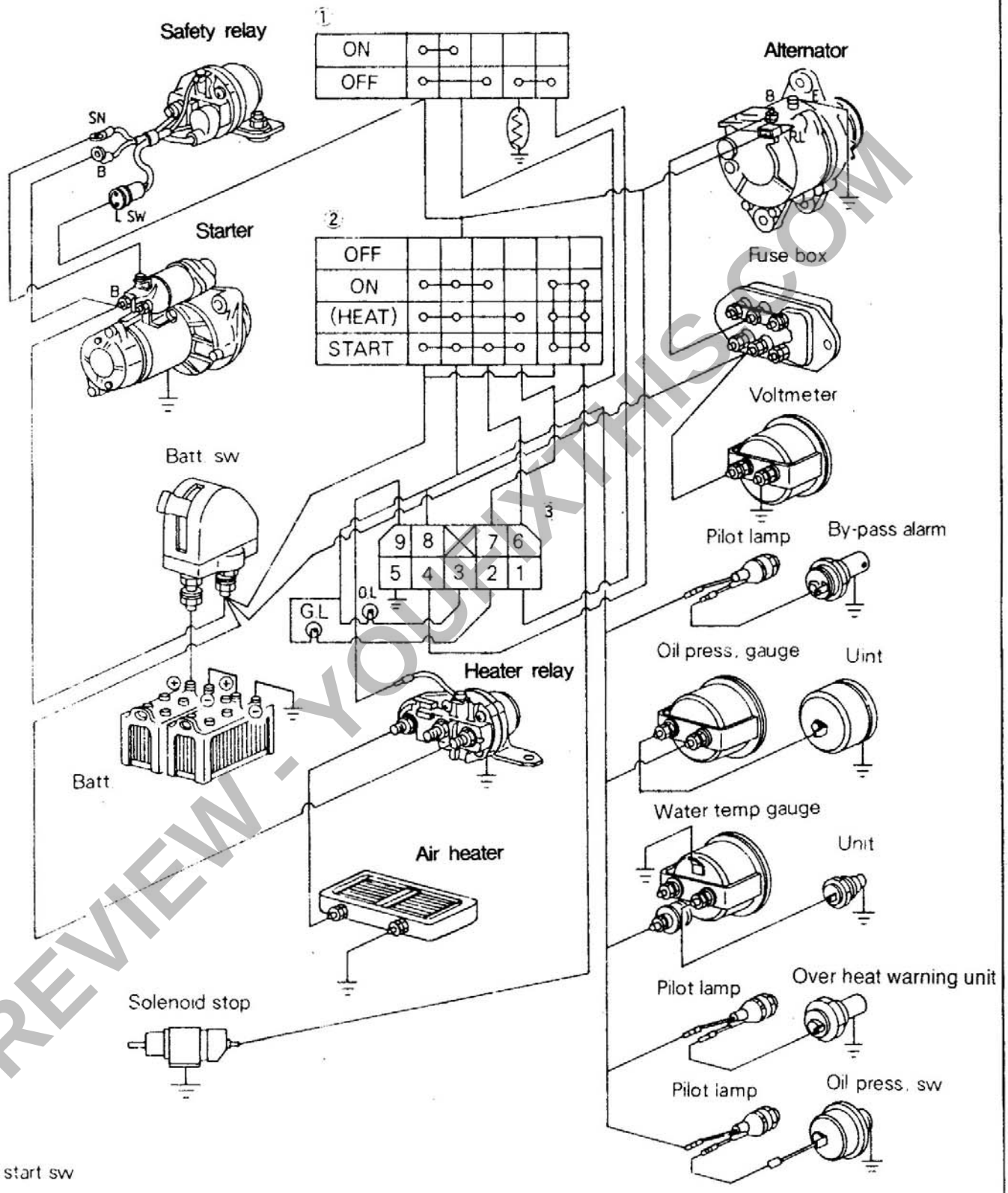


1 : Cold start sw
2 : Key sw
3 : Preheat controller
G.L : Green lamp
O.L : Orange lamp

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2-3 TIGHTENING TORQUE TABLE

2-3-1 Tightening Torque of Major Bolts and Nuts

Description			Thread size Dia. x Pitch mm	Torque N m(kgf m)	Remarks
Engine proper	Main bearing cap bolt		M18×2.5	370(38)	Wet
	Connecting rod nut		M13×1.25	115(12)	Wet
	Crankshaft pulley attaching bolt		M14×1.5	175(18)	
	Idler shaft bolt		M16×2	115(12)	
	Camshaft gear attaching nut		M27×1.5	265(27)	Wet
	Flywheel housing attaching bolt		M12×1.75	59(6)	
	Idler shaft nut (for attaching collar)		M16×1.5	98(10)	
	Flywheel attaching bolt		M16×1.5	255(26)	Wet
	Cylinder head bolt		M14×2	195(20)	Wet
	Rocker bracket attaching bolt		M10×1.5	34(3.5)	
	Rocker cover attaching screw		M10×1.25	9.8(1)	
Inlet and exhaust	Inlet manifold bolt		M10×1.5	29(3)	
	Exhaust manifold nut		M10×1.25	33(3.4)	
	Torbo-charger	Compressor wheel attaching nut		17 to 20 (1.73 to 2.07)	
		Compressor cover attaching bolt		6.9(0.7)	
		Turbine housing attaching bolt		17(1.7)	
Lubrication	Oil pump idler gear shaft nut		M12×1.25	59 to 78 (6 to 8)	LOCTITE No.262 to be applied
	Oil filter center bolt		M16×1.5	59 to 69 (6 to 7)	
	Regulator valve		M27×1.5	98(10)	
	Check valve(to be mounted to crankcase)		M12×1.75	34(3.5)	
Cooling	Fan coupling bolt(to retain damper as well)		M12×1.75	59(6)	
	Cooling fan bolt		M10×1.5	42(4.3)	
			M12×1.75	59(6)	

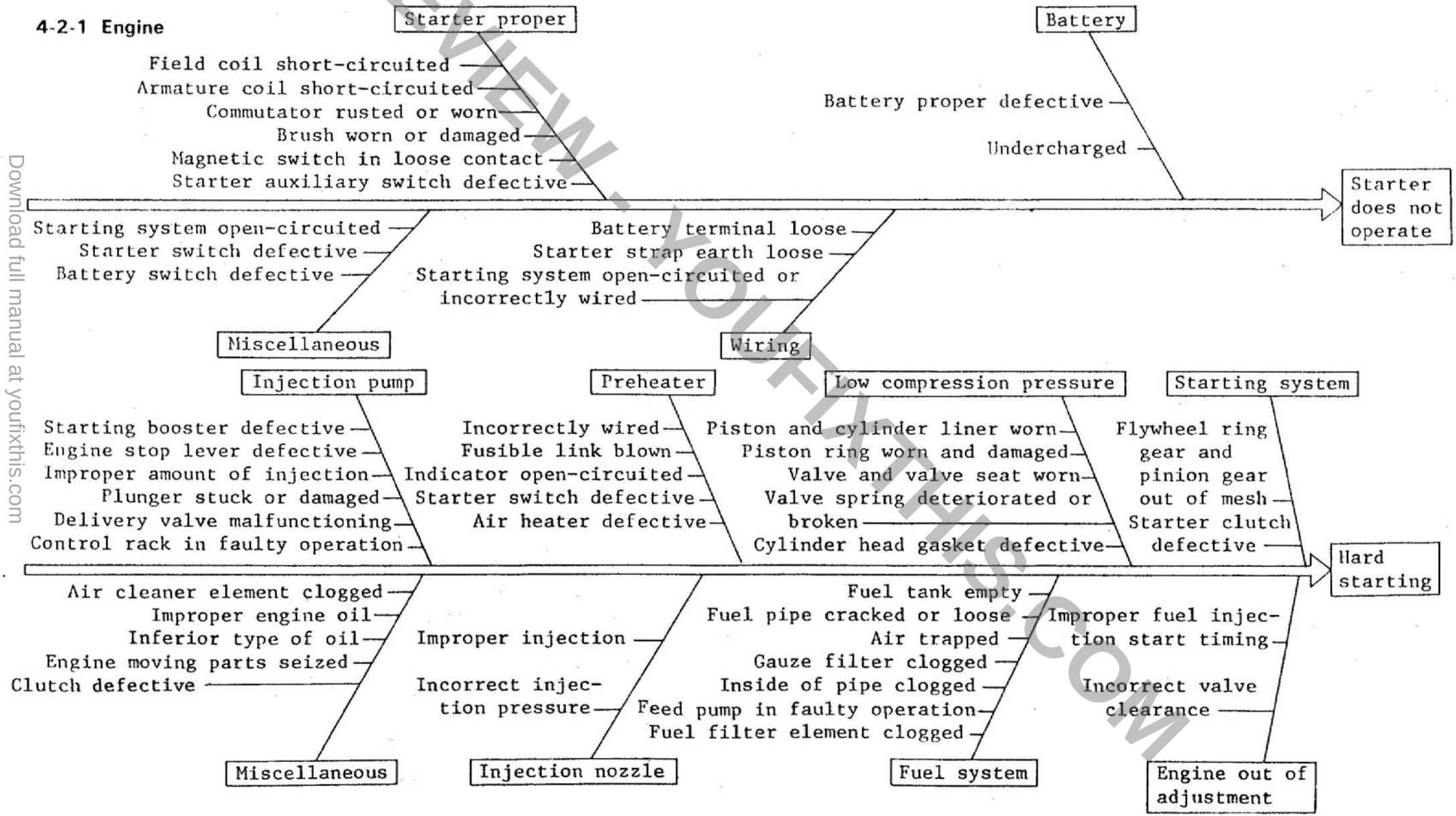
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4-2 TROUBLESHOOTING

The symptoms and causes shown in this paragraph are typical examples. In actual operations, locate the causes according to the symptoms.

4-2-1 Engine



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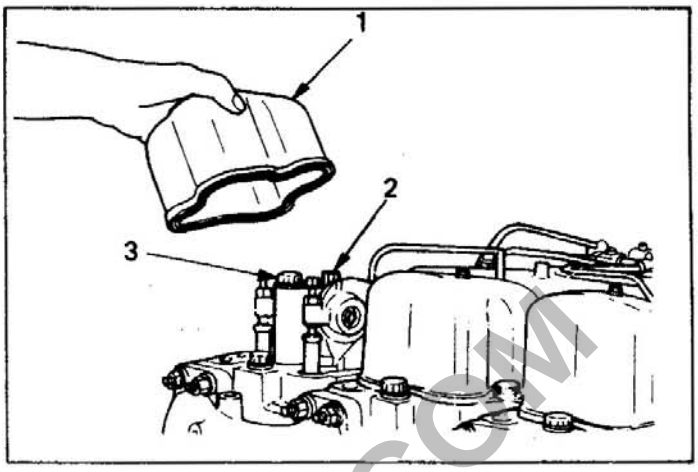
(1) Remove the following parts.

1 Rocker cover

2 Rocker bracket mounting bolt

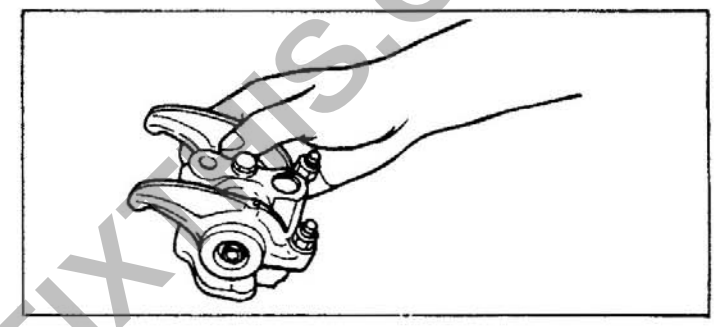
3 Cylinder head bolt

NOTE : Where the push rod is forcing the rocker up, the rocker adjusting screws should be loosened before all bolt are removed.



(2) Remove the rocker shaft bracket assembly from the cylinder head.

NOTE : The rocker shaft bracket assembly is set in position on the cylinder head by spring pins.



(3) Remove the following parts.

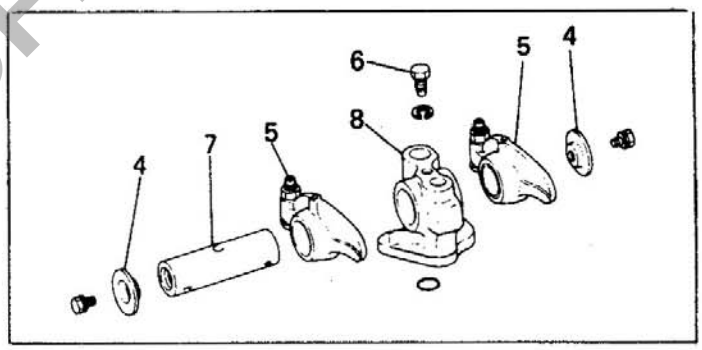
4 Thrust plate

5 Rocker

6 Set screw

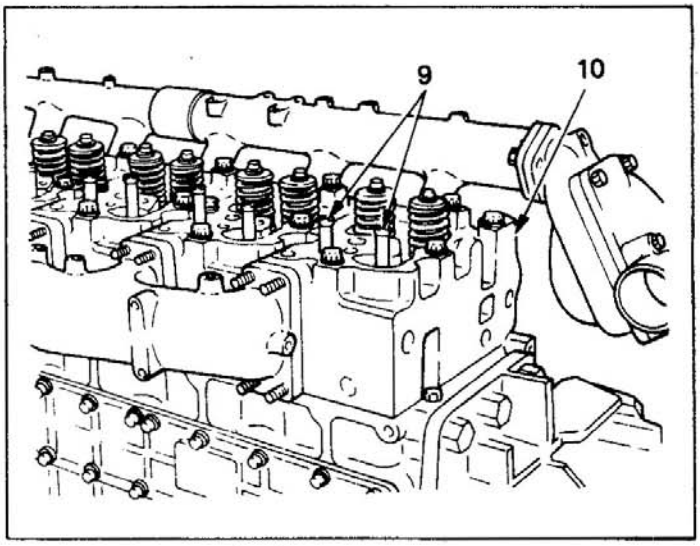
7 Rocker shaft

8 Rocker shaft bracket



(4) Withdraw the push rod 9 and remove the cylinder head 10 from the crankcase.

NOTE : 1. To remove the cylinder head, make sure that the injection nozzle is removed beforehand. If the cylinder head with nozzle mounted is placed on the work table, damage to the nozzle end projecting from the bottom surface of the cylinder head will result.

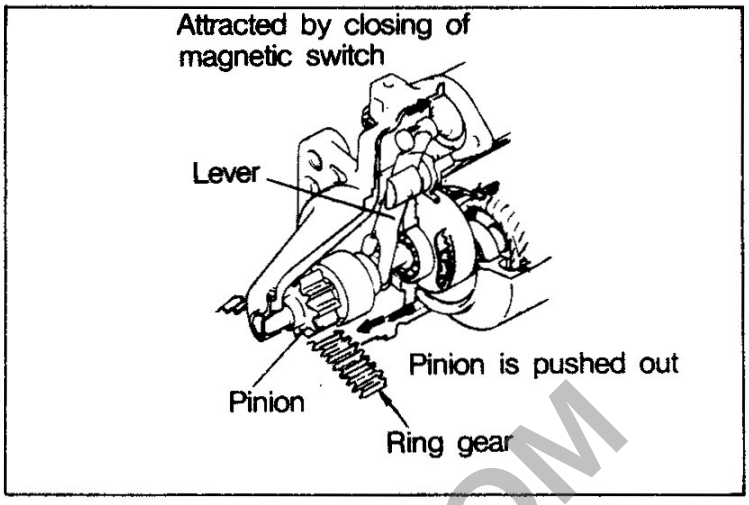


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When the armature turns, the rotation is transmitted through the rollers to the pinion by the wedge action of the outer race of the clutch.

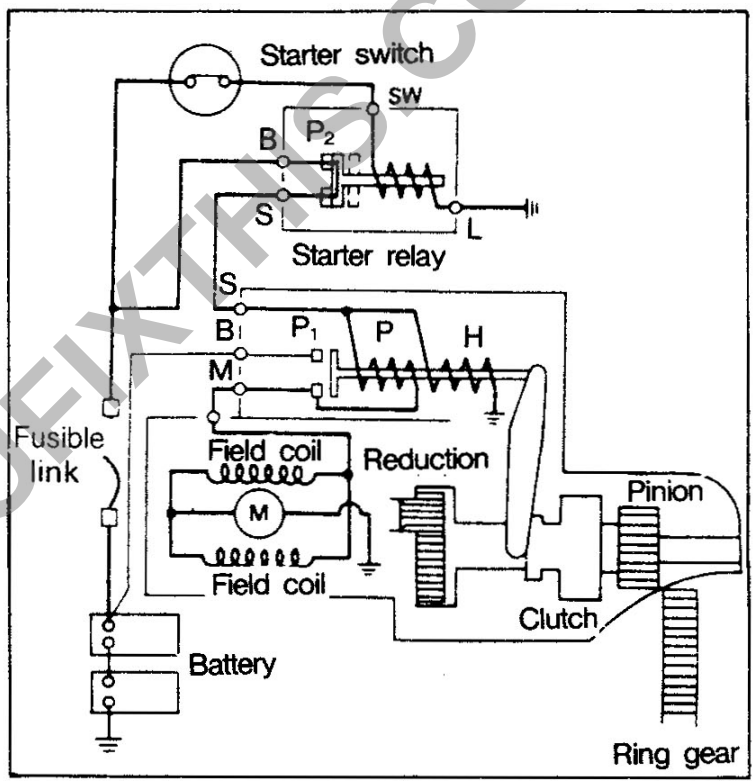
On the other hand, no torque is transmitted from the pinion side as the wedge action is released.



(c) Operation

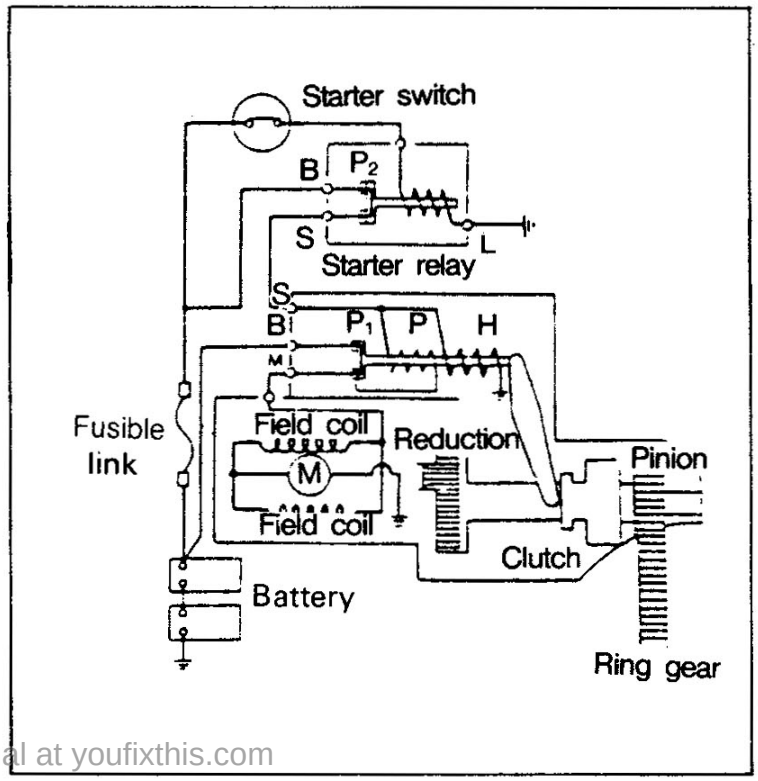
While the starter switch is ON, current flows from the terminal "SW" of the starter relay to the terminal "L" and closes the contact "P_2".

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.



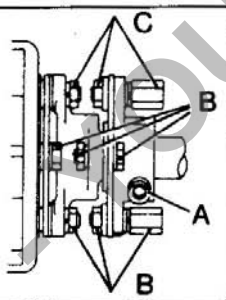
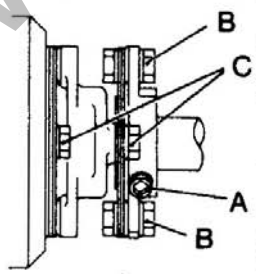
The plunger, attracted by the magnetic flux of the pull-in coil and holding coil, closes the contact "P_1" and simultaneously pushes out the pinion turning slowly on weak current.

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.



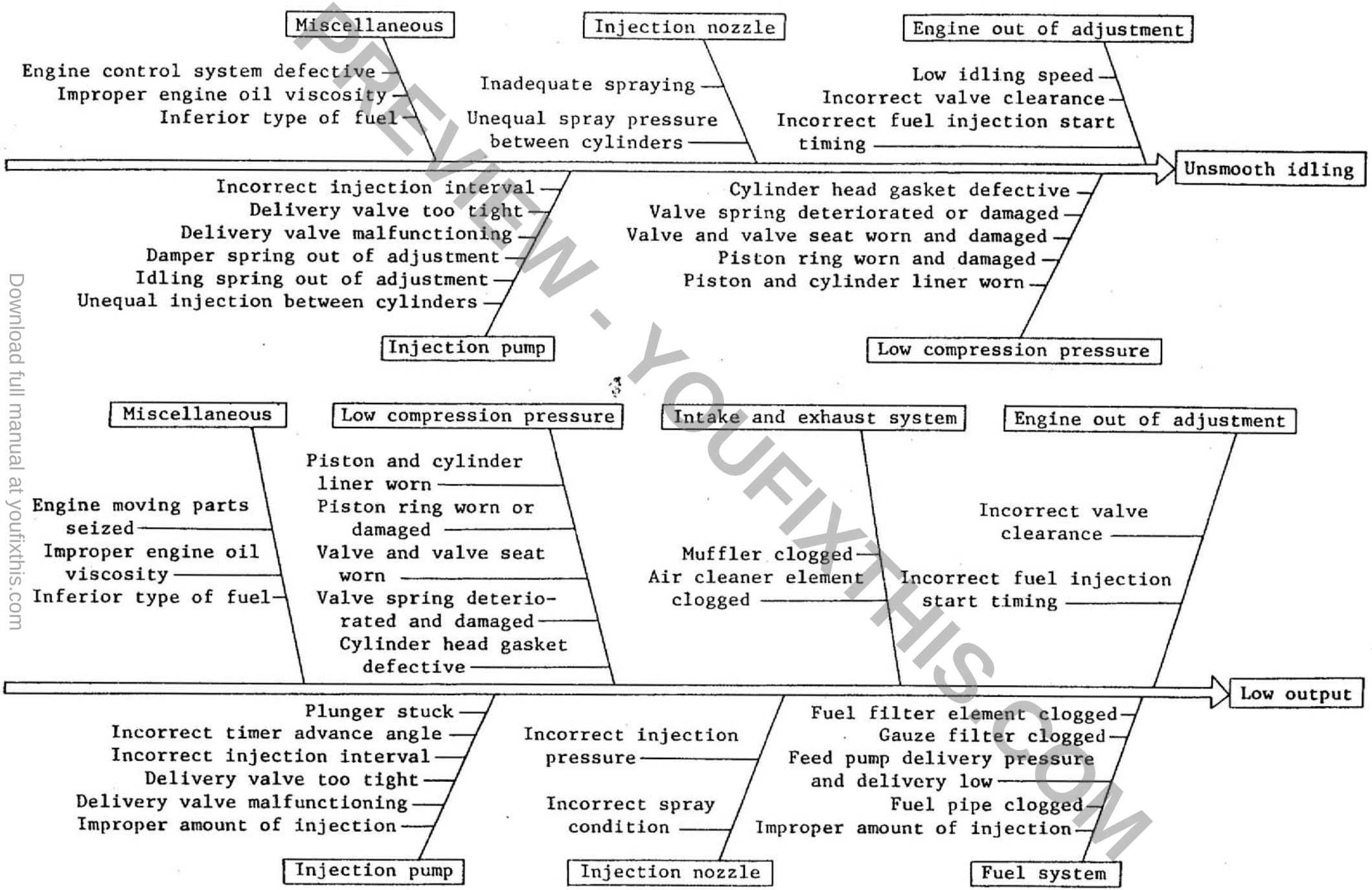
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Description				Thread size Dia. x Pitch mm	Torque N m(kgf m)	Remarks
Fuel	Injection pump bracket attaching bolt			M10×1.5	42(4.3)	
	Injection pump	Flange sleeve nut	P type		39 to 44 (4 to 4.5)	
		Delivery valve holder	AD type		64 to 69 (6.5 to 7)	Tighten to specified torque repeatedly three times.
			P type		110 to 115 (11 to 12)	
		Governor flyweight nut			49 to 59 (5 to 6)	
		Automatic timer round nut	AD type		83 to 98 (8.5 to 10)	
			P type		125 to 145 (13 to 15)	
	Injection pump	〔AD type〕 	A bolt		49 to 54 (5 to 5.5)	
			B bolt		29 to 34 (3 to 3.5)	
			C bolt		29 to 34 (3 to 3.5)	
		〔P type〕 	A bolt		74 to 83 (7.5 to 8.5)	
			B bolt		44 to 49 (4.5 to 5)	
			C bolt		44 to 49 (4.5 to 5)	
	Injection pipe union nut			M14×1.5	29(3)	
				M12×1.5	20(2)	
	Injection nozzle	Nozzle bolt(for attaching to cylinder head)		M8×1.25	15(1.5)	
		Inlet connector		M14×1.5	135(14)	
		Retainting nut			59 to 78 (6 to 8)	
		Nozzle cap nut			39 to 49 (4 to 5)	

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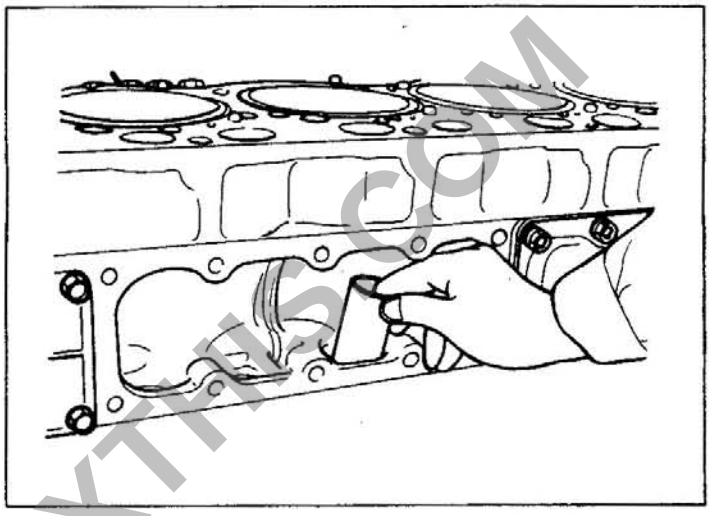


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2. When the cylinder head gasket is removed, make sure that the cylinder head and crankcase are not scratched.

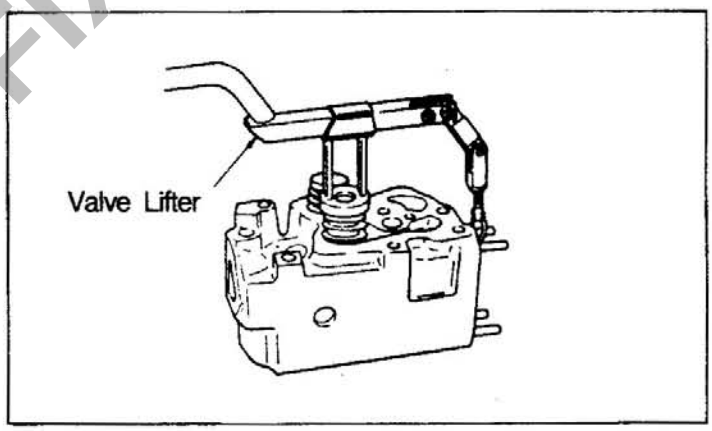
3. Since the cylinder head is located by dowel pins on the top surface of the crankcase, make sure that the cylinder head is lifted straight upward when removed.

(5) Remove the crankcase side cover 11 and remove the tappet 12 from the crankcase.



(6) Remove the valve cap 13. Using Valve Lifter(special tool) as shown, remove the valve cotter 14.

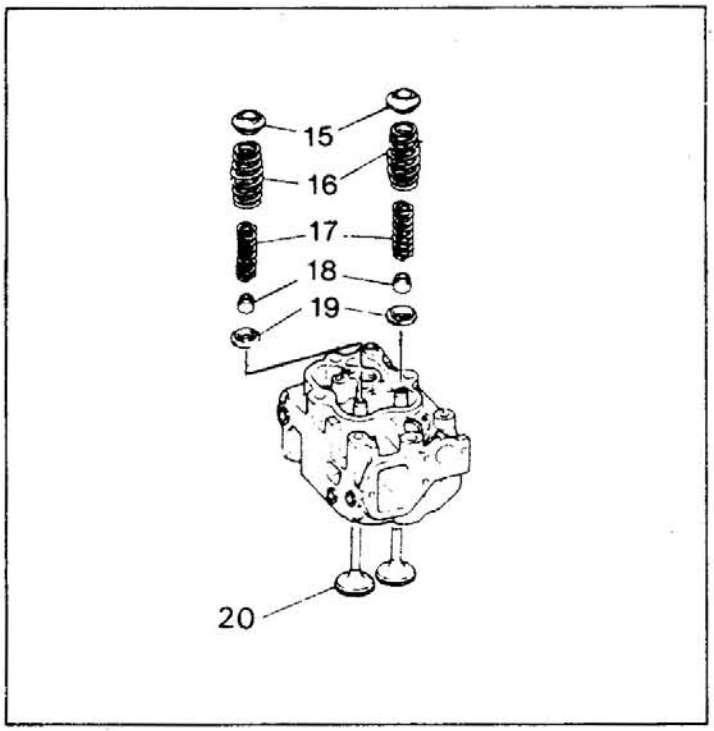
NOTE : Make sure that the valve spring is evenly compressed.



(7) Remove the following parts.

15 Upper retainer
16 Outer valve spring
17 Inner valve spring
18 Valve stem seal
19 Lower retainer
20 Valve

NOTE : When the valve stem seal was removed, make sure that a new one is installed.



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2-3-2 Tightening Torque of General Bolts and Nuts

When parts are tightened, use the bolts and nuts specified in the specifications. Parts for which no bolts and nuts are specified should be tightened with general bolts and nuts torqued as shown below.

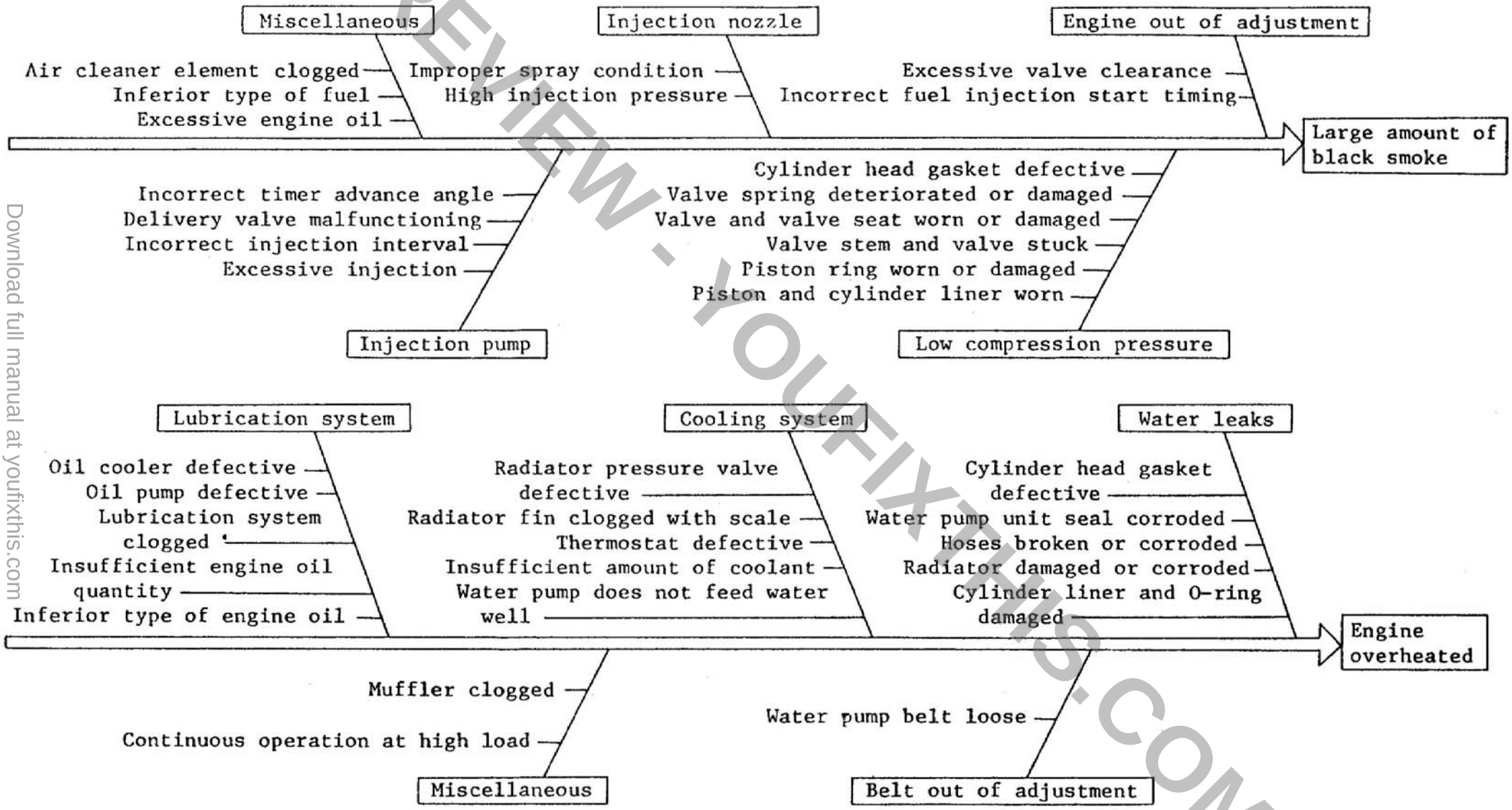
Unit : N m(kgf m)

Thread diameter mm	Pitch mm	4T (Head mark : 4 or ○)	7T (Head mark : 7 or ※)	8T (Head mark : 8 or ⊕)
5	0.8	2.0 to 2.9 (0.2 to 0.3)	4.0 to 5.8 (0.4 to 0.6)	5.0 to 6.8 (0.5 to 0.7)
6	1.0	4.0 to 5.8 (0.4 to 0.6)	6.9 to 10 (0.7 to 1.1)	7.9 to 11 (0.8 t 1.2)
		[4.0 to 5.8 0.4 to 0.6]	[7.9 to 11 (0.8 to 1.2)]	[8.9 to 13 (0.9 to 1.4)]
8	1.25	8.9 to 13 (0.9 to 1.4)	17 to 25 (1.7 to 2.6)	20 to 29 (2.0 to 3.0)
		[9.9 to 14 (1.0 to 1.5)]	[19 to 27 (1.9 to 2.8)]	[22 to 32 (2.2 to 3.3)]
10	1.25	19 to 27 (1.9 to 2.8)	35 to 53 (3.5 to 5.5)	45 to 58 (4.5 to 6.0)
		[21 to 30 (2.1 to 3.1)]	[39 to 58 (3.9 to 6.0)]	[50 to 63 (5.0 to 6.5)]
	1.5	18 to 26 (1.8 to 2.7	33 to 49 (3.3 to 5.0)	43 to 105 (4.3 to 6.0)
12	1.25	34 to 49 (3.4 to 5.0)	69 to 93 (7.0 to 9.5)	84 to 105 (8.5 to 11)
		[38 to 53 3.8 to 5.5]	[79 to 105 (8.0 to 11)]	[89 to 115 (9.0 to 12)]
	1.75	31 to 46 (3.1 to 4.7)	64 to 83 (6.5 to 8.5)	74 to 98 (7.5 to 10)
14	1.5	59 to 83 (6.0 to 8.5)	120 to 155 (12 to 16)	130 to 175 (13 to 18)
	2.0	54 to 73 (5.5 to 7.5)	110 to 135 (11 to 14)	120 to 165 (12 to 17)
16	1.5	94 to 125 (9.5 to 14)	180 to 235 (18 to 24)	200 to 260 (20 to 27)
	2.0	89 to 115 (9.0 to 12)	160 to 215 (16 to 22)	190 to 250 (19 to 26)

NOTE : 1. Threaded portion and bearing surface are in dry state.
2. Tightening torque of flange bolts and nuts is shown in[ ].

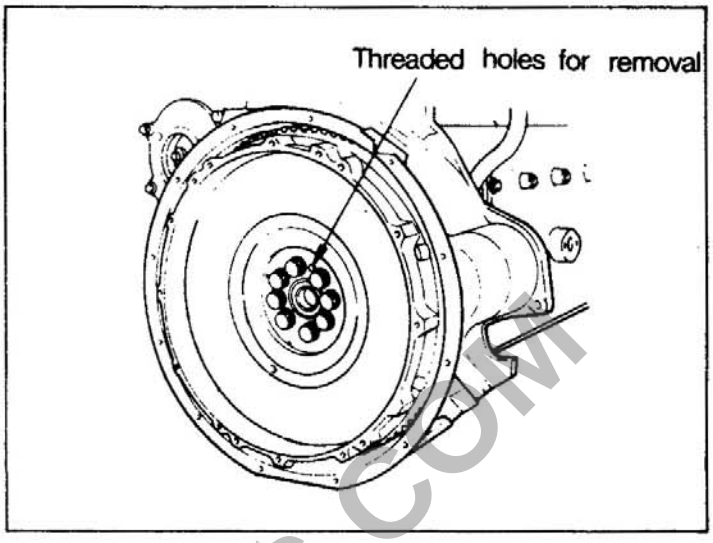
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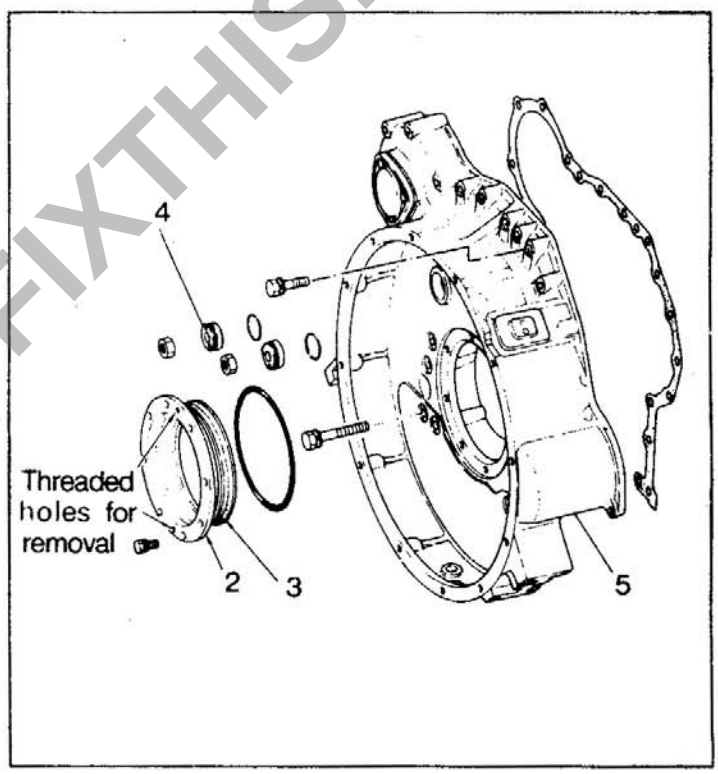
(1) Thread the mounting bolt into the removing threaded hole to remove the flywheel 1.



(2) Remove the following parts.

2 Oil seal retainer
3 Oil seal
4 Collar
5 Flywheel housing

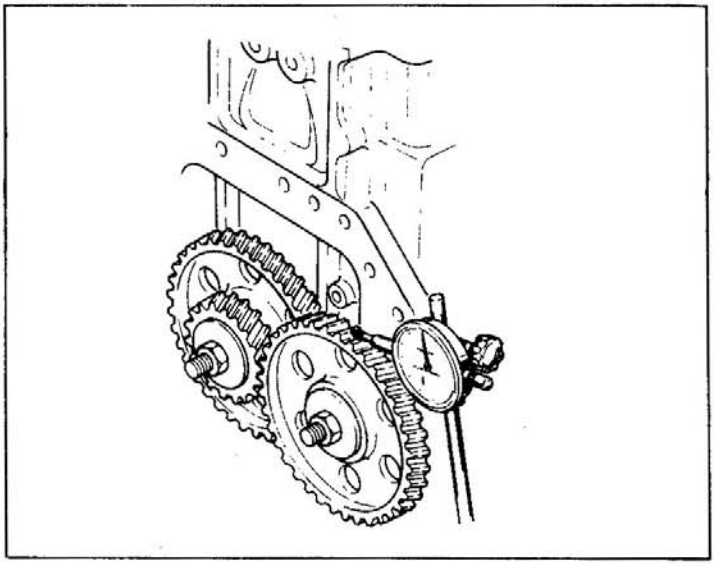
Remove the oil seal retainer with oil seal attached by threading the mounting bolts evenly into the removing threaded holes.



NOTE : Do not remove the pointer mounted to the inspection window of the flywheel housing.

(3) Measure the backlash between the individual gears. Parts that have exceeded the service limit should be replaced.

NOTE : For a pair of gears, the backlash should be measured at more than three points to determine whether it is acceptable.



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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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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	℃	℉	t℃=(1.8t℃+32)℉

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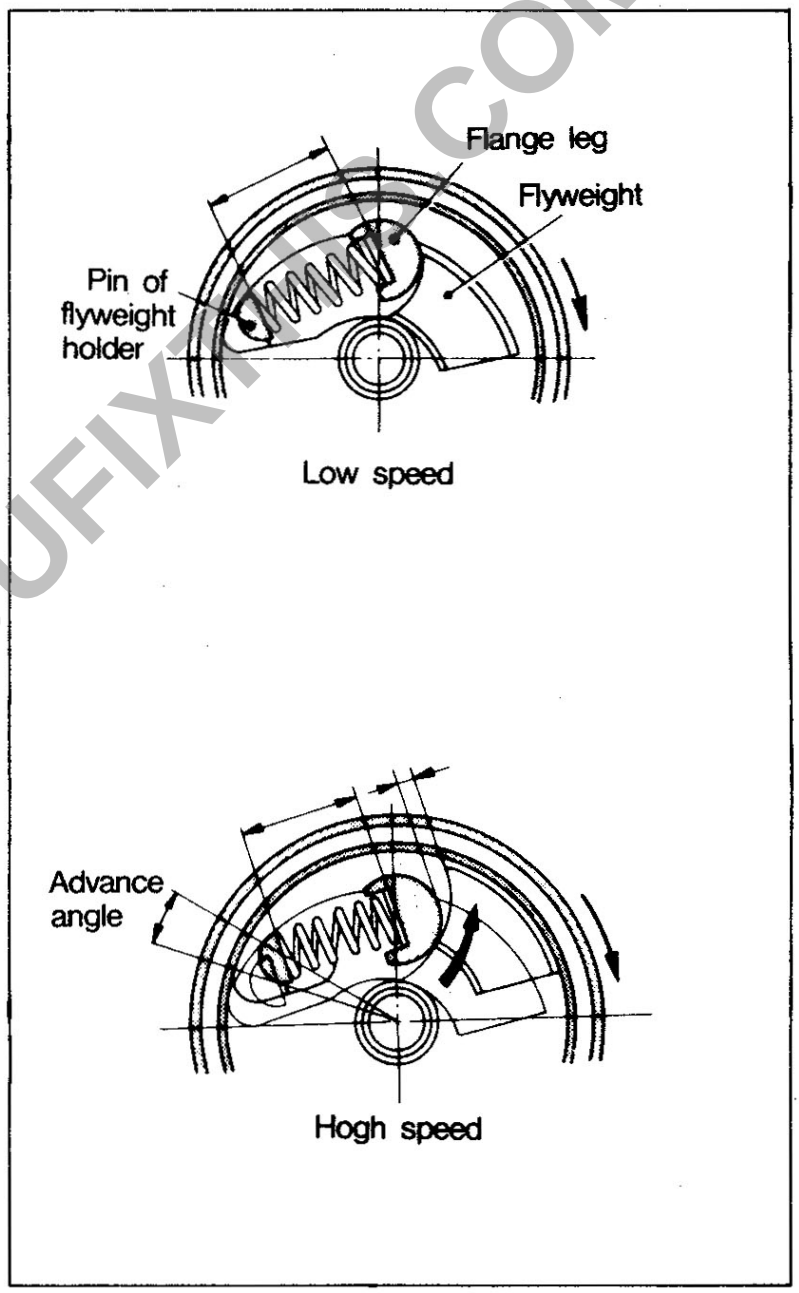
The two flyweights have a hole at one end. The pins of the flyweight holder fit in the holes. The flange legs touch the curved surfaces of the flyweights. Timer springs are mounted to the flyweight pins and flange legs.

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.



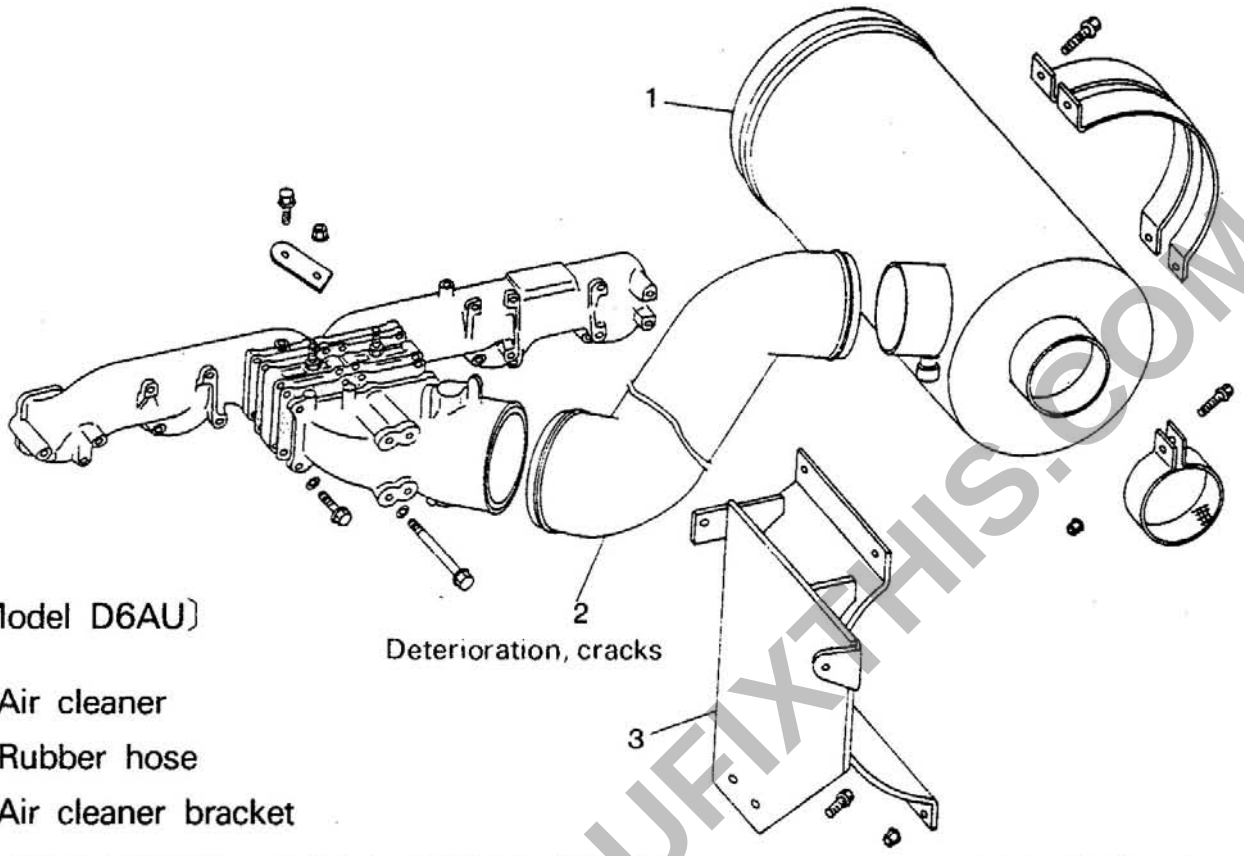
If the engine speed changes from a high to low speed, the centrifugal force of the flyweights will decrease and the flyweights will return to their original positions. At the same time, the pins of the flyweight holder will be pushed back by the timer springs.

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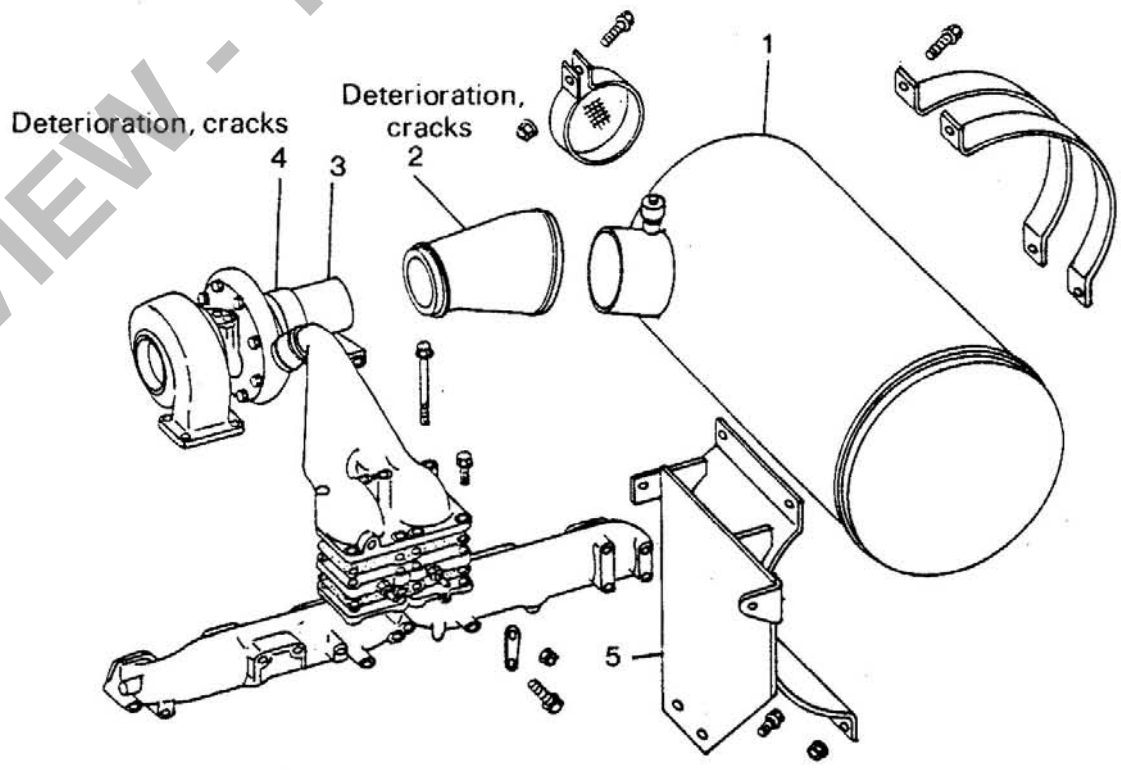
6-2-2 Inlet and Exhaust

(1) Air Cleaner



〔Model D6AU〕

1 Air cleaner
2 Rubber hose
3 Air cleaner bracket



〔Model D6AZ〕

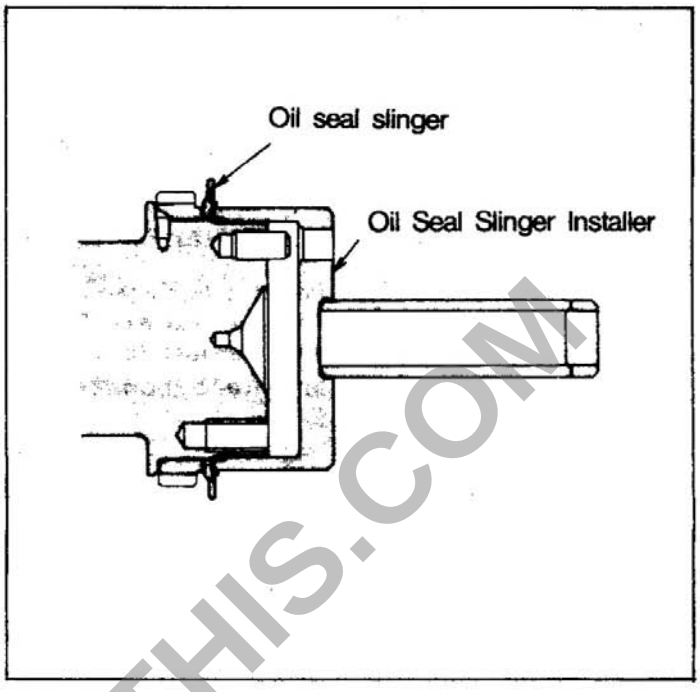
1 Air cleaner
2 Rubber hose
3 Air inlet pipe
4 Rubber hose
5 Air cleaner bracket

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(c) Heat the gear to about 100℃, using a piston heater, etc.
Locate the gear so that the dowel pin of the crankshaft will fit in the notch of the gear and fit the gear by lightly striking the gear end with a soft hammer.

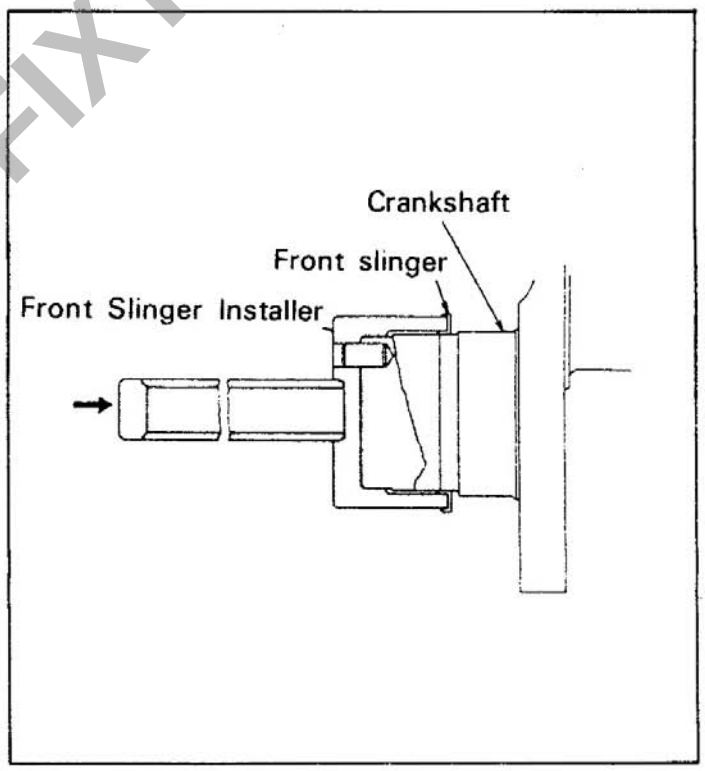
(b) Install the oil seal slinger, using Oil Seal Slinger Installer(special tool).
NOTE : Install the oil seal slinger with the threaded surface toward the flywheel.



(7) Relacement of Front Slinger

(a) Remove the front slinger from the crankshaft.

(b) Install the front slinger, using Front Slinger Installer(special tool).



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(4) RFD Type Governor

The part numbers are the ZEXEL part numbers.

Special Tool Name	Part No.	Use
Socket wrench	157914-0500	Removal and installation of lock nut
Special wrench	157915-0100	Removal and installation of round nut
Extractor	157926-5320	Removal of flyweight

(5) SA Type Automatic Timer

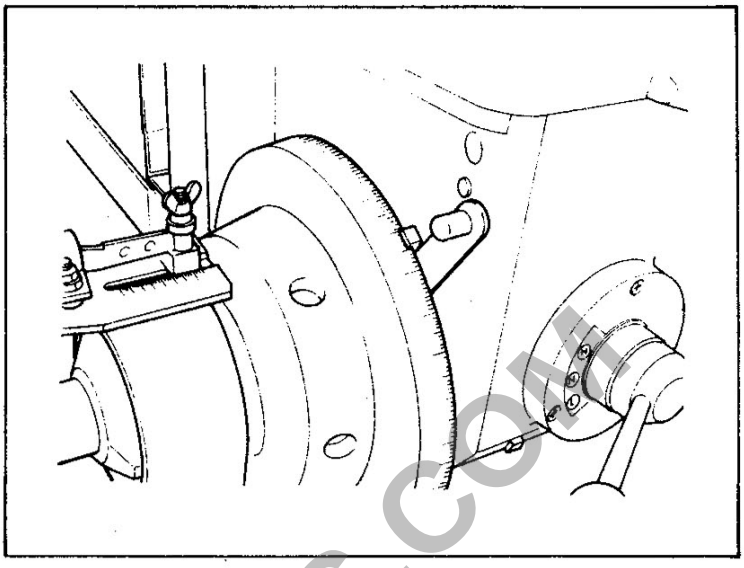
The part numbers are the ZEXEL part numbers.

Special Tool Name	Part No.	Use
SA type automatic timer special tool set	105790-5010	Disassembly and reassembly
Special spanner	157916-5320	Removal and installation of round nut
Extractor	157926-6210	Removal
Guide bolt	157924-0200	Disassembly and reassembly
Base	157924-0110	
Hand spanner	157916-6120	Removal and installation of timer case
Thrust bushing	157924-1500	Installation of oil seal
Guide bushing	157924-1200	
Block	157924-0800	
Guide bushing	157924-1300	
Guide	157924-0900	
Support	157932-0100	Installation of flyweight
Guide	157924-0400	
Thrust bushing	157924-0500	Installation of flange
Oil seal guide	157914-0600	Insertion of timer case

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(d) Adjustment of injection start interval



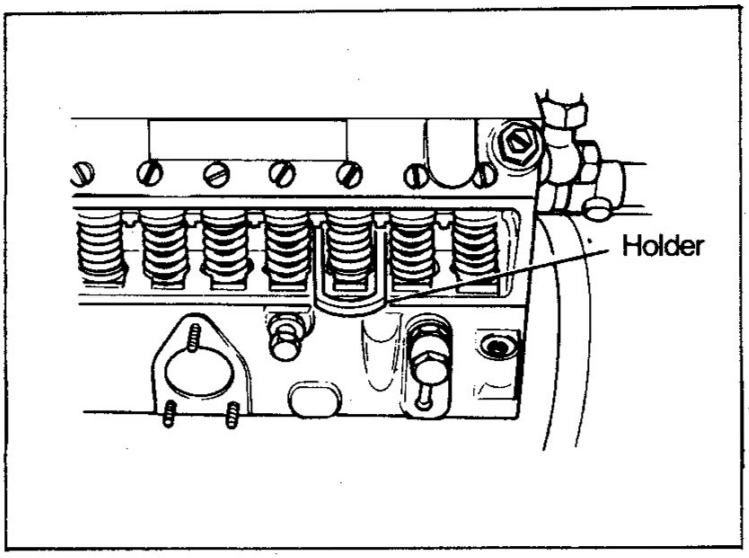
1) Couple tester nozzles to all the cylinders of the injection pump as in the case of adjustment of the prestroke.

2) Force fuel into the injection pump to let the fuel flow out from the tester nozzle.

3) On the basis of the static injection beginning of the No. 1 cylinder, measure the interval when the fuel ceases to flow out according to the injection sequence, using an angle scale.

NOTE : Injection sequence

1-5-3-6-2-4



4) If the prestroke and injection start interval are out of specification, insert a special tool(Holder) between the tappet and lower seat and then adjust by changing the shim thickness.

Shim thickness

29 Kinds from 0.20 to 1.60mm, 0.05mm apart

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