the coolant forced from the water pump flows around the element. the engine oil in the element is cooled or heated before it flows to the main oil gallery.



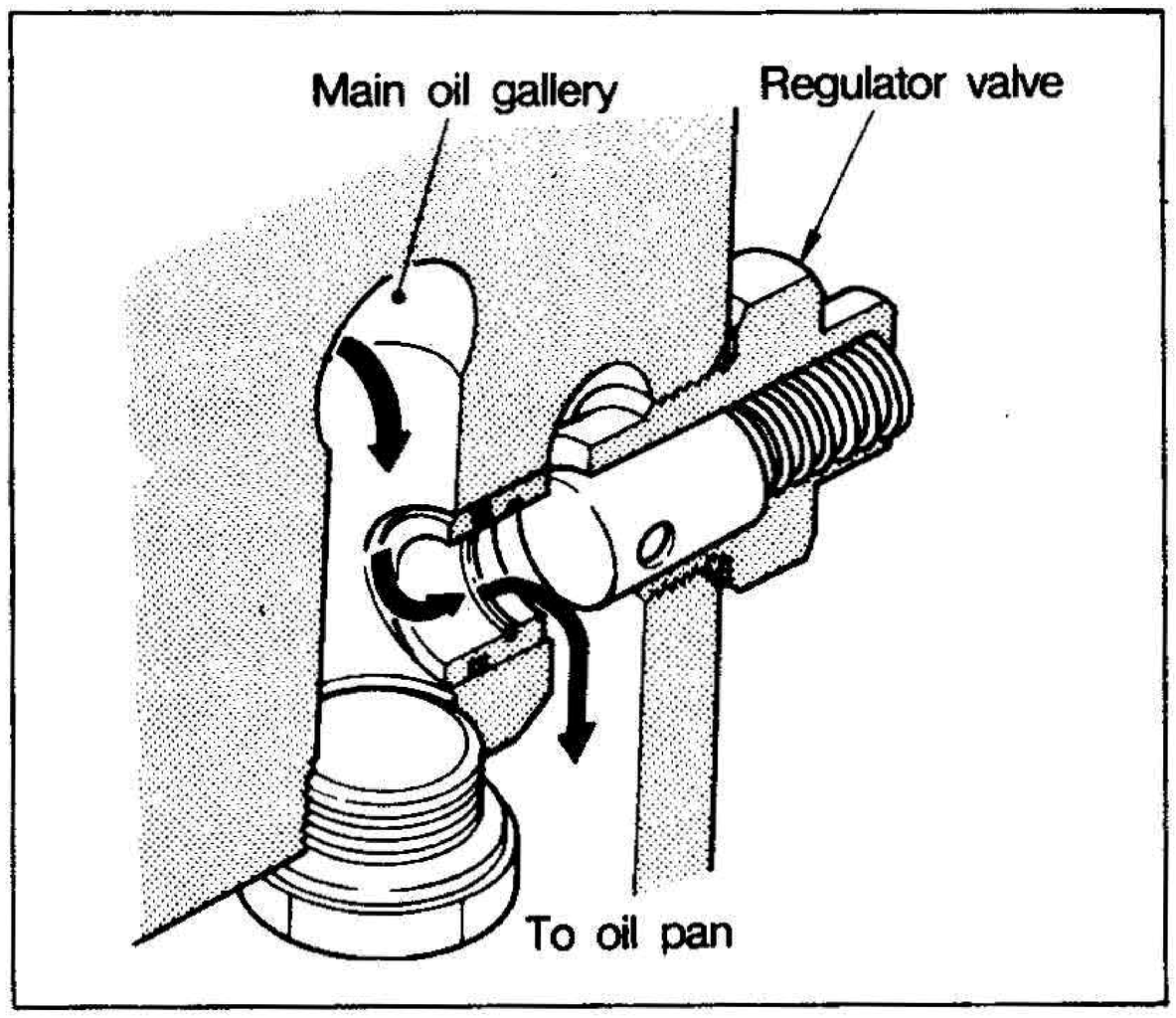
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When the oil viscosity is high at low temperatures or when the element is clogged and the element has high resistance to flow, the oil bypass valve provided at the oil cooler opens so that the engine oil flows to the main gallery without passing through the oil cooler.



(4) Regulator Valve

The regulator valve is mounted to the main oil gallery in the crankcase. When the oil pressure in the main gallery exceeds specification, the valve accomplishes the function of allowing the engine oil to escape to the oil pan, thereby protecting the lubrication system against overload.

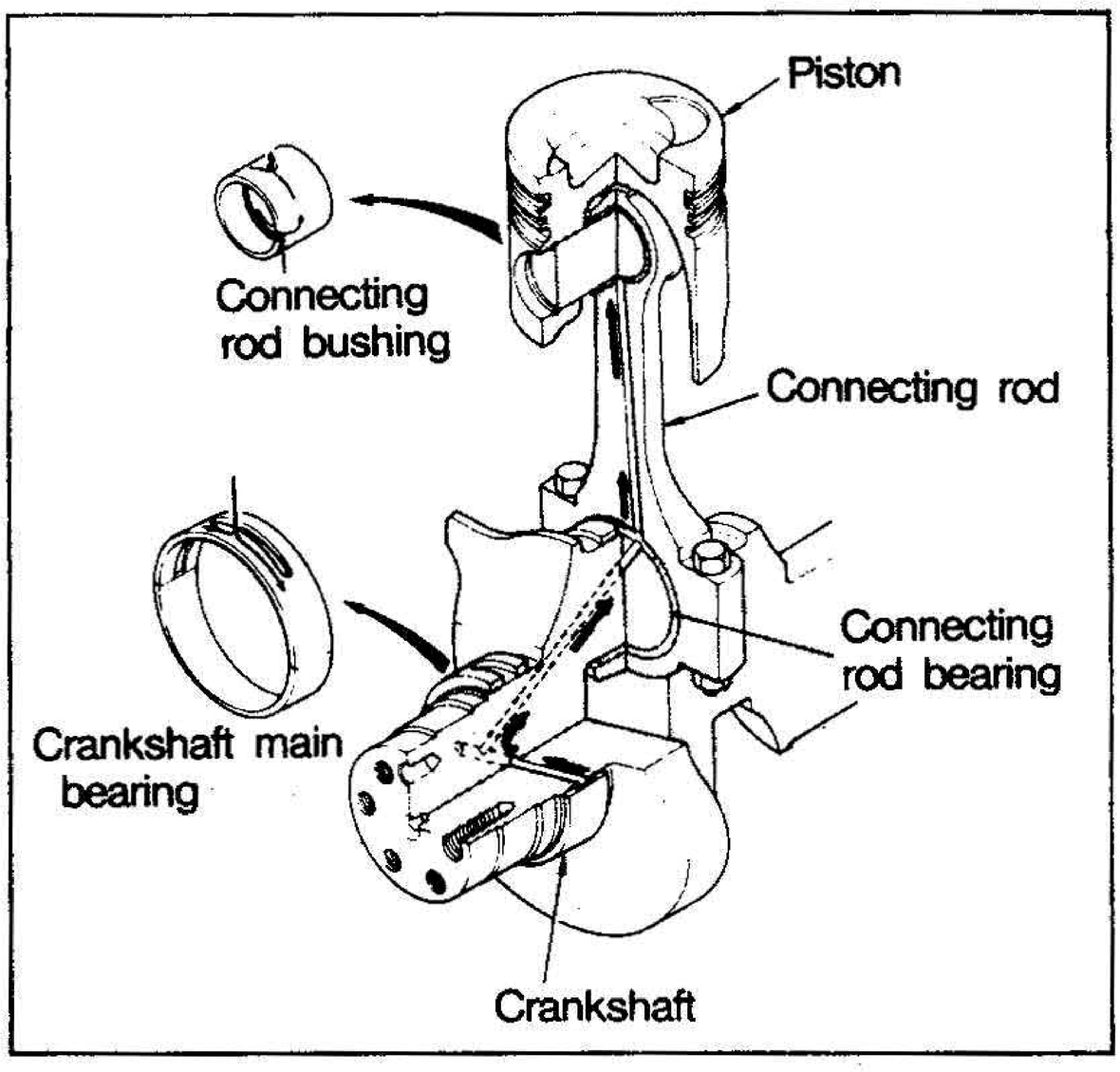


(5) Lubrication of Each Part

The engine oil forced to the oil main gallery lubricates each part as described below.

(a) Main bearing, connecting rod bearing and connecting rod bushing.

The oil hole extends from the oil main gallery to the crankshaft main bearing to lubricate the main bearing.

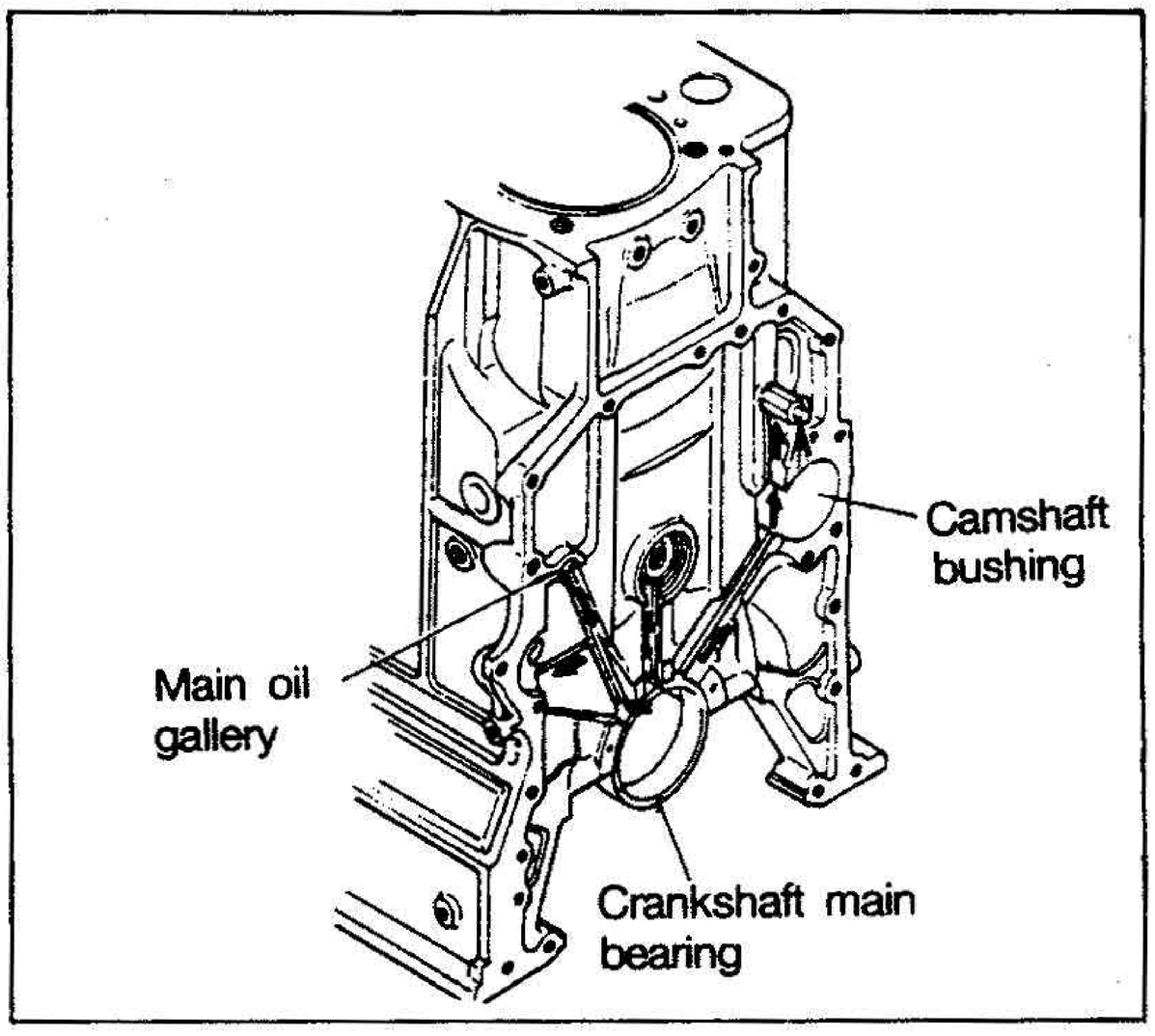


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Some of the engine oil which has lubricated the main bearing flows through the oil hole in the crankshaft and lubricates the connecting rod bearing. The oil then flows through the oil hole in the connecting rod and lubricates the connecting rod bushing.

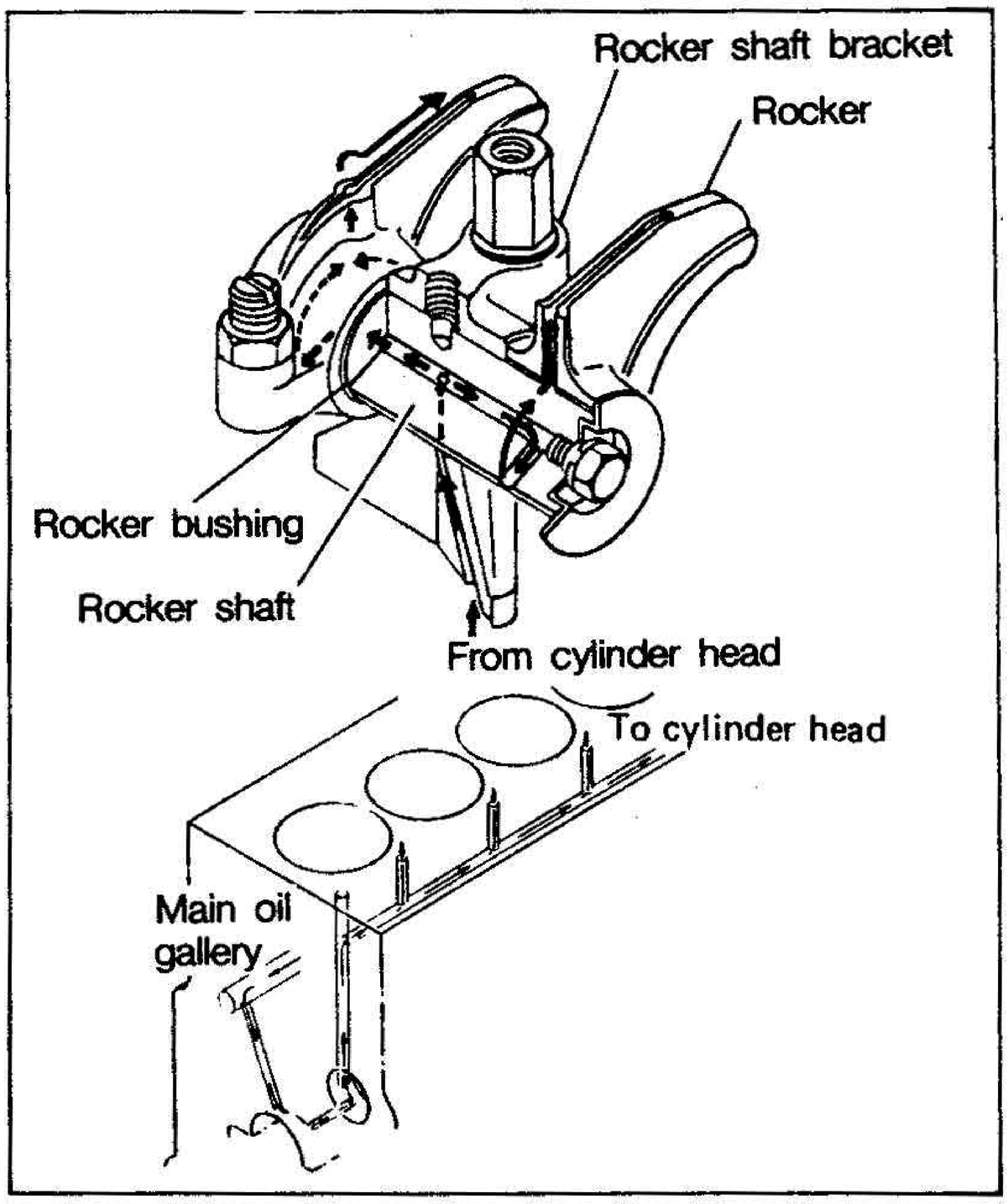
(b) Camshaft

Lubrication of the camshaft bushings is accomplished by the oil flowing through the oil holes to the individual camshaft bushings.



(c) The engine oil that has lubricated the No. 7 camshaft bushing is routed through the oil holes in the top of the crankcase to each cylinder head.

The engine oil forced to the cylinder head flows through the oil holes in the rocker shaft bracket and rocker shaft and lubricates all rocker bushings. The engine oil ejected from the oil hole at the top of the rocker arm lubricates the sliding portion contacting the valve cap, the valve stem portion and the push rod and adjus-

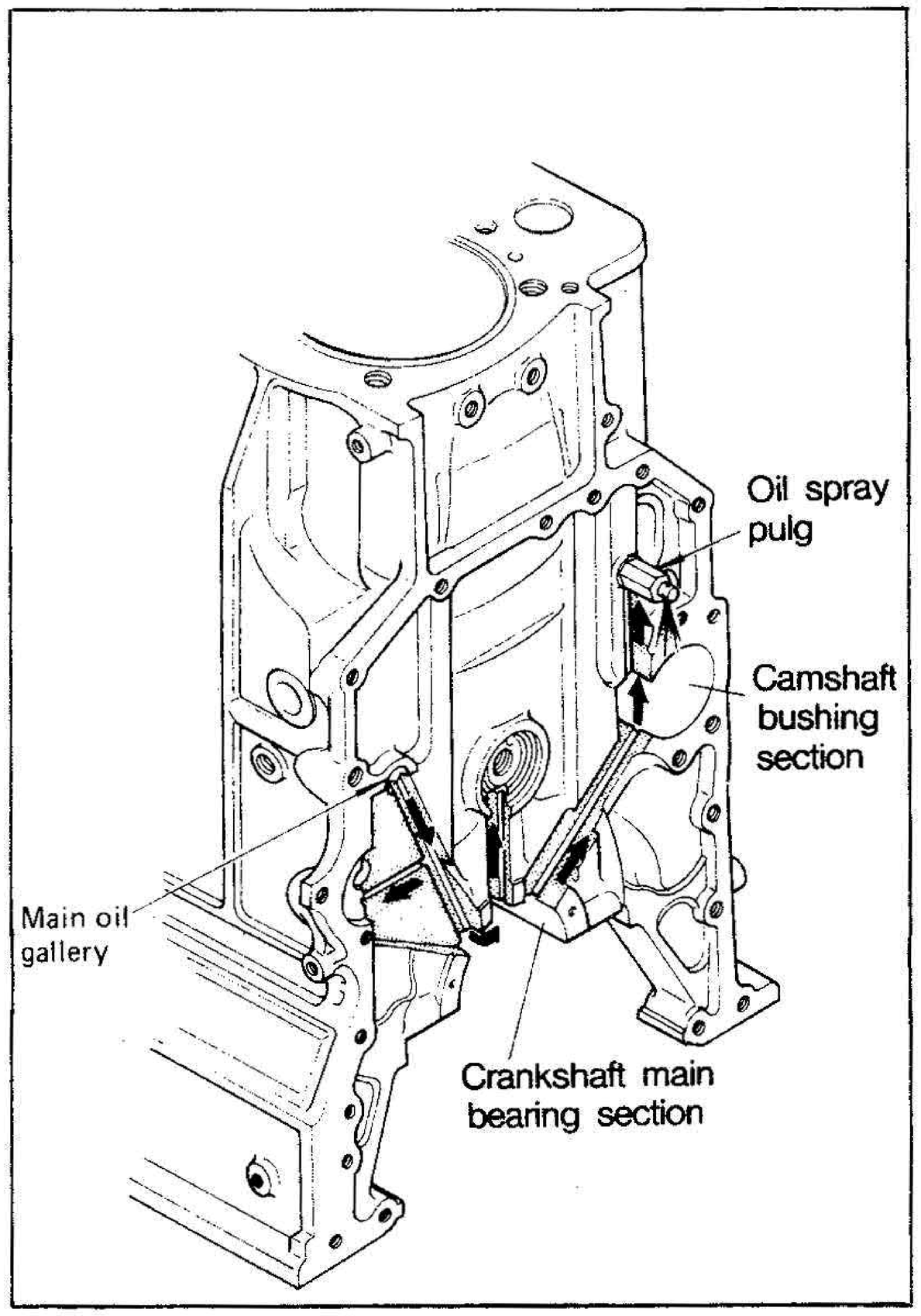


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ting screw portion, flows through the cylinder head and crankcase push rod hole, lubricates the tappet and camshaft cam portion, and returns to the oil pan.

(d) Timing gear

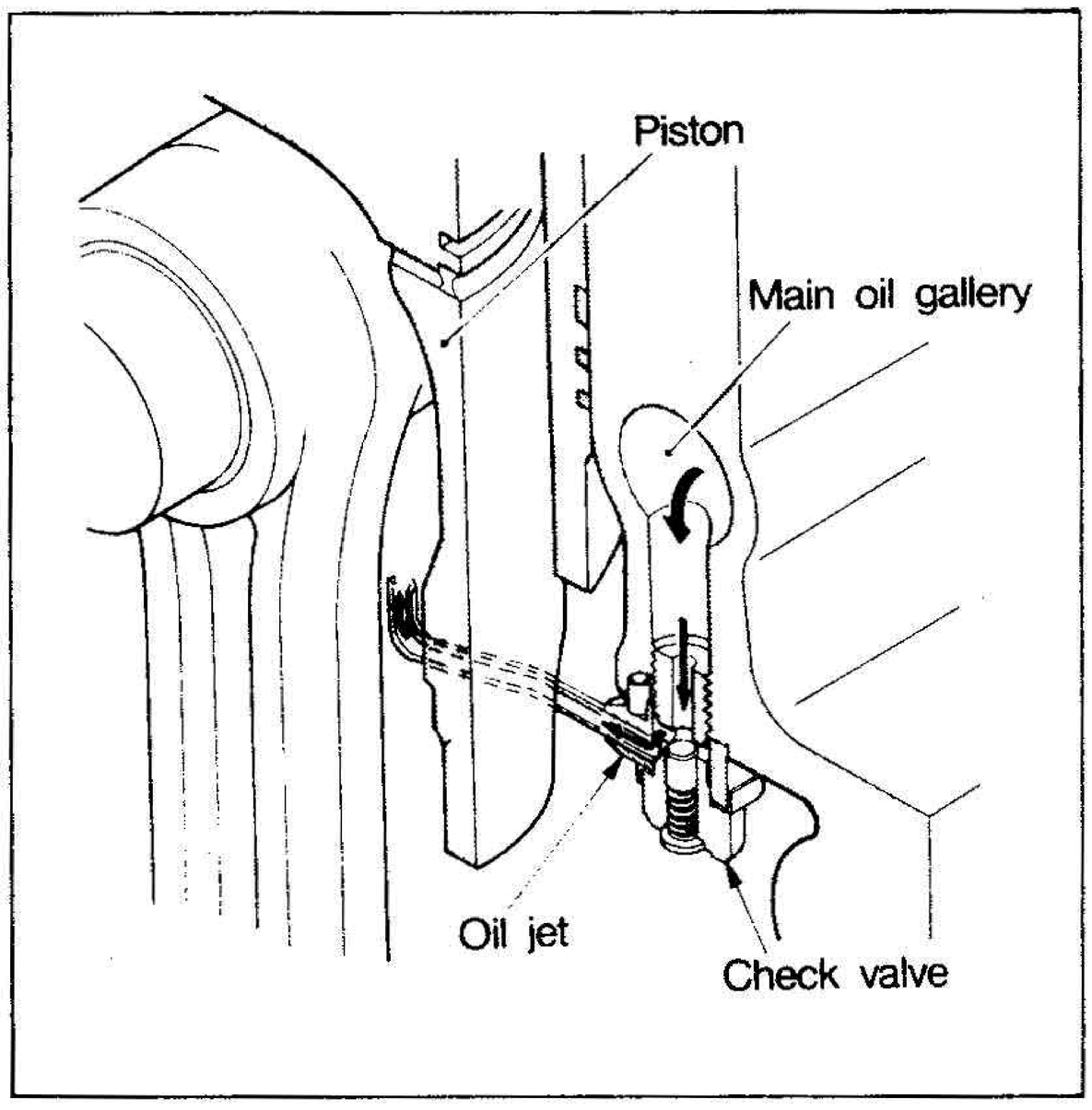
The idler shaft bushing of the timing gear is lubricated by oil through the oil hole from the oil main gallery and through the oil hole from the crankshaft main bearing at the rearmost end as shown. Each gear is lubricated by the oil spray plug.



(e) Cooling of piston

The oil jet provided under the main oil gallery for each cylinder sprays engine oil against the reverse surface of the piston to cool the piston.

The oil jet has a check valve which opens and closes at specified oil pressures, preventing reduction of the oil quantity(at low oil pressure) and reduction of the oil pressure.



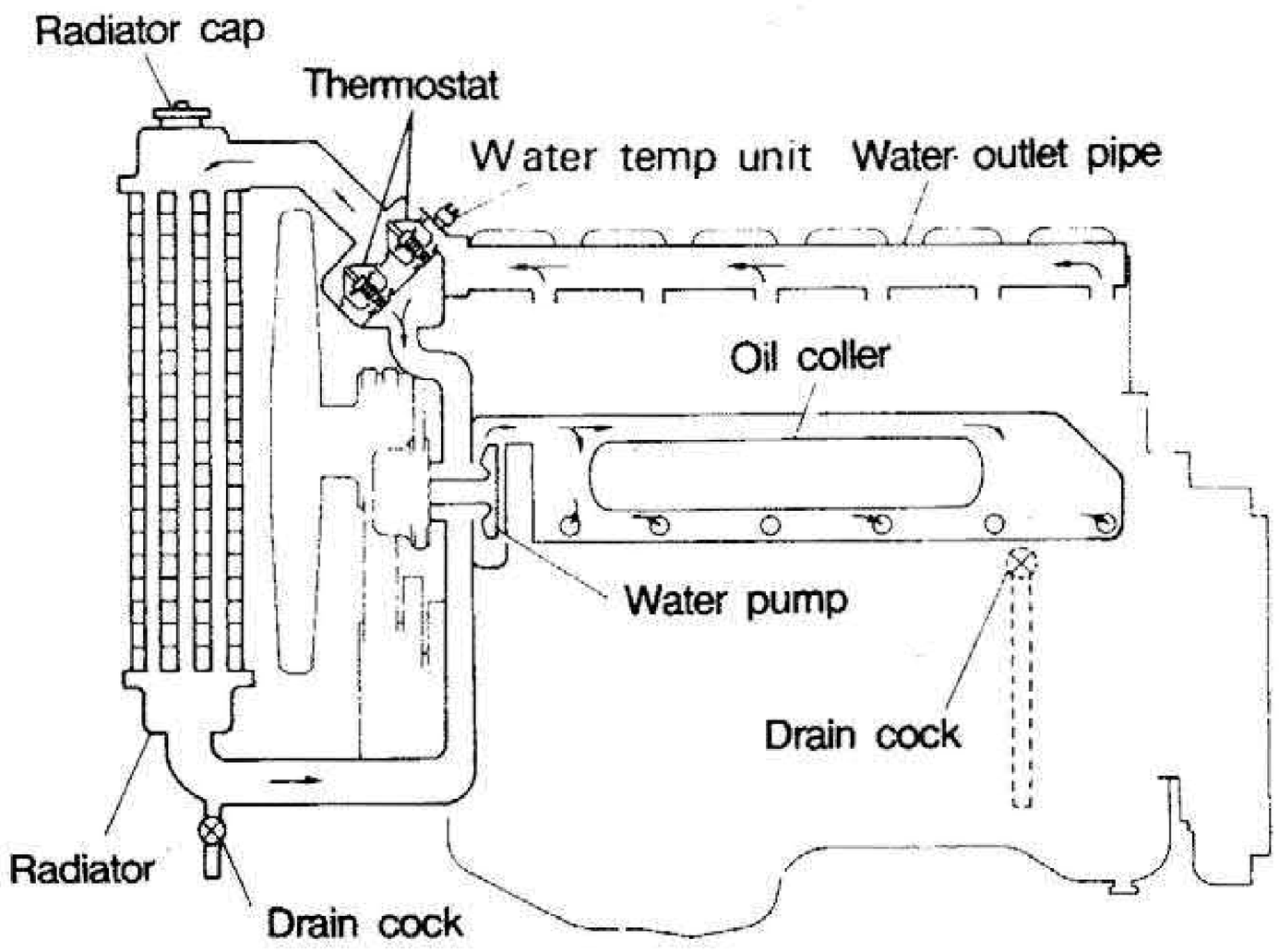
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1-3-4 Cooling

The engine cooling system is a water-cooled, forced circulation system using a water pump. Coolant, for the most part, is cooled by the radiator, but the cooling efficiency varies on different applications(as in an enclosed generator room in a building, operations in stationary condition, etc.). Therefore, variation in fan diameter, ventilation type(suction or blow-out type), radiator capacity, etc. have been made available for the individual applications.

Engines for fixed type power generators and those installed in the basement of a building usually employ a city water cooling system instead of radiator cooling system.

The following illustration is the schematic diagram of a radiator cooling system with a suction type ventilation.



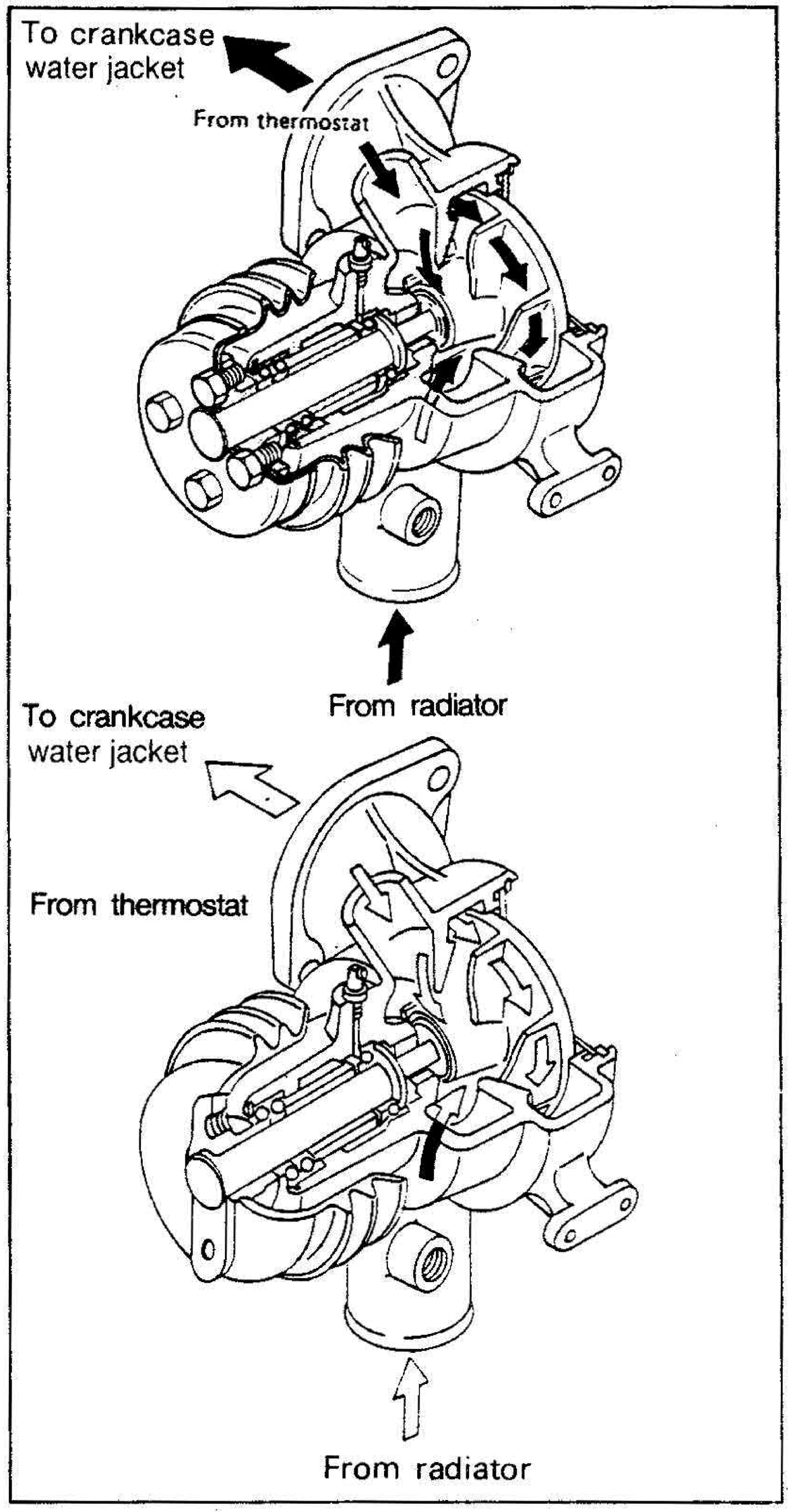
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(1) Water pump

The water pump is a centrifugal pump. Mounted on the left side of the crankcase, the pump is driven by the crankshaft pulley via a V belt.

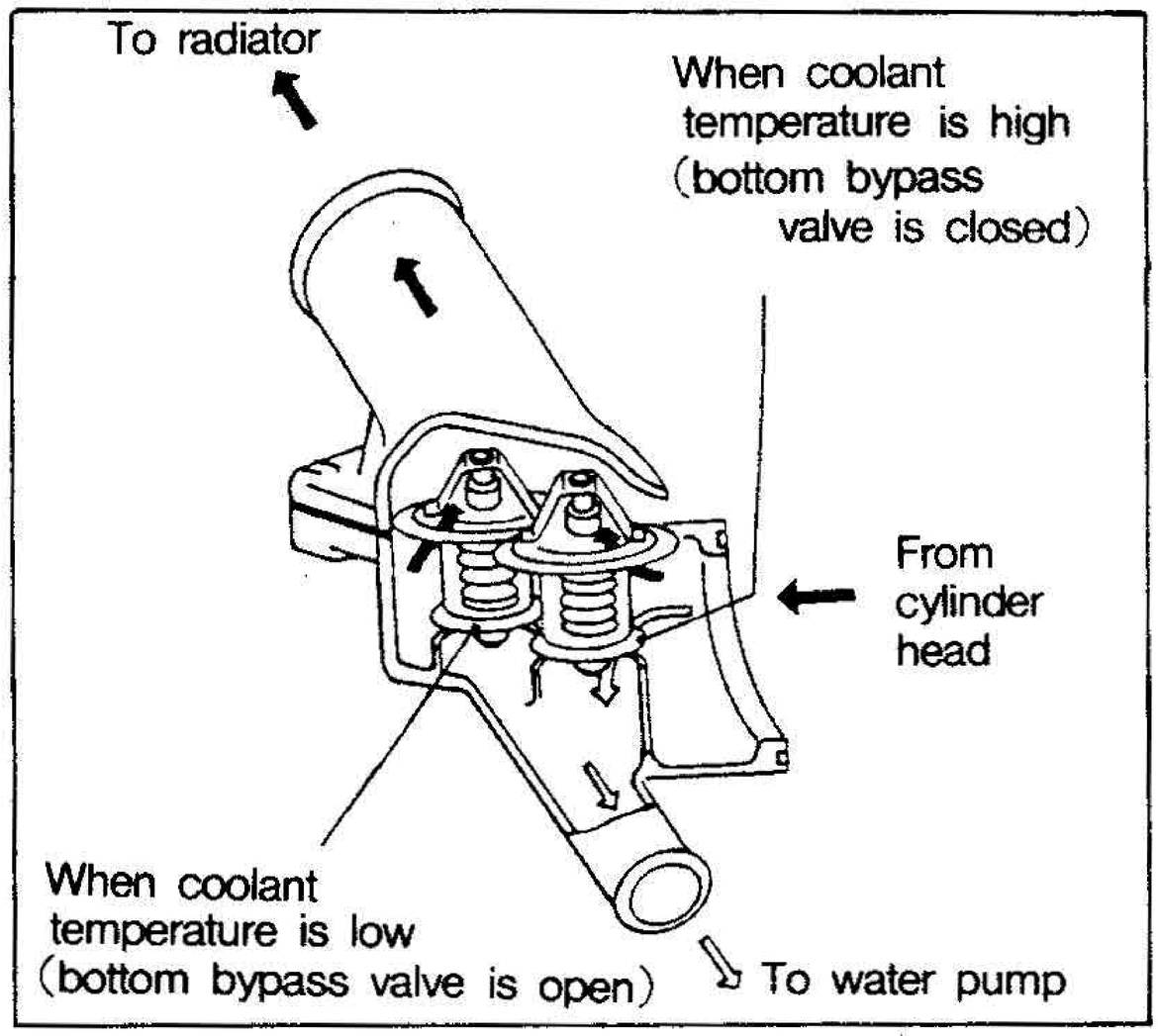
An impeller having a blade is mounted at one end of the water pump shaft and coolant is sealed off by a unit seal.

The ball bearing supporting the water pump shaft is lubricated with grease.



(2) Thermostat

The thermostat is a bottom bypass type with a special wax enclosed in a pellet. When the wax is heated, it changes from solid to liquid and its volume also changes. This change in volume changes the opening of the valve and changes the quantity of coolant fiowing into the radiator and water pump(bypass side), thereby controlling the coolant temperature.

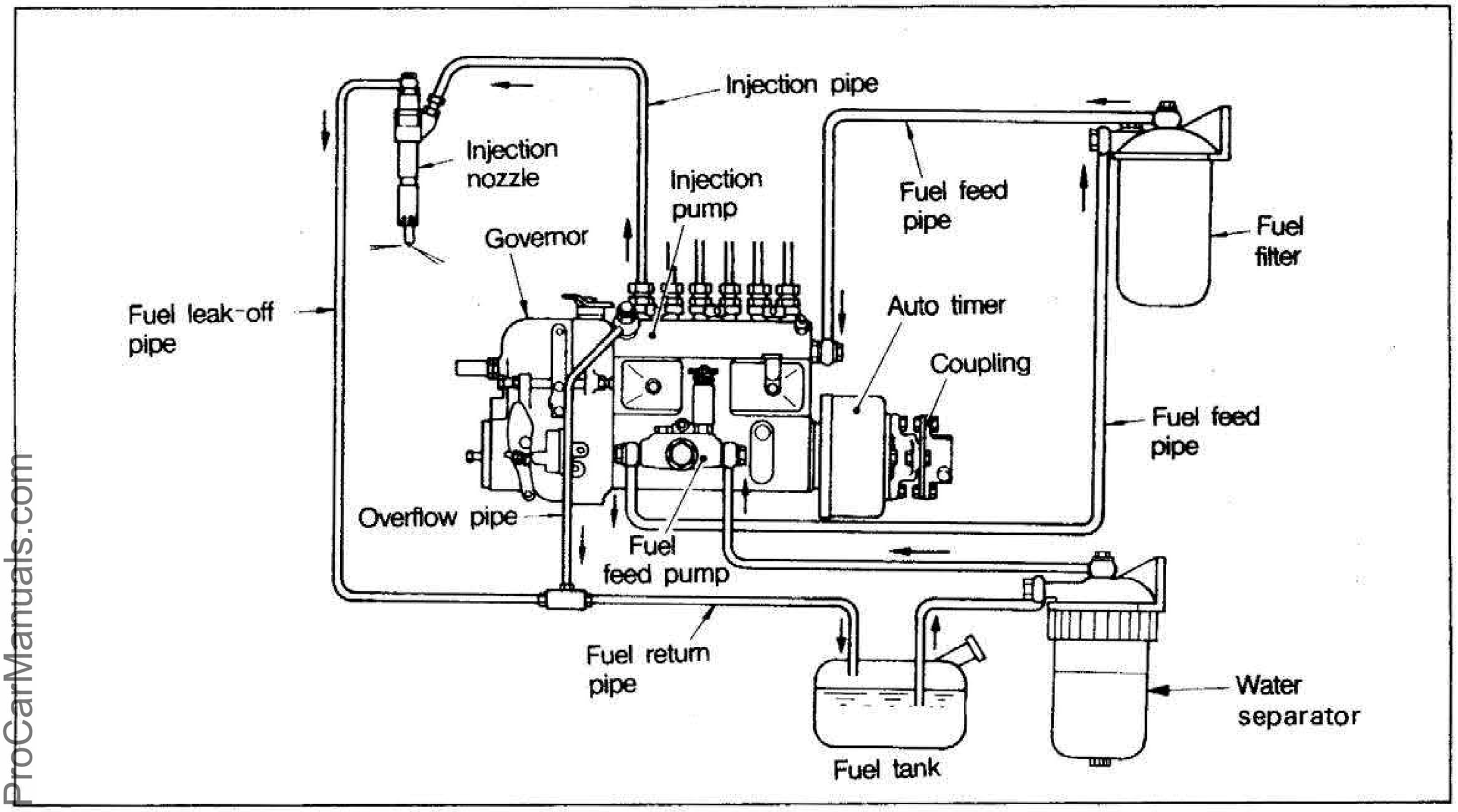


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1-3-5 Fuel

The fuel system consists of the injection pump general assembly(injection pump proper, governor, timer, feed pump and coupling), fuel filter, water separator, injection pipe, injection nozzle, fuel leak-off pipe, etc.

The injection pump is driven at one-half the engine speed.

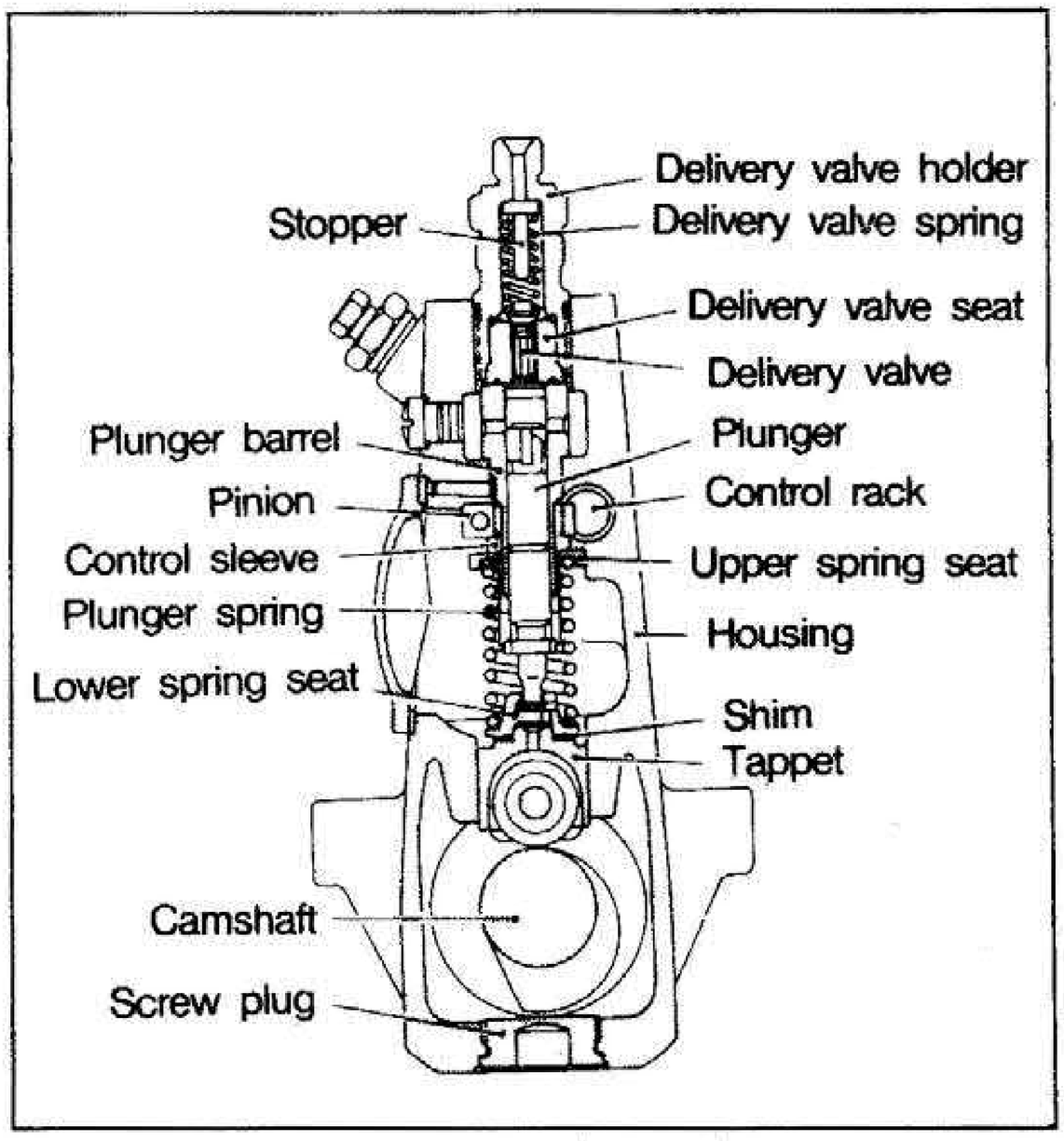


(1) Injection Pump Proper

(a) AD type injection pump [D6AU]

The camshaft driven at half the engine speed is supported by taper roller bearings at both ends. The camshaft has a cam for operating the plunger and a cam for operating the feed pump.

A tappet operating with the pump housing as the guide is in contact with the camshaft. The tappet changes the rotary motion of the cam



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to up-and-down motion which is transmitted to the plunger.

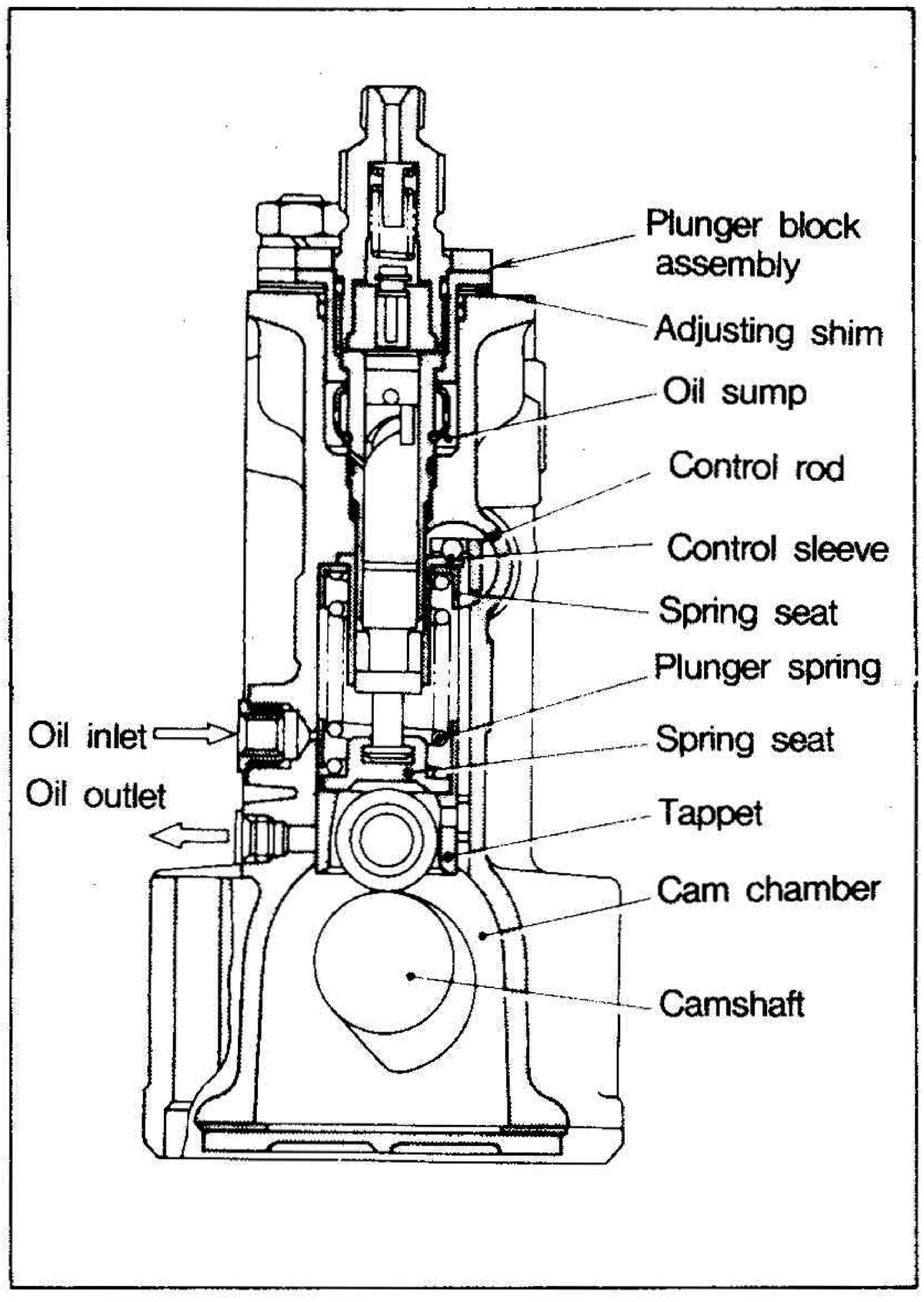
The plunger slides in the plunger barrel secured by the dowel pin of the pump housing.

A delivery valve is mounted on the top of the plunger by the delivery holder. An injection pipe is mounted to the holder.

(b) P type injection pump 〔D6AZ〕

The p type pump is a totally enclosed type and is constructed as shown.

The plunger barrel, delivery valve, delivery valve spring, etc. are secured on the flange sleeve by the delivery valve holder. These are put together as a unit to constitute a plunger block assembly and are mounted to the pump housing.



The cam chamber lubricates the tappet, pump housing, camshaft and governor by the forced lubrication system using engine oil. To minimize the leakage of fuel into the cam chamber, the plunger barrel has an oblique hole for returning the fuel that has leaked to the oil sump. To prevent leakage of the fuel in the oil sump into the cam chamber, O-ring is mounted on the periphery of the plunger barrel.

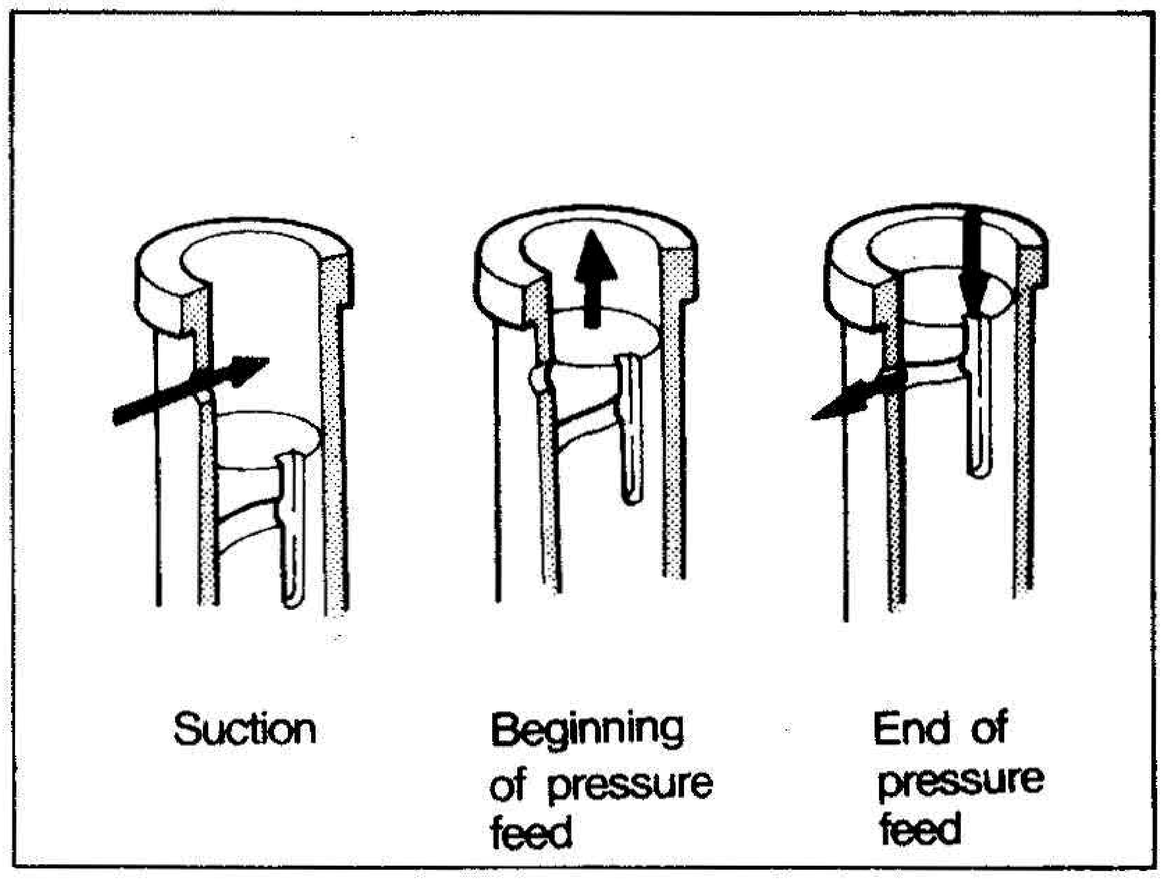
A deflector is also mounted on the periphery of the plunger barrel to prevent erosion of the pump housing by counter flow of fuel at the end of an injection.

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(c) Plunger

The plunger has an oblique groove and a vertical groove, while the plunger barrel has 2 inlet-outlet holes.

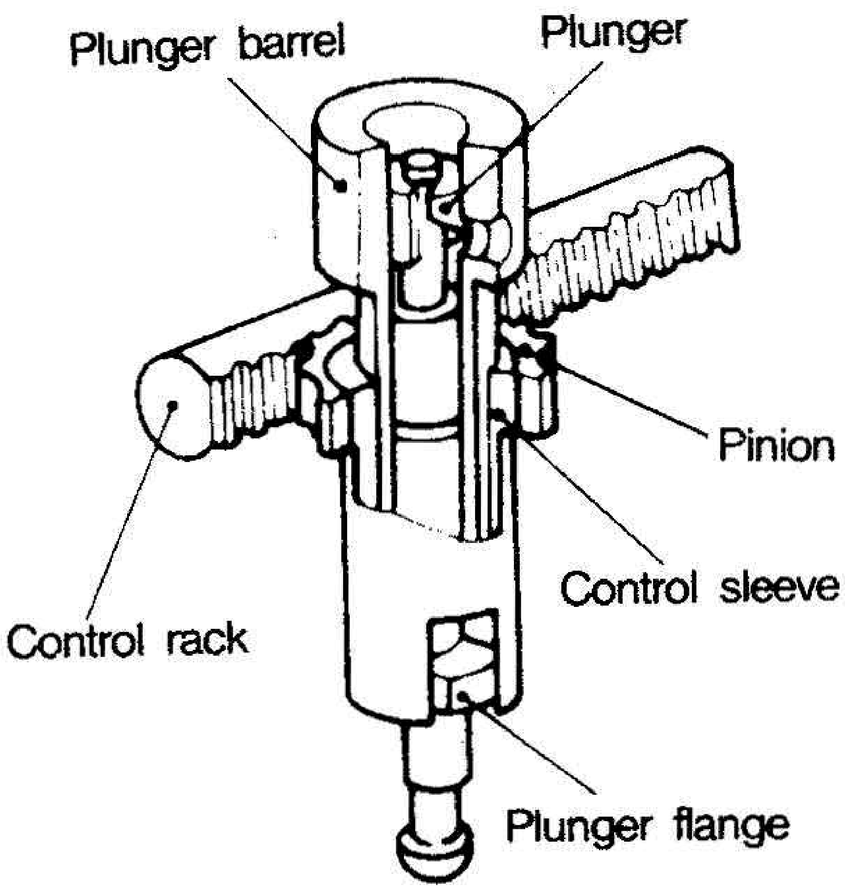
Pressurized feeding of fuel oil begins when the plunger, pushed up by the cam of cam shaft, closes the inlet-outlet holes of plunger barrel. When the plunger is further pushed up, fuel oil is discharged through the vertical groove of plunger from the inlet-outlet holes.



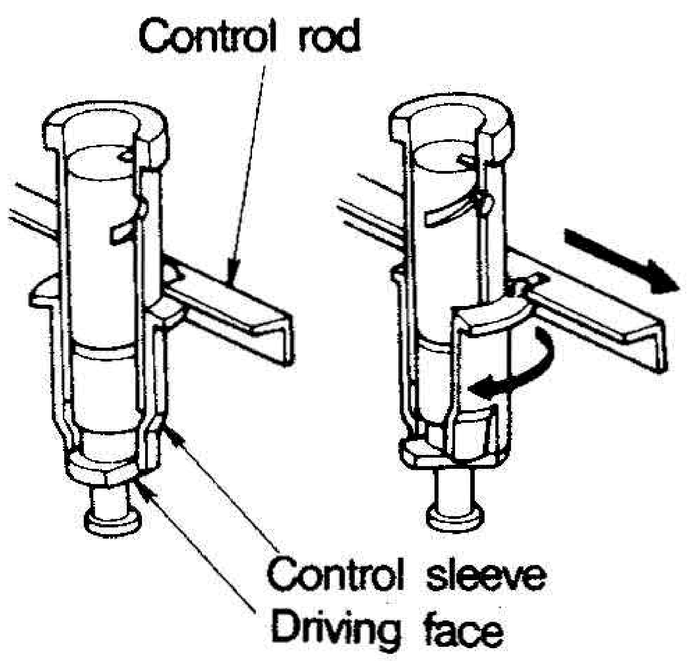
A deflector is installed on the periphery of the plunger barrel so that high pressure fuel oil discharged from inlet and outlet ports will not erode the pump housing. Fuel injection volume is controlled by the governor which moves the control rod(or the control rack) left and right and rotates the control sleeve which engages with the control rod(or the control rack and pinion). Since the driving face of plunger meshes with the control sleeve at the lower part thereof, the plunger turns with the rotation of control sleeve and injection volume is controlled through the changing of the effective stroke.

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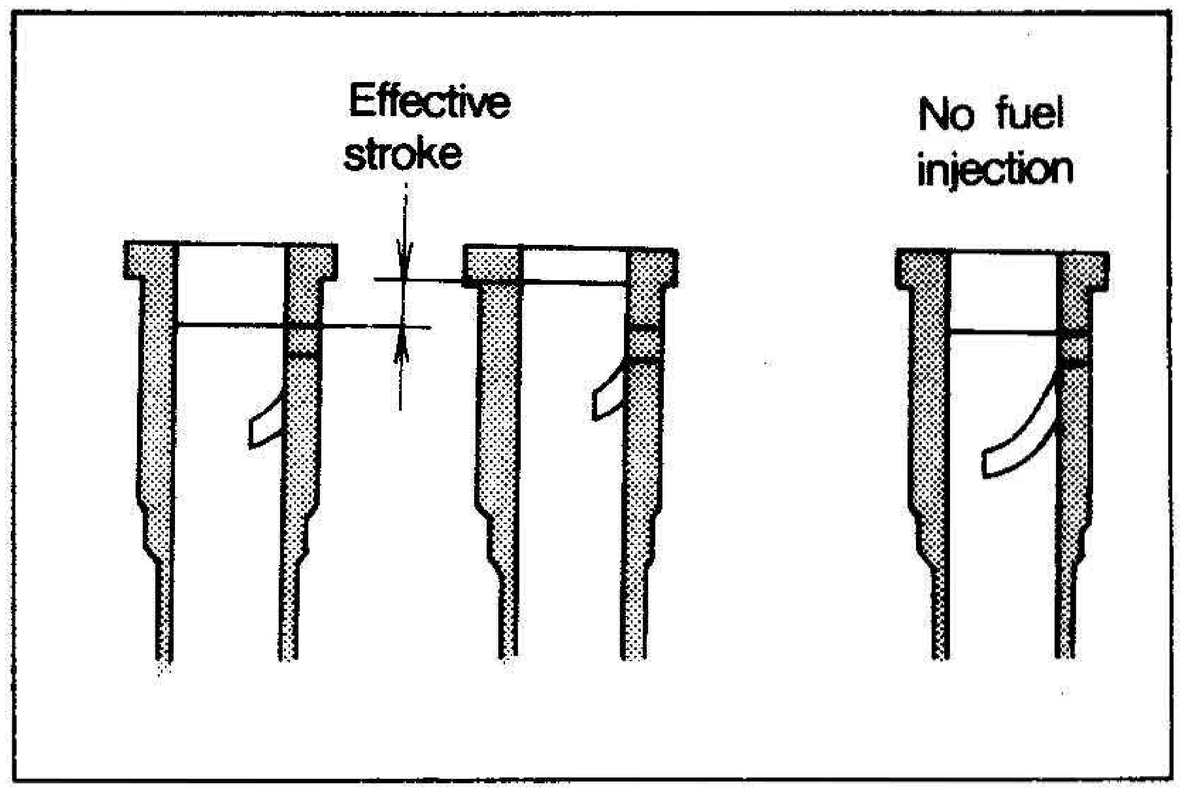
AD type injection pump



P type injection pump

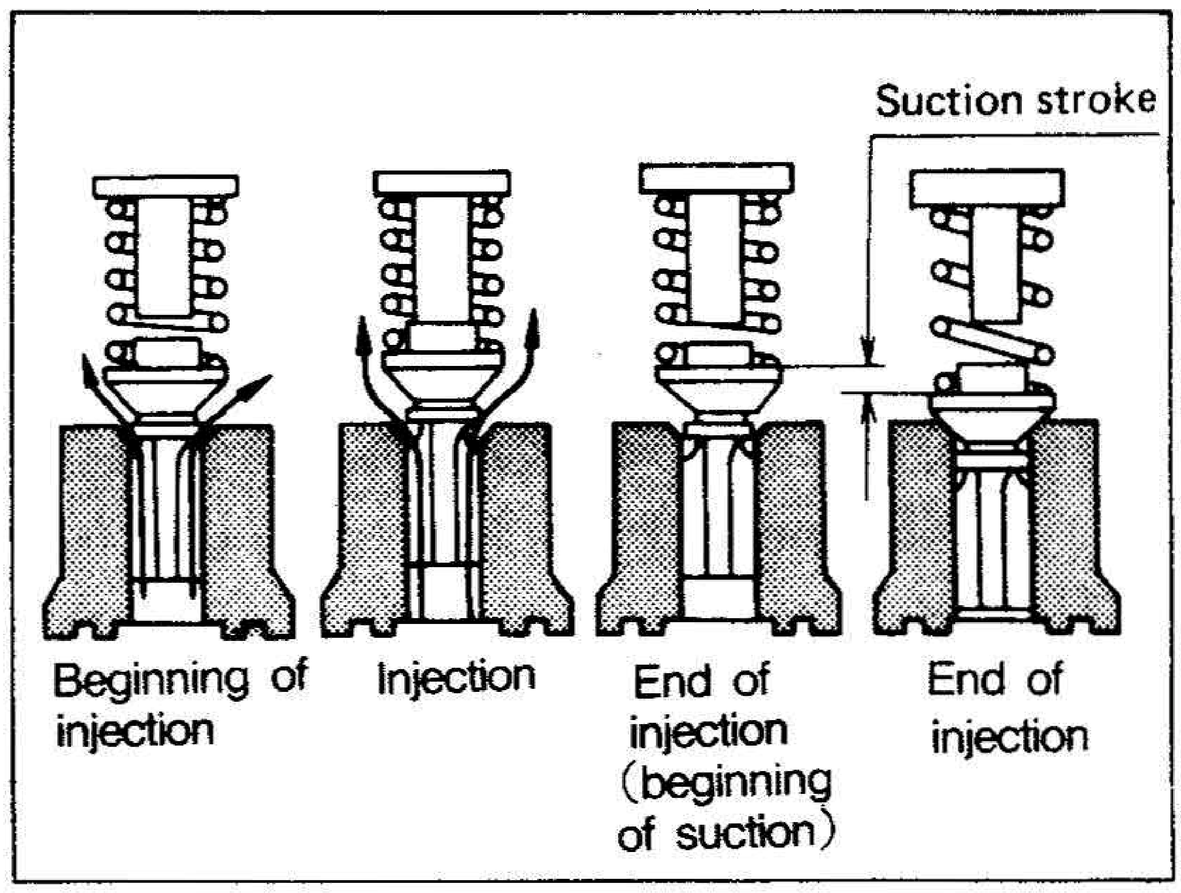


The effective stroke means the length of the plunger stroke from the time when the upper end of plunger closes the inlet-outlet holes of plunger barrel until the oblique groove of plunger opens to the inlet-outlet holes. When the effective stroke stands at zero, it indicates that no fuel injection takes place.



(d) Delivery valve

The fuel highly pressurized by the plunger pushes the delivery valve up and gushes out. When delivery of the fuel under pressure by the plunger is completed, the delivery valve is pushed back by the delivery valve spring and closes the fuel passage to prevent counter flow of the fuel.



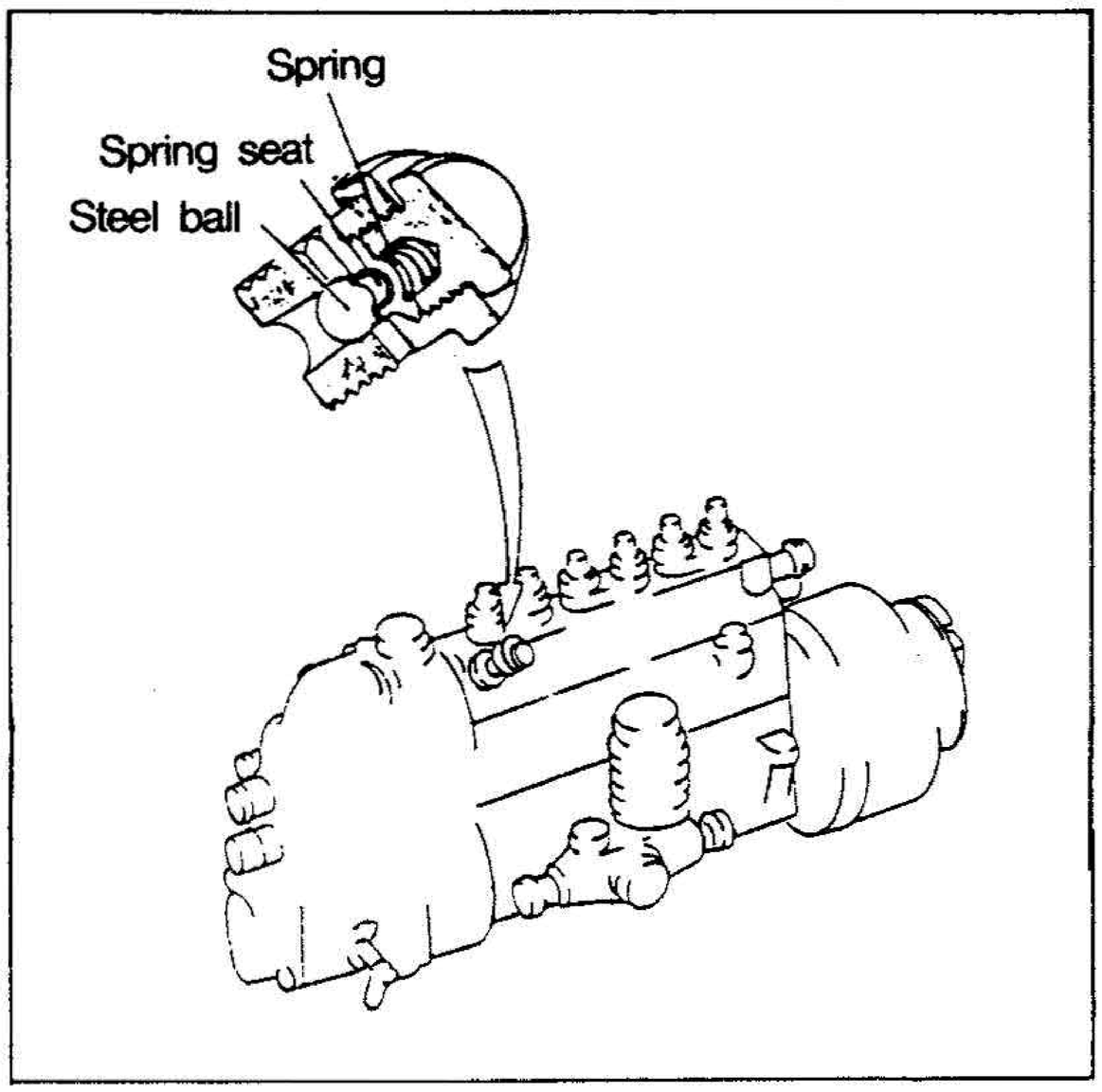
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The delivery valve is further brought down until it is held against the seat surface tightly. The amount of fuel corresponding to the stroke during the period is drawn back from above to instantly lower the residual pressure in the line between the delivery valve and nozzle. The draw-back effect improves the cutting of fuel from the nozzle and prevents after-injection dripping.

Adelivery valve stopper, provided on the top of the delivery valve spring, limits the lift of the delivery valve to prevent the surging of the valve during high speed operation. It also reduces the dead volume between the delivery valve and nozzle and stabilizes the injection rate.

(e) Overflow valve

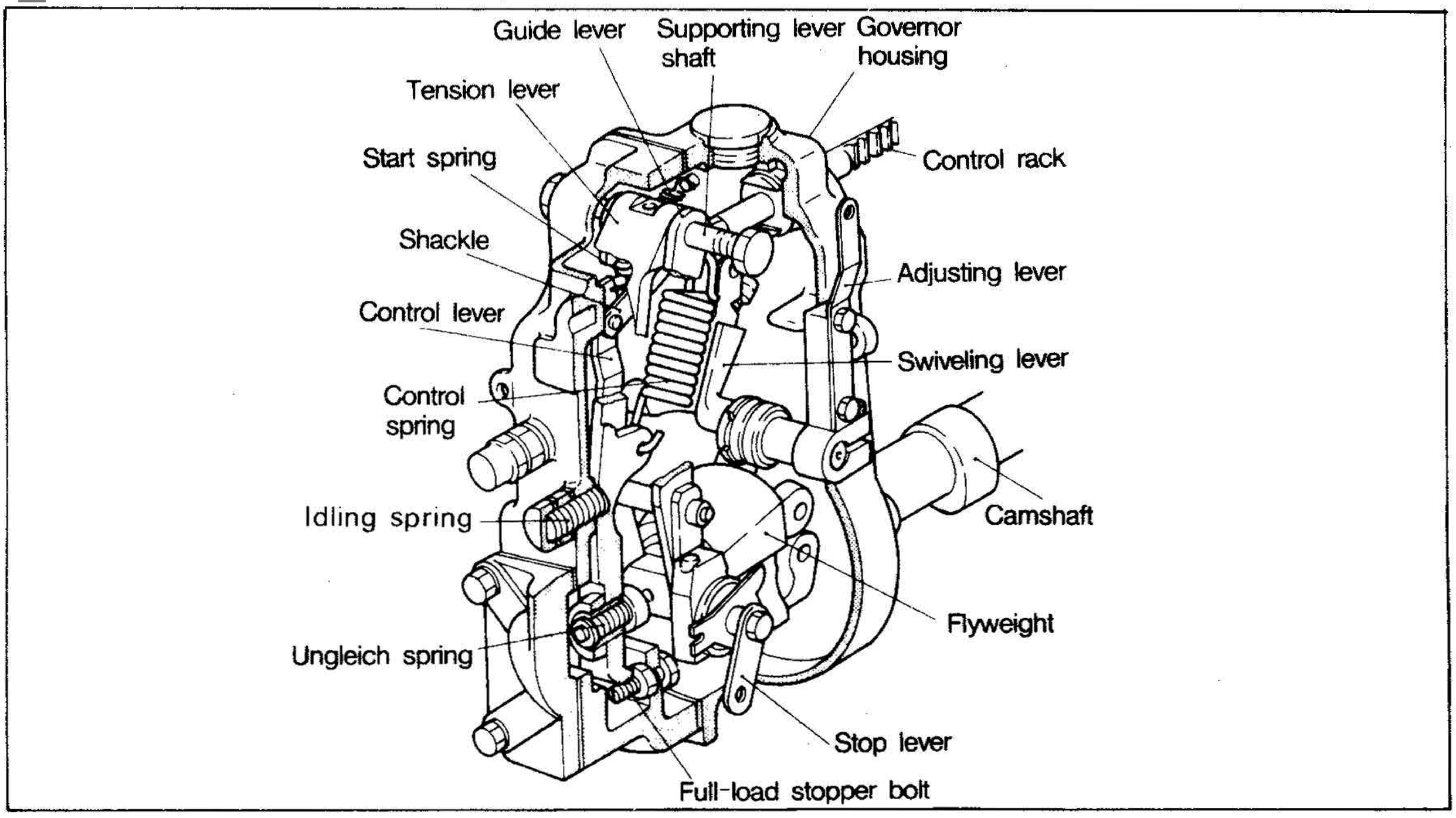
When the fuel pressure in the injection pump exceeds a predetermined pressure, the steel ball in the overflow valve is pushed up to let the fuel flow out from the injection pump and return to the fuel tank, thereby stabilizing the fuel temperature and temperature distribution in the injection pump and maintaining the injection rate into each cylinder constant.



(2) Governor

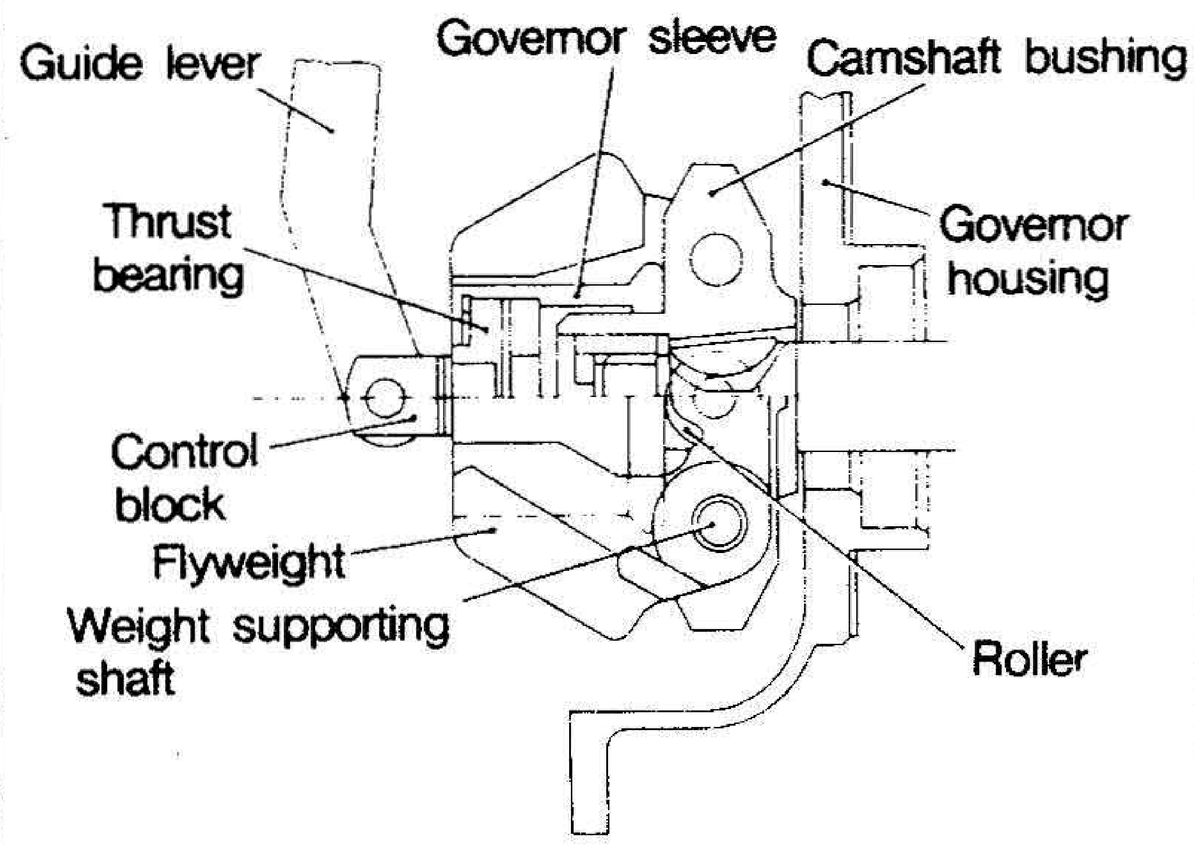
(a) RSV type governor

The RSV type governor is a centrifugal type all-speed governor coupled to the cam shaft of the injection pump. The governor not only controls the maximum and minimum speeds but also automatically controls the engine speed at any intermediate speed position.



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The governor, as shown, consists of flyweights mounted to the injection pump camshaft. When the flyweights turning on the flyweight supporting shaft open outward, the roller mounted to the end of flyweight arm pushes the end of the sleeve in the axial direction. The governor sleeve, being made integral with the control block through a bearing, moves only in the axial direction.



The control block, mounted to the guide lever hung on the supporting lever shaft of the governor cover, prevents rotation.

The control lever is mounted to the middle of the guide lever by the shaft with the bottom end as the fulcrum, whereas the top of the lever is coupled through the shackle to the control rack.

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The start spring, attached to the top end of the control lever, always pulls the control rack in the direction that fuel is increased.

The turning shaft of the swiveling lever is fitted into the bushing of the governor cover and its center is eccentric with respect to the mounting position of the control spring installed to the tension lever. The control spring is installed to the end of the swiveling lever. When the control spring receives tension, the bottom end of the tension lever touches the adjustable full-load stopper bolt.

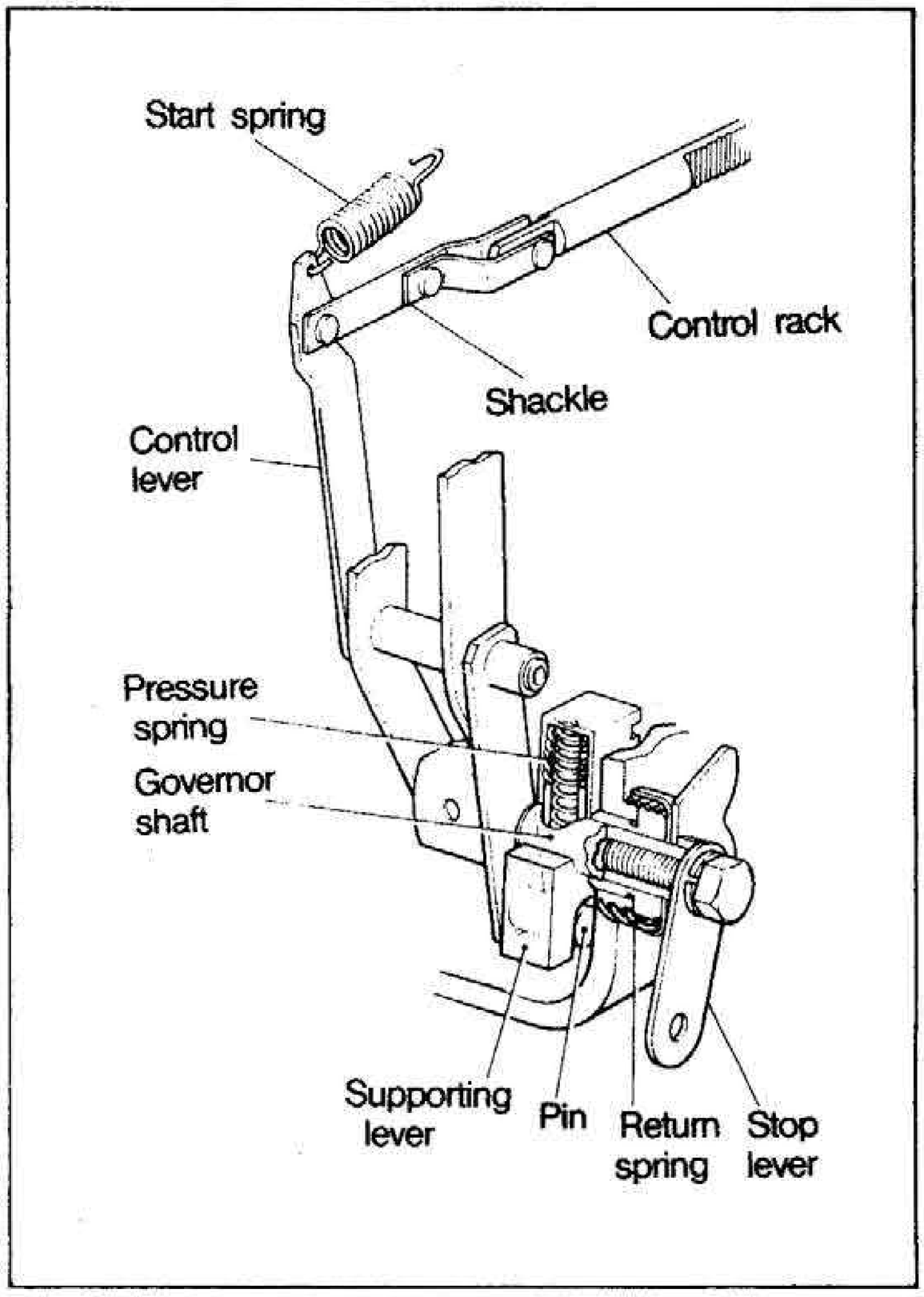
When the angle of the adjusting lever is changed, the angle of the swiveling lever is also changed and the tension of the control spring changed. This is because the turning center of the swiveling lever and the mounting position of the control spring installed to the tension lever are eccentric to each other as mentioned above.

An adjusting screw is also mounted to the swiveling lever. Adjustemnt of the screw changes the tension of the control spring, thereby making it possible to adjust the speed regulation.

An Ungleich spring is provided in the bottom portion of the tension lever. Adjust the tension of the spring by adding or removing shims.

An idling sub spring adjustable from outside is provided in the middle of the governor cover. During idling, the spring always keeps in contact with the tension lever to maintain a constant idling speed.

The stop lever, mounted through the supporting lever to the bottom end of the control lever, returns the control rack to the stop position with a slight pressure irrespective of the adjusting lever position.

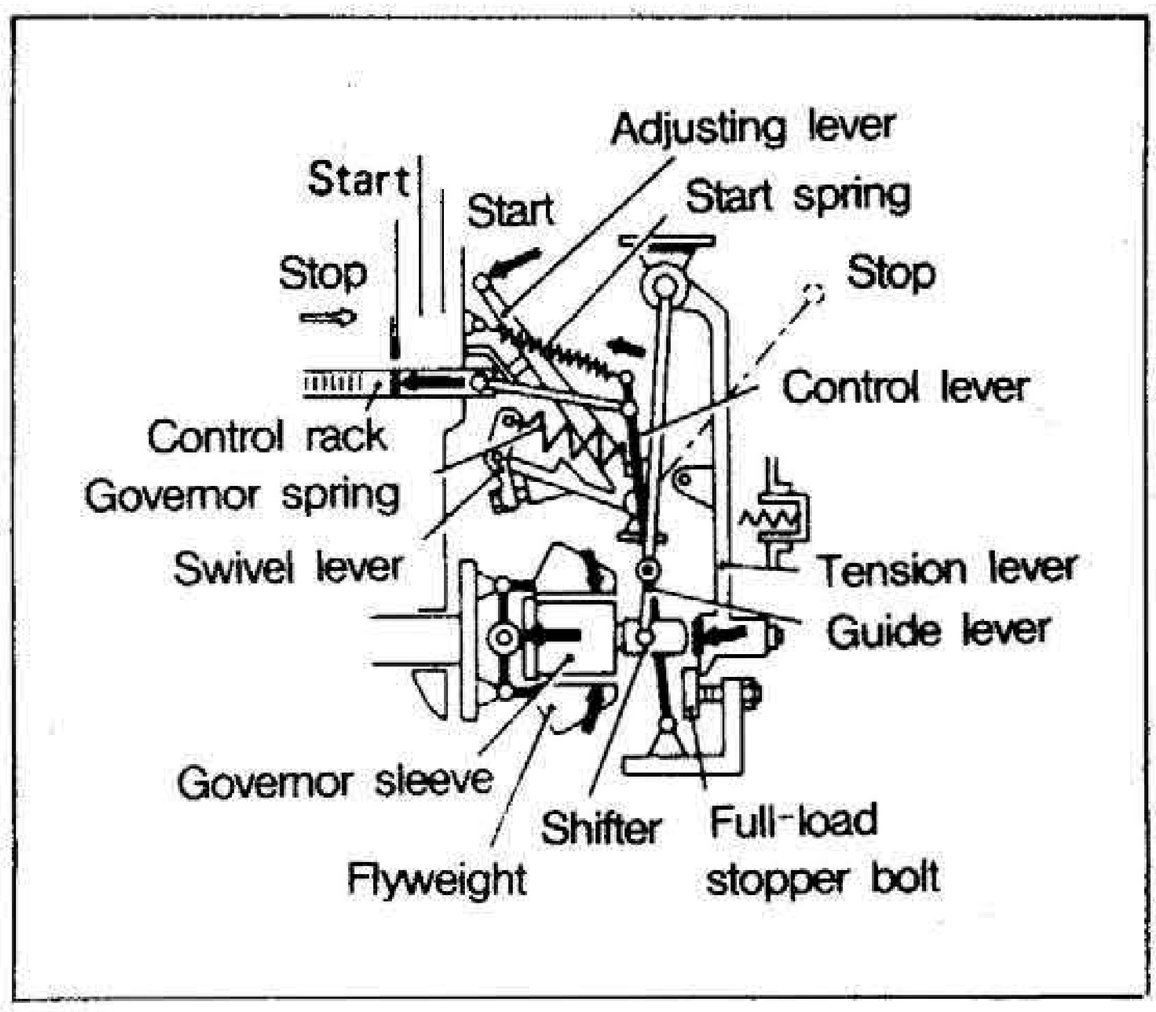


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1. Start of engine

When the adjusting lever is moved to the start position(until it touches the maximum speed stopper), the swiveling lever which moves with the adjusting lever pulls the control spring and moves the tension lever until it touches the full-load stopper bolt.

At that time, the flyweights are stationary, and the start spring with weak tension pulls the control lever in the direction that fuel is increased.



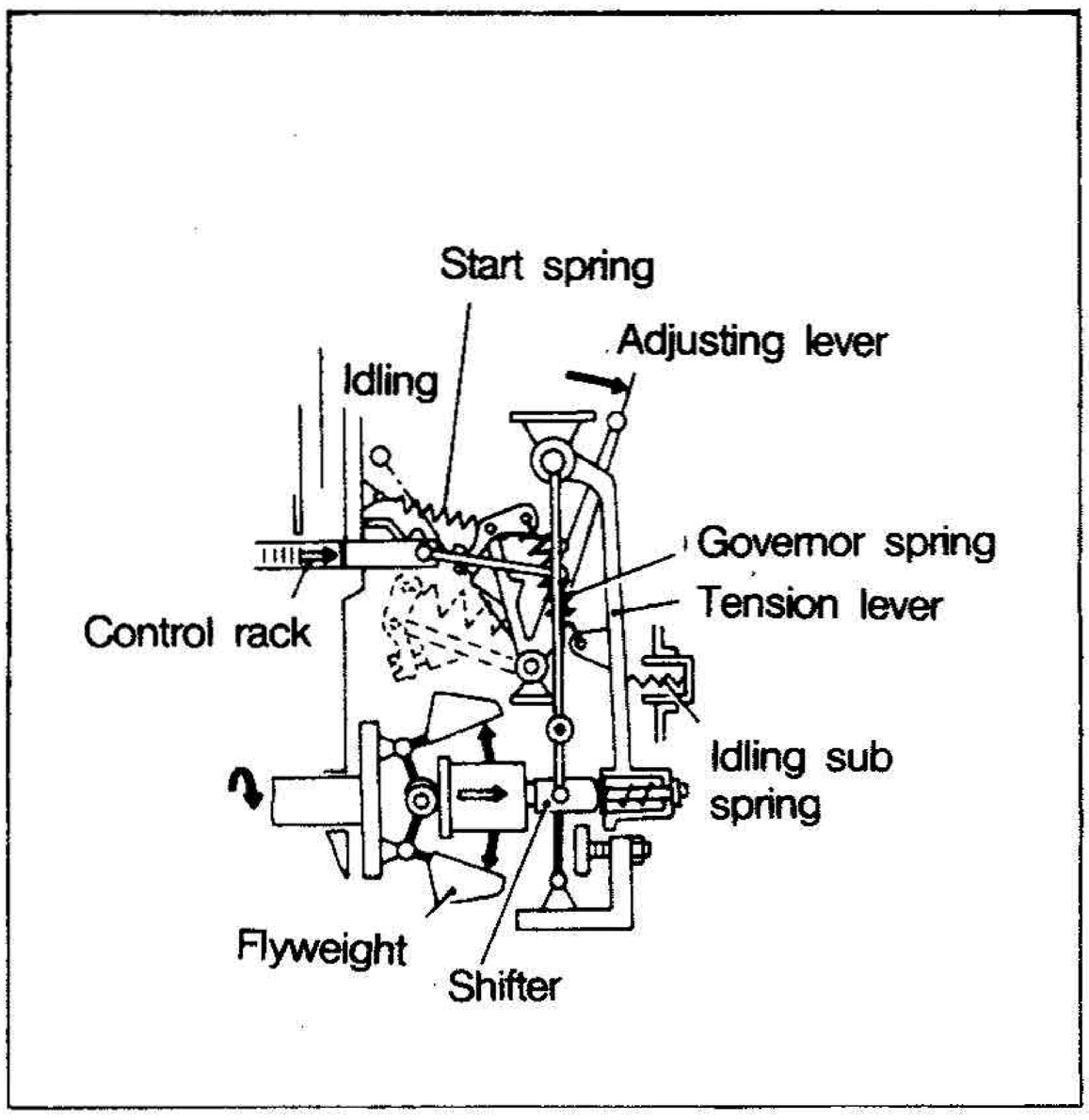
At the same time, the control block and governor sleeve push the flyweight roller to the left.

As the result, the tension lever and control block are spaced that much apart, and the corresponding amount of fuel is supercharged to facilitate starting.

2) Idling control

Once the engine is started and the adjusting lever returned to the idling position, the tension of the control spring is drastically reduced.

Now the flyweights can move outward even at a low speed, so the tension lever is pushed back until it touches the idling sub spring and places the control rack at the idling position. In this state, the centrifugal force of the flyweights and the weak-state control spring and idling sub spring achieve balance and maintain smooth idling.



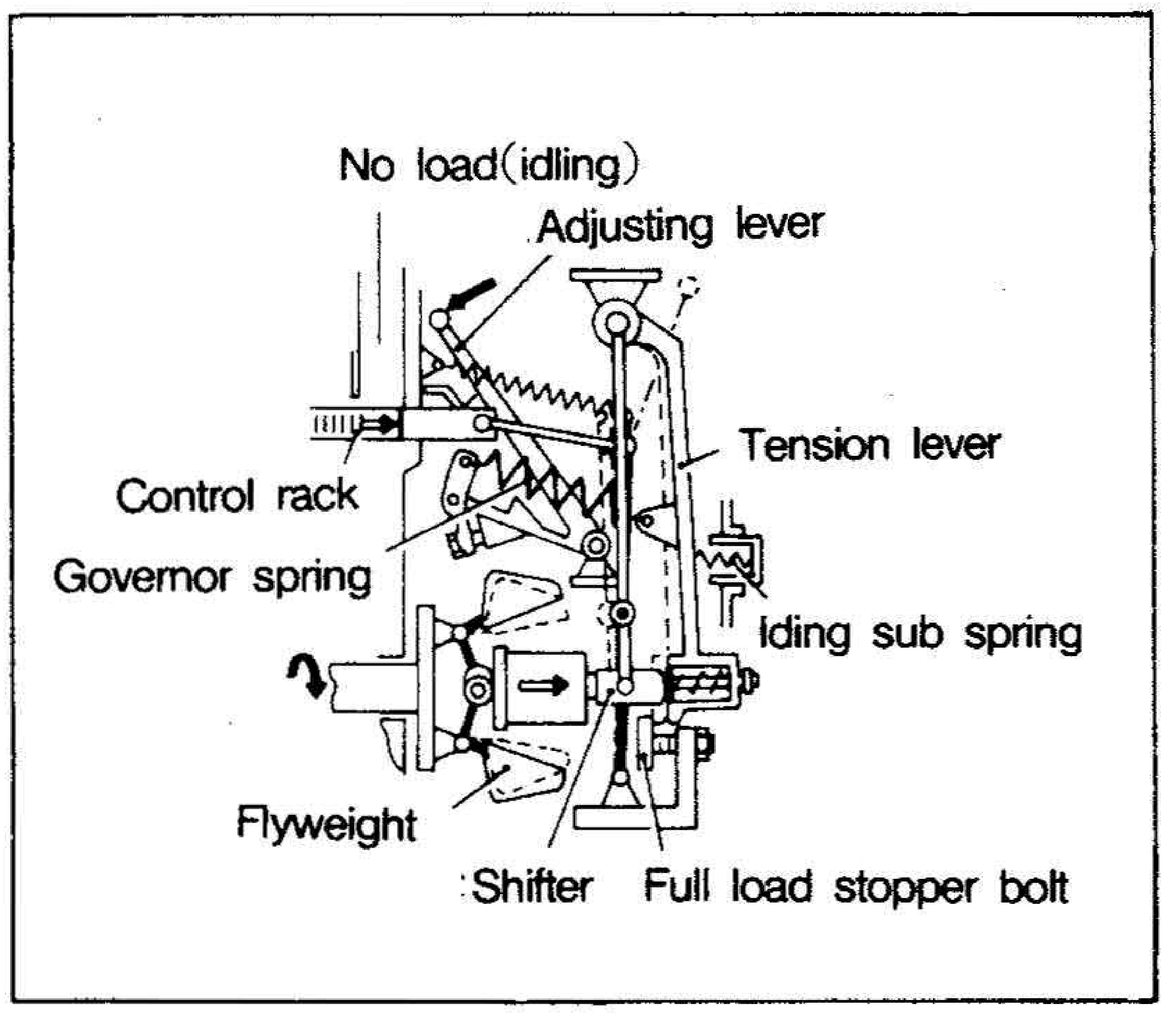
When the speed falls, the centrifugl force decreases, the flyweights move inward, and the idling sub spring pushes the tension lever to the left and moves the control rack in the direction that fuel is increased.

If the speed falls radically, the start spring with weak tension acts and moves the control rack in the direction that fuel is increased to maintain the idling speed.

3) Maximum speed control

When the adjusting lever is moved to the full-load position, the tension of the control spring is increased and pulls the tension lever until it touches the full-load stopper bolt.

When the engine exceeds the specified speed, the centrifugal force of flyweights becomes larger than the force of the control spring pulling the tension lever. So the tension lever is moved to the right and moves the control rack in the direction



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that fuel is reduced, thereby preventing the engine from exceeding the specified speed.

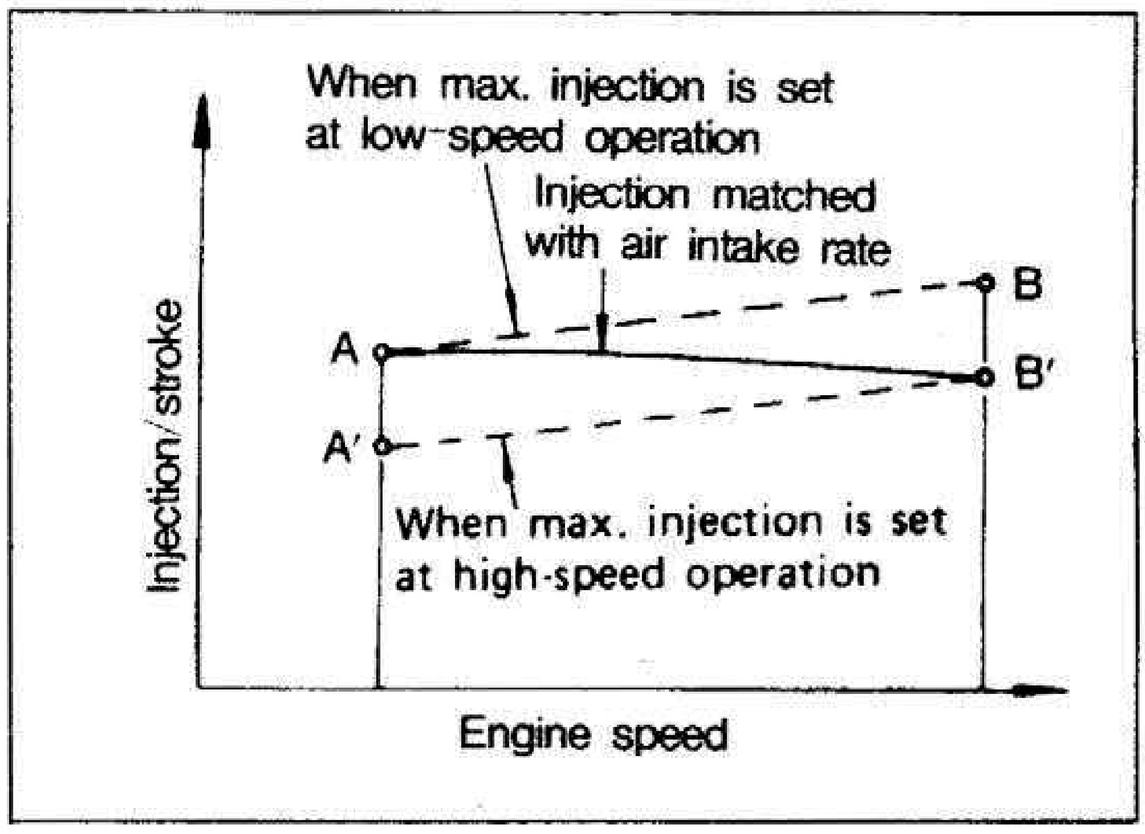
If the speed further increases, the centrifugal force of flyweight increases and pushes the tension lever to the right and also compresses the idling sub spring to pull the control rack back to the no-load maximum speed position, thereby preventing over-speed operation of the engine.

The RSV type governor controls the entire speed range from idling to maximum speed. If load increases or decreases at a certain speed determined by the position of the adjusting lever, the governor automatically funtions and maintains the engine speed constant at all times.

4) Ungleich operation

The Ungleich device controls fuel injection in such a way as to match the engine performance(the required injection varies with engine speed).

The air intake rate of the engine falls as the engine speed increases. The injection pump, on the other hand, increases the per-stroke injection as the speed increases, even with the control rack at the same position.

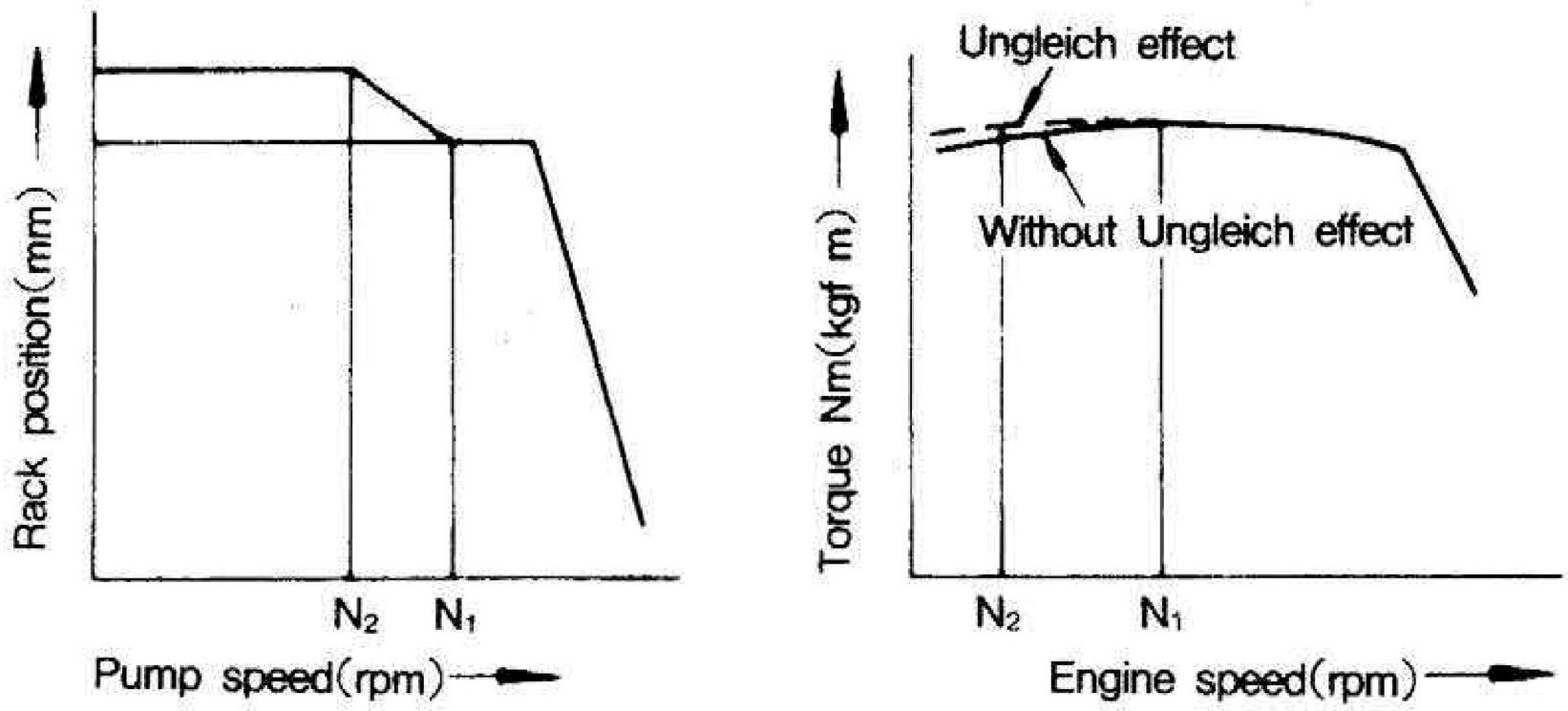


Therefore, if full load is set at point A to derive enough output at low speeds, the injection will reach B as the speed increases, and the engine will produce black smoke.

If full load is set at point B' to prevent black smoke, the low speed injection will come down to A', allowing combustion of more fuel.

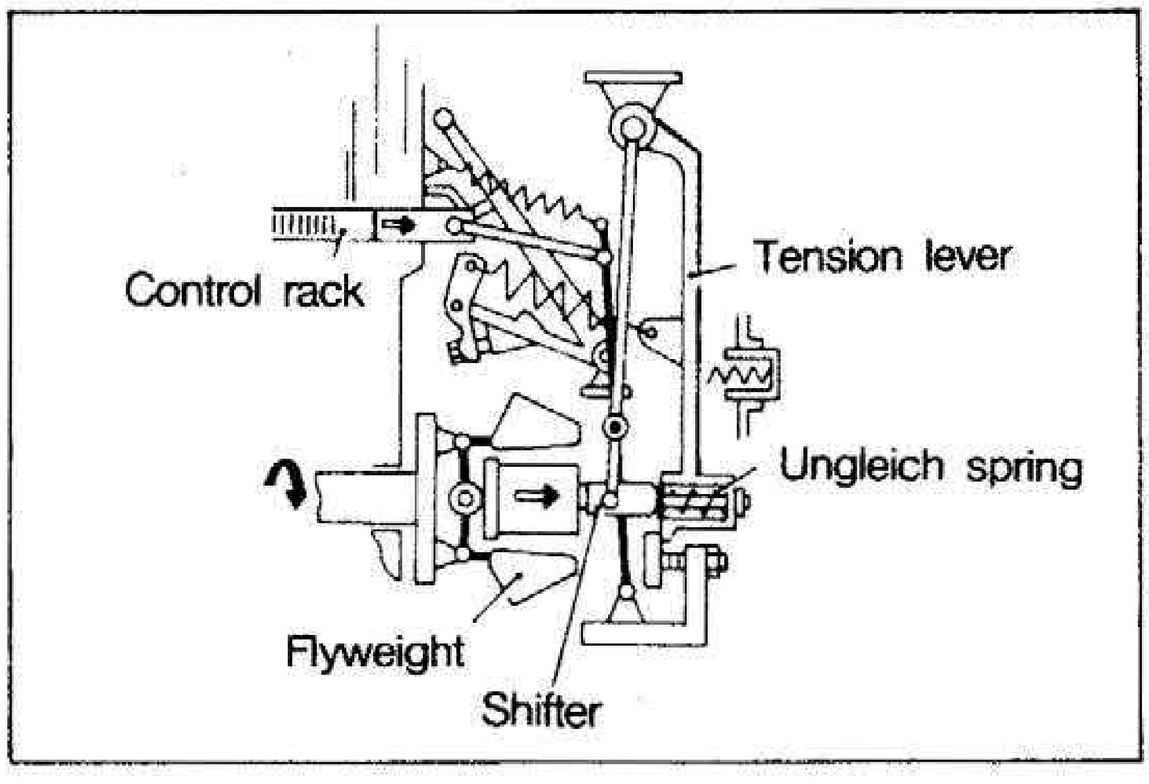
So the Ungleich device accomplishes the function of setting full load at point A to derive the largest possible torque in the low speed range, and changing it to adjust the injection to point B' in the high speed range.

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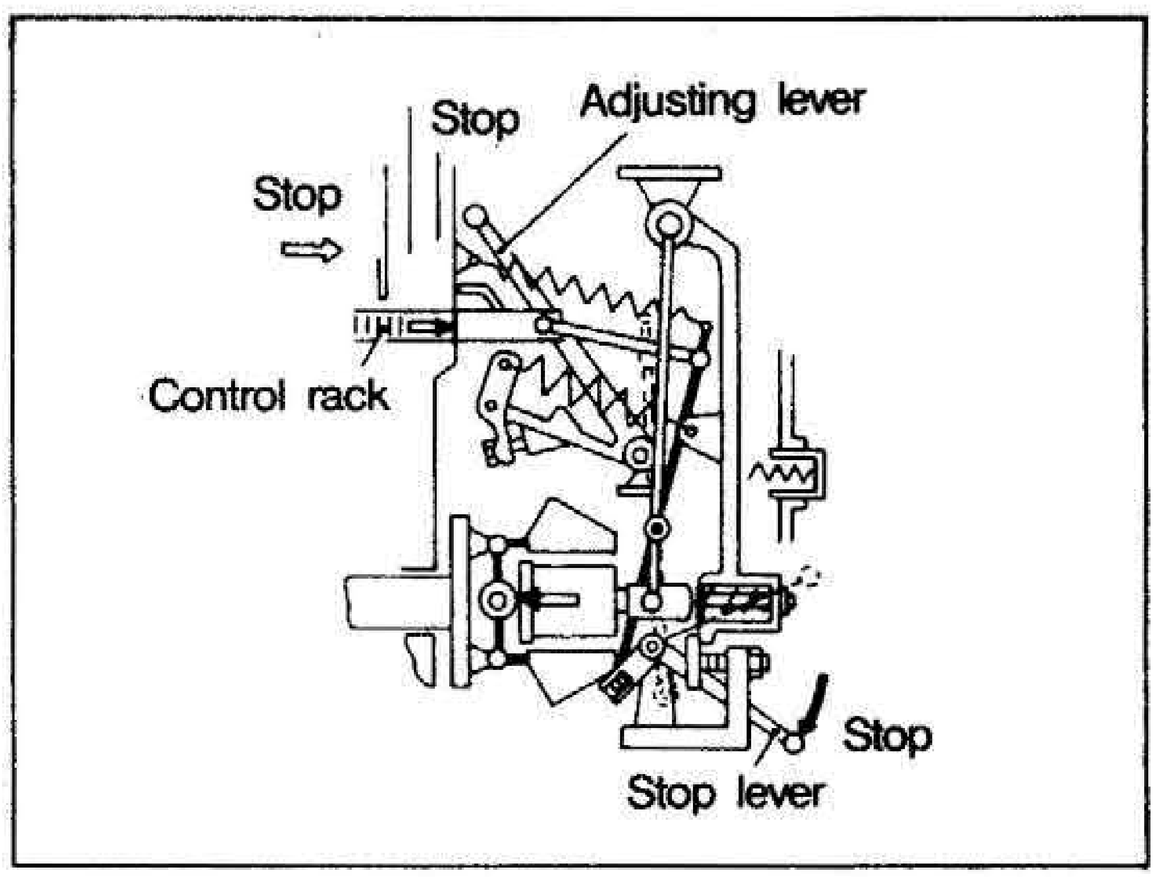
When the engine speed is low and the centrifugal force of flyweight smaller than the pressure of the Ungleich spring, the control block is moved as much as the Ungleich stroke to the left, so the control rack moves in the direction that fuel is increased to increase the torque of the engine at low speeds.



As the engine speed increases, the centrifugal force of flyweight increases. If it becomes larger than the pressure of the Ungleich spring, the Ungleich spring is slowly compressed before the start of high speed control, and the control rack moves in the direction that fuel is reduced. The Ungleich stroke is completed at the position where the control block directly touches the tension lever.

5) Engine stop

When the stop lever is moved to the stop position, the control rack is moved to the stop position to stop the engine regardless of the position of the adjusting lever.

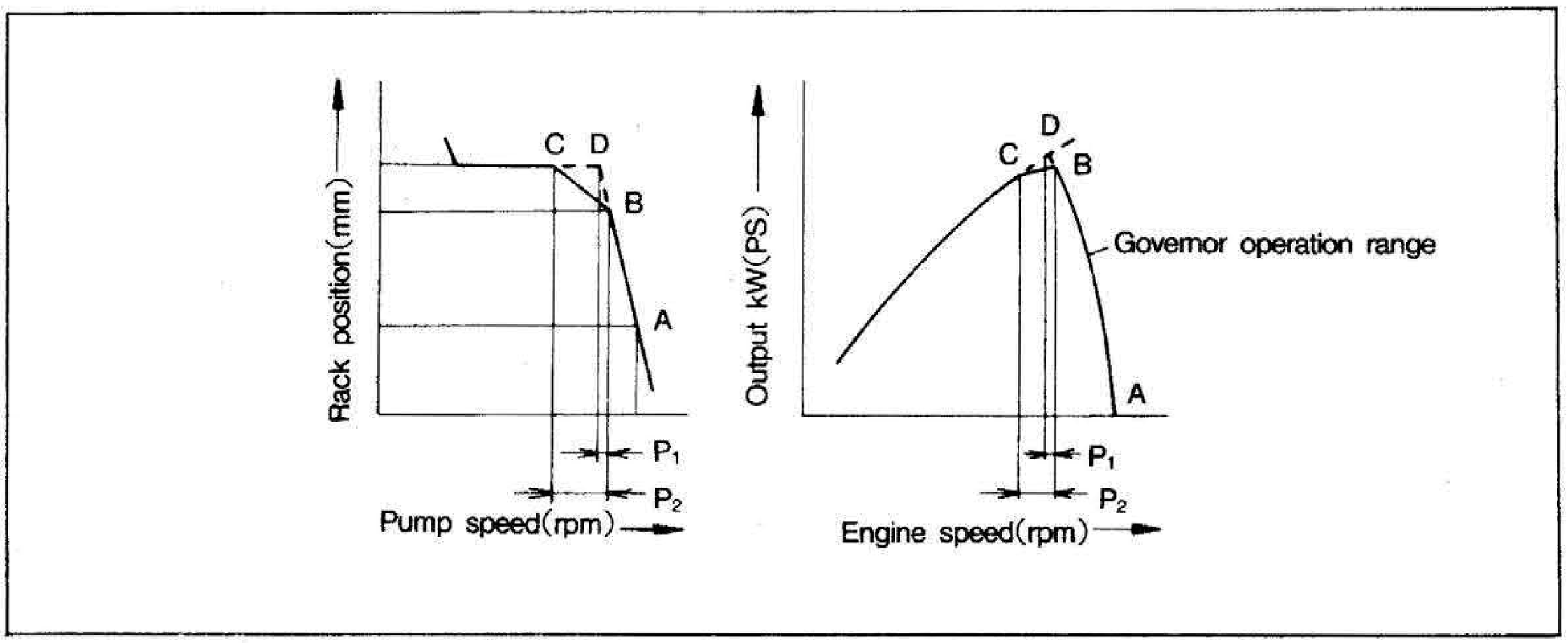


6) Operation of torque spring

Construction machinery engines are often subjected to a large load during operation, and reduced speeds often lead to stalls, To prevent this, a torque spring is provided.

When the adjusting lever is fixed in the lever set position, a sudden increase of load, if no torque spring is provided, will move the control rack along the B-D curve as the speed falls. The rotational displacement at the time may be expressed as P_1.

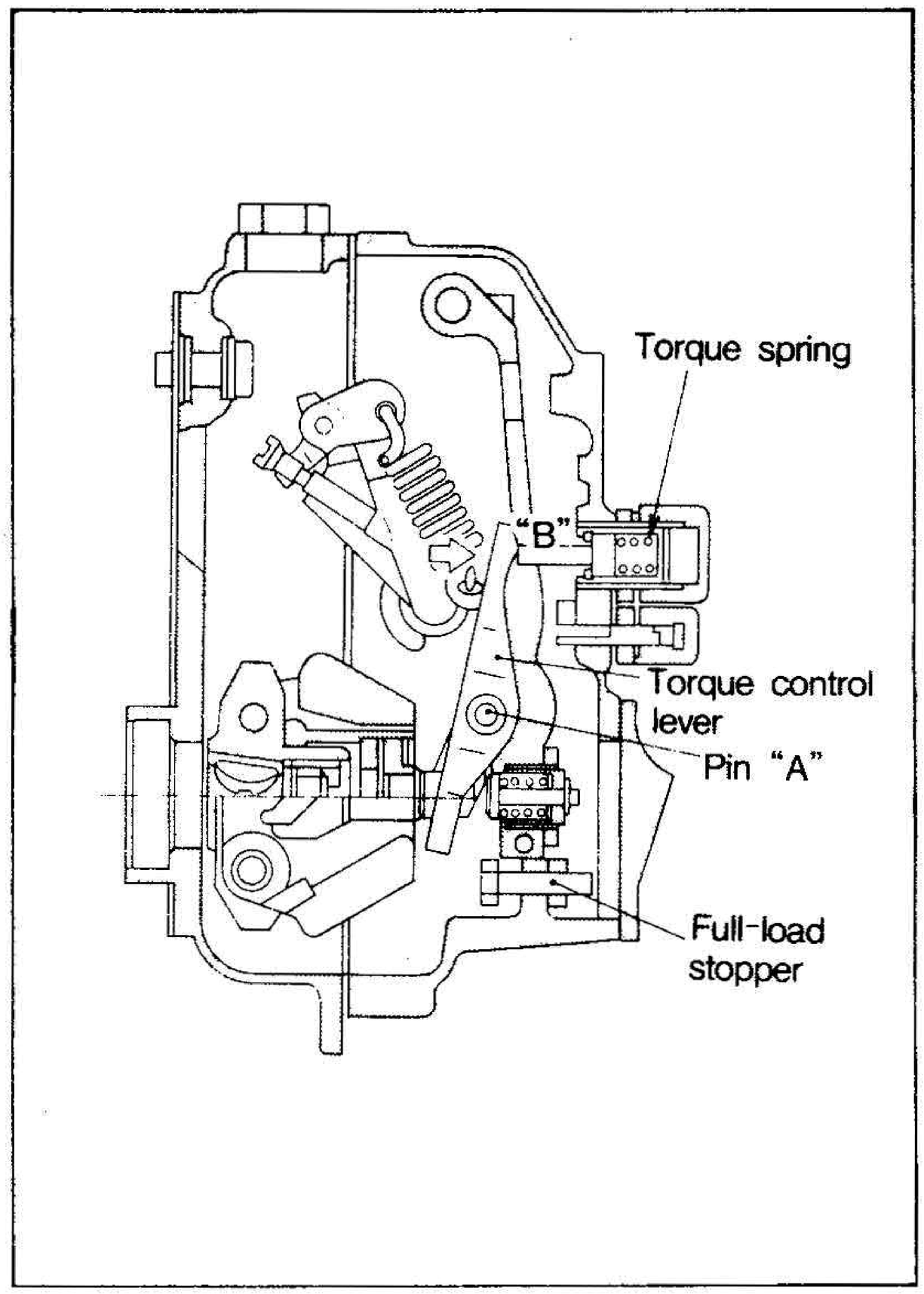
If a torque spring is provided, the control rack moves along B-C, and the rotational displacement at the time may be expressed as P_2. Therefore, large changes occur in P_2 and engine speed, and because of increased fuel injection, the engine torque increases, and large combustion noise warns the operator of the increased load, enabling him to take proper action to prevent stopping the engine.



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In an abrupt increase of load occurs when the engine is running at continuous rating, the engine speed falls. So the flyweights are moved inward and the tension lever pulled to left by the control spring, causing the control rack to move in the direction that fuel is increased.

At the time, the tension lever pin pushes the bottom of the torque control lever, and the lever moves with the pin "A" as the fulcrum, whereas the portion "B" is pushed to right. As the result, the torque spring performs the function of reducing movement of the tension lever.



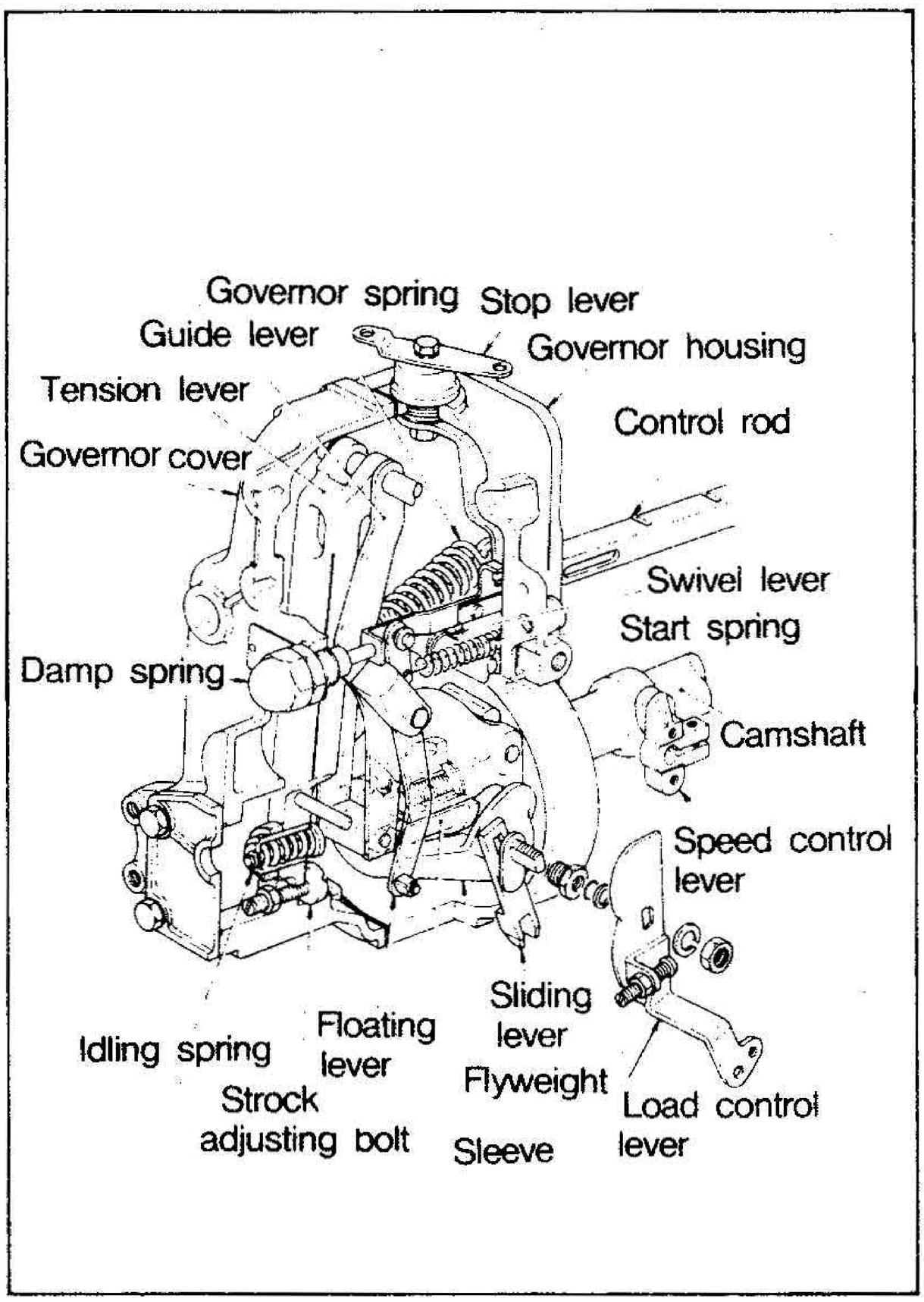
(b) RFD type governor

The RFD type governor is a minimum-maximum governor which controls only the minimum and maximum speeds.

The RFD type governor make it possible to increase or reduce fuel by the load control lever which operates the control rod. Any desired speed can be set as a displacement of the speed control lever changes the tension of the governor spring.

Because of the construction described above, the RFD governor can be operated as an all-speed governor by holding the load control lever in the FULL position and operating the speed control lever.

On the top of the governor, an engine stop lever is provided which creates



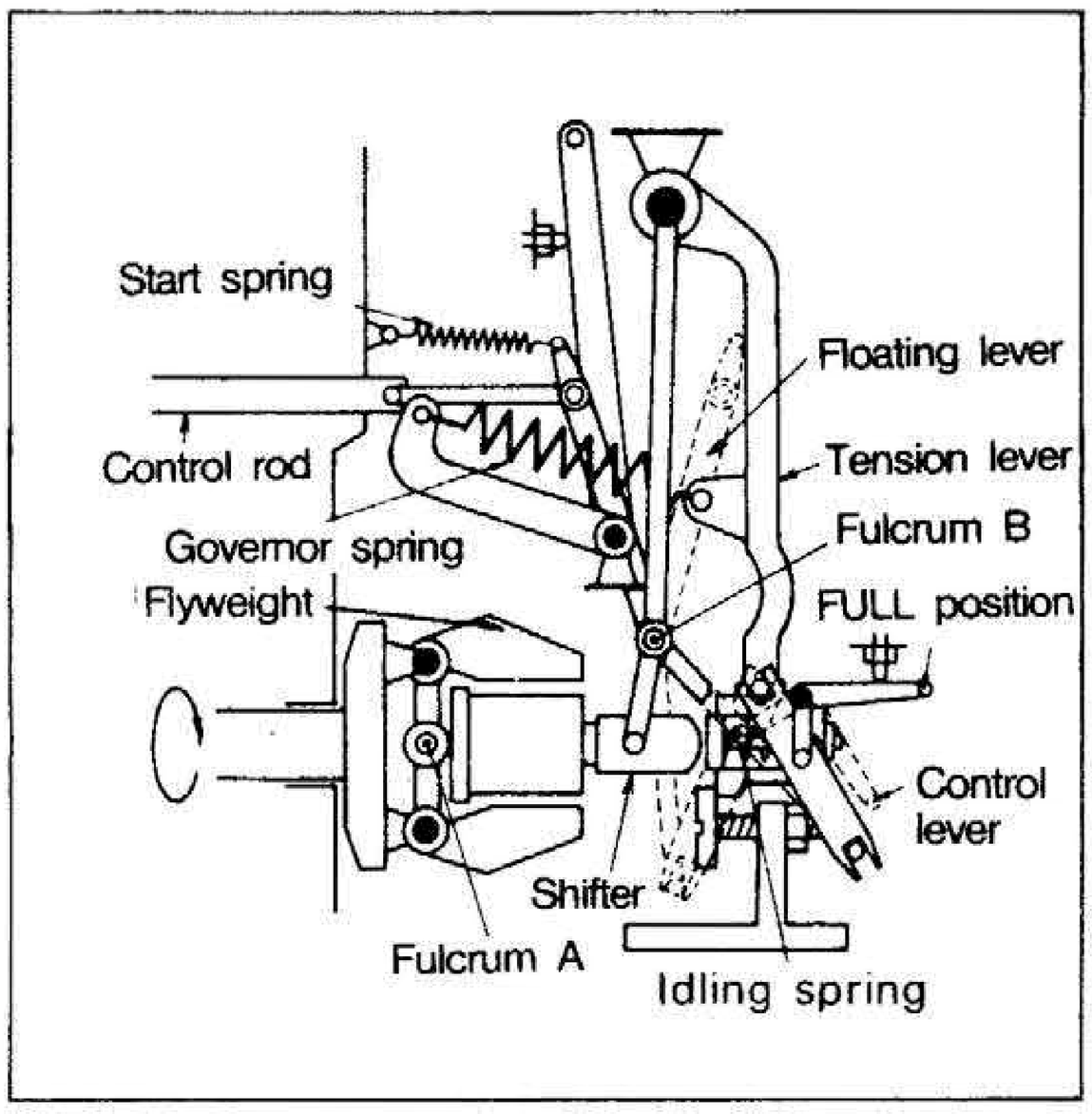
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a no-fuel injection state for stopping the engine. A cancel spring is provided to make sure that when the lever is operated, no undue force is applied to the link.

1) Start of engine and control of idling

When the engine is stationary, the flyweight is in closed position, pushed by the governor spring, idling spring and start spring.

If, in this condition, the load control lever is moved all the way to the FULL position (in the direction of greater fuel delivery), the start spring and idling spring will cause the control rod to move to the fuel increashing position.

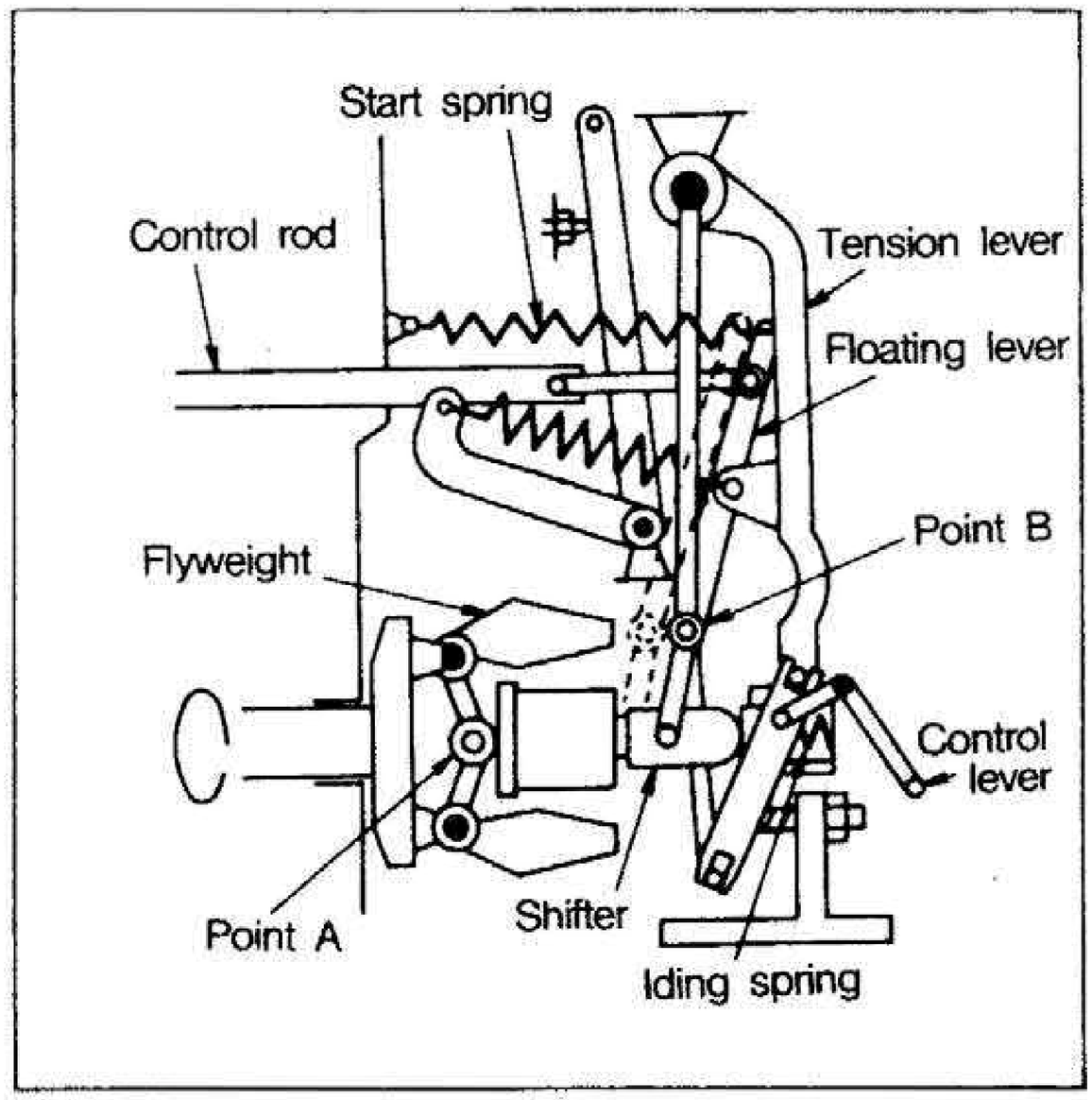


If the load control lever is placed to the idling position after the engine has started, the floating lever will move the control rod back to a position where a fuel injection rate suitable for the idling speed is available, with the point B as the fulcrum.

As the engine speed increases, the flyweights will move outward by the centrifugal force and will shift the shifter by the point A until the shifter compresses the idling spring.

At this time, the fulcrum B will also slightly move toward the tension lever and will move the control rod back in the direction for reducing the fuel injection rate.

As the engine speed decreases, the centrifugal force of the flyweights will decrease and the flyweights will move inward, so the point A will return toward the pump housing. This will set the shifter in the free state, pushing it back toward the pump housing by idling spring force.



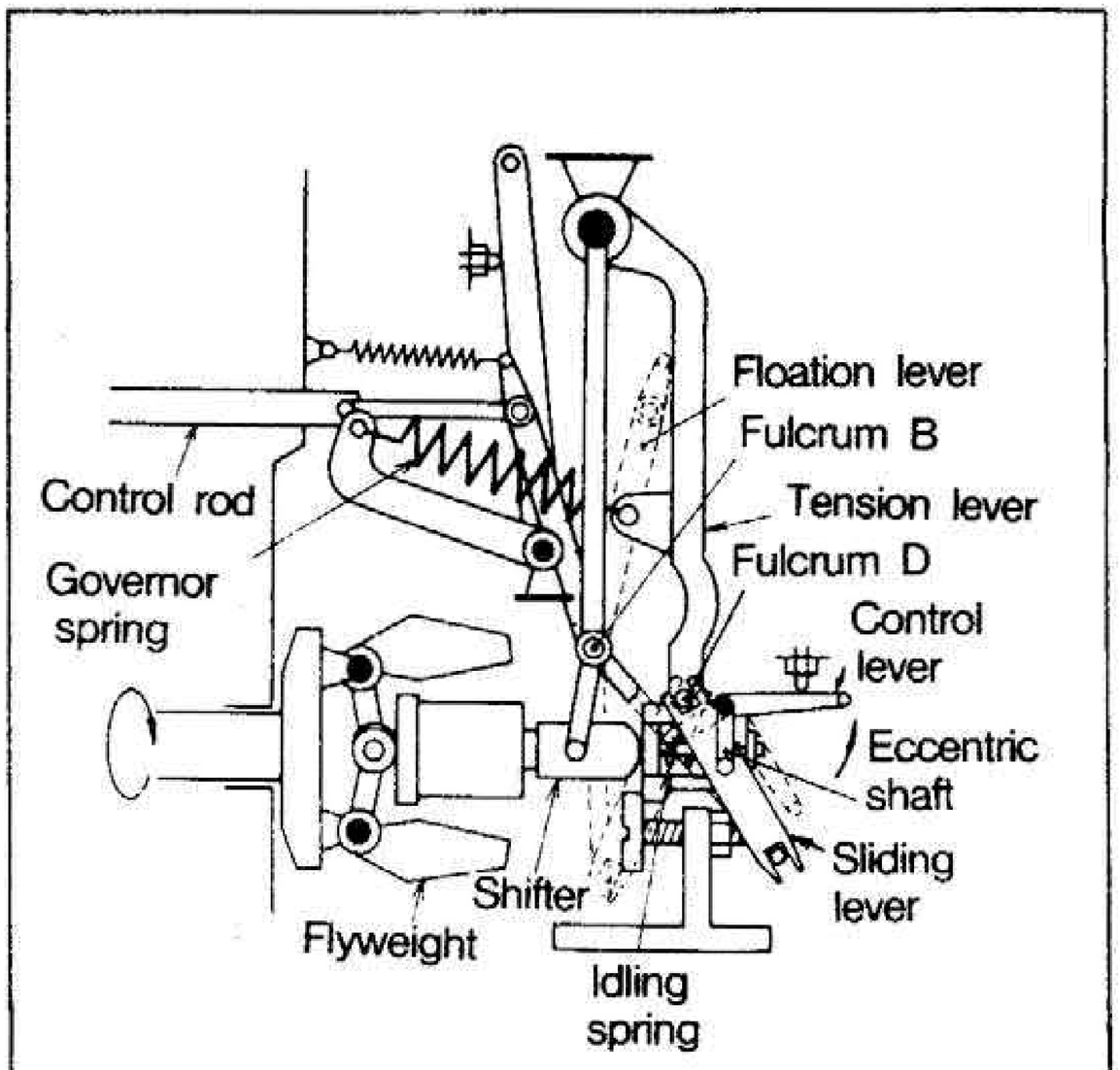
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At the same time, the fulcrum B will also slightly move toward the pump housing to push the control rod back in the direction for decreasing the fuel injection rate.

In this manner, the idling speed is maintained stable by slight adjustment of the injection rate.

2) Normal speed operation

If the control lever is moved toward FULL (in the direction of greater fuel delivery), the eccentric shaft coupled to the load control lever will cause the sliding lever to turn with the point D of the tension lever as the fulcrum. In addition, the floating lever will push the control rod back in the direction of greater fuel injection rate, with the point B as the fulcrum.



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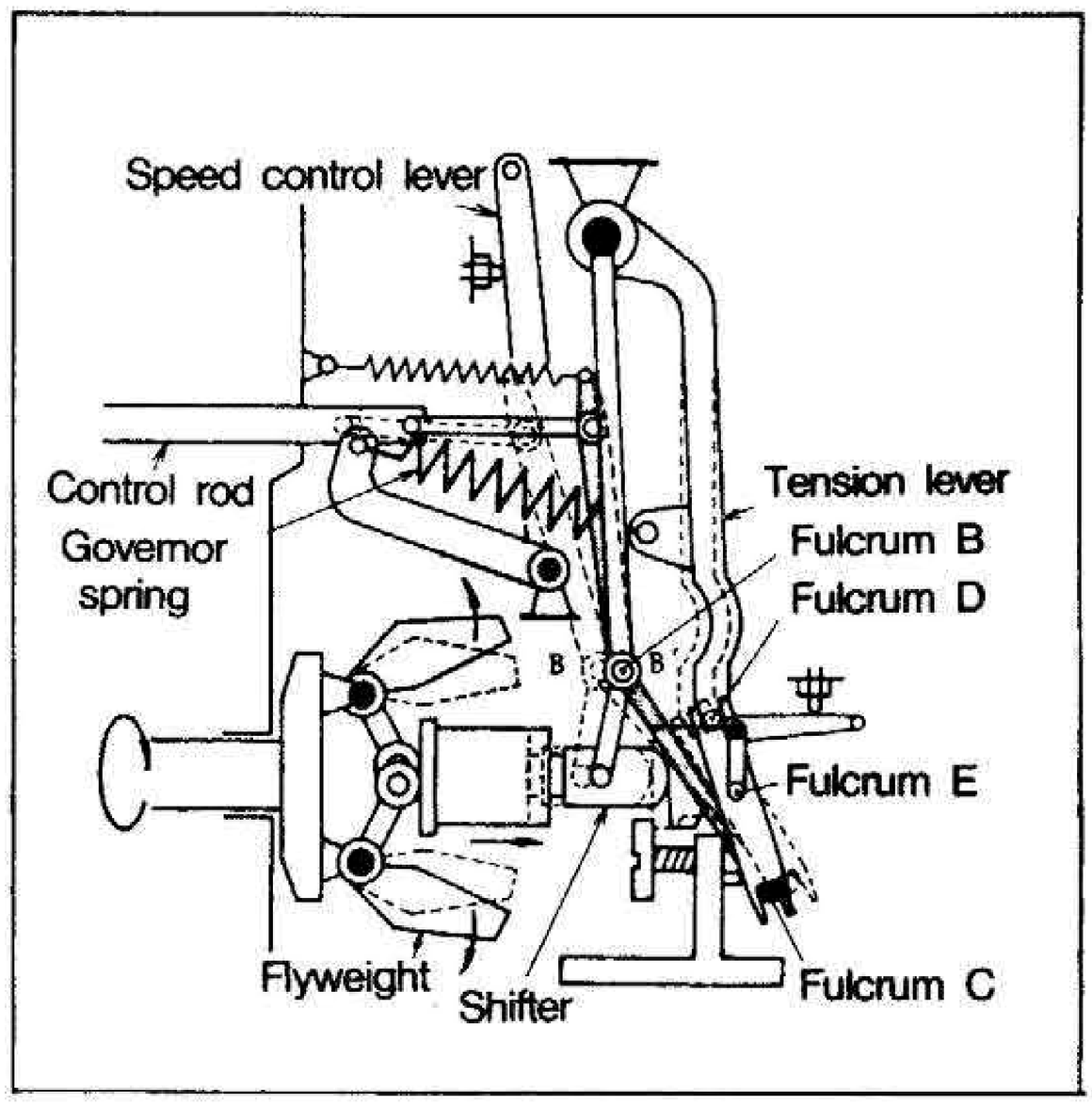
As the engine speed increases, the centrifugal force of the flyweight will increase, and the flyweight will push the shifter. In the normal speed range, however, the shifter will have only a thrust enough for compressing the idling spring and will not be able to push the tension lever out by overcoming the tension of the governor spring.

In this manner, the fuel injection rate is increased or reduced simply by operation of the load control lever which moves the control rod.

3) Control of maximum speed

If the engine speed exceeds a predetermined maximum speed because of changes in engine load, the centrifugal force of the flyweight will overcome the tension of the governor spring and will push the tension lever together with the shifter.

Movement of the shifter will move the point B, and movement of the tension lever will move the point D, and will also move the point C with the point E as the fulcrum.



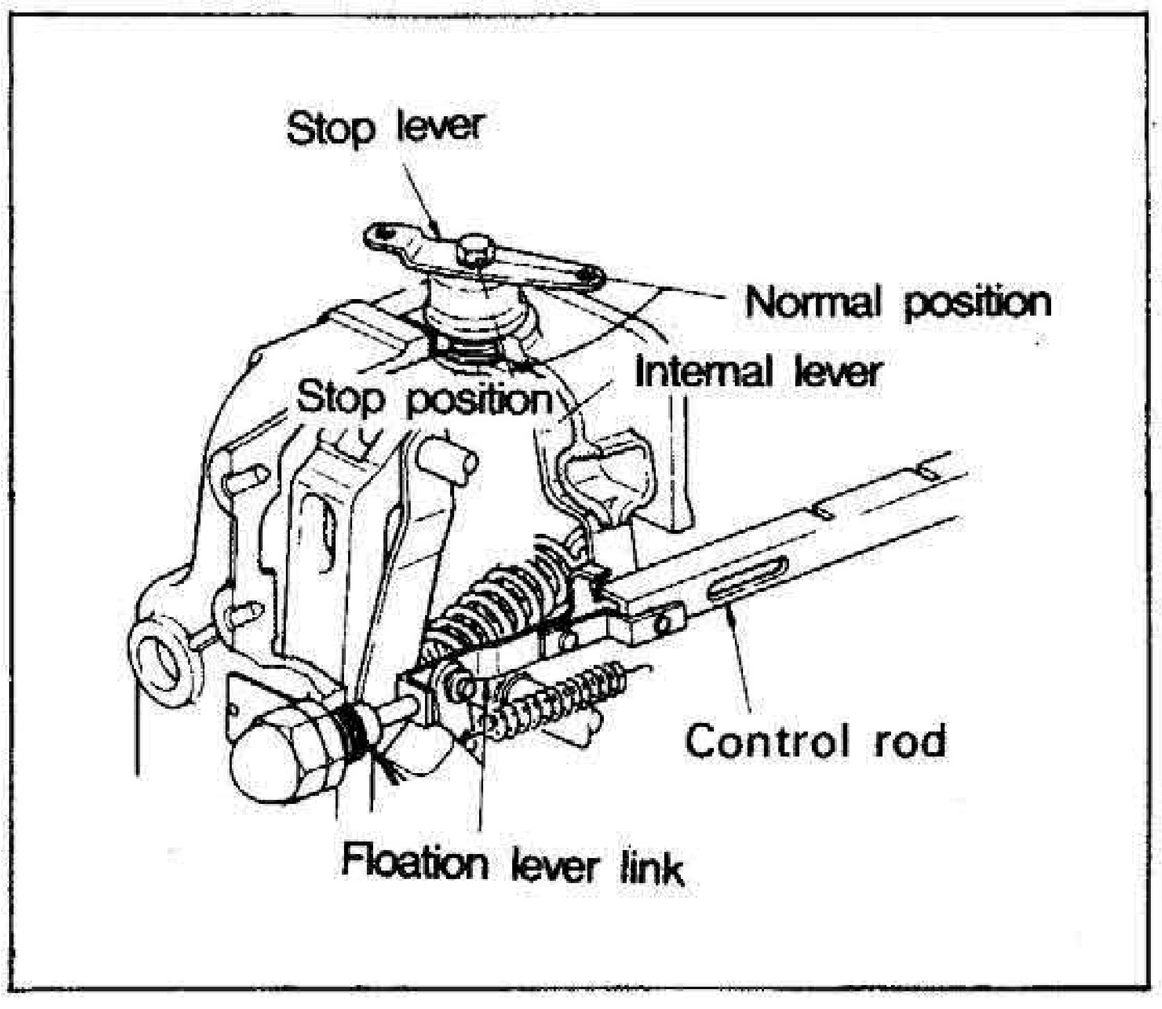
Movement of the point B and movement of the point C will combine to pull the control rod back in the direction of less fuel injection rate, thereby preventing the engine speed from increasing.

If an engine control mechanism which operates the speed control lever adjusting the tension of the governor spring is employed, the governor can be operated as an all-speed governor which maintains a desired engine speed constant.

4) Engine stop

To stop the engine, fuel is cut off by operation the stop lever on the top of the governor.

If the stop lever is operated, the internal lever pushes the pawl of the floating lever link to force the control rod out to the no-injection position.

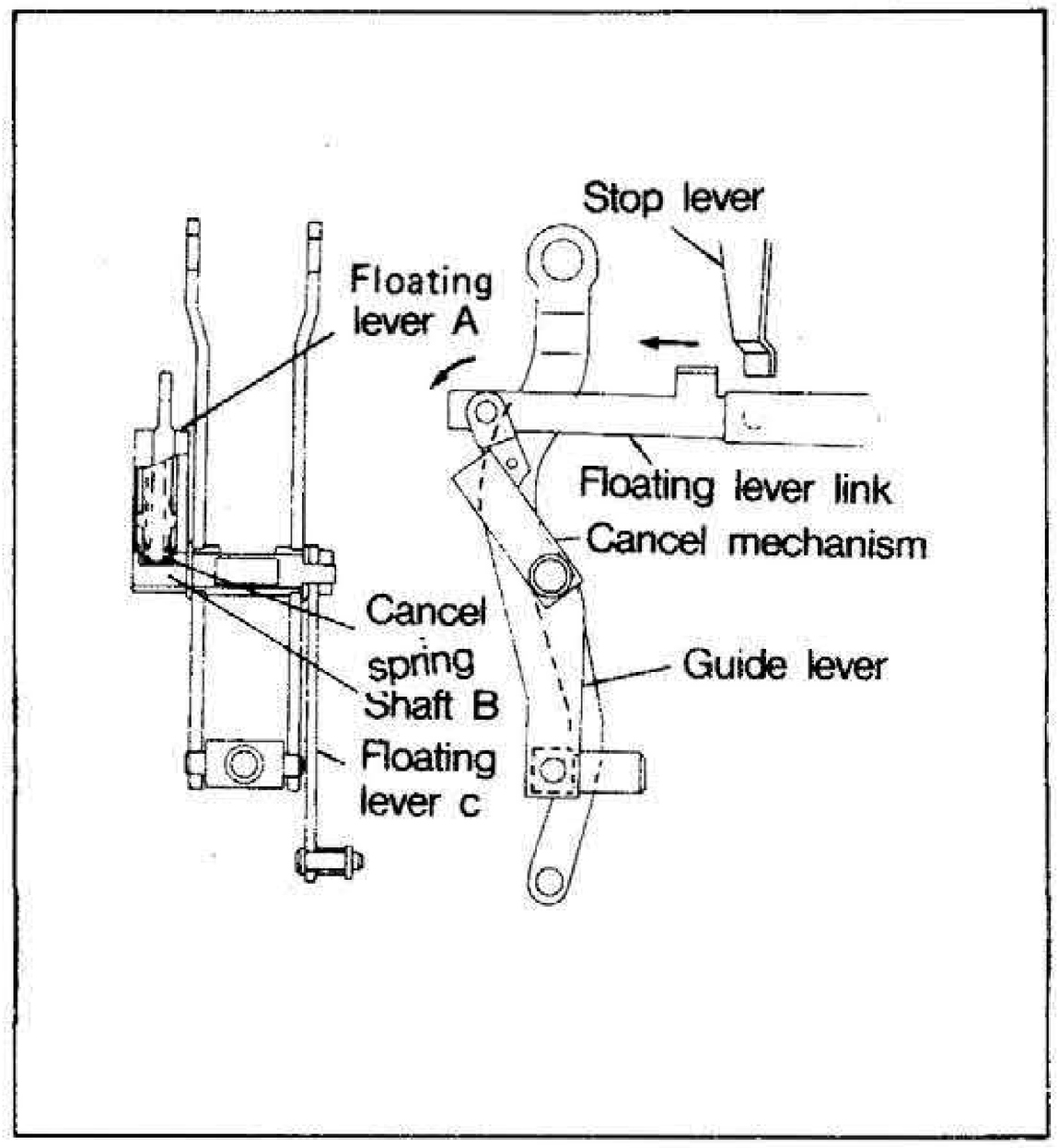


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Since the amount the control rod is moved by operation of the stop lever exceeds the operating range of the floating lever mechanism, damage to the link and allied parts is prevented by the cancel mechanism shown.

The floating lever A pushed by the floating lever link turns in such a way as to make the cancel spring bend over the shaft B. So no load is placed on the floating lever C blocked by the idle stopper bolt outside the governor.

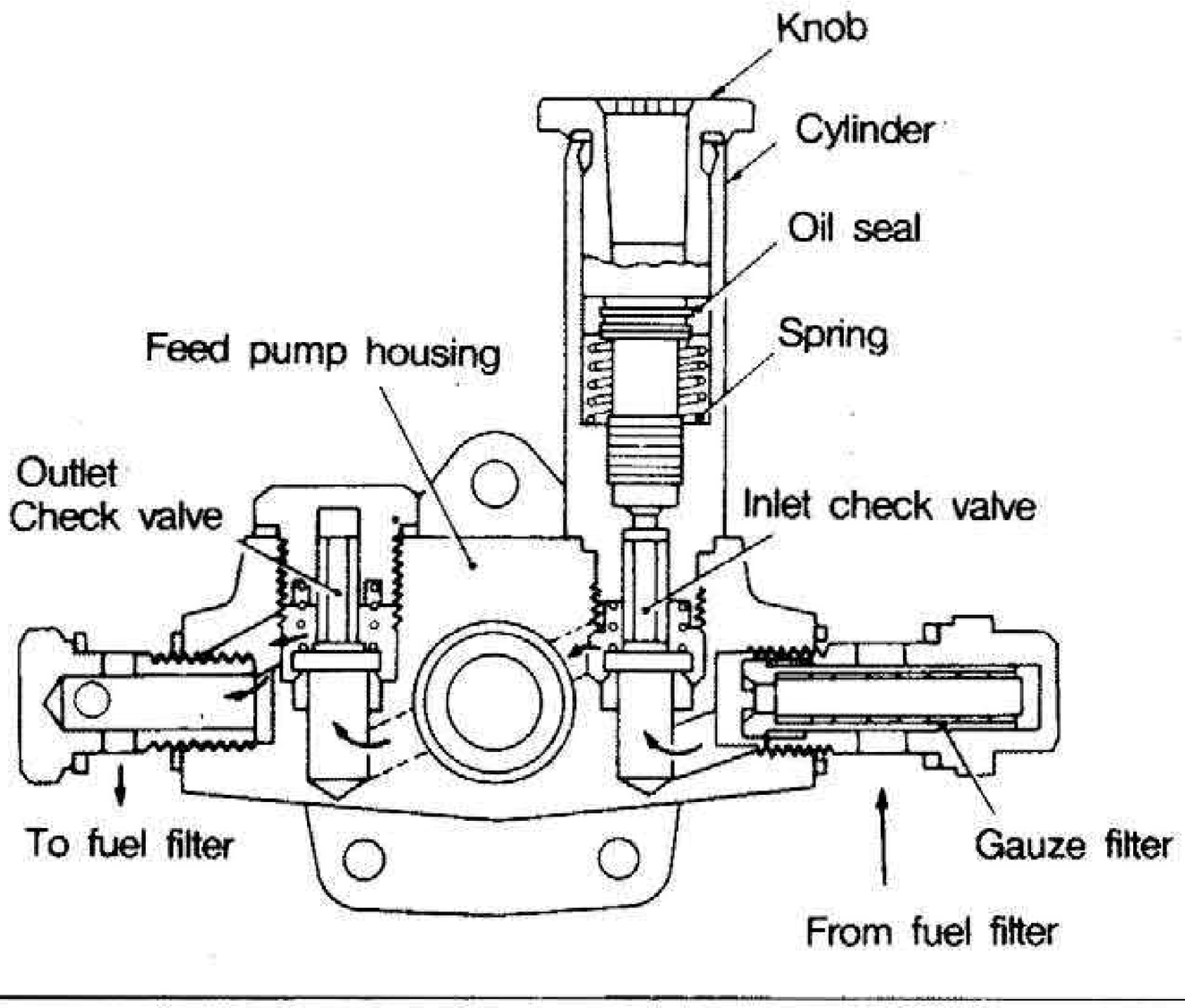
Operation of the ungleich device is the same as the RSV type governor.



(3) Feed Pump

Supply of fuel to the injection pump proper is accomplished by the feed pump mounted to the side of the injection pump proper and driven by the cam of the injection pump camshaft provided for the purpose.

The priming pump mounted to the feed pump makes it possible to lift fuel manually when the engine is stationary.



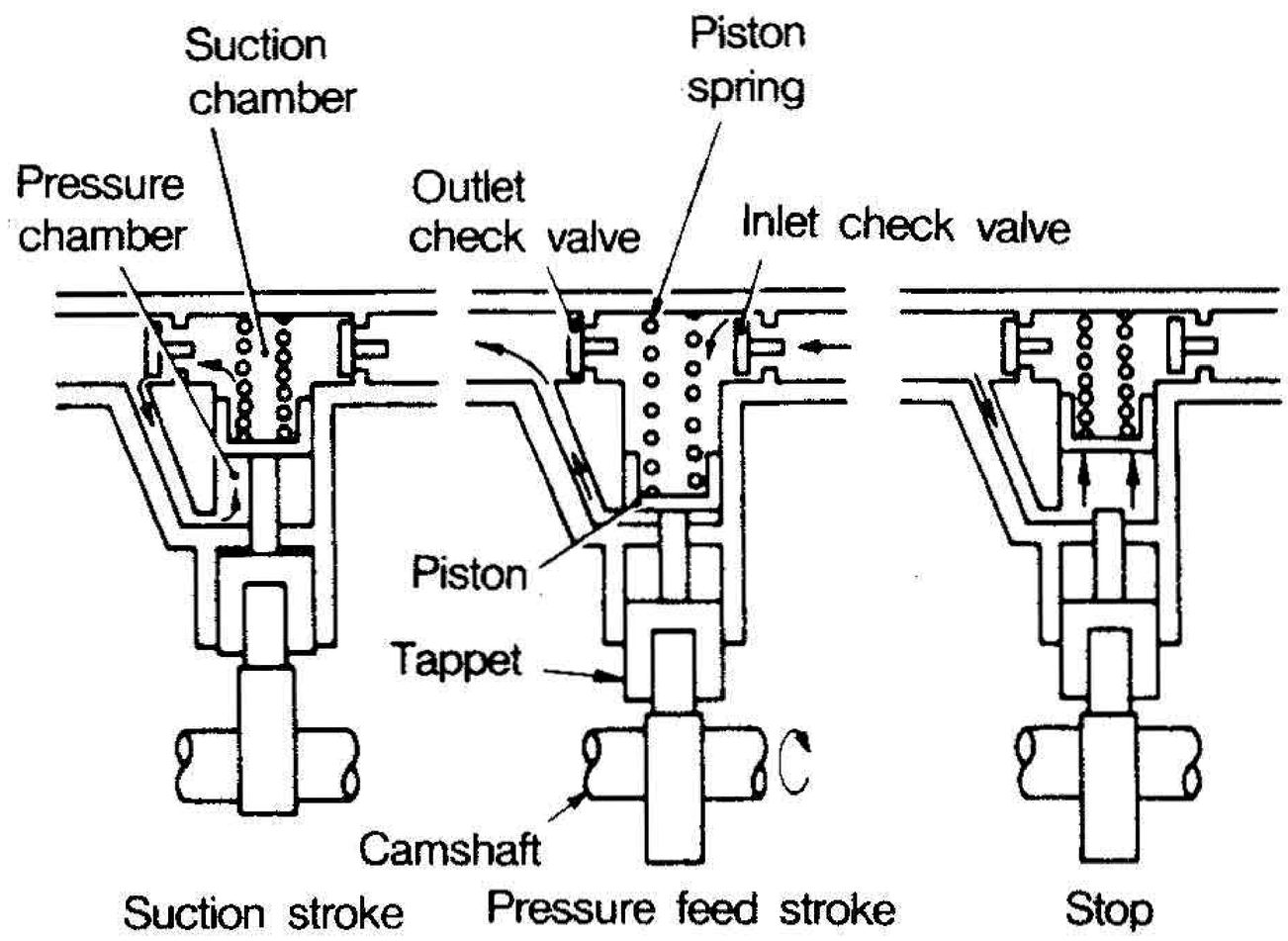
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The feed pump feeds fuel under pressure as follows.

When the piston is pushed up by the cam of the camshaft, the fuel in the suction chamber opens the outlet check valve, so most of the fuel is forced out and drawn into the pressure chamber. When the cam is moved away by rotation of the camshaft, the piston is pushed back by the pressure of the piston spring. At the time, the outlet check valve closes and the inlet check valve opens. So fuel is drawn into the suction chamber, whereas the fuel in the pressure chamber is forced out.

When the pressure of the pressure chamber or the delivery pressure exceeds specification, the piston cannot be brought back by the pressure of the piston spring, so the pump action stops and the fuel pressure in the fuel filter does not rise more than necessary.

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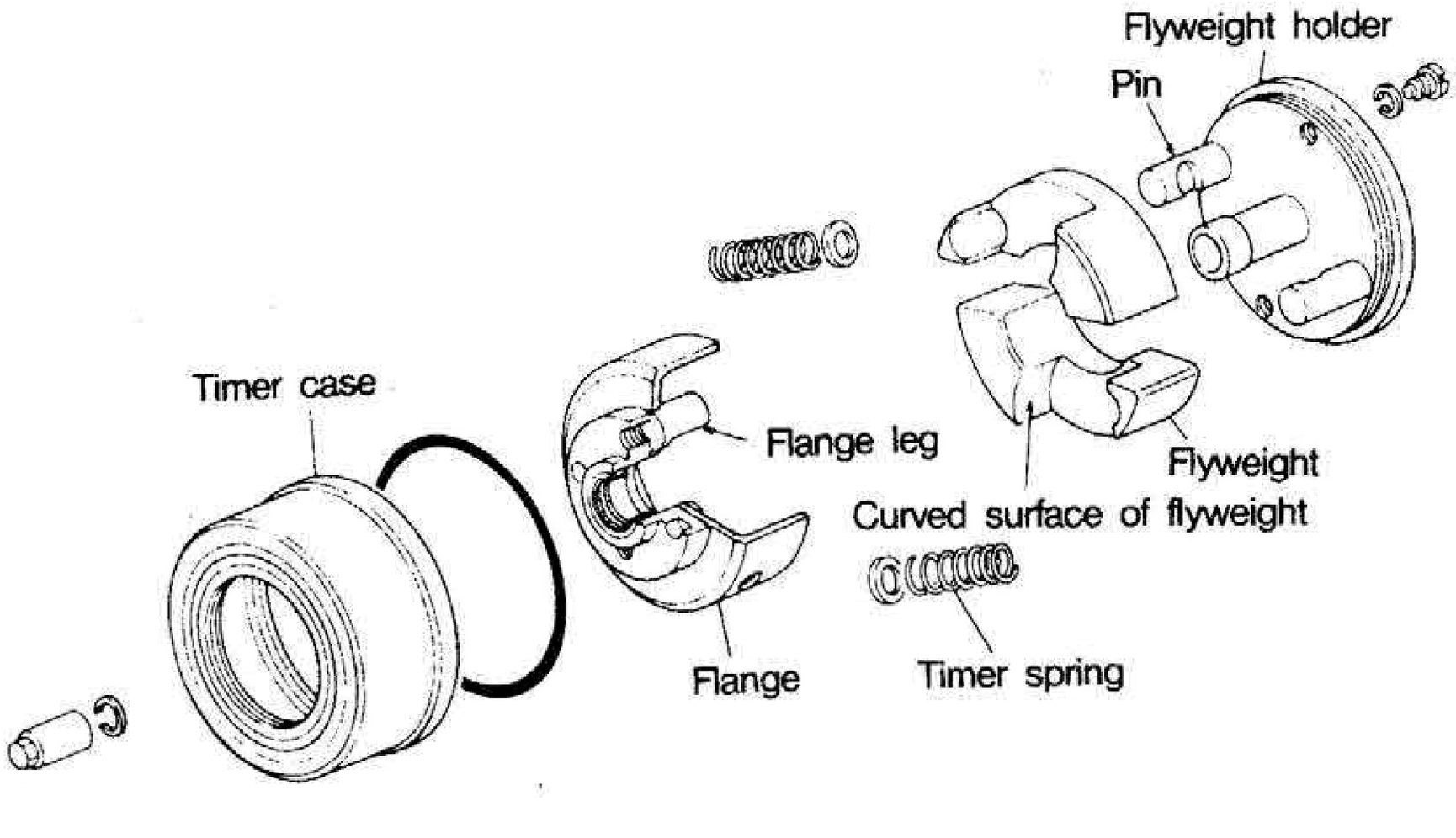
(4) Automatic Timer

The interval between fuel injection into the cylinder and its ignition is called the ignition delay interval. The ignition delay interval is constant regardless of the engine speed. If the ignition timing is always constant, changes in the engine speed will vary the relation between the piston position and ignition timing, making it impossible to obtain the best engine performance. To maintain the relation between the piston position and ignition timing constant at all times, the injection timing must be changed to match the engine speed.

The automatic timer is a device which automatically changes the injection timing according to the engine speed.

(a) SA type automatic timer

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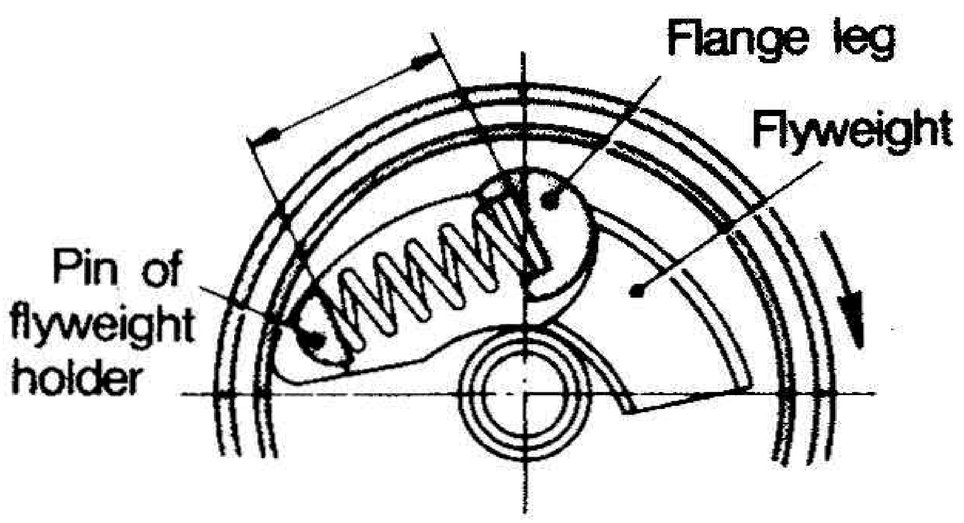
The two flyweights have a hole at one end. The pins of the flyweight holder fit in the holes. The flange legs touch the curved surfaces of the flyweights. Timer springs are mounted to the flyweight pins and flange legs.

Rotation of the engine is transmitted to the flange and from there to the flange legs, flyweights and flyweight holder and to the injection pump camshaft.

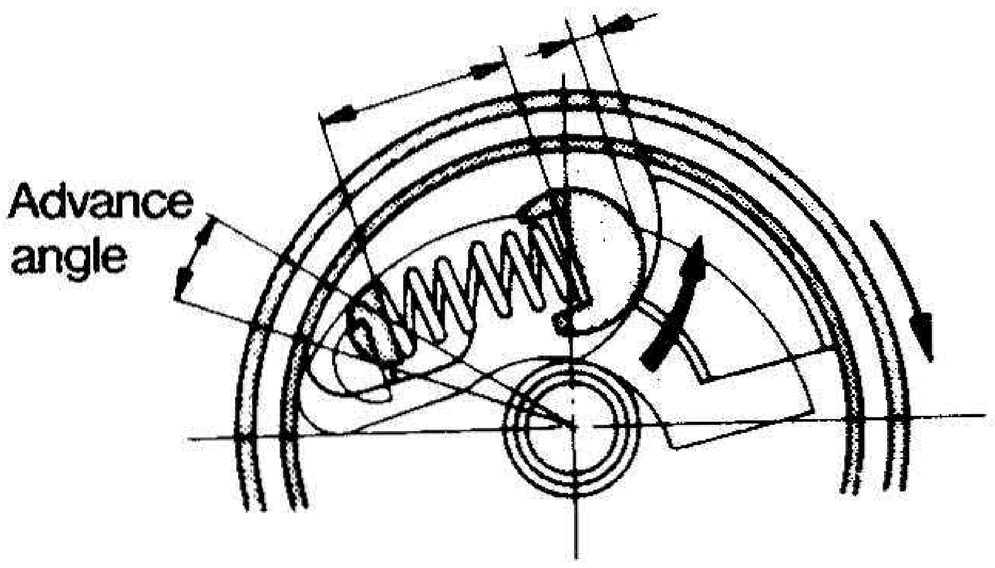
During low speed operation of the engine, no centrifugal force acts on the flyweights, so the timer springs have the longest installed length.

When the engine runs at a high speed, a centrifugal force acts on the flyweights and causes them to open outward with the pins of the flyweight holder as the fulcrums. The flange legs are pushed by the curved surfaces of the flyweights in the direction of the timer spring compression, but they cannot be moved because they are coupled to the drive side.

As a result, the pins of the flyweight holder are drawn in the turning direction, while compressing the timer springs, and move the camshaft of the pump in the turning direction to advance the injection timing.



Low speed

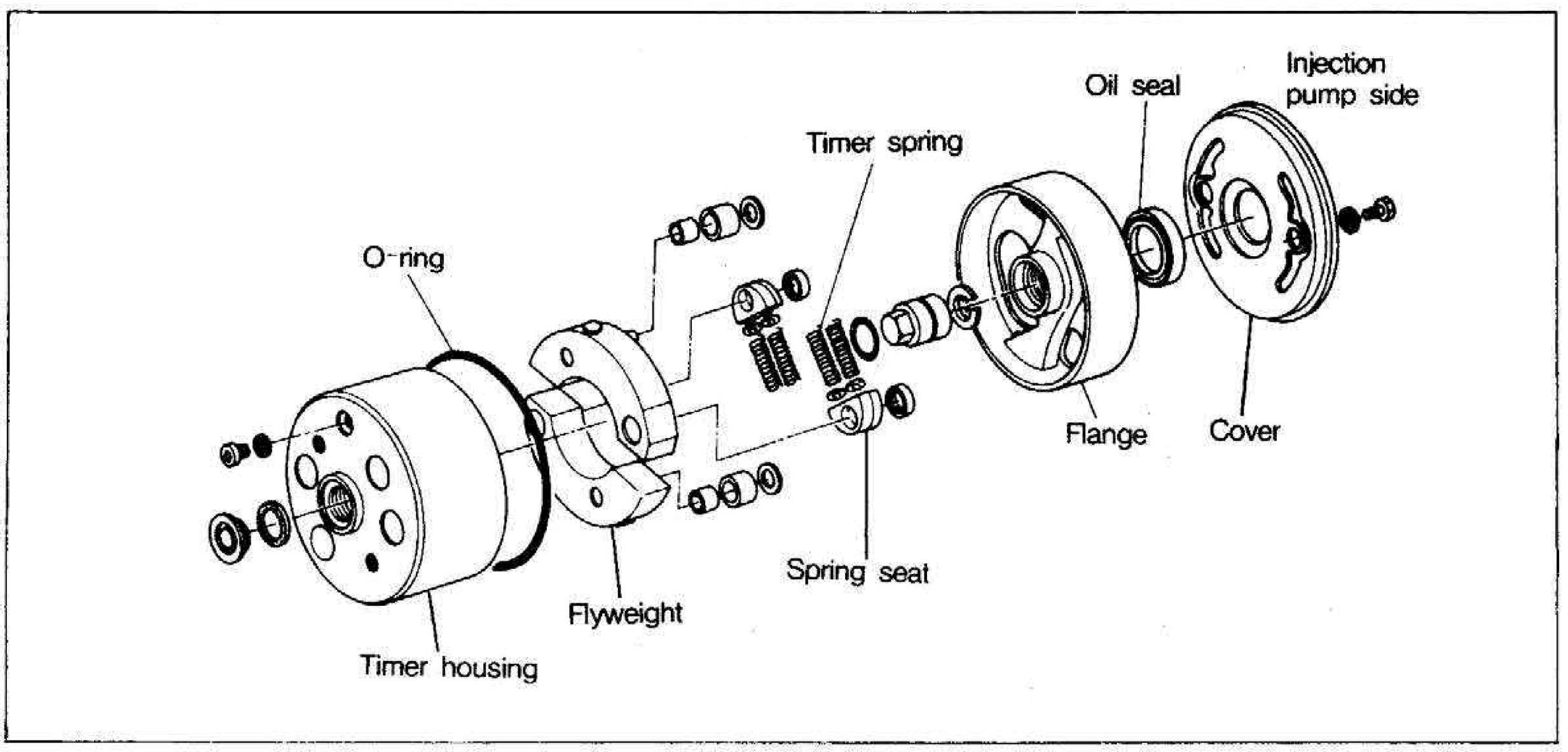


Hogh speed

If the engine speed changes from a high to low speed, the centrifugal force of the flyweights will decrease and the flyweights will return to their original positions. At the same time, the pins of the flyweight holder will be pushed back by the timer springs.

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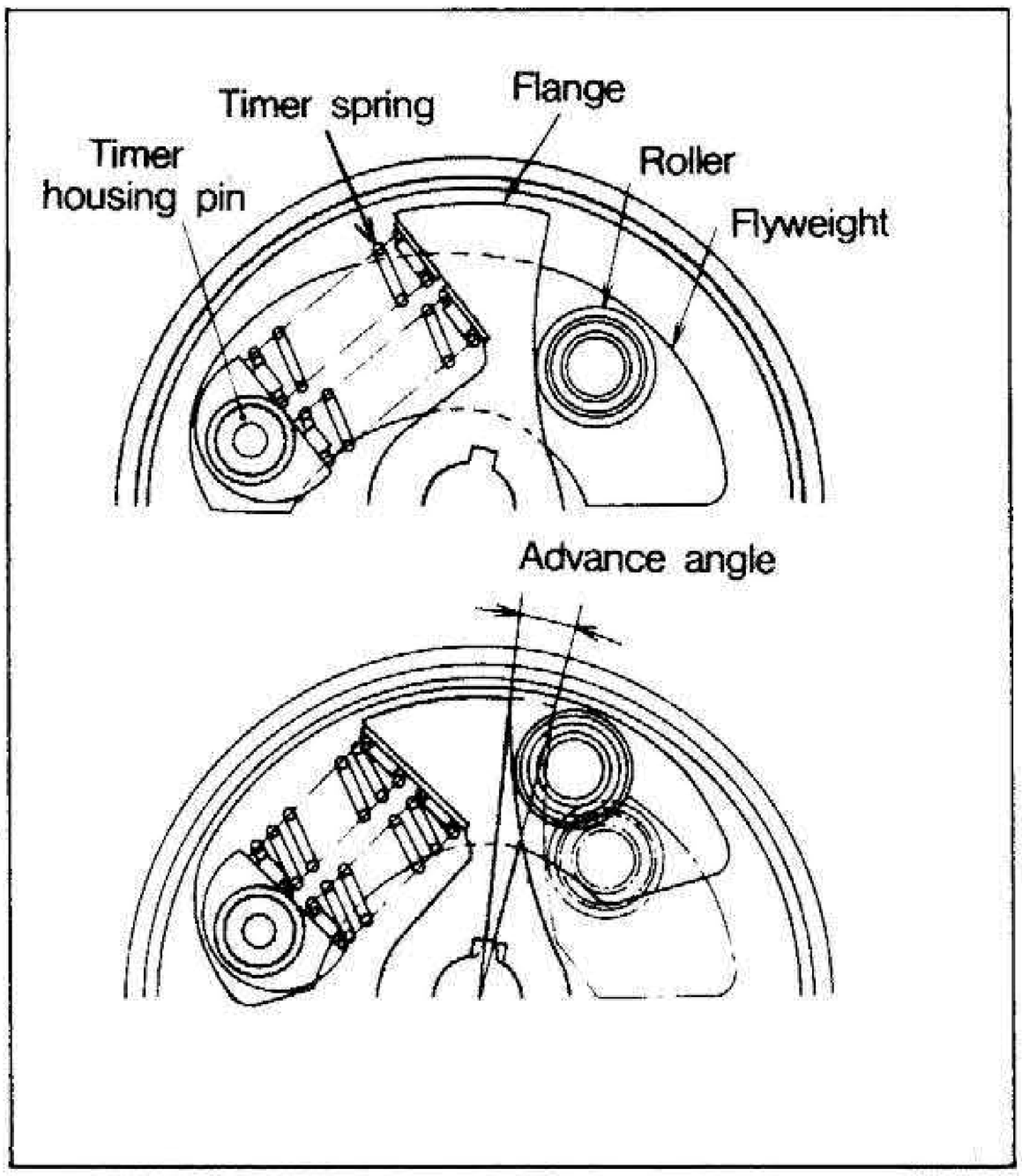
(b) SP type automatic timer



Two flyweights are fitted on the pins of the timer housing and are held in the timer housing. On the other hand, the injection pump connection side flange has a curved surface, and the roller fitted on the pin installed in the flyweight touches the curved surface. Timer springs are held between the spring seats fitted on the timer housing pins which extend through the flange and flyweight. These parts are housed in the timer housing and are totally enclosed with a cover, O-ring and oil seal.

When the engine is running at a low speed, the timer spring pressure is stronger than the centrifugal force of flyweight, so the roller of flyweight is held down by the flange, creating no advance state.

When the engine reaches a high speed, the centrifugal force of flyweight becomes stronger, the roller of flyweight pushes the curved surface of flange with the timer housing pin as the fulcrum, and the flyweight opens outward, while compressing the timer springs.



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In this manner, the roller installed on the flyweight moves the flange in the turning direction and advances the injection timing.

(5) Coupling

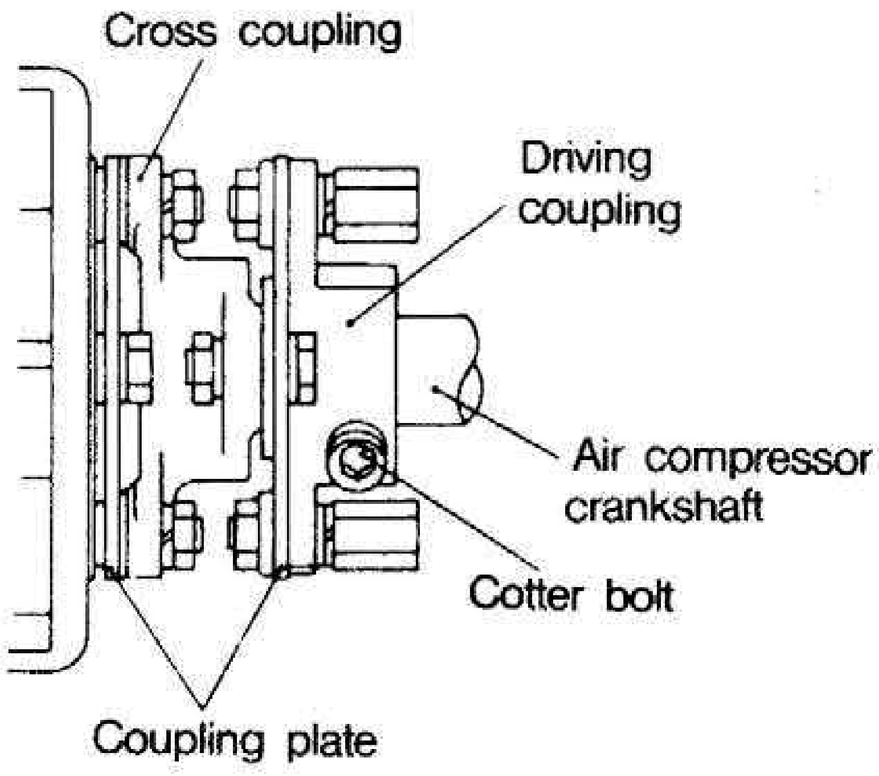
The coupling which transmits drive power from the air compressor crankshaft or injection pump drive crankshaft to the automatic timer is a laminated coupling consisting of thin plates placed one upon another.

The laminated coupling, thanks to the reversibility of the plates, absorbs excess forces other than the torque, thereby provideing protection against application of forces other than necessary to the injection pump.

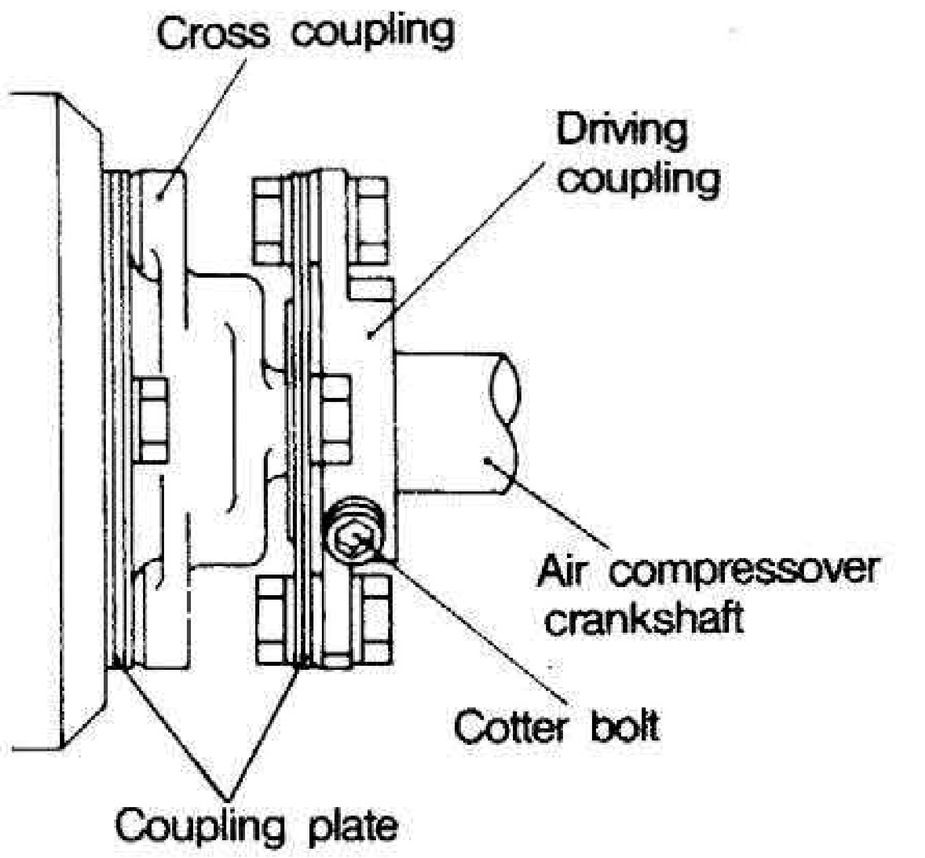
Adjustment of the fuel injection start timing is made by changing the installed condition of the driving coupling.

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AD type



P type



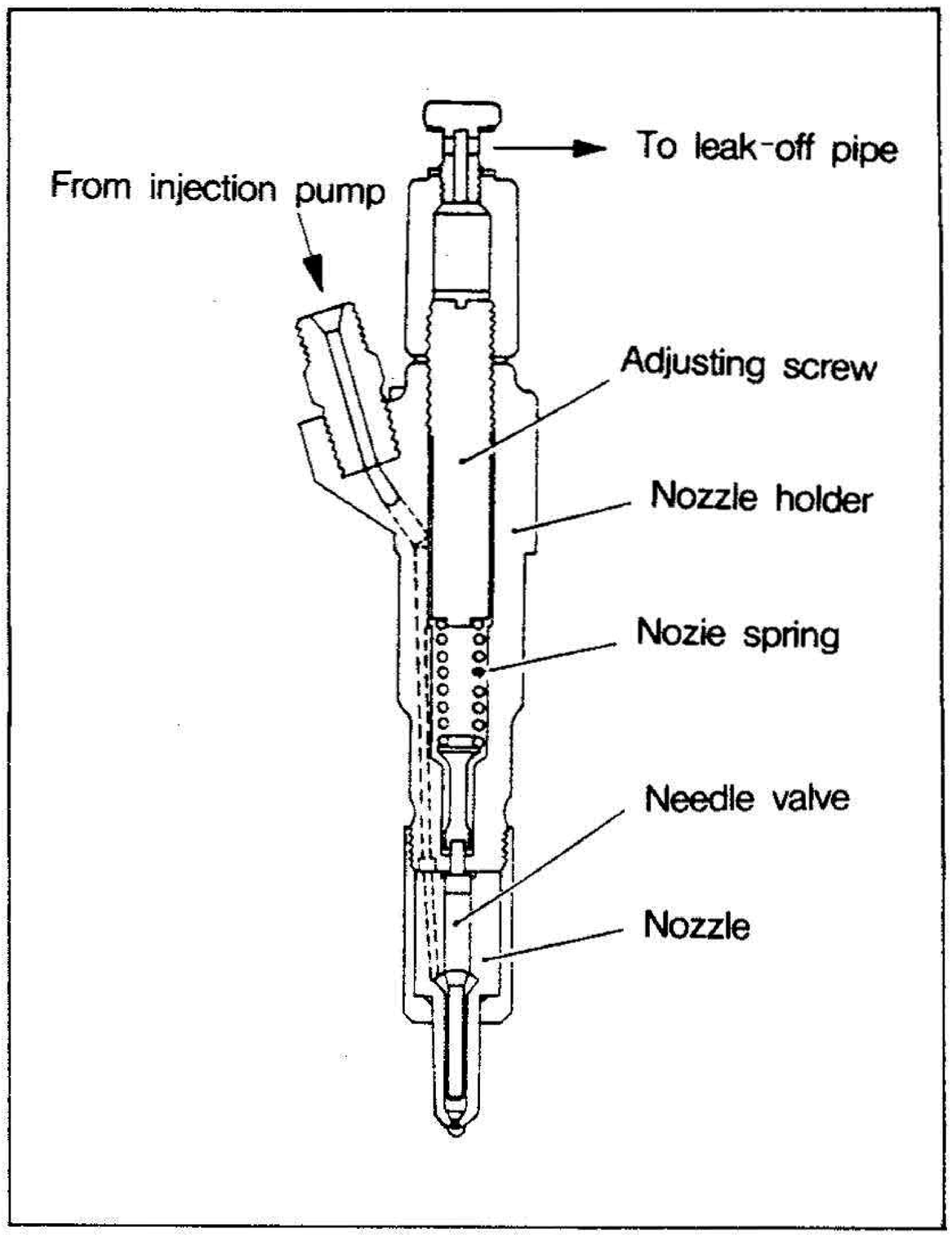
(6) Injection Nozzle

(a) Hole type(1-spring nozzle)

The fuel delivered from the injection pump enters the nozzle holder and has a pressure higher than the specified pressure. So the fuel overcomes the nozzle spring and pushes the needle valve up.

The high pressure fuel which has forced the needle valve up is injected from the orifice at the end of the nozzle into the engine combustion chamber.

Some of the high pressure fuel lubricates the needle valve, etc. and is returned through the fuel leak-off pipe to the fuel tank.

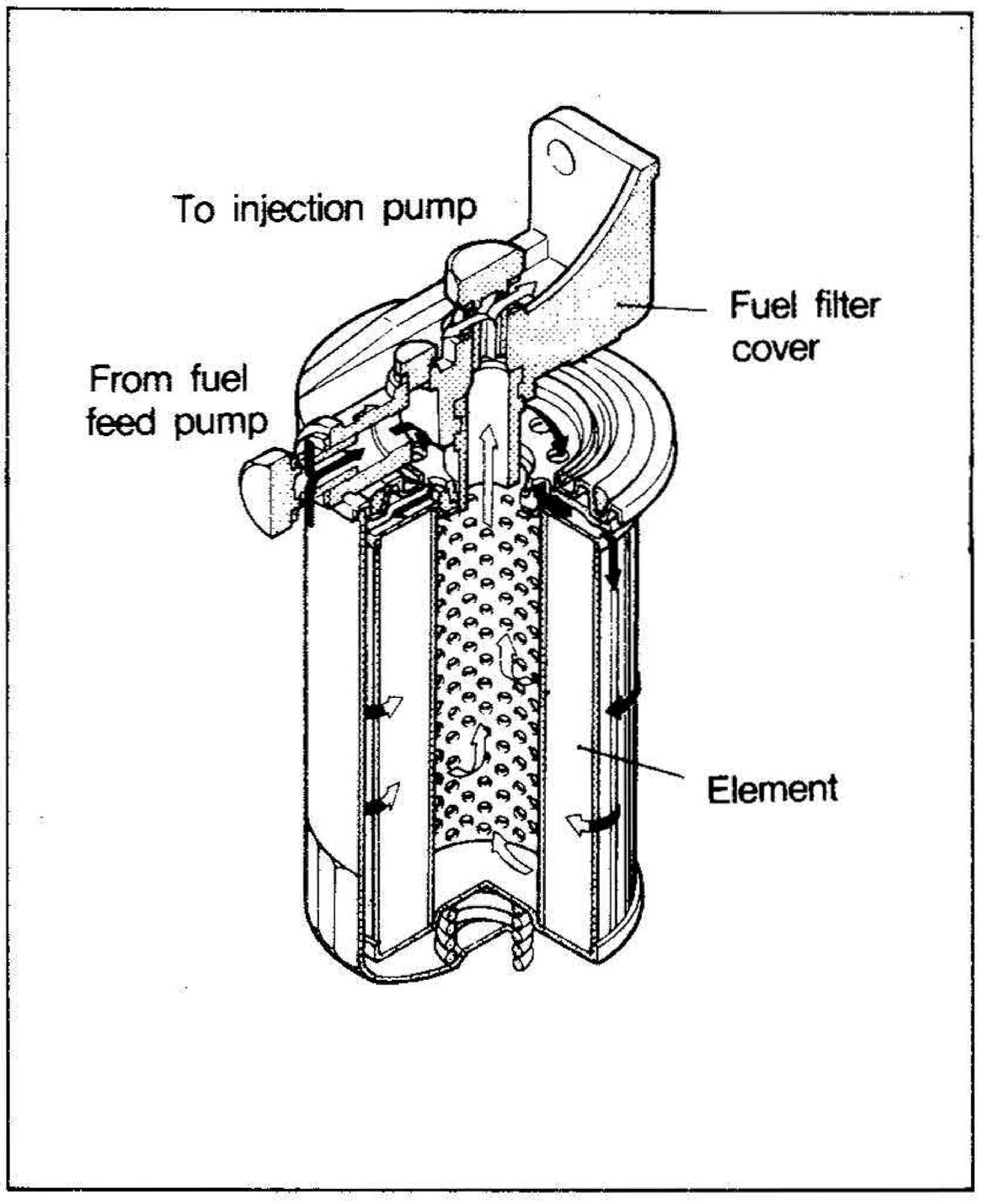


The injection pressure of the injection nozzle is adjusted by changing the tension of the nozzle spring with the adjusting screw.

(7) Fuel Filter

The fuel filter is a cartridge type. So the element is easily replaceable.

The fuel filter separates the water contained in the fuel fed under pressure from the feed pump of the injection pump and removes dust and dirt by the element.



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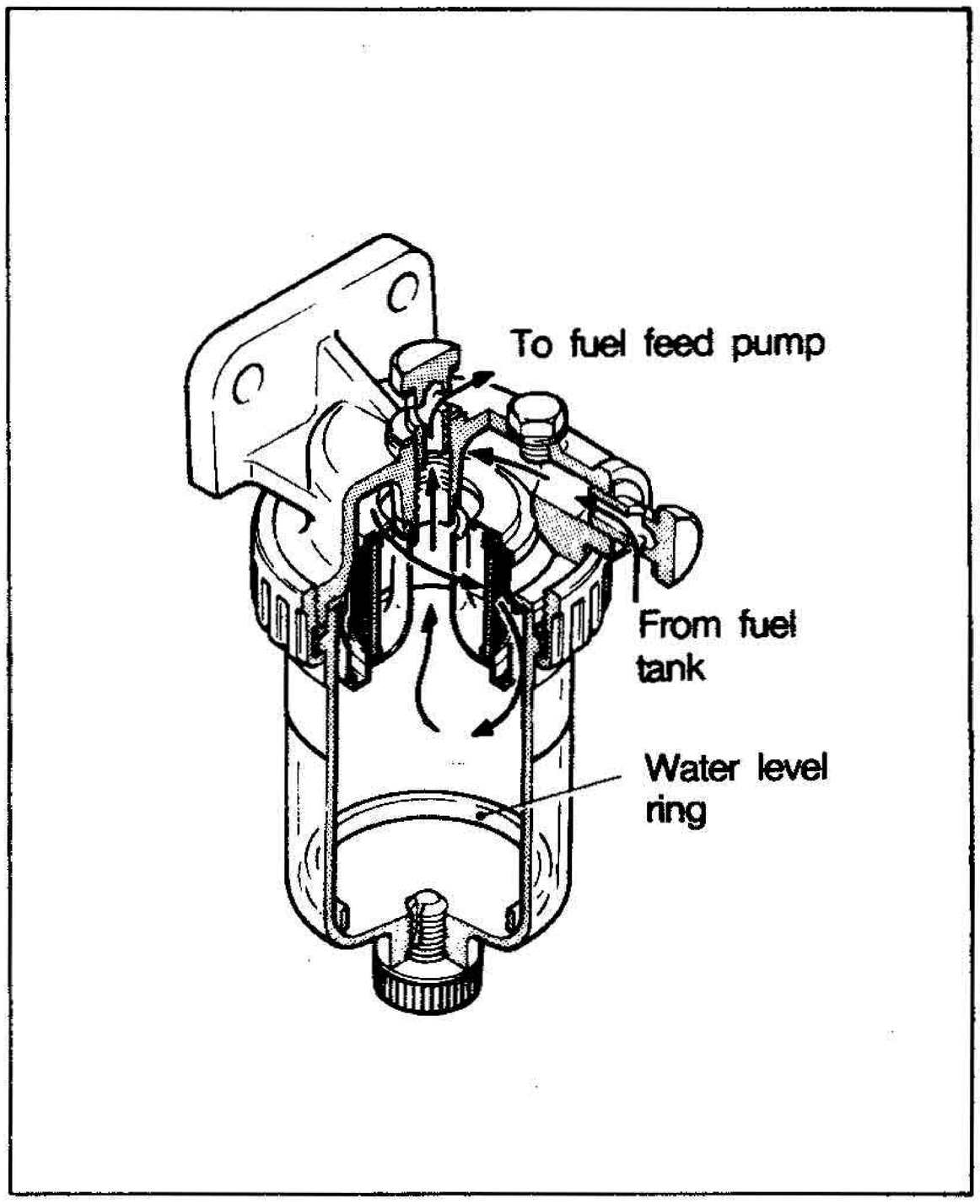
(8) Water Separator〔Option〕

The sedimenter type water separator separates gas oil and water centrifugally by taking advantage of their difference in specific gravity.

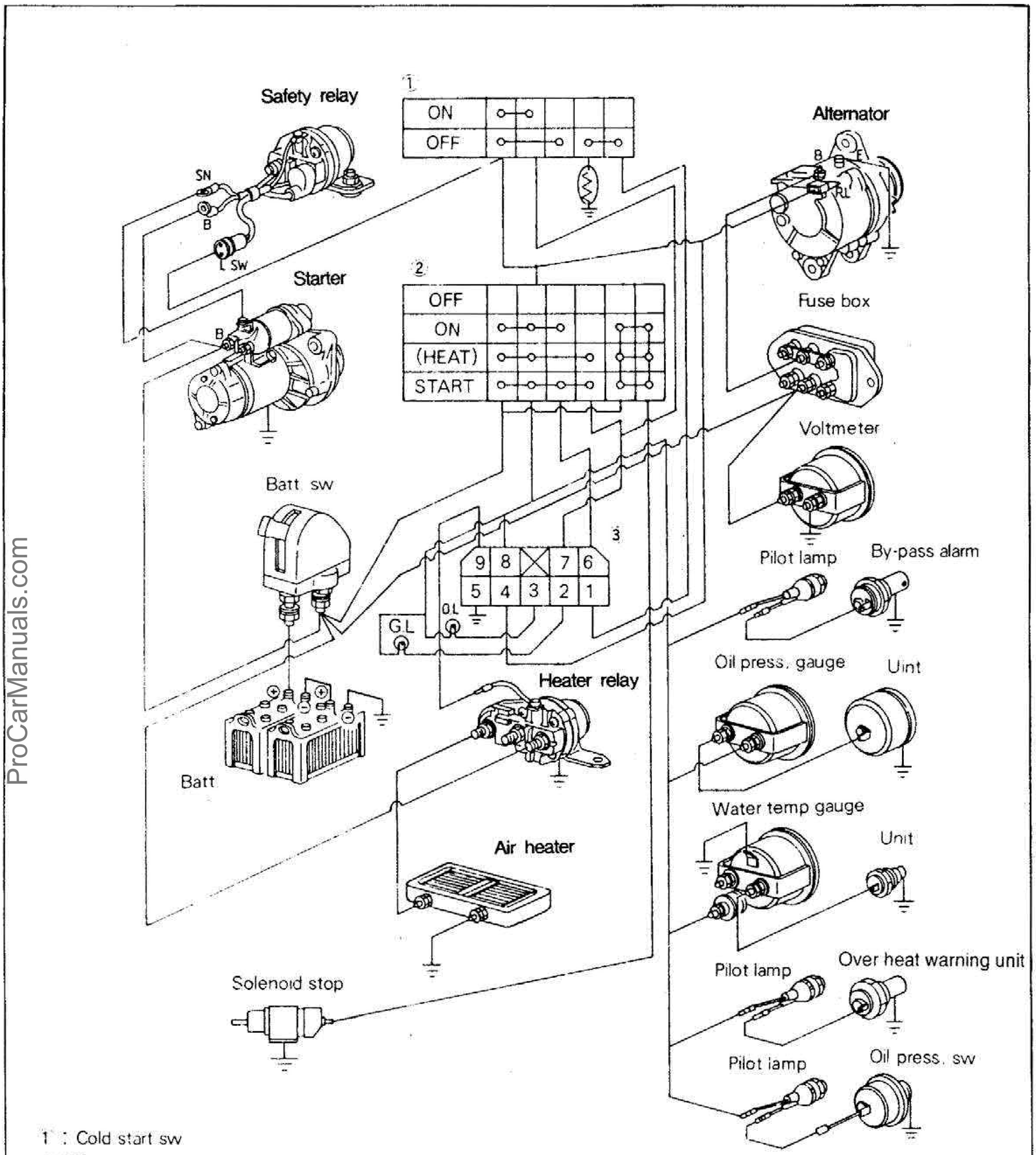
The fuel that has flowed in from the inlet connector is squeezed by the fuel path of the head to increase the flow velocity and spins. The separated water is sedimented in the case, where as the water-separated fuel is drawn through the fuel path in the center of the head into the feed pump.

The water separator sediments not only water but also mud components.

A red float goes up and down with the water level in the semitransparent case, making it possible to visually check the water quantity.



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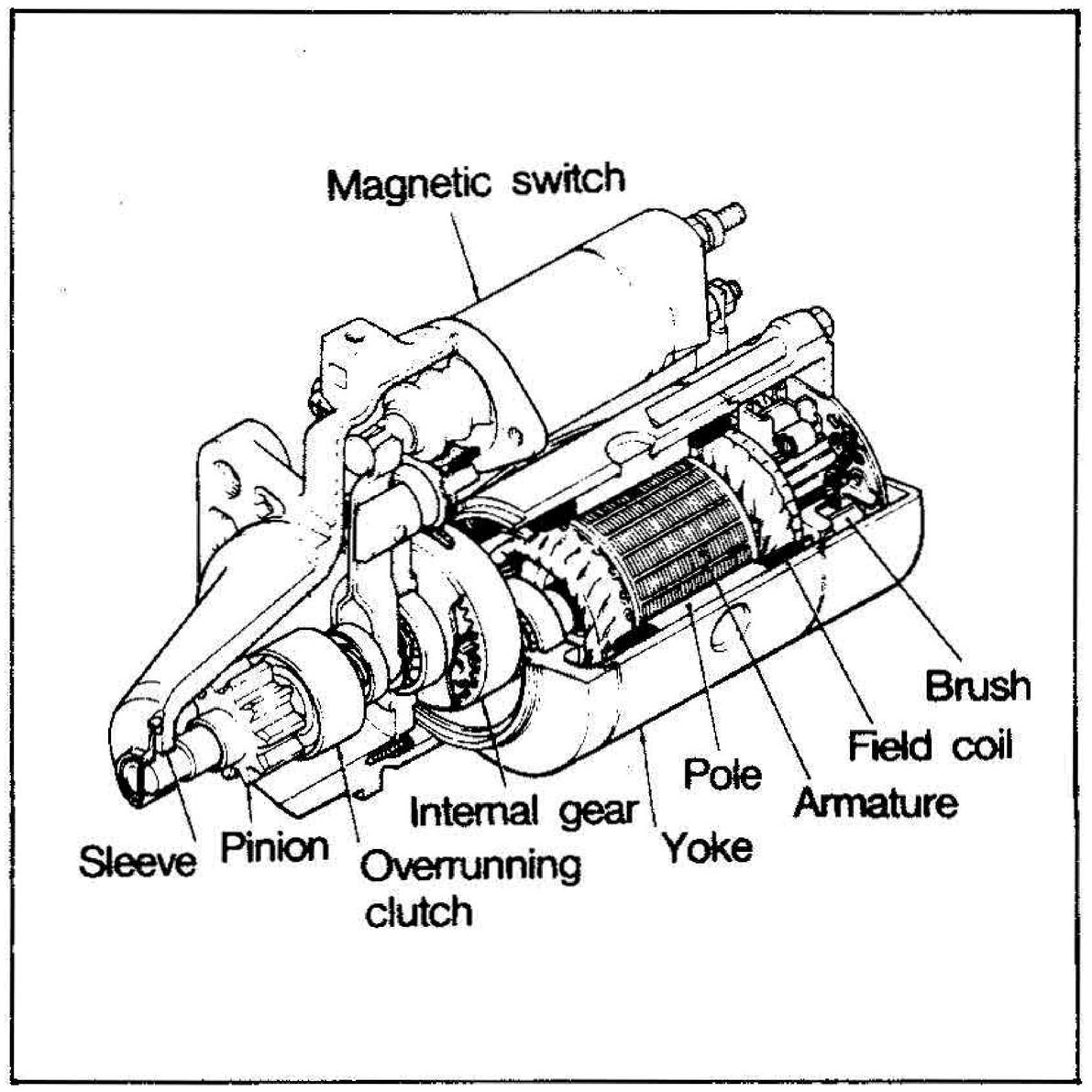
1 : Cold start sw
2 : Key sw
3 : Preheat controller
G.L : Green lamp
O.L : Orange lamp

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(1) Starter

The starter is a reduction type starter containing a smaller-size and higher-speed motor and a reduction gear mechanism.

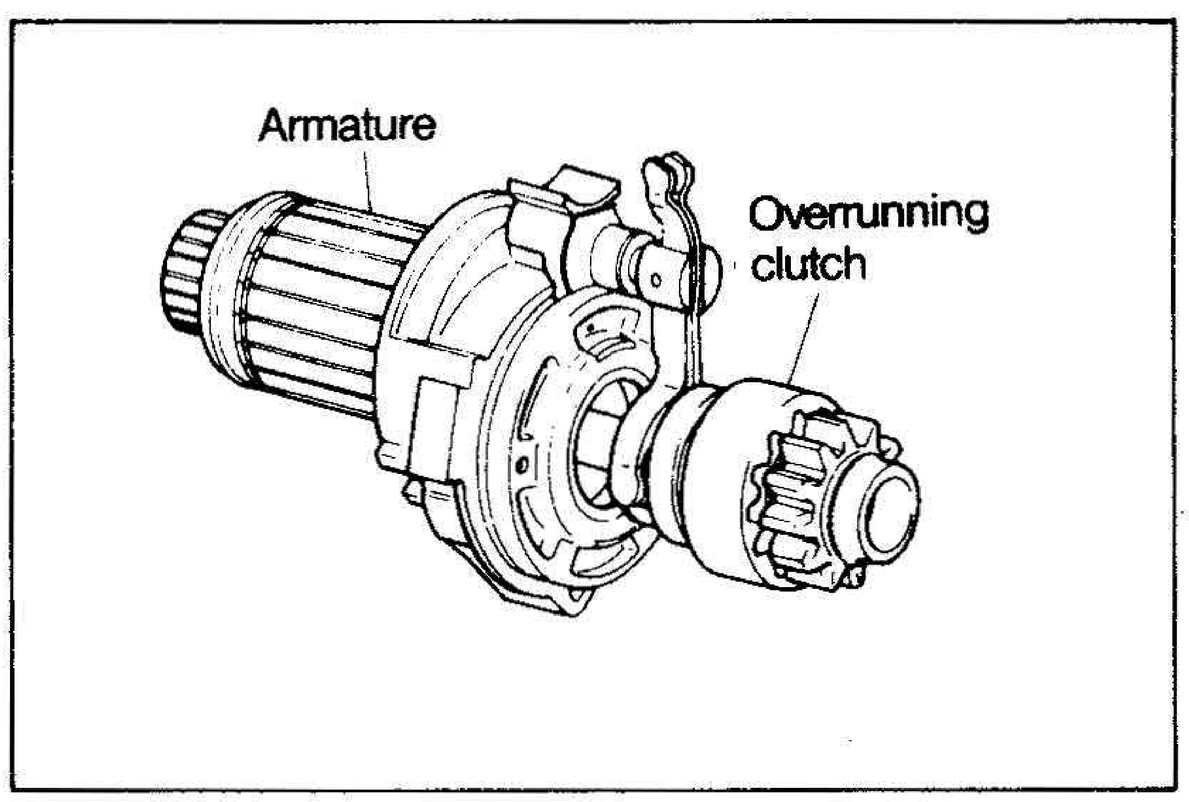
The starter may be broadly divided into the motor section which generates power, the overrunning clutch section which transmits the torque of the armature and prevents the starter from overrunning after the engine has started, the magnetic switch section which makes the pinion fit the ring gear and feeds the load current to the motor, and the reduction gear section which reduces the rotating speed of the armature and transmits the torque to the pinion.



(a) Reduction gear section

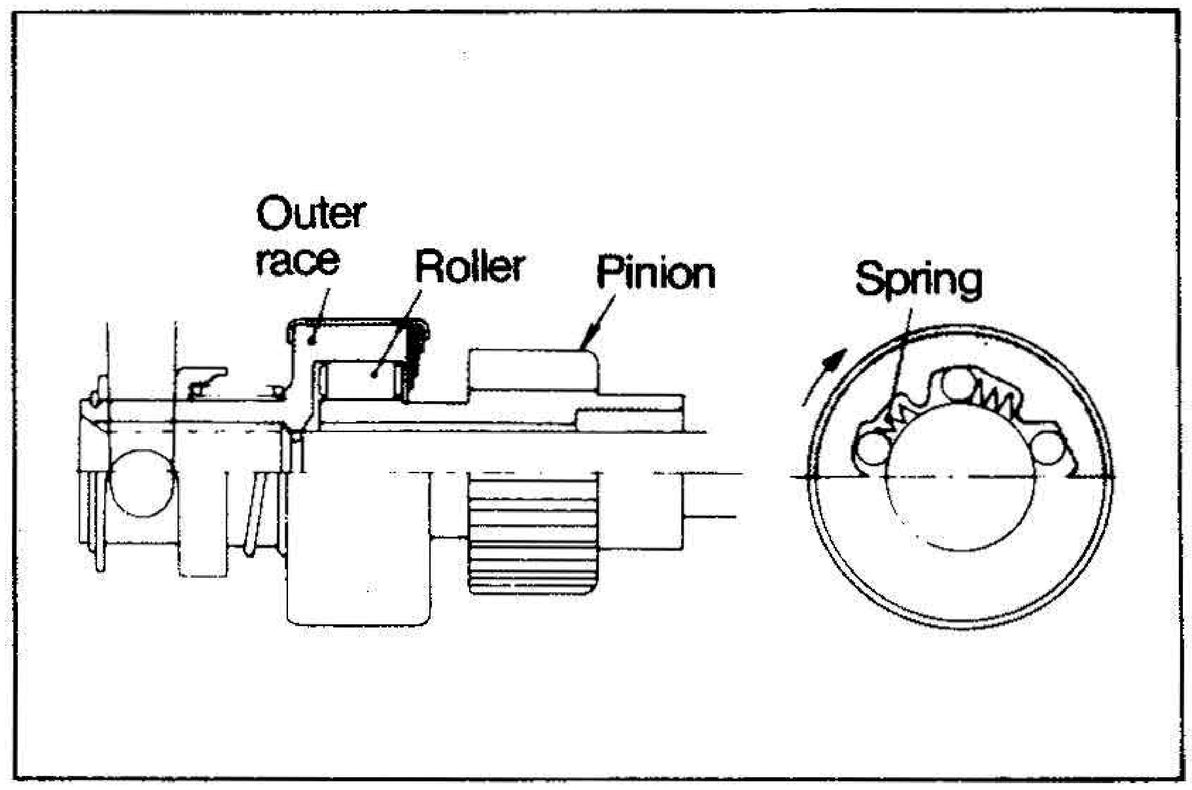
The end of the armature is shaped as a gear and is in mesh with the internal gears.

After reduction by the internal gears, the torque is multiplied several times and is transmitted to the pinion.



(b) Overrunning clutch

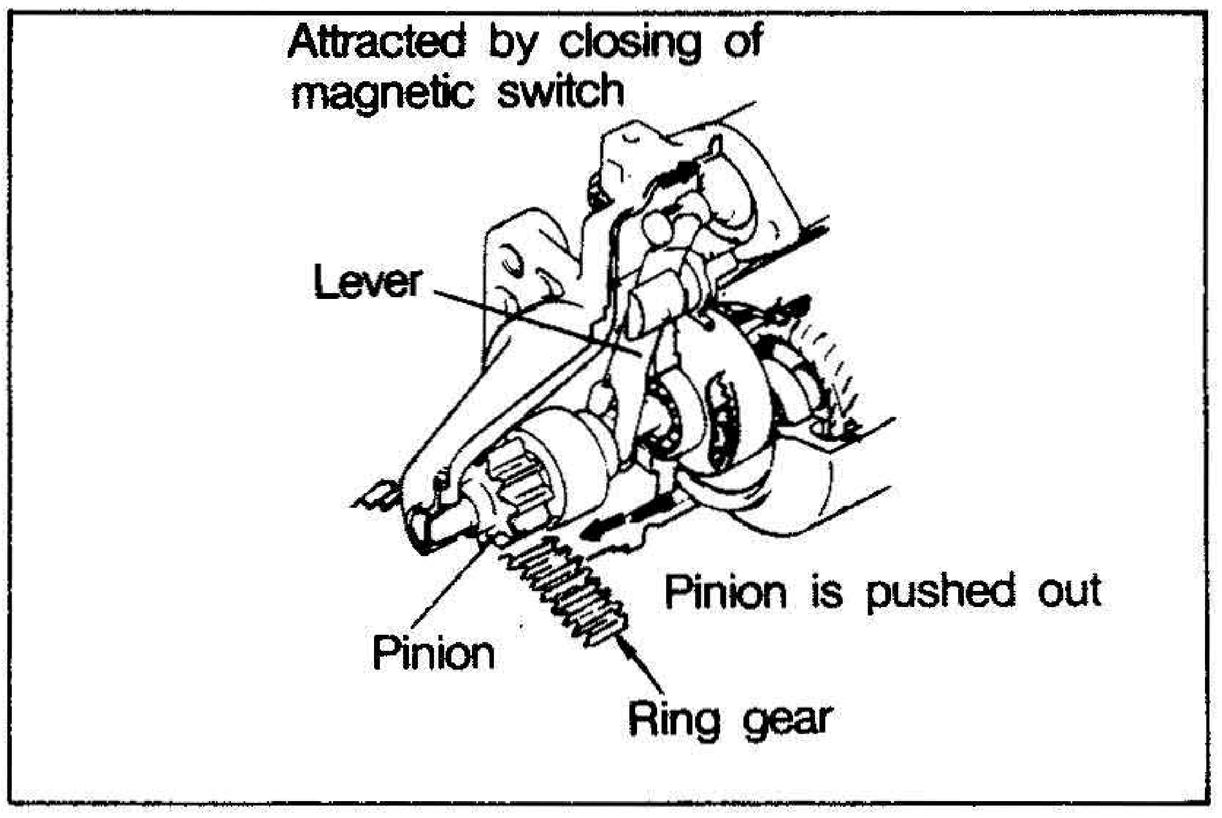
The overrunning clutch is a roller type. Each roller is set in the wedge-like groove provided between the outer and inner races(pinion) and is pressed against the narrower side of the groove by spring.



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When the armature turns, the rotation is transmitted through the rollers to the pinion by the wedge action of the outer race of the clutch.

On the other hand, no torque is transmitted from the pinion side as the wedge action is released.



(c) Operation

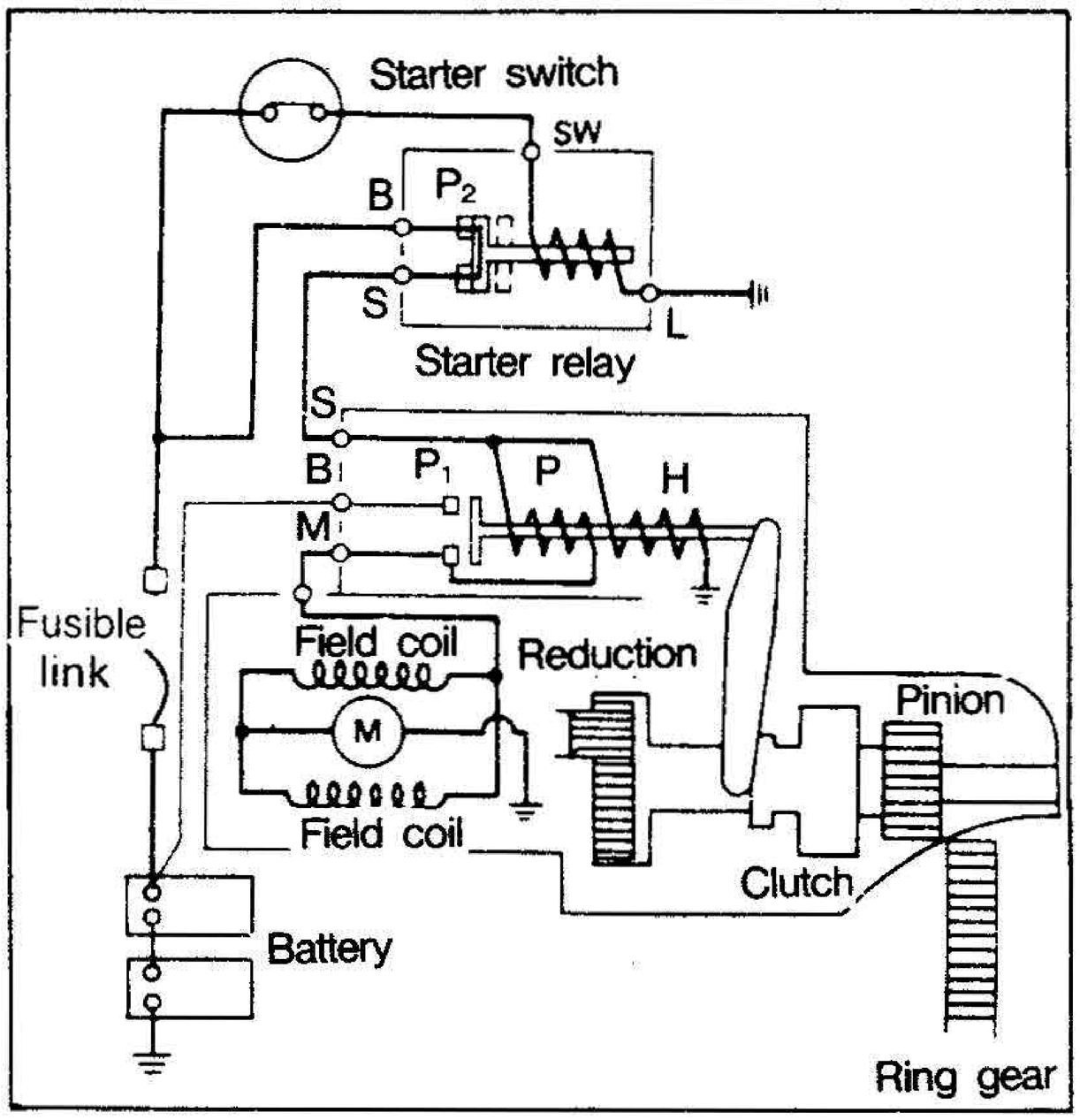
While the starter switch is ON, current flows from the terminal "SW" of the starter relay to the terminal "L" and closes the contact "P_2".

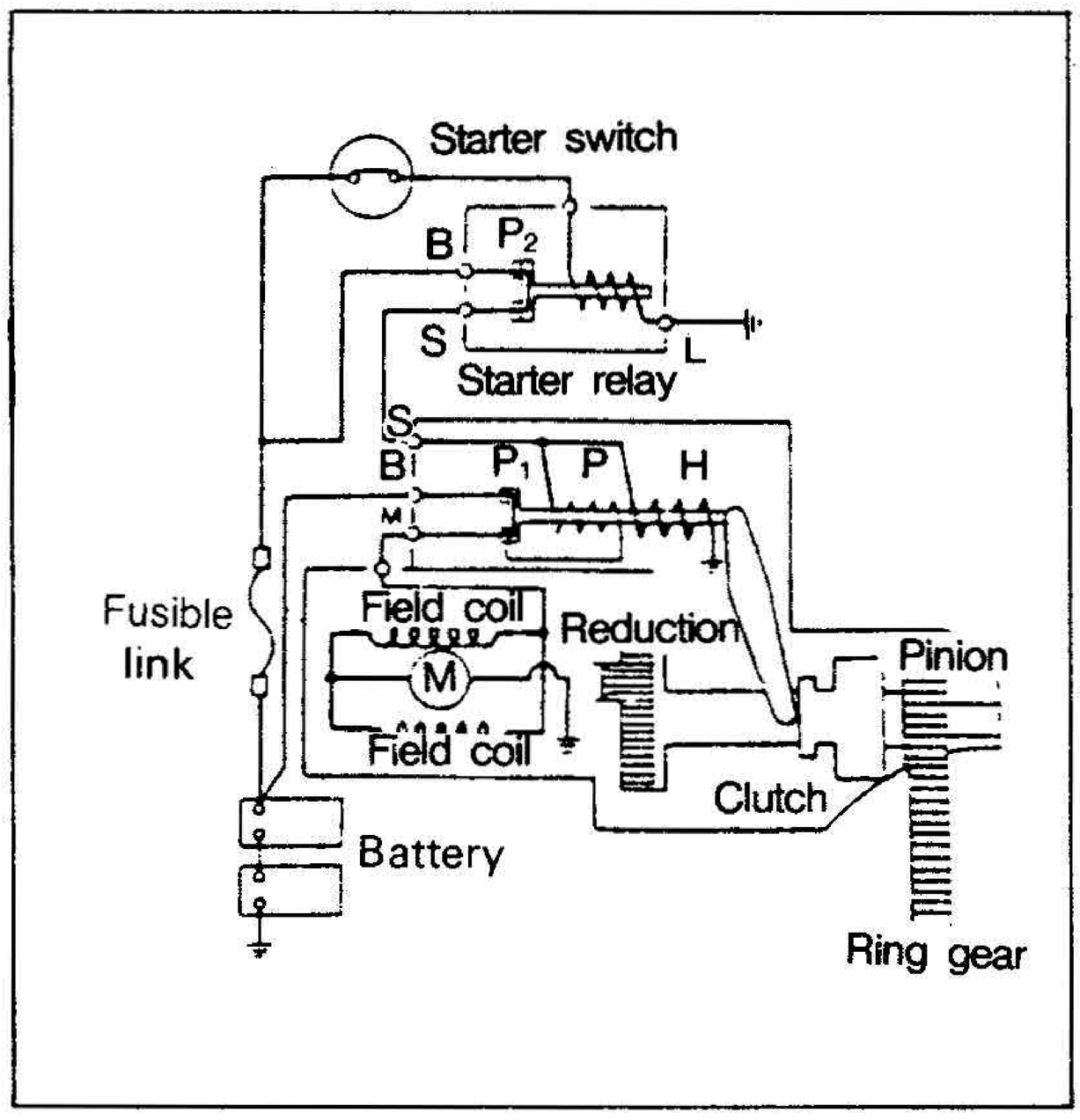
When the contact "P_2" closes, current from the battery flows from the terminal "S" of the magnetic switch to the pull-in coil "P" and holding coil "H".

Furthermore, the current that has decreased flows from the terminal "M" to the motor section.

The plunger, attracted by the magnetic flux of the pull-in coil and holding coil, closes the contact "P_1" and simultaneously pushes out the pinion turning slowly on weak current.

When the pinion comes into complete mesh with the ring gear, the contact "P_1" closes and the large current of the battery directly flows to the motor section to turn the pinion powerfully.





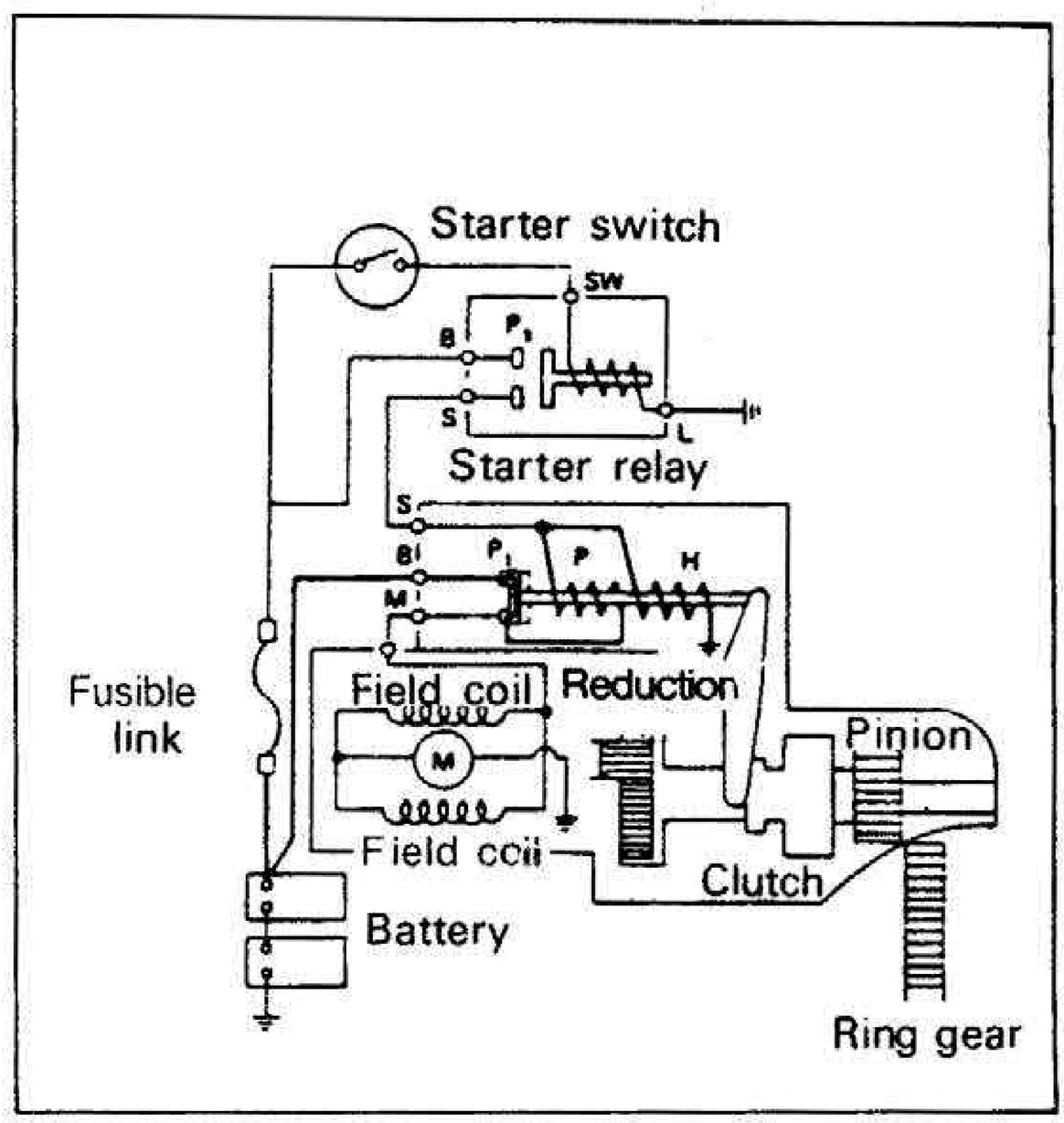
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In this condition, no current flows to the pull-in coil.

The plunger is retained by the holding coil alone.

When the starter switch is set to OFF, the contact point P_2 opens.

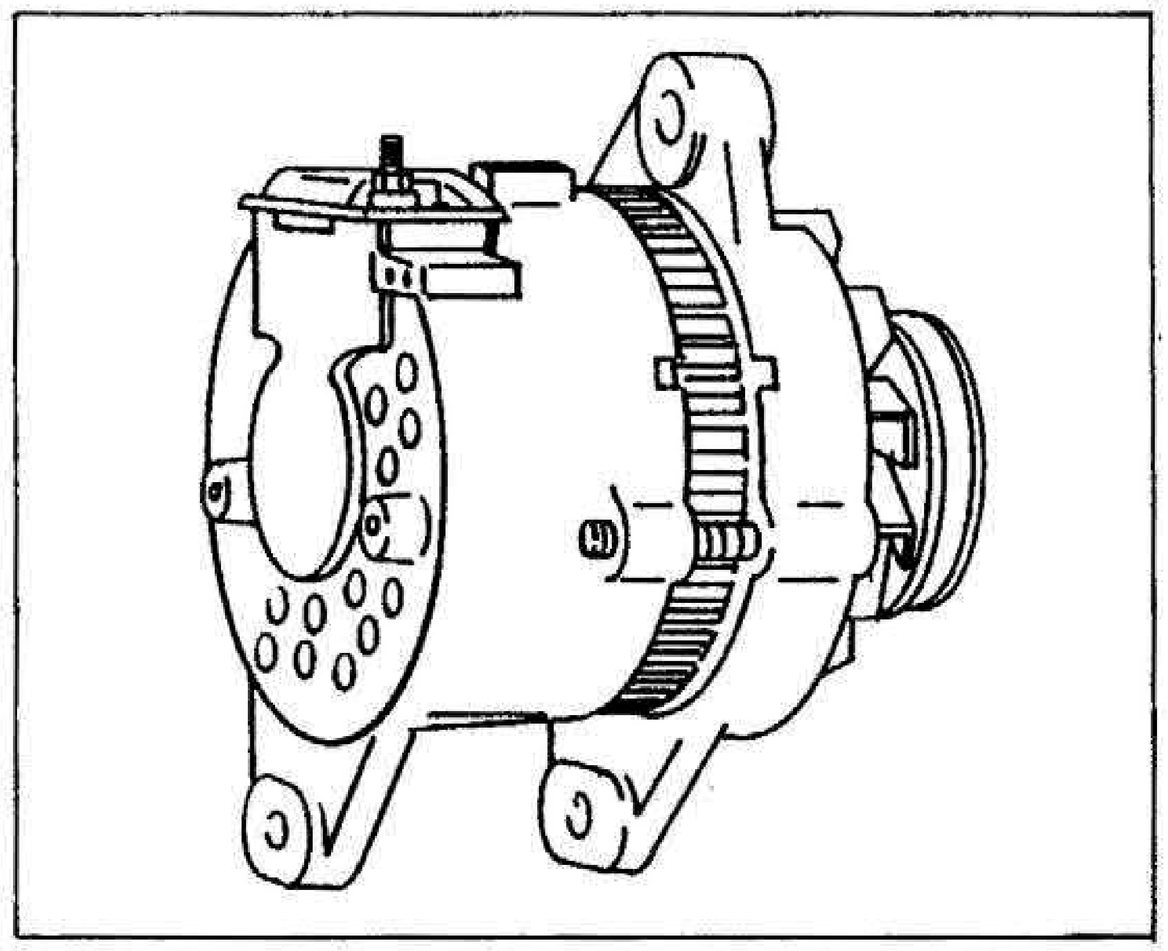
The moment the starter switch is opened, the P_1 is still in closed position and the battery current flows from the B terminal to the pull-in coil (P) and holding coil (H).
Since the direction of current that flows is reverse, the magnetic fluxes cancel each other, and the return spring pushes the plunger back to its original position. At the same time, the contact point P_1 opens, so the current to the motor section is cut off.



(2) Alternator

(a) 40A IC regulator built-in alternator

The 40A alterator is a compact IC regulator built-in alternator(abbreviated to built-in alterantor) consisting of an IC regulator built in the alternator rear bracket.

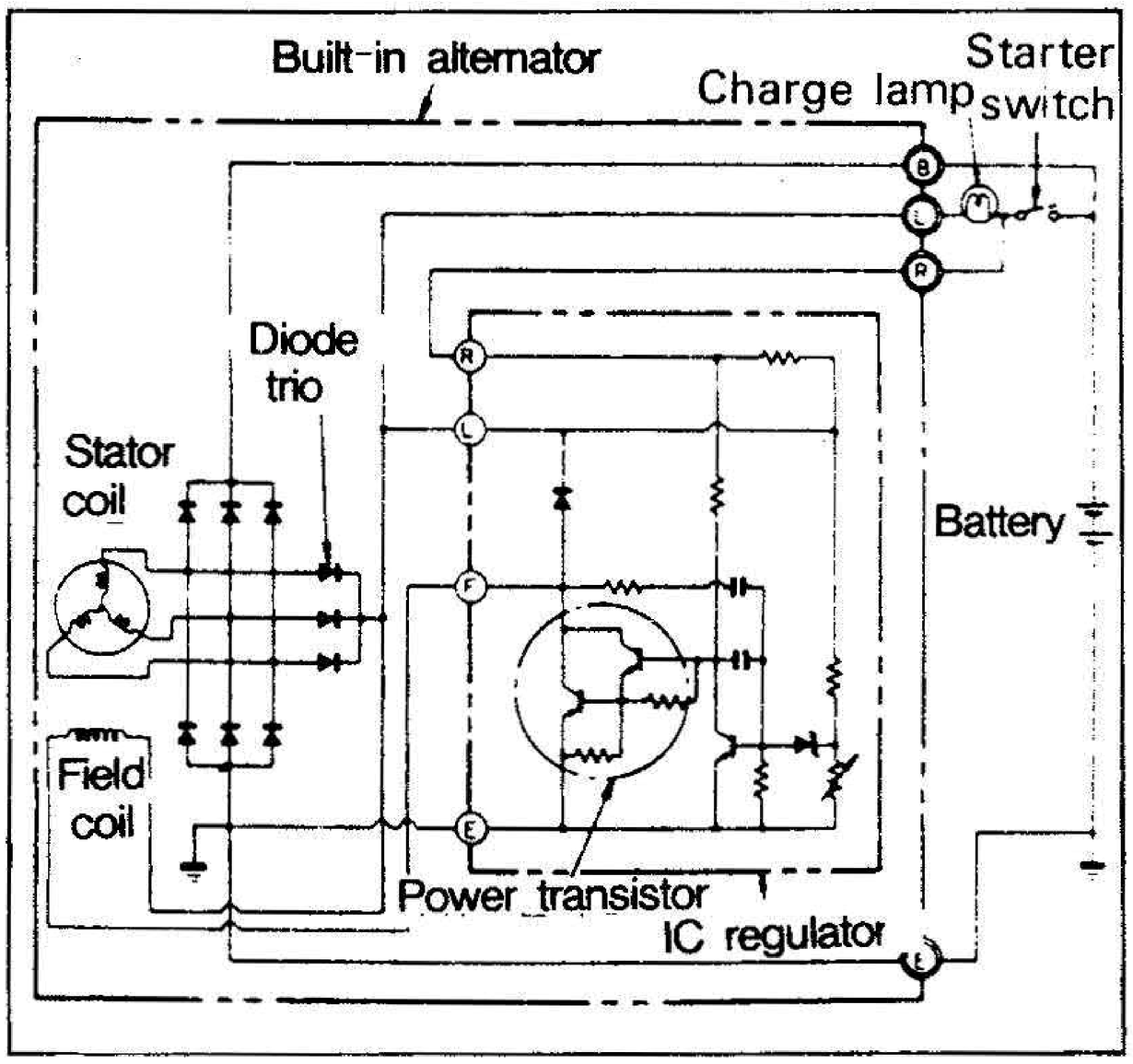


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The built-in alternator offers the following features.

1. The residual magnetism of the rotor allows the alternator voltage to build up through self-excitation.

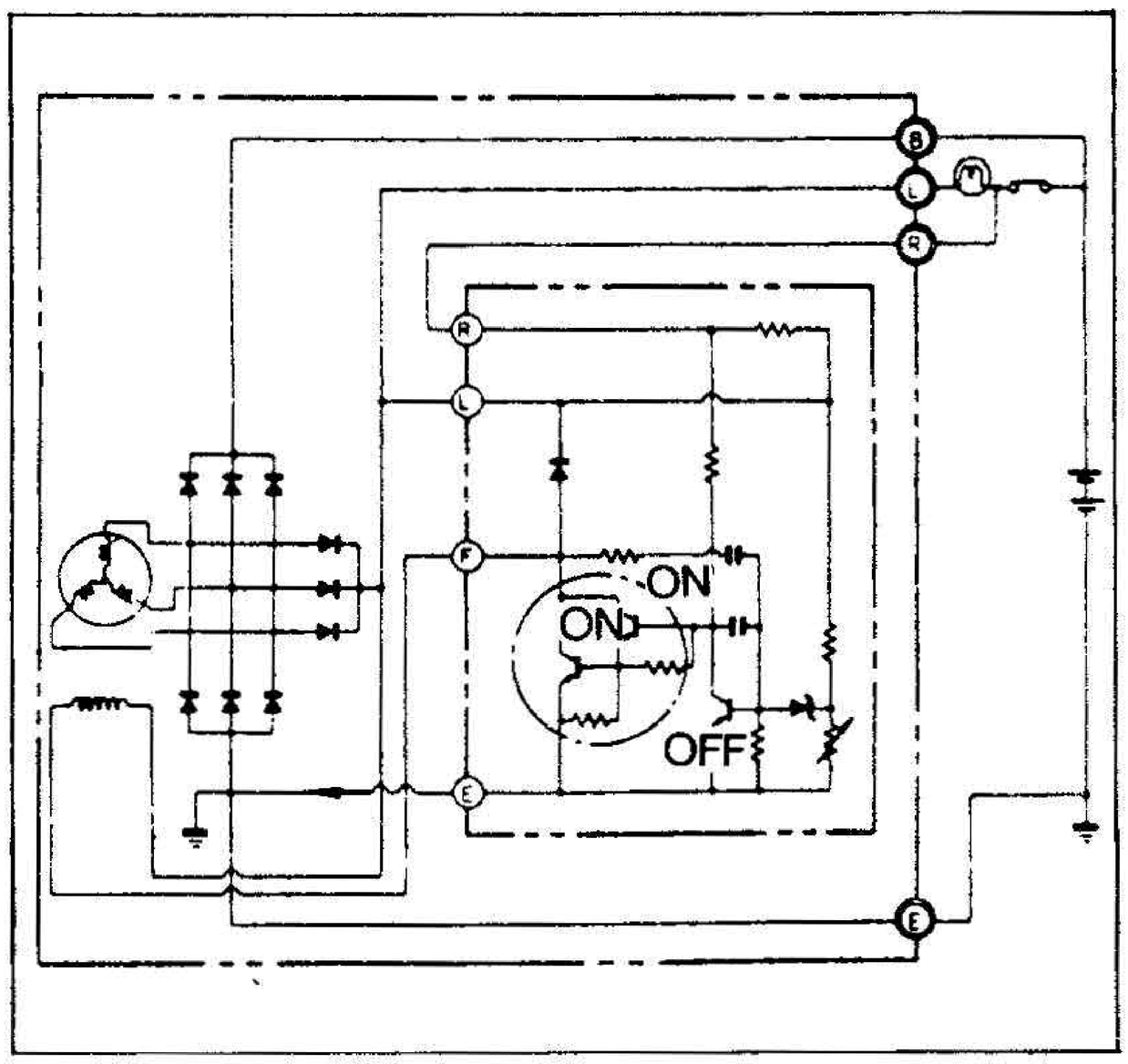
2. Field current directly flows from the diode trio to the field coil. So no voltage drop is caused by the starter switch and wiring as in the conventional alternator.



3. To make sure that the voltage builds up easily, power transistor base current is kept flowing. Therefore, when the battery switch is in closed position, current(10 mA or less) continues to flow through the regulator even when the engine is stationary.

When the battery switch is closed, current flows to the base of the power transistor and causes the power transistor to be ON.

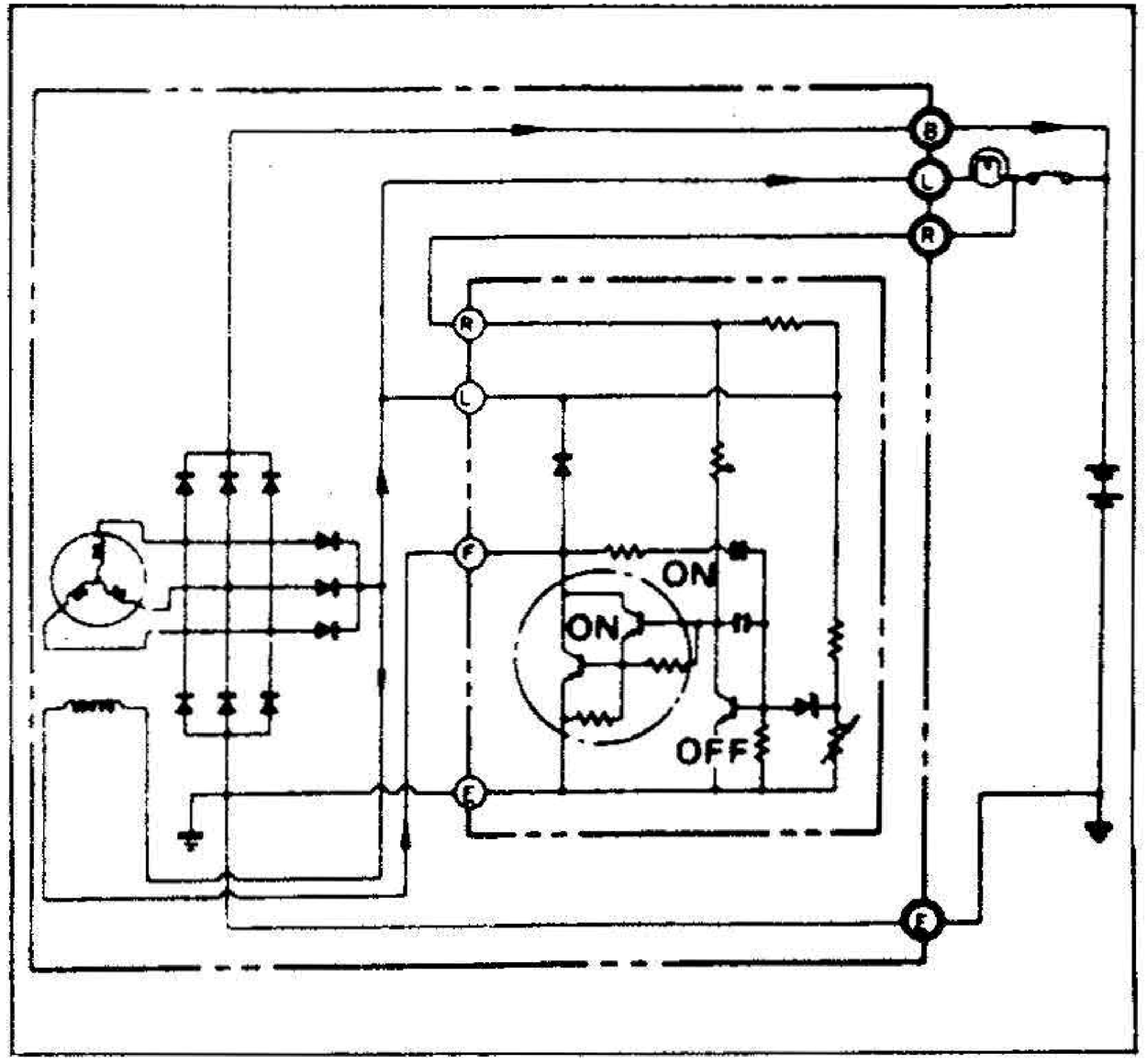
When the alternator is turned, the residual magnetism of the rotor causes the stator coil to generate a very small voltage, and current flows from the diode trio to the field coil to excite the rotor.



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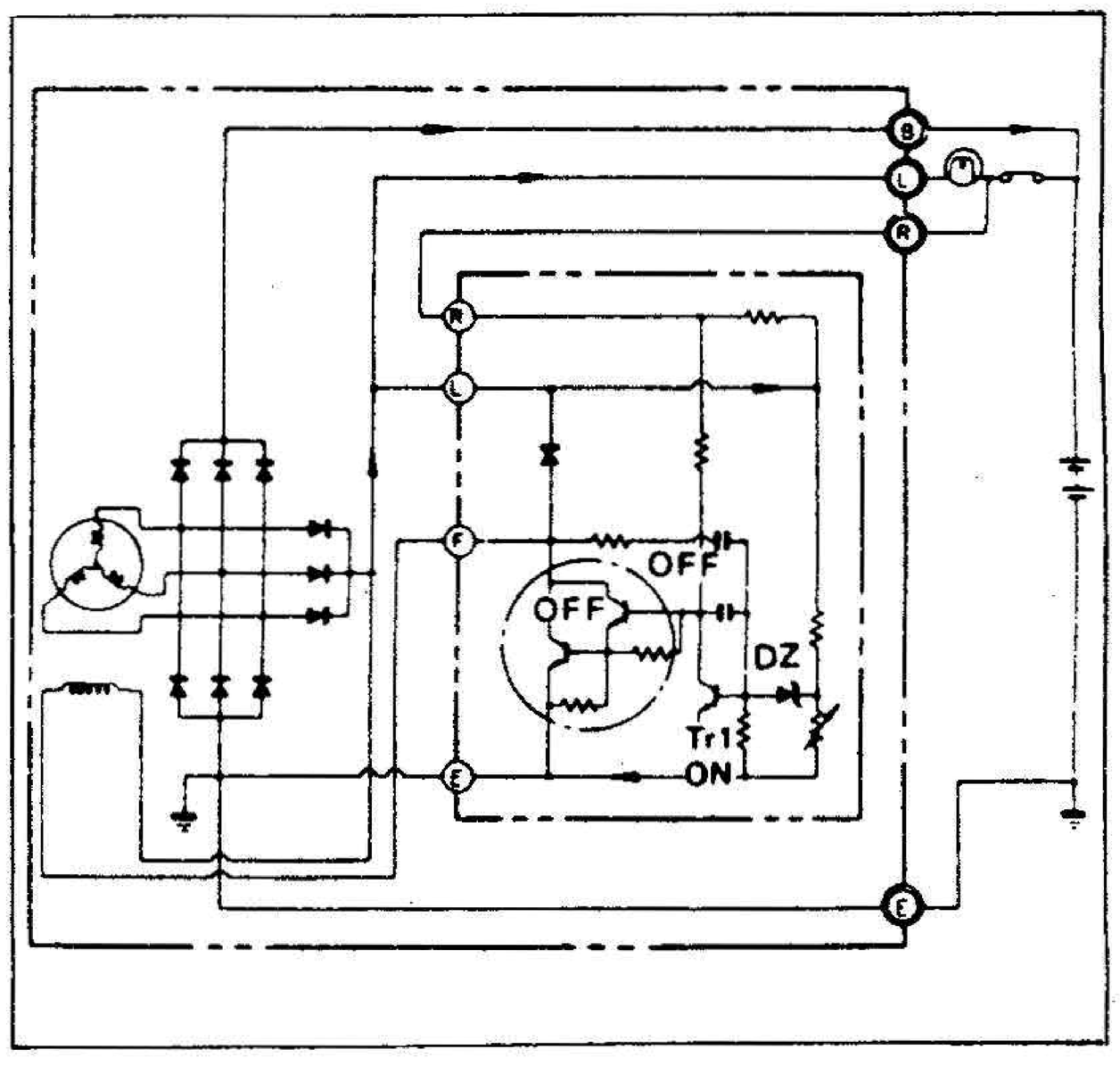
If the engine is started and the rotor excited, the stator coil generated voltage suddenly rises.

Current to the base of the power transistor is supplied from the alternator itself.



When the voltage generated by the alternator increases, the Zener diode "Dz" conducts, base current of the transistor "Tr_1" flows and causes "Tr_1" to be ON.

So current to the power transistor is short-circuited to "Tr_1", and the power transistor through which base current has ceased to flow is forced to the OFF state. As the result, no current flows to the field coil, and the voltage generated by the alternator falls.



When the generated voltage falls too far below the Zener voltage, "Dz" does not conduct so that "Tr_1" is forced to the OFF state.

Accordingly, base current flows again to the power transistor and causes the power transistor to be ON, so that current flows to the field coil and the voltage generated by the alternator rises.

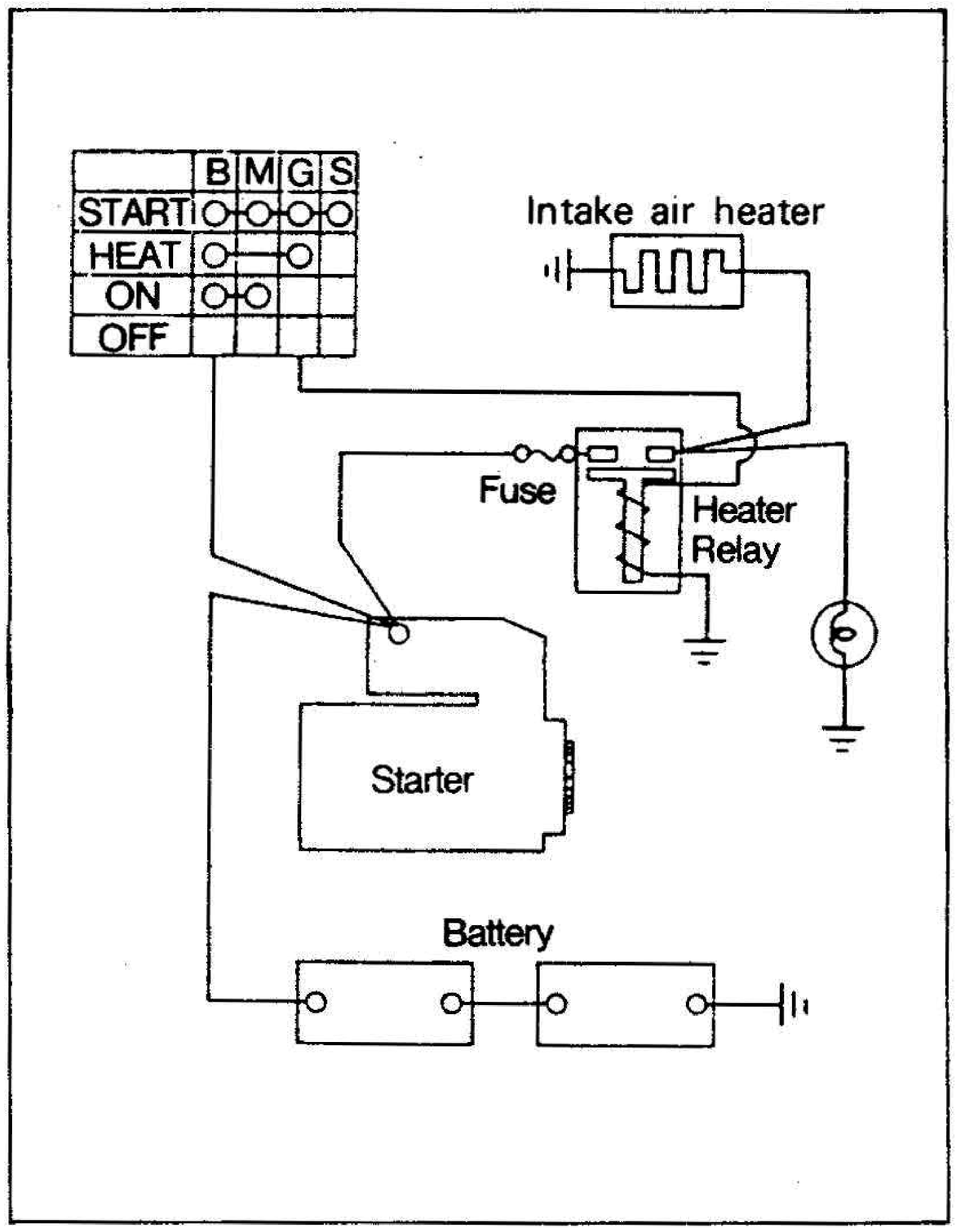
The voltage generated by the alternator is adjusted through repetition of such operations by the IC regulator.

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(3) Intake Air Heater

The intake air heater improves engine startability by heating intake air at engine starting.

When the starter switch is set to "HEAT" or "START" position, current is supplied to the intake air heater. If current is supplied for about 40 to 60 seconds with the starter switch at the "HEAT" position, the temperature of the intake air heater exceeds 800℃, and the air heater indicator indicating heated condition for the driver becomes red hot.

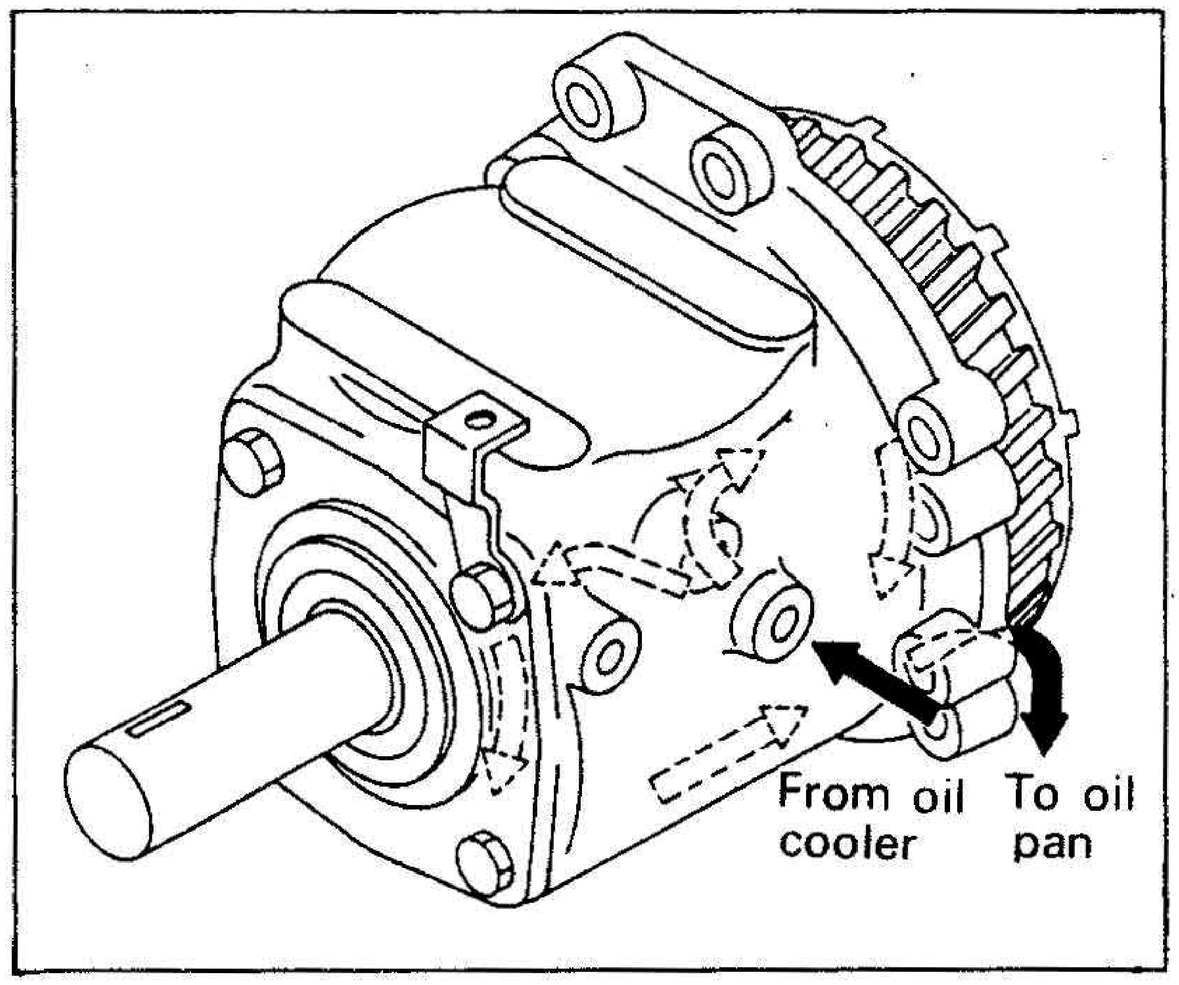


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1-3-7 Other Equipment

(1) Injection pump Drive

The injection pump drive is mounted to the flywheel housing on the left side of the engine and is driven at half the engine speed by the timing gear train(injection pump gears) of the engine. A coupling is mounted at the rear end of the injection pump drive crankshaft to drive the injection pump.



For lubrication of the parts, the engine oil is drawn by an oil pipe from the engine oil cooler. The oil flows through the oil hole in the shsft and lubricates the bearing.

Excess oil flows from the bottom hole in the crankcase and returns through the timing gear train to the oil pan.