Engine Removal / Installation

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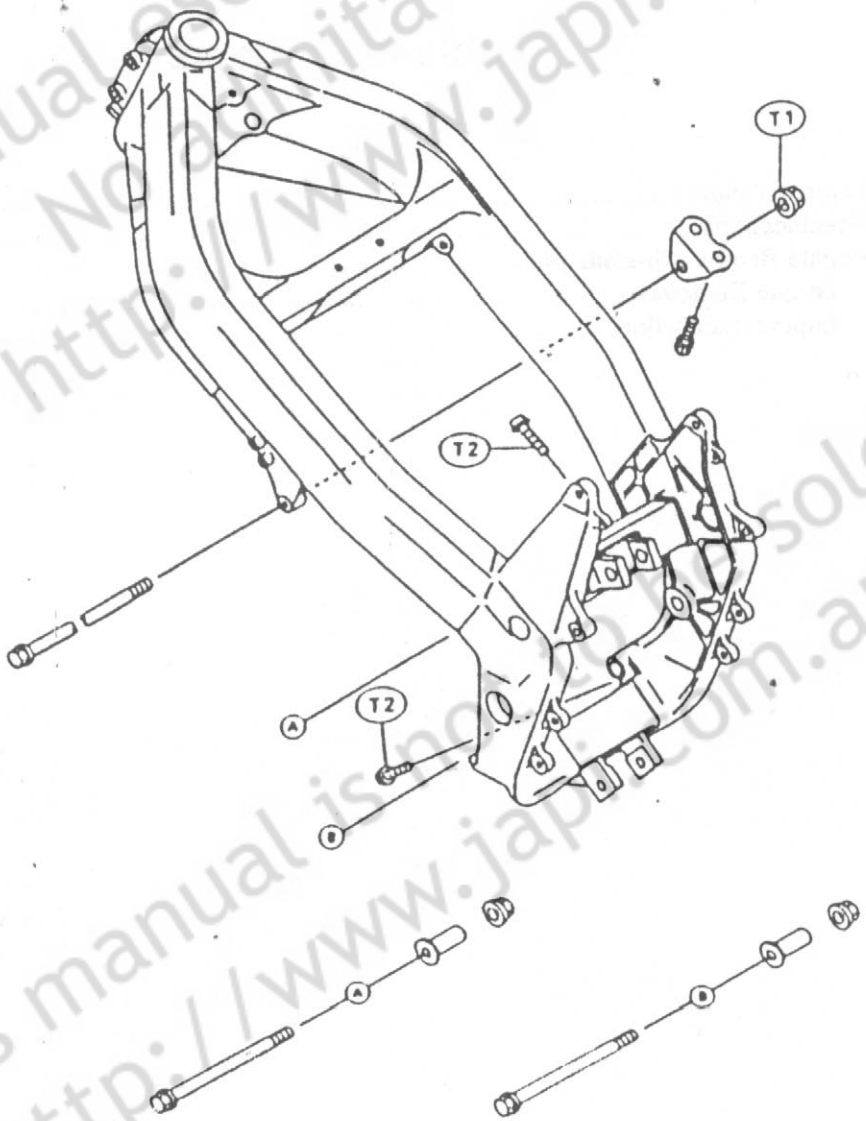
Exploded View



T1: 44 N-m (4.5 kg-m)
T2: 23 N-m (2.3 kg-m)

Specifications

Special Tool – Jack: 57001-1238

Engine Removal/Installation

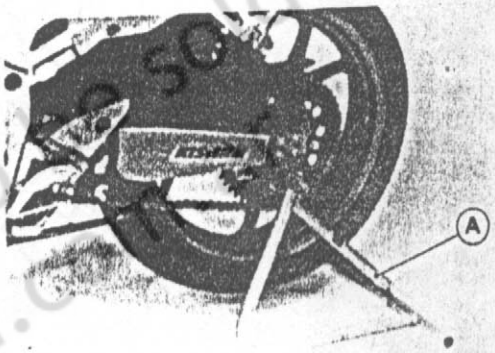
Engine Removal

- Remove:
  - Upper and Lower Fairings (see Frame chapter)
  - Engine Oil (Drain, see Engine Lubrication System chapter)
  - Coolant (Drain, see Cooling System chapter)
  - Shift Pedal
  - Engine Sprocket (see Final Drive chapter)
  - Fuel Tank (see Fuel System chapter)
  - Air Cleaner Housing (see Fuel System chapter)
  - Carburetors (see Fuel System chapter)
  - Radiator (see Cooling System chapter)
  - Muffler (see Engine Top End chapter)
  - Clutch Cable
- Disconnect wiring from the engine and free them from the clamps.
  - Spark Plug Caps
  - Pickup Coil and Oil Pressure Switch Lead Connector
  - Alternator Lead Connector
  - Neutral Switch Lead Connector
  - Battery Ground Lead
  - Starter Motor Lead
  - Water Temperature Sensor Lead

- Support the frame on the jack or a suitable stand [A].

  Special Tool – Jack: 57001-1238

- Squeeze the brake lever slowly and hold it with a band.

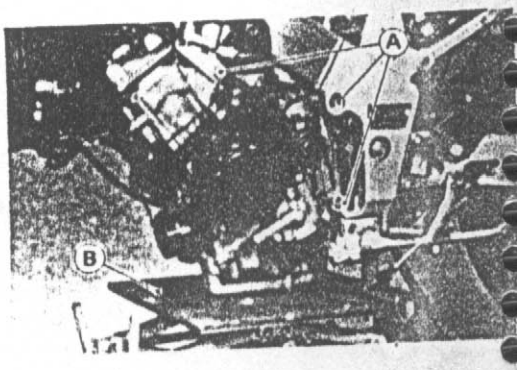


- Support the engine with a suitable stand [B].
- Remove the bolts [A] and nuts.

NOTE

○The drive chain will be removed from the output shaft when removing the engine.

- Remove the engine.

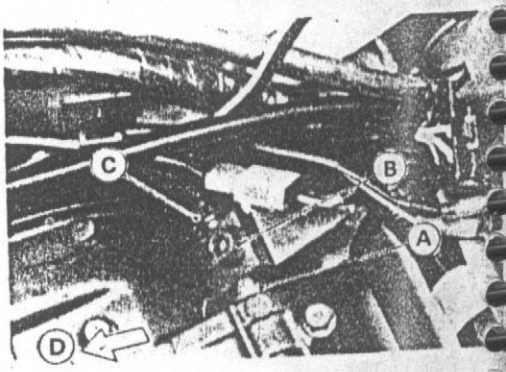


Engine Installation

- Support the engine with a suitable stand, and set it at the correct position.
- Install the mounting bolts and collars [A].
- Tighten the engine mount clamp bolts [B] temporarily.
- Tighten:

  Torque – **Engine Mount Nuts : 44 N-m (4.5 kg-m) [C]**
  Engine Mount Clamp Bolts : 23 N-m (2.3 kg-m)

  [D] Front



- Run the leads, cables and hoses correctly (see Cable, Wire and Hoses Routing section in General Information chapter).
- Install the removed parts (see appropriate chapters).
- Adjust:
  Throttle Cables (see Fuel System chapter)
  Choke Cable (see Fuel System chapter)
  Drive Chain (see Final Drive chapter)

Crankshaft / Transmission

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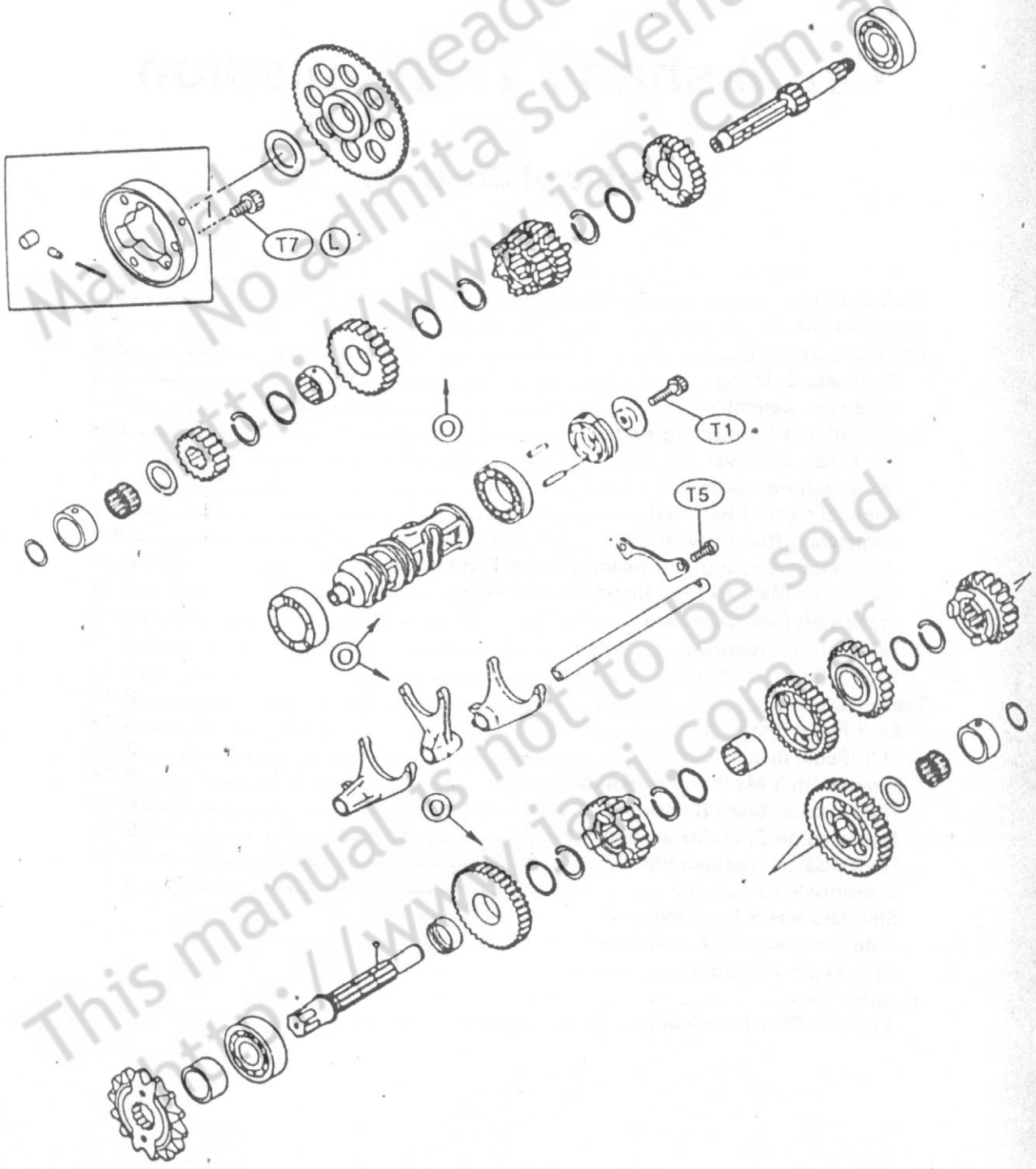
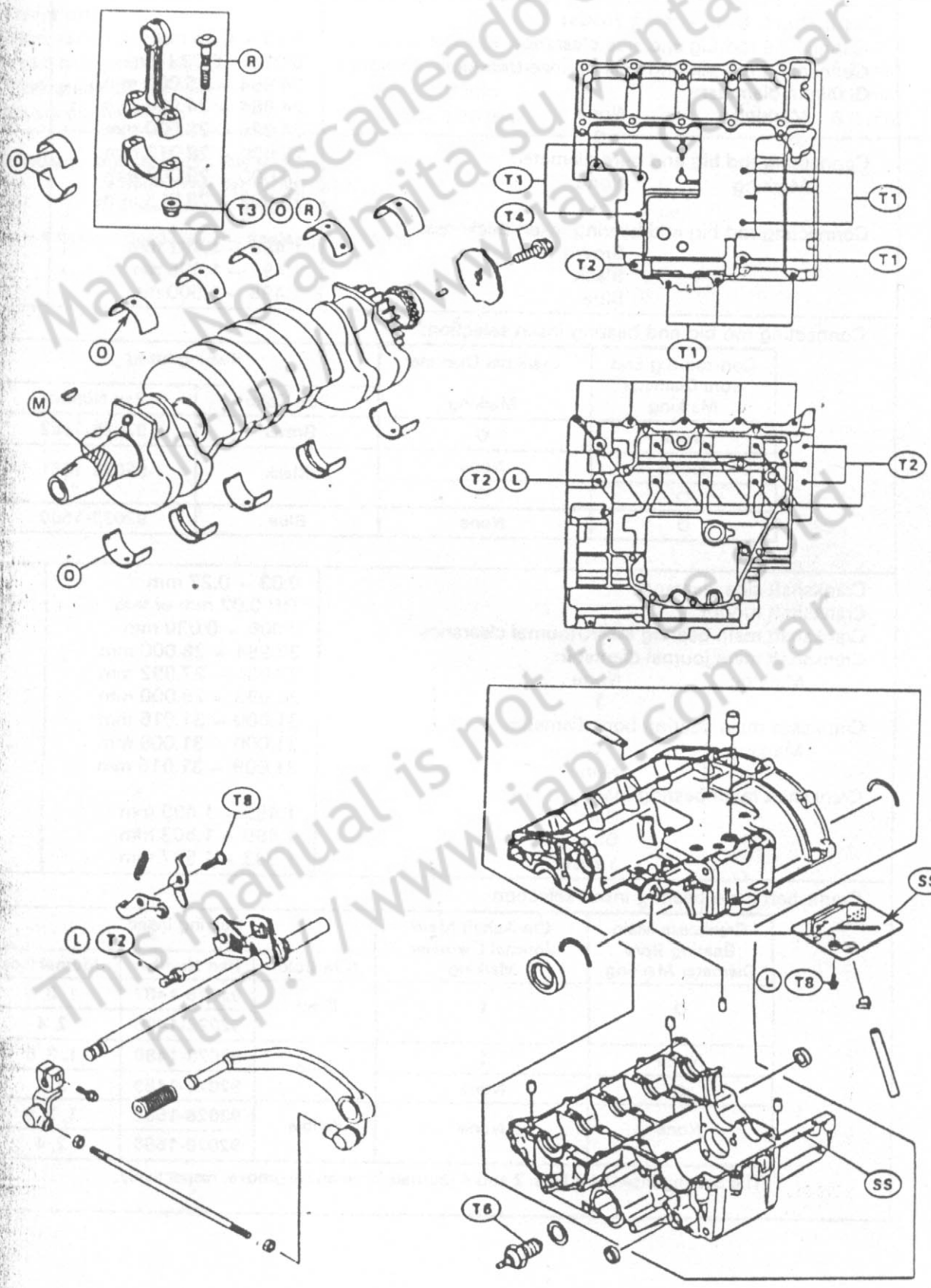
Exploded View



L: Apply a non-permanent locking agent.
M: Apply molybdenum disulfide grease.
O: Apply engine oil.
R: Replacement Parts
SS: Apply silicone sealant.

T1: 12 N·m (1.2 kg·m)
12: 20 N·m (2.0 kg·m)
T3: See the text.
T4: 39 N·m (4.0 kg·m)
T5: 5.4 N·m (0.55 kg·m)
T6: 15 N·m (1.5 kg·m)
T7: 34 N·m (3.5 kg·m)
T8: 11 N·m (1.1 kg·m)



Specifications

Item		Standard	Service Limit
Crankshaft, Connecting Rods:			
Connecting rod big end side clearance		0.13 ~ 0.38 mm	0.6 mm
Connecting rod big end bearing insert/crankpin clearance		0.013 ~ 0.039 mm	0.07 mm
Crankpin diameter:		24.984 ~ 25.000 mm	24.97 mm
Marking	None	24.984 ~ 24.994 mm	- - -
	O	24.995 ~ 25.000 mm	- - -
Connecting rod big end bore diameter:		28.000 ~ 28.013 mm	28.04 mm
Marking	None	28.000 ~ 28.007 mm	- - -
	O	28.008 ~ 28.013 mm	- - -
Connecting rod big end bearing insert thickness:			
	Brown	1.488 ~ 1.492 mm	- - -
	Black	1.492 ~ 1.496 mm	- - -
	Blue	1.496 ~ 1.500 mm	- - -

Connecting rod big end bearing insert selection:

Con-rod Big End Bore Diameter Marking	Crankpin Diameter Marking	Bearing Insert	
		Size Color	Part Number
None	O	Brown	92028-1562
None	None	Black	92028-1561
O	O		
O	None	Blue	92028-1560

Crankshaft side clearance		0.03 ~ 0.27 mm	0.50 mm
Crankshaft runout		TIR 0.02 mm or less	TIR 0.05 mm
Crankshaft main bearing insert/journal clearance		0.006 ~ 0.030 mm	0.06 mm
Crankshaft main journal diameter:		27.984 ~ 28.000 mm	27.96 mm
Marking	None	27.984 ~ 27.992 mm	- - -
	1	27.993 ~ 28.000 mm	- - -
Crankcase main bearing bore diameter:		31.000 ~ 31.016 mm	- - -
Marking	O	31.000 ~ 31.008 mm	- - -
	None	31.009 ~ 31.016 mm	- - -
Crankshaft main bearing insert thickness:			
	Black	1.495 ~ 1.499 mm	- - -
	Blue	1.499 ~ 1.503 mm	- - -
	Yellow	1.503 ~ 1.507 mm	- - -

Crankshaft main bearing insert selection:

Crankcase Main Bearing Bore Diameter Marking	Crankshaft Main Journal Diameter Marking	Bearing Insert*		
		Size Color	Part Number	Journal Nos.
O	1	Black	92028-1487	1, 3, 5
			92028-1490	2, 4
None	1	Blue	92028-1486	1, 3, 5
O	None		92028-1489	2, 4
None	None	Yellow	92028-1582	1, 3, 5
			92028-1586	2, 4

*The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

Item	Standard	Service Limit
Transmission:		
Shift fork ear thickness	4.9 ~ 5.0 mm	4.8 mm
Gear shift fork groove width	5.05 ~ 5.15 mm	5.3 mm
Shift fork guide pin diameter	5.9 ~ 6.0 mm	5.8 mm
Shift drum groove width	6.05 ~ 6.20 mm	6.3 mm

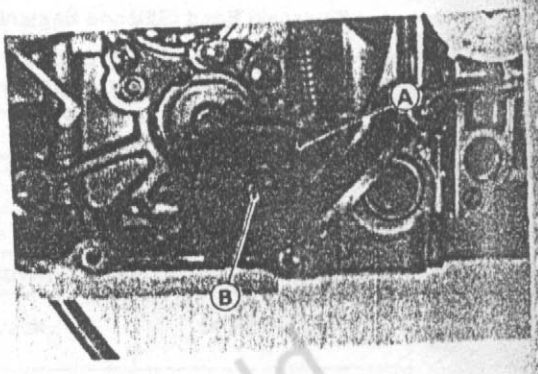
Special Tools – Outside Circlip Pliers: 57001-144
Bearing Driver Set: 57001-1129
Flywheel Holder: 57001-1313

Sealant – Kawasaki Bond (Silicone Sealant): 56019-120

Crankcase Splitting

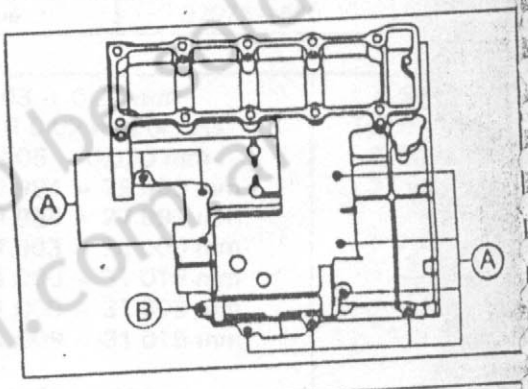
Crankcase Splitting

- Remove the engine (see Engine Removal/Installation chapter).
- Set the engine on a clean surface and hold the engine steady while parts are being removed.
- Remove:
  - Alternator Rotor
  - Starter Idle Gear and Shaft
  - Starter Motor
  - Clutch
  - Oil Filter
  - Pickup Coil
  - Timing Rotor
  - Water Pump
  - Oil Pump
  - External Shift Mechanism
- Tap lightly the left end of the oil pump shaft with a plastic mallet.
- Holding the pump drive gear [A] with hand, pull out the pump shaft [B].

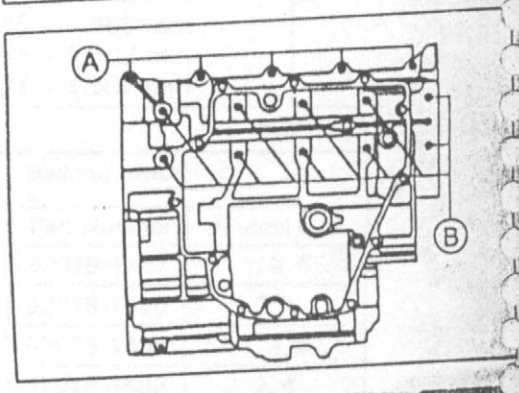


★If the crankshaft is to be removed, remove the pistons (see Engine Top End chapter).

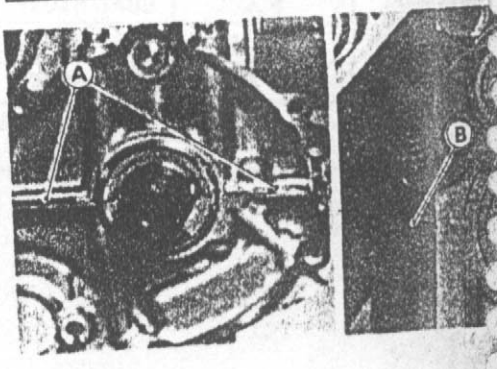
- Remove the upper crankcase bolts in the order listed.
  - Φ 6 mm Bolts [A]
  - Φ 7 mm Bolt [B]
- Turn the engine upside down, and remove the following.
  - Oil Pan
  - Oil Screen
  - Oil Pipe



- Remove the lower crankcase bolts in the order listed.
  - Φ 6 mm Bolts [A]
  - Φ 7 mm Bolts [B]



- Pry the points shown to split the crankcase halves apart, and remove the lower crankcase half.
  - Left Pry Point [A]
  - Right Pry Point [B]
- Tap lightly around the crankcase mating surface with a plastic mallet, and split the crankcase. Take care not to damage the crankcase.



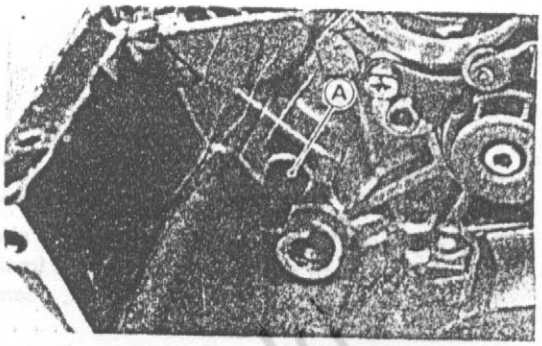
Crankcase Assembly

CAUTION

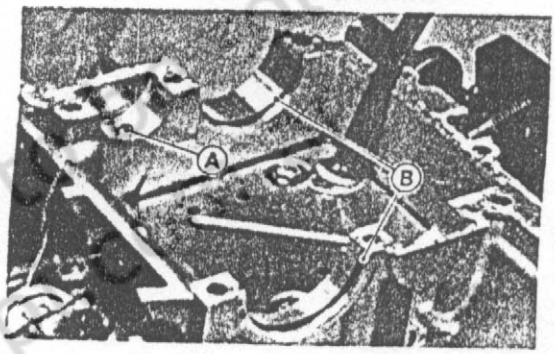
The upper and lower crankcase halves are machined at the factory in the assembled state, so the crankcase halves must be replaced as a set.

- With a high-flash point solvent, clean off the mating surfaces of the crankcases halves and wipe dry.
- Using compressed air, blow out the oil passages in the crankcase halves.
- Apply a non-permanent locking agent to the threads of the shift shaft return spring pin [A], and tighten it.

Torque – Shift Shaft Return Spring Pin (Bolt) : 20 N-m (2.0 kg-m)



- Check to see that the set pins [A] and set rings [B] are in place.
- Apply engine oil.
  - Transmission Gears
  - Ball Bearings
  - Shift Drum
  - Crankshaft Main Bearing Inserts
- Check to see that the shift drum and transmission gears are in the neutral position.
- Be sure to hang the camshaft chain on the crankshaft.

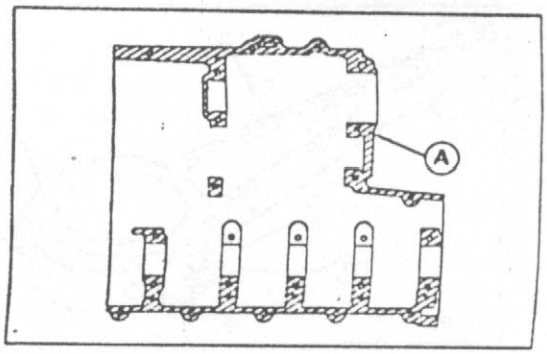


- Apply silicone sealant [A] to the mating surface of the lower crankcase half.

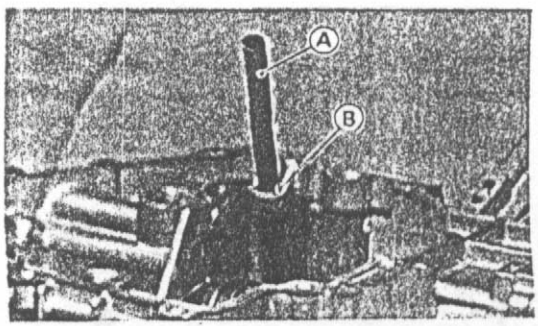
Sealant – Kawasaki Bond (Silicone Sealant): 56019-120

CAUTION

Do not apply silicone sealant around the crankshaft main bearing inserts.



- When installing the lower crankcase, run the breather hose [A] in the guide hole [B].

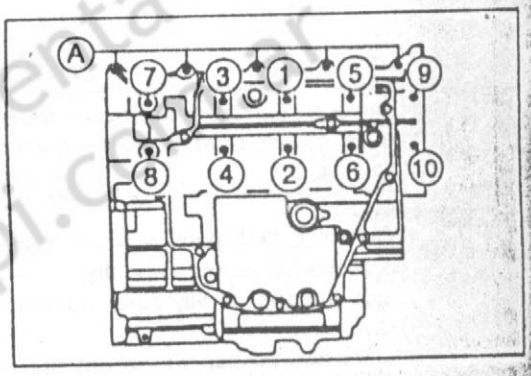


● Tighten the lower crankcase bolts.
○ Following the sequence numbers on the lower crankcase half, tighten the Φ 7 mm bolts [1 ~ 10].
○ Apply a non-permanent locking agent to the threads of the [8] bolt.
[1 ~ 8] 70 mm
[9, 10] 85 mm

Torque – **Crankcase Bolts Φ 7 mm : 20 N-m (2.0 kg-m)**

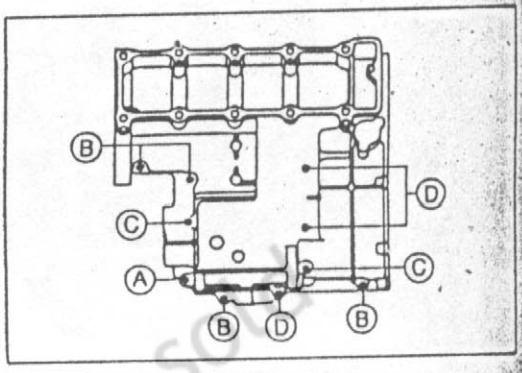
○ Tighten the Φ 6 mm bolts [A].

Torque – **Crankcase Bolt Φ 6 mm : 12 N-m (1.2 kg-m)**



● Tighten the upper crankcase bolts.
[B] 30 mm
[C] 65 mm
[D] 90 mm

Torque – **Crankcase Bolts Φ 7 mm : 20 N-m (2.0 kg-m) [A]**
Crankcase Bolts Φ 6 mm : 12 N-m (1.2 kg-m) [B, C, D]



● After tightening all crankcase bolts, check the following items.
○ Drive shaft and output shafts turn freely.
○ While spinning the output shaft, gears shift smoothly from the 1st to 6th gear, and 6th to 1st.
○ When the output shaft stays still, the gear can not be shifted to 2nd gear or other higher gear positions.

Crankshaft and Connecting Rods

Crankshaft Removal

- Split the crankcase (see Crankcase Splitting).
- Remove the crankshaft.

Crankshaft Installation

CAUTION

If the crankshaft, bearing inserts, or crankcase halves are replaced with new ones, select the bearing inserts and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.

- Apply engine oil to the crankshaft main bearing inserts.
- Install the crankshaft with the camshaft chain hanging on it.

Connecting Rod Removal

- Split the crankcase (see Crankcase Splitting).
- Remove the connecting rod nuts.
- Remove the crankshaft.

NOTE

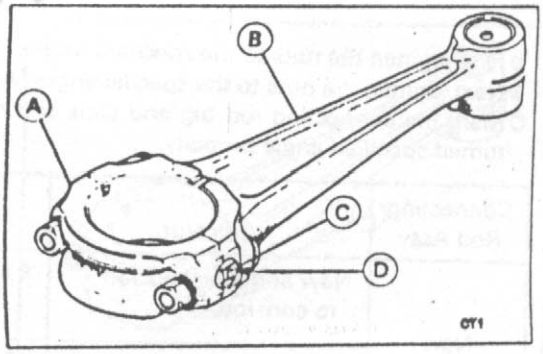
- *Mark and record the locations of the connecting rods and their big end caps so that they can be reassembled in their original positions.*

- Remove the connecting rods from the crankshaft.

Connecting Rod Installation

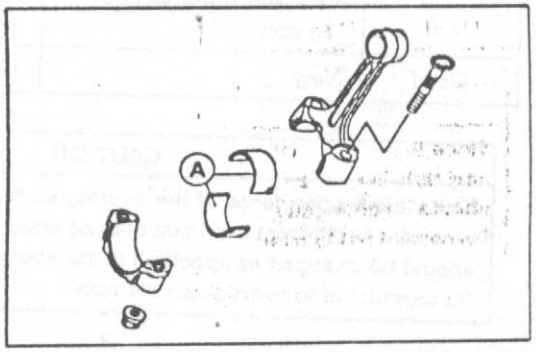
CAUTION

To minimize vibration, a pair of connecting rods (left two rods or right two) should have the same weight mark.



[A] Big End Cap
[B] Connecting Rod
[C] Weight Mark, Alphabet
[D] Diameter Mark

- If the connecting rods, big end bearing inserts, or crankshaft are replaced with new ones, select the bearing insert and check clearance with a plastigage before assembling engine to be sure the correct bearing inserts are installed.
- Apply engine oil to the inner surface [A] of upper and lower bearing inserts.



CAUTION

The connecting rod bolts are designed to stretch when tightened. Never reuse the connecting rod bolts. See the table below for correct bolt and nut usage.

- Be sure to clean the bolts, nuts, and connecting rods thoroughly with high-flash point solvent, because the new connecting rods, bolts, and nuts are treated with an anti-rust solution.

⚠WARNING

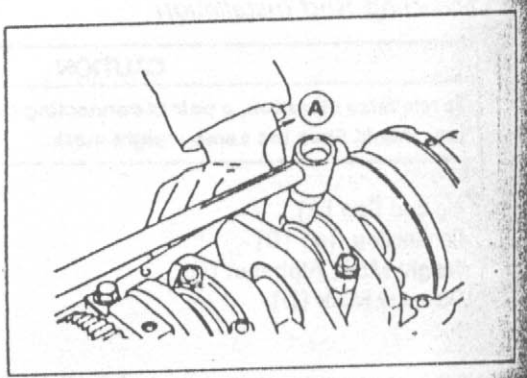
Clean the bolts, nuts, and connecting rods in a well-ventilated area, and take care that there is no spark or flame anywhere near the working area. This includes any appliance with a pilot light. Because of the danger of highly flammable liquids, do not use gasoline or low-flash point solvents to clean them.

CAUTION

Immediately dry the bolts and nuts with compressed air after cleaning.
Clean and dry the bolts and nuts completely.

- Apply a small amount of engine oil to the threads and seating surface of the connecting rod nuts.

- First, tighten the nuts to the specified torque. See the table below.
- Next, tighten the nuts to the specific angle [A] more.
- ○ Mark the connecting rod big end caps and nuts so that nuts can be turned specified angle properly.



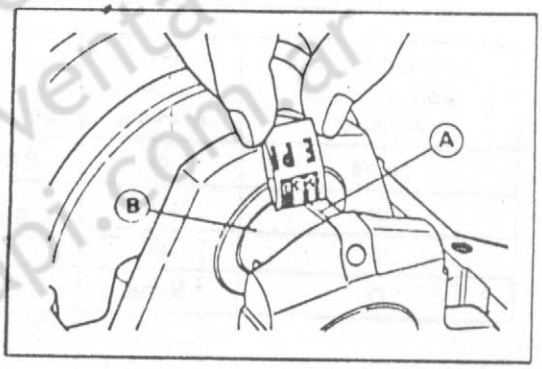
Connecting Rod Assy	Bolt, Nut	Torque + Angle N·m (kg·m)
New	New and attached to con-rod.	9.8 (1.0) + 120° ± 12°
	New and not attached to con-rod.	12 (1.2) + 150° ± 30°
Used	New	12 (1.2) + 150° ± 30°

CAUTION

Since the friction force of the seating surface and thread portion of new nuts is different from that of used ones, the nut tightening torque should be changed as specified in the above table.
Be careful not to overtighten the nuts.

Connecting Rod Big End Bearing Insert/Crankpin Wear

●Using a plastigage (press gauge) [A], measure the bearing insert/crankpin [B] clearance.

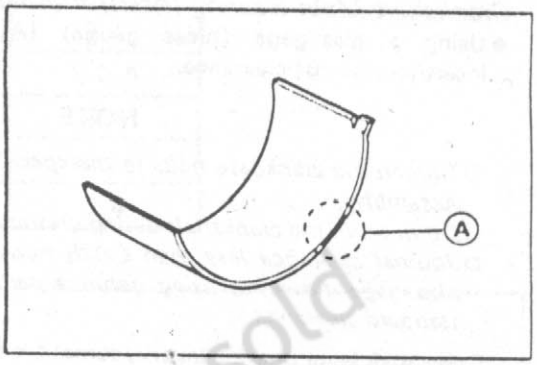


NOTE

○*Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).*
○*Do not move the connecting rod and crankshaft during clearance measurement.*

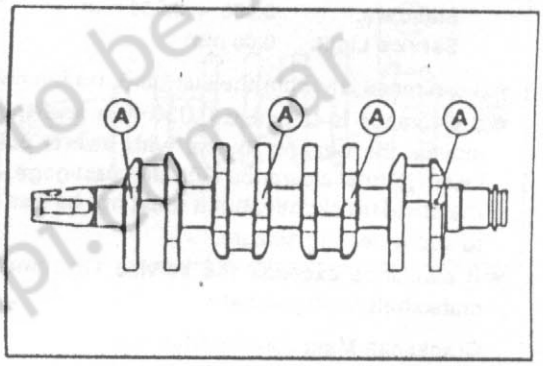
Connecting Rod Big End Bearing Insert/Crankpin Clearance
Standard: 0.013 ~ 0.039 mm
Service Limit: 0.07 mm

★If clearance is within the standard, no bearing replacement is required.
★If clearance is between 0.039 mm and the service limit (0.07 mm), replace the bearing inserts with inserts painted blue [A]. Check insert/crankpin clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.
★If the clearance exceeds the service limit, measure the diameter of the crankpins.



Crankpin Diameter
Standard: 24.984 ~ 25.000 mm
Service Limit: 24.97 mm

★If any crankpin has worn past the service limit, replace the crankshaft with a new one.
★If the measured crankpin diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.



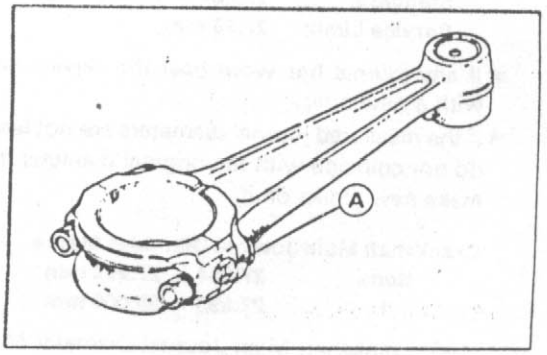
Crankpin Diameter Marks

None	24.984 ~ 24.994 mm
O	24.995 ~ 25.000 mm

[A]: Crankpin Diameter Marks, "O" mark or no mark.

●Measure the connecting rod big end bore diameter, and mark each connecting rod big end in accordance with the bore diameter.

[A]: Bore Diameter Mark (Around Weight Mark), "O" or no mark.



NOTE

○*Tighten the connecting rod big end nuts to the specified torque (see Connecting Rod Installation).*
○*The mark already on the big end should almost coincide with the measurement.*

Connecting Rod Big End Bore Diameter Marks

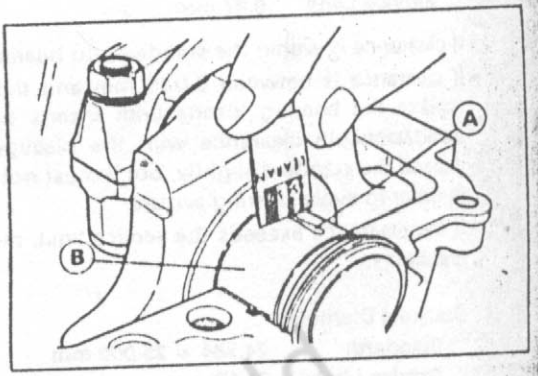
None	28.000 ~ 28.007 mm
O	28.008 ~ 28.013 mm

●Select the proper bearing insert in accordance with the combination of the connecting rod and crankshaft coding
●Install the new inserts in the connecting rod and check insert/crankpin clearance with the plastigage.

Con-rod Big End Bore Diameter Marking	Crankpin Diameter Marking	Bearing Insert	
		Size Color	Part Number
None	O	Brown	92028-1562
None	None	Black	92028-1561
O	O		
O	None	Blue	92028-1560

Crankshaft Main Bearing Insert/Journal Wear

● Using a plastigage (press gauge) [A], measure the bearing insert/journal [B] clearance.



NOTE

- *Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).*
- *Do not turn the crankshaft during clearance measurement.*
- *Journal clearance less than 0.025 mm can not be measured by plastigage, however, using genuine parts maintains the minimum standard clearance.*

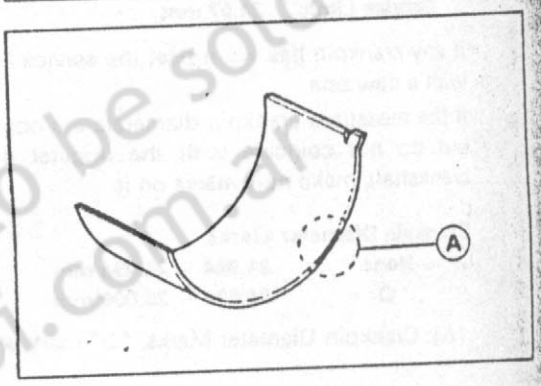
Crankshaft Main Bearing Insert/Journal Clearance

Standard: 0.006 ~ 0.030 mm
Service Limit: 0.06 mm

★ If clearance is within the standard, no bearing replacement is required.

★ If clearance is between 0.030 mm and the service limit (0.06 mm), replace the bearing inserts with inserts painted yellow [A]. Check insert/journal clearance with the plastigage. The clearance may exceed the standard slightly, but it must not be less than the minimum in order to avoid bearing seizure.

★ If clearance exceeds the service limit, measure the diameter of the crankshaft main journal.

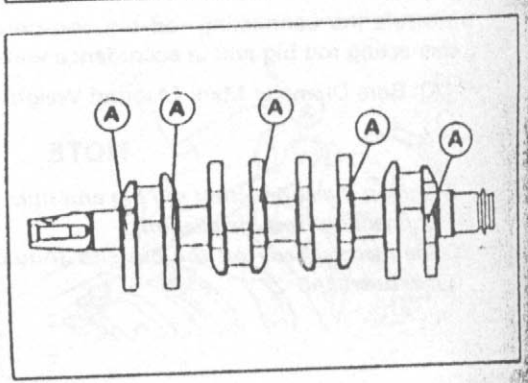


Crankshaft Main Journal Diameter

Standard: 27.984 ~ 28.000 mm
Service Limit: 27.96 mm

★ If any journal has worn past the service limit, replace the crankshaft with a new one.

★ If the measured journal diameters are not less than the service limit, but do not coincide with the original diameter markings on the crankshaft, make new marks on it.



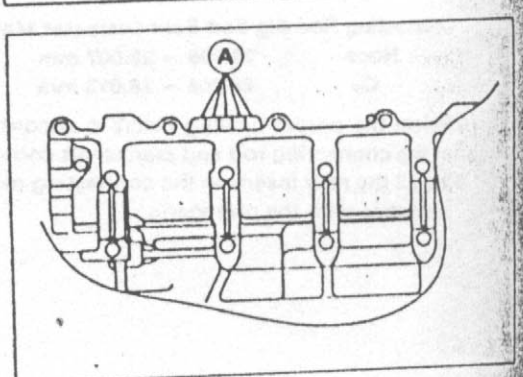
Crankshaft Main Journal Diameter Marks

None 27.984 ~ 27.992 mm
1 27.993 ~ 28.000 mm

[A]: Crankshaft Main Journal Diameter Marks, "1" mark or no mark

● Measure the main bearing bore diameter, and mark the upper crankcase half in accordance with the bore diameter.

[A]: Crankcase Main Bearing Bore Diameter Marks, "O" mark or no mark.



NOTE

- *Tighten the crankcase bolts to the specified torque (see Crankcase Assembly).*
- *The mark already on the upper crankcase half should almost coincide with the measurement.*

Crankcase Main Bearing Bore Diameter Marks

O	31.000 ~ 31.008 mm
None	31.009 ~ 31.016 mm

- Select the proper bearing insert in accordance with the combination of the crankcase and crankshaft coding.
- Install the new inserts in the crankcase halves and check insert/journal clearance with the plastigage.

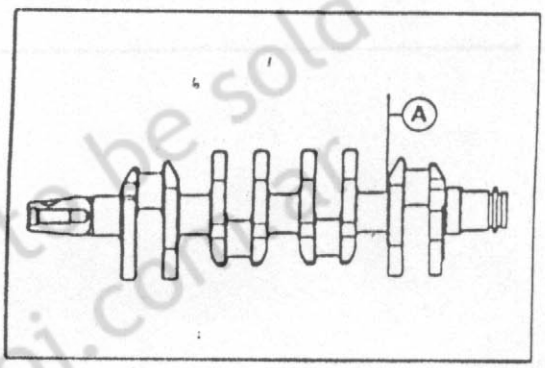
Crankcase Main Bearing Bore Diameter Marking	Crankshaft Main Journal Diameter Marking	Bearing Insert*		
		Size Color	Part Number	Journal Nos.
O	1	Black	92028-1487	1, 3, 5
			92028-1490	2, 4
None	1	Blue	92028-1486	1, 3, 5
O	None		92028-1489	2, 4
None	None	Yellow	92028-1582	1, 3, 5
			92028-1586	2, 4

*The bearing inserts for Nos. 2 and 4 journals have an oil groove, respectively.

Crankshaft Side Clearance

- Split the crankcase (see Crankcase Splitting).
- Insert a thickness gauge [A] between the crankcase main bearing and the #7 crank web at the #4 journal to determine clearance.

★If the clearance exceeds the service limit, replace the crankcase halves as a set.



CAUTION

The upper and lower crankcase halves are machined at the factory in the assembled state, so the crankcase halves must be replaced as a set.

Crankshaft Side Clearance

Standard:	**0.03 ~ 0.27 mm**
Service Limit:	**0.50 mm**

Timing Rotor Removal

- Remove:
  - Clutch Cover (see Clutch chapter)
  - Alternator Cover (see Electrical System chapter)
- Wipe oil off the outer circumference of the alternator rotor.
- Hold the alternator rotor steady with the flywheel holder, and remove the timing rotor bolt.

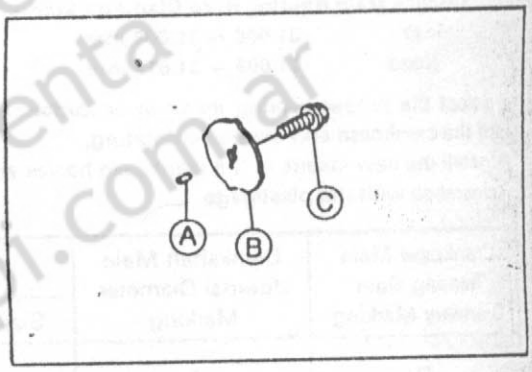
Special Tool – Flywheel Holder: 57001-1313

- Remove the timing rotor.

Timing Rotor Installation

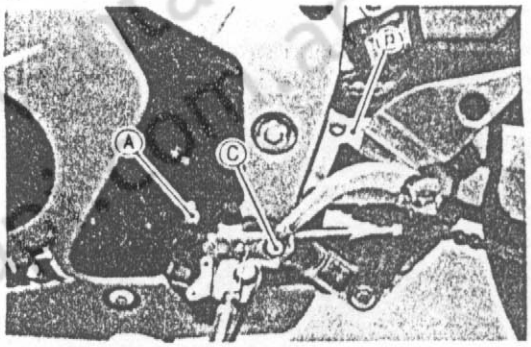
- Install:
  Pin [A]
  Timing Rotor [B]
- Using the flywheel holder, tighten the timing rotor bolt [C].

Torque – Timing Rotor Bolt : 39 N-m (4.0 kg-m)



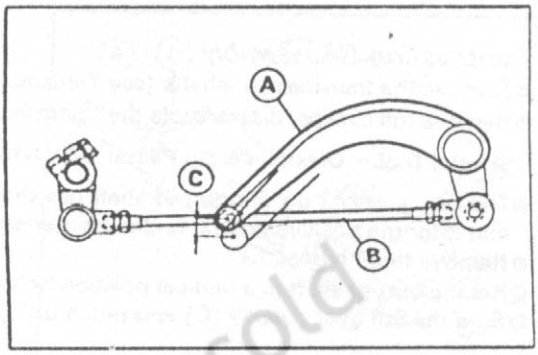
Transmission

Shift Pedal Removal



- Mark the position of the shift lever on the shift shaft so that it can be installed later in the same position.
- Remove:
  - Shift Lever [A]
  - Shift Rod
  - Bracket Bolts and Bracket [B]
  - Shift Pedal [C]

Shift Pedal Installation



- Install the shift pedal [A] so that the distance between the center of the shift pedal and the center line of the shift rod [B] is 10 mm [C] by loosening the front and rear locknuts and turning the rod

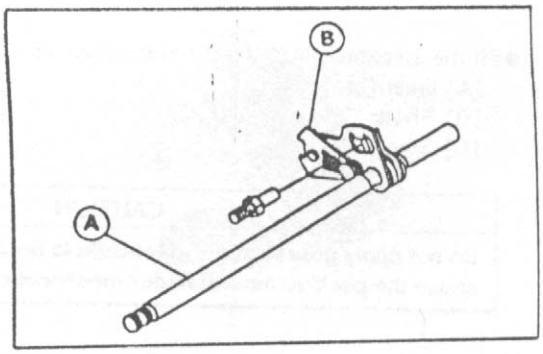
NOTE

○*The front locknut of the rod has left-hand threads.*

★If necessary, adjust the pedal position from the standard position to suit you as follows.

- Loosen the front and rear rod locknuts.
- Turn the rod to adjust the pedal position.
- Tighten the locknuts securely.

External Shift Mechanism Removal



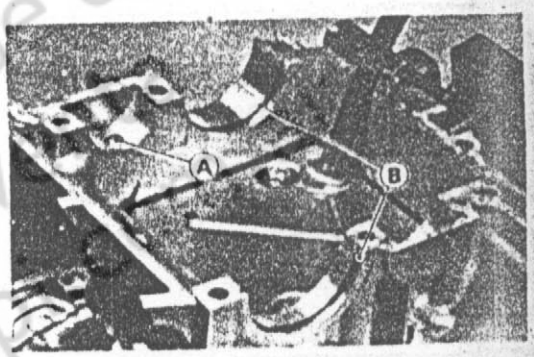
- Remove:
  - Lower Fairing (see Frame chapter)
  - Coolant (drain, see Cooling System chapter)
  - Engine Oil (drain, see Engine Lubrication System chapter)
  - Water Pump (see Cooling System chapter)
  - Oil Pump (see Engine Lubrication System chapter)
  - Shift Lever
  - Clutch (see Clutch chapter)
  - Oil Pump Drive Gear Shaft
- Remove the shift shaft [A] while pushing the shift mechanism arm [B] toward the shaft.

Transmission Shaft Removal

- Split the crankcase (see Crankcase Splitting).
- Remove the drive shaft and output shaft.

Transmission Shaft Installation

- Apply engine oil to the sliding portion of the gears and bearings.
- Check to see that the set pins [A] and set rings [B] are in place.
- Install the drive shaft and output shaft into the upper crankcase half.



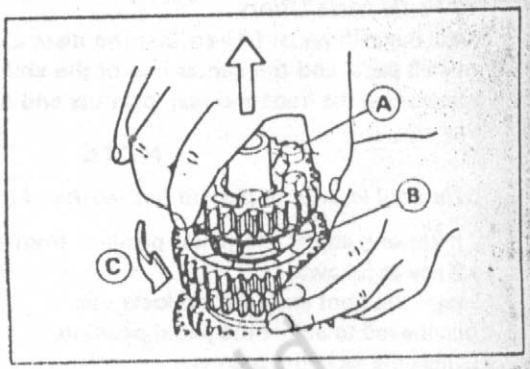
Transmission Disassembly

- Remove the transmission shafts (see Transmission Shaft Removal).
- Remove the circlips, disassemble the transmission shafts.

Special Tool – Outside Circlip Pliers: 57001-144

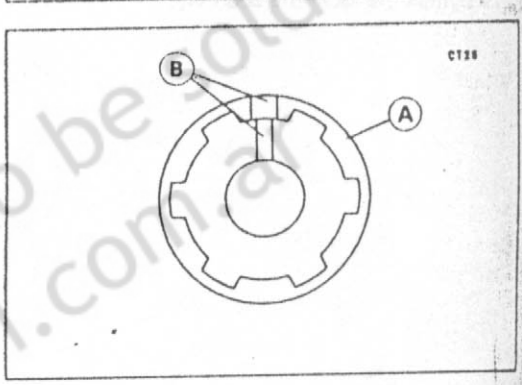
- The 5th gear [A] on the output shaft has three steel balls assembled into it for the positive neutral finder mechanism.
- Remove the 5th gear.

○ Set the output shaft in a vertical position holding the 3rd gear [B].
○ Spin the 5th gear quickly [C] and pull it off upward.



Transmission Assembly

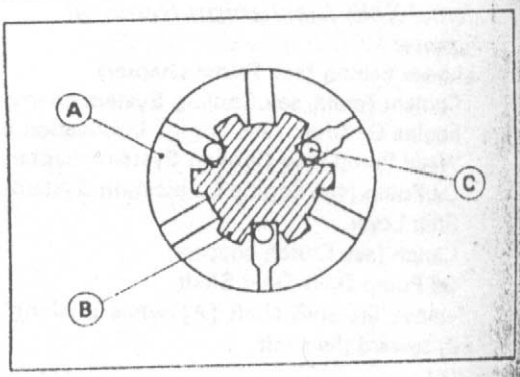
- Install the gear bushings [A] on the shaft with their oil holes [B] aligned with the shaft oil holes.



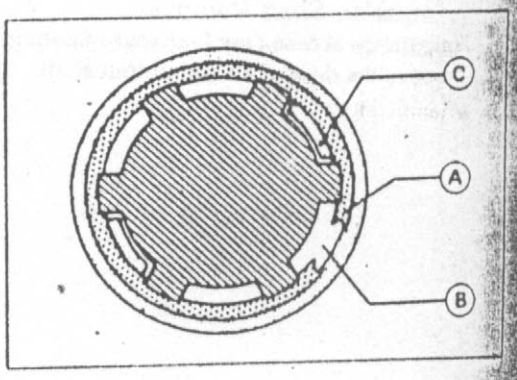
- Fit the steel balls into the 5th gear holes as shown.
  [A] Gear (5th)
  [B] Shaft
  [C] Steel Balls

CAUTION

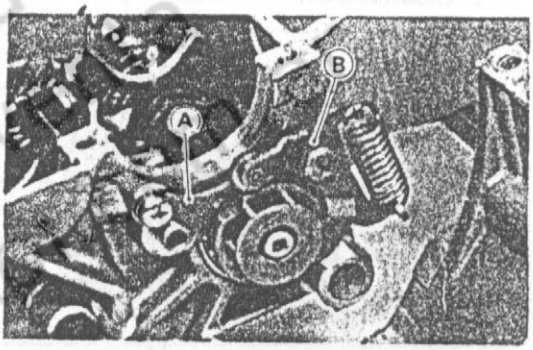
Do not apply grease to the steel balls to hold them in place. This will cause the positive neutral finder mechanism to malfunction.



- Replace any circlip that were removed with new ones.
- Install the circlips [A] so that the opening is aligned with a spline groove [B], and install toothed washers [C] so that the teeth are not aligned with the circlip opening.

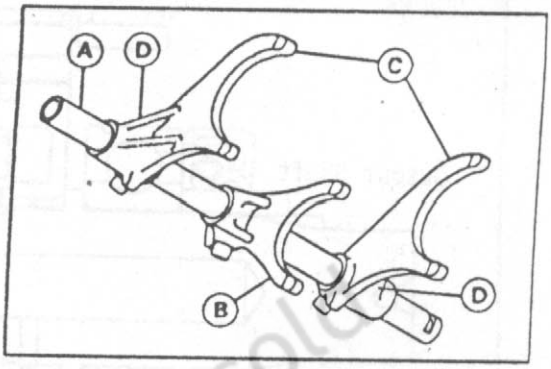


Shift Drum and Fork Removal



- Remove:
  - Lower Crankcase Half (see Crankcase Splitting)
  - External Shift Mechanism (see External Shift Mechanism Removal)
  - Shift Rod Holding Plate [A]
  - Shift Drum Set Lever [B]
- Pull out the shift rods, and take off the shift forks.
- Pull out the shift drum.

Shift Drum and Fork Installation



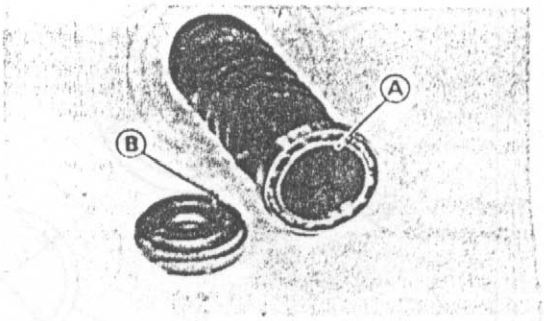
- Three shift forks are used. Fit each shift fork into the groove of the proper gear so that the shift fork guide pin is in the proper groove on the shift drum.
- Position the one with shortest ears on the drive shaft and place the pin in the center groove in the shift drum.
- Of the two forks on the output shaft, each rib faces outward.

[A] Shift Rod
[B] Shorter Fork (drive)
[C] Longer Forks (output)
[D] Ribs

- Tighten:

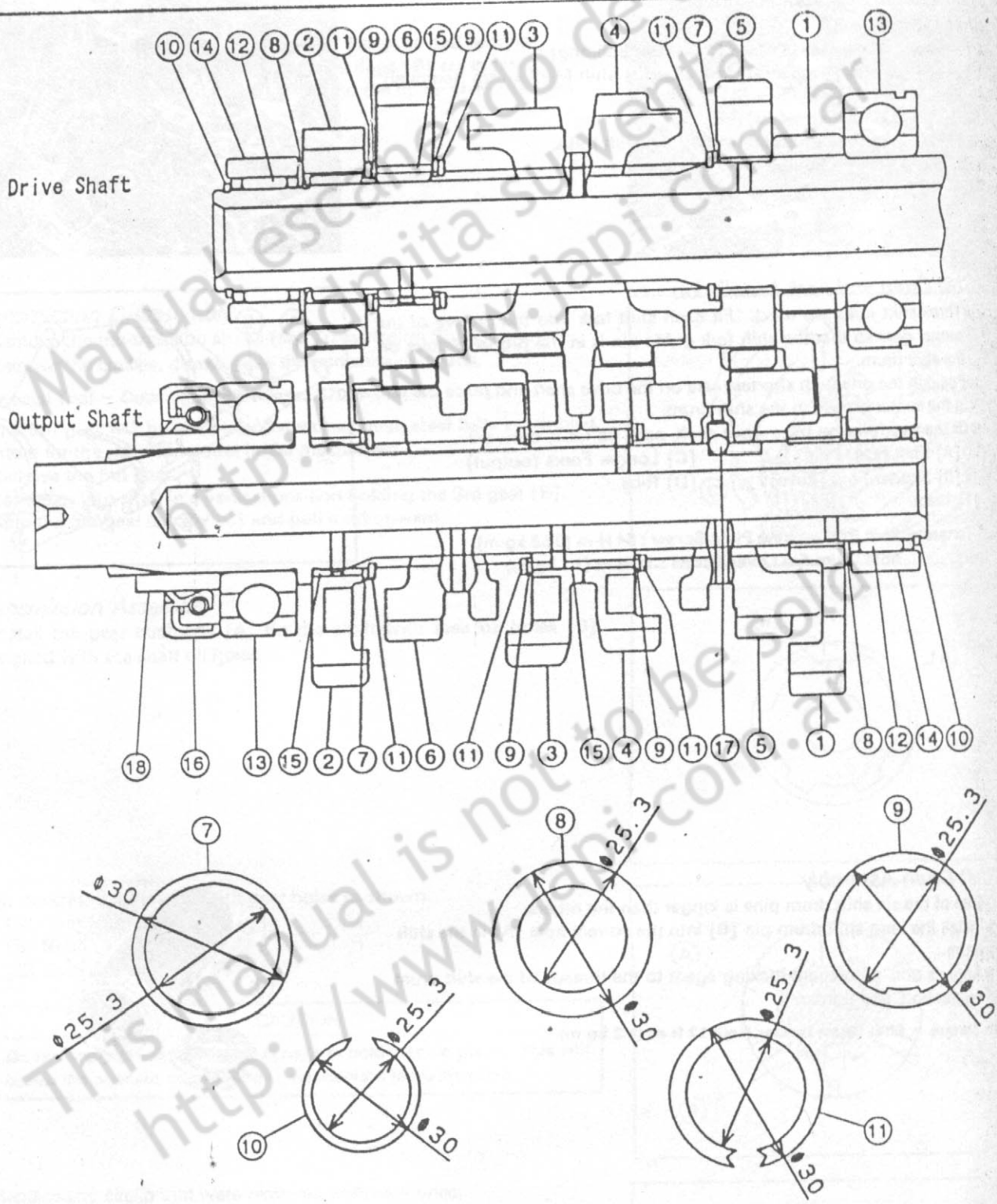
Torque – Shift Rod Holding Plate Screw : 54 N-m (0.55 kg-m)
Shift Drum Set Lever Screw : 11 N-m (1.1 kg-m)

Shift Drum Assembly



- One of the six shift drum pins is longer than the others.
- Install the long shift drum pin [B] into the correct hole [A] in the shift drum.
- Apply a non-permanent locking agent to the threads of the shift drum holder bolt, and tighten it.

Torque – Shift Drum Holder Bolt: 12 N-m (1.2 kg-m)



1. 1st Gear
2. 2nd Gear
3. 3rd Gear
4. 4th Gear
5. 5th Gear
6. 6th (Top) Gear
7. Thrust Washer
8. Thrust Washer
9. Toothed Washer
10. Circlip
11. Circlip
12. Needle Bearing
13. Ball Bearing
14. Outer Race
15. Bushing
16. Oil Seal
17. Steel Ball
18. Collar

Breather Case

Breather Plate Installation

- Apply silicone sealant to the breather plate mating surface (A) enough.

Sealant – Kawasaki Bond (Silicone Sealant): 56019-120

- Apply a non-permanent locking agent to the threads of the plate mounting bolts.

Torque – Breather Plate Mounting Bolt : 11 N-m (1.1 kg-m)