## RIM, SPOKES

The rim of each wheel is made of steel and is connected to the hub by the spokes. A rim band around the outside center of the rim keeps the tube from coming into direct contact with the rim and the spoke nipples.

The spokes are connected to the hub at a tangent and in different directions so that different spokes bear the brunt of the load during different conditions. With the spokes doing specialized work, the strength of the spokes can be used more effectively.

When the motorcycle is at rest (Fig. 485 A), the spokes above the axle are stretched and tense, while the spokes below the axle are slightly loose and do not provide support, During acceleration (B), the spokes running to the hub in the direction of rotation are stretched, while during deceleration or braking (C), the spokes running to the hub opposite to the direction of rotation are the ones that are stretched. In both cases B and C, the spokes that are not stretched (omitted from the diagram) are slightly loose and do not provide support. A damping action to the shock from the ground is achieved by flexing of the spokes since they are arranged in this cross pattern instead of running straight from the hub to the rim.

Since the spokes must withstand this repeated stress, it is important to take sufficient care that the spokes are not allowed to loosen and that they are tightened evenly. Loose or unevenly tightened spokes cause the rim to warp, increase the possibility of spoke breakage, and hasten nipple and spoke metal fatigue.
**NOTE:** The rim size in Table 68 is outer width by diameter, both in inches. The "W" means that the rim is welded. The spoke size is diameter number by length in millimeters. The two numbers for diameter size mean that each spoke has two diameters. To make the spoke more resistant to breakage, the diameter is greater near the hub.

### *Spoke breakage*

If any spoke breaks, it should be replaced immediately. A missing spoke places an additional load on the other spokes, which will eventually cause other spokes to break.

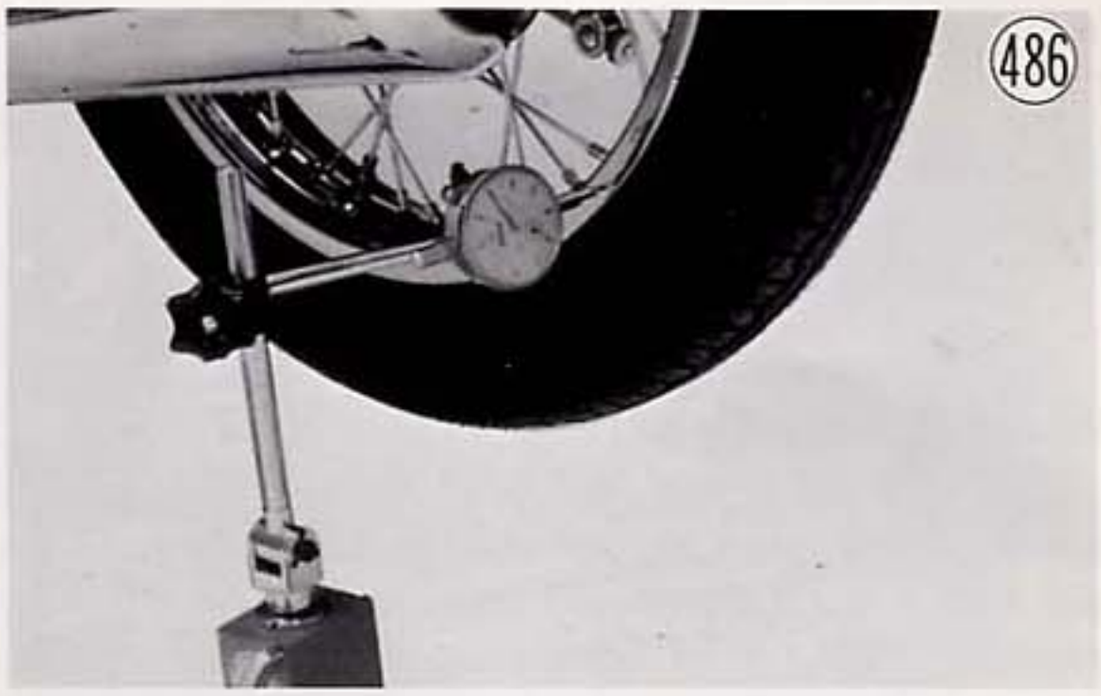
Periodically check that all the spokes are tightened evenly since they stretch a certain amount during use. Standard spoke tightening torque is 0.2 ~ 0.4 kg-m (17 ~ 35 in-lbs). Over or under tightening may cause breakage.

### *Rim runout*

Set a dial gauge to the side of the rim, and rotate the wheel to measure axial runout. The difference between the highest and lowest dial reading is the amount of runout.

**Table 68 Rim, Spoke Size**

| | | Spokes | | Rim |
|---|---|---|---|---|
| | | Inner | Outer | |
| Front | KZ400D | #8 x #9 x 174.5 x 102° | #8 x #9 x 174.0 x 83° | 1.85B x 18 |
| | KZ400S | #8 x #9 x 147.5 x 103° | #8 x #9 x 147.0 x 86° | 1.85B x 18W |
| Rear | | #8 x #9 x 148.0 x 104° | #8 x #9 x 147.5 x 85° | 1.85B x 18W |




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

**Table 69 Rim Runout**

| | Standard | Service Limit |
|---|---|---|
| Axial | under 1 mm | 2 mm |
| Radial | under 1 mm | 2 mm |

A certain amount of rim warp (runout) can be corrected by recentering the rim; that is, loosen some spokes and tighten others to change the position of different parts of the rim. If the rim is badly bent, however, it should be replaced.

## AXLE

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 to 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 0.7 mm, replace the axle.

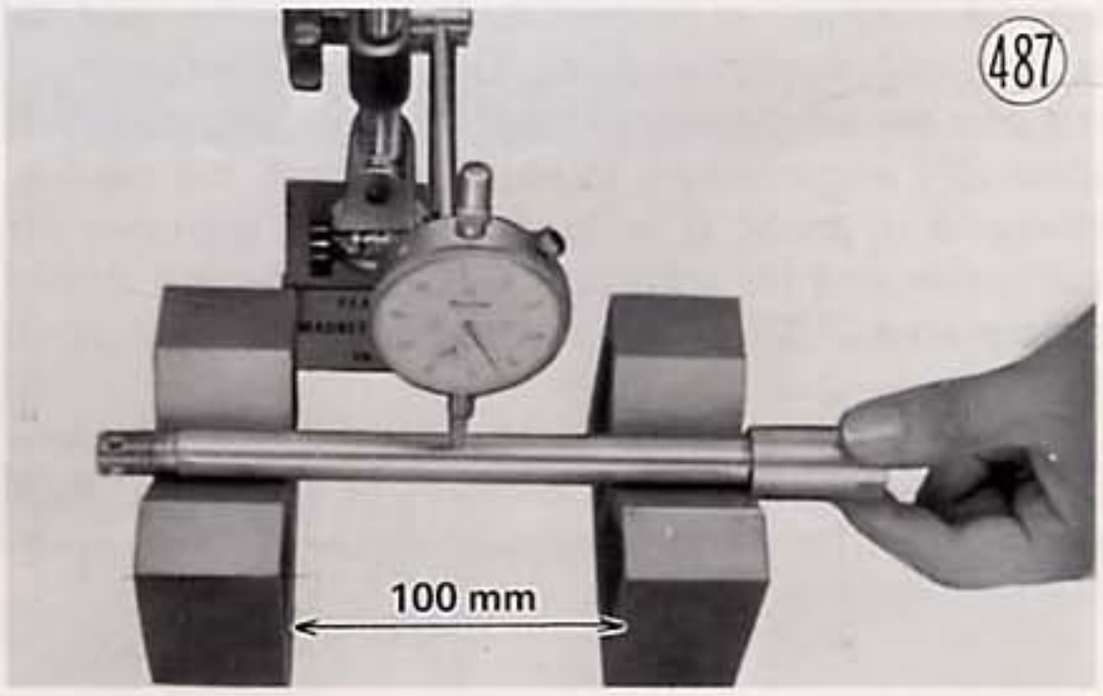


**Table 70 Axle Runout/100 mm**

| | Standard | Service Limit |
|---|---|---|
| Front | 0.1 mm | 0.2 mm |
| Rear | 0.05 mm | 0.2 mm |

## GREASE SEALS, WHEEL BEARINGS

A grease seal is installed in either side of the front hub and in the left side of the rear hub. Each grease seal except the KZ400S left front seal, is a rubber ring provided with a steel band around the outer circumference. The inner rib of the grease seal is held against the axle sleeve by a wire spring band, so that it will seal in the wheel bearing grease and keep dirt and moisture from entering the hub. A damaged grease seal will result in accelerated bearing wear.

The grease seal in the left side of the KZ400S front hub is of different construction, and is used to protect the speedometer gear. The rubber part seals the opening by pressing outward against the brake panel.

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

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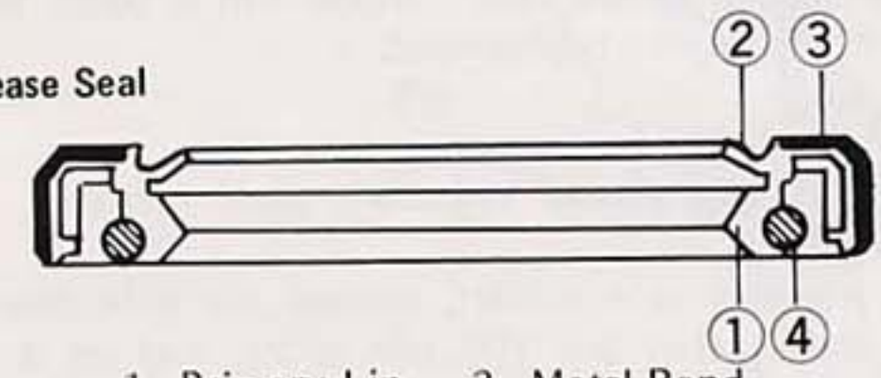
**Grease Seal**




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

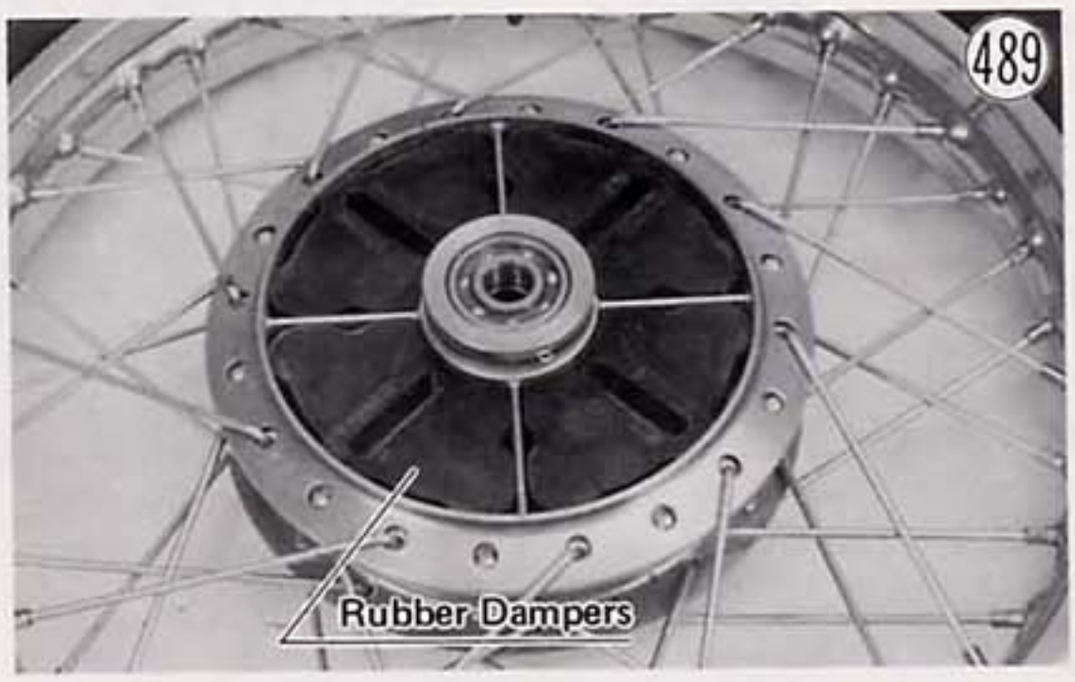
### *Inspection and lubrication*

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. Whenever 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.

Since the wheel bearings are made to extremely close tolerances, the wear cannot normally be measured. Wash the bearing with a high flash point solvent of some kind, 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, it must be replaced. If the same bearing is to be used again, re-wash it with a high flash point solvent of some kind, dry it, and pack it with good quality bearing grease before installation. Turn the bearing around by hand a few times to make sure the grease is distributed uniformly inside the bearing, and wipe the old grease out of the hub before bearing installation. Clean and grease the wheel bearings and the front hub gear housing (speedometer gear) in accordance with the periodic maintenance chart (Pg. 180).

## REAR WHEEL COUPLING

The rear wheel coupling connects the rear sprocket to the wheel. The forces that are transmitted between the rear sprocket and the rear hub are transmitted through rubber shock dampers in the coupling to absorb some of the shock resulting from sudden changes in torque due to acceleration or braking.




### *Damper inspection*

Remove the rear wheel coupling (Pg. 86), and inspect the rubber dampers.

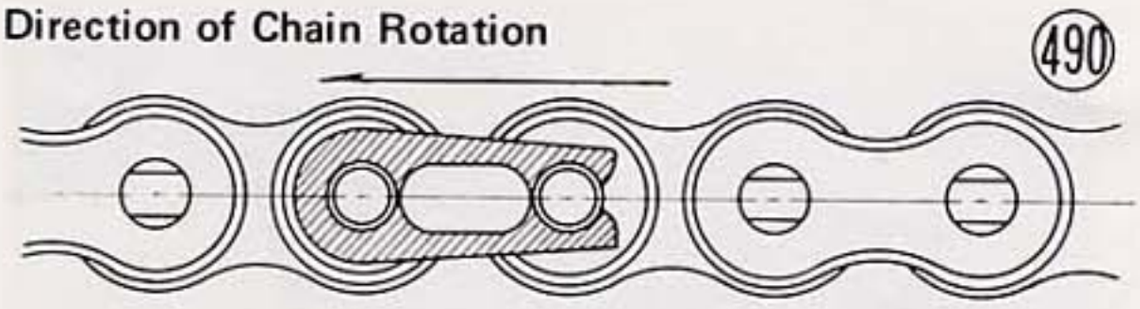
Replace the dampers if any appear damaged or deteriorated.

## DRIVE CHAIN

The drive chain used to transmit the engine power to the rear wheel is the Enuma EK530SH-G 100 link chain. This chain is provided with a master link to facilitate removal and replacement. To minimize any chance of the master link dislodging, the master link is fitted with the closed end of the "U" pointed in the direction of chain rotation. See Fig. 490.

**Table 71 Grease Seals, Wheel Bearings**

| | Front Wheel (KZ400D) | | Front Wheel (KZ400S) | | Rear Wheel | | |
|---|---|---|---|---|---|---|---|
| | Hub Left | Hub Right | Hub Left | Hub Right | Coupling | Hub Left | Hub Right |
| Bearing | #6302 | #6302 | #6302Z | #6302 | #6205 | #6303 | #6303Z |
| Grease Seal | WTC22427 | WTC40528 | WOC55687 | WTC25428 | WTC35527 | — | — |




Chain construction is shown in Fig. 493. Most chain wear occurs between the pins and bushings, and between the bushings and rollers, rather than on the outside of the rollers. This wear causes the chain to lengthen. If the chain is left unadjusted, the lengthening will lead to noise, excessive wear, breakage, and disengagement from the sprockets. If the chain is allowed to wear too much, the distance from roller to roller is so much greater than the distance between each tooth of the sprocket that the wear rapidly accelerates.

The rate of wear can be greatly reduced, however, by frequent and adequate lubrication, espeically between the side plates of the links so that oil can reach the pins and bushings inside the rollers.

### *Wear*

When the chain has worn so much that it is more than 2% longer than when new, it is no longer safe for use and should be replaced, Whenever the chain is replaced, inspect both the engine and rear sprockets, and replace for new ones if necessary. Overworn sprockets will cause a new chain to wear quickly.

Since it is impractical to measure the entire length of the chain, determine the degree of wear by measuring a 20 link length of the chain. Stretch the chain taut either by using the chain adjuster, or by hanging a 10 kg weight on the chain. Measure the length of 20 links on a straight part of the chain from pin center of the 1st pin to pin center of the 21st pin. Since the chain may wear unevenly, take measurements at several places. If any measurement exceeds the service limit, replace the chain.

**NOTE:** The drive system was designed for use with the Enuma EK530SH-G 100 link chain. For maximum strength and safety, the Enuma EK530SH-G 100 link chain must be used for replacement.

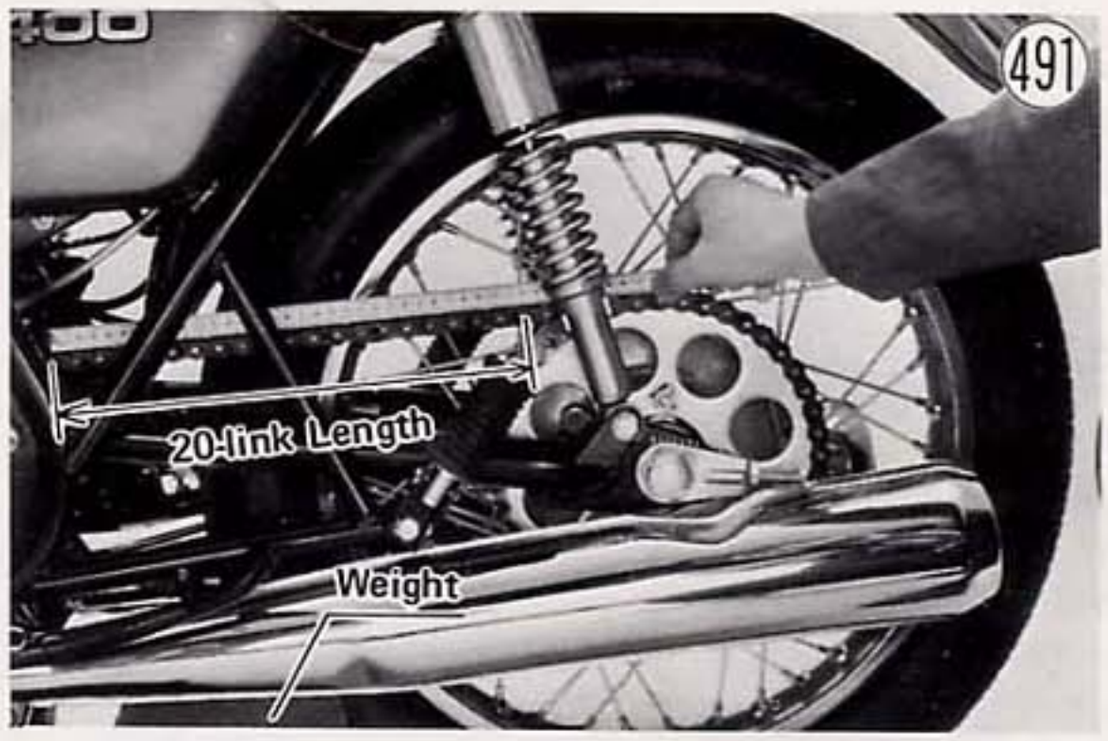
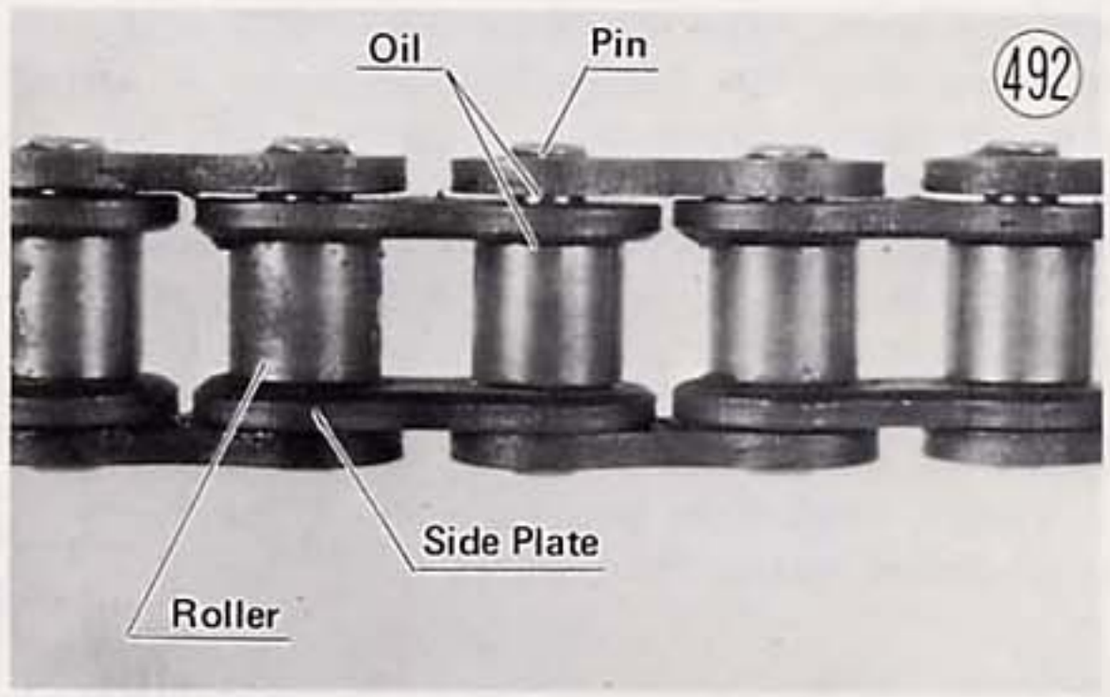


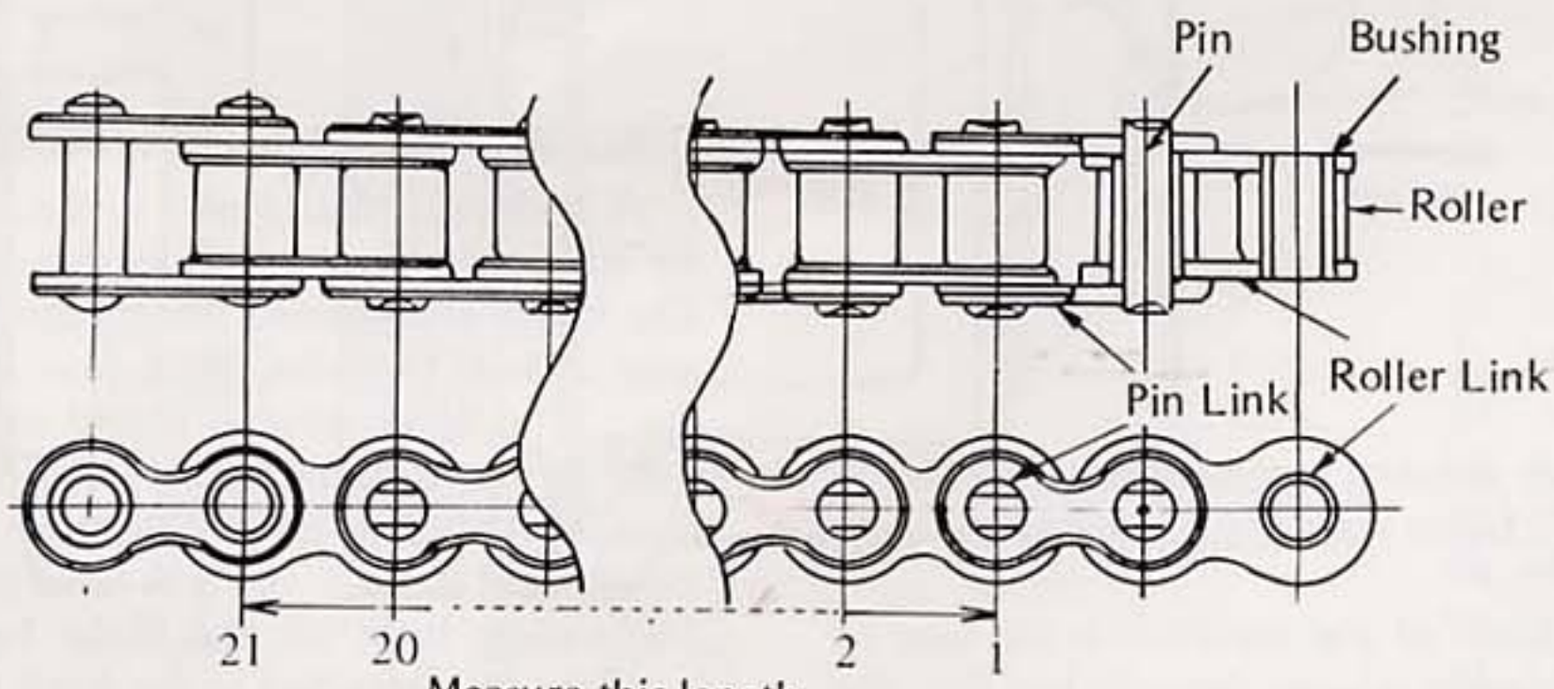

**Table 72 Drive Chain Length**

| | Standard | Service Limit |
|---|---|---|
| 20-link Length | 317.5 mm | 323 mm |

### *Lubrication*

In order for the chain to function safely and wear slowly, it should be properly lubricated in accordance with the periodic maintenance chart (Pg. 180). Lubrication is also necessary after riding through rain or on wet roads, or any time that the chain appears dry. Anytime that the motorcycle including the chain has been washed, the chain should be adequately lubricated on the spot in order to avoid rust.



The chain should be lubricated with a lubricant which will both prevent the exterior from rusting and also absorb shock and reduce friction in the interior of the chain. An effective, good quality lubricant specially formulated for chains is best for regular chain lubrication. If a special lubricant is not available, a heavy oil such as SAE 90 is preferred to a lighter oil because it will stay on the chain longer and provide better lubrication. Apply the oil to the sides of the rollers and between the side plates of the links so that oil will penetrate to the pins and bushings where most wear takes place. Wipe off any excess oil.

Dirt will cling to the oil and act as an abrasive, accelerating chain wear. Whenever the chain becomes particularly dirty, it must be cleaned in kerosene and then soaked in a heavy oil. Shake the chain while it is in the oil so that oil will penetrate to the inside of the rollers. If choosing to boil the chain in grease, better oil penetration to the interior is achieved, but care must be taken not to overheat the grease.

## SPROCKETS

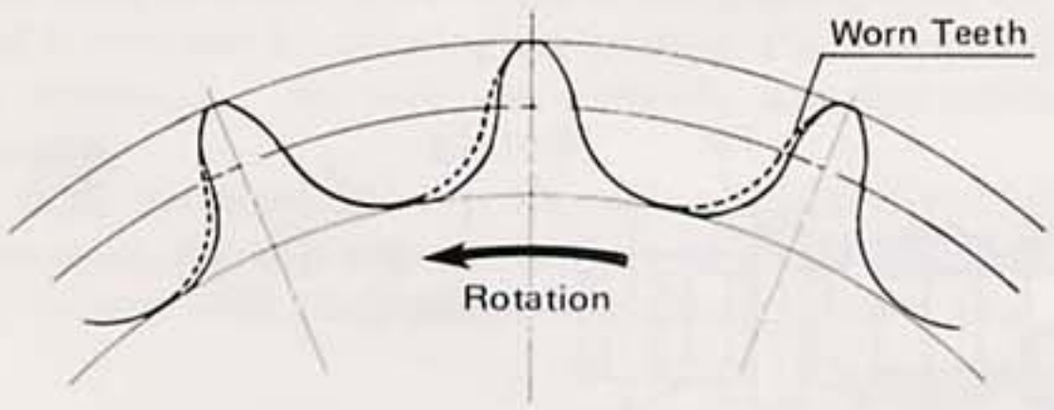
There are two sprockets for the drive chain. A forward sprocket, or engine sprocket, is mounted on the end of the output shaft and is used to drive the chain. A rear sprocket is connected to the rear wheel hub through the rear wheel coupling and is driven by the chain to turn the rear wheel.

Sprockets that have become excessively worn cause noise with the chain and greatly accelerate chain and sprocket wear. The sprockets should be checked for wear any time that the chain is replaced. A warped rear sprocket destroys chain alignment such that the chain may break or jump from the sprockets when traveling at high speed. The sprockets should be checked for wear and the rear sprocket for warp any time that the chain is replaced.

### *Sprocket wear*

Visually inspect the sprocket teeth. If they are worn as illustrated, replace the sprocket.

**Sprocket Teeth**




**NOTE:** If a sprocket requires replacement, the chain is probably worn also. Upon replacing a sprocket, inspect the chain.

Measure the diameter of the sprocket at the base of the teeth. If the sprocket is worn down to less than the service limit, replace the sprocket.

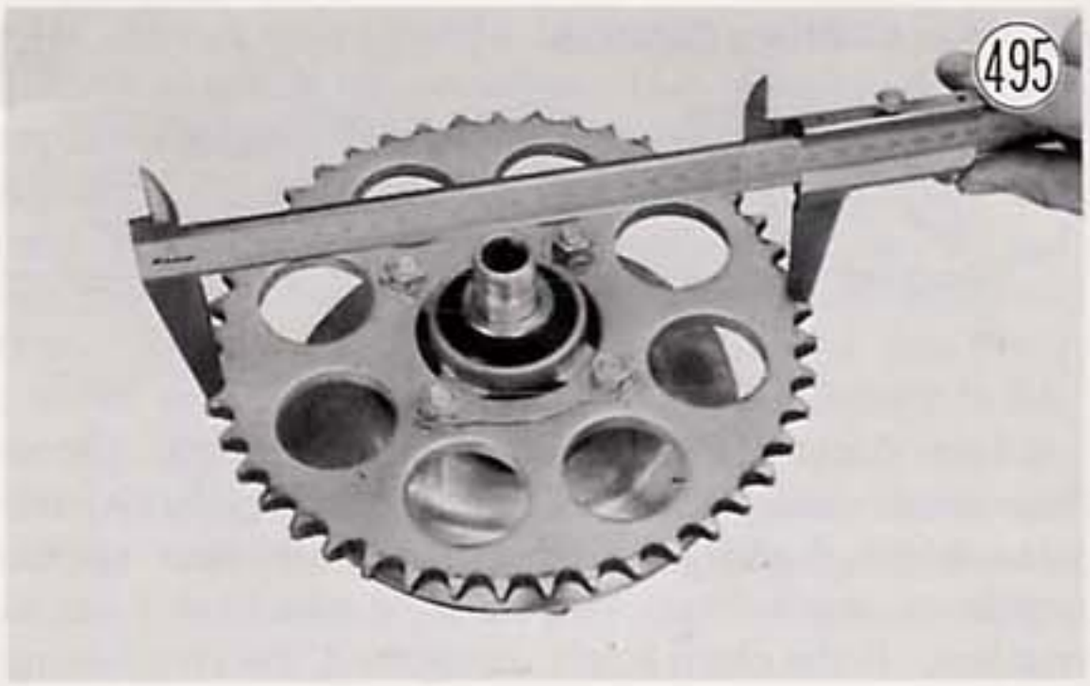



***Table 73 Sprocket Diameter**

| | Standard | Service Limit |
|---|---|---|
| Engine | 65.58~65.78 mm | 64.8 mm |
| Rear | 217.4 mm | 217.0 mm |

### *Rear sprocket warp*

Elevate the rear wheel so that it will turn freely, and set a dial gauge against the rear sprocket near the teeth as shown in Fig. 496. Rotate the rear wheel. The difference between the highest and lowest dial gauge reading is the amount of runout (warp).

If the runout exceeds the service limit, replace the rear sprocket.

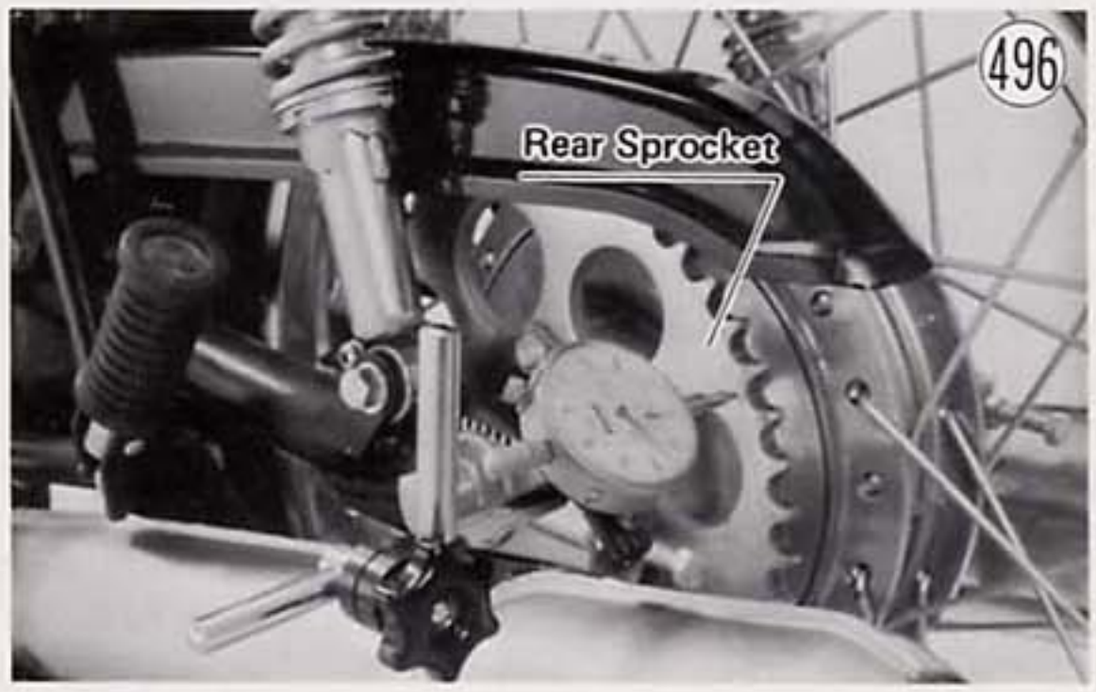



**Table 74 Rear Sprocket Warp**

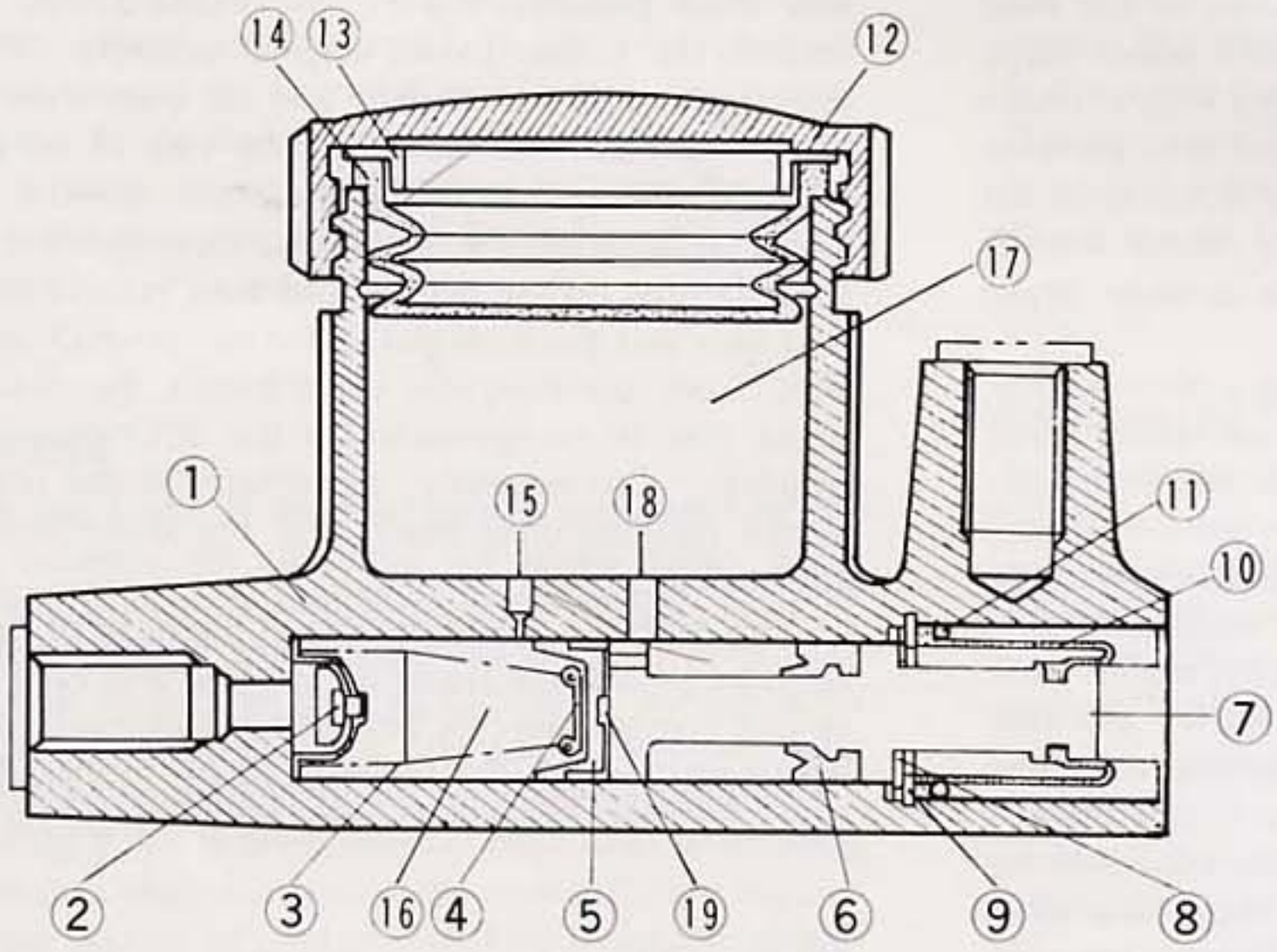
| Standard | Service Limit |
|---|---|
| under 0.3 mm | 0.5 mm |

## DISC BRAKE (Only on KZ400D)

A hydraulic disc brake is used on the front wheel for its superior braking performance and high reliability. The major components of the disc brake are the brake lever, master cylinder, brake line, caliper assembly, and disc. The brake lever is pulled to pressurize the brake fluid to move a piston in the master cylinder. Fluid pressure operates the front brake light switch and is transmitted through the brake line to operate the caliper. The switch turns on the brake light, and the caliper grips the disc attached to the front wheel, slowing wheel rotation.

## Master Cylinder (KZ400D)

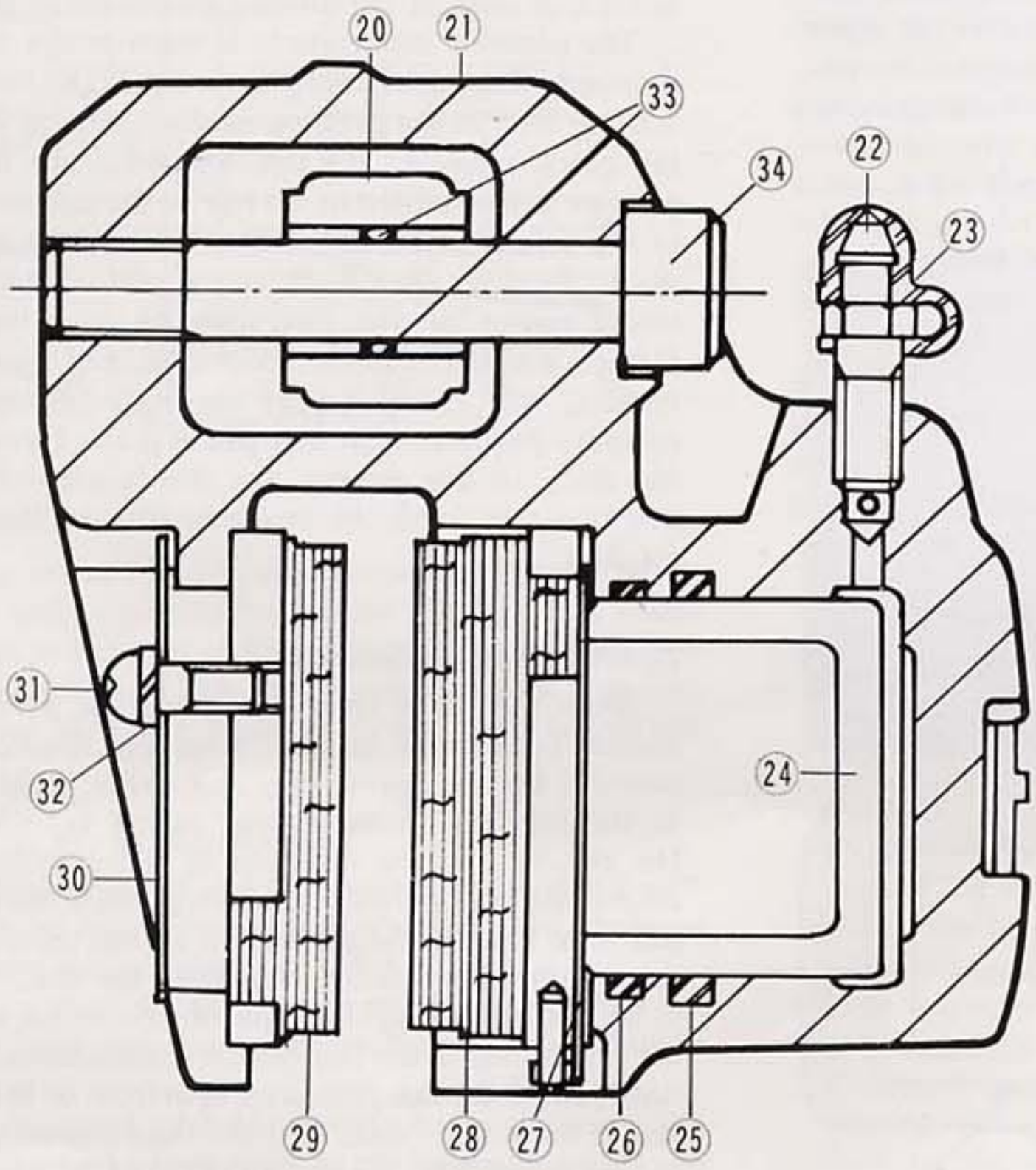
497




1. Master Cylinder Body
2. Check Valve
3. Spring
4. Spring Seat
5. Primary Cup
6. Secondary Cup
7. Piston
8. Stopper, Piston
9. Retaining Ring
10. Dust Seal
11. Stopper, Dust Seal
12. Cap
13. Ring Plate
14. Diaphragm
15. Relief Port
16. Pressure Chamber
17. Reservoir
18. Supply Port
19. Non-return Valve

## Caliper (KZ400D)

498




20. Holder
21. Caliper
22. Bleed Valve
23. Bleed Valve Cap
24. Piston
25. Fluid Seal
26. Piston Dust Seal
27. Anti-Squeak Shim
28. Pad A
29. Pad B
30. Metal Disc
31. Screw
32. Lock Washer
33. O Ring
34. Allen Bolt

The brake fluid is an extra heavy duty type with a high boiling point to withstand the heat produced from 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, piston, primary and secondary cups, non-return valve, check valve, and spring. The reservoir has two holes at the bottom: a relatively large supply port to supply fluid to the lines and a small relief port 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 check valve stops fluid from suddenly returning from the brake line when the lever is released, and thereby smooths brake operation. The non-return valve is in the head of the piston; it stops backward fluid flow when the brake is applied, but when the brake lever is released, allows flow around the cup to fill the vacuum in front of the piston so that the piston can return easily.

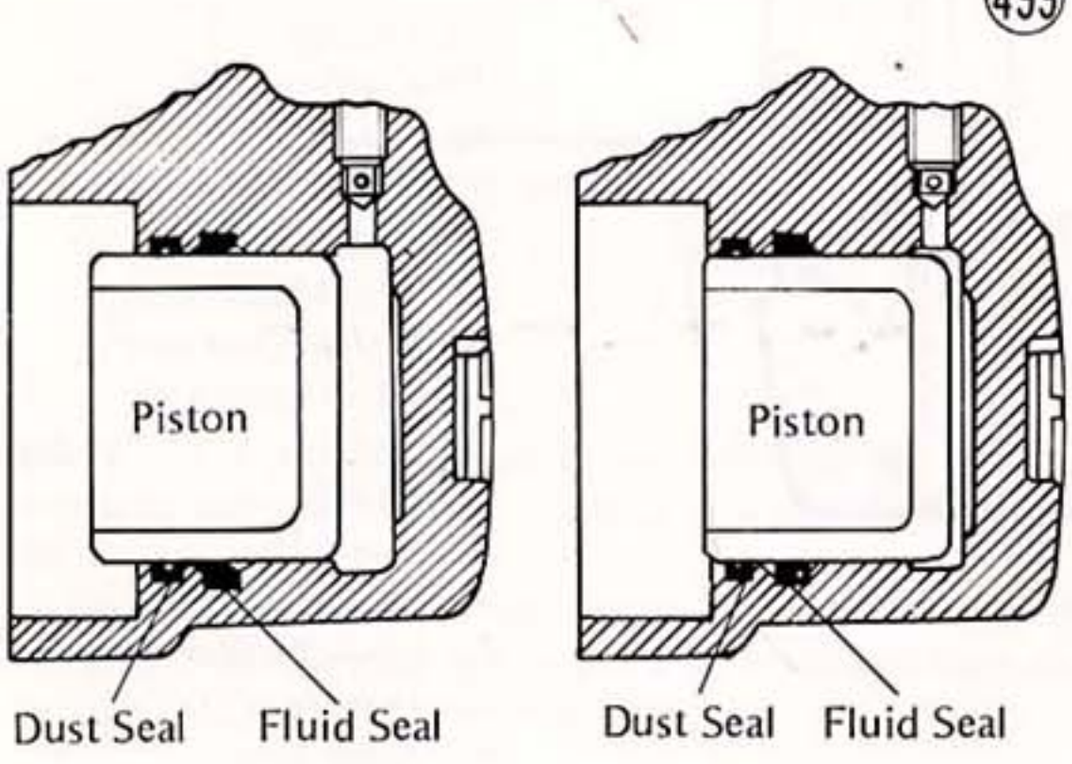
The caliper assembly includes pad A, pad B, and the piston, which is inside the caliper cylinder. Through the caliper run two shafts, which also pass through the caliper holder to mount the assembly to the left fork shock absorber. When the piston forces pad A against the disc, the shaft portion of the 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.

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 any possibility of brake fade common to drum brakes.

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 presses against the piston, and instead of sliding when the piston moves, the seal is only distorted, allowing no fluid leakage at all. When the brake lever 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 be distorted the additional amount that the piston travels. Instead, when piston travel forces the seal past its limit, the seal slips slightly on the piston, and then returns the piston to a new rest position not as far in. 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 stroke remains unchanged, and the brake never needs adjustment.

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

**Rubber Seal**




## Braking Stroke

When the brake lever is pulled, the piston (7) in the master cylinder (1) is pushed and moves forward against the force of the return spring (3). At this time, the primary cup (5) at the head of the piston closes the small relief port (15), which connects the pressure chamber (16) and the reservoir (17). 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 through the check valve (2) and out into the brake line. The pressure is transmitted in the line to the cylinder portion of the caliper assembly, where it forces the piston towards the disc. Pad A (28) at the end of the piston is forced 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 (3), and brake fluid pressure in the line and in the caliper master cylinder drops. The elasticity of the fluid seal (25) 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 a hairbreadth away from the disc.

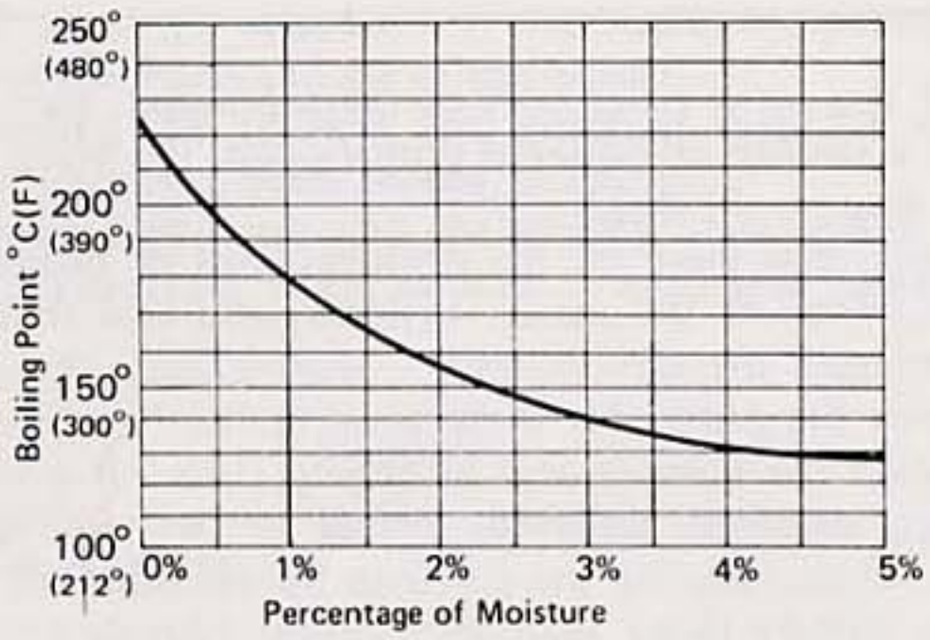
As the master cylinder piston moves back further, the brake fluid in the line (which still has some pressure) rushes to fill the low pressure area in front of the primary cup at the piston head. But the fluid is prevented from moving quickly by the check valve, and the low pressure area in front of the piston is not relieved. At this time,

fluid from the reservoir flows through the large supply port ⑱ into the space between the primary and secondary cups ⑥, through the non-return valve ⑲, and passes around the edges of the primary cup to fill the vacuum. When the piston has returned to its rest position against the stopper ⑧, the small relief port is uncovered, and, as the brake fluid returns from the line through the check valve, 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 the rubber parts of the brake mechanism, although a special rubber is used to make them resistant to deterioration from contact with the recommended brake fluids.

**Brake Fluid Boiling Point** (500)




The graph of Fig. 500 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. 180) and whenever it becomes contaminated with dirt or water.

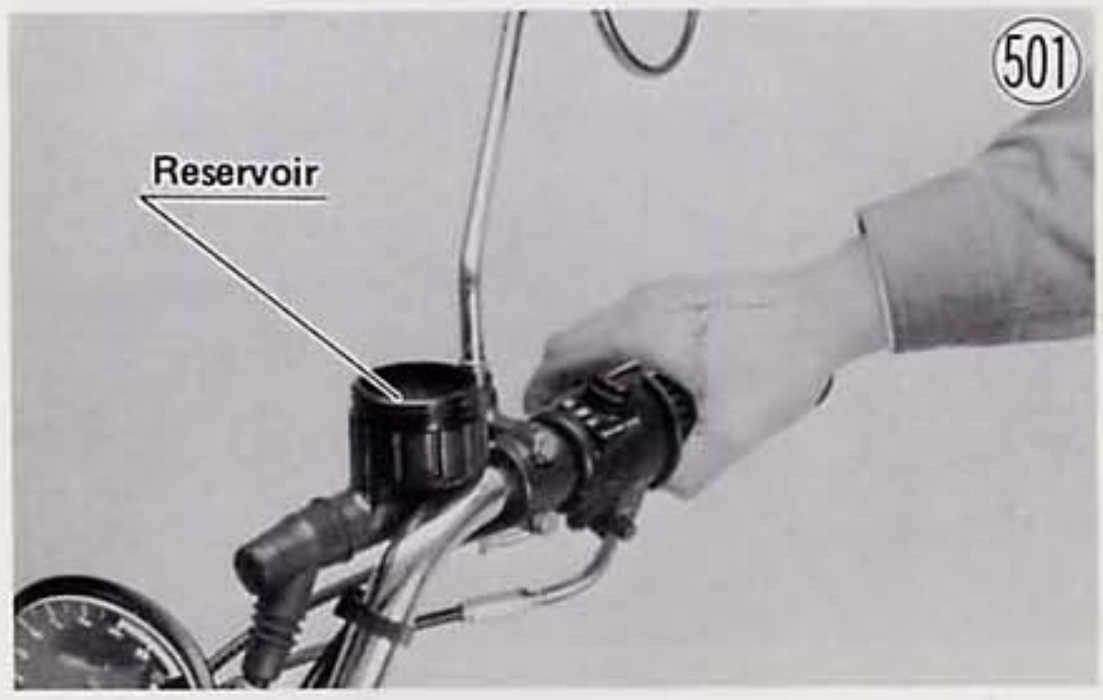
- Attach a clear plastic hose to the bleed valve on the caliper, and run the other end of the hose into a container.
- Open the bleed valve (counterclockwise to open), and pump the brake lever until all the fluid is drained from the line.
- Close the bleed valve, and fill the reservoir with fresh brake fluid.
- Open the bleed valve, squeeze the brake lever, close the valve with the lever held squeezed, and then quickly release the lever. Repeat this operation until the brake 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.

### *Bleeding the brake*

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

Bleed the air from the brake whenever brake lever 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 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.




- Replace 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 a few times until it becomes hard and then, holding the lever squeezed, quickly open (turn counterclockwise) and close the bleed valve. Then, release the lever. 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.

## 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 75 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 one of these markings.**

4. Don't leave the reservoir cap off for any length of time to avoid moisture absorbing into 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 disc, 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 spilt 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 of some kind. Do not use one which will leave an oily residue. Replace the pads for new ones if they cannot be cleaned satisfactorily.
8. Brake fluid quickly ruins painted surfaces; any spilt fluid should be completely wiped up immediately.
9. If any of the brake line fittings or the bleed valve is opened at any time, **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 2. Improper torque may cause the brake to malfunction.

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


*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 past the service limit.
•Check the piston for these same faults.
•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. (The secondary cup is part of the piston assembly. Replace the piston if the secondary cup requires replacement).
•Check that the spring is not damaged and is not shorter than the service limit.
•Replace the dust seal if damaged.

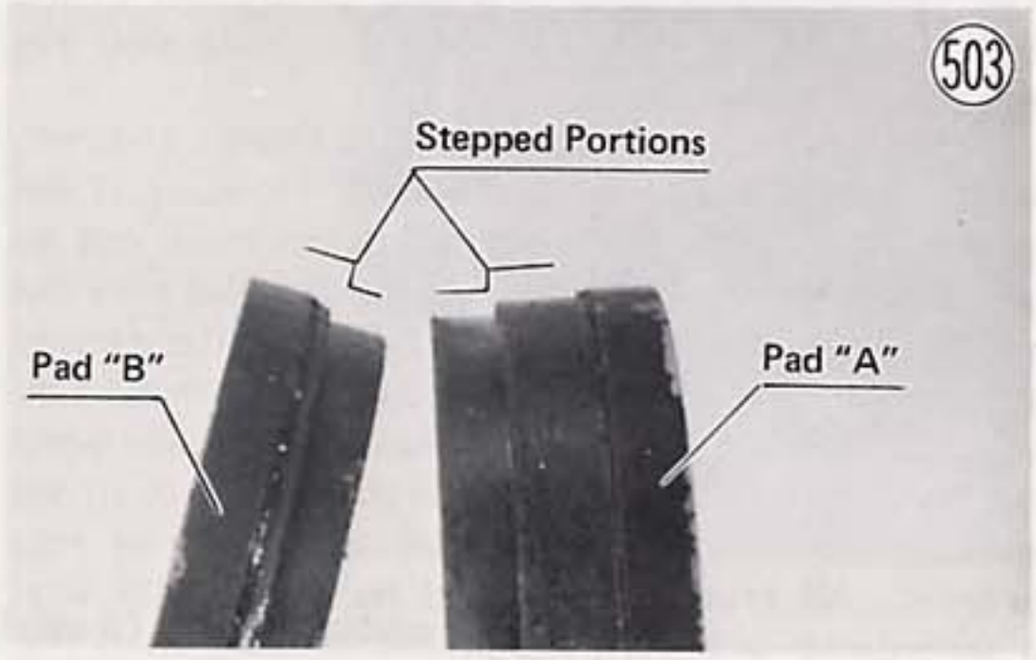
*Caliper parts wear*

Inspect the pads for wear. If either pad is worn down through the stepped portion, replace both pads

**Table 76 Master Cylinder Parts**

| Measurement | Standard | Service Limit |
|---|---|---|
| Cylinder inside diameter | 14.000~14.043 mm | 14.08 mm |
| Piston outside diameter | 13.957~13.984 mm | 13.90 mm |
| Primary, secondary cup diameter | 14.65~15.15 mm | 14.50 mm |
| Spring length (free) | 51.0 mm | 48.0 mm |

as a set. If any grease or oil spills on the pads, wash it off with trichloroethylene or a high flash point solvent of some kind. Do not use one which will leave an oily residue. If the oil cannot be thoroughly cleaned 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 seal under any of the following conditions: (a) fluid leakage around pad A; (b) brakes overheat; (c) there is a large difference in A and B pad wear; (d) the seal is stuck to the piston. If the fluid seal is replaced, replace the dust seal as well. Also replace both seals every other time the pads are changed.

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.

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

Check both seals and the **O** ring, and replace any that are cracked, worn, swollen or otherwise damaged.

**Table 77 Caliper Parts**

| | Standard | Service Limit |
|---|---|---|
| Cylinder inside diameter | 38.10~38.15 mm | 38.17 mm |
| Piston outside diameter | 37.97~38.02 mm | 37.90 mm |

### *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.

The metal pipe is made of plated steel, and will rust if the plating is damaged. Replace the pipe if it is rusted or cracked (especially check the fittings), or if the plating is badly scratched.

### *Disc wear, warp*

Besides wearing down, the disc may warp. A warped disc will cause the brake pads to drag on the disc and 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 of some kind. 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 disc as illustrated, and measure disc runout. If runout exceeds the service limit, replace the disc.

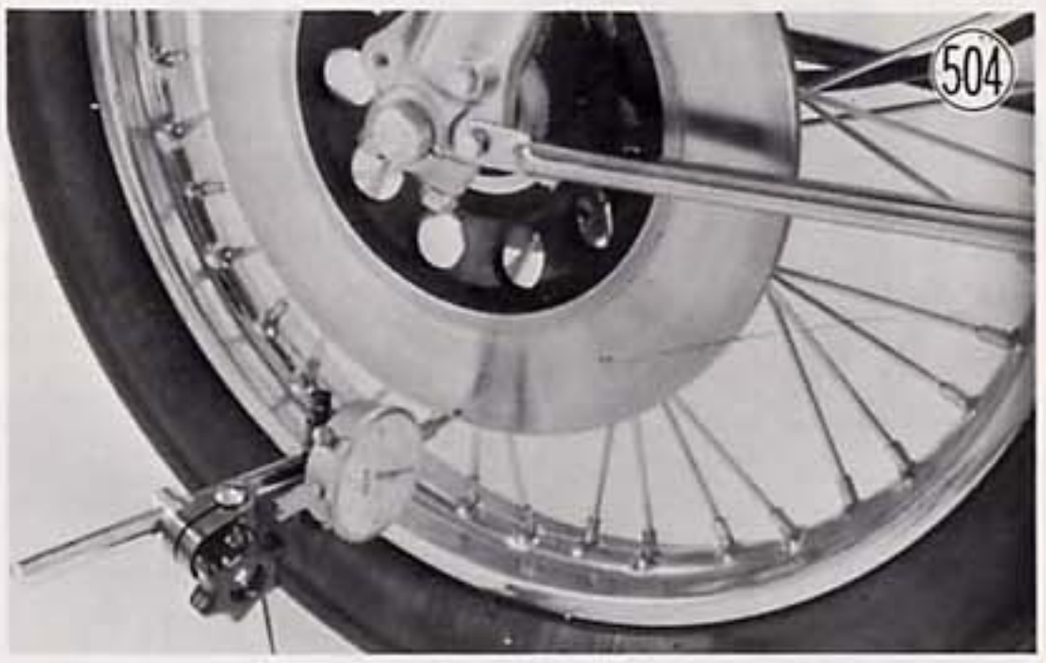



**Table 78 Disc Runout**

| Standard | Service Limit |
|---|---|
| under 0.1 mm | 0.3 mm |

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

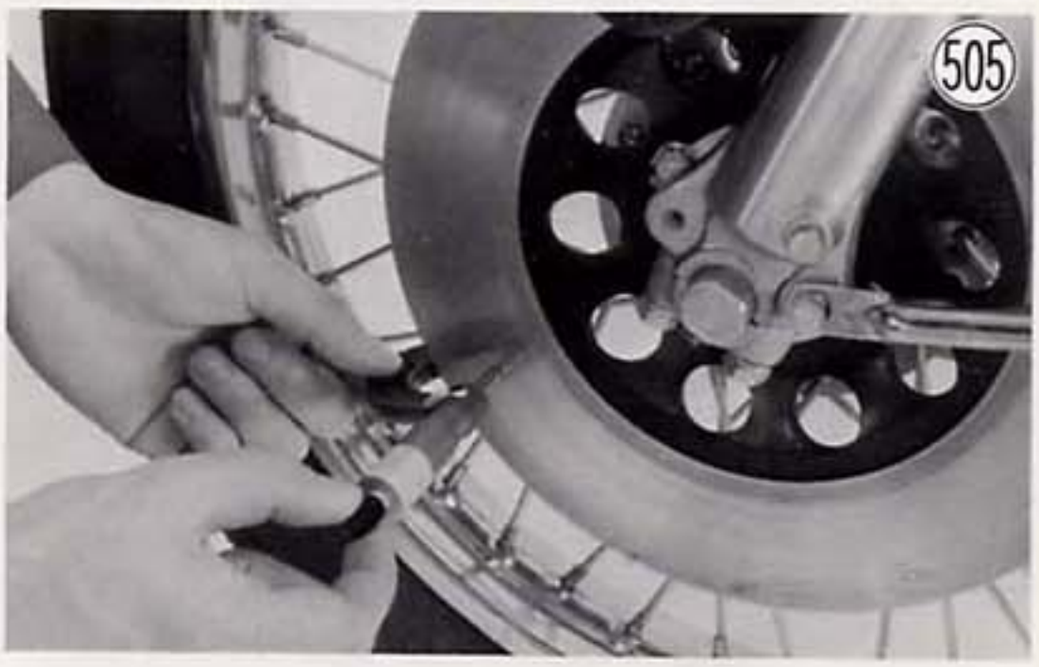


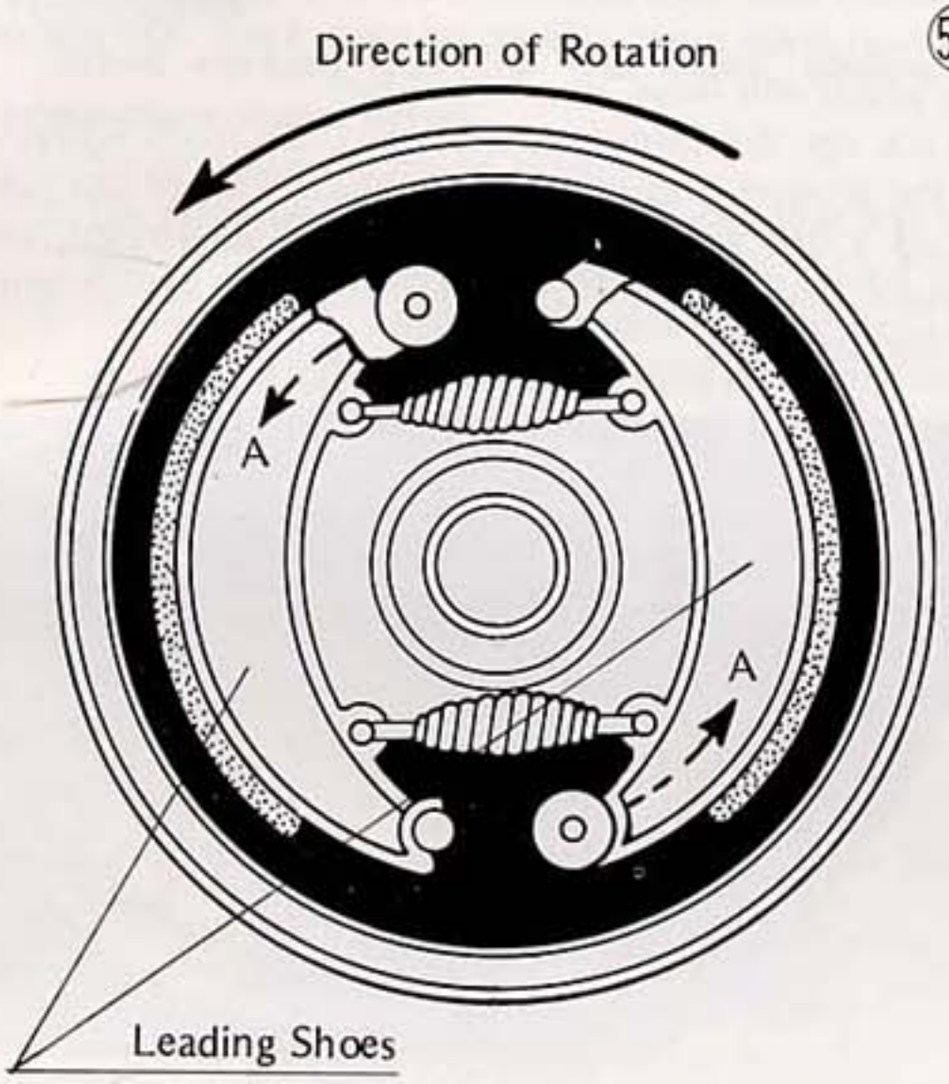

**Table 79 Disc Thickness**

| Standard | Service Limit |
|---|---|
| 6.90~7.10 mm | 6.0 mm |

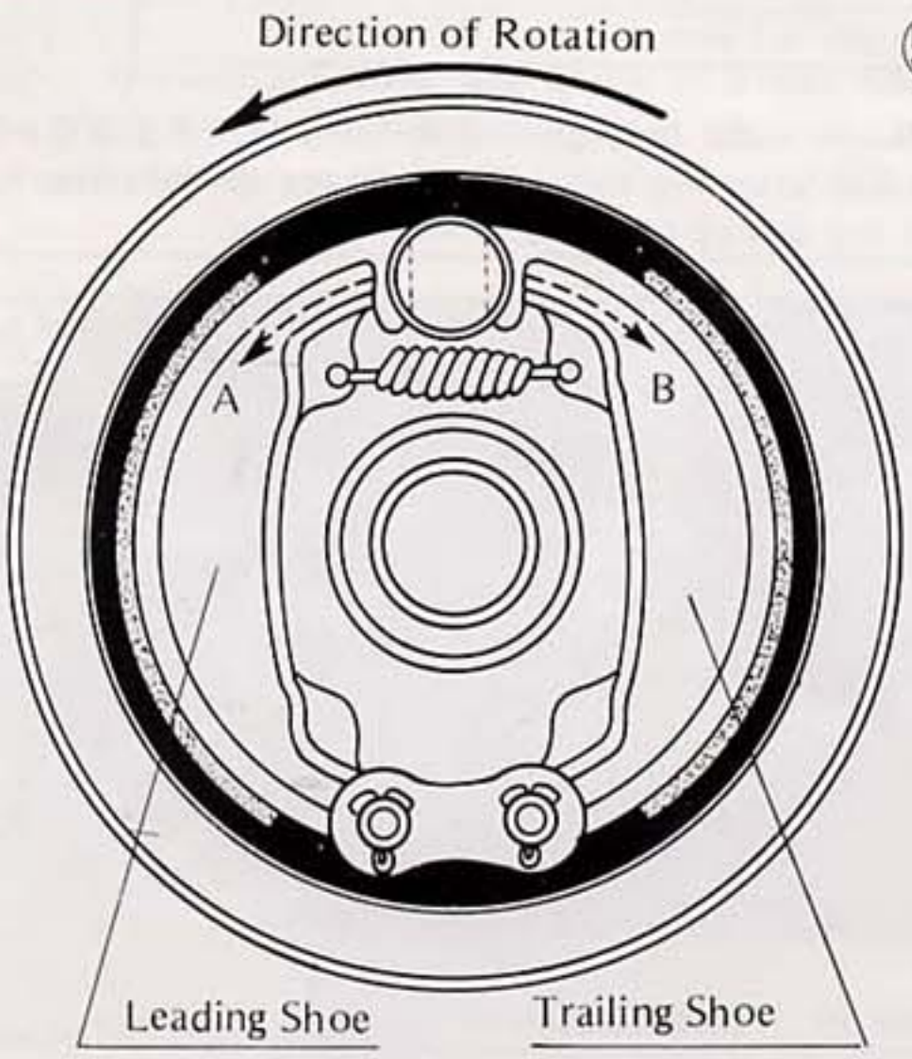
## BRAKES

The front wheel is equipped with a two-leading-shoe type of drum brake (only on KZ400S; the KZ400D has a disc brake on the front) and the rear wheel is equipped with a leading-trailing type of drum brake. "Two-leading-shoe" means that both brake shoes lead, that is, expand against the drum in the direction of drum rotation. "Leading-trailing" means that one of the two brake shoes leads, expanding against the drum in the direction of drum rotation, and the other shoe trails, expanding in the direction opposite drum rotation.

**Brake (KZ400S Front)**




**Brake (Rear)**




The force applied by the rider when braking is transmitted to the interior of the brake by a camshaft. The force applied at the brake pedal or brake lever is transmitted by a rod or a cable to the cam lever which then turns the camshaft. When the camshaft rotates, the large portion of the cam is forced between the two brake shoes. Since the shoes are only held together away from the drum by a spring, the cam overcomes spring tension and pushes the shoes outward against the drum. The leading shoe rotates in direction "A" and the trailing shoe in direction "B" as shown in the diagrams.

The friction between the linings and the drum, which decelerates the motorcycle, gradually wears down the brake shoe linings. On the outside of the brake panel is a brake lining wear indicator, which, as the brake is applied, moves in direct proportion to the distance that the brake shoe linings move to reach the brake drum. As the linings wear down, the lining surface has farther to travel before reaching the drum. The indicator accordingly travels farther until it finally points just to the left of the "U" in USABLE when the lining wear has reached the service limit.

Due to wear of the brake drum, shoe linings, and cam, periodic brake adjustment is required. However, if the brake parts become overworn, adjustment will not be sufficient to ensure safe brake operation. Not only can overworn parts crack (drum) and otherwise suffer damage as they lose their braking effectiveness, but, if the cam wears to the point where it turns nearly horizontal when the brake is fully applied, the brake may lock in the operated position, or brake pedal return may be very sluggish. All brake parts should be checked for wear in accordance with the periodic maintenance chart (Pg. 180).

*Brake drum wear*

Measure the inside diameter of the brake drum with calipers to determine wear. Since uneven drum wear will decrease braking effectiveness, take measurements at a minimum of two places. If the drum is worn unevenly or if it is scored, turn the drum down on a brake drum lathe or replace the hub. (Do not turn it down to the service limit, and do not turn it down if any diameter measurement exceeds the service limit). If any diameter measurement exceeds the service limit, replace the hub for a new one.


**Table 80 Brake Drum Inside Diameter**

| Standard | Service Limit |
|---|---|
| 180.0 ~ 180.2 mm | 180.75 mm |

*Brake shoe lining wear*

Check the thickness of the brake linings, and replace both shoes as a set if the thickness at any point is less than the service limit. If the thickness of the brake linings is sufficient, check the linings for uneven wear, and file or sand down any high spots. With a wire brush, remove any foreign particles imbedded in the lining surface. Wash off any oil or grease with a high flash point solvent of some kind. Do not use one which will

leave an oily residue. In case the linings are damaged or the surface cannot be restored by sanding and cleaning, the shoes must be replaced.

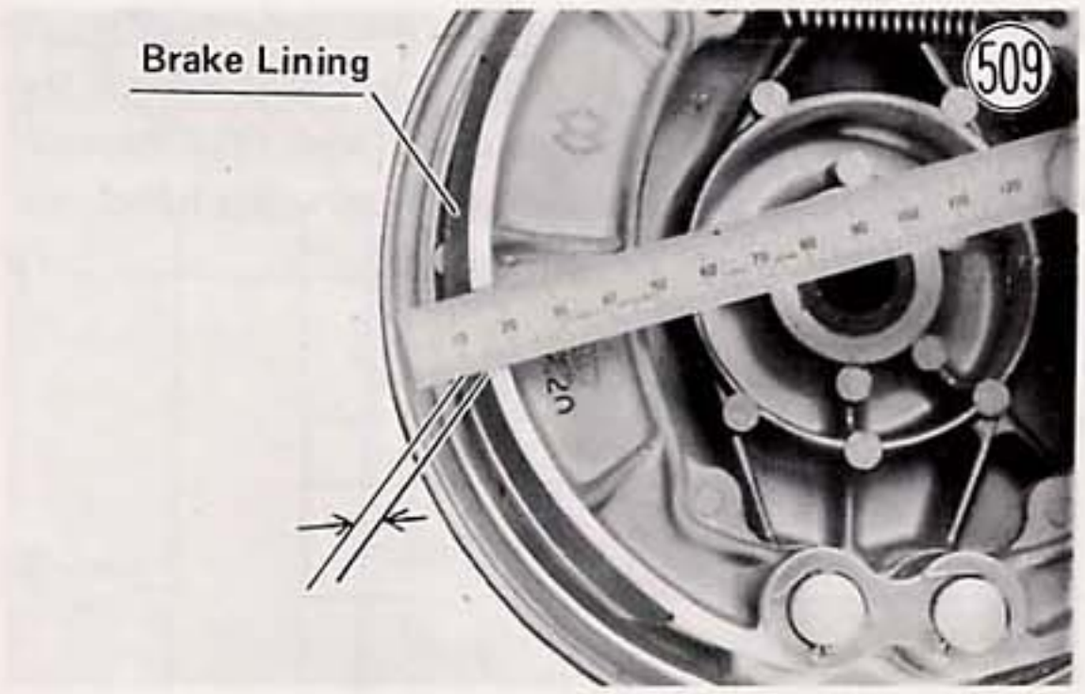



**Table 81 Brake Lining Thickness**

| | Standard | Service Limit |
|---|---|---|
| Front (KZ400S) | 4.75~5.20 mm | 2.5 mm |
| Rear | 5.35~6.05 mm | 2.5 mm |

*Brake shoe spring tension*

If the brake springs become stretched, they will not pull the shoes back away from the drum after the brake lever or pedal is released, causing the shoes to drag on the drum. Remove the springs, and check their free length with vernier calipers. If either is stretched beyond the service limit, replace both springs.

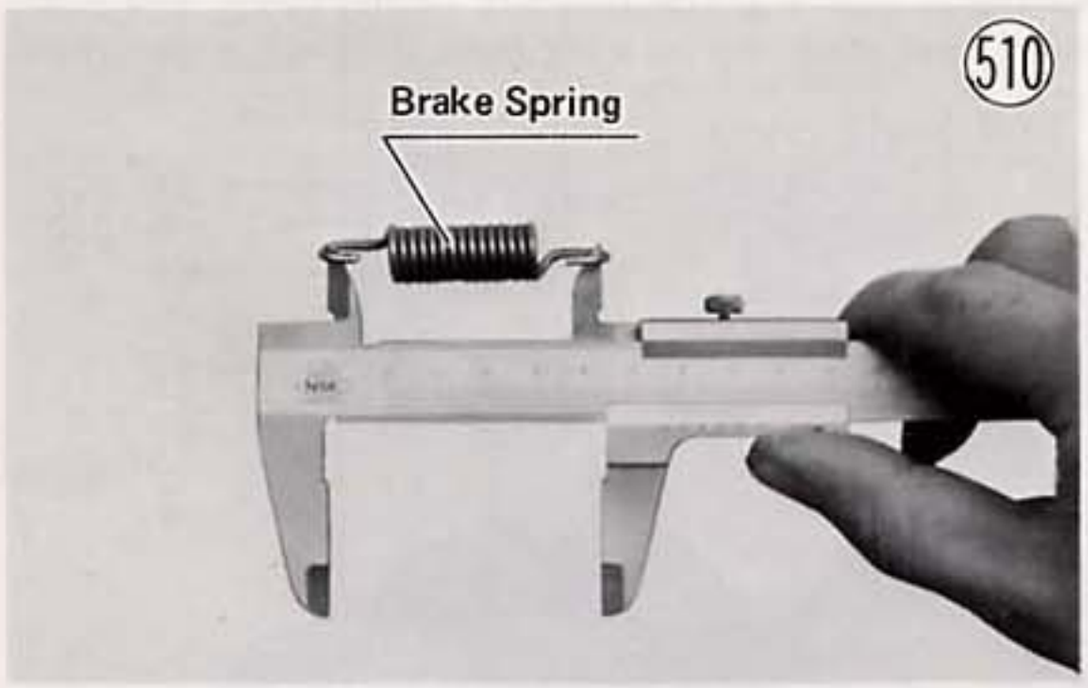



**Table 82 Brake Spring Free Length**

| | Standard | Service Limit |
|---|---|---|
| Front (KZ400S) | 46.7~47.3 mm | 48.5 mm |
| Rear | 56 mm | 58 mm |

*Camshaft, shaft hole wear*

Excessive shaft to hole clearance will increase camshaft play and reduce braking efficiency.

Measure the shaft diameter with a micrometer, and replace it if it is worn down to less than the service limit.


Measure the inside diameter of the camshaft hole, and replace the brake panel if the hole is worn past the service limit.

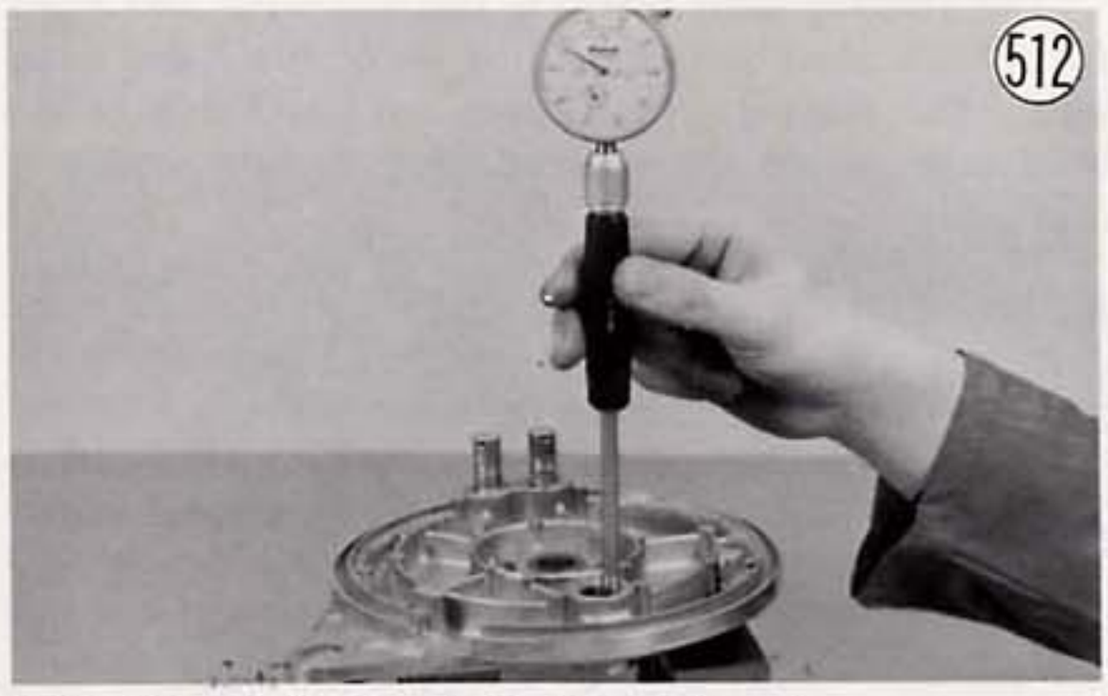
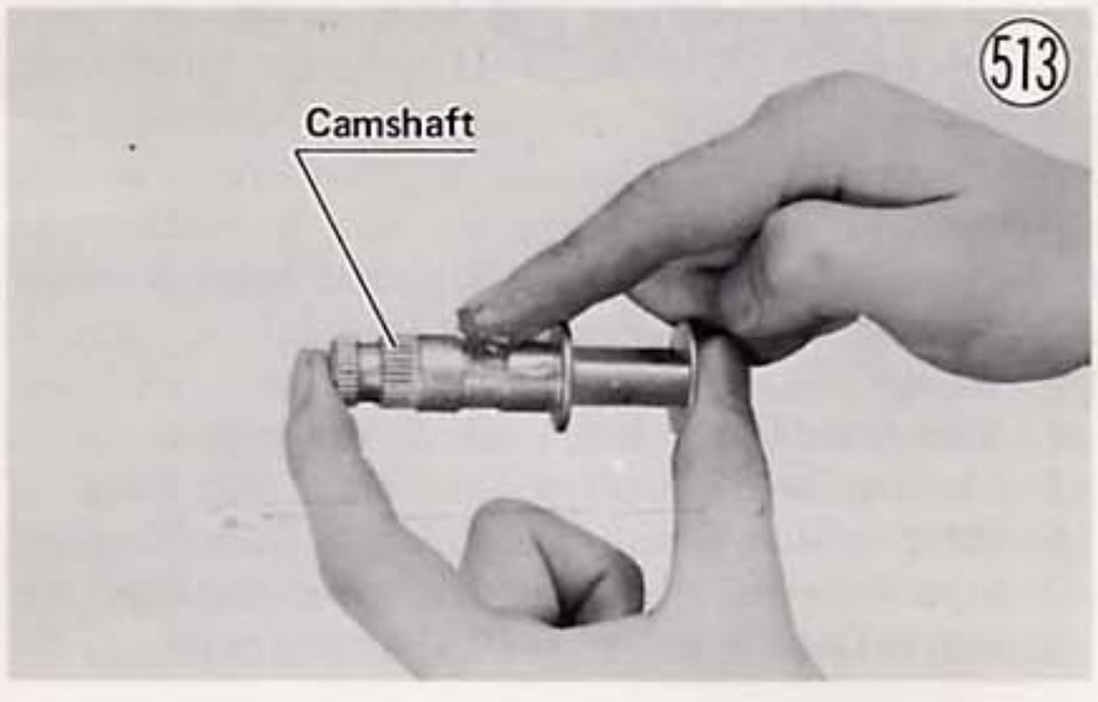


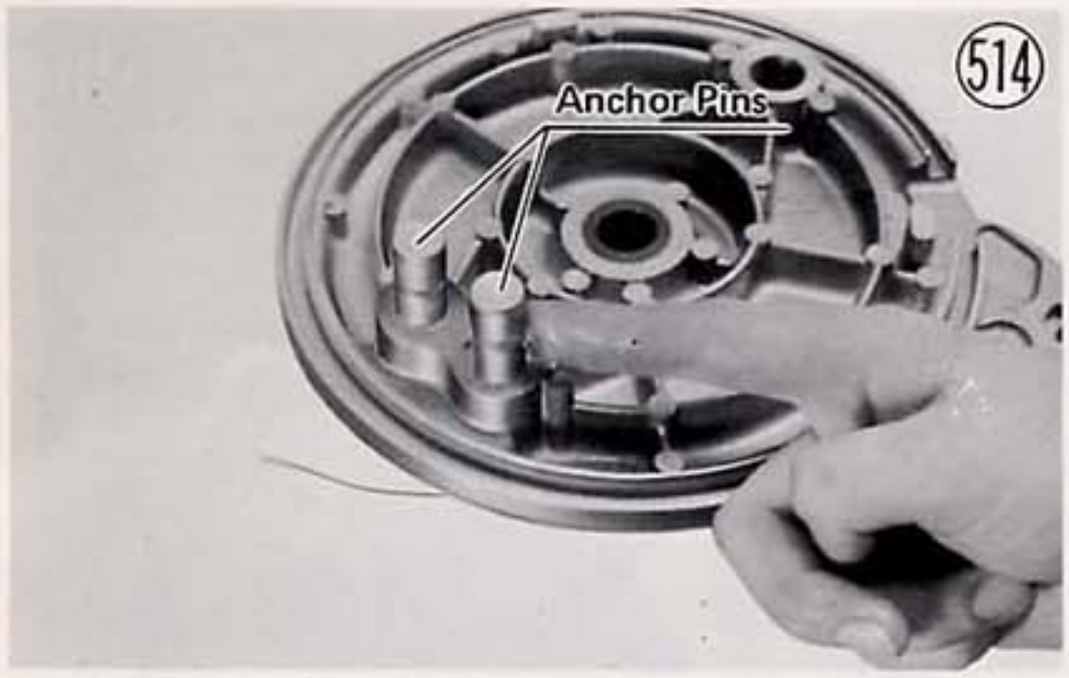

**Table 83 Brake Camshaft, Hole Diameter**

| | Standard | Service Limit |
|---|---|---|
| Camshaft (KZ400S Front) | 14.957~14.984 mm | 14.83 mm |
| Shaft Hole (KZ400S Front) | 15.000~15.027 mm | 15.18 mm |
| Camshaft (Rear) | 16.957~16.984 mm | 16.83 mm |
| Shaft Hole (Rear) | 17.000~17.027 mm | 17.18 mm |

*Lubrication*

Every time that the brake is disassembled, and in accordance with the periodic maintenance chart (Pg. 180), wipe out the old grease, and re-grease the brake pivot points. Apply grease to the brake shoe anchor pins, spring ends, and cam surface of the camshaft, and fill the camshaft groove with grease. Do not get any grease on the brake shoe linings, and wipe off any excess grease so that it will not get on the linings or drum after brake assembly.



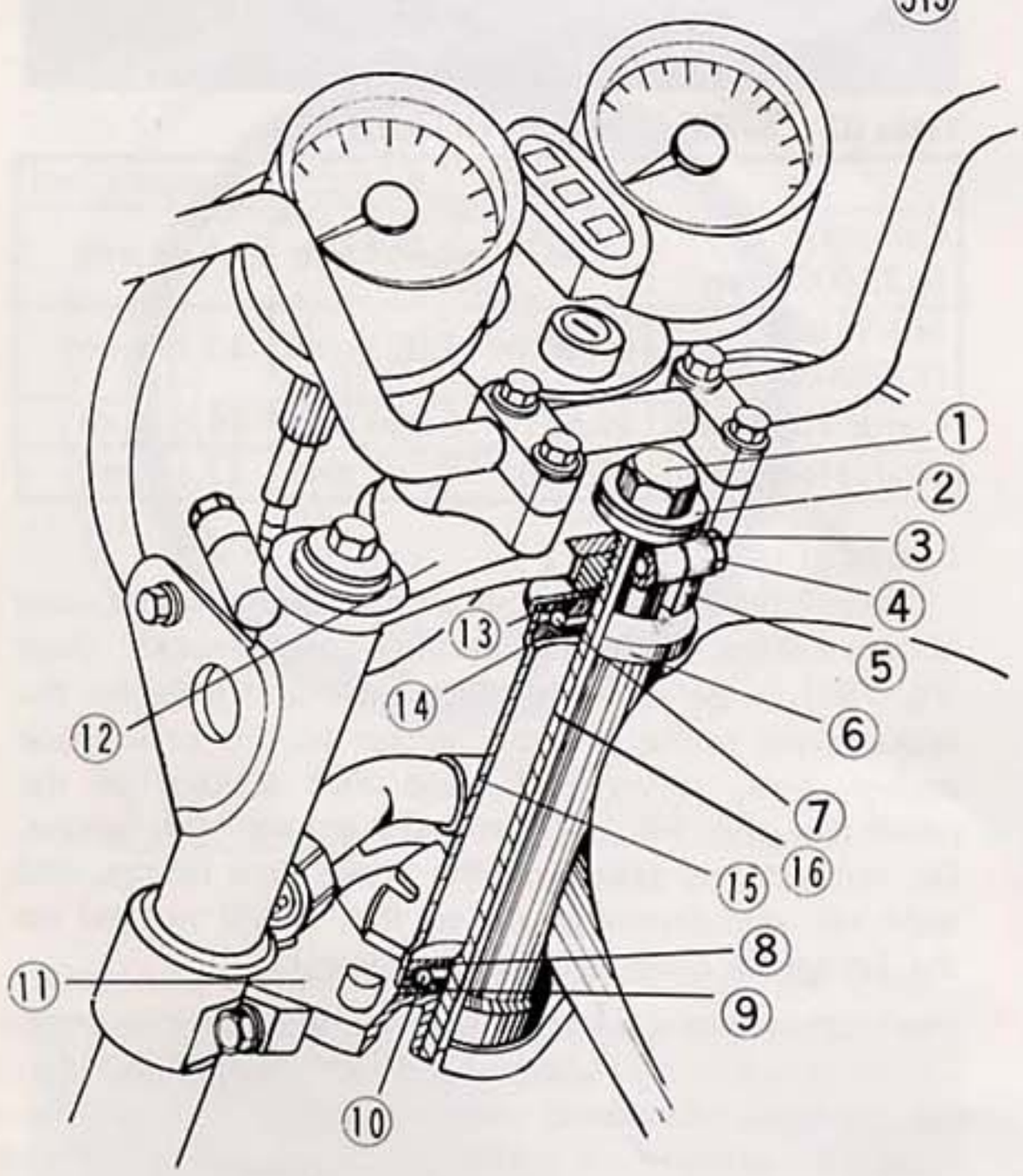



## STEERING STEM

The steering stem supports the handlebar and front fork shock absorbers, and turns inside the frame head pipe. Ball 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.

**Steering Stem**




1. Stem Head Bolt
2. Washer
3. Washer
4. Stem Head Clamp Bolt
5. Steering Stem Lock Nut
6. Steering Stem Cap
7. Steel Balls
8. Lower Outer Race
9. Lower Inner Race
10. Steel Balls
11. Stem Base
12. Stem Head
13. Upper Inner Race
14. Upper Outer Race
15. Frame Head Pipe
16. Steering Stem

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.

**Table 84 Bearing Ball Specifications**

| | Size | Number |
|---|---|---|
| Upper & Lower | ¼" | 19 each |

*Steering stem warp*

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

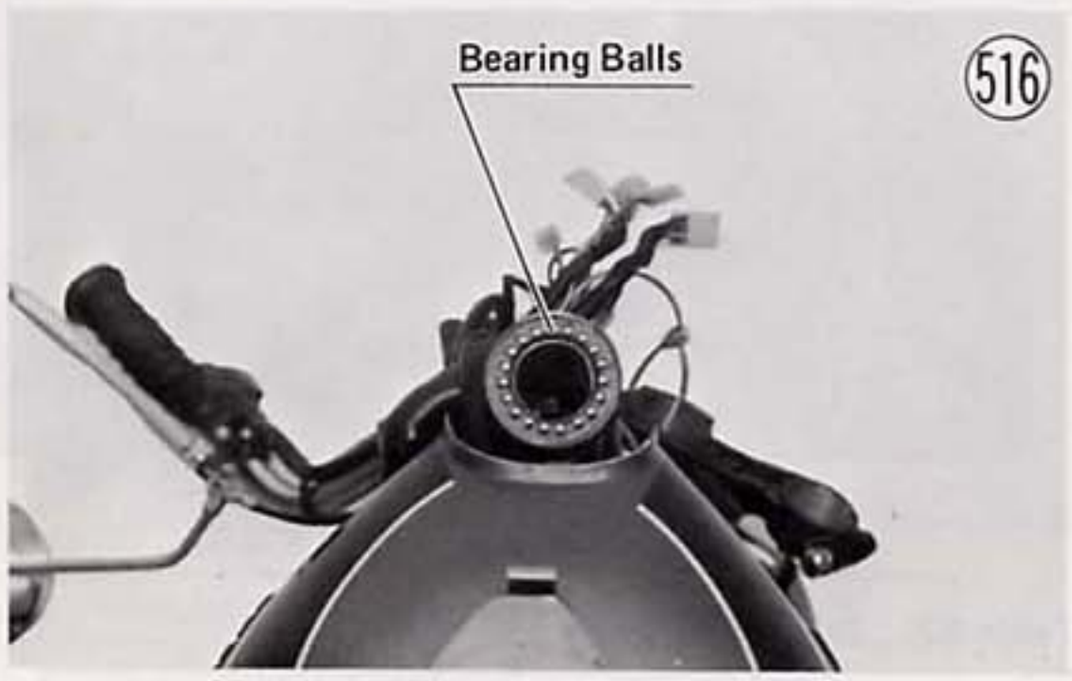
*Bearing wear, damage*

Wipe the bearings clean of grease and dirt, and examine the races and balls. If the balls or races are worn, or if either race is dented, replace both races and all the balls for that bearing as a set.

*Bearing lubrication*

In accordance with the periodic maintenance chart (Pg. 180), and whenever the steering stem is disassembled, the steering stem bearings should be relubricated.

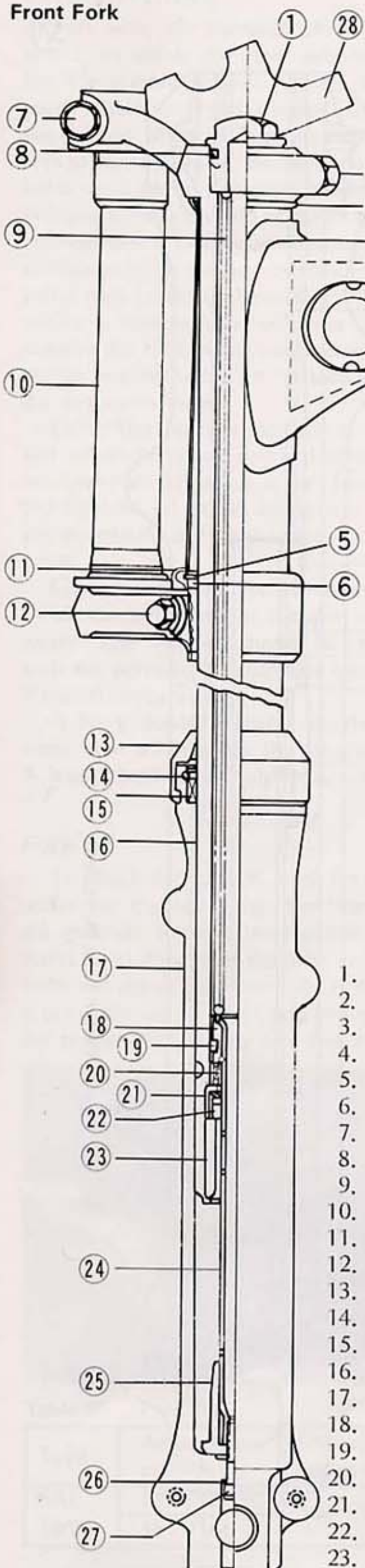
Wipe all the old grease off the races and balls, washing them in a high flash point solvent of some kind if necessary. Replace the bearing parts if they show wear or damage. Apply grease liberally to the upper and lower races, and stick the bearing balls in place with grease.




## FRONT FORK

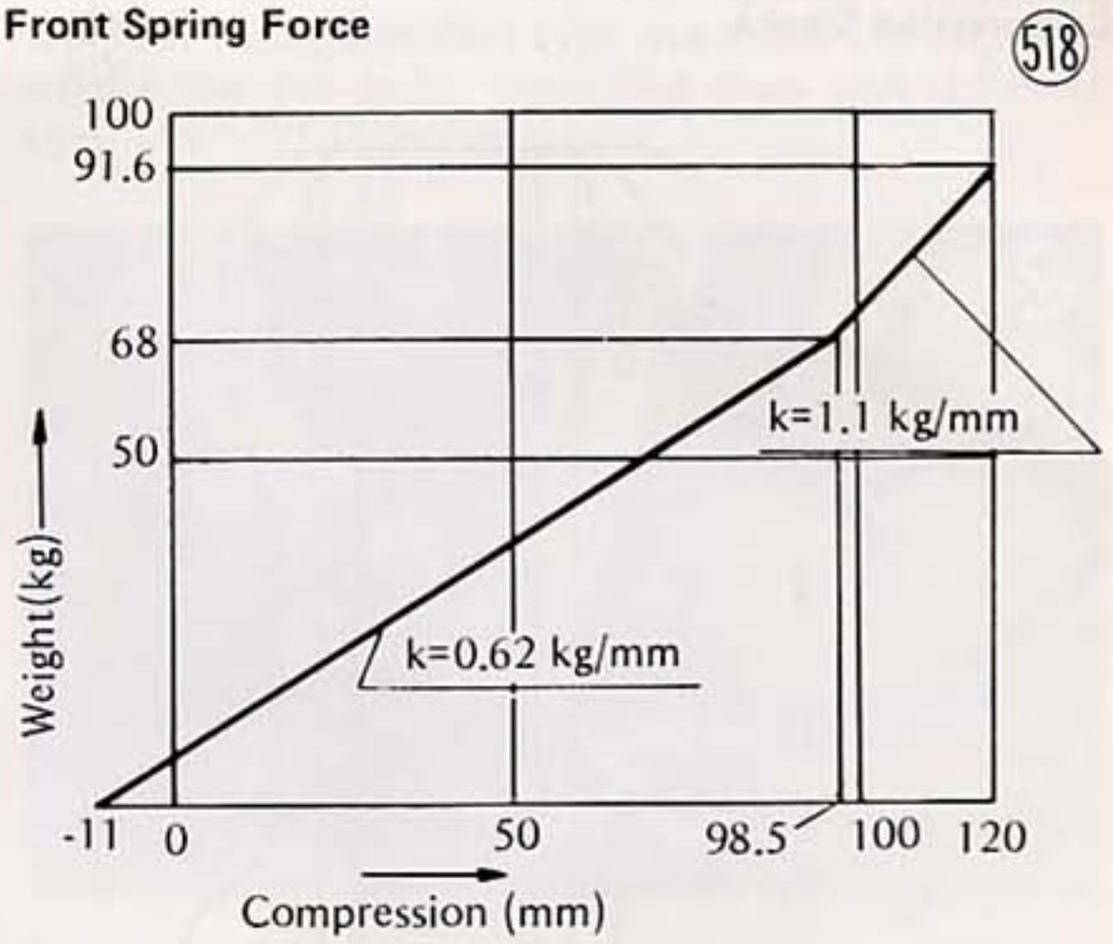
Front fork construction is shown in Fig. 517. It consists of two shock absorbers connected to the frame head pipe by the stem base and stem head bracket. It accomplishes shock absorption through spring action, air compression in the inner tube, and resistance to the flow of the oil forced into the cylinder by tube movement.

**Front Fork**




1. Top Bolt
2. Upper Clamp Bolt
3. Ring Cap
4. Fork Cover
5. Damper Ring
6. Damper
7. Stem Head Clamp Bolt
8. O Ring
9. Spring
10. Steering Stem
11. Stem Base Cover
12. Lower Clamp Bolt
13. Dust Seal
14. Clip
15. Oil Seal
16. Inner Tube
17. Outer Tube
18. Piston
19. Piston Ring
20. Spring
21. Spring Seat
22. Valve
23. Collar
24. Cylinder
25. Cylinder Base
26. Gasket
27. Allen Bolt
28. Stem Head

**Front Spring Force**




Each shock absorber is a telescopic tube including an inner tube ⑯, outer tube ⑰, cylinder ㉔, piston ⑱, collar ㉓, and cylinder base ㉕. 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 ⑲) is secured to the top of the cylinder. The collar (coupled with a non-return valve ㉒), 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 functions to form an oil lock at the end of the compression stroke to prevent the inner tube from striking the bottom. Vertically arranged 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.

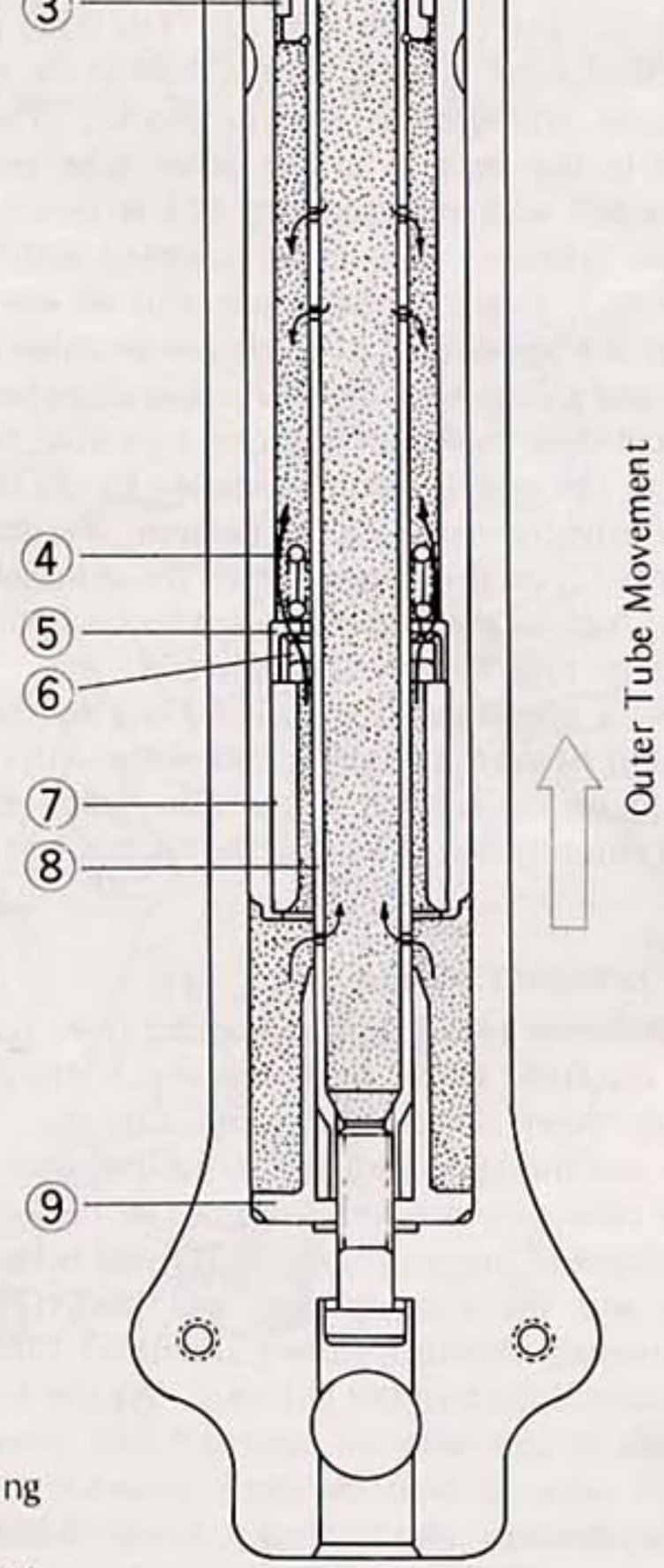
Oil is prevented from leaking out by the oil seal ⑮, which if fitted at the upper end of the outer tube. A dust seal ⑬ on the outside of the tube keeps dirt and water from entering and damaging the oil seal and tube surface.

*Compression stroke*

Whenever a load is placed on the front fork and whenever the front wheel receives a shock, the inner tube ⑩ moves down inside the outer tube ⑪, compressing both the spring ① and the air in the inner tube. At the same time, low pressure (suction) is created in an enlarging chamber (upper chamber) formed between the inner tube and the cylinder ⑧, and draws in oil from a diminishing chamber (lower chamber) formed between the outer tube and the cylinder. As the lower chamber shrinks in size with oil passing freely through the non-return valve ⑥ into the upper chamber, oil also passes freely through the cylinder lower orifices into the cylinder as the inner tube approaches the cylinder base ⑨. Near the end of the compression stroke, the clearance between the tapered-out cylinder base and the collar at the lower end of the inner tube approaches zero. The resulting resistance to the flow of oil through this small space slows the downward movement, finally forming an oil lock to finish the compression stroke.

Compression Stroke

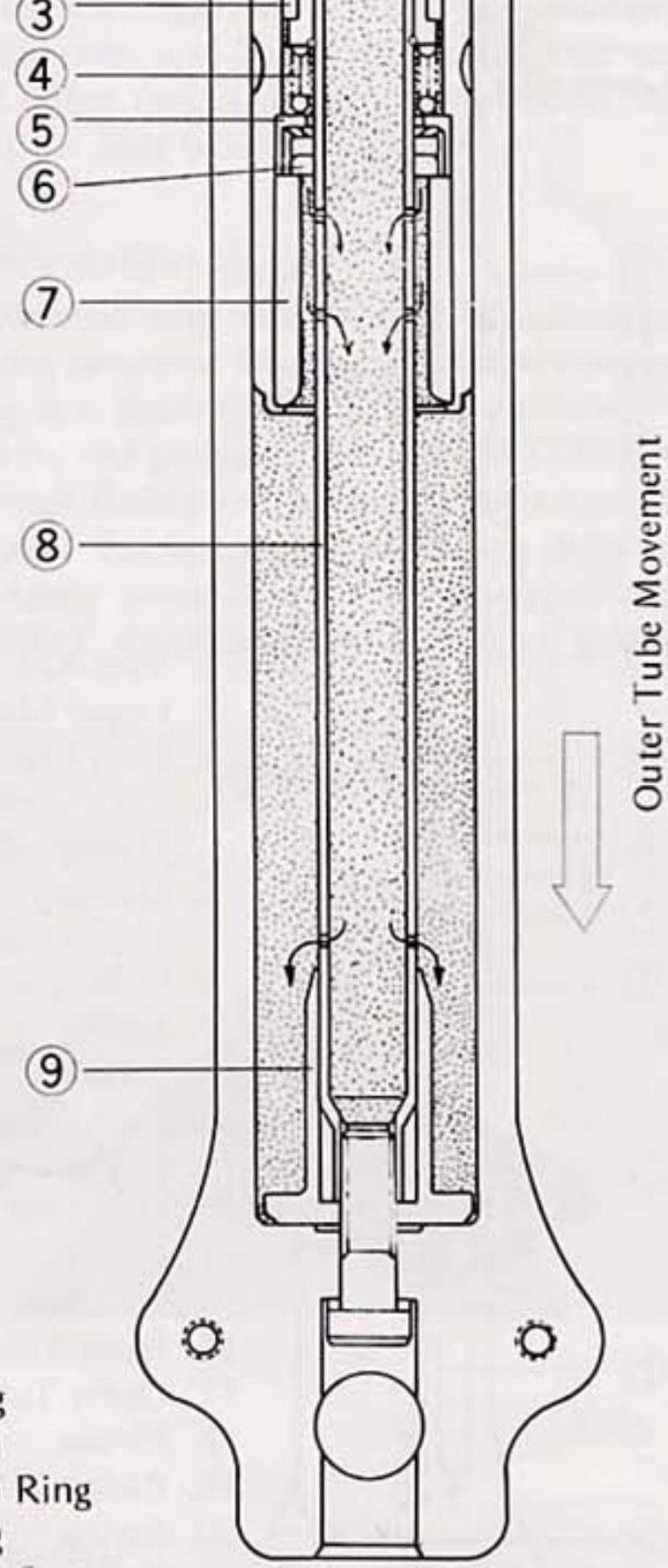
519




1. Spring
2. Piston
3. Piston Ring
4. Spring
5. Spring Seat
6. Valve
7. Collar
8. Cylinder
9. Cylinder Base
10. Inner tube
11. Outer tube

Extension Stroke

520




1. Spring
2. Piston
3. Piston Ring
4. Spring
5. Spring Seat
6. Valve
7. Collar
8. Cylinder
9. Cylinder Base
10. Inner tube
11. Outer tube

*Extension stroke*

Following the compression stroke is the extension stroke, in which the inner tube is pushed back out by the compressed spring. As the tubes move apart, the upper chamber grows smaller, forcing the oil through the cylinder upper orifices since the oil cannot return the way it came through the non-return valve. These small holes resist 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 the size of the upper chamber, one orifice is eliminated as an upper chamber outlet, which reduces the oil flow slowing extension. When the other orifice is eliminated, an oil lock forms, which finishes the extension stroke.

Either too much or too little oil in the shock absorbers will adversely affect shock damping. Too much oil or too heavy an oil makes 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 additon, will accelerate internal wear. The fork oil should be changed in accordance with the periodic maintenance chart (Pg. 180) or sooner if the oil appears dirty.

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

*Fork oil*

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 bolt 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.


**Table 85 Fork Oil**

| Type | Amount per side | Oil level from top of inner tube | Model |
|---|---|---|---|
| SAE 5W20 | 155~165 cc | 340~360 mm | 400D |
| | 161~166 cc | | 400S |

To drain out the old oil, remove the drain bolt from the lower end of the outer tube on each side. With the front wheel on the ground, push down on the handlebar a few times to pump out the oil. Replace the drain bolts, remove the top bolt from each side, and pour in the specified type and amount of oil. Then replace the top bolts, tightening them with 2.5 ~ 3.0 kg-m (18 ~ 22 ft-lbs) of torque.


*Spring tension*

Since the spring becomes shorter as it weakens, check its free length to determine its condition. If the spring of either shock absorber 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 shock absorbers balanced for motorcycle stability.

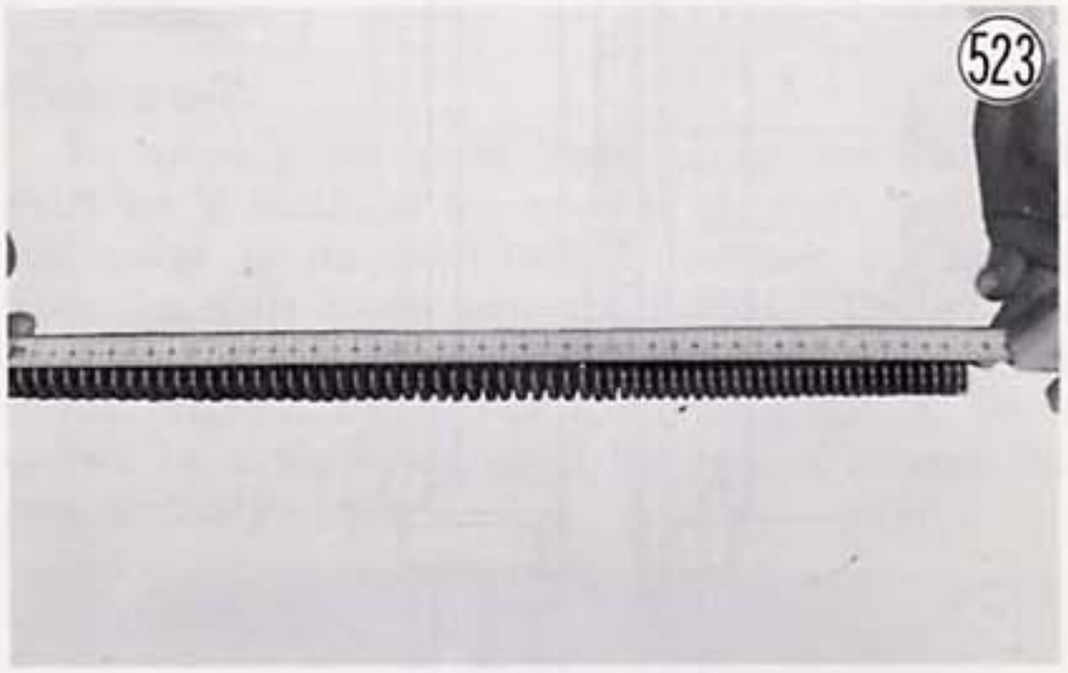



**Table 86 Fork Spring Free Length**

| Standard | Service Limit |
|---|---|
| 475 mm | 465 mm |

*Inner tube damage*

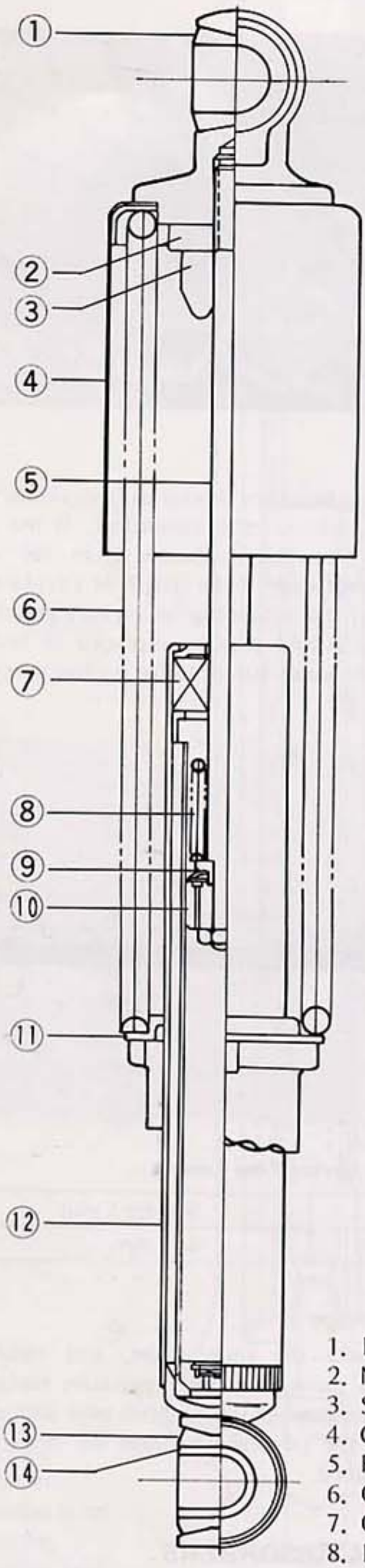
Visually inspect the inner tube, and repair any damage. If the damage is not repairable, replace the inner tube. Since damage to the inner tube damages the oil seal, replace the oil seal whenever the inner tube is repaired or replaced.

## 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

**Rear Shock Absorber**

524




1. Rubber Bushing
2. Nut
3. Stopper Rubber
4. Cover
5. Piston Rod
6. Outer Spring
7. Oil Seal
8. Inner Spring
9. Check Valve
10. Piston
11. Spring Seat
12. Outer Shell
13. Rubber Bushing
14. Collar

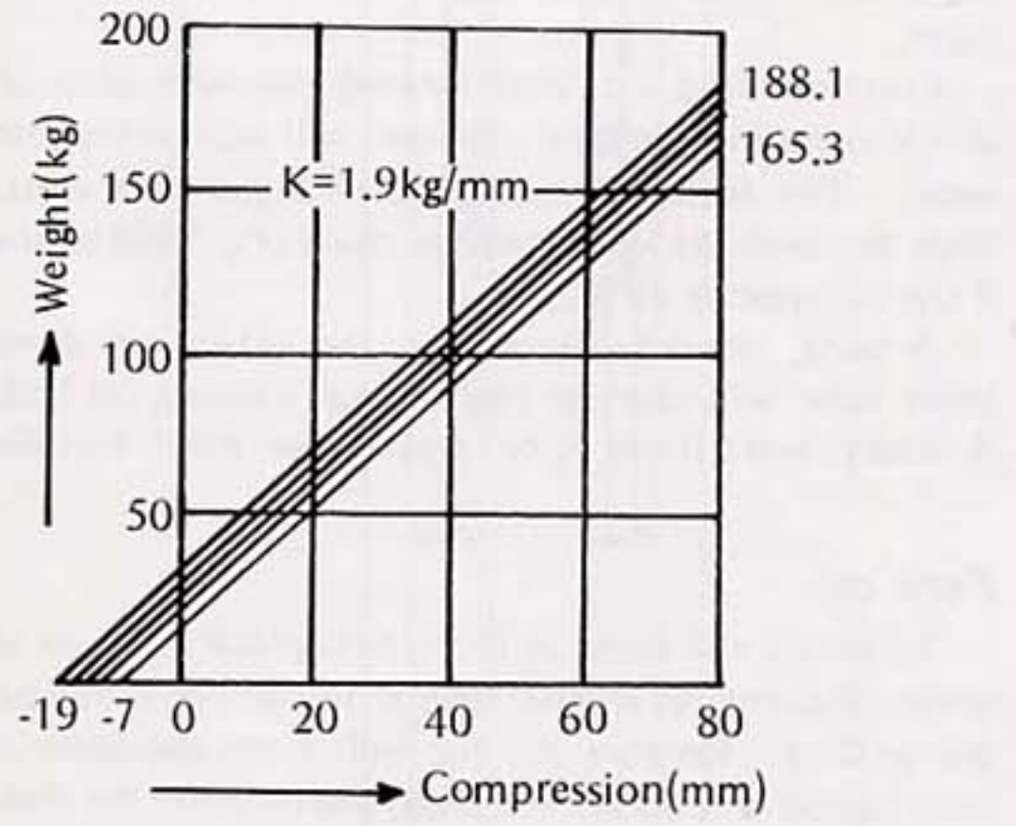
aided by the use of rubber bushings in both the upper and lower shock absorber mountings.

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 besides spring resistance to compression. When the unit is released, the spring should not suddenly snap it 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.

**Rear Spring Force**

525




*Bushings*

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

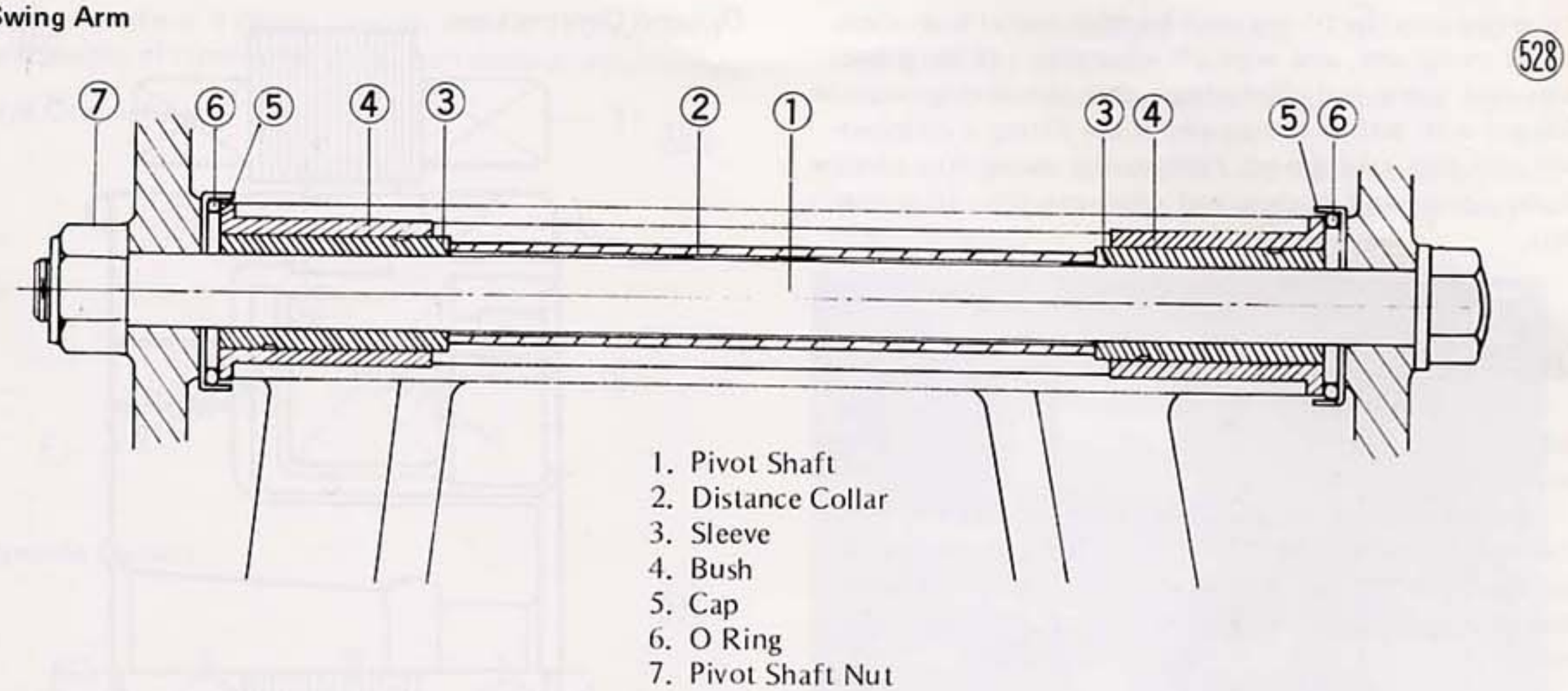
## SWING ARM

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 a shaft connected to the frame. When the rear wheel receives a shock, the swing arm, pivoting on its shaft, allows the wheel to move up and down in relation to the frame within the limits of the shock absorbers.

Wear takes place where the short sleeves and bushes rub together. If wear has progressed such that the swing arm has become loose, the motorcycle will be unstable, especially at high speeds. To minimize wear, the swing arm should be kept properly packed with grease.

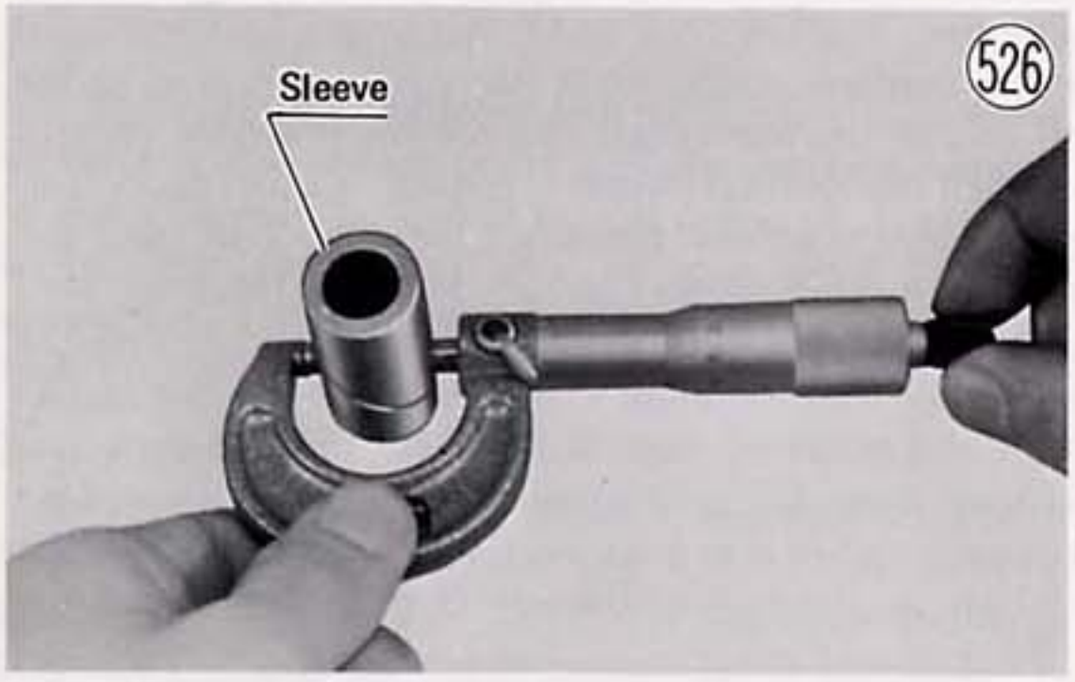
A bent pivot shaft or twisted swing arm will also cause instability by throwing the rear wheel out of alignment.

**Swing Arm**




*Sleeve, bush wear*

Measure the outside diameter of the sleeves at both ends with a micrometer. Replace both sleeves if the diameter of either is less than the service limit or if either shows visible damage.




Measure the inside diameter of each bush with a cylinder gauge. Replace both bushes if the diameter of either exceeds the service limit. Also, replace both bushes if either shows visible damage.

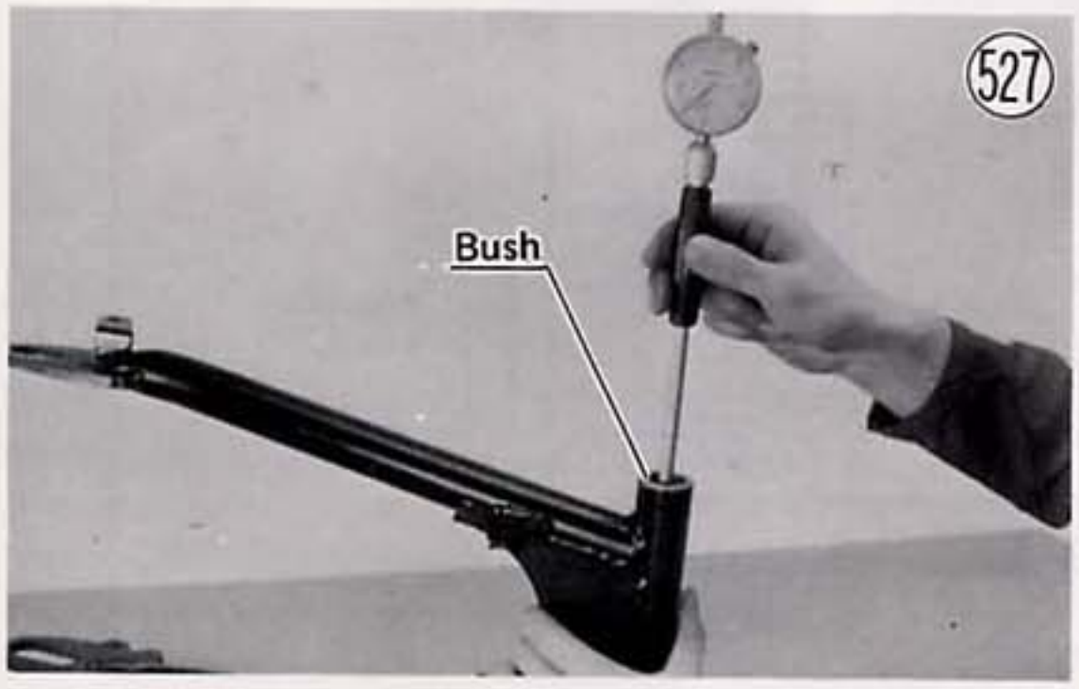



**Table 87 Swing Arm Sleeve, Bush Diameter**

| | Standard | Service Limit |
|---|---|---|
| Sleeve outside dia. | 21.979~22.000 mm | 21.95 mm |
| Bush inside dia. | 22.030~22.063 mm | 22.26 mm |

*Pivot shaft*

To measure the pivot shaft runout, set the pivot shaft on **V** blocks at the ends of the shaft, and set a dial gauge to the shaft halfway between the blocks. Turn the shaft to measure the runout. The amount of runout is the amount of dial variation. If the shaft runout exceeds the service limit, straighten it. If it cannot be straightened, or if the runout exceeds 0.7 mm, replace the shaft.

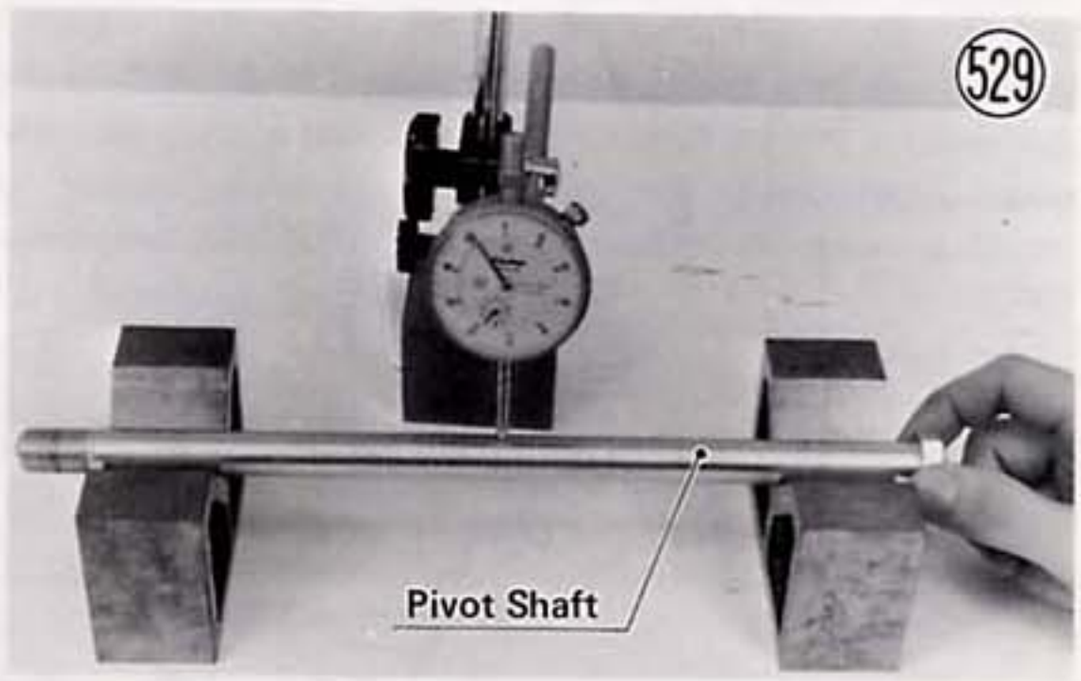



**Table 88 Pivot Shaft Runout**

| Standard | Service Limit |
|---|---|
| under 0.1 mm | 0.14 mm |

*Lubrication*

There is a grease fitting on the swing arm for lubrication. Grease the swing arm with regular cup grease as a part of general lubrication (Pg. 182) with the frequency given in the periodic maintenance chart (Pg. 180). Force

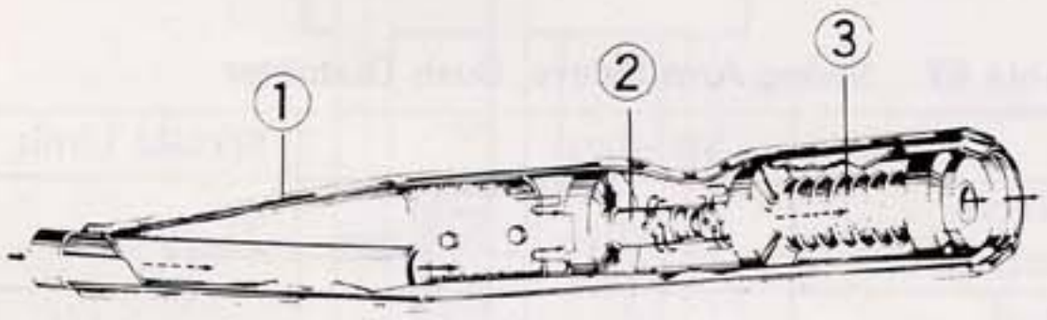
the grease into the fitting until it comes out at both sides of the swing arm, and wipe off any excess. If the grease does not come out, first check that the fitting is not clogged with dirt or old grease. If the fitting is clear but will still not take grease, remove the swing arm pivot shaft, sleeves and bushes, and clean out the old grease first.

## MUFFLERS

The mufflers reduce exhaust noise and conduct the exhaust gases back away from the rider while keeping power loss to a minimum.

If there is any exhaust leakage where the mufflers connect to the cylinder head, or if the gaskets appear damaged, replace the gaskets. If either muffler is badly damaged, dented, cracked or rusted, replace it for a new one.

**Muffler** (530)

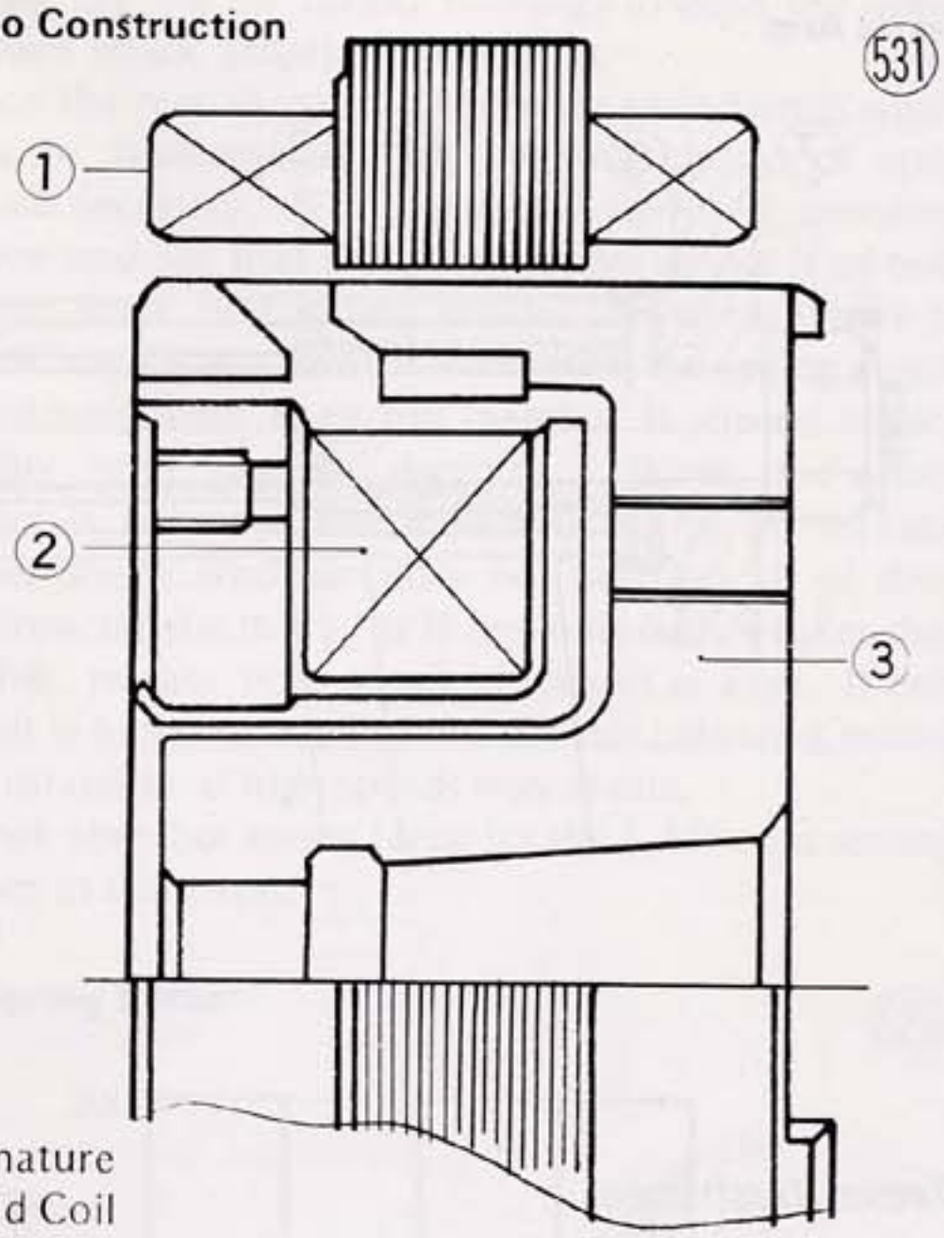



1. Muffler
2. Baffle Tube
3. Glass Wool

## DYNAMO

The dynamo generates the current required by the electrical circuits. The generated current is a 3 phase alternating current (AC), which is changed to direct current (DC) by a rectifier and controlled by a 2 point regulator to supply an even voltage to the circuit components.

**Dynamo Construction** (531)

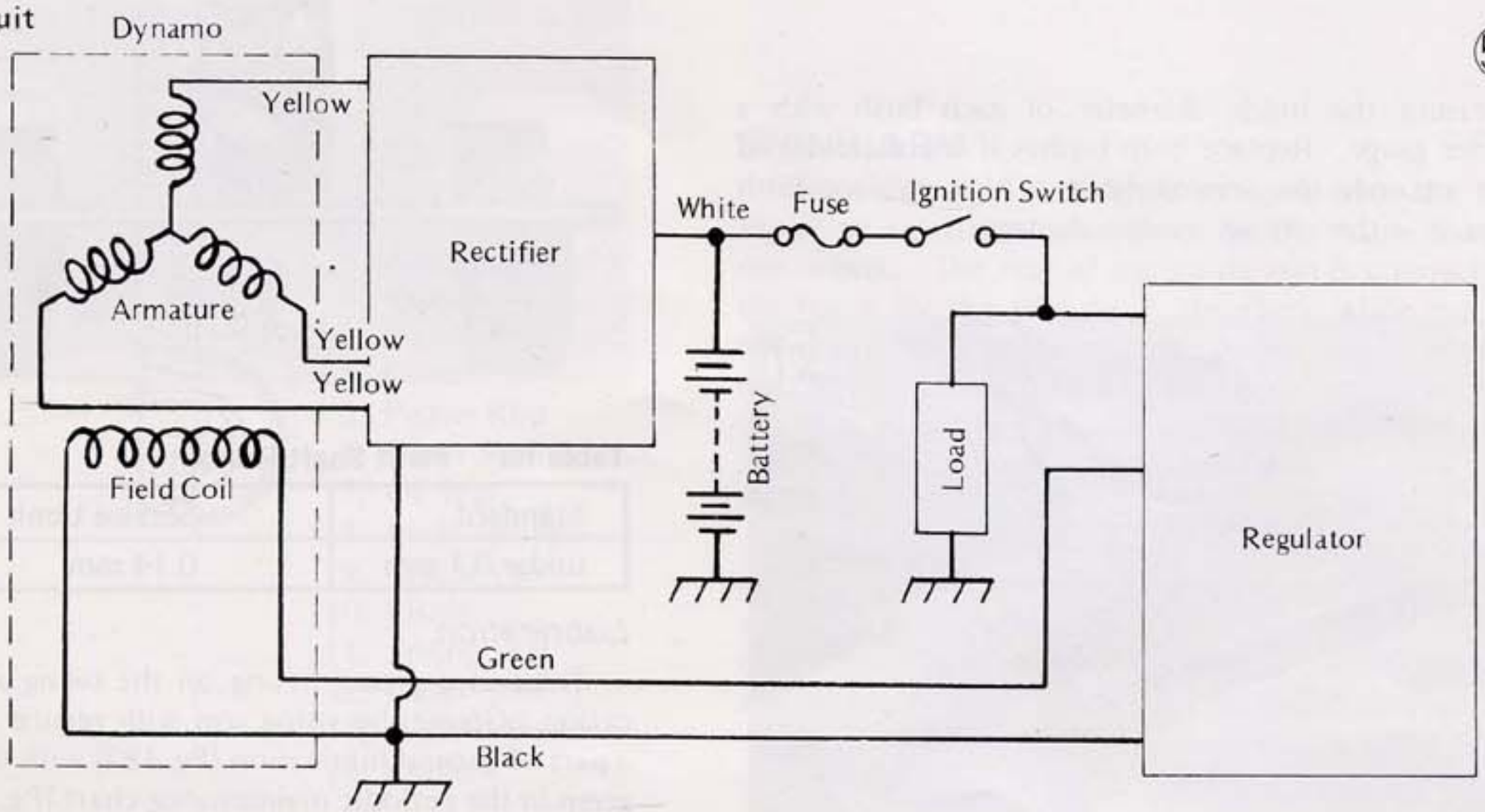



1. Armature
2. Field Coil
3. Rotor

The dynamo consists of a stationary field coil and armature and a revolving rotor, all of which are separately mounted. The field coil and armature are both mounted in the dynamo cover, while the rotor is secured to the left end of the crankshaft and rotates at engine rpm.

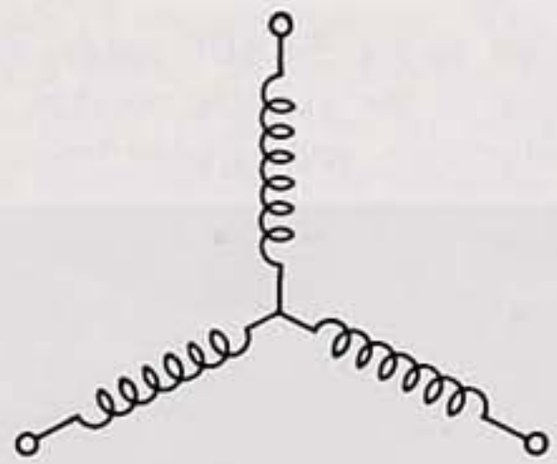
When the ignition switch is turned on, current controlled by the regulator flows to the field coil, and the resulting magnetic field (that accompanies electron flow) is concentrated in the rotor. Then, when starting the engine, the kickstarter or starter motor turns the crankshaft, and magnetic lines of force cut through the armature windings (3) generating current. These windings are connected in a wye connection (Fig. 533) to produce a 3 phase alternating current (Fig. 534). Since the

**Dynamo Circuit** (532)



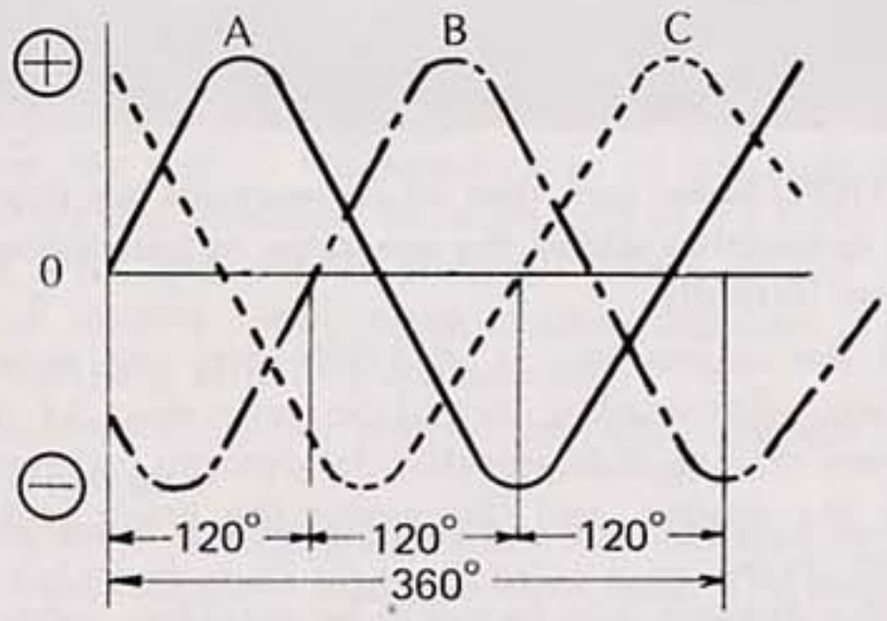
voltages of these 3 phases overlap, there is a continuous, even supply of current for the circuit components.

**Wye Connection**



533

**Dynamo Current**



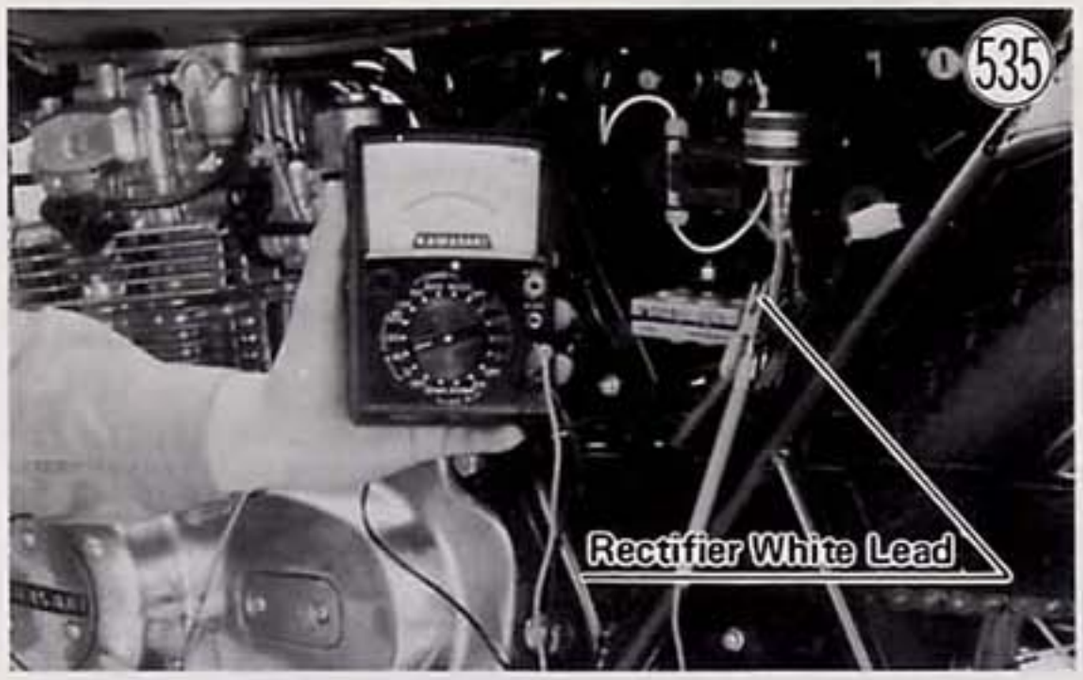

534

If the battery, rectifier, and regulator are all good but there is low voltage or insufficient charging current, the dynamo may be defective. A defective dynamo is due to either an electrical short or open in the field coil or armature. Either an electrical short or open will result in a low output or no output at all.

*Dynamo test*

Before making this test, check the condition of the battery (Pg. 162) and rectifier (Pg. 157). If the battery voltage is less than 12 volts, charge the battery. Both the output voltage and output amperage is checked.

- Remove the left side cover and the headlight unit (Pg. 92), and disconnect the 6P connector, which is on the left side of the motorcycle, and the 9P connector, which is in the headlight housing. This removes the load from the dynamo.
- Disconnect the rectifier white lead from the battery + lead.
- Set a multimeter to the 30 VDC range, and connect its + lead to the rectifier white lead and its – lead to chassis ground.



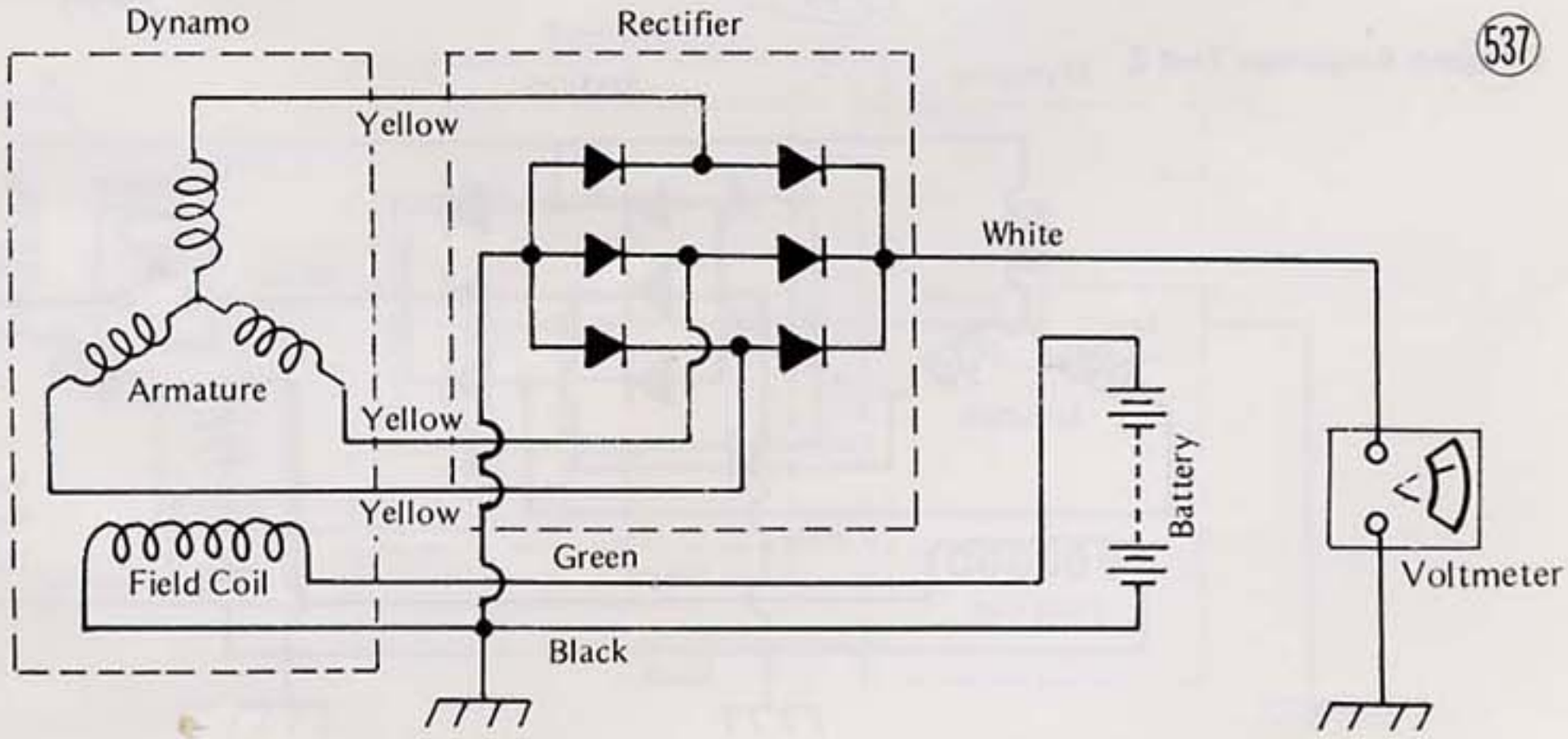

535

- Remove the right side cover, and disconnect the regulator green and brown leads from the regulator terminals marked F and I respectively. Connect the green and the brown leads together electrically.


536

**CAUTION: When connecting the green and the brown leads, be certain that the connection does not get shorted to chassis ground. Also, do not leave these leads connected any longer than necessary; disconnect them after finishing the test.**

**Dynamo Voltage Test**



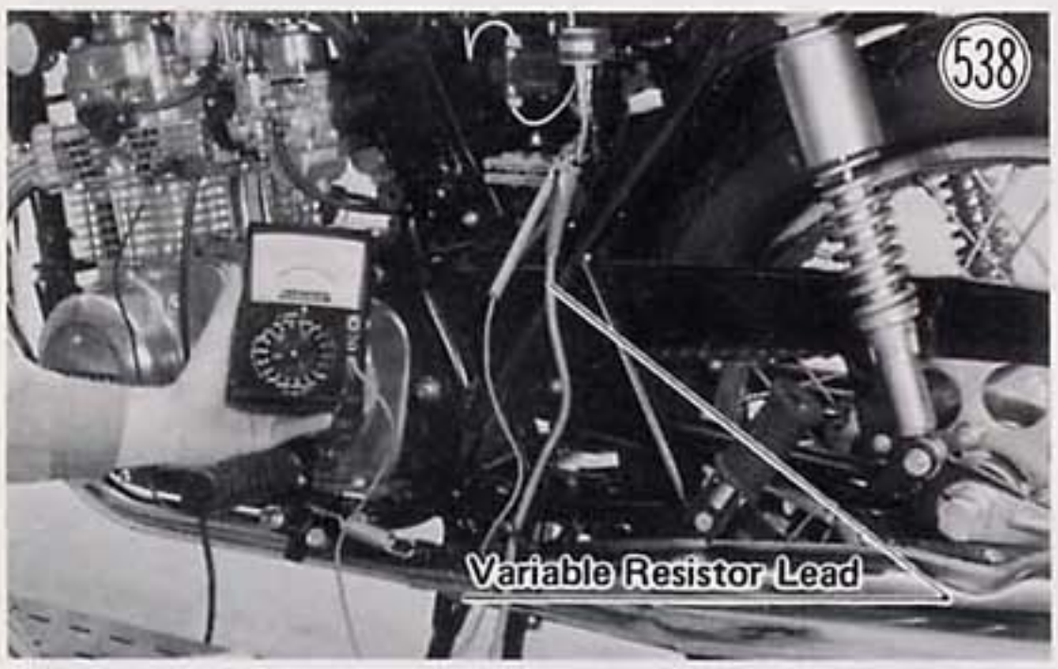

537

•Start the engine, run it at idling speed (1,100~1,300 rpm), and note the meter reading. The reading should be 14 VDC or more. A lower reading indicates the dynamo is defective.

**CAUTION: When or after starting the engine, DO NOT allow the engine to run at a higher rpm (not above 2,000 rpm) in order not to damage the rectifier and other electrical components.**

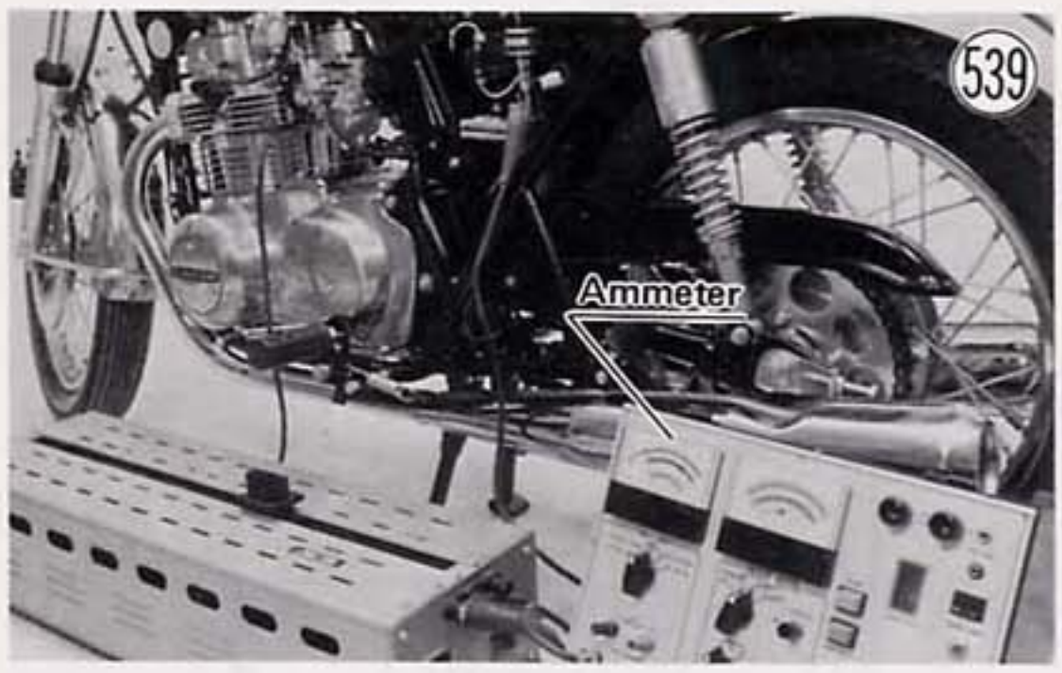
•Stop the engine, and connect a variable resistor (1Ω 200W) in series with the rectifier, one lead to the rectifier white lead and the other lead to chassis ground.

•Set the resistor at its highest resistance, and start the engine. While adjusting the resistor to keep the voltage at 14.5 VDC, gradually raise the engine speed up to 5,000 rpm.




•Stop the engine, disconnect the multimeter lead which is connected to chassis ground, and disconnect the variable resistor lead which is connected to the rectifier white lead.

•Set the multimeter to the 30 ADC range, and connect the meter – lead to the variable resistor. This puts the rectifier, multimeter, and variable resistor in series.



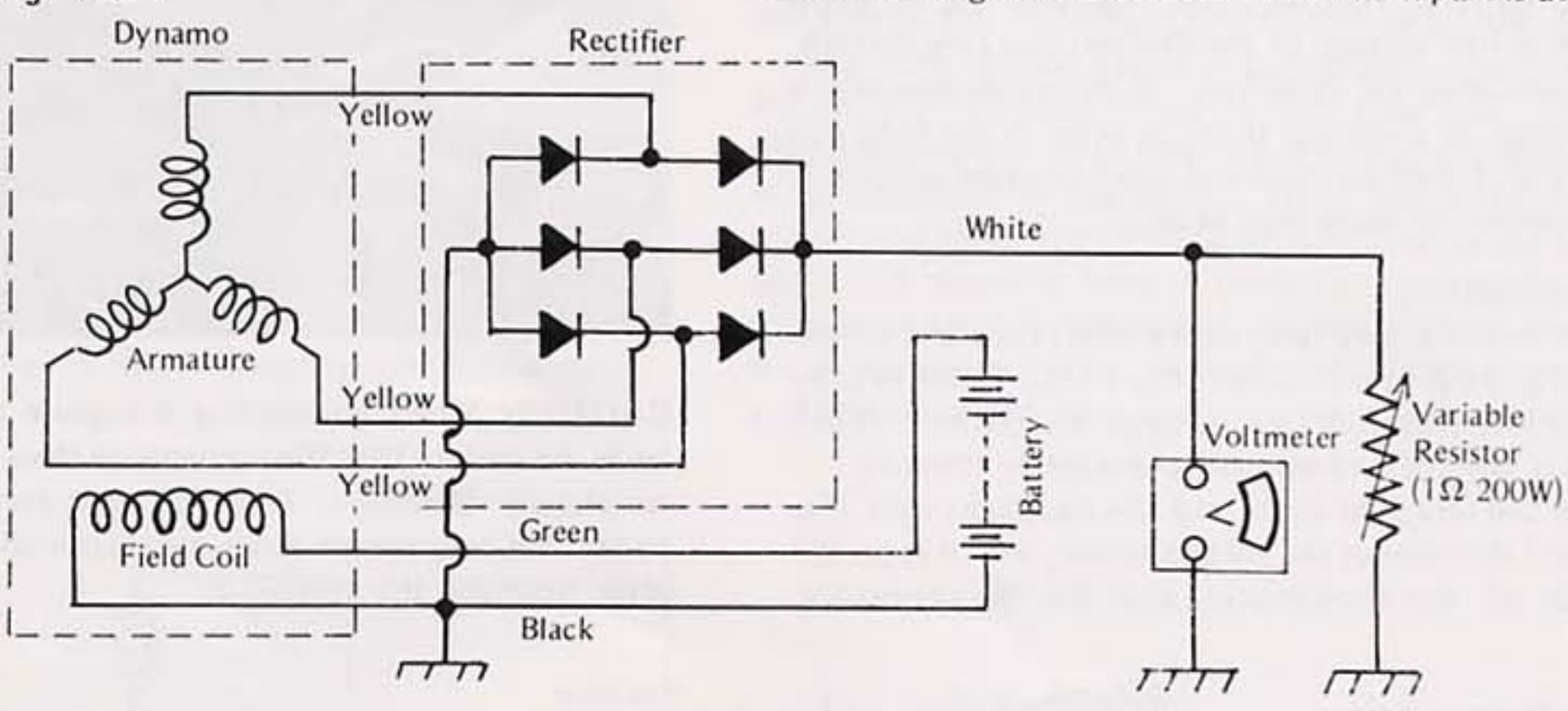

**CAUTION: Make sure that all connections are firm. A loose connection allows the generator output voltage to increase instantly.**

•Start the engine, run it at 5,000 rpm, and note the reading. The reading should be more than 13 ADC. A lower reading indicates that the dynamo is defective.

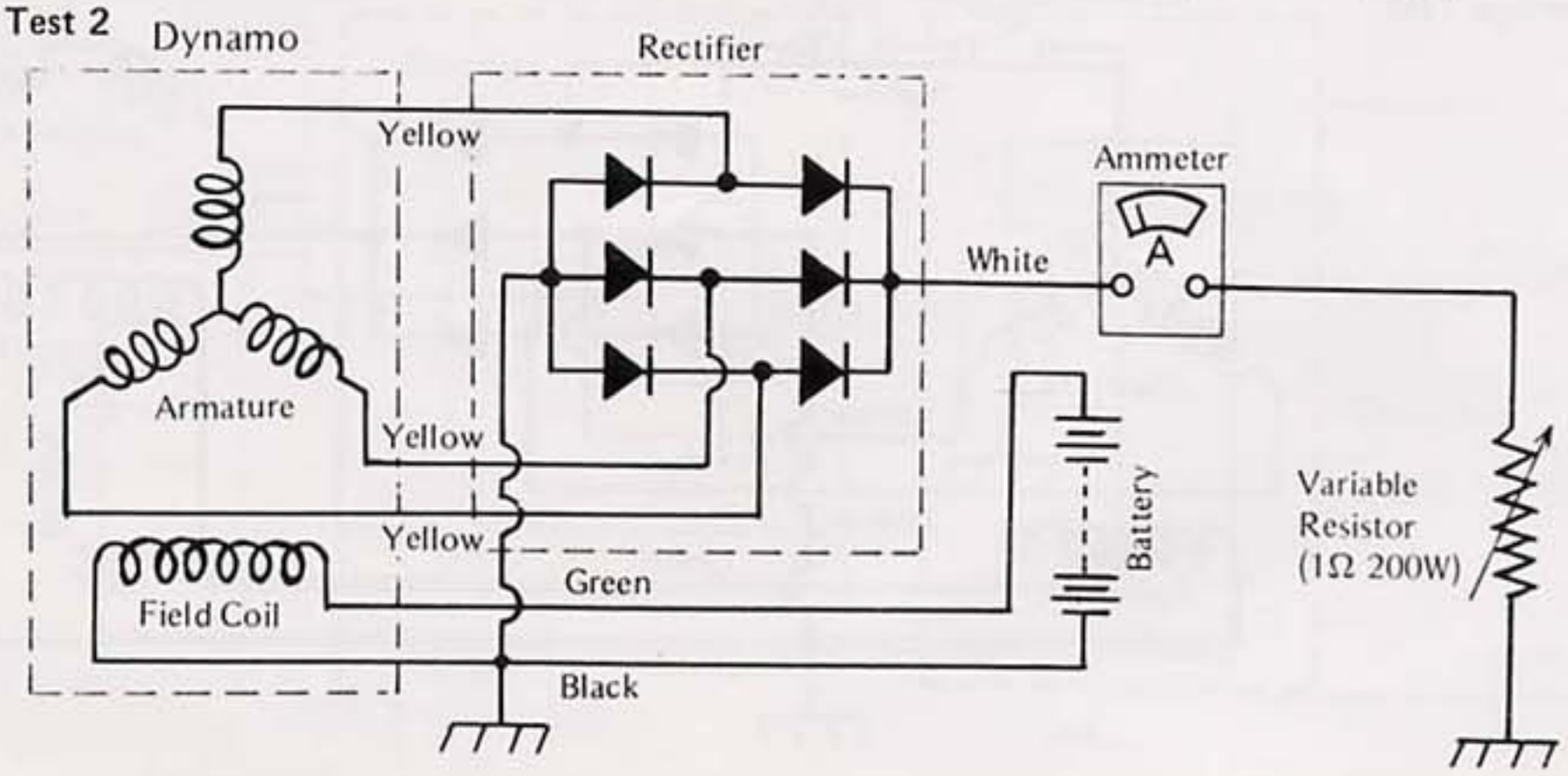
•Stop the engine, and disconnect the green and the brown leads.

If the dynamo was found to be defective, carry out the following checks to determine which part is defective.

**Dynamo Amperage Test 1**

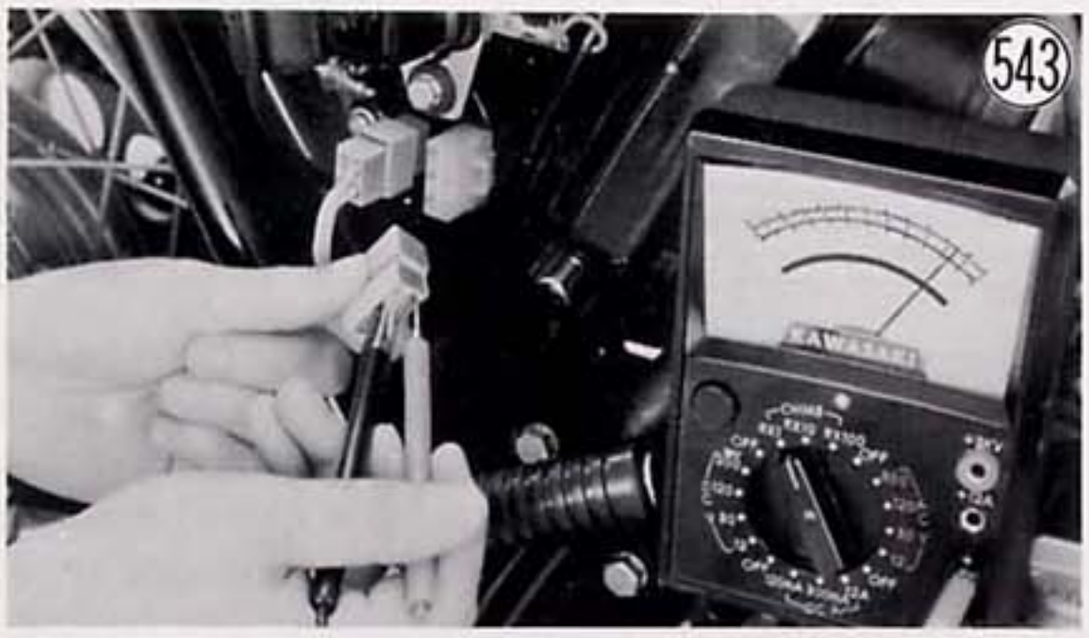



**Dynamo Amperage Test 2**



- Disconnect the white plug on the left hand side below the regulator.
- Set the multimeter to the R x 1 range, and measure for continuity between each of the three armature yellow leads (3 measurements). The readings should be 0.4 ~ 0.6 ohms. If there is resistance or no meter reading (infinity) for any two armature leads, the armature has an open and must be replaced.


- Using the highest resistance range of the multimeter, measure the resistance between each of the three armature leads and chassis ground. There should be no meter reading. Any meter reading indicates a short, necessitating armature replacement.
- Disconnect the white plug on the right hand side below the regulator.
- Using the R x 1 range, measure the resistance between the field coil green lead and black lead. The resistance should be 3.8 ~ 5.8 Ω. Less than this reading indicates a short in the coil, and a higher reading or no reading at all indicates an open. If the field coil is found to be open or shorted, replace the field coil with a new one.

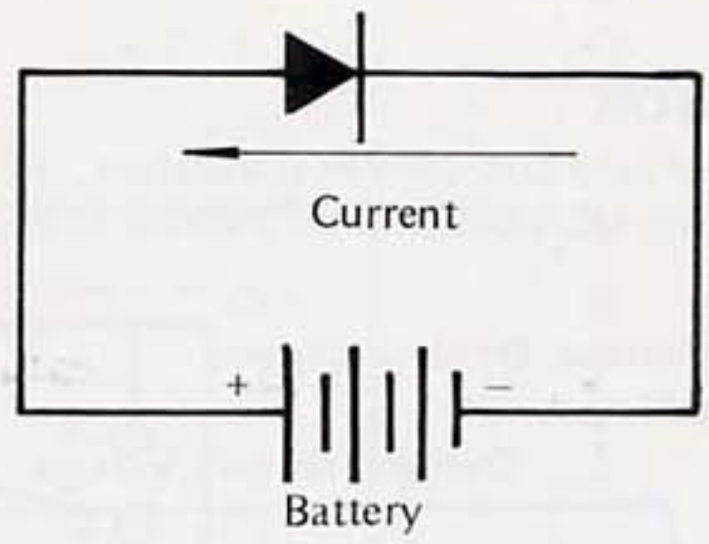



## RECTIFIER

The rectifier is used to change the alternating current (AC) from the dynamo to direct current (DC) for the battery charging, ignition, lighting, and other circuits. It contains six silicon diodes, two to rectify (change to DC) each of the three phases of the dynamo output. The diodes are connected in a bridge circuit arrangement for efficient, full-wave rectification.

The reason that a diode only permits direct current to flow in the part of the circuit in which it is connected is that a diode conducts appreciable current only in one direction. The current of electrons flows appreciably only from the – to the + side of the diode. However, a defective diode will conduct in both directions (a short) or not conduct at all (an open). If any of the diodes is shorted or open, the voltage from the rectifier will be below normal, and the battery may not charge adequately.

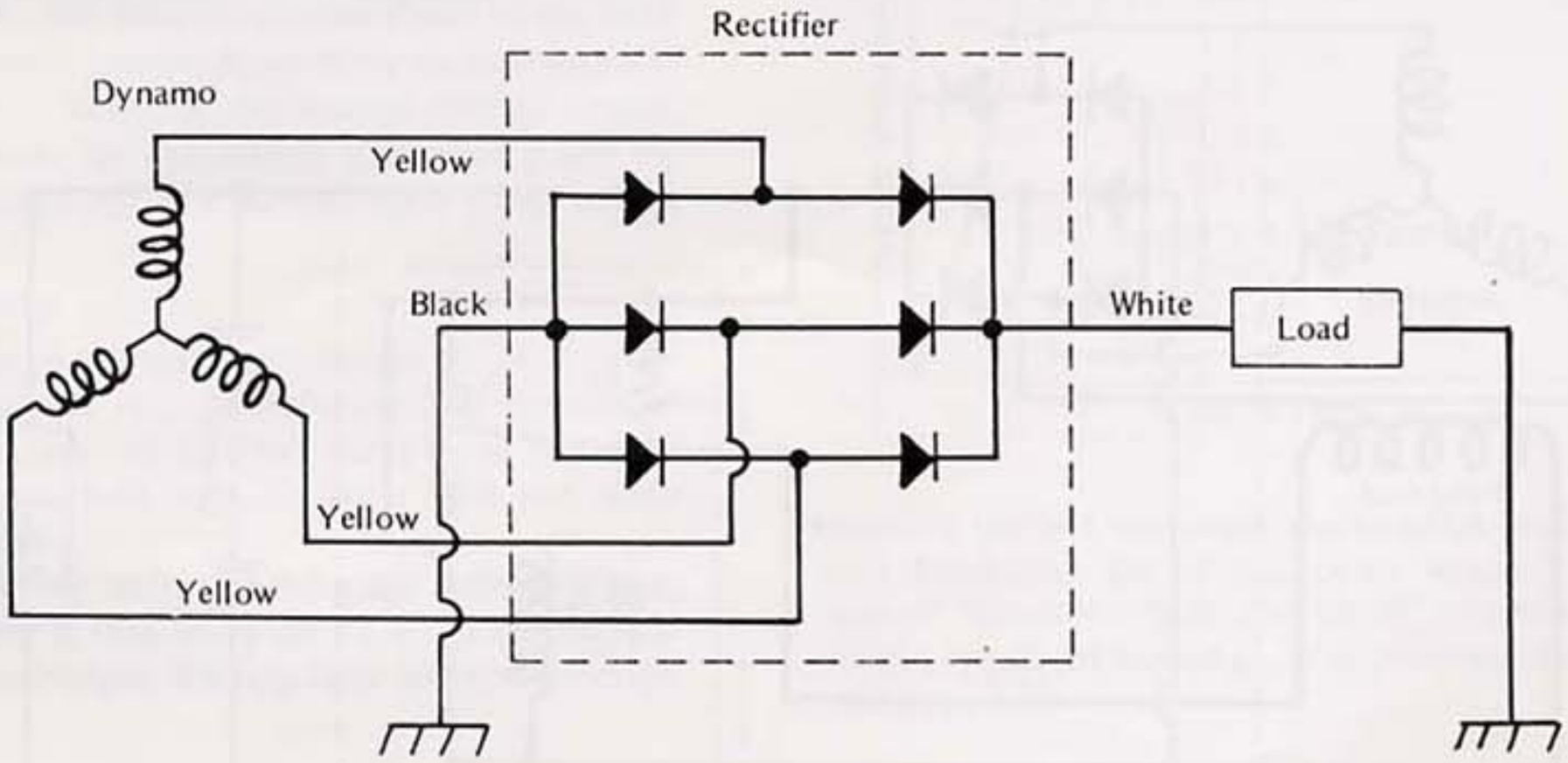
**Diode** (544)




*Inspection*

- With the engine off, remove the left side cover, disconnect the rectifier white lead from the battery + side, and disconnect the rectifier black lead.
- Remove the right side cover, and disconnect the white plug on the left hand side below the regulator.
- Using the R x 10 or R x 100 ohmmeter range, check the resistance in both directions between the white lead and each yellow lead, and between the black lead and each yellow lead. There is a total of 12 measurements. The resistance should be low in one direction and more than ten times as much in the other direction. If any

**Rectifier Circuit** (545)



two leads are low or high in both directions, the rectifier is defective and must be replaced.


**NOTE:** The actual meter reading varies with the meter used and the individual rectifier, but, generally speaking, the lower reading should be within $^1/_3$ scale of zero ohms.
**CAUTION: Be careful not to strike, scratch, or in any other way damage the rectifier. Such damage may cause the rectifier to short.**

## REGULATOR

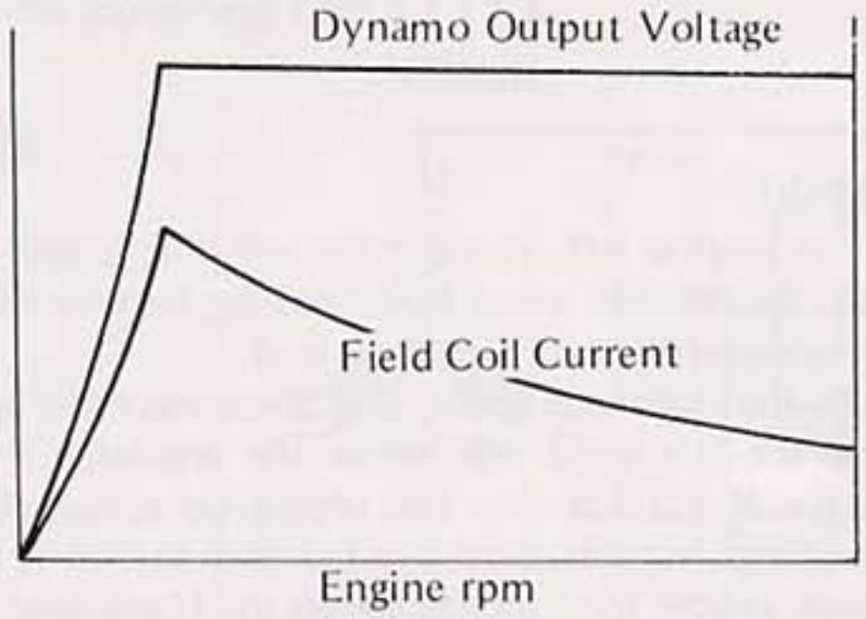
When the field coil current is constant, the dynamo output voltage increases with an increase in engine rpm. However, the voltage will become excessive at high engine rpm, burning out the lights and overcharging the battery unless the field current is reduced at higher rpm. The regulator is included in the circuit to reduce the field coil current at higher rpm, keeping the voltage between 14 ~ 15 V for all electrical equipment as shown in Fig. 547.

The regulator includes the armature, relay coil, resistance (Rf), and three contact points ($P_1$, $P_0$, and $P_2$). Resistance Rf is in series with the field coil, while the relay coil is connected to chassis ground. Point $P_0$ at the end of the armature is the movable contact point, which may be in contact with point $P_1$, in contact with no point, or in contact with point $P_2$.

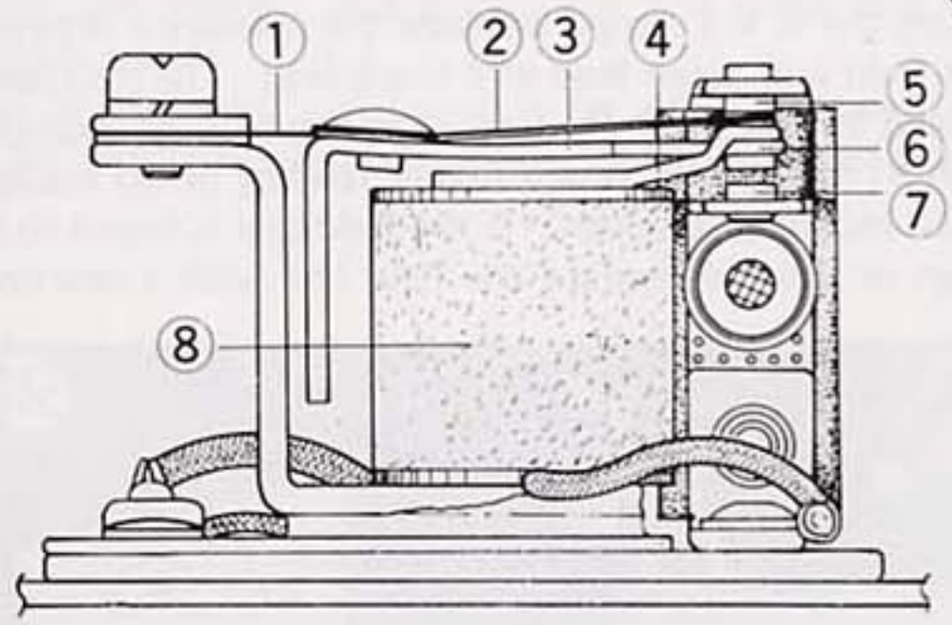
At low rpm the dynamo output voltage magnetizes the relay coil only slightly, and point $P_0$ is held against point $P_1$ by spring force. At this time the field coil current, $I_f$, flows through chassis ground → field coil → terminal F → points $P_0$ and $P_1$ → terminal I. The regulator circuit here has only negligible resistance to current $I_f$.

At moderate rpm the dynamo output voltage magnetizes the relay coil enough that it pulls point $P_0$ from $P_1$. At this time current $I_f$ flows through chassis ground → field coil → terminal F → resistor Rf → terminal I.

**Field Coil Current, Dynamo Output Voltage/Engine rpm** (547)

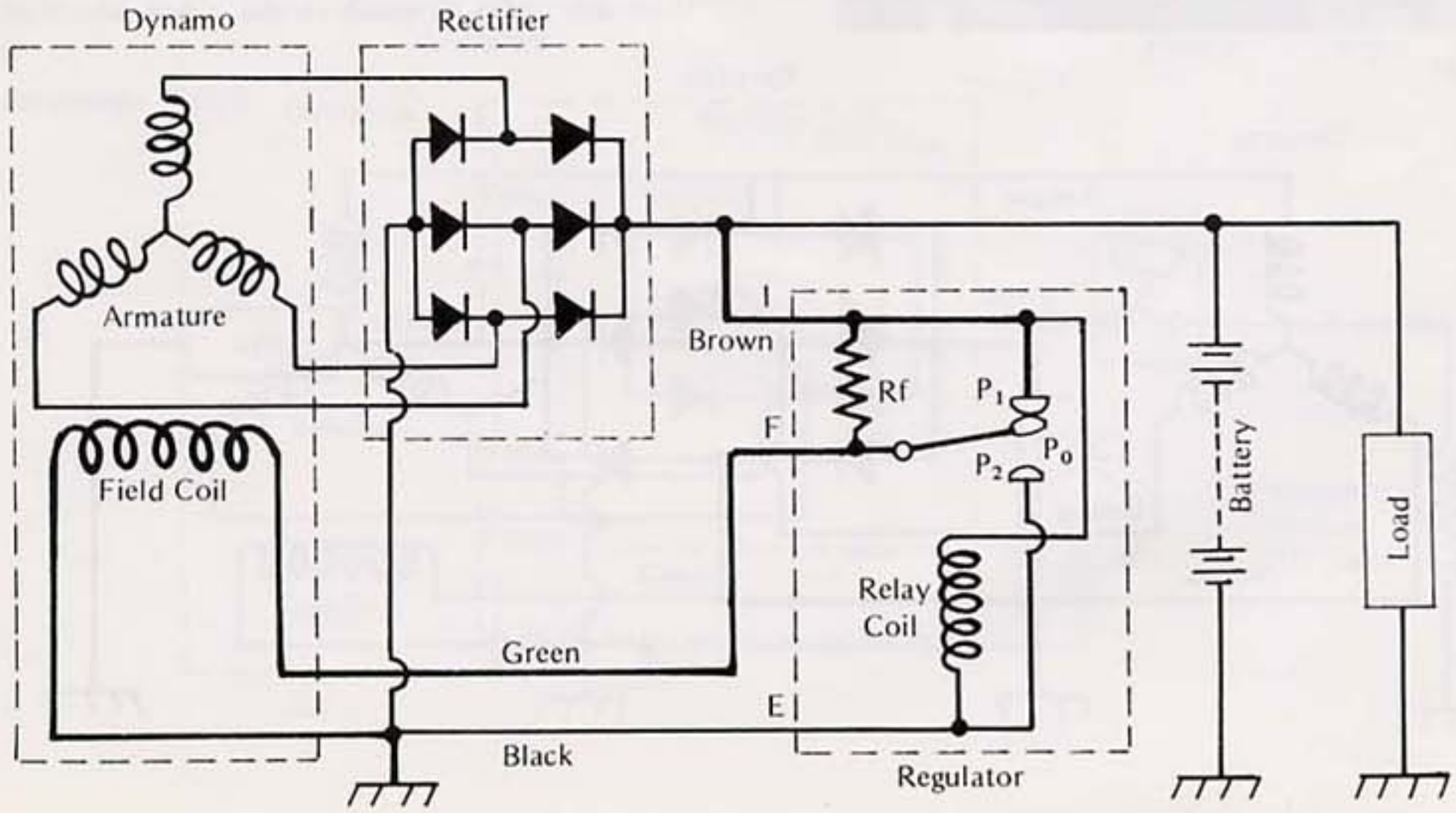



**Regulator Construction** (548)



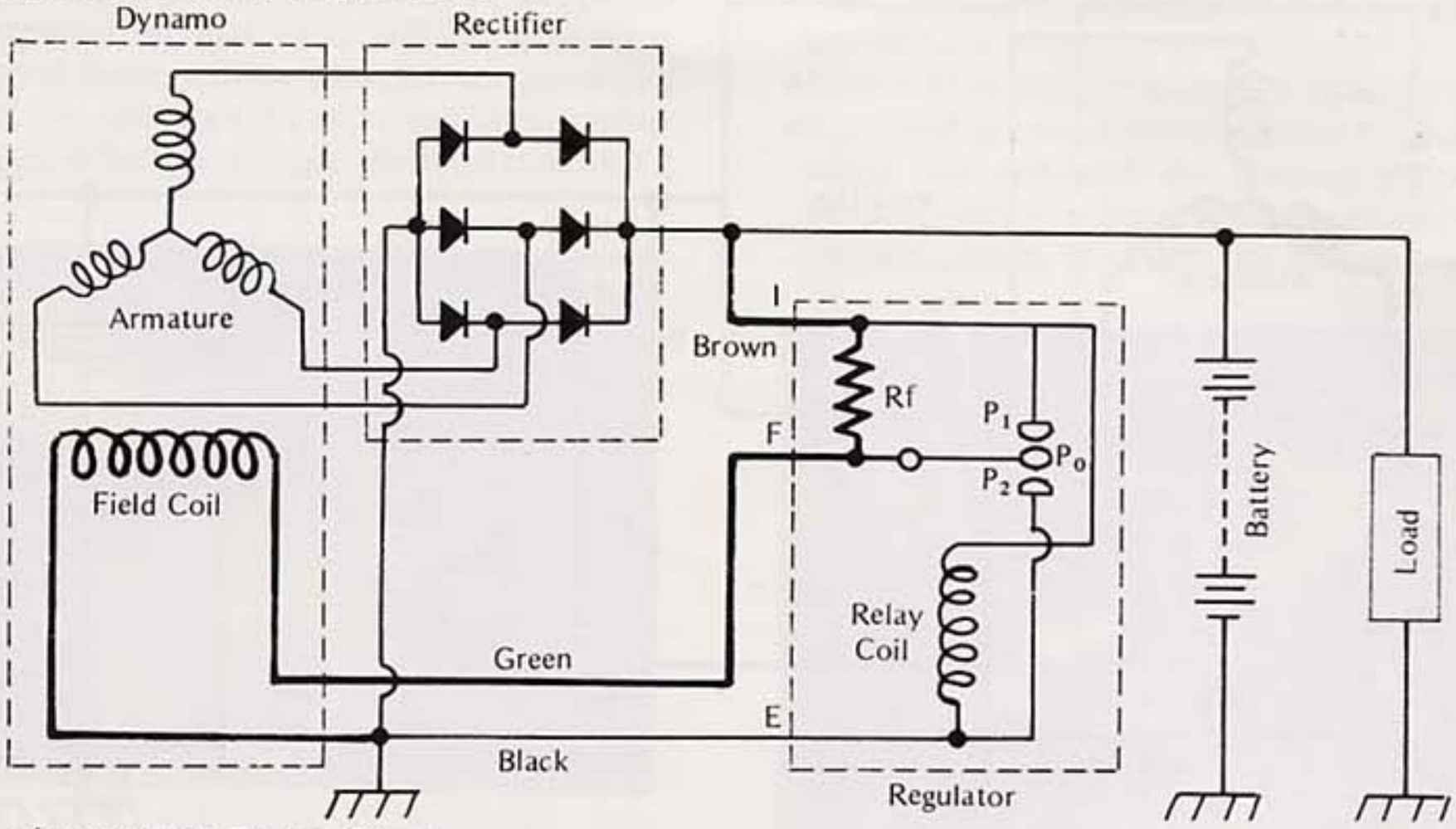

1. Spring 2. Spring 3. Armature 4. Adjuster Arm
5. Point $P_1$ 6. Point $P_0$ 7. Point $P_2$ 8. Relay Coil

**Regulator Operation at Low Engine Speed** (549)



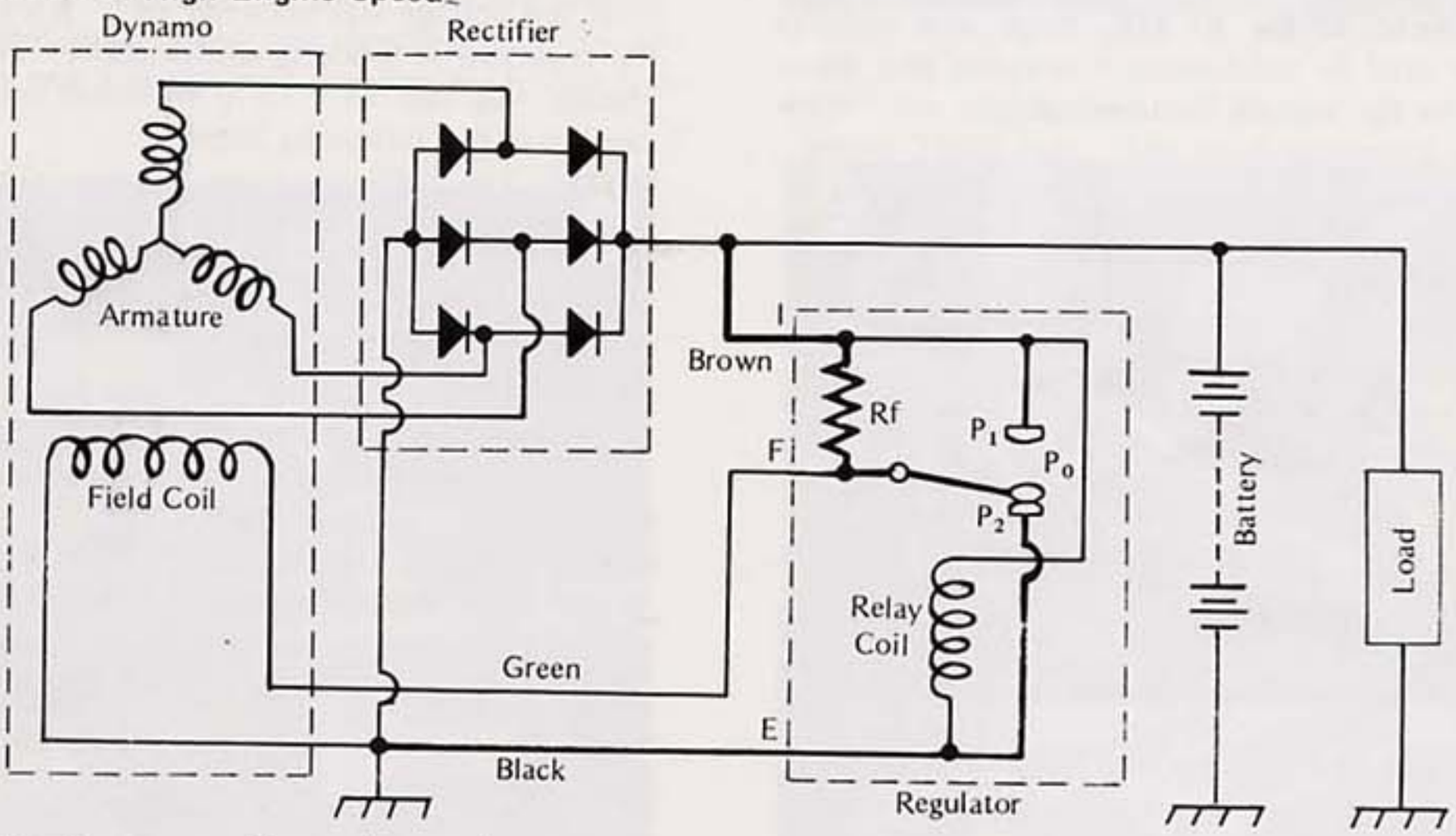
**Regulator Operation at Moderate Engine Speed**

550




**Regulator Operation at High Engine Speed**

551




The regulator circuit now provides resistance for current $I_f$, reducing current $I_f$. This reduces the dynamo output voltage from what it would be otherwise, keeping it still between 14~15 V.

At high rpm the dynamo output voltage magnetizes the relay coil sufficiently that it pulls point $P_0$ in contact with point $P_2$. At this time no current flows to the field coil, and the dynamo output depends on residual magnetism in the rotor. Then, as the output voltage drops, the relay coil loses its magnetism such that point $P_0$ separates from point $P_2$, and current again flows to the field coil.

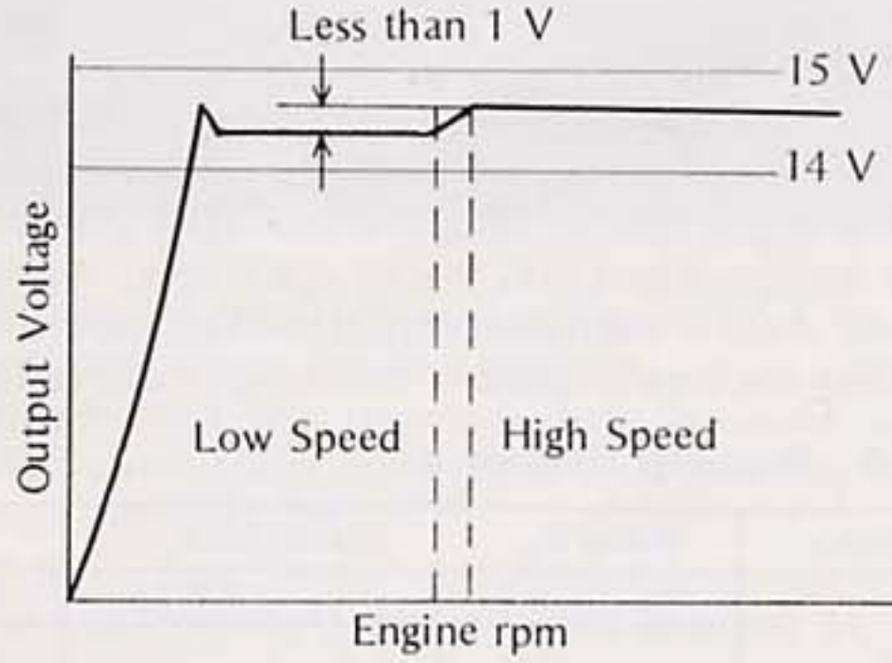
*Regulator testing*

If the battery continually discharges or if it overcharges, the regulator may be defective. Symptoms of excessive voltage are: (a) distilled water must be added often to all battery cells and (b) lights burn out when running at high rpm.

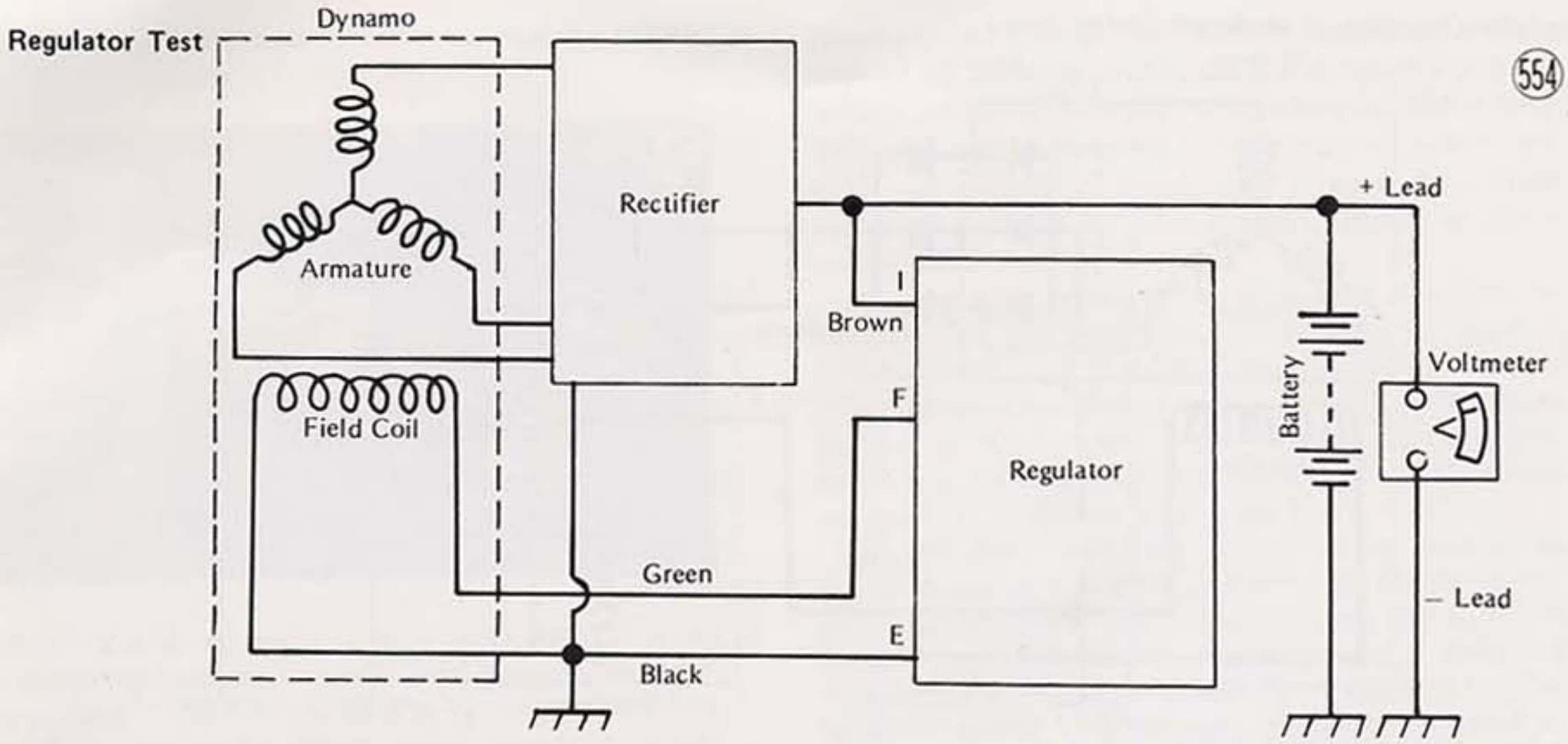
Check the battery before making the following test; charge the battery if it is less than 12 V. If the battery is defective or discharged, the regulator will not function properly.

**Regulator Controlled Dynamo Output Voltage**

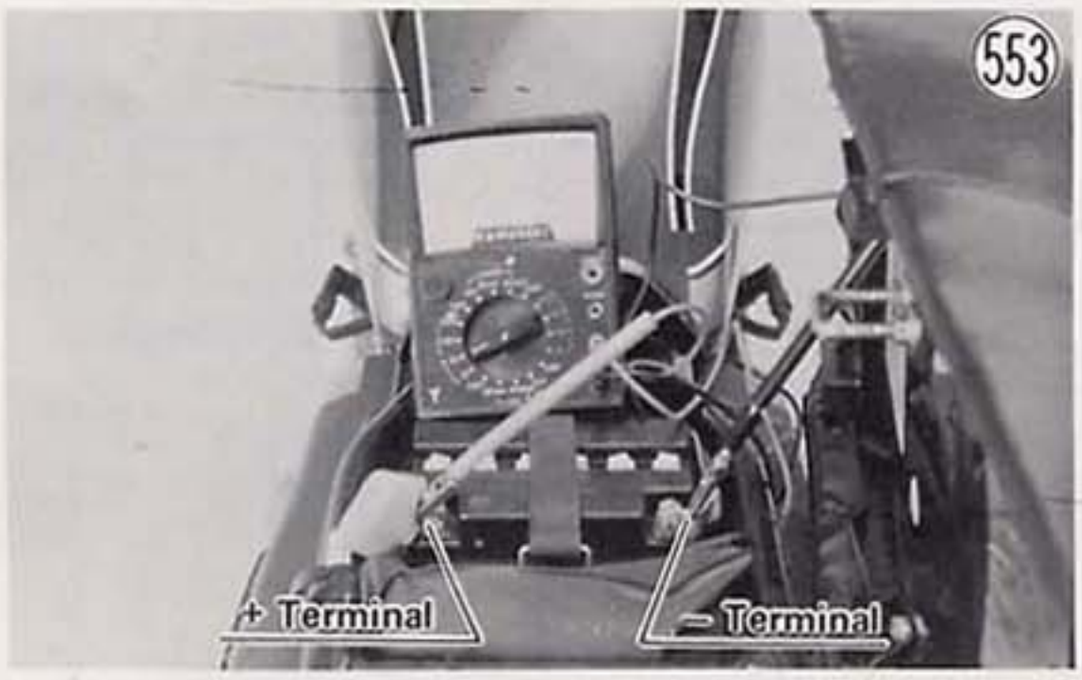
552




- Remove the left side cover and headlight unit (Pg. 92 ), and disconnect the 6P connector which is on the left side of the motorcycle and the 9P connector which is in the headlight housing. This removes the load from the dynamo.




•Set a multimeter to the 30 VDC range, and connect the + meter lead to the battery + terminal and the – meter lead to the battery – terminal.




•Start the engine, hold the speed at 1,600 rpm, and note the meter reading. The reading should be between 14 ~ 15 V.

•Gradually increase engine speed (do not decrease it at any point), and check the meter reading when the engine speed has reached 4,000 rpm. The reading should be between 14 ~ 15 V.

**NOTE:** If in the above test the engine speed is decreased before the meter is read at 1,600 rpm or 4,000 rpm, return the engine rpm to idling and then again gradually increase the speed to 1,600 rpm or 4,000 rpm. Due to hysteresis, there is a difference in the voltage depending on whether the engine speed is increasing or decreasing.

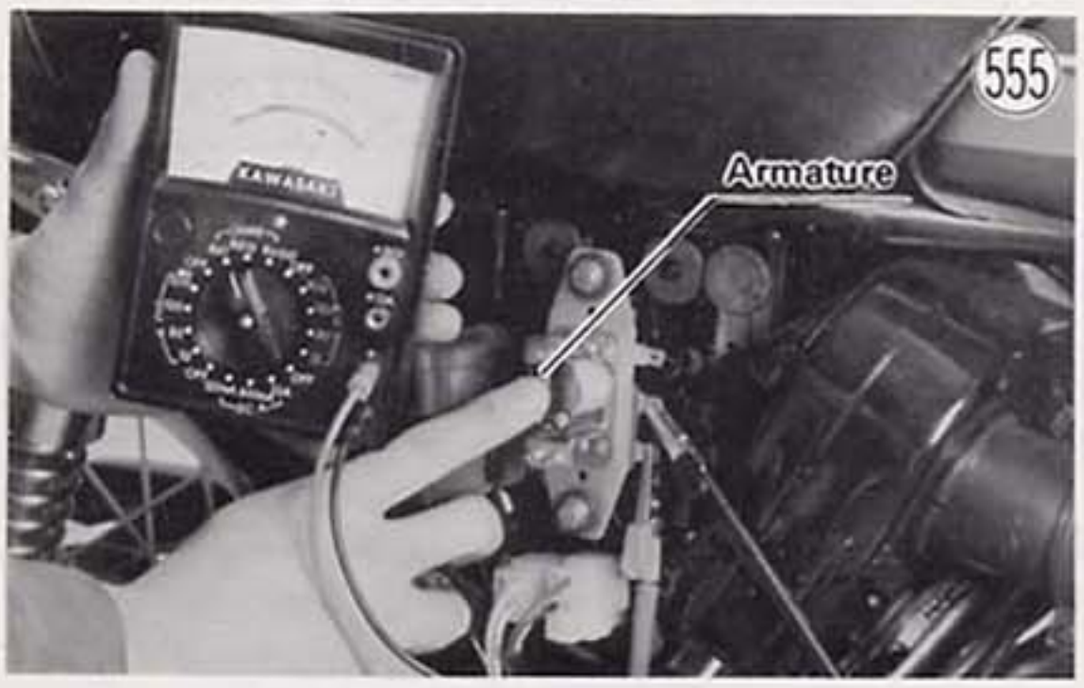
If the voltage was between 14 ~ 15 V in both checks, the regulator is working satisfactorily. However, if the voltage was not 14 ~ 15 V in either one of the tests, carry out the following steps:

**NOTE:** The following steps are necessary only if regulator operation is faulty. Do not otherwise open the regulator cover If the motorcycle is still under warranty, replace a faulty regulator; do not attempt to open or adjust it.

•Remove the right side cover, and disconnect the regulator leads, black, green, and brown, from the regulator terminals marked E, F, and I respectively.

•Remove the regulator cover.

•Set the multimeter to the Rx1 or Rx10 range, and measure the resistance in accordance with Table 89.




•If the points are fouled, clean them with clean paper or cloth, using an oil free solvent if necessary. To

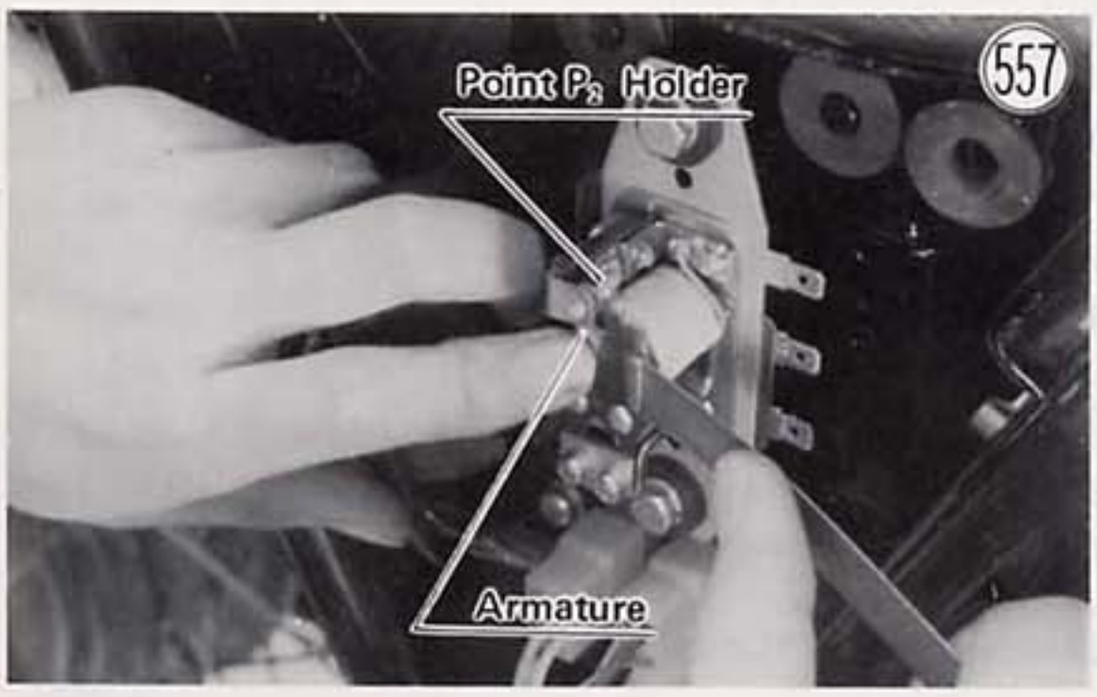
**Table 89 Regulator Resistance**

| Terminal | Point $P_0$ | Resistance | Remarks |
|---|---|---|---|
| F–I | Position 1 | 0 Ω | If more than 0 Ω, points $P_0$ and $P_1$ are dirty or fouled. |
| | Position 2 | about 9 Ω | If no reading, resistor Rf is open. If no resistance, there is a short. |
| F–E | Position 1 | about 100 Ω | If no reading, the relay coil is open. If no resistance, there is a short. |
| | Position 2 | 0 Ω | If more than 0 Ω, points $P_0$ and $P_1$ are dirty or fouled. |

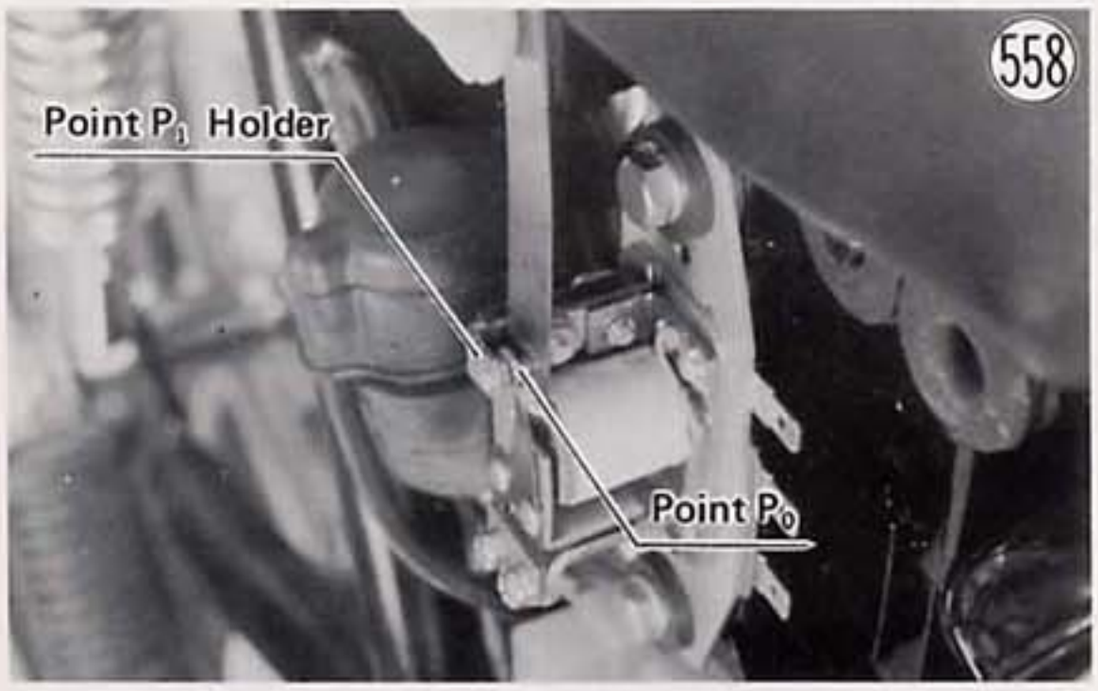
Position 1 Points $P_0$ and $P_1$ are in contact by spring force.
Position 2 Points $P_0$ and $P_2$ are in contact by pressing on the armature with a finger.

repair light damage, use emery cloth. If the points cannot be repaired so that there will be zero ohms resistance across them, replace the regulator for a new one. Also, if the resistance Rf, relay coil, or any other internal part is defective, replace the regulator with a new one.

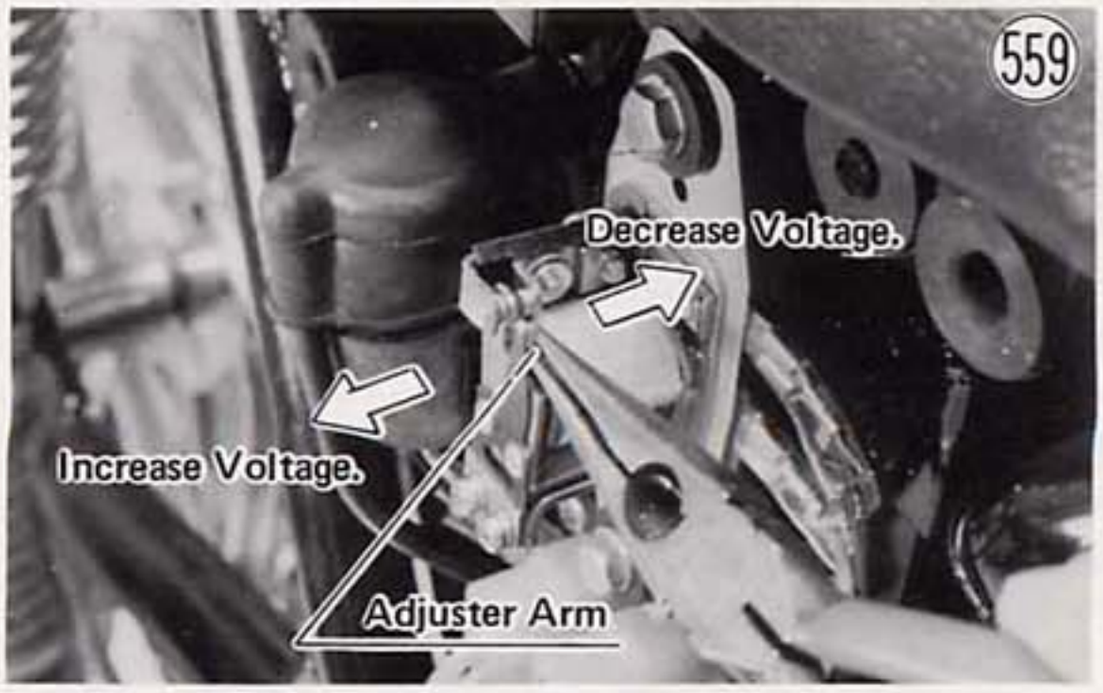

- Press down the armature, and inspect the armature gap with a thickness gauge. The gap should be 0.3 mm or more. If it is not, correct it by bending the holder for point $P_2$.



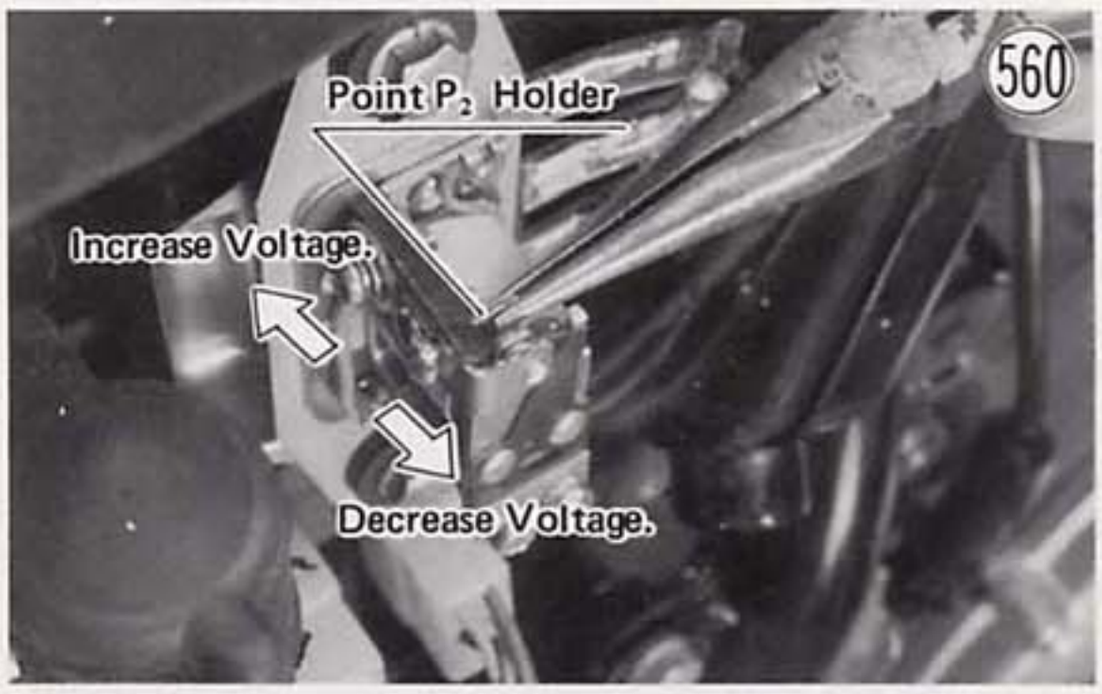

- Inspect the gap between points $P_2$ and $P_0$ with a thickness gauge. The gap should be 0.30~0.45 mm. If the gap is incorrect, adjust it by bending the holder for point $P_1$.




- Replace the regulator cover, and reconnect the leads (3) which were disconnected.
- Set the multimeter to the 30 VDC range, and connect the meter + lead to the battery + terminal and the meter – lead to the battery – terminal (Fig. 553).
- Start the engine, and note the voltage at various engine speeds.
- Turn off the ignition switch to stop the engine.
- If the voltage was abnormal, either too high or too low, adjust the regulator by bending the adjuster arm. Bending the arm up increases voltage, and bending the arm down decreases the voltage.




- Start the engine, and read the voltage with the engine below 2,000 rpm. The reading should be 14 ~ 15 V.
- Turn off the ignition switch to stop the engine.
- If the voltage was too low, bend the adjuster arm up, if the voltage was too high, bend the adjuster arm down.
- Start the engine, and read the voltage with the engine at 4,000 rpm. The reading should be 14 ~ 15 V.
- Turn off the ignition switch to stop the engine.
- If the voltage was too low, bend the holder for point $P_2$ down; if the voltage was too high, bend the holder for point $P_2$ up.




- Replace the regulator cover, and again check the voltage with the engine below 2,000 rpm and at 4,000 rpm. This recheck is necessary because the inner magnetic field is influenced by the metal cover, possibly changing regulator operation.
- If the voltage is still not correct, continue adjusting the regulator until the voltage is between 14 ~ 15 V.

## BATTERY

The battery supplies the current to the starter motor and serves as a back-up source of power to operate the electrical equipment whenever the engine is turning over too slowly for the dynamo to supply sufficient power.

With proper care, the battery can be expected to last a few years, but it may be completely ruined long before that if it is mistreated. Following a few simple rules will greatly extend the life of the battery.

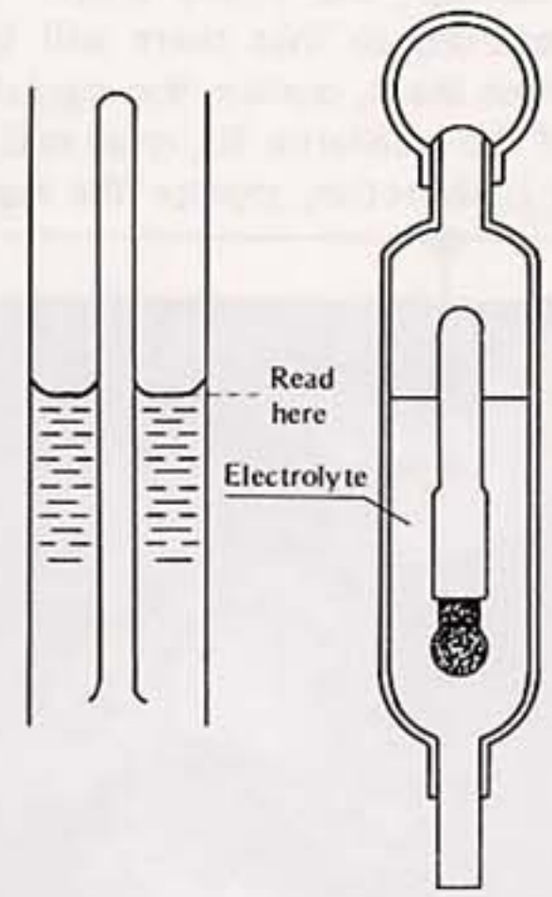
1. When the level of the electrolyte in the battery is low, add only distilled water to each cell until the level is at the upper level line marked on the outside of the battery. Ordinary tap water is not a substitute for distilled water and will shorten the life of the battery. Distilled water comes in a sealed, non-metallic container; any other water is not distilled water.
2. Never add sulphuric acid solution to the battery. This will make the electrolyte solution too strong and will ruin the battery within a very short time.
3. Avoid quick-charging the battery. A quick-charge will damage the battery plates.
4. Never let a good battery stand for more than 30 days without giving it a supplemental charge, and never let a discharged battery stand without charging it. If a battery stands for any length of time, it slowly self-discharges. Once it is discharged, the plates sulphate (turn white), and the battery will no longer take a charge.
5. Keep the battery well charged during cold weather so that the electrolyte does not freeze and crack open the battery. The more discharged the battery becomes, the more easily it freezes.
6. Always keep the battery vent hose free of obstruction, and make sure it does not get pinched or crimped shut. If battery gases cannot escape from this hose, they will explode the battery.
7. Always remove the battery from the motorcycle for charging it. If the battery is charged while still installed, battery electrolyte may spill and corrode the frame or other parts of the motorcycle.
8. DON'T INSTALL THE BATTERY BACKWARDS. The negative side is grounded.

### *Electrolyte*

The electrolyte is dilute sulphuric acid. The standard specific gravity of the electrolyte used in warm climates in a fully charged battery is 1.260 at 20°C (68°F). In particularly cold regions a solution with a standard specific gravity of 1.280 is used. The water in this solution changes to a gaseous mixture due to chemical action in the battery and escapes, which concentrates the acid in a charged battery. Consequently, when the level of the electrolyte becomes low, only distilled water should be added. If sulphuric acid is added, the solution will become too strong for proper chemical action and will damage the plates. Metal from the damaged plates collects in the bottom of the battery. This sediment will eventually cause an internal short circuit.

The specific gravity of the electrolyte is measured with a hydrometer and is the most accurate indication of the condition of the battery. When using the hydrometer, read the electrolyte level at the bottom of the meniscus (curved surface of the fluid). Fig. 562 shows the relationship between the specific gravity of the solution at 20°C (68°F) and the percentage of battery charge. Since specific gravity varies with temperature, and since the temperature of the solution being checked is likely to be other than 20°C (68°F), the formula

**Hydrometer** (561)




given below should be used to compute what the specific gravity would be if the temperature were 20°C (68°F). When the temperature goes up, the specific gravity goes down, and vice versa.

Celcius

$S_{20} = S_t + 0.0007\ (t - 20)$

Fahrenheit

$S_{68} = S_t + 0.0004\ (t - 68)$

$S_t$ = specific gravity at the present temperature

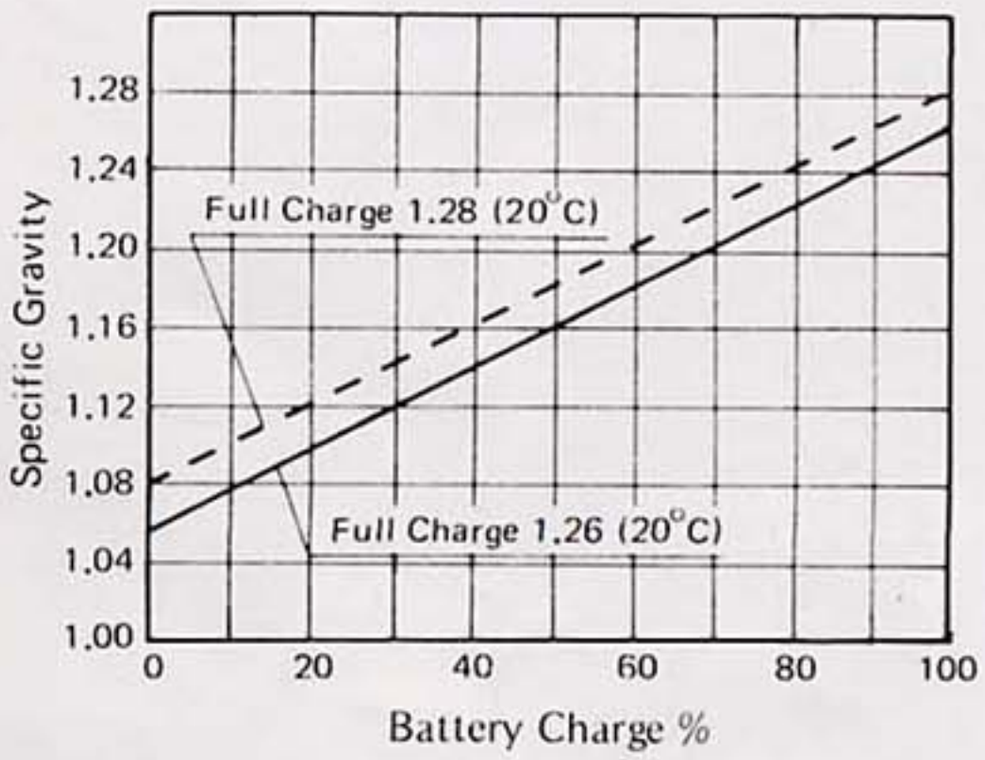
$S_{20}$ = specific gravity at 20°C

$S_{68}$ = specific gravity at 68°F

t = present temperature of solution

Generally speaking, a battery should be charged if a specific gravity reading shows it to be discharged to 50% or less of full charge.

**Specific Gravity/Battery Charge Relationship** (562)




### *Initial charge*

New batteries for Kawasaki motorcycles are dry charged and can be used directly after adding the electrolyte. However, the effect of the dry charge deteriorates somewhat during storage, especially if any air has entered the battery from imperfect sealing. Therefore, it is best to give the battery an initial charge before using it in order to ensure long battery life.

**CAUTION: Because the battery gives off an explosive gas mixture of hydrogen and oxygen, keep any sparks or open flame away from the battery during charging.**

- Pour a 1.260 (specific gravity at 20°C or 68°F) sulphuric acid solution into each cell of the battery up to the upper line.
- Let the battery stand for 30 minutes, adding more acid if the level drops during this time.

**NOTES:** 1. If the temperature of the solution is over 30°C (85°F), cool the solution before pouring it into the battery.

2. After pouring the acid into the battery, start charging the battery within 12 hours.

- Leaving the caps off the cells, connect the battery to a charger, set the charging rate at 1/10 the battery capacity, and charge it for 10 hours. For example, if the battery is rated at 12 AH, the charging rate would be 1.2 ampere. If a constant voltage charger is used, the voltage must be adjusted periodically to keep the current at a constant value.

**CAUTION: If the temperature of the electrolyte rises above 45°C (115°F) during charging, reduce the charging rate to bring down the temperature, and increase the charging time proportionately.**

- After charging, check the electrolyte level in each cell. If the level has dropped, add distilled water to bring it back to the upper line.
- Check the results of charging by measuring the specific gravity of each cell and by measuring battery voltage. Battery voltage of a 12 volt battery directly after the completion of charging should be 15 to 16 volts.

*Ordinary charge*

**CAUTION: Because the battery gives off an explosive gas mixture of hydrogen and oxygen, keep any sparks or open flame away from the battery during charging.**

- Clean off the battery using a solution of baking soda and water. Make especially sure that the terminals are clean.
- If the electrolyte level is low in any cell, fill to over the lower line but not up to the upper line since the level rises during charging. Figure the charging rate to be between 1/10 and 3/10 of battery capacity. For example, the maximum charging rate for a 12 AH battery would be 3/10 x 12 which equals 3.6 amperes.

**CAUTION: Charging the battery at a rate higher than specified above could ruin the battery. Charging at a higher rate causes excess heat, which can warp the plates and cause internal shorting. Higher than normal charging rates also cause the plates to shed active material. Deposits will accumulate, and can cause internal shorting.**

- Measure the specific gravity of the electrolyte, and use the graph, Fig. 562, to determine the percentage of discharge. Multiply the capacity of the battery by the percentage of discharge to find the amount of discharge in ampere-hours. Use this figure in the formula below to compute charging time.

$$\text{Charging time (hours)} = \frac{\text{amount of discharge (AH)}}{\text{charging current (A)}} \times 1.2 \sim 1.5$$

- Remove the caps from all the cells, and begin charging the battery at the rate just calculated. If a constant voltage charger is used, the voltage will have to be adjusted periodically to maintain charging current at a constant value.

**CAUTION: If the temperature of the electrolyte rises above 45°C (115°F) during charging, reduce the charging rate to bring down the temperature, and increase charging time proportionately.**

- After charging, check the electrolyte level in each cell. If the level has dropped, add distilled water to bring it back up to the upper line.
- Check charging results by measuring the specific gravity of each cell and by measuring battery voltage. Battery voltage of a 12 volt battery directly after the completion of charging should be 15 to 16 volts and the specific gravity of the electrolyte should be more than 1.250. If the voltage is lower than this, the battery is not completely charged or can no longer take a full charge. If the specific gravity of any one cell is lower than 1.250, there may be damage in the cell.

*Test charging*

When the battery is suspected of being defective, first inspect the points noted in the chart below. The battery can be tested by charging it by the ordinary charge. If it will take a charge so that the voltage and specific gravity come up to normal, it may be considered good except in the following cases:

★ If the voltage suddenly jumps to over 13 volts just after the start of charging, the plates are probably sulphated. A good battery will rise to 12 volts immediately and then gradually go up to 12.5 ~ 13 volts in about 30 to 60 minutes after charging is started.

★ If one cell produces no gas or has a very low specific gravity, it is probably shorted.

★ If there does not appear to be enough sediment to

**Table 90 Battery Troubleshooting Guide**

| | Good Battery | Suspect Battery | Action |
|---|---|---|---|
| Plates | (+) chocolate color<br>(–) gray | white (sulphated); + plates broken or corroded | Replace |
| Sediment | none, or small amount | sediment up to plates, causing short | Replace |
| Voltage | above 12 volts | below 12 volts | Test charge |
| Electrolyte level | above plates | below top of plates | Fill and test charge |
| Specific gravity | above 1.200 in all cells; no two cells more than 0.020 different. | below 1.100, or difference of more than 0.020 between two cells | Test charge |

short the plates, but one cell has a low specific gravity after the battery is fully charged, the trouble may be just that there is insufficient acid in that cell. In this case only, sulphuric acid solution may be added to correct the specific gravity.

★ If a fully charged battery not in use loses its charge after 2 to 7 days, or if the specific gravity drops markedly, the battery is defective. The self-discharge rate of a good battery is only about 1% per day.

## IGNITION SYSTEM

The ignition system, shown in Fig. 563, consists of the battery, contact breaker, condenser, ignition coil, and two spark plugs (Pg. 166). The battery supplies the current for the primary circuit, which includes the contact breaker points, condenser, and the primary winding of the ignition coil. When the points suddenly open with the ignition switch turned on, a surge of electrons is produced in the secondary circuit, which includes the ignition coil secondary winding and the two spark plugs. For this system to function properly, all ignition parts must be in good order, the ignition timing correctly set, the ignition and engine stop switches not shorted, and all wiring in good condition (no shorts or breaks, and no loose or tarnished connections).

With the ignition switch on and the points closed, current flows in the primary circuit, including the ignition coil primary winding where the magnetic field (which accompanies electron flow) is concentrated (due to the winding). When the points open, this circuit is broken stopping the electron flow and collapsing the magnetic field. As this field collapses, magnetic flux cuts through the secondary winding inducing current in the winding. The voltage of this current, dependent on the number of turns in the secondary winding and the speed of the drop in the primary winding voltage, is much greater than the voltage in the primary winding. It is this high voltage that causes a spark to jump across the spark plug electrodes. Since a greater ratio of secondary winding turns over primary winding turns and a sharper drop of primary winding voltage increase the secondary winding voltage that is produced, a certain ratio of turns in the ignition coil has been chosen and a certain voltage drop sharpness (determined by condenser and breaker point performance) has been designed in the ignition system such that a spark of sufficient but not excessive strength will be produced.

Ordinarily in a 4-stroke engine, a spark jumps across the spark plug electrodes only every other time that the piston for that spark plug rises (once every 720° of crankshaft rotation) because between each compression stroke, in which a fuel/air mixture ready for combustion is in the cylinder, there is an exhaust stroke, in which the piston rises only to push out the burned gases. However, even if a spark does jump across the electrodes during the exhaust stroke, there is no effect since there is no compression and no fuel to burn. Therefore, to eliminate any need for a distributor (thus simplifying the system, making it more reliable), the system is constructed so that both spark plugs fire every time both pistons rise (once every 360° of crankshaft rotation) although one piston is on the compression stroke and the other on the exhaust stroke.

The contact breaker consists of one fixed and one movable contact point. The movable point is pivoted, and the heel on one end is held against the cam surface on the timing advancer by a single leaf spring. As the crankshaft rotates, the heel rides on the cam surface, and, as the crankshaft reaches the position where ignition takes place, the high spot on the cam surface pushes out on the heel, which opens the points. As the heel wears down, the point gap narrows, affecting ignition timing. Consequently, the ignition timing must be periodically adjusted to compensate for heel wear.

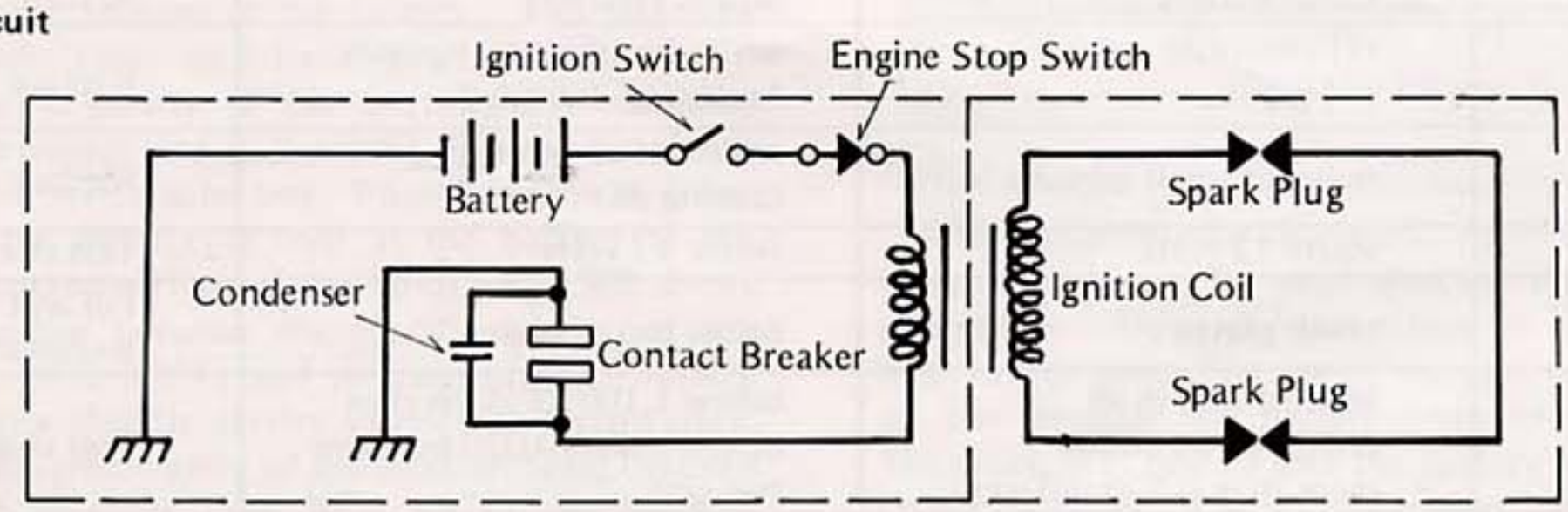
The condenser is connected in parallel across the contact breaker points and serves to prevent current from arcing across the points as they open. Arcing across the points would reduce the sharpness of the voltage drop in the primary winding, thus weakening the spark plug spark, and also damage the surface of the points. When the points are first opening, the condenser absorbs a certain amount of current, giving the points time to open far enough apart to where current will not arc across. However, if the condenser shorts, the current will simply flow through the condenser whenever the points open. When the condenser is otherwise defective, the current will not be prevented from arcing across the points at the time of ignition, resulting in poor spark plug performance and burned and pitted points.

Because the two spark plugs are connected in series, the current through one spark plug must go also through the other. Consequently, if a spark will not jump across the electrodes on one spark plug (due to dirty electrodes, faulty plug lead, etc.), no spark will jump across the electrodes on the other plug as well.

### *Contact breaker inspection*

When the points become dirty, pitted, or burned, or if the spring weakens, the points will not make the

**Ignition Circuit**



contact necessary to produce a good spark, resulting in unstable idling, misfiring, or the engine not running at all. Inspect the contact breaker in accordance with the periodic maintenance chart (Pg. 180), and repair or replace if necessary.

Clean the points with clean paper or cloth or using an oil-free solvent. A business card soaked in trichloroethylene can be used to remove traces of oil. To repair light damage, use emery cloth or an oilstone. If the points are badly worn down or damaged, or if the spring is weak, replace the contact breaker.

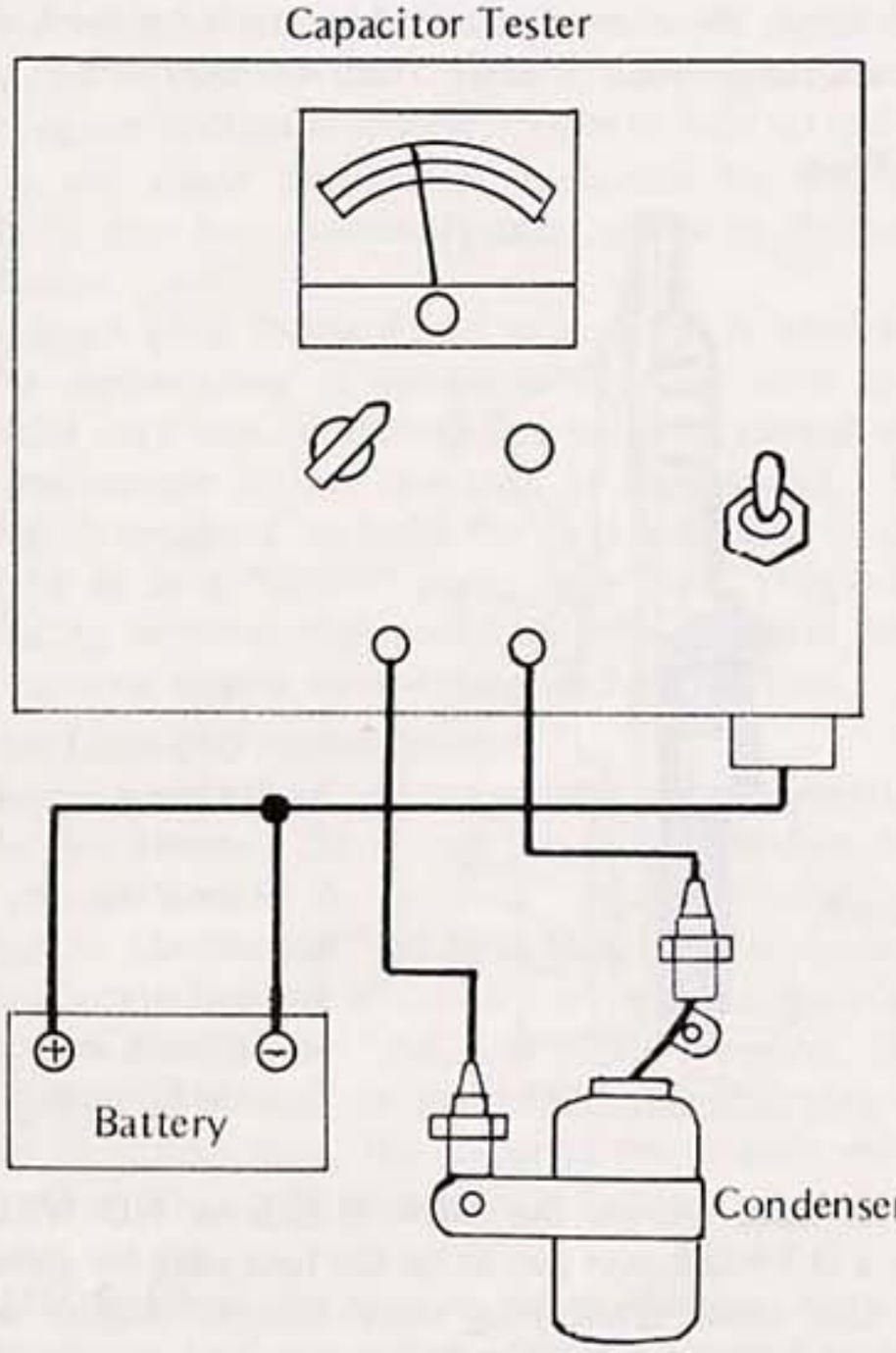
Whenever the contact breaker is inspected or replaced, apply a small amount of grease to the felt to lubricate the cam in order to minimize wear of the contact breaker heel. Be careful not to apply so much grease that it can drop off or be thrown onto the points, which will cause the points to foul and burn.

### *Condenser inspection*

The condenser can usually be considered to be defective if a long spark is seen arcing across the points as they open or if the points are burned or pitted for no apparent reason. Replace the condenser any time it appears defective and whenever the contact breaker is replaced.

**NOTE:** For checking with a capacitor tester, condenser specifications are: 0.22±0.02μfd., 1,000 WVDC.

**Condenser Test** (564)

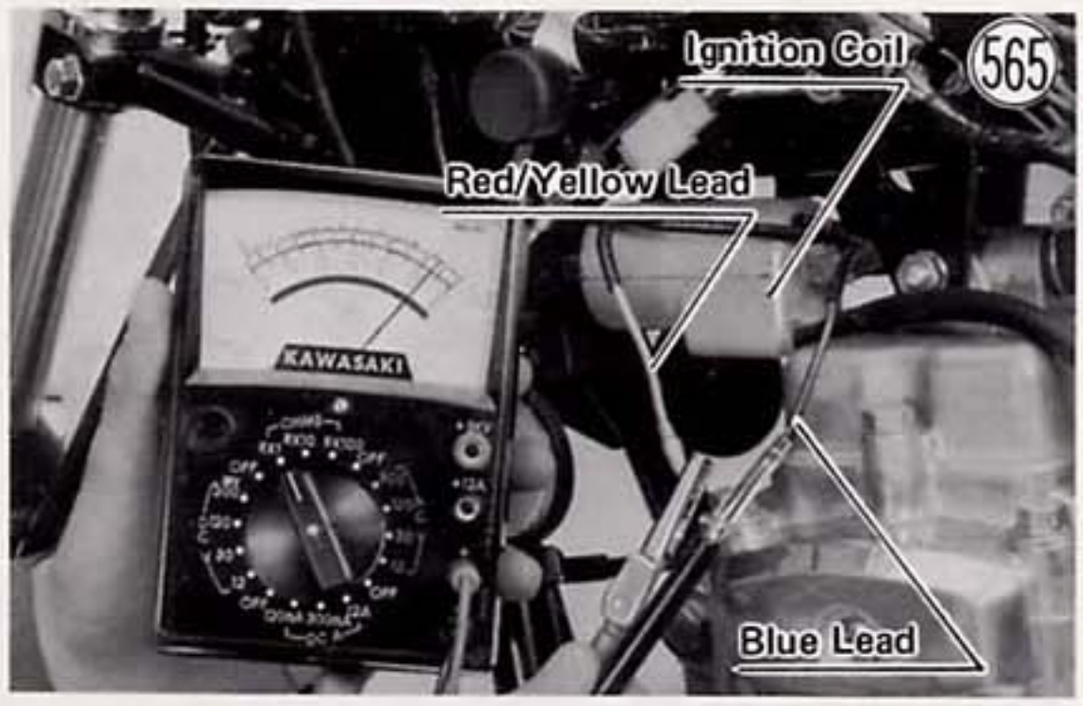



### *Ignition coil inspection*

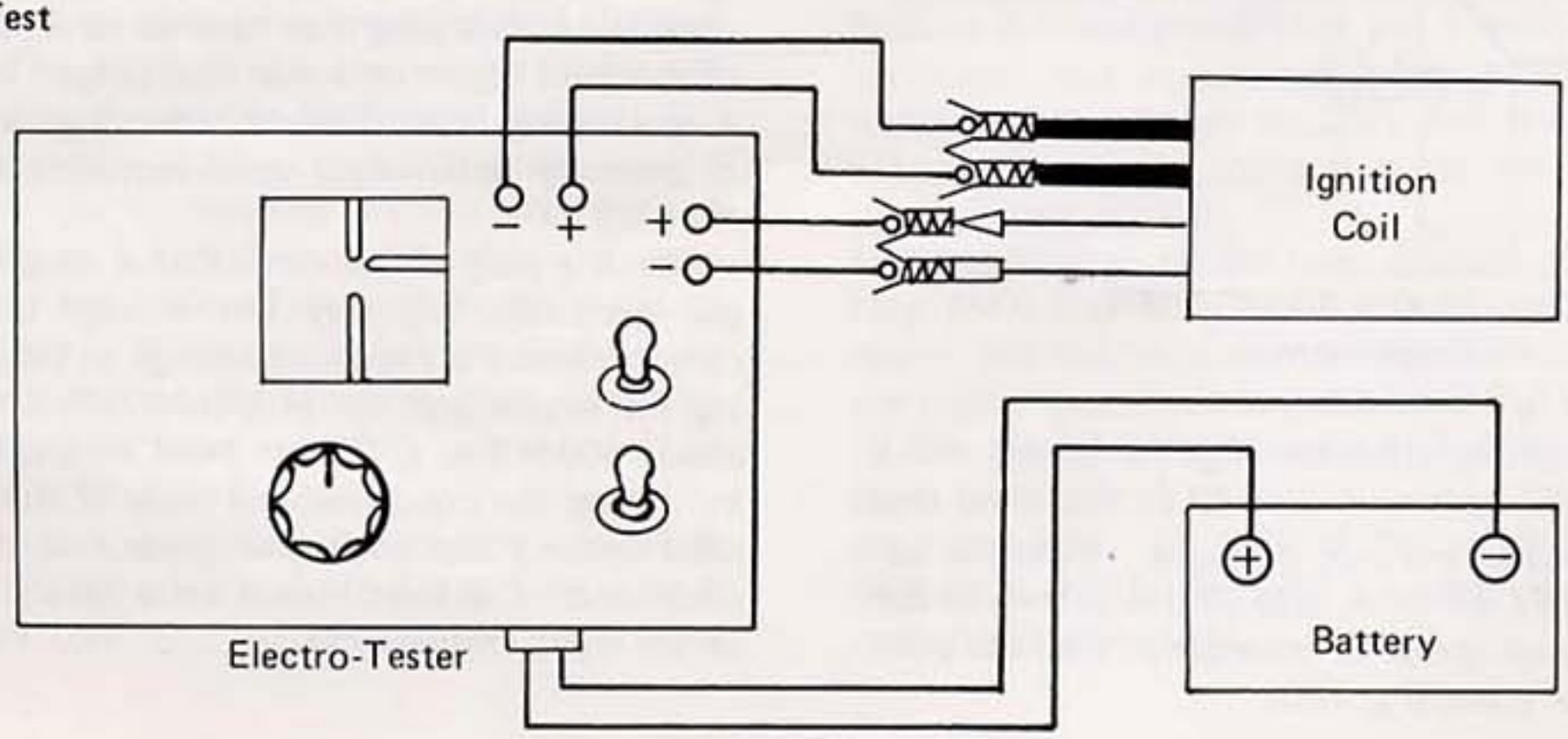
The most accurate test for determining the condition of the ignition coil is made with the Kawasaki electrotester. The ignition coil must be connected to the tester in accordance to the tester directions and should produce at least a 5 mm spark. Since an electrotester other than the Kawasaki electrotester may produce a different arcing distance, the Kawasaki electrotester is recommended for a reliable result.

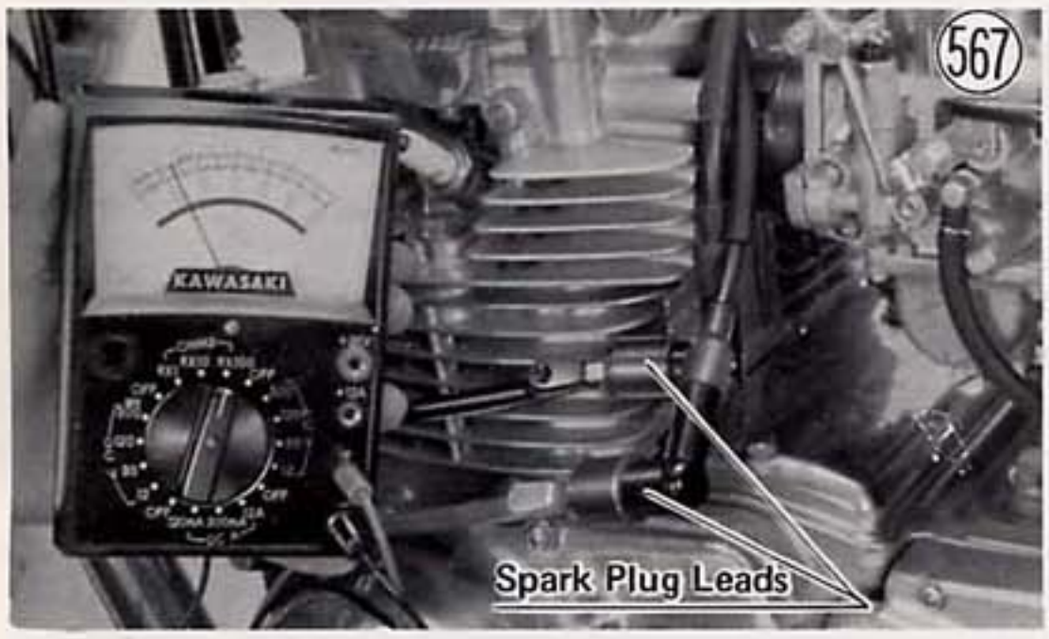
If an electrotester is not available, the coil can be checked for a broken or a badly shorted winding with an ohmmeter. However, an ohmmeter cannot detect layer shorts and shorts resulting from insulation breakdown under high voltage.

To measure the primary winding resistance, set the ohmmeter to the R x 1 range, and connect one ohmmeter lead to the red/yellow lead and the other to the blue lead from the ignition coil. The resistance should be 3.2 ~ 4.8 Ω. To measure the secondary winding resistance, set the ohmmeter to the R x 100 range, and connect one ohmmeter lead to one of the spark plug leads and the other ohmmeter lead to the remaining spark plug lead. The resistance should be about 10.4 ~ 15.6 KΩ.




**Ignition Coil Test** (566)






If the coil does not produce an adequate spark, or if either the primary or secondary winding does not have the correct resistance, replace the ignition coil.

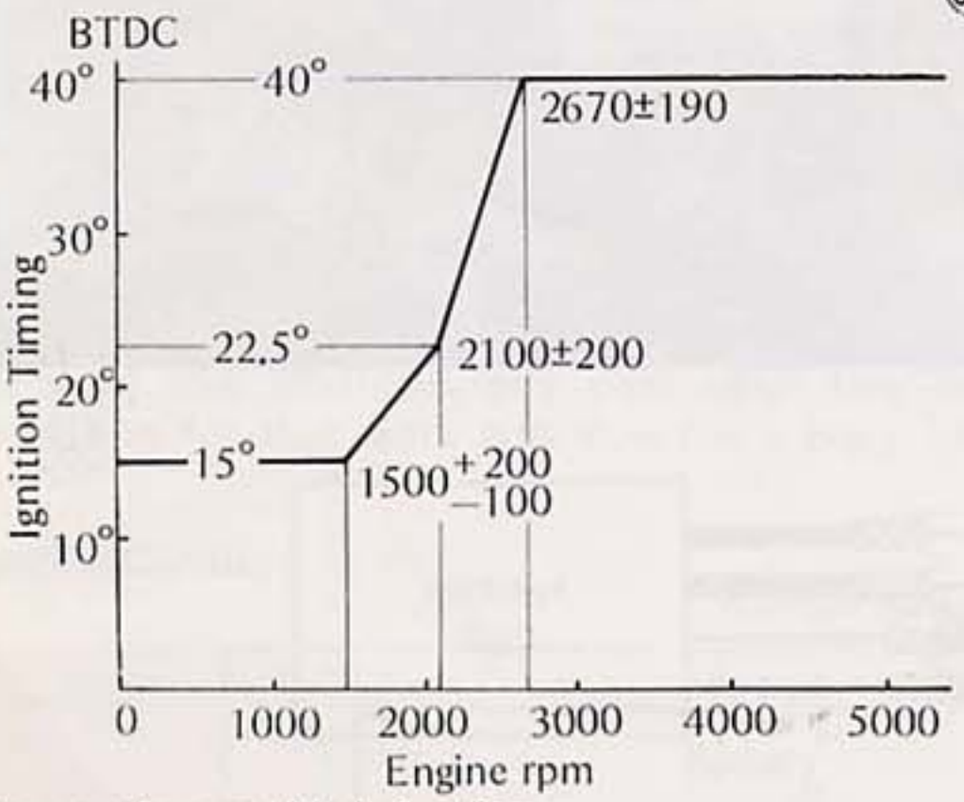
Check with the highest ohmmeter range for continuity between the red/yellow lead and the coil core and between the plug leads and the coil core. If there is any reading, the coil is shorted and must be replaced. Also, replace the ignition coil if either spark plug lead shows visible damage.

## TIMING ADVANCER

The timing advancer is a device that advances the ignition timing (makes the spark plugs fire sooner) as engine rpm rises. It consists of two weights and two springs connected to the timing cam that opens the contact breaker points. The more that the engine speed rises, the more that the weights are thrown out against spring tension, turning the cam in the direction of crankshaft rotation and causing the points to open sooner.

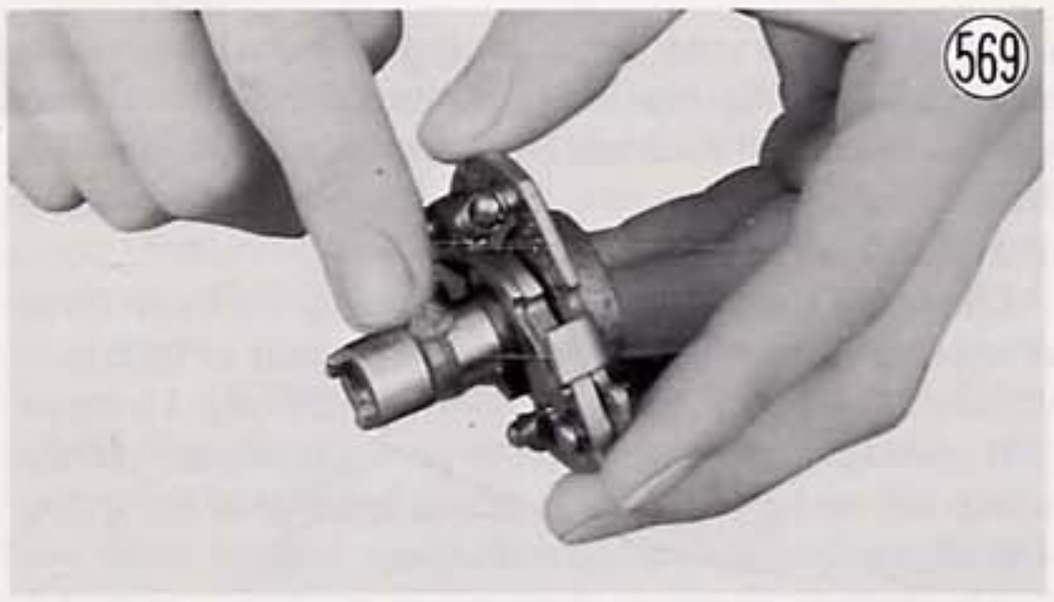
If the mechanism is damaged, has weak or broken spring(s), or does not move smoothly, the ignition timing will not advance smoothly or it may stick in one position. This will result in incorrect timing at certain engine speeds, causing poor engine performance. Failure to advance at all will cause poor high speed performance, and excessive advance will cause knocking and poor low speed performance.

**Ignition Timing/Engine rpm Relationship** (568)




*Inspection and lubrication*

Remove the timing advancer (Pg. 48 ), and check that the mechanism moves smoothly by hand and that no parts are visually worn or damaged. Wipe the advancer clean, apply oil to it, and fill the groove in the advancer body with grease in accordance with the periodic maintenance chart (Pg. 180).

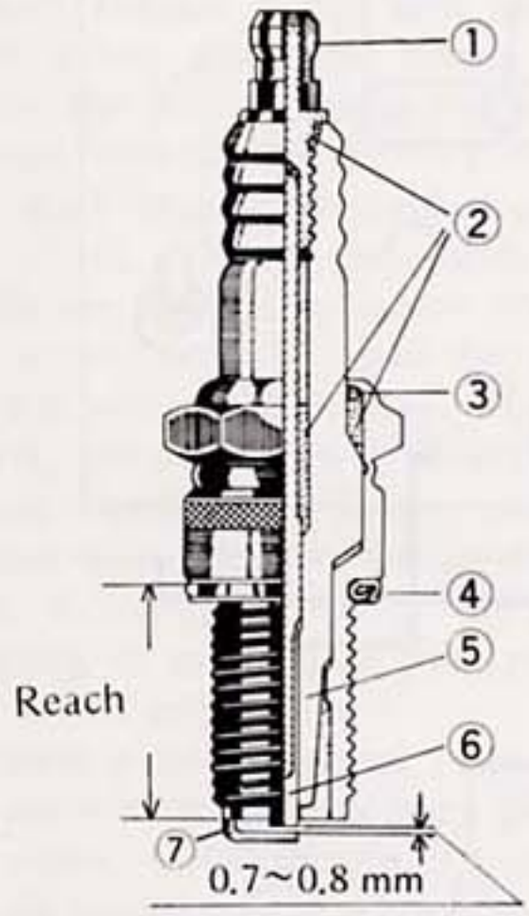



Replace the advancer (Pg. 49 ), adjust the timing (Pg. 12 ), and check it with a strobe light for both low and high speed operation (Pg. 13 ). If the timing differs from that which is shown in the graph (Fig. 568), replace the timing advancer with a new one.

## SPARK PLUGS

The spark plugs ignite the fuel/air mixture in the combustion chambers. To do this effectively and at the proper time, the correct spark plugs must be used, and the spark plugs must be kept clean and adjusted.

**Spark Plug**




Tests have shown the NGK B-8ES or ND W24ES set to a 0.7~0.8 mm gap to be the best plug for general use. But since spark plug requirements change with ignition and carburetion adjustments and with riding conditions, this plug may have to be replaced with one of the next higher or lower heat range. Whether or not a spark plug of a different heat range should be used is generally determined upon removing and inspecting the plug.

When a plug of the correct heat range is being used, the electrodes will stay hot enough to keep all the carbon burned off but cool enough to keep from damaging the engine and the plug itself. This temperature is about 400~800°C (750~1450°F) and can be judged by noting the condition and color of the ceramic insulator around the center electrode. If the ceramic is clean and of a light brown color, the plug is burning at the right temperature.

**Spark Plug Condition**


Carbon Fouling | Oil Fouling | Normal Operation | Overheating

A spark plug for higher operating temperatures is used for racing and other high speed applications. Such a plug is designed for better cooling efficiency so that it will not overheat and thus is often called a "colder" plug. If a spark plug with too high a heat range is used—that is, a "cold" plug that cools itself too well—the plug will stay too cool to burn off the carbon, and the carbon will collect on the electrodes and the ceramic insulator. If enough of this carbon collects, it may prevent a spark from jumping across the gap, or it may short the spark out by bridging across the electrodes or by conducting along the outside of the ceramic. Carbon build-up on the plug can also cause the electrodes to heat up red-hot, which will cause preignition, indicated by knocking, which in turn may eventually burn a hole in the top of the piston.

A spark plug in the lower heat range is used when engine temperature is comparatively low such as for constant city use or during the break-in period when the motorcycle is not operated at high speed. Such a plug is designed to hold the heat and thus is often referred to as a "hotter" plug. If a "hot" plug is used for racing or other high speed use, the plug will be too hot, causing engine overheating and preignition.

*Inspection and replacement*

Remove each plug and inspect the ceramic insulator. If the insulator is clean and has a light brown color, the correct plug is being used. If it is fouled black, change to the "hotter" NGK B-7ES. If the ceramic is burned white and the electrodes are burned, replace the plug with the "colder" NGK B-9ES. However, if the spark plug still fouls or overheats after changing to a hotter or colder plug, the cause of the trouble may be other than the spark plug such as faulty carburetion or ignition timing.

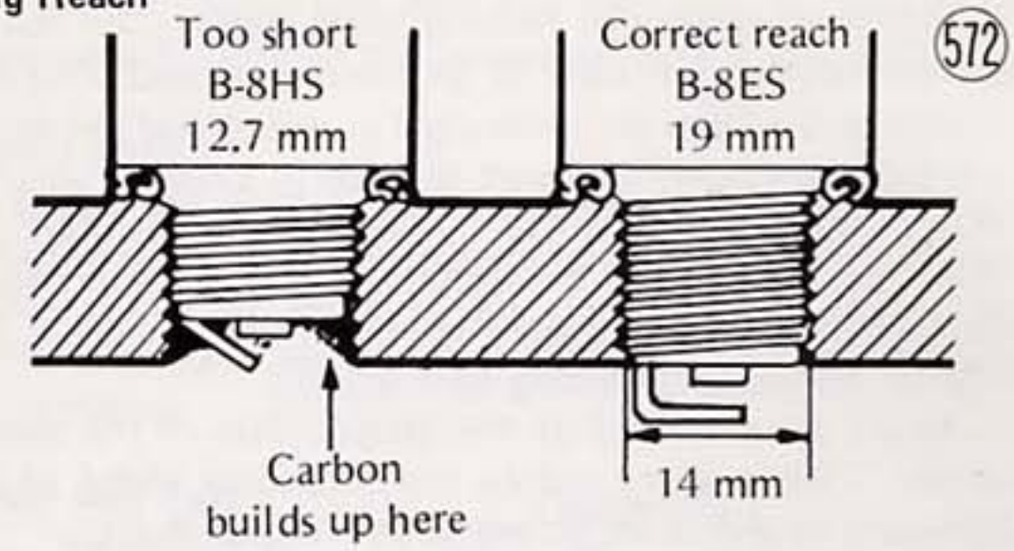
**CAUTION: When the type of riding changes—for example, a change to faster riding after the break-in period is over—the spark plugs should be inspected and changed if necessary. The NGK B-7ES plug in particular can damage the engine if used for high speed riding.**

Clean the electrodes and the ceramic insulator around the center electrode by scraping off any deposits and cleaning the plug in a high flash point solvent of some kind. If the gap has widened, reset it to the standard 0.7 ~ 0.8 mm gap. If the electrodes are badly worn down or burned, replace the plug. A plug must also be replaced any time there is visible damage such as cracked ceramic or damaged threads,

**NOTE:** If the spark plugs are replaced by any other than the recommended NGK B-7ES, B-8ES (standard) or B-9ES, make sure that the replacement plugs have the same:

(1) thread pitch
(2) reach (length of threaded portion must be 19 mm)
(3) diameter (diameter at threads must be 14 mm)
(4) electrode configulation (standard, not projected insulator or racing)

**Plug Reach**




If a plug with the wrong thread pitch or thread diameter is used, the cylinder head will be damaged. If a plug with too long or short a reach is used, carbon will build up around the plug or plug hole threads, possibly causing engine damage and making the old plug difficult to remove or the new one difficult to install.

## STARTER MOTOR CIRCUIT (Only on KZ400D)

The starter motor circuit includes the starter button (switch), starter relay, battery, and starter motor. When the ignition switch is on and the starter button is pushed, a small amount of current flows through the switch and the relay coil. This current magnetizes the relay core, which then pulls the armature to it, closing the relay contacts. The closed contacts complete a circuit for the starter motor, and the motor turns. The reason for using a relay instead of using the switch to turn on the starter motor directly is that the starter motor requires much current – enough that relatively thick wire is necessary to carry the current to the starter motor. Because it is not practical to put a heavy switch on the handlebar and have large wires running to it, the starter switch is made to carry just the light relay coil current, and heavy contacts inside the relay carry the starter motor current.

**NOTE:** Because of the large amount of current, never keep the starter button pushed any time that the starter motor will not turn over, or the current may burn out the starter motor windings.

The starter motor is installed with a sprocket and chain arrangement to transmit starter motor rotation to the crankshaft. In place of the solenoid used in automobiles, a clutch (Pg. 170) disengages the starter motor once the engine starts.

**Starter Motor Circuit**

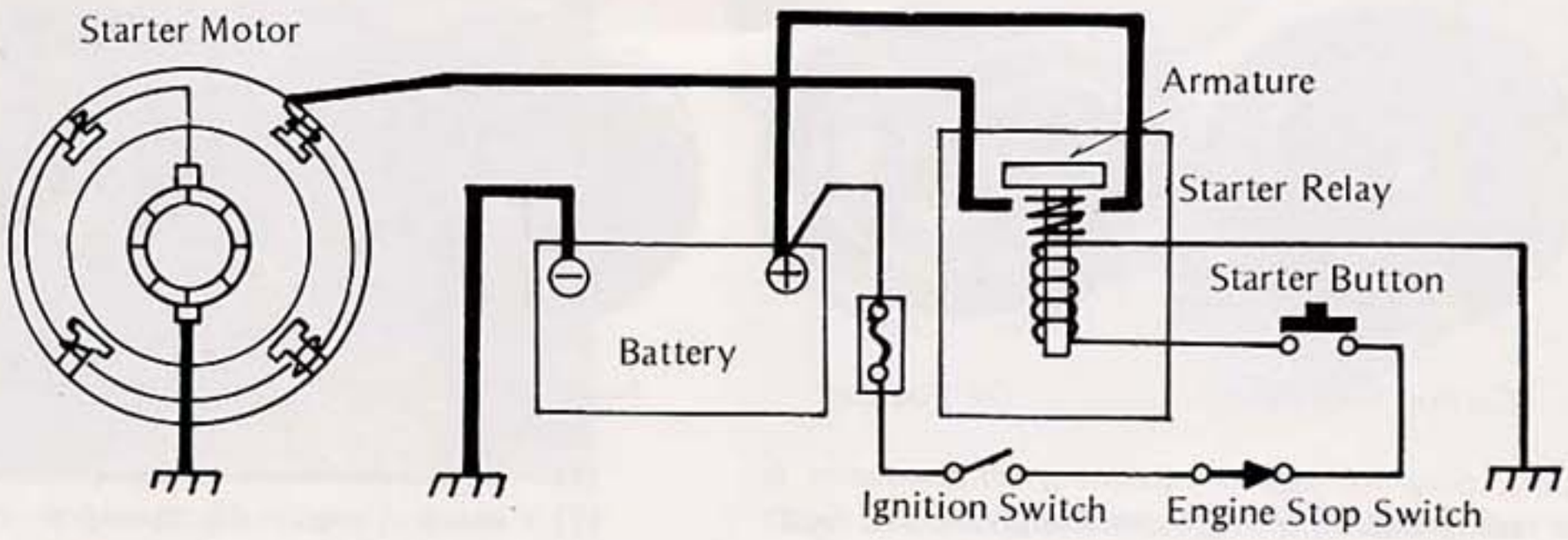
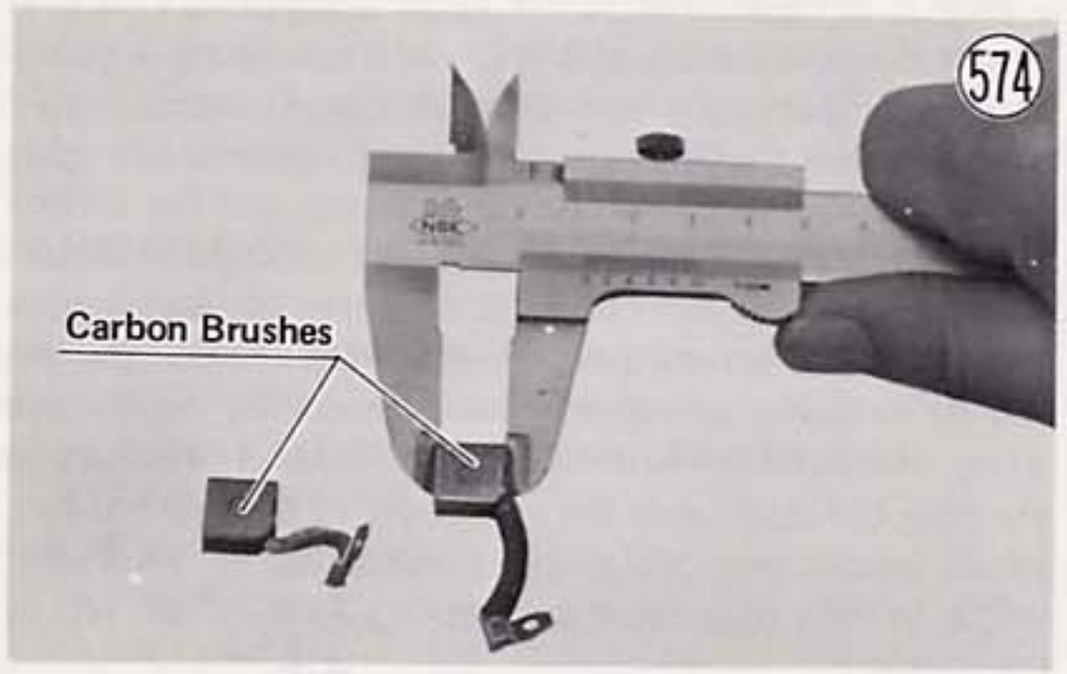



Fig. 575 shows starter motor construction. The field coils are wound around four cores, forming the yoke, and the armature windings are connected to the commutator and receive their current through the brushes. If the brushes are not making good contact, no starter motor current will flow at all since the field coils and armature windings are connected in series, and the motor will not turn over. A short or open in a coil or winding may also cause the motor to be inoperative. Particles from brush wear may be another cause of starter motor failure; these particles may get onto the bearing at the rear of the motor, causing heat seizure.

Gears are provided at the output side of the starter motor. These gears reduce the rotational speed of the armature to give more power to the output shaft.




*Carbon brushes*

Worn brushes or weak springs will cause poor brush contact.

Measure the length of the brushes, and replace both if either one is worn down to less than the service limit.

**Table 91 Starter Motor Brush Length**

| Standard | Service Limit |
|---|---|
| 11.0~12.5 mm | 6 mm |

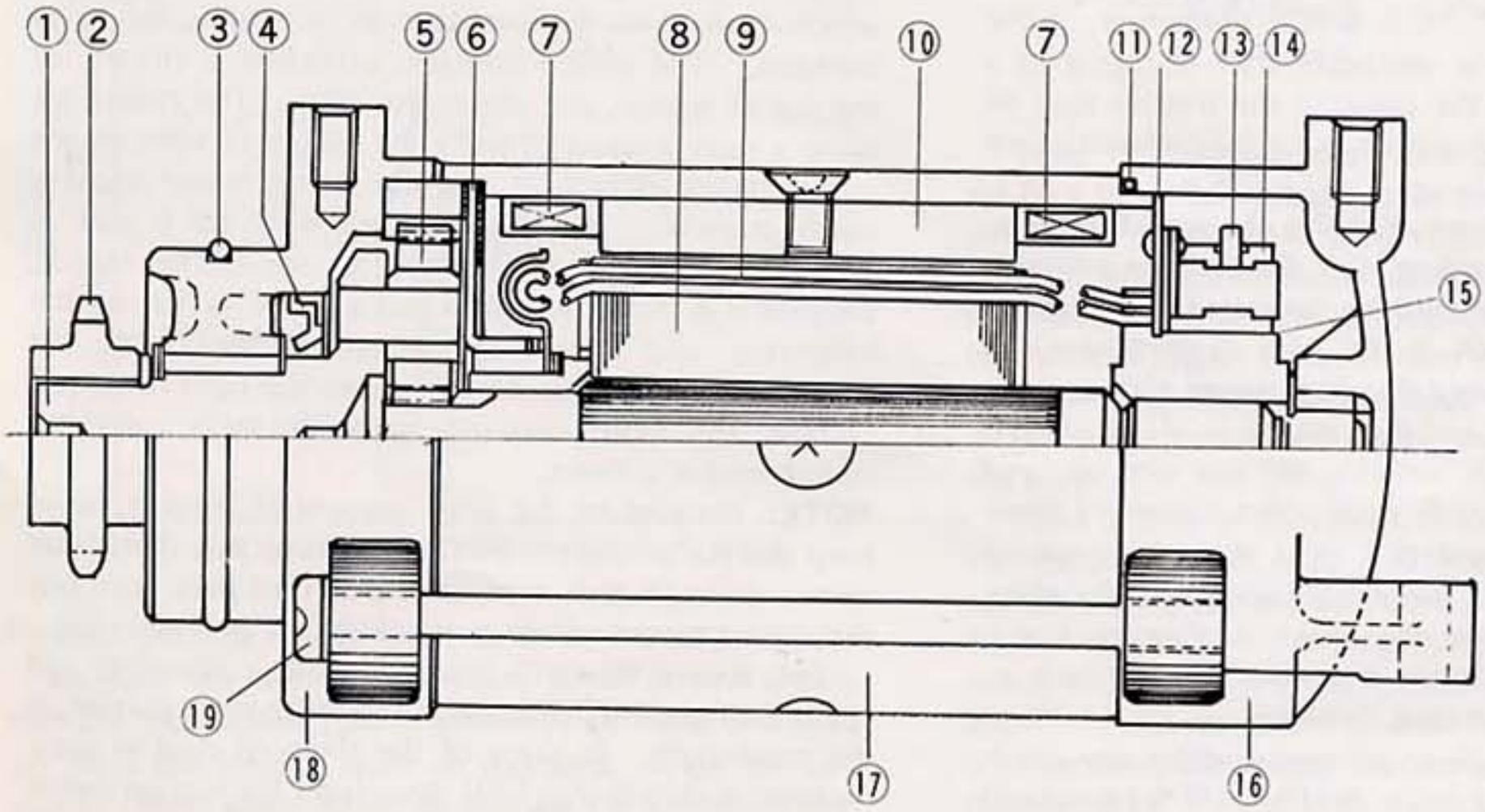
Spring tension should be 495~605 grams but a spring can be considered serviceable if it will snap the brush firmly into place.

*Commutator*

A dirty or damaged commutator will result in poor brush contact and cause the brushes to wear down quickly. In addition, particles from brush wear accummulating between commutator segments may cause partial shorts.

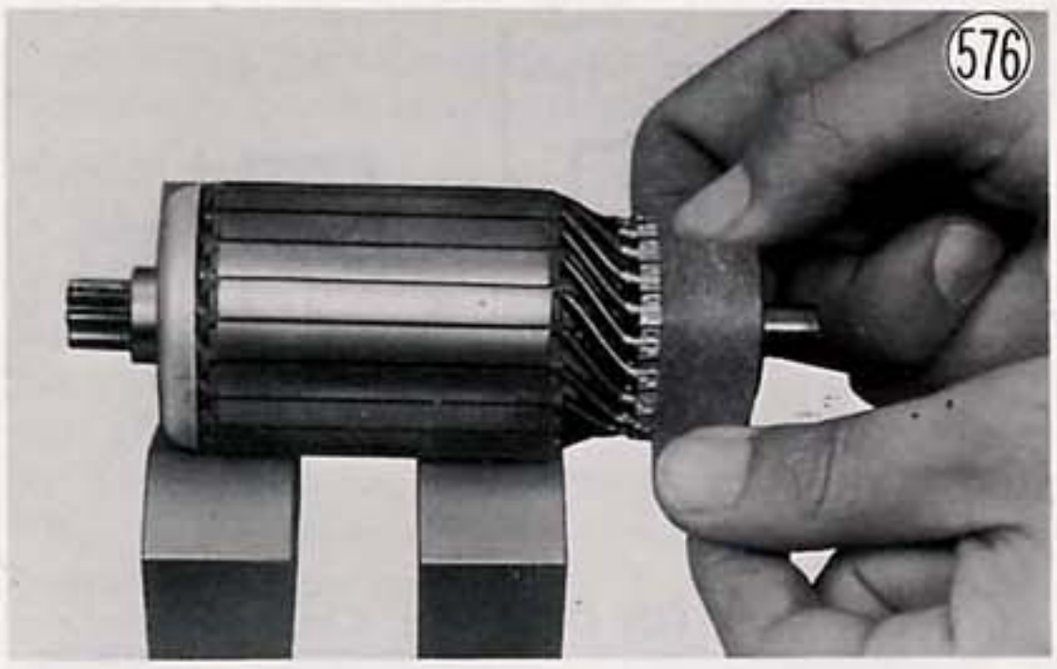
Correct the commutator surface if necessary with fine emery cloth, and clean out the grooves as illustrated. Determine as accurately as possible the depth

**Starter Motor Construction**




1. Shaft
2. Sprocket
3. O Ring
4. Grease Seal
5. Gears
6. End Plate
7. Field Coil
8. Armature
9. Armature Winding
10. Cores
11. O Ring
12. Brush Plate
13. Spring
14. Brushes
15. Commutator
16. End Cover
17. Yoke Assembly
18. End Cover
19. Screws

of the grooves between commutator segments. Replace the armature with a new one if the groove depth is less than the service limit.




**Commutator**

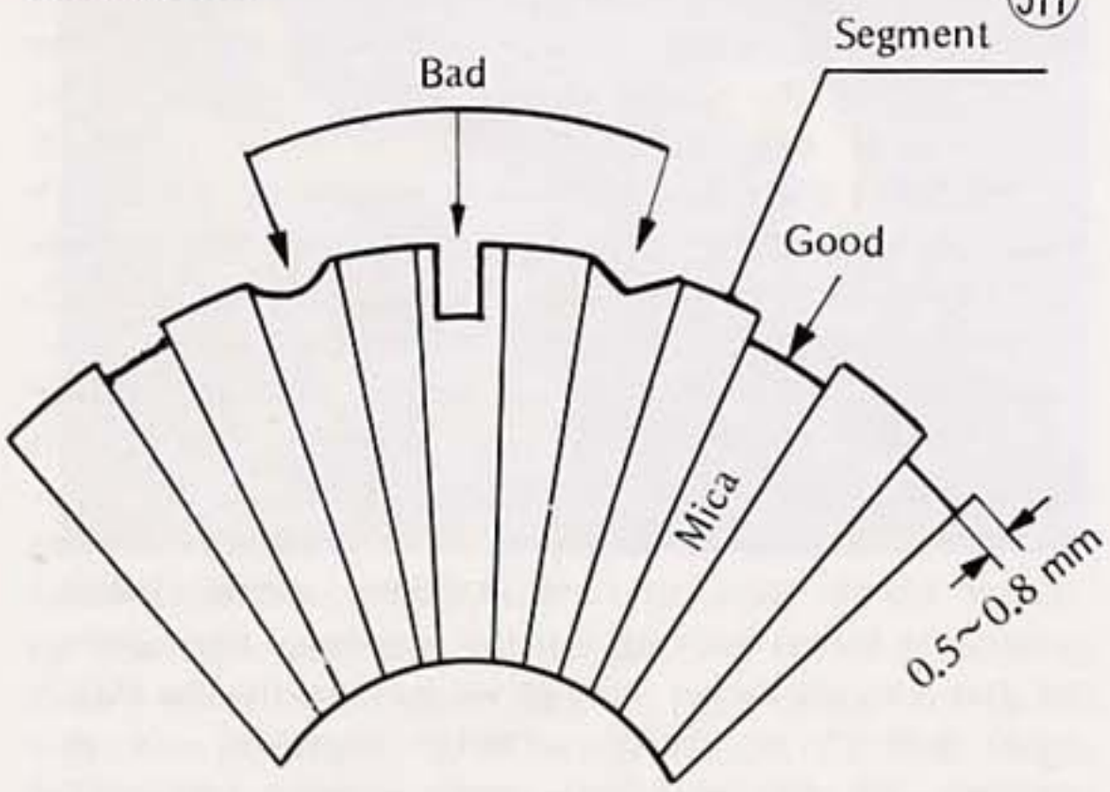
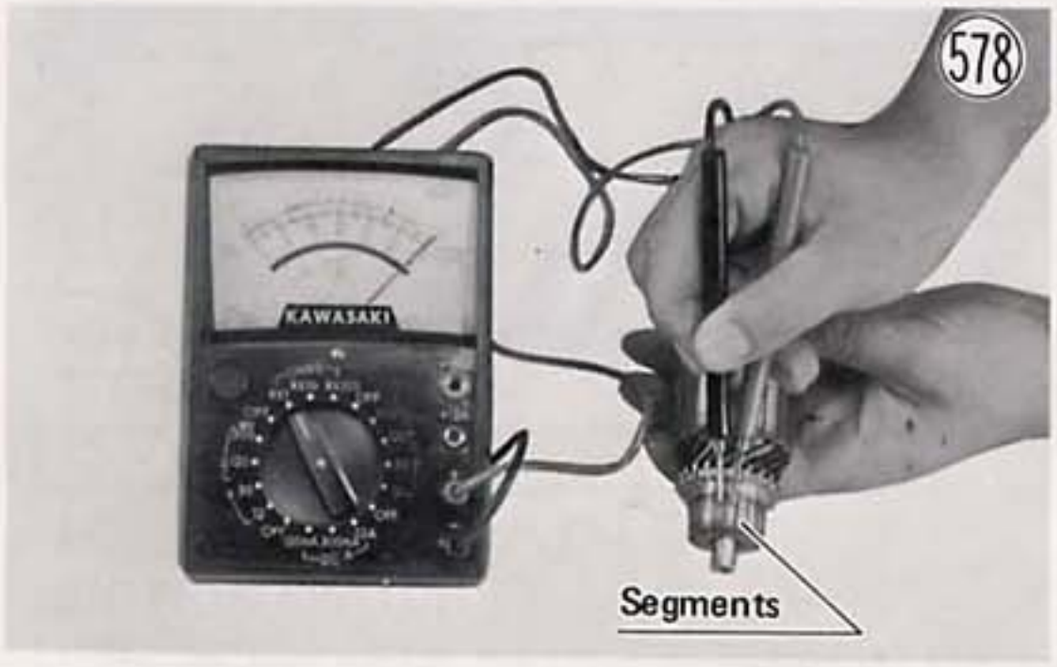


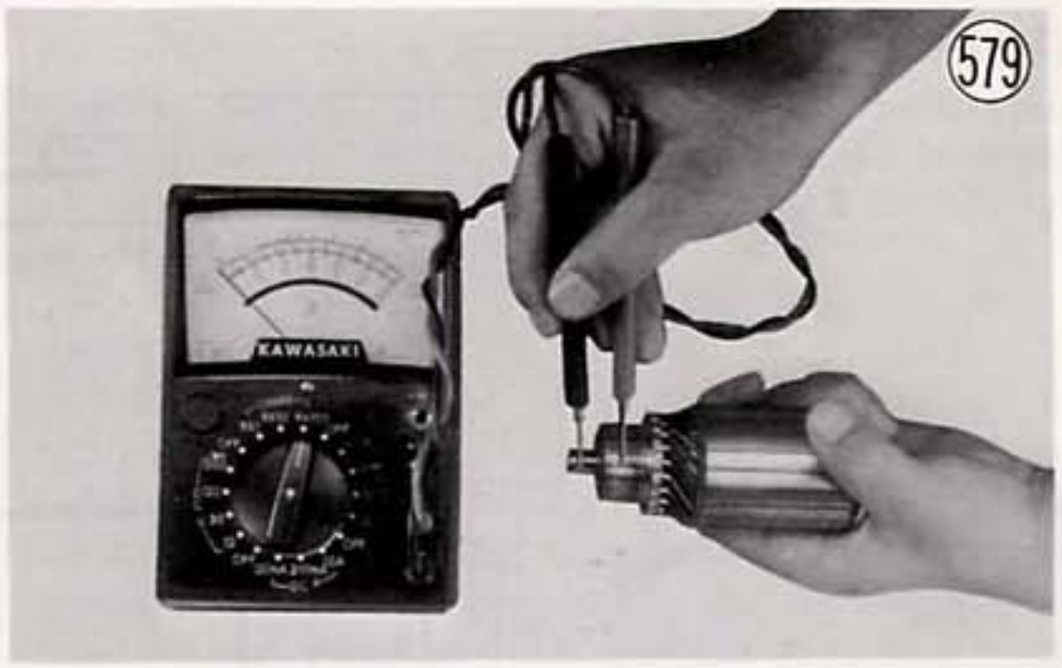

**Table 92 Commutator Groove Depth**

| Standard | Service Limit |
|---|---|
| 0.5~0.8 mm | 0.2 mm |

Using the R x 1 ohmmeter range, measure the resistance between each two commutator segments. If there is a high resistance or no reading between any two segments, a winding is open and the armature must be replaced.




Using the highest ohmmeter range, measure the resistance between the commutator and the shaft. If there is any reading at all, the armature has a short and must be replaced.

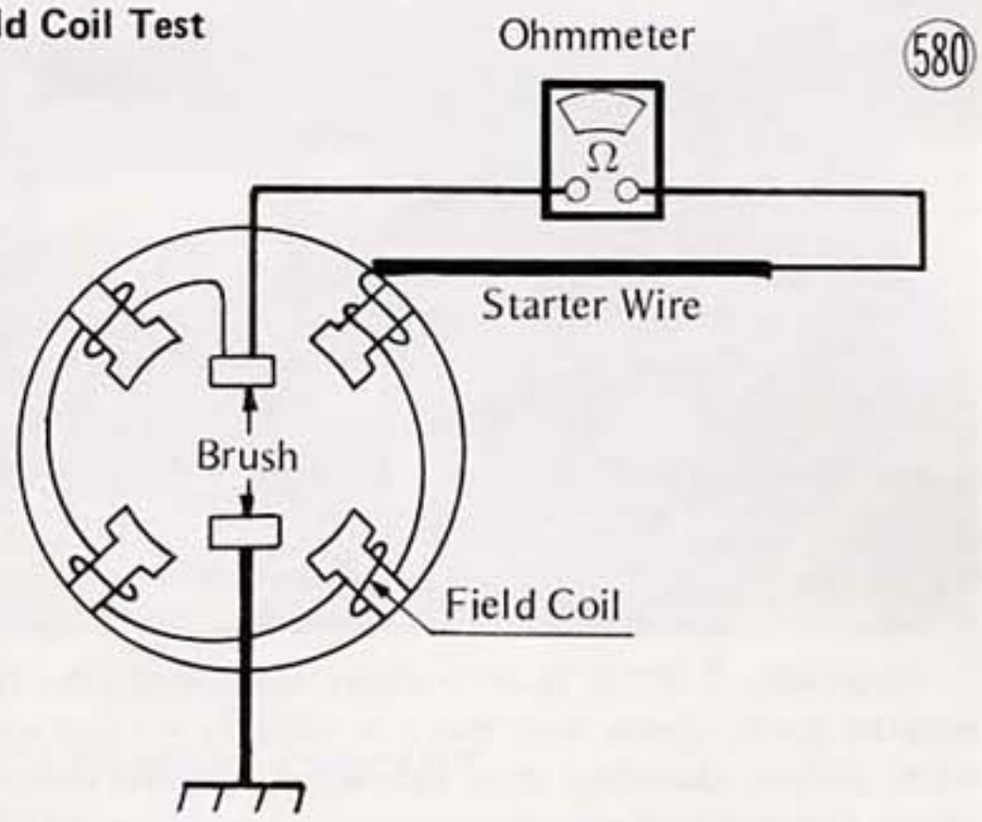



Even if the foregoing checks show the armature to be good, it may be defective in some manner not readily detectable with an ohmmeter. If all other starter motor and starter motor circuit components check good, but the starter motor still does not turn over or only turns over weakly, replace the armature with a new one.

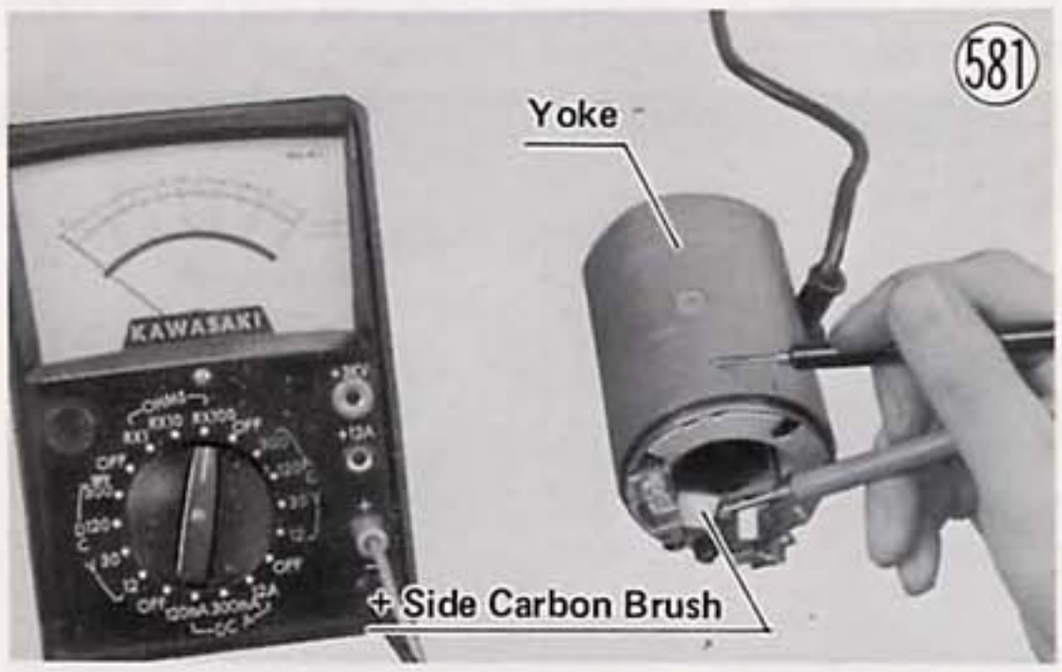
### *Field coils*

Using the R x 1 ohmmeter range, measure the resistance between the + side carbon brush and the starter motor lead. If there is not close to zero ohms, the field coils have an open and the yoke assembly must be replaced.

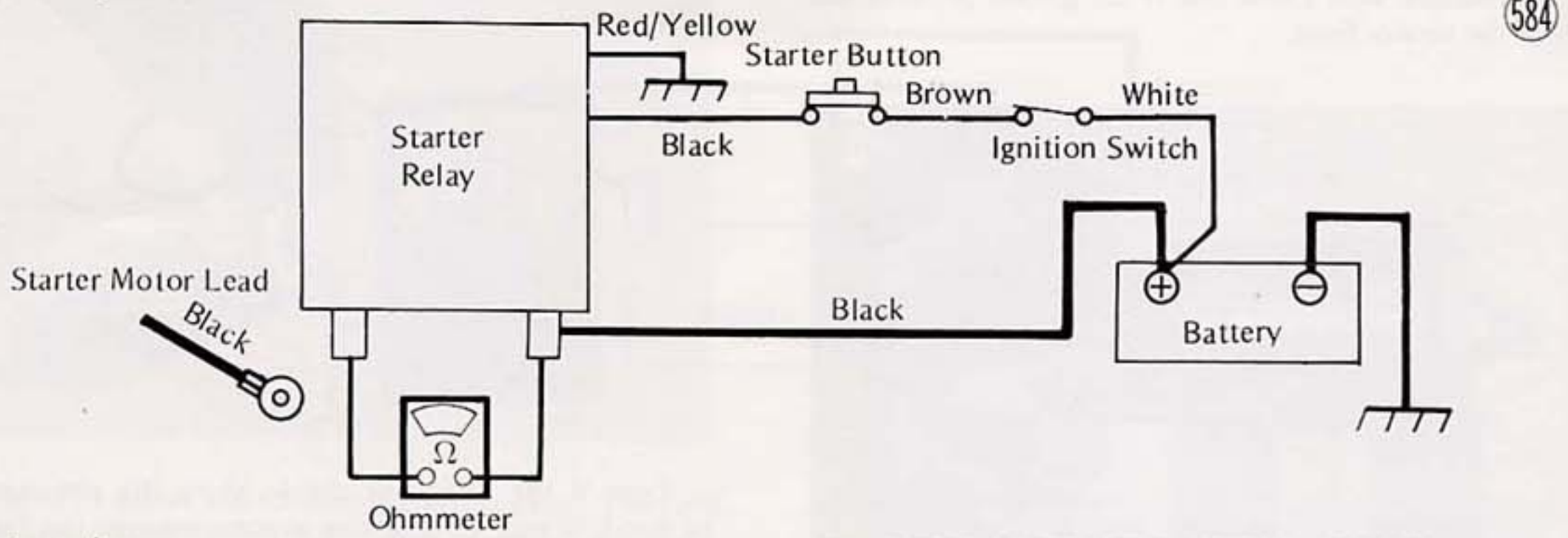
**Field Coil Test**




Using the highest ohmmeter range, measure the resistance between the + side carbon brush and the yoke (housing). If there is any meter reading, the coils are shorted to ground and the yoke assembly must be replaced.



**Starter Relay Contact Test**

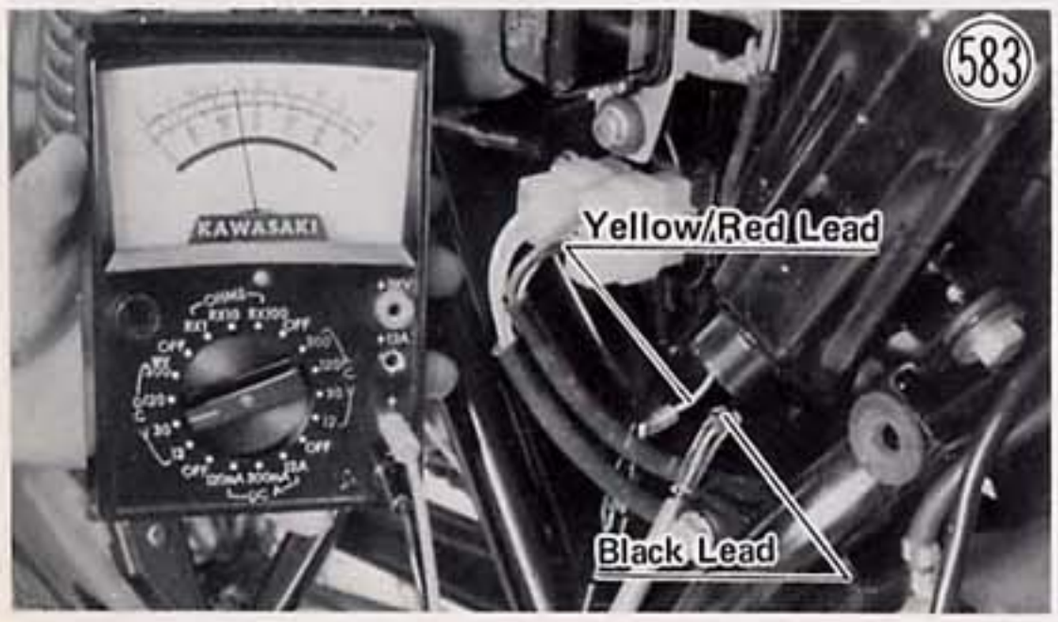



*Starter relay*

Disconnect the starter motor lead from the starter relay, and connect an ohmmeter set to the R x 1 range across the relay terminals. Push the starter button, and see if the meter reads zero ohms. If the relay makes a single clicking sound and the meter reads zero, the relay is good. If the relay clicks but the meter does not read zero, the relay is defective and must be replaced.

If the relay does not click at all, disconnect the other two leads (black and yellow/red), and measure the resistance across them. If the resistance is not close to zero ohms, the relay is defective.


However, if there is zero ohms resistance, the relay may be good; check that there is actually voltage to the relay before deciding that the relay is defective. To check for the voltage, first turn the meter to 30 VDC, connect the – meter lead to the yellow/red lead which was disconnected from the relay, and connect the + meter lead to the black lead. When the starter button is pushed, the meter should read battery voltage. If it does not, there is wiring trouble. If the meter reads battery voltage but the relay does not click, the relay is defective.



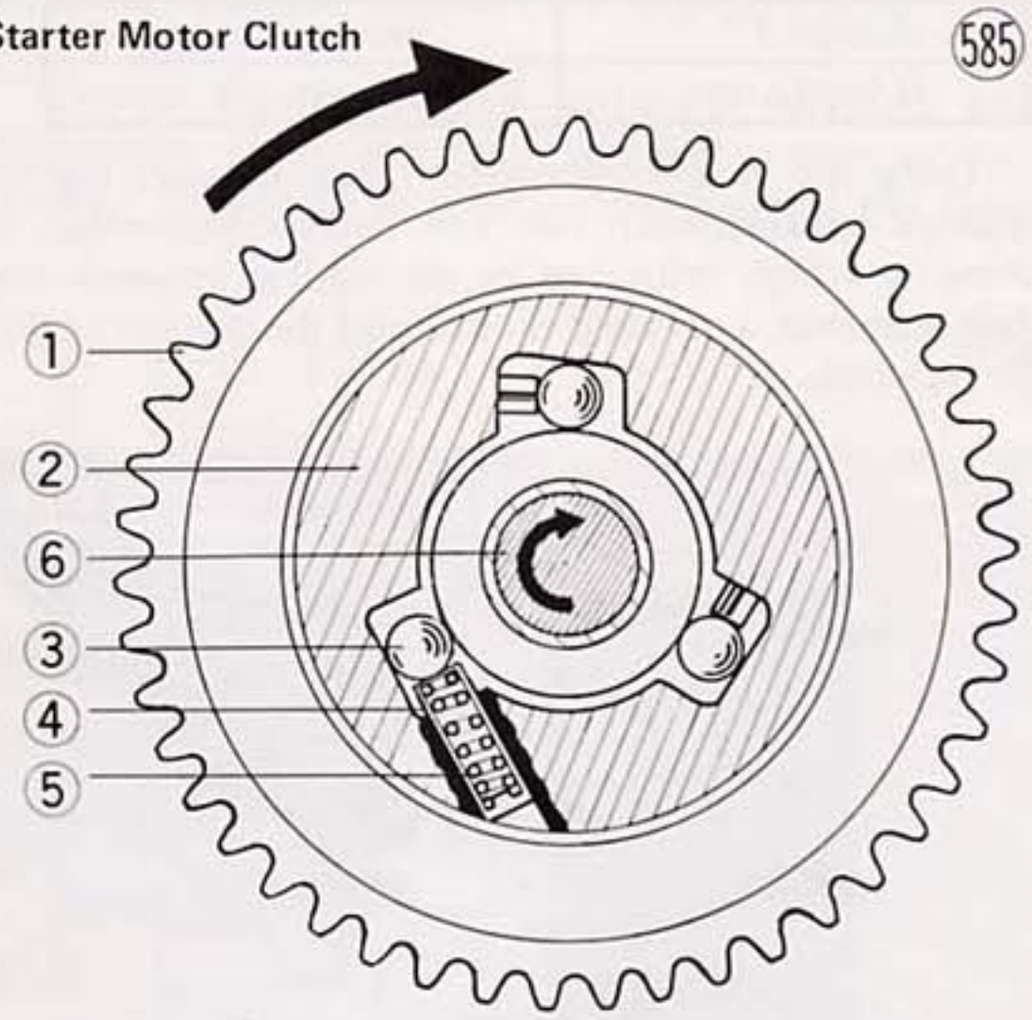

## STARTER MOTOR CLUTCH, CHAIN

(Only on KZ400D)

Fig. 585 shows starter motor clutch construction. The clutch body is fixed to the crankshaft through the rotor. When the starter clutch sprocket rotates in the direction of the arrow, each of the three rollers is wedged into the more narrow space between the clutch body and the starter clutch sprocket hub (the portion jutting out from the sprocket), thereby locking the clutch body and starter clutch sprocket together. With these two locked, starter motor rotation is transmitted to the crankshaft through the starter chain, starter clutch sprocket, rollers, clutch body, and rotor.

When the engine starts, at first friction with the starter clutch sprocket (and at higher speeds, inertia) moves the rollers back against the tension of their springs so that they no longer serve as wedges locking the clutch body and starter clutch sprocket together. In this manner, the engine rotates freely without forcing the starter motor to turn with it.

**Starter Motor Clutch**



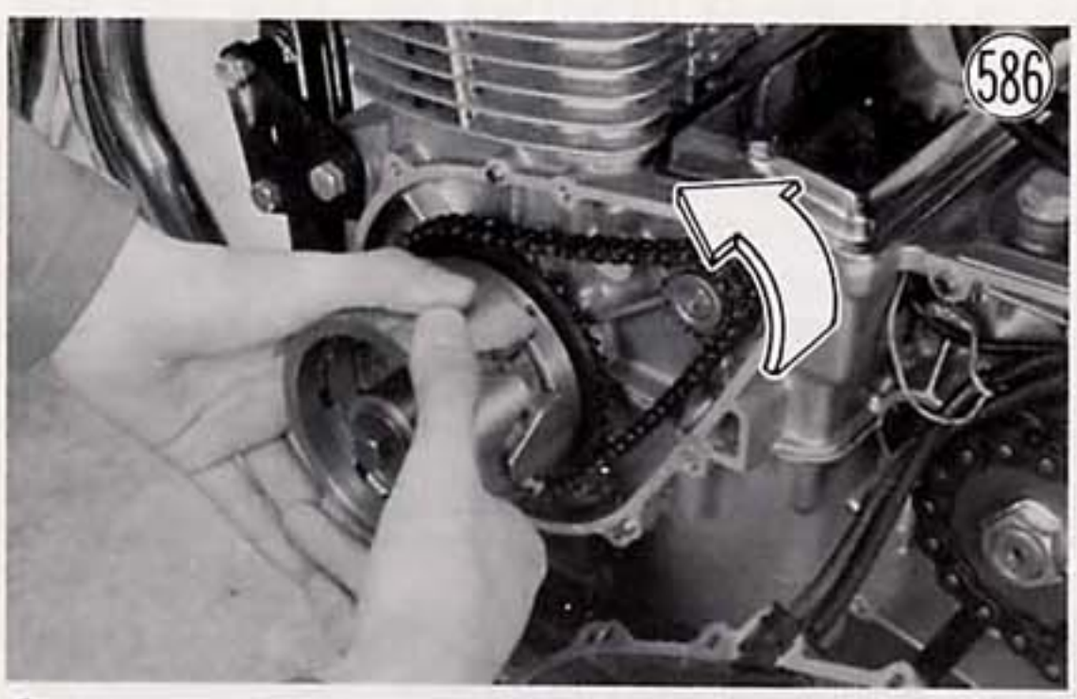

1. Sprocket
2. Starter Clutch
3. Roller
4. Spring Cap
5. Spring
6. Crankshaft

If the rollers or the starter clutch sprocket hub becomes damaged or worn, the rollers may lock in

place so that the starter motor will not disengage when the engine starts. On the other hand, roller or sprocket hub damage could prevent the clutch from engaging properly, causing the starter motor to run freely without transmitting the rotation to the crankshaft or to make noise while transmitting rotation.

### *Clutch inspection*

Remove the dynamo cover, and turn the rotor by hand. When turning the rotor counterclockwise, the starter clutch sprocket should turn with the rotor, but, when turning the rotor clockwise, the sprocket should not turn. If the clutch does not operate as it should or if it makes noise, disassemble the starter motor clutch (Pg. 45), examine each part visually, and replace any worn or damaged parts.




*Starter chain inspection*

Remove the starter chain (Pg. 46 ), hold the chain taut with a force of about 5 kg in some manner such as the one shown in Fig. 587, and measure a 20-link length. Since the chain may wear unevenly, take measurements at several places. If any measurement exceeds the service limit, replace the chain.

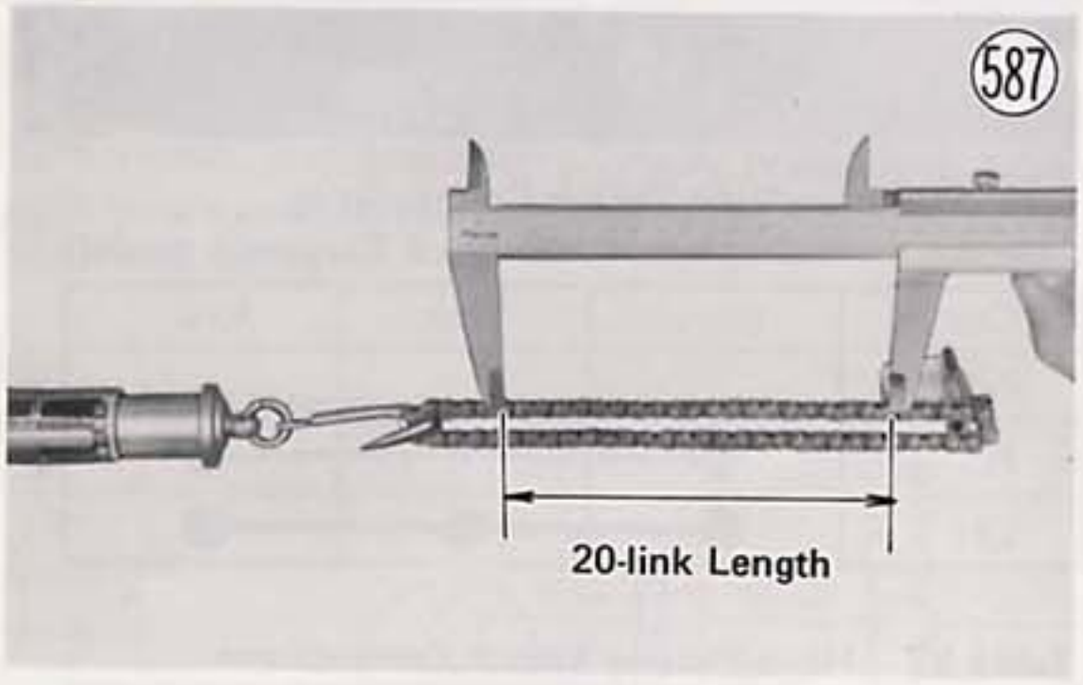



**Table 93 Starter Chain Length**

| Standard | Service Limit |
|---|---|
| 155.5 mm | 157.8 mm |

## IGNITION SWITCH

The ignition switch has three positions: off, on, and park. In the off position, all circuits are turned off and the key can be removed from the switch. In the on position, the motorcycle can be started, all electrical equipment can be used, the headlight, tail light, and meter illuminating lights are lit, and the key is held in the switch so that it can not be removed. In the park position, the tail light goes on so that the motorcycle can be more safely stopped along the road at night, all other electrical circuits are cut off, and the key can be removed from the switch.

### *Testing the switch*

Table 94 shows the internal connections of the ignition switch for each switch position. To check the switch, disconnect the lead plug from the switch, and use an ohmmeter to verify that there is continuity (zero ohms) between all the connections that are listed in the table for each switch position, and that there is no continuity between the leads that are not connected. If the switch has an open or short, replace the switch with a new one.


**Table 94 Ignition Switch Connections**

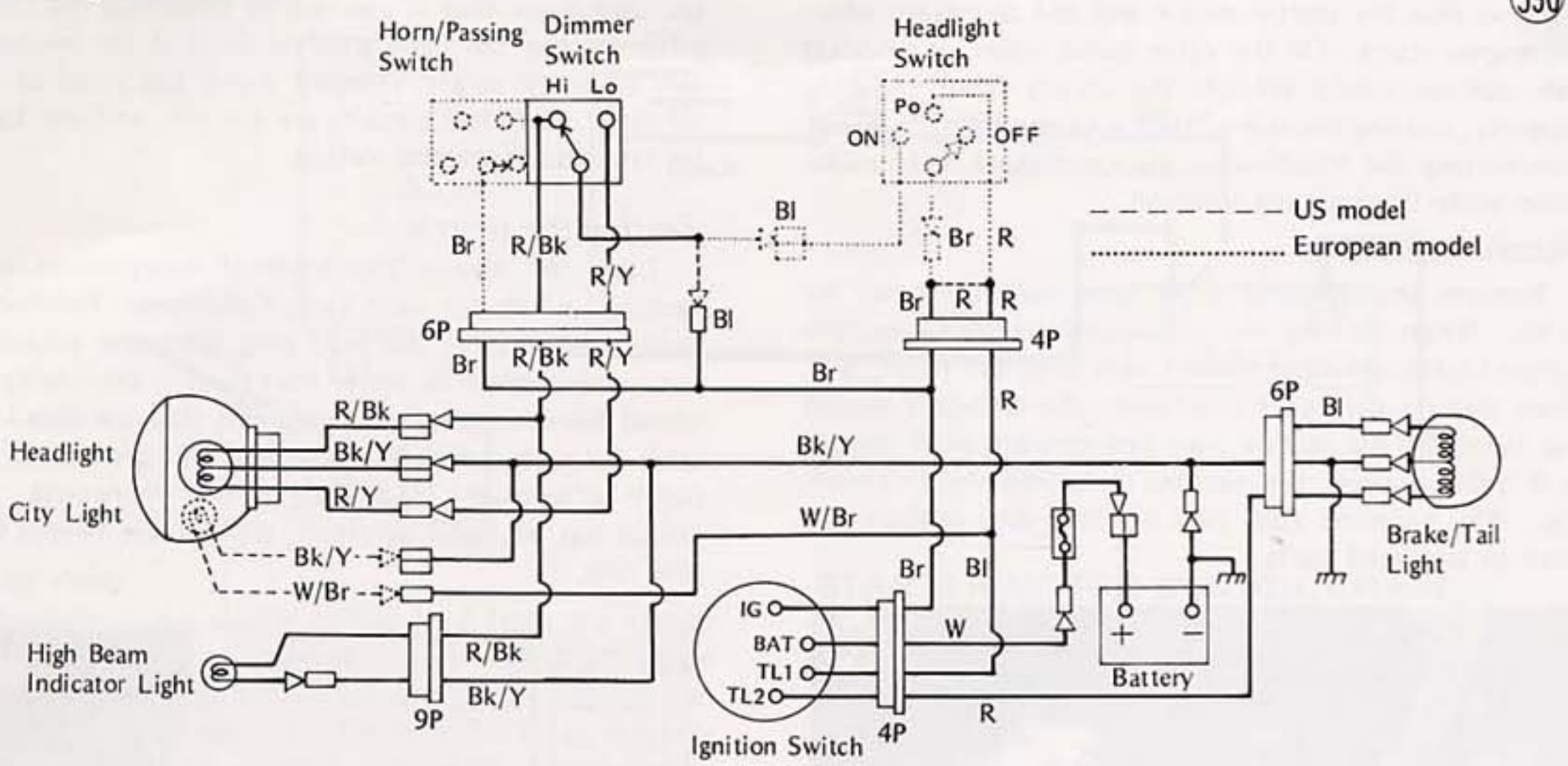
| LEAD | BAT | IG | TL 1 | TL 2 |
|---|---|---|---|---|
| OFF | | | | |
| ON | ● | ● | ● | ● |
| Park | ● | | | ● |
| COLOR | White | Brown | Blue | Red |

## HEADLIGHT CIRCUIT

The headlight circuit is shown in Fig. 590. When the ignition switch is turned on, the headlight circuit is completed, turning on the headlight, tail light, and meter illumination lights. The dimmer switch is used to select high or low beam. When the headlight is on high beam, the high beam indicator light is also lit.

A headlight switch is provided on the European model. The center **PO** position of the headlight switch turns on the city light and the tail light for driving in the city after dark. When the switch is turned to the **ON** position, the city light stays on even though the headlight is lit too. High or low beam can be selected only when the headlight switch is in the **ON** position. There is also a **PASS** position of the horn/passing button. This position is spring loaded, and can be used to turn on the passing beam whether the headlight is turned on or not. When the button is pushed to **PASS**, the headlight high beam (passing beam) comes on to signal the driver of the vehicle ahead that you are about to pass him. The passing beam goes off as soon as the button is released.

**Headlight Circuit**




The same bulb is used for both the tail light and the brake light, but the bulb has a separate filament for each light. The tail light filament is controlled by the headlight circuit. The brake light filament is controlled by the brake light circuit, which is explained in the following section.

## Headlight trouble

If the headlight does not light, check to see if the bulb has burned out. If the bulb has burned out, the sealed beam unit must be repalced. On the European model the headlight bulb or city light can be replaced separately as the headlight is of semi-sealed construction. If the bulb is good, check the dimmer switch and the headlight siwtch. Tables 95 and 96 show the connections in the dimmer switch for both high and low beam, and the connections in the headlight switch. Disconnect the leads to the dimmer switch or headlight switch, and use an ohmmeter to see that only the connections shown in the table have continuity (zero ohms). If the switch has an open or a short, it can be disassembled for repair. The contact surfaces may be cleaned, but no internal parts are available for replacement. If any parts are not repairable, the switch must be replaced as a unit. However, if the dimmer switch or headlight switch is good, check the ignition switch, the wiring, and the dynamo.

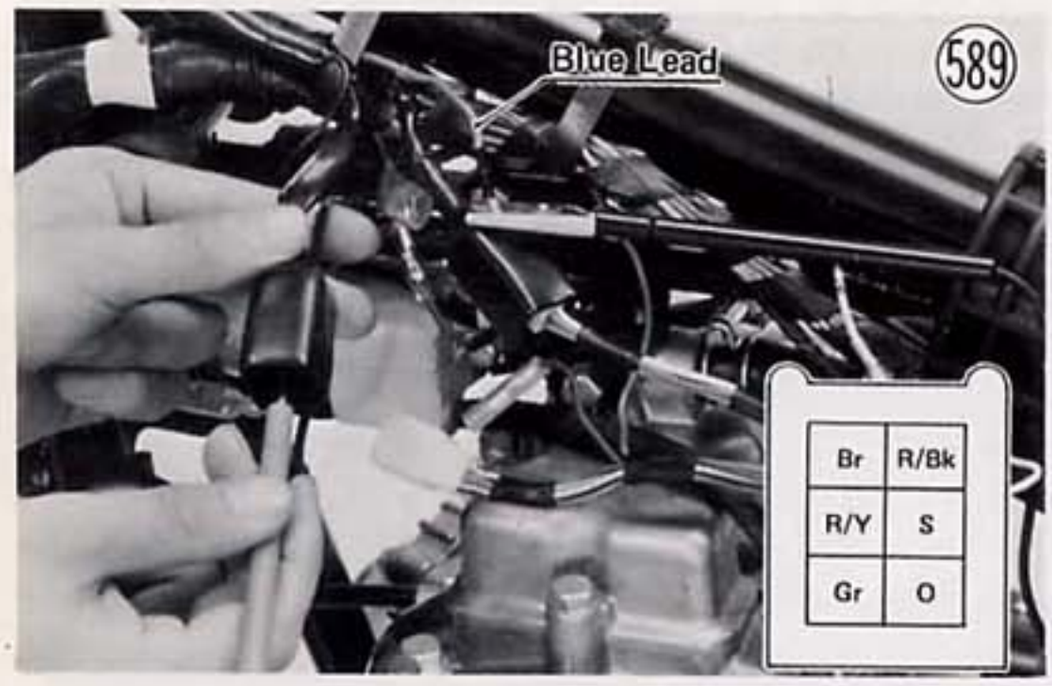



**Table 95 Dimmer Switch Connections**

| Color | R/Y | Blue | R/Bk |
|---|---|---|---|
| High Beam | | ● | ● |
| Low Beam | ● | ● | |


**Table 96 Headlight Switch Connections (Only on European model)**

| Color | Brown | Blue | Red |
|---|---|---|---|
| OFF | | | |
| PO | ● | | ● |
| ON | ● | ● | ● |

**Table 97 Horn/Passing Switch Connections**

| Color | Black | ⫫ | R/Bk | Brown |
|---|---|---|---|---|
| OFF | | | | |
| ON | ● | ● | ● | ● |
| Switch | Horn | | Passing | |

If the headlight lights but does not light brightly, the trouble may be that the headlight is of improper wattage or that the dynamo is not supplying sufficient current. However, the trouble may also be caused by a short or a component drawing too much current in some other part of the electrical system.

*Tail light trouble*

If the tail light does not go on when the ignition switch is turned on (or for the European model when the ignition switch is turned on and the headlight switch is turned to **PO** position), the filament is probably burned out. However, if the bulb is good, check the wiring, ignition switch, headlight switch, fuse and battery.

## BRAKE LIGHT CIRCUIT

The brake light circuit is shown in Fig. 594. When the ignition switch is turned on, the brake light goes on whenever the circuit is closed by either the front or rear brake light switch. The same bulb is used for both the brake and tail lights as explained in the preceding section.

The KZ400S front brake light switch is mounted on the front brake lever body and operated mechanically when the brake lever is pulled. The KZ400D has a pressure switch installed in the brake fluid line, and is operated by fluid pressure when the brake lever is pulled. The front brake switches never require adjustment and so are not designed to be adjusted. They can not be disassembled for repair and must be replaced when defective.

The rear brake light switch for both models is a plunger type switch actuated by a spring attached to the rear brake pedal. It can be adjusted by changing its position higher or lower in the mounting bracket (See Pg. 20).

The brake light failure indicator switch is in the brake light circuit as a warning device to indicate during vehicle operation whether or not the brake light is functioning properly. Brake light failure may be due to a burned out bulb or some other failure in the brake light circuit.

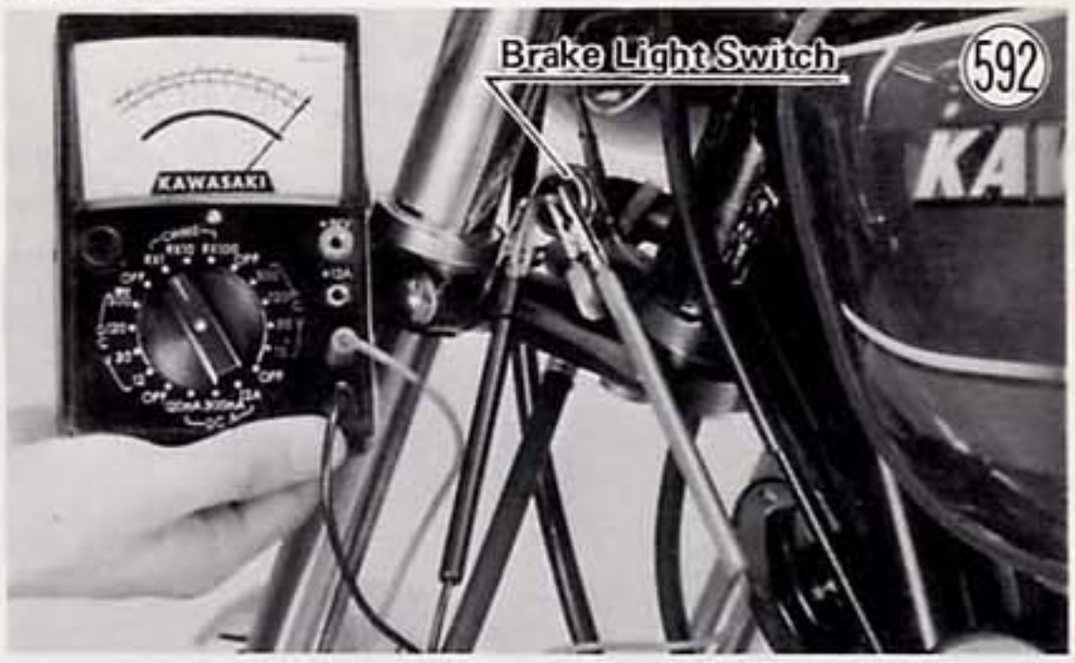
*Brake light circuit trouble*

Brake light circuit inspection involves the front brake light switch, rear brake light switch, brake light, brake light failure indicator switch, brake light failure indicator light, and wiring.

**[I] Front brake light switch inspection**

- Disconnect the front brake light switch leads.
- Set an ohmmeter to the R x 1 range, connect the meter to the switch terminals (KZ400D) or switch leads (KZ400S), and determine whether or not there is continuity whenever the front brake lever is squeezed. If there is no continuity, replace the switch.

**KZ400D**

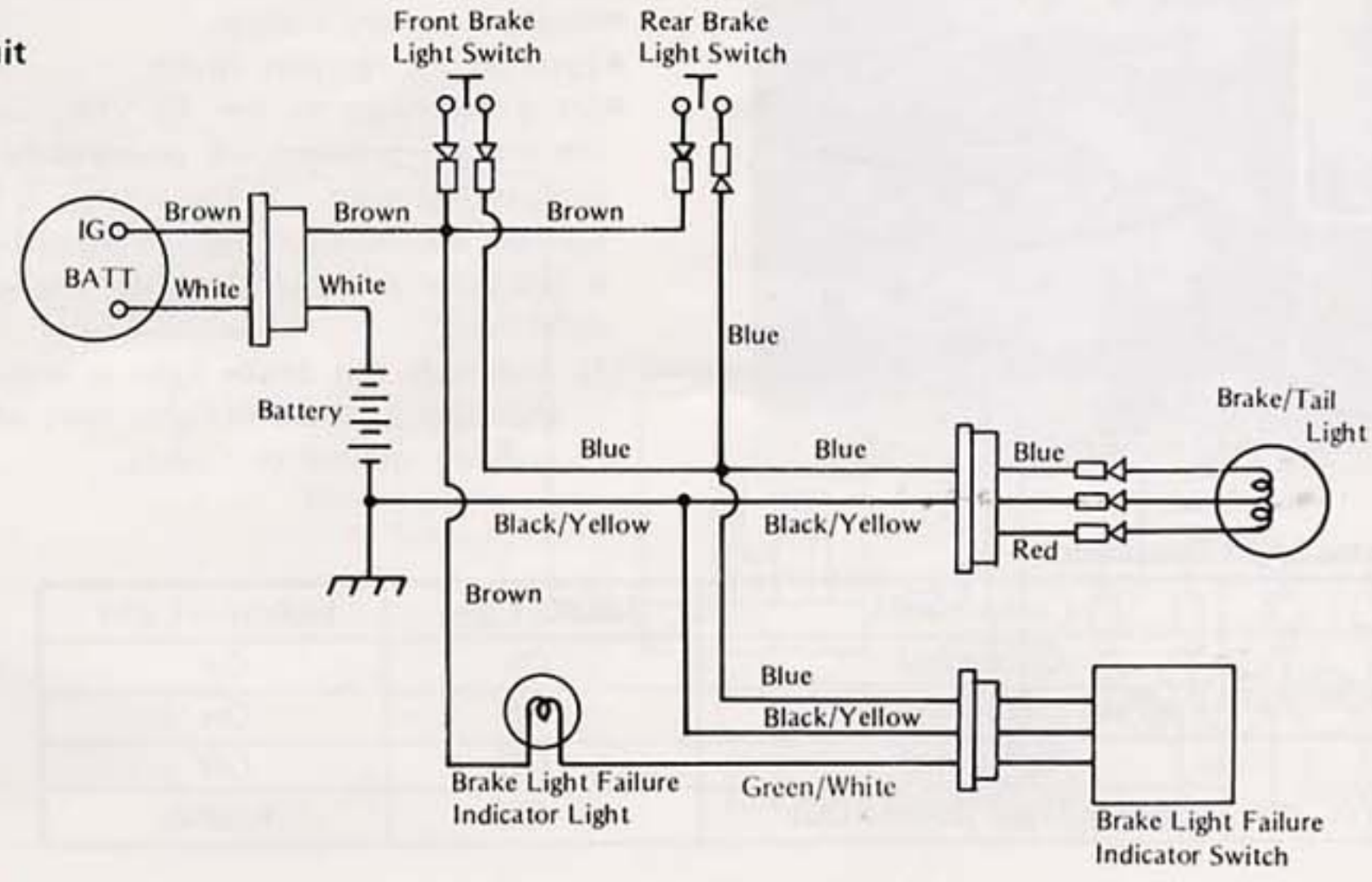



**KZ400S**


**NOTE (when the front brake light switch is replaced with a new one):**

1. If brake fluid spills when the switch is replaced, painted or chromed surfaces may become damaged.

**Brake Light Circuit**

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If any fluid spills on the fender or elsewhere, wipe it up immediately.

2. Apply a small amount of a non-permanent locking agent such as Kawasaki Liquid Lock-K to the switch threads before mounting the switch. However, so that no Lock-K will get mixed in with the brake fluid, do not apply any on the lower fourth of the threads.
3. After the switch has been installed, air bleed the front brake lines.

**[II] Rear brake light switch inspection**

•Disconnect the rear brake light switch leads.

•Inspect in the same way that the front brake light switch was inspected. If there is no continuity whenever the rear brake pedal is depressed, replace the switch.

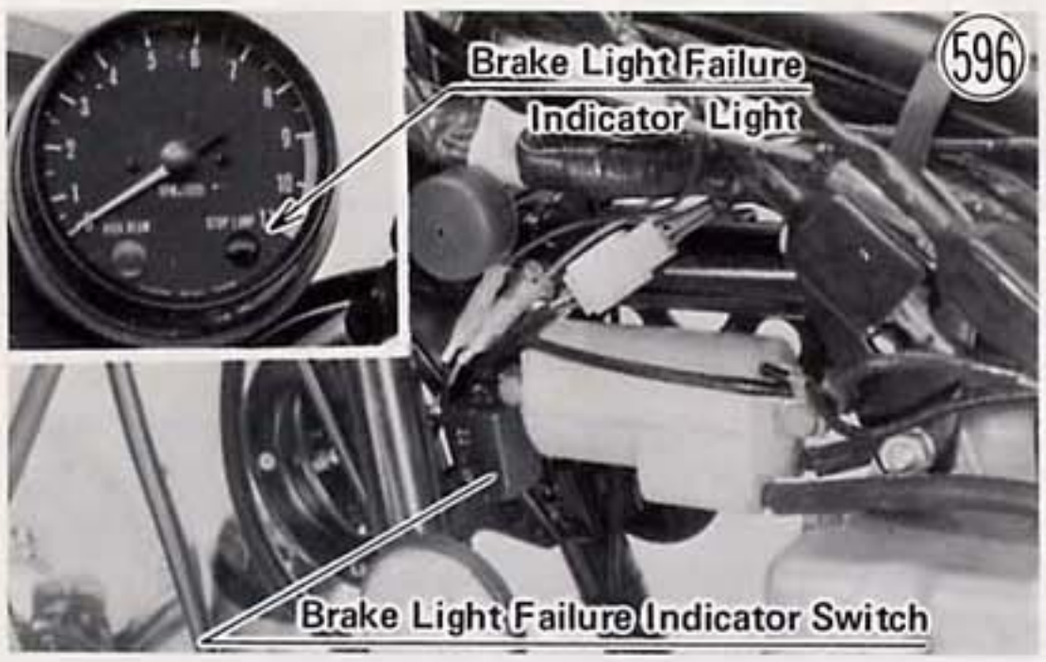

**[III] Brake light failure indicator switch inspection**

•Turn on the ignition switch, and apply the brakes. At this time the indicator light should go on.

•With the brake applied, remove the brake light bulb. At this time the indicator light should still be lit.

•With the brake applied and the bulb removed as in the previous step, release the brake. The indicator light should flash at a rate of 70~170 times a minute.

If the above conditions are met, the brake light failure indicator switch is functioning properly.




**[IV] Brake light circuit inspection**

(in all the measurements the — meter lead goes to chassis ground)

(1) Even though the brake light lights, the indicator light does not go on:

•Measure battery voltage.

•Turn on the ignition switch.

•Set a voltmeter to the 30 VDC range, and connect the meter to the blue indicator switch lead and to ground without disconnecting the indicator switch. If the voltage is less than battery voltage, the wiring is defective.


•Measure the voltage between the green/white indicator switch lead and ground. If the voltage is less than battery voltage, the indicator light is burned out; if the voltage is the same as battery voltage, the indicator switch is defective.

(2) The brake light is burned out, and, with neither brake applied, the indicator light doesn't flash:

a. the indicator light lights without flashing

•Measure battery voltage.

•Turn on the ignition switch.

•Set a voltmeter to the 30 VDC range, and measure the voltage between the blue indicator switch lead and ground. If the voltage is less than battery voltage, the indicator switch is defective; if the voltage is the same as the battery voltage, either the front or the rear brake light switch is defective.

b. the indicator light does not light

•Measure battery voltage.

•Turn on the ignition switch.

•Set a voltmeter to the 30 VDC range, and measure the voltage between the green/white indicator switch lead and ground. If the voltage is less than battery voltage, the indicator light is burned out; if the voltage is the same as battery voltage, the indicator switch is defective.

(3) Although the brake light is not burned out, the indicator light either lights even when neither brake is being applied or flashes:

**Table 98 Indicator Light Operation**

| Brakes | Components | Brake Light | Indicator Light |
|---|---|---|---|
| Brake Being Applied | All Normal | On | On |
| | Brake Light Burned Out | Off | On |
| Brake Not Applied | All Normal | Off | Off |
| | Brake Light Burned Out | Off | Flashes |

a. the indicator light does not go off when the brake is released

●If the brake light also won't go off when the brake is released, the brake light switch is defective; if it doesn't light, the indicator switch is defective.

b. the indicator light flashes

●Measure the battery voltage.

●Turn on the ignition switch.

●Set a voltmeter to the 30 VDC range, and connect the meter to the blue indicator switch lead and to ground. Apply one of the brakes, and note the voltage. If the voltage is less than battery voltage, the wiring is defective; if the voltage is the same as battery voltage, the indicator switch is defective.

## TURN SIGNALS

A wiring diagram of the turn signal circuit is shown in Fig. 569. When the ignition switch is on and the turn signal switch is turned to R or L, a ground is provided for the circuit so current can flow. Current to the right or left turn signals flows through the closed contacts and the resistance wire inside the turn signal relay, and the turn signals go on. The resistance wire quickly heats up, expands, and allows a spring to pull the contacts open. When the contacts have opened, the circuit is broken, the turn signals go off, and the resistance wire cools and contracts, closing the contacts so that the cycle can begin again. The indicator light in the turn signal circuit flashes on and off with the turn signals to indicate that they are working properly.

Since the turn signal relay is designed to operate correctly only when two turn signals (one front and one rear) and the turn signal indicator light are properly connected in the circuit, trouble may result from a burned out bulb, a bulb of incorrect wattage, loose wiring, as well as from a defect in the relay itself. In general, if the trouble with the circuit is common to both right and left turn signals, it is probably caused by a defective turn signal relay, although it may be due to a bad switch, wiring, or battery. If the trouble is with only one side—either right or left—then the relay is not at fault since the same relay is used for both sides.

### *Turn signal trouble*

(1)Neither right nor left turn signals come on at all:

●Check that battery voltage is normal.

●Unplug the relay leads and use an ohmmeter to check that there is continuity (close to zero ohms) between the relay terminals. If there is no ohmmeter reading, or if there is several ohms resistance, replace the relay with a new one.


●If the relay checks good, turn the meter to the 30 VDC range, connect the + meter lead to the brown lead that was disconnected from the relay, and connect the – meter lead to the orange lead. With the ignition switch on, first switch the turn signal switch to the R and then to the L position. The meter should register battery voltage at either position. If it does not, the fuse, ignition switch, or wiring is at fault. If battery voltage is read on the meter but the turn signals will still not work when the relay is reconnected, then recheck all wiring connections.

**Turn Signal Circuit**