ENGINE

CONTENTS

ENGINE COMPONENTS REMOVABLE WITH THE ENGINE IN PLACE

Engine components which can be removed while the engine is installed on the chassis are listed below. For the installing and removing procedures, refer to respective paragraphs describing each component.

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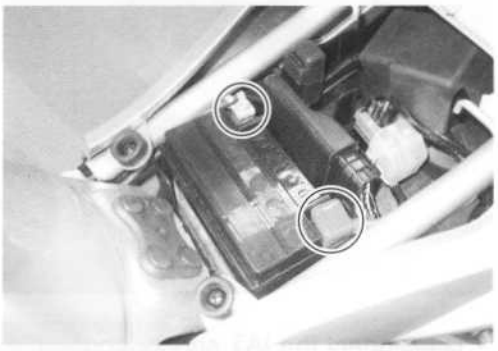
ENGINE REMOVAL AND INSTALLATION

ENGINE REMOVAL

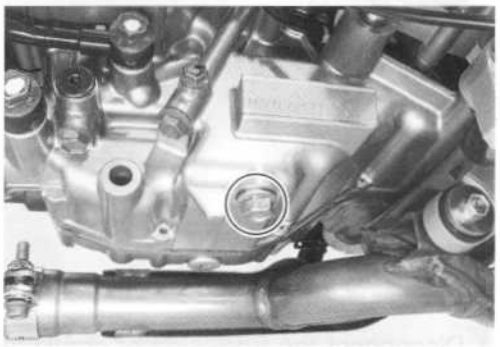
Before taking the engine out of the frame, wash the engine using a steam cleaner. Engine removal is sequentially explained in the following steps. Reinstall the engine by reversing the removal procedure.

- Remove the cowling. (SV650S) (☞7-6)
- Remove the front and rear seat. (☞7-4)
- Lift and support the fuel tank with the prop stay. (☞5-6)

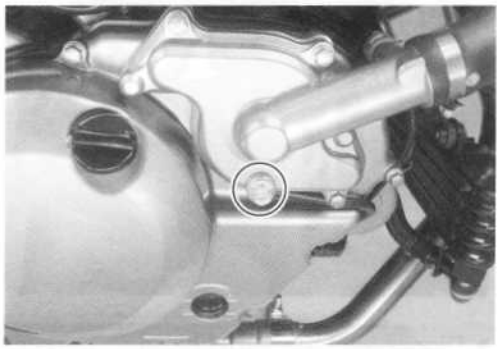
- Disconnect the battery ⊖ lead wire and ⊕ lead wire.



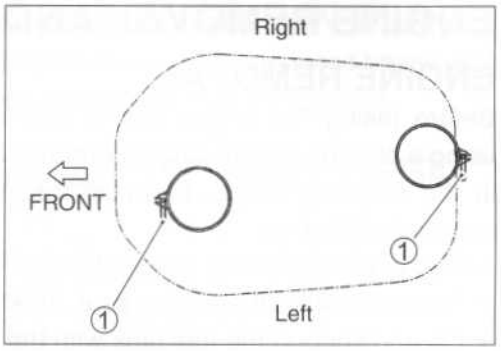
- Drain engine oil. (☞2-14)



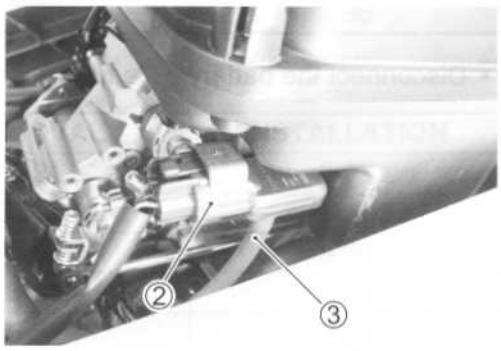
- Drain engine coolant. (☞2-20)



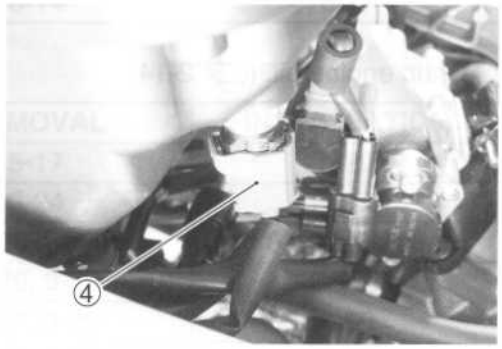
- Loosen the throttle body clamp screws ① at the air cleaner box side.



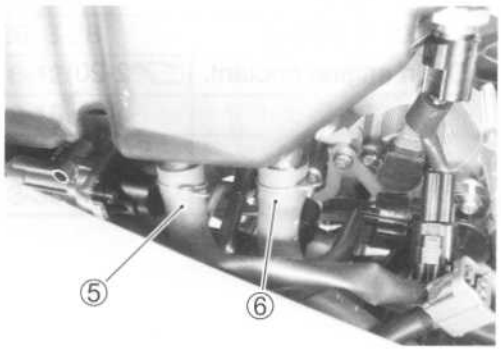
- Disconnect the IAP sensor coupler ② and hose ③.



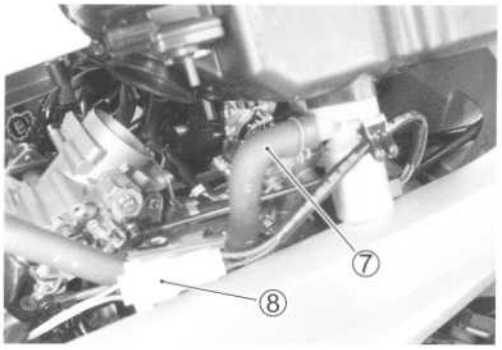
- Disconnect the IAT sensor coupler ④.



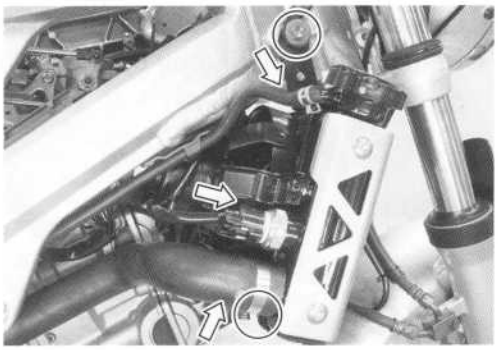
- Disconnect the front side of crankcase breather hose ⑤ and rear side of crankcase breather hose ⑥.



- Disconnect the PAIR hose ⑦ and coupler ⑧.

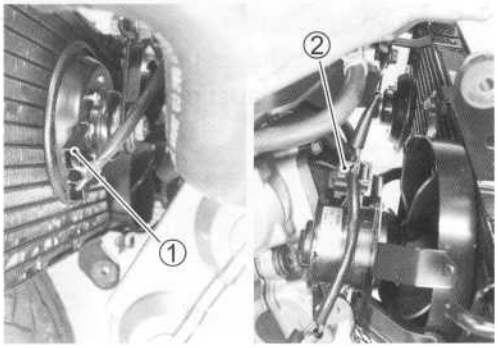


- Disconnect the cooling fan thermo-switch lead wire coupler.
- Disconnect the radiator outlet hose.
- Disconnect the reserve tank hose.
- Remove the radiator mounting bolts.



- Disconnect the radiator inlet hose.

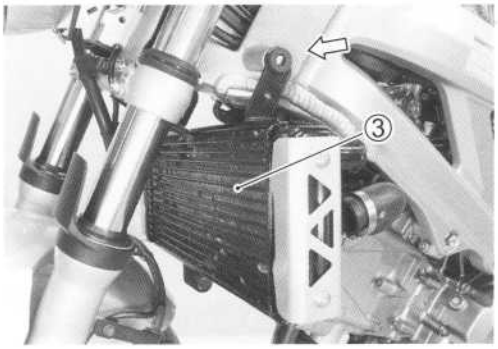
- Disconnect the horn coupler ① and cooling fan coupler ②.



- Remove the radiator ③.

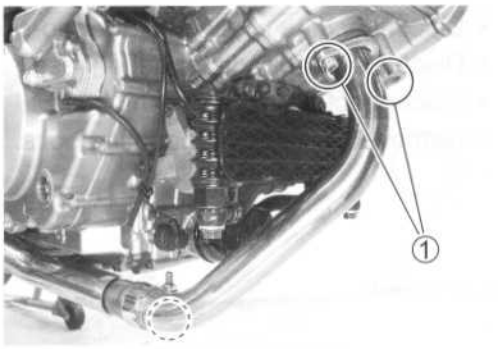
CAUTION

Be careful not to bent the radiator fin.

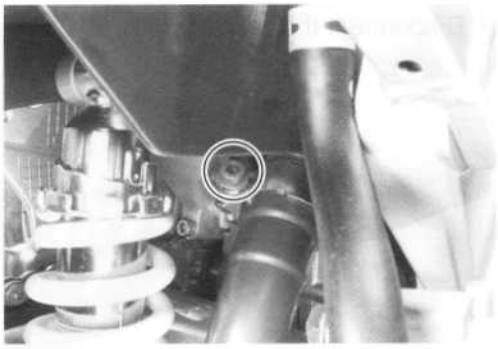


- Remove the throttle body. (☞5-17)

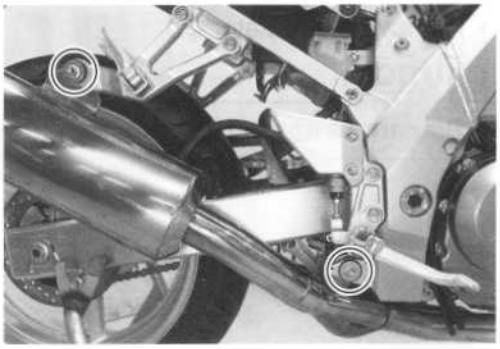
- Loosen the No.1 (Front) cylinder exhaust pipe connector bolt.
- Remove the No.1 (Front) cylinder exhaust pipe bolts ①.



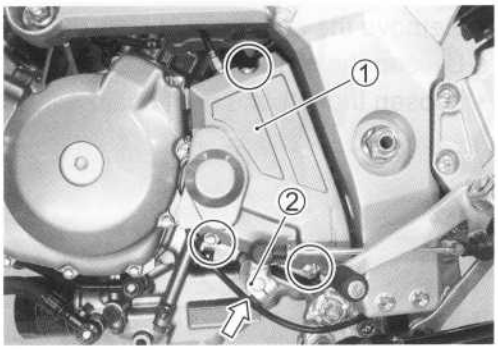
- Loosen the No.2 (Rear) cylinder exhaust pipe connector bolt.



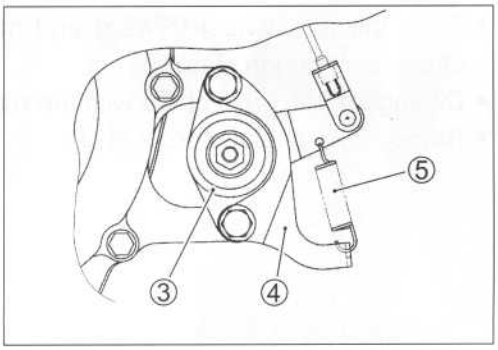
- Remove the muffler mounting bolt and nut.
- Remove the exhaust pipe mounting bolts and nut.
- Remove the exhaust pipe/muffler.



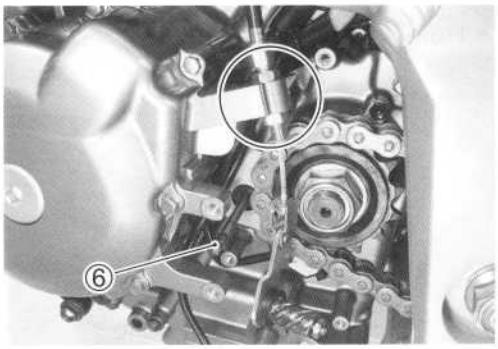
- Remove the engine sprocket cover ①.
- Remove the gearshift lever ②.



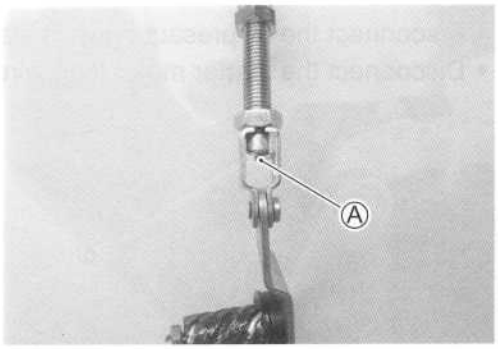
- Remove the clutch release assembly ③, its support plate ④ and spring ⑤.



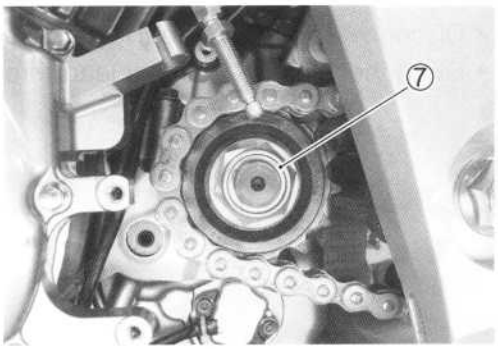
- Remove the clutch push rod ⑥.
- Remove the clutch cable from the generator cover.



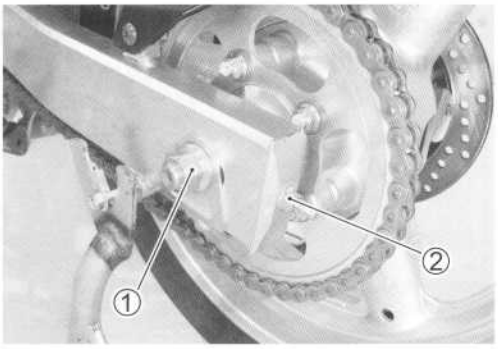
NOTE:
If it is necessary to replace the clutch cable or clutch release lever, pry up and bend down the stopper Ⓐ of the clutch release lever.



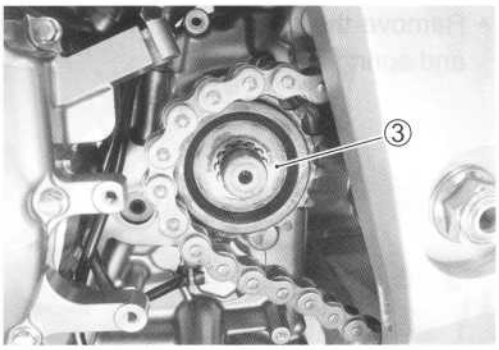
- Flatten the lock washer
- Remove the engine sprocket nut ⑦ and lock washer.



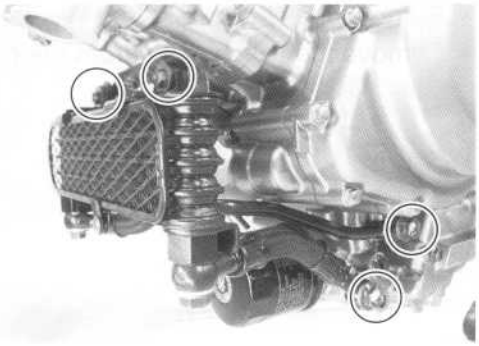
- Remove the cotter pin. (For E-03, 28, 33)
- Loosen the rear axle nut ①.
- Loosen the left and right chain adjusters ②.



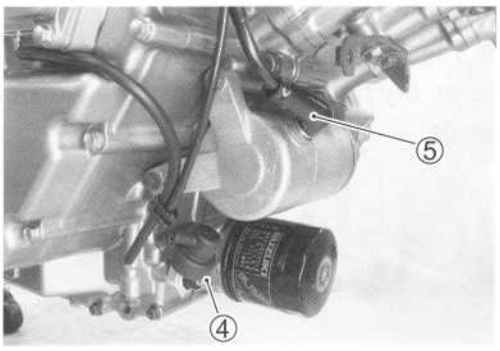
- Push the rear wheel forward and make sure that the drive chain has enough slack.
- Disengage the drive chain with the rear sprocket.
- Remove the engine sprocket ③.



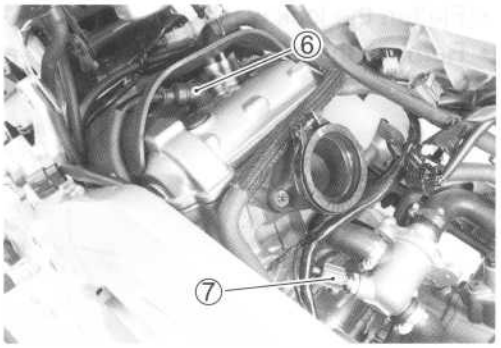
- Remove the oil cooler.



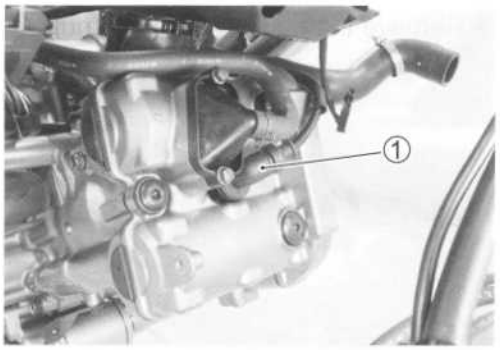
- Disconnect the oil pressure switch lead wire ④.
- Disconnect the starter motor lead wire ⑤.



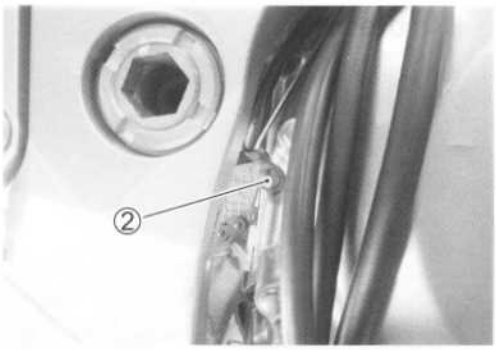
- Disconnect the No.2 (Rear) spark plug cap ⑥.
- Disconnect the ECT sensor lead wire ⑦.



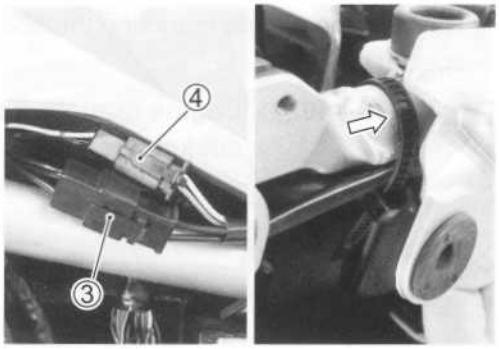
- Disconnect the No.1 (Front) spark plug cap ①.



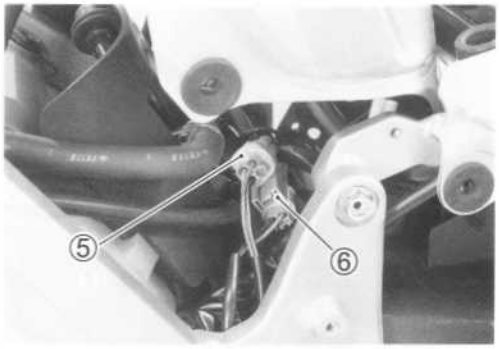
- Disconnect the ground lead wire ②.



- Disconnect the generator lead wire coupler ③.
- Disconnect the CKP sensor lead wire coupler ④.
- Disconnect the clamp.



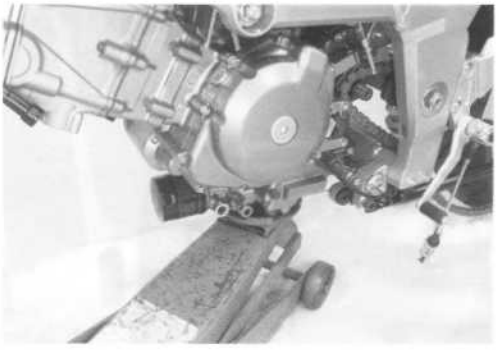
- Disconnect the GP sensor lead wire coupler ⑤.
- Remove the side-stand switch lead wire coupler ⑥.



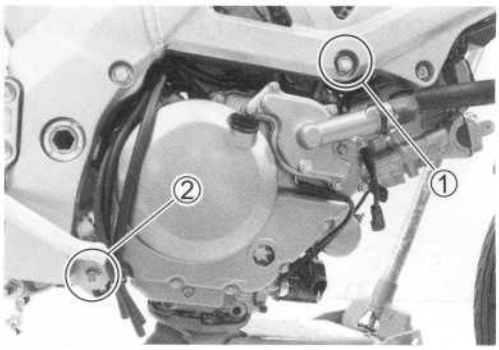
- Support the engine using an engine jack.

CAUTION

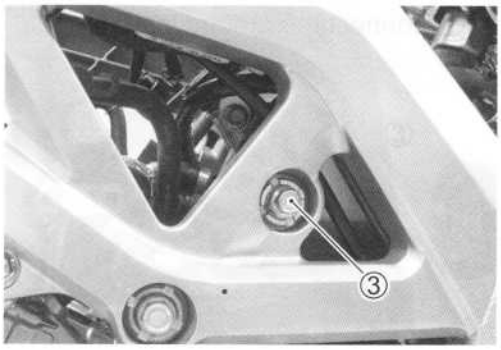
Do not support at the oil filter.



- Remove the engine mounting nuts ① and ②.

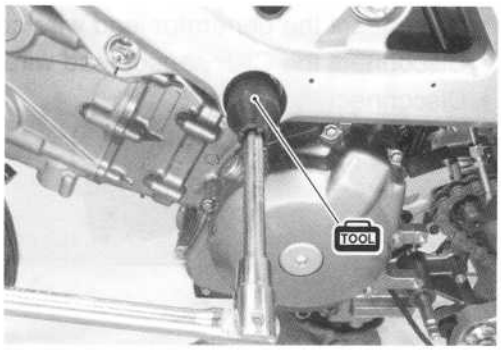


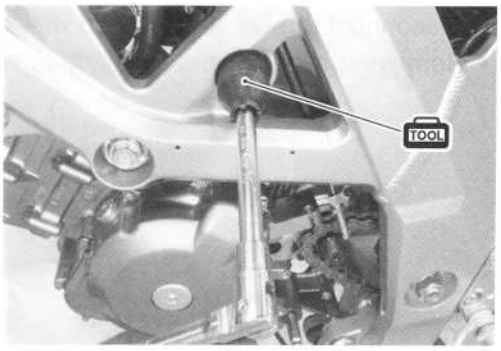
- Remove the engine mounting bolt ③.

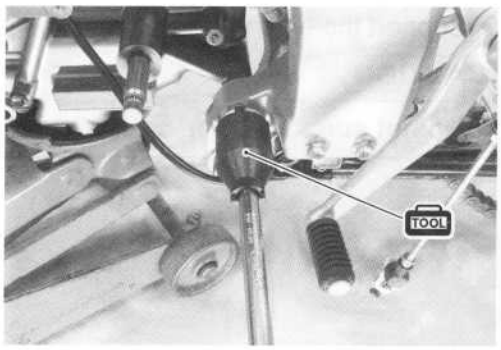


- Remove the engine mounting thrust adjuster locknuts with the special tool.

TOOL **09940-14990: Engine mounting thrust adjuster socket wrench**

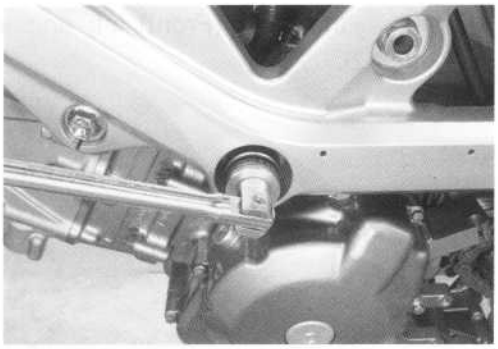


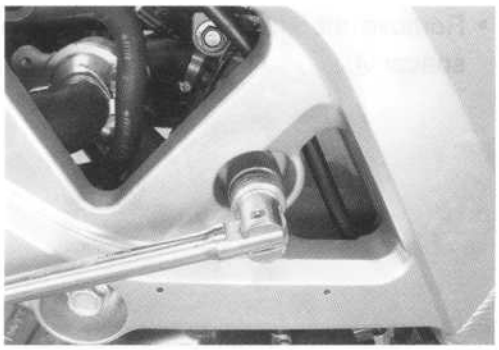


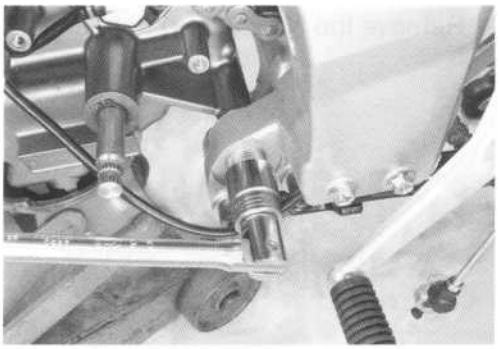


• Loosen the engine mounting thrust adjusters fully.

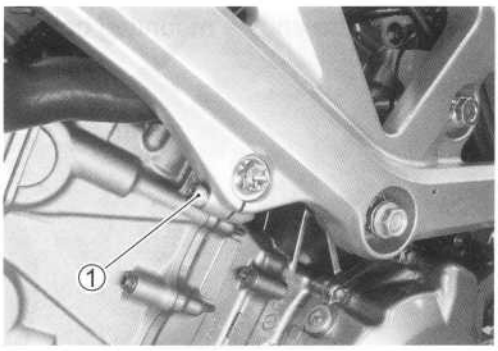
NOTE:
Do not remove the engine mounting bolts at this stage.

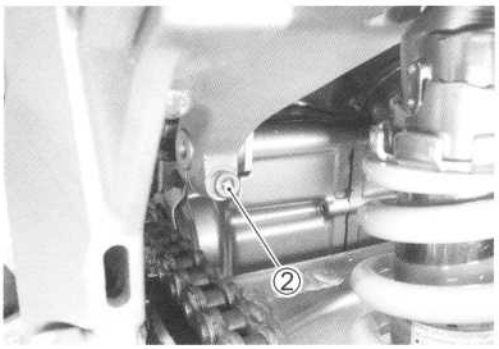




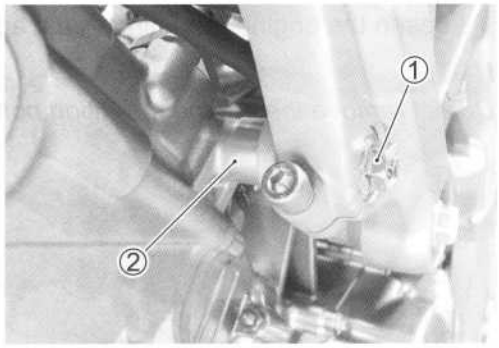


• Loosen the engine mounting clamp bolts ① and ②.

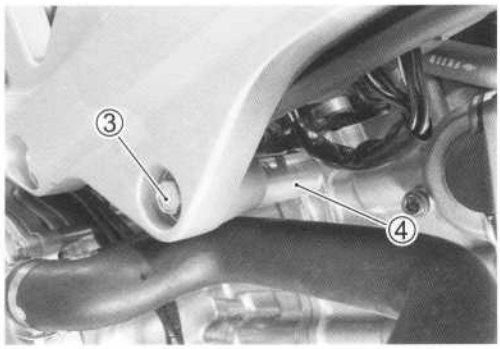




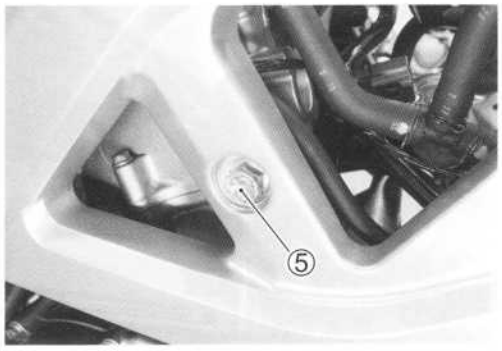
- Remove the No.1 (Front) left engine mounting bolt ① and spacer ②.



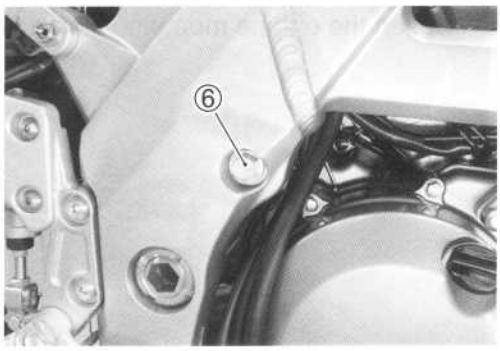
- Remove the No.1 (Front) right engine mounting bolt ③ and spacer ④.



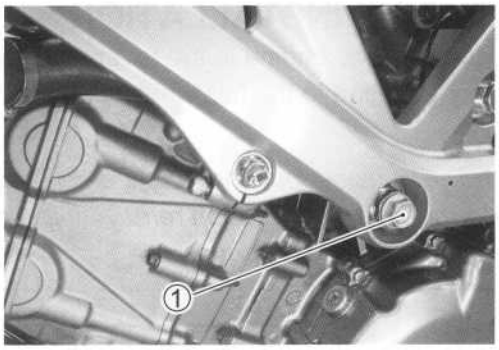
- Remove the No.2 (Rear) right engine mounting bolt ⑤.

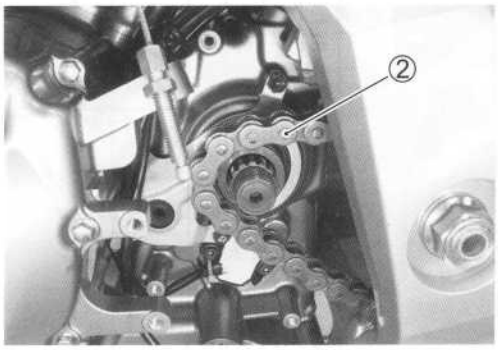


- Remove the engine mounting bolt ⑥.



- Remove the engine mounting bolt ① and gradually lower the front side of the engine. Then take the drive chain ② off the driveshaft.

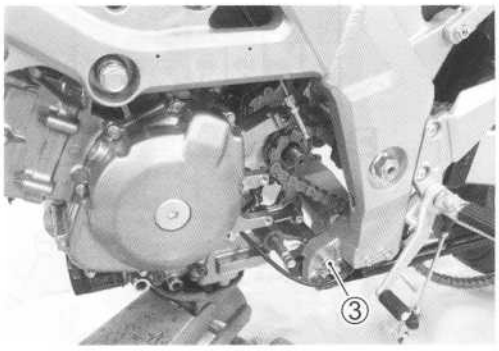


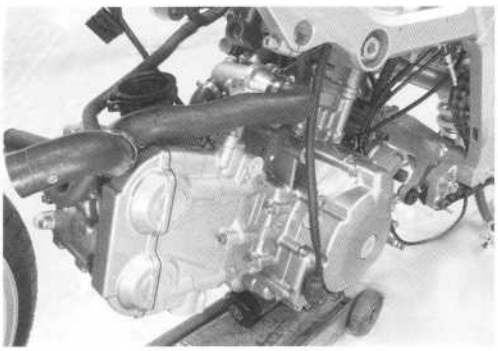


- Remove the engine mounting bolt ③ and lower the engine.

CAUTION

Be careful not to contact the No.2 (Rear) exhaust pipe with the frame and swingarm.





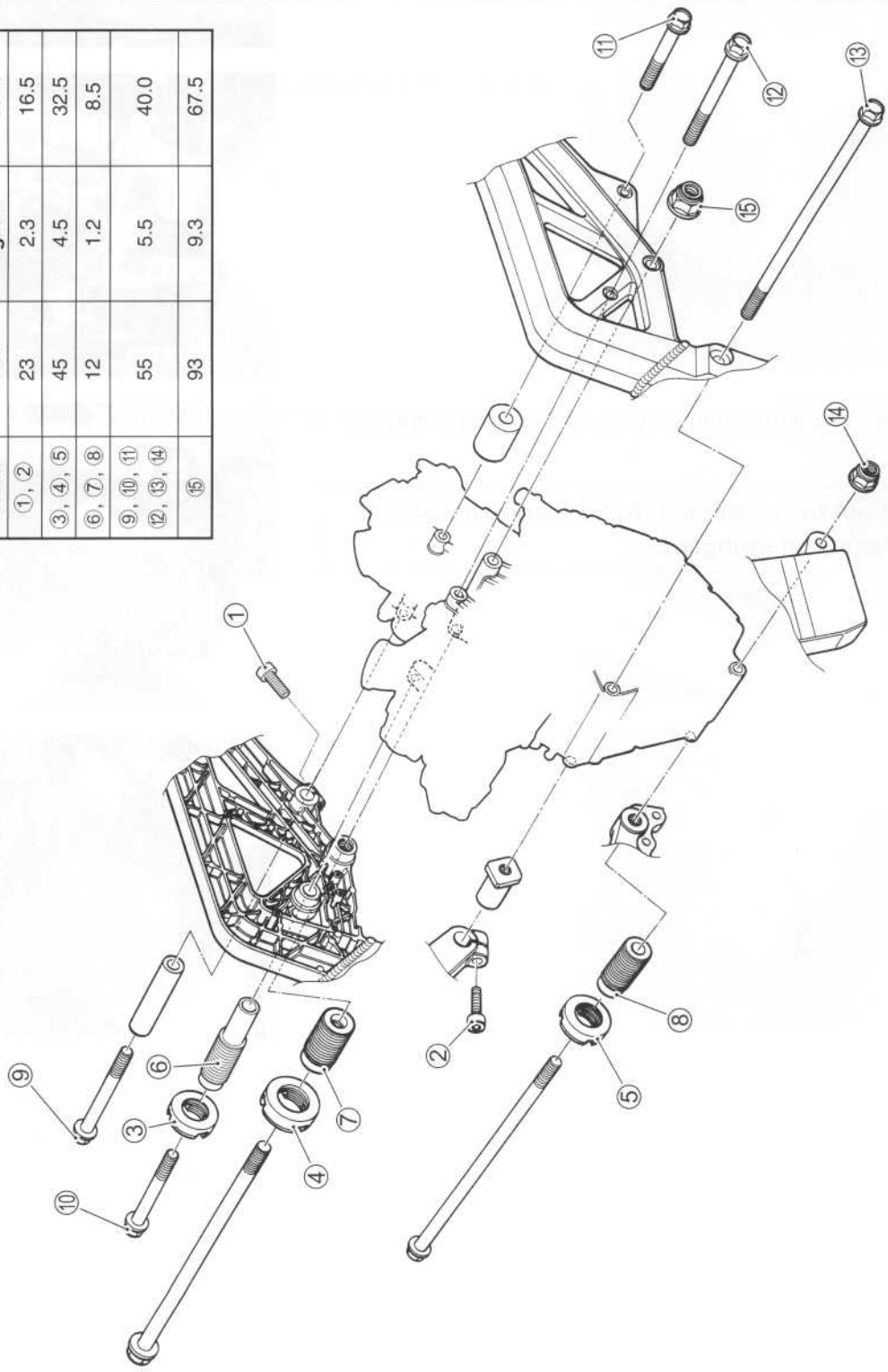
ENGINE INSTALLATION

Remount the engine in the reverse order of engine removal.
Pay attention to the following points:

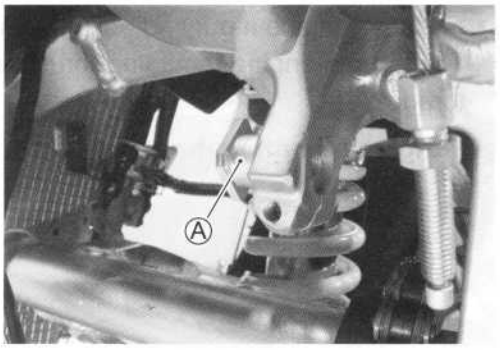
NOTE:

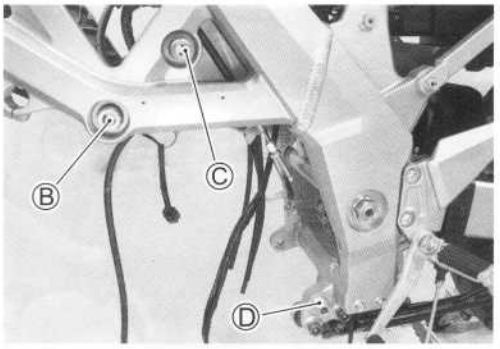
* *The engine mounting nuts are self-locking.*
* *Once the nut has been removed, it is no longer of any use. Be sure to use new nuts, and then tighten them to the specified torque.*

ITEM	N·m	kgf-m	lb-ft
①, ②	23	2.3	16.5
③, ④, ⑤	45	4.5	32.5
⑥, ⑦, ⑧	12	1.2	8.5
⑨, ⑩, ⑪ ⑫, ⑬, ⑭	55	5.5	40.0
⑮	93	9.3	67.5

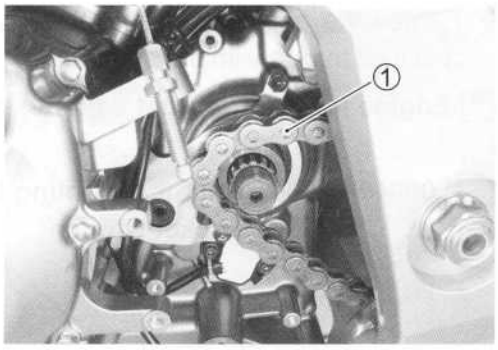


- Before installing the engine assembly, install the collar Ⓐ and engine thrust adjusters Ⓑ, Ⓒ, Ⓓ.



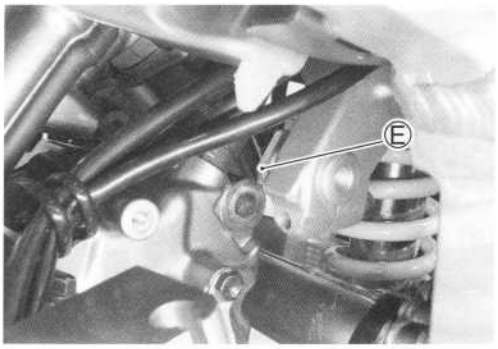


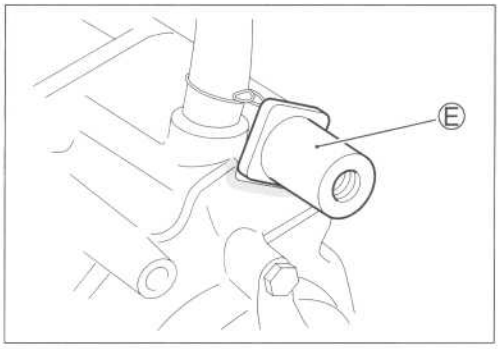
- Gradually raise the rear side of the engine assembly, and then put the drive chain ① on the driveshaft.



- Align the collar Ⓔ to the crankcase groove.
- Install all engine mounting bolts and tighten them temporarily.

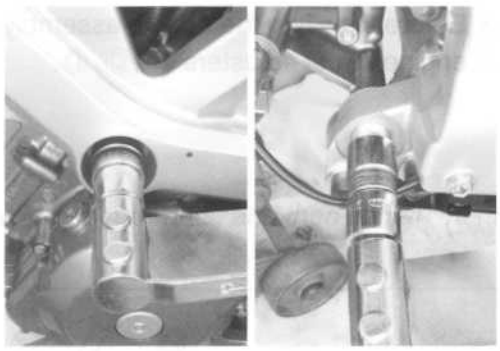
NOTE:
Install the collar Ⓔ onto the crankcase properly as shown in the illustration.





- Install all engine mounting bolts and spacers temporarily.
- Tighten the engine mounting thrust adjusters to the specified torque.

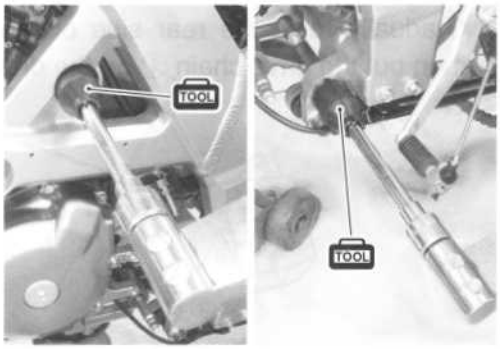
Engine mounting thrust adjuster: 12 N·m (1.2 kgf-m, 8.5 lb-ft)

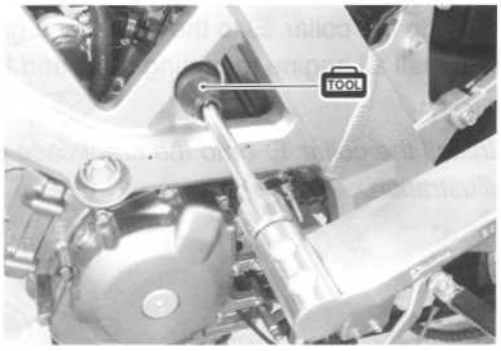


- Tighten the engine mounting thrust adjuster locknuts to the specified torque with the special tool.

Engine mounting thrust adjuster locknut: 45 N·m (4.5 kgf-m, 32.5 lb-ft)

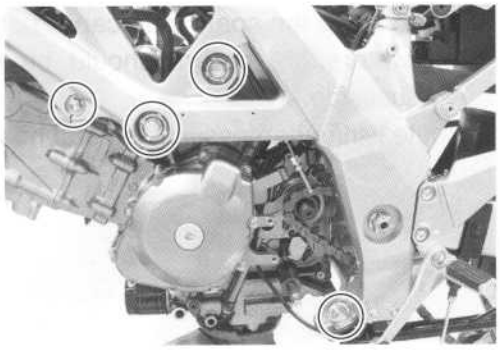
09940-14990: Engine mounting thrust adjuster socket wrench

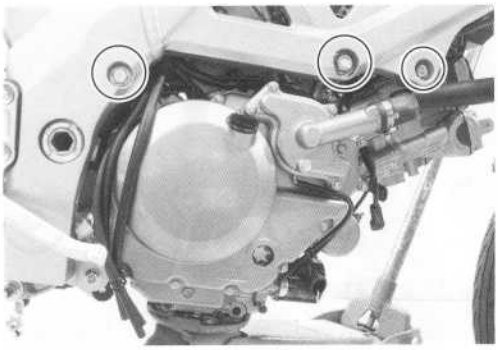




- Tighten all engine mounting bolts or nuts to the specified torque. (☞3-14)

NOTE:
The engine mounting nuts are self-locking. Once the nuts have been removed, they are no longer of any use.

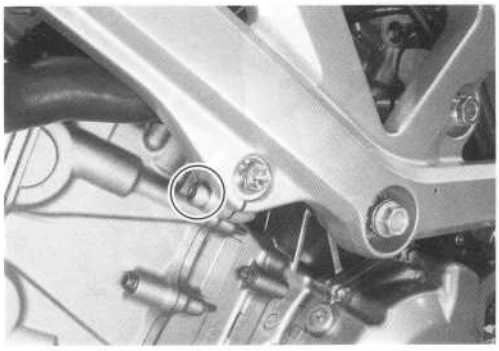


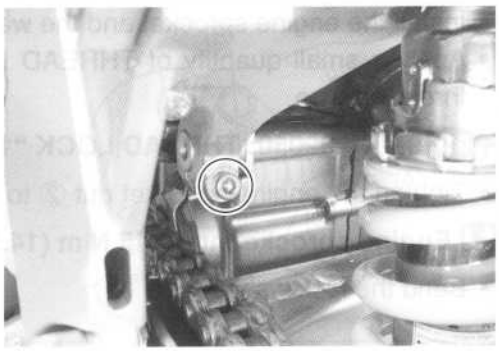


- Tighten all engine mounting clamp bolts to the specified torque. (☞3-14)

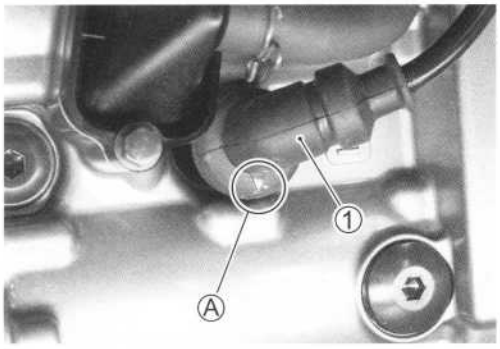
NOTE:
After tightening the engine mounting bolt or nut to the specified torque, tighten its clamp bolt.

Engine mounting clamp bolt: 23 N·m (2.3 kgf-m, 16.5 lb-ft)

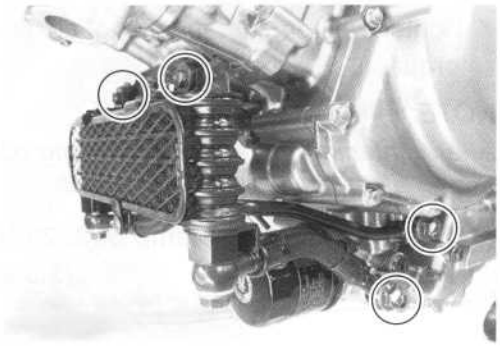




- When fitting the spark plug caps ①, the triangle marks Ⓐ on the water-proof covers should be faced to each cylinder exhaust side.
- Route wiring harness, cables and hoses properly. (☞9-14)



- Install the oil cooler. (☞6-22)



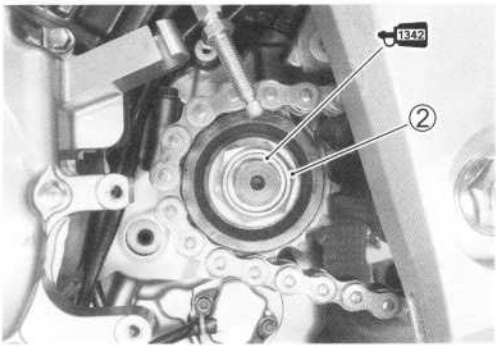
- Install the engine sprocket and the washer.
- Apply a small quantity of THREAD LOCK to the drive shaft thread portion.

1342 99000-32050: THREAD LOCK "1342"

- Tighten the engine sprocket nut ② to the specified torque.

Engine sprocket nut: 145 N·m (14.5 kgf-m, 105 lb-ft)

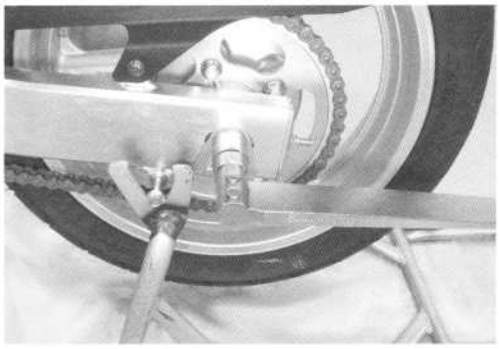
- Bend the lock washer.



- Adjust the drive chain slack. (☞2-24)
- Tighten the rear axle nut to the specified torque.

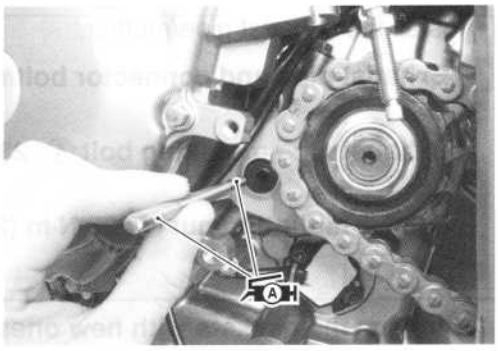
Rear axle nut: 100 N·m (10.0 kgf-m, 72.5 lb-ft)

- Install the cotter pin. (For E-03, 28, 33)



- Apply SUZUKI SUPER GREASE to the clutch push rod and install it.

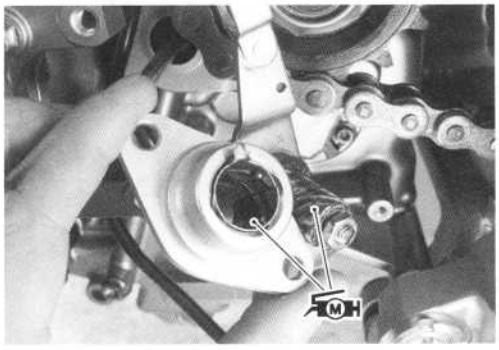
99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)



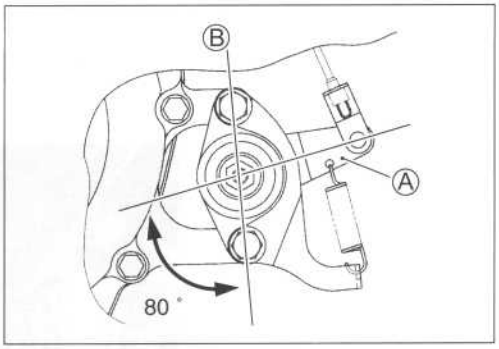
- Install the clutch cable to the generator cover temporarily.

- Apply SUZUKI MOLY PASTE to the clutch release.

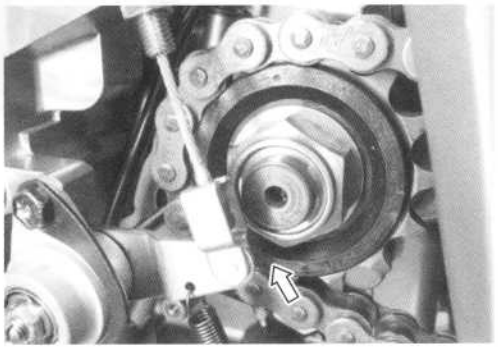
99000-25140: SUZUKI MOLY PASTE



- Assemble the clutch release so that the lever arm Ⓐ will be angle of 80 degree with axle Ⓑ.
- Adjust the clutch cable play. (☞2-19)



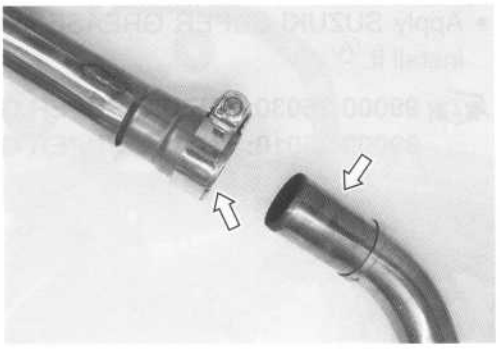
NOTE:
After installing the clutch release, make sure that there is clearance between the clutch cable end and the driveshaft end.



- Adjust the gearshift lever height. (☞2-19)

- Install the exhaust pipe/muffler.

Exhaust pipe and connector bolt/nut ③: 23 N·m (2.3 kgf-m, 16.5 lb-ft)
Exhaust pipe mounting bolt ④: 23 N·m (2.3 kgf-m, 16.5 lb-ft)
Muffler mounting nut ⑤: 23 N·m (2.3 kgf-m, 16.5 lb-ft)

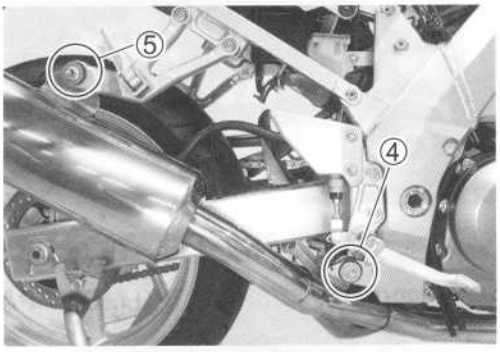


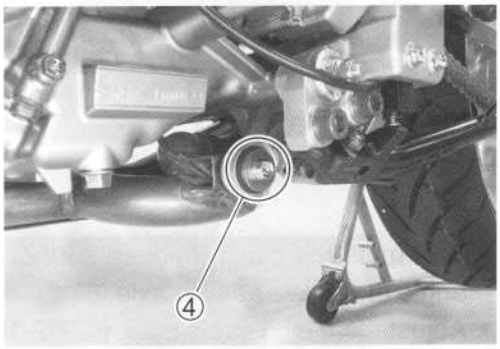
CAUTION

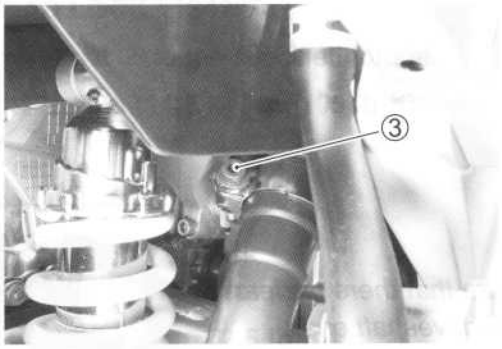
Replace the gaskets with new ones.

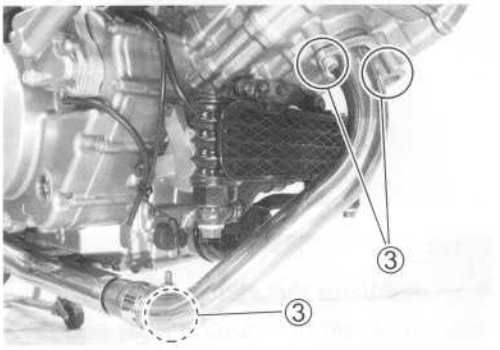
NOTE:
Apply gas sealer to inside and outside of the exhaust pipe connector.

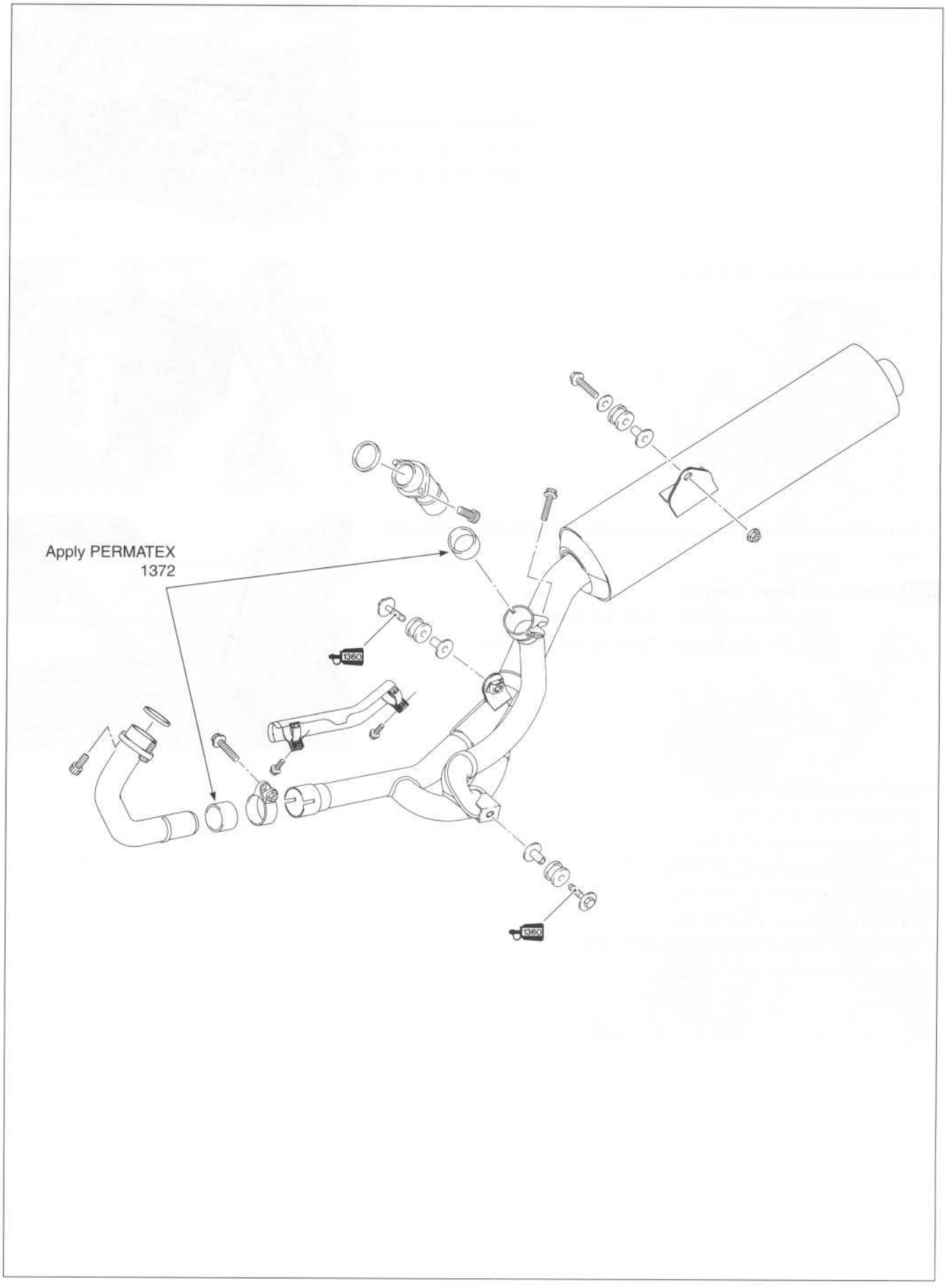
EXHAUST GAS SEALER: PERMATEX 1372





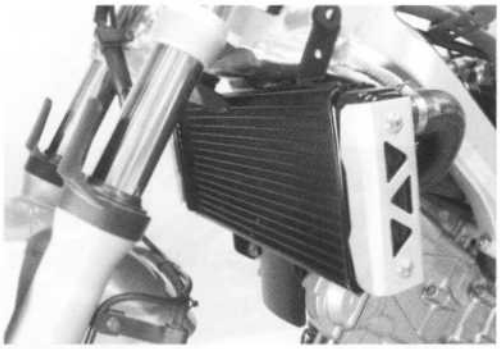





Apply PERMATEX
1372
1360
1360

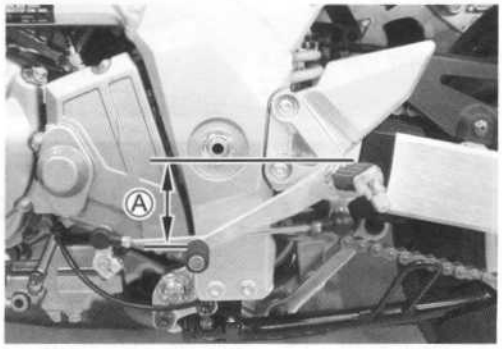
- Install the throttle body. (☞5-29)

- Install the radiator. (☞6-6)



- Install the gearshift lever and adjust the gearshift lever height Ⓐ.

DATA Gearshift lever height:
50 – 60 mm (1.97 – 2.36 in) for SV650
60 – 70 mm (2.36 – 2.76 in) for SV650S



- Adjust the following items.
* Engine oil (☞2-14)
* Engine coolant (☞2-20)
* Throttle cable play (☞2-17)
* Clutch cable play (☞2-19)
* Idling adjustment (☞2-16)
* Throttle body synchronization (☞5-33)
* Drive chain slack (☞2-22)

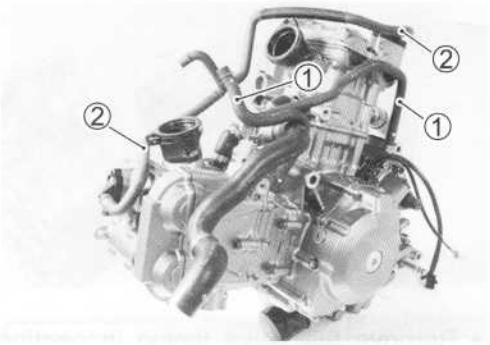
ENGINE DISASSEMBLY

ENGINE TOP SIDE

CAUTION

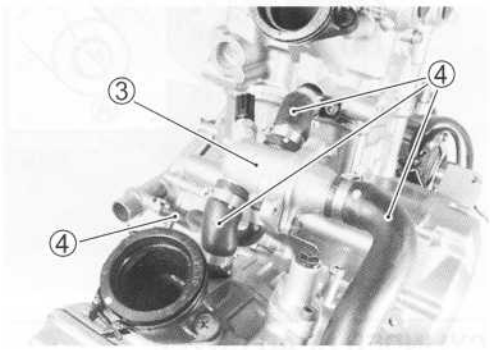
Identify the position of each removed part. Organize the parts in their respective groups (e.g., intake, exhaust) so that they can be reinstalled in their original positions.

- Remove the spark plugs. (☞2-6)
- Disconnect the crankcase breather hoses ①.
- Disconnect the PAIR hoses ②.

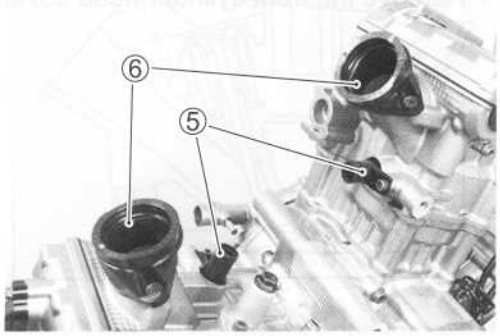


- Remove the thermostat case ③ along with the hoses ④.

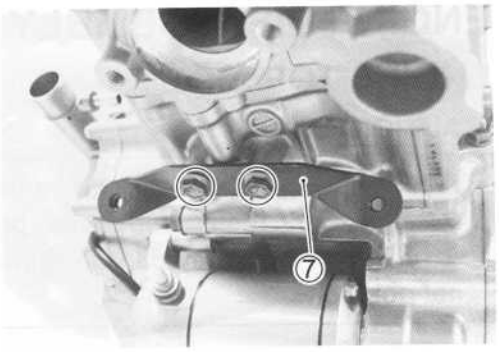
NOTE:
Refer to the section 5 for their servicing.



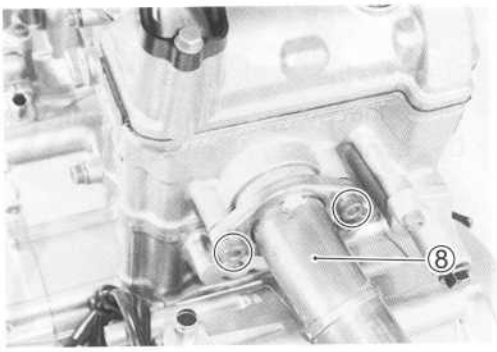
- Remove the water unions ⑤ and intake pipes ⑥.



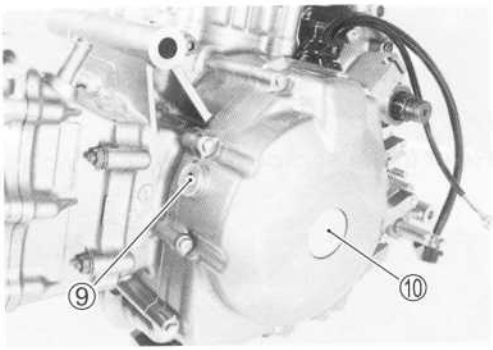
- Remove the oil cooler bracket ⑦.



- Remove the rear exhaust pipe ⑧ and gasket.

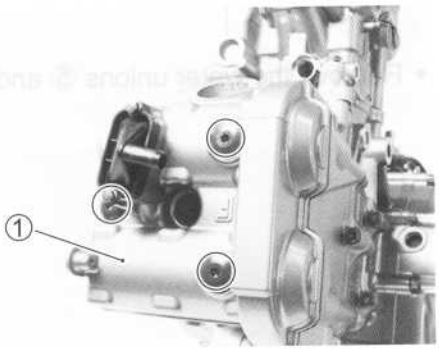


- Remove the valve timing inspection plug ⑨ and generator cover plug ⑩.

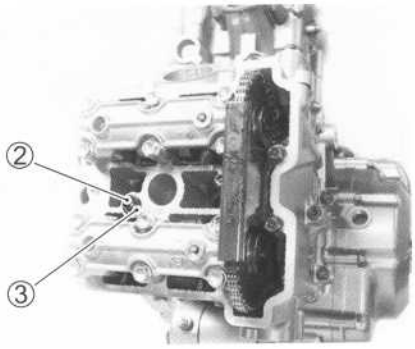


CYLINDER HEAD COVER

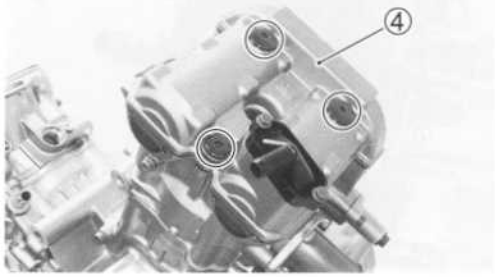
- Remove the front cylinder head cover ①.



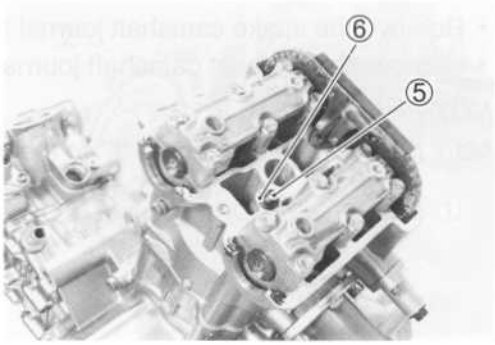
- Remove the dowel pin ② and O-ring ③.



- Remove the rear cylinder head cover ④.

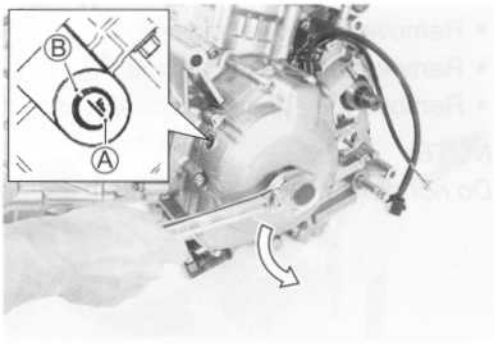


- Remove the dowel pin ⑤ and O-ring ⑥.



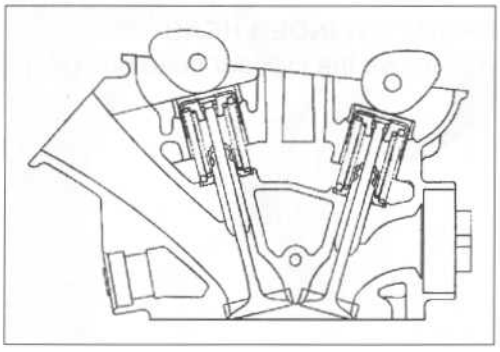
FRONT CAMSHAFTS

- Turn the crankshaft to bring the "| F" line Ⓐ on generator rotor to the index mark Ⓑ of the valve inspection hole and also to bring the cams to the position as shown in illustration.

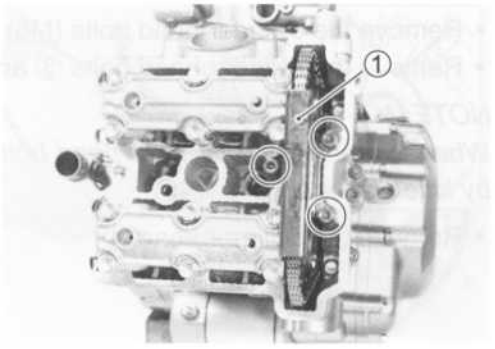


NOTE:

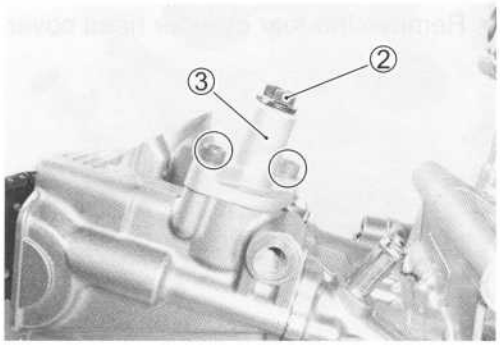
* *At the above condition, the front cylinder is at TDC of compression stroke.*
* *Before removing the camshafts, inspect the tappet clearance. (☞2-9)*



- Remove the cam chain guide ①.

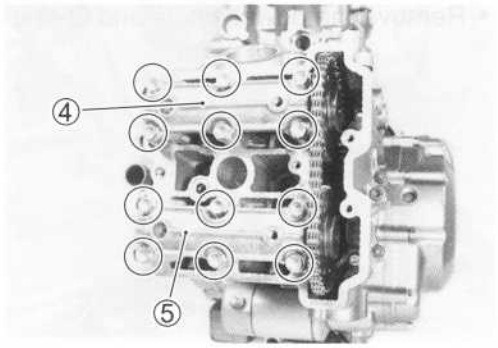


- Remove the spring holder bolt ②, spring and gasket.
- Remove the cam chain tension adjuster ③.



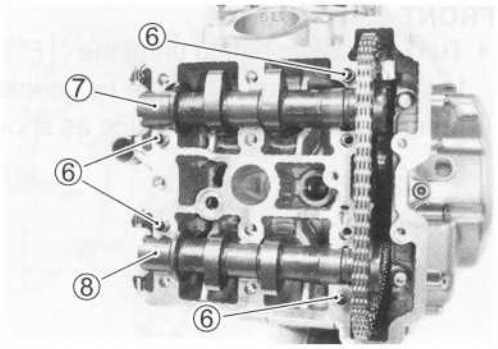
- Remove the intake camshaft journal holder ④.
- Remove the exhaust camshaft journal holder ⑤.

NOTE:
Mark the cylinder location as "F" to the camshaft journal holders.



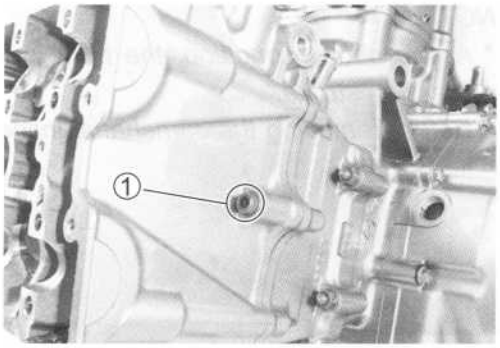
- Remove the dowel pins ⑥.
- Remove the intake camshaft ⑦.
- Remove the exhaust camshaft ⑧.

NOTE:
Do not drop the dowel pins into the crankcase.



FRONT CYLINDER HEAD

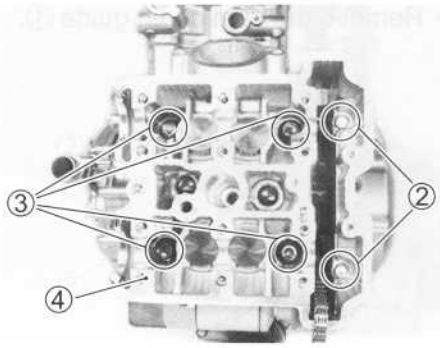
- Remove the cylinder head bolt (M6) ①.



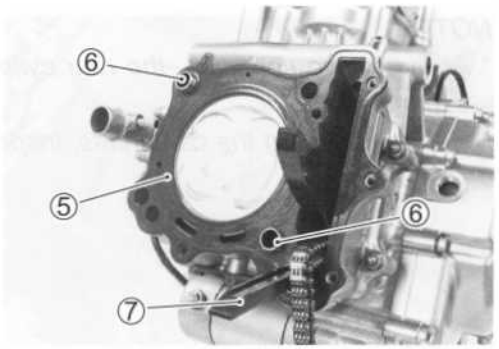
- Remove the cylinder head bolts (M6) ②.
- Remove the cylinder head bolts ③ and washers.

NOTE:
When loosening the cylinder head bolts, loosen each bolt little by little diagonally.

- Remove the cylinder head ④.

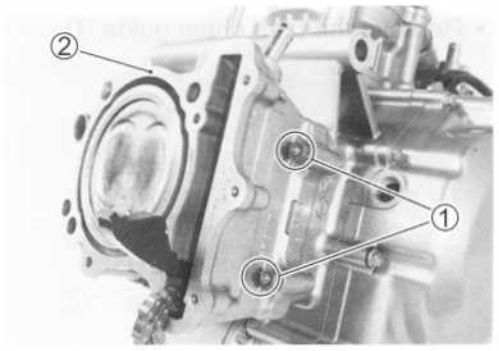


- Remove the cylinder head gasket ⑤, dowel pins ⑥ and cam chain guide ⑦.



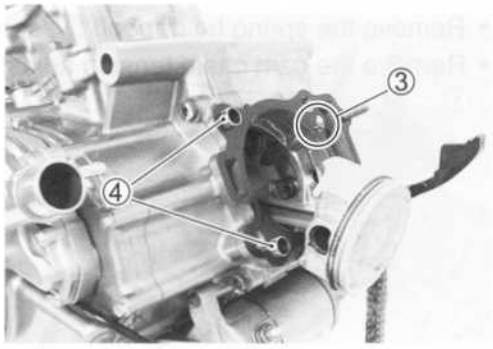
FRONT CYLINDER

- Remove the cylinder nuts ①.
- Remove the cylinder ②.



- Remove the cylinder base gasket ③ and dowel pins ④.

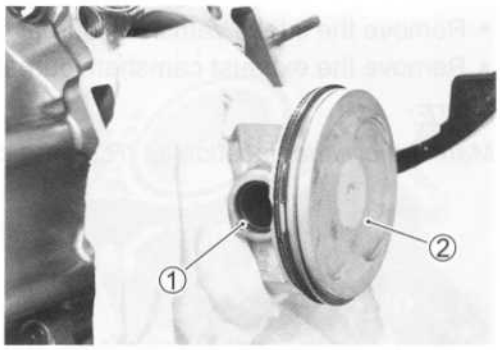
NOTE:
Make sure that the oil jet is inserted in the crankcase.



FRONT PISTON

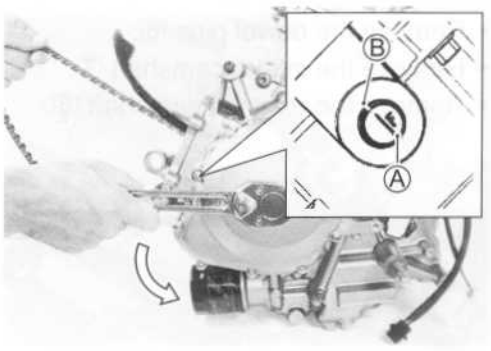
- Place a clean rag over the cylinder base so as not to drop the piston pin circlip into the crankcase.
- Remove the piston pin circlip ①.
- Remove the piston ② by driving out the piston pin.

NOTE:
Scribe the cylinder number on the head of the piston.

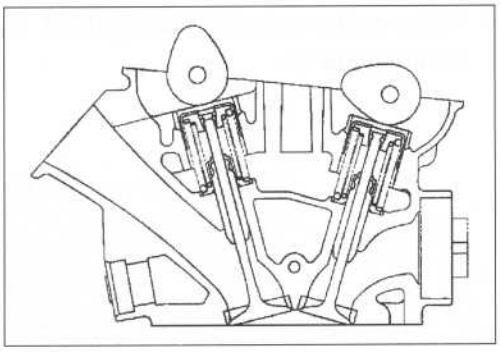


REAR CAMSHAFTS

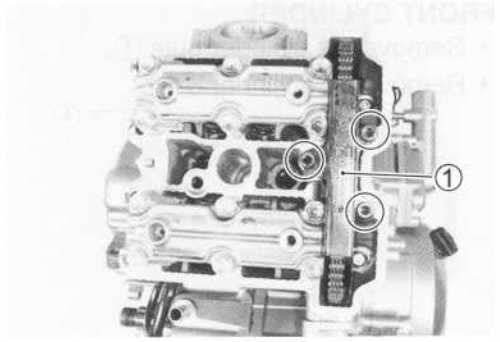
- Rotate the generator 360 degrees (1 turn) counterclockwise and align the "| F" line Ⓐ on the generator rotor with the index mark Ⓑ of the valve timing inspection hole.



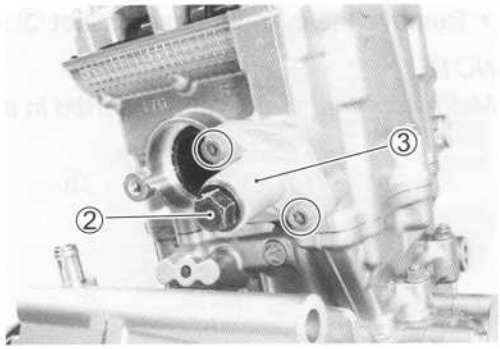
NOTE:
* *At the above condition, the rear cylinder is at ATDC 90 ° on expansion stroke.*
* *Before removing the camshafts, inspect the tappet clearance. (☞2-9)*



- Remove the cam chain guide ①.

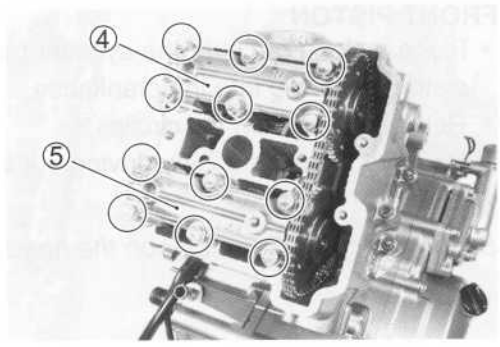


- Remove the spring holder bolt ②, spring and gasket.
- Remove the cam chain tension adjuster ③.

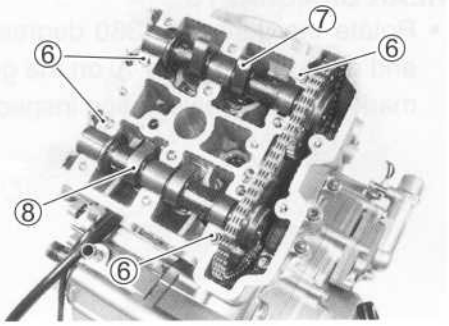


- Remove the intake camshaft journal holder ④.
- Remove the exhaust camshaft journal holder ⑤.

NOTE:
Mark the cylinder location as "R" to the camshaft journal holders.

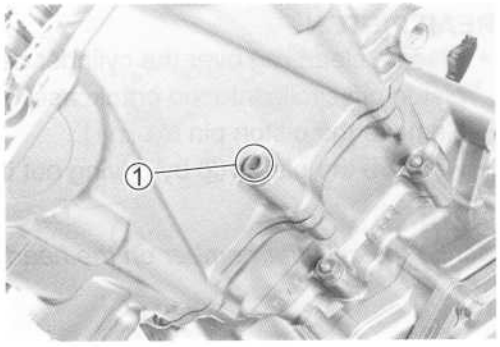


- Remove the dowel pins ⑥.
- Remove the intake camshaft ⑦.
- Remove the exhaust camshaft ⑧.



REAR CYLINDER HEAD

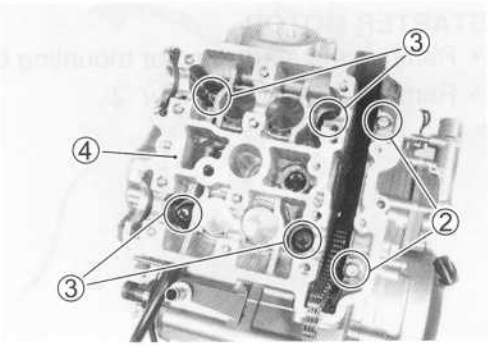
- Remove the cylinder head bolt (M6) ①.



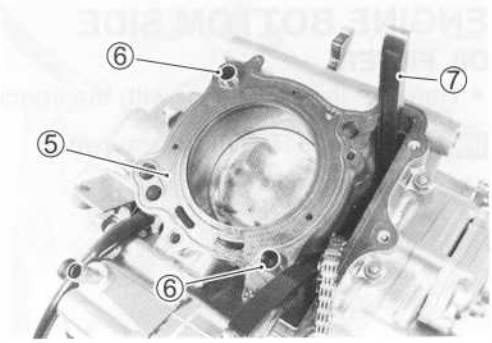
- Remove the cylinder bolts (M6) ②.
- Remove the cylinder head bolts ③ and washers.

NOTE:
When loosening the cylinder head bolts, loosen each bolt little by little diagonally.

- Remove the cylinder head ④.

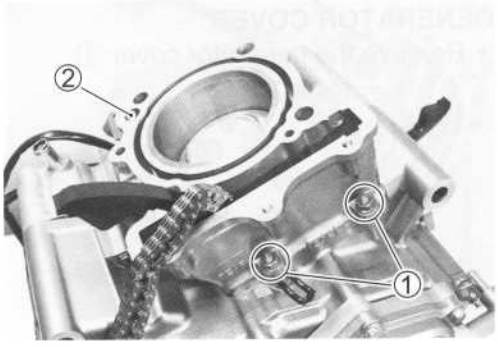


- Remove the cylinder head gasket ⑤, dowel pins ⑥ and cam chain guide ⑦.



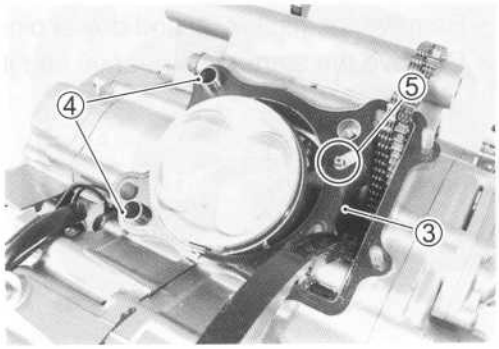
REAR CYLINDER

- Remove the cylinder nuts ① and clamp.
- Remove the cylinder ②.



- Remove the cylinder base gasket ③ and dowel pins ④.

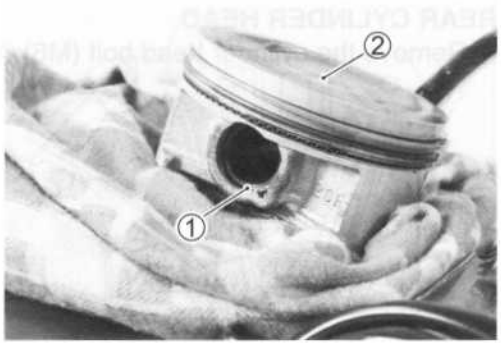
NOTE:
Make sure that the oil jet ⑤ is inserted in the crankcase.



REAR PISTON

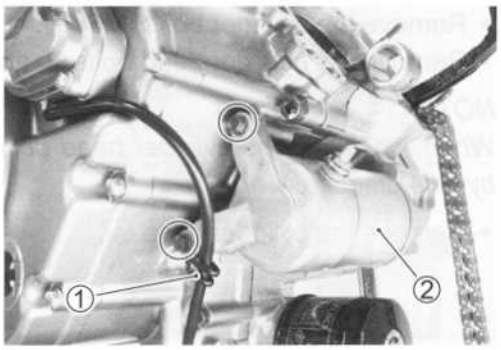
- Place a clean rag over the cylinder base so as not to drop the piston pin circlip into the crankcase.
- Remove the piston pin circlip ①.
- Remove the piston ② by driving out the piston pin.

NOTE:
Scribe the cylinder number on the head of the piston.



STARTER MOTOR

- Remove the starter motor mounting bolts and the clamp ①.
- Remove the starter motor ②.

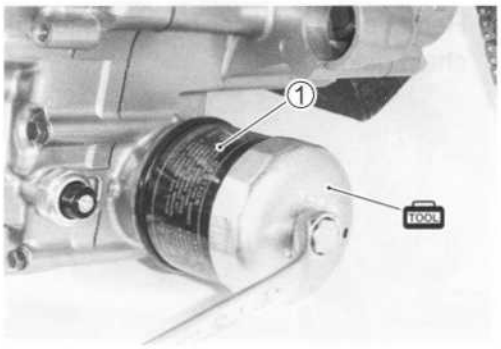


ENGINE BOTTOM SIDE

OIL FILTER

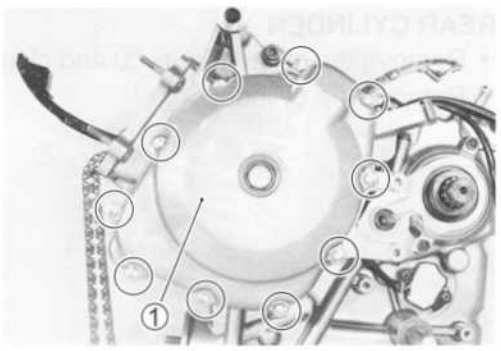
- Remove the oil filter ① with the special tool.

TOOL 09915-40610: Oil filter wrench

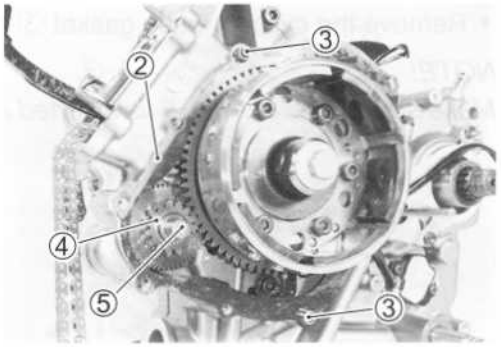


GENERATOR COVER

- Remove the generator cover ①.

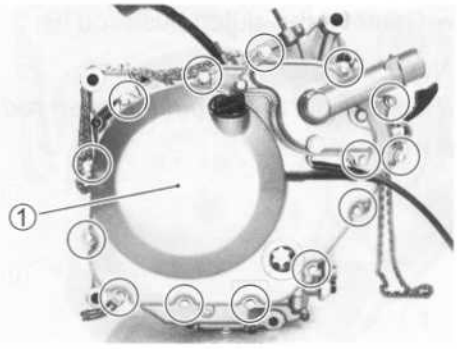


- Remove the gasket ② and dowel pins ③.
- Remove the starter idle gear ④ and its shaft ⑤.

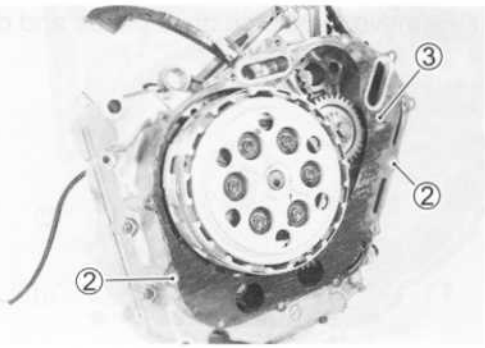


CLUTCH COVER

- Remove the clutch cover ①.



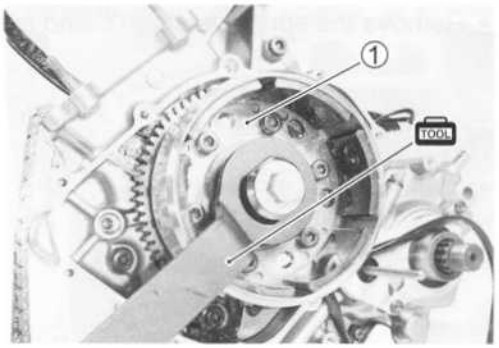
- Remove the dowel pins ② and gasket ③.



CLUTCH

- Hold the generator rotor ① with the special tool.

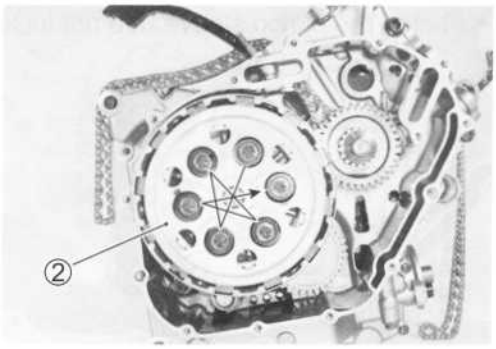
TOOL 09930-44530: Rotor holder



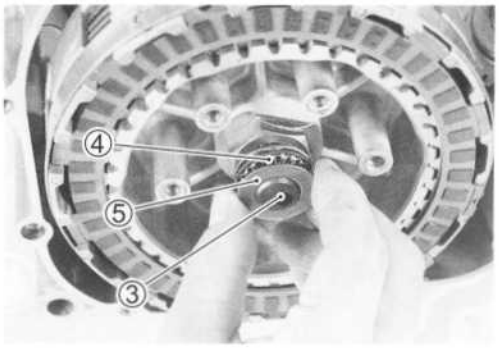
- Remove the clutch springs.

NOTE:
Loosen the clutch spring set bolts little by little and diagonally.

- Remove the pressure plate ②.

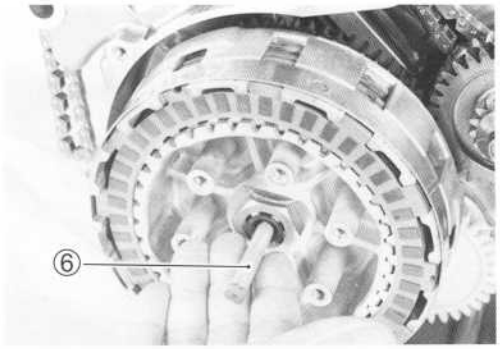


- Remove the clutch push piece ③, the bearing ④ and thrust washer ⑤.

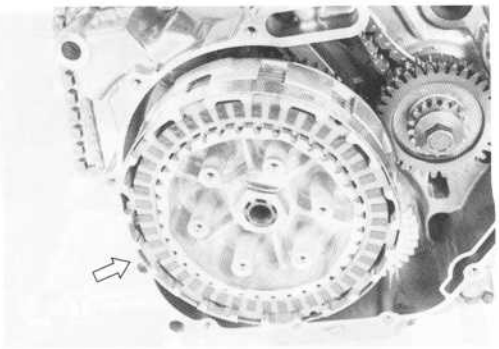


- Remove the clutch push rod ⑥.

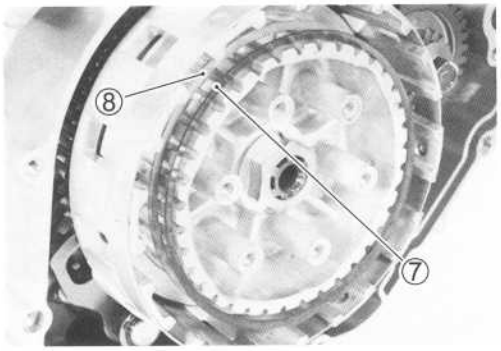
NOTE:
If it is difficult to pull out the push rod ⑥, use a magnetic hand or a wire.



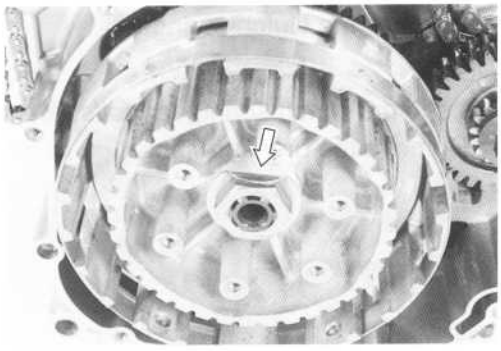
- Remove the clutch drive plates and driven plates.



- Remove the spring washer ⑦ and spring washer seat ⑧.



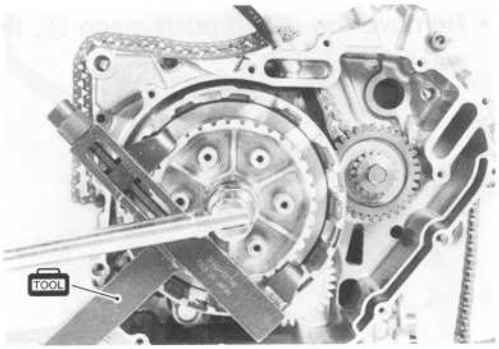
- Flatten the clutch sleeve hub nut lock washer.



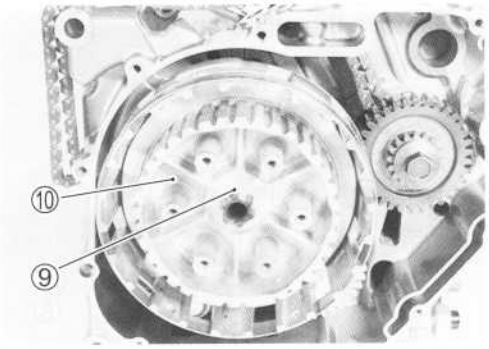
- Hold the clutch sleeve hub with the special tool.

TOOL 09920-53740: Clutch sleeve hub holder

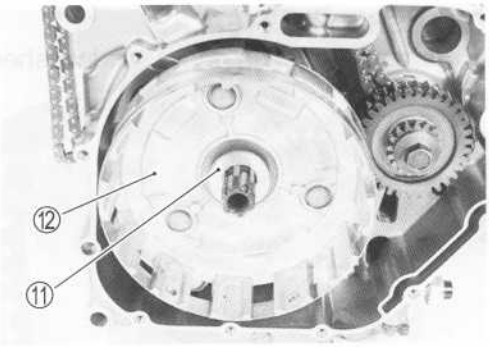
- Remove the clutch sleeve hub nut.



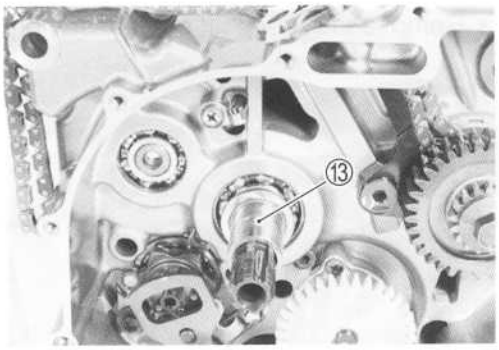
- Remove the lock washer ⑨.
- Remove the clutch sleeve hub ⑩.



- Remove the thrust washer ⑪.
- Remove the primary driven gear assembly ⑫.



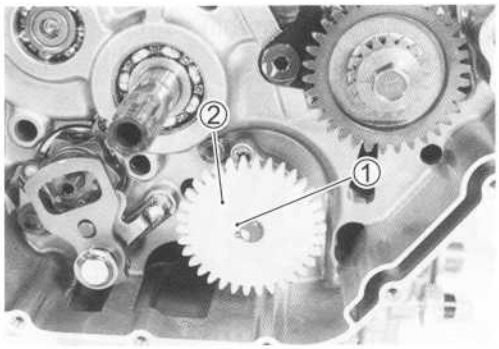
- Remove the spacer ⑬.



OIL PUMP

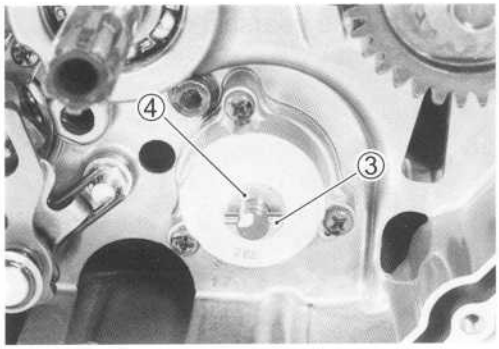
- Remove the snap ring ①.
- Remove the oil pump driven gear ②.

NOTE:
Do not drop the snap ring ① into the crankcase.

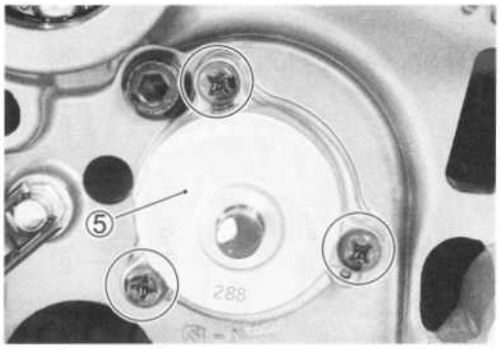


- Remove the pin ③ and the washer ④.

NOTE:
Do not drop the pin ③ and washer ④ into the crankcase.

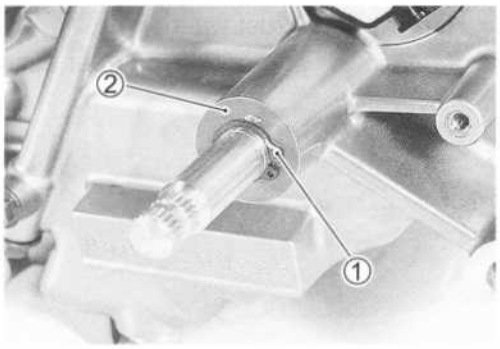


- Remove the oil pump ⑤.

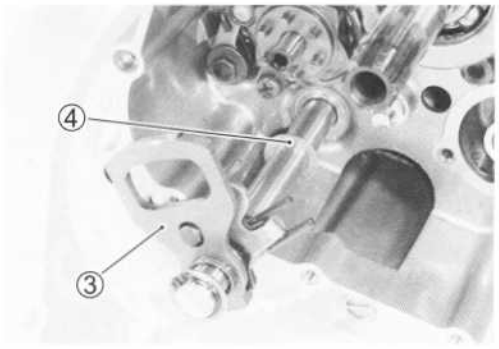


GEARSHIFT SYSTEM

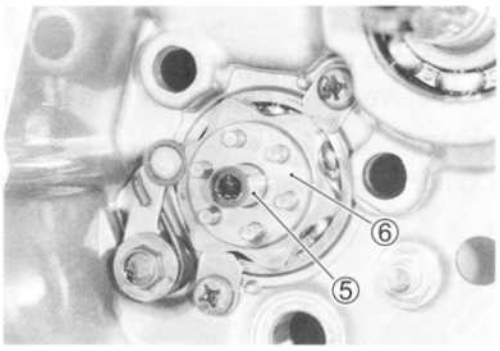
- Remove the snap ring ① and washer ②.



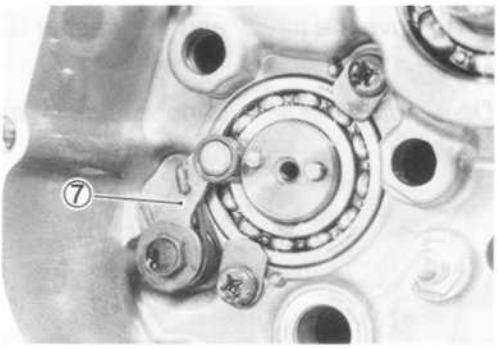
- Remove the gearshift shaft assembly ③ and washer ④.



- Remove the gearshift cam plate bolt ⑤.
- Remove the gearshift cam plate ⑥.

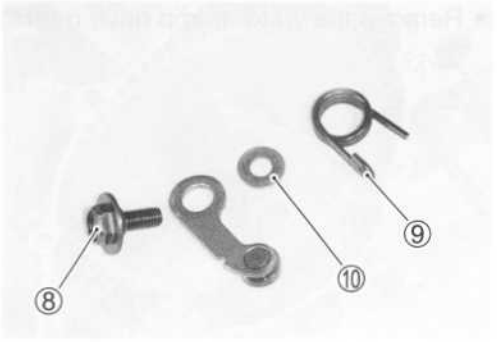


- Remove the gearshift cam stopper ⑦.



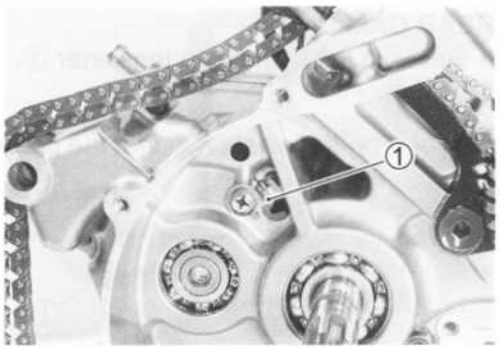
- Remove the following parts.

⑧ Gearshift cam stopper bolt
⑨ Gearshift cam stopper spring
⑩ Washer

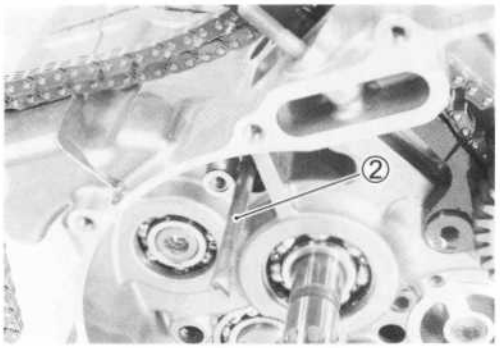


OIL PIPE

- Remove the oil pipe stopper ①.



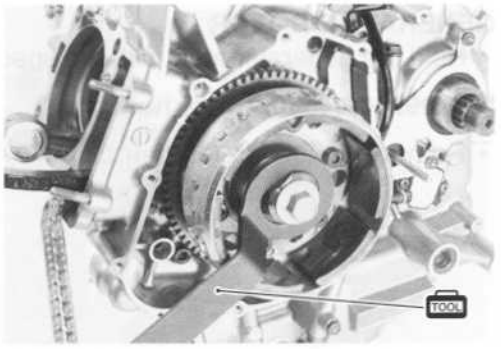
- Remove the oil pipe ②.



PRIMARY DRIVE GEAR

- Hold the generator rotor with the special tool.

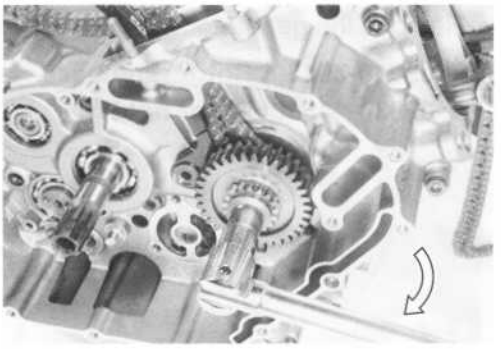
TOOL 09930-44530: Rotor holder



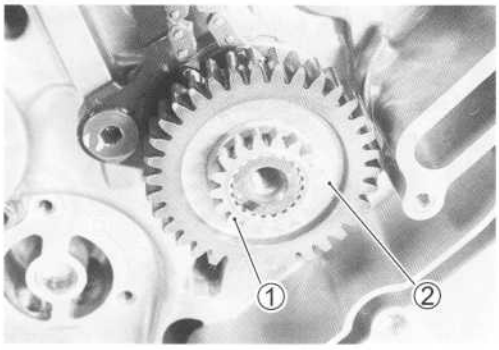
- Remove the primary drive gear bolt.

CAUTION

This bolt has left-hand thread. Turning it counter-clockwise may cause damage.



- Remove the water pump drive gear ① and primary drive gear ②.

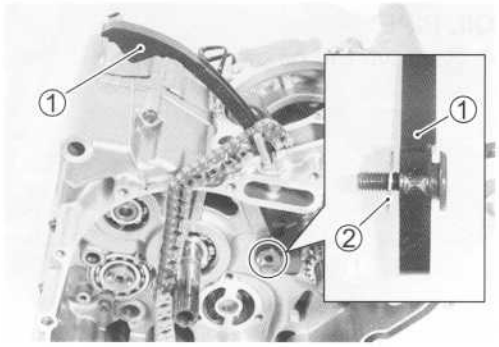


REAR CAM CHAIN

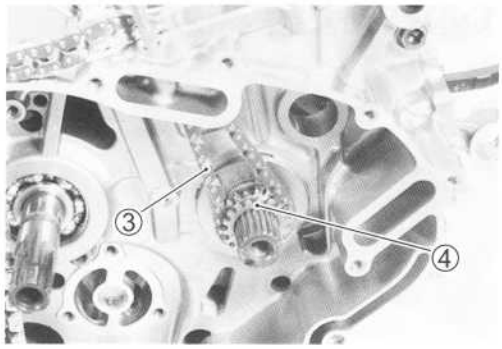
- Remove the cam chain tensioner ①.

NOTE:

Do not drop the washer ② into the crankcase.



- Remove the rear cam chain ③ and cam chain drive sprocket ④.

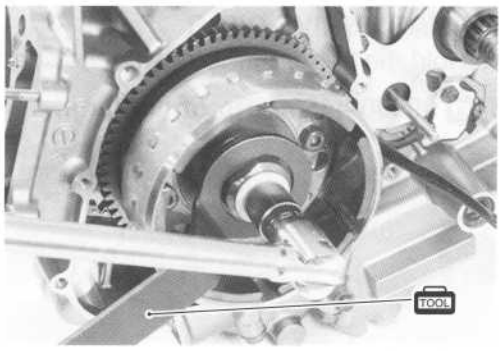


GENERATOR ROTOR

- Hold the generator rotor with the special tool.

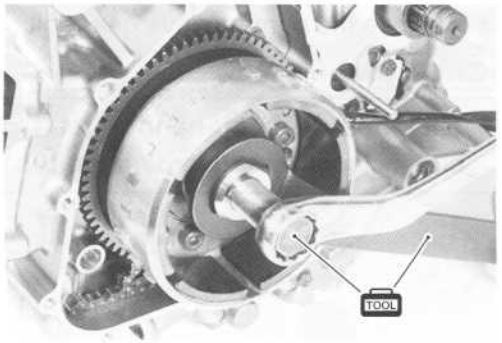
TOOL **09930-44530: Rotor holder**

- Remove the generator rotor bolt ①.

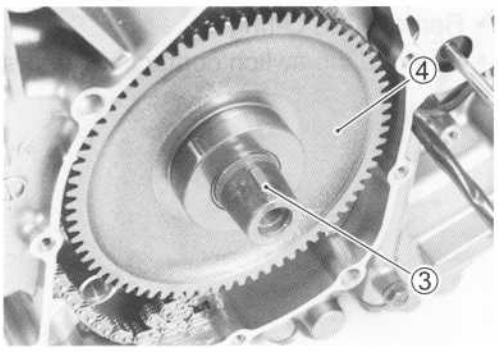


- Remove the generator rotor ② with the special tools.

TOOL **09930-30450: Rotor remover**
09930-44530: Rotor holder



- Remove the key ③.
- Remove the starter driven gear ④.

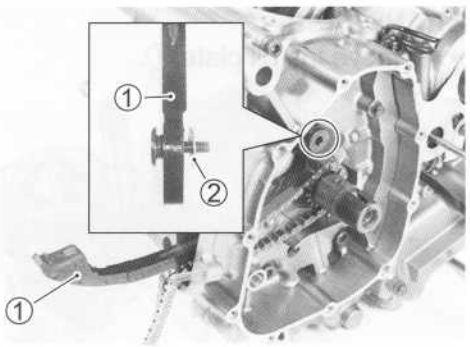


FRONT CAM CHAIN

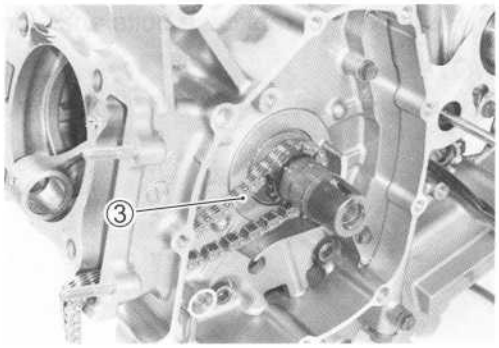
- Remove the cam chain tensioner ①.

NOTE:

Do not drop the washer ② into the crankcase.

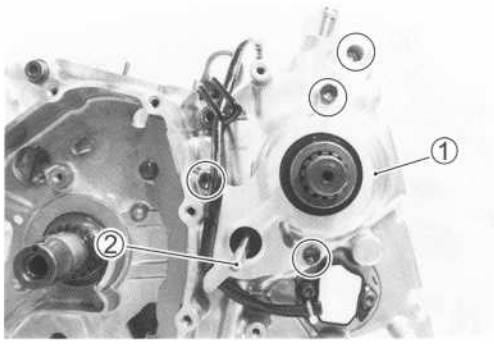


- Remove the front cam chain ③.

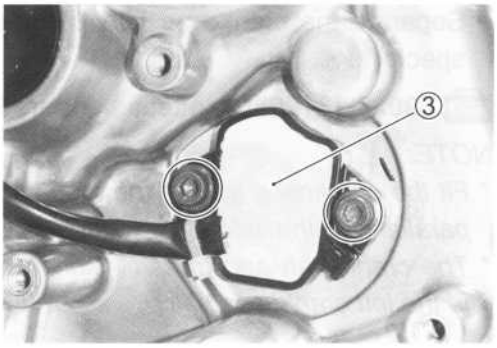


GEAR POSITION SWITCH

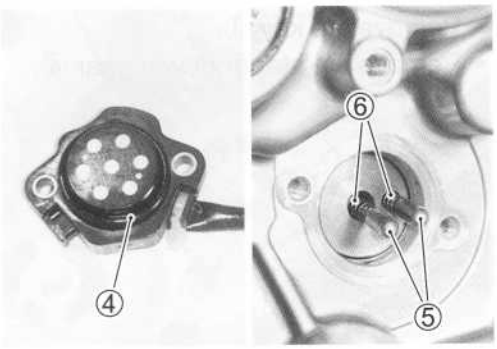
- Remove the driveshaft oil seal retainer ①.
- Remove the push rod ②.



- Remove the gear position switch ③.

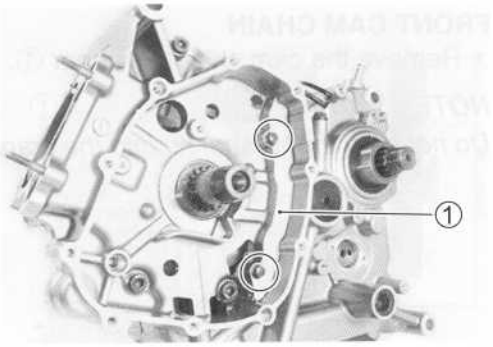


- Remove the O-ring ④.
- Remove the switch contacts ⑤ and springs ⑥.



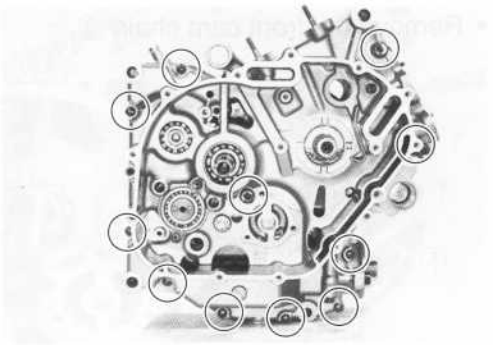
CRANKCASE

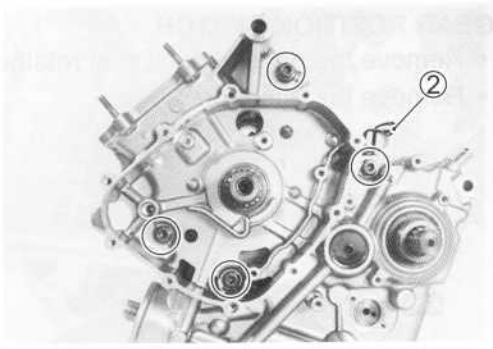
- Remove the oil plate ①.



- Remove the crankcase bolts and clamp ②.

NOTE:
Loosen the crankcase bolts diagonally and smaller sizes first.

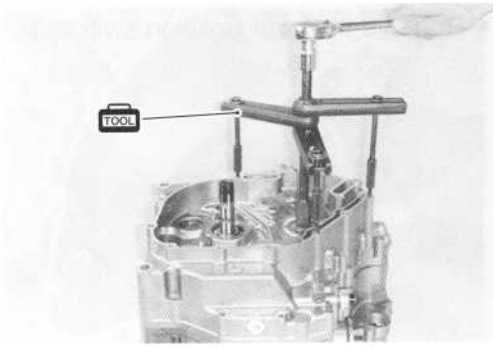




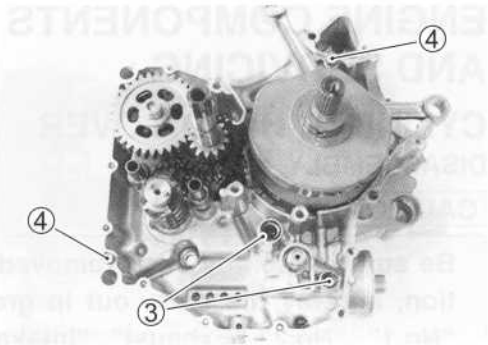
- Separate the crankcase into 2 parts, right and left with the special tool.

TOOL 09920-13120: Crankcase separating tool

NOTE:
* *Fit the crankcase separating tool, so that the tool arms are in parallel with the side of crankcase.*
* *The crankshaft and transmission components should remain in the left crankcase half.*

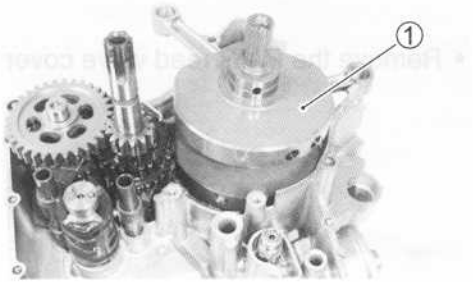


- Remove the O-rings ③ and dowel pins ④.



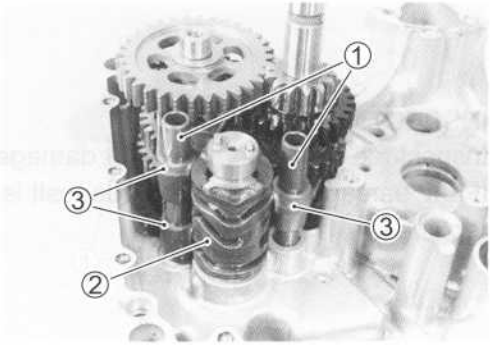
CRANKSHAFT

- Remove the crankshaft ①.

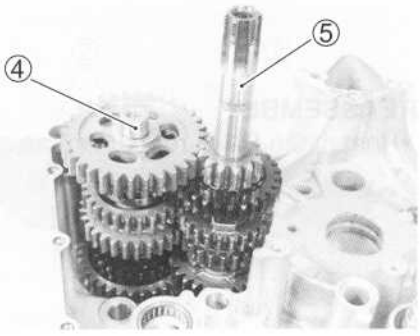


TRANSMISSION

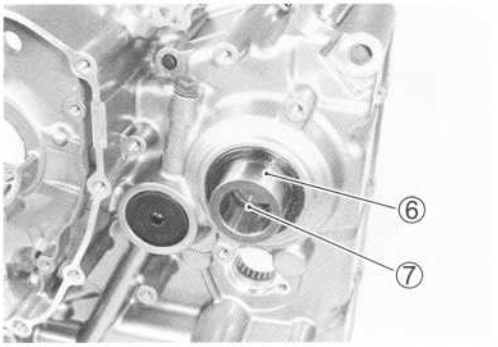
- Remove the gearshift fork shafts ①.
- Remove the gearshift cam ②.
- Remove the gear shift forks ③.



- Remove the driveshaft assembly ④ and countershaft assembly ⑤.



- Remove the engine sprocket spacer ⑥ and O-ring ⑦.



ENGINE COMPONENTS INSPECTION AND SERVICING

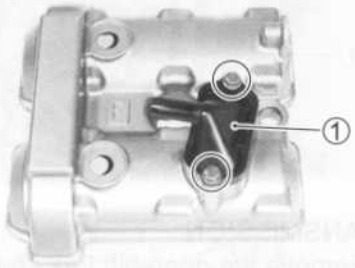
CYLINDER HEAD COVER

DISASSEMBLY

CAUTION

Be sure to identify each removed part as to its location, and lay the parts out in groups designated as "No.1", "No.2" "Exhaust", "Intake", so that each will be restored to the original location during assembly.

- Remove the PAIR reed valve cover ①.

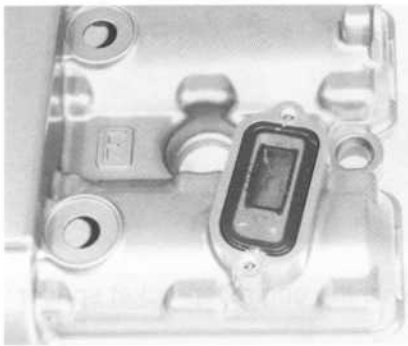


INSPECTION

Inspect the PAIR reed valve for damage and the carbon deposit. If any damage or the carbon deposit is found in the reed valve, replace it with a new one.

REASSEMBLY

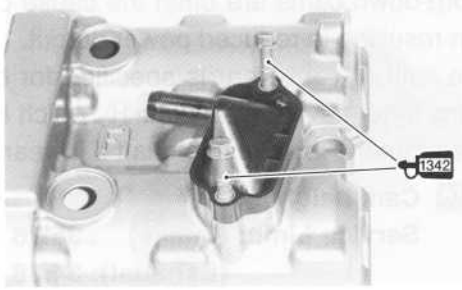
- Install the PAIR reed valve as shown.



- Apply THREAD LOCK to the bolts and then install the PAIR reed valve cover.

1342 99000-32050: THREAD LOCK "1342"

NOTE:
The inlet pipe of the PAIR reed valve cover must face left side of the engine.



CAMSHAFT/CAMSHAFT JOURNAL

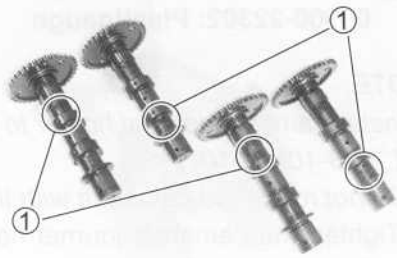
CAUTION

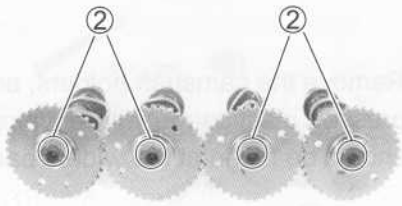
Be sure to identify each removed part as to its location, and lay the parts out in groups designated as "No.1", "No.2", "Exhaust", "Intake", so that each will be restored to the original location during assembly.

CAMSHAFT

- All camshafts should be checked for runout and also for wear of cams and journals if the engine has been noted as giving abnormal noise, vibration or lack power output. Any of these conditions may be caused by camshafts worn down or distorted to the service limit.
- The camshafts can be identified by the embossed letters ① and cords ② stamped on the camshaft ends.

	Letter ①	Cord ②
No.1 (Front) intake camshaft	INF	F
No.1 (Front) exhaust camshaft	EXF	G
No.2 (Rear) intake camshaft	INR	H
No.2 (Rear) exhaust camshaft	EXR	J

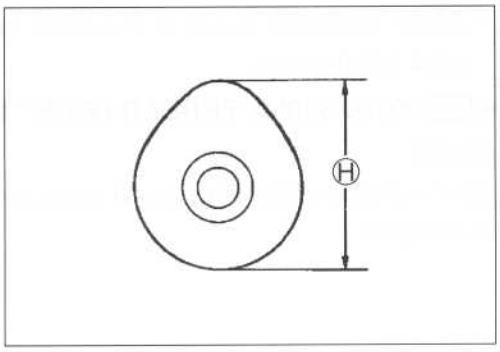




CAM WEAR

Worn-down cams are often the cause of mistimed valve operation resulting in reduced power output.

The limit of cam wear is specified for both intake and exhaust cams in terms of cam height Ⓗ, which is to be measured with a micrometer. Replace camshaft if it wears worn down to the limit.



DATA Cam height Ⓗ
Service Limit: (Intake) : 35.76 mm (1.408 in)
(Exhaust): 34.38 mm (1.354 in)

TOOL 09900-20202: Micrometer (25 – 50 mm)

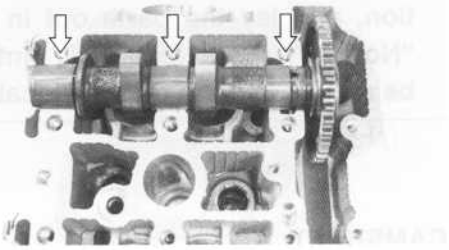
CAMSHAFT JOURNAL WEAR

Determine whether or not each journal is worn down to the limit by measuring the oil clearance with the camshaft installed in place.

- Use the plastigauge to read the clearance at the widest portion, which is specified as follows:

DATA Camshaft journal oil clearance
Service Limit (IN & EX): 0.150 mm (0.0059 in)

TOOL 09900-22301: Plastigauge
09900-22302: Plastigauge

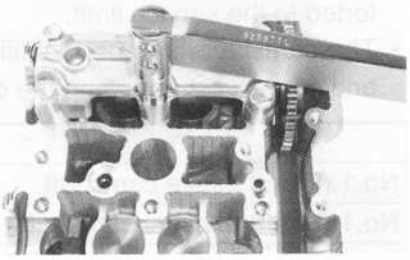


NOTE:

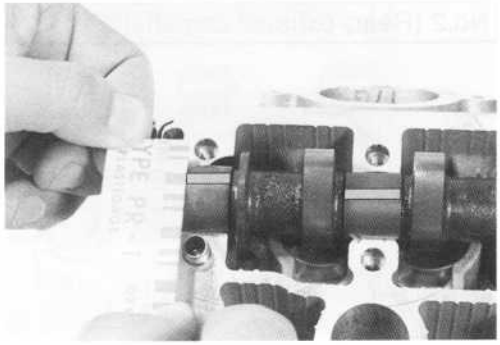
* *Install camshaft journal holder to their original positions. (☞3-103, 3-107)*
* *Do not rotate the camshaft with the plastigauge in place.*

- Tighten the camshaft journal holder bolts evenly and diagonally to the specified torque.

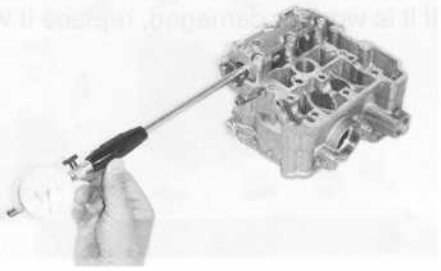
Camshaft journal holder bolt: 10 N·m
(1.0 kgf-m, 7.0 lb-ft)



- Remove the camshaft holders, and read the width of the compressed plastigauge with envelope scale. This measurement should be taken at the widest part.



If the camshaft journal oil clearance measured exceeds the limit, measure the inside diameter of the camshaft journal holder and outside diameter of the camshaft journal. Replace the camshaft or the cylinder head depending upon which one exceeds the specification.



DATA Journal holder I.D.
Standard (IN & EX): 22.012 – 22.025 mm (0.8666 – 0.8671 in)

TOOL 09900-20602: Dial gauge (1/1000, 1 mm)
09900-22403: Small bore gauge (18 – 35 mm)

DATA Camshaft journal O.D.
Standard (IN & EX): 21.959 – 21.980 mm (0.8645 – 0.8654 in)

TOOL 09900-20205: Micrometer (0 – 25 mm)

CAMSHAFT RUNOUT

Measure the runout using the dial gauge. Replace the camshaft if the runout exceeds the limit.

DATA Camshaft runout
Service Limit (IN & EX): 0.1 mm (0.004 in)

TOOL 09900-20607: Dial gauge (1/100 mm)
09900-20701: Magnetic stand
09900-21304: V-block set (100 mm)

CAM CHAIN TENSION ADJUSTER

Check that the push rod ① can slide smoothly with the lock ② of the ratchet mechanism released. If it does not slide smoothly or the ratchet mechanism is worn or damaged, replace the cam chain tension adjuster with a new one.

CAM CHAIN TENSIONER

Check the contacting surface of the cam chain tensioner. If it is worn or damaged, replace it with a new one.

CAM CHAIN GUIDE

Check the contacting surface of the cam chain guide.
If it is worn or damaged, replace it with a new one.

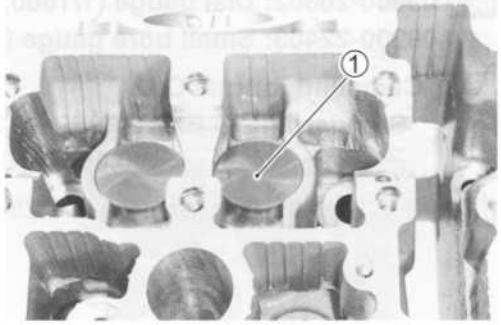
CYLINDER HEAD AND VALVE

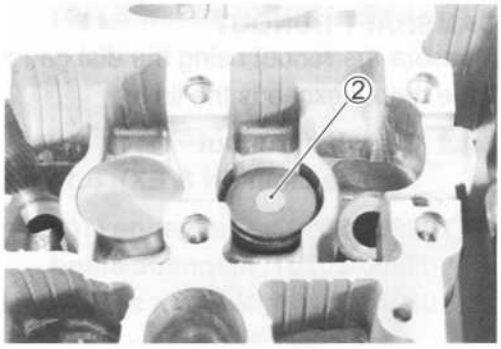
VALVE AND VALVE SPRING DISASSEMBLY

- Remove the tappets ① and shims ② by fingers or magnetic hand.

CAUTION

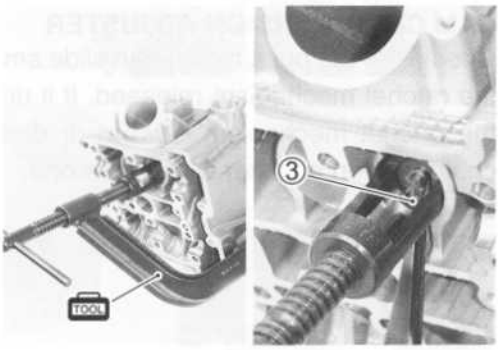
Identify the position of each removed part.





- Using special tools, compress the valve springs and remove the two cotter halves ③ from valve stem.

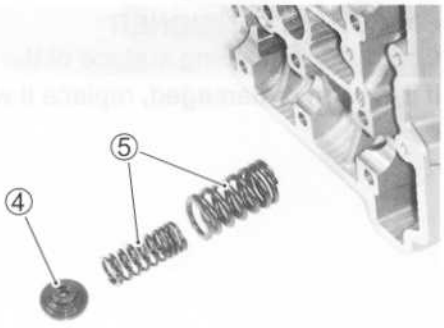
TOOL 09916-14510: Valve lifter
09916-14521: Valve lifter attachment
09916-84511: Tweezers



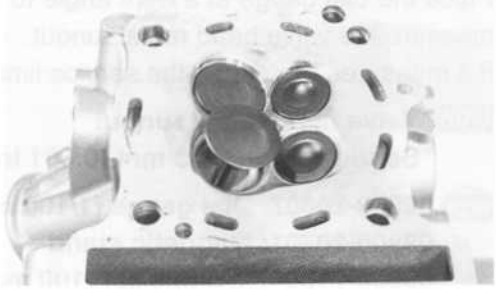
- Remove the valve spring retainer ④ and valve springs ⑤.

CAUTION

Be careful not to damage the tappet sliding surface with the special tool.



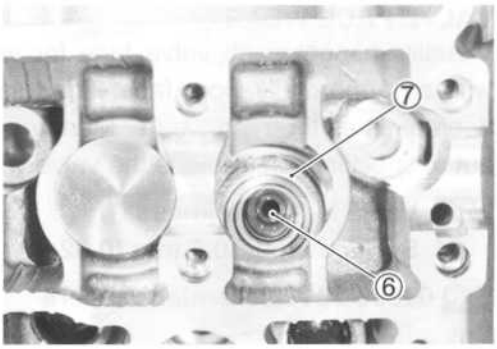
• Pull out the valve from the other side.



• Remove the oil seals ⑥ and spring seats ⑦.

CAUTION

Do not reuse the removed oil seals.



CYLINDER HEAD DISTORTION

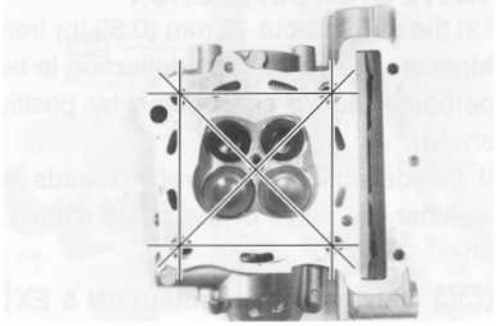
Decarbonize the combustion chambers.

Check the gasketed surface of the cylinder head for distortion with a straightedge and thickness gauge, taking a clearance reading at several places indicated.

If the largest reading at any position of the straightedge exceeds the limit, replace the cylinder head.

DATA Cylinder head distortion
Standard: 0.05 mm (0.002 in)

TOOL 09900-20803: Thickness gauge



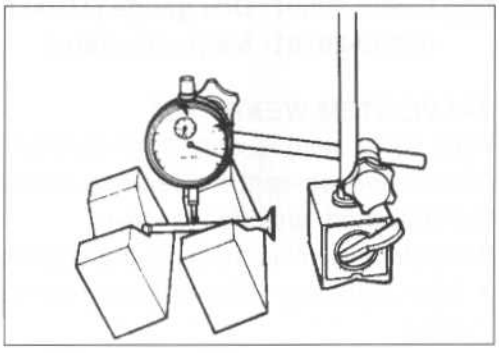
VALVE STEM RUNOUT

Support the valve using V-blocks and check its runout using the dial gauge as shown.

If the runout exceeds the service limit, replace the valve.

DATA Valve stem runout
Service Limit: 0.05 mm (0.002 in)

TOOL 09900-20607: Dial gauge (1/100 mm)
09900-20701: Magnetic stand
09900-21304: V-block set (100 mm)

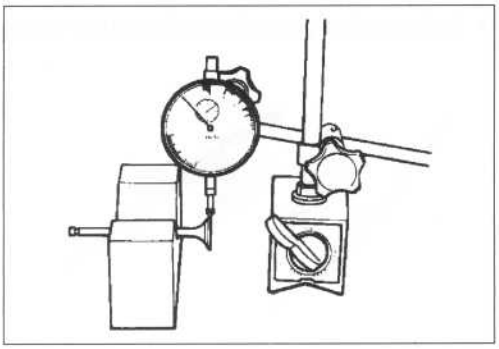


VALVE HEAD RADIAL RUNOUT

Place the dial gauge at a right angle to the valve head face and measure the valve head radial runout.
If it measures more than the service limit, replace the valve.

DATA Valve head radial runout
Service Limit: 0.03 mm (0.001 in)

TOOL 09900-20607: Dial gauge (1/100 mm)
09900-20701: Magnetic stand
09900-21304: V-block set (100 mm)

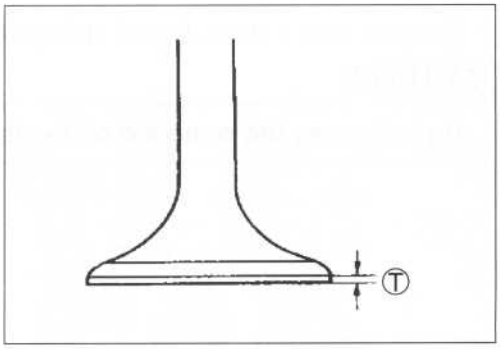


VALVE FACE WEAR

Visually inspect each valve face for wear. Replace any valve with an abnormally worn face. The thickness of the valve face decreases as the face wears. Measure the valve face Ⓣ. If it is out of specification, replace the valve with a new one.

DATA Valve head thickness Ⓣ
Service Limit: 0.5 mm (0.02 in)

TOOL 09900-20102: Vernier calipers

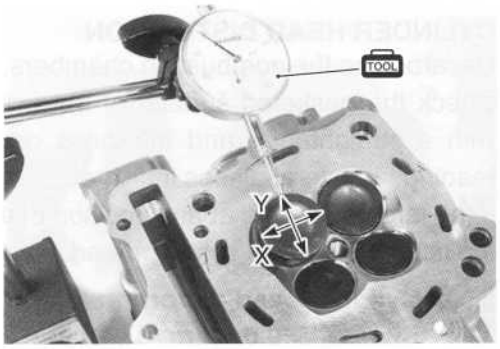


VALVE STEM DEFLECTION

Lift the valve about 10 mm (0.39 in) from the valve seat.
Measure the valve stem deflection in two directions, "X" and "Y" perpendicular to each other, by positioning the dial gauge as shown.
If the deflection measured exceeds the limit, then determine whether the valve or the guide should be replaced with a new one.

DATA Valve stem deflection (IN & EX)
Service Limit: 0.35 mm (0.014 in)

TOOL 09900-20607: Dial gauge (1/100 mm)
09900-20701: Magnetic stand



VALVE STEM WEAR

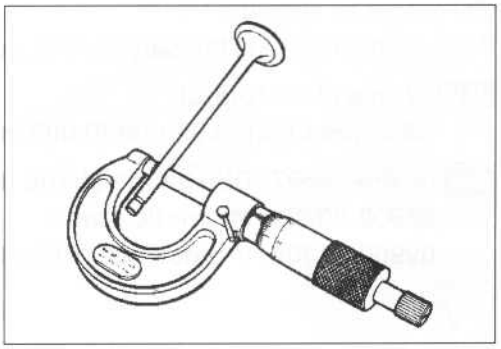
If the valve stem is worn down to the limit, as measured with a micrometer, where the clearance is found to be in excess of the limit indicated, replace the valve.
If the stem is within the limit, then replace the guide.

- After replacing valve or guide, be sure to recheck the clearance.

DATA Valve stem O.D.
Standard (IN): 4.465 – 4.480 mm (0.1758 – 0.1764 in)
(EX): 4.455 – 4.470 mm (0.1754 – 0.1760 in)

TOOL 09900-20205: Micrometer (0 – 25 mm)

NOTE:
If valve guides have to be removed for replacement after inspecting related parts, carry out the steps shown in valve guide servicing.



VALVE GUIDE SERVICING

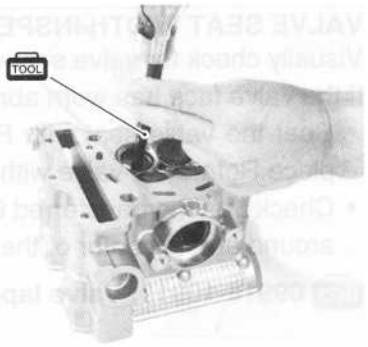
- Using the valve guide remover, drive the valve guide out toward the intake or exhaust camshaft side.

TOOL 09916-43210: Valve guide remover/installer

NOTE:

** Discard the removed valve guide subassemblies.*

** Only oversized valve guides are available as replacement parts. (Part No. 11115-18D72)*

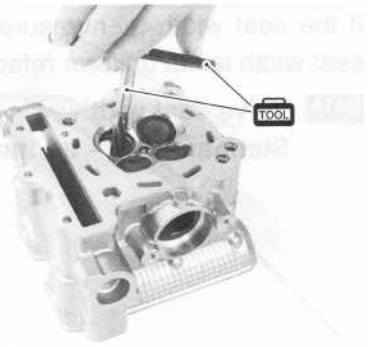


- Re-finish the valve guide holes in cylinder head with the reamer and handle.

TOOL 09916-34580: Valve guide reamer
09916-34542: Reamer handle

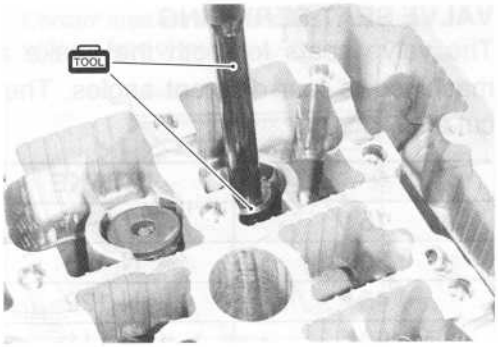
CAUTION

When refinishing or removing the reamer from the valve guide hole, always turn it clockwise.



- Apply engine oil to the valve guide hole, and valve guide.
- Drive the valve guide into the hole with the special tools.

TOOL 09916-43210: Valve guide installer/remover
09916-53330: Attachment

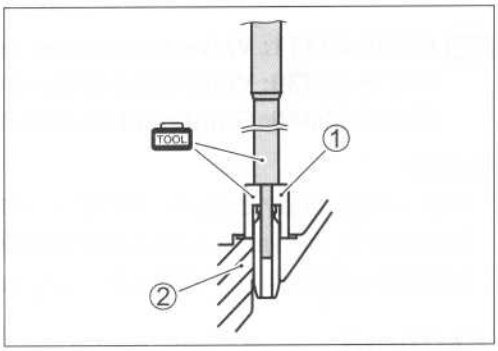


NOTE:

Install the valve guide until the attachment ① contacts with the cylinder head ②.

CAUTION

Failure to oil the valve guide hole before driving the new guide into place may result in a damaged guide or head.

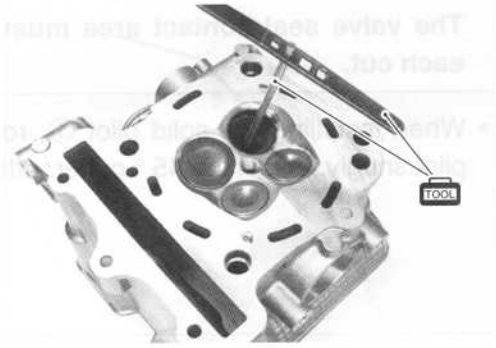


- After installing the valve guides, re-finish their guiding bores using the reamer.
- Clean and oil the guides after reaming.

TOOL 09916-33210: Valve guide reamer
09916-34542: Valve guide reamer handle

NOTE:

Insert the reamer from the combustion chamber and always turn the reamer handle clockwise.



VALVE SEAT WIDTH INSPECTION

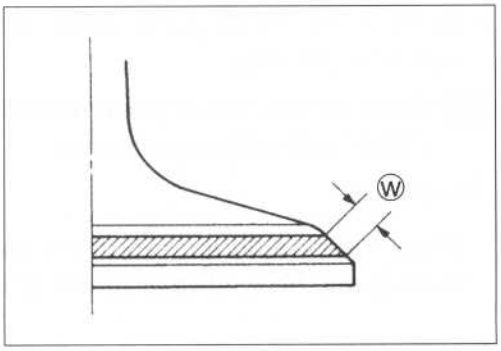
Visually check for valve seat width on each valve face.
If the valve face has worn abnormally, replace the valve.

- Coat the valve seat with Prussian Blue and set the valve in place.Rotate the valve with light pressure.
- Check that the transferred blue on the valve face is uniform all around and in center of the valve face.

TOOL 09916-10911: Valve lapper set

If the seat width Ⓦ measured exceeds the standard value, or seat width is not uniform reface the seat using the seat cutter.

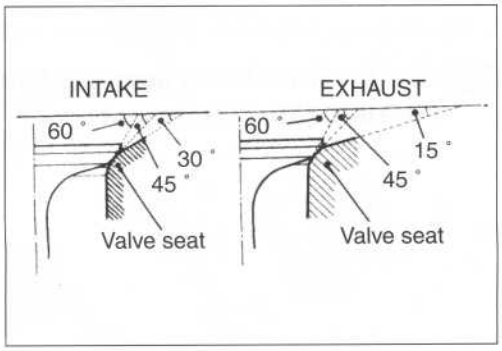
DATA Valve seat width Ⓦ
Standard: 0.9 – 1.1 mm (0.035 – 0.043 in)



VALVE SEAT SERVICING

The valve seats for both the intake and exhaust valves are machined to four different angles. The seat contact surface is cut at 45 °.

	INTAKE	EXHAUST
15 °		N-121
30 °	N-126	
45 °	N-122	N-122
60 °	N-111	N-111



TOOL 09916-21111: Valve seat cutter set
09916-20630: Valve seat cutter (N-126)
09916-20640: Solid pilot (N-100-4.5)

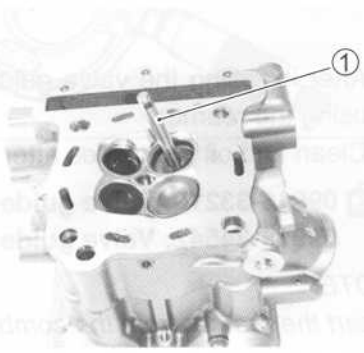
NOTE:

* *The valve seat cutters (N-121), (N-122) and (N-111) are included in the valve seat cutter set (09916-21111).*
* *Use the solid pilot (N-100-4.5) along with the valve seat cutter.*

CAUTION

The valve seal contact area must be inspected after each cut.

- When installing the solid pilot ①, rotate it slightly. Seat the pilot snugly. Install the 45 ° cutter, attachment and T-handle.

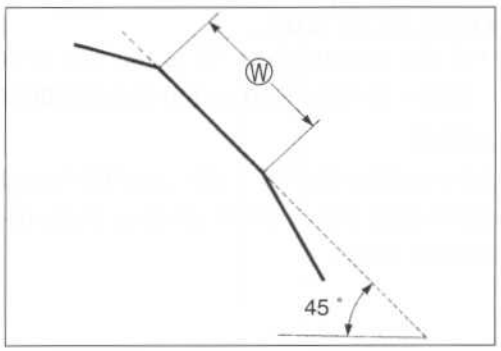


INITIAL SEAT CUT

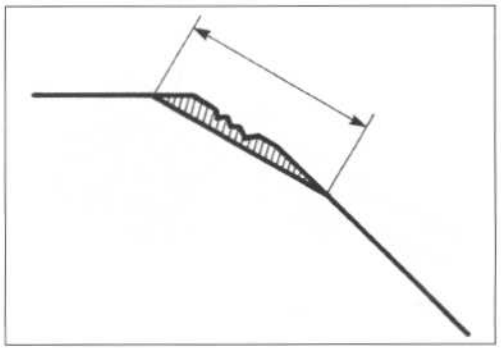
- Using the 45 ° cutter, descale and clean up the seat. Rotate the cutter one or two turns.
- Measure the valve seat width Ⓦ after every cut.

NOTE:

Cut only the minimum amount necessary from the seat to prevent the possibility of the valve stem becoming too close to the camshaft.

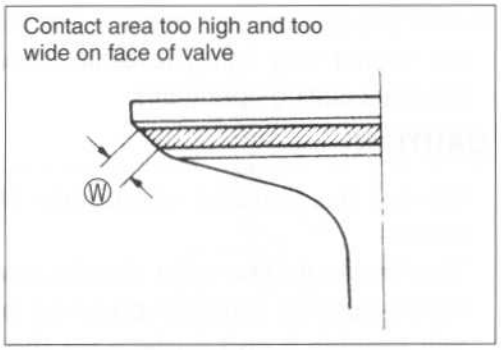


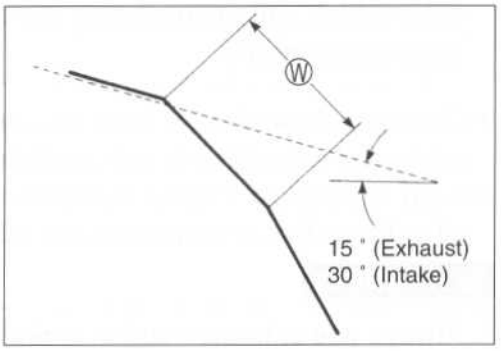
- If the valve seat is pitted or burned, use the 45 ° cutter to condition the seat some more.



TOP NARROWING CUT

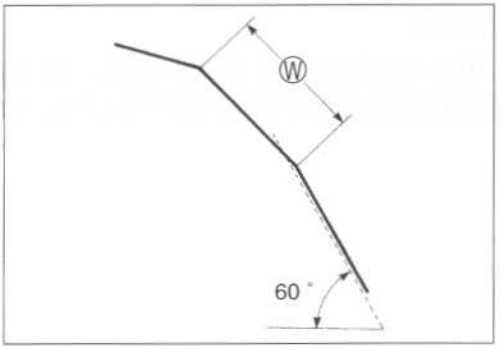
- If the contact area Ⓦ is too high on the valve, or if it is too wide, use the 15 ° (for the exhaust side) and the 30 ° (for the intake side) to lower and narrow the contact area.





BOTTOM NARROWING CUT

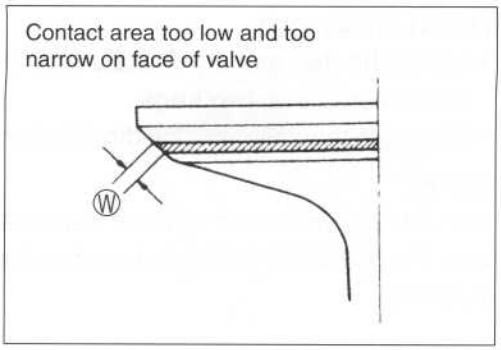
- If the contact area Ⓦ is too wide or too low, use the 60 ° cutter to narrow and raise the contact area.

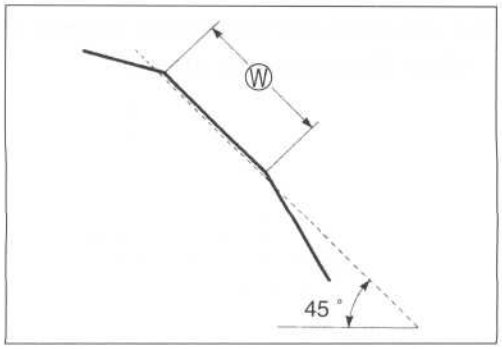


FINAL SEAT CUT

- If the contact area Ⓦ is too low or too narrow, use the 45 ° cutter to raise and widen the contact area.

NOTE:
After cutting the 15 °, 30 ° and 60 ° angles, it is possible that the valve seat (45 °) is too narrow. If so, re-cut the valve seat to the correct width.





- After the desired seat position and width is achieved, use the 45 ° cutter very lightly to clean up any burrs caused by the previous cutting operations.

CAUTION

Do not use lapping compound after the final cut is made.
The finished valve seat should have a velvety smooth finish but not a highly polished or shiny finish. This will provide a soft surface for the final seating of the valve which will occur during the first few seconds of engine operation.

- Clean and assemble the head and valve components. Fill the intake and exhaust ports with gasoline to check for leaks.
- If any leaks occur, inspect the valve seat and face for burrs or other things that could prevent the valve from sealing.

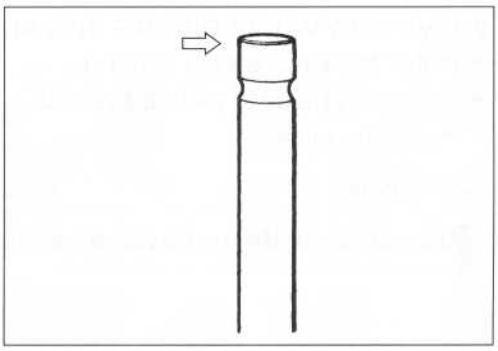
⚠ WARNING

Always use extreme caution when handling gasoline.

NOTE:
After servicing the valve seats, be sure to check the tappet clearance after the cylinder head has been reinstalled. (☞2-9)

VALVE STEM END CONDITION

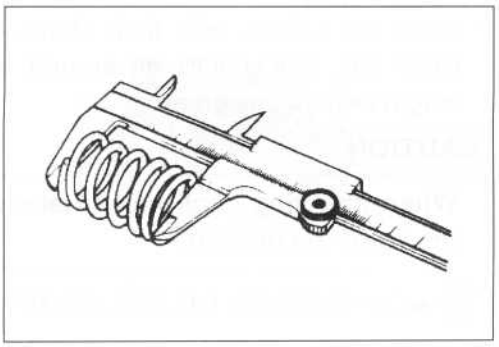
- Check the valve stem end face for pitting and wear.



VALVE SPRING

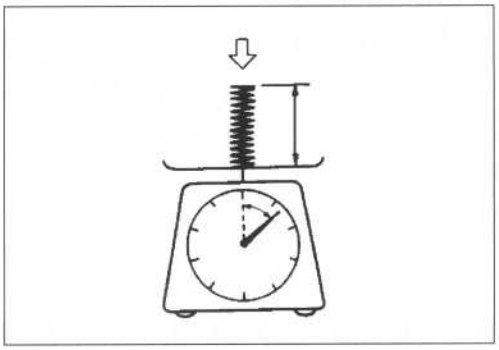
The force of the coil springs keeps the valve seat tight. Weakened springs result in reduced engine power output, and often account for the chattering noise coming from the valve mechanism.

- Check the valve springs for proper strength by measuring their free length and also by the force required to compress them. If the spring length is less than the service limit, or if the force required to compress the spring does not fall within the range specified, replace both the inner and outer springs as a set.



DATA Valve spring free length (IN & EX)
Service limit: INNER : 36.8 mm (1.45 in)
OUTER: 39.8 mm (1.57 in)

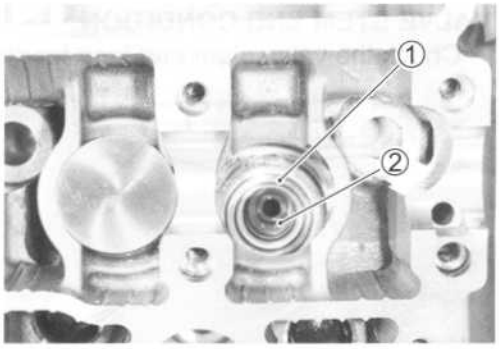
DATA Valve spring tension
Standard: (IN & EX) INNER : 4.1 – 4.7 kgf/29.9 mm (9.03 – 10.36 lbs/1.18 in)
OUTER: 16.6 – 19.2 kgf/33.4 mm (36.60 – 42.33 lbs/1.31 in)



TOOL 09900-20102: Vernier calipers

VALVE AND VALVE SPRING INSTALLATION

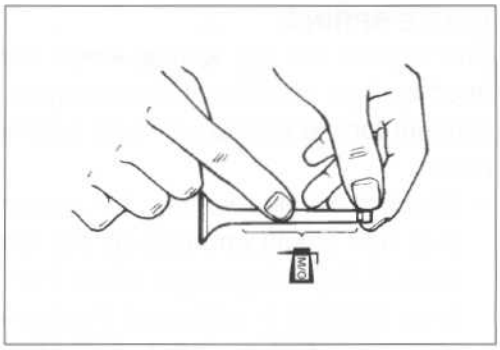
- Install the valve spring seats ①.
- Apply engine oil to each oil seal ②.
- Install the oil seal.



CAUTION

Do not reuse the removed oil seals.

- Insert the valves, with their stems coated with MOLYBDENUM OIL SOLUTION all around and along the full stem length without any break.



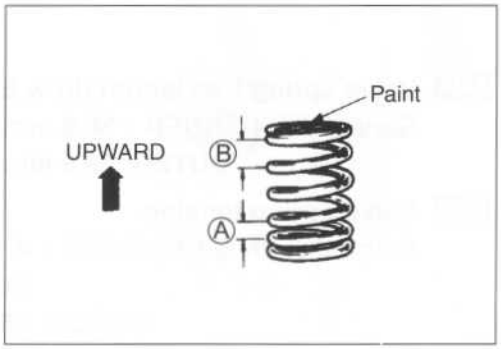
CAUTION

When inserting each valve, take care not to damage the lip of the oil seal.

MOLYBDENUM OIL SOLUTION

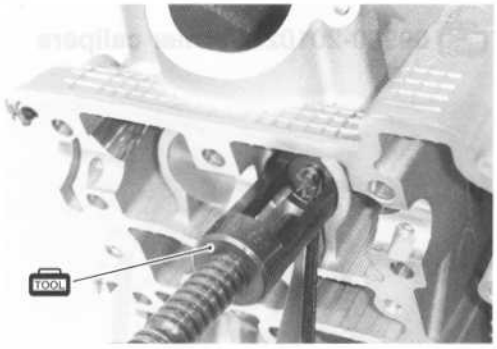
- Install the valve springs with the small-pitch portion Ⓐ facing cylinder head.

Ⓑ: Large-pitch portion



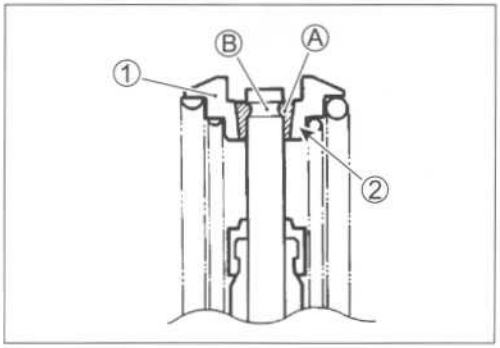
- Put on the valve spring retainer ①, and using the valve lifter, press down the springs, fit the cotter halves to the stem end, and release the lifter to allow the cotter ② to wedge in between retainer and stem. Be sure that the rounded lip Ⓐ of the cotter fits snugly into the groove Ⓑ in the stem end.

09916-14510: Valve lifter
09916-14521: Valve lifter attachment
09916-84511: Tweezers



CAUTION

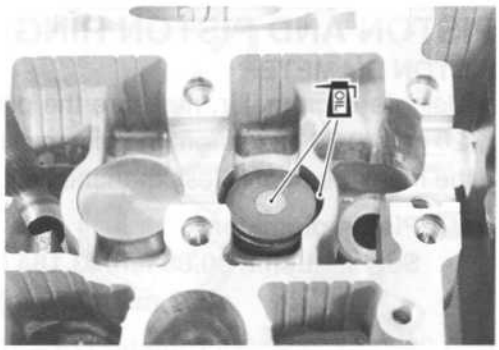
Be sure to restore each spring and valve to their original positions.



• Install the tappet shim and the tappet to their original position.

NOTE:

* *Before installing them, apply engine oil to the shims and tappets all over, also to the tappet chambers on the cylinder head.*
* *When seating the tappet shim, be sure the figure printed surface faces the tappet.*

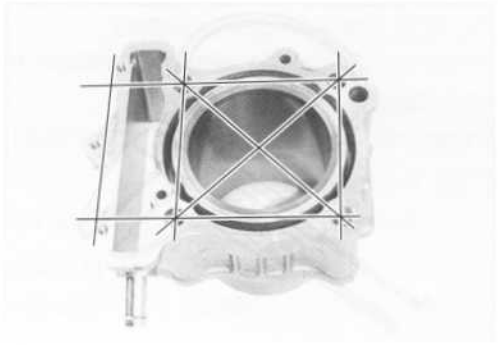


CYLINDER

CYLINDER DISTORTION

Check the gasketed surface of the cylinder for distortion with a straightedge and thickness gauge, taking a clearance reading at several places as indicated.

If the largest reading at any position of the straightedge exceeds the limit, replace the cylinder.

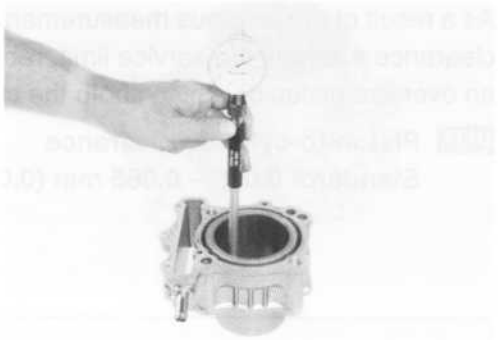


DATA Cylinder distortion
Service Limit: 0.05 mm (0.002 in)

TOOL 09900-20803: Thickness gauge

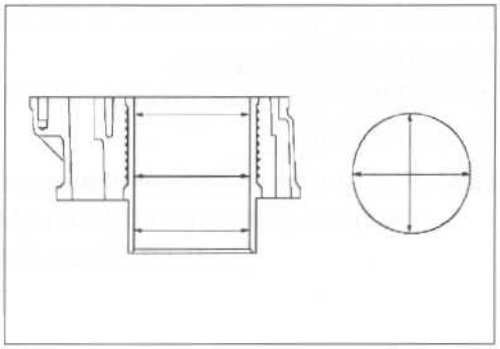
CYLINDER BORE

Inspect the cylinder wall for any scratches, nicks or other damage. Measure the cylinder bore diameter at six places.



DATA Cylinder bore
Standard: 81.000 – 81.015 mm (3.1890 – 3.1896 in)

TOOL 09900-20508: Cylinder gauge set



PISTON AND PISTON RING

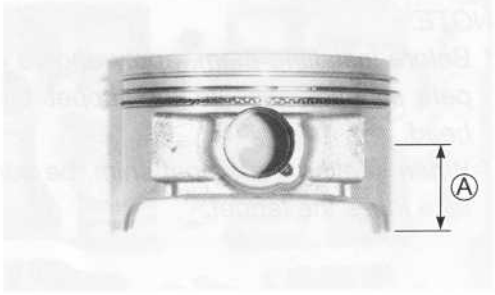
PISTON DIAMETER

- Using a micrometer, measure the piston outside diameter at 20 mm (0.79 in) Ⓐ from the piston skirt end.

If the measurement is less than the limit, replace the piston.

DATA Piston diameter
Service Limit: 80.88 mm (3.184 in)
at 20 mm (0.79 in) from the skirt end

TOOL 09900-20204: Micrometer (75 – 100 mm)



PISTON-TO CYLINDER CLEARANCE

As a result of the previous measurement, if the piston-to-cylinder clearance exceeds the service limit, rebore the cylinder and use an oversize piston or replace both the cylinder and piston.

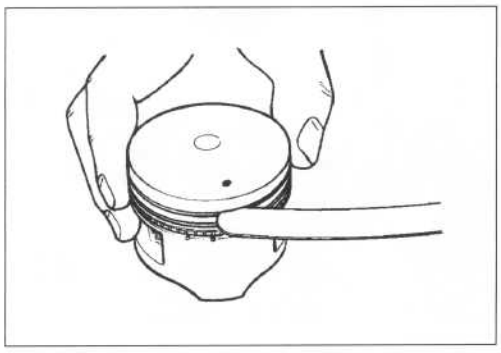
DATA Piston-to-cylinder clearance
Standard: 0.055 – 0.065 mm (0.0022 – 0.0026 in)

PISTON-RING-TO-GROOVE CLEARANCE

Measure the side clearances of the 1st and 2nd piston rings using the thickness gauge.

If any of the clearances exceed the limit, replace both the piston and piston rings.

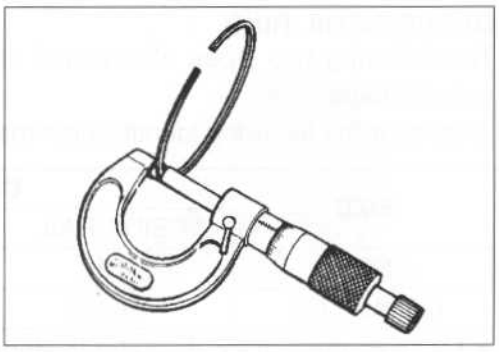
DATA Piston-ring-to-groove clearance
Service Limit (1st) : 0.18 mm (0.0071 in)
(2nd) : 0.15 mm (0.0059 in)



DATA Piston ring groove width
Standard (1st): 1.21 – 1.23 mm (0.0476 – 0.0484 in)
(2nd): 1.01 – 1.03 mm (0.0398 – 0.0406 in)
(Oil): 2.01 – 2.03 mm (0.0791 – 0.0799 in)

DATA Piston ring thickness
Standard (1st): 1.17 – 1.19 mm (0.0461 – 0.0469 in)
(2nd): 0.97 – 0.99 mm (0.0382 – 0.0390 in)

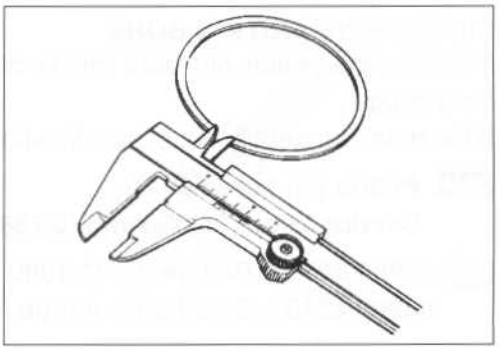
TOOL 09900-20803: Thickness gauge
09900-20205: Micrometer (0 – 25 mm)



PISTON RING FREE END GAP AND PISTON RING END GAP

- Measure the piston ring free end gap using vernier calipers.
- Next, fit the piston ring squarely into the cylinder and measure the piston ring end gap using the thickness gauge.

If any of the measurements exceed the service limit, replace the piston ring with a new one.



DATA Piston ring free end gap
Service Limit (1st): 7.6 mm (0.30 in)
(2nd): 8.8 mm (0.35 in)

TOOL 09900-20102: Vernier calipers

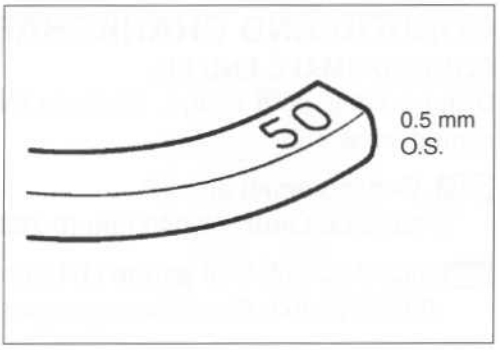
DATA Piston ring end gap
Service Limit (1st): 0.70 mm (0.028 in)
(2nd): 0.70 mm (0.028 in)

TOOL 09900-20803: Thickness gauge

OVERSIZE PISTON RING

The following two types of oversize piston rings are used.
They bear the following identification numbers.

SIZE	1st	2nd
STD	NIL	NIL
0.5 mm O.S.	50	50

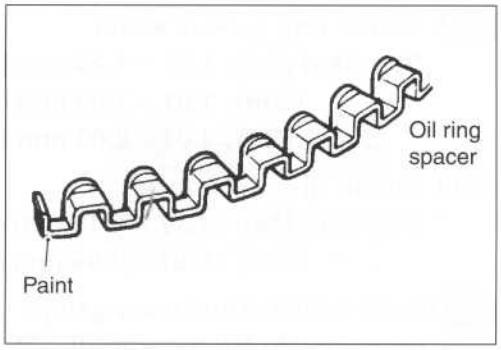


OVERSIZE OIL RING

The following two types of oversize oil rings are available as optional parts.
They bear the following identification marks.

SIZE	COLOR	
	SIDE RAIL	SPACER
STD	NIL	RED
0.5 mm O.S.	BLUE	BLUE

- Measure the outside diameter to identify the size.

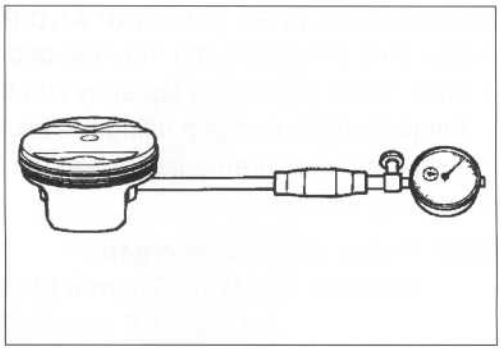


PISTON PINS AND PIN BORE

Measure the piston pin bore inside diameter using the small bore gauge.
If the measurement is out of specifications replace the piston.

DATA Piston pin bore I.D.
Service Limit: 20.030 mm (0.7886 in)

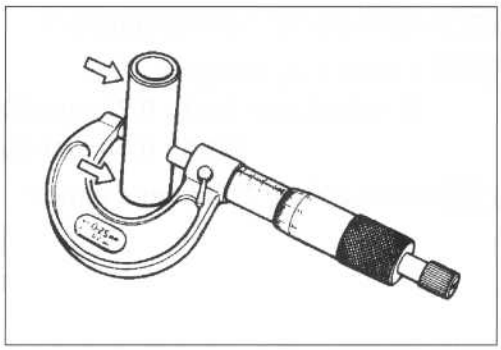
TOOL 09900-20602: Dial gauge (1/1000 mm)
09900-22403: Small bore gauge (18 – 35 mm)



Measure the piston pin outside diameter at three positions using the micrometer.
If any of the measurements are out of specification, replace the piston pin.

DATA Piston pin O.D.
Service Limit: 19.980 mm (0.7866 in)

TOOL 09900-20205: Micrometer (0 – 25 mm)



CONROD AND CRANKSHAFT

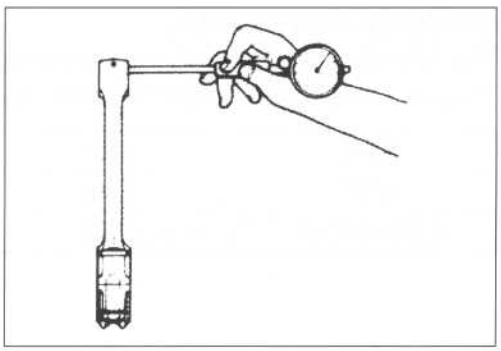
CONROD SMALL END I.D.

Using a small bore gauge, measure the inside diameter of the conrod small end.

DATA Conrod small end I.D.
Service Limit: 20.040 mm (0.7890 in)

TOOL 09900-20602: Dial gauge (1/1000 mm, 1 mm)
09900-22403: Small bore gauge (18 – 35 mm)

If the inside diameter of the conrod small end exceeds the limit, replace the conrod.



CONROD BIG END SIDE CLEARANCE

Check the conrod side clearance by using a thickness gauge.
If the clearance exceeds the limit, replace conrod or crankshaft.

DATA Conrod big end side clearance
Service Limit: 0.50 mm (0.020 in)

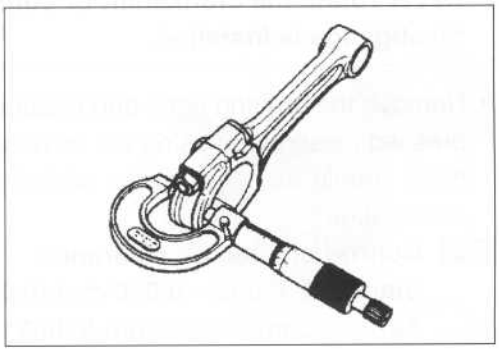
TOOL 09900-20803: Thickness gauge

CONROD BIG END WIDTH

Check the conrod big end width.

DATA Conrod big end width
Standard: 20.95 – 21.00 mm (0.825 – 0.827 in)

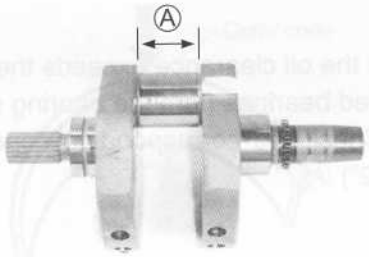
TOOL 09900-20205: Micrometer (0 – 25 mm)



CRANK PIN WIDTH

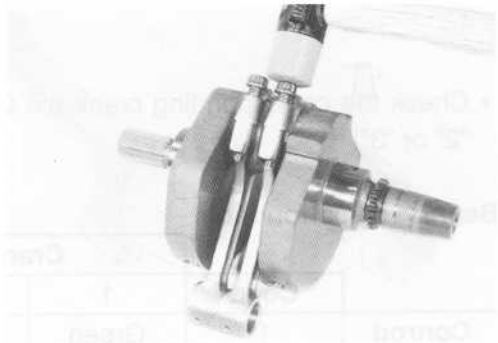
Check the crank pin width Ⓐ.

DATA Crank pin width
Standard: 42.17 – 42.22 mm (1.660 – 1.662 in)



CONROD REMOVAL AND BEARING INSPECTION

- Loosen the bearing cap bolts, and tap the bearing cap bolt lightly with plastic hammer to remove the bearing cap.



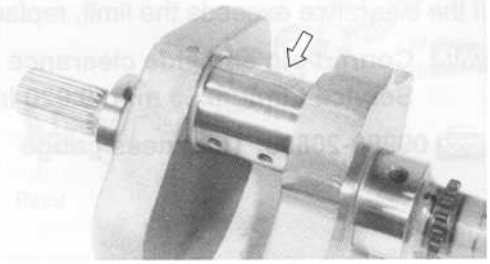
- Remove the conrods, and mark them to identify the cylinder position.

Inspect the bearing surfaces for any sign of fusion, pitting, burn, or flaws. If any, replace them with a specified set of bearings.

CONROD-CRANK PIN BEARING SELECTION

- Place the plastigauge axially along the crank pin, avoiding the oil hole, at TDC or BDC side as shown.

TOOL 09900-22301: Plastigauge
09900-22302: Plastigauge



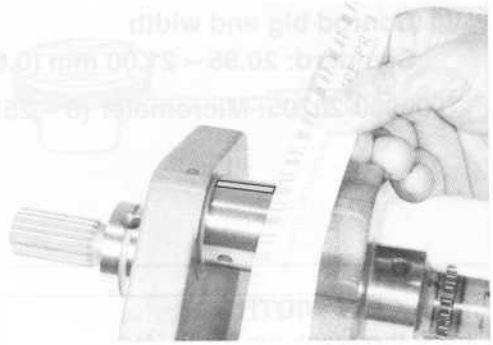
- Tighten the conrod cap bolts to the specified torque, in two stages. (☞3-60)

CAUTION

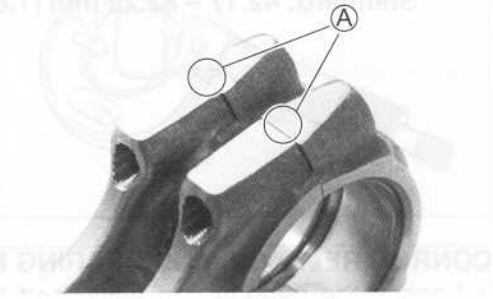
Never rotate the crankshaft or conrod when a piece of plastigauge is installed.

- Remove the bearing caps and measure the width of the compressed plastigauge using the envelope scale. This measurement should be taken at the widest part of the compressed plastigauge.

DATA Conrod big end oil clearance
Standard: 0.032 – 0.056 mm (0.0013 – 0.0022 in)
Service Limit: 0.080 mm (0.0031 in)



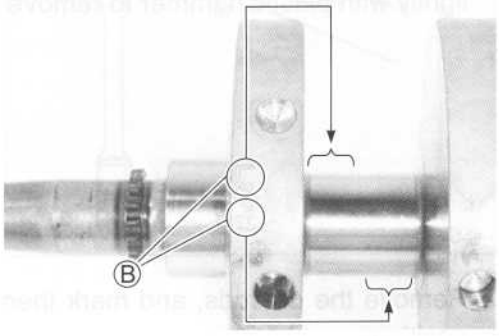
- If the oil clearance exceeds the service limit, select the specified bearings from the bearing selection table.
- Check the corresponding conrod I.D. code numbers ("1" or "2") Ⓐ.



- Check the corresponding crank pin O.D. code numbers ("1", "2" or "3") Ⓑ.

Bearing selection table

		Crank pin O.D. Ⓑ		
	Code	1	2	3
Conrod I.D. Ⓐ	1	Green	Black	Brown
	2	Black	Brown	Yellow

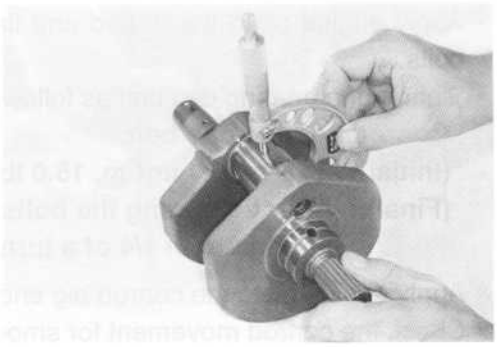


DATA Conrod I.D.

Code	I.D. specification
1	41.000 – 41.008 mm (1.6142 – 1.6145 in)
2	41.008 – 41.016 mm (1.6145 – 1.6148 in)

DATA Crank pin O.D.

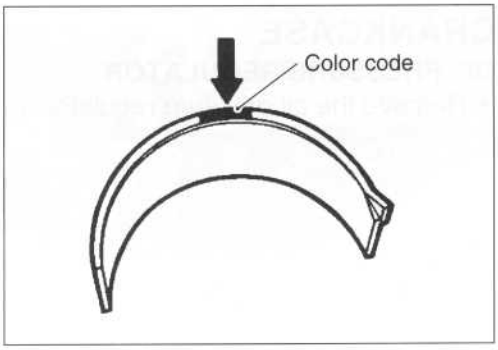
Code	O.D. specification
1	37.992 – 38.000 mm (1.4957 – 1.4961 in)
2	37.984 – 37.992 mm (1.4954 – 1.4957 in)
3	37.976 – 37.984 mm (1.4951 – 1.4954 in)



TOOL 09900-20202: Micrometer (25 – 50 mm)

DATA Bearing thickness

Color (Part No.)	Thickness
Green (12164 – 46E01-0A0)	1.480 – 1.484 mm (0.0583 – 0.0584 in)
Black (12164 – 46E01-0B0)	1.484 – 1.488 mm (0.0584 – 0.0586 in)
Brown (12164 – 46E01-0C0)	1.488 – 1.492 mm (0.0586 – 0.0587 in)
Yellow (12164 – 46E01-0D0)	1.492 – 1.496 mm (0.0587 – 0.0589 in)

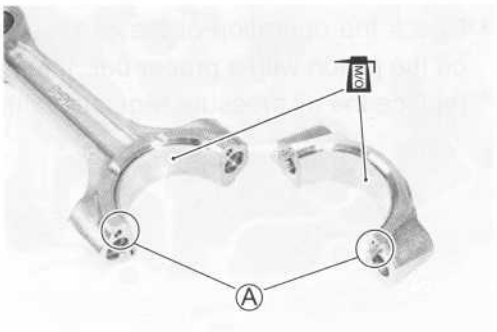


CAUTION

The bearings must be replaced as a set.

CONROD AND BEARING REASSEMBLY

- When fitting the bearings to the bearing cap and conrod, be sure to fix the stopper part Ⓐ first and press in the other end.



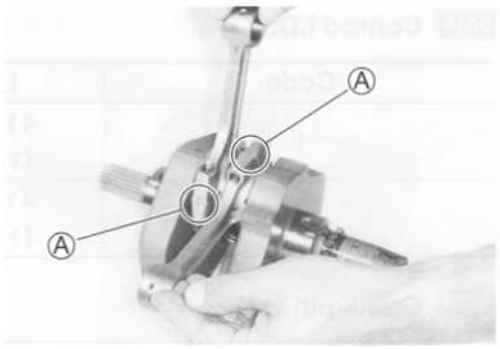
CAUTION

Be sure to clean the conrod big end.

- Apply MOLYBDENUM OIL SOLUTION to the crank pin and bearing surface.

MO MOLYBDENUM OIL SOLUTION

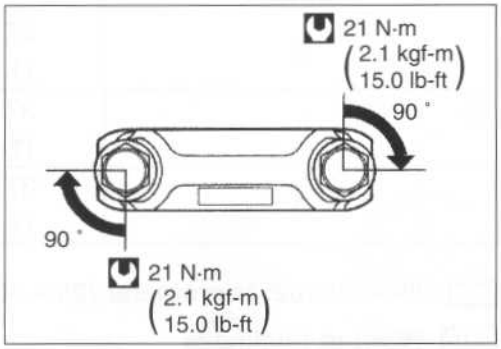
- When fitting the conrods on the crankshaft, make sure that I.D. codes Ⓐ of the conrods face each cylinder intake valve sides.



- Apply engine oil to the thread and flange of the bearing cap bolts.
- Tighten the bearing cap bolt as following two steps.

Conrod bearing cap bolt
(Initial): 21 N·m (2.1 kgf-m, 15.0 lb-ft)
(Final) : After tightening the bolts to the above torque, tighten them 1/4 of a turn (90 °).

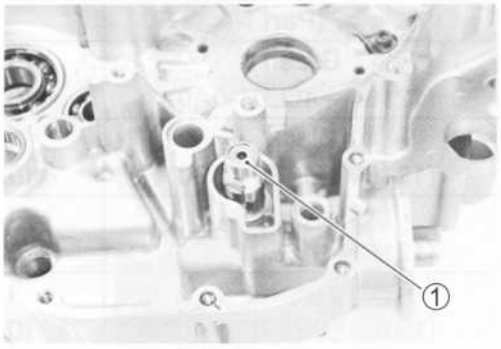
- Apply engine oil to the conrod big end side surfaces.
- Check the conrod movement for smooth turning.



CRANKCASE

OIL PRESSURE REGULATOR

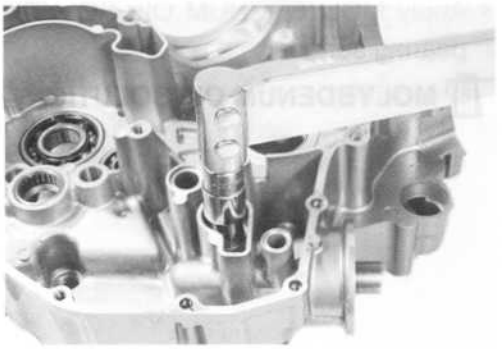
- Remove the oil pressure regulator ①.



- Check the operation of the oil pressure regulator by pushing on the piston with a proper bar. If the piston does not operate, replace the oil pressure regulator with a new one.

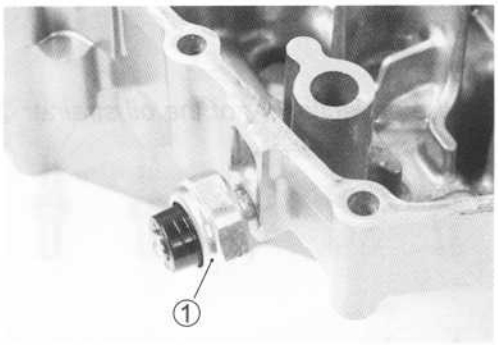
- Tighten the oil pressure regulator to the specified torque.

Oil pressure regulator: 27 N·m (2.7 kgf-m, 19.5 lb-ft)



OIL PRESSURE SWITCH

- Remove the oil pressure switch ①.
- Inspect the oil pressure switch. (☞8-36)

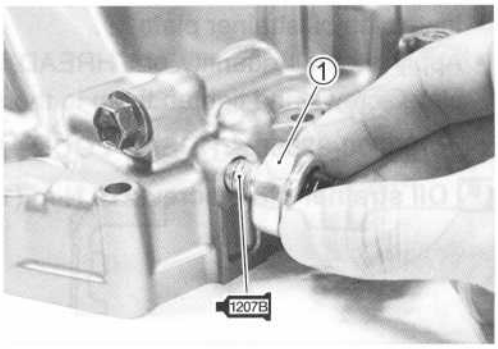


- Apply SUZUKI BOND to the thread part of the oil pressure switch ① and tighten it to the specified torque.

1207B 99104-31140: SUZUKI BOND "1207B" (USA)
99000-31140: SUZUKI BOND "1207B" (Others)

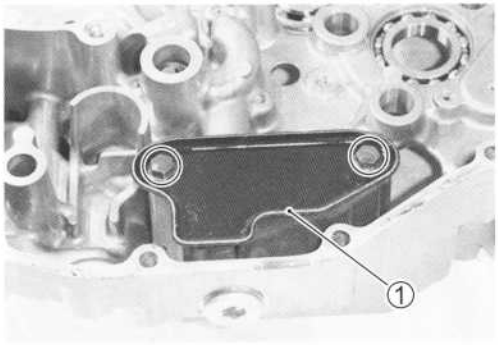
Oil pressure switch: 14 N·m (1.4 kgf-m, 10.0 lb-ft)

NOTE:
Be careful not to apply SUZUKI BOND to the hole of the thread end.

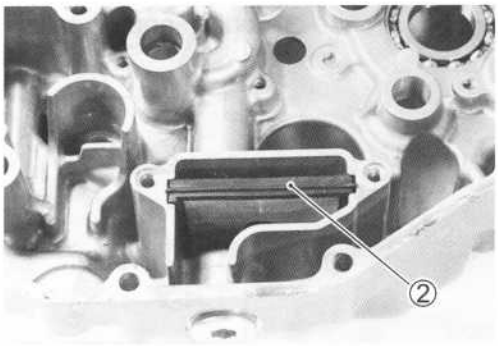


OIL STRAINER

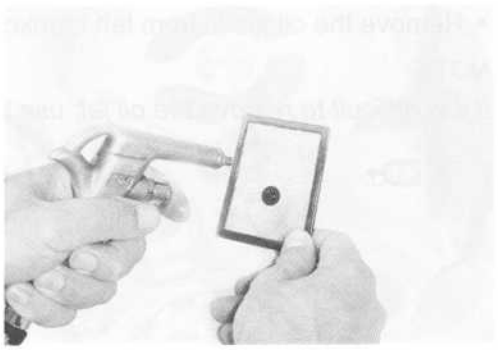
- Remove the oil strainer plate ①.



- Remove the oil strainer ②.

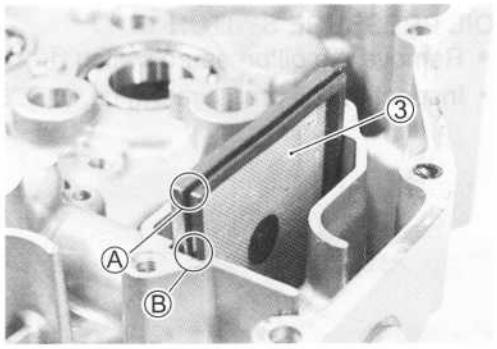


- Clean the oil strainer with a compressed air.



- Install the oil strainer ③.

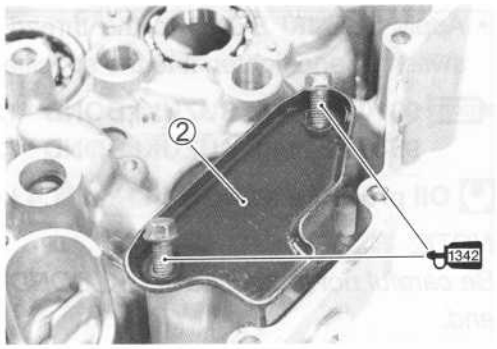
NOTE:
Fit the projection Ⓐ of the oil strainer ③ in the concave portion of the crankcase.



- Install the oil strainer plate ②.
- Apply a small quantity of THREAD LOCK to the oil strainer plate screws and tighten them to the specified torque.

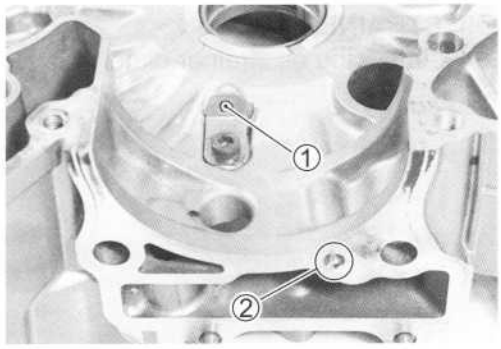
1342 99000-32050: THREAD LOCK "1342"

Oil strainer plate screw: 10 N·m (1.0 kgf-m, 7.0 lb-ft)

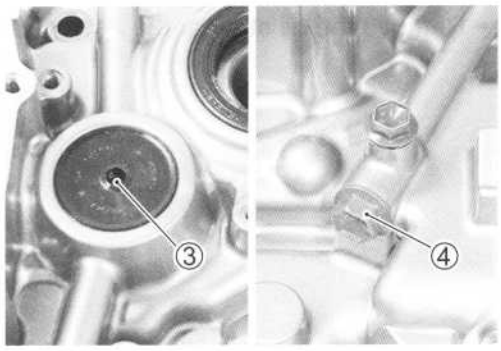


OIL JET
Removal

- Remove the oil jets ①, ② from the left and right crankcase halves.

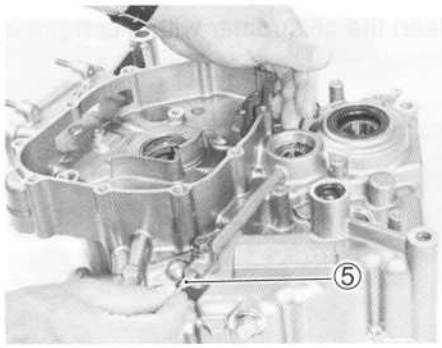


- Remove the oil seal ③ and oil gallery plug ④.



- Remove the oil jet ⑤ from left crankcase half.

NOTE:
If it is difficult to remove the oil jet, use a sting.



Inspection and cleaning

- Check the oil jets for clogging.
- If they are clogged, clean their oil passage with a proper wire and compressed air.

① Piston cooling oil jet
② Oil jet (#14) (For transmission)
③ Oil jet (#14) (For each cylinder head)

Installation

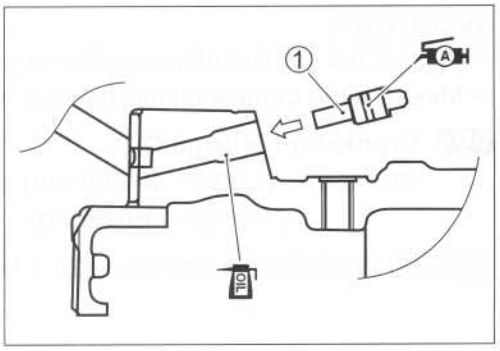
- Fit the new O-rings to each oil jets.

CAUTION

Use the new O-rings to prevent oil leakage.

NOTE:

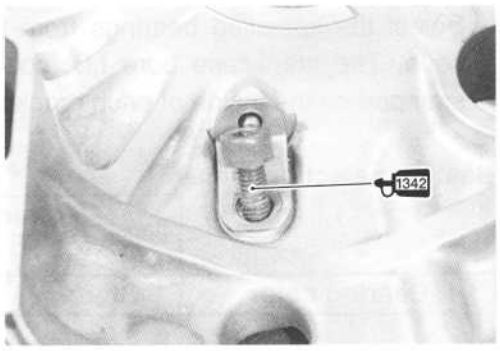
** Apply grease to the O-rings when installing the oil jets.*
** Apply engine oil to the oil jet holes on the crankcase.*



- Install the piston cooling oil jets ① to the left and right crankcase halves.
- Apply a small quantity of THREAD LOCK to the bolts and tighten them to the specified torque.

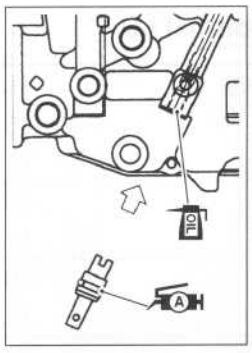
1342 99000-32050: THREAD LOCK "1342"

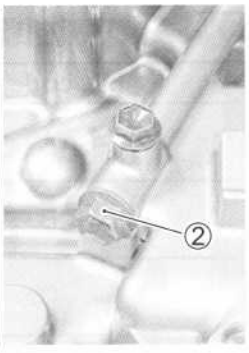
Piston cooling oil jet bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)



- Push the oil jet into the left crankcase half until it stops.
- Tighten the oil gallery plug ② to the specified torque.

Oil gallery plug (M8): 18 N·m (1.8 kgf-m, 13.0 lb-ft)



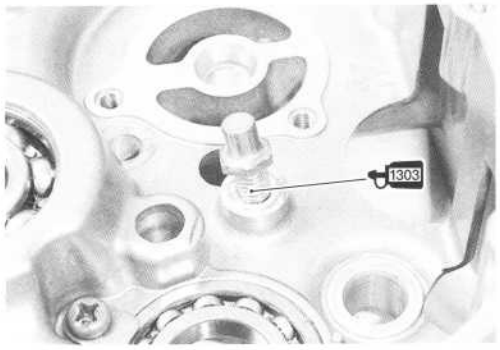


GEARSHIFT ARM STOPPER

- When installing the gearshift arm stopper bolt ①, apply a small quantity of THREAD LOCK to its thread and tighten it to the specified torque.

1303 99000-32030: THREAD LOCK SUPER "1303"

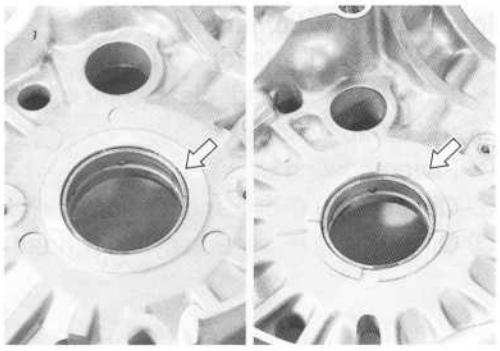
Gearshift arm stopper bolt: 19.0 N·m (1.9 kgf-m, 13.5 lb-ft)



CRANKSHAFT JOURNAL BEARING

INSPECTION

- Inspect the crankshaft journal bearings for any damage.
- If any, replace them with a specified set of bearings.

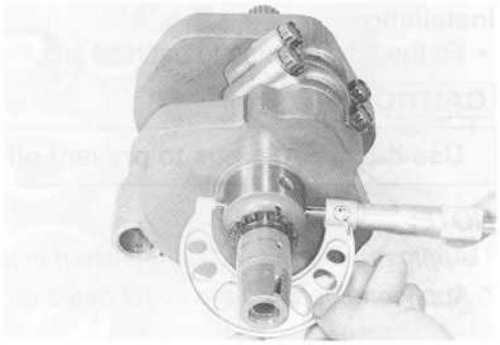


SELECTION

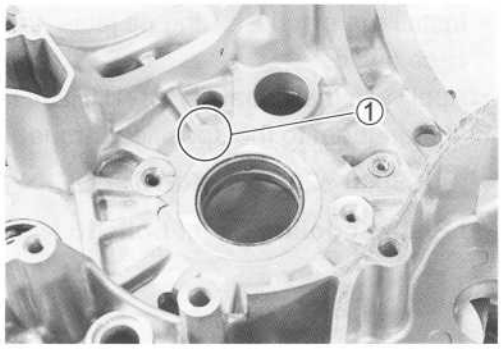
- Inspect the crankshaft journal for any damage.
- Measure the crankshaft journal O.D. with the special tool.

DATA Crankshaft journal O.D.
Standard: 41.985 – 42.000 mm
(1.6529 – 1.6535 in)

TOOL 09900-20202: Micrometer (25 – 50 mm)



- Select the specified bearings from the crankcase bore I.D. code. The crankcase bore I.D. code ① "A", "B" or "C", is stamped on the inside of each crankcase half.

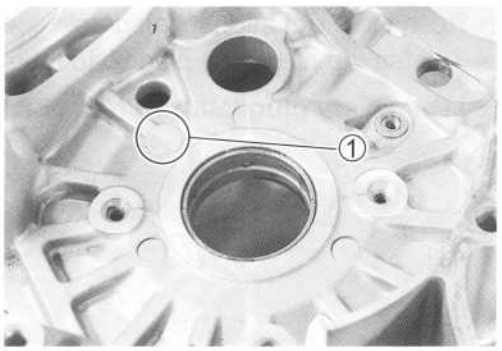


Bearing selection table

	Crankcase I.D. ①		
	A	B	C
Bearing color	Green	Black	Brown

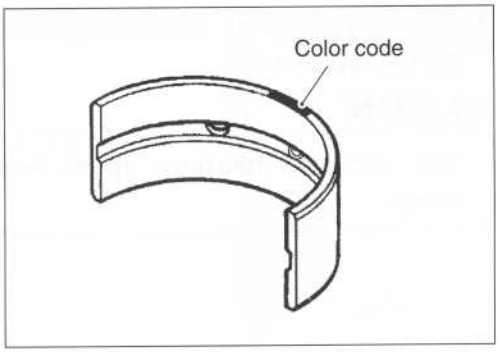
DATA Crank shaft journal I.D.

I.D. code ①	I.D. specification
A	46.000 – 46.006 mm (1.8110 – 1.8113 in)
B	46.006 – 46.012 mm (1.8113 – 1.8115 in)
C	46.012 – 46.018 mm (1.8115 – 1.8117 in)



DATA Bearing thickness

Color (Part No.)	Thickness
Green (12229 – 19F10-0A0)	1.993 – 1.996 mm (0.0785 – 0.0786 in)
Black (12229 – 19F10-0B0)	1.996 – 1.999 mm (0.0786 – 0.0787 in)
Brown (12229 – 19F10-0C0)	1.999 – 2.002 mm (0.0787 – 0.0788 in)



CAUTION

Bearing must be replaced as a set.

REPLACEMENT

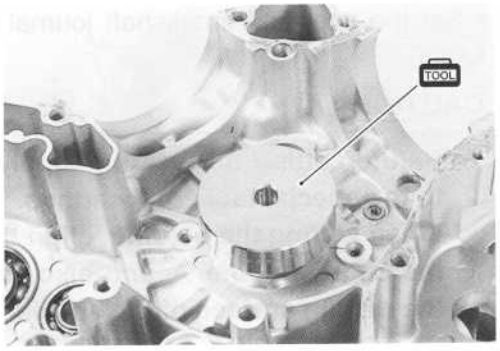
Use the special tool to replace the crankshaft journal bearings. The replacement procedure is as follows.

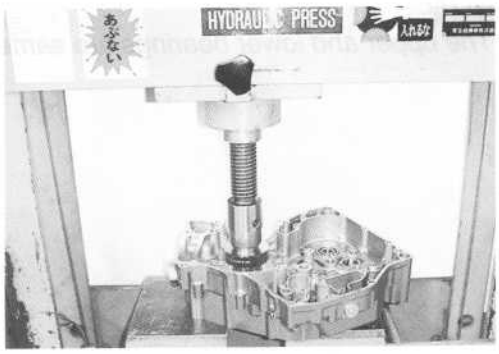
- Set the special tool as shown to remove the crankshaft journal bearings with the special tool.

TOOL 09913-60221: Journal bearing remover/installer

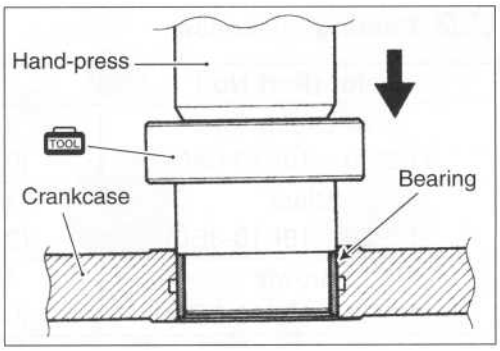
NOTE:

Remove the crankshaft journal bearings in only one direction, from inside to outside of each crankcase half.





- Gradually press out the bearing with the special tool by using the hand-press.

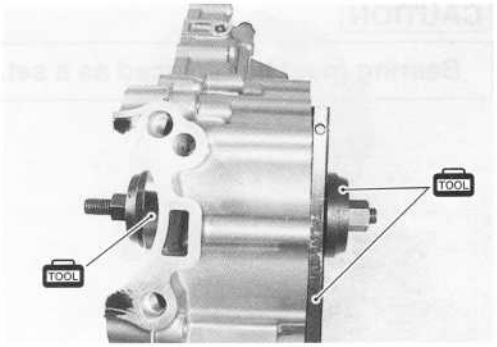


CAUTION

The removed bearings must be replaced with new ones.

NOTE:
Using the hand-press is recommended to remove the crankshaft journal bearings. However, the crankshaft journal bearings can be removed by using with the following special tools.

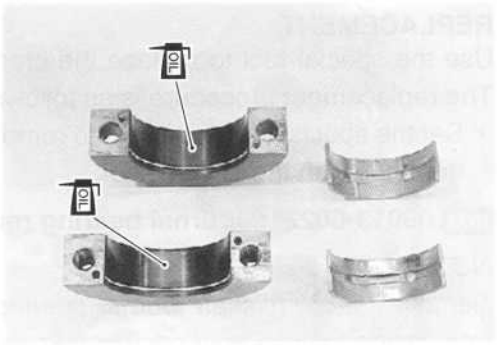
TOOL 09924-84510: Bearing installer set
09910-20116: Conrod holder
09913-60221: Journal bearing remover/installer



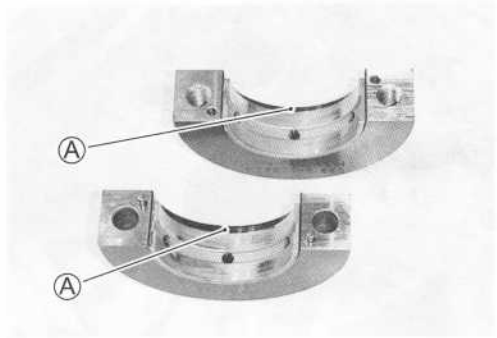
- Set the specified crankshaft journal bearings to the special tool.

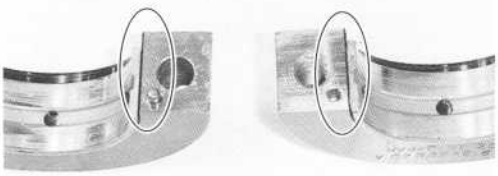
CAUTION

- *** Before setting the bearing, apply enough engine oil to the special tool and bearings.**
- *** When setting the bearing, align the bearing side with the engraved line Ⓐ and also the bearing end with the mating surface of the special tool.**



NOTE:
The upper and lower bearings are same.



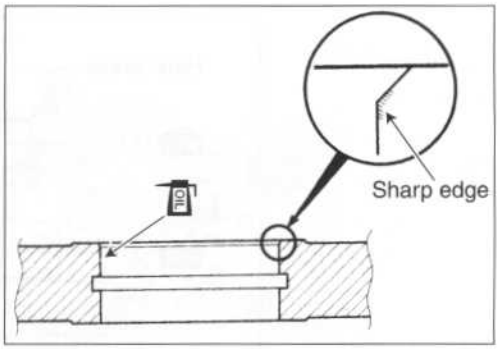


- Tighten the special tool bolts to the specified torque.

Special tool bolt: 23 N·m (2.3 kgf-m, 16.5 lb-ft)

CAUTION

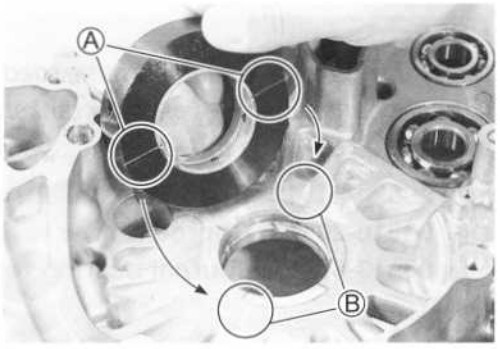
Before installing the bearings, lightly shave off the sharp edge part of the crankcase chamfer by using an oilstone and wash the crankcase bore with enough engine oil.



- Set the bearings installed in the special tool to the crankcase half as shown.

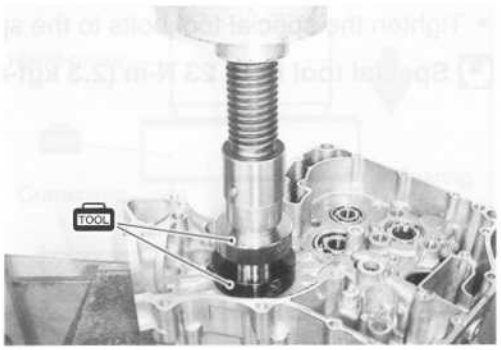
CAUTION

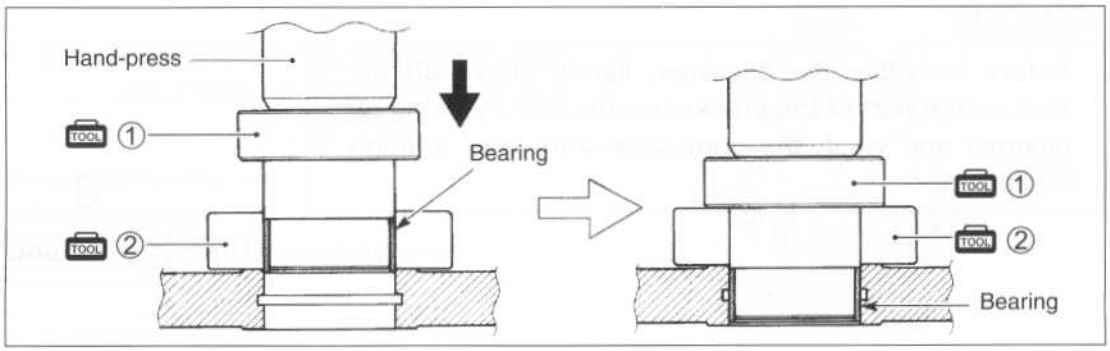
*** Be sure the bearing protruded side Ⓐ faces the crankcase bore.**
*** Align the bearing/special tool mating surface with the line Ⓑ on the crankcase.**



NOTE:
Install the bearing from inside to outside of each crankcase halves.

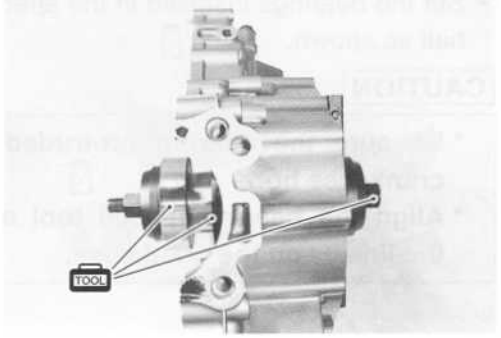
- Apply enough engine oil to the special tool and the bearings and then set the special tool carefully.
- Gradually press in the bearing into the main journal bore by using the hand-press until the special tool ① contacts the special tool ②.



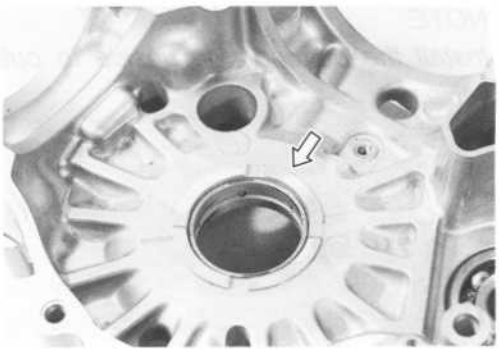


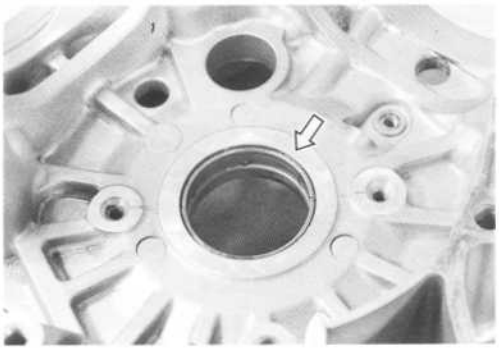
NOTE:
Using the hand-press is recommended to install the crankshaft journal bearings. However, the crankshaft journal bearings can be installed by using the following special tools.

TOOL 09924-84510: Bearing installer set
09910-20116: Conrod holder
09913-60221: Journal bearing remover/installer



- After installing the bearings, check the bearing surface for any scratch or damage.



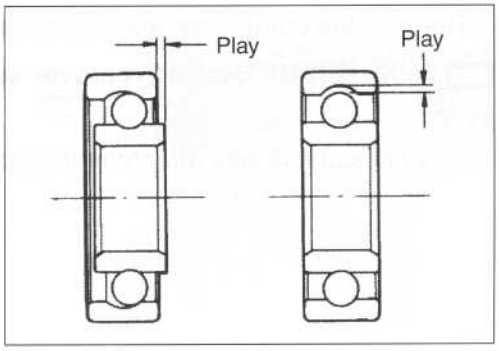


CRANKCASE BEARING AND OIL SEAL

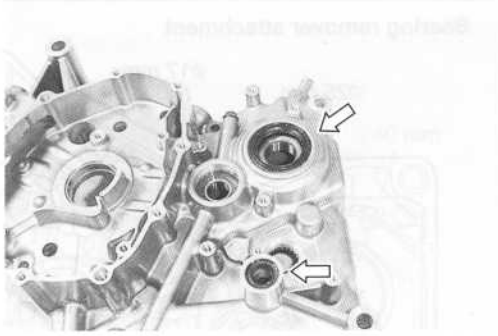
INSPECTION

Rotate the bearing inner race by finger to inspect for abnormal play, noise and smooth rotation while the bearings are in the crankcase.

Replace the bearing with new ones, if there is anything unusual.



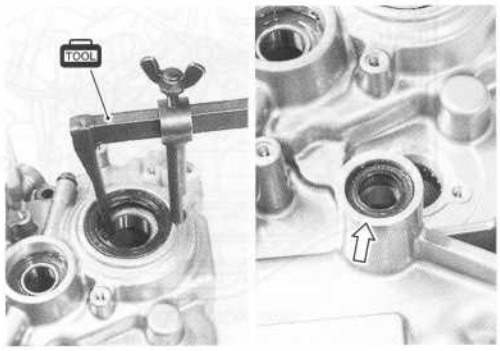
Inspect the oil seals for any damage.



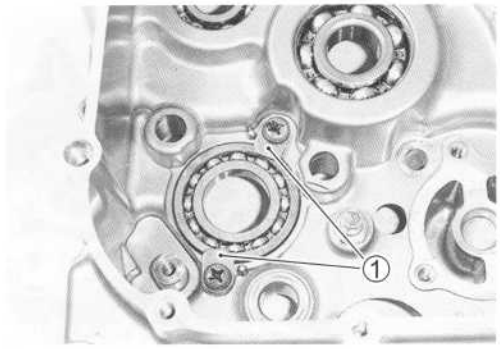
REMOVAL

- Remove the oil seals using the special tool or a suitable bar.

TOOL 09913-50121: Oil seal remover



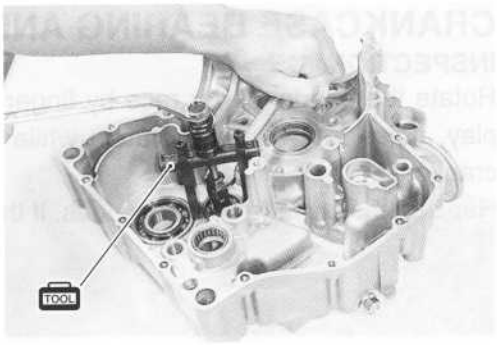
- Remove the bearing retainers ①.



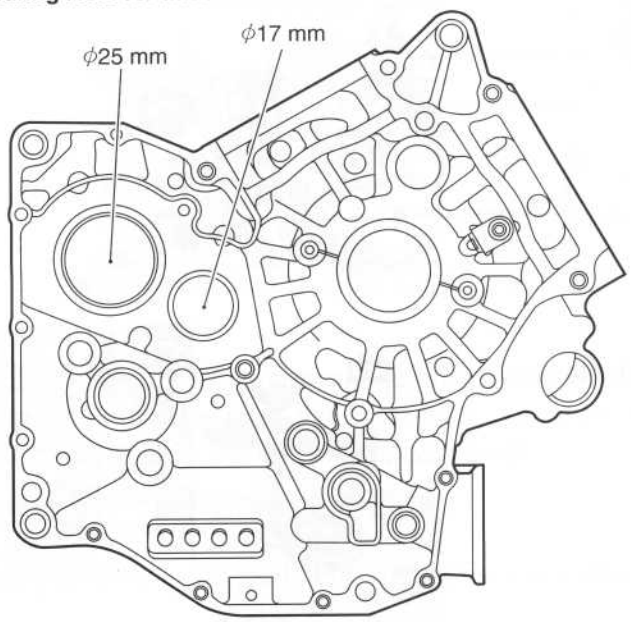
- Remove the crankcase bearings by using the special tool.

TOOL 09921-20240: Bearing remover set

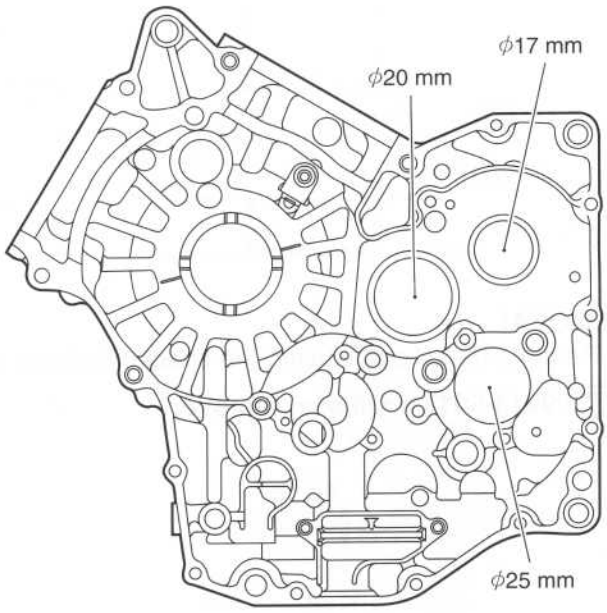
NOTE:
Select the suitable size attachment as following illustration.



Bearing remover attachment



Left crankcase



Right crankcase

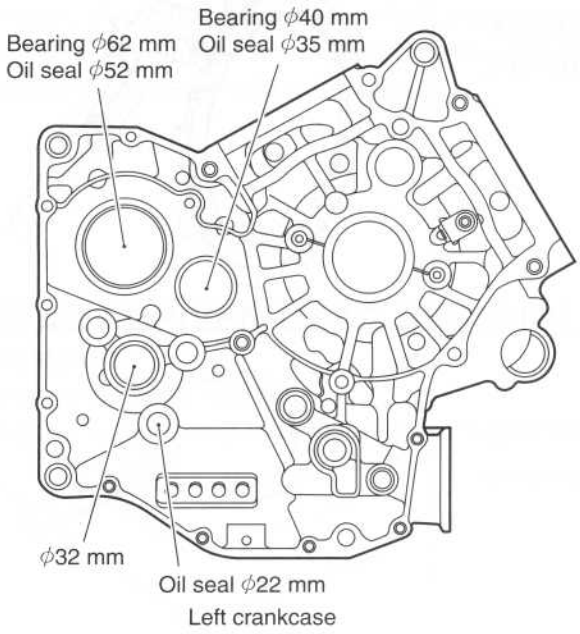
INSTALLATION

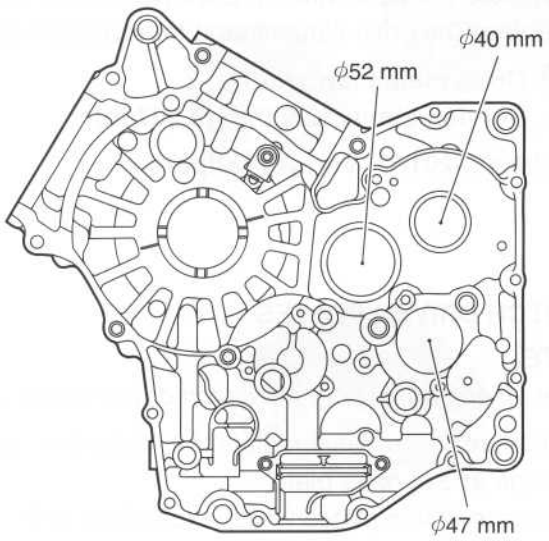
- Install the crankcase bearings and oil seals using the special tool.

TOOL 09913-70210: Bearing installer set

NOTE:
Select the suitable size attachment as following illustration.

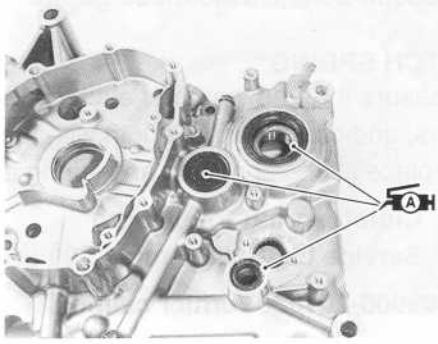
Bearing installer attachment





- Apply SUZUKI SUPER GREASE to the oil seal lip.

A 99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)

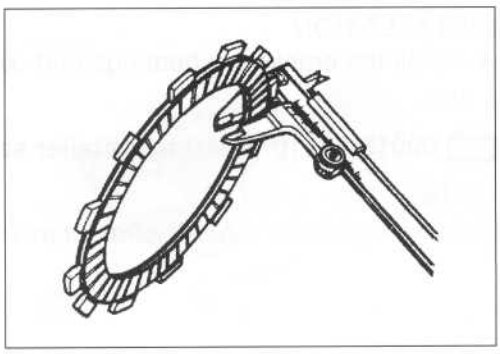


CLUTCH

CLUTCH DRIVE PLATES

NOTE:
Wipe off engine oil from the clutch drive plates with a clean rag.

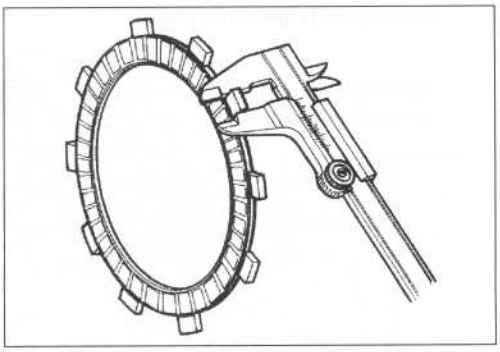
- Measure the thickness of drive plates with a vernier calipers.
- If each drive plate is not within the standard range, replace it with a new one.



DATA Drive plate thickness
Standard: 2.92 – 3.08 mm (0.115 – 0.121 in)

TOOL 09900-20102: Vernier calipers

- Measure the claw width of drive plates with a vernier calipers.
- Replace the drive plates found to have worn down to the limit.



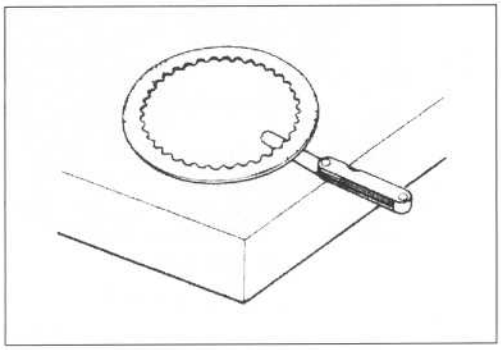
DATA Drive plate claw width
Service Limit: 12.9 mm (0.507 in)

TOOL 09900-20102: Vernier calipers

CLUTCH DRIVEN PLATES

NOTE:
Wipe off engine oil from the clutch driven plates with a clean rag.

- Measure each driven plate for distortion with a thickness gauge and surface plate.
- Replace driven plates which exceed the limit.



DATA Driven plate distortion
Service Limit: 0.10 mm (0.004 in)

TOOL 09900-20803: Thickness gauge

CLUTCH SPRING

- Measure the free length of each coil spring with a vernier calipers, and compare the length with the specified limit.
- Replace all the springs if any spring is not within the limit.

DATA Clutch spring free length
Service Limit: 50.5 mm (1.99 in)

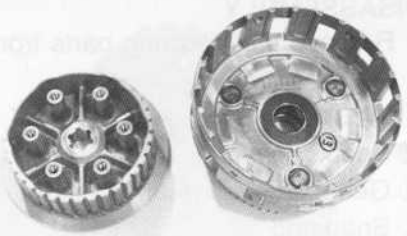
TOOL 09900-20102: Vernier calipers

CLUTCH BEARING INSPECTION

Smooth engagement and disengagement of the clutch depends on the condition of this bearing.
Inspect the clutch release bearing for any abnormality, particularly cracks, to decide whether it can be reused or should be replaced.

CLUTCH SLEEVE HUB/PRIMARY DRIVEN GEAR ASSEMBLY

Inspect the slot of the clutch sleeve hub and primary driven gear assembly for damage or wear caused by the clutch plates.
If necessary, replace it with a new one.



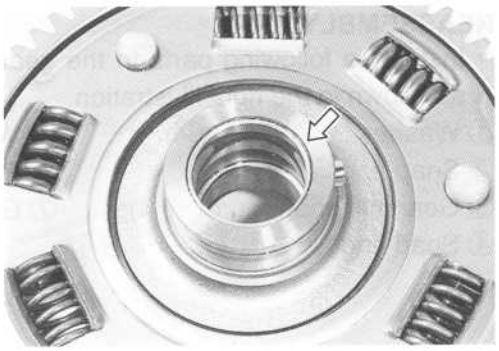
PRIMARY DRIVEN GEAR ASSEMBLY

DISASSEMBLY

- Remove the snap ring ①.
- Remove the oil pump drive gear ② and pin.

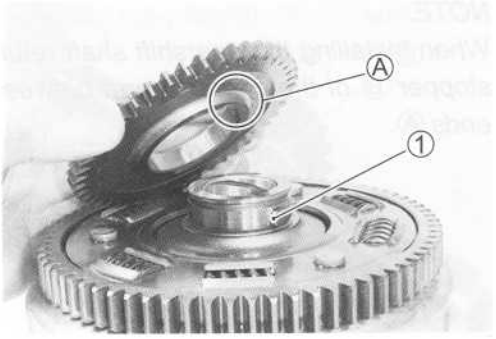
INSPECTION

Inspect the primary driven gear bushing for any damage.
Inspect the spring of primary driven gear for any damages.
If necessary, replace it with a new one.

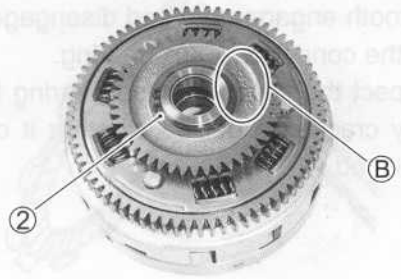


REASSEMBLY

- Install the pin ①.
- Align the oil pump drive gear slot Ⓐ with the pin ①.



- Install the oil pump drive gear with the letter Ⓑ faced upward.
- Install the snap ring ②.

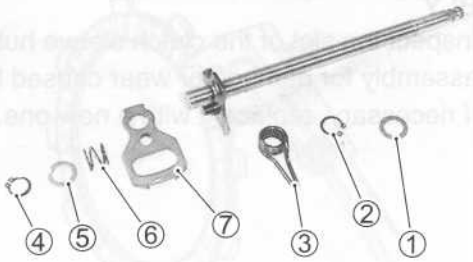


GEARSHIFT SHAFT/GEARSHIFT ARM

DISASSEMBLY

- Remove the following parts from the gearshift shaft/gearshift arm.

① Washer
② Snap ring
③ Gearshift shaft return spring
④ Snap ring
⑤ Washer
⑥ Plate return spring
⑦ Gearshift cam drive plate



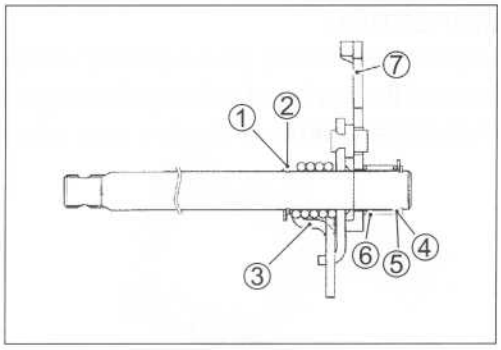
INSPECTION

Check the gearshift shaft/gearshift arm for wear or bend.
Check the return springs for damage or fatigue.

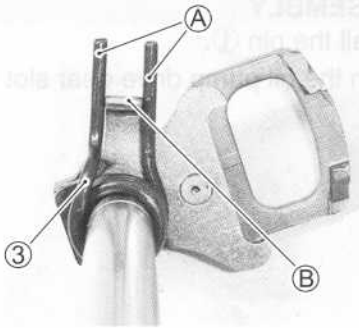
REASSEMBLY

- Install the following parts to the gearshift shaft/gearshift arm as shown in the right illustration.

① Washer
② Snap ring
③ Gearshift shaft return spring
④ Snap ring
⑤ Washer
⑥ Plate return spring
⑦ Gearshift cam drive plate



NOTE:
When installing the gearshift shaft return spring ③, position the stopper Ⓑ of the gearshift arm between the shaft return spring ends Ⓐ.



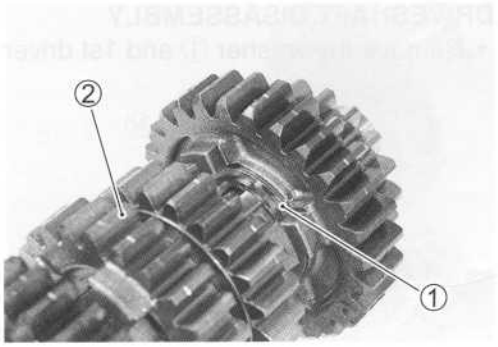
TRANSMISSION

COUNTERSHAFT DISASSEMBLY

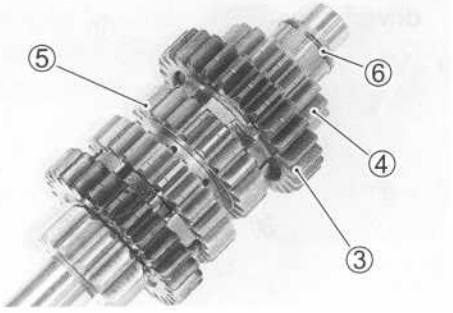
CAUTION

Be sure to identify each removed part as to its location, and lay the parts out in groups designated as "Drive" and "Driven", so that each will be restored to the original location during assembly.

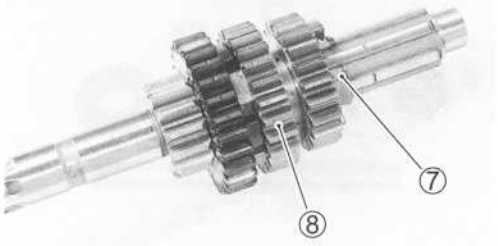
- Remove the 6th drive gear snap ring ① from its groove and slide it towards the 3rd/4th drive gears ②.



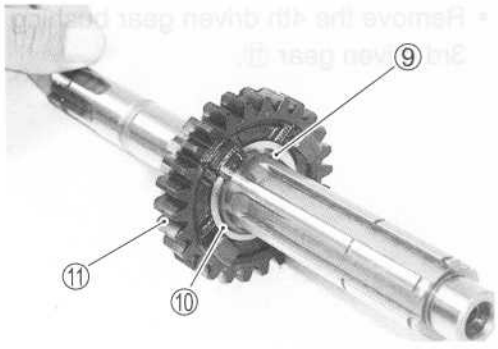
- Slide the 6th ③ and 2nd drive gears ④ toward the 3rd/4th drive gears ⑤, then remove the 2nd drive gear circlip ⑥.
- Remove the 2nd drive gear ④, 6th drive gear ③, bushing and washer.



- Remove the snap ring ⑦ and 3rd/4th drive gears ⑧.



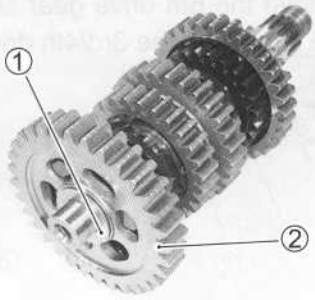
- Remove the snap ring ⑨, washer ⑩ and 5th drive gear ⑪.



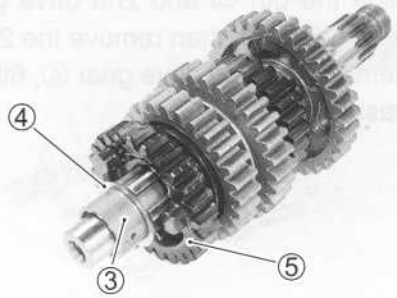
- Remove the 5th drive gear bushing ⑫.

DRIVESHAFT DISASSEMBLY

- Remove the washer ① and 1st driven gear ②.

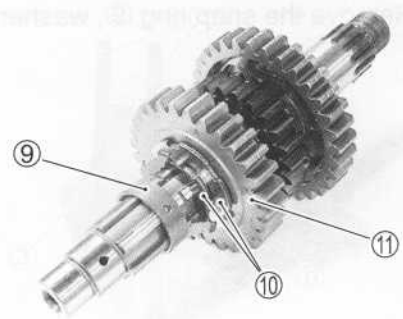


- Remove the 1st driven gear bushing ③, washer ④ and 5th driven gear ⑤.

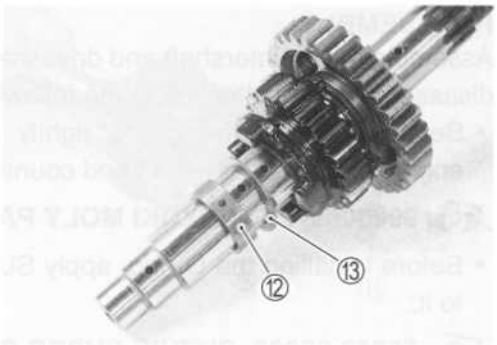


- Remove the snap ring ⑥, washer ⑦ and 4th driven gear ⑧.

- Remove the 4th driven gear bushing ⑨, lock washers ⑩ and 3rd driven gear ⑪.

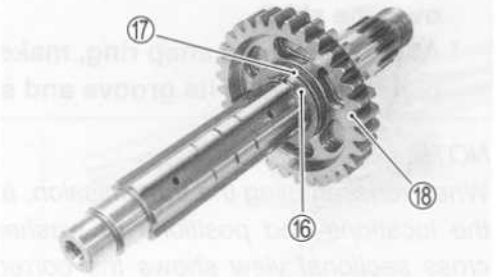


- Remove the 3rd driven gear bushing ⑫ and washer ⑬.



- Remove the snap ring ⑭ and 6th driven gear ⑮.

- Remove the snap ring ⑯ and 2nd driven gear bushing ⑰.
- Remove the 2nd driven gear ⑱.



INSPECTION

Inspect the each gear and bushing for wear and damage.
If they are found to be damaged, replace them with the new ones.

REASSEMBLY

Assemble the countershaft and driveshaft in the reverse order of disassembly. Pay attention to the following points:

- Before installing the gears, lightly coat MOLY PASTE or engine oil to the driveshaft and countershaft.

99000-25140: SUZUKI MOLY PASTE

- Before installing the O-ring, apply SUZUKI SUPER GREASE to it.

99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)

NOTE:

** Rotate the bushings by hand to inspect for smooth rotation. Replace the bushings if there is anything unusual.*

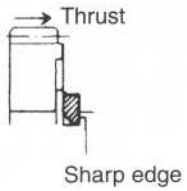
CAUTION

*** Never reuse a snap ring. After a snap ring has been removed from a shaft, it should be discarded and a new snap ring must be installed.**
*** When installing a new snap ring, do not expand the end gap larger than required to slip the snap ring over the shaft.**
*** After installing a snap ring, make sure that it is completely seated in its groove and securely fitted.**

NOTE:

When reassembling the transmission, attention must be given to the locations and positions of washers and snap rings. The cross sectional view shows the correct position of the gears, bushings, washers and snap rings. (☞3-80)

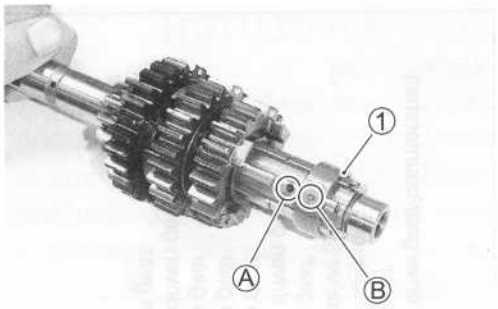
When installing a new snap ring, pay attention to the direction of the snap ring. Fit it to the side where the thrust is as shown in the illustration.

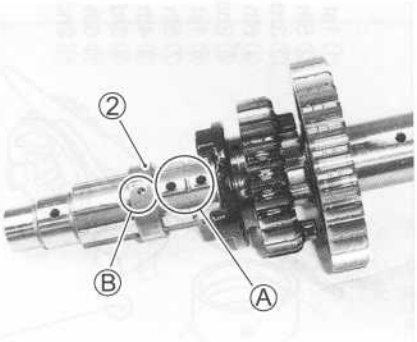


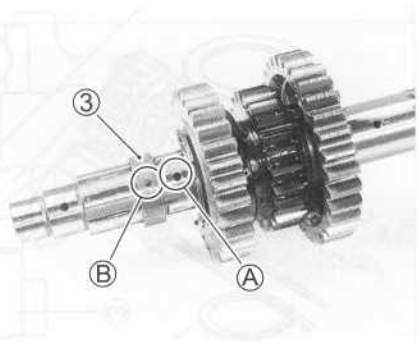
CAUTION

When installing the 6th drive gear, 3rd driven gear and 4th driven gear bushings onto the shaft, align the shaft oil hole Ⓐ with the bushing oil hole Ⓑ.

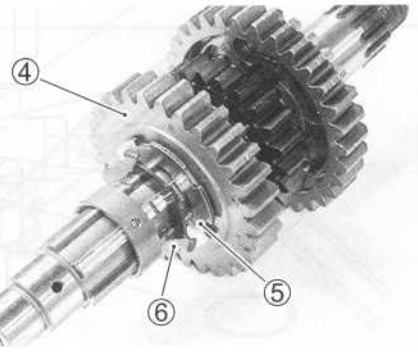
① 6th drive gear bushing
② 3rd driven gear bushing
③ 4th driven gear bushing

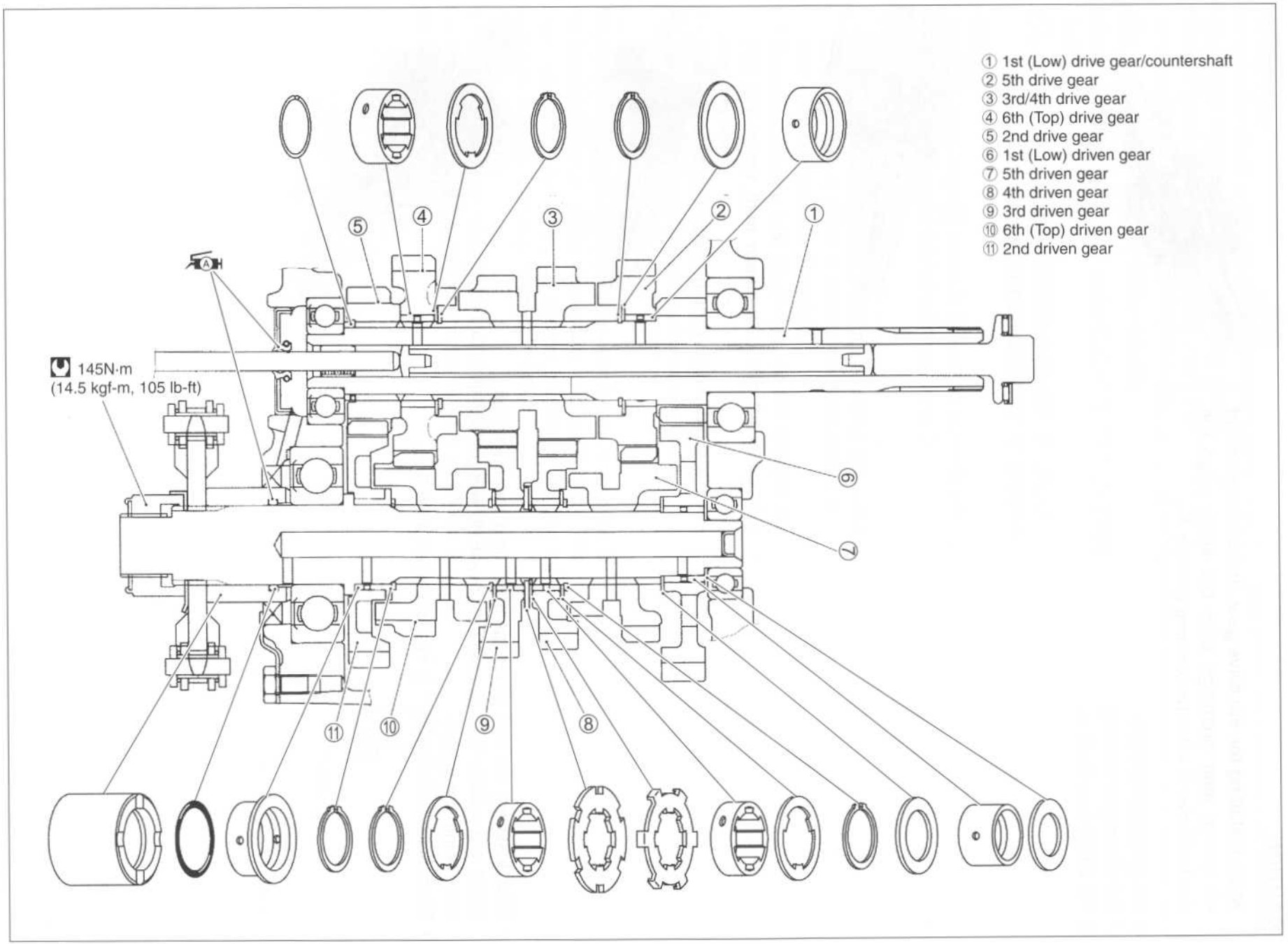






- After installing the 3rd driven gear ④ onto the driveshaft, install lock washer No.2 ⑤ onto the driveshaft, and position it so it fits into the groove.
- Then, fit lock washer No.1 ⑥ into lock washer No.2 ⑤.




① 1st (Low) drive gear/countershaft
② 5th drive gear
③ 3rd/4th drive gear
④ 6th (Top) drive gear
⑤ 2nd drive gear
⑥ 1st (Low) driven gear
⑦ 5th driven gear
⑧ 4th driven gear
⑨ 3rd driven gear
⑩ 6th (Top) driven gear
⑪ 2nd driven gear
A
145N·m
(14.5 kgf-m, 105 lb-ft)

GEARSHIFT FORK TO GROOVE CLEARANCE

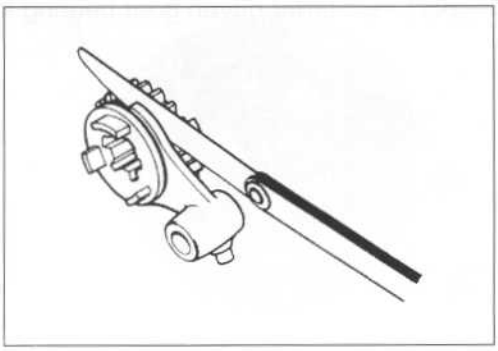
Using a thickness gauge, check the gearshift fork clearance in the groove of its gear.

The clearance for each gearshift fork plays an important role in the smoothness and positiveness of the shifting action.

DATA Shift fork to groove clearance
Service Limit: 0.50 mm (0.020 in)

TOOL 09900-20803: Thickness gauge
09900-20102: Vernier calipers

If the clearance checked is noted to exceed the limit specified, replace the fork or its gear, or both.

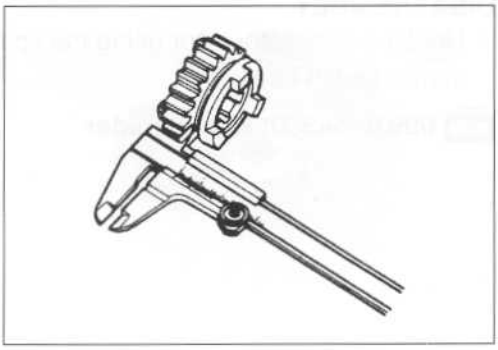


GEARSHIFT FORK GROOVE WIDTH

- Measure the gearshift fork groove width using the vernier calipers.

DATA Shift fork groove width
Standard: 5.5 – 5.6 mm (0.217 – 0.220 in)

TOOL 09900-20102: Vernier calipers

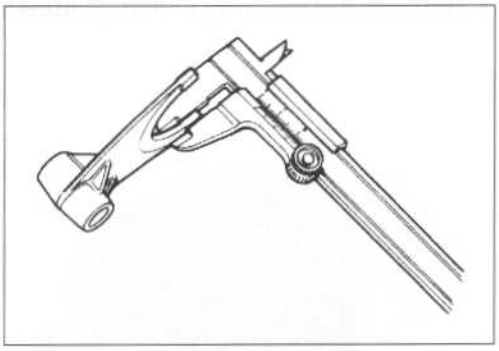


GEARSHIFT FORK THICKNESS

- Measure the gearshift fork thickness using the vernier calipers.

DATA Shift fork thickness
Standard: 5.3 – 5.4 mm (0.209 – 0.213 in)

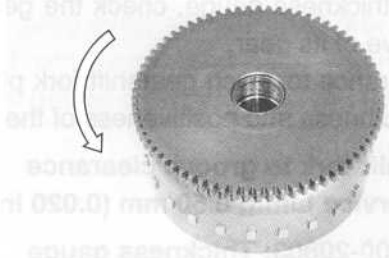
TOOL 09900-20102: Vernier calipers



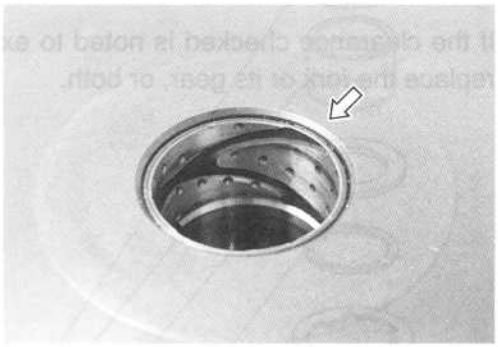
STARTER CLUTCH

INSPECTION

Install the starter driven gear onto the starter clutch and turn the starter driven gear by hand to inspect the starter clutch for a smooth movement. The gear turns in one direction only. If a large resistance is felt for rotation, inspect the starter clutch or the starter clutch contacting surface on the starter driven gear for wear and damage.
If they are found to be damaged, replace them with new ones.



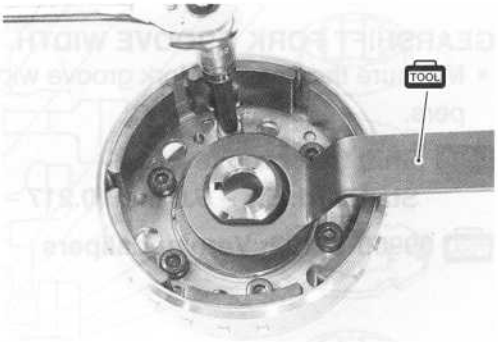
Inspect the starter driven gear bearing for any damage.



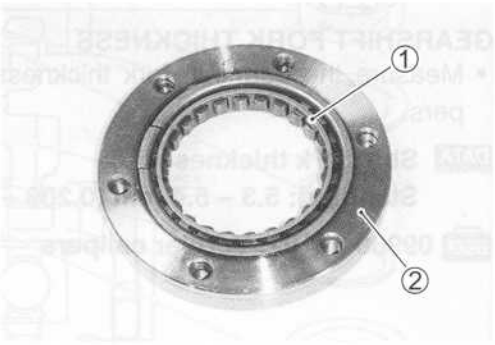
DISASSEMBLY

- Hold the generator rotor using the special tool and remove the starter clutch bolts.

TOOL 09930-44530: Rotor holder

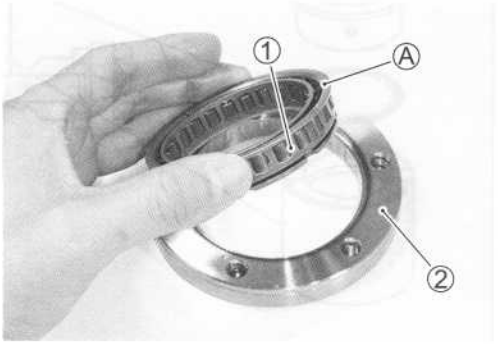


- Remove the one way clutch ① from the guide ②.

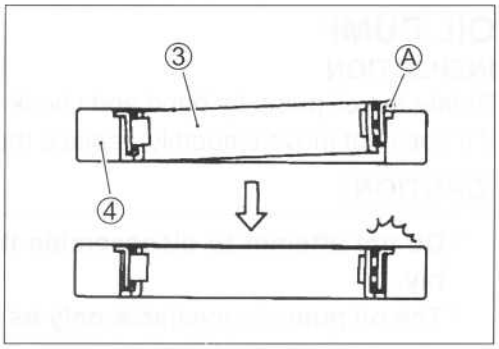


REASSEMBLY

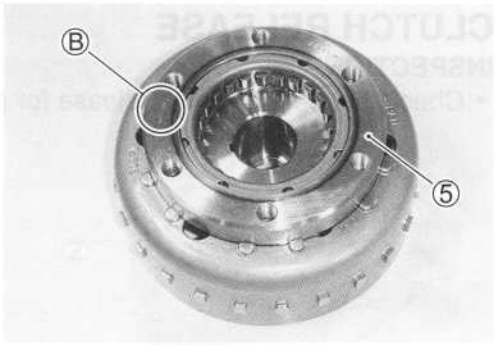
- When inserting the one-way clutch ① into the guide ②, fit the flange Ⓐ in the step of the guide ②.



- Be sure to seat the flange Ⓐ of the one way clutch ③ to the guide ④.



- Install the guide ⑤ to the generator rotor with the arrow mark Ⓑ faced upward.

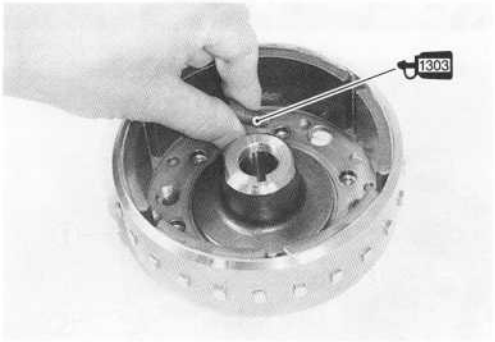


- Apply THREAD LOCK SUPER to the bolts and tighten them to the specified torque.

1303 99000-32030: THREAD LOCK SUPER "1303"

Starter clutch bolt: 25 N·m (2.5 kgf-m, 18.0 lb-ft)

- Apply engine oil to the one way clutch.



GENERATOR AND SIGNAL GENERATOR

INSPECTION

Refer to pages 8-10, 27 for generator and CKP sensor inspection.

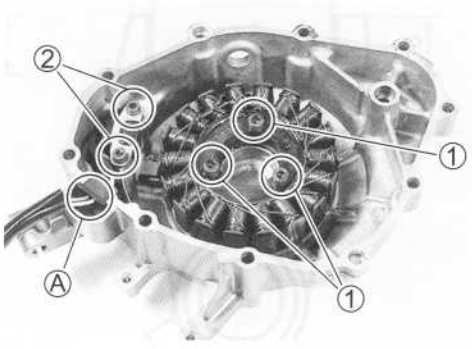
REASSEMBLY

- When installing the generator starter set bolts ① and the CKP sensor set bolts ② tighten them to the specified torque.

Generator stator set bolt: 11 N·m (1.1 kgf-m, 8.0 lb-ft)
CKP sensor set bolt: 6.5 N·m (0.65 kgf-m, 4.7 lb-ft)

NOTE:

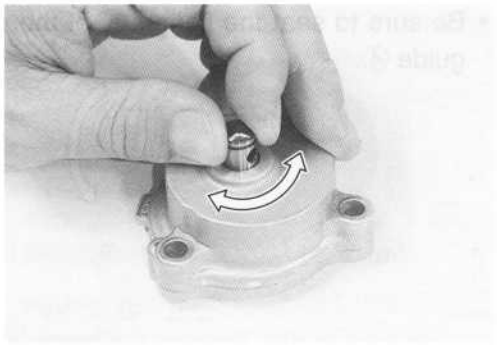
Be sure to install the grommet Ⓐ to the generator cover.



OIL PUMP

INSPECTION

Rotate the oil pump by hand and check that it moves smoothly. If it does not move smoothly, replace the oil pump assembly.



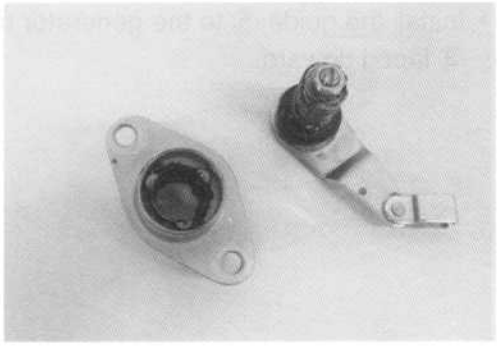
CAUTION

*** Do not attempt to disassemble the oil pump assembly.**
*** The oil pump is available only as an assembly.**

CLUTCH RELEASE

INSPECTION

- Check the teeth of clutch release for any damage and wear.



ENGINE REASSEMBLY

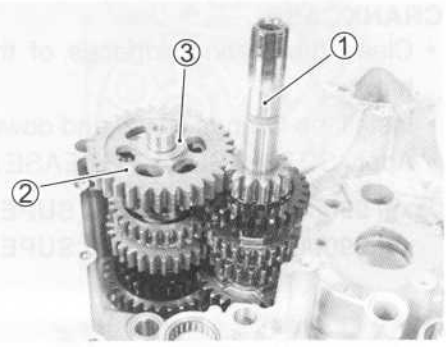
Reassemble the engine in the reverse order of disassembly.
The following steps require special attention or precautionary measures should be taken.

NOTE:
Apply engine oil to each running and sliding part before reassembling.

ENGINE BOTTOM SIDE

TRANSMISSION

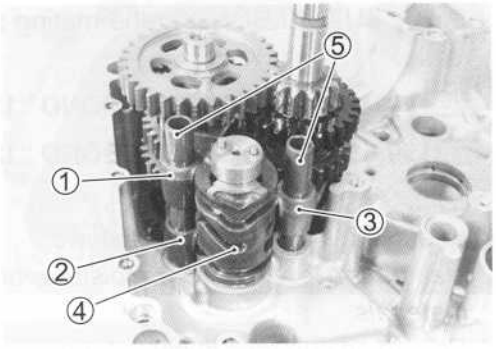
- Install the countershaft assembly ① and the driveshaft assembly ② to the left crankcase half.
- Install the washer ③ onto the driveshaft assembly ②.

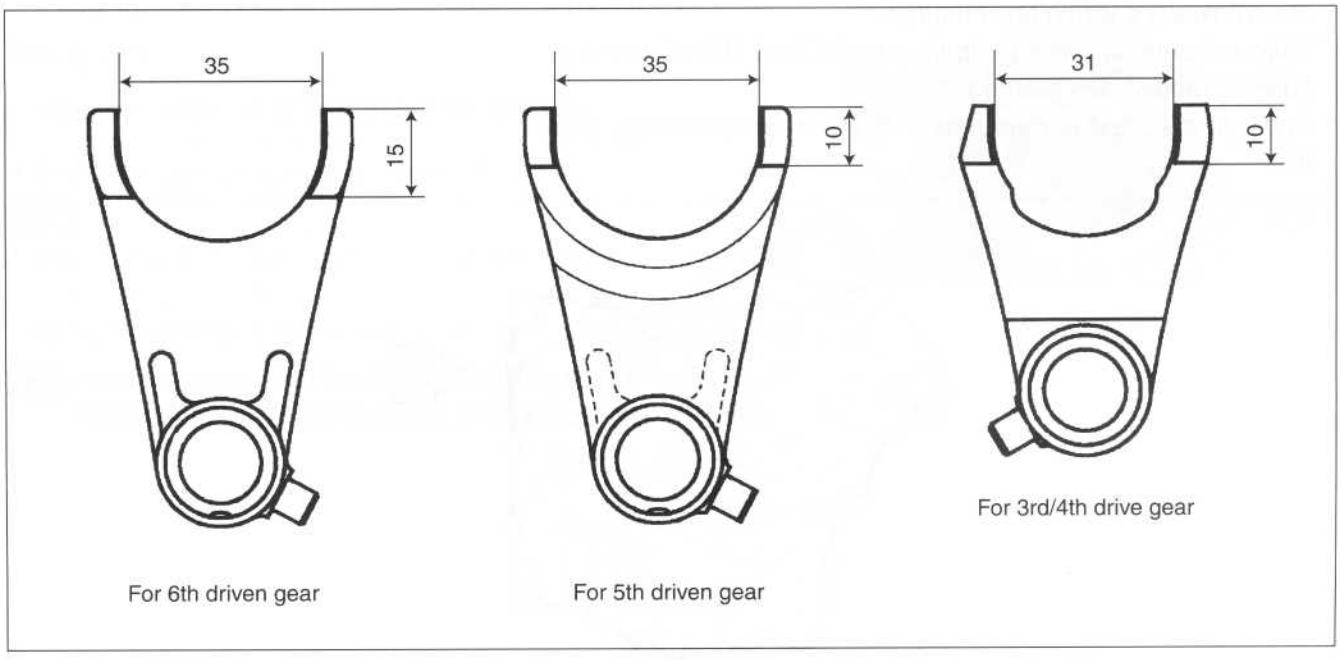


GEARSHIFT

- Install the gearshift forks ①/②/③, gearshift cam ④ and gearshift fork shafts ⑤.

NOTE:
Identify the gearshift forks as follows.
① For 5th driven gear
② For 6th driven gear
③ For 3rd/4th drive gear





CRANKSHAFT

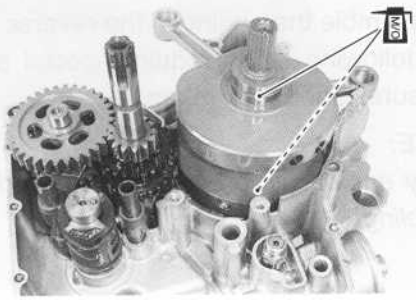
- Coat lightly MOLYBDENUM OIL SOLUTION to the crankshaft journal bearings.

MO MOLYBDENUM OIL SOLUTION

- Install the crankshaft into the left crankcase half.

CAUTION

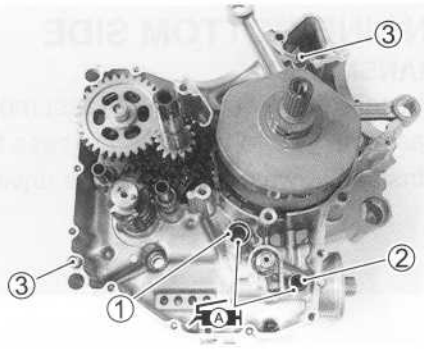
Never strike the crankshaft with a plastic hammer when inserting it into the crankcase. It will be easy to install the crankshaft to left crankcase.



CRANKCASE

- Clean the mating surfaces of the left and right crankcase halves.
- Install the O-rings ①, ② and dowel pins ③.
- Apply SUZUKI SUPER GREASE to the O-rings ①, ②.

A 99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)



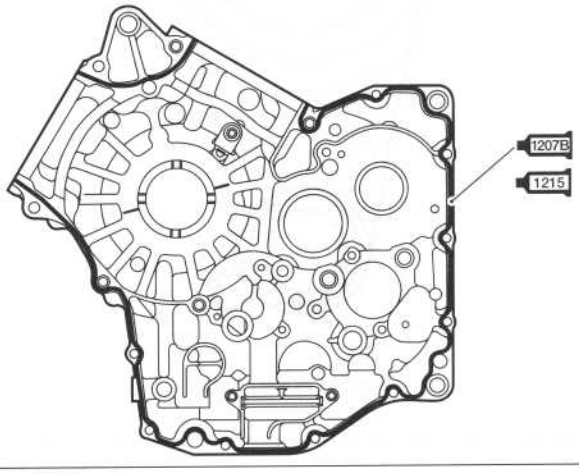
- Apply SUZUKI BOND to the mating surface of the left crankcase.

1207B 99104-31140: SUZUKI BOND "1207B" (USA)

1215 99000-31110: SUZUKI BOND "1215" (Others)

NOTE:
Use of SUZUKI BOND is as follows:

* *Make surfaces free from moisture, oil, dust and other foreign materials.*
* *Spread on surfaces thinly to form an even layer, and assemble the crankcases within few minutes.*
* *Take extreme care not to apply any SUZUKI BOND to the oil hole, oil groove and bearing.*
* *Apply to distorted surfaces as it forms a comparatively thick film.*

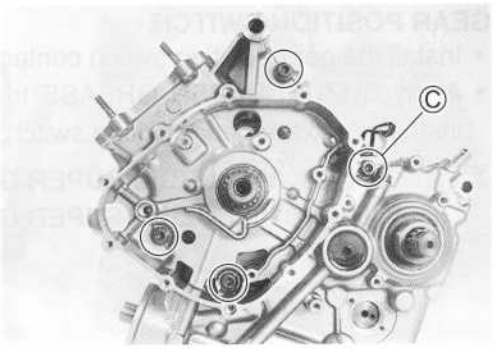


- When securing the right and left crankcase halves, tighten each bolt a little at a time to equalize the pressure. Tighten all the securing bolts to the specified torque values.

Crankcase bolt: (M8) 26 N·m (2.6 kgf-m, 19.0 lb-ft)
(M6) 11 N·m (1.1 kgf-m, 8.0 lb-ft)

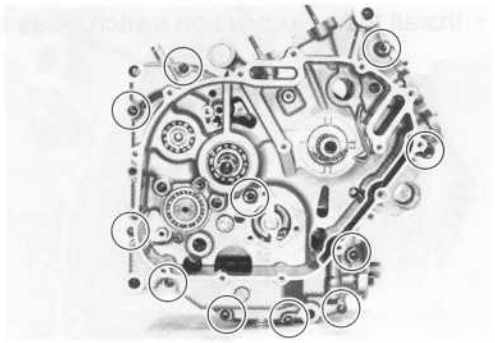
CAUTION

Do not drop the O-ring into the crankcase when assembling the right and left crankcase halves.



NOTE:

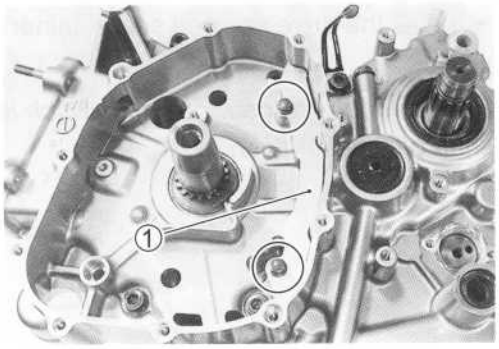
* *After the crankcase bolts have been tightened, check if the crankshaft, the driveshaft and the countershaft rotate smoothly.*
* *Fit the clamp to the bolt Ⓒ as shown.*



OIL PLATE

- Install the oil plate ① and the oil plate bolts tighten to the specified torque.

Oil plate bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)



ENGINE SPROCKET SPACER

- Install the new O-ring ① into the engine sprocket spacer ②.

CAUTION

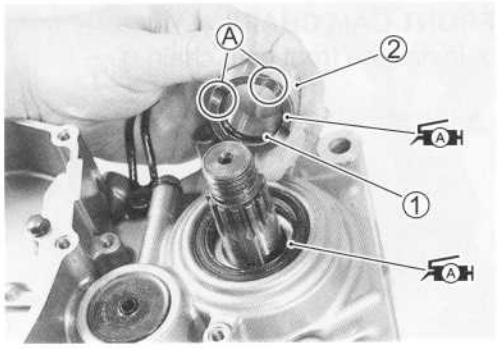
Use the new O-ring to prevent oil leakage.

- Install the engine sprocket spacer ②.

NOTE:

* *The grooved Ⓐ side of the engine sprocket spacer ① must face crankcase side.*
* *Apply SUZUKI SUPER GREASE to the oil seal lip and O-ring.*

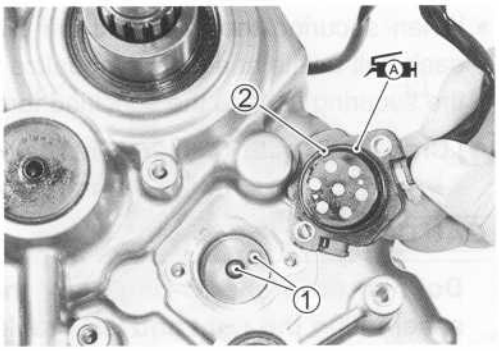
99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)



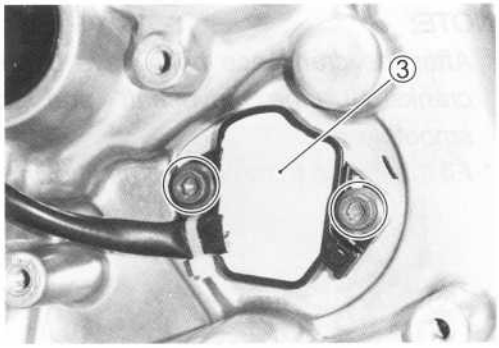
GEAR POSITION SWITCH

- Install the gear position switch contacts ① and springs.
- Apply SUZUKI SUPER GREASE to the O-ring ② and then install it onto the gear position switch.

99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)

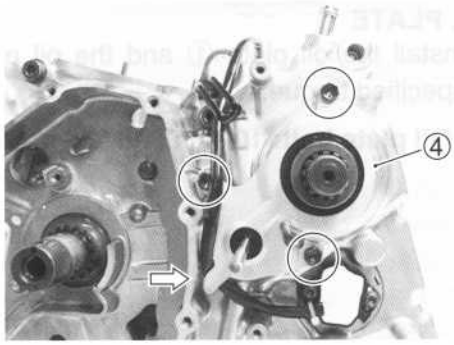


- Install the gear position switch ③ as shown.



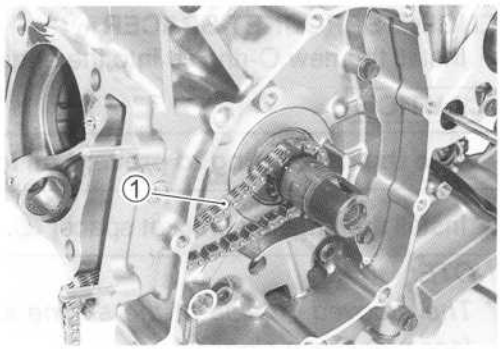
- Install the drive shaft oil seal retainer ④.

NOTE:
Pass through the gear position switch lead wire under the drive-shaft oil seal retainer.



FRONT CAM CHAIN

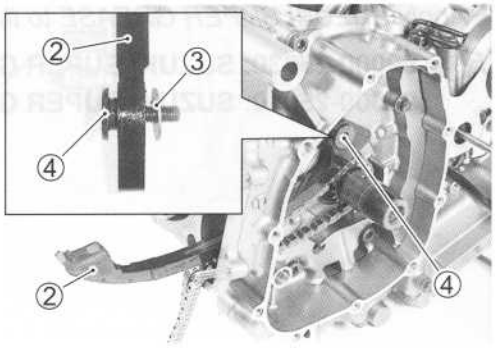
- Install the front cam chain ①.



- Install the cam chain tensioner ②, washer ③ and cam chain tensioner bolt ④.
- Tighten the cam chain tensioner bolt ④ to the specified torque.

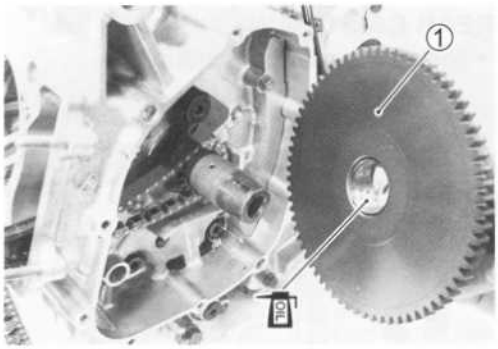
Cam chain tensioner bolt: 10 N·m (1.0 kgf-m, 7.0 lb-f)

NOTE:
The front and rear cam chain tensioners are the same.

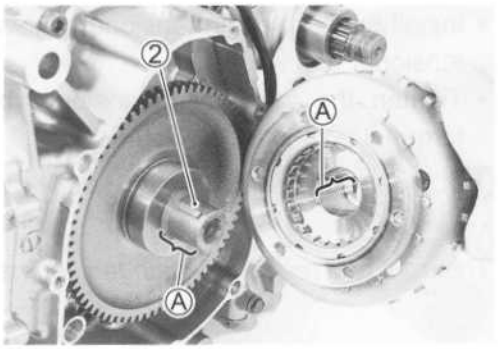


GENERATOR ROTOR

- Install the starter driven gear ①.
- Apply engine oil to the bushing of the starter driven gear.



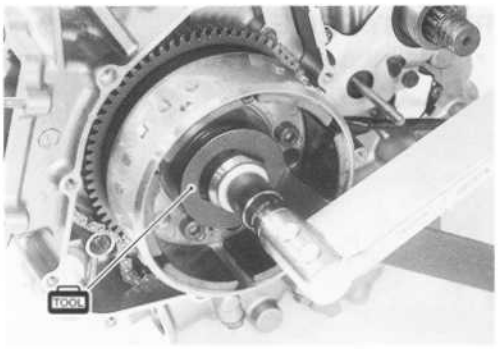
- Degrease the tapered portions Ⓐ of the generator rotor assembly and the crankshaft. Use nonflammable cleaning solvent to wipe off oily or greasy matter and make these surfaces completely dry.
- Fit the key ② in the key slot on the crankshaft completely.
- Install the generator rotor assembly onto the crankshaft.



- While holding the generator rotor with the special tool, tighten its bolt to the specified torque.

TOOL 09930-44530: Rotor holder

Generator rotor bolt: 120 N·m (12.0 kgf-m, 87 lb-ft)



CAM CHAIN DRIVE SPROCKET

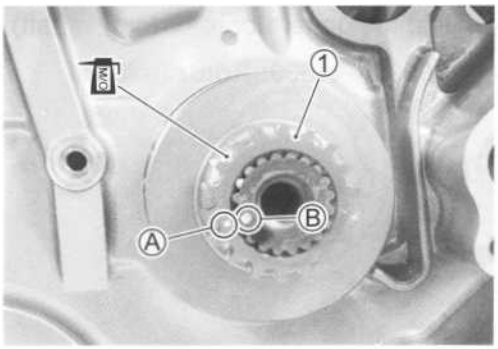
- Install the cam chain drive sprocket ① onto the crankshaft.

NOTE:

** Align the punched mark Ⓐ on the cam chain drive sprocket with the punched mark Ⓑ on the crankshaft.*

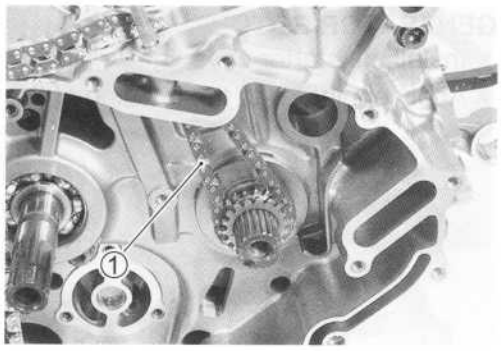
** Apply MOLYBDENUM OIL SOLUTION to the cam chain drive sprocket.*

MO MOLYBDENUM OIL SOLUTION



REAR CAM CHAIN

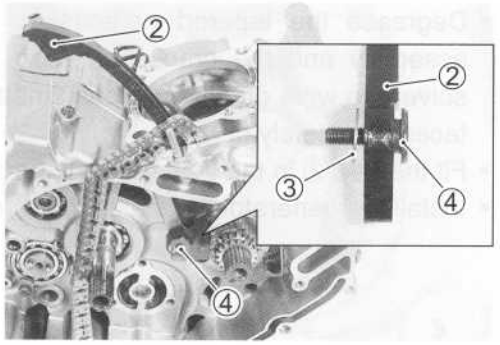
- Install the rear cam chain ①.



- Install the cam chain tensioner ②, washer ③ and cam chain tensioner bolt ④.
- Tighten the cam chain tensioner bolt ④ to the specified torque.

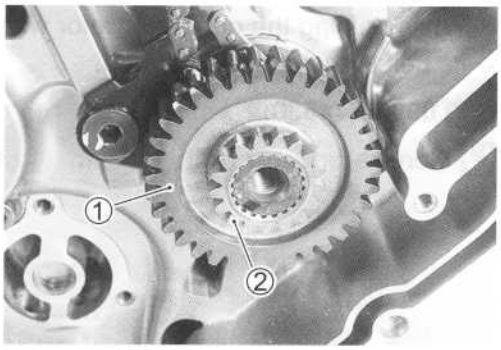
Cam chain tensioner bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)

NOTE:
The front and rear cam chain tensioners are the same.



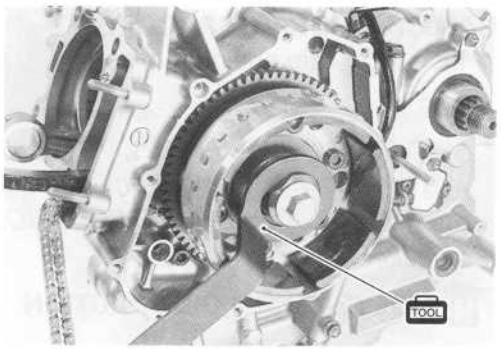
PRIMARY DRIVE GEAR

- Install the primary drive gear ① and water pump drive gear ②.



- Hold the generator rotor (crankshaft) with the special tool.

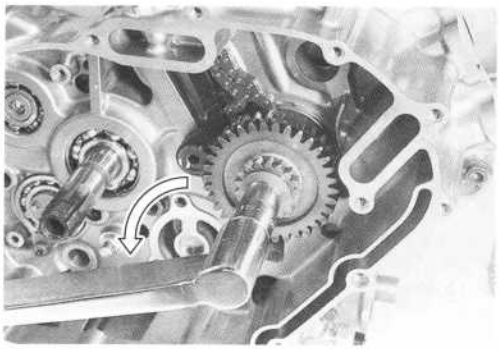
09930-44530: Rotor holder



- Tighten the primary drive gear bolt to the specified torque.

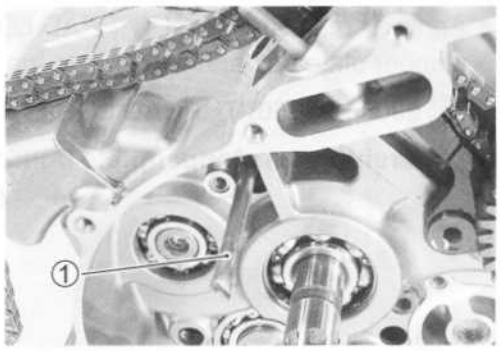
Primary drive gear bolt: 70 N·m (7.0 kgf-m, 50.5 lb-ft)

NOTE:
This bolt has left-hand thread.



OIL PIPE

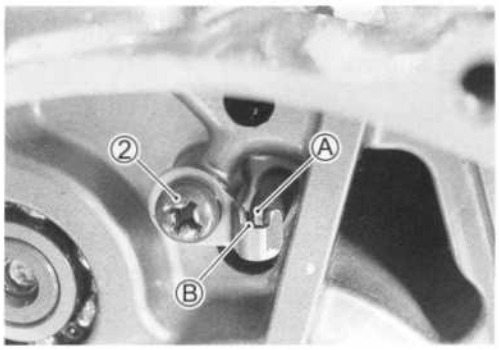
- Install the oil pipe ①.



- Tighten the oil pipe stopper screw ② to the specified torque.

Oil pipe stopper screw: 8 N·m (0.8 kgf-m, 6.0 lb-ft)

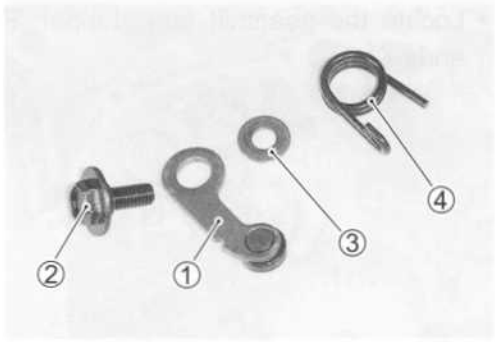
NOTE:
Align the projection Ⓐ of the oil pipe with the groove Ⓑ of its stopper.



GEARSHIFT SYSTEM

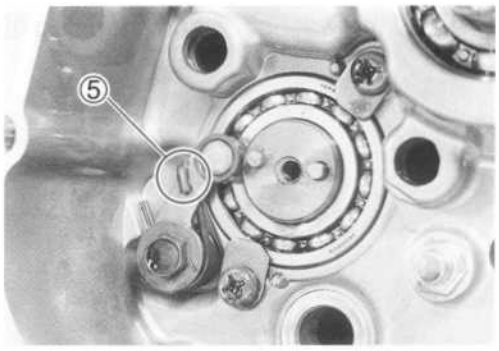
- Install the gearshift cam stopper ①, its bolt ②, washer ③ and return spring ④.

Gearshift cam stopper bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)

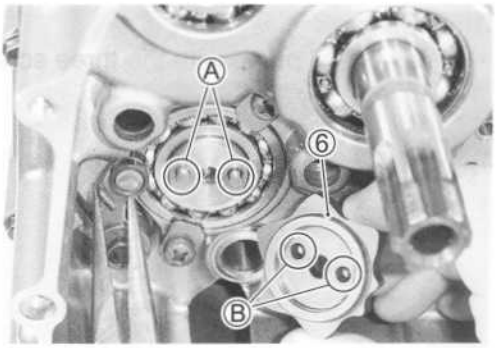


- Confirm the gearshift cam stopper movement.
- Check the neutral position.

NOTE:
Hook the return spring end ⑤ to the stopper.



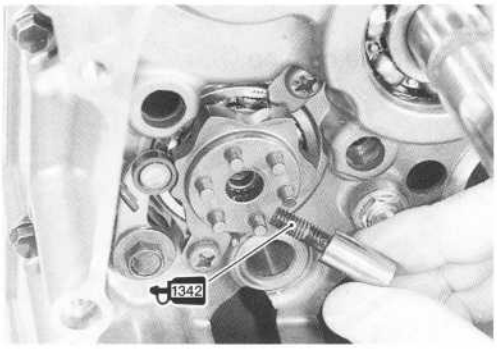
- Install the gearshift cam stopper plate ⑥ with the gearshift cam pins Ⓐ inserted into the gearshift cam stopper plate holes Ⓑ.



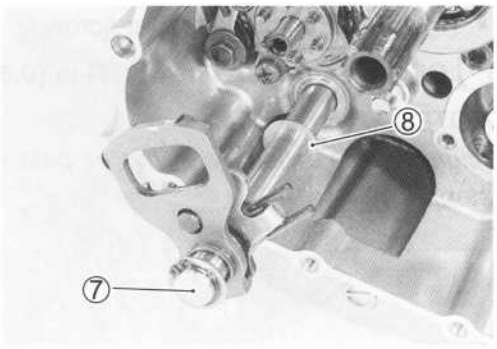
- Apply a small quantity of THREAD LOCK to the gearshift cam stopper plate bolt and tighten it to the specified torque.

1342 99000-32050: THREAD LOCK "1342"

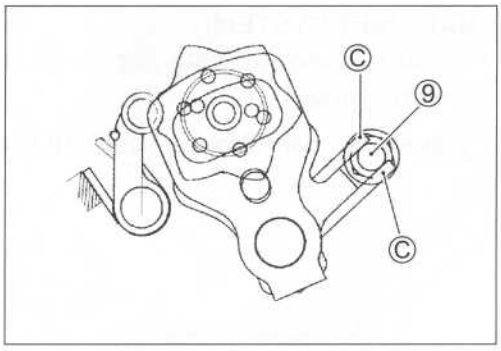
Gearshift cam stopper plate bolt: 13 N·m (1.3 kgf-m, 9.5 lb-ft)



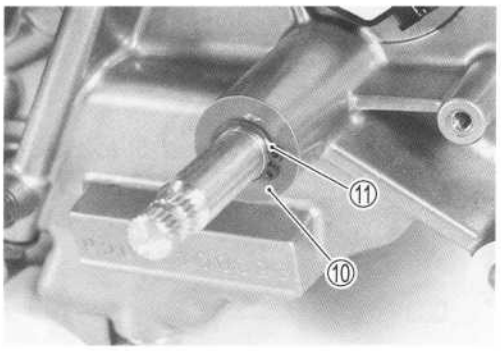
- Install the gearshift shaft/gearshift arm ⑦ with the washer ⑧ as shown.



- Locate the gearshift arm stopper ⑨ between return spring ends Ⓒ.

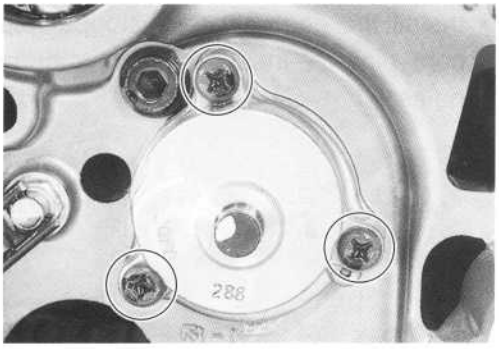


- Install the washer ⑩ and snap ring ⑪.

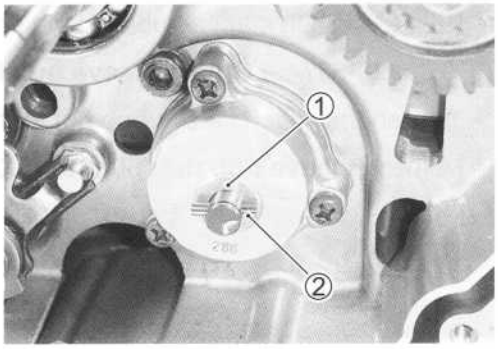


OIL PUMP

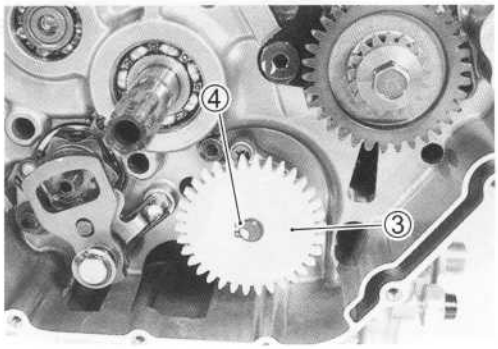
- Install the oil pump with the three screws.



- Install the washer ① and pin ②.

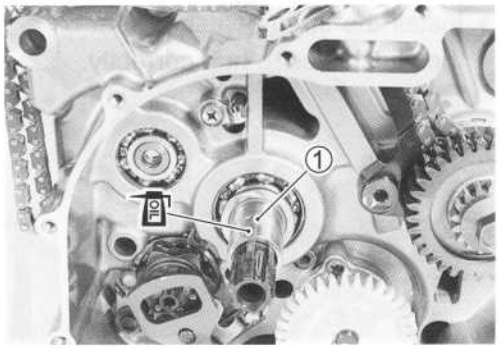


- Install the oil pump driven gear ③.
- Install the snap ring ④.



CLUTCH

- Install the spacer ① and apply ENGINE OIL to it.

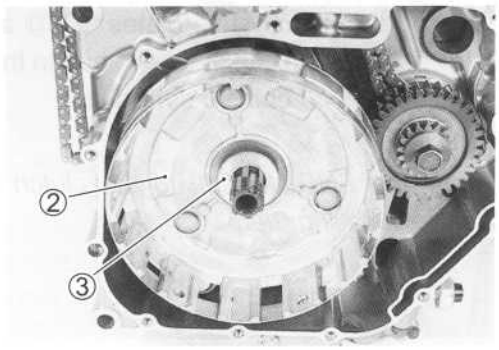


- Install the primary driven gear assembly ② onto the countershaft.

NOTE:

Be sure to engage the oil pump drive and driven gears, primary drive and driven gears.

- Install the thrust washer ③.



- Install the clutch sleeve hub ④ and lock washer ⑤.

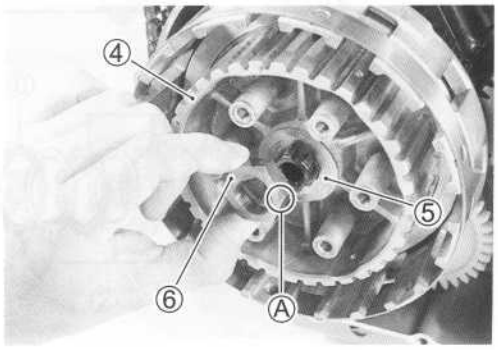
CAUTION

Replace the lock washer ⑤ with a new one.

- Install the clutch sleeve hub nut ⑥.

NOTE:

The chamfer side Ⓐ of the clutch sleeve hub nut faces outward.

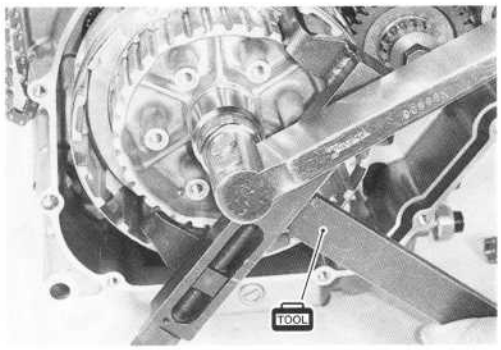


- Hold the clutch sleeve hub with the special tool.

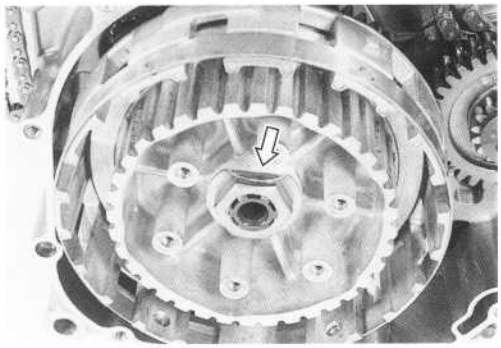
TOOL 09920-53740: Clutch sleeve hub holder

- Tighten the clutch sleeve hub nut to the specified torque.

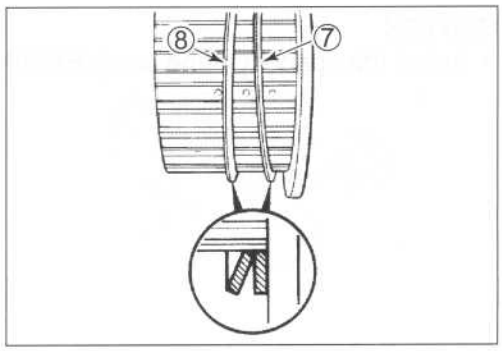
Clutch sleeve hub nut: 50 N·m (5.0 kgf-m, 36.0 lb-ft)



- Bend the lock washer to lock the nut securely.

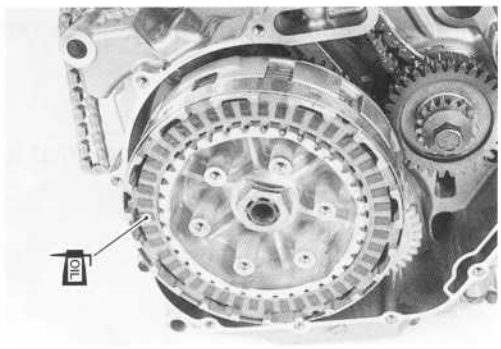


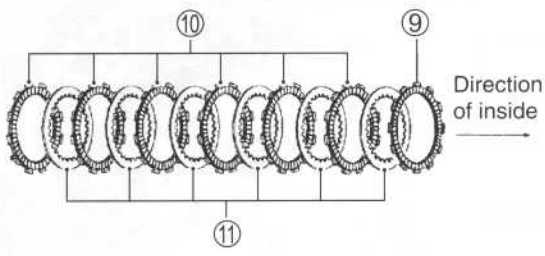
- Install the spring washer seat ⑦ and spring washer ⑧ onto the clutch sleeve hub correctly.

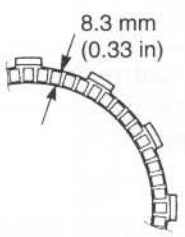


- Insert the clutch drive plates ⑨, ⑩ and driven plates ⑪ one by one into the clutch sleeve hub in the prescribed order, No.2 drive plate ⑨ being inserted first.

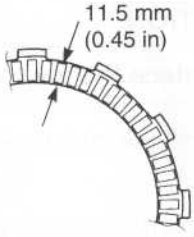
NOTE:
Apply the ENGINE OIL to the clutch driven and drive plates before installing them.





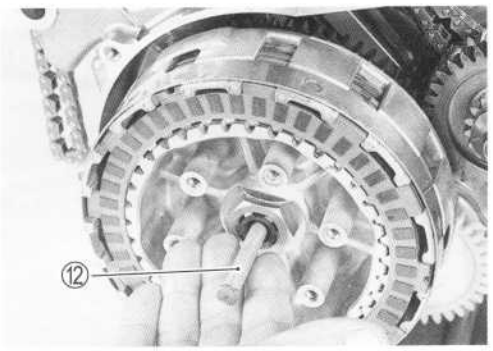


⑨ No.2 Drive plate



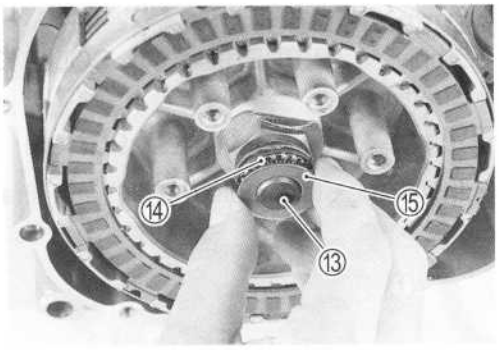
⑩ No.1 Drive plate

• Install the clutch push rod ⑫ into the countershaft.



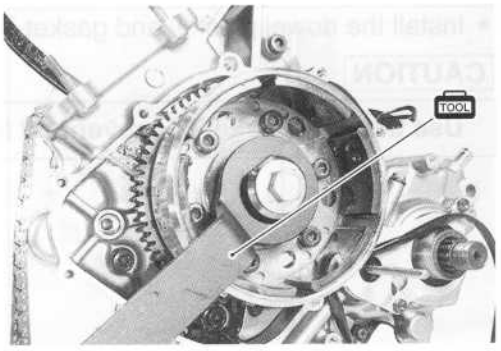
• Install the clutch push piece ⑬, the bearing ⑭ and thrust washer ⑮ to the countershaft.

NOTE:
Thrust washer ⑮ is located between the pressure plate and bearing ⑭.



• Hold the generator rotor (crankshaft) with the special tool.

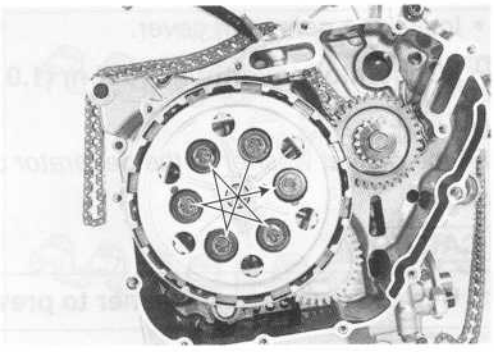
TOOL 09930-44530: Rotor holder



• Install the clutch pressure plate.
• Tighten the clutch spring set bolts to the specified torque.

Clutch spring set bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)

NOTE:
Tighten the clutch spring set bolts diagonally.

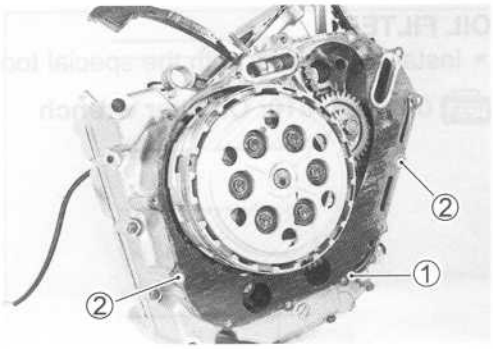


CLUTCH COVER

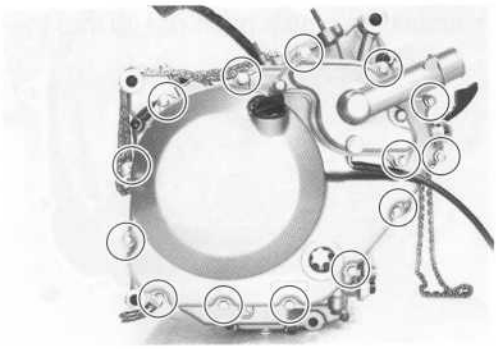
• Install the gasket ① and dowel pins ②.

CAUTION

Use the new gasket to prevent oil leakage.



- Install the clutch cover.

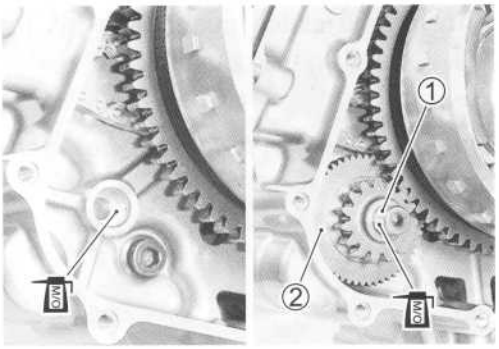


GENERATOR COVER

- Apply MOLYBDENUM OIL SOLUTION to both ends of the shaft ①.

MOLYBDENUM OIL SOLUTION

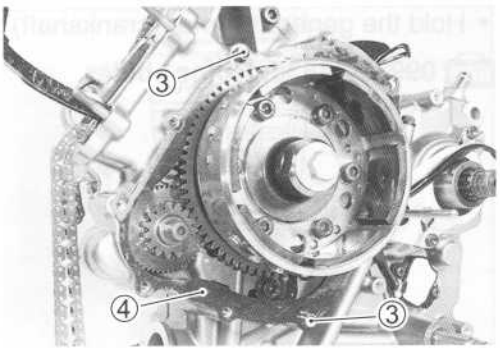
- Install the starter idle gear ② and shaft ①.



- Install the dowel pins ③ and gasket ④.

CAUTION

Use the new gasket to prevent oil leakage.



- Install the generator cover.

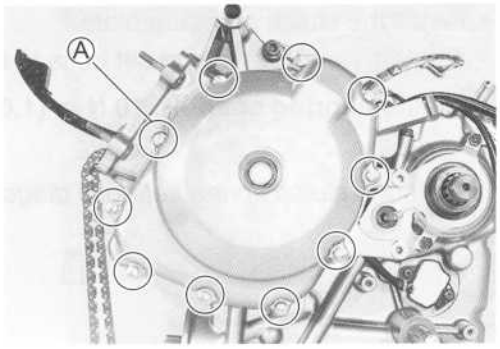
Generator cover bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)

NOTE:

Fit the gasket washer to the generator cover bolt Ⓐ correctly as shown.

CAUTION

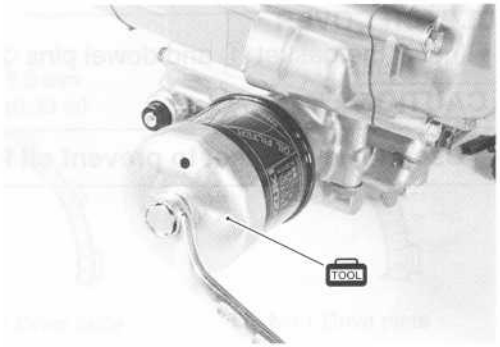
Use the new gasket washer to prevent oil leakage.



OIL FILTER

- Install the oil filter with the special tool. (☞2-15)

09915-40610: Oil filter wrench



STARTER MOTOR

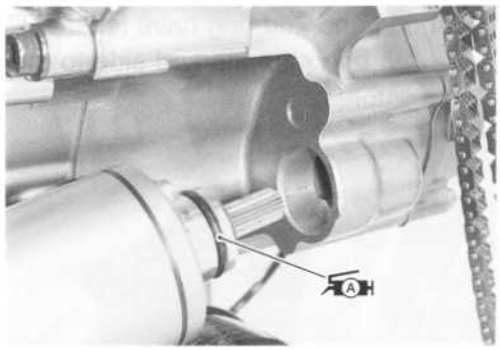
- Install the new O-ring to the starter motor.

CAUTION

Use the new O-ring to prevent oil leakage.

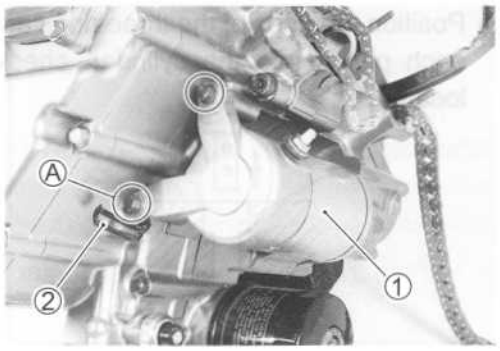
- Apply SUZUKI SUPER GREASE to the O-ring.

99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)



- Install the starter motor ①.
- Tighten the starter motor mounting bolts with the clamp ② securely.

NOTE:
First tighten the starter motor mounting bolt Ⓐ.

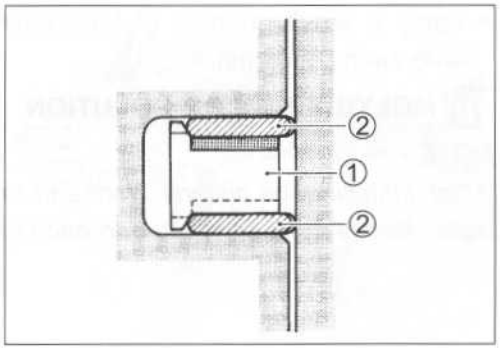


ENGINE TOP SIDE

PISTON

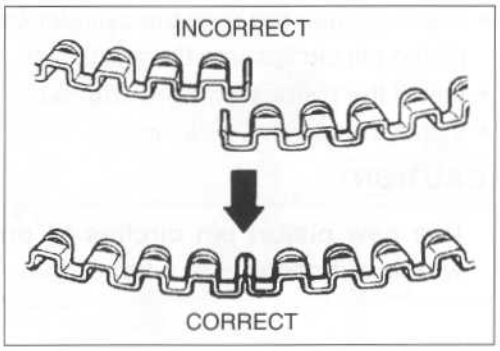
- Install the piston rings in the order of oil ring, 2nd ring and 1st ring.
- The first member to go into the oil ring groove is a spacer ①. After placing the spacer, fit the two side rails ②.

NOTE:
Side designations, top and bottom, are not applied to the spacer and side rails: you can position each either way.



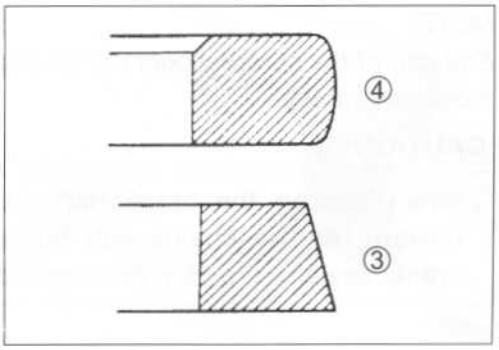
CAUTION

When installing the spacer, be careful not to allow its two ends to overlap in the groove.

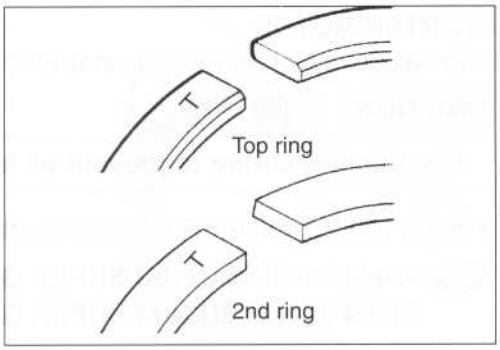


- Install the 2nd ring ③ and 1st ring ④.

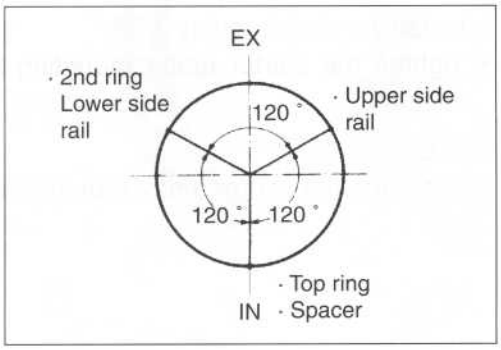
NOTE:
1st ring and 2nd ring differ in shape.



- 1st ring and 2nd ring have letters "T" marked on the side. Be sure to bring the marked side to the top when fitting them to the piston.



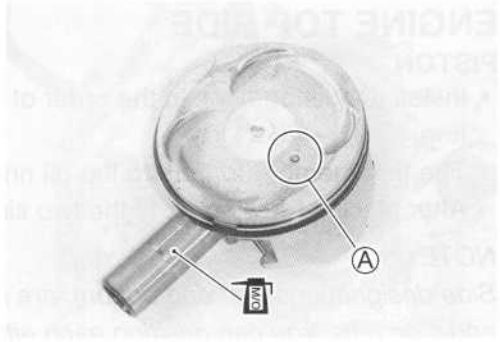
- Position the gaps of the three rings as shown. Before inserting each piston into the cylinder, check that the gaps are so located.



- Apply a small quantity of MOLYBDENUM OIL SOLUTION onto each piston pin.

M/O MOLYBDENUM OIL SOLUTION

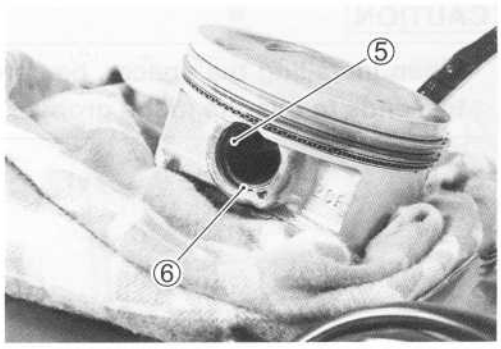
NOTE:
When installing the pistons, front and rear, the indents Ⓐ on the piston heads must be located to each exhaust side.



- Place a clean rag over the cylinder base so as not to drop the piston pin circlips into the crankcase.
- Install the pistons ⑤, front and rear.
- Install the piston pin circlips ⑥.

CAUTION

Use new piston pin circlips to prevent circlip failure which will occur with a bend one.



NOTE:
End gap of the circlip should not be aligned with the cutaway in the piston pin bore.

CAUTION

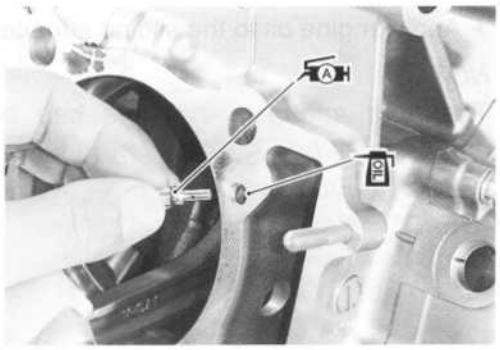
When turning the crankshaft, pull the cam chains upward, or the chains will be caught between the crankcase and the cam drive sprocket.

OIL JET

- Apply SUZUKI SUPER GREASE to the new O-rings.

A 99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)

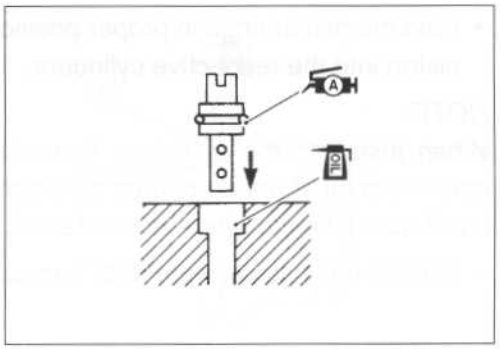
- Apply engine oil to the oil jet holes on the crankcase.



- Install each of the oil jet (#14) to the left and right crankcase, as shown in the illustration.

CAUTION

Use the new O-rings to prevent oil leakage.

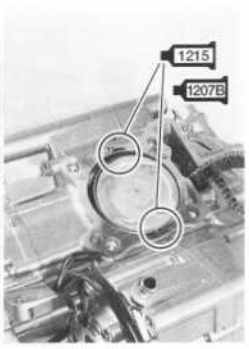


CYLINDER

- Coat SUZUKI BOND lightly to the mating surfaces at the parting line between the right and left crankcases as shown.

1207B 99104-31140: SUZUKI BOND "1207B" (USA)

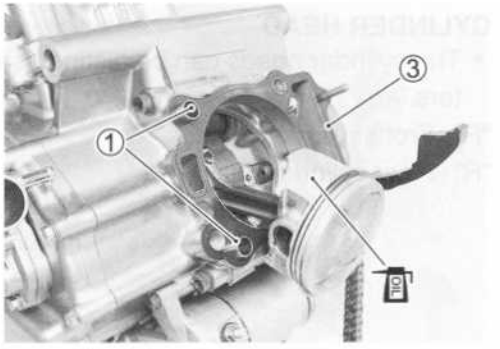
1215 99000-31110: SUZUKI BOND "1215" (Others)

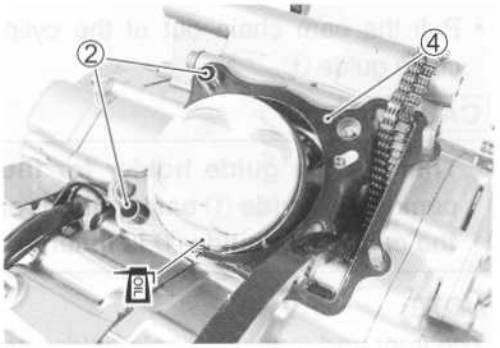


- Apply engine oil to the sliding surface of the pistons.
- Fit the dowel pins ①, ② and new gaskets ③, ④ to the crankcase.

CAUTION

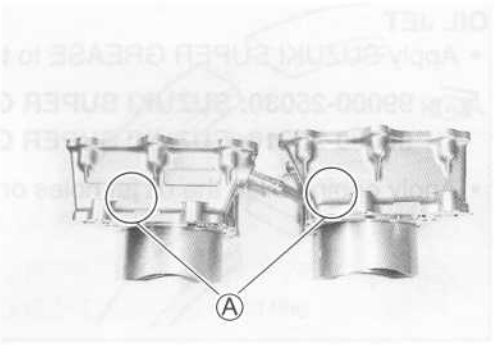
Use the new gaskets to prevent oil leakage.





- Apply engine oil to the sliding surface of the cylinders.

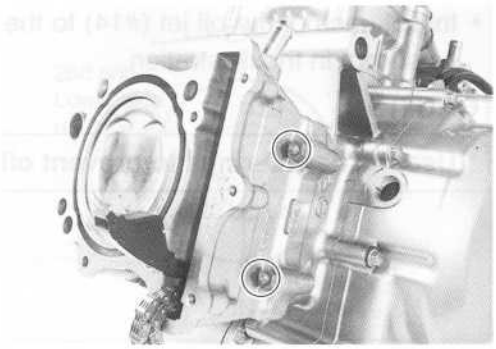
NOTE:
The front and rear cylinders can be distinguished by the embossed-letters Ⓐ.
"FRONT": Front cylinder
"REAR" : Rear cylinder

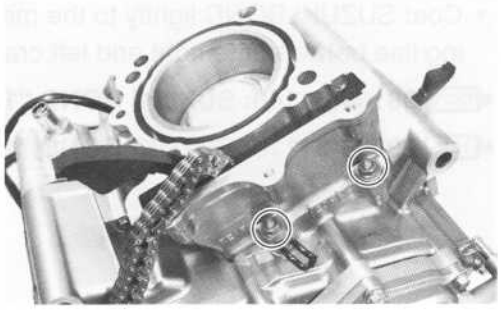


- Hold the piston rings in proper position, and insert each of the piston into the respective cylinders.

NOTE:
When installing the cylinders, keep the cam chains taut. The cam chain must not be caught between cam drive sprocket and crankcase when turning the crankshaft.

- Tighten the cylinder nuts (M6) temporarily.

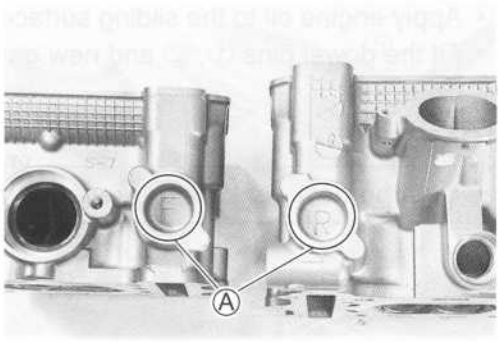




CYLINDER HEAD

- The cylinder heads can be distinguished by the embossed-letters Ⓐ.

"F" : Front cylinder head
"R": Rear cylinder head

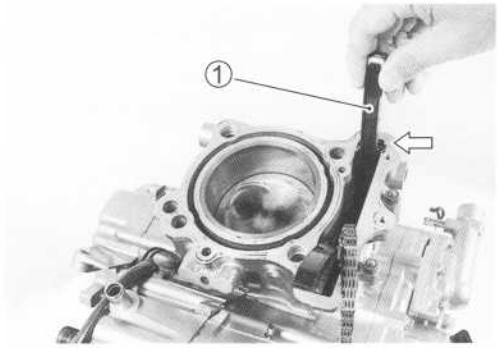


- Pull the cam chain out of the cylinder and install the cam chain guide ①.

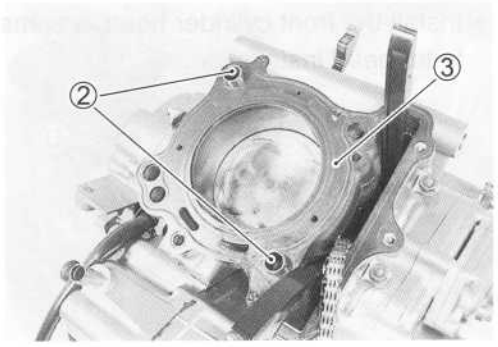
CAUTION

There is the guide holder for the bottom end of the cam chain guide ① cast in the crankcase. Be sure that the cam chain guide ① is inserted properly. (☞3-88)

NOTE:
The front and rear cam chain guides are the same.



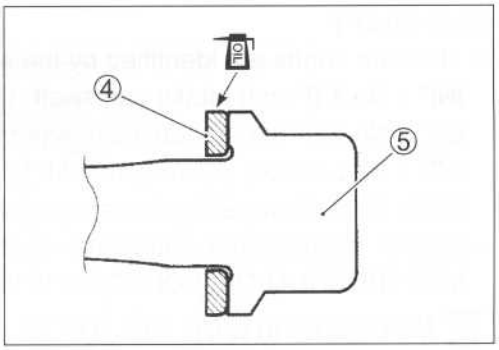
- Fit the dowel pins ② and new cylinder head gasket ③ to the cylinder.



CAUTION

Use the new gasket to prevent gas leakage.

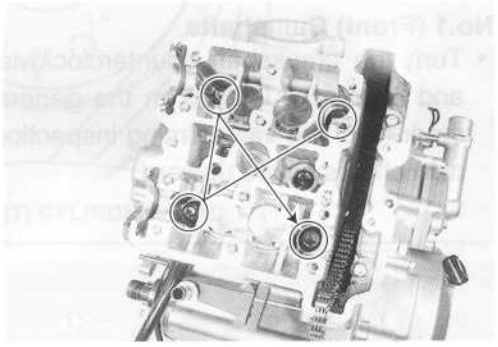
- Install the washers ④ to the cylinder head bolts (M10) ⑤ as shown.
- Apply engine oil to the washers and thread portion of the bolts before installing the cylinder head bolts.



- Place the rear cylinder head on the cylinder.

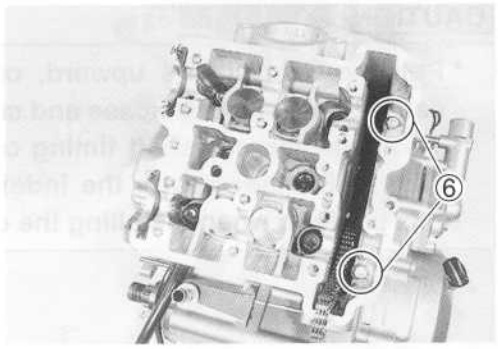
NOTE:
When installing the cylinder head, keep the cam chain taut.

- Tighten the cylinder head bolts (M10) to the specified two-step torque with a torque wrench sequentially and diagonally.

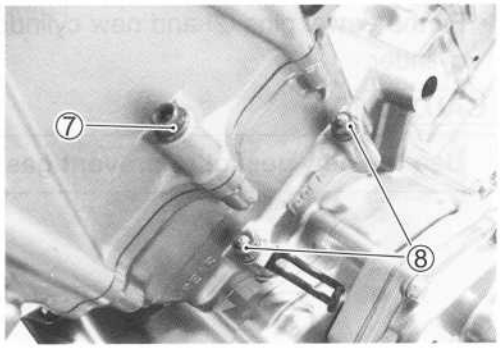


Cylinder head bolt (M10):
Initial 25 N·m (2.5 kgf-m, 18.0 lb-ft)
Final 42 N·m (4.2 kgf-m, 30.5 lb-ft)

- After firmly tightening the cylinder head bolts (M10), install the cylinder head bolts (M6) ⑥, ⑦.
- Tighten the cylinder head bolts ⑥, ⑦, and cylinder nuts ⑧.



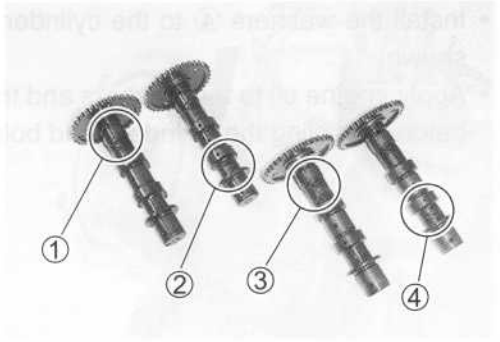
- Install the front cylinder head in same manner as the rear cylinder head installation.



CAM SHAFT

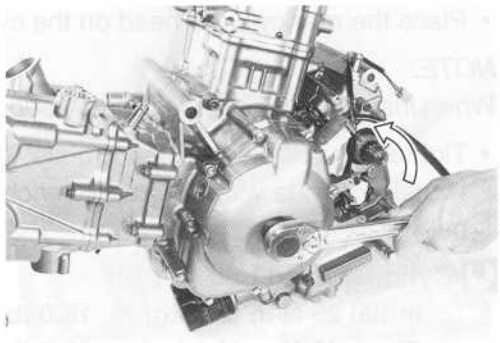
- The cam shafts are identified by the embossed letters.
  INF : No.1 (Front) intake camshaft ①
  EXF : No.1 (Front) exhaust camshaft ②
  INR : No.2 (Rear) intake camshaft ③
  EXR: No.2 (Rear) exhaust camshaft ④
- Before installing the camshafts to the cylinder head, apply MOLYBDENUM OIL SOLUTION to their journals.

MOLYBDENUM OIL SOLUTION



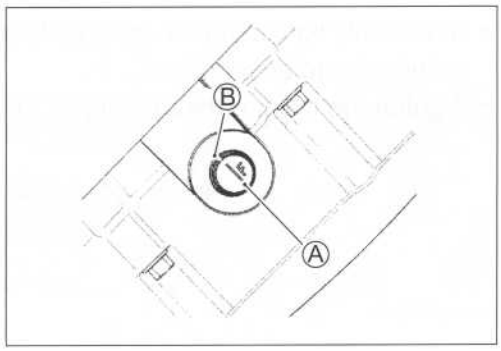
No.1 (Front) Camshafts

- Turn the crankshaft counterclockwise with the box wrench and align "|F" line Ⓐ on the generator rotor with the index mark Ⓑ of the valve timing inspection hole while keeping the cam chains pulled upward.



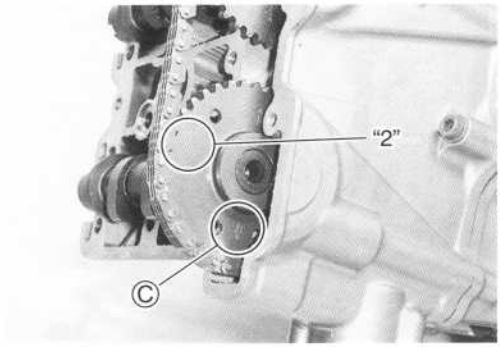
CAUTION

*** Pull the cam chains upward, or the chain will be caught between crankcase and cam drive sprocket.**
*** To adjust the camshaft timing correctly, be sure to align "|F" line Ⓐ with the index mark Ⓑ and hold this position when installing the camshafts.**

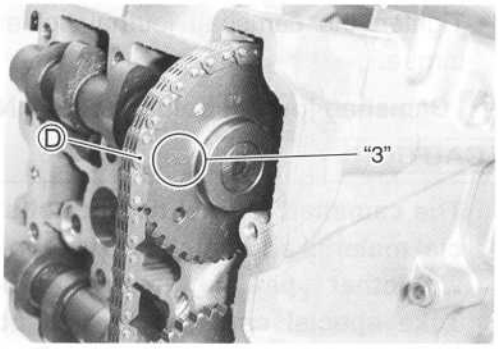


- Pull the cam chain lightly.
- The No.1 exhaust camshaft sprocket has an arrow mark "1F" Ⓒ. Install the exhaust camshaft so that the arrow Ⓒ is aligned with the mating surface of the cylinder head. (☞3-103)
- Engage the cam chain with the exhaust camshaft sprocket.

NOTE:
Before installing the camshaft, check that the tappets are installed correctly.

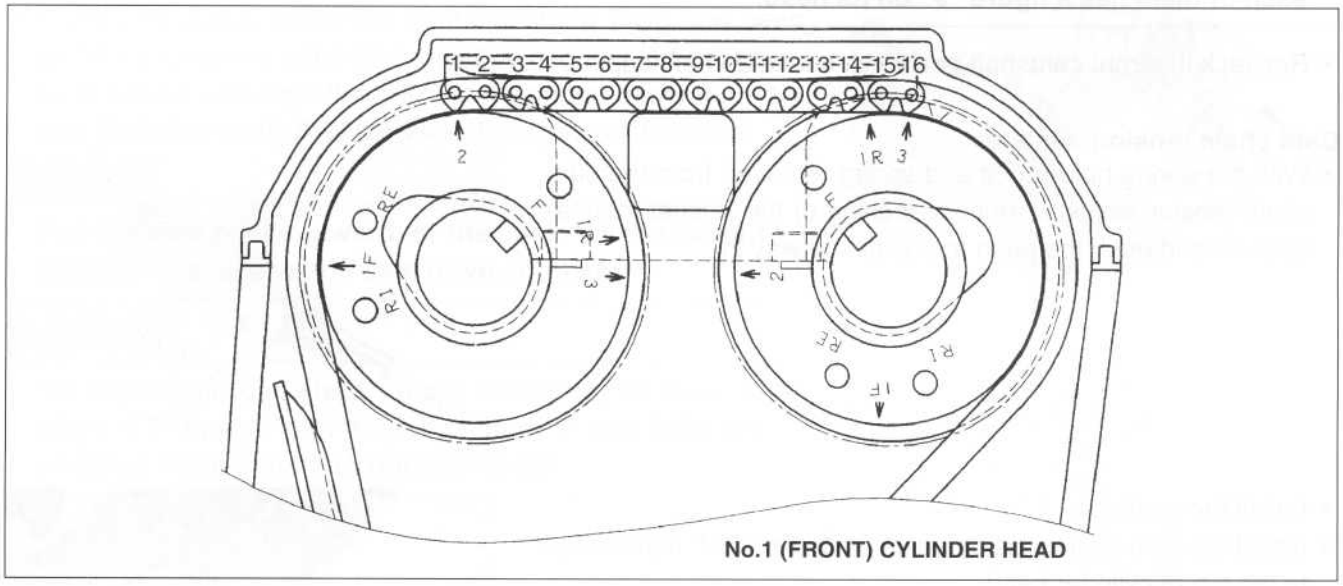


- The other arrow mark "2" on the exhaust camshaft sprocket should now be pointing straight up. Starting from the roller pin that is directly above the arrow mark "2" count out 16 roller pins (from the exhaust camshaft side going towards the intake camshaft side). Engage the 16 roller pin Ⓓ on the cam chain with the arrow mark "3" on the intake sprocket. (☞3-103)



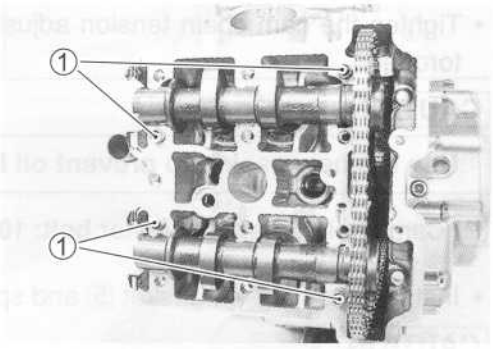
NOTE:

The cam chain should now be on all three sprockets. Be careful not to move the crankshaft until the camshaft journal holders and cam chain tension adjuster is secured.

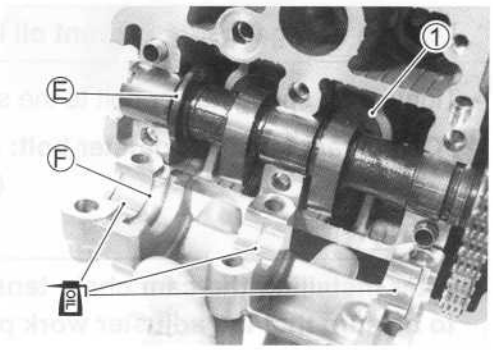


No.1 (FRONT) CYLINDER HEAD

- Install the dowel pins ①.



- Apply engine oil to the camshaft journal holders.
- Install the camshaft journal holders, intake and exhaust.
- Fasten the camshaft journal holders evenly by tightening the crankshaft journal holder bolts sequentially and diagonally.



NOTE:

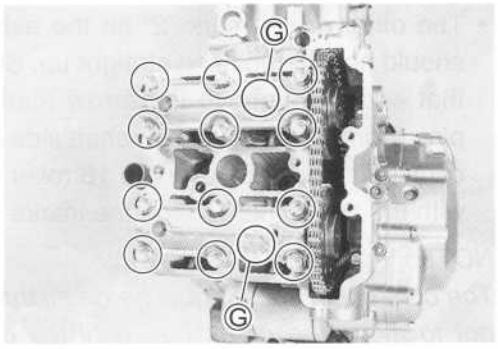
** Align the flange Ⓔ of the camshafts with the groove Ⓕ of the camshaft journal holders.*

** Damage to head or camshaft journal holder thrust surfaces may result if the camshaft journal holders are not drawn down evenly.*

** Each camshaft journal holder is identified with a cast-on letters Ⓖ.*

- Tighten the camshaft journal holder bolts to the specified torque.

Camshaft journal holder bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)



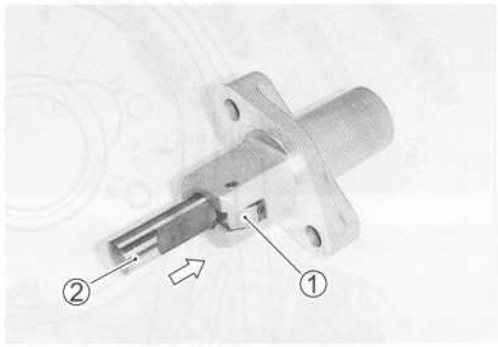
CAUTION

The camshaft journal holder bolts are made of a special material and much superior in strength, compared with other types of high strength bolts.
Take special care not to use other types of bolts instead of these special bolts. To identify these bolts, each of them has a figure "9" on its head.

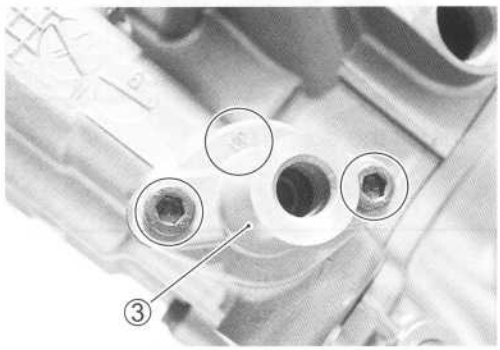
- Recheck the front camshaft positions, intake and exhaust.

Cam chain tension adjuster

- With the spring holder bolt and spring removed from the cam chain tension adjuster, release locking of the ratchet mechanism ① and push the push rod ② all the way in.



- Install the gasket.
- Install the cam chain tension adjuster ③ with "UP" mark faced to the top of cylinder head.
- Tighten the cam chain tension adjuster bolts to the specified torque.

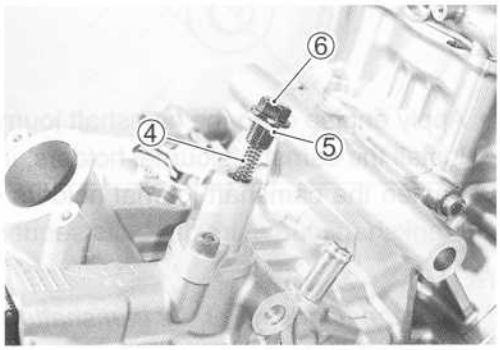


CAUTION

Use the new gasket to prevent oil leakage.

Cam chain tension adjuster bolt: 10 N·m (1.0 kgf-m 7.0 lb-ft)

- Install the spring ④, gasket ⑤ and spring holder bolt ⑥.



CAUTION

Use the new gasket to prevent oil leakage.

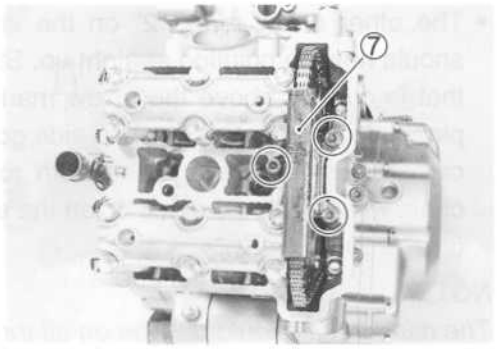
- Tighten the spring holder bolt to the specified torque.

Cam chain tension adjuster bolt: 35 N·m (3.5 kgf-m, 25.5 lb-ft)

CAUTION

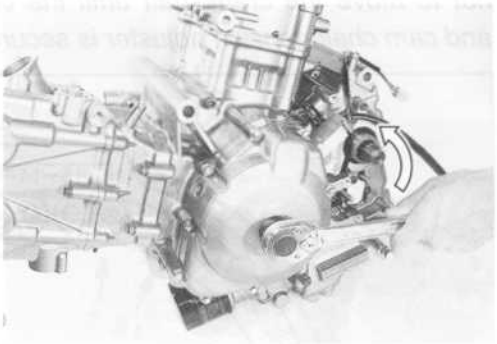
After installing the cam chain tension adjuster, check to be sure that the adjuster work properly by checking the slack of cam chain.

- Install the cam chain guide ①.



No.2 (Rear) Camshafts

- From the position where the front camshafts have now been installed, rotate the generator rotor 360 degrees (1 turn) counterclockwise and align the "| F" line Ⓐ on the generator rotor with the index mark Ⓑ of the valve timing inspection hole.

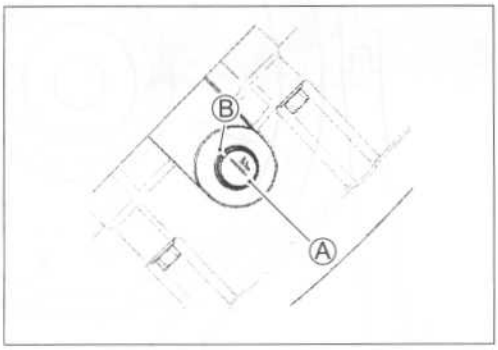


CAUTION

Pull the cam chain upward, or the chain will be caught between crankcase and cam drive sprocket.

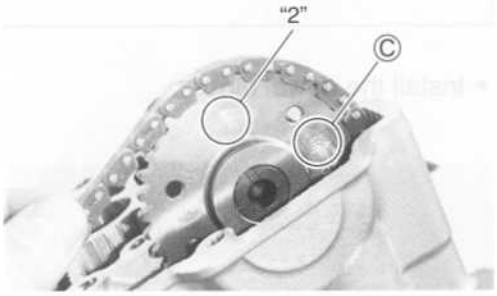
CAUTION

To adjust the camshaft timing correctly, be sure to align "| F" line Ⓐ with the index mark Ⓑ and hold this position when installing the camshafts.

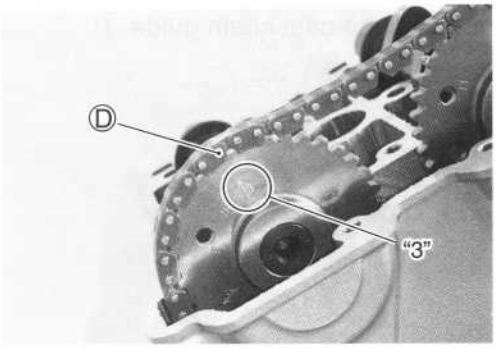


- Pull the cam chain lightly.
- The No.2 intake camshaft sprocket has an arrow mark "1R" Ⓒ. Install the intake camshaft so that the arrow Ⓒ is aligned with the mating surface of the cylinder head. (☞3-106)
- Engage the cam chain with the intake camshaft sprocket.

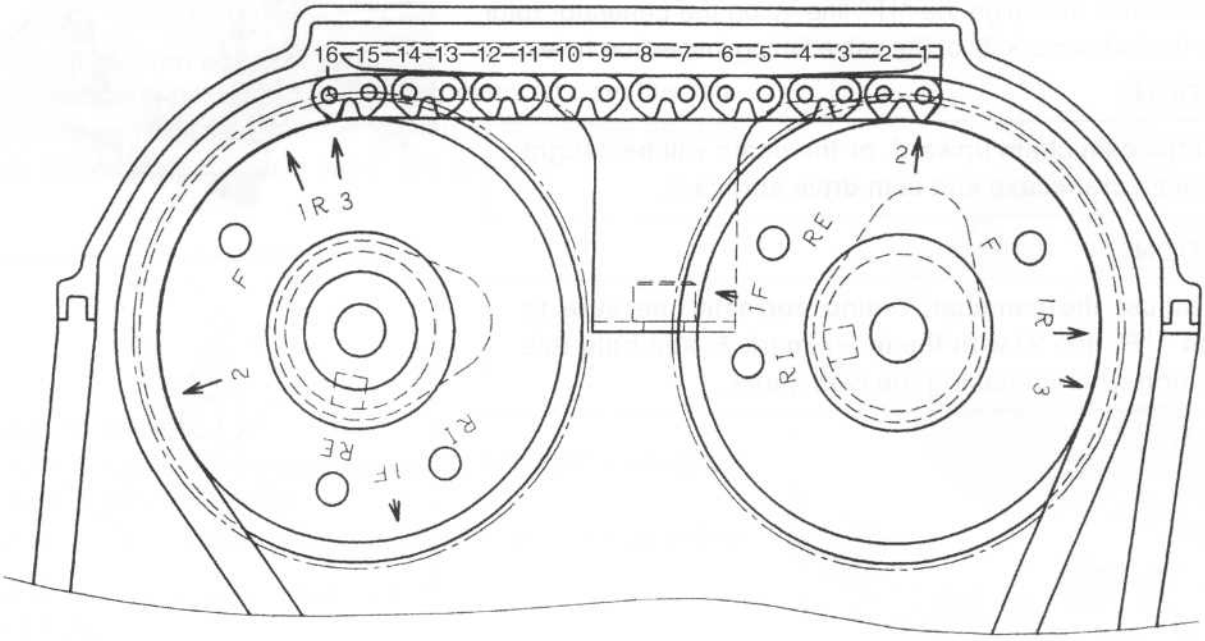
NOTE:
Before installing the camshaft, check that the tappets are installed correctly.



- The other arrow mark "2" on the intake camshaft sprocket should now be pointing straight up. Starting from the roller pin that is directly above the arrow mark "2" count out 16 roller pins (from the intake camshaft side going towards the exhaust camshaft side). Engage the 16th roller pin Ⓓ on the cam chain with the arrow mark "3" on the exhaust sprocket. (☞3-106)

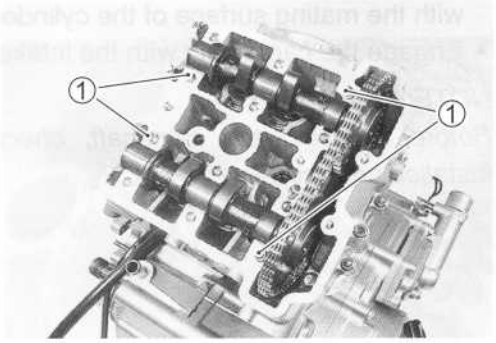


NOTE:
The cam chain should now be on all three sprockets. Be careful not to move the crankshaft until the camshaft journal holders and cam chain tension adjuster is secured.

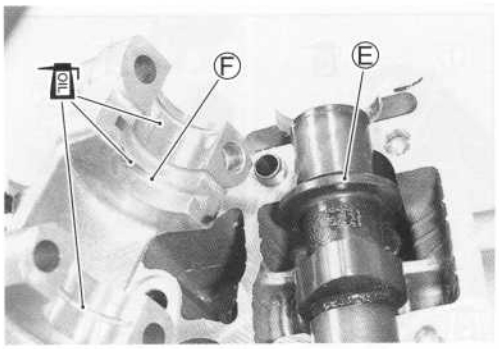


No.2 (REAR) CYLINDER HEAD

- Install the dowel pins ①.



- Apply engine oil to the camshaft journal holders.
- Install the camshaft journal holders, intake and exhaust.
- Fasten the camshaft journal holders evenly by tightening the camshaft journal holder bolts sequentially and diagonally.

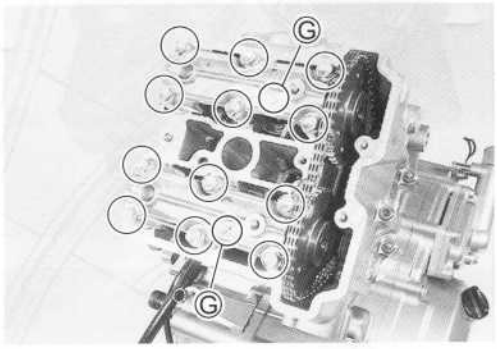


NOTE:

* *Align the flange Ⓔ of the camshafts with the groove Ⓕ of the camshaft journal holders.*
* *Damage to head or camshaft journal holder thrust surfaces may result if the camshaft journal holders are not drawn down evenly.*
* *Each camshaft journal holder is identified with a cast-on letter Ⓖ.*

- Tighten the camshaft journal holder bolts to the specified torque.

Camshaft journal holder bolt: 10 N·m (1.0 kgf-m, 7.0 lb-ft)



CAUTION

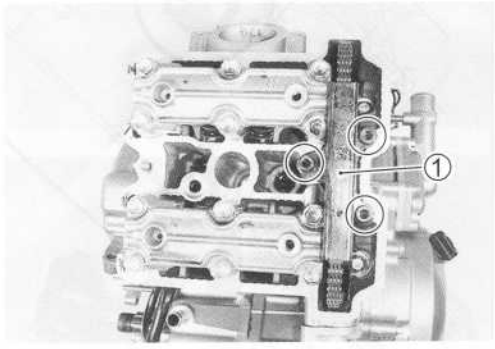
The camshaft journal holder bolts are made of a special material and much superior in strength, compared with other types of high strength bolts.
Take special care not to use other types of bolts instead of these special bolts. To identify these bolts, each of them has a figure "9" on its head.

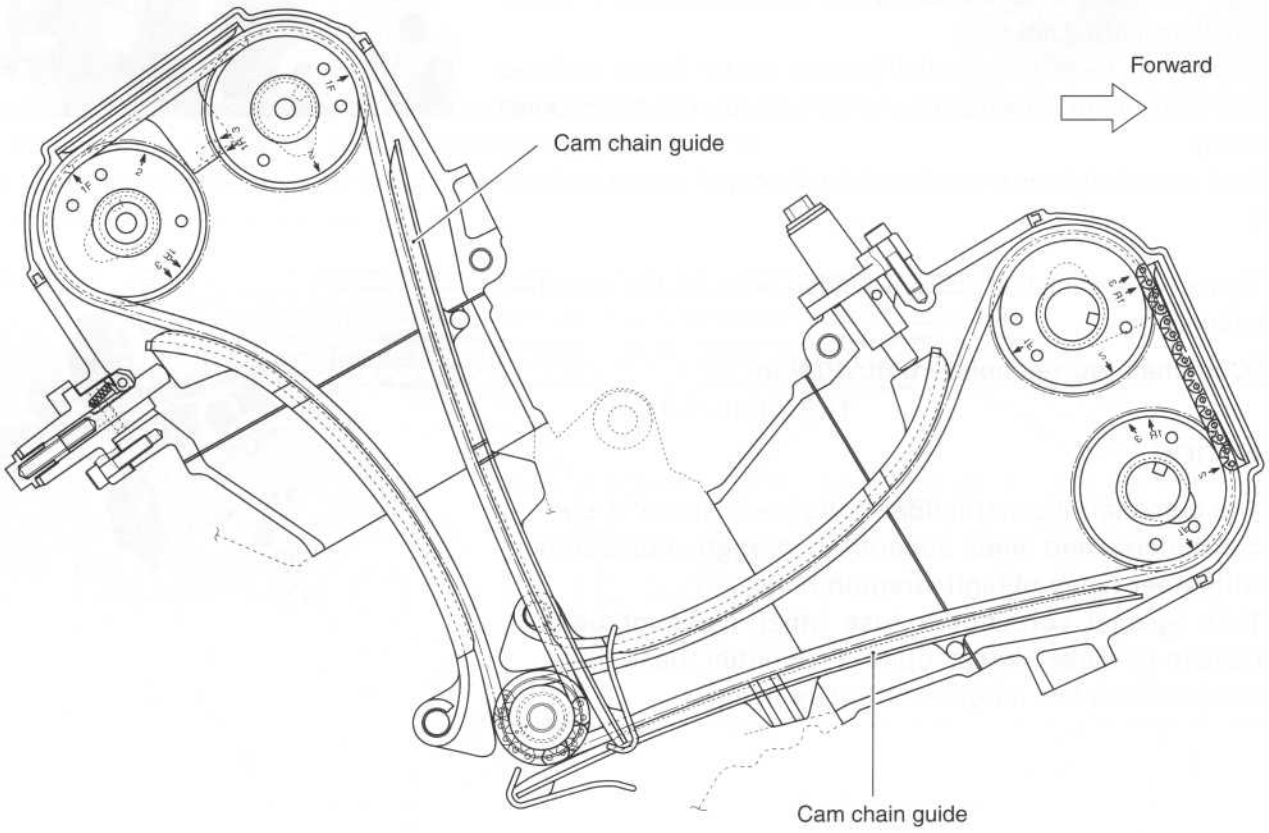
- Recheck the rear camshaft positions, intake and exhaust.

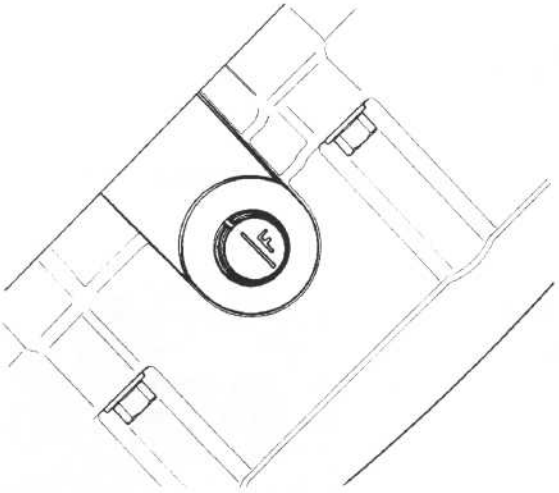
Camchain tension adjuster

- Install the camchain tension adjuster. (☞3-104)

- Install the cam chain guide ①.
- After installing the rear camshafts, rotate the generator rotor (same turns), and recheck the positions of the camshafts.







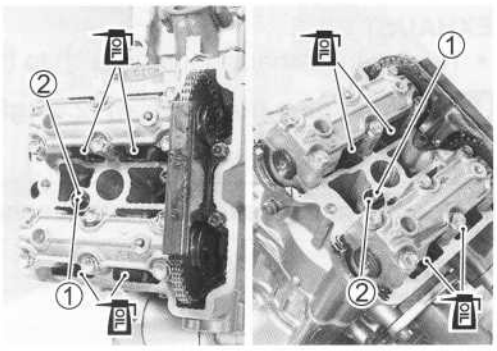
No.1 (Front) cylinde TDC of compression stroke

CYLINDER HEAD COVER

- Pour engine oil in each oil pocket in the front and rear cylinder heads.

NOTE:
Be sure to check the tappet clearance. (☞2-11)

- Install the dowel pins ① and O-rings ②.



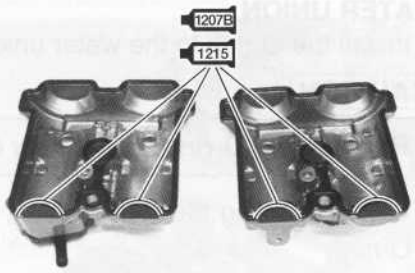
- Install the new gaskets to each cylinder head cover.
- Apply SUZUKI BOND to the cam end caps of the gaskets.

1207B 99104-31140: SUZUKI BOND "1207B" (USA)

1215 99000-31110: SUZUKI BOND "1215" (Others)

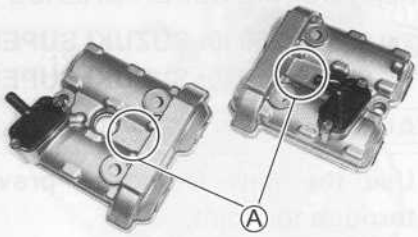
CAUTION

Use the new gaskets to prevent oil leakage.



- The cylinder head covers can be distinguished by the embossedletters Ⓐ.

"F": Front cylinder head cover
"R": Rear cylinder head cover



- Install the cylinder head covers on each cylinder head.
- Fit the gaskets ③, ④ to each head cover bolt.

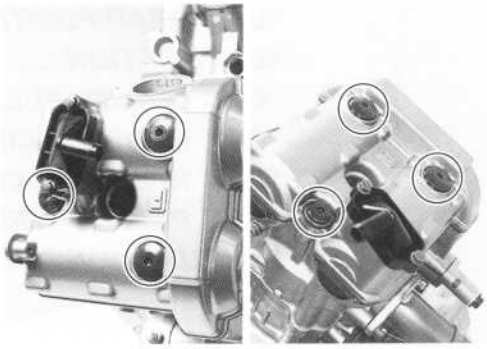
CAUTION

Use the new gaskets to prevent oil leakage.

NOTE:
The metal side of the gasket ③ must face to the bolt flange.

- After applying engine oil to the gaskets tighten the head cover bolts to the specified torque.

Head cover bolt: 14 N·m (1.4 kgf-m, 10.0 lb-ft)



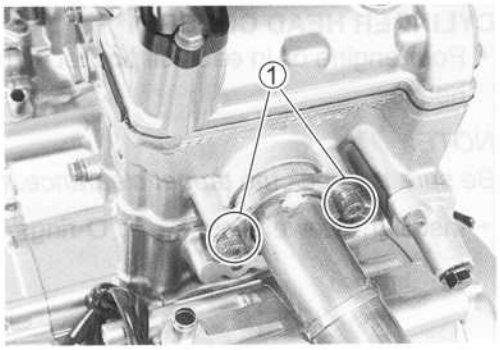
EXHAUST PIPE

- Tighten the exhaust pipe bolts ① to the specified torque.

Exhaust pipe bolt: 23 N·m (2.3 kgf-m, 16.5 lb-ft)

CAUTION

Use the new gasket to prevent exhaust gas leakage.



WATER UNION

- Install the O-ring to the water union.

CAUTION

Replace the O-ring with a new one.

- When installing the water union, apply engine coolant to the O-ring.

LLC ENGINE COOLANT

INTAKE PIPE

- Apply SUZUKI SUPER GREASE to the O-ring.

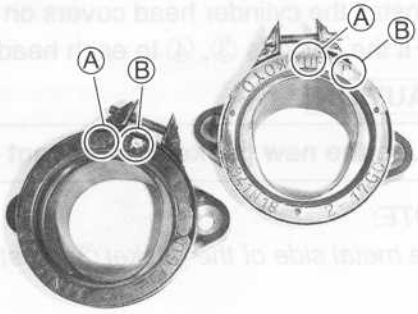
99000-25030: SUZUKI SUPER GREASE "A" (USA)
99000-25010: SUZUKI SUPER GREASE "A" (Others)

CAUTION

Use the new O-ring to prevent air from sucking through the joint.

- Make sure that the "UP" mark Ⓐ faces upward.
- Install the intake pipes.

NOTE:
The intake pipe can be identified by the mark Ⓑ.
F: Front cylinder head intake pipe
R: Rear cylinder head intake pipe

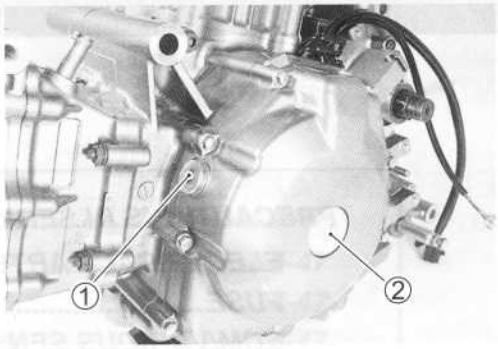


GENERATOR COVER PLUG

- Apply engine oil to the O-ring of the generator cover plug.
- Tighten the valve timing inspection plug ① and generator cover plug ② to the specified torque.

Valve timing inspection plug: 23 N·m (2.3 kgf-m, 16.5 lb-ft)

Generator cover plug: 11 N·m (1.1 kgf-m, 8.0 lb-ft)

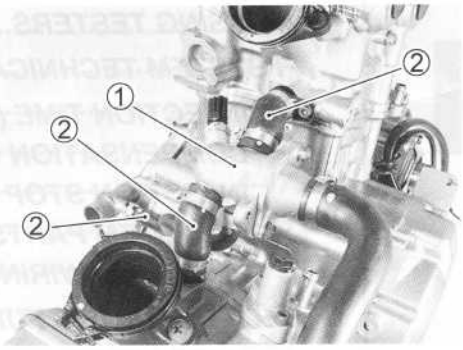


CAUTION

Use the new O-ring to prevent oil leakage.

THERMOSTAT CASE AND WATER HOSE

- Install the thermostat case ① along with the water hoses ② and tighten the clamp screws securely. (☞9-22)



SPARK PLUG AND HOSES

- Connect the PAIR hoses ①.
- Connect the crankcase breather hoses ②.
- Install the spark plugs. (☞2-8)