PHOENIX 480™

F 480 Workshop Manual

PUBLISHED IN 1972 BY

PACIFIC BASIN TRADING COMPANY

International Representative for F 480 Engines

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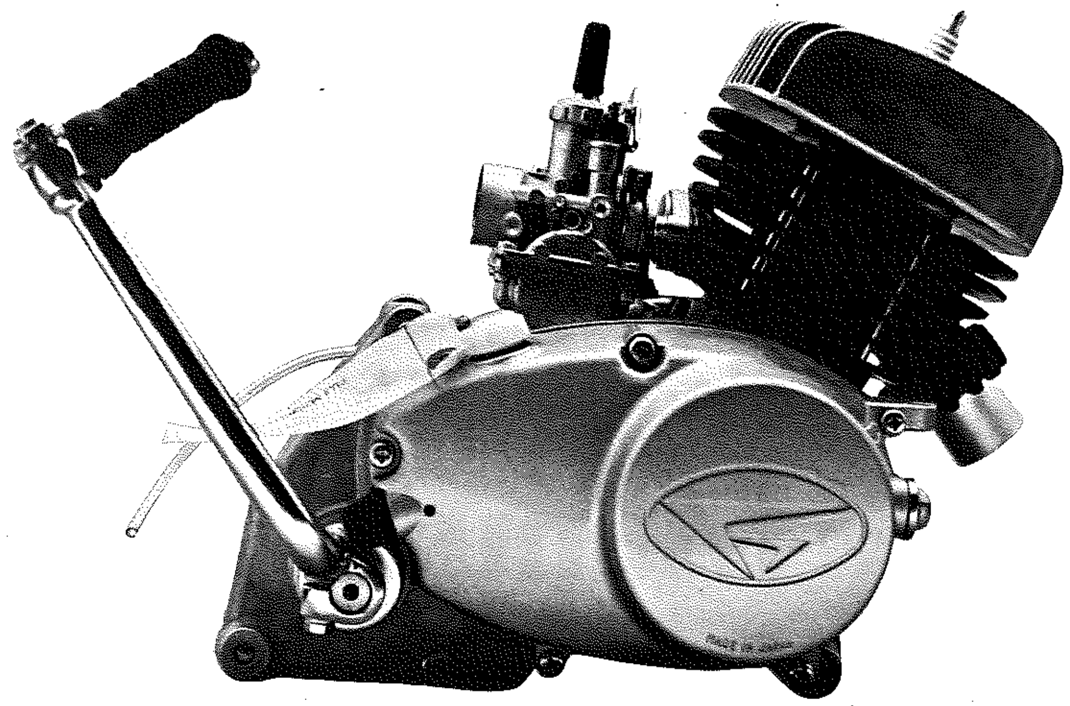

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INTRODUCTION

Pacific Basin Trading Company brings an entirely new concept to the minibike/compact motorcycle industry–the F 480 engine. New because it's the first engine/gearbox assembly designed especially for "midi" sized cycles–from power band to gear ratios, rugged dependability to ease of maintenance.

Its heritage is linked to the American know-how of Pacific Basin Trading Company, the technology of Hodaka Industrial Company, and the manufacturing genius of Fuji Motors Corporation, all of whom have made landmark efforts in the air-cooled engine industry.

The F 480 engine is simplicity personified, requiring but a minimum of special tools and man hours to complete normal repairs. To assist the owner or mechanic with such work, Pabatco has compiled this *Workshop Manual.* A thorough study of this text prior to beginning work will effect a considerable savings in time and, possibly, money. We dedicate this manual to keeping your F 480 performance at factory-new standards.

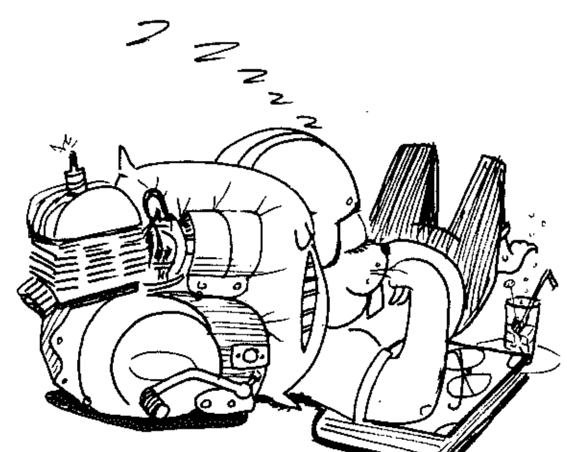
FOREWORD

This *Workshop Manual* is but one of a continuing series of manufacturer-to-consumer information media. Its use allows the reader to extract maximum utility—at minimum cost—from the F 480 series engine(s). It is both accurate and informative, an ideal text for simple maintenance and/or major repairs.

That minibike and compact motorcycle owners cherish their machines is a demonstrable fact; therefore, to those who use this *Manual,* I can recommend it to them as a useful reference volume which will help keep their engines in trim for many, many carefree hours.

E. C. Miley

President, Pacific Basin Trading Company



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Chapter I

Two Strokes: Basic Principles

For those individuals who are making their first acquaintance with a two-stroke engine through the ownership or repair of an F 480 engine, it will be beneficial to understand the basic principles of operation. For, in spite of the simplicity of only three moving parts, this engine employs a rather complicated formula in doing its work.

To begin with, let us consider the main essentials of a single cylinder engine. There is a piston which slides up and down a cylinder, a crankshaft, a connecting rod "connecting" piston to crankshaft, and a crankcase to support the cylinder and crankshaft. Referring to Fig. 1, imagine that combustion is pushing the piston down the cylinder, and you will see how up-and-down motion is converted to rotary motion. A second look at Fig. 1 shows that for each revolution of the crankshaft, the piston will make one stroke up and one stroke down the cylinder. Thus, for each crankshaft revolution there are two piston strokes with combustion occurring each time the piston reaches the top of the cylinder. Considering the foregoing, it is not hard to see why this type of engine received its name "two stroke."

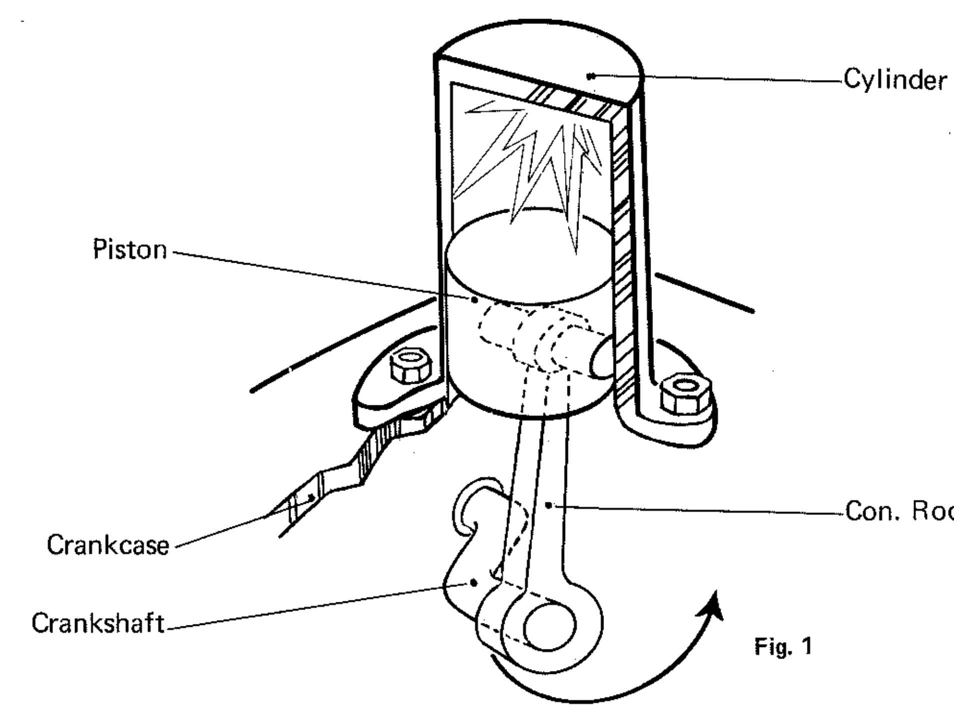
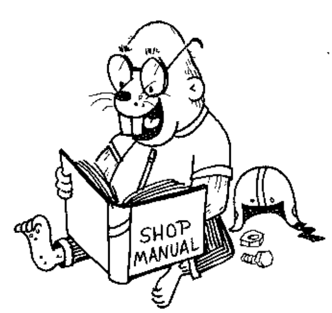


Fig. 1

Now that we have the main essentials in mind, let us see how the engine works. First, there is the question of how the engine manages to keep going during the strokes when no charge is burned. Consider this fact. If you lift a wheel clear of the ground and give it a spin, it will continue to spin until the energy of the spin is used up by wheel bearing friction. Now, if we attach a (fly) wheel to the engine crankshaft, the firing stroke will set the crankshaft spinning with enough energy to carry it until the next firing stroke. This is, of course, the method used in practice.

Next, let us examine the method by which the engine fuels itself, usually referred to as "breathing." The two-stroke system uses the piston as a sliding valve, opening and closing holes or "ports" cut into the cylinder wall. The F 480 engine uses four ports: an exhaust port through which burned gases pass out of the cylinder, the inlet port which connects carburetor to crankcase and the transfer ports, located at the upper ends of passages connecting cylinder to crankcase. Notice (Figs. 2 & 3) that the inlet port opening and closing is controlled by the bottom edge or "skirt" of the piston while transfer and exhaust ports are controlled by the top edge of the piston.

Referring now to Fig. 2, notice that we begin our explanation of the operating cycle with the piston at the bottom dead center position (B.D.C.). As the piston rises in the cylinder, numerous things take place: the top side of the piston seals off, first, the transfer ports, then the exhaust port, compressing fuel/air mixture into the cylinder head cavity above it, while at the same time the piston skirt uncovers the inlet port and a fresh charge of fuel/air mix is drawn into the crankcase. As the piston reaches the top of its stroke, the compressed mixture in the head cavity is ignited by means of an electrical spark. (Fig. 3) The expanding gases from the combustion process push the piston down the cylinder until the exhaust port is uncovered and at this point the burned gases escape through the exhaust system. The continued downward travel of the piston uncovers the transfer ports, allowing the mixture that was drawn into the crankcase to be pumped (transferred) into the cylinder (pumping action is a result of the inlet port's being sealed off by the piston skirt—causing a pressure rise in the crankcase as the piston descends.) The piston then begins to rise again to start another cycle of operation.



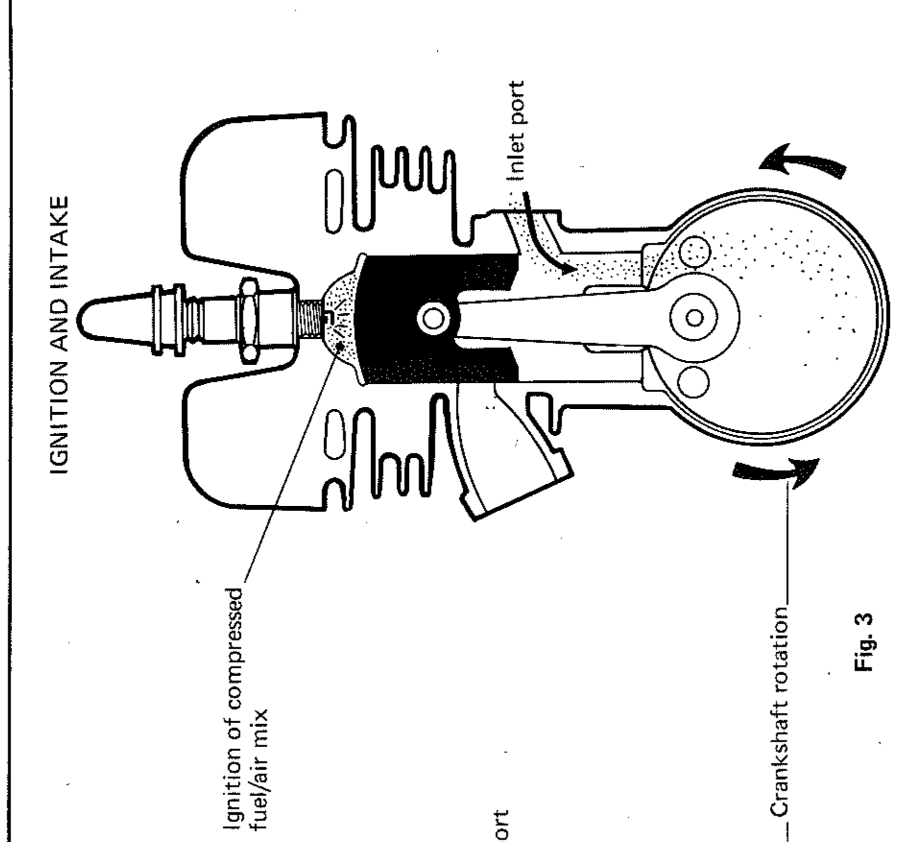


Fig. 3

The piston has reached top dead center (T.D.C.) and ignition is taking place. Note the inlet port below the piston; arrow shows path of incoming fuel/air mix from carburetor.

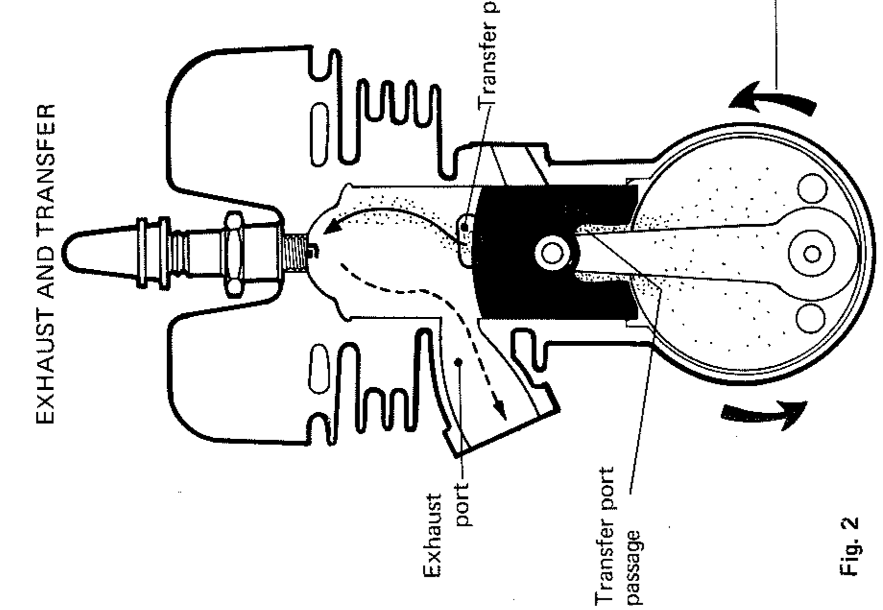


Fig. 2

Cutaway drawing of the F 480 two-stroke engine. Solid arrow depicts path taken by incoming fuel/air mixture. Dotted line arrow indicates exhaust exit path. As this is a sectional drawing, only one transfer port is shown.

Chapter II

Clutch

The F 480 clutch is a cable and lever operated, crankshaft mounted, spring tensioned, multiplate unit. It performs not only the function of (dis) connecting the power source (from) the gear train but counterbalances the opposite side-mounted magneto flywheel as well. The clutch unit is designed to operate in the gear case oil supply, which is common to both the primary drive and transmission gears.

Pulling the handlebar lever towards the handlebar causes the clutch lever to rotate in the clutch side cover. Referring to Fig. 4, note that as the cam-ended clutch lever turns, it pushes the clutch pressure piece (B), clutch release bearing (C), and clutch housing (D), towards the engine. This action compresses the clutch springs (E), and relieves tension from the friction discs (F), allowing clutch hub (G) to rotate free from the pinion gear (H).

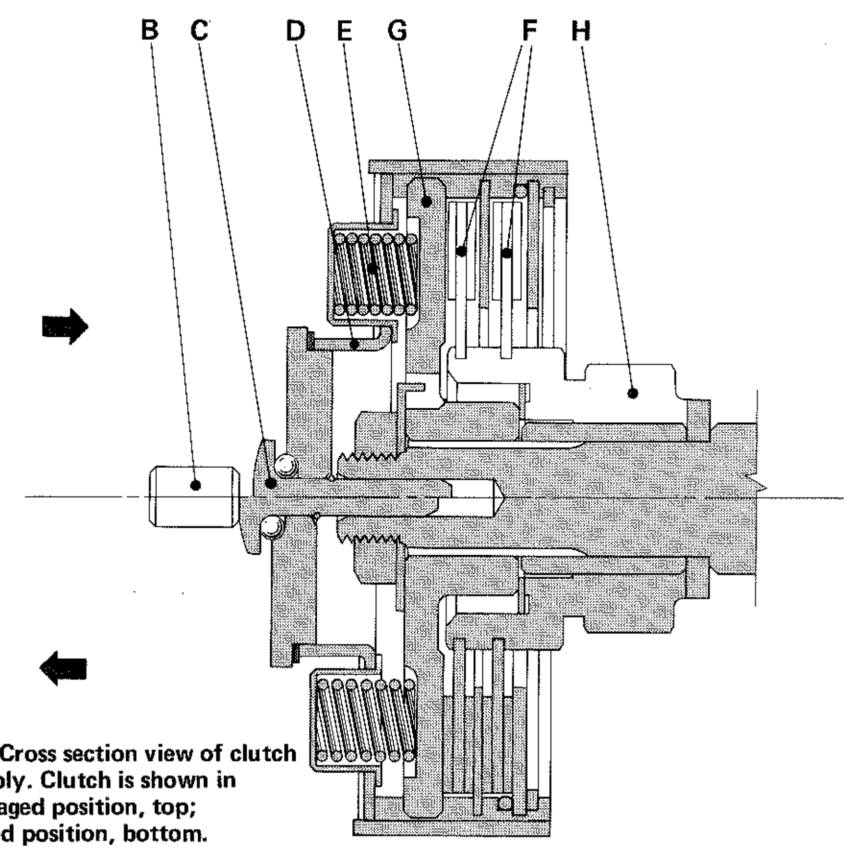


Fig. 4 Cross section view of clutch assembly. Clutch is shown in disengaged position, top; engaged position, bottom.

1. Clutch Cable Adjustment

In most instances, there will be two adjuster screws provided for clutch cable adjustment: one at the handlebar lever and one on the clutch side cover. To adjust cable slack using the handlebar lever adjuster (where provided), simply back off the lock nut and turn the adjuster screw (Fig. 5). Turns made in a *counterclockwise* direction take up slack in the cable. Adjusting cable slack by using adjuster screw on the clutch side cover (Fig. 6) is the same procedure, except that an end wrench is necessary to back off the 10mm lock nut. Correct adjustment calls for ¼" of "play" measured at the tip of handlebar lever.

Cautions:

Insufficient cable slack will cause clutch slip, engine overheating, loss of power, speed, and worn clutch components. Too much slack will not allow the clutch mechanism to release fully.

Secure adjuster screw lock nuts firmly after adjusting cable slack.

Examine inner cable for frayed or broken strands—replace cable if any are found.

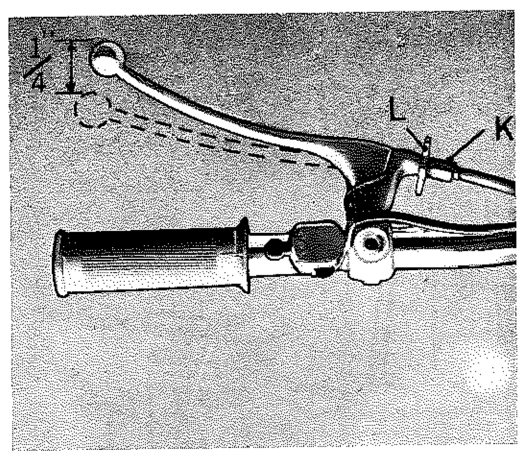


Fig. 5 Permissible lever freeplay shown by dotted line. Note adjuster screw (K) and lock nut (L) on handlebar lever.

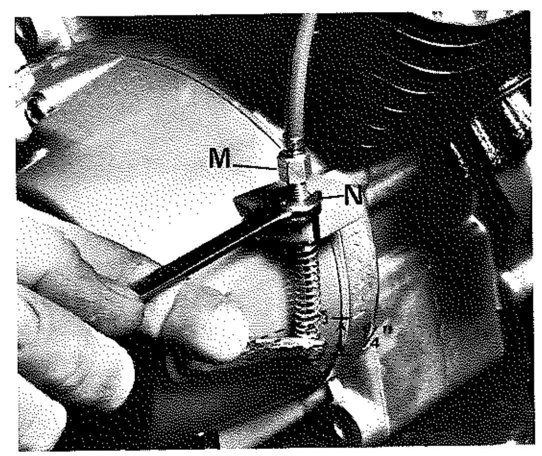


Fig. 6 Clutch cable and lever details. Dotted line indicates permissible lever free play. Note adjuster (M) and lock nut (N).

2. Clutch Lever Adjustment

It may become necessary to adjust clutch lever travel if: 1) Distance between top of clutch lever claw and underside of clutch adjuster boss on clutch side cover is less than one inch [with free play taken up]. 2) Distance between clutch lever claw and adjuster screw boss exceeds 1¼" [with free play taken up]. To adjust clutch lever free play, begin by tying down kickstarter lever in some fashion to prevent its returning to the rest position. Next remove cable assembly by slacking off lower adjusting screw, lifting clutch lever slightly, slipping ball-ended inner cable free of lever claw and finally unscrewing adjuster from casting. Drain transmission, using 13mm socket to remove drain plug on the lower right side of engine case (Fig. 8). Using a large Phillips bit in hammer driver tool, remove the five Phillips head clutch side cover mounting screws. If the side cover fails to come away easily, tap around its outside edges with a soft mallet. After removing side cover (Fig. 9), be sure to recover the clutch pressure piece (Fig. 4 item "B") setting it safely aside until reassembly. Finally, lift off clutch disc and disc spacers from clutch cover (Fig. 10).

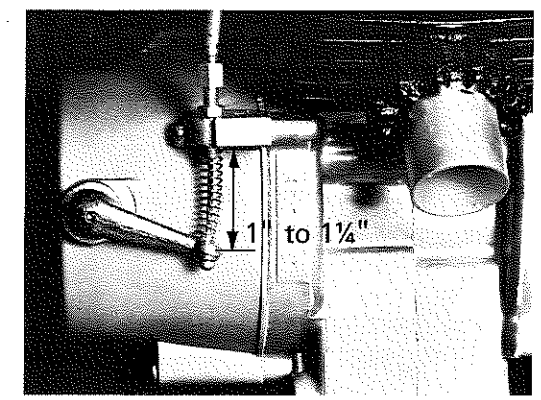


Fig. 7 Arrows indicate correct distance from top of clutch lever claw to underside of the adjusting boss.

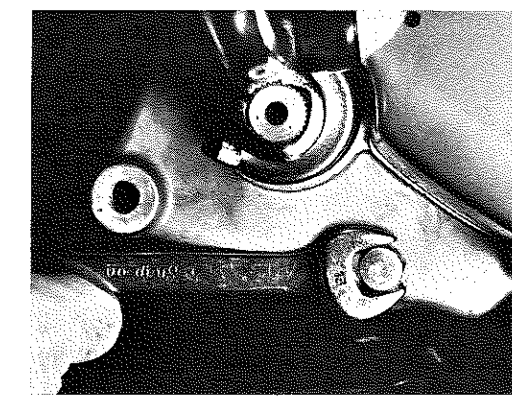


Fig. 8 Transmission drain plug location.

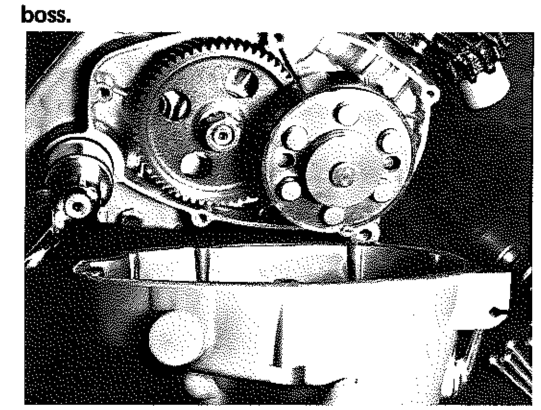


Fig. 9 Removing clutch side cover.

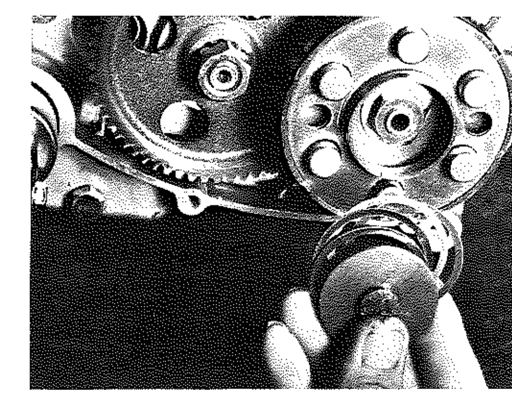


Fig. 10 Removing clutch disc and spacers.

Lever freeplay is *decreased* by adding more or thicker spacers or *increased* by removing or replacing with thinner ones. Spacers are available in .2mm, .3mm and .5mm for this purpose. Checking lever travel after spacing calls for reversing disassembly process, checking for 1" minimum, 1¼" maximum as per Fig. 7. Leave cable assembly disconnected until lever adjustment is correct.

Cautions:

Clean clutch side cover with solvent and stiff brush, dry with air blast or clean cloth and lubricate pressure piece chamber with a smear of chassis grease to help hold pressure piece in place during reassembly.

Remove old side cover gasket from cases; clean mating edges with lacquer thinner. Apply thin coat of gasket sealer to side cover gasket surface and position *new* gasket on cover prior to reassembly.

Lever play adjustment test must be carried out with side cover, pressure piece, disc and cover gasket in place.

If side cover is stubborn to remove—keep tapping gently with soft mallet—never pry off with a tool such as a screwdriver as this will ruin gasket mating surface.

Avoid overtightening mounting screws when replacing side cover—otherwise the gasket will be extruded out between the cases resulting in poor seal and loss of lubricant.

Replace gear case oil only after correct free play of the clutch lever has been obtained as it may take several tries to arrive at proper settings.

3. Lubrication

A. Clutch Cable Assembly

The clutch cable assembly is best lubricated by removing it from the handlebar lever. Apply tip of oil can to the inner cable while working cable housing up and down, to distribute lubricant through housing. Use SAE 30 oil or one of the popular "chain and cable" oils for this service.

Recommended mileage between service — 1,000 miles

B. Clutch Assembly

The clutch assembly and clutch lever are automatically oiled from the transmission (gear case) oil supply. Because the friction discs run in an oil bath it is necessary to

use only recommended types of oil. Special oil additives, "slick" oils, detergent oils, and the like often cause the friction discs to slip. If the machine is new—drain and replace original transmission oil due to the fact this lubricant is primarily for shipping purposes.

Recommended oil for transmission (gear case)	**(above 32°F.) SAE 30 W—Service MM** **(below 32°F.) SAE 20 W—Service MM**

Recommended mileage between oil change — 1,000 miles or every 20 hours

4. Clutch Service

A. Removing Clutch Assembly

Begin by removing clutch side cover and clutch disc (described in item #2 *Clutch Lever Adjustment).* Next, bend lock tab away from crankshaft nut, insert holding tool (#909523) into clutch cover (Fig. 11) and back off 19mm (od) crankshaft nut in a *clockwise* direction. Pull clutch assembly free of crankshaft splines. Pinion gear and bushing should come away with clutch assembly—if not, slip them off also. Finally remove heavy thrust washer from crankshaft.

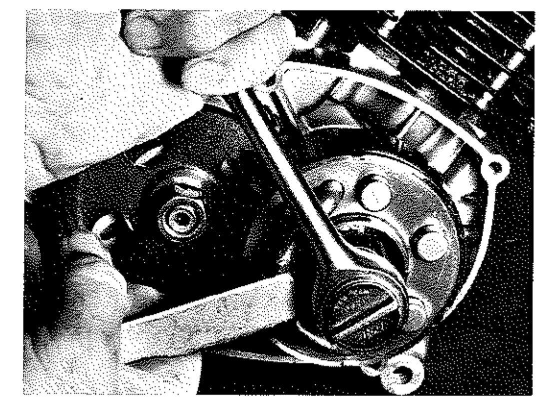


Fig. 11 Clutch holding tool in position.

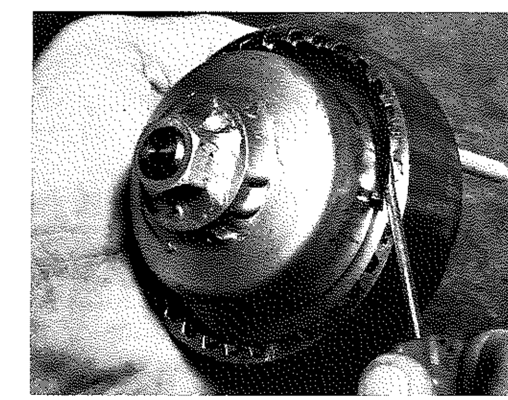


Fig. 12 Removing clutch snap rings with clutch compressor tool.

B. Removing Clutch Lever from Side Cover

The clutch lever is secured in the side cover by means of a tapered brass rivet. To remove the lever it is necessary to drill out the rivet.

Assuming the clutch side cover is free of the engine assembly and the pressure piece (Fig. 17 item 'b') has been laid aside—begin by center punching the rivet head exactly on center. Using a #40 drill bit (.098") drill *straight* through rivet to a depth of ½" then remove remnants of rivet with a pick. Lever is now free and can be withdrawn with the fingers. Finally, remove "O" ring seal from groove in the lever.

C. Disassembling Clutch Assembly

Remove clutch pinion bushing from inside pinion gear but leave pinion gear meshed in clutch hub. Insert clutch compressor tool pilot shaft down through pinion gear and clutch hub. Tighten compressor tool backing plate (Fig. 12) onto outer (cover) end of pilot shaft. Install cup-shaped compressor tool pressure piece onto inner (engine) side of pilot shaft.

Tighten pressure piece against clutch plate until tension against snap ring is relieved. Using a suitable pick, slip the snap ring from its groove in the clutch housing. Remove pressure piece and shake out the outer steel plate and friction disc. Repeat the process to remove the second snap ring securing the second set of clutch plates. Complete disassembly by removing compressor tool, pushing clutch hub, springs and spring caps out through open end of clutch housing.

Caution: **Do not overtighten compressor tool pressure piece against clutch plate–use only enough pressure to relieve plate tension against snap ring.**

D. Cleaning and Inspecting Clutch Components

Clean all parts with solvent and stiff brush, dry with air blast or clean cloth. Remove any traces of gasket material and/or sealer adhering to engine case or clutch side cover. Use razor scraper and cloth saturated with lacquer thinner for this job, being careful not to gouge gasket surfaces.

On a clean cloth, lay out clutch assembly as per Fig. 13. Beginning with the clutch housing, inspect the internal gear teeth for roughness. If steel clutch plates have indented clutch housing teeth more than .010", or if housing is warped, replace with new part. If indented wear is less than .010", use fine cutting file to polish smooth. In similar fashion, check indented wear on pinion gear teeth where friction discs ride.

Use a micrometer to measure friction disc thickness. Friction discs measure 0.157" (4mm) when new, require replacement when worn to 0.142" (3.6mm) or less. If friction material appears blackened or charred, discard and install new discs. The steel clutch plates should be checked on a flat piece of heavy plate glass. Lightly

holding the friction surface down against the glass, attempt to slide a 0.002" feeler gauge between the underside of the plate and the glass. Try this at several points around the circumference of the plate. If the feeler gauge can be slipped underneath the plate at one or more points, replace the plate. If the friction surface is cracked or scored, replace the plate. Next, inspect clutch hub for scored friction surface or worn splines in hub center—replace as necessary. Measure free length of clutch springs with vernier caliper. Standard free length of spring is 0.79" (20mm). Replace springs as a set if not up to standard.

Check condition of crankshaft nut and washer. If lock washer has been bent over several times, replace. Discard nut for new one if threads or shoulders appear damaged. Rotate center piece of clutch disc assembly. If bearing runs rough or ball bearings have escaped, install new part.

Examine clutch pinion bushing for wear by installing on crankshaft and slipping pinion gear over bushing, rocking gear in an up-and-down motion with the fingers. Total movement should not exceed approx. 0.003", otherwise replacement is necessary. If bushing shows signs of swelling due to overtightened nut on crankshaft, replace. Examine pinion gear teeth for wear; replace if teeth show signs of indentation *Note! If pinion gear requires replacement, then primary gear on transmission mainshaft must be replaced at the same time, if noisy gear operation is to be avoided.* Finally, examine pinion gear teeth for fractures or chipped teeth; replace as necessary.

Moving on to the clutch side cover, the only inspection necessary for worn parts will be the fit of the clutch lever in the side cover. Look for elongated or "egg" shaped wear pattern in the side cover lever chamber. If total up-and-down movement exceeds 0.010", replace side cover and lever. As a matter of course, replace the lever "O" ring seal if lever has been removed from side cover. Examine side cover for fractures, holes or damaged gasket surface; replace as necessary.

E. Reassembling Clutch Assembly

Hold clutch housing–backing plate side down–and install the six spring caps. Set clutch springs into spring caps and insert clutch hub–flat side down–into clutch housing. Position pinion gear (rotor splines down with thin thrust washer between rotor and hub) atop clutch hub spline boss. Install friction disc over pinion gear and mesh with rotor teeth, follow with a steel clutch plate. Insert compressor tool pilot shaft *down through* pinion gear and hub. Tighten compressor tool backing plate against clutch housing and run down cup-shaped pressure piece against steel clutch plate. Tighten pressure piece only far enough to push steel plate clear of second (inside) snap ring groove. Install the round section (wire type) snap ring in its groove, making sure the ring is fully seated. Remove compressor tool pressure piece and repeat process for second set of clutch plates. Finish the assembly by installing the outer "square section" snap ring, then disassemble and remove compressor tool.

F. Reassembling Side Cover Assembly

Install new "O" ring in groove nearest claw end of clutch lever. Lubricate lever with a thin smear of chassis grease and insert into side cover chamber. Peg brass rivet down with flat ended punch while holding lever fully home in side cover. Finally, lubricate pressure piece chamber with smear of chassis grease and insert pressure piece.

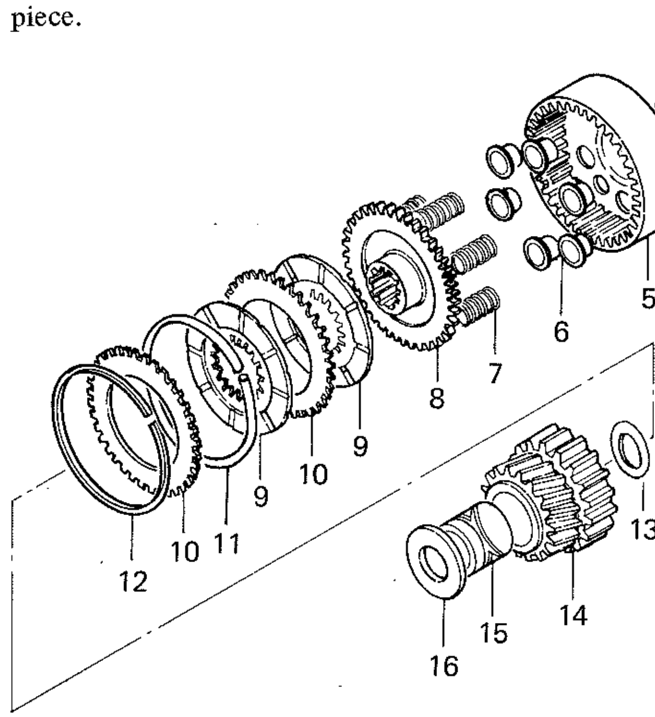


Fig. 13 Clutch Assembly

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Fig. No.	Part Name
1	Clutch release bearing
2	Shim(s)
3	Nut
4	Washer
5	Clutch housing
6	Spring caps
7	Clutch springs
8	Clutch hub
9	Friction disc
10	Clutch plate (steel)
11	Snap ring (round section)
12	Snap ring (square section)
13	Thrust washer
14	Pinion gear
15	Pinion gear bushing
16	Pinion gear thrust washer

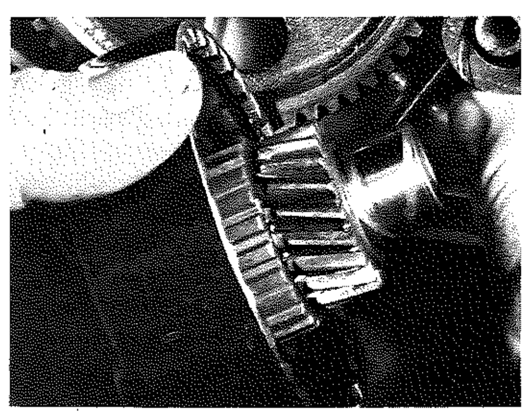


Fig. 14 Pinion bushing position. Note open ends of oil grooves face engine case.

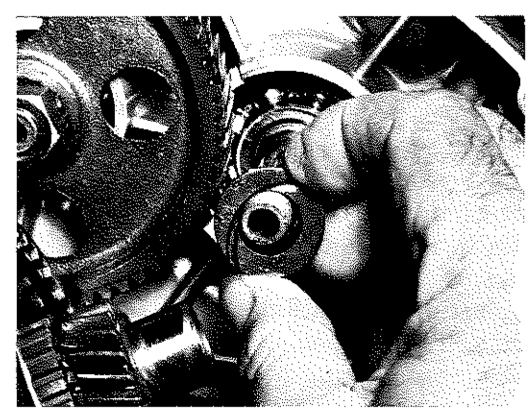
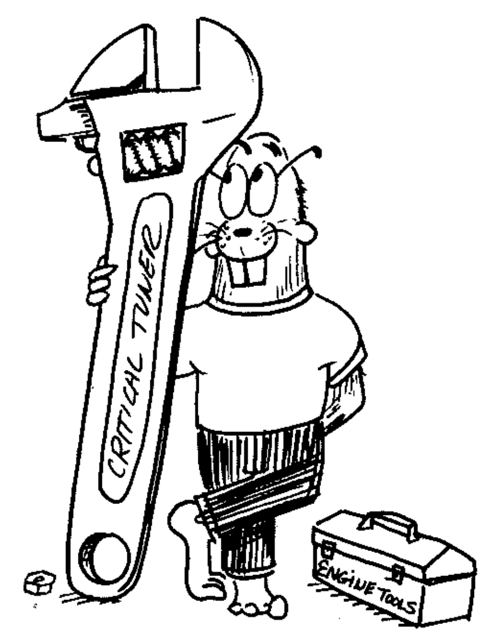


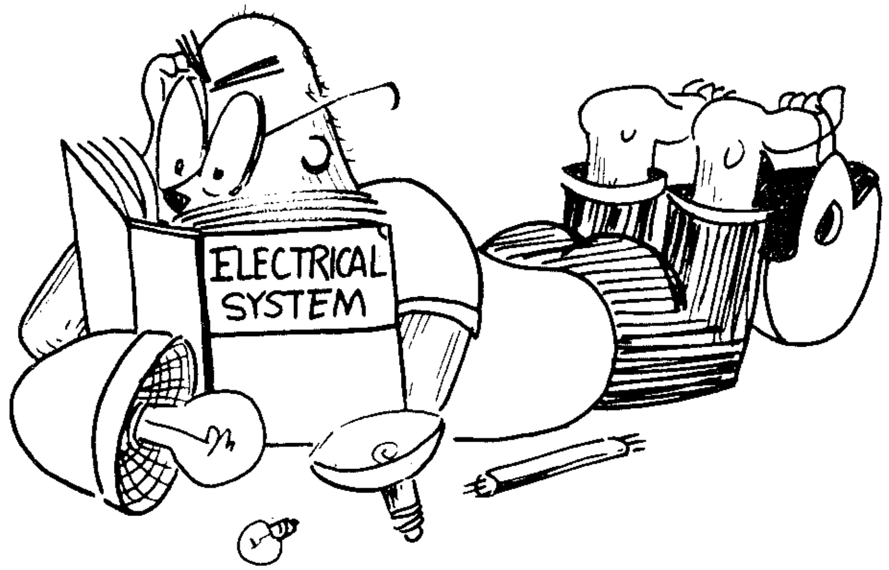
Fig. 15 Pinion bushing thrust washer must be positioned grooved side outwards.

G. Remounting Clutch and Side Cover Assemblies

Slide pinion gear thrust washer–*grooved side outwards*–over crankshaft. Check pinion gear bushing to determine that *open ends* of oil groove face the engine side of the pinion gear. (Fig. 14) Slip clutch assembly (complete with pinion gear and bushing) onto crankshaft, being careful to mate hub splines with those of crankshaft. Install lock washer onto crankshaft, locating square tab into blind hole in clutch hub. Run down the 19mm (od) crankshaft nut in *counterclockwise* direction. Tighten nut with torque wrench to 250 inch lbs. (2.9 kg.m.) *Note! Overtightening crankshaft nut will cause pinion bushing to swell and seize.* Fold lock washer over one flat of nut with the aid of a sharp screwdriver. Use care not to damage clutch disc seat on clutch housing when bending lockwasher.

Install clutch disc, spacers and side cover and adjust lever free play as per instructions given in *#2 Clutch Lever Adjustment.*

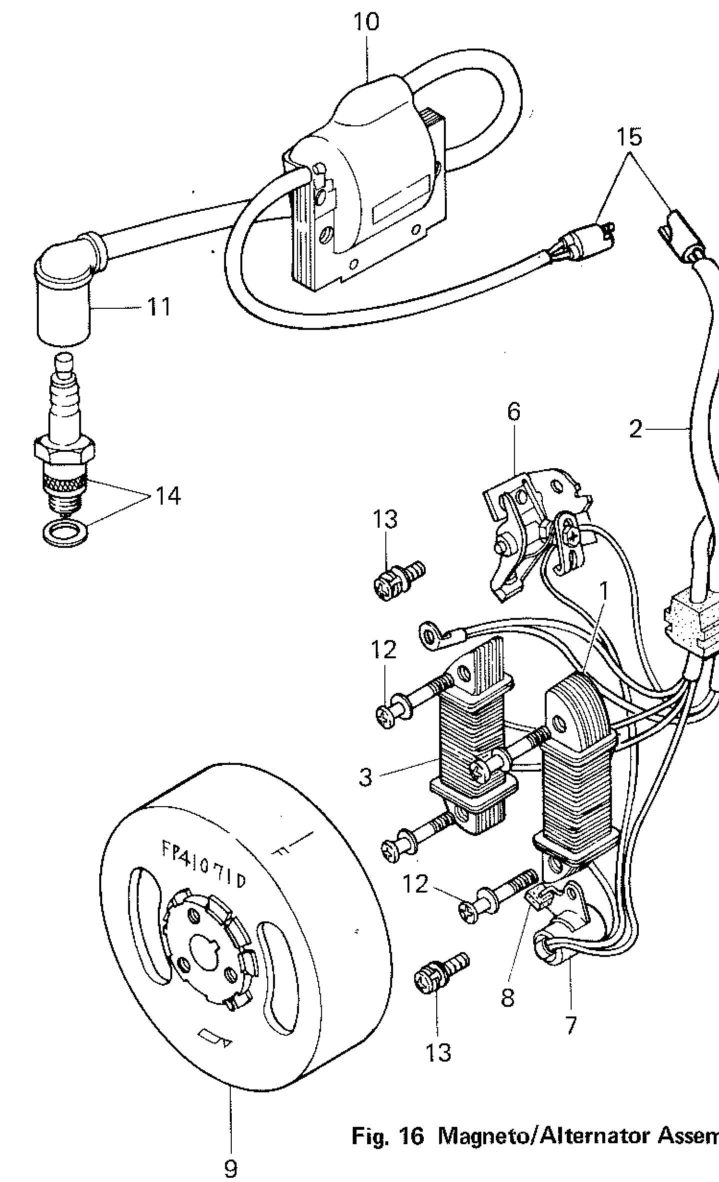




Chapter III

Magneto/Alternator Assembly

The F 480 magneto/alternator assembly comprises a dual electrical system (Fig. 16). One-half of the system incorporates the lighting coil; the other half, the condenser, breaker points and primary exciting coil. Both systems are mounted to the left side engine case. A steel flywheel containing permanent magnets and



Index to Fig. 16

Fig. No.	Part Name
1	Primary exciting coil
2	Primary cord
3	Lighting coil
4	Lighting coil wire
5	Grommet
6	Breaker points
7	Condenser
8	Felt pad
9	Flywheel
10	Ignition coil
11	Plug cap
12	Screw
13	Screw
14	Spark plug
15	Molex connector

Fig. 16 Magneto/Alternator Assembly

mounted on the left end of the crankshaft surrounds the ignition and lighting components. An externally mounted ignition coil completes the ignition circuit.

The lighting coil consists of a winding of copper wire over a laminated iron core. One end of the winding is grounded to the engine case, the other end is divided into two power taps. In operation, the rotating flywheel (containing the magnets) passes over the coil core ends continuously. As the magnets come into and pass out of register with the core ends, a reversal of the magnetic lines of force causes low voltage current to be generated in the lighting coil winding. Depending upon the lighting system employed, the generated current may be used to directly power the lights or a portion may be routed through a selenium rectifier to charge the battery with the balance going to the lights.

The primary exciting coil consists of a winding of copper wire over a laminated iron core. One end of the wiring grounds to the engine case, the other end terminates in the wiring juncture atop the condenser. The external ignition coil consists of a primary (low tension) and a secondary (high tension) winding over an iron core. Ignition coil windings are protected by a heavy coat of HT Epoxy. Both primary and secondary windings of the ignition coil ground to the coil's core and, via a blue lead, to the engine case. The open end of the ignition coil primary winding connects (via a black lead) to the insulated wiring juncture atop the condenser. From the condenser, a short black lead connects to the insulated side of the breaker points. The open end of the ignition coil secondary winding terminates in the high tension lead to the spark plug (See Fig. 16 for schematic illustration).

Low voltage current is generated in the primary exciting coil windings by the action of the flywheel magnets passing in and out of register with the coil's core ends. The generated current flows through the wiring harness to ground via the ignition coil's primary winding and contact breaker points. When the breaker points are opened by the crankshaft breaker cam, voltage drop in the primary winding of the ignition coil *induces* a high voltage discharge from the secondary winding. This induced current passes to the spark plug electrodes via the high tension lead.

The condenser acts as a buffer to absorb primary winding current at the instant the breaker points open, preventing an arclike spark from burning away the points. The charge stored in the condenser is released as the points close, thus helping reestablish current flow in the primary system.

From the foregoing, it may be seen that the instant of breaker point opening determines the ignition firing point. Ignition firing or "timing" point is usually expressed in so many degrees of crankshaft rotation (or thousandths of an inch) piston travel before top dead center of stroke.

1. Adjusting Breaker Points (Timing Engine)

A. Magneto Cover Removal.

Using a small Phillips bit screwdriver, remove shifter cover screws, dropping cover away. Use large Phillips bit in hammer driver tool to remove the four magneto cover mounting screws. Looking through the shifter cover opening, tilt the magneto cover in such a manner as to disengage shifter sliding pin (Fig. 17) from control shaft, then lift cover free.

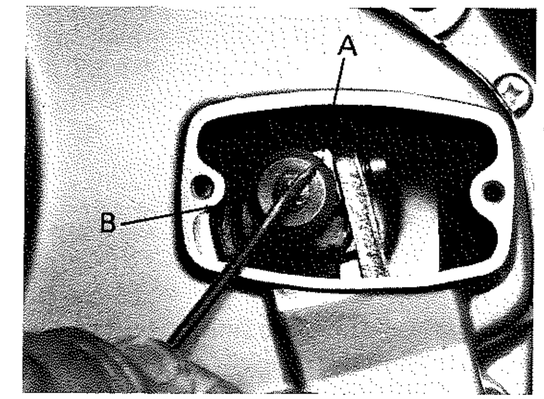


Fig. 17 View showing shifter sliding pin (A) engagement with control shaft spool (B).

Fig. 18a Engine timing marks (TDC position shown).

B. Timing the Engine by Gap Setting Method

With magneto cover free of engine, begin by rotating flywheel until F/T mark aligns with *left*-hand mark on engine case (Fig. 18). Insert flat bladed screwdriver through topmost inspection window of flywheel face, back off contact breaker setting screw, and use screwdriver blade (inserted into adjusting notch of breaker points) to adjust gap setting wider or closer as needed. Measure point gap with feeler gauge to attain a 0.012" (0.3mm) to 0.015" (0.4mm) setting, *with setting screw secured.*

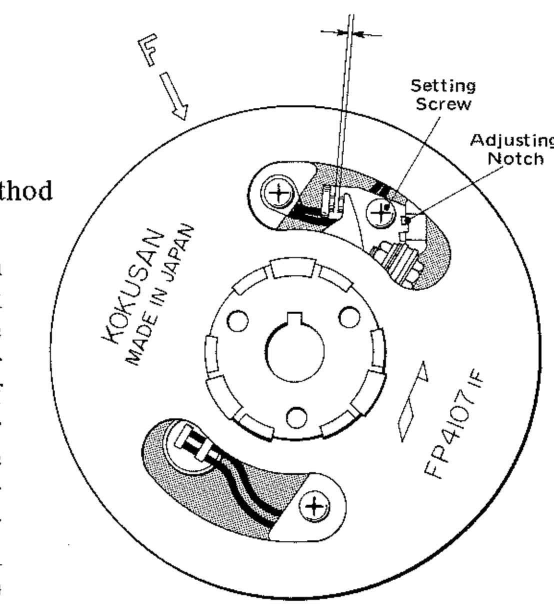


Fig. 18b Breaker Gap Setting.

C. Alternative Timing Methods

1) For average service, the engine timing marks are quite accurate (Fig. 18). To set timing using timing marks for reference, begin by disconnecting primary cord wires at Molex plug juncture near ignition coil. Disconnect black lead from lighting cord harness at "kill" button or ignition switch juncture. Shield lead to prevent accidental grounding against engine or frame. Clip one lead from continuity light or ohm meter to black wire prong on primary cord Molex plug and other lead to engine for ground. Rotating the flywheel counterclockwise, observe the point at which light dims or meter indicator needle shows points to be opening. Adjust point gap setting so that when F mark aligns with *right*-hand crankcase mark the points just open. When F mark is aligned with right-hand crankcase mark, piston will be at 25° before top dead center (BTDC). Aligning the F mark with the left-hand crankcase mark positions the piston at top dead center (TDC).

2) For those mechanics using the degree wheel method of engine timing, set breaker points to open at 25° BTDC. If extremely accurate timing is desired, set point break at 25° 10'.

3) For those mechanics using the dial indicator method, set point opening at 0.102" (2.6mm) BTDC.

Special Note! If ohm meter is used to determine point opening, it must be sensitive enough to read down to 0.5 ohm, otherwise it will be necessary to disconnect and insulate ignition coil ground wire to obtain an accurate reading.

Cautions:

Before setting point gap, always clean points with point stone, finishing the job by drawing a clean strip of heavy paper through the points.

Use care not to damage point spring while adjusting point gap. Use a proper sized screwdriver bit on contact breaker setting screw.

Clean new breaker points with alcohol or acetone to remove polishing wax on contact surfaces.

2. Lubrication

The magneto/alternator assembly has only one lubrication point, this being the felt pad (Fig. 16) supplying the crankshaft breaker cam with a film of oil. To service, remove flywheel from engine (flywheel removal described in Section 4, Par. A) and clean magneto components with air blast. Wipe crankshaft cam surface with clean cloth and smear a *thin* film of SAE 10W oil on cam. Apply 2 to 4 drops of 10W oil to felt pad and reassemble flywheel onto crankshaft (flywheel remounting covered in Section 4, Par. G).

Recommended mileage between service — 1,000 miles

Cautions:

Do not overlubricate felt pad; excessive oil will foul contact breaker points.

Clean felt pad in solvent and squeeze dry before oiling.

If felt pad is worn so that it no longer contacts cam surface, replace with new felt.

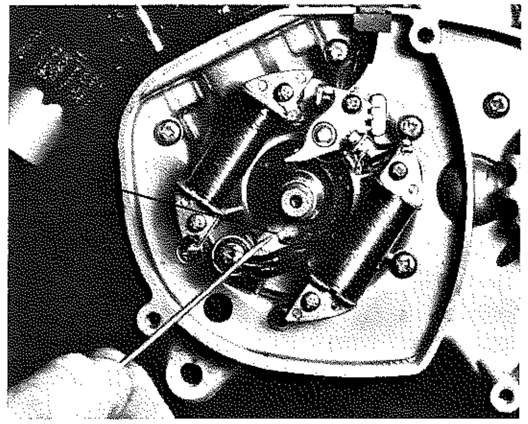


Fig. 19 Magneto assembly (less flywheel). Note location of felt lubricating pad (C).

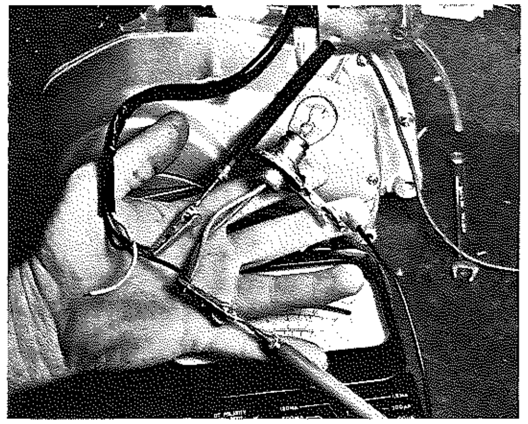


Fig. 20 Bulb/socket rig for 25-watt circuit load.

3. Tests and Checks

Test #1 Lighting Coil Output

Necessary equipment: 20K ohm AC Voltmeter, 3 ft. jumper wire, Electric or mechanical tachometer.

1) Disconnect yellow, green and blue lighting cord harness wires at nearest juncture point from engine. 2) Rig an old taillight bulb/socket combination (Fig. 20) so that both filaments are tied to a common lead (for this test, use a 5/20 watt stop/taillight bulb. This serves to place a 25-watt load on lighting coil, duplicating normal operating loads). 3) Connect test socket "common" lead to green lighting cord harness wire. 4) Use jumper wire to establish ground connection between bulb socket and engine case. 5) Shield test socket leads and wiring harness leads to prevent accidental grounding during test. 6) Check condition of bulb filaments before and after test. *They must be in working order.* 7) Connect one lead from AC voltmeter to test socket/green lead connection. Connect the remaining voltmeter lead to lighting cord blue wire. 8) If electric tachometer is used, connect tachometer to lighting cord black wire. Start engine and read output over prescribed engine speeds. 9) Switch test socket "common" lead onto lighting cord yellow wire and read output again. Factory specifications call for:

Green alternator lead wire	2.4 volts @ 2500 rpm 6.1 volts @ 8000 rpm	w/25-watt circuit load
Yellow alternator lead wire	4.5 volts @ 2500 rpm 8 volts @ 8000 rpm	w/25-watt circuit load

Readings higher than factory specification indicate either an inadequate circuit load or a better than average output. Readings less than -10% of factory specifications indicate shorted lighting coil winding. In the case of no or low voltmeter readings, it will be necessary to perform Test #2.

Test #2 Lighting Coil Continuity

Necessary equipment: Volt-ohm meter capable of reading down to 0.1 ohm.

Assuming lighting cord harness wires are disconnected as per *Test #1,* proceed as follows: 1) Clip one lead from ohm meter to yellow lighting cord wire, the other to the blue lighting cord wire. 2) Set meter to proper scale and read. 3) Switch meter lead from yellow to green lighting cord wire and read. Factory specification calls for 2.5 ohm reading (yellow wire), 0.8 ohm reading (green wire). Refer to p. 84

Readings higher than factory specification indicate an open circuit. Readings less than specification indicate shorted condition. If either condition exists, it is necessary to remove flywheel and either repair or replace lighting coil. If lighting coil checks out to specifications yet output is low, recharge flywheel magnets or replace flywheel.

Test #3 Cranking Voltage Check

Necessary equipment: 5mm gap test plug (Wico P/N S-14821)

Remove high tension lead from spark plug and install onto test plug terminal, ground test plug to cylinder fin, turn ignition switch on and kick engine over briskly.

A fat, blue spark at regular intervals indicates enough cranking voltage to fire the engine.

Weak, thin, or yellow colored sparks as well as irregular or no sparks indicate tests for which the magneto components must be removed to perform. The same is also true if misfiring occurs that cannot be corrected by spark plug or carburetion changes.

Test #4 Isolation Check

Necessary equipment: 5mm gap test plug. (Wico P/N 14821), 6-volt battery with leads.

This test helps separate coil and condenser problems from contact breaker, flywheel magnetism or wiring faults.

1) Remove magneto cover and flywheel (for procedure—see Section 1, Par. A, and Section 4, Par. A). 2) Insert a thin strip of heavy paper between breaker points. 3) Disconnect lighting cord black wire at "kill" button or ignition switch. 4) Attach spark plug lead to 5mm test plug and ground plug body to cylinder head. 5) Ground negative lead from 6-volt battery to engine case and strike positive lead briefly but rapidly across wire junction atop condenser.

If sparks occur across test plug electrodes each time positive battery lead is touched as described, the coil and condenser may be assumed to be in operating condition, and ignition fault probably lies in the breaker points. If weak, irregular or no sparks occur, then coil and condenser must be tested for fault (see Test #5).

Test #5 Ignition Coil and Condenser Check

Due to the variety of test equipment in use it is impossible to outline test procedures for every type of test rig. Basically, there are five tests which should be applied to the ignition coil and to the condenser. The ignition coil test should check coil power (output), primary winding continuity, secondary winding continuity, coil ground, and surface insulation and/or breakdown. The condenser test should check for leakage or short and capacitance. Coil test data supplied in this text are based on manufacturers' test equipment. If the particular test rig being used does not correlate to the data supplied here, then it will be necessary to compare coil and condenser performance against similar components known to be in working order.

As some test equipment will test components on the machine while others require their removal, no attempt will be made here to describe test preparations. Consult Section 4 for flywheel and magneto components removal.

Coil and Condenser data:

Coil:	**Primary resistance**	**1.6 ohm + or - 10%**	
	Secondary resistance	**5000 ohms + or - 10%**	
	Power test	**Steady fire over**	**6mm 3pt. gap @ 1000 rpm** **8mm 3pt. gap @ 3000 rpm**
Condenser data:			
	Capacitance	**0.25 to 0.27 Mf. (+ or -10%)**	

Test #6 Primary Exciting Coil Output

Necessary equipment: AC voltmeter, mechanical or vibration type tachometer.

Free primary cord from frame clips enough to expose Molex plug juncture near ignition coil. Splice one lead from voltmeter into blue wire connector and one into the black wire connector. Do not disconnect the Molex plug during this test. Connect tachometer in the usual manner for the type of instrument used. Start engine and read voltmeter scale for specifications listed below. Readings higher than factory specification indicate possible trouble in the ignition coil's primary winding. Readings lower than factory specification require the coil to be replaced.

Primary Exciting Coil Output: **8 volts @ 2500 rpm**
15 volts @ 8000 rpm

Test #7 Primary Exciting Coil Continuity

Necessary equipment: Volt-ohm meter capable of reading down to 0.1 ohm.

Remove magneto cover and flywheel *(for procedure–see Section 1, Par. A, and Section 4, Par. A).* Unsolder primary exciting coil lead from atop condenser. Unsolder primary coil ground lead from coil core. Connect leads from volt-ohm meter to primary exciting coil leads and read meter scale.

Factory specification calls for 0.6 ohm reading (+ or - 10%)

Readings higher than factory specification indicate an open circuit (broken wire). Readings lower than factory specification indicate shorted condition. Repair or replace as necessary. Next, make continuity check of ignition primary cord wires, test for shorted or open conditions.

In rare instances, the coil core may not ground to the engine case, due to corrosion. Check for this condition by making continuity test between core and case. If condition exists, remove coil and sandpaper the respective mating surfaces bright, then reassemble.

4. Magneto/Alternator Service

A. Flywheel Removal

Remove magneto cover as per Section 1, Par. A. Using holding tool (P/N 909523) to prevent flywheel rotation (Fig. 21), back off flywheel nut with 19mm socket wrench in *counterclockwise* direction. Next, screw flywheel puller screws into flywheel face far enough to fully engage thread passages in flywheel. Be sure screws are tightened equally to prevent cocking of puller. Hold puller body with 19mm end wrench (Fig. 22) and tighten puller stud *clockwise* against crankshaft until flywheel "pops" off its tapered seat. Handle flywheel carefully. Heating with a torch to aid removal will destroy magnetism. The same is true if the flywheel is dropped or struck with a hammer. Finally, remove the crankshaft key from crankshaft. Use side cutters or small punch to remove key. Store key for handy recovery.

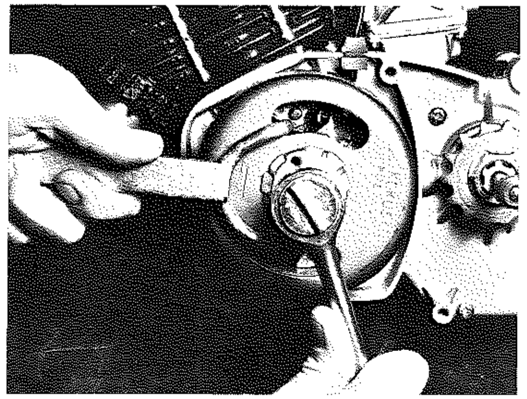


Fig. 21 Removing flywheel nut.

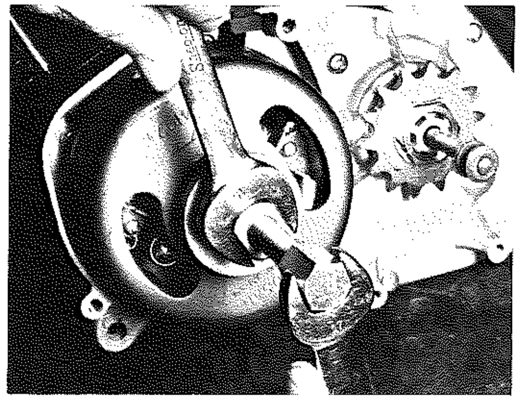


Fig. 22 Using flywheel puller to remove flywheel.

B. Disassembling Magneto Frame Components

With a small Phillips bit screwdriver, unscrew the two screws holding the primary exciting coil to the engine case, the lighting coil retaining screws, condenser fixing screw and contact breaker point setting screw. Lift out the entire component assembly, using care to work the rubber grommet (through which pass the primary and lighting cord wires) free of the engine case. The condenser is removed by unsoldering the wire connection atop it. The lighting coil is best left *in place* as testing may be accomplished without further disassembly. Breaker points are removed by first loosening the 6mm nut holding the spade clipped black wires to insulated terminal, then lifting wire free. The primary exciting coil will have been released with the unsoldering of the condenser juncture.

C. Cleaning and Inspecting Magneto Components

Wash all parts in cleaning solvent and dry with air blast. Ignition coil, primary exciting coil, condenser and lighting coil are tested as described in Tests 1 through 5.

Examine breaker points for pitted or burned contact surfaces. If a light dressing down with point stone fails to restore the contact surface, replace points. Examine breaker point spring for damage or loss of tension. Normal tension is between 24 and 32 ozs. Check breaker point insulated terminal for carbonized insulating surfaces, scraping any such material away with knife or sandpaper. Test continuity of all magneto wiring with continuity light or ohm meter. Replace all worn, damaged or frayed wiring. Lightly sandpaper magneto frame surfaces where components mount to insure positive ground connection when components are remounted. Likewise the same treatment should be given mounting surfaces of each component. Check flywheel magnet surface for signs of contact with coil core ends. If this condition is evident, check the engine crankshaft bearings for looseness (up and down motion of crankshaft), improper flywheel mounting, worn fit of flywheel to crankshaft taper or improper spacing of coil cores. In the case of worn engine bearings or crankshaft mounting taper damage, the engine must be dismantled completely for necessary service. If the flywheel hub taper surface is worn, pitted, or elongated, replace. Carefully examine flywheel for cracks or fractures. Discard and replace if such conditions are evident.

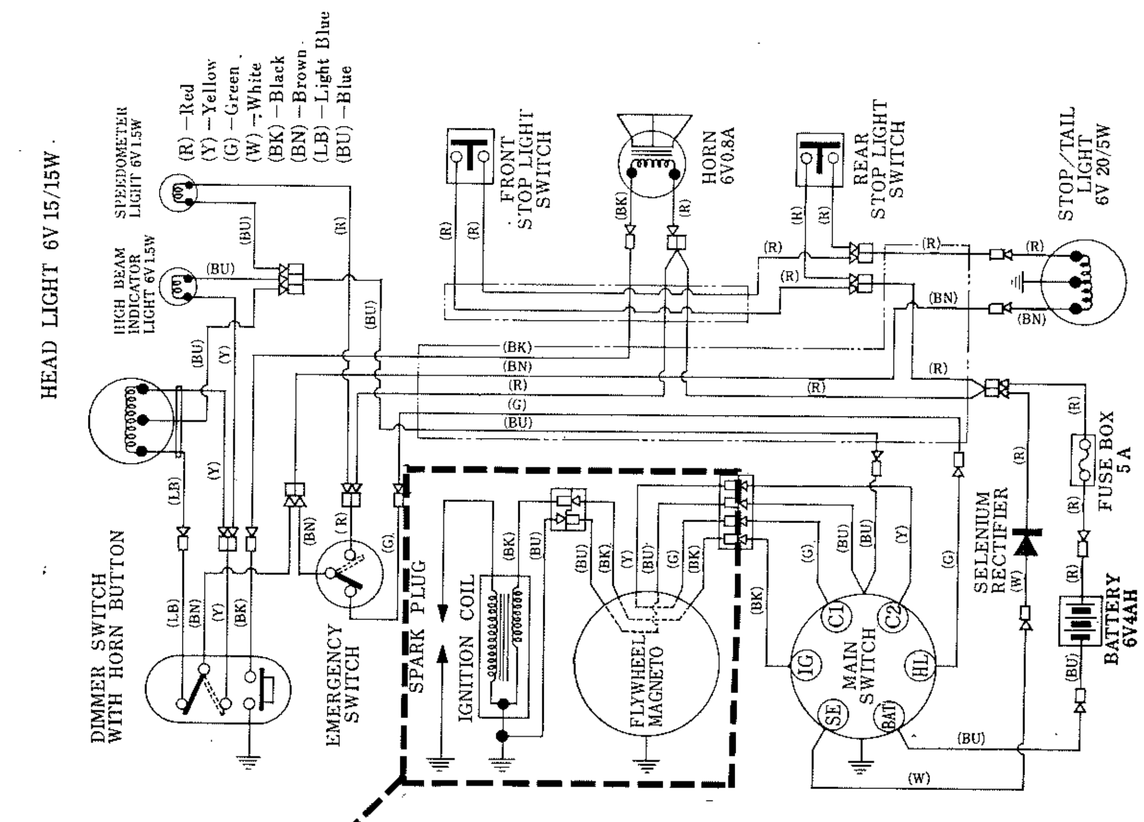
D. Reassembling Magneto Components

Reassembly is essentially the reverse order of disassembly. Special attention must be paid, however, to the routing of the magneto wires. Notice that all wires pass under ignition and lighting coils as well as between breaker point mounting lugs. Before tightening components in place, check to see if wires are likely to be trapped between respective mounting surfaces, thus causing a short. Lighting and ignition coils have centering "pilots" on their mounting surfaces–*these must be registered into recesses in engine case mounting lugs before attempting to tighten mounting screws.* Solder black wire from breaker point, ignition primary cord and primary exciting coil atop condenser. *Special note! Current will not pass through a "cold" solder joint. Be careful to "puddle" the solder with hot iron. Do not allow wires to move until solder has "set." Use care not to overheat condenser with soldering iron.* Finally, oil point cam felt with 2 to 4 drops of SAE 10W oil, smear a thin coat of oil on crankshaft breaker cam and clean points by drawing a clean heavy strip of smooth hard paper between them.

E. Remounting Flywheel and Magneto Cover

Install key in crankshaft keyway, tap key fully home with brass drift pin. *Carefully* position flywheel onto crankshaft, aligning key with keyway before pushing flywheel home on its taper. Install lock washer and crankshaft nut, insert holding

tool (P/N 909523) into flywheel face *(check tool prong position to avoid possible damage to coil windings)* and tighten nut clockwise to 170 in. lbs. (1.96 kg. m.). Check coil core ends for 0.010" (0.25mm) air gap between core end and flywheel magnet surface by measuring through flywheel inspection windows with feeler gauge. To adjust air gap spacing, place strips of business card paper between core ends and magnet surface. Loosen coil mounting screws and retighten. Remove paper strips and recheck air gap. This procedure applies to primary exciting coil as well as lighting coil. It must be carried out on both ends of the coil at the same time, hence the use of paper strips. Next, set ignition timing as outlined in Section 1, Par. A or B. Check spark at high tension terminal with 5mm gap test plug. Install magneto cover onto engine case, being careful to engage shifter sliding pin in control shaft groove (Fig. 17). Insert magneto cover mounting screws and tighten with Phillips bit in hammer driver tool. Position shifter cover on magneto cover and tighten in place.



MAIN SWITCH
0 IG-E
1 E-BAT C1-SE
2 E-BAT SE-C2-HL

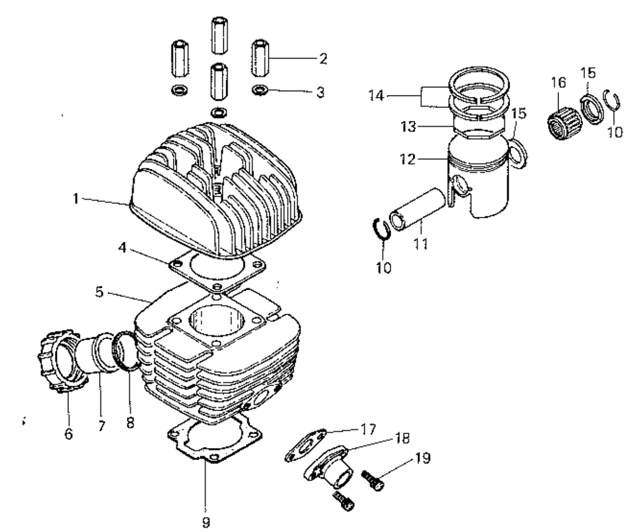
Fig. 23 Wiring Diagram.

Chapter IV

Cylinder and Piston

The cast Meehanite cylinder and alloy cylinder head are secured to the engine cases by means of long studs which pass through cylinder and head. The cylinder base is spigoted to enhance rigidity. Ports and passages in the cylinder are "cast in." The cylinder head uses a hemispherical shaped combustion chamber with central spark plug location. The piston is of high temperature alloy, permanent mold cast, cam ground, two ring, deep skirt, semi-dome design. Ring grooves are fitted with brass anti-rotation pegs. Piston rings are cast grey iron with the top ring chrome faced. The bottom ring is equipped with a steel expander ring to eliminate piston slap. The piston pin is push fit and secured by snap rings. Cylinder head gasket is soft aluminum sheet while cylinder base gasket is manufactured from fibrous (oil sheet) material.

Fig. 24 Cylinder and Piston Assembly.



Index to Fig. 24

Fig. No.	Part Name
1	Cylinder head
2	Cylinder head nut
3	Cylinder head washer
4	Cylinder head gasket
5	Cylinder
6	Exhaust nut
7	Exhaust pipe
8	Exhaust gasket
9	Cylinder base gasket
10	Snap ring
11	Piston pin
12	Piston
13	Expander ring
14	Piston rings
15	Thrust washer
16	Needle bearing
17	Inlet pipe gasket
18	Inlet pipe
19	Screw

1. Cylinder and Piston Service

A. Cylinder Head and Cylinder Removal

Prior to beginning work, thoroughly pressure wash cylinder and cylinder base area to minimize the chance of debris falling into the crankcase as the cylinder is lifted. Begin work by removing spark plug, exhaust pipe and air cleaner assembly. Back off clamp screw on carburetor spigot and remove carburetor by twisting gently from side to side, all the time pulling rearwards. Loosen and remove the four cylinder head nuts with 12mm socket wrench, turning nuts in counterclockwise direction. Lift cylinder head free and carefully remove aluminum gasket. Rotate engine with kick starter until piston reaches top center. Lift cylinder casting until spigot end clears cases far enough to permit a clean cloth to be tucked underneath piston. (Fig. 25) (This prevents possibility of broken rings, carbon particles or dirt dropping into "crankcase"). Finally, lift cylinder free of thru studs (store cylinder until needed by placing cylinder head end down to prevent possible damage to spigot).

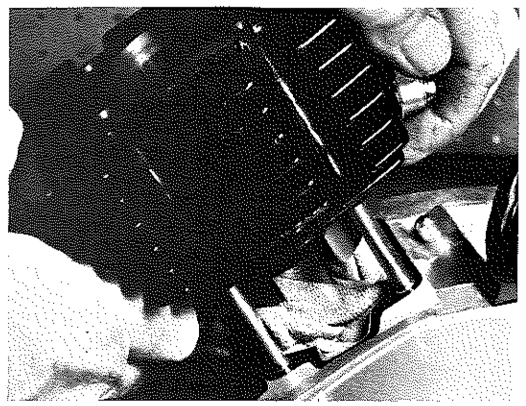


Fig. 25 Removing cylinder (note cloth tucked underneath piston).

Fig. 26 Method of removing piston pin snap rings.

B. Piston Removal

Insert tip end of steel scribe (or ice pick) between snap ring and piston pin through access slots cut in piston sidewall. Pry snap rings free of their respective grooves, using care not to gouge or scratch piston surfaces. Insure that cloth tucked into crankcase mouth will prevent snap rings and/or piston pin thrust washers from falling into crankcase.

Support piston with one hand while using piston pin tool (P/N 2531-96400) or round dowel to push piston pin out of piston about ¾". Grasp exposed end of piston pin with long-nosed pliers (Fig. 27) and continue to withdraw pin until piston is freed from connecting rod. Should pin fail to push out easily, heat piston lightly with butane torch and try again. If pin fails to push out after heating, then a screw-type extractor must be employed. *Never attempt to drive pin through piston with hammer and punch methods–you may remove the pin but the connecting rod will have been bent in the process.* After the piston has been lifted clear, remove and shake out cloth, protecting crankcase. Carefully remove cylinder base gasket (or its remains) then recover crankcase opening until reassembly.

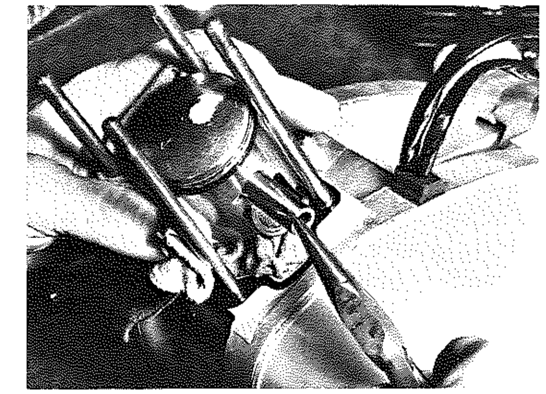


Fig. 27 Withdrawing piston pin.

C. Cleaning, Inspecting, Measuring and Fitting Operations

1) Decarbonizing (decoking)

This service always requires head, cylinder and piston to be removed from engine.

Scrape carbon deposits from exhaust passage with stout-bladed knife, using care not to damage exhaust port opening or cylinder walls. Use #200 grit sandpaper to finish removing carbon in exhaust passage after scraping with knife. Clean carbon from piston ring grooves with ring groove scraper or end edge of old piston ring (broken in half so it is easy to use as a tool). When cleaning ring grooves, be careful not to remove metal with the scraper or piston ring efficiency will be lost. Clean carbon build-up from cylinder head cavity. Use considerable care not to scratch cylinder head gasket surface or rough up combustion chamber surface with cleaning tools. If cylinder head spark plug threads are carbon fouled, clean by running 14mm tap through spark plug hole. Exhaust pipe and muffler must be removed for decoking at the same time as similar operations are performed on cylinder. For special instructions regarding exhaust components, see chapter on Exhaust System.

2) Cleaning

Clean parts in solvent, dry with air blast or clean cloth. Piston sidewalls may be restored to high luster by rubbing briskly with soap-filled steel wool pad and rinsing under running water. Lightly hone cylinder walls to remove glaze. If piston seizure has left aluminum deposited on the cylinder wall, it can be dissolved by applying muriatic (hydrochloric) acid with a small, stiff brush, washing acid off with running water after three to five minutes and repeating the process until the aluminum deposit is cleared away. Cylinder may then be lightly honed without "egging" the bore or loading hone stones with aluminum. After honing cylinder walls, wash again in solvent and lubricate cylinder walls with a thin film of motor oil to protect finish.

3) Cylinder and Piston Scores

If cylinder scores of more than 0.001" to 0.002" in depth remain in cylinder afte: clean-up honing operation, it is advisable to rebore and fit next largest size piston. Piston scores may be polished down with fine oilstone or #400 grit sandpaper (wet or dry type). If piston scoring is deeper than 0.002" to 0.003" or if an area wider than ½" is involved, it is advisable to replace piston. If piston seizure has caused metal to be pulled into ring grooves, carefully clean grooves with thin, fine-toothed file until proper ring clearance is obtained (Fig. 28).

4) Measuring Tools

The importance of piston to cylinder wall fit in a two-cycle engine cannot be overstated. It is strongly recommended that precision expanding gauges and micrometers be employed to measure the piston and cylinder, rather than strip type feeler gauges and the like.

5) Measuring Piston and Cylinder for Wear

To check piston wear: Measure piston diameter at bottom edge of skirt and at a right angle to piston pin (Fig. 29 Diameter "B"). Standard pistons measure 1.888"+/-0.0005" (47.96mm+/-.015mm) in diameter at piston skirt when new and should be replaced if wear is in excess of 0.002" (0.05mm).

To check ring groove wear: Use new rings and strip-type feeler gauge to measure ring groove clearance (see Fig. 28). Proper clearance is 0.0008" to 0.0024" (0.02mm to 0.06mm). Replace piston if ring groove wear exceeds limits.

To check cylinder wear: Measure cylinder wall diameter at top and bottom of bore. If measurement differential exceeds 0.004" (0.1mm), cylinder taper is excessive and reboring to next largest oversize is recommended.

To check piston to cylinder clearance: Compare piston skirt measurement to the measurement made at bottom of cylinder bore. If differential exceeds 0.006" (0.15mm), then cylinder to piston clearance is excessive and reboring is recommended (unless fitting a new piston of the same original size will bring cylinder to piston clearance within limit). Factory oversized pistons are available in 0.25mm, 0.50mm, 0.75mm, 1.00mm or +0.010", +0.020", +0.030", +0.040".

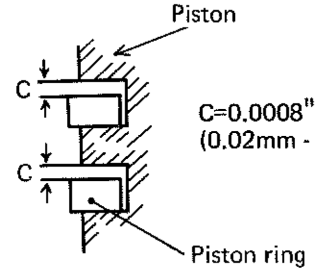
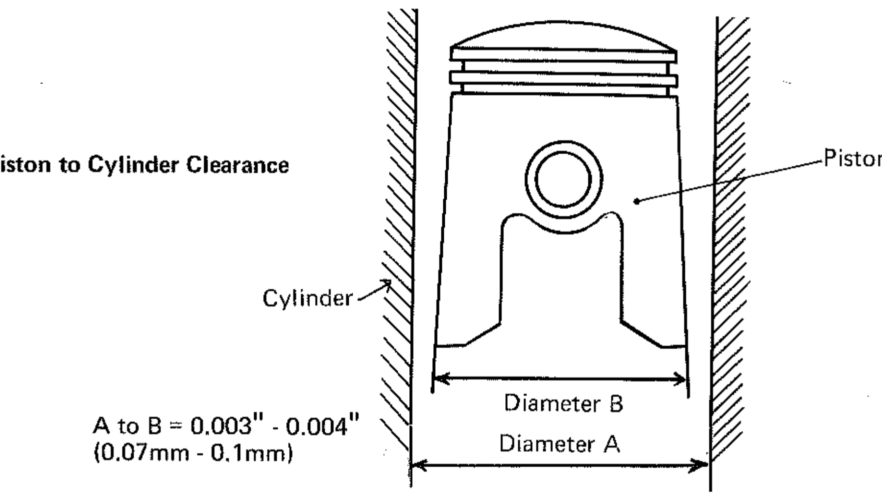


Fig. 28 Piston Ring Side Clearance Measurements.

Fig. 29 Piston to Cylinder Clearance

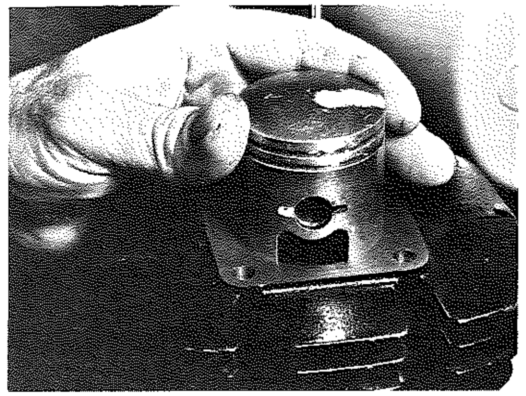


6) Cylinder Boring and Piston Fitting

When reboring, fit new pistons to between 0.003" (0.07mm) and 0.004" (1mm) total clearance (See Fig. 29). It is advisable to bring the cylinder bore out to final dimension with cylinder hone, passing hone rapidly to and fro in bore to insure cross-hatched finish. After final honing operation, bevel port edges 1/64" with fine file to prevent rings from "hooking" the edge. Wash cylinder and piston *thoroughly* after fitting up work is done to insure that all abrasives have been cleaned away. After cleaning, protect bore finish by coating with thin film of motor oil. Check piston ring to groove clearance for a minimum of 0.0008" (Fig. 28). Push piston pin through pin bosses. If pin will not push through, ream pin bosses very lightly with bar reamer until push fit is assured.

7) Fitting New Rings to Cylinder

Insert new ring into cylinder bore and square it by pushing down approximately ½" with bottom edge of piston (Fig. 30). Use feeler gauge to measure end gap (Fig. 30a). If gap is insufficient, remove ring and file end edge with fine file until proper clearance is obtained. Gap specification calls for 0.006" (0.15mm) to 0.014" (0.36mm) on top ring, 0.004" (0.1mm) to 0.012" (0.3mm) on bottom ring (Fig. 30b). For purposes of identification, the top ring is chrome faced. If ring gap exceeds specification, either the wrong size ring has been selected or cylinder dimension is too large.



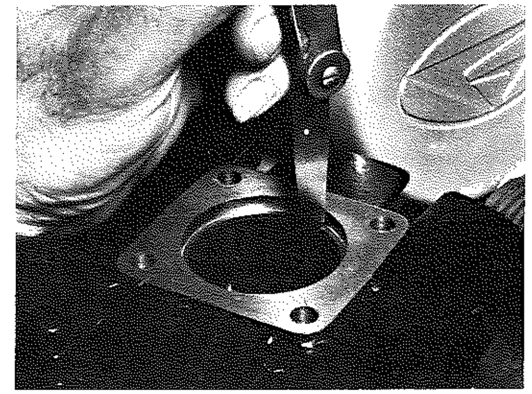
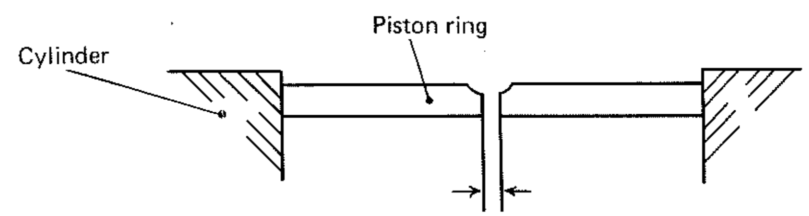


Fig. 30 Using piston skirt to square piston ring in cylinder.

Fig. 30a Measuring piston ring end gap.

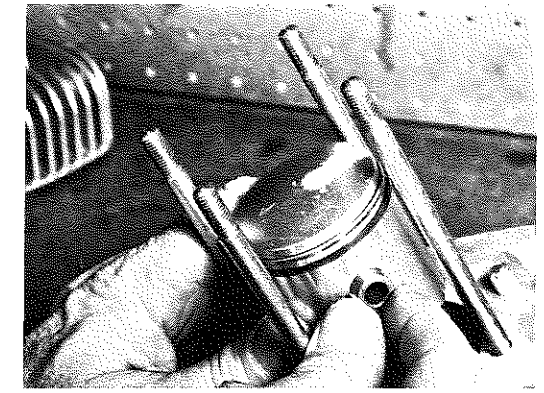


1st Ring Gap 0.006" - 0.014" (0.15mm - 0.36mm)
2nd Ring Gap 0.004" - 0.012" (0.1mm - 0.3mm)

Fig. 30b Piston Ring End Gap Measurements

D. Reassembling Piston Onto Connecting Rod

Install piston rings onto piston with semicircle cutaway at ring gap facing towards anti-rotation pegs. Note that top ring is chrome faced and that steel expander ring must be installed in lower ring groove prior to installing lower ring. Lubricate piston with a thin film of oil, especially the ring lands. Coat inside edges of piston pin bosses with a heavy long-fibre grease. Using the grease as a temporary adhesive, install piston pin thrust washers against piston pin bosses. Slide piston pin tool through pin boss and thrust washers so as to center them prior to installation. Note that oil grooves cut into *one side only* of the thrust washers *must face* towards connecting rod bearing. Insert needle bearing into rod eye and lubricate with a few drops of engine oil. Carefully install piston over connecting rod with anti-rotation peg (top groove) facing rear of engine. Insert tapered end of piston pin tool through piston and connecting rod. Register hole in piston pin with pilot stub on piston pin tool then push pin fully home. Center pin between snap ring grooves in pin bosses. Use steel scribe to install *new* snap rings in pin bosses. Check to see snap rings are firmly bedded in grooves.



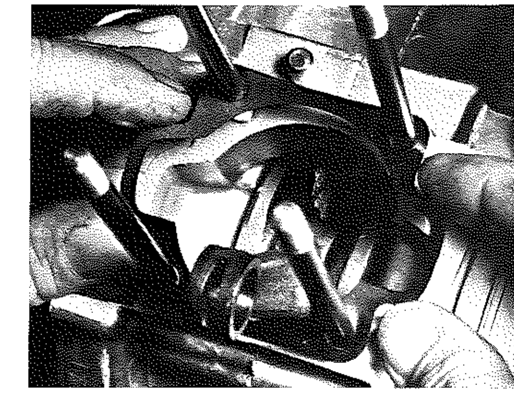
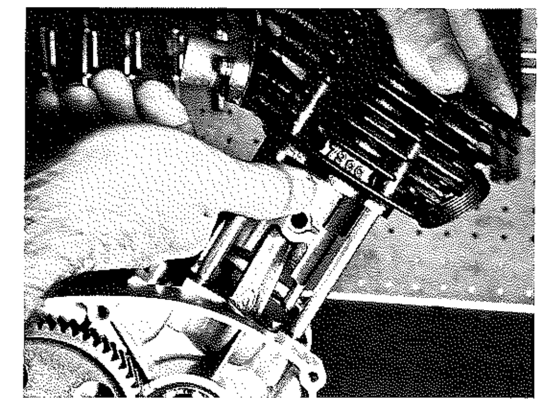


Fig. 31 Installing piston onto connecting rod

Fig. 32 Installing cylinder base gasket.



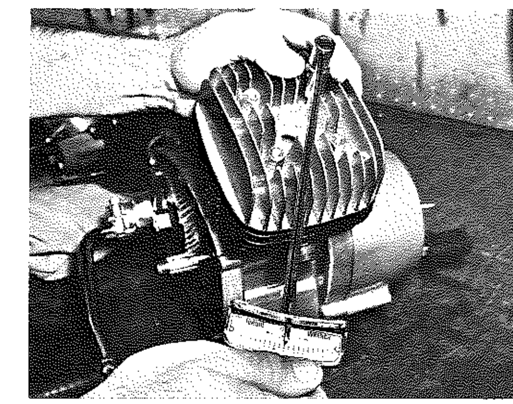


Fig. 33 Installing cylinder.

Fig. 34 Using torque wrench to tighten cylinder head nuts.

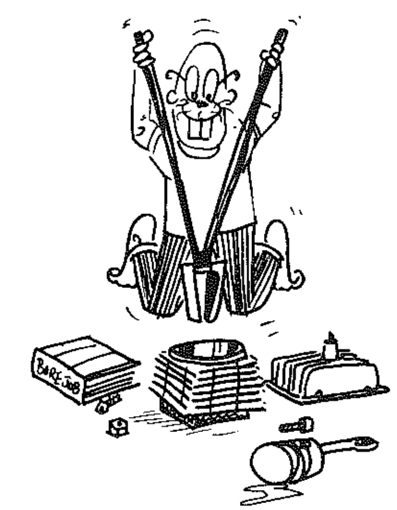
E. Remounting Cylinder and Cylinder Head

Remove cloth protecting crankcase and install new base gasket (Fig. 32). Carefully check alignment of gasket to case as it will properly fit only one way. Position piston at the top of its stroke and align rings so that their end gaps are directly over anti-rotation pegs. Check to see that cylinder is lightly lubricated, then slip cylinder over through-studs and lower carefully onto piston. Compress piston rings with the fingers and slip cylinder over piston (Fig. 33) (do not use force to lower cylinder or damaged piston and rings will result). Continue to lower cylinder onto engine base, being careful not to let spigot catch and pull base gasket. *Install new gasket over* through-studs, replace cylinder head and push down against gasket. Place flat steel washers over through-studs and run nuts down finger tight. Use torque wrench (Fig. 34) to finish tightening cylinder and stud nuts to 105 in. lbs. (1.2 kg. m.). Install carburetor onto manifold, tightening clamp screw only moderately. Install air cleaner, spark plug and high tension lead. Using a *new* gasket, hook up exhaust pipe, tightening nut with special wrench (P/N 909522).

Chapter V

Engine Case Assembly

Includes: Crankcase, crankshaft, transmission and kick starter assemblies plus magneto cover shifter assembly.



The F 480 crankcase is die cast aluminum alloy, split along the vertical center line. Crankshaft support is by single race ball bearing in either crankcase half. Transmission main and countershafts are opposite end bush and ball bearing mounted. The crankcase is separated from the transmission by internal walls in the casting.

The balanced, single throw, forged steel crankshaft is of "built up" design, crankshaft halves being pressed onto a crank pin which mounts the one-piece, forged steel connecting rod. Caged needle bearings are used at either end of the connecting rod, the rod being centered on its throw by thrust washers on the piston pin. The four-speed constant mesh transmission uses a patented, spring loaded control shaft to select gear changes. Transmission shafts and gears are machined from steel forgings, then high frequency heat treated.

The kick start system employs a roller clutch, operating through the transmission to turn the engine crankshaft.

The magneto cover houses the positive locating, ratchet selector system necessary to operate the transmission control shaft.

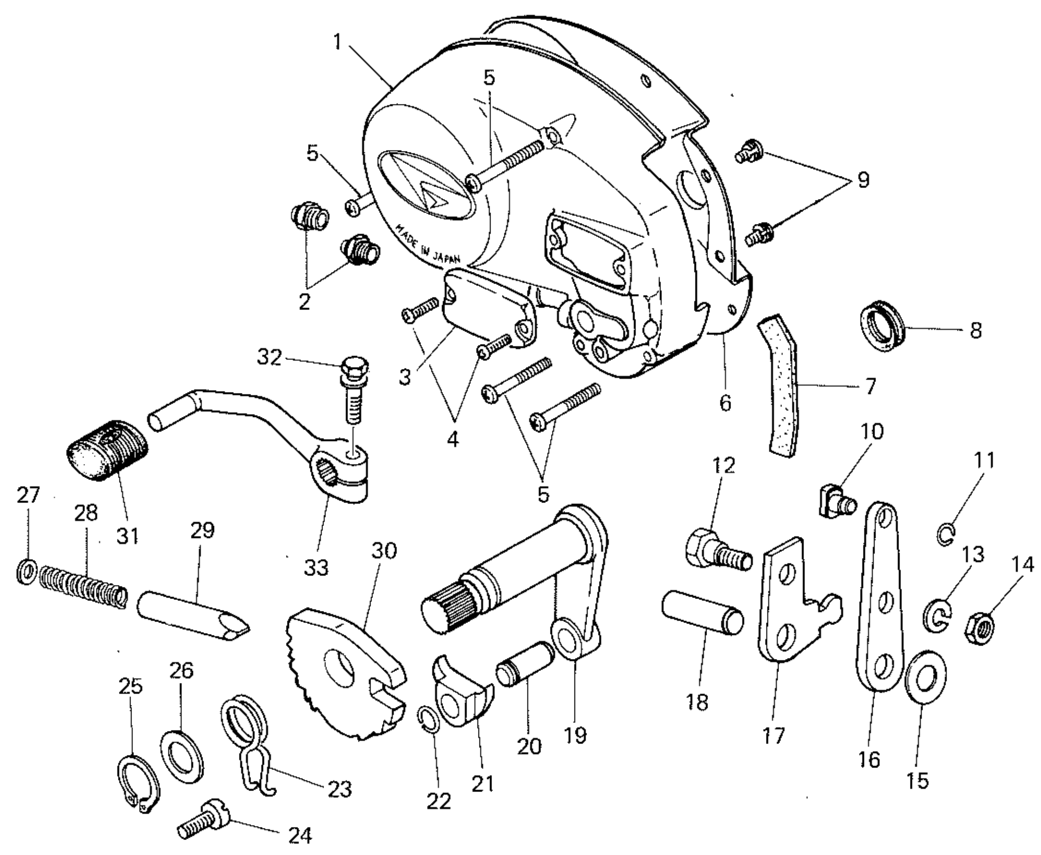


Fig. 35 Magneto Cover Assembly.

Index to Fig. 35

Fig. No.	Part Name	Fig. No.	Part Name
1	Magneto case	18	Shifter pin
2	Grease nipple	19	Foot change shaft
3	Shifter cover	20	Foot change shaft key pin
4	Shifter cover screw	21	Foot change shaft key
5	Case screw	22	Snap ring
6	Inside cover	23	Foot change ratchet spring
7	Inside cover packing	24	Center screw
8	Dust seal	25	Snap ring
9	Inside cover screw	26	Shim
10	Slide pin	27	Washer
11	Snap ring	28	Plunger spring
12	Adjust bolt	29	Plunger
13	Lock washer	30	Foot change ratchet
14	Nut	31	Foot change rubber
15	Shim	32	Pinch bolt
16	Shifter arm	33	Foot change lever
17	Shifter guide		

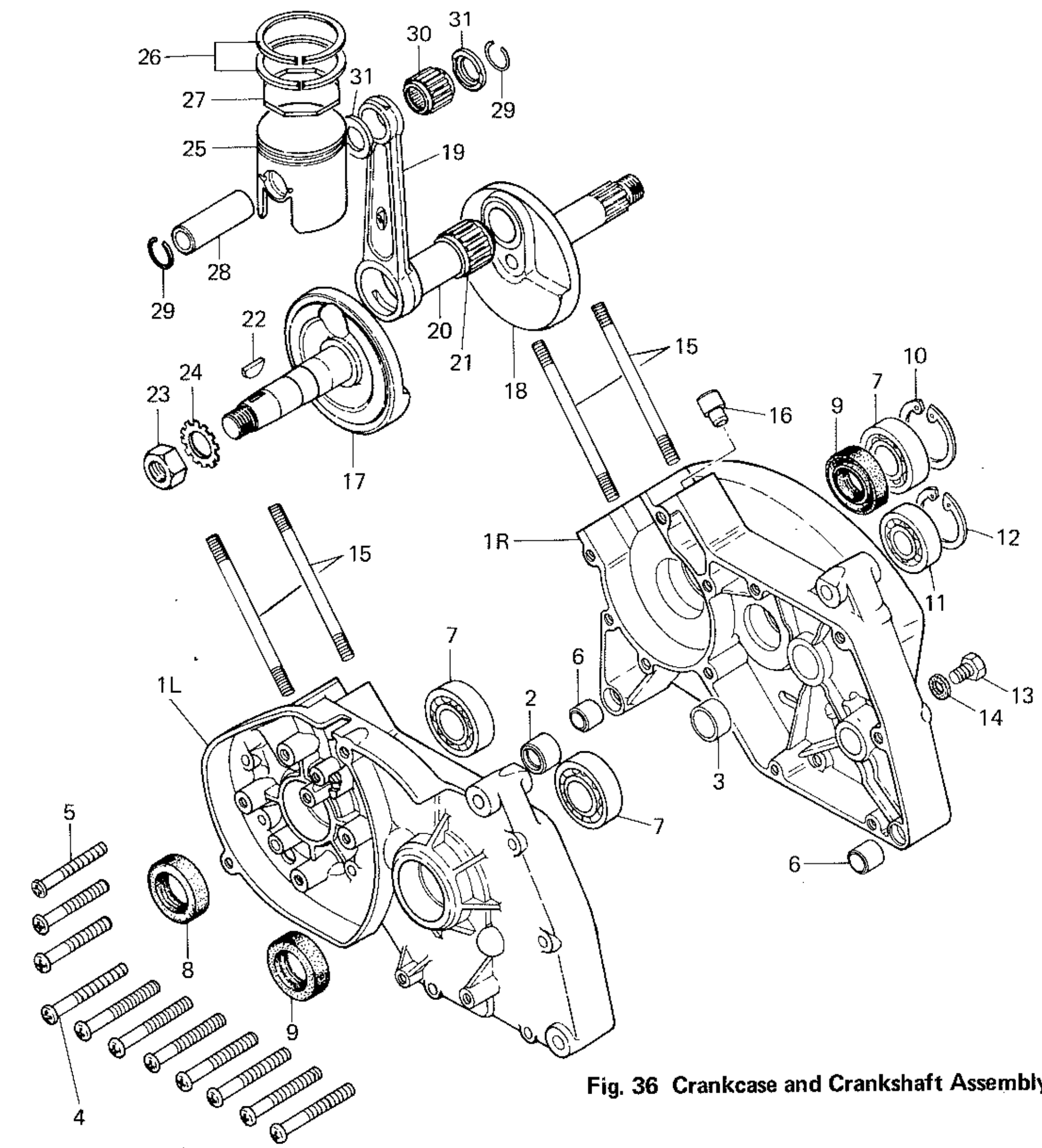


Fig. 36 Crankcase and Crankshaft Assembly

Index to Fig. 36

Fig. No.	Part Name	Fig. No.	Part Name	Fig. No.	Part Name
1	Crankcase, (L & R)	11	Bearing	22	Key
2	Bushing, main shaft	12	Snap ring	23	Nut
3	Bushing, counter shaft	13	Bolt	24	Washer
4	Screw	14	Gasket, drain	25	Piston
5	Screw	15	Stud, cylinder	26	Ring, set
6	Dowel, crankcase	16	Breather	27	Expander
7	Bearing	17	Crankshaft, L	28	Piston pin
8	Seal, crankshaft L	18	Crankshaft, R	29	Snap ring
9	Seal, crankshaft R & counter shaft	19	Connecting rod	30	Needle bearing
		20	Crank pin	31	Thrust washer
10	Snap ring	21	Bearing, big end		

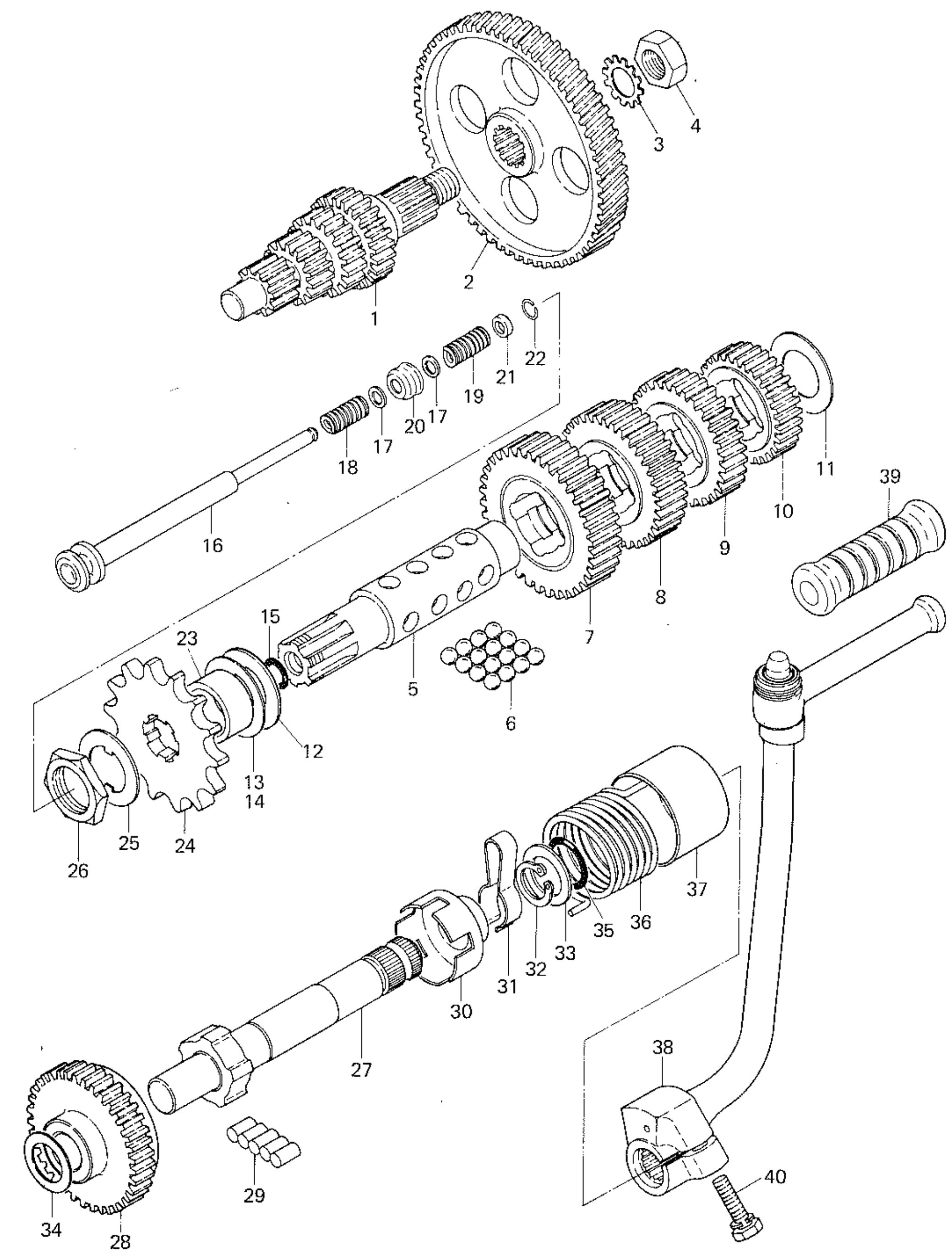
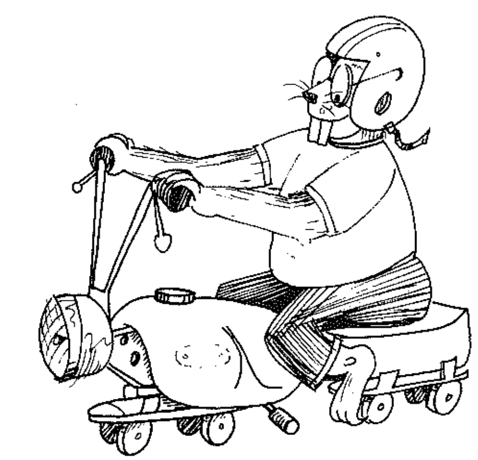


Fig. 37 Transmission and Kick Starter Assembly.

Index to Fig. 37

Fig. No.	Part Name
1	Main shaft
2	Gear, primary
3	Washer
4	Nut
5	Countershaft
6	Ball
7	Gear, 1st 39T
8	Gear, 2nd 34T
9	Gear, 3rd 30T
10	Gear, 4th 28T
11	Spacer, R
12	Spacer, L
13	Shim, t-0.2
14	Shim, t-0.3
15	O ring
16	Control shaft
17	Washer
18	Spring, L
19	Spring, R
20	Ball receiver
21	Stopper
22	Snap ring
23	Collar
24	Sprocket
25	Washer
26	Nut
27	Kick shaft
28	Kick gear
29	Roller
30	Roller, retainer
31	Snap, retainer
32	Snap ring
33	Plate
34	Shim
35	O ring
36	Kick spring
37	Spring cover
38	Kick lever, assembly
39	Rubber, pedal
40	Bolt

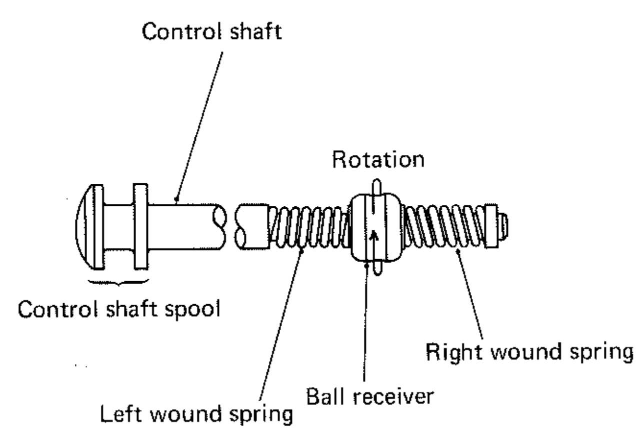


Briefly, the gear box operates in the following manner:

Gear selections are made by raising or depressing the foot change lever. The lever is attached via the foot change shaft to a ratchet which is spring loaded on either side of its axis (Fig. 39). After the lever has been operated, the ratchet spring automatically returns the lever to its central position. As the lever is operated, the foot change shaft key engages the ratchet which, in turn, moves the shifter arm assembly a selected distance towards or away from the transmission counter shaft (Fig. 39). A sliding pin is fitted to the tip of the shifter arm to engage the spool end of the control shaft. The control shaft operates lengthwise within the hollow transmission counter shaft.

As the shift mechanism moves the control shaft to and fro within the counter shaft, the ball receiver (Fig. 38) pushes sets of steel balls out of their pockets in the counter shaft. The steel balls engage depressions machined in the inner bore of the counter shaft gear selected (Fig. 40). The engagement of the steel balls permits input (mainshaft) power to be transmitted through the gear selected to the output (counter shaft) sprocket. If the ball-receiving depressions of the counter shaft gear are not aligned over the steel balls as the gear selection is made, the spring loaded ball receiver will maintain a steady pressure on the ball set selected until the shaft turns enough to align ball pockets with gear depressions. The ball receiver then pushes the ball set home and the shift is completed.

Fig. 38 Control Shaft Details.



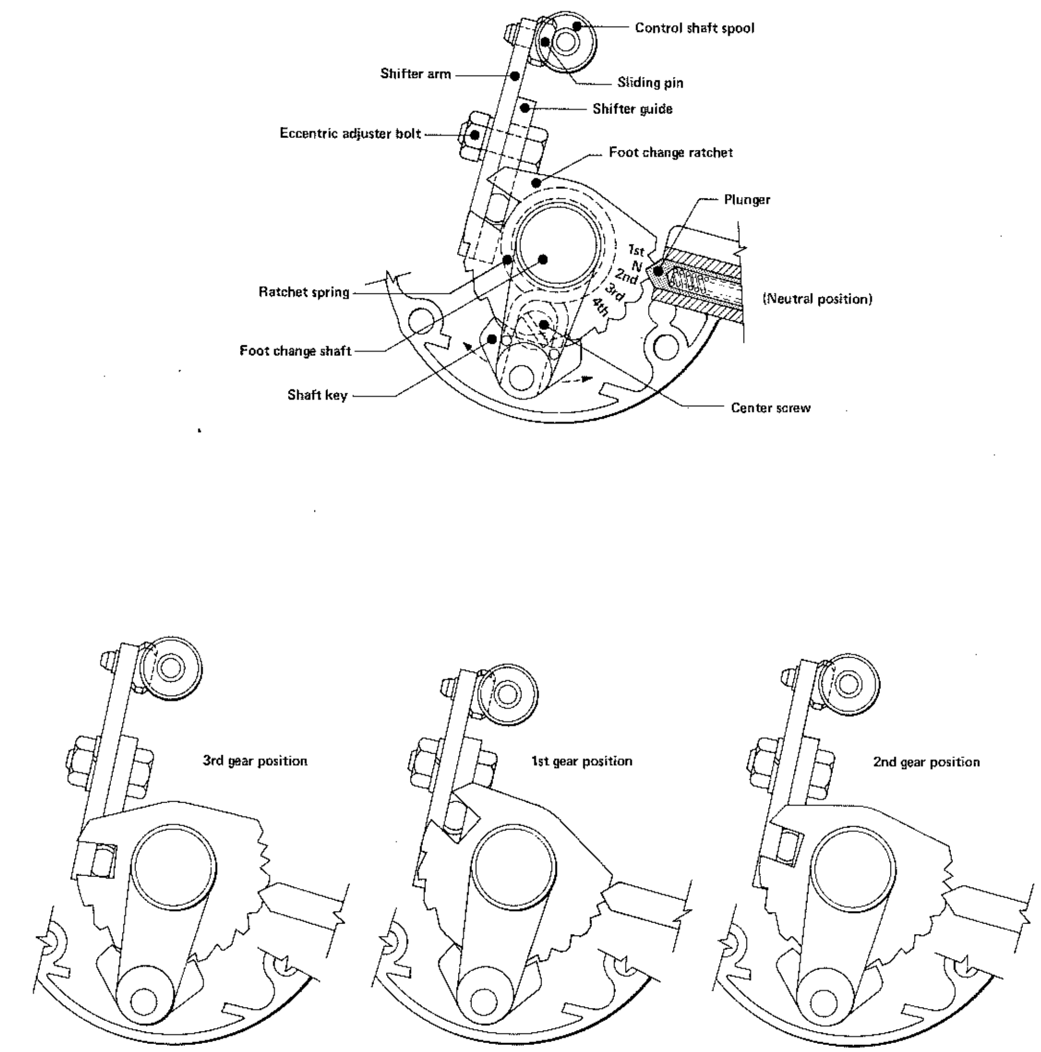


Fig. 39 Shift Mechanism Details.

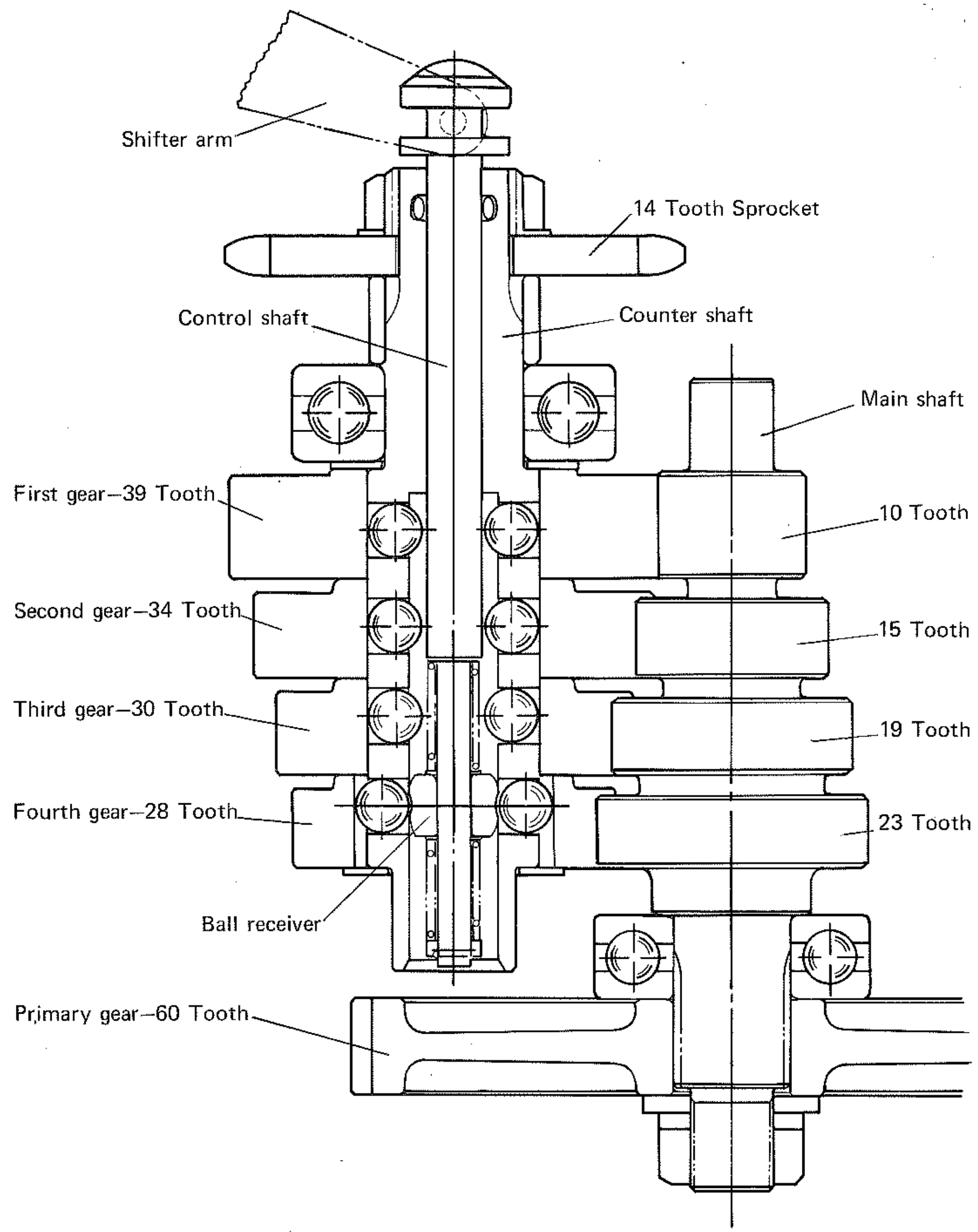


Fig. 40 Cross Section View of Transmission– Top (4th) Gear Engaged.

The kick starter operation is as follows:

Depressing the kick crank rotates the traverse mounted kick shaft, within the transmission cavity. As the shaft rotates, ramps, on the surface of the shoulder near the blind end of the shaft, force a set of steel rollers outward until they engage and drive the kick shaft mounted kick gear (Fig. 41 'A'). As the kick gear is driven, it turns the counter shaft second gear, mainshaft, primary gear, clutch pinion gear, and crankshaft, to bring the piston over and through the firing cycle. As the kick crank reaches the limit of its stroke and is allowed to return, the steel rollers descend the kick shaft ramps to their rest positions (Fig. 41 'B'). If the engine begins to operate as the kick crank lever is being depressed, the rotation of the kick gear *by the engine* disengages the rollers.

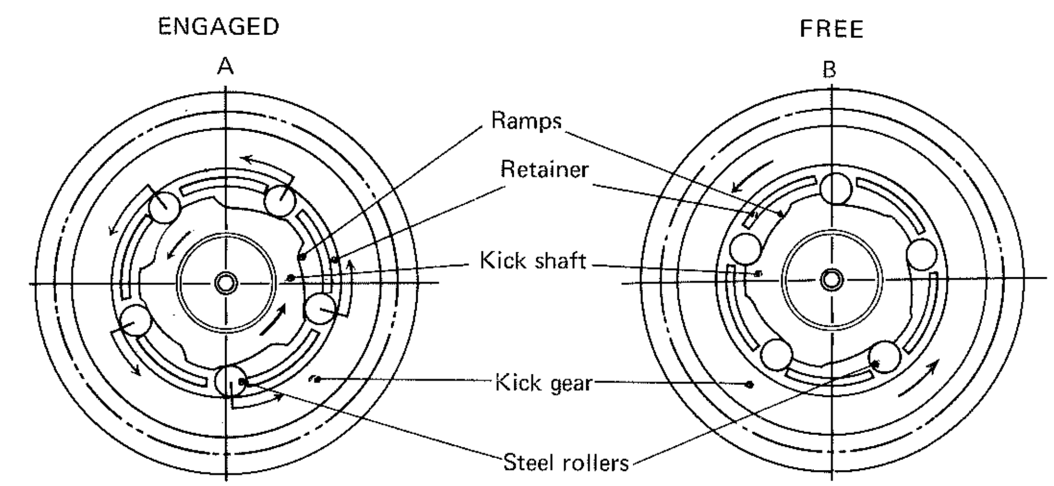


Fig. 41 Cross Section View of Kick Starter Drive Mechanism.

1. Adjusting Transmission Gear Selector System

Place a stand or block under the cycle so it is held upright with the rear wheel clear of the ground. Shift transmission to 3rd gear. Remove the two Phillips head screws securing the shifter cover to the magneto cover (Fig. 35) and set cover aside. Using a metal stylus, scribe a line from the head of the shifter arm adjusting bolt down and across the shifter guide (Fig. 42). Turn the lock nut securing the shifter arm adjusting bolt counterclockwise one turn. (Prevent adjusting bolt from turning while loosening lock nut by holding with 10mm end wrench). Rotate the eccentric shouldered adjuster bolt ¼ turn *counterclockwise* from scribed line and tighten lock nut (again prevent adjuster bolt from turning while tightening lock nut). Rock rear wheel forward and backward to test for low gear engagement. Repeat engagement test for second, third, and top gears. If engagement appears to be satisfactory, test ride the machine as final proof. If the transmission fails to shift properly during the road test or while rocking the wheel to test engagement, back off the adjusting bolt lock nut, reset adjuster bolt position to ¼ turn *clockwise* from scribed line on shifter guide and tighten lock nut and test as before. Properly adjusted, the transmission will not skip a gear, neither will it allow the gear to come in and out of engagement under acceleration. After adjusting, check lock nut for tightness and replace shifter cover and screws.

Special Note!

It may be that adjusting the gear selector system in the normal manner fails to provide a properly shifting transmission. In such cases the transmission will upshift properly but skip or "hang" gears while downshifting (or vice versa). The cause for this condition is too much or too little foot change shaft movement in relationship to its stops. This condition can be quickly checked visually in the following manner: Remove magneto cover and foot change inside cover from inside the magneto cover. Shifting from the second gear position to third (see Fig. 39) hold the shift lever fully depressed. Do not release! Observe the ratchet plunger engagement with the third gear notch of the ratchet. Correctly spaced, the ratchet plunger will have slid into register with the notch and climbed the ascending face of the notch approximately 1/64". In other words, the ratchet plunger tries to climb out of the notch into which it has just been shifted at full depression of the foot shift lever. Should the plunger fail to climb out the prescribed amount, use a rotary file to trim away a portion of the magneto cover where the foot change shaft contacts it. Use extreme care not to remove too much metal, stopping often to check progress in the manner outlined above.

Check back or down shifting spacing in the same manner but shift from fourth to third for the check.

Should the ratchet plunger climb appreciably higher out of the notch than 1/64", then it is necessary to disassemble the magneto cover assembly and grind off a portion of the engagement face of the foot change shaft key to reduce ratchet travel. Because of the leverages involved, only a small amount (.005" to .010") should be removed at any one time, then reassemble the unit for checking. Grind parallel to the original shape of the engagement face unless the shaft key does not fit squarely into the engagement notch(es) in the ratchet in which case it becomes necessary to reshape the key contour slightly to attain a proper fit.

2. Lubrication

A. Engine Assembly

The engine components are automatically lubricated by the oil which is mixed with the gasoline supply. Recommended oil for engine use is any brand name SAE 30W *two-cycle* oil and is to be mixed at a ratio of 16:1 for the first 10 hours and 20:1 thereafter. *(An exception to this would be the use of "smokeless' 40:1 two-cycle*

oils in which case the manufacturer's mixing recommendations should be followed). Regardless of the type selected, mixing oil with gasoline in quantities greater than called for will do nothing to aid engine lubrication and, in fact, cause considerable harm to engine performance. The use of automotive (four-cycle) motor oils in the F 480 engine is discouraged due to excessive carbon formations resulting from its use.

B. Transmission Assembly

The clutch, kick starter, transmission and primary gears are automatically lubricated from the transmission oil supply. Because the clutch friction discs operate in the transmission lubricant, it is necessary to use only the recommended types of oil (specific oil additives, "slick" oils, detergent oils, and the like, often cause friction discs to slip). If the machine is new or the original transmission oil supplied with the machine has not been changed, drain and replace with recommended type of oil. The original oil is intended as anti-rust protection for shipping purposes and, while it will satisfactorily lubricate transmission components, it exhibits a tendency to foam.

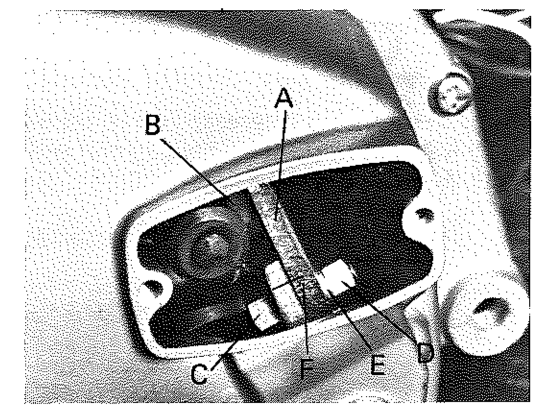


Fig. 42 Looking through shifter cover opening. Note location of (A) shifter arm, (B) slide pin, (C) adjust bolt, (D) locknut, (E) lockwasher and (F) scribed line.

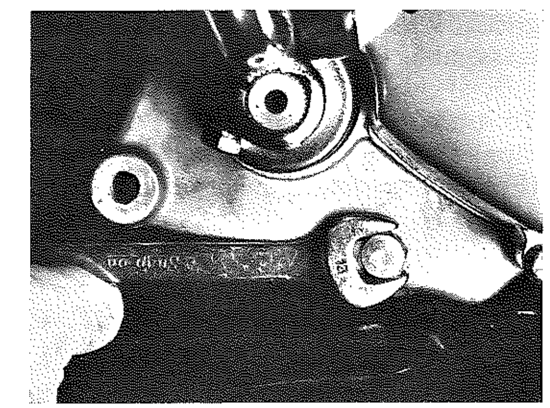


Fig. 43 Transmission drain plug location.

To change transmission oil—drain dirty oil into suitable container, using 13mm wrench to remove drain plug located on lower right side of engine cases (Fig. 43). When draining oil, lay the machine over on its left side for a minute or so and return to the vertical position. This insures draining oil trapped in clutch side cover.

Special Note! During the first 20 hours of machine operation changing transmission oil as frequently as every 4 hours is highly encouraged. Metal particles from the "bedding down" process contaminate lubricant and are best eliminated by frequent oil changes.

After old oil has been thoroughly drained, replace and tighten drain plug in engine case, remove combination filler plug/oil gauge in clutch side cover and refill transmission with 1¼ pints (590cc) of recommended oil. Check oil level by screwing filler plug/oil gauge down snug in case, then removing. Oil level should be just covering engraved line nearest plug end of oil gauge. (Hold machine in vertical position while checking oil level).

Recommended oil { **Above 32 F. SAE 30W non detergent—Service MM**
Below 32 F. SAE 20W non detergent—Service MM

Recommended service frequency — every 1,000 miles or 20 hours

C. Magneto Cover Shifter Mechanism

The foot change shaft is lubricated with chassis grease applied through a grease nipple in the magneto cover. The spring loaded ratchet plunger is likewise lubricated. The balance of shifter cover components are simply smeared with a heavy coat of grease whenever the cover assembly is disassembled for service, cleaned and reassembled.

To lubricate foot change shaft and ratchet plunger, apply tip of grease gun to grease nipples in magneto cover and give the fittings from one to three strokes of the gun. (For specific details of magneto cover disassembly and/or service—see pages 65 and 66.)

Recommended lubricant—Any brand name automotive chassis grease—short fibre type.

Recommended service frequency { **Grease nipple—every 20 hours**
Shifter components—every 50 hours

Cautions:

Do not overfill transmission. Excessive amounts of lubricant will be forced out through countershaft seal or transmission breather.

Double check drain and filler plugs after changing transmission oil to insure they are properly tightened.

Transmission filler plug should be tightened with the fingers only. Never use pliers to snug down plug.

Transmission drain plug is equipped with washer. If washer is damaged, replace; otherwise oil can leak past the head of the drain plug.

3. Crankcase, Crankshaft, Transmission and Kick Starter Service

A. Removing Engine Assembly From Frame *

Drain transmission oil. Remove air cleaner assembly. Unscrew mixing chamber cap from carburetor top, pulling throttle slide assembly free of carburetor body. Use exhaust nut wrench (P/N 909522) to remove bezel nut holding exhaust pipe to cylinder. Remove muffler assembly from frame. Disconnect magneto primary coil wire at Molex plug juncture near ignition coil. Unhook lighting cord wires at nearest juncture point from engine. (If color-coded matching wires are not used at this juncture, then record exact wire-to-wire pairing). Remove clutch cable. Place transmission in neutral and remove master link from drive chain. Pull drive chain free of countershaft sprocket. Finally, remove the engine mounting bolts and pull engine free of frame.

*(*This text is intended for general information only—different chassis makers will have deviations from the above peculiar to their machines.)*

B. Dismantling Engine Case Assembly

Although helpful, it is not necessary to mount engine in a fixture or jig to disassemble. Begin work by removing magneto cover, flywheel and magneto components.* Next, remove clutch side cover, clutch assembly and pinion gear.* Then remove cylinder head, cylinder and piston.*

*(*Consult Chapters II, III, and IV for detailed instruction)*

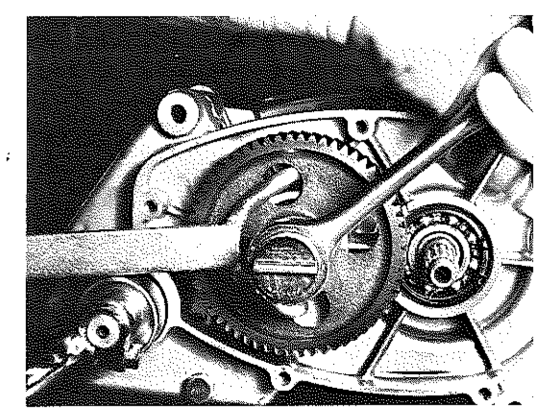


Fig. 44 Removing nut securing primary gear to transmission main shaft.

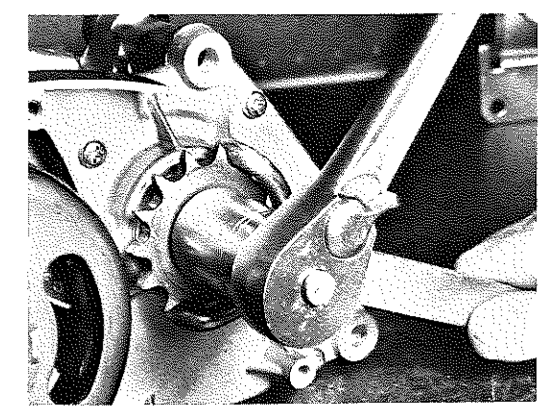


Fig. 45 Removing countershaft sprocket nut.

After clutch side cover has been removed, release kick crank lever, allowing it to rotate until the tension is off return spring. Remove kick crank clamp bolt counterclockwise with 10mm wrench and lift crank free of shaft. Remove kick spring and cover by pulling straightaway from case. Holding primary gear with holding tool (P/N 909523) back off main shaft nut counterclockwise with 19mm socket wrench (Fig. 44). After removing lock nut, primary gear may be removed by pulling gear straightaway with fingers.

The countershaft sprocket nut is locked in position by a steel washer which is partially bent over one flat of the nut. Bend this washer flat with screwdriver or flat punch and use 26mm socket to remove nut. Hold shaft from turning with holding tool (P/N 909523) while removing nut (Fig. 45). After removing nut, pull lock washer free then remove sprocket. Next, remove countershaft collar by pulling straightaway with the fingers. (Fig. 46).

Use hammer driver tool with large Phillips bit and remove the eleven crankcase setting screws on the left side of engine cases, turning them in a counterclockwise direction to loosen. *Tap* crankcase halves apart evenly from end to end (Fig. 47) with plastic mallet. Separate cases to approximately ¾", then tilt crankcase assembly on its right side, grasp left case with the fingers and push on ends of countershaft and crankshaft with the thumbs. Left case will then come free, leaving all crankcase components in right case half. Crankshaft, transmission shafts, gears, and kick starter components may then be lifted clear of right crankcase half. When removing counter shaft gears from counter shaft, the steel balls are likely to fall out. Therefore, it is advisable to dismantle counter shaft assembly over suitable container such as a flat pan, to prevent possible loss of the steel balls. *(Special Note! Crankshaft, transmission, and kick starter parts may be separately removed for individual service—without disturbing adjacent components).*

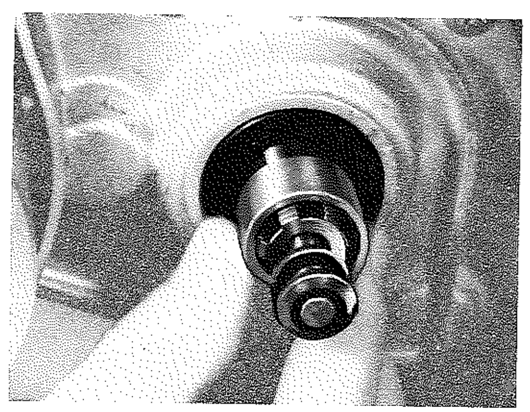


Fig. 46 Removing shaft collar from countershaft.

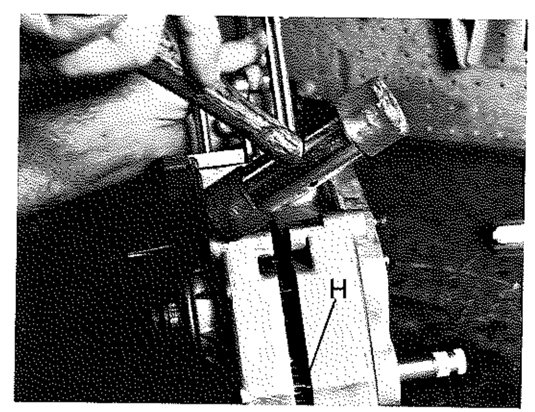


Fig. 47 Method of separating crankcase halves. Note (H) crankcase alignment dowel.

The control shaft is removed from countershaft by depressing control shaft spring stopper with the tip of a small screwdriver or open end wrench and prying snap ring from shaft with tip of pen knife. Control shaft may then be withdrawn from opposite end. Be careful to shake the stopper, springs (2), steel washers (2), and ball

receiver from inside countershaft. Remove countershaft "O" ring seal from inside sprocket end of shaft with stylus or probe. *(Special Note! Control shaft may be removed for service without splitting crankcase. Simply remove magneto cover and clutch side cover. Control shaft snap ring is accessible from outer right side of crankcase (Fig. 48).*

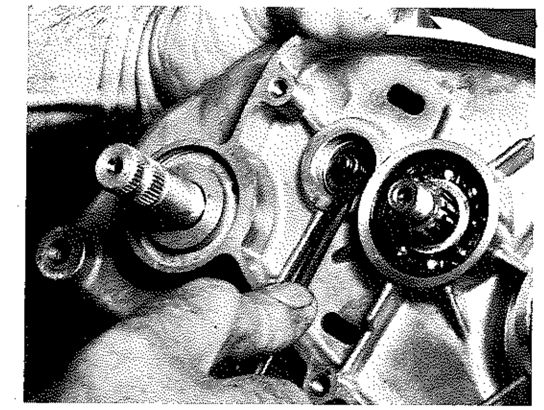


Fig. 48 Using screwdriver to depress control shaft spring stopper.

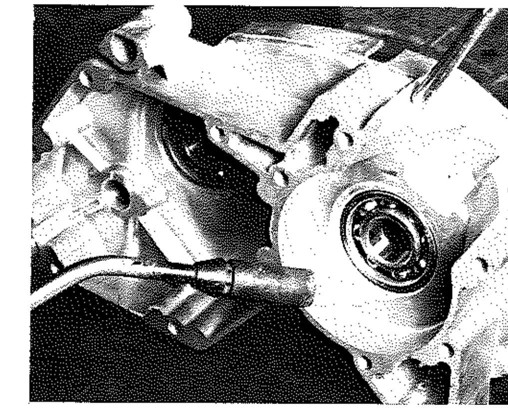
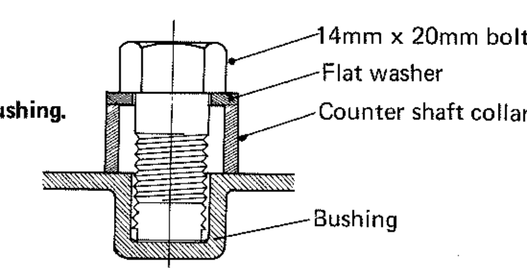


Fig. 49 Heating bearing bosses with butane torch.

Remove and discard crankshaft oil seals and counter shaft oil seal from cases by reaching through the bearings with flat punch or screwdriver blade and driving seal away from bearing. When removing oil seals, use care not to damage seal shoulder surface with tools. Lift and discard "O" ring seal from right case kick starter passage with metal stylus or probe. Remove ball bearing snap rings in right case with snap ring pliers. Heat cases around bearing bosses with butane torch (Fig. 49) and tap bearings free of case with brass drift and hammer. Do not allow torch flame play on bearings while heating. *(Note! the following operations should be performed only if bushings show evidence of radial wear).* Tap counter shaft bushing out of right case with bushing driver. Remove main shaft bushing in left case as follows: Thread bushing with 14mm bottom tap. Place counter shaft collar and flat washer over bushing and tighten 14mm x 20mm bolt into bushing (Fig. 50). As bolt tightens, bushing is pulled from case.

Fig. 50 Method of Extracting Mainshaft Bushing.



C. Cleaning and Inspecting Engine Case Components

Detailed instruction for cleaning and inspecting magneto components, clutch assembly, and cylinder/piston assembly are covered in Chapters II, III, and IV.

Clean engine case components in solvent, dry with air blast or clean cloth. Pay special attention to cleaning crankshaft bearing oil passage of left case and transmission breather in right case (Fig. 51). Clean traces of gasket sealer from cases with lacquer thinner. After drying, protect ball bearings and connecting rod needle bearing by oiling lightly.

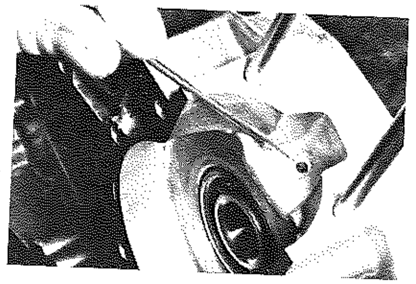
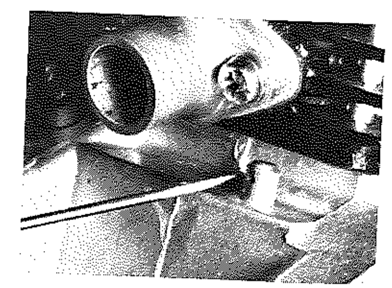


Fig. 51 1. Oil passage in left crankcase half.
2. Transmission breather.



Inspect ball bearings for wear by placing face down on clean work bench, hold inner and outer races with fingers and attempt to push bearing retainer and balls around with a wood dowel. If retainer and balls can be slipped between the races, bearing is worn to the point of replacement. Check bearings for galled or pitted conditions by rotating. If bearing action is rough or catchy, replace. Inspect crankcases for fractures, damaged sealing surfaces, or worn bearing mounts. If fractured in a critical area such as through a bearing mount, it is advisable to replace cases. Crankcase center line sealing surface must be free of gouges, dents or other damage that would prevent good case to case seal. Replace if conditions warrant. In the instance of sloppy bearing to case fit (outer bearing race spinning in bearing mount), it is advisable to replace crankcases. *(Note! Crankcases are supplied in pairs only!)*

Examine the four counter shaft gears for chipped or broken teeth, galled or roughened bores, or other physical damage. Replace any such damaged gears. Inspect counter shaft and replace if gear surface is worn more than .0005" (.013mm), if gear surface is galled, if sprocket mounting splines are broken or worn more than .005" (.13mm), or if sprocket nut threads will not properly accept sprocket nut. Check counter shaft sprocket for hooked or chisel-pointed chain teeth or damaged splines in hub. Discard and fit new sprocket if wear is appreciable. Examine control shaft for bent condition by chucking tip end in electric drill, If shaft rotates in an eliptical pattern at the spool end, replace. Examine snap ring seat at tip end of control shaft. Replace shaft if damage or wear would allow snap ring to come off under operating conditions. As a preventative maintenance procedure, discard and replace control shaft springs and snap ring. Carefully inspect steel counter balls, shaft spacers, counter shaft nut and lock washer, replacing parts if physical damage or wear is apparent.

Examine main shaft gear cluster for chipped or broken teeth, broken or worn splines, worn or damaged threads or roughened bearing surfaces. Replace if such conditions are present. Check main shaft primary gear for visibly worn teeth, broken teeth, worn or damaged splines in hub—replace if worn or damaged.

Inspect kick shaft for possible depressions worn into shoulder ramps by the action of steel rollers. Any wear in excess of 0.0005" (0.013mm) makes replacement advisable. Examine kick shaft and kick crank splines for worn or smashed teeth. If replacement is necessary, replace both shaft and crank at the same time. Replace the kick roller retainer as preventative maintenance procedure. Check kick gear for damaged teeth, galled shaft bore, or scored roller bore surface, replacing gear if conditions indicate. Look steel rollers over carefully. Replace if worn or galled. Discard kick spring cover for new one if bent or dented. Check kick spring for wear at angles formed by mounting prongs. Install new spring if wear is visible.

Visually examine crankshaft assembly for the following conditions: Galled bearing mounting surfaces, chipped keyway, worn spots on taper, worn or broken clutch hub splines, damaged threads at shaft ends, discolored appearance of connecting rod big end, chewed or otherwise damaged thrust washers, rough and catchy action of rod needle bearing, radial movement in rod big end. Any of the foregoing conditions requires crankshaft disassembly to replace defective parts.

Check crankshaft for the following: **a)** Piston pin to connecting rod bearing clearance with piston pin installed in i. d. of needle bearing is 0.0003" (0.007mm) to 0.0006" (0.014mm) (if clearance is in excess of this amount, connecting rod requires replacement). **b)** Crankshaft bearing surface runout -0.0008" (0.013mm) maximum allowable (Fig. 52). Measure runout in alignment jig or device capable of measuring both right and left bearing surfaces simultaneously. Crankshaft runout or "drift" may be corrected by the usual brass hammer and wooden block methods of aligning flywheels, checking progress often in alignment jig.

If crankshaft assembly requires dismantling, heat area around crankpin with butane torch and use a two leg puller to pull flywheel from crankpin. *Caution! Never press crankpin needle bearing area through mounting bores to disassemble crankshaft as this can easily ruin the crankpin mounting bores.* Repeat heating process on the opposite flywheel and employ the puller to push crankpin out of mounting bore. If connecting rod or needle bearing requires replacement, it is advisable to replace crankpin, rod and bearing as an assembly.

D. Reassembling Crankshaft Assembly

Press new crankpin into one-half of the crankshaft until pin comes flush with outer edge of mounting bore. Install needle bearing and connecting rod onto crankpin. Set opposite half of the crankshaft into position, aligning carefully with eyesight and/or carpenters squares and press onto crankpin. As with the first half, press the crankpin flush with outer edge of mounting bore. Mount crankshaft assembly into alignment jig and measure bearing surface runout (Fig. 52). Adjust flywheel with *brass* hammer and hardwood block, recheck in jig, repeat process until runout is at or less than 0.001" (0.025mm). As a final precaution, check distance measurement "A" per Fig. 52 and lubricate needle bearing with oil.

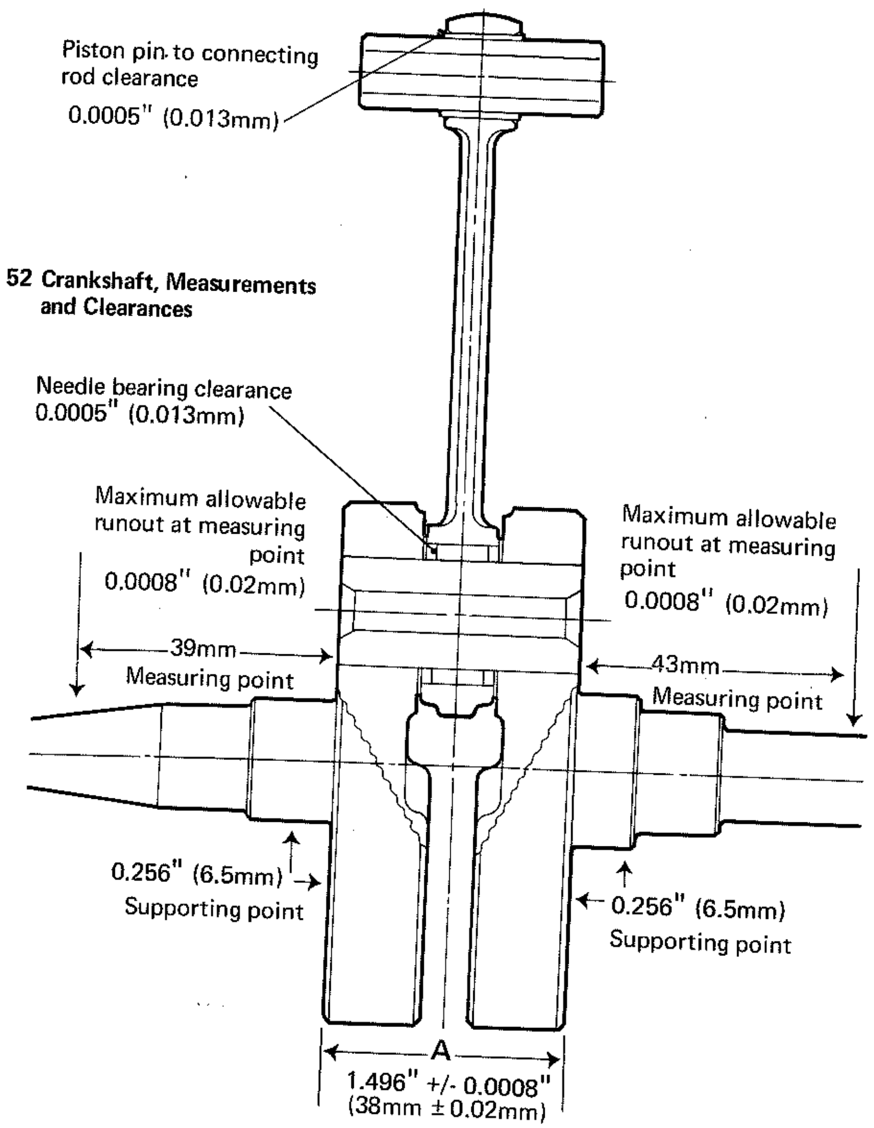


Fig. 52 Crankshaft, Measurements and Clearances

E. Reassembling Engine Case Assembly

Heat bearing bosses in crankcases with butane torch (Fig. 49) and install ball bearings. Use snap ring pliers to replace bearing snap rings in right case. Tap transmission countershaft bushing into right case with bushing driver. Use bushing driver to install main shaft bushing flush with surface in left case. Install inner right case crankshaft oil seal, cupped side *away from* bearing and flush with crankcase surface.

Insert new "O" ring into groove in right case kick shaft passage. Install outer left case crankshaft and counter shaft oil seals, cupped side towards bearings and flush with case surface. Lubricate oil seals and bearings with a small amount of motor oil and insert crankshaft assembly into right case. Check that splined end of shaft protrudes from primary side of right case and connecting rod is not resting against sealing edge of case.

Insert new "O" ring into groove in counter shaft bore at threaded end of shaft. Lubricate "O" ring lightly with oil and push control shaft into counter shaft bore. Install left wound spring, steel washer, ball receiver, steel washer, right wound spring, and spring stopper *(collar side towards snap ring groove)* over tip end of control shaft. Use snap ring tool (P/N 909525) to install snap ring onto control shaft. Check carefully to see that snap ring has fully engaged its seat and spring stopper collar surrounds snap ring. *(Special Note! Control shaft springs must be installed so that spring angles face each other (Fig. 38). A quick method of determining which spring is right or left wound is to make a loose pyramid with the thumb and first two fingers of one hand, inserting the spring part way into pyramid and turning spring clockwise with the other hand. If the spring is wound left hand, it will wind out of the pyramid–if wound right hand, it will wind down into the pyramid).*

Place a little grease in the ball pockets of the counter shaft and insert the 16 steel counter balls into the counter shaft pockets. Lubricate the counter shaft bushing in the right case, slip the 19mm i.d. steel spacer onto bushing end of counter shaft and install shaft into right case. Install main shaft into ball bearing in right case. Place the 28T, 30T, and 34T counter shaft gears over counter shaft with gear shoulders towards threaded end of shaft.

Slip kick roller retainer, notched side first, onto kick shaft from splined end. Push roller retainer hold snap onto backside of retainer. Install snap ring onto groove behind kick roller retainer. Hold kick shaft vertically, with retainer against kick shaft shoulder and insert the five steel rollers. Install kick gear over blind end of kickshaft so that the gear shoulder covers the roller mechanism. Slip the 16mm i.d. x 1.5mm thick thrust washer over splined end of kickshaft and install shaft assembly into right case. Finish kickshaft assembly by placing .3mm thick thrust washer over blind end of shaft, seat hold snap tang between casting webs in right case to prevent its rotation and mesh kick gear with 34T countershaft gear.

Place the 39T countershaft gear onto countershaft–*shoulder side out.* Install 21mm i.d. x 1.5mm thick spacer and 21mm i.d. x 0.2mm thick shim over countershaft end. Check that crankcase alignment dowels are in place, coat centerline sealing edge of both cases with non-hardening gasket sealer (Fig. 54) and slip left case into place. Ease left case *evenly* onto alignment dowels and gently tap cases together. *Be careful that connecting rod does not become trapped between edge of cases during this operation.* Install the 11 Phillips head crankcase screws* and tighten with hammer driver tool. Check kickshaft end play and countershaft end play after tightening cases together. Proper end play is 0.002" (0.05mm) to 0.004" (0.1mm). Thrust washers are available for this purpose. *(*Note! Three of the crankcase screws are 40mm in length, the other eight are 45mm in length–see Fig. 55 for installation pattern.*

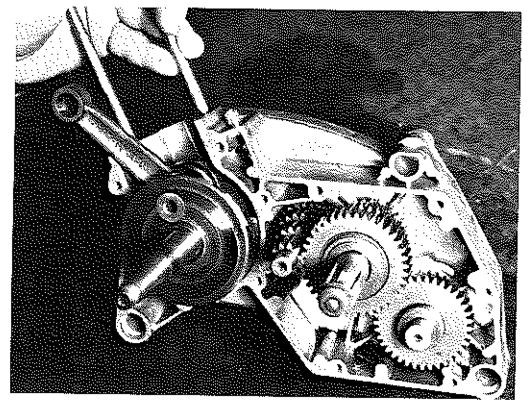


Fig. 53 Components assembled into right case.

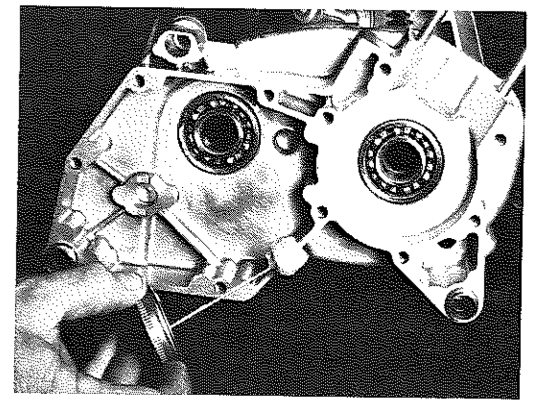


Fig. 54 Applying sealer to crankcase sealing edge prior to reassembly.

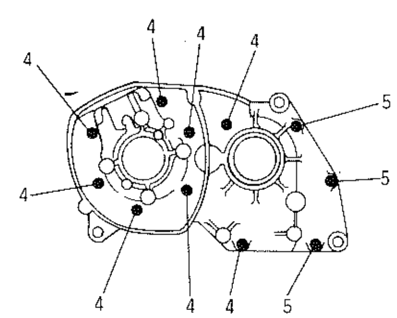


Fig. 55 Installation pattern for crankcase screws. #5 holes are for 40mm screws - #4 holes are for 45mm screws.

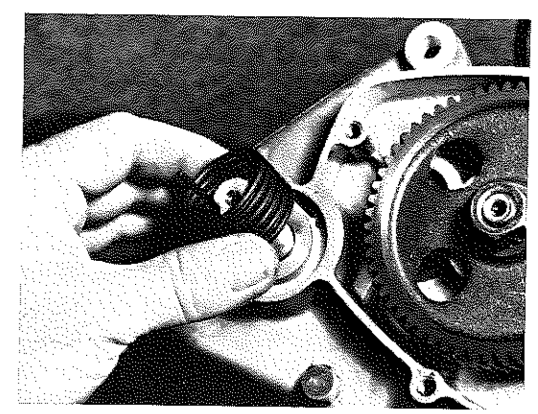


Fig. 56 Installing kick spring. Short prong of spring fits into crankcase.

Push sprocket collar onto counter shaft, install sprocket, lock washer and nut, tighten nut clockwise with 26mm socket, holding sprocket from turning with holding tool (P/N 909523). Bend lock washer over one flat of sprocket nut with screwdriver or punch. Turn engine over onto left side and insert short prong of kick spring into case (Fig. 56). Slip spring cover over spring, align kick crank over shaft splines and kick spring prong, push crank home, install clamp bolt and tighten and rotate kick crank counterclockwise enough to clear engine mounting bolt hole. Then lock the crank from returning with screwdriver inserted into bolt hole. Install primary gear onto mainshaft. *(Note!·On some primary gears the hub is machined longer on one side. If this is true of the primary gear being installed, mount the long hub side towards engine case).* Install mainshaft lock washer and nut, tighten to 180 in. lbs. (2.0 kg. m.). Engine reassembly from this point is covered in Chapters II, III and IV.

4. Magneto Cover Shifter Assembly Service

A. Disassembling Magneto Cover Assembly

Assuming the magneto cover to be free of the engine, begin work by removing the two Phillips head screws securing the foot change inside cover to magneto cover. Use 10mm wrench to remove clamp bolt from foot change lever and lift lever free. Employ a pair of snap ring pliers to remove the snap ring (Fig. 35) from foot change shaft. Push foot change shaft out of magneto cover and lift ratchet and spring free. (Be sure to recover foot change shaft shim(s). Remove snap ring holding shaft key to foot change shaft and pull key free. Remove ratchet plunger and plunger spring. Unscrew grease nipples with 10mm box end wrench. *Note! If shifter pin requires removal (so as to shim up excessive end play, etc.) is will be necessary to drill a 1/8" hole through the magneto cover axially in line with the shifter pin passageway. (Fig. 57) Use a 3" length of 1/8" welding rod to tap the shifter pin out of the magneto cover. Recover shifter pin shims from case after removing shifter pin.* Remove snap ring from sliding pin and unscrew lock nut from adjusting bolt. Shifter arm assembly is now free to come apart.

B. Cleaning and Inspecting for Wear

Wash all parts in solvent, dry with air blast or cloth. Examine magneto cover for fractures, "egg" shaped wear pattern in foot change shaft or shifter pin passages, worn or damaged foot change shaft stops, or other apparent damage. Replace as necessary. Examine foot change shaft for worn or broken splines. If shaft splines are damaged, replace foot change lever at same time. Check shaft key pin in foot change shaft for worn or loose condition; if necessary, press new pin into shaft. Inspect shaft key for wear by comparing it to a new one; if wear is appreciable, replace. As a preventative maintenance procedure, replace sliding pin and shaft key snap rings with new ones. Inspect ratchet teeth for signs of wear. Replace ratchet if indented wear exceeds 0.005". Check ratchet spring for broken, bent, or nicked prongs; replace as per condition. As matter of course, replace the snap ring securing the foot change shaft in the case. Examine shifter arm and shifter guide for wear in shifter pin or adjusting bolt holes; if wear is apparent, replace parts. Inspect ratchet plunger for worn tip or rusted condition; if worn, replace; if rusted, sandpaper clean. Check plunger spring condition and replace if rusty, or spring coils have collapsed. Replace inside cover dust seal as a preventative maintenance procedure. Examine inside cover sponge rubber packing—if packing no longer provides an effective seal, peel off old one and replace with new.

C. Reassembling Magneto Cover Assembly

Lubricate foot change shaft, shifter pin and ratchet plunger passages with chassis grease. Push sliding pin into shifter arm and secure with snap ring. Insert adjusting bolt through shifter guide and shifter arm as per Fig. 35. Place lock washer onto bolt and secure lightly with lock nut. Push shifter pin through both shifter arm and shifter guide to align. Insert shifter arm assembly into case and measure side clearance with feeler gauge. Proper side clearance is 0.02mm—spacers are available in 0.02mm and 0.03mm sizes for this purpose. Tap shifter pin through cover until visible at shifter arm slot. Insert shifter arm assembly into slot (engagement pawl of shifter guide outwards—sliding pin on shifter arm facing front of case) and tap pin almost through arm and guide. Install spacers and tap pin through and into cover until pin clears foot change shaft passageway.

Install ratchet spring prongs facing outward and astride the head of the center screw in the cover (Fig. 39, Plate "A"). Insert ratchet plunger and plunger spring into cover. Place ratchet-slotted side down into cover. Engage plunger in neutral notch and shifter guide pawl into large notch on ratchet, (Fig. 39). Place shaft key onto foot change shaft pin, (shoulder side out) and secure with snap ring. Insert foot change shaft through ratchet and cover, center shaft key shoulders between spring prongs. Install shaft shim(s) and snap ring on outside of shaft. Check foot shaft end play. Proper end play is between 0.008" (0.2mm) and 0.012" (0.3mm). Spacers are available in 0.2mm and 0.3mm sizes to correct end play movement.

After checking (or adjusting) foot change shaft end play, install foot change lever and check action of ratchet mechanism. Pack shifter mechanism cavity with chassis grease to prevent dirt and water from fouling shifter components. Position inside cover on magneto cover and tighten the Phillips head screws holding cover in place. Adjust shifter arm position as described in section #1, item "B". Mount assembly according to instructions in Chapter III. *Note! If shifter pin has been removed by drilling access hole in magneto cover, it will be necessary to seal the access hole to prevent water entering the passageway. This is best accomplished by using a self-tapping sheet metal screw or sealing with Epoxy.*

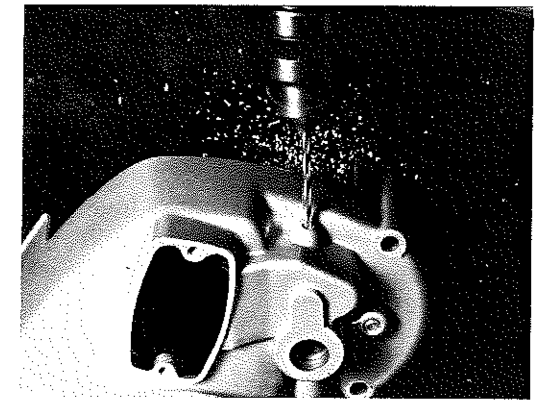


Fig. 57 Method of drilling access hole in order to remove shifter pin.

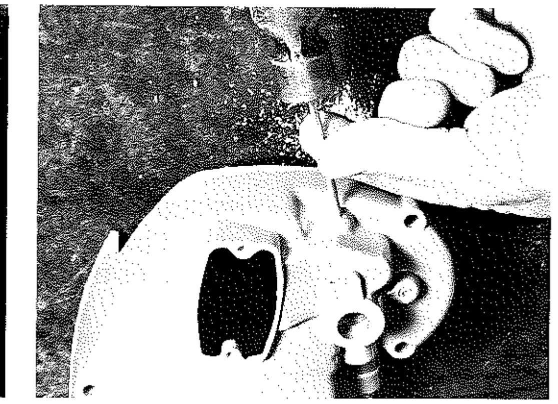


Fig. 58 Using 1/8" welding rod "punch" to remove shifter pin from magneto cover.

A. Heat Ranges

Spark plugs are designed in several "Heat Ranges." "Heat Range" refers to the ability of spark plugs to absorb and dissipate heat. Spark plugs with long insulator noses retain heat enough to burn off oil and combustion deposits under light service conditions. Spark plugs with short insulator noses will transfer heat rapidly and prevent pre-ignition and detonation under severe service conditions.

B. Numbering System for Heat Range

The NGK Spark Plug numbering system on the insulators indicates the "Heat Range" of each type. The higher or larger numbers designate "colder" plugs which dissipate heat quickly for high speed and heavy load. The lower or smaller numbers designate "hotter" plugs which retain the heat for low speed and light load. For example, if the B-8S becomes fouled with carbon or combustion products, replace with series B-7S. If the B-8S becomes overheated and causes pre-ignition or rapid electrode wear, replace with B-9S.

C. Length (Reach)

The length of the threads on a spark plug is called "reach." Various reaches from ½" to ¾" are used in different types of engines. Caution: There are also different lengths of spark plugs with the same thread size. When choosing a spark plug, be sure to select the correct reach. If a wrong length plug is used, the engine's full performance cannot be obtained. If the reach is too long, there is a possibility of the plug nose's touching the piston and damaging it. Correct reach for the F 480 engine is 3/8".

D. Electrode Gap

The correct electrode gap setting for F 480 engines is 0.024" (0.6mm) to 0.027" (0.7mm). Measure gap with feeler gauge and bend only the side (ground) electrode when resetting gap.

E. Cleaning

Even if the plug is the correct type, carbon deposits accumulate on the firing end over a period of time. The carbon deposits decrease the efficiency of the plug as carbon easily transmits electricity.

Clean deposits from firing end with small wire brush and air blast. File center electrode flat with point file and regap. If spark plug is oil fouled, it is best to replace the plug as cleaning will rarely restore it to service.

Use of a "sand blast" type spark plug cleaner to clean oily plugs is discouraged. Effective service life after such cleaning is far too short and quite often abrasive grit, trapped between shell and insulator, falls into the engine when the plug heats enough to expand and release the trapped particles.

F. Installation

Before installing plug, clean gasket seat. (Be careful not to allow dirt to fall into cylinder when cleaning gasket seat).

Smear a small quantity of graphite or molybdenum disulfide on spark plug threads and insert into cylinder head. Run plug down finger tight against gasket. Use a 13/16" (21mm) spark plug socket and torque wrench and tighten plug clockwise to 30 in. lbs. (0.35 kg. m.). Snug terminal nut with pliers and install high tension lead.

G. Various Aspects of Firing Ends

Examination of spark plug firing ends is an excellent means of determining engine operation condition.

H. Normal Operation

Under normal operating conditions, the firing end of the plug will appear brownish white to greyish white. (Fig. 61)

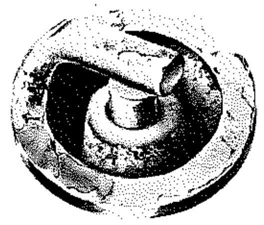


Fig. 61 Normal Operating Condition.

I. Oil Fouled

If the firing end appears wet and oily (Fig. 62), check for the following:

1) Excessive choking
2) Incorrect heat range (fit hotter plug)
3) Incorrect spark plug gap (gap plug 0.024" to 0.027")
4) Overrich fuel/oil mixture (correct)
5) Overrich fuel/air mixture (re-jet carburetor)
6) Ignition timing is late (time engine at 25° B.T.D.C.)
7) Burned or pitted breaker points (replace)
8) Low compression (overhaul top end assembly)
9) Dirty air cleaner element (clean)

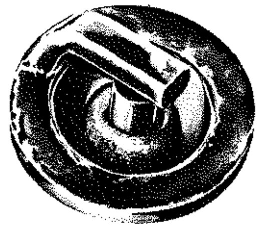


Fig. 62 Oil Fouled.

J. Carbon Fouled

Dry carbon deposits covering the plug firing end usually indicate the plug has been in service for some time (Fig. 63). Clean and gap as previously described or replace with new plug. If the deposits have a blackish appearance, chances are the heat range is somewhat cold for operating conditions or the main jet one step too rich.

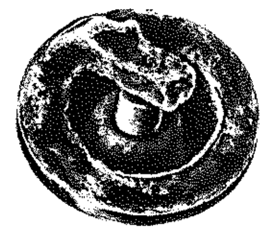


Fig. 63 Carbon Fouled.

K. Overheating

Serious engine overheating is indicated if the plug firing end appears ash white in color, the electrodes are eroded, or if the insulator nose cone is blistered (Fig. 64).

To determine the cause, check the following:

1) Severe operating conditions (fit colder plug)

2) Plug is loose in head or no gasket is fitted (tighten plug: replace gasket)

3) Wrong length (reach) plug (fit plug with 3/8" reach)

4) Fuel/air mixture too lean (check for crankcase air leak, blown head gasket, lean carburetor setting)

5) Insufficient or no oil in gasoline supply (correct to 20:1)

6) Ignition timing too far advanced (retime engine to 25° B.T.D.C.)

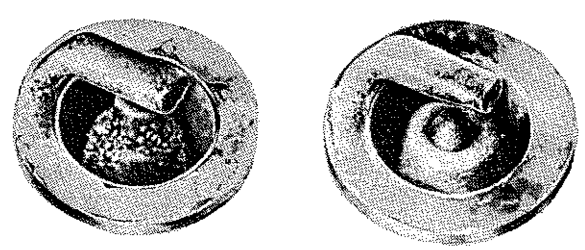


Fig. 64 Overheated Condition.

L. Whiskering

A lead or carbon particle's bridging the spark plug electrodes (Fig. 65) is quite often due to dirt either in the fuel supply or entering through the carburetor with the air stream. In some cases the brand of fuel or lubrication oil have produced "lead balling," a condition similar to whiskering. There is evidence to indicate a malfunctioning or out-of-time magneto will cause the plug to whisker. If plug whiskering occurs only rarely with the machine in question, simply clean the whisker from between the electrodes. If, however, the condition repeats itself with any degree of regularity, check for the following:

1) Dirt in fuel; no air cleaner or defective air cleaner (correct)

2) Heat range (try one range colder)

3) Brand of fuel or oil (change brands)

4) Ignition timing or magneto malfunction (retime or test magneto)

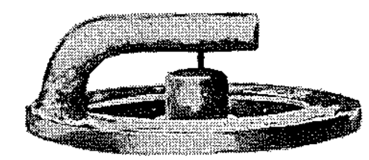
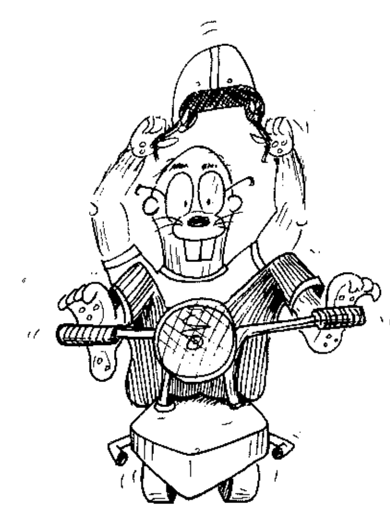


Fig. 65 Whiskered Condition.



Chapter VII

Fuel System

Includes: Carburetor, manifold, fuel lines, throttle cable assembly, twistgrip assembly, and air cleaner assembly.

1. Carburetor

The 18mm Mikuni, fitted as standard equipment to F 480 engines, is diecast alloy construction with brass fittings. Air vents and an overflow pipe prevent the engine from filling with raw fuel in the event of a leaking float valve. The carburetor design is conventional sliding throttle type with integral float chamber, and incorporates a built-in starting carburetor instead of the more usual choke or flooding device. A dual float controls the spring-loaded float valve, insuring an even fuel supply under all riding conditions.

The carburetor's function is to proportion and atomize the fuel/air mix drawn in by the engine. The twistgrip controls the volume of the indrawn mixture; therefore, the power.

Briefly, the Mikuni carburetor operates as follows:

A. Starting Circuit

Depressing the carburetor starter lever lifts the plunger unit inside the mixing chamber casting (see Fig. 66). As the engine is cranked over, vacuum (atmospheric depression) created in the crankcase serves to draw fuel up through the starter main jet where it mixes with air in the float chamber emulsion tube and again with air coming through the air horn inlet passage. The air/fuel mixture then enters the throttle bore through an orifice located behind the throttle slide, thus providing the engine with a fuel rich mixture for starting.

B. Idle to Intermediate Speed Circuit

At idle speed the throttle valve is almost closed, allowing only a small amount of air to pass under the valve. Air also enters through the air inlet, is metered past the pilot air screw and into the engine through the low speed orifice in the throttle bore (Fig. 67). As air passes through the orifice well, it mixes with fuel drawn up through the pilot jet. When the throttle valve is opened, air is directed initially across the low speed orifice and then across the needle jet, drawing fuel up through, first, the low speed orifice and then the needle jet. In this manner the transition from the idle to intermediate circuit is accomplished. The cutaway on the throttle valve influences

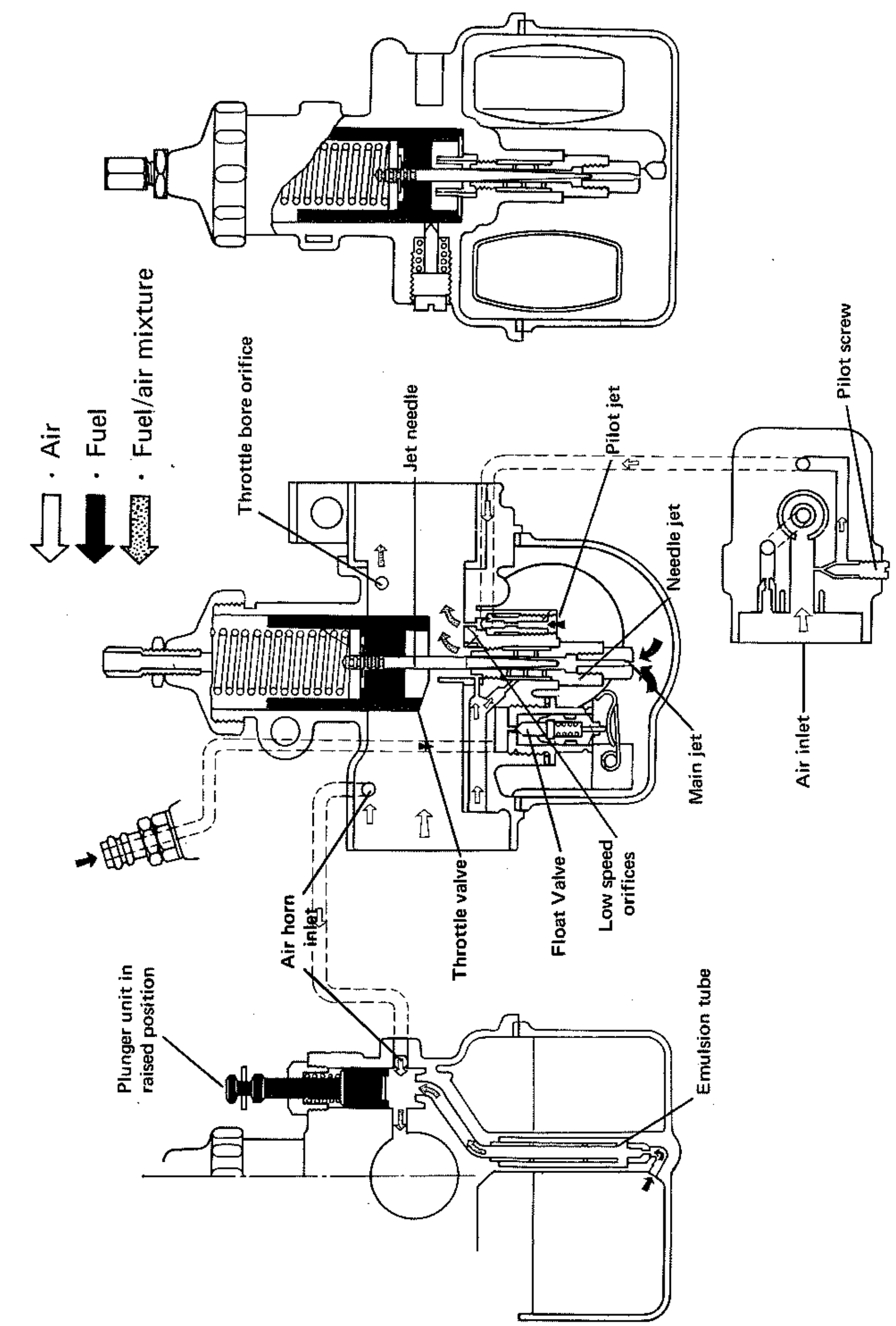


Fig. 66 Starting Circuit F 480 Carburetor.

air stream direction from just off idle setting to approximately ¼ throttle opening. The fuel/air mixing ratio in the idle to intermediate speed circuit is controlled by the externally adjustable pilot air screw and the height of the throttle valve cutaway.

C. Intermediate to High Speed Circuit

As the throttle valve is opened past the ¼ open position, the air stream mixes with fuel drawn through the needle jet from the main jet (Fig. 68). Incoming air also enters the air jet and mixes with fuel passing through the needle jet, creating a bubbling mixture which is more easily atomized by the venturi air stream. From ¼ to ¾ throttle valve openings the height of the needle in the needle jet controls the fuel/air mixing ratio and from ¾ to full open the main jet size controls the mixture ratio.

Fig. 67 Idle to Intermediate Speed Circuit.

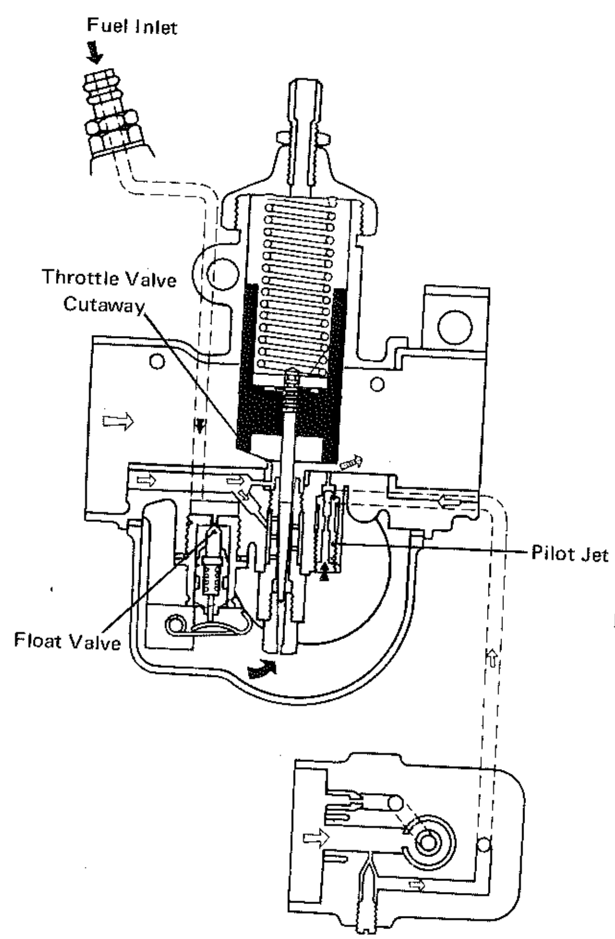
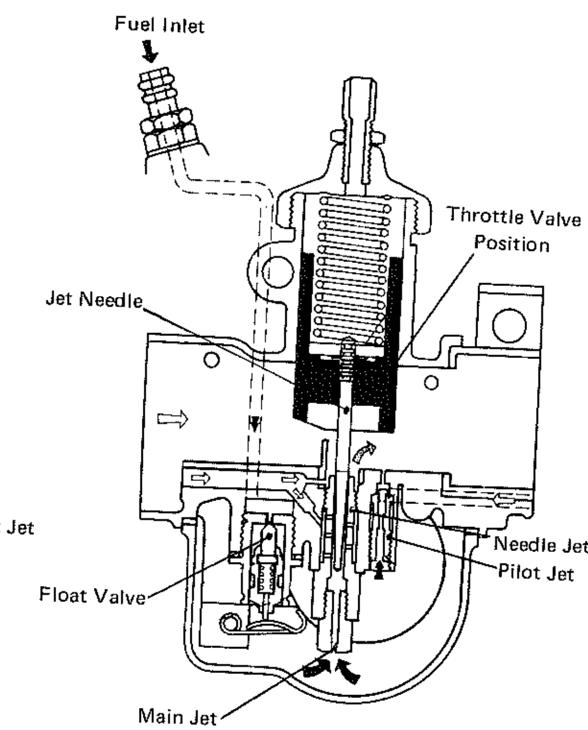


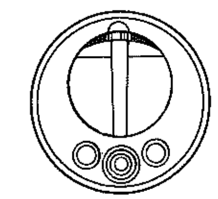
Fig. 68 Intermediate to High Speed Circuit.



D. Mixture Adjustments

The carburetor operation is automatic throughout the throttle range. Adjust the carburetor in the following sequence to avoid disturbing completed adjustments. It is assumed normal fuels are used, ignition timing is standard and the engine is in good condition and free of air leaks.

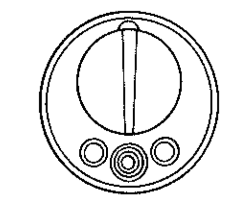
1st) Main Jet



Throttle Opening

Between

¾-1



Road test the machine at full throttle on a straight and level road. Use top (4th) gear for test purposes. If the engine rpm increases when the throttle is backed off slightly, the main jet size is too large (rich). If the engine "4 strokes," smokes heavily or stutters at full throttle setting, the main jet size is too large (rich). If the engine rpm drops when the throttle is backed off slightly, the main jet size is correct or slightly small (lean). *Note: always adjust for a slightly rich main jet—then drop down one jet size and the main jet should be correct.* The standard main jet is a #80, the next larger, a #90, the next smaller, a #70.

To change main jet, begin by turning off fuel cock(s) and removing air cleaner assembly. Next, remove carburetor from manifold, using a flat bladed screwdriver to back off spigot clamp bolt. (Unless the carburetor is to be dismantled for cleaning at this time, it is unnecessary to remove mixing chamber cap and throttle cable/slide assembly.) Invert the carburetor and unscrew the four Phillips head screws holding float chamber in place. Tap chamber lightly with heel of screwdriver to break gasket seal. Lift float chamber free and remove main jet with 6mm wrench, replace main jet with chosen size and reassemble in reverse order. Road test for result. Cross check adjustment by examining the condition of the spark plug firing end (see Chapter VI).

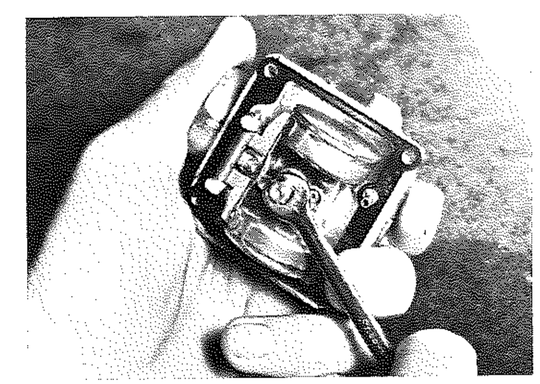
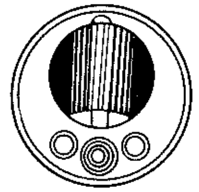
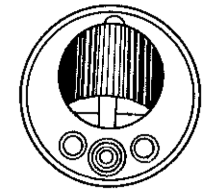


Fig. 69 Removing Main Jet.

2nd) Pilot Jet



Throttle Opening
Between
0-⅛



Turn pilot screw lightly onto its seat and back out 1¼ turns. Start engine and allow it to warm up thoroughly. Turn knurled throttle adjuster (Fig. 70) in the mixing chamber side clockwise until engine speed is approximately 1800 rpm (fast idle). Turn the pilot air screw (Fig. 71) clockwise until engine runs at its slowest speed. After finding slowest speed, back the air screw ¼ turn counterclockwise (engine speed will still be high at this stage). Next, turn throttle adjuster counterclockwise until engine almost stops (approx. 1200 rpm). Turn pilot air screw in and out within ¾ of a turn to find the position where the engine runs best. The mixture adjustment is complete at this point.

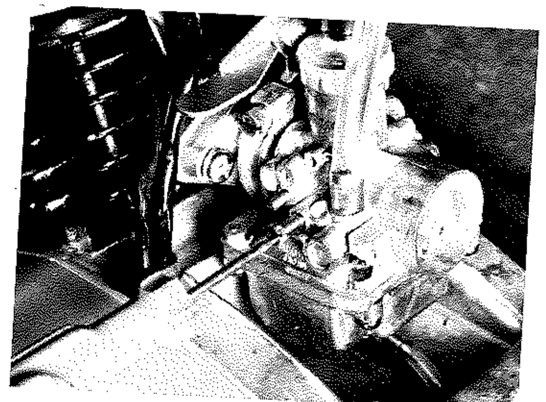


Fig. 70 Using knurled throttle adjuster to regulate engine idle speed.

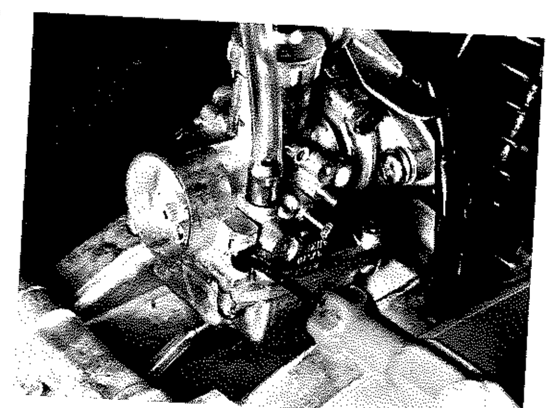
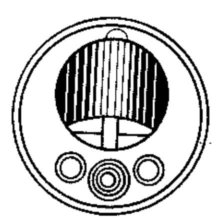
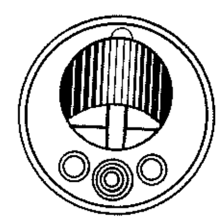


Fig. 71 Adjusting idle mixture with pilot air screw.

3rd) Throttle Valve Cutaway

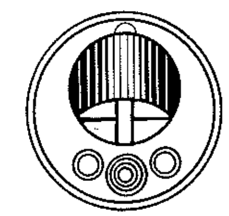


Throttle Opening
Between
⅛-¼

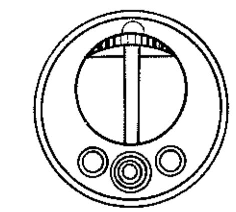


Throttle valves are numbered to indicate the height of the cutaway (Fig. 72) (for example a marking of 2.0 indicates the height of the cutaway to be 4mm). Fitting a replacement throttle valve with a higher number decreases air velocity over needle jet, resulting in a leaner mixture ratio, while a smaller numbered valve increases air velocity with the opposite result. Adjusting by changing cutaway, however, affects engine performance at speeds below ¼ throttle opening; therefore, unless there is an urgent necessity or a special racing application do not change from the standard cutaway.

4th) Jet Needle



Throttle Opening
Between
¼-¾



There are 5 grooves in the jet needle. Beginning with the topmost groove, they are counted 1, 2, 3, etc. on down (Fig. 73). The 4th groove is the standard position. Road test the machine. If between ½ and ¾ throttle openings the exhaust smoke is white in color or the engine is sluggish or "4 strokes," it indicates the mixture is rich. If the engine rpm fluctuates while riding at the same throttle setting as described above or the machine feels as though the brake were being lightly applied, the fuel mixture is too lean. To correct rich or lean condition, unscrew mixing chamber cap, and pull throttle valve assembly clear. Collapse throttle spring and pull it to one side of the valve. Push jet needle out through the top of the throttle valve, being careful to recover the jet needle spring seat. Use pliers to remove the jet needle clip and reposition higher (leaner) or lower (richer) as necessary. Reassemble in reverse order and road test for result. *Note: Jet needle changes of one notch affect main jet size by 10%, therefore, after adjusting jet needle, recheck main jet operation for rich or lean condition.*

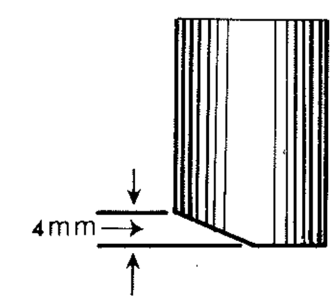


Fig. 72 Throttle Valve Cutaway.

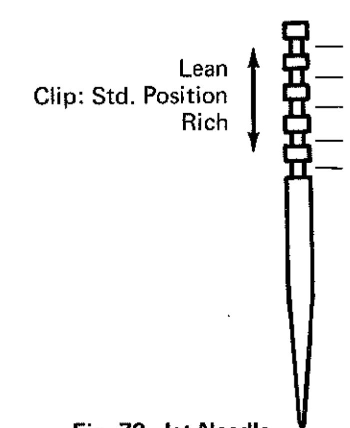
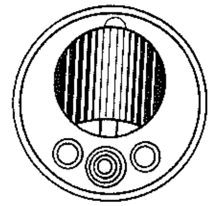
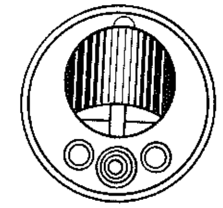


Fig. 73 Jet Needle

5th) Pilot Jet



Throttle Opening
Between
0-1/8



Finish the carburetor adjustments by touching up pilot air screw adjustment to insure crisp acceleration from idle.

E. Engine Idle Speed Adjustment

Adjust engine idle speed by turning knurled adjuster (Fig. 70) counterclockwise to slow idle speed or clockwise to increase idle speed. Before adjusting, check throttle cable housing to insure housing has between 1/32" to 1/16" free slack, turning cable adjuster (Fig. 70) in or out if necessary. Set idle speed for 1500 rpm with the headlight switched on (the alternator requires some engine power for operation).

F. Float Level Adjustment

Assuming the carburetor is free of the engine, begin by removing the four Phillips head screws securing the float chamber cover and tap the cover with the heel of the screwdriver to break gasket seal. Lift cover free, and holding carburetor inverted, measure float height for ¾" (19mm) between points shown in Fig. 74. If float requires adjusting, bend the needle actuating tab as shown in Fig. 75.

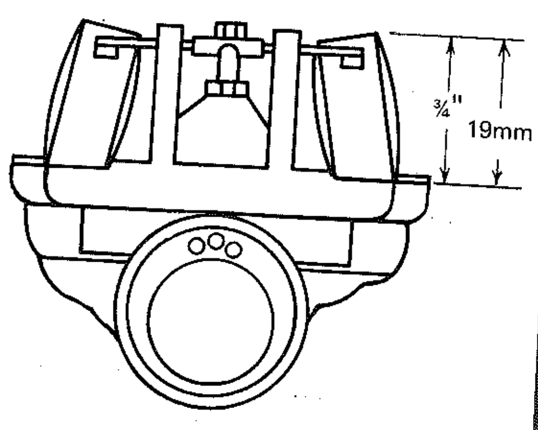


Fig. 74 Float Height Adjustment.

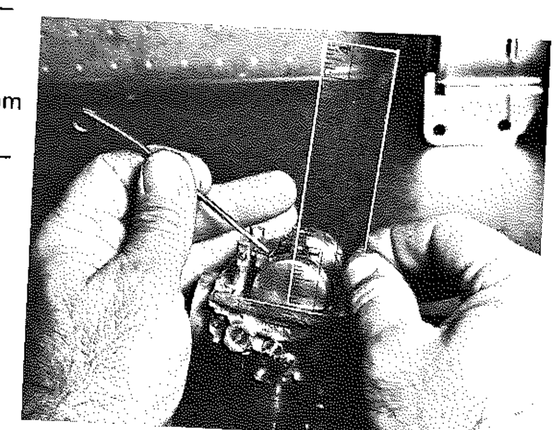


Fig. 75 Method of Adjusting Float Height.

Measure both sides to insure floats are matching height (correcting if necessary) and reassemble in reverse order.

Cautions:

Do not bend or twist floats to adjust float height, bend only the needle actuating tab.

Allow float to rest against float valve without pressure from tools or fingers while measuring float height.

G. Carburetor Service

1) Removing Carburetor From Engine

Turn off fuel cock(s) and disconnect fuel hose at carburetor inlet. Remove air cleaner assembly. Back off carburetor spigot clamp screw with flat bladed screwdriver. Pull carburetor from manifold and slip rubber cover on mixing chamber cap upwards on cable housing. Unscrew mixing chamber cap and pull throttle valve assembly clear of mixing chamber body. Remove drain tube from overflow pipe on float chamber body.

2) Removing Throttle Valve Assembly From Throttle Cable

Compress the throttle spring while holding the cable housing against the cable adjuster and slip the ball ended throttle cable free via the vertical groove in the throttle valve, then slip cable and housing from throttle valve assembly.

3) Dismantling Carburetor

Unscrew the four Phillips head screws securing float chamber body and tap cover to break gasket seal. Lift off body, remove and discard gasket. Push out float arm pin securing float and remove float and float needle. Use 6mm wrench and unscrew main jet counterclockwise. Use 8mm wrench and remove needle jet in similar fashion. Remove float valve seat with 8mm box end wrench and discard fibrous valve seat gasket. Unscrew pilot air screw counterclockwise and remove air screw and spring. Use a small flat bladed screwdriver and remove counterclockwise, pilot jet from mixing chamber casting. Use 12mm wrench to remove starter plunger unit and lever assembly. Unscrew cable adjuster from mixing chamber cap. Push jet needle and spring seat out of throttle valve and pull clip from jet needle with pliers.

4) Cleaning and Inspecting

Wash parts in solvent and dry with air blast or clean cloth. Use high pressure air blast to clear all jets and passages of dirt or foreign materials. Test soft plugs in mixing chamber casting with air pressure and liquid soap for leakage. Should a loose soft plug be discovered, stake around the plug with a thin punch and coat the area with non-hardening gasket sealer.

Special Note! Never use a wire or pin to clear obstructions from jets and passageways. To do so invites damage to precisely drilled holes. The starter plunger is Neoprene tipped, therefore, to avoid damaging the Neoprene, clean only in gasoline or solvent.

Inspect and replace mixing chamber casting if: fractured, throttle guide is worn or broken, mounting flange is warped, throttle valve bore is worn, threads are defective, or "home" modifications have been attempted.*

Compare markings on jets, float valve seat, throttle valve and jet needle with those listed for the stock carburetor, if other than stock parts have been fitted, change them for stock parts.** Inspect jets, throttle valve, float pin, cable adjuster screw, throttle adjuster screw, mixing chamber cap and top for damage, wear or modification attempts. Replace any questionable hardware. Examine float valve and seat for wear. Valve should be free of visible wear and spring pin should function, otherwise replace. Check float for leaking by shaking gently after holding submerged in gasoline for 10 minutes, inspect float also for bent or twisted conditions, repair or replace as necessary. Examine Neoprene seal on starter plunger and replace if indented or rough appearing. As a matter of course, replace float chamber gasket, float valve seat gasket and jet needle clip. Finally, check float chamber body for warped gasket surface.

*It is a fairly common occurrence for carburetor modifications to be carried out in an attempt to cure problems such as an air leak in the engine. Be sure to check out the engine condition thoroughly if this type of "cure" has been attempted.

**For a listing of stock part numbers, see Chapter VIII. Unless the engine is set up for special racing applications, the use of the other than stock components will only adversely affect carburetor operation.

5) Reassembling Carburetor

Arrange carburetor parts on a clean cloth. Install starter plunger assembly into mixing chamber body. Install pilot jet, being careful to properly engage threads. Install needle jet, tighten with 8mm wrench. Next, install main jet and tighten with 6mm wrench. Install new fiber washer over float valve seat and tighten seat into body casting. Insert float valve into float seat, position float over float valve and secure in place with float arm pin. Measure and adjust float height as per instructions under item F *Float Level Adjustment.* Position new float chamber gasket on mixing chamber casting. Install float chamber body onto gasket and secure to mixing chamber with four Phillips head screws. Install pilot air screw and spring; run screw down *lightly* on its seat and back out 1¼ turns. Slip drain tube onto overflow pipe and mount carburetor assembly onto manifold. Tighten carburetor spigot clamp bolt securely. Make sure carburetor is aligned through its vertical centerline with cylinder. Push fuel hose over fuel pipe on carburetor and install fuel line clip.

Install new clip in 4th notch of jet needle, place needle into throttle valve and position spring seat over jet needle.

Install cable adjuster into mixing chamber top. Assemble throttle valve, spring and mixing chamber top. Slip rubber cover and mixing chamber cap onto throttle cable assembly. Install throttle cable into throttle valve assembly. Insert assembly into mixing chamber with throttle valve cutaway facing air cleaner. (Be careful to engage jet needle in needle jet and throttle valve guide in groove of throttle valve.) Tighten mixing chamber cap and adjust throttle cable housing slack between 1/32" and 1/16". Turn throttle adjuster screw out until throttle valve is closed, then turn back one full turn. Start engine and proceed to tune carburetor according to instructions under item D *Mixture Adjustments.*

2. Manifold Assembly

The manifold (Fig. 76) is cast aluminum alloy with mating surfaces machine finished. Fibrous gaskets seal manifold to cylinder juncture. A phenolic heat block is permanently installed into the spigot neck of the carburetor and serves as both heat shield and gasket to the inlet neck of the manifold.

A. Service

Replace manifold gasket if manifold is removed for cleaning or cylinder assembly is removed for service. Check mating edges with straight edge and replace if warped in excess of .001". Replace manifold if fractured or cracked. Replace stretched or damaged manifold studs. Use lock washers in good condition between nuts and flanges.

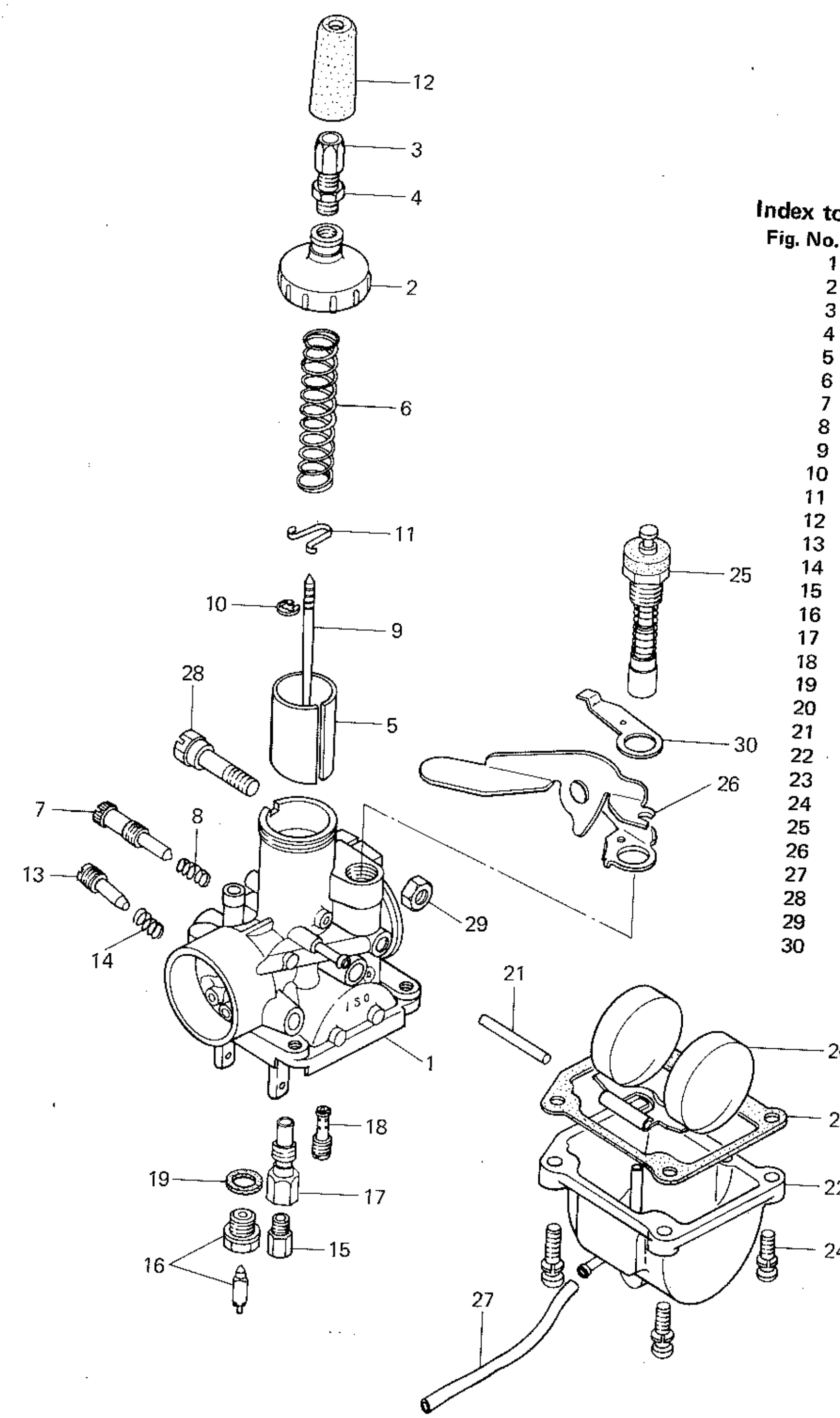
Special Note! Tighten manifold onto cylinder **evenly** *to avoid warping flanges!*

3. Fuel Lines

F 480 carburetors are designed to accept 3/16" i. d. clear plastic (PVC) tubing.

A. Service

Clear fuel line material tends to harden and shrink with age; therefore, it is advisable to replace fuel lines at least every 6 months. Use fuel line clips or safety wire fuel line connections to prevent leaks or the possibility of a line's coming off while the machine is being ridden. Carefully examine fuel hose connections to insure clip or safety wire has not cut tubing. When installing new fuel lines, do not allow them to rest against any part of engine or frame as vibration will quickly wear a hole in the tubing.



Index to Fig. 76

Fig. No.	Part Name
1	Body, mixing chamber
2	Cap, mixing chamber
3	Adjuster, cable
4	Nut, cable adjuster
5	Valve, throttle
6	Spring, throttle
7	Adjuster, throttle
8	Spring, throttle adjuster
9	Jet needle
10	Clip, jet needle
11	Seat, jet needle spring
12	Cover, mixing chamber top
13	Screw, pilot air
14	Spring, pilot air screw
15	Main jet
16	Needle valve
17	Needle jet
18	Pilot jet
19	Gasket, needle valve
20	Float
21	Pin, float arm
22	Body, float chamber
23	Gasket, float chamber
24	Screw, float chamber
25	Plunger unit, starter
26	Lever, starter
27	Vent pipe
28	Bolt, carburetor setting
29	Nut
30	Spring, starter lever set

Fig. 76 Carburetor and Manifold Assembly.

4. Throttle Cable Assembly

The throttle cable assembly consists of a double ball ended, stranded steel cable inside a flexible steel coil housing covered with plastic sheath.

A. Adjustment

Adjust cable housing slack from either the twistgrip cable adjuster* or mixing chamber adjuster by backing off jam nut and turning adjuster screw in or out as necessary. Correct adjustment calls for 1/32" to 1/16" slack.

**If so equipped.*

Cautions:

Tighten jam nuts after adjusting cable slack.

Adjust cable slack with throttle valve in closed position.

Do not adjust idle speed with cable adjuster(s). Use throttle adjuster on mixing chamber side for idle speed settings.

B. Lubrication

Remove throttle cable assembly from twistgrip by unscrewing the two Phillips head screws holding the twistgrip housing together and lifting cable free of twistgrip pipe. Use SAE 30W oil to lubricate cable. Apply tip of oil can to inner cable and work housing up and down while oiling to distribute lubricant throughout cable housing. After oiling, wipe off excess oil and reassemble twistgrip.

Recommended mileage between service—1,000 miles

Caution: **Do not bend or kink cable while removing or installing cable.**

C. Service

Remove throttle cable assembly as described under item B *Lubrication.* Inspect cable assembly and replace if kinked, outer housing is raveled, inner cable has broken or frayed strands, or cable assembly is rusty.

5. Twistgrip Assembly

The twistgrip pipe and two-piece housing are die cast alloy or plastic construction. A rubber grip covers the handle portion of the grip pipe.

A. Lubrication

Unscrew the two Phillips head screws holding the housing together and disassemble from handlebar. Clean components in solvent and dry with air blast. Coat handlebar with chassis grease where grip pipe turns as well as drum surface and insides of housings. Reassemble and tighten mounting screws *evenly.*

Recommended mileage between service—1,000 miles

Cautions:

Rest grip pipe cable holder atop lower housing shoulder before installing upper housing.

Install twistgrip assembly to allow rubber grip 1/8" clearance at handlebar tip to prevent drag.

B. Service

Disassemble twistgrip from handlebar. Clean in solvent and dry with air blast. Inspect grip pipe for broken or worn cable holder, drag at handlebar tip or other evident damage, replace as per condition. Inspect housings for wear, damaged threads, or fractures, replacing if such conditions are found. Inspect screws and replace if damaged, stretched or worn. Replace rubber grip if worn, loose or torn. When installing new grip, swill a small quantity of gasoline inside the grip and insert quickly over the grip pipe. When the gasoline evaporates, the rubber will adhere tightly to the grip pipe making adhesive sealers unnecessary.

When reassembling twistgrip, lubricate as per item A *Lubrication*. Rest grip pipe cable holder atop lower housing shoulder before installing upper housing, tighten screws evenly and check grip for 1/8" clearance at handlebar tip.

6. Air Cleaner Assembly

The air cleaner assembly consists of a washable poly-foam element in a two-piece canister. The connector between air cleaner and carburetor is a formed Neoprene hose clamped by spring clips (Fig. 77).

In operation air enters the inlet, strikes the indented end of the element and is deflected around and through the element. Large particles of dirt entering with the air stream are directed against the inner surface of the air cleaner body and collect there rather than on the element.

A. Cleaning and Lubrication

Release spring clips securing air cleaner body to mouthpiece and remove both element and body for cleaning. Clean parts in solvent and dry with air blast. Lubricate element and inside of air cleaner body lightly with SAE 10W oil. Reassemble onto mouthpiece.

Recommended mileage between service—1,000 miles

Cautions:

Use moderate air pressure to clean element to avoid damage.

Too much or too heavy a lubricant will cause overrich carburetion.

When oiling element, use only a small amount of oil and work thoroughly into material, including felt liners.

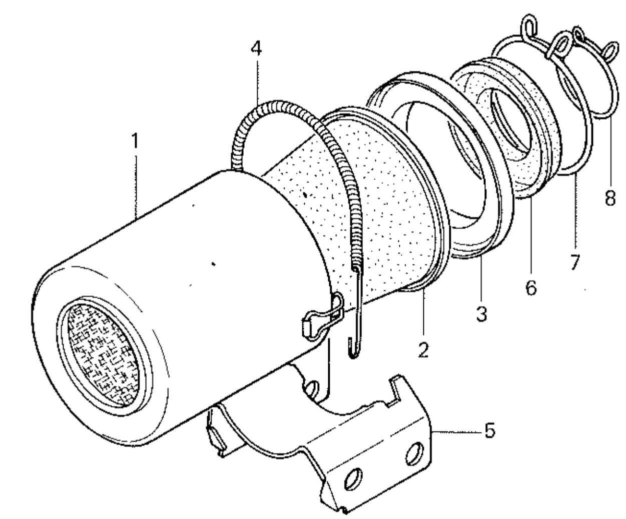


Fig. 77 Air Cleaner Assembly.

Index to Fig. 77

Fig. No.	Part Name
1	Body
2	Element
3	Mouthpiece
4	Spring
5	Bracket
6	Joint
7	Large spring
8	Small spring

Chapter VIII

Supplementary Specifications

ENGINE

Type	25° inclined single cylinder, two stroke/cycle air cooled engine. Loop scavenged, piston port induction.
Model	F 480
Rated horsepower	6.6 H.P./7000 RPM
Maximum torque	5.06 ft. lbs. /6000 RPM
Bore	48mm (1.89")
Stroke	44mm (1.73")
Piston displacement	79.6cc (4.86 C.I.)
Compression ratio	7:1
Exhaust duration	162°
Transfer duration	126°
Inlet duration	131°
Lubrication system	Fuel/oil mix
Fuel mixture	16:1—first 10 hours running time 20:1—thereafter
Recommended engine lubrication	SAE 30 W cycle 2 oil.
Starting system	Kick starter

CARBURETOR

Type	Horizontal mounted Mikuni instrument with sliding throttle and needle valve
Model	VM 18
Main jet	#80
Venturi	18mm
Needle jet	0-0
Jet needle	4F1-8
Needle clip position	4th notch
Pilot jet	#30
Idle screw adjustment	Appx. 1¼ turns from closed
Throttle slide	#3.0
Float valve seat	#1.5
Air cleaner	Washable poly foam element type.
Float adjustment	19mm (0.750" or ¾")

MAGNETO/ALTERNATOR

Type	Flywheel type Kokusan Electric Co. unit.
Model	FP4107
Lighting coil	21.8 watt rated
Lighting coil output	Green lead: 2.4 volts @ 2500 rpm, 6.1 volts @ 8000 rpm w/25 watt circuit load Yellow lead: 4.5 volts @ 2500 rpm, 8 volts @ 8000 rpm w/25 watt circuit load
Lighting coil resistance	2.5 ohm yellow lead 0.8 ohm green lead
Lighting coil air gap	Fixed

MAGNETO/ALTERNATOR Con't.

Ignition coil:	
Primary resistance	1.6 ohms
Secondary resistance	5000 ohms
Power test	Steady fire over 6mm gap @ 1000 rpm, 8mm gap @ 3000 rpm
Primary exciting coil output	8 volts @ 2500 RPM 15 volts @ 8000 RPM
Primary exciting coil resistance	0.6 ohm
Spark plug	B-8S
Condenser capacitance	0.25 to 0.27 Mf. (+or-10%)
Magneto drive	Engine crank shaft
Contact breaker gap	0.012" to 0.015" (0.3mm to 0.4mm)
Spark plug gap	0.024" to 0.027" (0.6mm to 0.7mm)
Firing point (ignition timing)	25° (0.102" or 2.6mm BTDC)
Ignition coil air gap	Fixed

CLUTCH

Type	2 plate, wet type, crankshaft mounted, spring tensioned.
Clutch spring free length	0.79" (20mm)
Clutch lever free play	See text
Clutch lever adjustment	By spacer
Spacers available	0.2mm -0.3mm -0.5mm
Friction plate thickness (new)	0.157" (4mm)

PRIMARY DRIVE

Type	Helical cut gears
Pinion gear	19
Primary (mainshaft) gear	60
Primary ratio	3.16:1
Gear module	1.5

TRANSMISSION

Type	4-speed constant mesh with foot-operated gearchange. Straight cut gears. (Pat. #495715) Gear ratio: 1 speed (low) 12.32 2 speed (2nd) 7.16 3 speed (3rd) 4.99 4 speed (4th) 3.84
Gear module	1.5
Foot change shaft end play	0.008" to 0.012" (0.2mm to 0.3mm)
Foot change shaft end play adj.	By shim
Shims available	0.2mm -0.3mm
Shifter arm adjustment method	Eccentric bolt
Shifter arm side play	0.002" to 0.005" (0.05mm to 0.15mm)
Shifter guide adjustment	By spacer
Spacers available	0.2mm -0.3mm
Countershaft end play	0.002" to 0.004" (0.05mm to 0.1mm)

KICK STARTER

Kick shaft end play	0.002" to 0.004" (0.05mm to 0.1mm)
End play adjustment	By washer
Washers available	0.3mm

TORQUE SETTINGS

Cylinder head nuts	105 in. lb. (1.2 kg. m.)
Flywheel nut	170 in. lb. (2 kg. m.)
Clutch nut	250 in. lb. (2.9 kg. m.)

CLEARANCES

Max. cylinder wear (taper)	0.008" (+0.2mm) maximum
Piston to cylinder	0.004" (0.1mm) total
Piston ring end gaps:	
Top ring	0.006" to 0.014" (0.15mm to 0.35mm)
Bottom ring	0.004" to 0.012" (0.10mm to 0.30mm)
Piston ring side play:	
Top ring	0.0004" to 0.0024" (0.01mm to 0.06mm)
Bottom ring	0.0008" to 0.0024" (0.02mm to 0.06mm)
Piston pin to piston	0.00008" (0.002mm)
Piston pin to connecting rod bearing.	0.0003" to 0.0006" (0.007mm to 0.014mm)

COMPRESSION PRESSURE

Normal compression pressure	80 to 150 lbs.

TIMING SPECIFICATIONS

F 480 Ignition Timing

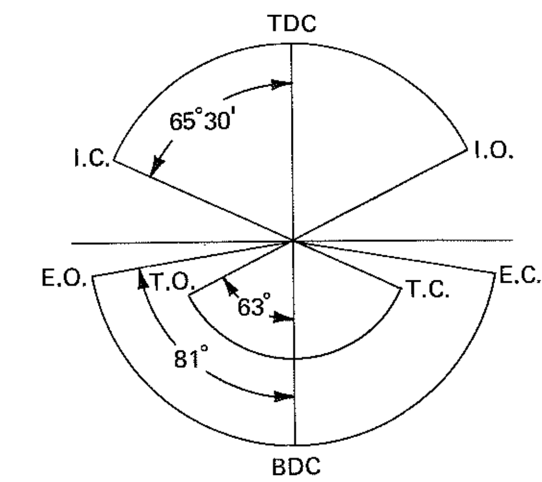
(0.079") = 2.0mm = 22°01' B.T.D.C.
(0.083") = 2.1mm = 22°34' B.T.D.C.
(0.087") = 2.2mm = 23°07' B.T.D.C.
(0.091") = 2.3mm = 23°39' B.T.D.C.
(0.094") = 2.4mm = 24°10' B.T.D.C.
(0.098") = 2.5mm = 24°40' B.T.D.C.
(0.102") = 2.6mm = 25°10' B.T.D.C. (std.)
(0.106") = 2.7mm = 25°40' B.T.D.C.
(0.110") = 2.8mm = 26°09' B.T.D.C.
(0.114") = 2.9mm = 26°38' B.T.D.C.
(0.118") = 3.0mm = 27°06' B.T.D.C.

F 480 Transfer Port Timing (Standard)
(1.34") 34mm . . . . 63°

F 480 Exhaust Port Timing (Standard)
(1.10") 28mm . . . . 81°

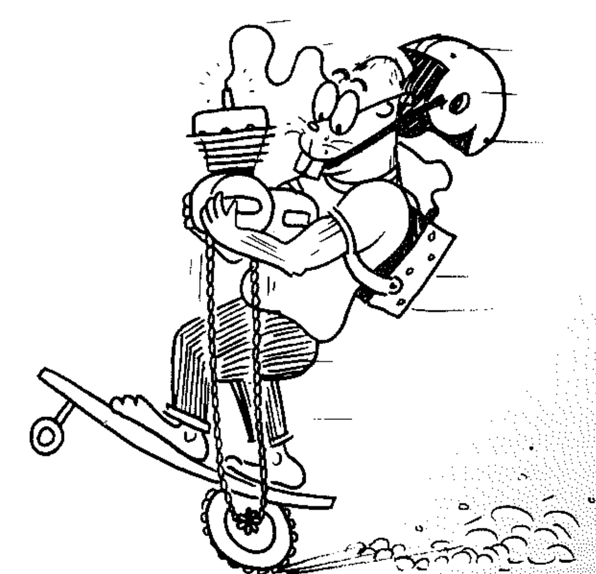
F 480 Inlet Port Timing (Standard)
(2.68") 68mm . . . . 65°30'

Fig. 78 F 480 Port Timing Diagram.



F 480 Stock Engine Port Timing (total duration)

Inlet	131°
Exhaust	162°
Transfer	126°



CONVERSION TABLE/GALLON to QUART to PINT to LITER

GALLON		QUART		PINT		LITER
1	=	4	=	8	=	3.785
¼	=	1	=	2	=	0.946
1/8	=	½	=	1	=	0.473
.264	=	1.056	=	2.113	=	1

One Imperial Gallon—1.2 US gallons or 4.537 liters or 277.3 C.I. One liter—1000 cc

METRIC EQUIVALENTS

m indicates one meter
cm indicates one hundredth of a meter
mm indicates one thousandth of a meter
km indicates one thousand meters

LENGTH

1mm.=0.03937 In.
Cm.=0.3937 In.
Meter=3.28 Ft.
Meter=1.094 Yd. (39.37 In.)
Kilom.-0.621 Mile

In.=2.54 Cm.
Ft.=0.3048 Meter
Yd.=0.9144 Meter
Mile= 1.61 Kilom.

AREA

Sq. Cm.=0.1550 Sq. In.
Sq. M.=10.76 Sq. Ft.

Sq. In.=6.45 Sq. Cm.
Sq. Ft.=0.0929 Sq. M.

VOLUME

Cu. Cm.=0.061 Cu. In.
Cu. M.=35.315 Cu. Ft.

Cu. In.=16.38 Cu. Cm.
Cu. Ft.=0.028 Cu. M.

CAPACITY

Liter=0.0353 Cu. Ft.
Liter=0.2642 Gallons (U.S.)
Liter=61.023 Cu. In.

Cu. Ft.=28.32 Liters
Gal. = 3.785 Liters
Cu. In.=0.0164 Liter

Liter=2.202 lb. of fresh water @ 62°F.

WEIGHT

Gram=15.432 Grains
Gram=0.0353 Oz.
Kilogram=2.2046 lbs.
Kilogram=0.0011 Ton (Sht)
Met. Ton=1.1025 Ton (Sht)
Grain=0.0648 Gram

Oz.=28.35 Gram
Lb.=0.454 Kilgm.
Ton (Sht)=907.18 Kilgm.
Ton (Sht)=0.907 Metric Ton
Ton (Sht)=2000 lb.

PRESSURE

1 Kilogram per Sq. Cm.=14.2233 Lbs. per Sq. In.
1 Lb. per Sq. In.=0.070307 Kilgms. per Sq. Cm.
1 Kilogram per Sq. Meter=0.20482 Lbs. per Sq. Ft.
1 Lb. per Sq. Ft.=4.8824 Kilgms. per Sq. Meter
1 Kilgm. per Sq. Cm.=0.96784 Standard Atmosphere
1 Standard Atmosphere-1.033228 Kilgm. per Sq. Cm.
1 Metric Atmosphere=1.033228 Kilgm. per Sq. Cm.
1 Sdt. Atmosphere=4.6959 Lbs. per Sq. In.

CONVERSION FACTORS

Inches to centimeters (cm)	Multiply by 2.54
Meters (m) to yards	Multiply by 70 and divide by 64
Kilometers (km) to miles	Multiply by 5 and divide by 8
Cubic inches to cubic centimeters	Multiply by 16.39
Grams to ounces	Multiply by 567 and divide by 20
Liters to U.S. pints	Multiply by 95 and divide by 20
Degrees centigrade to degrees Fahrenheit	Multiply by 9, divide by 5 and add 32
Degrees Fahrenheit to degrees Centigrade	Subtract 32, multiply by 5 and divide 9

CONVERSION CHART – CUBIC INCHES TO CUBIC CENTIMETERS
(1 C.I. = 16.387 cc)

C.I.	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	16.39	18.03	19.66	21.30	22.94	24.58	26.22	27.86	29.50	31.14
2	32.77	34.41	36.05	37.69	39.33	40.97	42.61	44.25	45.88	47.52
3	49.16	50.80	52.44	54.08	55.72	57.35	58.99	60.63	62.27	63.91
4	65.55	67.19	68.83	70.46	72.10	73.74	75.38	77.02	78.66	80.30
5	81.94	83.57	85.21	86.85	88.49	90.13	91.77	93.41	95.05	96.68
6	98.32	99.96	101.60	103.24	104.88	106.52	108.15	109.79	111.43	113.07
7	114.71	116.35	117.99	119.63	121.26	122.90	124.54	126.18	127.82	129.46
8	131.10	132.74	134.37	136.01	137.65	139.29	140.93	142.57	144.21	145.84
9	147.48	149.12	150.76	152.40	154.04	155.68	157.32	158.95	160.59	162.23
10	163.87	165.51	167.15	168.79	170.43	172.06	173.70	175.34	176.98	178.62

APPROXIMATE WEIGHT OF VARIOUS LIQUIDS

Liquid	lbs. per gallon
Alcohol	6.576
Gasoline	6.042
Kerosene	6.668
Lubricating oil	7.584
Water	8.335

APPROXIMATE WEIGHT OF VARIOUS MATERIALS

Material	lbs. per cubic foot
Aluminum (cast)	165
Bronze (phosphor)	554
Brass (cast-rolled)	534
Copper (cast-rolled)	556
Glass (plate)	184
Iron (wrought)	485
Iron (gray cast)	442
Mercury	847
Monel metal	555
Lead	710
Nickel	537
Platinum	1330
Rubber goods	94
Steel (cold-drawn)	489
Tin (cast-hammered)	459
Tungsten	1200
Zinc (cast-rolled)	440

CONVERSION CHART/Fraction Inch to Decimal Inch to mm

Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.
	.000400	.0100	13/32	.406250	10.3187		.984259	25.0000		1.800000	45.7196
	.000800	.0200	27/64	.421875	10.7156	63/64	.984375	25.0031		1.811037	46.0000
	.001200	.0300		.433074	11.0000	1	1.000000	25.4001	1-13/16	1.812500	46.0376
	.001600	.0400	7/16	.437500	11.1125		1.023629	26.0000	1-27/32	1.843750	46.8313
	.002000	.0500		.450000	11.4300	1-1/32	1.031250	26.1938		1.850000	46.9896
	.002400	.0600	29/64	.453125	11.5094		1.050000	26.6699		1.850407	47.0000
	.002800	.0700	15/32	.468750	11.9062	1-1/16	1.062500	26.9876	1-7/8	1.875000	47.6251
	.003100	.0800		.472444	12.0000		1.062999	27.0000		1.889777	48.0000
	.003500	.0900	31/64	.484375	12.3031	1-3/32	1.093750	27.7813		1.900000	48.2596
	.003900	.1000	1/2	.500000	12.7000		1.100000	27.9397	1-29/32	1.906250	48.4188
1/128	.007900	.2000		.511814	13.0000		1.102369	28.0000		1.929147	49.0000
	.011800	.3000	33/64	.515625	13.0969	1-1/8	1.125000	28.5751	1-15/16	1.937500	49.2126
1/64	.015625	.3969	17/32	.531250	13.4937		1.141739	29.0000		1.950000	49.5296
	.015700	.4000	35/64	.546875	13.8906		1.150000	29.2097		1.968522	50.0000
	.019700	.5000		.550000	13.9700	1-5/32	1.156250	29.3688	1-31/32	1.968750	50.0063
	.023600	.6000		.551184	14.0000		1.181113	30.0000	2	2.000000	50.8001
	.027600	.7000	9/16	.562500	14.2875	1-3/16	1.187500	30.1626		2.007892	51.0000
1/32	.031250	.7937	37/64	.578125	14.6844		1.200000	30.4797	2-1/32	2.031250	51.5939
	.031500	.8000		.590554	15.0000	1-7/32	1.218750	30.9563		2.047262	52.0000
	.035400	.9000	19/32	.593750	15.0812		1.220483	31.0000		2.050000	52.0695
	.039370	1.0000		.600000	15.2400	1-1/4	1.250000	31.7501	2-1/16	2.062500	52.3876
3/64	.046875	1.1906	39/64	.609375	15.4781		1.259853	32.0000		2.086632	53.0000
	.050000	1.2700	5/8	.625000	15.8750	1-9/32	1.281250	32.5438	2-3/32	2.093750	53.1814
1/16	.062500	1.5875		.629924	16.0000		1.299223	33.0000		2.100000	53.3395
5/64	.078125	1.9844	41/64	.640625	16.2719		1.300000	33.0197	2-1/8	2.125000	53.9751
	.078740	2.0000		.650000	16.5100	1-5/16	1.312500	33.3376		2.126002	54.0000
3/32	.093750	2.3812	21/32	.656250	16.6687		1.338593	34.0000		2.150000	54.6095
	.100000	2.5400		.669294	17.0000	1-11/32	1.343750	34.1313	2-5/32	2.156250	54.7688
7/64	.109375	2.7781	43/64	.671875	17.0656		1.350000	34.2897		2.165372	55.0000
	.118110	3.0000	11/16	.687500	17.4625	1-3/8	1.375000	34.9251	2-3/16	2.187500	55.5626
1/8	.125000	3.1750		.700000	17.7800		1.377963	35.0000		2.200000	55.8795
9/64	.140625	3.5719	45/64	.703125	17.8594		1.400000	35.5597		2.204742	56.0000
	.150000	3.8100		.708664	18.0000	1-13/32	1.406250	35.7188	2-7/32	2.218750	56.3564
5/32	.156250	3.9687	23/32	.718750	18.2562		1.417333	36.0000		2.244112	57.0000
	.157418	4.0000	47/64	.734375	18.6531	1-7/16	1.437500	36.5126	2-1/4	2.250000	57.1501
11/64	.171875	4.3656		.748034	19.0000		1.450000	36.8297	2-9/32	2.281250	57.9439
3/16	.187500	4.7625	3/4	.750000	19.0500		1.456703	37.0000		2.283482	58.0000
	.196850	5.0000	49/64	.765625	19.4469	1-15/32	1.468750	37.3063		2.300000	58.4195
	.200000	5.0800	25/32	.781250	19.8437		1.496073	38.0000	2-5/16	2.312500	58.7376
13/64	.203125	5.1594		.787409	20.0000	1-1/2	1.500000	38.1001		2.322852	59.0000
7/32	.218750	5.5562	51/64	.796875	20.2406	1-17/32	1.531250	38.8938	2-11/32	2.343750	59.5314
15/64	.234375	5.9531		.800000	20.3200		1.535443	39.0000		2.350000	59.6895
	.236220	6.0000	13/16	.812500	20.6375		1.550000	39.3696		2.362226	60.0000
1/4	.250000	6.3500		.826779	21.0000	1-9/16	1.562500	39.6876	2-3/8	2.375000	60.3251
17/64	.265625	6.7469	53/64	.828125	21.0344		1.574817	40.0000		2.400000	60.9594
	.275590	7.0000	27/32	.843750	21.4312	1-19/32	1.593750	40.4813		2.401596	61.0000
9/32	.281250	7.1437		.850000	21.5900		1.600000	40.6396	2-13/32	2.406250	61.1189
19/64	.296875	7.5406	55/64	.859375	21.8281		1.614187	41.0000	2-7/16	2.437500	61.9126
	.300000	7.6200		.866149	22.0000	1-5/8	1.625000	41.2751		2.440966	62.0000
5/16	.312500	7.9375	7/8	.875000	22.2250		1.650000	41.9096		2.450000	62.2294
	.314960	8.0000	57/64	.890625	22.6219		1.653557	42.0000	2-15/32	2.468750	62.7064
21/64	.328125	8.3344		.900000	22.8600	1-21/32	1.656250	42.0688		2.480336	63.0000
11/32	.343750	8.7312		.905519	23.0000	1-11/16	1.687500	42.8626	2-1/2	2.500000	63.5001
	.350000	8.8900	29/32	.906250	23.0187		1.692927	43.0000		2.519706	64.0000
	.354330	9.0000	59/64	.921875	23.4156		1.700000	43.1796	2-17/32	2.531250	64.2939
23/64	.359375	9.1281	15/16	.937500	23.8125	1-23/32	1.718750	43.6563		2.550000	64.7694
3/8	.375000	9.5250		.944889	24.0000		1.732297	44.0000		2.559076	65.0000
25/64	.390625	9.9219		.950000	24.1300	1-3/4	1.750000	44.4501	2-9/16	2.562500	65.0876
	.393704	10.0000	61/64	.953125	24.2094		1.771667	45.0000	2-19/32	2.593750	65.8814
	.400000	10.1600	31/32	.968750	24.6062	1-25/32	1.781250	45.2438		2.598446	66.0000

CONVERSION CHART/Fraction Inch to Decimal Inch to mm cont.

Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.	Frac. Inch	Dec. Inch	mm.
	2.600000	66.0394		2.952780	75.0000	3-5/16	3.312500	84.1377		3.661449	93.0000
2-5/8	2.625000	66.6751	2-31/32	2.968750	75.4064	3-11/32	3.343750	84.9314	3-11/16	3.687500	93.6627
	2.637816	67.0000		2.992150	76.0000		3.346485	85.0000		3.700000	93.9792
	2.650000	67.3094	3	3.000000	76.2002		3.350000	85.0892		3.700819	94.0000
2-21/32	2.656250	67.4689	3-1/32	3.031250	76.9939	3-3/8	3.375000	85.7252	3-23/32	3.718750	94.4564
	2.677186	68.0000		3.031520	77.0000		3.385855	86.0000		3.740189	95.0000
2-11/16	2.687500	68.2626		3.050000	77.4693		3.400000	86.3592	3-3/4	3.750000	95.2502
	2.700000	68.5794	3-1/16	3.062500	77.7877	3-13/32	3.406250	86.5189		3.779559	96.0000
	2.716556	69.0000		3.070890	78.0000		3.425225	87.0000	3-25/32	3.781250	96.0439
2-23/32	2.718750	69.0564	3-3/32	3.093750	78.5814	3-7/16	3.437500	87.3127		3.800000	96.5192
2-3/4	2.750000	69.8501		3.100000	78.7393		3.450000	87.6292	3-13/16	3.812500	96.8377
	2.755930	70.0000		3.110260	79.0000		3.464595	88.0000		3.818929	97.0000
2-25/32	2.781250	70.6439	3-1/8	3.125000	79.3752	3-15/32	3.468750	88.1064	3-27/32	3.843750	97.6314
	2.795300	71.0000		3.149635	80.0000	3-1/2	3.500000	88.9002		3.850000	97.7891
	2.800000	71.1194		3.150000	80.0093		3.503965	89.0000		3.858299	98.0000
2-13/16	2.812500	71.4376	3-5/32	3.156250	80.1689	3-17/32	3.531250	89.6939	3-7/8	3.875000	98.4252
	2.834670	72.0000	3-3/16	3.187500	80.9627		3.543339	90.0000		3.897669	99.0000
2-27/32	2.843750	72.2314		3.189005	81.0000		3.550000	90.1691		3.900000	00.0591
	2.850000	72.3893		3.200000	81.2793	3-9/16	3.562500	90.4877	3-29/32	3.906250	99.2189
	2.874040	73.0000	3-7/32	3.218750	81.7564		3.582709	91.0000		3.937043	100.0000
2-7/8	2.875000	73.0251		3.228375	82.0000	3-19/32	3.593750	91.2814	3-15/16	3.937500	100.0130
	2.900000	73.6593	3-1/4	3.250000	82.5502		3.600000	91.4392		3.950000	100.3291
2-29/32	2.906250	73.8189		3.267745	83.0000		3.622079	92.0000	3-31/32	3.968750	100.8060
	2.913410	74.0000	3-9/32	3.281250	83.3439	3-5/8	3.625000	92.0752		3.976413	101.0000
2-15/16	2.937500	74.6126		3.300000	83.8192		3.650000	92.7092	4	4.000000	101.6000
	2.950000	74.9293		3.307115	84.0000	3-21/32	3.656250	92.8689			

DIMENSIONS OF POPULAR BALL BEARINGS

Used For Motorcycle (inch)								
Bearing No.	6000	6001	6002	6003	6004	6005	6006	6007
Inside diam.	0.3937	0.4724	0.5906	0.6693	0.7874	0.9843	1.1811	1.3780
Outside diam.	1.0236	1.1024	1.2598	1.3780	1.6535	1.8504	2.1654	2.4409
Thickness	0.3150	0.3150	0.3543	0.3937	0.4724	0.4724	0.5118	0.5512
Bearing No.	6200	6201	6202	6203	6204	6205	6206	6207
Inside diam.	0.3937	0.4724	0.5906	0.6693	0.7874	0.9843	1.1811	1.3780
Outside diam.	1.1811	1.2598	1.3780	1.5748	1.8504	2.0472	2.4409	2.8346
Thickness	0.3543	0.3937	0.4331	0.4724	0.5512	0.5906	0.6299	0.6693
Bearing No.	6300	6301	6302	6303	6304	6305	6306	6307
Inside diam.	0.3937	0.4724	0.5906	0.6693	0.7874	0.9843	1.1811	1.3780
Outside diam.	1.3780	1.4567	1.6535	1.8504	2.0472	2.4409	2.8346	3.1496
Thickness	0.4331	0.4724	0.5118	0.5512	0.5906	0.6693	0.7480	0.8268

DRILL SIZES

Inch Decimal Equivalent

80	.0135	61	.039	42	.0935	23	.154	4	.209		
79	.0145	60	.040	41	.096	22	.157	3	.213		
78	.016	59	.041	40	.098	21	.159	2	.221		
77	.018	58	.042	39	.0995	20	.161	1	.228		
76	.020	57	.043	38	.1015	19	.166			O	.316
75	.021	56	.0465	37	.104	18	.1695	A	.234	P	.323
74	.0225	55	.052	36	.1065	17	.173	B	.238	Q	.332
73	.024	54	.055	35	.110	16	.177	C	.242	R	.339
72	.025	53	.0595	34	.111	15	.180	D	.246	S	.348
71	.026	52	.0635	33	.113	14	.182	E	.250	T	.358
70	.028	51	.067	32	.116	13	.185	F	.257	U	.368
69	.02925	50	.070	31	.120	12	.189	G	.261	V	.377
68	.031	49	.073	30	.1285	11	.191	H	.266	W	.386
67	.032	48	.076	29	.136	10	.1935	I	.272	X	.397
66	.033	47	.0785	28	.1405	9	.196	J	.277	Y	.404
65	.035	46	.081	27	.144	8	.199	K	.281	Z	.413
64	.036	45	.082	26	.147	7	.201	L	.290		
63	.037	44	.086	25	.1495	6	.204	M	.295		
62	.038	43	.089	24	.152	5	.2055	N	.302		

CONVERSION CHART: TIRE PRESSURES

18-lb. sq. in. . . . . 1.26 Kg. sq. cm.
20-lb. " . . . . 1.40 "
22-lb. " . . . . 1.54 "
24-lb. " . . . . 1.68 "
26-lb. " . . . . 1.82 "
28-lb. " . . . . 1.96 "
30-lb. " . . . . 2.10 "
32-lb. " . . . . 2.25 "
36-lb. " . . . . 2.53 "

CONVERSION CHART: TEMPERATURE

0 deg. C. . . . . 32 deg. F.
10 " . . . . 50 "
15.6 " . . . . 60 "
21 " . . . . 70 "
26.7 " . . . . 80 "
32 " . . . . 90 "
37.8 " . . . . 100 "
49 " . . . . 120 "
100 " . . . . 212 "

HANDY FORMULAS

To find:

Circumference of a circle: Multiply the diameter by 3.1416.

Area of a circle: Multiply the diameter by itself and then by 0.7854. (or multiply the radius by itself then by 3.1416)

Volume of a cylinder: Find the area of the end then multiply by the length.

Area of the surface of a sphere: Multiply the diameter by itself then by 3.1416.

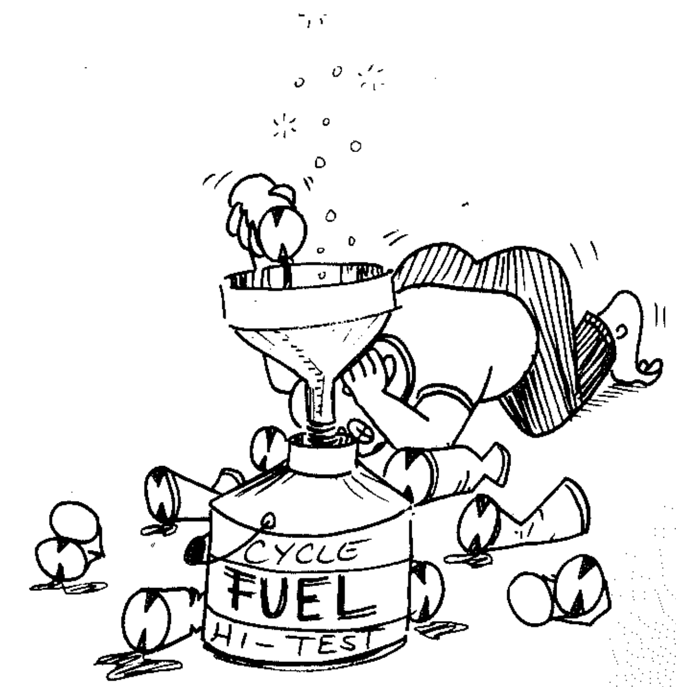
Volume of a sphere: Multiply the diameter by itself and multiply this product by the diameter again. Then multiply this product (diameter cubed) by 0.5236.

Area of a triangle: Multiply the base by the height and divide by 2.

Piston displacement: The area of the head of the piston in square inches, times the number of inches in the stroke, times the number of cylinders, is the engine displacement in cubic inches. The formula is:

$$D^2 \times 0.7854 \times L \times N = \text{Displacement in Cu. In.}$$

Here D equals piston diameter or cylinder bore. L is the stroke in inches. N is the number of cylinders.



NGK SPARK PLUGS CONVERSION CHART

THREAD SIZE	HEAT RANGE	NGK	CHAMPION	A-C	AUTO-LITE	BOSCH	KLG	LODGE
14MM Reach 3/8"	Hot Cold	B-4 B-6 B-7 B-7C* B-77C* B-8 B-9 B-10	J14J J12J,UJ12 J11,J11J J8,UJ8,J8J J7,J7J J6,UJ6,J6J J63T,J63R J4,J4J,J61Y J2J	C49 48,C47,C47W,M47 46,C46,M46 45,C45,C45W,M45 44,C44,M44,M44B 43,C42-4,C43 M44C,M43 42,C42-1,M42 41	A11,AT10 A9,AT8 A7,AT6 AT4 A3,AT3 A3,AT3 A23 AT2 AT1 A901	W45T3 W145T3 W175T3 W225T3 W240T3	TFS20 TFS30 TFS50 FS70 FS75 FS100	BAN CAN,CCAN HAN 2HAN 3HAN
14MM Reach ½"	Hot Cold	B-4H B-6H B-7H B-7HC* B-7HZ B-77HC* B-8H B-8HC* B-9H B-10H	L14 L10,L90 L86,L85 L7,L92Y L81,L87Y L5,L82Y L63R L58R L4J	46FF 45F,45FD,45FF 44FF,44F 43F,42F,42FF	AE6 AE4 AE3 AE23 AE2 AE903	W95T1 W145T1 W175T1 W225T1 W240T16 W240T1 W270T16	F20 F50 F70 F75 FP70 F80,PF70 F100	B14,BN CN,C14,CC14 HN,H14 HH14 2HN 3HN
14MM Reach 3/4"	Hot Cold	B-4E B-6E B-7E B-7EC* B-77EC* B-8E B-9E B-10E	N21 N18 N8,N84 N6 N5 N4 N63R	47XL 46N,46XL 45N,45XL,C45XL 44N,44XL 43N 43XL,C42N 42XL	AG9 AG7 AG5 AG4 AG3 AG2 AG23	W95T2,W125T2 W145T2 W160T2 W175T2 W225T2,W235P21 W240T2,W240T17 W260T20,W280T2 W250P21 W270T17	FE20 FE30 FE50,PFE50 FE70,PFE70 FE75 FE80 FE100 FE220 FE250	BLN,BL14 CLNH,CC14 HBLN HLN 2HLN HLNP,3HLN

*Competition Types

RACING SPARK PLUGS

THREAD SIZE	GAP	HEAT RANGE	NGK	CHAMPION	AUTO-LITE	BOSCH	KLG	LODGE
14MM Reach 3/8"	0.5mm +0.00 -0.05	Hot Cold	B- 8N B- 9N B-10N B-11N B-12N	J59T,J58T,J58R J56T J55T J53T	A903 A603 A403 A203		F260(With spacer) F280(") F300(") F300(") F340(")	R47(With spacer) R49(") R51(") R52(") R53(")
14MM Reach ½"	0.5mm +0.00 -0.05	Hot Cold	B- 8HN B- 9HN B-10HN B-11HN B-12HN	L58R L56T L55T L53T L52T	AE903 AE603 AE403 AE203	W310T16 W340T16 W370T16 W400T16 W440T16	F260 F280 F300 F320 F340	R47 R49 R51 R52 R53
14MM Reach ¾"	0.5mm +0.00 -0.05	Hot Cold	B- 8EN B- 9EN B-10EN B-11EN B-12EN	N58R N55T N53T N52T	AG903 AG603 AG403 AG203	W310T17 W340T17 W370T17 W400T17 W440T17	FE260 FE280 FE300 FE320 FE340	RL47 RL49 RL51 RL52 RL53

This flat-rate schedule is based on actual time consumed by an experienced motorcycle mechanic working on a typical "clean" used machine. In every case, stated times are based on work procedures outlined in the F 480 *Workshop Manual.*

In quoting flat-rate schedules, allowance should be made for *collision damage and/or mutilated parts.* Similarly, if the machine is greasy or dirty, a separate cleaning charge should be made and the machine cleaned prior to beginning work. Additional charge should be made for machines with *rusted or corroded parts.*

FLAT-RATE TIME SCHEDULE

A. GENERAL MAINTENANCE — TIME (in tenths)

1A 5
Remove magneto cover, flywheel, and breaker points. Install new points, condenser, and retime ignition. Replace magneto cover.

2A 7
Remove magneto cover and flywheel, remove and replace ignition or lighting coil, and retime ignition. Replace magneto cover.

3A 5
Remove carburetor and air cleaner, clean and replace. Adjust carburetor.

4A 2
Change oil in transmission.

5A 1.5
Service and Tune-up. Includes items 1A, 4A, 5A, plus tighten external nuts and bolts. Visual inspection and road test.

C. ENGINE WORK

1C 8
Decarbonizing: Remove muffler, cylinder head, cylinder and piston. Clean carbon from muffler element, header pipe, cylinder head, cylinder and piston. Reassemble.

2C 1.3
Top end overhaul. Same as item 1C plus: Clean carburetor, air cleaner. Clean and adjust breaker points, spark plug. Install new piston rings and reassemble.

3C 1
Remove engine assembly from frame.

4C 5
Dismantle engine.

5C 5
Clean and inspect dismantled engine components.

6C 4
Remove and replace crankshaft main bearings, transmission bearings, oil seals.

7C 7
Rebuild crankshaft assembly and realign.

8C 2
Remove and replace transmission bushings.

9C 1.0
Reassemble engine, retime ignition, adjust carburetor (preliminary setting).

10C 3
Install engine assembly into frame, reconnect controls, wiring, and fuel supply. Road test.

11C 5
Remove clutch cover, rebuild clutch assembly, replace clutch and clutch cover.

12C 6
Remove clutch cover. Remove and replace control shaft components. Replace clutch cover.

13C.. .2
Remove and replace kick crank spring and/or kick crank.

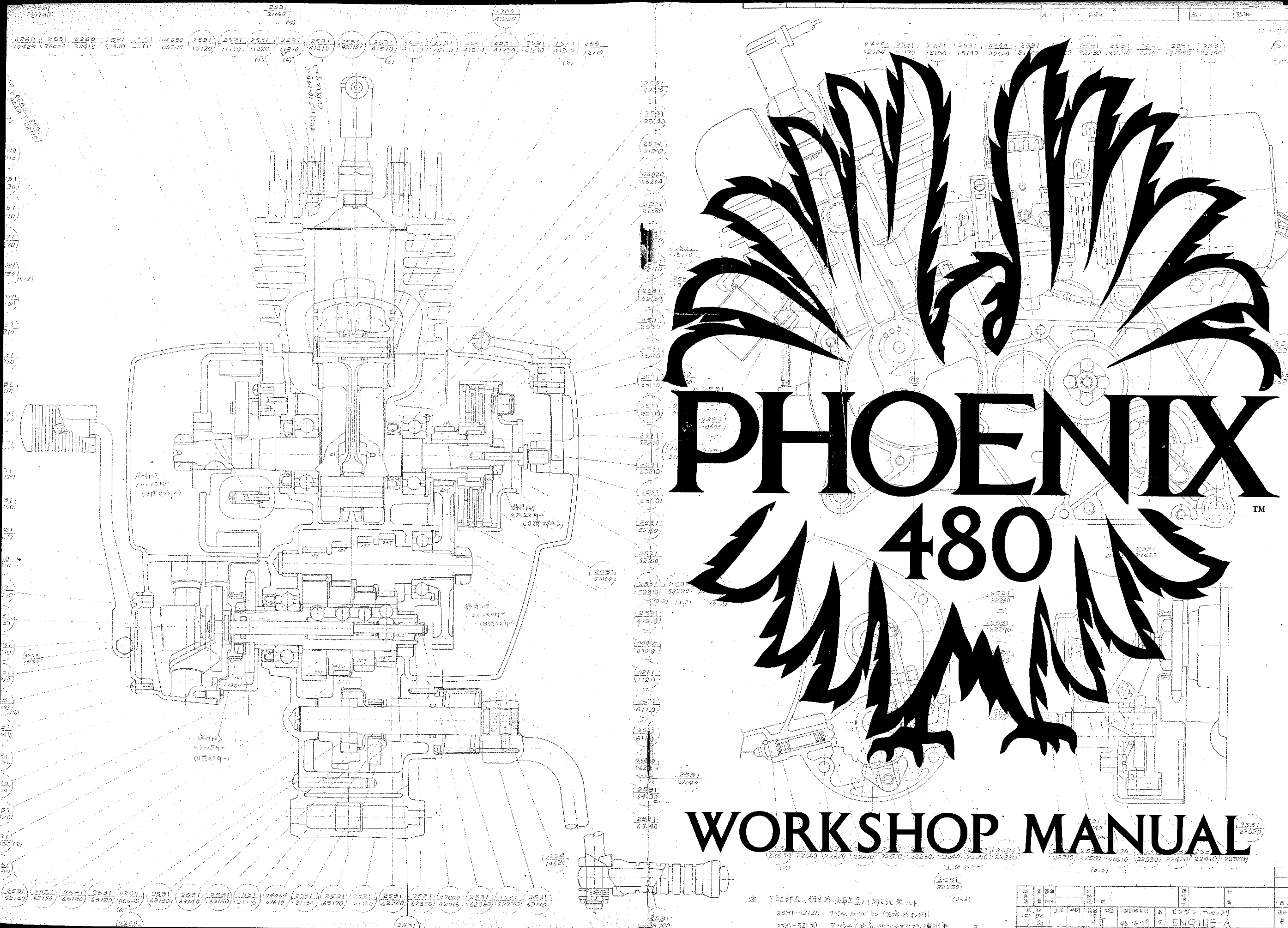
14C.. .4
Remove clutch cover and remove clutch lever from same, replace clutch lever and reassemble cover onto engine.

15C.. .5
Remove clutch cover. Remove and replace primary gears. Replace cover.

16C.. .5
Remove magneto cover. Disassemble shifter mechanism. Clean, lubricate and reassemble shifter assembly. Replace magneto cover.

17C.. .1
Remove and replace muffler assembly.

THE END



PHOENIX 480™

WORKSHOP MANUAL