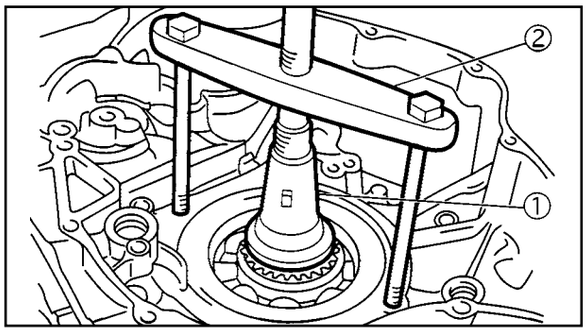

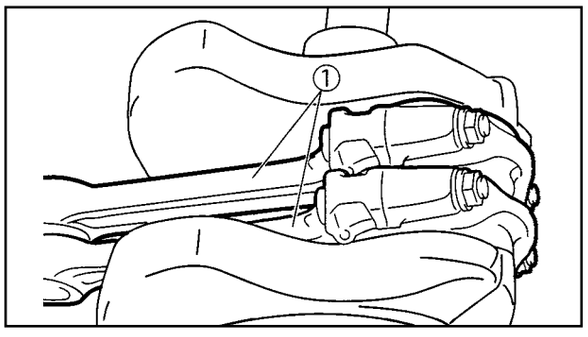

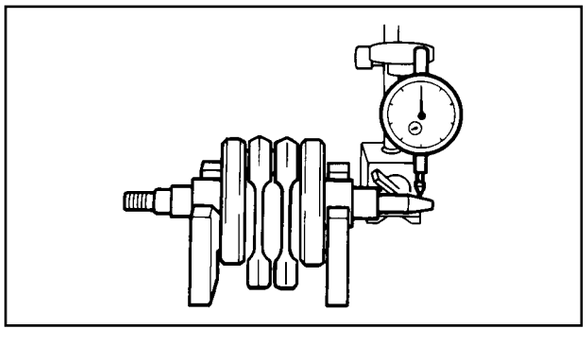

EB412111

REMOVING THE CRANKSHAFT

1. Remove:
   • crankshaft assembly ①

NOTE:

• Remove the crankshaft assembly with the crankcase separating tool ②.
• Make sure that the crankcase separating tool is centered over the crankshaft assembly.

Crankcase separating tool
90890-01135

EB412121

REMOVING THE CONNECTING RODS

1. Remove:
   • connecting rods ①
   • big end bearings

NOTE:

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

EB413404

CHECKING THE CRANKSHAFT AND CONNECTING RODS

1. Measure:
   • crankshaft runout
   Out of specification → Replace the crankshaft.

Crankshaft runout
Less than 0.02 mm

2. Check:
   • crankshaft journal surfaces
   • crankshaft pin surfaces
   • bearing surfaces
   Scratches/wear → Replace the crankshaft.
3. Measure:
   • crankshaft-pin-to-big-end-bearing clearance
   Out of specification → Replace the big end bearings.

Crankshaft-pin-to-big-end-bearing clearance
0.044 ~ 0.073 mm

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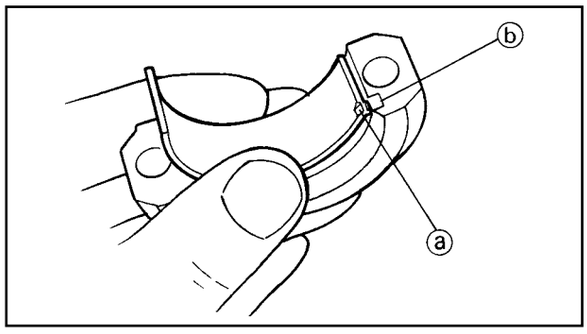
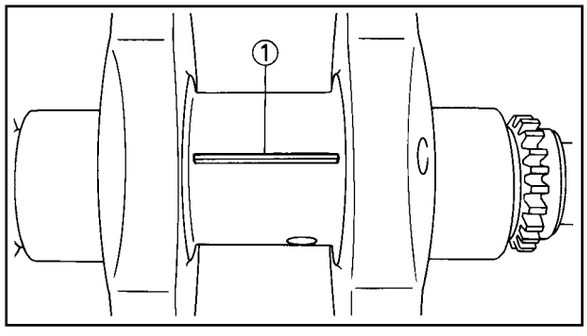
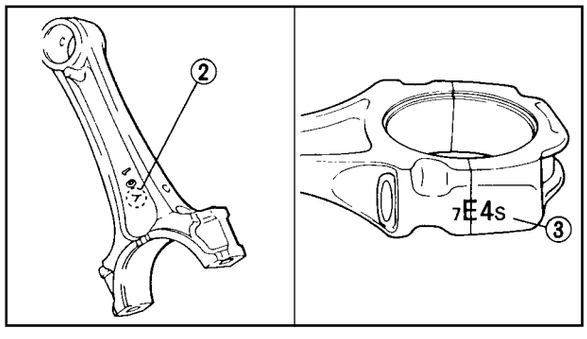
The following procedure applies to all of the connecting rods.







CAUTION:

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

a. Clean the big end bearings, crankshaft pins, and the inside of the connecting rod halves.
b. Install the big end upper bearing into the connecting rod and the big end lower bearing into the connecting rod cap.

NOTE:

Align the projections ⓐ on the big end bearings with the notches ⓑ 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.
- Apply molybdenum disulfide grease onto the bolts, threads, and nut seats.
- Make sure that the "Y" mark ② on the connecting rod faces towards the left side of the crankshaft.
- Make sure that the characters ③ 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.**
- **Without pausing, tighten the connecting rod nuts to the specified torque. Apply continuous torque between 4.3 and 4.8 m•kg. Once you reach 4.3 m•kg, DO NOT STOP TIGHTENING until the specified torque is reached. If the tightening is interrupted between 4.3 and 4.8 m•kg, loosen the connecting rod nut to less than 4.3 m•kg and start again.**

Refer to "INSTALLING THE CONNECTING RODS".

	Connecting rod nut **48 Nm (4.8 m•kg)**

f. Remove the connecting rod and big end bearings.
   Refer to "REMOVING THE CONNECTING RODS".
g. Measure the compressed Plastigauge ® width ① on each crankshaft pin.
   If the clearance is out of specification, select replacement big end bearings.

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4. Select:
   • big end bearings (P_1, P_2)

NOTE:

- The numbers ① stamped into the crankshaft web and the numbers ② on the connecting rods are used to determine the replacement big end bearing sizes.
- "P_1, P_2" refer to the bearings shown in the crankshaft illustration.

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For example, if the connecting rod "P_1" and the crankshaft web "P_1" numbers are "4" and "1" respectively, then the bearing size for "P_1" is:

Bearing size for "P_1" :
"P_1" (connecting rod) – "P_1" (crankshaft web) =
4 – 1 = 3 (brown)

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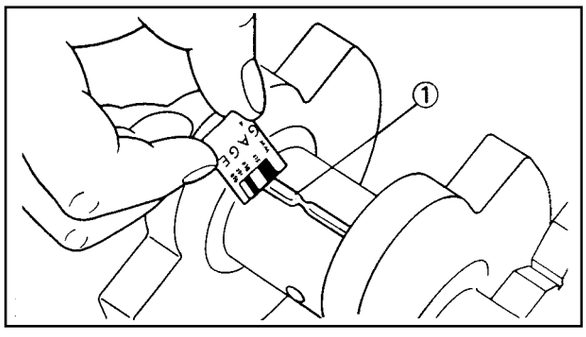
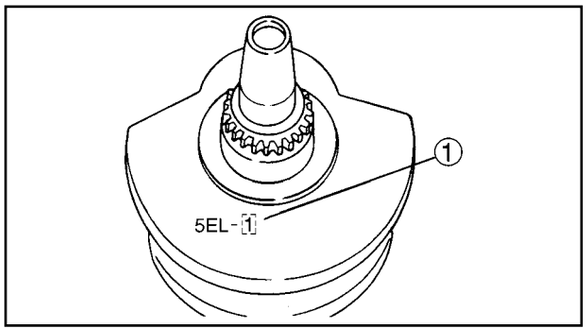
Rear cylinder lower bearing/Front cylinder upper and lower bearing.

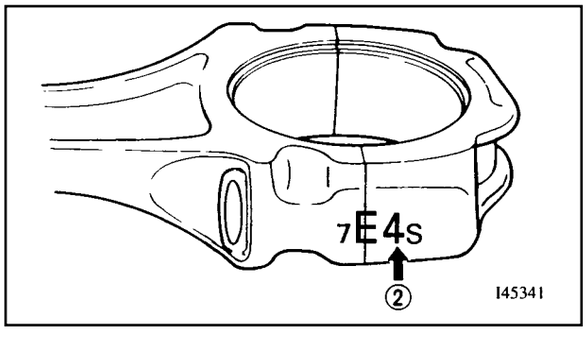
BEARING COLOR CODE	
1	blue
2	black
3	brown
4	green
5	yellow

Rear cylinder upper bearing

BEARING COLOR CODE	
1	black
2	
3	brown
4	green
5	



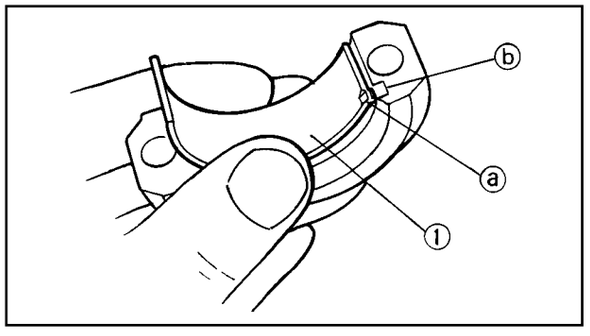




EB412440

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.

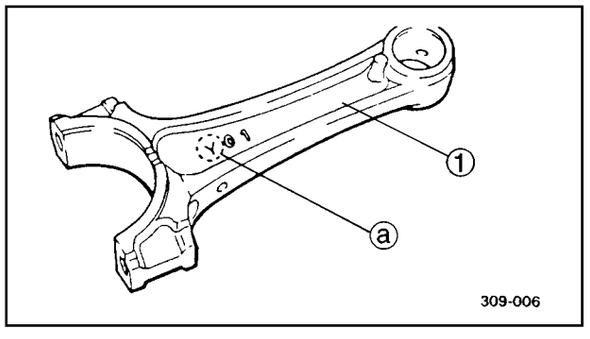


INSTALLING THE CRANKSHAFT

1. Install:
   - connecting rod bearings ①

NOTE:

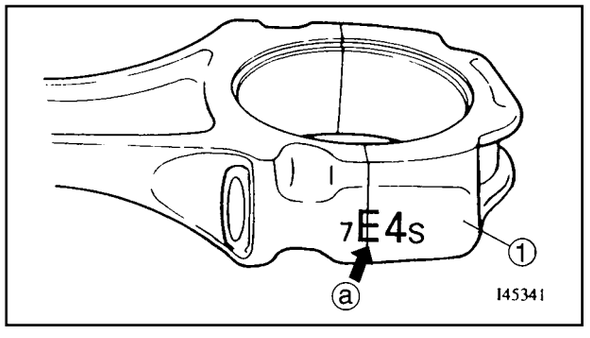
- Align the projection ⓐ of the bearings with the notches ⓑ in the connecting rod cap.
- Install each bearing in its original place.



2. Install:
   - connecting rods ①

NOTE:

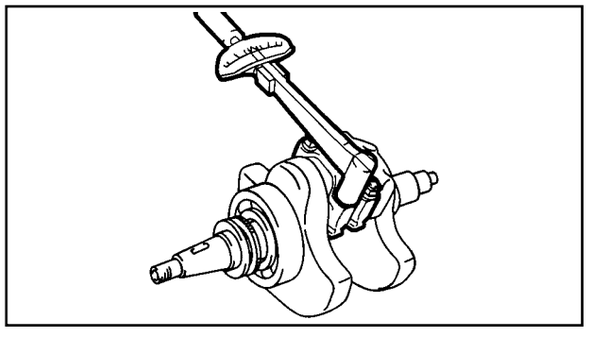
- The stamped "Y" mark ⓐ on the connecting rods should face towards the left side of the crankcase.
- Install each connecting rod in its original place.



3. Install:
   - connecting rod cap ①

NOTE:

Be sure that the characters ⓐ on the side of the cap and connecting rod are aligned.

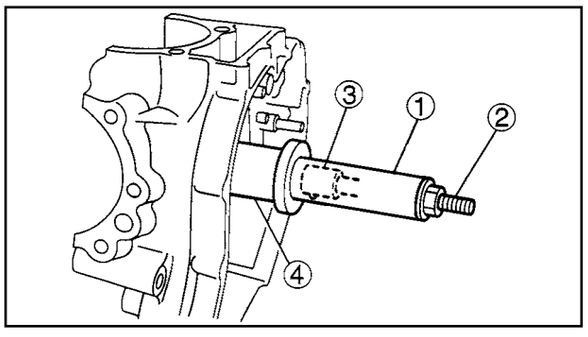


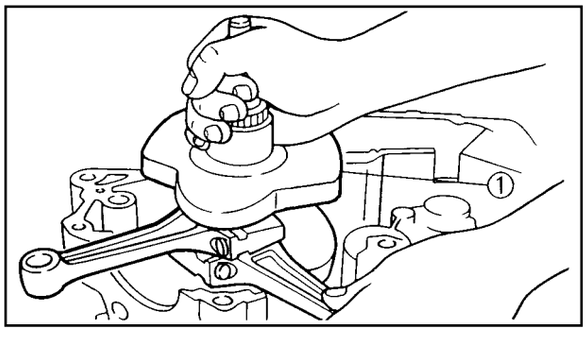
4. Tighten:
   - nuts (connecting rod cap)

48 Nm (4.8 m•kg)

NOTE:

Apply molybdenum disulfide grease to the rod cap bolt threads and nut surfaces.





CAUTION:

- **When tightening the nuts be sure to use an F-type torque wrench.**
- **Without pausing tighten to full torque specification. Apply continuous torque between 4.3 and 4.8 m•kg. Once you reach 4.3 m•kg DO NOT STOP TIGHTENING until final torque is reached. If the tightening is interrupted between 4.3 and 4.8 m•kg, loosen the nut to less than 4.3 m•kg and start again.**

5. Install:
   - crankshaft installing tool

NOTE:
Attach the spacer to the bearing inner race.

Crankshaft installer pot ①
90890-01274
Crankshaft installer bolt ②
90890-01275
Adapter ③
90890-04130
Spacer ④
90890-04060

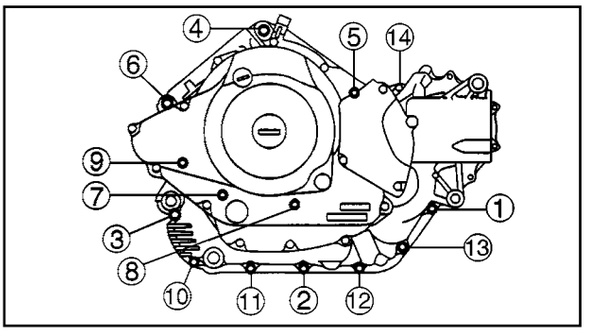
6. Install:
   - crankshaft ①

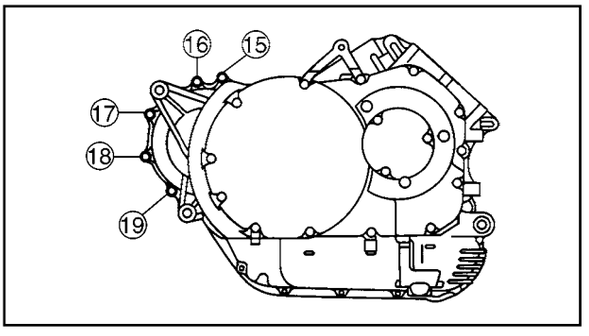
NOTE:
Align the left connecting rod with the rear cylinder sleeve hole.

ASSEMBLING THE CRANKCASE

1. Apply:
   - engine oil
     (onto the main journal bearings)
   - sealant
     (onto the crankcase mating surfaces)

Yamaha Bond No. 1215:
90890-85505





2. Tighten:
   • crankcase bolts
     (follow the proper tightening sequence)

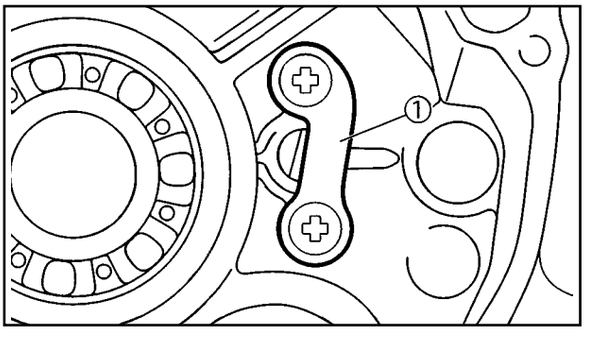
NOTE:
The numbers embossed on the crankcase indicate the crankcase tightening sequence.

④ ~ ⑥ (M10) **38.5 Nm (3.85 m•kg)**
① ~ ③, ⑦ ~ ⑲ (M6) **10 Nm (1.0 m•kg)**

NOTE:
• Lubricate the bolt threads with engine oil.
• Tighten the bolts in increasing numerical order.

M6 × 30 mm	① ~ ③, ⑩ ~ ⑭, ⑰ ~ ⑲
M6 × 30 mm (Chromium plated bolt)	⑮, ⑯
M6 × 55 mm	⑧
M6 × 80 mm	⑦, ⑨
M10 × 60 mm	⑤
M10 × 70 mm	④
M10 × 100 mm	⑥

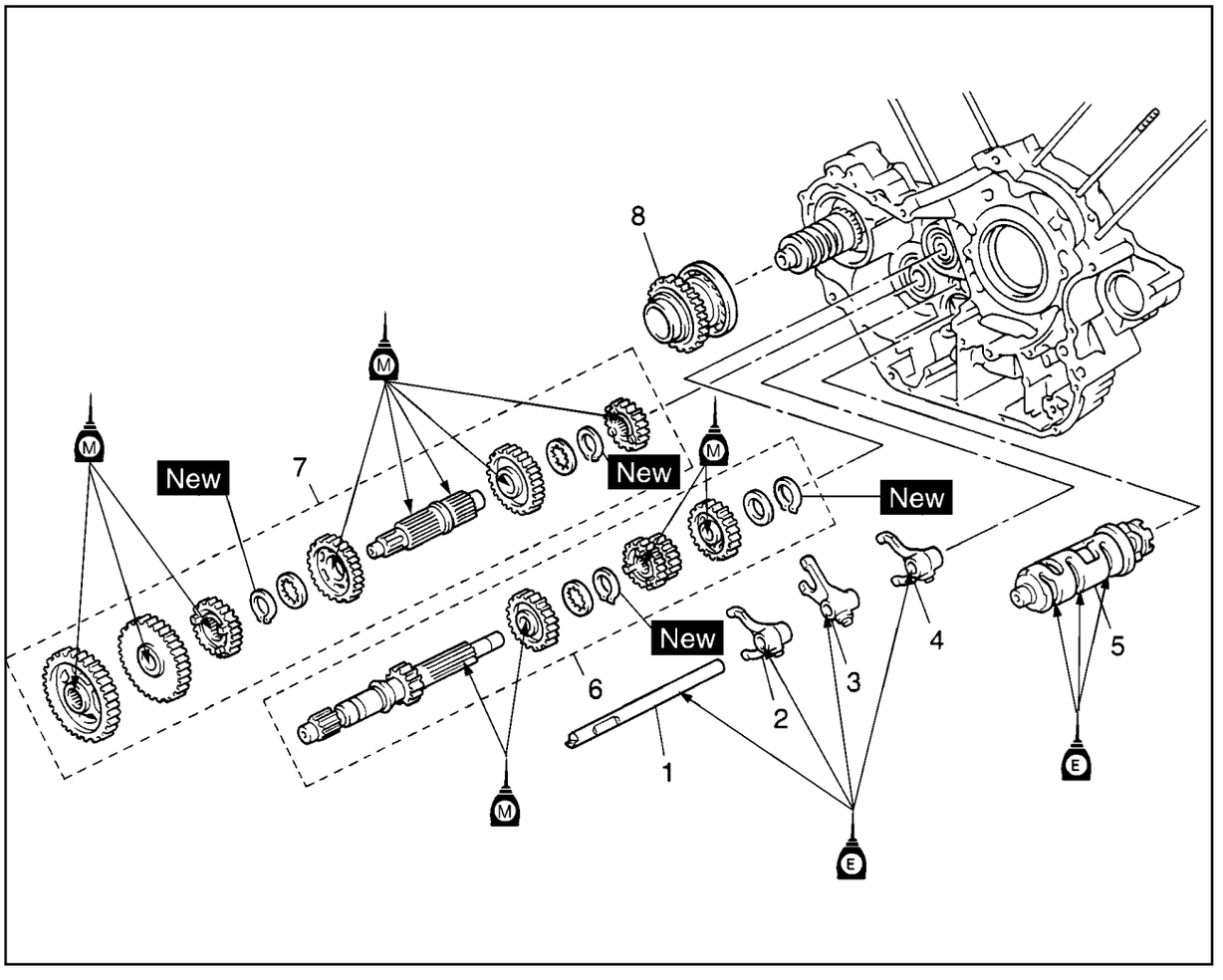
⑲: with engine ground lead



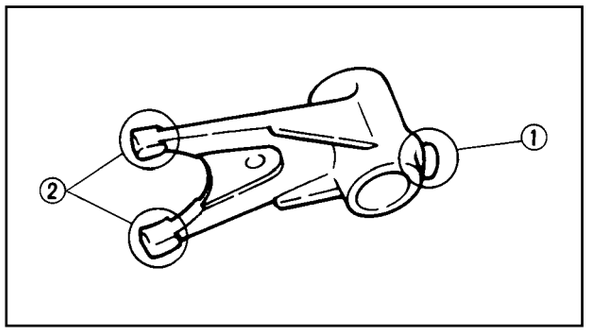
3. Install:
   • shift shaft stopper plate ①

NOTE:
Install the shift shaft stopper plate as shown.

TRANSMISSION



Order	Job name/Part name	Q'ty	Remarks
	Transmission removal		Remove the parts in the order listed.
	Crankcase separation		Refer to "CRANKSHAFT".
1	Guide bar	1	
2	Shift fork 1 "R"	1	
3	Shift fork 2 "C"	1	
4	Shift fork 3 "L"	1	Refer to "INSTALLING THE
5	Shift drum	1	TRANSMISSION".
6	Main axle assembly	1	
7	Drive axle assembly	1	
8	Middle driven gear	1	
			For installation, reverse the removal procedure.

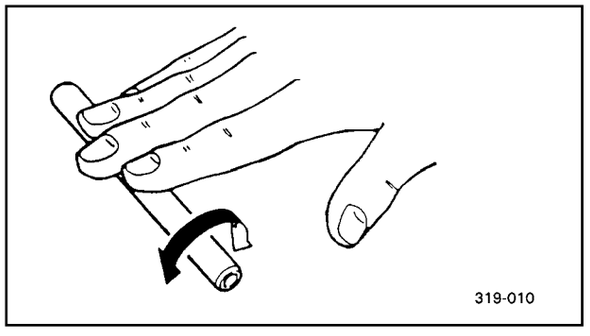


EAS00421

CHECKING THE SHIFT FORKS

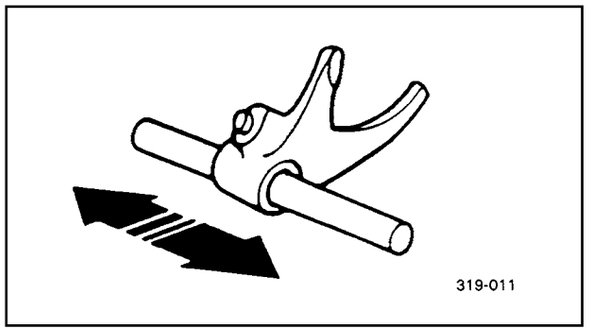
The following procedure applies to all of the shift forks and related components.

1. Check:
   - shift fork cam follower ①
   - shift fork pawl ②
     Bends/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.

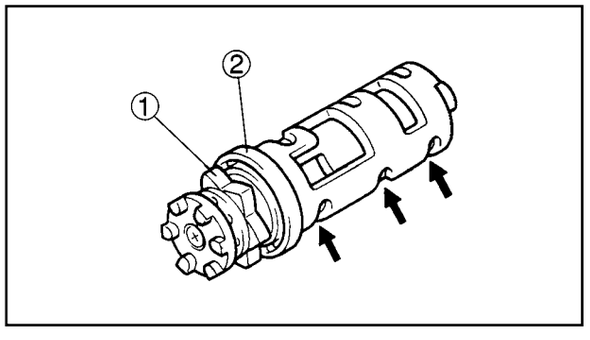


⚠ WARNING

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



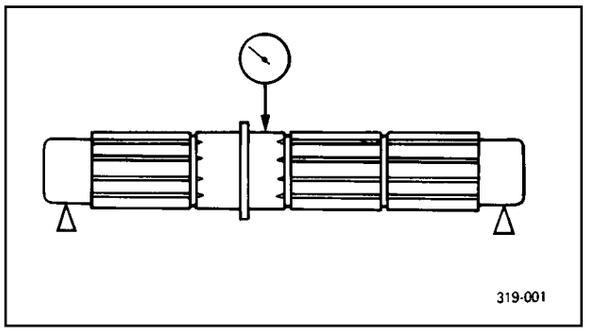
3. Check:
   - shift fork movement
     (on the shift fork guide bar)
     Rough movement → Replace the shift forks and shift fork guide bar as a set.



EAS00422

CHECKING THE SHIFT DRUM ASSEMBLY

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



EAS00424

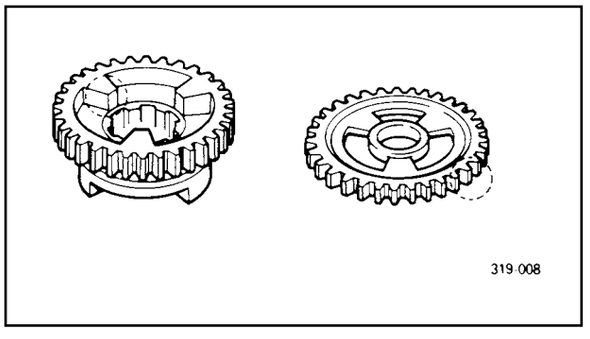
CHECKING THE TRANSMISSION

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

Main axle runout limit
0.08 mm

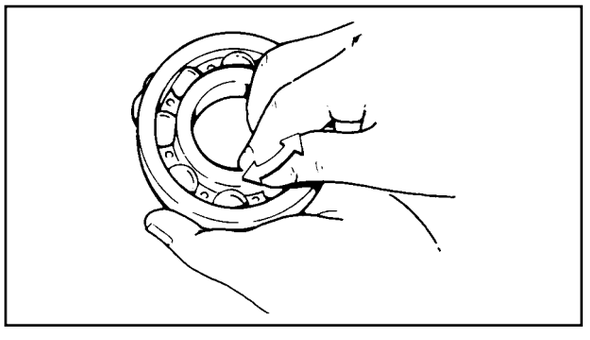
2. Measure:
   • drive axle runout
   (with a centering device and dial gauge)
   Out of specification → Replace the drive axle.

Drive axle runout limit
0.08 mm



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 movement
   Rough movement → Replace the defective part(-s).
5. Check:
   • washers
   Damage/bends/looseness → Replace.



6. Check:
   • bearings
   Unsmooth → Replace.

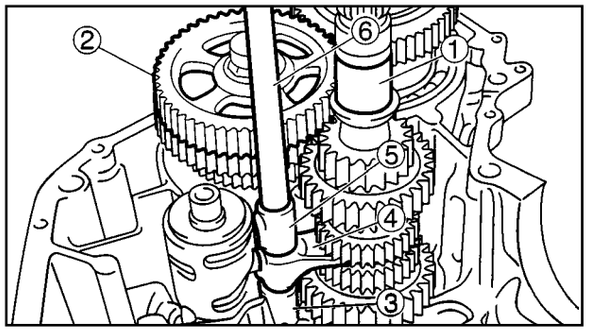
EAS00430

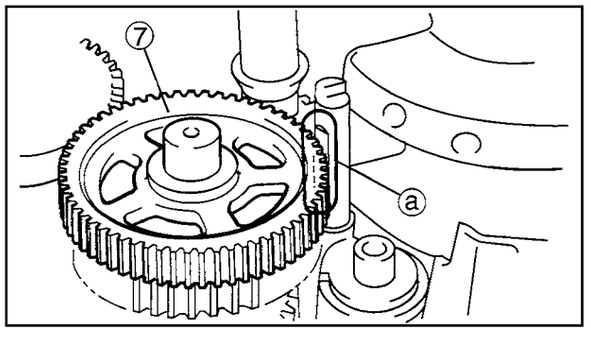
INSTALLING THE TRANSMISSION

1. Install:
   - shift drum assembly

NOTE:

Turn the shift drum assembly to the neutral position.





2. Install:
   - main axle assembly ①
   - drive axle assembly ②
   - shift fork “L” ③
   - shift fork “C” ④
   - shift fork “R” ⑤
   - shift fork guide bars ⑥

NOTE:

- The embossed marks on the shift forks should face towards the right side of the engine and be in the following sequence: “R”, “C ”, “L”.
- When installing the middle drive gear ⑦, align the slit ⓐ on the guide bar with the middle drive gear.

⚠ WARNING

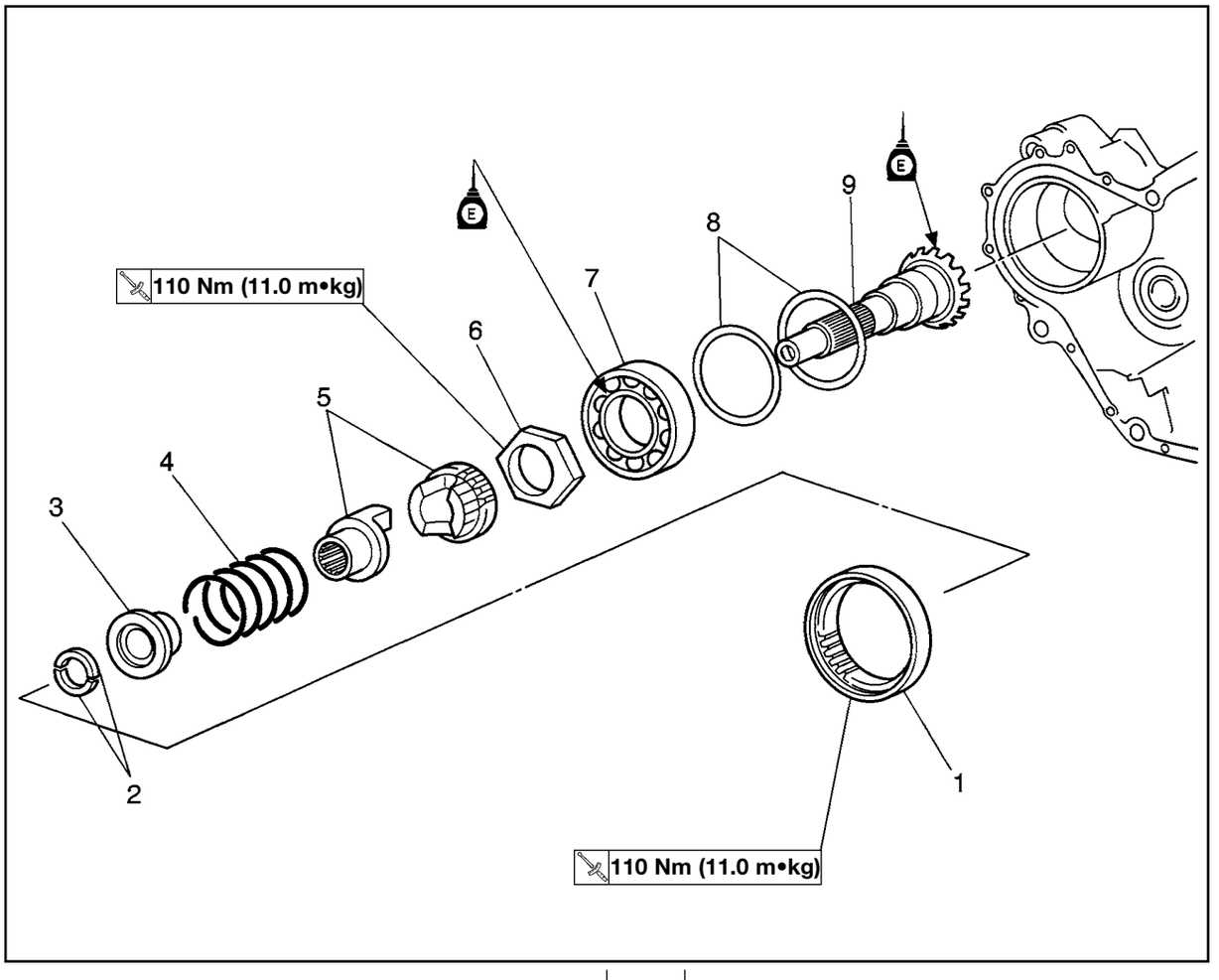
Always use new circlips.

3. Check:
   - transmission
     Rough movement → Repair.

NOTE:

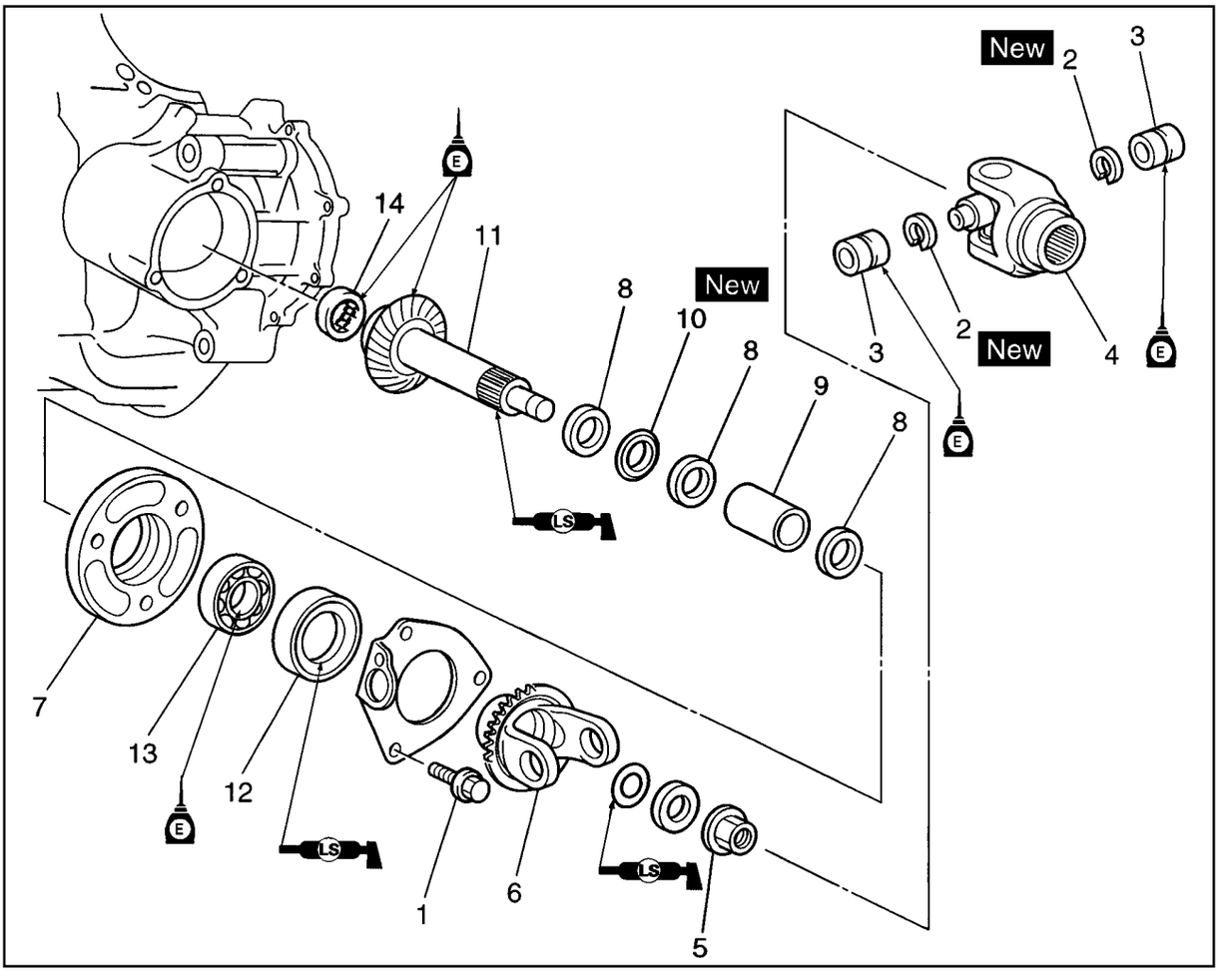
Oil each gear, shaft, and bearing thoroughly.

MIDDLE GEAR
MIDDLE DRIVE PINION GEAR

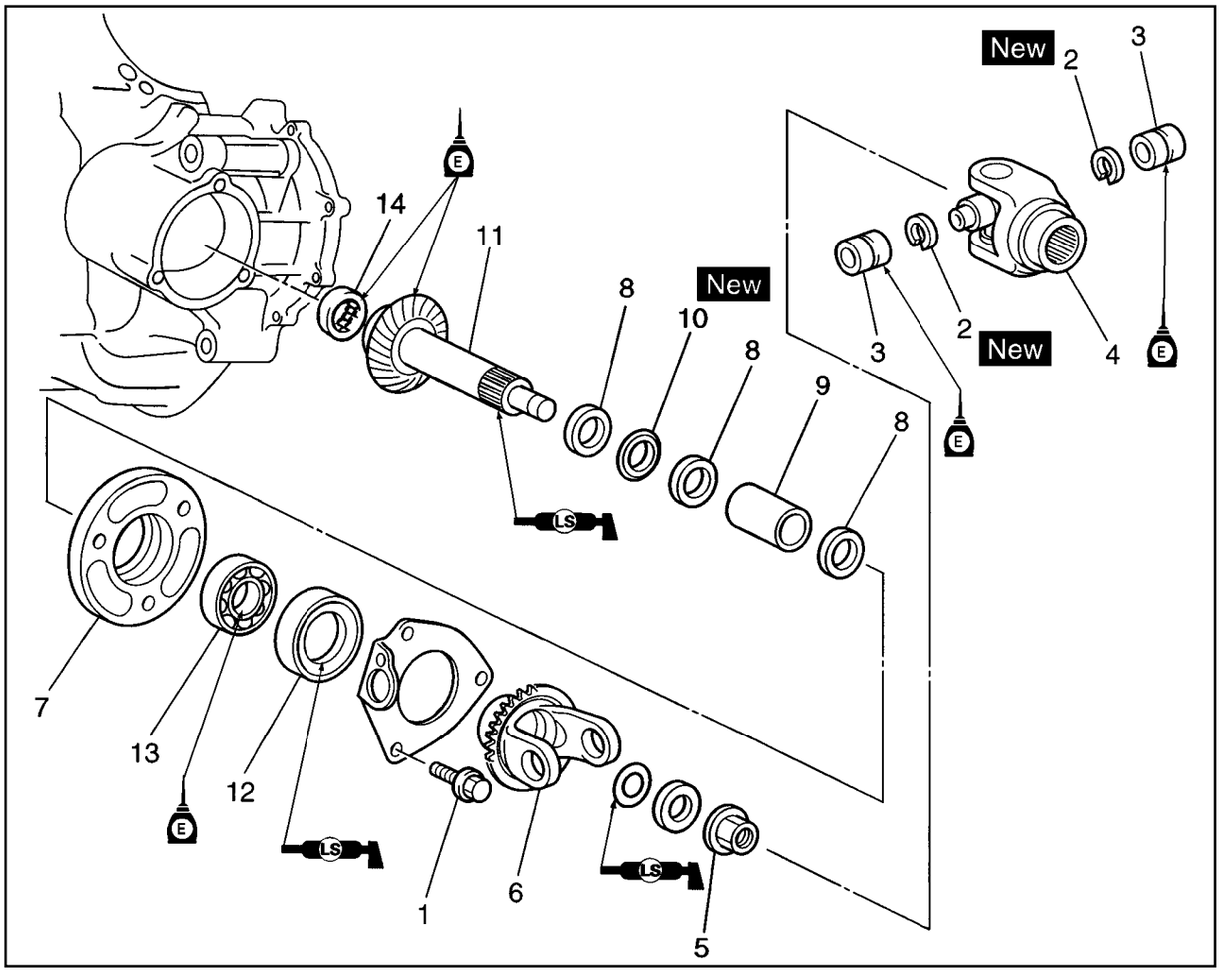


Order	Job name/Part name	Q'ty	Remarks
	Removing the middle drive pinion gear		Remove the parts in the order listed.
	Separate the crankcase		Refer to "CRANKSHAFT AND CONNECTING ROD".
1	Bearing retainer	1	Refer to "REMOVING THE MIDDLE DRIVE SHAFT ASSEMBLY/INSTALLING THE MIDDLE GEAR ASSEMBLY AND ADJUSTING THE BACKLASH".
2	Spring retainers	2	Refer to "DISASSEMBLING/ ASSEMBLING THE MIDDLE DRIVE SHAFT ASSEMBLY".
3	Spring seat	1	
4	Damper spring	1	
5	Damper cams	2	
6	Nut	1	
7	Bearing	1	
8	Shim(-s)	1	
9	Middle drive pinion shaft	1	
			For installation, reverse the removal procedure.

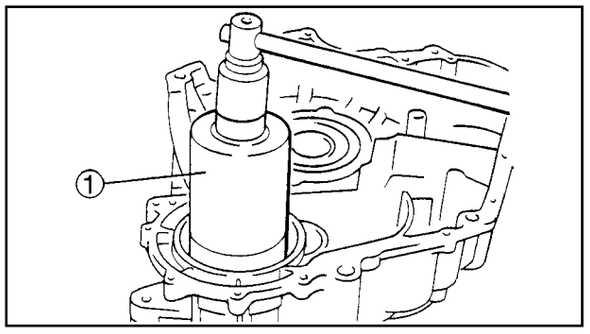
MIDDLE DRIVE PINION GEAR

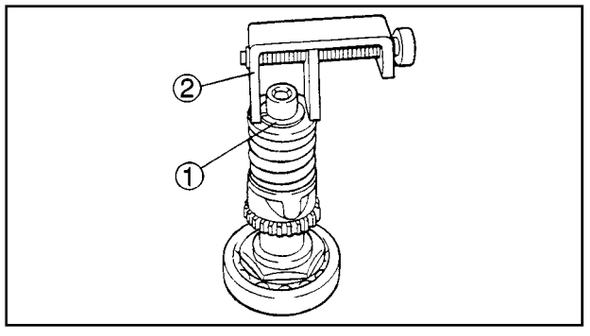


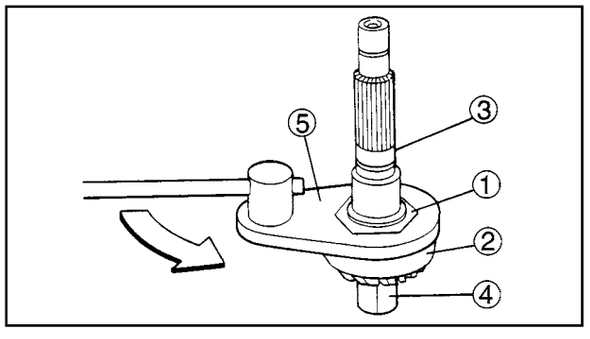
Order	Job name/Part name	Q'ty	Remarks
	Removing the middle driven pinion gear		Remove the parts in the order listed.
1	Bolts	3	Refer to "REMOVING THE MIDDLE DRIVEN SHAFT ASSEMBLY/ INSTALLING THE UNIVERSAL JOINT".
2	Circlips	2	
3	Bearings	2	
4	Driven yoke	1	
5	Nut	1	Refer to "REMOVING THE MIDDLE DRIVEN SHAFT ASSEMBLY/INSTALLING THE MIDDLE GEAR ASSEMBLY AND ADJUSTING THE BACKLASH".
6	Drive yoke	1	Refer to "INSTALLING THE MIDDLE GEAR ASSEMBLY AND ADJUSTING THE BACKLASH".
7	Bearing housing/O-ring	1/1	
8	Washers	3	
9	Collar	1	



Order	Job name/Part name	Q'ty	Remarks
10	Collapsible collar	1	Refer to "INSTALLING THE MIDDLE
11	Middle driven shaft	1	GEAR ASSEMBLY AND ADJUSTING THE BACKLASH".
12	Oil seal	1	Refer to "ASSEMBLING THE MIDDLE
13	Bearing	1	DRIVEN SHAFT ASSEMBLY".
14	Bearing		
			For installation, reverse the removal procedure.







REMOVING THE MIDDLE DRIVE SHAFT ASSEMBLY

1. Remove:
   - bearing retainer
   - middle drive shaft assembly

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a. Straighten the thread on the bearing retainer.
b. Attach the bearing retainer wrench ①.

	Bearing retainer wrench: **90890-04137**

c. Remove the bearing retainer and middle drive shaft assembly.

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DISASSEMBLING THE MIDDLE DRIVE SHAFT ASSEMBLY

1. Remove:
   - spring retainers ①

NOTE:

While compressing the spring with a damper spring compressor ②, remove the spring retainers.

	Damper spring compressor **90890-04090**

2. Straighten the thread on the middle drive shaft nut.
3. Remove:
   - middle drive shaft nut ①
   - bearing ②
   - middle drive shaft ③

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a. Attach the middle drive shaft holder ④ onto the middle drive shaft as shown.

	Middle drive shaft holder **90890-04055**

b. Secure the middle drive shaft holder in a vice.
c. Loosen the middle drive shaft nut with the middle drive shaft nut wrench ⑤.

	Middle drive shaft nut wrench **90890-04138**

d. Remove the middle drive shaft nut and bearing.

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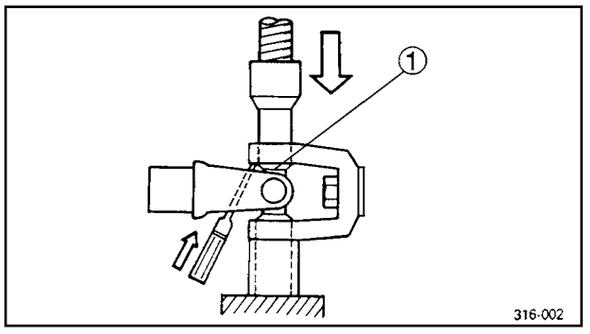

REMOVING THE MIDDLE DRIVEN SHAFT ASSEMBLY

1. Remove:
   • universal joint

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a. Remove the circlips ①.
b. Place the universal joint in a press.
c. With a pipe of the proper diameter positioned beneath the universal joint driven yoke as shown, press the bearing into the pipe.

NOTE:

It may be necessary to lightly tap the universal joint driven yoke.

d. Repeat the above steps to remove the opposite side's bearing.
e. Separate the universal joint yokes.

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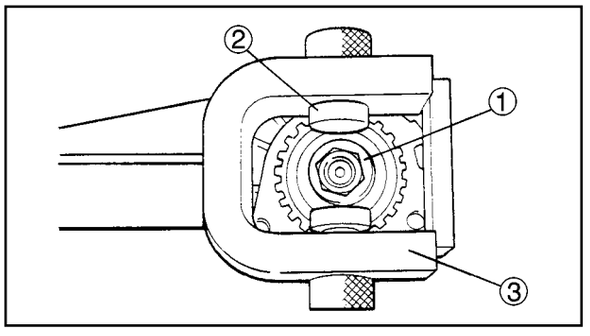
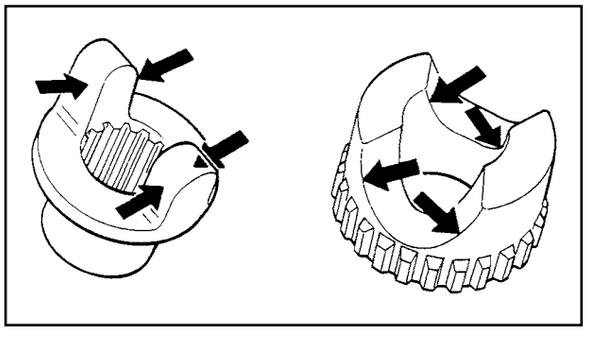
2. Loosen:
   • middle driven shaft nut ①



NOTE:

While holding the universal joint driven yoke ② with the universal joint holder ③, loosen the middle driven shaft nut.

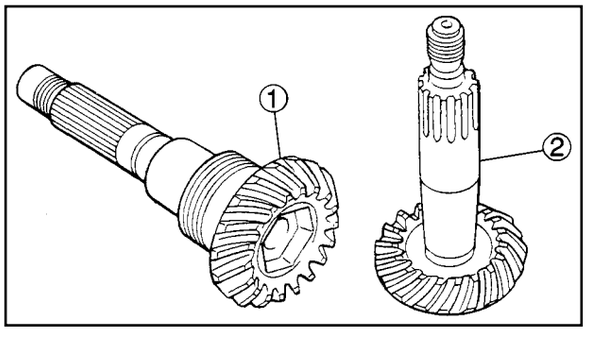
	Universal joint holder **90890-04062**



EAS00438

CHECKING THE MIDDLE DRIVE SHAFT ASSEMBLY

1. Check:
   • damper cam surface
   Scratches/wear → Replace the damper cam.
2. Check:
   • spring
   Cracks/damage → Replace.



EAS00439

CHECKING THE MIDDLE DRIVEN SHAFT ASSEMBLY

1. Check:
   • middle drive gear ①
   • middle driven gear ②
   Galling/pitting/wear → Replace the middle driven shaft assembly.
2. Check:
   • bearings
   Damage/pitting → Replace the middle drive shaft bearing housing assembly.