

TM-10-1287
OCTOBER 18, 1941

OPERATION AND MAINTENANCE

INDIAN MOTORCYCLE MODEL 741-B

Engine Numbers GDA-101 to GDA-5600

War Department Contract Number DA-W398-QM (O.I. 13)

**INDIAN MOTORCYCLE COMPANY
SPRINGFIELD, MASS., U.S.A.**

**TM-10-1287
OCTOBER 18, 1941**

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OPERATION AND MAINTENANCE MANUAL

Compiled and Edited by
THE INDIAN MOTORCYCLE COMPANY

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CAUTION

NO ADDITIONAL EQUIPMENT
WILL BE ADDED ON THIS MOTORCYCLE

MODEL:
741-30.07 CU. IN.

SPEED:
NOT TO EXCEED 60 M.P.H.

OIL:
ABOVE - 32° F. — — — S.A.E. 50
Between 32° and 10° F. — S.A.E. 30
BELOW +10° F. — — — S.A.E. 10 W

SPARK PLUGS:
USE ONLY MFG'S. NO. C-14

INDIAN MOTORCYCLE CO.
SPRINGFIELD, MASS., U.S.A.

43053



INDIAN MOTORCYCLE COMPANY
Springfield, Mass., U.S.A.

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Introduction

This manual contains all of the information necessary to the proper operation, care, maintenance and repair of the Indian Military model motorcycles known as models 640 and 741.

Complete detailed operations are given and fully illustrated for the repair of all major and sub-assemblies with factory clearances and specifications.

Note: The importance of properly servicing new machines prior to placing them in service cannot be overestimated. We respectfully direct your attention to the "New Motorcycle Inspection" charts on pages 0-7 and 0-8 and to the periodic inspection forms on page 0-11.

Throughout, — the entire manual follows the standard "Federal Group System" as used in all parts books, instruction and repair manuals to facilitate your finding the information readily.

Service diagnosis tables are given covering the major units and while no attempt has been made to make them all inclusive — the most probable service information is listed.

Through the proper care, operation and maintenance as pointed out in this manual, you can maintain the performance of the motorcycle or motorcycles entrusted to you at their highest peaks of efficiency.

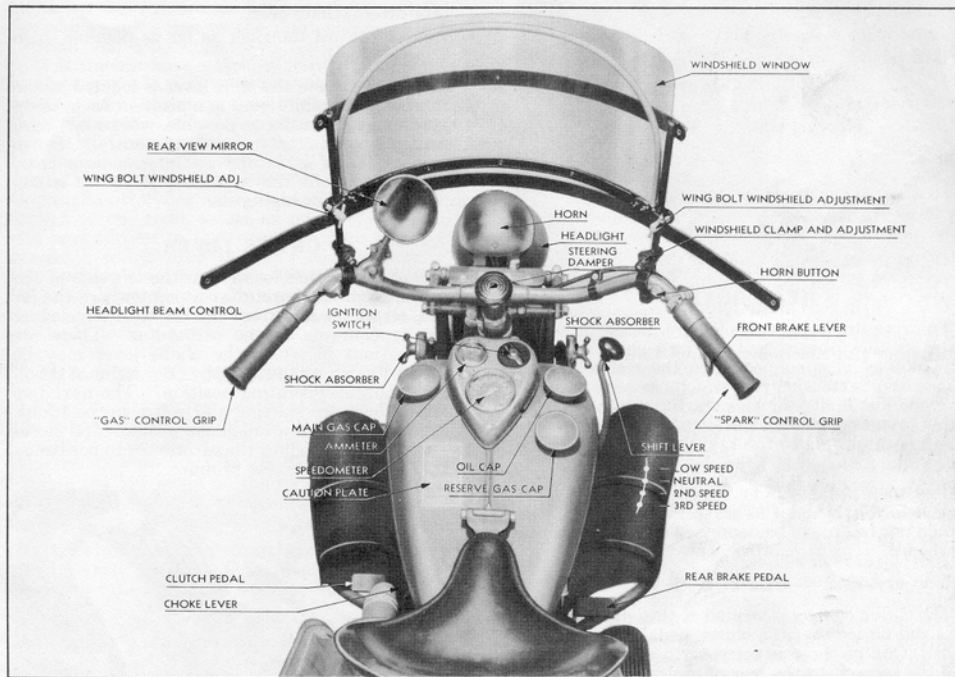
INDIAN MOTORCYCLE COMPANY
Springfield, Mass.

OPERATION

(Controls)

CONTROLS

THEIR LOCATION — OPERATION — USE



While the above illustration is taken of a Model 640-B, all controls are identical to the Model 741-B with the exception that the Model 741 the shift is located at the rear of the tank.

THROTTLE

The throttle or gas control is controlled by means of twisting the left handlebar rubber grip. By turning the grip inward (to the right) the throttle is opened and the speed increased; turning it outward (to the left) closes the throttle or cuts down the speed.

SPARK CONTROL

Similar to the gas or throttle control, the spark advance is also controlled by a rubber grip but at the right handlebar. Turning the spark control grip inward (to the left) advances the spark; turning it outward (to the right) retards the spark. A simple rule to remember is turning both the throttle and spark grips inward (toward the rider) increases the speed; turning both grips outward decreases the speed.

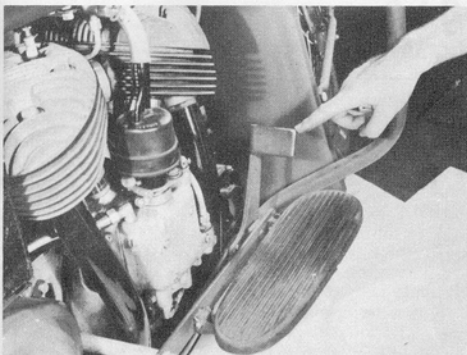
Both the spark and throttle control grips operate a spiral inside the grip itself, which pulls and pushes

a control wire through its outside cables to the carburetor throttle control and distributor control arm. These cables should periodically be saturated with a very light oil that will seep inside of the cable to provide the inside wire control a frictionless surface to prevent binding and sticky operation.

FRONT BRAKE

The front brake is controlled by means of a hand lever at the right handlebar, just forward of the spark control grip. The brake is released when the hand brake lever is in its natural position; and by squeezing or putting pressure on the hand brake lever (drawing it up towards the handlebar) the front wheel brake is brought into operation.

The hand lever should have approximately $\frac{1}{2}$ " motion when properly adjusted. Pressure on the hand brake lever pulls a wire control cable which, in turn, operates the brake arm on the brake plate at the front wheel.

(Controls)**OPERATION****REAR BRAKE**

The rear brake is controlled by means of a foot pedal at the forward end of the right footboard. The foot pedal is connected to the rear wheel by means of an extension rod, which crosses under the machine just under the kick starter, and actuates a second extension rod on the left side of the machine which is connected to the brake control arm at the rear brake plate.

The foot pedal should have approximately $\frac{1}{2}$ " play before it brings the brake into operation and should not be able to be depressed all the way to the footboard.

CLUTCH

The clutch control is located at the left footboard. You will notice that the clutch pedal itself has two pads. One of these is referred to as a "toe pad" and the second (to the rear of the pedal) as a "heel pad." In an engaged position, the heel pad of the clutch pedal should be resting almost on the footboard itself. In a disengaged position, the toe pad should be pressed forward as far as possible.

Unlike a spring type of clutch, the clutch pedal is equipped with a friction disc and tension spring to hold the clutch in any position. The reason for this is so that the rider, in operation of the motorcycle, may disengage the clutch and use both feet to maintain a standing still balance without the danger of having the clutch snap back into an engaged position and cause the motorcycle to jump forward.

SHIFT LEVER

The shift lever controls the transmission gears and allows the machine to be shifted from one speed to another. The lever is located at the right front section of the tanks on the Model 640 and on Model 741 is located at the rider's thigh, from a riding position.

For shift levers located at the front tank position, the gear change positions are as follows:

Forward as far as possible, low gear.

Back toward the rider one notch, neutral.

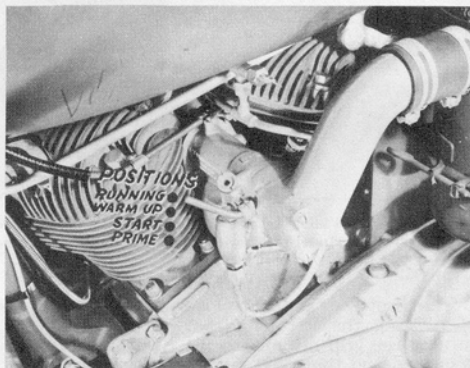
Back one more notch toward the rider, second or intermediate gear.

Back toward the rider as far as possible, high gear.

On models where the shift lever is located at the rider's thigh, the shift lever in a position back, or up towards the rider as far as possible, will be low gear. Down one notch, or forward, is neutral. Down one more notch is second or intermediate gear; and down towards the footboard as far as it will go, will be third or high gear.

CHOKE LEVER

The choke lever is located on the left side of the machine at the carburetor at a point where the air intake elbow leading from the oil bath air cleaner meets or connects to the carburetor. There are four positions in which the choke lever may be shifted. Pulled up towards the rider as far as it will go, is a normal operating position. The next two notches down are starting and warm up positions. All the way down is a full choke position and closes the choke valve to allow the carburetor to pass more gas into the cylinders for priming.

**IGNITION SWITCH**

The ignition switch is located at the right in the instrument panel. Several types of switches have been used on Models 640, so that their operation may best be tested by actual operation of the switch with an eye kept on the ammeter to measure the current drain as the switch is flicked from one position to another.

On the latest model 640-B's and model 741-B's a key locking switch using the standard Military No. H-700 key is used. With this switch it is not necessary to leave the key in its position during operation of the machine; it is only necessary to unlock the switch, after which the key may be re-

OPERATION

(Controls)

moved, leaving it in an unlocked position. Caution should be taken, however, to lock the switch on leaving the machine. The switch, when turned as far to the left as possible, will be in an "off" position. One notch to the right will operate the ignition and send current to the ignition system so that the machine may be started. Two notches to the right will still pass current to the ignition system and at the same time to the blackout lighting equipment. In order to turn the switch to the service lighting equipment, it is necessary to depress the small button on the switch face before the switch can be turned to its next notch to the right. When the small button has been depressed and the switch flicked to the right as far as possible, the switch will pass current to the ignition system and to the service headlight and tail light circuits only. In this position the Hi-Lo beam control switch on the left handlebar is also brought into the circuit. Stop Lights are connected so they operate only on the B. O. and service circuits.

HI-LO HEADLIGHT BEAM CONTROL

This control switch is located at the left handlebar and is operated by flicking the "toggle type" switch forward or backward. There are only two positions on this switch. In its first position it will operate the low beam on the service headlight and in its next position it will switch the current from the low beam to the high beam of the service light.

The switch itself is automatically cut out of the circuit when the main light switch at the panel is in any other position than its service headlight position.

STEERING DAMPER

The steering damper is located at the handlebar top just ahead of the instrument panel. The purpose of the steering damper is to increase the stability of the machine under hard, fast riding. Its adjustment brings into play a set of friction discs underneath the fork head which, by being tightened or loosened, control the ease with which the handle-

bars may be turned either to the left or right. Under normal conditions this control should be left fairly loose and can best be adjusted by the rider under actual riding conditions. It should never be tightened (turned to the right) to a point where the handlebars will turn too hard but should be adjusted to a point where it is easiest for an individual rider to handle the particular machine.

RIDE CONTROLS

Ride control adjustments are provided on the left and right sides of the front fork. Through loosening or tightening the wing handles, the spring action of the front fork can be "snubbed" or "freed" to meet the individual requirements of the rider and the particular road surface being travelled. On a fairly smooth road or concrete highway, it will perhaps best be found to leave these rather loose; whereas on rough country roads or washboard dirt roads, it will no doubt be found that they must be tightened up somewhat to snub the fork spring action in order to increase the control that the rider has over the machine.

HORN BUTTON

The horn button is located at the right handlebar in a natural thumb position and operates the horn by pressing the button at its center.

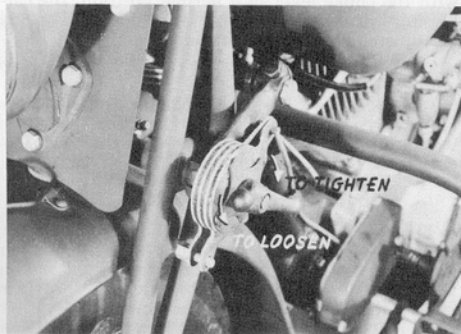
AIR PUMP

The air pump is located on the left side of the machine at the top safety guard tube and is held to the tube by means of two spring clips. The pump may be removed from its position by being released from the clips. A short rubber connecting tube is screwed into the handle of the pump and must be unscrewed, removed from the pump handle, and attached at the base of the pump before being used to pump up a tire. The pump is provided only as an emergency means of pumping a tire.

KICK STARTER

The kick starter, or starting arm by which the motor is started, is located at the right side of the machine just below the saddle. A rubber pedal shaped to fit the rider's foot is used in order to give the rider extra purchase for pressing down the pedal to start the engine. Starting the engine is accomplished through throwing the rider's weight, through his right foot, onto the pedal and pressing the kick starter pedal down to the bottom of its natural swing. A spring automatically returns the kick starter pedal to an "up" position as soon as pressure is taken off the pedal. A ratchet adjustment allows the pedal to come back up when foot pressure is released.

The pedal is also geared to the transmission so that a full swing will turn over the engine several revolutions.



(Use of Controls)**OPERATION****AMMETER**

The ammeter is located at the left side of the instrument panel and indicates the amount of current being used. It also indicates the flow of current being supplied to the battery by the generator or rate of discharge from the battery. When the engine exceeds its idling speed, the generator charges the battery and the needle should show on the positive side. At a slower speed, the needle will show on the negative or minus side.

It is very important that under operating condition the ammeter be watched closely to ascertain the flow of current from or to the battery, since this military motorcycle depends entirely on the condition of the battery for its ignition and lighting operation.

SPEEDOMETER

The speedometer on the Model 640-B machines is located in the instrument panel at the forward section of the tanks and indicates the road speed in miles per hour, in addition to registering the complete mileage that the machine has travelled since its first operation. The speedometer on the Model 640-B is driven from the rear wheel.

On the Model 741-B the speedometer is located on the front fork directly forward of the handlebar

and is driven from the front wheel. It also registers, as well as miles per hour, the complete distance that the machine has travelled since its first operation.

GASOLINE TANK SHUT-OFFS

Gasoline tank shut-offs are provided on both the left and right sides of the machine for each individual tank. The main tank is on the left side and holds approximately 2 3/10 U. S. gallons of gas. The reserve or right tank with its filler cap at the rear, holds approximately 1 3/10 U. S. gallons of gas. Directly underneath the tanks on either side the shut-offs are located. It is advisable to operate the machine on one tank at a time, always keeping a supply of gas in reserve so that when one tank runs dry the operator will keep in mind the fact that his gas supply is running low.

GAS TANK FILLER CAPS

A gas tank filler cap is located at the left forward section of the tank and another at the right rear section of the tank.

OIL FILLER CAP

The oil filler cap and oil storage tank is located at the right front section of the tank. The oil tank has a capacity of approximately 2 3/4 U. S. quarts.

◆

USE OF CONTROLS IN MOTION

SPARK CONTROL

The spark control should always be turned to a fully advanced position under normal riding conditions. For negotiating steep hills it may be found advisable to slightly retard the spark (turning it outward) in order to prevent detonation and keep from firing the spark plugs too quickly while the machine is under load. It may also be found advisable, on some machines, to slightly retard the spark to avoid a kickback at the kick starter pedal when starting. Machines will vary somewhat and by a careful manipulation of the spark control there will be found one spot on each machine that will allow easier and quicker starting than any other spot.

THROTTLE CONTROL

By turning the throttle control inward towards the tanks (to the right) the speed of the machine on the highway will be increased. When slowing for traffic or slowing to come to a standstill, the throttle should be turned as far to the outside as possible or in a "closed" position. In a "closed" position the motor will still continue to run providing that the carburetor is properly adjusted. The throttle must also be closed at each time when a change in gears is made.

CHOKE

The machine should not be run with the choke lever in a full choke position. The full choke position is to be used only when priming or starting the engine and should be pulled up towards the rider one notch for starting, two notches for warming up, and under normal conditions—for continuous riding—should be in an "up" position as far as it will go. If the machine will not operate with the choke lever in a normal position, the carburetor apparently is out of adjustment and should be adjusted by a unit mechanic.

With a warm engine, or an engine that has been stopped for only a short time, it will undoubtedly not be necessary to use the choke lever at all. It is best, with a warm engine, to try starting the engine without using the choke lever and then using it only if the engine fails to start after several kicks.

FRONT BRAKE

The front brake control is adjusted to a point where it will not lock the front wheel except on loose dirt or gravel. Under normal conditions on the highway, the use of the front brake provides only a dragging action of the front wheel rather than a locking action. However, caution should

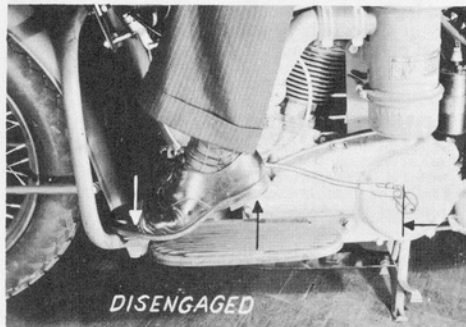
OPERATION

(Use of Controls)

be used in applying the front wheel brake on loose cinders or sand, since the friction of the wheel to the ground will not be great enough to keep it from becoming locked. It is also advisable that the front wheel brake not be used in turns at high speed, since there is always a possibility that loose dirt may allow the wheel to become locked and it is not the purpose of the front wheel brake lever to provide any locking action.

REAR BRAKE

Due to the leverage that is possible through the rear brake pedal action, it is advisable that the rear brake be used only lightly and pressed down with caution, since the rear brake will lock when the pedal is pressed all the way down. A finer braking action and a quicker braking action can be secured by pres-



sing the pedal far enough to drag the rear wheel to a stop rather than slide it. A locked rear wheel will slide and may cause the rider to skid uncomfortably. Expert manipulation of the foot brake control will add greatly to the tire life of the machine.

CLUTCH CONTROL

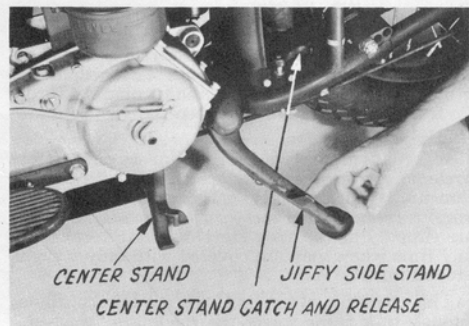
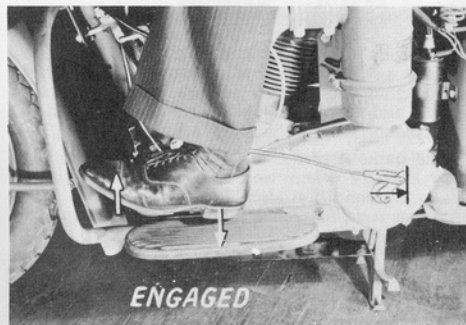
The clutch disengages the engine power output from the transmission so that a change of gears from

one speed to another may be effected. It is absolutely necessary that the clutch pedal be pressed as far forward as possible, with the toe plate down, in shifting from one gear to another. Failure to push the clutch far enough or disengage the clutch far enough, may cause a grinding of the transmission gears and cause serious transmission damage. In starting from a standstill, the clutch should be eased back very gently with the heel of the rider's foot to accomplish smooth starting. The friction discs and tension spring of the clutch pedal should be tight enough so that the clutch control pedal does not creep back from a disengaged position when the rider's foot is taken from the pedal. If it is found that the clutch does creep back into an engaged position, adjustment should be made by the unit mechanic and tension increased at the pedal friction discs.

STANDS

On the Model 640-B machine a side Stand is located on the left side of the machine to the rear of the transmission at the frame. The purpose of this Stand is to provide a stand which can be kicked outward so that the machine may be rested on it when not in use.

On the Model 640-B a center stand is also provided so that the machine can be rested in an upright position. To operate the center stand there is a release lever at the lower end of the mudguard directly in back of the transmission on the left side of the machine. Pull the release lever out away from the machine and the center stand will drop down. This cannot be released until the Jiffy Stand is out. With the machine resting on its Jiffy or side stand, swing the weight of the machine over onto the Jiffy Stand and the center stand will automatically swing itself forward by means of a spring to a position where the machine can be straightened up onto the center stand alone. To catch the center stand back in its normal running position push the machine forward off of the stand, catch the toe of the shoe underneath the stand bringing it up as far as possible under the machine and catching it back in place with the release lever.



(How to Ride)

OPERATION

JIFFY AND CENTER STANDS

Under no conditions should a machine be driven with either the center or Jiffy Stand down. A Jiffy Stand that has not been returned to its normal running position back up against the frame tube, is dangerous and may possibly spill the rider as he tries to negotiate a left turn.

JIFFY STAND ON MODEL 741-B

On this model the Jiffy Stand is located underneath the footboard at the left side of the machine. This can be swung out away from the machine to right angles with the motor, so that the machine may be rested on this side stand. Under no condition should a rider try to operate the Model 741-B with the side stand not returned to its normal position up under the footboard.

REAR STAND

On the Model 741-B a rear stand is provided at the rear of the machine. This is held in place by a spring clip at the mudguard and can be released by pulling out on the spring catch. This will drop the rear stand down so that the machine may be pulled back up onto the stand so that it will rest in an upright position.

SHIFT LEVER

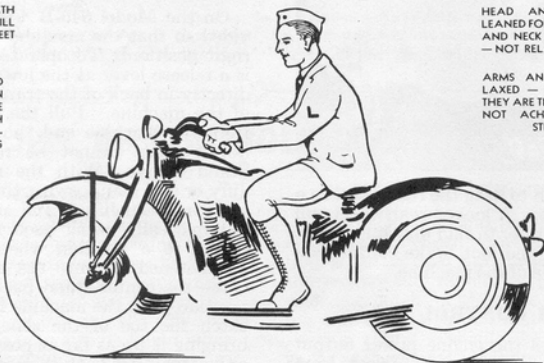
In starting an engine the shift lever should always be positioned in its neutral position and any change of gears should be properly made by first disengaging the clutch before shifting the lever to bring into play a gear change. Shifting the lever without first disengaging the clutch may result in serious damage to the transmission. It is advisable, when breaking in a new machine, to use the intermediate gear on steep hills or at any time when a load is placed on the engine.

SUGGESTIONS ON HOW TO RIDE

EYES GLUED TO PATH
YOUR WHEELS WILL
TAKE FIFTY FEET
AHEAD OF YOU.

FIRM BUT NOT RIGID
VISE LIKE GRIP ON
BARS. USE THE
BARS TO STEER WITH
NOT AS SOMETHING TO HANG
ON TO!

KNEES TIGHTLY
GRIPPING SIDES OF
TANK. USE THEM
TO HANG ON WITH



HEAD AND SHOULDERS
LEANED FORWARD... BACK
AND NECK MUSCLES TIGHT
— NOT RELAXED

ARMS AND ELBOWS RELAXED — NOT TENSED IF
THEY ARE TENSED YOU WILL
NOT ACHIEVE SENSITIVE
STEERING

SIT TIGHT
... FIRMLY
IN SADDLE

FEET AS FAR BACK ON FOOTBOARDS
AS POSSIBLE — PRESSED DOWN HARD ON FOOTBOARDS

Avoid sudden starts. A motorcycle can take off from a standing start somewhat faster than the ordinary vehicle. Use caution in turning the throttle from a standing start to keep the vehicle under control at all times.

Wet roads are not necessarily slippery on a motorcycle, any more than they are on a car. Use caution until you are fairly well acquainted with the various types of road surfaces. All roads, however, are slippery at the very start of a rainstorm or at any time when they are covered with only a slight ground mist.

This condition alters itself when a rain continues enough to a point where the roads are "washed."

The reason for this is that when the roads first become wet, the oily film left from automobile exhausts that has settled on the surface, becomes "slick" and remains that way until the road is so wet that this top surface "washes" off.

The painted traffic lane line on all highways is very slippery when wet and should be avoided. Under no condition should you approach a curve on a wet road in such a manner as to be forced to cross these lines.

Concrete surface highways are not slippery when wet except over the dark oil streak that is left on most concrete highways and which is very noticeable.

O P E R A T I O N

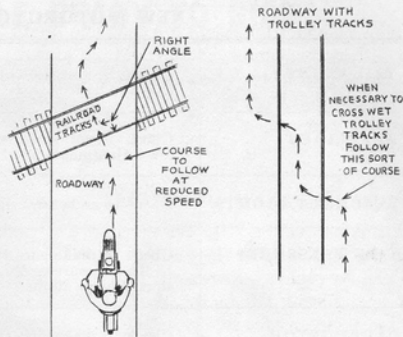
(New M/C Inspection)

Always cross car tracks or railroad tracks with extreme caution, whether they are wet or dry.

In parking the machine always leave the clutch pedal in an engaged position with the heel plate against the footboard. Failure to do this constantly will, in time, weaken the clutch springs and may cause slipping.

Riding over rough country, through dirt and on backwoods roads, should be practised as much as possible. A keener sense of judgment and greater experience can be gotten more quickly through riding of this type than by continual riding on paved roads.

Keep your machine in tip top condition and report to your unit mechanic any noises or peculiarities about the particular machine you are riding that do not seem quite right.



NEW MOTORCYCLE INSPECTION

NOTE: The following items should be checked very carefully on new machines as they are taken from the crates and set up in a ready-to-ride condition. Transportation of the vehicle from the factory to its final destination sometimes jars and shakes the vehicle to such a point that it is necessary to recheck all of the fittings, bolts and nuts, to see that they are tight. In order to systematically check the condition of the motorcycle, we suggest that the following items listed on this sheet be checked as to their condition.

SPEEDOMETER DRIVE	Check the lubrication. (See lubrication recommendations)
STEERING DAMPER ACTION	By turning the steering damper control handle, check to see whether or not the friction plates underneath the fork head are brought into play. Friction plates should never be allowed to become coated with oil or grease. Sometimes excessive lubrication of the fork fittings will cause grease to gather on the friction plates.
BATTERY	Check to see that the battery is fully charged and has the correct water level. Check all ground connections.
CONTROLS	Check the operation of all controls including the throttle, spark, clutch, shift lever, hand brake and foot brake. Lubricate with #10 oil the throttle and spark control cables, allowing the oil to seep inside of the casing to lubricate the control wire inside the casing. This should be done the full length of the cable that is exposed.
STEERING HEAD	With the steering damper control loosened, check to make sure that the steering head works freely but at the same time is not loose.
LUBRICATION	Check all lubrication fittings, oil pump and oil holes, in accordance with the standard lubrication charts for the machine.
BRAKES — FRONT AND REAR	Check the action of the front and rear wheel brakes. The front wheel brake handle should be able to move about $\frac{1}{2}$ of an inch play before bringing the brake into action. The rear wheel brake should be adjusted to allow the foot pedal to depress about 1 inch before bringing the brake into action.
WIRING	Check all wiring terminals to make sure that they are tight and check the length of all wires to make sure that they are not pinched or in a position to become pinched.

NEW MOTORCYCLE INSPECTION (Continued)

TAIL LIGHT	Check the operation of the tail lights to make sure that the wire is tight in its socket and that the light is O. K.
HEADLIGHT	Check the service headlight with the light lit to make sure that the beam on its high and low adjustments is set to conform to regulations.
BLACKOUT LIGHTS	Check to make sure that all blackout lights are in operation and that the wires are tight.
TIRE PRESSURES	Check to make sure that the tires are properly inflated. The front tire should carry 18 lbs. pressure — the rear tire 20 lbs. In checking sidecar equipment the sidecar tire should be at 20 lbs.
CARBURETOR ADJUSTMENT	Check to make sure that the throttle control opens and closes to its limit the throttle control valve at the carburetor. Low and high speed needle adjustments should be adjusted by a unit mechanic, in accordance with the instructions given under "Adjustment of the Carburetor" in the Fuel System Section of this Manual.
FUELING THE MACHINE	Check the gas and oil supply. The left tank should be filled to within a couple of inches of the top with gas, the right rear tank should be filled to within a couple of inches of the top with gas, and the right front tank should be filled to within two inches of the top with the correct and proper grade of oil. Note: It has been done by inexperienced persons, i.e., filling the oil tank with gas and the gas tank with oil. Never, under any conditions, be guilty of this error. If this does happen and gas is put into the oil tank, it is very serious. The oil tank should be drained immediately so that the gasoline does not enter the lubrication system.
PRIMARY DRIVE AND TRANSMISSION LUBRICATION	The primary drive and transmission are lubricated from the same filler cap. Remove the level screw in the side of the case and fill according to lubrication Recommendations on page 41-21.
BROKEN PARTS	Check the machine from one end to another for parts that may possibly have become broken in transit.
LOOSE NUTS AND BOLTS	Check the entire machine with the proper wrenches, making sure that all nuts and bolts are tight, and as they should be.
WHEEL STUDS	On models with interchangeable wheels, the wheels are held by means of six wheel studs. The Model 741 and Model 640 do not have these wheel studs but on other models check to make sure that the wheel studs are as tight as possible.
OIL BATH AIR CLEANER	Check to make sure that the oil bath air cleaner has the proper amount of oil in the oil reservoir. This should be filled with the same oil as is used for the engine.
GENERATOR CHARGING RATE	With the service headlight on, or lighted, check the generator charging rate at the ammeter. It should break even with the motor racing slightly with all lights on. If it does not, boost the rate by moving the third brush at the generator in accordance with instructions given under the Electrical Section of this Manual.
SADDLE POSITION	Check to make sure that the saddle position is proper for the rider to whom the machine is to be assigned.
ROAD TEST	After completely setting up a new machine and checking the points mentioned previously, the machine should be subjected to a road test of several miles, checking under actual riding conditions the action of the complete machine with any necessary adjustments being made by the unit mechanic on completion of the road test.

OPERATION

(Servicing)

MAKING THE MOTORCYCLE READY TO RIDE

FILLING THE GAS TANKS

Remove the filler cap from the left tank and fill with gasoline to within an inch or so of the top (approximately 2 1/10 U. S. gallons). Remove the right rear cap from the right tank and fill to within approximately one inch of the top with gasoline (approximately 1 1/10 U. S. gallons).

FILLING THE OIL TANK

The proper and correct grade of oil to be used in filling the oil tank, oil bath air cleaner, transmission and primary drive, must be governed by the climatic temperature and conditions. Reference to the oiling recommendations under "Motor Lubrication" should be consulted.

Remove the filler cap at the front section of the right tank and fill to within two inches of the top of the tank. This space of two inches, or approximately, must be left to allow for expansion of the oil vapors (capacity 2 3/4 U. S. quarts).

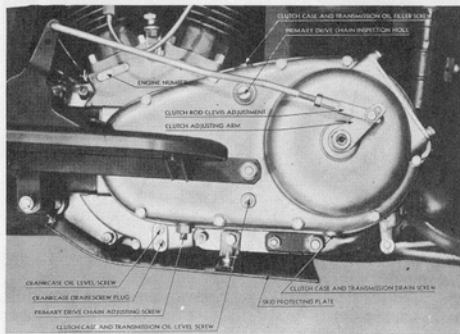
FILLING THE OIL BATH AIR CLEANER

Remove the reservoir on the oil bath air cleaner at the left side of the machine and fill with the same grade of oil as used in the oil tank to the oil level line marked on the reservoir.



TRANSMISSION AND PRIMARY DRIVE

The transmission and primary drive should be filled with oil of proper grade according to lubrication recommendation chart, page 41-21. The transmission and primary drive are both filled and their oil level checked by the same means. To fill, remove the oil level screw directly under the left footboard rear mounting shaft. Directly over this and on top of the primary drive cover case there is an oil filler screw plug; the one on the side of the case is an inspection screw plug but the one on top of the case is



the one we are interested in. Remove this top plug and pour in oil until it begins to flow out of the hole from which the oil level screw plug was removed. Allow time for the oil to run from the primary drive into the transmission before rechecking the level. This must be done with the machine in a vertical position and not resting on the side stand. If the oil level is checked on the side stand, it will necessarily be inadequate when the machine is returned to an upright position. Replace both of these plugs after checking the level and filling the transmission.

CHECKING THE OIL CIRCULATION

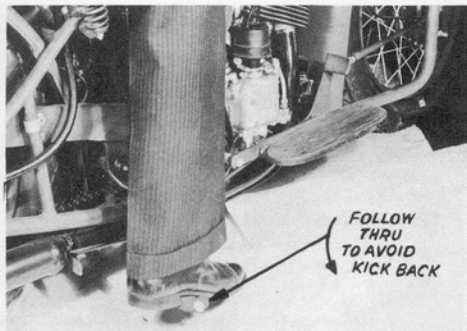
When the engine has been started for the first time, or after standing for some length of time, the circulation of the oil should be checked. To do this remove the filler cap at the oil tank and, with a flashlight, watch the return of oil to the tank while the engine is running. The oil should return through its return tube with a pulsating action. In the event that, after a few minutes, the oil does not return through this return tube, check the motor lubrication completely.

STARTING THE MOTOR

- (a) Open the gasoline tank shut-off located underneath the gasoline tank. Separate shut-offs are provided for each tank. To open turn either one counterclockwise.
- (b) Set the gear shift lever in a neutral position.
- (c) Check to make sure that the clutch pedal is in an engaged position with the heel plate of the pedal pressed down toward the footboard as far as it will go. If the clutch is not in this position, the kick starter will not turn over the engine when operated and may possibly injure the rider as he throws his weight onto the pedal.
- (d) Check to make sure the ignition switch is in an "off" position.

(Starting)

OPERATION



- (e) Prime the engine by pressing down on the kick starter with your foot, two or three times. The first few kicks should be made with the gas control handlebar grip wide open (clockwise) as far as it will go. The choke lever at the carburetor should be in a full choke position (all the way down).
- (f) When fully primed, return the choke lever one notch up, twist the left grip gas control to a closed position as far to the outside as it will go, then open it a fraction of a turn.
- (g) Advance the spark control by turning the right grip to the left (inward) as far as it will go, then back off about a third of a turn to a slightly retarded position.
- (h) Turn the ignition switch to the first notch and press down on the kick starter with a good strong kick, following through with the foot to avoid danger of the kick starter kicking back.
- (i) If the engine does not start, check and repeat the process over again.
- (j) As soon as the engine starts, open the throttle just enough to keep it running while warming up. When it begins to warm up, pull the choke lever up one more notch. A cold motor should be allowed a minute or two to warm up. When the engine is completely warmed up, pull the choke lever all the way up to its normal running position.

Note: Starting a "hot" or warm motor does not usually require the use of a choke. Racing the motor while standing still is the worst abuse you can give it and should not be done at any time.

HOW TO BREAK IN A MOTOR PROPERLY

By far, the most important of all is the "breaking in" of the motorcycle engine. Many operators of motorcycles have often wondered, after running their machines not more than 20 to 25 miles an hour for a period of 500 to 1,000 miles, why they should not then be able to ride the machine wide open.

The reason that this cannot be done is that these lower speeds do not subject the various parts to the rapid and maximum expansion caused by the heat of a wide open throttle.

For the first hundred miles avoid all steep hills and run at speeds of 20 to 35 miles per hour, using gear changes to relieve any load that steep hills may place on the engine. Do not exceed a speed of 40 miles an hour in spurts or when passing another vehicle.

During the next 400 miles it will be all right to ride at from 35 to 40 miles an hour. However, do not ride over 50 miles an hour during this period, and then only for a short distance. If in this period the motor does not seem to be freeing up quite as much as it should, continue operation at these speeds further.

Generally, at the end of 500 miles, it is safe to actually begin breaking in an engine but before doing so the machine should be given a thorough inspection and checked over. Special attention should be given to the tightening of all of the cylinder and manifold nuts, as well as the proper adjustment of tappets and drive chains. By this time it should be safe to begin breaking in the motor to full throttle operation; in other words, having done exactly as outlined for the first 500 miles, it is about time to begin breaking the motor in for speed.

After first riding at 35 miles per hour, open the throttle wide and allow the machine to reach a speed of 55 miles per hour — then close the throttle quickly and permit the machine to slow down, under compression, to about 35 miles per hour. Do this several times and make sure that the motor has had time to cool by slow running between these spurts. The speed can be increased five miles per hour for every 100 miles of riding until the maximum speed has been reached. For example, at 600 miles allow the machine to reach 60 miles per hour before closing the throttle, etc. Be sure at all times to shut off immediately when the various speeds have been reached to allow the engine to cool. At this time the machine must accelerate quickly and, if not, stiffness is indicated and more limbering up of the engine is necessary. Throughout the entire period of breaking in, just remember that good judgment must be used and that any time there are signs of stiffness or laboring the machine should be stopped and allowed to cool. Particular care must be taken to shut off immediately on reaching top speed, and even after 1,000 miles the machine should not be run at its full speed for too long a period.

A WORD OF CAUTION — do not race a cold motor — allow the temperature to rise slowly and be sure the oil and engine are thoroughly warmed up before attempting fast riding. A few minutes' warming up period to allow the oil to completely circulate and free up all of the engine parts, will more than be repaid in dependable performance.

OPERATION

(M/C Checkup)

DAILY CHECK SHEET

1.	Gas	
2.	Oil	
3.	Tire Pressures	
4.	Tire Condition — Check for breaks, cuts or bruises.	
5.	Brakes	
6.	Carburetor Adjustment	
7.	Lubrication	
8.	Washing and Cleaning. The engine should be washed off completely if the machine has been subjected to operation under extremely dusty conditions on the previous day's run.	
9.	Functional Failures. Any functional failure noted in the previous day's operation should be brought to the attention of the unit mechanic and remedied at once.	

WEEKLY OR 50 HOUR CHECK

1.	Fork Head Fitting	
2.	Wheels	
3.	Oil Tanks, Primary Drive and Transmission	
4.	Chain Adjustment	
5.	Carburetor Adjustment	
6.	Ignition Points	
7.	Spark Plugs	
8.	Battery	
9.	Primary Drive Adjustment	
10.	Control Grips	
11.	Generator Chain Adjustment	
12.	Lubrication	
13.	Road Test	

FIRST 300 MILE CHECK SHEET

Note: Army Models should be checked between two and three hundred miles, depending on the type of service which they are immediately put into. In other words, if a new machine is subjected to severe mileage in its very first miles the 300 mile check should be given even earlier.

TAPPET ADJUSTMENT	Intake tappets should be adjusted to .006 — exhaust tappets to .008, with the motor cold.
PRIMARY DRIVE	The oil level in the primary drive and transmission should be checked to make sure that it is up to the oil level.
PRIMARY DRIVE CHAIN	The primary drive chain should be adjusted, or checked for adjustment, so that it has about $\frac{3}{4}$ of an inch up and down play, or a play equal to the distance of the inspection hole in the side of the case.
REAR CHAIN	The rear chain should be checked for adjustment. Refer to "Care of the Chain" for lubrication data.
GENERATOR CHAIN ADJUSTMENT	The generator chain should be checked to take up on any excess slack that might have developed in the first miles. There should be $\frac{1}{2}$ inch up and down play at the chain's center.
ALL CONTROLS	All controls should be checked to make sure that they are in proper working order, with particular attention being given to the lubrication of the throttle and spark control cables.
LOOSE NUTS AND BOLTS	All nuts and bolts should be checked to make sure that they are tight. In the first mileage of any machine, depending somewhat on the type of use to which the machine is put, looseness will develop and should be taken up.
OIL	Drain and refill the oil tank at the forward section of the right tank. Remove the oil bath air cleaner reservoir and fill with fresh oil to its mark. If the machine has been subjected to operation under extremely dusty conditions, the air cleaner should be removed and cleaned in gasoline, in accordance with the instructions given in this Manual under "Care of the Oil Bath Air Cleaner."
DAILY CHECK	The above points should be checked in addition to the points mentioned under "Daily Check."

LUBRICATION

Lubrication is the most vital factor in the life of the motorcycle, and regular and periodic attention should always be given to the proper lubrication of the entire vehicle.

Vehicles in military use are difficult to prescribe lubrication recommendations for because of the fact that the vehicles are subjected to operations that are far from being normal.

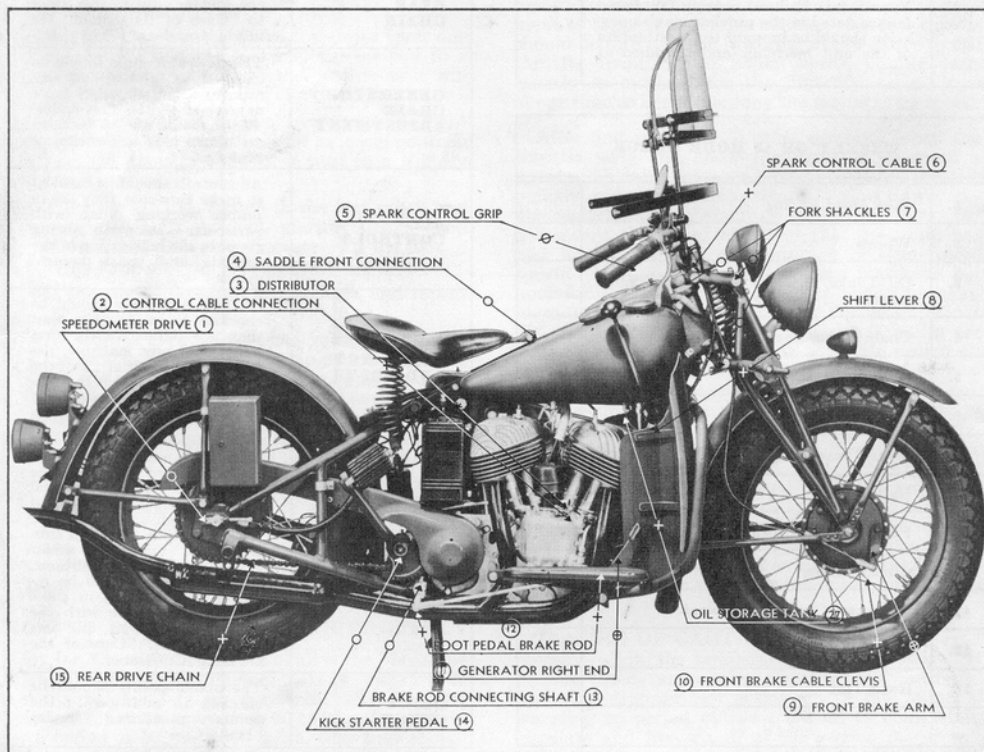
Operation extensively of the vehicle over dusty surfaces will naturally accumulate excess dirt onto the wearing and exposed parts of the vehicle and necessitate washing which, in turn, will shorten the periods of lubrication.

Where vehicles are not in use for some time and

then brought back into use, their lubrication should be checked over completely, including the oil that goes into the engine and circulates throughout the system. A machine that has stood for any length of time will necessarily allow the lubricants to harden and for this reason should be checked over very carefully.

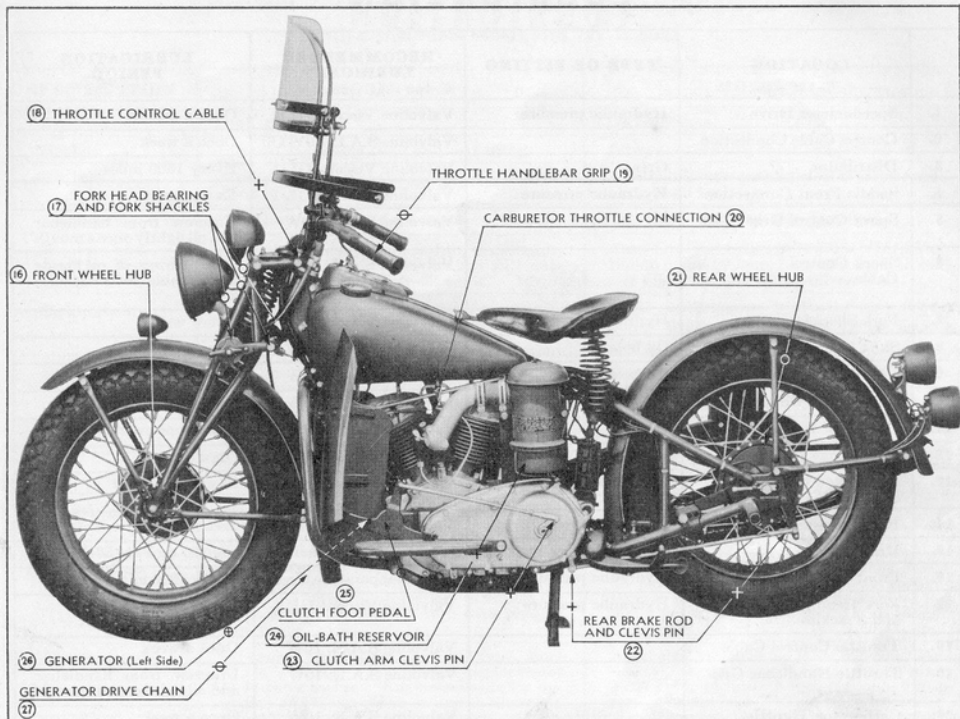
LUBRICATION AND GREASING OF THE MILITARY MODELS 640 AND 741

For reference as to the location of the fittings, connections and oil holes on either side of the machine, refer to the illustrations for both sides of the machine. All of these fittings and oil holes are identified against the key numbers.



OPERATION

(Lubrication)



KEY

- Hydraulic Grease Fittings
- ⊕ Oil Holes
- * Grease Cups
- + Oil
- ⊖ Grease

(Lubrication)

OPERATION

LUBRICATION

	LOCATION	TYPE OF FITTING	RECOMMENDED LUBRICANT	LUBRICATION PERIOD
1.	Speedometer Drive	Hydraulic pressure	Valvoline Viscous GL-1	Once a month
2.	Control Cable Connection		Valvoline S.A.E. 10W Oil	Once a week
3.	Distributor	Grease cup	Valvoline Viscous GL-1	Every 1500 miles
4.	Saddle Front Connection	Hydraulic pressure	Valvoline Viscous GL-1	Every month
5.	Spark Control Grip		Valvoline S.A.E. 10W	Unscrew from handlebar and oil lightly once a month
6.	Spark Control Cable		Valvoline S.A.E. 10W	A few drops of oil inside fabric cable covering once a week
7.	Fork Shackles	Hydraulic pressure	Valvoline Viscous GL-1	Every week
8.	Shift Lever	Oil hole	Valvoline S.A.E. 10W	Once a week
9.	Front Brake Arm	Oil hole-640-pressure 741	Valvoline S.A.E. 10W	Every week
10.	Front Brake Cable Clevis		Valvoline S.A.E. 10W	Every week
11.	Generator Right End	Oil cup	Valvoline S.A.E. 10W	Few drops every 500 miles
12.	Foot Brake Pedal Rod		Valvoline S.A.E. 10W	Once a week
13.	Brake Rod Connecting Shaft	Hydraulic pressure	Valvoline Viscous GL-1	Every 500 miles
14.	Kick Starter Pedal	Hydraulic pressure	Valvoline Viscous GL-1	Every month
15.	Drive Chain	(Refer to instructions under "Care of Chain" in Group 57 on Page 57-1)		
16.	Front Wheel Hub	Hydraulic pressure	High Temperature Grease	Every 1000 miles
17.	Fork Head Bearing and Shackles	Hydraulic pressure	Valvoline Viscous GL-1	Every week
18.	Throttle Control Cable		Valvoline S.A.E. 10W	Once a week
19.	Throttle Handlebar Grip		Valvoline S.A.E. 10W	Unscrew from handlebar and oil lightly once a month
20.	Carburetor Throttle Connection		Valvoline S.A.E. 10W	Once a week
21.	Rear Wheel Hub	Hydraulic pressure	High Temperature Grease	Every 1000 miles
22.	Rear Brake Rod and Clevis Pin		Valvoline S.A.E. 10W	Once a week
23.	Clutch Arm Clevis Pin		Valvoline S.A.E. 10W	Once a week
24.	Oil Bath Reservoir		Same grade of oil as used in engine	Remove, drain and clean every time oil is changed in tanks. Refill to oil level with the same grade of oil as used in engine and replace
25.	Clutch Foot Pedal	Hydraulic pressure	Valvoline Viscous GL-1	Every month
26.	Generator Left End	Oil cup	Valvoline S.A.E. 10W	Every 500 miles
27.	Oil Storage Tank		Engine oil in accordance with oil recommendation table on Page 41-21	Drain and refill with 2.3 U.S. quarts every 1000 miles, add necessary oil between changes
28.	Generator Drive Chain for Model 640 only		Viscote T.D. 250	Remove cover plate and grease every 1000 miles
Note: For Model 741 generator drive chain, lubrication is automatic and controlled by the breather oil oil pipe from the oil storage tank. This also should apply on Model 640's that may have been converted to automatic lubrication.				

O P E R A T I O N

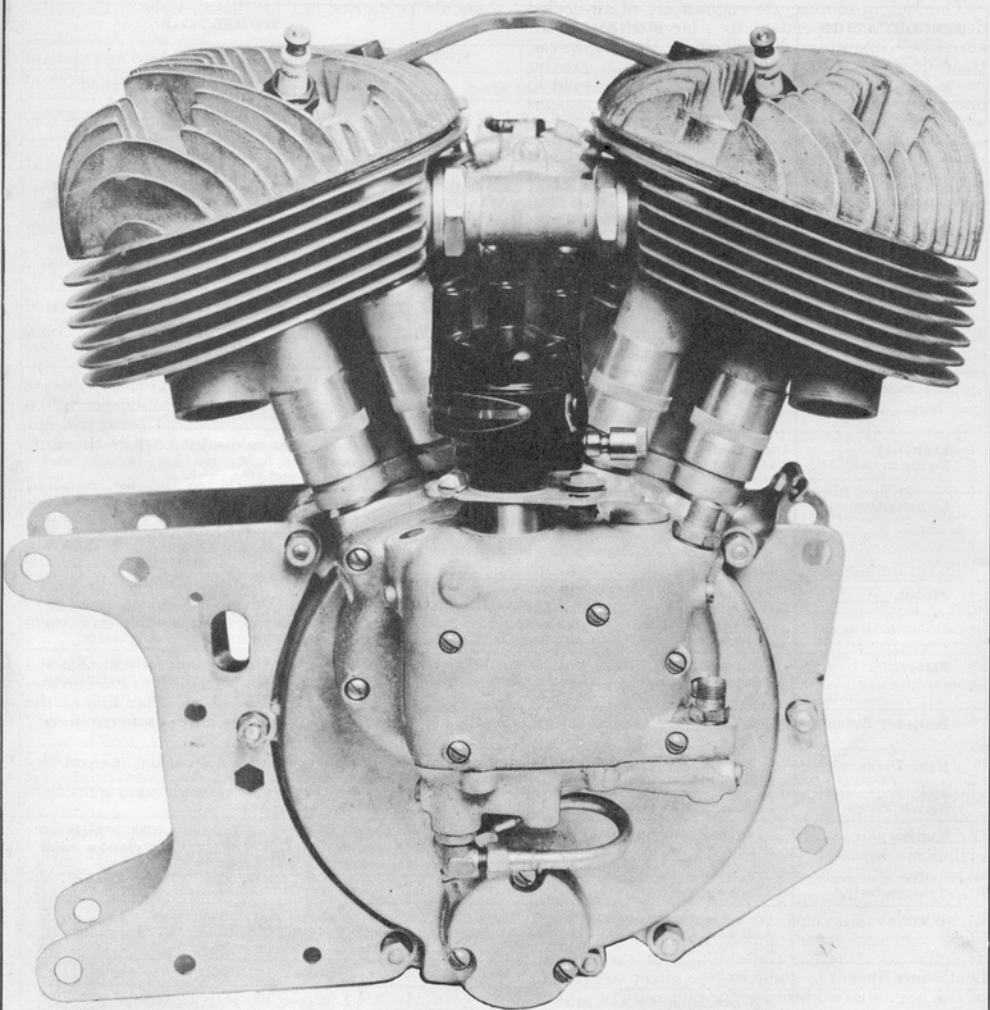
(Machine Specifications)

MOTORCYCLE SPECIFICATIONS AND ENGINE DATA

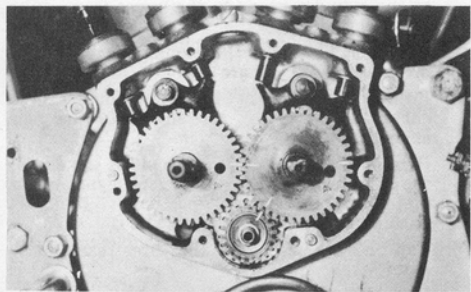
Military Models 640-B and 741-B Solo

SPECIFICATION	MODEL 640-B	MODEL 741-B
Air Cleaner	Oil bath type.	Oil bath type.
Brakes	Internal expanding front and rear wheel.	Internal expanding front and rear wheel.
Clutch	Multiple Raybestos and steel disc type operating in oil bath.	Multiple Raybestos and steel disc type operating in oil bath.
Cylinders	"L" Head cast iron, deep finned.	"L" Head cast iron, deep finned.
Electric and Ignition System	Auto-Lite generator, Auto-Lite distributor, Indian 6 volt 29 amp. hour battery with outside filler caps and safety-fill vents.	Auto-Lite generator, Auto-Lite distributor, Indian 6 volt 29 amp. hour battery with outside filler caps and safety-fill vents.
Equipment	Front safety guards, Legshields, Rear view mirror, Front windshield, Tool set, Pressure grease gun, Hand air pump.	Front safety guards, Rear view mirror, Tire pump, Grease gun, Luggage carrier, Saddle bags, Tire chain, Tool set.
Frame	Seamless steel tubing, Steering damper and ride controls.	Single tube, seamless chrome Molybdenum steel with steering damper and ride controls.
Heads	Detachable aluminum alloy, deep finned.	Detachable aluminum alloy, deep finned.
Instruments	Indirect lighted speedometer, ammeter, special H-D keylocking switch with blackout safety button and three keys.	Indirect lighted speedometer, ammeter, special H-D keylocking switch with blackout safety button and three keys.
Lighting Equipment	Blackout front fender light. Blackout rear tail and stop light. Service headlight and service tail and stop lights.	Blackout front fender light. Blackout rear tail and stop light. Service headlight and service tail and stop lights.
Lubrication	Patented Indian Dry Sump System. Large oil pump capacity with gear return pump. Hydraulic chassis lubrication fittings. Oil pump geared scavenger return with plunger type feed.	Patented Indian Dry Sump System. Large oil pump capacity with gear return pump. Hydraulic chassis lubrication fittings. Oil pump geared scavenger return with plunger type feed.
Motor	Air-cooled, two cylinder, 42° "V" type. Bore — 2 $\frac{1}{8}$ ", Stroke — 3 $\frac{1}{4}$ ", Piston displacement 45.44 cubic inches. Engine suitable for operation on gasoline of 68 octane or better.	Air-cooled, two cylinder, 42° "V" type. Bore — 2 $\frac{1}{8}$ ", Stroke — 3 $\frac{1}{4}$ ", Piston displacement 30.07 cubic inches. Engine suitable for operation on gasoline of 68 octane or better.
Pistons	Cam ground "T" slot Lynite Metal. Three compression rings $\frac{1}{16}$ " wide, and one oil control ring $\frac{1}{8}$ " wide.	"Trunk" type aluminum pistons. Three compression rings $\frac{1}{16}$ " wide, and one oil control ring $\frac{1}{8}$ " wide.
Primary Drive	$\frac{3}{8}$ " Pitch three row chain operating in oil bath.	$\frac{3}{8}$ " Pitch three row chain operating in oil bath.
Rear Drive	$\frac{5}{8}$ " Pitch, $\frac{3}{8}$ " wide roller chain. Length 96 rollers.	$\frac{5}{8}$ " Pitch, $\frac{3}{8}$ " wide roller chain. Length 92 rollers.
Spark Plugs	Indian "C" 14 mm.	Indian "C" 14 mm.
Tanks	Main and reserve gasoline tanks — total capacity 3.5 U.S. gallons. Oil storage tank capacity 2.3 U.S. quarts.	Main and reserve gasoline tanks — total capacity 3.5 U.S. gallons. Oil storage tank capacity 2.3 U.S. quarts.
Transmission	Three speeds forward.	Three speeds forward.
Wheels	Wire wheels, drop center rims. Tires: 18 x 4.00 4 ply. Pressure: Front 18 lbs., rear 20 lbs.	Wire wheels, drop center rims. Tires: 18 x 3.50 2 ply. Pressure: Front 18 lbs., rear 20 lbs.
Wheel Base	57 Inches	56 $\frac{3}{4}$ Inches
Weight	537 Lbs. complete with accessories	456 Lbs. complete with accessories
Turning Radius	6'	8'
Overall Length	90"	88 $\frac{1}{8}$ "
Overall Height	46" Less windshield	39 $\frac{3}{4}$ "
Overall Width	32 $\frac{1}{2}$ " Less windshield	33 $\frac{1}{2}$ "

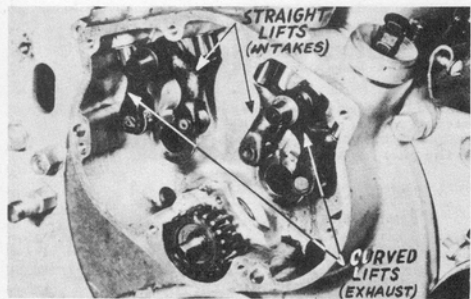
ENGINE



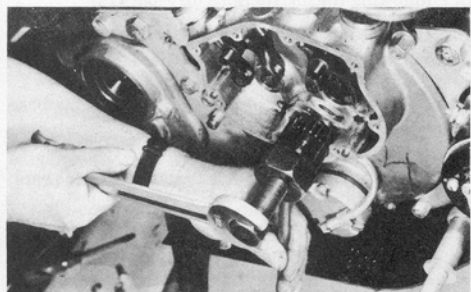
THE MOTORCYCLE ENGINE



TIMING GEARS LINED UP ON MARKS: The timing cam gears and driver pinion gear are all marked and must line up with each other so that the valves will be properly timed. Note — the front cam gear sets lower in the case to mesh with the pinion driver and uses a longer push rod to operate the valves for the front cylinder.



VALVE LIFT LEVER MECHANISM: Showing the lift levers in position. The two center lifts operate the intake valves and are assembled on the lift shafts first. The two outside lifts are assembled last, and have offset pads to line up with the valve tappet rods. Lift rollers should operate freely — if they show a tendency to bind, remove the roller rivets and replace with new rollers and rivets.



REMOVING THE TIMING PINION GEAR: The pinion gear should be removed with a special gear puller (No. 33T69) so that the oil extension tube at the end of the shaft will not be damaged. The pinion gear is a press fit on a keyed shaft and is not tapered. The timing pinion nut has a left-hand thread.

17. Remove the cam gears carefully so as not to disturb the lift assemblies in the case.
 - (a) Inspect the cam gears, cam lobes and shafts for wear. Cam shafts should measure .0015 clearance in bushings.
18. Note the positions and appearance of the lifts. The lift rollers on the exhaust lifts, front and rear, are offset. The intake lifts are not.
19. Remove both the front and rear exhaust lifts first and label each for future assembly. The intake lifts are the two center ones.
20. Remove both the front and rear intake lifts, and label each for future assembly.
 - (a) Inspect the lift rollers on each of the four lifts. Worn and sloppy lift rollers should be replaced by filing off the end of the rivet that acts as a shaft for the rollers and tapping out each rivet.
 - (b) Install new lift rollers and new rivets, peening the soft end of the rivet to hold it in place.
Use care in peening the rivet so as not to bend the end of the lift together. The rolls should revolve freely on the lift.
 - (c) Remove and inspect the lift shafts.
21. Remove the timing pinion nut and washer. (Left hand thread.) Use special gear puller 33T69. This tool enables pulling the pinion gear without damaging the oil extension tube at the end of the shaft.
22. Remove the three screws holding the pump sump to the right lower side of the case, pull off the sump unit and drain the oil from the cases.
23. Remove the front anchor plates by taking out the three bolts holding them to the engine case.
24. Remove the top center bolt in the case.
25. Remove the lower center bolt at the lowest point on the cases.
26. Separate the two halves of the cases by tapping lightly. Pull the right half away from the left, holding the rods so that the flywheel assembly will stay with the left half.
27. Remove the roller retainers and rollers from the pinion shaft.
28. Lay the left half of the case over on its side and remove the flywheel assembly at the same time.
29. Remove the four roller retainers and rolls from the left case along with the center spacer.

ENGINE

(Motor Base)

30. It is unnecessary to remove the roller bearing housing from the left case unless worn or loose in the case. If necessary to remove:

- Remove the housing nut in the outside of the case. (Left hand thread)
- Heat the case in boiling hot water and tap out from the inside toward the outside of the case.
- Loose housings should be replaced with oversize outside diameter housings or copper plate the old housing to .003 oversize, according to the case diameter. Base should be heated to install.

31. If the bearing housing in the right case is worn, remove and replace.

- Heat the case in boiling water and, using a $\frac{1}{8}$ " punch in back of the housing from the timing case side, tap out the housing.
- Replace with an oversize outside diameter housing or have the old housing copper plated to .003 oversize, according to the case diameter. To install, heat base and press in.
- Shims are placed in back of this bearing to control flywheel end play.

32. Remove the lock washer lock screw and lock washer on one of the crankshaft nuts.

33. Remove crankshaft nuts and separate the wheels holding the rods so that they will stay with the wheel on which the shaft is still assembled.

34. Note the position of the male and female rods to the flywheel. The female rod is the front rod.

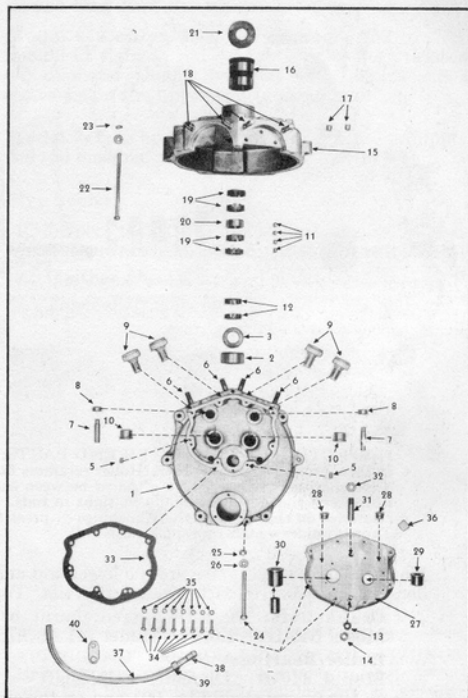
35. Slide the two rods and their bearings off the shaft together.

36. Separate the two rods and remove all rollers and retainers.

37. Unless loose in the wheels or worn, it is not necessary to remove the shafts left with the wheels.

POSITION OF ASSEMBLY

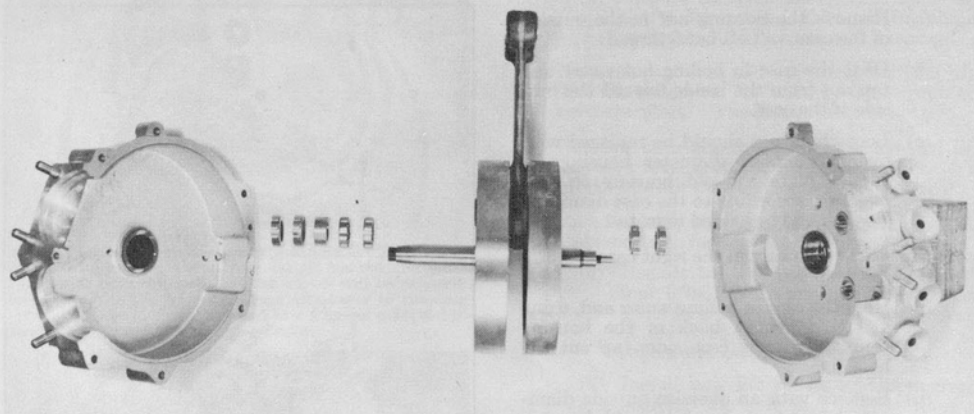
LOWER END ENGINE BASE



CRANKCASE PARTS

- | | |
|--|---|
| 1. Crank Case—Right Half | 20. Spacer |
| 2. Pinion Shaft Housing (Std.) | 21. Nut ($\frac{1}{8}$ —24 Jam) |
| 3. Housing Washer | 22. Crank Case Center Bolt |
| 4. Washer Shim | 23. Nut ($\frac{1}{4}$ x 20 Std.) |
| 5. Case Cover Dowel Pin | 24. Bolt ($\frac{1}{4}$ —28 x 3- $\frac{1}{4}$ Hex.) |
| 6. Cylinder Stud | 25. Nut ($\frac{1}{4}$ —28 Std.) |
| 7. Valve Lift Shaft | 26. Lock Washer ($\frac{1}{4}$ Std.) |
| 8. Lift Shaft Bushing (Std.) | 27. Cam Case Cover |
| 9. Push Rod Guide | 28. Valve Lift Shaft Bushing |
| 10. Cam Bushing (Std.) | 29. Cam Bushing — Front |
| 11. Pinion Shaft Roller | 30. Cam Bushing — Rear |
| 12. Roller Retainer | 31. Breather Inlet Tube |
| 13. Pinion Shaft Felt Washer | 32. Tube Lock Nut |
| 14. Felt Washer Retainer | 33. Cover Gasket |
| 15. Crank Case — Left Half | 34. Screw (#12-24 x 34 Fill. Hd.) |
| 16. Drive Shaft Housing (Std.) | 35. Lock Washer (#12) |
| 17. Screw ($\frac{1}{8}$ Pipe Thread) | 36. Breather Valve Disc |
| 18. Cylinder Stud | 37. Breather Tube Assembly |
| 19. Roller Retainer | 38. Tube Cone |
| | 39. Tube Nut |
| | 40. Breather Tube Clip |

INSPECTION OF ENGINE LOWER END PARTS



INSPECTION OF THE LOWER END PARTS: Illustrated above — the lower end parts are laid out in their proper assembly order. Roller retainers fit to their shafts back to back with the four sets on the drive shaft side separated by a spacer between each pair. If retainers are cracked or broken — replace. Lower end rod bushings should fit tight in rods. Cam case bushings — press fit to heated case — .015 clearance on shafts. Lift shaft bushings — press fit to heated case — shafts tight to bushings in cover. Tappet guides — .002 on tappet push rod.

Note: This inspection covers the lower end and timing case parts only. The inspection of cylinder, piston and valve parts is covered in the "Top Overhaul" instructions starting on Page 41-3

Crankshaft: If worn, scored, burnt or ringed — replace. Diameter on drive surfaces: Model 640-B — 1.000 Model 741 — .875

Roller Bearings:

Model 640-B: Diameter crankshaft — .249, pinion and drive shaft — .2495. Clearance on the pinion should be .001 and on the crankshaft .002. If worn to .248 — replace. Clearance of rollers on shaft and in rods or housings should not total over .002 to .0025.

Model 741: Diameter crankshaft — .249, pinion and drive shaft — .2495. Clearance on the pinion should be .001 and on the crankshaft .002. If worn to .248 — replace. Clearance of rollers on shaft and in rods or housings should not total over .002 to .0025.

Bearing Retainers: If cracked or broken, replace.

Lower End Rod Bushings:

Model 640-B Inside diameter — 1.500

Model 741-B Inside diameter — 1.375

Should fit tight in rod. If the bushings are worn, replace and lap to fit, using a special lapping tool with lapping compound, or use new rods. (Tool No. 22T1486)

Drive Shaft on Left Flywheel: If worn, burnt, ringed or loose — replace. Diameter: Model 640-B — .875 Model 741 — .875

Pinion Drive Shaft on Right Flywheel: If worn, burnt, ringed or loose — replace. Diameter: Model 640-B — .812 Model 741 — .812

Drive Shaft Housing: Diameter: Model 640-B — 1.375 Model 741 — 1.375

Pinion Shaft Housing: Diameter: Model 640-B — 1.3125 Model 741 — 1.3125

Right Crankcase Timing Case Bushings:

1. **Cam Bushings:** Press fit into heated case, .0015 clearance on shaft.

2. **Lift Shaft Bushings:** Press fit into heated case.

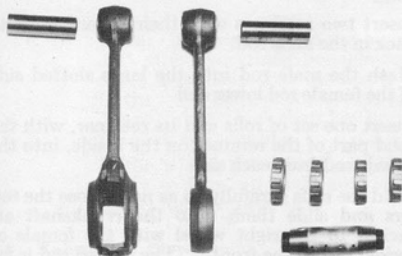
3. **Lift Shafts:** Tight in bushings.

4. **Valve Tappet Guides:** Clearance on tappet .002. If worn, drive out of case with offset punch and replace.

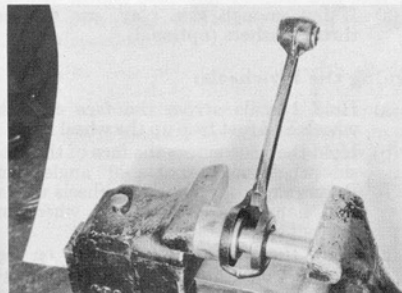
CONNECTING RODS

Rod Alignment: Tools required: — Two close fitting, hardened and ground straight arbors (not tapered), a surface plate in good condition, inside micrometers or special gauge.

1. Fit the arbors to the connecting rod on a parallel. The upper and lower bushings should be central to within $\frac{1}{64}$ ". Use a square on both sides of the rod to check.
2. Rods must be capable of lying flat on parallels.
3. Arbors must be same distance apart on either side of the rod. Mark the larger arbor with a pencil about 2" away from each side of the rod and take measurements at those points.
4. Bend or twist the rods near the top to align. Bend slightly more than necessary, then allow to spring back to eliminate any strain in the rod.



CONNECTING RODS, BEARINGS, AND CRANK-SHAFT: All loose or worn parts should be replaced. A loose lower end would cause excessive noise and reduce the efficiency of the oiling system. The female or "forked" rod (left, above) is the front cylinder rod — the male rod goes to the rear cylinder.



REMOVAL OF THE LOWER END BUSHINGS: Using the same tool as used for installation in the photo to the left — select the disc that is ringed only on one side and that fits into the bushing. Assemble the tool as shown above, using the sliding, long spacer against the disc. By closing the jaws of the vise, the bushing will be pressed out and into the large cupped end of the tool.

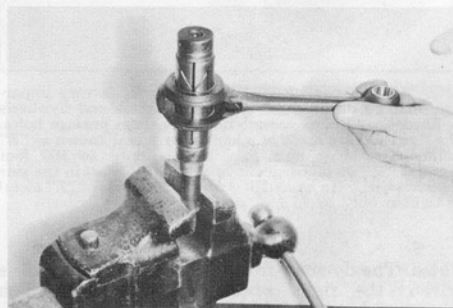
Upper End Rod Bushing:

Model 640 only: Inside diameter — .752 to .753. Should fit tight in rod. (Arbor press fit) (Piston pin diameter should be .750 with .002 to .003 clearance on the upper end bushing.)

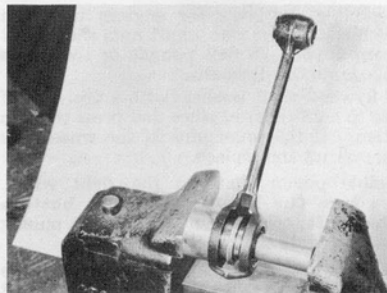
Model 741: The Model 741 does not use an upper end rod bushing.

Flywheels:

1. Inspect thrust washers in both wheels. These washers are held in place, each with two pins.
2. If either wheel is cracked or damaged, replace.
3. Taper shaft holes should be free from all burrs.

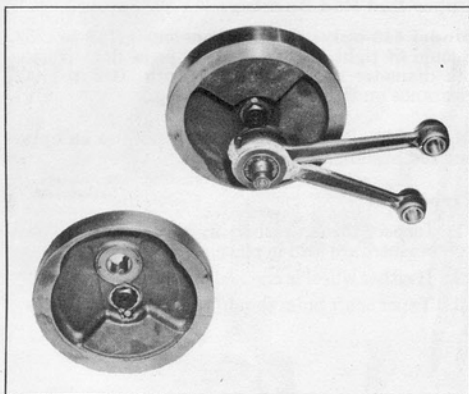


LAPPING OUT THE ROD LOWER END BUSHINGS: Using the special lapping arbor shown above with the correct sleeve, hold the tool (No. 22T1486) in a vise as illustrated and coat the sleeve with regular fine valve grinding compound. Adjust the sleeve to fit the inside of the bushing and increase the sleeve adjustment as the bushing becomes lapped.



INSTALLING LOWER END BEARINGS: To install a new bearing assemble the tool as shown above using the largest machined disc of the tool with the proper ridge fitted into the bearing. Then line up the bushing in position and tighten the vise. By closing the jaws of the vise, the bushing will be pressed into the rod.

FLYWHEELS



THE MOTORCYCLE FLYWHEELS: It is very important that all oil passages in the crankshaft and flywheels be lined up. Before assembling, note these passage holes. The flywheels are made of a hard alloy metal known as "Z" metal. The shaft nuts may be tightened to 100 foot pounds. "Z" metal wheels have a raised "Z" cast in the side of each wheel. (In assembling wheels not made of "Z" metal — tighten only to 75 foot pounds.)

ASSEMBLY

Note: The flywheel from which the pinion shaft is driven is the "right" wheel. The wheel from which the power drive shaft is driven is the "left" wheel.

The flywheels are made of an extremely hard alloy metal known as "Z" metal, which is the strongest metal workable for flywheel construction. This metal allows the shaft nuts to be tightened to 100 foot pounds.

In assembling flywheels for engines in which wheels are made of cast iron, shaft nuts should not be tightened beyond 75 foot pounds or the shafts will be pulled into the flywheels.

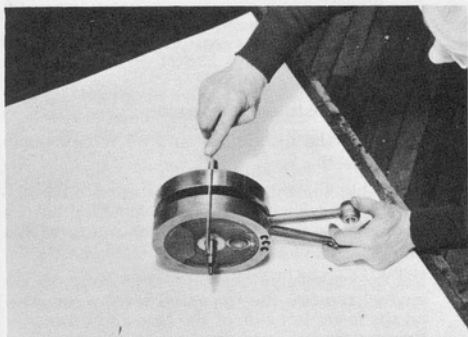
1. Coat flywheel shaft washers with a thin coat of grease to hold them in place and press them in position. If the small pins in the wheels are worn, pull out and replace.
2. Assemble pinion shaft to the right wheel. **Make sure the keyway does not bottom in the shaft**, otherwise it will prevent pulling it up tightly into the wheel.
3. Place the wheel in a vise with the **wheel web** between the jaws and attach the pinion shaft nut, pulling it up with a torque wrench to 100 foot pounds for "Z" metal or 75 foot pounds for other metals.
4. Position the nut lock ring and tighten the nut to line up the screw hole before inserting the lock ring screw.

5. Insert the lock ring screw and tighten.
6. Assemble the main drive shaft in the left wheel in the same manner, checking the keyway and putting it in a vise to pull up and lock the shaft nut.
7. True each wheel on its shaft rotating the wheel on its shaft centers, using a small brass or lead hammer to true the shaft in the wheel.
8. Assemble the main crank pin to the right flywheel lining up the hole in the tapered end of the shaft with the hole in the flywheel.
9. Assemble, tighten and lock the outside nut with a torque wrench, pulling up the nut tighter to position the lock ring and screw.
10. Assemble rollers and retainers for the rod lower ends.
11. Insert two retainers with their rollers, back to back in the male rod.
12. Mesh the male rod into the large slotted side of the female rod lower end.
13. Insert one set of rolls and its retainer, with the solid part of the retainer on the inside, into the female rod from each side.
14. Hold the rods carefully so as not to lose the rollers and slide them onto the crankshaft attached to the right wheel with the female or forked rod to the front. (The forked rod is for the front cylinder.)
15. Assemble the left flywheel to the crankshaft; tighten and lock the shaft nut in place.
16. Connecting rod side play should not be greater than .015 to .020.
 - (a) If not enough side play, use thinner thrust washers (optional).
17. **Truing the Flywheels:**
 - (a) Hold a scale across the face of both wheels and first true up the wheel faces.
 - (b) Hold the scale across the face of the outside wheel surfaces at a 90° angle from the crank pin, tapping the wheels with a lead hammer to bring both wheels in contact with the scale.
 - (c) Place the wheels in a lathe or on the special truing device and test the rotation of the wheels. (Special Indian truing device No. TP9796)
Indicate high spots on the rim of each flywheel and tap with a lead hammer to true shafts until indicators show wheels to be true. (Maximum allowable runout, .002)

ENGINE

(Flywheels)

TRUING THE FLYWHEELS: Hold a scale as shown above, across the face of both wheels and true up the wheel faces. Holding the scale across the face of the outside wheel surfaces at a 90° angle from the crank pin, tap the wheels with a lead hammer to bring both wheels in contact with the scale.



Note: If the shafts are out more than .005 after everything possible has been done, it is likely that the shafts do not fit the taper holes of the wheels properly due to dirt or a high shaft key preventing the shaft from seating.

If the wheels have been tapped excessively to true, all shaft nuts should be tested for tightness again.

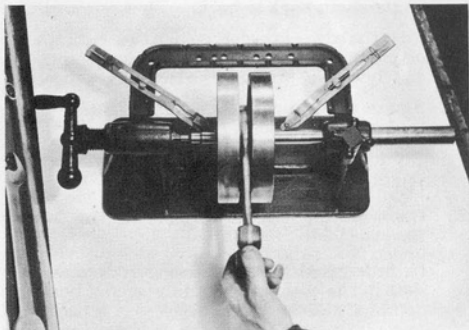
18. Balancing Flywheels:

Each flywheel in any engine has been individually balanced to a predetermined weight at the factory and the assembly further balanced for the pistons and rings used in the original engine specifications.

If other than the factory specified original pistons are used in the flywheels, they should be balanced again.

- (a) Assemble one piston with all rings and attach to the male connecting rod with its wrist pin and both lock rings.
- (b) Place the flywheel assembly on two parallel bars or "knife edges" with the piston and rods hanging free. Turn the wheels until the crankshaft is halfway up. The piston and rod assembly should stay in any position if perfectly balanced. If it drops to the bottom, the wheels are too heavy at the crankshaft side. If the crankshaft rolls to the top and the counterweighted sides of the wheels rotate to the bottom, the wheels are too heavy on the counterweight side.
- (c) If too heavy on either side — place the wheels in a drill press and drill out the flywheel on its heavy sides. The drill-

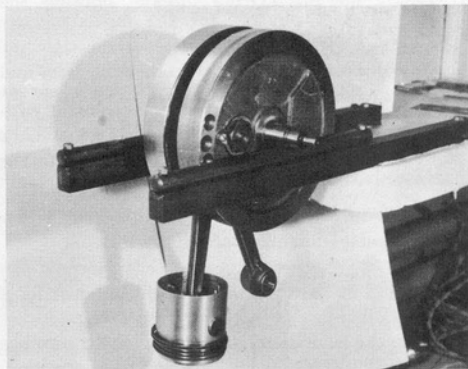
TRUING THE FLYWHEELS: After truing the flywheels faces, it is necessary to true up the rotation of the wheels. This can be done in the special truing device shown above (Indian No. TP9796). The gauges on each side indicate the high spots of each wheel. The high spots should be tapped with a lead hammer to true the shafts until the indicators show not over .0015 to .002 motion.



ing should be made thru both wheels. It is advisable to block between the wheels to prevent squeezing them together when drilling on the counterweight sides. In drilling use a $\frac{5}{16}$ " drill.

- (d) Test after each drilling until the rods and piston will stay in any position around the entire revolution of the wheels.

19. Assemble rollers and retainers for the pinion shaft and slide over shaft. Cover with fresh motor oil and assemble to the right half of the engine case.



BALANCING THE FLYWHEELS: Any change in the type of piston and weight will automatically throw the flywheels out of balance. The piston and rod assembly should be capable of balancing in any rotated position. If too heavy remove metal from the heavy side by drilling (use a $\frac{5}{16}$ " drill) through both wheels. Block between the wheels to prevent squeezing and test after each drilling.

(Assembly)

ENGINE

20. Assemble the remaining four sets of rolls in their retainers.
21. Place one set back to back on the flywheel drive shaft.
22. Slide spacer onto shaft and place the other set on the shaft, back to back.
23. Coat the edge of the left engine case with shellac or permatex and assemble to the main shaft and flywheels, pressing the two halves together.
24. Attach the top center bolt and tighten — and the lower center bolt.
 - (a) Flywheel end play in the cases should be from .015 to .020.

25. Centralizing the Flywheels in the Motor Base:

In order that the connecting rods clear the slots in the crankcases and upper rod bushings do not strike the piston bases — it is necessary to centralize the rods in the machined openings of the case to within $\frac{1}{64}$ ".

- (a) Movement necessary is equal to $\frac{1}{2}$ the variation in distance.
 - (b) To move towards the drive shaft end, remove the right case from the flywheels and remove the bearing housing. Place a shim of the exact thickness as for movements required and reassemble the housing.
 - (c) To move the flywheels toward the timing case side remove the right case from the flywheels and remove the bearing housing. Grind off the housing the exact amount for the movement required.
 - (d) Reassemble, bolt together the cases and remeasure until the flywheels are at least within $\frac{1}{64}$ " of being central with .015 to .020 end play.
26. Assemble the lifter shafts. Press fit into the case bushings.
 27. Assemble the front intake and rear intake lifts.
 28. Assemble front and rear exhaust lifts.
 29. Assemble the pinion drive gear. The key should fit tightly into the shaft and gear for a drive on fit. (Left-hand thread nut)
 30. Slip the front cam into place. (Front cam has a worm drive end.)
 31. Slip rear cam into position.
 32. Rotate the flywheels until the marks on the pinion gear point toward the cam gears. Rotate the cam gears and line up with the pinion drive gear.

33. Assemble the short tappet rods into the tappet guides for the rear cylinder.
34. Assemble the long tappet rods into the tappet guides for the front cylinder.
35. Oil the timing case gears and tappets with motor oil.
36. Assemble timing case gasket — use shellac or permatex.
37. Assemble the timing case cover.
38. Assemble the distributor and oil return pump drive pinion.
39. Assemble the oil pump gasket and oil pump holding the breather disc in position on its pump recess on the back of the pump with a light coating of grease.

Before assembling the oil pump body to the engine, remove the upper oil level screw plug on the lower left side of the case and center the flywheel timing mark in the inspection hole.

Check both rear valve tappets (they should be down) with the rear rod coming up on the compression stroke — $\frac{3}{8}$ " before top dead center.

With a screwdriver down the distributor drive shaft opening, turn the slotted shaft until the slot is at right angles to the pump. Then slide the pump body into position against the cam case. **As the pump is brought into place the spiral gear on the rear cam shaft will move the slotted shaft of the distributor drive slightly.** Back off the pump body and turn the slotted shaft in the direction necessary to compensate for the change so that when the pump body is brought into position against the cam case, the slot in the distributor drive shaft will be at a right angle to the pump body.

40. Fit pistons, rings and wrist pins to the engine and cylinders as instructed on Page 41-4 and 41-5.
41. Assemble manifold loosely to the cylinders and assemble the carburetor brace to keep the manifold at its correct position.
42. Tighten down the cylinder base nuts and tighten the manifold and carburetor brace mounting.
43. Loosely attach the motor drive sprocket and rotate the flywheels until the exhaust valve for the rear cylinder is closed.
44. Adjust the tappet .008 clearance.
45. Rotate the flywheels until the intake valve is closed and adjust for .006 clearance.
46. When properly adjusted rotate the flywheels until both valves in the rear cylinder are closed and bring the piston up to $\frac{3}{8}$ " from top dead center.

THE MOTORCYCLE ENGINE

The Indian motorcycle engines are of air-cooled design and are dependent to a large extent on air currents to operate coolly and efficiently. However, their design allows them to withstand a greater heat than a water-cooled engine would be able to operate under. This is one of the main reasons why the proper lubrication of the motorcycle engine is so vitally important to its efficient operation. The engine is lubricated by the patented Indian Dry Sump Lubrication System. In this system the oil is held in the storage tank and pumped, by force, to the engine, where it then travels through drilled passages to the lower end bearings and to the rest of the internal sections of the engine. After its passage through the engine, the oil accumulates in the lowest part of the motor base and is force pumped through a scavenge pump and returned to the storage tank through outside cooling lines. Positive in its operation, there are no adjustments necessary in this dry sump system and its high efficiency makes possible the efficient operation of the engine.

The engine is held by anchor plates on both sides of the motor base, to the front and rear sections of the frame, and a cylinder clamp is used at the top of the engine to provide an additional mounting to the engine frame.

CYLINDERS AND HEADS

The cylinders are cast individually and the cylinder heads are removable for cleaning and servicing. The cylinders are factory honed with a No. 500 hone to obtain a mirror finish that will require less breaking in than would normally be expected. In removing the cylinders from the engine care should be taken that the valve tappets are loosened and all tension released on the valve springs. If this is not done there is danger that the mounting base of the cylinder may break when the cylinder is loosened or tightened at its base studs. Care should be taken in handling the cylinders so that the air cooling fins do not become damaged. It will be noted that in the area surrounding the exhaust port the fins are somewhat larger than over the rest of the cylinder; this is for the purpose of cooling this cylinder area which develops the most heat.

The cylinder heads are fitted with a brass insert to accept a standard 14 m.m. motorcycle spark plug. Oil and grease should never be allowed to accumulate on either the cylinder or the cylinder head since it will to some degree affect the cooling of the engine in addition to making a dirty appearance.

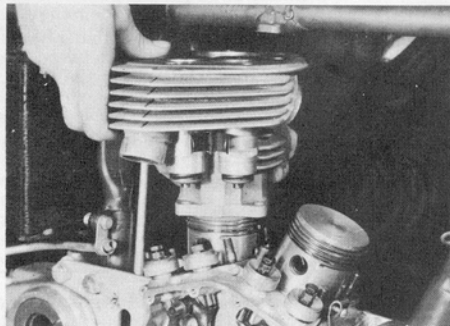
TOP OVERHAUL

To remove the cylinders from the engine for a top overhaul it is not necessary to remove the engine from the frame; these can be removed with the engine still in the frame. The following procedure

should be carried out for disassembly of the cylinders:

1. Disconnect the battery ground lead and shut off the gasoline feed lines at the shut-off valves on the underside of the tanks.
2. Disconnect the gasoline feed line at the carburetor and at both tank shut-offs.
3. Disconnect the oil bath air cleaner intake at the carburetor on the left side of the machine.
4. Loosen the hose clamps on the carburetor intake and swing the entire intake up out of the way.
5. Disconnect the throttle control at the carburetor.
6. Remove the brace below the carburetor bowl at the crankcase. Remove the nut holding this brace to the crankcase. Loosen the nut holding the brace at the bowl itself.
7. Remove the shift connecting rod running front to back over the engine and underneath the tank on Model 640. On Model 741 it will not be necessary to remove any part of the shift lever mechanism.
8. Loosen and disconnect the intake manifold at the cylinders. Use either the special Indian intake manifold wrench No. 101440, or, if this is not available, use a blunt end tool and tap to loosen the special manifold nuts. The above applies to the Model 640. On the Model 741 use a manifold open end wrench.
9. Remove the carburetor and manifold as a single unit.
10. On the right side of the engine, disconnect the oil feed and return lines from the tank connections and oil pumps. The shorter line of the two is the feed line. Have a nipple cap handy

Caution should be taken in either removing or assembling the cylinders to make sure that the valve tappets are "down" as far as they will go and tappets loosened to relieve any tension at the valve springs.



ENGINE

(Assembly)

47. Hold the distributor body with the condenser towards the engine and turn the shaft clockwise until the big lobe of the cam just starts to break the points.
48. In this position, assemble the distributor body into the oil pump body. The slot on the end of the shaft will mesh with the drive in the oil pump body.
49. Rotate the flywheels to close the front cylinder valves and adjust. Intake .006. Exhaust .008.
50. Assemble cylinder heads and gaskets, leaving off the head bolt holding the control cable on the left side. Attach the top cylinder engine brace. The short head bolts assemble on left side of head (thin side of head).
51. Assemble the front anchor plates to the engine case.
52. Assemble the oil pump sump and the oil line connecting it to the oil pump. The sump valve should be at the lowest point possible when assembling to case.
Use a new gasket, shellac or permatex to seal.

Mounting the Engine Into the Frame

1. Position the engine at the right side of the frame and swing into position.
2. Catch the top brace bolts in position.
3. Catch the front anchor bolt and all three rear anchor bolts. When all are in position together, tighten all nuts and bolts.
4. Assemble the generator and its back plate into position and attach.
5. Attach the motor drive sprocket and its shaft key, and tighten as much as possible.
6. Connect the generator drive chain and adjust until it has only $\frac{1}{8}$ " up and down slack on the lower rolls. Tighten the generator.
7. Check the gasket at the transmission and assemble the clutch case back plate.
8. Attach the generator drive cover.
9. Tighten the clutch sprocket driver nut. (Left-hand thread)
10. Attach the primary drive chain.
11. Assemble the clutch and clutch case cover according to instructions given under Group 4200 on Page 42-1 and 42-2.
12. Lock the transmission in gear and tighten the motor drive sprocket nut.
13. Replace the rear footboard shaft brace. The rear shaft has a machined surface part way from the end of the shaft. Slide it through the motor base anchor plates from the right side. When its leading end comes flush with the left rear anchor plate, position all spacers and drive it all the way through and home. Slip the outside spacer on the shaft.
14. Replace the front footboard shaft. Drive through from the right replacing spacers and washers between the anchor plates and at both ends.
15. Connect the oil line from the oil pump through the clip at the battery mounting and to the chain.
16. Attach the muffler and exhaust tubes working the tubes up onto the cylinders and connecting at the frame and fender brace bolts.
17. Attach the motor base skid plate. Flat head bolts to the engine brackets — "U" bolts around the front footboard shaft spacers.
18. Attach both the oil feed and return lines from the tank to the pump.
19. Attach the oil breather tube and pass it through its clip on the front frame tube.
20. Thread the spark control cable under the tank and through its mounting clip at the front engine anchorage and to the distributor. Attach to the distributor control arm.
21. Assemble the right safety guard tube through the "U" bolt on the top frame plate and over the footboard shaft at the bottom.
22. Attach the brake pedal and connect at the rear clevis.
23. Attach the brake spring to the pedal.
24. Place a long spacer on the rear footboard shaft.
25. Connect the brake spring to the footboard bracket and assemble the footboard to the mounting shafts. Replace nuts, washers, and tighten.
26. Connect the ignition wire to the distributor body.
27. Replace the distributor cap and snap the rear plug wire into the cap in the hole towards the rear. Snap the coil high tension cable to the center connection and the front plug cable to the front connection.
28. Pull down the ignition boot.
29. Attach the left safety guard tube, sliding the top part of the tube through the "U" bolt

(Assembly)**ENGINE**

- connection and the lower end onto the footboard shaft.
30. Attach the left footboard and clutch pedal. See instructions under Group 4200 on Page 42-2 for "Clutch Lever Adjustment."
 31. Attach the carburetor feed line at both gas tank shut-offs and at the carburetor.
 32. Attach the shift lever center rod — cotter-pin both ends.
 33. Attach the legshields. See instructions under Section 6200-Page 62-0 — for complete instructions on assembling.
 34. Attach oil bath air cleaner and mounting plate.
 35. Loosen the flexible tube clamps and line up the air intake tube with the carburetor. Attach to the carburetor and tighten the hose clamps.
 36. Attach spark plugs.

Making the Engine Ready to Run

1. Remove the clutch case oil level screw and filler cap and fill with the same grade of oil as used in the engine until oil flows out of the level screw hole. See lubrication recommendations on page 41-21
2. Replace the filler cap and level screw.
3. Remove the air cleaner oil bath reservoir and refill with the same grade of oil as used in the engine.
4. Refill the main oil tank with the proper grade of oil for the temperature in which the machine is to be operated.
5. Follow instructions on Page O-9 for starting the motor.

Note: Cylinder heads should be tightened after the engine has been run until thoroughly warmed up; and all nuts, bolts and connections checked for tightness.

Starting the Engine After an Overhaul

1. Open the gasoline tank shut-off located underneath the gasoline tank. Separate shut-offs are provided for each tank. To open, turn either one counterclockwise.
2. Set the gear shift lever in a "neutral" position. The gear shift lever, when pushed forward as far as it will go, will be in "low" or first speed. Back towards the driver one notch is "neutral."

3. Check to make sure that the clutch pedal is in an engaged position with the heel plate of the pedal pressed down toward the footboard as far as it will go.
4. Check to make sure the "ignition" key is in an "off" position.
5. Prime the engine by pressing down on the kick starter with your foot two or three times.
 - (a) First few kicks should be made with the "gas" control handlebar grip (left one) wide open. (Clockwise as far as it will go gives a wide open throttle.)

The "choke" lever at the carburetor should be in a "choked" position. All the way down.
6. When fully primed, return the "choke" lever one notch "up" and twist the left grip (gas control) to a closed position (as far to the outside as it will go), then open it a fraction of a turn.

Advance the spark control by turning the right grip to the left (inward) as far as it will go, then "back off" about 1/3 of a turn to a slightly retarded position.

7. Turn the ignition key to the first notch or letter "I" on the dial and press down on the kick starter with a good strong kick.
8. If the engine does not start, check and repeat the entire process over again.
9. As soon as the engine starts, open the throttle just enough to keep it running while warming up. When it begins to warm up, pull the "choke" lever "up" one more notch. A cold motor should be allowed a minute or two to warm up. When the engine is completely warmed up — pull the choke lever all the way "up" to its normal running position.

Note: Starting a "hot" or "warm" motor does not usually require the use of the "choke" lever. Racing the motor, while standing still, is the worst abuse you can give it and should not be done at any time.

10. Allow to warm up fully and run for several minutes, then allow it to cool off and recheck to tighten all head bolts, case bolts, etc.
11. Recheck tappets. Intake .006 — exhaust .008. (Cold motor)

MOTOR LUBRICATION

The lubricating system is what is known as the patented "Indian Dry Sump Lubrication System." With this means of lubrication, the oil is carried in the storage tank in the forward section of the gasoline tanks. It is pumped from the tank to the motor automatically in sufficient quantity to properly lubricate the engine at all speeds. It is then picked up from the motor base by means of a scavenger pump and sump valve and returned through an outside cooling line back to the storage tank.

The return pump operates at several times the capacity of the inlet pump to relieve any possibility of an oversupply of oil remaining in the bases.

The motor should never be raced while cold. It should be run slowly to warm up the oil supply so that it will flow smoothly and protect the moving parts of the engine.

To check the flow of oil from the return pump to the storage tanks:

- Remove the filler cap.
- Inspect the return line. The oil should bubble from this line with the motor idling fairly fast.
- If the oil does not return after the motor has been run for a few minutes, race the motor slightly opening and closing the throttle.

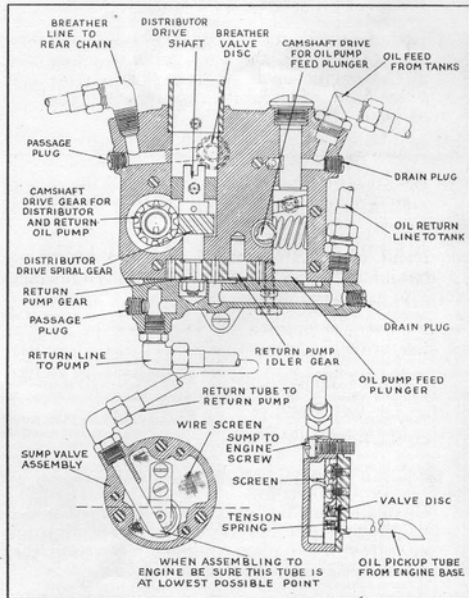
If it still does not return and there is sufficient oil in the storage tank, let the engine idle and check immediately for oil leaks and loose connections right from the feed line through the entire system — the pump, the sump at the motor base, and the return line.

If there appear to be no leaks and all connections are tight, pull the oil return tube in the tank over under the refill opening. Then, with a pressure oil can, force oil into this line. Do not be afraid of forcing too much oil in the line. When the entire line is filled, the oil will gush back into the tank. If, after several attempts, this does not start the oil flowing back into the tank, shut off the engine. The purpose of priming this return pipe in the above manner is to free the sump valve at the motor base. Sometimes a speck of dirt will clog the sump valve or the valve may become set through long periods when the machine is not started.

To Clean the Oil Pump Sump

Note: To remove the sump valve from the motor base, it is necessary to first remove the exhaust pipes on the right side of the engine, according to instructions under "Disassembly of the Engine." Page 41-2, instructions 12 thru 18.

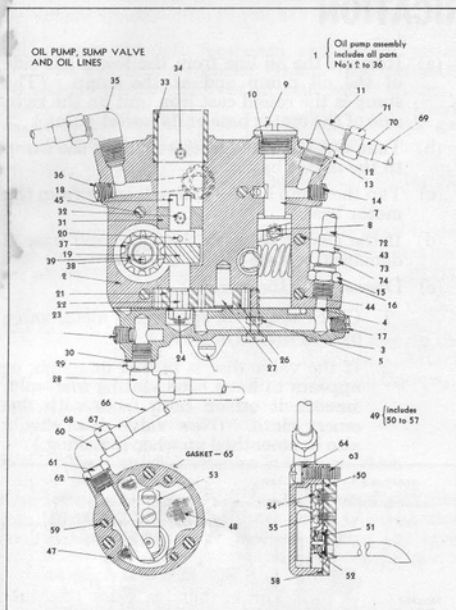
- Remove the oil line from the lower left side of the oil pump and at the sump. (The sump is the round cast iron unit on the right side of the motor base at its lowest point.)
- Take out the three screws holding the sump to the motor base.
- Tap the sump lightly and pull away from the motor base.
- If the gasket between the sump and base is damaged, replace with a new one.
- Disassemble the sump.
 - Check the small spring and metal valve disc on the valve plate.
 - If the valve disc is burled or rough, or appears to have been seating unevenly, smooth it off on both faces with fine emery cloth. (New valve discs should also be smoothed up when installing.)



MOTOR LUBRICATION: Since the successful operation of the pumping system depends to a great degree on its being air tight, any failure of the mechanism or failure of the oil to return to the tank should be checked first at all oil lines, nipples and connections for the entire system. A pin hole or air leak in any section of the pump or return lines may cause complete failure of the lubrication system or decrease its efficiency. The Sump Valve should periodically be removed from the machine, taken apart and cleaned.

(Lubrication)

ENGINE



3. Reassemble the valve disc and spring to the plate.
4. Wash all parts in clean gasoline.
5. Oil the sump valve and spring and check its movement. It should work easily.
6. Reassemble the valve plate to the sump housing **checking the positioning of the plate so that the sump valve will be at its lowest possible point when the sump is assembled to the base.**
7. Replace the gasket between the motor base and the sump.
8. Replace the pump and draw up all screws tightly.
9. Replace the oil line from the sump to the lower oil pump connection.
10. Replace the exhaust tubes, muffler, foot brake and footboard according to instructions in Section 4100 on Page 41-6 for "Assembly of the Engine."

Checking the Oil Level in the Motor Base

The oil level in the motor base should never be too high. Too high a level will allow the flywheels to dip into the oil and cause overloading, overheating and excessive carbon deposits throughout the engine. To check the level, remove the level screw on the left side of the motor base just above the drain screw.

If the oil drains out of this hole with the machine in an upright position, remove the lower drain screw and drain off all of the oil in the base.

When this condition occurs, the oil sump should be removed and cleaned.

Always replace the oil drain and level screws after an inspection and drain has been made before doing anything else.

Changing to Fresh Oil

The old oil in the storage tanks should be drained every 500 to 1000 miles.

- (a) Remove the drain plug underneath the oil tank.
- (b) Drain off old oil.
- (c) Flush out the tank with gasoline and allow the gas to evaporate after flushing.
- (d) Replace the oil drain plug.
- (e) Refill the oil tank with the proper grade of oil in relation to the temperature in which the machine is being used. (2 Quarts)

OIL PUMP, SUMP VALVE AND OIL LINES

1. Oil Pump Assembly
2. Body
3. Body Lower Cover
4. Cover Gasket .004 Optional
5. Cover Gasket .002 Optional
6. Screw — (#12-24 x 1/2)
7. Feed Pump Plunger
8. Plunger Guide Screw
9. Plunger and Body Upper Cap
10. Cap Lead Washer
11. Feed Tube Body Elbow
12. Elbow Lock Nut
13. Nut Lead Washer
14. Feed Hole Pipe Plug
15. Return Tube Nipple
16. Nipple Washer
17. Return Hole Pipe Plug
18. Return Gear Pump Drive Shaft
19. Shaft Driven Gear (Angle Cut)
20. Shaft Driven Rivet
21. Oil Pump Gear
22. Gear and Shaft Key
23. Gear and Shaft Washer
24. Washer Nut (1/4-28 Std.)
25. Lock Washer (1/4" Std.)
26. Oil Pump Idler Gear
27. Idler Gear Stud
28. Sump to Pump Tube Body Elbow
29. Elbow Lock Nut
30. Elbow Lead Washer
31. Return Pump Drive Shaft
32. Screw — (1/4-20 x 1/2 Headless)
33. Distributor Upper Sleeve
34. Upper Sleeve Set Screw
35. Cam Case Breather Body Elbow
36. Breather Hole Pipe Plug
37. Distributor Drive Gear
38. Cam Shaft Key (1/4 x 1/2 Std.)
39. Nut (1/4-20 Jam Std.)
40. Lock Washer (1/4 Std.)
41. Pump Body to Cam Case Cover Gasket
42. Screw (#12-24 x 1/2 Fill. Hd.)
43. Screw (#12-24 x 1 1/2 Fill. Hd.)
44. Screw (#12-24 x 2 Fill. Hd.)
45. Screw (#12-24 x 2 1/2 Fill. Hd.)
46. Lock Washer (#12 Std.)
47. Sump Housing and Tube Assembly
48. Housing and Back Plate Screw
49. Back Plate Complete Assembly
50. Back Plate Assembly
51. Valve Disc
52. Valve Disc Spring
53. Spring Bracket Assembly
54. Screw (#8-32 x 1/4 Rd. Hd.)
55. Screw (#8-32 x 1/2 Rd. Hd.)
56. Screw Nut (#8-32 Std.)
57. Lock Washer (#8 Std.)
58. Housing and Plate Gasket
59. Screw (#8-32 x 1/4 Flat Hd.)
60. Housing Elbow
61. Elbow Lock Nut
62. Lock Nut Lead Washer
63. Screw (1/4-20 x 1/2 Fill. Hd.)
64. Crank Case Screw Fibre Washer
65. Housing and Crank Case Gasket
66. Sump Valve and Pump Tube Assembly
67. Tube Cone
68. Tube Nut
69. Tank to Pump Feed Tube Assembly
70. Tube Cone
71. Tube Nut

ENGINE

(Lubrication)

The old oil in the crankcase should be drained off at the same time.

- Remove the oil drain plug on the lower left side of the motor base at the lowest point.
- Tip the machine to the left and allow the oil to drain off.
- Replace the drain plug. The oil level will automatically take care of itself when the engine is started because of the patented Indian dry sump lubrication system.

Recommended Grades of Indian Oil

Engine and Oil Bath Air Cleaner

Above 32°F.....	S.A.E. 50.....	Navy Symbol 1100
Between 32°F & 10°F.....	S.A.E. 30.....	Navy Symbol 1065
Below 10°F.....	S.A.E. 10W.....	Navy Symbol 2110

Primary Drive and Transmission

Above 10°F.....	S.A.E. 30.....	Navy Symbol 1065
Below 10°F.....	S.A.E. 10W.....	Navy Symbol 2110

Generator

All Temperatures.....	S.A.E. 10W.....	Navy Symbol 2110
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Distributor — Chassis — Wheels

All Temperatures —	Valvoline-Viscous G.L.-1
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CLEANING THE OIL SUMP RETURN VALVE

The purpose of the oil sump return valve is to pick up from the motor base excess oil as it accumulates in the base. Inside the sump there is a small metal valve disc which operates on a tension spring, opening and closing automatically according to the pressure that is built up in the base. As the valve opens, the oil is scavenged through this sump and returned by a gear driven pump to the oil tank. The sump should periodically be cleaned by removing it from the machine and disassembling it completely. The exhaust pipes must be removed from the machine in order to remove the sump valve as a unit. After removing the exhaust pipes, disconnect the sump return tube between the oil pump and the sump; take out the three screws that attach the sump to the motor base; slide out and away from the motor base. A paper gasket is used between the sump and the motor base.

Remove the sump back plate and the wire mesh screen from the sump.

It is very important that the valve disc be absolutely smooth and free from burrs. A valve disc that is slightly burred should be smoothened up with fine grinding compound and washed off with clean gasoline before installing. In assembling the

sump valve disc to the sump, caution should be used to seat the valve just exactly right on the spring seat.

In the event that oil does not return to the engine after the sump valve has been repaired, it must be completely disassembled and the sump valve rechecked because, in all likelihood, it has been assembled improperly but with proper care and caution there is no reason why the assembly cannot be correct the first time.

WET SUMPING

NOTE: By wet sumping it is meant that an excess amount of oil is carried in the crank case.

Wet sumping may be caused by one or more of the three following conditions:

- The sump valve pick-up tube may be installed in the motor in such a way that the opening at the end of the tube is too close to the bottom of the crank case. To correct this condition, remove the oil level screw from the left half crank case and insert a thin screwdriver or any long bent instrument through this screw hole and pry up on the end of the sump pick-up tube until it is about $\frac{1}{8}$ to $\frac{3}{16}$ " above the floor of the crank case.

If you should not be able to raise this tube sufficiently, it will be necessary to remove the sump valve and cut off a portion of the tube at the bend so that there is a full opening.

By this tube being too close to the crank case at the opening, it of course restricts the amount of oil which can be picked up through the sump valve, causing the motor to overload and wet sump in speeds above 50 miles per hour.

- It may possibly be that the tube on the sump housing is too long. This would tend to restrict the flow of oil. If this is the case, a piece of the tube should be cut off from its open end.
- The surface of the sump valve disc may be found to be uneven, which of course will not give proper seating on the back plate. If this condition exists, regrind the disc by using a fine valve grinding compound. This may be done by placing the disc, with the compound, on a surface plate or sheet of plate glass, revolving the disc in the compound until it has a smooth surface.

To check the sump valve before reassembling to the motor, the valve should be fully assembled and oil pressure applied to the return nipple opening. If the valve is seating satisfactorily, it should hold 8 to 10 pounds of pressure.

(Tappets)

ENGINE

ADJUSTING THE TAPPETS

All valves have adjustable tappets to compensate for wear. The intake valves are those nearest the carburetor manifold in each cylinder while the exhaust are those farthest to the front and to the rear.

If the engine is to run quietly and maintain its power, the clearance between the valve stem and tappet must be correct.

All adjustments must be made with a cold motor.

Intake	—	.006
Exhaust	—	.008

Instructions for Adjusting

1. Turn the engine over by kicking down on the kick starter to lower the tappet being adjusted. **The tappet must be at its lowest point.**
2. Unloosen the outside valve covers on all valves and slide up out of the way. (Use Special Indian Tool 101826.)
3. Use two special $\frac{3}{16}$ " thin wrenches with long shanks (Indian 35W242). Hold the bottom hex with one wrench and unloosen the middle lock nut.
4. Holding the bottom hex with one wrench, turn the top hex to the left to increase the clearance or to the right to lessen the clearance.
5. Slide the feeler gauge for the correct clearance between the tappet and the valve stem.

Test by trying to slide the next larger feeler gauge between. If on the exhaust the .008 feeler should pass through but the .009 should not be able to go through.

6. When the correct setting is obtained, hold the lower hex and tighten the middle hex, watching that the top hex does not turn. If it does turn, hold it with one wrench while bringing the middle lock nut up snug.
7. Test again for clearance when tightened. If it has changed, reset until the clearance is perfect with the lock nut tightened.

8. Repeat the same procedure for each valve, first kicking the kick starter over to make sure the tappet is at its lowest point.
9. Screw valve covers back into place.

VALVE STEMS AND GUIDES RUNNING DRY

Should you find that the valve tappets are apparently running exceedingly dry, it is probably due to the fact that the machine is being operated at low speeds and building up a crank case vacuum that is drying the lubrication away from the guides. Normally the motorcycle is constructed so that proper lubrication is taken care of by the breathing oil inside the cam case but excessive crank case vacuum will tend to drain the oil from the cam case into the crank case.

This condition can satisfactorily be overcome by drilling a $\frac{1}{8}$ " hole in the crank case breather disc at the oil pump. This will reduce the crank case vacuum and will allow a dampness of oil to accumulate around the valve stems, tappets and push rods.

A brief explanation of crank case pressure and crank case vacuum is as follows:

The front and rear pistons travelling up and down at the same time, on their downward stroke open the breather disc, causing the air pressure in the crank case to pass out through the breather valve. When the pistons start up, the breather valve closes and very little air is drawn back into the motor base. This creates a vacuum in the base and tends to draft the oil away from the push rods. At higher speed, the volume of air in the crank case tends to equalize itself with outside atmospheric pressure. At this point the oil has a chance to travel from the crank case to the cam case and up to the push rods, and into the valve assembly.

When the cylinder and piston rings are worn to such an extent to allow a blowby on compression and firing strokes, a pressure builds up in the motor base.

It is desirable to have a certain amount of vacuum in the base at all times but where a machine is operated continually at lower speeds it will be necessary to reduce this vacuum by drilling the crank case breather disc.

ENGINE**(Servicing)****SERVICE DIAGNOSIS****CONNECTING ROD BEARING FAILURE**

1. Excessive bearing clearance.
2. Rough crankshaft surface.
3. Improperly fitted.
4. Restricted oil passage.
5. Lack of oil.
6. Loose in connecting rod.
7. Bent connecting rod.
8. Crankshaft out of round.
9. Improper viscosity and grade of oil.

CRANKSHAFT BEARING FAILURE

Note: Crankshaft bearing failures are due to the same causes as the connecting rod bearing failures.

LACK OF POWER

1. Low or uneven compression.
2. Improper ignition timing.
3. Improper spark plug and/or distributor point gap setting. (Refer to Ignition Section)
4. Dirty air cleaner.
5. Carburetor improperly adjusted or worn. (Refer to Fuel System)
6. Fuel line leaks.
7. Low octane fuel.
8. Overheating.
9. Improper valve adjustment.

LOW OR UNEVEN COMPRESSION

1. Tight valve tappet clearance.
2. Sticky valves.
3. Excessive valve guide clearance.
4. Broken valve spring or weak spring.
5. Leaky cylinder head gasket.
6. Worn piston rings.
7. Piston rings seized in piston grooves.
8. Piston ring grooves worn.
9. Broken piston rings.
10. Improper fit of piston rings.
11. Improper fit of piston to cylinder.
12. Excessive cylinder wear.
13. Leaks at spark plugs. Loose or defective gaskets.
14. Incorrect valve timing.

EXCESSIVE WEAR OF PISTONS AND CYLINDERS

1. Pistons improperly installed and fitted.
2. Piston rings improperly fitted in groove and cylinder.
3. Piston rings seized in grooves or broken.

4. Air cleaner fouled, permitting dirt to enter engine through intake system.
5. Fuel mixture too rich, diluting lubricating oil.

BURNED VALVES AND SEATS

1. Improper clearance at the tappets.
2. Excessive carbon deposits around valve heads and seats.
3. Valves sticking in guides.
4. Weak valve springs.
5. Improper valves.
6. Overheating.
7. Fuel mixture too lean. (Refer to Fuel Section)
8. Improper valve timing.
9. Plugged muffler or restricted and bent exhaust pipes.

STICKY VALVES

1. Valve stems scored or dirty.
2. Lack of lubrication to the valves.
3. Valve springs weak or broken.
4. Insufficient clearance of the valve stem to the guide.
5. Tappet sticking in tappet guide.
6. High gum content in fuel and lubricating oil.
7. Warped valve stem.

EXCESSIVE OIL CONSUMPTION

1. Worn pistons, rings and cylinders.
2. Piston rings broken or seized in grooves.
3. Oil control rings clogged with carbon and sludge.
4. Cylinders and pistons scored.
5. Oil leaks due to loose connections, defective gaskets and seals.
6. Excessive main and connecting rod bearing clearance.
7. Defective sump return valve.
8. Oil level too high in the motor base.
9. Overheating.

OIL CIRCULATION FAILURE

1. Improper grade and viscosity of oil. (Dirty, worn and diluted oil.)
2. Clogged sump valve screen.
3. Sticky sump valve disc.
4. Clogged oil passages.
5. Leaky oil lines. Check for leaks at the connections and at all elbows and nipples. A pin hole in a nipple casting or elbow casting would cause failure.

SERVICE DIAGNOSIS (Con'd)

OVERHEATING

1. Late ignition timing.
2. Improper valve timing.
3. Fuel mixture too lean. (Refer to Fuel Section "Carburetor Adjustment") Page 43-5
4. Air cleaner not functioning properly.
5. Using poor grade of oil.
6. Not using enough oil.
7. Sump valve not working properly; clean screen and valve disc.
8. Excessive carbon deposit.
9. Weak valve springs.
10. Running with retarded spark.
11. Slipping clutch or dragging brake.
12. Running motor too fast in second or low gears.
13. Poor compression.

ENGINE MISSING (POPPING, SPITTING, SKIPPING, BACKFIRING)

1. Valve tappet clearance too close.
2. Defective ignition system. (Refer to Ignition Section)
3. Leaky intake manifold.
4. Improper fuel mixture. (Refer to "Carburetor Adjustment")
5. Pitted or burned valve seats.
6. Weak or broken valve springs.
7. Valves sticking in guides.
8. Overheating.
9. Pistons and rings worn excessively, permitting "blowby."
10. Clogged carburetor.
11. Dirt in carburetor bowl.
12. Inferior grade of fuel.
13. Faulty Condensor.

Motor will not start.

1. Gasoline supply exhausted, carburetor pipe shut off or clogged by dirt or water.
2. Cylinder flooded by too much priming; pump out excess gas by kicking motor over just a few times with the throttle and choke open.
3. Mixture too lean. Adjust according to instructions under "Adjusting the Carburetor"
3. Oil congealed in motor; kick motor over a number of times before trying to start.
5. Clutch slips so that starter fails to turn motor fast enough. See "Clutch Adjustments."

Motor stops continually after starting.

1. Gasoline pipe clogged; motor will start on

kicking but gets no more fuel. Disconnect pipe and clean.

Motor stops suddenly.

1. Gasoline tank empty, filler cap air vent plugged or gasoline pipe or carburetor clogged by dirt or water.
2. Loose, broken or fouled spark plug or its cable unfastened.
3. Oil supply in tank or engine exhausted; do not run until motor turns freely again, as severe damage to cylinder, piston or bearings will result; refill with oil and turn motor over slowly till chance of injury is removed.

Motor knocks. (Gas Knock or Detonation)

1. You are opening throttle too fast, or failing to retard the spark, when accelerating or in extremely hard pulling. Open throttle more slowly.
2. Improper gas mixture, usually too lean. The correct mixture is a little hard to get; be patient and thorough; the result will greatly increase the motor's power and flexibility, and enable it to pull hard hills without knocking, etc.
3. Heavy carbon deposits; show up on quick acceleration and when pulling hard hills; shows only when motor is hot.
4. Overheated motor due to low oil supply or oil of poor quality. Sometimes due to running too fast in second or low gear, or to a carburetor adjusted for too lean a mixture.
5. Distributor points set too far apart, making too early breaking of contact.

Motor hard to start.

1. Too much or too heavy oil in motor.
2. Too much choking; clear motor of its excess gas.
3. Weak kicking of the starter; give a hard, powerful kick; it often takes a few days of practice to acquire the knack of this.
4. Poor carburetor adjustment; usually too lean.
5. Spark plug points dirty or too far apart.
6. Distributor points pitted, dirty, too far apart or too close.
7. Faulty Condensor.

Motor races when idle.

1. Throttle does not close.
2. Throttle cable not properly adjusted, or dry and needs oil poured down inside of cable casing.
3. Worn throttle stem; replace.

ENGINE

(Clearances)

CLEARANCE AND SPECIFICATIONS — ENGINE

SPECIFICATION	CLEARANCE	
	Model 640B	Model 741-B
Cam shaft bushing clearance.....	.001 to .0015	.001 to .0015
Cam shaft end play.....	.006	.006
Clutch springs — free length.....	$\frac{7}{8}$ "	$\frac{7}{8}$ "
Connecting rod side play.....	.010 to .015	.010 to .015
Connecting rod roller bearing clearance.....	.0015 to .0025	.0015 to .0025
Crankshaft and roller bearing clearance.....	.001 to .0015	.001 to .0015
Flywheel end play.....	.015 to .020	.015 to .020
Pistons: —		
Top land.....	.021 to .025	.018 to .022
Other lands.....	.016 to .020	.012 to .016
Skirt.....	.003	.006
Cam ground at wrist pin bosses to.....	.013	
Piston ring end gap.....	.012 to .018	.012 to .018
Piston ring width: —		
Compression rings.....	$\frac{1}{16}$ "	$\frac{1}{16}$ "
Oil rings.....	$\frac{5}{32}$ "	$\frac{1}{8}$ "
Piston ring groove clearance.....	.002 to .003	.002 to .003
Piston pin clearance in rod.....	.002	.0015
Piston pin diameter.....	.750	.750
Piston side play on upper rod bushing.....	$\frac{3}{32}$ "	$\frac{3}{32}$ "
Piston diameter.....	2.872	2.494
Cylinder diameter.....	2.875	2.500
Distributor breaker points.....	.020	.020
Spark advance.....	$\frac{3}{8}$ "	$\frac{3}{8}$ "
Spark plug gap.....	.025 to .030	.025 to .030
Valves: —		
Intake.....	.006	.006
Exhaust.....	.008	.008
Seat degree.....	35°	35°
Face degree.....	35°	35°
Stem diameter.....	.338	.338
Guide hole diameter.....	.343	.343
Valve spring free length.....	$2\frac{5}{8}$ "	$2\frac{7}{16}$ "
Valve lift end play.....	.010	.010
Valve seat width.....	$\frac{3}{32}$ " to $\frac{1}{8}$ "	$\frac{3}{32}$ " to $\frac{1}{8}$ "

(Engine Specifications)

ENGINE

SPECIFICATIONS

FOR MODEL 640-B AND MODEL 741-B

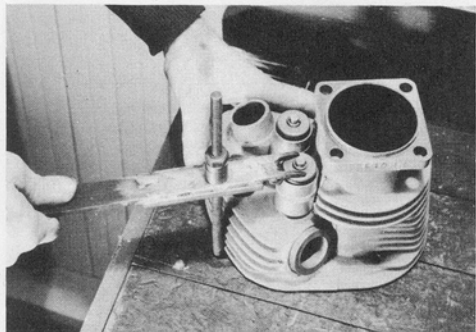
MOTOR	Two cylinder 42° "V" type air-cooled				
	Model 640-B		Model 741-B		
Bore.....	2 $\frac{7}{8}$ "		2 $\frac{1}{2}$ "		
Stroke.....	3 $\frac{1}{2}$ "		3 $\frac{1}{16}$ "		
Cu. In. Displacement.....	45.44		30.07		
CYLINDERS	"L" Head cast iron				
HEADS	Aluminum alloy deep finned				
PISTONS	Model 640-B — Cam ground "T" slot Lynite Pistons				
	Model 741-B — "Trunk" type Lynite Pistons				
RINGS	Model 640-B — 3 Compression rings — $\frac{1}{16}$ " wide				
	1 Oil control ring — $\frac{3}{32}$ " wide				
	Model 741-B — 3 Compression rings — $\frac{1}{16}$ " wide				
	1 Oil control ring — $\frac{1}{8}$ " wide				
CLUTCH	Multiple disc Raybestos and steel operating in oil				
TRANSMISSION	Three speeds				
PRIMARY DRIVE	$\frac{3}{8}$ " Pitch three row chain				
FINAL DRIVE	$\frac{5}{8}$ " Pitch $\frac{3}{8}$ " wide roller chain				
	Length — model 640, 96 rollers — model 741, 94 rollers				
LUBRICATION	Patented "Indian Dry Sump System"				
	Large oil pump capacity gear return pump				
	Hydraulic chassis lubrication fittings				
ELECTRIC AND IGNITION SYSTEM	Auto-Lite generator				
	Auto-Lite distributor				
	Indian 6 volt 29 ampere hour battery				
GEAR RATIO	Countershaft Sprocket (Solo Gears)	Rear Wheel Sprocket	Low	Second	High
	17 teeth	40 teeth	12.58	7.16	5.09
	18 "	40 "	11.77	6.76	4.82
	19 "	40 "	10.25	6.41	4.56
PRIMARY DRIVE RATIO	Motor Sprocket	Clutch Sprocket	Ratio		
	24 teeth	52 teeth	2.166 to one		
Rear wheel turns 799 times per mile with 18 x 4.00 tire. (Less traction slippage)					
CARBURETOR	Model 640-B: 1 $\frac{1}{4}$ " — $\frac{15}{16}$ " venturi				
	Float level $\frac{1}{4}$ " from top rim of bowl to float				
	Model 741-B: 1" — $\frac{13}{16}$ " venturi				
	Float level $\frac{1}{4}$ " from top rim of bowl to float				
SPARK PLUGS	Indian "C" Spark Plugs 14 m.m.				

(Top Overhaul)**E N G I N E**

- to cap the tank connection to keep the oil supply from draining out of the tank when the feed line is removed. The longer line of the two is the oil return line.
11. On Model 640 disconnect the oil breather line running from the tank to its unconnected end just under the skid plate. On the Model 741 the breather line should be disconnected at the tank and at the generator chain guard on the left side of the machine.
 12. Remove the footboard on the right side of the machine. Slide the entire footboard assembly away from the machine and when it pulls free from its mounting shafts, release the brake spring from the footboard brace.
 13. Disconnect the brake rod at the clevis just ahead of the kick starter. This is cotter-pinned only. Remove the cotter pin and pull out the clevis.
 14. Remove the brake pedal by sliding it off of the shaft.
 15. Remove the bolt holding the muffler tail pipe at the rear fender brace.
 16. Remove the bolt holding the muffler at the frame just ahead of the rear axle.
 17. Loosen the clamp holding the exhaust pipes just forward of the junction of the rear exhaust pipe to the main pipe. This is attached to the skid plate.
 18. Pulling down and away from the machine, slide the exhaust pipes out. On the Model 741 it will be necessary to remove the cylinder screws holding the exhaust pipes at the cylinders.
 19. Disconnect the oil pump breather leading from the pump assembly to the rear chain. Disconnect at the pump and at the battery cradle.
 20. Disconnect the spark plug high tension wires.
 21. Remove the spark plugs.
 22. Disconnect the tube through which the high tension wires pass underneath the tank.
 23. Unfasten the distributor cap. By disconnecting the wire going to the main body of the distributor and sliding it out of the tube, the entire distributor cap assembly may be removed.
 24. Remove the bracket between the cylinder heads and the frame connection midway between the gasoline shut-off valves underneath the tanks. Use a special $\frac{3}{8}$ " cylinder head wrench — Indian No. 101472.
 25. Remove all of the cylinder head bolts, using a special $\frac{3}{8}$ " socket extension — Indian No. 102312, in order to keep from damaging the cylinder head fins. There are two short bolts used in the left or thin side of each cylinder head. Assemble the longest bolts to the thickest part of the head — note this for future assembly.
 26. With the head bolts removed, tap the cylinder head lightly, front and back, to break the gasket seal. Don't force a screwdriver into the gasket because this will damage the gasket beyond use.
 27. Remove the cylinder heads and mark the gaskets so that you can put them back in their original position unless, of course, the gaskets are burnt, in which case new gaskets should be used when reassembling.
 28. Unscrew the valve covers on the right side of the engine and slide these covers up out of the way. (Special Indian Tool No. 101826).
 29. Turn the motor over slowly with the kick starter until all of the valves are closed and tappets free.
 30. Unloosen each valve tappet adjusting screw and back off on the adjustment as far as possible to relieve all tension on the valves.
 31. Remove the cylinder base nuts and lock washers (Special Curved Wrench — Indian No. 35W206). There are two special $\frac{1}{16}$ " diameter lock washers used on the right front and right rear cylinder base studs. If larger $\frac{3}{8}$ " washers are used on these two studs, they will interfere with the screwing down of the valve spring covers. Note for reassembly.
 32. Check the position of the pistons to make sure that they are at the bottom of the stroke.
 33. Grip the front cylinder firmly and slide it up smoothly toward the tanks. If the piston follows the cylinder, return the piston to bottom dead center. When you have the cylinder all the way up, tilt it toward the rear cylinder until it clears the top of the piston and remove.
 34. Follow the same procedure and remove the rear cylinder, tilting it toward the front piston.
 35. Check the piston rings immediately to see if there are any broken. If there are, remove them carefully so as not to let any pieces fall into the motor base.
 36. Remove the cylinder base paper gaskets. New gaskets should be used for reassembly but if there are none available remove them carefully and save them.
 37. Raise the pistons slightly and lay a clean rag around the rods so that nothing will drop into the motor base.
 38. To remove the valves from the cylinders, place a clean rag on the work bench and turn the cylinder upside down. Remove the outside valve cover. Compress the valve springs by pressing on the valve collar until the taper keys on the valve stem can be removed. Slip off these keys, then relieve the spring. The spring, collar and inside valve cover, can then be slid up and off of the cylinder.
 39. By this same method remove all of the other valve spring and cover assemblies, paying special attention to marking each valve so that you can replace it in the proper port and cylinder.

ENGINE

(Valves — Pistons)



REMOVAL OR ASSEMBLY OF THE VALVES FROM OR TO THE CYLINDER: The simple tool illustrated above can very readily be made up in any shop out of an old tire iron or piece of steel strap. Compress the valve spring collar as shown to remove the taper keys on the valve stems.

40. To remove the pistons take a small nose pair of pliers and on the drive side twist the lock ring to the right and pull out. The wrist pin can then be pressed out from the other side. Be careful not to nick the wrist pin hole in the piston or rod bushing. When the pin has been pushed out past the rod bushing, the piston can be removed from the engine and the pin pressed all of the way out on the bench.

INSPECTION

All parts should be carefully checked for clearances with all carbon removed from ports, etc.

Valves: Check the valve stems for wear. All stems should measure .338. If they are worn down beyond .333, replace them with new valves. If the face of the valve is badly pitted, burned, warped, or ringed, reface to a smooth surface of 35°, unless they are so bad that a sharp edge is left at the top after grinding, if so replace.

Valve Guides: The inside measurements of all guides should be .343. Worn valve guides and valve stems allow air to upset the idling speeds of an engine and cause noisy operation. They must be replaced if worn above .350 dia.

1. **To replace:** Drive out the old valve guides using a special drift (Indian No. 30T764). Care should be taken to press the new guides carefully and straight into the cylinder until they are fully seated. Whenever new guides are installed, valve seats should be recut.

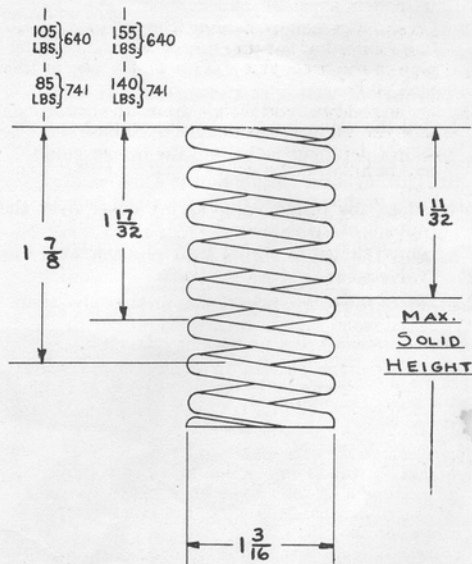
Valve Seats: If the valve seats are more than $\frac{1}{8}$ " wide, or are pitted badly, burned, ringed or warped, reface them with a 35° cutter to a smooth surface.

When refacing, bolt the cylinder to a bench or a heavy block. Do not clamp the cylinder in a vise. Heavy vise clamping will distort a cylinder.

Valve Grinding: Use a coarse grinding compound for the first grinding operations. Rotate the valve in the cylinder and lift every complete rotation. During rotation, heavy pressure should not be given because it will cause rings in the valve seat and on the valve.

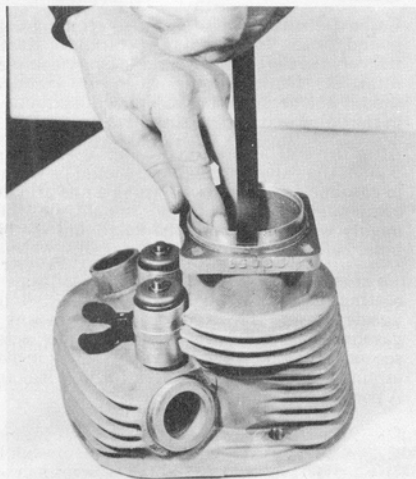
After several operations using coarse compound, the valve seat and face should be washed in gasoline and finished off, using a fine grinding compound. All compound should be thoroughly washed off both the valve and the cylinder before reassembly is attempted.

To check to see whether the valve is properly seating, close the valve and turn the cylinder upside down. Then pour a small amount of gasoline into the port. Let it set for a few seconds, then, keeping the valve closed, inspect around the head of the valve for any leakage. A perfect seat should not leak.



Valve Springs: The correct operation of the valves depends entirely upon the tension and length of the valve springs. If they are badly burned or shorter than they should be, or lack the necessary tension, they should be replaced. Standard length for model 640 is $2\frac{5}{8}$ ", for model 741 — $2\frac{7}{16}$ ". They should be replaced when more than $\frac{3}{16}$ " below standard.

FITTING THE PISTON TO THE CYLINDER: The piston to cylinder clearance measurement should be taken as illustrated above — with the piston in the cylinder in the exact position that it would be in under normal operation.



Assembly of Valves to Cylinder:

1. Oil the valve stems and valve seats.
2. Slip the proper valve into the proper guide.
3. Turn cylinder upside down.
4. Place the inside valve spring cover over the outside of the guide.
5. Slip the valve spring into position over the valve stem.
6. Place the valve spring collar on the valve stem.



MEASURING THE PISTON: (The illustration above shows a micrometer being used to measure a "T" slot piston on its thrust faces.) "T" slot pistons are cam ground and it is necessary to measure on both the thrust face side and on the wrist pin side. "Trunk" type pistons not being cam ground, may be measured from any surface.

7. Compress the valve spring and slip the valve stem keys into position on the valve stem and release the spring so that the keys fit down snugly and securely into the spring collar.
8. Slide the outside valve spring cover over the inside valve spring cover with the threaded edge toward the base of the cylinder.

Cylinder Heads: All carbon deposits should be removed from the inside of the cylinder head, using a fine wire brush.

Pistons: Remove the old rings. Scrape the carbon from the ring grooves. If there is no tool handy for scraping the grooves, break one of the old rings and use it to clean the grooves. Care should be taken so as not to gouge the ring grooves. Worn rings will allow the engine to pump excess oil and may break up in operation. Maximum groove clearance should not be over .008 to .010. The correct ring groove clearance is .002 to .003. Rings should not bind, however, in the grooves.

1. **For Model 640-B — Cylinder and Piston Clearances:** The standard bore of the cylinder is $2\frac{1}{8}$ " or 2.875. The standard piston size is 2.872. This gives a piston clearance of .003 between the cylinder and the piston. Piston clearances should be measured with the piston in the cylinder ("T" slot towards the front of the cylinder or same as it would be under actual operation) taking all measurements across the thrust face or 90° from wrist pin of the piston skirt. Feeler gauge should be inserted between this thrust face and the cylinder wall.

For Model 741-B — Cylinder and Piston Clearances: The standard bore of the cylinder is $2\frac{1}{2}$ " or 2.500. The standard piston size is 2.494.

This gives a piston clearance of .006 between the cylinder and the piston. Piston clearances should be measured with the piston in the cylinder, with the piston being held in position just as it would be under actual operation. A feeler gauge should be inserted between the piston and cylinder wall.

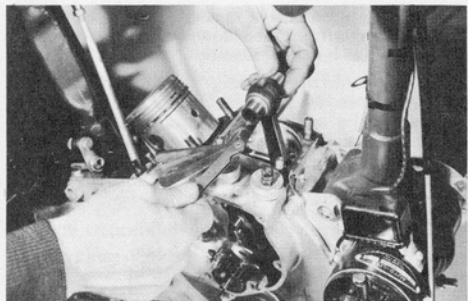
2. **Piston Oversizes:** Oversize pistons can be had as follows: —

	.005	.010	.020	.030	.040	.050	.060
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3. **Piston Clearances:**

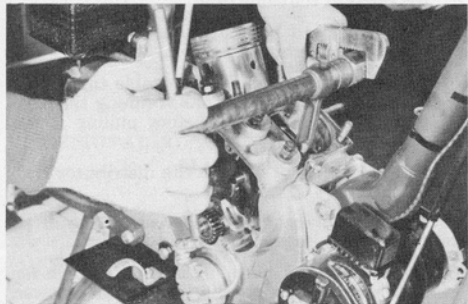
	640	741
Top land	.021 to .025	.018 to .022
Second, third, fourth lands	.016 to .020	.012 to .016
Skirt	.003	.006
Cam ground at wrist pin bosses to:	.013	
4. **Piston Specifications:** For the Model 640-B Indian pistons are of Lynite "T" slot construction, cam ground to Van Norman "E" contour,

ENGINE

(Top Overhaul)



FITTING THE WRIST PIN TO THE UPPER ROD BUSHING — MODEL 640-B ONLY: The wrist pin should be fitted with .002 clearance to the upper rod bushing. The illustration shows the wrist pin clearance being taken.



CONNECTING ROD UPPER BUSHINGS — MODEL 640-B: The illustration shows special tool 24T5331 being used to remove the bushing. The same tool can also be used to install the new bushing. The same hammer to remove or install a bushing, because it may affect the alignment of the rod.



FITTING RINGS TO THE PISTON: Worn rings allow the engine to pump excess oil and may break up in operation. Maximum ring groove clearance due to wear should not be over .008 or .010. The proper clearance should be .002 to .003 and rings should not bind in the grooves.

and have three compression rings $\frac{1}{16}$ " wide and one oil regulating ring $\frac{5}{32}$ " wide. For the Model 741 Indian pistons are of Lynite "Trunk" type construction, and have three compression rings $\frac{1}{16}$ " wide and one oil regulating ring $\frac{1}{8}$ " wide.

5. **Wrist Pins:** Wrist pins should be fitted to the pistons — free sliding with a thumb press fit into the piston at room temperature.

Overize wrist pins are available as follows: .002 — .005 — .010. The standard size is .750 or $\frac{3}{4}$ ".

6. **Connecting Rod Upper Bushings on Model 640:** Piston pins should have a clearance of .002 in the upper connecting rod bushing. These bushings are grooved for lubrication. The bushing is a press fit into the connecting rod. If the bushing is loose in the rod, it should be replaced with a new bushing of an overize outside diameter with a press fit. Use special tool 24T5331 for removing or installing new bushings.

The side play clearance between the piston bosses and the ends of the bushing is $\frac{3}{32}$ ".

- 6a. The Model 741 does not make use of a connecting rod upper bushing. The piston pin should have a clearance of .0015 in the connecting rod. If the piston wrist pin does not conform to these specifications, a new pin of an overize outside diameter should be used and the piston, line reamed to fit the wrist pin.

Fitting New Rings: Fit the new rings into the cylinder with an end gap of from .012 to .018. It may be necessary to file the ends of the rings to obtain this gap.

Ring groove clearance should be from .002 to .003 but should not bind in the ring grooves.

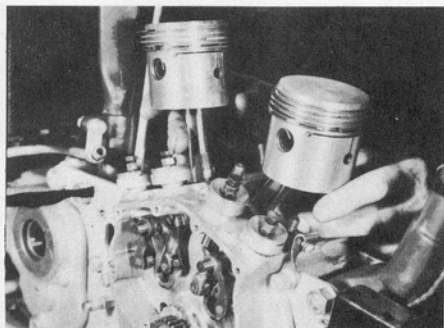
ASSEMBLY AFTER A TOP OVERHAUL

1. Assemble the pistons to the connecting rods. On the Model 640-B, which uses a "T" slot piston, the "T" slot should be facing the front of the machine. On the Model 741 there is no "T" slot, since a "trunk" type piston is used and either surface can face the front. Use a new lock ring to lock the piston in position on the wrist pin. A special tool is available for installing the lock rings — Indian No. 32T248. If one is handy, place the lock ring on the tool in such a manner that the projecting end of the ring slides freely in the ejecting slot. Hold the tool in position against the wrist pin hole and strike a quick blow to the ejecting plunger of the tool, thus transferring the lock ring from the tool to the piston groove.

Test the lock ring to see that it is a tight fit and securely in the groove. Caution cannot be overestimated in reference to installing or removing the lock ring. Improper removal or

(Top Overhaul)

ENGINE



REMOVING OR ASSEMBLING THE PISTONS: The "T" slot of each piston must face toward the front of the engine as illustrated. In removal, lay a clean rag around the rods at the case to safeguard against any broken rings or other pieces from dropping into the engine case.

installation will undoubtedly damage the ring groove and, may allow the lock ring to loosen up and become free, thereby scoring the cylinder walls badly and possibly ruining the cylinder. Use caution to make absolutely certain that the lock ring fits snug and tight. A loose lock ring operating under high r.p.m. will exert a tremendous pressure on the piston ring groove if it is loose.

2. Coat the pistons and rings with motor oil. Then stagger the ring gaps of each ring so that no two come at the same spot on the piston. They should be about equal distance apart.
3. Remove the protecting cloth covering the cylinder base so that the piston may be pushed to a bottom dead center position.
4. Replace the cylinder base gaskets. Use new ones.
5. If the valve push rods have been removed, replace the two short rods in the rear cylinder tappet guides. The longer pair are for the front cylinder.
6. Assemble rear cylinder. Be sure outside valve covers are in place. Use one special small diameter lock washer at the rear stud on the valve side.
7. Assemble front cylinder. Be sure outside valve covers are in place. Use one special small diameter lock washer on the front stud on the valve side.
8. Check valve tappet push rod positions and make sure that all are at their lowest point before attempting to tighten down cylinder base nuts. If these push rods are not **all the way down**, you may break off the cylinder base flange in tightening. To guard against this, you can watch the valves in the cylinder

and if they show a tendency to open as the cylinder is tightened down, the push rods are not yet at bottom center.

9. Reassemble the carburetor and manifold to the cylinders. It may be necessary to slightly loosen the cylinder base stud nuts to line up the manifold nuts. If so, loosen the base nuts, catch several threads of each manifold nut, then tighten base nuts before tightening manifold nuts.
10. Set the tappet clearance as follows:
Inlet.....006
Exhaust.....008
11. Reassemble cylinder head gaskets and cylinder heads, using the two short head bolts for each head at the thinnest part of the head (left side of head.) Replace the brace between the cylinder heads and the frame connections under the tanks at the same time.
12. Check all head bolts at 50 to 55 foot pounds pressure for tightening down.
13. Reassemble the high tension cable tube to the clamp underneath the tank, running the small wire through the tube before pulling it into position.
14. Attach the small wire to the distributor body connection.
15. Reassemble the distributor cap and pull the boot down into position.
16. Insert the spark plugs, attaching the high tension wire from the distributor cap that is toward the rear of the machine to the rear plug and the front to the front plug.
17. Attach the oil pump breather going from the top rear pump connection to the chain. This attaches to the pump nipple and to the battery cradle.
18. On Model 640 attach all oil lines — two from the tank to the pump and one from the tank (narrow pipe) to the frame clip and to the ground. On Model 741 the breather line should be connected from the tank to the generator guard on the left side of the machine.
19. Replace the exhaust pipe and muffler assembly. It will be necessary to slide the front cylinder exhaust tube up between the generator and boss on the oil pump assembly first. This can be done by swinging the rear of the muffler away from the machine considerably, then bringing it back as the exhaust tube is brought into place.
20. Attach the rear muffler tube at the fender brace and at the frame just ahead of the rear axle.
21. Attach the clamp holding the exhaust pipes at the skid plate just ahead of the junction of the front and rear exhaust tubes.

ENGINE

(Removal)

22. Replace the brake pedal and its bushing on the footboard forward shaft. Attach the round end of the return spring to the pedal.
23. Connect and cotter-pin the brake rod clevis at the connection just under the kick starter.
24. Slip the brake pedal return spring into the small hole of the footboard brace and attach the entire assembly to the footboard mounting shafts.
25. Replace and cotter-pin the shift connection rod over the cylinders.
26. Replace the nut and washer holding the carburetor bowl brace and tighten at both the motor base and carburetor bowl.
27. Connect the throttle control at the carburetor, checking its operation to make sure it opens all the way with full throttle and closes all the way with a slight buckle to the cable at closed throttle.
28. Bring the carburetor or air cleaner intake into position against the carburetor and screw into place. Check the clamp fitting for tightness at the air cleaner.
29. Replace the gasoline feed line at the tanks and carburetor.
30. Open the gasoline shut-off valves.
31. Start the engine and let it warm up.
 - (a) Check the oil return to the tank. Remove the oil tank cap and make sure that the oil is returning.
 - (b) When fully warmed up, check and tighten the cylinder head bolts.
32. Stop the engine and recheck the valve tappet settings.

(a) Inlet	.006	}	cold motor
Exhaust	.008		
33. Screw down valve covers.

COMPLETE ENGINE OVERHAUL

REMOVAL OF ENGINE FROM THE MACHINE

Battery

1. Disconnect and remove the battery from the machine to prevent damage to the wiring and electrical circuit.

Remove the Safety Guards

1. Loosen and remove the nut at the clutch arm and pry off the operating lever, leaving it connected at the clevis.
2. Remove both footboard brace nuts and slide the complete footboard and clutch pedal assembly off the machine as a unit.
3. At the top of the safety guard, loosen the top clamp "U" bolt and pull off the left safety guard tubing.

Remove the Left Legshield

1. Take off by removing the four flat head bolts holding it to the upper and lower braces.

Remove the Oil Bath Air Cleaner as a Unit

1. Remove the screws holding the aluminum air intake tube to the carburetor.
2. Remove the uppermost nut directly behind the air cleaner unit, holding the mounting plate to the frame anchor.
3. Remove the front clutch case bolt holding the mounting plate to the case.
4. Remove the back case bolt by removing the nut and lock washer in back of the plate first. This bolt screws into threads in the case before going thru the mounting plate.

5. Slide the complete assembly — air cleaner, mounting plate, hose and intake tube, off.

Remove the Carburetor Feed Line

1. Check to make sure both left and right side shut-offs are closed.
2. Remove the feed line at both tank connections and at the carburetor.

Remove the Shift Lever Center Rod

1. Cotter-pinned at both ends. Remove cotter pins and washers and pull out rod.

Disconnect Carburetor Control

1. At the carburetor.
2. At the front cylinder head. (Remove the cylinder head bolt, leaving the clamp on the cable.)

Remove the Right Footboard

1. Take off the two mounting brace nuts and pull away from the machine, disconnecting the brake pedal spring at the same time.

Remove Brake Pedal Assembly

1. Disconnect the clevis pin at the end of pedal rod. (Cotter-pinned only.)
2. Tap brake pedal "off" from end of footboard mounting shaft.

Remove Right Safety Guard Tube

1. Loosen the top "U" bolt clamp and slide the tube away from the machine.

(Removal)**E N G I N E****Remove the Right Legshield**

1. Remove the four flat head bolts holding the shield to the braces.
2. Remove the upper and lower braces from the front frame tube. This is not absolutely necessary but it makes it easier to work on the engine removal.

Remove the Skid Plate

1. Where the front and rear exhaust pipes merge remove the clamp holding the exhaust to the skid plate.
2. Directly in back, remove the bolt holding the skid plate to the base bracket.
3. Remove the same connection on the left side of the machine.
4. Remove the "U" bolts at the front of the plate and drop the plate away from the machine. Note the position of the spacers on the front footboard shaft.

Remove the Exhaust Pipes and Muffler Assembly

1. Disconnect the rear tail pipe at the rear fender brace.
2. Remove the bolt at the frame just under the axle.
3. Work the exhaust pipes "off" from the cylinders by swinging the entire assembly "out" and down.

Disconnect the Ignition

1. At the control adjustment.
2. Loosen the clamp holding the cable just ahead of the front cylinder.
3. Remove the clamp holding the control cable at the frame head.
4. Thread the entire cable back out of the cylinder clamp and bring it back up out of the way.
5. Slide up the distributor boot and unfasten the clamps.
6. Remove the distributor top and pull out the high tension wires (snap terminals).
7. Disconnect the high tension wires at the spark plugs.
8. Disconnect the ignition wire from the back side of the distributor body, turning the cable tube up out of the way.

Remove the Footboard Shafts

1. On the left side of the machine, remove the outside spacer on the rear shaft.

2. Using a lead hammer or rawhide mallet, tap the shaft thru to the right side. (A second spacer is used between the clutch case back plate and engine mounting plates and a third between the anchor plates. These will drop out.)
3. Use a drift and tap the shaft all the way thru to the right side.
4. Remove the front shaft, using a drift to work it out of the engine mounting plates.

Remove the Primary Drive

(In removing the engine from the frame, it is not necessary to remove the transmission case; for this reason, it is advisable to disassemble the clutch case and clutch from the engine while on the machine.)

1. Drain the clutch case.
2. Remove all case cover bolts and screws on the face side.
3. Remove the four bolts holding the oblong plate at the rear and top of the case.
4. With a screwdriver, turn the clutch worm to the right to release the outside cover and at the same time work the front section of the cover away from the machine.
5. Using a special clutch release tool, disassemble the clutch. (See instructions for disassembly on page 42-1.)
6. Remove the generator drive cover and disconnect the drive chain. (Removable link) On Model 741, necessary to disconnect breather tube cover and all cover bolts and gaskets.
7. Remove the primary drive chain, slipping it off over the clutch sprocket. (Removable link)
8. Remove the motor drive sprocket. Take off the nut and pull the sprocket from its shaft. This is keyed to the shaft.
9. Remove the clutch case back plate. (Five bolts behind clutch sprocket may be removed by using a thin walled socket wrench thru the holes in the sprocket.) (One remaining bolt at front end of back plate near drive sprocket shaft.)
10. Remove the clutch case back plate, pulling it away from the engine and transmission case at the same time.

Remove the Generator

1. Disconnect the battery wire at the circuit breaker on the generator body.
2. Remove the screws holding the generator back plate to the engine case (left side of engine).

ENGINE

(Disassembly)

3. Remove the one bolt holding the generator bracket to the frame and drop the generator down and away from the frame.

Oil Lines

1. Drain oil tank.
2. Disconnect both the feed and return lines at the tanks and at the oil pump.
3. Disconnect the tank breather line and slide the line up out of its clip and off.
4. Disconnect the breather line running from the pump to the rear chain both at the pump and at the battery mounting clip and remove.

Removing the Engine as a Unit

1. Disconnect the top brace holding the engine

at the cylinder heads to the upper frame tube under the tanks.

2. Place blocks under the engine to prevent it dropping before you are ready.
3. From either side take off the nuts for the three engine bolts holding the engine to the rear anchor plates.
4. Remove the one main frame bolt at the end of the front frame tube, holding the engine anchor plate to the frame. (Do not remove the front anchor plates from the engine.)
5. Tap out with a drift — the three rear anchor bolts.
6. From the right side of the machine, remove the blocks placed under the engine to keep it from dropping and drop the engine down from the front end and out from the frame on the right side.

DISASSEMBLY OF THE COMPLETE ENGINE

As the engine is disassembled, parts should be cleaned and inspected except where new parts are to be used in the reassembly. Parts such as valves, guides, springs, bushings, shafts, pinions, gears, rollers and retainers, should be checked for wear and new parts used for reassembly where wear has made the part too much undersize.

1. Remove the spark plugs.
2. Remove the cylinder heads.
3. Loosen the clamp screw on top of the oil pump at the distributor and pull the distributor body "up" out of the housing.
4. Disconnect the short oil line between the sump and the oil pump.
5. Remove the body screws holding the oil pump to the engine and pull the pump away from the engine. The oil pump unit, unless giving trouble, should not be disassembled but merely cleaned thoroughly. On the inside of the pump housing there is a recessed hole in which a breather valve disc operates. Use caution in removing to prevent damage to this disc. It must be perfectly smooth and flat (no burrs) to function properly.
6. Remove the spiral gear from the rear cam shaft.
7. Using special valve cover tool No. 101826, unscrew the valve covers and slide them up out of the way.
8. Remove the carburetor brace nut at the left side of the engine.
9. Using special tool No. 101440, loosen and unscrew the manifold nuts.
10. Remove the manifold and carburetor as a unit. Disassemble the carburetor and clean according

to carburetor instructions under Group 4300 "Fuel System."

11. Remove the cylinder base nuts and lift the cylinders, being careful not to injure the pistons by letting them fall against the base.
 - (a) Inspect and check valves, guides, springs, etc., in each cylinder, according to instructions under "Inspection of the Cylinder, etc." on Page 41-3
12. Remove the lock rings, piston pins and pistons, following the instructions on Page 41-3
13. Remove the valve tappets. The two longer ones operate for the front cylinder, the shorter ones for the rear.
14. Remove the screws on the left side of the base holding the timing case cover to the case.
15. Work the case cover away from the engine using care so as not to disturb the lifts or gears. Remove its gasket.
 - (a) Inspect all case cover bushings for wear.
 - (b) Cam shaft cover bushings are a press fit into case and should have .0015 clearance on cam gear shafts.
 - (c) Lift shaft bushings are also a press fit in cover.
16. Rotate the flywheels until the timing marks on the cam gears line up.

CLUTCH

(Disassembly)

THE MOTORCYCLE CLUTCH

The motorcycle clutch on the Model 640 and Model 741 is an "oil" type clutch and operates in a constant oil bath.

Clutch pressure is obtained through the use of twelve (12) springs on the pressure plate. Pressure may be increased by the addition of four (4) springs, making a total of sixteen (16).

CAUTION: Never operate the vehicle when the clutch is slipping. See "Clutch Adjustments."

TO DISASSEMBLE CLUTCH

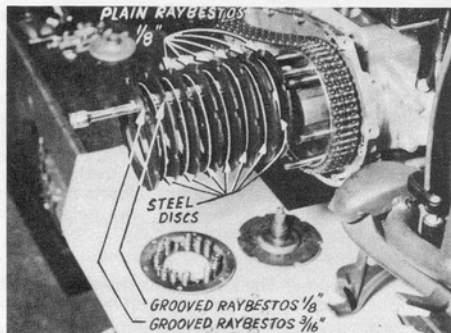
Note: The distance between the clutch spring plate and pressure plate should not be more than $\frac{3}{16}$ ". If it is greater, it means that the Raybestos discs are worn and should be replaced.

1. Fit special tool 23T269 onto the worm of the clutch release shaft and tighten until all spring tension on the clutch plates is released.
2. Straighten up all of the washers on the nuts holding the clutch outside plate and take off the nuts.
3. Remove the tool used to release the spring tension.
4. Remove the outside plate. Clutch springs will come out with this plate.
 - (a) There are 12 springs used in the original factory construction.
 - (b) Clutch slipping may be stopped by using a maximum of 16 springs. However, this should never be necessary if the clutch levers are properly adjusted.
 - (c) Springs should be $\frac{7}{8}$ ". If less than $\frac{13}{16}$ " they should be replaced.
5. Remove all of the steel and fibre clutch discs. A hooked wire will prove useful to slide these off.

- (a) If the fibre discs are cracked or worn, the clutch action will not be smooth. They should be replaced.
- (b) If the steel discs are grooved or warped, or have ridges, they should be replaced with new discs.

(c) The clutch make-up is as follows:

1. Plain Raybestos disc ($\frac{1}{8}$ " thick)
2. Steel disc
3. Plain Raybestos disc
4. Steel disc
5. Plain Raybestos disc
6. Steel disc
7. Plain Raybestos disc
8. Steel disc
9. Plain Raybestos disc
10. Steel disc



CLUTCH MAKE-UP

11. Plain Raybestos disc
 12. Steel disc
 13. **GROOVED** Raybestos disc ($\frac{1}{8}$ " thick). Assembled with grooved surface facing towards the outside.
 14. Steel disc
 15. Heavy **GROOVED** Raybestos disc ($\frac{3}{16}$ " thick). Assembled with grooved surface facing towards inside.
6. Check the bearing races on the clutch throwout. If they are worn or pitted, new parts should be used.
 7. Check the ball bearings and retainer. If the bearings fall out of the retainer, a new retainer and bearings should be used.

ASSEMBLY

1. Replace all clutch discs as listed in the clutch make-up under No. 5 (c) clutch disassembly. The first disc to insert will be a Raybestos plain disc.
 - (a) The grooved discs are made as such to allow oil to flow to the clutch release bearings. Stagger grooves between two discs when assembling.
2. Replace the clutch throwout assembly and plate.
3. Replace springs. If 12 are used, leave open studs at even intervals to equalize pressure.
4. Replace outside plate and, using special tool, compress the springs so that the plate can be pressed into position on the studs.

(Adjustments-Specifications)**CLUTCH**

5. Using flat washers, tighten down all nuts and turn over the edge of each washer to lock the nuts in position.
6. Release the tool from the clutch release worm.

Clutch Adjustments

The clutch is operated by means of a lever on the outside of the primary drive case cover. The lever is connected to the clutch pedal by a steel shaft with a clevis adjusting connection. Partial adjustment can be made by screwing the clevis to the right or left to lengthen or shorten the clutch rod. The clutch pedal should have 1" of play between the heel pad and the footboard.

To do this:

- (a) Loosen the lock nut at the clevis on the rod.
- (b) Remove the cotter pin and the plain washer on the lever end of the shaft.
- (c) Turn the clevis to the left to lengthen the adjustment or to the right to shorten the rod. Shortening the rod will decrease the clutch friction and lengthening it will increase the clutch friction.

If the clutch drags in severe cold weather, it is probably not due to improper adjustment but to too heavy a lubrication oil in the primary drive.

If greater adjustment is required than is possible to obtain by shortening or lengthening the rod — further adjustment can be made by removing the clutch arm.

- (a) Remove the nut and lock washer holding the clutch arm.
- (b) The clutch arm hole and shaft are hexagonal in shape.
- (c) Shift the arm one "hex" at a time to obtain the proper adjustment. Sixteen (16) different positions can be obtained through shifting this adjustment. (8 on one side and 8 more $\frac{1}{2}$ way between by turning lever over.)

The tension on the foot pedal can be adjusted by loosening or tightening the castle nut on the end of the foot pedal shaft. When making this adjustment, always replace the cotter pin through the castellated nut and the shaft.

Clutch Lubrication

If the clutch is inclined to drag when shifting and not release fully with the toe pedal all the way down, drain and refill the primary drive and transmission with a "lighter" grade of motor oil. The drain plug is located underneath the primary drive case cover immediately below the clutch.

Both the clutch and transmission are lubricated from the oil carried in the primary drive case.

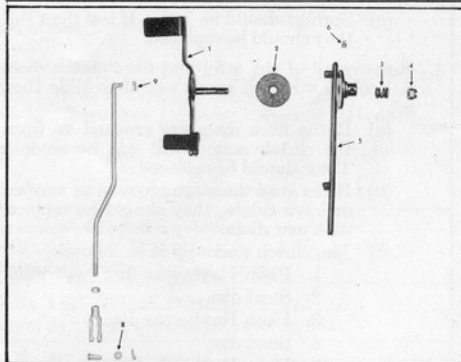
Passage holes are drilled between the transmission and the primary case in back of the clutch drive sprocket.

CLUTCH SPECIFICATIONS

	No. Used
CLUTCH PLATES: Raybestos $\frac{3}{16}$ " groove	1
Raybestos $\frac{1}{8}$ " "	1
Raybestos $\frac{1}{8}$ "	6
Steel discs	7
CLUTCH SPRINGS: Free length $\frac{3}{8}$ "	
52 Lbs. Pressure @ $\frac{3}{8}$ "	12

SERVICE DIAGNOSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
Slipping	Improper Adjustment	Readjust according to instructions.
	Worn Raybestos Discs	Install new clutch plates — Raybestos
	Weak Springs	Install new springs
Creeping	Too heavy a lubricant	Flush and refill with a lighter grade of oil.
	Improperly adjusted friction pedal disc	Adjust pedal
	Glazed pedal friction disc	Renew disc



CLUTCH PEDAL FRICTION PLATE: Friction discs are used at the clutch pedal to control the tension of the pedal itself so that it will stay in either an engaged or disengaged position. Sometimes, due to excessive lubrication of the pedal shaft, grease and dirt will accumulate on the friction disc and give it a glazed surface that will not enable the pedal to be held in its disengaged position. When this occurs, replace the discs with new discs.

FUEL SYSTEM

(Carburetor)

THE FUEL SYSTEM

In the fuel system of the motorcycle the gasoline is held in gas storage tanks directly above the engine and utilizes the gravity flow to pass the gasoline from the storage tanks to the carburetor. Each tank is provided with a separate shut-off and both connect with a single tube pipe leading to the carburetor on the left side of the engine.

In the event of a leak developing in the gas tanks, the ultimate danger of gasoline dripping onto the hot motor requires that the tanks be removed and, after draining, be repaired. The tanks are of soldered construction and minor leaks may be repaired without a great deal of difficulty, by resoldering the seams. However, before any soldering to the tanks is done, the tanks should be dried out and flushed thoroughly with carbon tetrachloride to eliminate any danger of fumes still remaining in the tanks. All inlets to the tank are reinforced with brass plates soldered to the inside of the tank.

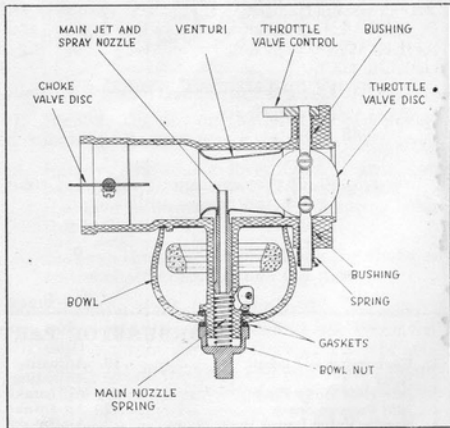
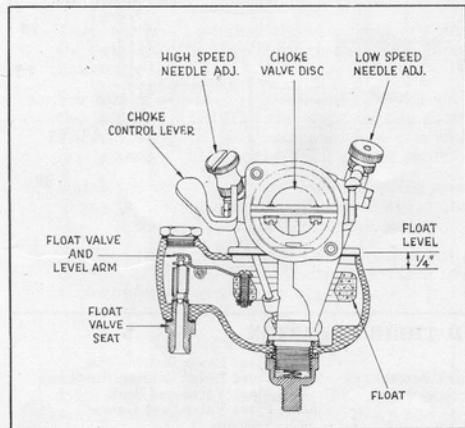
THE CARBURETOR

The carburetor should be inspected and cleaned periodically, especially under adverse operating conditions. The most common carburetor trouble, besides improper adjustment, is caused by water and

dirt accumulating in the float bowl. The float bowl may be drained by removing the clamp at the motor base and carburetor bowl—unscrewing the nut holding the bowl to the carburetor and letting the gasoline drain through. On some carburetors a drain screw at the lowest point in the bowl is provided. However, a proper cleaning can be obtained only by removing the bowl.

Removal and Disassembly of the Carburetor

1. Close both shut-off valves at the gas tank.
2. Disconnect the line at the carburetor bowl.
3. Disconnect the carburetor throttle control at the carburetor by removing the cotter pin.
4. Remove the small nut at the motor base holding the clamp below the bowl.
5. Unscrew the two screws holding the carburetor air cleaner intake to the carburetor.
6. From the right side of the motorcycle, reach in beside the manifold and remove the three screws holding the carburetor to the manifold.
7. Remove the carburetor and inspect the gasket at the manifold connection.

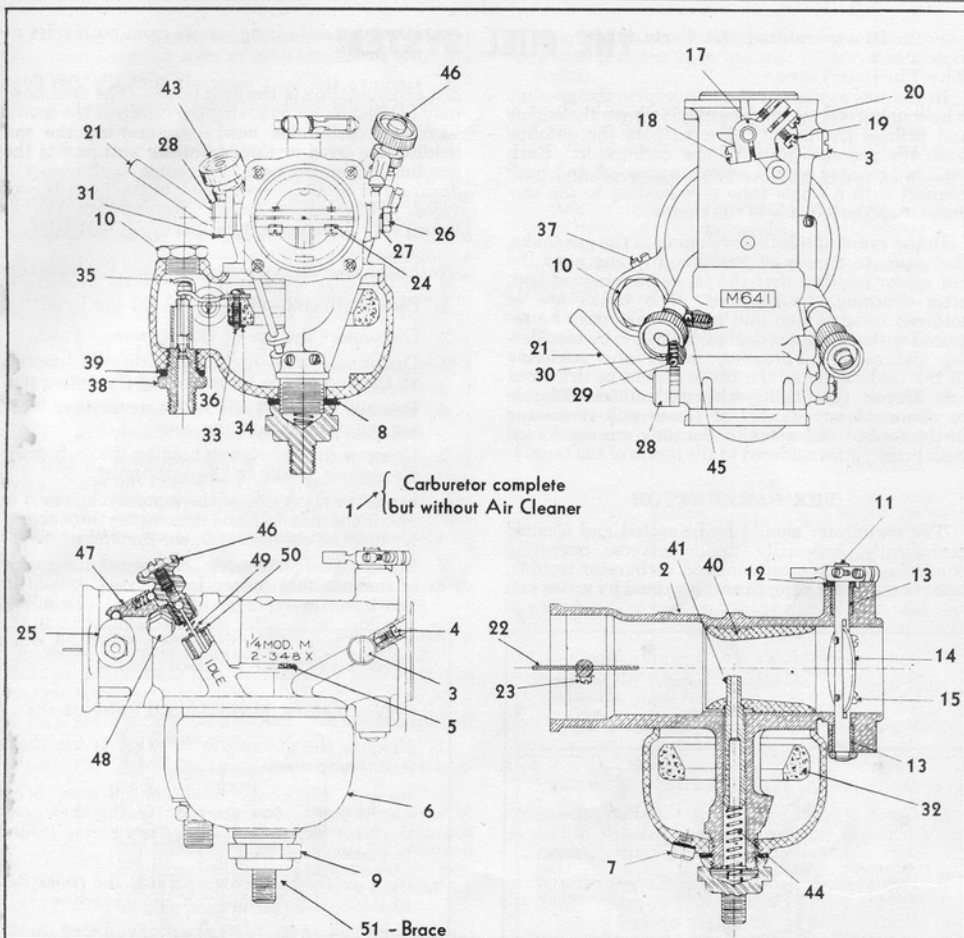


CARBURETOR: Worn throttle shaft bushings will greatly affect the carburetion at idling speeds. Throttle shaft bushings should be inspected and if found to be worn, replaced. The throttle disc, if removed, must be reassembled with the degree mark to the right of the shaft when closed. Before tightening the screws holding the disc to the shaft, close the valve to center the disc in the carburetor body. Worn needle valves and seats should be replaced. Cork floats, if damaged or cracked, should be replaced.

CARBURETOR: The most common carburetor trouble, besides improper adjustment, is caused by water and dirt accumulating in the float bowl. To function properly, the manifold at the cylinders must be tight and free from air leaks, as well as the gasket between the carburetor and the manifold. A leaky carburetor would signify a sticky float valve or too high a float level or both.

(Carburetor Parts)

FUEL SYSTEM



CARBURETOR PARTS AND THEIR LOCATION

- | | | |
|-------------------------------------|--------------------------------------|--|
| 1. Carburetor — Linkert | 19. Adjusting Screw | 36. Float Lever Bearing Pin |
| 2. Body | 20. Adjusting Screw Lock Screw | 37. Float Lever Bearing Pin Screw |
| 3. Idle Hole Body Plug | 21. Air Intake Shaft | 38. Float Valve and Seat |
| 4. Idle Passage Screw | 22. Air Intake Disc | 39. Float Valve Seat Gasket |
| 5. Needle Valve Lower Body Screw | 23. Air Intake Disc Screw | 40. Venturi |
| 6. Bowl and Float Assembly Complete | 24. Screw Lock Washer | 41. Nozzle |
| 7. Bowl Drain Plug | 25. Air Intake Cam | 42. Nozzle Spring |
| 8. Bowl Gasket | 26. Air Intake Shaft Nut | 43. High Speed Needle Valve |
| 9. Bowl Nut | 27. Air Intake Shaft Nut Lock Washer | 44. High Speed Needle Valve Spring |
| 10. Bowl Cover Plug | 28. Air Intake Shaft Stop | 45. High Speed Needle Valve Friction Ball |
| 11. Throttle Shaft Assembly | 29. Shaft Lever Friction Ball | 46. Low Speed Needle Valve and Knurl Assembly |
| 12. Throttle Shaft Spring | 30. Shaft Lever Spring | 47. Low Speed Needle Valve Lift Lever Assembly |
| 13. Throttle Shaft Bushing | 31. Shaft Lever Pilot Screw | 48. Lift Lever Bearing Pin |
| 14. Throttle Disc | 32. Float | 49. Lift Lever Return Spring |
| 15. Throttle Disc Screw | 33. Float Screw | 50. Lift Lever Spring Seat |
| 17. Throttle Lever Assembly | 34. Float Nut | |
| 18. Clamp Screw | 35. Float Lever Assembly | |

FUEL SYSTEM**(Disassembly)****Disassembling the Carburetor****The Throttle Valve**

1. Looking inside the carburetor from the throttle end, close the throttle valve and remove the two small screws holding the valve to the shaft.
2. Open the throttle and slide the disc out.
3. On Schebler model carburetors remove the cotter pin at the lower end of the throttle shaft outside, and slip off the washers and tension spring. Slide the shaft up out of the body.

On Linkert model carburetors loosen the clamping screw at the throttle control lever and slide the shaft out from the bottom.

4. If shaft is worn, replace it.
5. Inspect the bushings; if worn, replace with new ones. Worn shafts and bushings leak air and interfere with the idling adjustment.

Assembly

1. On the Schebler Model Carburetor — with the bushings in the body, slide the shaft through from the top.
2. On the Linkert Model Carburetor — replace the tension spring and washer at the other end and cotter-pin.
3. Turn the shaft so that the slot faces out and slide the throttle disc through the shaft about halfway.
4. For Model 640-B the disc should face you with the lettering "13" to the right of the shaft. For Model 741-B the disc should face you with the lettering "12" to the right of the shaft.
5. Catch the two screws into the shaft; then press firmly on the throttle disc so that it will center itself in the body before tightening screws.
6. Replace the lock screw for the adjusting screw on top of the shaft and adjust so that the throttle disc is just barely opened.

The Bowl and Float

1. Remove the large nut at the bottom of the bowl and take off the gasket. The spray nozzle spring and spray nozzle will drop down and out.
2. Remove carburetor bowl and its top gasket. Inspect the thick cork gasket at the bottom. If either is damaged, replace with new ones. (Linkert Carburetor does not use these two gaskets.)
3. Remove the body cap screw on top of the bowl. If the fibre gasket is damaged, replace with a new one.

4. Remove the bearing screws from both sides of the body.
5. Remove the float lever pin and slip the float out of the bowl.
6. Remove the float seat valve and unscrew the needle valve seat out from the bottom. If the gasket is worn, replace.
7. If the needle valve and seat are worn, replace.
8. If the cork float is damaged or cracked, replace with a new float.
9. If the float lever fingers are worn, broken, or badly bent, replace.

Assembling the Float to the Body

1. Replace the gasket of the float needle valve seat and screw the valve into the bowl.
2. Replace the needle valve.
3. Slip the float back into the bowl so that the three fingers fit the ball end of the needle valve without play but operate freely.
4. Replace the float lever pin and screw bushings in the bowl case.
5. The float, when raised in the bowl, should be $\frac{1}{4}$ " from the top edge of the bowl. To adjust the float level, bend the float lever next to the float. Remove the float from the bowl when bending this lever.

The Choke Throttle and Venturi

1. Remove the nut on the left side of the choke lever shaft.
2. Remove the choke lever control arm, being careful not to lose the ball bearing that holds the lever in position. There is a spring behind this ball.
3. Remove the two screws holding the choke disc to the shaft and slide out the disc.
4. Slide the shaft from the body, being careful not to lose the ball bearing at the needle valve end.
5. Reach inside the body and pull out the venturi. (The spray nozzle coming up from the bowl chamber must be removed to do this.)
6. Clean the venturi.
(Model 640: The venturi size is $\frac{15}{16}$ " at its smallest opening.)
(Model 741: The venturi size is $\frac{13}{16}$ " at its smallest opening.)
7. Unscrew high speed needle valve and remove.
8. Unscrew low speed needle valve and remove.

(Repair)**FUEL SYSTEM**

9. Check both needles. The needle shafts should be straight. If the points are bent, polish them off and remove any burrs.
10. Remove the screw plugs at both needle valve sockets, the two on the low speed needle valve side of the body and the one countersunk at the manifold end, and clean all passages by blowing out with an air hose.

Assembly

1. Return all body screw plugs taken out under No. 10 instruction for disassembly.
2. Screw in the low speed needle valve and the high speed needle valve.
3. Replace venturi — with the large end toward the throttle or manifold end.

Check the position of the hole in the venturi. It must line up with the needle valve spray nozzle that pushes through from the bowl side. Use the spray nozzle to position the venturi.

4. Replace the throttle shaft disc and lever, sliding the shaft through from the right and attaching the control lever with its ball bearing stop — then inserting the choke disc. Place the choke disc in the shaft slot with the hole toward the inside. Catch both screws, position the disc by closing the lever and screw up tight.
5. Insert the spray nozzle from the bowl end — small end first with the slotted side toward the choke end of the passage. The spray nozzle must go all the way in so that the end passes through the drilled passage of the venturi and up inside the body passage.
6. When assembling Schebler Carburetors, replace the top bowl gasket. Use a new one if the old one is damaged.
7. Check to make sure the heavy cork gasket at the base of the bowl mounting is in place. These two gaskets are not used on the Linkert Carburetor.
8. Slip the bowl into position with the gas line connection at a right angle to the body — then shift it about 1" toward the high speed needle.
9. Replace the lower bowl gasket, spray valve spring and the bowl retaining nut.

Assembly of the Carburetor to the Machine

1. Loosely attach the carburetor brace to the bowl.
2. Slip the manifold gasket into position, using the manifold screws to hold it in position.
3. Bring the manifold end of the carburetor up to the manifold and catch the brace at the bottom of the bowl to the motor base stud at the same time.

4. From the right side of the engine reach through with a screwdriver and catch all three screws, then pull them up evenly and as tight as possible.
5. Replace the nut at the motor base brace and tighten the brace nut to the carburetor bowl.
6. Swing the air intake pipe from the air cleaner up to the carburetor and screw into position.
7. Connect the throttle control cable and test to check the amount of throw from the grip control. At closed throttle the cable should buckle slightly.
8. Connect the gas line at the carburetor bowl.
9. Open the tank shut-off valves.

CARBURETOR GAS FILTER

Model 741 is equipped with a gasoline filter which attaches to the carburetor at the float valve. This should periodically be removed by unscrewing the knurled wheel on the bowl retaining wire and removing the filter bowl from the filter. With the filter bowl removed, allow the gasoline from the tank to flow through the filter head for a moment or two to clean out the filter head itself. Wash out the filter bowl in a clean pail of gas before reassembling. A small cork gasket is used between the filter head and filter bowl; this must be replaced to prevent leaks at the filter head.

CARBURETOR FLOAT LEVER AND NEEDLE VALVE ADJUSTMENT

If too much play has developed between the three fingers of the float lever and the ball on top of the float needle, a lean carburetor mixture will result, due to lack of the proper amount of gas in the bowl. The needle valve does not open far enough to keep the bowl properly filled at all times.

Such a lean mixture will cause quick overheating, misfiring, spitting back through the carburetor, hard starting, and a very much lowered top speed.

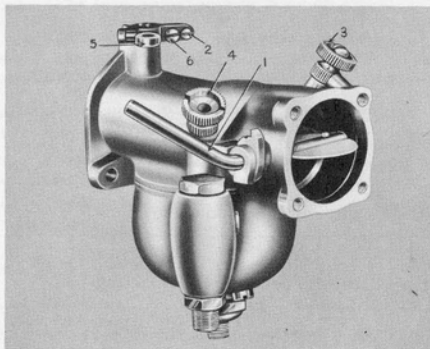
To correct this trouble:—

1. Remove the float assembly from the bowl.
2. Bend the top finger down closer to the two lower fingers.
3. Check so that there is very little play but do not pinch the fingers.
4. Adjust the float level in the bowl by bending the lever at the float end.
5. The correct height is $\frac{1}{4}$ " from the top of the bowl to the top of the float. Refer to the carburetor cross sectional diagram.

FUEL SYSTEM

(Adjustment)

CAUTION!! Too lean a mixture will cause overheating at high speeds and may cause severe injury.



ADJUSTING THE CARBURETOR

- Turn the adjusting screw (6) at the throttle control to the right; make sure the throttle valve is slightly open. One turn should be sufficient.
- Turn both needle valves (3 and 4) to the right until they seat, using caution not to force. If turned in tight, it may injure the needle valve seat inside.
- Turn the high speed needle valve (4) (the valve towards the front of the machine) to the left one and one-half ($1\frac{1}{2}$) turn.
- Turn the low speed needle valve (3) (the valve towards the rear of the machine) two full turns to the left.
- Prime and start the engine and allow it to warm up. When it is thoroughly warmed, check to make sure the choke lever (1) is all the way open.
- Retard the spark control and adjust the low speed needle valve (3) by turning it to the right and left until the engine fires evenly. Turning this valve to the right (clockwise) gives a leaner mixture — turning it to the left gives a richer mixture.
- To adjust the high speed needle valve (4) open the throttle part way, then turn the needle valve (4) to the right (clockwise) until the motor starts to stall. At this point, reverse the direction and turn the needle valve to the left until the engine runs at its fastest point.
- Check the adjustment by retarding the spark and opening the throttle quickly. If the motor backfires through the carburetor — it indicates too lean a mixture and the needle valve (4) should be turned to the left more. Turn the needle valve about a quarter ($\frac{1}{4}$) of a turn each time. If the motor chokes when the throttle is opened, it indicates that the mixture is too rich and the high speed needle should be turned to the right. Repeat the above until a satisfactory adjustment is obtained.
- Although the high and low speed needle valves (3 and 4) operate independently, they more or less affect each other. For this reason, return to the low speed needle adjustment (3) and readjust with the throttle closed.
- Regulate the idling speed by the adjusting screw (6) at the carburetor control (5). Turning to the left slows down the idling speed — turning it in toward the right increases the idling speed.

CARBURETOR SERVICE TIPS

- If the motor does not idle evenly, check the manifold for air leaks with the motor running, by squirting gasoline around the manifold joints both at the carburetor and at the cylinder. (Use an oil can filled with gasoline for testing.) If the idling speed changes when the gas is squirted on any of these connections, an air leak is indicated and the connections should be tightened.
- This same test should be made at the valve guides.
- If the motor runs irregularly — and at wide open throttle it backfires through the carburetor, the mixture is too lean.
- If the engine backfires through the muffler — the mixture is too rich.

All carburetors are carefully calibrated and tested for the engine and are as nearly foolproof as it is possible to make them and still allow for high and low speed outside adjustments. About the only thing that will cause them to work badly is an accumulation of dirt or water in the bowl.

- To check the flow of fuel at the carburetor, remove the gasoline line connection at the bowl and open each tank shut-off valve separately.
- If the air vent in the gasoline cap becomes plugged, a vacuum will be set up in the tank and stop the flow of gas to the carburetor. To check this, remove the filler caps on each tank and inspect the air vent hole and spring. Unplug the hole if it is plugged.
- Make sure the gasoline shut-off valves are turned on and that there is gasoline in the tanks.

(Servicing)

FUEL SYSTEM

SERVICE DIAGNOSIS

SYMPTOM	PROBABLE CAUSE	REMEDY
Excessive Fuel Consumption	Poor carburetor adjustment	Adjust high and low speed needle valves
	Improper float level adjustment	Adjust throttle stop screw
	Dirty Air Cleaner	Clean according to the instructions
	Fuel leaks	Check all lines and connections
	Sticking controls	Choke lever not completely open. Throttle not completely closing
	Excessive idling	Stop engine when machine is not in use
	Overheating	See reasons for overheating under "Engine Diagnosis"
	Brakes dragging	Adjust
	Tires under-inflated	Inflate to 18 lbs. pressure front, 20 lbs. rear
	Rich fuel mixture	Adjust high and low speed needle valves
Fast Idling	Carburetor controls sticking	Adjust controls
	Leaky manifold	Inspect manifold for air leaks and tighten manifold nuts and carburetor screws holding the carburetor to the manifold

CARBURETOR SPECIFICATIONS

	MODEL 640	MODEL 741
Make	Linkert	Linkert
Model	M641	M-741
Venturi	$1\frac{5}{16}$ "	$1\frac{3}{16}$ "

FUEL SYSTEM

Air-Cleaner

OIL BATH AIR CLEANER

OIL BATH AIR CLEANER

This type of air cleaner filters the air going into the carburetor through an oil bath. For this reason, it can easily be understood that as it is used, the oil becomes filled with dust and dirt. It is recommended that the oil reservoir be removed from the cleaner body — cleaned and refilled every time the oil is drained from the motorcycle tanks.

Where the motorcycle is operated under extremely dusty conditions, it is recommended this cleaning and refilling with fresh oil be done more frequently.

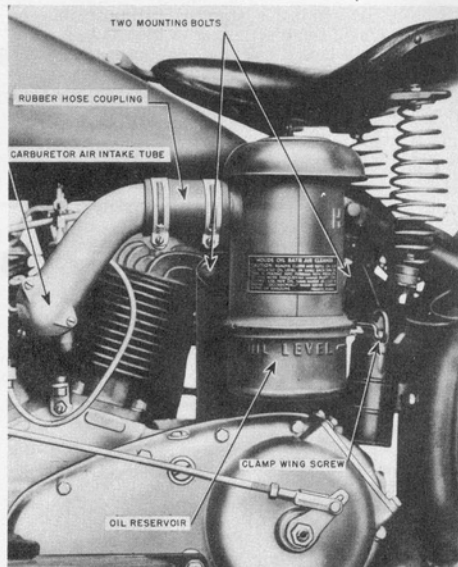
Occasionally disassemble the entire cleaner and wash all parts thoroughly in clean gasoline.

At all times when refilling the oil bath, use the same grade of oil as used for the motorcycle.

Disconnecting, Dismantling, Cleaning and Reassembling the Cleaner Body

1. Loosen the clamp holding the rubber connection tube nearest the air cleaner.
2. Remove the two bracket bolts holding the bracket to the mounting plate.
3. Remove the air cleaner from the machine.
4. Loosen the wing bolt on the lower half of the body and remove the bottom section of the case.
5. Dump out the old oil and clean the case in gasoline.
6. Slip off the baffle cup at the reservoir end.
7. Remove the nut and top of the cleaner and take off the cover. Model 640 only.
8. Dip the body of the air cleaner into a pail of clean gasoline and slosh around so that the gas can wash off the insides of the element.
9. Remove the body from the gasoline and allow it to dry. (An air gun will aid in drying the filter element more quickly.)
10. When thoroughly dry, wet the inside filter element with clean motor oil — the same grade as used in the motorcycle tanks.
11. Replace the baffle cup on the lower side of the cleaner.
12. Refill the reservoir to the oil level line and attach to the cleaner body, making sure it seats up against the body before tightening down the clamp.
13. Tighten the wing bolt and clamp.
14. Replace the cover, making sure that the word "front" is directly over the connection that leads to the carburetor intake hose. Model 640 only.

15. Mount the cleaner into position on the mounting plate.
16. Connect the rubber hose to the air intake tube and tighten the clamp.



Draining and Refilling the Oil Bath Only

1. Unscrew the wing bolt holding the clamp part way up from the bottom of the cleaner assembly and at the same time hold the bottom of the case up in place to keep it from dropping off.
2. Free the bottom section of the cleaner from the cleaner body and remove by dropping down and away from the machine.
3. Dump out the old oil and clean the case in a pail of clean gasoline. Also remove the baffle cup from the bottom of the case — clean in gasoline and put back into position.
4. Refill the case with the same grade of oil as used in the motorcycle up to the oil level mark on the case.
5. Slide the case up to and under the clamp on the cleaner body.
6. Tighten down the clamp making sure the bottom section slides into a seated position.

MUFFLER AND EXHAUST SYSTEM

The exhaust gases from the motorcycle engine are passed off through two tubular exhaust pipes that are welded into a single unit, thence through a muffler and out to the rear of the motorcycle, through an extended tail pipe.

Unlike the exhaust system of an automobile or truck, in which there is danger of the exhaust gases seeping into a closed cab and making it dangerous for the driver, the exhaust system on the motorcycle engine does not require the amount of sealing that would be required in either the automobile or truck.

It is important, however, that the exhaust pipes be kept free and open and if by any chance they

become closed up through travelling over rocky and rough country, the exhaust pipes should be replaced.

Both the exhaust pipes and muffler should fit securely and tightly to the machine. Should the exhaust pipes become loose at the cylinder exhaust ports, they should be tightened securely in order to maintain the correct amount of back pressure at the exhaust valve to keep the valve stems from warping or burning. Operation of the motorcycle engine without the exhaust pipes allows cold air to readily strike the valves and cool them unevenly so that the valves and stems would, in short order, become burnt and warped.

COOLING

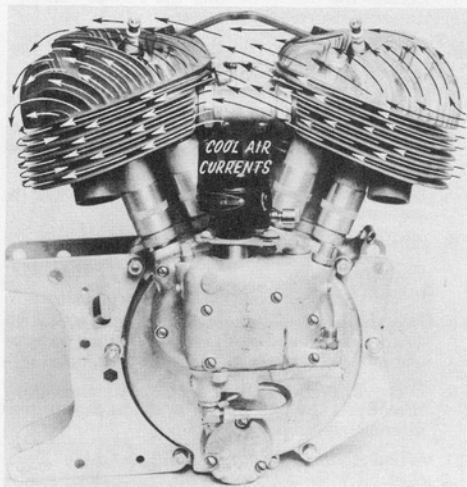
Since the motorcycle engine is of the air-cooled design, it depends upon the circulation of air currents around the cylinders and heads for the proper cooling of the engine. For this reason the engine should not be run constantly while the machine is standing still.

Overheating may be caused through allowing grease and dirt to accumulate on the outside surfaces of the cylinders and heads, as well as for those reasons mentioned under "Overheating" in "Engine Diagnosis."

In the Repair Shop, when an engine is being "run in" after an overhaul, it is recommended that a circulating fan be directed from each side toward the engine to partially cool and carry away the heated air immediately around the cylinders.

Should dirt and rust accumulate on the cylinders, it is advisable to wire brush the cylinders and heads.

Operation of the machine in warm climates and during the warmer months of the year in northern climates with legshield equipment attached to the motorcycle, will greatly affect the cooling of the engine. The legshield equipment should be removed from the machine during warm weather.



Air Currents Circulate to Cool Both
Cylinders and Heads

(Generator)

ELECTRICAL

Brushes worn short should be replaced. Both stationary brushes are Auto-Lite GAS 12. The third or moveable brush is Auto-Lite GAS 13.

Natural wear of the brushes causes carbon dust to collect on the inside of the generator and its accumulation will cause unsatisfactory operation. It will soon mix with the oil that reaches the interior from the bearings or other sources and form a gummy paste that will coat itself all around the commutator end of the body. Clean with gasoline and wipe all parts.

The commutator should be free from all oil or dirt. No. .00 sandpaper should be used in cleaning and should be wiped with a clean rag. (Never use emery cloth or any other cleaning material.) Never put lubricants on the commutator or brushes.

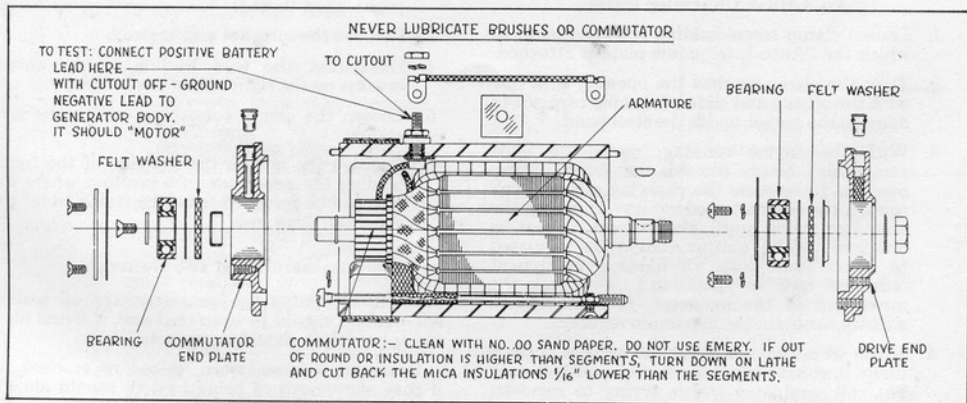
The brushes should be free to move and make good contact with the commutator's polished surface.

Disassembly

If its surface has been pitted, the armature should be removed and a slight cut taken in a lathe across its face. After this, it should be carefully polished.

1. Remove the machine mounting clamp from the generator.
2. Remove the inspection steel band. If the gasket is damaged or broken, replace it for reassembly.
3. Disconnect the two black wire leads from the brushes and pull the wires thru the inspection slots so that they are out of the way.
4. Remove the two long body screws at the commutator end plate.
5. Tap and pry off the drive end plate from the other end.

6. Remove the armature and commutator end plate as a unit.
7. Remove the three screws and triangle plate and gasket from the commutator end.
8. Remove the flat head screw and washer on the shaft.
9. Slide the end plate off the armature, using care not to damage the brushes by letting them snap off the edge of the commutator.
10. Disconnect the ground for the field coils at the drive end of the body.
11. Remove the two outside body screws holding the field magnets and field inside the body.
12. Remove the field magnets. If the insulating sheet is worn between the fields and the body, it should be replaced. This insulation protects the field center connection from touching the body or the long body screw passing through the loop.
13. On the commutator end plate, push out from the inside the armature end bearing; this is a slide fit and will drop out from the outside.
14. At the same time push out the flat washer, felt disc and metal cup.
15. Inspect the bearing; if loose, burned, or the balls show wear, or if loose on the armature shaft, replace.
16. Unless the fibre mountings holding the brush assembly in the end plate are burned, or the brush anchorages are loose, it is not necessary to remove this assembly. If the brush anchors are loose, remove the screws holding it to the



ELECTRICAL

(Generator)

body and replace with a new assembly, using care not to bend the spring clips bearing on the "third" brush plate.

17. Check the oil passage filler in the end plate. It should be free and open.
18. Take the drive end — end plate. Remove the three screws holding the metal plate on the inside of the drive end end plate and remove the plate.
19. Tap out the bearing from the outside and remove the felt washer and retaining washer disc. If the bearing is burned, pitted, worn, or does not fit the armature shaft snugly, replace.
20. Check the oil passage in the drive end end plate.
21. If the oil caps on either drive end are broken, pry out and replace.

Testing the Generator Parts

1. Armature

When the armature is revolving inside the generator, centrifugal force sometimes causes the coils to expand and strike the laminations. Check to be sure no worn spots show on any of the wiring.

Check the segments on the commutator end. If out of round or any mica insulation between the segments is higher than the segments themselves, turn down in a lathe, then cut back the mica insulation so that it is about $\frac{1}{32}$ " lower than the copper segments.

If any of the armature wiring is broken or the insulation is badly burned, replace with a new armature. Test for shorts and "open" with a standard "growler".

If the shaft ends are worn, replace with a new armature.

2. Field Coils

If the field coil insulation is badly burned or worn, these should be replaced.

To test the field coils, connect one end to a regular storage battery and complete the circuit to the other battery terminal through a headlamp bulb or other 6 volt bulb.

If the lamp lights, it will indicate that the field coils are okay. If the lamp does not light, it would indicate an open circuit in one or both of the coils. If an open circuit is found, replace with new coils.

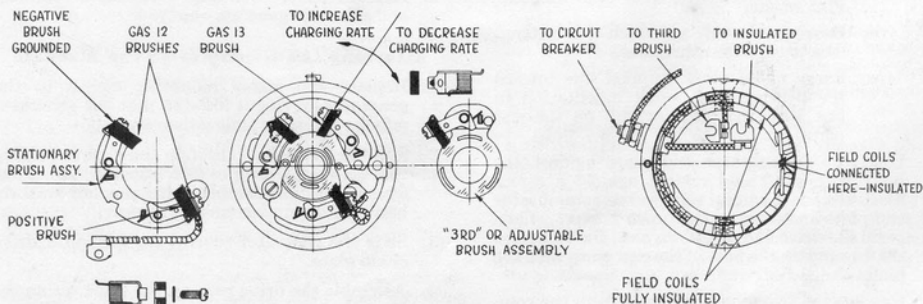
Single coil resistance at 6 volts is 5 amps. Both fields at 6 volts — 2.5 amps. Test with a meter.

Assembling the Generator

Both end bearings should be packed with a neutral grease of high melting point. All parts should be thoroughly cleaned in gasoline. This does not apply to field coils or wiring.

Brushes should have a minimum length of $\frac{3}{8}$ ". If not, replace GAS 13 on moveable brush holder. Two GAS 12 used on stationary holders.

1. If the short insulator for the wire leading thru the body to the cut-out is loose, burned or worn, remove and replace with a new insulator.
2. Replace the field coils and their magnets with the short ground lead from the coils lining up with the ground hole connection in the body at the drive end.



(Generator)**ELECTRICAL**

3. Slip the looped insulating sheet under the field coils at the commutator end so that the long body bolts will be able to pass through the loop when the two ends are in place.
4. Replace and tighten the two large screws holding the coils and magnets to the body.
5. Connect the ground (flat head screw lock washer and nut).
6. Draw the leads from the cut-out and field coil out through the nearest inspection slot in the body.
7. Slip the commutator end of the armature into the end plate, lifting the brush holders up onto the commutator so as not to scratch it or ruin the brushes. Replace GAS 13 carbon on moveable holder; GAS 12 carbons on stationary holders with lettered side towards screw head.
8. Replace the commutator end bearing (small) in this order:
 - (a) Cupped washer (cupped side facing armature).
 - (b) Felt washer
 - (c) Flat washer
 - (d) Bearing (the side on which it is lettered face away from armature).
9. Replace the small flat countersunk washer and screw in the shaft.
10. Slide the armature through the generator body.
11. Take the drive end end plate and from the inside replace in the following order:
 - (a) Cupped washer (cupped side toward the armature).
 - (b) Felt washer
 - (c) Flat washer
 - (d) Bearing (the side on which it is lettered face toward the armature).
 - (e) Large metal plate (cupped side toward the bearing with small indentation in line with the oil filler cup on the end plate).
12. Hold the commutator end plate against the body with shaft end resting against a raised block so that it cannot slide in the commutator end plate and damage the brush holder. Then press the drive end end plate onto the armature shaft lining up the hole in the end plate with the pin in the body.
13. Replace the two long body bolts from the commutator end plate to hold both plates against the body. When tightened, there should be no end play in the armature but it should turn freely and easily.

14. Replace the triangle cover on the commutator end and its gasket.
15. If new felt washers have been used, use enough oil (S.A.E. 10W) in both end caps to saturate the felts but if the same washers have been used — use only a few drops of oil.
16. Attach the lead from the field coil to the moveable brush (through the inspection slot).
17. Attach the lead from the cut-out to the positive brush.
18. Inspection band and gasket can be replaced after the generator has been placed on the machine and regulated for output.
19. **To test:** Connect two leads to a 6 volt battery. Ground one to the generator. Touch the other to the lead going to the cut-out. It should "motor" if assembled properly.
20. Check the wires going to the brushes to make certain no wire touches the armature or bears against a brush spring where it can become worn in use.

The Generator Cut-out

The cut-out should have a gap between its contact points of .018 to .020. The gap between the magnet core and armature should be .025.

Failure of the points to break without load will cause pitted points, short circuit, and will discharge the battery and burn out relay coils.

1. Remove from generator body and disconnect.
2. Pry up the clamping edges of the cover.
3. Polish the contact points and set to .018 to .020.
4. Use .00 sandpaper and clean magnet core, contact and bar. Set to .025.
5. Replace cover, bending over edges, connect and attach to generator body.

Attaching the Generator to the Machine

1. Replace the frame mounting clamp to the generator leaving it loose so that the generator may be turned or slide either way.
2. Slip the frame bolt through the clamp, holding the generator in position against the front frame tube. Assemble plate and felt washers between chain plate and generator.
3. Slide the generator toward the generator drive chain plate.
4. Assemble the drive gear on the shaft, using the keyway, and tap into position. Tighten sprocket nut on shaft.
5. Slip the generator chain over the drive sprocket and connect.

ELECTRICAL

(Generator Drive)

6. Line up the generator, right or left, until the chain lines up straight.
7. Adjust the mounting bolts forward or backward until the chain has approximately $\frac{1}{2}$ " up and down slack at its center.
8. Tighten the frame bolt, then take up the nut at the rear of the lower bolt and lock the front nut so that the generator cannot move.
9. Grease the chain with Marfax No. 2 grease and replace the chain guard cover. This is not necessary on Model 741 since lubrication is automatically provided by the tank breather tube.
10. Connect the lead to the generator or cut-out.

Generator Tips

Never operate a generator with a disabled battery or battery out of the circuit. The generator will burn out.

To safeguard the generator ground it to the machine by attaching a wire from the lead coming from the generator to the cut-out — to the frame of the motorcycle. Do not attach the wire from the battery lead of the cut-out.

Emergency running: Three or four dry cells connected in place of the disabled battery will answer the purpose until a new battery can be installed. Connect the dry cells in series with the carbon or center terminal to the generator or battery wire and ground the outside terminal to the frame.

The following points should be carefully watched.

- Bearings should be properly lubricated.
- Inspection strap should be tight.
- Brushes should be clean.
- Commutator should be clean.
- Commutator should be smooth.
- Brushes should operate freely.
- Brushes should make complete contact.

GENERATOR CHAIN ADJUSTMENT

Remove the cover over the generator drive on the left side of the motorcycle.

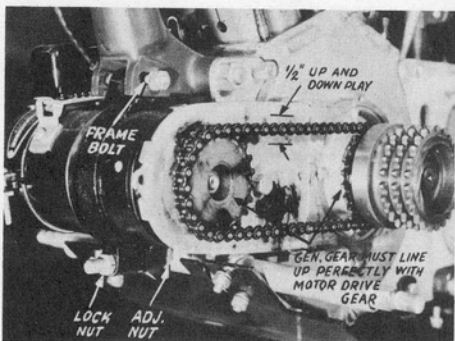
The chain, when properly adjusted, should have approximately $\frac{1}{2}$ " up and down slack.

To adjust, loosen the bolt holding the generator to the frame. Loosen the front nut on the adjusting screw underneath the generator. On this same adjusting screw, there is an adjusting nut in back and in under the generator.

Turn this counterclockwise to tighten the drive chain, at the same time sliding the top of the generator forward an even amount.

When the chain is properly adjusted, tighten the top bolt and bottom lock nut and replace the cover.

GENERATOR CHAIN ADJUSTMENT. The generator chain guard must be removed for adjustment. The chain should have $\frac{1}{2}$ " up and down play at its center. To adjust: loosen the bolt holding the generator to the frame (top) and the nut underneath the generator at the clamp as illustrated. Move the generator either forward or back by turning the adjusting nut at the rear of the clamp bolt underneath.



GENERATOR DRIVE CHAIN LUBRICATION

On the Model 741 the generator drive chain is lubricated through a breather line running from the tank to the generator drive chain and cover.

On the Model 640 lubrication originally is provided by removing the cover and applying grease (Valvoline Viscote T. D. 1) to the chain and leaving a supply on the inside of the cover. To convert the Model 640 so that lubrication of the generator chain will be automatic, it is only necessary to drill the top of the chain cover and bring the tank breather line over and into the chain guard.

To do this — remove the generator chain cover and drill a $\frac{5}{16}$ " hole 3" from the straight edge on the top side $\frac{1}{16}$ of an inch from the back side of the cover.

In this hole place a rubber grommet (Indian Pat. No. 44225) and insert the tank breather tube, cutting off the breather tube to the correct length. Care should be taken that the breather tube does not protrude too far inside of the cover so that it will strike the generator chain. It should be curved slightly at its end so that it aims directly for the chain.

To seal the cover so that moisture and dirt will be kept out, a standard tool box rubber (Indian Pat. No. 102593) may be used. This rubber is of ample length to go around the chain cover and the only thing necessary in installing the rubber would be to notch out the rubber for the clips on the chain cover back plate.

This conversion will lengthen the life of the generator chain and automatically provide the proper lubrication.

(Generator Servicing)

ELECTRICAL

GENERATOR ALIGNMENT

Care should be taken, in reassembling the generator to the machine, that the generator drive chain is perfectly aligned with both the generator driving gear and the motor drive sprocket. Alignment can be made by moving the generator either to the right or left in its clamp. If the generator is not properly aligned, excessive wear of both the drive gear and generator chain will result.

GENERATOR SERVICE DIAGNOSIS

Trouble and Probable Cause	Remedy
Low or No Ampere Output	
1. Cutout improperly adjusted...	Check and adjust.
2. High resistance in the circuit...	Check and repair
3. Excessive brush wear...	Replace brushes
4. Worn or dirty commutator....	Clean or turn down
Excessive Ampere Output	
1. Poor ground connections.....	Clean and tighten
2. Defective field coils.....	Replace
Noisy Generator	
1. Brush contact irregular.....	Replace and check spring tension of brush holders
2. Excessive bearing wear.....	Replace
3. Improperly adjusted drive chain.....	Adjust
4. Generator drive not aligned properly.....	Check alignment

SPECIFICATIONS

Generator

Make.....	Auto-Lite
Model.....	GAS -4166-1
Voltage.....	6-8 volts
Rotation viewed from drive end..	counter clockwise

Service Data

Generator end play.....	$\frac{1}{32}$ "
-------------------------	------------------

Cold Output

Amperes.....	19
Volts.....	8
R.P.M.....	2900

Hot Output

Amperes.....	10
R.P.M.....	2900

Cut-Out Relay

Air gap.....	.030
Point opening.....	.025
Points close at.....	900 P.P.M.
Points close at.....	6.4 volts

BATTERY

The Indian Motorcycle battery is a six volt, heavy duty, 29 ampere hour, wet battery.

CARE OF THE BATTERY

When new machines are received, the battery should be removed from the machine and placed on a battery rack if the machine is not to be put into service immediately.



Batteries which are allowed to set idle for a period of time before they are placed into service will sulphate, which is extremely detrimental to the battery. Oftentimes, the machines are not put into use for several months after they have been delivered from the factory, and if the battery has not been given attention during this time it will not take a charge when the machine is put into service.

By removing the batteries from the machines and placing them in a battery rack or bench, it is very easy to give them the proper attention by recharging them every four or six weeks. In this way the battery will be kept in first-class condition to be put into the machine as soon as the machine is requisitioned for service.

CARE OF UNFILLED OR DRY BATTERIES

Do not remove the filler plugs until you are ready to fill and charge the battery.

Do not use a constant potential to "initial" charge the battery. The filling "Electrolyte" is a solution of pure sulphuric acid and pure water, having a specific gravity as shown below in the table.

PROCEDURE FOR MAKING A DRY UNFILLED BATTERY READY FOR SERVICE

1. Unscrew the filler plugs and press down firmly with the finger on the red button of the cell being filled in order to close the vent and prevent overfilling.
2. With the red button depressed, add the electrolyte until the filling well reaches the top.
3. Remove the finger to allow the electrolyte to fall to its correct level.
4. Do the same on all cells and replace filler plugs.
5. Allow the battery to stand not less than 12 hours nor more than 24 hours so that the electrolyte will cool and completely saturate the plates.

ELECTRICAL

(Battery)

- After standing, restore the electrolyte level by adding distilled or approved water to the cells while pressing on the red button as outlined above.
- Charge the battery at 1.5 amperes until the specific gravity stops rising. This will require approximately 84 hours. If the temperature of the electrolyte exceeds the temperature shown in the table, reduce the charging rate and increase the time proportionately.
- If necessary to restore the electrolyte level during charging, use only approved water.
- After completion of the charge, the specific gravity of the electrolyte should be within the limits shown below. If not, adjust by removing some of the solution and replacing with approved water or electrolyte, as required.

	Temperature Control	Tropical Climate
Filling Gravity.....	1.345 specific gravity (37° Be.)	1.245 specific gravity (28.5° Be.)
Maximum Temperature.....	100°F. (43°C.)	125°F. (52°C.)
Final Gravity.....	1.270 — 1.290 (31°-33° Be.)	1.200 — 1.225 (24°-26.5° Be.)

SPECIFICATIONS

Indian Fill-Rite Battery
6 Volts
29 Ampere Hour

Over-all Dimensions:

Length	6 $\frac{1}{2}$
Width	3 $\frac{1}{16}$
Height	7 $\frac{3}{8}$
Insulation	— Wood
Container	— Hard Rubber
Weight Wet	— 15 Lbs.
Weight Dry	— 13 Lbs.
Plates per cell	5
Plate size	5 $\frac{1}{16}$ x 3 $\frac{1}{2}$
Positive thickness	.135
Negative thickness	.090
Normal charging rate	1.5 amperes
U. S. Gov. Battery No. 3 MC	

Keep battery properly filled with distilled water. Coating terminals with vasoline will prevent corrosion.

Keep battery clamps down snug (not tight).

Negative post and terminal are grounded to frame.

Positive wire runs to ammeter.

To remove battery, loosen two lock nuts and bolts in frame at top of battery. Slide out battery clamp bracket.

Slide battery out on right side of machine.

Note: A rubber cushion is fitted on battery support under battery.

OVERCHARGING

This condition is brought about by too high a charging rate of the generator and not to any temperature condition.

When the machines leave the factory the generator is set so that the charging rate is in balance with the amperage load through the ignition and driving lights.

In cases where machines are used for daylight driving only, this charging rate is too high. The charging capacity of the generator is more than sufficient to carry ignition and standard equipment lighting continuously without drawing on the battery. Therefore, generators should be adjusted to suit the particular driving conditions.

When a machine is used for daylight driving only, the generator should be set to charge approximately 4 amps., which is one-half of the charging rate adjusted at the factory.

BATTERIES BOILING OVER

This condition is brought about by the battery being overcharged due to too high a generator charging rate. The generator, at the factory, is set so that its charging rate is in balance with the amperage load drawn through the ignition and service headlights. Where the machine is used for daylight driving, this charging rate is too high. Therefore, the generator should be adjusted to suit the particular driving condition.

LIGHTING SYSTEM

The lighting system consists of a service headlight, tail light and stop light, instrument panel control switch, and full blackout headlight, tail light and stop light equipment. Both the blackout and service headlight equipment is operated by the ignition and light switch at the instrument panel. By turning the switch two notches to the right, the blackout lighting equipment is turned on. In this position the blackout stop light will also operate. By pressing the small control button on the ignition

and light switch and turning the switch knob one notch further to the right, the service lighting equipment is brought into the circuit. In this position the service stop light will also operate.

SERVICE HEADLIGHTS

The service headlight is of the conventional type with a separate reflector lens, lens gasket, lens retaining ring and bulb. The bulb is of the prefocus type and therefore is in constant focus. To replace

(Lighting)

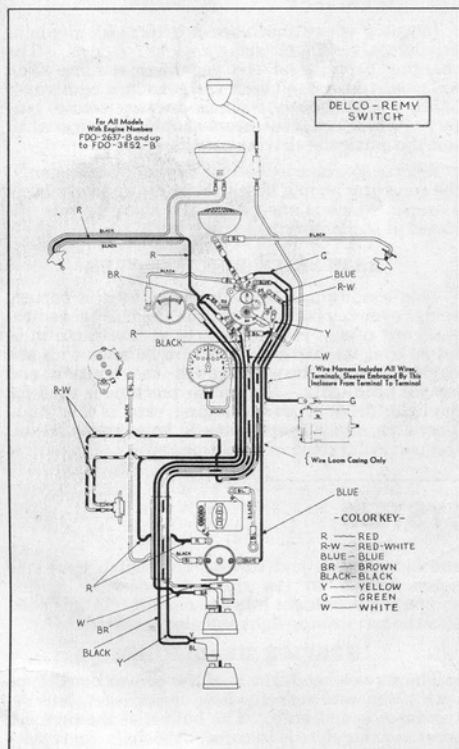
ELECTRICAL

the bulb, remove the outside retaining ring, carefully remove the lens at the same time, then remove the burnt out bulb and replace.

BLACKOUT LIGHTS

The blackout headlamp, lens and bulb, can be replaced by simply removing the outer moulding (door). This will give access to the blackout lens and bulbs. The earlier types were equipped with a removable filter and lens section and a replaceable bulb. To replace the bulb in these early types it is merely necessary to remove the rubber gasket with its lens and filter in order to get at the bulb. This same applies to the early blackout tail lamp and stop light equipment. On the latest models the blackout equipment used contains bulb units which

The diagram below shows the wiring on early Model 640 machines using the "Delco-Remy" type switch. Its use has since been discontinued in favor of the new "H-D" switch. Conversion to the H-D switch may be made by referring to the wiring diagram (next page) and conversion instructions covering the new switch.



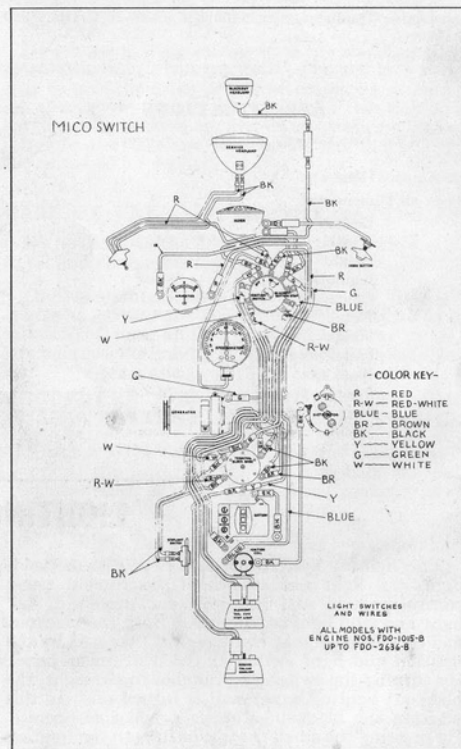
are sealed with full filter and blackout mask equipment inside of single elements. In order to replace these units it is merely necessary to remove the light door and remove the lighting element as a unit.

"BLACKOUT" IGNITION — LIGHT SWITCH REPLACEMENT

Note: Due to the fact that on some of the early Model 640 machines there were several types of switches in use, the following paragraphs apply to the different switches.

MICO SWITCH: The "Mico" ignition and light switch operates solely with a key and safety button; in other words, the key must be retained in the switch at all times in order to provide ignition and

The wiring diagram below with its terminal block is shown as used on the early Model 640. This has since been obsolete. Conversion to the new wiring diagram and new switch can be made by referring to the wiring diagram (next page) marked "H-D Switch" and following the conversion instructions.



ELECTRICAL

(Distributor)

THE ELECTRICAL SYSTEM

The electrical system provided on the Indian motorcycle employs the use of a standard distributor with **standard ignition coil**; an Auto-Lite standard generating unit, a standard generator circuit breaker, a 29 ampere hour Indian storage battery with standard horn or signal equipment and lighting equipment, in conformation to Government regulations.

THE DISTRIBUTOR

The distributor unit on this motorcycle is an Auto-Lite Distributor and **fires each cylinder individually** (not the waste power double spark ignition).

The distributor body is mounted on the right side of the engine at the oil pump assembly, and advancement and retardment is manually controlled by the handlebar grip at the right handlebar. For ordinary servicing of the distributor body assembly, it should not be removed from the motorcycle.

Breaker Point Adjustment and Ordinary Cleaning

1. Slide the rubber boot covering up from the distributor cap.
2. Unsnap the two spring clips holding the cap to the distributor body and lift up out of the way.
3. Pull off the distributor rotor. This is a press fit.
4. Wipe off the inside of the body cap and the body with a clean gasoline dampened rag. There should be no accumulation of oil or dust in the distributor.
5. Touch up the contacts in the cap and on the rotor — and smooth up the breaker points. Use either No. .00 sandpaper or a fine platinum file.
6. To adjust the points, loosen the lock nut holding the stationary breaker point set screw. Turn the engine over with the kick starter until the cam opens the points to their widest opening. Using a feeler gauge, set the points at .020 by turning the adjustable point to right or left. When the proper gap of .020 is made, hold the adjustable point in position and tighten the lock nut.
7. Apply a very light touch of a neutral grease to the cam and **not over** one drop of S.A.E. 10W oil to the pin at which the main breaker point anchors.
8. Replace the rotor, using care to turn it slowly until it drops into its slotted position, then replace the cap and boot, checking the high tension leads to see that they are tight in the cap.

Removal and Disassembly of the Distributor

Ordinarily it is not advisable to remove the distributor from the machine for repair but if at any time it is found that the rotor shaft becomes sloppy in the housing, through lack of greasing at the grease cup, or the rotor develops too much backlash or play, the unit should be removed and a new shaft installed.

The rotor, when on the shaft, should have approximately a rotating play of only ($\frac{1}{8}$ "') **at the end**. A greater play than this will cause uneven timing and be almost impossible to adjust.

If, when the engine is turned over with the kick starter, the rotor does not turn, it will mean that either the drive shaft from the oil pump is frozen in the oil pump body or the bevel drive gear on the shaft is stripped. In either case, it will be necessary to remove the oil pump body from the engine and replace either the gear, the shaft, or both.

Removing the Distributor

1. Disconnect the control cable (remove cotter pin).
2. Lift the rubber cap and pull out the high tension cables, swinging them up out of the way.
3. Disconnect the wire from the distributor body.
4. Unfasten the distributor cover clamps and remove the cover.
5. Try to turn the rotor right and left. If it has too much play, the rotor shaft is worn. Free play on new equipment is approximately ($\frac{1}{8}$ "').
6. To test the drive shaft at the pump, kick over the engine with the kick starter. If it does not rotate the distributor rotor, it is a sign that the bevel gear at the base of the drive inside the oil pump is stripped or broken.
7. For further disassembly — loosen the lower clamp under the distributor body at the oil pump and lift the distributor "up" out of the pump.

Disassembly of the Distributor Body to Remove the Rotor Shaft

1. Remove the rotor.
2. File the head off the pin holding the shaft collar at the drive end of the distributor shaft and remove the pin.
3. Slide off the collar and flat washer, and slide out the shaft from the top.

Assembly

1. Place flat washer on drive shaft.
2. Slide shaft into distributor body.
3. Assemble flat washer and drive collar.
4. Pin collar and bevel the pin head.

ELECTRICAL

(Wiring)

lighting. The switch positions on the "Mico" switch are as follows:

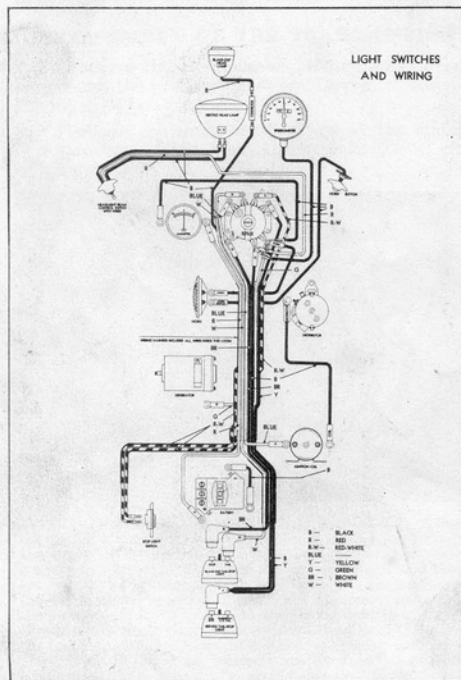
1. With the key inserted, turn **left** (counterclockwise) all of the way for an "OFF" position. This is the only position in which the switch can be locked.
2. Turn to **first right position** (clockwise) for ignition only.
3. Turn to **second right position** (clockwise) for ignition and "blackout lights."
4. Press safety button and turn to **third right position** (clockwise) for ignition and service lights.

REPLACEMENT SWITCH KIT FOR REPLACING "MICO" SWITCHES

A replacement switch kit is made available by the factory in order to convert the machines with

"H-D" TYPE SWITCH AND WIRING DIAGRAM AS USED ON MODELS 640-B AND 741

Conversion kits are made available for converting models using other type switches.



"Mico" switches to the latest type H-D switch, which is currently being installed on all new military machines. The kit consists of the following parts:

1. One complete H-D type switch, Part #76170.
2. Four switch mounting spacers $\frac{5}{32}$ long, Part #37688.
3. Four switch mounting screws #8-32 x $\frac{3}{8}$ long.
4. Four #8 lock washers.
5. One sub-mounting plate complete with brackets, Part #44202.
6. One rubber grommet for instrument panel hole, Part #44201.
7. Three switch terminal screws #6-32 x $\frac{1}{4}$ long, Part #A-6020.
8. Three terminal screw lock washers #6, Part #19B110.

INSTALLATION INSTRUCTIONS

Study the wiring diagrams for both the old switch being replaced and the new one being installed, taking care to select the proper diagram for the switch being removed. Note that while the switches differ in respect to the actual location of the terminals about the switch, all wires going to each terminal remain the same.

REPLACING "MICO" SWITCH

Remove instrument panel cover; disconnect all wires to switch and ammeter; remove instrument sub-mounting plate with switch and ammeter attached; remove ammeter from sub-mounting plate and reassemble on new sub-mounting plate, Item 5, taking **particular care** to see that **insulating washers are assembled correctly**; assemble new switch, Item 1, to this plate (place switch on panel with safety button toward front of machine) with screws, Item 3, and spacers, Item 2, (assemble spacers between switch mounting feet and sub-panel); replace wire between ammeter and switch; remove terminal screws from old switch and use in new switch when reassembling wires; connect all wires to the switch according to the wiring diagram, arranging them to prevent any interference. If wires appear too short, it may be necessary to pull up some of the slack from between the tanks. Rubber grommet, Item 6, is furnished to reduce the size of opening in the instrument panel cover to fit the new H-D switch. Insert grommet in panel opening — making sure that groove is firmly seated. Operate all positions of switch and check results. Assemble instrument panel cover and check to avoid shorting or pinching of wires.

(Wiring)**ELECTRICAL**

"DELCO-REMY" SWITCH

The standard military "Delco-Remy" switch is also used on some of the earlier Model 640-B military machines. This switch operates with a key for ignition only, and with a hand lever and safety button for the lights.

REPLACING "DELCO-REMY" SWITCH

The proper procedure for assembling this unit is exactly the same as for the "Mico" unit except that the rubber grommet, Item 6, is not used.

The above replacement instructions apply only when an older type "Blackout" switch ("Mico" or "Delco") is replaced with a new H-D type switch.

LATEST TYPE H-D IGNITION AND LIGHT SWITCH

The latest Model 640-B military machines and Model 741-B machines are equipped with this type switch. The switch has a winged knob for operating both ignition and lights, together with a safety button for service lights. The switch includes a

lock and key to permit locking as desired when the machine is not in use. This lock uses the standard Army Key Code #H-700. When the switch is unlocked and the motorcycle in use, the key should be removed from the lock. This H-D type switch is the latest switch now being used for replacement on all machines in the field. Reference to its connection into the circuit should be noted on the wiring diagram pertaining to the particular machine in use.

WIRING HARNESS

When a new wiring harness is assembled to a machine care should be taken that the harness is clamped securely to the frame tubes where clamps are provided, and caution taken that the cable be fitted so that there is no possible danger of it being pinched when the tanks are assembled to the machine or when the front forks are turned.

Should the wiring harness or any of the wiring become pinched, there is immediate danger of shorting the entire wiring system and burning either a part of, or the entire harness.



THE AUTO-LITE MOTORCYCLE DISTRIBUTOR

DISTRIBUTOR CAP REAR CYLINDER HIGH TENSION FRONT CYLINDER CABLE

CARBON TERMINAL

ROTOR

The distributor should be kept clean at all times. Worn or pitted points should be replaced or touched up with No. 00 sandpaper. Failure to produce current at the ignition points may result from these most common causes: Dead battery — poor connection — shorted switch — dirty points — breaker arm freezing open at its pivot pin — moisture in distributor cap — cracked distributor cap — defective spark coil — shorted or defective condenser — broken primary wire — cracked or broken rotor.

CONDENSER GROUNDED

BREAKER POINT

SPARK CONTROL CABLE CONNECTION

CAM AND SHAFT

INSULATING BUSHING

COIL

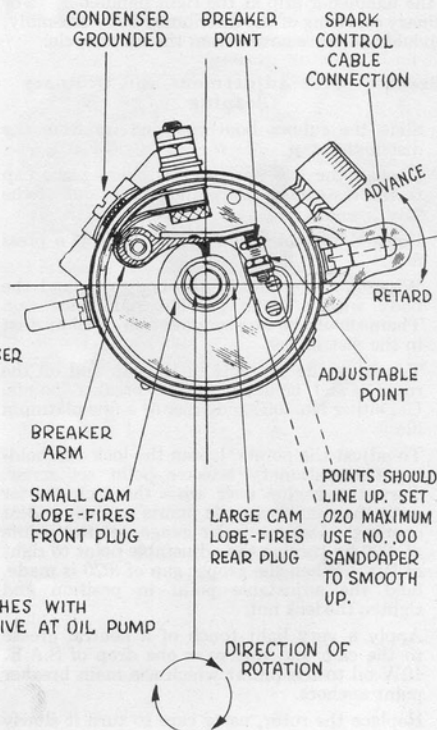
GREASE

CONDENSER

CONTROL ARM

BUSHINGS

SHAFT MESHES WITH SLOTTED DRIVE AT OIL PUMP



ELECTRICAL

(Timing)

TIMING THE IGNITION

All timing of the ignition must be done with the distributor control lever in a fully advanced position.

The breaker points should be at maximum opening of .020.

FLYWHEEL TIMING MARKS LOCATIONS

Model 640-B — the flywheel timing mark inspection hole is located at the **lowest** point on the left side of the engine. Remove the upper plug (previously referred to as the oil level plug).

Model 741-B — the flywheel timing mark inspection hole is located on the left side of the engine just below the carburetor bowl brace.

IGNITION TIMING POSITIONS

Model 640-B — with the flywheel timing mark centered at the inspection hole — the **rear** piston will be in a **firing position** $\frac{3}{8}$ " before top dead center.

Model 741-B — with the flywheel timing mark centered at the inspection hole — the **front** piston will be in a **firing position** $\frac{3}{8}$ " before top dead center.

Checking the Spark Timing Without Removing the Cylinder Head

1. Lift (unscrew) the valve covers. (Special tool 101826) on model 640-B.
2. Remove the crankcase "oil level" screw on the lower left side of the motor base. On Model 741 the timing plug inspection hole is located just under the carburetor on the left engine case.
3. The flywheel is marked with a figure "+" which can be located by looking into the inspection hole on the left side of the motor base. The flywheel mark will show up on either the compression or exhaust strokes so that a check and recheck should be made, making sure that the setting is made on "**compression**" only — as follows.
4. Rotate the flywheels until the flywheel mark lines up with the oil level hole. Use a flashlight to position the flywheel mark accurately.
5. Check to make sure operation No. 4 is made on compression. **Both valves should be on their seats in a closed position and all tappets free and open.**
6. In this position the rear piston will be $\frac{3}{8}$ " before T.D.C.

7. Unfasten and remove the distributor cap.
8. Remove the distributor rotor.
9. Note the cam lobes on the distributor breaker cam. One lobe is larger than the other. The larger of the two operates for the rear cylinder; the narrow cam lobe operates for the front cylinder.
10. Loosen the distributor body clamp at the left and rotate the body either left or right until the correct cam lobe (with the advance control arm in full advance position — in toward the engine) just starts to make contact with the breaker point insulating arm off the right side of the cam.

Use a test light on the breaker points to check this opening. If no test light is available, turn the ignition switch on and check the movement of the ammeter indicating hand to check the point of contact.

The moment the contact is made, the ammeter indicator will register a discharge. When the points open, the indicator will return to zero.

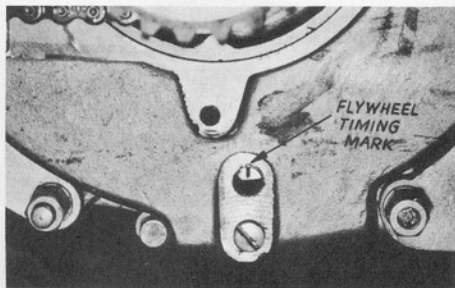
11. When the large cam just makes contact with the breaker arm, tighten the body clamp to hold the body in this position.
12. Rotate the flywheels until the distributor cam fully opens the breaker points, then set the adjustable point so that there is a maximum clearance of .020.
13. Replace the rotor and distributor cap.
14. Replace the oil level screw and close the valve covers, screwing them down into place.

Timing with Cylinder Head Removed

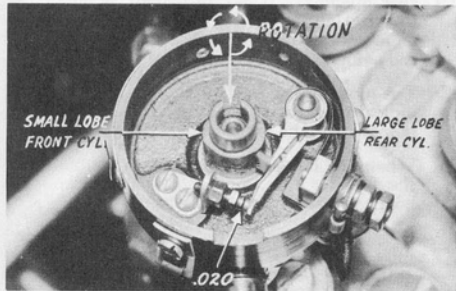
1. Turn over the engine with the kick starter until the rear piston is coming "up" on its compression stroke. (Both valves will be closed.)
2. Bring the piston "up" until it reaches a point $\frac{1}{32}$ " before top of cylinder wall.
3. Loosen the advance arm control clamp and push it to a fully advanced position (towards the motor). If the cable control is connected, advance the spark control to full advance.
4. Rotate the distributor body to right or left to a point where the breaker points are just beginning to break on the large end of the cam.
5. When adjusted as to timing, tighten the lower clamp.

(Timing)

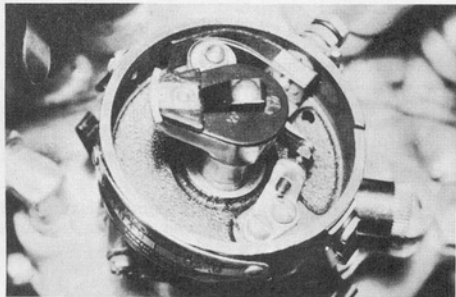
ELECTRICAL



IGNITION TIMING WITHOUT REMOVING THE CYLINDER HEAD: On the Model 640 the flywheel timing mark is located as shown in the above illustration — by removing the upper motor base drain plug on the left side of the engine. On the Model 741 the flywheel timing mark inspection plug is somewhat larger and located on the left side of the engine just below the carburetor brace.



DISTRIBUTOR HOUSING BODY: Showing the position of the fiber block of the breaker arm just making contact with the large lobe of the driven cam. The center cam is driven to the right (clockwise). Points should be clean, free from pits, and set at a maximum gap of .020.

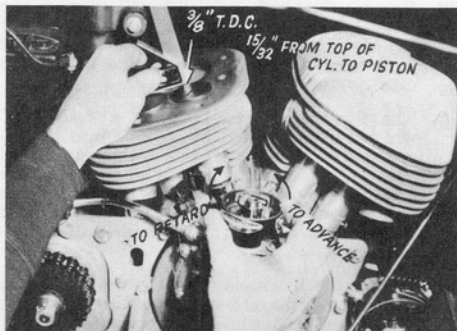


DISTRIBUTOR BODY SHOWING POSITION OF ROTOR WHEN CORRECTLY TIMED: The distributor rotor should point toward the rear wheel on a parallel with the motorcycle when properly timed to fire the rear cylinder. The control arm should be in a fully advanced position when points are beginning to open.

6. Check breaker point clearance before putting on the rotor and cap. Points should be set at .020.
7. Replace rotor cap and cylinder head.

Timing an Engine on Which the Distributor Has Been Removed

1. Remove the rear cylinder head.
2. Turn over the engine with the kick starter until the rear piston is coming "up" on its compression stroke. (Both valves will be closed.)
3. Bring the piston "up" until it reaches a point $\frac{13}{32}$ " before top of cylinder wall.
4. With the distributor cap and the rotor removed, hold the distributor with the terminal part and condenser to the rear and rotate the shaft clockwise until the large cam just begins to break off the right side of the large cam. (Note one cam on the cam shaft is small, the other is large.)
5. With the cam shaft in this position, face the distributor body so that the condenser is towards the engine and slide the assembly into the oil pump body, turning it slightly to right or left to make sure the shaft meshes with the slotted drive in the pump housing.
6. Rotate the distributor body to right or left to a point where the breaker points are just beginning to break on the large end of the cam.
7. Tighten the lower clamp.



IGNITION TIMING WITH REAR CYLINDER HEAD REMOVED: On compression stroke, position rear piston $\frac{3}{8}$ " B.T.D.C. (before top dead center) or $\frac{15}{32}$ " below the top of the cylinder and turn the distributor body so that the fibre block of the breaker arm just starts to make contact with the large lobe of the driver cam.

IMPORTANT: Both valves should be on their seats on rear cylinder as illustrated and tappets free.

ELECTRICAL**(Spark Plugs)**

8. Loosen the advance control arm and check its position. It should be at full advance with the cam in the above position.
9. Connect the cable control.
10. Check the breaker points. They should be set at .020.
11. Replace the rotor and cap.
12. The front plug wire attaches to the front high tension terminal of the cap; the rear plug wire to the rear terminal and the coil wire to the center terminal.
13. Connect the battery wire to the distributor body terminal just above the condenser.
14. Replace the cylinder head.

SPARK PLUGS

The spark plug provides suitable electrodes inside the cylinder, which can be jumped by a high voltage from an induction coil to produce a spark for igniting the fuel mixture.

The two electrodes are insulated from each other—the center one being surrounded by insulating material (usually porcelain) while the other is attached to the steel shell, which is grounded when the plug is screwed into the cylinder head.

The conditions under which spark plugs must operate are severe. They must be able to withstand an electrical pressure of 12,000 to 14,000 volts under high compression pressures and temperatures 40 to 45 times per second when the engine is running at high speed. The pressure in the combustion chamber from the explosion of the fuel charge tends to force the plug from the cylinder head. At the same time the heat of combustion, which on high compression engines may reach a maximum of 2500°F. or more, tends to burn and distort the electrodes, which would change the spark gap setting. In addition, the surfaces of the insulator may become overheated and burned, which materially decreases the resistance of the insulator and usually causes electrical leakage around the plugs. Internal strains due to sudden changes in temperature tend to crack the insulator.

High compression pressures and increased speeds result in higher temperatures that necessitate the use of a spark plug which will dissipate heat very rapidly. The extent to which a plug will dissipate heat depends on the length of insulation exposed to the combustion gases.

Hence, for engines which develop a lot of heat, a plug with a short insulation (or a cold plug) should be used. For low compression or low speed engines, a plug with a long insulation (or a hot plug) should be used.

The illustration shows three plugs of various heat ranges and also the path of heat conductions.

The heat characteristics of an engine are not the only thing that have to be considered in the selection of a spark plug. The conditions under which motorcycles are operated have an important bearing on their selection. Exceptionally severe service, such as continuous runs in mountainous country or running at high speeds for long distances, will require a colder plug than that used for ordinary service.

Because of the wide variety of conditions under which military motorcycles are required to operate, it is advisable that the spark plug chart be consulted in making a decision as to the proper spark plugs to be used.

Replacing Points

Breaker points, if badly pitted or burned, should be replaced. Both points should be replaced at the same time.

To replace:—

1. Lift the distributor cap; lift off the rotor.
2. With the point of a screwdriver, snap the spring of the breaker point arm off from its anchor pin on the body and at the same time lift the breaker arm up off its anchor pivot.
3. Loosen the set screw of the adjustable point and screw out the point.
4. Install the new adjustable point, backing it well onto the mounting.
5. Install the new breaker arm point, holding the spring under tension against the breaker arm while slipping it onto its pivot anchor. Slip the springs onto the body pin.
6. Use one drop of oil at the breaker arm point.
7. Turn the engine over with the kick starter until the highest point of the cam is against the insulated contact of the breaker arm. Then set the adjustable point so that there is .020 clearance between the points and lock in position.
8. Both points should face and meet each other squarely when closed. By loosening the two screws holding the adjustable point mounting to the body, the point can be turned slightly either way so that it will meet the breaker arm point squarely.
9. Replace the rotor and cap.

Testing the Ignition System

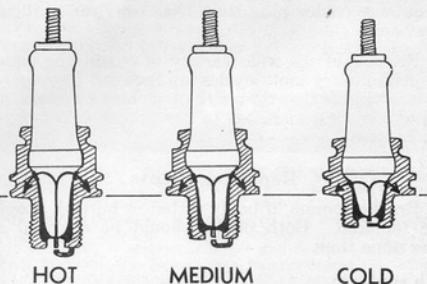
The system may be tested for its operating condition and efficiency as follows:

1. Snap out the high tension wire (center terminal) from the distributor cap and place it so that it comes to within about $\frac{1}{4}$ " from the cylinder or any metal part of the machine.

(Spark Plugs)

ELECTRICAL

2. Turn the ignition switch "on" and crank the engine with the kick starter. If a good snappy blue spark jumps between the high tension wire and the motorcycle, it is evident that the coil, breaker points and condenser are operating properly.



3. If a feeble yellow spark appears, or none at all, it will signify one or more of the following, and each part should be checked individually:

- Weak battery.
- Corroded battery terminals.
- Short circuit, open circuit, loose connection, broken wire, poor contact at switch.
- Breaker points not functioning — either dirty or sticking.
- Leaky — open circuited or short circuited condenser.
- Defective coil.
- Improper wiring.
- Cracked distributor cap or rotor.

HEAT RATING OF INDIAN SPARK PLUGS

Cold Motor ↓ Hot Motor	TYPE OF SERVICE	Motor Temperature	Plug Type	Hot Plug ↑ Cold Plug
	Cold motor, low speed, low compression, cold climate, oily engine, frequent stops and starts.	1350 1450	Indian - A Indian - B	
	Normal or average motor operation.	1450 1500	Indian - C	
	High speed, severe service These two types can be shielded for police radio use	1500 1600	Indian - Z - 38 Indian - Z - 43	
	Hot motor, severe service, high speed, long trips.	1800	Indian - D	
	Racing, extreme service, hot climate, high compression, continuous high speed.		Indian - 59 - T	

AUTOMOBILE
TYPE HOT PLUGINDIAN
AINDIAN
BINDIAN
CINDIAN
DINDIAN
Z43INDIAN
59-T

ELECTRICAL (Ignition Trouble Shooting)

ADJUSTMENT OF THE SPARK PLUGS

Spark plugs should be kept clean and points free from blisters. The correct spark gap is from .025" to .030". The spark plugs must be kept clean and properly adjusted for satisfactory engine performance and economical operation. Porcelains must be free from cracks and excessive carbon formations. To adjust the spark plug clearance, adjust by bending the side electrode only. **Never attempt to bend the center electrode** since this is held solidly within the porcelain and will crack the porcelain, rendering the plug unfit for further service.

SPARK PLUG REPLACEMENT

Spark plugs should be tested periodically on an approved tester and replaced if found faulty. To insure maximum efficiency and economy, replace the spark plugs as soon as they begin to lose their efficiency. Refer to the table of spark plugs and their heat ranges in selecting the proper plug, because a cold plug will cause a misfire and a hot plug will result in pre-ignition and premature spark plug failure.

SERVICE DIAGNOSIS

In diagnosing the ignition system for trouble it is well to remember that there are many things that can happen, which will cause unsatisfactory performance and in some cases failure of the engine to start, that will not be found in the ignition system. Therefore, it is recommended that a thorough check be made of the fuel system, carburetor and fuel lines, before condemning the ignition system. A simple check to determine if the ignition system is at fault is to turn on the ignition

switch and crank over the engine with the kick starter. Watch the ammeter while the engine is being kicked over to see if the needle oscillates. This will indicate that the breaker points are "making" and "breaking" the primary circuit. No movement of the ammeter needle is an indication that the primary circuit is not being completed.

The following chart will be helpful in locating the source of trouble and its correction:

FAILURE OF ENGINE TO START DUE TO IGNITION FAILURES

TROUBLE AND PROBABLE CAUSE	REMEDY
1. Ammeter Function Normal with Weak or No Spark	
(a) Defective condenser.....	Replace
(b) Defective distributor.....	Replace
(c) Defective rotor.....	Replace
(d) Defective coil.....	Replace
(e) Coil to distributor wire shorted.....	Repair or replace
(f) Spark plug wires broken or insulation cracked.....	Replace
2. Ammeter Shows No Discharge or No Spark is Delivered to Plugs	
(a) Ammeter to switch wire connection loose.....	Repair or replace
(b) Ammeter to battery lead connection short in wire or loose connection.....	Repair or replace
(c) Defective ignition switch.....	Replace
(d) Defective ammeter.....	Replace
(e) Distributor points not closing.....	Adjust
(f) Oil film or foreign matter on contact points.....	Clean and adjust
(g) Switch to coil wire loose or shorted.....	Repair or replace
(h) Defective coil.....	Replace
(i) Discharge or defective battery.....	Charge or replace
(j) Oil soaked or fouled spark plugs.....	Clean or renew
(k) Moisture in distributor cap.....	Clean and dry out
(l) Cracked distributor cap.....	Replace
(m) Shorted or defective condenser.....	Replace

FAILURE OF ENGINE TO START DUE TO IGNITION FAILURES (Continued)

TROUBLE AND PROBABLE CAUSE	REMEDY
3. Normal Discharge on Ammeter with No Spark Being Delivered to Plugs (a) Distributor points not opening.....	Adjust
4. Excessive Discharge on Ammeter with Ignition Switch on Zero with Switch Off (a) Switch to coil wire shorted..... (b) Defective coil.....	Repair or replace Replace
5. Excessive Discharge on Ammeter with Switch On or Off (a) Short in ammeter to switch wire..... (b) Short in lighting switch..... (c) Short in generator circuit.....	Repair or replace Check and repair Check and repair

DISTRIBUTOR FUNCTIONAL FAILURES WITH ENGINE RUNNING

TROUBLE AND PROBABLE CAUSE	REMEDY
1. Rough or "Roll" at Idling Speed (a) Spark plug gaps too close..... (b) Timing too far advanced.....	Adjust Reset
2. High Speed Miss (a) Spark plug gaps too wide..... (b) Defective spark plugs..... (c) Distributor points too wide, dirty-burned..... (d) Breaker arm spring tension weak..... (e) Spark plug wires broken or insulation cracked..... (f) Weak coil..... (g) Weak condenser..... (h) Primary wire loose at connections..... (i) Defective battery..... (j) Battery terminals badly corroded.....	Adjust Replace Adjust Adjust Replace Replace Replace Clean and tighten conns. Test, repair or replace Clean terminals
3. Idle or Medium Speed Miss (a) Crack in distributor cap..... (b) Rotor contact too short..... (c) Spark plugs cold or of improper heat range..... (d) Spark plugs defective..... (e) Spark plug wires broken or insulation poor..... (f) Spark plug points too close, fouled or dirty..... (g) Distributor points too close — or too far apart..... (h) Distributor points dirty, pitted or burned.....	Replace Replace Replace with correct type Replace Replace Clean and adjust Clean and adjust Clean and adjust

ELECTRICAL

(Generator)

TROUBLE AND PROBABLE CAUSE	REMEDY
(i) Primary wire broken, or connections loose.....	Replace or tighten
(j) Leaky condenser.....	Replace
(k) Battery charge low; generator not running fast enough to charge.....	Test battery — adjust generator
(l) Condensation in distributor and distributor cap or under rubber cap.....	Clean and wipe dry
4. Unnecessary "Ping" with Open Throttle Under Load	
(a) Ignition timing too far advanced.....	Reset
(b) Spark plugs too hot — improper heat range.....	Replace with correct type
5. Lack of Power	
(a) Ignition timing late.....	Reset
6. Backfiring	
(a) Spark plug wires crossed.....	Check firing position

THE GENERATOR

The generator used on the Model 640 and Model 741 military machines is known as the "Indian Auto-Lite."

It is of the third brush, 6 volt, regulating type and can be adjusted to increase or reduce the charging rate.

It is driven by an enclosed chain direct from the motor sprocket on the left side of the machine, forward of the motor base.

To Adjust Charging Rate

- Loosen clamp screw holding the steel band to which the "Auto-Lite" name plate is attached.
- Turn the clamp so that the opening is in line with the oil cup and slide off, taking care not to damage the gasket under the steel band.
- With the engine running, move the third (moveable) brush toward the front of the machine to increase the charging rate or back toward the engine to reduce it — checking the ammeter swing until the correct output is obtained. (The output should be regulated to break even with all lighting equipment normally used in operation.) To check the movement of the ammeter, race the engine slightly to obtain the maximum register.
- If the armature contact at the brushes appears dirty it should be cleaned and polished with No. .00 sandpaper before trying to regulate. (Emery cloth should never be used.)

- When properly regulated — replace the metal band and gasket and tighten the clamp screw.

Removing the Generator From the Machine

Note: — Disconnect battery ground terminal to prevent short.

- Remove the cover on the left side of the engine over the generator drive.
- Remove the nut holding the drive sprocket (right-hand thread).
- Remove the sprocket and keyway.
- Disconnect the wire leading to the circuit breaker on the right side of the generator.
- Loosen the clamp connection under the generator.
- Remove the nut on the left side of the frame holding the generator to a position where the bolt can be removed from the frame to let the generator drop free.

Disassembly of the Generator

In disassembling the generator, the oil sealing felt washers should be examined and, if found matted or hardened, should be replaced.

Bearings, if loose, worn, pitted or cracked, or if they show signs of being heated, should also be replaced.

TRANSMISSION

(Disassembly)

THE MOTORCYCLE TRANSMISSION

The transmission of the motorcycle is encased in an aluminum gear box directly underneath the rider's saddle just forward of the rear mudguard. It is of the three speed type with the main shaft mounted on roller bearings. Shifting is accomplished by means of a shifting fork, which operates a sliding gear on the main shaft selective for first, second and high speeds.

Lubrication is furnished to the transmission through drilled passageways between the transmission case and the primary drive case. Lubrication of the primary drive case automatically lubricates and furnishes the proper level of oil in the transmission.

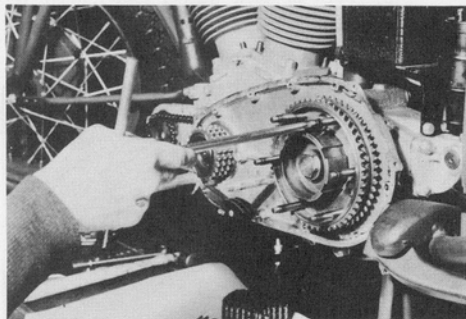
A drain plug is located on the underneath side of the transmission case.

In order to make repairs to the transmission it is necessary that the primary drive and primary drive back plate be removed from the left side of the machine. This will allow for making repairs to the transmission case while it is in the machine or will further allow for removing the transmission case completely from the frame.

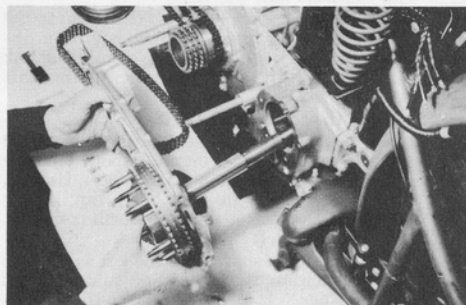
DISASSEMBLY OF THE TRANSMISSION

To remove the transmission, the primary drive case cover, the primary chain and the clutch assembly must be removed.

1. Remove the main shaft driver at the clutch sprocket. This is keyed to the shaft. (Left-hand nut)



REMOVING THE PRIMARY BACK PLATE: Rotate the clutch sprocket to line up the back plate bolts through the holes in the sprocket. Use a $\frac{3}{16}$ " thin walled socket wrench to remove. The bolts are coarse thread and there are five (5) of them. A sixth bolt holds the back cover at the front motor sprocket. (It is not necessary to remove the motor sprocket.) Caution should be used in replacing these bolts because they screw into the aluminum housing of the transmission case. Do not use heavy leverage to tighten. Shakeproof "Star" lock washers are used on all of these inside bolts. All bolts are "coarse" thread.



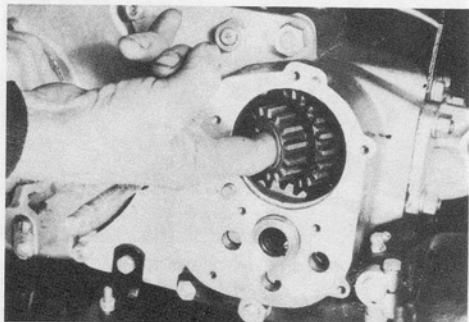
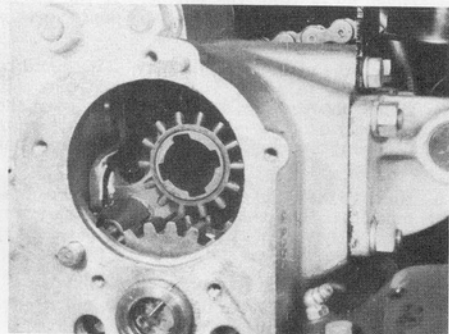
REMOVING THE BACK COVER: Before attempting to remove the back plate, the kick starting ratchet and lever assembly must be removed from the opposite side of the transmission. After removing the back cover bolts, slide the cover plate and clutch sprocket assembly and main shaft away from the machine as a unit as illustrated above. When reassembling, a new transmission case gasket should be used.

2. Rotate the clutch sprocket looking through one of the three holes until it lines up with a cap screw underneath. There are five of these bolts.
3. Remove the five bolts, using a $\frac{3}{16}$ " thin wall socket. Because these bolts screw directly into the aluminum case of the transmission, they have a coarse thread ($\frac{1}{4}$ -20). Never use a fine thread bolt in any aluminum casting.
4. To the rear of the motor shaft, there is another cap screw holding the back plate to the engine. Remove this screw and pull the complete case cover away from the engine. If the gasket between the transmission case and cover is damaged — replace it.
5. Check the main shaft end play — it should be from .005 to .010. To reduce end play add shims between the sprocket driver gear and ball bearing. To increase end play, add shims between the clutch drive sprocket and ball bearing.
6. Remove the chain guard on the other side of the machine. The chain guard is split part way toward the rear so that it will only be necessary to remove the front section.
7. Remove the kick starter gear assembly.
 - (a) Straighten the lock washer and remove the outside shaft nut.
 - (b) Remove the gear ratchet.
 - (c) Slide off the kick starter gear and the spring back of it.
 - (d) Slide off the spring washer.

(Disassembly)

TRANSMISSION

8. Remove the countershaft drive sprocket.
 - (a) Flatten out the washer and take off the outside nut.
 - (b) Tap off the sprocket. If the chain to the rear wheel has not previously been disconnected — remove the connecting link and free the chain from the countershaft sprocket.
9. Remove the shifter fork shaft.
 - (a) On the right side of the case, just to the right of the bearing and about halfway up, you will see a small hole. Using a drift punch in this hole, tap lightly and the shifter fork shaft will come out from the left side of the case.
10. Pull out the main shaft from the left side of the case. Watch for the main shaft and sprocket thrust washer. It may fall out into the bottom of the case.
11. Remove the shifter gear and fork from the left side of the case.
12. Remove the snap ring on the left side of the case. This holds the shaft for the triple gear set in place.
13. With a small punch tap out the shaft from the right side of the case, driving it out of the left side. Remove the triple gear set. (If the oil seal gasket at the end of the shaft is damaged, replace it.)
14. Remove the drive sprocket inside the case by tapping it lightly from outside of the case on the right side with a lead or rawhide hammer.
15. Remove the collar in back of the sprocket up against the bearing and case.
16. Remove the large bearing nut on the left side of the case at the bearing. (Use special wrench No. T17736.) Turn the nut to the left.
17. Remove the felt oil seal and the felt retainer.
18. Tap the bearing lightly on all sides to remove from the case. This bearing comes out toward the outside of the case.
 - (a) If the bearing is worn or pitted, it should be replaced.
 - (b) When replacing the large metal retainer washer, be sure to assemble properly. The outside edge of the washer should bear against the outside bearing race. The washer should not strike the inside ball race. If this is assembled in reversed order, the bearing will lock when assembly is complete.
19. To remove the main shaft driver from the transmission shaft:
 - (a) Grip the main shaft in a vise, using copper plate on the jaws to prevent marking the shaft.
 - (b) Straighten the lock washer and remove the nut. This has a left-hand thread.
 - (c) Pull the clutch driver off of the main shaft and slide the main shaft out of the clutch gear.
 - (d) The bushing in the clutch driver is a press fit. Remove in an arbor press. New bushing should be reamed to fit main shaft with .002 clearance, with a groove made for oiling.
 - (e) The shaft size is .905.
 - (f) The bushing size, reamed, should be .907.
20. To remove the bearing from the clutch case back cover:
 - (a) Turn up lock washer and remove the $1\frac{5}{8}$ " nut. (Special Indian wrench No. 27T350)
 - (b) Remove the locking washer.



DISASSEMBLY OF THE TRANSMISSION: The shifter (sliding) gear should be removed first. By positioning the gear in 2nd gear as illustrated, it will slide out freely. Using your hands, reach in and press the shifter gear toward the rear of the transmission case until it is free of the shifter fork.

REMOVING THE SHIFTER GEAR: When the shifter gear is pressed free from the shifter fork, cock it sideways as illustrated, and guide it out of the transmission case. A shifter gear that has broken gear teeth or that is badly chipped and rounded on the teeth should be replaced. The gear teeth are machined with a slightly rounded edge.

TRANSMISSION

(Disassembly)

- (c) Slide the clutch gear and shaft out from the case side.
- (d) The bearing originally is pressed into the case cover. Place the plate in boiling water to remove the bearing. If the bearing is worn or pitted, replace. Do not remove unless necessary to replace.
- (e) Note how the bearing is assembled in the back plate. Inspect both sides. There is a large opening on one side. When reassembling this bearing back into the case, this wide opening should be at the top and facing the transmission case.

Note: When removing bushings or bearings which are pressed into aluminum, always heat the aluminum before removing.

21. Sprocket Driver Gear Bushing

- (a) Drive out with an offset punch.
- (b) Press in new bushing.
- (c) Ream to fit shaft with .002 clearance.
- (d) Shaft size is .905.
- (e) Bushing size, reamed, should be .907.

22. Bushing for the Triple Gear Shaft

- (a) These are pressed into the case and are made of steel.
- (b) Drive the bushing on the left side of the case into the case to remove.

DO NOT REMOVE UNLESS LOOSE

23. Triple Gear Bushings

- (a) Brass bushings are used at both ends of the triple gear.
- (b) There is a steel spacer tube inside the gear between the bushings. This spacer is drilled for oil passage and must be lined up with the oil holes in the gear. Remove by using an offset punch.

- (c) New brass bushings should be pressed in with the bushing pressed into the large gear end first and brought flush with the gear face. The bushing for the small gear end should be pressed in after the steel spacer is inserted and lined up with oil holes in the gear shaft. This bushing should protrude about $\frac{1}{16}$ " out of the shaft.

1. Line ream new bushings to $\frac{3}{4}$ " or .750. The gear shaft is ground to .748. Clearance should be .002.

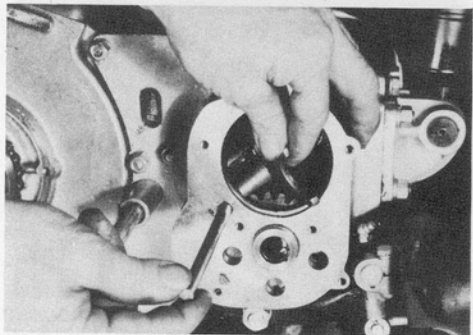
Transmission Case Assembly

1. Install triple gear first.

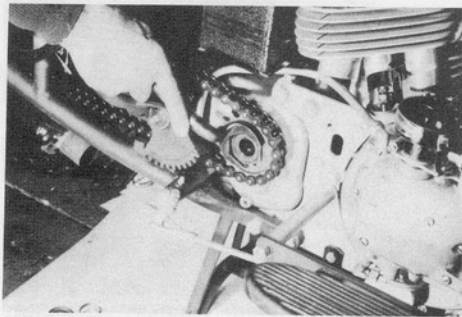
- (a) Place the small round gasket in the shaft bushing.
- (b) Place the triple gear in the transmission — small end first — facing the left side of the case.
- (c) Leave in this position until the left side bearing and sprocket drive are put in place.

2. Sprocket Drive Gear

- (a) Press the bearing into the left side of the case and tap lightly until it seats against the case. The outside edge of the washer should bear against the outside bearing race. The washer should not strike the ball race.
- (b) Replace the collar against the bearing inside, the case.
- (c) Slip the sprocket drive gear in through the bearing from inside the case and press into place.
- (d) Replace the felt oil retainer first, then the felt oil seal.



REMOVING THE SHIFTER FORK: Note the shaft being held in the fingers above. On the opposite side of the transmission case there is a small hole drilled in line with the shifter fork shaft. With a fine blunt end punch — tap the shaft out so that it can be grasped as illustrated.



REMOVING THE COUNTERSHAFT DRIVER GEAR: Before attempting to remove the driver gear, the kick starter ratchet and countershaft sprocket must be removed as illustrated above. Then the triple gear set in the case must be dropped by removing its center shaft to allow room to remove the driver gear.

(Inspection)**TRANSMISSION**

- (e) Replace the outside locking nut and draw up tightly into position. Use special wrench — Indian T17736.
- (f) Place the gear thrust washer in the end of the gear using heavy grease to hold it in position until the main shaft is installed.

3. Triple Gear Shaft

- (a) Raise the triple gear from the bottom of the case until it lines up with the shaft.
- (b) Slip the shaft in from the left side of the case and drive it through the triple gear and home to the bushing on the other side of the case far enough so the lock rings may be snapped into place.
- (c) Insert the snap ring in the left bushing.

4. Gear Shifter Assembly

- (a) Place the gear shifter fork and the shifter gear with the 4 dog end towards the driver gear.
- (b) Slide the shifter fork shaft into the case and guide the fork onto the shaft so that it can be driven through and home to the bushing on the right side of the case.
- (c) Tap the shaft into place.

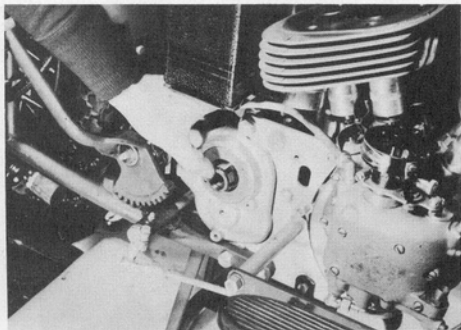
5. Clutch Sprocket Assembly

- (a) Assemble the bearing to the transmission side of the clutch case back cover. Inspect both sides of the bearing before assembly. There is a large opening on one side. This opening should be at the top and facing the transmission case.
- (b) Using an arbor press — press the bearing into the case cover.

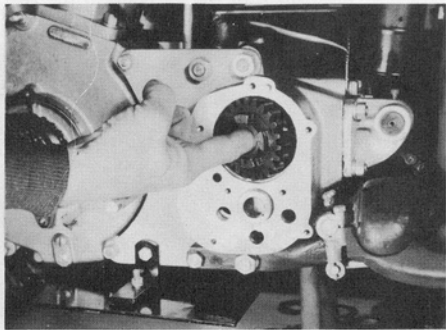
- (c) Slide the gear and shaft into the bearing from the transmission side.
- (d) Slip on the flat lock washer and 1½" nut and tighten. Use Indian wrench 27T350.
- (e) Turn over the edges of the washer to lock the nut in place.

6. Main Shaft

- (a) Place the thrust washer on the main shaft over tapered keyway end.
- (b) End play on the main shaft should be from .005 to .010.
 1. To increase three speed main shaft end play, remove clutch gear from clutch case back plate, place shims between clutch gear and clutch gear bearing. This bearing is assembled in clutch case back plate.
 2. To reduce end play, add shims between the sprocket driver gear inside the case and the case bearing.
 3. Press the clutch drive sprocket into position.
 4. Slide the tapered keyway end of the main shaft through the clutch sprocket from the transmission side.
 5. Insert the keyway in the tapered end.
 6. Press the clutch driver onto the keyway shaft and put on locking washer and nut. (Left-hand thread)
 7. Clamp the main shaft into a vise with copper jaws.
 8. Tighten the clutch driver nut and lock by bending the washer over the nut.



REMOVING THE COUNTERSHAFT SPROCKET DRIVER GEAR: With the chain sprocket removed, the countershaft driver gear may be pressed toward the inside of the case as shown. Care should be taken so that the splined surfaces do not become checked or nicked and the threads damaged. If the gear does not slide freely into the case, use a rawhide mallet and tap the protruding end lightly to free it from its bearing.

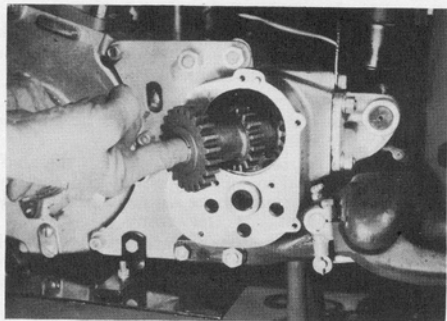


REMOVING THE COUNTERSHAFT SPROCKET DRIVER GEAR: Reach into the case and guide the driver gear out as illustrated. If the gear teeth are broken or the driving "dogs" on the side of the gear badly worn, the driver gear should be replaced. On the driver dog end of this countershaft driver gear, a steel thrust washer is used. Be sure that the washer, which may or may not cling to the gear, is removed from the case.

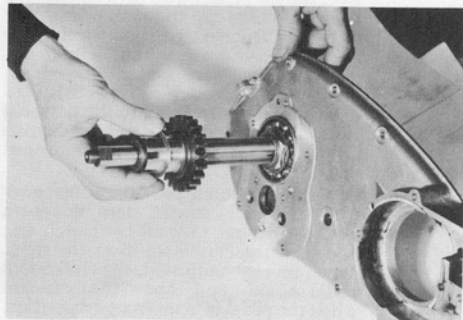
TRANSMISSION

(Assembly)

9. The entire unit is ready to assemble into the case.
7. Place the gasket on the left side of the transmission case.
8. Line up the shifter gear inside the case and slide the main shaft and cover assembly up to the transmission and engine, working the clutch sprocket backward and forward to line up the splines of the main shaft.
9. Turn clutch sprocket until a cap screw hole is lined up with the hole in the sprocket.
 - (a) Replace 5 cap screws in this manner, using a $\frac{1}{16}$ " thin wall socket wrench. Do not tighten until all screws are in case, then pull up evenly.
 - (b) Replace the 6th cap screw holding the back cover to the engine.
10. Check the end play again on the main shaft. (.005 to .010)
11. Assemble the countershaft sprocket, tapping it into position.
12. Replace the flat washer and nut, locking the nut into position by bending the washer over the nut.
13. Assemble the kick starter gear.
 - (a) Slide the cupped spring retaining washer onto the shaft, cup side out.
 - (b) Slip the spring over the shaft, seating it in the cup.
 - (c) Press kick starter gear onto shaft.
 - (d) Replace the gear ratchet.
 - (e) Replace the flat lock washer and nut, locking the nut by turning the washer over the shaft and over the nut.
14. Replace the drive chain from the countershaft sprocket to the rear wheel.
15. Replace the chain guard.
16. Follow for clutch assembly instructions, under "Assembly of the Clutch" on page 42-1.
17. Replace primary drive chain, following instructions under "Assembly of the Primary Drive Chain" on page 49-1.
18. Replace the primary drive case cover.
 - (a) Grease the gasket edge of the cover and press a new cover gasket into position.
 - (b) Line up the footboard shaft through the cover and the clutch release worm at the same time.
 - (c) Using a screwdriver, turn the clutch worm into the cover, guiding the cover until brought home against the rear cover plate.
 - (d) Replace all bolts on the cover. Those with coarse threads screw through the cover into the aluminum base of the engine and transmission case. Those with fine threads are tightened, using nuts and lock washers.
 - (e) Replace the two special bolts holding the air cleaner plate to the case. The fine thread bolt is used in the front, the coarse thread in the rear hole.
 - (f) Attach the rear oblong aluminum plate at the top rear of the cover. (Four coarse thread bolts and washers.)
 - (g) Replace the spacer on the footboard brace shaft and press up to the case.
19. Replace the left footboard clutch pedal and rod unit.



REMOVING THE TRIPLE GEAR SET: With the shaft already removed as noted under removal of the countershaft driver gear, the triple gear can be lifted from the bottom of the case as illustrated. A fibre oil seal washer used at the right end of the triple gear center shaft. Remove this also and note that when reassembling, the washer should be replaced in the case first so that when the shaft is reassembled, it will be in its sealing position.



TRANSMISSION END PLAY: Transmission end play can be taken up by using a shim of from .005 to .010 thickness on the sprocket driver gear as illustrated above. This places the shim between the driver gear and the transmission case bearing. To replace the back plate cover bearing — remove the main shaft and clutch sprocket. By heating the back plate in boiling water the bearing may be pressed free.

(Assembly)

TRANSMISSION

20. With a screwdriver, turn the clutch release worm to the right as far as you can, then turn back to the left until it feels as though it were beginning to release the clutch.

(a) Attach the hexagonal cut clutch arm to the nearest position possible without turning the clutch release worm too far to the left. (The clutch pedal should be in a disengaged position.)

(b) Replace the nut and lock washer loosely for checking purposes later.

21. Check the adjustment of the primary drive chain according to instructions under "Adjustment of the Primary Drive Chain."

22. Check and tighten the oil drain screw underneath the case cover immediately below the clutch.

23. Remove the oil level screw in the face of the case cover just below the rear footboard shaft.

24. Remove the oil filter cap on top of the case cover and fill with motor oil until oil begins to drip out of the oil level hole.

25. Replace the oil level screw and oil filter cap. (Filling the primary drive case with oil automatically fills the transmission.)

26. Check the clutch operation.

(a) Engage the clutch foot pedal. (Heel plate against the footboard.)

(b) Try pressing the kick starter. If the engine turns over press the toe pad of the pedal down and disengage the clutch. Press the kick starter again. In this position it should not turn the engine over.

(c) If the kick starter turns over the engine with the toe pedal down (in a disengaged position), take off the clutch arm and shift it to the next position turning the clutch release worm to the "left." Repeat the procedure under (a) and (b) until the kick starter turns over the engine and transmission with the pedal in an engaged position and turns over only the transmission in a disengaged position.

(d) If, with the clutch pedal in either position, the kick starter does not turn over the engine, take off the clutch arm and turn the clutch worm to the right. When properly adjusted, the clutch foot pedal should stop 1" above the footboard when the pedal is in an engaged position.

(e) When the proper adjustment is made, tighten the nut and lock washer on the clutch arm.

2. Remove the nut on the main shaft holding the kick starter gear and ratchet assembly to the transmission main shaft.

Remove in the following order:

- | | |
|-----------------|----------------------|
| 1. Lock washer | 3. Kick starter gear |
| 2. Ratchet stop | 4. Tension spring |
| 5. Spring cup | |

The drive sprocket nut may then be removed and the sprocket removed from the countershaft drive.

In replacing the drive sprocket, be sure to tap it all the way on the countershaft slotted surface so that it rests solidly on the countershaft.

THE KICK STARTER

The kick starter on a motorcycle corresponds to the electrical starting equipment provided for starting the engine. Its operation is extremely simple and operates on a ratchet gear principle. As the kick starter is pressed downward, it meshes with the kick starter gear, which turns over the transmission main shaft and, through the clutch and primary drive, turns over the engine flywheels. **The kick starter will not operate or turn over the engine if the clutch pedal is in a disengaged position; it must be in an engaged position in order to turn over the flywheels of the engine.**

There is very little that can get out of order with the starting pedal other than perhaps a broken spring or the pedal becoming sticky on the shaft because of failure to lubricate the starter crank.

For disassembly: —

1. Remove the front section of the chain guard from the machine.
2. Remove the lock ring at the end of the starter crank. It will be found easier to remove the lock ring if the crank is pressed inward on its shaft, thereby exposing the lock ring to a greater degree.
3. Remove the flat washer and slide the starter crank away from the machine.
4. Remove the starter crank return spring.

For reassembly: —

1. Place one end of the spring in the hole of the pin on the starter.
2. Slide the starter crank part way on the shaft with the pedal in such a position that the free end of the spring can be slipped into the hole on the inside of the starter crank.
3. Slide the crank further onto the shaft and crank to the left, winding up the spring tension. Then slide the starter crank all the way home on the shaft.
4. Assemble the washer and lock ring to the end of the shaft. (Make sure the lock ring seats into the groove.)
5. Kick to see that it operates as it should.
6. Lubricate the hydraulic pressure fitting so that the shaft will have ample lubrication.
7. Replace the chain guard front section.

COUNTERSHAFT DRIVE SPROCKET
(TRANSMISSION)

1. Remove the front section of the chain guard.

THE PRIMARY DRIVE

The primary drive of the motorcycle is located at the left side of the motor base and is encased in an aluminum housing.

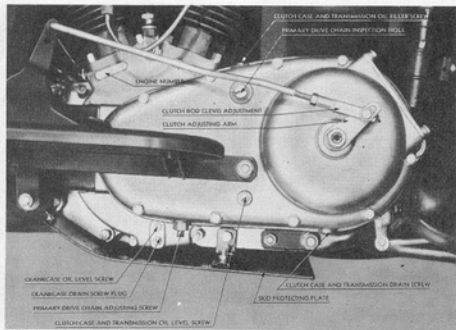
The purpose of the primary drive is to transmit power from the motor drive sprocket to the clutch drive sprocket, where selective gear ratios are then obtainable through the transmission.

The primary drive of the Indian operates in an oil bath and is sealed so that no road dirt or grit can possibly affect or cause undue wear to the primary drive chain itself.

The chain is of three row construction to withstand many times the strain and stress that could possibly be exerted under constant use. Its life is practically that of the motorcycle itself. However, its proper operation and maximum life depend on its being periodically inspected, adjusted and lubricated. Improper alignment after overhaul of the clutch drive sprocket will also greatly affect the life of the primary drive chain.

Adjustment of the Primary Drive Chain

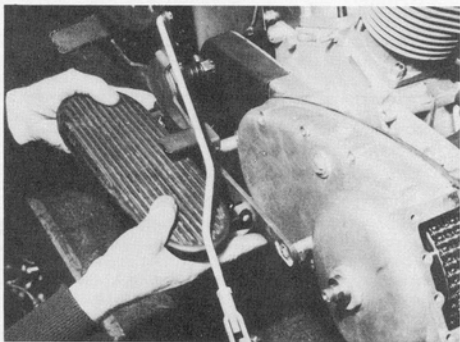
Excessive slack in the primary drive chain is taken up by means of a shoe underneath the chain, inside the case, which can be raised or lowered by means of an adjusting screw and lock nut on the underside of the primary drive case cover.



Adjustment is as follows:

1. Remove the inspection plug on the upper face of the case cover. (The plug on top of the cover is the oil filler plug.)
2. Loosen the lock nut on the chain adjusting screw under the case and screw up or down until the chain can be moved up or down through the inspection hole a distance of approximately $\frac{3}{4}$ ". This is equal to the diameter of the hole.

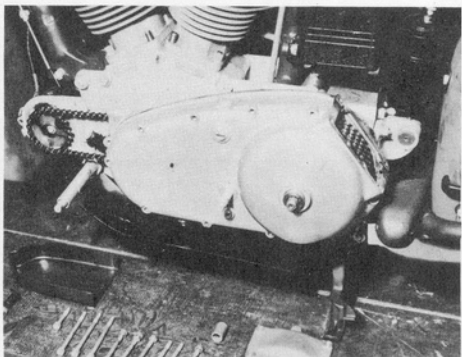
DISASSEMBLY OF THE PRIMARY DRIVE: Remove the clutch arm, rod, pedal and footboard assembly as a unit by removing the clutch arm nut and washer, the two footboard brace nuts, and sliding the assembly away from the machine. Drain the primary case by removing the drain plug. Remove the rectangular aluminum plate at the rear of the case as illustrated above.



3. Tighten the lock nut of the adjusting screw, holding the screw with a screwdriver to keep it from changing the adjustment.
4. Replace the inspection plug.

Disassembly

1. Remove the drain screw on the bottom of the primary drive case cover directly under the air cleaner unit and allow oil to drain off.



REMOVING THE CASE COVER: First remove the generator drive cover guard at the front of the case. Then remove all of the bolts holding the case cover to the back plate. Extreme care should be taken to note the thread size of each bolt removed. All fine thread bolts go thru the cases and have lock washers and nuts. All coarse thread bolts go into the aluminum cases of engine and transmission.

PRIMARY DRIVE

(Assembly)

2. Take off the nut and lock washer on the clutch release arm.
3. Pry and work the clutch arm off of the shaft (hexagonal cut).
4. Take off the two $\frac{5}{8}$ " nuts and their lock washers, holding the footboard bracket.
5. Remove the footboard bracket, footboard, clutch pedal and rod, as a unit.
6. Remove the bolts holding the oblong aluminum plate at the rear of the case cover.
7. Remove the two long bolts immediately below the oil bath air cleaner unit. These go all the way through the case and the brace plate holding the air cleaner. The one towards the rear has a coarse thread, the other a standard machine thread.
8. Remove all bolts on the case cover, paying strict attention to where they are taken from. Those going into the aluminum cases are coarse threads. All those with nuts and lock washers are fine threads.
9. Remove the spacer on the shaft to which the footboard was mounted, coming through the drive case cover.
10. Using a screwdriver, turn the clutch release shaft to the right and at the same time guide the front section of the case so that it comes away from the machine evenly. When the clutch release shaft is free of the case cover, the cover will be free to take off.

To Remove Primary Drive Chain

1. Remove the adjusting shoe under the chain near the motor drive sprocket.
2. Remove the chain connecting link and take off the chain.

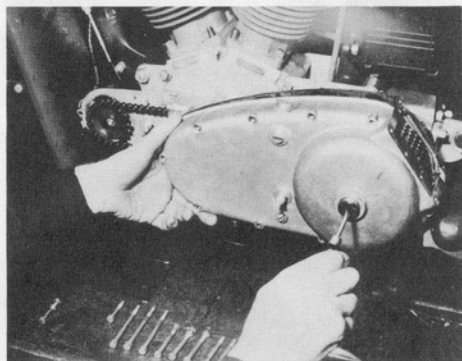
Assembly of the Primary Drive Chain

1. Slip the chain over the clutch sprocket and motor sprocket.
2. Replace the connecting link from the outside — using the cotter pins in the link on the back plate end.
3. Replace the chain adjusting shoe.

Lubrication of the Primary Drive and Transmission

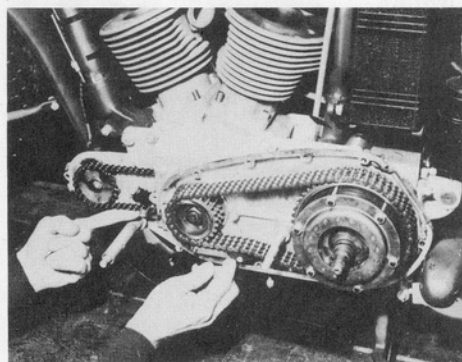
The oil should occasionally be drained and replaced with fresh oil.

REMOVING THE PRIMARY CASE COVER: The clutch worm holds the cover tightly to the case. By turning the clutch worm with a screwdriver to the right (clockwise) and at the same time guiding the cover with the hand at the front as shown above, the cover will come off easily. New gaskets should always be used when reassembling. Use a heavy grease to hold the new gasket in position when reassembling.



The oil level should be checked every 500 miles.

- (a) Remove the oil level screw just under the footboard brace shaft on the face of the primary drive cover.
- (b) Remove the oil filler cap on top of the case cover and fill with fresh motor oil until oil flows from the oil level hole.
- (c) Replace both the level screw and the filler cap.



THE PRIMARY DRIVE CHAIN AND GENERATOR DRIVE CHAIN: Showing the adjusting shoe on which the primary chain rides (right-hand) and the generator drive chain (left-hand). The primary chain is adjustable only when the case cover is on and should have $\frac{3}{4}$ of an inch up and down play at the chain inspection hole in the case cover. Chains have split connecting links for disassembly.

(Front-Rear)

A X L E S

FRONT AND REAR AXLES

Both the front and rear axles are solid steel shafts extending through the fork ends and are held solid to the fork. The front axle should be cotter-pinned at both ends. Should either the front or rear axle become bent or the threaded ends burred or stripped, a new axle should be installed.

This solid center axle on both wheels slides through the hollow axle of the wheel hub. The

hollow axle of the wheel hub is held stationary and the wheel revolves on taper roller bearings which may be adjusted by means of adjusting nuts on the ends of the hollow axle itself.

Both front and rear wheels should be adjusted for side play so that they have just a slight amount of side play with the wheel able to spin freely.



BRAKES

(Adjustment)

THE BRAKE SYSTEM

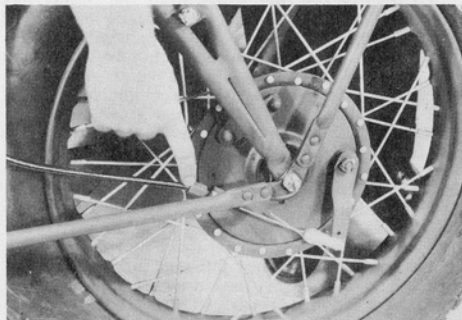
The Indian Military motorcycle is equipped with brakes on both the front and rear wheels; the front wheel brake operating from a hand lever on the right handlebar; the rear wheel brake operating from a foot pedal at the right footboard. Both of these brakes are individually adjusted. The rear wheel brake is of a locking type that will lock and skid the wheel. The front wheel brake is of a dragging type that will, when properly adjusted, not lock the wheel but drag it to a stop. Application of the brakes should be practised by individual drivers so that they may become better familiar with the action of both brakes and their effectiveness. The front wheel brake is also designed so that when being held on a steep incline the front wheel can be locked by holding the hand brake lever at the handlebar. In other words, the front wheel can be locked by holding the lever when the motion of the front wheel is to turn in its opposite direction from normal.

ADJUSTMENT OF THE BRAKES

Adjustment of the Front Wheel Brake

The front wheel brake may be adjusted by "backing off" on the long screw through which the cable passes on the rear of the brake plate.

1. Loosen the lock nut holding this screw and turn the screw right or left until the hand lever has approximately $\frac{1}{2}$ " play at the handlebar grip.

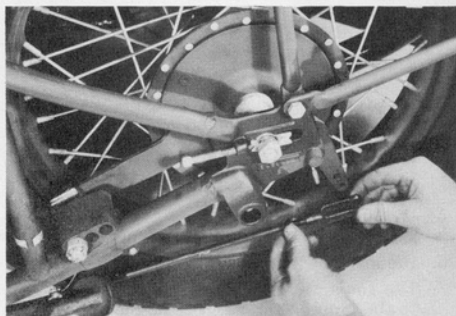


2. If enough adjustment cannot be made with the adjusting screw, loosen the nut on the cable clevis at the brake arm and pull more cable through the clevis lock nut.
3. Always tighten the lock nuts after making any adjustment.

Adjustment of the Rear Wheel Brake

The rear wheel brake may be adjusted at two places by shortening or lengthening the brake rods

at the clevis connections. The first clevis from a brake pedal position is at the end of the brake pedal rod, directly at the cross shaft on the right side of the machine. This is at a point directly under the kick starter pedal. By removing the cotter pin and clevis pin and loosening the lock nut on the rod, the clevis may be used to either shorten or lengthen this adjustment. The second clevis is located at the brake arm on the left side of the machine at the brake plate. This may be adjusted in the same



manner as the first clevis, i.e., by removing the cotter pin and clevis pin, loosening the lock nut on the rod, and lengthening or shortening the rod by screwing the clevis on or off.

Be sure to cotter-pin all clevis pins when reassembling and tighten the clevis lock nuts. The rear brake is properly adjusted when the foot pedal has about $\frac{1}{2}$ " of free play before bringing the brake into action. It should never be adjusted so that the pedal can be pushed all of the way to the footboard. When no further brake adjustment can be made to secure brake action, the brakes should be relined.

Note: On Model 741 additional adjustment can be made at the brake plate arm. The brake arms on both front and rear wheel brake plates are serrated so that they can be shifted on their shafts.

RELINING THE BRAKES

Sometimes improper lubrication or too much lubrication of the wheel hydraulic pressure fittings at the wheel hub will force an oversupply of lubricant past the wheel bearings and into the brake housings. When this occurs, the lubricant will, through centrifugal force, coat the brake drum surface and the brake bands as well, to such a point that the brakes will become ineffective. When this condition does occur, merely cleaning off the brake band surfaces and the brake drums will not be a permanent remedy. The parts must all be cleaned

(Relining)**B R A K E S**

and new linings installed, since the lubricant will work its way deeper into the brake linings than it appears and provide a surface that will glaze readily.

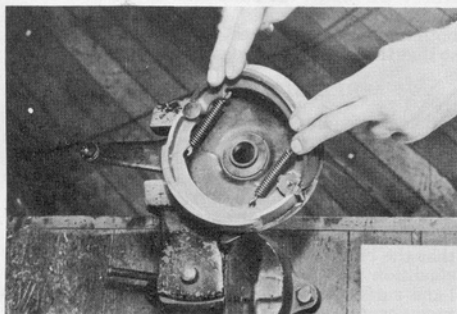
Since the brake plate can only be installed in one position as far as centering is concerned, it is only necessary to make certain that the brake plate centers itself on the hollow axle. In this position the band will be centered in relation to the brake drum surfaces.

Front Wheel

1. Raise the front of the machine by placing supporting blocks under the motor and its front anchor plate (disconnect the speedometer cable at the front wheel drive, 741) disconnect the front hand brake at its adjustment anchorage, remove the center axle, then drop the front wheel from the front fork.
2. Remove the outside nut and spring washer from the brake plate side.
3. Remove the brake assembly as a unit.
4. Disconnect the two springs holding the brake shoes in place and remove the shoes.
5. Remove old linings.
6. Use Indian moulded brake linings already cut to the proper length and place the rivets in the lining.
7. There are 7 rivets in each shoe. Rivet from the center toward each end, being sure that the rivets are all the way into the lining. If the rivet heads are not all the way down, they may score the brake drum.

Reassembly:

1. Attach the brake shoes back in place on the brake plate and snap back springs into place.
2. Reassemble the entire unit back onto the wheel.
3. Assemble the flat spring washer and lock nut, tightening it until there is a tension on the spring washer.



4. Replace the wheel into the fork, sliding it up into position until the front brake plate anchor fits into position on its fork anchorage. Then slip the center axle through the fork and wheel to hold the wheel in place. Tighten and cotter-pin the castellated axle nuts. Connect the speedometer front cable drive and the front brake cable, connecting the clevis to the brake arm and adjusting it according to adjustment instructions for the front wheel brake on Page 52-1.

Rear Wheel:

The Model 640-B is equipped with a center stand for holding the machine in a vertical position. In order to disconnect the rear wheel prior to removing it from the frame, stand the machine on the center stand. When all of the following instructions have been followed for disconnecting the rear wheel for removal, rest the machine on both the center and side stands in such a position that the rear wheel can be slid out at an angle from the right side of the machine.

On the Model 741 the machine is equipped with a rear type stand for holding the machine in a vertical position and the mudguard has a removable rear section so that it may be raised to allow the rear wheel to be removed. On the Model 741, place the machine on the rear stand and disconnect the rear mudguard at the rear lower braces almost at the tail light, swinging it up when disconnection has been made complete.

To remove the rear wheel from the Model 640 and Model 741, disconnect the brake rod at its clevis connection, removing the cotter pin and clevis pin. Then remove the anchor bolt to which the brake plate anchors. The chain should be disconnected by removing the chain connecting link and rolling it off of the rear wheel sprocket. After this has been done, remove the center axle nut from the right side or muffler side of the machine and remove the center axle, pulling it out from the left side of the machine. The chain adjusting locks on both sides will come free, as will the spacers on both sides of the wheel. On the Model 640 be careful that the speedometer drive on the right side of the machine does not fall and injure the drive ring. The Model 741 has no speedometer drive since the speedometer is driven from the front wheel.

When the wheel has been removed from the machine, proceed as follows:

1. Remove the spacer on the brake side and pull out the complete brake plate assembly.
2. Remove the two springs holding the shoes together and take off the shoes.
3. Remove the old lining.
4. Replace with new Indian moulded lining and rivet into place.

B R A K E S

(Specifications)

New lining should be riveted from the center outwards toward each end to prevent high spots.

Be sure all rivets in both shoes are drawn well into the lining, otherwise they may score the drum.

5. Replace the shoes on the brake plate and snap the two springs back into place.
6. Slide the complete assembly into the wheel drum and replace the wheel.
7. Connect the rear drive chain and adjust. See Page 57-2.
8. On Model 640 be sure that the speedometer drive ring meshes properly with the slotted surface of the wheel.
9. Be sure that the brake anchorage is securely tightened after the brakes have been adjusted, and that axle nuts are tight and the brake clevis cotter-pinned and locked in position.

BRAKE SPECIFICATIONS**Brakes — Front and Rear Wheels**

Internal expanding type. Front brake hand operated, rear brake foot pedal operated.

Brake Linings

Linings are 2 per wheel

Length — 640 — $(108^{\circ}-31\frac{1}{32})$ 1. Rad.)

— 741 — $(108^{\circ}-31\frac{1}{64})$ 1. Rad.)

Width 1"

Thickness — 640 — .156

— 741 — .203

Brake Return Springs

Free length, close wound — if stretched, replace

Brake Adjustment

Pedal travel before brake application. $\frac{1}{2}$ "

Hand brake travel before brake application. $\frac{1}{2}$ "

WHEELS — HUBS — BEARINGS — HOLLOW AXLES

Since the motorcycle travels on two wheels only, the alignment of the wheels to the motorcycle and their balance and adjustment is far more important than it would be on a four wheeled vehicle.

Faulty wheel alignment or wheel bearing adjustment or balance would cause a machine to handle awkwardly and might result in the driver having difficulty in maintaining the proper balance of the vehicle itself.

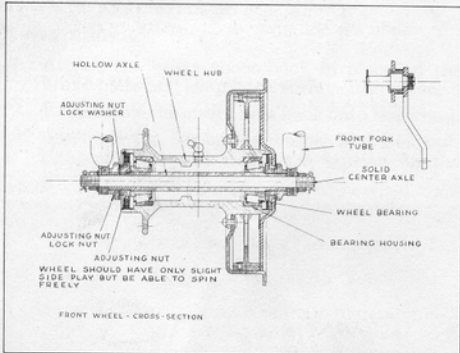
Wheels should "track" perfectly. Both the front and rear wheels should be perfectly "in line" with each other.

By its very construction the assembly of the front wheel to the fork must be in alignment to the assembly. There is no possible adjustment for aligning the wheel to the fork except to make sure that the wheel rim runs true to its hub. The rear wheel, and its assembly into the rear fork must be watched very closely as it is possible to install the wheel out of alignment. The wheel rim should be checked at any time when the wheel has been removed and replaced to see that it runs perfectly straight in relation to the fork.

Adjustment of the chain adjusting screws can throw the wheel either into or out of alignment.

ADJUSTMENT OF THE FRONT WHEEL BEARING

1. Block up the machine so that the wheel is "off" the floor.

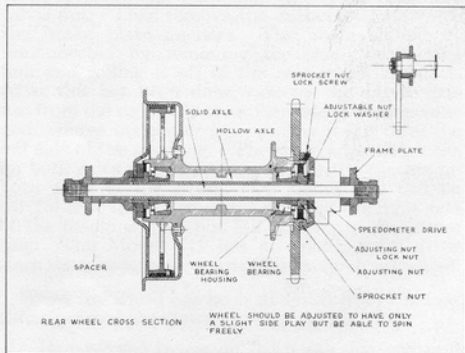


FRONT WHEEL HUB AND BEARING: The illustration shows a cross section of the Model 640-B wheel hub and axle assembly. However, for wheel bearing adjustment purposes it will suffice for both the Model 640-B and Model 741. To adjust or check the adjustment of the front wheel bearing, raise the machine off the ground. The wheel should have only very little side play. If it has too much play, loosen the center axle and straighten the adjusting nut lock washer. By turning the adjusting nut in or out, side play can be reduced or increased.

2. Remove the cotter pin and loosen the axle nut on the left side of the machine.
3. Loosen the lock nut and straighten out the flat lock washer that is bent over the adjusting nut.
4. Take up on the adjusting nut until the wheel drags slightly.
5. "Back off" (loosen) the adjusting nut until the wheel spins perfectly free and has a very slight amount of side play.
6. Bend the lock washer over one of the flats on the adjusting nut.
7. Tighten the lock nut.
8. Tighten and cotter-pin the left outside axle nut.
9. Check to make sure, tightening of the solid Axle does not bind the wheel Bearings.

ADJUSTMENT OF THE REAR WHEEL BEARING

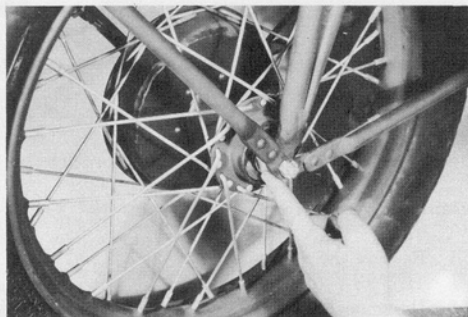
1. Place the machine on the center or rear stand so that the wheel is free or "off" the floor.
2. Remove the right axle nut and chain adjusting washer.
3. Slide the axle part way out from the left side. (Do not remove it all the way.) It should only be slid out far enough so that the spacer on the right side (sprocket side) and the speedometer drive can be removed.



REAR WHEEL HUB, BEARING, AND BRAKE SECTION: The cross section diagram shows the wheel hub as used on the Model 640-B, the only difference between the 640 and 741 Models being that the speedometer drive is omitted on the Model 741. To check rear wheel side play it is necessary to raise the machine off the ground. If it has too much or too little side play (should spin freely with brake released) adjust until the wheel spins freely without side play.

WHEELS

(Hollow Axles)



Do not use too much grease — overlubrication of the wheel bearings will allow grease to work its way to the brake drums and destroy brake action.

HOLLOW WHEEL AXLE

To Remove the Hollow Center Axle of the Rear Wheel

4. **For Model 640-B** remove the spacer on the right side and drop the speedometer drive, using care when dropping the speedometer drive so as not to damage the prongs on the drive ring. **For Model 741** there is no speedometer drive from the rear wheel. Remove the spacer on the right side.
 5. Slide the axle back through the frame to hold the wheel in position.
 6. Remove the lock nut on the center axle.
 7. Bend up the flat washer locked over the flat side of the adjusting nut.
 8. Tighten the adjusting nut until the wheel drags slightly.
 9. "Back off" (loosen) the adjusting nut until the wheel spins perfectly free and has a very slight amount of side play. (It may be necessary to disconnect the chain at the connecting link and drop the chain from the sprocket to gauge the "wheel spin" accurately.
 10. Bend the flat washer over the flat side of the adjusting nut.
 11. Tighten the lock nut.
 12. **For Model 640** slide the axle to the left side again and replace the speedometer drive and spacer. **For Model 741** slide the axle to the left side again and replace the spacer.
 13. Check the position of the chain adjusting washer on the left side of the axle.
 14. Replace the chain adjusting washer on the right side.
 15. Replace and tighten the outside right axle nut.
- Wheel bearings should be partially packed with a good fibre bearing grease every six months.
- Hydraulic pressure fittings are located at the center of each wheel hub. These should be greased every 1000 miles with a high temperature grease.
1. Disconnect the rear drive chain at the connecting link using care to remove the link with the chain in such a position that the chain does not slip "off" the front sprocket.
 2. Disconnect the brake rod at the lever arm clevis on the left side of the machine.
 3. Loosen the brake anchor connecting at the left lower frame tube.
 4. Remove the right axle nut and chain adjusting washer.
 5. Slide the axle part way out from the left side.
 6. Remove the spacer at the right side and drop down the speedometer drive.
 7. Pull the axle out of the frame and wheel from the left side.
 8. Slide the wheel down and out from the machine, laying the machine over so that it rests on both the center and jiffy stand.
 9. Remove the spacer on the brake drum side and slide the complete drum assembly out from the wheel.
 10. Loosen the set screw in the sprocket lock nut on the sprocket side.
 11. Remove the sprocket nut. (Not necessary to remove the sprocket.)
 12. Remove the center axle nut on the sprocket side.
 13. Remove the "bent over" lock washer.
 14. Remove the adjusting nut.
 15. Remove the snap ring spring felt washer retainers and felt washer.
 16. Remove the felt washer from the left side and its retainer.
 17. Slide the hollow center axle out from the wheel hub and remove both wheel bearings.
 18. If the bearing races are worn, remove and replace. If the bearings are worn or show traces of being burned or scored, replace.

(Disassembly)**W H E E L S****Reassembly Order**

1. Pack the bearings with a good fibre bearing grease.
2. Both races and bearings are the same. Replace races, first assembling them snugly into the wheel hub.
3. Replace bearings, tapered end toward the hub.
4. Slide the hollow axle through.
5. Left end — assembly order:
 - 5-1 Felt retaining steel washer, cupped side toward inside.
 - 5-2 Felt washer.
 - 5-3 Axle nut — long shank.
6. Right side — assembly order:
 - 6-1 Felt retaining steel washer, cupped side toward inside.
 - 6-2 Felt washer.
 - 6-3 Felt retaining steel washer, cupped side toward inside.
 - 6-4 Adjustable axle nut.
7. Turn the left axle nut onto the shaft until the axle end is flush with the axle nut. This will leave just enough room on the right side to accept the lock ring and lock nut.
8. Tighten the adjustable axle nut (right side) until the wheel drags when turned. Then back off on the nut until there is a slight end play.
9. Assemble the flat washer and bend the side over the adjustable nut to lock it in place. Then assemble the lock nut and tighten. Replace the spring snap ring.
10. Replace the sprocket lock nut and draw up snugly. Tighten the set screw in the lock nut.
11. Replace the brake plate assembly and spacer.
12. Slide the wheel in position and guide the brake anchor arm to the frame anchorage.
13. Replace axle from the left side with outside nut on the axle and the drain adjusting washer in position. Slide the axle through only part way to hold the wheel.
14. **For Model 640** replace the speedometer drive on the right side, turning the wheel to mesh the speedometer drive ring. Then place the spacer between the drive and the frame. **For Model 741** place the spacer between the sprocket side of the wheel and the frame.
15. Line up and bring the axle all the way through — checking the position of the left chain adjusting washer.

16. Replace the right chain adjusting washer and outside nut.
17. Connect the drive chain over the wheel sprocket.
18. Check and tighten the brake arm anchor (cotter pin).
19. Connect the brake rod clevis to the brake lever.

Removing the Hollow Axle From the Front Wheel Hub

1. Remove the cotter pin from the left end of the axle and the axle nut and lock washer.
2. Disconnect the front brake clevis at the lock nut holding the wire cable to the clevis and slide the cable up out of the adjustable anchorage.
3. **For Model 640-B** slide the axle through, pulling it out from the right side. It is not necessary to remove the cotter pin or nut or lock washer, unless new axle replacement is necessary.

For Model 741 disconnect the speedometer drive cable, then slide the axle through, pulling it out from the right side. It is not necessary to remove the cotter pin or nut or lock washer, unless new axle replacement is necessary.

4. Remove the wheel from the fork.
5. Loosen and take off the adjustable lock nut on the left side. Remove the flat locking washer and adjustable nut.
6. Remove the snap ring spring.
7. Remove the felt washer retaining washer, the felt washer and the second washer retainer.
8. Right side — remove the outside lock nut and steel spring washer.
9. Pull out the complete brake plate assembly.
10. Remove the hollow axle nut.
11. Remove the felt washer and its retainer.
12. Slide the axle out of the wheel bearings.
13. Remove the wheel bearings.
14. If the bearing races in either side of the hub are worn, scored or marked, replace. Both sides are the same.
15. If the wheel tapered bearings are worn, replace.

Assembly

1. Pack with a good fibre grease and replace both tapered bearings.

W H E E L S**(Servicing)**

2. Slide the hollow axle through the bearings.
3. Right side —
 - 3-1 Replace the felt retaining washer, cupped side towards the inside.
 - 3-2 Replace the felt washer.
 - 3-3 Replace the axle nut and allow enough length past the nut to accommodate the brake plate, spring washer and outside nut.
4. Left side —
 - 4-1 Replace felt washer retainer, cupped side towards the hub.
 - 4-2 Replace felt washer.
 - 4-3 Replace the second retainer, cupped side towards the hub.
 - 4-4 Replace the spring snap ring.
 - 4-5 Replace first axle nut and bring up snug until wheel binds when axle is turned. Then back off slightly until a very slight end play is felt.
 - 4-6 Replace the lock washer, bending it over the flat side of the axle nut, then replace the outside lock nut and tighten.
5. Slide the complete brake assembly into position.
6. Assemble the spring washer and lock nut bringing it up so that there is a slight tension on the spring.
7. Replace the wheel into the fork, guiding the brake anchor arm up onto the anchor post on the inside of the fork.
8. Line up and slide the axle through from the right side.
9. Assemble the lock washer to the left side and the axle nut. Cotter-pin in place.
10. Slip the front brake cable wire down through the adjustment anchor and connect it to the clevis, drawing it into the clevis only far enough to leave about 1" play at the control handle.

SERVICE DIAGNOSIS**Front axle grinding****PROBABLE CAUSE****REMEDY**

- | | |
|----------------------|-------------------------------------|
| Improper lubrication | See lubrication recommendations |
| Broken hollow axle | Disassemble, inspect and renew axle |
| Warped center axle | Remove and install new axle |
| Brake too tight | See brake adjustments on Page 52-1 |

Rear axle grinding

- | | |
|----------------------|--|
| Improper lubrication | See lubrication recommendations on Page O-14 |
| Broken hollow axle | Remove, disassemble and replace |
| Warped center axle | Remove and replace |
| Out of alignment | See wheel alignment |
| Brake too tight | See brake adjustments on Page 52-1 |
| Chain too tight | See chain adjustments on Page 57-2 |
| Chain too loose | See chain adjustments on Page 57-2 |



WHEEL LACING

The same instructions will apply to any wheel provided that the correct size and length of spoke for the particular wheel to be laced are at hand.

For the Models 640 and 741B military motorcycles, the spoke requirements are:

Front Wheel

Factory No.	Spoke Diameter	Length	Quantity	To Be Used
39454	.148	8 $\frac{3}{16}$	10	Hub side outside
42309	.148	8 $\frac{3}{16}$	30	Hub side inside and all brake drum side
H23142	nipple	—	40	All spokes

Rear Wheel

39454	.148	8 $\frac{3}{16}$	10	Hub side outside
42309	.148	8 $\frac{3}{16}$	10	Hub side inside
39601	.148	8 $\frac{1}{2}$	20	Brake drum side
H23142	nipple	—	40	All spokes

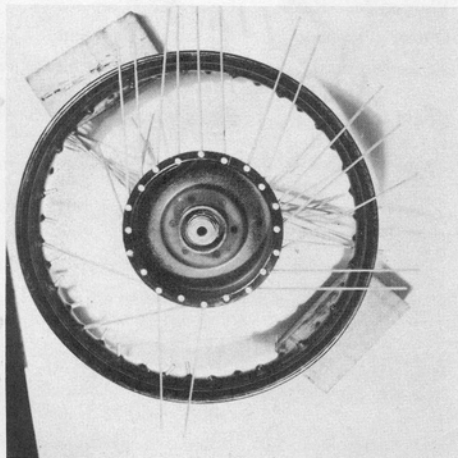
1. Assemble the spokes to the hub first —

- From the hub side insert the 10 outside spokes first. Slide these through from the inside toward the outside — in those holes which are countersunk on the hub inside.
- From the hub side insert the 10 inside spokes next. Slide them through from the outside toward the inside. These

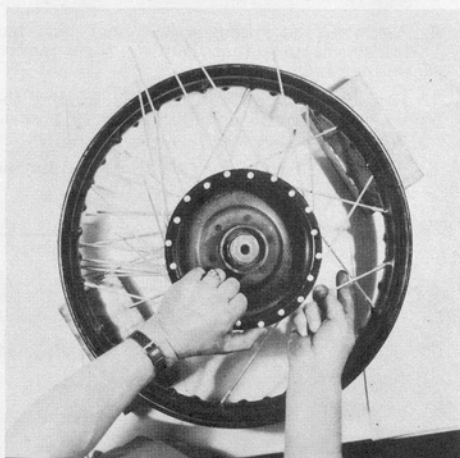
holes are countersunk on the outside of the hub flange.

- From the brake drum side insert the 20 spokes from the outside, sliding them through from the outside to the inside.
- Bring the spokes on both sides together so that the wheel hub may be placed on the bench with the wheel hub or sprocket side on the bench, leaving the brake side facing you.

- Now take the rim. Examine it closely. The row of nipple holes in one side are angled greater on one side than the other. The side on which they angle greatest is the brake side. You can readily see that these spokes must enter the rim at a greater angle because of the brake drum. If you cannot determine which side has the greatest angle — insert a half dozen or so nipples into the holes. These will give you a more noticeable angle to see.
- Face the side of the rim with the largest angle up circling the brake hub and the spokes. Center the hub to the rim.
- On the brake side take one of those spokes nearest you, leading from the holes nearest the drum, and bring it to the left, lining up



LACING OR SPOKING A WHEEL: The first step in lacing or spoking a wheel is to assemble the spokes to the wheel hub. The spokes on the brake drum side all thread from the outside towards the inside as shown above, with all heads facing out. On the hub side, note the countersunk holes. Every other hole is countersunk on the outside — the other holes on the inside. Lay out the wheel and rim as shown above — brake side up. Examine the rim closely — the side on which the nipple holes are angled greatest is the brake drum side.



LACING THE BRAKE DRUM SIDE OF A WHEEL: When all spokes leading to the left are in place, hold the rim firmly and twist the brake drum counterclockwise until all of the spokes just assembled are tight and straightened out. Then take any spoke leading from the outside row of holes and swing it to the right as illustrated above. This crosses over the tops of the spokes previously placed and lines up with its proper rim hole. Repeat with all outside spokes until the brake drum side is complete, nipping each spoke loosely as you go along.

WHEELS

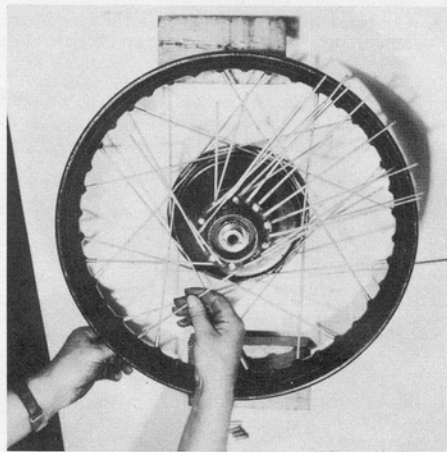
(Lacing)

spoke with any one of the holes in the top row with which it lines up.

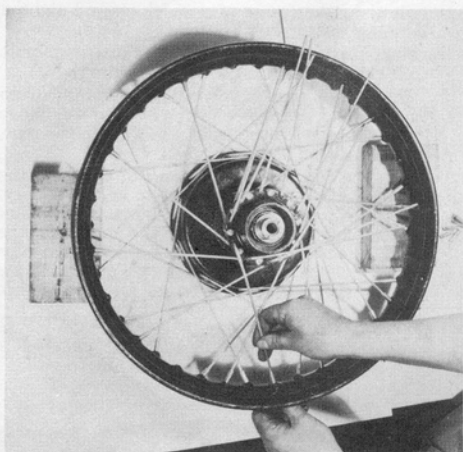
5. Take the next spoke to the left of that spoke already in place and cross it over the spoke just attached, letting it rest on the outside of the rim.
6. Take the next spoke leading from the row of holes nearest the drum and bring it to the left. This will line up with the 4th hole from the spoke just attached. Attach a nipple part way and cross the spoke from the next outside hole back over it, letting it rest on the rim.
7. Repeat operations (5) and (6) until all inside spokes are attached, connecting one inside spoke to every fourth hole.
8. When all the inside row of spokes are connected, **turn the wheel hub counterclockwise as far as it will go to straighten out the spokes** just attached.
9. Now take the outside spokes, crossing them to the right and spread them loosely around the rim.
10. Take any one and cross it over four spokes to the right and loosely connect a nipple. This may already produce a strain on the spoke being assembled.
11. Repeat operation (10) until the entire row of spokes from the outside of the drum flange are in place, crossing each one to the right over

four spokes already connected. Each will be four holes to the right from the last connected.

12. When all have been connected, turn the wheel upside down and rest on the brake drum.
13. Straighten up the spokes on the top side, arranging them loosely around the hub.
14. Take any one from the underside of the hub flange and swing it to the left, connecting it with a nipple to the hole with which it lines up on the rim.
15. Swing the next spoke, which will be one leading from the top of the flange, and swing it to the right out of the way; then take the next "underside" spoke and swing it to the left, connecting it with a nipple to the fourth hole from the previous underside spoke just connected.
16. Repeat operation (15) until all underside spokes are in place.
17. Take any one of the spokes leading from the top side of the flange and swing it to the right, connecting it to the hole with which it lines itself. This will make the spoke cross four of the other spokes that lead from the underside of this hub flange.
18. In every fourth hole to the right, connect the next spoke to the right until the wheel is completely laced.
19. The wheel is now ready for truing.



LACING THE HUB SIDE OF A WHEEL: Turn the wheel over so that the hub side faces up as illustrated. Take any one of the spokes leading from the underside of the hub and swing it to the left connecting it with a nipple in the hole with which it lines up in the rim. Swing the next spoke, which will be one leading from the top of the hub flange, to the right, out of the way. Take the next underside spoke and swing it left — lining it up every 2nd hole from the one just connected and nipple it loosely. Repeat until all of the underside spokes are in place.

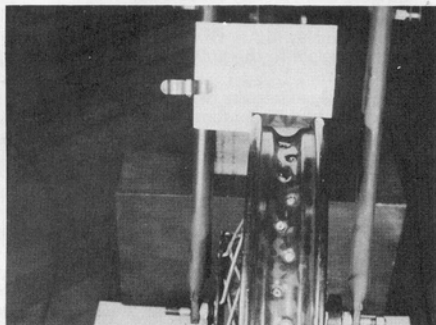


LACING THE HUB SIDE OF A WHEEL: After all of the spokes leading from underneath the hub flange are in place, take any one of the remaining spokes and cross it to the right as illustrated above, until it lines up with the proper rim nipple. Do the same with all remaining spokes to finish lacing the complete wheel. On the rim inside, using a screw-driver, screw up all of the nipples, taking up a turn at a time on each spoke nipple until all are equally tightened. The wheel is now ready to be trued up.

(Truing)

WHEELS

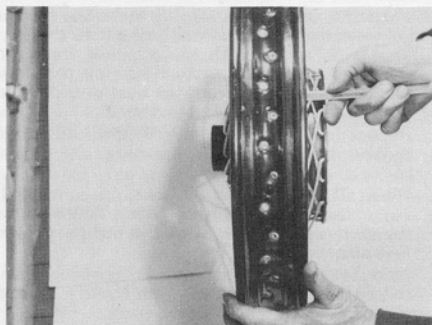
TRUING THE WHEEL: If not properly trued, a wheel will run in a warped line or eccentric to the wheel hub. A simple method and one which is always at hand is shown above. Cut a piece of cardboard as shown and hold it to the fork using one of the pump clips. Spin the wheel. If it runs eccentric, loosen the spokes on the low side and tighten those on the high side until it runs perfectly concentric.

**Truing the Wheel Rim**

1. Insert a set of bearing races and bearings into the wheel hub.
2. Assemble the wheel hub axles complete according to instructions on pages 53-2 and 53-3.
3. If no special truing stand is available, place the wheel in the frame of a machine and tighten the axle nuts to hold the wheel in place.
4. Start at the valve hole and screw up each nipple one turn at a time until they are quite tight.
5. The outside edge of the rim on the brake drum side should run true — $1\frac{1}{8}$ " in from the flange on the brake for the front wheel. On the rear, this should be $1\frac{1}{2}$ ".
6. Spin the rim and hold a piece of chalk in from the front of the rim, using a rest to hold it steady. If the rim runs eccentric, loosen the spokes on the low side and tighten the spokes on the high side one turn at a time until the rim runs concentric.
7. When the rim spins true as far as the face

LINING UP THE WHEEL HUB TO THE RIM — FRONT WHEEL: To measure the horizontal position of the hub hold a steel rule as shown in the above illustration. The flange on the brake drum should measure true $1\frac{1}{8}$ " out from the outside edge of the wheel rim.

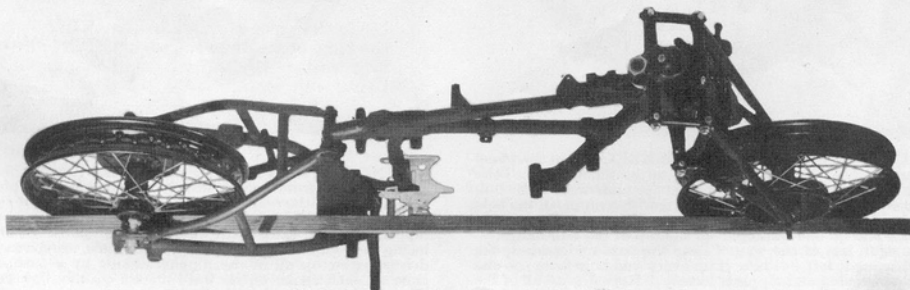
IMPORTANT — in lining up a hub for the rear wheel, measurement should be $1\frac{1}{2}$ ".



(front) is concerned — test for warp. Spin the wheel and hold a piece of chalk in from the side on a steady rest until it begins to touch the side of the wheel.

8. Where short chalk marks are made on the wheel rim, loosen the spoke at the chalk mark and tighten the spoke on the opposite side.
9. Continue this operation until the rim is true and no high or low spots occur on the side of the rim.
10. When all spoke nipples are tight and the rim true, file off any spoke ends that protrude through the nipple so that they will not puncture a tube when tire and tube are mounted.

ALIGNING THE WHEELS TO THE FRAME: Proper handling of the motorcycle is greatly affected unless the wheels "track" straight or are lined up "true" with the frame. To check wheel alignment take a straight piece of board, or pipe, and bring it up against both front and rear wheel rims as illustrated. The rims of both wheels should **parallel** the board and face flush with both the front and back edges of both rims, resting against the truing board.



STEERING

(Adjustment)

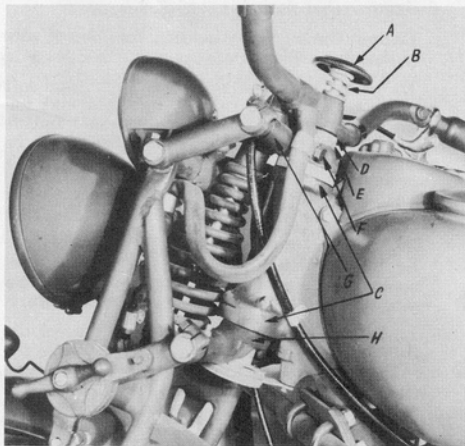
STEERING GEAR

The handlebars on a motorcycle correspond to the steering wheel on a four-wheeled motor vehicle. Through turning either to the left or right, the front wheel may be steered. Steering is accomplished through the handlebars being solidly bolted to the front fork and the front fork itself operating on bearings at both the upper and lower portions of the frame head. The only adjustment that is necessary is adjustment of the fork head bearing that directly controls the proper movement to the left or right of the handlebars.

To adjust the steering head or fork head bearings, proceed as follows:

ADJUSTMENT OF THE STEERING HEAD

1. Jack up the front end of the motorcycle so that the front wheel is clear of the ground.
2. Loosen the steering damper control (A) by screwing it counterclockwise to the left, until there is no tension on the spring (B) under the knob.
3. Turn the handlebars to the right and to the left. There should be a very slight amount of drag if the bearings (C) are adjusted properly.



4. If there is no drag or too much drag, loosen the top lock nut (D) and second nut (E) on the fork stem just under the handlebar top.
5. Loosen the lock bolt (F) on the left side, clamping the fork top (G) to the stem (H).
6. Underneath the handlebar head loosen or tighten the adjusting nut (E) to adjust the amount of drag or play in the steering head.

7. When the above adjustment is completed, tighten down the lock nut (D) and the fork head lock bolt (F) then readjust the steering damper (A).

Note: If there is a decided click or seems to be a slight catch when the front end is jacked up and the handlebars are turned from left to right, more than likely the top set of ball bearings needs replacement of one or more ball bearings. If this is the case, the fork should be removed from the machine and a new set of bearings installed. See instructions for disassembly under the front fork on Page 54-4.

HANDLEBARS

Note: The handlebars of the motorcycle encase their respective spark and throttle control cables and wiring from the horn button on the right bar and wiring from the Hi-Lo headlight beam control switch on the left bar. To assemble the handlebars and their controls to the machine, proceed as follows:

HANDLEBAR ASSEMBLY TO THE MOTORCYCLE

1. Place the handlebars in position, running the black control cable on the left side down through the top of the fork ahead of the top fork connection and in back of the lower fork connection on the left side of the machine. Do the same with the right black control cable on the right side of the machine.

Cables

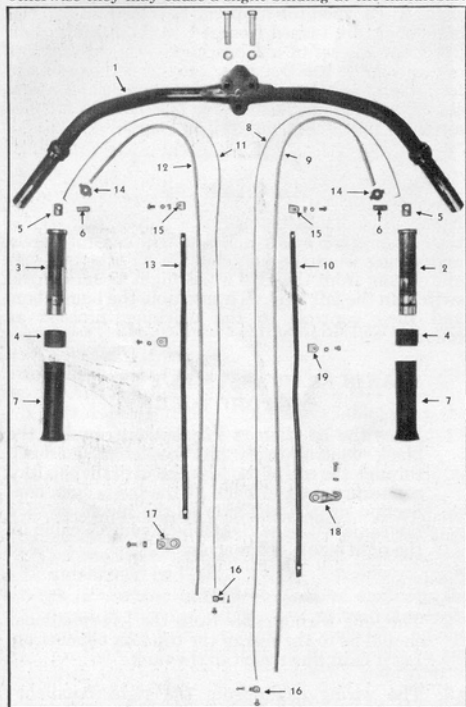
2. The long wiring cable from the left handlebar should be to the rear of the top fork connection. Let it hang down next to the tank.
3. The wiring cable from the right handlebar should be pulled through the right of the fork the same as the left control cable.
4. Using the bolts supplied in the cloth bag with the handlebars, use the two long bolts and two lock washers in the front handlebar holes and tighten into place.
5. Remove the two screws holding the instrument panel cover, lift up and remove the cover.

WIRING

6. In connecting the wiring leading from the handlebars to the motorcycle, refer to the wiring diagrams for individual models under the Electrical Section of this Manual, starting on Page 46-16.

(Handle Bars)**S T E E R I N G**

INTERNAL CONSTRUCTION OF HANDLEBAR CONTROLS IN THEIR PROPER POSITION: Caution should be taken to make sure that there are no sharp bends in the control cable system. Sharp bends will tend to bind the controls and restrict their smooth operation. Grip control sleeves should be removed occasionally and coated with a light film of grease. Control cables should be oiled their entire visible length occasionally so that the oil can seep into the inside for smooth operation of the wire. Rubber grips should not be pushed too far up on the spiral sleeve, otherwise they may cause a slight binding at the handlebar.

**HANDLEBARS**

- | | |
|---|---|
| 1. Handlebar Top Assembly | 10. Ignition Casing Cover |
| 2. Grip Control Sleeve Assembly — Right | 11. Throttle Control Wire |
| 3. Grip Control Sleeve Assembly — Left | 12. Throttle Wire Casing |
| 4. Control Sleeve Stop Nut | 13. Throttle Casing Cover |
| 5. Spiral Block | 14. Casing Upper Stop |
| 6. Spiral Block Pin | 15. Casing Stop Clip |
| 7. Handlebar Grip | 16. Control Wire Clamp |
| 8. Ignition Control Wire | 17. Throttle Wire Casing Cylinder Head Clip |
| 9. Ignition Wire Casing | 18. Ignition Wire Casing Crank Case Clip |
| | 19. Control Wire Casing Frame Clip |

Connecting Control Cables

- Right control cable.
Push the fabric covering up tight against the handlebar.

Thread the cable down ahead of the shift lever casting at the frame, then between the front cylinder and the frame looping it back through the clamp at the base of the front cylinder just in back of the front exhaust pipe. (It may be necessary to loosen the engine bolt holding this clamp to put the clamp in the right position. It can be loosened from the opposite side.) Then thread the wire back to the distributor between the front valve cover and the front exhaust pipe.

Use the small round connection block with the set screw on the block and cotter pin on the small end, and connect the cable to the distributor.

Remove the small clamp at the fork head where the cable runs next to the frame. Open the clamp and bend it around the cable and attach back in place.

Turn the right grip to the left, counterclockwise, as far as possible.

Press the control arm of the distributor in toward the machine as far as it will go.

Slip the cable in the motor base clamp back or forward so that the end of the outside armored cable is about $\frac{3}{8}$ " away from the distributor connection. Then tighten the motor base clamp so that the cable cannot slip.

Tighten the set screw holding the control wire at the distributor.

To test: Turn the right grip right and left to make sure that the full advance and full retard is obtained. The cable should buckle slightly when fully retarded or turned to the left.

- Take the left black control cable and pass it through the clamp on the left side of the front cylinder head.

Leave the clamp loose and using the other connection block with the set screw and cotter pin, connect the control wire to the carburetor.

Push the carburetor control lever toward the front cylinder as far as it will go and slide the control outside cable back or forward through the clamp at the cylinder head until the armored end is about $\frac{1}{2}$ " from the carburetor lever.

Tighten the cylinder head clamp.

Turn the left grip to the right (clockwise) as far as it will go, and tighten the set screw at the block. Turn the grip to right and left to check the lever throw. It should make a full throw in both directions and when fully closed should buckle the cable slightly. (The grip turned as far as it will go to the left, counterclockwise, closes the throttle.)

STEERING

(Steering Damper)

Remove the clip at the frame head near the fork and attach the cable to it, pushing the black covering up towards the handlebar as far as it will go.

To Replace a Broken Control Wire

The same procedure will hold true for either the spark or throttle control cables.

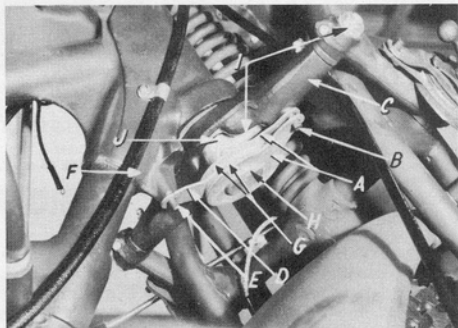
1. Unscrew the sleeve nut just forward of the handlebar rubber grip from the handlebar and twist to remove from the bars.
2. Disconnect the control wire **only** at the set screw at the other end of the control and pull out the broken wire from that end.
3. Slide the spiral block end in the slotted handlebar tube out of the bar.
4. Grip the spiral block in a vise and tap out the cross pin to remove the old wire.
5. Take a new wire and make a right angle bend in one end about $\frac{5}{16}$ " from the end.
6. Slip the angled end into the block through the small hole until it drops into place in the pin groove.
7. Tap the pin back into the block to hold the wire. The pin must extend evenly from both sides of the block or else it will bind in the handlebar.
8. Grease the wire and slide it back into the handlebar, guiding it through the cable until the block slides all the way into the handlebar slots.
9. Twist the grip back onto the handlebar, turning it to make sure that the block spirals in and out of the grip. Then tighten the sleeve nut to the handlebar.
10. Connect the wire at the other end of the control and lock in position.
11. Test the control. If it is O.K. — trim off the excess wire at the connection.

Steering Damper

Place the small coil spring on the steering damper handle and slip the long shaft down through the handlebar top.

Check the steering damper anchor plates under the frame head. The top and bottom plates (A) should anchor at the stud (B) on the right underside of the fork (C) — the middle anchor plate (D) should anchor to the pin (E) under the frame head (F).

When all anchor plates are in position, screw down (to the right) the steering damper until it just barely starts to compress the spring under the handle.



STEERING DAMPER FRICTION DISCS AND PLATES SHOWING PROPER ASSEMBLY OF FRICTION DISCS: If no adjustment of the damper can be made by tightening the control wheel at the handlebars, it is advisable to replace the friction discs (G) and, in some instances, use an extra center plate (D). Friction discs (G) should at all times be clean and dry. If grease from fork lubrication has wet these discs, replace them.

STEERING DAMPER FAILURE

Sometimes steering damper failure is caused through inability to tighten the hand wheel control enough to bring the friction plates of the damper into play.

When this condition exists, the steering damper stop and post (H) are drawn tight against the fork bolt by tightening of the steering damper wheel. This binds the fork bolt in the crown, holding it fast. This bolt should work freely in the fork crown at all times. This failure holds the bolt (I) fast in the crown and leverage of the fork links produces a twisting load that will cause the bolt to bend or break and at the same time render the steering damper ineffective.

To correct this condition remove the steering damper assembly and turn the steering damper stop (J) upside down so that the greatest distance between the fork bolt hole and outside surface of this stop is installed at the top. Then reassemble the steering damper, using a spacing washer (Indian Part No. 22B20) underneath the steering damper post between the post damper flange and the bottom damper plate. Installation of this spacing washer should allow the steering damper discs to come into play when the steering damper control handle is screwed down.

HANDLE BAR WIRING ASSEMBLY

Run the two longest wires from the cable leading out of the left handlebar through the rubber insulated hole in the fork shield just under the center of the horn.

Run the two short **small diameter** wires through the other rubber insulated hole in the fork shield

(Fork Disassembly)**STEERING**

The last wire (short large diameter) presses into the snap terminal mounting behind the fork shield.

Slide the rubber casing back to the handlebar and clamp at the lower clamp on the fork shield.

Slide the short piece of rubber covering in position

so that the harness can be clamped behind the fork shield.

Press the two headlight wires into the headlight. Either wire in either plug is perfectly O.K.

Remove the cover plate on the back of the horn and attach the horn wires. Replace cover plate.

FRONT FORKS

In removing the front fork from the machine it is not necessary to remove the wheel from the fork nor the mudguard, headlight, shock absorbers or other accessory equipment, unless complete disassembly is needed. For all ordinary replacement of parts, side links, etc., only those parts damaged need be removed for replacement.

To replace the fork spring, it is necessary only to dismantle the top section of the fork and the top cross links on either side, after which the spring can be screwed back off from its anchoring posts.

REMOVAL OF THE FORK FROM THE FRAME FOR BEARING REPLACEMENT

Note: Before any work is performed on the front fork assembly, the machine should be raised so that the front wheel is completely off of the ground, either by blocks under the engine base or by suitable rigging from a hoist.

To Remove the Front Fork From the Machine

1. Remove the hand brake lever from the handlebar by unscrewing the screws holding the clamp to the bar. Swing the lever and cable to the front, out of the way.
2. Disconnect all of the wire terminals from the headlight and from the horn.
3. Disconnect the wire for the front fender light at the snap-out terminal just behind the fork shield on the left side.
4. Unscrew the steering damper on the handlebars.
5. Remove the two bolts holding the handlebar to the fork top and lift the handlebars up out of the fork stem. It may be necessary to tap the handlebars up out of their socket. It is not necessary to disconnect the controls and wires from the handlebar to the machine.
6. When the bars are out, rest them back over the tank panel.
7. Remove the lock nut and second nut holding the fork top to the stem in the frame.
8. Loosen the lock bolt on the left side of the fork top.

9. If the fork top does not slide off by itself, tap it from underneath, using care not to damage the threads on the stem.
10. Remove the round ball race cone from the fork stem.
11. Make sure that all of the ball bearings in the race at the fork head are all in place and will not drop out when the stem is removed. A layer of grease will hold them in place.
12. Note the position of the steering damper anchor plates underneath the frame head for future reference.
13. Slide the fork stem down out of the frame head letting the whole assembly come free from the machine.
14. Check the ball bearings in the head and the ball race. If they are worn, cracked, or chipped, replace. The race should also be replaced if worn.
15. Check the round adjusting cone race. If this is worn or ringed, it should be replaced.
16. The bearing on the lower part of the fork stem is pressed onto the stem. Remove it by tapping with a wooden block. Check this bearing; if it is worn, replace.

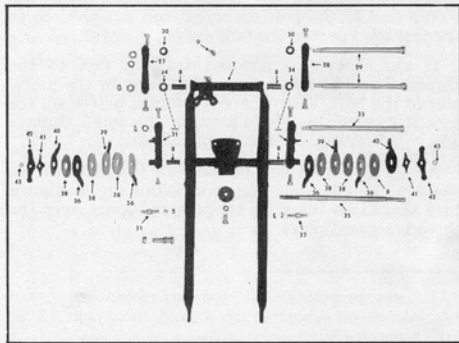
Note: If for any reason replacement of any of the fork parts is necessary, further dismantling can be done when the fork is removed from the machine, removing those parts necessary to make the needed replacements.

1. Replace the bearing on the lower fork stem, driving it into place with a wooden block. The side of this bearing marked "thrust" is the top and should be placed on the stem in this position. The bottom of the bearing is flanged slightly to seat squarely on the base of the fork stem. If the bearing is put in upside down, difficult steering will result.
2. Grease the bearing and stem thoroughly and slide it back up into frame head. Check the steering damper anchorage underneath the frame head. The top anchor fits over the pin on the right underside of the fork. The middle and bottom anchors slide over the pin underneath the frame head.

STEERING

(Fork-Repair)

FORKS: In reassembling, be sure to assemble the shaft "35" to which the friction disc plates attach, so that it is centered in the fork with an equal amount of the shaft protruding from each side. All friction discs and plates should fit past the threaded ends of the shaft and center themselves on the machined part of the fork link bearing to operate properly. All bushings should be free on the shaft. Frozen, rusted, cracked or marked bushings should be replaced. Side links should be brought up snug, then back off $\frac{1}{4}$ turn on shafts "29" and "33" to operate smoothly.



FORK PARTS

- | | |
|---------------------------|-----------------------------|
| 7. Fork Main Assembly | 36. Fork Damper Inner |
| 8. Cross Tube Bushing | Plate — Bent |
| 9. Angle Lubricator | 37. Fork and Plate Side |
| 27. Fork Upper Link—Right | Stud |
| 28. Fork Upper Link—Left | 38. Fork Damper Friction |
| 29. Upper Link Bolts | Discs |
| 30. Upper Link Rear Bolt | 39. Center Friction Plate — |
| Spacer | Flat |
| 31. Lower Link — Right | 40. Outer Friction Plate — |
| 32. Lower Link — Left | Bent |
| 33. Lower Link Rear Bolt | 41. Spring Washer |
| 34. Lower Link Rear Bolt | 42. Hand Wheel |
| Spacer | 43. Hand Wheel Lock Ring |
| 35. Lower Link Front Bolt | |

- Replace the ball bearings and round ball race at the top of the frame head. Grease thoroughly with Marfax No. 3 or equal.
- Replace the fork top on the stem, being careful not to damage the threads on the stem. If these threads are damaged at all, the stem unit should be replaced.
- Tighten down the first lock nut, bringing the fork up snugly into position until there is a slight drag when the fork is turned either left or right and then lock with the second nut.
- Tighten the lock bolt on the left side of the fork top.
- Replace the handlebars and drive home.
- Replace the two bolts anchoring the handlebars to the top.
- Check the drag on the fork by turning it to right and left. If it is not correct, readjust according to instructions for "Adjustment of the Steering Head."

- Replace the steering damper and its spring, checking the position of the anchor plates underneath the frame head. Do not draw this up tight. Tighten only until a slight tension makes itself felt on the spring under the damper.
- Connect the wire for the front fender light at the snap-in terminal just behind the fork shield on the left side. Refer to Wiring Diagrams — Page 46-16.
- Connect the terminals to the headlight and horn. Refer to Wiring Diagrams — Page 46-16.
- Connect the hand brake lever to its original position on the left handlebar.

To Replace the Front Fork Spring

- Remove the steering damper.
- Take out the two bolts holding the handlebar to the fork top.
- Loosen the pinch bolts locking the shaft through the top cross links at the rear and on both sides.
- Remove the nut on the right side of this shaft and unscrew the shaft from the opposite side until it has passed all of the threads on the top right fork link. The shaft can then be driven out with a tap.
- Loosen the lock nut holding the fork head to the machine. Take off the second nut also.
- Loosen the pinch bolt on the left side of the fork head and drive the fork head off of the top of the stem, being careful not to damage the threads on the fork stem.
- Unscrew the fork spring from both the top and the lower fork anchorages.

Assembly

- Screw the spring back onto the lower fork anchorage worm.
- Loosen the bolt holding the top anchorage worm to the fork head and screw the worm tightly into the top of the spring.
- Replace the fork head on the fork stem at the frame.
- Grease and replace the shaft holding the top cross links to the fork head from the left side, screwing it through the threads in the right cross link. **Draw this up tight; then back off so that the fork links do not bind.**
- Replace the lock nut and washer on the shaft and tighten the pinch bolts in each cross link.
- Replace the large nuts on the fork stem and tighten down.

(Fork)

STEERING

7. Tighten the pinch bolt on the fork head at the left side.
8. Tighten the bolt holding the top spring anchor worm to the fork head.
9. Replace the handlebars, lock bolts and steering damper.

FORK SHACKLE BOLTS

In making replacements of fork shackle bolts or fork links it has been found, in some instances, that when the set screws are tightened on the fork shackles, the shackle tightens to the threads of the fork bolt before it draws up on the diameter of the bolt itself. When this occurs, it places an added strain on the fork bolt and may cause it to break.

When a fork is being repaired or a fork bolt is being replaced, the threads on the shackles should be run through with a tap. Take the shackle and lock bolt and tighten the lock bolt in the shackle. Then run through the threads with a tap.

To determine the proper amount of clearance at the threads, saw off an old broken bolt and place it into the part of the shackle which does not have threads and tighten the shackle adjusting screw until the shackle is tight on the bolt. If the threaded end of another bolt can be screwed into the shackle loosely with the fingers, the threads in the shackle then are sufficiently relieved so that when the shackle is tightened up in the fork assembly it will clamp fast to the bolt diameter and not hold on to the threaded part of the bolt only.

If the shackle is allowed to hold fast to the threaded end of the bolt and be loose on the diameter of the bolt, when there is a strain placed on the fork it carries the whole load on the small threads and will oftentimes cause them to break.

A $\frac{7}{16}$ x 20 tap should be used for tapping out the shackle threads, and as the shackles are hardened care should be taken in tapping by going over the threads several times.



FRAME

(Alignment)

THE MOTORCYCLE FRAME

The motorcycle frame is constructed of seamless steel tubing, for maximum strength and long life. Cross tubes are used to provide strength at the points under the greatest strain. The frame as a unit becomes further strengthened when the engine has been assembled to it, because of the added support which the engine and engine support plates give to the lower tubes.

However, no amount of external or internal bracing and reinforcement can withstand the severe shocks that collision sometimes involves.

CHECKING FRAME ALIGNMENT ON THE MILITARY MODEL 640 AND MILITARY MODEL 741 MOTORCYCLES

Note: The following parts are necessary to check frame alignment:

- 1 — $\frac{3}{4}$ " Diameter steel bar 3' long (designated as Symbol "A" on the diagram).
- 1 — Straight edge bar 1" x 1" x 5' long (designated as Symbol "B" on the diagram).

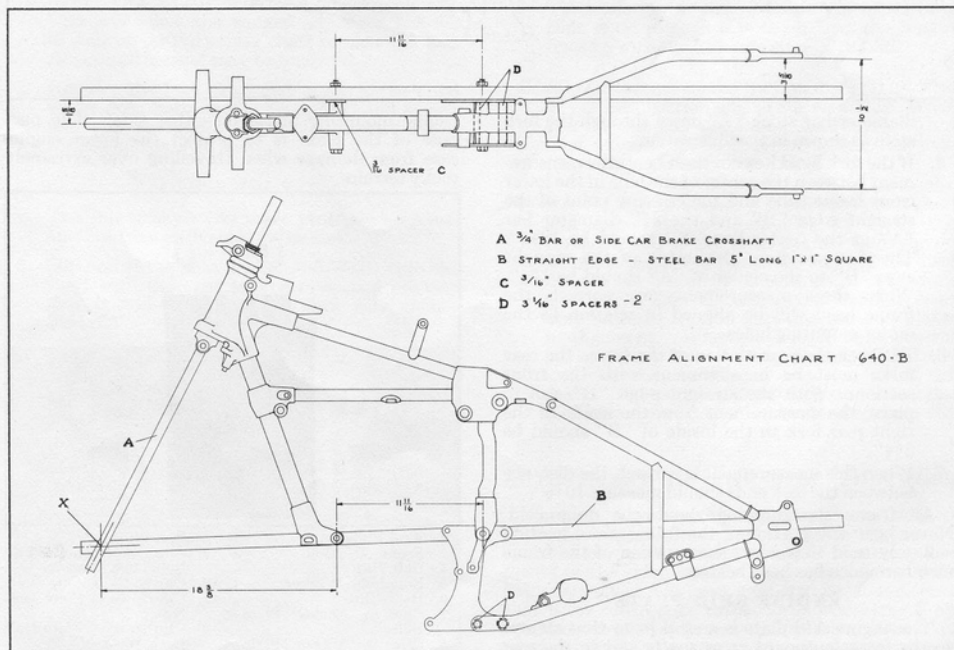
Note: Drill two (2) $\frac{1}{2}$ " holes in the straight edge stock as indicated on the diagram.

- 1 — Spacing washer $\frac{3}{16}$ " thick with a $\frac{9}{16}$ " hole.

- 2 — Bolts $\frac{1}{2}$ -20 x $5\frac{1}{4}$ " long.
- 2 — Nuts $\frac{1}{4}$ -20.
- 2 — Footboard shaft spacers.

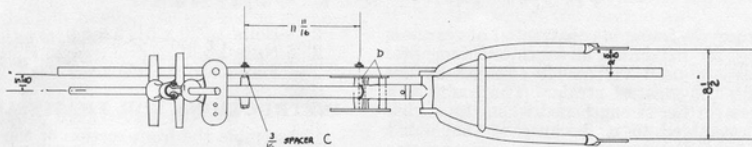
INSTRUCTIONS FOR FRAME ALIGNMENT

1. Assemble the front section of the frame to the rear section, using the two footboard shaft spacers "D" indication on the illustration, between the rear motor hangers at the lower part of the rear section of the frame. This will place the frame in its proper relation to the front or rear sections.
2. Check the distance between the holes on the lower part of the front frame tube and the large hole on the lower part of the rear frame tube. This distance between centers should be $11\frac{11}{16}$ " for correct fitting of the motor in the frame.
3. Bolt the straight end to the right side of the frame through the holes already drilled in the bar stock, using the $\frac{3}{16}$ " spacer "C" on the front right side between the bar and frame.
4. Assemble the fork crown and bracket with its bearing to the fork head. Then slide the $\frac{3}{4}$ "



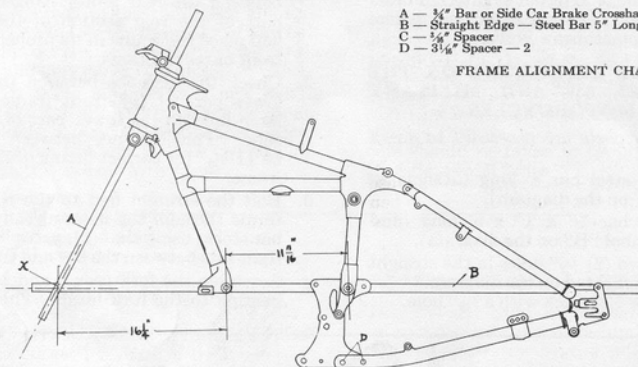
(Alignment)

FRAME



- A — $\frac{1}{4}$ " Bar or Side Car Brake Crossshaft
 B — Straight Edge — Steel Bar 5' Long 1" x 1" Square
 C — $\frac{1}{8}$ " Spacer
 D — $\frac{3}{16}$ " Spacer — 2

FRAME ALIGNMENT CHART 74-1



diameter bar stock "A" down through the fork stem as shown in the illustration.

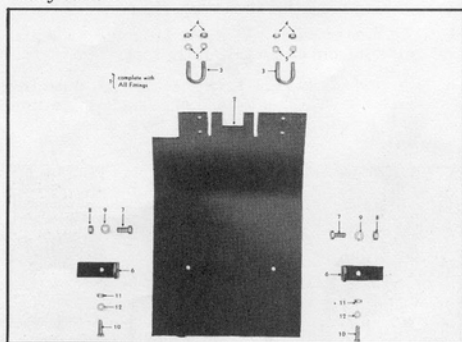
5. If the fork head has not been bent, the measurement between the center of the hole in the lower front frame tube and the crossing point of the straight edge "B" and the $\frac{3}{4}$ " diameter bar "A" at the center line "X" should be $18\frac{3}{8}$ ". The distance from the inside of the straight edge "B" to the center of "A" should be $1\frac{5}{8}$ ". When these measurements are correct, the frame head will be aligned in relation to the motor mounting holes.
6. To check the rear section of the frame the rear forks must be in alignment with the front section. With the straight edge "B" still in place, the measurement from the inside of the right rear fork to the inside of "B" should be $3\frac{5}{8}$ ".
7. When this measurement is correct, the distance between the fork ends should measure $10\frac{1}{2}$ ".

All frame straightening should be done cold. Never heat any portion of the frame, since heating will only tend to weaken that portion of the frame member which has been heated.

ENGINE SKID PLATE

The engine skid plate is a steel plate that clamps to the front footboard cross shafts and to the rear

engine mounting plates on either side. The purpose of the plate is to protect the lower engine case from damage when travelling over extremely rocky terrain.



- | | |
|-------------------------------|---|
| 2. Skid Plate | Bolt Nuts |
| 3. Front "U" Bolt | 9. Clip to Anchor Plate |
| 4. Bolt Nut | Bolt Lock Washers |
| 5. Bolt Lock Washer | 10. Clip to Skid Plate Bolt |
| 6. Rear Clips | 11. Clip to Skid Plate Bolt Nut |
| 7. Clip to Anchor Plate Bolts | 12. Clip to Skid Plate Bolt Lock Washer |
| 8. Clip to Anchor Plate | |

SHOCK CONTROLS

(Assembly)

FRONT FORK RIDE CONTROLS

Shock controls are provided on the Indian military motorcycles Model 741 and Model 640-B. These are referred to as "Ride Controls" and are positioned on both the left and right sides of the fork at the lower front cross shaft connecting the fork to the fork shackle.

The shock controls consist of four steel plates, three of them with bent tongues and the fourth with a straight tongue. These are separated by friction discs so that when pressure is applied through tightening the wing handles on either end, the action of the fork can be either freed or snubbed, according to the individual action that is required for the surface of the roadway that is being travelled.

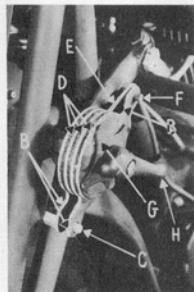
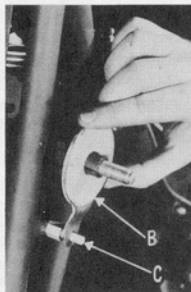
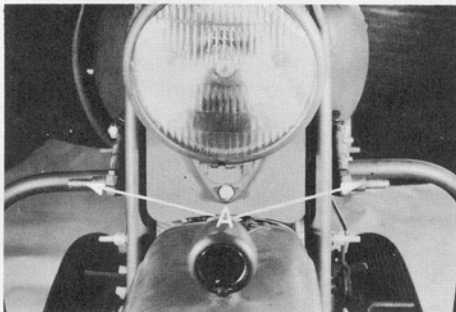
Overlubrication of the fork fittings at times allows lubricant to work its way into the friction discs to such an extent that the discs become glazed and lose their ability to provide the proper action. When such a condition occurs, the shock controls should be disassembled and new discs installed.

DISASSEMBLY OF THE SHOCK CONTROLS

1. Turn the wing handles on both the left and right sides to tighten both shock controls. This will allow the winged adjusting handles to pull up on the center shaft so that the lock rings on either end may be removed.
2. Remove the lock rings and unscrew the hand wheel from both ends. With the hand wheels removed, the plates and friction discs may be slipped off the cross shaft.

ASSEMBLY

1. The center shaft (A) must protrude an equal amount from either side of the fork.
2. Slip one of the bent anchor plates (B) onto the shaft with the bent tongue in such a position that it will slide over the fork side anchor stud (C).



3. Slide one of the friction discs (D) onto the shaft, then take the straight tongued anchor plate (E) and slide it on in such a position that the tongue fits over the stud (F) at the shackle.
4. Slide another friction disc (D) into position.
5. Take one of the bent friction plates (B) and slide it on in such a position that the tongue lines up with the fork side stud (C) again.
6. Slip on another of the friction discs (D). This is the last friction disc of the assembly. Then slip on the last remaining steel plate with a bent tongue (B), so that the tongue fits over the anchorage on the side link (F).
7. Slip the spring washer (G) onto the cross shaft and screw the wing handle (H) onto the threaded end of the cross shaft. Care should be taken that all of the plates and friction discs fit over the bushing that extends from the fork side link. The purpose of this bushing is to keep both the friction discs and the steel plates in alignment. When the winged hand control is in position, tighten it up enough so that the lock ring may be slipped onto the end of the shaft. The purpose of the lock ring is to keep the hand adjustment from backing off from the shaft.

ADJUSTMENT OF THE RIDE CONTROLS

Through loosening or tightening the winged handles, the spring action of the front fork can be snubbed or freed to meet the individual requirements of the rider and the particular road surface being travelled. It will perhaps be found best that these controls be rather loose when travelling over smooth surfaced roads and snubbed somewhat when travelling over very rough or rugged surfaces.

THE MOTORCYCLE FENDERS

The fenders of the military motorcycle are constructed so that the greatest amount of clearance is possible between the wheel and the fender proper.

The fenders on the Model 640 are both of one-piece construction. The front fender on the Model 741 is also of one-piece construction while the rear fender on the Model 741 is of a two-piece construction, so that the rear portion of the fender may be removed to allow the rear wheel to be taken out for servicing.

The front fenders on both the 640 and 741 Models are braced from the front fork axle and held in position to the fork with a single bolt. A leather washer is used between the top of the fender and the fork itself. On the Model 640 the fender braces are riveted together at the fork axle and bolted to anchorages that are spot welded to the fender. The rear fenders on both models are braced from the rear fork and clamped to the frame by means of a clamp directly behind the transmission. The brace connections on the fender are spot welded to the fender.

CENTER STANDS

The Model 640-B is equipped with a center stand directly under the frame in a position slightly to the rear of the engine. The center stand is cast and is allowed to swing on two frame bolts. It is held up in a riding position by means of a clamp at the lower left side of the rear fender. When released from this fender clamp, a spring automatically releases the center stand so that when the machine is tilted to the left the stand itself will swing into position so that the machine, when straightened up, may be stood in a vertical position.

To take the machine off of the center stand, it is only necessary to push the machine forward and raise the stand so that the rear mudguard catch can lock the stand in a riding position.

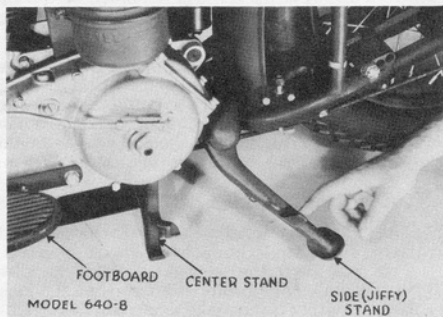
It is hardly necessary to remove the center stand from the machine unless it becomes broken. Ordinary replacement of a spring can be made with the center stand on the machine. If, however, it becomes necessary to remove the stand, remove the two frame bolts holding the center stand to the frame.

REAR STAND

The Model 741 is equipped with a rear stand for holding the machine in a vertical position. This is held in position for riding by means of a spring clip bolted to the rear fender. With this spring clip released, the rear stand will automatically drop to the ground and it is only necessary to lift up and pull backward on the motorcycle to place it on the stand. By pushing the motorcycle forward and off the stand, the stand may be returned to its original position.

JIFFY STAND

On the Model 640 the Jiffy Stand is located on the left side of the motorcycle just to the rear of the left footboard. The stand consists of a cast leg anchored to the frame and held in position by means of a spring. To release the Jiffy Stand, bring it outward and away from its normal riding position. For ordinary spring replacement it is not necessary to remove the stand leg from the machine. The only time that it would be necessary to remove the leg would be for complete replacement of this part.



On the Model 741 the Jiffy Stand consists of steel bar stock bent to shape and anchored at the left front footboard shaft. A release spring for holding the stand in a riding position is connected from the footboard shaft casting and held to the Jiffy Stand leg by means of a spring clip. In the event that the leg does not return far enough up and under the machine for a safe riding position, the spring clip should be adjusted to increase the tension on the spring. This will automatically hold the leg closer to the machine.

In the event that the forward casting becomes damaged, it is necessary to remove the left footboard and side rail assembly complete in order to remove the Jiffy Stand casting from the front shaft for replacement.

FOOTBOARDS

The footboards on both the Model 741 and Model 640 are of a moulded rubber-to-steel construction with the footboards being bolted to cleats that are anchored and held by clevis pins to the side rails. All parts are replaceable individually.

REAR CHAIN GUARD

On both the Model 741 and Model 640 the rear chain guard is constructed in split sections so that the forward section may be removed separately

F E N D E R S

(Rear Chain)

for service work on the kick starter or countershaft drive sprockets. The chain guard connection clips are spot welded and riveted to the chain guard. Should they become loose, they should be riveted and respotted. Loose chain guards are a menace and there is always danger of a loose guard breaking loose completely.

FRONT CHAIN GUARD

Both the Model 741 and Model 640 are equipped with a chain guard just forward of the engine over the generator drive. On the Model 741 the chain guard is sealed to the back plate by gaskets and the breather line from the tank, for the purpose of providing lubrication to the generator drive chain. In removing the generator drive cover this oil line should be disconnected from the cover.

On the Model 741 the cover is attached to the back plate by means of several bolts around its outside edge. On the Model 640 the generator cover is attached to the back plate by two bolts — one at its leading front edge and the other at the rear section. The generator cover should always be in place when the machine is operated, for the protection of the generator drive chain and assembly. Their purpose is to keep dirt and foreign matter from getting to the chain.

THE REAR DRIVE CHAIN

Care and Adjustment of the Rear Drive Chain

Keep the chain at the proper tension at all times. This can be determined by lifting the bottom of the chain at its center. It should lift about one inch (1") when properly adjusted. A loose chain may jump the sprockets and damage spokes and chain guard. Tight chains cause extra wear on the chain rollers and result in chain breakage.

LUBRICATION

Rear drive motorcycle chains operating most of the time at high speed provide a very difficult problem in lubricating efficiency.

The chains operating in the open without means of providing enclosed or automatic lubrication collect sand, dust and grit which work their way into the chain joints, causing them to become stiff and to wear excessively.

It is just as important to properly lubricate the bearings of a motorcycle chain as it is to lubricate the bearings on any other integral part of the motorcycle. If the pins, bushings and rollers of the chain are allowed to become bone dry, excessive elongation, "stiff joints", and uneven wear will result. If dirt and other foreign matter is allowed to stay upon the chain for any period of time, they will eventually work their way into the precision made chain bearings, scoring the hardened surfaces and doing irreparable damage to the chain.

Smearing non fluid grease on the surface of the chain is a doubtful lubricating expedient due to the fact that it does not penetrate into the chain bearings, and acts as a catch-all for road dust and debris.

We recommend that two methods of lubrication be used on rear drive motorcycle chains used in army service, as follows: —

PERIODIC LUBRICATION AT EVERY 250 MILES

1. Leave chain on motorcycle.
2. Jack up machine and clean off surface sand and dirt with brush or waste.
3. Revolve chain and pour kerosene on slack side, preferably with a spout can. If spout can is not obtainable, use waste saturated in kerosene.
4. Start motor and revolve chain slowly until kerosene is dispelled.
5. Pour engine oil (preferably #10 or #20) on slack side of chain. Care should be used when applying the oil so that it penetrates between the inside and outside chain plates inasmuch as it is more easily carried to the pin in this manner.

PERIODIC LUBRICATION AT EVERY 1000 MILES

6. Take the used chain off the machine, putting it in a shallow pan with a piece of wire netting or substitute in the bottom of the pan to keep the chain about $\frac{1}{2}$ " above the bottom. Cover the chain with kerosene, and soak thoroughly. When the dirt and old oil are dissolved, shake the chain well in the kerosene and then clean it, inspecting every joint, making sure they are free from dirt and flexible.
7. Immerse the chain in a pan of hot grease, heated to a consistency of ordinary light cylinder oil. Allow the chain to soak in this mixture for a short time, keeping the grease hot if possible, and moving the chain so that the grease will reach all inside parts.

Take the chain out, wiping off all the surplus oil from surface of chain.

NOTE: When conditions render it impossible to immerse chain in the melted grease, substitute immersion in pan containing #10 or #20 fluid oil.

8. Install chain back on motorcycle. If this procedure is followed, a hard lubricating material will be incorporated in all vital wearing parts of the chain after it is dried.

(Rear Chain Adjustment)**F E N D E R S**

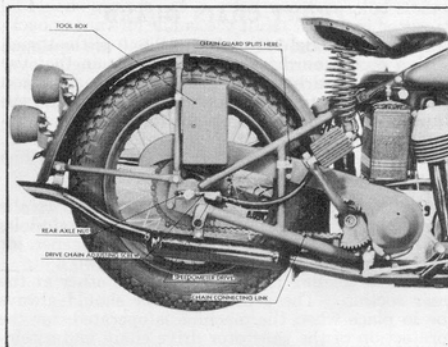
Less road dirt will be picked up by the apparently dry, yet well lubricated chain, and longer life and greater satisfaction will be obtained.

The split, or open, end of the spring clip on the connecting link should be pointing in the **opposite direction** to chain travel. (It will be necessary to remove the front half of the chain guard to attach the chain to the front sprocket.)

CHAIN ADJUSTMENT

1. Loosen the rear axle nut on the left side of the machine.
2. Remove the cotter pin and loosen the bolt holding the brake plate anchor arm to the frame on the left side of the machine.
3. Tighten (turning clockwise), or loosen (turning counterclockwise), the adjusting screws on both sides of the rear frame just ahead of the axle. These center on a notched plate that is fitted to the axle. It is important that these be turned equally to keep the wheel straight in the frame.
4. Test the chain until it has about 1" up and down play at its center on the bottom.

5. Tighten and cotter-pin the brake anchor bolt and tighten the rear axle nut.
6. If a big adjustment has been made, check the foot brake pedal action. It may be necessary to remove the clevis pin on the rear brake plate arm and adjust the clevis forward or backward to correct the brake action.

**REAR DRIVE SPROCKET**

Loose or tight drive chains cause excessive wear of the drive sprockets and sharpen the teeth of the sprockets to such a point that they do not provide adequate surface for the chain bearings, allowing the chain to stretch and wear abnormally. When drive sprockets become sharp, they should be removed and replaced with new sprockets.

1. To remove the rear sprocket, remove the rear wheel from the frame. A lock nut holds the sprocket to the wheel hub. The lock nut is held by a safety set screw in position.
2. Remove the set screw of the sprocket nut and remove the sprocket nut (right-hand thread).
3. Drive off the sprocket.
4. Replace with new sprocket. (Standard specifications — 40 teeth)
5. Replace sprocket nut and tighten nut set screw.
6. Replace the wheel in the machine.

SADDLE**(Battery Mount)**

SADDLE

The motorcycle saddle is constructed so that it may be adjusted either forward or backward in order to give the saddle the proper relation to the handlebars for the individual rider. In moving the saddle forward or backward, the front two saddle bolts and rear bolts at the springs should be loosened in order to shift the saddle forward or backward. Before tightening the saddle top, the spring action should be checked to make certain that the springs operate straight. In order to adjust the bottom positioning of the springs, loosen the lower support bracket and move it either forward or backward.

TOOL BOX

Both Models 640 and 741 are equipped with a tool box for carrying an emergency supply of tools.

This is located on the right rear portion of the motorcycle and it is bolted to the rear chain guard and fastened to the fender brace by means of a clip. On Model 640, the tool box is equipped with a lock using a separate key. Model 741 is equipped with a lock that uses the standard Army H-700 key.

BATTERY MOUNTS

The battery mount on the Model 741 and Model 640-B is located just over the transmission case directly in back of the rear cylinder. The lower mount consists of a steel plate bolted to the frame and to the transmission case. The battery hold-down clamp fits over the top of the battery and is tightened down by means of two locking screws. The upper clamp should always be tight to a point where it will keep the battery from shifting.



SPEEDO-METER — SAFETY GUARDS

SPEEDOMETER — SAFETY GUARDS

The speedometer on the Model 640-B is located in the instrument panel at the gasoline and oil tanks. In order to remove the speedometer for servicing, it is necessary to remove the two screws holding the panel cover and remove the fuel tanks.

However, for ordinary servicing it is not necessary to remove the speedometer head itself. For bulb replacement remove the panel cover and pull out the speedometer light socket. This is on a spring arrangement and snaps out or into place.



Usually speedometer failure is caused, on the Model 640, through breakage of the drive ring at the speedometer drive on the rear wheel usually due to binding somewhere in the system. To remove the speedometer drive ring for replacement, remove the right axle nut and slide the axle shaft out towards the left side of the machine so that the spacer between the speedometer drive and the frame fork, and the speedometer drive itself, can drop free of the axle.

A wire snap ring holds the speedometer drive ring in position. To replace the drive ring, wipe off the accumulated grease and remove the retaining ring.

On installing the drive back to the motorcycle, make sure that the drive ring protruding clips mesh properly with the slotted surface of the wheel housing. The speedometer drive cable on the Model 640 is of the "link" type. Repairs to the cable can be made by unscrewing the cable housing from the speedometer head and from the speedometer drive, without removing the cable from the machine.

Should it become necessary to remove the speedometer head, disconnect all fuel lines and remove the tanks from the frame.

SPEEDOMETER — MODEL 741

The speedometer on the Model 741 is of the "front drive" type and is mounted on the front fork. The drive is of the wire cable type, and should speedometer failure occur it is most likely that

failure will take place at the cable. The front drive is driven from a gear mounted to the wheel hub, inside the front wheel between the hub and the brake plate.

SAFETY GUARDS

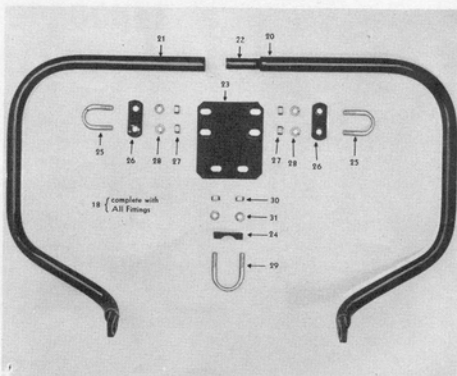
Both the Models 741 and 640 are equipped with front safety guards for the protection of the rider. These are made of steel tubing and clamped securely to the front main frame posts and to the cross shaft to which the footboards are mounted on both the left and right sides.

The safety guards are of the "split" type so that should either the left or right guard become damaged, either half may be replaced. They are split at their top cross member. For assembly position of the safety guard parts, refer to the accompanying illustration.

ASSEMBLING SAFETY GUARDS TO A MACHINE

The safety guards should be assembled to the machine before the legshields.

1. Take the steel plate. The end with the four holes is the top.
2. Attach the two small "U" bolts through these holes, then slip one of the flat steel plates over the ends of the "U" bolt, attaching lock washers and catching the nuts on all ends by about three threads.



SAFETY GUARDS

- | | |
|------------------------------------|----------------------------|
| 20. Frame Tube — Right | 25. Plate & Guard "U" Bolt |
| 21. Frame Tube — Left | 26. "U" Bolt Reinforcement |
| 22. Frame Tube Upper Reinforcement | 27. "U" Bolt Nut |
| 23. Plate | 28. Lock Washer |
| 24. Plate and Frame Block | 29. Plate & Frame "U" Bolt |

WINDSHIELD — LEGSHIELDS

3. Hold the plate up in front of the frame just ahead of the front cylinder and forward of the shift lever arm with the loop ends of the "U" bolts already attached, toward the front.
4. Using the small casting with the half round surface, fit it between the steel plate and the frame tube and attach to the frame with the large "U" bolts; catch in place but do not tighten down.
5. Remove the footboard brace mounting nuts on both sides of the machine and slip the footboards off and up so that you will have free access to the front mounting bolts.
6. Remove the first spacer from the clutch (left side).
7. Take the left half of the safety guard and slide the lower end onto the footboard shaft — at the same time guiding the top half through the "U" bolts on the front of the anchor plate just attached. It may be necessary to raise or lower the anchor plate to line up the "U" bolts with the safety guard.
8. On the right or brake pedal side, remove the brake pedal and the flat washer.
9. Attach the right half of the safety guard in the same manner as the left.
10. Replace the flat washer and brake pedal — catch the spring into position on the pedal and footboard brace and slip the footboard onto the original mounting shafts. Attach and tighten the footboard bolts.
11. On the clutch or left side, slip the spacer back onto the shaft and attach the footboard.
12. Tighten all "U" bolts on the anchor plate, twisting the guards, if necessary, to make them even.
4. The legshields are cut away on the top. The angled side is the inside. Take the left shield and attach it to the top brace with the flat head bolt.
5. Move the lower brace up or down to line up the lower fitting and attach with a flat head bolt.
6. Attach the right shield in the same manner.
7. Check to see if straight and if top brace is up against safety guard anchor plate. Tighten top "U" bolt.

ASSEMBLING THE WINDSHIELD TO A MACHINE

1. Loosen the windshield handlebar clamps and slide the drilled anchor bolt up onto the windshield rods.
 2. Turn both clamps so that the windshield rods are in front of the handlebar, and so that the bolt through which the windshield slides is at the top and center of the handlebars.
 3. This should leave the small clamp bolts under the bar.
 4. The windshield shafts should extend below the top bolt fitting about $2\frac{1}{2}$ ".
 5. Tighten the top bolts first, then the lower, tilting the windshield to get the proper angle.
 6. The top half of the windshield can be raised or lowered by loosening the wing bolts on either side and raising or lowering the shield.
 7. Attach the windshield apron. Press snaps into place at top edge and on outside ends. The top cut goes over and behind the horn, the lower behind the headlight. Fasten the top strap across between the headlight and horn, the lower strap across under the headlight.
 8. Bring the two springs on the apron around back and under the fork, catching the ends together.
- The windshield is adjustable both as to height and to the upright angle.
- The upright angle can be adjusted by loosening the handlebar clamps and tilting the shield until the correct angle is obtained.
- To raise or lower the transparent shield section, loosen the two wing screws on the driver's side and slide the top section up or down. The shield should be just high enough to deflect the air current over the rider's head.

ASSEMBLING LEGSHIELDS TO A MACHINE

Model 640B

1. Take the largest steel brace with the large straight angled ends.
2. Attach it to the frame tube just below the safety guard anchor plate, using one of the metal castings between the brace and frame. The flat side to the brace, the curved side to the frame. The angled ends should point slightly up and towards the rear of the machine. If they point down, turn the brace around. Attach to the frame with the "U" bolt and leave loose enough so that it can be turned, if necessary.
3. Attach the shorter brace in the same manner so that the angled ends point to the rear and down. Leave the brace loose enough to be turned or moved up or down.

TIRES — TOOLS

TIRES AND TUBES

The tires on the Model 640 are 18 x 4.00.

The tires on the Model 741 are 18 x 3.50.

Originally, either Firestone or Goodyear Tires are supplied by the factory but any comparative tire of the same dimensions, that meets Government specifications, may be used for replacement.

CHANGING TIRES

Tires are all important to a motorcycle. They should have plenty of tread and as soon as they become worn to a smooth surface, should be replaced.

Changing the Front Tire

1. Jack up the front end of the machine so that it is well off the ground.
2. Loosen the cable lock nut holding the wire cable to the brake arm clevis and pull out the wire. Slip the cable back out of the adjusting screw at the rear part of the brake plate.
On Model 741 — disconnect the speedometer drive cable.
3. Remove the cotter pin and axle nut from the left side of the machine.
4. Pull out the axle from the other side, being careful not to damage the threads.
5. Let the air out of the tube, remove the nut at the tube stem and take tire from the wheel.
6. Mount new tire and tube, being careful to line up the balancing mark on the tire with the valve stem.
7. Slide wheel back into fork catching brake arm to the anchor stud on the inside of the right fork stem.
8. Replace axle, axle nut and cotter pin.
9. Replace and adjust front brake cable.

Changing the Rear Tire

1. Put the machine on the center stand (Model 640); rear stand for Model 741-B.
2. Turn the wheel until the connecting link is at the rear of the wheel sprocket and lock the machine in gear. (The reason being to prevent the chain from slipping off the front sprocket and the resulting extra labor of replacing it.)
3. Disconnect the connecting link and slip the chain from the sprocket.

4. Disconnect the rear brake clevis by removing the clevis pin at the brake arm.
5. Remove the cotter pin and loosen the bolt holding the brake plate anchor to the frame.
6. Take off the right rear axle nut and drive the shaft about 2/3 out.
7. On Model 640-B — remove the spacer between the frame and the speedometer drive and swing the speedometer drive out of the way so as not to damage the drive clip.

On Model 741 — remove the spacer on the right side between the wheel hub and the frame plate.

8. Remove the axle and let the wheel drop.
9. On Model 640-B — pull out the jiffy stand and tip the machine to the left, resting it on both the jiffy and center stand. The wheel can then be slipped out from the right side.
On Model 741 — remove the brace bolts holding the rear mud guard section and remove mud guard rear section up out of the way so that the wheel can be taken out.

10. Remove tire and mount new tire and tube, watching that balancing mark on tire lines up with valve stem.
11. Slip the wheel back into the frame with the long spacer on the brake plate side. Slip the brake plate anchor to the frame stud at the same time.
12. Slide the axle through part way from the left side.
13. On Model 640-B — position the speedometer drive so that the drive clips fit into the wheel hub and slide the spacing washer between the drive and the frame. (Not necessary on Model 741 because the speedometer is driven from the front wheel.)
14. Turn the chain adjusting plate on the left side, short end to the front, and push the axle through.
15. Slip the right chain adjusting plate onto the axle, short end front, and replace the axle nut. Do not tighten.
16. Slip the drive chain back onto the sprocket and connect with the spring opening of the clip facing the ground.
17. Adjust the chain according to instructions shown under "Care of the Rear Drive Chain" on Page 57-2.

T I R E S — T O O L S**(Tool Equipment)**

18. Tighten the axle nut, tighten and cotter-pin the brake anchor stud and connect the rear brake clevis.
19. Always test the rear wheel brake whenever it has been disconnected.

TIRE BALANCING

Motorcycle tires are marked on the outside of the case with a spot indicating that part of the tire which, when mounted, should be placed at the valve stem of the tube when assembling the tube into the tire, and the tire into the rim.

Failure to install the tube into the tire with the valve stem at this spot, may induce wheel tread scuff and rough handling at high speed.

TIRE PRESSURES

Low tire pressures cause weaving and wobbling of a machine at the higher speeds. Most generally, low tire pressure will cause wheel wobble above 50 miles an hour. The tires should be inflated with 18 lbs. pressure in the front tire and 20 lbs. in the rear for proper handling and for best tire mileage.

BULBS

The bulb at the speedometer is a Mazda No. 55, 3 c.p., 6 to 8 volts. The service headlight bulb is a prefocus Mazda with a 21-32 c.p. rating. The "blackout" headlight lamp is a single contact, 6 to 8 volt, 3 c.p. bulb.

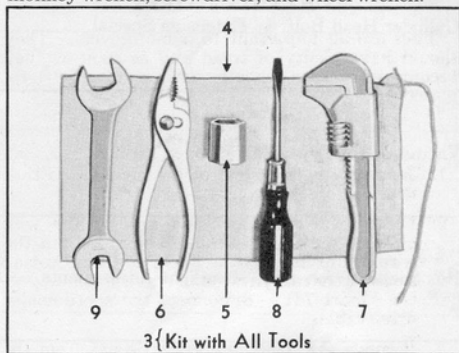
The bulb for the service tail and stop light is a double contact, 6 to 8 volt, 21 c.p. and 3 c.p.

On the older type "blackout" equipment, the bulbs are single contact, 6 to 8 volts, 3 c.p.

On the newer type "blackout" tail lamp assemblies the bulbs are a sealed part of the filter assembly and are replaceable only as an assembly. Refer to the Parts Price List for the correct unit for installation.

TOOL EQUIPMENT**First Echelon**

The tools supplied in the tool roll of each machine should generally be considered sufficient for this Division. The tools included in this machine tool equipment consist of a spark plug wrench, pliers, monkey wrench, screwdriver, and wheel wrench.



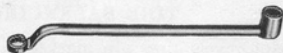
- 3 { Kit with All Tools
4. Tool Bag
 5. Spark Plug Adapter
 6. Pliers
 7. Monkey Wrench
 8. Screwdriver
 9. Wheel Nut Wrench

TOOLS

SECOND ECHELON

In addition to the tools supplied for the First Echelon, the additional special motorcycle tools are suggested for Second Echelon use.

Cylinder Head Wrench, $\frac{5}{8}$ Special — length 11"..... **101472**



Cylinder Head Bolt, $\frac{5}{8}$ Extension Special..... **102312**



Vacuum Grip Type, Valve Cover Tool..... **101826**



Box Socket Wrench for Headlight Adjustments..... **102347**



◆

THIRD AND FOURTH ECHELONS

A complete set of tools and special items may be selected on the basis of the amount of work and the necessity for using these specially adapted tools, to expedite repairs on a production basis. The following list is suggested:

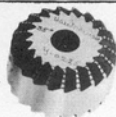
Cylinder Base Stud Nut Wrench..... **35W206**



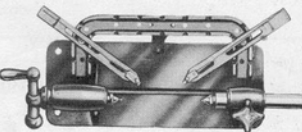
Clutch, Sprocket and Transmission, Offset Jaw — $1\frac{5}{8}$ "
Open End..... **27T350**



Cylinder Valve Seat Cutter, Model 741 and Model 640,
 $2\frac{1}{4}$ " — 35° **101909**



TOOLS

Pilot Only	Model 640 — $\frac{3}{8}$ "	101916	
	Model 741 — $\frac{5}{16}$ "	101914	
Taper Sleeve		101917	
Handle		101919	
Crossrod		101918	
Piston Pin Hole Reamer for Upper Rod Bushing — Model 640-B		101431	
Flywheel Truing Stand with Indicators and Centers		TP9796	
Lapping Tool and Sleeve for Lower Connecting Rod Bushings, Model 640-B		22T1486	
Arbor Only	Model 640-B or 741-B	21T316	
Sleeve for Model 741 Lower Rod Bushing		101508	
Sleeve for Model 640 only		101507	
Special Clutch Assembly Tool		23T269	
Pinion Gear Puller for Model 640 and Model 741		33T69	

TOOLS

THIRD AND FOURTH ECHELONS (Con'd)

Special Tool for Removing and Installing Connecting Rod,
Upper Bushings on Model 640-B.....

24T5331



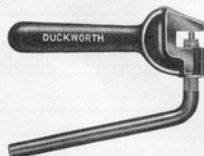
Flywheel Nut Wrench — Special.....

23T286



Chain Repair Tool.....

35W155



Intake Manifold Tool for Model 640-B.....

101440



Intake Manifold Wrench for Model 741-B, 1½" Special
Straight Jaw.....

102311



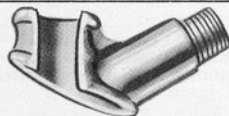
Special Tool for Installing or Removing Connecting Rod
Lower End Bushings.....

42189



Special Tool for Bending Handle Bars, can be used equally
well to straighten safety guards or other steel tubing.
Cast iron construction, threaded to accept standard
1¼" iron pipe for extension handle, sold without
extension.....

101434



Special Spoke Tightening Tool, short, hexagonal ¾" steel
tool, milled to fit the spokes.....

7T359



Special Valve Guide Drift Punch, tool steel punch for
installing or removing new valve guides in cylinders....

30T764



Special Wrist Pin Drift, tool steel drift for installing or
removing wrist pins from pistons.....

30T763



TOOLS

(Micrometers)

MICROMETER CALIPERS

GENERAL

The micrometer is the most commonly used adjustable gauge, and it is important that the mechanic understand thoroughly its mechanical principles, construction, use, and care. The figure shows a 1-inch outside micrometer caliper with the various parts clearly indicated. Before making any attempt to use the tool, the mechanic should become familiar with its nomenclature, especially the frame, anvil, spindle, barrel (or sleeve), screw, and thimble. Micrometers are generally intended to measure distances to one ten-thousandth of an inch; the measurement is usually expressed or written as a decimal, so the mechanic should also know the method of writing and reading decimals.

DECIMALS

The decimal system is a method of expressing fractions and mixed numbers. For example, 2.000 inches written decimally indicates exactly 2 inches. All figures to the left of the decimal point are whole numbers; all figures to the right of it indicate parts of whole numbers. Starting from the decimal point and moving to the right, the first digit indicates tenths; the second, hundredths; the third, thousandths; the fourth, ten-thousandths; and so on. Thus, 2.3 is read two and three-tenths; 1.85 is read one and eighty-five hundredths; 4.071 is read four and seventy-one thousandths; 0.2318 is read twenty-three hundred and eighteen ten-thousandths. (When there is no number to the left of the decimal point, the quantity indicated is less than 1.)

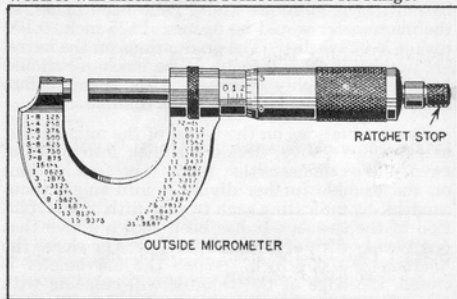
TYPES OF MICROMETERS

Three types of micrometers are commonly used in automotive work; the outside micrometer (including the screw thread micrometer), the inside micrometer, and the depth micrometer. The outside micrometer is used for measuring outside dimensions, such as the diameter of a piece of round stock. The screw thread micrometer is used to determine the pitch diameter of screws. The inside micrometer is used for measuring inside dimensions, as, for example, the inside diameter of a tube or hole, the bore of a cylinder, or the width of a recess. The depth micrometer is used for measuring the depth of holes or recesses.

SELECTING MICROMETER

All three types of micrometers are usually made so that the longest movement possible between the sleeve and the anvil is 1 inch. This movement is called the "range." The frames of micrometers, however, are available in a wide variety of sizes, from 1 inch up to as large as 24 inches for special work. The range of a 1-inch micrometer is from

0 to 1 inch; in other words, it can be used on work where the part to be measured (between the spindle and the anvil) is 1 inch or less. A 2-inch micrometer has a range from 1 inch to 2 inches, and will measure only work between 1 and 2 inches thick; a 6-inch micrometer has a range from 5 to 6 inches thick. It is necessary, therefore, that the mechanic in selecting a micrometer first find the approximate size of the work to the nearest inch, and then select a micrometer that will fit it. For example, to find the exact diameter of a piece of round stock: If it is found by using a rule that the diameter is approximately $5\frac{1}{4}$ inches, a micrometer with a 5 to 6-inch range would be required to measure the exact diameter. Similarly, with inside and depth micrometers, rods of suitable lengths must be fitted into the tool to reach the desired dimension within an inch, after which the exact measurement is read by turning the sleeve. The size of a micrometer is sometimes given as the size of the largest work it will measure and sometimes as its range.



MECHANICS OF MICROMETER

The micrometer actually records the endwise travel of a screw during a whole turn or any part of a turn. The micrometer screw has a pitch of 40 threads to the inch; in other words; if the screw is turned 40 times, it will move the spindle exactly 1 inch either toward or away from the anvil. A clockwise turn moves the spindle toward the anvil; a counterclockwise turn moves the spindle away from the anvil. Therefore, by simple arithmetic, it is plain that a single turn of the screw moves the spindle one-fortieth or twenty-five thousandths (0.025) of an inch. ($1.000 \text{ inch} \div 40 = 0.025 \text{ inch}$.)

READING MICROMETER

As explained above, if the sleeve of a micrometer is turned through one complete revolution, the micrometer opens or closes 0.025 inch. Hence, to change the opening 0.001 inch, the sleeve should be turned through only one twenty-fifth of a revolution. To divide the inch into 1,000 parts by using

(Micrometers)

T O O L S

the micrometer, therefore, the problem involved is to count the number of complete revolutions, plus any part of a revolution in twenty-fifths, that the sleeve makes to set the spindle and anvil exactly against the work being measured. For this purpose, the barrel and thimble of all micrometers are marked as shown in Figure 1. The revolution line on the barrel should be understood first. It is graduated in lines 0.025 inch apart so that each complete revolution of the sleeve moves the thimble exactly 0.025 inch along the barrel, or from one graduation to the next. Two complete revolutions move the thimble 0.050 inch, three revolutions 0.075 inch, and four revolutions 0.100 inch (1/10 inch). The numbers at every fourth graduation on the revolution line indicate, therefore, tenths of an inch. ($4 \times 0.025 \text{ inch} = 0.100 \text{ inch}$.) Assuming, for example, that the micrometer is closed and the screw is turned counterclockwise through 4 whole revolutions, the edge of the thimble would exactly coincide with the fourth graduation on the revolution line (marked 1) and the micrometer would be opened 1/10 inch. If the edge of the thimble coincided with the next graduation on the barrel, five revolutions would have been made, so the micrometer would be opened 0.125 inch (0.100 inch + 0.025 inch.) The graduations on the barrel are numbered from 0 to 10. The mechanic should become thoroughly familiar with them before considering the graduations on the thimble.

The graduations on the barrel of the micrometer, as explained above, divide the inch into parts of twenty-five thousandths each; the graduations on the thimble further divide it into single thousandths, by indicating each twenty-fifth of a revolution of the sleeve. It has been shown above that one twenty-fifth of a revolution opens or closes the micrometer 0.001 inch. When the micrometer is closed, the edge of the thimble will coincide with zero on the barrel, and **zero on the thimble will also coincide with the revolution line**. As the thimble is turned, each time a graduation on the thimble passes the revolution line on the barrel, the micrometer opens 0.001 inch.

With practice the mechanic can read a micrometer correctly at a glance; however, in learning to do so the following procedure is recommended: Using pencil and paper, find the largest number on the revolution line between zero and the edge of the thimble. Use the middle reading in Figure 1 as an example; this figure is 2. Write it as 0.200 inch. Then add to it the number of **unmarked** graduations between this figure and the edge of the thimble, which in the example being used is 1, or 0.025 inch. Set this down under 0.200 inch, already written. At this point, if the zero graduation on the thimble coincided with the revolution line, the reading would be complete, as follows:

0.200 inch
0.025 inch

0.225 inch, final reading

However, the zero graduation on the thimble and the revolution line do not coincide, so it is necessary that the number of graduations **between zero on the thimble and the revolution line** be added to the 0.225 inch reading. In this example, there is one such graduation. Write this as 0.001 inch, and the complete addition is as follows:

0.200 inch
0.025 inch
0.001 inch

0.226 inch, final reading

Therefore, in the example being used, the micrometer is open 0.226 inch. Using a similar procedure with the top reading in Figure 1, the result works out as follows:

0.300 inch (largest number on revolution line between zero and edge of thimble)
0.000 inch (number of unmarked graduations between this and edge of thimble)
0.004 inch (number of graduations on the thimble between zero and the revolution line)

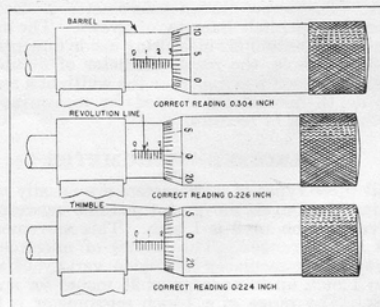
0.304 inch, correct final reading

Using the same procedure again with the bottom reading in Figure 1:

0.200 inch (largest number on revolution line between zero and edge of thimble)
0.000 inch (number of unmarked graduations between this and edge of thimble)
0.024 inch (number of graduations between zero on the thimble and the revolution line)

0.224 inch, correct final reading

It should be noticed particularly in this last example that the edge of the thimble **appears** to coincide with the 0.025 graduation on the barrel; but if this were true, the zero line on the thimble would coincide with the revolution line, which it does not do. In other words, unless the zero graduation on the thimble coincides with the revolution line, the third figure of the final reading **cannot be zero**.



NOMENCLATURE

TERMINOLOGY

For purposes of clarity and ready reference, the following terms are defined:

Acceleration

The average rate of change of an increasing velocity or speed, as feet per second per second. The opposite of deceleration.

Angular Velocity

The rate of angular motion, usually expressed in degrees, revolutions per second, or revolutions per minute (r.p.m.).

Automotive

Self-propelling; hence pertaining to vehicles or machines such as automobiles, motorcycles, airplanes, or motor boats.

Axial

In the direction of the axis.

Axis

A center line. A line about which something rotates or about which it is evenly arranged.

Bearing

A part in which a journal, pivot, or pin turns or revolves. A part on or in which another part slides.

Bevel Gear

One of a pair of meshing gears whose working or pitch surfaces are inclined to the center lines of the driving and driven shafts. The pitch surface is a portion of a cone.

Body

A mass or portion of matter distinct from other masses, as a moving body.

Bronze

An alloy consisting essentially of copper and tin.

Bushing

A detachable lining of bronze, babbitt or other anti-friction metal used as a bearing for a shaft, spindle, or pivot.

Centrifugal Force

The force acting on a rotating body which tends to throw it away from its center of rotation.

Compression

Act of pressing into a smaller space or reducing in size or volume by pressure.

Concentric

Having the same center, as circles or spheres, one within another. Opposed to eccentric.

Deceleration

The average rate of change of a decreasing velocity or speed, as feet per second per second. The opposite of acceleration.

Energy

Capacity for doing mechanical work, usually measured in foot-pounds.

Foot-Pound

The work done in lifting 1 pound 1 foot. A measurement of energy, work, or torque.

Force

The action that one body may exert upon another to change its motion or shape. Forces between bodies are always equal in amount and opposite in direction. Forces are measured in pounds.

Friction

The resistance to relative motion between two bodies in contact. If the bodies are in sliding contact, the resistance is called sliding friction; if they are in rolling contact, it is called rolling friction.

Fulcrum

The support, as a wedge-shaped piece or a hinge, about which a lever turns.

Gear Ratio

The ratio at which gears can transmit speed or torque. When speed is increased, torque is decreased, and vice versa. For example, a 60-tooth gear driving a 12-tooth gear gives a ratio of 1 to 5, which means that the driven gear revolves five times as fast as the driving gear, increasing speed and reducing torque. On the other hand, a 12-tooth gear driving a 60-tooth gear gives a ratio of 5 to 1, which means that the driven gear revolves five times as slowly as the driving gear, increasing torque and decreasing speed.

Heat

A form of energy.

Helical

In the shape of a helix, which is the shape of a screw thread or coil spring.

Herringbone Gear

A gear with double helical teeth inclined in opposite directions from the center of the face.

Horsepower

A unit for measuring power, which is 550 foot-pounds per second or 33,000 foot-pounds per minute.

NOMENCLATURE

Idler Gear

A gear placed between a driving and driven gear to make them rotate in the same direction. It does not affect the gear ratio.

Integral

Part of the same piece. An integral part as distinguished from a separate part that is fastened on.

Jack Shaft

An intermediate driving shaft.

Member

Any essential part of a machine or structure.

Meshing

The mating or engaging of the teeth of two gears.

Pilot

A short plug at the end of a shaft to align it with another shaft or rotating part.

Pinion

The smaller of two mating or meshing gears.

Poppet

A spring loaded ball engaging a notch. A ball latch.

Power

The capacity to do work or the rate at which it is done. It is measured in horsepower.

Radial

Originating from or acting upon a common center, as the spokes in a wheel.

Ratio

The numerical relation between two things expressed as the division of one quantity by the other. Thus the ratio of 48 to 12 is represented by 48/12 or 48:12, or 4 to 1, as in gear ratio.

Reaction

An opposing force.

Rotating

Turning or revolving.

Shackle

A swinging support for the end of a spring that permits it to vary in length as it deflects.

Solenoid

A coil of wire that has magnetic properties when an electric current is passed through it.

Spider

A part consisting of a ring or solid center with projections outward used to space and align adjoining parts.

Spiral Bevel Gear

A bevel gear having curved teeth.

Spline

A series of parallel keys integral with a shaft, mating with corresponding grooves cut in a hub or fitting.

Spur Gear

A gear having straight teeth.

Strain

A deformation or change of shape resulting from stress.

Stress

The forces exerted on, within, or by a body during tension or compression. The opposing reaction of the interior elements of a solid body against forces tending to deform it.

Synchronize

To make two or more events or operations occur at the proper time with respect to each other.

Tension

A stress caused by pulling.

Thrust

A force tending to push a body out of alignment. A force exerted endwise through a member upon another member.

Torque

A twisting or wrenching effort. Torque is the product of force multiplied by the radial distance from the center of rotation to the point at which it is applied. It is usually measured in foot-pounds.

Torsion

The act of twisting or the state of being twisted. The deformation of a body caused by twisting.

Trunnion

Either of two opposite pivots or cylindrical projections from the sides of a part or assembly, supported by bearings, to provide a means of swiveling or turning the part or assembly.

Velocity

The rate of motion or speed at any instant. Usually measured in miles per hour or feet per second or minute.

Vibrate

To move back and forth unceasingly over the same path; generally said of the rapid succession of motions of the parts of an elastic body.

Work

The energy expended to overcome resistance.

Worm

A short revolving screw, the threads of which mesh with the teeth of a worm gear.

Worm Gear

A gear having concave, helical teeth that mesh with the threads of a worm. Also called a worm wheel.