

CHILTON'S
MOTO GUZZI
REPAIR & TUNE-UP GUIDE



**ALL V7, V750 AMBASSADOR, AND V850 ELDORADO
MODELS FROM 1966-1972**

CHILTON'S *New Repair and Tune-Up Guide*

Moto Guzzi

ILLUSTRATED

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Motorcycle
Industry
Council

CHILTON BOOK COMPANY

RADNOR, PENNSYLVANIA

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First Edition

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Published in Radnor, Pa. by Chilton Book Company
and simultaneously in Ontario, Canada,
by Thomas Nelson & Sons, Ltd.
Manufactured in the United States of America

Library of Congress Cataloging in Publication Data

Chilton Book Company. Automotive Editorial Dept.

Chilton's new repair and tune-up guide: Moto Guzzi.

i. Moto Guzzi motorcycle. I. Title.

TL448.M66C47 1973 629.28'775 73-17292

ISBN 0-8019-5866-0

ISBN 0-8019-5908-X (pbk.)

ACKNOWLEDGMENTS

PREMIER MOTOR CORPORATION

Hasbrouck Heights, New Jersey

ROAD RIDER MAGAZINE

South Laguna, California

YBM Cycle Sales

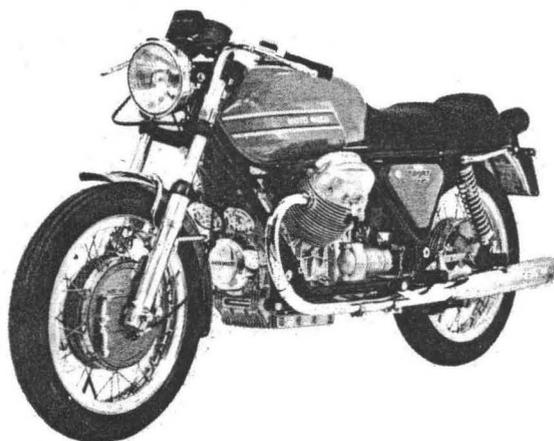
3ryn Mawr, Pennsylvania

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I • Model Identification and Development



History and Model Development

Here's a little history to share with your riding buddies while sipping coffee and swapping lies after the day's ride.

The Moto Guzzi story has its roots in the universal camaraderie of men at war. The war in question was "the war to end all wars", and the setting an air base in sunny Italy. It seems there were three fellows, a couple of flying aces named Giovanni Ravelli and Giorgi Parodi, and Carlo Guzzi their mechanic, who liked each other a lot and who kicked around a scheme for building the ultimate motorcycle after the world was made free for mom and apple pie. Guzzi had the design, Ravelli the racing experience, and Parodi had the money to turn their dream into reality. Unfortunately Ravelli never made it through the war, hence the symbol of an eagle in flight, however Guzzi and Parodi pressed on and soon introduced their first machine after the original design: a 500 cc single set horizontally in its frame, with the unlikely configuration of the flywheel mounted outside the crankcases.

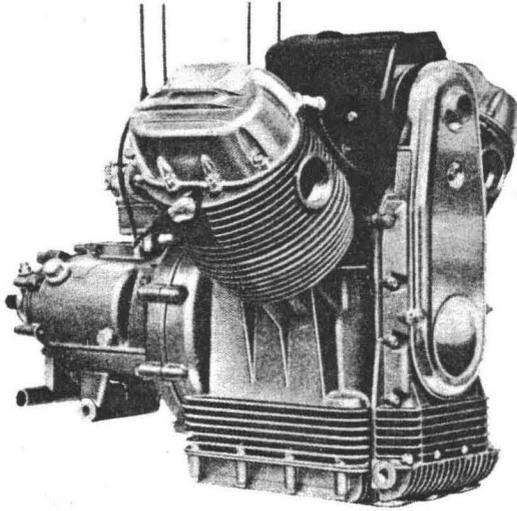
Shortly after springing their unique machine on the world, the fledgling factory sponsored Also Finizi in the Targa Florio, an event which they walked away with. From that time until 1957, when the fac-

tory withdrew from racing, the Moto Guzzi marque took home an unprecedented 3,329 international wins, a feat which never has been duplicated in the history of the sport. The machine which established a name for the company with an unexpected win in the 1924 Grand Prix, the first such contest which they entered, was a refined version of the original big thumper. They remained with this design until after the Spanish Grand Prix of 1954 when it became evident that there just wasn't any way to coax the necessary ponies they'd need to remain competitive out of the tried and true single.

As is usually the case, need provides the means, and the factory's racing hopes became centered about a machine of revolutionary concept—a water cooled, double overhead cam, 500 cc eight banger that could turn an unbelievable 1200 rpm and deliver a scorching 72 bhp to the rear wheel. Unfortunately the factory quit racing before the 175 mph bike was fully sorted out and the promising V8 never did get the chance to bring home the laurels expected of it.

All their years of racing, however, were not in vain. Moto Guzzi learned a lot about making machines that don't break down too often, handle well despite their tremendous bulk, and stop when and where you want them to. This information was incorporated in 1966 into their first big tourer for the American market, the

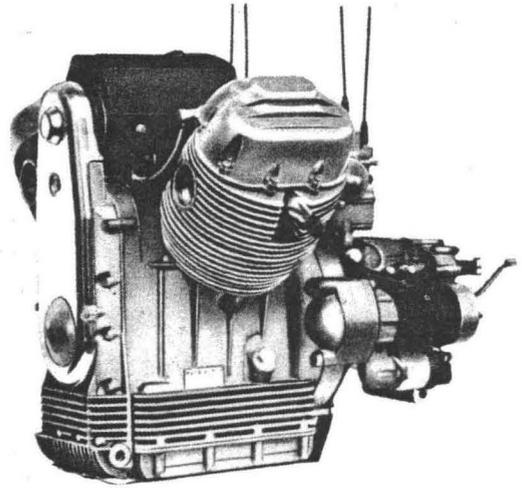
700 cc V7, a former police bike noted for its reliability, smoothness, and easy maintenance.



A V750 engine

In 1969 the bore was increased from 80 to 83 mm and the V7 became known as the 750 Ambassador. As with many of the companies who produce quality touring machines, Moto Guzzi refines rather than redesigns their bikes. A new 750 isn't much different than the first such model; yes it does have redesigned instrumentation and the battery covers now hide the air cleaner, but more important than that, the clutch throw out bearing has been changed from the caged ball type to a needle bearing with a considerably longer life expectancy. Since the limited life of this bearing was the biggest complaint of Guzzi owners and since this is no longer a problem, the new Guzzis are almost truly bullet proof.

1972 marked the advent of two new big twins from the Guzzi factory; the 850 Eldorado and the 750 Sport. The big 850 is a stroked 750 engine, bringing its vital measurements to 83 x 78 mm, boosting the horsepower from 60 to 64.5, and offering gobs of increased torque in case you want to plow a field with it. The biggest news is the new five speed cluster mounted in a redesigned transmission case with bigger bearings. Other refinements are boosted compression (from 9:1 to 9.2:1), turn signals, a self-returning choke, additional internal and external crankcase webbing for added strength, new gearshift and clutch



A V850 engine

linkage, a considerably stronger rear hub assembly with a larger oil capacity and a sludge trap, and about 30 more pounds bringing the overall curb weight to a whopping 569 lbs.

This big new Guzzi is very nice, but what's really exciting is the cafe racer like Sport model. Only from Italy could so sleek and sexy a machine stem. Its lines are beautiful, the craftsmanship is second to none, and its handling characteristics have to be experienced to be believed. Aside from the clip ons, 18 in. alloy rims, and racing tank incorporated to lend a sporty air, the designers went to great lengths to make the machine lighter, faster, and more nimble. The huge generator was replaced with a smaller more compact alternator mounted on the front of the crankshaft, a smaller Spanish-Bosch starter motor is fitted, the flywheel, ring gear, and clutch assemblies have all been lightened, the carbs have been replaced with units which are one millimeter larger, the pistons have one more oil ring and now boost the compression to 9.8:1, the cam has been redesigned, the gear ratios are closer, the final drive ratio is higher, the brakes are now dual double leading shoes up front with double leaders in the rear, the super smooth exhaust system features two noise reducing crossovers, and the old distributor ignition has been replaced with an all new dual point coil system. Lighting is now courtesy of a quartz-iodide Marelli lamp, rims come to you from Borrani, Michelin has contributed all new tires that stick like glue right up to the edge, and

the rear shocks are from Koni—what more could you ask for?

Model Identification

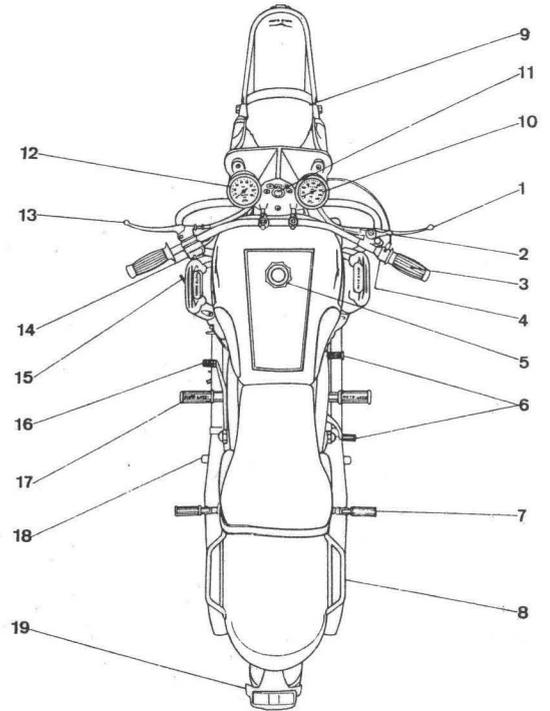


Serial number locations

Each machine comes from the factory with a serial number stamped on the frame down tube and on the left hand crankcase cover. When ordering parts from your dealer, mention these numbers to avoid winding up with parts for the wrong model year.

Controls and Accessories

Conversion kits are available to mount the gear shift lever on the left side and the rear brake lever on the right side.



Control layouts

- | | |
|--------------------------|----------------------------------|
| 1. Front brake lever | 11. Ignition key |
| 2. Air control lever | 12. Rev-counter |
| 3. Throttle control grip | 13. Clutch lever |
| 4. Starter button | 14. Light switch and horn button |
| 5. Filler cap | 15. Side stand |
| 6. Gearshift lever | 16. Rear brake pedal |
| 7. Pillion footrest | 17. Footrests |
| 8. Pillion handgrip | 18. Center stand |
| 9. Headlight | 19. Tail light |
| 10. Speedometer | |

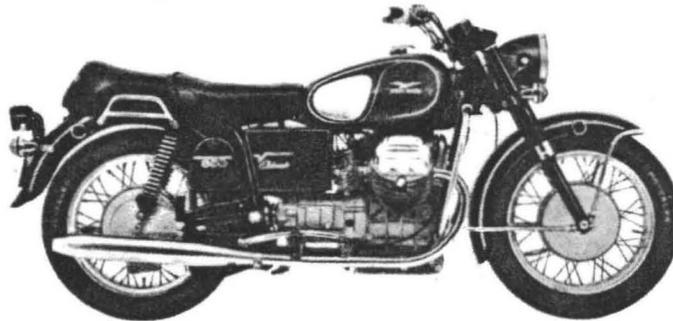
General Specifications

Model	V700	V750	V850
DIMENSIONS			
Wheelbase (in.)	56.9	57.8	58.8
Length (in.)	87.5	88.3	88.3
Width (in.)	31.2	32.6	31.3
Height (in.)	41.2	42.1	32.5
Minimum ground clearance (in.)	5.9	5.9	5.9
Curb weight (lbs)	536	502	548

General Specifications (cont.)

Model	V700	V750	V850
CAPACITIES			
Fuel tank (gals)	5.28	5.84	5.84
Reserve tank (gals)	1.0	1.0	1.0
Sump (qts)	3.25	3.25	3.25
Transmission (pts)	1.75	1.75	1.75
Drive box (oz)	4.0	4.0	11.4
Fork legs (oz)	5.4	5.4	5.4
ENGINE			
Type	four-stroke; push-rod operated overhead valves		
Number of cylinders	2	2	2
Cylinder disposition	"V" 90°	"V" 90°	"V" 90°
Bore X stroke (mm)	80 x 70	83 x 70	83 x 78
Displacement (cc)	703.717	757.486	844.05
Compression ratio (: 1)	9	9	9.2
Maximum rpm	6000	6500	6500
Horsepower at maximum rpm (SAE)	50	60	64
Carburetion (Dell'Orto) right side	S.S.I	VHB 29 CD	VHB 29 CD
left side	S.S.I	VHB 29 CS	VHB 29 CS
Lubrication	pressure; gear driven off crankshaft		
TRANSMISSION			
Clutch type	flywheel mounted, dry, twin driven plates		
Gearbox type	constant meshed gears bolted to crankcase		
Engine/gearbox ratio (1 :)	1.375	1.375	1.235
Internal gear ratios (1 :)			
First gear	2.230	2.230	2.000
Second gear	1.333	1.333	1.388
Third gear	0.954	0.954	1.047
Fourth gear	0.750	0.750	0.869
Fifth gear	—	—	0.750
Secondary drive type	constant speed homokinetic double joint cardan shaft		
Overall gear ratios (1 :)			
First gear	14.180	13.413	11.424
Second gear	8.473	8.015	7.929
Third gear	6.063	5.735	5.980
Fourth gear	4.768	4.510	4.964
Fifth gear	—	—	4.284
PERFORMANCES			
Maximum speed per gear (solo) (mph)			
First gear	41.0	38.5	42.2
Second gear	59.6	64.6	61.2
Third gear	74.5	89.2	81.9
Fourth gear	106.0	115.0	102.1
Fifth gear	—	—	120.1
Climbing ability per gear (solo) (%)			
First gear	60	60	87
Second gear	34	40	47
Third gear	23	20	28
Fourth gear	14	8	17
Fifth gear	—	—	9

2 • Maintenance



The importance of maintaining a motorcycle conscientiously and carefully cannot be overstressed. Apart from the obvious benefits of safety and economy, a well-maintained bike will generally be ridden with more care and consideration than a dirty, out-of-tune motorcycle. When something is wrong with their machine, even something very minor, many riders tend to become annoyed and will treat the bike more harshly than they normally would. This, naturally, does nothing but aggravate the situation and may lead to component failure sooner than expected.

To counter the tendency toward frustration and anger when one's motorcycle is not right, a special attitude toward maintenance must be developed. Here in America, manufacturers of mechanical appliances, especially the automotive companies, advertise their products as being practically maintenance free. While it is true that maintenance operations have been reduced and maintenance intervals have been lengthened, it becomes all the more important that necessary services be carried out exactly when prescribed and with great care. Unfortunately, exactly the opposite is true in most cases, and a "drive it till it breaks" attitude prevails.

However unfortunate this may be to the automobile driver's bank balance, one who approaches motorcycling in the same manner is risking a great deal more than money. With a car, unless a wheel or

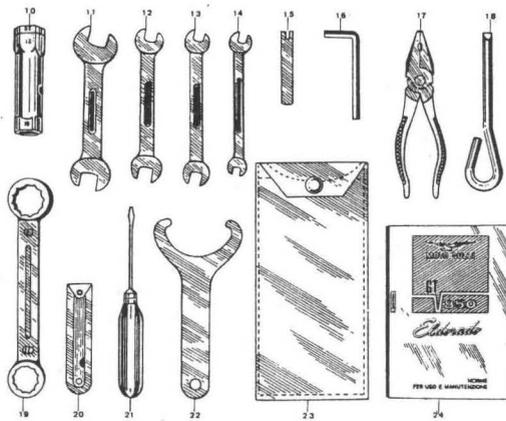
something falls off, a mechanical failure does not affect basic vehicular stability. Motorcycles, however, tend to go down rather suddenly and spectacularly when a component fails under stress and the result can be quite painful.

Men who are involved with other types of machines that are unpleasant to be around when mechanical failure occurs, take their jobs very, very seriously. Aircraft maintenance crews and professional racing mechanics use maintenance check lists and logbooks to make certain that no operations are overlooked and that no component is stressed beyond its maximum working life. They do not view maintenance as corrective action, but as an ordered procedure of cleaning, inspection, adjustment, lubrication, and replacement of critical items at regular intervals, as *preventive* action.

Motorcycle maintenance should be approached in basically the same manner. Keeping a machine properly serviced need not be excessively time consuming, but services should be performed regularly and in a professional manner. This means that the owner/mechanic must have:

1. An adequate supply of good quality tools.
2. A fairly clean place to work.
3. Enough time to do the job properly.
4. Necessary working specifications and procedures.

It should be noted that, just as in break-



Basic tools necessary for maintenance operations

10. Wrench, box 19/21/22 mm
11. Wrench, open ended 17/19 mm
12. Wrench, open ended 13/14 mm
13. Wrench, open ended 10/11 mm
14. Wrench, open ended 7/8 mm
15. Wrench, open ended tappet adjusting
16. Allen key, 5 hex
17. Pliers, universal
18. Screwdriver
19. Wrench, ring, double 22/27 mm
20. Feeler gauge
21. Screwdriver
22. Wrench, damper adjusting
23. Tool bag
24. Instruction booklet

ing-in a bike and getting acquainted with it, a feel should be developed for the maintenance needs of the various components. The conditions under which the machine is used will have a great bearing on when attention is necessary and it may be beneficial to modify the maintenance schedule after a few thousand miles have been covered and the bike's peculiarities have become known.

Daily Inspection

Daily inspection does not have to involve more than a quick "confirmation" check of the bike and should take no more than a few seconds. Items to be checked before each ride include:

1. Operation of the lights—especially tail and brake lights.
2. Brake adjustment.
3. Engine oil level.

Weekly Inspection

In addition to the items that are checked daily, inspect and adjust if necessary:

1. Tire pressure (when cold)
2. Battery electrolyte level
3. Clutch cable free play
4. Tightness of critical nuts and bolts such as axle nuts, engine mounting bolts, and control fasteners.

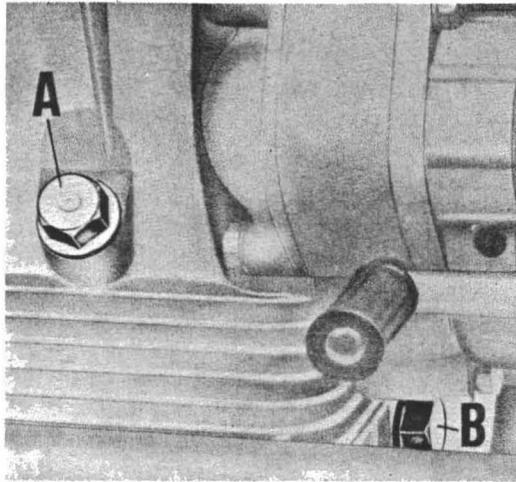
At this time it would be a good idea to clean the bike as thoroughly as time permits, even if it is only to hose it down and wipe it dry. A motorcycle can accumulate an amazing amount of dirt in a short time and, if allowed to build up for a few weeks, it will take hours to clean and reduce engine cooling efficiency. If the bike is to be taken to a high-pressure car wash be careful to keep the spray away from the air cleaner, carburetors, and wheel bearings. Hot water under pressure can work its way into all kinds of places where it shouldn't be. Remember to check the brakes after washing, as water can make them useless on the first few applications. Drag them slightly, if necessary, to dry them out. Start the engine immediately after washing and allow it to run for about ten minutes to evaporate any water that has accumulated in vital areas.

Oil Changes and Lubrication

ENGINE OIL

The engine oil level should be checked using the dipstick (A) at least every 300 miles without fail and the oil should be changed every 1,800 miles under normal conditions, or more often if used in dusty or extremely cold climates. The oil level should be above the minimum mark on the dipstick, but below the top mark as measured with the engine at its normal operating temperature. Turn down the filler cap one turn when taking a reading to get accurate results.

Drain the oil with the engine at its normal operating temperature by removing first the filler plug (A), and then the drain plug (B), and allow the oil to drain into a

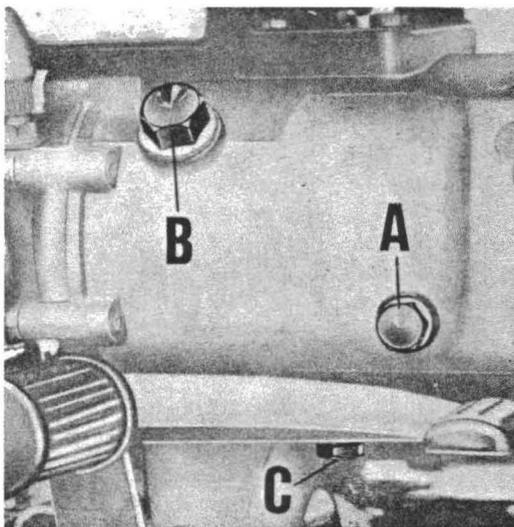


Engine oil filler and drain plugs

suitable receptacle. Remember to replace the drain plug before refilling.

TRANSMISSION OIL

The oil level of the transmission should be checked every 1,800 miles, or more often if the transmission leaks. Check the level with the engine at its normal operating temperature by removing the level plug (A); the oil should come right up to the lower lip of the level plug hole. If it looks like the transmission needs oil and it's getting close to replacement time, replace it now, but if the level is down due to leakage, add fresh oil until it begins to run out the level hole.

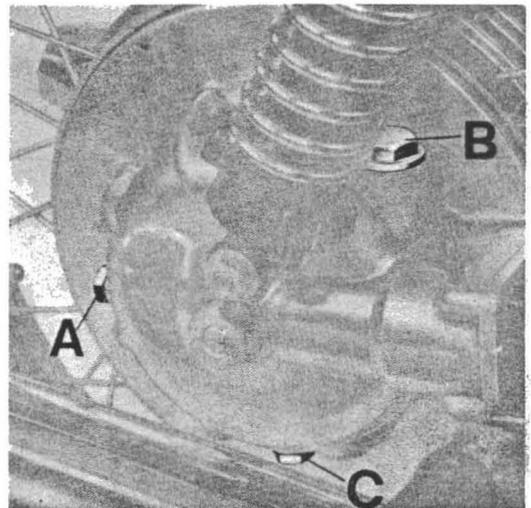


Transmission oil level, filler, and drain plugs

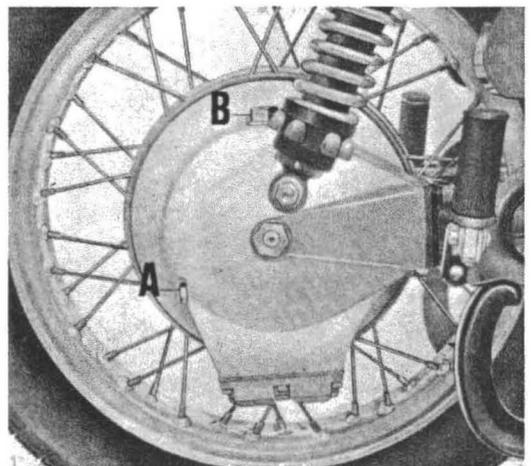
The transmission oil should be changed every 6,000 miles or at least once annually. With the engine at its normal operating temperature remove the filler plug (B), level plug (A), and drain plug (C) and allow the oil to drain into a suitable receptacle. Secure the drain plug and add fresh oil through the filler plug until it begins to run out through the level plug, then secure the remaining two plugs.

REAR WHEEL DRIVE OIL

The rear wheel drive oil should be checked every 1,800 miles and changed every 6,000 miles (or annually) as in the case of the transmission oil. Follow all of



Drive box level, filler, and drain plugs (V700 and V750)



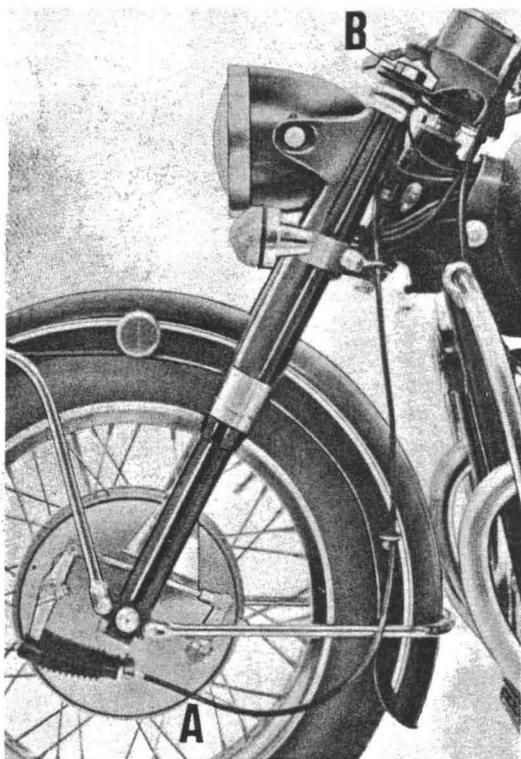
Drive box level and filler plugs, and drain cover (V850)

the above procedures given in the above section.

NOTE: On the Sport and V850 models, there is no drain plug. Instead, the bottom cover is removed to drain the oil.

FRONT FORK OIL

The oil in the forks should be changed every 12,000 miles, annually, or whenever necessary. Failure to carry out this service may lead to premature fork seal leakage due to contamination in the oil, or in extreme cases, damage to the suspension components through rusting or scoring.



Front fork drain and filler plugs

Drain the oil after riding the machine so the oil is flowing freely in the forks. Draining is accomplished by removing the drain plugs and washers (A) from the bottom of each fork leg and then removing the filler caps from the top of each leg. Pumping the forks several times will ensure that all the oil has drained. To refill the forks install the drain plugs, renewing the washers if necessary, and add the necessary amount of lubricant. If the forks have been taken apart and cleaned you should add an additional 10 cc to make up for the oil that

normally would be coating the internal parts.

STEERING HEAD BEARINGS

The steering head bearings should be removed and repacked with fresh bearing grease every 12,000 miles or whenever necessary.

WHEEL BEARINGS

The wheel bearings should be removed and repacked with fresh bearing grease every 12,000 miles or whenever necessary.

CONTROL CABLES

The control cables should be thoroughly lubricated every 600 miles, or whenever necessary, with grease or a commercial chain spray. Silicon base sprays provide the longest lasting protection against friction. An easy way to perform this task is to disconnect the cable at the handlebar, form a funnel around it with a piece of plastic, and pour the lubricant into the funnel. When the lubricant begins to drip out of the bottom of the cable, the lubrication process is complete. Lubricate the handlebars with grease or chain spray, then operate them several times to ensure complete penetration.

SWING ARM BEARINGS

The swing arm bearings do not require periodic maintenance, however it is a good idea to inspect and thoroughly repack them any time work on the swing arm assembly becomes necessary.

OIL BREATHER UNIT

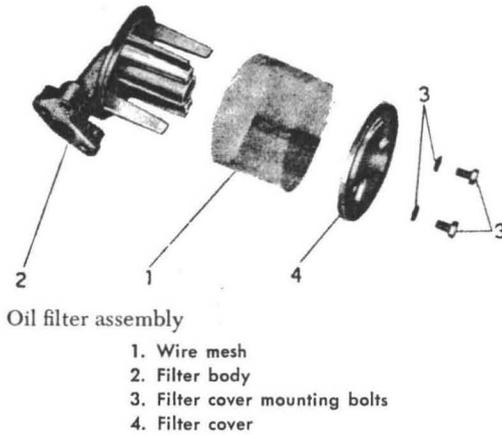
Whenever you place the machine in storage for an extended period of time the possibility of undesirable deposits forming on the breather diaphragm is present. This may cause the diaphragm to stick resulting in oil leakage. Before returning the machine to active duty, it is advisable to remove and inspect the unit in the following manner:

1. Remove the breather unit securing bolt.
2. Remove the breather by backing it out to the left.
3. Soak the unit in a suitable solvent, then blow it dry.
4. Check the action of the pressure relief valve by moving it with a suitable rod inserted into the central tube of the

breather. Free the rod, if necessary, then clean the unit thoroughly in solvent, blow it dry, and install it on the machine.

OIL FILTER

An oil filter is fitted to all of the models covered in this guide, but is not a regular maintenance item. However, if for any reason you suspect that there may be foreign objects in the oil supply, the filter should be removed, thoroughly cleaned, and then remounted in conjunction with a flushing of the crankcase. The filter is mounted above the oil pump which is located in the right hand lower corner of the crankcase immediately behind the oil pump gear. Access to the filter is most easily gained by removing the sump pan, but can also be reached by removing the oil pump assembly.



Oil filter assembly

- 1. Wire mesh
- 2. Filter body
- 3. Filter cover mounting bolts
- 4. Filter cover

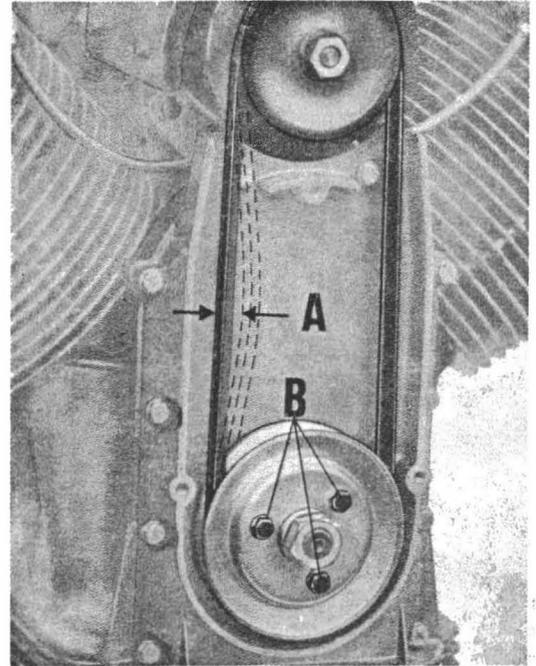
Routine Checks and Adjustments

GENERATOR BELT

Over a period of time the generator belt will become loose and the need for adjustment will arise to prevent slipping and the subsequent loss of generating efficiency. Normal belt slack (A) is about 1 cm per 10 kgs (0.39 in./21 lbs). Avoid overtightening the belt as this may cause premature wear to the belt and generator assemblies.

Adjust the generator belt in the following manner:

1. Remove the three bolts (B) which secure the outer half-pulley to the pulley hub, then remove the half-pulley.



Adjusting the generator belt tension

2. Add or remove spacing collars as necessary. Removing spacers will increase belt tension and installing spacers will decrease it. Spacers should be removed or installed one at a time and, if more than one spacer is removed, the extras should be placed at the front and rear of the pulley so as not to throw the pulleys out of alignment.

3. Replace the outer half-pulley and secure the three mounting bolts. Recheck the adjustment and repeat the operation until a satisfactory adjustment is attained.

GENERATOR

Every 6000 miles, or whenever necessary, the generator commutator should be cleaned with a clean cloth slightly moistened with clean gasoline.

If carbon or copper dust has settled in the mica insulators, it should be blown clean with compressed air.

At this time inspect the brushes and replace them if chipped, excessively worn, or if they look like they won't last another 6000 miles. Make sure you use authorized replacement parts, and be sure the brushes make perfect contact with the commutator.

REGULATOR

The regulator is sealed to keep you from tampering with it if you don't know what

you're doing. If the unit is malfunctioning it should be replaced or returned to your dealer for repair.

STARTER MOTOR

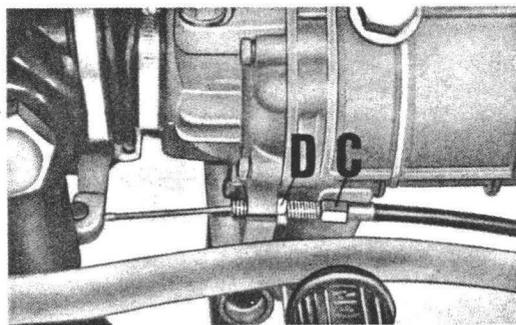
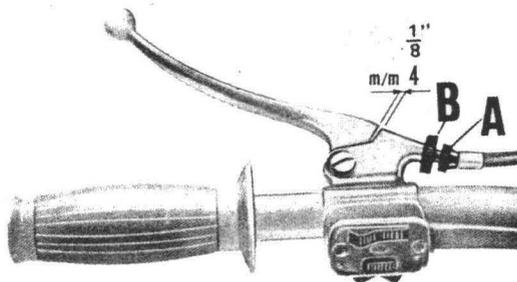
Every 12,000 miles, or whenever necessary, the starter motor commutator should be cleaned with a clean cloth moistened with clean gasoline.

Carbon or copper dust between the rotor segments should be blown away with compressed air. At this time the brushes should be inspected and replaced if worn, damaged, or if they look like they won't make it for another 12,000 miles. They must be in perfect contact with the commutator to avoid damage to it.

CLUTCH LEVER

Check the clutch adjustment periodically or whenever you experience clutch engagement or gear-shifting problems. Free play at the lever should be about $\frac{1}{8}$ in. (4 mm) and can be adjusted by loosening the thumb screw (B) at the lever and screwing the adjuster (A) in or out as necessary until a correct adjustment is arrived at. Secure the thumb screw before riding the machine or the adjustment may be lost.

If the clutch has been slipping, the adjuster should be backed out; if the clutch has been dragging, as evidenced by loud

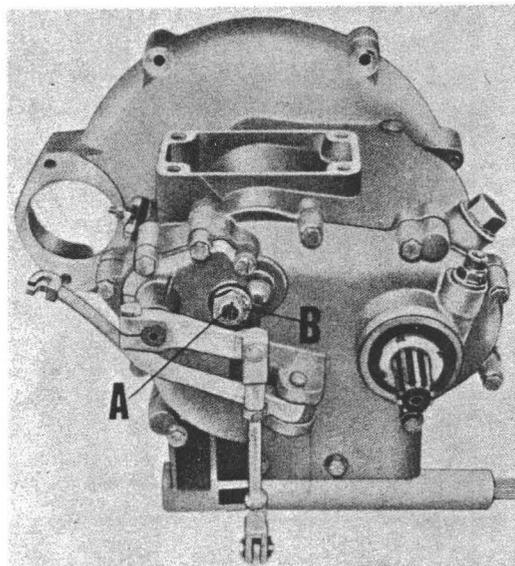


Adjusting the clutch cable

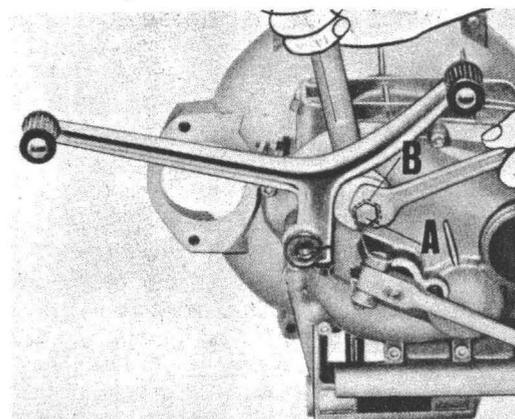
gear engagements or creeping at stop lights, the adjuster should be turned in. If adjustment at the hand lever does not prove sufficient, additional adjustment may be made at the release lever by loosening the locknut (D) and adjusting the cable adjuster (C) as necessary. Make sure that the clutch releases completely to avoid accelerated wear to the clutch mechanism and make sure that adjustments at the release lever do not adversely affect the adjustment at the hand lever which may have to be done again.

SHIFTER MECHANISM

If noisy gear shifts cannot be alleviated by adjusting the clutch, try adjusting the shifter mechanism. Loosen the locknut (B), then rotate the adjusting screw (A), on



Gearbox adjustment (V700 and V750)



Gearbox adjustment (V850)

V700 and V750 models, or the eccentric nut (B) on the V850 model, in and out until a position is arrived at where the gears will shift smoothly both up and down throughout the range, and where Neutral can be readily found.

When the best adjustment is arrived at, the locknut should be secured while the adjusting screw or eccentric nut is held steady by means of a screwdriver.

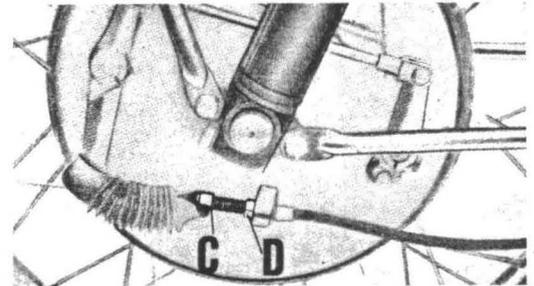
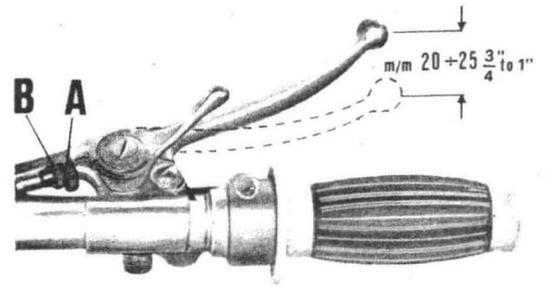
BRAKES

The brakes should be checked periodically and adjusted whenever necessary. If adjustment at the front brake hand lever or at the thumb screw on the rear brake rod fails to provide the desired results, it may be because the linings have worn down to a point where they no longer can contact the brake drum, or because they have become grease or oil impregnated and cannot generate enough friction to effectively stop the machine. In this case, the brakes should be taken down and thoroughly examined so the proper corrective steps can be taken. It is possible to get a little more life out of the linings by removing the brake actuating lever from the brake in question and rotating it back a couple of degrees on its shaft. The lever should be spread a little, after the pinch bolt has been removed, to aid in its removal and to avoid damage to the splines. It is essential that the linings be inspected before such a move is made to insure that there is enough lining left so that the drum is not scored. When new linings are installed after this has been done it will be necessary to reposition the lever to its original location.

Front Brake Adjustment

There should be about $\frac{3}{4}$ -1 in. (20-25 mm) of free play at the hand lever when the brake is properly adjusted. This is the distance the tip of the lever can move before the brake shoes contact the drum.

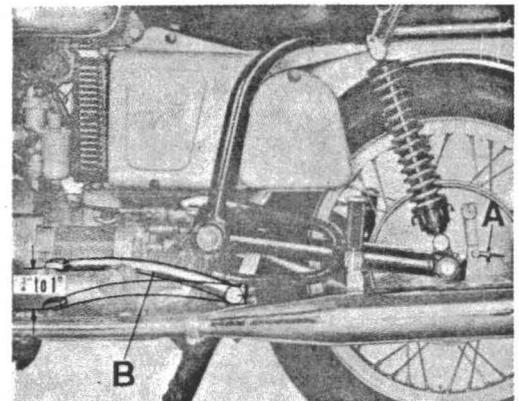
Adjust the brake by loosening the thumbscrew (A) and rotating the adjuster (B) until the proper adjustment is arrived at, at which time the thumbscrew should once again be secured. If you are unable to attain the desired results at the hand lever, further adjustments can be made by loosening the locknut (D) and adjusting the adjuster (C) located on the brake backing plate.



Front brake adjustment

Rear Brake Adjustment

There should be about $\frac{3}{4}$ -1 in. (20-25 mm) of free play at the tip of the brake pedal (B) before the brake shoes begin to contact the brake drum. All adjustments to the rear brake are made at the thumb screw (A) located on the end of the brake rod. Usually the linings are completely worn by the time the adjuster reaches the threaded portion of the brake rod.

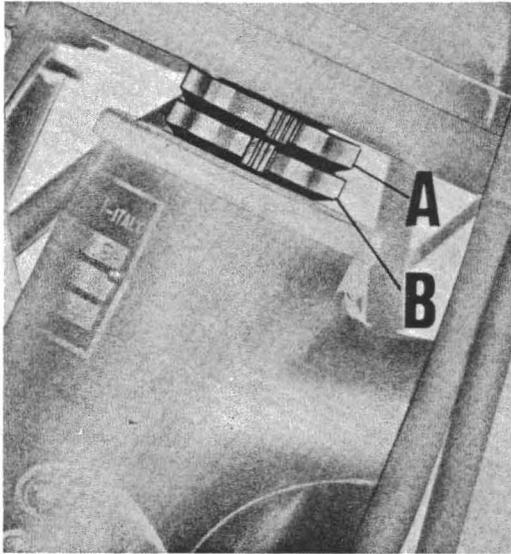


Rear brake adjustment

STEERING HEAD

Excessively loose steering may be remedied provided it is not due to wear of the steering head bearings. Loosen the locknut

(A) and adjust the lockring (B), using a suitable wrench, to a position where the steering is smooth and free but not loose. The forks should fall to either side, rather than only one side each time they are released, and there should not be an appreciable amount of play when the forks are grasped at the bottom and pulled back and forth.



Steering head bearing adjustment

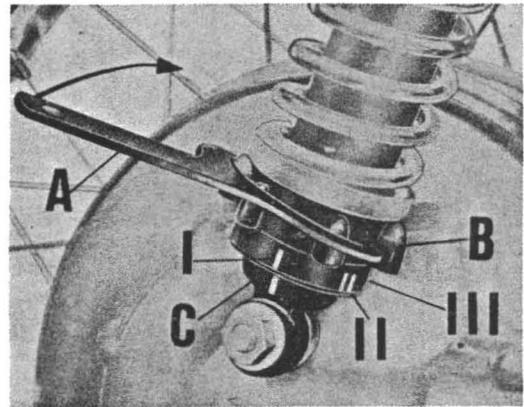
When the play is as desired, secure the locknut while keeping a firm hold on the lockring so the adjustment is not lost. If the steering is adjusted too loose or too tight it will result in rapid wear of the bearings and their races.

REAR SHOCK ABSORBERS

The rear shocks require no periodic adjustment, but various circumstances may warrant adjusting the load level to a more suitable position.

The shocks come with three possible adjustments designed to meet all load requirements. The first position is for normal conditions, the second position is for carrying additional equipment or a passenger, and the third position is for two-up riding with additional equipment.

The shocks are adjusted by means of the special wrench (A) which comes with each machine. Using the wrench to turn the adjusting cam (B) counterclockwise will move the shock from position "1" to position "2" and so on. The shock is properly



Shock absorber adjustments

adjusted when the mark for the desired setting is aligned with the fixed mark (C). Make sure both shocks are always kept on the same setting.

TIRES AND WHEELS

Examine the tires for casing damage (splits, bubbles, etc.) and for objects lodged in the tread. Replace the tires before the tread is completely worn off, or if the tread becomes unevenly worn, because it may prove more costly to repair the bike if you dump it. Always maintain the correct tire pressure and always check the pressure before riding since heat causes the air inside to expand. If you plan to do some high-speed riding, if you weigh a lot, or if you plan to do most of your riding with two aboard or hauling a lot of extra weight, it's a good idea to increase the pressure a couple of pounds. A good rule of thumb is to increase the pressure by 2 lbs for every weight increase of 50 lbs over the norm (usually considered as a rider of 150 lbs).

Check the tightness of the spokes, but unless a spoke is obviously too loose, do not attempt to tighten it or the wheel may become distorted. Tighten a loose spoke until it is approximately as taut as the neighboring spokes. If any spokes are broken, or if a large number are loose, the wheel should be removed for complete servicing. Consult the "Chassis" chapter for additional information.

BATTERY

Service

The battery is the source of all spark for starting, operating the accessories without

the engine running, and providing the necessary current when the generator is producing an insufficient amount.

Electricity is generated through the chemical reaction of opposite charges bathed in electrolyte (liquified sulphuric acid). Each cell is in series with a cell of opposite charge and each produces two volts (V) of current.

Every 1800 miles the battery electrolyte level should be checked and the battery topped up if necessary. Distilled water should be used, rather than additional battery acid, and each cell should be covered by about 1/4 in. of acid. Avoid overfilling the battery as this may cause the electrolyte to boil over and ruin your chrome and paint. Be very careful when working with a battery because electrolyte will strip off skin, clothing, etc., as well as paint and chrome in a matter of seconds. Baking soda can be used to neutralize the acid if necessary, but if the stuff gets on your skin or near your eyes, consult a physician immediately.

Check the condition of the battery breather tube. It must extend to a point below the frame where relatively little damage can be done if the battery spills or boils over. Make sure that the battery tube is not pinched or closed off or the battery may build up enough pressure to explode.

The state of the battery's charge should be checked periodically with a hydrome-

ter. If the specific gravity reading on any cell is below 1.200 (at 68° Fahrenheit), the battery should be recharged. Do not use a high-output battery charger unless absolutely necessary. If the battery must be charged quickly, observe these rules;

1. Do not charge the battery at an amperage rate greater than its rated amp/hr capacity.

2. Never allow the electrolyte temperature to exceed 122° F while charging or fall below 104° F.

3. Do not quick-charge a fully discharged battery.

4. Do not quick-charge a battery in which the specific gravity of one or more cells is noticeably lower than the others.

5. Do not charge the battery in a confined room or near heat, since hydrogen gas is released during charging.

6. Disconnect the battery positive (+) lead if the battery is to be charged while on the motorcycle.

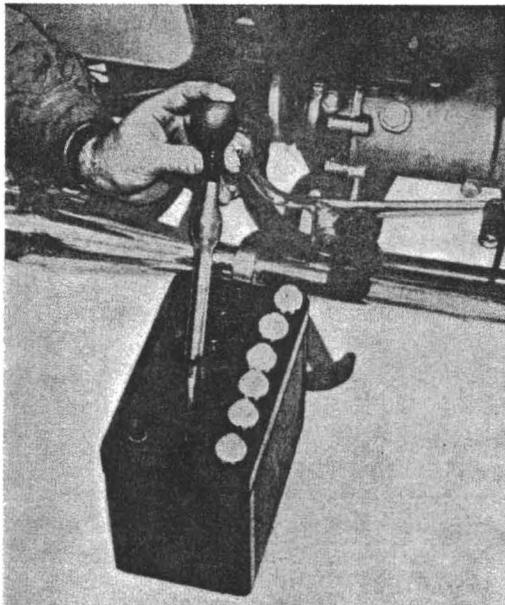
7. Thirty minutes is usually adequate charging time at maximum charging rate.

An adjustable, low-output (trickle) charger is an alternative to the high-output charger and is available at most automotive supply stores at a reasonable cost. A battery that is charged at a low rate will take and retain a fuller charge and plate damage due to high current is less likely to occur. When charging a battery at a low rate do not exceed 1/10th its normal amperage.

Do not charge a battery for an extended period of time (more than 15 hours) at a rate of charge greater than 1/10th of its rated 32 amps, or 3.2 AH.

When rechecking the specific gravity of the cells after charging, allow sufficient time for the gas bubbles to be released or a false (low) reading will be obtained. A good battery should have a specific gravity reading of 1.260–1.280 in all cells at 68° F. The battery is in need of replacement if one or more of the cells is excessively low. If a charging system fault is suspected as the reason why the battery goes dead, consult the "Electrical System" chapter for additional information.

Do not neglect to keep the battery case and terminals clean. A solution of baking soda and water works well to remove corrosion, but take care to keep the baking soda from entering any of the cells or the electrolyte will be neutralized. Petroleum



Checking the state of charge of the battery

jelly can be used as a corrosion inhibitor on the terminals after they have been cleaned. Check the level of the battery every week. Electrolyte evaporates rapidly in the summertime and you may wind up with a dry, dead battery after only a few weeks.

Cleaning

WASHING AND WAXING

Unfortunately, most riders tend to ignore an accumulation of dirt on their machines. This is especially true when you're on the road for some time and can't get it together to keep yourself as clean as you'd like let alone your long suffering mount. True, the brakes are sealed and the machine is built to take rough treatment, but if you leave the bike sitting in last month's mud, you'll eventually regret it. Nothing wears out wheel bearings, seals, and a nice finish faster than dirt. If you want the bike

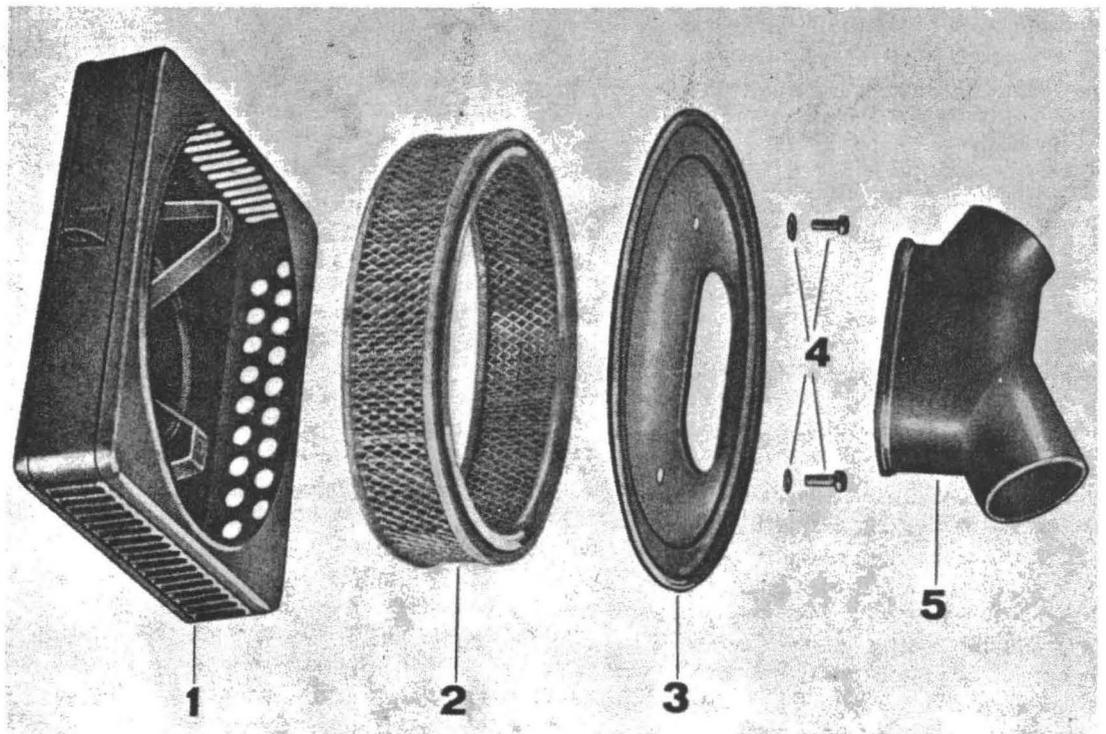
to last, you must treat it right and keep it clean.

The best way to wash the machine is with hot soapy water and a soft-bristled brush. In some instances you may need something stronger, such as a commercial grease cutter, to clean the engine area. Do not wash the machine at a commercial high-pressure detergent car wash because the high-pressure water and detergent will cut not only through the dirt, but your wheel bearing packings as well. After the machine has been cleaned thoroughly, start it up and ride it around for about ten minutes to evaporate any water which might have accumulated in any vital areas.

Protect painted finishes with automotive-type wax and use chrome polish and preservative on plated surfaces. A good heavy application of these two will not only brighten appearance but will also prevent corrosion.

AIR CLEANER

The air filter element used on these machines is a dry paper type and can be found in the air filter box which is secured



Air cleaner assembly

- | | |
|-------------------|-------------------------|
| 1. Filter body | 4. Cover securing bolts |
| 2. Filter element | 5. Junction tube |
| 3. Filter cover | |

to the frame. The element can be cleaned with kerosine and blown dry, or the dirt can merely be blown off with compressed air. If the element ever becomes saturated with oil or becomes too dirty to clean, it must be replaced. The air filter should be attended to at least every 9000 miles or whenever necessary as conditions dictate.

DECARBONIZATION

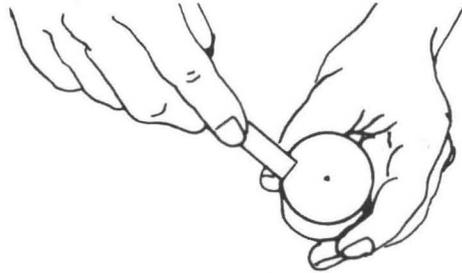
Anything which isn't burned up during combustion winds up as a carbon deposit somewhere in the cylinder or head assemblies. Although most riders don't consider decarbonization as a maintenance item necessary for four-strokes, they're dead wrong. Carbon doesn't build up as quickly in a four-stroke as in a two-stroke, but it does build up and can cause pre-ignition or abnormally raised compression.

Normally, heat is dissipated throughout the cylinder head and piston crown. If a heavy layer of carbon is present, however, it acts like an insulating blanket which causes an undesirable and excessive concentration of heat on all of the top end components. Coupled with this is the fact that carbon buildup decreases the displacement of the combustion chamber and therefore increases the compression ratio. This will cause excessive heat and pre-ignition which will harm the rod bearings and eventually hole the piston.

Decarbonizing should be performed whenever necessary, every 10,000 miles, or whenever work is done on the top end. The piston ring grooves should be thoroughly cleaned whenever the rings are replaced, or every second or third time the head is decarbonized. If the valves need to be decoked, they should be disassembled first to avoid possible damage to their seats.

It is important to remove only the carbon and not half of the piston or head while performing this operation. Use a blunt blade, such as a butter knife, to decarbonize all surfaces other than the piston ring grooves which may be cleaned out with a sharpened portion of broken piston ring. Wipe the surface clean periodically with a cloth dipped in clean solvent so you can see what's doing. When you can see metal, you've removed enough. It is not important to restore the piston to a like-new condition, but rather to remove only as much carbon as is necessary to re-

store efficient engine operation. Remember that aluminum gouges easily so don't bear down heavily on the decarbonizing instrument.



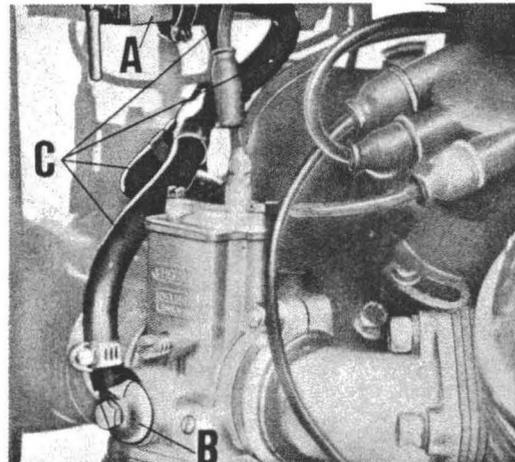
Decarbonizing the piston crown



Decarbonizing the ring grooves

FUEL LINES

Periodically, or after an extended period of storage, the fuel lines (C) should be removed and thoroughly flushed out along with the fuel tank, petcocks (A), adaptor filters (B), and the carburetor float bowls. Clean these items thoroughly with solvent or gasoline, flush them thoroughly, and place them back on the machine.



Fuel line fittings

MUFFLERS

If necessary, excessive sludge and carbon deposits can be removed from the mufflers by removing them and filling them up with a solution of boiling water and caustic soda, or a suitable substitute, in a ratio of about 5:1. After allowing them to dry for about an hour, the mufflers should be emptied and thoroughly rinsed with boiling water while shaking them vigorously.

Storage Procedures

SHORT-TERM STORAGE

1. Wash the bike thoroughly and ride it until normal operating temperature is reached and all water is evaporated.
2. Drain and replenish the engine, transmission, and drive box oil.
3. Run the engine long enough to circulate the fresh oil.
4. Fill the fuel tank with the brand of gasoline normally used.
5. Remove the air filter element, close the fuel petcock, and start the engine. Squirt a couple shots of oil into the carburetor, or until the engine stalls. This serves to lubricate the valves, rings, and cylinders. It may also foul the spark plugs, so keep this in mind when trying to start the machine. Turn the ignition off as soon as the engine dies.
6. Drain the carburetor float bowl and replace the air cleaner element.
7. Check the battery electrolyte level. Charge the battery if necessary. Disconnect the positive lead, clean the battery

surface and terminals thoroughly, and coat the terminals with petroleum jelly.

8. Lubricate all points on the machine thoroughly.

9. Heavily wax and polish all metal surfaces, especially the chrome. If the wax is the type that can be polished when dry, it may be left on during storage.

10. Place the bike on its center stand or block it upright. Place boards under the tires to prevent rot.

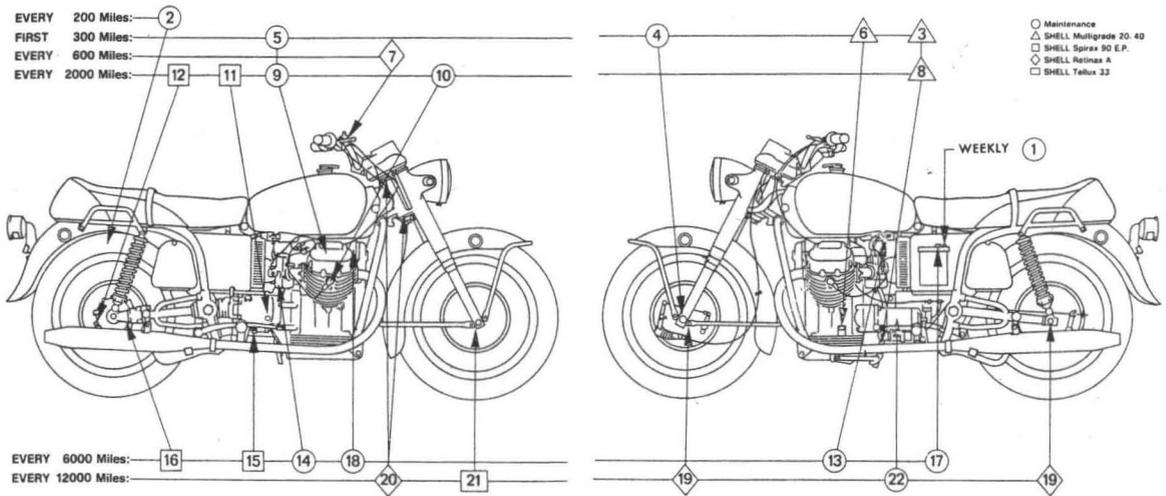
11. Cover the bike with a porous material (i.e. an old blanket) to help fight condensation. If the bike is to be stored outside, it may be covered with a non-porous material, but should be uncovered periodically to prevent rust.

12. To remove the machine from storage, clean off any dust or polish, check over all of the maintenance points, and adjust the timing, valves, carburetors, generator belt, etc. as necessary. The carburetors and crankcase breathers may be gummed up and in need of cleaning, the plugs may need replacement, and the battery will probably need water.

LONG-TERM STORAGE

For periods in excess of two months, perform all of the above steps and also:

1. Disconnect the fuel lines and drain off all but about one quart of gasoline.
2. Pour one-half cup of oil into the tank and coat the walls of the tank by rocking the machine back and forth.
3. Seal the fuel line and petcock openings but do not connect the two.
4. Remove and fully charge the battery and store it in a cool, dry place. Recharge the battery every two months.
5. Drain the gas tank thoroughly and flush it out before trying to start the bike.



Maintenance and lubrication points

Periodic Maintenance and Lubrication Chart

Weekly

- ① Check battery electrolyte level
 - 2. Check tire pressure
- After 300 miles on a rebuilt motor
- 3. Drain and replace the crankcase oil
 - 4. Secure all nuts and bolts
 - 5. Check and adjust tappets if necessary

Every 600 miles

- 6. Check the level of the crankcase oil and replenish if necessary
- 7. Lubricate the cables

Every 1800 miles

- 8. Replace crankcase oil supply
- 9. Check and adjust tappets if necessary
- 10. Clean and gap spark plugs
- 11. Check transmission oil and replenish supply if necessary
- 12. Check drive box oil supply and replenish if necessary

Every 6000 miles

- 13. Clean gas taps, filters, lines and tank vent
- 14. Disassemble carburetor and rebuild if necessary, but if she's running good leave her alone
- 15. Change transmission oil
- 16. Change drive box oil
- 17. Check the battery terminals, then clean, secure, and vaseline them if necessary
- 18. Clean generator commutator with a clean cloth slightly moistened with gasoline

Every 12000 miles

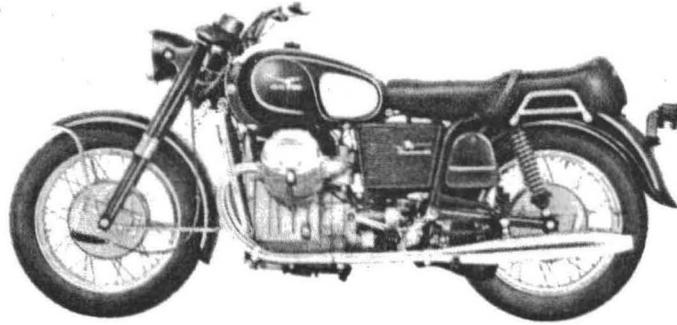
- 19. Check condition of wheel bearings and replace or repack the assembly as necessary
- 20. Inspect steering head bearings and replace or repack as necessary
- 21. Replace fork oil
- 22. Clean starter motor commutator with a clean cloth slightly moistened with gasoline

① The numbers indicate reference points on the accompanying illustration

Maintenance Data

Model	V700	V750	V850
Engine Oil Capacity (qts)	3.25	3.25	3.25
Transmission Oil Capacity (pts)	1.75	1.75	1.75
Drive Box Oil Capacity (oz)	4.0	4.0	11.4
Fork Oil Capacity (oz)	5.4	5.4	5.4
Tires (all models):			
Front (in.)	4.00 x 18		
Front Pressure (psi)	21		
Rear (in.)	4.00 x 18		
Rear Pressure (psi):			
solo	25		
duo	28		

3 · Tune-Up



When performing a tune-up, you are restoring to peak efficiency certain engine components which are subject to changes in operating efficiency during use. A tune-up is nothing more than a series of adjustments performed in logical order, one at a time, to predetermined specifications. There is no guess work involved. There are no complicated disassembly procedures and it is not necessary for you to have years of experience in diagnosing engine problems and speed tuning. All tune-up operations are quite straight forward.

A tune-up involves the following procedures in the order shown:

1. Valve clearance adjustment.
2. Contact points service.
3. Ignition timing.
4. Spark plug service and compression check.
5. Carburetor adjustment.

There are no special tools that are necessary to perform a tune-up other than the tool kit which came with the bike and a continuity tester which can be made out of a taillight bulb with two wires soldered to it.

Bear in mind that items not covered in this chapter, such as air and fuel filter servicing, cleaning and checking the battery, etc., can have an effect on the results of a tune-up. It is assumed that you have maintained your bike passably well. If not, refer to the "Maintenance" chapter for the engine-related maintenance procedures,

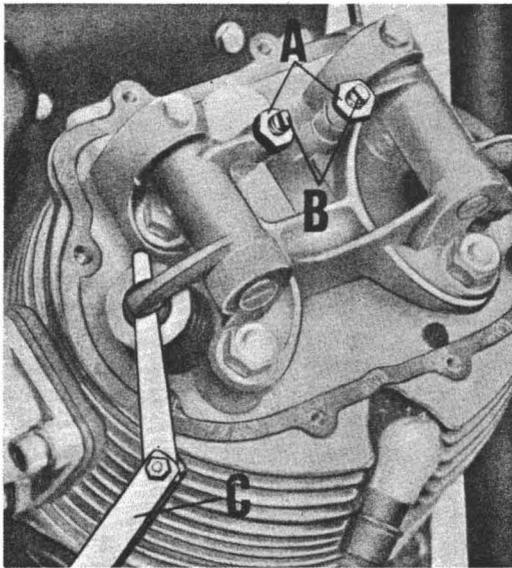
and carry them out before beginning the tune-up. Remember that the bike must be stone cold before the tappets can be adjusted, so don't run the engine before beginning.

Valve Clearance

Valves should be set with the engine stone cold. Since the clearances you will be working with are relatively small, take care to adjust the valves as closely as possible to specification. Excessive clearance can cause unnecessary noise and accelerated cam lobe wear; insufficient clearance can be responsible for hard starting, rough running, accelerated wear to the valve train and, ultimately, burned valves and valve seats. Take your time and make sure you've done it right. Make sure the surface of your feeler gauges is smooth and unmarred, or an accurate adjustment may not be attained. After the first or second time you will develop a feel for the correct clearance and the job will go much faster.

The tappets should be adjusted every 1800 miles or whenever necessary. If the engine is new or has just been rebuilt, especially if it was the top end, the valves should be adjusted after the first 300 miles. Remember, if you can hear the tappets they are probably alright but if, after starting the engine, you can't hear them, shut it

off immediately and wait until the engine is stone cold, or at least until you can't feel any warmth at all when laying your hand on the cylinders, before adjusting them again. If necessary you can set them a little loose in order to get home, but definitely don't ride with them too tight. A good way to listen to the valves is to place the tip of a long screwdriver against the valve cover and then listen by placing your ear on the handle.



Adjusting the valves

ADJUSTMENT

1. Rotate the engine until the piston is at TDC (top dead center) of the compression stroke (clearance at both tappets). You can find TDC by inserting a screwdriver into the spark plug hole and rotating the engine carefully taking care not to jam the screwdriver. The tip of the screwdriver should rest gently on the piston crown. TDC is that point at which the piston is at its highest point of travel and is about to go down.

2. Remove the rocker box covers and check the clearances with appropriate size feeler gauges. The inlet valves should be set at 0.15 mm (0.0059 in.), and the exhaust valves should be set at 0.25 mm (0.0098 in.). If adjusted properly, the feeler gauge should be able to be withdrawn freely with a slight tugging pressure. If you aren't sure, try using the next over and under size gauges to gain a better perspective.

3. If the tappets were not properly adjusted, do so using the wrench supplied in the tool kit or a suitable substitute. Loosen the locknut (A) and screw in the adjusting screw (B) to reduce the clearance and out to enlarge it. Upon arriving at a correct adjustment secure the nut while holding the adjusting screw stationary. Recheck the adjustment as securing the nut may have altered it.

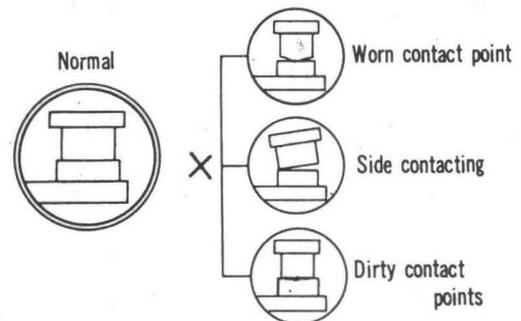
4. Repeat the above procedures on the remaining cylinder.

5. When securing the rocker box cover securing screws, do so evenly in a crossed pattern to avoid deforming the gasket.

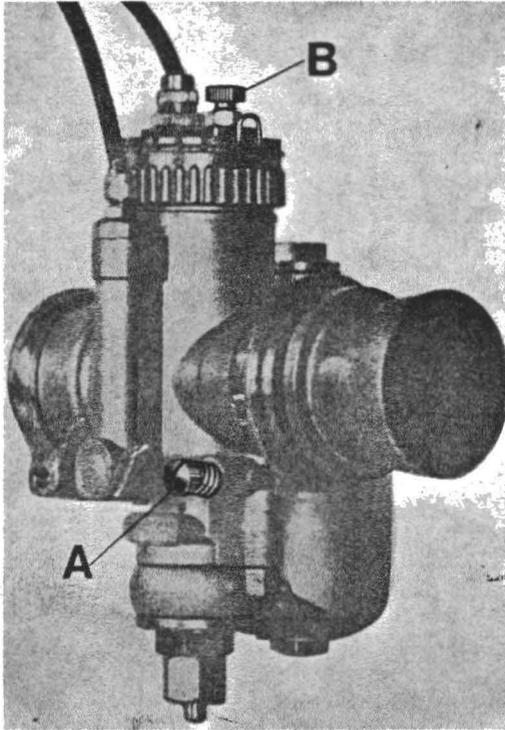
Contact Breaker Points

SERVICE

Every 1800 miles, or more often if necessary, examine the contact points for pitting, misalignment, and excessive wear of the rubbing block which rides on the breaker cam. If the points are in good condition except for a slight amount of pitting, they may be cleaned with an ignition points file. Allow the points to spring shut on the file and move the file back and forth without exerting any pressure against the points' surface. Remove dirt and grit from between the points by pulling a thick piece of paper, such as a business card, through the points two or three times. Remember that the object is to restore the points to a serviceable condition, not a like-new condition. You don't want to remove too much of the point surface. Make sure the point surfaces are seating evenly and correct, if necessary, by bending the fixed point.



Breaker point contact conditions



Adjustment points on the V700 carburetor

about $\frac{1}{4}$ throttle. The adjustment is made with the throttle cable adjusters which are located where the cables meet the carburetor cap. Secure the locknut to prevent engine vibration from altering the adjustment.

4. Adjust the idle speed as desired by acting on the throttle slide adjusters (B) which are located on the carburetor caps. Both cylinders should be running at the same speed as evidenced by an even exhaust pulse. Another way of adjusting the carburetors for an even idle speed is to remove one spark plug lead, taking care to insulate yourself sufficiently, and then adjust the opposite cylinder's carburetor. When the cylinder which is running is adjusted to about $\frac{1}{2}$ of the desired idle speed, replace the plug lead on the dormant cylinder and remove the lead from the one you just adjusted. Now repeat the procedure for the remaining cylinder. Secure the locknuts when a satisfactory idle speed is attained.

5. Adjust the idle mixture screws (A) to obtain the smoothest idle mixture. It may be necessary to readjust the idle speed (B) to keep the engine running. Turn the idle mixture screw in until the engine rpm be-

gins to drop off, then turn it out until it begins to drop off again. The ideal mixture is somewhere in the middle at that point where the smoothest and strongest idle is. Readjust the idle speeds as necessary.

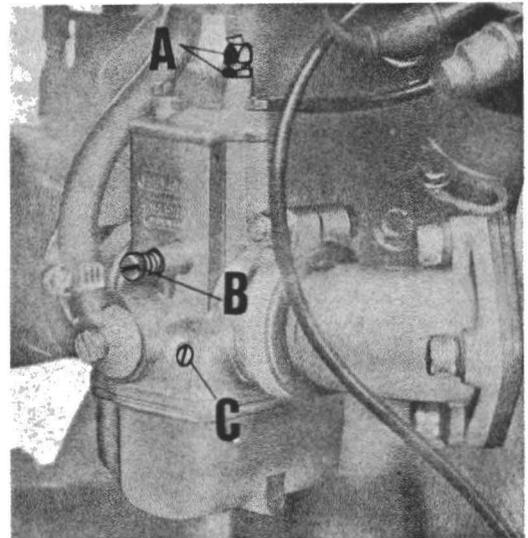
6. If it was necessary to close the idle mixture screws (A) all the way, the pilot jets are probably too small and larger ones should be fitted. If it was necessary to turn the idle screws out more than $1\frac{1}{2}$ turns, the pilot jets are probably too large and smaller ones should be fitted. Change jets one size at a time until the desired results are attained.

7. Recheck the throttle slide synchronization and make sure the locknuts on the slide and idle speed adjusters have been secured.

V750 AND V850

1. Check the adjustment of the choke mechanism. It should have about 4 mm (0.016 in.) of free play when in the fully closed position to ensure that engine vibration can't cause the choke to open.

2. Remove the air filter box and inlet sleeves, then check the throttle slide synchronization by touching the slides with your fingers while operating the throttle. If both slides don't open simultaneously, adjust them by means of the cable adjuster (A).



Adjustment points on the V750 and V850 carburetor

3. Adjust the idle speed by rotating the idle speed adjusting screw (C) in to re-

If the points are heavily pitted, replace the points and condenser. Disconnect the electrical leads, taking care to note where everything goes; unscrew the points from their base plate and the condenser from the side of the distributor body and mount the new parts.

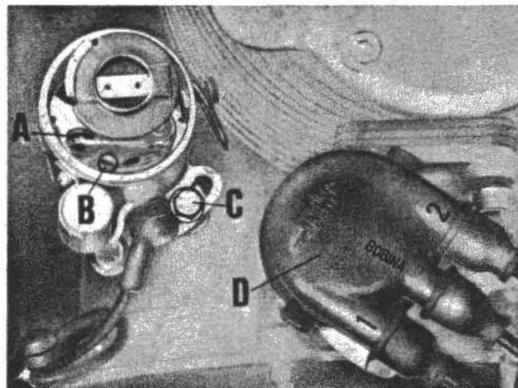
Place a drop or two of some non-oily solvent on a piece of paper and pull it through the points to remove any dirt or preservative coating from the contact surfaces. Put a small daub of distributor cam lubricator, oil, or another high-melting point grease on the contact breaker cam (oil should be placed directly on the felt pad but use it sparingly to avoid contaminating the contact surfaces). This will prevent the points' rubbing block and cam from wearing excessively and thereby reducing the points' gap.

BREAKER POINT GAP ADJUSTMENT

1. Remove the distributor cap and rotor, then rotate the engine until the points are open as far as they will go. This is the point where the rubbing block is on the highest point of the breaker cam.

2. Check the point gap (A) with a 0.42–0.48 mm (0.16–0.18 in.) feeler gauge. If the gap is incorrect, adjust it by loosening the adjusting screw (B) slightly so the points can be moved but will not spring shut. Pry the points to open or close the gap by prying with a screwdriver at the adjusting position. Secure the retaining screw when you are satisfied with the adjustment, then check it again to make sure the adjustment hasn't been altered by the securing of the screw.

3. Run a business card through the points to remove any deposits which may



Adjusting the point gap

have come off the feeler gauge. Inspect the points to make sure none of the paper was left on the points. This can occur if the points are slightly pitted, and will probably drive you nuts trying to locate your missing spark.

Ignition Timing

Moto Guzzi engines are designed to provide the same accuracy in ignition timing whether the engine is statically (without the engine running) or dynamically (with the engine running) timed. The main advantage of dynamic timing is that any defects in the automatic advance mechanism, which would not become immediately noticeable to the naked eye, become very obvious under the strobe light.

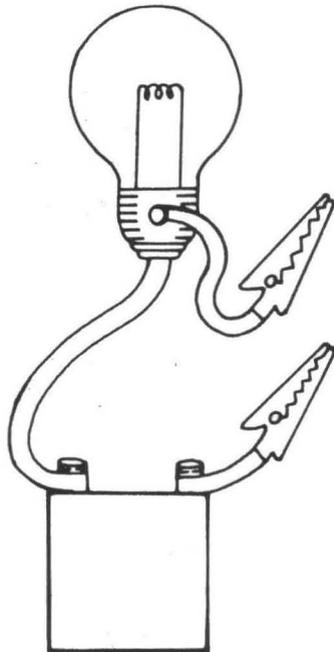
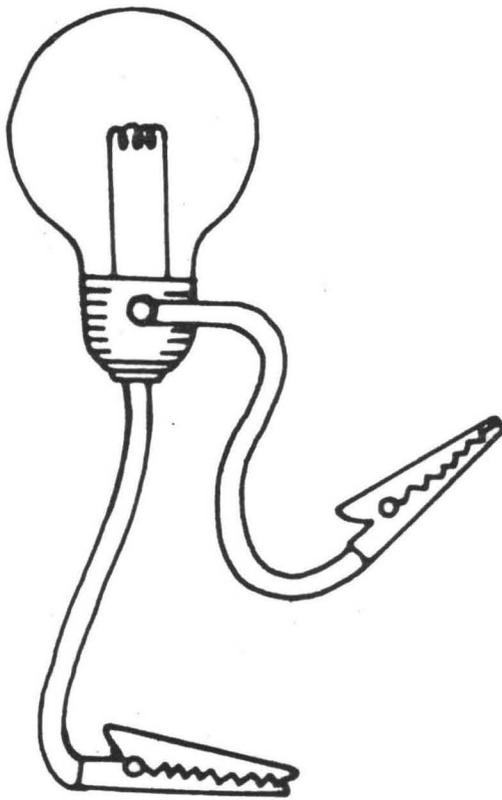
A suitable static timing light can be made out of a taillight bulb and two pieces of wire. Solder the leads to the bulb—one to the casing and one to the contact on the bottom of the bulb—then attach alligator clips to the lead ends. The bulb will light when the points open and thereby indicate whether the timing is advanced or retarded. A more sophisticated timing light can be made by adding a flash light battery wired in series with the bulb. With this sort of continuity tester, the light will go out when the points open. A word of caution: if you use a light with a battery wired in series to it, the motorcycle's power source cannot be used without burning out the test light bulb. If you use just a bulb with two leads, you must use the machine's power source.

To time an engine dynamically, you need a strobe light which should be attached as directed by the manufacturer of the light. The engine should be timed while at normal operating temperature and while running at the engine speeds indicated in the procedures.

STATIC TIMING

1. Remove the spark plugs, distributor cap (D) and rotor, and the generator belt cover. Rotate the engine when necessary by rotating the generator belt pulley.

2. Make sure that the contact points are correctly gapped at 0.42–0.48 mm (0.016–0.018 in.) as described in the "Con-

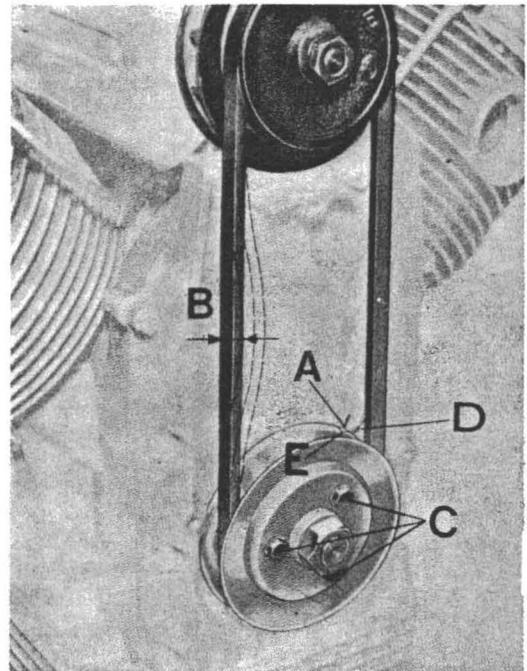


Timing lights

tact Breaker Points Adjustment” section.

3. Rotate the engine until the No. 2 cylinder (the one on the left hand side) is at TDC on its compression stroke (clearance

at both tappets). The arrow (D) on the timing cover should be in alignment with the slot (E) on the generator belt pulley. If you go past the slot, rotate the engine around again rather than turning it backward. If you find that the mark and slot don't line up when the piston is at TDC, and you're sure you're on the compression stroke, then the valve timing may be off a few degrees. Consult the "Valve Timing" section of the "Engine and Transmission" chapter for additional information.



Static timing marks

4. Position the distributor rotor so the metal contact piece will skim the metal contact piece in the distributor cap pertaining to No. 2 cylinder. This can be approximated by positioning the cap and making sure that the rotor contact piece is directed toward the "2" on the cap. It may be necessary to loosen the bolt which secures the distributor (C), and rotate the distributor body a few degrees. Consult the "Breaker Point Gap Adjustment" section for an illustration with the securing bolt in it.

5. Connect one lead of the test light to the contact breaker spring or the hot line to the points, and the other lead to ground. Rotate the generator belt pulley until the pulley slot (E) is aligned with the left hand mark (A) on the timing cover.

duce the idle speed and out to increase it. The optimal setting under normal conditions is about $1\frac{1}{2}$ turns off its seat for the left hand carb and $1\frac{3}{4}$ –2 turns for the right hand unit. Consult Step 4 of the previous section for additional information. The idle speed should be about 1000–1200 rpm.

4. Disconnect the right hand cylinder plug lead with the engine turned off, then start the engine and count the number of pulses before it stalls. If the engine did not fire four or five times, adjust the idling screw (B) and repeat the process until it does so. Reconnect the plug lead and perform the same operation on the opposite cylinder.

Tune-Up Analysis

The carburetor jets and spark plugs which came with your machine are those which will provide the most efficient performance in the most frequently encountered climates. These should suit your purposes, with perhaps minor carburetor adjustments, unless you enter a region of radically different altitude or atmospheric conditions.

SPARK PLUG READINGS

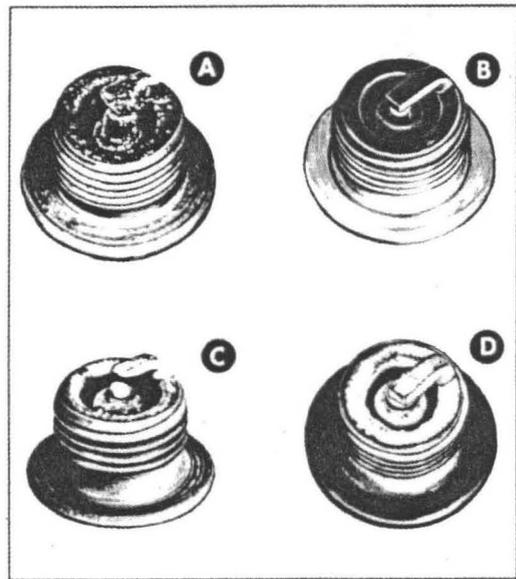
1. Adjust the timing, tappets, and carburetors until the engine runs at its best.

2. Remove and clean the plugs or install new ones. Make sure the gap is set correctly at 0.6 mm (0.23 in.).

3. Run the machine up to high rpm, pull in the clutch, and kill the engine. Do not release the clutch until the transmission is in Neutral or the engine is completely stopped.

4. Remove the plug and examine it for the following conditions:

A. A wet, black, and shiny deposit on the plug base, electrodes, and ceramic tip (around the positive electrode) indicates an oil-fouled plug caused by worn rings and pistons, loose valves, bad valve guide seals, weak spark, faulty ignition circuit, improper points gap, dirty points, improper timing (overly retarded), weak coil, or too cold a plug heat range.



Spark plug deposits

B. A smooth, sooty, jet-black deposit indicates an excessively rich gas mixture, long periods of engine idling, or too cold a plug.

C. A very light brown, dry, blistered, or glassy-looking deposit indicates an overheated plug. This may be accompanied by cracks in the ceramic tip and is caused by an overly lean air-fuel mixture, an excessively high operating temperature, improper valve seating, advanced ignition timing, or a plug which is too hot. The deposit becomes a conductor when hot and causes irregular firing, especially at high rpm.

D. A plug with a milky or tan deposit indicates a well-balanced ignition and mixture. This type of deposit will not adversely affect performance if kept to a minimum, but no type of deposit should be allowed to build up. Both plugs should burn the same way.

When in doubt about the condition of your plugs, it's best to replace them. This is the best rule for efficiency. Remember, spark plugs, like any other component, can be defective from the start. If a plug ever becomes burned to the extent of the plug in Fig. C, it must be replaced since the gap will never be right. Plugs should also be replaced if the ceramic portion is cracked since this will cause stray spark. Never use a plug without a gasket because this may cause damage to the seat and cause compression loss.

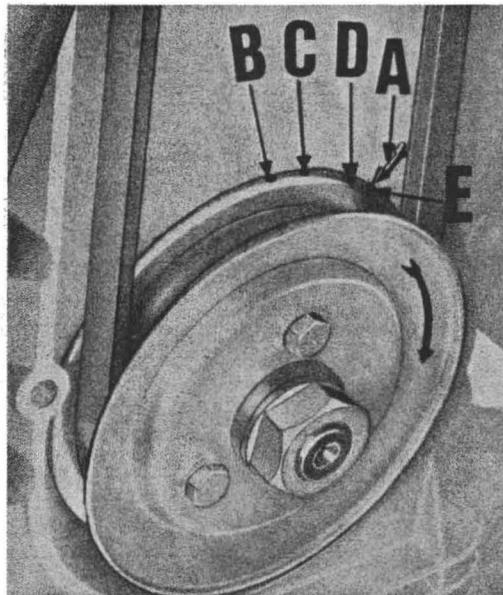
This mark is in a position 10° advanced of the TDC arrow.

6. At this point the contact points should just begin to open and the timing light should come on. If the timing is not dead on, loosen the distributor adjusting bolt (C) and rotate the distributor body to the right or left as necessary. Secure the distributor when a correct timing is achieved and recheck the results with the light.

7. Secure the distributor cap to the distributor and the cables to the plugs and coil. The plug lead labeled "2" must be attached to the plug in No. 2 cylinder. The lead labeled "BOBINA" goes to the coil. Replace the generator belt cover.

DYNAMIC TIMING

There are three possible degrees of advanced timing which may be used when timing any of the engines covered in this guide. The marks in the accompanying illustration indicate:



Dynamic timing marks

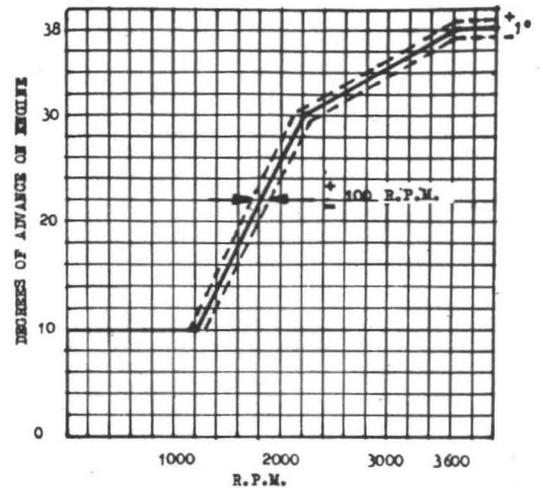
A—the timing reference arrow stamped on the timing chest

B—the TDC mark for the No. 2 cylinder

C—this mark is 10° fixed advanced before TDC

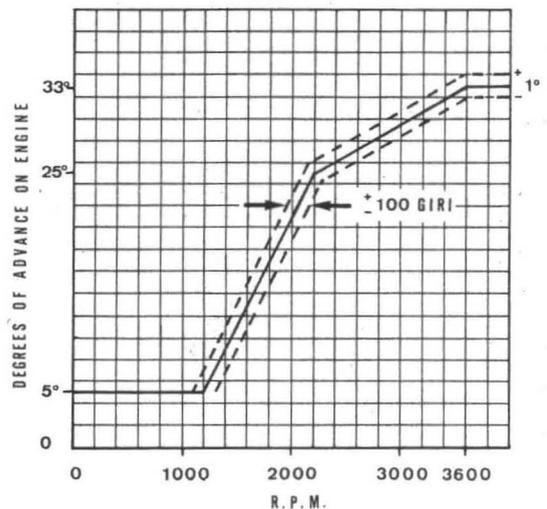
D—this mark is 28° automatically advanced of TDC

E—this mark is the fully advanced position (38°) of TDC. This mark is a total of both the fixed and advanced positions.



Advance curve for V700 and V750 models

By checking the timing at all of these three positions you can determine if the advance mechanism works through its three phases. Proceed with the timing in the following manner:



Advance curve for V850 models

1. Remove the generator belt pulley cover, then run the machine until its normal operating temperature is reached.

2. Connect the strobe light as directed by the manufacturer of the light. There should be one lead to the No. 2 cylinder spark plug, one to the battery positive (+) terminal, and one to the battery negative (-) terminal.

3. Start the engine and direct the light at the timing cover arrow (A). Make sure

that the "C, D, and E" pulley marks align with the arrow at the following engine speeds:

- a. Mark "C" at 1200 ± 100 rpm
 - b. Mark "D" at 2200 ± 100 rpm
 - c. Mark "E" at 3600 ± 100 rpm
4. If the strobe shows that the timing is advanced or retarded, adjust it by loosening the distributor adjusting bolt and rotating the distributor body slightly until the pulley mark corresponding to the selected engine rpm is in alignment with the timing chest arrow when under the beam of the strobe light. The adjustment to the distributor can be made with the engine running.
 5. If the strobe indicates a fault with the advance mechanism, consult the "Electrical System" chapter for additional information.

Carburetor Adjustment

All adjustments to the carburetors should be made after the valves have been set according to specification and after the engine has reached its normal operating temperature.

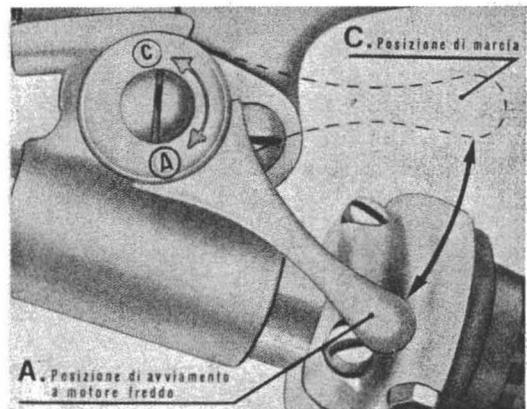
Avoid using excessive pressure on any of the adjusting needles as this may cause the needles to become blunted and their seats to become beveled. Carburetors are the most often tinkered with engine component and are probably the single component which requires the least amount of attention once properly adjusted. If the bike seems to idle roughly one day and then smooth the next, don't make yourself crazy trying to find a setting where it will run the same every day—it doesn't exist. Variations in atmospheric pressure and the engine's mood will result in slight day-to-day performance variations.

It is a good practice to check the mixture after you've set it. The best way to do this is to clean the spark plug, install it, then run the engine up to a high speed, pull in the clutch, and cut the power. Do not allow the machine to come back to an idle or to run at low rpm before turning it off. Remove the plug and check its condition. If you've done a good job, providing that you are using the correct heat range plug, the electrode will look tan or milky.

If the mixture is too rich, the tip will look black and sooty. If the mixture is too lean, the plug will look bleached and white. Repeat the mixture adjustment process while making small ($\frac{1}{8}$ – $\frac{1}{4}$ turn) adjustments until the plug looks right. Consult the "Tune-Up Analysis" section for further information.

If you should ever see your exhaust pipe turn yellow or blue, you can be sure the mixture is way too lean and you should correct the situation immediately. It's safest to have the mixture slightly rich, but if it gets too rich, as evidenced by dark exhaust smoke, it will cause accelerated carbon build up, and may cause damage to the top end because the excess fuel cleans the protective oil coating off the cylinder walls.

NOTE: Make sure the choke is in the closed position (C) before making any adjustments. The other position (A) is for cold weather starting.



Choke positions

V700

1. Turn in the idle adjusting screws of both carburetors until they reach their seat, then back them out 1–1½ turns to make sure they're even.

2. Start the engine and run it until its normal operating temperature is reached.

3. Synchronize the carburetors by adjusting the throttle cables in such a way that both throttle slides open simultaneously. This can be done by placing your fingers in the carburetor throat and feeling for when both slides lift up and seat at the same time. Verify, or adjust in this manner, the adjustment by feeling for an even exhaust pulse when the bike is running at

SPARK PLUG HEAT RANGE

Spark plugs are generally intended to maintain a temperature range of between 450 and 850° C under varying engine operating temperatures. If the temperature at the tip drops below 450° C, the electrode will foul with carbon deposits; if it rises above 850° C, pre-ignition and possible engine damage will result. This is why varying heat ranges are available in one step gradations.

The first consideration in correcting an improper spark plug condition is changing heat ranges. Never go more than one step hotter or colder at a time. Use a hotter plug for short rides at low speeds and a colder plug for touring or high-speed use. If the plugs aren't right after changing one step, a carburetor adjustment is in order.

CARBURETOR MIXTURE ADJUSTMENT

Adjust the carburetors as directed in the "Carburetor Adjustment" section. In most cases, adjustments at the needles can compensate for mixture deficiencies, but the jets may be exchanged if necessary.

If, upon opening the throttle, the engine is sluggish about picking up speed and shows a tendency to backfire, decelerate, or refuse to run at peak rpm, and if opening the choke makes things a little better, the mixture is too lean due to a restrictive main jet. Going one or two sizes larger will probably improve the performance. Raising the jet needle a notch may also help as this will also enrich the mixture.

If, upon opening the throttle, the exhaust note becomes duller and the engine emits black smoke, and if opening the choke up somewhat accentuates the condition, the mixture is too rich and a smaller main jet is called for. Lowering the jet needle may also help as this will lean out the mixture.

If a change of more than one size is required, change step-by-step. Most dealers will let you exchange jets until you find the performance you're looking for. Never go too lean as this is an invitation to major motor mayhem. New needle adjustments will probably be necessary, but this can only be determined by trial and error.

CYLINDER COMPRESSION CHECKS

Compression checks, like spark plug readings, are a good indication of what's

going on inside those cylinder walls. Compression will drop when trouble is not far off, so the rider who periodically checks his compression can save himself a lot of grief and excessive damage. Your dealer will be able to check this for you in minutes if you don't have a compression gauge, or you can buy a cheap automotive-type gauge so you can do it at home. Perform this test every couple of tune-ups, with the engine hot, in the following manner:

1. Remove the spark plug and screw the compression gauge into its place. Automotive-type gauges must be held firmly in place. Lubricating the rubber tip of the gauge with engine oil will allow it to seal better. Make sure there is no reading on the gauge before conducting the check.

2. Hold the throttle wide open with the choke closed, and kick the engine through about five times while watching the gauge. A minimum of 100 psi should register with no more discrepancy than 15 psi between the two cylinders. Perfect compression is somewhere around 165–170 psi.

Low readings can indicate a leaking head gasket, valves which are too tightly adjusted or are burned, or worn piston rings. If you obtain a low reading, squirt a couple of shots of oil into the spark plug hole and recheck the compression. If the pressure increases significantly, the indication is that the rings are worn. If it does not increase and there is evidence of a cylinder head gasket leak, the chances are that the head gasket is blown and must be replaced. If there is no evidence of a bad head gasket or worn rings, the process of elimination points its finger at the valves. To make certain that it is not just insufficient valve clearance that is doing you in, back out the adjusters a couple of turns and recheck the compression. Do this even if you have just adjusted the valves because you may have goofed. If you still don't have good compression, button it up and get ready to do a job on the top end. Be sure to reset the valves if you plan to do any riding in the meantime.

A sudden drop in compression, from one tune-up to the next for instance, indicates something serious such as frozen rings, a hole in the piston, stuck or burned valves, etc. If the compression has been going down steadily over a period of time, it's probably only due to natural wear and

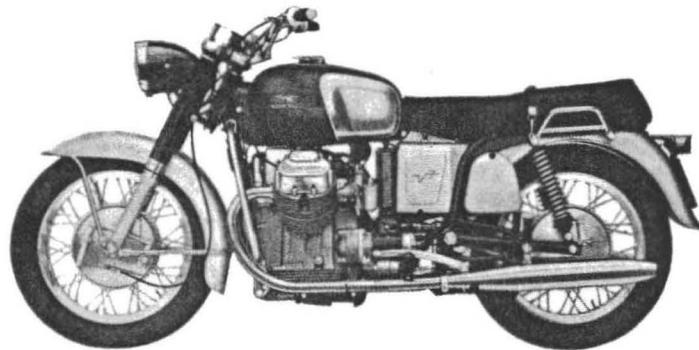
you've still got some riding time left. If you ever note an increase in compression from one check to the next, hold off on celebrating the miracle of the self-repairing motorcycle. What you've got is a burned

offering of sorts—excessive carbon deposits on the piston crown. This must be remedied by scraping off the carbon as described in the “Decarbonization” section of the “Maintenance” chapter.

Tune-Up Specifications (All Models)

Ignition Timing	
Breaker point gap	0.42–0.48 mm (0.016–0.018 in.)
Ignition timing (fully advanced)	38°
Spark Plugs	
Type	Marelli CW 25 LVT Bosch W225 T2 Champion N5
Gap setting	0.6 mm (0.23 in.)
Tappet Adjustment	
Clearance (cold):	
Intake	0.15 mm (0.0059 in.)
Exhaust	0.25 mm (0.0098 in.)
Carburetor Adjustment	
Consult “Carburetor Adjustment” section	

4 • Engine and Transmission



Operational Description

All of the Moto Guzzi models covered in this guide come equipped with twin-cylinder, four-stroke engines laid out in a 90° "V" configuration, and have pushrod actuated overhead valves.

The light alloy cylinders have hard chrome linings, are amply finned for efficient air cooling, and fit into recesses machined into the crankcase. The heads and rocker box covers are light alloy and the valve seats are inserted cast iron items. The piston is also light alloy, and features four rings, three of which (two compression and one oil scraper) are fitted above the piston pin, and one additional oil ring which is below the pin.

The crankcase is composed of one major casting which houses the crankshaft, camshaft, lubrication assemblies, and a sump pan, both of which are made of a light alloy. The crankshaft is a one piece unit which rides on plain bearings which are housed in flanges which bolt to the crankcase. The connecting rods are of steel and have thin wall bearings on the large end and bronze bushings at the small end.

The valve train, which consists of a camshaft, tappets, pushrods, rocker arms, and the overhead valves, is driven at half engine speed by the crankshaft.

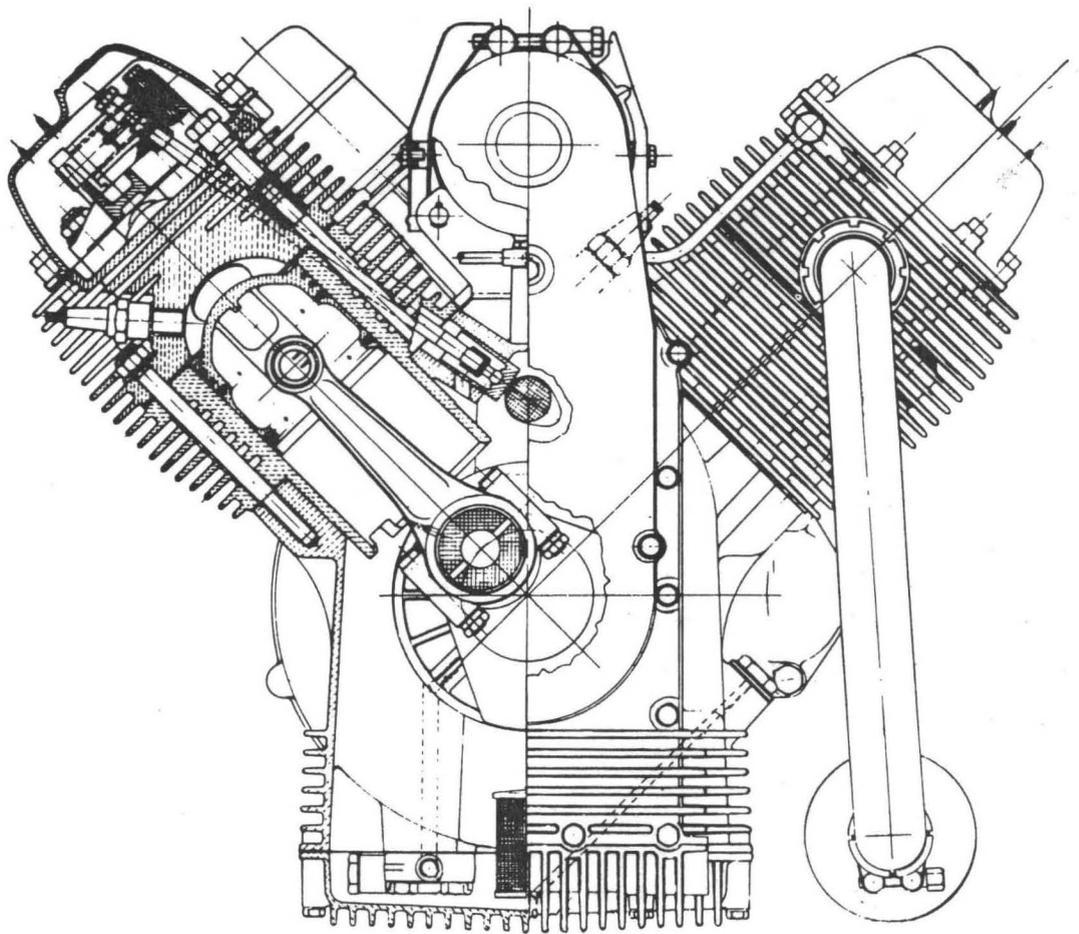
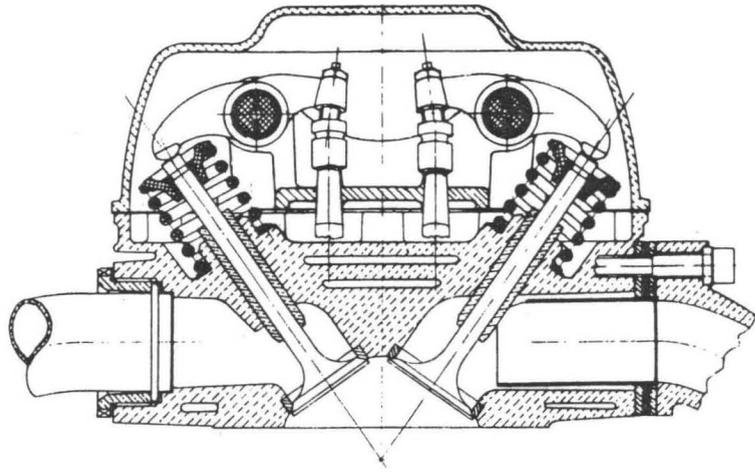
The dry clutch is an automotive type

construction and resides in a housing which is bolted to the back of the crankcase. Bolted to this is the transmission which is a four-speed on the V700 and V750 models and a five-speed on the V850. A universal joint connects the drive shaft to the transmission layshaft and a pinion and bevel gear arrangement drives the rear wheel. The drive shaft, by the way, serves as one half of the rear swing arm assembly.

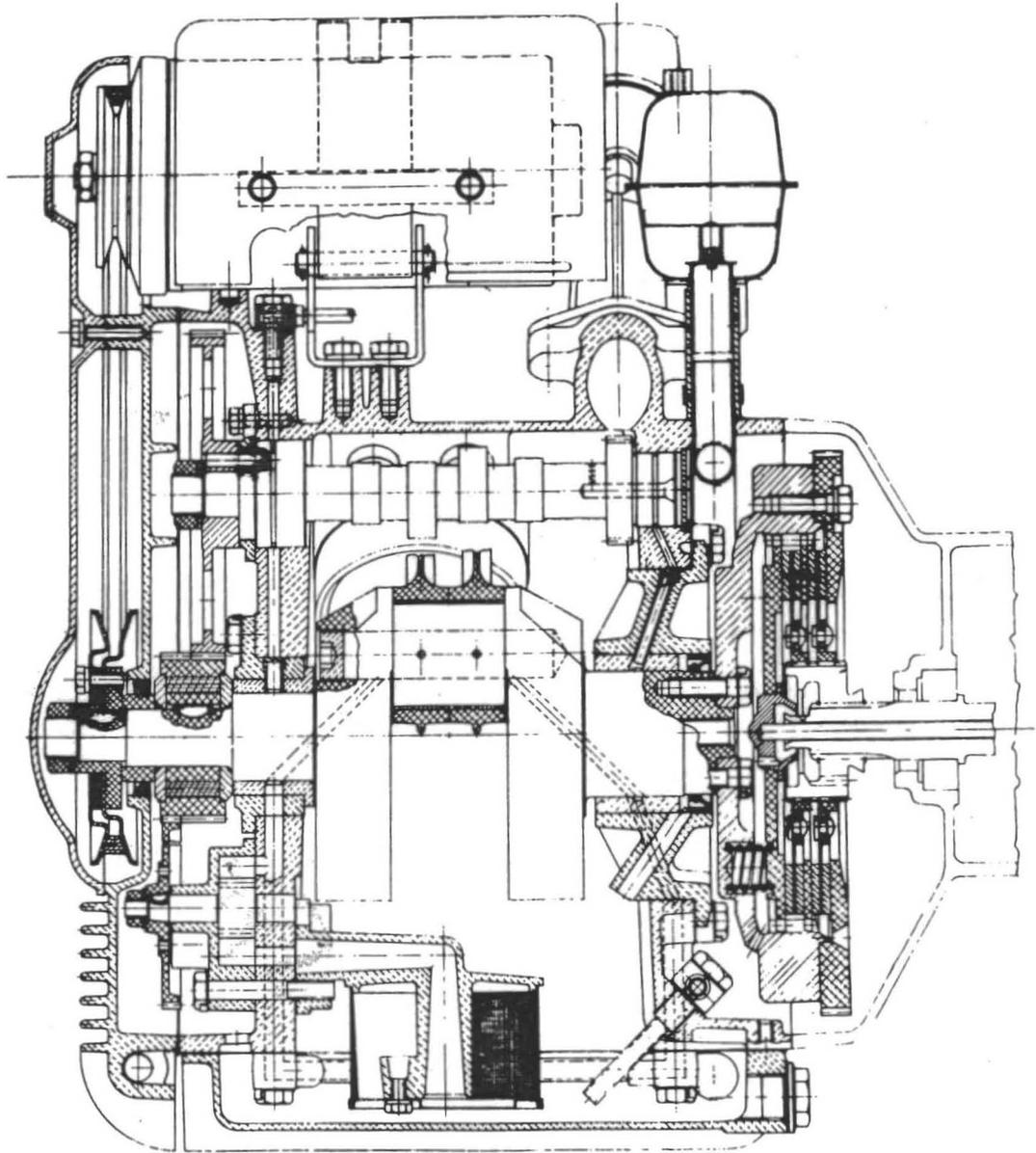
Lubrication for the wet sump is provided through pressure and splash by a crankshaft driven gear type pump and the oil is filtered by a wire gauze element mounted on the oil pipe. A relief valve is incorporated in the pipe and serves to reroute excessive pressure into the atmosphere. The crankcase breather system consists of a tube which delivers oil vapors to the breather tank. After the vapors have condensed, the oil returns to the sump.

Ignition is by battery, coil, and distributor and the distributor is driven directly off of the crankshaft; starting is electric only.

The four-stroke engine requires four complete cycles of the piston to complete one power stroke. During the intake stroke, the intake valve opens and the fuel mixture is drawn into the cylinders as a result of the sudden vacuum created by the piston's downward motion. As the piston moves toward the top of its travel on the compression stroke, both valves are closed



Front view of the engine detailing the top end assemblies



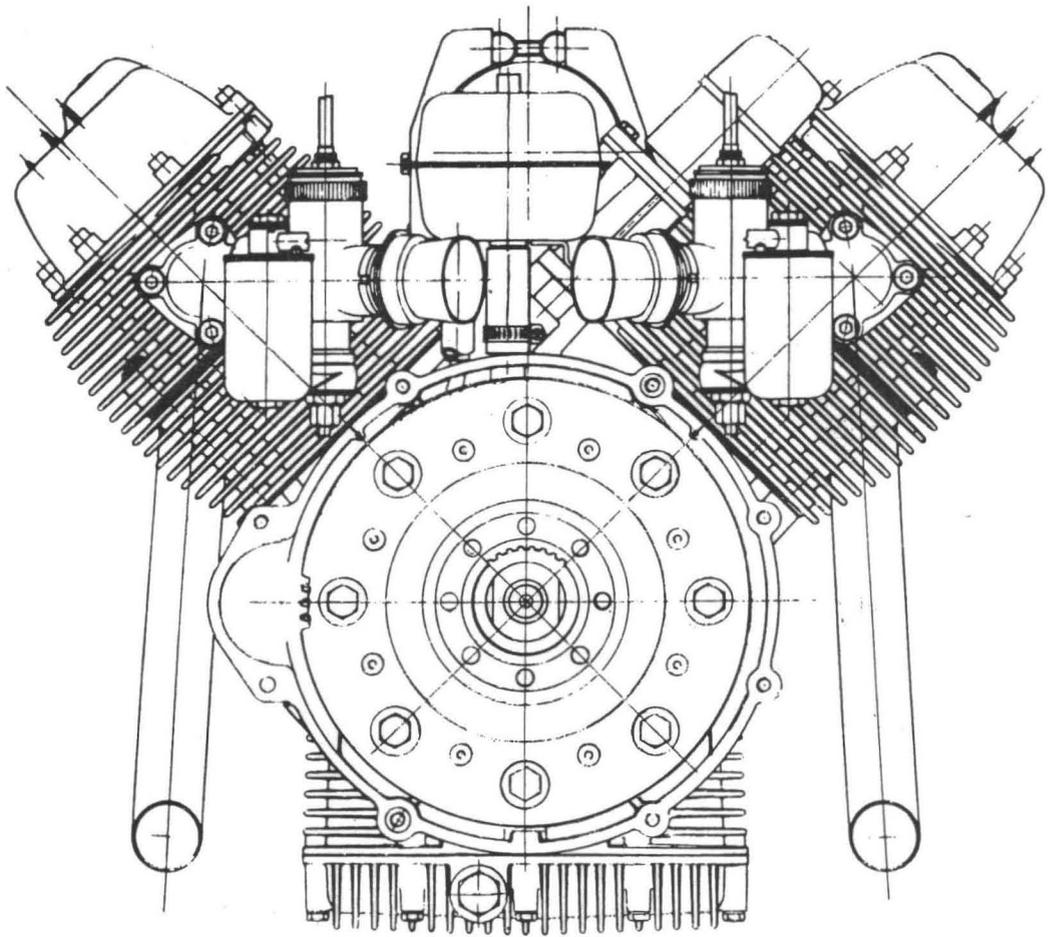
Side view of the engine detailing the bottom end assemblies

and the combustible materials are compressed. When the breaker points are opened by the action of the breaker cam, the spark plug fires and ignites the charge. The resulting combustion forces the piston down in the power stroke. As the piston moves down toward its lowest point of travel, the exhaust valve opens. As the action of the flywheel sends the piston back up on the exhaust stroke, the remains of the previous charge are forced out through the exhaust valve. Just before the piston reaches the top of its travel the intake

valve opens and the exhaust flow induces the intake flow which continues while the exhaust valve closes. The process now repeats itself since each of the four cycles has been completed.

Engine Service

When preparing to do any work on the engine, it is essential that cleanliness is



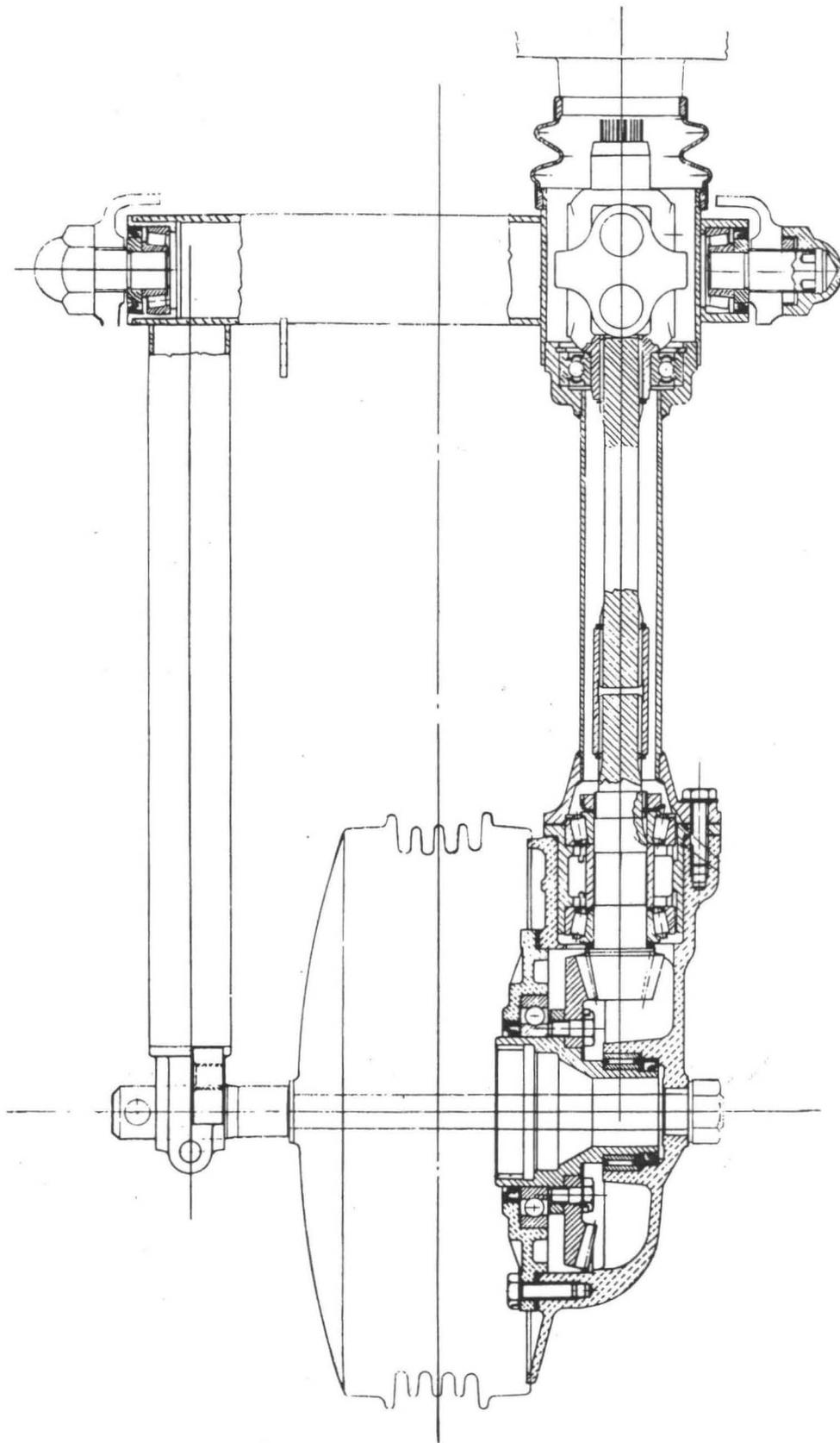
Rear view of the engine showing the carburetors and the clutch assembly

maintained and that an area suitable to work in is available. Naturally, the tools and parts necessary to accomplish the task are also required. It is best, when performing a job for the first time, to familiarize yourself as much as possible with the components and procedures with which you will be working. The time spent here will be well rewarded through an increase in confidence and a decrease in needless mistakes and aggravation. In addition, the satisfaction gained in *knowing* that the job was done right is immeasurable.

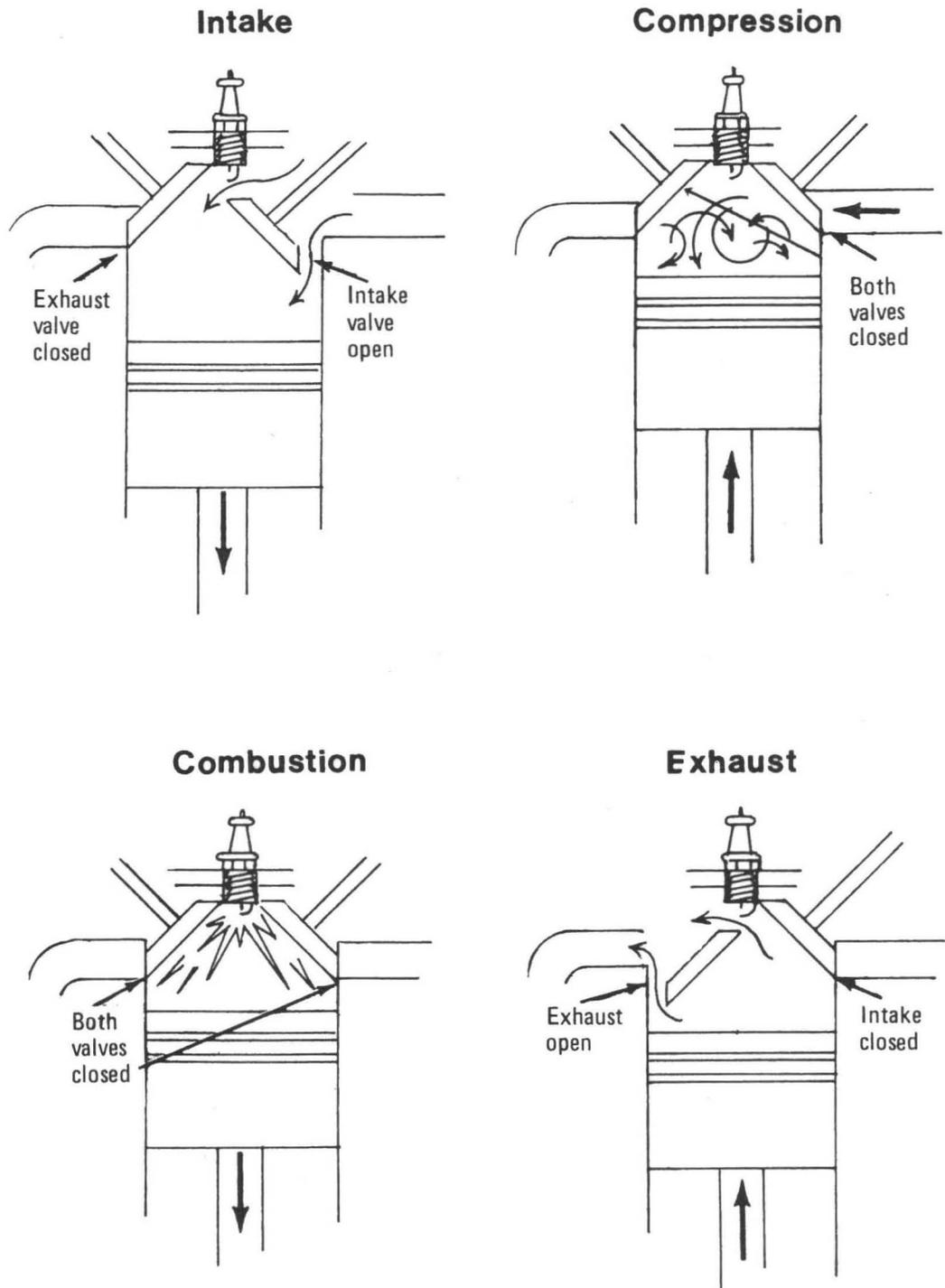
Cleanliness and a careful approach are imperative. A quick ring job could become a complete engine disassembly if simple precautions are not taken. Lay out and mark all parts in sequence as they are removed; this way the correct order of reassembly will be obvious. If possible, clean the engine parts in solvent and blow them dry with compressed air. When cleaning

ball or roller bearings, don't spin them until they have been thoroughly cleaned and dried because particles in the solvent bath often get caught in the bearing races and can only be removed with high-pressure air.

A good general rule to follow when disassembling an unfamiliar engine is to restrain yourself. When a nut or bolt seems to require an inordinate amount of pressure to remove it, don't just give it the old heave-ho effort. Instead, sit back, relax for a few minutes, and then survey the situation. More engine damage is caused by swinging a heavy wrench than by most other causes combined, and the reason is usually a mechanic who is blinded by frustration. These engines are constructed primarily with aluminum alloy, so you have to be careful. Use the best tools you can get your hands on and try to avoid hammer-and-chisel techniques. You'll probably



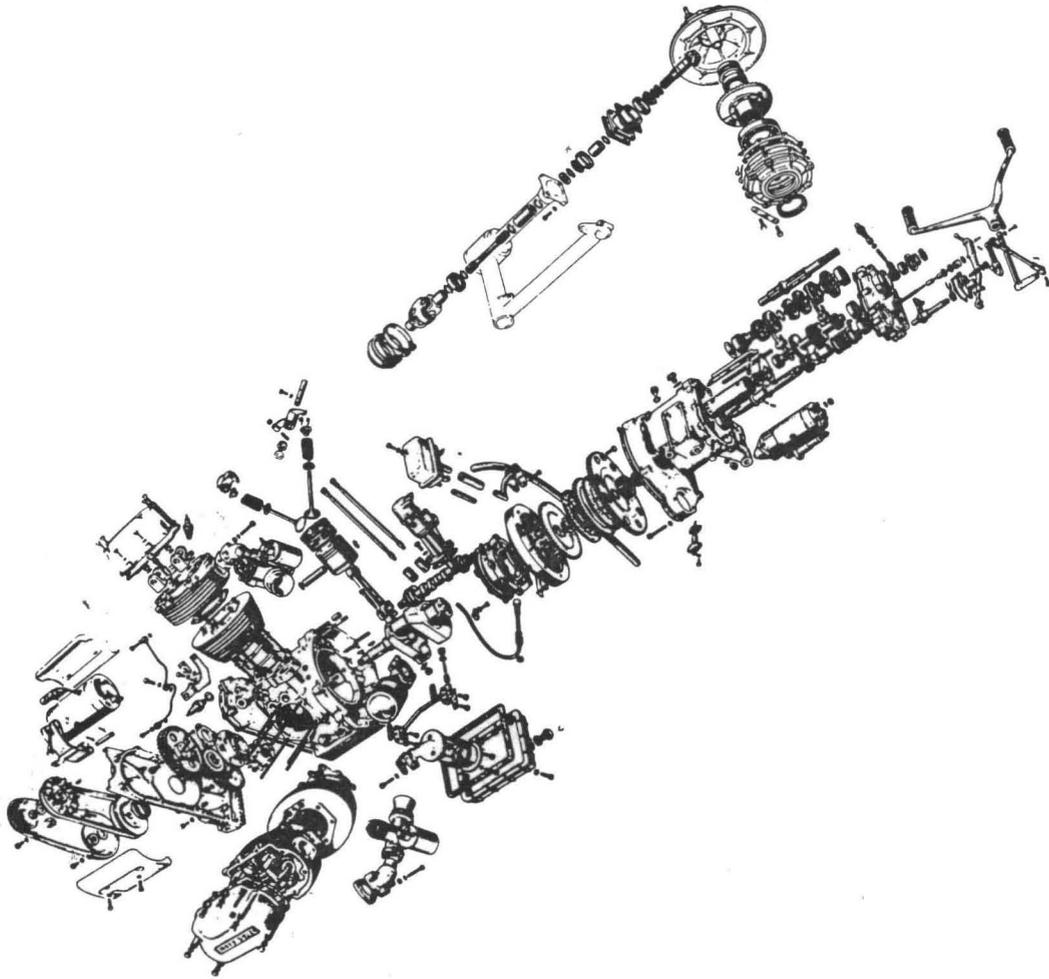
Top view of the rear drive assembly



Four-stroke engine operation

be unable to get most of the factory tools (see the "Appendix" for an illustrated list), but if you know how they are supposed to work, and you have an idea of how they look, you can probably fabricate some-

thing simple to get around them. Even if you get stuck, remember that most of the cost of engine work that a shop charges you for is the labor to strip it down and put it back together. This means that you



Engine, transmission, and rear drive assemblies

can bring an assembly to your dealer and have him use the special tool on it for a fraction of the customary cost for such a job.

Remember that once you've rebuilt the engine it's like new and must be broke in again. How you treat it for the first thousand miles is going to determine how well and how long it's going to keep running. Don't push a tight engine more than it wants to go. All those new parts have to wear in properly and that takes time. New engines run extra hot so it's important to keep them well timed and to not run them at constant high speeds for extended periods of time. Stop and let your engine cool off every so often if you're going a great distance. Back off while riding to get that extra oil up to the top end. If a plug should start to foul while you're riding, stop immediately and clean it off or re-

place it. Never try to clear it by revving the engine since it probably won't work and will only fill the combustion chamber with oil; not the most ideal situation for your new engine.

Do the following after the first 500 miles and then again at 1,000 miles:

1. Drain the oil and replace it with fresh oil. Don't be alarmed by all the little metal shavings (unless it was only a top end job you just did), because that's natural for a new or rebuilt motor.
2. Inspect all hardware for a tight fit and secure it as necessary.
3. Replace the spark plugs, adjust the valves, set the point gap, adjust the timing, and check the carburetion.

NOTE: *This manual is intended primarily for the touring models, however if you are one of the fortunate few who own one of the limited production Sport*

models, you'll find that most of the procedures are applicable for your machine.

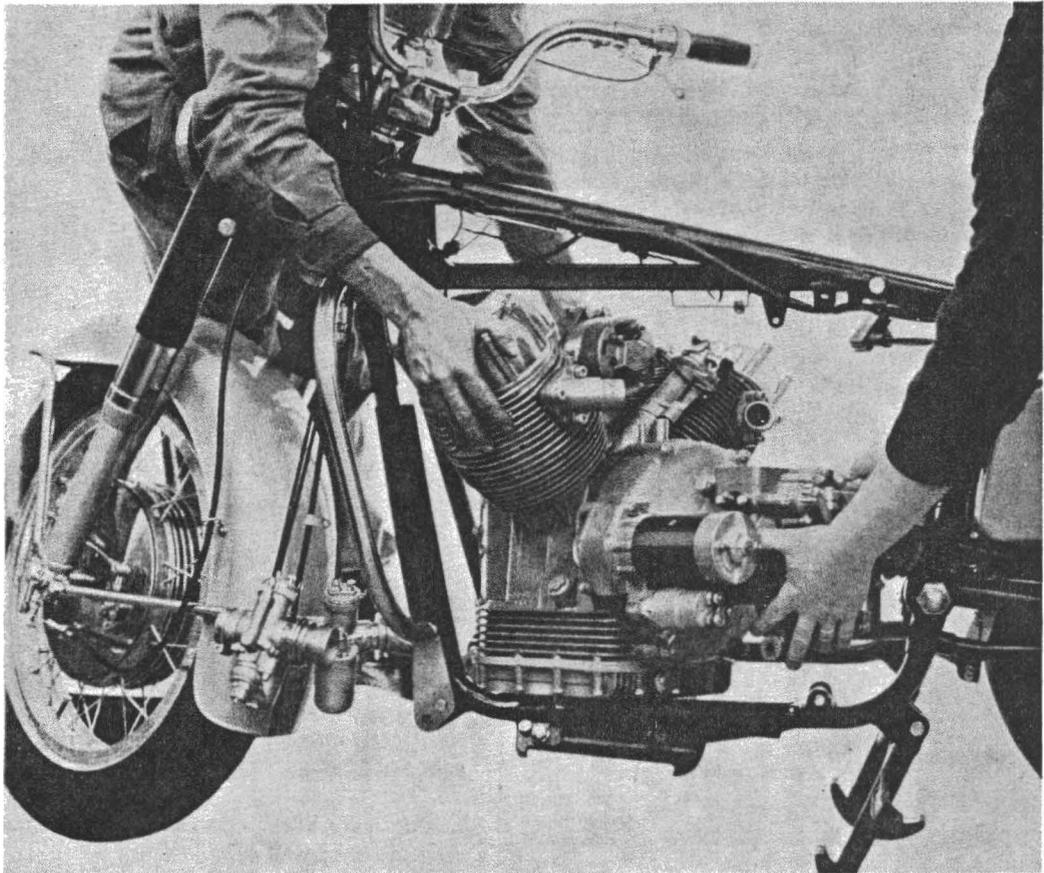
Engine Removal and Installation

It is not necessary to remove the engine from the frame to perform most of the jobs you'll probably encounter if you ride one of these big twins for a while. The bottom end is extremely durable, rarely needs attention, and only for work on the crankshaft, camshaft, clutch, and transmission assemblies should you remove the engine from the frame. If you are good, however, you'll find that by moving the engine forward in the frame it is possible to work on the clutch or remove the transmission. It is also possible to remove the camshaft through the front of the engine, but this re-

quires more skill than if you have the engine sitting in front of you on a work bench.

Remove the engine from the frame in the following manner:

1. Run the engine until its normal operating temperature is reached, then drain the oil.
2. Remove the battery covers from both sides, then disconnect the battery cables.
3. Disconnect the speedometer cable from the transmission housing.
4. Remove the tank, seat, and battery, then remove the battery support plate.
5. Disconnect the throttle and choke cables at the carburetors, or remove the carburetors and position them out of the way as indicated in the accompanying illustration.
6. Disconnect the clutch, starter, and neutral indicator cables from their mounting positions on the engine.
7. Disconnect and remove the ignition



Removing the engine and transmission from the frame

coil, distributor cap, spark plug leads, and the distributor rotor.

8. Remove the generator covers, generator belt guard, and the generator unit. It is not entirely necessary to remove the generator; it may be repositioned as in the accompanying illustration to gain sufficient clearance.

9. Remove the exhaust system.

10. Block the engine to keep it from falling out of the frame, then remove the bolts which secure the engine-transmission assembly to the frame. Remove the engine by slipping it forward, tilting it to the right, and lifting it out of the frame. At this point the engine should be thoroughly cleaned and degreased before any further disassembling is carried out.

NOTE: *Removing the engine should be done by at least two people to avoid dropping it; also, it is pretty heavy and you probably won't be able to handle it yourself.*

11. Installing the engine is merely a reversal of the removal process. Make sure you replenish the oil supply and readjust the various systems as necessary.

Top End Service

CYLINDER HEAD

Removal and Disassembly

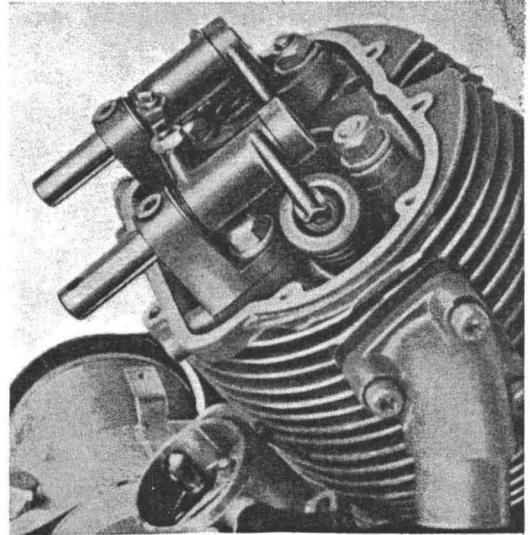
1. Remove the spark plug leads and plugs, then disconnect the cylinder head lubrication pipe.

2. Remove the rocker cover securing screws, rocker covers, and cover gaskets. If the cover is reluctant to leave its seat, tap it gently with a hammer and wood block.

CAUTION: *Do not attempt to pry the cover off or it will probably never be oil tight again.*

3. Remove the rocker spindle bolts and washers, then remove the rocker arm spindles, rocker arms, and the rocker arm springs and washers. The tappet adjusting screw and locknut may be removed from the rockers.

NOTE: *It is a good practice to lay all the components out on a clean surface in the order in which they are removed. Do not mix parts from the different assemblies.*



Removing the rocker spindles

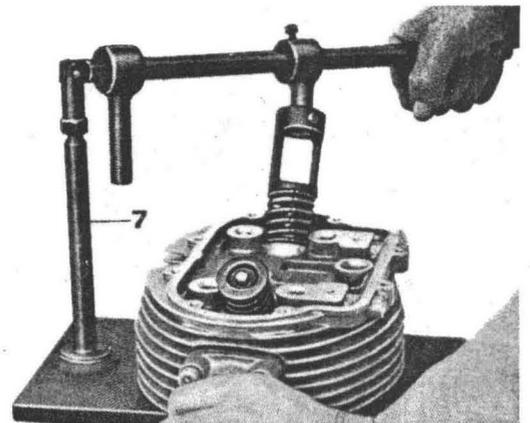
4. Remove the push rods, keeping them separate for installation in their original locations.

5. Remove the rocker arms support by removing the four long and two short bolts which secure the support to the head, the head to the cylinder, and the cylinder to the crankcase.

NOTE: *If you wish to remove the intake manifold, do so before the cylinder securing studs are removed.*

6. Lift the cylinder head off of the cylinder and remove the head gasket. Tap the side of the head gently with a hammer and wood block to free it if necessary.

7. Remove the valves by compressing the valve springs with either the factory tool (No. 60907200 which is indicated by No. 7 in the accompanying illustration), or a suitable valve spring compressor. With

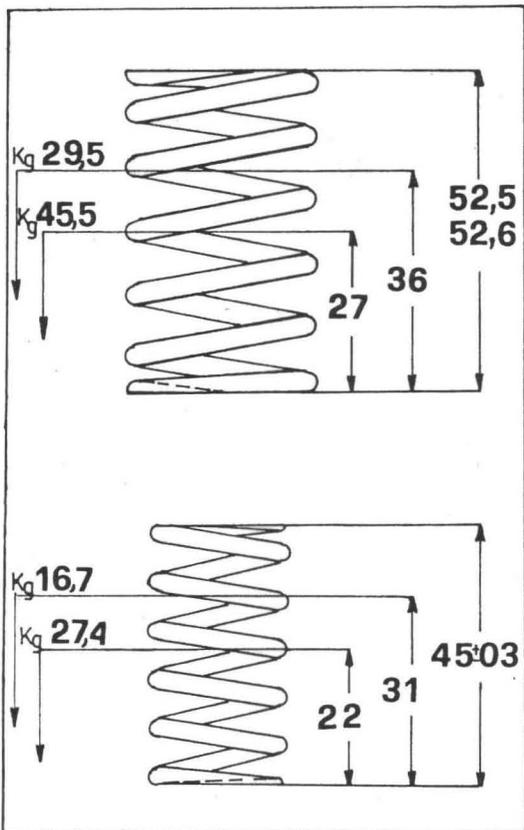


Removing the valves with the special tool

V750 and V850 (external spring):

With the valve in its CLOSED position, the spring tension should be $65 \pm 3\%$ lbs ($29.5 \pm 3\%$ kg) and the spring should compress to 36 mm (1.417 in.).

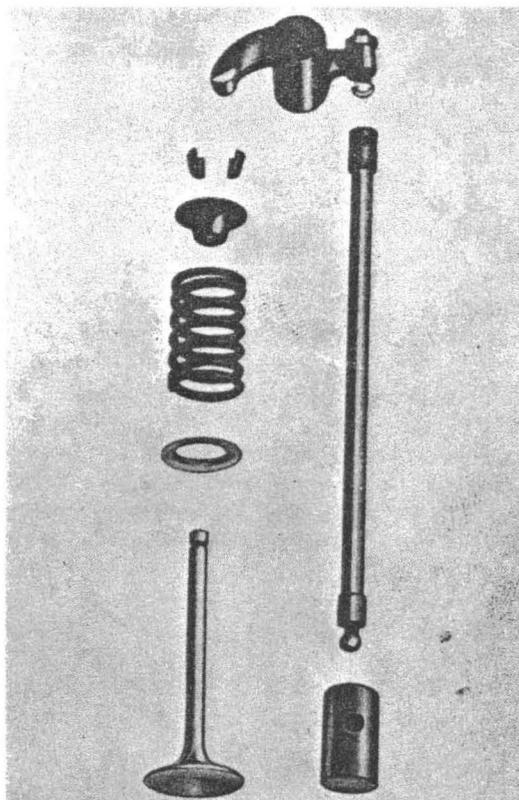
With the valve in its OPEN position, the spring tension should be $100 \pm 3\%$ lbs ($45.5 \pm 3\%$ kg) and the spring should compress to 27 mm (1.063 in.).



Valve spring dimensions (V750 and V850)

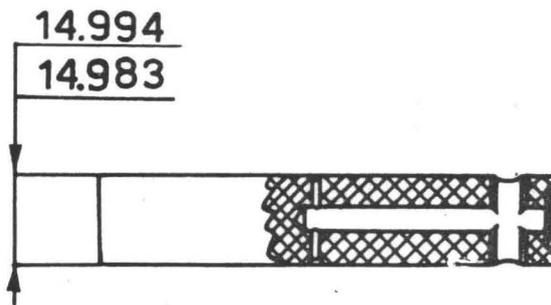
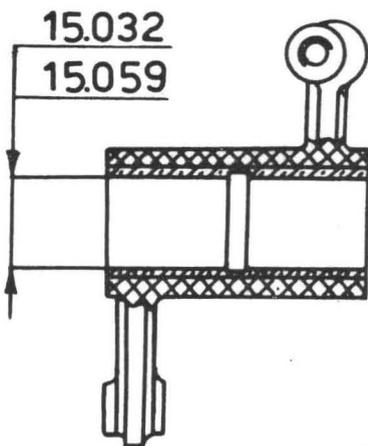
V750 and V850 (internal spring):

With the valve in its CLOSED position, the spring tension should be $37 \pm 3\%$ lbs ($16.7 \pm 3\%$ kg) and the spring should compress to 31 mm (1.220 in.).



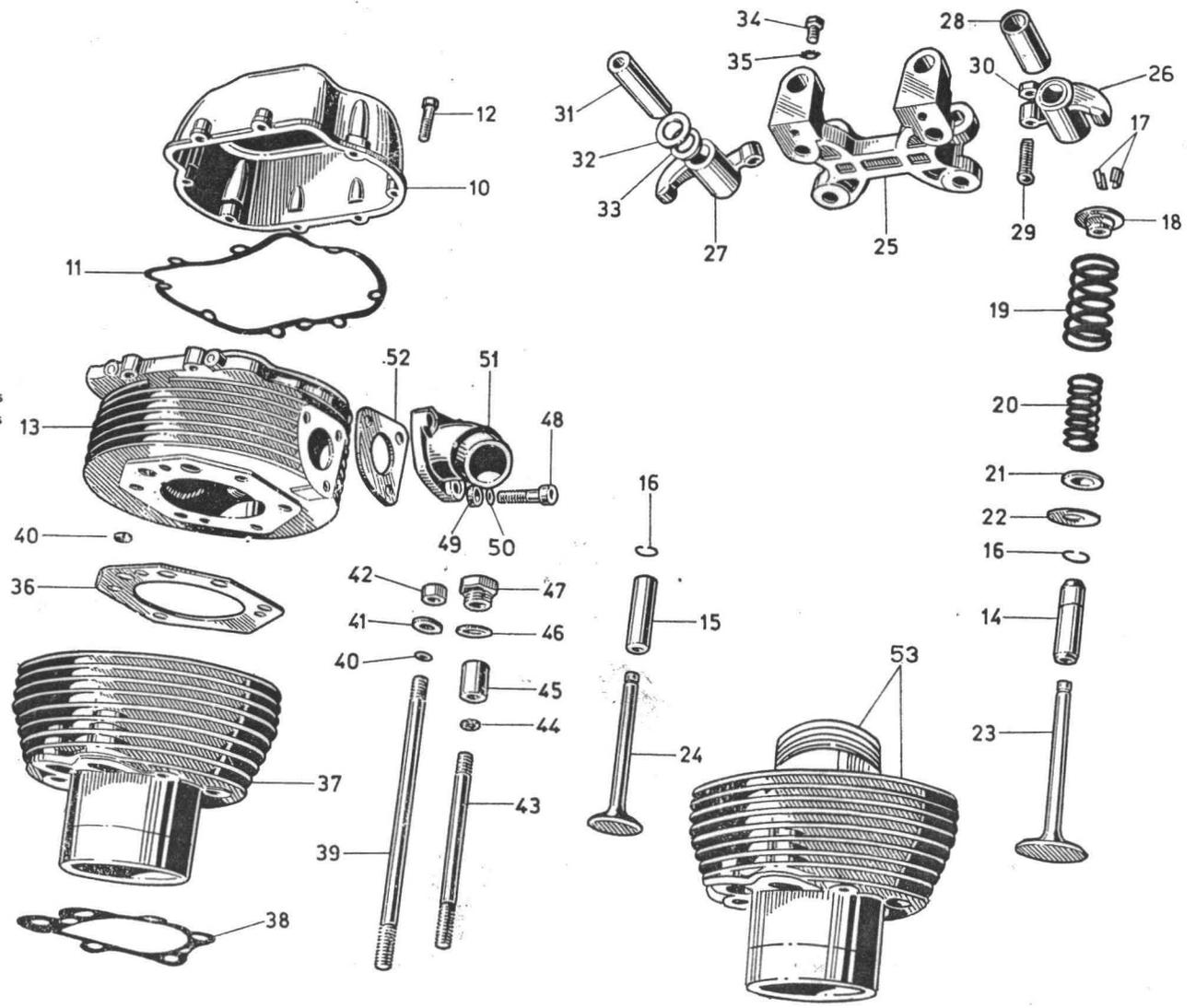
Valve mechanism

With the valve in its OPEN position, the spring tension should be $60 \pm 4\%$ lbs ($27.4 \pm 4\%$ kg) and the spring should compress to 22 mm (0.866 in.).



Rocker arm and spindle dimensions

- 10. Rocker box cover
- 11. Rocker box gasket
- 12. Rocker box cover screw
- 13. Cylinder head r/h
- 14. Inlet valve guide
- 15. Exhaust valve guide
- 16. Valve guide circlip
- 17. Valve keepers
- 18. Valves top collar
- 19. Outer valves spring
- 20. Inner valves spring
- 21. Collar bottom
- 22. Bottom collar-to-cylinder head washer
- 23. Inlet valve
- 24. Exhaust valve
- 25. Rocker arm support
- 26. R/h rocker arm complete with bushings
- 27. L/h rocker arm complete with bushings
- 28. Rocker arm bushing
- 29. Rocker arm adjusting screw
- 30. Rocker arm adjusting screw locknut
- 31. Rocker arm spindle
- 32. Spacer
- 33. Spring
- 34. Spindle locating bolt
- 35. Lock washer
- 36. Head gasket
- 37. Cylinder
- 38. Cylinder base gasket
- 39. Cylinder-cylinder head stud (long)
- 40. Washer
- 41. Washer
- 42. Nut
- 43. Cylinder-cylinder head stud (short)
- 44. Washer
- 45. Guide sleeve
- 46. Washer
- 47. Nut
- 48. Carburetor manifold allen bolt
- 49. Insulating washer
- 50. Washer
- 51. Manifold r/hand
- 52. Manifold insulating gasket
- 53. Piston and cylinder assembly



the spring compressed, remove the keepers then remove the compressor and complete the disassembly.

8. The valve guides may be removed by drifting them out with a suitable drift.

NOTE: *Do not remove valve guides unless they must be replaced. Consult the following "Inspection and Repair" section for additional information.*

Inspection and Repair

1. Clean all parts, other than the rocker cover gasket, in a suitable solvent and blow them dry. Although replacing the gasket is the recommended procedure, it is possible to clean the gasket with gasoline, but do not allow it to become saturated.

2. Remove any carbon deposits which may have formed on the cylinder head or piston assemblies. Carbon deposits can be softened with a decarbonizing solvent and scraped off with a blunt instrument such as a butter knife. Do not use a caustic soda solution to clean aluminum parts. Avoid gouging the piston crown or removing any metal. It is not necessary to restore the components to a like-new condition. Periodically, as you work, wipe the surface clean with a clean rag soaked in clean solvent. If this is done with the cylinder still in place, you can catch the carbon flakes by pressing a line of grease around the piston on top of the rings. Rotating the piston will leave the grease ring with the carbon trapped in it on the cylinder, and it can then be wiped out. The cylinder head assemblies should be disassembled before being decarbonized so you'll have to disassemble the valves to clean them up even if they don't need a valve job.

3. Inspect the cylinder head for warpage on the gasket surface by laying a straightedge across the head and measuring the distance between the straightedge and the gasket surface with feeler gauges. If the clearance exceeds 0.05 mm (0.002 in.) the head must be lapped or replaced to avoid blowing head gaskets and to prevent oil leaks. Repair the head in the following manner:

a. Place a sheet of fine grit emery paper on a flat surface and move the head around in a figure-eight motion while applying mild pressure. It is better to work slowly with mild pressure than

quickly with heavy pressure. Don't remove any more metal than is necessary.

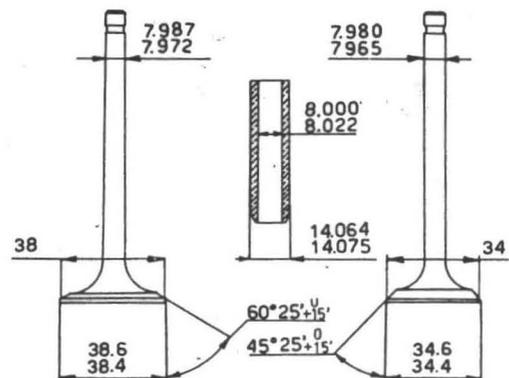
b. An alternative method is to use a piece of glass and a fine valve grinding compound instead of the emery paper.

c. Check the results with Prussian blue or red lead. To do this, lay out some very fine sandpaper on a flat surface. Coat the gasket surface of the head with the dye and allow it to dry. Move the head very gently over the sandpaper just long enough to remove the dye, then look at the gasket surface. If the head is flat all of the dye will have been removed. If there is still dye on the head, repeat the process or turn the job over to your dealer.

CAUTION: *Do not remove excessive amounts of metal from the gasket surface. If the operation is not done correctly the head will have to be milled and this may result in a raised compression ratio in that cylinder. This must be corrected for in the opposite cylinder. If the lapping process fails to correct leaks, check the cylinder gasket surface for flatness and lap it too, if necessary.*

4. Inspect the valves for a burned, bent, scored, pitted, or otherwise damaged condition and replace them as necessary. Measure the valve stem diameter and replace the valve if not within its serviceable limits of 7.982–7.987 mm (0.3138–0.3142 in.) for the inlet valve, and 7.965–7.980 mm (0.3136–0.3142 in.) for the exhaust valve. These figures apply to all of the models covered in this guide.

NOTE: *If this operation is beyond your abilities, take the disassembled and decarbonized head assembly and the specifications to any qualified machinist and let him do the job. The cost when done*



Valve stem, guide, and seat dimensions (V700)

10. Inspect the rocker arms and spindles for signs of wear, pitting, other damage, or excessive side play between the rockers and their spindles, and replace them as necessary. If the tappet adjusters are damaged, they may be replaced independently of the rockers, and bushings are available to replace those in the rockers. The following are useful specifications:

I/D of Rocker Arm Bushing (After Pressing-in and Machining)	Diameter of Rocker Arm Spindle	Fitting Clearance
15.032–15.059 mm (0.5918–0.5929 in.)	14.983–14.994 mm (0.5899–0.5903 in.)	0.038–0.076 mm (0.0015–0.0029 in.)

CAUTION: *The contact surfaces must be mirror polished.*

11. Inspect the rocker arms support and spindles for signs of wear, scoring, or other damage and replace the necessary components. Check for a smooth operation of the rocker on the spindle and either replace or turn down the damaged parts until they operate smoothly. If there is excessive side play between the rocker and spindle, they must be replaced.

12. Inspect the remaining hardware, washers, head gasket, etc. for signs of wear or damage and replace them as necessary.

Assembly and Installation

1. Assembly is in the reverse order of disassembly. New head gaskets and valve keepers should be used for sure and any other gaskets whose condition seems questionable should also be replaced. Lightly lubricate all parts as they are installed.

2. Place a new head gasket between the cylinder and cylinder head, taking care to correctly align all oil hole passages in the cylinder and gasket.

NOTE: *Although it is not recommended specifically by the manufacturer, a light coating of gasket sealer may be used at your own discretion. If you do this, make absolutely sure that none of the oil passages become blocked and that none of the sealer gets in the cylinder.*

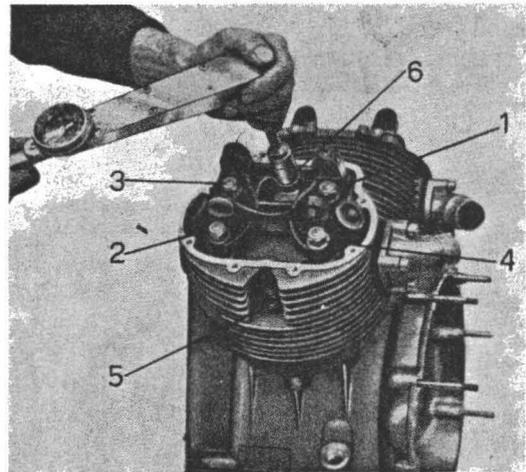
3. Position the cylinder head, with the valves already assembled, on the cylinder mounting studs, insert the pushrods in their original locations, then slip the rocker arms support over the studs and into place.

4. Place washers over the studs, then in-

stall the nuts and tighten them down finger tight. Secure the nuts progressively in the order shown in the accompanying illustration to a specified torque of 27.48 ft lbs (3.8 kg m).

CAUTION: *Failure to secure the nuts progressively or tightening them excessively may result in a warped cylinder head or a damaged head gasket. Failure*

to secure the nuts to their correct torque setting may result in loss of compression or oil leakage.



Cylinder head bolt torquing sequence

5. Position the rocker arm assemblies on the support, then insert the rocker arm spindles through the rocker arms, taking care to keep the washers and springs in their correct locations, and secure the spindles in position by installing and securing the rocker spindle bolts through the rocker support and the appropriate mounting holes in the spindle. It may be necessary to use a punch as an aid in installing the spindles.

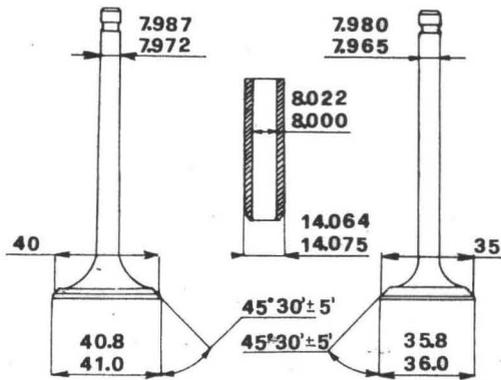
6. Position a new rocker cover gasket between the head and the cover, then secure the cover mounting screws in a crossed sequence.

7. Connect the cylinder head lubrication pipe, then mount and secure the inlet manifold reducing bushing, manifold seal-

in this manner is nominal. Don't forget to bring new keepers with you because, for safety's sake, you don't want the head assembled with the old ones.

5. Inspect the condition of the valve face contact area and the valve seat for a pitted, burned, or otherwise damaged condition. If the valve is burned, worn, or damaged it must be replaced. The valve seat may be cut to restore it to its intended dimensions which are as follows:

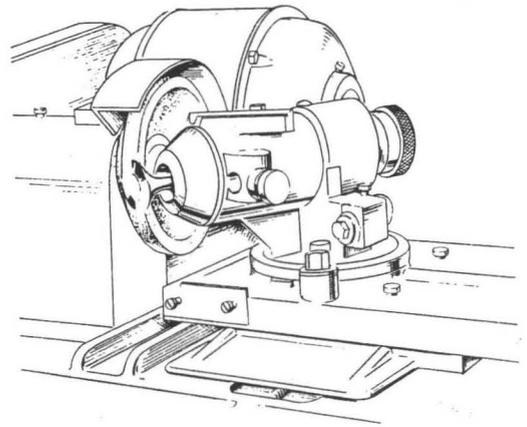
- a. V700:
inlet valve $60^{\circ} 25' \pm 15'$
exhaust valve $45^{\circ} 25' \pm 15'$
- b. V750 and V850:
inlet valve $45^{\circ} 30' \pm 5'$
exhaust valve $45^{\circ} 30' \pm 5'$



Valve stem, guide, and seat dimensions (V750 and V850).

The valve face must also be cut to these specifications and this can be done by placing them in a lathe and spinning them against a cutter set at the appropriate angle. Cut inlet valve faces at an angle of $60^{\circ} 25' \pm 15'$, and exhaust valve faces at $45^{\circ} 25' \pm 15'$ for all of the models covered in this guide. The minimum diameter of the valve face contact area is 0.8 mm (0.0315 in.). If, after grinding the valve, the edges are rough, smooth them out on a grinding wheel, but avoid removing excessive amounts of metal.

NOTE: Whenever you cut valve seats you change the distance from the seat to the valve keepers and this means that the spring will be too short. If the compressed length of the valve spring is not within its limits of 37–38 mm (1.456–1.496 in.), and you are sure it's not because the spring is worn and slightly collapsed, shim the spring by installing suitable washers between the



Refacing a valve

bottom valve spring collar and the surface of the cylinder head.

6. If the seat has just been cut, or if the seat looks all right and you just want to ensure a good seal between the seat and valve, lap the valves in at this time in the following manner:

a. Lightly oil the valve stem and insert it in the guide.

b. Apply a light coat of lapping compound to the seat. It is best to apply a few evenly spaced daubs rather than a random application.

c. Slip a gas line over the valve stem and rotate it back and forth in your hands while applying mild pressure against the seat by pulling on the gas line.

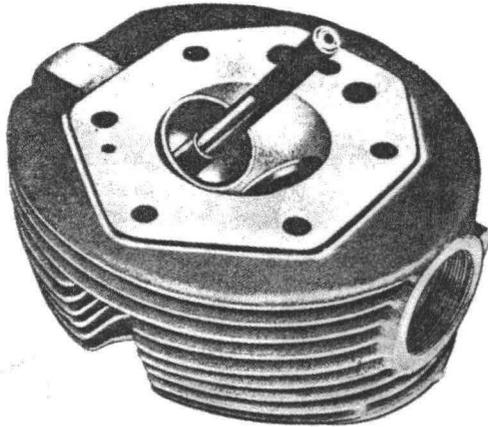
d. Clean the seat area when smooth, and assemble the valve. Pour some gas into the spring side of the head and allow the head to sit. If there is no leakage through the seat after a few minutes, the lapping has been successful.

7. Measure the clearance between the valve stem and guide with a dial indicator, then measure the diameter of the stem with a micrometer in several places along the stem. The valve stem should be of the same diameter all along its length and should be replaced if uneven (consult Step 4 of this section). If the stem is within specifications and the clearance between the stem and guide is excessive, the guide must be replaced. The inside diameter of the guide should be within 8.000–8.022 mm (0.3149–0.3158 in.) for both the inlet and exhaust valves. The clearances between the stem and guide for the inlet valve should be within 0.013–0.050 mm (0.0005–0.0019 in.), and the clearances for

the exhaust valve should be within 0.020–0.057 mm (0.0008–0.0022 in.).

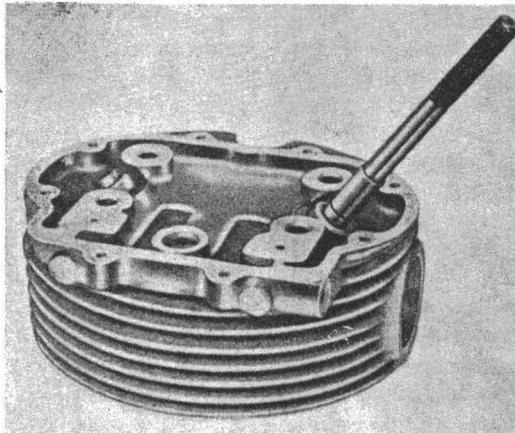
8. If the valve guide must be replaced, do so in the following manner:

- a. Remove the guide by drifting the valve out with a suitable drift. Heating the head to about 200° F. will loosen the guide slightly and facilitate its removal.



Drifting out a valve guide

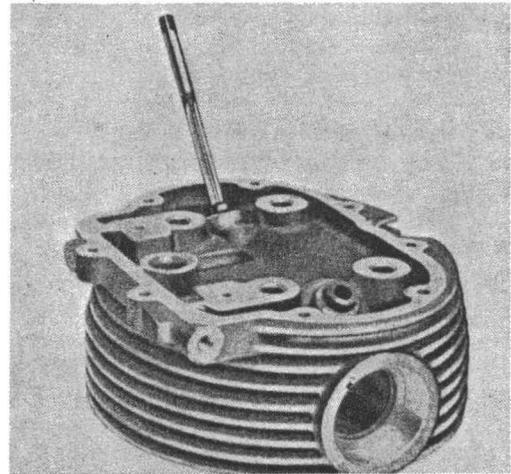
- b. Lubricate the new guide and carefully drift it into place. Again, heating the head will make the job easier.



Installing a valve guide

- c. Ream the newly installed guide with a suitably sized reamer to make sure it hasn't collapsed slightly inside. Take care not to deform the guide and oil the reamer lightly when it encounters interference. Remove metal chips as soon as they occur and always continue to rotate the reamer when removing or installing it. The condition of the valve

seat should be carefully inspected as it may need attention if you were kind of sloppy while installing the guide.



Reaming out a newly installed guide

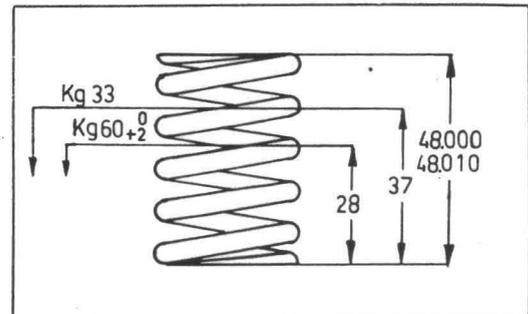
- 9. Inspect the valve springs for a worn, pitted, collapsed, or otherwise damaged condition and replace them as necessary. The spring tension can be checked on a suitable tester, which you probably won't have access to, so either take the springs to your dealer for testing, visually compare them to new ones, or replace them.

NOTE: Valve springs should always be replaced in complete sets.

The correct valve spring tensions are as follows:

V700:

With the valve in its CLOSED position, the spring tension should be $72 \pm 2\%$ lbs ($33 \pm 2\%$ kg) and the spring should compress to 37 mm (1.456 in.).



Valve spring dimensions (V700)

With the valve in its OPEN position, the spring tension should be $132 \pm 2\%$ lbs ($60 \pm 2\%$ kg) and the spring should compress to 28 mm (1.024 in.).

ing gasket, and the manifold to the head.

8. Complete the assembly procedures in the reverse order of disassembly. The engine should be spun over several times to lubricate the top end before it is started.

CYLINDER AND PISTON ASSEMBLY

Disassembly

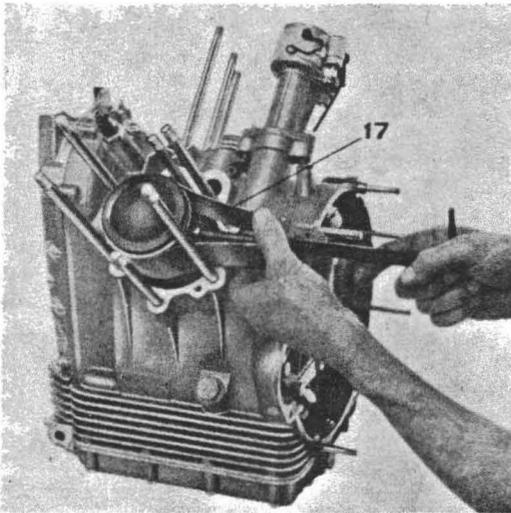
1. Remove, but do not disassemble, the cylinder head as described in the cylinder head "Removal and Disassembly" section.

2. Rotate the engine to TDC on the cylinder on which you are working, then carefully lift the cylinder off of the piston, and remove the cylinder base gasket.

NOTE: As soon as there is sufficient clearance, a clean oil soaked rag should be placed between the cylinder and crankcase to prevent any foreign objects, such as pieces of broken rings, from falling into the crankcase. This rag should be kept in position as long as the crankcase is vulnerable.

3. Remove the piston pin circlips by prying them out with a pointed instrument, then press out the pin using either the factory tool (No. 26907800, for the V700 and V750, which is indicated by No. 17 in the accompanying illustration, or by No. 13907860 for the V850) or a suitable drift, then remove the piston.

CAUTION: To avoid deforming the connecting rod, hold it steady while drifting out the pin. Applying heat to the piston crown with an iron or hot towels will make it easier.



Removing the piston pin

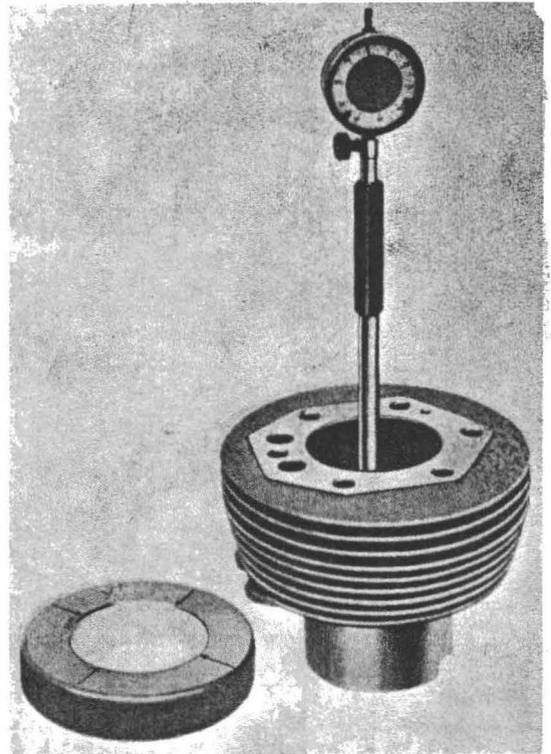
4. Remove the piston rings with a ring expander or by hand. Take care to avoid damaging the piston.

Inspection and Repair

1. Clean all parts, other than the gaskets, in a suitable solvent and blow them dry. Make sure the oil passages are clear. Thoroughly decarbonize the piston and cylinder assemblies. The piston ring grooves can be easily decarbonized with a piece of broken piston ring.

2. Inspect all parts for signs of excessive wear or damage and replace them as necessary.

3. Measure the cylinder in at least three places along the piston's path using an inside micrometer. After the measurement for each position is taken, rotate the micrometer 180° to make sure you've gotten the most accurate measurement possible. If the cylinder is scored or ovalized in excess of 0.10 mm (0.00394 in.), the liner



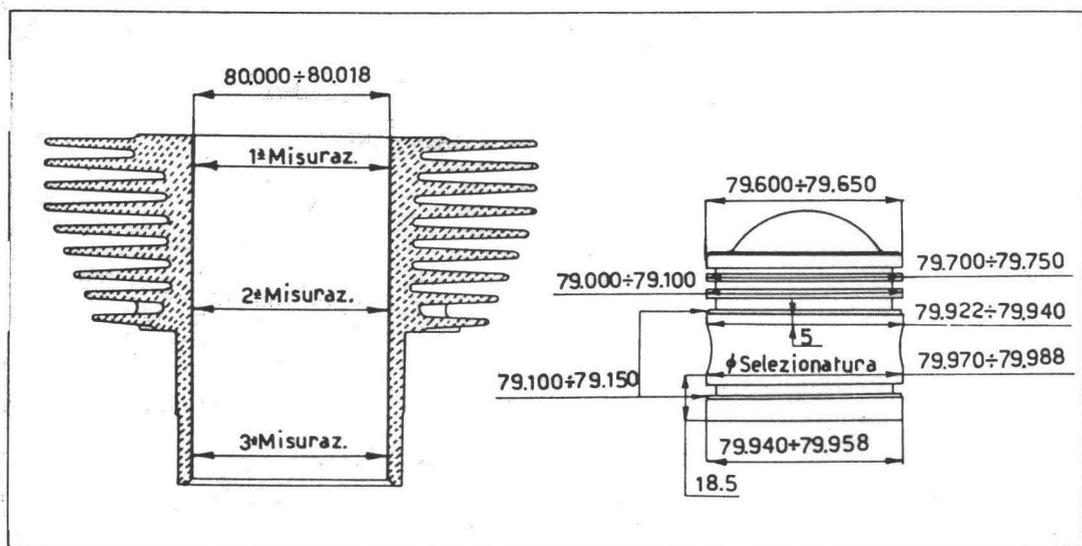
Checking the cylinder bore for wear

must be replaced. The sizes of the available liners which may be used are indicated in the accompanying illustrations for each of the models covered in this guide. Various pistons and rings, which must be

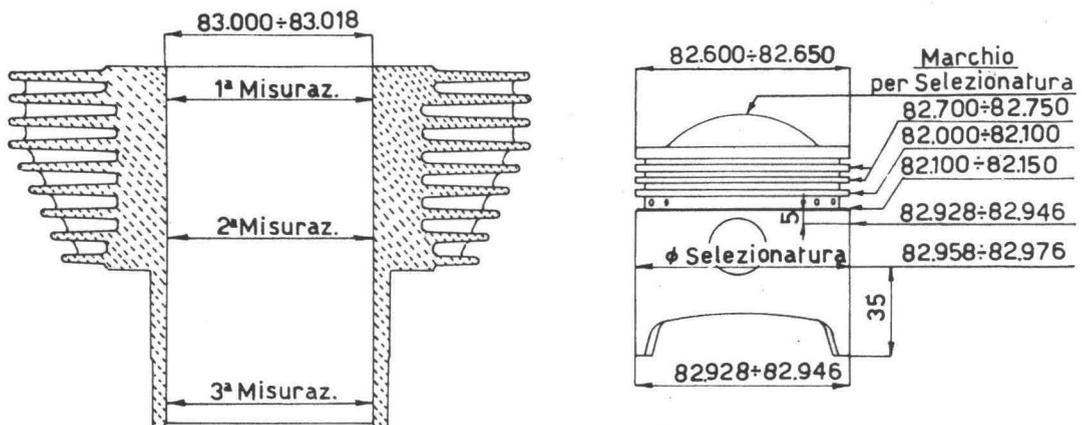
used in conjunction with the appropriate cylinder class, are available for each of the cylinder diameters listed in the following charts:

Class A	Class B	Class C
V700		
80.000 mm (3.14963 in.)	80.006 mm (3.14987 in.)	80.012 mm (3.15010 in.)
80.006 mm (3.14987 in.)	80.012 mm (3.15010 in.)	80.018 mm (3.15034 in.)

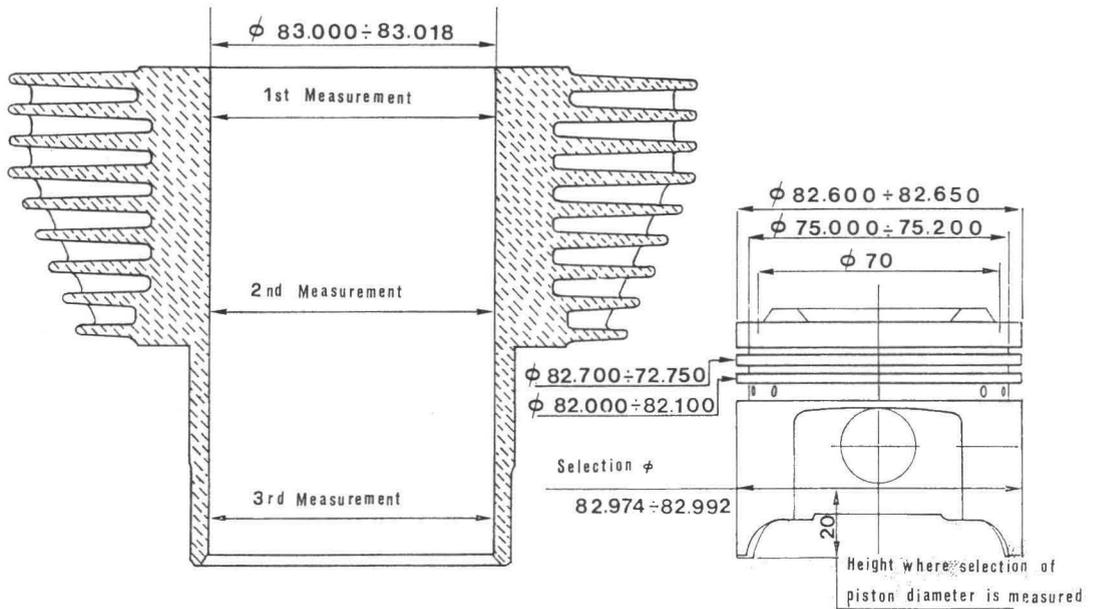
Class A	Class B	Class C
V750		
83.000 mm (3.2677 in.)	83.006 mm (3.2679 in.)	83.012 mm (3.2681 in.)
83.006 mm (3.2679 in.)	83.012 mm (3.2681 in.)	83.018 mm (3.2683 in.)
V850		
83.000 mm (3.2677 in.)	83.006 mm (3.2679 in.)	83.012 mm (3.2681 in.)
83.006 mm (3.2679 in.)	83.012 mm (3.2681 in.)	83.018 mm (3.2683 in.)



Cylinder and piston dimensions (V700)



Cylinder and piston dimensions (V750)

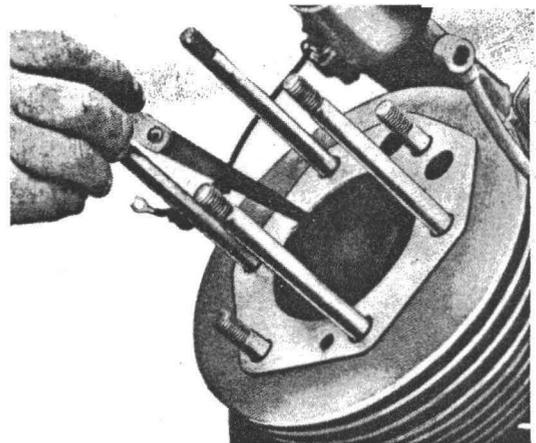


Cylinder and piston dimensions (V850)

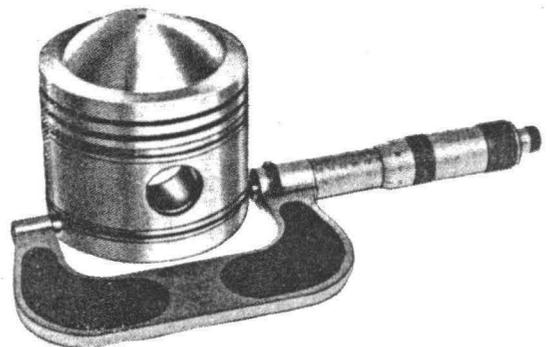
The liners can be removed by boiling the cylinder in oil to expand the cylinder away from the liner. Tapping the heated assembly should loosen the liner which should then slip out. The new liner can then be carefully pressed into the cylinder. If this sounds like too much hassle, take the cylinder and new liner to your local dealer and let him do it or have him suggest someone who can do it. The piston to be used with the new liner should be selected after the liner is installed.

NOTE: Although it is not recommended by the factory, Volkswagen replacement liners and pistons may be used as a temporary measure in case of emergency.

4. Measure the pistons in the locations shown in the accompanying illustrations. If the clearances are beyond the limits specified in the illustrations, the piston must be replaced along with the cylinder liner. In all cases, the piston and liner must be compatible and the piston's ovalization as measured at a point perpendicular to the piston pin holes and at the height indicated in the illustration (18.5 mm for the V700, 35 mm for the V750, and 20 mm for the V850) must be at least 0.055–0.065 mm (0.0021–0.0025 in.) less than the selected size. The available pistons are listed in the following charts:



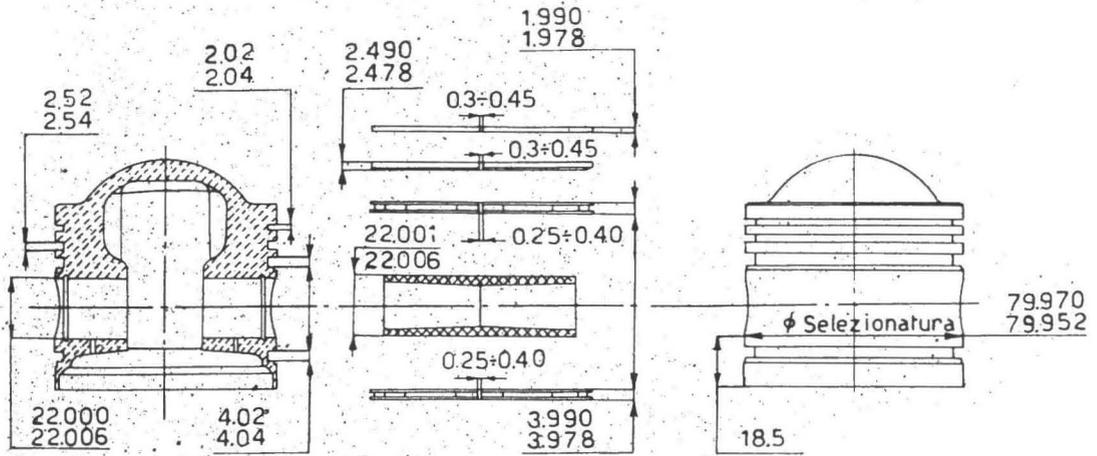
Measuring piston-to-cylinder clearance



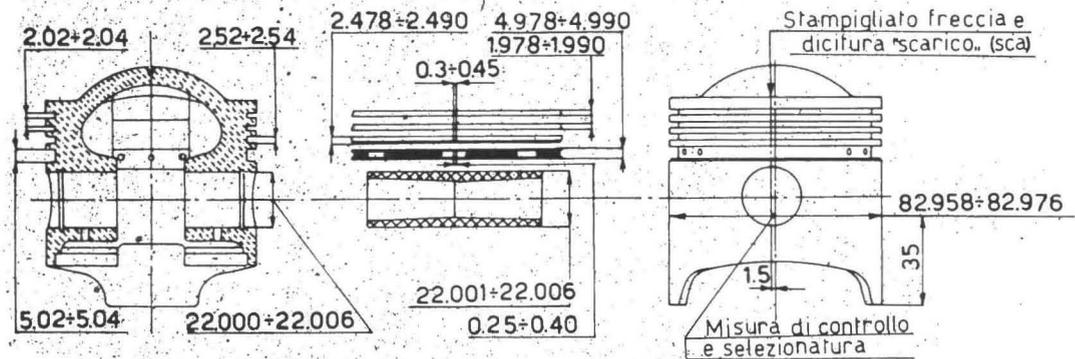
Measuring the piston diameter

Class A			Class B			Class C		
V700								
79.952 mm (3.14774 in.)			79.958 mm (3.14798 in.)			79.964 mm (3.14821 in.)		
79.958 mm (3.14798 in.)			79.964 mm (3.14821 in.)			79.970 mm (3.14845 in.)		
V750								
82.958 mm (3.2260 in.)			82.964 mm (3.2262 in.)			82.970 mm (3.2264 in.)		

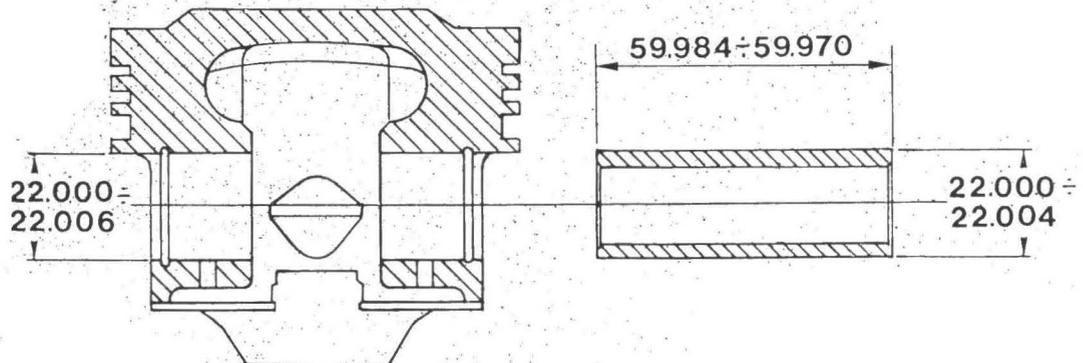
Class A			Class B			Class C		
V750								
82.964 mm (3.2262 in.)			82.970 mm (3.2264 in.)			82.976 mm (3.2266 in.)		
82.968 mm (3.2664 in.)			82.974 mm (3.2666 in.)			82.980 mm (3.2668 in.)		
82.974 mm (3.2666 in.)			82.980 mm (3.2668 in.)			82.986 mm (3.2671 in.)		



Piston dimensions (V700)

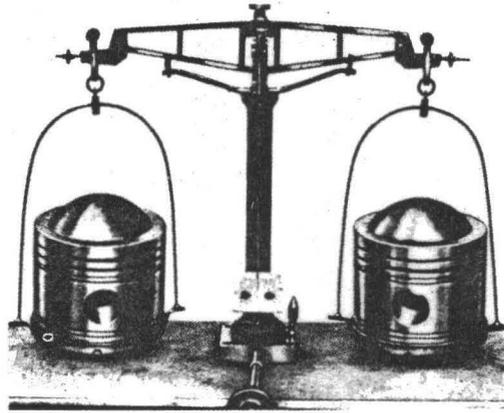


Piston dimensions (V750)



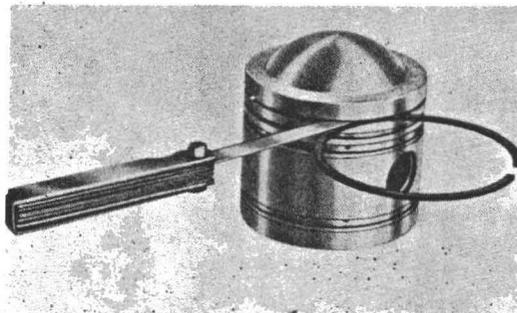
Piston dimensions (V850)

5. Weigh the two pistons which are to be used. If the difference is in excess of 1.5 g., the heavier of the two should be lightly and evenly filed along the bottom edge of its skirt. Remove any burrs which may have been formed by gently sanding with fine emery cloth.



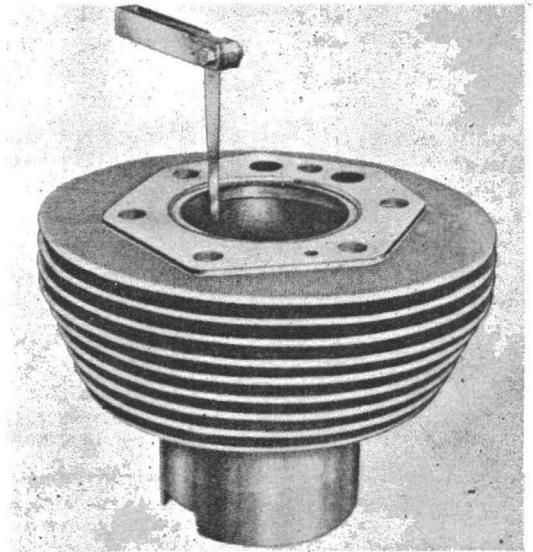
Balancing the pistons

6. Measure the vertical clearance between the new piston rings which are to be fitted and the ring grooves in the piston. If the clearance for any of the grooves exceeds the limits of 0.030–0.062 mm (0.001–0.0024 in.), the piston must be replaced.



Checking ring-to-piston side clearance

7. Measure the end gap on each of the rings to be fitted. The measurement can be made with feeler gauges, when the ring is inserted in the cylinder, just below its lip. The end gap for piston compression rings is 0.30–0.45 mm (0.012–0.018 in.), and the gap for the oil scraper rings is 0.25–0.40 mm (0.010–0.016 in.). Correct the gap if necessary by filing one end of the ring. Make sure you file it evenly and finish it so it's smooth and straight across.



Checking ring end gap

8. Inspect the piston pin for signs of wear, scoring, pitting, or other damage and replace it as necessary. The pin is a press fit and the negative allowance between it and the piston pin hole is 0.001 mm (0.00004 in.) for the V700 and V750, and 0.004 mm (0.00015 in.) for the V850. The correct specifications for the piston pin hole can be found in the illustrations of the pistons found in Step No. 4.

Assembly and Installation

1. Assembly is basically in the reverse order of disassembly.

2. Install the piston rings on the pistons by using a ring expander or do it by hand taking care not to damage the piston. Make sure they will rotate smoothly around the piston, then stagger their end gaps every 90°.

3. Install the pistons on the connecting rods; use the same tool which you used to remove the piston pin to secure it, then install a new pair of circlips by using snapping pliers.

NOTE: *As an aid in installation, the piston should be heated and well lubricated and the piston pin holes should be heated to about 140° in a bath of oil. Secure the connecting rod to avoid damaging it or the big end bearing.*

4. Position the cylinder base gasket on the cylinder. The mating surfaces of the cylinder and crankcase must be perfectly clean.

5. Start the cylinder on the mounting studs, then carefully bring it down over the piston, taking care to avoid damaging the piston rings. Thoroughly lubricate the cylinder bore and the piston assembly as an aid in installation. A ring compressor (a suitably sized hose clamp will work also) may be used, but you'll probably find it as easy to use your hands.

NOTE: The rag should remain over the crankcase until the last moment to prevent any possible pieces of broken ring from falling into the crankcase cavity.

Bottom End Service

CONNECTING RODS

Small End Bearing

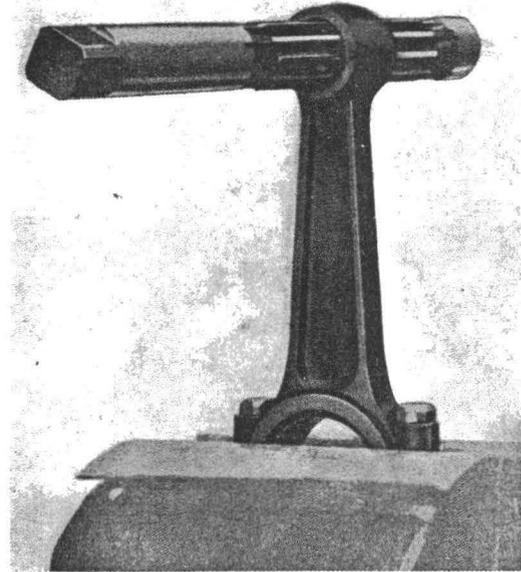
REMOVAL AND INSTALLATION

1. Run the engine until its normal operating temperature is reached, then drain the oil. This job may be done with the engine in or out of the frame, but the oil must be drained.
2. Remove the cylinder head, cylinder, and piston assemblies as directed in the "Top End Service" section.
3. Remove the crankcase sump pan, then unbolt the bottom half of the connecting rod after bending back the locking tab of the lockwashers and remove it and the lower bearing shell.
4. Pull the connecting rod up and out of the crankcase. The big end bearing is a plain bearing in two half shells, so don't forget to remove the top shell if it hasn't fallen out.

NOTE: Connecting rod assemblies must be kept separate for reassembly in their original positions.

5. Secure the connecting rod in a wood jawed vise, then remove the small end bearing by drifting it free with a suitable drift if it appears to be marked, scored, or excessively worn.

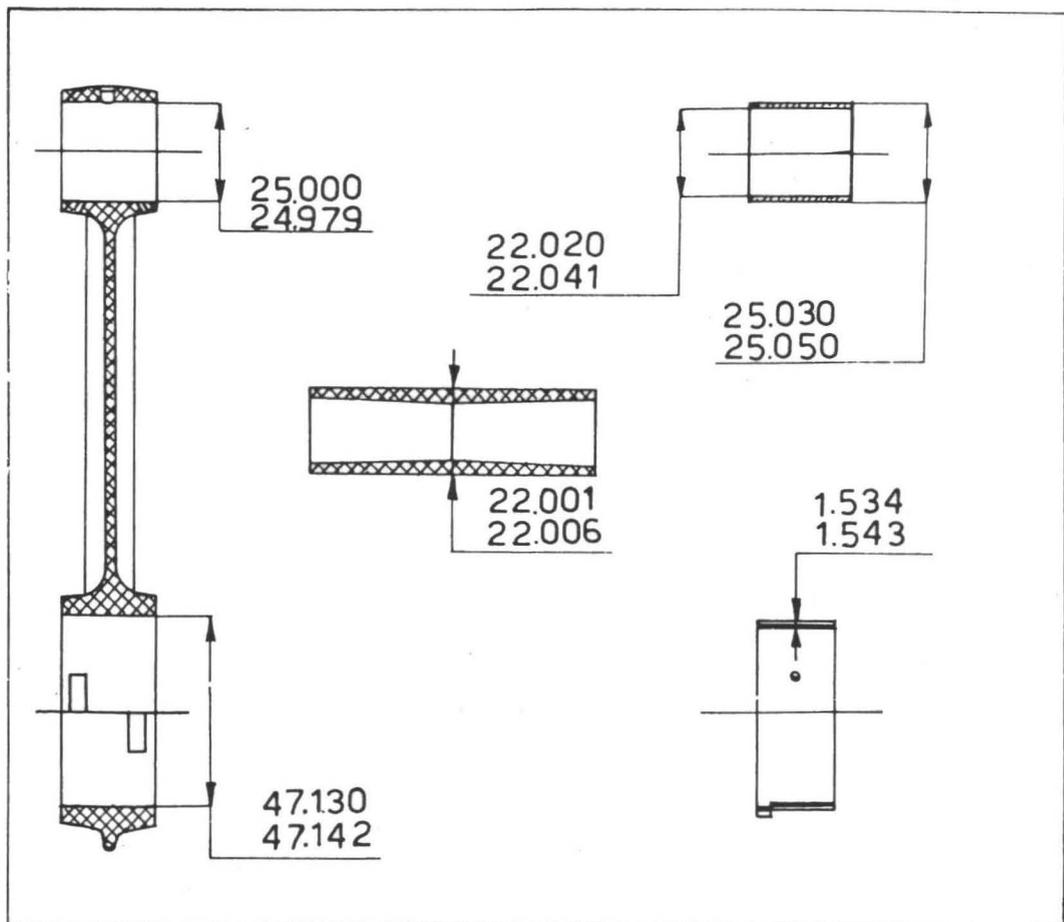
6. Replace the bearing by pressing it in, then drill through the oil passage in the connecting rod with a suitable drill. Ream the bearing out with a suitable reamer until you arrive at a perfectly rounded inside diameter of 22.020–22.041 mm (0.8669–0.9678 in.).



Reaming the small end bearing to size



Connecting rod assembly



Connecting rod dimensions

7. Reinstall the connecting rod on the crankshaft as directed in the "Connecting Rod Installation" section, then complete the assembly in the reverse order of disassembly. Don't forget to replace the sump pan gasket and refill the sump with oil.

NOTE: The diameter of the piston pin should be 22.001–22.006 mm (0.8662–0.8663 in.) and the clearance between the pin and the small end bearing should be 0.014–0.040 mm (0.0005–0.0015 in.). Replace the pin at this time if necessary.

Big End Bearing

REMOVAL AND INSTALLATION

1. Run the engine until its normal operating temperature is reached, then drain the sump and remove the sump pan.

2. Remove the nuts and lockwashers which secure the bottom halves of the connecting rod together and then remove the

bottom half of the rod and the lower bearing shell.

3. Remove the two bolts which secure the connecting rod halves together, taking care not to scratch the crankshaft journal, then carefully push the connecting rod up until the upper bearing half is free for removal.

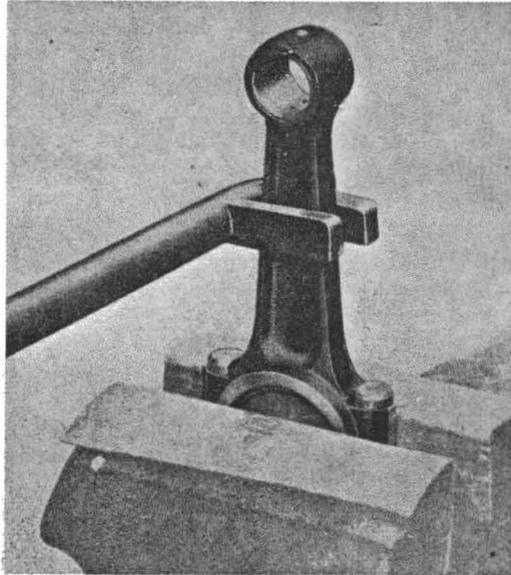
4. Replace the big end bearing while installing the connecting rod on the crankshaft as described in the "Connecting Rod Installation" section, then complete the reassembly in the reverse order of disassembly. Be sure to replace the sump pan gasket and refill the sump with oil.

Connecting Rod Installation

1. Make sure that the rod is perfectly straight. The axes of the big and small bearing holes must be parallel to each other. If the rod is bent slightly, but shows no signs of fatigue or other damage, it may be bent back as indicated in the accom-

panying illustration. The rod must not be bent more than 0.03 mm (0.00118 in.) when measured at a point 200 mm (7.874 in.) from the big end bearing hole.

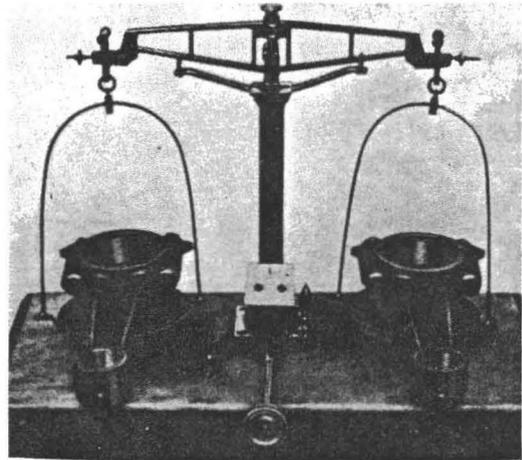
NOTE: When bending the rod, make sure the jaws of the vise are wood or use some other means of protecting the rod.



Straightening a connecting rod

2. Weigh the two connecting rods in their completely assembled form (i.e., including big and small end bearings, nuts, bolts, and lockwashers). The weight of an assembled rod should be 560 ± 10 g (1 lb $3\frac{3}{4}$ oz) and the maximum permissible difference is 3 g (46 grains). If the difference is greater, you should get a rod to match

one or the other or try to file off some of the material from the heavier one; however, matching is a better idea than filing.



Balancing the connecting rods

3. Select new big end bearings to fit the crankshaft journal. Be careful to avoid scratching the crankshaft while measuring it with your caliper or micrometer. The following charts list the oversize bearings available to fit an undersize crankshaft. If the crankshaft must be ground to remove score marks or to make the available bearings fit it, remove it as described in the "Crankshaft" section and have your local dealer or a qualified machinist match the rods and bearings to it.

NOTE: Even if a crankshaft is only slightly scored or marked, it must be re-ground before it is put back into service or a violent failure may occur.

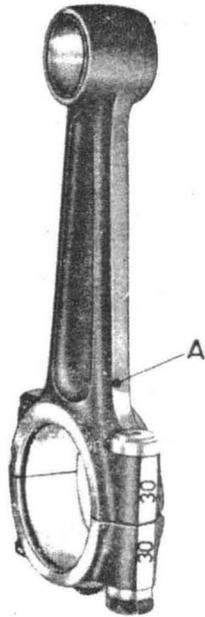
Big End Bearings Inside Diameter:

Original Thickness	Oversize			
	0.254 mm (0.010 in.)	0.508 mm (0.020 in.)	0.762 mm (0.030 in.)	1.016 mm (0.040 in.)
1.534–1.543 mm (0.06039–0.06074 in.)	1.661–1.670 mm (0.06539–0.065748 in.)	1.788–1.797 mm (0.07–0.07074 in.)	1.915–1.924 mm (0.07539–0.07574 in.)	2.042–2.051 mm (0.08039–0.08074 in.)

Crankshaft Journal Outside Diameter:

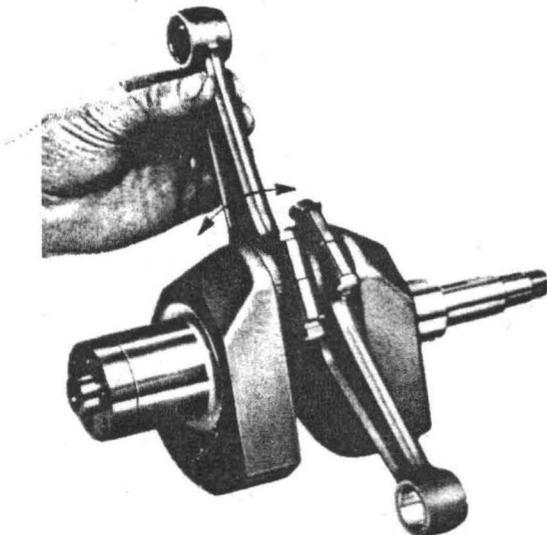
Original Diameter	Undersize			
	0.254 mm (0.010 in.)	0.508 mm (0.020 in.)	0.762 mm (0.030 in.)	1.016 mm (0.040 in.)
44.013–44.033 mm (1.7328–1.7336 in.)	43.759–43.779 mm (1.7228–1.7236 in.)	43.505–43.525 mm (1.7128–1.7136 in.)	43.251–43.271 mm (1.7028–1.7036 in.)	42.997–43.017 mm (1.6928–1.6936 in.)

4. Temporarily secure the connecting rods on the crankshaft journal. The oil passages (A) on the big end must be facing upward for the left hand cylinder's rod and facing downward for the right hand cylinder's rod. When the bottom cap is fitted, it should be done so the numbers marked on the side of the top and bottom halves are aligned.



Connecting rod correctly assembled

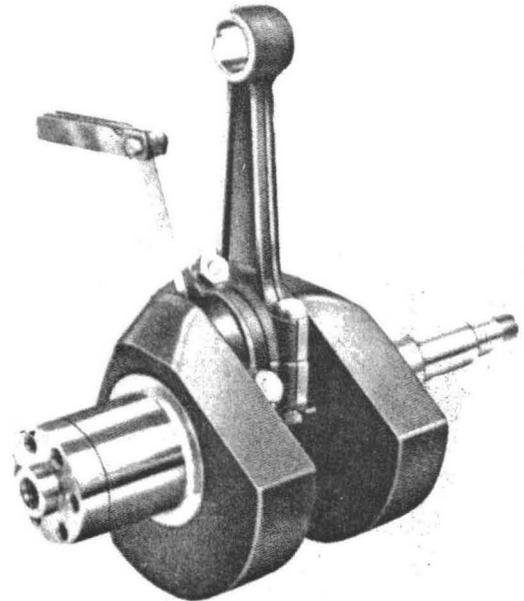
5. Make sure that the bearing-to-crankshaft journal lateral play is within the specified limits of 0.011–0.061 mm



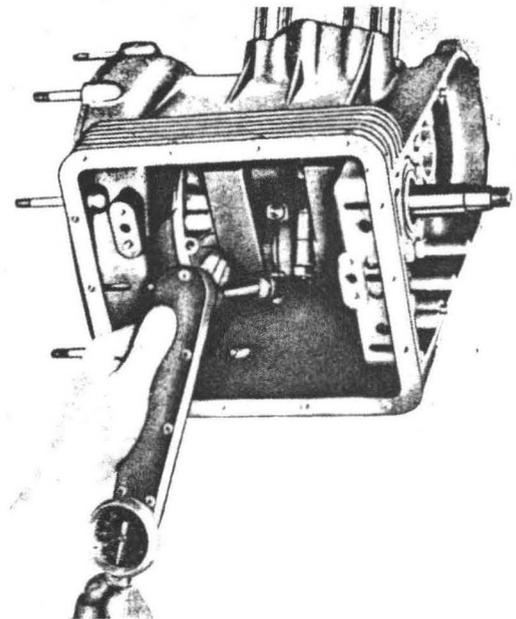
Checking lateral play

(0.000433–0.0024 in.). This is best measured with a dial indicator and is corrected by installing larger bearings.

6. Make sure that the connecting rod-to-crankshaft journal side clearance is within the specified limits of 0.3–0.5 mm (0.0118–0.0196 in.). This is best measured with feeler gauges and is usually corrected by grinding the journal down to the next undersize and then compensating by installing the appropriate oversize bearings.



Checking rod-to-journal clearance



Securing the connecting rods

7. When you are satisfied with the way the rods fit on the crankshaft, torque the nuts to 25.31 ft lbs (3.500 kg m), then bend the locking tab up against a flat side of the nut. If you wish, a small amount of thread sealer may be used.

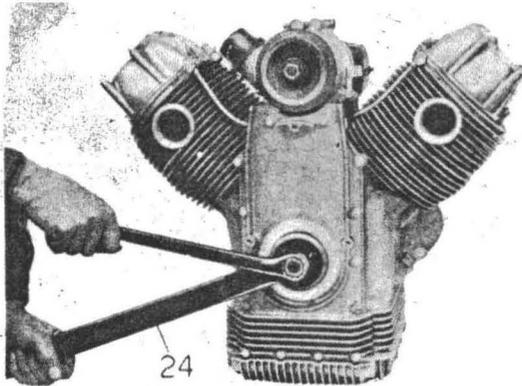
TIMING CHEST

Disassembly

1. Remove the engine from the frame as directed in the "Engine Removal and Disassembly" section.

2. Remove the generator belt cover and belt. The belt can be removed by withdrawing the three bolts which secure the outer half of the driving pulley.

3. Secure the clutch assembly with the special tool (No. 12911801) or a suitable substitute, then remove the nut which secures the inner half of the generator driving pulley and remove the pulley half. Then mount either the special tool (No. 12905300 which is indicated by No. 24 in the accompanying illustration), or a suitable substitute, to the pulley hub and remove the crankshaft nut.

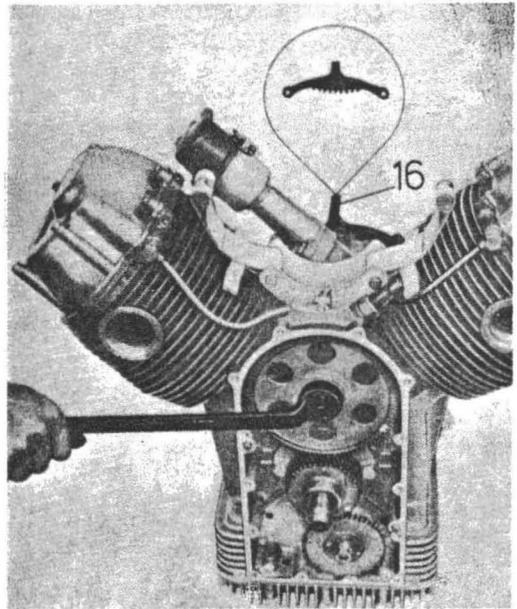


Removing the pulley hub

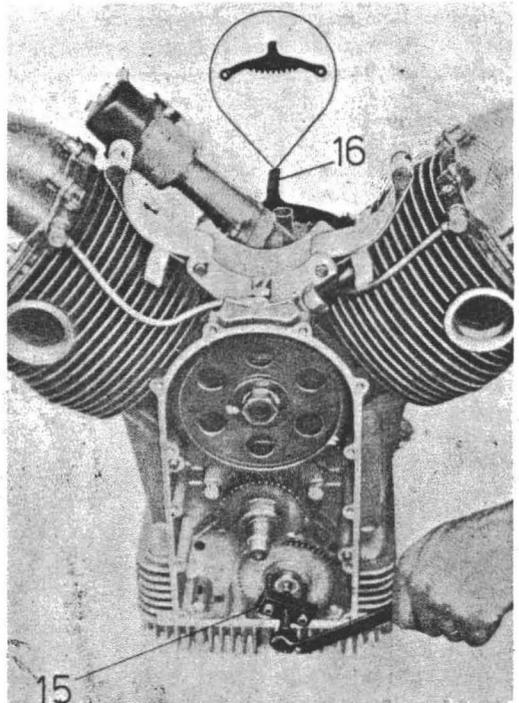
4. Remove the screws which secure the timing cover to the crankcase, then remove the cover. Tap the cover gently with a wood block and hammer to break its seal, if necessary. Remove the seal ring from the cover if necessary.

5. Remove the cam wheel securing nut, then remove the cam wheel. The clutch should still be secured as directed in Step No. 3 by the special tool (16).

6. Remove the oil pump gear from its tapered shaft with the pump gear puller (No. 32906302 which is indicated by No. 15 in the accompanying illustration) or a



Removing the cam wheel



Pulling the oil pump gear

suitable substitute. The clutch must be secured by the special tool (16).

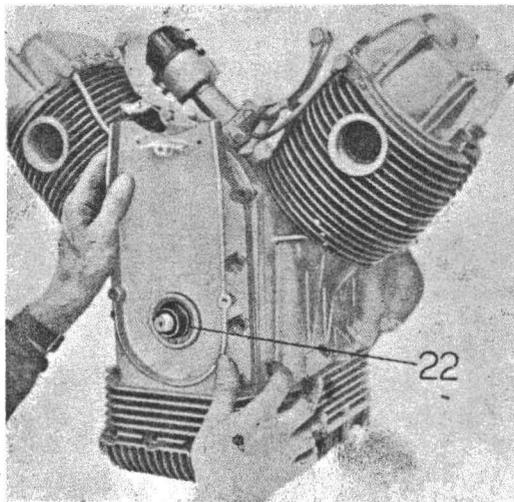
7. Remove the crankshaft timing gear from the end of the crankshaft. The gear is a keyed on press fit and must be pulled with a suitable puller.

Inspection and Repair

1. Clean all parts other than gaskets and rubber seals in a suitable solvent, then blow them dry.
2. Inspect all parts for signs of wear or damage and replace them as necessary. The gear teeth must be in good condition and gears which mesh together must be replaced in sets.
3. Woodruff keys, gaskets, and rubber seals should all be replaced as these are short-life items.
4. Inspect the generator belt for signs of wear, cracking, or other damage and replace it at this time if necessary.

Assembly

1. Assembly is in the reverse order of disassembly.
2. Consult the "Valve Timing" section for instructions on installing the three timing chest gears.
3. When installing the timing cover, some provision must be made to protect the seal ring. This is easily done by using the special tool (No. 12908300 which is indicated by No. 22 in the accompanying illustration).



Installing the timing cover

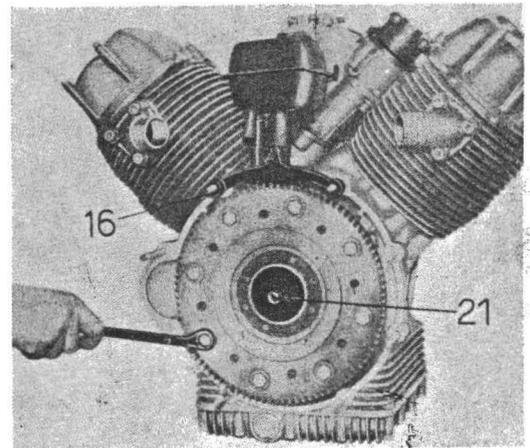
4. Install and adjust the generator belt as described in the "Maintenance" chapter, then tune the engine, if necessary, as directed in the "Tune-Up" chapter.
5. Install the engine in the frame as described in the "Engine Removal and Installation" section, then replenish the crankcase oil supply.

CLUTCH

Disassembly

1. Remove the engine as directed in the "Engine and Transmission" section, or remove the engine mounting hardware, disconnect the transmission, and slide the engine forward as far as it will move in the frame. Removing the engine will make the job go easier.
2. Secure the starter ring gear using either the factory tool (No. 12911801 which is indicated by No. 16 in the accompanying illustration) or a suitable substitute. Remove the bolts which secure the ring gear to the flywheel, then remove the clutch assembly.

NOTE: The bolts must be removed evenly in a crossed pattern to avoid deforming the pressure plate.

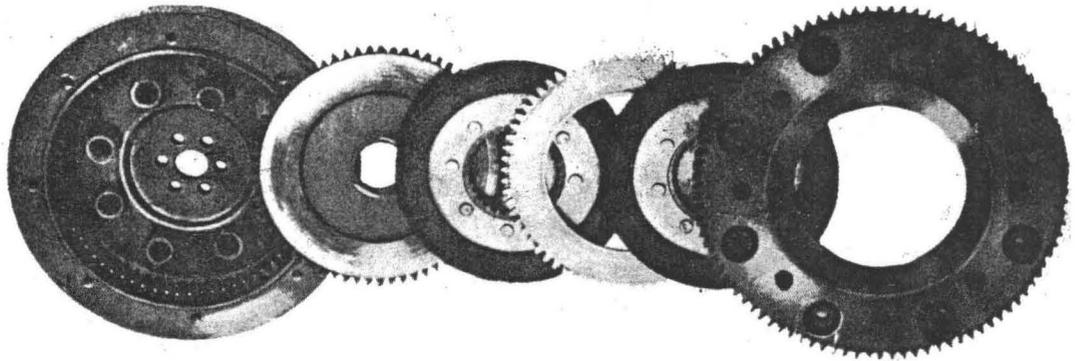


Removing the starter ring gear

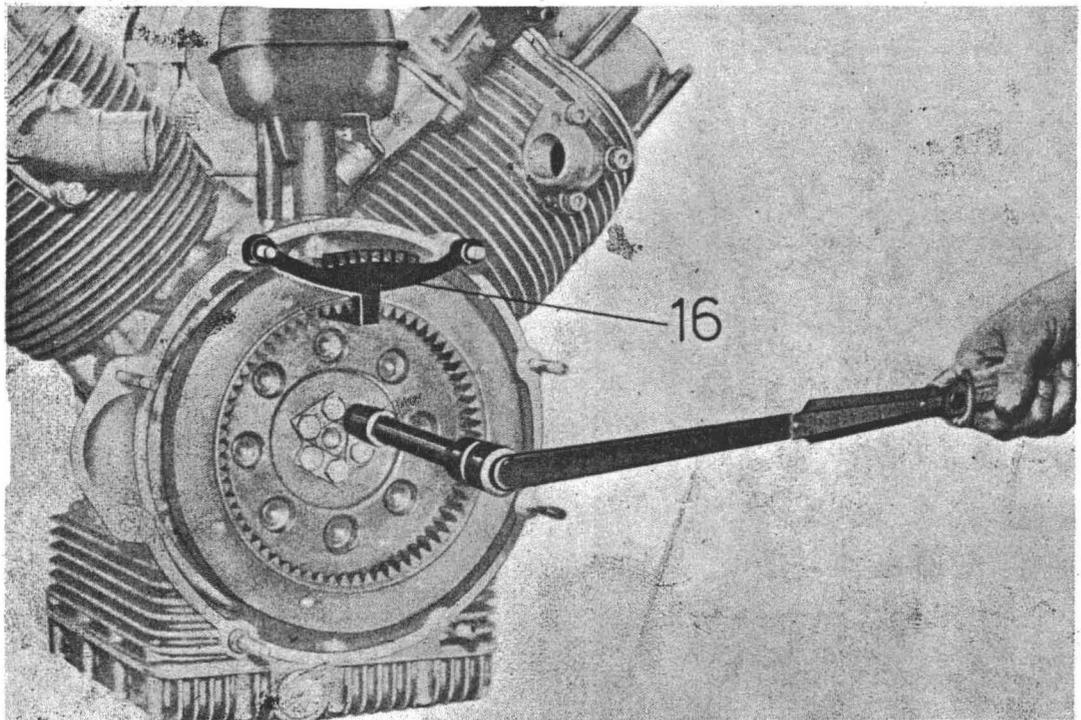
3. Remove the eight bolts which secure the flywheel, which serves as a clutch hub to the crankshaft, and remove the flywheel. It is not necessary to remove the flywheel unless it is obviously damaged.
4. The release mechanism may be disassembled if so desired.

Inspection and Repair

1. Clean all parts other than the friction plates in a suitable solvent, then blow them dry.
2. Inspect the clutch springs for a worn, damaged, or collapsed condition and replace them, as a set, if necessary. The springs should be pressure tested to check their efficiency; this can be carried out by your local dealer. If, however, the neces-



Clutch assembly



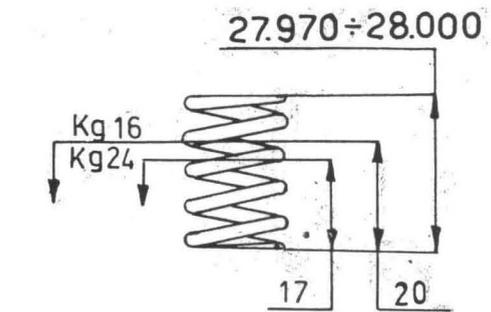
Removing the flywheel from the crankshaft

sary test equipment is not available, compare them with new springs and replace them if their condition seems doubtful. The following are the necessary test specifications:

V700:

With the spring compressed to 20 mm (0.7874 in.), the load should be $16 \pm 10\%$ kg ($35.27 \pm 10\%$ lbs).

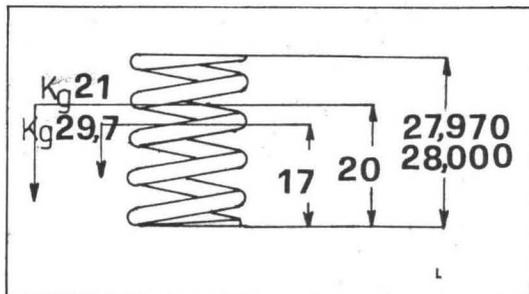
With the spring compressed to 17 mm (0.6692 in.), the load should be $24 \pm 10\%$ kg ($52.9 \pm 10\%$ lbs).



Clutch spring dimensions (V700)

V750 and V850:

With the spring compressed to 20 mm (0.7874 in.), the load should be $21 \pm 25\%$ kg (46.3 \pm 25% lbs).



Clutch spring dimensions (V750 and V850)

With the spring compressed to 17 mm (0.6692 in.), the load should be within 28.7–29.7 kg (64.6–66.8 lbs).

3. Inspect the pressure plate for signs of wear, cracks, warpage, cracked or chipped teeth, or other damage and replace it as necessary.

4. Inspect the starter ring gear for signs of wear, warpage, cracked or chipped teeth, or other damage and replace it as necessary.

5. Inspect the driven plates for signs of wear, scoring, chipped teeth, warpage, grease impregnation, or other damage and replace them (as a complete set) if necessary. Each plate should be 8 mm (0.3149 in.) thick as measured at a point on which there is friction material and the plates must be replaced if worn down to 7.5 mm (0.2953 in.).

6. Inspect the drive plates for signs of wear, scoring, heat damage, chipped teeth, warpage, or other damage and replace them (as a set) if necessary.

7. Inspect the release mechanism and cable for signs of wear or damage and replace the damaged components as necessary. The mechanism should move smoothly and easily throughout its range. Lubricate the assembly with oil or a light grease.

Assembly

1. Assembly is basically in the reverse order of disassembly.

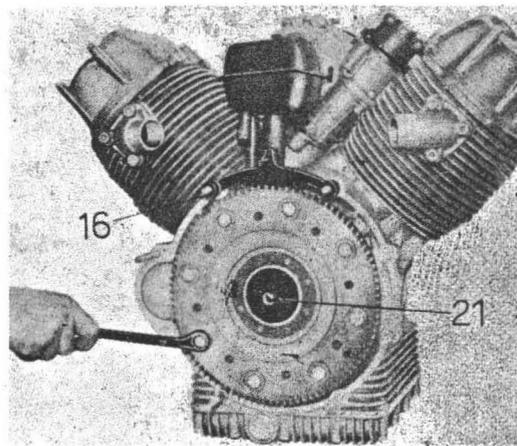
2. Secure the flywheel to the crankshaft by means of bolts and lockwashers, then torque the bolts down to 25 ft lbs (3.5 kg m).

3. Insert the clutch springs into their

housings in the flywheel, then mount the pressure plate so that the punch-marked tooth on the pressure plate is in alignment with the arrow marked on the flywheel.

NOTE: There is an arrow on the flywheel which indicates TDC and which serves as a reference mark for assembling the clutch pressure plate.

4. Mount the clutch dismantling and assembling tool (No. 12906500 which is indicated by No. 21 in the accompanying illustration) on the crankshaft, screwing it down enough so the clutch plates and ring gear can be so positioned that the securing bolts can be screwed down into the flywheel. The flywheel's motion must be blocked by using either the factory tool (No. 12911801 which is indicated by No. 16 in the accompanying illustration) or a suitable substitute. Remove the dismantling and assembling tool.



Securing the starter ring gear

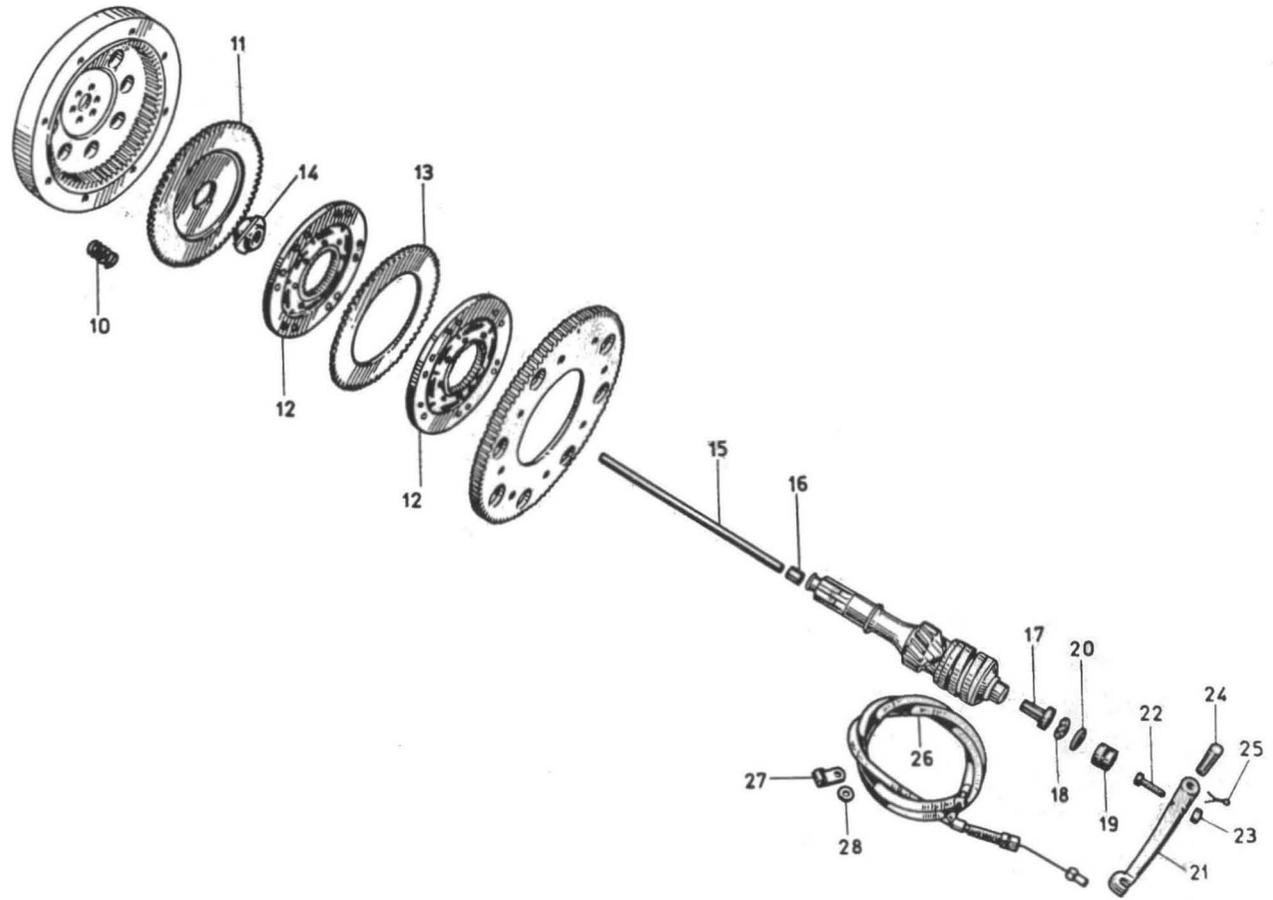
NOTE: The purpose of the dismantling and assembling tool is to properly align the teeth of the plates in the hub so the bolts will be able to be turned down into the flywheel. A used plate with a bolt in it can be used instead, or you could try to juggle the whole thing by hand. At any rate don't forget to align the punched tooth and arrow.

5. Complete the assembly in the reverse order of disassembly, then adjust the clutch and refill the crankcase sump as necessary.

THROWOUT BEARING REPLACEMENT

If your machine has the older ball-type throwout bearing rather than the newer

- 10. Clutch spring
- 11. Clutch pressure plate
- 12. Complete clutch plate
- 13. Clutch intermediate plate
- 14. Clutch plate washer
- 15. Clutch push rod
- 16. Rubber tube
- 17. Inner body
- 18. Complete cage
- 19. Outer body
- 20. Seal
- 21. Clutch actuating lever
- 22. Adjusting screw
- 23. Lever adjusting screw nut
- 24. Clutch lever-to-gear box pin
- 25. Lever pin securing split pin
- 26. Clutch cable
- 27. Clutch cable band
- 28. Washer



Clutch assembly

roller type, and you like to hold the clutch while waiting for the light to change, you'll probably find it necessary to replace the bearing sooner or later. The following information will make it easy for you to do the job in a matter of minutes and without a lot of unnecessary wrenching:

1. Drill a 2 x 3 in. hole in the battery shelf to make the bearing more accessible. You'll find this hole also helpful in adjusting the transmission.

NOTE: This is not absolutely necessary if you aren't into drilling a hole in your bike, but it will make the job considerably easier.

2. Disconnect the clutch cable and remove the release lever.

3. Remove the bearing components (parts 17-20 in the exploded illustration) using either of the following methods:

a. Apply air pressure to the 17 mm plug located on the left hand front of the transmission, almost under the left hand carburetor. There is a small vent hole in the plug, so applying pressure to it will cause the bearing to pop out of its housing.

NOTE: Along with the bearing will probably be some oil, so be ready to catch it with a rag.

b. If you don't have access to an air pressure source, remove the race by drawing it out with a magnet until you can grasp or hook it with something. The damaged bearing parts can be removed with a magnet too.

CRANKSHAFT AND CAMSHAFT

Removal

1. Remove the engine from the frame as directed in the "Engine Removal and Disassembly" section. Then remove the distributor body and gasket by removing the screws and washers which secure the support.

2. Remove the cylinder heads as directed in the "Cylinder Head" section.

3. Disassemble the timing chest as described in the "Timing Chest" section.

4. Disassemble the clutch as directed in the "Clutch" section.

5. Withdraw the cam tappets from their tunnels in the crankcase by lowering a magnet down to them. You may also remove them by removing the cylinders as directed in the "Cylinder and Piston As-

sembly" section and then plucking the tappets off of their seats.

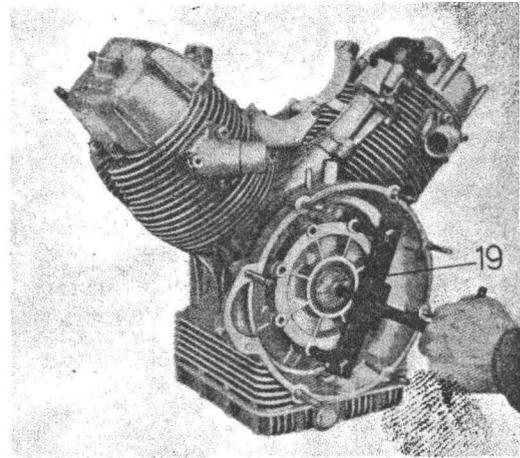
NOTE: Keep the tappets separate for installation in their original locations.

6. Remove the crankcase sump pan, then remove the connecting rods and their big end bearings as directed in the "Big End Bearing" section.

7. Remove the bolts which secure the camshaft mounting flange to the crankcase, then remove the flange and camshaft.

8. Remove the bolts and lockwashers which secure the crankshaft timing side bearing flange to the crankcase, then remove the flange complete with the timing side main bearing. Support the crankshaft while working on the flywheel side bearing.

9. Remove the lockwashers and bolts which secure the flywheel side crankshaft main bearing flange to the crankcase, then pull the flange from the case using either the factory puller (No. 12913600 which is indicated by No. 19 in the accompanying illustration) or a suitable substitute. The factory puller presses on the crankshaft. As you withdraw the flange, be prepared to support the crankshaft, then remove the crankshaft.

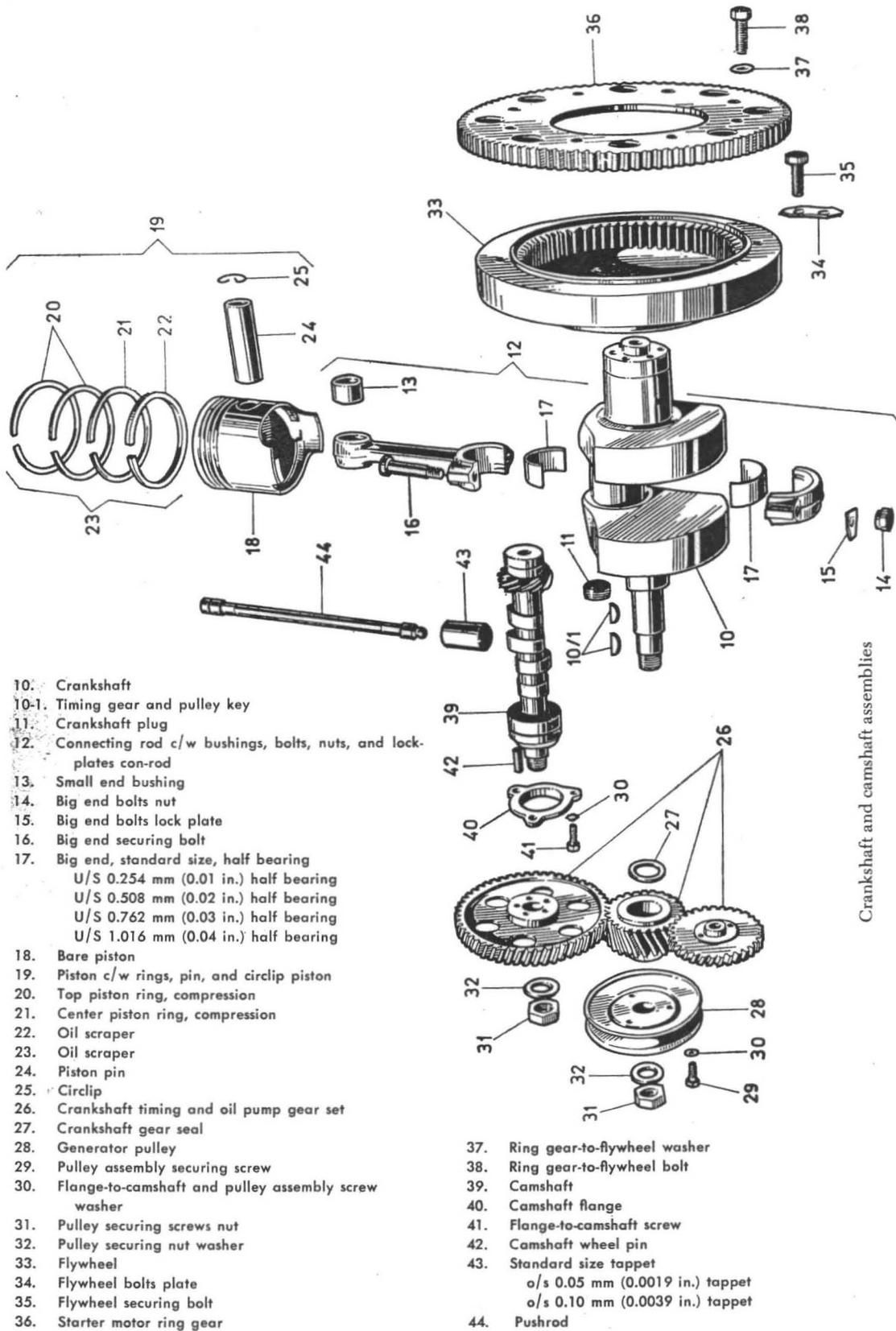


Removing the main bearing flange

Inspection and Repair

1. Clean all parts, other than seals and gaskets, in a suitable solvent; then blow them dry taking care to blow clear all oil passages.

2. Inspect all parts for wear or damage and replace them as necessary. Consult the various sections dealing with particular



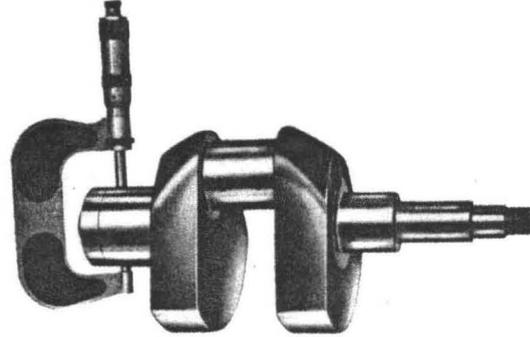
Crankshaft and camshaft assemblies

- 10. Crankshaft
- 10-1. Timing gear and pulley key
- 11. Crankshaft plug
- 12. Connecting rod c/w bushings, bolts, nuts, and lock-plates con-rod
- 13. Small end bushing
- 14. Big end bolts nut
- 15. Big end bolts lock plate
- 16. Big end securing bolt
- 17. Big end, standard size, half bearing
U/S 0.254 mm (0.01 in.) half bearing
U/S 0.508 mm (0.02 in.) half bearing
U/S 0.762 mm (0.03 in.) half bearing
U/S 1.016 mm (0.04 in.) half bearing
- 18. Bare piston
- 19. Piston c/w rings, pin, and circlip piston
- 20. Top piston ring, compression
- 21. Center piston ring, compression
- 22. Oil scraper
- 23. Oil scraper
- 24. Piston pin
- 25. Circlip
- 26. Crankshaft timing and oil pump gear set
- 27. Crankshaft gear seal
- 28. Generator pulley
- 29. Pulley assembly securing screw
- 30. Flange-to-camshaft and pulley assembly screw washer
- 31. Pulley securing screws nut
- 32. Pulley securing nut washer
- 33. Flywheel
- 34. Flywheel bolts plate
- 35. Flywheel securing bolt
- 36. Starter motor ring gear
- 37. Ring gear-to-flywheel washer
- 38. Ring gear-to-flywheel bolt
- 39. Camshaft
- 40. Camshaft flange
- 41. Flange-to-camshaft screw
- 42. Camshaft wheel pin
- 43. Standard size tappet
o/s 0.05 mm (0.0019 in.) tappet
o/s 0.10 mm (0.0039 in.) tappet
- 44. Pushrod

component systems for additional information.

3. Carefully inspect the crankshaft for signs of wear, ovalization on bearing paths, scoring or seizing marks, or other damage. Slight seizure marks of the bearing surface can be removed with fine

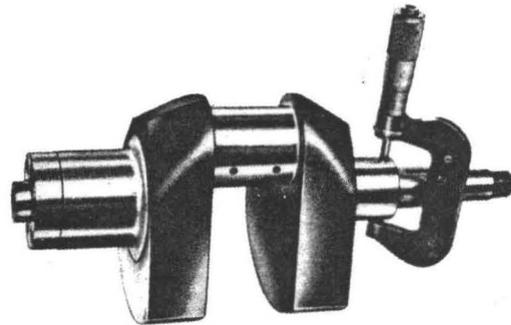
emery paper, but scoring or ovalization must be corrected by regrinding and then compensated for with oversize bearings. Regrinding should be carried out by your local dealer or a qualified machinist. Here are the necessary specifications for doing the job:



a. Diameter of flywheel side main bearing surface on crankshaft:

Measuring the flywheel side main bearing surface

Original Diameter	Undersize			
	0.2 mm (0.00787 in.)	0.4 mm (0.01574 in.)	0.6 mm (0.02362 in.)	0.8 mm (0.03149 in.)
53.970 mm (2.1248 in.)	53.770 mm (2.1169 in.)	53.570 mm (2.1090 in.)	53.370 mm (2.1013 in.)	53.170 mm (2.0930 in.)
53.951 mm (2.1240 in.)	53.751 mm (2.1162 in.)	53.551 mm (2.1033 in.)	53.351 mm (2.1004 in.)	53.151 mm (2.0926 in.)



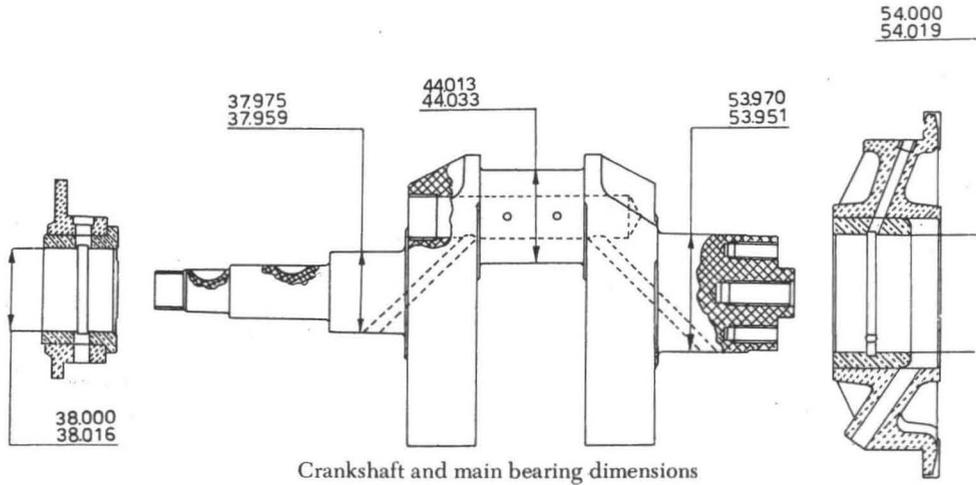
b. Diameter of timing side main bearing surface on crankshaft:

Measuring the timing side main bearing surface

Original Diameter	Undersize			
	0.2 mm (0.00787 in.)	0.4 mm (0.01574 in.)	0.6 mm (0.02362 in.)	0.8 mm (0.03149 in.)
37.975 mm (1.4951 in.)	37.775 mm (1.4872 in.)	37.575 mm (1.4793 in.)	37.375 mm (1.4715 in.)	37.175 mm (1.4636 in.)
37.959 mm (1.4944 in.)	37.759 mm (1.4866 in.)	37.559 mm (1.4787 in.)	37.359 mm (1.4707 in.)	37.159 mm (1.4629 in.)

c. Inside diameter of flywheel side main bearing:

Original Diameter	Undersize			
	0.2 mm (0.00787 in.)	0.4 mm (0.01574 in.)	0.6 mm (0.02362 in.)	0.8 mm (0.03149 in.)
54.000 mm (2.1260 in.)	53.800 mm (2.1171 in.)	53.600 mm (2.1102 in.)	53.400 mm (2.1024 in.)	53.200 mm (2.0945 in.)
54.019 mm (2.1267 in.)	53.819 mm (2.1188 in.)	53.619 mm (2.1109 in.)	53.419 mm (2.1031 in.)	53.219 mm (2.0952 in.)



d. Inside diameter of timing side main bearing:

Original Diameter	Undersize			
	0.2 mm (0.00787 in.)	0.4 mm (0.01574 in.)	0.6 mm (0.02362 in.)	0.8 mm (0.03149 in.)
38.000 mm (1.4961 in.)	37.800 mm (1.4883 in.)	37.600 mm (1.4803 in.)	37.400 mm (1.4725 in.)	37.200 mm (1.5646 in.)
38.016 mm (1.4967 in.)	37.816 mm (1.4889 in.)	37.616 mm (1.4809 in.)	37.416 mm (1.4731 in.)	37.216 mm (1.5652 in.)

e. Bearing-to-crankshaft clearances:

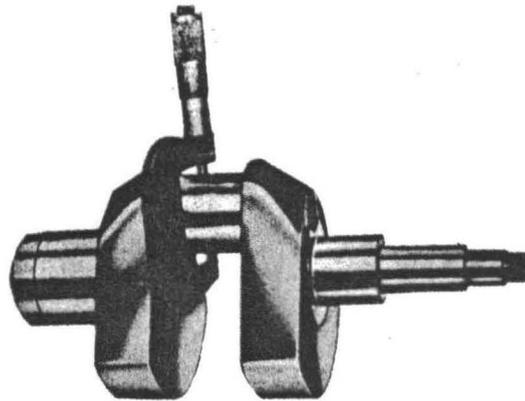
Crankshaft—timing side main bearing clearance must be within 0.025–0.057 mm (0.00098–0.00224 in.)

Crankshaft—flywheel side main bearing clearance must be within 0.030–0.068 mm (0.00118–0.0027 in.)

Crankpin—big end bearing clearance must be within 0.011–0.061 mm (0.0004–0.0024 in.)

NOTE: Consult the "Connecting Rod Installation" section for additional information on the available bearings and for fitting instructions.

f. Check the static balance of the



Measuring the crankpin diameter

crankshaft by applying a weight of 1.586+0.015 Kg (3.50 lbs).

g. When regrinding the crankshaft, the shoulder relief radiuses for the crankpin and the flywheel side of the crankshaft must be restored. The shoulders for the crankpin must be 1.5 mm (0.059 in.) and for the flywheel side they must be 3 mm (0.118 in.).

NOTE: Replacement main bearings come already mounted in their flanges.

4. Inspect the flywheel and timing side main bearing assemblies for signs of wear, damage, scoring, or ovalization and replace them as necessary.

5. Inspect the seals for signs of wear or damage to their lips and replace them, during the assembly process, as necessary. Even if the seals are only slightly questionable, they should be replaced.

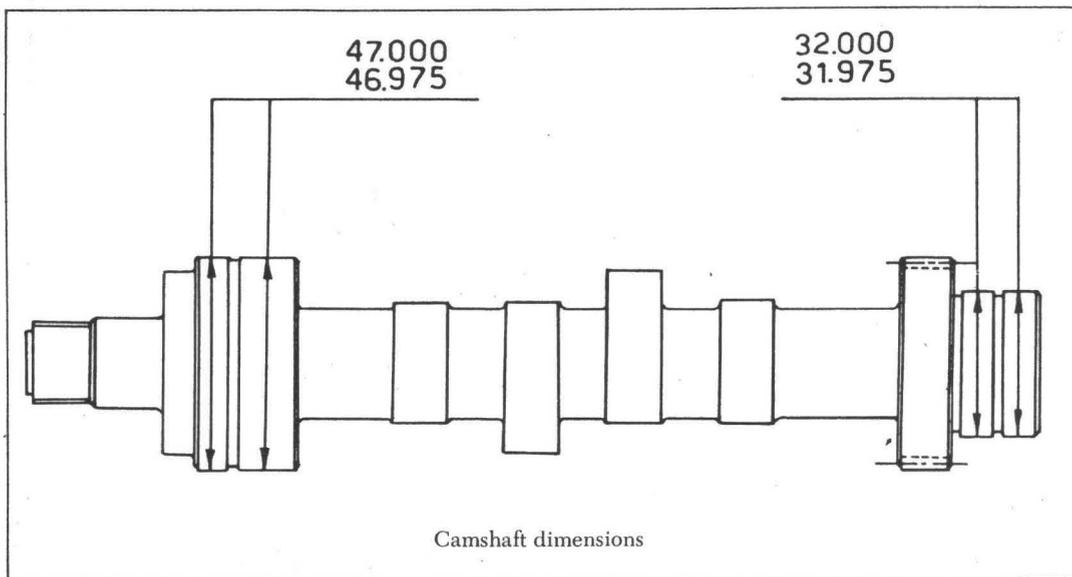
6. Inspect the camshaft for signs of wear, pitting, scoring, or other damage, especially on the lobes and bearing journals, and replace it as necessary. Slight score marks can be removed with fine emery paper. The following specifications will enable you to determine when wear necessitates replacing either the cam or the bearings in which it rides:

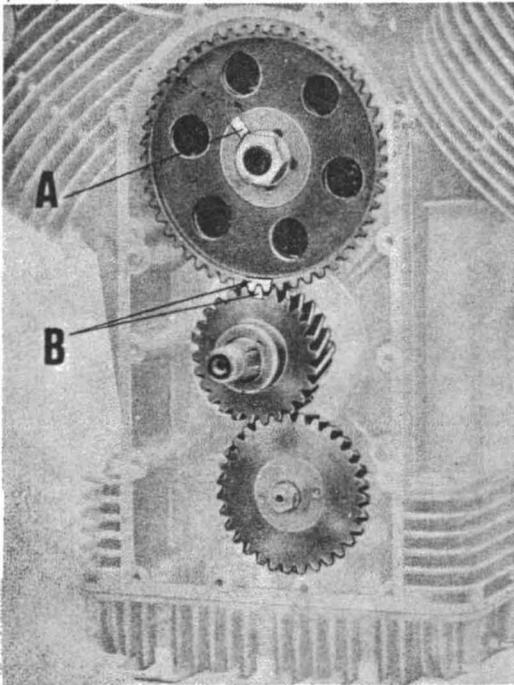
The flywheel side camshaft bearing is a plain type bearing which is pressed into the crankcase and probably will never have to be replaced. If, however, the bearing becomes worn or damaged it can be replaced by either reaming, cutting, or pulling it out of the crankcase, pressing in a new one and then reaming the new one to size.

CAUTION: When removing the bushing, especially if you plan to ream or cut it out, take care not to remove or damage any of the crankcase material.

7. Inspect the tappets for signs of wear, scoring, or other damage and replace them as necessary; slight score marks can be removed with fine emery paper. The tappet-camshaft contact area must be perfectly smooth or both components will wear out quickly. The tappets must move smoothly in their guides with no hesitation or binding and the guides must not be scored or worn out of shape. Oversize tappets are available, but if the guide is scored or deformed, you should consult your dealer for additional information, unless you are qualified to ream out the guide. The following are some useful specifications:

	Camshaft Journals Diameter	Housing in Crankcase Diameter	Fitting Clearance
Timing side	46.975–47.000 mm (1.8494–1.8504 in.)	47.025–47.064 mm (1.8511–1.8529 in.)	0.025–0.089 mm (0.0009–0.0035 in.)
Flywheel side	31.975–32.000 mm (1.2588–1.2598 in.)	32.025–32.064 mm (1.2607–1.2623 in.)	0.025–0.089 mm (0.0009–0.0035 in.)





Mark the engaging gears as shown

still mounted in the frame, it can be easily done with the special tool (No 12913800 which is indicated by No. 25 in the accompanying illustration) made available from the factory. If you don't have access to this tool and can't fabricate one to do its job, you'll have to pull the engine from the frame.

1. Remove the gears and wheel as described in the "Timing Chest" section. Even if only one gear appears extensively damaged it is a good practice to replace them all since they all act upon each other at least indirectly.

2. Install the special tool on the cam wheel so the dowel on the tool fits into the wheel's keyway, which was used to mount the wheel, and which is marked by a daub of paint.

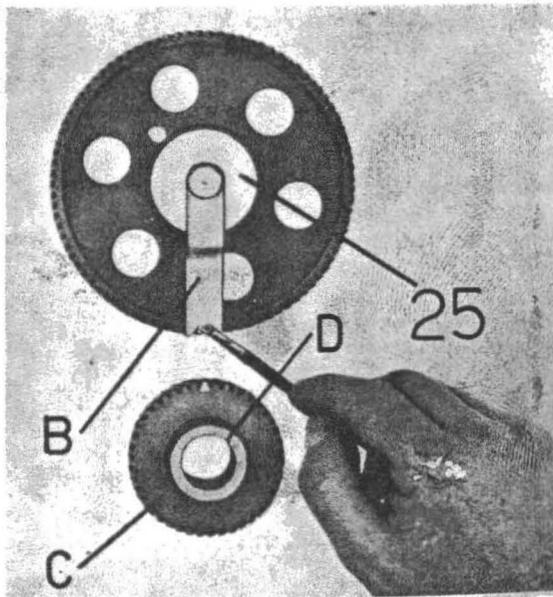
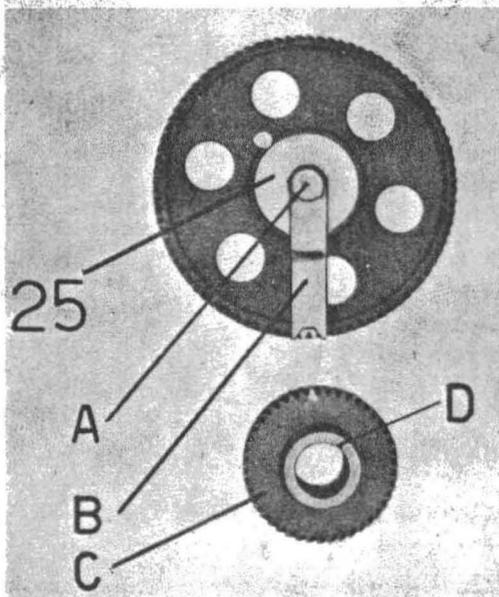
3. Loosen the bolt (A) on the tool and rotate the tool arm (B) until the notch on its end spans the two marked teeth, then secure the bolt.

4. Remove the tool from the damaged wheel and install it on the new wheel. Keep repositioning the dowel on the tool, in each of the five keyways of the wheel, until the notch on the end of the arm exactly spans two teeth of the wheel. Mark the keyway, where the tool's dowel is inserted, and the two teeth with a daub of paint for future reference.

5. Determine the position of the new mark on the timing gear, by counting the number of teeth between the mark and the keyway, and then mark the corresponding tooth on the new gear.

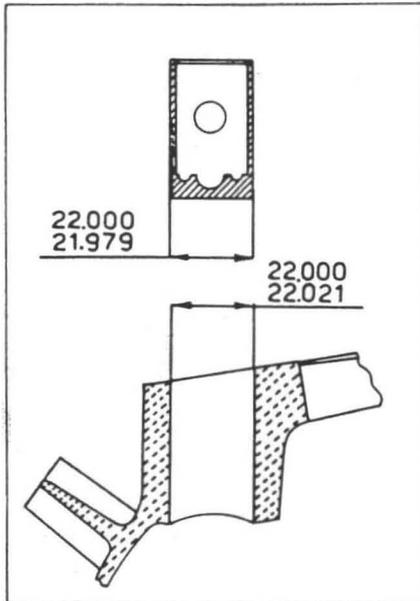
6. Install the gears as directed in the "Timing Chest" section.

7. Check the timing by rotating the engine, with the tool described in the "With the Engine Removed From the Frame"

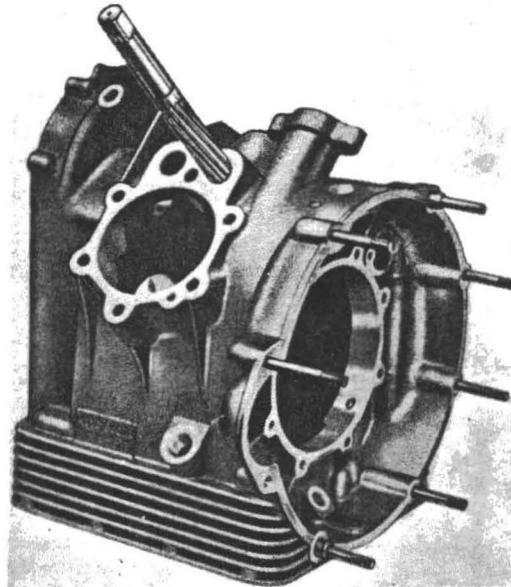


Using the special tool to mark the new gears

	I/D of Guides	O/D of Tappets	Fitting Clearance
Original	22.021–22.000 mm (0.8669–0.8661 in.)	22.000–21.979 mm (0.8661–0.9046 in.)	0–0.042 mm (0–0.0016 in.)
Oversize 0.05 mm (0.0019 in.)	22.071–22.050 mm (0.8688–0.8680 in.)	22.050–22.029 mm (0.8680–0.8672 in.)	0–0.042 mm (0–0.0016 in.)
0.10 mm (0.0039 in.)	22.121–22.100 mm (0.8708–0.8700 in.)	22.100–22.079 mm (0.8700–0.8692 in.)	0–0.042 mm (0–0.0016 in.)



Tappet and guide dimensions



Reaming a tappet guide to size

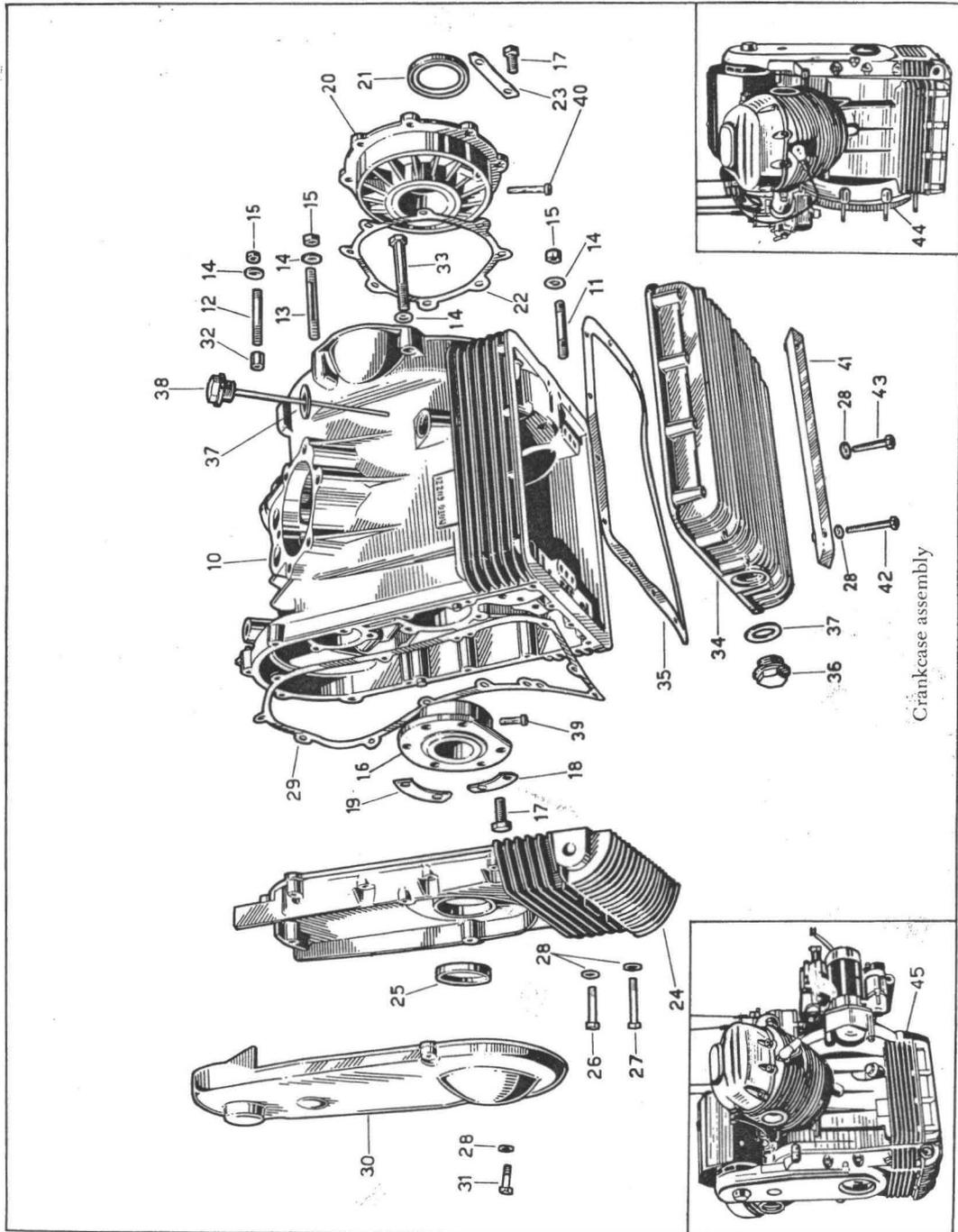
8. Inspect the pushrods for score marks, warp, wear, or other damage and replace them as necessary. Do not attempt to repair or straighten them as it's just not worth it in the long run.

Key for figure on page 63.

10. Crankcase
11. Gear box fixing bolt
12. Gear box fixing bolt
13. Gear box fixing bolt
14. Gear box and starter motor fixing bolts washer
15. Gear box fixing bolts nut
- 16.* Timing side flange c/w journal bearing
 - Timing side (u/s 0.0078 in.) flange c/w journal bearing
 - Timing side (u/s 0.015 in.) flange c/w journal bearing
 - Timing side (u/s 0.023 in.) flange c/w journal bearing
 - Timing side (u/s 0.031 in.) flange c/w journal bearing
17. Flange-to-crankcase and timing cover bolt
18. Flange-to-timing cover nuts lock plate
19. Flange securing nut lock plate
20. Flywheel side flange c/w main bearing

9. Inspect the crankcase for signs of wear or damage, especially at mating surfaces, and consult your dealer about any repairs which may be necessary. The studs themselves are replaceable separately, and pressed-in bushings can be pulled or

- Flywheel side (u/s 0.0078 in.) flange c/w main bearing
- Flywheel side (u/s 0.015 in.) flange c/w main bearing
- Flywheel side (u/s 0.023 in.) flange c/w main bearing
- Flywheel side (u/s 0.031 in.) flange c/w main bearing
- 21. Seal on crankshaft, flywheel side
- 22. Flange, flywheel side, gasket
- 23. Flywheel side bolt lock plate
- 24. Timing cover
- 25. Timing cover seal
- 26. Short timing cover screw
- 27. Long timing cover screw
- 28. Timing cover screws, generator belt cover, and oil sump washer
- 29. Timing cover gasket
- 30. Belt cover



Crankcase assembly

- 31. Belt cover screw
- 32. Locating bush
- 33. Starter motor retaining bolt
- 34. Oil sump
- 35. Oil sump gasket
- 36. Oil drain plug
- 37. Oil drain and filler plug washer
- 38. Oil filler plug
- 39. Main bearing-to-timing side flange pin

- 40. Main bearing-to-flywheel side flange pin
- 41. Oil sump guard plate
- 42. Guard plate securing screw
- 43. Oil sump screw
- 44. Engine c/w clutch, without gearshift
- 45. Engine c/w clutch, with gearshift

* c/w: complete with

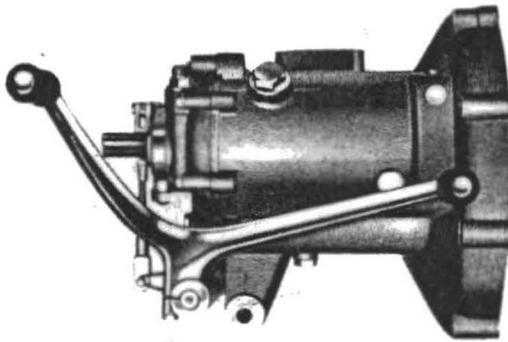
section, and checking to make sure the painted teeth engage.

Rear Wheel Drive

TRANSMISSION

Operational Description

All of the Moto Guzzi transmissions covered in this guide are of the constant mesh variety and all of the models, other than the V850 which is equipped with a five speed, come with a four speed gear box which is driven off of the clutch shaft.



Assembled transmission

The mainshaft, which is engaged with the clutch shaft, drives the layshaft; the power to the rear wheel is delivered at this point via the drive box assembly.

When the shifter pedal is moved, the shifter drum to which it is attached is rotated. A spring loaded plunger selects the next gear by engaging one of the five possible positions drilled into the drum. As the drum rotates, the shifter forks, which serve to move the two layshaft sliding dog gears, slide in their grooves cut into the drum and therefore guide the motion of the forks which in turn guide the motion of the dog gears.

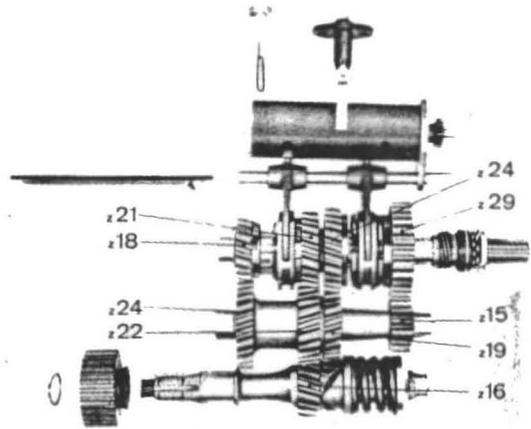
The pawl mechanism is drilled through to allow it to act as a breather and is incorporated in the drain plug. An electric neutral indicator switch and warning light are also fitted.

Removal and Disassembly

FOUR-SPEED MODELS

1. Remove the engine from the frame as directed in the "Engine Removal and

Installation" section, unbolt the transmission from it (or loosen the motor mounts), slide the engine forward in the frame, and then unbolt the gearbox. In any event, the transmission must be removed from the engine and frame before it is worked on.

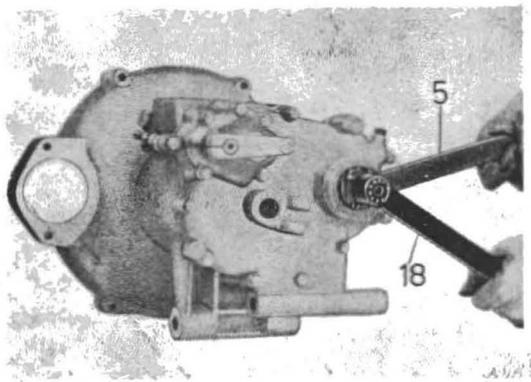


Assembled four-speed transmission

2. Drain the transmission oil as directed in the "Maintenance" section.

3. Remove the clutch release lever and the shifter pedal, then disconnect the tachometer cable.

4. Disengage the tab washer by using either the special factory tool (No. 12907100 which is indicated by No. 18 in the accompanying illustration), or a suitable substitute, and then remove the layshaft lock-ring by using either the factory tool (No. 12905400 which is indicated by No. 5 in the accompanying illustration) or a suitable substitute.



Removing the layshaft lock-ring

5. Remove the layshaft spacer and the tachometer drive gear, taking care not to lose the ball.

reamed out, pressed in, and then reamed to size.

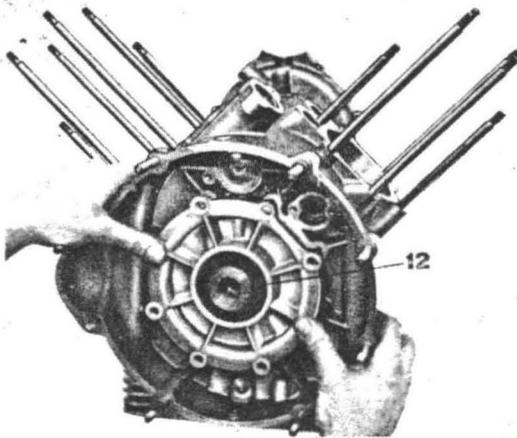
Assembly

1. Assembly is basically in the reverse order of disassembly. Consult the assembly sections pertaining to the various component systems. As a matter of course, all gaskets, seals, keys, and valve keepers should be replaced. All components should be thoroughly oiled during their installation and all parts and mating surfaces should be kept scrupulously clean.

2. Mount and secure the timing side main bearing flange assembly by means of the bolts and lockwashers.

3. Install the crankshaft into the timing side flange, then mount and secure, by means of the bolts and lockwashers, the flywheel side flange so the crankshaft is supported by both main bearings. The lubrication ducts in the flange must be aligned with the passages in the crankcase and the seal in the flange should be protected during installation by using either the special tool (No. 12912000 which is indicated in the accompanying illustration by No. 12) or a suitable substitute.

CAUTION: Failure to protect the seal will probably result in its leaking and this will cause the dry clutch to become oil impregnated causing it to slip and provide generally unsatisfactory performance.



Mounting the flywheel side main bearing flange

4. Install the camshaft in its flywheel side bearing, then secure the camshaft support flange to the crankshaft so the camshaft is supported.

5. Install the connecting rods on the

crankshaft as described in the "Connecting Rod Installation" section. Remember to bend up the locking tab against a flat on the nut.

6. Install the oil pump, filter, and pipe assemblies, if they have been removed, as directed in the "Lubrication" chapter; then mount and secure the sump pan.

7. Install the piston assemblies as described in the "Cylinder and Piston Assembly" section, install the tappets in their guides, then mount the cylinders.

8. Install the cylinder head assembly as directed in the "Cylinder Head" section, then slip the pushrods into place. Do not secure the rocker box cover as the tappets will have to be adjusted.

9. Mount the flywheel and clutch assemblies on the crankshaft as described in the "Clutch" section.

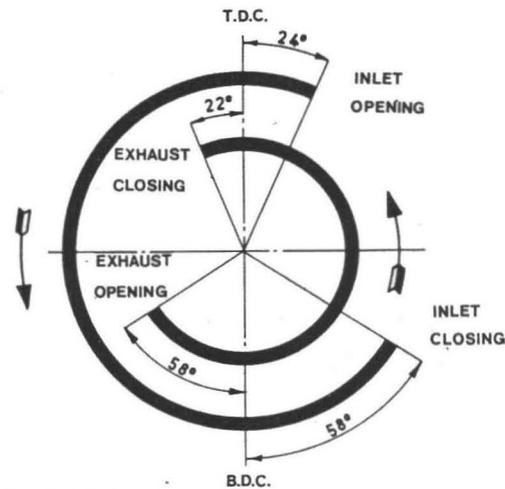
10. Assemble the timing chest as directed in the "Timing Chest" section and set the valve timing correctly as described in the "Valve Timing" section.

11. Install and adjust the generator belt as described in the "Maintenance" section.

12. Adjust the tappets as directed in the "Tune-Up" chapter, then secure the rocker box covers, tightening the screws in a cross pattern.

13. Install the spark plugs, oil pressure gauge cable, and distributor support assembly. Insert the distributor so its teeth mesh with the gear on the camshaft, then set the points gap and adjust the timing.

14. Install the engine in the frame as directed in the "Engine Removal and Installation" section, then fill the sump with $3\frac{1}{4}$ quarts of fresh oil.



Camshaft Timing

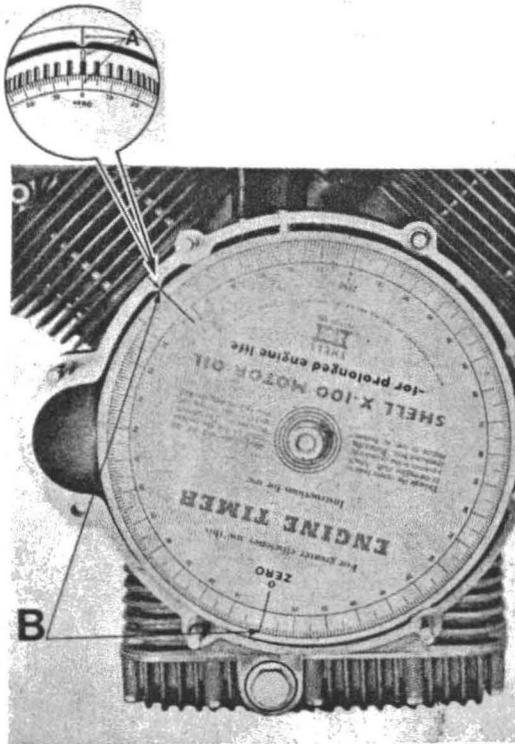
VALVE TIMING

The inlet valve opens at 24° before top dead center (BTDC) and closes 58° after bottom dead center (ABDC); the exhaust valve opens at 58° before bottom dead center (BBDC) and closes 22° after top dead center (ATDC).

With the Engine Removed From the Frame

1. Adjust the tappets to 0.5 mm (0.0195 in.), to provide an arbitrary wide clearance, either as directed in the "Tune-Up" section, or by following these simpler procedures:

- a. Rotate the flywheel until its timing mark is in alignment with the timing mark scribed on the crankcase. If the crankcase mark (A) is no longer there, line the flywheel up with the nub on the crankcase flange.



Checking the timing

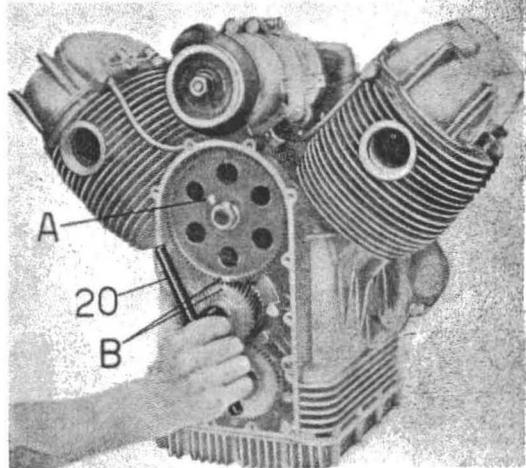
- b. The valves on the left-hand cylinder are now closed and are ready to be adjusted.

2. Mount a degree wheel on the flywheel in such a manner that the zero on the degree wheel, the arrow on the flywheel, and the line on the crankcase are

all aligned. (See (A) on the accompanying illustration.)

3. Rotate the flywheel 122° (the distance indicated by (B) in the illustration) in the direction of normal engine operation until the exhaust valve of the left-hand cylinder begins to open.

4. At this point, the only timing gear which should be installed is the oil pump gear. Mount the crankshaft timing gear on the crankshaft, then, using a screwdriver, rotate the camshaft counterclockwise until the rocker arm on the exhaust valve of the left hand cylinder begins to touch the valve. A special factory tool (No. 12912900 which is indicated by No. 20 in the accompanying illustration) is available to rotate the engine with, but a suitable substitute may be used.



Lining up the timing marks

5. Mount the cam wheel on the camshaft in such a manner that the dowel slots in the camshaft and cam wheel will align without necessitating moving the crank or camshaft. A new key should be used.

NOTE: It is a good idea, when installing new gears, to mark the teeth (B) which are engaged in the cam wheel and the crankshaft timing gear, and the point on the wheel where it is keyed to the shaft (A), with a daub of paint for future reference.

6. Adjust the tappets to their correct specifications.

With the Engine Installed In the Frame

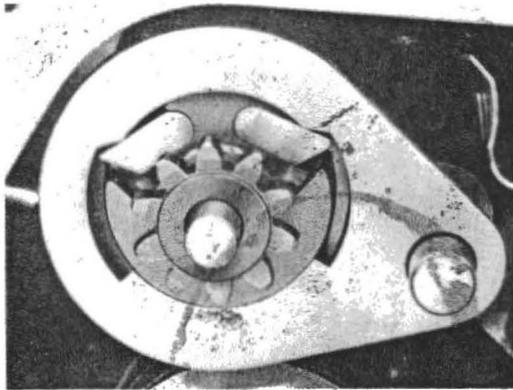
If it ever becomes necessary to replace one of the timing gears while the engine is

6. Remove the shifter cover screws, then remove the cover assembly which includes the shaft, sector, return spring and offset adjusting screw.

7. Remove the gearbox cover mounting screws and cover, then remove the clutch outer body, clutch cage, and clutch push-rod. Tap the cover with a wood block and hammer, if necessary, to loosen it.

8. Remove the clutch inner body circlip, the oil pick-up plate, the drain plug, and the pawl and spring which are housed in the drain plug.

9. Remove the gear control cam plate and the shifter inner body assembly which includes the plungers, pawls, and pawl springs.



Shifter inner body assembly

10. Remove the shifter drum rod, disengage the shifter forks from the drum grooves, then remove the drum.

11. Remove the shifter fork shaft, then disengage and remove the forks from the layshaft sliding gears.

12. Remove the layshaft assembly and disassemble it in the following order:

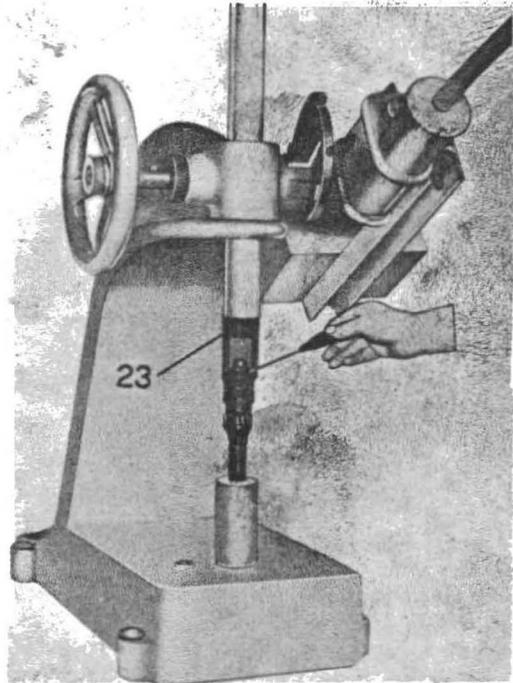
- a. Adjusting washer
- b. First gear
- c. Circlip
- d. Second gear

- e. Fourth gear floating bushing
- f. Fourth gear
- g. Thrust washer
- h. Third gear

13. Remove the mainshaft assembly including the thrust washers and spacers.

14. Remove the clutch shaft complete with the cush drive assembly; then remove the two cush drive plate keepers, the cush drive plate, the cush drive spring, the sliding sleeve, and the clutch shaft-to-mainshaft driving gear. The easiest way to disassemble this assembly is by clamping the shaft on a press or in a wood-jawed vise and using either the special tool (No. 12905900 which is indicated by No. 23 in the accompanying illustration), or a suitable substitute to compress the spring.

NOTE: Use a screwdriver with a daub of grease on its tip to remove the keepers.



Disassembling the clutch shaft

Key for page 68 (continued)

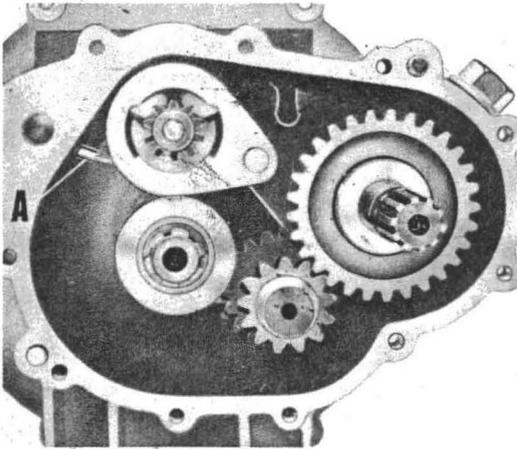
- 33. Oil pick up cup
- 34. Fork operating shaft
- 35. Gear selector fork
- 36. Gear box main shaft
- 37. Main shaft high gear end thrust washer
- 37/1. Main shaft seal, intermediate
- 38. Layshaft
- 39. Layshaft lock-ring
- 40. Safety lock-ring washer
- 41. Spacer
- 41/1. Tachometer gear retaining ball
- 42. Adjusting washer

- 43. 1st. gear c/w bushing
- 44. 1st. gear bushing
- 45. Layshaft circlip
- 45/1. Thrust circlip-to-bush washer
- 46. Sliding 1st. and 2nd. gear sleeve
- 47. 2nd. gear c/w bushing
- 48. 2nd. and 3rd. gear bushing
- 49. 3rd. gear c/w bushing
- 50. Sliding 3rd. and high gear sleeve
- 51. Top gear
- 52. Floating high gear bush
- 52/1. Bush-to-shaft thrust washer
- 53. Clutch shaft

- 54. Clutch inner body circlip
- 55. Inner clutch body
- 56. Cush drive plate semi-collar
- 57. Cush drive plate
- 58. Cush drive spring
- 59. Sliding muff
- 60. Clutch shaft counter gear
- 61. Guiding operating shaft bush
- 62. Inner operating shaft bush
- 63. Gearshift r/h lever
- 64. R/h lever shaft

* c/w: complete with

15. Remove the neutral indicator unit (A).



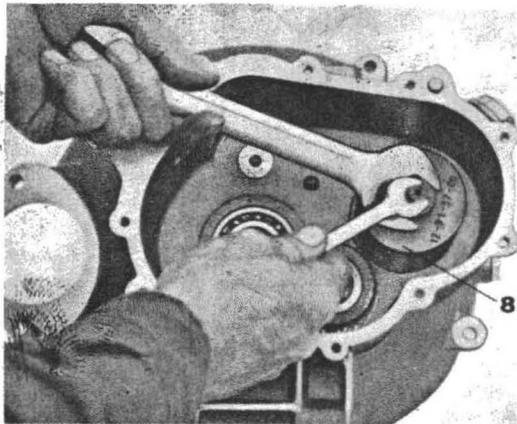
Neutral indicator

16. Remove the filler and drain plugs from the housing.

17. Remove the clutch shaft seal from the gearbox and the layshaft seal from the gearbox cover.

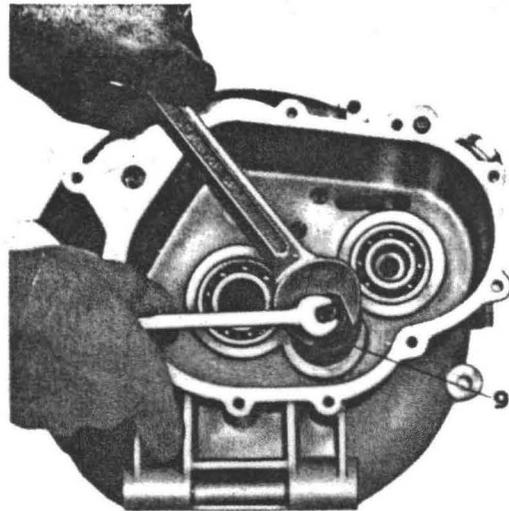
18. Remove, only if replacement is deemed necessary, the following bearings in the manner indicated.

a. Using either the special tool (No. 12913700, which is indicated by No. 8 in the accompanying illustration) or a suitable substitute, remove the layshaft bearing.



Removing the layshaft bearing

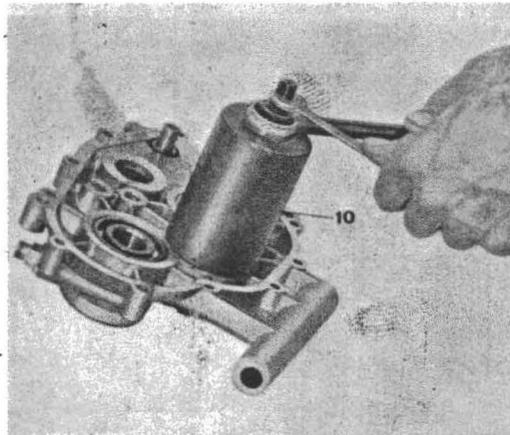
b. Using either the special tool (No. 12913100 which is indicated by No. 9 in the accompanying illustration) or a suitable substitute, remove the mainshaft bearing.



Removing the mainshaft bearing

c. Drift out the clutch shaft bearing with an appropriate drift.

d. Remove the gearbox cover mainshaft and clutch shaft bearings using either the special puller (No. 12907000 which is indicated by No. 10 in the accompanying illustration) or a suitable substitute.



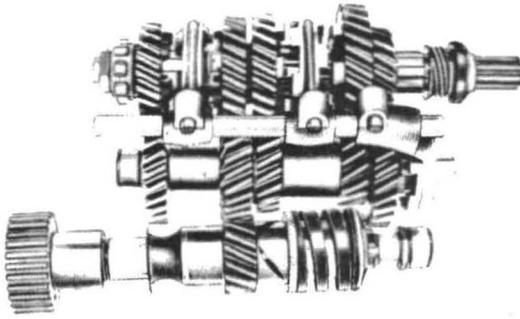
Removing the mainshaft bearing from the cover

e. Drift out the layshaft bearing with an appropriate drift.

NOTE: Heating the cases to about 150–160° C (300–350° F) will make removing the bearings considerably easier.

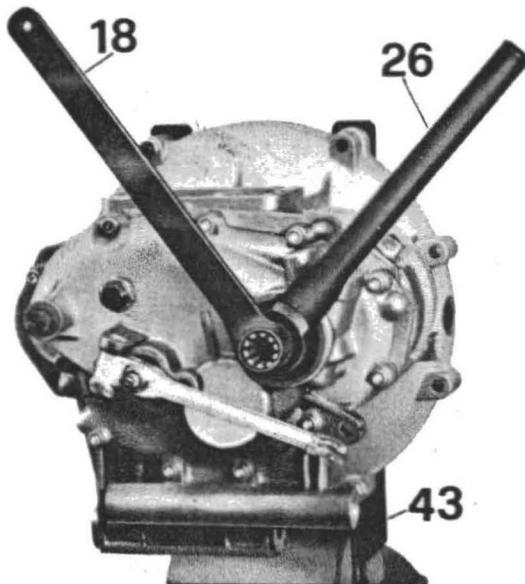
FIVE SPEED MODELS

1. Follow steps 1–7 in the “Four Speed Models” section. The transmission should be in its Neutral position.



Assembled five-speed transmission

NOTE: When loosening the layshaft securing nut, use the special tools designed for use on the V850 rather than those listed in the "Four-Speed Models" section. These are Nos. 12907100 and 14905400 which are indicated by Nos. 18 and 26 in the accompanying illustration.



Loosening the layshaft nut

2. Remove the layshaft from its bearing in the cover, taking care not to lose the tachometer gear shim.

3. Remove the shifter fork rod, then remove the high gear shifter fork.

4. Remove the high gear sliding dog gear from the layshaft, then remove the layshaft high gear.

5. Remove the mainshaft high gear along with its roller cage and bushing in the following manner:

- a. Depress the stop pin down into its housing using a suitable pointed instrument, then turn the bushing in either

direction and withdraw the gear, complete with roller cage and bushing, to within reaching distance of the shaft hole.

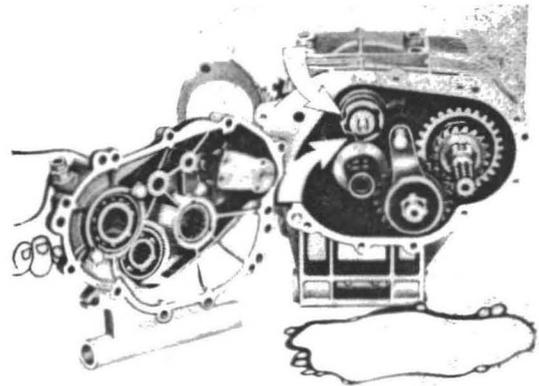
- b. Place your left thumb against the spring loaded stop pin, to prevent it from springing off into the cosmos, and at the same time withdraw the gear assembly with your right hand.

- c. Remove the stop pin and spring assembly.

6. Remove the breather plug from the top of the transmission housing and remove the spring. The pawl will remain in the housing for removal only after the entire assembly has been taken down.

7. Remove the screws which secure the neutral indicator in the housing, then remove the indicator.

8. Remove the shifter drum and rod, taking careful notice of the way in which the shims are positioned on the drum and the way the drum is positioned in the gearbox, so they may be replaced in their original locations; then remove the rod from the drum.



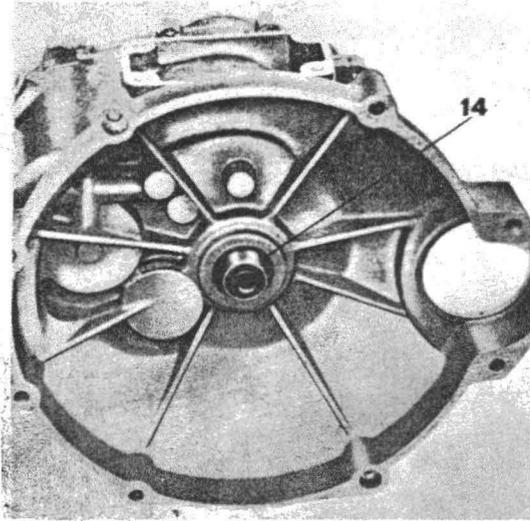
Shifter drum assembly

9. Remove the layshaft from the gearbox, then disassemble it in the following order:

- a. Cover side seal ring.
- b. First gear, roller cage, and bushing
- c. First gear sliding dog gear
- d. Nut located on the side of fourth gear
- e. Roller bearing.
- f. Adjusting washers
- g. Fourth gear, roller cage, and bushing
- h. Fourth gear sliding dog gear
- i. Fixed sleeve on shaft
- j. Shim

special tool (No. 12910700 which is indicated by No. 14 in the accompanying illustration) or a suitable substitute, to protect the seal ring.

NOTE: Failure to install the shaft correctly will result in damage to the seal ring and eventual oil leakage on the clutch.



Protect the seal before installing the clutch shaft

7. Install the shifter forks to the two sliding dog gears, install the shifter drum, then insert the fork ends in the drum grooves.

8. Slip the fork shaft through the forks, then mount the camplate on the shaft.

9. Rotate the shifter drum until the shifter pawl enters the fourth gear position hole and the sliding dog gear engages the second gear.

10. Install the assembled shifter inner body which includes the springs, plungers, and pawls.

11. Slip the first gear and an adjusting washer on the layshaft.

12. Install the oil pick-up plate and the neutral indicator unit in the gearbox; then mount the gearbox cover and a new cover gasket, making sure the indicator doesn't interfere with the mating of the box and cover. A light coating of a gasket sealer may be used at your discretion.

NOTE: When securing the cover screws, do so evenly in a cross pattern to avoid deforming the cover gasket.

13. Mount the tachometer driving gear, spacer, and lockwasher on the layshaft; then install the lock ring using either the

special tools (Nos. 12907100 and 12905400) or suitable substitutes. Secure the ring by bending the locking tab in the lock ring slot.

14. Assemble the sector quadrant and shifter shaft assembly, the shifter return spring and the offset adjusting screw, along with its washer and locknut, to the shifter cover; then mount the cover assembly using a new gasket and making sure that the quadrant is engaging the shifter inner body. A light coat of a gasket sealer may be used at your discretion.

NOTE: When securing the cover, tighten the short and long screws evenly in a cross pattern to avoid deforming the cover gasket.

15. Mount the gear shifter operating lever on the shifter shaft, securing it by means of the two circlips which fit in the clutch shaft grooves.

16. Install the clutch rubber tube, pressure rod, inner body, cage and outer body, and seal ring; then mount the clutch operating lever to the gearbox by means of its pin and cotterpin.

17. Install the drain plug, add 1 $\frac{3}{4}$ pts of either Shell Spirax 90 E.P. oil, or a suitable substitute, to the gearbox; then install the filler and level plugs.

18. Mount the transmission to the engine, complete the assembly in the reverse order of disassembly, and adjust the transmission as described in the "Transmission Adjustment" section.

FIVE SPEED MODELS

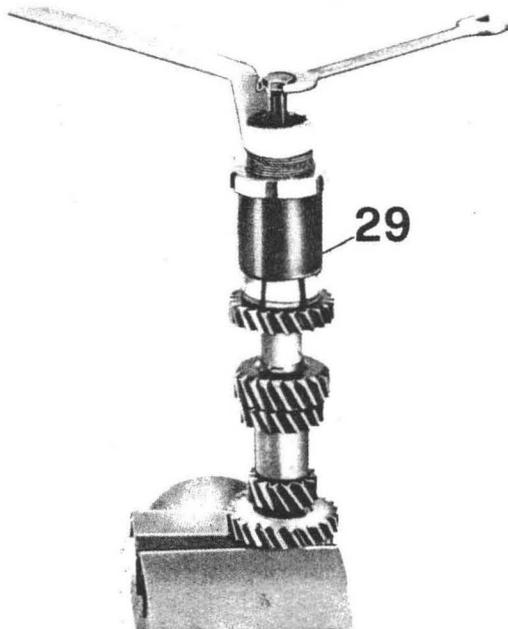
1. Assembly is basically in the reverse order of disassembly. Lubricate all parts, other than those surfaces on which a sealant is used, with clean oil as you put them together and make sure that all parts are perfectly clean.

2. When installing the bearings, it is recommended that a light coat of green Loctite® be used on the outer races and bearing housings. Be very careful to avoid getting any Loctite® in the bearings and allow them to set for about 12 hours before continuing with the assembly. Install the bearings as follows:

a. Install the clutch shaft bearing into its gearbox housing using either the special drift (No. 14928900 which is indicated in the accompanying illustration by No. 34) or a suitable substitute.

k. Third gear, roller cage, and bushing

10. Remove the mainshaft assembly from the gearbox, taking care to note the positions of the shims for reassembly in their original positions. The mainshaft inner bearing race may be removed with either the special puller (No. 14928500 which is indicated by No. 29 in the accompanying illustration) or a suitable substitute.



Removing the mainshaft inner bearing race

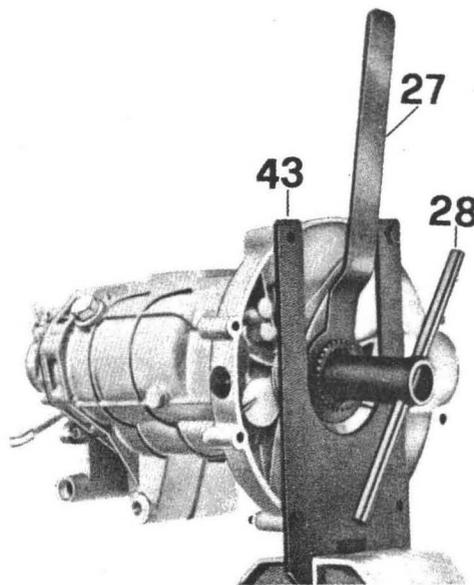
11. Bend back the locking tabs, then remove the clutch body retaining ring from the clutch side of the clutch shaft using either the special tools (Nos. 14912800 and 14912600 which are indicated by Nos. 27 and 28 in the accompanying illustration) or suitable substitutes.

NOTE: The transmission mount (No. 14929600 which is indicated by No. 43 in the accompanying illustration) is a useful item for such work as this, but is in no way necessary for the successful completion of the task.

12. Remove the clutch fixed body, taking care to note the position of the seals between the body and the bearing and the seals in the shaft groove.

13. Remove the clutch shaft from the bearing taking care not to lose the oil scoop between the shaft and bearing.

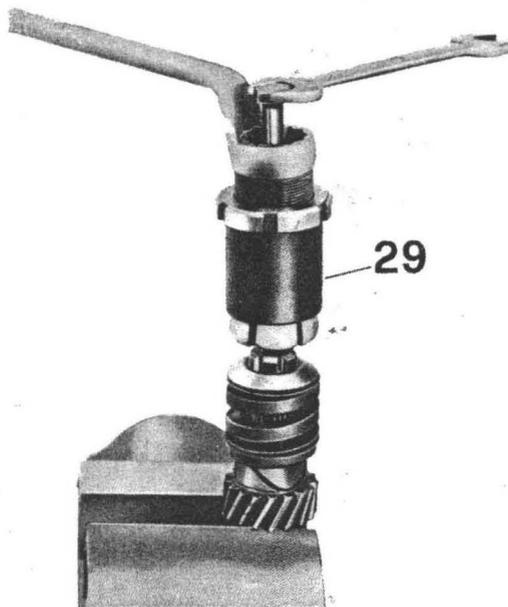
NOTE: Tap the end of the shaft gently



Removing the retaining ring

with a soft mallet if it is reluctant to leave its seat.

14. Remove the inner roller bearing race and the spacer nut from the clutch shaft using either the special puller (No. 14928500 which is indicated by No. 29 in the accompanying illustration) or a suitable substitute.



Removing the clutch shaft inner bearing race

15. Install the clutch shaft in a wood-jawed vise, then use either the special tool (No. 12905900), or a suitable substitute, to

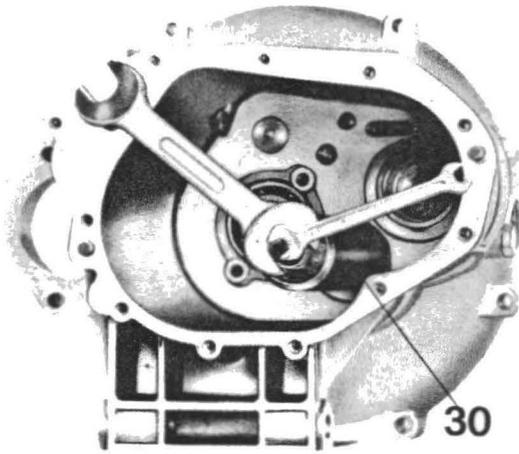
compress the spring enough so the keepers can be removed; then remove the tool and slip off the cush plate, spring, sliding sleeve, and the intermediate gear.

NOTE: Use a screwdriver with a daub of grease on its tip to remove the keepers.

16. Remove the bearings from the gearbox in the following manner, especially if they have been secured with Loctite®:

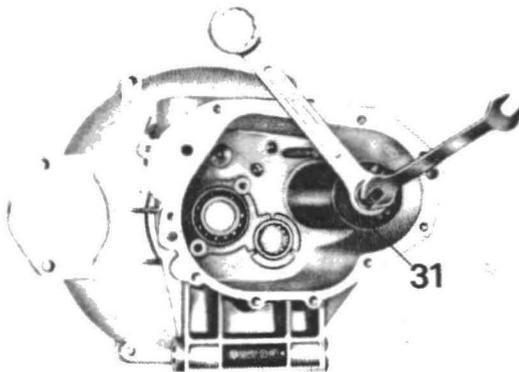
a. Place the gearbox in an oven and heat it up to 150–160° C (300–350° F).

b. Remove the mainshaft roller bearing by using either the special puller (No. 14913100 which is indicated by No. 30 in the accompanying illustration) or a suitable substitute.



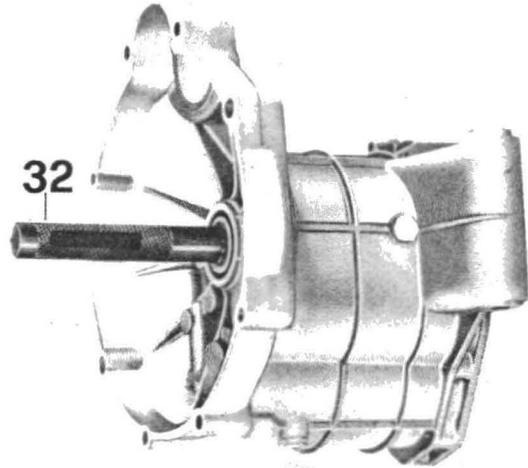
Removing the mainshaft roller bearing

c. Remove the mainshaft roller bearing outer race by using either the special puller (No. 14913700 which is indicated by No. 31 in the accompanying illustration) or a suitable substitute.



Removing the mainshaft bearing outer race

d. Remove the clutch shaft seal, the lockplate securing bolts, and the lockplate, then drift out the clutch shaft bearing by using either the special drift (No. 14929200 which is indicated by No. 32 in the accompanying illustration) or a suitable substitute.

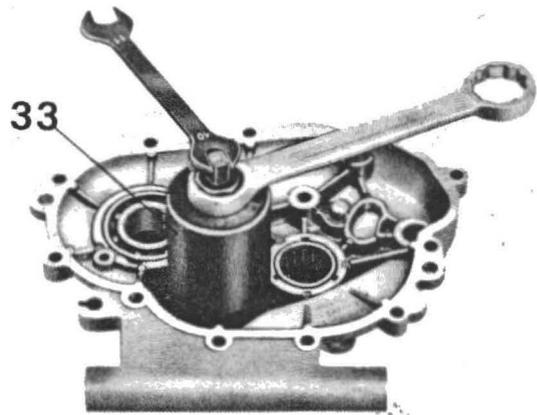


Drifting out the clutch shaft bearing

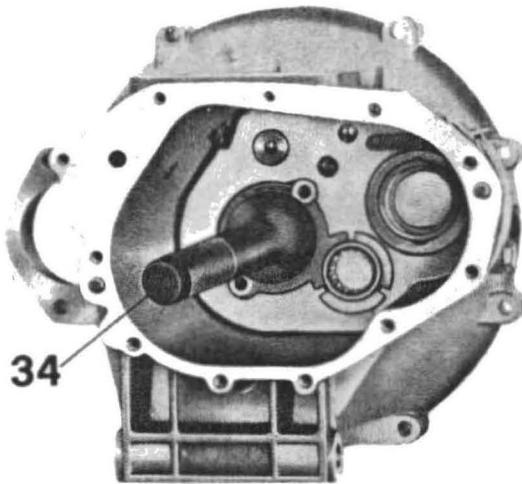
17. Remove the shifter mechanism from the transmission cover by carefully tapping the assembly free with a soft mallet, then remove the shifter return spring, the spring guide pin, the operating pawls, the pawl return springs, and the shifter adjusting screw and locknut.

If the pawls must be removed, do so by removing the pins with the aid of a 3–4 mm (0.11–0.15 in.) tool; the pawl springs will come out with the pins. A 10 mm (0.39) reamer may be used to ream out the pawl housings.

18. Remove the bearings from the gearbox cover in the following manner, espe-

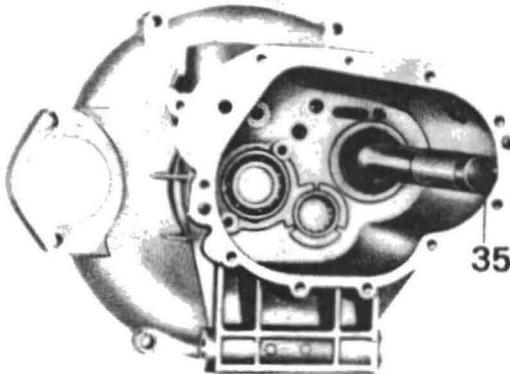


Removing the mainshaft bearing



Installing the clutch shaft bearing

b. Press the outer layshaft bearing race into its gearbox housing using either the special drift (No. 14929100 which is indicated by No. 35 in the accompanying illustration) or a suitable substitute.

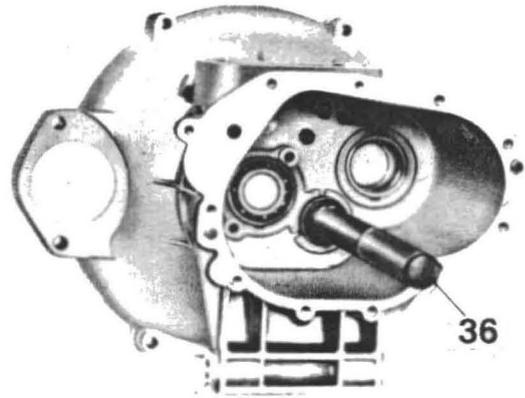


Installing the layshaft bearing outer race

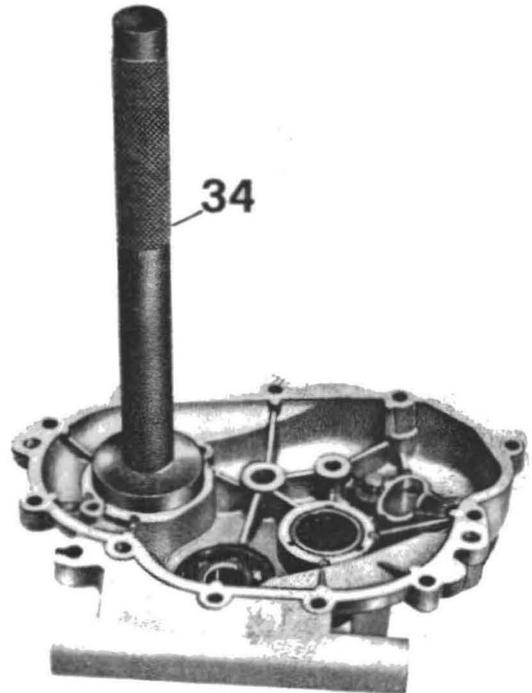
c. Install the mainshaft bearing in its gearbox housing using either the special drift (No. 14928800 which is indicated in the accompanying illustration by No. 36) or a suitable substitute.

d. Press the layshaft bearing in its housing in the gearbox cover using either the special drift (No. 14928900 which is indicated by No. 34 in the accompanying illustration) or a suitable substitute.

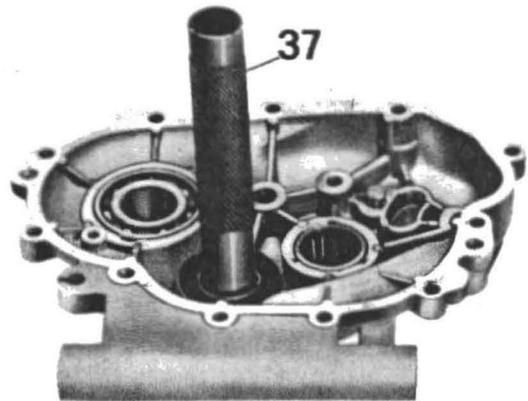
e. Install the mainshaft bearing in its cover housing using either the special drift (No. 14929000 which is indicated by No. 37 in the accompanying illustration) or a suitable substitute.



Installing the mainshaft bearing



Installing the layshaft bearing



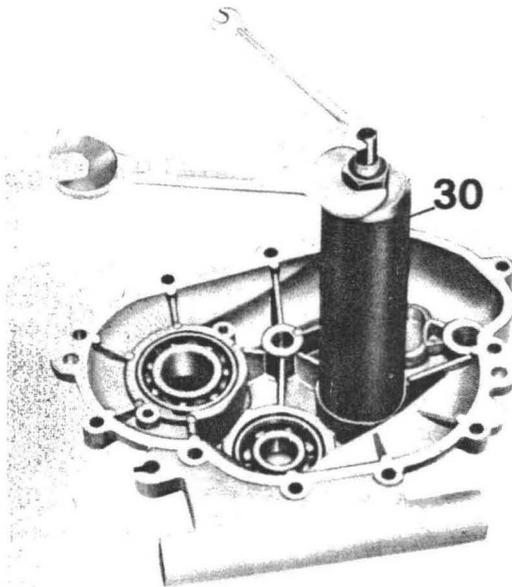
Installing the mainshaft bearing

cially if they have been secured with Loctite®:

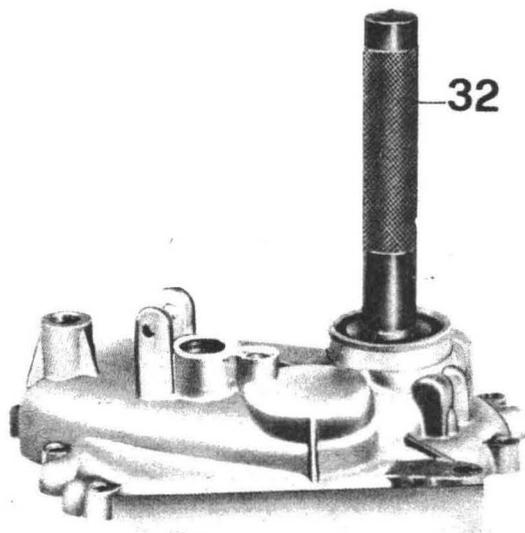
a. Place the cover in an oven and heat it up to 150–160° C (300–350° F).

b. Remove the mainshaft bearing by using either the special puller (No. 14907000 which is indicated in the accompanying illustration by No. 33) or a suitable substitute.

c. Remove the clutch shaft bearing by using either the special puller (No. 14913100 which is indicated by No. 30 in the accompanying illustration) or a suitable substitute.



Removing the clutch shaft bearing



Removing the layshaft bearing

d. Remove the layshaft seal and the lockplate securing screw, then remove the lockplate.

e. Remove the layshaft bearing by using either the special tool (No. 14929200 which is indicated by No. 32 in the accompanying illustration) or a suitable substitute.

Inspection and Repair

ALL MODELS

1. Clean all parts, other than gaskets and seals, in a suitable solvent, then blow them dry. Take care to blow clear all oil passages.

2. Inspect the transmission housing and cover for signs of wear, damage, stripped threads of the bosses, or irregularities on mating surfaces, and replace them as necessary.

NOTE: When purchasing transmission components it is important to provide the serial number so you can be sure of receiving the correct components.

3. Inspect all gaskets, seals, circlips, washers, and keepers for signs of wear, damage, distorted, or crushed lips and replace them as necessary.

CAUTION: It is generally considered to be a good practice to replace all of these short-life components any time they are removed. Failure to do this may very well result in serious damage. In all cases, replace the keepers and circlips, as these usually will not perform properly once they have been disturbed.

4. Inspect the bearings for signs of wear, pitting, scoring, excessive play, or rough motion and replace them as necessary. Do not spin unlubricated bearings and do not attempt to replace individual balls or races as this is a false economy.

5. Inspect the mainshaft and layshaft assemblies for signs of wear, pitting, scoring, seizure marks, chipped or damaged gear teeth dogs, or splines, and replace them as necessary.

NOTE: Whenever you have one obviously damaged gear, slight damage has probably occurred to at least any gears with which it directly or indirectly engages. For this reason, gears should be replaced as gear systems to insure that there will be no subsequent failure.

6. Inspect the fifth gear (on five speed models) bushing retainer and spring for

signs of wear, damage, or, in the case of the spring, a collapsed condition and replace them as necessary. The spring should show a load of 1.40 kgs (3.08 lbs) when compressed to a length of 8 mm (0.031 in.).

7. Check the clearances between the layshaft gear bushings and the shaft (V700 and V750 models). The clearances should be as follows:

a. The inside diameter of the first, second, and third gear bushings must be within 27.040–27.061 mm (1.0646–1.0655 in.).

b. The outside diameter of the layshaft bushing support for first, second, and third gears must be within 26.987–27.000 mm (1.0624–1.0630 in.).

c. The bushing-to-layshaft fitting clearance must be within 0.040–0.074 mm (0.0016–0.0028 in.).

d. The inside diameter of the fourth gear floating bushing must be within 20.007–20.028 mm (0.7877–0.7885 in.).

e. The outside diameter of the layshaft floating bushing support for fourth gear must be within 19.987–20.000 mm (0.7868–0.7874 in.).

f. The bushing-to-layshaft fitting clearance must be within 0.007–0.041 mm (0.0003–0.0016 in.).

8. Check the clearances between the layshaft bushings and gears (V700 and V750 models). The clearances should be as follows:

a. The outside diameter of the first, second, and third gear bushings must be within 31.060–31.099 mm (1.2228–1.2243 in.).

b. The inside diameter of the first, second, and third gears must be within 31.000–31.025 mm (1.2205–1.2214 in.).

c. The negative clearance for the gear bushings must be within 0.035–0.099 mm (0.0014–0.0039 in.).

d. The outside diameter of the fourth gear floating bushing must be within 22.960–22.939 mm (0.9309–0.9031 in.).

e. The inside diameter of the fourth gear must be within 23.021–23.000 mm (0.9063–0.9055 in.).

f. The clearance between the fourth gear and its floating bushing must be within 0.040–0.082 mm (0.0016–0.0032 in.).

9. Inspect the clutch shaft assembly for signs of wear or damage and replace the

necessary components. The sliding sleeve must be able to slide smoothly and freely and the engaging teeth must be devoid of chips, score marks, or other damage.

10. Inspect the cush plate assembly, making sure that the retainer is not cracked or damaged, the plate grooves are not rough or damaged, and that the drive spring is not collapsed or damaged, and replace any parts as necessary.

11. Inspect the shifter drum assembly for worn or damaged drum grooves, camplate, pawl holes, pawl spring, shifter inner body teeth, or any other damage, and replace any parts as necessary.

12. Inspect the shifter forks for wear or damage, especially to the nub which rides in the drum grooves, and replace them as necessary.

13. Generally inspect all remaining parts not listed above and replace any which appear to be worn or damaged.

Assembly

FOUR SPEED MODELS

1. Assembly is basically in the reverse order of disassembly. Lubricate all parts, other than those surfaces on which a sealant is used, with clean oil as you put them together and make certain that all parts are perfectly clean.

2. Press all bearings into the cover and case using light applications of green Loctite® (which is the sealant recommended by the factory) at your own discretion. Make absolutely certain that no Loctite® gets into the bearings. When installing the layshaft bearing in the case, make sure you use a bottom plate to protect the fourth gear floating bushing.

CAUTION: *The Loctite® must be allowed to set for at least 12 hours before you continue with the assembly.*

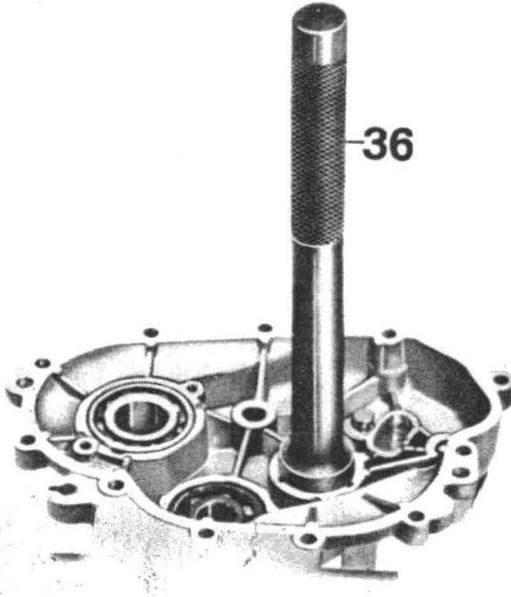
3. Install the clutch shaft seal ring on the gearbox.

4. Install the mainshaft with the two thrust washers and the intermediate washer between the roller bearing and the fourth gear side of the shaft.

5. Place the fourth gear, its floating bush, and the thrust washer on the bearing; then insert the assembled layshaft (except for the first gear) through the thrust washer and gear and into the bearing.

6. Install the assembled clutch shaft assembly in the gearbox, using either the

f. Install the clutch shaft bearing in its cover housing using either the special drift (No. 14928800 which is indicated by No. 36 in the accompanying illustration) or a suitable substitute.

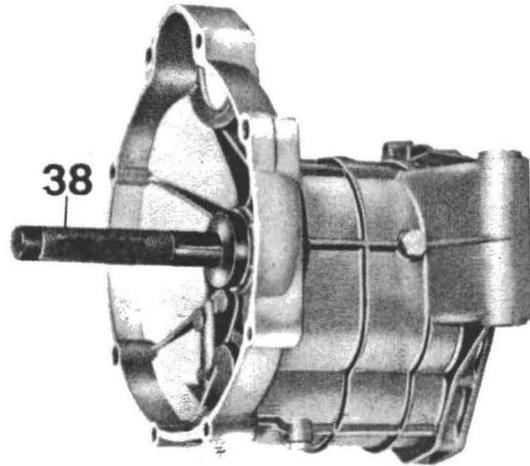


Installing the clutch shaft bearing

a light coat of green Loctite[®], taking care not to allow any of it to penetrate the bearing.

NOTE: Use only the modified type retainers (part No. 14213802) for the best results.

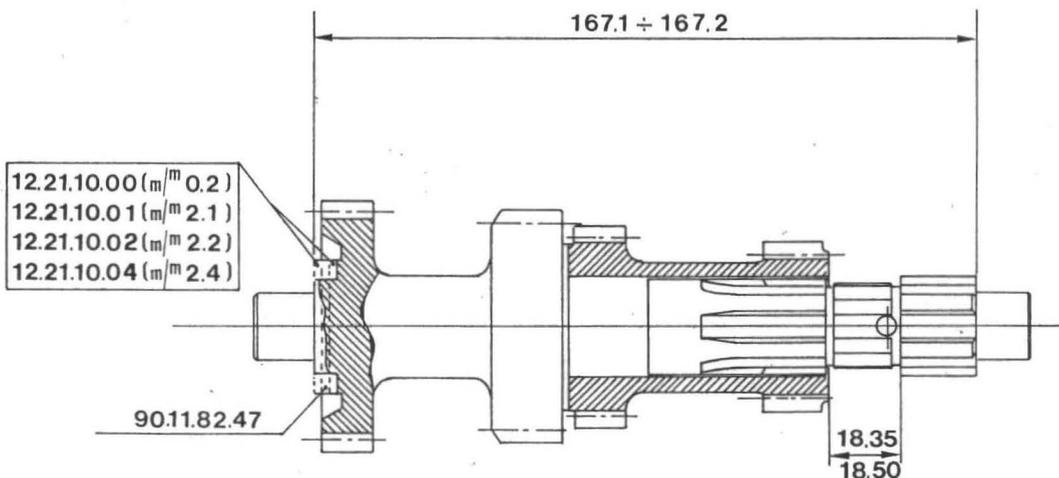
4. Install the clutchshaft seal in the gearbox using either the special drift (No. 14929400 which is indicated by No. 38 in the accompanying illustration) or a suitable substitute.



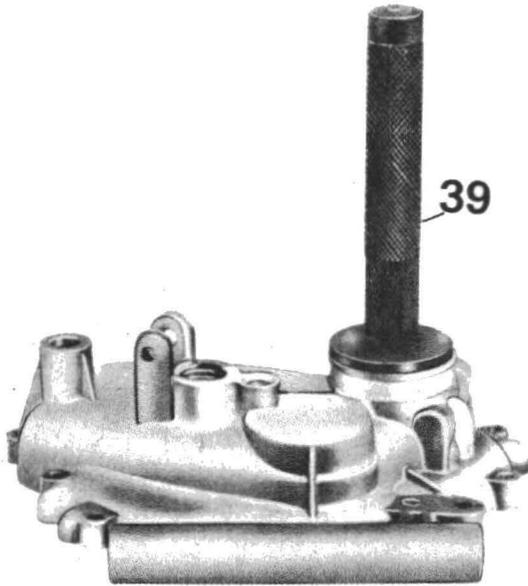
Installing the clutch shaft seal

3. Install the layshaft bearing retainers in the gearbox cover, making sure that they seat absolutely flush with the outer bearing races. Mill away any projections which may prevent a perfect seal and use

5. Install the layshaft seal in the gearbox cover using either the special drift (No. 14929500 which is indicated by No. 39 in the accompanying illustration) or a suitable substitute.



Shimming the mainshaft



Installing the layshaft seal

6. Install the selector shaft seal in its housing in the gearbox cover.

7. Assemble the shifter body by inserting the pawls and springs and securing them to the shifter body with flexible pins; then install the shifter quadrant shaft, gear, and return spring to the shifter body and mount the assembled body to the gearbox cover.

8. Shim up the mainshaft so the distance between the cover bearing and the gearbox bearing is within 167.1–167.2 mm (6.578–6.582 in.). Shims are available in the following sizes: 0.2, 2.1, 2.2, and 2.4 mm (0.0788, 0.8274, 0.8668, 0.9456 in.) and may be fitted on the gearbox end of the shaft with bronze spacers between them. The part numbers are given in the accompanying illustration.

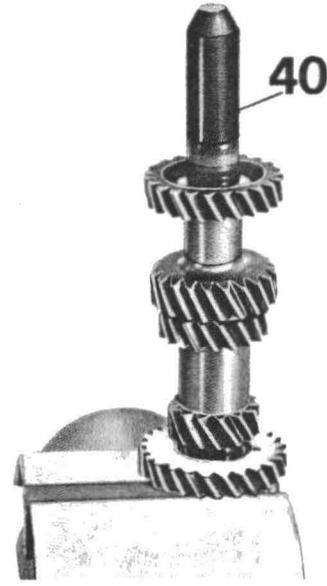
9. Press the mainshaft roller bearing inner race onto the shaft using either the special tool (No. 14928600 which is indicated by No. 40 in the accompanying illustration) or a suitable substitute.

10. Assemble the following components on the layshaft gearbox end:

a. Slip the second gear bushing on the shaft so the bushing head faces the transmission cover.

b. Fit the second gear roller cage on the second gear bushing, then mount the second gear on the cage so its engaging dogs are facing the gearbox cover.

c. Slip the third gear bushing on the shaft so its head faces the second gear,



Installing the mainshaft bearing inner race

assemble the third gear roller cage on the bushing, then install the third gear on the roller cage so its engaging dogs are facing the gearbox.

d. Place a shim on the shaft, install the fixed sleeve on the shaft with its stepped down end facing the third gear, then slip the third and fourth gear sliding sleeve onto the shaft with its stepped down end facing the third gear.

e. Slip the fourth gear bushing on the shaft, install the roller cage on the bushing, then position the fourth gear on the shaft so its engaging dogs face the sliding sleeve.

11. Assemble the following components on the layshaft gearbox cover end:

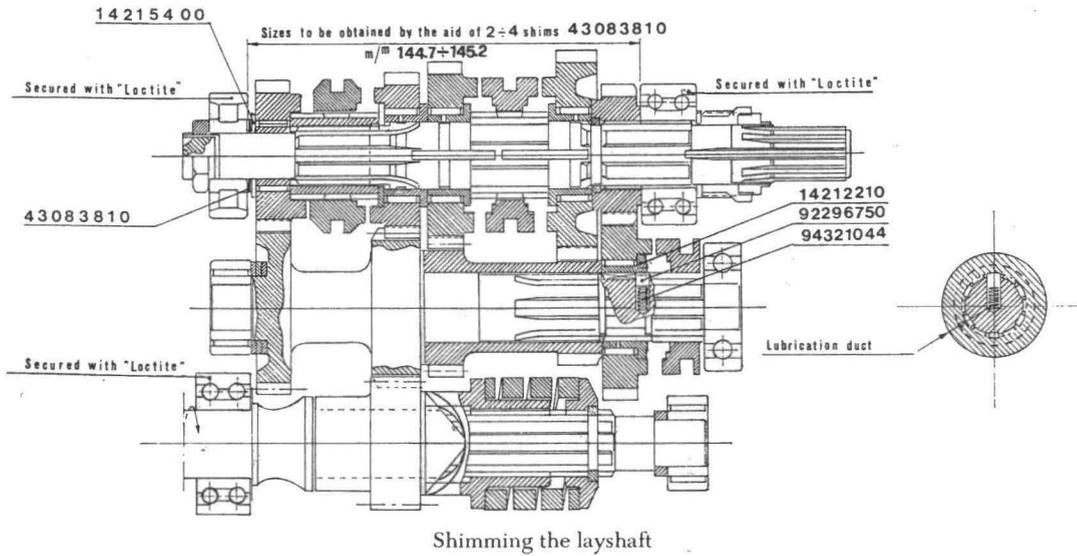
a. Slip the first and second gear engaging sleeves on the shaft.

b. Position the first gear bushing on the shaft so its head faces second gear, fit the first gear roller cage on the bushing, then install the first gear on the roller cage.

c. Position the seal in its groove in the shaft, then slip the fourth gear on the shaft so its stepped down end is fitted on the seal ring.

12. Shim the layshaft on the fourth gear side until the distance between the shims and the fourth gear is within 144.7–145.2 mm (5.692–5.715 in.). This can generally be accomplished with between two and four shims.

13. Mount the roller bearing on the



Shimming the layshaft

fourth gear end of the layshaft, secure the nut on the fourth gear end of the shaft by hammering the nut tang with a chisel along the line of the shaft groove, then mount the assembled layshaft in the transmission housing.

14. Assemble the first, second, third, and fourth gear shifting forks on the layshaft dog gears.

15. Install the splined shifter drum, along with its shaft and a spacer, in the gearbox. Then look through the hole in the ratchet pawl to see if the pawl hole is aligned with one of the six holes in the drum. If the holes are misaligned, replace the spacer with larger or smaller ones until both holes are in perfect accord.

16. Position the nubs of the shifter forks in the drum grooves using either the special tool (No. 14929300 which is indicated by No. 41 in the accompanying illustration) or a suitable substitute.

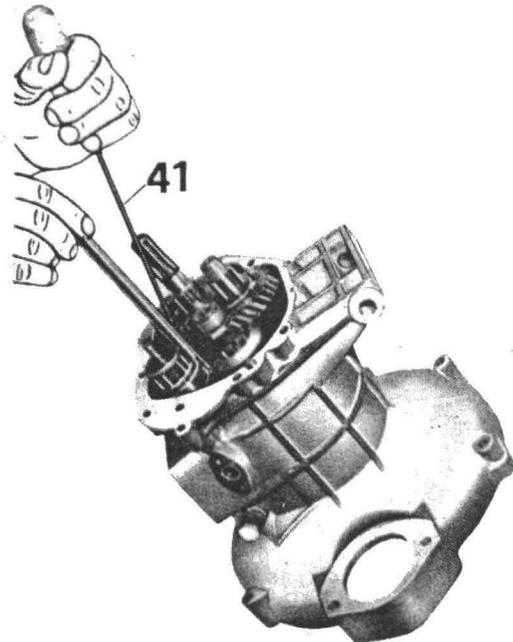
17. Temporarily secure the peg, spring, and cap in their gearbox housing.

18. Slip the shifter fork retaining rod through the fork eyes.

19. Mount and secure the neutral indicator to the gearbox, making sure that the blade contacts the button on the drum.

20. Assemble the clutch shaft assembly in the following manner:

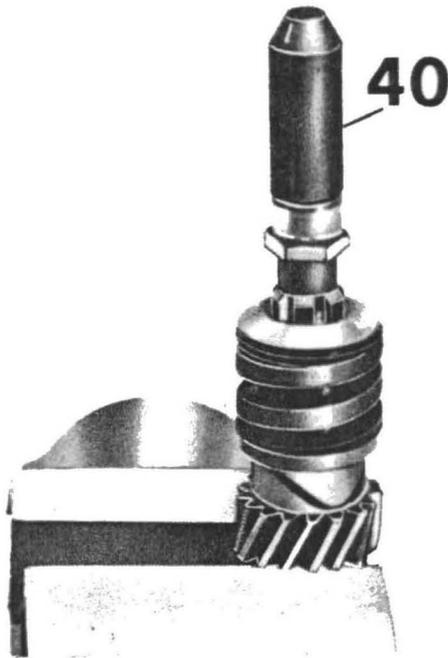
- a. Install the idle gear so its engaging dogs face the gear box cover, then position the coupling sleeve so its engaging dogs face the idle gear.
- b. Slip the cush spring and spring



Fitting the shifter forks to the drum

plate on the shaft, then use either the special tool (No. 12905900), or a suitable substitute, to compress the spring enough so two new keepers can be installed.

c. Secure the spacer nut, then install the clutch shaft roller bearing inner race in the cover using either the special tool (No. 14928600 which is indicated by No. 40 in the accompanying illustration) or a suitable substitute.



Installing the clutch shaft bearing inner race

d. Install, on the gearbox end of the shaft, the oil seal in its groove, and the oil scoop between the shaft and gearbox bearing; then mount the shaft assembly in the gearbox bearing and retaining ring.

21. Assemble the mainshaft assembly in the following manner:

a. Mount the fifth gear roller cage and gear on the bushing, then slip the gear, cage, and bushing assembly on the splined portion of the shaft.

b. Mount the spring in its drilling in the shaft, then position the stop pin on top of the spring.

c. Depress the spring with the thumb of your left hand while slipping the fifth gear assembly over it, then rotate the bushing to either the right or left until the stop peg seats into one of the bushing's six splines.

d. Slip the fifth gear engaging sleeve and shifter fork onto the shaft, so the fork eye slips over the fork rod, then engage the fork nub in the drum groove.

22. Assemble the gearbox cover in the following manner:

a. Install the retaining washer on the shifter drum along with one or more shims.

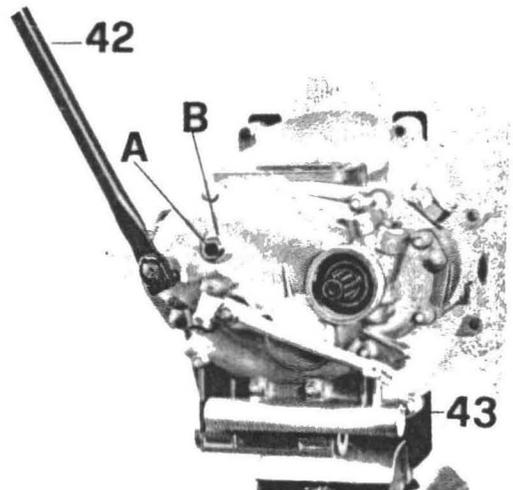
b. Shift the drum into the neutral position, place a new cover gasket on the

mating surface, mount the cover while tapping it lightly with a soft mallet to properly seat all of the shafts and mating surfaces, then lightly screw in the four cover screws.

NOTE: A *sparing application of a suitable gasket sealer may be used at your own discretion, but make sure none of it gets inside the gearbox.*

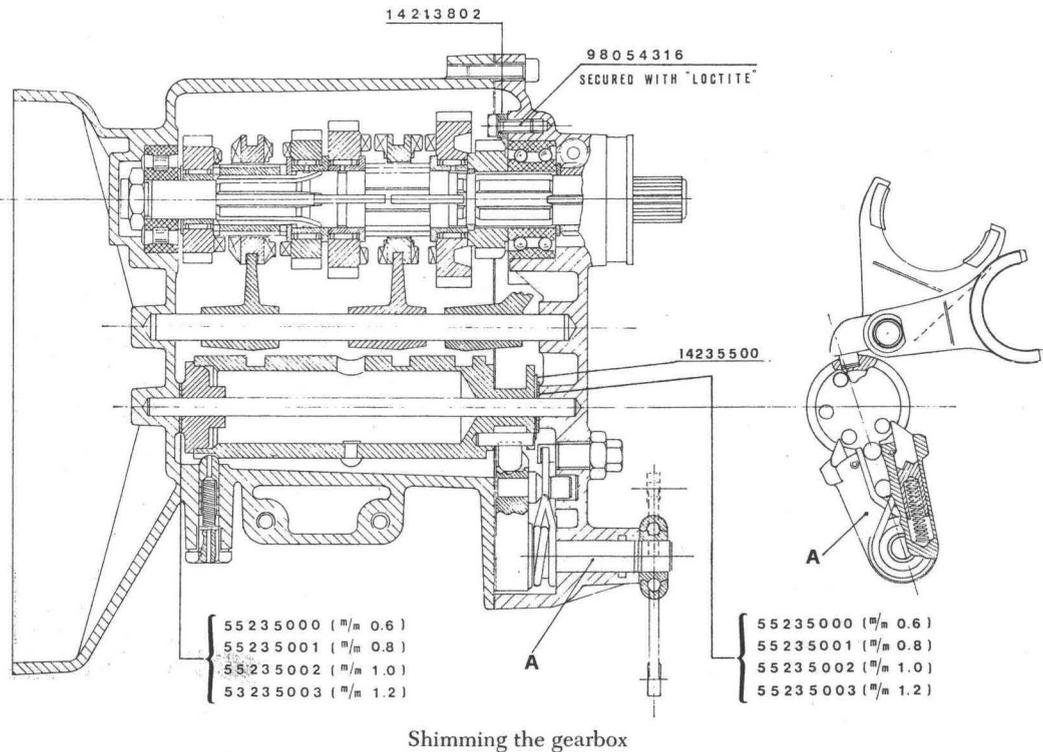
c. Slip the shim, tachometer drive gear, and the drive gear stop ball onto the layshaft, then temporarily secure the layshaft securing nut.

d. Mount either the special tool (No. 14928700 which is indicated by No. 42 in the accompanying illustration), or any suitable substitute which you can use to shift the transmission, onto the shifter shaft.



e. Loosen the locknut (B) and rotate the adjusting screw (A) until a suitable adjustment is achieved in which all gears, including Neutral, can be easily engaged. If ease of shifting cannot be attained, remove the gearbox cover and add or remove spacer shims from between the gearbox and the shift drum to alleviate shifting problems related to First and Third gears, or between the gearbox cover and the drum to alleviate shifting problems related to Second and Fourth gears. 0.6, 0.8, 1.0, and 1.2 mm (0.023, 0.031, 0.039, and 0.047 in.) shims are available.

f. Remount the cover and recheck the gearbox operation. If all of the gears engage smoothly, including Neutral, secure the layshaft nut using either the special



tools (Nos. 14905400 and 12907100) or suitable substitutes, then hammer the nut with a chisel at the shaft groove to lock it into place.

g. Secure the cover mounting screws, remove the tool from the shifter shaft, and mount and secure the shift lever on the shifter shaft.

h. Secure the oil breather plug which serves to secure the gearbox spring and stop peg.

23. Mount the bearing inner body seal, inner body, safety washer, and the inner body locking nut on the clutch shaft using either the special tools (Nos. 14912800 and 14912600) or suitable substitutes, then bend one of the locking tabs into one of the locknut grooves.

24. When installing the clutch unit on the main shaft and gearbox cover, position the small rubber tube in the shaft, mount the inner body, mount the throwout bearing on the inner body, and mount the inner body and seal on the gearbox cover. Then slip the clutch pushrod into the operating shaft at the gearbox end, mount the release mechanism on the cover along with the adjusting screw and locknut and then, using cotter pins and pins to secure it,

install the shifter lever return spring in its housing in the cover.

25. Adjust the gearbox as described in the "Transmission Adjustment" section.

26. Replenish the gearbox oil supply as directed in the "Maintenance" chapter, then mount the transmission to the engine and frame.

Transmission Adjustment

FOUR SPEED MODELS

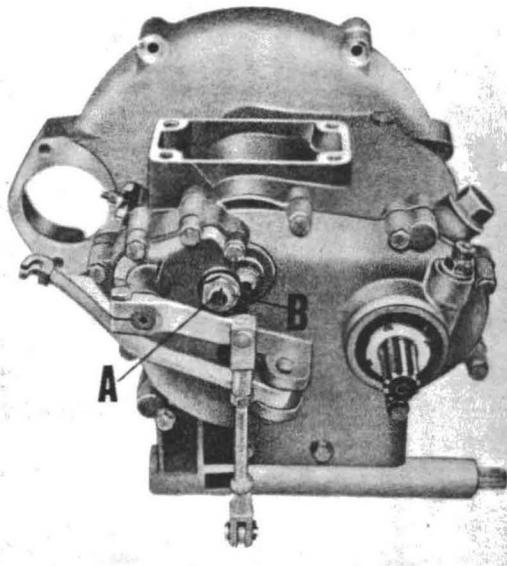
1. Loosen the locknut (B), and screw the adjusting screw (A) in or out until a position is located where all gears engage smoothly and quietly.

2. Secure the locknut while holding the adjusting screw steady with a screwdriver.

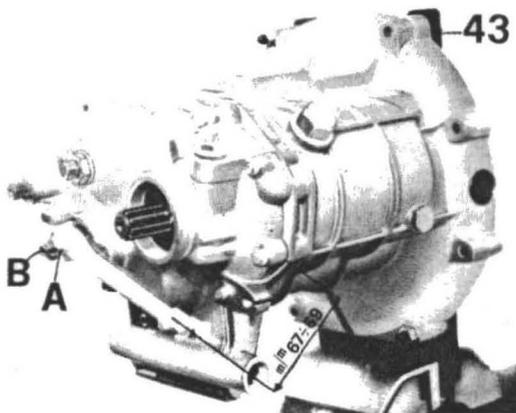
FIVE SPEED MODELS

1. Loosen the locknut (A) and screw the adjusting screw in or out until a distance of 67–69 mm (2.63–2.71 in.) is established between the gearbox cover and the center of the round slot which secures the cable.

2. Secure the locknut while holding the adjusting screw steady with a screwdriver.



Adjusting the transmission (four-speed models)

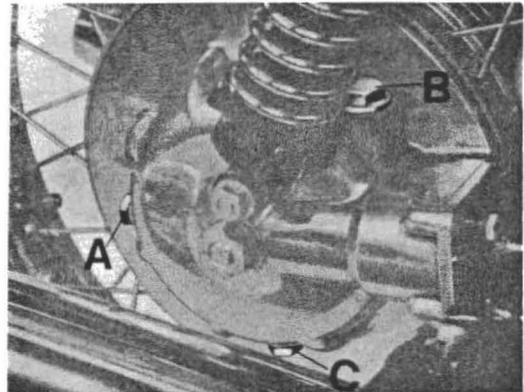


Adjusting the transmission (five-speed models)

DRIVE BOX

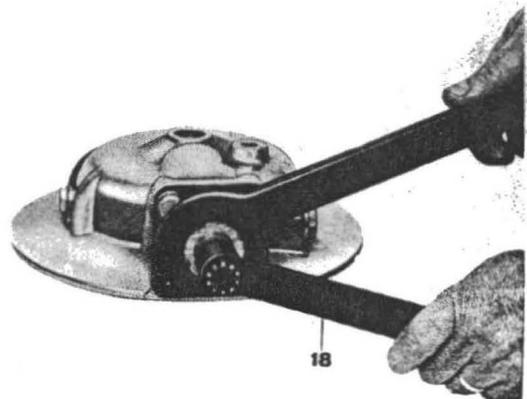
Disassembly
(with the engine and transmission mounted in the frame)

1. Remove the drive box drain plug (C) and filler plug (B), and allow the oil to drain.
2. Remove the rear wheel as described in the "Chassis" chapter.
3. Remove the four nuts or bolts which secure the drive box and remove the box along with the shaft and sleeve.
4. Remove the drive shaft from the sleeve, the two circlips from the shaft, and the sleeve from the bevel pinion.



Drive box plug locations

5. Remove the drive box gasket and oil seal.
6. Bend back the locking tab then, using either the special tool (No. 12907100 which is indicated by No. 18 in the accompanying illustration) or a suitable substitute, remove the lock-ring which secures the bevel pinion.

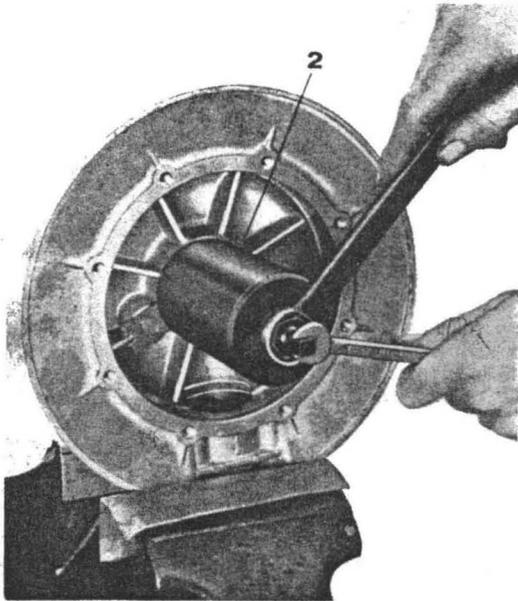


Removing the bevel pinion locking

7. Remove the bearing housing, then further disassemble it by removing the bevel pinion, both bearings, the shims, and the spacer.
8. Remove the housing-to-drive box gasket and seal ring.
9. Bend back the locking tabs, remove the eight bolts which secure the flange to the drive box, then remove the flange. Remove the seal ring and bearing from the flange.
10. Remove the gaskets from between the flange and shim, and from between the shim and drive box.
11. Remove the internally toothed sleeve and bevel crown from the rear

wheel coupling, then remove the bevel crown gear from the sleeve by removing the lockwashers and bolts.

12. Remove the roller bearing stop screw, plate, bearing cage, and the inner race, then remove the outer race by using either the special puller (No. 12906900 which is indicated by No. 2 in the accompanying illustration) or a suitable substitute.



Removing the roller bearing outer race

13. Remove the roller bearing cage retaining ring, drive box oil seal, wheel-to-drive box spacer, and the level plug and gasket.

14. If you wish to remove the universal double joint, gaiters, and bands, you'll have to either remove the engine and transmission assemblies from the frame or remove the swing arm assembly as directed in the "Chassis" chapter.

Inspection and Repair

1. Clean all parts, other than seals and gaskets, with a suitable solvent, then blow them dry.

2. Inspect the drive box for signs of cracks, scoring, or damage of the bearing housing surfaces or drive box mating surfaces, or other damage and replace it as necessary. All gaskets and seals should be replaced as a matter of course.

3. Inspect the drive box flange for cracks, scoring, or damage, especially to

the mating surfaces and bearing and seal ring housings, and replace it as necessary. The seal ring should be replaced as a matter of course.

NOTE: Although the hot set-up is to replace the seal rings, they may be reused in a pinch if completely undamaged.

4. Inspect the distance shims for signs of wear or damage and replace them as necessary. The shim sizes are 0.10, 0.15, 1.00, 1.20, 1.50 mm (0.0039, 0.0059, 0.0394, 0.0472, 0.0591 in.).

5. Inspect the internally toothed sleeve for signs of wear or damage to the bearing surface and teeth, and replace it if not perfect.

6. Inspect the bevel gear pinion and crown for signs of wear, scoring, or damage to any of the teeth or splines.

7. Inspect the cage retaining ring for signs of wear or scoring of the contact surface and replace it if not in perfect condition.

8. Inspect the distance pieces for signs of wear or damage and replace them if necessary.

9. Inspect the bearings, cages, housings, spacers, etc. for any signs of wear or damage and replace them as necessary. Bearing action must be perfectly smooth.

CAUTION: Do not spin bearings when dry.

10. Inspect all remaining hardware for signs of wear or damage and replace them as necessary. Rubber bands and gaiters must be free of cracks or wear and should retain their original elasticity if they are to be reused.

Assembly

1. Assembly is in the reverse order of disassembly. Use new gaskets, seals, and lockwashers whenever possible.

2. Replace the oil drain plug, position the rear wheel-to-drive box spacer and press the drive box oil seal into place.

3. Install the bearing cage retaining ring, roller bearing outer race, bearing cage, and inner race, then secure the bearing stop screw and plate.

4. Assemble the bevel crown to the internally toothed sleeve by means of the securing bolts and locking tabs.

5. Press the bearing and seal ring into the drive box flange, position new gaskets on the drive box and box flange, then mount the flange to the box.

NOTE: Do not secure the locking tabs until after the bevel gear adjustment is performed as directed in the "Bevel Gear Adjustment" section.

6. Install the front bearing, bearing spacer, distance adjusting shims, and the rear bearing into the bearing housing.

7. Mount the spacer shim and adjusting shims onto the bevel pinion and slip the pinion shank into the bearing housing, then secure it with a lock-ring and lock-ring safety washer using either the special tool (No. 12907100) or a suitable substitute.

NOTE: After the bevel gear adjustment is carried out, secure the lock-ring by bending the lockwasher locking tab. Consult the "Bevel Gear Adjustment" section for additional information.

8. Secure the bearing housing and bevel pinion to the drive box by means of the securing nuts and washers.

NOTE: This must not be done until the bevel gear adjustment is carried out as directed in the "Bevel Gear Adjustment" section.

9. Install the ball bearing to the swing arm and secure it with a circlip.

10. Install the double joint in the swing arm bearing and fit the gaiters and bands

over the joint. The bands should be used to secure the gaiters on the swing arm side only.

NOTE: If the engine and transmission have been removed from the frame, the front side of the gaiters must be secured when installed in the engine and transmission assembly.

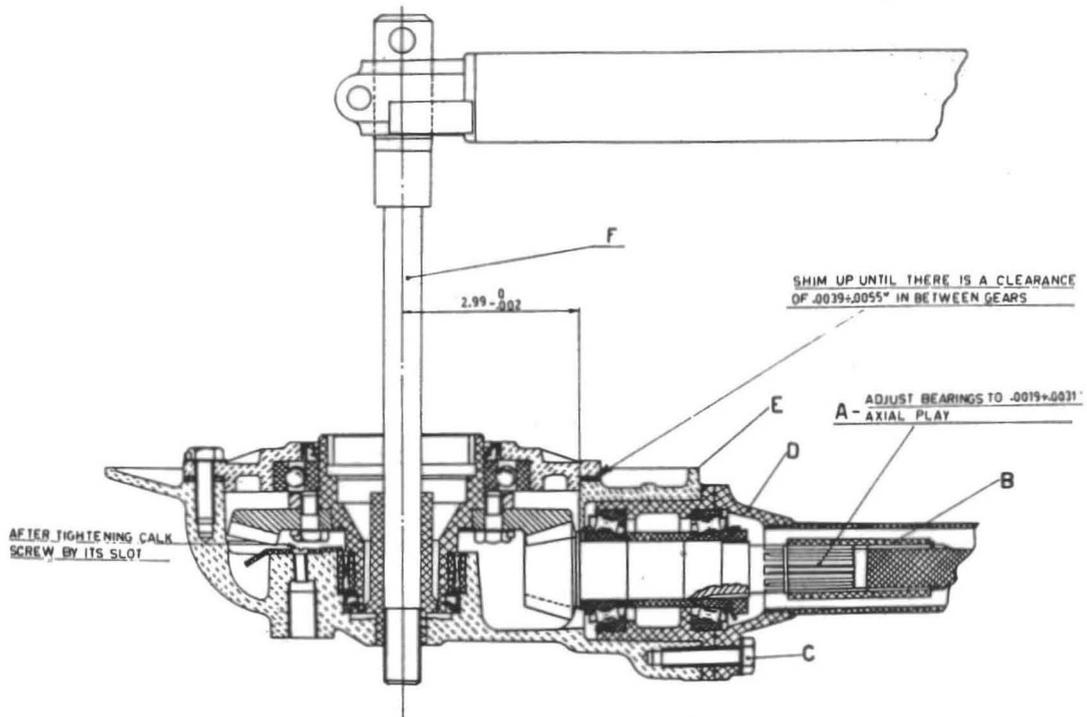
11. Position the circlips in their grooves in the drive shaft, then install the shaft into the double joint and bevel drive sleeve.

12. Insert the splined portion of the bevel pinion (A) into the sleeve (B) and secure it without locking the four bolts and lockwashers which secure the drive box (E) to the swing arm (D). Then insert the rear wheel spindle (F) through the left-hand side of the swing arm and into the drive box, then secure the four bolts (C) and remove the spindle (F).

13. Replenish the drive box oil supply with 0.4 pts for the V700 and V750, or 0.9 pts for the V850, of a high quality 90 E.P. weight gear oil.

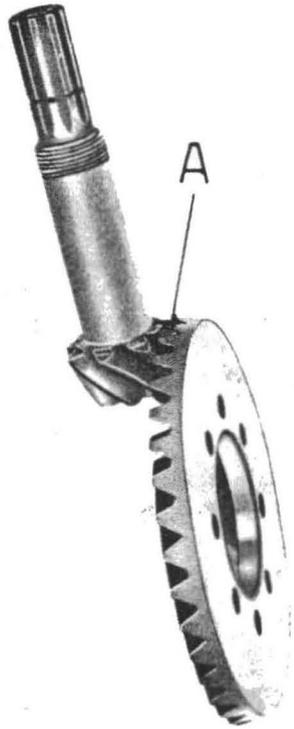
BEVEL GEAR ADJUSTMENT

1. Adjust the pinion-to-crown clearance of the bevel gear set to 0.010–0.015 mm (0.0039–0.0059 in.). Make sure the meshing



Assembling the drive box

surfaces (A) of the gears are in proper contact.

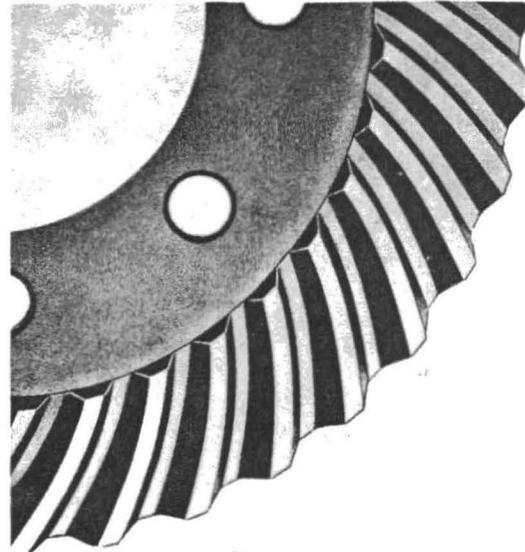


Proper gear engagement

2. Check for correct teeth contact in the following manner:

- a. Coat the crown teeth with lead oxide, then rotate the pinion while keeping the crown braked so the rotation will take place under load, so contact marks will appear on the coated surface of the crown.

- b. Make sure that the contact is correct by comparing it with the accompanying illustration. If the contact marks are incorrect, go onto the next step.



Correct gear engagement

3. If the contact pattern is not correct, consult the following steps and illustrations to arrive at a solution:

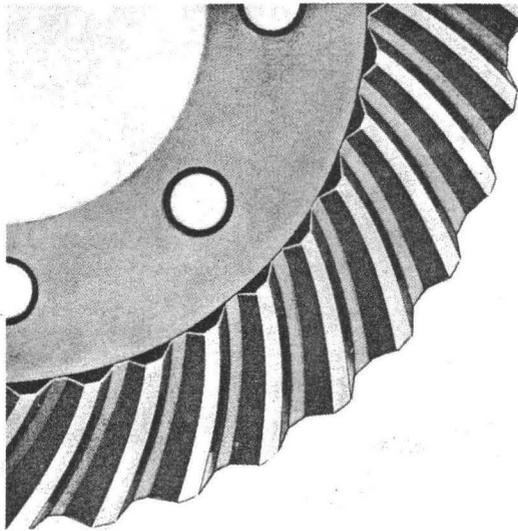
NOTE: After adding or removing shims, readjust the pinion-to-crown clearance before rechecking the contact pattern.

- a. Excessive contact at the bottom of the tooth flank indicates that the pinion is too deeply inserted in the crown and this may be remedied by reducing the number of adjusting shims, or by using a thinner shim.

Key for page 86 (continued)

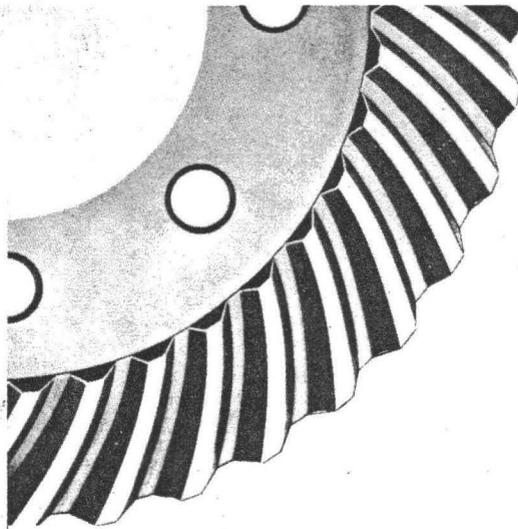
- 30. Ball rear fork bearing
- 31. Rear drive box
- 32. Drive box oil filler plug
- 33. Oil filler plug gasket
- 34. Oil level and drain plug
- 35. Oil level and drain plug washer
- 36. Bevel gear retaining nut
- 37. Drive box bolts nut
- 38. Taper roller in housing bearing
- 39. Housing bearing
- 40. Drive box-to-bearing housing gasket
- 40/1. Rear drive box seal
- 41. Bearing housing-to-rear fork gasket
- 42. Bearings distance piece
- 43. Spacer-to-bearing shim
 - Bevel gears spacer shim
- 44. Bevel set spacer
 - Bevel set spacer
 - Bevel set spacer
- 45. Bevel gear set
- 46. Flange
- 47. Flange fixing bolt lock plate
- 48. Drive box flange
- 49. Flange-to-spacer and spacer-to-drive box gasket
- 50. Shim 0.8 mm (0.031 in.)
 - Shim 0.9 mm (0.035 in.)
 - Shim 0.1 mm (0.039 in.)
 - Shim 1.1 mm (0.043 in.)
 - Shim 1.2 mm (0.047 in.)
 - Shim 1.3 mm (0.051 in.)
- 51. Seal
- 52. Bevel gear-to-journal bolt
- 53. Bevel gear bolts-to-journal bearing lock plate
- 54. Ball bearing
- 55. Journal bearing
- 56. Roller bearing
- 57. Cage retaining ring
- 58. Seal
- 59. Bearing stop plate
- 60. Roller bearing stop plate screw
- 61. Flange securing screw washer

NOTE: Shims are available in the following sizes: 0.10, 0.15, 1.00, 1.20, 1.50 mm (0.0039, 0.0059, 0.0394, 0.472, 0.591 in.).



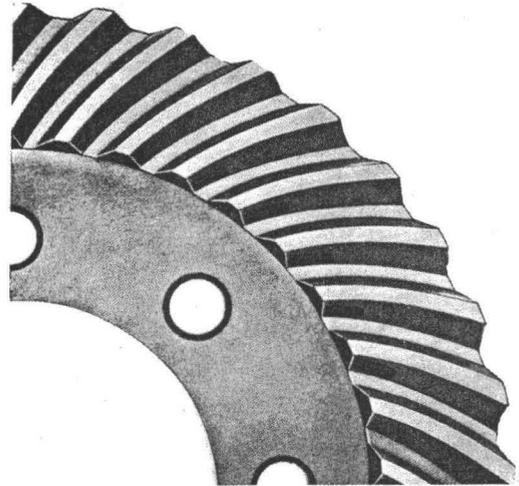
Pinion too deep in the crown

b. Excessive contact at the heel of the tooth indicates that the crown is too far from the pinion and this may be remedied by increasing the number of shims, or by using a thicker shim.



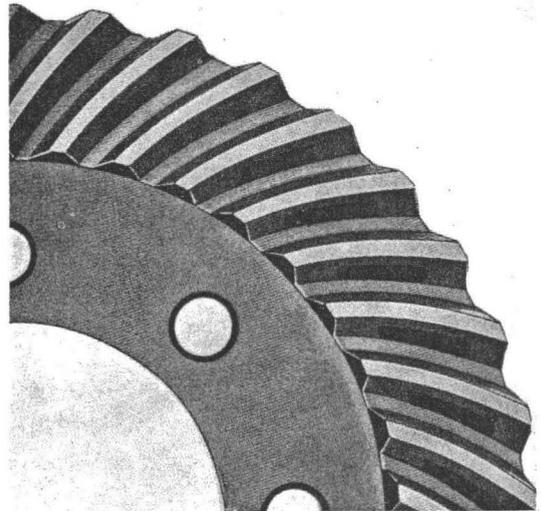
Crown too far from pinion

c. Excessive contact at the crest of the tooth indicates that the pinion is too far from the crown and this may be remedied by increasing the number of shims, or by using a thicker shim.



Pinion too far from crown

d. Excessive contact at the top land of the tooth indicates that the crown is too close to the pinion and this may be remedied by reducing the number of shims, or by using thinner shims.



Crown too close to pinion

FINAL DRIVE SERVICE

Although you won't find this information listed in any maintenance chart, you can be reasonably sure that you'll have to replace the drive shaft dust boot about once a year if your machine gets used regularly. There is a special replacement boot available that is split for easy installation, but it will not function as satisfactorily as the standard item.

The easiest way to install a new boot is

by removing the rear wheel and swing arm, not by sliding the engine forward. Before installing the boot, clean off the drive shaft assembly and swing arm with clean gasoline or some other suitable solvent, and use a sealer on the mating surfaces. Allow the sealer to dry thoroughly before proceeding with the assembly, then secure the boot clamps to ensure an oil tight seal.

Drilling a small breather hole in the drive box filler plug will allow excessive pressure to be vented. A No. 50 drill will do the trick and a small rubber boot can be fashioned to prevent dirt or water from getting into the oil supply.

NOTE: If you are troubled by excessive oil build-up in the drive boot, try setting the shocks up a step higher when you are carrying a heavy load.

Engine and Transmission Specifications Piston, Cylinder, and Crankshaft Assemblies

V700

Cylinder barrel diameter:	80.000–80.018 mm (3.1496–3.1503 in.)
Piston diameters:	
—at piston top	79.600–79.650 mm (3.1338–3.1358 in.)
—below top ring	79.700–79.750 mm (3.1378–3.1397 in.)
—below 2nd ring	79.000–79.100 mm (3.1102–3.1141 in.)
—at recess below oil scrapers	79.100–79.150 mm (3.1149–3.1161 in.)
—5 mm (0.196 in.) below top oil scraper recess	79.922–79.940 mm (3.1465–3.1472 in.)
—selection diameter at 18.5 mm (0.728 in.) over piston bottom edge	79.952–79.970 mm (3.1477–3.1484 in.)
—at piston bottom	79.922–79.940 mm (3.1465–3.1472 in.)
—piston pin housing diameter	22.000–22.006 mm (0.8661–0.8663 in.)
Piston pin diameter	22.001–22.006 mm (0.86614–0.86634 in.)
Main shaft diameter, flywheel side	53.970–53.951 mm (2.1248–2.1240 in.)
Main shaft diameter, timing side	37.975–37.959 mm (1.4951–1.4944 in.)
I/D of main bearings c/w flange:	
—flywheel side	54.000–54.019 mm (2.1260–2.1268 in.)
—timing side	38.000–38.016 mm (1.4961–1.4967 in.)
Undersize range of main bearings available as spare parts: 0.2 mm (0.00787 in.)–0.4 mm (0.01574 in.)–0.6 mm (0.02362 in.)–0.8 mm (0.03149 in.)	
Crankpin diameter	44.013–44.033 mm (1.7328–1.7336 in.)
Diameter of con-rod big end bearing housing	47.130–47.142 mm (1.9016–1.8559 in.)
Original thickness of con-rod bearings	1.534–1.543 mm (0.06039–0.06070 in.)
Oversize range of big end bearings 0.254 mm (0.010 in.)–0.508 mm (0.020 in.)–0.762 mm (0.030 in.)–1.016 mm (0.040 in.)	
I/D of small end bushing (after pressing in):	22.020–22.041 mm (0.8669–0.8677 in.)

Piston, Cylinder, and Crankshaft Assemblies (cont.)

V750 and V850

Cylinder barrel diameter:	80.000–80.018 mm (3.1496–3.1503 in.)
Piston diameters:	
—at piston top	82.600–82.650 mm (3.2520–3.2538 in.)
—below top ring	82.700–82.750 mm (3.2558–3.2578 in.)
—below 2nd ring	82.000–82.100 mm (3.2283–3.2322 in.)
—at recess below oil scrapers	82.100–82.150 mm (3.2322–3.2342 in.)
—5 mm (0.196 in.) below top oil scraper recess	82.928–82.946 mm (3.2648–3.2655 in.)
—selection diameter at 18.5 mm (0.728 in.) over piston bottom edge	82.958–82.976 mm (3.2660–3.2667 in.)
—at piston bottom	82.928–82.946 mm (3.2648–3.2665 in.)
—piston pin housing diameter	22.000–22.006 mm (0.8661–0.8663 in.)
Piston pin diameter	22.001–22.006 mm (0.86614–0.86634 in.)
Main shaft diameter, flywheel side	53.970–53.951 mm (2.1248–2.1240 in.)
Main shaft diameter, timing side	37.975–37.959 mm (1.4951–1.4944 in.)
I/D of main bearings c/w flange:	
—flywheel side	54.000–54.019 mm (2.1260–2.1268 in.)
—timing side	38.000–38.016 mm (1.4961–1.4967 in.)
Undersize range of main bearings available as spare parts: 0.2 mm (0.00787 in.)–0.4 mm (0.01574 in.)–0.6 mm (0.02362 in.)–0.8 mm (0.03149 in.)	
Crankpin diameter	44.013–44.033 mm (1.7328–1.7336 in.)
Diameter of con-rod big end bearing housing	47.130–47.142 mm (1.9016–1.8559 in.)
Original thickness of con-rod bearings	1.534–1.543 mm (0.06039–0.06070 in.)
Oversize range of big end bearings 0.254 mm (0.010 in.)–0.508 mm (0.020 in.)–0.762 mm (0.030 in.)–1.016 mm (0.040 in.)	
I/D of small end bushing (after pressing in):	22.020–22.041 mm (0.8669–0.8677 in.)

Camshaft and Valve Train Assemblies

V700

I/D of camshaft housings in crankcase	
—timing side	47.025–47.064 mm (1.8511–1.8529 in.)
—flywheel side	32.025–32.064 mm (1.2607–1.2623 in.)
Diameter of camshaft journals	
—timing side	46.975–47.000 mm (1.8494–1.8504 in.)
—flywheel side	31.975–32.000 mm (1.2588–1.2598 in.)

Camshaft and Valve Train Assemblies (cont.)

V700

Diameter of tappet guides	22.021–22.000 mm (0.8669–0.8661 in.)
O/D of original tappet	22.000–21.979 mm (0.8661–0.9046 in.)
Tappet oversize range	0.05–0.10 mm (0.0019–0.0039 in.)
I/D of rocker arms	15.032–15.059 mm (0.5918–0.5929 in.)
Diameter of rocker arms spindles	14.983–14.994 mm (0.5899–0.5903 in.)
I/D of inlet and exhaust valve guide housings	14.000–14.018 mm (0.5512–0.5519 in.)
O/D of inlet and exhaust valve guides (original) (spares)	14.064–14.075 mm (0.5537–0.5541 in.) 14.107–14.118 mm (0.55541–0.55545 in.)
I/D of inlet and exhaust valve guides (after pressing-in)	8.000–8.022 mm (0.3149–0.3158 in.)
Diameter of inlet valve stem	7.972–7.987 mm (0.3138–0.3144 in.)
Diameter of exhaust valve stem	7.965–7.980 mm (0.3136–0.3142 in.)
Diameter of inlet valve head	38.4–38.6 mm (1.5118–1.5197 in.)
Diameter of exhaust valve head	34.4–34.6 mm (1.3543–1.3622 in.)

V750 and V850

I/D of camshaft housings in crankcase —timing side —flywheel side	47.025–47.064 mm (1.8511–1.8529 in.) 32.025–32.064 mm (1.2607–1.2623 in.)
Diameter of camshaft journals —timing side —flywheel side	46.975–47.000 mm (1.8494–1.8504 in.) 31.975–32.000 mm (1.2588–1.2598 in.)
Diameter of tappet guides	22.021–22.000 mm (0.8669–0.8661 in.)
O/D of original tappet	22.000–21.979 mm (0.8661–0.9046 in.)
Tappet oversize range	0.05–0.10 mm (0.0019–0.0039 in.)
I/D of rocker arms	15.032–15.059 mm (0.5918–0.5929 in.)
Diameter of rocker arms spindles	14.983–14.994 mm (0.5899–0.5903 in.)
I/D of inlet and exhaust valve guide housings	14.000–14.018 mm (0.5512–0.5519 in.)
O/D of inlet and exhaust valve guides (original) (spares)	14.064–14.075 mm (0.5537–0.5541 in.) 14.107–14.118 mm (0.55541–0.55545 in.)
I/D of inlet and exhaust valve guides (after pressing-in)	8.000–8.022 mm (0.3149–0.3158 in.)

Camshaft and Valve Train Assemblies (cont.)

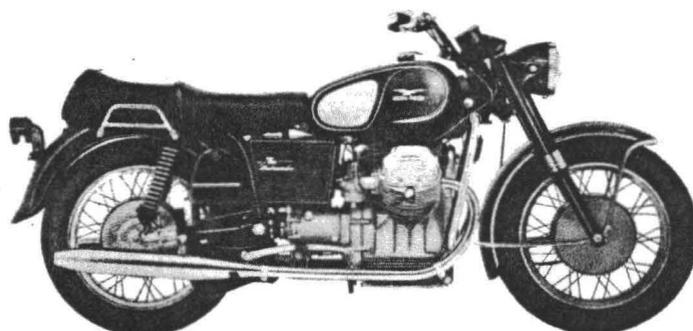
V750 and V850

Diameter of inlet valve stem	7.972–7.987 mm (0.3138–0.3144 in.)
Diameter of exhaust valve stem	7.965–7.980 mm (0.3136–0.3142 in.)
Diameter of inlet valve head	40.8–41.0 mm (1.605–1.615 in.)
Diameter of exhaust valve head	35.8–36.0 mm (1.409–1.417 in.)

Transmission

<i>Model</i>	<i>V700</i>	<i>V750</i>	<i>V850</i>
Gearbox:			
Type	four-speed	four-speed	five-speed
Engine-gearbox ratio (1 :)	1.375 (16–22)	1.375 (16–22)	1.235 (17–21)
Internal gear ratios (1 :)			
First gear	2.230 (13–29)	2.230 (13–29)	2.000 (14–28)
Second gear	1.333 (18–24)	1.333 (18–24)	1.388 (18–25)
Third gear	0.954 (22–21)	0.954 (22–21)	1.047 (21–22)
Fourth gear	0.750 (24–18)	0.750 (24–18)	0.869 (23–20)
Fifth gear	—	—	0.750 (24–18)
Secondary drive:			
Type	shaft	shaft	shaft
Bevel layshaft gear—rear wheel ratio (1 :)	4.625 (8–37)	4.375 (8–35)	4.625 (8–37)
Overall gear ratios (1 :)			
First gear	14.180	13.413	11.424
Second gear	8.473	8.015	7.929
Third gear	6.063	5.735	5.980
Fourth gear	4.786	4.510	4.964
Fifth gear	—	—	4.284

5 • Lubrication System



Operational Description

The engines of all models covered in this guide are lubricated by the same wet sump lubrication system which relies on pressure and splash oiling of all engine components. The heart of the system is a crankshaft driven, parallel gear type pump which supplies the necessary oil pressure; the recovery system is by gravity.

The oil passes through a wire gauze strainer after leaving the pump and is then routed through passages in the crankcase to the various component systems. An oil pressure gauge and a relief valve are incorporated in the delivery circuit before the oil is dispersed throughout the engine. The oil is pumped through the main bearings to the camshaft and crankshaft assemblies and then to the connecting rod big-end bearings. The oil then exits from the sides of the bearings and is splashed, through the action of centrifugal force, all over the bottom end. The head assembly is lubricated by oil pumped up through tubing and the oil then lubricates the cylinder walls as gravity returns it to the sump. The full circuit therefore is from the pump through the filter, through the oil lines to the relief valve and crankcase breather, through the pressure gauge, and then to the top and bottom end assemblies.

The gearbox and rear hub drive assem-

blies are independently lubricated through a splash system. Their oil supplies are separate from the crankcase sump.

OIL PUMP

The oil pump is a long-life item which seldom requires repair. Therefore, one should check all related possibilities which might contribute to a "light-on" or "no-pressure" situation before disassembling the pump.

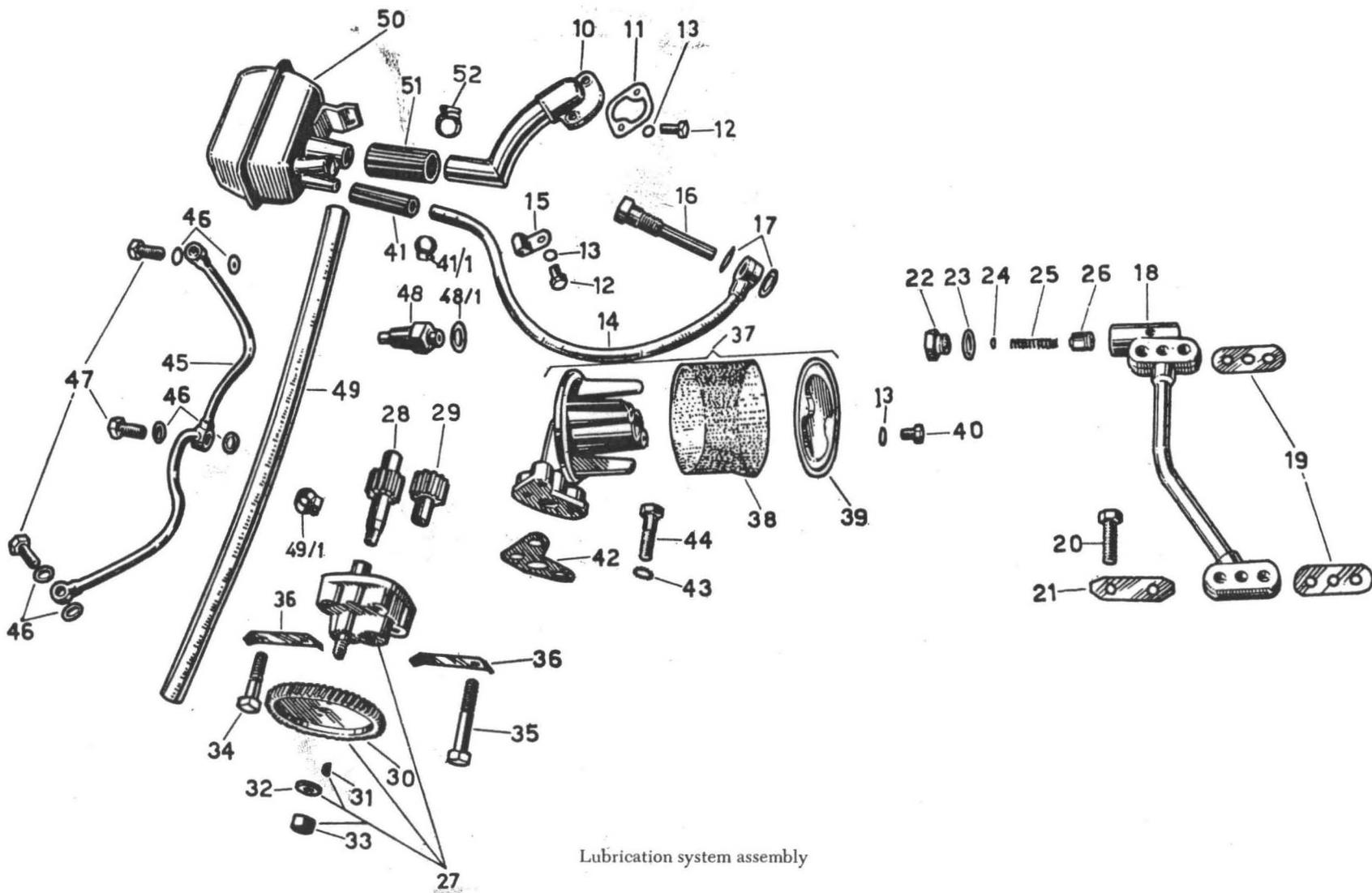
OIL PRESSURE RELIEF VALVE

The oil pressure relief valve is designed to be a maintenance free item and must be replaced if it fails to function correctly. The unit is mounted on the oil pipe and works by opening whenever the oil pressure exceeds its prescribed rating. When the valve opens, the pressure level drops and the valve will stay open until the pressure returns to normal.

The prescribed maximum rate of delivery pressure for a 700 cc engine is 35.6–42.7 lbs/sq. in. (2.5–3.0 kgs/sq. cm.); the pressure for 750 and 850 cc engines is 54.0–60.0 lbs/sq. in. (3.8–4.2 kgs/sq. cm.). Consult your local dealer for additional information.

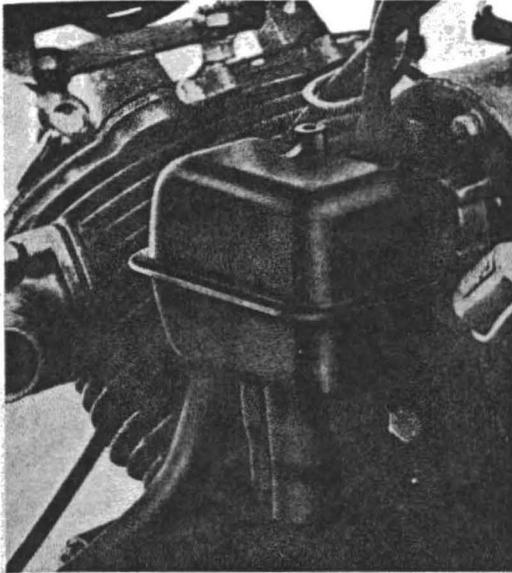
OIL BREATHER

The purpose of the crankcase oil breather is to provide an exit for the excess pressure released by the relief valve. When the relief valve opens to return the



Lubrication system assembly

oil pressure to within the specified bounds, the crankcase breather returns the discharged oil to the crankcase and blows an oil mist into the atmosphere to relieve the pressure.



Oil breather box

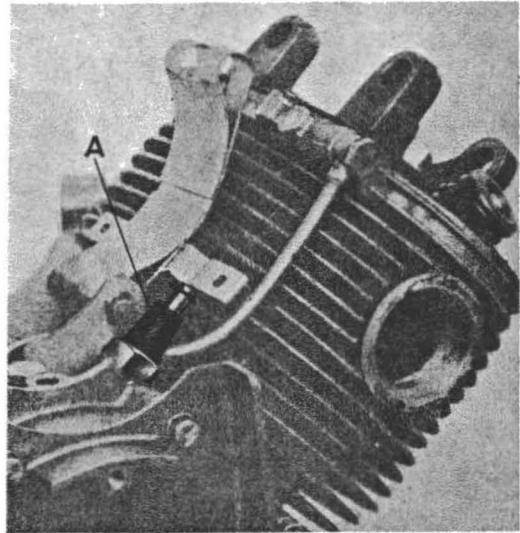
The breather is composed of a box with a diaphragm which is held against the breather pipe by a pre-loaded spring which is calibrated to the necessary pressure for proper operation. The breather tube, oil return tube, and the vent tube are all connected to the box by rubber sleeves and bands.

Key for page 94

10. Breather tube
11. Breather tube washer
12. Breather tube and return pipe band screw
13. Breather tube, band securing screws, and bottom plate bolt washer
14. Oil return from breather box tube
15. Oil return tube band
16. Return pipe securing hollow bolt
17. Hollow bolt washer
18. Oil pipe
19. Oil pipe washer
20. Oil pipe securing bolt
21. Oil pipe screws lock plate
22. Oil relief valve plug
23. Washer
24. Bottom plate
25. Spring
26. Oil relief valve plunger
27. Complete oil pump
28. Gear driving spindle
29. Driven gear
30. Driving gear
31. Oil pump driving gear key
32. Driving gear nut washer

OIL PRESSURE GAUGE

The oil pressure gauge (A) is a crankcase mounted solenoid switch which is connected to a warning light mounted on the instrument panel, and it serves as an indication of insufficient oil pressure. The oil pressure light will light when the key is turned on and should go off as soon as the engine is running. It is not uncommon for the light to flicker or glow gently while the engine is running at a slow idle, especially just after the engine has been started. Raising the idle speed slightly should make the light go out. If at any time the light should come on while the engine is



Oil pressure gauge solenoid

33. Driving gear nut
34. Oil pump securing screw
35. Oil pump securing screw
36. Pump securing screws lock plate
37. Oil cleaner, complete
38. Oil filter, gauze
39. Bottom plate
40. Plate securing bolt
41. Flexible return pipe line
- 41/1. Recovery pipe-to-flexible line band
42. Washer
43. Filter screw spring washer
44. Filter securing screw
45. Oil delivery-to-cylinder heads pipe
46. Oil pressure solenoid washer
47. Oil pipes-to-cylinder heads screw
48. Oil pressure solenoid
- 48/1. Oil pressure solenoid seal
49. Vent tube
- 49/1. Breather tube band
50. Complete oil breather assembly
51. Flexible center tube
52. Breather tube-to-flexible pipe band

running, shut down immediately and determine the reason why. Chances are that it will be a problem with the electrical aspect of the gauge, but if it is a mechanical problem, failure to stop the engine may result in the engine stopping itself—permanently.

The gauge is a non-repairable item which must be replaced if defective.

Oil Pump Repair

Removal and Disassembly

1. Run the engine until its normal operating temperature is reached, then drain the oil.

2. Remove the generator belt cover and the driven generator pulley. The outer half of the generator pulley can be removed after removing the three securing bolts, spacer washers, and drive belt, and the inner half can be removed after unscrewing the nut which secures it to the crankshaft. A special tool (No. 12911801) is available to secure the clutch while breaking the nut loose, but a suitable substitute may be used.

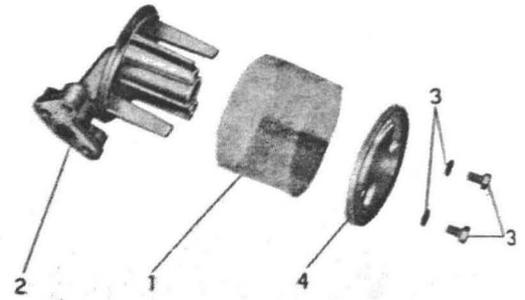
3. Remove the timing chest cover by removing the bolts which secure it to the crankshaft, then remove the sealing ring from the timing cover.

4. Remove the oil pump gear by breaking loose the nut which secures it to its shaft in the same manner in which the generator belt pulleys were removed. The gear is a press fit on a tapered shaft, and must be pulled off with an oil pump gear puller (No. 32906302) or a suitable substitute.

5. Remove the oil pump mounting screws and pump, then remove the key, the driven gear, and the driving shaft.

6. Remove the oil pump filter retaining screws and filter assembly from the oil pipe located above the pump. The filter can be further broken down by removing the gasket, bottom plate (4), wire gauze (1), and the filter housing (2). You may wish to approach the filter from below by removing the sump.

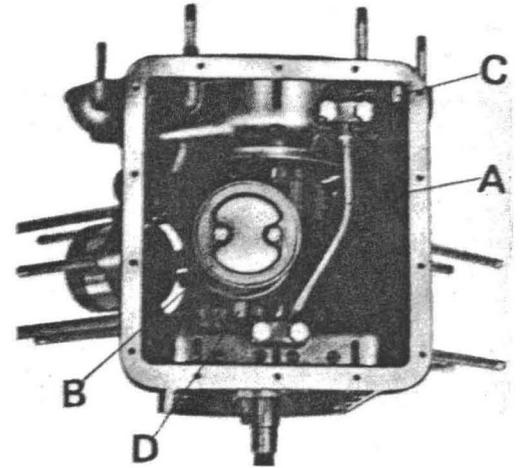
7. Remove the oil pipe by bending back the lockwasher locking tabs, then removing the securing bolts and washers. The re-



Oil filter assembly

1. Filter element
2. Filter body
3. Cap mounting bolts
4. Filter cap

lief valve assembly can now be removed from the pipe and this assembly can be further broken down into a plunger, spring, bottom plate, and plug.



Lubrication components mounted in the crankcase

- A. Oil pipe
- B. Oil filter
- C. Oil pressure relief valve
- D. Oil pump

8. Remove the oil pressure gauge solenoid from the crankcase at this time if it has failed to function as intended.

Inspection and Repair

1. Clean all parts in a suitable solvent, then blow them dry. Oil lines should be blown out with compressed air. If gasket sealer has been used on any of the mating surfaces, they should be carefully scraped clean.

2. Inspect all parts for signs of excessive wear or damage, and replace them as necessary. Gaskets, keys, and other short-

life items should be replaced as a matter of course.

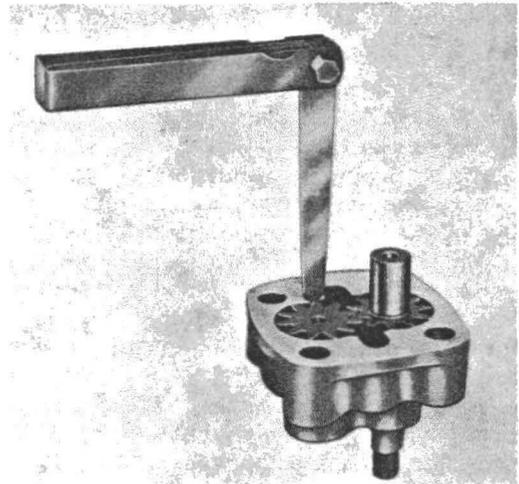
3. Measure the width of the pump gears and replace them if worn past their serviceable limit. The gears should be 15.983–15.994 mm (0.6293–0.6297 in.) wide.

4. Measure the depth of the gear housing in the pump body and replace the unit if it is worn greater than its serviceable limit of 16.000–16.027 mm (0.6299–0.6309 in.). The areas to be measured are indicated in the accompanying illustration.

5. Measure the outside diameter of the pump gears and replace them as a set if worn past their serviceable limit of 25.993–25.980 mm (1.0233–1.0227 in.).

6. Measure the inside diameter of the gear housings within the pump body and replace the unit if worn past their serviceable limits of 26.000–26.033 mm (1.0236–1.0249 in.).

7. Check the clearance between the pump gear shafts and the supports upon which they ride in the pump body. The outside diameter of the gear shafts should be within serviceable limits of 11.994–11.983 mm (0.4722–0.4717 in.), and the inside diameter of the supports should measure 12.000–12.018 mm (0.4724–0.4731 in.). The clearance between the supports and the shafts must be within 0.006–0.035 mm (0.00023–0.00137 in.) or the worn components must be replaced.

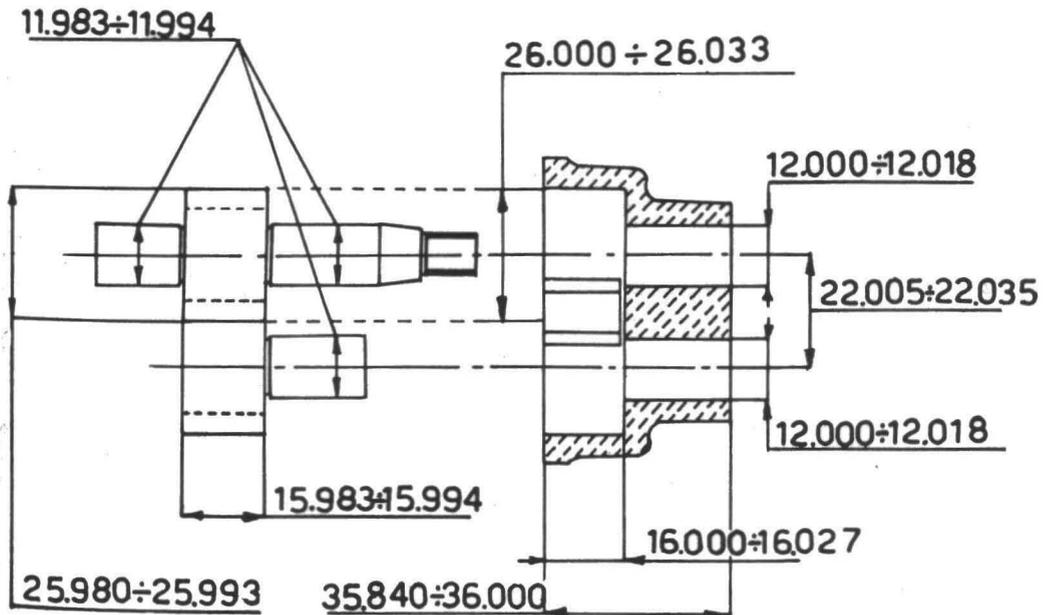


Checking clearances with feeler gauges

8. Inspect the oil filter wire gauze type strainer for a clogged or damaged condition and replace it as necessary.

9. If the oil pressure relief valve has not been functioning correctly, replace it at this time. Consult the “Oil Pressure Relief Valve” section for additional information.

10. Replace the oil pressure solenoid if it has failed to function. Before replacing the unit, you should make sure that the problem isn't in the bulb or associated wiring.



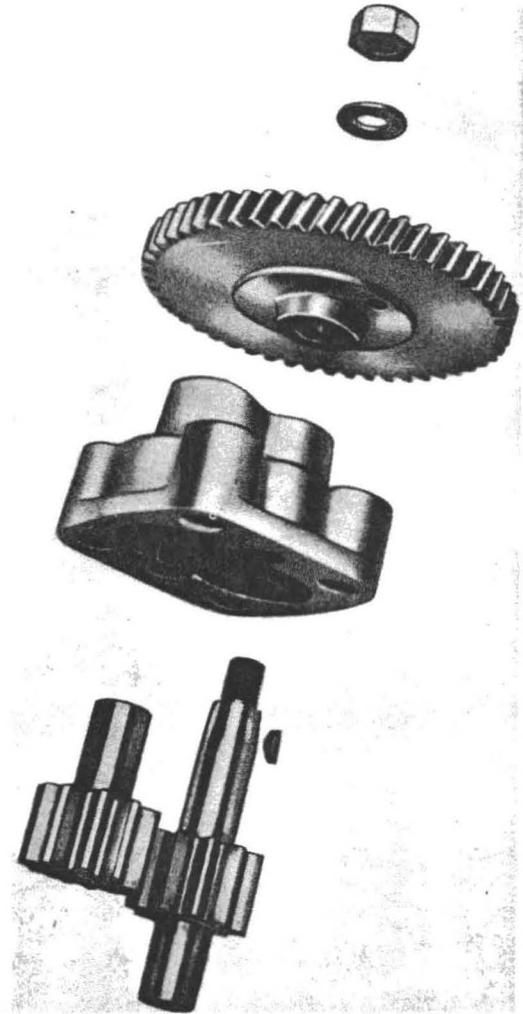
Pump assembly dimensions

Assembly

1. Assembly is basically in the reverse order of disassembly.

2. Secure the oil pipe, filter, and pump assemblies to the crankcase, then consult the "Engine and Transmission" chapter for information on how to reassemble the timing case and the generator pulley assemblies. Make sure you correctly time the valve gear if the correct timing has been lost. Instructions on adjusting the generator belt tension can be found in the "Maintenance" chapter.

3. Remember to refill the sump with oil before starting the engine. Rotating the engine through a few times before starting it is a good idea so there will be oil on all the parts. After running the engine, check the sump for a good seal or you may wind up with a dry sump and a slick garage floor. The sump mating surface must be perfectly clean or a good seal will not form. Use a good sealer sparingly at your own discretion.



Pump assembly

Oil Pump Specifications

OIL PUMP (all models):

Gear width	15.983–15.994 mm / 0.6293–0.6297 in.
Depth of gear housing in pump body	16.000–16.027 mm / 0.6299–0.6309 in.
Gear housing outside diameter	25.993–25.980 mm / 1.0233–1.0227 in.
Gear housing inside diameter	26.000–26.033 mm / 1.0236–1.0249 in.
Gear shaft outside diameter	11.994–11.983 mm / 0.4722–0.4717 in.
Shaft support inside diameter	12.000–12.018 mm / 0.4724–0.4731 in.
Clearance between shafts and supports	0.006–0.035 mm / 0.00023–0.00137 in.

OIL PRESSURE:

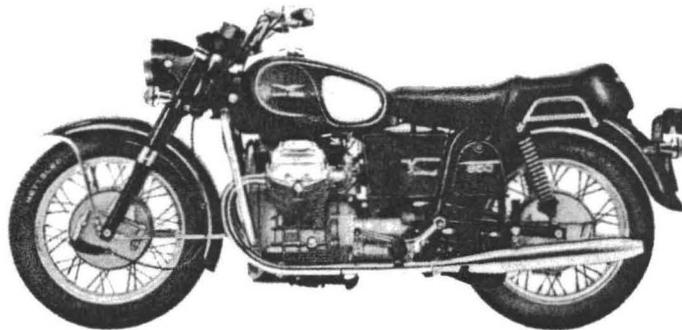
Maximum delivered pressure;

V700 35.6–42.7 lbs/sq in. / 2.5–3.0 kgs/sq cm

V750 54.0–60.0 lbs/sq in. / 3.8–4.2 kgs/sq cm

V850 54.0–60.0 lbs/sq in. / 3.8–4.2 kgs/sq cm

6 • Fuel System



The carburetors used on Moto Guzzi models are simple, functional, Amal type slide units which can be relied on to provide accurate metering and efficient delivery of fuel to the cylinders. When working on the carbs, clean conditions and deftness of touch are the variables which will determine the degree of success of a rebuild. Passages should be blown out with compressed air to avoid scoring their bores, and rebuild kits should be used in their entirety, rather than merely replacing the obviously damaged parts.

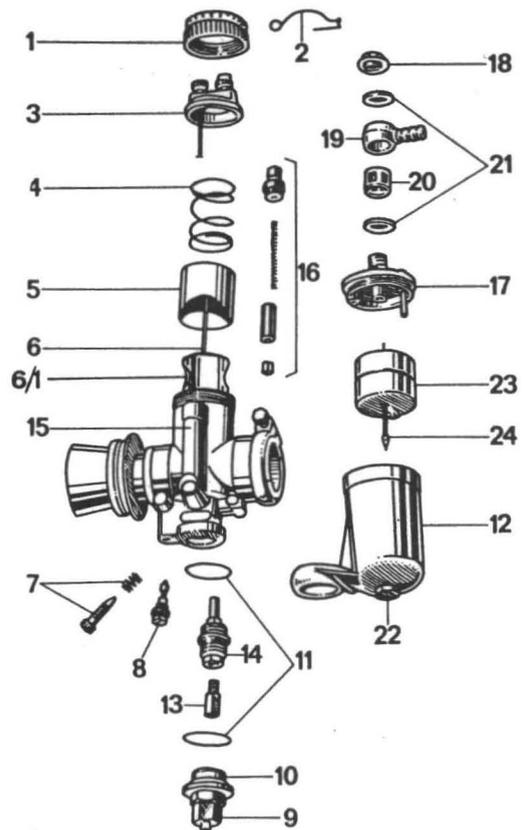
Carburetor

DISASSEMBLY AND ASSEMBLY

V700

1. Remove the spring clip (2) from the mixing chamber cap (1) on the top of the carburetor, then remove the chamber cap.

2. Carefully, taking care not to foul the needle against the carburetor bore, lift up the mixing chamber cover (3) assembly complete with the throttle slide spring (4), slide (5), tapered needle (6), and venturi bock (6/1). The cover assembly can be further disassembled, if necessary, by compressing the spring up against the cover, removing the needle clip and needle, and



V700 carburetor assembly

disengaging the throttle and choke cables from their respective slides.

3. Remove the air adjusting screw (7)

and its spring, then remove the pilot jet (8).

4. Remove the float chamber plug (22) and allow the fuel to drain into a suitable receptacle.

5. Remove the float bowl plug (9), float chamber securing bolt (10), bolt washers (11), float chamber (12), main jet (13), and the jet holder assembly (14) which includes the atomizer and the atomizer nozzle.

6. Disconnect the carburetor from the air cleaner, remove the carburetor body (15) from the intake manifold by loosening the pinch bolt, and remove the choke (16).

7. Remove the float chamber cover and tickler assembly (17), then remove the banjo cap (18), banjo (19), fuel filter (20), and the banjo washers (21).

8. Remove the float (23) and float needle (24) assembly from the float chamber.

9. Assembly is in the reverse order of disassembly. Make sure all parts are perfectly clean and avoid overtightening any of the jets or adjusting screws.

V750 and V850

1. Remove the screws (3) which secure the mixing chamber cap (1) to the carburetor body, then lift off the cap and carefully pull the throttle slide (4) out of the carburetor bore taking care not to foul the taper needle (5) on the sides of the bore.

2. Disassemble the cap assembly by compressing the slide spring (2) against the cap, removing the needle clip and needle, and then disengaging the throttle cable from the slide. The cable can now be withdrawn and the cable adjuster can be removed from the top of the cap.

3. Remove the throttle slide stop screw and spring (6) and the pilot air screw and spring (17).

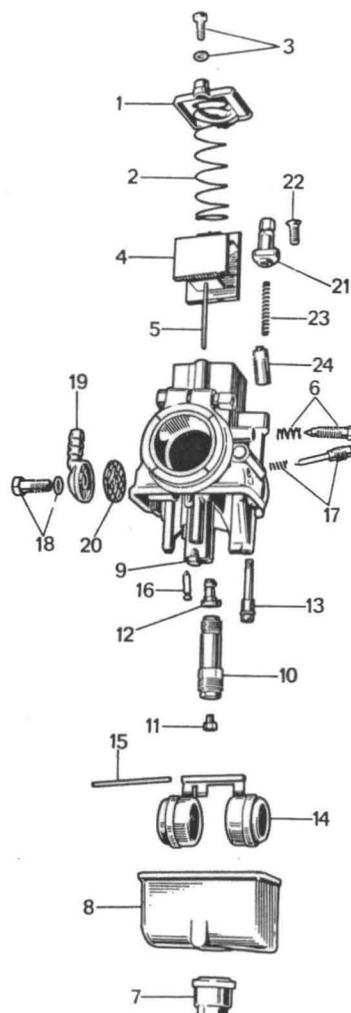
4. Remove the float bowl drain plug (7) and allow the fuel to drain into a suitable receptacle.

5. Remove the float bowl (8) and pilot jet (9).

6. Remove the accelerator pump (10), main jet (11), needle jet (12), and pilot jet (13).

7. Remove the float (14), float pivot pin (15), and the float needle (16).

8. Remove the banjo securing bolt and washer (18), banjo (19), and fuel filter (20).



V750 and V850 carburetor assembly

9. Remove the screw (22) which secures the choke fitting (21), withdraw the choke slide (24), spring (23), and fitting, then disengage the choke cable from the slide.

10. Disconnect the air cleaner from the carburetor, then remove the carburetor body from the intake manifold by loosening the pinch bolt and pulling the body free.

11. Assembly is in the reverse order of disassembly. Make sure all parts are perfectly clean and avoid overtightening any of the jets or adjusting screws.

INSPECTION AND REPAIR

All Models

1. Clean all parts in a suitable solvent, then blow them dry. Pay special attention

to the ducts and jet passages which should be blown rather than poked clear.

2. Inspect the throttle slide for score or wear marks or for cracks and replace it as necessary. The slide should be able to smoothly slide down the carburetor bore of its own weight and without the aid of lubrication. If the slide does not move smoothly it may be lightly sanded with a fine emery cloth to remove burrs, as long as the sanding does not mar the surface of the slide.

3. Inspect the taper needle for signs of wear along the shaft and in the clip grooves. If the needle is worn or blunted or if its fit in the spring clip is loose, the offending component must be replaced.

4. Inspect the jets for signs of wear or damage to their threads and bores and replace them as necessary.

5. Inspect the float for a fuel clogged or otherwise damaged condition and replace it as necessary. The float needle should be secure in the float on the V700 model.

6. Inspect the float needle and needle seat for wear, damage, or anything which could prevent them from seating together properly.

7. Inspect the adjusting screws for blunt tips or damage to their shafts or threads and replace them as necessary.

8. Inspect the fuel filter for a clogged condition and clean or replace it as necessary.

9. Inspect the float chamber, bowl, and carburetor body for cracks or damage which could cause air or fuel leaks and look for sediment deposits which could interfere with the proper operation of any of the components. Damaged parts must be replaced and sediment must be carefully removed with a blunt blade and a deft

touch to avoid scoring the surface of the part in question.

Fuel Tank

Whenever the motorcycle is to be stored for an extended period of time, the tank should be drained and the inside should be bathed with a gas/oil mixture. This will leave an oil film on the walls of the tank after the fuel evaporates. This, and the use of high octane gasolines with moisture-absorbing additives, are the best rust preventive measures. Before subsequent use, the tank should be flushed out with gasoline or kerosine.

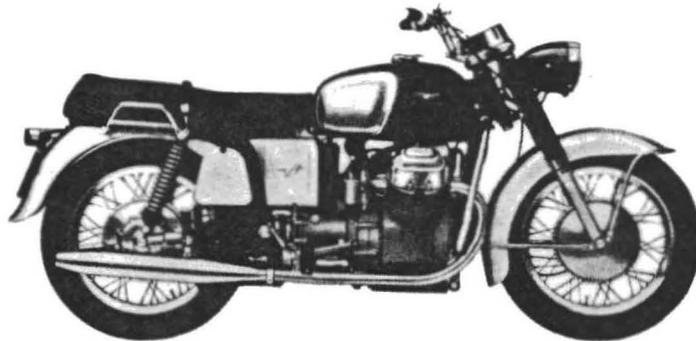
If the tank becomes rusted within, measures must be taken to prevent rust particles from entering the carburetor. Either a series of screens in the petcock or a fuel strainer should be employed. Some of the rust can be removed by removing the tank and inserting some small ball bearings. Shaking the tank will cause the bearings to knock the rust loose and the tank can be flushed clean with gasoline or kerosine and blown dry. Do not use large bearings as they may dent the walls. Before using, make sure that the filter in the petcock is clean, and that the gas cap breather vent is clear.

Tanks may be arc-welded, gas-welded, or soldered to repair leaks. All traces of gasoline and fumes must be removed before this is done because, otherwise, the tank will explode. Any work of this sort should be done by your dealer, unless you are an experienced welder. Epoxy may be used on small cracks in areas which are not under great pressure, but this is more of a temporary measure than a remedy.

Carburetor Specifications

<i>Model</i>	V700	V750 and V850
Standard Carburetor Settings		
Type: (Dell'Orto)		
right side	S.S.I.	VHB 29 CD
left side	S.S.I.	VHB 29 CS
Choke tube diameter	29 mm	29 mm
Throttle slide	80	60
Atomizer	265	265
Main jet	120	145
Pilot jet	55	45
Needle	M14	SV5 / SV9
Float	14 gm	NA
Starter atomizer	NA	80
Idling screw (number of turns off seat)		
right side	1-1½	2-2½ / 1-1½
left side	1-1½	1½-2 / 1¾-2
Needle setting (number of notches from top)	3	2

7 · Electrical System

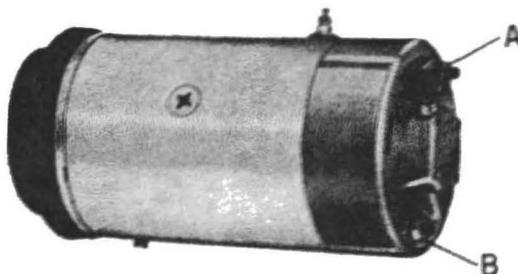


The models covered in this guide have a battery-coil ignition, and are equipped with a starter motor, distributor, and generator.

Charging System

GENERATOR

The models covered in this guide come equipped with a Marelli DN 62 Type N generator which, at 2400 rpm, produces 300 watts at 12 volts. The unit is of the open construction type, has two poles, and operates in conjunction with a separate



Generator terminals

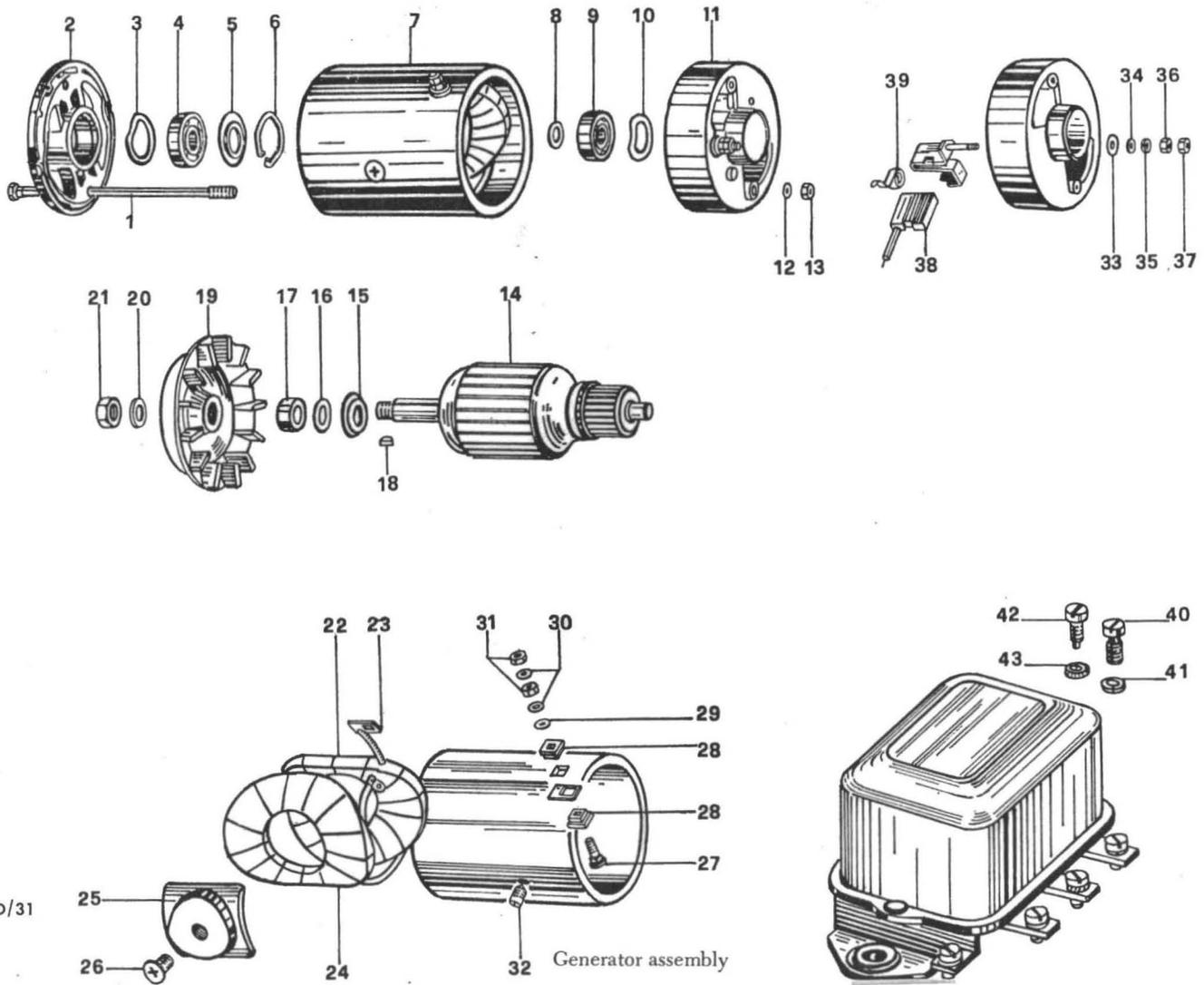
regulator unit. The rotor spins on two permanently lubricated ball bearings which are intended to be maintenance free items. The cover assembly is attached by means of two studs which pass through the unit. There are two terminals D+/51 (A) and DF (B), located on the commutator end of the housing which are used to connect the regulator wiring to the generator. The D+ terminal is connected to the positive brush and the DF terminal is connected to one end of the rotor assembly. When the generator is attached to the regulator, the D+ and DF terminals of both units must be connected.

Operational Description

The generator is belt driven off of the crankshaft and generates current proportionally with the engine rpm. Current is not delivered until the regulator contacts close and then the juice is channeled to the accessories according to their demand, and to the battery according to its state of charge.

The rotation of the rotor through the field coils causes the charge to be generated and the juice is picked up by the brushes for delivery to the terminals.

1. Generator DN 62 M, complete
2. Stud
3. End cover
4. Spring washer
5. Grease retainer
6. Retaining ring bearing
7. Body complete with coils generator
8. Flat washer
9. Ball bearing
10. Washer spring
11. Holder assembly brush
12. Washer spring
13. Fixing nut cover
14. Armature
15. Grease retainer
16. Shim 0.1 mm
Shim 0.2 mm
17. Spacer
18. Woodruff key
19. Pulley with fan
20. Washer spring
21. Securing nut pulley
22. Oil with square terminal feed
23. Cable connector grounding
24. Coil with small terminal field
25. Shoe pole
26. Pole shoe screw
27. Terminal screw DF
28. Insulating block
29. Flat washer
30. Washer spring
31. Terminal nut
32. Dowel locating
33. Washer insulating
34. Flat washer
35. Washer spring
36. Terminal securing nut
37. Terminal end nut
38. Brush
39. Spring brush
IR 50 BA complete regulator
40. Screw for terminals D/61 DF, OF, D/31
41. Washer spring
42. Screw for DF terminal
43. Toothed washer



Generator assembly

Generator Testing Data

FEATURES

Type No.	Rated Voltage	Current A	Direction of Rotation	Operating Speed		Regulator Unit	
	V			min. °	max	Type No.	No. of Cores
DN 62 N	12	25	CW	2400 rpm	10000 rpm	IR 50 BA	3

° at full power

GENERATOR WITHOUT REGULATOR
ELECTRICAL TESTS (AT ROOM
TEMPERATURE OF 20° C; 68° F)

Overall resistance of field winding (CD)	4.6 ± 0.2Ω
Rating of damping resistance (RS)	—
Connection speed with no load (tension 13 V)	1500 RPM
Load rating (tension 13 V, current 23 A)	2300 RPM

TENSION AND INSULATION TESTS

Check dielectric rigidity by feeding for 3 secs. with 50 V, 50 Hz, A.C. Check insulation resistance by feeding with 500 V, D.C.-Resistance value must be over 2 MΩ

MECHANICAL TESTS AND DIMENSIONS

Brush spring load	1000–1100 gms (2.2–2.4 lbs)
I/D of pole shoes after installation	65.7–66.0 mm (2.5865–2.5984 in.)
O/D of rotor	64.9–65.0 mm (2.551–2.559 in.)

NOTE: When carrying out above tests, temporarily disconnect possible groundings.

Generator With Regulator

Regulator	Connection Voltage	Recovery Current	No-load Adjusting Voltage	Loaded Adjusting Voltage	Current Limiter On	Load at Rated Voltage
	V	A	V	V	A	W
IR 50 BA	11.5 ÷ 13	2 ÷ 8	13.8 ÷ 14.4	—	28.5–30.5	300

Troubleshooting the Generating System

The following is the most direct approach to take in locating generating system difficulties:

1. The following items are indicators of a faulty generating system:
 - a. Failure of the generator light to operate.
 - b. Repeated or sudden battery discharging.
 - c. Excessive battery water evaporation indicating an overcharged state.

2. In testing the generating system do not commit the following mistakes which will result in damage to the system:

- a. Do not reverse the generator polarity.
- b. Do not short or ground any wires unless specifically instructed to do so.
- c. Do not operate the engine while the generator output terminal is disconnected.
- d. Always connect positive to positive and the negative to negative when con-

necting a charger or booster to the battery.

e. Keep the generator and regulator units connected.

3. Check for a faulty generator light in the following manner:

a. If the ignition is on and the light remains on, disconnect the generator leads at their terminals. If the light stays on, check for a short between these two leads.

b. If the generator light doesn't go on when the ignition switch is turned on, check for a short between the two leads. If the light still doesn't come on, reverse the two leads. If the light still doesn't come on, check for an open circuit in the following manner:

(A) Connect the two leads of a voltmeter to ground and the DF generator terminal and check for a reading. Go on to the next step if a reading is obtained. No reading indicates an open circuit between the DF terminal and the battery. Correct this, then see if the light goes on when the ignition is turned on.

(B) Either connect or disconnect both generator leads, turn the ignition switch on, and momentarily ground the D+ terminal lead only. If the light does not come on, check for a burned out bulb, blown fuse, faulty bulb socket, or an open condition between the D+ terminal and the ignition switch. Remove the ground from the D+ terminal if the light comes on and, with both terminals connected, ground the generator.

(C) If the light still hasn't come on, check for open circuits between the wiring harness and the No. 1 terminal, generator brushes, slip rings, and field windings.

(D) If the light came on in the first step and there was a voltmeter reading, replace the regulator.

(E) Consult the next section if the light stays on when the motor is running.

4. Locate the reason for an undercharged battery in the following manner:

a. Make sure the reason the battery keeps going down is not because the accessories have been left on without the engine running.

b. Check the drive belt for proper tension.

c. Check the battery for shorting with

a voltmeter or hydrometer indicated by one or more dead cells.

d. Inspect all wiring for loose or poor connections.

e. Connect the leads of a voltmeter from ground to the generator "BAT" terminal, then the no. 1 terminal, then the no. 2 terminal. No reading indicates an open condition between the battery and the voltmeter connection.

5. Check the generator in the following manner if the problem hasn't yet been discovered:

a. Disconnect the battery ground wire, connect an ammeter so the current will pass through it from the generator D+ terminal to the lead which was connected to the D+ terminal, and reconnect the battery ground wire.

b. Turn on all of the accessories and attach a carbon pile across the battery terminals. Operate the engine until the maximum current output is obtained.

c. If the generator is good, amperage output will be within 10 percent of its rated output. Go back and recheck the previous steps.

d. Ground the generator by inserting a screwdriver through the generator test hole if amperage isn't within 10 percent of its normal rating.

e. Recheck with a carbon pile as described above. If the reading is still not within 10 percent, the regulator must be replaced.

f. Recheck with a carbon pile and overhaul the generator if the reading still isn't within 10 percent of its rated amperage.

6. Locate the reason for an overcharged battery in the following manner:

a. Check the state of battery charge with a voltmeter or hydrometer.

b. Connect the leads of a voltmeter to ground and to the generator DF terminal to check for an open reading (zero). The voltage, in any case, should not exceed 12 volts at 0° F. Discrepancies in measurements taken in cold and hot conditions are to be expected.

7. If the above test proves that the circuit is good and excessive water evaporation still indicates an overcharged battery, separate the generator end frames and check the field windings for a shorted condition in the following manner:

a. Connect the leads of an ohmmeter

from the brush lead clip to the end frame and then reverse the connections. The ohmmeter must be set on its lowest range scale.

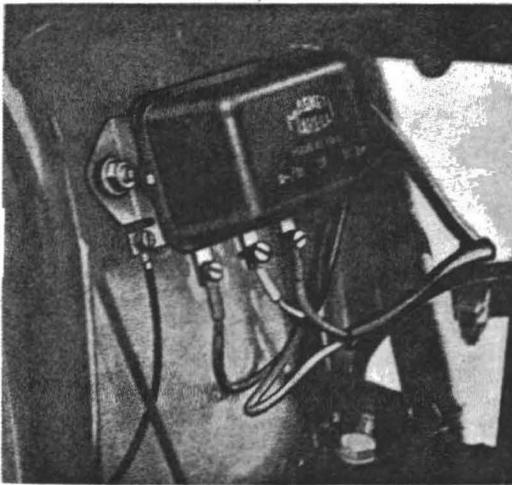
b. If both readings are zero, check for a grounded brush lead. This is probably caused by a missing or damaged insulating washer or insulating screw sleeve.

c. If, after replacing the insulating elements, both readings are still zero, the regulator is defective and must be replaced.

8. Consult the "Troubleshooting" chapter for additional information. If the generator is in need of attention, it should be returned to your dealer or a qualified specialist.

REGULATOR

All of the models covered in this guide use the Marelli IR 50 BA type regulator which is a three coil unit and is mounted to the frame. The unit is not repairable or adjustable and must be replaced if defective.



Mounted regulator

Operational Description

Theoretically simple, the generator is a unit consisting of numerous turns of wire rotating in a magnetic field. The voltage generated increases as the speed of rotation increases, all other factors (such as the strength of the magnetic field) assumed to remain constant. The generator just described will produce a pulsating DC flow.

In motorcycle application, all of the usages of electrical power, including the

lights, spark plugs, etc., draw their energy from the battery. Obviously, some method is necessary to recharge the battery, or it would quickly become dead.

The generator accomplishes this function by imposing the correct voltage across the battery terminals to keep it charged.

As stated earlier, the amount of voltage which the generator puts out is dependent upon how fast it turns; the generator is driven off of the crankshaft and, therefore, the faster the engine speed, the greater the voltage produced.

This of course would be a very crude system were it operable. A kind of metering system is necessary so that the generator delivers precisely the required voltage for the needs of the system. For this purpose, a voltage regulator is used.

The regulator works by varying the strength of the magnetic field in which the generator coils (or armature) turns. By lowering the field strength, the voltage produced by the generator is also lowered, even if it maintains the same rpm.

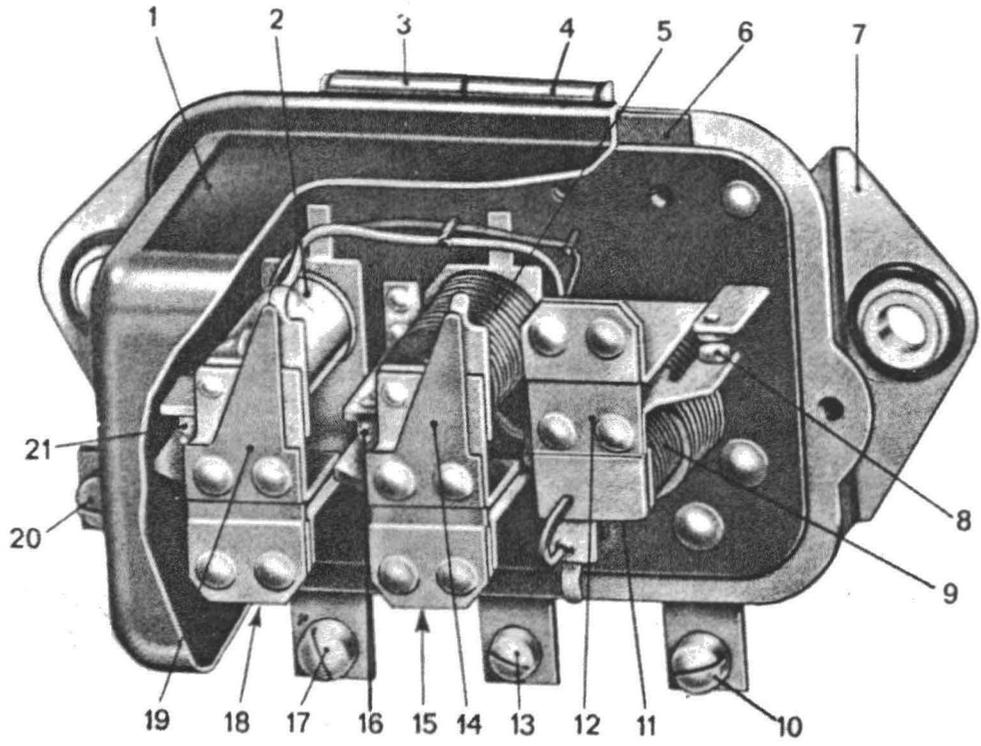
The voltage regulator consists of three elements, each of which has a distinct function to perform.

The operation of the voltage regulator can best be understood by referring to the accompanying diagrams.

Figure (A) describes the operation when the engine is not running or is at a very low idle. All power for the motorcycle's engine and lighting accessories is taken from the battery. No current flows from the voltage regulator to the battery because the Cut Out contacts (CI) are open.

Figure (B) shows the generator just coming into play. CD represents the field coil of the generator. It is actually an electro-magnet and provides the magnetic field necessary for the armature to produce electricity.

Although in theory, current must flow in the field coil before a magnetic field is produced, in actual practice there is a very slight residual magnetism present because the field coil is wound on steel "pole shoes." This residual magnetism is enough to start the generator producing current as soon as it starts to turn. Following the wiring diagram from terminal D+51 through the contacts CR and CL to terminal DF/67, it can be seen that the generator provides its own current to flow through the field coil. By regulating the amount of



Regulator assembly

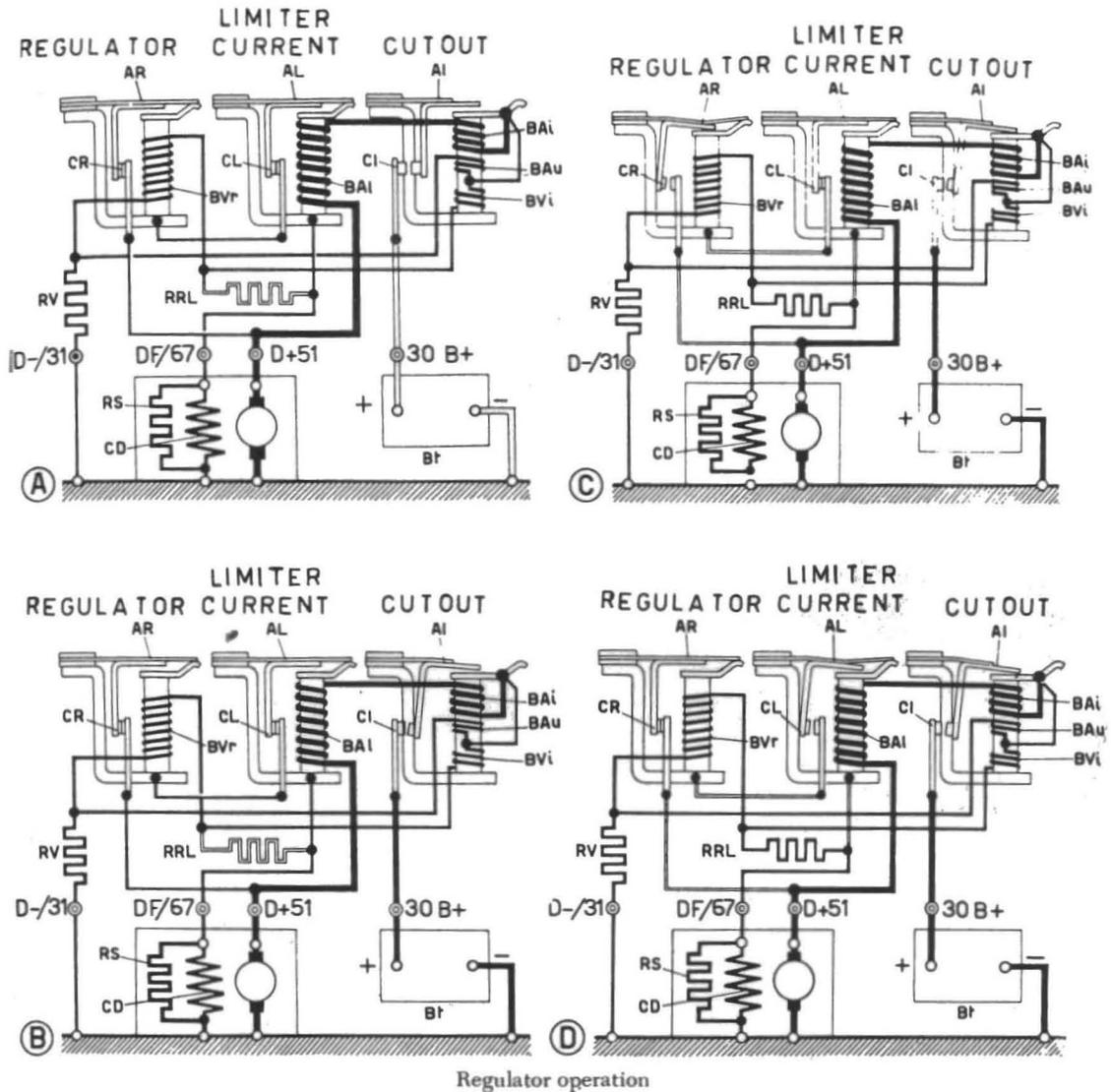
- | | |
|-------------------------------------|-----------------------------------|
| 1. Cover | 12. Circuit breaker keeper |
| 2. Regulator voltage coil | 13. Generator excitation terminal |
| 3. Voltage resistance | 14. Limiter keeper |
| 4. Regulator and limiter resistance | 15. Current limiter |
| 5. Limiter current coil | 16. Limiter contacts |
| 6. Cover gasket | 17. Generator positive terminal |
| 7. Regulator securing flange | 18. Tension regulator |
| 8. Circuit breaker contacts | 19. Regulator keeper |
| 9. Circuit breaker current coil | 20. Negative terminal |
| 10. Battery positive pole terminal | 21. Regulator contacts |
| 11. Circuit breaker | |

voltage drop (and therefore current flow) across CD, the regulator varies the output of the generator.

In Figure (B) again, the Cut Out contacts (CI) have been closed by the strength of the magnetic field created in the cut out coil by the generator output. That is, revs have increased to the point at which the generator is putting out substantial electrical power. Notice that the current will now flow through the contact points to the battery where it will provide the energy necessary to run the engine, lights, etc., without allowing the battery to run down.

As we said before, however, it is possible for the generator to produce too much voltage, which would result in a

burned out electrical system. In Figure (C) we reach a stage at which generator output must be cut down somewhat. Slowing down the rotation of the armature would be the theoretical solution, but it is connected to the crankshaft of a moving motorcycle, so this is impossible. What happens instead involves the Regulator coil. The Cut Out coil has a secondary winding. A current flow is induced in this coil which is dependent upon that in the primary winding of the coil. The current flows through the regulator coil as shown. When the voltage across this coil is of sufficient strength, it opens the Regulator contact (CR), again by electromagnetic attraction. This has the effect of forcing current going to the field coil (CD) to first



Regulator operation

pass through the Resistor RRL. This resistor is connected in series with the field coil as can be seen. There will be a voltage drop across it, which will result in a *decreased* voltage across the field coil. This means that the field strength will be weakened and the output of the generator at the given rpm will be reduced.

The Current Limiter (Figure D) has basically the same function as the Regulator. When the battery is low and there is a sudden demand for power for lights (for example), the generator will try to provide the needed power as fast as possible. This may result in a power surge which will burn it out. The Current Limiter, then, opens at contact CL to engage the resistor RRL and limit generator output.

Ignition System

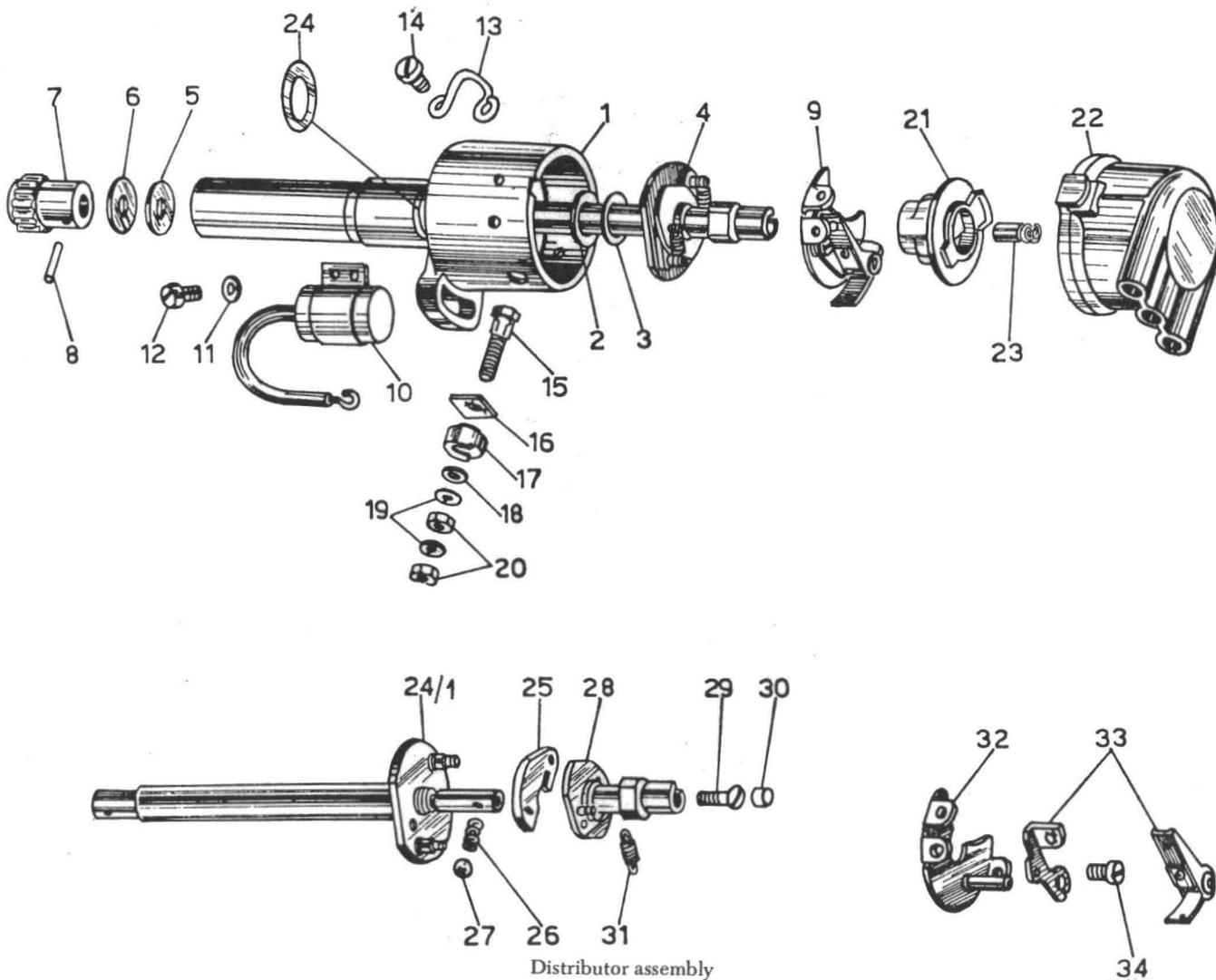
DISTRIBUTOR ASSEMBLY

The models covered in this guide come equipped with a Marelli S123A distributor which houses the automatic spark advance unit, the contact breaker assembly, the condenser, the rotor, and the high voltage distributor cap to which the high tension spark plug leads, and the lead from the ignition coil are attached. The distributor is gear driven directly off of the camshaft.

Automatic Spark Advance

The automatic spark advance is housed in the distributor body and is driven off

- Distributor S 123 A, complete
1. Housings with bushings
 2. Bakelite washer
 3. Flat washer
 4. Automatic advance assembly
 5. Spacer
 6. Shim 0.1 mm
Shim 0.2 mm
Shim 0.5 mm
 7. Driving pinion
 8. Securing peg pinion
 9. Breaker unit, complete contact
 10. Condensor CE 29 D
 11. Spring washer
 12. Condensor fixing screw
 13. Securing spring cap
 14. Spring fixing screw cap
 15. Terminal bolt
 16. Insulating plate
 17. Insulating block
 18. Flat washer
 19. Spring washer
 20. Terminal nut
 21. Distributor rotor
 22. Distributor cap
 23. Carbon brush
 24. Seal
 - 24/1. Shaft
 25. Advance weight
 26. Ball retaining spring
 27. Ball
 28. Cam
 29. Cam retaining screw
 30. Cam felt pad
 31. Weight spring 8 coils
Weight spring 9 coils
 32. Complete plate with pin
 33. Breaker set contact
 34. Point plate fixed screw

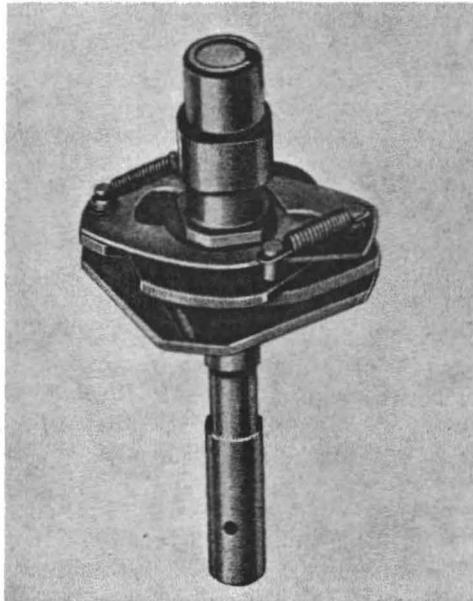


Distributor assembly

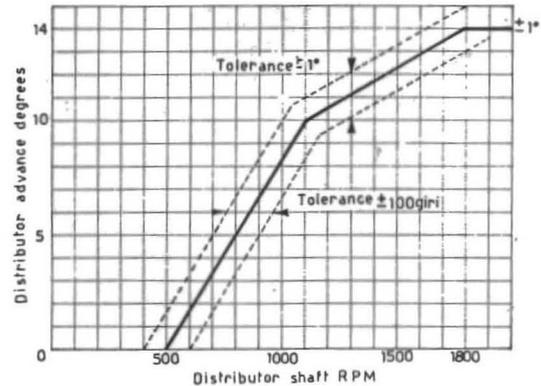
the camshaft. In its rest position, the advance unit provides a slightly retarded spark for easier starting and a smooth idle at low engine rpm. When the engine rpm reaches a certain pre-determined level, the centrifugal weights of the advance unit begin to move as depicted in the accompanying illustration. The degree to which the spark can be advanced (14° is full advance) is determined by pins which slide in grooves whose length is predetermined to allow the spark to be advanced to the most fortuitous number of degrees. The springs which attach the weights to the

cam mounted plate are calibrated to allow the spark to be advanced gradually according to engine rpm.

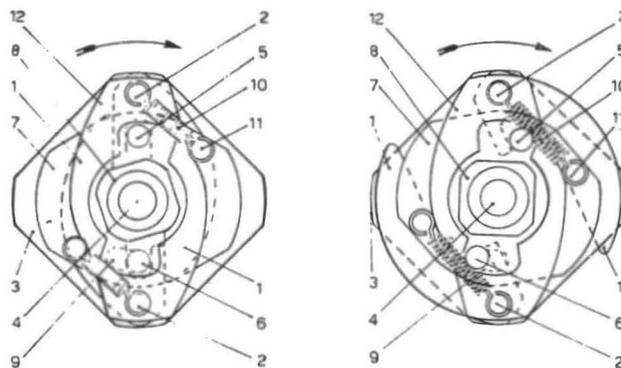
If the advance mechanism is suspected of improper operation, the best way to check it is to static time the engine and then check the timing with a strobe light. Any irregularities should show up immediately. If the felt follower of the contact breaker is not kept properly lubricated, or if the unit is very old, the cam may become worn in which case the entire unit must be replaced. If the advance springs become damaged or stretched out, they may be replaced. Any other damage to the assembly will result in the need for replacement. This provides only as much of an advance as is necessary to perform the job and the use of springs allows the spark to return to a more retarded position as the number of engine rpms drops off.



Advance mechanism



Automatic spark advance diagram

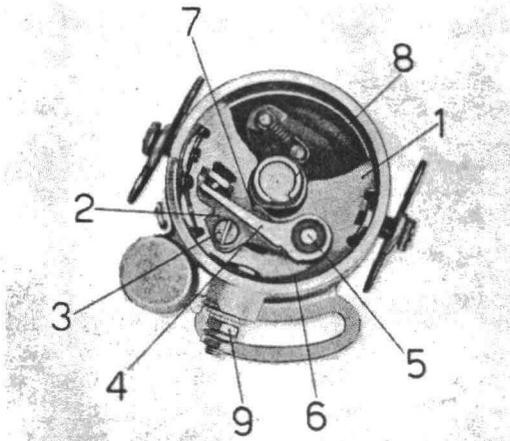


Advance mechanism operation

- | | |
|----------------------------|--------------------------|
| 1. Weight | 7. Plate, solid with cam |
| 2. Stud | 8. Cam |
| 3. Plate, solid with shaft | 9. Plate slot |
| 4. Shaft | 10. Return spring |
| 5. Cam control pin | 11. Spring stud |
| 6. Cam control pin | 12. Lock plate |

Contact Breaker

The contact breaker assembly is comprised of a pair of contact points which are used to interrupt the spark in order to regulate it so that there is spark to the spark plug only when necessary to ignite the fuel mixture. The breaker assembly is mounted on a plate which is situated in the distributor immediately over the advance mechanism. The advance unit cam protrudes through the breaker plate and the felt pad of the movable point arm rides on it so the points are open each time the cam lobe meets the pad. The other point is stationary and is affixed to the fixed contact point holder which is secured directly to the breaker base plate in order to provide a ground for the points.



Contact breaker assembly

1. Plate
2. Fixed contact point holder
3. Point holder securing screw
4. Breaker arm
5. Breaker arm pin
6. Flat spring
7. Felt pad
8. Cam
9. Terminal for connection to coil

Condenser

The condenser is wired in parallel to the contact points and functions as an electrical storage reservoir and prevents arcing across the points. The condenser serves to absorb any current which tries to run back through the system due to an overload situation and feeds it back into the coil. When the points are closed, the current flows straight through them to ground. When the points open, the current is still trying to get through but has no means of

doing so. If not for the condenser it might arc across the points. When the condenser reaches its capacity, it discharges the current back through the primary windings and eventually to the spark plug.

If the contact points become pitted repeatedly and it's not due to dirt or oil on the contact surface, the condenser is probably at fault and must be replaced. The condenser is mounted on the distributor.

Coil

All of the models covered in this guide come equipped with a Marelli BE 200 D ignition coil. A coil consists of two windings: a primary winding which is comprised of thick wire turned a small number of times and the secondary winding made of thinner wire turned a greater number of times. The coil functions to boost the voltage fed to it in order to provide a spark strong enough to jump the spark plug air gap.

If you get a weak or erratic spark at the plug, and you are fairly sure that the rest of the ignition system is in good shape, it may be time to replace the coil. Although these are long-life items they sometimes do go bad. Check for continuity through the coil, a lack of continuity indicates a break in the windings, or install a new one and check for a stronger spark.

Distributor Cap and Rotor

The distributor cap and rotor function together in order to bring juice into the distributor from the coil, and then send it back out to the spark plugs. Both the cap and rotor are made of molded bakelite with metal contacts imbedded in them.

The current comes into the distributor cap through the center lead and is passed to the rotor via a spring loaded carbon brush which is always in contact with the center of the rotor. As the rotor, which is affixed to the cam spindle so it rotates at the same speed as the camshaft, passes the metal contacts in the distributor cap (there is one contact for each of the three leads), the rotor contact comes in contact with the lead contacts and sends spark to the appropriate cylinders. The leads are marked on the distributor cap as to their appropriate cylinders.

The distributor cap and rotor are intended to be long-life items, however they are subject to wear, especially the high

tension leads which rot and tend to leak and the contacts which tend to corrode. Leaky high tension leads are dangerous and rob performance as they fail to deliver a hot enough spark to the plug in severe cases. Check for leaks by lightly running your fingers over the leads and feeling for that tell tale tingle, or run the bike at night and watch for dancing blue sparks. The leads should be replaced as a set. Check the rotor and cap for cracks which might hold moisture and replace them as necessary, preferably as a set.

Spark Plugs

Moto Guzzi recommends the use of either Marelli CW 225 LVT or Bosch W 225 T 2 type spark plugs, however any suitable plug manufactured by another company may be used.

If you ever get stuck for a plug, one popular brand which you can almost always get at an automotive parts house is Champion. The following are the Champion plugs which may be used in Moto Guzzis:

Model	Standard Plug	Gold Palladium Plug
850 cc V-850	N-3	N-3G
750 cc V-750 (½ in. reach)	L-81	L-6G
750 cc V-750 (¾ in. reach)	N-4	N-4G
700 cc V-700 (½ in. reach)	L-81	L-6G
700 cc V-700 (½ in. reach)	N-3	N-3G

For additional information on spark plugs consult the "Tune-Up" chapter.

Battery

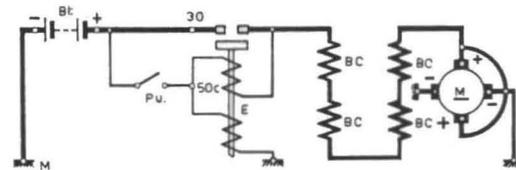
For information on the care and feeding of your battery, consult the "Maintenance" chapter. The following are some useful specifications:

Voltage: 12V
Capacity: 32Ah
Length: 230 mm (9.0551 in.)
Width: 139 mm (5.4724 in.)
Height: 180 mm (7.0866 in.)
Weight (wet): 28.6 lbs.

Starter System

STARTER MOTOR

The models covered in this guide come equipped with a Marelli MT 40 type starter motor which is very similar in construction to the Bendix equipped Delco units found in most American cars. The motor operates on 12 volts, has four poles, rotates in a clockwise direction, and produces 0.7 hp.



Starter wiring diagram

BC. Field coil
Bt. Battery
E. Electromagnet
Pu. Ignition key
M. Ground

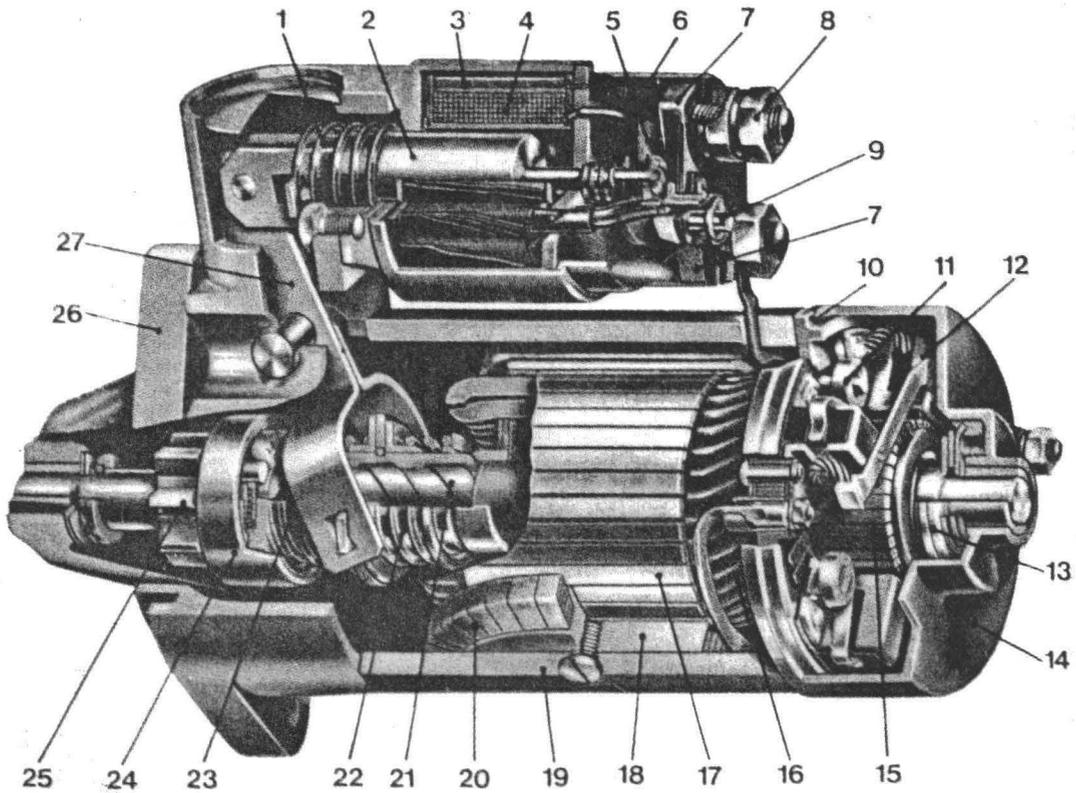
Operational Description

When the ignition is switched on, juice is fed to the starter but the solenoid is not engaged (A). At this point there isn't any current in the starter windings and the pinion gear is free.

When the starter button is pushed (B), the solenoid, which is in effect an electromagnet, is activated and this causes the solenoid to close. The action of the solenoid causes the coupling control lever to shift which brings the pinion gear into contact, but not engagement, with the flywheel ring gear.

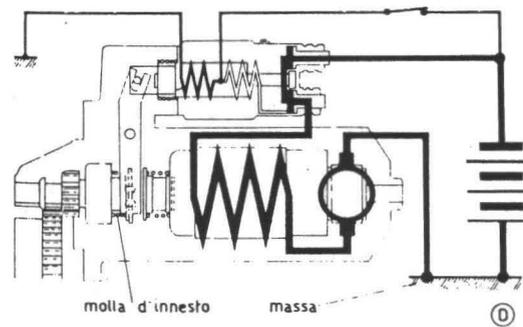
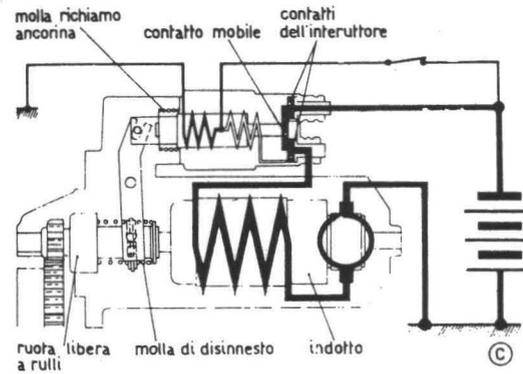
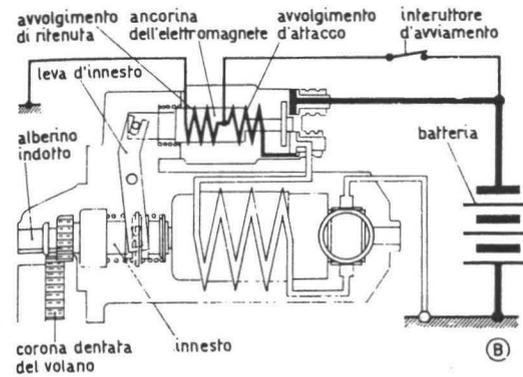
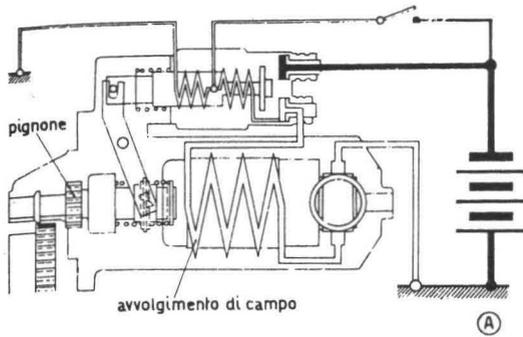
In the next frame (C) we see that the current is in the starter windings and therefore the motor has begun to spin. The centrifugal force brings the pinion into total engagement with the flywheel ring gear and the starter turns over the engine.

Once the engine is running, the flywheel turns at higher revs than the starter motor is capable of. It is at this point (D) that the over-ride provision built into the starter takes over and allows the pinion to disengage itself from the ring gear. You'll notice that the solenoid is still engaged which means the starter button is still depressed. If not for the over-ride system, the



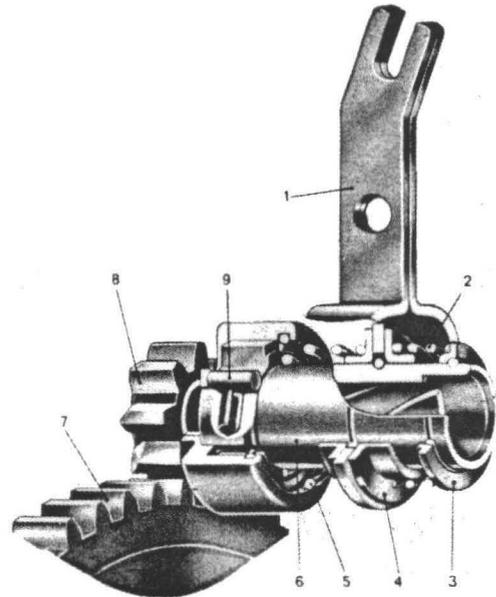
Starter assembly

1. Keeper return spring
2. Solenoid keeper
3. Retaining coil
4. Coupling coil
5. Movable contact
6. Solenoid switch
7. Switch contacts
8. Terminal for connection to battery
9. Terminal for connection to ignition key
10. Brush holder ring
11. Brush spring
12. Brush
13. Disc brake
14. End cover, commutator side
15. Commutator
16. Rotor winding
17. Rotor
18. Pole shoe
19. Casing
20. Field winding
21. Fast pitch thread
22. Release spring
23. Coupling spring
24. Roller freewheel
25. Pinion
26. End cover, pinion side
27. Coupling control lever



Starter operation

starter would be forced to spin past its limits since it hasn't the power to counteract the engine's rotation, and this would cause damage to both the starter and flywheel assemblies. You are supposed to release the starter button as soon as the engine catches, but in the event that you don't, the mechanism jams, or the button is accidentally pressed while the engine is running, you won't damage anything because the pinion will free-wheel.



Cutaway view of the engaging mechanism

- 1. Control lever
- 2. Release spring
- 3. Release spring housing ring
- 4. Sleeve
- 5. Coupling spring
- 6. Coupling hub
- 7. Flywheel ring gear
- 8. Pinion gear
- 9. Roller freewheel

The disc brake device fitted to the brush end of the starter is designed to stop the rotation of the armature shortly after the button is released. This is to prevent damage to the pinion and ring gear teeth in the event that the operator attempts to use the starter again, after failing to start the engine the first time, before the armature has the time to stop of its own accord. With the brake setup, you know the starter isn't spinning any longer.

Starter Motor Repair

The starter assembly is a long-life unit which, under normal operating conditions, should not require attention. If the starter fails, and a solution cannot be found in the appropriate section of the "Trouble-

shooting" chapter, the unit should be removed and returned to your dealer or a qualified specialist for repairs. The following is some useful testing information and specifications which may be of assistance:

Starter Motor Testing Data

FEATURES

Type No.	Rated Voltage	Rated Output	Direction of Rotation	Pinion Gear		Solenoid Switch
	V	HP		No. of Teeth	Module	Type No.
MT 40 H	12	0.7	CW	8	2.5 D.P.	IE 13 DA

ELECTRICAL TESTS

Operating Condition	Voltage V	Current A	RPM	Torque	
				Kg cm	ft lb
No-load	11.6	+25	11000-11500	—	—
Full load	10	+100	3200-3500	0.15	1.08
Short circuit	7	-300	—	0.75	5.42

VOLTAGE AND INSULATION TEST

Check dielectric rigidity by feeding for 3 sec.s with 500 V, 50 Hz, A.C. Check insulation resistance feeding with 100 V, D.C.

Resistance value must be 2 MΩ

NOTE: When carrying out above tests, temporarily disconnect possible ground connections.

MECHANICAL TESTS AND DIMENSIONS

Torque under no load	0.4-0.5 Kg/cm ² (2.89-3.61 ft lb)
Torque necessary for disc brake to stop rotor	2.5-4.0 Kg/cm ² (18-28.9 ft lb)
Diameter of pole shoes	52.6-53.0 mm (2.0708-2.0865 in.)
O/D of rotor	51.9-52.0 mm (2.0468-2.0472 in.)
I/D of bushing, coupling side	10 ^{+0.015} / ₋₀ mm (0.3937 ^{+0.0005} / ₋₀ in.)
I/D of bushing, commutator side	10 ^{+0.015} / ₋₀ mm (0.3937 ^{+0.0005} / ₋₀ in.)

Solenoid Repair

The solenoid is a non-repairable item which must be replaced if defective. The easiest way to determine whether or not the solenoid is operating, is to listen for

the distinctive click it makes when activated. If it doesn't click, it's probably bad and should be replaced. For those of you with a more scientific bent, here are a few interesting bits of data:

SOLENOID SWITCH TEST

Type No.	Absorption	Coupling Voltage	Release Voltage	Load Force		Total Core Travel
	A	V	V	Kg	lbs	
DE 13 DA	27-53	4	1-6 / 0.4-2	15	33.06	9.5 mm (0.374 in.)

Teeth Contact Test

There should remain about 1 mm (0.0394 in.) of coupling lever travel when the tooth faces of the pinion and ring gears come into contact. Therefore, when the switch contacts are completely closed, the coupling spring should have to be compressed one millimeter more before the coils of the spring touch each other. Perform the test by inserting a 1 mm thick feeler between the pinion and ring gears, then push the coupling lever and use a continuity tester to determine if the switch contacts have closed.

Miscellaneous Electrical Information

LIGHTS

The models covered in this guide come equipped with sealed beam headlights which must be replaced if defective. If the lens or seal breaks, the reflector quickly tarnishes and the light output is reduced. Use only replacement units of the same type to make sure that the proper voltage requirements are met. The beam is 168 mm (6.6 in.) in diameter.

The sealed beam unit can be removed by removing the securing screw at the bottom of the headlamp rim, and rotating the unit slightly so that the rim will disengage from the headlamp shell retaining shell. The headlamp can then be disengaged from the spring clip and replaced.

Beam Adjustment

1. Draw a horizontal line on a wall at the height of the center of the light.

2. With the motorcycle on a level surface about 25 feet away, turn the beam on the test line.

3. Have someone sit on the machine, rather than using the center stand, and be sure that the tires have the correct amount of air.

4. The top of the main circle of light produced by the high beam should be even with the test line.

5. Adjust the light for center position so the beam is perpendicular to the line of the handlebar. The light can be adjusted by loosening the bolts which secure the headlight shell to the fork ears. Recheck the adjustment after the securing bolts have been secured.

FUSES

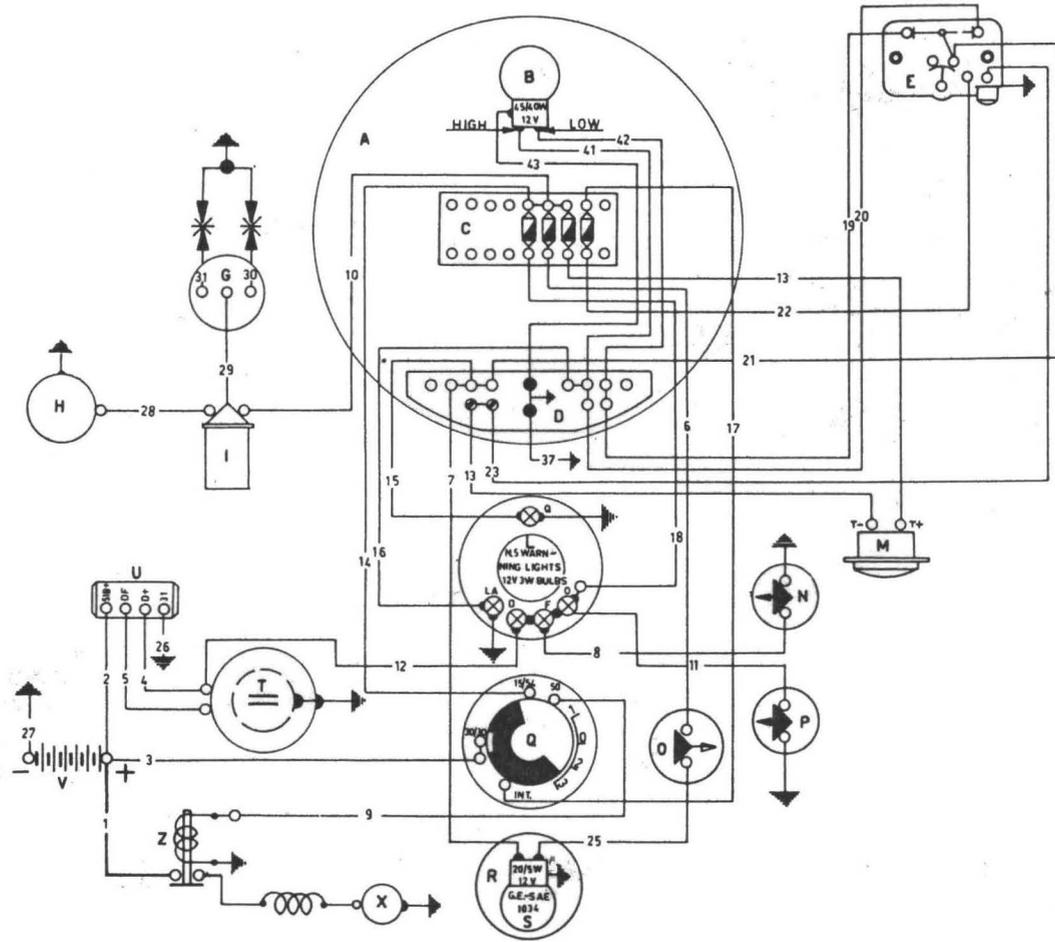
The fuse box is in the headlight shell, and houses four fuses on the standard model and more, depending on the number of accessories, on the police models. Do not indiscriminately replace fuses without attempting to locate the source of the failure. Use the wiring diagram and work back from the fuse box. When working with the fuses it's a good idea to also check the condition of the headlight terminal plate to which the fuse box is attached. Fuses must be replaced with 25 A fuses only.

BULBS

All bulbs used on the models covered in this guide are 12 V. The following list shows their wattage ratings:

Headlight (USA models); 45-40 W (European and Police models)	45-45 W
Tail light (twin filament)	20-5 W
Speedometer (A)	3 W
High beam indicator (B)	3 W
Ammeter (C)	3 W
Neutral indicator (D)	3 W
Oil pressure gauge (E)	3 W

WIRING DIAGRAMS



Wiring diagram (V700 USA model)

KEY TO CABLE COLORS

1. Black: battery V to starter motor relay Z
2. Red: regulator U 51B+ to battery V +
3. Red: battery V to ignition switch Q
4. Grey-red: generator T to regulator U (D+)
5. White: generator T to regulator U (DF)
6. Black: terminal with fuses C to stop cut-out O
7. Yellow: distributing block D to tail light bulb R
8. Green: neutral cut-out N to warning light F on speedometer
9. Brown ignition switch Q (50) to starter relay Z
10. Blue-black: terminal block C to H.T. coil I
11. Grey: oil pressure cut-out P to speedometer L
12. Red: generator T to warning light D on speedometer L
13. Black: distributing block D to horn M (T—)
14. Red: terminal block with fuses C to ignition switch Q
15. White: distributing block D to warning bulb Q in speedometer L
16. Yellow-black: distributing block D to warning light LA on speedometer
17. Brown: terminal block C to ignition switch Q (Int.)
18. White-black: terminal block C to speedometer L
19. Green: distributing block C to light switch E
20. Green-black: distributing block D to light switch E
21. Grey-red: distributing block D to light switch E
22. Brown: terminal block G to light switch E
23. Black: distributing block D to light switch E
25. Black: stop light cut-out O to tail light bulb S
26. Black: regulator U to ground
27. Black: battery V to ground
28. Black: H.T. coil I to contact breaker H
29. Black: H.T. coil I to distributor G
30. Black: distributor G to spark plug F
31. Black: distributor G to spark plug F
37. Black: distributing block D to ground

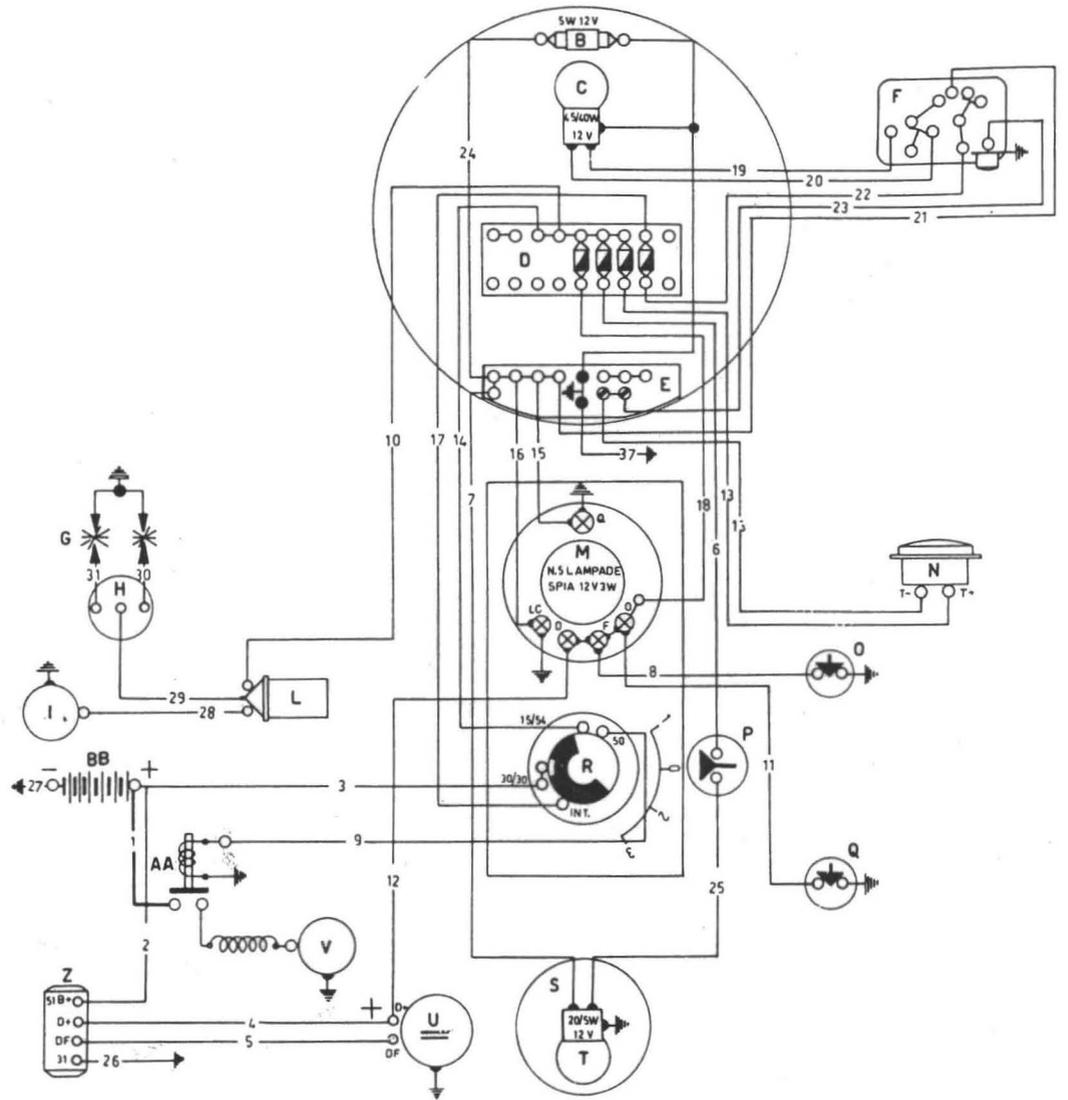
41. Green-black: distributing block D to high beam filament B
42. Green: distributing block D to low beam filament B
43. Black: headlight bulb B to distributing block D

IGNITION SWITCH POSITION

- 0—
 1—30/30 int.
 2—30/20 int. 15/54
 3—30/30 int. 15/54 50

LEGEND

- A Headlight
 B Main light bulb
 C Terminal block with fuses
 D Distributing block
 E Light switch and horn button
 F Spark plug
 G Distributor
 H Contact breaker
 I H.T. coil
 L Speedometer and warning light bulbs
 M Horn
 N Neutral indicator cut-out
 O Stop light cut-out
 P Oil pressure cut-out
 Q Ignition switch
 R Number plate and tail light
 Plate illumination and stop light
 T Generator
 U Regulator
 V Battery
 Z Starter motor relay
 X Starter motor



Wiring diagram (V700 European model)

KEY TO CABLE COLORS

1. Black: battery + to starter motor
2. Red: battery to regulator 51 B +
3. Red: ignition switch 30/30 to battery +
4. Grey-red: regulator to generator D +
5. White: regulator DF to generator DF
6. Black: terminal with fuses to stop cut-out
7. Yellow: distributing block to tail light bulb
8. Green: instrument board F to neutral indicator cut-out
9. Brown: ignition switch to starter motor
10. Blue-black: terminal block to coil
11. Grey: instrument panel O to oil pressure solenoid
12. Red: instrument panel D to generator D +
13. Black: terminal box with fuses to horn
14. Red: ignition switch 15/54 to terminal block
15. White: instrument panel Q to distributing block
16. Yellow-black: instrument panel LC to distributing block E
17. Brown: ignition switch int. to terminal block with fuses
18. White-black: instrument panel D to terminal block with fuses
19. Green: light switch to headlight bulb
20. Green-black: light switch to headlight bulb
21. Grey-red: light switch to distributing block
22. Brown: light switch to terminal with fuses
23. Black: horn button to distributing block
24. Blue: town driving bulb to distributing block
25. Black: stop cut-out to stop bulb
26. Black: regulator to ground
27. Black: battery to ground
28. Black: H.T. coil to contact breaker
29. Black: H.T. coil to distributor
30. Black: distributor to spark plug
31. Black: distributor to spark plug
37. Black: headlight D to ground

IGNITION SWITCH POSITION

- 0—
- 1—30/30 int.
- 2—30/30 int. 15/54
- 3—30/30 int. 15/54 50

KEY TO CABLE COLORS

1. Black: Battery V to starter motor solenoid Z
2. Red: Regulator U 51 B+ to battery V
3. Red: Battery V to ignition switch Q
4. Grey-red: Generator T to regulator U (D+)
5. White: Generator T to regulator U (DF)
6. Black: Terminal with fuses C to stop cut-out O
7. Yellow: Distributing block D to tail light bulb R
8. Green: Neutral cut-out N to warning light DD
9. Brown: Starter button L to starter solenoid Z
- 9/1. Blue-black: Terminal block C to starter button
10. Blue-black: Terminal block C to H.T. coil I
- 10/1. Blue-black: Rev-counter BB (+) to H.T. coil I
11. Grey: Oil pressure cut-out P to oil pressure indicator FF
12. Red: Generator T to warning light EE
13. Black: Distributing block D to horn M (T—)
14. Red: Terminal block C to ignition switch Q (15-54)
15. White: Distributing block D to speedometer AA
16. Yellow-black: Distributing block D to warning light CC
17. Brown: Terminal block C to ignition switch Q (Int.)
18. White-black: Terminal block C to warning light EE
19. Green: Distributing block D to light switch E
20. Green-black: Distributing block D to light switch E
21. Grey-red: Distributing block D to light switch E
22. Brown: Terminal block C to light switch E
23. Black: Distributing block D to light switch E
25. Black: Stop light cut-out O to tail light bulb S
26. Black: Regulator U to ground
27. Black: Battery V to ground
28. Black: H.T. coil I to contact breaker H
29. Black: H.T. coil I to distributor G
- 29/A. Black: H.T. coil I to revcounter BB
30. Black: Distributor G to spark plug F
31. Black: Distributor G to spark plug F
37. Black: Headlight B to ground
- 37/A. Black: Rev-counter BB to ground
- 37/B. Black: Starter motor solenoid Z to neutral indicator N
41. Green-black: Distributing block D to high beam filament B
42. Green: Distributing block D to low beam filament B

43. Black: Headlight bulb B to ground on distributing block D

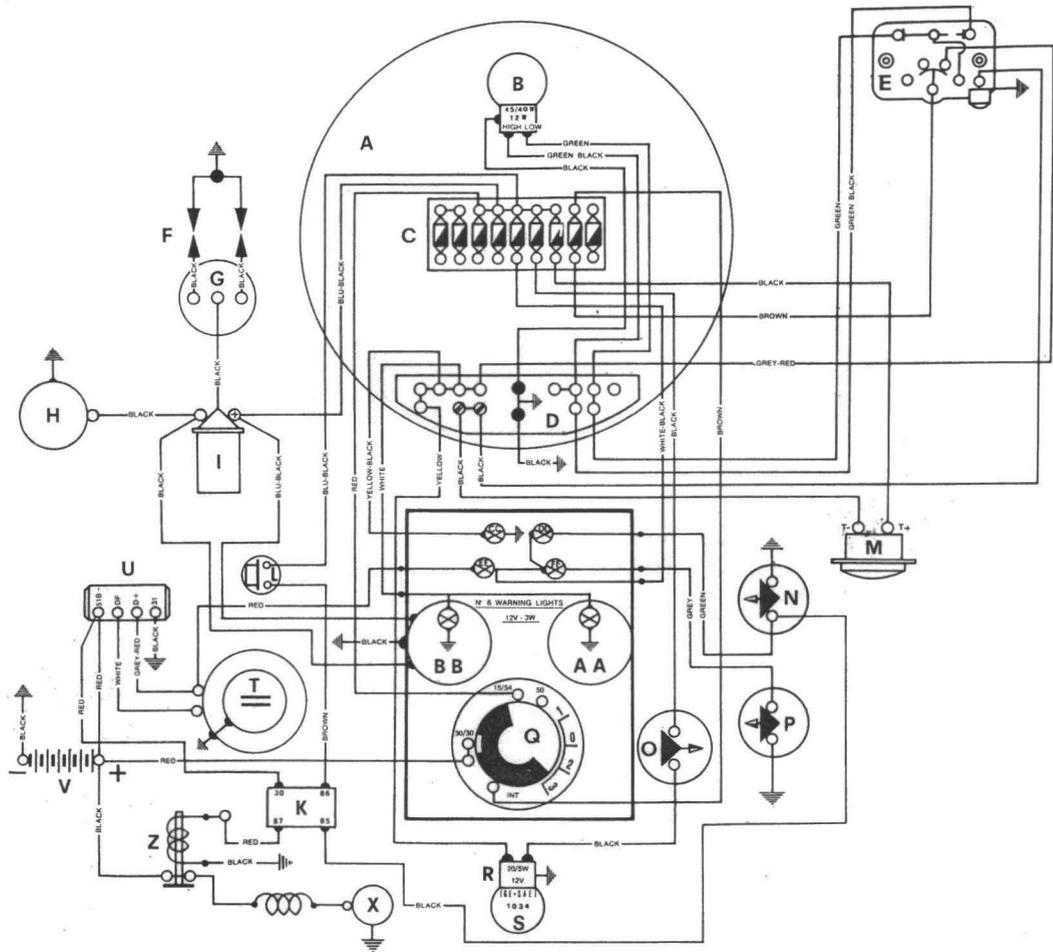
LEGEND

- A Headlight
- B Main driving lights
- C Terminal block with fuses
- D Distributing block
- E Light switch and horn button
- F Spark plugs
- G Distributor
- H Contact breaker
- I H.T. coil
- L Starter button
- M Horn
- N Neutral indicator cut-out
- O Stop light cut-out
- P Oil pressure cut-out
- Q Ignition switch
- R Number plate and tail light
- S Plate illumination and stop light
- T Generator
- U Regulator
- V Battery
- Z Starter motor solenoid
- X Starter motor
- AA Speedometer (with illumination bulb)
- BB Rev-counter (with illumination bulb)
- CC Lights indicator (red)
- DD Neutral indicator (orange)
- EE Generator charge indicator (red)
- FF Oil pressure indicator (red)
- K Relay for starter solenoid

IGNITION SWITCH POSITION

- 0—
- 1—30/30 Int.
- 2—30/30 Int. 15/54
- 3—30/30 int. 15/54 50

Note: Position 3 does not serve on machines with starter button.



Wiring diagram (V750 European model)

KEY TO CABLE COLORS

1. Black: Battery (+) to starter motor
2. Red: Battery to regulator 51 B +
3. Red: Ignition switch 30/30 to battery +
4. Grey-red: Regulator to generator D +
5. White: Regulator DF to generator DF
6. Black: Headlight to stop cut-out
7. Yellow: Headlight terminal to tail light
8. Green: Warning light F to neutral indicator cut-out
9. Brown: Starter button to starter motor solenoid
10. Blue-black: Headlight terminal to H.T. coil
11. Grey: Warning light F to oil pressure cut-out
12. Red: Warning light A to generator
13. Black: Distributing block to horn
14. Red: Ignition key 15/54 to headlight terminal
15. White: Speedometer AA to distributing block
16. Yellow-black: Warning light CC to distributing block
17. Brown: Ignition switch INT to headlight terminal
18. White-black: Warning light FF to headlight terminal
19. Green: Light switch to distributing block
20. Green-black: Light switch to distributing block
21. Grey-red: Light switch to distributing block
22. Brown: Light switch to headlight terminal
23. Black: Horn button to distributing block
24. Black: Horn T+ to headlight terminal
25. Blue: Parking light to distributing block
26. Black: Stop light cut-out to tail bulb
27. Black: Regulator to ground
28. Black: Battery to ground
29. Black: H.T. coil to contact breaker
30. Black: H.T. coil to distributor
31. Black: Distributor to spark plug
32. Black: Distributor to spark plug
33. Black: Headlamp to ground
34. Green: Distributing block to low beam light
35. Green-black: Distributing block to high beam light
36. Black: Headlight bulb to ground
37. Black: Parking light to ground
38. Blue-black: Headlight terminal to button horn
39. Blue-black: H.T. coil + to rev-counter
40. Black: H.T. coil—to rev-counter 1
41. Black: Rev-counter BB to ground
42. Black: Starter motor to ground

LEGEND

- A Headlight
- B Main light bulb
- C Terminal block with fuses
- D Distributing block
- E Light switch and horn button
- F Spark plug
- G Distributor
- H Contact breaker
- I H.T. coil
- L Starter button
- M Horn
- N Neutral indicator cut-out
- O Stop light
- P Oil pressure cut-out
- Q Ignition switch
- R Number plate and tail light
- S Plate illumination
- T Generator
- U Regulator
- V Battery
- Z Starter motor solenoid
- X Starter motor
- AA Speedometer with illumination bulb
- BB Rev-counter
- CC Lights indicator (red)
- DD Neutral indicator (orange)
- EE Charge indicator (red)
- FF Oil pressure indicator (red)
- GG Parking light
- K Relay for starter solenoid

IGNITION SWITCH POSITION

- 0—
- 1—30/30 Int.
- 2—30/30 Int. 15/54
- 3—30/30 Int. 15/54 50

Note: Position 3 does not serve on machines with starter button.

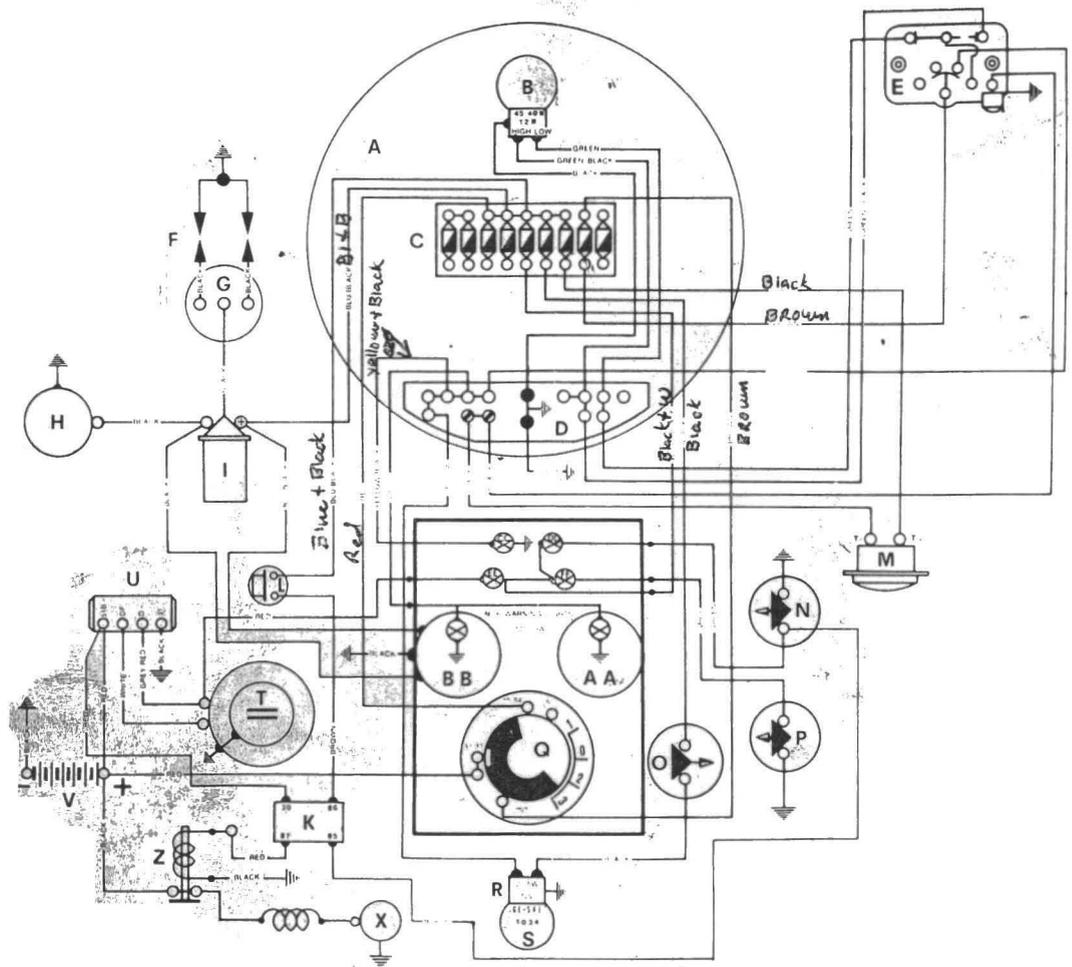
33. Black-yellow: L/H turn indicator 43 to rear block 40
34. Yellow-black: Distributing block 40 to front block 30
35. Yellow: Supplementary light 50 to cut-out 6
36. Blue: Front lateral light switch (red) 31 to front block 13
37. Red: Generator 21 to indicator light 19
38. Black: H.T. coil 28 to contact breaker 27
39. Black: H.T. coil 28 to distributor 26
40. Black: Distributor 26 to plug 29
41. Black: Starter motor relay 24 to starter motor 25
42. Black: Starter motor relay 24 to neutral indicator cut-out 39
43. Yellow: Headlight distributing block 4 to rear distributing block 40
44. Brown: Starter relay 24 to start button 33
45. Yellow: L/H rear light 45 to rear block 40
46. Blue-black: Rear amber flasher 43 to rear distributing block 40
47. Yellow: Number plate and stop light 41 to rear block 40
48. Black: Number plate and stop light 41 to rear block 40
49. Yellow: R/H rear flasher 42 to rear block 40
50. Yellow: R/H rear blue light 44 to rear block 40
51. Yellow: R/H rear block 40 to front distributing block 13
52. Blue-black: Rear distributing block 40 to front distributing block 13
53. Green: Neutral indicator cut-out 39 to amber indicator 18
54. Blue: Front distributing block 13 to red warning lamp for front red light 8
55. Blue: Front distributing block 13 to R/H red front light 46
56. Blue-black: Front distributing block 13 to amber rear-light cut-out 35
57. Yellow: Front distributing block 13 to turn signal 32
58. Yellow: Front distributing block 13 to green warning lamp for R/H flasher 11
59. Yellow-black: Front distributing block 13 to green warning light 18
60. Yellow-black: Front distributing block 13 to turn signal lamp switch 32
61. Black-white: Rear amber cut-out 35 to cut-out 7
62. Black: Rear block 40 to stop light cut-out 37
63. Blue-black: Rear light amber flasher 42 to rear block 40
64. Yellow-black: Front distributing block 13 to amber turn indicator bulb 49
65. Blue-black: Front block 13 to blue warning light 9
5. Fuse for horn and additional light
6. Cut-out for additional light
7. Cut-out for rear amber flashers
8. Red warning lamp for front red lights (bulb 3W—12V)
9. Blue warning light for amber rear lamps (bulb 3W—12V)
10. Green warning lamp for L/H flasher (bulb 3W—12V)
11. Green warning lamp for R/H flasher (bulb 3W—12V)
12. Instrument panel
13. Front distributing block
14. Mile speedometer
15. Speedometer illumination lamp (3W—12V)
16. Red warning light for high beam (bulb 3W—12V)
17. Red oil pressure indicator (bulb 3W—12V)
18. Amber neutral indicator lamp (bulb 3W—12V)
19. Red indicator light for insufficient battery charge
20. Ignition switch
21. Generator
22. Regulator
23. Battery
24. Starter motor relay
25. Starter motor
26. Distributor
27. Contact breaker
28. H.T. coil
29. Spark plug
30. Light switch and horn button
31. Front side red lights switch
32. Turn signal flashing lamps switch
33. Start button
34. Turn flashers cut-out (28W—12V)
35. Amber rear lights cut-out (40W—12V)
36. Horn
37. Stop light cut-out, rear brake
38. Oil pressure solenoid
39. Neutral indicator cut-out
40. Rear distributing block
41. Number plate and stop light (5/20W—12V)
42. R/H rear light amber flasher (bulb 5/20W—12V)
43. L/H rear light amber flasher (bulb 5/20W—12V)
44. R/H rear light, blue (bulb 5W—12V)
45. L/H rear light, blue (bulb 5W—12V)
46. R/H red front light (bulb 15W—12V)
47. L/H red front light (bulb 15W—12V)
48. R/H amber turn indicator (bulb 15W—12V)
49. L/H amber turn indicator (bulb 15W—12V)
50. Additional light for police duties
51. Stop light cut-out, front brake

LEGEND

1. Headlight
2. High and low beam lamp (45/40W—12V)
3. Terminal block with fuses
4. Distribution block in headlight

IGNITION SWITCH POSITION

- 0—
 1—30/30 Int.
 2—30/30 Int. 15/54
 3—Not applicable for systems incorporating starter button.



Wiring diagram (V850 Eldorado model)

LEGEND

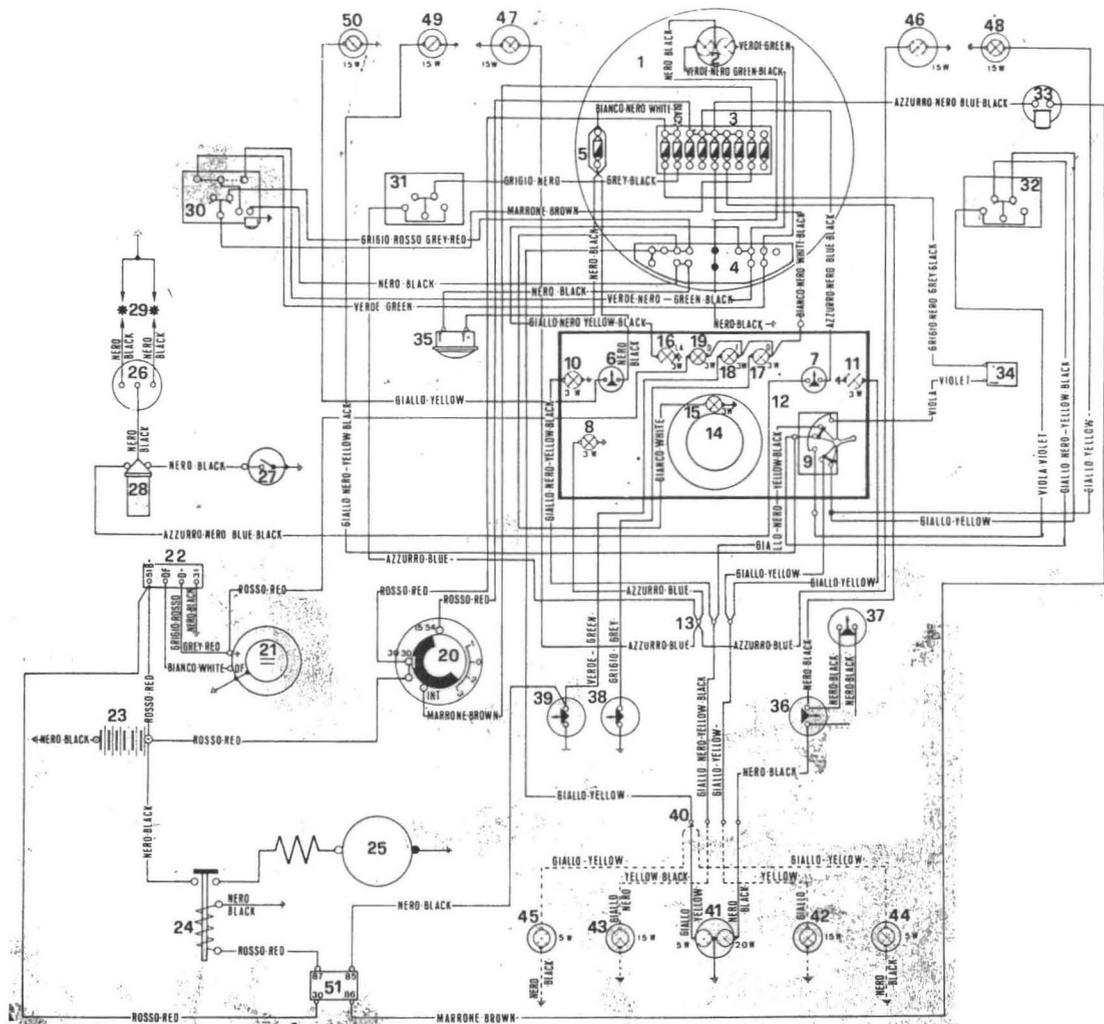
- A Headlight
- B Main driving lights
- C Terminal block with fuses
- D Distributing block
- E Light switch and horn button
- F Spark plugs
- G Distributor
- H Contact breaker
- I H.T. coil
- L Starter button
- M Horn
- N Neutral indicator cut-out
- O Stop light cut-out
- P Oil pressure cut-out
- Q Ignition switch
- R Number plate and tail light
- S Plate illumination and stop light
- T Generator

- U Regulator
- V Battery
- Z Starter motor solenoid
- X Starter motor
- AA Speedometer (with illumination bulb)
- BB Rev-counter (with illumination bulb)
- CC Lights on indicator (red)
- DD Neutral indicator (orange)
- EE Generator charge (red)
- FF Oil pressure indicator (red)
- K Relay for starter solenoid

IGNITION SWITCH POSITION

- 0—
- 1—30/30 Int.
- 2—30/30 Int. 15/54
- 3—30/30 Int. 15/54 50

Note: Position 3 does not serve on machines with starter button.

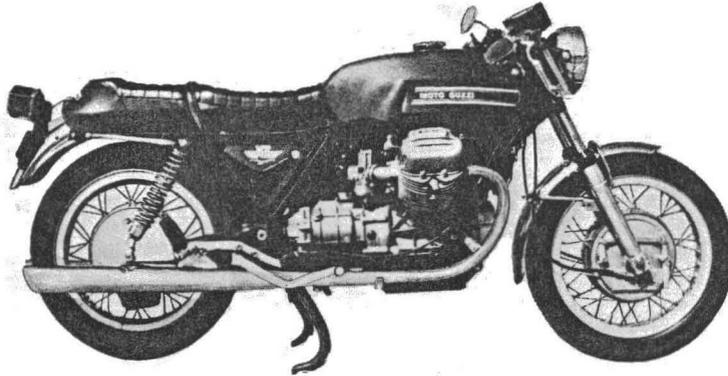


Wiring diagram (V850 Police model)

LEGEND

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Headlight 2. High and low beam bulb (45/40W—12V) 3. Terminal block with fuses 4. Distributing block in headlight 5. Horn fuse 6. Courtesy light cut-out 7. Coil disconnection cut-out 8. Red warning light, front red lights on 9. Turn lights and rear flashing lights switch 10. Green warning light, L/H turn light on (3W—12V bulb) 11. Green warning light, R/H turn light on (3W—12V bulb) 12. Instrument panel 13. Shunting connection, front 14. Mile speedometer 15. Bulb, speed: illumination (3W—12V) 16. Red warning light, high light on (3W—12V bulb) 17. Red warning light, oil pressure (3W—12V bulb) 18. Orange warning light, neutral indicator (3W—12V bulb) 19. Red warning light, generator charge (3W—12V) 20. Ignition switch 21. Generator 22. Voltage regulator 23. Battery 24. Starter motor relay | <ol style="list-style-type: none"> 25. Starter motor 26. Distributor 27. Contact breaker 28. Coil 29. Spark plug 30. Light switch and horn button 31. Ground switch for relay 32. Turn lights, front red lights, and radio control switch 33. Starter button 34. Flasher unit for turn lights, and rear lights 35. Horn 36. Rear brake stop cut-out 37. Front brake stop cut-out 38. Oil pressure hydraulic cut-out 39. Neutral indicator cut-out 40. Rear shunting connections 41. Plate and stop light (5/21W—12V bulb) 42. Rear orange flashing light (21W—12V bulb), R/H 43. Rear orange flashing light, L/H (21W—12V bulb) 44. Rear R/H blue light (5W—12V bulb) 45. Rear L/H blue light (5W—12V bulb) 46. Front R/H red light (21W—12V bulb) 47. Front L/H red light (21W—12V bulb) 48. Front R/H turn light indicator (orange) (15W—12V bulb) 49. Front L/H orange turn light indicator (15W—12V bulb) 50. Supplementary light 51. Starter motor solenoid relay |
|--|---|

8 • Chassis



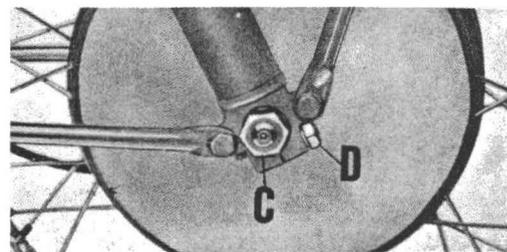
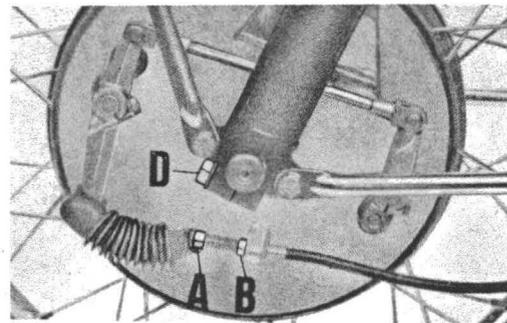
All of the Moto Guzzi models covered in this guide, with the exception of the V750 Sport, use the same chassis, forks, wheels, and brakes. The Sport comes equipped with the double leading shoe front brake used on the other models mounted on its rear wheel, and has a dual double leading shoe brake as its front brake. In addition to this, the Sport frame and suspension components are unique in comparison to those found on the touring models.

Wheels

REMOVAL AND INSTALLATION

Front Wheel

1. Block up the machine so the front wheel remains raised off the ground.
2. Disconnect the front brake cable (A) from the brake actuating lever. This can be easily accomplished by applying the brake and stopping the lever from returning to its seat, thus causing an excessive amount of slack in the cable. Remove the cable adjuster (B).
3. Remove the axle nut (C) and both axle pinch bolts (D), then remove the axle, taking care not to score it, by gently pressing it out through the left hand side.
4. Gently push the wheel down far enough to disengage the brake backing



Front wheel mounting points

plate from its anchoring lug on the left hand slider, then remove the wheel.

5. Installation is done in the following manner:

- a. Position the wheel assembly between the sliders, making sure that the brake backing plate is anchored to the lug on the left hand fork slider.
- b. Install the axle from the left hand side, working it gently through until it meets its seat.

c. Secure the slider pinch bolts and the axle nut.

d. Screw the cable adjuster into its seat on the backing plate, secure the cable to the lever, and adjust the brake as described in the "Maintenance" chapter.

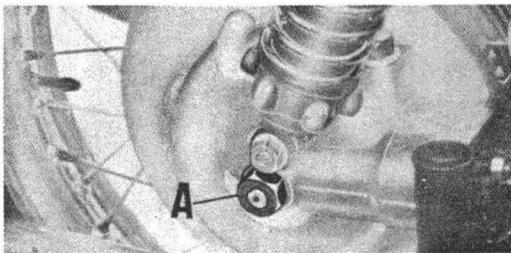
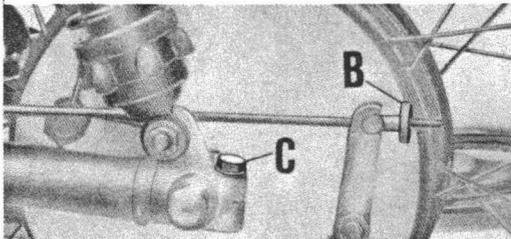
Rear Wheel

1. Wheel removal can be greatly facilitated by blocking up the rear wheel sufficiently so the wheel can be removed without having to lay the bike over on its side. If this is impractical don't hesitate to lay it over, but not yet.

2. Remove the axle nut (A) which secures the axle in the drive box.

3. Remove the nut which secures the brake backing plate to the anchoring lug.

4. Remove the rear brake adjusting thumb screw (B). This is easily accomplished by applying the brake, blocking the actuating lever from returning to its seat by prying with a screwdriver at the pinch bolt (C), and then removing the thumb screw.



Rear wheel mounting points

5. Remove the pinch bolt (C) which locks the axle to the swing arm and carefully remove the axle while taking care not to score it.

6. Press the wheel to the left enough to disengage it from the internally toothed sleeve in the drive box.

7. If you haven't got the rear wheel blocked up, carefully tilt or lay the machine over to its right hand side and remove the wheel from the machine.

NOTE: *The gas tank and battery should be removed before the machine is laid down.*

8. Installation is done in the following manner:

a. With the machine tilted over on its right hand side, carefully insert the wheel so the central body teeth engage the teeth of the drive box sleeve.

b. Place the brake control rod in the actuating lever, then install the positioning pin and secure the thumb screw.

c. Carefully install the axle from the left hand side until it reaches its seat.

d. Secure the anchor rod to the backing plate, then secure the axle setting bolt.

e. Secure the axle nut and adjust the brake as described in the "Maintenance" chapter.

Wheel Hubs and Brakes

DISASSEMBLY

Front Wheel

1. Remove the wheel assembly as described in the previous section.

2. Remove the brake backing plate.

3. Remove the bolts which secure the actuating lever to the cam, then remove the levers and rod from the backing plate.

4. Remove the brake shoes, cams, and brake shoe pins.

5. Remove the seal ring, bearing housing, taper roller bearing, adjusting washers, and distance collar from the left hand backing plate.

6. Remove the seal ring, bearing housing, and roller bearing from the right hand backing plate.

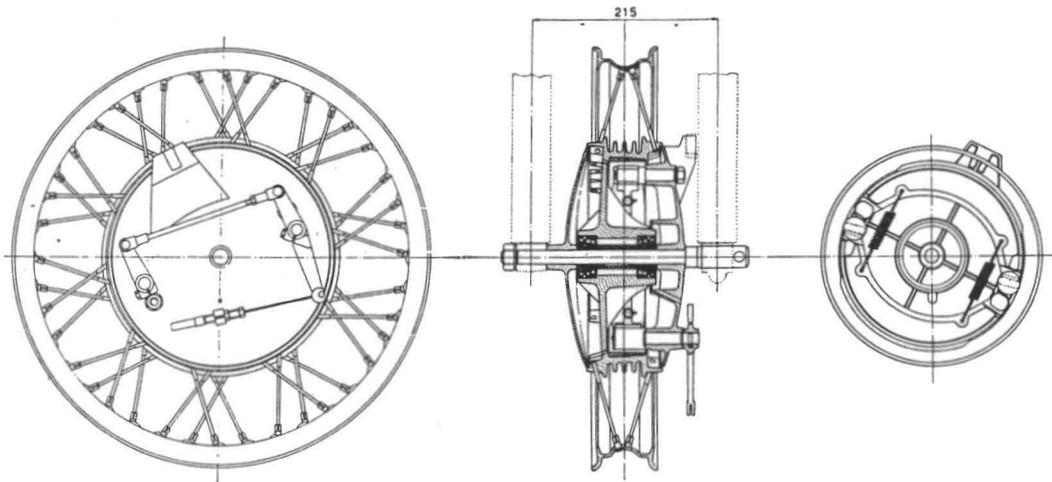
Rear Wheel

1. Remove the wheel assembly as described in the "Rear Wheel Removal and Installation" section.

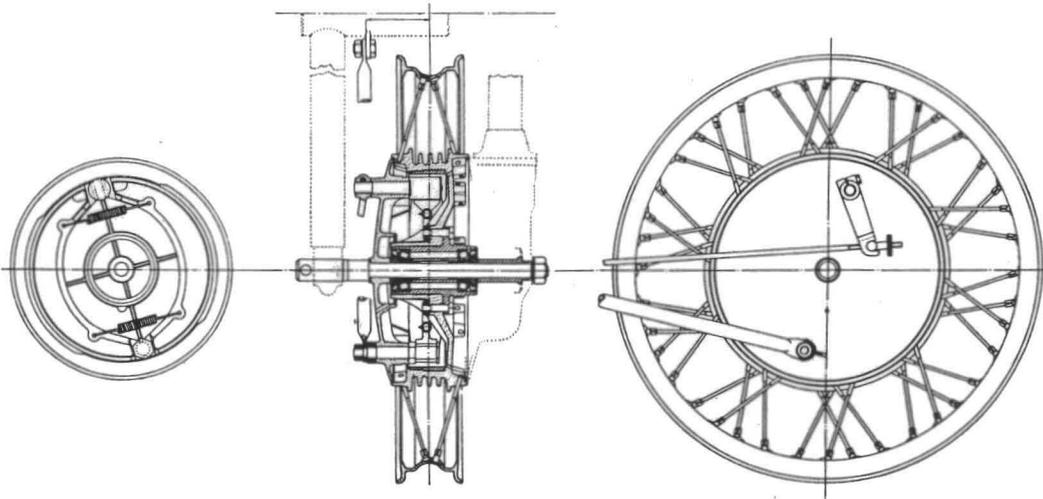
2. Remove the brake backing plate.

3. Remove the bolt and nut which secure the lever to the cam on the shoe pin, then remove the shoes, cam, and shoe pin.

4. Remove the seal ring, bearing housing, taper roller bearing, adjusting washers, and the bearing spacer from the left hand cover.



Front hub cross section



Rear hub cross section

5. Remove the seal ring, bearing housing, and taper roller bearing from the right hand cover.

6. Remove the six central body securing bolts, then separate the body and hub.

INSPECTION AND REPAIR

Both Wheels

1. Inspect the wheel rims and spokes for damage or an out-of-true condition and consult the "Wheel Truing" section for additional information if necessary.

2. Clean all parts in a suitable solvent, except for the brake shoe linings, and blow them dry.

3. Examine the linings and shoes for signs of damage, such as cracks or excessive wear, and replace them as necessary.

If the linings are grease impregnated, cracked, or worn beyond their serviceable limit of 2.5 mm (0.984 in.), they must be replaced. Glazing or a slightly greasy surface can be remedied by soaking in gasoline and brushing with a wire brush. When removing glazing it is not necessary to go deep; go only as deep as is necessary to remove surface glazing.

4. Inspect the brake shoe springs for a collapsed, fatigued, or otherwise damaged condition and replace them as necessary. The front springs, under a load of 46.2 lbs and the rear springs under a load of 132.2 lbs, with a 5% load variation, must extend to 98 mm (3.8583 in.). If measuring devices are not available, compare the springs to a new set and replace them if their condition seems questionable.

5. Examine the brake shoe cams for shiny wear spots, scoring, pitting, or damage to the lobe, stem, or splines and replace them as necessary.

6. Examine the brake shoe pins for scoring or an otherwise damaged condition at both the contact surface and at the threads, and replace them as necessary.

7. Inspect the hub seals for burrs, cracks, stiffness, or damage and replace them as necessary. It's not a bad idea to replace them as a matter of course since you've got them out, but that's up to you.

8. Inspect the roller bearing housings for scoring, wear, or damage, especially to the surface on which the bearing is pressed, and make sure that the contact ends are not damaged. Replace them as necessary.

9. Inspect the roller bearing outer raceway for the inner ring, and the inner raceway for the outer ring, for signs of wear, scoring, pitting or any other damage that might mar the smooth and glossy surface of the races. Balls and rollers must be perfectly smooth all over their surface and their motion within the races must be smooth and free; however **DO NOT SPIN-DRY BEARINGS**. Bearings must be replaced as a complete assembly as repaired bearings will not provide satisfactory operation.

When installing bearings, press only on the ring which is going to be coupled with the housing or shaft, and check to make sure that the bearing will spin freely, with some backlash, after it is installed.

10. Examine the adjusting washers for warpage or damage to their faces and replace them as necessary.

11. Inspect the brake cam actuating levers for damage, especially to the splines, and replace them as necessary.

12. Inspect the brake drums for a smooth surface along the brake swept area. If slightly scored, the area can be cleaned up with emery cloth; but if the scoring is deep, or if the drum is out of round, it should be taken to your dealer, or a qualified machinist, to be turned down. On front wheel drums, make sure that the bearing housings are smooth and clean.

13. Examine the rear wheel central body for damage to the teeth and bearing housings and replace it as necessary. The edges of the teeth should be clean and free

of chipping or scoring and the housings should be smooth.

14. At this time you may wish to check the front brake cable for signs of wear or damage to either the cable or sheath. If the cable has even one or two frayed strands, it should be replaced.

ASSEMBLY

Front Wheel

1. Assemble the taper roller bearing, bearing housing, and seal ring to the right side backing plate.

2. Assemble the bearing distance collar, adjusting washers, taper roller bearing, bearing housing, and seal ring to the left-hand backing plate.

3. Check for excessive end play and alleviate it if necessary by removing one adjusting washer. If the wheel does not rotate freely, it will be necessary to add washers until the desired results are obtained.

4. Mount the brake shoes, cams, shoe pins, levers, and rod to the backing plate and install the assembly. If rod play is excessive, disconnect the rod from the double acting lever, undo the adjusting nut, adjust the fork on the rod enough to just take up the play, then secure the nut and connect the rod fork to the lever by using the pin and cotter pin.

5. Mount the wheel and adjust the front brake. The wheel should spin freely and bearing side play should remain minimal.

Rear Wheel

1. Secure the central body to the hub using its six mounting nuts, washers, and bolts.

2. Assemble the taper roller bearing, bearing housing, and seal ring to the left side backing plate.

3. Check for excessive end play and alleviate it if necessary by removing one adjusting washer. If the wheel does not rotate freely, it will be necessary to add washers until the desired results are obtained.

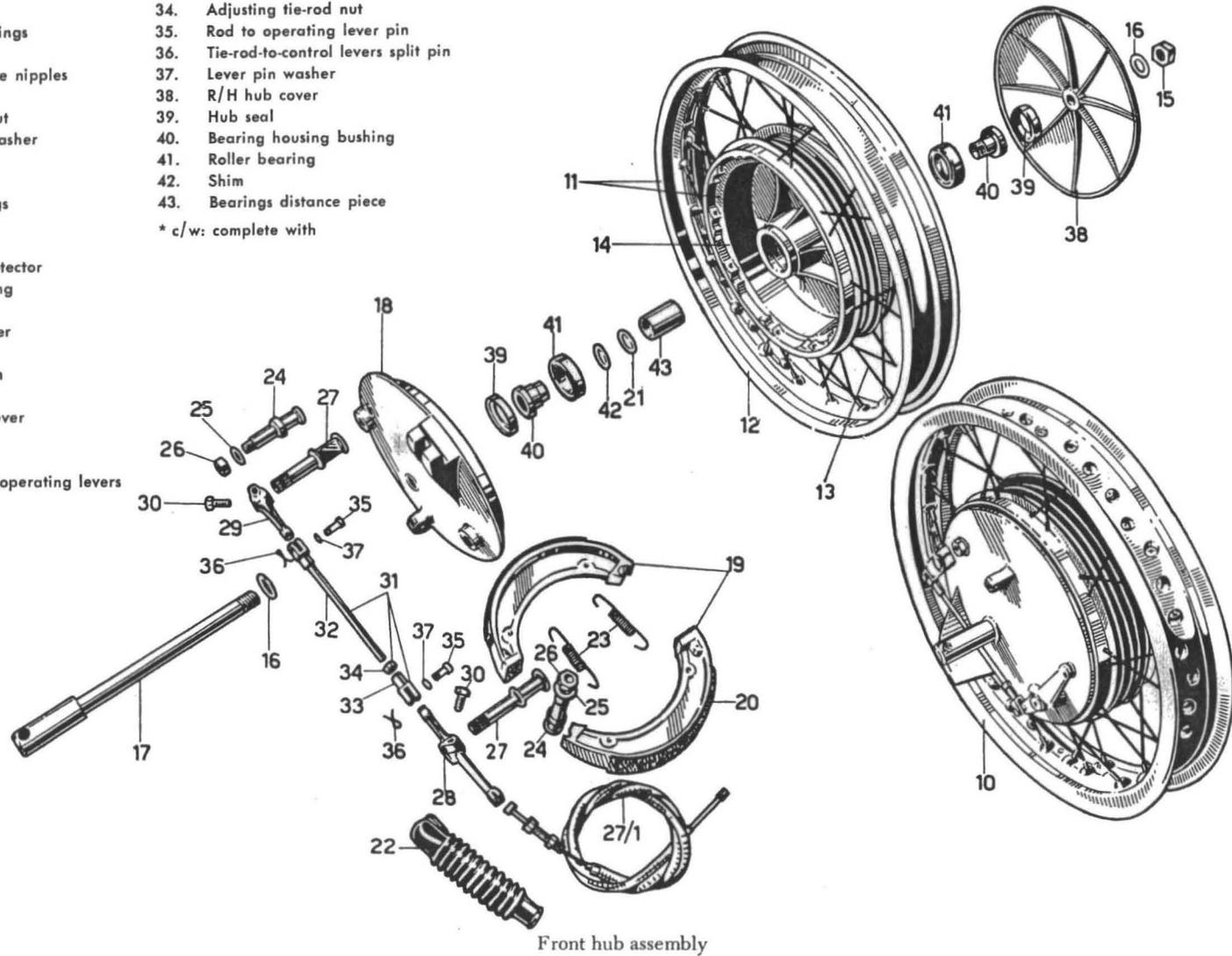
4. Mount the shoe pin, cam, and shoes to the backing plate, then install the assembly on the wheel.

5. Install the wheel and adjust the back brake. The wheel should spin freely and bearing side play should be minimal.

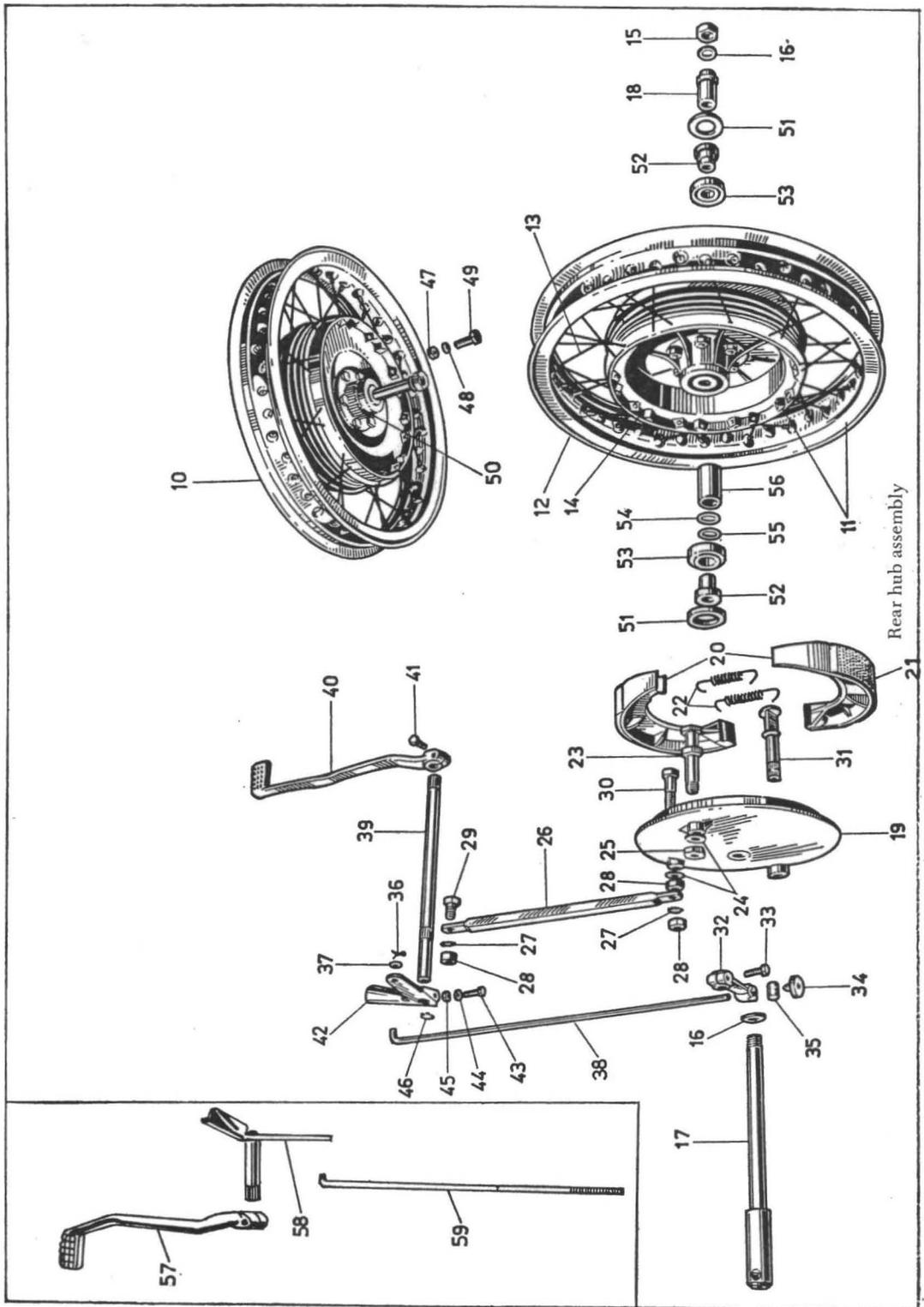
- 10. Complete front wheel
- 11. Front wheel with bearings
- 12. Front wheel rim
- 13.* Front wheel, c/w spoke nipples
- 14. Front wheel hub
- 15. Front wheel spindle nut
- 16. Front wheel spindle washer
- 17. Front wheel spindle
- 18. Rear hub cover
- 19. Brake shoe, c/w linings
- 20. Brake shoe lining
- 21. Shim
- 22. Cable end rubber protector
- 23. Front brake shoe spring
- 24. Brake shoes pin
- 25. Brake shoe pins washer
- 26. Brake shoe pins nut
- 27. Front brake shoes cam
- 27/1. Front brake cable
- 28. Cam, double action lever
- 29. Brake cam lever
- 30. Lever-to-cams bolt
- 31. Tie-rod c/w forks for operating levers
- 32. Tie-rod
- 33. Tie-rod fork

- 34. Adjusting tie-rod nut
- 35. Rod to operating lever pin
- 36. Tie-rod-to-control levers split pin
- 37. Lever pin washer
- 38. R/H hub cover
- 39. Hub seal
- 40. Bearing housing bushing
- 41. Roller bearing
- 42. Shim
- 43. Bearings distance piece

* c/w: complete with



Front hub assembly



- | | |
|-------------------------------|---|
| 10. Complete rear wheel | 18. Rear wheel spindle spacer |
| 11.* Rear wheel c/w bearings | 19. Rear hub cover |
| 12. Rear wheel rim | 20. Rear brake, c/w linings and plates shoe |
| 13. Rear wheel spoke | 21. Rear brake shoes lining |
| 14. Rear wheel hub | 22. Rear brake shoes spring |
| 15. Rear wheel spindle nut | 23. Rear brake shoes pin |
| 16. Rear wheel spindle washer | 24. Rear brake shoes washer |
| 17. Rear wheel spindle | 25. Shoe pin nut |

26. Rear hub cover tie-rod
27. Rear hub cover rod washer
28. Rear hub cover rod nut
29. Tie-rod securing to rear fork screw
30. Hub cover securing screw
31. Rear shoes control cam
32. Cam operating lever
33. Lever-to-cam screw
34. Rear brake adjusting rod thumb screw
35. Lever on rear hub cover roller
36. Tie-rod to shoe split pin
37. Tie-rod to lever washer
38. Rear brake control tie-rod
39. C/W lever spindle
40. Rear brake control lever
41. Rear brake lever-to-spindle screw
42. Rear brake spindle lever
43. Lever to spindle screw
44. Lever securing screw washer
45. Lever securing screw to pin nut

46. Pin retaining circlip
47. Central body securing bolt nut
48. Central body bolt washer
49. Central body securing bolt
50. Central body
51. Seal
52. Taper roller bearing housing
53. Taper roller, hub bearing
54. Bearing-spacer washer
55. Washer
56. Hub bearings spacer

FOR MACHINES WITH REAR BRAKE PEDAL
ON L/H SIDE:

57. Rear brake lever
58. Spindle c/w lever
59. Rear brake tie-rod

* c/w: complete with

Wheel Truing and Balancing

Wheel truing is easy once you've done it a couple of times, but you can do a pretty accurate job on your first attempt if you take the time to do it right. Before you start you should check the rim for damage, and have it straightened if necessary, and replace any spokes or spoke nipples which look to be in questionable shape.

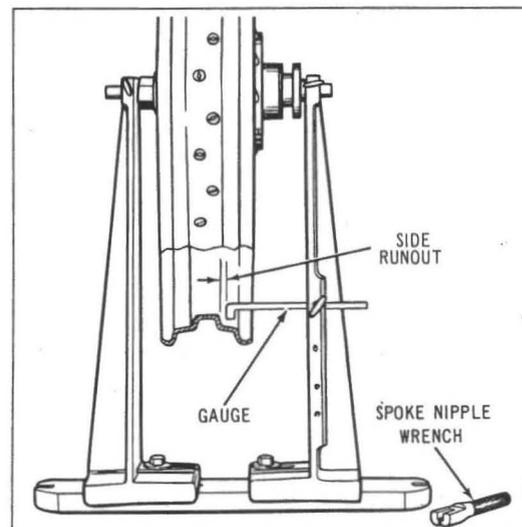
A truing stand should be used in conjunction with a dial indicator or a fixed stylus so the amount of runout can be accurately determined; but in a pinch, the front forks of an old bicycle can be substituted for a stand and a screwdriver can serve as your stylus. A spoke nipple wrench, and these are so cheap you really should get one, should be used to protect the nipples and the surface of the rim, but a pair of wrapped up pliers will do. Work slowly, avoid overtightening the nipples, and always maintain an even tension on the spokes. The job should be done with the tire removed so you can be sure that the spokes will not puncture the tube, but you can get away with doing it with the tire mounted if you're too lazy to do it the right way. The following are some pretty basic procedures; you'll have to supply the patience:

1. Install the wheel in a stand so the hub will turn freely on the axle. Make sure the axle is on a parallel plane with the floor.

2. Turn each nipple until the spoke threads are just covered. A spoke wrench or pliers should be used, but a screwdriver can be used from the tube side of the rim, if necessary, once the tire and tube have been removed.

3. Working from the valve hole, turn in each nipple three full turns. If the spokes are not taut, turn each nipple one more full turn.

4. Lay a straight edge across the hub and rim on both sides of the wheel to determine if the hub is centered. The object of the following steps is to bring both side measurements into agreement.



Correcting sideways runout

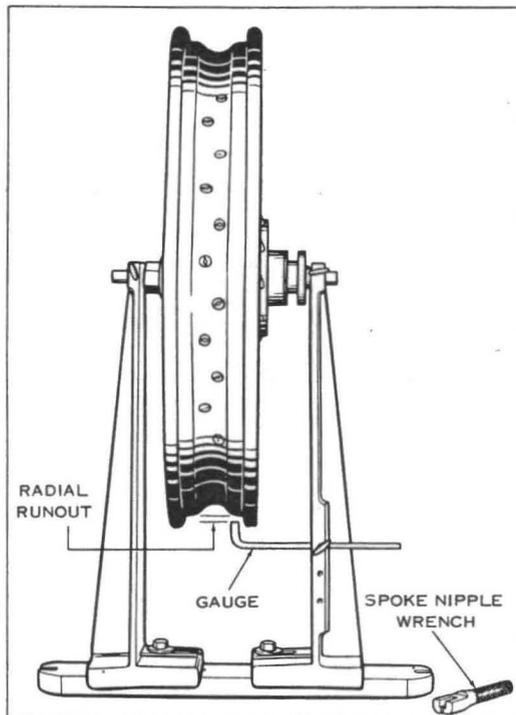
5. Slowly rotate the wheel and set the gauge, or stylus, to touch the rim at its highest point to correct for sideways runout.

6. Loosen the gauge side nipples at their highest point and tighten the opposite nipples an equal amount.

7. Continue to perform the above procedure until the rim passes the gauge at equal distances all around the rim.

8. Correct for excess distance between the rim and gauge by reversing the above procedures until a sideways runout of $\frac{1}{32}$ in. or less is attained.

9. Slowly rotate the wheel and set the gauge to correct for radial runout.



Correcting radial runout

10. Radial runout is corrected by loosening the nipples at those points where the wheel does not run on the gauge, and then by tightening the opposite nipples where the rim does run on the gauge.

11. A correctly trued wheel will skim over the gauge with radial variations of $\frac{1}{32}$ in. or less.

12. Working from the valve hole, tighten the nipples one turn at a time each all around the rim until the spokes are normally taut. Repeatedly check the rim with a gauge.

13. Seat each spoke into the hub flange by punching them smartly with a flat nosed punch and hammer.

14. Smooth off the spoke ends at the tube side of the rim with a file to prevent tube damage.

Wheel balancing should be done on a truing stand also, but may be done on the front forks as long as the brakes aren't dragging. Balancing should be done with balance weights, but solder can be wrapped around the spoke nipples instead. The way to do it is to spin the wheel and see where it stops, then mark the rim at its lowest point. Do this several times to determine where the heaviest section of the wheel is, and then begin adding weight to the opposite side of the rim as a counter balance. When you've got it right, the wheel shouldn't stop at any one spot in particular. If all of that sounds like a hassle, try using some of the tire balancing fluid on the market. This stuff is really fine and is super easy to use. All you have to do is put some of it in the wheel right through the air valve and then spin the wheel. When the stuff settles after a few miles you've got a perfectly balanced wheel that will remain balanced at any speed.

Suspension

FRONT FORKS

Disassembly

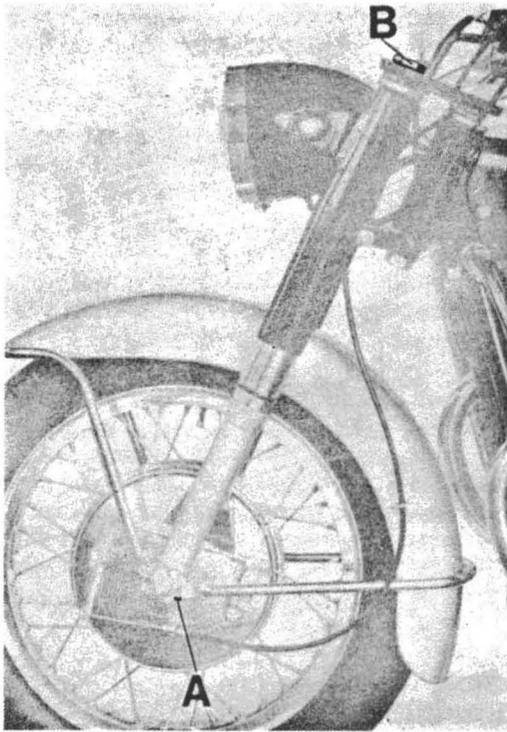
1. Disconnect the clutch and brake cables at the handlebars, remove the clamp screws and caps, and remove the handlebars.

2. Remove the instrument panel mounting screws, disconnect the electrical cables and the speedometer drive, then remove the instrument panel.

3. Remove the speedometer from the instrument panel.

4. Remove the nut and fork filler caps (B) from the top triple clamp plate, then pull the plate using an appropriate wrench and tool No. 60910500 (labeled "3" in the accompanying illustration) or a suitable substitute puller.

5. Remove the steering stem lock-ring

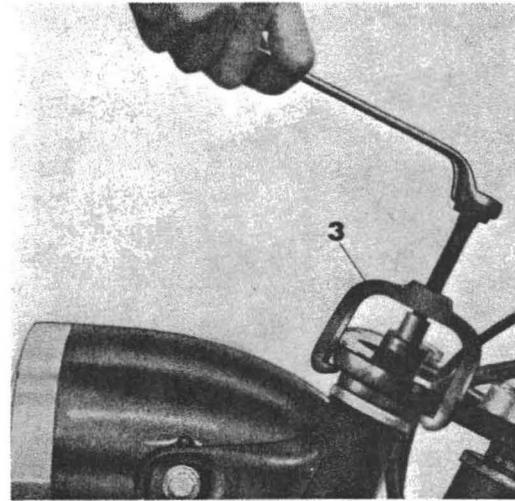


Fork drain and filler plugs

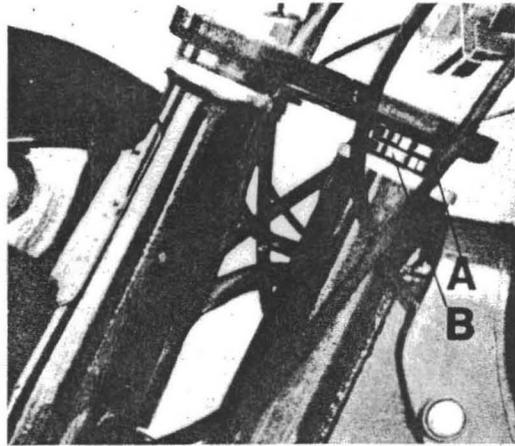
(B) and lock-cap (A) from the top of the steering stem.

6. Remove the pinch bolts which secure the bottom triple clamp to the fork tubes.

7. Either drain the forks now by removing the drain plugs (A), or pull out the tube and slider assemblies and then invert



Removing the top triple clamp plate



Steering stem lock ring and cap

- | | |
|---|--|
| 24. Bottom yoke | 45. Top fork cover bushing |
| 25. Handlebar clamps bolt | 46. Handlebar clamp-to-headlight bracket bolt |
| 26. Clamp bolts-to-bottom yoke washer | 47. Handlebar clamp-to-headlight bracket bolt washer |
| 27. Clamp bolts-to-bottom yoke nut | 48. Oil drain from forks screw |
| 28. Front brake cable eyelet | 49. Oil drain screw washer |
| 29. Rubber front brake cable guide ring | 50. Front fender |
| 30. Headlight bracket, r/h | 51. Front fender decal |
| 31. Headlight bracket, l/h | 52. Top front fender stay |
| 32. Headlight bracket bottom plate | 53. Bottom front fender stay |
| 33. Front fork spring | 54. Stay and center attachment plate screw |
| 34. Fork springs housing | 55. Stay securing screws washer |
| 35. Seal | 56. Center fender securing plate |
| 36. Fork rod | 57. Eyelet securing screw nut |
| 37. Fork rod and bottom fork link retaining lock ring | 58. Plate securing screws-to-fender washer |
| 38. Bottom fork rod bushing | 59. Front fender-to-fork screw |
| 39. R/H fork cover | 60. Front fork-to-fender screws washer |
| 40. L/H fork cover | 61. Front fork-to-fender screws nut |
| 41. Fork cover gasket | 62. Cable guide eyelet |
| 42. Adjusting top bush washer 0.1 mm = 0.0039 in. | 63. Eyelet securing screw |
| 43. Fork cover circlip | 64. Eyelet securing screw spring washer |
| 44. Fork cover adjusting 2.0 mm shim 0.078 in. | 65. Front brake guiding eyelet rubber ring |
| Fork cover adjusting 2.1 mm shim 0.082 in. | 66. Front fender plug |
| Fork cover adjusting 2.2 mm shim 0.086 in. | 67. Front fender amber reflector |
| Fork cover adjusting 2.3 mm shim 0.090 in. | |
| Fork cover adjusting 2.4 mm shim 0.094 in. | |

and drain the oil. It will be lots neater if you remove the oil first.

8. Remove the spring housings and springs as an assembly, then remove the headlight bracket bottom plate.

9. Remove the spring housings, then remove the seal ring and rubber ring from the housings.

10. Remove the circlip and adjusting washer, then remove the fork bottom cover and bushing.

11. Remove the bottom slider bushing lock-ring, then extract the bushing.

12. Remove the nut which secures the steering stem, from the bottom of the lower triple clamp, then remove the stem.

Inspection and Repair

1. Clean all parts in a suitable solvent, then blow them dry.

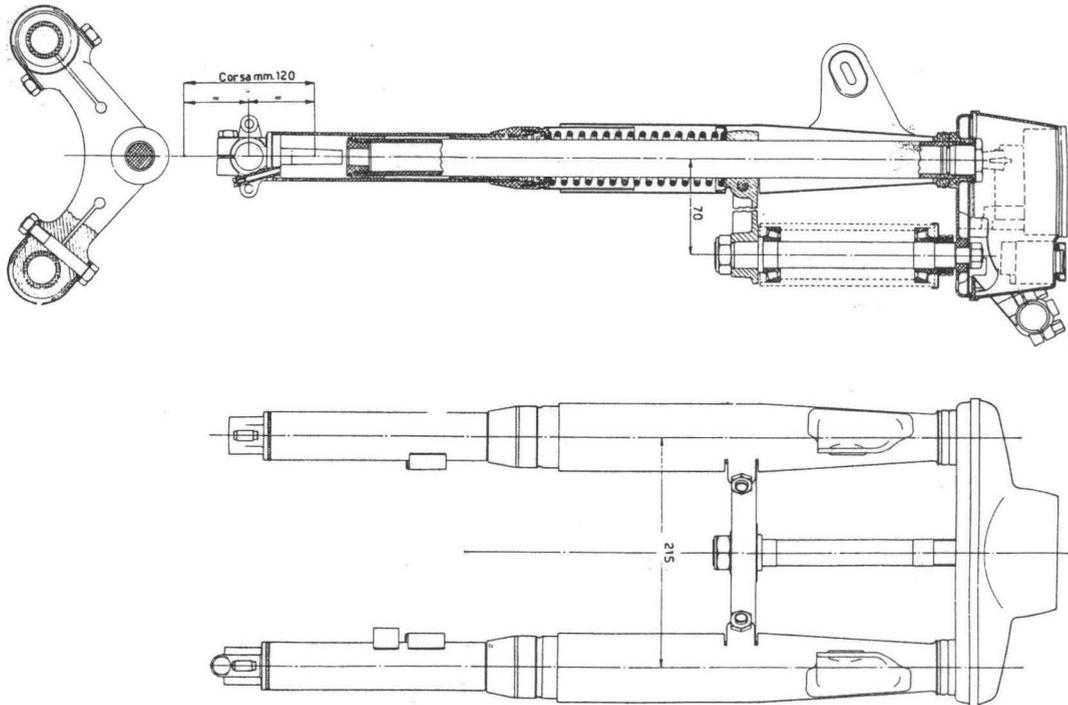
2. Inspect the fork tubes for signs of warpage, damage, or scoring of the chromed portion which slides inside the bushings. Roll the tubes on a flat surface to check for warpage and turn them over to your dealer or a qualified machinist for straightening if necessary. Replace the tube(s) if badly scored or if the threads are stripped or damaged. Using a micrometer or calipers, check the diameter of the

tubes at the chromed portion, which must extend 120 mm (4.722 in.), and replace them if worn past their serviceable limit of 34.720–34.695 mm (1.3669–1.3659 in.). Using feeler gauges, check the clearance between the tubes and bushings and replace them if worn past their serviceable limit of 0.040–0.105 mm (0.0015–0.0041 in.) at the top bushing, and 0.020–0.044 mm (0.0007–0.0017 in.) at the bottom bushing.

3. Inspect the top bushings for signs of wear, damage, or scoring which would interfere with the proper operation of the forks, or which could damage the fork tubes, and replace them as necessary. Using inside and outside micrometers, measure the bushings and replace them if worn past their serviceable limits of 34.760–34.800 mm (1.3685–1.370 in.) for the inside diameter, and 40.010–39.971 mm (1.5751–1.5735 in.) for the outside diameter.

4. Inspect the bottom bushings as described above. Their values are 34.700–34.739 mm (1.3661–1.3676 in.) for the inside diameter, and 39.950–39.911 mm (1.5728–1.5712 in.) for the outside diameter.

5. Inspect the fork bottom covers for damage or scoring of their inner surfaces



Front fork dimensions

and replace them as necessary. Using an inside micrometer, measure the inside diameter of the cover, then use feeler gauges to measure the clearances between the cover and the top and bottom bushings, and replace the components if worn past their serviceable limits. The inside diameter of the cover should be 40.010–40.050 mm (1.5751–1.5767 in.). The clearance between the cover and the top bushing should be 0–0.079 mm (0–0.10031 in.), and the clearance between the cover and the bottom bushing should be 0.099–0.100 mm (0.0038–0.0039 in.).

6. Inspect the fork springs for signs of wear, fatigue, excessive tilt, or damage and replace them as necessary. A new spring should be 230 ± 15 mm (9.0551 in.), and should be replaced if collapsed more than 3%. With a load of 110 ± 4 lbs the spring should be 170 mm (6.6929 in.), and with a load of 231 \pm 8 lbs, the spring should be 104 mm (4.0945 in.). If a device for measuring load is not available, merely measure the spring free length or compare them to a new set. Your dealer may be able to measure the load for you if you bring him the springs already removed from the fork assembly.

7. Inspect the spring housings for wear or damage. If the seal ring or gasket is burred, worn, or has lost its elasticity, they should be replaced.

8. Inspect the filler plug rubber O-rings and seals for wear, cracks, or distortion and replace them as necessary.

9. Inspect the steering head roller bearings for wear, damage, excessive play, or rough motion and replace them as necessary. The bearings must all be perfectly round and devoid of score marks or pitting and the races must be perfectly smooth and glossy. Do not spin the bearings when dry.

10. Inspect the steering adjusting lock-rings for signs of wear or damage, especially to the threads, and replace them as necessary.

11. Inspect the fork neck steering tube and the steering stem for signs of wear, scoring, dings, damage, or anything which could hinder their smooth motion, and replace or repair damaged components as necessary. If there are cracks around the frame neck, they should be immediately attended to by your local dealer or a qualified welder.

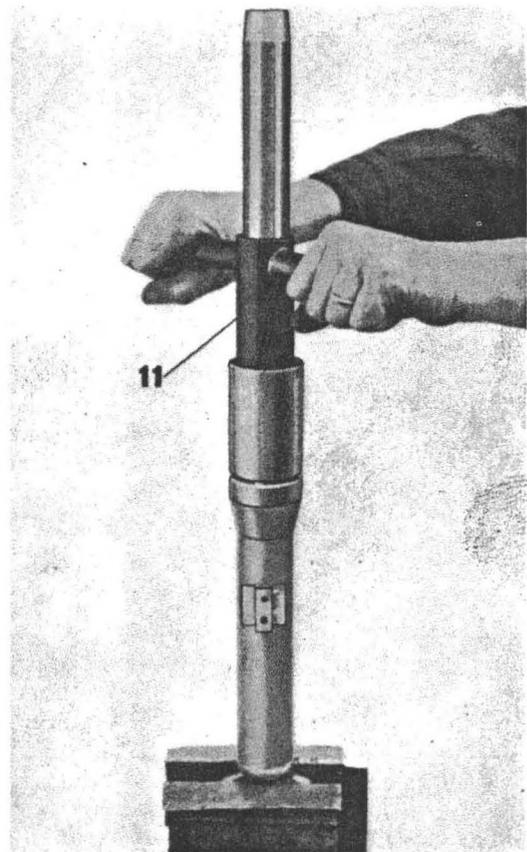
Assembly

1. Install the top and bottom fork cover bushings, then secure them with bushing lock-rings. Use new lock-rings if the old ones are distorted.

2. Install the fork tubes complete with the sliders, then position the adjusting washer in the top portion of the cover and install the circlip in the cover groove.

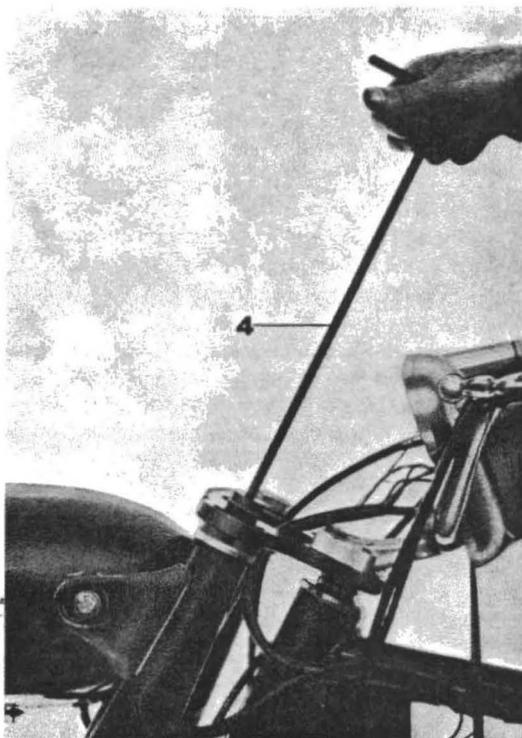
3. Place the fork cover gasket, cover, and spring housing in position.

4. Carefully press the seal ring into position, then secure the spring housing using Tool No. 12912600 (labeled "11" in the accompanying illustration) or a suitable substitute.



Installing the oil seal

5. Slip the fork springs over the fork tubes and position them in the spring housing; then insert the fork tubes in the bottom triple clamp and headlight bracket using Tool No. 12909500 (labeled "4" in the accompanying illustration), or a suitable substitute, to position them.



Lining up the fork components with the factory tool

6. Install the pinch bolts and secure the headlight bracket, then secure the steering stem to the bottom triple clamp with its nut.

7. Pack the steering head bearings with fresh grease and install them in the frame neck, then slip the steering stem and fork assembly into position so the stem seats fully inside the neck, and install the steering stem cap.

8. Position the steering stem lock-ring and adjust the steering play as desired. The forks should pivot freely in the fork neck without binding or falling to one side. When the steering is to your satisfaction, fit and secure the lock cap using Tool No. 60910500 or a suitable substitute.

9. Position the rubber rings and caps in the headlight brackets, then position the top triple clamp plate.

10. Install the fork drain plugs and their gaskets, then fill each tube with 5.4 oz (0.160 l) of fork oil. Shell Tellux 33 is the factory recommended lubricant, but substitutes can be made.

11. Position the filler plug seals, washers, and plugs, then fit the top triple clamp plate washer, and the nut which secures the plate, to the steering stem.

12. Mount the handlebar clamps on the top triple clamp plate, install the speedometer drive on the instrument panel, connect the electric cables, and secure the speedometer.

13. Mount the instrument panel on the top triple clamp plate, then install the handlebars and their clamp caps and screws.

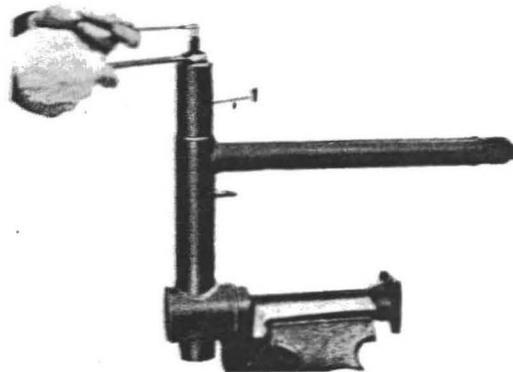
SWING ARM

Disassembly

1. Remove the rear wheel drive as described in the "Engine and Transmission" chapter.

2. Remove the cap nuts and lock nuts from the fork support spindles, then remove the support spindles.

3. Remove the spacers and sealing rings, then remove the two roller bearings. The bearing outer races can be easily pulled from the swing arm using Tool No. 12904700 (labeled "1" in the accompanying illustration), however a suitable substitute may be used.



Removing the outer bearing races

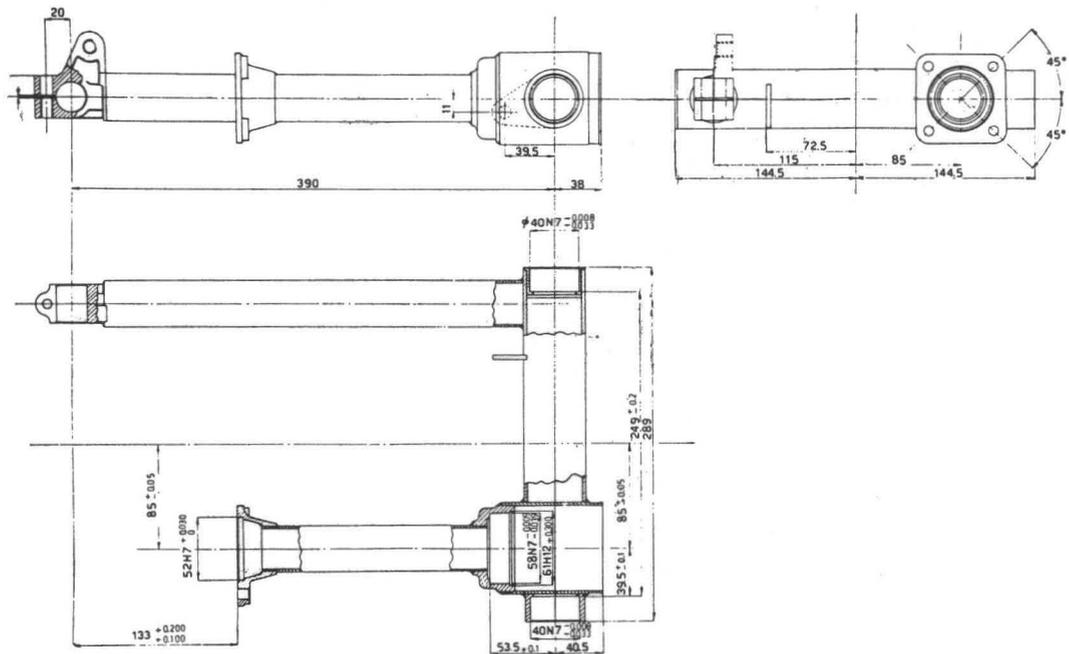
INSPECTION AND REPAIR

1. Clean all parts in a suitable solvent, then blow them dry.

2. Inspect the swing arm for signs of fatigue, wear, bends, twist, or cracks and replace it as necessary. Pay special attention to the condition of the bearing housings and the flange surface which contacts the drive box; these must be smooth and unmarred.

3. Inspect all threaded parts, especially the support spindles, for damage or stripping and replace them as necessary.

4. Inspect the seals for signs of wear, cracks, damage, or loss of elasticity and re-



Swing arm dimensions

place them as necessary. It isn't a bad idea to replace them at this time as a matter of course.

5. Inspect the bearings for wear, damage, excessive play, or rough motion and replace them as necessary. The bearings must all be perfectly round and devoid of score marks or pitting, and the races must be perfectly smooth and glossy. Do not spin the bearings when dry.

Assembly

1. Carefully press the lubricated bearings into their housings, then press in the two sealing rings.

2. Position the spacers while slipping the swing arm into position in the frame.

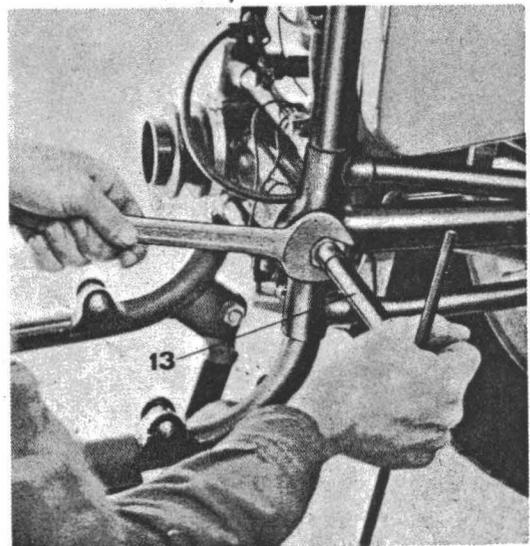
3. Insert the support spindles then temporarily secure the assembly with the lock nuts.

4. Tighten the lock nuts evenly using Tool No. 12903000 (labeled "13" in the accompanying illustration), or a suitable substitute, and an appropriate wrench to hold the locknuts. The fork should be able to swing freely when secured.

5. Complete the assembly in the reverse order of disassembly.

REAR SHOCK ABSORBERS

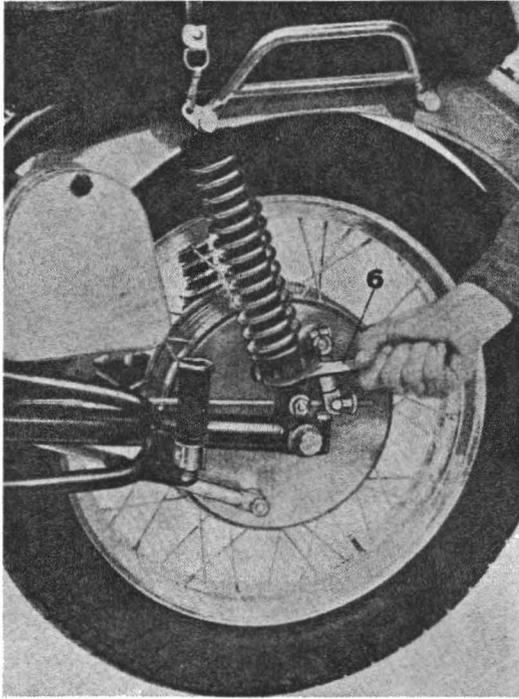
The rear shocks found on all of the Moto Guzzi touring models have three po-



Securing the swing arm

sitions to adjust for rider weight. These adjustments, carried out with Tool No. 12912700 (labeled "6" in the accompanying illustration) or a suitable substitute, are to vary the spring load to compensate for the need for a stiffer spring under certain conditions.

Remove the shocks by removing the nuts which secure them to their bosses on the frame, swing arm, and drive box. The rubber bushings may be removed for



Adjusting a rear shock absorber

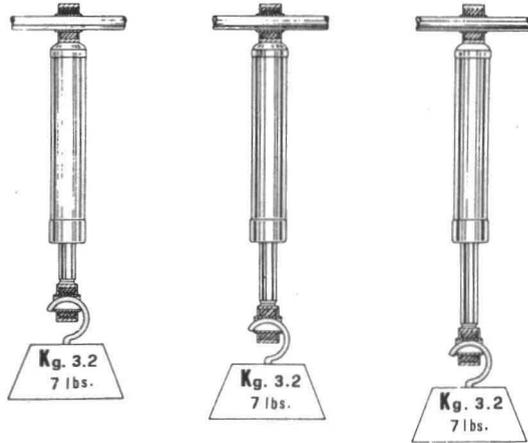
inspection along with the shocks at this time, and should be replaced if worn, cracked, or lacking flexibility.

The shock units are not rebuildable and must be replaced if found defective. Numerous replacement units, which surpass the originals in quality and damping characteristics, are available; or you can replace them with the Koni shocks which come on the Sport model. The Koni shock is rebuildable but must be returned to the manufacturer if you want the job done right. The way to test them is to remove the spring by compressing the shock until the split collar can be removed, then push in the piston rod and pull it out again. If the shock is functioning correctly, the piston should be noticeably easier to push in than to pull out.

STEERING DAMPER (V850)

The steering damper is a non-repairable item which must be replaced if defective. The damper unit should be periodically checked for efficiency, and should be considered suspect if high speed wobbling develops. Check the damper in the following manner:

1. Hang the damper by its fixed eyehole as depicted in the accompanying illustration.



Checking the steering damper

2. Attach a weight of 7 lbs to the pushrod eyehole.

3. Pull the rod into various positions and observe whether or not the weight is sufficient to move the rod. If it does move, the dampening ability of the unit is defective and the unit should be replaced. It is particularly important to check the unit with the rod withdrawn halfway out of the damper body.

Frame

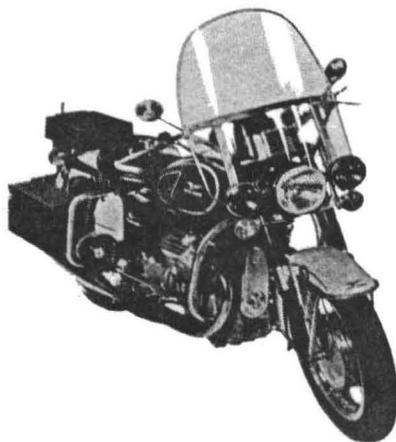
It is not necessary to strip down the frame completely to work on it, but if damage is suspected it isn't a bad idea to take it all down so a more thorough examination can be made. If cracks or breaks are present, take the frame to a qualified welder or to your local dealer to have the work done. Never allow an amateur to lay a torch on anything which is under stress because you certainly don't want to find out what a lousy job he did while you're tooling along at 60 mph.

You can save most of the cost of frame repair by stripping the bike yourself and taking just the frame to the shop. Most of the expense is the preparation and the re-fitting of all the equipment. If in doubt about the condition of your frame, consult your local dealer, but don't guess or you may be really sorry.

If it becomes necessary to strip down the frame, work in this suggested order:

Remove the fuel tank, seat, engine, gear-

9 • Troubleshooting



Introduction

There are certain steps which, if followed, can transform the confusing art of troubleshooting into an exact science. Random efforts often prove confusing, so a logical method should be adopted. Troubleshooting is nothing more than a systematic process of elimination, tracing back and checking various components until the fault is located. In most cases, this takes very little time and requires very few special tools.

Before you start, try to determine if this is a new problem or one that's been coming on gradually. If you are an aware rider you'll know whether or not performance has been diminishing and consulting the troubleshooting guide in this section may provide an immediate answer. Also, whenever a problem shows up just after work has been done on the bike, check first those areas that were involved, regardless of the nature of the work.

When troubleshooting the engine, you will be concerned with three major areas: the ignition system, the fuel system, and the cranking compression pressure. The engine needs spark, fuel, and compression to run, and it will be your job to determine which of these it lacks and why. Let's say that your engine won't start one morning, but it was running fine the night

before. The most obvious thing to check first, but which is often overlooked, is the fuel supply. Keep in mind that even if there is gas in the tank, a low supply can sometimes make starting difficult. Check to see if you have fuel at the carburetors by unscrewing one of the float bowl plugs. If so, you can be pretty sure that it is not a lack of fuel that is preventing the engine from starting. If not, trace the system back until the blockage is found and clean it out.

As far as compression is concerned, there are very few conditions that will cause a sudden loss of compression, and such an occurrence will happen only while the engine is running. You should be able to tell if you have sufficient compression simply by the way the engine sounds as it is cranked over. Or, if you have the spark plugs out, cover the plug hole with your finger and turn the engine over. If the pressure forces your finger off the hole, there should be enough compression for the engine to start. Of course, the most accurate way to check compression is by using a compression gauge.

So you have found that the engine has relatively normal compression and is getting fuel. The final area of investigation is the electrical system. Check to see if you are getting spark to the cylinders by removing the plug leads, one at a time, and inserting a metal object such as a nail into the plug connectors. Using a piece of rub-

ber as insulation, hold the nail about $\frac{1}{8}$ in. from the engine and crank it over. If you have spark at the leads, remove and check the plugs. If not, simply trace the ignition system back with a test light (simply a 12V bulb, such as a tail light bulb, with two wires attached), used to check continuity until a break in the system is discovered.

Start by checking for electricity at the points when they are open. If you have juice there, the problem lies in the coil, spark plug high tension wires, or in the wires between the coil and points. If you find that there is no supply of juice to the coil, start looking for loose connections in the wiring between the coil and the ignition switch. Speaking of connectors, whenever you have a problem with the electrical system, they are one of the first things you should examine. These little devils have the habit of pulling loose for no particular reason, and cause far more trouble and aggravation than any other part of the electrical system.

All of the above can be considered troubleshooting the engine to get it running, not troubleshooting to cure running faults. Once you have found the general location of the trouble, it is usually very simple to make pinpoint checks or temporarily substitute new parts to determine exactly where the problem lies. The most important thing to remember is to try to remain rational and approach the troubleshooting procedure logically. If you do this, chances are that you will find what you are looking for and save yourself some time, money, aggravation, and embarrassment (when the mechanic explains that you have pushed the bike four miles and paid him five dollars to replace a fuse).

Troubleshooting an engine that is running poorly is often a bit trickier than trying to determine why an engine won't start. You will still be involved with the compression, fuel system, and electrical system of your engine, but the problems will be subtler and more difficult to detect. It pays here, if you are making adjustments or fine-tuning, to make one adjustment at a time, thoroughly check the results, and record the findings. Otherwise, you will confuse yourself, ruin the results of one adjustment with another, and accomplish nothing.

Assuming that your engine has not ex-

perienced with a big bang, any mechanical difficulties that you suspect will have taken some time to develop and are most often related to wear. Try to remember if a new sound shortly preceded the trouble because sounds can often help trace the problem. Don't become paranoid about "new" noises though, because you can imagine all kinds of terrible sounds if you really try.

Remember, when you are trying to diagnose a running fault, to check all the parts related to the component you are examining. For example, suppose you are carefully scrutinizing a carburetor expecting a revelation at any moment. In the meantime, don't forget to check the intake tube clamps, the air filter, and the fuel filter to make sure that the carburetor is not being sabotaged in one way or another by these associated components (too much air or too little air or fuel). Or, if you are busy getting zapped by the high tension lead while checking for sufficient spark, don't forget to make sure that the plug connector is tightly attached to the wire and that the wire insulation is not worn or cracked. Look for the little things and check systematically and thoroughly. In many cases a qualified mechanic may be able to help you with a specific problem without even having to look at the bike. He's seen it all before, so don't hesitate to ask; the worst it can get you is a service appointment for next week.

Engine Noises

One of the first indications of change in the condition of your motorcycle is the sounds which emanate from it. A thoughtful rider will know that something is going wrong long before it happens and may be able to correct it before it leads to costly repairs.

Every machine has its own sounds and these sounds will remain constant until something begins to go wrong. Stay attentive and whenever a new sound appears, seek consultation from a qualified mechanic who has heard them all before.

VALVE CLATTER

When tappet adjustment time comes rolling around you'll know it because the

valves will speak up and let you know. Valves always make some noise, especially when cold, but will really get noisy when in need of attention. When listening to the tappets, keep in mind that if you can hear them, chances are that they're alright; but if you can't hear anything as soon as you start the bike, they're too tight and will cause damage to the valve train. Listen to your valves by placing the metal tip of a screwdriver against the rocker box and your ear against the handle.

PINGING

Poor quality gasoline, advanced ignition timing, incorrect spark plug heat range, or a piece of metal in the combustion chamber can be the causes of pinging.

Pinging sounds are generally associated with the top end, and occur at middle range speeds during acceleration. Most of the time it is caused by pre-ignition due to the use of low octane fuel in a high compression engine. These unnecessary detonations cause undue strain on piston assemblies and bearings.

If the ignition timing is advanced too far, the force of the combustion will try to force the piston down before it completes its rotation. This is another type of pre-ignition and is as harmful as the use of poor fuel. When pistons end up with holes in them, it is usually because of this.

If the spark plug in use is too hot, it can't dissipate its heat quickly enough and begins to act like a glow plug. This causes pre-ignition also and can be corrected by using a colder plug.

Carbon or metal pieces in the combustion chamber can heat up and act like a glow plug. This is less common than the others and only occurs when the engine is running hot. The only way to quiet this type of pinging is through top end surgery.

PISTON SLAP

Slap occurs most often at mid-throttle range during acceleration and requires top end disassembly to eliminate it. The noise is metallic and is caused by excessive piston-cylinder clearance. If the noise goes away after the engine warms up, the condition is not urgent but you had better start planning on rebuilding the top end very soon.

KNOCK

If you hear a mighty knocking noise coming from the bottom end while accelerating, you can be pretty sure that the main bearings haven't long to go. It also may be a crankshaft problem and is remedied in either case by taking down the engine and replacing the worn parts.

RAP

When the connecting rod bearings start to go, rap develops. This is most often heard during deceleration and increases in intensity with the speed of the engine.

DOUBLE RAP

This is caused by excessive piston-piston pin clearance and is most noticeable as a quick succession of raps at idle speeds.

Engine Troubleshooting

Possible Causes	Remedy
<i>Engine fails to start</i>	
Gas tank empty, fuel petcock off, or fuel line clogged Engine flooded Insufficiently charged battery Corroded, loose, or broken battery terminal connection Fouled or improperly gapped spark plugs	Fill tank, open petcock, or disconnect and blow out gas line Remove spark plugs and dry out Check electrolyte level and charge battery Clean, secure, and/or replace
Spark plug cables leaking or damaged Badly oxidized or dirty contact points Contact breaker points or ignition timing out of adjustment	Clean and gap, or replace. Consult "Tune-Up" chapter Consult "Electrical System" chapter Consult "Electrical System" chapter Consult "Electrical System" chapter

Engine Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Engine fails to start</i>	
Loose connection in ignition circuit	Check wiring harness connections
Defective ignition coil or condenser	Replace
Clutch slipping and not turning engine over	Consult "Engine and Transmission" chapter
Valves sticking or too tight	Consult "Tune-Up" chapter
Engine and transmission oil too heavy for climatic conditions	Drain oil and replace with a lighter grade
<i>Engine is hard to start</i>	
Spark plugs in bad condition or partially fouled	Consult "Tune-Up" chapter
Spark plug cable in bad condition and leaking	Consult "Electrical Systems" chapter
Contact breaker points dirty, pitted, or out of adjustment	Consult "Tune-Up" chapter
Battery insufficiently charged	Check electrolyte level and charge battery
Carburetor out of adjustment	Consult "Tune-Up" chapter
Defective ignition coil or condenser	Replace
Oil too heavy for climatic conditions	Drain oil and replace with a lighter grade
Ignition timing out of adjustment	Consult "Tune-Up" chapter
Loose or intermittently grounded wires at battery, coil, or contact breaker	Check connections
Poor compression	Consult "Tune-Up" chapter
Contact breaker advance mechanism sticking	Consult "Tune-Up" chapter
<i>Starter motor fails to operate or start engine</i>	
Transmission not in Neutral	Select Neutral
Battery insufficiently charged, or loose or corroded connections	Check electrolyte level, charge battery, and check connections
Starter relay, control circuit, or solenoid defective	Consult "Electrical Systems" chapter
Clutch slipping	Consult "Clutch and Transmission" chapter
Electric starter shaft pinion gear not engaging	Consult "Electrical Systems" chapter
<i>Engine idles poorly and misfires during acceleration</i>	
Spark plugs dirty	Clean as described in "Tune-Up" chapter
Weak spark	Consult "Electrical Troubleshooting" chapter
Poor connection at spark plug cable	Check and secure
Air leakage at carburetor manifold	Consult "Fuel System" chapter
Obstruction in carburetor main jet	Consult "Fuel System" chapter
Incorrect carburetor adjustment	Consult "Tune-Up" chapter
Water in carburetor	Disassemble and clean
Mixture too rich (mid throttle range misfire)	Consult "Tune-Up" chapter
Retarded ignition timing (low speed poor performance)	Consult "Tune-Up" chapter
Automatic advance unit sticking (low speed poor performance)	Lubricate breaker cam
<i>Spark plug fouls repeatedly</i>	
Too cold a plug for the type of service	Use a plug one step hotter
Piston rings badly worn	Replace as directed in "Engine and Transmission" chapter
Cracked ceramic portion of spark plug	Replace plug
Too rich a fuel mixture	Consult "Tune-Up" chapter
<i>Loss of compression and power</i>	
Valves sticking due to gummed valve stems	Consult "Engine and Transmission" chapter
Valve tappets set too tight or too loose	Consult "Tune-Up" chapter
Collapsed or damaged piston	Replace as described in "Engine and Transmission" chapter
Badly worn piston rings	Replace as described in "Engine and Transmission" chapter
Damaged head gasket	Replace as described in "Engine and Transmission" chapter

Engine Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Engine partially seizes or slows after sustained high speed operation</i>	
Spark plug too hot and causing pre-ignition	Use a plug one step cooler
Piston seizure	Replace piston and rings as described in "Engine and Transmission" chapter
Carburetor mixture too lean causing overheating	Consult "Tune-Up" chapter
Insufficient oil supply, oil not circulating, or pump working insufficiently	Consult "Lubrication Systems"
<i>Engine overheats</i>	
Valves or rings excessively worn	Consult "Engine and Transmission" chapter
Insufficient oil supply, oil not circulating, or pump working insufficiently	Consult "Lubrication Systems"
Heavy carbon deposits on piston crown	Consult "Engine and Transmission" chapter
Retarded ignition timing	Consult "Tune-Up" chapter
Automatic advance unit sticking in the retarded position	Lubricate the breaker cam
<i>Engine detonates or pre-ignites</i>	
Spark plug too hot for service application	Use a plug one step cooler
Spark excessively advanced	Consult "Tune-Up" chapter
Carburetor mixture too lean	Consult "Tune-Up" chapter
Excessive carbon deposits on piston crown	Consult "Tune-Up" chapter
Fuel octane rating too low	Use a higher quality fuel
<i>Engine backfires</i>	
Spark advanced too much	Retard ignition timing slightly
Automatic advance unit sticking	Lubricate breaker cam
<i>Engine uses too much oil</i>	
Breather valve blocked	Clean out valve
Piston rings worn or frozen	Replace as directed in "Engine and Transmission" chapter
Chain oiler excessively open	Consult "Maintenance" section
Oil leak to outside	Replace gasket or seal
Oil grade too light	Drain and use a heavier grade oil
<i>Contact points burn or pit rapidly</i>	
Defective condenser	Replace as directed in "Tune-Up" section
Loose condenser terminals	Secure terminals
Loose or dirty battery terminals	Secure and clean terminals
Dirty contact points	Clean points
<i>Rapid piston and cylinder wear</i>	
Operating in dusty conditions without an air cleaner or with a dirty or clogged air cleaner element	Install air cleaner or replace element

Clutch and Transmission Troubleshooting

<i>Possible Causes</i>	<i>Remedy</i>
<i>Clutch slips</i>	
Release mechanism improperly adjusted	Adjust as directed in "Maintenance" chapter
Release worm and lever sticking	Check cable for binding, and lever spring for damage
Clutch spring tension too loose	Adjust as described in "Maintenance" chapter
Friction discs worn or oil impregnated	Replace as directed in "Engine and Transmission" chapter

Clutch and Transmission Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Clutch drags</i>	
Release mechanism incorrectly adjusted	Adjust as described in "Engine and Transmission" chapter
Release worm and lever excessively worn	Replace as described in "Engine and Transmission" chapter
Friction discs grimy	Replace as described in "Engine and Transmission" chapter
Steel plates warped	Replace as described in "Engine and Transmission" chapter
Clutch sprocket keys excessively worn or damaged	Replace as described in "Engine and Transmission" chapter
<i>Grinding when shifting (especially first gear)</i>	
Clutch drags	Replace or readjust as described in "Engine and Transmission" and "Maintenance" chapters
Transmission oil too heavy	Drain and refill with a lighter grade oil
<i>Transmission jumps out of gear</i>	
Shifter rods improperly adjusted	Consult "Engine and Transmission" chapter
Shifter forks improperly adjusted	Consult "Engine and Transmission" chapter
Insufficient spring tension	Consult "Engine and Transmission" chapter
Worn gear dogs	Consult "Engine and Transmission" chapter
Worn cam plate	Consult "Engine and Transmission" chapter
Shift linkage improperly adjusted	Consult "Engine and Transmission" chapter
<i>Transmission shifts hard</i>	
Clutch dragging	Consult "Engine and Transmission" chapter
Transmission oil too heavy	Drain and refill with a lighter grade oil
Bent shifter rods	Replace as directed in "Engine and Transmission" chapter
Shifter forks bent due to excessive force used when shifting	Replace as directed in "Engine and Transmission" chapter
Worn gear dogs	Replace as directed in "Engine and Transmission" chapter

Carburetor Troubleshooting

<i>Possible Causes</i>	<i>Remedy</i>
<i>Carburetor floods repeatedly</i>	
Float set too high	Reposition float as described in "Fuel System" chapter
Fuel inlet valve sticking	Free valve and clean seat as described in "Fuel System" chapter
Fuel inlet valve and/or valve seat worn or damaged	Replace as described in "Fuel System" chapter
Dirt or other foreign matter between fuel inlet valve and its seat	Blow passages clear as described in "Fuel System" chapter
Carburetor float sticking due to improper alignment in bowl	Reposition float as described in "Fuel System" chapter
Carburetor inlet lever improperly set	Reset correctly as described in "Fuel System" chapter
<i>Idle mixture too rich</i>	
Dirt or other foreign matter in idle channel	Blow passage clear as described in "Fuel System" chapter
Taper needle adjusted too lean	Readjust as described in "Tune-Up" chapter

Carburetor Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Lean mixture at sustained mid range speeds</i>	
Taper adjustment too lean	Adjust as described in "Tune-Up" chapter
Dirt or other foreign matter in fuel ports or channels	Blow clear as described in "Fuel System" chapter
<i>Lean mixture at sustained high speeds</i>	
Dirt or other foreign matter in nozzle system	Blow clear as described in "Fuel System" chapter
Main jet too small, damaged, or blocked	Replace as described in "Fuel System" chapter
Main jet plug screw not secured	Secure as described in "Fuel System" chapter
<i>Lean mixture during acceleration</i>	
Dirt or other foreign matter in fuel channels	Blow clear as described in "Fuel System" chapter
Improper carburetor adjustment	Adjust carburetor as directed in "Tune-Up" chapter
<i>Lean mixture throughout throttle range</i>	
Filter screens plugged or dirty	Clean or replace as described in "Fuel System" chapter
Air leak at intake manifold	Secure manifold or replace gasket as described in "Fuel System" chapter
<i>Idle mixture too lean</i>	
Carburetor flooding	See above
Idle adjustment screw blunt	Replace as described in "Fuel System" chapter
Idle adjustment hole damaged or oversize	Replace carburetor body
<i>Rich mixture at sustained mid range speeds</i>	
Intermediate jet adjustment too rich	Adjust as directed in "Tune-Up" chapter
Main jet too large, loose, or missing	Replace or secure as directed in "Fuel System" chapter
Carburetor flooding	See above
Choke improperly adjusted	Adjust as directed in "Tune-Up" chapter
<i>Rich mixture at sustained high speeds</i>	
Main jet too large, loose, or missing	Replace or secure as directed in "Fuel System" chapter
Carburetor flooding	See above
<i>Rich mixture throughout throttle range</i>	
Carburetor flooding	See above
Choke valve partially closed	Inspect friction spring and slide assembly as directed in "Fuel System" chapter
Choke improperly adjusted	Adjust as directed in "Tune-Up" chapter

Electrical Troubleshooting

<i>Possible Causes</i>	<i>Remedy</i>
<i>Generator does not charge battery</i>	
Blown fuse on generator or battery (+) terminal	Check and, if necessary, replace fuse. Fuse contact could also be defective or fuse could be improperly housed in its seat
Break in charge circuit	Locate break and repair it. Breaks are generally due to loose or oxidated terminals
Direction of rotation contrary to normal	Reset correct direction of rotation
Slack generator belt	Adjust belt to correct tension
Faulty battery	Check battery

Electrical Troubleshooting (cont.)

Possible Causes	Remedy
<i>Generator does not charge battery</i>	
Defective contact of brushes with commutator; dirty commutator; brushes not freely sliding in holders or worn out Grounded brush holder	Clean commutator, clean brush holders, or replace brushes Reset brush holder insulation and replace it if necessary
Grounded or broken rotor winding Short-circuited rotor	Replace rotor Clean carefully between rotor blades. Make sure that there are no welding drops on front face and especially on back side of commutator ring. If so, remove them. Failing to attain a good result, replace rotor
Rotor unwelded from commutator	Renew welding if rotor does not show any other fault
Broken, short-circuited, or grounded field windings	Replace field coils unless grounding is spotted and eliminated
Generator lacks residual magnetism	Re-excite generator by connecting, for an instant, the (+) and (-) field winding terminals to (+) and (-) battery terminals
Circuit breaker out of setting Oxidation of circuit breaker contacts Jammed contact breaker keeper; deformed movable contact spring; broken or short-circuited contact breaker windings	Set circuit breaker according to testing data Clean circuit breaker contacts Replace regulator unit and send for repair to authorized dealer
Tension regulator out of setting Oxidation of tension regulator contacts Broken tension regulator windings or broken current circuit and excitation circuit	Reset tension regulator according to testing data Clean tension regulator contacts Replace regulator unit and send it for repair to an authorized dealer
<i>Generator is slow to start battery charge</i>	
Faulty regulator unit Partially short-circuited rotor Partially short-circuited field windings Grounded field windings	Replace regulator unit Replace rotor Replace field windings Replace windings if grounding cannot be eliminated
Circuit breaker out of setting	Reset circuit breaker. If good result is not attained, replace circuit breaker
<i>Battery gets only partially charged</i>	
Low setting of regulator unit Oxidation of regulator unit contacts Loose or defective connections inside regulator unit Faulty battery	Set regulator according to testing data Clean regulator unit contacts Check and make connections positive Check battery
<i>Generator overcharges battery</i>	
Faulty generator grounding Excitation circuit and generator (+) in direct short circuit High setting of regulator unit Faulty regulator windings	Re-establish connection Overhaul system and eliminate fault Set regulator according to testing data Remove regulator and send it for repair to an authorized dealer
<i>Battery discharges over generator</i>	
Faulty regulator unit	Replace regulator unit
<i>Generator tension is not constant and exceeds prescribed value</i>	
Faulty regulator unit	Replace regulator unit

Electrical Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Tension oscillates and is not constant</i>	
Oxidation of regulator unit contacts	Clean regulator unit contacts
Regulator unit with altered air gaps, loose screws, etc.	Send regulator unit to an authorized dealer for repair
<i>Overheating of generator</i>	
Short circuited rotor	Replace rotor
Regulator unit damaged or out of setting	Reset regulator unit or replace it
<i>Brushes wear out too quickly</i>	
Offset commutator	Turn commutator and remove excess mica
Excessive pressure of brush holder springs	Take spring pressure down to correct load
Brushes of poor quality	Replace brushes and fit with original parts
<i>Excessive sparking at commutator</i>	
Break in rotor winding	Replace rotor
Rotor unwelded from commutator	Renew weldings if there is no other fault
Offset commutator	Turn commutator and remove excess mica
Loose brush holder springs	Replace springs or restore correct spring load
Worn out brushes	Replace brushes
Mica protruding from commutator bars	Remove excess mica
<i>Noisy generator operation</i>	
Rotor rubs against pole shoes	Make sure pole shoes are correctly secured to casing. Replace bearings
<i>Motor does not rotate and no current absorption</i>	
Break of circuit between battery and starter motor	Locate break and repair it. Check battery terminal blocks and starter cable terminals. Tighten securing nuts
Break of circuit between starter motor and ignition key	Locate break and repair it. Check condition of key switch contacts and, if necessary, clean them carefully, smoothing surface with suitable file
Oxidation of battery terminal blocks or loose terminals	Clean battery terminal block and tighten terminals
Ignition key switch does not close circuit	Clean contacts of ignition key switch or replace complete switch
Solenoid switch oxidated contacts or with grounded or broken winding	Clean movable and stationary contacts of solenoid switch or replace winding
Brushes are too worn out and fail to contact the commutator	Replace brushes, making sure to fit original parts
<i>Starter motor is absorbing current but does not rotate or rotates very slowly</i>	
Rotor rubbing against polar shoes or jammed between same	If bushings are too worn out, replace them. Check bearings alignment. Check rotor shaft. Check that polar shoes are properly housed and secured to casing
Rotor shaft is seized	Replace bushings and recondition rotor shaft
Rotor shaft is too tightly housed in bushings	Clean rotor shaft and bushings and lubricate. If not enough, replace bushings
Short circuited or grounded field winding	Strip field coils and replace them if repair is impossible
Discharged battery or deteriorated in one or more cells	Charge or repair battery
<i>Starter motor rotates but fails to start engine</i>	
Break or grounding in rotor	Replace rotor
Short circuited rotor	Remove copper and carbon dust from commutator and brush holders and check rotor. Replace it if necessary

Electrical Troubleshooting (cont.)

<i>Possible Causes</i>	<i>Remedy</i>
<i>Starter motor rotates but fails to start engine</i>	
Worn out ring gear teeth: pinion does not engage in ring gear	Replace flywheel ring gear
Incorrect assembling: ring gear is only partially engaged by pinion	Check coaxiality and distance between pinion and ring gear
Impurities in coupling device assembly, which does not slide properly on rotor shaft	Clean and lubricate. If necessary, clean complete coupling device assembly
Pinion engages ring gear but doesn't start	Replace faulty pinion flywheel. Replace or overhaul faulty clutch. Replace or repair solenoid switch
<i>Starter motor sets itself to work but makes excessive or unusual noise</i>	
Faulty mechanical parts	Check bushings and replace them if necessary
Presence of foreign matter	Eliminate foreign matter
<i>Starter motor does not deliver full output</i>	
Brushes not making good contact on commutator	Replace brushes or make them match with commutator by setting the motor to work for a certain time without any load. Check load of brush springs and replace them if any yielding is there
Brushes don't slide freely in brush holder	Clean brush holder guides or replace brush holder
<i>Brushes wear out too quickly</i>	
Ovalized commutator	Turn commutator and remove excess mica
Mica protruding from commutator blades	Clean commutator and remove excess mica
Loose brush holders	Tighten brush holder securing screws and rivets
Brushes exercise excessive pressure on commutator	Check spring load for the required value
Unsuitable brushes	Replace brushes and fit with original parts
<i>Sparking at commutator</i>	
General overload	Overhaul starter motor
Loose brush springs	Replace springs
Mica protruding from copper	Remove excess mica and clean commutator
Loose brush holder	Tighten brush holder securing screws and rivets
<i>Misfiring</i>	
Grounded or uncertain high tension connections	Fix or replace high tension connections
Ignition coil cap showing traces of discharge or burnouts	Replace ignition coil
Distributor cap showing signs of discharge or burnouts	Replace distributor cap
Distributor rotor showing traces of discharge or burnout	Replace distributor rotor
Ignition coil with short circuited or broken secondary winding (coil supplies very weak sparks)	Replace ignition coil
Contact breaker periodically grounded (current absorbed by primary winding does not drop to zero when points open)	Check insulations and, if necessary, replace them. Clean contact breaker plate with pure gas
Contact breaker points dirty, oxidated, burnt out	Clean contact breaker points thoroughly and, if necessary, smooth down surfaces using suitable file
Irregular gap of contact breaker points, either due to excessive wear of same (gap too wide) or excessive wear of felt pad (gap too narrow)	Clean contact breaker points thoroughly and adjust gap. If necessary, replace contact breaker set
Contact breaker points are out of alignment	Align points, adjust gap, and tighten down adjusting screw
Periodically short circuited condenser, lacking insulation or broken (strong sparking)	Replace condenser

Electrical Troubleshooting (cont.)

*Possible Causes**Remedy**Misfiring at high speed*

Grounded or uncertain high tension connections	Fix or replace high tension connections
Ignition coil cap showing traces of discharge or burnouts	Replace ignition coil
Distributor cap showing traces of discharge or burnouts	Replace distributor cap
Distributor rotor showing traces of discharge or burnouts	Replace distributor rotor
Ignition coil with short circuited or broken secondary winding (coil supplies very weak sparks)	Replace ignition coil
Uncertain low tension connections	Check connections, tighten screws and nuts, renew weldings
Contact breaker periodically grounded (current absorbed by primary winding does not drop to zero when points open)	Check insulations and, if necessary, replace them.
Contact breaker points are dirty, oxidated, or burnt out	Clean contact breaker plate with pure gas.
Irregular gap of contact breaker points, either due to excessive wear of same (gap too wide) or excessive wear of felt pad (gap too narrow)	Clean contact breaker points thoroughly and, if necessary, smooth down surfaces using suitable file
Contact breaker points are out of alignment	Clean contact breaker points thoroughly and adjust gap. If necessary, replace contact breaker set
Contact breaker arm too tightly fitted on pin	Align points, adjust gap, and tighten down adjusting screw
Lack of pressure at contact breaker points	Clean and lubricate pin with a few drops of suitable oil
Periodically short circuited condenser, lacking insulation or broken	Check and replace contact breaker arm if necessary. Check spring load to be as required by testing data
	Replace condenser

Spark failure

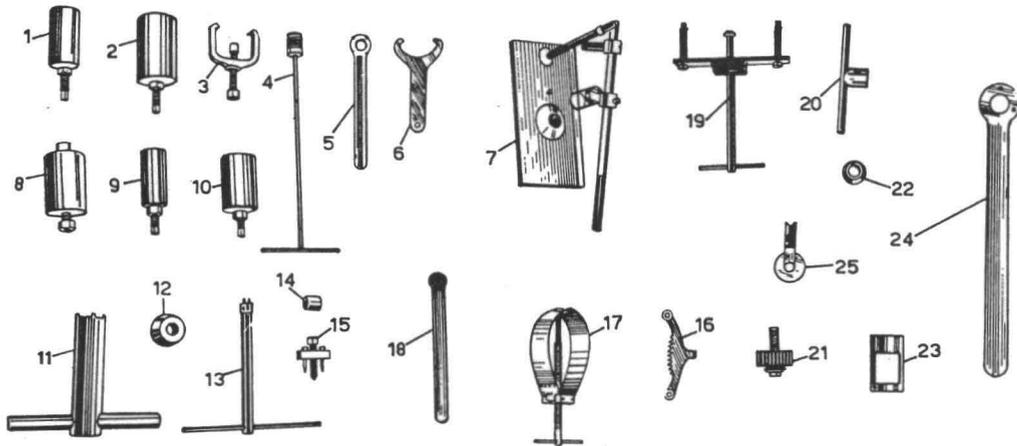
Break in connections	Locate break and repair or replace connections
Ignition coil cap perforated by high tension lead or grounded	Replace ignition coil
Distributor cap grounded or perforated by high tension lead	Replace distributor cap
Distributor rotor perforated by high tension lead or grounded	Replace distributor rotor
Short circuited ignition coil winding (on test bed, ammeter shows absorption to be higher than normal)	Replace ignition coil
Grounded ignition coil primary winding (current flow does not stop even with open contact breaker points)	Replace ignition coil
Break in ignition coil primary winding (current does not flow through coil)	Replace ignition coil
Too wide or too narrow contacts gap	Adjust to correct gap and tighten down screw which secures fixed contact plate. If necessary, replace contacts set.
Contact breaker arm seized on pin	Remove contact breaker arm. Clean pin and lubricate with a few drops of suitable oil. Replace arm if necessary
Short circuited condenser	Replace condenser

Chassis Troubleshooting

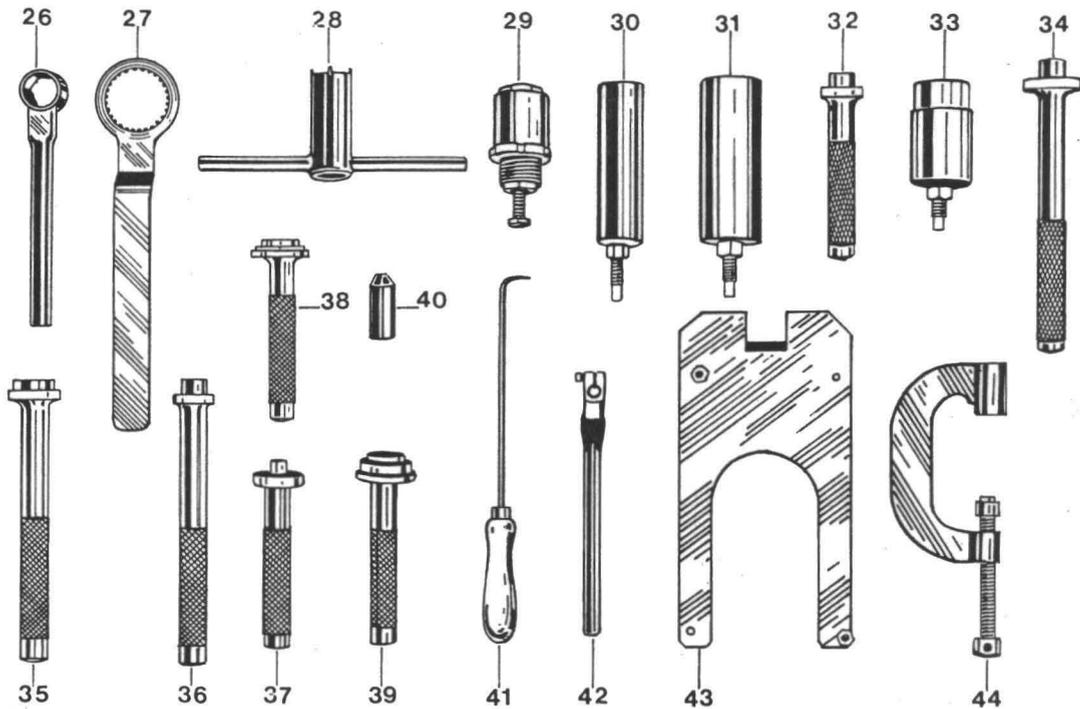
<i>Possible Causes</i>	<i>Remedy</i>
<i>Excessive vibration</i>	
Engine mounting bolts loose	Secure
Broken frame	Consult your dealer
Loose axle nuts	Secure
Excessive wheel hub radial play	Replace wheel hub bearings as described in "Chassis" chapter
Loose spokes	Secure
Rear wheel out of alignment	Align rear axle to path of front wheel
Wheel rims out of true	Consult "Chassis" chapter
Tires unevenly worn	Replace and check wheel alignment and true
Tires incorrectly inflated	Correct as specified
Worn steering head bearings	Replace as directed in "Chassis" chapter
Worn rear shocks or shock bushings	Replace as directed in "Chassis" chapter
Swing arm bushings too loose or too tight	Replace as directed in "Chassis" chapter
Excessive front end loading	Remove excessive weight from the front end
<i>Poor front fork operation</i>	
Fork oil contaminated	Drain and replace
Worn or leaky seals evidenced by dirt or water in the fork oil	Replace seals as described in "Chassis" chapter
Worn breather valve	Replace as described in "Chassis" chapter
Worn shock absorber or collapsed spring	Replace as described in "Chassis" chapter
Excessive clearance in slider bushings as evidenced by excessive play between slider and tube	Replace as described in "Chassis" chapter
Bent tubes, stem, brackets, or sliders	Consult your dealer
<i>Brakes do not hold</i>	
Brake pads glazed or worn	Replace as directed in "Chassis" chapter
Brake pads oil impregnated	Replace as directed in "Chassis" chapter
Brake linkage improperly adjusted	Readjust as directed in "Maintenance" chapter
Brake control cables improperly lubricated	Lubricate
Brake drum worn or damaged	Replace as directed in "Chassis" chapter

Appendix

Special Tools



Factory tools



Factory tools for working on five-speed transmissions

<i>Part No.</i>	
1. 12904700	Puller for taper bearing races on rear fork
2. 12906900	Puller for roller bearing race in drive box
3. 60910500	Steering top linking plate puller
4. 12909500	Front fork rods assembling tool
5. 12905400	Wrench for removal of layshaft lockring
6. 12912700	Lockring adjusting tool for rear dampers
7. 60907200	Valve dismantling and assembling tool
8. 12913700	Puller for layshaft ball bearing in transmission box
9. 12913100	Puller for mainshaft roller bearing in transmission box
10. 12907000	Puller for mainshaft and clutch shaft bearings in transmission box cover
11. 12912600	Special wrench for front fork lockring
12. 12912000	Flange assembling and oil seal locating tool on crankshaft, flywheel side
13. 12903000	Tool for rear fork taper roller bearing adjustment
14. 12910700	Bush for oil seal fitting on mainshaft
15. 32906302	Oil pump gear puller
16. 12911801	Flywheel and clutch unit holding tool
17. 26907800	Piston pin puller
18. 12907100	Layshaft and rear drive bevel holding tool
19. 12913600	Tool for removing the flange complete with bearing, flywheel side
20. 12912900	Special tool to check positioning marks on timing gears
21. 12906500	Clutch dismantling and assembling tool
22. 12905900	Tool for removal of clutch shaft
23. 12908300	Tool for timing cover assembling and oil seal locating on crankshaft, timing side
24. 12913800	Tool for transfer of positioning marks on timing gear
25. 12905300	Tool for holding crankshaft when removing bevel nut
26. 14905400	Tool for tightening layshaft nut
27. 14912800	Tool for inner clutch body-to-clutch shaft
28. 14912600	Hooked wrench for tightening inner clutch body lockring to clutch shaft
29. 14928500	Puller for bearing races on main and clutch shafts
30. 14913100	Puller for main shaft roller bearing in gearbox and clutch shaft bearing in cover
31. 14913700	Puller for layshaft roller bearing race in gearbox
32. 14929200	Punch for removing clutch shaft bearing from gearbox and layshaft bearing from gearbox cover
33. 14907000	Puller for main shaft ball bearing in gearbox cover
34. 14928900	Punch for pressing clutch shaft bearing in gearbox housing and layshaft bearing in gearbox cover housing
35. 14929100	Punch for pressing layshaft roller bearing race in gearbox housing
36. 14928800	Punch for pressing main shaft roller bearing in gearbox and clutch shaft bearing in gearbox cover
37. 14929000	Punch for pressing main shaft ball bearing in gearbox cover
38. 14929400	Punch for pressing clutch shaft seal in gearbox
39. 14929500	Punch for pressing layshaft seal in gearbox cover
40. 14928600	Tool for layshaft bearing inner race
41. 14929300	Tool for positioning sliding muffs forks
42. 14928700	Tool for operating gear selector
43. 14929600	Gearbox support
44. 13907860	Piston pin puller

Metric Conversion Charts

Millimeters to Inches— Fractions

<i>1/1000</i>		<i>1/100</i>		<i>1/10</i>	
<i>mm</i>	<i>inches</i>	<i>mm</i>	<i>inches</i>	<i>mm</i>	<i>inches</i>
0.001	0.000039	0.01	0.00039	0.1	0.00394
0.002	0.000079	0.02	0.00079	0.2	0.00787
0.003	0.000118	0.03	0.00118	0.3	0.01181
0.004	0.000157	0.04	0.00157	0.4	0.01575
0.005	0.000197	0.05	0.00197	0.5	0.01969
0.006	0.000236	0.06	0.00236	0.6	0.02362
0.007	0.000276	0.07	0.00276	0.7	0.02756
0.008	0.000315	0.08	0.00315	0.8	0.03150
0.009	0.000354	0.09	0.00354	0.9	0.03543

Decimals to Millimeters— Fractions

<i>1/1000</i>		<i>1/100</i>		<i>1/10</i>	
<i>inches</i>	<i>mm</i>	<i>inches</i>	<i>mm</i>	<i>inches</i>	<i>mm</i>
0.001	0.0254	0.01	0.254	0.1	2.54
0.002	0.0508	0.02	0.508	0.2	5.08
0.003	0.0762	0.03	0.762	0.3	7.62
0.004	0.1016	0.04	1.016	0.4	10.16
0.005	0.1270	0.05	1.270	0.5	12.70
0.006	0.1524	0.06	1.524	0.6	15.24
0.007	0.1778	0.07	1.778	0.7	17.78
0.008	0.2032	0.08	2.032	0.8	20.32
0.009	0.2286	0.09	2.286	0.9	22.86

Inches to Millimeters—Units

<i>inches</i>	<i>0</i>	<i>10</i>	<i>20</i>	<i>30</i>	<i>40</i>
0		254.0	508.0	762.0	1016.0
1	25.4	279.4	533.4	787.4	1041.4
2	50.8	304.8	558.8	812.8	1066.8
3	76.2	330.2	584.2	838.2	1092.2
4	101.6	355.6	609.6	863.6	1117.6
5	127.0	381.0	635.0	889.0	1143.0
6	152.4	406.4	660.4	914.4	1168.4
7	177.8	431.8	685.8	939.8	1193.8
8	203.2	457.2	711.2	965.2	1219.2
9	228.6	482.6	736.6	990.6	1244.6

One Inch—25.399978 millimeters.

One Meter—39.370113 inches.

One Mile—1.6093 km.

One Km—0.62138 miles.

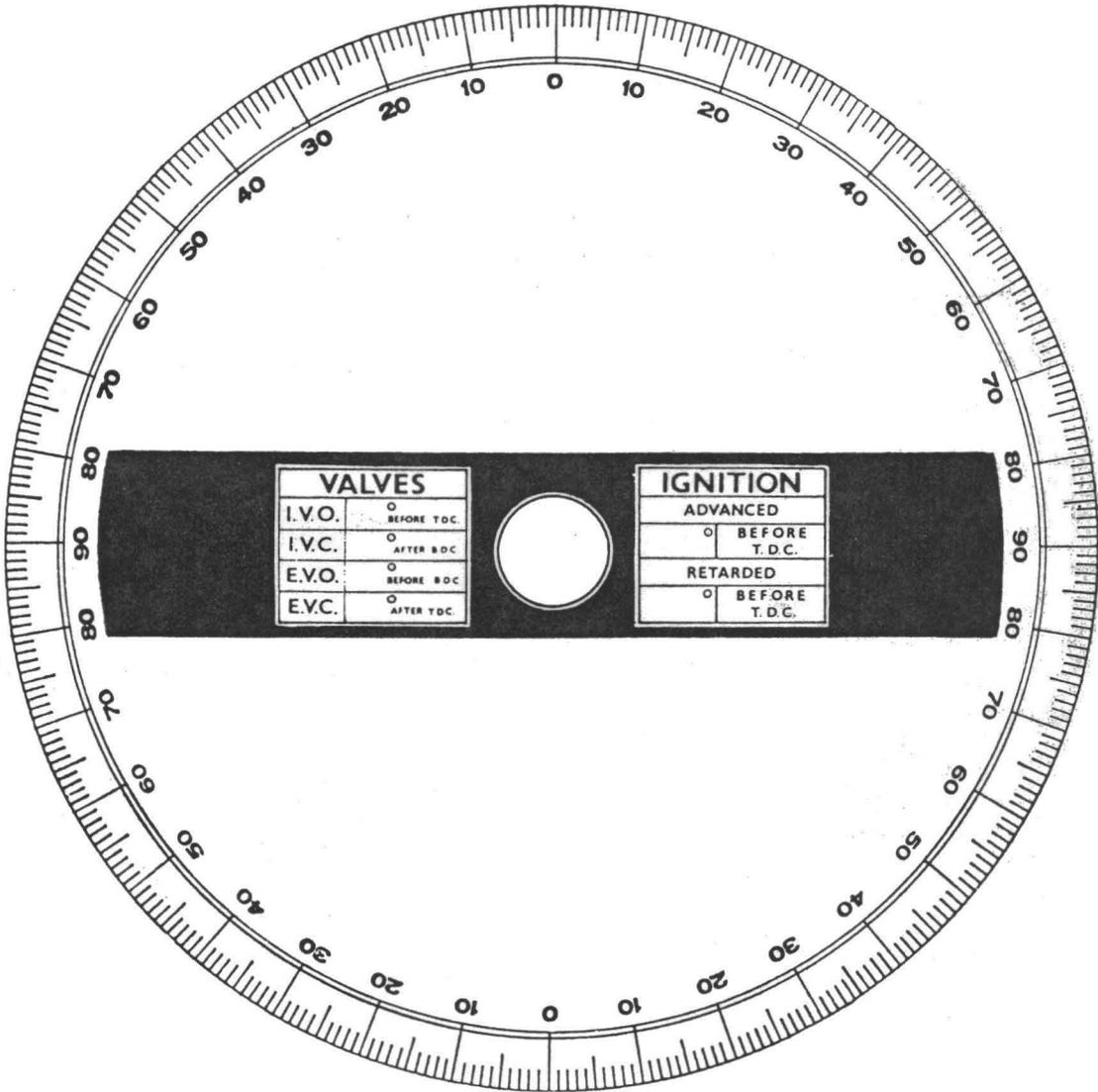
Millimeters to Inches—Units

<i>mm</i>	0	10	20	30	40
0		0.39370	0.78740	1.18110	1.57480
1	0.03937	0.43307	0.82677	1.22047	1.61417
2	0.07874	0.47244	0.86614	1.25984	1.65354
3	0.11811	0.51181	0.90551	1.29921	1.69291
4	0.15748	0.55118	0.94488	1.33858	1.73228
5	0.19685	0.59055	0.98425	1.37795	1.77165
6	0.23622	0.62992	1.02362	1.41732	1.81103
7	0.27559	0.66929	1.06299	1.45669	1.85040
8	0.31496	0.70866	1.10236	1.49606	1.88977
9	0.35433	0.74803	1.14173	1.53543	1.92914
<i>mm</i>	50	60	70	80	90
0	1.96851	2.36221	2.75591	3.14961	3.54331
1	2.00788	2.40158	2.79528	3.18891	3.58268
2	2.04725	2.44095	2.83465	3.22835	3.62205
3	2.08662	2.48032	2.87402	3.26772	3.66142
4	2.12599	2.51969	2.91339	3.30709	3.70079
5	2.16536	2.55906	2.95276	3.34646	3.74016
6	2.20473	2.59843	2.99213	3.38583	3.77953
7	2.24410	2.63780	3.03150	3.42520	3.81890
8	2.28347	2.67717	3.07087	3.46457	3.85827
9	2.32284	2.71654	3.11024	3.50394	3.89764

Conversion Table

<i>To change</i>	<i>Multiply</i>
cc → cu in.	cc × 0.0610 = cubic inches
cc → oz (Imp)	cc × 0.02816 = ounces (Imperial)
cc → oz (U.S.)	cc × 0.03381 = ounces (U.S.)
cu in → cc	cu in. × 16.39 = cubic centimeters
ft-lb → in. lbs	ft-lb × 12 = inch pounds
ft-lb → kg-M	ft-lb × 0.1383 = kilogram-meters
gal (Imp) → liter	Imp gal × 4.546 = liters
gal (U.S.) → liter	U.S. gal × 3.785 = liters
in → mm	in × 25.40 = millimeters
kg → lbs	kg × 2.205 = pounds
kg-M → ft lbs	kg-M × 7.233 = foot-pounds
kg/sq cm → lbs/sq in	kg/sq cm × 14.22 = pounds/square inch
km → mi	km × 0.6214 = miles
lb → kg	lb × 0.4536 = kilograms
lb/sq in → kg/sq cm	lb/sq in. × 0.0703 = kilograms/square centimeter
liter → cc	liter × 1,000 = cc
liter → oz (U.S.)	liter × 33.81 = ounces (U.S.)
liter → qt (Imp)	liter × 0.8799 = quarts (Imperial)
liter → qt (U.S.)	liter × 1.0567 = quarts (U.S.)
mi → km	mi × 1.6093 = kilometers
mm → in	mm × 0.03937 = inches
qt (Imp) → liter	Imp qt × 1.1365 = liters
qt (U.S.) → liter	U.S. qt × 0.9463 = liters

Degree Wheel



\$7.95

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