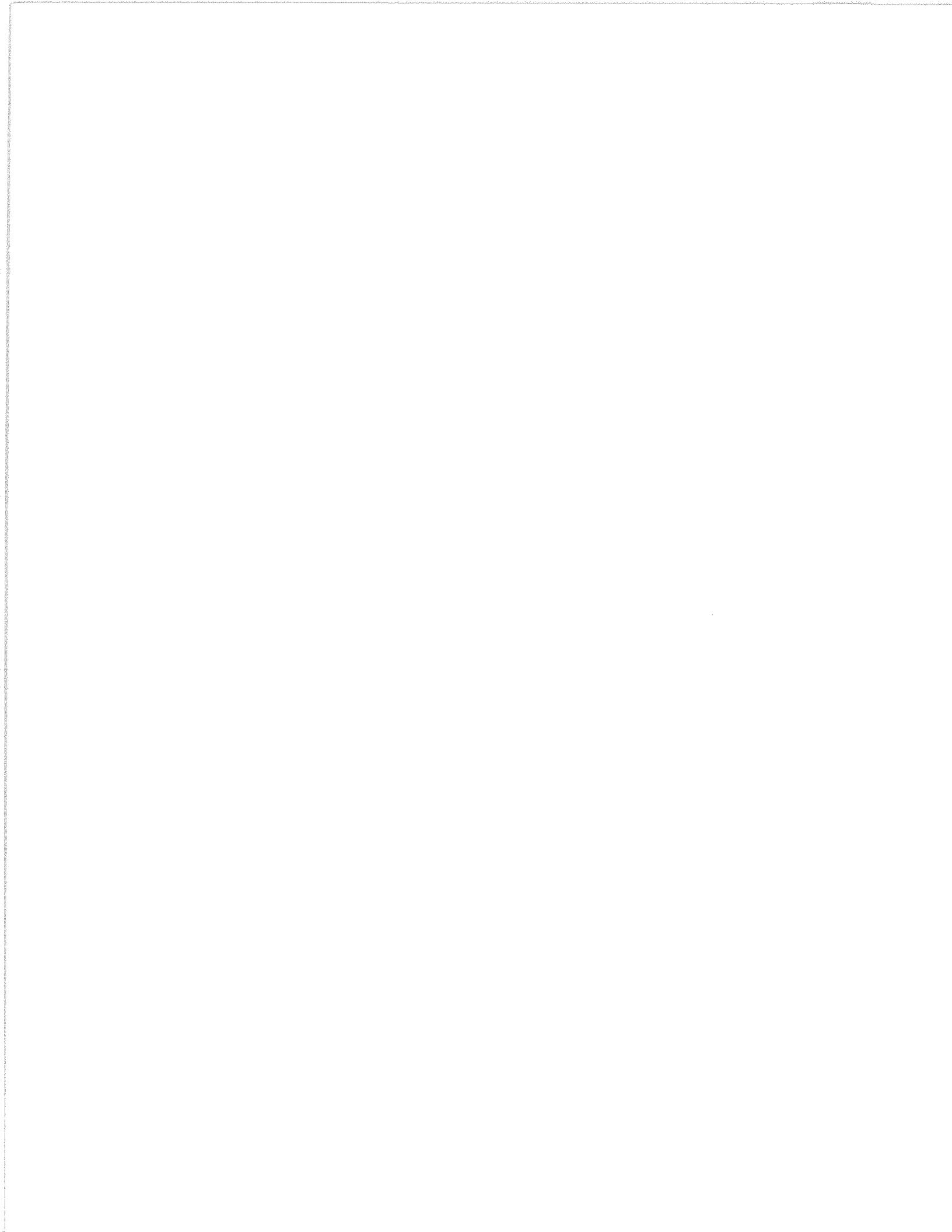


**SERIES 610  
820**

# **SERVICE MANUAL**

**Rokon International Inc**  
50 Railroad Ave Rochester, NH 03839  
Tel: 603 335 3200 Fax: 603 335 4400



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**Section**

# 1

## **INTRODUCTION**

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## INTRODUCTION

**GENERAL INFORMATION**

This manual contains instructions for servicing and repairing Chrysler's Power Bee 610 and 820 series industrial engines.

The manual is divided into sections. Each section covers a major component or operating system of the engine. Information, specifications and illustrations are based on information available at the time this manual was printed. Continued improvement and advancement of product design may cause changes that cannot be included in this manual.

**NOTE**

610 Series and some 610 parts are no longer in production; for replacement, consult Chrysler.

When a question arises about these engines or this publication, please contact Chrysler Marine Service Department for the latest information. Write to:

**Marine Division, Chrysler Corporation**  
Publication Supervisor  
105 Marine Drive  
Hartford, WI 53027

**SAFETY**

This notation appears before warnings in the text. It means that the step which follows must be carried out to avoid the possibility of personal injury or death. These warnings are intended to help the technician avoid any potential hazards encountered in normal service procedures. It is urged that the reader take advantage of this information to prevent possible injury to himself or bystanders.

**TERMS**

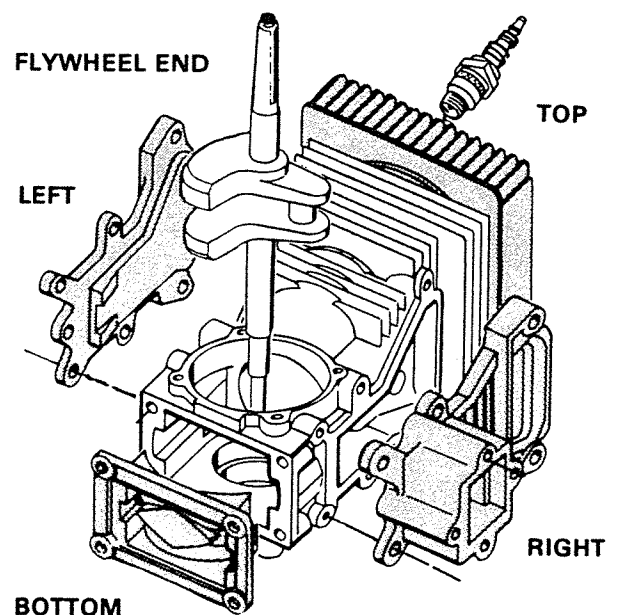
Since these engines can be mounted in many different positions, the following terms are used to describe "sides" or "ends" of the engine. Table 1., Figure 1.

	Flywheel end of crankshaft
	Drive end of crankshaft
Top	Cylinder head, spark plug end
Bottom	Crankcase cover*
Right Side	The transfer cover* on right when looking at flywheel end.
Left Side	The transfer cover* on left

*Table 1. Terms.*

**\*NOTE**

Carburetor and reed valve are located on one of these "sides". The cover on that side is the intake manifold on that model. Carburetor position is also described as follows, looking at flywheel end; 3 o'clock (right), 6 o'clock (bottom), 9 o'clock (left).



*Figure 1. Engine "Sides", Ends.*

**Rotation.** Left hand reverse rotation - flywheel turns CCW looking from flywheel end (crankshaft turns CW, looking from drive end).

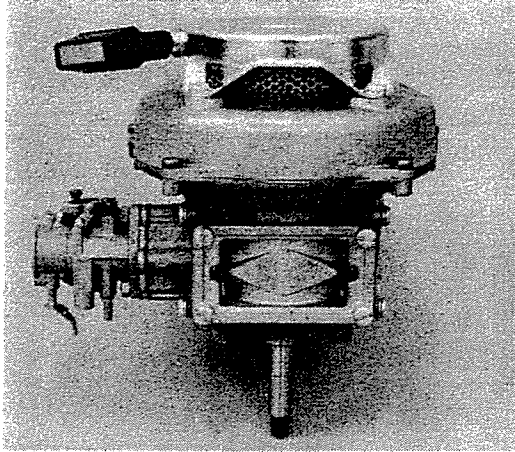
Right hand standard rotation - flywheel turns CW looking from flywheel end (crankshaft turns CCW, looking from drive end).

## TOOLS

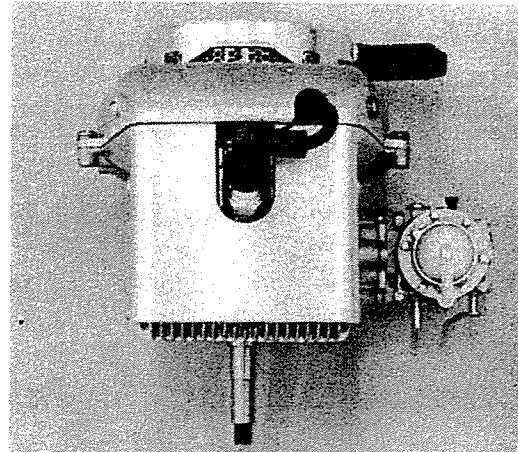
A list of tools needed is included in Section 2. In addition, a list of tools needed for each section is listed at the beginning of the section.

## NOTE

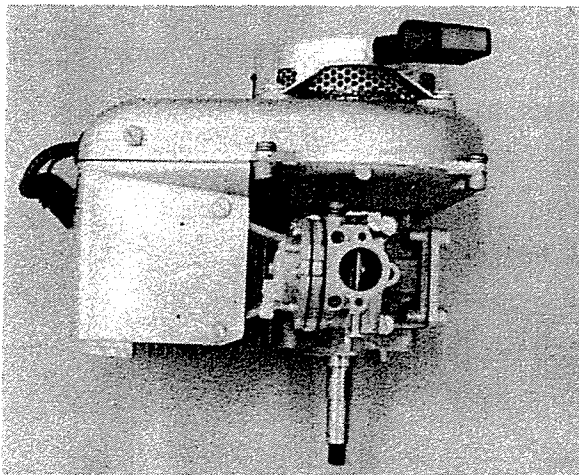
Not all tools or materials listed will be needed in all cases. Special tools listed are Chrysler Marine numbers.



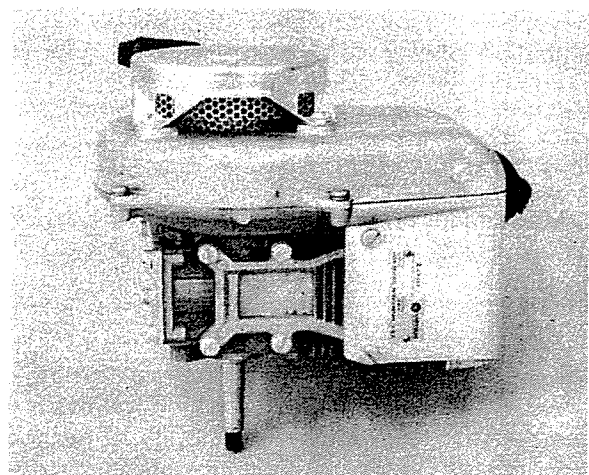
**BOTTOM**



**TOP**



**LEFT SIDE**



**RIGHT SIDE**

*Figure 2. Power Bee Engine, 4 Views.  
(Model 82006 Shown)*

Section

# 2

## GENERAL SERVICE INFORMATION

### CONTENTS

Engine Type .....	9
Engine I.D. ....	9
Engine Applications .....	9
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Specifications .....	12
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**GENERAL SERVICE INFORMATION****ENGINE TYPE**

The 610 and 820 series are 6.1 and 8.2 cu. in. air cooled, 2 cycle, loop scavenged engines, ranging in horsepower from 4.7 to 10 H.P. depending on model.

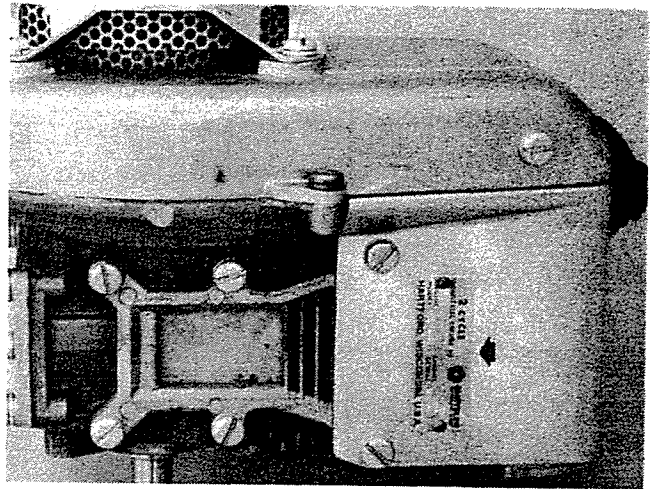
**ENGINE I.D.**

Figure 1 shows the model no. and serial no. on an identification plate attached to the cylinder cover. Always use these numbers in correspondence to identify the engine clearly and to insure correct parts are obtained when ordered.

**ENGINE APPLICATIONS**

These engines, designed for use in a wide range of industrial settings, are available in right and left hand rotation (see Engine Specifications) with different carburetor mountings and with interchangeable crankshafts featuring different

power take off ends according to customer needs. Table 1 shows some of the major original applications for selected models.



*Figure 1. Typical Engine Identification.*

<b>MODEL NO.</b>	<b>MAJOR USE</b>	<b>CUSTOMER</b>
61001	Kart	
61002	Kart	
61003	Duster	Buffalo Turbine, N.Y.
61005	Earth Auger	General Equipment, Minn.
61006	"Stock" Chain Saw	C-B Tool Co., Lancaster, PA.
61010	Chain Saw	Mono Mfg. Co., Springfield, MO.
61012	Kart	
61014	Bike	Micro Sound, CA.
82001	Kart	
82002	Kart	
82003	Fire Pump	Gorman-Rupp
82004	Snowmobile	Pioneer, Quebec, Canada
82005	Stock: Pumps, Augers, Drills, Saws	
82006	Stock: Pumps, Augers, Drills, Saws	
82007	Trail Bike	Nethercutt, (Now Rokon)
82008	Chain Saw	Whitehead, Atlanta, GA.
82009	Fire Pump	Albin Motors, Sweden
82010	Chain Saw	Mono Mfg. Co., Springfield, MO.
82011	Fire Pump	Waterous
82012	Snowmobile	Pioneer, Quebec, Canada
82015	Snowmobile	Sno Pony
82017	Snowmobile	Sportcraft
82019	Motor Bike	Artic Enterprises
82021	Motor Bike	Track & Sport
82023	Off Road Vehicle	"Go Joe" Rupp
82026	Utility Engine	
82027	Utility Engine	
82029	Fire Pump	Waterous
82030	Sno-Runner	Chrysler
82032	Abrasive Saw	Racine Railroad Products

**Table 1. Selected Original Engine Applications.**

**Application Notes.**

1. **H.P.** Find out how the customer will use the engine. Note that H.P.'s are given for top RPM. For example, Model 82002 is rated at 10 H.P. at 8000 RPM. (If engine will be operated at 5500 or 6000 RPM, 10 H.P. is not available at 5500-6000 RPM.)
2. **Special Use.** Note that models are designed for certain uses. Table 1. For example, Model 80002 is designed for intermittent duty (as a kart engine). Therefore, it should not be used for continuous duty at peak HP (8000 RPM).
3. **Accessories.** Accessories below are available for the 820 Series.

ACCESSORY	PART NO.
Ignition Shutoff Toggle Switch	3071-1
Engine Mount Kit (2-Piece)	3251-1
Air Cleaner	3181-1
End Manifold Kit	3301-1
Carburetor Elbow	3311-1 or 3331-1

4. **Customer, Dealer Supplied Items.**

**NOTE**

The following items are not supplied by Chrysler because of the wide variety of and uses.

- A. Muffler.
- B. Fuel tank.

**TORQUE SPECIFICATIONS**

**SPECIAL ITEMS**

PART	TORQUE
Flywheel Nut .....	420 in. lbs. (482 kg/cm)
Connecting Rod Screws ..	80-90 in. lbs. (92-103 kg/cm)
Spark Plug .....	120-180 in. lbs. (138-207 kg/cm)
Support Plate Screws .....	70-85 in. lbs. (80-98 kg/cm)
Cylinder Head Screws ..	90-100 in. lbs. (103-115 kg/cm)

**STANDARD HARDWARE**

SCREWS	GENERAL TORQUE
10-24 .....	30 in. lbs. (34 kg/cm)
10-32 .....	35 in. lbs. (40 kg/cm)
12-24 .....	45 in. lbs. (52 kg/cm)
1/4-20 .....	70 in. lbs. (80 kg/cm)
5/16-18 .....	160 in. lbs. (184 kg/cm)
3/8-16 .....	270 in. lbs. (310 kg/cm)

## SPECIFICATIONS

<b>ENGINE</b>							
<b>Model #</b>	<b>H.P.</b>	<b>R.P.M.</b>	<b>Bore &amp; Stroke</b>	<b>Cu. In. Displ.</b>	<b>Bore</b>	<b>Original Year Built</b>	
61001	7.5	8000	2-3/16 x 1-5/8	6.1	Cast Iron	1962	<b>610 SERIES</b>
61002	7.5	8000	2-3/16 x 1-5/8	6.1		1962	
61003	4.7	8000	2-3/16 x 1-5/8	6.1		1963	
61005	5.5	6000	2-3/16 x 1-5/8	6.1		1963	
61006	5.5	6000	2-3/16 x 1-5/8	6.1		1963	
61010	4.7	8000	2-3/16 x 1-5/8	6.1		1963	
61012	8.0	8000	2-3/16 x 1-5/8	6.1		1963	
61014	5.5	6000	2-3/16 x 1-5/8	6.1		1965	

<b>Model #</b>	<b>H.P.</b>	<b>R.P.M.</b>	<b>Bore &amp; Stroke</b>	<b>Cu. In. Displ.</b>	<b>Bore</b>	<b>Original Year Built</b>	
82001	10.0	8000	2-17/32 x 1-5/8	8.2	Chrome	1961	<b>820 SERIES</b>
82002	10.0	8000	2-17/32 x 1-5/8	8.2		1961	
82003	7.0	7000	2-17/32 x 1-5/8	8.2		1963	
82004	10.0	8000	2-17/32 x 1-5/8	8.2		1963	
82005	6.4	6000	2-17/32 x 1-5/8	8.2		1962	
82006	6.4	6000	2-17/32 x 1-5/8	8.2		1965	
82007	7.0	6500	2-17/32 x 1-5/8	8.2		1963	
82008	6.5	8000	2-17/32 x 1-5/8	8.2		1962	
82010	6.5	8000	2-17/32 x 1-5/8	8.2		1963	
82011	6.7	7000	2-17/32 x 1-5/8	8.2		1968	
82012	7.0	7000	2-17/32 x 1-5/8	8.2		1963	
82014	7.0	7000	2-17/32 x 1-5/8	8.2		1964	
82015	6.4	6000	2-17/32 x 1-5/8	8.2		1969	
82017	6.4	6000	2-17/32 x 1-5/8	8.2		1971	
82019	6.4	6000	2-17/32 x 1-5/8	8.2		1971	
82021	6.4	6000	2-17/32 x 1-5/8	8.2		1971	
82023	6.4	6000	2-17/32 x 1-5/8	8.2		1973	
82026	7.0	7000	2-17/32 x 1-5/8	8.2		1977	
82027	7.0	7000	2-17/32 x 1-5/8	8.2		1977	
82029	6.7	7000	2-17/32 x 1-5/8	8.2		1977	
82030	7.0	7000	2-17/32 x 1-5/8	8.2	1980		
82032	7.0	7000	2-17/32 x 1-5/8	8.2	1980		

## SPECIFICATIONS (cont.)

IGNITION							
Model No.	Champion Spark Plug	Plug Gap	Breaker Point Gap (in.)	① Ignition Timing Stator Position	② Angle BTDC	③ Distance BTDC (in.)	
61001	L-4-J	.030	.015	MR	26°	.102	<b>610 SERIES</b>
61002	L-4-J	.030	.015	MR	26°	.102	
61003	L-4-J	.030	.015	FR	22°	.074	
61005	L-7-J	.030	.015	MR	26°	.102	
61006	L-4-J	.030	.015	FR	22°	.074	
61010	L-4-J	.030	.015	FR	22°	.074	
61012	L-4-J	.030	.015	MR	26°	.102	
61014	L-7-J	.030	.015	MR	26°	.102	

Model No.	Champion Spark Plug	Plug Gap	Breaker Point Gap (in.)	Ignition Timing Stator Position	Angle BTDC	Distance BTDC (in.)	
82001	L-4-J	.030	.015	MR	26°	.102	<b>820 SERIES</b>
82002	L-4-J	.030	.015	MR	26°	.102	
82003	L-4-J	.030	.015	MR (+ 2°)	28°	.118	
82004	L-4-J	.030	.015	MR	26°	.102	
82005	L-7-J	.030	.015	MR	26°	.102	
82006	L-7-J	.030	.015	MR	26°	.102	
82007	L-10-J	.030	.015	MR	26°	.102	
82008	L-7-J	.030	.015	MR	26°	.102	
82009	L-7-J	.030	.015	FR	22°	.074	
82010	L-7-J	.030	.015	FR	22°	.074	
82011	L-7-J	.030	.015	MR	26°	.102	
82012	L-7-J	.030	.015	FR	22°	.074	
82014	L-4-J	.030	.015	FR	22°	.074	
82015	L-7-J	.030	.015	MR	26°	.102	
82017	L-7-J	.030	.015	MR	26°	.102	
82019	L-7-J	.030	.015	MR	26°	.102	
82021	L-7-J	.030	.015	MR	26°	.102	
82023	L-7-J	.030	.015	MR	26°	.102	
82026	RL-7-J	.030	.015	MR	26°	.102	
82027	RL-7-J	.030	.015	MR	26°	.102	
82029	RL-7-J	.030	.015	MR	26°	.102	
82030	L-90	.030					
82032	RL-7-J	.030	.015	MR	26°	.102	

### NOTES

① **Stator Position.** MR — Mid Range, FR — Full Retard. Adjust according to direction of engine rotation. With standard rotation, flywheel turns clockwise looking from flywheel end. For FR, set stator plate all the way clockwise. With reverse rotation, for FR, turn stator plate all the way counterclockwise.

② **Angle BTDC (Before Top Dead Center).** Degree of spark advance BTDC when stator plate is set (see number ①).

③ **Distance BTDC (Before Top Dead Center).** Distance in inches from top of piston to top of cylinder when ignition occurs and with stator plate set (see number ①).

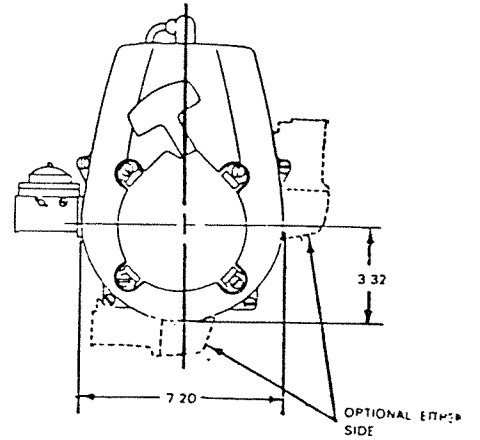
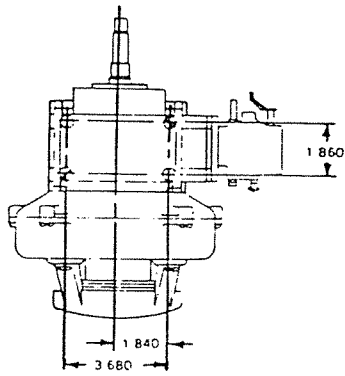
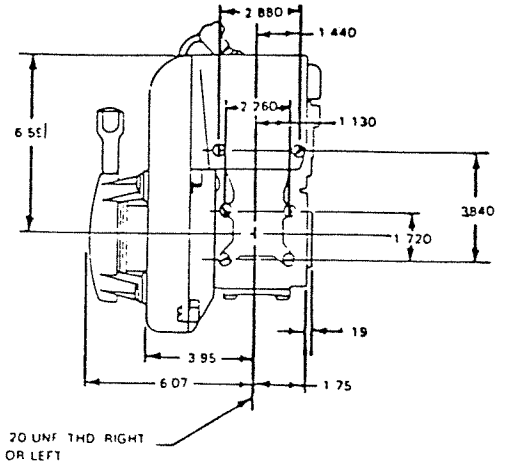
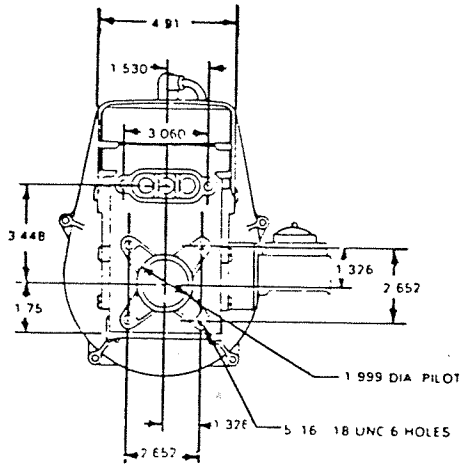


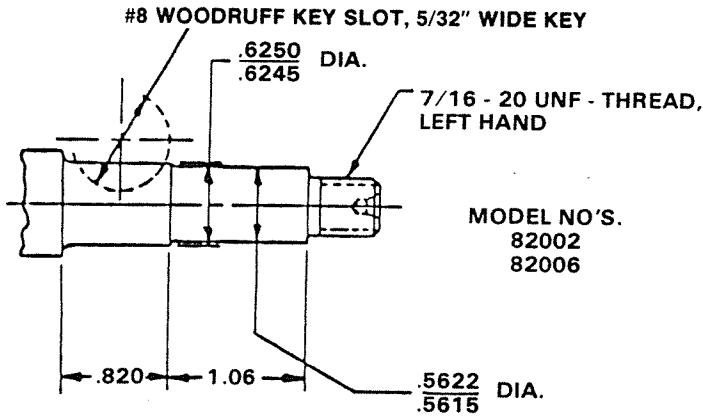
## SPECIFICATIONS (cont.)

<b>CARBURETOR</b>					
<b>APPROXIMATE SETTINGS</b>					
<b>Model #</b>	<b>Reed Stop Setting</b>	<b>Rotation Drive End View</b>	<b>Lo-Speed</b>	<b>High-Speed</b>	
61001	.26	CCW	1-1/8	1-1/8	<b>610 SERIES</b>
61002	.26	CW	1-1/8	1-1/8	
61003	.26	CCW	1-1/8	1-1/8	
61005	.26	CCW	1-1/8	1-1/8	
61006	.26	CW	1-1/8	1-1/8	
61010	.26	CW	1-1/8	1-1/8	
61012	.26	CW	1-1/8	1-1/8	
61014	.26	CW	1-1/8	1-1/8	

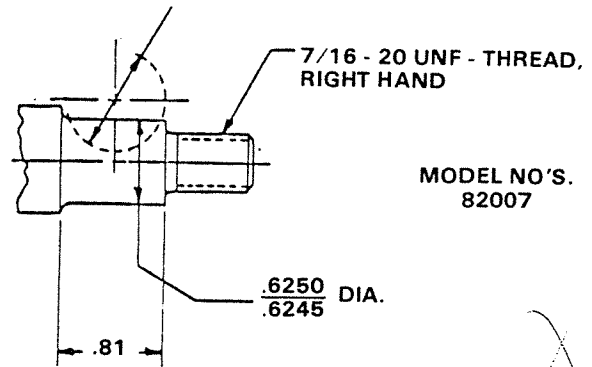
<b>Model #</b>	<b>Reed Stop Setting</b>	<b>Rotation Drive End View</b>	<b>Lo-Speed</b>	<b>High-Speed</b>	
82001	.26	CCW	1-1/8	1-1/8	<b>820 SERIES</b>
82002	.26	CW	1-1/8	1-1/8	
82003	.26	CCW	1	1	
82004	.26	CW	1	1	
82005	.26	CCW	1-1/8	1-1/8	
82006	.26	CW	1-1/8	1-1/8	
82007	.26	CCW	1-1/8	1-1/8	
82008	.26	CW	1-1/8	1-1/8	
82009	.26	CCW	1-1/8	1-1/8	
82010	.26	CW	1-1/8	1-1/8	
82011	.26	CCW	1-1/8	1-1/8	
82012	.26	CW	1-1/8	1-1/8	
82014	.26	CW	1-1/8	1-1/8	
82015	.26	CCW	1-1/8	1-1/8	
82017	.26	CCW	1-1/8	1-1/8	
82019	.26	CCW	1-1/8	1-1/8	
82021	.26	CCW	1-1/8	1-1/8	
82023	.26	CCW	1-1/8	1-1/8	
82026	.26	CW	1	1	
82027	.26	CCW	1	1	
82029	.26	CCW	1	1	
82030	.26	CW	1	1	
82032	.26	CW	1	1	

# MOUNTING DIMENSIONS 820 MODELS

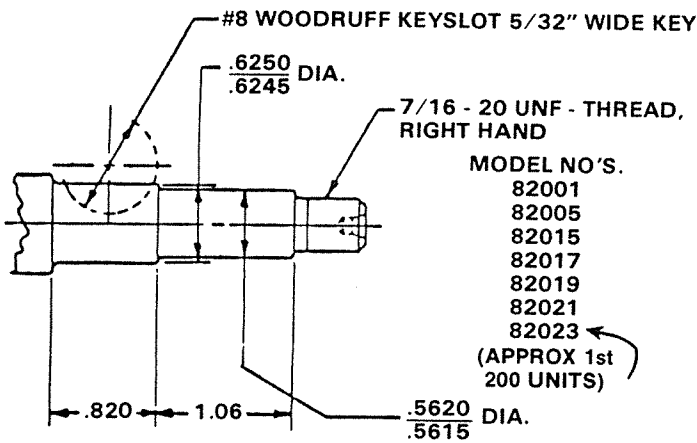




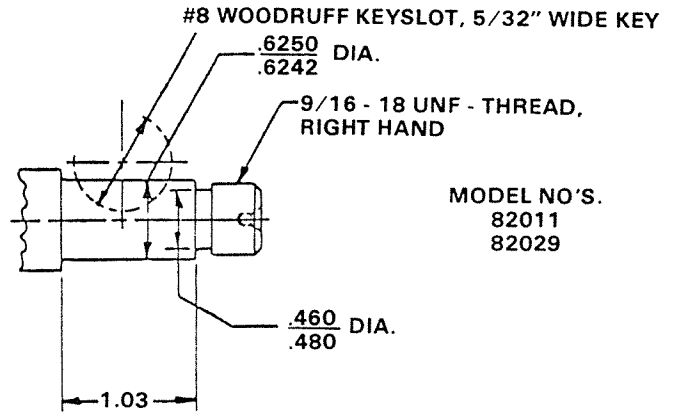
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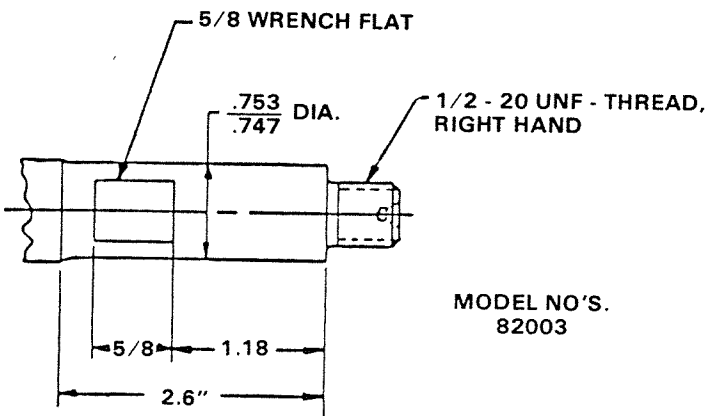
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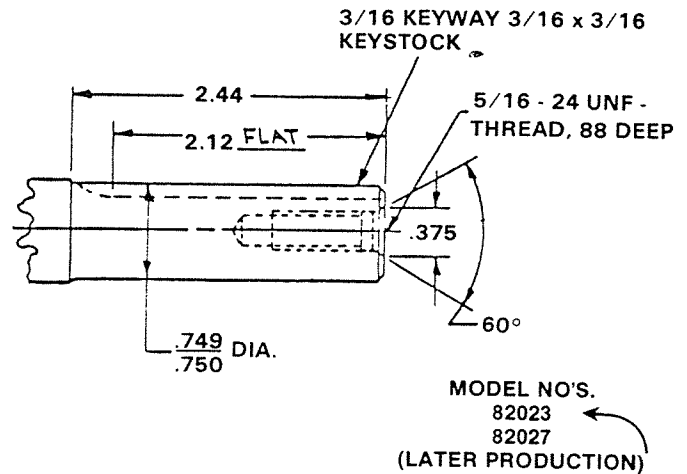
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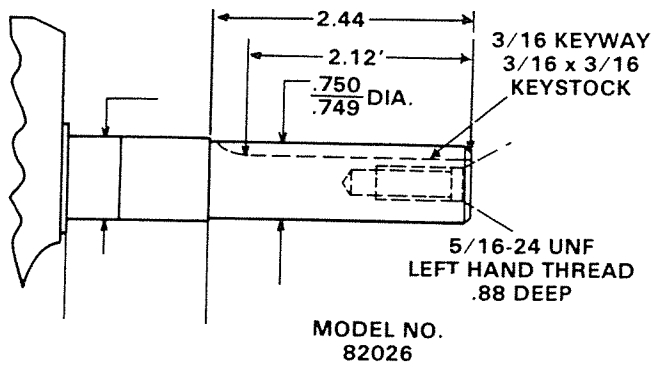
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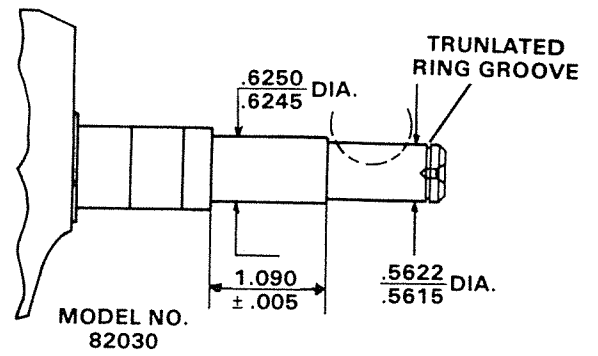
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**235018**



CRANKSHAFT NO.  
**256018**

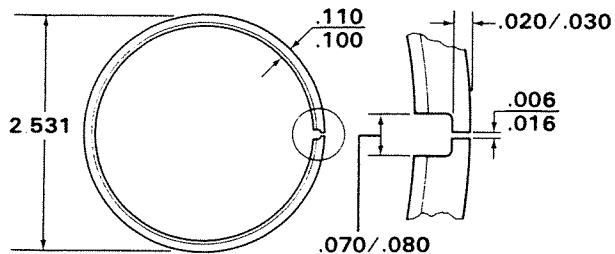


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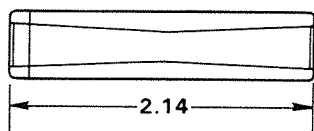


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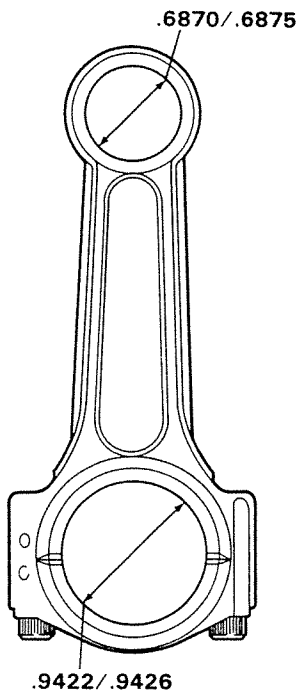
820 SERIES



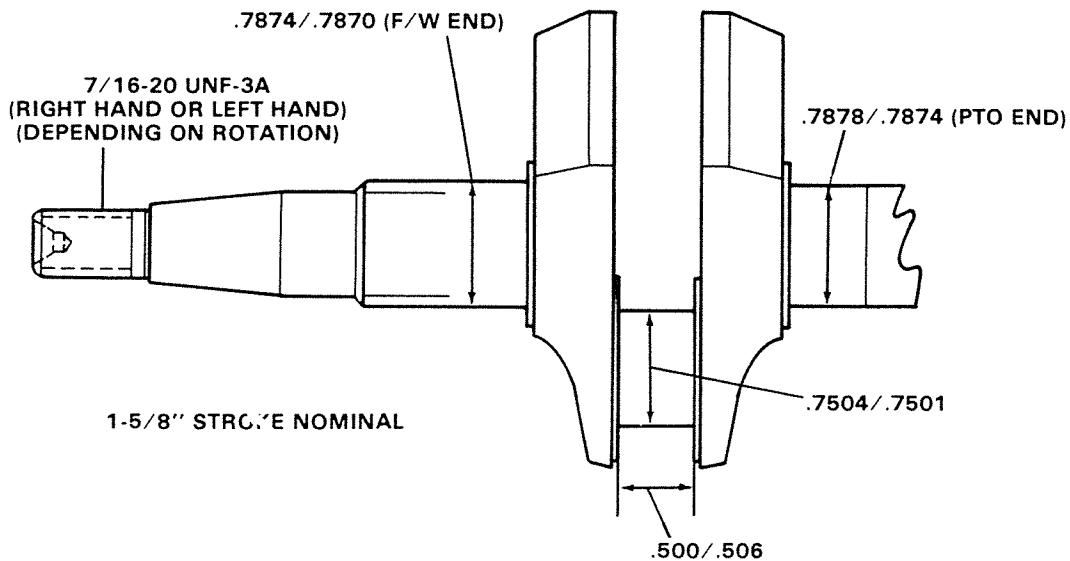
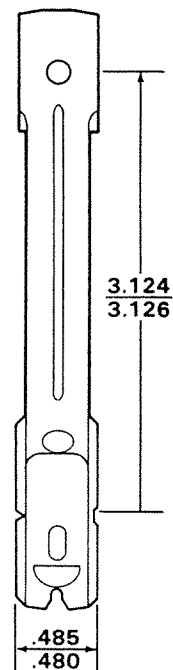
PISTON RING (@ GAUGE DIA.)



PISTON PIN

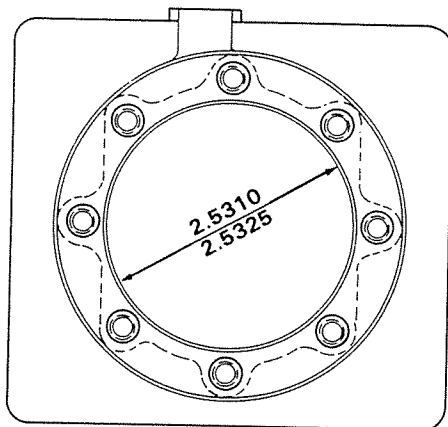


CONNECTING RODS

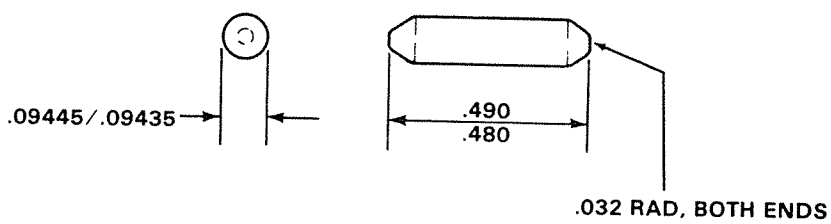


CRANKSHAFT

820 SERIES



CYLINDER



CRANKPIN ROLLER

## TOOLS, MATERIAL NEEDED

<b>SECTION 3 — STARTER</b>	
<b>Tools, Material</b>	
<b>NAME</b>	<b>USE</b>
Screwdriver	
File	Dressing up shoes, Type A.
Grease, multipurpose wheel bearing grease (thin film)	Lubricating, spring rotor.
Tape	Easing installation of rotor, Types B, C.
Sealant (Special Tool T 2963-1)	Securing dog retainer screw, Types B & C.
Impact Wrench	Removing dog retainer screw, Types B & C.

<b>SECTION 4 — FUEL SYSTEM</b>	
<b>Tools, Material</b>	
<b>NAME</b>	<b>USE</b>
Screwdriver	
Thin Wall, 5/16" Socket	Removing inlet seat.
Solvent	
Screwdriver	
Drill, 1/8" & Installer, 5/16", Flat End	Replacing welch plug

<b>SECTION 5 — MAGNETO IGNITION SYSTEM</b>	
<b>Tools, Material</b>	
<b>NAME</b>	<b>USE</b>
Screwdriver	
Wrench, Socket	
Knock off nut (Special Tool T 2923 for left hand; T 8965 for right hand)	Removing flywheel nut
Hammer	
Lapping Compound	Lapping flywheel
Solvent	
Torque wrench	
Coil, condenser tester	Testing coil, condenser
Pliers	
Lubricant, Special Tool No. T 2961	Lubricating cam wiper felt
Tension gauge	Checking point spring tension
Spark plug gauge & gapping tool	Resetting spark plug gap

<b>SECTION 6 — SOLID STATE ELECTRICAL SYSTEM</b>
Magneto Ignition Tools Are Needed (except for lubricant and tension gauge) Plus the following:

<b>NAME</b>	<b>USE</b>
Flashlight Continuity Tester such as Chrysler Marine T 2938-1 or ohmmeter	Testing electrical components for shorts
Voltmeter	Testing voltage regulator

<b>SECTION 7 — ENGINE</b>	
<b>Tools, Material</b>	
<b>NAME</b>	<b>USE</b>
Compression tester	Testing engine compression
Socket wrenches	
Screwdriver	
Knock off nut	Removing Flywheel (See Section 5)
Hex bits, ratchet	Removing connecting rod cap screws; Removing cylinder head bolts
Arbor press and soft hammer	Removing crankshaft; re-moving/installing crankshaft bearings
Ring expander (Special Tool T 8926)	Removing, installing piston rings
Snap ring pliers	Removing piston pin retaining rings
Punch, standard or Special Tool T 8919	Removing piston pin; crankshaft seal
Lacquer thinner	Cleaning gasket surfaces
Cleaning solution or rotary brush, Special Tool T 2991	Removing carbon from exhaust ports, passages
Inside micrometer or dial indicator	Measuring I.D. of cylinder for taper and out of round
Cylinder hone, drill	Reconditioning cast iron cylinder bores only
Torque wrench	
Spark plug tap, Special Tool T 2947	Cleaning spark plug hole threads
Glass or flat plate	Checking flatness of cylinder head
Emery cloth No. 120 & NO. 180	Resurfacing cylinder head
Seal installer	Installing crankshaft seals
Light motor oil	Oiling rollers, other parts
Ring compressor	Compressing rings to install piston
Locquic Activator	Cleaning connecting rod screws; and on model 82030 only - cleaning support plate screws
Sealant, Special Tool T 2963-1, (Loctite D)	Securing connecting rod cap screws
Loctite Pipe Sealer	Model 82030 only — securing stator
Loctite 271	Model 82030 only — securing support plate
Hex bit adapter, Special Tool (T 8929)	Torquing connecting rod cap screws

## OPERATING INSTRUCTIONS

**Fuel.** Use gasoline and oil as shown in Table 1.

GAS	
85 OCTANE MINIMUM	
1st Preference	Regular leaded
2nd Preference	Premium leaded
3rd Preference	No lead
DO <b>NOT</b> USE: low octane white gas, naphtha or lamp gas, or any fuel not intended for modern gasoline engine.	
OIL	
1st Preference	Chrysler BIA, TC-W 2 Cycle Oil
2nd Preference	SAE 40 Oil

**Table 1. Fuel and Oil Specifications.**

### Fuel Mixture.

1. In a separate, clean container, thoroughly mix one-third (1/3) pint of oil with each gallon of gasoline. Table 2.

FUEL MIX: 25 to 1	
Gasoline	Oil
1/2 gal. (2.3 l.)	1/6 pt. (79 ml.)
1 gal. (3.8 l.)	1/3 pt. (158 ml.)
2 gal. (7.6 l.)	2/3 pt. (316 ml.)
3 gal. (11.4 l.)	1 pt. (474 ml.)

**Table 2. Fuel/Oil Mixture.**

2. Strain the fuel mixture through a fine mesh screen when filling the fuel tank to remove any dirt or water.

### Starting.

1. Fill fuel tank with fuel prepared as outlined above. Wipe up all spilled gasoline.
2. Move choke to closed position.
3. Turn ignition switch "ON". When starting engine for first time, perform steps one and two under "Carburetor Adjustment".
4. Crank engine part way through compression to bleed of some compression, then crank with quick, short pulls. When engine starts, move choke to open position.
5. Perform steps outlined under "Carburetor Adjustment", if necessary.

**Stopping.** Move the ignition switch to "OFF" position to stop engine by shorting magneto to ground.

### NOTE

Carburetor and ignition adjustments are covered in detail in Sections 4 and 5.

### Carburetor Adjustment.

#### CAUTION

Do not force needles tightly closed or seats will be damaged.

1. Turn both adjustment needles clockwise until completely closed.
2. Open both needles by turning counterclockwise one (1) turn. (This is average setting.)
3. Install tachometer on spark plug lead.
4. Warm up engine
5. Adjust idle mixture so that engine does not bog or accelerate slowly.

#### CAUTION

Do not set high speed adjustment any leaner than necessary or piston may seize at high speed.

6. Turn high speed needle clockwise until four-cycling stops.
7. Turn idle stop screw to obtain dependable idle of 2200 RPM (max.) or less

### Ignition.

1. Breaker point gap must be .015. Set points with cam follower at index mark on breaker cam.
2. If the magneto stator plate is loosened or removed for any reason, timing and breaker point adjustment must be rechecked. See Specifications in this Section and Ignition Section (5).
3. Correct breaker point adjustment is important. Timing will automatically be advanced if the breaker point setting is greater than .015, or retarded if less than .015.

**Spark Plug.** Check and clean spark plugs regularly. Set spark plug gap. See Specification Chart in this Section and see Ignition Section (5).

### Storing Engine.

1. Do not run engine to remove the fuel left in the carburetor. Drain carburetor by removing fuel strainer cover.



2. Remove spark plug and pour 1/4 cup of oil into the cylinder. Replace spark plug.
3. Crank engine over once or twice to circulate the oil.

4. If engine is to be stored in an extremely damp area, remove crankcase cover and lubricate upper and lower main bearings and both ends of connecting rod.

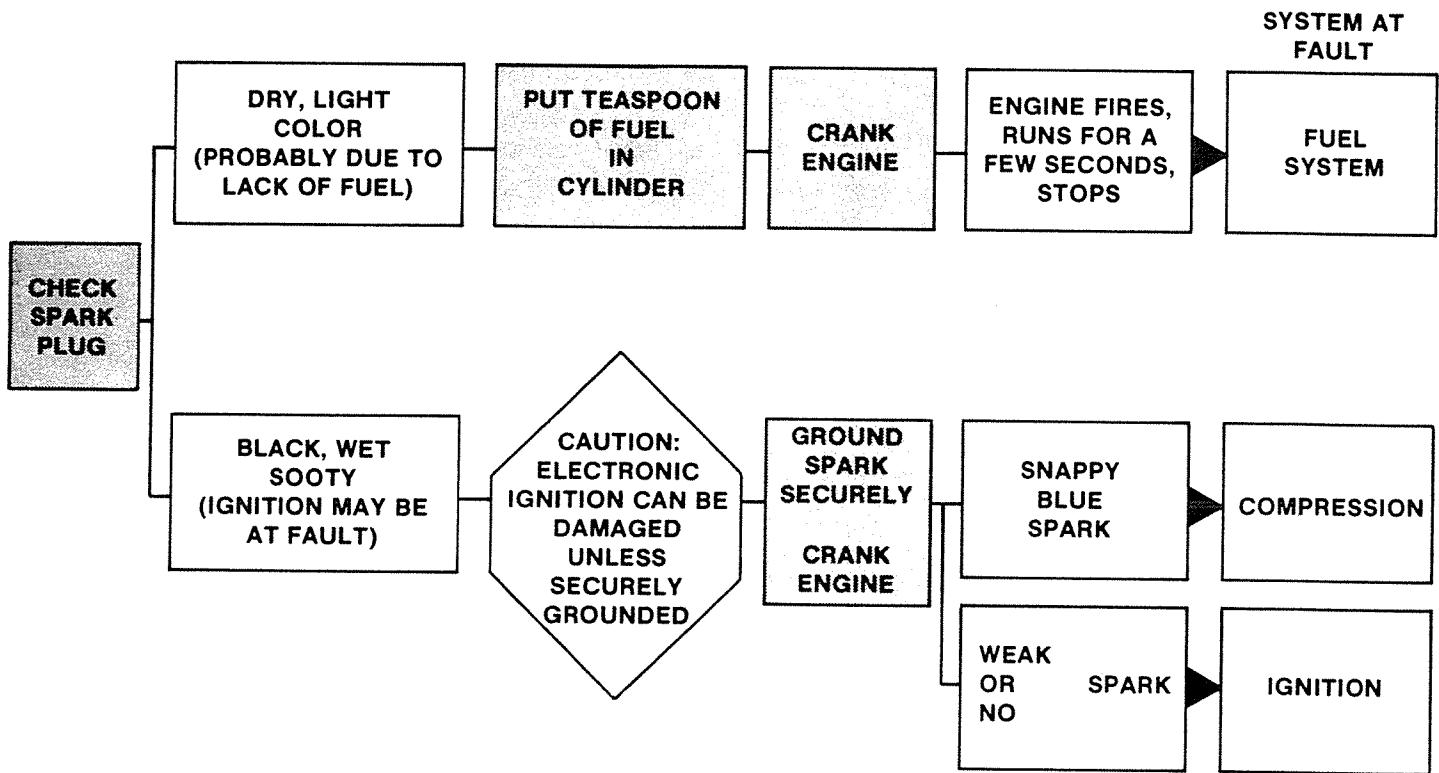
## TROUBLESHOOTING STRATEGY

### General Notes.

1. Check simple parts first: for example, check air filter before suspecting carburetor needs overhaul.
2. Think of engine in terms of basic requirements and systems:

- A. Fuel/air mixture.
- B. Ignition
- C. Compression.

1. Find system at fault by following chart below.



2. Check groups of possible causes in troubleshooting chart below.

3. Continue troubleshooting in Fuel, Ignition or Engine Sections in this manual.

## TROUBLESHOOTING

Problem	Probable Cause	Test Procedure/Remedy
1. Engine will not start	A. No fuel in tank.	
	B. Spark plug not firing.	Check for wrong, defective or fouled plug. Check for spark: Remove plug, attach lead wire and ground plug against cylinder. Crank engine to determine if spark will jump gap on plug. If no spark or weak spark, remove flywheel and check wiring, connections, hi-tension lead wire, lead wire spark plug connector, coil, condenser and points.
	C. Breaker points set wrong.	Check, reset to .015 gap.
	D. Fuel not reaching combustion chamber.	Check carburetor for dirt. Check hi-speed and idle adjustments. Remove spark plug and inspect. If plug is dry, pour a small amount of fuel into cylinder through spark plug hole, exhaust ports or carburetor. Check fuel system for obstructions, incorrect mixture, pinched line, dirty filter, closed fuel tank vent, air leak.
	E. Engine flooded.	Close high speed needle. Dry excess fuel from spark plug. Install spark plug and crank until engine starts, then open high speed needle 3/4 - 1 turn. Readjust after warm-up.
	F. Engine air leak, lack of compression	Test and overhaul if necessary. See Section 7.
2. Engine hard to start	A. Water or dirt in fuel, stale fuel mixture, or too much oil in fuel.	Drain fuel tank and carburetor. Fill with fresh fuel mixture. Be sure to strain through fine screen.
	B. Weak ignition spark.	See problem one, part B.
	C. Engine over or under choked.	See problem one, parts D and E.
	D. Carburetor out of adjustment.	See "Carburetor Adjustment" in this Section or in Section 4A.
	E. Gasket or seal leaks.	Inspect gaskets and seals closely once engine is running.
	F. Open or broken reed.	Engine will "spit back" through carburetor while idling or starting: Remove reed plate and inspect. Refer to "Reed Valve" Section (4B) for correct setting or replacement.
	G. Spark plug fouled.	Remove and inspect.
	H. Breaker points not adjusted.	Reset to .015 gap.
3. Engine starts but will not continue to run	A. Insufficient fuel supply or wrong mixture.	
	B. Fuel line restricted or filter clogged.	Disconnect fuel line from carburetor to see if fuel flows freely. Check filter.
	C. Carburetor out of adjustment.	See "Carburetor Adjustment" in this Section or in Section 4A.
	D. Vent screw on filler cap closed.	
	E. Faulty fuel pump or dirty carburetor.	Remove fuel pump and carburetor from engine, disassemble and inspect.

<b>Problem</b>	<b>Probable Cause</b>	<b>Test Procedure/Remedy</b>
	F. Air leak in fuel system.	Inspect fuel system for leaks.
	G. Wrong, defective or fouled spark plug.	Remove and inspect.
	H. Weak coil or defective wiring.	
	I. Air leak in engine.	Test and overhaul if needed.
4. Engine misses.	A. Dirt in fuel system or wrong fuel mixture.	
	B. Carburetor out of adjustment.	See "Carburetor Adjustment" Section.
	C. Spark plug wrong, fouled or defective.	Remove and inspect.
	D. Faulty ignition.	Remove flywheel and inspect coil, all wires and connections. Test coil. Check hi-tension lead wire for leaks.
	E. Points oily or not adjusted.	Clean. Set gap at .015.
	F. Air leak in engine.	Check cylinder head bolt torque.
5. Engine lacks power.	A. Air cleaner clogged.	Clean with solvent.
	B. Carburetor dirty or not adjusted properly.	Refer to "Carburetor Adjustment" Section.
	C. Spark plug wrong, defective or fouled.	Check specification chart. Check and clean plug.
	D. Fuel system leaks, wrong mixture, fuel line restricted, filter dirty, fuel tank vent screw closed.	
	E. Muffler or exhaust clogged.	Remove carbon. Use wooden or blunt tool on exhaust ports.
	F. Faulty ignition.	Check wiring, coil.
	G. Worn or stuck piston rings or leaky head gasket.	Test compression with gauge. If compression is low, replace rings or head gasket.
	H. Scored piston or cylinder wall.	Check compression. Disassemble engine and inspect piston, rings and cylinder wall.
6. Engine overheats.	A. Engine overloaded.	Allow engine to cool. Reduce load.
	B. Air flow restricted.	Clean flywheel, cylinder fins, screen.
	C. Carburetor adjustment too lean.	See "Carburetor Adjustment" Section.
	D. Insufficient oil in fuel.	
	E. Incorrect spark plug.	See "Specification Chart".
	F. Scored piston or cylinder wall.	Disassemble engine and inspect.
7. Engine noisy or knocking.	A. Loose flywheel.	Torque to specifications given in Torque Chart.
	B. Spark plugs, wrong heat range.	Use proper plugs.
	C. Worn bearings.	Disassemble engine and inspect bearings.
	D. Broken or loose parts inside engine.	Disassemble and inspect.

<b>Problem</b>	<b>Probable Cause</b>	<b>Test Procedure/Remedy</b>
8. Engine stalls under load.	A. Carburetor adjustment too lean.	See "Carburetor Adjustment" Section.
	B. Fuel line restricted or tank vent closed.	
	C. Faulty fuel pump.	Remove pump, disassemble and inspect diaphragm and other parts.
	D. Engine overloaded.	
9. Poor acceleration.	A. Carburetor out of adjustment.	See "Carburetor Adjustment" Section.
	B. Air cleaner clogged.	Clean with solvent.
	C. Timing advanced.	Retime.
	D. Chipped or broken reeds.	Remove reed plate and inspect.
	E. Leaking gaskets.	
	F. Exhaust restriction.	
	G. Poor compression.	Disassemble engine and inspect piston, rings cylinder wall and head gasket.
10. Poor high speed performance.	A. Carburetor out of adjustment.	See "Carburetor Adjustment" Section.
	B. Low compression.	Check for broken or worn rings, scored piston or cylinder wall or leaky head gasket.
	C. Pre-ignition.	Check for pre-ignition: Allow engine to heat up thoroughly, turn ignition switch to "Off" position. If engine continues to run, check for the following: dirty or incorrect spark plug, excessive carbon or foreign matter in combustion chamber, carburetor adjustment too lean, excessive back pressure from muffler.
	D. Carburetor icing.	Snow in carburetor bore will cause richness, smoking, poor power. Remove snow or ice, do not lean out.



**Section**

# 3

## **STARTER**

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Tools, Material Needed .....	30
Inspection and Repair .....	32
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**GENERAL**

This section deals with disassembly, repair and reassembly of the starter.

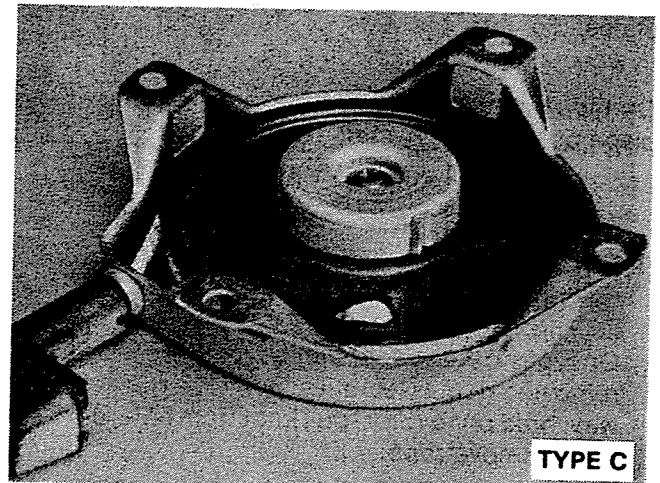
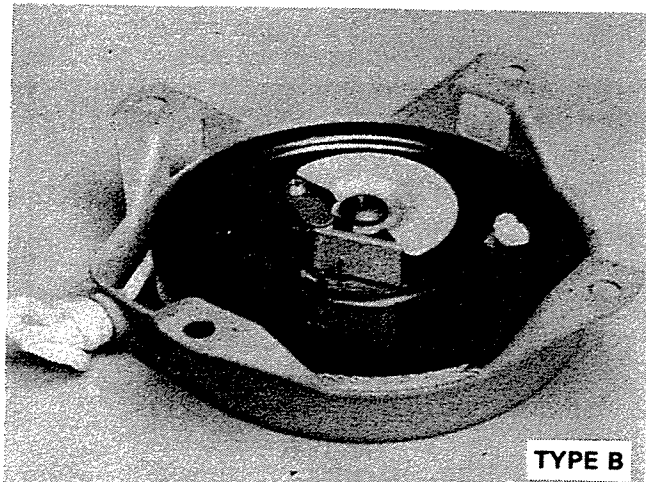
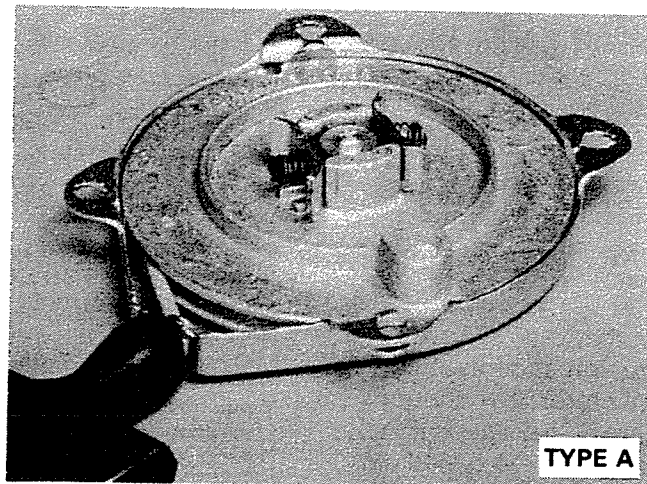
**DESCRIPTION**

The starter is a hand operated, automatic rewind starter, attached to the fan housing. The starter rope is wound around a rotor. The rotor includes a friction shoe or dog assembly that engages the

starter cup. The rotor engages a rewind spring that serves as the rewind force. There are three (3) styles of starters. Figure 1.

**MODEL DIFFERENCES**

Starters are supplied in standard or reverse rotation depending on engine model (application). Therefore, the rope and rewind spring are wound in two (2) ways, and the starter housing rope hole varies in position.



**Figure 1. Starter Types.**

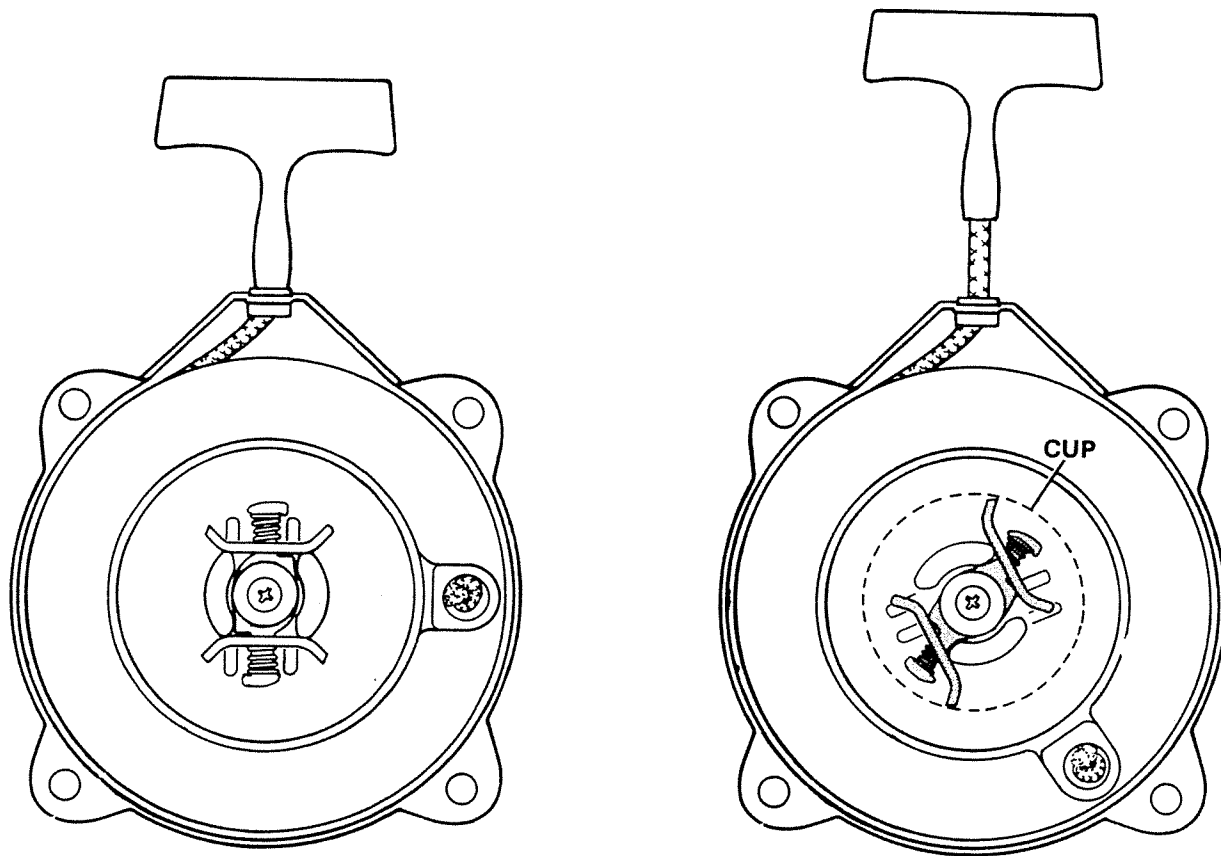


Figure 2. Starter Operation, Type A.

## OPERATION

Pulling the starter rope turns the rotor. On type A starters a spring holds the friction shoe assembly against the bottom of the rotor by friction, momentarily restricting rotation of the friction shoe assembly. This moves the friction shoe plates off center so that the sharp, leading edges of the shoe plates dig into the side of the starter cup. The flywheel is turned, providing starting force.

On type B and C starters, a dog assembly takes the place of the friction shoe assembly.

## REMOVAL

### NOTE

On types B & C, ropes can be removed without removing dog assemblies: pull rope out all the way; hold on to rotor, pull knot from hole, untie knot, remove rope.

1. Remove starter from fan housing by removing four (4) screws and lockwashers. Figure 3.

## TOOLS, MATERIAL NEEDED

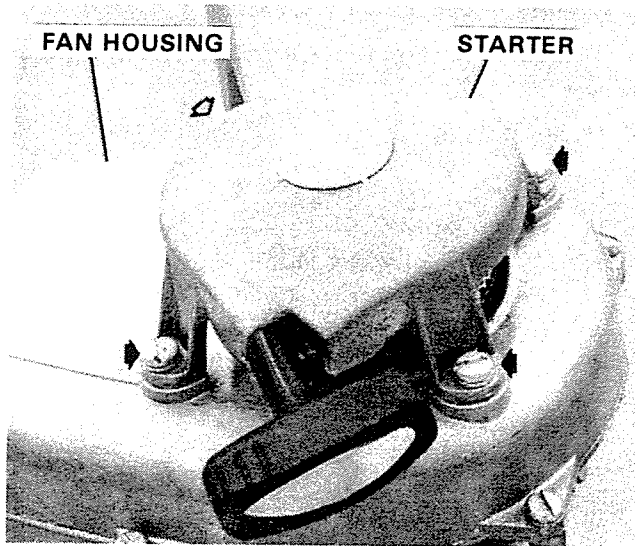
SECTION 3 — STARTER	
Tools, Material	
NAME	USE
Screwdriver	
File	Dressing up shoes, Type A.
Grease, multipurpose wheel bearing grease (thin film)	Lubricating spring, rotor.
Tape	Easing installation of rotor, Types B, C.
Sealant (Special Tool T 2963-1)	Securing dog retainer screw, Types B & C.
Impact Wrench	Removing dog retainer screw, Types B & C.

2. Remove shoe or dog assembly as follows:

### NOTE

Keep careful track of attaching parts. There are slight differences within types.





**Figure 3. Removing Starter.**

**Type A.**

**NOTE**

In next step hold on to retainer washer to keep from losing parts.

- A. Remove retaining ring or screw from hub. Figure 4.
- B. Remove washers, spring, friction shoe assembly.

**Type B.**

- A. Remove dog assembly by removing screw from retainer using impact wrench. Figure 4.
- B. Remove cam assembly by placing starter in vise with protective jaws and removing screw. Figure 4.

**Type C.**

- A. Remove dog assembly by removing screw using impact wrench. Figure 4.
- 3. Remove rotor and starter rope as follows:

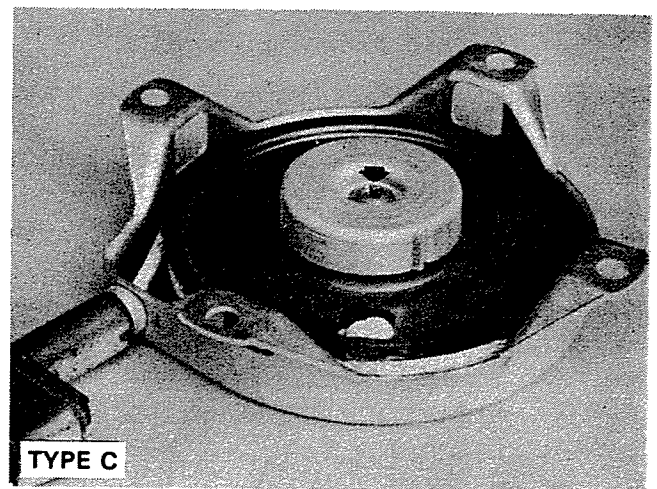
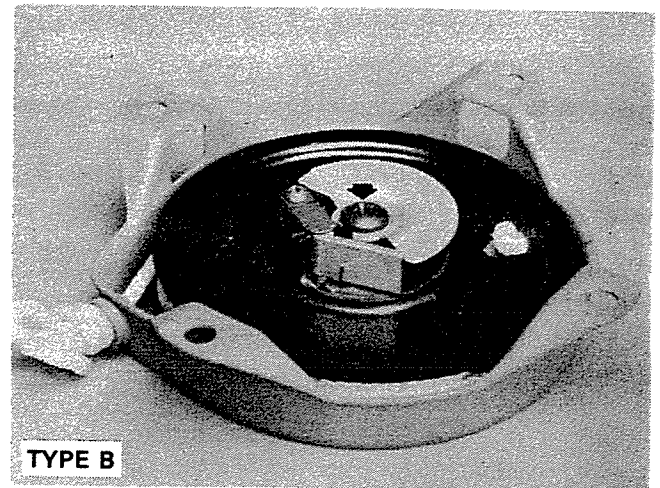
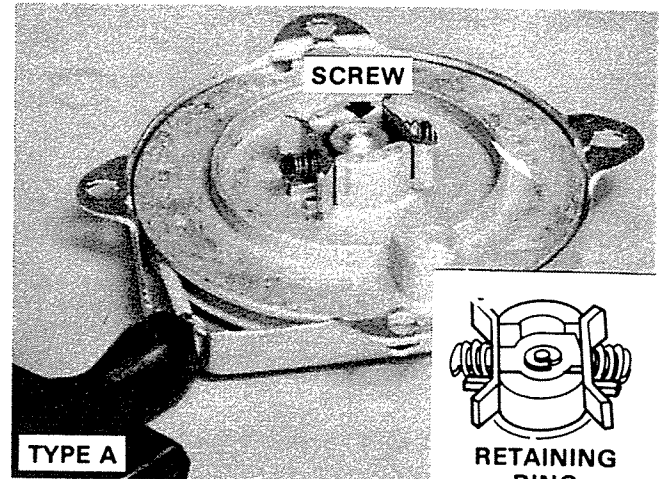
**CAUTION**

Hold on to rotor to keep it from unwinding fast. There are several types of handles. When detaching rope from handle be sure it does not become free before you are prepared.

- A. Remove handle, untie knot and allow rotor to unwind **slowly**.

**CAUTION**

In next step, lift rotor out carefully or rewind spring may fly out.



**Figure 4. Removing Shoe or Dog Assembly.**

- B. Lift rotor with rope about half an inch from cover. Detach spring from rotor.
- C. Note direction in which rope is wound. Untie knot in rope in rotor slot and pull rope out of rotor.

4. Remove rewind spring as follows:

**CAUTION**

Spring is under tension.

**NOTE**

Note direction in which spring is wound.

**Type A.**

A. Remove and unwind spring carefully, one loop at a time, from inside out, while holding back rest of spring. Figure 5.

**Types B and C.**

A. Remove spring with keeper. Figure 5.

**INSPECTION AND REPAIR**

1. Inspect and repair shoe or dog assembly as follows:

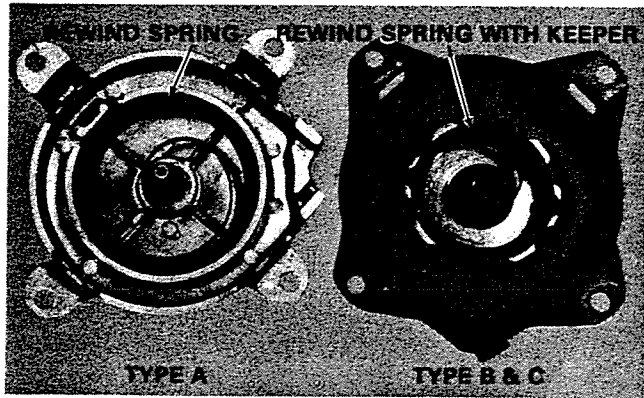
A. Wash parts in solvent.

**Type A.**

B. Inspect shoe plates for wear. Edge must be sharp. Touch up with file if needed. Figure 6.



*Figure 6. Inspecting Shoe Plate.*



*Figure 5. Removing Spring.*

**Types B and C.**

C. Inspect dogs and springs for wear.

2. Inspect brake spring for wear.

3. Inspect starter rope for wear. Check length, it must be 48 in. (122 cm).

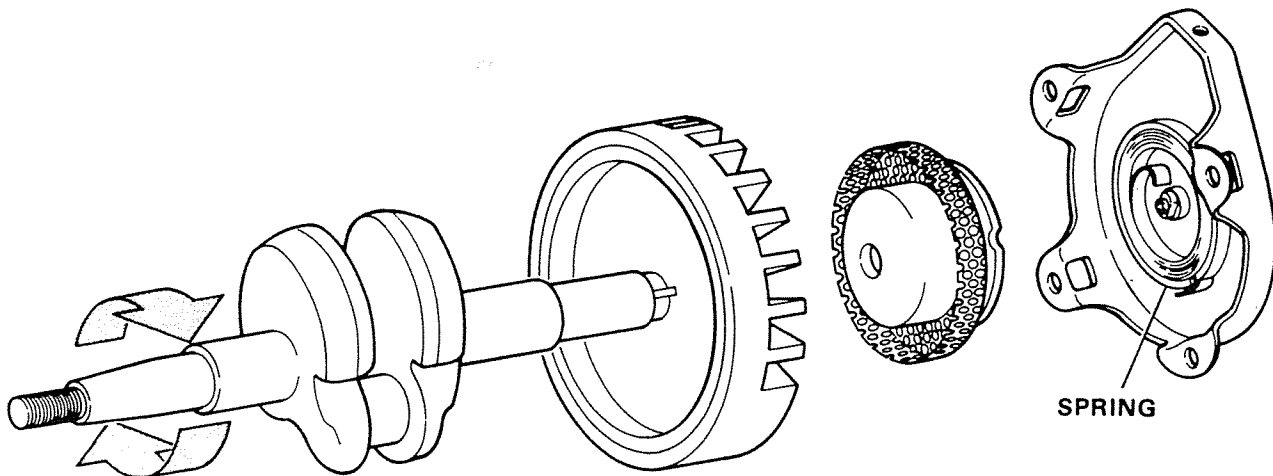
**REASSEMBLY**

**Rewind Spring.**

1. Install spring as follows:

**NOTE**

Spring position depends on rotation of engine. Figure 7.



*Figure 7. Spring Position and Engine Rotation.  
(CW Drive End, CCW [reverse] at Flywheel End  
Shown)*

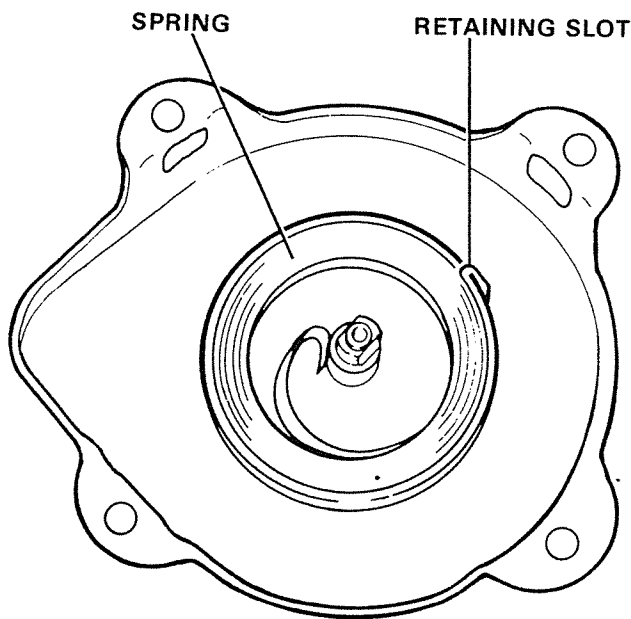
**Type A.**

**Old Spring.**

1. Wind spring into tight coil.
2. Install spring with hook in retaining slot; Figure 8, and apply a generous coat of grease to spring.

**New Spring.**

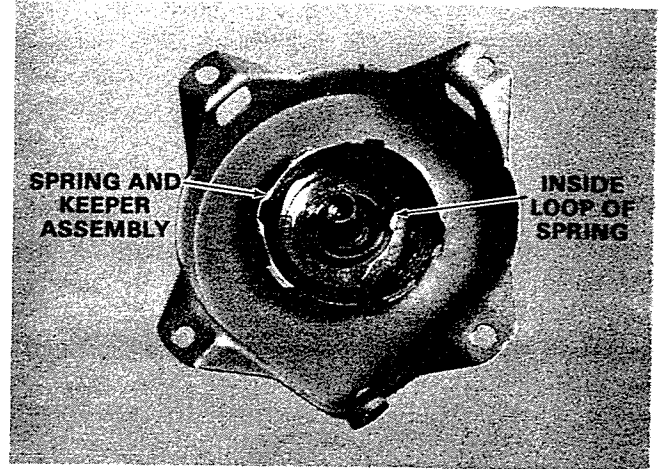
1. Place spring in cover, leaving spring retainer on spring.
2. Remove retainer carefully so spring does not pop out.



**Figure 8. Installing Spring, Type A Starter.  
(Position for Reverse Rotation Engines  
CCW at Flywheel End)**

**Types B and C.**

1. Place spring and keeper assembly into cover. Figure 9.

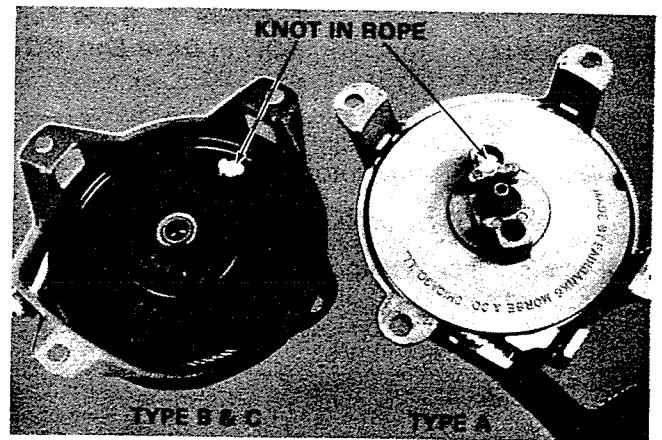


**Figure 9. Installing Spring, Type B and C Starters.**

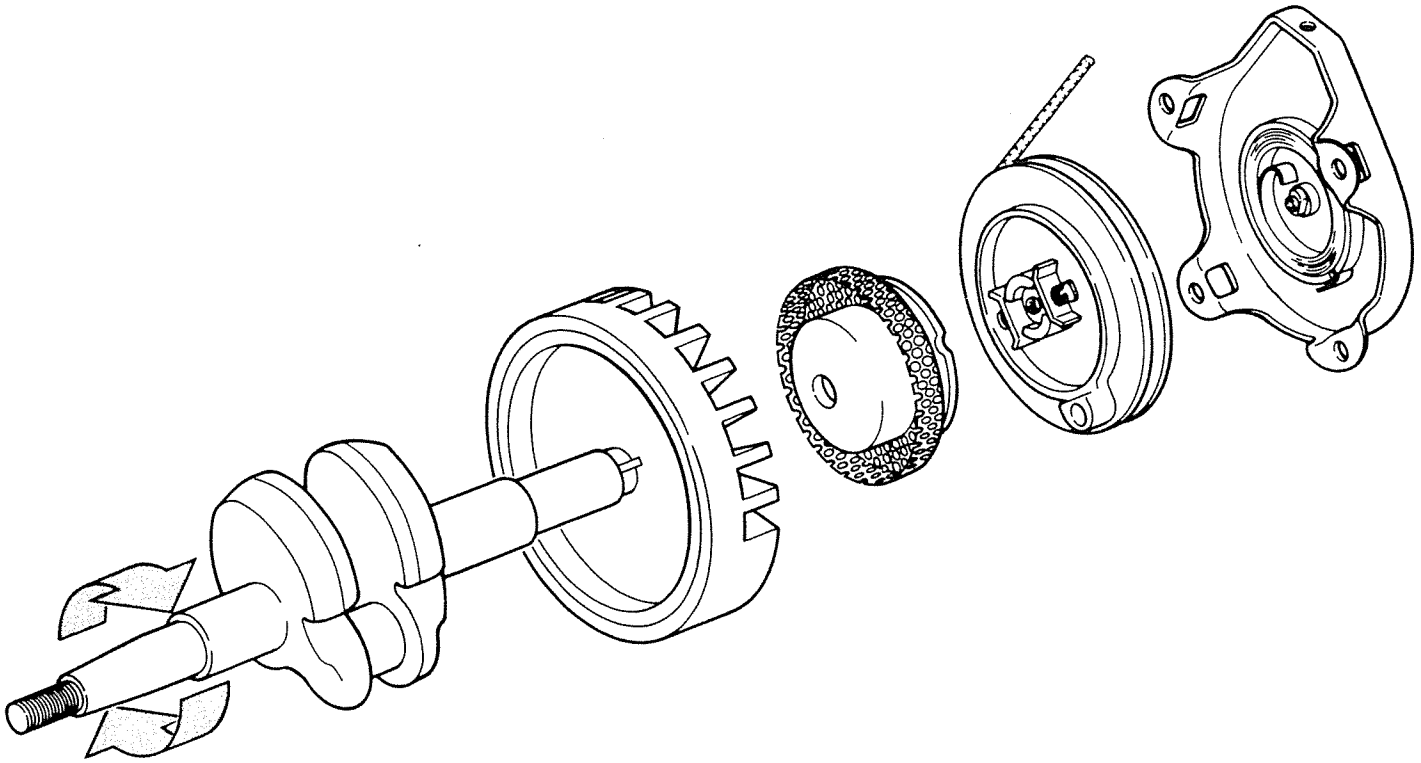
2. Oil spring and grease cover shaft lightly.

**Rope.**

1. Tie knot in one end of starter rope, thread other end of rope through hole in rotor until knot is seated firmly in hole. Figure 10.



**Figure 10. Starter Rope Knot Position.**



**Figure 11. Rope Position and Engine Rotation.**  
(CW at Drive End, CCW [reverse] at Flywheel End.)

2. Wind rope around rotor.

**NOTE**

Rope position depends on rotation of engine.  
Figure 11.

3. Install rotor as follows:

**Type A.**

- A. Place rotor in cover and press down while turning rotor so that end of rewind spring engages notch on under side of pulley.

**NOTE**

If this doesn't work easily, a screwdriver may help.

**Types B and C.**

- A. Use a small piece of tape to hold end of starter rope against rotor. (This keeps rope out of the way during later step: checking spring tension.)
- B. Install spring and keeper assembly to rotor by lining up notches and pushing assemblies together.

- C. Place entire assembly in housing and turn rotor until end of rewind spring engages notch in starter housing.

4. Put tension on spring as follows:

**CAUTION**

Keep firm hand on rotor so it will not unwind unexpectedly.

- A. Turn rotor three (3) full turns (type A) or two (2) full turns (types B, C) and hold.
  - B. Put end of rope through hole in cover and tie knot in rope outside cover to keep tension.
5. Check spring for bottoming as follows:

**CAUTION**

In next step keep hand on rotor to keep assembly in place.

- A. Pull rope all the way out.
- B. Try to turn rotor by hand about 1/4 of a turn.
- C. If rotor turns, spring is O.K.

D. If rotor won't turn, recheck as follows: Untie knot, unwind rotor one full turn to take tension off spring, retie knot and recheck for bottoming. If rotor won't turn 1/4 turn, replace spring.

6. Install handle.

### Shoe (Dog) Assembly.

#### Type A.

#### NOTE

One end of friction shoes has sharp edges which must face the way they turn or starter will not work. Shoes must also be positioned one way only. Figure 12, top.

1. Assemble and install friction shoe assembly.

#### NOTE

Two Type A assemblies are shown in Figure 12; Position of brake spring and number of washers may vary, see parts book for exact assembly.

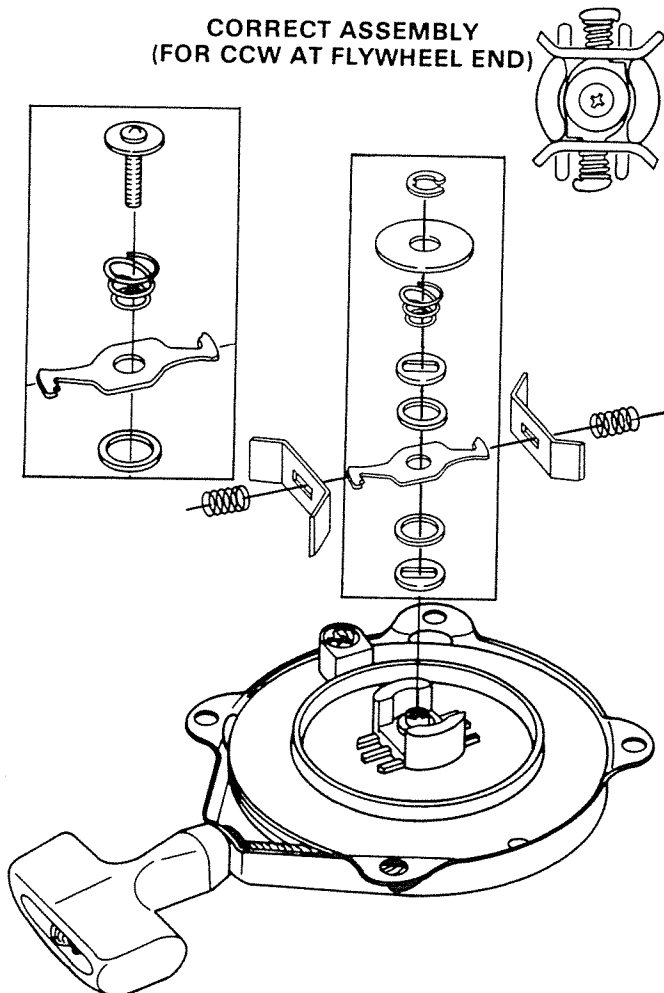


Figure 12. Installing Friction Shoe Assembly.  
(Type A Starter)

2. Check operation: When rope is pulled, friction shoes should extend; when rope is released, shoes should retract.

3. Install and center starter as follows:

A. Install to engine **finger tight only**.

B. Pull rope until shoes engage starter cup. This centers starter on engine.

#### CAUTION

Failure to center starter will cause damage.

C. Tighten mounting screws.

#### Type B.

1. Assemble dog assembly as follows. Figure 13.

A. Install brake spring in hole in starter hub, place cam on hub, place grease on underside of screw head and secure cam with screw.

B. Install dog spring with angled end of spring up, into hub.

C. Install dog in cut out by moving end of spring away from hub, and installing dog, releasing spring.

#### NOTE

Dogs should now be held in place by spring.

D. Place dog retainer on hub, apply sealant, Special Tool No. T 2963-1 to threads of screw and secure.

2. Check operation: when rope is pulled, dog should extend; when rope is released, dog should retract.

3. Secure starter to engine with screws and lockwashers.

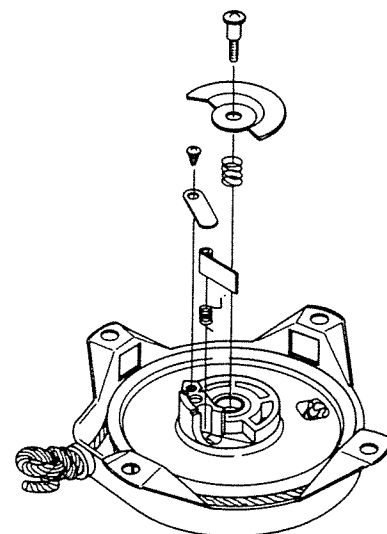


Figure 13. Installing Dog Assembly, Type B Starter.

**Type C.**

1. Assemble dog assembly as follows. Figure 14.
  - A. Place dog springs with angled ends up in cut outs on pulley hub.
  - B. Install dogs in cut outs by moving ends of springs out away from hub, installing dogs, and releasing springs.

**NOTE**

Dogs should now be held in place by spring.

- C. Place retainer screw spring in center bore of hub, place retainer on hub.

- D. Place sealant, Special Tool No. T 2963-1 on threads of retainer screw and grease under head. Secure.

2. Check operation: When rope is released, dogs should retract.

3. Install and center starter as follows:

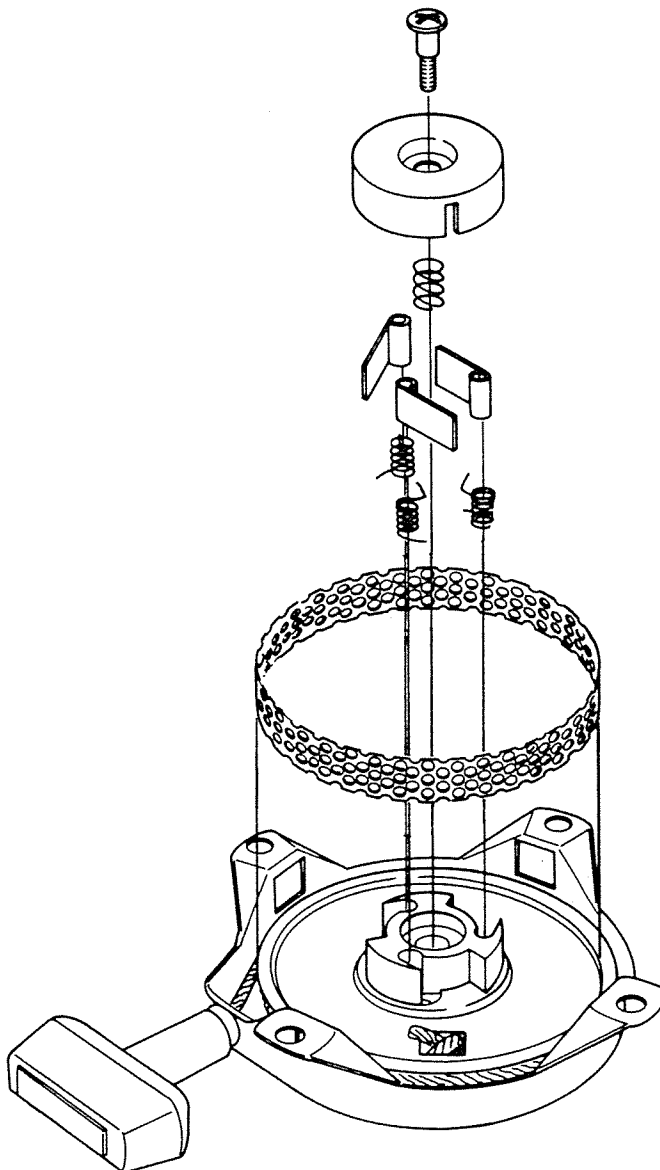
- A. Secure starter, **finger tight only.**

- B. Pull rope until dogs engage starter cup. This centers starter on engine.

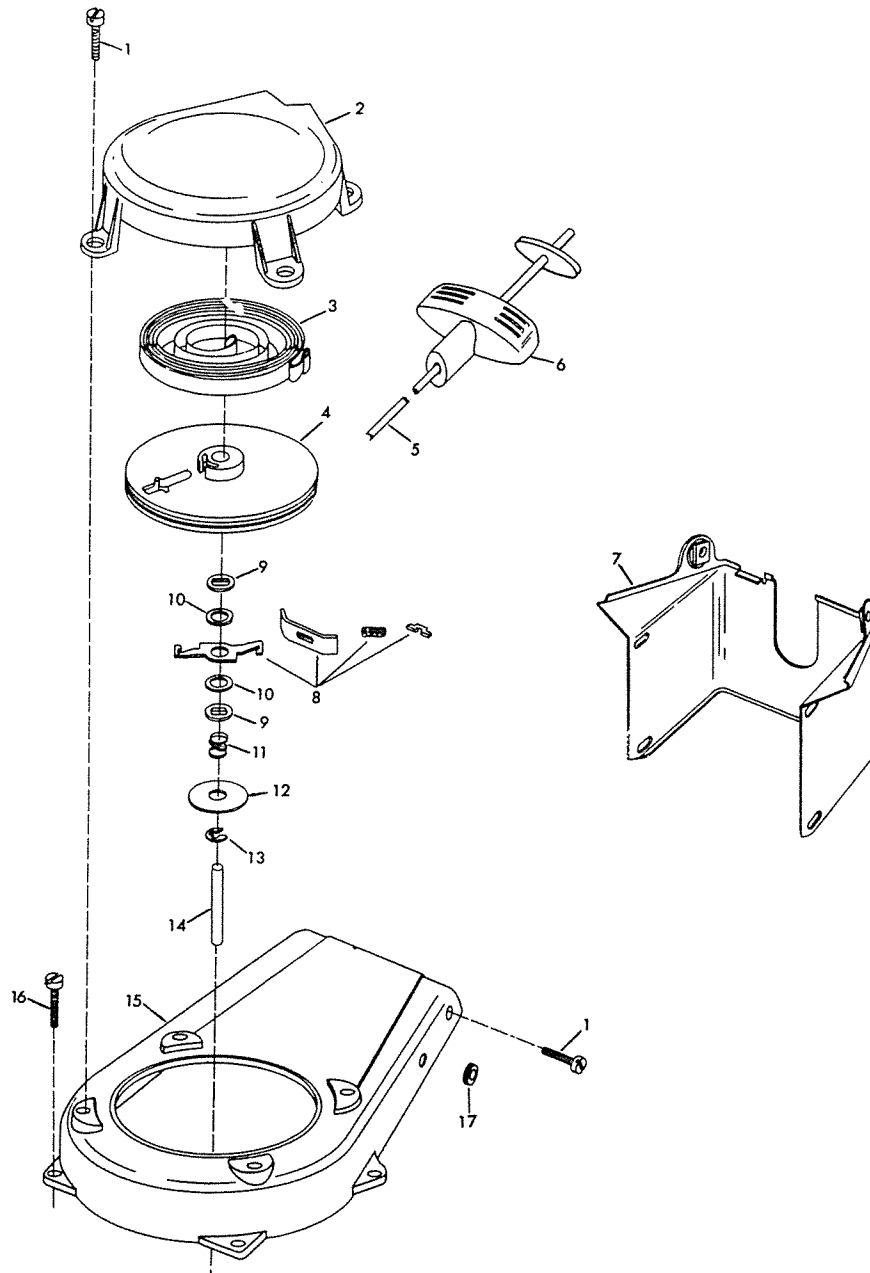
**CAUTION**

Failure to center starter will cause damage.

- C. Tighten mounting screws.



**Figure 14. Installing Dog Assembly, Type C Starter.**



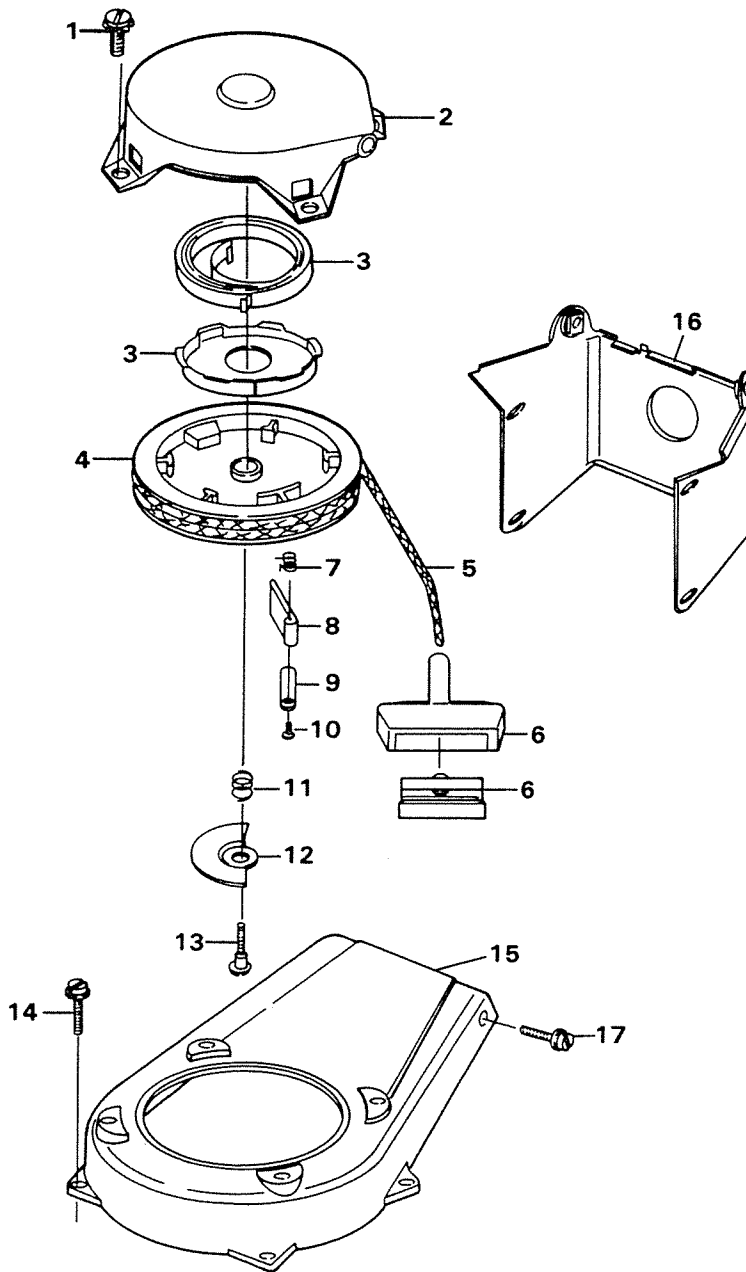
**ILLUS.  
NO. DESCRIPTION**

- 1 Pan hd screw w/lockwasher, 1/4-20 x 1/2
- 2 Cover
- 3 Rewind spring
- 4 Rotor
- 5 Cord
- 6 T-handle w/insert
- 7 Cylinder cover
- 8 Friction shoe plate assembly
- 9 Brake washer
- 10 Fiber washer

**ILLUS.  
NO. DESCRIPTION**

- 11 Brake spring
- 12 Brake retainer washer
- 13 Retainer ring
- 14 Centering pin
- 15 Fan housing
- 16 Pan hd screw w/lockwasher, 1/4-20 x 5/8
- 17 Grommet

**Figure 15. Starter, Type A, Exploded View.**

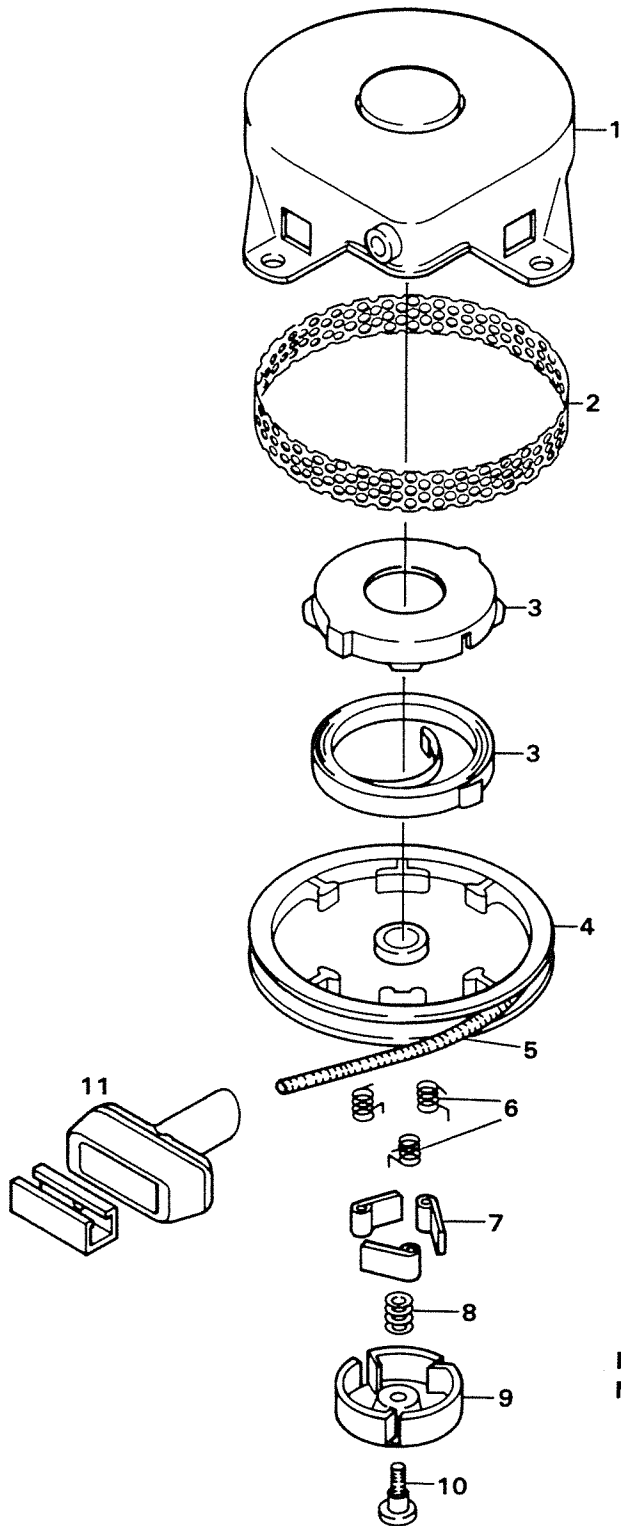


ILLUS. NO.	DESCRIPTION
1	Pan hd screw w/lockwasher
2	Cover
3	Spring and keeper
4	Pulley w/bearing
5	Rope
6	Handle w/retainer
7	Dog spring
8	Dog
9	Dog retainer
10	Screw
11	Brake spring

ILLUS. NO.	DESCRIPTION
12	Dog cam
13	Screw
14	Pan hd screw w/lockwasher, 1/4-20 x 5/8
15	Fan housing
16	Cylinder cover
17	Screw, 1/4-20 x 1/2

Figure 16. Starter, Type B, Exploded View.





ILLUS. NO.	DESCRIPTION
1	Cover
2	Screen
3	Spring and Keeper
4	Pulley
5	Cord
6	Spring
7	Dogs
8	Spring
9	Dog Retainer
10	Screw
11	Handle w/Retainer

Figure 17. Starter, Type C, Exploded View.



# Section

# 4

# FUEL SYSTEM

## CONTENTS

<b>4A. CARBURETOR AND FUEL PUMP</b>	
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# Subsection

# 4A

## CARBURETOR AND FUEL PUMP

### GENERAL

This subsection covers adjustment and repair of the carburetor.

### MODEL DIFFERENCES

All carburetors in use are all Tillotson, HL series. They are functionally the same, although small differences which relate to specific applications, mean that parts catalogs must be used. Table 1 lists engine models and carburetors.

### DESCRIPTION AND OPERATION

The HL carburetor contains three (3) castings — main body, diaphragm cover and fuel pump body. The carbs contain an integral impulse type fuel pump which will lift approx. 10-12" fuel head. The fuel pump is operated by crankcase pressure/vacuum pulses from the engines

crankcase, therefore the impulse hole in flange of carburetor must be properly aligned with carb gasket and reed plate upon installation. The pulse is transferred to the fuel pump diaphragm which causes fuel to be drawn through the inlet flipper of pump and then through the outlet flipper of pump. The flippers function like inlet and outlet check valves on a mechanical fuel pump.

The HL carburetor is a "demand type" carburetor. In proper operation, no fuel flows to engine until the engine is cranked or operating. Lower pressure in the throttle bore/venturi causes the main metering diaphragm to depress the inlet lever which allows the inlet needle to unseat, allowing fuel to fill fuel chamber and flow through calibrated hoses (lo speed) and nozzle (hi-speed) based on engine demand and throttle shutter opening. The fuel pump aids fuel flow by furnishing fuel to engine in

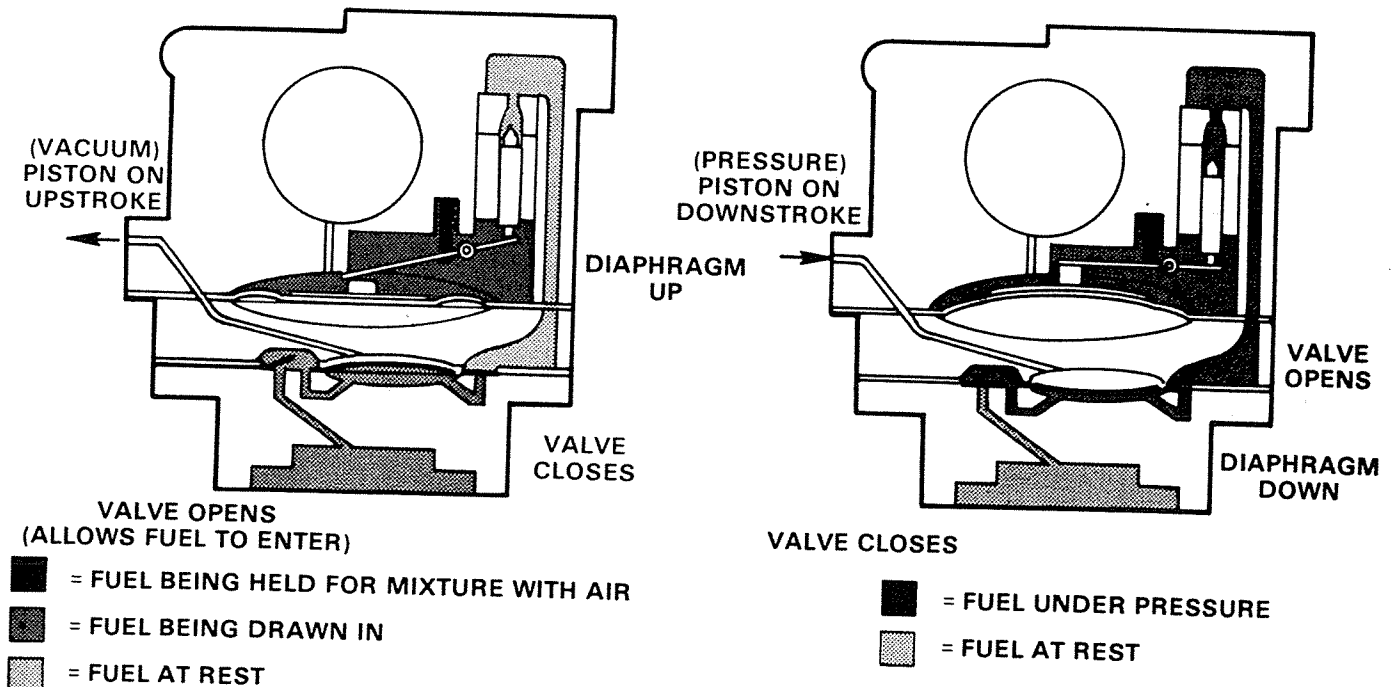
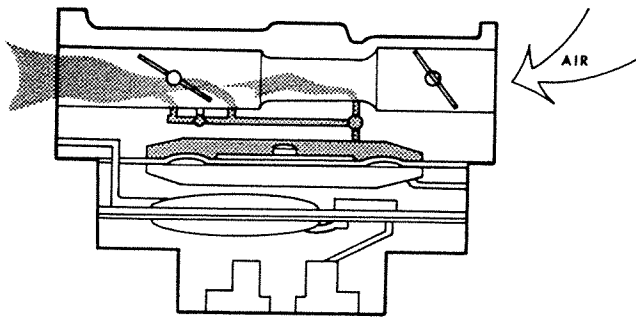


Figure 1. Operation of Carburetor.

larger quantities than possible with no pump. The pump cannot move fuel unless fuel tank is vented, therefore tank venting is important.

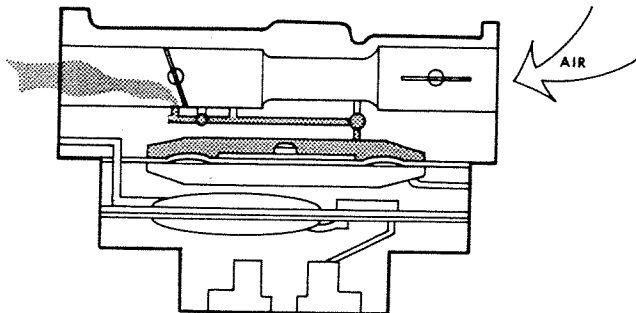
Flow through supply openings depends partly on main (HI) and idle (LO) adjustment needle settings. Flow through discharge ports varies with position of throttle shutter that blocks off or exposes ports to engine demand and determines mode of operation (starting, idle, etc.). Flow is enhanced by the venturi (narrowing in opening that causes air to flow faster and drop in pressure).

**Starting Choke Operation.** Choke shutter is closed, throttle shutter is open. Fuel passes through main, primary idle, and secondary idle fuel discharge ports.



**Figure 2. Starting Choke Operation.**

**Idle Operation.** The choke shutter is open, the throttle shutter is slightly open blocking the secondary idle discharge port.

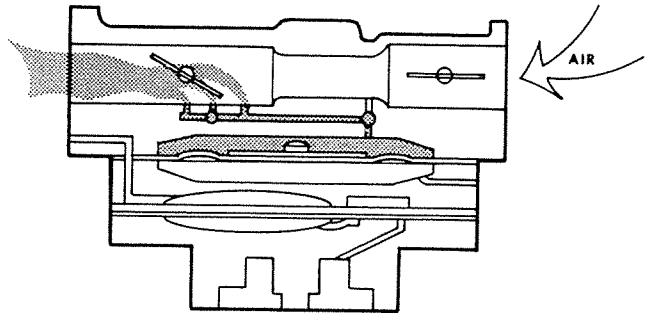


**Figure 3. Idle Operation.**

**Immediate Operation.** Choke shutter is open, throttle shutter is about half open.

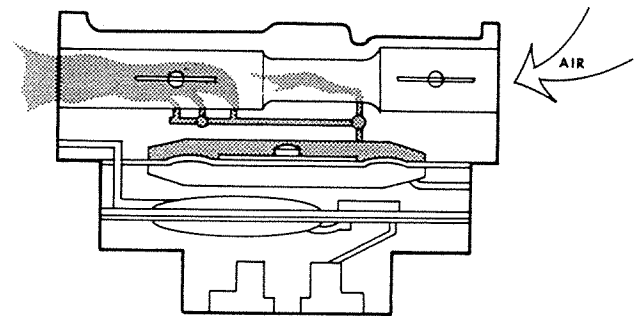
Engine speed and air flow increase as throttle shutter opens.

The amount of fuel delivered increases when throttle shutter uncovers secondary discharge port, exposing it to engine suction.



**Figure 4. Intermediate Operation.**

**High Speed Operation.** Both choke and throttle shutter are open. Fuel delivered reaches maximum when throttle is fully open, due to maximum exposure of all discharge ports to engine demand and to venturi effect.



**Figure 5. High Speed Operation.**

## TOOLS, MATERIAL NEEDED

SECTION 4A — CARBURETOR	
Tools, Material	
NAME	USE
Screw driver	
Thin Wall, 5/16" Socket	Removing inlet seat.
Solvent	
Screwdriver	
Drill, 1/8" & Installer, 5/16"	
Flat End	Replacing welch plug

ENGINE MODEL NO.	CARBURETOR	
	PART NO.	TILLOTSON HL NO.
61006, 61010 61014, 82010	174061	HL 130A
82005, 82006, 82011 82017, 82019, 82029	174061-2	HL 189B
82032	174061-2	HL 189B
61001, 61002, 61012	175061	HL 134A
82002, 82003, 82026, 82027	175061-2	HL 232B
82008	229061	HL 122A
82007	236061	HL 173A
82030	560061	HL 320A

**Table 1. Engines and Carburetors Used Together.**

## CARBURETOR ADJUSTMENTS

**General Note.** The diaphragm carburetor has adjustable (not fixed) jets. This feature helps provide the right carburetor settings. Engine will not run at full speed, will pop and will be damaged if mixture too lean; engine will not develop full power and will roll and run unevenly if mixture too rich.

Therefore, correct adjustment is important and readjustment may become necessary as conditions change.

Warm weather — set leaner 1/8 turn

Cold Weather — set richer 1/8 turn.

**Adjustment Set Up.**

### CAUTION

Turn adjustment screws completely closed very carefully to avoid damaging needle and seats.

1. Set both high and low speed needles at one (1) turn open before starting. Figure 6.

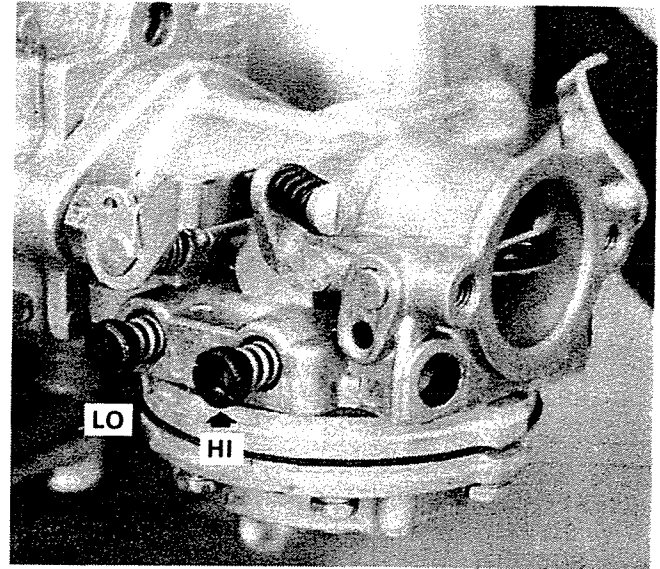
### NOTE

This is a rich setting and will be adjusted to best setting under load.

2. Install tachometer on spark plug lead.
3. Warm up engine.

**Low Speed Adjustment.**

1. Accelerate and decelerate engine; if engine bogs or accelerates slowly, turn idle mixture screw counterclockwise until performance is O.K.



**Figure 6. High Speed and Idle Screws.**

### NOTE

Average setting is one (1) turn open.

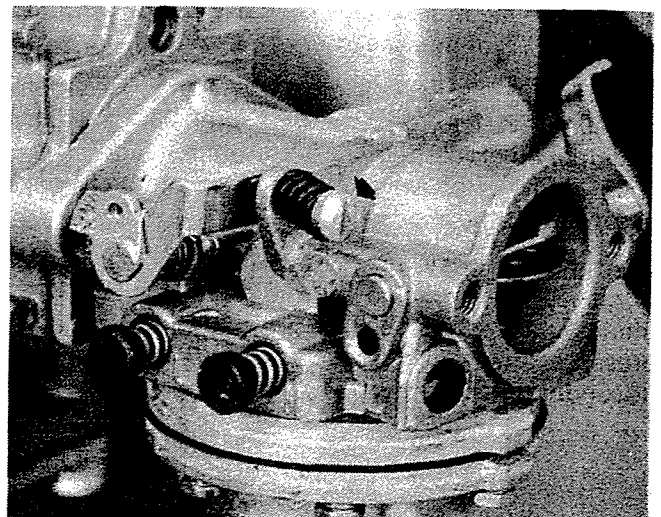
**High Speed Adjustment.**

### CAUTION

Do not set any leaner than necessary or piston may seize at high speed.

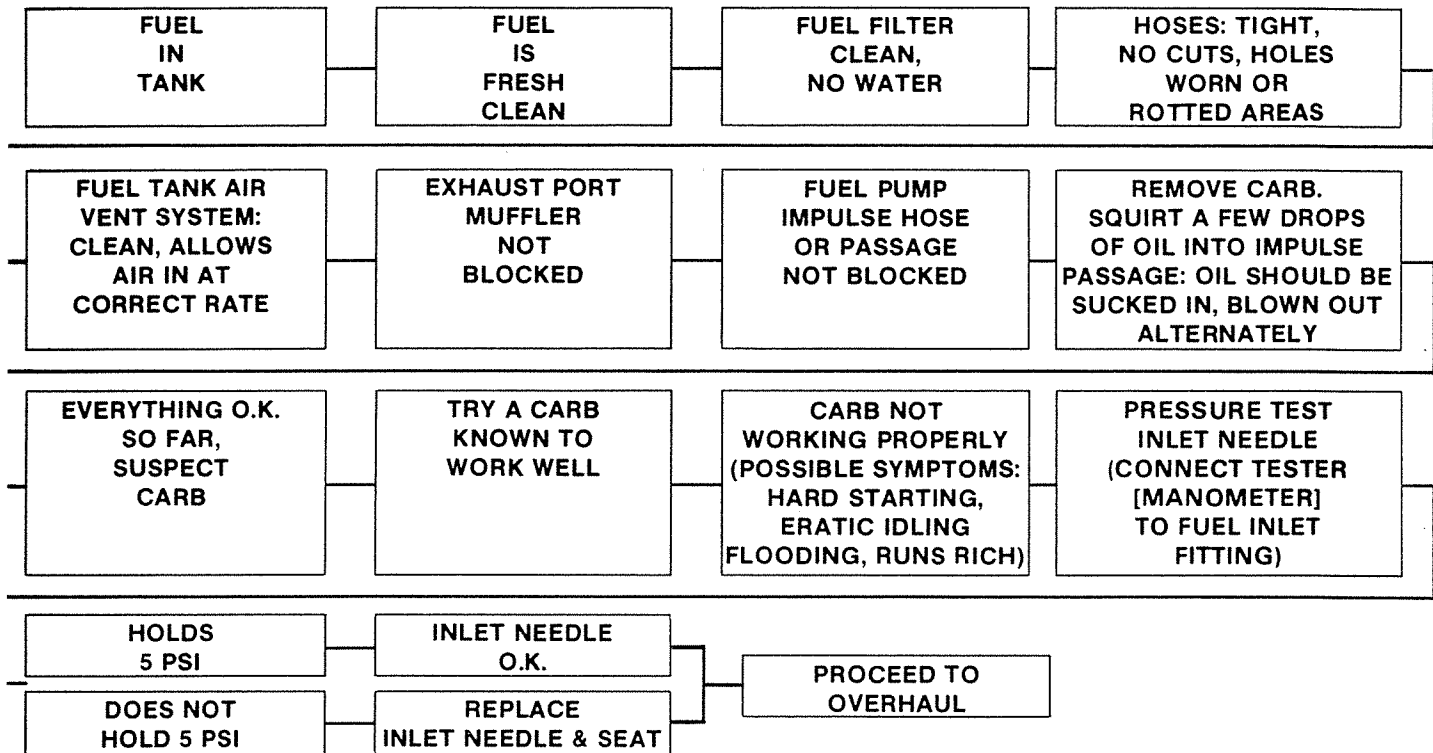
1. Turn high speed needle clockwise until four-cycling stops.

**Idle Stop Screw.** Turn idle stop screw to obtain a dependable idle of 2200 RPM or less. Figure 7.



**Figure 7. Adjusting Idle Stop Screw.**

## FUEL SYSTEM TROUBLESHOOTING



1. Before suspecting or tearing down carburetor, check that other components of fuel system are in operating condition.

### Carburetor Service Notes.

1. A flooding carb is usually nothing more than foreign material - dirt, fuzz, etc., trapped between top of inlet needle and its rubber seat. Remove foreign material and carb is functional. If inferior oil or old gasoline is used, varnish can build up around sides and tip of inlet needle.

2. If inlet needle sticks in closed position, use air or pressure tester to loosen by blowing 10-15# of air into fuel inlet barb of carburetor. (Symptom is: engine will run on prime, but won't continue to run on own fuel supply.)

3. Also check "pop-off" pressure - if needle is stuck in closed position this may take 20-30# pressure, then gauge will fall back to 5-10# range. "Pop-off" pressure after initial loosening may take 10-20# depending on carb model.

### OVERHAUL

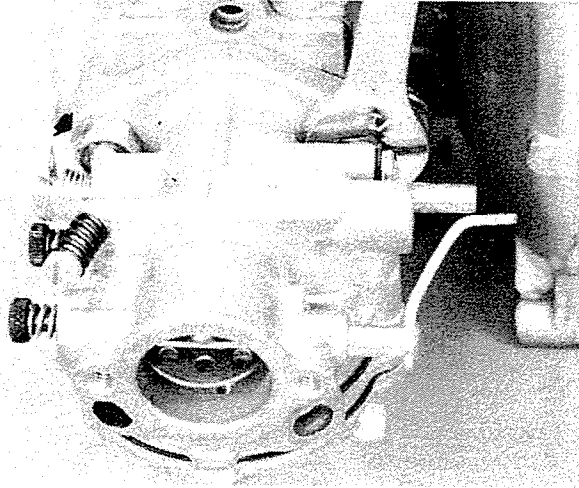
**General.** Repair kits are available and include the diaphragm, strainer screen, needle adjusting springs and a complete gasket set. A gasket set including all gaskets is also available.

### NOTE

Consult parts catalogs for specific repair and gasket sets.

### Removal.

1. Remove air filter or air cleaner.
2. Close fuel shut off valve and disconnect fuel line at carburetor.
3. Disconnect throttle linkage.
4. Remove carburetor from reed plate or carburetor elbow. Figure 8.

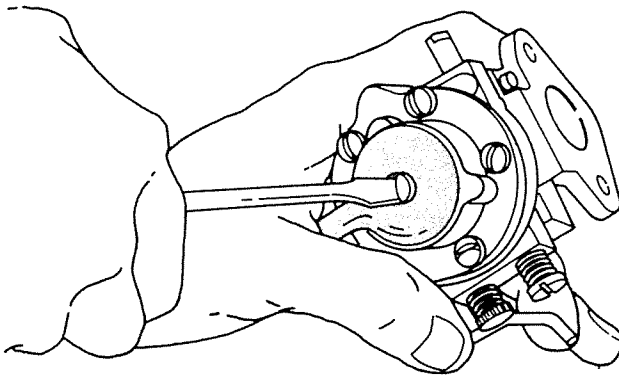


**Figure 8. Removing Carburetor.**

5. Remove air cleaner.

**Disassembly and Inspection.** Inspect each part of carburetor as it is disassembled.

1. Remove strainer cover, gasket and strainer. Inspect strainer and gasket for damage. Figure 9.



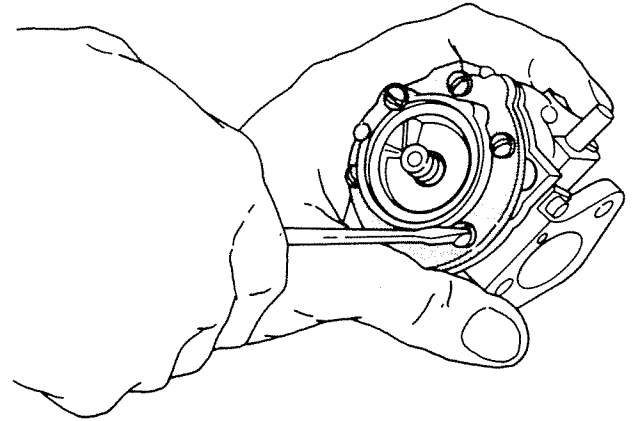
**Figure 9. Removing Strainer.**

2. Remove six (6) screws holding carburetor sections together and remove bottom section. Figure 10. Check passages for blockages. Inspect diaphragm for damage.

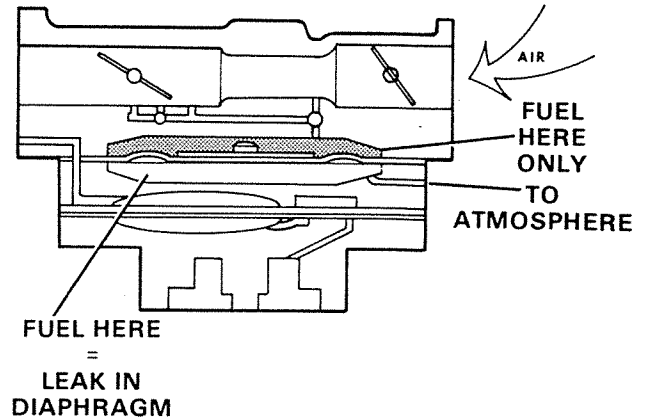
3. Separate top two sections. Inspect upper metering diaphragm for damage.

**NOTE**

An indication of possible diaphragm failure would be fuel on both sides of the diaphragm. Fuel should be found only on the top side. Figure 11.



**Figure 10. Removing Bottom Section.**

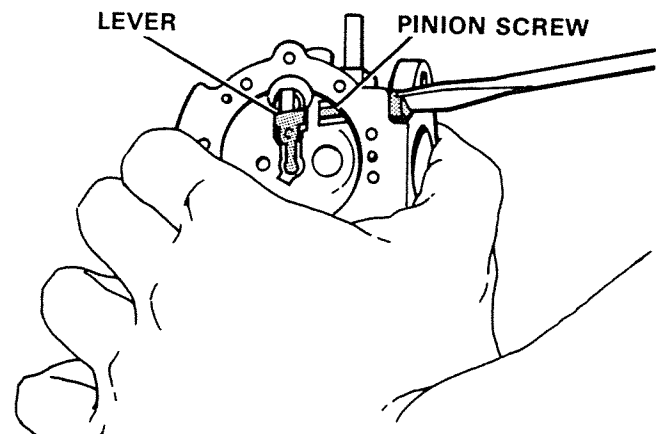


**Figure 11. Inspecting Diaphragm for Leak.**

4. Remove inlet control lever pinion screw, lever, tension spring and needle. Figure 12.

**NOTE**

Some later models have a pin in place of lever pinion screw.



**Figure 12. Removing Inlet Valve.**



Inspect needle valve face for grooves or rings.  
Figure 13.

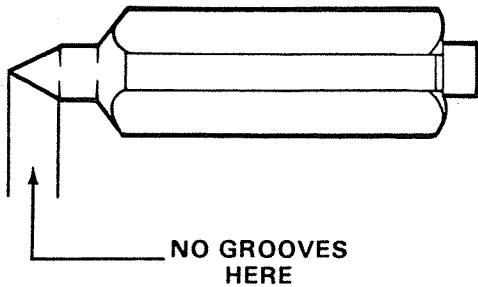


Figure 13. Inspecting Inlet Valve Needle.

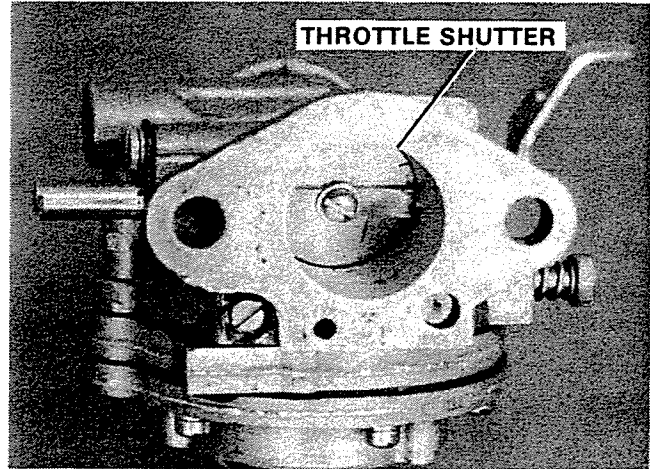


Figure 15. Position of Throttle Shutter.

5. Remove inlet seat and gasket. Use a **thin wall** 5/16 in. socket. Replace gasket if worn.

6. Remove low and high speed adjustment screws. Inspect for damage, especially the needle points which should have no rings or grooves where they seat. Figure 14.

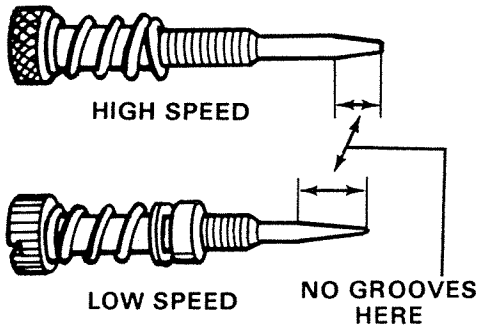


Figure 14. Inspecting Adjustment Screws.

7. Examine throttle and choke assemblies for damage and/or excessive wear (noticeable shaft movement).

8. If excessive wear is found in the throttle area, proceed as follows:

A. Note position of throttle shutter. Figure 15.

B. Remove screw retaining throttle shutter and remove shutter from shaft.

C. Inspect body and throttle shaft for wear. Shaft is replaceable. If body is worn, carburetor must be replaced.

9. If excessive wear is found in the choke area, proceed as follows:

A. Note position of choke shutter. Figure 16.

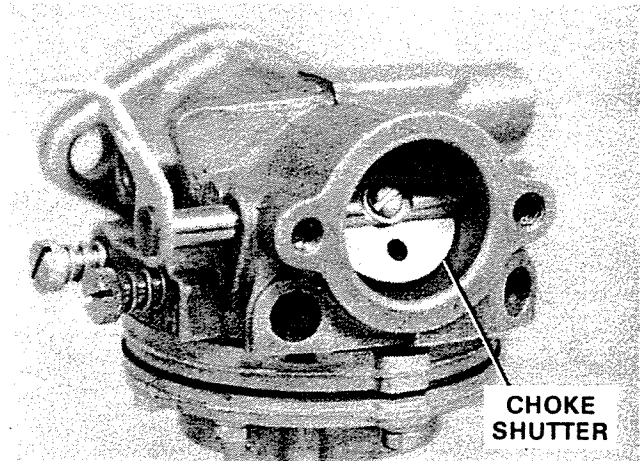


Figure 16. Position of Choke Shutter.

B. Remove screw retaining choke shutter and remove shutter from shaft.

C. Inspect body and choke shaft for wear. Shaft is replaceable. If body is worn, carburetor must be replaced.



Detent ball and spring will "fly" out of carburetor body when choke shaft is removed.

D. Pull choke shaft from carburetor.

10. Inspect carburetor body and fuel passages for damage.

### NOTE

Some models have a ball check type main nozzle; some models have a brass vent tube to choke bore (instead of "directly" to atmosphere).

### CAUTION

Do not pass drills or wire through jets or passages. This may enlarge them, affecting carburetor calibration.

11. If fuel supply channels or discharge ports are extremely clogged, remove welch plug as follows:

### CAUTION

In next step, drill carefully to avoid damage to ports and casting behind plug.

A. Carefully drill 1/8" dia. hole just through plug.

B. Pry out plug.

12. After carburetor has been inspected for wear, clean in good commercial grade cleaning solution. Follow cleaning manufacturer's instructions.



### WARNING

Wear safety glasses while working with compressed air.

13. Use compressed air to dry internal passages of carburetor.

**Reassembly.** Make certain all parts are clean and dry prior to reassembly.

1. Install new welch plug (3/8") as follows:

A. Insert plug convex side up. Figure 17.

### CAUTION

DO NOT depress plug too far. Figure 17.

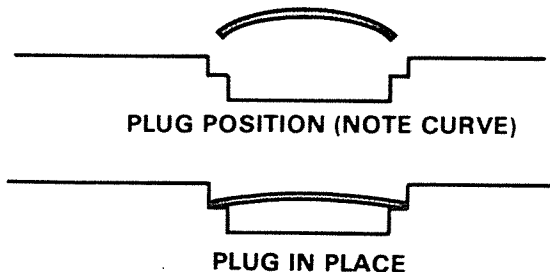


Figure 17. Inserting Welch Plug.

B. Flatten plug until it fits tightly, using a tool, 5/16" in diameter, with a flat end.

2. Assemble throttle assembly to carburetor as follows:

A. Slide throttle shaft into body.

### CAUTION

Throttle shutter is beveled and can be only assembled one way. See enlarged section in Figure 18.

B. Assemble throttle shutter to shaft, leave screw loose.

C. Open and close throttle several times to locate shutter in throttle bore. Tighten screw.

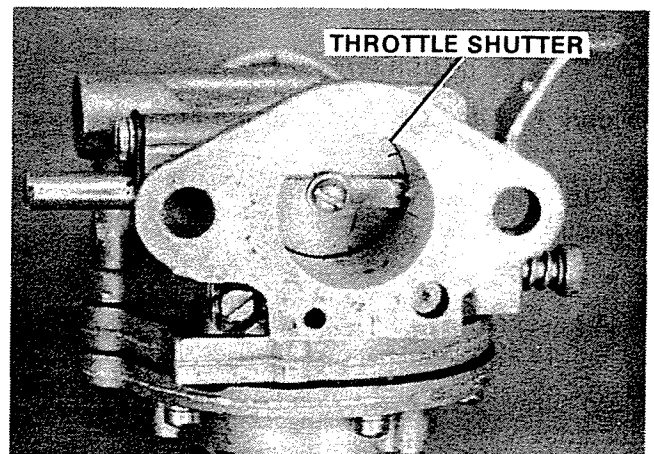
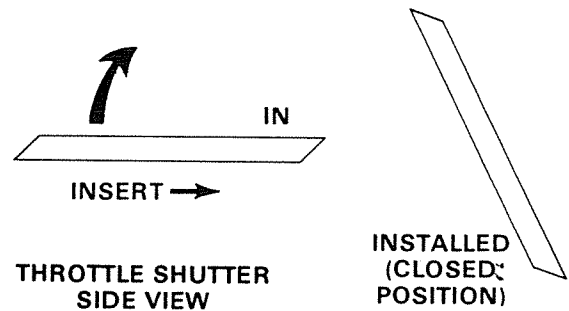


Figure 18. Assembling Throttle Shutter to Shaft.

3. Assemble choke to carburetor as follows:

A. Place detent spring and ball in body.

B. Depress ball and spring and slide choke shaft through body.

C. Position choke shutter on shaft and secure.

4. Place gasket in needle valve seat cavity and install needle valve seat. Torque seat to 25 - 35 in. lbs. (28.7 - 40.2 kg/cm)
5. Place needle valve in seat and tension spring cavity.
6. Place inlet needle control lever locating button in end of tension spring.
7. Hold in place with finger and insert control lever pinion screw. Secure screw.
8. Check that inlet control lever is flush with floor of chamber; adjust by bending tab. Figure 19.

### CAUTION

Do not force inlet needle into rubber seat while adjusting inlet control lever.

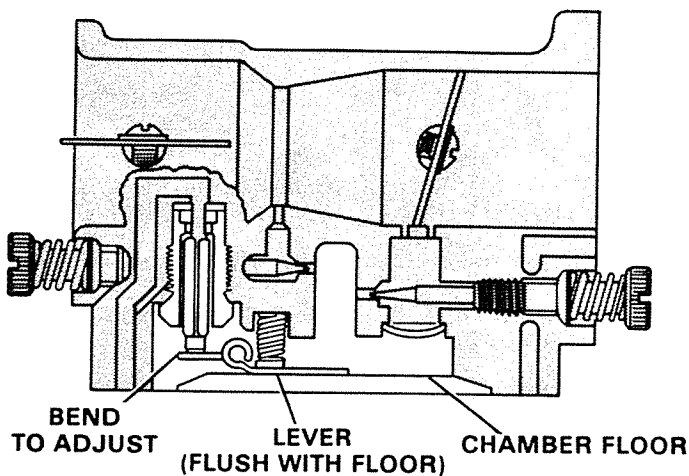


Figure 19. Checking Inlet Control Lever Position.

9. Pre-assemble and install low and high speed adjusting screws.

### NOTE

Adjustment screws have different tapers. See Figure 20.

Turn screws in carefully and slowly by hand until seated. Back out one (1) turn.

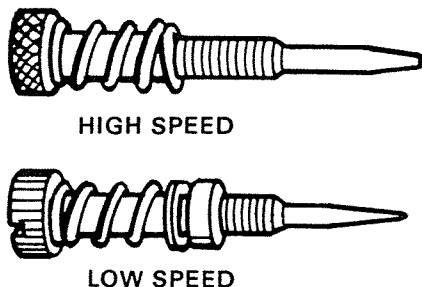


Figure 20. Adjustment Screws.

10. Place gasket and upper diaphragm on body, note position of three (3) locating pins and place large diameter of metal disc toward body. Figure 21.
11. Place cover (middle section) over diaphragm. Figure 21.
12. Place gasket on middle section and lay diaphragm on it. Install lower section (fuel pump body) and secure assembly with screws. Figure 21.

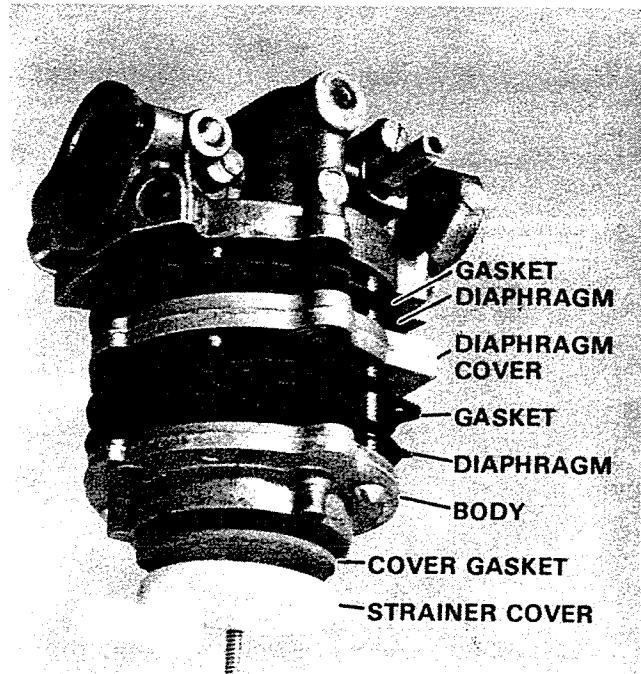


Figure 21. Assembling Carburetor.

13. Place strainer and gasket in body. Place strainer cover in cavity and secure. Figure 21.

### Air Cleaner.

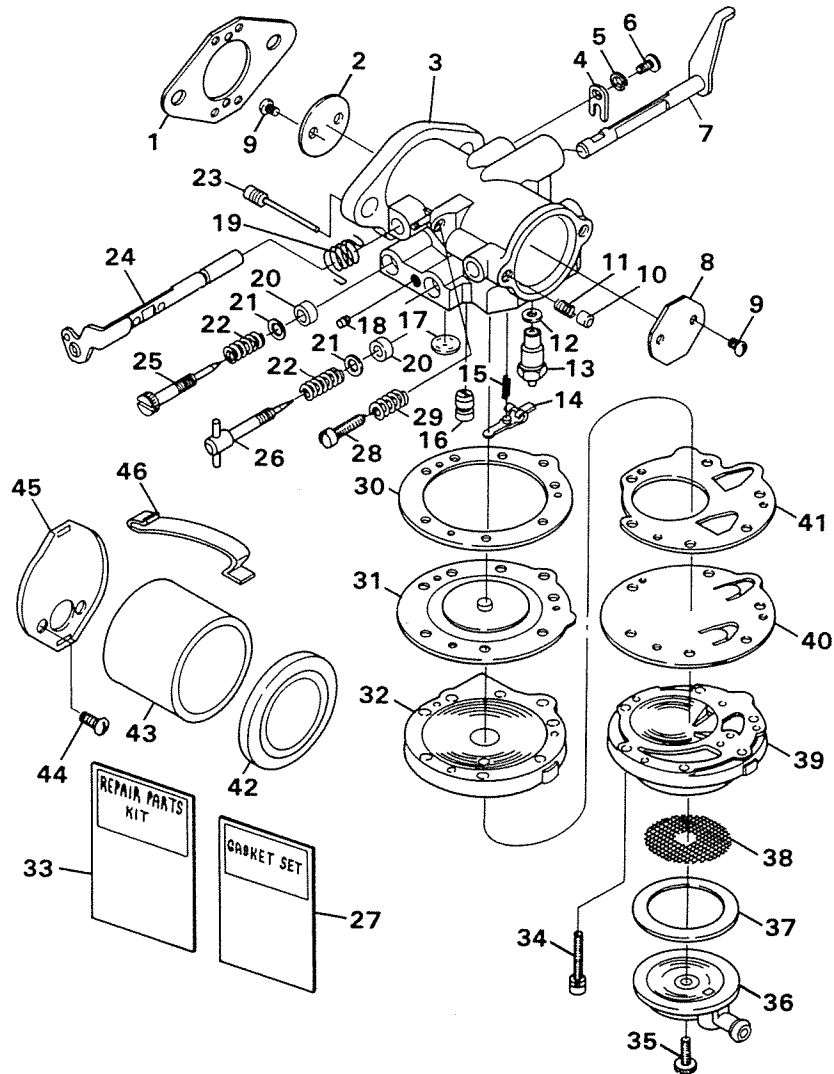
### NOTE

An air cleaner kit is available for engines that do not already have them. The 3181-1 is about 3-1/2 in. in diameter and 3 in. long, held together by two (2) clips. (Many machine manufacturers use own air filters on these engines.) Air cleaners will extend engine life unless not cleaned regularly. To clean, follow machine manufacturer's directions (wash and oil, tap or use air from inside out, etc. depending on material of air filter element.)

### Installation.

1. Place a new carburetor flange gasket over studs. (Be sure impulse hole is properly aligned with carb and crankcase.)

2. Slide carburetor over studs, secure with nuts.
3. Connect and adjust throttle.
4. Reattach fuel line.
5. Install air cleaner.
6. Start engine and adjust carburetor.



- |                                |                                       |                               |
|--------------------------------|---------------------------------------|-------------------------------|
| 1 CARBURETOR GASKET            | 18 DRAIN SCREW                        | 35 STRAINER COVER SCREW       |
| 2 THROTTLE SHUTTER             | 19 THROTTLE SHAFT RETURN SPRING       | 36 STRAINER COVER             |
| 3 CARBURETOR BODY              | 20 ADJUSTMENT SCREW PACKING           | 37 STRAINER COVER GASKET      |
| 4 THROTTLE SHAFT CLIP          | 21 ADJUSTMENT SCREW WASHER            | 38 STRAINER SCREEN            |
| 5 CLIP LOCKWASHER              | 22 ADJUSTMENT SCREW SPRING            | 39 FUEL PUMP BODY             |
| 6 CLIP RETAINING SCREW         | 23 CONTROL LEVER PINION SCREW         | 40 FUEL PUMP DIAPHRAGM        |
| 7 CHOKE SHAFT AND LEVER        | 24 THROTTLE SHAFT & LEVER             | 41 FUEL PUMP GASKET           |
| 8 CHOKE SHUTTER                | 25 IDLE ADJUSTMENT SCREW              | * 42 COVER, AIR CLEANER       |
| 9 SHUTTER SCREW                | 26 MAIN ADJUSTMENT SCREW              | * 43 ELEMENT, AIR CLEANER     |
| 10 CHOKE FRICTION PIN          | 27 GASKET SET                         | * 44 SCREW                    |
| 11 CHOKE FRICTION SPRING       | 28 IDLE SPEED REGULATING SCREW        | * 45 BASE, AIR CLEANER        |
| 12 INLET SEAT GASKET           | 29 IDLE SPEED REGULATING SCREW SPRING | * 46 CLIP, AIR CLEANER        |
| 13 INLET NEEDLE, SEAT & GASKET | 30 DIAPHRAGM GASKET                   | THROTTLE SHAFT ARM            |
| 14 INLET CONTROL LEVER         | 31 DIAPHRAGM                          | (NOT SHOWN)                   |
| 15 INLET TENSION SPRING        | 32 DIAPHRAGM COVER                    | * = 3181-1 CHRYSLER POWER BEE |
| 16 NOZZLE CHECK VALVE          | 33 REPAIR PARTS KIT                   | AIR CLEANER ACCESSORY         |
| 17 WELCH PLUG                  | 34 BODY SCREW & LOCKWASHER            |                               |

Figure 22. Carburetor (Typical), Exploded View.



## REED VALVE ASSEMBLY

**DESCRIPTION**

The reed valve is between the carburetor and the crankcase of the motor. The reed valve times the injection of the fuel/air mixture from the carburetor into the crankcase by opening only when pressure in the crankcase drops to a predetermined point on the compression stroke. The reeds are designed to keep contact with the reed plate until pressure changes in the crankcase. Reed travel away from the plate is limited by the reed stop. When crankcase pressure increases, built in spring action of the reeds returns them and holds them against the plate.

**SERVICING****Removal.****NOTE**

Steps to remove the carburetor are covered in Section 4A.

1. Remove carburetor.
2. Remove screws securing reed plate to carburetor adapter.
3. Remove reed plate assembly.

**Inspection.**

1. Check reed(s) as follows. Figure 1.
  - A. Check for flatness: press center of reed lightly with finger. There should be no movement, reeds must lie flat (no pretension, preload). (Pretension causes fuel spit back or air flow restriction).
  - B. Check opening: reed should not stand open more than .010 in. (.25 mm). (This allows air to be expelled through carburetor.)
  - C. Check that reed closes easily and tightly.

**NOTE**

Tightness can be checked with a flashlight.

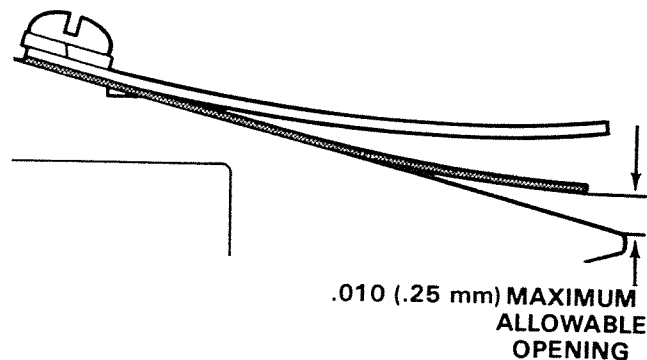
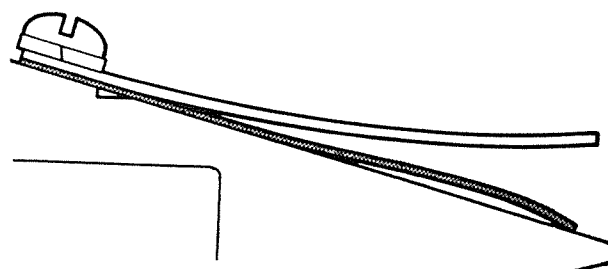
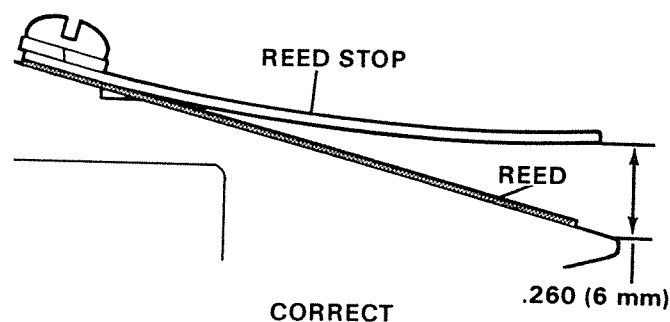


Figure 1. Inspecting Reeds.

D. Reeds not passing these inspections or displaying obvious damage, such as cracks or pieces broken from them, must be replaced.

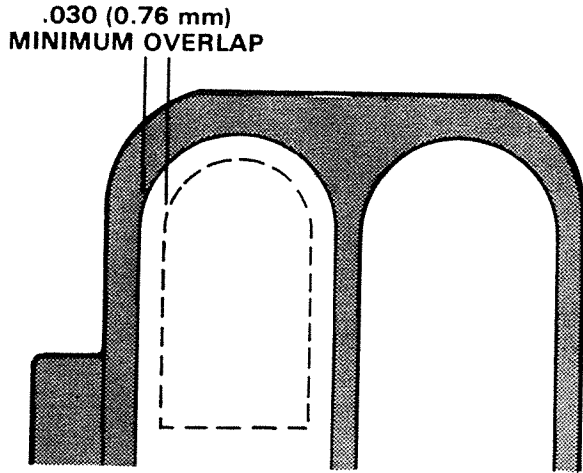


Figure 2. Measuring Reed Overlap.

#### Disassembly.

1. Remove screws and lockwashers securing reed stop and reeds.

#### Assembly.

1. Lay new reed on reed plate to check for flatness.
2. Carefully locate reed over openings in reed plate. A minimum of .030 in. (0.76 mm) overlap is required. Figure 2.
3. Install reed stop. Secure with screws and lockwashers.

#### Installation.

1. Place a new gasket on reed side of reed plate.
2. Install reed plate.

#### NOTE

In next step, be sure that impulse hole in carburetor is aligned with hole in reed plate and gaskets.

3. Install carb gasket and carburetor.

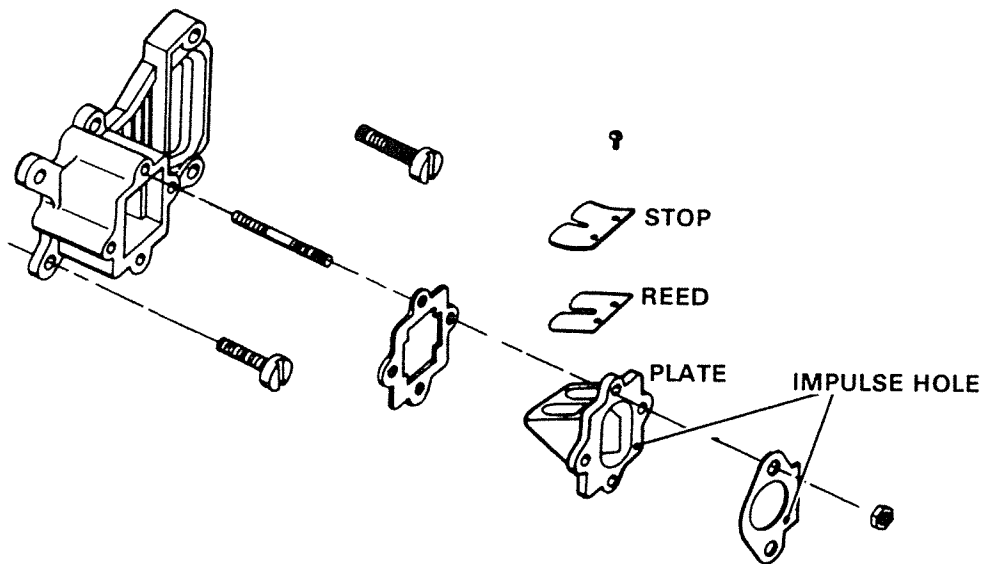


Figure 3. Reed Valve Assembly, Exploded View.

## MAGNETO IGNITION SYSTEM

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## MAGNETO IGNITION SYSTEM

### GENERAL

This section covers troubleshooting the ignition system and replacement of the electrical components.

### DESCRIPTION

The magneto ignition system has five (5) major components: Flywheel, Coil, Spark Plug, Condenser and Breaker Points. Figure 1.

### MODEL DIFFERENCES

Magneto systems in use are very similar but have some critical differences: starter cups vary, depending on application; flywheel nuts are R.H. or L.H. thread depending on engine rotation.

Be sure to consult parts catalog.

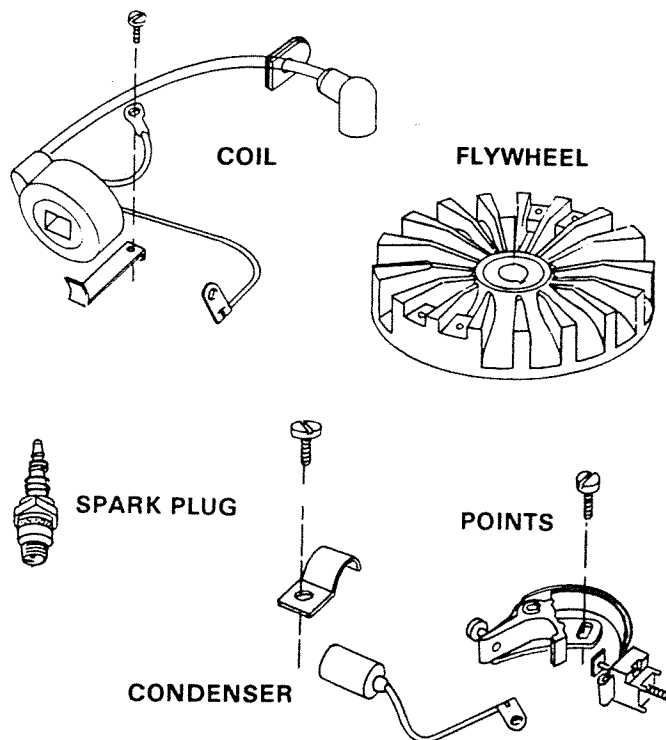


Figure 1. Ignition System Components.

### OPERATION

Rotation of magnets on the outer edge of the flywheel creates a rotating magnetic field which cuts through the coil winding, building a very strong magnetic field. As the magnets pass the coil, the magnetic field collapses sending a high voltage charge to the spark plug.

### TOOLS, MATERIAL NEEDED

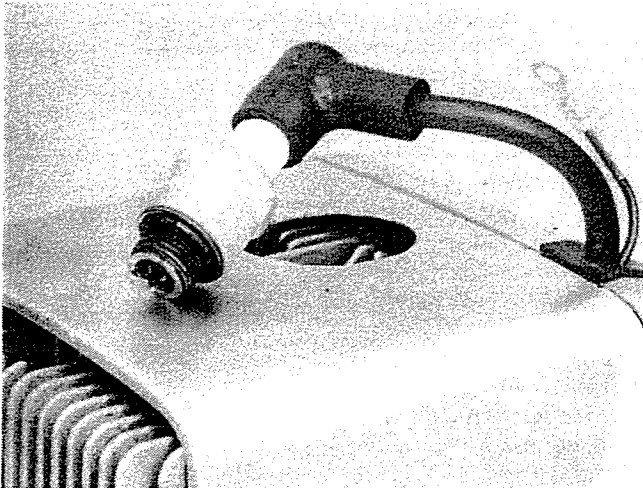
SECTION 5 — IGNITION SYSTEM	
Tools, Material	
NAME	USE
Screwdriver	
Socket	
Knock off nut (Special Tool T 2923 for left hand; T 8965 for right hand)	Removing flywheel nut
Hammer	
Lapping Compound	Lapping flywheel
Solvent	
Torque wrench	
Coil, condenser tester	Testing coil, condenser
Pliers	
Lubricant, Special Tool No. T 2961	Lubricating cam wiper felt
Tension gauge	Checking point spring tension
Spark plug gauge & gapping tool	Resetting spark plug gap

### TROUBLESHOOTING

**General.** An ignition malfunction will result in engine missing, surging or not running at all. These same symptoms can also be the result of insufficient, contaminated or excessive fuel. **First** determine that the cause of the problem is not the fuel system. See Troubleshooting Guide in Section 2.

**Preliminary Test.** Remove spark plug, attach lead wire to a test plug with gap set at about .170", and ground plug to cylinder. Crank engine to determine if there is enough spark to jump gap between center electrode and threads of plug. There should be a bright blue spark. Figure 2. A weak yellow or red spark means insufficient spark voltage. Insufficient spark voltage can be caused by various things:

- A. Poor grounds. Check grounds.
- B. Damaged or worn high tension lead. Replace lead.
- C. Malfunctioning kill switch or ignition switch. Disconnect leads from switches and repeat test. If defective, replace switches.
- D. Poorly grounded or defective coil. Test coil.
- E. A strong spark and sufficient fuel mixture are both available but engine will stall, not run or runs erratically: Flywheel key may be missing or sheared; or cam may be cracked.



**Figure 2. Testing Spark Voltage.**

## FLYWHEEL

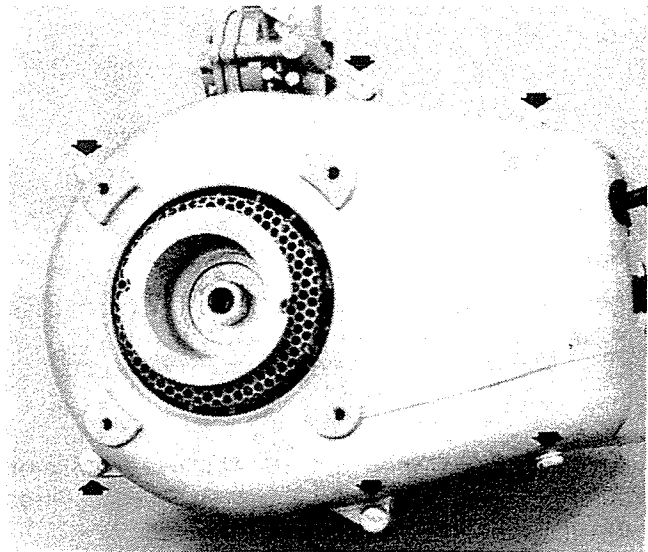
### Removal.

1. Remove fan housing assembly by removing six (6) screws. Figure 3.

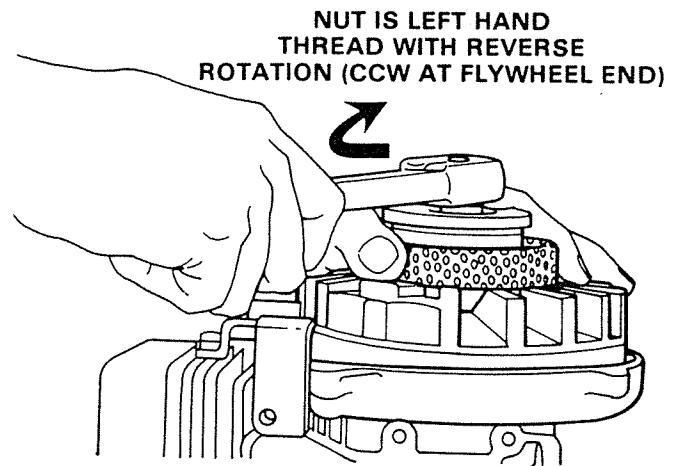
### NOTE

Flywheel nut may be left hand or right hand thread; left hand when engine rotates clockwise (drive end) and right hand when engine rotates counterclockwise at drive end. If nut is difficult to remove, use brace; or wedge screwdriver between fins, being careful not to damage fins.

2. Remove flywheel nut, lockwasher, starter cup and sceen. Figure 4.



**Figure 3. Removing Fan Housing.**



**Figure 4. Removing Flywheel Nut.**

### CAUTION

Do not hit knock-off nut with excessive force. Damage to crankshaft and bearings may result.

3. Remove flywheel by installing T 2923 (left hand) or T 8965 (right hand) knock-off nut 2-8 turns. Pry up on flywheel in line with key way. Hit knock-off nut sharply. Figure 5.
4. Remove flywheel key.

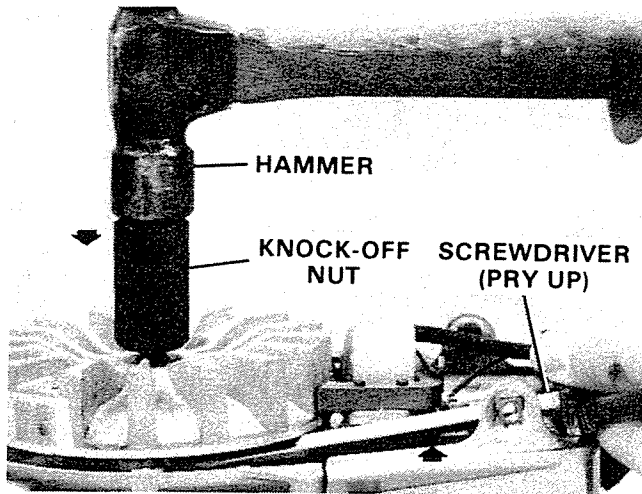


Figure 5. Removing Flywheel.

### Inspection.

1. Visually inspect flywheel for cracks or breaks. The magnets are permanently assembled and are not replaceable.



### WARNING

Cracked or chipped flywheels must be replaced. At high engine RPM a damaged flywheel can fly apart causing personal injury.

2. Inspect crankshaft taper and taper in bore of flywheel for fretting and working. If wear is found, flywheel bore must be lapped.
3. Test contact between crankshaft and flywheel bore as follows.
  - A. Clean end of crankshaft and flywheel bore.
  - B. Draw three (3) vertical lines on crankshaft, 120° apart, using a dark lead pencil. Figure 6.

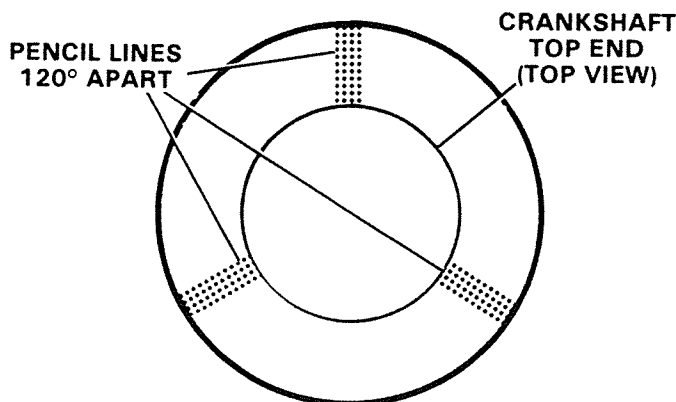


Figure 6. Marking Flywheel.

- C. Mount flywheel without key, turn flywheel one full turn while pushing down gently. Do not allow crankshaft to turn.
- D. Remove flywheel and check contact (percentage of lines rubbed off). Figure 7.

### NOTE

Crankshaft and bore should have a minimum of 80% contact.

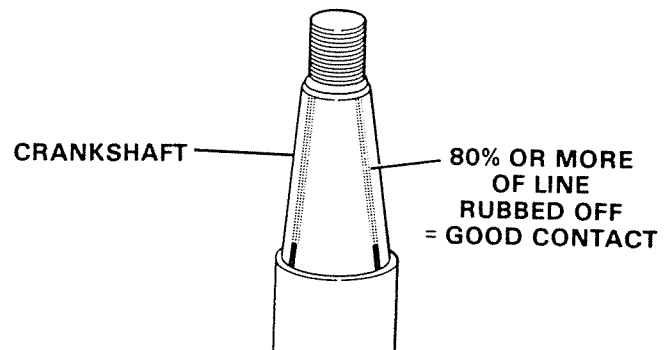


Figure 7. Checking Contact: Flywheel Bore, Crankshaft.

- E. If 80% or more of lines is gone, contact is O.K.; if not lap flywheel as outlined below.

### Lapping Flywheel Bore.

1. Remove flywheel key from crankshaft. Check key for wear, crack or damage.
2. Apply a light coating of lapping compound to tapered part of crankshaft.
3. Install flywheel on crankshaft and rotate flywheel gently back and forth 1/4 turn. **DO NOT** rotate flywheel completely around crankshaft.
4. Rotate flywheel 90° and repeat above operation. Figure 8.

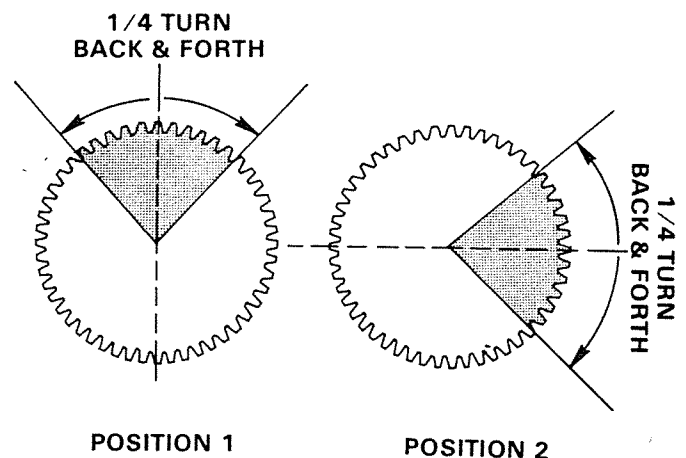


Figure 8. Lapping Flywheel.

5. Remove flywheel, wipe compound from crankshaft and flywheel.

6. If flywheel has been lapped because of poor contact with crankshaft, recheck % of contact: replace crankshaft and/or flywheel if 80% contact can not be obtained.

**Installation.** Check crankshaft and flywheel tapers for traces of oil. This assembly must be perfectly dry. Swab tapered surfaces with solvent and blow dry with compressed air.



### WARNING

Wear safety glasses when working with compressed air.

1. Assemble key to crankshaft.
2. Install flywheel (slot aligned with key), starter cup and screen, lockwasher and nut. Figure 9.

### NOTE

Lockwashers are left hand or right hand depending on nut, engine rotation.

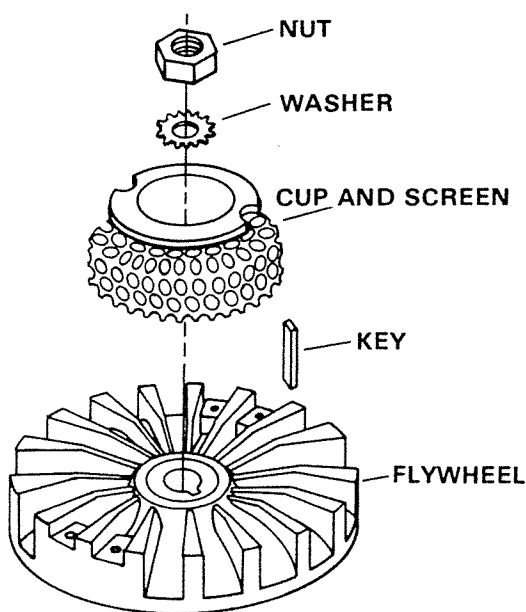


Figure 9. Installing Flywheel.

3. Torque nut to 420 in. lbs. (482.7 kg/cm).
4. Install fan housing assembly. Figure 10.

## CONDENSER

**General.** When the magnetic field in the coil

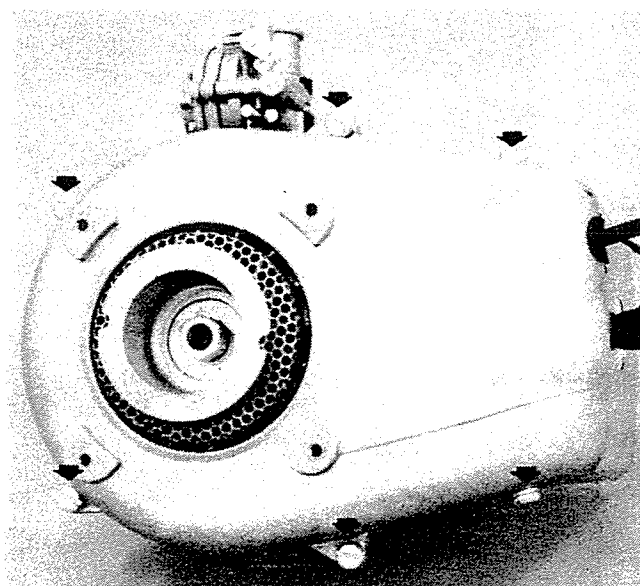


Figure 10. Installing Fan Housing.

collapses, voltage much higher than the original voltage is induced into the primary winding. As the breaker points open, current tends to continue flowing across the points. The resulting arc would damage the points in a short time.

The condenser, by absorbing the surge of high-voltage, dampens the tendency of current to arc across the points. The condenser also allows the magnetic field to collapse rapidly, which contributes to high-voltage being induced into the secondary windings.

**Service Note.** If points burn or pit quickly, condenser may be weak or have leaks.

### Removal.

1. Remove flywheel.
2. Remove dust cover and gasket by moving one end of hold down spring clip to the side.
3. Remove condenser lead from breaker point terminal block.
4. Remove screw retaining condenser clamp and condenser to stator plate. Figure 11.

### Testing Condenser.

### NOTE

Condensers can be tested by using a "test" condenser (one known to work); and ohmmeter; or an ignition analyzer. An ohmmeter should show low resistance at first then a quick rise to a high value. Tests using a (mercotronic) ignition analyzer are shown below.

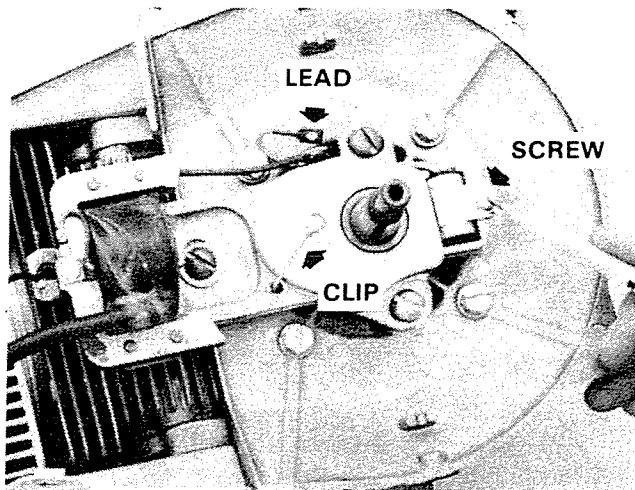


Figure 11. Removing Condenser.

### Condenser Capacity Test.

1. Plug tester into a 115-volt, 60 cycle "AC" outlet.
2. Turn selector knob to "CONDENSER CAPACITY" position. Figure 12.
3. Clip test leads together. Press red button and turn meter set knob until meter point lines up with set scales on right-hand side of meter. Release red button and disconnect leads. This sets the meter.
4. Connect small red test lead to condenser lead.
5. Connect small black test lead to body of condenser.
6. Press the red button and observe meter pointer on the "CONDENSER CAPACITY" scale.
7. Condenser capacity should be 18 minimum to 23 maximum. If not, replace the condenser.
8. Turn selector knob to "OFF" and test condenser for leakage or short.

### Condenser Leakage or Short Test.

#### NOTE

Leave test leads connected as shown. Figure 12.

9. Turn selector knob to "CONDENSER LEAKAGE AND SHORT" position.
10. Press red button and observe meter pointer for at least 15 seconds. Pointer should move to the right and return all the way to the left on the "CONDENSER LEAKAGE OR SHORT" scale. If pointer does not return, replace condenser.
11. Turn selector knob to "OFF". Remove tester leads and test condenser series resistance.

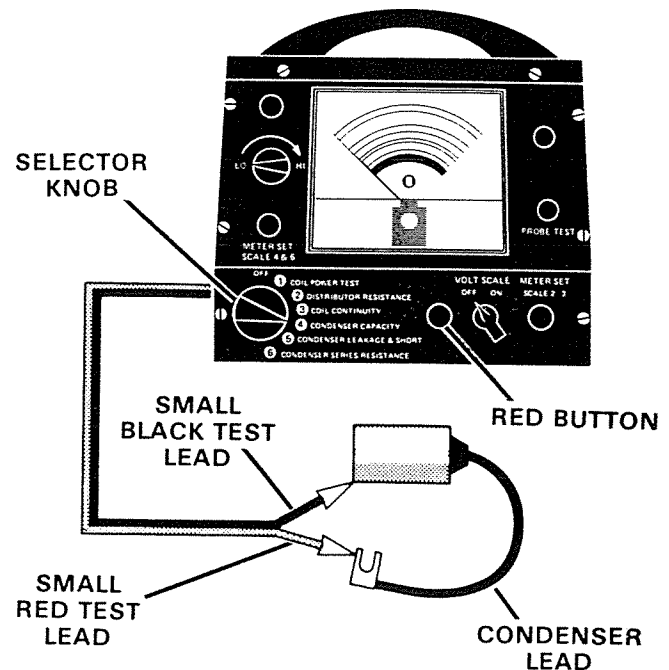


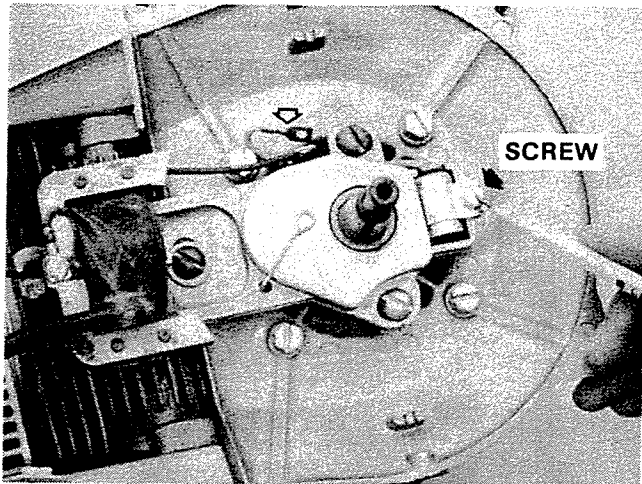
Figure 12. Testing Condenser Capacity.

### Condenser Series Resistance Test.

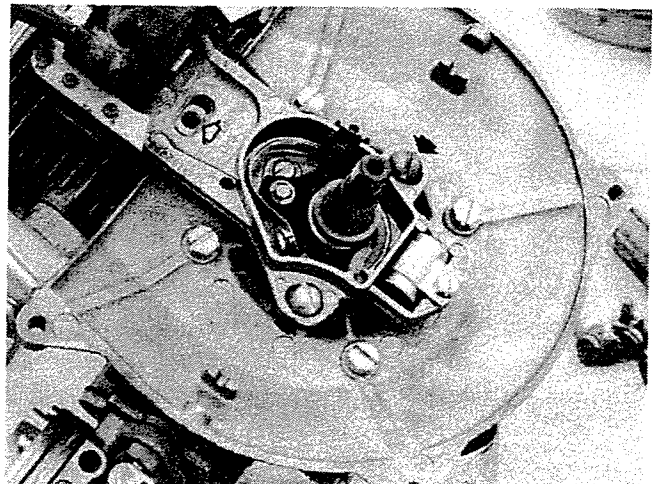
12. Place selector knob in "CONDENSER SERIES RESISTANCE" position.
13. Clip the small black test lead and the small red test lead together. Turn meter set knob until meter pointer lines up with set scales on right-hand side of meter. Disconnect leads. This will set the meter.
14. Connect small red test lead to condenser lead.
15. Connect small black test lead to condenser body.
16. Meter must remain in the green area on the right-hand side of the "CONDENSER SERIES RESISTANCE" scale.
17. If meter pointer moves to the red area, series resistance is poor. Replace condenser.
18. Disconnect tester leads and unplug the tester.

### Installation.

1. Install condenser on stator plate and secure with screw. Figure 13.
2. Connect condenser lead wire to terminal block of breaker point. Figure 13.
3. Install flywheel as previously outlined.



**Figure 13. Installing Condenser.**



**Figure 15. Removing Stator Plate and Coil.**

## COIL AND STATOR PLATE

**General.** The ignition coil does not require servicing on a regular basis. However, the coil should be kept in clean condition and the terminals and connections must be tight to provide good electrical contact.

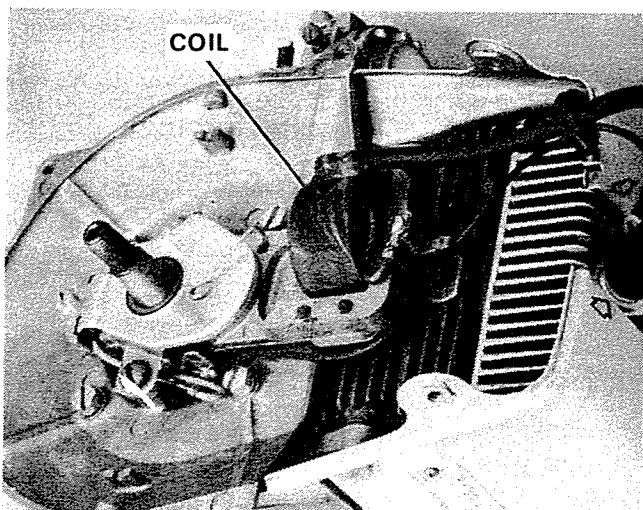
### Removal.

1. Remove flywheel.
2. Disconnect ground and spark leads. Figure 14.

### NOTE

Note the exact position of stator plate and of screws in slots.

3. Remove plate with coil by removing three (3) screws. Figure 15.



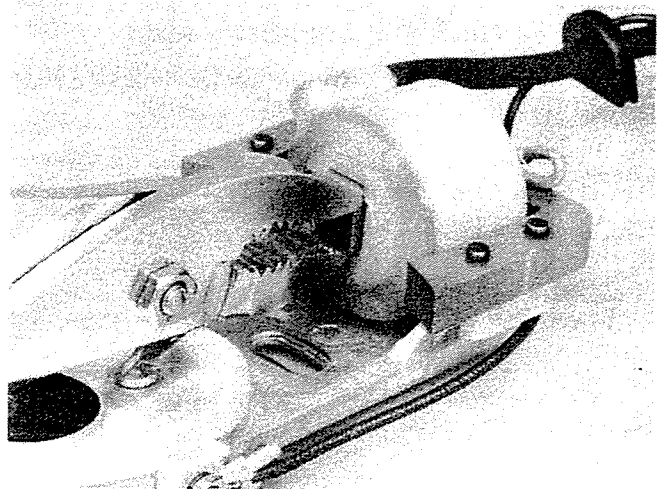
**Figure 14. Disconnecting Coil Leads.**

### NOTE

If coil is to be tested, do not disassemble: Go to coil power test on next page.

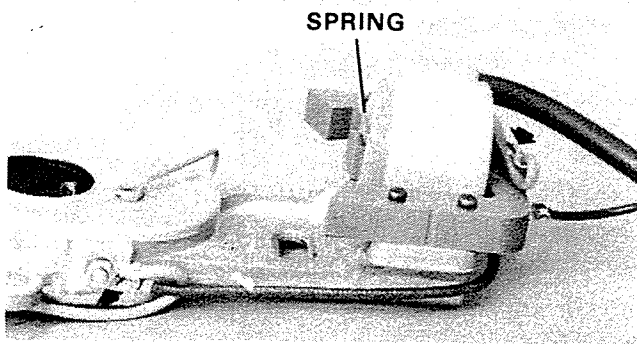
### Disassembly.

1. Disconnect coil lead wire.
2. Straighten coil lamination. Figure 16.



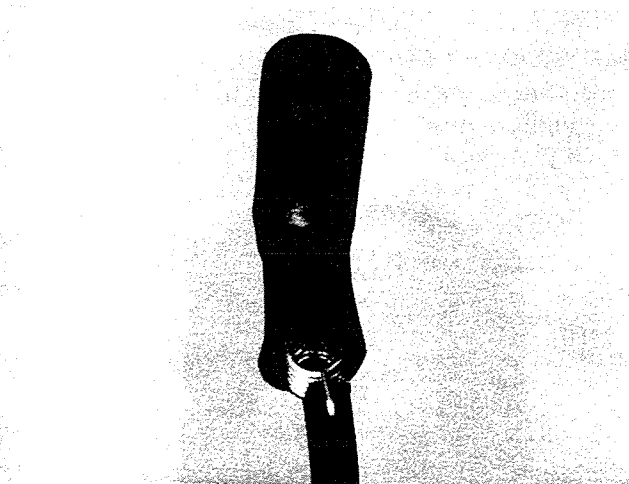
**Figure 16. Straightening Coil Lamination.**

3. Pry lip of coil wedge spring up from coil laminations. Figure 17.



**Figure 17. Removing Coil.**

4. Pull coil from laminations.
5. Remove sparkie cover and sparkie spring from end of lead wire. Figure 18.



**Figure 18. Sparkie Cover & Spring.**

**Inspection.**

1. Check coil for cracks or gouges in insulation and for evidence of overheating.

**Coil Tests.**

**SPECIFICATION NOTE**

There are four (4) models of wico coils in use. Check with manufacturer for specifications on coil continuity (primary and secondary).

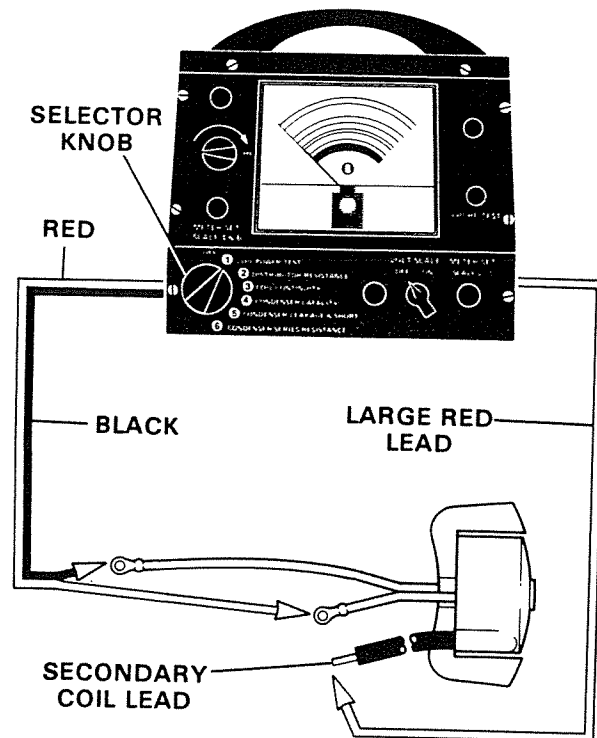
**Coil Power Test.**

1. Connect analyzer to coil as follows: Figure 19.



**WARNING**

Perform all tests to the coil on a wooden or insulated bench top to prevent leakage or shock hazards.



**Figure 19. Testing Coil Power.**

- A. Connect analyzer large red lead to the secondary coil lead.
- B. Connect analyzer red test lead to either primary coil terminal.
- C. Connect adapter black test lead to remaining primary coil terminal.

2. Test coil power as follows:

- A. Make sure current control knob is on "LO", and turn selector knob to "COIL POWER TEST" position.
- B. Slowly turn current control knob clockwise until meter pointer shows 1.5 on the "COIL POWER TEST" scale. At this time, the spark gap should be firing steadily.
- C. Return the current control knob to "LO" and turn selector knob to "OFF".

3. Results:

If spark gap was firing steadily, the coil is good. Leave the tester connected and test the coil highspeed. If spark gap was not firing steadily, replace the coil.

**Coil High-Speed Test.** Leave analyzer and coil connected. Figure 19.

## IMPORTANT

Complete this test as quickly as possible. Return the current control knob to "LO" and selector knob to "OFF" immediately after test.

1. Turn selector knob to "COIL POWER TEST" position.
2. Turn current control knob to "HI" or until meter reaches full scale. Observe spark gap and turn current control knob to "LO" and selector knob to "OFF".
3. If spark gap fired steadily, the coil is good at high-speed. If spark gap did not fire steadily, replace the coil.
4. Remove the large red analyzer lead from coil and proceed to next test.

### Coil Surface Insulation Test.

1. Plug test probe into jack in front of analyzer. Figure 20.

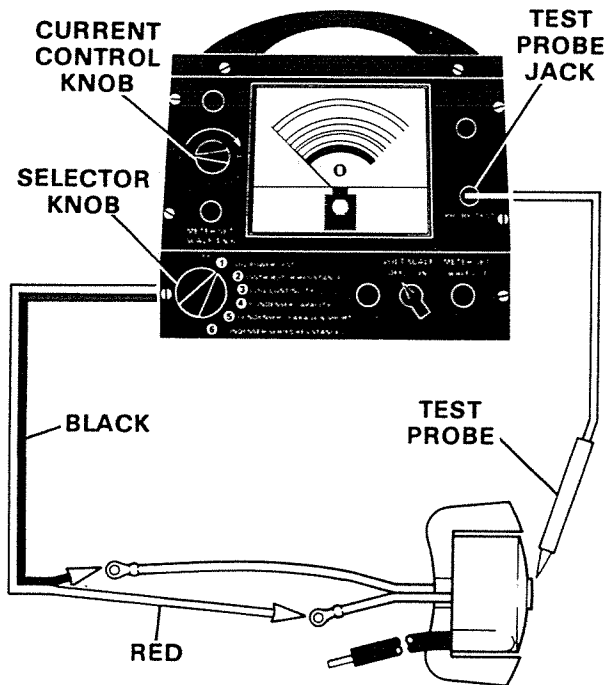


Figure 20. Testing Coil Surface Insulation.

4. Move test probe over entire insulated surfaces of coil and spark plug lead.

## IMPORTANT

Do not hold test probe at one point too long. Complete test as rapidly as possible.

## NOTE

A faint spark may occur around coil without having a leak. A strong spark indicates a leak.

5. Return current control knob to "LO" and selector knob to "OFF".
6. Remove all connections and test coil continuity.

**Coil Continuity Test.** To perform this test, proceed as follows:

1. Turn selector knob to "DISTRIBUTOR RESISTANCE" position. With test leads apart, turn meter set knob until meter pointer lines up with set mark on right side of meter.
2. Connect small red test lead to either primary terminal. Connect small black test lead to remaining primary terminal. Figure 21.

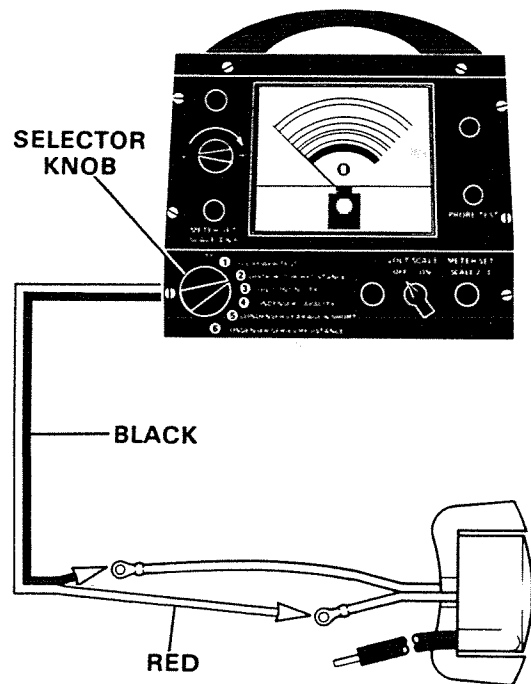


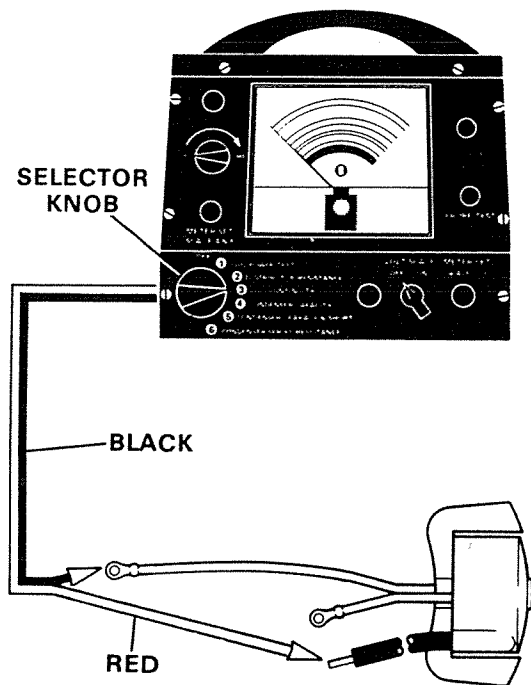
Figure 21. Testing Coil Continuity, Test #1. (Primary)

2. Turn selector knob to "COIL POWER TEST" position.
3. Turn current control knob to "HI" or until meter reaches full scale.

3. Take meter resistance reading.
4. If readings are high or low, replace the coil. Turn selector knob to "OFF". Remove test leads and test secondary continuity.



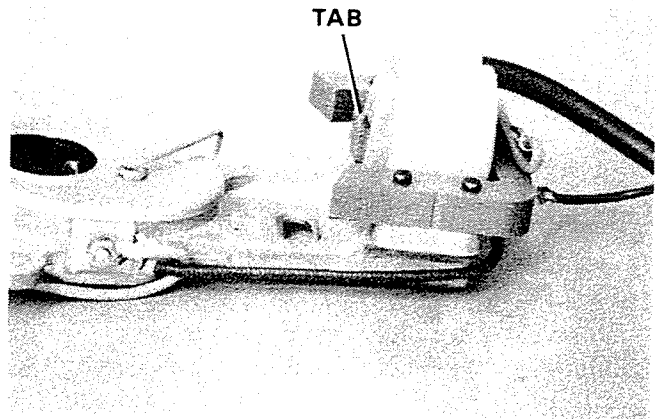
5. Turn selector knob to "COIL CONTINUITY" position. Figure 22.
6. Clip the small red test lead and the small black test lead together. Turn meter set knob until meter pointer lines up with set scale on right-hand side of meter. This sets the meter.
7. Connect small red test to the spark plug lead.
8. Connect small black test lead to either primary terminal.
9. Take meter reading. If readings are high or low, replace the coil.
10. Remove the test leads from coil and turn selector knob to "OFF".



**Figure 22. Testing Coil Continuity, Test #2. (Secondary)**

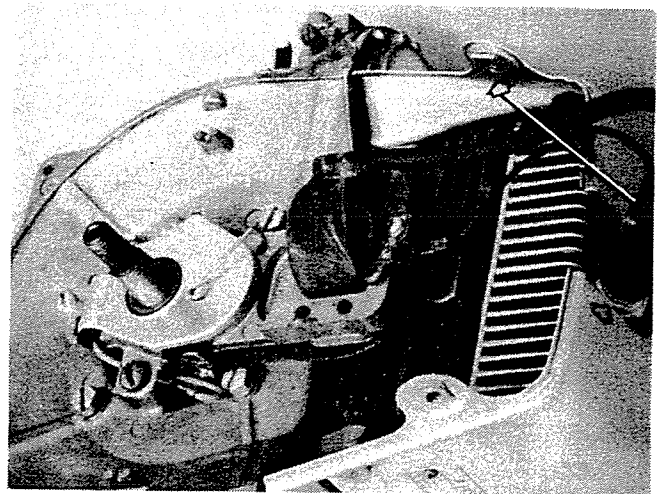
**Installation.**

1. Install sparkie cover and spring tightly.
2. Install coil on laminations as follows:
  - A. Slide coil onto laminations with larger end (tab) of spring on inside facing up. Figure 23.
  - B. Secure coil by bending bottom lamination down using screwdriver.



**Figure 23. Installing Coil.**

3. Connect coil leads. Figure 24.



**Figure 24. Connecting Coil Leads.**

4. Secure stator with three (3) screws.

**NOTE**

Timing is determined by position of screws in slots. Check specifications, Section 2.

5. Attach ground and spark plug wire leads.
6. Install flywheel.

**BREAKER POINTS**

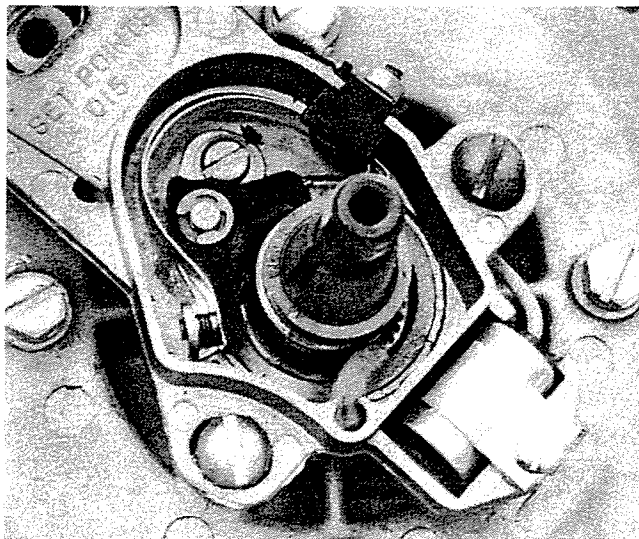
**Operation.** Engine operation is greatly affected by breaker point condition and the size of the gap. If points are burned or badly oxidized, little or no current will pass. As a result, the engine may not operate at all or if it does run, it is likely to miss at full

throttle. Points must be open for a definite time for the magnetic field in the ignition coil to build up to sufficient value. If the contact points are closed for too short a time, a weak spark will be produced by the coil. If points are set too wide, they will open before the primary current reaches the maximum value. If set too close, they will open after the primary has passed its maximum value.

**Service Notes.** White frosty points are O.K. Always replace badly burned or pitted breaker points. A certain amount of build up or metal transfer occurs under normal operating conditions; however, if this occurs too frequently and becomes excessive, the condenser may be at fault. Slightly pitted points can be dressed down with a point file, although this should be done only as a temporary field fix since points may tend to arc more after filing. Replace points at first opportunity after filing. If the points are oxidized, rub a piece of coarse cloth between the surfaces. Dirty or oily points can be cleaned with cloth but make sure no particles of lint are left on surfaces.

#### Removal.

1. Remove flywheel.
2. Remove dust cover and gasket.
3. Remove screw holding breaker point to stator plate. Figure 25.



**Figure 25. Removing Breaker Points.**

4. Disconnect lead wires from coil and condenser from breaker point.
5. Remove breaker point.

#### Installation.

1. Position breaker points on stator plate, install but do not tighten hold down screw.
2. Connect condenser and coil leads to breaker points.
3. Check cam wiper felt for sufficient lubricant. (Check by squeezing between fingers.) If dry, work a small amount of lubricant (Special Tool No. T2961) into felt with fingers.

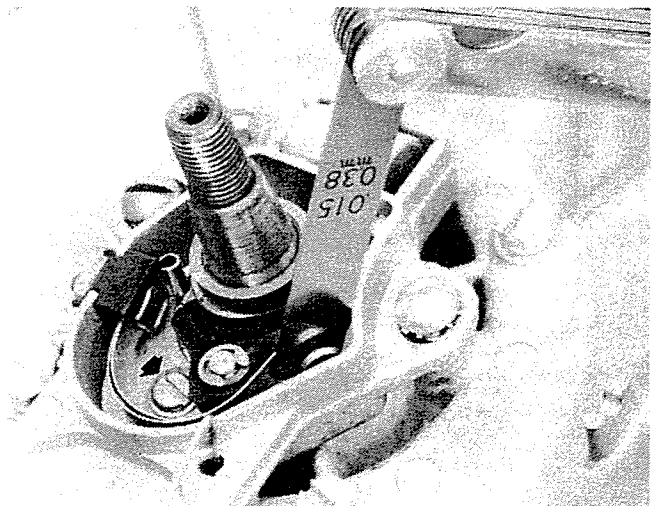
#### CAUTION

Do not over lubricate felt. Excessive lubricant causes point failure.

4. Adjust breaker point gap as outlined below.
5. Install dust cover gasket.
6. Install flywheel.

#### Adjusting Breaker Point Gap.

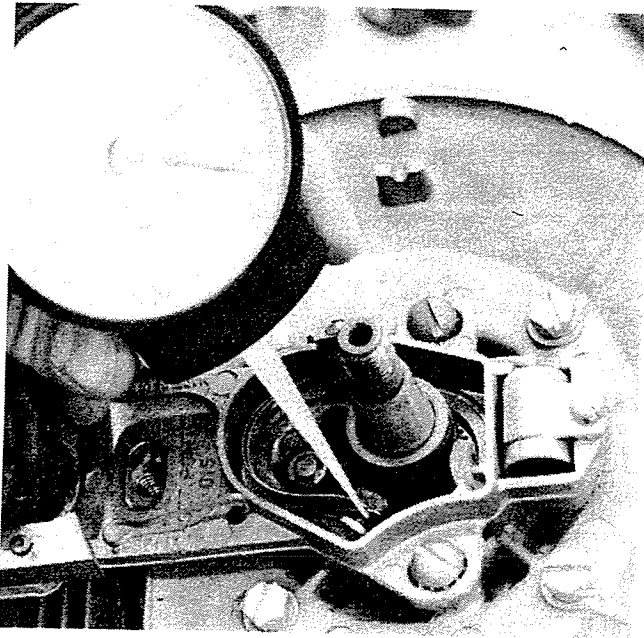
1. Install flywheel nut on crankshaft. Rotate magneto stator to WOT position. See Specifications, Section 2. Turn crankshaft until index mark on high point of cam lines up with follower arm on breaker point, Figure 26.



**Figure 26. Adjusting Points.**

2. Adjust breaker point opening to .015 in., check several times then tighten breaker point hold down screw. Figure 26.
3. Check breaker point spring tension. Tension must be 16 to 32 oz. measured at right angles to surface at center of contact, Figure 27. A breaker point with too little tension will bounce and cause ignition advance to vary and thus cause premature power head failure. A breaker point with too much

tension will cause premature point follower wear which leads to poor performance.



*Figure 27. Checking Spring Tension.*

## SPARK PLUGS

**Description.** A spark plug consists of two electrodes separated by an air gap. The side electrode is connected to the shell of the spark plug. The center electrode is completely insulated from the shell.

The high voltage, produced in the secondary coil winding, is applied to the center electrode and causes a spark to jump the gap to the side electrode. This spark ignites the fuel-air mixture and starts the combustion process in the cylinder.

The gap between electrodes is critical because it affects the entire range of engine performance — starting, idling, accelerating, power and top speed.

**Removal.** Use a 13/16 in. deep well socket with rubber insert to protect spark plug insulation.

**Inspection.** In nearly every case of spark plug failure, the cause must be corrected before new or reconditioned spark plugs are installed. Otherwise, servicing will be needed again in a short time.

Engine misfire or generally poor operation is often caused by spark plugs in poor condition or with improper gap setting. The first thing to do after removing a spark plug is to carefully note its condition as this is often an indicator of the ignition trouble. Plugs fail for various reasons. Often the porcelain insulator cracks or becomes coated with oil, carbon or other deposits. This can cause the high voltage ignition impulse to pass from the center electrode to ground without jumping the spark gap. As an engine operates, the electrodes are gradually burned or worn away. In time, the gap becomes so wide that the available ignition voltage cannot jump the gap and the engine misses.

**Servicing.** Every 100 hours remove plug, check condition and reset gap. Good operating conditions are indicated if plug has light coating of gray or tan deposit. A dead white, blistered coating could indicate overheating. A black (carbon) coating or dry black fluffy deposits can indicate an "overrich" fuel mixture caused by improper carburetor adjustment. Wet sludgy deposits can mean oil fouled plugs, caused by too much oil in fuel mixture.

### CAUTION

Sandblasting a plug risks the chance of sand being introduced into the engine. Plug may be carefully wire brushed or scraped, however new plug gives more certain results. Set spark gap to .030 in. (.76 mm).

**Installation.** Reinstall plug and torque to 120 to 180 in. lbs. (137 - 206 kg/cm).



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## SOLID STATE ELECTRICAL SYSTEM

### GENERAL

The solid state electrical system consists of two independent systems: Ignition System and A.C. Lighting System (when used).

### MODELS

The solid state electrical system is currently available on Model 82030 (Sno Runner).

### DESCRIPTION

**Ignition System.** The rotation of magnets on the outer edge of the flywheel creates a rotating magnetic field which cuts through the coil winding, building a very strong magnetic field. As the

magnets pass by the coil, the magnetic field collapses sending a high voltage charge to the spark plug. A kill switch grounds the coil when turned either right or left, and is on in the center position. In addition, an ignition switch grounds the ignition system when turned off.

**Lighting System.** The rotation of generating magnets located in the flywheel creates a rotating magnetic field which cuts through the windings of the alternator stator and generates 12 volts A.C. This current is fed directly to the lights. Ninety (90) watts is generated at operating speed. A voltage regulator prevents excessive voltage in the system at high engine RPM.

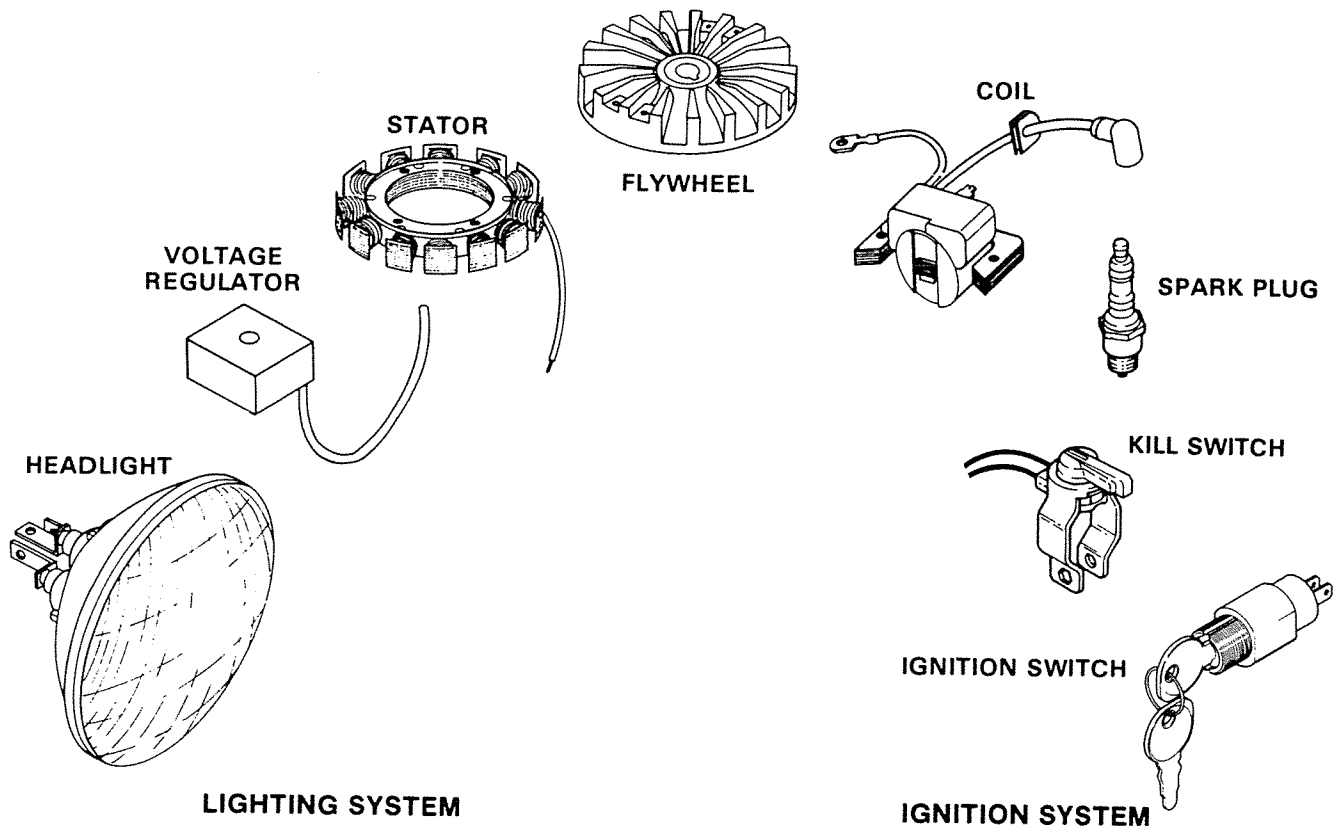
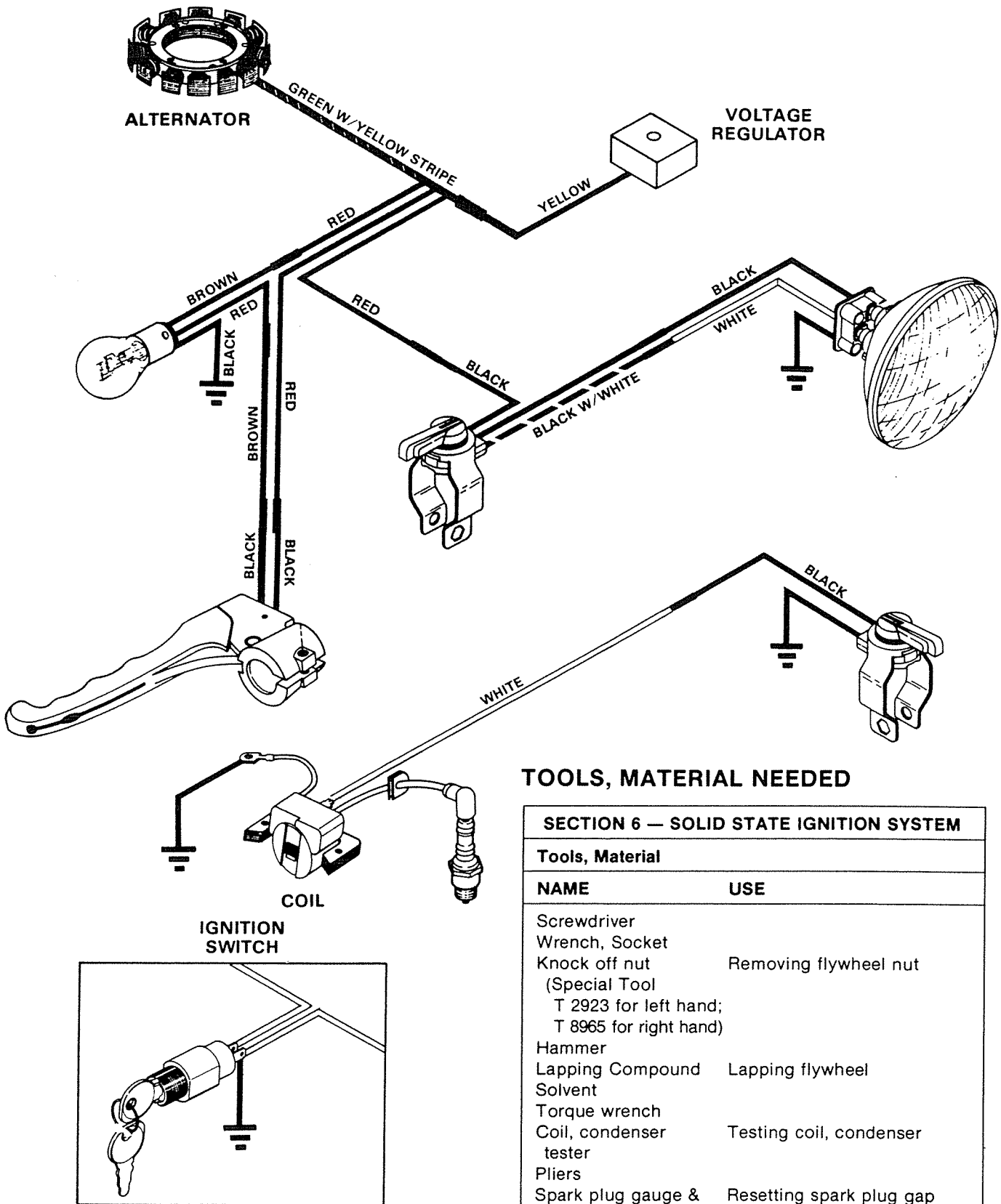


Figure 1. Electrical System. (Sno Runner Shown)



**Figure 2. Wiring Diagram.**  
*(Current Lighting Application for Sno Runner Shown)*

### TOOLS, MATERIAL NEEDED

SECTION 6 — SOLID STATE IGNITION SYSTEM	
Tools, Material	
NAME	USE
Screwdriver	
Wrench, Socket	
Knock off nut (Special Tool T 2923 for left hand; T 8965 for right hand)	Removing flywheel nut
Hammer	
Lapping Compound	Lapping flywheel
Solvent	
Torque wrench	
Coil, condenser tester	Testing coil, condenser
Pliers	
Spark plug gauge & gapping tool	Resetting spark plug gap
Flashlight Continuity Tester such as Chrysler Marine T 2938-1 or ohmmeter	Testing electrical components for shorts
Voltmeter	Testing voltage regulator
Loctite pipe sealer	Securing stator

## SOLID STATE IGNITION SYSTEM

### GENERAL

This subsection covers troubleshooting, testing and replacing electrical components of the solid state ignition system.

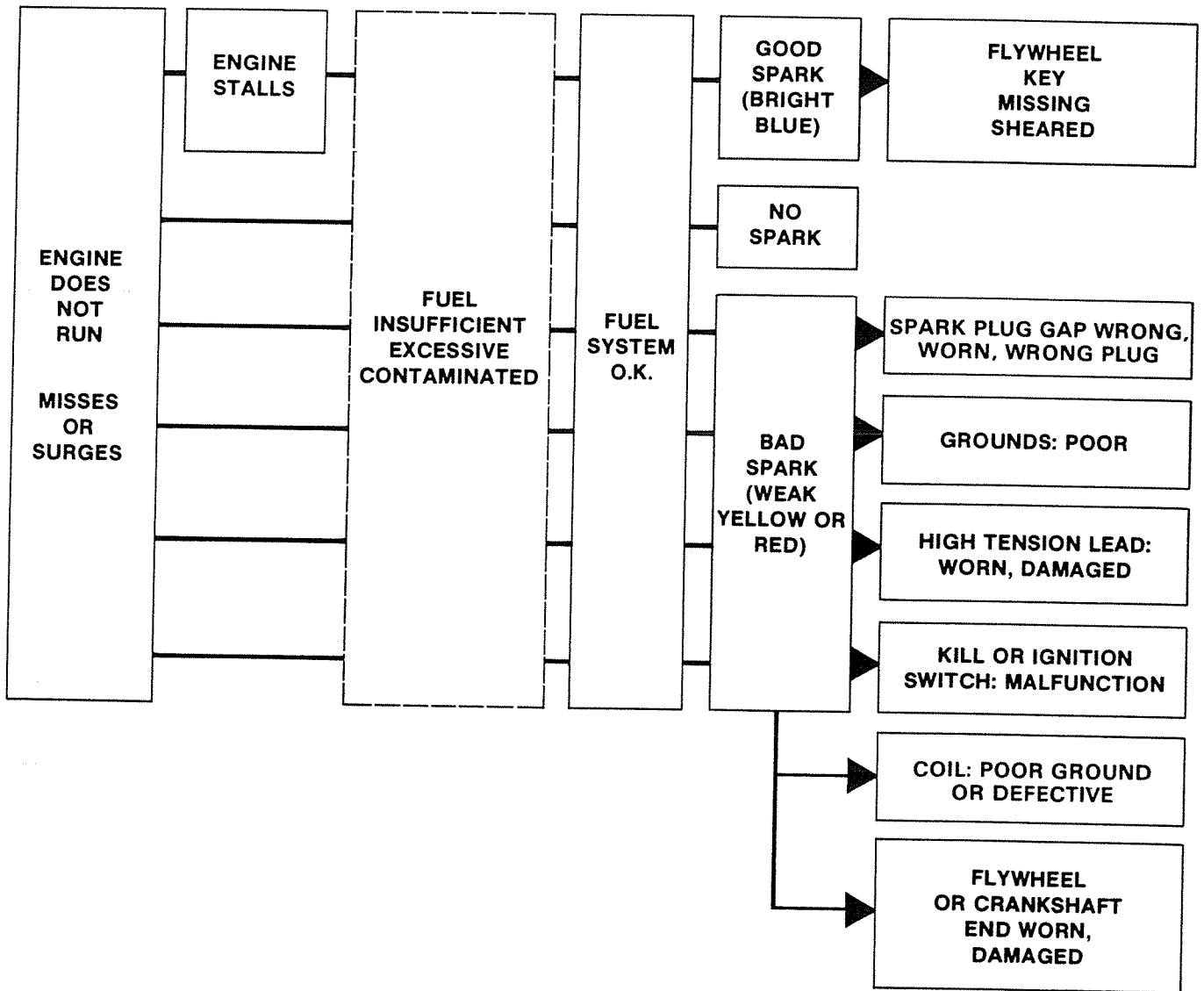
Flywheel, Coil, Spark Plug, Kill Switch and Ignition Switch.

### DESCRIPTION

The ignition system has five (5) major components:

### TROUBLESHOOTING

**General.** Check troubleshooting strategy and information in Section 2 then follow steps below:





## TESTS

### NOTES

1. Tests for coil are under Magneto Ignition System, Section 5.
2. Tests for kill switch, ignition and other switches are under Overhaul in this section.

### Spark.

### CAUTION

Solid state ignition must be securely grounded or damage to electrical components may result.

1. Install a test plug or open gap to about .170".
2. Ground spark plug **securely** to engine.

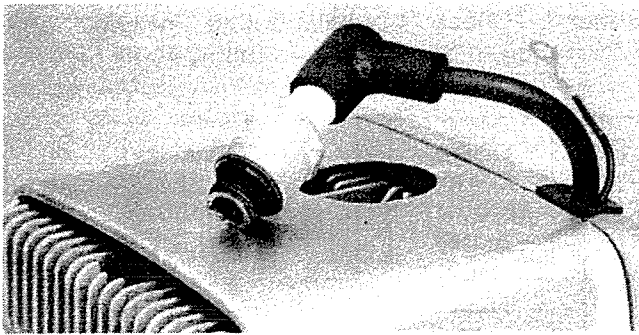


Figure 1. Testing for Spark.

3. Crank engine: spark should be strong enough to jump to threads of spark plug.

## OVERHAUL

### FLYWHEEL

Service flywheel as outlined in Section 5.

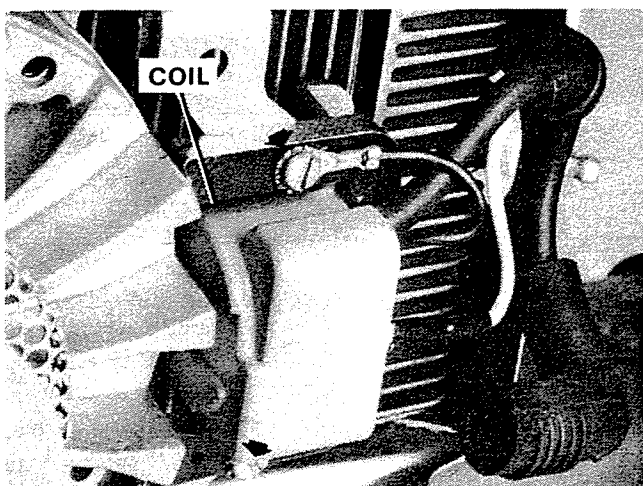


Figure 2. Removing Coil.

## COIL

### Removal.

1. Disconnect spark lead.
2. Remove fan housing with starter as an assembly.
3. Disconnect coil lead (white) from spade terminal. Figure 2.
4. Remove coil from bracket by removing two (2) screws. Figure 2.

### NOTE

If coil is to be tested, do not disassemble, go to testing.

**Testing.** See Magneto Ignition Section 5.

### Disassembly.

1. Separate coil from laminations by prying lip of coil wedge spring away from laminations and pulling coil free. Figure 3.

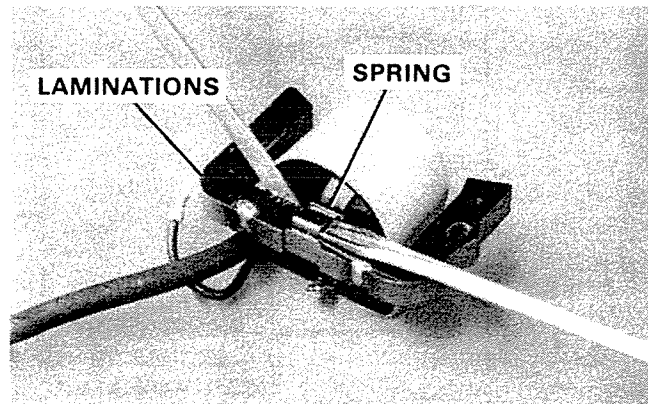


Figure 3. Separating Coil From Laminations.

### Reassembly.

1. Assemble coil to laminations so that large lip of spring is "down" and on side opposite leads. Figure 4.

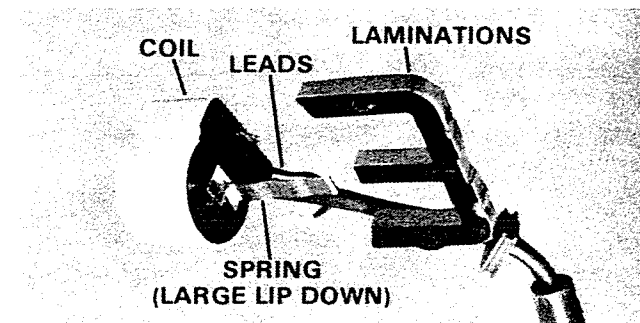


Figure 4. Assembling Coil.

### Installation.

1. Secure assembly to bracket with ground lead eyelet under head of screw. Figure 5.

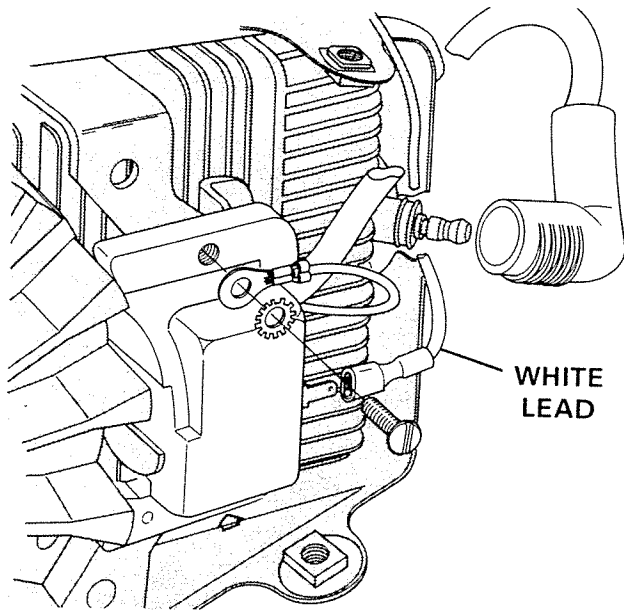


Figure 5. Installing Coil.

2. Connect white lead to spade terminal. Figure 5.
3. Install fan housing and starter assembly and connect spark lead.

### SPARK PLUG

Service spark plug as outlined in Magneto Ignition System, Section 5.

### KILL SWITCH

The kill switch is a three position switch: center is run, right or left of center is off. When the switch is moved right or left of center, it grounds the coil to the frame.

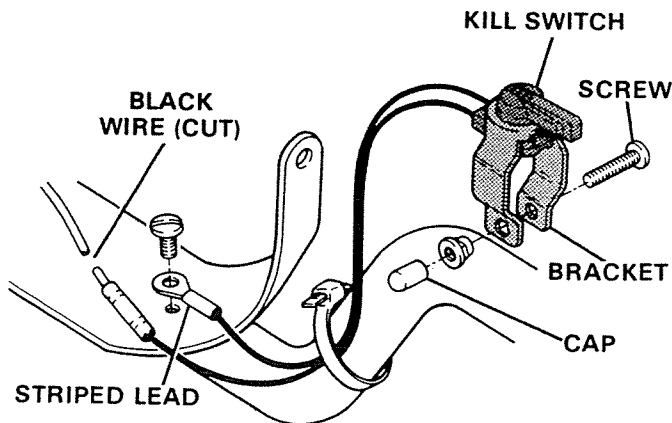


Figure 6. Removing or Installing Kill Switch.  
(Sno Runner Shown)

### Removal.

1. Remove protective cap from screw end.
2. Remove screw and nut and pull switch from mounting location. Figure 6.
3. Cut black wire beyond connector.
4. Remove screw securing black/white stripe wire.

**Testing.** Test may be made with an ohmmeter or T 2938-1 circuit tracer.

1. Connect tester leads for each wire.
2. In center position, T 2938-1 tester should remain dark, ohmmeter should indicate  $\infty$  (infinity). If not, switch is defective. Figure 7.
3. Place switch in both left and right positions. T 2938-1 tester should light, ohmmeter should drop to zero. If tester does not light or is dim (assuming tester batteries are fresh) or some resistance is noted on the ohmmeter in either switch position, switch is defective. Figure 7.

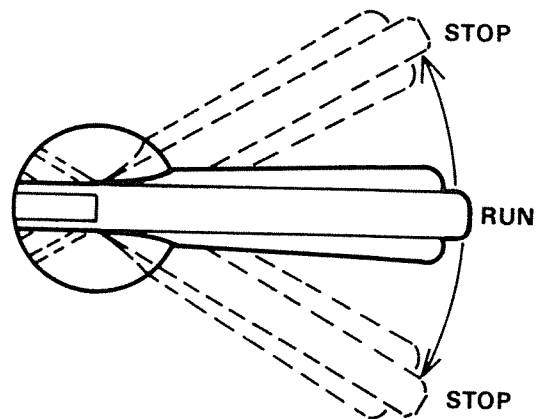


Figure 7. Testing Kill Switch.

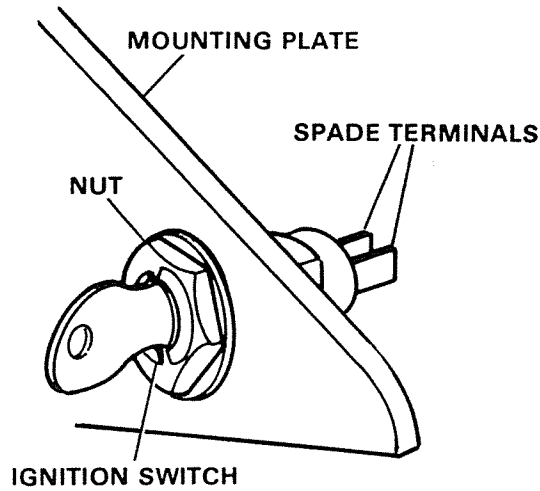
### Installation.

1. Connect black switch wire to red wire from harness.
2. Secure black/white stripe wire eyelet with screw.
3. Secure switch assembly with screw and nut. Place protector on screw end.

## IGNITION SWITCH

### Removal.

1. Remove wires from spade terminals at rear of switch. Figure 8.
2. Remove nut securing switch to mounting plate. Figure 8.



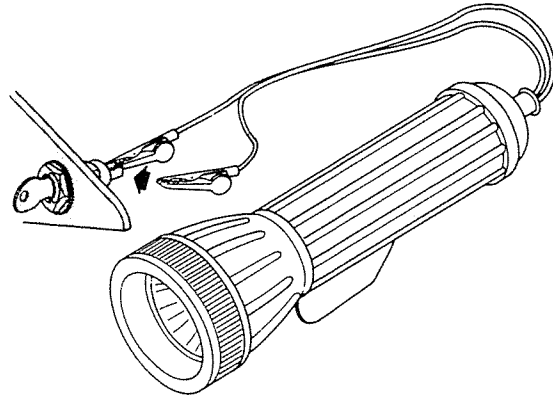
**Figure 8. Removing or Installing Ignition Switch.**

**Testing.** Test may be made with an ohmmeter or T 2938-1 circuit tracer.

1. Place leads on spade terminals.

2. When switch is in "OFF" position, T 2938-1 tester should light, ohmmeter should indicate zero. Figure 9.

3. With switch in "ON" position, T 2938-1 tester should remain dark, ohmmeter should indicate  $\infty$  (infinity).



**Figure 9. Testing Ignition Switch.**

### Installation.

1. Place switch in position in mounting plate hole. Secure with nut and washer.
2. Replace wires at switch terminals.

---

**SOLID STATE LIGHTING SYSTEM**
**GENERAL**

This subsection is concerned with troubleshooting the lighting system, testing and replacement of its components.

**DESCRIPTION**

The lighting system consists of two (2) major components: Alternator Stator, Voltage Regulator; and other lights, switches, such as Brake and Tail Light Assembly, Brake Switch, Head Light and Dimmer Switch, **depending on application.**

**TROUBLESHOOTING**

When diagnosing a problem in the lighting system, care must be taken to think of the system as a whole. Poor electrical connections in the wiring, worn or cracked insulation of the wires themselves or overloading of the electrical system will give false impressions that the problem is within the alternator when it may not be. **A careful, visual inspection of the wiring should be made prior to resorting to meter testing.**

**TESTING**

To test wiring for continuity, use circuit continuity tester such as Chrysler Marine Special Tool T 2938-1 or an ohmmeter.

**NOTE**

**Do not** hook tester in series with any of the lights. The current draw by the light will drain tester batteries.

1. Connect tester at each end of wire being tested.
2. Failure of tester to light or a very high ohm reading anywhere along a circuit indicates a problem in that circuit. Replace bad wire and continue test.
3. Start engine and check light operation. If lights still do not work, check alternator.
4. Connect one tester light to green/yellow stripe wire from alternator stator, other tester lead to

ground. Tester should light, ohmmeter should read one ohm, nominal.

**ALTERNATOR STATOR****Removal.**

1. Remove fan housing.
2. Remove flywheel.
3. Remove screws securing stator, cut lead wire at connector, remove stator.

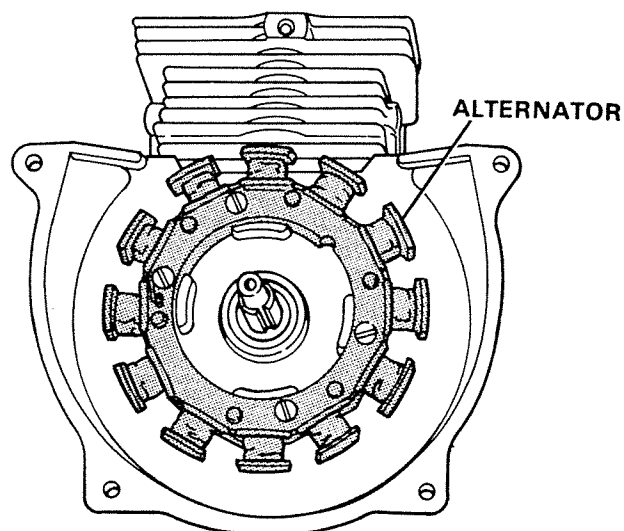
**Cleaning and Inspection.** Use a brush or compressed air to clean the stator windings. Clean pole laminations with No. 400 or finer sandpaper. Inspect for loose connections or burnt insulation.

**WARNING**

Wear safety glasses when working with compressed air.

**Installation.**

1. Position alternator on support plate, secure with screws using Loctite pipe sealer. Figure 1.



**Figure 1. Installing Alternator.**

2. Guide lead wire through rubber grommet in support plate.

## VOLTAGE REGULATOR

**Testing.** Testing is done with voltage regulator installed, using a voltmeter.

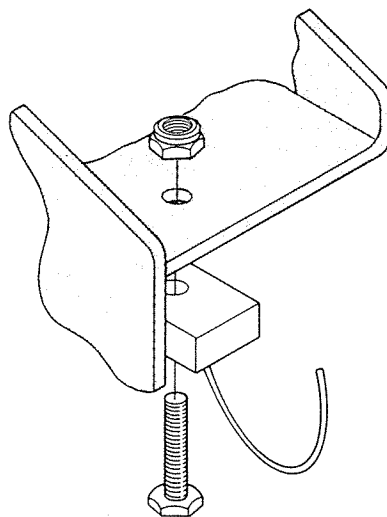
1. Attach one voltmeter lead to any red wire. Ground other lead to frame.
2. Start engine.
3. Indicated voltage should be 14.2 volts  $\pm$  0.3 at idle.
4. Open throttle, voltage reading should remain within this range.

### Removal.

1. Remove screw and nut securing regulator.
2. Cut lead wire at connector.

### Installation.

1. Secure regulator with nut and screw. (Be sure of good, clean ground)
2. Connect lead wire.



**Figure 2. Removing or Installing Voltage Regulator. (Sno Runner Shown)**

## SWITCHES

Test any additional switches following general principle of steps outlined under Ignition Switch in this section.

**Section**

# 7

## **ENGINE**

### **CONTENTS**

General .....	81
Description .....	81
Model Differences .....	81
Principle of Operation .....	81
Tools, Material Needed .....	83
Troubleshooting .....	83
Pressure Testing .....	84

## GENERAL

An engine needs three basic ingredients to run: proper fuel/air mixture, compression, and a spark at the right time. The information in this section is concerned with compression, and the parts of the power head that develop compression.

## DESCRIPTION

The power head is a two-cycle engine which consists of a cylinder, piston, rod, crankshaft, and crankcase. The cylinder delivers one power impulse per crankshaft revolution.

## MODEL DIFFERENCES

As noted in "Terms", Section 1, engine may be mounted in different positions and carburetor may be mounted on either transfer port cover or on crankcase cover. See Section 2 for model uses and differences.

## PRINCIPLE OF OPERATION

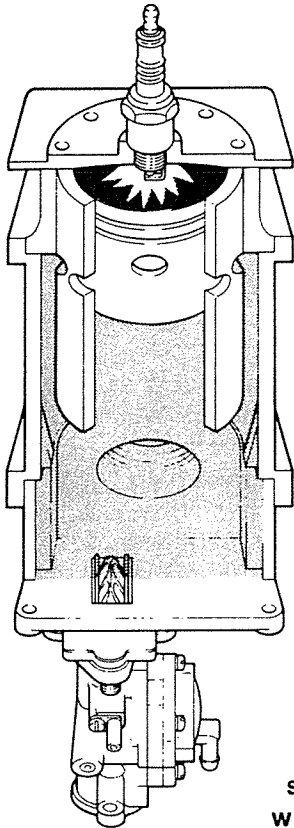
The power head incorporates a **loop scavenged** system. As the piston uncovers the intake ports on the downstroke, fuel/air mixture enters the combustion chamber from the crankcase. The two sets of intake ports are approximately 90° to the exhaust port. This directional effect forces the two incoming charges to merge and flow up and around the smooth dome shape in the cylinder head, then down and out the exhaust ports.

The piston in a two-cycle engine acts as an inlet valve, exhaust valve, and air pump. When a two-cycle engine starts, the crankshaft turns and the piston rises. With the piston approaching Top Dead Center (combustion chamber filled with a compressed mixture of air and fuel) the spark plug ignites the compressed mixture. The resulting explosion forces the piston down which in turn rotates the crankshaft. Figure 1A.

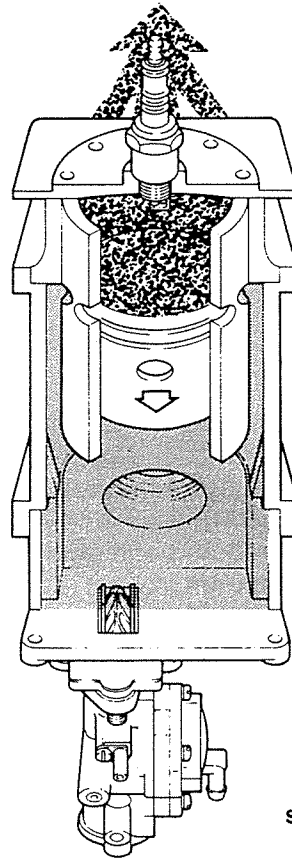
As the piston moves down, it first uncovers the exhaust ports. The exhaust escapes through the ports and the combustion chamber pressure falls.

Meanwhile, a fresh supply of air/fuel mixture is being compressed in the crankcase by the downstroke of the piston. Figure 1B. As the piston nears the bottom of this stroke, it uncovers the inlet ports and this fresh air/fuel mixture rushes into the combustion chamber in an effort to equalize the pressure between the crankcase and combustion chamber. The flow pattern of the fresh air/fuel mixture pushes the burned exhaust gases from the cylinder. Figure 1C.

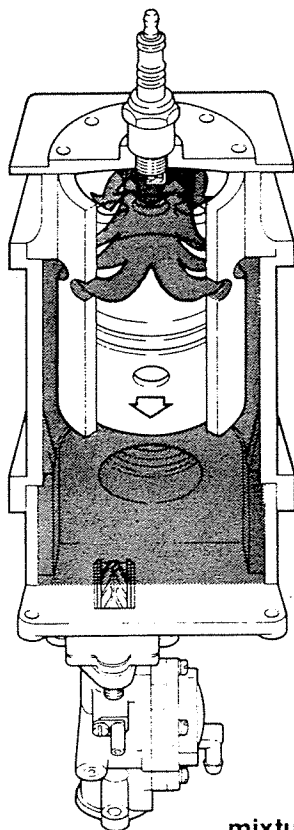
Now the compression stroke begins; the intake ports and exhaust port are covered by the rising piston. As pressure increases in the combustion chamber, it decreases in the crankcase. This decrease in pressure permits a new air/fuel mixture from the carburetor to enter through the reed valve, thus preparing the next cylinder charge. Figure 1D.



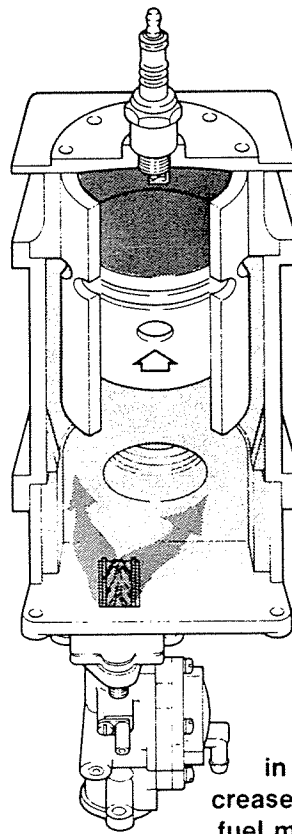
**A. COMBUSTION**  
Spark plug ignites the compressed mixture. Rapid expansion forces the piston down which rotates the crankshaft.



**B. EXHAUST**  
Exhaust escapes through port and combustion chamber pressure falls. Fresh supply of fuel is compressed in crankcase.



**C. INTAKE**  
Inlet port is uncovered, fuel mixture enters combustion chamber. Flow pattern of fresh fuel mixture helps push out exhaust.



**D. COMPRESSION**  
Intake and exhaust ports are covered by piston. Pressure increases in combustion chamber and decreases in crankcase, allowing fresh fuel mixture to enter through reeds.

*Figure 1. Operation of the 2-Cycle Motor.*



**Break-In.** The Power Bee engine needs at least 1 1/2 hours break-in running time before it reaches near optimum performance. Evaluation of engine power and performance should only be made after engine is broken in.

## TOOLS, MATERIAL NEEDED

SECTION 7 — ENGINE	
Tools, Material	
NAME	USE
Compression tester Socket wrenches Screwdriver Knock off nut	Testing engine compression
Hex bits, ratchet	Removing Flywheel (See Section 5)
Arbor press and soft hammer	Removing connecting rod cap screws; Removing cylinder head bolts
Ring expander (Special Tool T 8926)	Removing crankshaft; re- moving/installing crankshaft bearings
Snap ring pliers	Removing, installing piston rings
Punch, standard or Special Tool T 8919	Removing piston pin; crankshaft seal
Lacquer thinner	Cleaning gasket surfaces
Cleaning solution or rotary brush, Special Tool T 2991	Removing carbon from exhaust ports, passages
Inside micrometer or dial indicator	Measuring I.D. of cylinder for taper and out of round
Cylinder hone, drill	Reconditioning cast iron cylinder bores only
Torque wrench	
Spark plug tap, Special Tool T 2947	Cleaning spark plug hole threads
Glass or flat plate	Checking flatness of cylinder head
Emery cloth No. 120 & NO. 180	Resurfacing cylinder head
Seal installer	Installing crankshaft seals
Light motor oil	Oiling rollers, other parts
Ring compressor	Compressing rings to install piston
Locquic Activator	Cleaning connecting rod screws; and on model 82030 only - cleaning support plate screws
Sealant, Special Tool T 2963-1, (Loctite D)	Securing connecting rod cap screws
Loctite Pipe Sealer	Model 82030 only — securing stator
Loctite 271	Model 82030 only — securing support plate
Hex bit adapter, Special Tool (T 8929)	Torquing connecting rod cap screws

## TROUBLESHOOTING

See charts in Section 2. Poor engine performance and/or hard starting may be signs of a compression problem. Other signs include excessively smoky exhaust, badly fouled plug, power surging or extreme power loss. All can indicate engine compression problems. When internal damage or wear is suspected as the cause of an engine problem, a compression test should be done **first**.

### Compression Test.

#### NOTE

Compression specs vary, since customers commonly modify compression ratio for special use. See Section 2 for customer list. Original factory specs are given for some engines in the steps below.

1. Remove spark plug from the power head.
2. Insert tip of compression tester into spark plug hole of cylinder. Figure 2.

#### NOTE

Be sure compression release is closed on models equipped with them.

3. Set throttle to wide open position.
4. Crank the engine over with the starter several times to make sure that the cylinder comes up for the compression portion of its stroke several times.

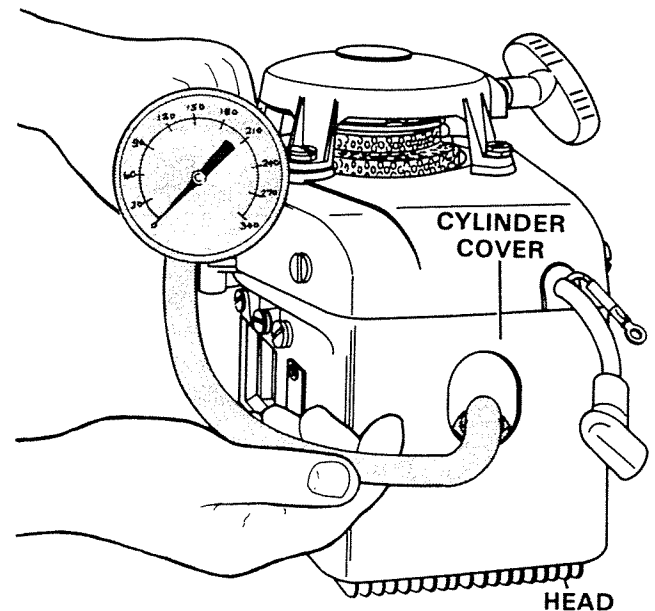


Figure 2. Compression Gauge Installed.

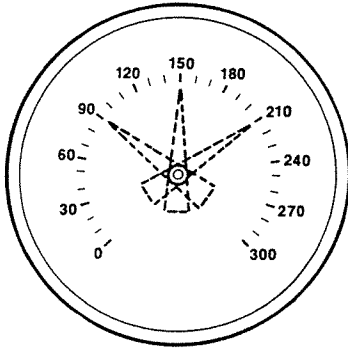
5. Note the reading on the gauge.

## NOTE

Compression generally should be within 10 p.s.i. of specification. If not, cylinder head should be removed and an inspection made to find the problem (leaking head gasket, scored cylinder etc.)

## NOTE

Sometimes simply tightening the head bolts to the proper torque will cure a leaky head gasket.



**Figure 3. Compression Range.**  
(Consult corporate customers for specs)

## NOTE

Original factory specs for Models 61001, 61002, 82001 and 82002 only are: 190-210 p.s.i. (134-148 kg/cm<sup>2</sup>) cold and 170-185 p.s.i. (12-13 kg/cm<sup>2</sup>) hot.

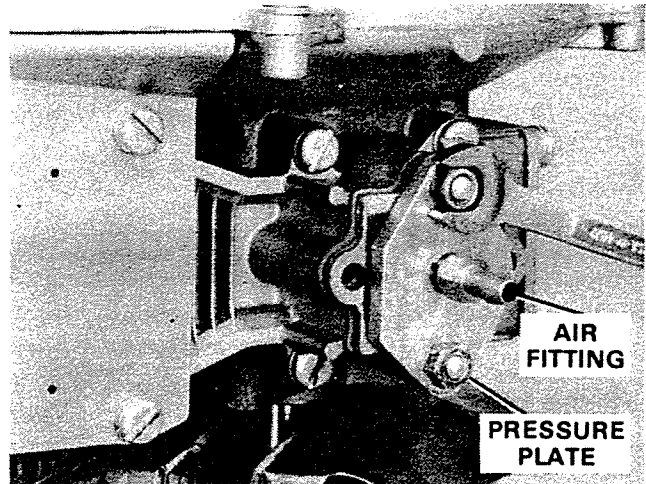
## PRESSURE TESTING

### NOTE

Air leaks can occur at the following places: head gasket, crankshaft seals, carburetor mounting surface, block (cracks), compression release, cylinder, cylinder head, manifold and cover castings.

Signs often include racing, fast idling, and sometimes loss of power, erratic idling, hard starting or overheating. (One chain of events: extra air leans mixture, raises operating temperature, boils fuel; causing vapor lock and hard starting.)

1. Make sure engine is "air tight" as follows:
  - A. Block exhaust port using plate with holes drilled for muffler attaching holes.
  - B. Remove carburetor, install a plate with a hose fitting for pressure tester or manometer. Figure 4.
2. Set up pressure tester that will deliver no more than 5 p.s.i.



**Figure 4. Installing Plate for Pressure Testing.**

## CAUTION

Do not connect high pressure air hose, seals and gaskets could be damaged.

3. Test for leaks by applying soapy water to all engine surfaces, applying air pressure and checking for bubbles indicating leaks.

## NOTE

Another method: blow cigarette smoke through a tube connected to intake port.



## WARNING

Follow safety precautions when using flammable material near engines.

**Motor Noises.** Learning to recognize certain sounds made by a running motor can help troubleshoot internal problems. These sounds can be traced down to their exact location using a mechanics stethoscope.

### Removal Notes.

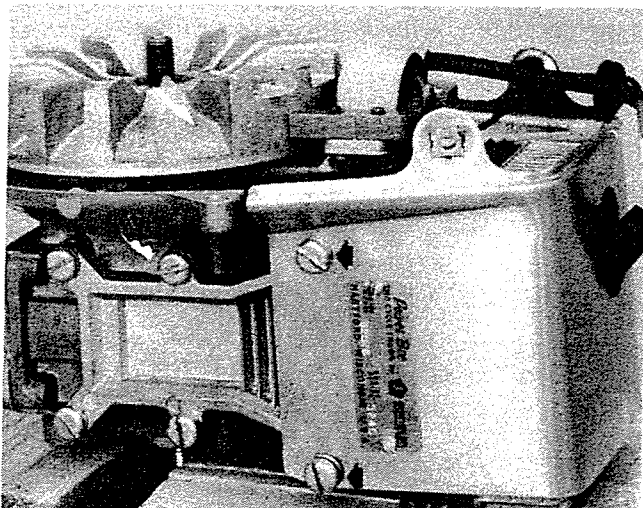
1. Note routing of fuel line, and set up of throttle linkage when disconnecting fuel system.
2. Note engine mounting system used.

## OVERHAUL

### Disassembly.

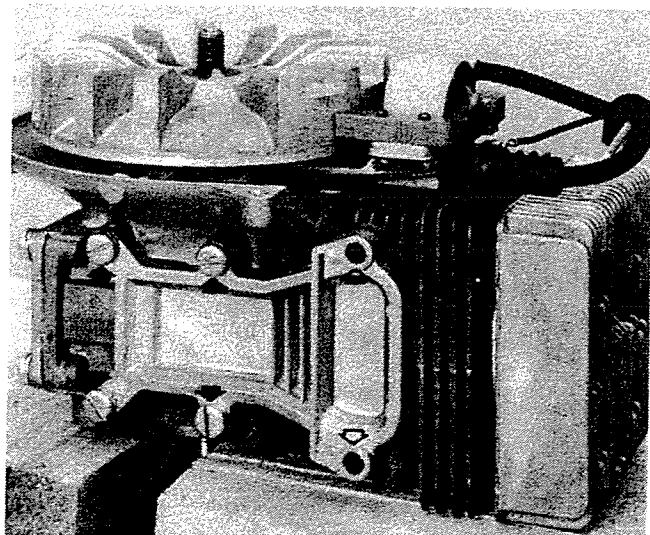
1. Remove spark plug.
2. Remove fan housing with starter as an assembly; remove starter cup.
3. Remove carburetor elbow (some applications), then remove carburetor as outlined in Section 4A and reed valve as outlined in Section 4B.

4. Remove cylinder cover by removing four (4) screws. Figure 5.



**Figure 5. Removing Cylinder Cover.**

5. Remove both transfer covers by removing four (4) remaining screws (of six) that hold each cover to engine. Figure 6.



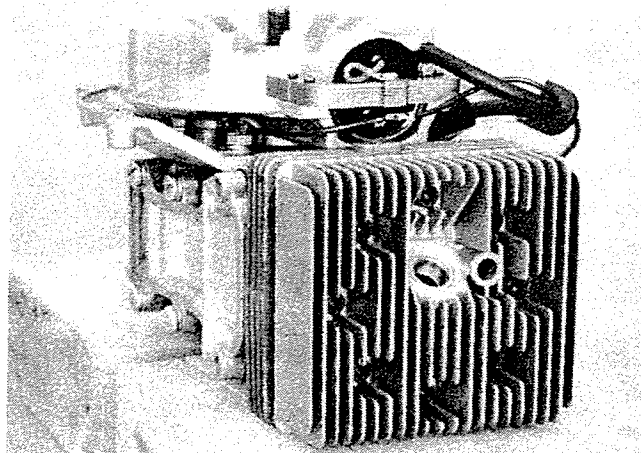
**Figure 6. Removing Transfer Covers.**

6. Remove cylinder head by removing eight (8) screws and washers. Figure 7.

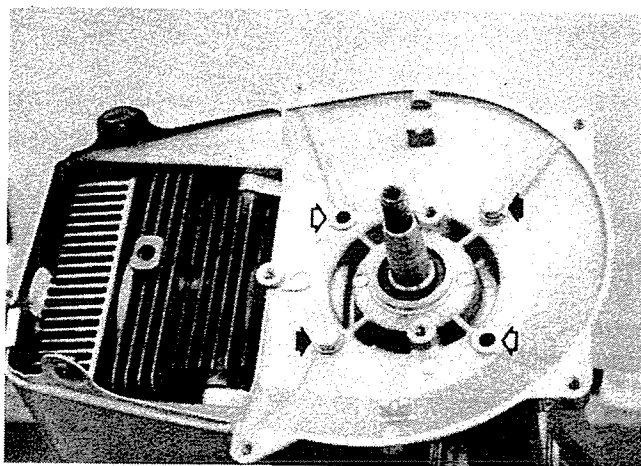
7. Remove flywheel and stator plate as outlined in Section 5.

8. Remove support plate. Figure 8.

9. Remove crankcase cover. Figure 9.



**Figure 7. Removing Cylinder Head.**



**Figure 8. Removing Support Plate.**



**Figure 9. Removing Crankcase Cover.**

### **CAUTION**

Use of a worn wrench may strip connecting rod screws.

10. Disconnect crankshaft from connecting rod by removing connecting rod screws, rod cap and needle bearings. Figure 10.

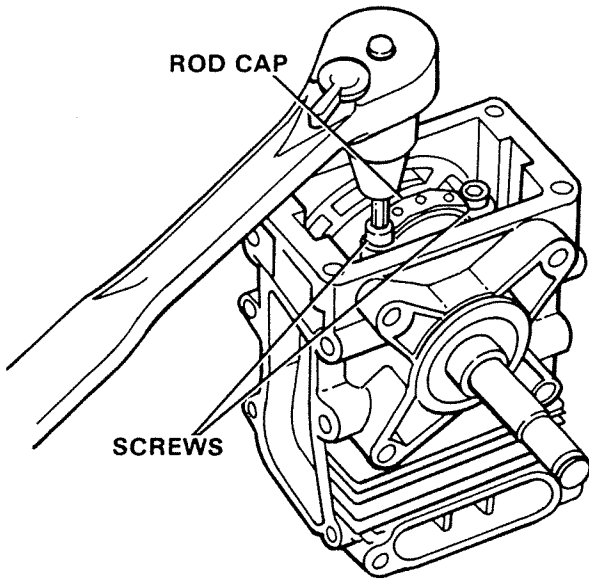


Figure 10. Disconnecting Crankshaft.

11. Push piston assembly out of cylinder.

12. Remove crankshaft with bearings from cylinder using an arbor press or by tapping end of crankshaft lightly with a plastic or rubber hammer. Figure 11.

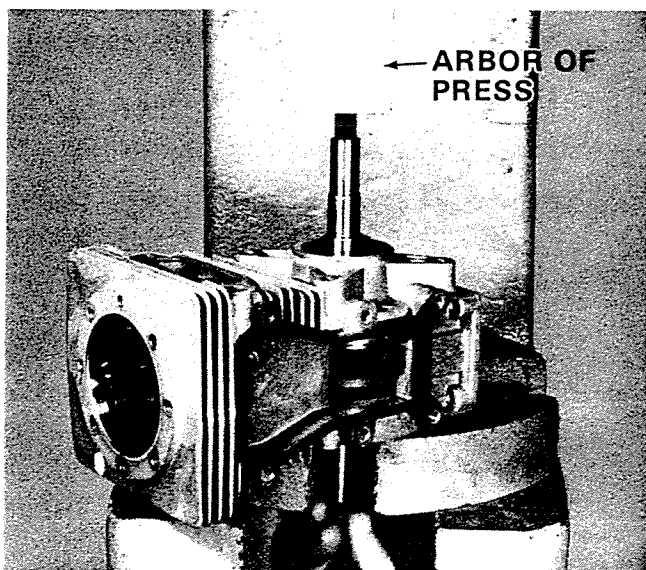


Figure 11. Removing Crankshaft.

**NOTE**

Lower crankshaft bearing is assembled to shaft with a light press fit.

13. Remove lower crankshaft bearing from crankshaft with arbor press; upper bearing by tapping lightly with a plastic or rubber hammer. Figure 12.

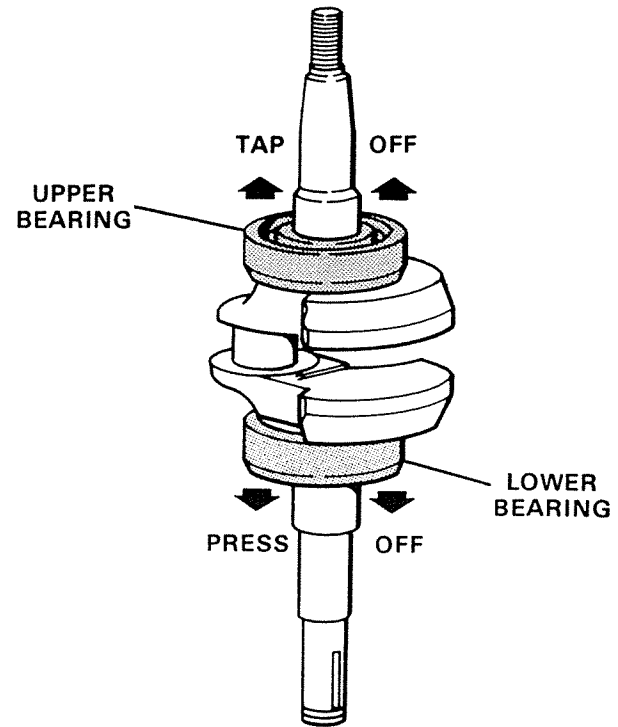


Figure 12. Removing Crankshaft Bearings.

14. Disassemble piston as follows:

A. Remove rings from piston with ring expander. Special Tool No. T 8926. Figure 13.

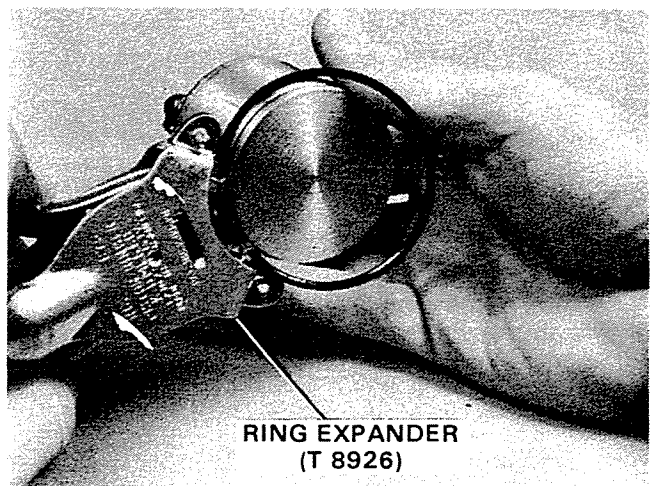


Figure 13. Removing Piston Rings.

- B. Remove retaining rings with snap ring pliers.
- C. Remove rod from piston by driving out piston pin using a small punch in opened end of pin, tapping lightly while supporting piston with hand or pillow block. Figure 14.

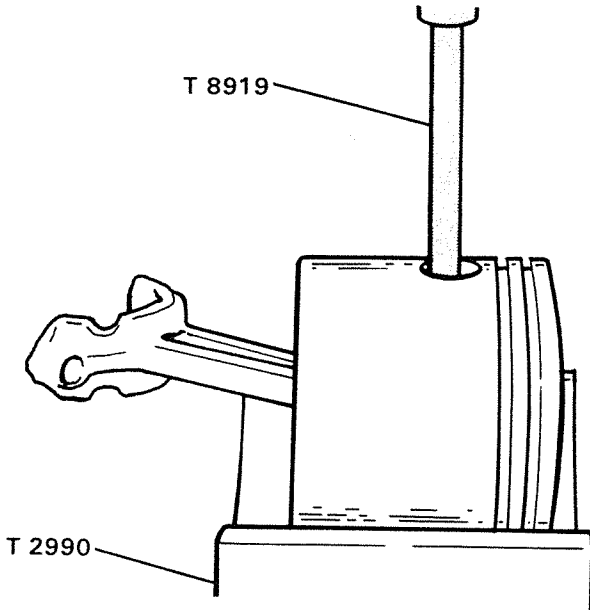


Figure 14. Removing Piston Pin.

### Inspection and Repair.

#### NOTE

Refer to specifications for dimensions.

#### NOTE

Gasket set includes head gasket, cylinder exhaust gasket, crankcase cover gasket, two (2) transfer cover gaskets, carburetor adapter gasket (some models), reed plate gasket, carburetor gasket and bearing cage gasket.

#### CAUTION

Do not scrape surfaces of support plate and cylinder where bearing cage gasket seats. This could cause a leak.

1. Clean all dried cement off gasket surfaces with lacquer thinner.



#### WARNING

Wear safety glasses when working with compressed air.

2. Wash all parts in solvent. Dry with compressed air.
3. Inspect and repair cylinder block as follows:

- A. Remove carbon from exhaust ports and all exhaust passages, using cleaning solution or rotary brush. Special Tool No. T 2991.

#### NOTE

Carbon build up restricts exhaust gases and greatly reduces engine performance.

- B. Measure the I.D. of cylinder bore at three points with an inside micrometer or dial indicator. Measure 1/4" (6.35 mm) down from top, 1/4" (6.35 mm) up from exhaust port and about 3/16" (4.76 mm) down from lower edge of intake port. Also take measurements 90° from first set. Figure 15.

#### NOTE

The taper, or difference between the largest and smallest measurements, must not be more than .002" (0.05 mm).

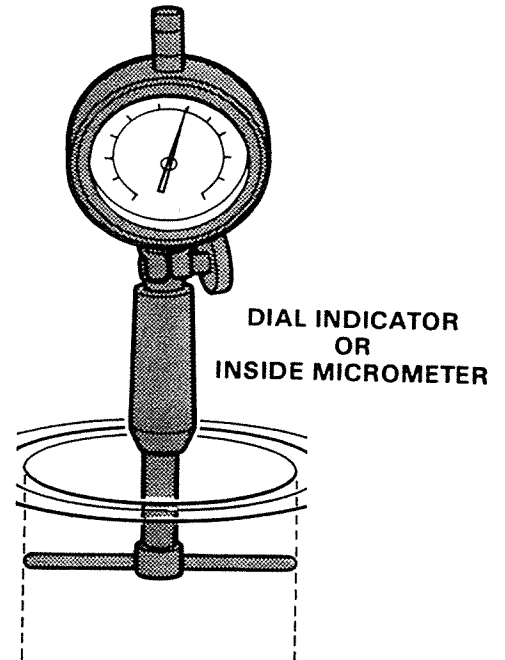
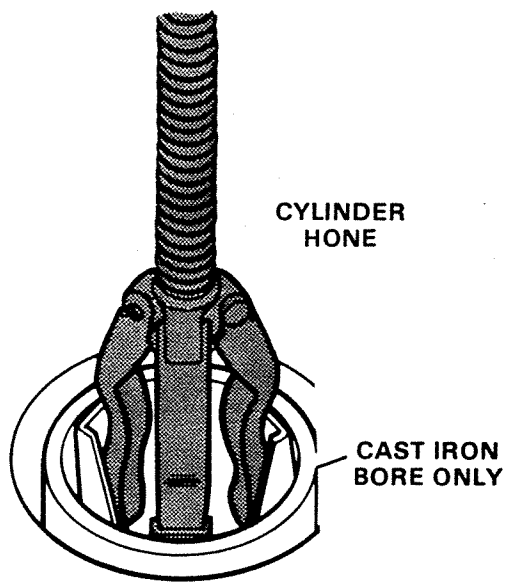


Figure 15. Measuring Cylinder.

- C. Replace cylinder block if wear is more than .002 in. (0.05 mm) or if cylinder is out of round.
- D. If cast iron (only) cylinder bore is within wear tolerance, but slightly scored, hone with a fine stone cylinder hone. Figure 16.

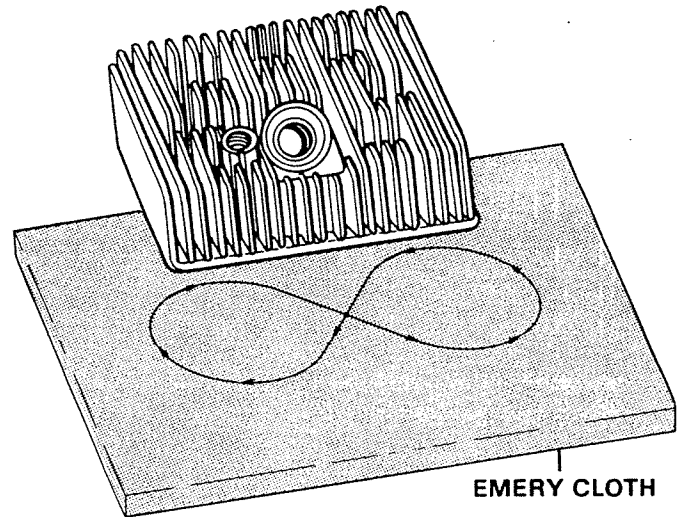
#### NOTE

Use a low rpm drill with rapid up and down motion to resurface and remove any aluminum deposits. On chrome bores, if piston seized and there is no excessive damage to cylinder, hone aluminum out of bores.



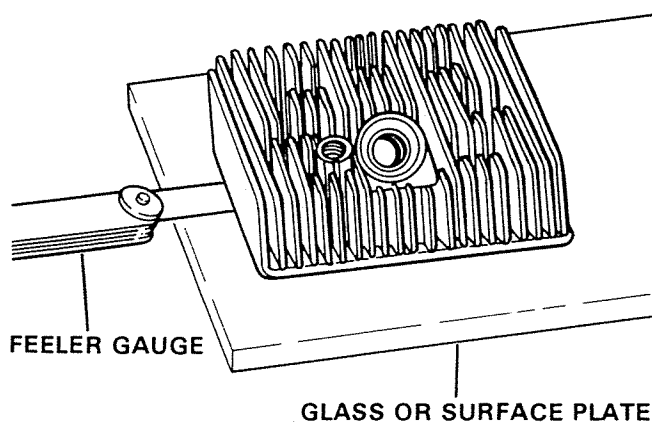
**Figure 16. Honing Cylinders.**  
(Cast Iron Bores, 610 Series Only)

unchanged. Continue until entire gasket surface has dull finish. Finish off with No. 180 emery cloth. Figure 18.



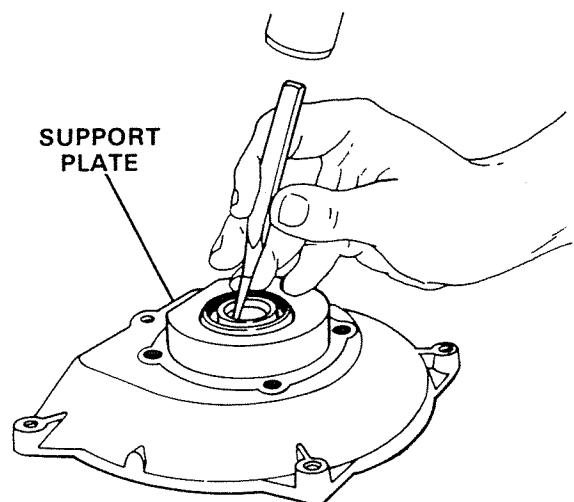
**Figure 18. Resurfacing Cylinder Head.**

4. Inspect and repair cylinder head as follows:
  - A. Clean carbon from spark plug threads in cylinder head with a spark plug tap. Special Tool No. T 2947.
  - B. Check flatness of cylinder head by laying gasket surface on a piece of plate glass or surface plate. Measure at different points between head and glass with feeler gauge. Figure 17.



**Figure 17. Checking Flatness of Cylinder Head.**

5. Check crankshaft as follows:
  - A. Check threads on end of crankshaft for damage. Repair.
  - B. Inspect keyway and tapered ends of shaft for scoring, wear.
  - C. Measure crankshaft.
6. Inspect and repair support plate as follows:
  - A. Inspect housing for cracks or other damage.
  - B. Inspect seal (top end of crankshaft or magneto end) for wear, nicks or other damage.



**Figure 19. Removing Top End Seal.**

- C. Resurface cylinder head, if it is only slightly warped: lay a sheet of No. 120 emery cloth on the glass and slide head around in a figure 8 motion, exerting light and even pressure. Examine gasket surface area: high spots will be dull, low spots

- C. If seal is bad, remove with punch. Figure 19.
- D. Press new seal in with sealing lip down until seal bottoms out. Figure 20.

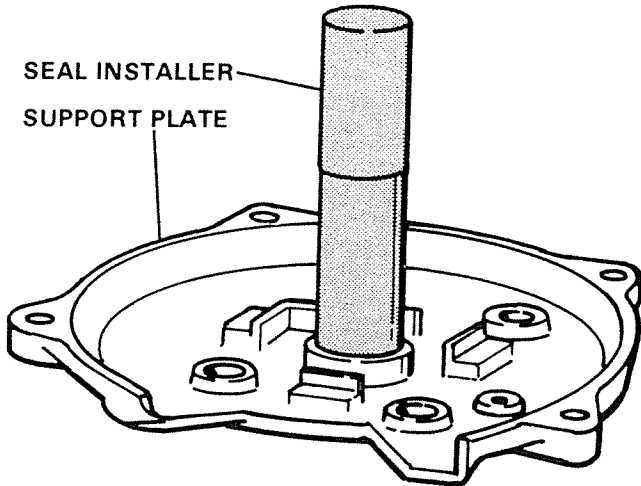


Figure 20. Installing Top End Seal.

- 7. Inspect and install new crankshaft bearings, if needed, as follows:
  - A. Check bearings for rust, cracks, wear.

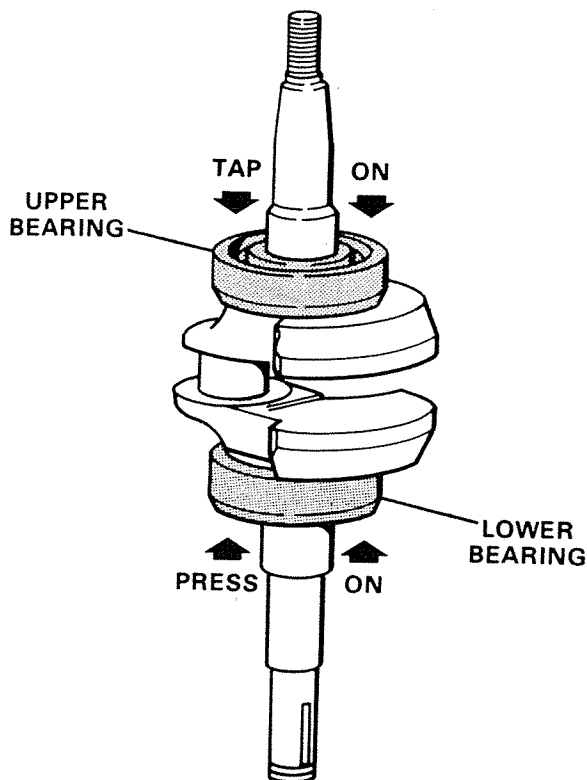


Figure 21. Installing Crankshaft Bearings.

## CAUTION

If using arbor press to install lower bearing, **support** flat part of shaft (between counterweights) to prevent damage.

- B. Install lower crankshaft bearing, lettered side out, until it seats on shoulder of crankshaft, using arbor press. Figure 21.
- C. Tap upper bearing on with plastic hammer.
- 8. Inspect and repair lower crankshaft seal (drive end or crankcase seal) as follows:
  - A. Check seal for nicks, wear.
  - B. If seal is worn or damaged, remove seal with punch.

## NOTE

New seal is installed later.

- 9. Check connecting rod as follows:
  - A. Inspect crankpin bore of connecting rod for overheating (blue color) or pitting.
  - B. Inspect needle bearings in piston pin bore of rod: if needles are burned or pitted, replace entire rod.
- 10. Examine rollers with magnifying glass for spalling, the first sign of roller break down; also check ends of rollers.

## NOTE

If in doubt, replace rollers.

- 11. Check piston as follows:
  - A. Inspect piston for excessive wear and scoring.

## NOTE

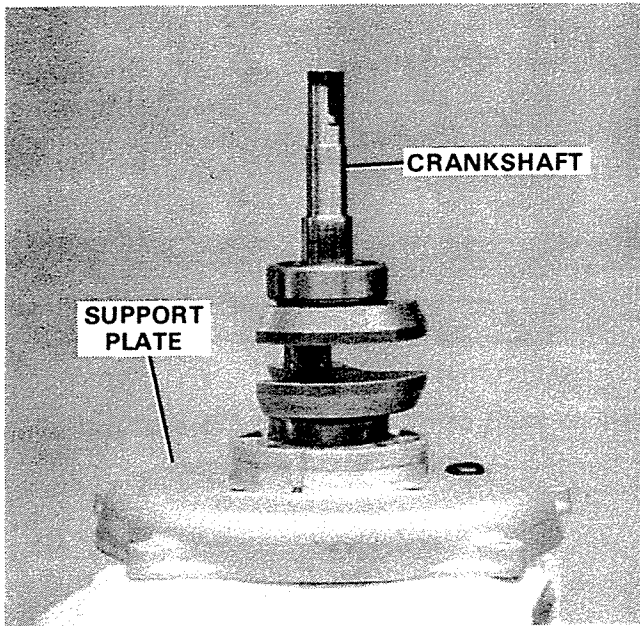
The type of damage helps determine the cause: diagonal wear is not normal — new pistons can be damaged quickly in the same way. Scoring can be caused by overheating, carburetor misadjustment, incorrect clearances between piston and cylinder and/or improper break-in procedure.

- 12. Examine end of piston pin very closely for signs of wear.



## Reassembly.

1. Press or tap crankshaft with both bearings into support plate. Figure 22.

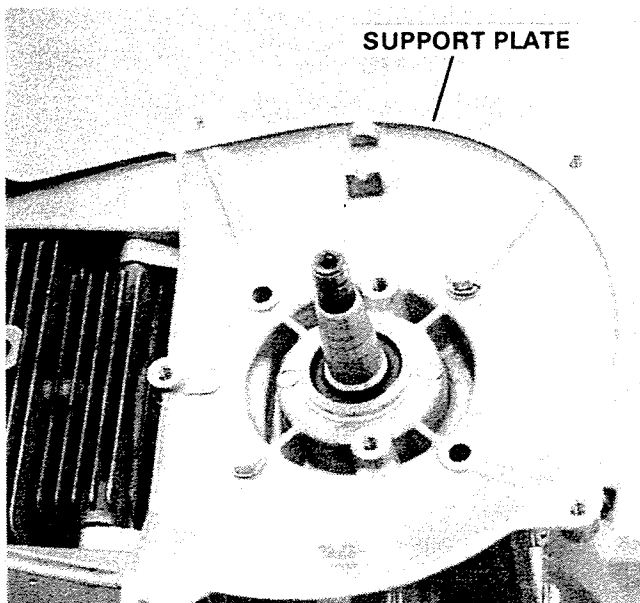


**Figure 22. Installing Crankshaft to Support Plate.**

2. Install assembly to cylinder as follows:

A. Place gasket where support plate mounts to cylinder block, making sure holes line up.

B. Install assembly in cylinder block.



**Figure 23. Installing Support Plate.**

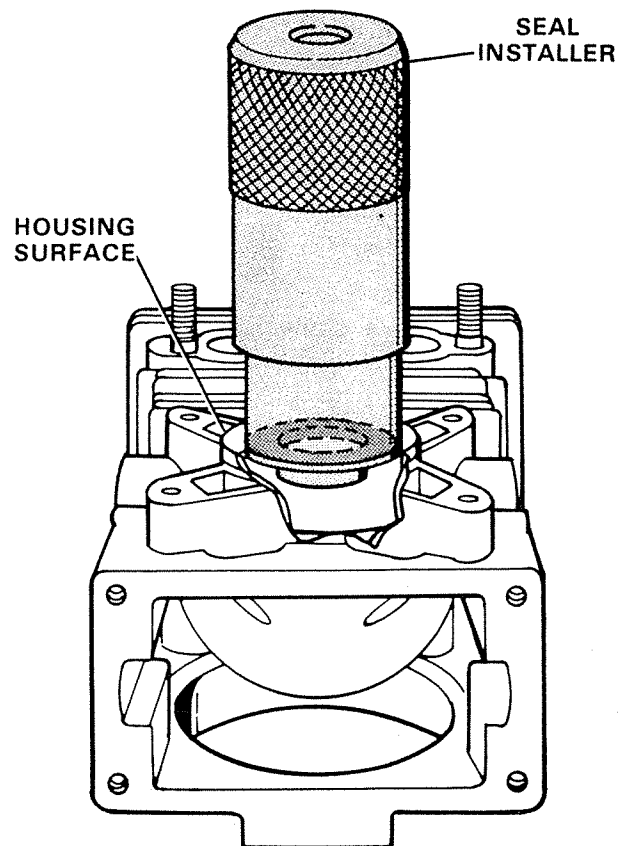
## NOTE

On model 82030, clean support plate screws with Locquic Activator, then use Loctite 271.

3. Secure support plate to cylinder block with four (4) screws tightened evenly to 70-85 in. lbs. (80-97 kg/cm). Figure 23.

4. Install lower crankshaft seal (drive end or crankcase seal) as follows:

A. Press seal into bore with sealing lip down, until seal is 0.15-0.35 inches (3.81-8.89 mm) below surface of housing. Figure 24.



**Figure 24. Installing Lower Crankshaft Seal.**

5. Assemble piston to connecting rod as follows:

## NOTE

Piston is heated for installation of pin.

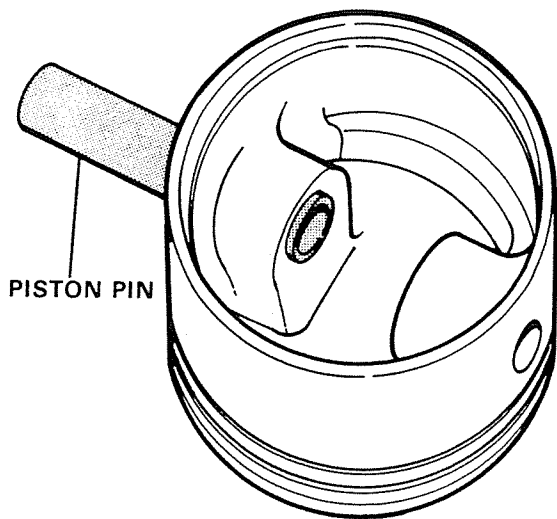
## NOTE

Open end of piston pin goes on side of piston with staking rings.

A. Heat piston (with a light, for example).

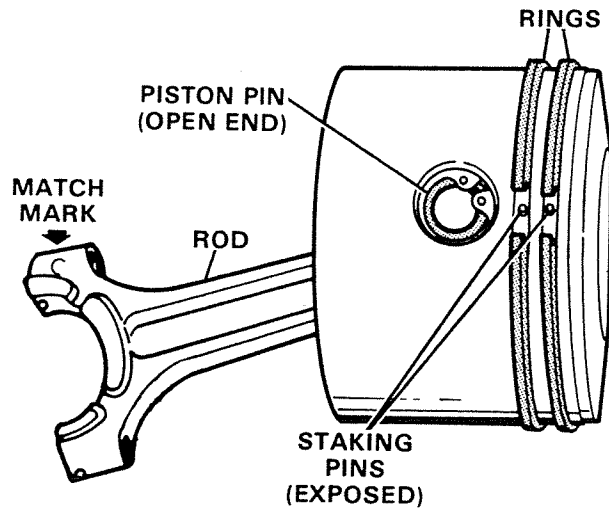
B. Install piston pin part way in piston so that end of pin is flush with pin boss inside piston. Figure 25.





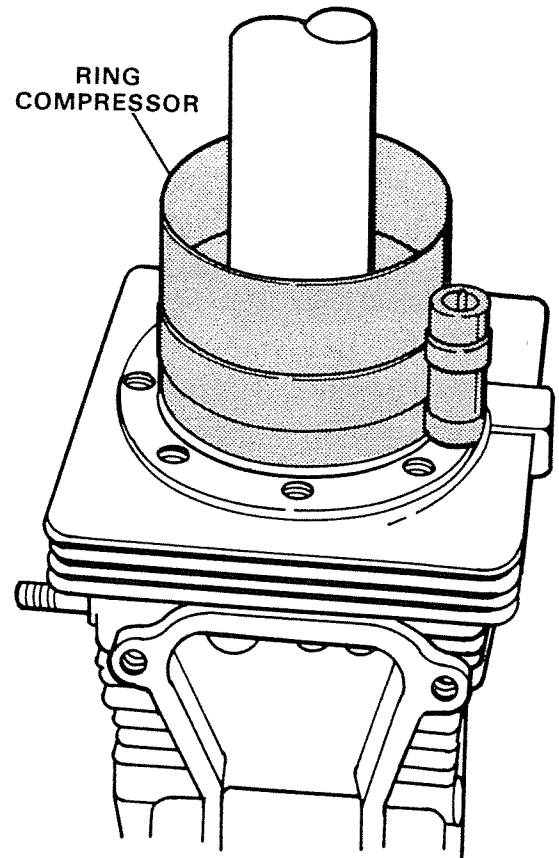
**Figure 25. Positioning Piston Pin in Piston.**

- C. Hold piston so that staking pins face up. Figure 26.
- D. Insert connecting rod into piston so that match mark will face up toward support plate. Figure 26.
- E. Align piston pin with rod and gently tap pin into rod until grooves for retaining rings are completely exposed on both sides of piston.
- F. Install new piston pin retaining rings. Figure 26.



**Figure 26. Assembling Piston to Connecting Rod.**

- G. Install piston rings. Special Tool No. T 8926, piston ring expander. Rings must not cover staking pins in piston. Figure 26.
- H. Coat piston, rings and cylinder wall with a light coat of oil.



**Figure 27. Installing Rod and Piston in Cylinder.**

**CAUTION**

The open end of piston pin, staking pins and match mark on rod must face up toward support plate. Make sure that ends of piston rings do not cover staking pins.

- 6. Insert rod and piston skirt into top of cylinder and guide piston into cylinder using ring compressor, Special Tool No. T 2997 or fingers. Figure 27.

- 7. Install connecting rod to crankshaft as follows:

**CAUTION**

Be certain that needle bearings and bearing surfaces are clean to prevent wear and damage to engine.

**CAUTION**

**Oil rollers.** This removes wax from new rollers and ensures rollers can roll as soon as engine is started.

**DO NOT grease rollers.** This will cause rollers to skid, develop flat spots, and cause early bearing or connecting rod failure.

A. Apply a light coat of oil to connecting rod bore and crankshaft.

### NOTE

There are twenty eight (28) rollers total.

B. Install fourteen (14) needle bearings in rod.

C. Swing connecting rod with rollers under crankpin throw of crankshaft and pull connecting rod up to crankpin throw.

D. Install remaining fourteen (14) needles.

8. Install rod cap as follows:

A. Align match mark on cap with match mark on rod.  
Figure 28.

B. Tighten screws gradually and move cap back and forth gently until it is properly aligned with the connecting rod: joint should not be visible.

C. If joint is visible, loosen cap, realign, then retighten screws, using hex bit adapter (Special Tool No. T 8929) and torque wrench. Torque screws to 80 - 90 in. lbs. (91.9 - 103.4 kg/cm) Figure 28.

9. Install stator plate and flywheel as outlined in Section 5.

10. Install cylinder head as follows:

A. Apply gasket sealing compound to cylinder head mounting surface.

B. Install cylinder head gasket and cylinder head. Torque screws to 90-100 in. lbs. (103-115 kg/cm) in order shown in Figure 29.

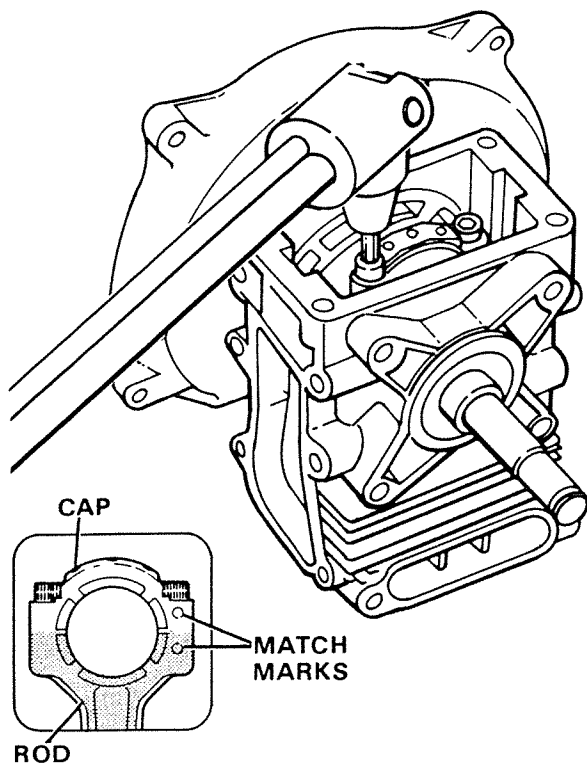


Figure 28. Installing Rod Cap.

### NOTE

Clean screws with Locquic Activator; then apply sealant, Special Tool No. T 2963-1 (Loctite D) to screws sparingly.

### CAUTION

Be careful to keep sealant from getting into cylinder or on rollers.

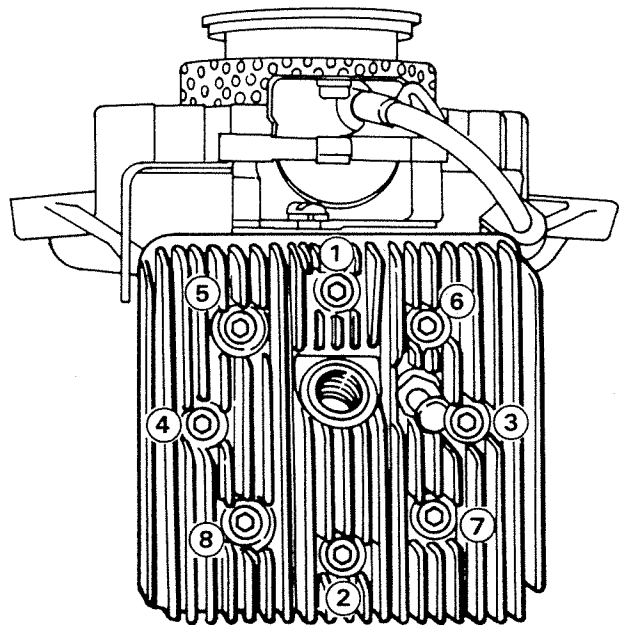
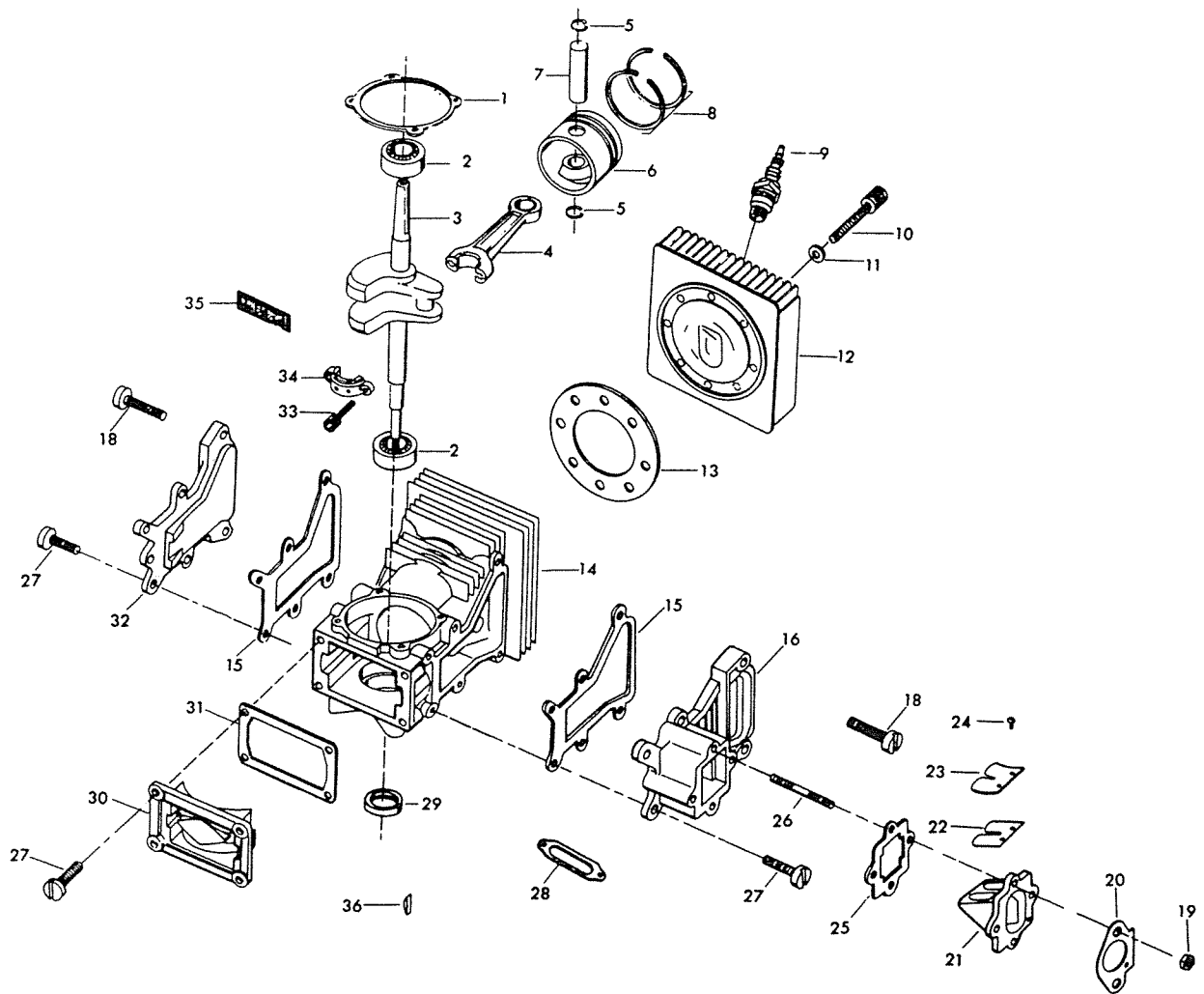


Figure 29. Installing Cylinder Head.

11. Install cylinder cover and transfer cover.

12. Reinstall reed valve and carburetor.

13. Install spark plug; torque to 120-180 in. lbs.



ILLUS. NO.	DESCRIPTION	ILLUS. NO.	DESCRIPTION
1*	Bearing Cage Gasket	21	Reed Plate
2	Ball Bearing	22	Reed
3	Crankshaft	23	Reed Stop
4	Connecting Rod	24	Rd Hd Screw w/Lockwasher, 6 - 32 x 1/4
5	Retaining Ring	25	Manifold Gasket
6	Piston	26	Carburetor Stud
7	Piston Pin	27	Pan Hd Screw w/Lockwasher, 1/4 - 20 x 3/4
8	Piston Ring Set	28	Cylinder Exhaust Gasket
9	Spark Plug (AC44-FF)	29	Seal, Drive End
10	Socket Hd Cap Screw 1/4 - 20 x 1-1/16	30	Crankcase Cover
11	Plain Washer	31	Cover Gasket
12	Cylinder Head	32	Cover
13	Head Gasket	33	Connecting Rod Screw
14	Cylinder	34	Connecting Rod Cap, Crankpin Roller Set
15	Cover Gasket	35	Woodruff Key Gasket (not shown)
16	Manifold		
18	Pan Hd Screw w/Lockwasher, 1/4 - 20 x 7/8		
19	Hex Nut, 1/4 - 20		
20	Carburetor Gasket		

**Figure 30. Engine, Exploded View (Model 82019 Shown)**

