LAWN-BOY V-ENGINE SERVICE MANUAL

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LAWN-BOY®

Service Manual

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SAFETY INFORMATION

This safety symbol means WARNING or PERSONAL SAFETY INSTRUCTION - read the instruction because it has to do with your safety. Failure to comply with the instruction may result in personal injury or even death.

This manual is intended as a service and repair manual only. The safety instructions provided herein are for troubleshooting, service and repair of the engine only. The individual Operator's manual will contain safety information on the complete product powered by the V engine. Operator's manuals with complete instructions are available through:

Lawn-Boy Corporation
Publications Department
8111 Lyndale Avenue South
Bloomington, MN 55430 U.S.A.

SAFETY TIPS

Avoid unexpected starting of engine...
Always turn off the powered product and disconnect spark plug wire before attempting cleaning, adjustment or repair.

Avoid lacerations and amputations...
Stay clear of all moving parts whenever the engine is running. Treat all normally moving parts as if they were moving whenever the engine is running or has the potential to start.

Avoid burns...
Do not touch the engine while it is running or shortly after it has been running.

Avoid Falls...
Do not operate the powered product on slippery surfaces or if footing is questionable.

Avoid fires...
Wipe up any spilled fuel or oil immediately.

Avoid asphyxiation...
Never operate an engine in a confined area without proper ventilation.

Avoid fires and explosions...
Use a container designed for gasoline. Avoid spilling fuel and never smoke while working with any type of fuel.

Avoid accidental misuse of fuel...
Always store fuel in a properly labeled container designed for gasoline.

Avoid injury due to inferior parts...
Use only Lawn-Boy® original parts to ensure that important safety criteria are met.

Avoid injury to bystanders...
Always clear the area of bystanders before starting or testing powered equipment.

Avoid injury due to projectiles...
Always clear the area of sticks, rocks or any other debris that could be picked up and thrown by the powered equipment.

SPECIFICATIONS

Engine Specifications

Item	Specification
Type	Air cooled, 2-cycle
Bore	2.3810 - 2.3800" (60.477 - 85.852 mm)
Stroke	1.7520 - 1.7497" (44.501 - 44.442 mm)
Connecting rod length	3.00" (76.2 mm)
Wrist pin diameter	.5000" (12.7 mm)
Wrist pin offset	.070" (1.78 mm) toward major thrust side
Crankpin diameter	.742" (18.85 mm)
Top and bottom main bearings	Dia: Top: .875" (22.23 mm) Bottom:1.125" (28.58 mm)
Displacement	7.78 cu in (127.51 cc)
Horsepower	4.5
Compression ratio	5.91:1 (Range of 5.151 - 6.668:1)
Compression	Approximately 90 - 115 psi
Engine rotation	Counterclockwise as viewed from the PTO
Carburetor - '93 models	Dual - circuit Walbro, float type, with fixed main jet
Carburetor - '94 models (& up)	Single-circuit Lawn-Boy with fixed main jet, float type, with primer
Fuel required	32:1 premix unleaded regular (87 octane $\frac{R+M}{2}$): 2-cycle oil
Recommended oil	Lawn-Boy Ashless 2-cycle oil
Fuel tank capacity	1.5 quarts
Ignition type	Solid state CD Pack, magneto type
CD Pack air gap	.010" (.25 mm)
Spark timing	2° - 8° BTDC (Cranking); 22° - 28° (Running)
Spark plug / air gap	Champion RJ12C / .035" (.889 mm)
Starting system	Rope rewind
Governor	Air vane
Governed engine speed	3050+/- 100 RPM
Idle speed	2200 - 2800 RPM
Air cleaner	Oiled, foam type
Choke	Manual, butterfly type (Walbro only)
Fuel filter	In-tank and in-carburetor
Piston	Permanent mold, high silicon aluminum
Piston rings	Cast iron, semi-keystone top ring

SPECIFICATIONS (cont'd)

Engine Fastener Torque Requirements

Item	Torque
Nut, Blade	45 - 50 ft lbs (60 - 67 N•m)
Nut, Flywheel	375 - 425 in lbs (42 - 47 N•m)
Screw, Air vane	5 - 7 in lbs (.5 - .8 N•m)
Screw, Brake plate assembly	60 - 70 in lbs (6.7 - 7.8 N•m)
Screw, Carburetor mounting	45 - 55 in lbs (5.0 - 6.1 N•m)
Screw, CD ignition pack	90 - 110 in lbs (10 - 12 N•m)
Screw, Cylinder to crankcase	105 - 115 in lbs (12 - 13 N•m)
Screws, Engine mounting	300 - 350 in lbs (34 - 39 N•m)
Screw, Ground strap stop	15 - 25 in lbs (1.7 - 2.8 N•m)
Screw, Muffler cover	150 - 190 in lbs (17 - 22 N•m)
Screw, Muffler plate	140 - 200 in lbs (16 - 22 N•m)
Screw, Reed *	10 - 13 in lbs (1.1 - 1.5 N•m)
Screw, Rod cap to rod	65 - 75 in lbs (7.3 - 8.4 N•m)
Screw, Shroud	58 - 70 in lbs (6.5 - 7.8 N•m)
Screw, Shroud base	60 - 70 in lbs (6.7 - 7.8 N•m)
Spark plug	150 - 200 in lbs (17 - 23 N•m)
Rewind starter *	65.15 in lbs (7.3 - 8.4 N•m)

* Use thread-locking compound

SPECIFICATIONS (cont'd)

Carburetor Specifications (Walbro LMR-16)

Item	Specification
Type	Walbro LMR-16, float type
Seat material	Viton
Inlet needle "pop-off" pressure	5 psi (.7 Kg/cm²)
Venturi diameter	.438" (11.13 mm)
Nominal idle needle setting	5/8 - 3/4 turn out
Float Height	NA (non-adjustable float)

Carburetor Specifications (Primer Start)

Item	Specification
Type	Lawn-Boy, float type, single-circuit, with primer
Body material	Minlon
Seat material	Viton
Inlet needle "pop-off" pressure	5 psi (.7 Kg/cm²)
Main jet	67.5 mm
High altitude main jet	65 mm
Float height	7/16" to 15/32" bowl flange (no gasket) to top of float

SPECIAL TOOL REQUIREMENTS

V-Engine Tool Requirements

DESCRIPTION	PART NUMBER	COMMENTS / USE
V Engine Tool Kit	612490	Includes tools shown below necessary to service V Engine.
Air Gap Gauge	604659	Sets .010" gap between flywheel and coil.
Piston Stop	612103	Prevents piston from traveling over TDC. Use when servicing flywheel or installing piston.
Crankshaft Gauge	609968	Sets correct gap on crankshaft support.
Piston Ring Compressor	609967	Compresses rings into piston grooves during installation of piston.
Seal Puller	681867	Use to remove upper and lower crankshaft seals.
Seal Installer	608976	Use to properly position upper and lower crankshaft seals.
E-12 Torx Socket	Purchase Locally	Use to remove crankcase fasteners.

Where to Purchase: Order through Lawn-Boy parts department as you would any other part.

Note: The tools included in this kit are also found in the D and F Engine Tool Kit (part number 683625.) If you already own that kit, you do not need to purchase any additional special tools.

TROUBLESHOOTING

Contents

Engine Will Not Start When "Cold"

Possible Causes	Remedies
Fuel tank is empty	Fill with clean, fresh, properly-mixed, unleaded fuel
Bad fuel	Drain tank and float bowl, fill tank with clean, fresh, unleaded, properly-mixed fuel
Fuel filter plugged	Replace fuel tank
Air cleaner plugged	Wash and re-oil air cleaner element
Fouled spark plug	Remove and replace the spark plug
No spark at spark plug	See "Engine Will Not Produce Spark" table
Insufficient momentum	Check for loose blade
Incorrect ignition timing	Check for sheared flywheel key
Low compression	See "Engine Has Low Compression" table
Engine flooded with fuel	See "Engine Flooded With Fuel" table
Reed valves not closed	Replace reed valves

TROUBLESHOOTING (cont'd)

Engine Will Start When "Cold", But Not When "Hot"

Possible Causes	Remedies
Engine is flooded	See "Engine Flooded With Fuel" table
Excessive alcohol in fuel	Use no more than 10% ethanol blend
Engine is overheated	See "Engine Overheats" table
Clogged bowl vent	Clean bowl vent

Engine Will Not Produce Spark

Possible Causes	Remedies
Spark plug wire disconnected	Reconnect spark plug wire
Spark plug fouled or damaged	Replace spark plug
Spark plug wire damaged	Replace CD pack
Coil kill wire grounded	Locate and eliminate the unwanted ground
Ignition coil failed	Replace CD pack
Flywheel magnets failed	Replace flywheel

Engine Flooded With Fuel

Possible Causes	Remedies
Overuse of "choke" position ('93 units only)	Take throttle off "choke" position
Throttle cable misadjusted	Adjust throttle cable
Air cleaner plugged	Wash and re-oil air cleaner element
Fouled spark plug	Replace spark plug
Carburetor needle stuck open	Clean carburetor, replace failed parts

Engine Has Low Compression

Possible Causes	Remedies
Worn piston rings	Replace piston rings or short block
Piston ring(s) stuck in groove	Replace piston and rings
Cylinder worn	Remove and replace short block

TROUBLESHOOTING (cont'd)

Engine Lacks Power

Possible Causes	Remedies
Dull blade	Sharpen or replace blade
Housing choked with grass & debris	Clean housing thoroughly
Plugged exhaust system	Clean exhaust ports
Muffler plugged	Clean or replace muffler
Flywheel key sheared	Replace flywheel key
Carburetor dirty	Clean carburetor
Intake air leak	Repair or replace failed component(s)
Low compression	See "Engine Has Low Compression" table

Engine Surges

Possible Causes	Remedies
Fouled idle circuit ('93 models only)	Clean idle circuit
Air leak	Check sealing surfaces, oil seals, gaskets, and port plugs
Restricted fuel flow	Check filters and fuel line

Engine Backfires

Possible Causes	Remedies
Flywheel key sheared	Replace key
Muffler filled with carbon	Clean muffler
Exhaust ports plugged	Clean ports

Engine Overheats

Possible Causes	Remedies
Cylinder head cooling fins clogged	Clean fins thoroughly
Restricted main carburetor jet	Clean carburetor and jet
Improper gas to oil mixture	Ensure mixture is 32:1
Cooling air intake plugged	Remove foreign material and clean

Engine Vibrates Excessively

Possible Causes	Remedies
Blade out of balance	Balance blade or replace if damaged
Bent blade	Replace blade
Loose engine mounting screws	Tighten engine mounting screws
Bent crankshaft	Replace crankshaft
Flywheel out of balance	Replace flywheel

TROUBLESHOOTING (cont'd)

Engine Crankshaft Will Not Turn

Possible Causes	Remedies
Engine brake incorrectly engaged	Disengage brake and inspect and repair as necessary
Blade jammed in housing	Inspect and repair or replace
Piston seized in its cylinder	Inspect and repair or replace
Starter jammed	Repair starter

Engine Produces Mechanical Knocking Sound

Possible Causes	Remedies
Loose blade	Inspect and tighten blade nut to correct torque
Loose flywheel	Inspect and tighten flywheel nut to correct torque
Pre-ignition is occurring	See "Engine Pre-ignites" table
Loose rod cap	Inspect and repair and tighten nuts to correct torque
Loose engine mounting bolts	Tighten bolts

Engine Pre-Ignites

Possible Causes	Remedies
Wrong spark plug - too hot	Install the correct type of spark plug
Low quality fuel	Replace with fresh unleaded regular fuel
Carbon buildup in engine	Decarbon engine and muffler
Excessive alcohol in fuel	Replace with fresh unleaded fuel having no more than 10% ethanol
Sheared flywheel key	Inspect and repair

Engine Smokes Excessively

Possible Causes	Remedies
Slight oil accumulation in crankcase	None; normal on startup
Air cleaner element clogged	Clean and re-oil or replace air cleaner element
Fuel/oil mixture too rich	Drain fuel tank and fill with fuel of correct mixture
Carburetor running too rich	Clean and check carburetor

TROUBLESHOOTING

Engine Stalls

Possible Causes	Remedies
Engine out of fuel	Refill with fresh fuel of the correct mixture
Engine overloaded	Unload engine and restart
Spark plug fouled	See "Spark Plug Fouled" table
Fuel cap vent plugged	Replace fuel cap
Ignition inadvertently grounded	Inspect and repair to remove unwanted ground
Carburetor vent plugged	Clear vent of obstruction
Engine overheated	Clear debris from fins or cause of overheating

Spark Plug Fouled

Possible Causes	Remedies
Incorrect spark plug	Use correct spark plug
Carburetor running too rich	Clean / rebuild carburetor
Clogged air cleaner element	Clean and re-oil element or replace
Overuse of "choke" position ('93 units only)	Move control off "choke" position and check throttle cable adjustment
Weak ignition system	Replace CD ignition pack
Worn rings and/or cylinder	Rebuild engine or short block
Use of leaded fuel	Drain fuel tank and replace with fresh, unleaded regular fuel having the correct oil mixture
Fuel/oil mixture too rich	Drain fuel tank and fill with fuel of correct mixture
Wrong oil	Use Ashless Lawn-Boy 2-Cycle Oil

MAINTENANCE

Recommeded Maintenance Schedule

Frequency	Item	Comments
5 Hours	Fasteners	Check blade and engine mounting fasteners frequently. Keep all nuts, bolts and screws tight to ensure safe operation.
25 Hours	Air Filter	Remove and clean each mowing season or every 25 hours; **more frequently if operating conditions are dusty.**
	Spark Plug	Clean, inspect and regap; replace if necessary.
	Housing	Remove the buildup of grass clippings and dirt.
	Self-Propelled Mechanism	Clean grass clippings and debris under drive belt cover and drive belt.
50 Hours	Blade	Sharpen or replace; maintain more frequently if edge is dulled quickly in rough or sandy conditions.
	Blade Brake	Check stopping time every 50 hours or at start of each mowing season. Blade must stop within 3 seconds of releasing bail; if not, repair or replace.
	Lubrication	Grease rear height adjuster brackets (self-propelled models only).
	Exhaust Ports	Clean every 50 hours or at least once each mowing season.
	Fuel System	Check for leakage and/or deterioration of fuel hose; replace if necessary.
100 Hours	Cooling System	Clean grass clippings, debris or dirt that clog engine air cooling fins; **do more frequently under dirty or high chaff conditions.**

Air Filter

Once every season, or every 25 hours, clean the air filter housing and element. **Do so more frequently under dusty conditions.**

Notes: Do not operate the engine without the air filter in place. Doing so may damage the engine or cause excessive engine wear.

Figure 1 shows the '93 carburetor; '94 models have an additional wire clamp to release.

1. To remove air filter, snap cover latch open, swing to side and unhook. Remove the cover and air filter **(Figure 1).**

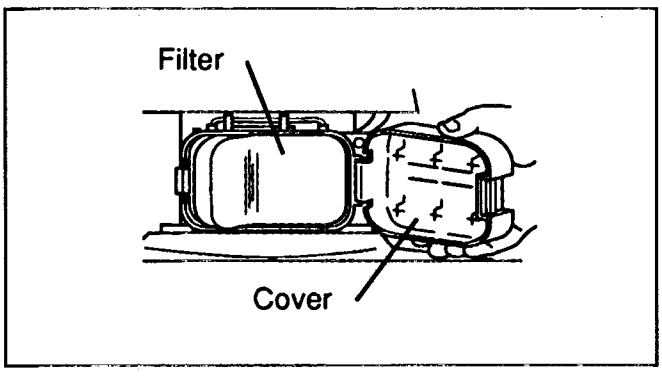


Figure 1

MAINTENANCE (cont'd)

Air Filter (cont'd)

2. Wash air filter in laundry detergent. Squeeze filter to remove excess liquid and blot dry with a paper towel or rag **(Figure 2).**

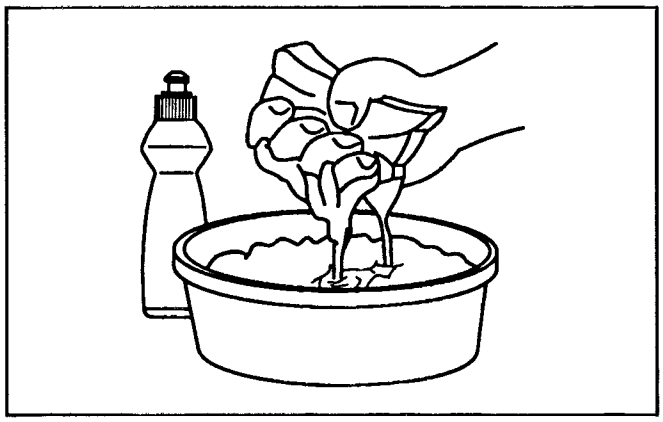


Figure 2

3. Apply one tablespoon of SAE 30 oil to the air filter **(Figure 3).** Lightly squeeze filter until oil is distributed evenly throughout filter. Blot lightly with paper towel to remove excess oil.

   Replace filter with cleanest side facing carburetor.

Note: Be sure filter is properly seated in air box and is not puckered (allowing direct passage of air and dirt to carburetor).

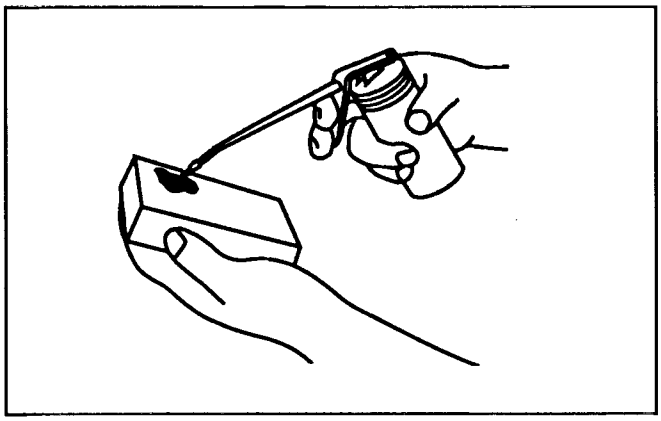


Figure 3

Spark Plug

A spark plug that is dirty, pitted, carbon covered or has worn electrodes may cause hard starting and poor operation.

Clean or replace spark plug once a season or every 25 hours, whichever occurs first. Use Champion RJ12C, or equivalent.

Remove spark plug and clean with a wire brush, removing carbon buildup. DO NOT SANDBLAST. Check condition of plug for cracks, damaged or worn electrodes. Replace if necessary.

1. Set spark plug gap at 0.035 inch (.85mm). See **Figure 4.**

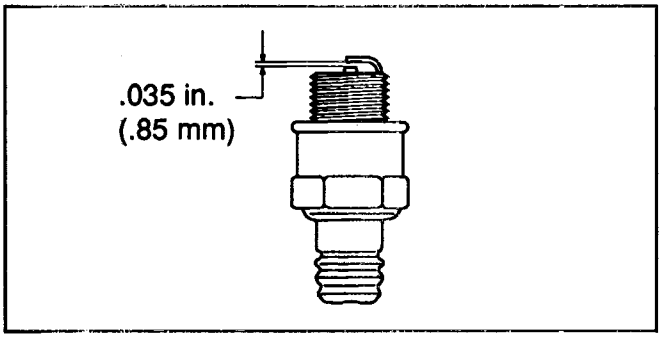


Figure 4

2. Install spark plug finger tight, then torque to 180 in lbs (15 ft lbs) (20 N•m). **Figure 5.**

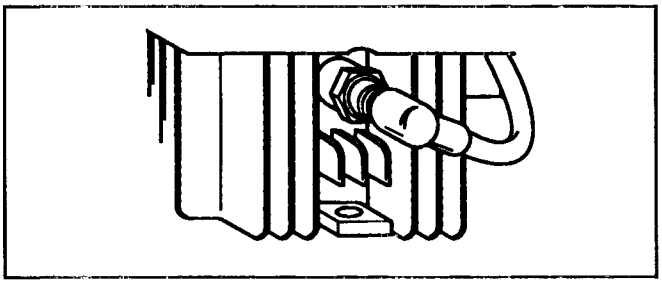


Figure 5

MAINTENANCE (cont'd)

Cleaning The Exhaust System

Warning: Disconnect the spark plug wire to prevent accidentally starting the engine.

1. Using a 1/2" drive with a 15/16" socket, remove the blade nut that secures both the mulch fan and blade to the engine. Use heavy duty gloves to hold the blade while removing the nut **(Figure 6).**

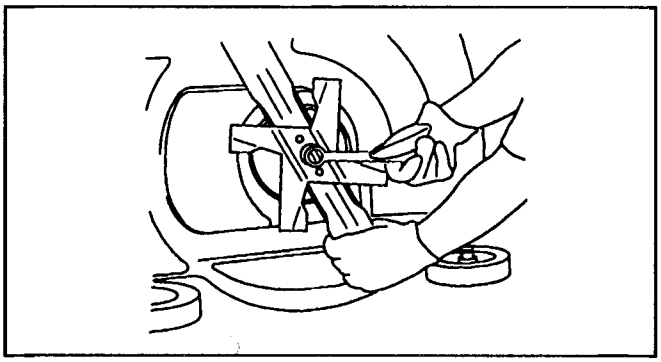


Figure 6

2. Using a soft hammer, gently tap the blade drive to remove it from the shaft of the engine **(Figure 7).**

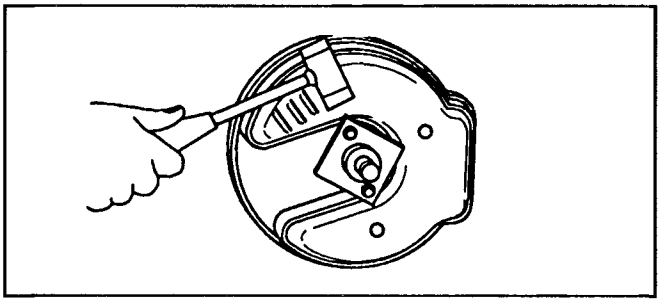


Figure 7

3. If necessary, clean the small louvers in the muffler cover; they must be open.

4. Remove the three bolts to remove the muffler cover. Drop the cover down to inspect the condition of the exhaust ports, etc. **(Figure 8).**

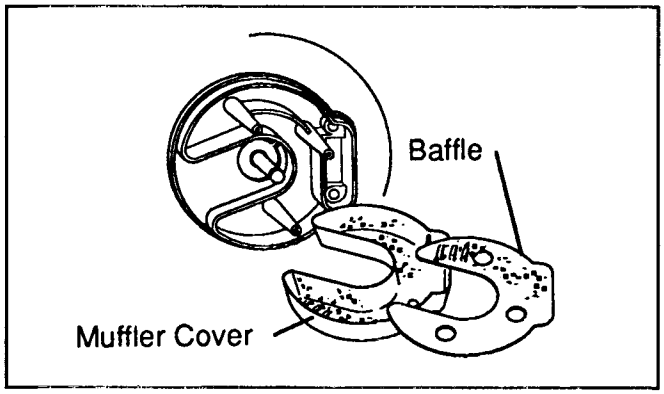


Figure 8

5. Pull the starter rope until the piston covers the exhaust ports **(Figure 9).** Clean them with a 3/8" (9 mm) wooden dowel.

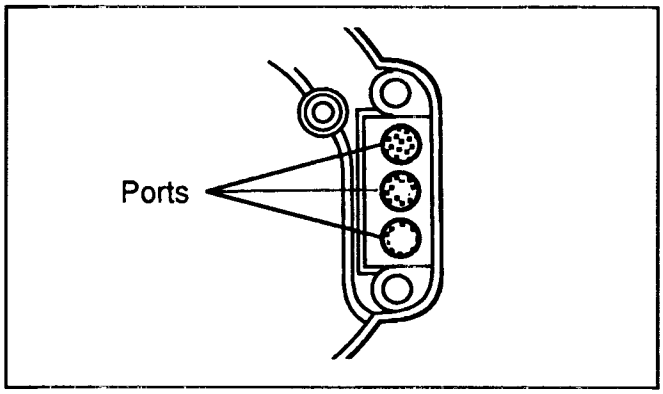


Figure 9

Reassembling Exhaust System

1. Insert three bolts into the muffler cover and tighten to a torque of 150-190 in lbs (17-22 N•m).
2. Re-install the blade drive, beveled edge towards the engine to match its shaft angle.
3. Re-install the blade and mulch fan with the 15/16" nut. Be sure the small circular bosses on the blade drive collar match the holes in the blade. Tighten the nut to 50 ft lbs (68 N•m) **(Figure 6).**

SECTION 1 WALBRO LMR-16 CARBURETOR

LMR-16 Carburetor - Identification

The LMR-16 carburetor can be identified by its aluminum body. Walbro (the manufacturer's name) is also stamped on the side of the body. These carburetor's were used on 1993 models.

LMR-16 Carburetor - Theory of Operation

As the crankshaft rotates, the piston moves back and forth in the cylinder, alternately creating a pressure or a partial vacuum in the crankcase **(Figure 10).**

When a vacuum is created by upward piston movement, the reed valve opens and air rushes through the carburetor throat. The carburetor throat is a venturi tube (large at each end but with a smaller center passage). When the air rushes through this tube, air pressure at the center of the passage is lowered.

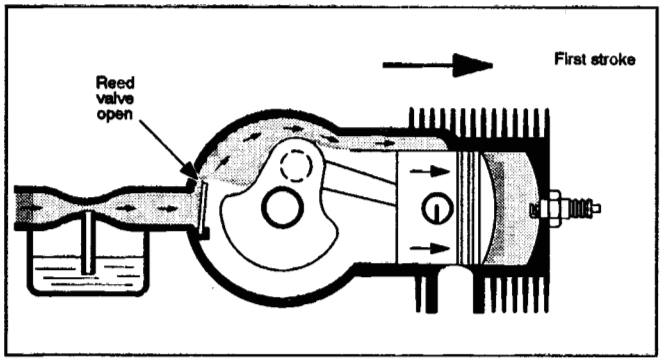


Figure 10

By inserting a tube from the carburetor float bowl into the venturi **(Figure 11),** lower air pressure at the venturi draws fuel through the tube. The fuel/oil mix is then picked up by, and mixed with, the moving air. This fuel/oil/air mixture enters the crankcase through the reed valves **(Figure 10)** thereby sustaining operation of the engine as long as fuel is supplied to it.

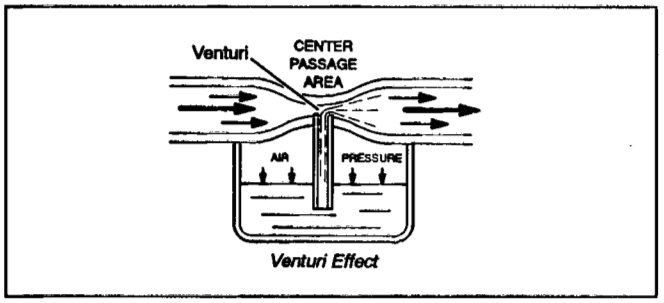


Figure 11

LMR-16 Carburetor - Governor Theory

The shaft of the governor air vane is attached to the throttle disc of the carburetor so that air flow, created by the rotating flywheel, attempts to close the throttle. The governor spring resists this force and attempts to open the throttle. The balance between these two forces is the governed engine speed. Spring tension may be changed via an adjustable collar which produces a 50 - 75 RPM change in engine speed for each adjustment "click" **(Figure 12).**

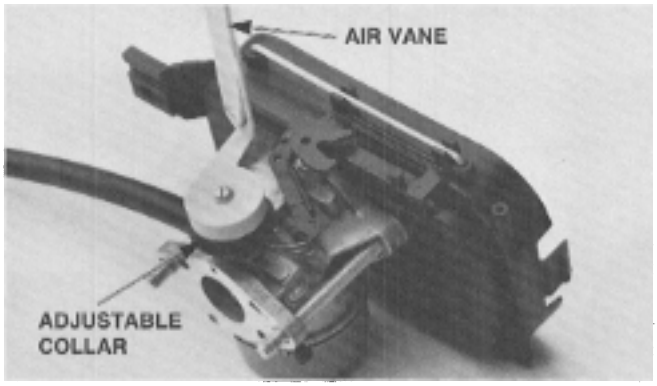


Figure 12

LMR-16 Carburetor - Removal

1. Disconnect spark plug wire.
2. Remove Fuel Tank (See page 38).
3. Open and remove air cleaner cover and air filter element.
4. Detach carburetor from engine by removing two mounting bolts. Remove and discard the two small carburetor gaskets. Save the carburetor heat shield.
5. Disconnect the fuel line.
6. Pull the carburetor assembly down and away from the engine such that the air vane clears the hole in the shroud base **(Figure 13).**

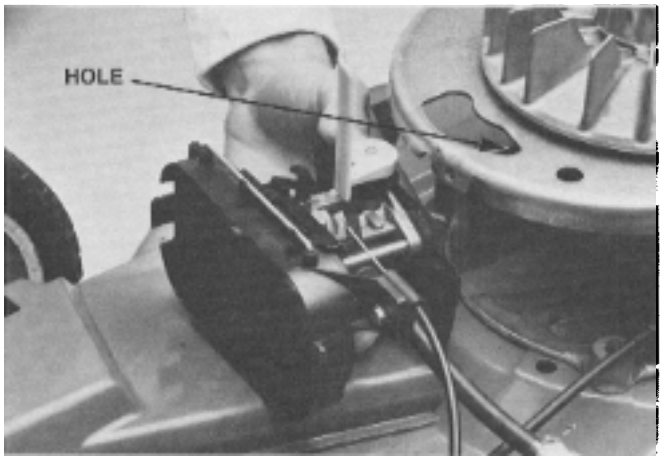


Figure 13

7. Remove the throttle cable screw and nut and disconnect the cable from the control lever **(Figure 14).**

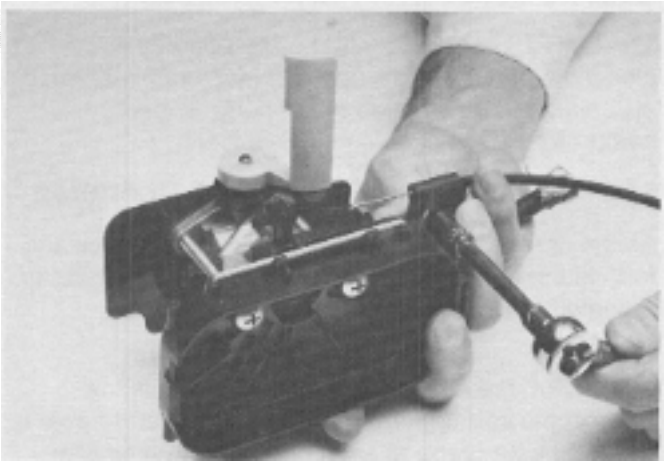


Figure 14

CAUTION: Be careful in the next step to prevent damage to the governor spring.

8. Hold the carburetor in one hand and lift the air cleaner box so that the control lever clears the choke shaft. Rotate the carburetor counterclockwise and remove the spring from the control lever.

LMR-16 Carburetor - Disassembly

1. Remove the in-line filter from the fuel inlet.
2. Remove the screw holding the air vane to the throttle shaft. Remove the air vane collar and governor spring and remove the throttle valve screw, plate and shaft **(Figure 15).**

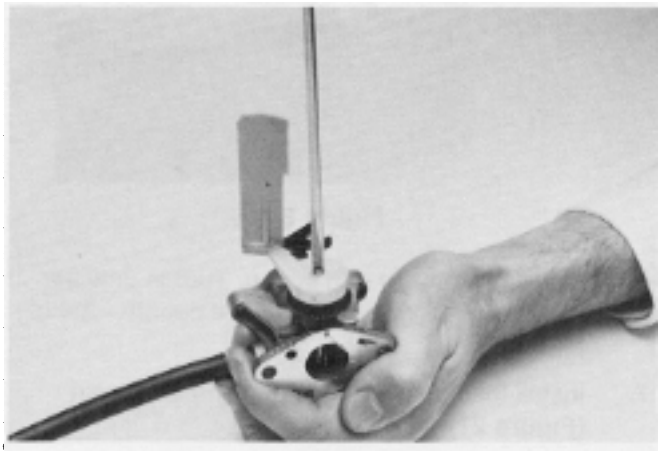


Figure 15

3. Gently bend spread the slot in the choke shaft and remove the choke plate using pliers. Lift the choke shaft and spring from the carburetor **(Figure 16).**

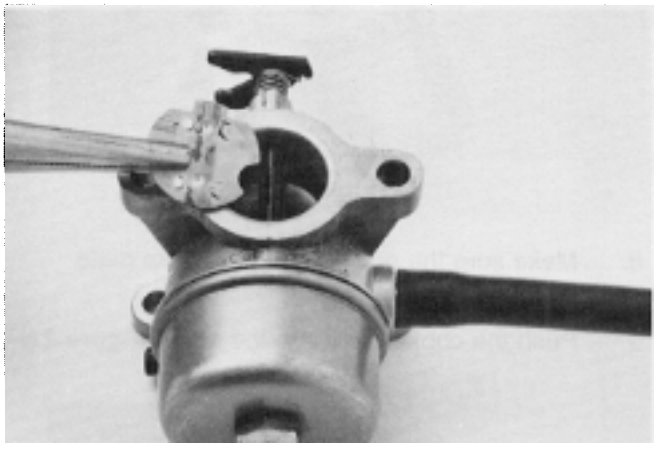


Figure 16

4. Remove the idle adjustment needle and spring.
5. Remove the bowl retaining bolt and gasket, the bowl and the bowl gasket.
6. Remove the float shaft, float and inlet needle.
7. Remove the fuel inlet (Viton) seat using a short piece of wire or a shot of compressed air.
8. Using an awl, pierce the Welch plug, then carefully remove it so that the idle progression holes are exposed **(Figure 17).**

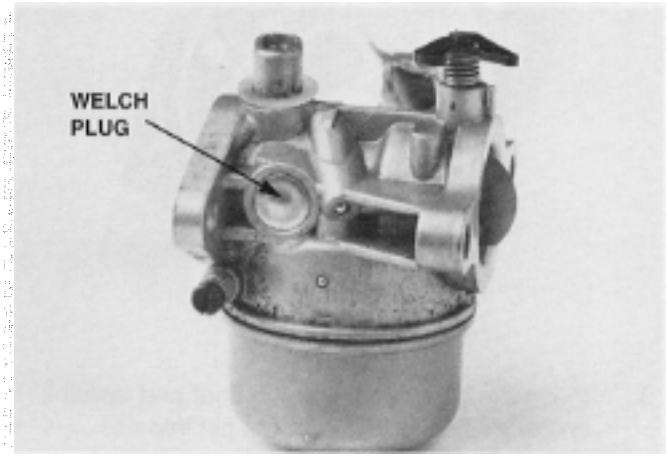


Figure 17

LMR-16 Carburetor - Cleaning and Inspection

Thoroughly clean all the carburetor parts and inspect them for wear. Wash the jets and passages and blow dry with compressed air immediately.

CAUTION: Never enlarge or restrict any passageway in the carburetor.

Note: Since this carburetor has a special external sealer, use a spray cleaner to clean external surfaces. Immersing the entire carburetor in a cleaning solution will remove the seal coating.

LMR-16 Carburetor - Assembly

1. Install Welch plug using a blunt tool having the same diameter as the Welch plug.
2. Install the fuel inlet valve seat: coat the seat with oil and install it grooved side down **(Figure 18).**

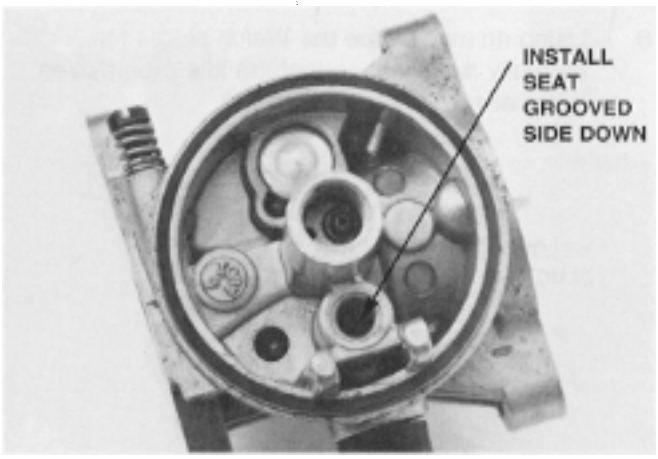


Figure 18

3. Place the inlet needle on the float and install it on carburetor. Push the float pin into the carburetor body through the float hinge **(Figure 19).**

   Note: The float is not adjustable so it is not necessary to check float height. However, always make sure that no liquid is inside the float before reinstalling.

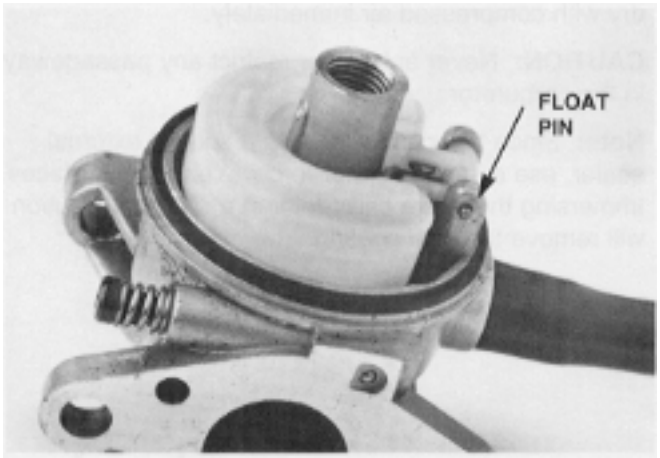


Figure 19

4. Position the bowl gasket on the top edge of the carburetor body.
5. Place bowl onto the carburetor body and install the bowl retaining bolt and gasket **(Figure 20).**

Figure 20

6. Install idle needle and spring. Turn in until the needle seats lightly then back it out 5/8 - 3/4 of a turn.
7. Install the choke shaft and spring as shown **(Figure 21).**

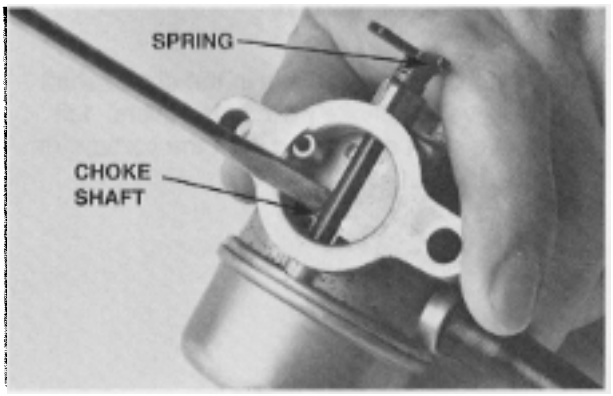


Figure 21

8. Make sure the opening on the choke plate faces left.
9. Push the choke plate into the shaft **(Figure 22)**

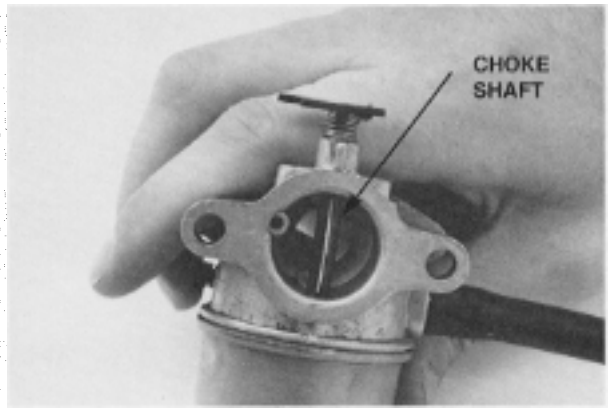


Figure 22

LMR-16 Carburetor - Assembly (cont'd)

10. Place a drop of Loctite on the screw and install the throttle shaft and valve with the valve hole to the left **(Figure 23).**

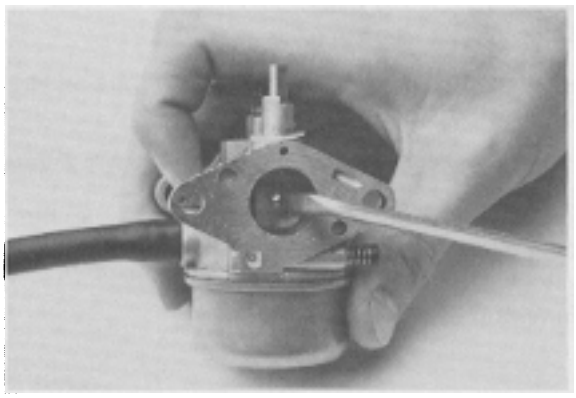


Figure 23

11. Place the governor spring into the collar and place the collar and spring onto the throttle shaft. Position the collar so that the window is in line

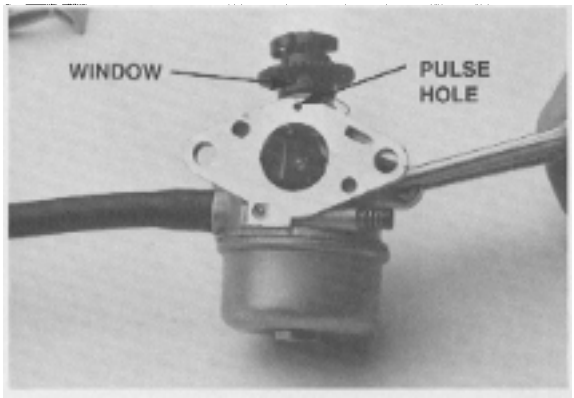


Figure 24

with the pulse hole **(Figure 24).**

12. Install the air vane and screw **(Figure 25).**

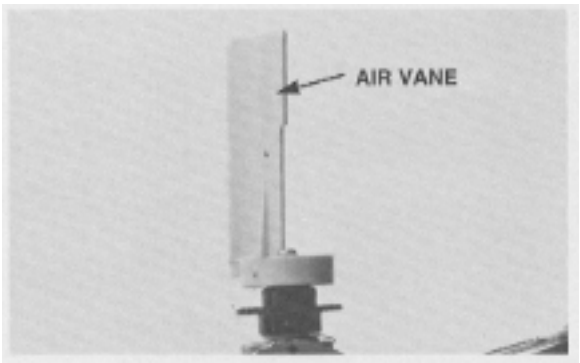


Figure 25

LMR-16 Carburetor - Presetting the Governor

1. Hold the carburetor with the mounting flange facing you and the throttle wide open.
2. Preset the governor by turning the collar so that the window on the collar is 3-4 clicks to the right of the pulse hole.

LMR-16 Carburetor - Assembling Air Box to Carburetor

1. Hook the end of the governor spring into the control lever and move the air box counterclockwise.
2. Lift the control lever over the choke shaft and place on the front of the carburetor. Make sure the post on the lever activates the choke.
3. Install the carburetor mounting bolts **(Figure 26).**

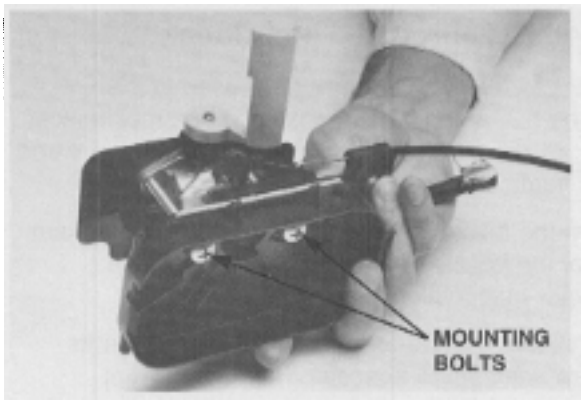


Figure 26

4. Place one carburetor-to-crankcase gasket onto the carburetor for mounting bolts.
5. Install the heat shield as shown **(Figure 27).**

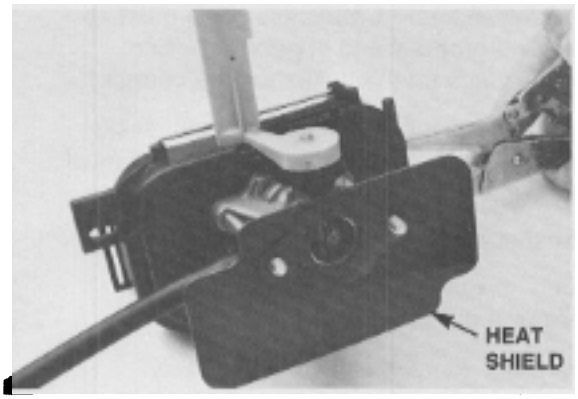


Figure 27

LMR-16 Carburetor - Assembly (cont'd)

6. Install the remaining carburetor gasket; make sure all pulse holes are aligned.
7. Hook the control cable into the control lever and fasten the cable to the air box.

LMR-16 Carburetor - Installation

1. While holding the carburetor and parts together, turn the assembly and guide the air vane into the opening in the shroud base **(Figure 13).**
2. Install the bolts finger tight.
3. Pull the carburetor to the left and push the air box to the right. Tighten the bolts and torque to 45 - 55 in lbs (5.1 - 6.2 N•m).
4. Check that the choke moves freely.
5. Install a cleaned and re-oiled element into the air box and install the air box cover.

LMR-16 Carburetor - Final Check

The '93 Lawn-Boy LMR carburetor used in the V Engine has an all metal housing with a mechanical choke, an adjustable idle mixture, a fixed main jet and a fixed float.

Perform the following preliminary checks to eliminate some of the possibilities that may contribute to carburetor malfunction:

1. Ignition system - ensure that all components are adjusted to specs and are the correct components.
2. Fuel tank and in-line filters - must not be plugged.
3. Fuel cap vent - hole must not be plugged.
4. Air filter - must be clean and oiled.
5. Crankcase seal - Crankcase seals must be installed properly and in good condition; torque value on the bolts must be correct.
6. Carburetor flange gaskets and heat shield - must be installed correctly (pulse holes must be aligned).
7. Exhaust ports - must not be restricted.
8. Fuel - mixture must be new and not of unknown quantities, not old, etc.
9. Governor air vane - must move freely.

LMR-16 Carburetory - Choke Adjustment

1. Move throttle control to "choke" position.
2. Look into the carburetor and be sure the choke is closed. Tighten the hex screw and nut on the black plastic cable holder to keep the cable in place.
3. Install the in-line fuel filter and attach the fuel line to the carburetor fitting.

LMR-16 Carburetor - Servicing the Air Filter

1. To remove the air filter, at the left side, snap the cover latch open, swing it to the right and unhook it. Remove the cover and air filter element **(Figure 28).**

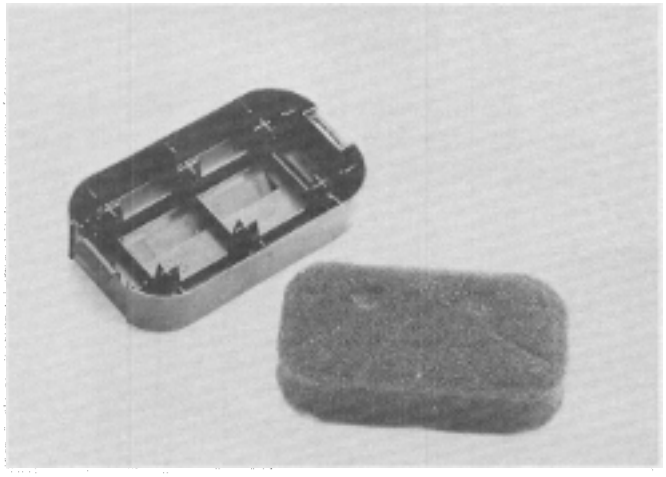


Figure 28

2. Clean and re-oil the air filter element according to the procedure in Maintenance, pages 19 and 20.

CAUTION: Do not operate the engine without a filter element or with a dry element; engine life will be shortened.

LMR-16 CARBURETOR-TROUBLESHOOTING

Engine Starts Hard

Possible Causes	Remedies
No fuel in carburetor	Clean tank, air cleaner element and carburetor
Choke valve not closing	Clean bowl vent and adjust cable
Carburetor bolts loose	Tighten bolts to 45 - 55 in lbs (5.1 - 6.2 N•m)
Mislocated gaskets	Loosen bolts, realign gaskets and tighten

Engine Runs Rich

Dirty air cleaner	Clean or replace air filter element
Choke partially closed	Inspect and repair as necessary
Idle screw setting incorrect	Adjust to 1/2 to 5/8 turn open
Dirt in carburetor	Clean carburetor

Engine Runs Lean

Carburetor bolts not tight	Tighten bolts to 45 - 55 in lbs (5.1 - 6.2 N•m)
Improper carburetor adjustment	Adjust to 5/8 to 3/4 turn open
Dirt in idle mixture pocket	Remove Welch plug and clean
Restricted filter(s)	Clean filter(s)
Welch plug leaking	Seal all Welch plugs

Engine Surges

Fuel restricted	Clean vents and filters
Air leak	Check carburetor and crankcase seals/bolts

Fuel Leaks From Carburetor

Dirt under inlet needle	Remove inlet needle, clean or replace seat
Bowl vent plugged	Remove bowl and clean with compressed air
Float leaking (heavy)	Replace float
Float stuck (gummed carburetor)	Remove bowl and clean carburetor

SECTION 2 PRIMER START CARBURETOR

Primer Start Carburetor - Identification

The primer start carburetor is easily identified by its primer and its black plastic body. It is different from earlier Lawn-Boy plastic body carburetors because it does not have the adjustable needle behind the air-vane governor. This carburetor is found on 1994 and newer V-Engines.

Primer Start Carburetor - Theory of Operation

As the crankshaft rotates, the piston in a vertically mounted engine moves back and forth in cylinder, alternately creating a pressure or a partial vacuum in the crankcase **(Figure 29).**

When a vacuum is created by upward piston movement, the reed valve opens and air rushes through the carburetor throat. The carburetor throat is a venturi tube (large at each end but with a smaller center passage). When air rushes through this tube, air pressure at the center of the passage is lowered.

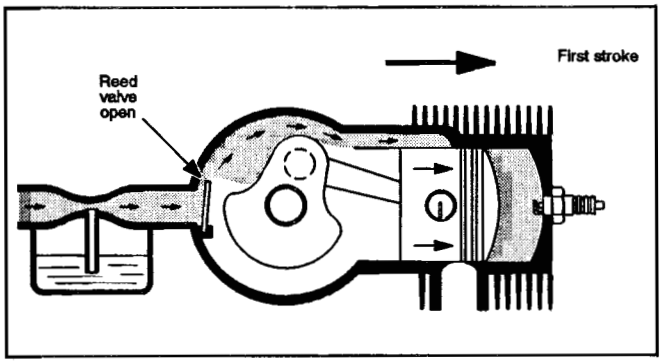


Figure 29

By inserting a tube from the carburetor float bowl into the venturi **(Figure 30),** lower air pressure at the venturi draws fuel through the tube. The fuel/oil mix is then picked up by, and mixed with, the moving air. This fuel/oil/air mixture enters the crankcase through the reed valves,**(Figure 29)** thereby sustaining operation of the engine as long as fuel is supplied to it.

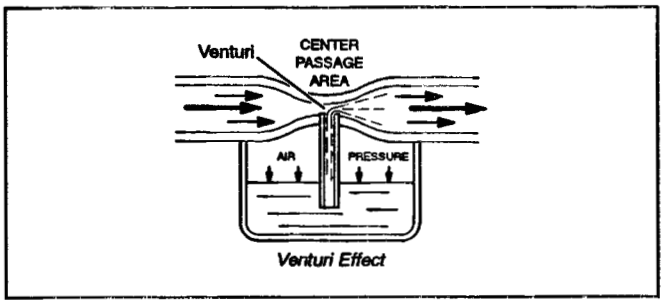


Figure 30

Primer Start Carburetor - Governor Theory

The shaft of the governor air vane is attached to the throttle disc of the carburetor so that air flow, created by the rotating flywheel, attempts to close the throttle. The governor spring resists this force and attempts to open the throttle. The balance between these two forces is the governed engine speed. Spring tension may be changed via an adjustable collar which produces a 50 - 75 RPM change in engine speed for each adjustment "click" it is moved **(see Figure 31).**

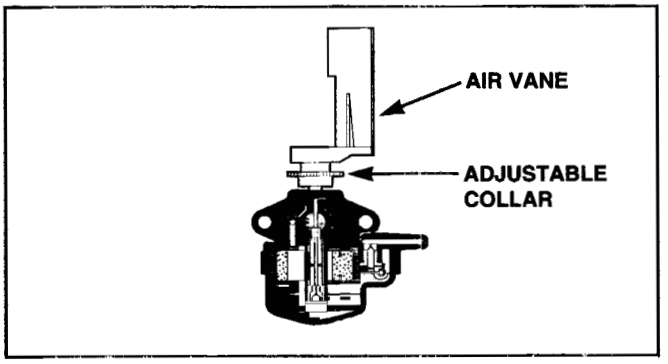


Figure 31

Primer Start Carburetor - Removal

1. Disconnect spark plug wire.
2. Remove fuel line and drain; remove the fuel tank (see page 38).
3. Open and remove air cleaner cover and air filter element. Remove the two plastic plugs covering the mounting screws.
4. Detach carburetor from engine by removing two mounting screws. Discard the two smaller carburetor gaskets on either side of the carburetor shield. Keep the heat shield for later installation.
5. Disconnect the fuel line and the primer tube from the carburetor fittings **(Figure 32).**

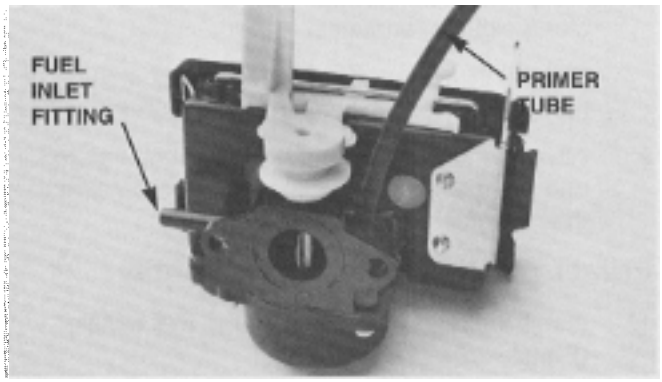


Figure 32

6. Pull the carburetor assembly down and away from the engine such that the air vane governor clears the hole in the shroud mounting base.
7. Remove the throttle cable screw and nut from the throttle cable mounting bracket.

   CAUTION: Be careful in the next step to avoid damage to the delicate governor spring.
8. Slide the white plastic control lever to either end of its adjustment and snap it to the locked position to help restrict its movement while you disconnect the throttle cable from the control lever **(Figure 34).**

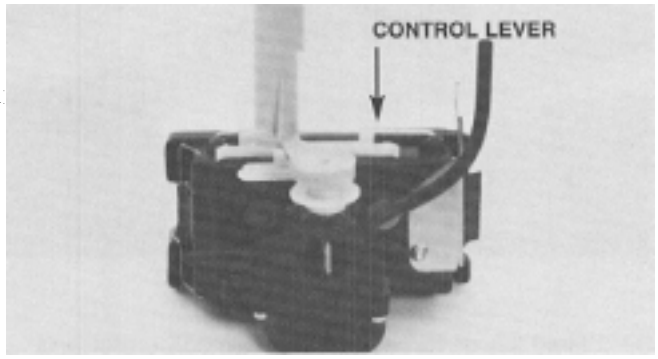


Figure 34

Primer Start Carburetor - Dissassembly

1. At the throat of the carburetor, using a needle nose pliers, gently pull the throttle plate out of the air vane assembly shaft **(Figure 35)**. Notice the orientation of the small protrusions on the throttle plate as you pull it out. The single protrusion should be on your left; next to the hole at the 9 o'clock position).

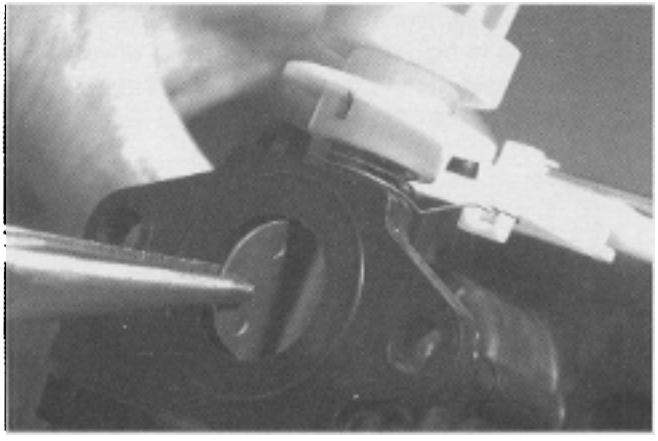


Figure 35

3. Hold the governor collar on the carburetor and lift the air vane/throttle shaft out of the carburetor. Lift the collar and spring up, detaching the spring from the speed control lever.
4. Turn the carburetor over and remove the four bowl retaining screws, the bowl gasket and the bowl **(Figure 36).** Discard the bowl gasket.

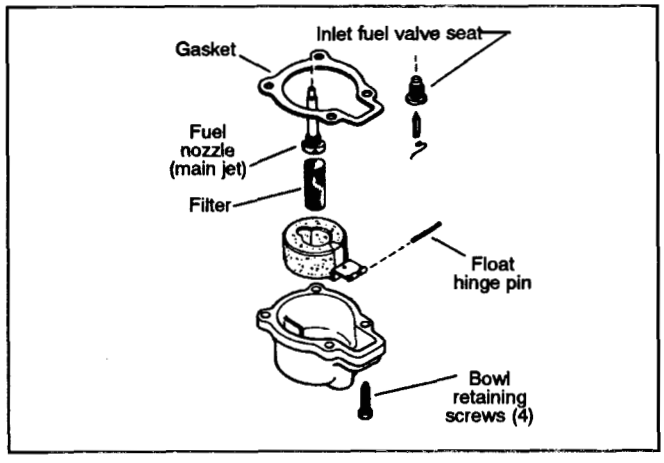


Figure 36

5. Remove the fuel filter from the fuel nozzle.
6. Remove the float hinge pin, the inlet valve needle assembly (with its clip) and the float **(Figure 36)**. Discard the needle and clip.
7. Inspect the float for cracks or deterioration of the cork.
8. Remove the brass inlet fuel valve seat and discard it **(Figure 36).**
9. Remove the nozzle and the high speed jet from the nozzle.

Primer Start Carburetor - Cleaning and Inspection

1. With the carburetor completely disassembled, thoroughly clean all parts in a parts cleaning solution and inspect for wear or deterioration. Blow dry all carburetor passages with compressed air. Use a spray cleaner only to clean external surfaces.

   CAUTION: If tag wire is used, never enlarge or restrict any passageway in the carburetor.

2. Always check the carburetor mounting flange and the fuel bowl mounting flange to be sure they are flush.

Primer Start Carburetor - Assembly

1. Install the high speed jet into the fuel nozzle **(Figure 36).**
2. Turn the carburetor over and install the nozzle assembly into the carburetor body.
3. Install a new brass inlet fuel valve seat.
4. Install a new inlet valve needle and clip on the float.
5. Install the float assembly with a new float hinge pin in the bottom of the carburetor. Ensure that the hinge pin is positioned properly to keep the float level. The float should be free to move up and down easily in the carburetor body.
6. Adjust float so height is 7/16" to 15/32" from bowl flange (gasket not in place) to top of float.
7. Install the fuel filter over the fuel nozzle.

Primer Start Carburetor - Assembly (cont'd)

8. Install a new fuel bowl gasket and the fuel bowl with the four bowl retaining screws.
9. Hook the governor spring into the bottom of the governor collar.
10. Holding the spring in the collar, hook the other end of the spring into the speed control arm. Place the collar and spring over the carburetor fitting. **(Figure 37)**
11. Install the air vane and throttle shaft into the carburetor body by very carefully pushing the shaft through the collar into the carburetor body.
12. Push the throttle plate into the throttle shaft. (The plate only inserts one way).

Primer Start Carburetor - Installation

1. Install new gaskets and the heat shield (removed in a previous procedure) on the carburetor. The air cleaner element and its cover should not be in place at this time.
2. Guide the air vane through the opening in the shroud base from the bottom of the base and attach the carburetor to the engine with two mounting screws. Tighten them to a torque of 45-55 in lbs (5.1 - 6.2 N•m). Replace the cap plugs.
3. Insert the bent wire of the throttle cable into the vertical tab of the speed control lever. Set the throttle to fast and the speed control lever so that the throttle plate is sprung to the full open position.
4. Install the fuel line and primer tube on the appropriate carburetor fittings.
5. Check that the choke/air vane assembly moves freely.
6. Install the air filter element and cover.

Primer Start Carburetor - Presetting the Governor

Note: Each "click" of the governor collar represents approximately 50-75 RPMs.

1. Turn the collar clockwise to increase spring tension (and engine RPMs) or counterclockwise to decrease spring tension and RPMs **(Figure 37)**. Preset the governor collar 3 or 4 clicks clockwise.

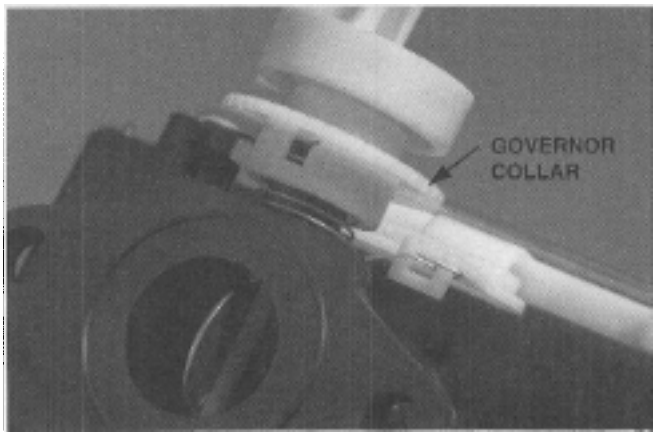


Figure 37

2. Use a tachometer to check engine speed; normal setting is 3050 +/- 150 RPM.

Primer Start Carburetor - Final Check

The Primer Start carburetor used in V Engines has an all Minlon housing with a fixed high speed jet and an adjustable float.

Perform the following preliminary checks to eliminate some of the possibilities that may contribute to carburetor malfunction:

1. **Ignition system** - ensure that all components are adjusted to specs and are the correct components.
2. **Fuel tank filter** - must not be plugged.
3. **Fuel cap vent** - hole must not be plugged.
4. **Air filter** - must be clean and oiled.
5. **Crankcase seal** - Crankcase seals must be installed properly and in good condition; torque value on the bolts must be correct.
6. **Carburetor flange gaskets and heat shield** - must be installed correctly.
7. **Exhaust ports** - must not be restricted.
8. **Fuel** - mixture must be new, not unknown, etc.
9. **Governor air vane** - must move freely.

Primer Start Carburetor - Servicing the Air Filter

1. To remove the air filter, at the left side unsnap the wire holder from the cover, and then unsnap the cover from the clear plastic shell. Remove the cover and air filter element **(Figure 38).**
2. Clean and re-oil the air filter element according to the procedure in Maintenance, pages 19 and 20.

   CAUTION: Do not operate the engine without a filter element or with a dry element; engine life will be shortened.

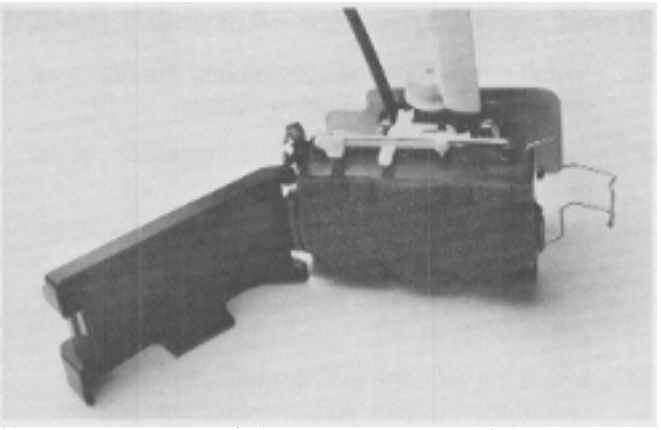


Figure 38

PRIMER START CARBURETOR TROUBLESHOOTING

Engine Starts Hard

Possible Causes	Remedies
Primer malfunction	Repair or replace as necessary
No fuel in carburetor	Clean tank, air cleaner element and carburetor
Carburetor bolts loose	Tighten bolts to 45 - 55 in lbs (5.1 - 6.2 N•m)
Mislocated gaskets	Loosen bolts, realign gaskets and tighten

Engine Runs Rich

Dirty air cleaner	Clean or replace and re-oil air filter element
High altitude operation	Install high altitude jet
Dirt in carburetor	Clean carburetor
Primer line pinched	Inspect and correct problem
Dirt in primer vent	Clean and/or replace as necessary

Engine Runs Lean

Carburetor bolts not tight	Tighten bolts to 45 - 55 lbs (5.1 - 6.2 N•m)

Fuel Leaks From Carburetor

Dirt under inlet needle	Remove inlet needle and clean or replace
Bowl vent plugged	Remove bowl and clean with compressed air
Float leaking (heavy)	Replace float
Float stuck (gummed carburetor)	Remove bowl and clean carburetor

SECTION 3 FUEL SYSTEM

Fuel System - Operation

The V Engine uses a 1.5 quart plastic fuel tank **(Figure 39)** with a non-replaceable 75 micron in-tank filter screen. The filter is chemically welded in the bottom of the tank over a sediment reservoir. The tank is mounted above the level of the carburetor and uses gravity to supply fuel through a .25" I.D. (6.35 mm) rubber hose to the carburetor. The fuel hose is friction-fitted to the tank outlet at one end and to the carburetor at the other end.

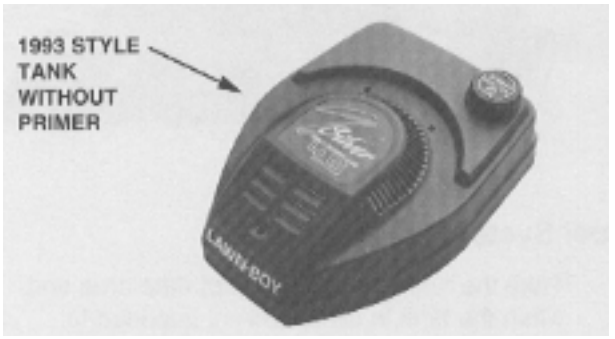


Figure 39

The fuel tank is vented through an opening in the fuel cap. The fuel opening on the tank is 1.75" (45 mm) diameter and is opposite the fuel outlet, helping to prevent damage to the filter screen by funnels and gasoline filler spouts that may be inserted into the fuel tank during refueling. The placement of the cap also prevents interference with the starting rope in Zone Start applications.

The fuel cap is a four piece design **(Figure 40)** with an inner sealing disc that is vented to a baffle assembly in the body of the cap. The baffle assembly allows expansion in the tank without the loss of fuel. Atmospheric pressure is allowed into the tank from an opening in the cap to allow gravity to feed fuel to the carburetor. (If an individual part of the cap fails, the entire assembly must be replaced.)

Fuel System - Cap Service

1. The fuel cap may not be disassembled; however, the vent opening on the cap and inner sealing disc should be kept free of debris.
2. The ventilating ability of the cap may be tested by filling the cap with water and observing the flow of water out of the vent opening in the top of the cap. If water does not drain, the vent opening may be plugged or restricted.
3. If the fuel cap will not vent properly, replace the entire cap assembly.

Figure 40

Fuel System - Tank Removal

1. Disassemble the starter rope "T" handle **(Figure 41)** sufficiently to untie (or cut) the starter rope knot and release the rope. (The plastic rope stop prevents the rope from rewinding completing into the starter).

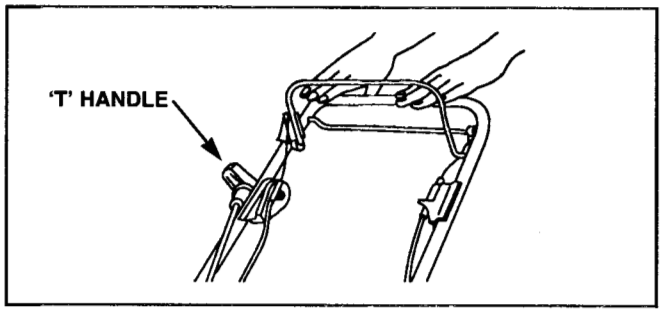


Figure 41

Note: To remove the fuel tank, you may either crimp the fuel hose and use a forceps to remove the fuel hose from the carburetor...

OR

You may reach under the edge of the fuel tank to pull the hose off the tank outlet, but you must be ready to catch the fuel that will drain out of the tank.

If you use this method, you must have a container large enough to hold the amount of fuel in the tank.

CAUTION: Avoid fire and explosion. Store fuel in a container designed for gasoline and ***never smoke while working around gasoline.*** Release the clamping pliers and drain the fuel into a container designed to receive gasoline.

2. If you removed the fuel line from the tank outlet, catch the fuel as it drains out of the tank outlet. Set the fuel aside and away from the immediate working area.

3. Using a # T25 TORX driver, remove the three screws with captive washers and spacers that secure the fuel tank to the shroud assembly **(Figure 42)**

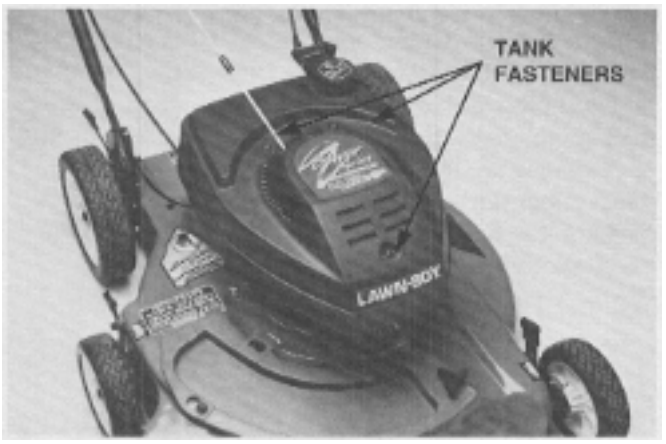


Figure 42

Fuel System - Cleaning

1. Take the fuel tank to an appropriate area and wash the tank in clean solvent intended for cleaning engine parts.
2. Back wash the filter screen by directing cleaning solvent, under moderate pressure, through the sediment reservoir and screen, opposite the direction of fuel flow.
3. Wash the tank again with clean solvent.
4. Clean or replace the fuel hose.

Fuel System - Tank Installation

1. Fasten the tank to the engine with the three screws with captive washers and spacers.
2. Connect the fuel line.

SECTION 4 IGNITION SYSTEM

Ignition System - Troubleshooting

Check the ignition system in the following order:

- Spark plug (connection & wire, condition)
- CD Pack (air gap, connections or spark)
- Flywheel (key and magnets)

Use the following table to aid in diagnosing the problem.

Problem	Possible Cause	Suggested Remedy
Misfiring, no firing, engine surges, engine dies (Note: these symptoms may also be caused by fuel symptom problems).	Spark plug or lead wire loose Spark plug in poor condition	Tighten plug to specifications
	CD Pack air gap wrong	Adjust (see CD Pack - Service in this section).
	CD Pack high tension lead loose	Secure with GE silicon sealant.
	CD Pack leads loose or dirty	Clean and tighten leads.
	CD Pack defective	Replace CD Pack.
	Flywheel key damaged or sheared	Replace key and check keyway (see Servicing the Flywheel in this section).
	Flywheel magnets demagnetized or weak	Replace flywheel.

Ignition System - Spark Plug Operation

The spark plug ignites the oil-fuel mixture by producing a spark just before the piston reaches top dead center (TDC). A spark plug is typically constructed as shown in **Figure 43.**

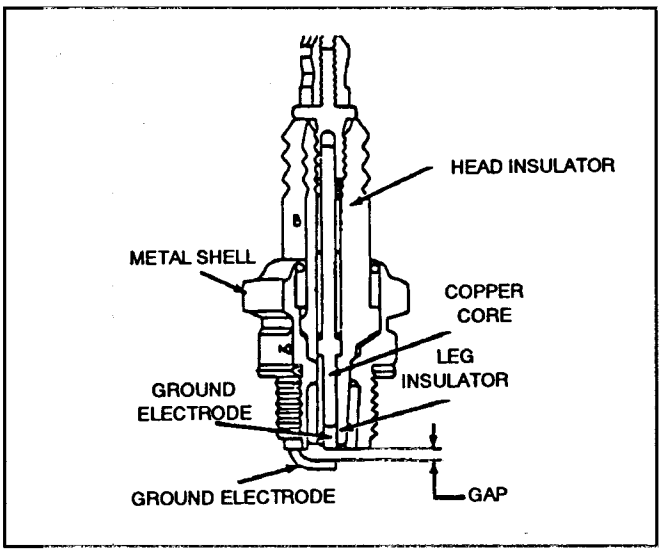


Figure 43

Ignition System - Spark Plug Service

1. Check spark plug with chart in this subsection and replace, following specifications given on this page.

CAUTION: Do not clean plug with a sand blaster.

2. Clean with a wire brush, removing the carbon buildup. Check conditions of the plug for cracking or damage. Replace as necessary.

Item	Specification/Action
Plug type	Champion RJ12C or equivalent
Frequency of change	As needed (see Troubleshooting in this subsection)
Check, clean and gap	Every 25 hours Gap at .89 mm (.35")
Torque value	144-180 in lbs (18.3 N•m)

Ignition System - CD Pack Operation

The V Engine uses a solid state ignition module to generate an electrical pulse for the spark plug. The term "solid state" is a broad term applied to any electrical system which uses electronic components such as diodes, transistors, silicon controlled rectifiers, etc., that take the place of one or more of the older standard mechanical ignition components.

Electronic components are very small, have no moving parts, require no mechanical adjustments, and are not affected by wear as are mechanical devices. They deliver uniform performance throughout component life under adverse operating conditions, can be hermetically sealed so that they are unaffected by dust, dirt, oil or moisture.

The Capacitive Discharge (CD) system is breakerless, and contains electronic components that replace mechanical points and related accessories (such as a breaker cam, spark advance assembly, etc).

Figure 44 shows the location of the CD Pack used in the V Engine.

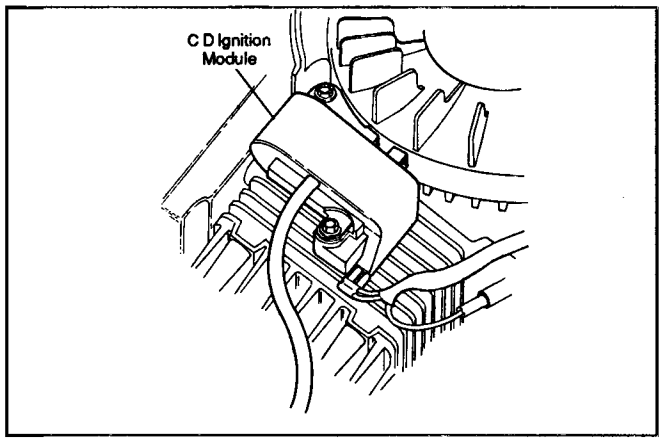


Figure 44

As the flywheel magnet passes the CD Pack, an AC voltage is induced into the charge coil. This AC voltage is converted by a rectifier into a DC signal which is then stored in a capacitor **(Figure 45).**

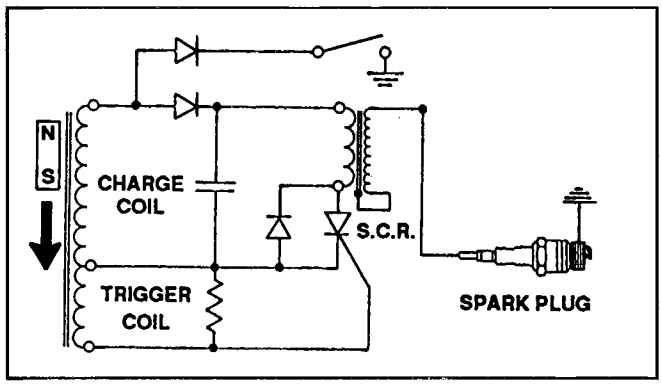


Figure 45

When the SCR is triggered or "fires", up to 200 volts DC, stored in the capacitor, travels to the spark coil. Here it is stepped up to as much as 25,000 volts and is discharged across the electrodes of the spark plug **(Figure 46).**

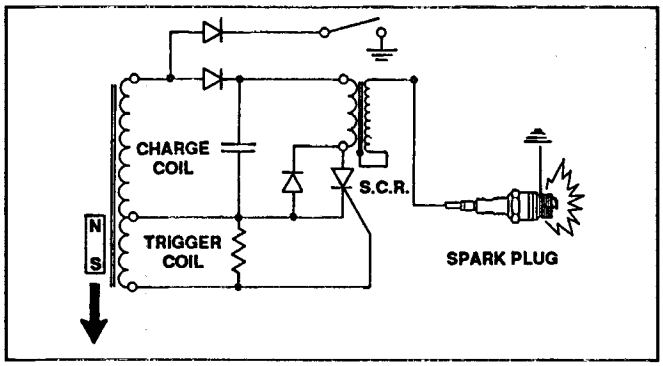


Figure 46

At slower speeds, the flywheel magnet induces a smaller charge in the trigger coil. This action triggers the silicon controlled rectifier (SCR) enabling easier starting in a "retarded firing position" about 5 degrees before top dead center (BTDC) **(Figure 47).**

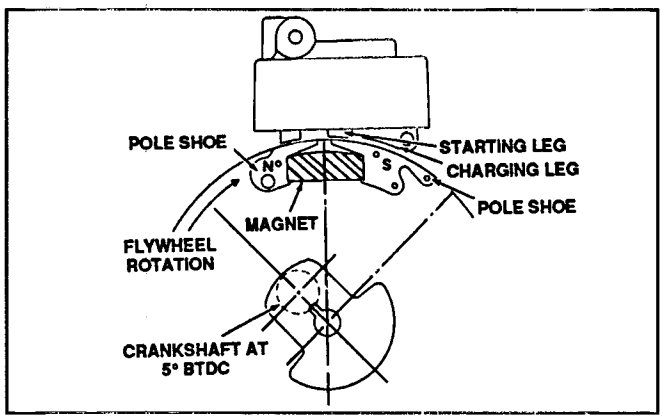


Figure 47

At faster speeds (about 800 RPM), the flywheel magnets induce a large enough charge in the trigger coil to trigger the SCR in the "advanced firing position" (about 25 degrees BTDC) **(Figure 48).**

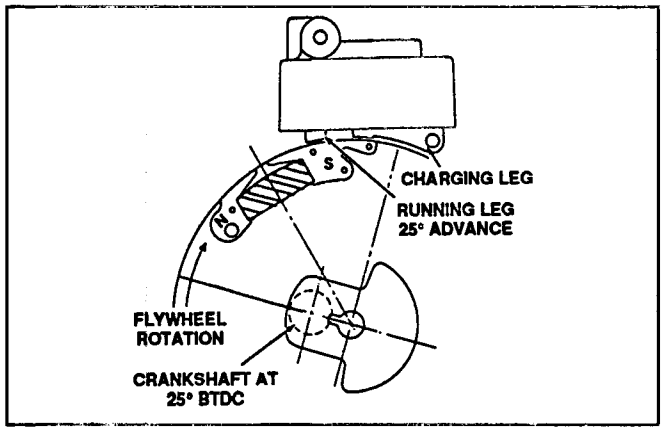


Figure 48

Ignition System - CD Pack Air Gap Adjustment

1. Rotate flywheel until the magnets are directly adjacent to the CD Pack as shown in **Figure 49.**

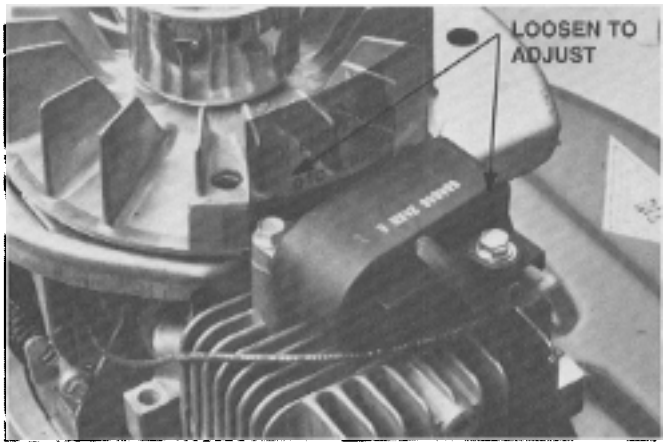


Figure 49

2. Adjust gap by loosening screws, inserting Lawn Boy gauge (p/n 604659) or a piece of .010" shim stock and tightening screws.

Ignition System - CD Pack Removal/Installation

1. Disconnect leads and remove mounting screws.
2. Remove screws, replace CD Pack and set gap as outlined in step 1 above. Tighten screws to a torque of 100 in. lbs (11 N•m) **(Figure 50).**

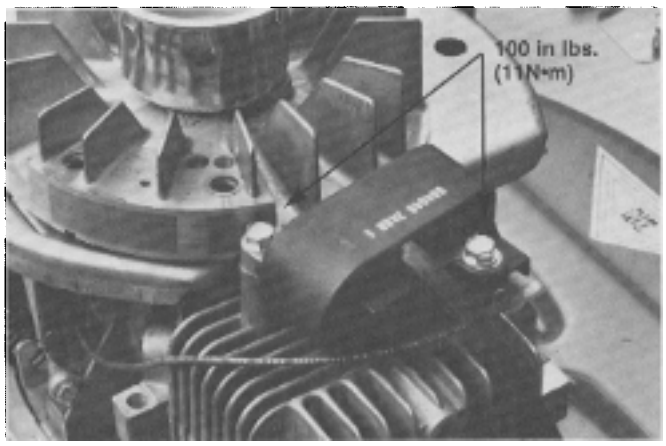


Figure 50

Ignition System - Flywheel Operation

The flywheel is connected directly to the crankshaft (secured by a flywheel key and nut) and turns at the same speed as the crankshaft. Two permanent magnets, imbedded in the flywheel, rotate past the coil in the CD Pack to begin the generation of electricity.

Imbedded in the opposite side of the flywheel are steel counterweights which offset the weight of the magnets. These counterweights are not magnetic.

Ignition System Flywheel Removal

1. Remove spark plug and install piston stop (p/n 677389) **(Figure 51).**

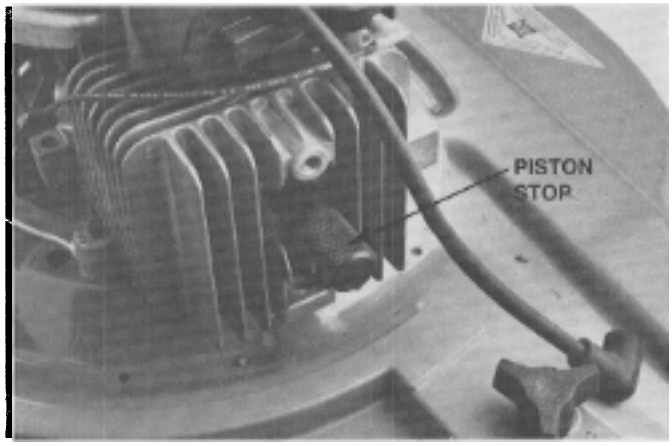


Figure 51

2. Remove shroud and fuel hoses.
3. Remove flywheel nut.
4. Remove flywheel by pulling up on edge of flywheel while striking wide fin of flywheel with a soft hammer **(Figure 52)**.

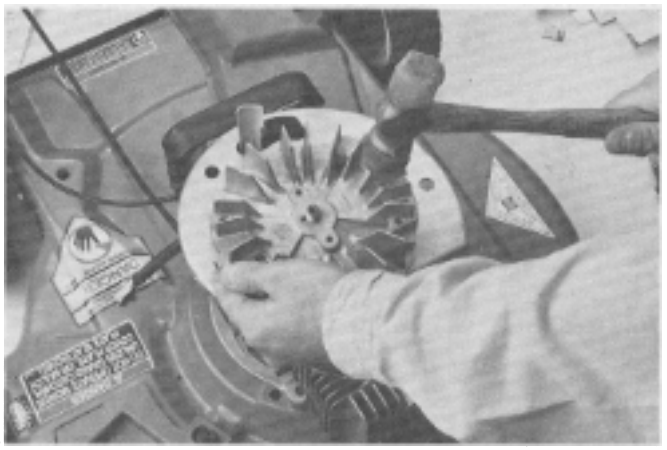


Figure 52

5. Remove key and check its condition.
6. Replace crankshaft and/or flywheel if keyway is distorted or cracked.
7. Check flywheel for wear and flywheel magnets for strength.

Ignition System - Flywheel Installation

1. Make sure flywheel keyway is absolutely clean.
2. Make sure key is installed correctly **(Figure 53).**
3. Locate keyway cutout in flywheel over key and shaft.

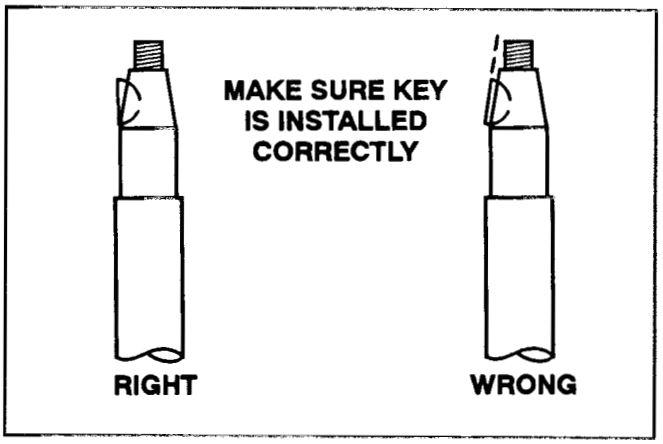


Figure 53

4. Torque flywheel nut **(Figure 54)** to 375-425 in lbs (43 - 47 N•m).

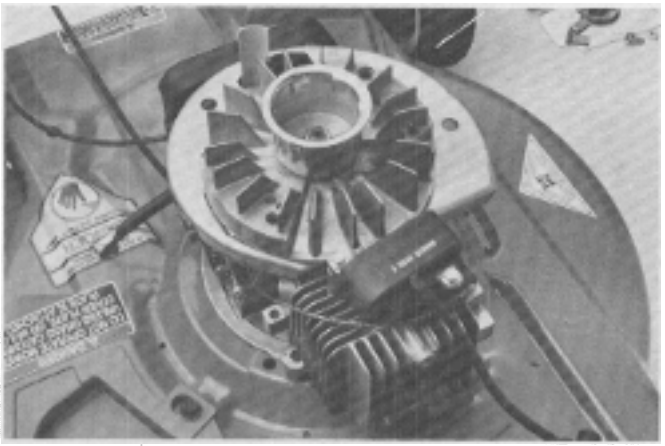


Figure 54

SECTION 5 REWIND STARTER

Rewind Starter - Operation

The rewind starter operates through a retainer/friction disc that causes two engagement dogs to extend from the center of the rewind starter and engage the inside of the starter hub on the flywheel. The engagement dogs move into contact with the starter hub when the rewind rope is pulled. When the engine starts, the speed of the engine exceeds the speed of the rewind starter and forces the starter dogs back into the center of the rewind mechanism, disengaging them from the starter hub.

Rewind Starter - Removal and Disassembly

Note: The rewind starter assembly housing is riveted to the shroud.

1. Remove the fuel tank.
2. Remove the four screws that secure the shroud to the shroud base **(Figure 55).** Note that the front screw is a 3/8" hex while the other three are 5/16" hex.

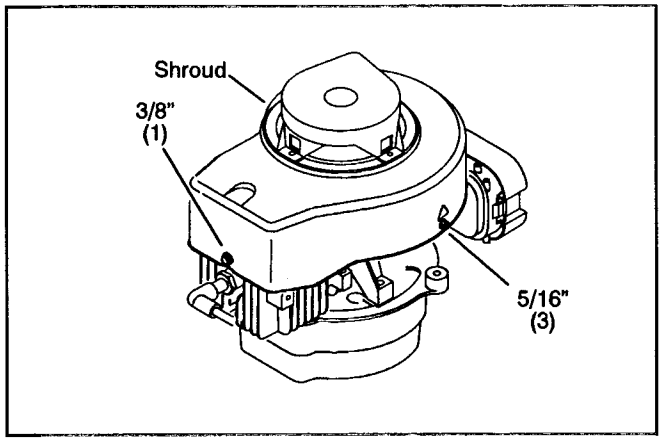


Figure 55

3. To service and/or replace the starter engagement dogs and springs, turn the shroud over to gain access to the starter mechanism.
4. Use a No. 1 Phillips screwdriver to remove the Phillips-head shoulder screw from the center of the rewind mechanism and lift the retainer plate from the starter.

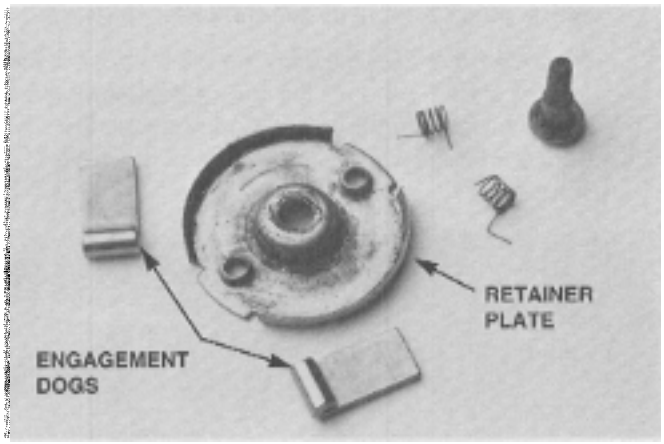


Figure 56

5. Remove the two starter engagement dogs and springs. Take note of the positioning of the springs for correct installation later. **(Figure 56).**
6. Completely extend the rewind rope of the starter and hold the reel in place. Untie the knot in the end of the rope, withdraw the rope and slowly allow the reel to unwind to a relaxed state.
7. Remove the reel from the rewind housing. The rewind spring is captured in the reel and will not fall out or be released suddenly if you are careful. The rewind spring is not serviceable. If the spring has failed, an entirely new spring and reel assembly must be used for repair.

Rewind Starter - Reassembly

1. Lubricate the center post of the rewind starter with a small amount of general purpose grease.
2. Place the reel assembly on the center post of the rewind starter and turn the reel counterclockwise until the hook on the reel spring engages the spring retainer on the center post of the starter. **(Figure 57).**

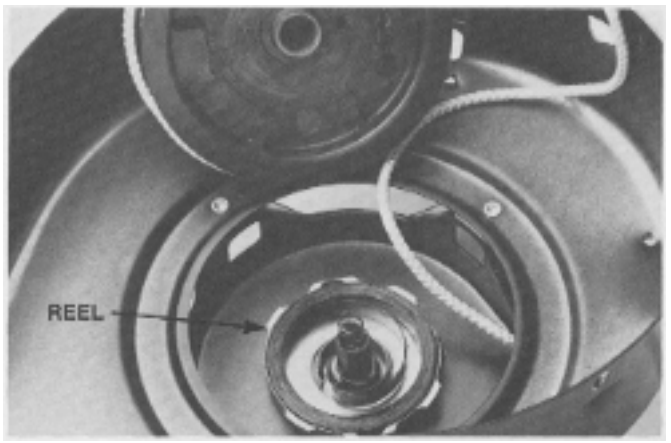


Figure 57

3. Install the engagement dog springs and the center spring as shown in **Figure 58.**

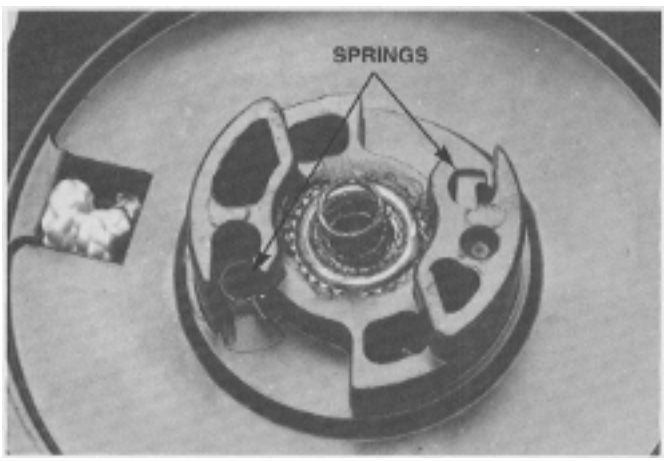


Figure 58

4. Install the retaining plate and Phillips shoulder screw. Tighten the screw to a torque of 33 in lbs (3.7 N•m). **(Figure 59).**

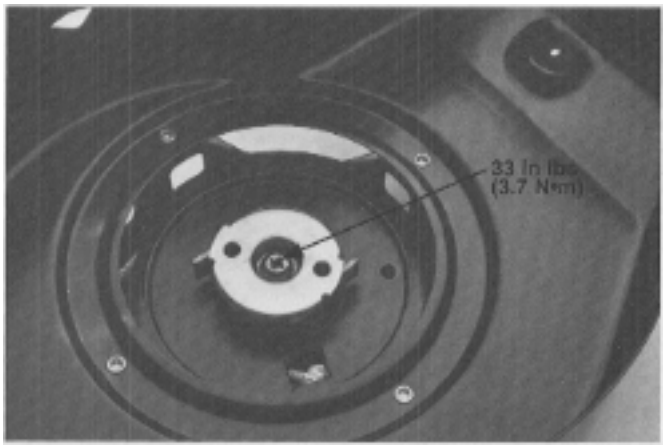


Figure 59

CAUTION: Wear gloves for protection while performing procedures of the next step.

5. Pretension the spring by turning the pulley plate counterclockwise 5 turns. Insert the rope through the guide, then the reel.
6. Tie a single knot in the end of the rope; then singe the end with a lighter to prevent the knotted end of the rope from fraying **(see Figure 60).**

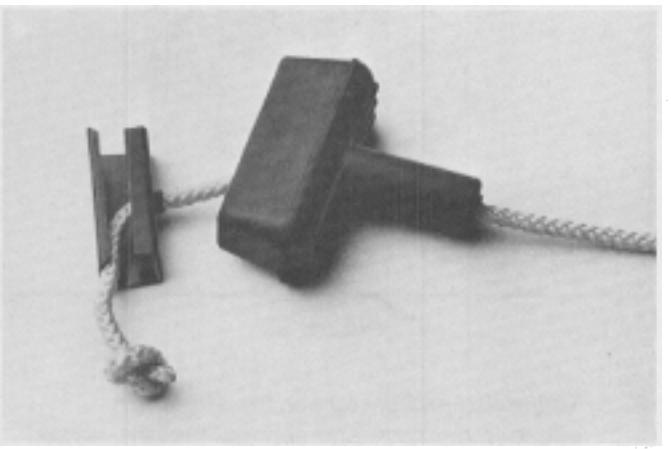


Figure 60

Rewind Starter - Reassembly (cont'd)

7. Reattach the shroud to the shroud base with four screws. Be sure the 3/8" screw (3/8" head, 1/4" Dia) is installed at the front of the shroud. Tighten all screws to a torque of 58 - 70 in lbs (6.6 - 7.9 N•m). **(Figure 61)**
8. Turn the fuel tank over and notice the two extruded tabs. These tabs match the holes in the rear portion of the shroud and will automatically align the mounting holes of the fuel tank and shroud when the fuel tank is inserted correctly.
9. Push the fuel tank onto the shroud and secure it with 3 screws and spacers removed previously. Tighten all screws securely.

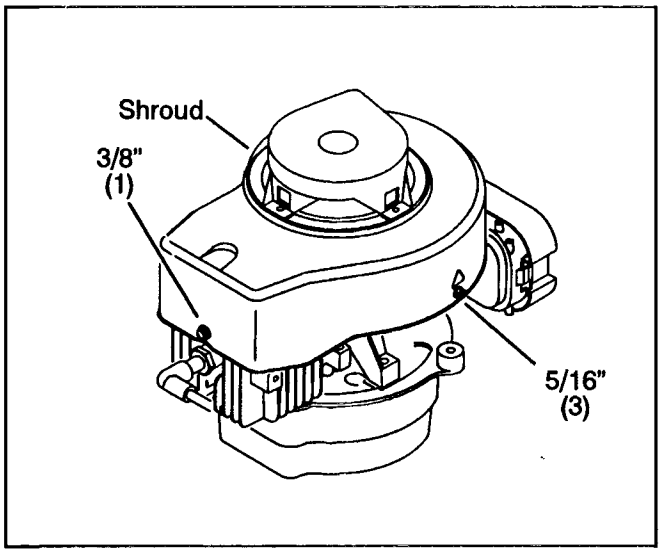


Figure 61

SECTION 6 ENGINE

Engine - Description

Two-cycle engines have special advantages which make their use more practical in certain applications. Two cycle engines are lightweight with an excellent power-to-weight ratio and can be operated in any position. They are also notably easy to maintain and service because of their uncomplicated design. The Lawn-Boy Two-Cycle V Engine used on Lawn-Boy rotary motors is a reed valve design. This design name describes the path of the fuel/air mixture into the cylinder/crankcase and combustion chamber, and the exhausting of spent gases.

Engine - Theory of Operation

Two two-cycle (or two-stroke) engine is one of the simplest and most efficient power systems ever developed.

Figures 62 and 63 below show what happens inside the engine during one full crankshaft revolution. Fuel intake, fuel ignition and the exhaust of burned gases all take place during a single 360-degree rotation of the crankshaft.

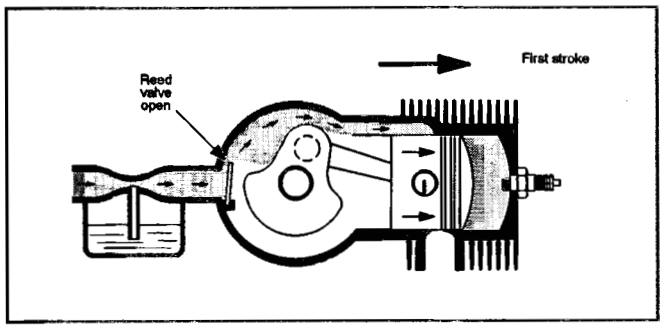


Figure 62

Beginning at a point where the top of the piston is just below the exhaust port, the piston moves forward toward the crankcase. As the transfer port is uncovered, the air/fuel mixture stored in the pressurized crankcase is forced into the combustion chamber.

The crankshaft continues its rotation and the piston begins its travel toward the spark plug. As it moves, the piston seals off the transfer port first, then the exhaust port. When both ports are sealed, the remaining travel compresses the air/fuel mixture to prepare it for ignition. The travel of piston towards the spark plug is called the compression stroke **(Figure 62)**.

The movement of the piston towards the spark plug also has an important effect in the crankcase. Once the transfer port is sealed, the crankcase is under vacuum. This action pulls the reed valve open and draws in a fresh charge of air/fuel mixture.

Just before the piston reaches top dead center (TDC), the spark plug fires. When the engine is functioning properly, the air/fuel mixture ignites, causing a burn that occurs evenly through the power stroke. (If the compression ratio is too high, the air/fuel mixture actually explodes, which can be heard and is identified as detonation). The burn continues as the piston changes direction and begins its travel towards the crankcase.

When the piston opens the exhaust port, high-pressure exhaust gases exit the exhaust port. Further movement of the piston towards the crankcase uncovers the transfer port which allows a fresh charge of oil/fuel mixture to enter the combustion chamber. As the exhaust gases continue to exit the exhaust port the engine is readied for another cycle.

The 2-cycle engine is always well lubricated as long a the correct oil/fuel mixture is maintained in the fuel tank. Oil suspended in the fuel vapor adheres to all moving parts, keeping them continually coated, regardless of operating angle. **Figure 63** illustrates the second (or power) stroke of a 2-cycle engine.

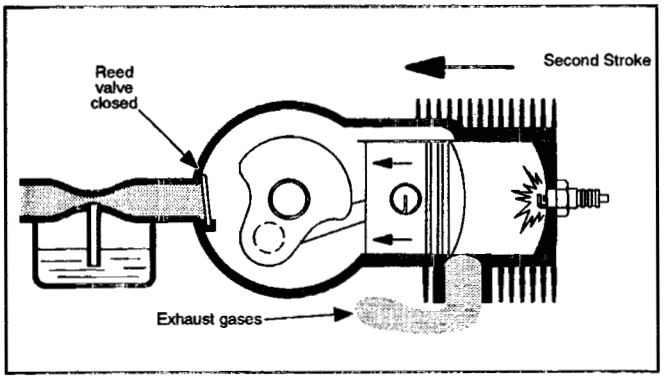


Figure 63

Engine - Service Tips

The numbers in parentheses in the discussions that follow refer to the exploded views in Appendix A. The major items are:

1. **Cylinder/Crankcase Halves (21, page A-2).** The two halves are a matched pair and cannot be mixed. Check cleaning and assembly procedures under Engine Disassembly in this subsection. Be sure to use Loctite 515 on the mating surfaces. Torque the four washer-head screws that secure the two halves to 105 - 115 in lbs (12 - 13 N•m).
2. **Oil Seals (3, page A-2).** Visually inspect for leaky or damaged oil seals (two locations).
3. **Core Plugs (1, page A-2).** Visually inspect for damaged or leaky plugs (four locations).
4. **Muffler Baffle (1, page A-3).** This item should be cleaned every 50 hours (maximum) to keep carbon from clogging exhaust system power loss) and from entering engine (causing piston scoring).
5. **Muffler Plate Screws (2, page A-3).** Screws may have loosened due to vibration. They should be tightened to a torque of 140 - 200 in lbs (16 - 22 N•m).
6. **Exhaust ports** should be inspected and cleaned as necessary **(Figure 64).**

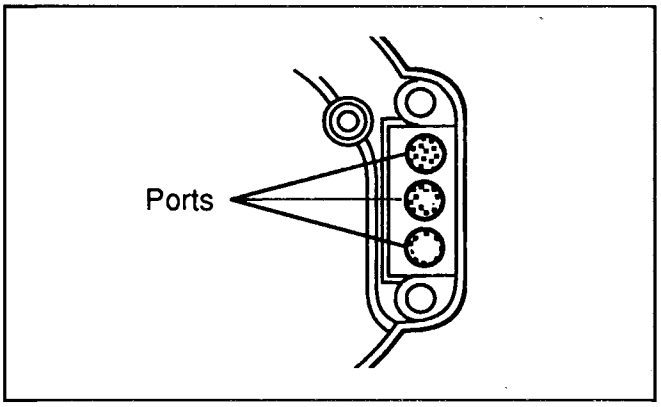


Figure 64

7. **Carburetor Gaskets (24, page A-4).** Carburetor gaskets (24) on either side of the carburetor shield (1) may be leaking or damaged causing air leaks into the engine (may cause power fluctuations). Ensure that air cleaner/carburetor mounting screws (6) are tightened to a torque of 45 - 55 in lbs (5.0 - 6.1 N•m).

Engine - Removal

Prior to disassembling the engine and prior to further troubleshooting a malfunction, separate it from the mower as follows:

1. Disconnect the spark plug wire.
2. Disassemble the "T" starter handle to untie the knot in the starter rope. (The plastic rope stop will keep the rope from rewinding completely into the starter).
3. Remove the fuel tank (page 38).
4. Remove the shroud (page 43); starter comes off with shroud.
5. Remove the flywheel (page 41).
6. Remove the remaining bolts securing the shroud base to the crankshaft halves **(Figure 65).**

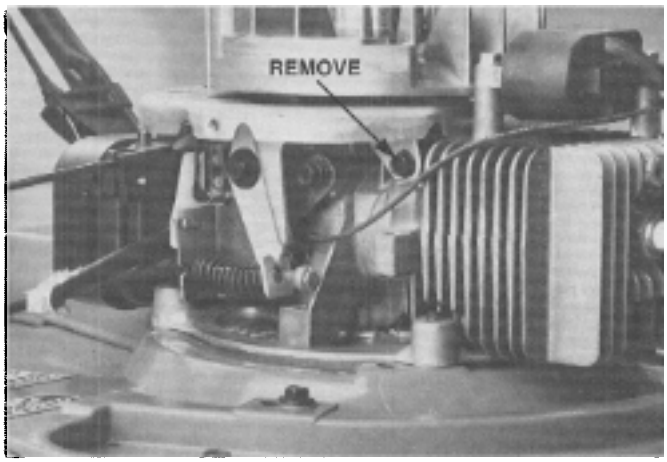


Figure 65

Engine - Removal (cont'd)

5. Remove brake plate assembly by removing one 10 mm shoulder screw and one 3/8" washer-head screw. Place the assembly on the mower deck and disconnect the ground wire (that goes to the CD Pack). **(Figure 66).**

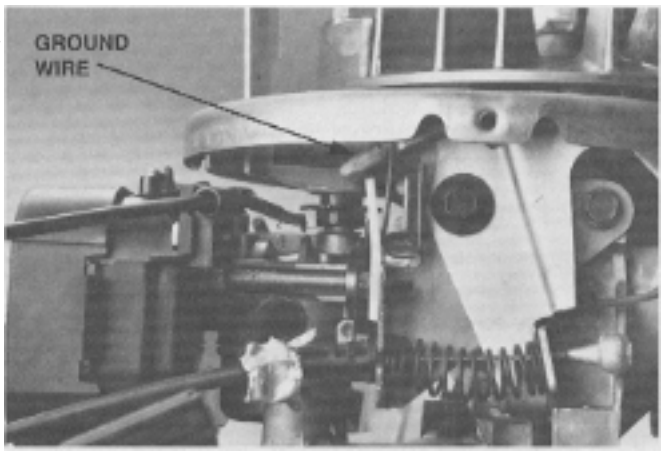


Figure 66

7. Remove the CD Pack (page 41).

   Note: Step 8 covers '93 carburetors; '94 carburetors have an additional wire holder that must be released to remove the air cleaner element. Mounting screws are identical.

8. Snap open the air cleaner cover (catch on left, hinge on right) and remove the air filter element. Remove the two screws securing the carburetor to the engine. Disconnect the fuel line from the carburetor. Separate the carburetor from the engine with controls attached and set it on the mower deck.

9. On self-propelled models only, remove the 5/16" screw to remove the belt drive cover. Remove two 3/8" screws with spacers that secure the belt drive guide bracket to the drive unit **(Figures 67 & 68)**. Remove the drive belt from the pulley (belt will stay with the engine as cover is removed).

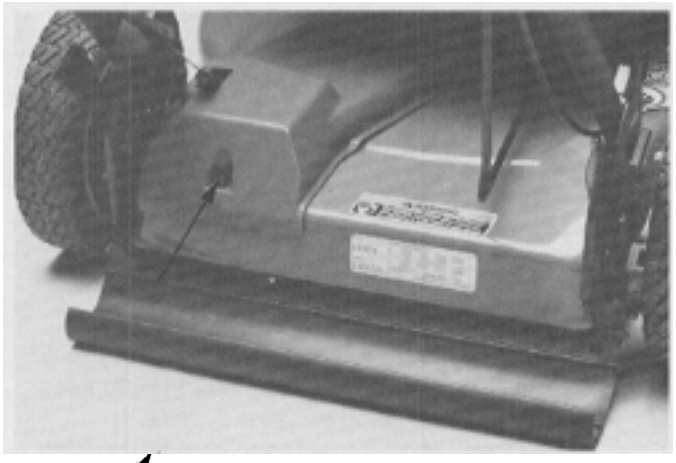


Figure 67

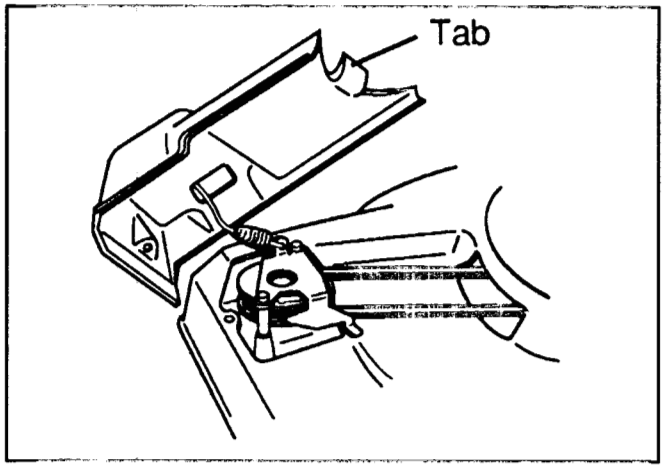


Figure 68

Engine - Removal (cont'd)

10. Remove the spark plug and install piston stop (p/n 677389) in the spark plug hole.

11. Remove the 15/16" blade nut that secures the blade and mulch fan to the engine shaft. Use heavy duty gloves to hold the blade while removing the nut.

    Notes: Due to the nature of the self-locking material in the blade nut, use a new nut after the fourth time it has been removed and re-installed.

    Since the engine shaft and blade collar protrude beyond the bottom of the muffler cover, have a couple of short lengths (about 1 ft ea) of 2 x 4's set about four inches apart to set the engine on after removing it in the next step.

12. Under the mower deck, remove the three 1/2" bolts that secure the engine to the mower deck and lift the engine (with drive belt) up and out of the deck and set it on the 2 x 4's (or equivalent arrangement).

Engine - Disassembly

Note: In addition to the figures supplementing the engine disassembly in the following paragraphs, the engine exploded view is shown on page A-2. Numbers used in the text refer to that view.

1. Remove the four crankcase cap screws with a Torx No. E-12 socket and separate the halves using a screwdriver **(Figure 69).**

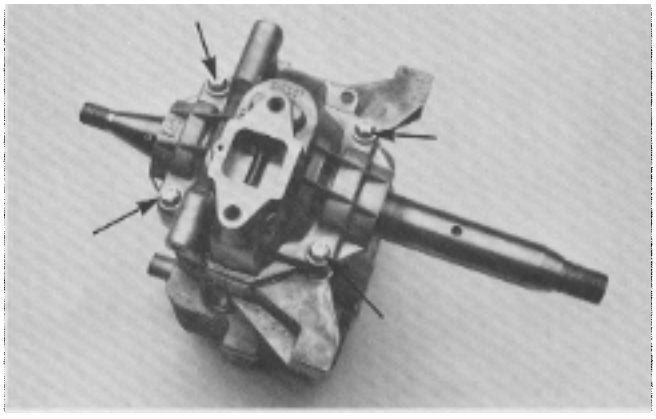


Figure 69

2. Remove the entire crankshaft assembly and discard the oil seals (3, page A-2).

3. Carefully remove the HSH (hex, sockethead) cap screws (9, page A-2) to remove the connecting rod cap and the split bearing liner. The needle roller bearings are under the split bearing liner **(Figure 70).**

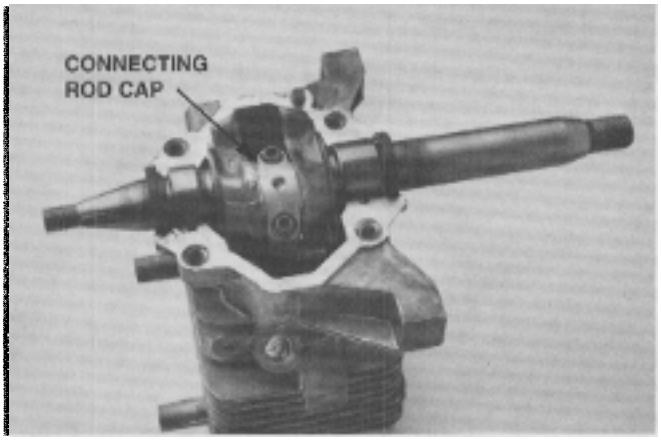


Figure 70

4. Remove the piston and rod assembly; separate the assembly if necessary, using a compression pliers (p/n 303857) on the retaining ring (16). Use wrist pin knock out tool (p/n 602884) to punch out wrist pin (17). **(Figure 71).**

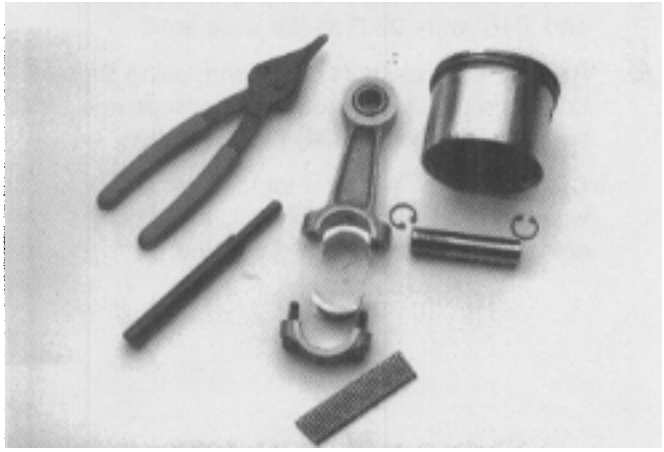


Figure 71

Engine - Inspection and Repair

1. Check bearings for wear and freedom of movement; replace if questionable.
2. Check rings for sticking, remove and check rings for wear or damage; replace rings if questionable.
3. Check all parts for wear or damage and replace if questionable.
4. Clean crankcase surfaces with Gel Seal and Gasket Remover **(Figure 72).**

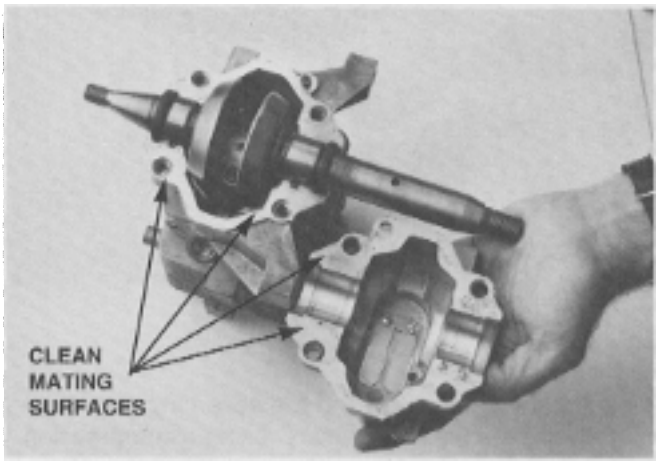


Figure 72

5. Check that the ring end gap is between .006" and .016" with .030" as the wear limit.
6. Replace core plugs (1) if leaking, using Screw Lock (p/n 682301) on outside surfaces and special tool (p/n 609904) for installation.

   CAUTION: Do not attempt to clean any hole with a drill bit. An enlarged hole will reduce compression and engine efficiency.

Engine - Reed Valve Service

These assemblies **(Figure 73)** permit fuel mixtures to enter the crankcase on compression strokes and to trap fuel mixtures in the crankcase on power strokes.

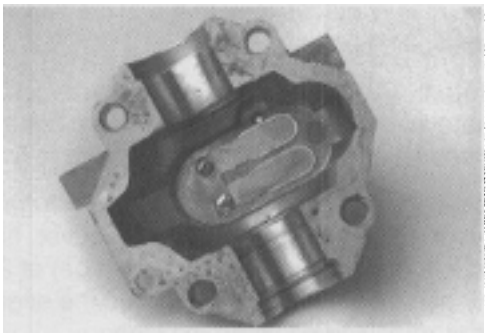


Figure 73

1. Check clearance between tip of reed and plate; replace reeds if clearance is more than .015" (.4 mm).

   CAUTION: Do not use compressed air to clean reeds.
2. Clean reeds carefully, by hand, using carburetor solvent.
3. When replacing reeds, install smooth edge down **(Figure 74)** and use Loctite 271 on threads of screws.

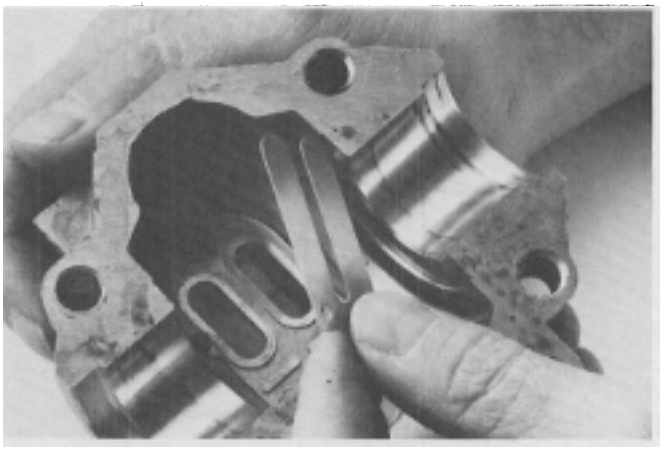


Figure 74

Engine - Reassembly

1. Secure wrist pin using snap ring. Make sure square edge of snap ring faces out and ring opening faces up (toward top of piston) **(Figure 75)**.

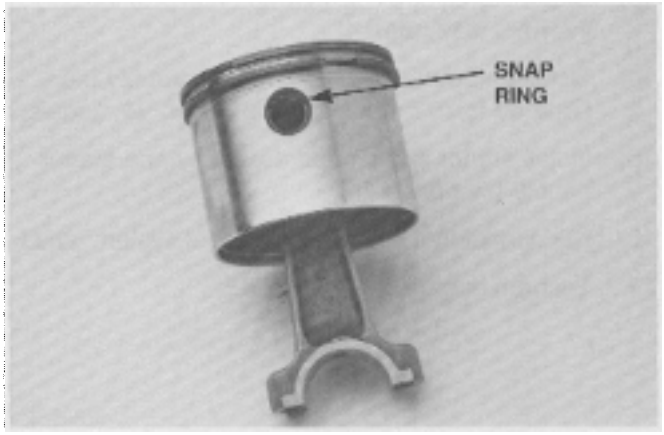


Figure 75

2. Install pressure back piston ring in top groove with bevel facing up; stagger ring gaps.

   CAUTION: Use piston stop to prevent top ring from falling into cylinder and causing damage.

3. Assemble rod cap. Ensure that dovetail ends of liners are matched. Install new needles p/n 683911.

   Note: One side of the paper is sticky; remove paper carefully while installing needle bearings. There should be 32 needle bearings on the lower connecting rod.

4. Lubricate and assemble bearings (lettered side out) to crankshaft and install crankshaft.

5. Install rod cap; ensure that mating marks are aligned. Clean old screws thoroughly and apply Loctite 271 **(Figure 76)**. Torque to 70 in•lbs (7.8 N.m).

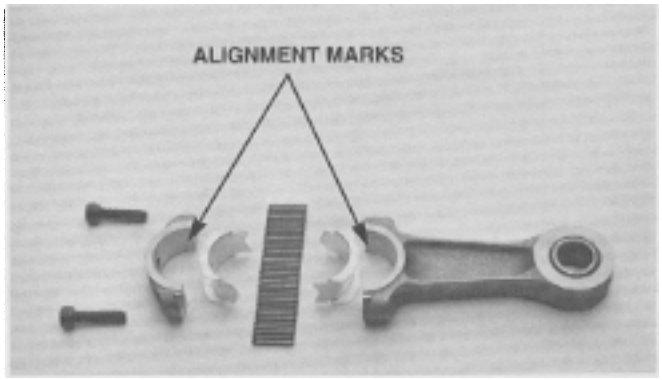


Figure 76

6. Oil parts and use piston stop (p/n 677389) and ring compressor (p/n 609967) to install piston with "BTM" mark facing down toward exhaust ports **(Figure 77)**.

   Note: Letters "BTM" were omitted on some engines. However, the small "rectangle" should still be visible through ports.

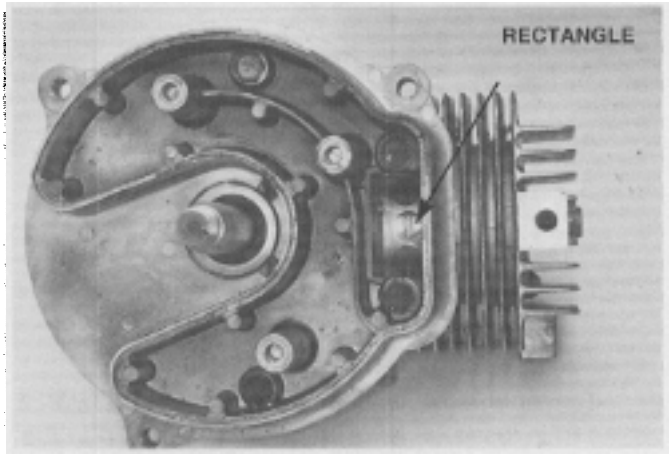


Figure 77

7. Apply Loctite 515 gasket maker very thinly to the crankcase cover sealing surface, being careful not to get sealant on bearings or seals **(Figure 78)**.

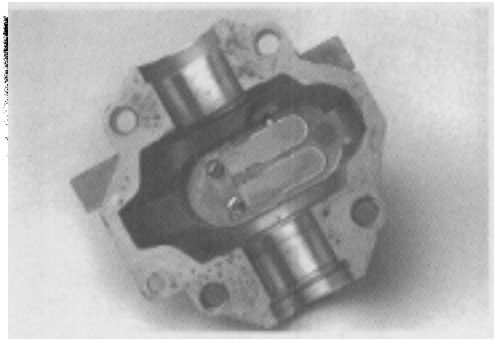


Figure 78

8. Carefully align the two crankcase halves using the alignment pin and its matching hole; press the two halves together **(Figure 79)**.

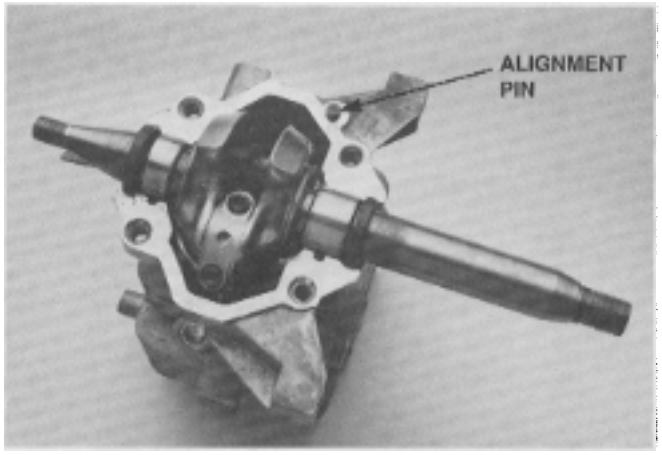


Figure 79

9. Tighten the hex washer head screws to a total of 110 in lbs (12.5 N•m), ***tightening only 20 in lbs (2.26 N•m) increments at a time*** while checking that the crankshaft turns freely **(Figure 80)**.

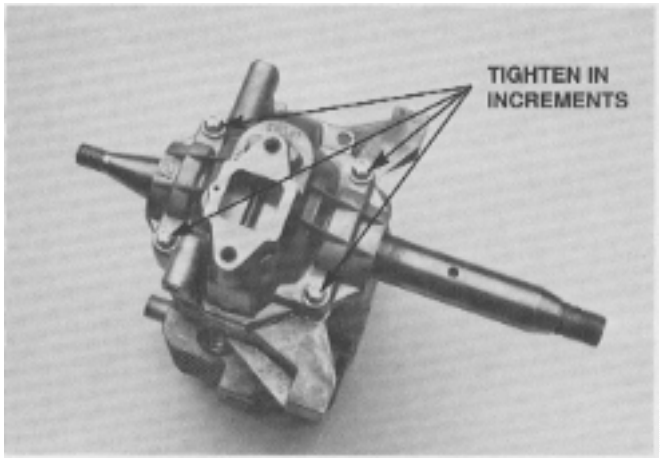


Figure 80

Reinstalling External Components

10. Reattach the flywheel brake system.
11. Install new oil seals.
12. Install shroud base.
13. Clean crankshaft and flywheel hub and install flywheel (see page 42).
14. Install carburetor and governor assembly (see page 30 for '93 models, page 35 for '94 models).
15. Install starter and shroud assembly and starter handle (see page 45).
16. Reconnect fuel lines and electrical system leads.
17. Test run engine.

SECTION 7 PIVOTING ZONE START BRAKE

Introduction

In 1982 the federal government mandated that all consumer walk behind mowers with a cut of 25" (63.5 cm) or less be equipped with safety devices. There are two primary criteria which these devices must meet:

1. A two-step operation must be performed in order to start the blade rotating.
2. The blade must come to a stop within three seconds of the operator leaving the operator's position.

One of the ways the Lawn Boy Corporation met these requirements was with the "zone start system." This system utilizes a kill switch and a brake which stops the engine when the operator releases the blade control bail **(Figure 81)**. The two-step blade engagement criteria is met by requiring the operator to pull the bail to the handle first, then pull the recoil rope from the operator's position.

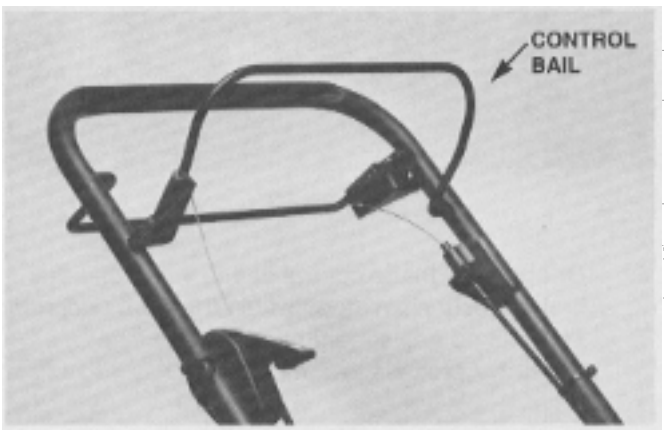


Figure 81

Pivoting Zone Start Brake - Operation

The pivoting style zone brake system has two main functions. The first function of the system is to stop the production of spark and the second is to stop the engine and the blade.

Stopping spark production is controlled by a switch.

The switch is closed when the blade control bail is in the "at rest" (vertical) position **(Figure 81)**. Lowering the bail to the main mower handle opens the switch.

Switch leads are connected to the primary side of the coil and to ground. When the switch is closed, the electronic ignition module is bypassed so that it cannot interrupt primary current flow. This action prevents the coil from producing the high voltage necessary to generate spark. When the switch is open, the ignition coil produces spark.

Stopping the engine and blade is accomplished by means of a brake that is applied to the bottom of the flywheel. The brake spring is in the "braked" position when the blade control bail is in the "at rest" or vertical position. When the blade control bail is lowered to the mower handle, the brake is retracted from the under side of the flywheel to allow the engine to run.

Pivoting Zone Start Brake - Disassembly

See **Figure 82**; disassembly continued next page.

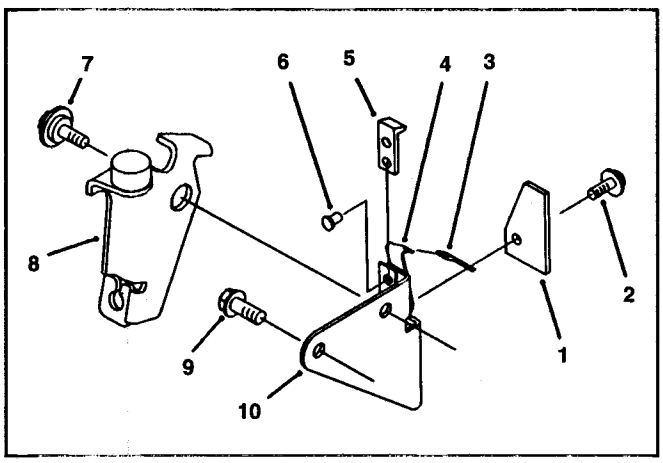


Figure 82

1 - Ground strap stop
2 - Self-tapping screw
3 - Brake switch leadwire
4 - Ground strap
5 - Insulation strap
6 - Plastic rivet (self expanding) (2)
7 - Shoulder screw (10 mm)
8 - Brake plate assembly
9 - Screw
10 - Brake mounting plate

Pivoting Zone Start Brake - Disassembly (cont'd)

Note: Numbers in parentheses in the following procedures refer to Figure 82 on previous page.

1. If the engine and blade are taking more than 3 seconds to stop when the blade control bail is released , inspect the brake pad for excessive wear and replace if necessary. Note that the brake pad and the brake plate are replaceable only as an assembly.
2. To reduce the pressure of the spring between brake mounting plate (10) and brake plate (8), squeeze tabs of brake cable that hold it in place at the brake mounting plate. Push cable through the hole in brake mounting plate.
3. Slide cable out through horizontal slot in brake mounting plate. Also, slide the ball end of the cable up through the vertical slot in the brake plate.

   Note: In step 4, some units may use a 3/8" head with 1/4" diameter screw (rather than a 10 mm).
4. Remove the 10 mm shoulder screw (7) to remove the brake plate and brake pad attached to it.
5. If the ground strap or any part of this assembly requires replacement, remove the second screw (9) to remove the brake mounting plate from the engine.

Pivoting Zone Start Brake - Assembly

1. If the brake mounting plate was not removed from the engine, simply reconnect the grounding lead to the push-on terminal directly above the ground strap stop (4) and continue with the reassembly process.

   Note: If the brake mounting plate was removed, tighten screw (9) to 60 - 70 in lbs (6.78 - 7.91 N•m).
2. Secure the replacement brake plate to the engine with shoulder screw (7). Tighten it to 90 in lbs (9.2 N•m). Ensure that the brake plate pivots freely.
3. Slide the cable into the narrow slot on the brake mounting plate and then push the cable into the hole making sure the tabs lock into the bracket.
4. One end of the compression spring has a hook shape to it; that end hooks over an indentation in the brake plate. Squeeze the compression spring and slip it over the cable between the brake mounting plate and brake plate.
5. Insert the leaded ball end of the cable into the vertical slot of the brake plate **(Figure 83)**.

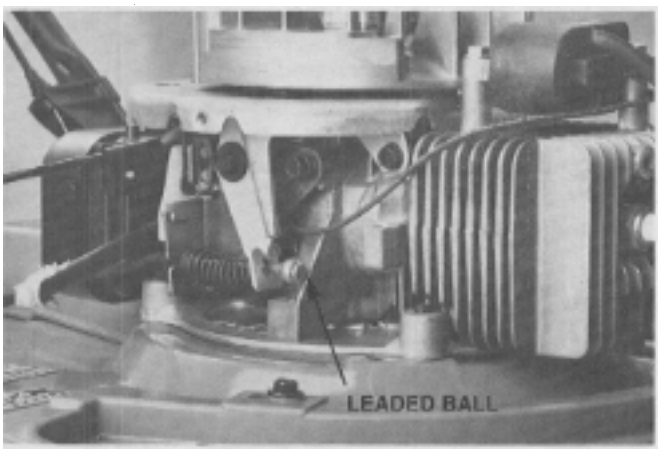


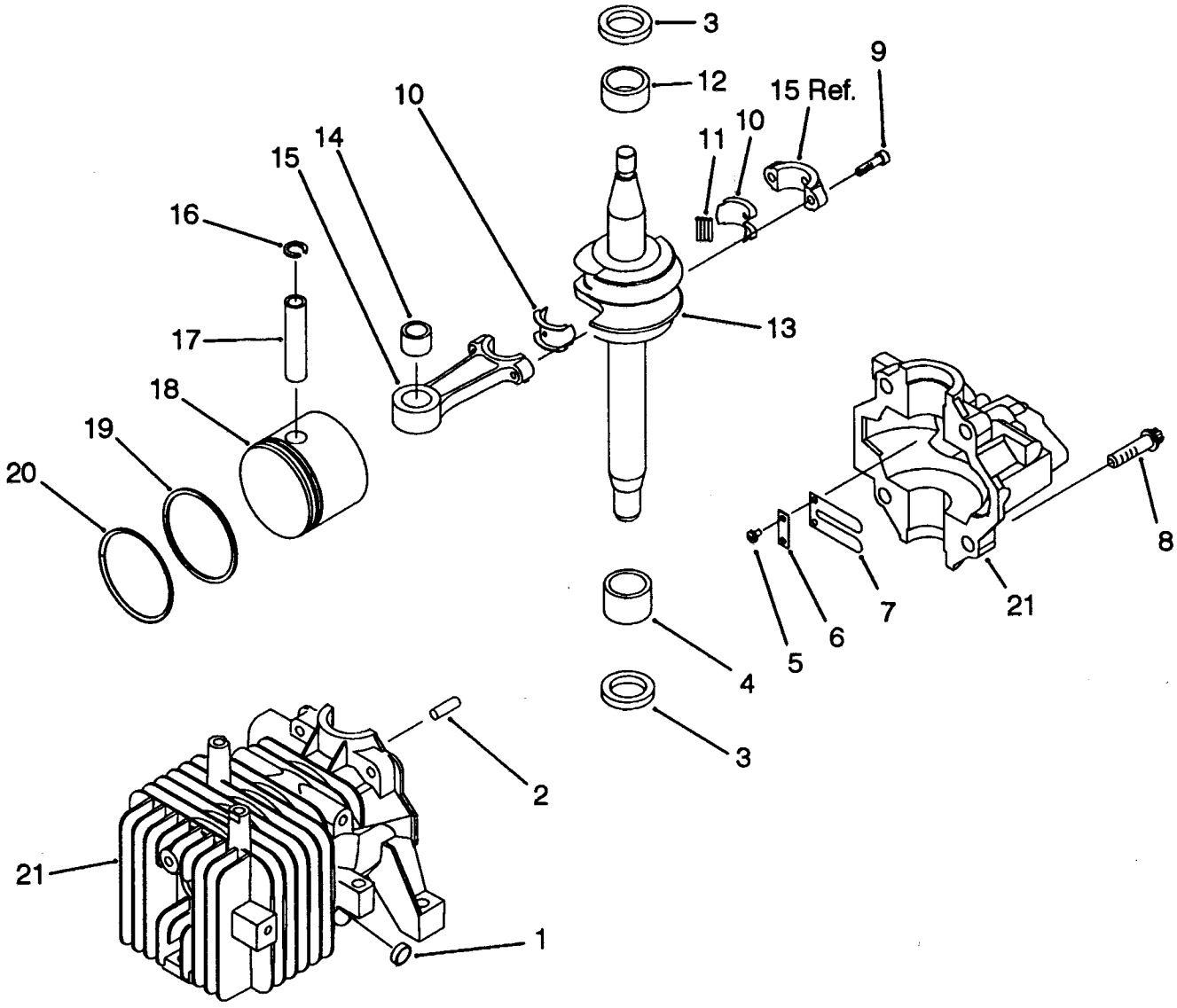
Figure 83

6. Operate the blade control bail to verify that the brake mechanism stops within three (3) seconds. There is no adjustment needed after this assembly process is completed.

APPENDIX A

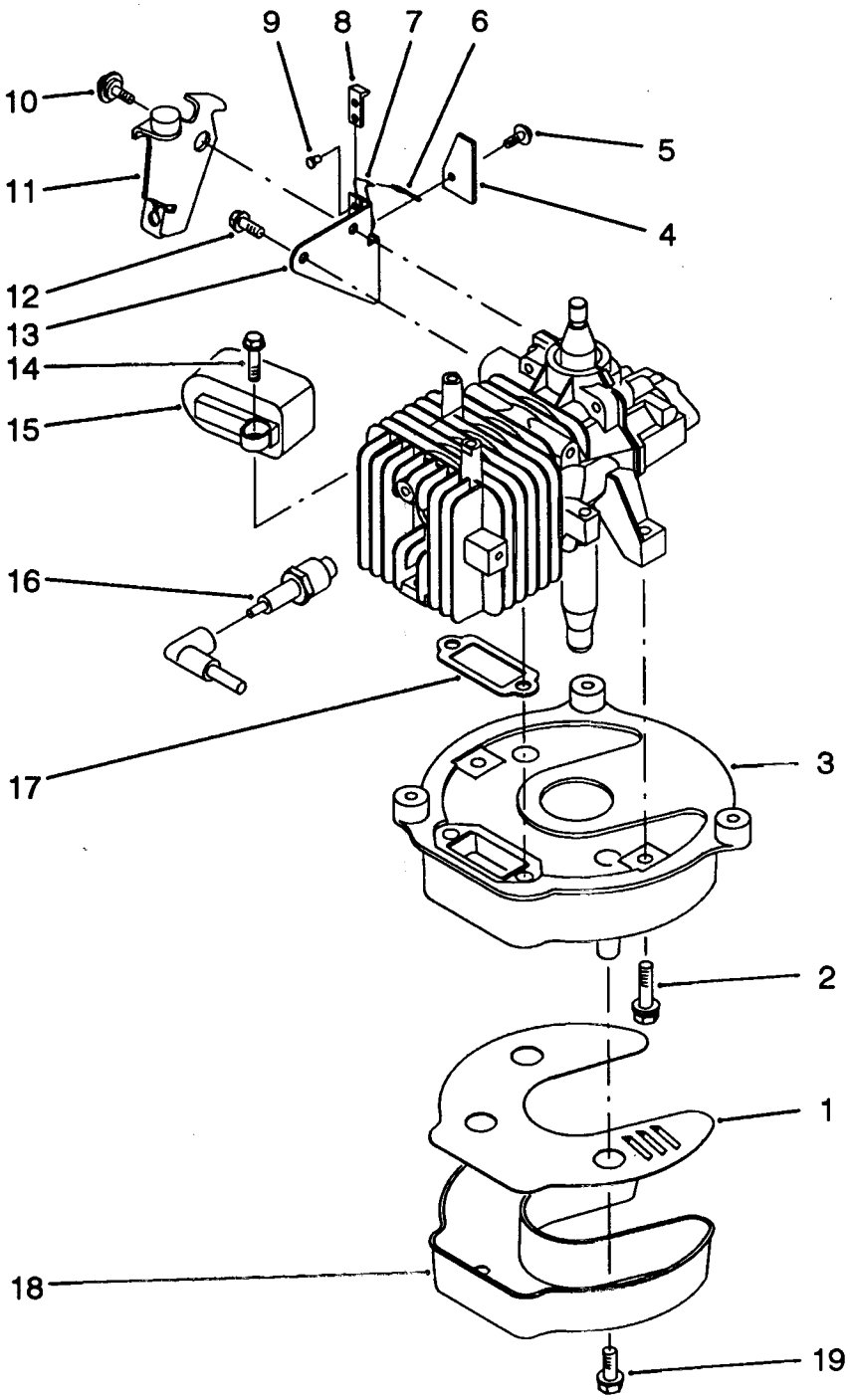
This appendix contains an assortment of diagrams which may help you in the service and repair of the V Engine. They are listed below as they appear on the following pages of this section.

Power Head - Exploded View



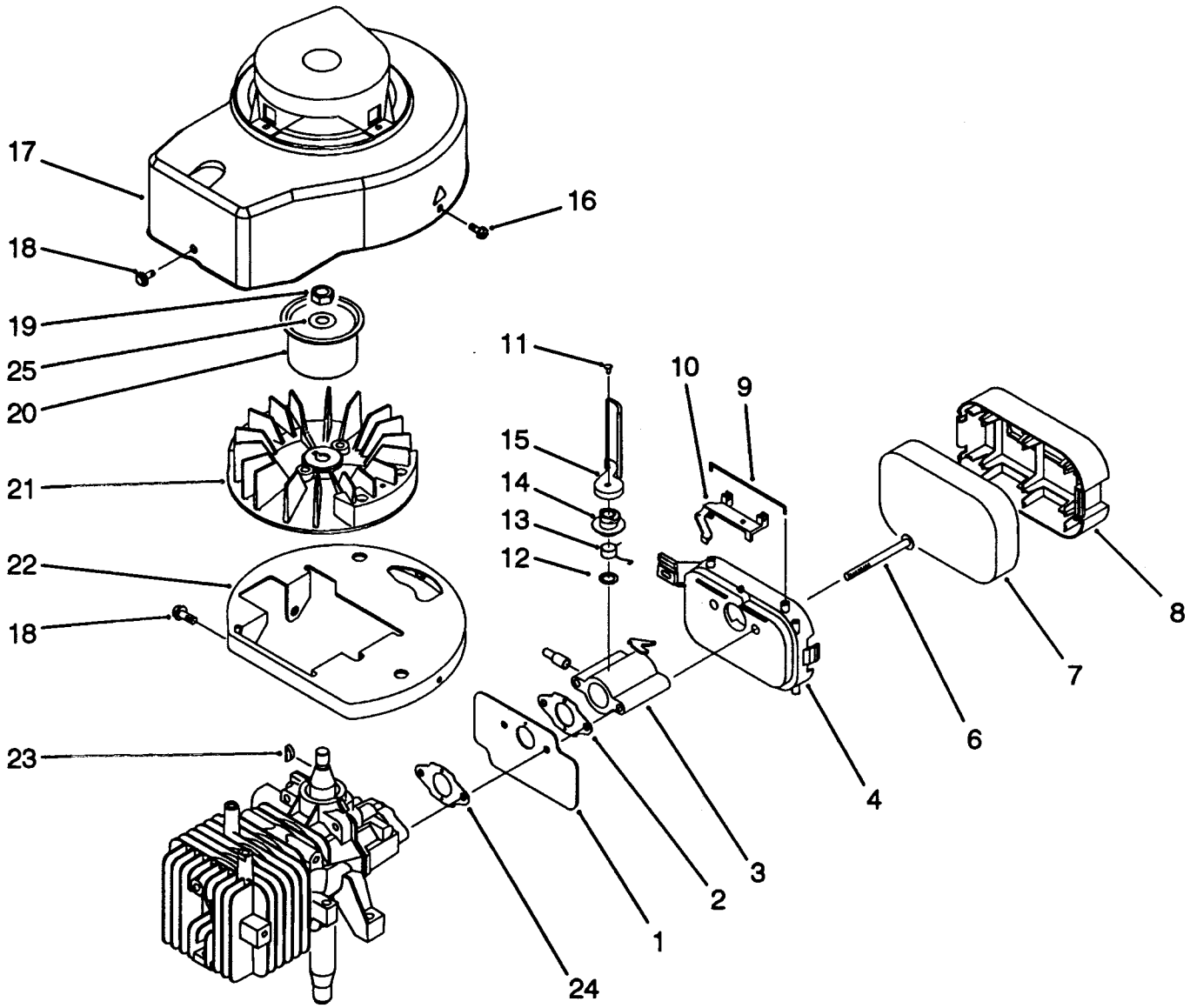
1 - Core plug (4)
2 - Dowel
3 - Oil Seal (2)
4 - Needle bearing
5 - Slotted head screw (2)
6 - Reed backup plate
7 - Carburetor reed
8 - Washer head hex screw (4)
9 - HSH cap screw (2)
10 - Split liner (2)
11 - Needle Bearings
12 - Upper main bearing
13 - Crankshaft
14 - Bearing
15 - Connecting rod assembly
16 - Retaining ring
17 - Wrist pin
18 - Piston
19 - Piston ring
20 - Top piston ring
21 - Cylinder and crankcase assembly
22 - Sealant (not illustrated)

Ignition and Exhaust - Exploded View



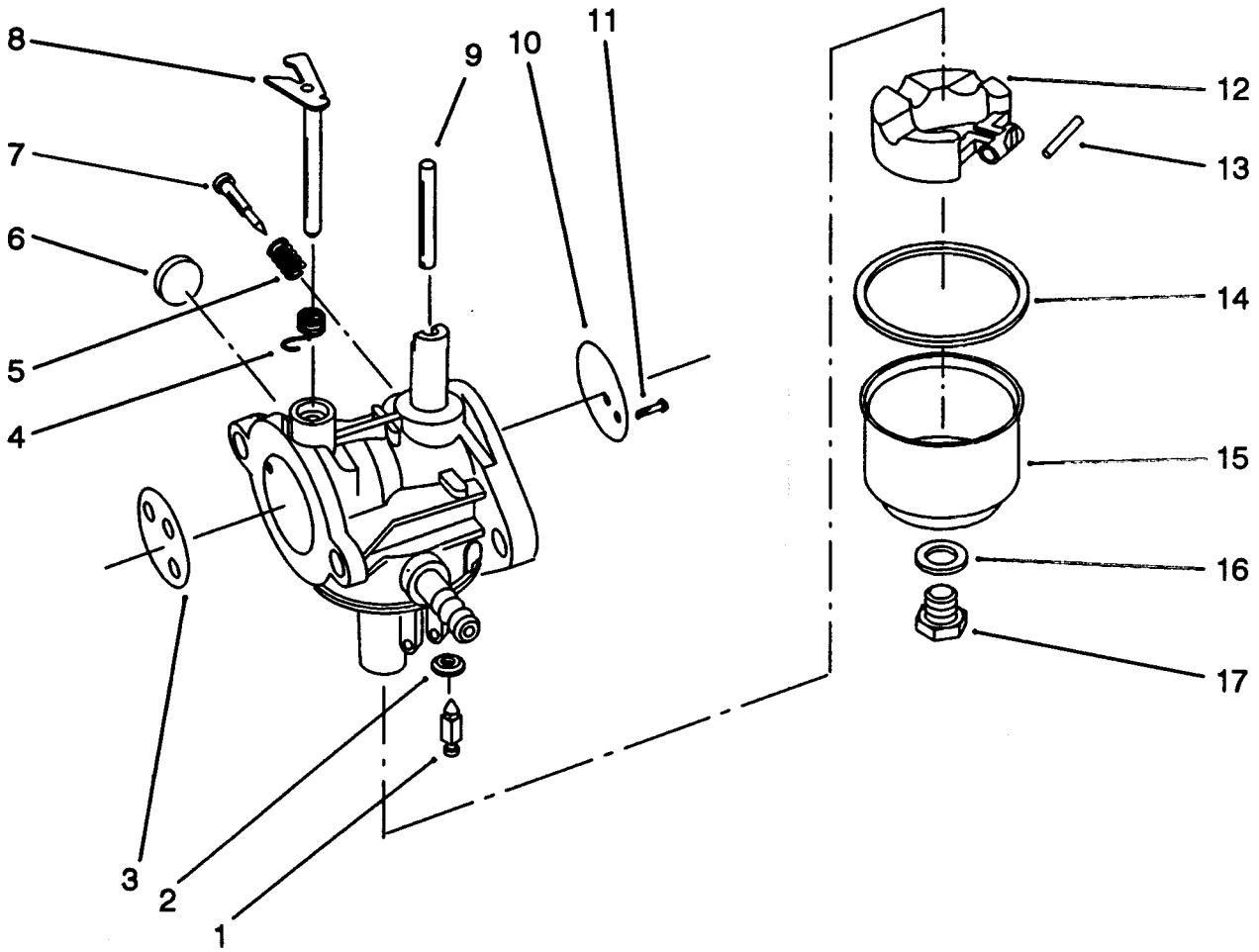
1 - Baffle
2 - Screw (4)
3 - Muffler plate
4 - Ground strap stop
5 - Self-tapping screw
6 - Brake switch leadwire
7 - Ground strap
8 - Insulation strap
9 - Self-expanding plastic rivet (2)
10 - Shoulder screw
11 - Brake plate assembly
12 - Screw
13 - Brake mounting plate
14 - Hex washer-head screw
15 - CD ignition pack
16 - Spark plug
17 - Exhaust gasket
18 - Muffler cover
19 - Screw (3)

Starter and Walbro LMR-16 Carburetor - Exploded View



1 - Carburetor heat shield
2 - Gasket
3 - Carburetor assembly
4 - Air filter base
5 - (not used)
6 - Screw (2)
7 - Air filter
8 - Air filter cover
9 - Retainer
10 - Lever
11 - Screw
12 - Washer
13 - Throttle spring
14 - Air vane collar
15 - Air vane
16 - Screw (3)
17 - Shroud assembly
18 - Hex flange nut (4)
19 - Nut
20 - Starter hub
21 - Flywheel assembly
22 - Shroud base
23 - Key
24 - Carburetor gasket
25 - Lockwasher

Walbro LMR-16 Carburetor - Exploded View

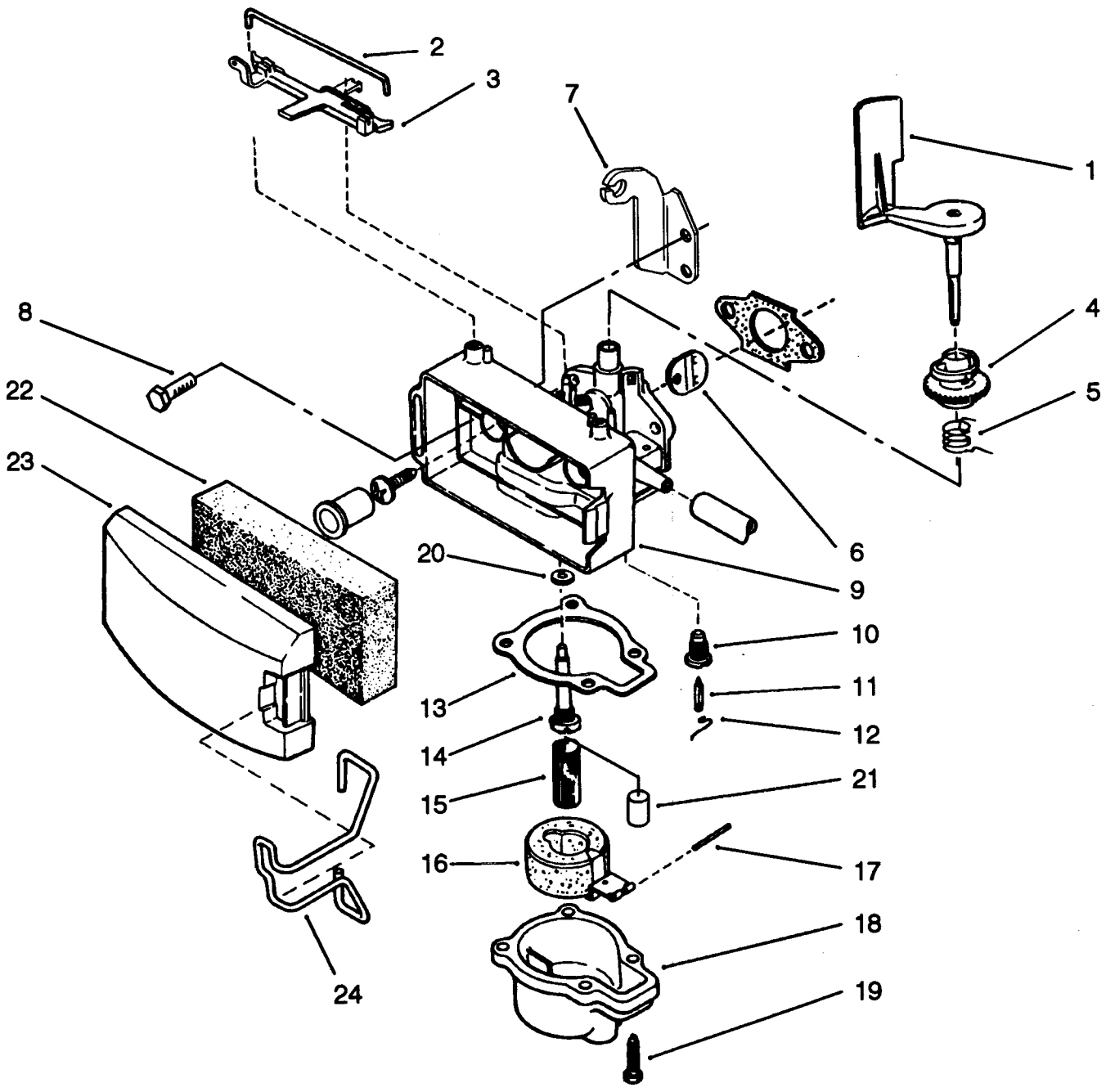


Ref No.	Part No.	Description	Quantity
1		Valve inlet needle	1
2		Valve seat	1
3		Choke valve	1
4		Choke return spring	1
5		Idle needle spring	1
6		Welch plug	2
7		Idle needle	1
8		Choke shaft	1
9		Throttle shaft	1
10		Throttle valve	1
11		Throttle valve screw	1
12		Float	1
13		Float shaft	1
14		Bowl gasket	1
15		Fuel bowl	1
16		Bowl retainer gasket	1
17		Bowl screw	1

Ref No.	Part No.	Description	Quantity
*	684286	Throttle kit (Includes 9, 10, & 11)	1
•	684285	Idle needle kit (Includes 5 & 7)	1
*	683783	Float assembly kit (Includes 12, 13, & Bowl kit)	1
*	682782	Bowl kit (Includes 15, 17, & Gasket kit)	1
*	683778	Gasket kit (Includes 14 & 16)	1
•	683777	Overhaul kit (Includes 1, 2, 6, 13, & Gasket kit)	1
*	683781	Choke kit (Includes 3, 4, & 8)	1

* = Not illustrated

Primer Start Carburetor Assembly - Exploded View



1 - Air vane
2 - Retainer
3 - Lever
4 - Air vane collar
5 - Throttle spring
6 - Throttle plate
7 - Cable bracket
8 - Screw (2)
9 - Air filter base
10 - Inlet seat
11 - Inlet needle
12 - Retainer
13 - Gasket
14 - Main nozzle
15 - Filter screen
16 - Float
17 - Float pin
18 - Carburetor bowl
19 - Screw (4)
20 - Washer
21 - Main jet
22 - Air filter
23 - Air filter cover
24 - Air filter cover retainer