



## CHAPTER 4. ENGINE OVERHAUL

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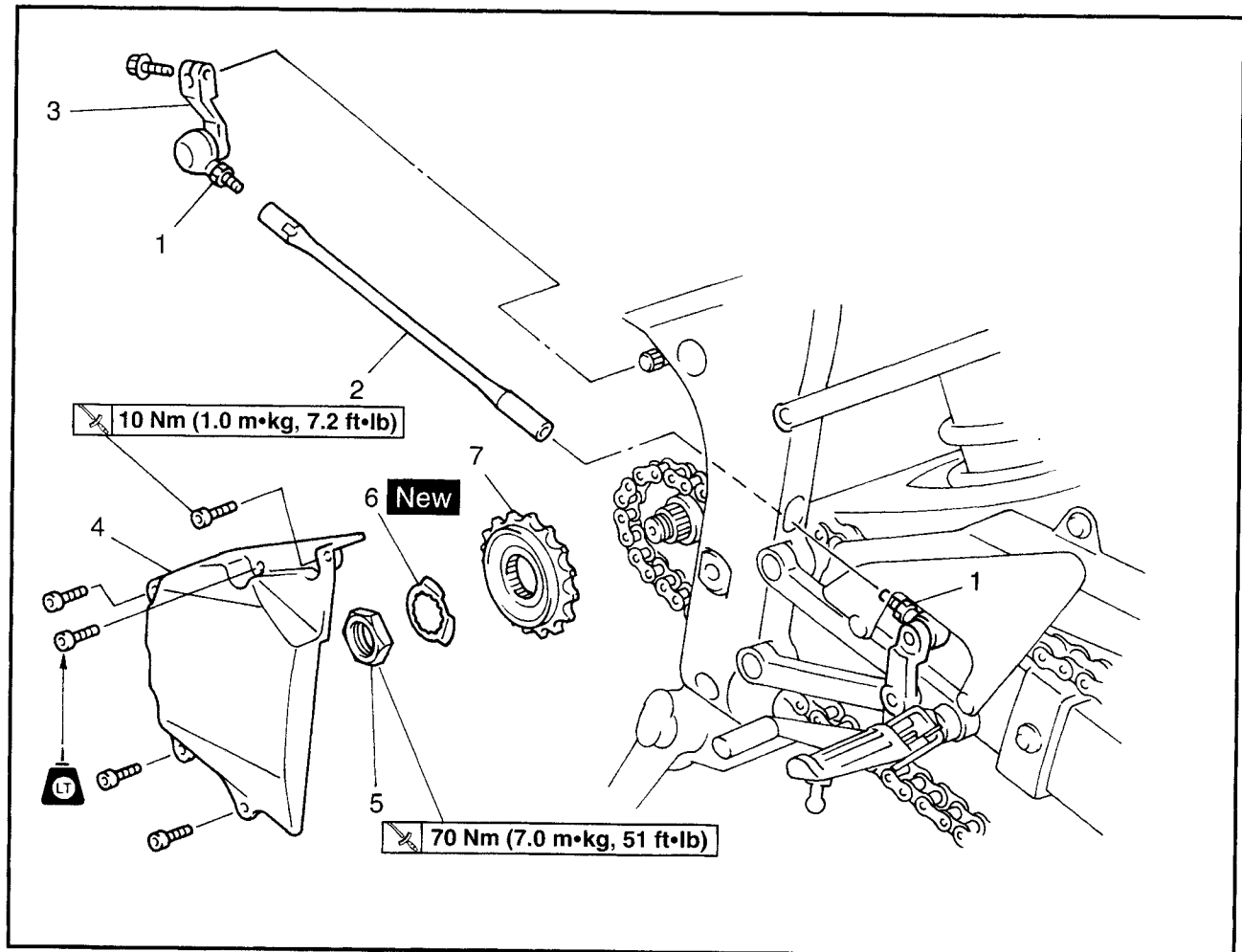
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EAS00190

# ENGINE OVERHAUL

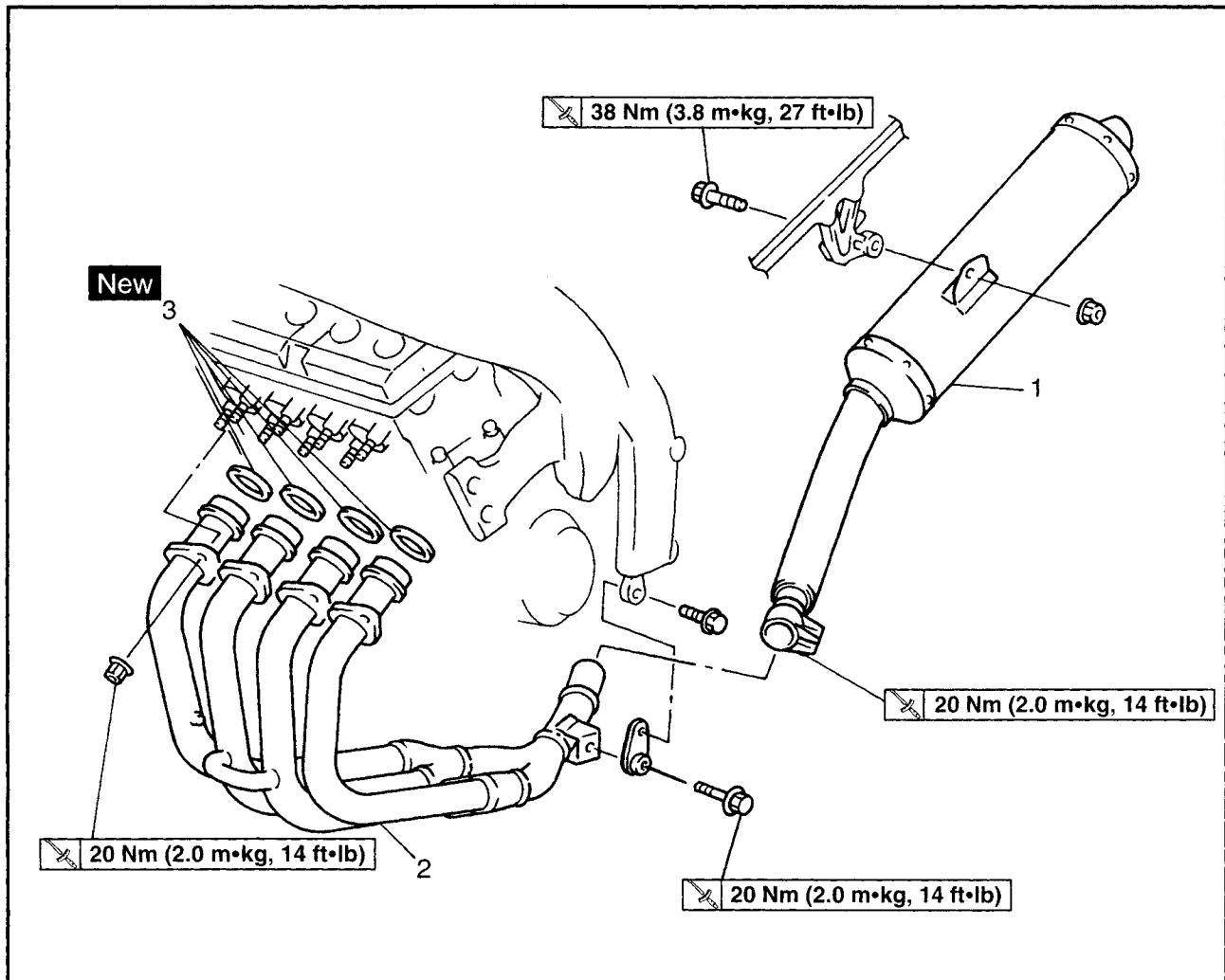
## ENGINE DRIVE SPROCKET



Order	Job/Part	Q'ty	Remarks
	<b>Removing the drive sprocket</b>		
	Reserve tank	2	Remove the parts in the order listed. Refer to "CHANGING THE COOLANT"
1	Locknut	1	
2	Shift rod	1	
3	Shift arm	1	
4	Drive sprocket cover	1	
5	Nut	1	
6	Lock washer	1	
7	Drive sprocket	1	
			For installation reverse the remove procedure.



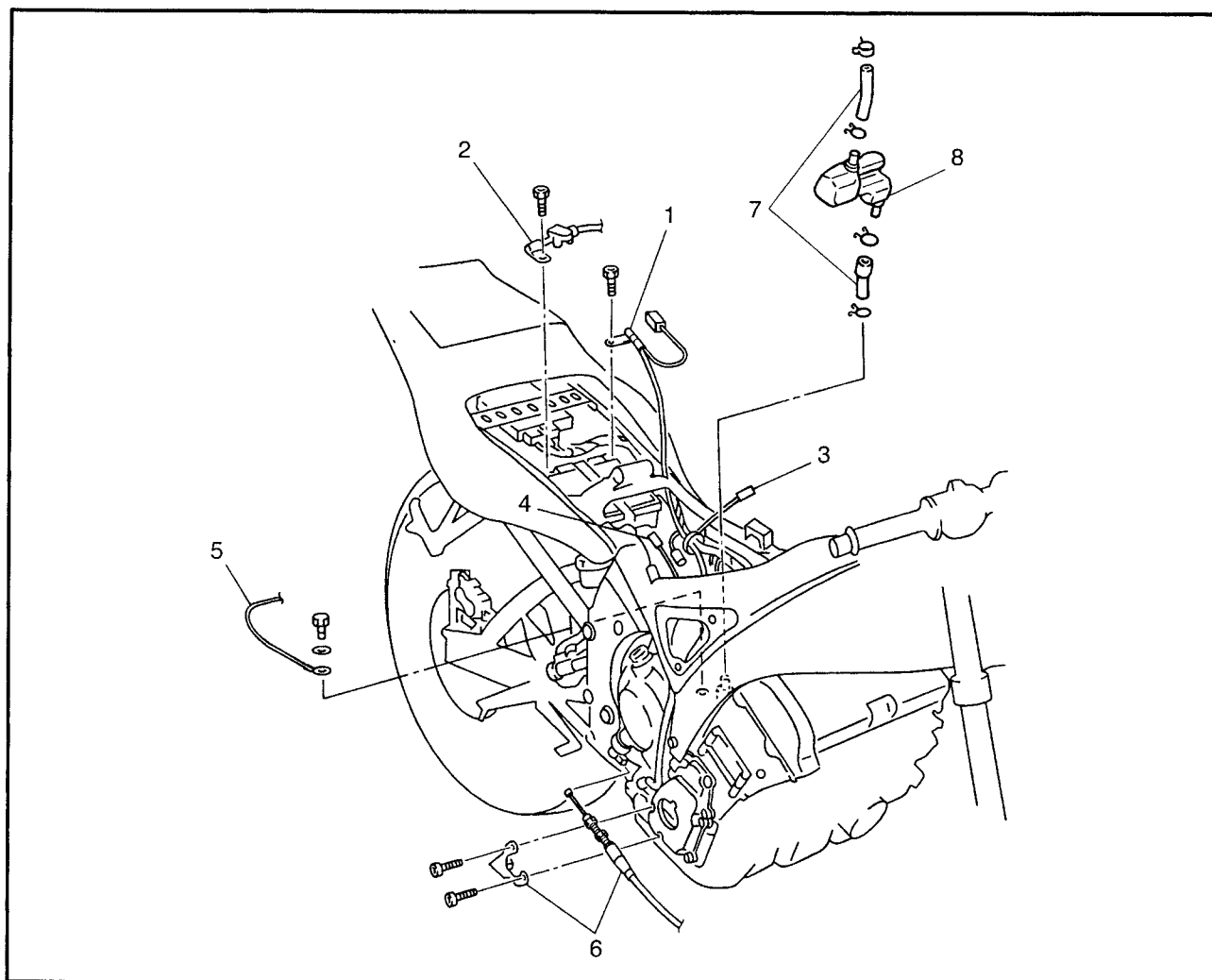
## EXHAUST ASSEMBLY



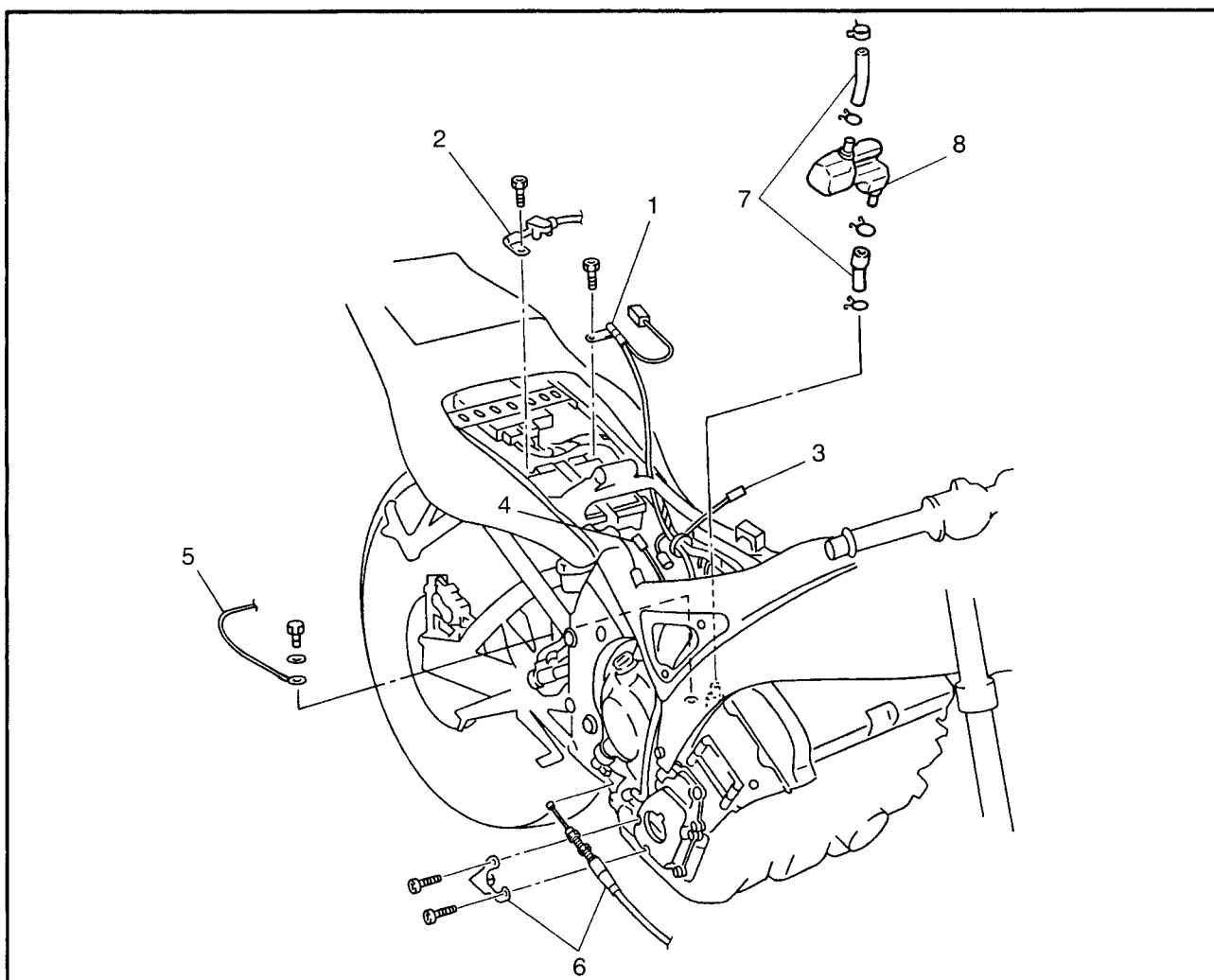
Order	Job/Part	Q'ty	Remarks
	<b>Removing the exhaust assembly</b> Bottom cowl and side cowlings Coolant		Remove the parts in the order listed. Refer to "COWLINGS" in chapter 3 Drain. Refer to "CHANGING THE COOLANT" in chapter 3. Refer to "RADIATOR" in chapter 5.
1	Radiator assembly	1	
2	Muffler	1	
3	Exhaust pipe assembly	1	
	Exhaust pipe gasket	4	
			For installation reverse the removal procedure.




## LEADS AND HOSES



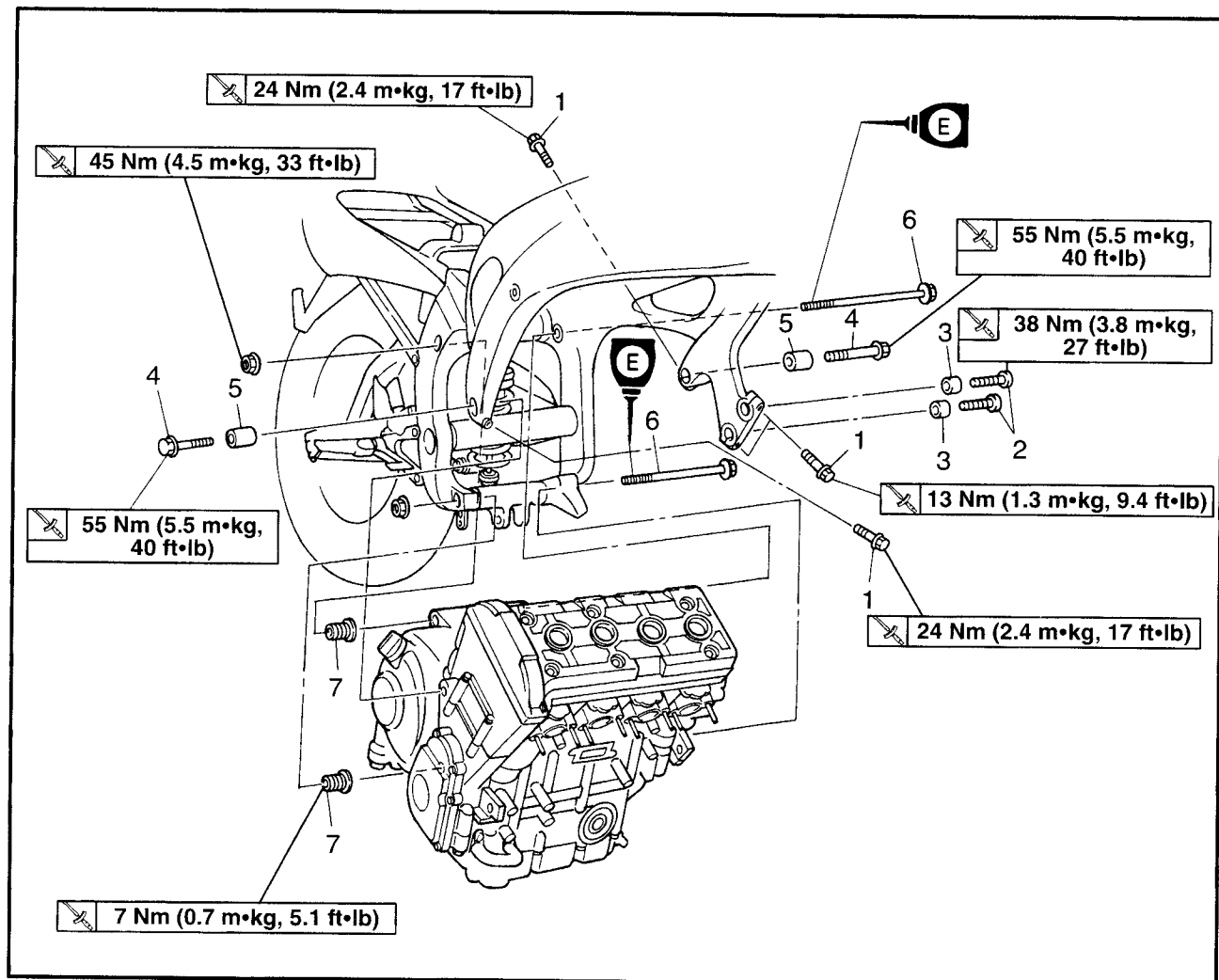
Order	Job/Part	Q'ty	Remarks
	<b>Disconnecting the leads and hoses</b>		
	Fuel tank		Disconnect the parts in the order listed.
	Air filter case		Refer to "FUEL TANK" in chapter 3.
	Carburetor assembly and joints		Refer to "AIR FILTER CASE AND IGNITION COILS" in chapter 3.
	Engine oil and oil filter cartridge		Refer to "CARBURETORS" in chapter 6.
	Oil cooler		Drain.
			Refer to "CHANGING THE ENGINE OIL" in chapter 3.
			Refer to "OIL COOLER" in chapter 5.



Order	Job/Part	Q'ty	Remarks
1	Battery negative lead	1	<b>CAUTION:</b>  _____ <b>First, disconnect the negative lead, then the positive lead.</b> _____  For connecting reverse the disconnecting procedure.
2	Battery positive lead	1	
3	Stator coil assembly coupler	1	
4	Pickup coil coupler	1	
5	Engine earth	1	
6	Clutch wire and holder	1	
7	Crankcase breather hose	1	
8	Separator	1	



## ENGINE



Order	Job/Part	Q'ty	Remarks
	<b>Removing the engine</b>		Remove The Parts In The Order Listed. <b>NOTE:</b> _____ Place a suitable stand under the frame and engine.
1	Pinch bolts	4	Refer to "INSTALLING THE ENGINE".
2	Button head bolts	2	
3	Collars	2	
4	Front mounting bolts	2	
5	Collars	2	
6	Rear mounting bolts	2	
7	Engine mounting adjust bolts	2	
			<b>NOTE:</b> _____ Use the point shaft wrench to loosen the engine mounting adjust bolt.
			For Installation, Reverse The Removal Procedure.



EAS00192

## INSTALLING THE ENGINE

### 1. Install:

- engine mounting adjust bolts ①
- rear mounting bolts ②
- self-locking nuts ③
- collars ④
- front mounting bolts ⑤
- collars ⑥
- button head bolts ⑦
- pinch bolts ⑧

### NOTE:

- Lubricate the rear mounting bolt threads with lithium soap base grease.
- Do not fully tighten the nuts and bolts.

### 2. Tighten:

- self-locking nut 45 Nm (4.5 m•kg, 33 ft•lb)
- front mounting bolts 55 Nm (5.5 m•kg, 40 ft•lb)
- button head bolt 38 Nm (3.8 m•kg, 27 ft•lb)
- pinch bolt M8 24 Nm (2.4 m•kg, 17 ft•lb)
- M6 13 Nm (1.3 m•kg, 9.4 ft•lb)
- engine adjusting bolts

### NOTE:

Use the pivot shaft wrench ① to tighten the engine mounting adjust bolt to finger tightness.



**Pivot shaft wrench**  
90890-01471

### 3. Install:

- drive sprocket 70 Nm (7.0 m•kg, 51 ft•lb)

### 4. Install:

- drive sprocket cover 10 Nm (1.0 m•kg, 7.2 ft•lb)

### NOTE:

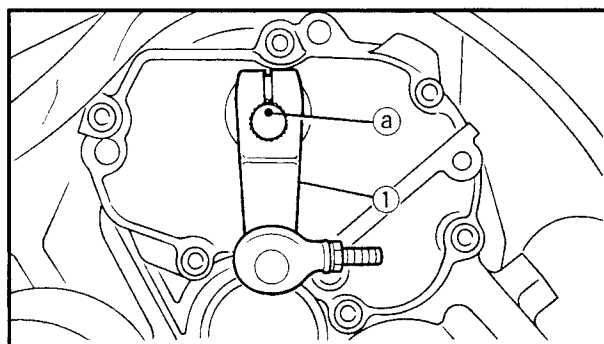
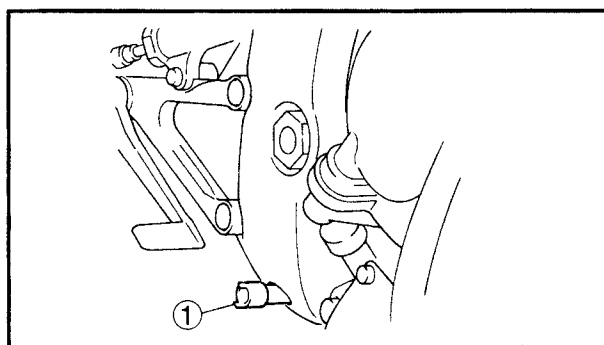
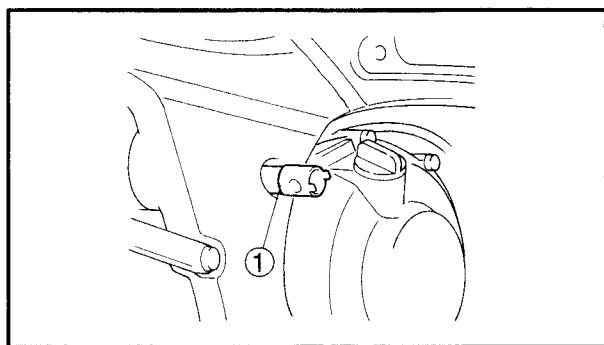
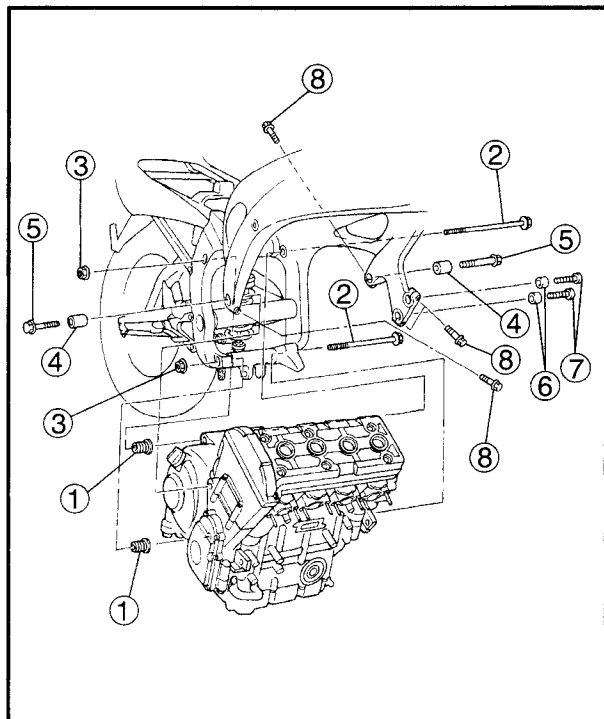
Refer to "CABLE ROUTING" in chapter 2.

### 5. Install:

- shift arm ① 10 Nm (1.0 m•kg, 7.2 ft•lb)

### NOTE:

Align the punch mark ① in the shift shaft with the slot in the shift arm.



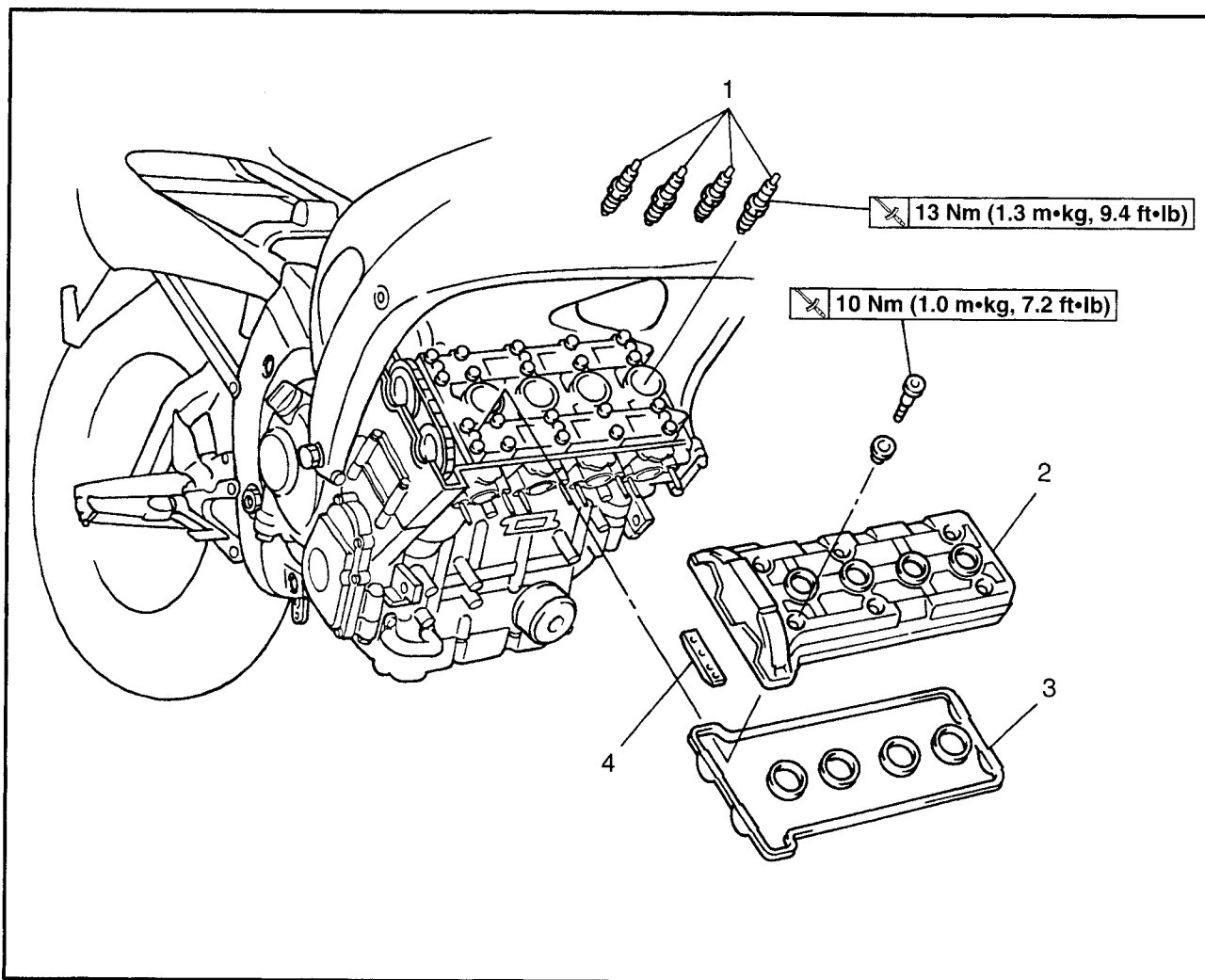




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# CAMSHAFTS

## CYLINDER HEAD COVER

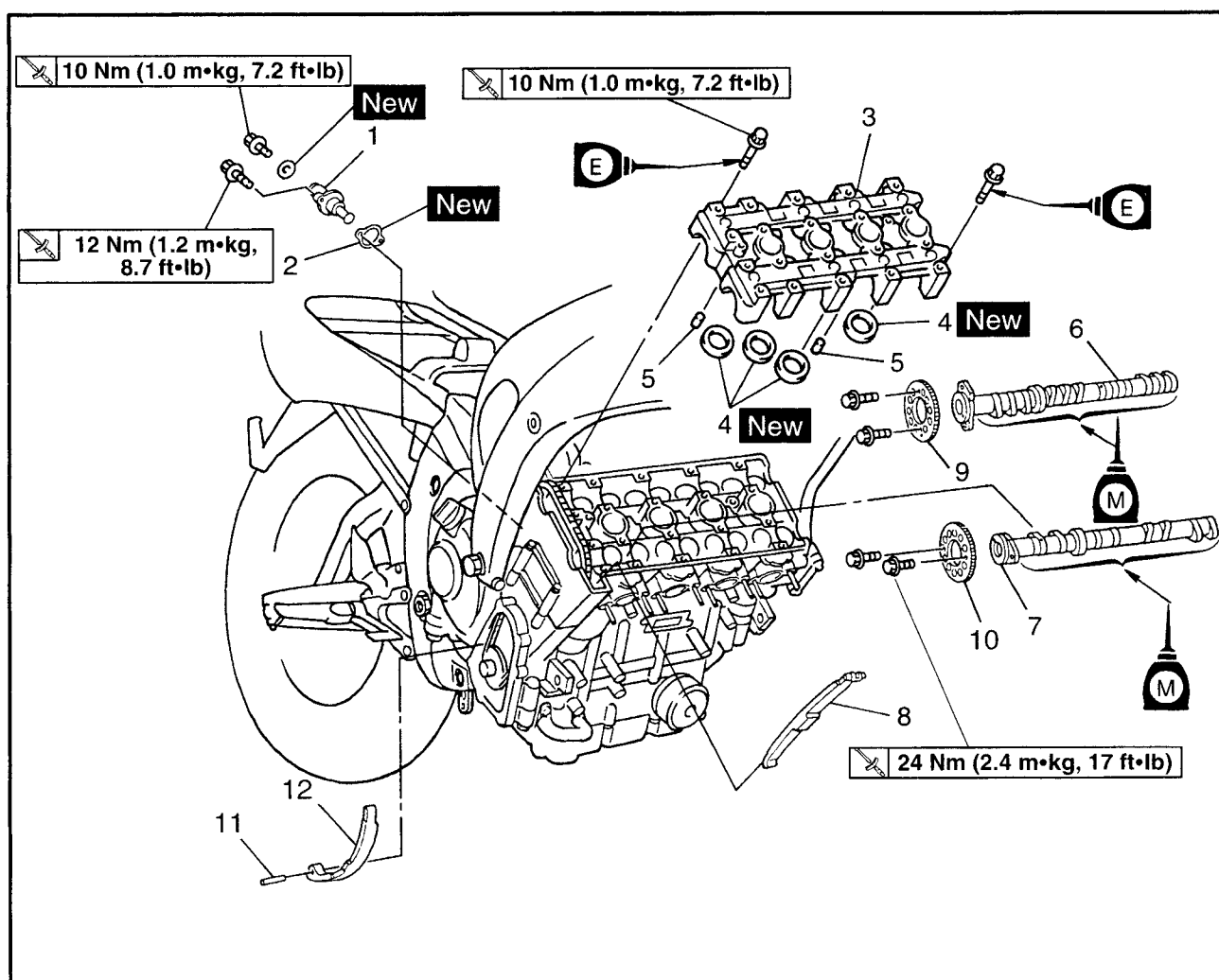


Order	Job/Part	Q'ty	Remarks
	<b>Removing the cylinder head cover</b>		
	Carburetor assembly		Remove the parts in the order listed.
	Radiator assembly		Refer to "CARBURETORS" in chapter 6.
1	Spark plugs	4	Refer to "RADIATOR" in chapter 5.
2	Cylinder head cover	1	
3	Cylinder head cover gasket	1	
4	Timing chain guide (top side)	1	
			For installation reverse the removal procedure.

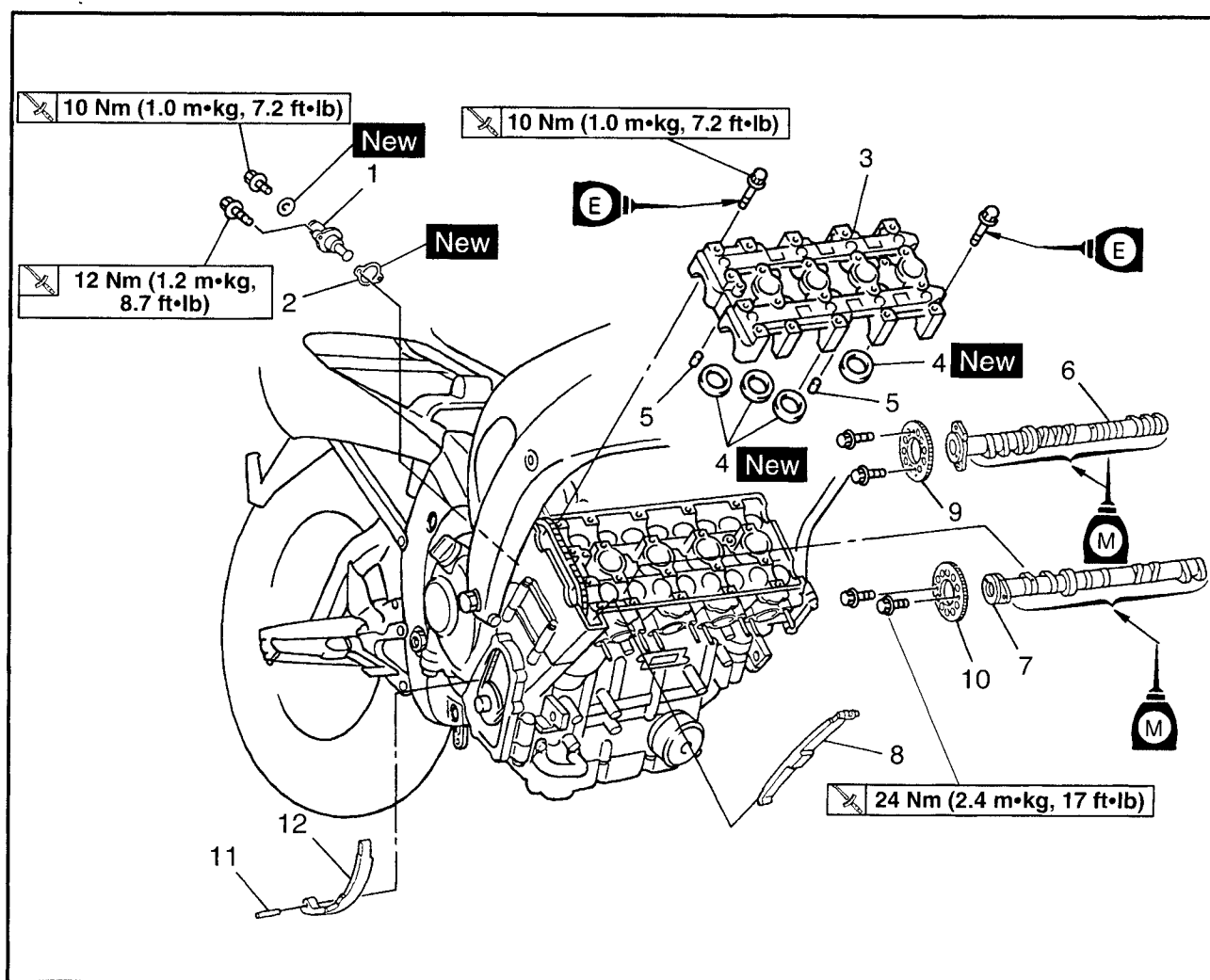


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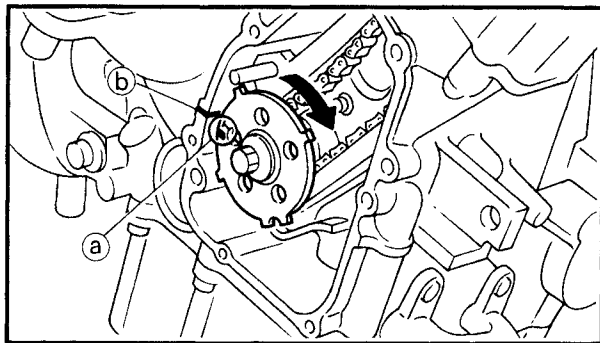
## CAMSHAFTS



Order	Job/Part	Q'ty	Remarks
	<b>Removing the camshafts</b>		
	Pickup coil rotor cover		Remove the parts in the order listed. Refer to "PICKUP COIL AND PICK UP COIL COVER".
1	Timing chain tensioner	1	Refer to "REMOVING/INSTALLING THE CAMSHAFTS". <b>NOTE:</b> During removal, the dowel pins may still be connected to the camshaft cap.
2	Timing chain tensioner gasket	1	
3	Camshaft cap	1	
4	Camshaft cap gasket	4	
5	Dowel pin	2	
6	Intake camshaft	1	Refer to "REMOVING/INSTALLING THE CAMSHAFT".
7	Exhaust camshaft	1	
8	Timing chain guide (exhaust side)	1	



Order	Job/Part	Q'ty	Remarks
9	Intake camshaft sprocket	1	Refer to "INSTALLING THE CAMSHAFTS".
10	Exhaust camshaft sprocket	1	
11	Pin	1	
12	Timing chain guide (intake side)	1	
			For installation reverse the removal procedure.



EAS00198

**REMOVING THE CAMSHAFTS**

## 1. Align:

- TDC mark on the pickup coil rotor (with the crankcase mating surface)

## a. Turn the crankshaft clockwise.

- b. When piston #1 is at TDC on the compression stroke, align the mark (a) on the pickup coil rotor with the crankcase mating surface (b).

**NOTE:**

TDC on the compression stroke can be found when the camshaft lobes are turned away from each other.

## 2. Remove:

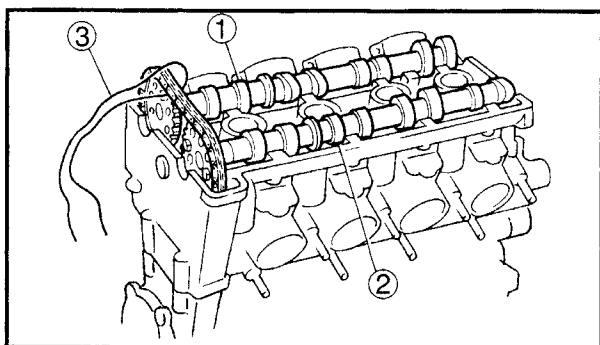
- timing chain tensioner

## 3. Remove:

- camshaft cap
- dowel pins

**CAUTION:**

To prevent damage to the cylinder head, camshafts or camshaft cap, loosen the camshaft cap bolts in stages and in a crisscross pattern, working from the outside in.



## 4. Remove:

- intake camshaft (1)
- exhaust camshaft (2)

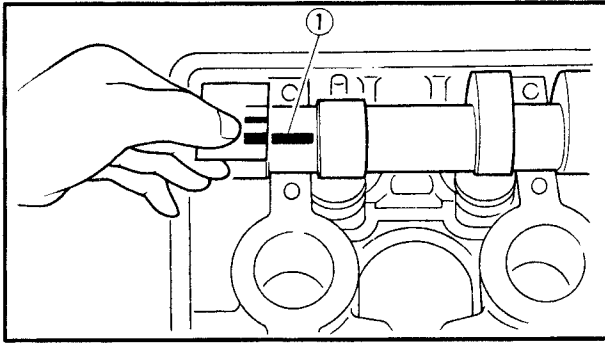
**NOTE:**

To prevent the timing chain from falling into the crankcase, fasten it with a wire (3).

## 5. Remove:

- timing chain guide (exhaust side)





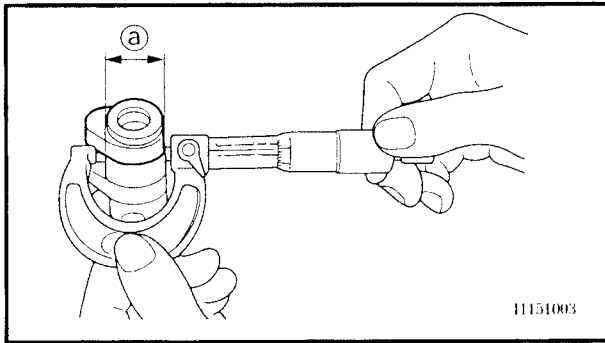
**NOTE:**

- Tighten the camshaft cap bolts in stages and in a crisscross pattern, working from the inner caps out.
- Do not turn the camshaft when measuring the camshaft-journal-to-camshaft-cap clearance with the Plastigauge®.



**Camshaft cap bolt**  
**10 Nm (1.0 m•kg, 7.2 ft•lb)**

- d. Remove the camshaft caps and then measure the width of the Plastigauge® ①.



5. Measure:

- camshaft journal diameter (a)  
 Out of specification → Replace the camshaft.  
 Within specification → Replace the cylinder head and the camshaft caps as a set.



**Camshaft journal diameter**  
**22.967 ~ 22.980 mm**  
**(0.9042 ~ 0.9047 in)**

EAS00208

## CHECKING THE CAMSHAFT SPROCKETS, AND TIMING CHAIN GUIDES

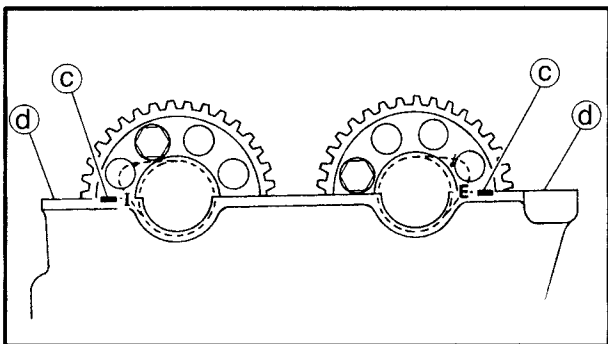
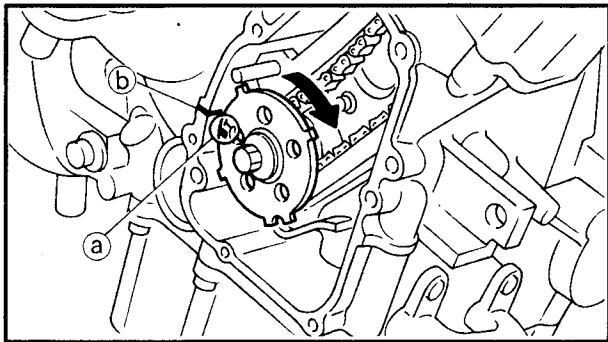
The following procedure applies to all of the camshaft sprockets and timing chain guides.











## 6. Check:

- TDC mark (a)  
Make sure that the TDC mark is aligned with the crankcase mating surface (b).
- camshaft sprocket timing mark (c)  
Make sure that the camshaft sprocket timing mark is aligned with the cylinder head edge (d)  
Out of alignment → Adjust.  
Refer to the installation steps above.

## 7. Measure:

- valve clearance  
Out of specification → Adjust.  
Refer to "ADJUSTING THE VALVE CLEARANCE" in chapter 3.

## 8. Install:

- cylinder head cover gasket
- cylinder head cover

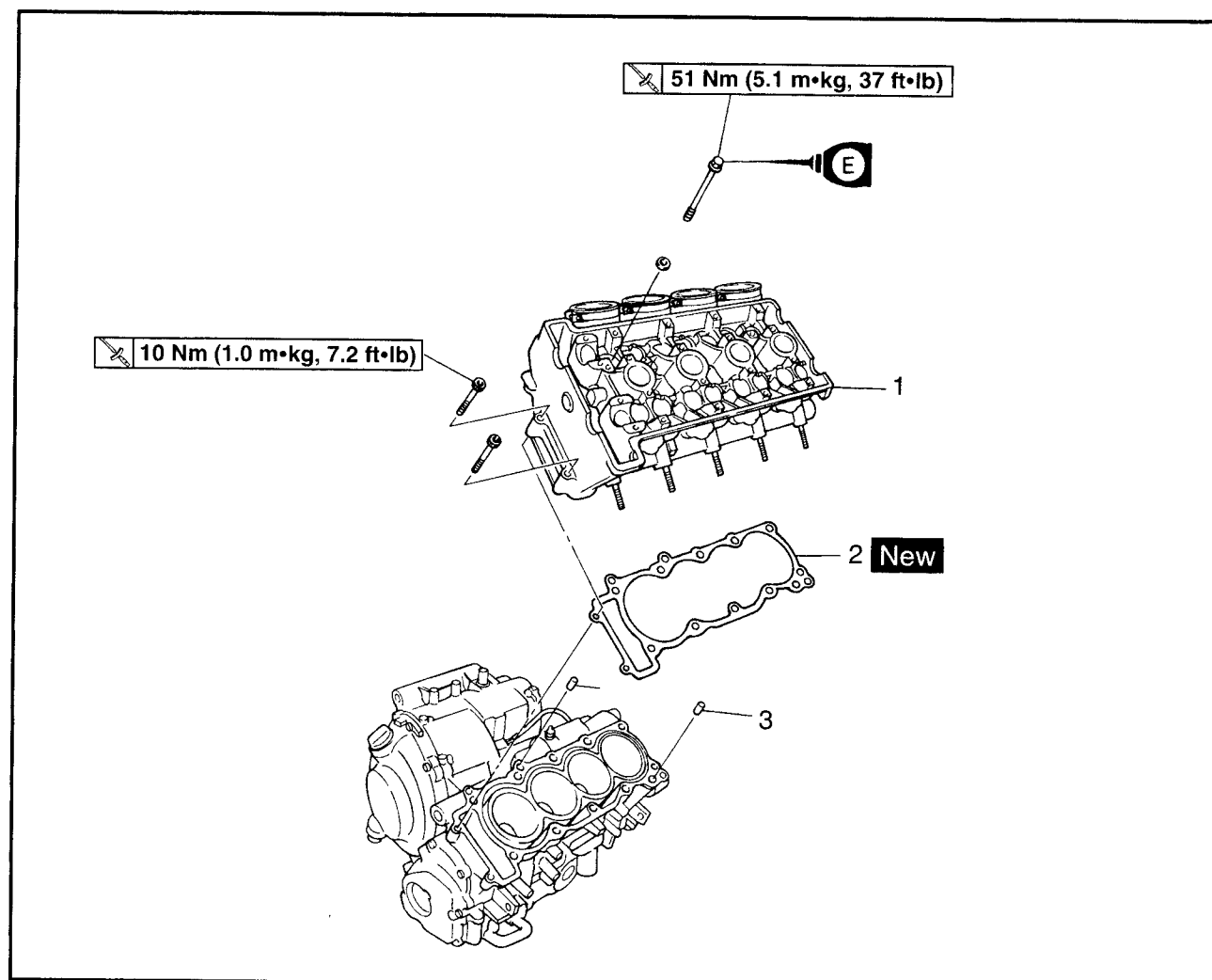
**NOTE:**

- Apply bond TB1541 onto the mating surfaces of the cylinder head cover and cylinder head cover gasket.
- Apply bond 1215B onto the mating surfaces of the cylinder head cover gasket and cylinder head.
- Tighten the cylinder head cover bolts in stages and in a crisscross pattern.

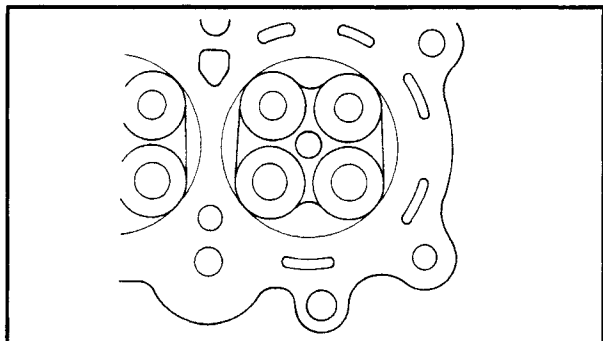
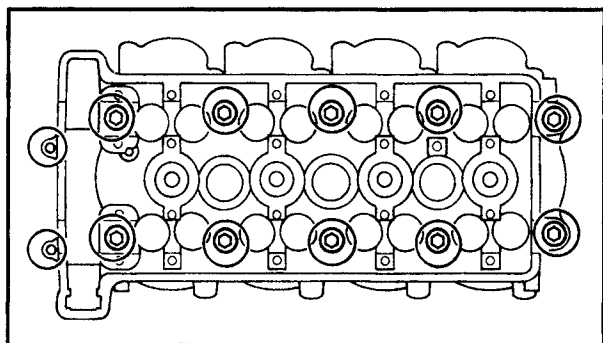


EAS00220

## CYLINDER HEAD



Order	Job/Part	Q'ty	Remarks
1	<b>Removing the cylinder head</b> Intake and exhaust camshafts Water hose Temp sensor lead Front mounting bolt Cylinder head	1	Remove the parts in the order listed. Refer to "CAMSHAFTS". Disconnect Disconnect Refer to "ENGINE". Refer to "REMOVING/INSTALLING THE CYLINDER HEAD".
2	Cylinder head gasket	1	
3	Dowel pin	2	For installation reverse the removal procedure.



EAS00223

**REMOVING THE CYLINDER HEAD**

1. Remove:
  - cylinder head bolts
  - cylinder head

**NOTE:**

Loosen each bolt and nut 1/2 of a turn at a time, in stages and in a crisscross pattern. After all of the bolts and nuts are fully loosened, remove them.

EAS00229

**CHECKING THE CYLINDER HEAD**

1. Eliminate:
  - combustion chamber carbon deposits (with a rounded scraper)

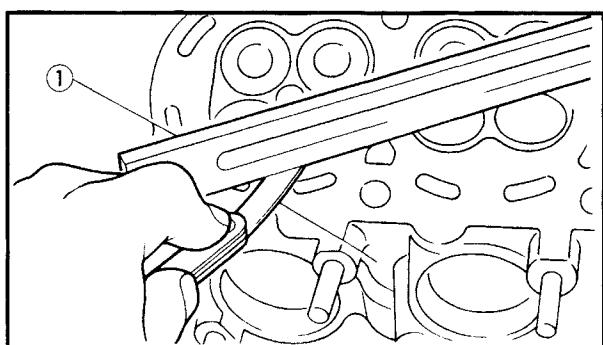
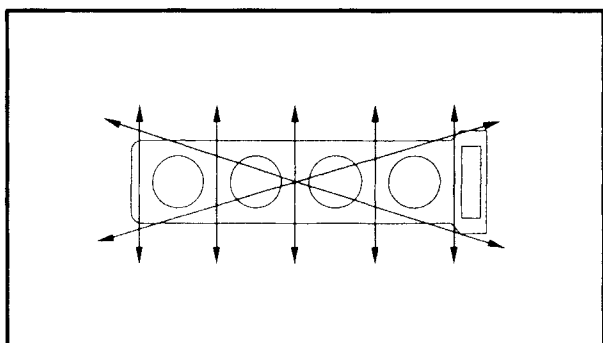
**NOTE:**

Do not use a sharp instrument to avoid damaging or scratching:

- spark plug bore threads
- valve seats

2. Check:

- cylinder head
  - Damage/scratches → Replace.
- cylinder head water jacket
  - Mineral deposits/rust → Eliminate.



3. Measure:

- cylinder head warpage
  - Out of specification → Resurface the cylinder head.



**Max. cylinder head warpage**  
**0.05 mm (0.002 in)**

- a. Place a straightedge ① and a thickness gauge ② across the cylinder head.
- b. Measure the warpage.
- c. If the limit is exceeded, resurface the cylinder head as follows.



- d. Place a 400 ~ 600 grit wet sandpaper on the surface plate and resurface the cylinder head using a figure-eight sanding pattern.

**NOTE:**


To ensure an even surface, rotate the cylinder head several times.




EAS00223

**INSTALLING THE CYLINDER HEAD****1. Install:**

- cylinder head gasket
- cylinder head
- cylinder headbolt

(M10)  51 Nm (5.1 m•kg, 37 ft•lb)

(M6)  10 Nm (1.0 m•kg, 7.2 ft•lb)

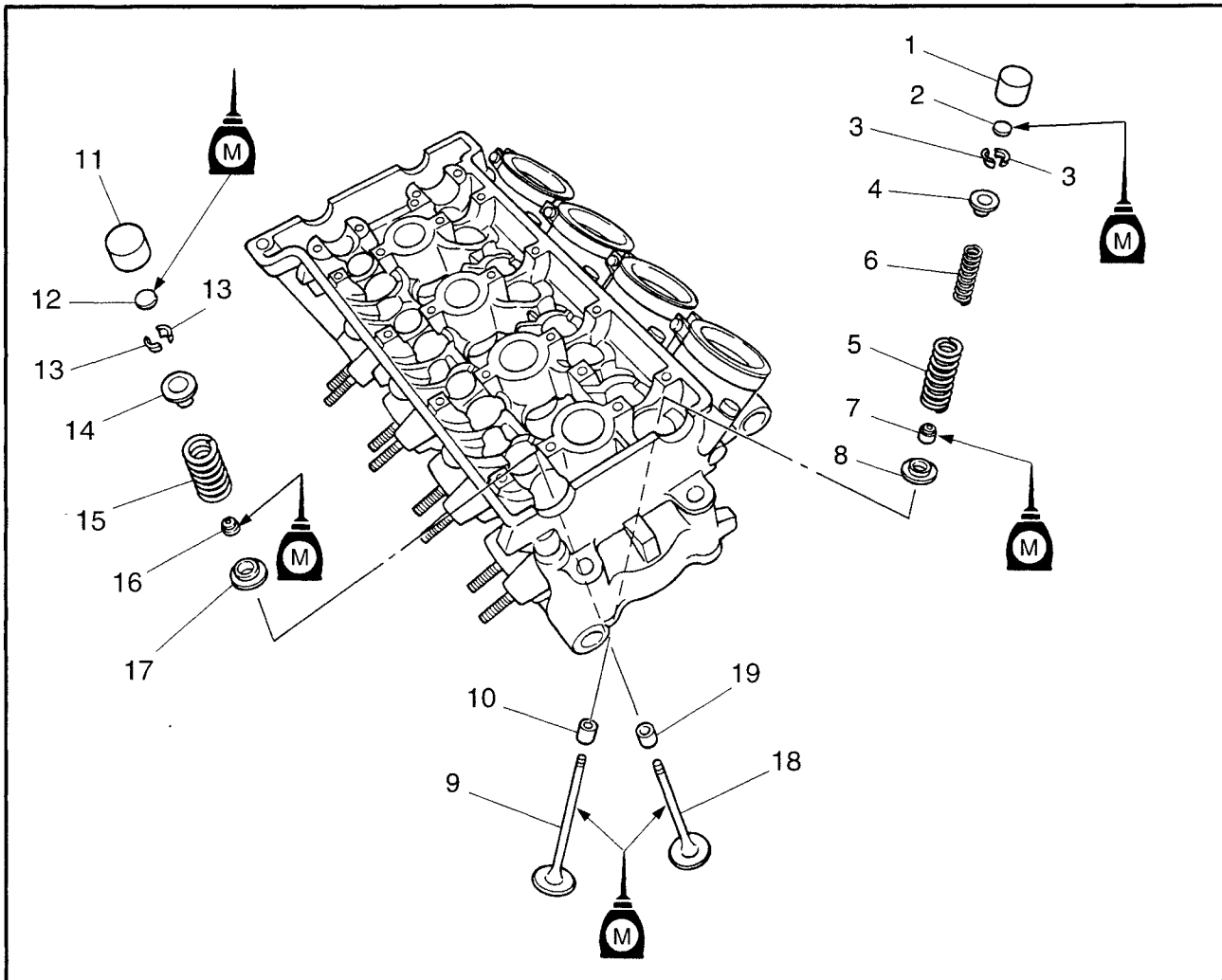
**NOTE:**

- Lubricate the cylinder head nuts with engine oil.
- Tighten the cylinder head nuts and bolts in two stages and in a crisscross pattern.

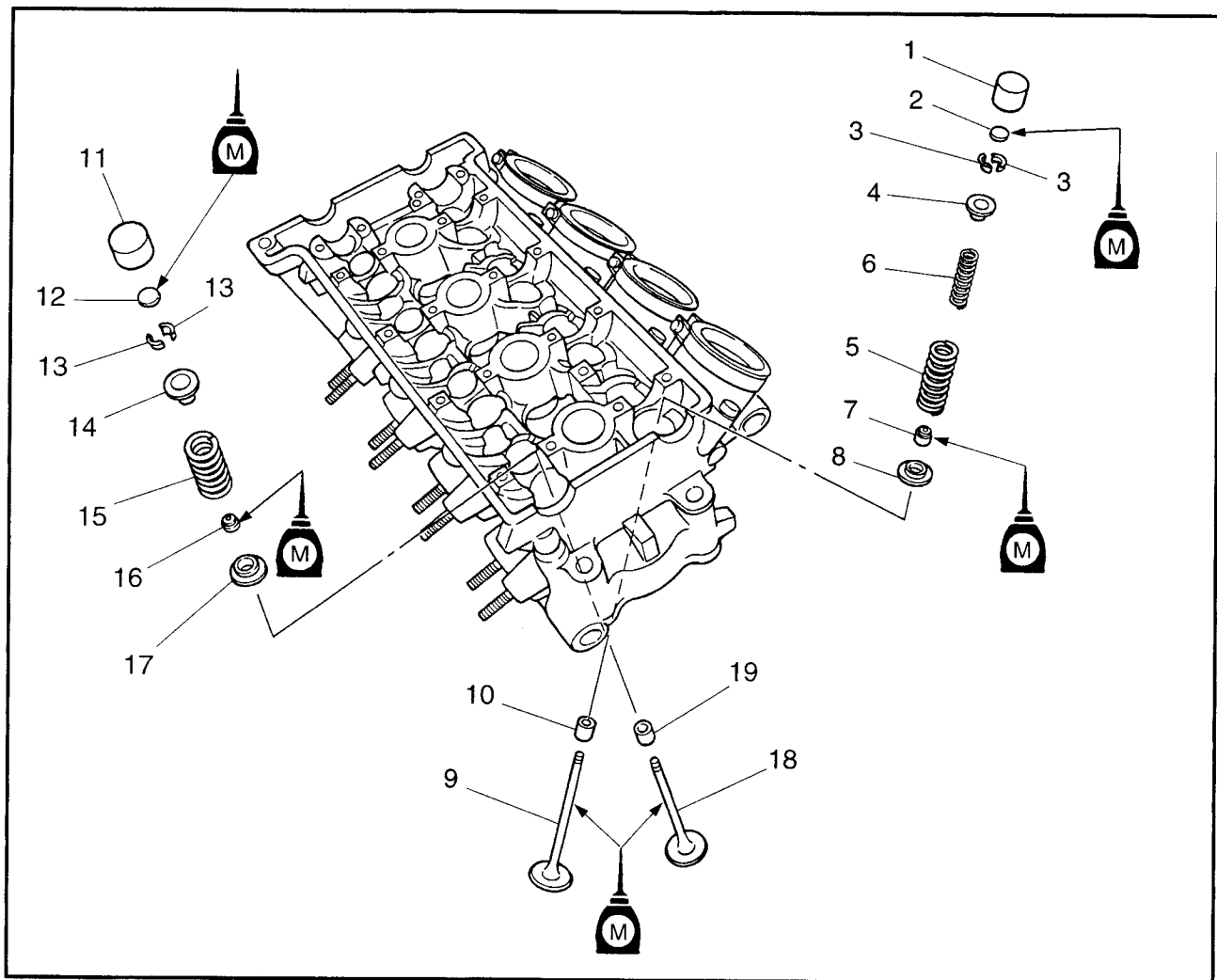


EAS00236

## VALVES AND VALVE SPRINGS



Order	Job/Part	Q'ty	Remarks
	<b>Removing the valves and valve springs</b>		
	Cylinder head		Remove the parts in the order listed.
			Refer to "CYLINDER HEAD".
1	Intake valve lifter	8	Refer to "REMOVING/INSTALLING THE VALVES".
2	Intake valve pad	8	
3	Intake valve cotter	16	
4	Intake valve upper spring seat	8	
5	Intake valve spring outer	8	
6	Intake valve spring inner	8	
7	Intake valve oil seal	8	
8	Intake valve lower spring seat	8	
9	Intake valve	8	
10	Intake valve guide	8	



Order	Job/Part	Q'ty	Remarks
11	Exhaust valve lifter	8	Refer to "REMOVING/INSTALLING THE VALVES".
12	Exhaust valve pad	8	
13	Exhaust valve cotter	16	
14	Exhaust valve upper spring seat	8	
15	Exhaust valve spring	8	
16	Exhaust valve oil seal	8	
17	Exhaust valve lower spring seat	8	
18	Exhaust valve	8	For installation, reverse the removal procedure.
19	Exhaust valve guide	8	



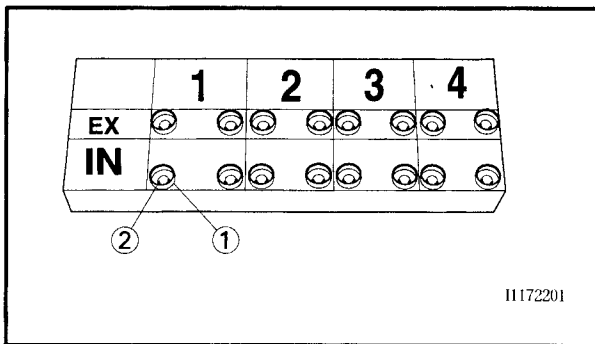
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## REMOVING THE VALVES

The following procedure applies to all of the valves and related components.

**NOTE:**

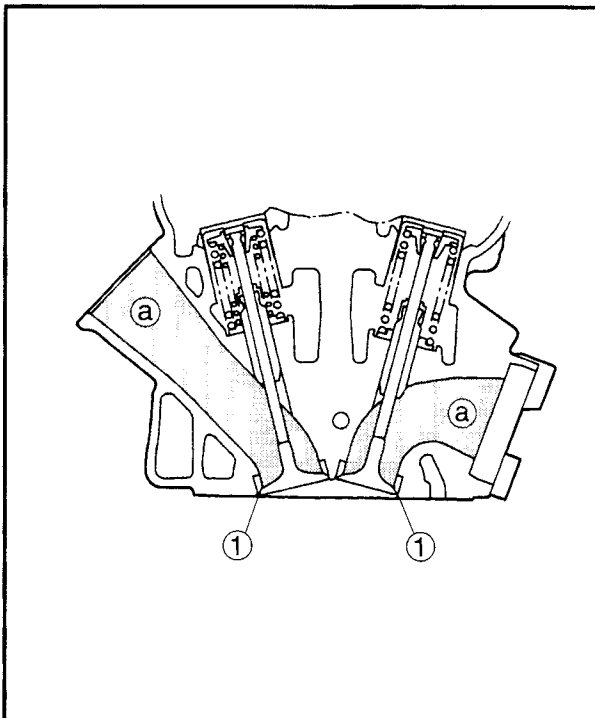
Before removing the internal parts of the cylinder head (e.g., valves, valve springs, valve seats), make sure that the valves properly seal.



1. Remove:
  - valve lifter ①
  - valve pad ②

**NOTE:**

Make a note of the position of each valve lifter and valve pad so that they can be reinstalled in their original place.



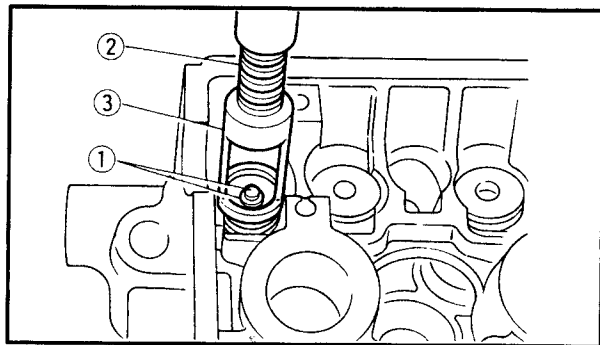
2. Check:  
 • valve  
 (for leakage)  
 Leakage at the valve seat → Check the valve  
 face, valve seat, and valve seat width.  
 Refer to “CHECKING THE VALVE SEATS”.

- Pour a clean solvent (a) into the intake and exhaust ports.
- Check that the valves properly seal.

**NOTE:**

There should be no leakage at the valve seat  
①.





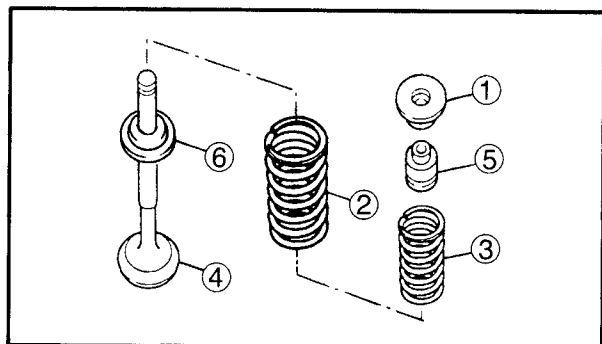
3. Remove:
- valve cotteners ①

## NOTE:

Remove the valve cotteners by compressing the valve spring with the valve spring compressor ② and attachment ③.



**Valve spring compressor**  
90890-04019, YM-04019  
**Attachment**  
90890-04114, YM-01253-1



4. Remove:
- upper spring seat ①
  - valve spring outer ②
  - valve spring inner (intake only) ③
  - valve ④
  - oil seal ⑤
  - lower spring seat ⑥

## NOTE:

Identify the position of each part very carefully so that it can be reinstalled in its original place.

EAS00239

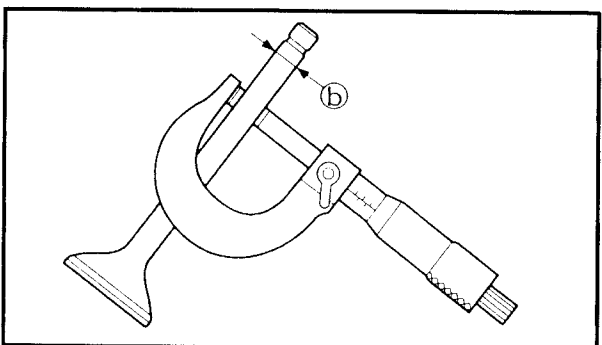
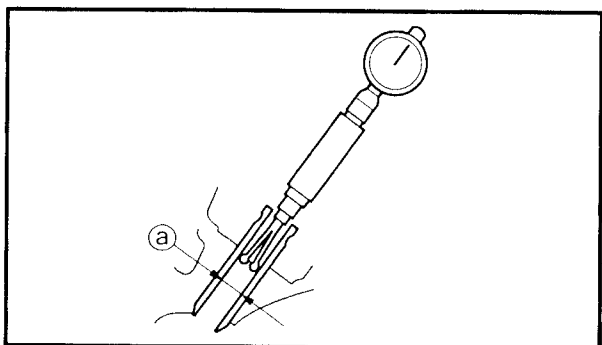
## CHECKING THE VALVES AND VALVE GUIDES

The following procedure applies to all of the valves and valve guides.

1. Measure:
- valve-stem-to-valve-guide clearance

**Valve-stem-to-valve-guide clearance =**  
**Valve guide inside diameter (a) –**  
**Valve stem diameter (b)**

Out of specification → Replace the valve guide.



## Valve-stem-to-valve-guide clearance

### Intake

0.010 ~ 0.037 mm  
(0.0004 ~ 0.0015 in)

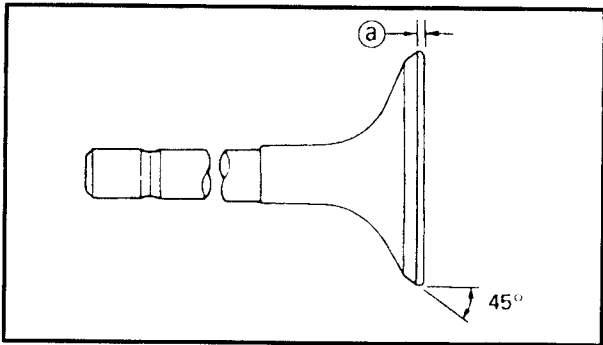
<Limit> : 0.08 mm (0.0031 in)

### Exhaust

0.025 ~ 0.052 mm  
(0.001 ~ 0.002 in)

<Limit>: 0.1 mm (0.0039 in)





5. Measure:

- valve margin thickness (a)

Out of specification → Replace the valve.

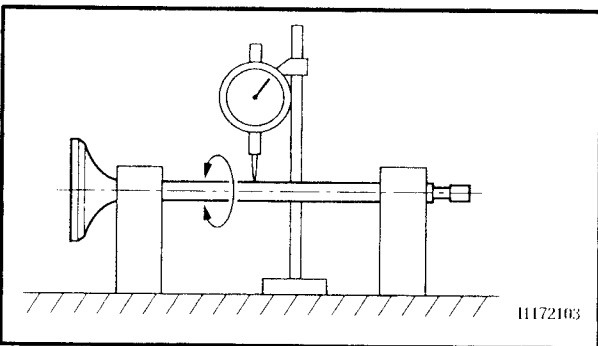


## Valve margin thickness

0.6 mm ~ 0.8 mm

(0.0236 ~ 0.0315 in)

<LIMIT>: 0.5 mm (0.02 in)



6. Measure:

- valve stem runout

Out of specification → Replace the valve.

## NOTE:

- When installing a new valve, always replace the valve guide.
- If the valve is removed or replaced, always replace the oil seal.



## Valve stem runout

0.04 mm (0.0016 in)

EAS00240

## CHECKING THE VALVE SEATS

The following procedure applies to all of the valves and valve seats.

1. Eliminate:

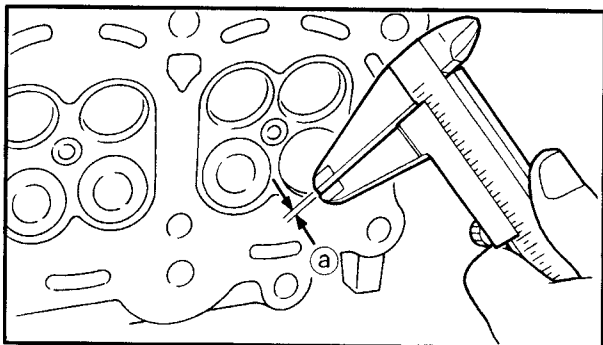
- carbon deposits  
(from the valve face and valve seat)

2. Check:

- valve seat  
Pitting/wear → Replace the cylinder head.

3. Measure:

- valve seat width (a)  
Out of specification → Replace the cylinder head.



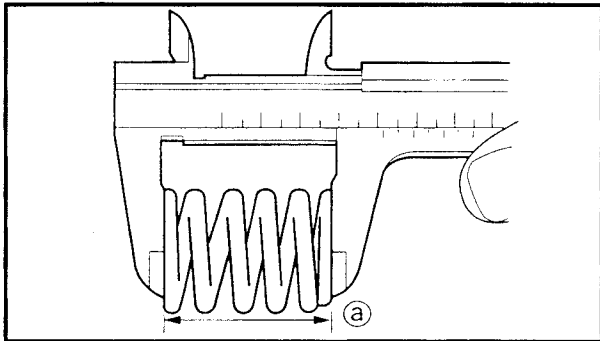
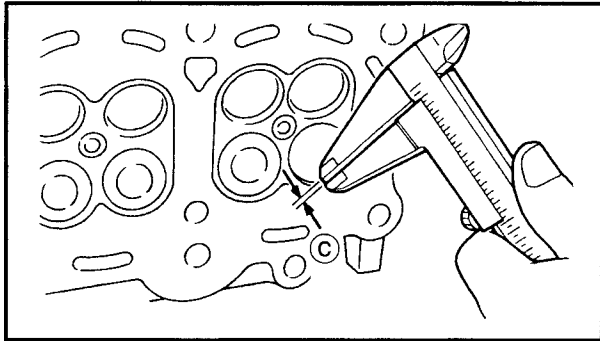
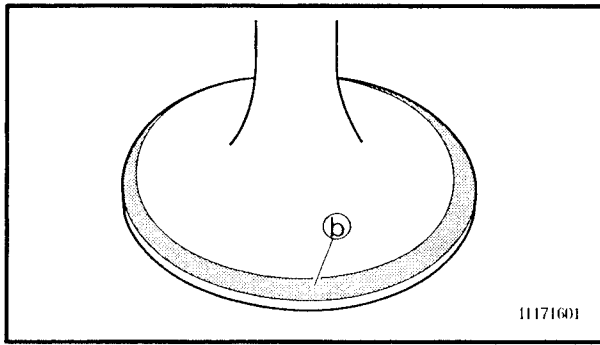
## Valve seat width

Intake: 0.9 ~ 1.1 mm

(0.0354 ~ 0.0433 in)

<Limit>: 1.6 mm (0.06 in)





- e. Apply a fine lapping compound to the valve face and repeat the above steps.
- f. After every lapping procedure, be sure to clean off all of the lapping compound from the valve face and valve seat.
- g. Apply Mechanic's blueing dye (Dykem) ⑥ onto the valve face.
- h. Install the valve into the cylinder head.
- i. Press the valve through the valve guide and onto the valve seat to make a clear impression.
- j. Measure the valve seat width ⑦ again. If the valve seat width is out of specification, reface and lap the valve seat.

EAS00241

## CHECKING THE VALVE SPRINGS

The following procedure applies to all of the valve springs.

1. Measure:
- valve spring free length (a)  
Out of specification → Replace the valve spring.



### Valve spring free length

**Intake valve spring (inner)**

**37.0 mm (1.46 in)**

**<Limit>: 35mm (1.38 in)**

**Intake valve spring (outer)**

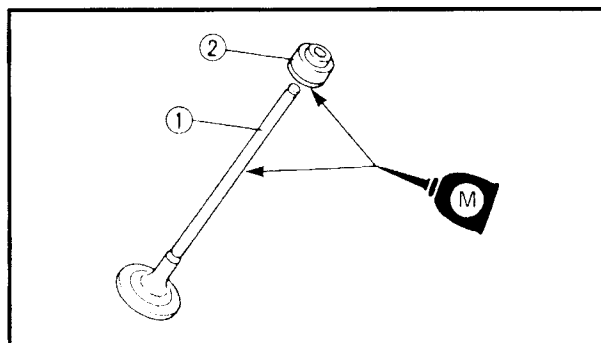
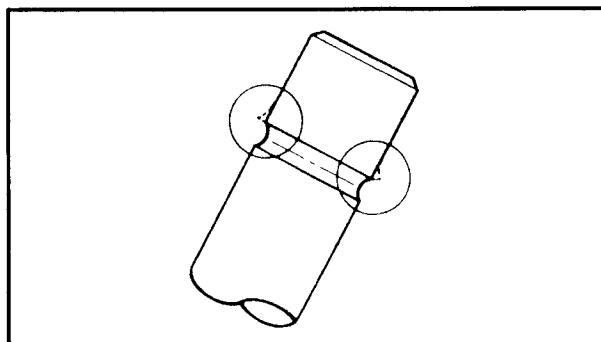
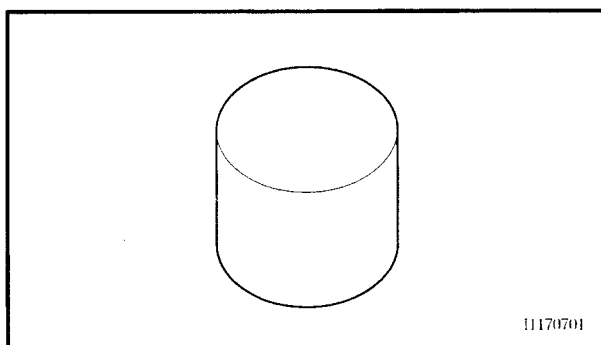
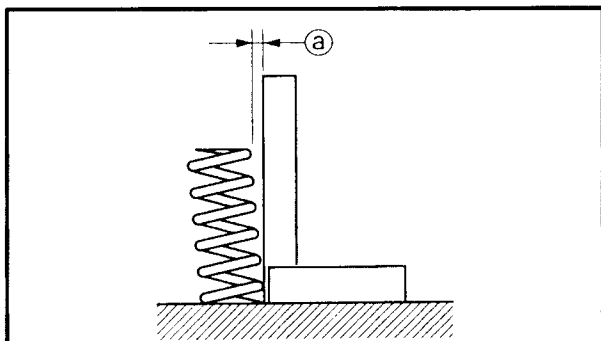
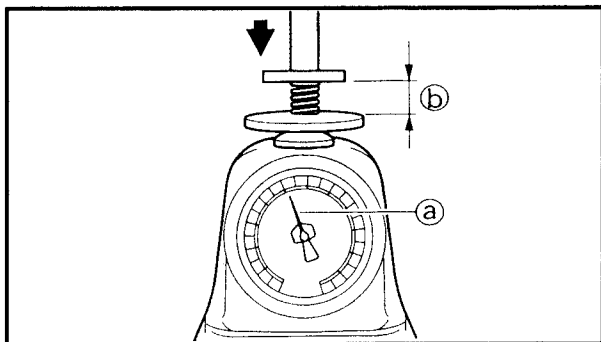
**38.4 mm (1.51 in)**

**<Limit>: 36.5mm (1.44 in)**

### Exhaust valve spring

**41.7 mm (1.64 in)**

**<Limit>: 39.5mm (1.56 in)**



## 2. Measure:

- compressed spring force (a)

Out of specification → Replace the valve spring.

## (b) Installed length



### Compressed spring force (installed)

#### Intake valve spring inner

69 ~ 79 N (15.51 ~ 17.76 lb,  
7.04 ~ 8.06 kg) at 30.0 mm  
(1.18 in)

#### Intake valve spring outer

114 ~ 132 N (25.63 ~ 29.67 lb,  
11.62 ~ 13.46 kg) at 32.5 mm  
(1.28 in)

#### Exhaust valve spring

160 ~ 184 N (35.97 ~ 41.36 lb,  
16.32 ~ 18.76 kg) at 36.1 mm  
(1.42 in)

## 3. Measure:

- valve spring tilt (a)

Out of specification → Replace the valve spring.



### Max. Spring tilt

#### Intake valve spring inner

2.5° / 1.6 mm (0.06 in)

#### Intake valve spring outer

2.5° / 1.7 mm (0.07 in)

#### Exhaust valve spring

2.5° / 1.8 mm (0.07 in)

EAS00242

## CHECKING THE VALVE LIFTERS

The following procedure applies to all of the valve lifters.

## 1. Check:

- valve lifter

Damage/scratches → Replace the valve lifters and cylinder head.

EAS00247

## INSTALLING THE VALVES

The following procedure applies to all of the valves and related components.

## 1. Deburr:

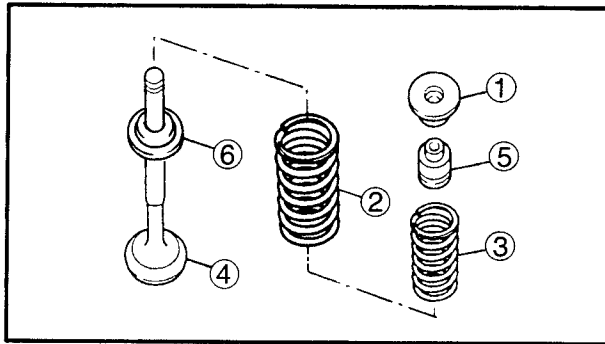
- valve stem end  
(with an oil stone)

## 2. Lubricate:

- valve stem (1)
- oil seal (2)  
(with the recommended lubricant)



**Recommended lubricant**  
Molybdenum disulfide oil

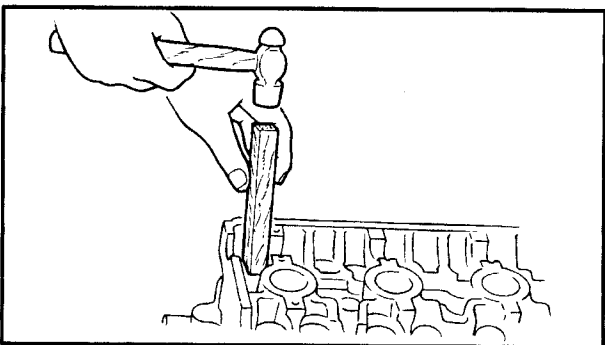
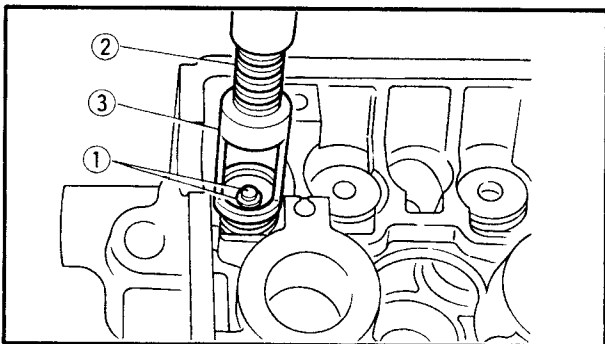
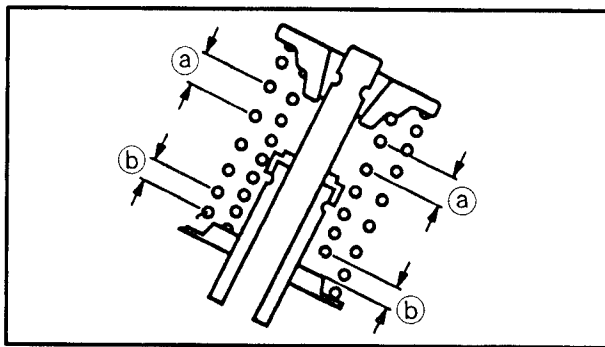


3. Install:
- lower spring seat ⑥
  - oil seal ⑤ **New**
  - valve ④
  - valve spring inner (intake only) ③
  - valve spring outer ②
  - upper spring seat ①  
(into the cylinder head)

**NOTE:**

- Make sure that each valve is installed in its original place. Refer to the following embossed marks.
- Install the valve spring with the larger pitch ② facing up.

② Smaller pitch



4. Install:
- valve coppers ①

**NOTE:**

Install the valve coppers by compressing the valve spring with the valve spring compressor ② and attachment ③.



**Valve spring compressor**  
90890-04019, YM-04019  
**Attachment**  
90890-04114, YM-01253-1

5. To secure the valve coppers ① onto the valve stem, lightly tap the valve tip with a soft-face hammer.

**CAUTION:**

Hitting the valve tip with excessive force could damage the valve.



6. Lubricate:

- valve pad  
(with the recommended lubricant)



**Recommended lubricant**  
**Molybdenum disulfide oil**

7. Install:

- valve pad
- valve lifter

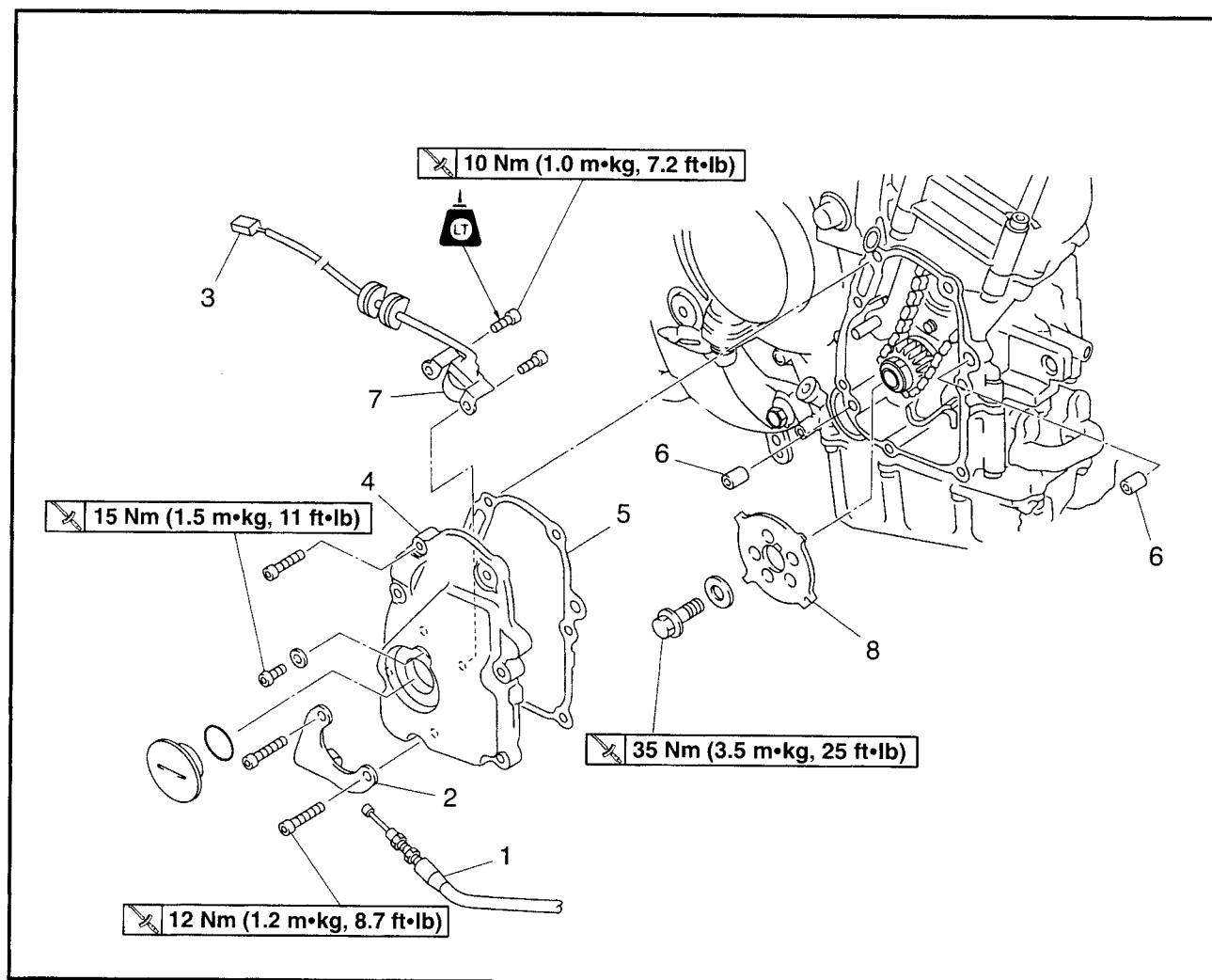
**NOTE:**

- The valve lifter must move smoothly when rotated with a finger.
- Each valve lifter and valve pad must be reinstalled in its original position.

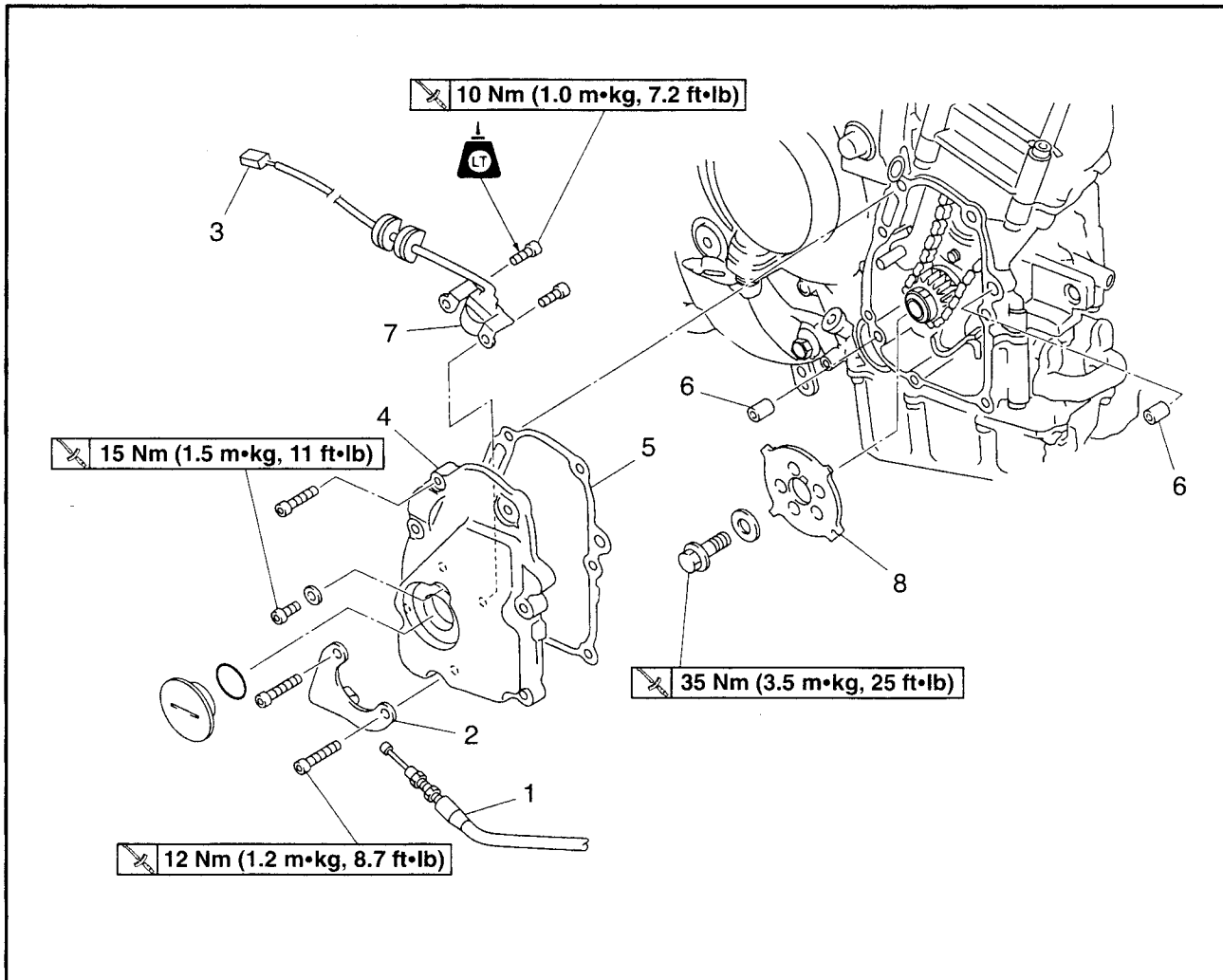




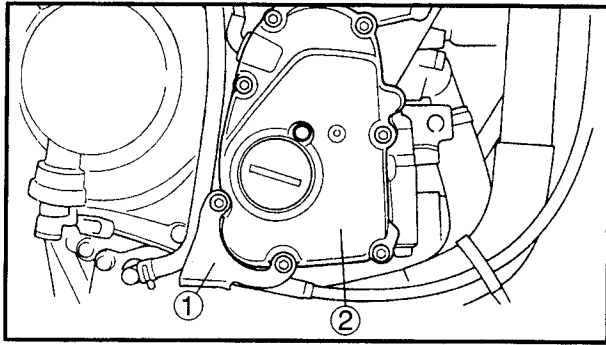
## PICKUP COIL AND PICKUP COIL ROTOR



Order	Job/Part	Q'ty	Remarks
	<b>Removing the pickup coil and pickup coil rotor</b> Riders seat and fuel tank  Bottom cowl and right side cowl Engine oil  Generator cover		Remove the parts in the order listed.  Refer to "SEATS" and "FUEL TANK" in chapter 3. Refer to "COWLINGS" in chapter 3.  Drain. Refer to "CHANGING THE ENGINE OIL" in chapter 3. Refer to "STARTER CLUTCH AND GENERATOR".



Order	Job/Part	Q'ty	Remarks
1	Clutch cable	1	Disconnect
2	Clutch cable holder	1	
3	Pickup coil coupler	1	
4	Pickup coil cover	1	
5	Pickup coil cover gasket	1	Refer to "REMOVING/INSTALLING THE PICKUP COIL ROTOR".
6	Dowel pin	2	
7	Pickup coil	1	
8	Pickup rotor	1	
			For installation reverse the removal procedure.



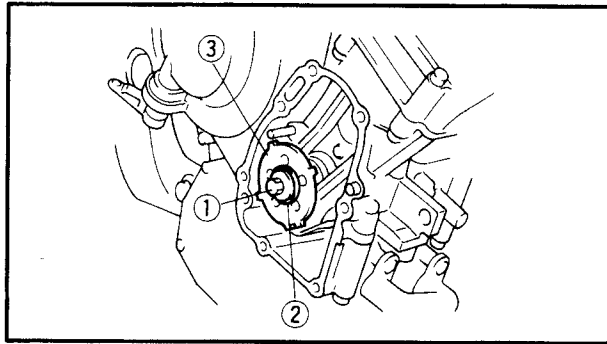
### REMOVING THE PICKUP COIL ROTOR

1. Remove:

- clutch cable holder ①
- pickup coil cover ②

#### NOTE:

Loosen each bolt 1/4 of a turn at a time, in stages and in a crisscross pattern. After all of the bolts are fully loosened, remove them.

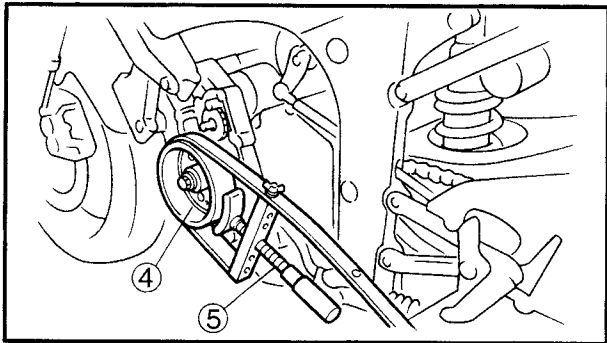


2. Remove:

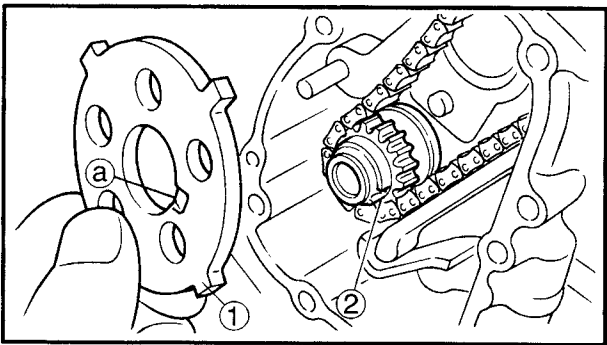
- pickup coil rotor bolt ①
- plain washer ②
- pickup coil rotor ③

#### NOTE:

While holding the generator rotor ④ with the rotor holding tool ⑤, loosen the pickup coil rotor bolt.



**Sheave holder**  
90890-01701, YS-01880



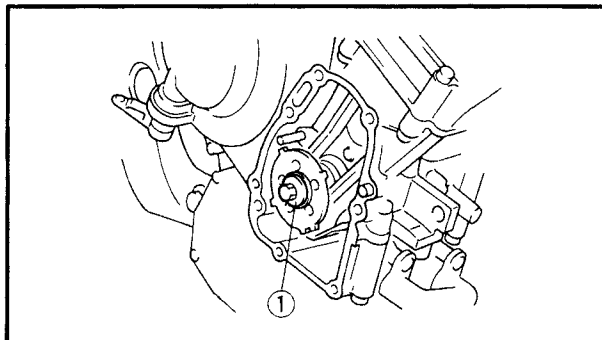
### INSTALLING THE PICKUP COIL ROTOR

1. Install:

- pickup coil rotor ①
- plain washer
- pickup coil rotor bolt


#### NOTE:

When installing the pickup coil rotor, align the pin ② in the crankshaft sprocket with the groove @ in the pickup coil rotor.



2. Tighten:

- pickup coil rotor bolt ①

 35 Nm (3.5 m•kg, 25 ft•lb)

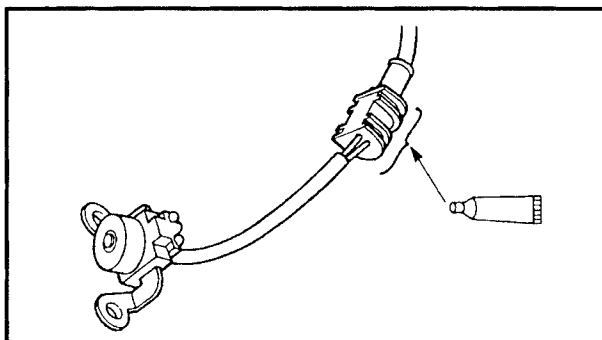
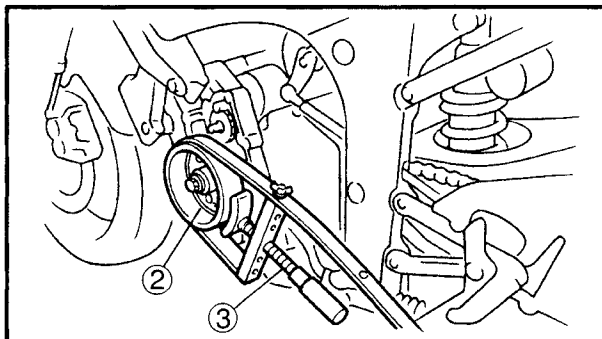
### NOTE:

While holding the generator rotor ② with the sheave holder ③, tighten the pickup coil rotor bolt.



**Sheave holder**

90890-01701, YS-01880



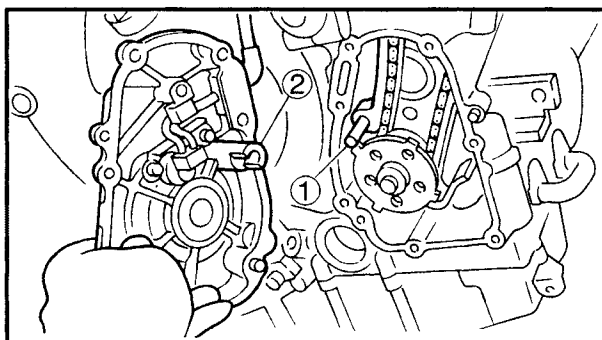
3. Apply:

- sealant  
(onto the pickup coil lead grommet)



**Yamaha bond No.1215**

90890-85505, ACC-1100-15-01



4. Install:

- pickup coil cover
- clutch cable holder

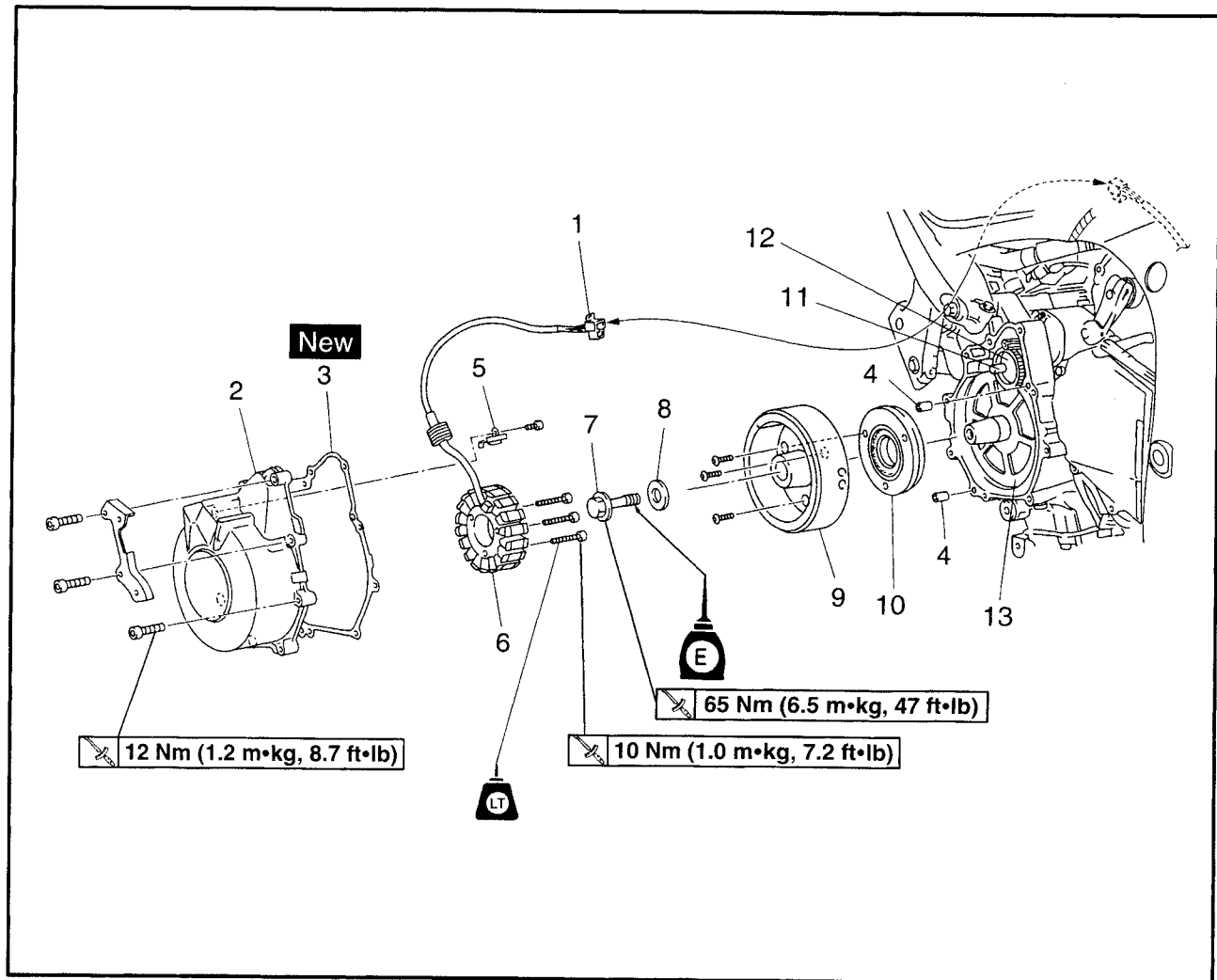
### NOTE:

- When installing the pickup coil cover, align the timing chain guide (intake side) pin ① of the with the hole ② in the pickup coil cover.
- Tighten the pickup coil cover bolts in stages and in a crisscross pattern.

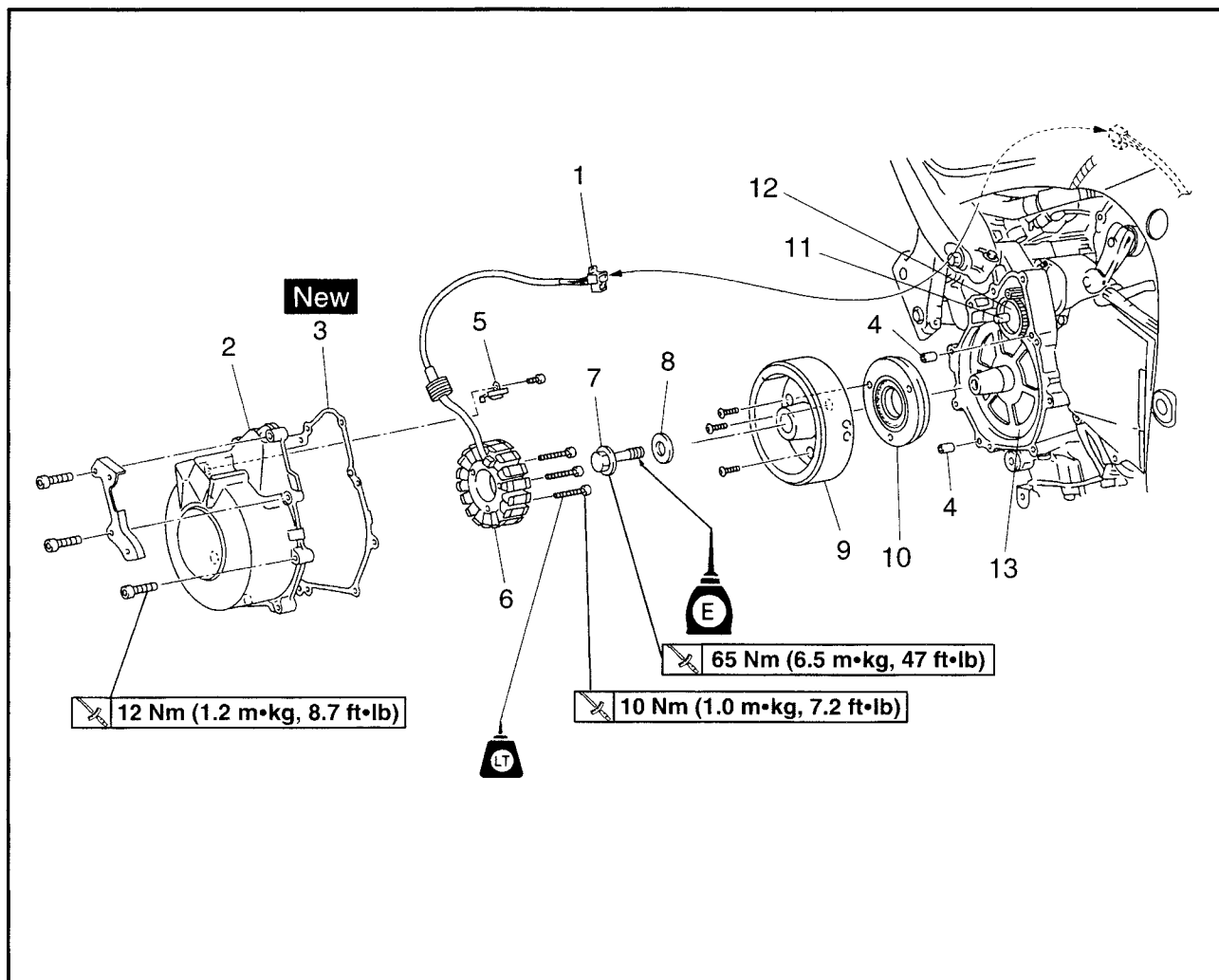


EAS00341

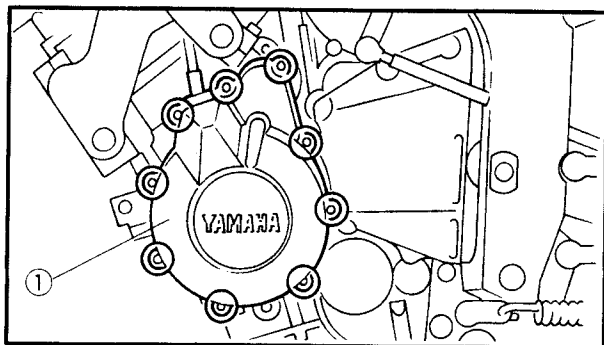
## STARTER CLUTCH AND GENERATOR



Order	Job/Part	Q'ty	Remarks
	<b>Removing the starter clutch and generator</b>		Remove the parts in the order listed.
	Riders seat and fuel tank		Refer to "SEATS" and "FUEL TANK" in chapter 3.
	Bottom and left side cowlings		Refer to "COWLINGS" in chapter 3.
	Engine oil		Drain. Refer to "CHANGING THE ENGINE OIL" in chapter 3.
	Coolant reservoir		Drain. Refer to "CHANGING THE COOLANT" in chapter 3.
1	Stator coil assembly coupler	1	Disconnect.
2	Generator cover	1	Refer to "REMOVING/INSTALLING THE GENERATOR".
3	Generator rotor cover gasket	1	
4	Dowel pin	2	
5	Stator coil assembly lead holder	1	
6	Stator coil assembly	1	



Order	Job/Part	Q'ty	Remarks
7	Generator rotor bolt	1	Refer to "REMOVING/INSTALLING THE GENERATOR".
8	Plain washer	1	
9	Generator rotor	1	
10	Starter one-way assy	1	
11	Idler gear shaft	1	
12	Idler gear	1	
13	Starter clutch gear	1	For installation reverse the removal proceduer.



EAS00346

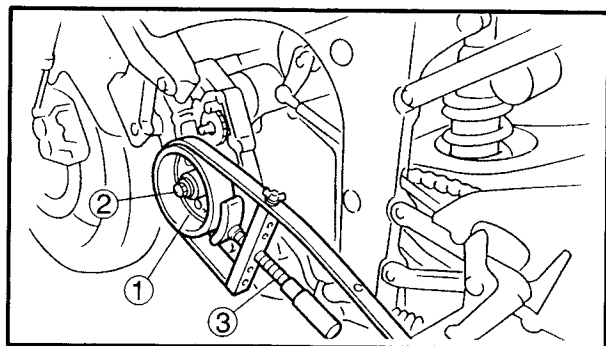
**REMOVING THE GENERATOR**

1. Remove:

- generator rotor cover ①

**NOTE:**

Loosen each bolt 1/4 of a turn at a time, in stages and in a crisscross pattern. After all of the bolts are fully loosened, remove them.



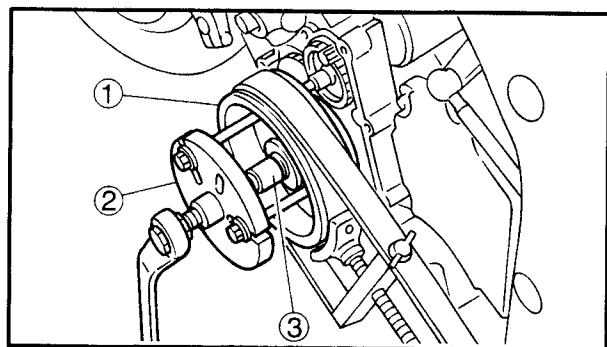
2. Remove:

- generator rotor bolt ①
- Plain washer

**NOTE:**

While holding the generator rotor ② with the sheave holder ③, loosen the generator rotor bolt.

Do not allow the sheave holder to touch the projection on the generator rotor.

**Sheave holder**

90890-01701, YS-01880

3. Remove:

- generator rotor ①
- (with the flywheel puller ② and adapter ③)

**Flywheel puller**

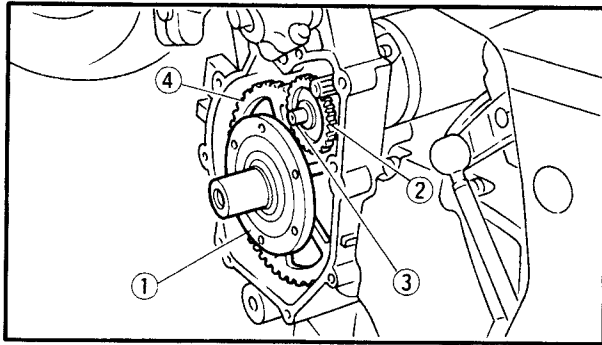
90890-01362, YU-33270

**Flywheel puller attachment**

90890-04089, YM-33282







EAS00355

### INSTALLING THE STARTER CLUTCH

1. Install:
  - starter clutch gear (1)
  - idler gear (2)
  - idler gear shaft (3)
  - starter one-way assy (4)

EAS00354

### INSTALLING THE GENERATOR

1. Install:
  - generator rotor (1)
  - washer (2)
  - generator rotor bolt (3)

#### NOTE:

Clean the tapered portion of the crankshaft and the generator rotor hub with lacquer thinner.

2. Tighten:

- generator rotor bolt (3)

65 Nm (6.5 m•kg, 47 ft•lb)

#### NOTE:

While holding the generator rotor (2) with the sheave holder (3), tighten the generator rotor bolt.

Do not allow the sheave holder to touch the projection on the generator rotor.



**Sheave holder**  
90890-01701, YS-01880

3. Apply:
  - sealant  
(onto the stator coil assembly lead grommet)

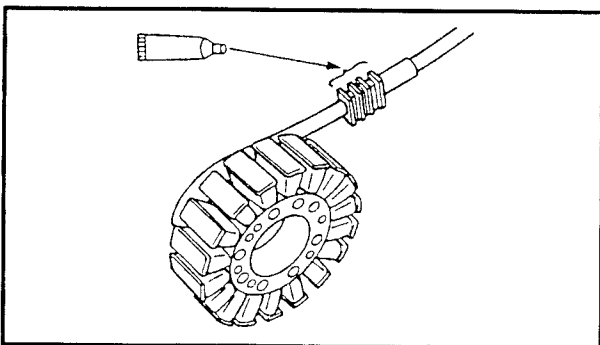


**Yamaha bond No.1215**  
90890-85505, ACC-1100-15-01

4. Install:
  - stator coil
5. Install:
  - generator rotor cover

#### NOTE:

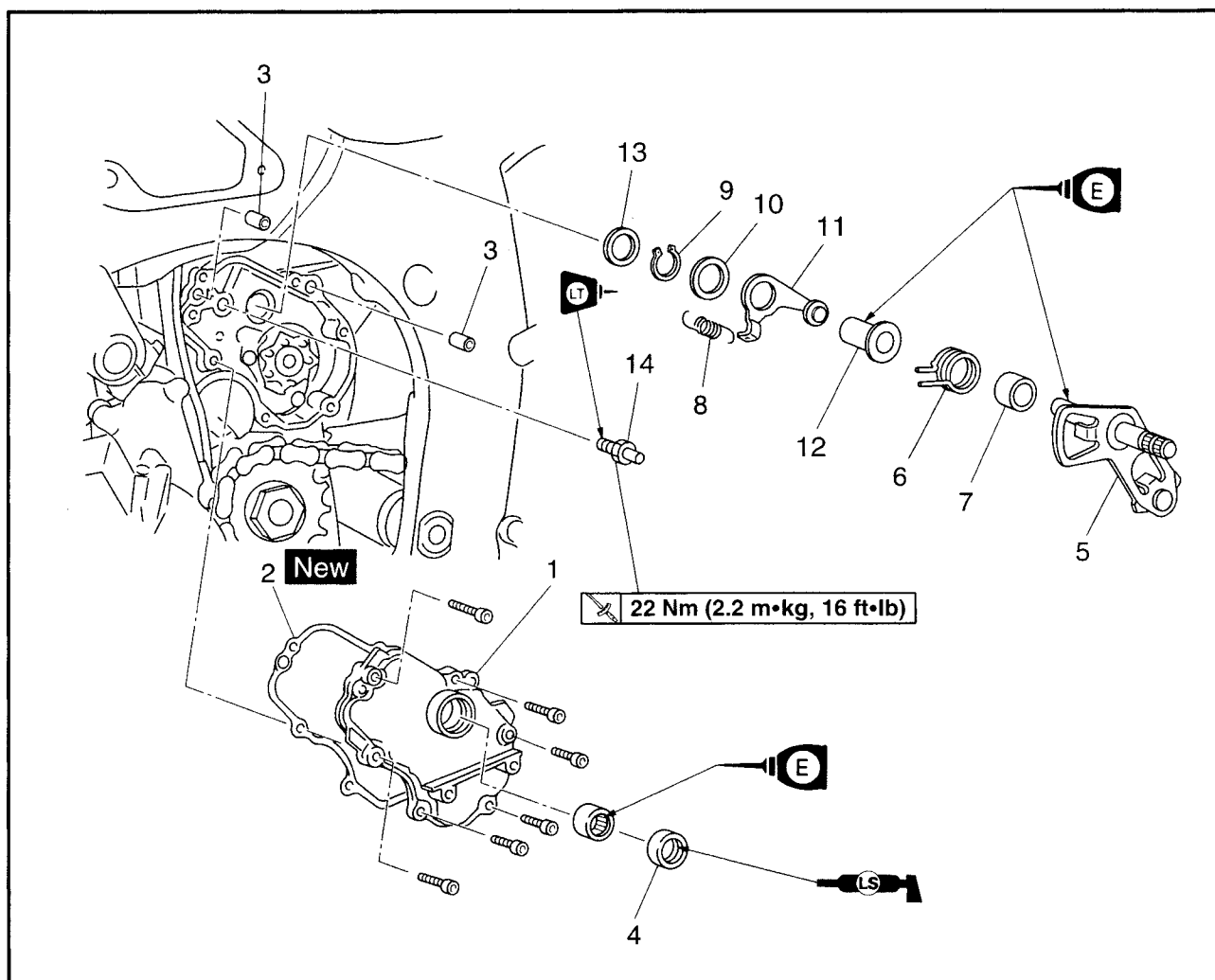
Tighten the generator rotor cover bolts in stages and in a crisscross pattern.



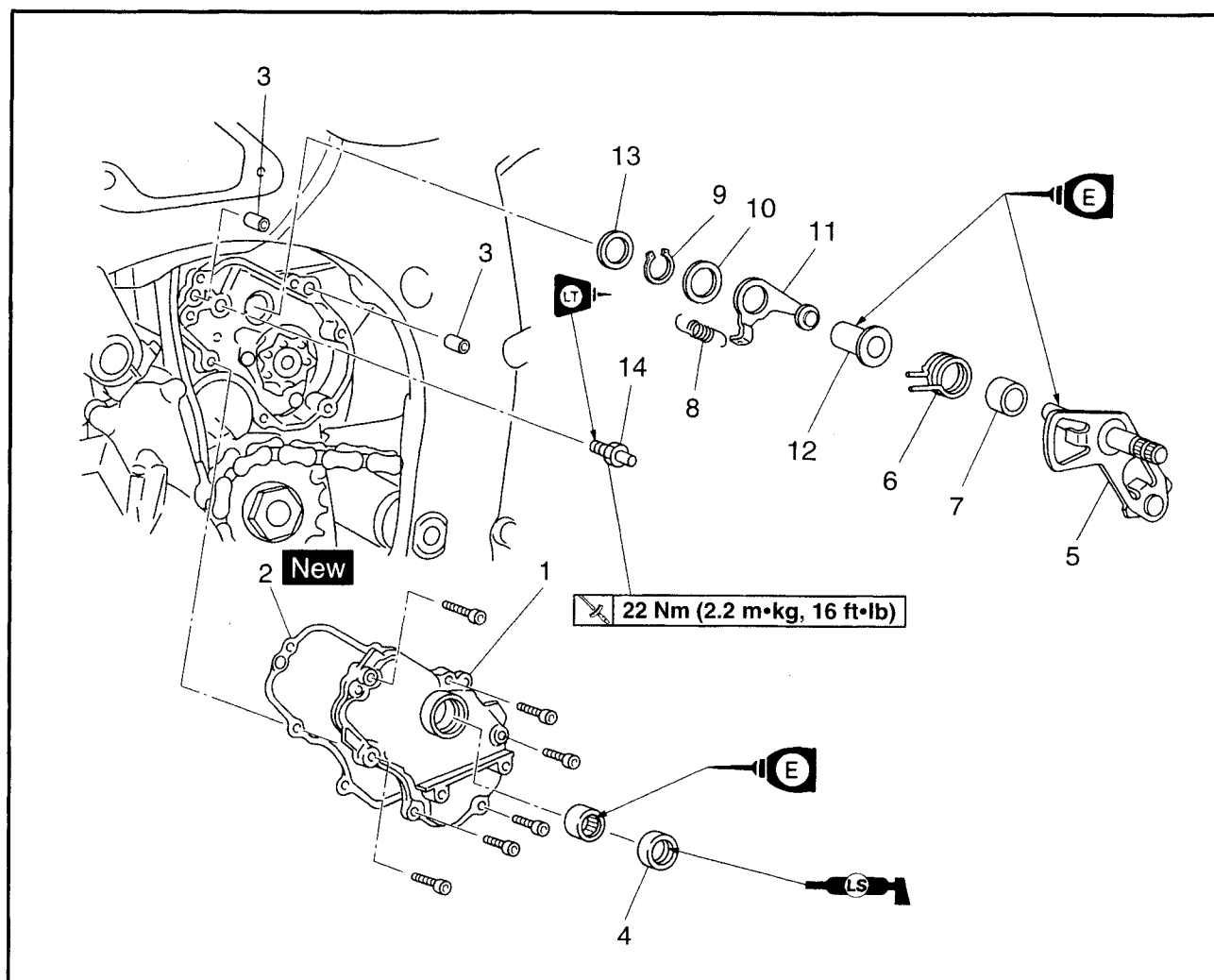


EAS00327

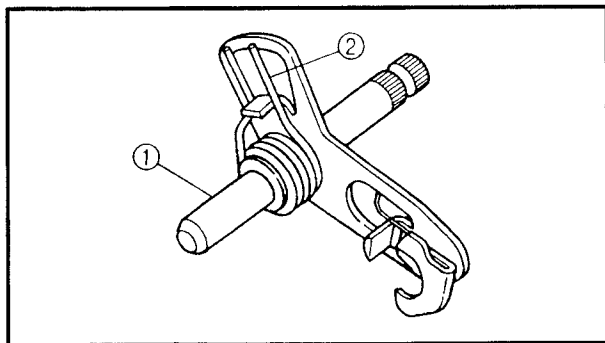
## SHIFT SHAFT



Order	Job/Part	Q'ty	Remarks
	<b>Removing the shift shaft</b>		
	Coolant reserver		Remove the parts in the order listed. Drain. Refer to "CHANGING THE COOLANT" in chapter 3. Refer to "ENGINE".
	Drive sprocket cover, sift rod and sift arm.		
1	Shift shaft cover	1	
2	Shift shaft cover gasket	1	
3	Dowel pin	2	
4	Oil seal	1	
5	Sift shaft	1	Refer to "INSTALLING THE SHIFT SHAFT".



Order	Job/Part	Q'ty	Remarks
6	Shift shaft spring	1	Refer to "INSTALLING THE SHIFT SHAFT".
7	Collar	1	
8	Stopper lever spring	1	
9	Circlip	1	
10	Washer	1	
11	Stopper lever	1	
12	Collar	1	
13	Washer	1	
14	Shift shaft spring stopper	1	For installation reverse the removal procedure.

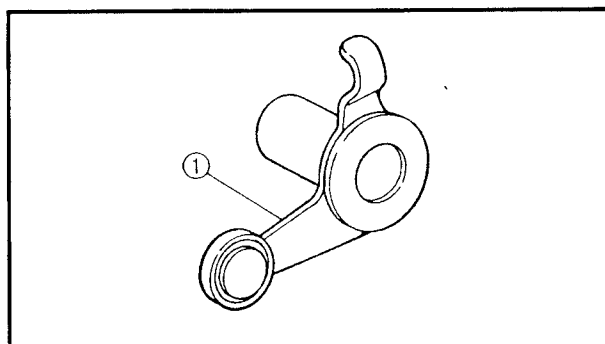


EAS00329

**CHECKING THE SHIFT SHAFT**

## 1. Check:

- shift shaft ①  
Bends/damage/wear → Replace.
- shift shaft spring ②  
Damage/wear → Replace.

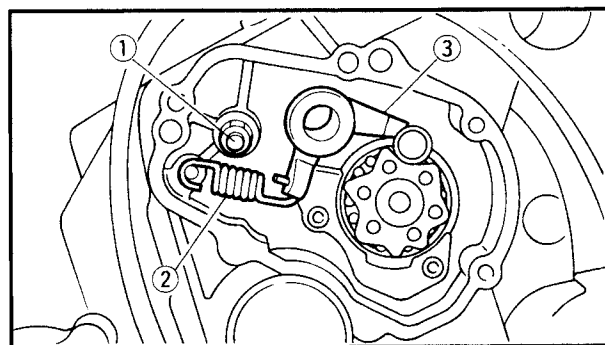


EAS00330

**CHECKING THE STOPPER LEVER**

## 1. Check:

- stopper lever ①  
Bends/damage → Replace.  
Roller turns roughly → Replace the stopper lever.



EAS00334

**INSTALLING THE SHIFT SHAFT**

## 1. Install:

- shift shaft spring stopper ①

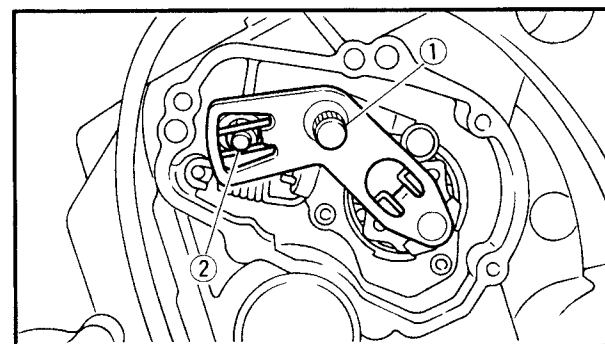


**22 Nm (2.2 m•kg, 16 ft•lb)**

- stopper lever spring ②
- washer
- stopper lever ③

**NOTE:**

- Apply LOCTITE® to the threads of the shift shaft spring stopper.
- Hook the ends of the stopper lever spring onto the stopper lever and the crankcase boss.
- Mesh the stopper lever with the shift drum segment assembly.



## 2. Install:

- shift shaft ①
- collar

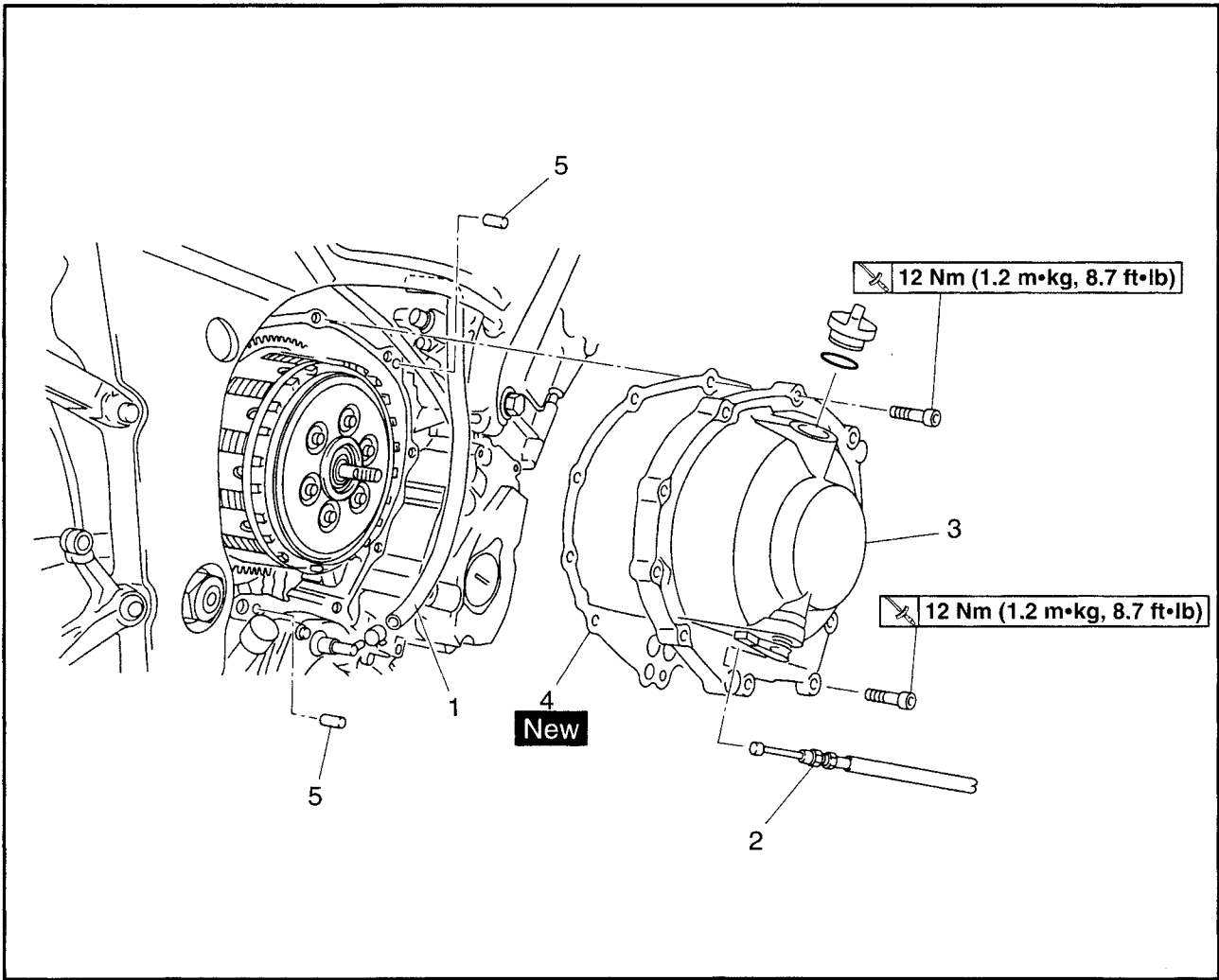
**NOTE:**

- Lubricate the oil seal lips with lithium soap base grease.
- Install the end of the shift shaft spring onto the shift shaft spring stopper ②

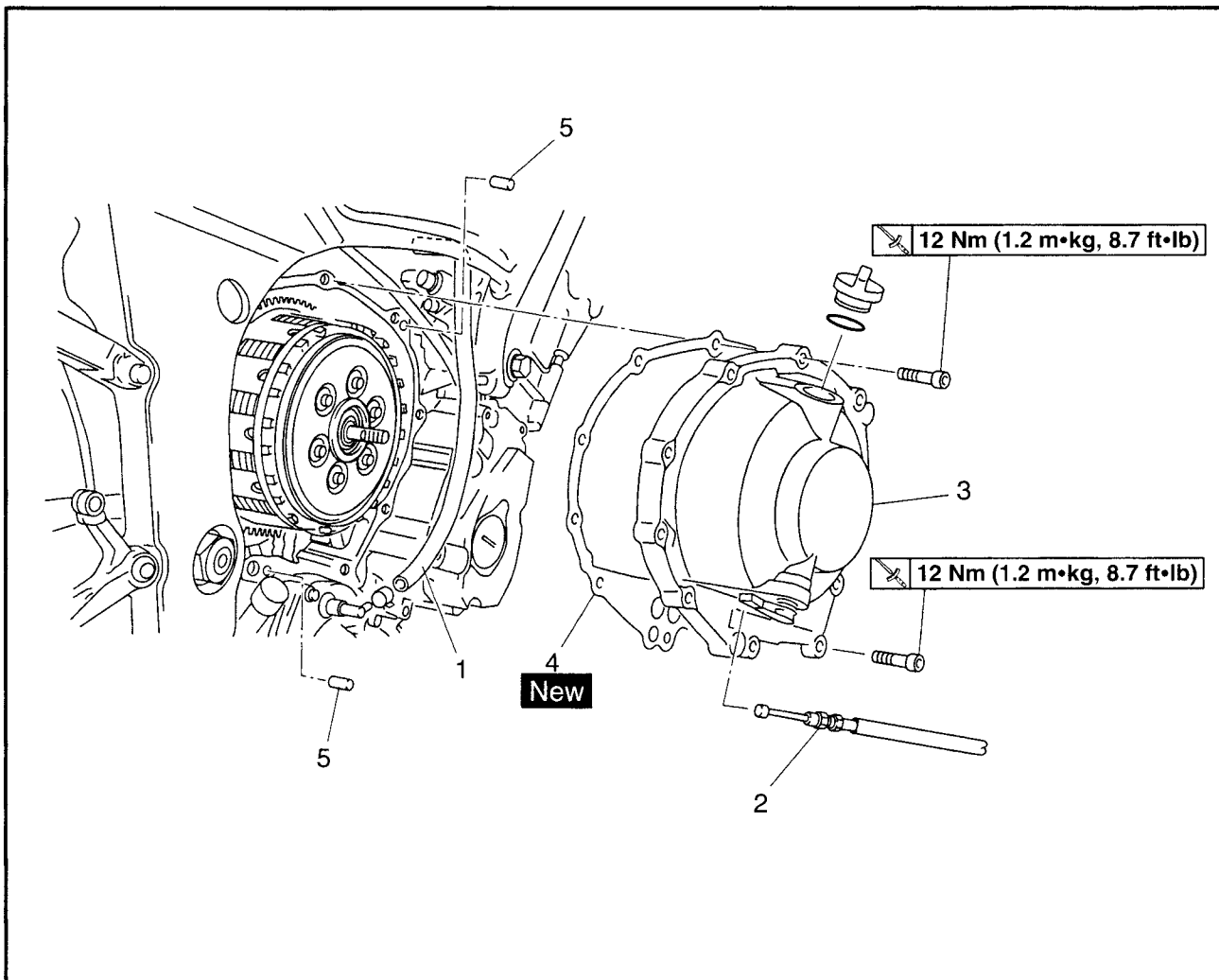


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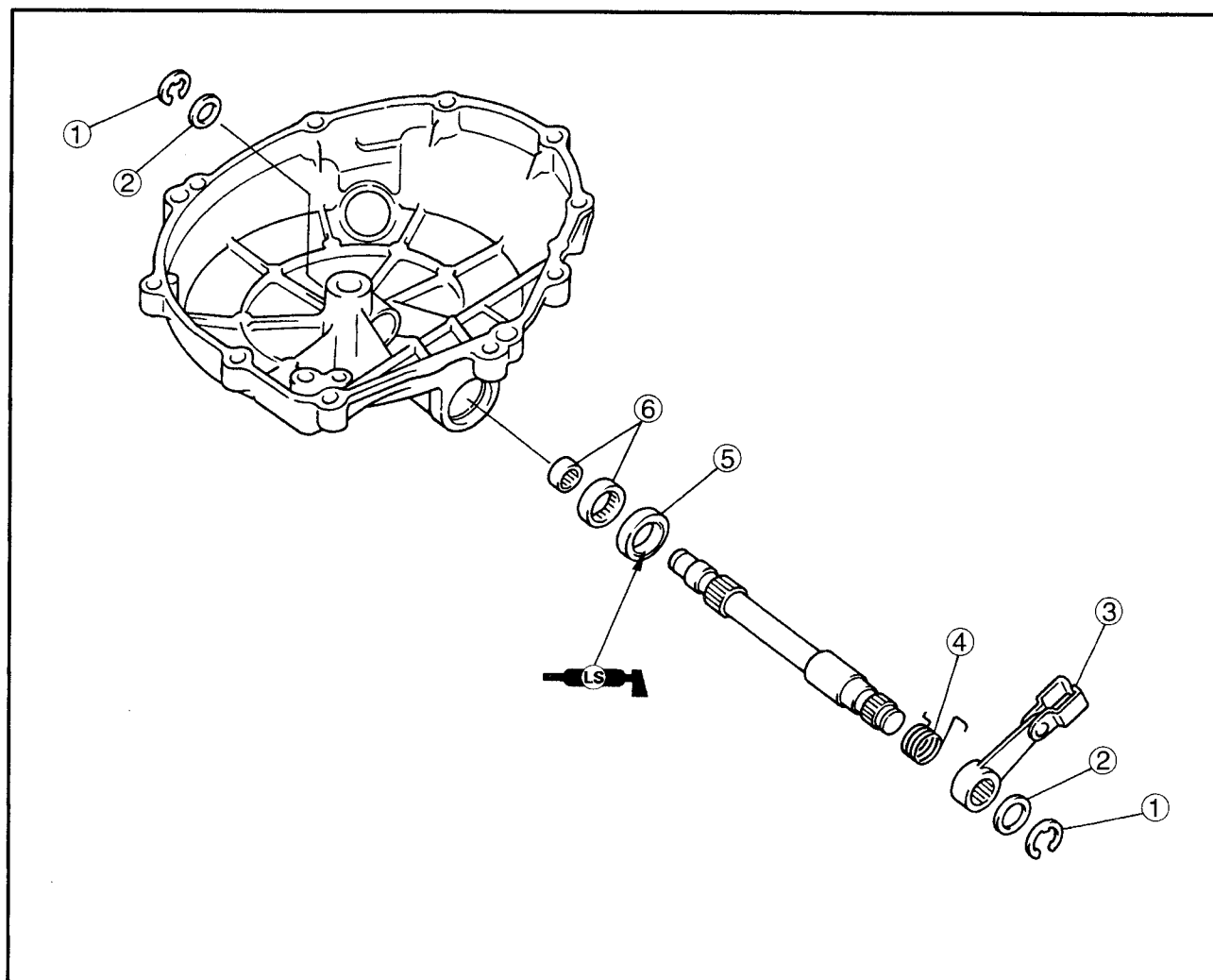
# CLUTCH CLUTCH COVER



Order	Job/Part	Q'ty	Remarks
	<b>Removing the clutch cover</b> Bottom cowing and right side cowing Engine oil		Remove the parts in the order listed. Refer to "COWLINGS" in chapter 3. Drain.
	Coolant		Refer to "CHANGING THE ENGINE OIL" in chapter 3. Drain. Refer to "CHANGING THE COOLANT" in chapter 3.
1	Therm bypass hose	1	
2	Clutch cable	1	



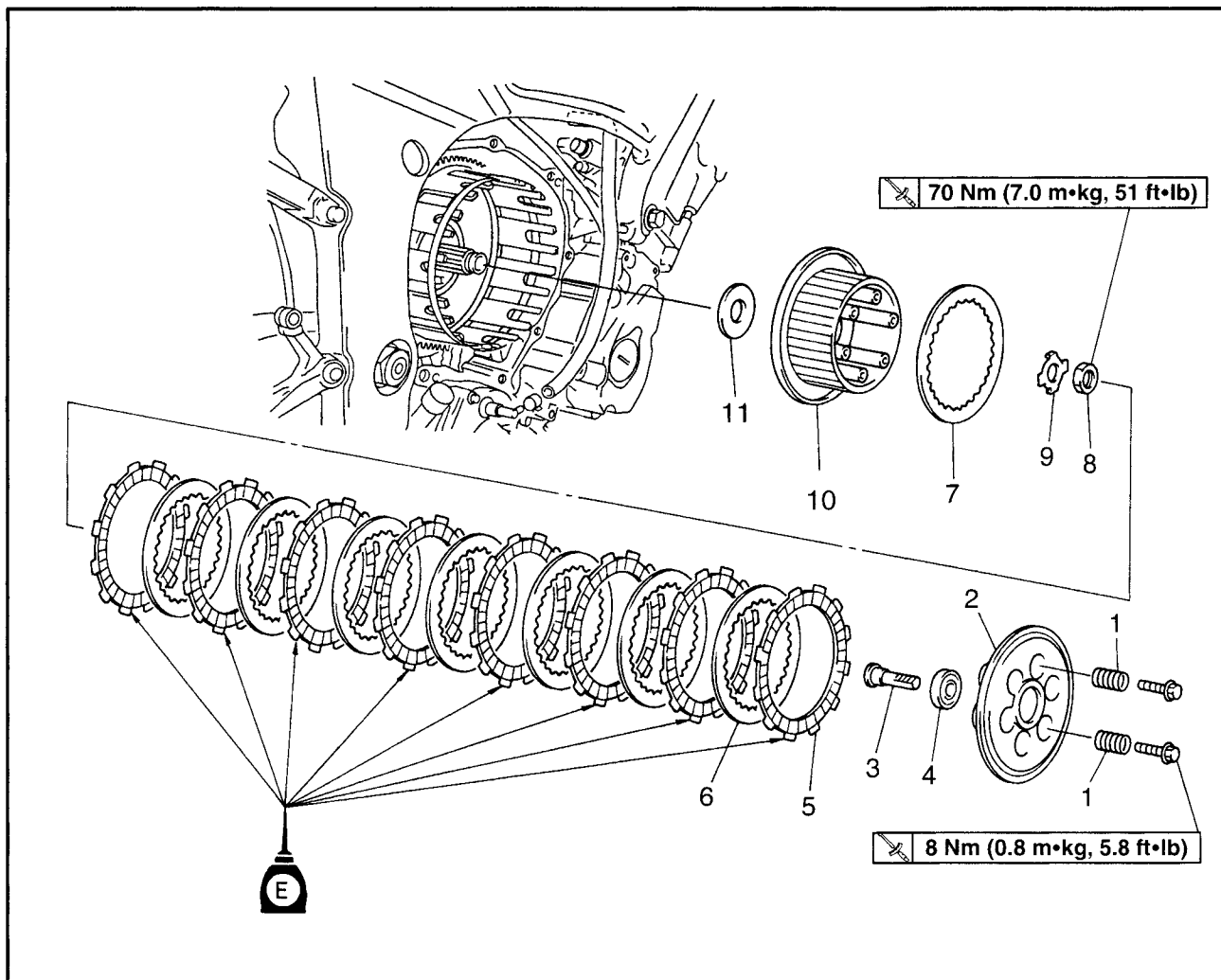
Order	Job/Part	Q'ty	Remarks
3	Clutch cover	1	Refer to "REMOVING/INSTALLING THE CLUTCH".  For installation reverse the removal procedure.
4	Clutch cover gasket	1	
5	Dowel pin	2	



Order	Job/Part	Q'ty	Remarks
	<b>Disassembling the clutch cover assembly</b>		Disassemble the parts in the order listed.
①	Circlip	2	
②	Plain washer	2	
③	Pull lever	1	Refer to "INSTALLING THE CLUTCH".
④	Pull lever spring	1	
⑤	Oil seal	1	
⑥	Bearing	2	For assembly, reverse the disassembly procedure.

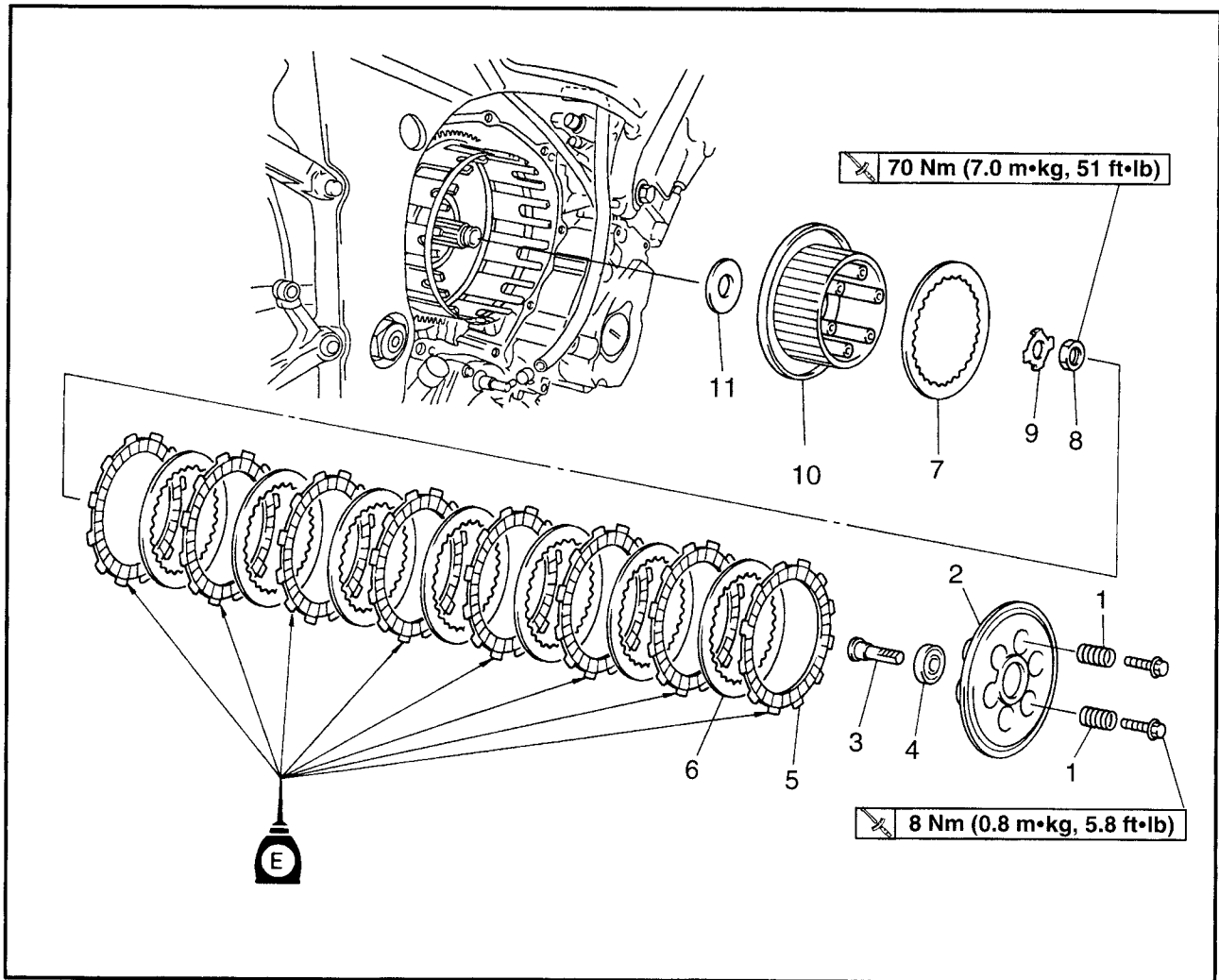


## CLUTCH

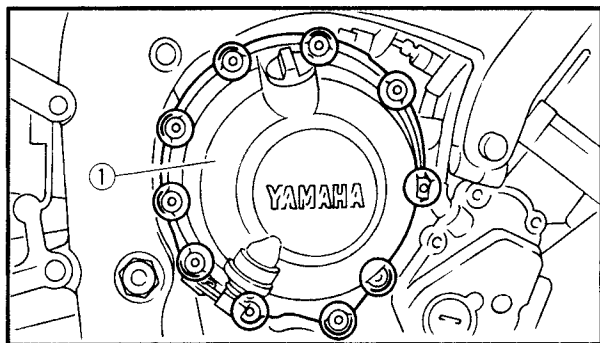


Order	Job/Part	Q'ty	Remarks
	<b>Removing the clutch</b>		
1	Compression spring	6	Remove the parts in the order listed.
2	Pressure plate	1	
3	Pull rod	1	Refer to "INSTALLING THE CLUTCH".
4	Bearing	1	
5	Friction plate	8	
6	Clutch plate	7	
7	Clutch plate	1	Refer to "REMOVING/INSTALLING THE CLUTCH".
8	Clutch boss nut	1	
9	Lock washer	1	
10	Clutch boss	1	





Order	Job/Part	Q'ty	Remarks
11	Thrust plate	1	For installation, reverse the removal procedure.



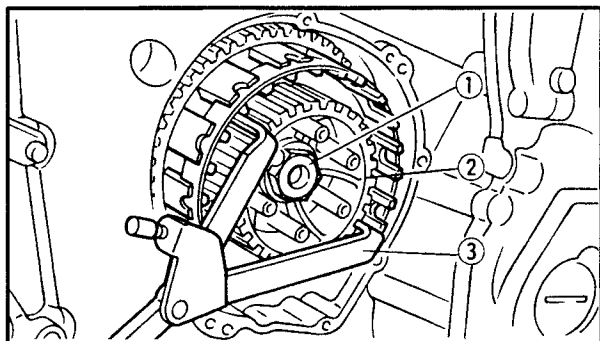
EAS00277

**REMOVING THE CLUTCH**

1. Remove:
  - clutch cover ①

**NOTE:**

Loosen each bolt 1/4 of a turn at a time, in stages and in a crisscross pattern.  
After all of the bolts are fully loosened, remove them.



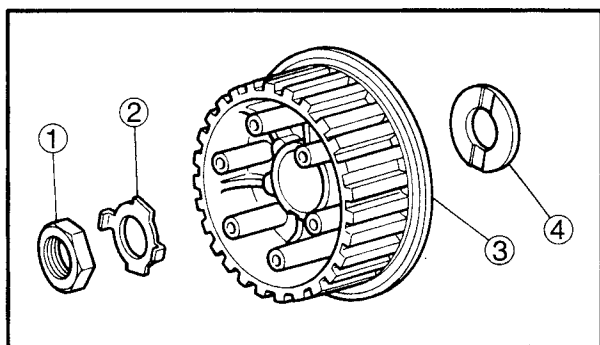
- Pressure plate
  - Friction and clutch plates
2. Straighten the lock washer tab.
  3. Loosen:
    - clutch boss nut ①

**NOTE:**

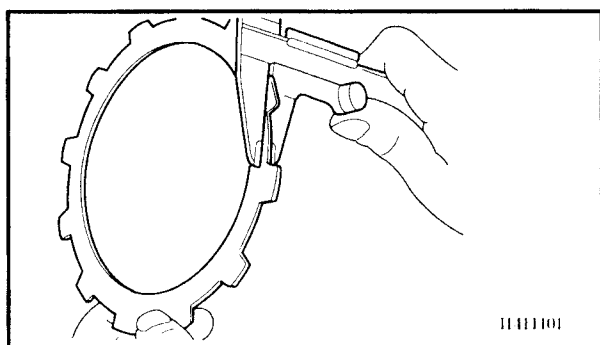
While holding the clutch boss ② with the clutch holding tool ③, loosen the clutch boss nut.



**Clutch holding tool**  
90890-04086, YM-91042



4. Remove:
  - clutch boss nut ①
  - lock washer ②
  - clutch boss ③
  - thrust plate ④



EAS00280

**CHECKING THE FRICTION PLATES**

The following procedure applies to all of the friction plates.

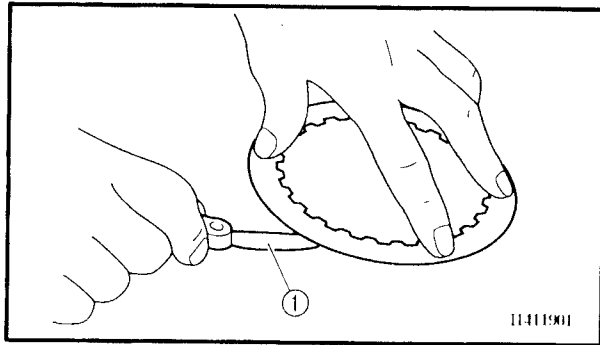
1. Check:
  - friction plate  
Damage/wear → Replace the friction plates as a set.
2. Measure:
  - friction plate thickness  
Out of specification → Replace the friction plates as a set.

**NOTE:**

Measure the friction plate at four places.



**Friction plate thickness**  
2.9 ~ 3.1 mm (0.114 ~ 0.122 in)  
<Limit>: 2.8 mm (0.11 in)



EAS00281

**CHECKING THE CLUTCH PLATES**

The following procedure applies to all of the clutch plates.

## 1. Check:

- clutch plate

Damage → Replace the clutch plates as a set.

## 2. Measure:

- clutch plate warpage

(with a surface plate and thickness gauge ①)

Out of specification → Replace the clutch plates as a set.



**Max. clutch plate warpage**  
0.1 mm (0.0039 in)

EAS00282

**CHECKING THE CLUTCH SPRINGS**

The following procedure applies to all of the clutch springs.

## 1. Check:

- clutch spring

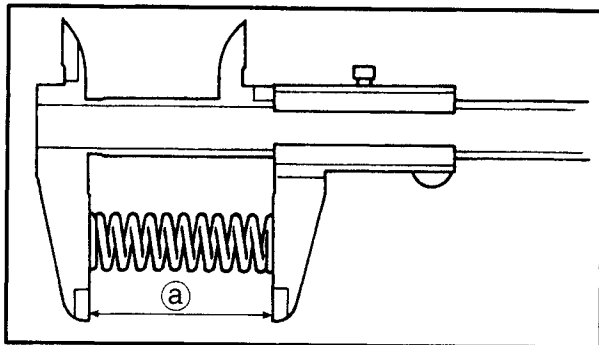
Damage → Replace the clutch springs as a set.

## 2. Measure:

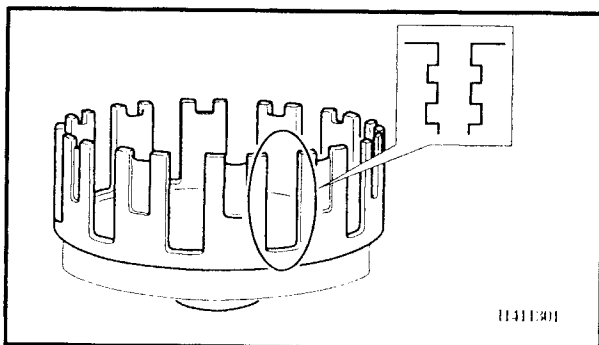
- clutch spring free length ②

Out of specification → Replace the clutch springs as a set.

Clutch spring free length



**Clutch spring free length**  
55 mm (2.17 in)  
<Limit>: 54 mm (2.13 in)



EAS00284

**CHECKING THE CLUTCH HOUSING**

## 1. Check:

- clutch housing dogs

Damage/pitting/wear → Deburr the clutch housing dogs or replace the clutch housing.

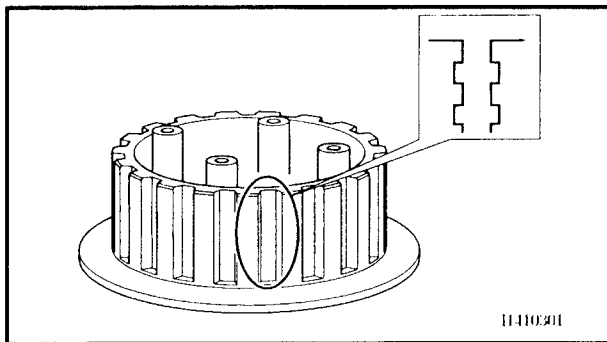
**NOTE:**

Pitting on the clutch housing dogs will cause erratic clutch operation.

## 2. Check:

- bearing

Damage/wear → Replace the clutch housing.



EAS00285

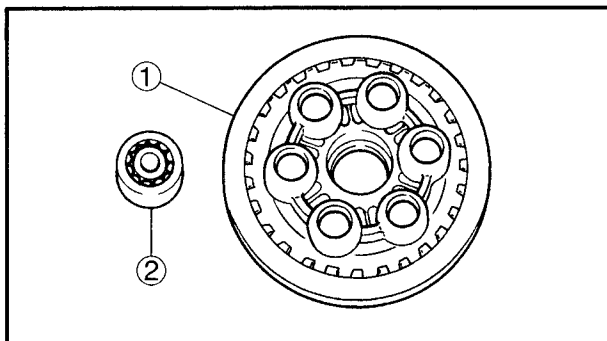
**CHECKING THE CLUTCH BOSS**

## 1. Check:

- clutch boss splines  
Damage/pitting/wear → Replace the clutch boss.

**NOTE:**

Pitting on the clutch boss splines will cause erratic clutch operation.

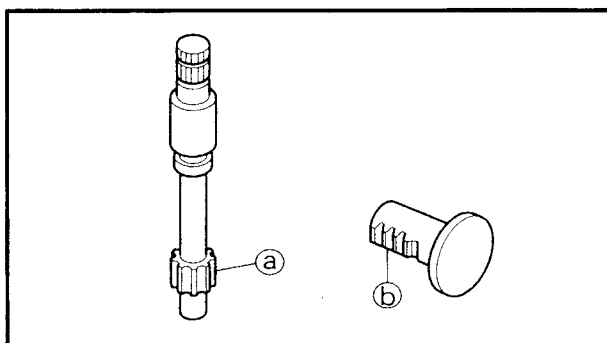


EAS00286

**CHECKING THE PRESSURE PLATE**

## 1. Check:

- pressure plate ①  
Cracks/damage → Replace.
- bearing ②  
Damage/wear → Replace.



EAS00287

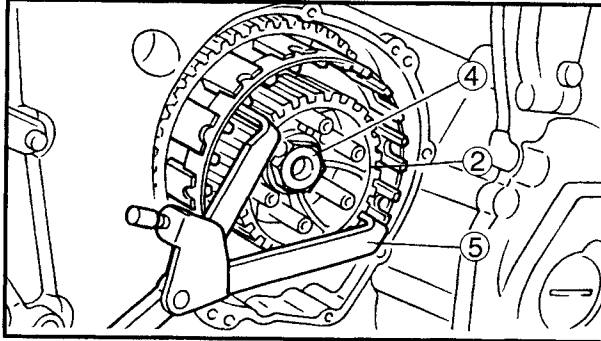
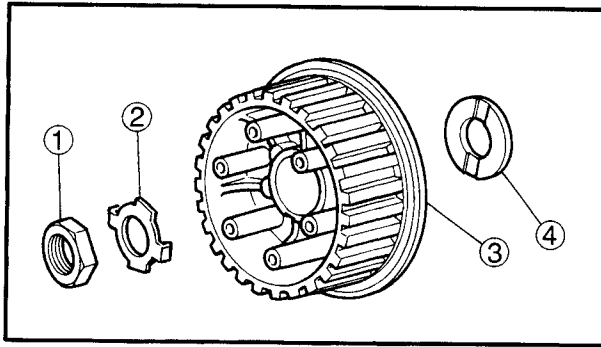
**CHECKING THE PULL LEVER SHAFT AND PULL ROD**

## 1. Check:

- pull lever shaft pinion gear teeth (a)
- pull rod teeth (b)  
Damage/wear → Replace the pull rod and pull lever shaft as a set.

## 2. Check:

- pull rod bearing  
Damage/wear → Replace.



EAS00296

**INSTALLING THE CLUTCH**

1. Install:
  - thrust plate ①
  - clutch boss ②
2. Install:
  - lock washer ③ **New**
  - clutch boss nut ④

70 Nm (7.0 m•kg, 51 ft•lb)

**NOTE:**

While holding the clutch boss ② with the clutch holding tool ⑤, tighten the clutch boss nut.



**Clutch holding tool**  
90890-04086, YM-91042

3. Bend the lock washer tab along a flat side of the nut.
4. Lubricate:
  - friction plates
  - clutch plates
  - (with the recommended lubricant)

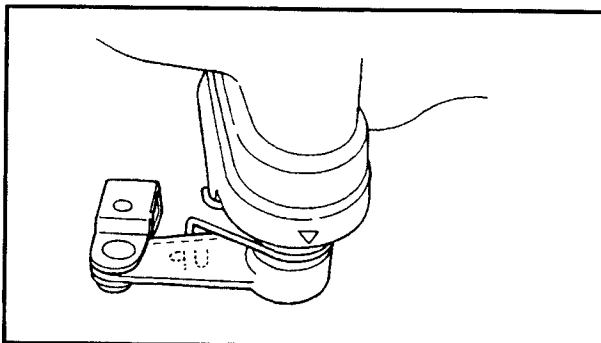
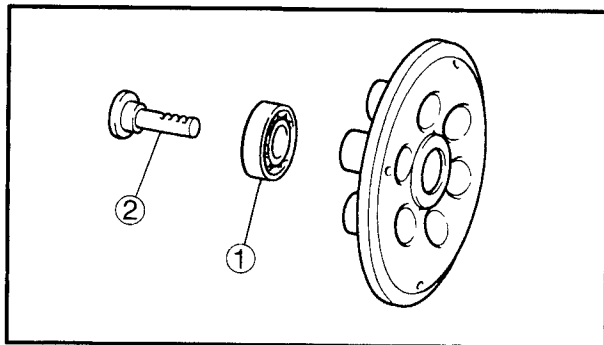


**Recommended lubricant**  
**Engine oil**

5. Install:
  - friction plates
  - clutch plates

**NOTE:**

First, install a friction plate and then alternate between a clutch plate and a friction plate.

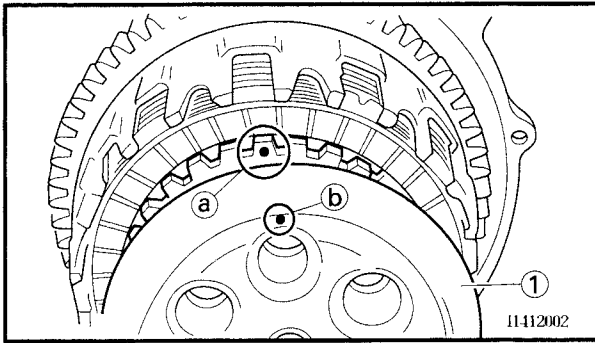
**NOTE:**

Install the pull rod so that the teeth face towards the rear of the motorcycle. Then, install the clutch cover.


Tighten the clutch cover bolts in stages and in a crisscross pattern.

Apply oil onto the bearing.

Apply molybdenum disulfide grease onto the pull rod.



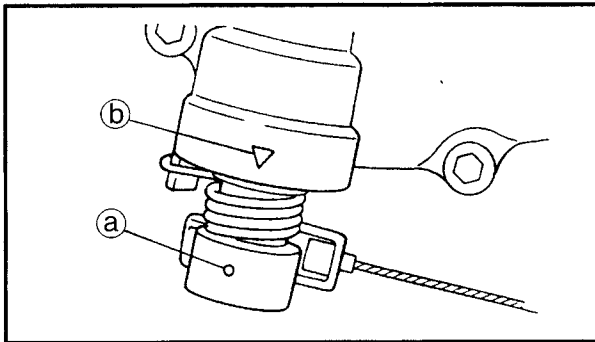
7. Install:
- pressure plate ①
  - clutch springs
  - clutch spring bolts

 8 Nm (0.8 m•kg, 5.8 ft•lb)


**NOTE:**

Tighten the clutch spring bolts in stages and in a criss cross pattern.

Align the punch mark ⑥ in the pressure plate with the punch mark ⑤ in the clutch boss.



8. Install:
- clutch cover

 12 Nm (1.2 m•kg, 8.7 ft•lb)

**NOTE:**

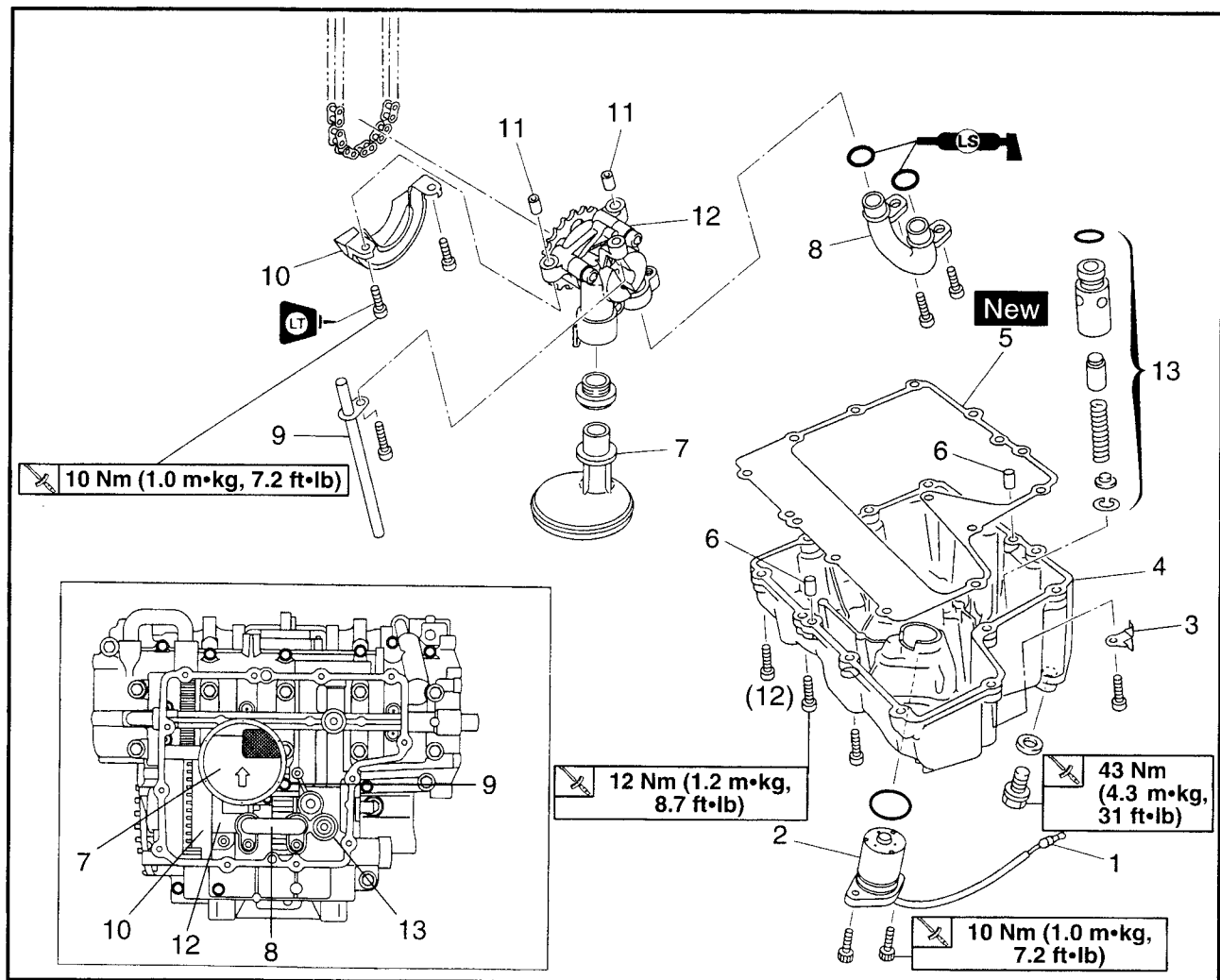
• When installing the clutch cover, push the pull lever and check that the punch mark ⑤ on the pull lever aligns with the mark ⑥ on the clutch cover. Make sure that the pull rod teeth and pull lever shaft pinion gear are engaged.

• Tighten the clutch cover bolts in stages and in a crisscross pattern.

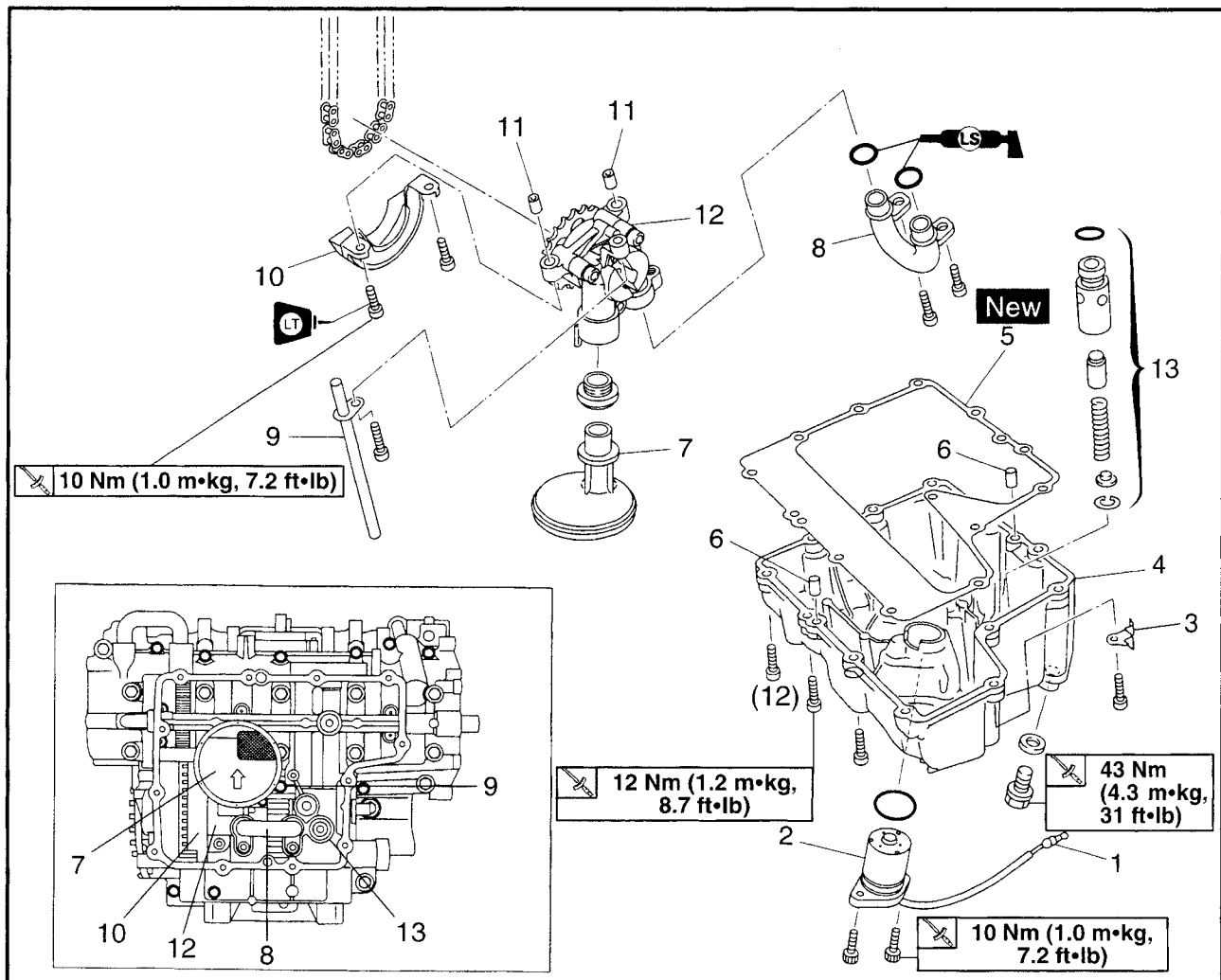


EAS00356

## OIL PAN AND OIL PUMP



Order	Job/Part	Q'ty	Remarks
	<b>Removing the oil pan and oil pump</b>		Remove the parts in the order listed.
	Engine oil		Drain.
	Coolant		Refer to "CHANGING THE ENGINE OIL" in chapter 3.
	Radiator assembly and water pump assembly		Drain.
	Exhaust pipe assembly		Refer to "CHANGING THE COOLANT" in chapter 3.
1	Oil level switch coupler	1	Refer to "RADIATOR" and "WATER PUMP" in chapter 5.
2	Oil level switch	1	Refer to "ENGINE".
			Disconnect.



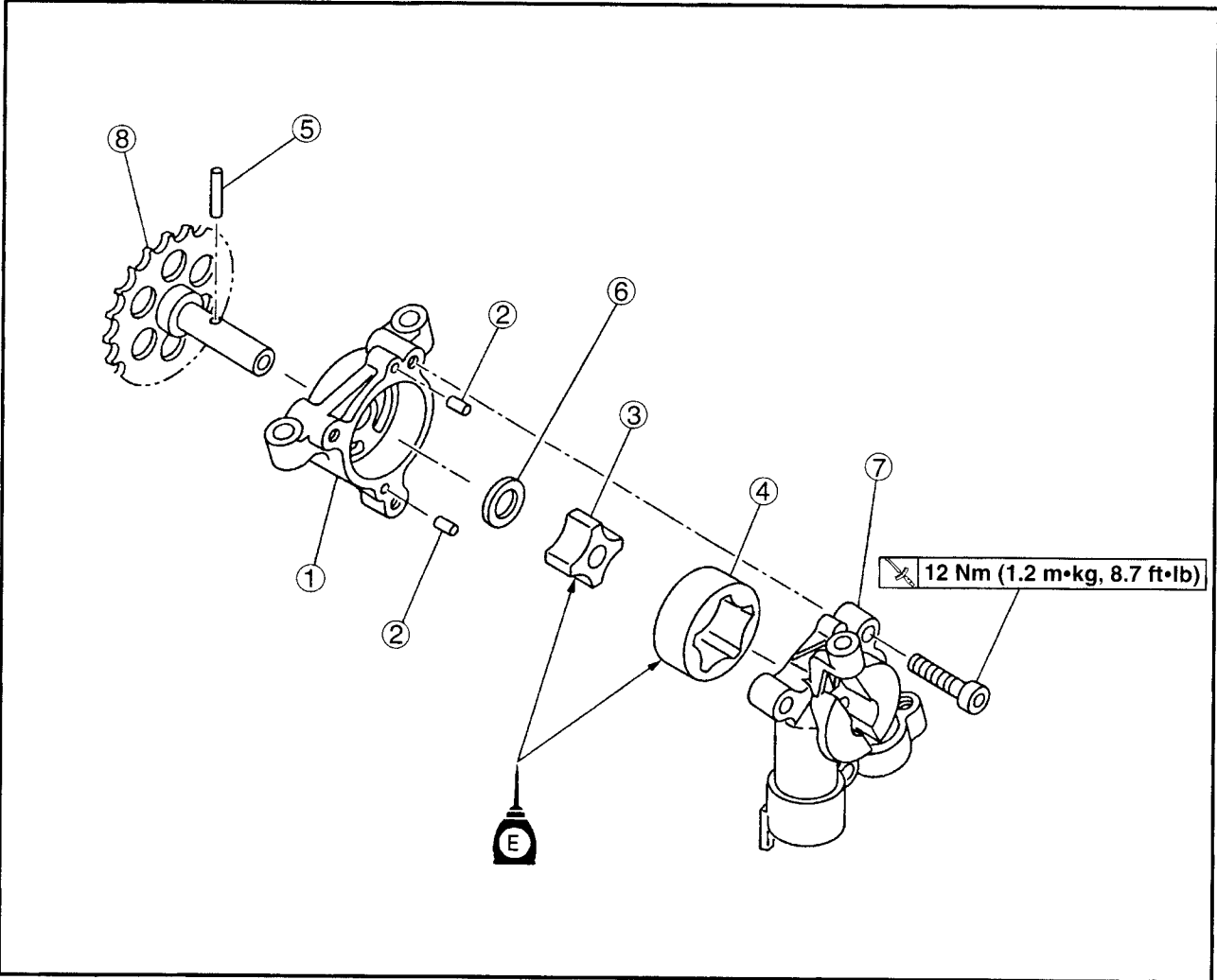
Order	Job/Part	Q'ty	Remarks
3	Oil level switch lead holder	1	Refer to "REMOVEING/INSTALLING THE OIL PAN."
4	Oil pan	1	
5	Oil pan gasket	1	
6	Dowel pin	2	
7	Oil strainer	1	Refer to "INSTALLING THE OIL STRAINER".
8	Oil pipe	1	Refer to "INSTALLING THE OIL PUMP".
9	Oil delivery pipe	1	
10	Gear cover	1	
11	Dowel pin	2	
12	Oil pump assembly	1	For installation, reverse the removal procedure.
13	Relief valve assembly	1	



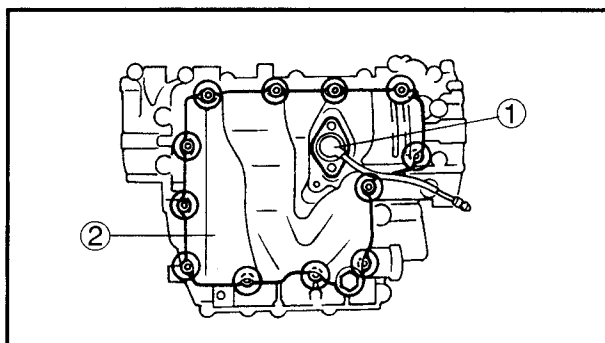


EB411010

OIL PUMP



Order	Job/Part	Q'ty	Remarks
	<b>Disassembling the oil pump assembly</b>		Disassemble the parts in the order listed.
①	Oil pump rotor housing	1	
②	Dowel pin	2	
③	Oil pump inner rotor	1	
④	Oil pump outer rotor	1	
⑤	Dowel pin	1	
⑥	Washer	1	
⑦	Oil pump cover	1	
⑧	Driver gear	1	
			For assembly reverse the disassembly procedure.



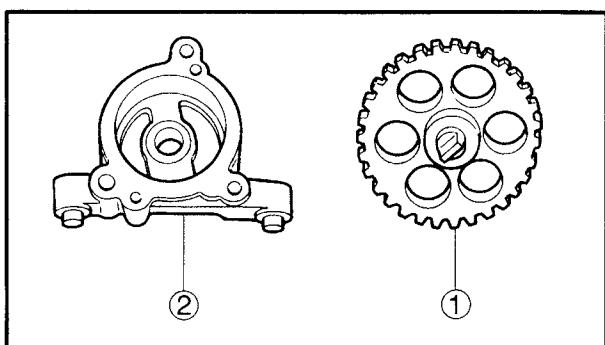
EAS00362

**REMOVING THE OIL PAN**

1. Remove:
  - oil level switch ①
  - oil pan ②
  - oil pan gasket
  - dowel pins

**NOTE:**

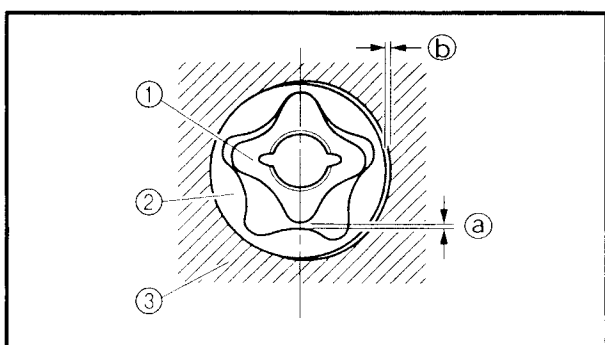
Loosen each bolt 1/4 of a turn at a time, in stages and in a crisscross pattern.  
After all of the bolts are fully loosened, remove them.



EAS00364

**CHECKING THE OIL PUMP**

1. Check:
  - oil/pump driven gear ①
  - rotor housing ②
 Cracks/damage/wear → Replace the defective part(-s).



2. Measure:
  - inner-rotor-to-outer-rotor-tip clearance ①
  - outer-rotor-to-oil-pump-cover clearance ②
 Out of specification → Replace the oil pump.

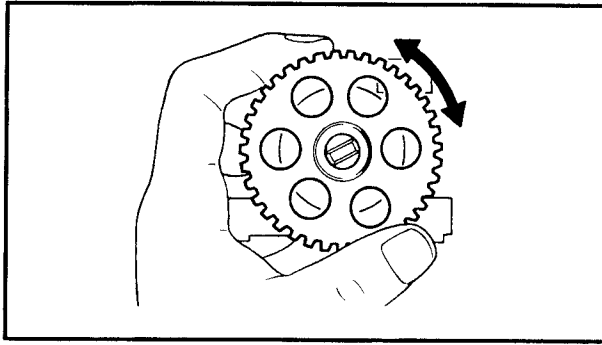
- ① Inner rotor
- ② Outer rotor
- ③ Oil pump cover

**Inner-rotor-to-outer-rotor-tip clearance**

0.03 ~ 0.09 mm  
(0.0012 ~ 0.0035 in)  
<Limit>: 0.15 mm (0.0059 in)

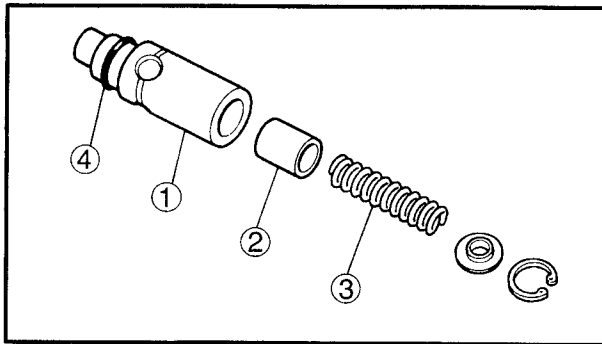
**Outer-rotor-to-oil-pump-cover clearance**

0.03 ~ 0.08 mm  
(0.0012 ~ 0.0031 in)  
<Limit>: 0.15 mm (0.0059 in)



## 3. Check:

- oil pump operation  
Unsmooth → Repair or replace the defective part(s).



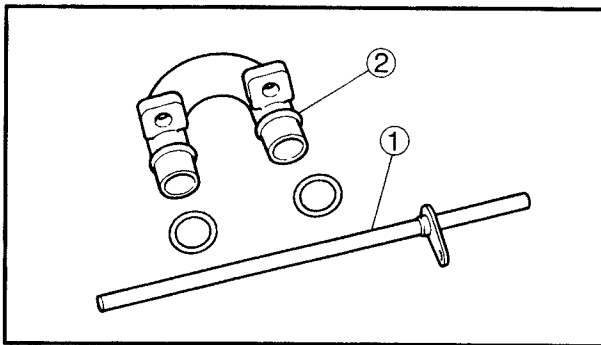
EAS00365

**CHECKING THE RELIEF VALVE**

## 1. Check:

- relief valve body ①
- relief valve ②
- spring ③
- O-ring ④

Damage/wear → Replace the defective part(s).



EAS00367

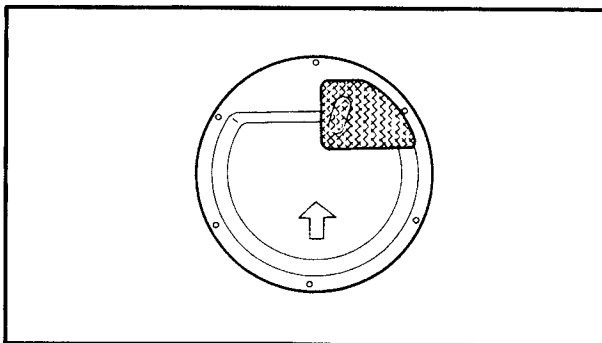
**CHECKING THE OIL DELIVERY PIPE AND OIL PIPE**

## 1. Check:

- oil delivery pipe ①
- oil pipe ②

Damage → Replace.

Obstruction → Wash and blow out with compressed air.



EAS00368

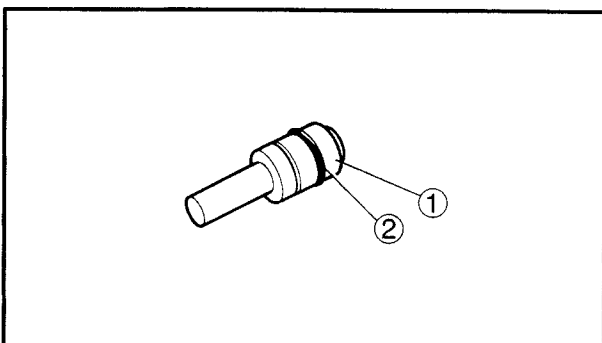
**CHECKING THE OIL STRAINER**

## 1. Check:

- oil strainer ①

Damage → Replace.

Contaminants → Clean with engine oil.



EAS00373

**CHECKING THE OIL NOZZLES**

The following procedure applies to all of the oil nozzles.

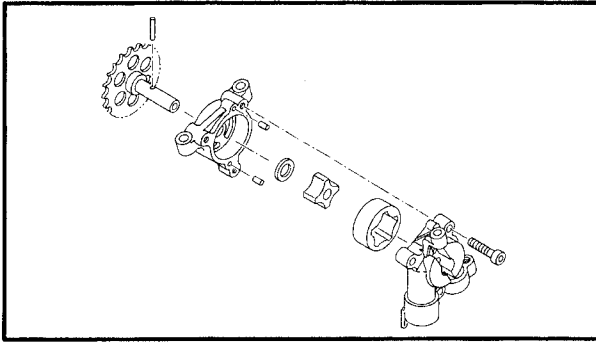
## 1. Check:

- oil nozzle ①
- O-ring ②

Damage/wear → Replace the oil nozzle.

oil nozzle passage

Obstruction → Blow out with compressed air.



EAS00375

**ASSEMBLING THE OIL PUMP**

1. Lubricate:
  - inner rotor
  - outer rotor
  - impeller shaft  
(with the recommended lubricant)



**Recommended lubricant**  
**Engine oil**

2. Check:
  - oil pump operation
 Refer to "CHECKING THE OIL PUMP".

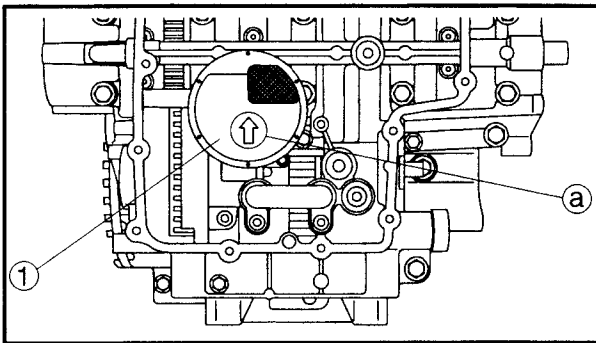
EAS00376

**INSTALLING THE OIL PUMP**

1. Install:
  - oil pump ①  **12 Nm (1.2 m•kg, 8.7 ft•lb)**

**NOTE:**

Install the oil pump assembly drive chain onto the oil pump assembly driven sprocket.



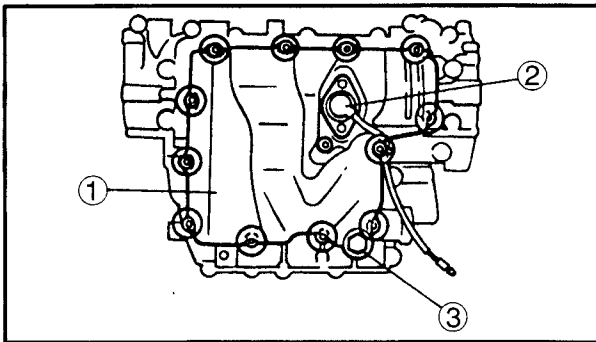
EAS00378

**INSTALLING THE OIL STRAINER**

1. Install:
  - oil strainer ①




**NOTE:**

The arrow ① on the oil strainer housing must point towards the front of the engine.



EAS00380

**INSTALLING THE OIL PAN**

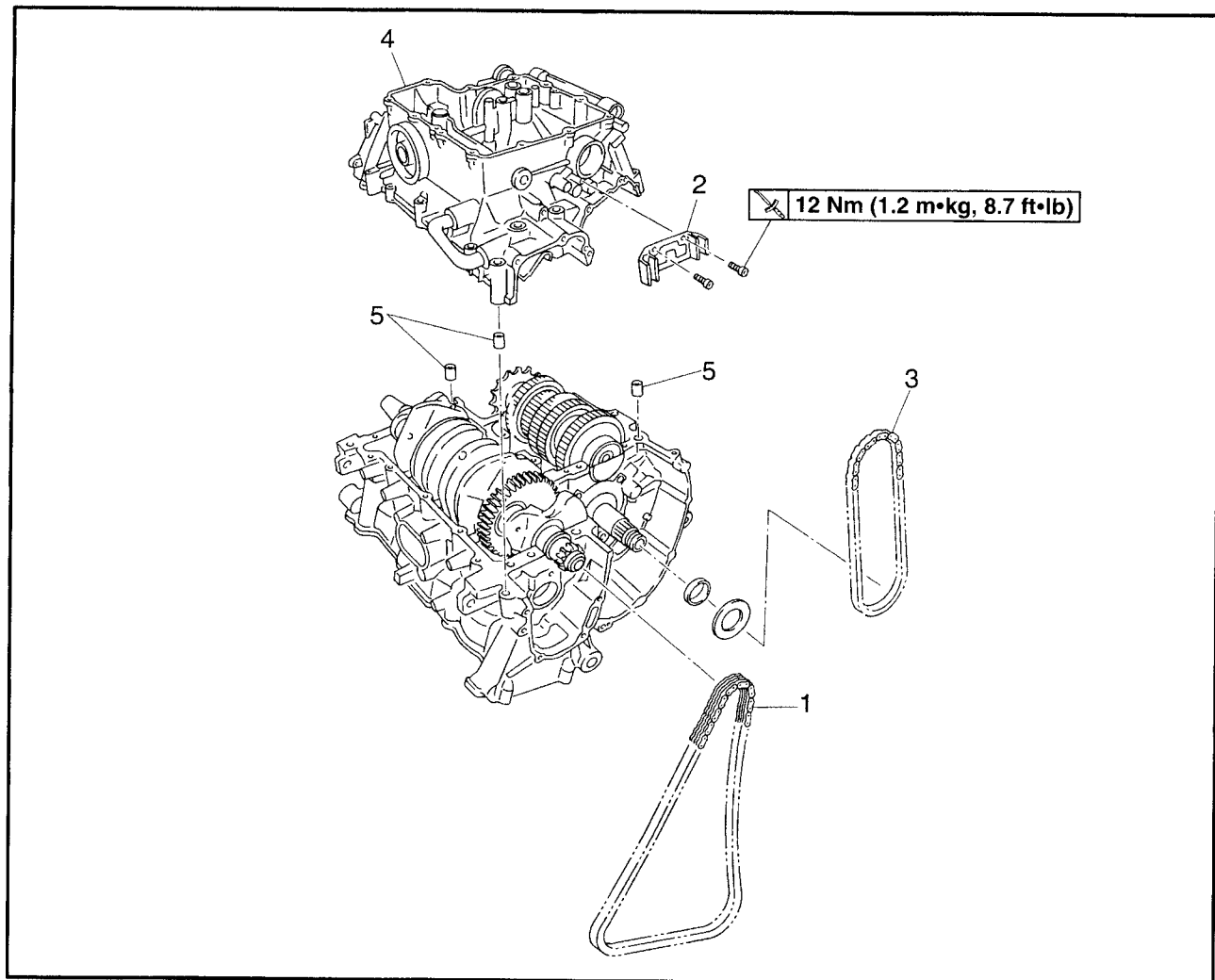
1. Install:
  - dowel pins
  - oil pan gasket **New**
  - oil pan ①  **12 Nm (1.2 m•kg, 8.7 ft•lb)**
  - oil level switch ②  **10 Nm (1.0 m•kg, 7.2 ft•lb)**
  - engine oil drain bolt ③  **43 Nm (4.3 m•kg, 31 ft•lb)**

**NOTE:**

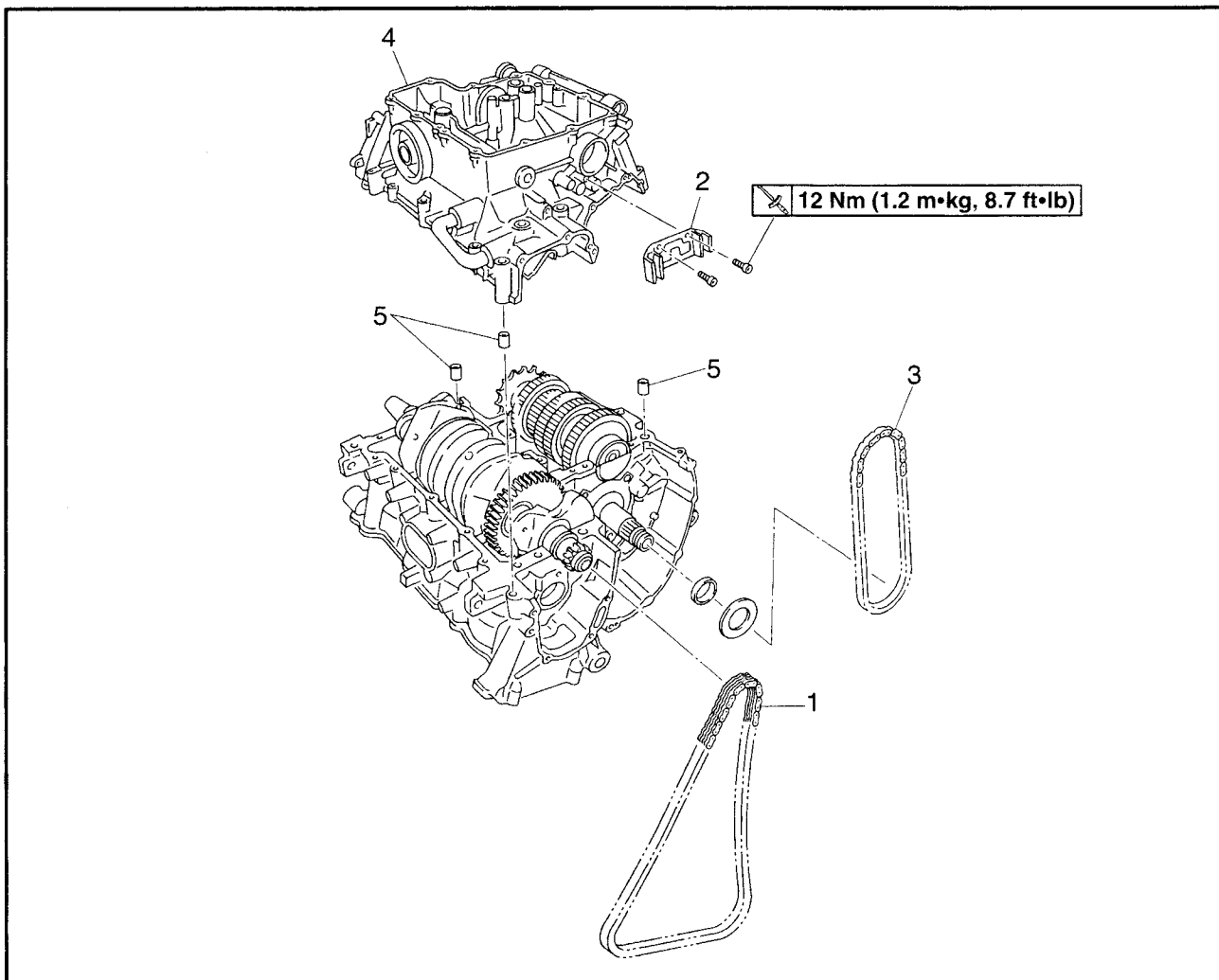
- Tighten the oil pan bolts in stages and in a crisscross pattern.
- Lubricate the oil level switch O-ring with lithium soap base grease.



## CRANKCASE



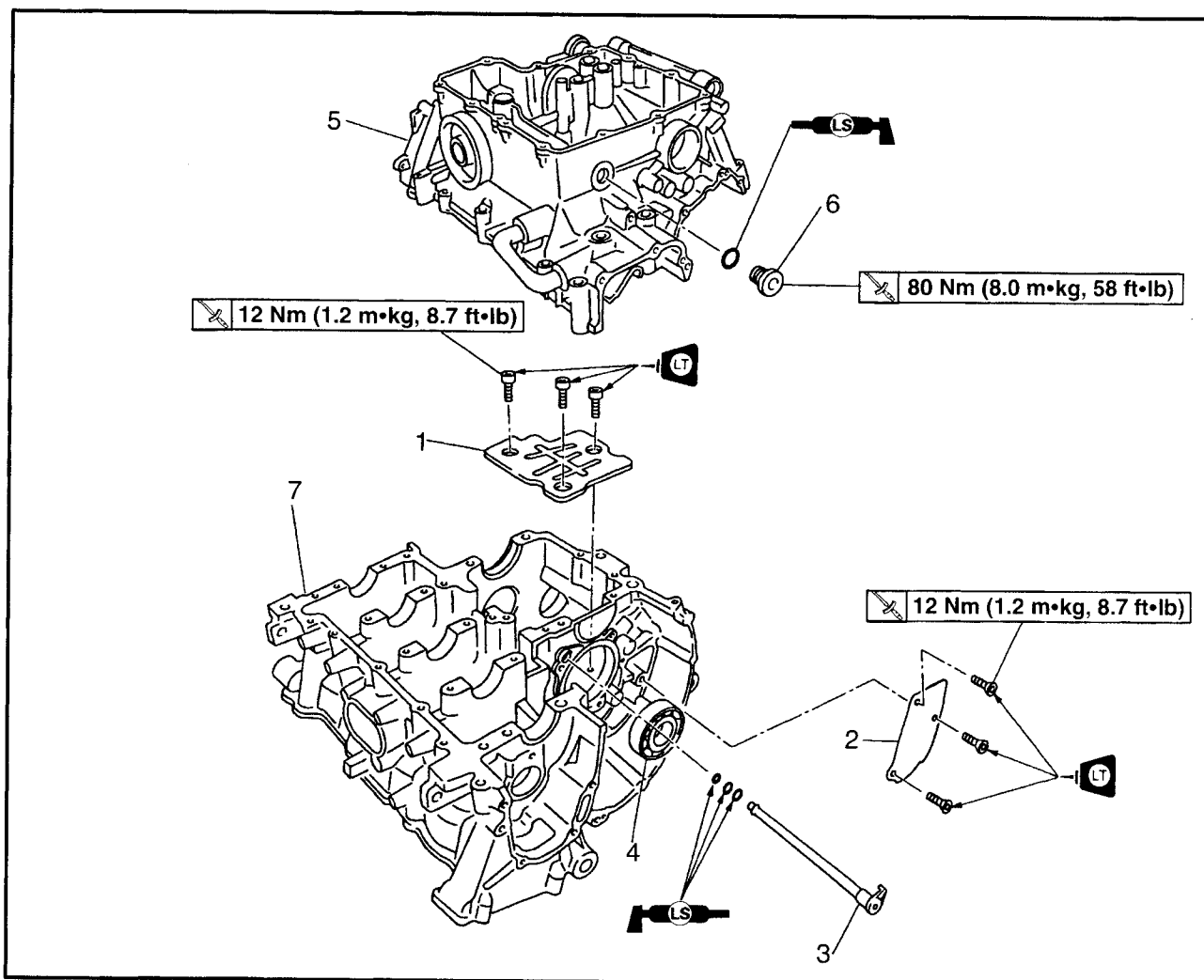
Order	Job/Part	Q'ty	Remarks
	<b>Separating the crankcase</b>		
	Engine		Remove the parts in the order listed.
	Cylinder head		Refer to "ENGINE".
	Starter clutch and generator		Refer to "CYLINDER HEAD".
			Refer to "STARTER CLUTCH AND GENERATOR".
	Shift shaft		Refer to "SHIFT SHAFT".
	Pickup coil and pickup rotor		Refer to "PICKUP COIL AND PICKUP ROTOR".
	Clutch assembly		Refer to "CLUTCH".
	Water pump assembly		Refer to "WATER PUMP" in chapter 5.
	Oil pan and oil pump		Refer to "OIL PAN AND OIL PUMP".



Order	Job/Part	Q'ty	Remarks
1	Timing chain	1	Refer to "DISASSEMBLY/ASSEMBLY THE CRANKCASE".
2	Oil pump drive chain guide	1	
3	Oil pump drive chain	1	
4	Lower crankcase	1	
5	Dowel pin	3	For installation, reverse the removal procedure.



## OIL BAFFLE PLATES AND OIL FILTER BOLT



Order	Job/Part	Q'ty	Remarks
	<b>Removing the oil baffle plates and oil filter bolt</b>		Remove the parts in the order listed.
	Transmission		Refer to "TRANSMISSION".
1	Oil baffle plate	1	
2	Oil baffle plate	1	
3	Oil delivery pipe	1	
4	Bearing	1	
5	Lower crankcase	1	
6	Oil filter bolt	1	
7	Upper crankcase	1	
			For instalation, reverse the removal procedure.



EAS00384

**DISASSEMBLING THE CRANKCASE**

1. Place the engine upside down.

**NOTE:**

- Loosen each bolt 1/4 of a turn at a time, in stages and in a crisscross pattern. After all of the bolts are fully loosened, remove them.
- Loosen the bolts in decreasing numerical order (refer to the numbers in the illustration).
- The numbers embossed on the crankcase indicate the crankcase tightening sequence.

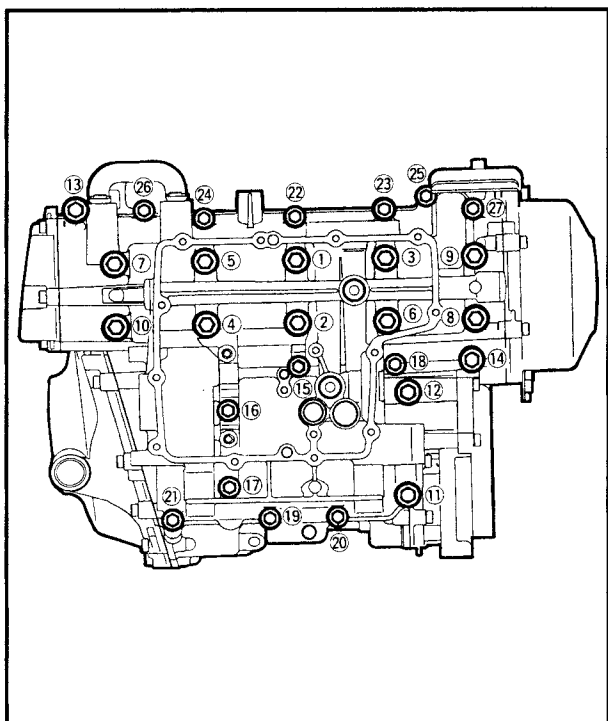
2. Remove:  
crankcase bolts
3. Remove:  
• lower crankcase

**CAUTION:**

Tap on one side of the crankcase with a soft-face hammer. Tap only on reinforced portions of the crankcase, not on the crankcase mating surfaces. Work slowly and carefully and make sure that the crankcase halves separate evenly.

M8 × 85 mm bolts: ① ~ ⑦ ⑩  
 M8 × 115 mm bolts: ⑧ ⑨  
 M8 × 65 mm bolt: ⑪ ⑫  
 M6 × 65 mm bolts: ⑬ ⑭ ⑰ ⑳  
 M6 × 55 mm bolts: ⑮ ㉒ ~ ㉔  
 M6 × 45 mm bolt: ⑯ ㉓ ~ ㉕  
 M6 × 75 mm bolt: ⑱

4. Remove:  
• dowel pins







EAS00399

**CHECKING THE CRANKCASE**

1. Thoroughly wash the crankcase halves in a mild solvent.
2. Thoroughly clean all the gasket surfaces and crankcase mating surfaces.
3. Check:
  - upper crankcase
  - lower crankcase
  - Cracks/damage → Replace.
  - oil delivery passages
  - Obstruction → Blow out with compressed air.

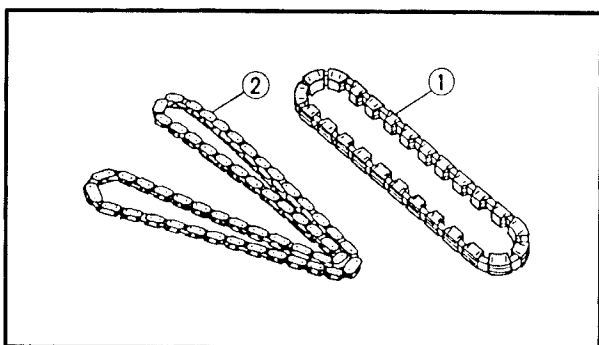
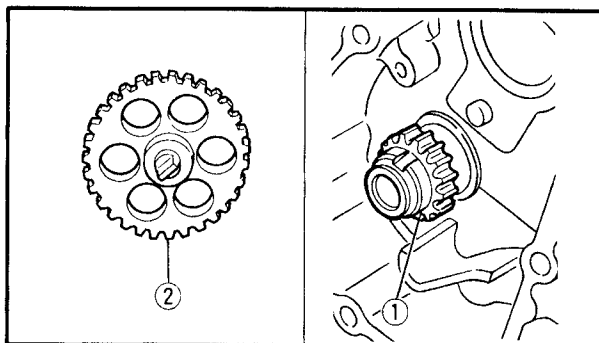
EAS00401

**CHECKING THE BEARINGS AND OIL SEALS**

1. Check:
  - bearings
  - Clean and lubricate the bearings, then rotate the inner race with your finger.
  - Rough movement → Replace.
2. Check:
  - oil seals
  - Damage/wear → Replace.

**CHECKING THE SPROCKETS AND CHAINS**

1. Check:
  - crankshaft sprocket ①
  - oil/water pump assembly drive sprocket ②
  - Cracks/damage/wear → Replace the defective part(-s).



2. Check:
  - timing chain ①
  - Damage/stiffness → Replace the timing chain and crankshaft sprocket as a set.
  - oil/water pump assembly drive chain ②
  - Damage/stiffness → Replace the oil/water pump assembly drive chain and oil/water pump assembly drive sprocket as a set.



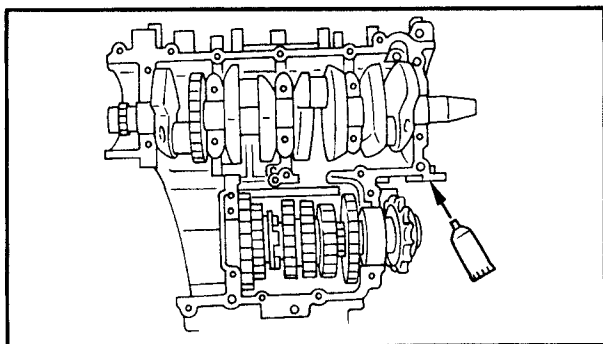
EAS00415

**ASSEMBLING THE CRANKCASE****1. Lubricate:**

- crankshaft journal bearings  
(with the recommended lubricant)



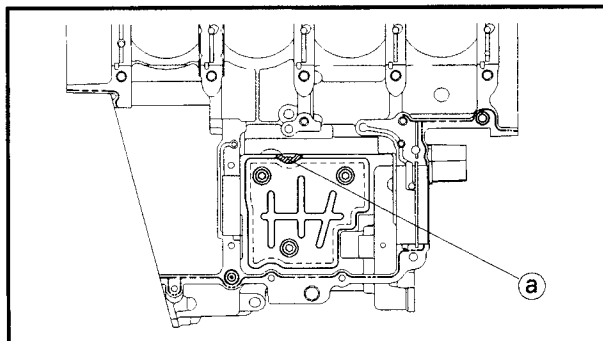
**Recommended lubricant**  
**Engine oil**

**2. Apply:**

- sealant  
(onto the crankcase mating surfaces and the groove (a) of the oil baffle plate)



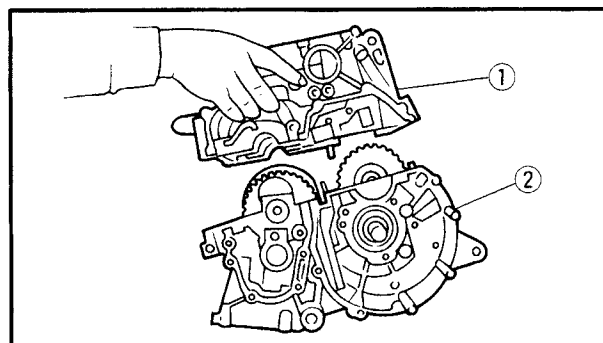
**Yamaha bond No. 1215**  
**90890-85505, ACC-1100-15-01**

**NOTE:**

Do not allow any sealant to come into contact with the oil gallery or crankshaft journal bearings. Do not apply sealant to within 2 ~ 3 mm of the crankshaft journal bearings.

**3. Install:**

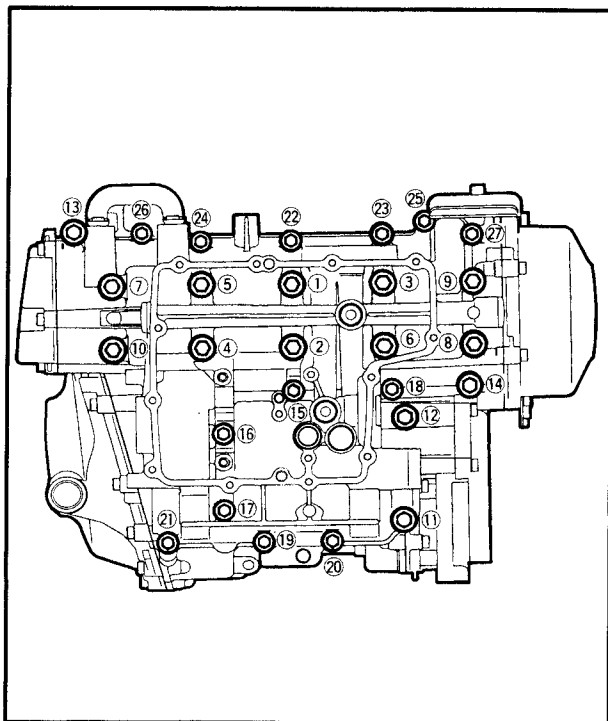
- dowel pin

**4. Set the shift drum assembly and transmission gears in the neutral position.****5. Install:**

- lower crankcase ①  
(onto the upper crankcase ②)

**CAUTION:**

**Before tightening the crankcase bolts, make sure that the transmission gears shift correctly when the shift drum assembly is turned by hand.**



6. Install:

- crankcase bolts

**NOTE:**

- Lubricate the bolt threads with engine oil.
- Install a washer on bolts ① ~ ⑩.
- Install a gasket on bolt ②①.
- Not lubricate seal bolts ⑬ ⑭
- Tighten the bolts in the tightening sequence cast on the crankcase.

M8 × 85 mm bolts: ① ~ ⑦ ⑩

M8 × 115 mm bolts: ⑧ ⑨

M8 × 65 mm bolt: ⑪ ⑫

M6 × 65 mm bolts: ⑬ ⑭ ⑰ ⑲

M6 × 55 mm bolts: ⑮ ⑯ ~ ⑳

M6 × 45 mm bolts: ⑰ ⑱ ~ ㉑

M6 × 75 mm bolts: ㉒



**Bolt ⑮ ~ ㉒**

**12 Nm (1.2 m•kg, 8.7 ft•lb)**

**Bolt ⑬ ~ ⑭**

**14 Nm (1.4 m•kg, 10 ft•lb)**

**Bolt ① ~ ⑫**

**24 Nm (2.4 m•kg, 17 ft•lb)**

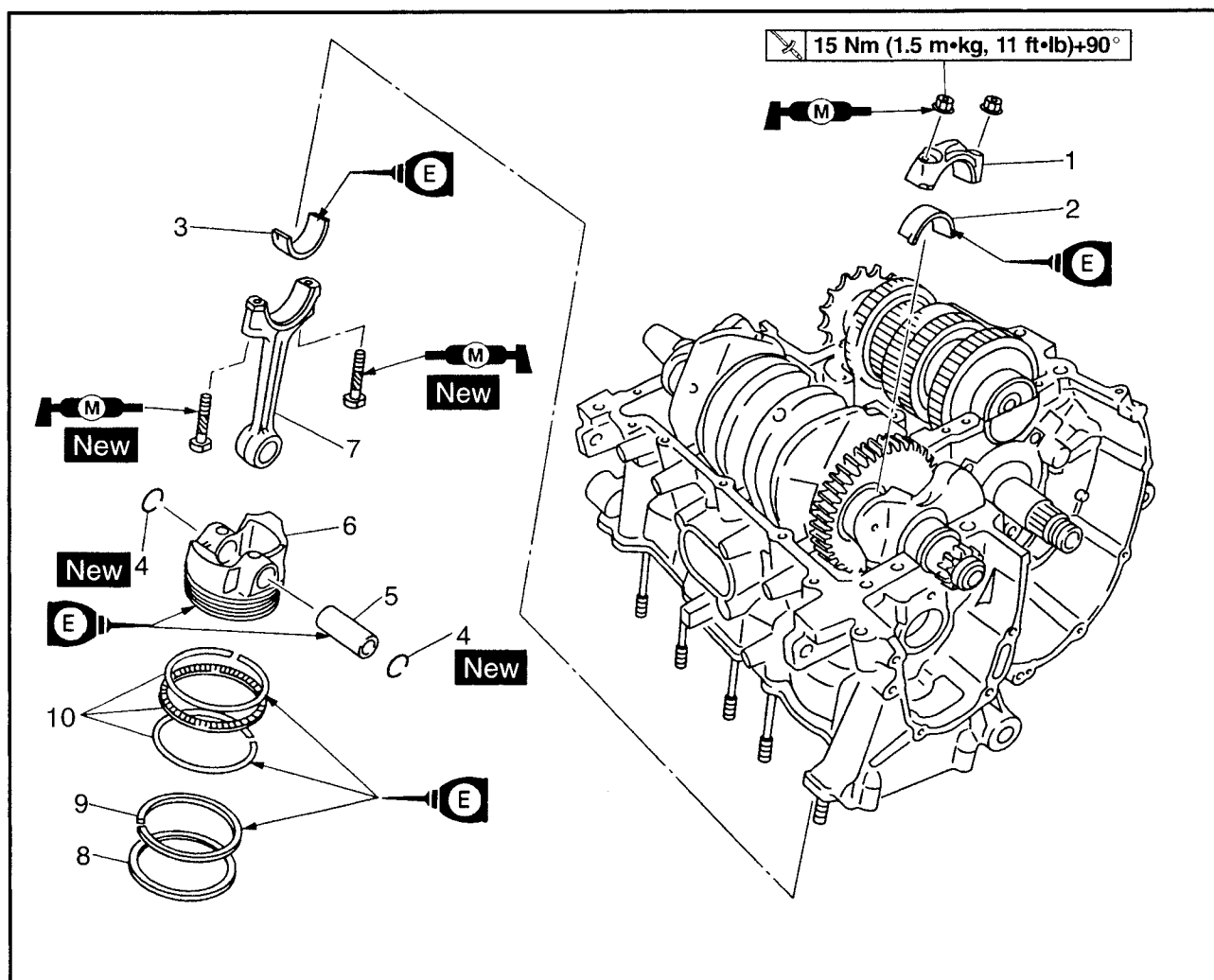
**⚠ WARNING**

**Always use new copper washers.**

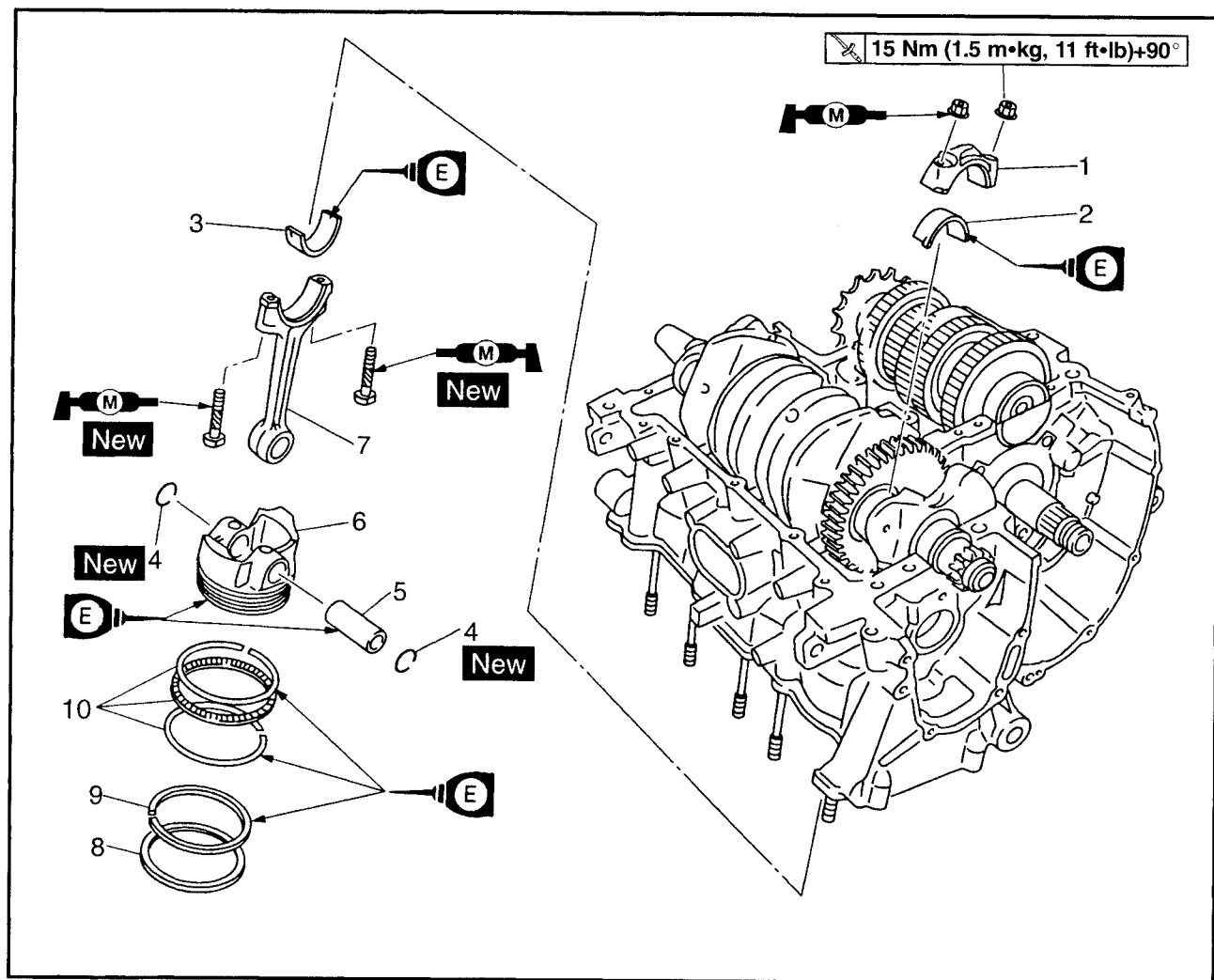


EAS00252

## CONNECTING RODS AND PISTONS



Order	Job/Part	Q'ty	Remarks
	<b>Removing the connecting rods and pistons</b>		
	Lower crankcase		Remove the parts in the order listed.
			Separate.
			Refer to "CRANKCASE".
1	Connecting rod cap	4	Refer to "REMOVING/INSTALLING THE CONNECTING RODS AND PISTONS".
2	Big end lower bearing	4	
3	Big end upper bearing	4	
4	Piston pin clip	8	
5	Piston pin	4	
6	Piston	4	
7	Connecting rod	4	



Order	Job/Part	Q'ty	Remarks
8	Top ring	4	Refer to "REMOVING/INSTALLING THE CONNECTING RODS AND PISTONS".  For installation, reverse the removal procedure.
9	2nd ring	4	
10	Oil ring	4	



EAS00393

## REMOVING THE CONNECTING RODS AND PISTONS

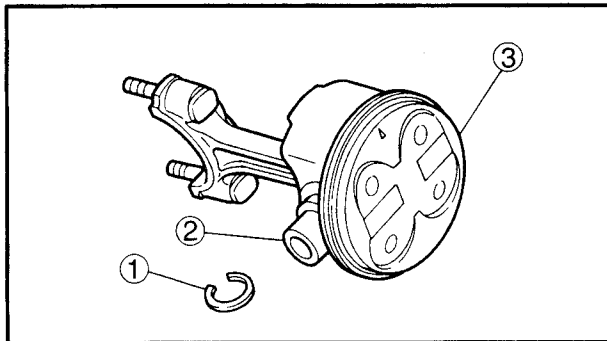
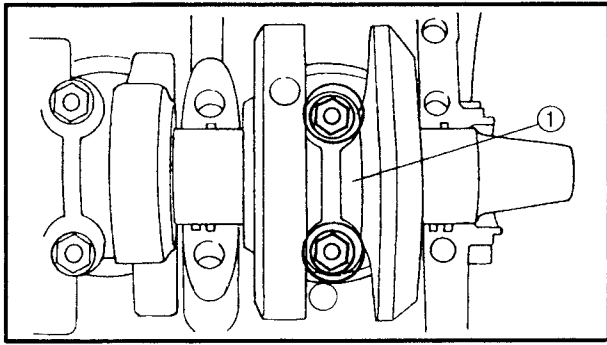
The following procedure applies to all of the connecting rods and pistons.

1. Remove:

- connecting rod cap ①
- big end bearings

### NOTE:

Identify the position of each big end bearing so that it can be reinstalled in its original place.



2. Remove:

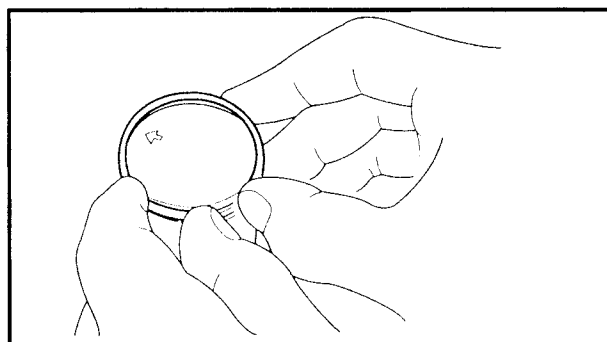
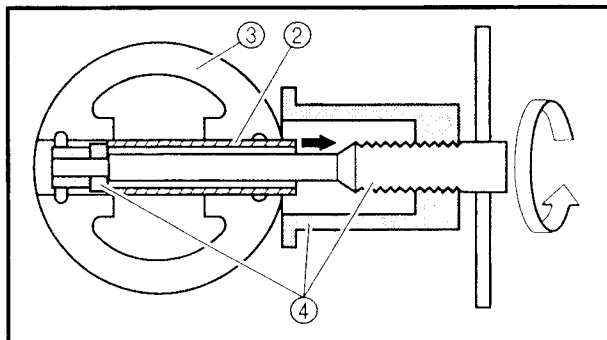
- piston pin clips ①
- piston pin ②
- piston ③
- connecting rod

### CAUTION:

Do not use a hammer to drive the piston pin out.

### NOTE:

- For reference during installation, put identification marks on the piston crown.
- Before removing the piston pin, deburr the piston pin clip groove and the piston pin bore area in the piston. If both areas are deburred and the piston pin is still difficult to remove, remove it with the piston pin puller ④.



3. Remove:

- top ring
- 2nd ring
- oil ring

### NOTE:

To remove a piston ring, open the end gap with your fingers and lift the other side of the ring over the piston crown.



**Piston pin puller**  
90890-01304, YU-01304



EAS00262

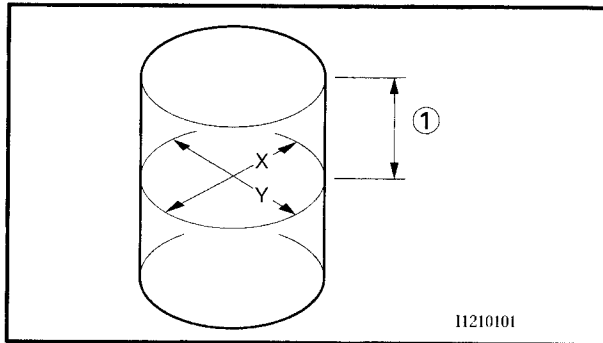
**CHECKING THE CYLINDER AND PISTONS**

The following procedure applies to all of the cylinders and pistons.

## 1. Check:

- piston wall
- cylinder wall

Vertical scratches → Replace the crankcases, and the piston and piston rings as a set.



## 2. Measure:

- piston-to-cylinder clearance

## a. Measure cylinder bore "C" with the cylinder bore gauge.

**NOTE:**

Measure cylinder bore "C" by taking side-to-side and front-to-back measurements of the cylinder. Then, find the average of the measurements.

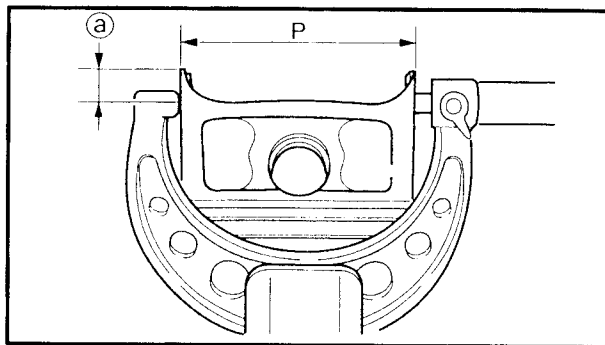


**Cylinder bore gauge**  
90890-03017, YU-03017

<b>Cylinder bore "C"</b>	<b>65.50 ~ 65.51 mm</b> <b>(25.787 ~ 25.791 in)</b>
<b>Max. taper "T"</b>	<b>0.05 mm (0.002 in)</b>
<b>Out of round "R"</b>	<b>0.05 mm (0.002 in)</b>

b. If out of specification, replace the crankcases, and the piston and piston rings as a set.

c. Measure piston skirt diameter "P" with the micrometer.



**Micrometer**  
90890-03008, YU-03008

① 4 mm from the bottom edge of the piston

	<b>Piston size "P"</b>
<b>Standard</b>	<b>65.460 ~ 65.475 mm</b> <b>(2.5772 ~ 2.5778 in)</b>

d. If out of specification, replace the piston and piston rings as a set.



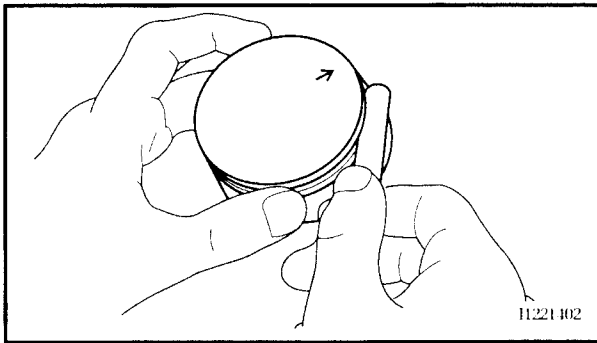
- e. Calculate the piston-to-cylinder clearance with the following formula.

**Piston-to-cylinder clearance =  
Cylinder bore “C” –  
Piston skirt diameter “P”**



**Piston-to-cylinder clearance**  
**0.025 ~ 0.050 mm**  
**(0.001 ~ 0.002 in)**  
**<Limit>: 0.07 mm (0.0028 in)**

- f. If out of specification, replace the crankcases, and the pistons and piston rings as a set.



EAS00263

## CHECKING THE PISTON RINGS

1. Measure:
  - piston ring side clearance  
Out of specification → Replace the piston and piston rings as a set.

**NOTE:** \_\_\_\_\_

Before measuring the piston ring side clearance, eliminate any carbon deposits from the piston ring grooves and piston rings.



**Piston ring side clearance**

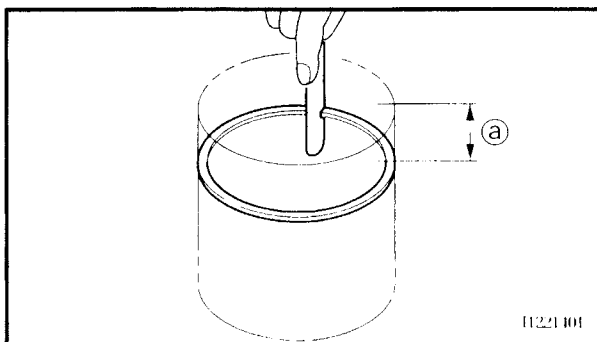
**Top ring**  
0.030 ~ 0.065 mm  
(0.0012 ~ 0.0026 in)  
<Limit>: 0.115 mm (0.005 in)

**2nd ring**  
0.020 ~ 0.055 mm  
(0.0008 ~ 0.0022 in)  
<Limit>: 0.115 mm (0.005 in)

2. Install:
  - piston ring  
(into the cylinder)

**NOTE:** \_\_\_\_\_

Level the piston ring in the cylinder with the piston crown.



Ⓐ 5 mm (0.20 in)





## 3. Measure:

- piston ring end gap

Out of specification → Replace the piston ring.

**NOTE:**

The oil ring expander spacer's end gap cannot be measured. If the oil ring rail's gap is excessive, replace all three piston rings.

**Piston ring end gap****Top ring**

0.15 ~ 0.25 mm

(0.006 ~ 0.009 in)

<Limit>: 0.50 mm (0.02 in)

**2nd ring**

0.40 ~ 0.50 mm

(0.016 ~ 0.02 in)

<Limit>: 0.85 mm (0.033 in)

**Oil ring**

0.10 ~ 0.35 mm

(0.004 ~ 0.014 in)

ABS00266

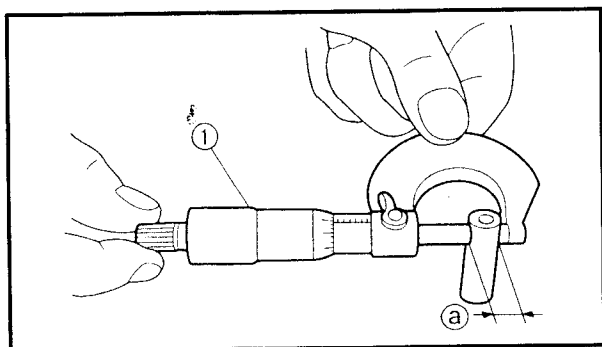
**CHECKING THE PISTON PINS**

The following procedure applies to all of the piston pins.

## 1. Check:

- piston pin

Blue discoloration/grooves → Replace the piston pin and then check the lubrication system.



## 2. Measure:

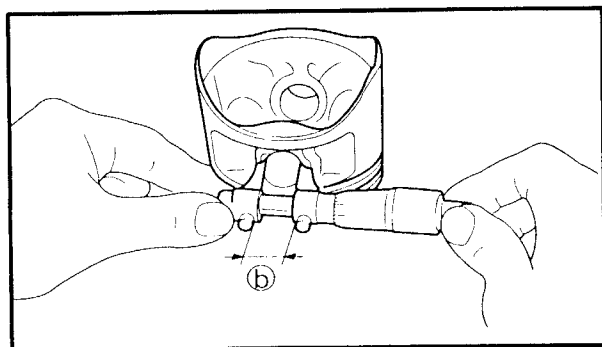
- piston pin outside diameter (a)

Out of specification → Replace the piston pin.

**Piston pin outside diameter**

15.991 ~ 16.000 mm

(0.6296 ~ 0.6299 in)



## 3. Measure:

- piston pin bore diameter (in the piston)

Out of specification → Replace the piston pin.

**Piston pin bore diameter  
(in the piston)**

16.002 ~ 16.013 mm

(0.6300 ~ 0.6304 in)

- $$\text{Piston-pin-to-piston-pin-bore clearance} = \text{Piston pin bore diameter (in the piston)} - \text{Piston pin outside diameter}$$



**0.002 ~ 0.022 mm**  
**(0.00008 ~ 0.0009 in)**  
**<Limit>: 0.072 mm (0.0028 in)**

- crankshaft-pin-to-big-end-bearing clearance  
Out of specification → Replace the big end bearings.

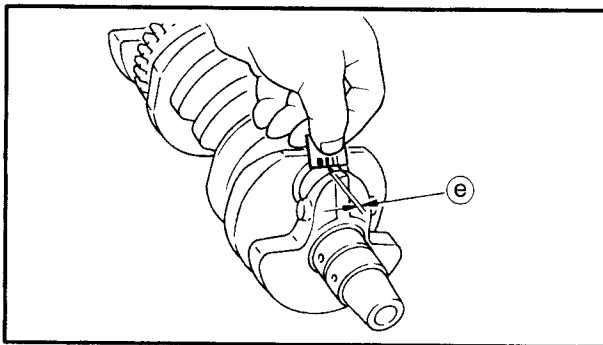
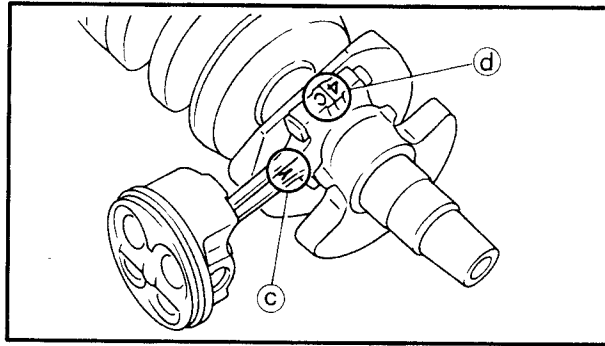
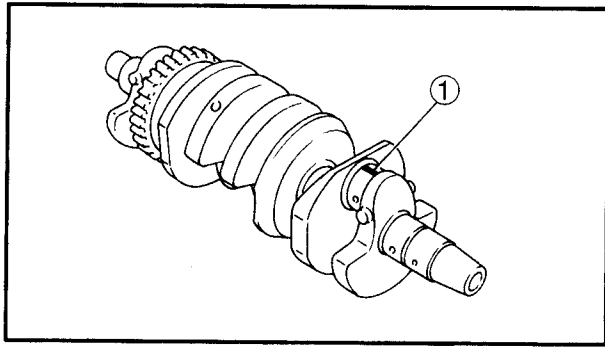


**0.028 ~ 0.052 mm**  
**(0.0011 ~ 0.002 in)**

**CAUTION:**

A line drawing of a hand holding a dental arch. A central tooth is labeled 'a' and two side teeth are labeled 'b'.

- Align the projections (a) on the big end bearings with the notches (b) in the connecting rod and connecting rod cap.



- c. Put a piece of Plastigauge® ① on the crankshaft pin.
- d. Assemble the connecting rod halves.

**NOTE:**

- Do not move the connecting rod or crankshaft until the clearance measurement has been completed.
- Lubricate the bolt threads and nut seats with molybdenum disulfide grease.
- Make sure that the “Y” mark (C) on the connecting rod faces towards the left side of the crankshaft.
- Make sure that the characters (d) on both the connecting rod and connecting rod cap are aligned.

- e. Tighten the connecting rod nuts.

**CAUTION:**

- When tightening the connecting rod nuts, be sure to use an F-type torque wrench.
- After tightening the connecting rod nut to the specified torque, turn the connecting rod nut another  $+90^{\circ}$ .

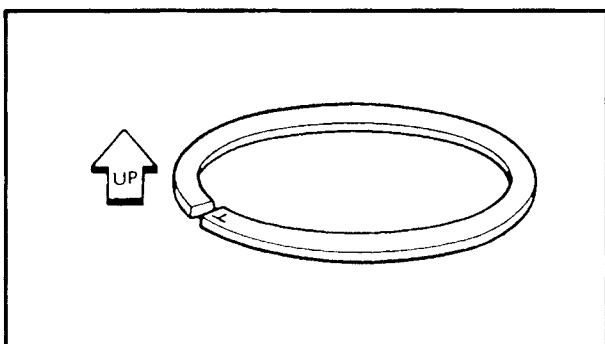
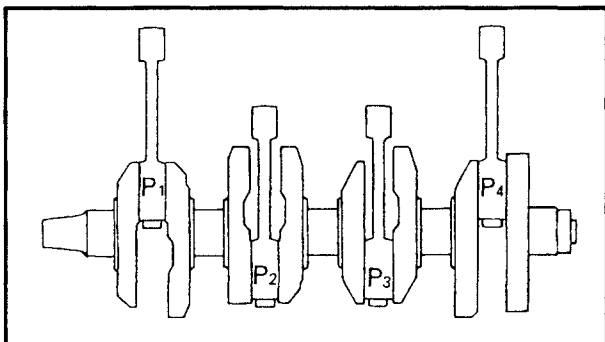
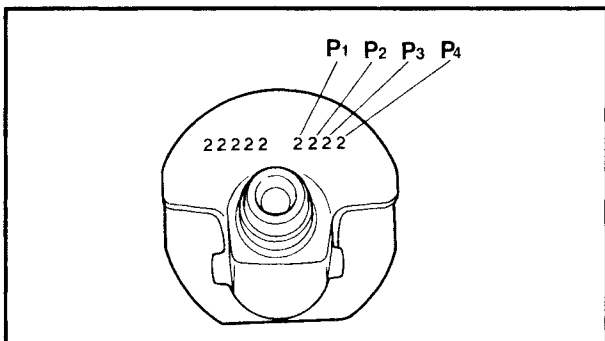
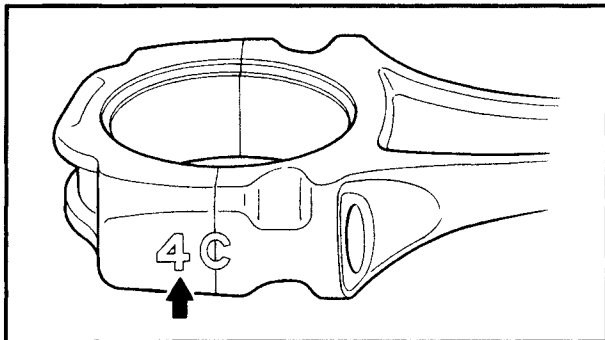
Refer to "INSTALLING THE PISTONS AND CONNECTING RODS".



**Connecting rod nut**  
15 Nm (1.5 m•kg, 11 ft•lb) + 90°

- f. Remove the connecting rod and big end bearings.  
Refer to “REMOVING THE CONNECTING RODS AND PISTONS”.
- g. Measure the compressed Plastigauge® width ⑤ on the crankshaft pin.  
If the crankshaft-pin-to-big-end-bearing clearance is out of specification, select replacement big end bearings.





## 2. Select:

- big end bearings ("P<sub>1</sub>" ~ "P<sub>4</sub>")

**NOTE:**

- The numbers stamped into the crankshaft web and the numbers on the connecting rods are used to determine the replacement big end bearing sizes.
- "P<sub>1</sub>" ~ "P<sub>4</sub>" refer to the bearings shown in the crankshaft illustration.

For example, if the connecting rod "P<sub>1</sub>" and the crankshaft web "P<sub>1</sub>" numbers are "5" and "1" respectively, then the bearing size for "P<sub>1</sub>" is:

$$\text{"P}_1 \text{ (connecting rod) - "P}_1 \text{ (crankshaft) = } 5 - 1 = 4$$

**BIG END BEARING COLOR CODE**

1	blue
2	black
3	brown
4	green

EAS00271

**INSTALLING THE PISTONS AND CONNECTING RODS**

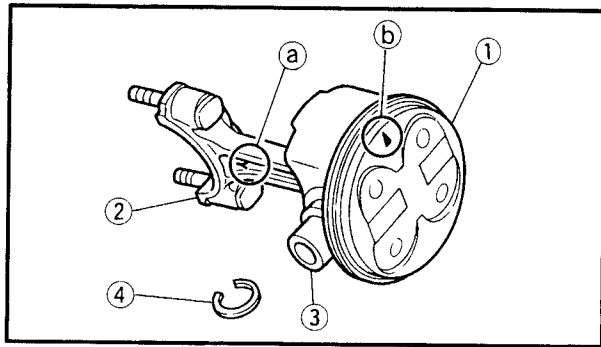
The following procedure applies to all of the pistons and cylinders.

## 1. Install:

- top ring
- 2nd ring
- oil ring

**NOTE:**

Be sure to install the piston rings so that the manufacturer's marks or numbers face up.

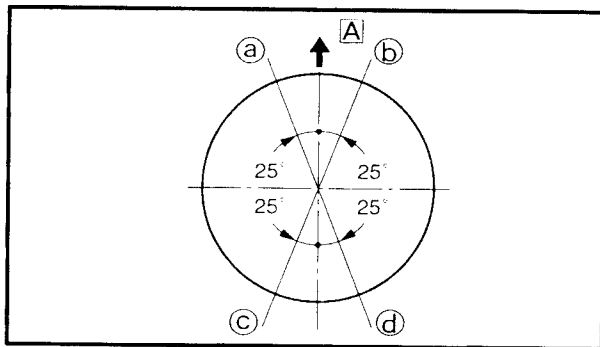


### 2. Install:

- piston ①  
(onto the respective connecting rod ②)
- piston pin ③
- piston pin clip ④ **New**

### NOTE:

- Apply engine oil onto the piston pin.
- Make sure that the "Y" mark (a) on the connecting rod faces left when the arrow mark (b) on the piston is pointing up. Refer to the illustration.
- Reinstall each piston into its original cylinder (numbering order starting from the left: #1 to #4).



### 3. Offset:

- piston ring end gaps

- (a) Top ring
- (b) Lower oil ring rail
- (c) Upper oil ring rail
- (d) 2nd ring
- (A) Intake side

### 4. Lubricate:

- piston
- piston rings
- cylinder  
(with the recommended lubricant)

	<b>Recommended lubricant</b> <b>Engine oil</b>
--	---

### 5. Lubricate:

- bolt threads
- nut seats  
(with the recommended lubricant)

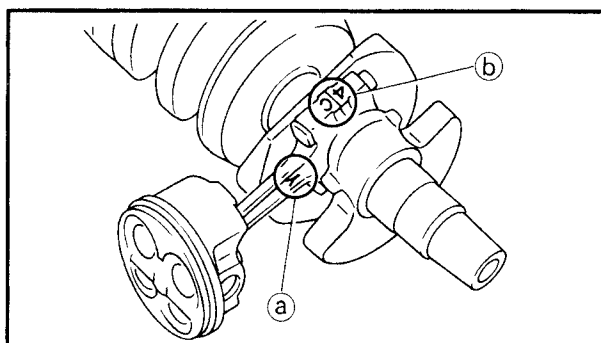
	<b>Recommended lubricant</b> <b>Molybdenum disulfide grease</b>
--	--



6. Lubricate:
- crankshaft pins
  - big end bearings
  - connecting rod big end inner surface (with the recommended lubricant)



**Recommended lubricant**  
**Engine oil**




7. Install:
  - big end bearings
  - connecting rod assembly (into the cylinder and onto the crankshaft pin).
  - connecting rod cap (onto the connecting rod)

**NOTE:**

- Align the projections on the big end bearings with the notches in the connecting rods and connecting rod caps.
- Be sure to reinstall each big end bearing in its original place.
- While compressing the piston rings with one hand, install the connecting rod assembly into the cylinder with the other hand.
- Make sure that the “Y” marks (a) on the connecting rods face towards the left side of the crankshaft.
- Make sure that the characters (b) on both the connecting rod and connecting rod cap are aligned.

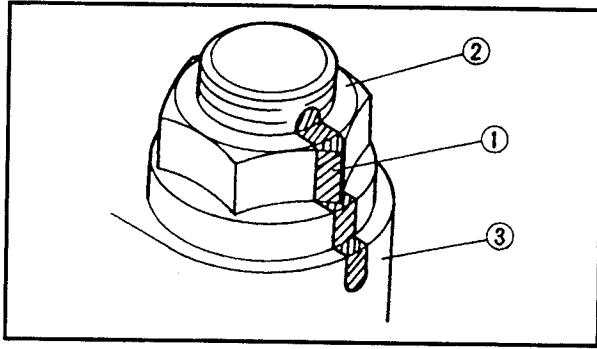
8. Align:
  - bolt heads  
(with the connecting rod caps)
9. Tighten:
  - connecting rod nuts

	15 Nm (1.5 m•kg, 11 ft•lb)+90°
---	--------------------------------

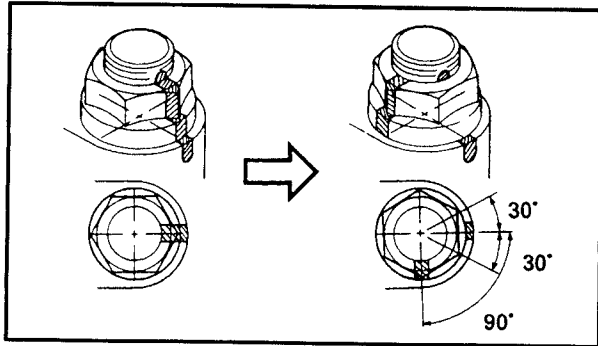
- a. Replace the connecting rod bolts and nuts with new ones.

**CAUTION:**

**Tighten the connecting rod bolts using the plastic-region tightening angle method. Always install new bolts and nuts.**



- b. Clean the connecting rod bolts and nuts.
- c. Tighten the connecting rod nuts.
- d. Put a mark ① on the corner of the connecting rod nut ② and the connecting rod ③.



- e. Tighten the nut further to reach the specified angle ( $90^\circ$ ).

### **⚠ WARNING**

When the nut is tightened more than the specified angle, do not loosen the nut and then retighten it.

Replace the bolt with a new one and perform the procedure again.

### **CAUTION:**

- Do not use a torque wrench to tighten the nut to the specified angle.
- Tighten the nut until it is at the specified angles.

### **NOTE:**

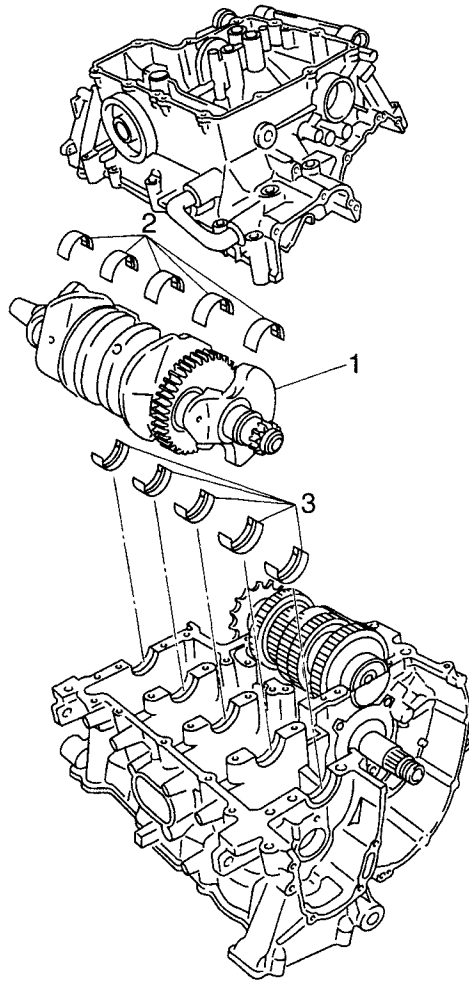
When using a hexagonal nut, note that the angle from one corner to another is  $60^\circ$ .





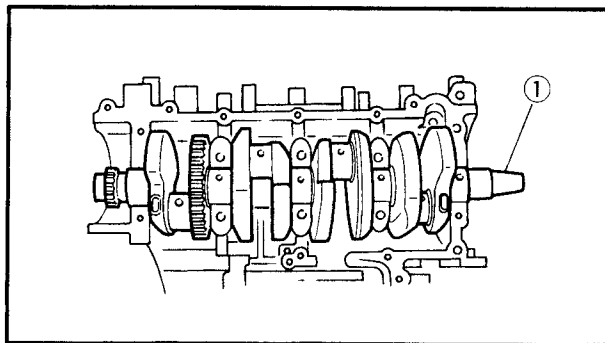
EAS00381

## CRANKSHAFT



Order	Job/Part	Q'ty	Remarks
	<b>Removing the crankshaft</b>		
	Crankcase lower		Remove the parts in the order listed. Separate. Refer to "CRANKCASE".
	Connecting rods and pistons		Refer to "CONNECTING RODS AND PISTONS".
1	Crankshaft	1	Refer to "REMOVING/INSTALLING THE CRANKSHAFT".
2	Crankshaft journal lower bearing	5	
3	Crankshaft journal upper bearing	5	
			For installation, reverse the removal procedure.





EAS00387

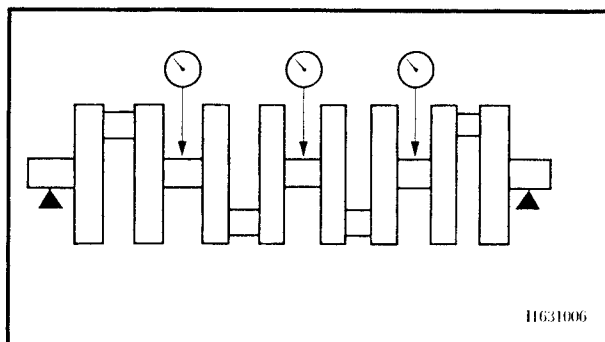
**REMOVING THE CRANKSHAFT**

## 1. Remove:

- crankshaft ①
- crankshaft journal upper bearings (from the upper / lower crankcase)

**NOTE:**

Identify the position of each crankshaft journal upper bearing so that it can be reinstalled in its original place.



EAS00397

**CHECKING THE CRANKSHAFT**

## 1. Measure:

- crankshaft runout

Out of specification → Replace the crankshaft.



**Max. crankshaft runout**  
0.03 mm (0.0012 in)

## 2. Check:

- crankshaft journal surfaces
- crankshaft pin surfaces
- bearing surfaces

Scratches/wear → Replace the crankshaft.

**CHECKING THE CRANKSHAFT JOURNAL BEARINGS**

## 1. Measure:

- crankshaft-journal-to-crankshaft-journal-bearing clearance

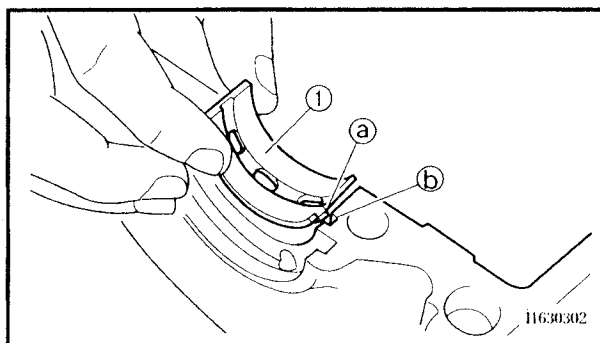
Out of specification → Replace the crankshaft journal bearings.



**Crankshaft-journal-to-crankshaft-journal-bearing clearance**  
0.034 ~ 0.058 mm  
(0.0013 ~ 0.0023 in)

**CAUTION:**

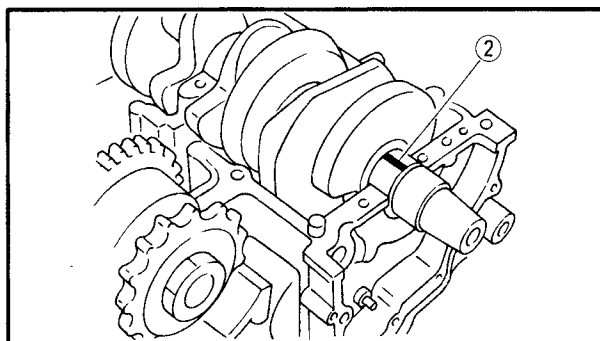
Do not interchange the crankshaft journal bearings. To obtain the correct crankshaft-journal-to-crankshaft-journal-bearing clearance and prevent engine damage, the crankshaft journal bearings must be installed in their original positions.



- a. Clean the crankshaft journal bearings, crankshaft journals, and bearing portions of the crankcase.
- b. Place the upper crankcase upside down on a bench.
- c. Install the crankshaft journal upper bearings ① and the crankshaft into the upper crankcase.

## NOTE:

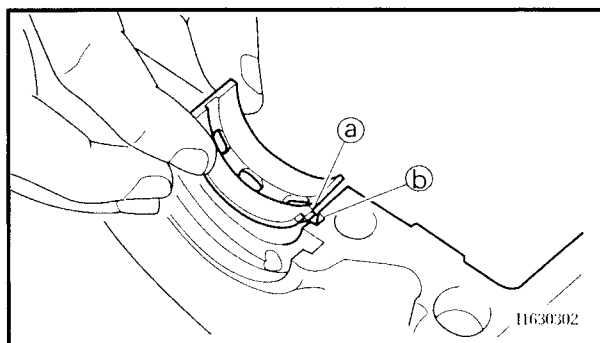
Align the projections (a) on the crankshaft journal upper bearings with the notches (b) in the upper crankcase.



- d. Put a piece of Plastigauge® (2) on each crankshaft journal.

## NOTE:

Do not put the Plastigauge® over the oil hole in the crankshaft journal.

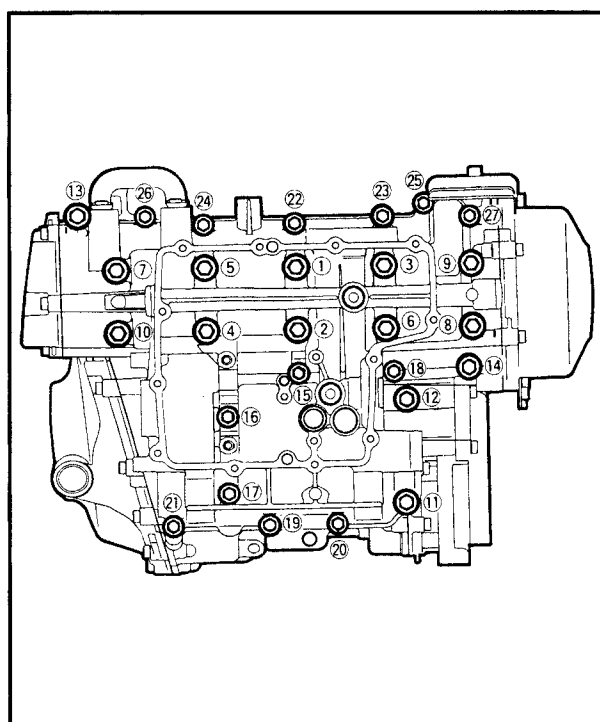


- e. Install the crankshaft journal lower bearings into the lower crankcase and assemble the crankcase.

## NOTE:

- Align the projections (a) on the crankshaft journal lower bearings with the notches (b) in the lower crankcase.
- Do not move the crankshaft until the clearance measurement has been completed.

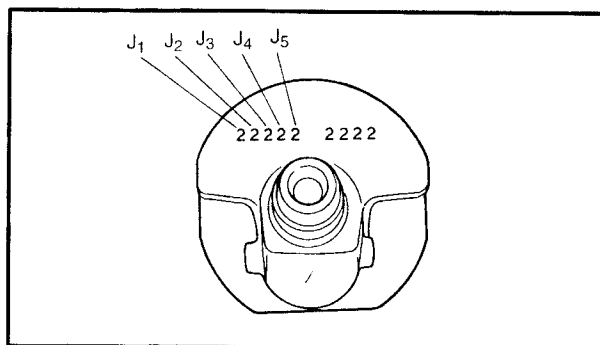
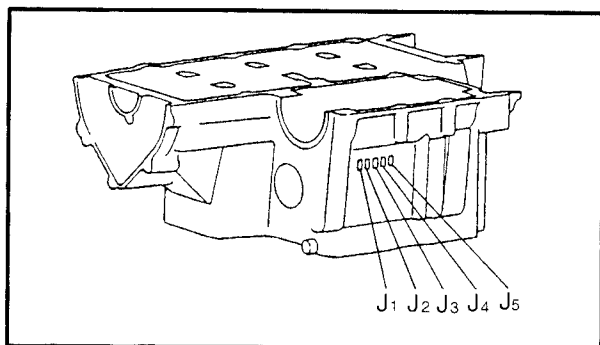
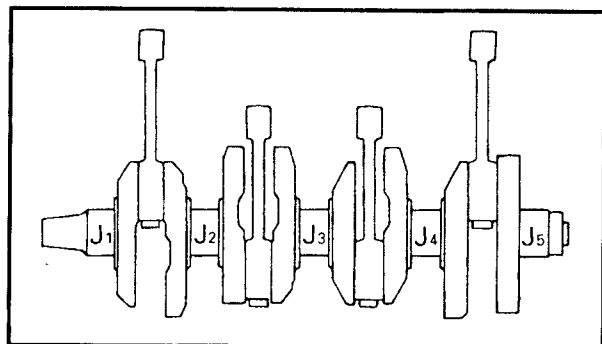
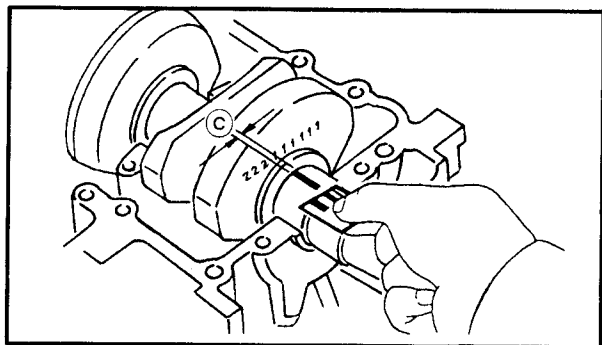
- f. Tighten the bolts to specification in the tightening sequence cast on the crankcase.



- Bolt ⑮ ~ ⑳**  
12 Nm (1.2 m•kg, 8.7 ft•lb)
- Bolt ⑬ ⑭**  
14 Nm (1.4 m•kg, 10 ft•lb)
- Bolt ① ~ ⑫**  
24 Nm (2.4 m•kg, 17 ft•lb)

## NOTE:

Lubricate the crankcase bolt threads with engine oil.



- g. Remove the lower crankcase and the crankshaft journal lower bearings.
- h. Measure the compressed Plastigauge® width (C) each crankshaft journal.  
If the clearance is out of specification, select replacement crankshaft journal bearings.

2. Select:

- crankshaft journal bearings ( $J_1 \sim J_5$ )

**NOTE:**

- The numbers stamped into the crankshaft web and the numbers stamped into the lower crankcase are used to determine the replacement crankshaft journal bearing sizes.
- “J<sub>1</sub>” ~ “J<sub>5</sub>” refer to the bearings shown in the crankshaft illustration.
- If “J<sub>1</sub>” ~ “J<sub>5</sub>” are the same, use the same size for all of the bearings.

For example, if the crankcase “J<sub>1</sub>” and crankshaft web “J<sub>1</sub>” numbers are “6” and “2” respectively, then the bearing size for “J<sub>1</sub>” is:

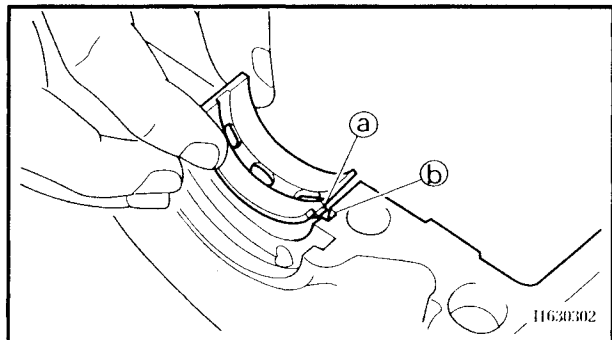
**Bearing size for  $J_1$ :**

**"J<sub>1</sub>" (crankcase) – "J<sub>1</sub>" (crankshaft web) – 1 =**  
**6 – 2 – 1 = 3**

<b>CRANKSHAFT JOURNAL BEARING COLOR CODE</b>	
<b>0</b>	<b>White</b>
<b>1</b>	<b>Blue</b>
<b>2</b>	<b>Black</b>
<b>3</b>	<b>Brown</b>
<b>4</b>	<b>Green</b>

**NOTE:**

If the size is the same for all “J<sub>1</sub> to J<sub>5</sub>”, one digit for that size is indicated. (crankcase side only)



EAS00407

**INSTALLING THE CRANKSHAFT**

## 1. Install:

- crankshaft journal upper bearings  
(into the upper / lower crankcase)

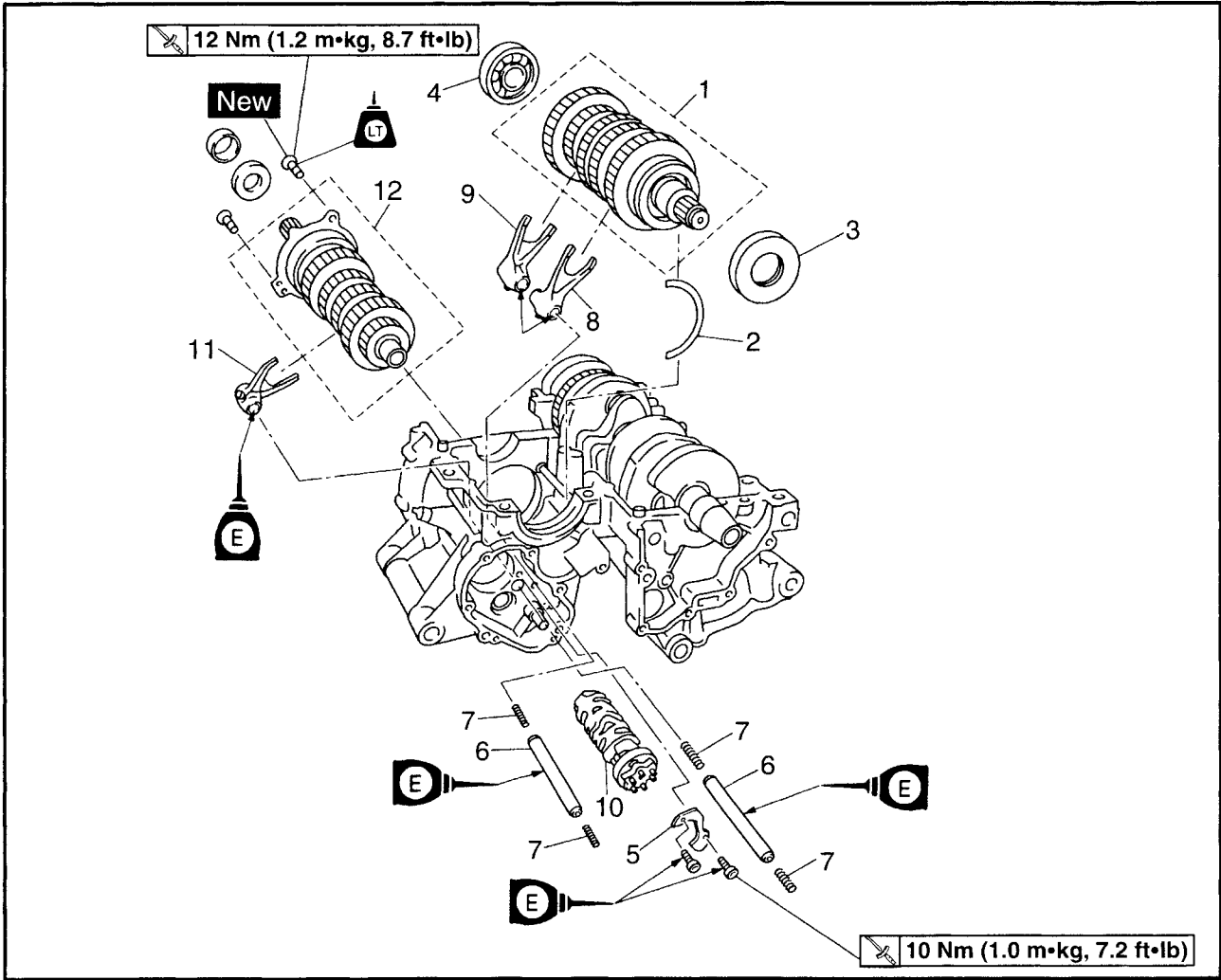
**NOTE:**

- Align the projections (a) on the crankshaft journal upper bearings with the notches (b) in the upper crankcase.
- Be sure to install each crankshaft journal upper bearing in its original place.

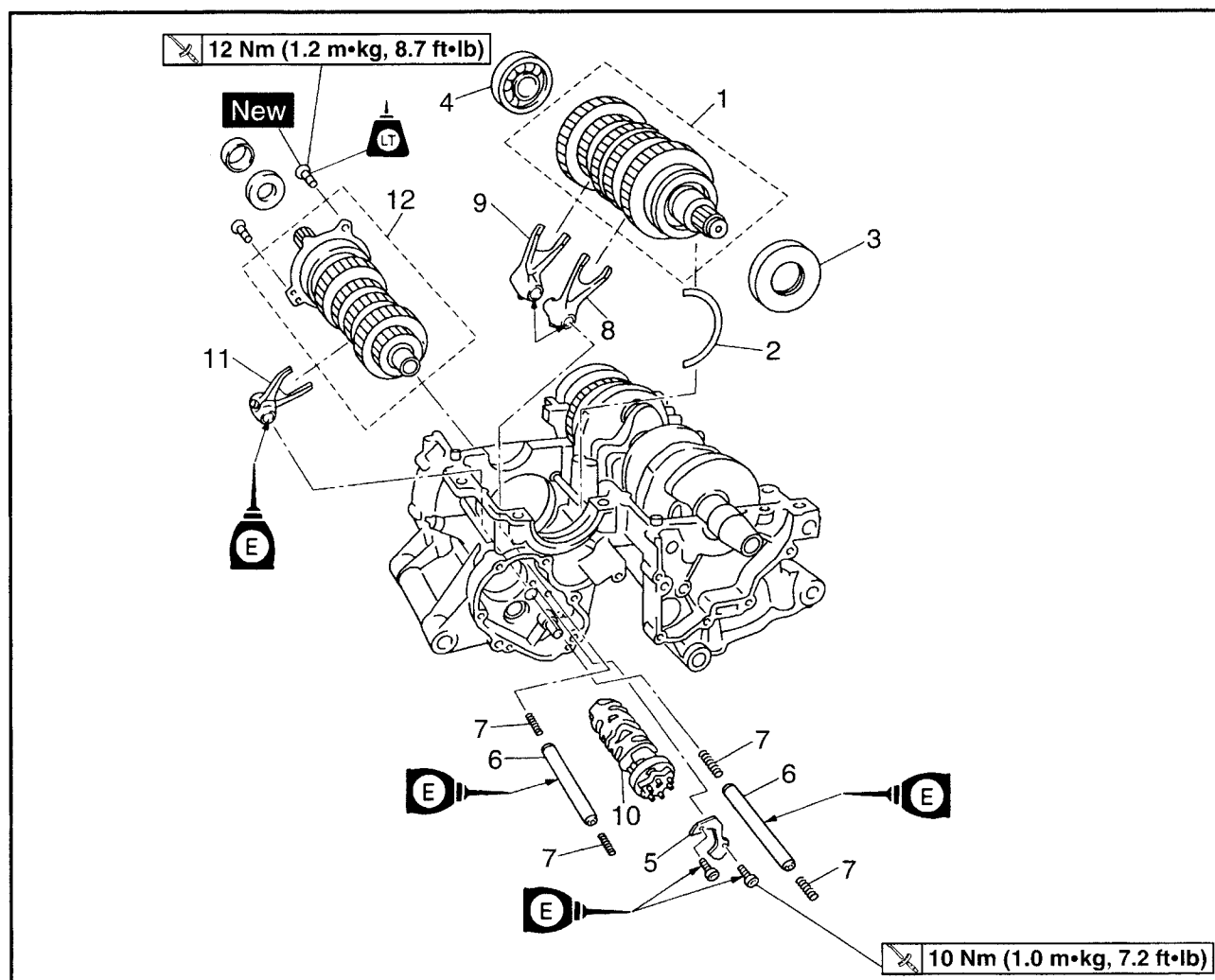


EAS00419

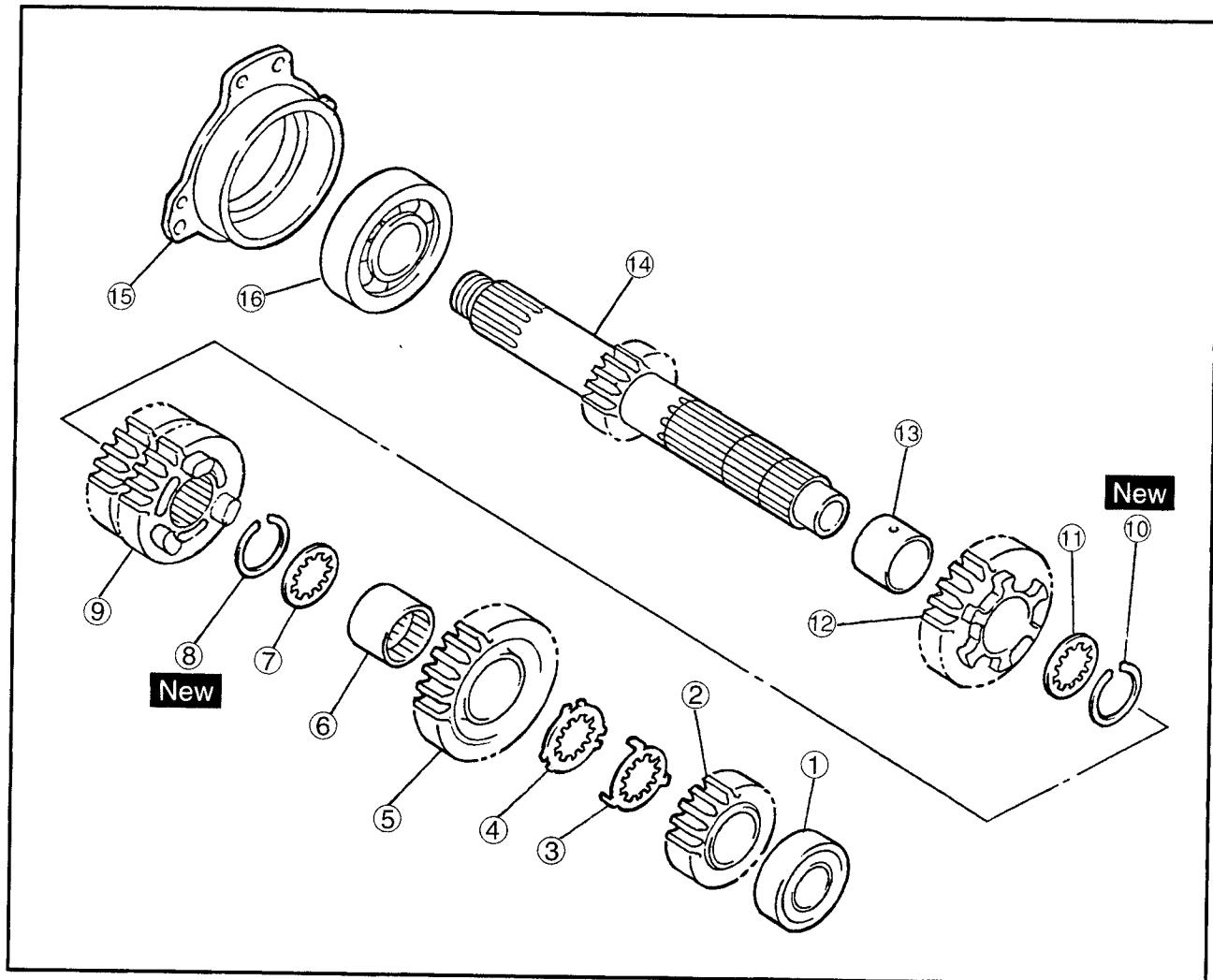
TRANSMISSION



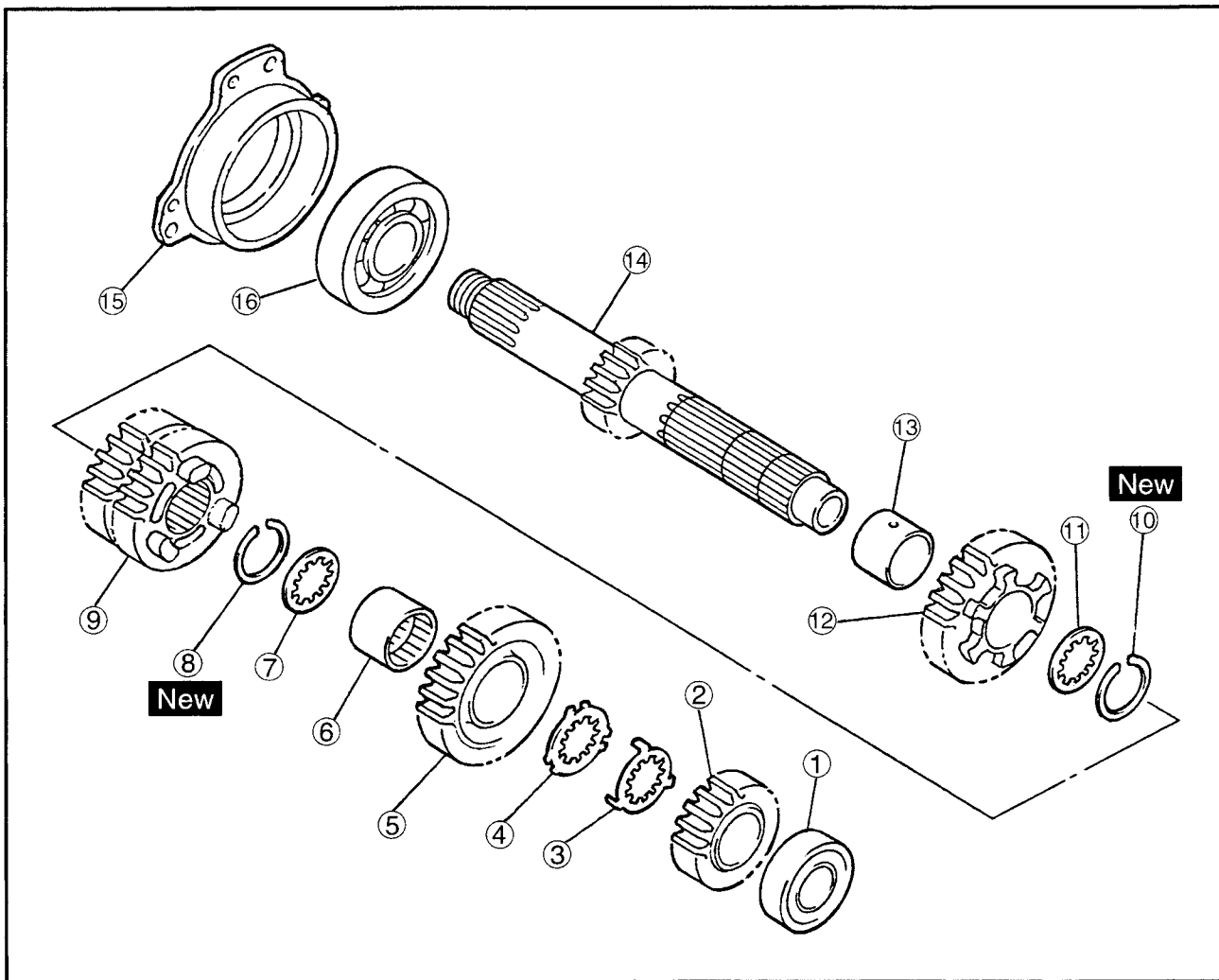
Order	Job/Part	Q'ty	Remarks
	<b>Removing the transmission</b>		
	Crankcase lower		Remove the parts in the order listed. Separate. Refer to "CRANKCASE".
	Shift shaft and stopper lever		Refer to "SHIFT SHAFT".
1	Drive axle assembly	1	
2	Circlip	1	
3	Oil seal	1	
4	Bearing	1	
5	Shift bar stopper	1	
6	Shift fork guide bar	2	



Order	Job/Part	Q'ty	Remarks
7	Spring	4	Refer to "INSTALLING THE TRANSMISSION". Refer to "REMOVING THE TRANSMISSION".
8	Shift fork "L"	1	
9	Shift fork "R"	1	
10	Shift drum assembly	1	
11	Shift fork "C"	1	
12	Main axle assembly	1	For installation, reverse the removal procedure.

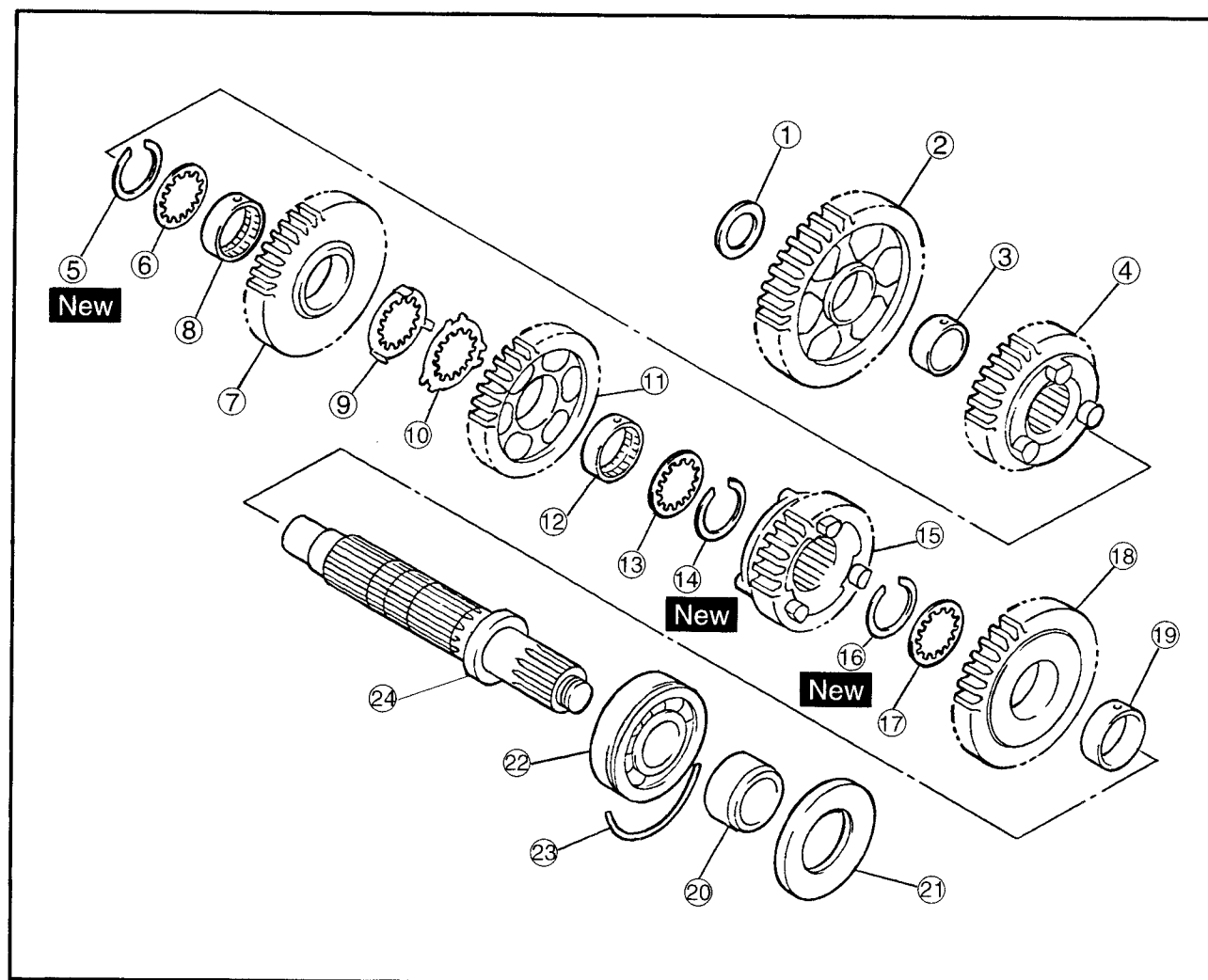


Order	Job/Part	Q'ty	Remarks
	<b>Disassembling the main axle assembly</b>		Remove the parts in the order listed.
①	Bearing	1	
②	2nd pinion gear	1	
③	Toothed lock washer	1	
④	Toothed lock washer retainer	1	
⑤	6th pinion gear	1	
⑥	Collar	1	
⑦	Washer	1	
⑧	Circlip	1	
⑨	3rd pinion gear	1	
⑩	Circlip	1	

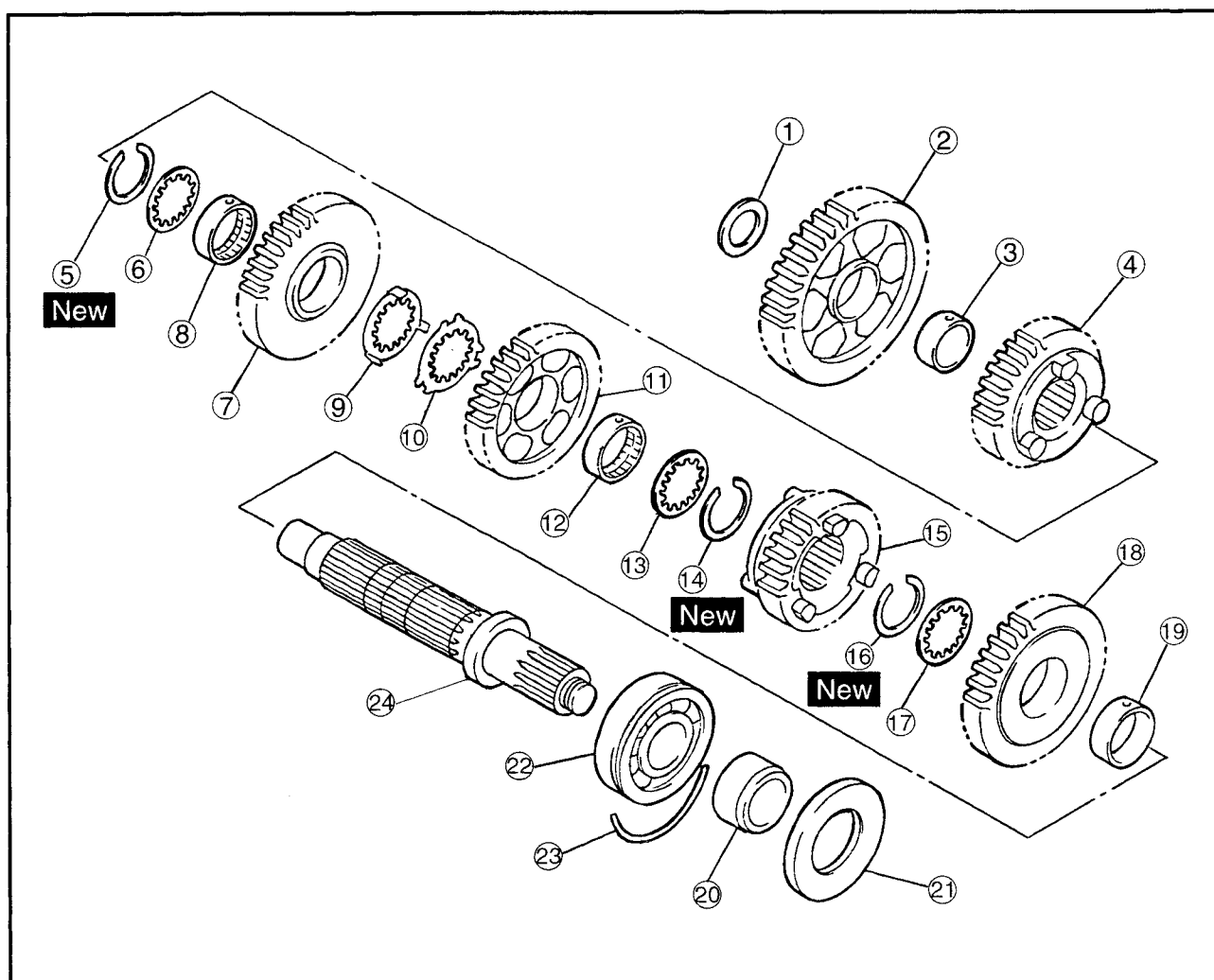


Order	Job/Part	Q'ty	Remarks
⑪	Washer	1	For installation, reverse the removal procedure.
⑫	5th pinion gear	1	
⑬	Collar	1	
⑭	Main axle	1	
⑮	Bearing housing	1	
⑯	Bearing	1	

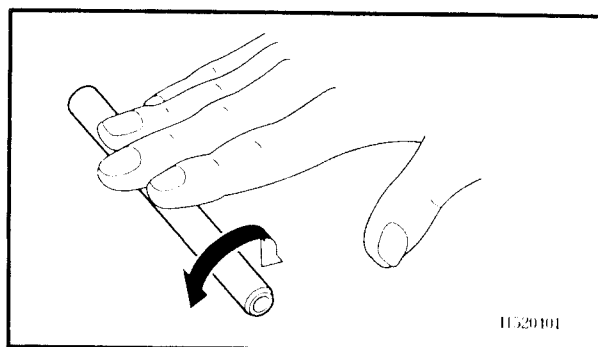
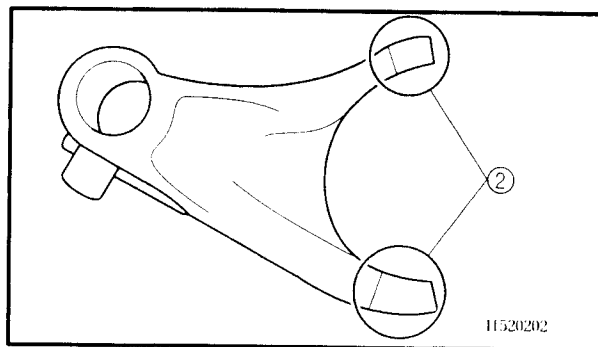
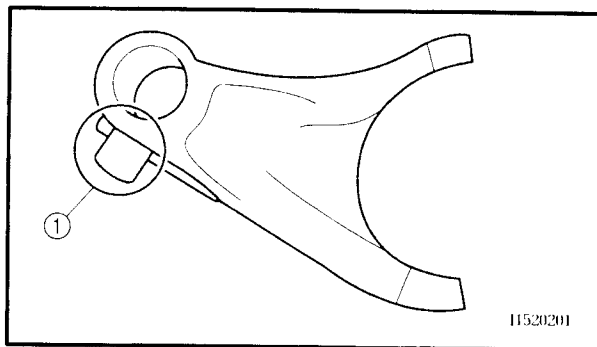
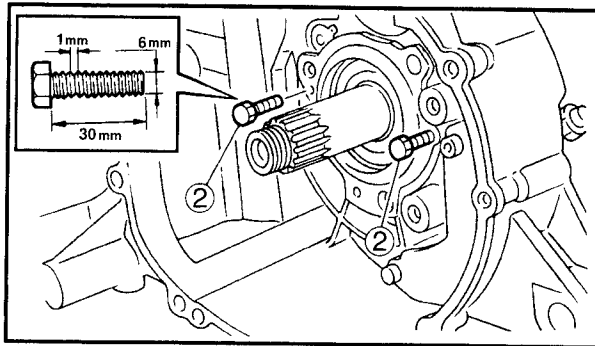
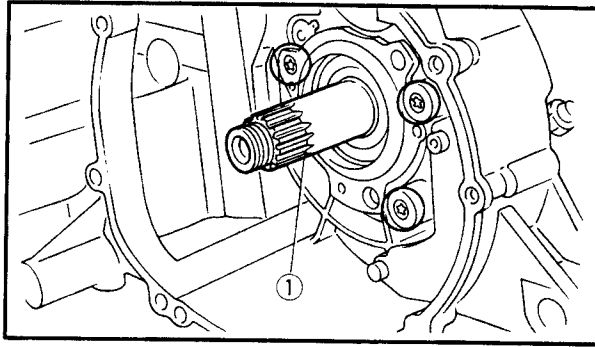




Order	Job/Part	Q'ty	Remarks
	<b>Disassembling the drive axle assembly</b>		Remove the parts in the order listed.
①	Washer	1	
②	1st wheel gear	1	
③	Collar	1	
④	5th wheel gear	1	
⑤	Circlip	1	
⑥	Washer	1	
⑦	3rd wheel gear	1	
⑧	Collar	1	
⑨	Toothed lock washer	1	
⑩	Toothed lock washer retainer	1	
⑪	4th wheel gear	1	



Order	Job/Part	Q'ty	Remarks
⑫	Collar	1	For installation, reverse the removal procedure.
⑬	Washer	1	
⑭	Circrip	1	
⑮	6th wheel gear	1	
⑯	Circrip	1	
⑰	washer	1	
⑱	2nd wheel gear	1	
⑲	Collar	1	
⑳	Collar	1	
㉑	Oil seal	1	
㉒	Bearing	1	
㉓	Circrip	1	
㉔	Drive axle	1	



EAS00420

## REMOVING THE TRANSMISSION

1. Remove:
  - drive axle assembly
2. Remove:
  - main axle assembly ①  
(with the Torx® wrench T30)

- a. Insert two bolts ② of the proper size, as shown in the illustration, into the main axle assembly bearing housing.
- b. Tighten the bolts until they contact the crankcase surface.
- c. Continue tightening the bolts until the main axle assembly comes free from the upper crankcase.

EAS00421

## CHECKING THE SHIFT FORKS

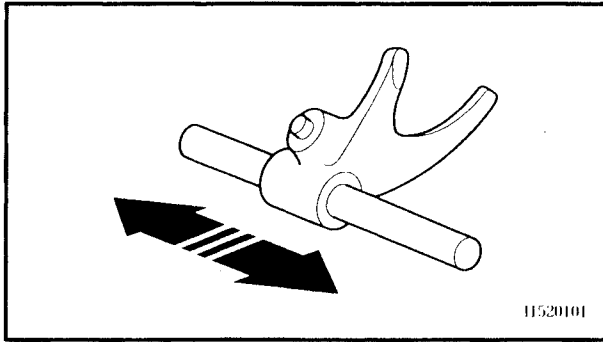
The following procedure applies to all of the shift forks.

1. Check:
  - shift fork cam follower ①
  - shift fork pawl ②Bends/damage/scoring/wear → Replace the shift fork.

2. Check:
- shift fork guide bar  
Roll the shift fork guide bar on a flat surface.  
Bends → Replace.

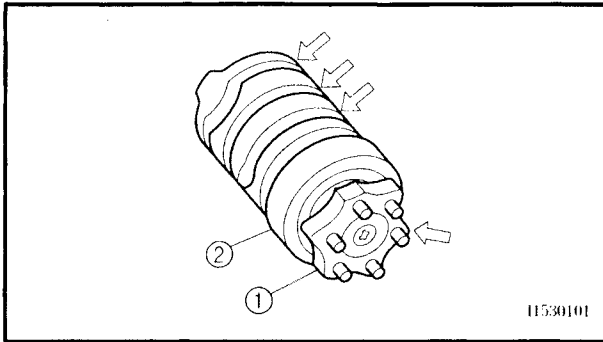
**⚠ WARNING**

**Do not attempt to straighten a bent shift fork guide bar.**



## 3. Check:

- shift fork movement  
(along the shift fork guide bar)  
Rough movement → Replace the shift fork(-s) and shift fork guide bar as a set.



EAS00422

**CHECKING THE SHIFT DRUM ASSEMBLY**

## 1. Check:

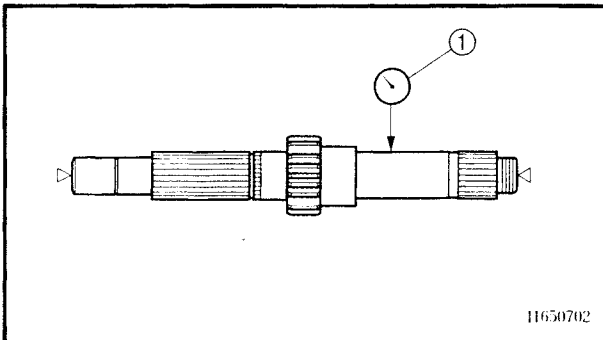
- shift drum grooves  
Damage/scratches/wear → Replace the shift drum assembly.
- shift drum segment ①  
Damage/wear → Replace the shift drum assembly.
- shift drum bearing ②  
Damage/pitting → Replace the shift drum assembly.

EAS00425

**CHECKING THE TRANSMISSION**

## 1. Measure:

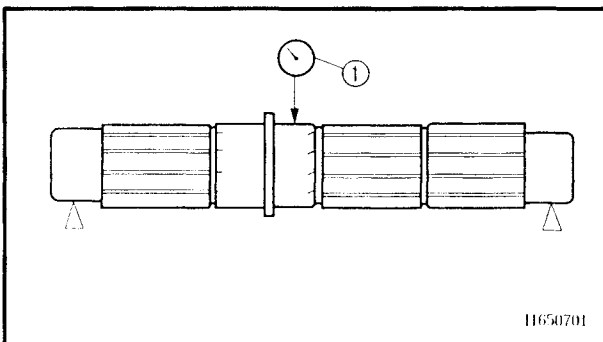
- main axle runout  
(with a centering device and dial gauge ①)  
Out of specification → Replace the main axle.



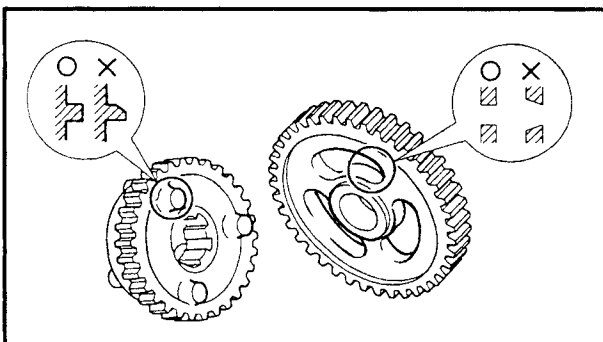
**Max. main axle runout**  
**0.02 mm (0.0008 in)**

## 2. Measure:

- drive axle runout  
(with a centering device and dial gauge ①)  
Out of specification → Replace the drive axle.



**Max. drive axle runout**  
**0.02 mm (0.0008 in)**



## 3. Check:

- transmission gears  
Blue discoloration/pitting/wear → Replace the defective gear(-s).
- transmission gear dogs  
Cracks/damage/rounded edges → Replace the defective gear(-s).



4. Check:
  - transmission gear engagement  
(each pinion gear to its respective wheel gear)  
Incorrect → Reassemble the transmission axle assemblies.
5. Check:
  - transmission gear movement  
Rough movement → Replace the defective part(-s).
6. Check:
  - circlips  
Bends/damage/looseness → Replace.

## INSTALLING THE TRANSMISSION

1. Install:
  - main axle assembly
  - shift fork "C"
  - shift drum assembly
  - shift fork "R"
  - shift fork "L"
  - springs
  - shift fork guide bars
  - drive axle assembly

### NOTE:

- Carefully position the shift forks so that they are installed correctly into the transmission gears.
- Install shift fork "C" into the groove in the 3rd and 4th pinion gear on the main axle.
- Install shift fork "L" into the groove in the 6th wheel gear and shift fork "R" into the groove in the 5th wheel gear on the drive axle.
- Make sure that the drive axle bearing circlip is inserted into the grooves in the upper crankcase.

2. Check:
  - transmission  
Rough movement → Repair.

### NOTE:

Oil each gear, shaft, and bearing thoroughly.