

# WORKSHOP MANUAL



## 6.280 HE

60 300076

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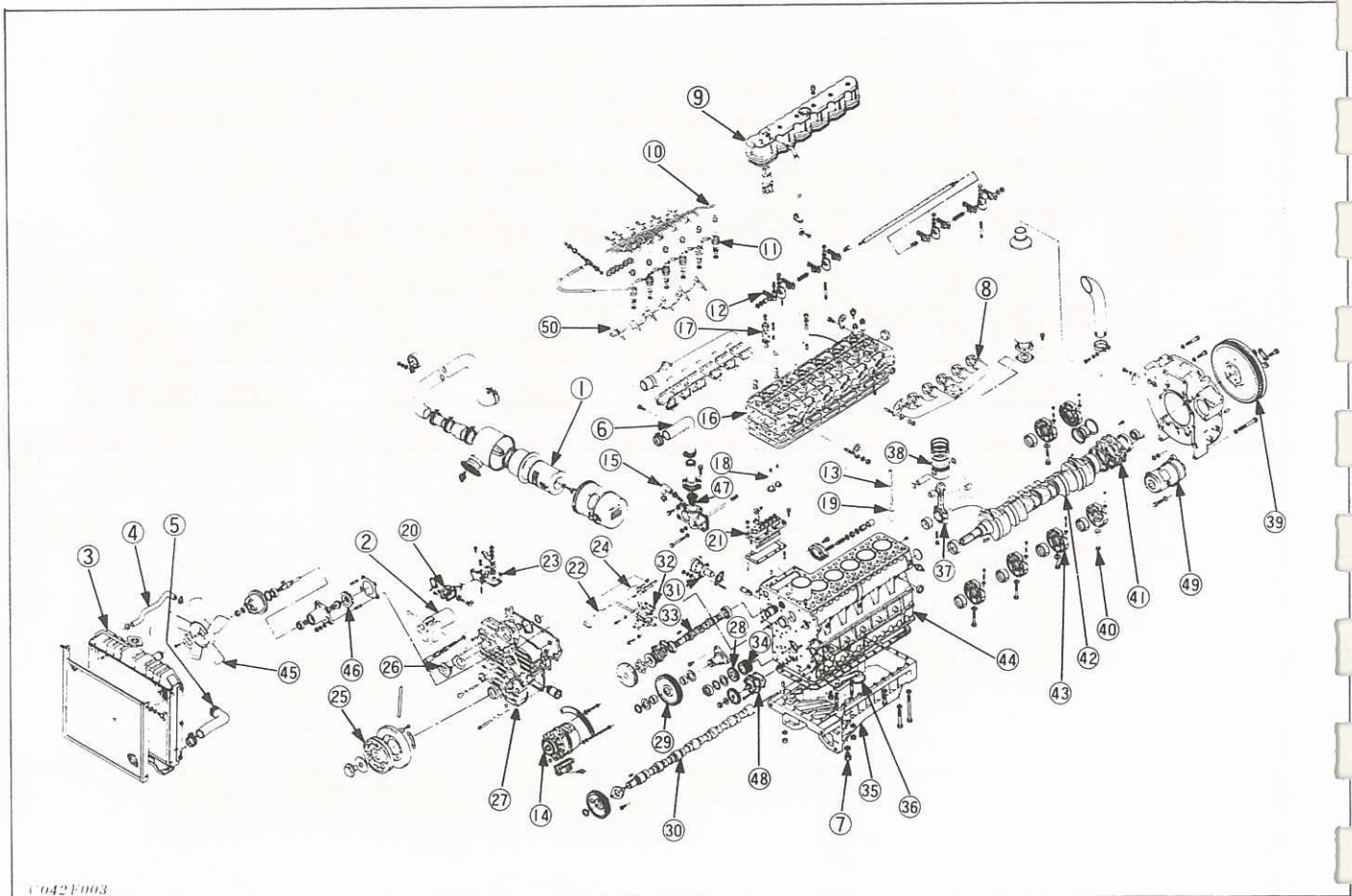
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# ENGINE COMPONENTS (Keyed in accordance with Dismantling Procedure)

## ELEMENTS DU MOTEUR (Repérés selon la procédure de démontage)

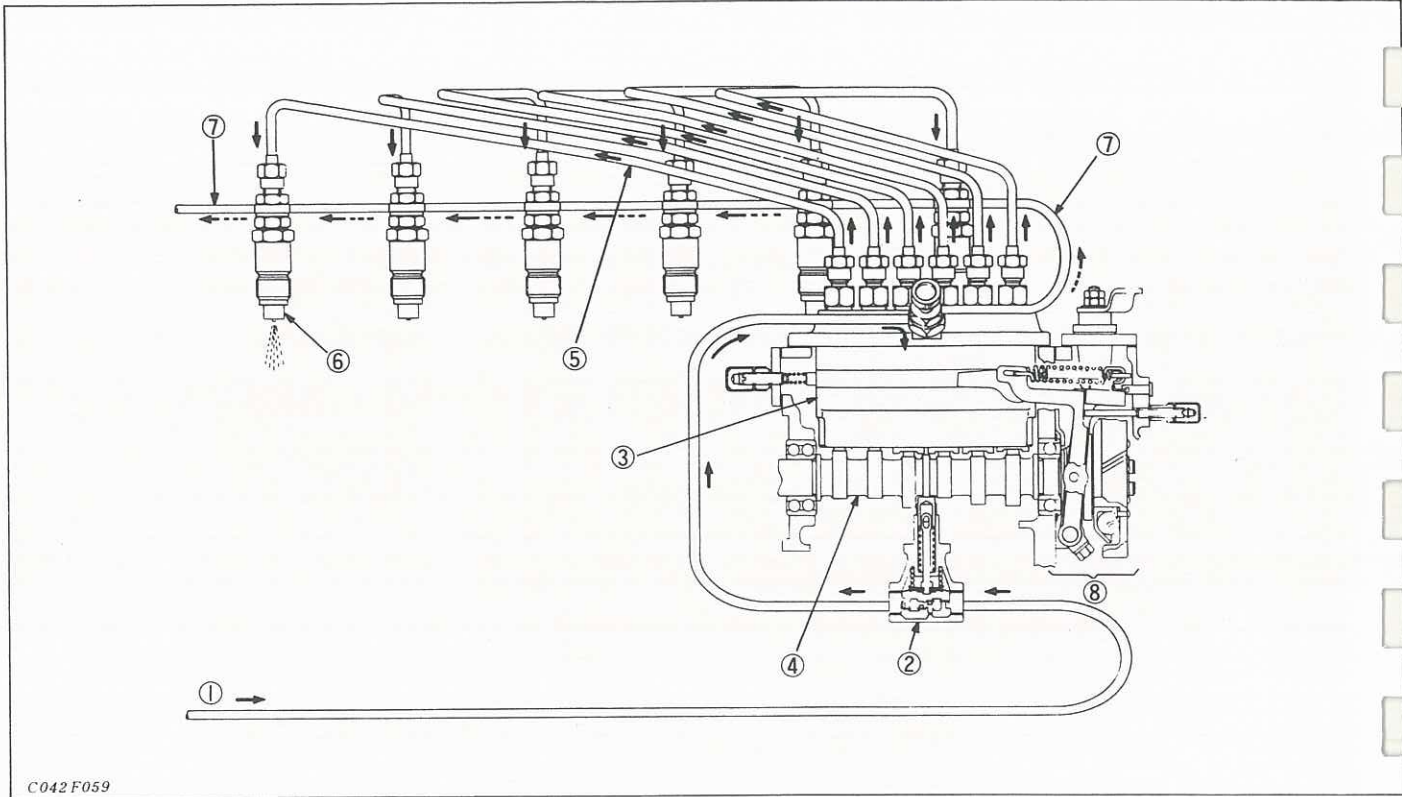
### MOTORTEILE (Auflistung in Übereinstimmung mit den Ausbaurbeiten)



C042F003

- |                         |                             |                          |
|-------------------------|-----------------------------|--------------------------|
| (1) Air Cleaner         | (17) Valve Spring           | (34) Crankshaft Gear     |
| (2) Oil Filter 2        | (18) Valve                  | (35) Oil Pan             |
| (3) Radiator            | (19) Tappets                | (36) Oil Strainer        |
| (4) Return Pipe 3       | (20) Injection Pump Cover   | (37) Connecting Rod Cap  |
| (5) Water Pipe 1        | (21) Injection Pump         | (38) Piston              |
| (6) Water Pipe 4        | (22) Governor Spring        | (39) Flywheel            |
| (7) Drain Plug          | (23) Speed Adjustment Plate | (40) Bearing Case Bolt 2 |
| (8) Exhaust Manifold    | (24) Start Spring           | (41) Bearing Case Cover  |
| (9) Cylinder Head Cover | (25) Fan Drive Pulley       | (42) Crankshaft          |
| (10) Injection Pipe     | (26) Hour Meter Unit        | (43) Main Bearing Case   |
| (11) Injection Nozzle   | (27) Gear Case              | (44) Crankcase           |
| (12) Rocker Arm         | (28) Oil Pump Drive Gear    | (45) Fan                 |
| (13) Push Rod           | (29) Idle Gear              | (46) Water Pump          |
| (14) Alternator         | (30) Camshaft               | (47) Thermostat          |
| (15) Return Pipe 2      | (31) Fuel-feed Pump         | (48) Oil Pump            |
| (16) Cylinder Head      | (32) Fork Lever Holder      | (49) Starter             |
|                         | (33) Fuel Camshaft          | (50) Glow Plug           |

# FUEL SYSTEM

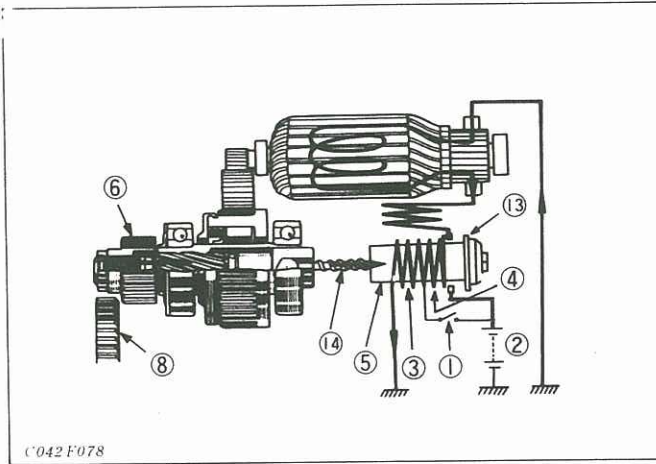


C042F059

When the engine is running, fuel from the fuel tank is cleansed of foreign matter as it passes through the fuel filter and is fed to injection pump (3) by the action of fuel feed pump (2). The injection pump is operated by the action of fuel camshaft (4) and fuel is pressure-fed to the injection nozzles (6) after passing through injection pipes (5), and the nozzles spray fuel into the combustion chambers.

Fuel that lubricates the injection pump and nozzles and fuel leakage is automatically returned to the fuel tank through overflow pipe (7).

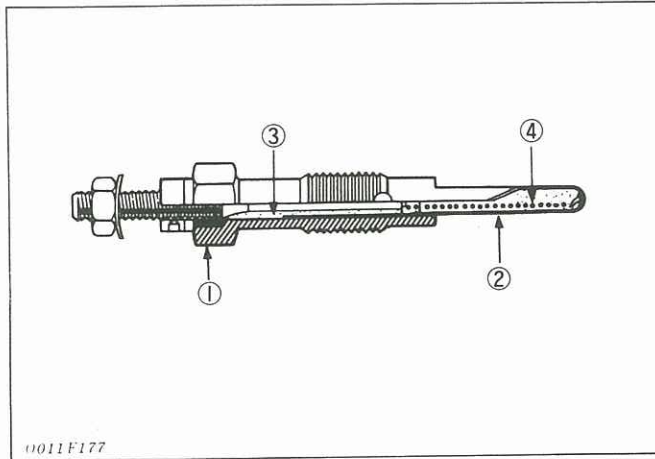
- (1) From Fuel Filter
- (2) Fuel Feed Pump
- (3) Injection Pump
- (4) Fuel Camshaft
- (5) Injection Pipe
- (6) Injection Nozzle
- (7) Overflow Pipe
- (8) Governor



### ■ When Key Switch Is Released

When the key switch is released, the key switch automatically reverts to the "ON" position from "START", and the starter circuit becomes "OFF". At that time, current flows from battery (2) to pull-in coil (4) and holding coil (3) through contact plate (13) but the magnetism of the pull-in coil and that of the holding coil are reversed, thereby mutually cancelling each other, and plunger (5) returns to its original position as a result of the force of main spring (14). Contact plate (13) then opens and pinion gear (6) disengages from ring gear (8) and stops rotating.

- (13) Contact Plate
- (14) Main Spring



### 2. Glow Plug

As a quick-heating glow plug is used to reduce pre-heating time, starting can be readily performed in approximately half the conventional pre-heating time. Six glow plugs are joined in parallel and operate during pre-heating and start rotation.

Glow plug specification	
Type	Sheathed
Rated voltage	10 V
Power consumption	6.4 to 7.8 A

- (1) Housing
- (2) Metallic Tube
- (3) Insulation Powder
- (4) Heating Coil

Item	Factory Specification			Allowable Limit		
	S2200-B	S2600-B	S2800-B	S2200-B	S2600-B	S2800-B

### [Rocker Arm]

Clearance between rocker arm shaft and bushing	0.018 to 0.070 mm (0.00071 to 0.00276 in.)			0.15 mm (0.0059 in.)		
Rocker arm shaft O.D.	13.973 to 13.984 mm (0.55012 to 0.55055 in.)			-		
Rocker arm bushing I.D.	14.002 to 14.043 mm (0.55126 to 0.55287 in.)			-		
Adjustment of compression release	0.750 to 1.125 mm (0.0295 to 0.0443 in.)	-	-	-	-	-

### [Tappet]

Clearance between tappet and guide	0.020 to 0.062 mm (0.00079 to 0.00244 in.)			0.07 mm (0.0028 in.)		
Tappet O.D.	23.959 to 23.980 mm (0.94327 to 0.94410 in.)			-		
Tappet guide I.D.	24.000 to 24.021 mm (0.94488 to 0.94571 in.)			-		

### [Camshaft]

Camshaft side clearance	0.07 to 0.22 mm (0.0028 to 0.0087 in.)			0.3 mm (0.0118 in.)		
Camshaft alignment	-			0.08 mm (0.0031 in.)		
Cam height (IN., EX.)	33.36 mm (1.3134 in.)			33.31 mm (1.3114 in.)		
Oil clearance of camshaft	0.050 to 0.091 mm (0.00197 to 0.00358 in.)			0.15 mm (0.0059 in.)		
Camshaft journal O.D.	39.934 to 39.950 mm (1.57221 to 1.57284 in.)			39.88 mm (1.5701 in.)		
Camshaft bearing I.D.	40.000 to 40.025 mm (1.57480 to 1.57579 in.)			-		

### [Timing Gear]

Timing gear backlash	0.04 to 0.11 mm (0.0016 to 0.0043 in.)			0.15 mm (0.0059 in.)		
Idle gear side clearance	0.20 to 0.51 mm (0.0079 to 0.0201 in.)			0.9 mm (0.035 in.)		
Clearance between idle gear shaft and idle gear bushing	0.020 to 0.054 mm (0.00079 to 0.00213 in.)			0.1 mm (0.004 in.)		
Idle gear shaft O.D.	27.967 to 27.980 mm (1.10106 to 1.10158 in.)			-		
Idle gear bushing I.D.	28.000 to 28.021 mm (1.10236 to 1.10319 in.)			-		
(Service Parts Dimension) Clearance between idle gear shaft and idle gear bushing	0.020 to 0.079 mm (0.00079 to 0.00311 in.)			0.1 mm (0.004 in.)		
Idle gear bushing I.D.	28.000 to 28.046 mm (1.10236 to 1.10417 in.)			-		

### [Cylinder Liner]

Cylinder liner I.D.	76.000 to 76.019 mm (2.99213 to 2.99288 in.)	82.000 to 82.022 mm (3.22835 to 3.22921 in.)	85.000 to 85.022 mm (3.34646 to 3.34732 in.)	76.17 mm (2.9988 in.)	82.17 mm (3.2350 in.)	85.17 mm (3.3532 in.)
	or +0.15 mm (0.0059 in.)					
Oversized cylinder liner I.D.	76.500 to 76.519 mm (3.01181 to 3.01256 in.)	82.500 to 82.522 mm (3.24803 to 3.24890 in.)	85.500 to 85.522 mm (3.36614 to 3.36701 in.)	76.67 mm (3.0185 in.)	82.67 mm (3.2547 in.)	85.67 mm (3.3728 in.)
	or +0.15 mm (0.0059 in.)					
Height from cylinder block	-0.025 to +0.025 mm (-0.0010 to +0.0010 in.)			-		



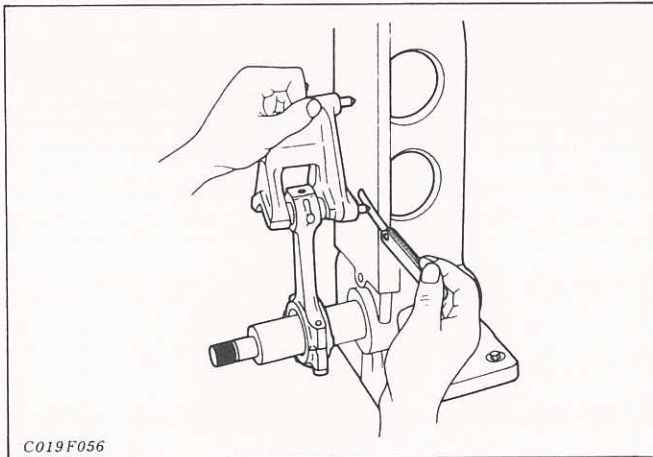
C056P010

### Radiator Tester

Code No.: 07909-31551

Application: Use to check of radiator cap pressure, and leaks from cooling systems.

(See page S-139)



C019F056

### Connecting Rod Alignment Tool

Code No.: 07909-31661

Application: Use to check the connecting rod alignment

Applicable range: Connecting rod large end I.D. 30 to 75 mm (1.18 to 2.95 in dia.)

Connecting rod length

65 to 330 mm (2.56 to 12.99 in.)

(See page S-121)



O011P105

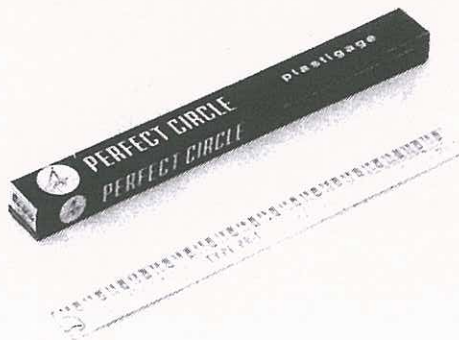
### Nozzle Tester

Code No.: 07909-31361

Application: Use to check the fuel injection pressure and spraying condition of nozzle.

(See page S-49, S-151)

Measuring range: 0 to 50 MPa (0 to 500 kgf/cm<sup>2</sup>, 0 to 7000 psi)



C056P011

S-57

### Press Gauge

Code No.: 07909-30241

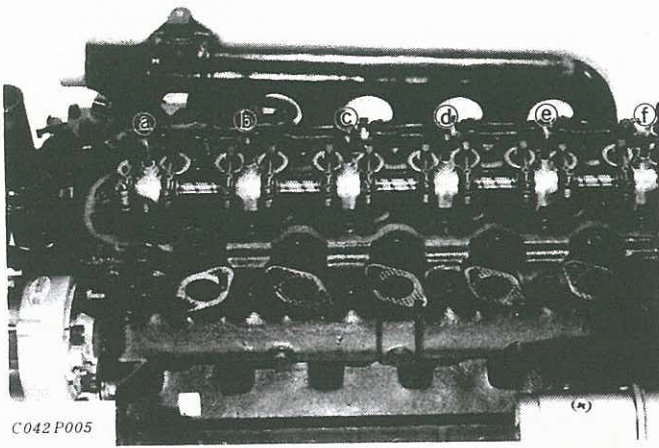
Application: Use to check the oil clearance between crankshaft and bearing, etc.

(See page S-123, S-125)

Measuring range: Green — 0.025 to 0.076 mm (0.01 to 0.03 in.)

Red — 0.051 to 0.152 mm (0.02 to 0.06 in.)

Blue — 0.102 to 0.229 mm (0.04 to 0.09 in.)



### Alternator, Fan Belt and Rocker Arm

1. Remove the alternator.
2. Remove the fan belt.
3. Remove the rocker arm bracket mounting nuts.
4. Remove the rocker arm as a unit.
5. Remove the push rods.

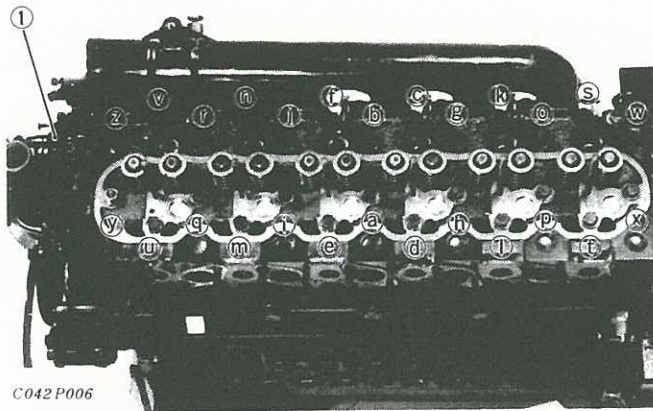
#### ■ Important:

- After reassembling the fan belt, be sure to adjust the fan belt tension. (See page S-43, S-139)
- After reassembling the rocker arm, be sure to adjust the valve clearance. (See page S-49, S-71)

#### (When reassembling)

- When putting the push rods onto the tappets, check to see if their ends are properly engaged with the grooves.
- Check to see that there are no cracks on the belt surface.
- Tighten the rocker arm bracket mounting nuts in the order as shown below.  
c → d → e → b → a → f → c → d → e → b → a → f

Tightening torque	Rocker arm bracket mounting nut	16.7 to 20.6 N·m 1.7 to 2.1 kgf·m 12.3 to 15.2 ft·lbs
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### Cylinder Head

1. Loosen the pipe band, and remove the water return pipe 2 (1).
2. Remove the cylinder head screws and nuts in the order of (z) to (a), and remove the cylinder head.
3. Remove the cylinder head gasket and O-ring.

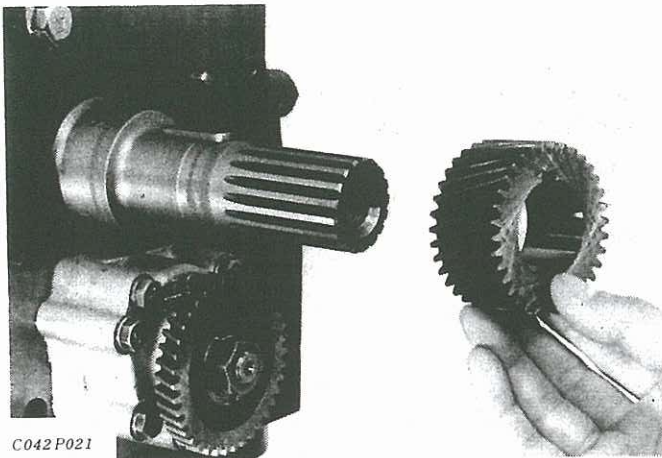
#### (When reassembling)

- Replace the head gasket with a new one.
- Install the cylinder head, using care not to damage the O-ring.
- Tighten the cylinder head screws and nuts gradually in the order of (a) to (z) after applying engine oil.
- Retighten the cylinder head screws and nuts after running the engine for 30 minutes or longer under the rated load.
- Before retightening, firstly loosen the head bolts by 1/3 turn and retighten them at the specified torque mentioned in the table.

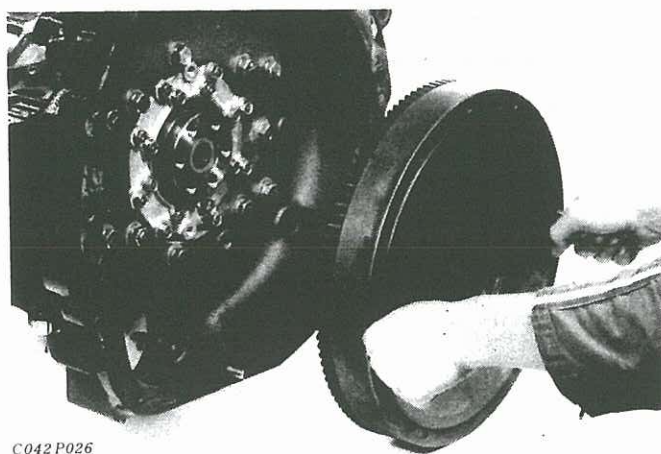
Tightening torque	Cylinder head screw and nut	88.3 to 92.2 N·m 9.0 to 9.4 kgf·m 65.1 to 68.0 ft·lbs
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(1) Water Return Pipe 2

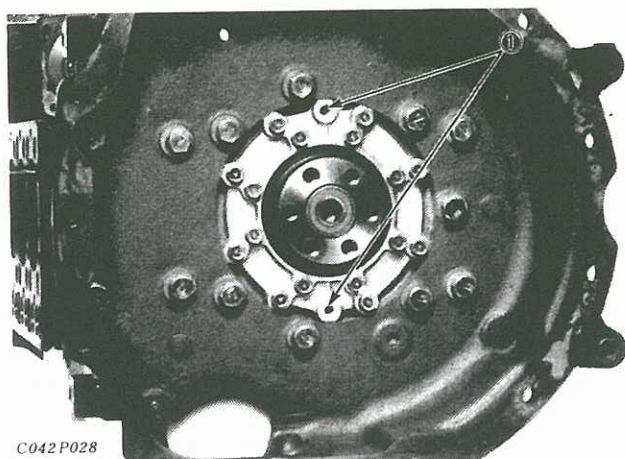
## [5] FLYWHEEL AND CRANKSHAFT



C042 P021



C042 P026



C042 P028

### Crank Gear

1. Remove the crank gear with a special-use puller set (Code No.07916-09032).
2. Remove the feather key on the crankshaft.

#### **(When reassembling)**

- Check to see that the feather key is on the crankshaft.
- Heat the crank gear to approx. 80°C (176°F), and fit on the crankshaft.  
If there is fear of the shaft being damaged, apply moderate heat to the gear.

### Flywheel

1. Lock the flywheel not to turn using the flywheel stopper (See page S-65).
2. Remove the flywheel screws, except for two which must be loosened and left as they are.
3. Set a flywheel puller (Code No. 07916-32011) (See page S-53), and remove the flywheel.

#### **(When reassembling)**

- Apply engine oil to the flywheel screws.
- Be sure to bend-up the lock-washer to prevent loosening.

Tightening torque	Flywheel screw	98.1 to 107.9 N·m 10.0 to 11.0 kgf·m 72.3 to 79.6 ft·lbs
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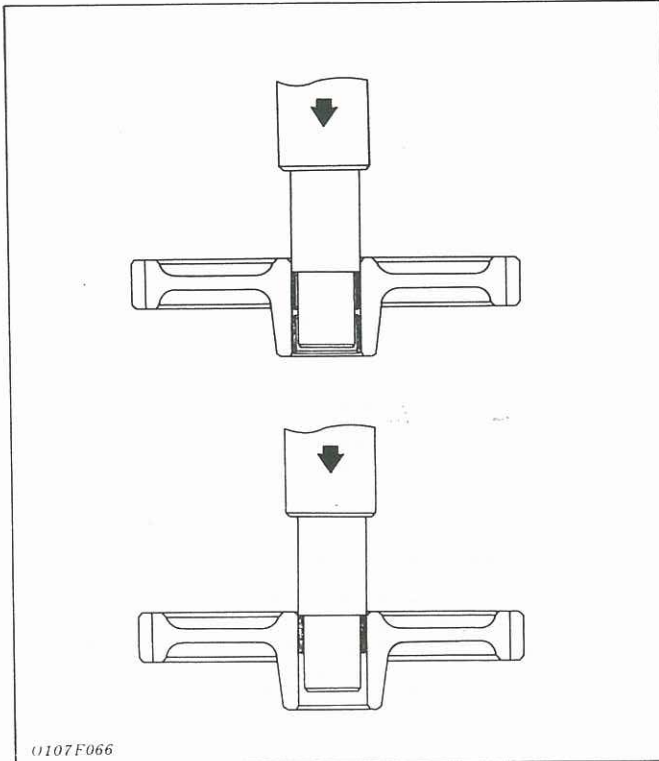
### Bearing Case Cover

1. Remove the bearing case cover mounting screws.  
[First remove the eight screws inside, and then work on the eight screws outside.]
2. Screw the two screws removed above into the right and left holes (1) of the bearing case cover, and remove the cover.

#### **(When reassembling)**

- When installing the bearing case cover, check to see that there are no scratches on the oil seal lip. Then, apply engine oil, and install.

(1) Screw Holes



## Replacing Idle Gear Bushings

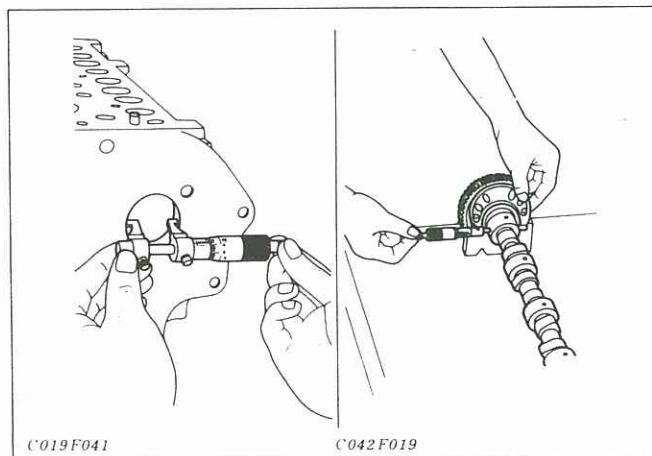
1. Press the used bushings out using a idle gear bushing replacing tool (See page S-63).
2. Press fit new bushings (Service parts: Code No. 15221-24981).

### (Reference)

- Service parts dimension

Clearance between idle gear shaft and idle gear bushing	Factory spec.	0.020 to 0.079 mm 0.00079 to 0.00311 in.
	Allowable limit	0.1 mm 0.004 in.

Idle gear shaft O.D.	Factory spec.	27.967 to 27.980 mm 1.10106 to 1.10158 in.
Idle gear bushing I.D.	Factory spec.	28.000 to 28.046 mm 1.10236 to 1.10417 in.

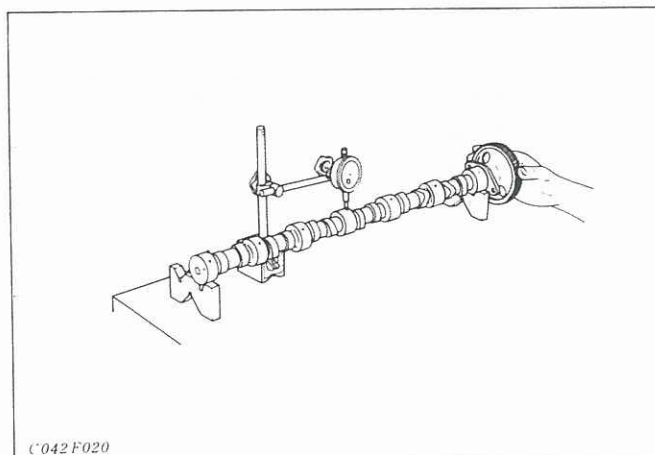


## Oil Clearance of Camshaft

1. Measure the camshaft bearing I.D. with an inside micrometer.
2. Measure the camshaft journal O.D. with an outside micrometer, and calculate the oil clearance.
3. If the oil clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft	Factory spec.	0.050 to 0.091 mm 0.0020 to 0.0035 in.
	Allowable limit	0.15 mm 0.0059 in.

Camshaft journal O.D.	Factory spec.	39.934 to 39.950 mm 1.57221 to 1.57284 in.
Camshaft bearing I.D.	Factory spec.	40.000 to 40.025 mm 1.57480 to 1.57579 in.



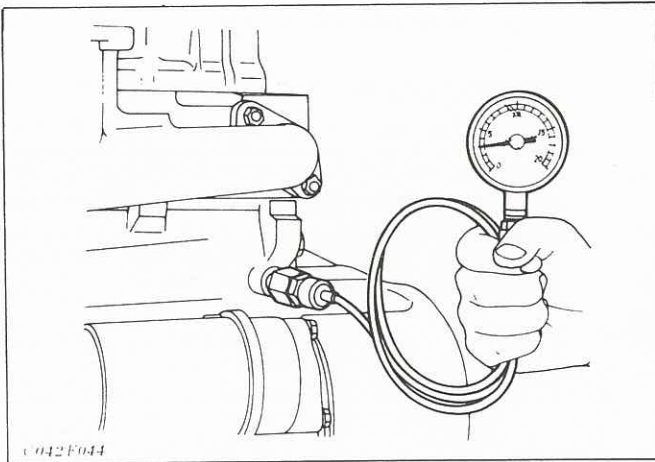
## Camshaft Alignment

1. Gently put the camshaft on V blocks.
2. Set a dial indicator to the journal.
3. While slowly rotating the camshaft, read the dial indicator. The camshaft flexure is half of the reading.
4. If the measurement exceeds the allowable limit, replace the camshaft.

Camshaft alignment	Allowable limit	0.08 mm 0.0031 in.
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# LUBRICATING SYSTEM

## CHECKING

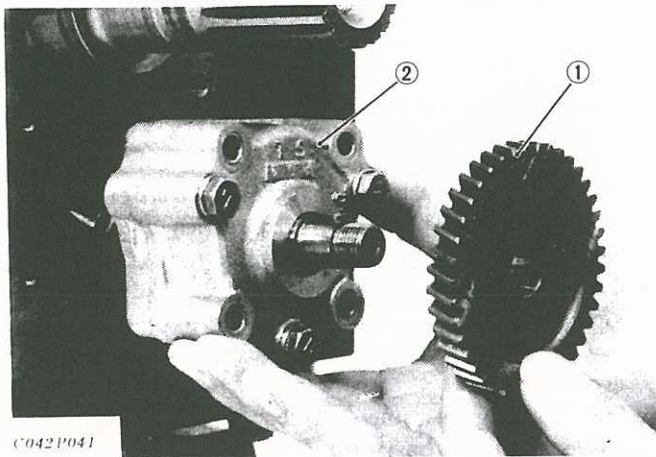


### Engine Oil Pressure

1. Remove the oil switch and set a pressure tester (Code No. 07916-32031).
2. Start the engine. Measure the oil pressure both at idling and at the rated speed.
3. If the measurement is less than the allowable limit, check the oil pump, oil gallery, oil clearance and relief valve.

Engine oil pressure	Factory spec.	294 to 441 kPa [ At rated speed ] 3.0 to 4.5 kgf/cm <sup>2</sup> 42.7 to 64.0 psi
		49 kPa [ At idle speed ] 0.5 kgf/cm <sup>2</sup> 7.11 psi
	Allowable limit	245 kPa [ At rated speed ] 2.5 kgf/cm <sup>2</sup> 35.6 psi

## DISASSEMBLY AND ASSEMBLY



### Oil Pump

1. Straighten the claw washer, and remove the nut.
2. Pull out the oil pump drive gear (1) with a puller.
3. Remove the oil pump mounting bolts.
4. Remove the oil pump (2).

- (1) Oil Pump Drive Gear  
(2) Oil Pump

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