Maintenance–Chassis

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WHEELS

Tubeless tires are installed on the wheels of this motorcycle. The main advantage of the tubeless tires is an added measure of driving safety. In the event of a puncture, tubeless tires would not blow out but instead tend to lose air gradually. Another advantage is cooler running characteristics.

The tire and rim form a leakproof unit by making airtight contacts at the tire chafers and the rim bead seat and rim flanges instead of using an inner tube.

WARNING **The tires, rims, and air valves on this motorcycle is designed only for tubeless type wheels. The recommended standard tires, rims, and air valves must be used for replacement. For correct performance, do not install a tube in a tubeless tire.**

Wheel construction is shown in Fig. J4 and J5. The following sections Pgs. 194 ~ 201 cover the tires, rims, air valve, axles, wheel bearings, and grease seals. For the brakes, see Pgs. 203 ~ 210.

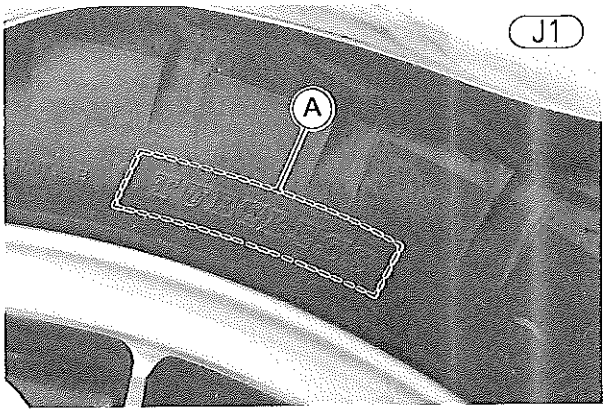
Tires

Structure of the tubeless tire is characterized by an inner liner and chafers.

The inner liner is a layer of thicker rubber which covers the inside wall of the tire. The inner liner is made from special quality of rubber which is hard to admit the air. Generally chafers reinforce tire beads which are likely damaged by friction with the rim. The chafers of tubeless tires have a characteristic of airtightness as well.

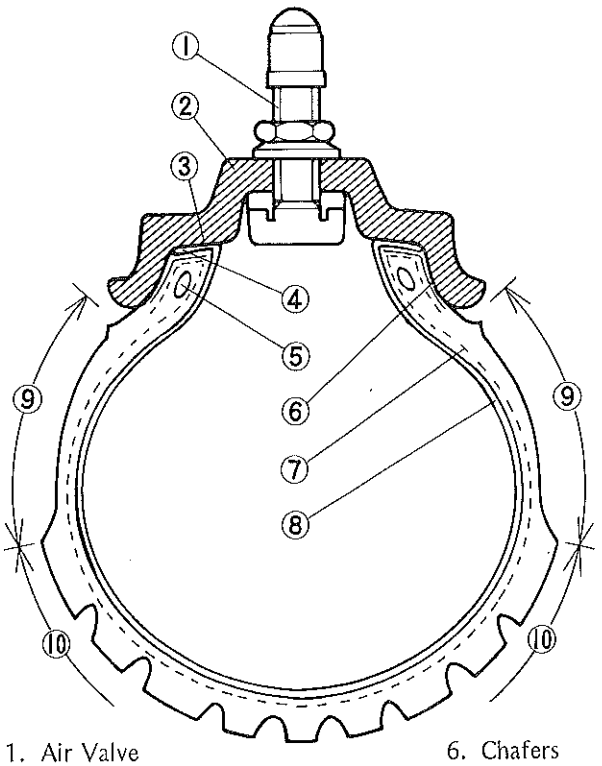
Since airtightness of tubeless tires is accomplished by closely seating the chafers in good condition on the rim, be careful not to damage the chafers when handling tubeless tires.

The indication of "TUBELESS" on the tire sidewall shows that the tire is designed for tubeless use.



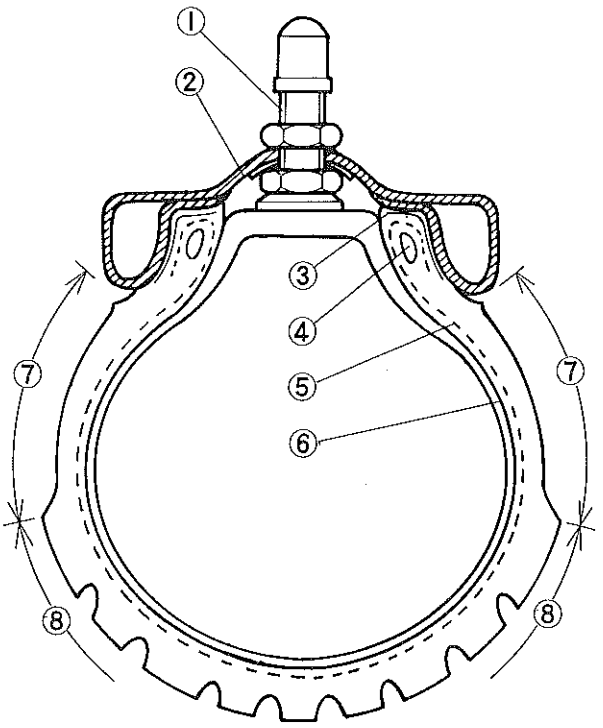
A. "TUBELESS"

Tubeless Tire J2



1. Air Valve
2. Rim
3. Rim Sealing Area
4. Bead Sealing Area
5. Bead Wires
6. Chafers
7. Plies
8. Inner Liner
9. Side Wall
10. Tread

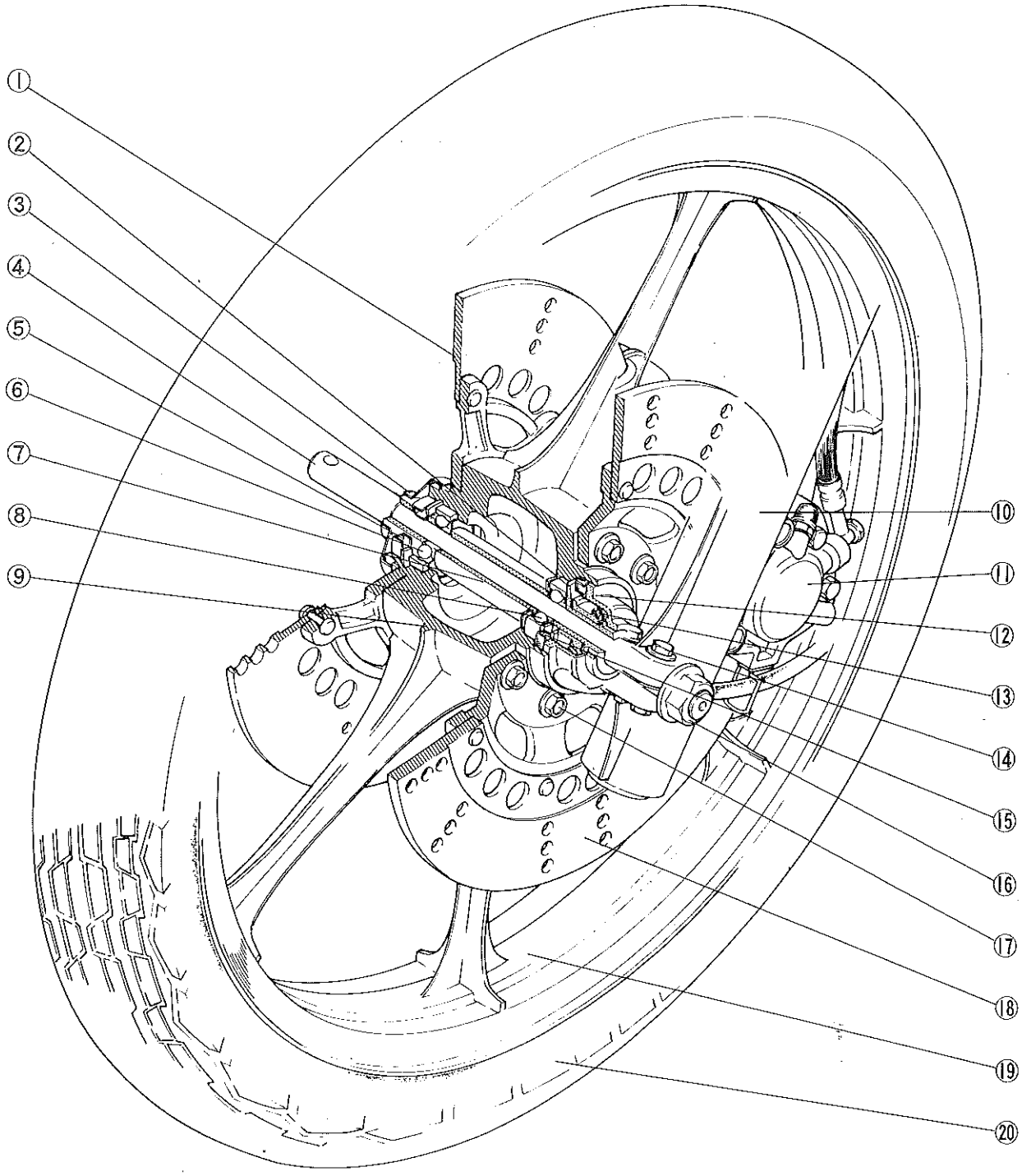
Tube Tire J3



1. Air Valve
2. Rim
3. Chafers
4. Bead Wires
5. Plies
6. Tube
7. Side Wall
8. Tread

Front Wheel

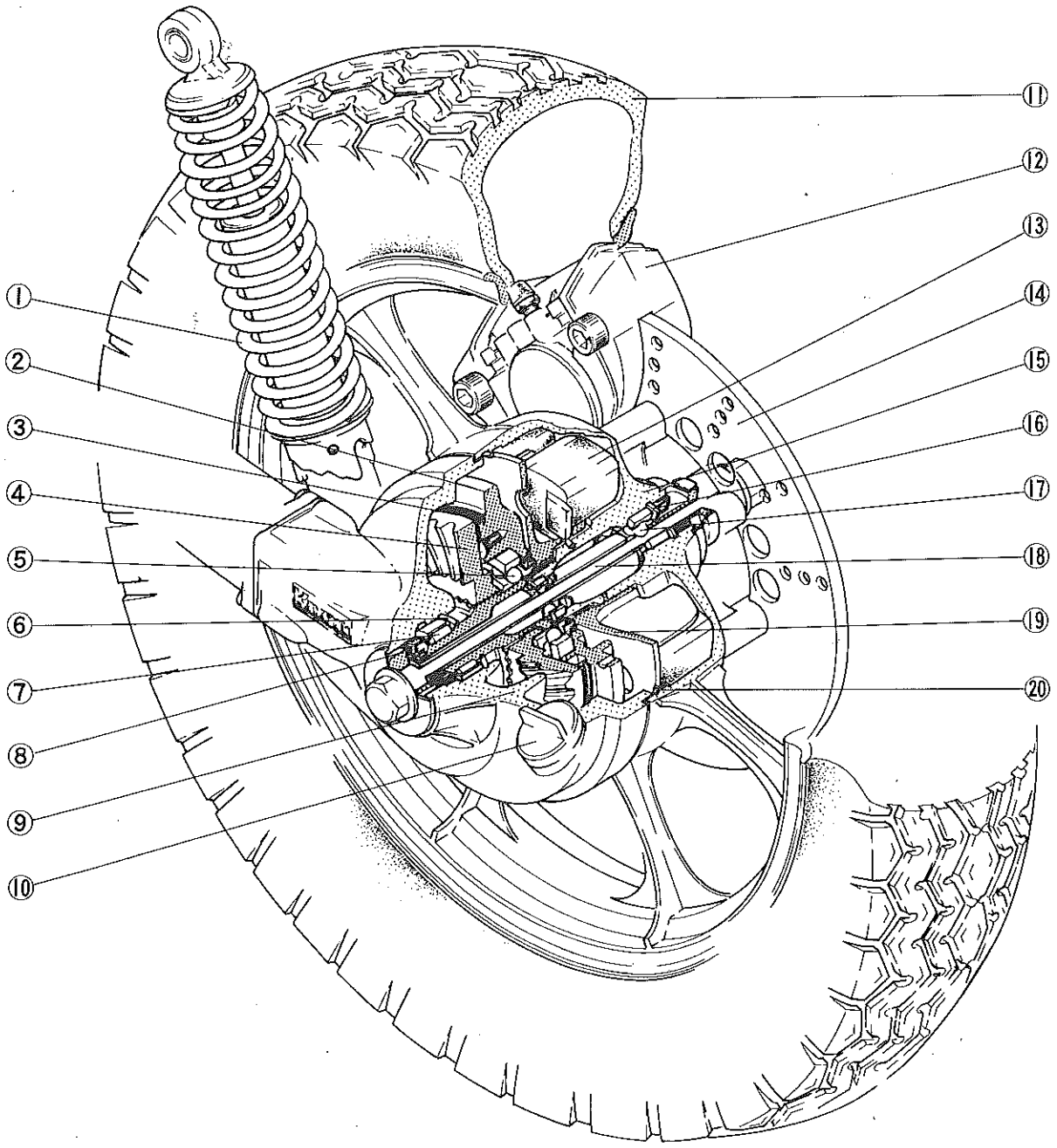
J4



1. Front Right Brake Disc
2. Speedometer Gear Drive
3. Collar
4. Front Axle
5. Grease Seal
6. Ball Bearing
7. Distance Collar
8. Ball Bearing
9. Front Hub
10. Fork Leg
11. Front Caliper
12. Speedometer Gear Housing
13. Speedometer Gear
14. Axle Clamp Bolt
15. Grease Seal
16. Axle Nut
17. Disc Mounting Bolt
18. Front Left Brake Disc
19. Rim
20. Tire

Rear Wheel

J5



1. Rear Shock Absorber
2. Gear Case Cover
3. O Ring
4. Ring Gear
5. Ball Bearing
6. Circlip
7. Needle Bearing
8. Oil Seal
9. Final Bevel Gear Case
10. Filler Plug
11. Tire
12. Rear Caliper
13. Rubber Damper
14. Brake Disc
15. Rear Hub
16. Circlip
17. Ball Bearing
18. Rear Axle
19. Wheel Coupling
20. Retainer

The tires are designed to provide good traction and power transmission during acceleration and braking even on bad surfaces. To do this, they must be inflated to the correct pressure and not overloaded. The maximum recommended load, in addition to vehicle weight, is 193 kg.

If the tires are inflated to too high a pressure, the ride is rough, the center portion of the tread wears quickly, and the tires are easily damaged.

If inflation pressure is too low, the shoulder portions of the tread wear quickly, the cord suffers damage, fuel consumption is high, and handling is poor. In addition, heat builds up at high speeds, and tire life is greatly shortened.

WARNING **To ensure safe handling and stability, use only the recommended standard tires for replacement, inflated them to the standard pressure (Table J1). A certain variation from the standard pressure may be desired depending on road surface conditions (rain, snow, rough surface, etc.).**

Table J1 Tires, Air Pressure (measured when cold)

	Load	Air Pressure	Size	Make, Type
Front	———	2.00 kg/cm² (28 psi)	3.50V-19 4PR	Dunlop F8 Tubeless or Bridgestone L303 Tubeless
Rear	Up to 97.5 kg	2.25 kg/cm² (32 psi)	4.50V-17 4PR	Dunlop K100 Tubeless or Bridgestone S705 Tubeless
	97.5 ~ 165 kg	2.50 kg/cm² (36 psi)		
	165 ~ 193 kg	2.80 kg/cm² (40 psi)		

Tire wear, damage

Tires must not be used if they are getting bald, or if they are cut or otherwise damaged. As the tire tread wears down, the tire becomes more susceptible the puncture and failure. 90% of tire failures occur during the last 10% of tire life.

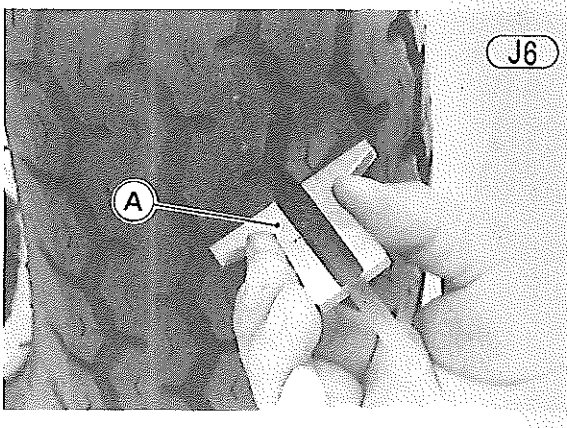
Visually inspect the tire for cracks and cuts. Replace the tire in case of bad damage. Remove any imbedded stones or other foreign particles from the tread. Swelling or high spots indicate internal damage, requiring tire replacement.

Measure the depth of the tread with a depth gauge, and replace the tire if the tread depth is less than the service limit.

Table J2 Tire Tread Depth

Tire	Standard		Service Limit	
			Under 130 kph	Over 130 kph
Front	Ⓓ 3.5 mm	Ⓑ 3.8 mm	1 mm	1 mm
Rear	Ⓓ 7.2 mm	Ⓑ 5.8 mm	2 mm	3 mm

Ⓓ : Dunlop Ⓑ : Bridgestone



A. Depth Gauge

Tire repair

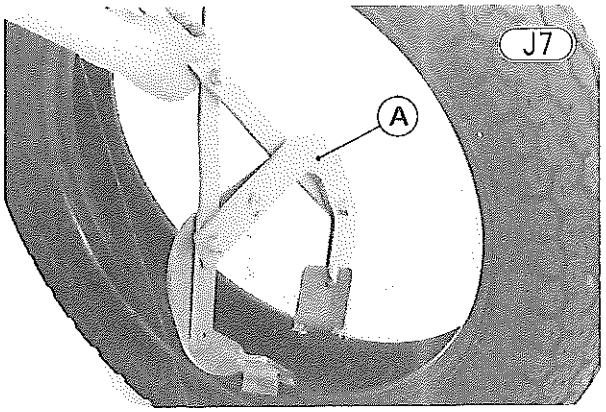
Currently two types of repair for tubeless tires have come into wide use. One type is called temporary (external) repairs which can be carried out without removing the tire from the rim, and another type is called permanent (internal) repairs which require the tire removal. It is generally understood that higher running durability is obtained by permanent (internal) repairs than by temporary (external) ones. Also, permanent (internal) repairs have the advantage of permitting a thorough examination for secondary damage not visible from external inspection of the tire. For these reasons, Kawasaki does not recommend temporary (external) repair. Only appropriate permanent (internal) repairs are recommended.

The tubeless tire repair methods described here describe the methods for COMBI UNITS made by TIP TOP (trade names). Repair methods may vary slightly from make to make. Follow the repair methods indicated by the manufacturer of the repair tools and materials so that safe results can be obtained.

WARNING **Punctured tire cannot thoroughly recover the original performance by any repair method. When being repaired with COMBI UNITS made by TIP TOP, do not exceed 80 kph within 24 hours after repair, and 180 kph at any time after that.**

- Locate and mark the puncture and remove the injuring object.
- Remove the tire from rim (Pg. 132).
- Inspect the tire carefully. If any damage mentioned below is found, replace the tire with a new one:
  1. Puncture or tear larger than 3 mm diameter.
  2. Two punctures within 40 cm distance.
  3. Three punctures or more in one tire.
  4. Puncture or damage on sidewall.
- Inspect the rim. If there is any damage such as is mentioned on Pg. 199, replace the rim with a new one.
- Repair the tire puncture. COMBI UNITS made by TIP TOP used here to describe the internal repair methods of tubeless tires.
  - Spread the tire slightly at the injury with the bead breaker (special tool). Choose a reamer of slightly greater diameter than the injury.

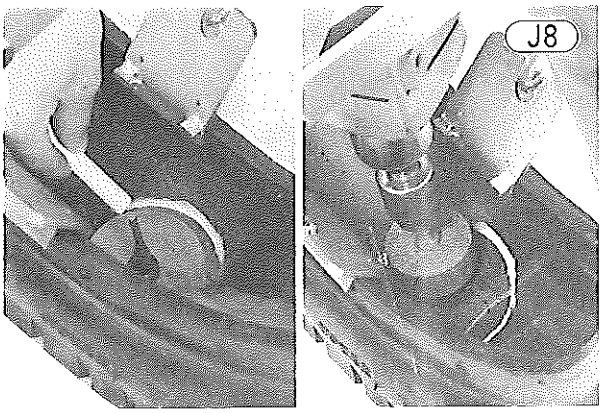
NOTE: The diameter of a reamer must be less than 3 mm at maximum.



A. Bead Breaker (57001-1072)

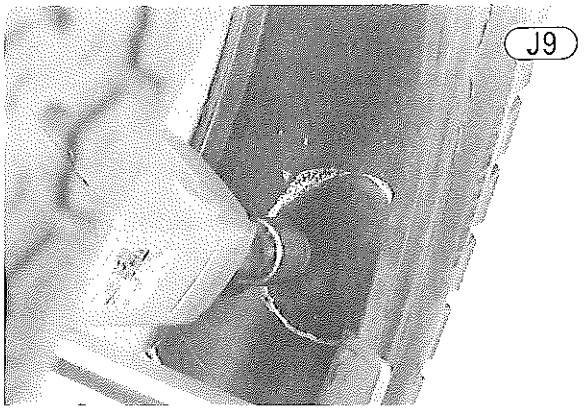
oBefore buffing the tires, thoroughly clean the area around the puncture with a suitable solvent and scrape out all mold lubricants (i.e. silicon, graphite, etc.). Let dry before buffing.

oCenter the COMBI UNIT on the puncture inside of the tire and draw an outline (do not use crayon). Buff the area slightly larger than the COMBI UNIT. Buff the area and remove the buffing dust.



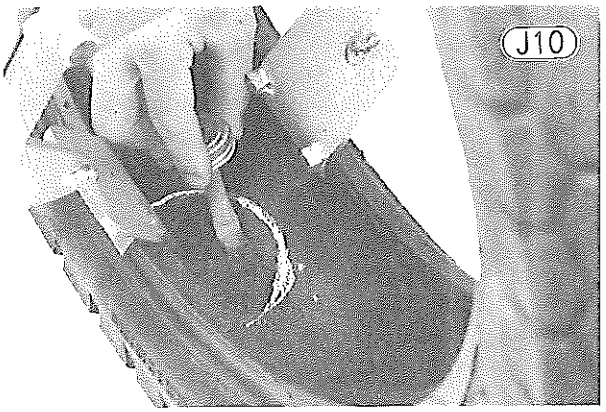
oCenter the reamer in the break inside of the tire and screw into the puncture.

NOTE: Be careful not to expand the injury with the reamer.

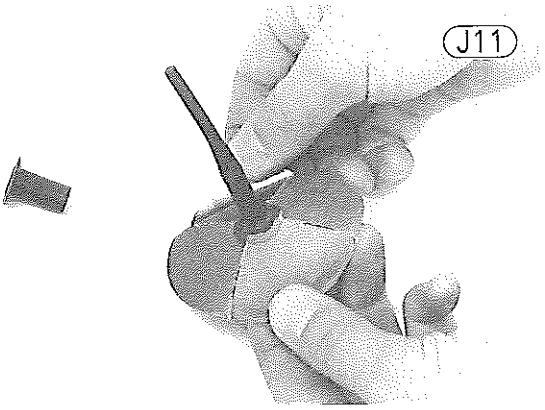


oClean the buffed area thoroughly.

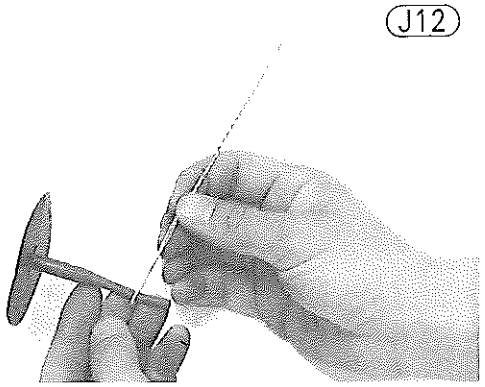
oCoat the puncture channel with a heavy larger of Rema special Tire Cement. Using clean fingers or a brush, spread thin, even coat of the same Cement to the buffed surface. Keep the repair area up to permit faster evaporation of solvent. Allow approximately 10 minutes for drying.



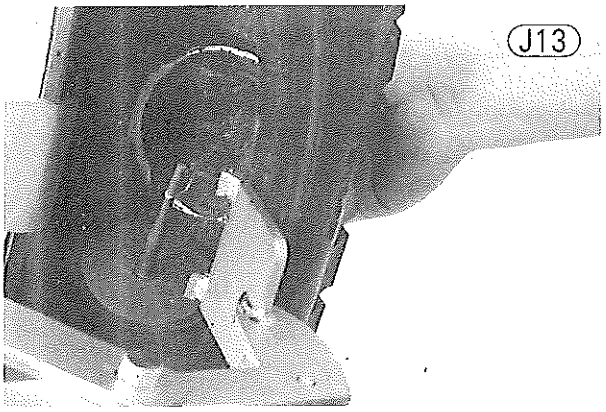
oUse the COMBI UNIT for the motorcycle tires. Re-remove the protective sleeve from the stem of the COMBI UNIT. Break the metal foil across the center, and peel the foil toward the edge. Coat the surface with a thin layer of Special Tire Cement. Do not touch the patch area.



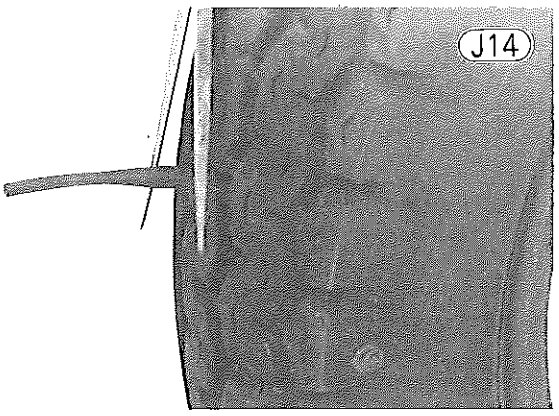
oRun the stem of the COMBI UNIT through the inserting wire.



○Apply Special Tire Cement to the upper end of the stem (30 mm above the patch) so that the stem of the COMBI UNIT slips smoothly.
○Pull the end of the stem through the puncture without turning until the base presses against inside of the tire.



○Roll the stitcher over the patch as hard as possible, keeping strokes close together and working from the center outwards.
○Cut off the protruding rubber tail flush with the tire surface.



●Install the tire on the rim (Pg. 133).
●Balance the wheel (Pg. 26).

Rims

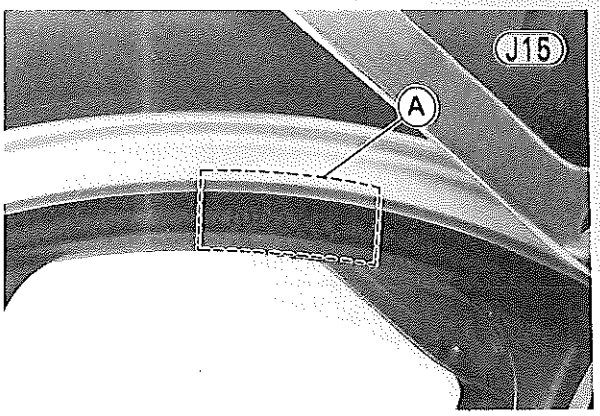
The rims for tubeless tires are specially designed in shape, size, and finish to be airtight and to keep the tire from coming off from the rim.

The indication "TUBELESS" on the rim shows that the rim is specially designed for tubeless tires.

Table J3 Rim Size, Type*

	Size, Type
Front	19 x MT 1.85 TUBELESS
Rear	17 x MT 2.50 TUBELESS

*The rim size shown in the table is the inner width of the rim flanges and bead seat diameter, both in inches.



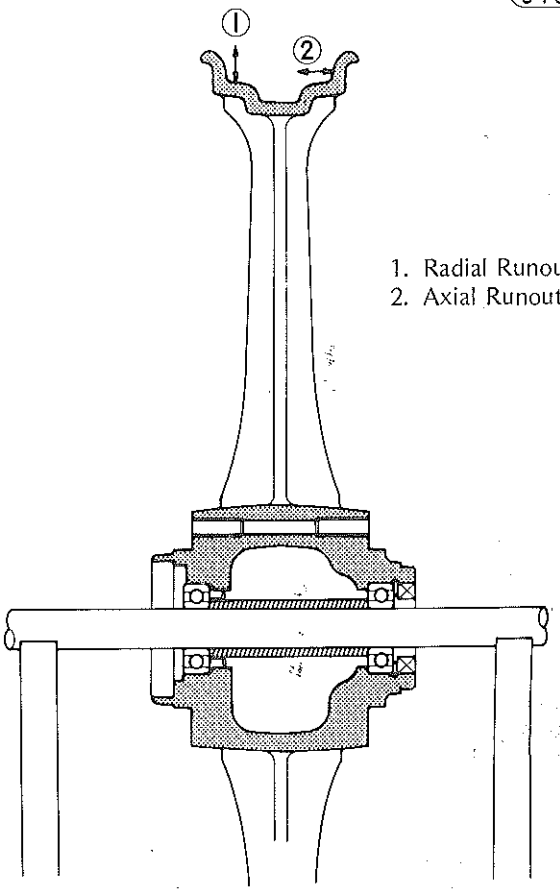
A. "TUBELESS"

Rim runout measurement

If there is any doubt as to the condition of the wheel, or if the wheel has received a heavy impact, check the rim runout as follows:

Remove the tire and suspend the wheel by the axle. Set a dial gauge against the side of the rim, and rotate the wheel to measure the axial runout. The difference between the highest and lowest dial readings is the amount of runout.

Rim Runout Measurement J16



1. Radial Runout
2. Axial Runout

Set the dial gauge against the outer circumference of the rim, and rotate the wheel to measure radial runout. The difference between the highest and lowest dial readings is the amount of runout.

If rim runout exceeds the service limit, check the wheel bearings first. Replace them if they are damaged. If the problem is not due to the bearings, the wheel must be replaced. Do not attempt to repair a damaged wheel.

Table J4 Rim Runout (with tire removed)

	Service Limit
Axial	under 0.5 mm
Radial	under 0.8 mm

Rim damage

Carefully inspect the wheel for small cracks, dents, bents, or warp. If there is any damage to the wheel, it must be replaced.

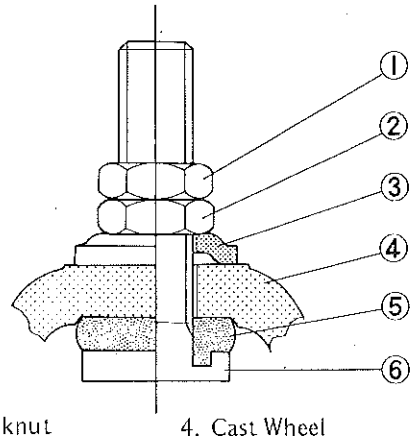
WARNING **Never attempt to repair a damaged wheel. If there is any damage besides wheel bearings, the wheel must be replaced to insure safe operational condition.**

If the rim has a scratch deeper than 0.5 mm and/or across the rim sealing surface, replace the wheel.

Air Valves

For tubeless tires, the air valve is installed directly on the rim. The airtightness between the rim and the valve stem is ensured with a rubber grommet.

Air Valve (J17)



1. Locknut
2. Nut
3. Washer
4. Cast Wheel
5. Grommet
6. Valve Stem

Axles

A bent axle causes vibration, poor handling, and instability.

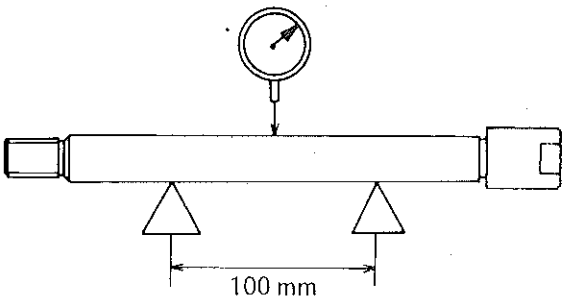
To measure axle runout, remove the axle, place it in V blocks that are 100 mm apart, and set a dial gauge against the axle at a point halfway between the blocks. Turn the axle to measure the runout. The amount of runout is the amount of dial variation.

If runout exceeds the service limit, straighten the axle or replace it. If the axle cannot be straightened to within tolerance, or if runout exceeds the repair limit, replace the axle.

Table J5 Axle Runout/100 mm

	Standard	Service Limit
Front	under 0.1 mm	0.2 mm
Rear	under 0.05 mm	0.2 mm

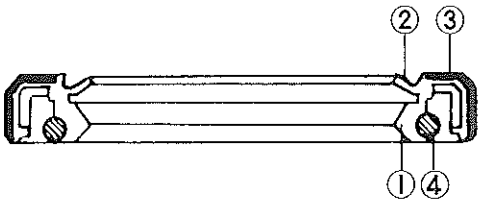
Axle Runout (J18)



Grease Seals

A grease seal is fitted in the speedometer gear housing, in the right side of the front hub, and in the right side of the rear hub. Each grease seal is a rubber ring equipped with a steel band on its outer circumference. The grease seal inner lip is held against the axle collar by a wire spring band. Since the grease seal not only seals in the wheel bearing grease but also keeps dirt and moisture from entering the hub, the use of a damaged grease seal will cause the wheel bearing to wear quickly.

Grease Seal (J19)



1. Primary Lip
2. Secondary Lip
3. Metal Band
4. Wire Spring Band

A wheel bearing is fitted in both sides of each hub. Since worn wheel bearings will cause play in the wheel (resulting in vibration and instability), they should be cleaned, inspected, and greased periodically.

Inspection and lubrication

If the grease seals are examined without removing the seals themselves, look for discoloration (indicating the rubber has deteriorated), hardening, damage to the internal ribbing, or other damage. If the seal or internal ribbing has hardened, the clearance between the seal and the axle sleeve will not be taken up, which will allow dirt and moisture to enter and reach the bearing. If in doubt as to its condition and whenever the seal is

removed for greasing the bearing, the seal should be replaced. The seals are generally damaged upon removal.

Clean and grease the speedometer gear housing (front hub) in accordance with the Periodic Maintenance Chart (Pg. 10).

DRIVE LINE

This motorcycle uses a shaft instead of a chain to transmit the engine power to the rear wheel. The drive line of this motorcycle includes a cam damper, front bevel gears, propeller shaft, final bevel gears, and rear wheel coupling. The drive line construction is shown in Fig. J20. The following sections cover the bevel gears, propeller shaft, rear wheel coupling, and cam damper.

Bevel Gears, Bearings, Oil Seals

This motorcycle has two sets of bevel gears. The front bevel gears are located on the left side of the engine, and are used to drive the propeller shaft. The rear bevel gears, or final bevel gears are located on the left side of the rear wheel, and are driven by the propeller shaft to turn the rear wheel.

The bevel gears are lapped together at the factory to get the best tooth contact. They must be replaced as a set.

The backlash and tooth contact pattern of the bevel gears are very important as strength, wear, and quiet operation are to be of the best quality. And so the backlash and tooth contact pattern of the bevel gears must be checked and adjusted when replacing any of the parts which have influence on them. These patterns are brought out by coating the teeth with a checking compound.

The front drive and driven gear assemblies and final pinion assembly have two opposed tapered roller bearings which are preloaded by tightening a nut or bolt. In order to prevent the gear from moving axially under load, the bearings must be properly preloaded.

The front bevel gears are lubricated by engine oil. The final bevel gears are lubricated by hypoid gear oil carried a separate sump in the final gear case.

Bevel gear inspection

Disassemble the front or final bevel gears, and check the bevel gears for scoring, chipping, or other damage. Replace the bevel gears as a set if either gear is damaged.

Bearing wear, damage

Since the ball bearing in the ring gear assembly is made to extremely close tolerances, the wear must be judged by feel rather than by measurement. Clean the ball bearing in a high flash-point solvent, dry it (**do not spin it while it is dry**), and oil it. Spin it by hand to check its condition. If it is noisy, does not spin smoothly, or has any rough spots, replace the final bevel gears as a set.

The rollers in the needle and tapered roller bearings wear so little that the wear is difficult to measure. Instead, inspect the bearings for abrasion, color change, or other damage. If there is any doubt as to the condition of a bearing, replace it.

Oil seal damage

Inspect the oil seals, and replace any if the lips are misshapen, discolored (indicating the rubber has deteriorated), hardened, or otherwise damaged. Since an oil seal is nearly always damaged on removal, any removed oil seals must be replaced. When pressing in an oil seal which is marked, press it in with the mark facing outward.

Propeller Shaft

The propeller shaft connects the front bevel driven gear with the final pinion gear to transmit the engine power to the rear wheel.

The engine is mounted on the frame, and the rear wheel is moved up and down in relation to the frame. When the rear wheel moves up and down, the propeller shaft must be able to flex. To allow the propeller shaft to move without breaking, a universal joint is used at the front end of the propeller shaft.

As the rear wheel moves up and down, it swings on an arc that is different from that of the drive line. As a result, the distance between the front bevel driven gear and the final pinion gear will change to some extent. To allow the propeller shaft to adjust to these variations in length, sliding joints are used at each end of the propeller shaft.

The splines of the final pinion joint are curved, thereby allowing the sliding joint to compensate for slight misalignment of the properller shaft.

Inspection

The rollers in the needle bearings of the propeller shaft universal joint wear so little that the wear is difficult to measure. Instead, inspect the needle bearings for abrasiton, color change, or other damage. If there is any doubt as to the condition of either needle bearing, replace the propeller shaft.

Inspect the splines of the propeller shaft sliding joints, replace the joint part if its splines are chipped or damaged.

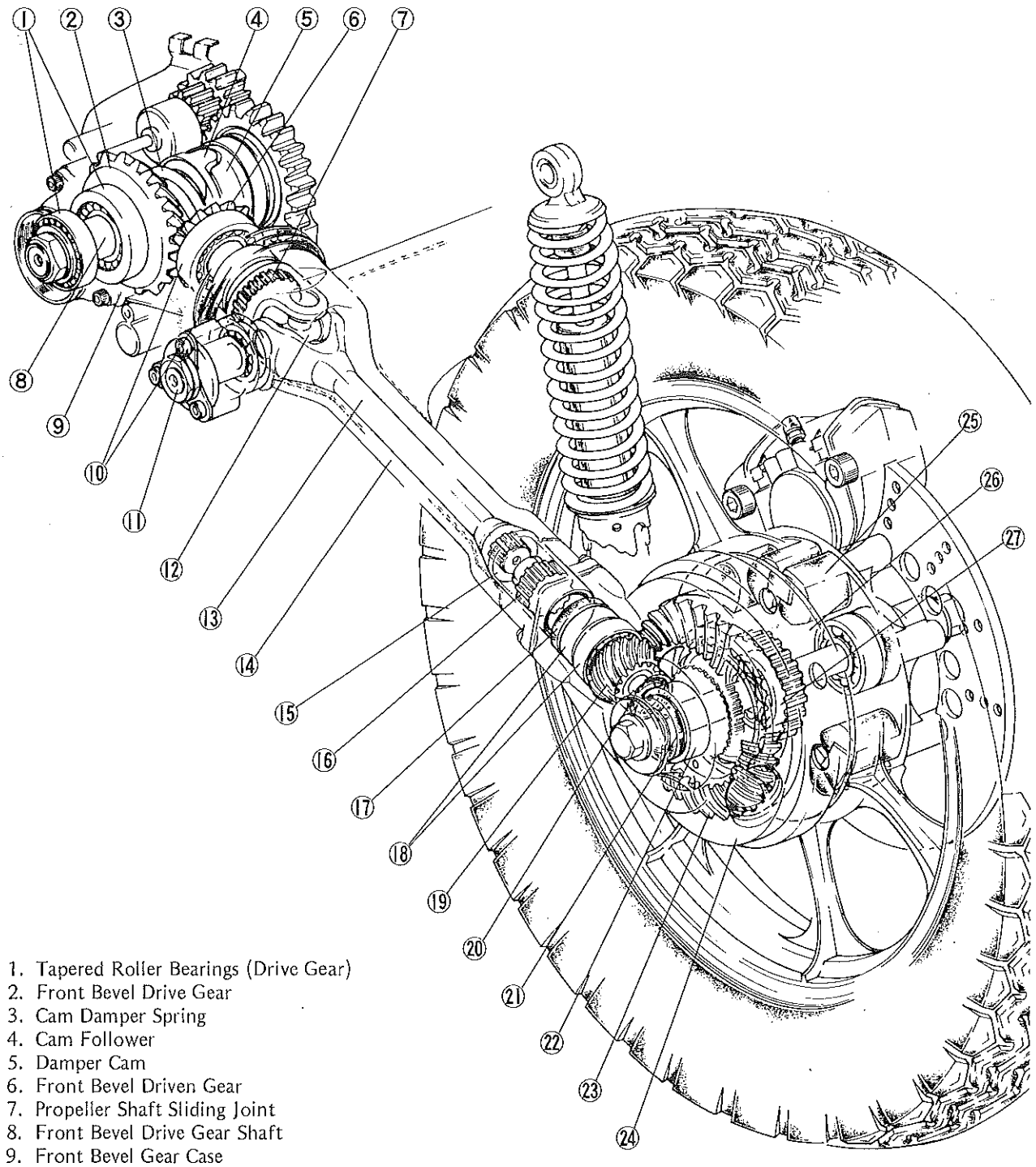
Lubrication

In accordance with the Periodic Maintenance Chart (Pg. 10), and whenever the drive line is disassembled, the sliding joints of the propeller shaft shold be lubricated.

Wipe off all the old grease, washing them in a high flash-point solvent if necessary. Apply a thin coat of a high temperature grease to the sliding joint splines at the front of the propeller shaft. Pack the propeller shaft joint at the rear of the propeller shaft with 25 cc (20 grams) of high temperature grease.

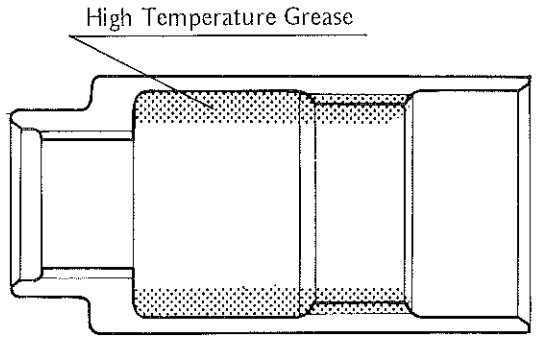
Drive Line

(J20)



1. Tapered Roller Bearings (Drive Gear)
2. Front Bevel Drive Gear
3. Cam Damper Spring
4. Cam Follower
5. Damper Cam
6. Front Bevel Driven Gear
7. Propeller Shaft Sliding Joint
8. Front Bevel Drive Gear Shaft
9. Front Bevel Gear Case
10. Tapered Roller Bearings (Driven Gear)
11. Swing Arm Pivot Shaft
12. Universal Joint
13. Propeller Shaft
14. Swing Arm
15. Propeller Shaft Joint
16. Propeller Shaft Sliding Joint
17. Oil Seal
18. Tapered Roller Bearings (Pinion Gear)
19. Final Bevel Pinion Gear
20. Needle Bearing (Pinion Gear)
21. Oil Seal
22. Needle Bearing (Ring Gear)
23. Final Bevel Ring Gear
24. Final Bevel Gear Case
25. Rubber Damper
26. Rear Wheel Coupling
27. Ball Bearing (Ring Gear)

Propeller Shaft Joint Lubrication (J21)



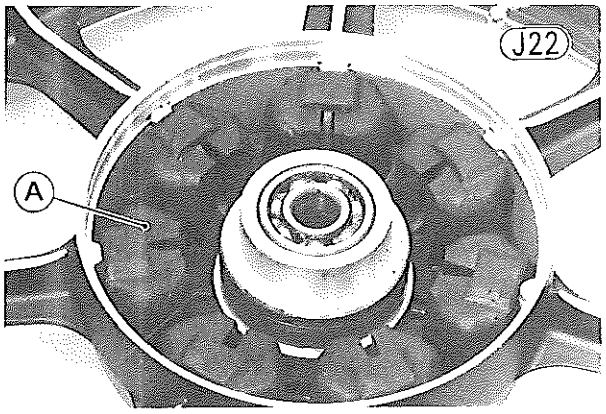
Rear Wheel Coupling

The rear wheel coupling connects the final bevel gear to the wheel. A rubber shock damper in the coupling absorbs some of the shock resulting from sudden changes in torque due to acceleration or braking.

Rubber damper inspection

Remove the rear wheel coupling (Pg. 118), and inspect the rubber damper.

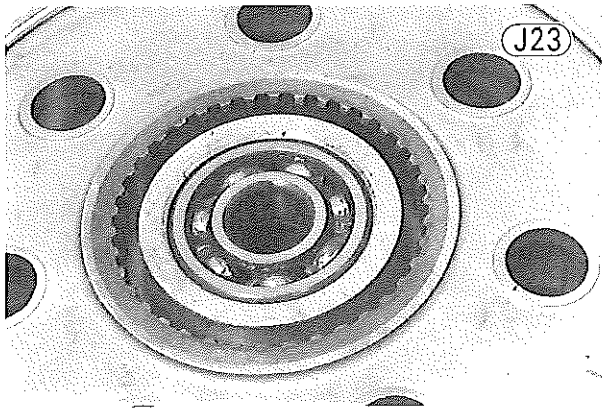
Replace the damper if it appears damaged or deteriorated.



A. Rubber Damper

Coupling inspection

Inspect the coupling splines; replace the coupling if its splines are chipped or damaged.



Cam Damper

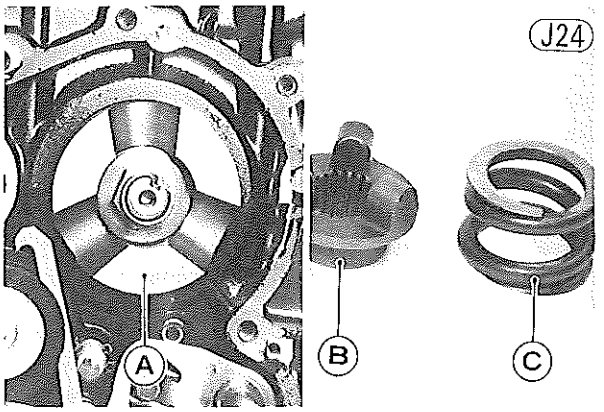
The cam damper includes the damper cam, cam follower, and damper spring. The cam follower is splined and able to move sideways (axially) on the front bevel drive gear shaft. The damper cam is fixed on the end of the transmission output shaft. The damper spring presses the cam follower against the cam. Normally the cam and cam follower turn together and work as a coupling.

When the cam damper receives a shock, the cam follower slides on the curve of the cam and moves sideways (axially) on the shaft to compress the damper spring. The cam and cam follower are twisted momentarily by the shock. The cam damper changes the shock from a rotating force to a sliding movement sideways on the shaft and thereby absorbs the shock.

Inspection

Remove the front bevel gear case, and inspect the damper cam, cam follower, and damper spring.

Replace any parts that appear to be damaged.



A. Damper Cam
B. Cam Follower
C. Damper Spring

BRAKES

A hydraulic disc brake is used on each wheel for superior braking performance and high reliability. The major components of each disc brake are the brake lever (front) or the brake pedal (rear), master cylinder, brake line, caliper assembly, and disc. The brake lever is pulled or the brake pedal is pushed to move a piston in the master cylinder and pressurize the brake fluid. Fluid pressure is transmitted through the brake line to operate the caliper. The caliper grips the disc attached to the wheel, slowing wheel rotation. Front brake lever pushes the front brake light switch, and the rear brake pedal pulls the rear brake light switch. Each switch turns on the brake light.

The brake fluid is an extra heavy duty type with a high boiling point to withstand the heat produced by friction of the caliper pads on the disc. Since the boiling point and thus the performance of the fluid would be reduced by contamination with water vapor or dirt from the air, the reservoir is sealed with a rubber diaphragm under the cap. This cap seal also prevents fluid evaporation and spillage should the motorcycle fall over. The

fluid is further protected by rubber seals in the caliper assembly and at the master cylinder brake line fitting.

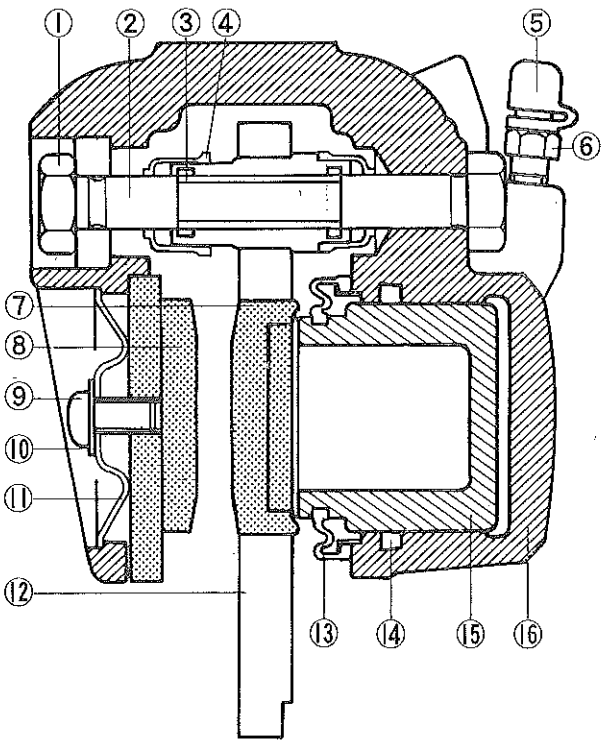
The master cylinder assembly includes the reservoir ①, piston ⑥, primary and secondary cups ④, ⑦, non-return valve ⑤, and spring ③. The reservoir has two holes at the bottom: a relatively large supply port ⑮ to supply fluid to the lines and a small relief port ⑭ to admit excess fluid from the line. The primary and secondary cups stop the fluid from leaking back around the piston while the piston is moving forward to pressurize the line. The non-return valve is in the head of the piston; it stops backward fluid flow when the brake is applied. When the brake lever is released, the valve allows flow around the cup to fill the vacuum in front of the piston so that the piston can return easily.

The front wheel has a floating-type caliper. The front caliper assembly includes pad A ⑦, pad B ⑧, and the piston ⑮, which is inside the caliper cylinder. Through the caliper run two shafts ②, which also pass through the caliper holder ⑫ to mount the assembly to the left front fork. When the piston forces pad A against the disc, the shaft portion of the caliper assembly slides through the holder such that pad B is also forced against the disc, both brake pads being kept parallel to the disc.

The rear wheel has a fixed caliper. The rear caliper assembly consists of two caliper halves ⑥, ⑩, bolted together, with each half containing a cylinder; a set of opposed pistons ⑨; and two pads ⑧. The pad anti-rattle springs ② hold the pads in position apart from the disc when the rear brake is not applied. When the brake is applied, the pressurized fluid is delivered to the piston areas on both sides of the caliper at the same time. Each piston goes forward until it is pressed against the disc, so no lateral movement of the disc and caliper is needed. There is a drilled internal fluid passage which is sealed by O ring where the two caliper halves join.

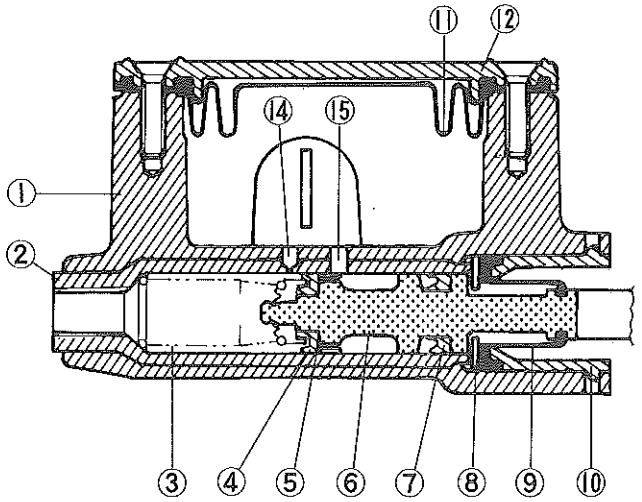
Front Caliper

J25

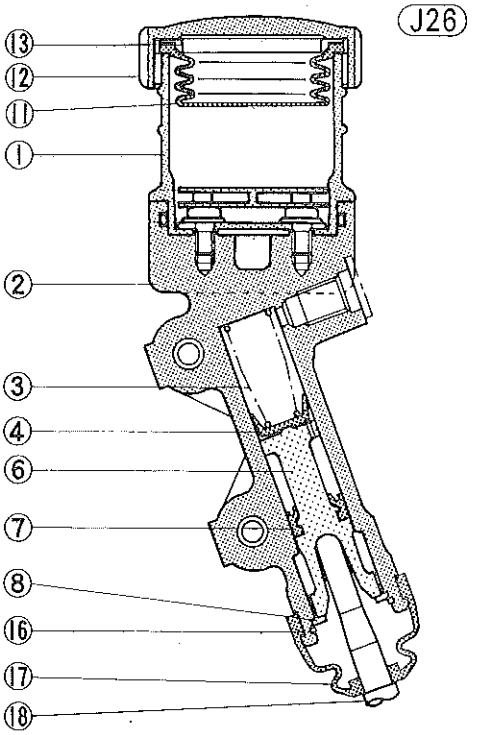


1. Nut
2. Caliper Holder Shaft
3. Bushing
4. Dust Cover
5. Bleed Valve Cap
6. Bleed Valve
7. Pad A
8. Pad B
9. Screw
10. Lockwasher
11. Metal Plate
12. Caliper Holder
13. Dust Seal
14. Fluid Seal
15. Piston
16. Caliper

Master Cylinders

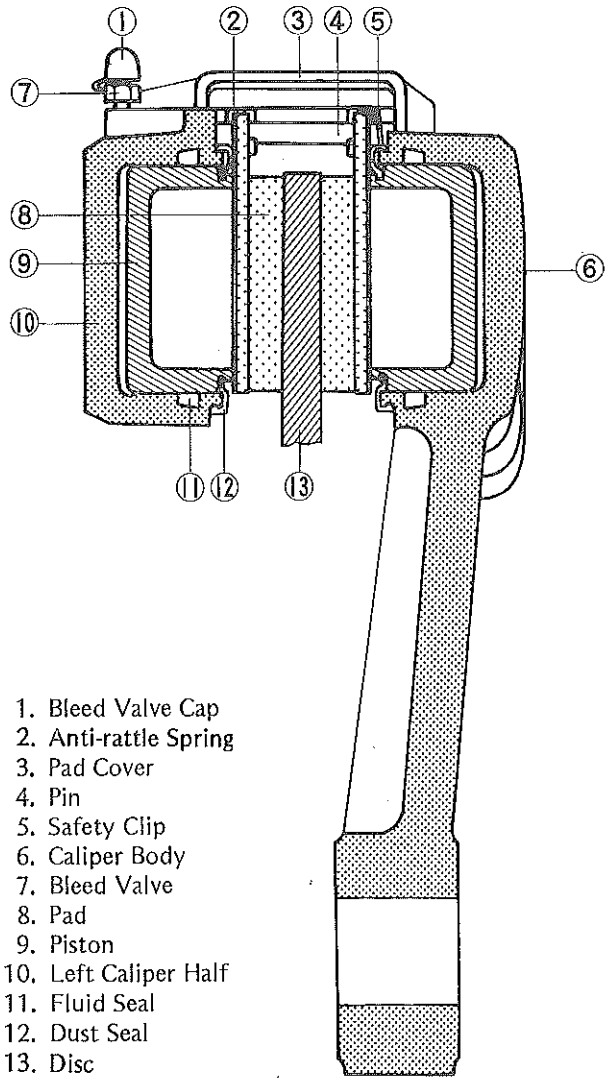


J26



1. Reservoir
2. Master Cylinder Body
3. Spring
4. Primary Cup
5. Non-return Valve
6. Piston
7. Secondary Cup
8. Piston Stop
9. Dust Seal
10. Liner
11. Diaphragm
12. Cap
13. Plate
14. Relief Port
15. Supply Port
16. Retainer
17. Dust Cover
18. Push Rod

Rear Caliper (J27)



1. Bleed Valve Cap
2. Anti-rattle Spring
3. Pad Cover
4. Pin
5. Safety Clip
6. Caliper Body
7. Bleed Valve
8. Pad
9. Piston
10. Left Caliper Half
11. Fluid Seal
12. Dust Seal
13. Disc

Unlike a drum-type brake, the components of the disc brake which perform the actual braking action, i.e., the disc and pads, are open to direct contact with the air flow past the motorcycle. This provides for excellent dissipation of the heat from brake friction, and minimizes the possibility of brake fade common to drum brakes.

The automatic wear adjustment mechanism of the rear caliper is the same as that of the front caliper, and caliper operation is the same as for the front caliper except that the rear caliper is held stationary and has two pistons. So a separate explanation of the braking and release strokes of the rear caliper will be omitted.

Automatic Wear Adjustment

When fluid pressure develops in the cylinder, the piston is pushed exerting pressure against the brake pad, which in turn presses against the brake disc. The pressurized fluid is prevented from leaking by a fluid seal fitted into the cylinder wall. The seal is pressed against the piston and, instead of sliding when the piston moves, the seal is only distorted, allowing no fluid leakage at all (See Fig. J28). When the brake lever or pedal is released and fluid pressure lowers, the elasticity of the seal returns the piston to its original position. After the brakes are used for a while and the pads wear slightly, the rubber seal will no longer be able to distort the additional amount that the piston travels. Instead, when piston travel forces the seal past its limit, the seal slips on the piston. The seal then returns the piston to a new rest position that is closer to the disc.

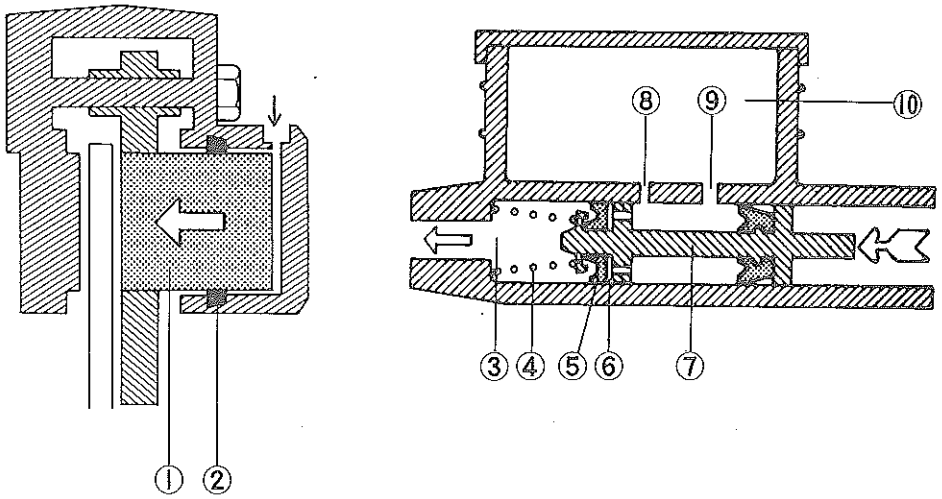
A small amount of fluid from the reservoir supplements the fluid in the brake line to compensate for the difference in piston position. Consequently, the length of the brake lever or pedal stroke remains unchanged, and the brake never needs adjustment.

The seal and the cup at the head of the master cylinder piston are made of special heat resistant rubber for best performance and to prevent deterioration. For this reason, only standard parts should be used.

Braking Stoke

When the brake lever is pulled, the piston ⑦ in the master cylinder is pushed and moves forward against

Braking Stroke (J28)



1. Piston
2. Fluid Seal
3. Pressure Chamber
4. Spring
5. Primary Cup
6. Non-return Valve
7. Piston
8. Relief Port
9. Supply Port
10. Reservoir

the force of the return spring ④. At this time, the primary cup ⑤ at the head of the piston closes the small relief port ⑧, which connects the pressure chamber ③ and the reservoir ⑩. Until this port is fully closed, the brake fluid does not start being pressurized, in spite of the forward movement of the piston.

The pressure stroke starts as soon as the relief port is closed. The piston compresses the brake fluid, which is being used as the pressure medium, forcing it out into the brake line. The pressure is transmitted through the line to the cylinder portion of the caliper assembly, where it forces the piston ① towards the disc. The piston presses pad A against the disc, but since the disc is immovable, further pressure cannot move the pad any farther. Instead, the entire caliper assembly moves in the opposite direction such that pad B is also forced against the disc. In this manner, the disc is gripped between the two pads, and the resulting friction slows wheel rotation.

Braking Release Stroke

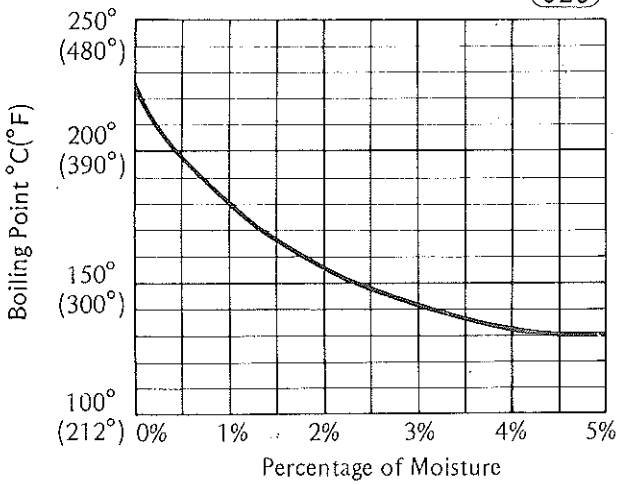
When the brake lever is released, the piston in the master cylinder is quickly returned toward its rest position by the spring ④, and brake fluid pressure drops in the line and in the caliper cylinder. The elasticity of the fluid seal ② in the cylinder then returns the piston. This leaves no pressure against either pad A or B so that slight friction against the disc pushes them both slightly away from the disc.

As the master cylinder piston moves back further, the brake fluid in the line rushes to fill the low pressure area in front of the primary cup at the piston head. At this time, fluid from the reservoir flows through the large supply port ⑨ into the space between the primary and secondary cups, through the non-return valve ⑥, and passes around the edges of the primary cup to fill the vacuum. When the piston has returned to its rest position against the stop, the small relief port is uncovered. As the brake fluid returns from the line, excess fluid passes through the relief port into the reservoir until the brake line pressure returns to zero.

Brake Fluid

When the brake is applied, heat is generated by the friction between the disc and the brake pads. While much of this heat is immediately dissipated, some of it is transmitted to the brake fluid and may raise fluid temperature to as high as 150°C (300°F) during brake operation. This temperature could boil the brake fluid and cause a vapor lock in the lines unless fluid with a high boiling point is used and has been kept from being contaminated with dirt, moisture, or a different type of fluid. Poor quality or contaminated fluid can also deteriorate from contact with the recommended brake fluids.

Brake Fluid Boiling Point (J29)

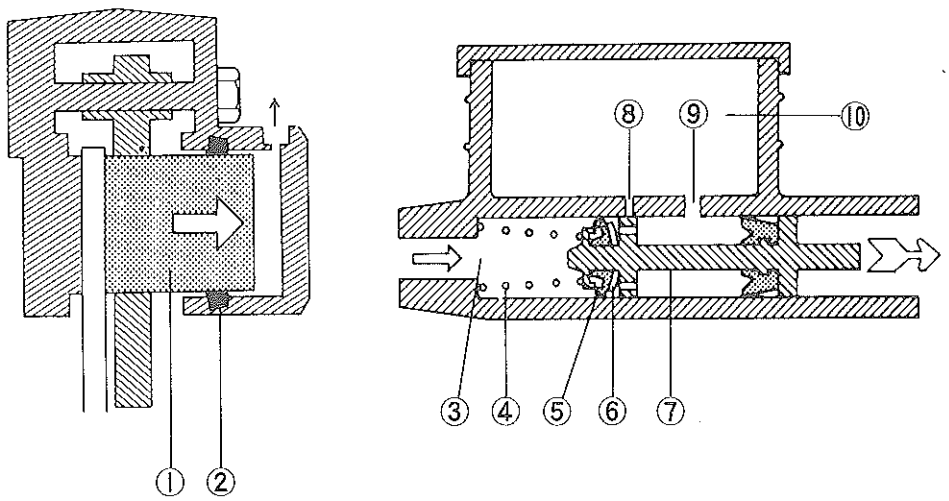


The graph of Fig. J29 shows how brake fluid contamination with moisture lowers the fluid boiling point. Although not shown in the graph, the boiling point also lowers as the fluid gets old, is contaminated with dirt, or if two different types of brake fluid are mixed.

Changing the brake fluid

The brake fluid should be changed in accordance with the Periodic Maintenance Chart (Pg. 10) and whenever it becomes contaminated with dirt or water.

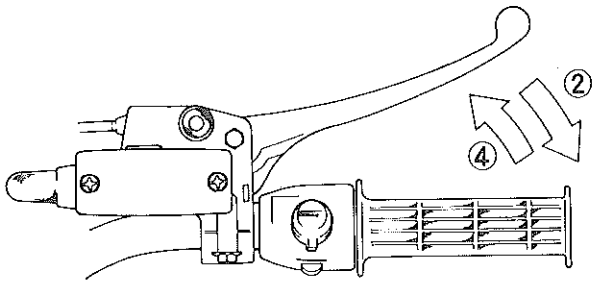
Braking Release Stroke (J30)



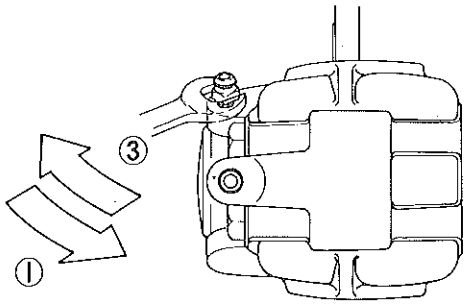
1. Piston
2. Fluid Seal
3. Pressure Chamber
4. Spring
5. Primary Cup
6. Non-return Valve
7. Piston
8. Relief Port
9. Supply Port
10. Reservoir

- Attach a clear plastic hose to the bleed valve on the caliper, and run the other end of the hose into a container.
- Remove the reservoir cap, and remove the rubber cap on the bleed valve.
- Open the bleed valve (counterclockwise to open), and pump the brake lever or pedal until all the fluid is drained from the line.
- If a dual disc brake is used, repeat the previous step one more time for the other side.
- Close the bleed valve(s), and fill the reservoir with fresh brake fluid.
- Open the bleed valve, apply the brake by the brake lever or pedal, close the valve with the brake held applied, and then quickly release the lever or pedal. Repeat this operation until the brake line is filled and fluid starts coming out of the plastic hose. Replenish the fluid in the reservoir as often as necessary to keep it from running completely out.
- Bleed the air from the lines.

Filling up the Brake Line (J31)



1. Open the bleed valve.
2. Apply the brake, keeping the brake applied.
3. Close the bleed valve.
4. Then quickly release the brake.



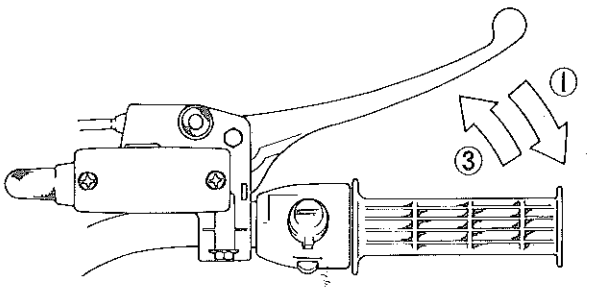
Bleeding the brake

The brake fluid has a very low compression coefficient so that almost all the movement of the brake lever or pedal is transmitted directly to the caliper for braking action. Air, however, is easily compressed. When air enters the brake lines, brake lever or pedal movement will be partially used in compressing the air. This will make the lever or pedal feel spongy, and there will be a loss in braking power.

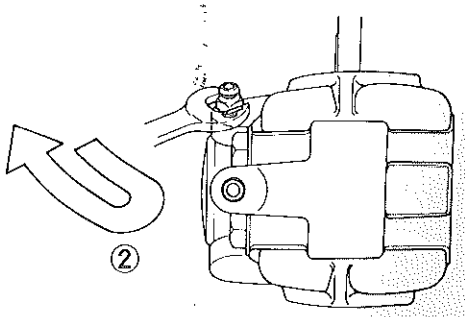
Bleed the air from the brake whenever brake lever or pedal action feels soft or spongy, after the brake fluid is changed, or whenever a brake line fitting has been loosened for any reason.

- Remove the reservoir cap, and check that there is plenty of fluid in the reservoir. The fluid level must be checked several times during the bleeding operation and replenished as necessary. If the fluid in the reservoir runs completely out any time during bleeding, the bleeding operation must be done over again from the beginning since air will have entered the line.
- With the reservoir cap off, slowly pump the brake lever or pedal several times until no air bubbles can be seen rising up through the fluid from the holes at the bottom of the reservoir. This bleeds the air from the master cylinder end of the line.
- Install the reservoir cap, and connect a clear plastic hose to the bleed valve at the caliper, running the other end of the hose into a container. Pump the brake lever or pedal a few times until it becomes hard and then, holding the lever squeezed or the pedal pushed down, quickly open (turn counterclockwise) and close the bleed valve. Then release the lever or pedal. Repeat this operation until no more air can be seen coming out into the plastic hose. Check the fluid level in the reservoir every so often, replenishing it as necessary.
- If a dual disc brake is used, repeat the previous step one more time for the other side.

Bleeding the Brake Line (J32)



1. Hold the brake applied.
2. Quickly open and close the valve.
3. Release the brake.



WARNING

When working with the disc brake, observe the precautions listed below.

1. Never reuse old brake fluid.
2. Do not use fluid from a container that has been left unsealed or that has been open a long time.
3. Do not mix two types of fluid for use in the brake. This lowers the brake fluid boiling point and could cause the brake to be ineffective. It may also cause the rubber brake parts to deteriorate. Recommended fluids are given in the table.

   NOTE: The type of fluid originally used in the disc brake is not available in most areas, but it should be necessary to add very little fluid before the first brake fluid change. After changing the fluid, use only the same type thereafter.

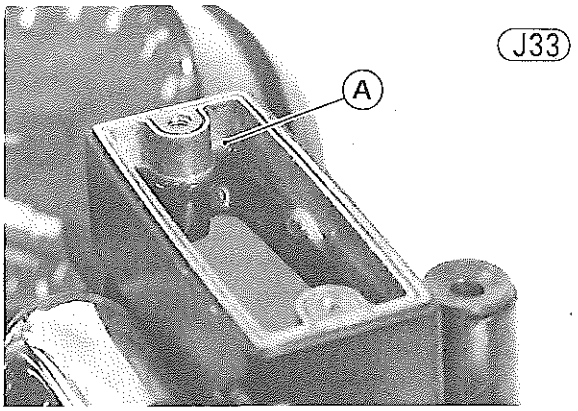
Table J6 Recommended Disc Brake Fluid

Atlas Extra Heavy Duty
Shell Super Heavy Duty
Texaco Super Heavy Duty
Wagner Lockheed Heavy Duty
Castrol Girling-Green
Castrol GT (LMA)
Castrol Disc Brake Fluid

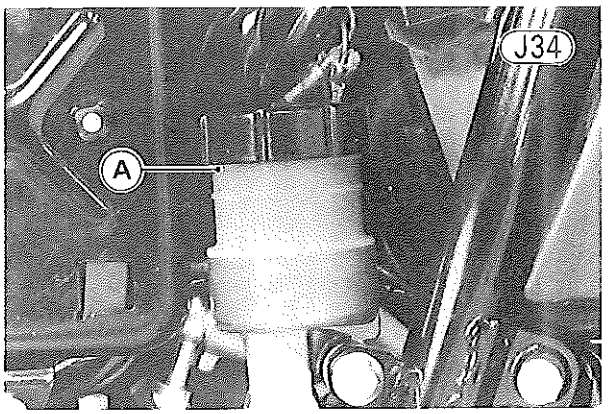
The correct fluid will come in a can labeled D.O.T.3. Do not use fluid that does not have this marking.

4. Don't leave the reservoir cap off for any length of time to avoid moisture contamination of the fluid.
5. Don't change the fluid in the rain or when a strong wind is blowing.
6. Except for the disc pads and discs, use only disc brake fluid, isopropyl alcohol, or ethyl alcohol for cleaning brake parts. Do not use any other fluid for cleaning these parts. Gasoline, motor oil, or any other petroleum distillate will cause deterioration of the rubber parts. Oil spilled on any part will be difficult to wash off completely and will eventually reach and break down the rubber used in the disc brake.
7. When handling the disc pads or disc, be careful that no disc brake fluid or any oil gets on them. Clean off any fluid or oil that inadvertently gets on the pads or disc with a high flash-point solvent. Do not use one which will leave an oily residue. Replace the pads with new ones if they cannot be cleaned satisfactorily.
8. Brake fluid quickly ruins painted surfaces; any spilled fluid should be completely wiped up immediately.
9. If any of the brake line fittings or the bleed valve is opened at any time, the **AIR MUST BE BLED FROM THE BRAKE.**
10. When installing or assembling the disc brake, tighten the disc brake fittings to the values given in Table G1. Improper torque may cause the brake to malfunction.

- When air bleeding is finished, install the rubber cap(s) on the bleed valve, and check that the brake fluid is filled to the upper level line marked in the reservoir (handlebar turned so that the reservoir is level).



A. Level Line



A. Level Line

Master cylinder parts wear

When master cylinder parts are worn or damaged, proper brake fluid pressure cannot be obtained in the line, and the brake will not hold.

If the small relief port becomes plugged, especially with a swollen or damaged primary cup, the brake pads will drag on the disc.

- Check that there are no scratches, rust or pitting on the inside of the master cylinder, and that it is not worn part the service limit.
- Check the piston for these same faults.

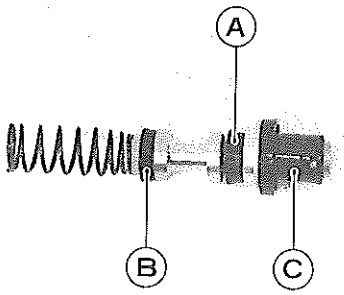
NOTE: The cups and spring are part of the piston assembly. Replace the piston assembly if any one of the cups or the spring requires replacement.

- Inspect the primary and secondary cups. If a cup is worn, damaged, softened (rotted), or swollen, replace it. When inserting the cup into the cylinder, see that it is slightly larger than the cylinder (standard values given in the table). If fluid leakage is noted at the brake lever, the cups should be replaced.

Table J7 Master Cylinder Parts

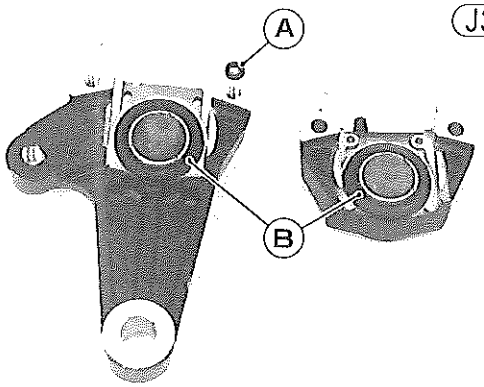
	Measurement	Standard	Service Limit
Front	Cylinder Inside Diameter	15.870~15.913 mm	15.95 mm
	Piston Outside Diameter	15.827~15.854 mm	15.77 mm
	Primary Cup Diameter	16.15~16.65 mm	16.00 mm
	Secondary Cup Diameter	16.55~17.05 mm	16.40 mm
	Spring Free Length	36.6~40.6 mm	34.7 mm
Rear	Cylinder Inside Diameter	15.870~15.913 mm	15.95 mm
	Piston Outside Diameter	15.827~15.854 mm	15.77 mm
	Primary, Secondary Cup Diameter	16.45~16.95 mm	16.30 mm
	Spring Free Length	49.2~53.2 mm	37.2 mm

J35



A. Secondary Cup **C. Dust Seal**
B. Primary Cup

J36



A. O Ring **B. Dust Seals**

●Replace the dust seal if damaged.

Caliper parts wear

Inspect the pads for wear. For the front disc brakes, check the thickness of the pad linings, and replace both pads as a set if the thickness of either pad is less than 1 mm. For the rear disc brake, if either pad is worn down through the stepped portion, replace both pads as a set. If any grease or oil spills on the pads, wash it off with trichloroethylene or a high flash-point solvent. Do not use one which will leave an oily residue. If the oil cannot be thoroughly clean off, replace the pads.

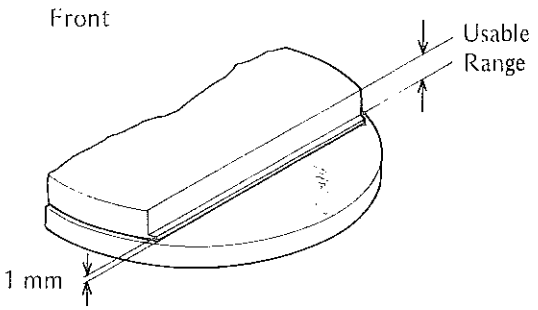
The fluid seal around the piston maintains the proper pad/disc clearance. If this seal is not satisfactory, pad wear will increase, and constant pad drag on the disc will raise brake and brake fluid temperature.

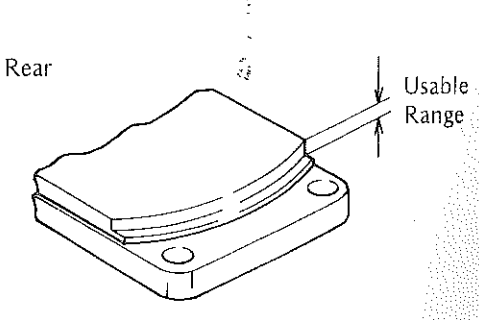
Replace the fluid seals under any of the following conditions: (a) fluid leakage around the pad; (b) brakes overheat; (c) there is a large difference in left and right pad wear; (d) the seal is stuck ot the piston. If the fluid seal is replaced, replace the dust seal as well. Also, replace all seals every other time the pads are changed.

Check the dust seals, dust covers, and O rings, and replace any that are cracked, worn, swollen or otherwise damaged.

Disc Brake Pads

J37





Measure the cylinder inside diameter and piston outside diameter.

Replace the cylinder and piston if they are worn out of tolerance, badly scored, or rusty.

Table J8 Caliper Parts (Front, Rear)

	Standard	Service Limit
Cylinder Inside Diameter	42.850~42.900 mm	42.92 mm
Piston Outside Diameter	42.788~42.820 mm	42.75 mm

Caliper holder shafts must slide smoothly in the caliper holder. If the shafts do not slide smoothly, one pad will wear more than the other, pad wear will increase, and constant drag on the disc will raise brake and brake fluid temperature. Check to see if the caliper holder shafts are not badly worn or stepped. If the shafts are damaged, replace the shafts and the caliper holder.

Brake line damage

The high pressure inside the brake line can cause fluid to leak or the hose to burst if the line is not properly maintained.

Bend and twist the rubber hose while examining it. Replace it if any cracks or bulges are noticed.

Disc wear, warp

Besides wearing down, the disc may warp. A warped disc will cause the brake pads to drag on the disc and will wear down both the pads and disc quickly. Dragging will also cause overheating and poor braking efficiency. Poor braking can also be caused by oil on the disc. Oil on the disc must be cleaned off with trichloroethylene or a high flash-point solvent. Do not use one which will leave an oily residue.

Jack up the motorcycle so that the front wheel is off the ground, and turn the handlebar fully to one side. Set up a dial gauge against the front disc as illustrated, and measure disc runout. Remove the jack, set the motorcycle up on its center stand, and then measure the rear disc runout. If runout exceeds the service limit, replace the disc.

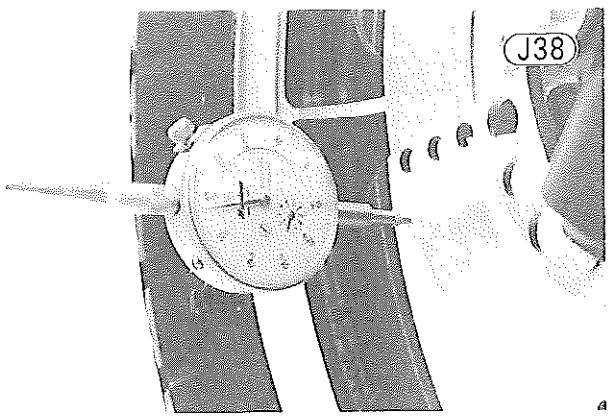


Table J9 Disc Runout (Front, Rear)

Standard	Service Limit
under 0.15 mm	0.3 mm

Measure the thickness of each disc at the point where it has worn the most. Replace the disc if it has worn past the service limit.

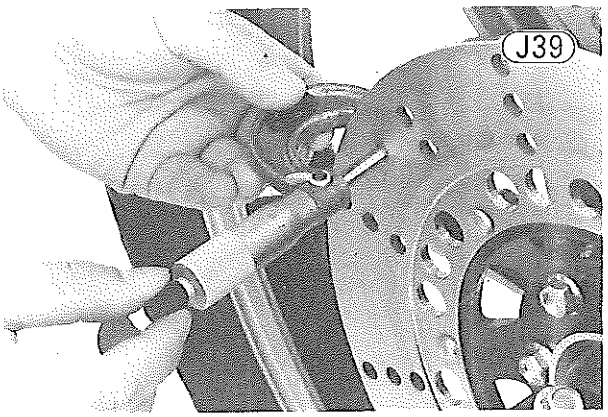


Table J10 Disc Thickness

	Standard	Service Limit
Front	4.8~5.1 mm	4.5 mm
Rear	6.8~7.1 mm	6 mm

STEERING STEM

The steering stem supports the handlebar and front fork, and turns inside the frame head pipe. Tapered roller bearings in the upper and lower ends of the head pipe enable the steering stem to turn smoothly and easily.

The steering stem itself does not wear, but it may become bent. If it becomes bent, the steering will be stiff, and the bearings may become damaged.

The steering stem will require periodic adjustment as it becomes loose due to bearing wear. Overtightening during adjustment, however, will make the steering stiff and cause accelerated bearing wear. Lack of proper lubrication will also bring about the same results.

From overtightening or from a heavy shock to the steering stem, the bearing race surfaces may become dented. Damaged bearing races will cause the handlebar to jerk or catch when turned.

Steering stem warp

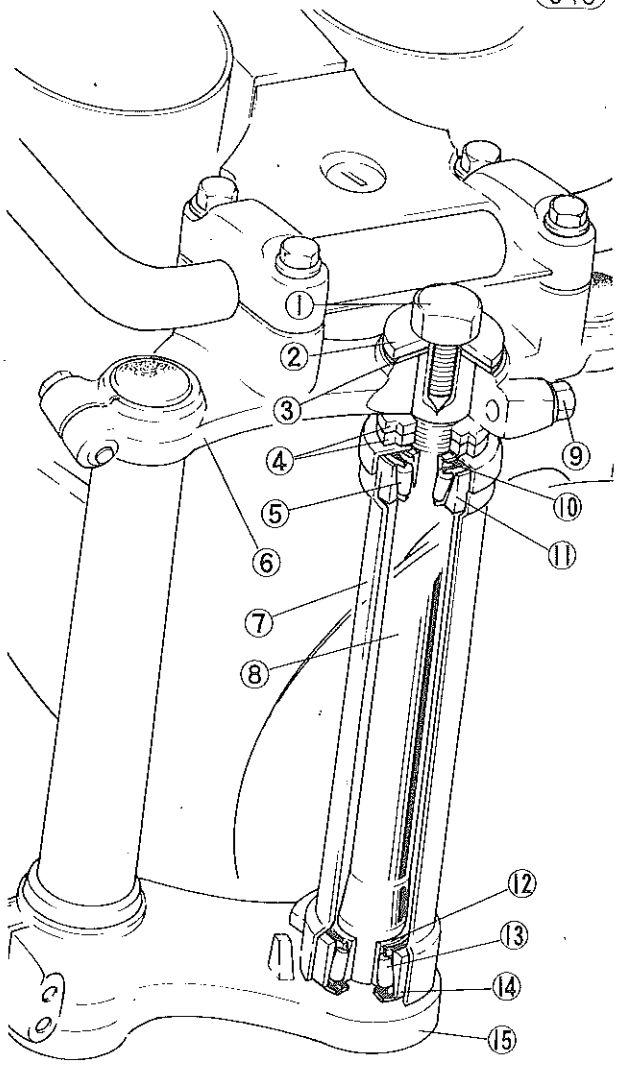
Examine the steering stem, and replace it if it is bent.

Bearing wear, damage

Wipe the bearings clean of grease and dirt, and examine the races and rollers. If the rollers or races are worn, or if either race is dented, replace the bearing.

Steering

J40



1. Stem Head Bolt
2. Flat Washer
3. Wave Washer
4. Stem Locknuts
5. Tapered Roller Bearing
6. Stem Head
7. Frame Head Pipe
8. Steering Stem
9. Head Clamp Bolt
10. Upper Inner Race
11. Upper Outer Race
12. Lower Inner Race
13. Tapered Roller Bearing
14. Lower Outer Race
15. Stem Base

Bearing lubrication

In accordance with the Periodic Maintenance Chart (Pg. 10), and whenever the steering stem is disassembled, the steering stem bearings should be relubricated.

Wipe all the old grease off the bearings, washing them in a high flash-point solvent if necessary. Replace the bearing parts if they show wear or damage. Apply grease liberally to the upper and lower bearings.

J41

Grease seal deterioration, damage

Inspect the grease seal for any signs of deterioration or damage, and replace it if necessary.

Replace the grease seal with a new one whenever it has been removed. The grease seal comes off whenever the lower bearing inner race is removed.

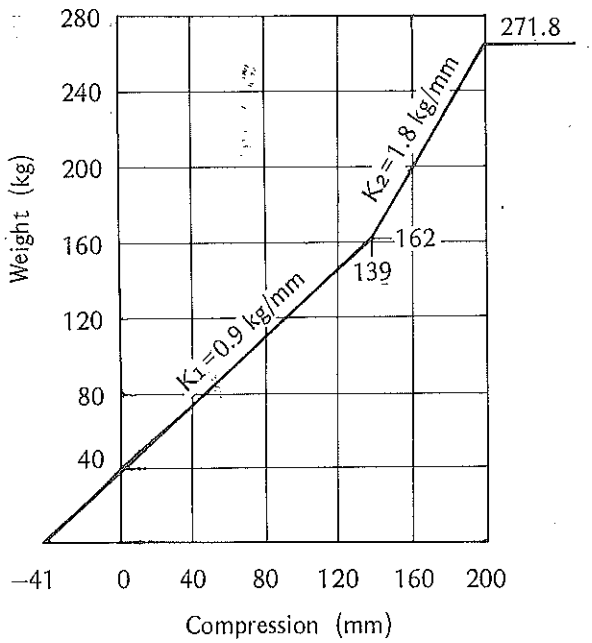
FRONT FORK

Front fork consists of the fork legs connected to the frame head pipe by the stem base and stem head bracket. It accomplishes shock absorption through spring action, air compression in the inner tube, and resistance to the flow of the oil forced into the cylinder by tube movement.

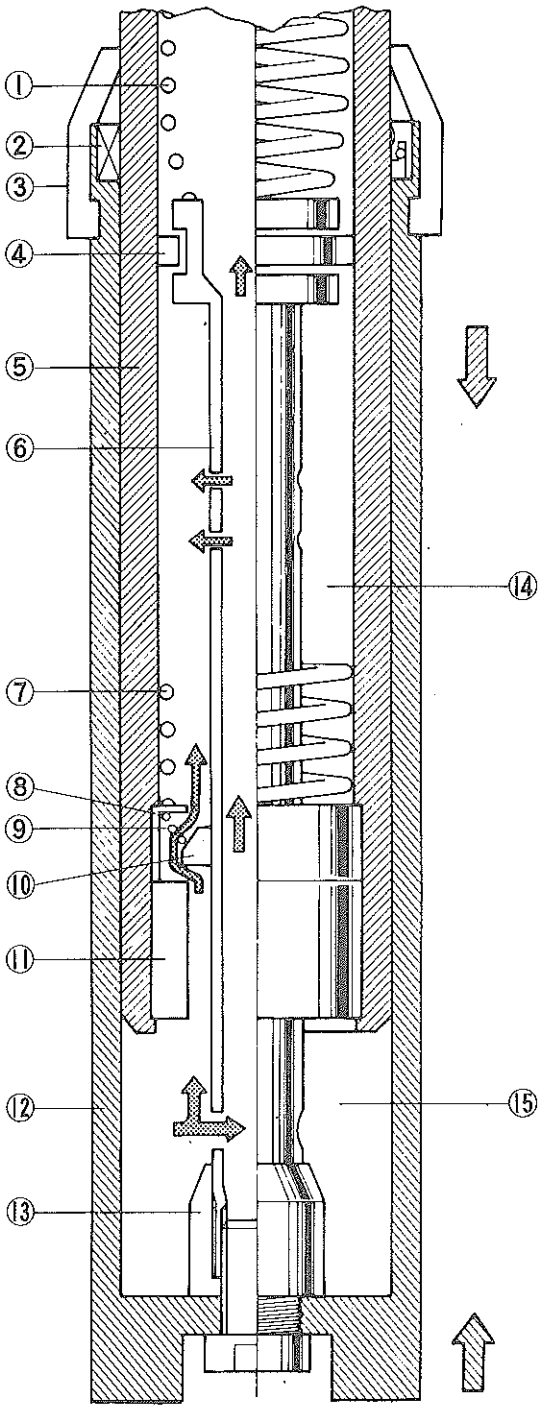
Each fork leg is telescopic tube including an inner tube ⑤, outer tube ⑫, cylinder and piston unit ⑥, collar ⑪, and cylinder base ⑬. The inner tube fits into the outer tube, altering its position in the outer tube as the tube arrangement absorbs shocks. The cylinder is fixed to the bottom of the outer tube and the piston (equipped with a piston ring ④) is secured to the top of the cylinder. The collar (coupled with a non-return valve ⑩), fixed in the lower end of the inner tube, forms the upper part of the lower chamber and together with the piston helps seal the upper chamber. The collar and cylinder base configuration function to form an oil lock at the end of the compression stroke to prevent the inner tube from striking the bottom. Small orifices (2) in the upper part of the cylinder bring about an oil lock at the end of the extension stroke to prevent the inner tube from striking the top.

Oil is prevented from leaking out by the oil seal ②, which is fitted at the upper end of the outer tube. A dust seal ③ on the outside of the tube keeps dirt and water from entering and damaging the oil seal and tube surface.

Front Fork Spring Force (US model) (J42)



Compression Stroke (J43)



1. Spring
2. Oil Seal
3. Dust Seal
4. Piston Ring
5. Inner Tube
6. Cylinder and Piston Unit
7. Spring
8. Spring Seat
9. Spring
10. Non-return Valve
11. Collar
12. Outer Tube
13. Cylinder Base
14. Upper Chamber
15. Lower Chamber

Compression Stroke

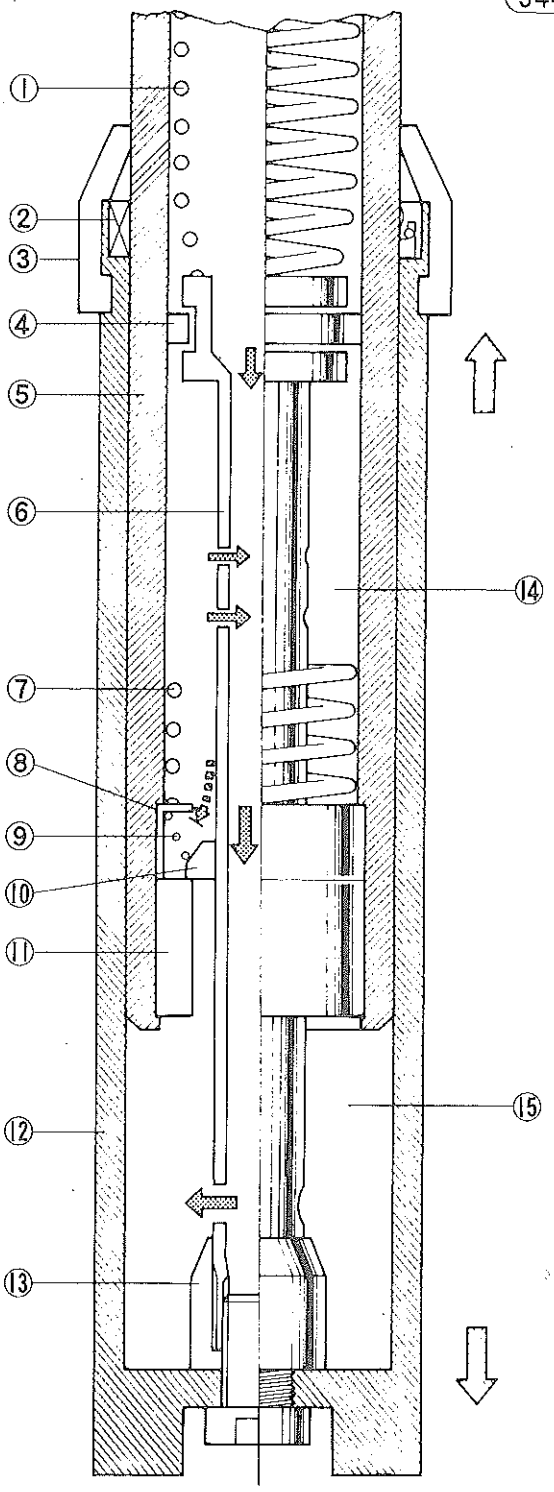
Whenever a load is placed on the front fork and whenever the front wheel receives a shock, the inner tube ⑤ moves down inside the outer rube ⑫, or the outer tube moves up, compressing both the springs ① and the air in the inner tube. At the same time, low pressure (suction) is created in an enlarging chamber (upper chamber ⑭) formed between the inner tube and the cylinder ⑥, and oil is drawn in from a diminishing chamber (lower chamber ⑮) formed between the outer tube and the cylinder. As the lower chamber shrinks in size with oil passing freely through the non-return valve ⑩ into the upper chamber, oil also passes freely through the cylinder lower orifices into the cylinder as the inner tube approaches the cylinder base ⑬. Near the end of the compression stroke, the clearance between the tapered-out cylinder base and the collar ⑪ at the lower end of the inner tube approaches zero. The resulting resistance to the flow of oil through this small space slows the movement, finally forming an oil lock to finish the compression stroke.

Extension Stroke

Following the compression stroke is the extension stroke, in which the compressed spring extends to push the inner tube back out of the outer tube. As the tubes move apart, the upper chamber grows smaller, forcing

Extension Stroke

J44



1. Spring
2. Oil Seal
3. Dust Seal
4. Piston Ring
5. Inner Tube
6. Cylinder and Piston Unit
7. Spring
8. Spring Seat
9. Spring
10. Non-return Valve
11. Collar
12. Outer Tube
13. Cylinder Base
14. Upper Chamber
15. Lower Chamber

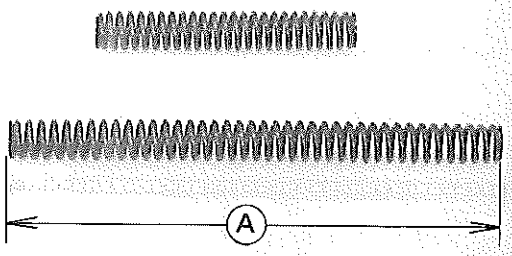
the oil through the way it came through the non-return valve. These small holes restrict the oil flow into the inner tube damping fork extension. Near the end of the extension stroke both the cylinder spring and the arrangement of the cylinder upper orifices provide further resistance to extension. As the collar rises, reducing orifices are eliminated and an oil lock forms, finishing the extension stroke.

Spring

Spring tension

Since the spring becomes shorter as it weakens, check its free length to determine its condition. If the spring of either fork leg is shorter than the service limit, it must be replaced. If the length of a replacement spring and that of the remaining spring vary greatly, the remaining spring should also be replaced in order to keep the fork legs balanced for motorcycle stability.

J45



A. Free Length

Table J11 Fork Springs Free Length

		Standard	Service Limit
US model	Short	203 mm	193 mm
	Long	375.5 mm	366 mm
European model		586 mm	576 mm

Inner Tube

A bent, dented, scored, or otherwise damaged inner tube will damage the oil seal, causing oil leakage. A badly bent inner tube may cause poor handling.

Inner tube damage

Visually inspect the inner tube, and repair any damage. If the damage is not repairable, replace the inner tube. Since damage to the inner tube damages the oil seal, replace the oil seal whenever the inner tube is repaired or replaced. Temporarily assemble the inner and outer tubes, and pump them back and forth manually to check for smooth operation.

CAUTION **If the inner tube is bent or badly creased, replace it. Excessive bending, followed by subsequent straightening, can weaken the inner tube.**

Fork Oil

Either too much or too little oil in the fork legs will adversely affect shock damping. Too much oil or

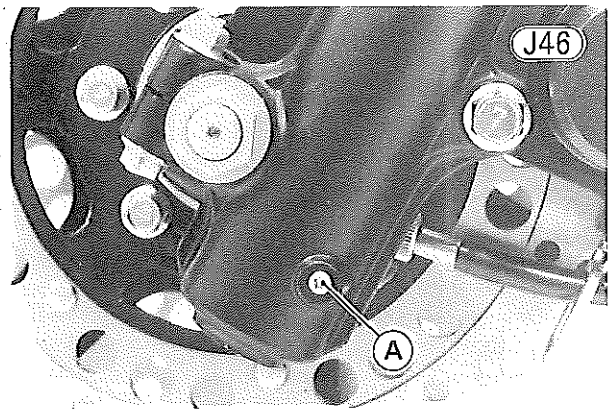
too heavy an oil makes the action too stiff; too little oil or too light an oil makes the action soft, decreases damping potential, and may cause noise during fork movement.

Contaminated or deteriorated oil will also affect shock damping and, in addition, will accelerate internal wear. The fork oil should be changed periodically (Pg. 10) or sooner if the oil appears dirty.

Fork oil change

To drain the old oil, remove the drain screw from the lower end of the outer tube. With the front wheel on the ground and the front brake fully applied push down on the handlebar a few times to pump out the oil. Install the drain screw and gasket, remove the top plug and springs from the inner tube, and pour in the type and amount of oil specified in Table J12. Check the oil level, and install the springs and top plug. If the oil is below the specified level, add oil and recheck the oil level.

NOTE: After the front fork oil is changed, but before checking the oil level, pump the forks several times to expel the air from the upper and lower chambers.



A. Drain Screw

Table J12 Fork Oil

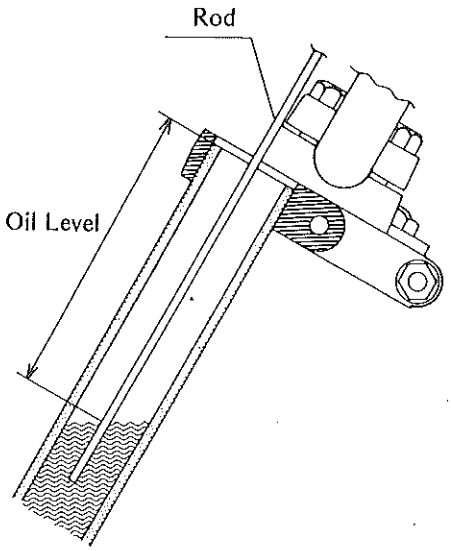
Type	When changing oil	After disassembly and completely dry	Oil Level (without springs)
SAE 10W	about 310 cc Ⓔ320 cc	336~344 cc Ⓔ346~354 cc	480 mm Ⓔ470 mm from top of inner tube

Ⓔ: European model

Oil level

To check the fork oil level, first place a jack or stand under the engine so that the front wheel is raised off the ground. Remove the top plug and fork springs from the inner tube. Insert a rod down into the tube, and measure the distance from the top of the inner tube to the oil level. If the oil is below the correct level, add enough oil to bring it up to the proper level, taking care not to overfill.

Front Fork Oil Level J47



REAR SHOCK ABSORBERS

The rear shock absorbers serve to dampen shock transmitted to the frame and rider from the rear wheel. For this purpose, they are connected between the frame and the rear end of the swing arm. Shock absorption is performed by the spring and by the resistance to the flow of oil inside each unit. Shock absorption is further aided by the use of rubber bushings in both the upper and lower shock absorber mountings.

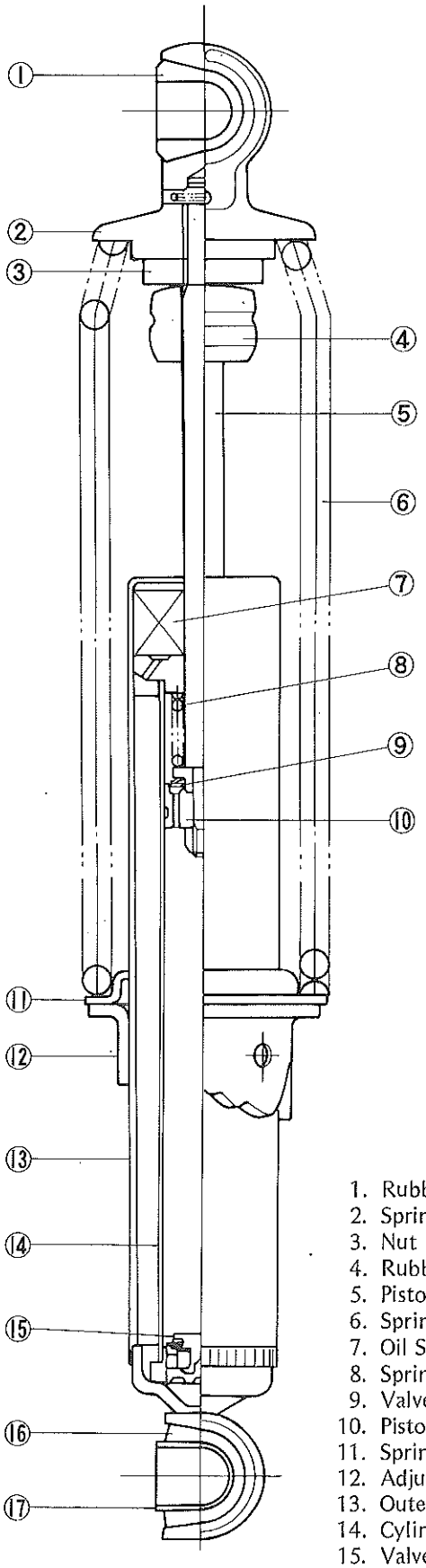
Since the rear shock absorbers are sealed units which cannot be disassembled, only external checks of operation are necessary. With the shocks removed, compress each one and see that the compression stroke is smooth and that there is damping in addition to spring resistance to compression. When the unit is released, the spring should not suddenly snap out to full length. It should extend smoothly with notable damping. When the shock absorber is operated, there should be no oil leakage. If either shock absorber does not perform all of these operations satisfactorily, or if one unit feels weaker than the other, replace both shock absorbers as a set. If only one unit is replaced and the two are not balanced, motorcycle instability at high speeds may result.

Shock absorber spring force for the 5 different settings is shown in the graph.

Bushings

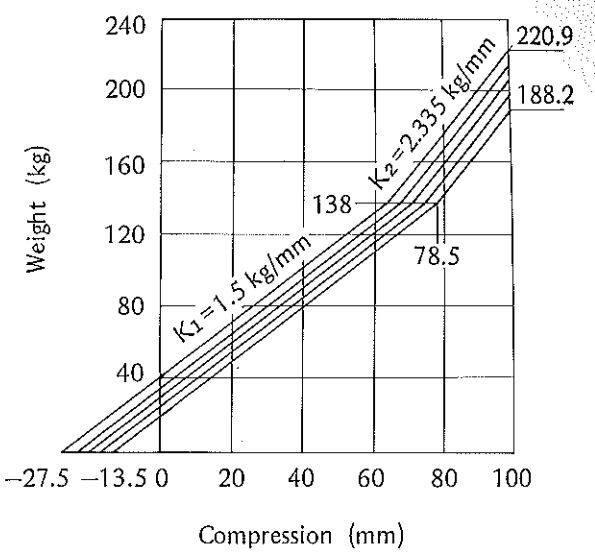
Check the rubber bushings, and replace any that are worn, cracked, hardened, or otherwise damaged.

Rear Shock Absorber (J48)



1. Rubber Bushing
2. Spring Seat
3. Nut
4. Rubber Stop
5. Piston Rod
6. Spring
7. Oil Seal
8. Spring
9. Valve
10. Piston
11. Spring Seat
12. Adjusting Sleeve
13. Outer Shell
14. Cylinder
15. Valve
16. Rubber Bushing
17. Collar

Rear Shock Absorber Spring Force (US model) (J49)



SWING ARM

The swing arm is designed to work with the shock absorbers to dampen the shock to the frame from the rear wheel. The rear of the swing arm is connected to the frame by the rear shock absorbers, while the front end pivots on the shafts connected to the frame. When the rear wheel receives a shock, the swing arm, pivoting on its shafts, allows the wheel to move up and down in relation to the frame within the limits of the shock absorbers.

This motorcycle has tapered roller bearings at the swing arm pivot. If bearing wear has progressed such that the swing arm hsa become loose, the motorcycle will be unstable. To minimize wear, the swing arm should be kept properly lubricated.

A twisted swing arm will also cause instability by throwing the rear wheel out of alignment.

Swing arm bearing wear

The rollers in the bearings wear so little that the wear is difficult to measure. Instead, inspect the bearings for abrasions, color change, or other damage. If there is any doubt as to the condition of either bearing, replace both bearings.

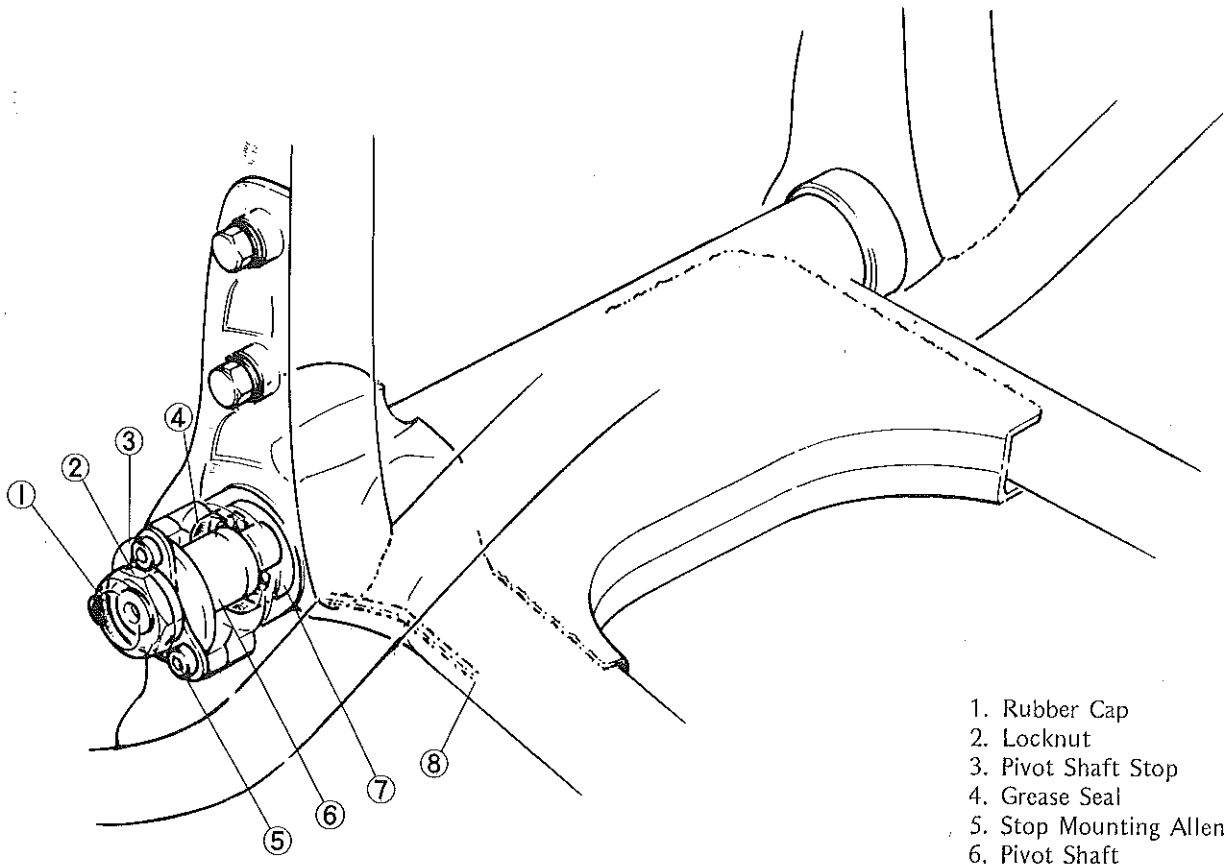
Swing arm lubrication

In order for the swing arm to function safely and wear slowly, it should be properly lubricated in accordance with the Periodic Maintenance Chart (Pg. 10). Lubrication is also necessary after disassembly.

Remove the swing arm (Pg. 150), clean out the old grease, and apply grease to the bearings.

Swing Arm

J50



1. Rubber Cap
2. Locknut
3. Pivot Shaft Stop
4. Grease Seal
5. Stop Mounting Allen Bolt
6. Pivot Shaft
7. Tapered Roller Bearing
8. Swing Arm