Small Engine Service & Repair

Second Edition

Student Reference

10-7650-S

Step by Step Procedure
Set of 8 Student Manuals

In cooperation with
Agricultural Education Department of Practical Arts and Vocational-Technical Education
College of Education and College of Agriculture, Food and Natural Resources
University of Missouri-Columbia

MISSOURI AGRICULTURAL EDUCATION

Agricultural Education Section Division of Vocational and Adult Education
Department of Elementary and Secondary Education, *Jefferson City, Missouri*

10-7650-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Set of 8 Student Manuals

Instructional Materials Laboratory
University of Missouri - Columbia

Small Engine Repair Series

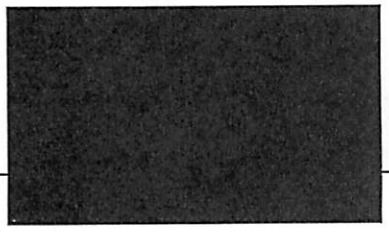
Step-By-Step Procedure Manuals

10-7661-I	Instructor	***Small Engine Service and Repair - Instructor Guide***
10-7651-S	Module 1	***Installing Magnetron Ignition and Breaker Points***
10-7652-S	Module 2	***Carburetor Service and Repair***
10-7653-S	Module 3	***Rewind Starters***
10-7654-S	Module 4	***Compression***
10-7655-S	Module 5	***Governors***
10-7656-S	Module 6	***Lubricating Small Engines***
10-7657-S	Module 7	***Troubleshooting Small Engines***
10-7658-S	Module 8	***Operation and Maintenance of Small Engines***

These manuals are available from:

Instructional Materials Laboratory
University of Missouri-Columbia
10 London Hall
Columbia, Missouri 65211

1-800-669-2465

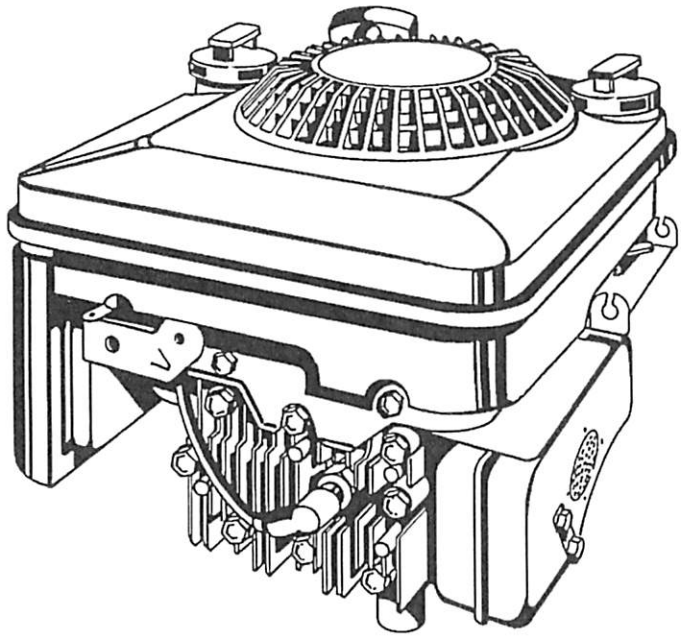


10-7651-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Installing Magnetron Ignition and Breaker Points

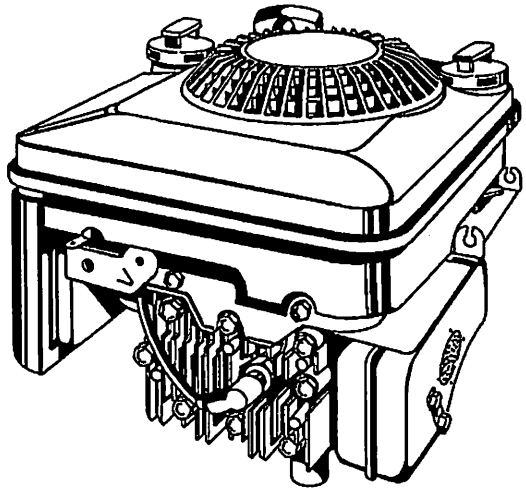


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

MODULE 1

Installing Magnetron Ignition and Breaker Points



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed their time and talents in the development of Installing Magnetron® Ignition and Breaker Points, Second Edition.

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Kristin Desborough, Word Processor
Linda Winn, Graphic Designer

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References

Service and Repair Instructions, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gas Engines, Alfred C. Roth,, The Goodheart-Wilcox Comapnay, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine Service Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Unit Objectives

After completion of this unit, you should be able to identify tools and their appropriate use, properly install the Composite Magnetron® Ignition, and test the system. This knowledge will be evidenced by your ability to properly install the Composite Magnetron® Ignition System, test it, and have it perform correctly.

Specific Objectives

After completing this unit, you should be able to:

1. Identify and use Magnetron® Ignition System installation tools.
2. Identify Composite Magnetron® Ignition Systems.
3. Install Composite Magnetron® Ignition Systems.
4. Test the Magnetron® Ignition Systems.

Installing and Servicing Composite Magnetron® Ignition Systems

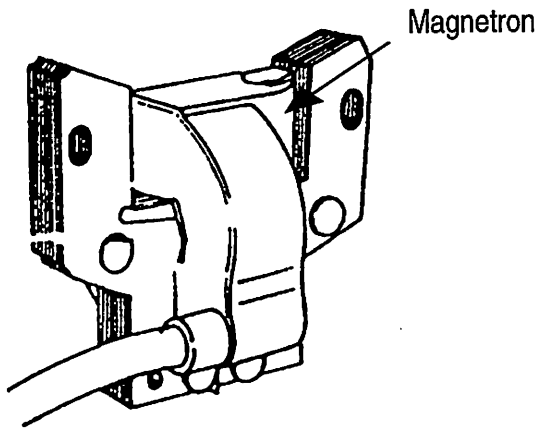
Step-by-Step Procedure

Introduction

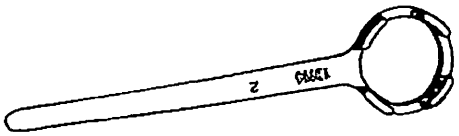
The Magnetron® Ignition System is now a standard feature on all Briggs & Stratton small engines. The Magnetron® transistor and inductor coil are encased around the ignition coil body. It has proven to be a high-quality ignition system.

The Magnetron® Ignition System is designed to provide a strong spark in the combustion chamber of a small engine at the proper time for igniting the fuel-air mixture.

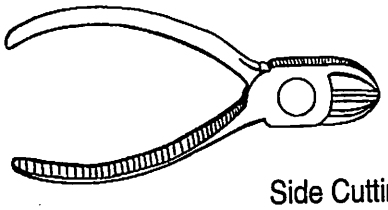
Detailed procedures for servicing the system are covered in this module.



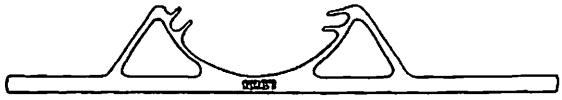
Tools



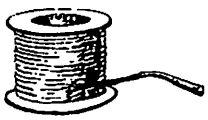
Starter Clutch Wrench



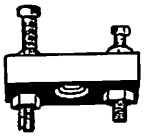
Side Cutting Pliers



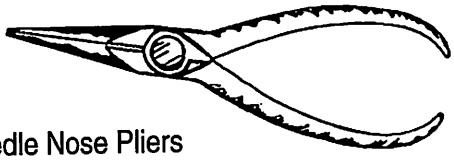
Flywheel Holder



60-40 Solder

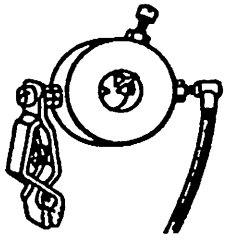


Flywheel Puller



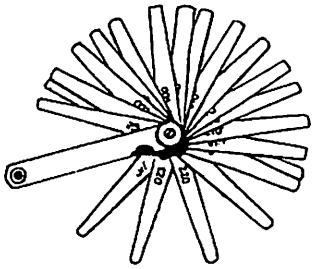
Needle Nose Pliers

Slot Head Screwdriver



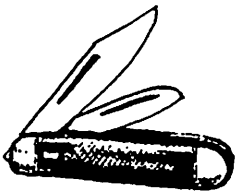
Spark Tester

Starter Clutch Wrench



Feeler Gauge

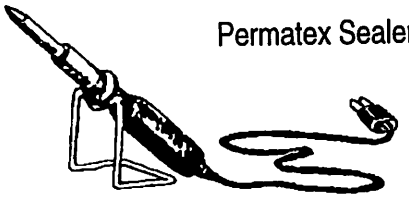
Plunger Plug



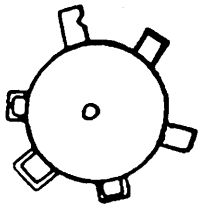
Pocket Knife

Penetrating Oil

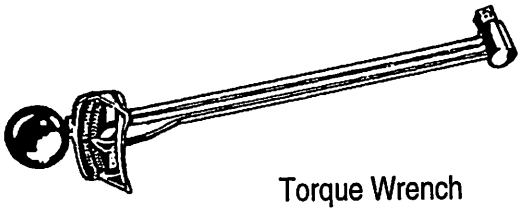
Permatex Sealer



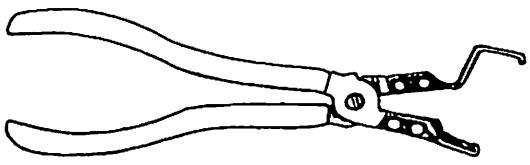
Soldering Iron



Spark Plug Gap Tool

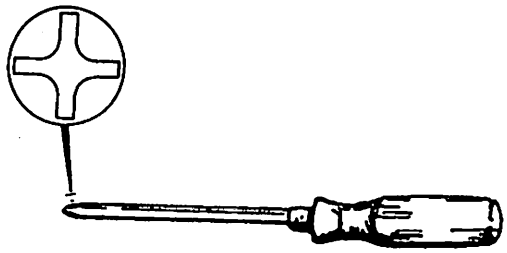


Torque Wrench

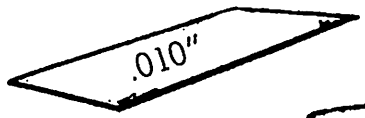


Condenser Spring Compressor

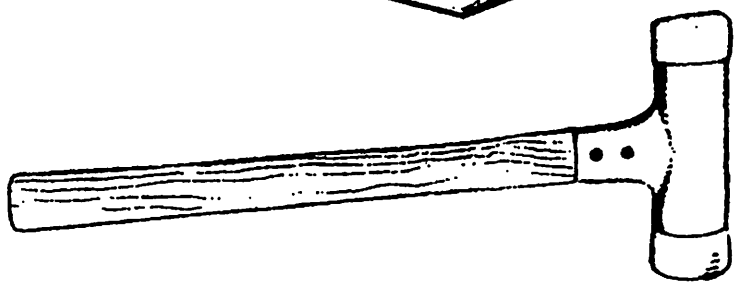
Breaker Points and Condenser



Phillips Screwdriver

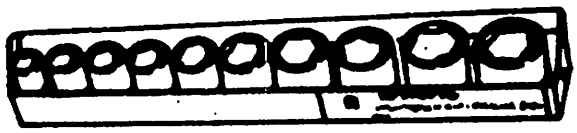


Shim Stock

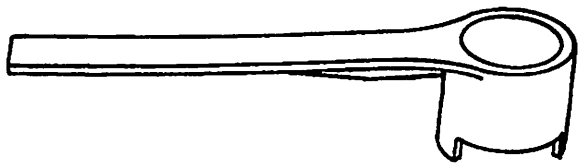


Mallet

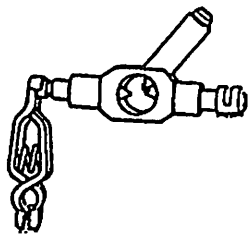
Box Wrench



Socket Set

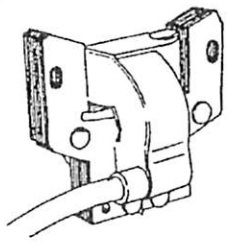


Flywheel Holder



Spark Tester

B. Step-By-Step Procedure For Servicing a Composite Magnetron® Ignition Armature



Testing

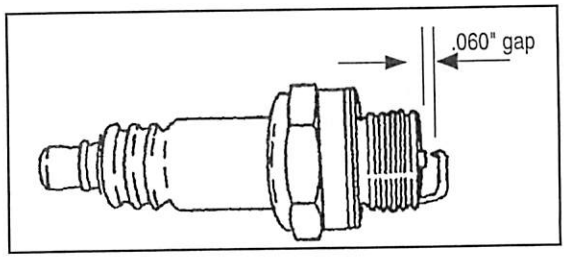
1. Read operator's manual and *Briggs & Stratton's Service And Repair Instructions.*

2. Organize your work station. When disassembling engine, place bolts, nuts and parts in containers for safekeeping.

3. Wear proper safety equipment.

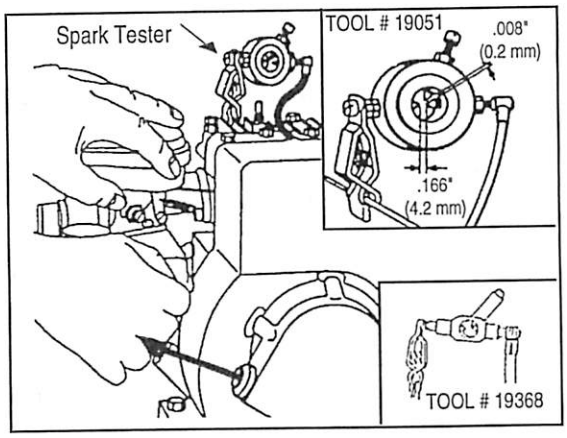
4. Select proper tools and supplies (see section A).

5. Disconnect spark plug wire and remove spark plug.



6. Check ignition. Use a new spark plug and gap electrode to .060". Install spark plug. If the engine will start and accelerate properly with this wide gap, the spark is good. Remove and regap new plug to .030 and install.

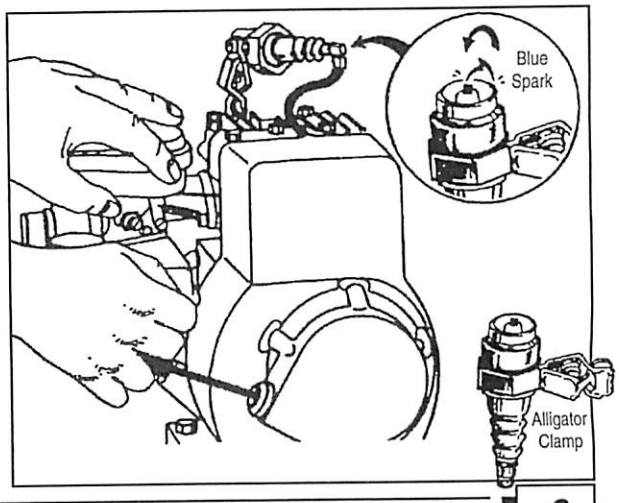
   If engine does not start and accelerate properly and is **not equipped with a 12-volt starter**, proceed to Step 7. If the engine does not start properly and **is equipped with a 12-volt starter**, proceed to **Optional Step 7.**



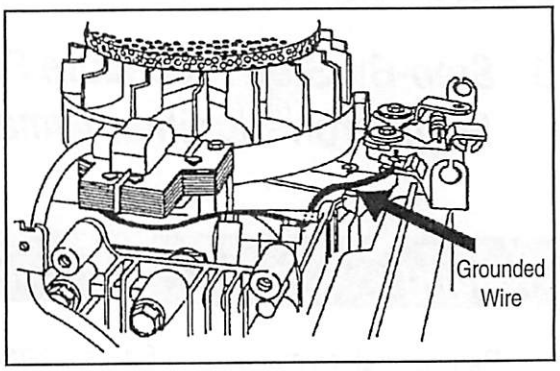
7. Troubleshoot Magnetron® Ignition System *without 12-volt system.*

WARNING: DO NOT REMOVE SPARK PLUG WHEN CHECKING IGNITION. A fire or explosion may occur.

a. Two methods of testing spark can be used:
(1) Use Briggs & Stratton tester 19051 or 19368. Spin flywheel rapidly with one end of the ignition cable clipped to the tester and with the other end of the tester grounded to the cylinder head. If spark jumps the .166" tester gap the system is functioning satisfactorily. In testing Magnetron® ignition, the flywheel must rotate at least 350 RPM.



(2) Using a test plug, rotate flywheel a minimum of 350 RPM and observe the spark. If the gap is a bright blue color, the system is functioning satisfactorily.

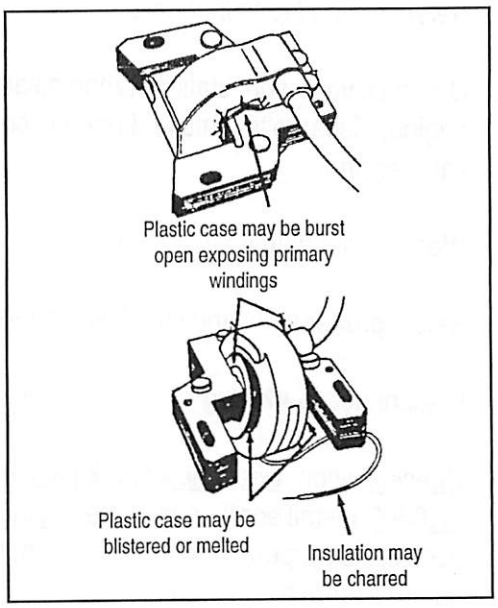


<u>If spark does not jump the tester gap, check the following:</u>

- Armature air gap is too wide.
- Kill switch wire is grounded.
- Ignition armature ground wire is broken.
- Other external wires are broken.
- Ignition switch is defective.
- Armature is defective.

OPTIONAL 7. Troubleshoot ignition armature equipped with Magnetron® on engines *with 12-volt starters.*

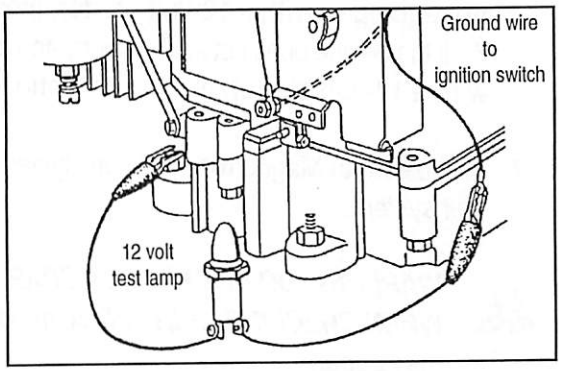
a. <u>Observe condition of the armature</u>. If the plastic case of the coil has burst open, or if the coil's primary wires and insulation are charred, check the ignition switch and electrical connections before installing new ignition armature.

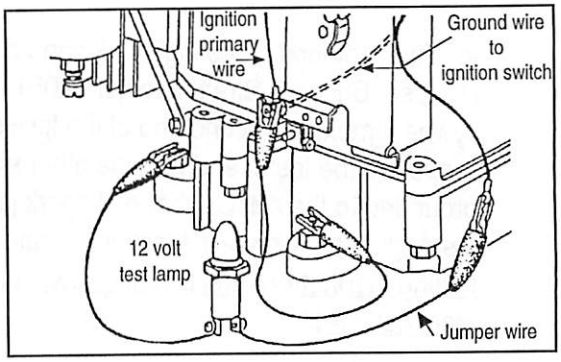


NOTE: Complete armature assembly MUST be replaced if equipped with an Integral Magnetron®.

NOTE: Damage can occur when high current from the battery is accidentally directed through the primary windings of the armature coil. This is caused by a defective ignition switch. If battery current flows through the primary windings of the armature coil, even for a few seconds, the coil can be damaged. The Magnetron® module is usually not affected when the armature coils are damaged.

b. <u>Check for a defective ignition switch</u>. Disconnect ground wire at terminal on engine. Connect a test lamp or voltmeter between ground and the end of the ground wire lead as illustrated. If test lamp lights even momentarily, switch is defective and must be replaced. Actuate switch a minimum of 50 times during the test.





8. Disable engine from starting. Short the spark plug wire to ground, or attach a jumper wire between ground and the remote magnet to ground wire terminal as illustrated.

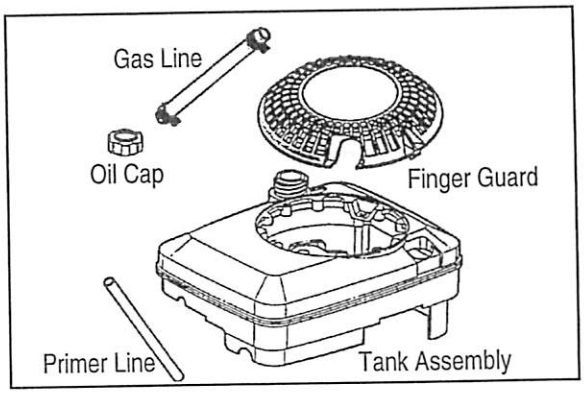
Illustrations courtesy of Briggs & Stratton Corporation

Disassembly

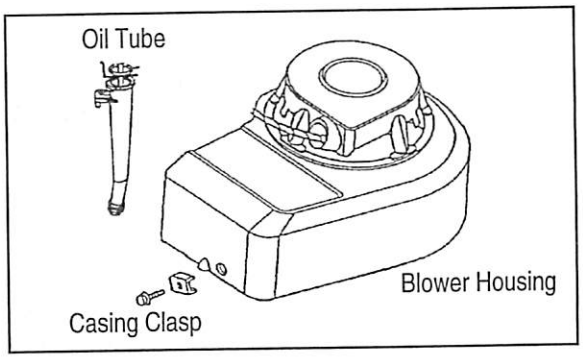
9. Remove tank assembly to access blower housing.

   a. Finder guard
   b. Oil cap
   c. Gas line
   d. Primer line (if available)

   NOTE: On some models you may not have tank assembly.



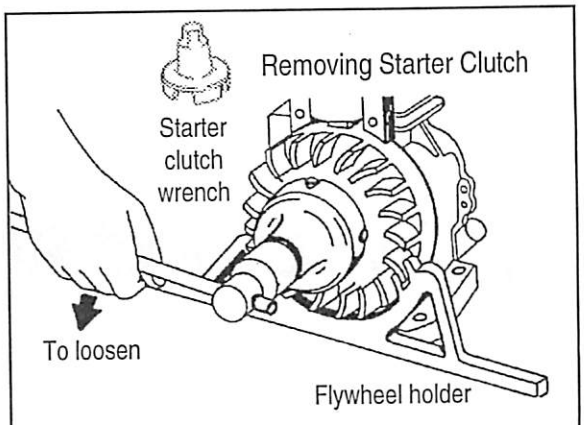
10. Remove blower housing, oil tube and casing clamp. You now have access to the armature.

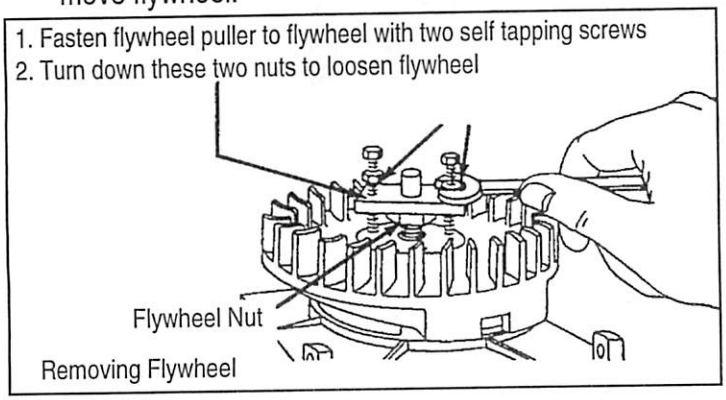


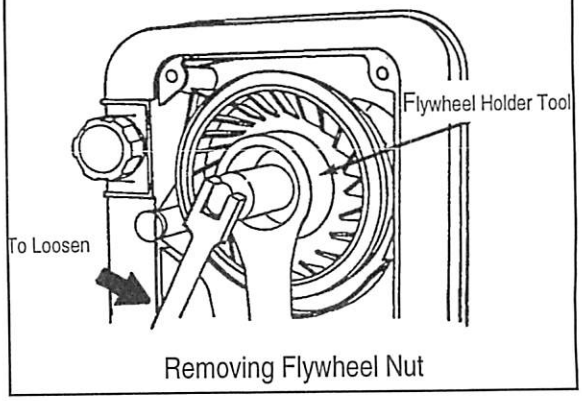
11. Test Magnetron® Armature. Specifications are supplied by Tester Mfg. Refer to MS-7862, Testing Briggs and Stratton Coils.

    NOTE: Removal of flywheel is not required when removing Magnetron® armatures except to inspect flywheel key and key ways on crankshaft and flywheel.

12. Replace and check flywheel key. Remove screen from flywheel. Remove starter clutch or flywheel nut. Remove flywheel.



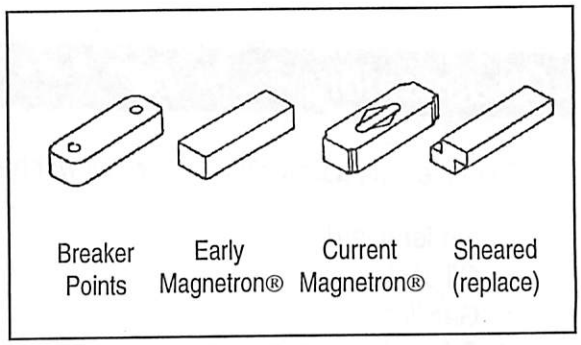




Illustrations courtesy of Briggs & Stratton Corporation

13. Inspect flywheel key and key ways, flywheel and crankshaft.

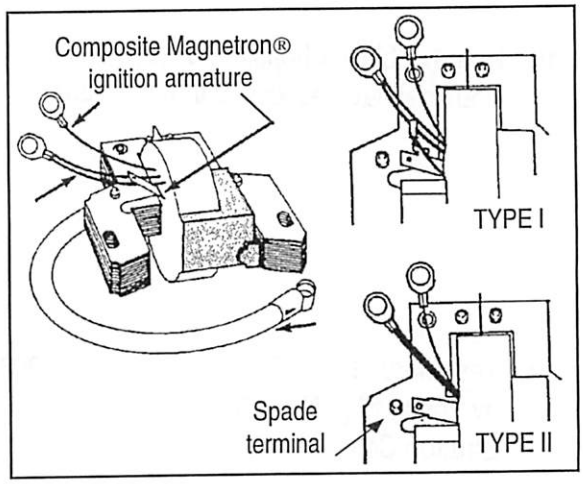
NOTE: Timing of Magnetron® ignition is controlled by the flywheel key on all model series except 230000, 240000 and 320000.



NOTE: You will have determined if the Magnetron® Armature needs to be replaced. Use the following procedures to replace the Magnetron Armature.

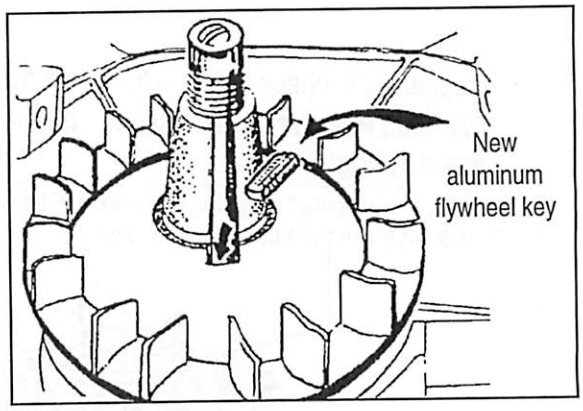
14. To service the Composite Magnetron® ignition armature assembly, first remove armature mounting screws and lift off armature. Disconnect stop switch wire at spade terminal on composite armatures.

Note: Magnetrons® are produced in two versions, composite (Type I, Type II) and replaceable module.



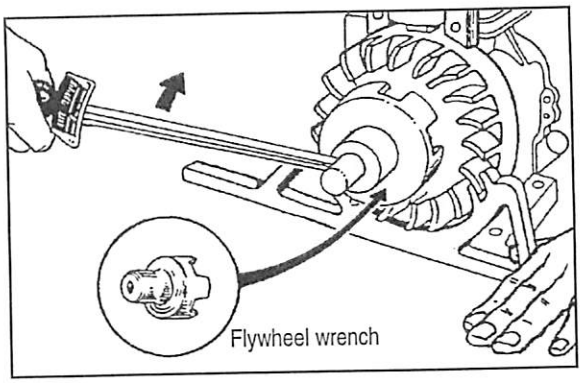
Reassembly

15. Clean crankshaft and flywheel taper of oil or dirt. Slide the flywheel onto crankshaft and line up both key ways. **Insert new flywheel key into key way.**



Illustrations courtesy of Briggs & Stratton Corporation

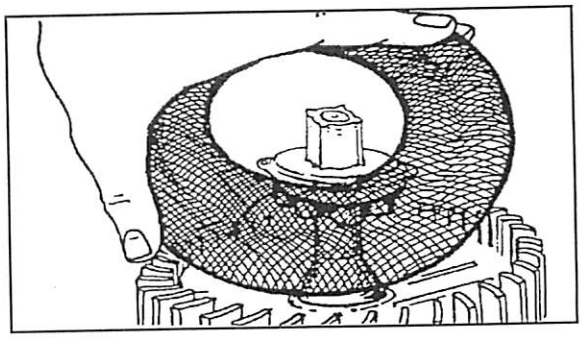
16. Install Belleville Washer on crankshaft with hollow side toward flywheel. Place starter clutch onto crankshaft and torque to specification. See chart.



FLYWHEEL TORQUE

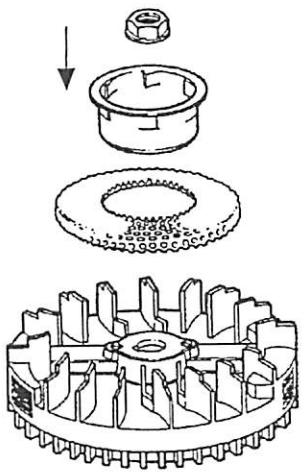
Basic Model Series	Ft./Lbs.	Mkg
60000, 80000, 90000, 110000	55	7.9
100000, 130000	60	8.3
140000, 170000, 190000, 220000, 250000	65	9.3
233400, 243400, 326400 400000, 420000	145	20.0

17. Attach flywheel screen.



18. Install (when used) fan retainer or rotating screen cup and flywheel nut. Torque to specifications.

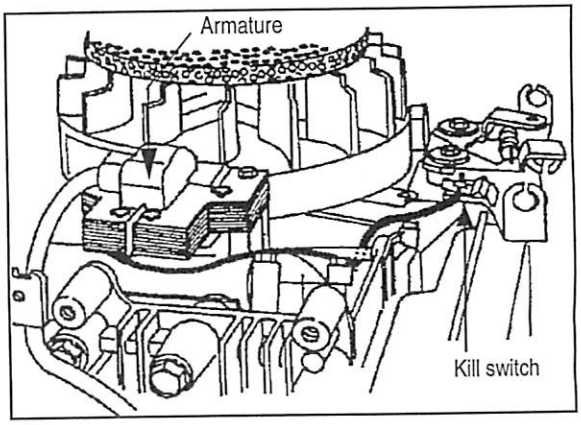
NOTE: Torque flywheel nut to 55 ft. lbs.



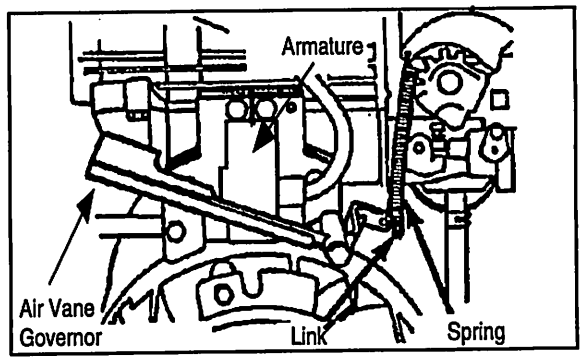
19. Install new Magnetron® ignition armature on engine.

    a. On engines with optional internal governor. Route and connect stop switch wire to kill switch.

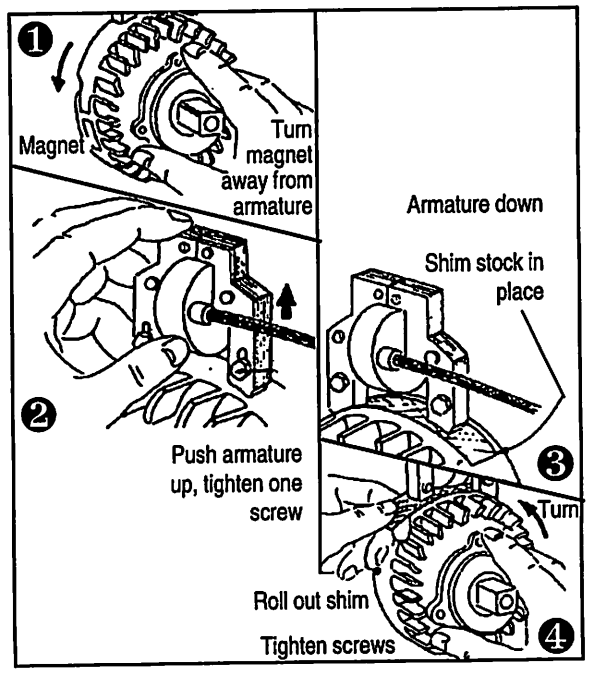
    NOTE: Make sure you have installed armature with rivet head up.



b. On engines with an air vane governor, the mounting holes of the armature are slotted. Push armature away from flywheel as far as possible and tighten one mounting screw. You are now ready to set the air gap.



20. With armature away from flywheel, place the proper thickness gauge between armature and flywheel. While holding gauge, turn flywheel until magnets are directly below laminations. Loosen the one screw holding armature and let magnets pull armature down against flywheel. Tighten both mounting screws. Rotate flywheel and remove gauge.

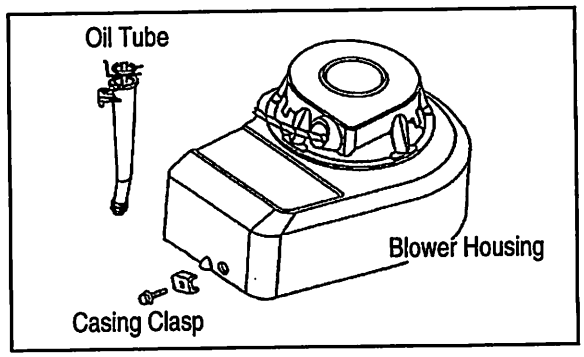


21. Determine flywheel/armature air gap. See chart for air gap specifications.

FLYWHEEL ARMATURE AIR GAP

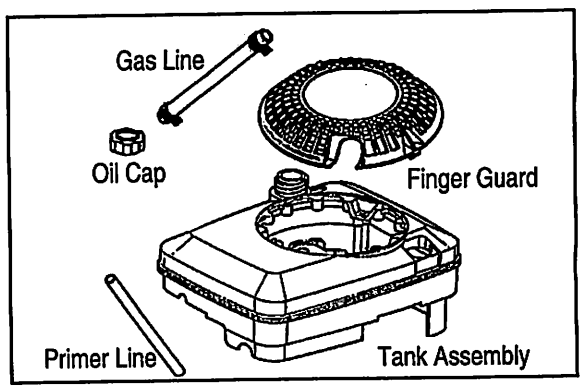
Basic Model Series	Inches	mm
60000, 80000, 90000, 110000	.010	0.15/0.25
62000	.010	0.15/0.25
100000, 130000	.010/.014	0.25/0.36
140000, 170000, 190000, 220000, 250000	.010/.014	0.25/0.36
233400, 243400, 326400 400000, 420000	.010/.014	0.25/0.36

22. Install blower housing, oil tube and casing clamp.



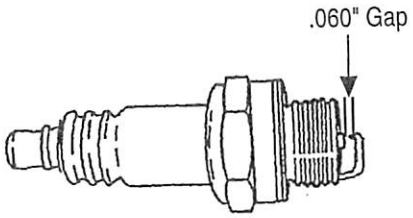
23. Install tank assembly (when used).

a. Finger guard
b. Oil cap
c. Gas line
d. Primer line (if available)

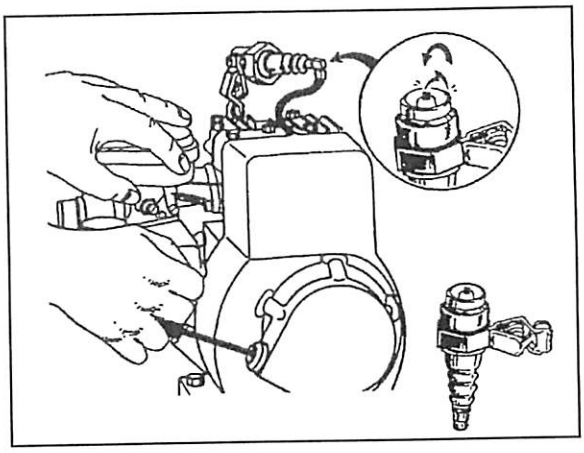


Illustrations courtesy of Briggs & Stratton Corporation

Testing

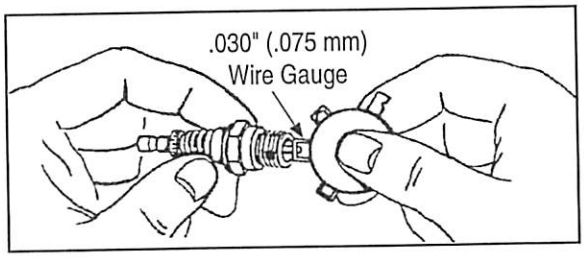


24. Check Ignition (Magnamatic).



(a) Use a new spark plug. Gap electrode to .060". Install spark plug. If the engine will start and accelerate properly with this wide gap, the spark is good.

(b) Using a test spark plug, rotate flywheel a minimum of 350 RPM and observe the spark. The gap should be a bright blue color. The system is functioning satisfactorily.



25. Gap new spark plug to .030" gap and install.

NOTE: Always use a wire gauge.

26. Clean your work area and return tools and equipment to their proper places.

Installing and Servicing Composite Magnetron® Ignition Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed when installing and servicing a Composite Magnetron® ignition system. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and assembly.

Yes	No		Disassembly
___	___	1.	Read *Briggs & Stratton Service and Repair Instructions.*
___	___	2.	Organize your work station.
___	___	3.	Wear proper safety clothing.
___	___	4.	Select proper tools and equipment.
___	___	5.	Disconnect spark plug wire and remove spark plug.
___	___	6.	Check ignition.
___	___	7.	Troubleshoot Ignition System.
___	___	8.	Disable engine from starting.
___	___	9.	Remove tank assembly.
___	___	10.	Remove blower housing, oil tube and casing clamp.
___	___	11.	Test Magnetron® armature.
___	___	12.	Replace and check flywheel key.
___	___	13.	Inspect flywheel key and key ways, flywheel and crankshaft.
			Reassembly
___	___	14.	Service the Composite Magnetron® armature assembly.
___	___	15.	Clean crankshaft and flywheel taper.
___	___	16.	Install Belleville Washer.
___	___	17.	Attach flywheel screen.
___	___	18.	Install fan retainer. Torque to specifications.
___	___	19.	Install new Magnetron® ignition armature.
___	___	20.	Adjust proper armature and flywheel gap.
___	___	21.	Adjust flywheel and armature air gap.
___	___	22.	Install blower housing, oil tube and casing clamp.
___	___	23.	Install tank assembly (when used).
___	___	24.	Check ignition.
___	___	25.	Gap new spark plug to specifications.
___	___	26.	Clean work area and return tools and equipment to proper places.

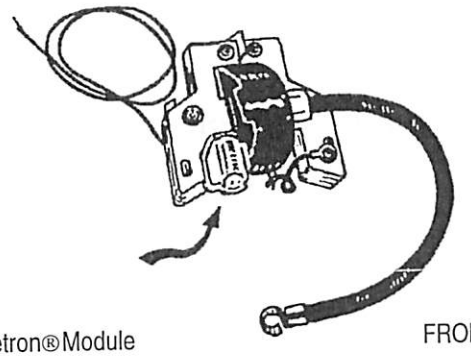
Student's Signature _____ Instructor's Signature _____ Date _____

Magnetron® Retrofit Installation

Step-by-Step Procedure

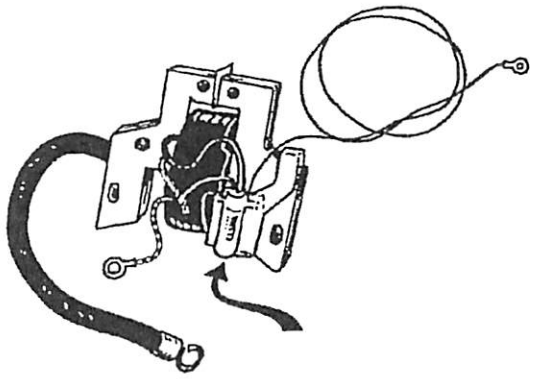
Introduction

The new Briggs & Stratton ignition system (no breaker points and condenser) is called Magnetron®. It is possible, with a minimum effort, to retrofit the Magnetron® ignition system to most older engines equipped with breaker points and condenser.



Magnetron® Module

FRONT VIEW



REAR VIEW

Magnetron® Module

Magnetron Retrofit Installation

Step-by-Step Procedure

Unit Objectives

After completing this unit, you should be able to identify tools and how to properly use them, properly install a Magnetron Retrofit ignition, and test the system. This knowledge will be evidenced through your ability to propely install Magnetron Retrofit Ignition, test it and have it perform correctly.

Specific Objectives

After completion of this unit, you should be able to:

1. Identify tools and their proper use.
2. Identify component parts of the Magnetron.
3. Install the "Magnetron" Retrofit module.
4. Test the "Magnetron" Retrofit ignition.

A. Tools and Supplies

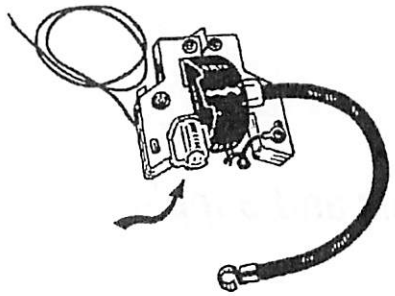
Tools

Spark plug wrench 3/4", 13/16"
Slot head screwdrivers 4", 6"
Phillips head screwdrivers 4", 6"
Putty knife
Socket set 3/8", 7'16"
Wire feeler gage
Flywheel holder tool
Starter clutch wrench
Flywheel puller
Torque wrench
Needle nose pliers
Soldering iron
Side cutting pliers
Condenser spring compressor
Air gap gauge .010

Supplies

Penetrating oil
New spark plug
Magnetron Ignition Kit
60/40 solder (rosin core)
Permatex No. 2 (or similar sealer)

B. Installing Magnetron® Retrofit Kit



Disassembly

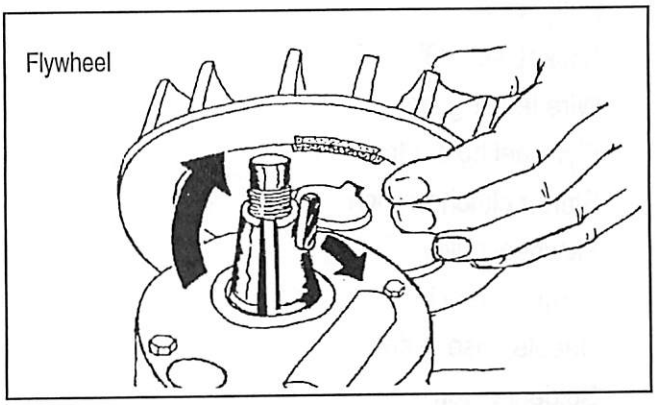
1. Read operator's manual and *Briggs & Stratton Service and Repair Instructions.* Magnetron® Ignition System Module can only be used on 7-hp (or larger) engines equipped with a two-leg armature.

2. Wear proper safety equipment.

3. Select proper tools and equipment.

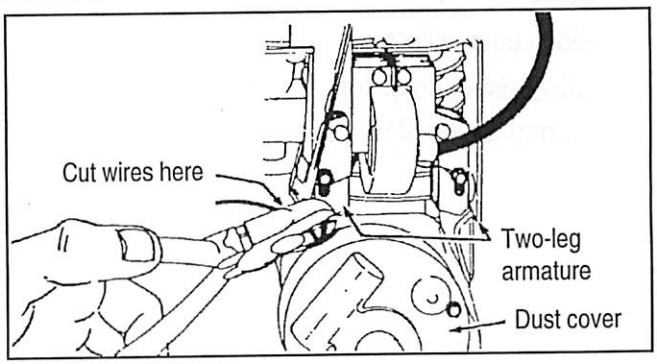
4. Disconnect spark plug wire and remove spark plug. Remove blower housing, screen, starter clutch or nut, flywheel and flywheel key.

   NOTE: Discard the old key. A new key is furnished in Magnetron® Ignition Kit.
   NOTE: The old ignition will be inactive. You may leave it in place as in step 5 or remove it as in step 6.



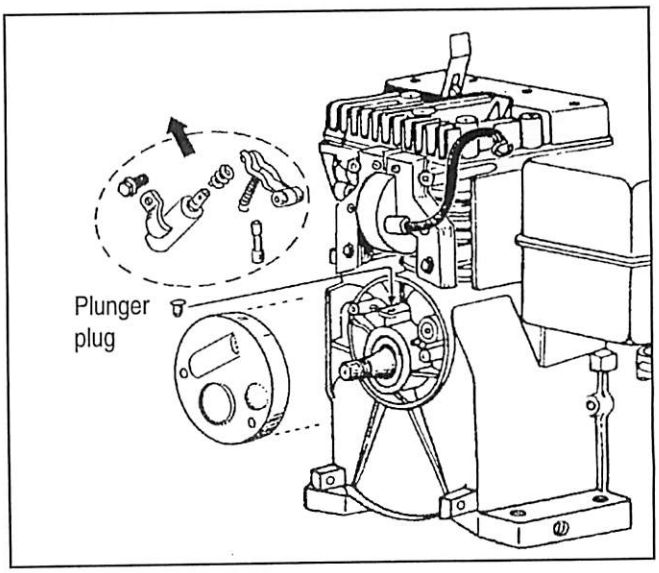
5. Cut armature primary and stop switch wires as close as possible to the dust cover when leaving the old ignition.

   NOTE: This step applies only when leaving the old ignition on the engine.
   NOTE: Magnetron Ignition System Module can only be used on engines equipped with a two-leg armature.



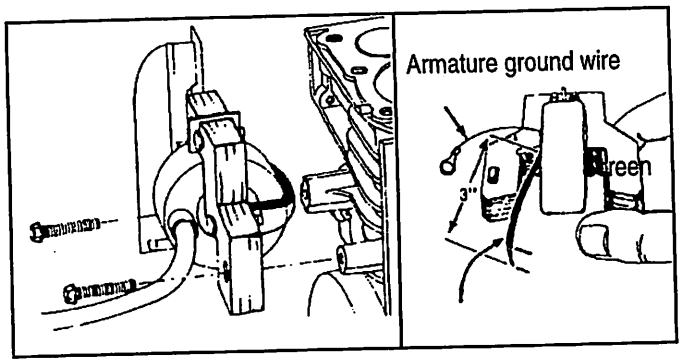
6. Remove dust cover, breaker points, condenser, and plunger. **Plunger hole must be plugged using part #231143.** Place dust cover on engine.

   NOTE: Follow this step only when removing the breaker points, condenser and plunger. Do this when excessive oil is entering the plunger hole into the ignition.

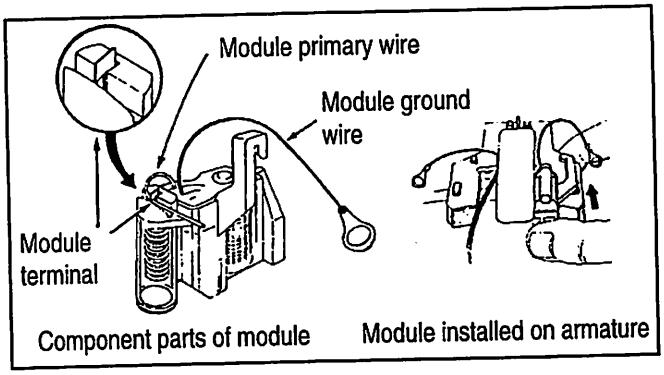


Illustrations courtesy of Briggs & Stratton Corporation

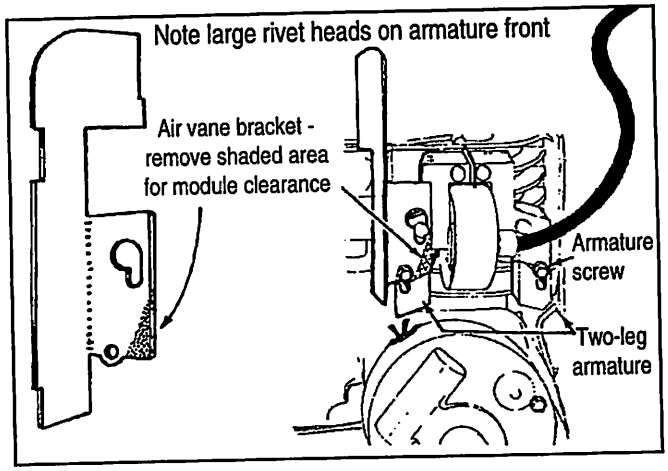
7. Remove screws and armature from the engine. Now cut armature primary wire 3". Strip insulation 5/8" and clean wire. Be sure varnish is removed and wire is not nicked or cut.



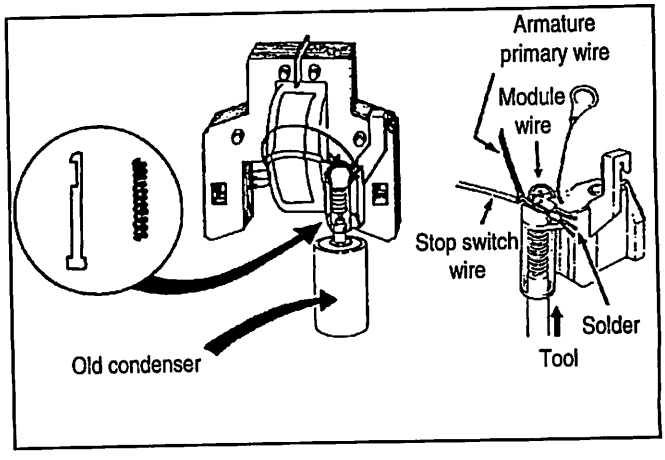
8. Install module as shown in illustration. Air vane brackets or guides on armature must be altered for module clearance.



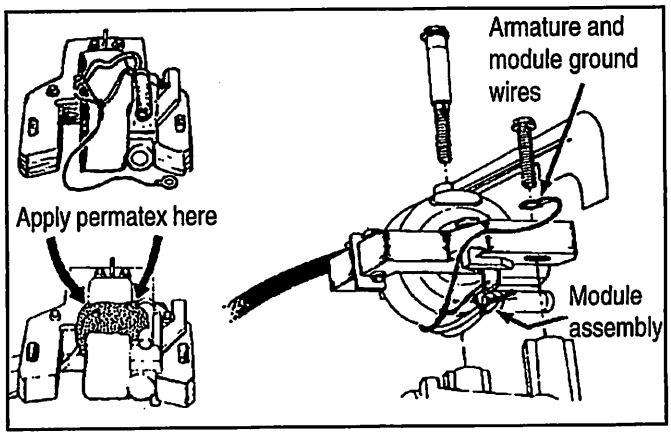
NOTE: On 7 h.p. engines and larger, the Magnetron module can only be used on a two-leg armature.



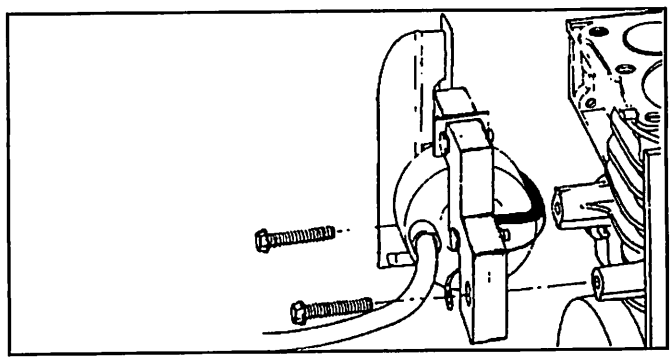
9. Insert spring and wire clip into module. Use a condenser or similar tool to press spring and insert armature primary wire, new stop switch wire and module primary wire.



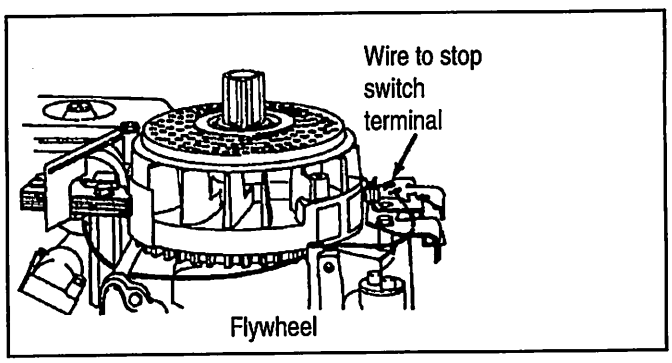
10. Twist armature ground wire and module ground wires together (two turns) close to armature coil and solder. Remove shortest ground wire by cutting it off close to soldered connection. (Only one ground wire terminal needs to be attached under the armature mounting screw.) **Do not install ground wire terminal on governor blade side of armature.** Solder wire ends using 60/40 resin core solder.



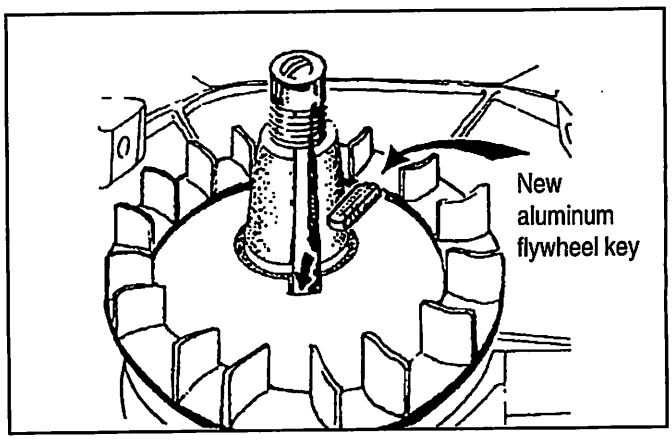
11. Fasten armature to the cylinder. The module ground wire terminal must be attached to armature with screws as shown in illustration. **DO NOT install ground wire terminal on governor blade side of armature. Module terminal MUST be toward the cylinder after assembly of armature to the engine.**



12. Route stop switch wire from module, following the same path as the original wire. Fasten wire to kill switch terminal. Keep wire away from flywheel.

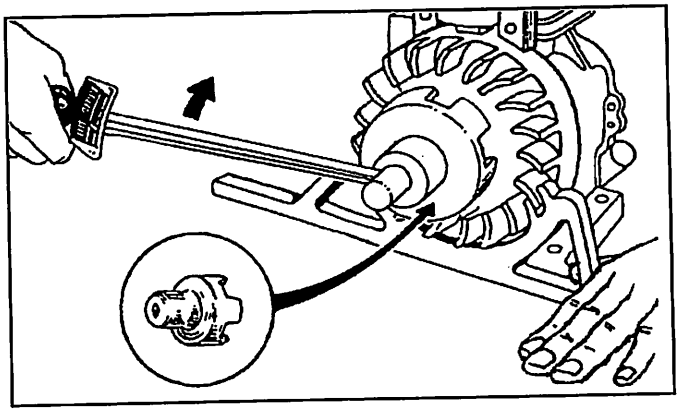


13. Install flywheel using the new flywheel key. **Do not use the original flywheel key.**



Illustrations courtesy of Briggs & Stratton Corporation

14. Torque the flywheel hex nut or starter clutch to specification. See chart for flywheel torque.

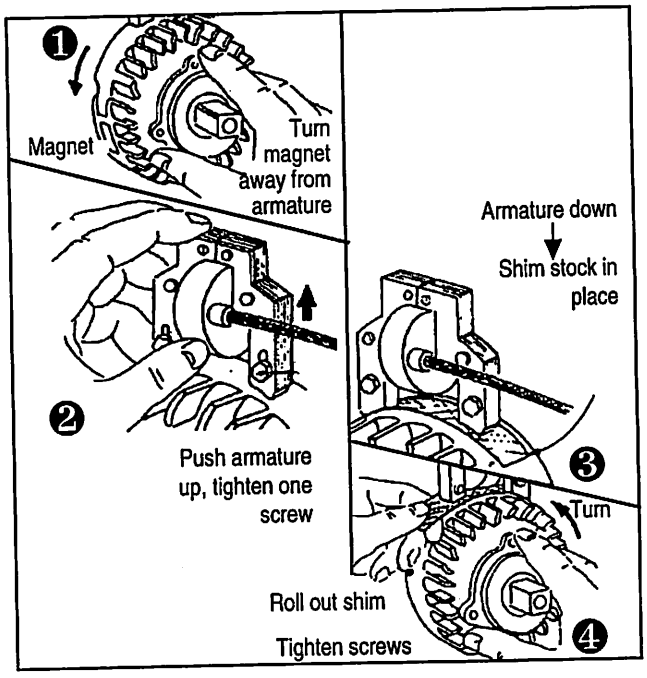


FLYWHEEL TORQUE

Basic Model Series	Ft./Lbs.	Mkg
60000, 80000, 90000, 110000	55	7.9
100000, 130000	60	8.3
140000, 170000, 190000, 220000, 250000	65	9.3
233400, 243400, 326400 400000, 420000	145	20.0

WARNING: FAILURE TO APPLY PROPER TORQUE MAY RESULT IN A SHEARED FLYWHEEL KEY. This may produce a dangerous kickback when starting engine.

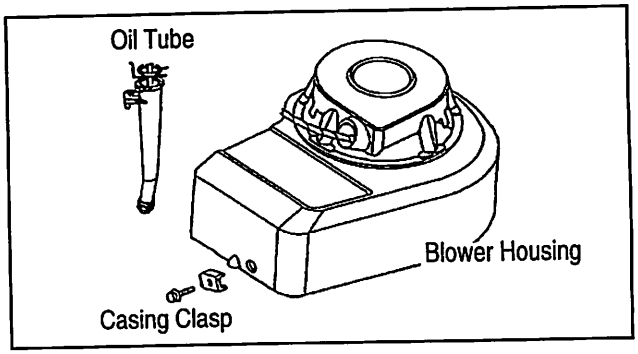
15. Set the flywheel/armature air gap to specification noted for your engine. See illustration.



FLYWHEEL ARMATURE AIR GAP

Basic Model Series	Inches	mm
60000, 80000, 90000, 110000	.010	0.15/0.25
62000	.010	0.15/0.25
100000, 130000	.010/.014	0.25/0.36
140000, 170000, 190000, 220000, 250000	.010/.014	0.25/0.36
233400, 243400, 326400 400000, 420000	.010/.014	0.25/0.36

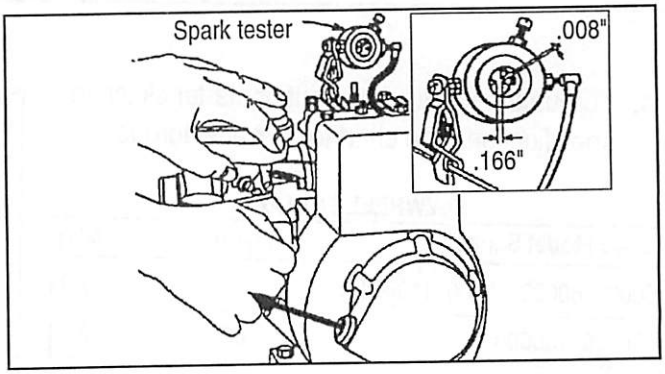
16. Install blower housing, oil tube and casing clamp.



Illustrations courtesy of Briggs & Stratton Corporation

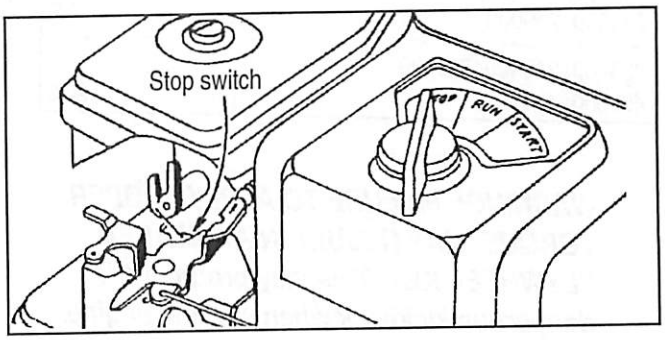
Testing

17. Test spark. See illustration.

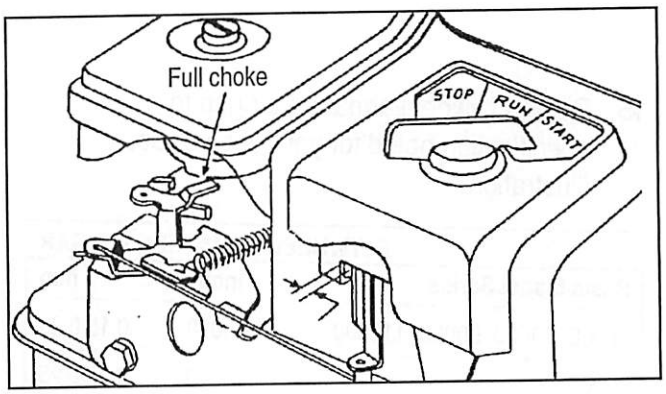


NOTE: This test must be performed before starting engine to determine if STOP switch is functioning properly.

(a) Place the equipment stop switch control in "STOP" position.

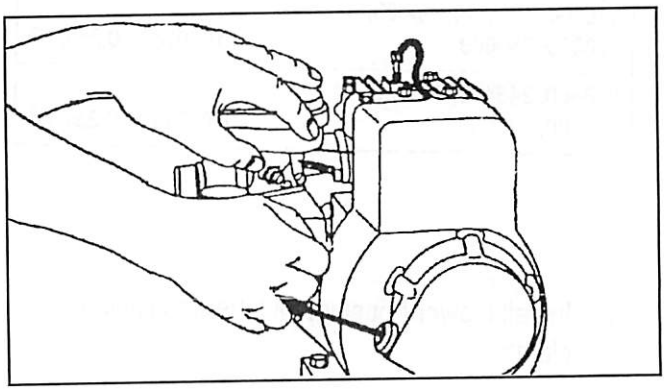


(b) Pull starter. The engine is required to obtain a speed of approximately 350 RPM to produce a spark. There should be no spark. If spark occurs, check the stop switch and connections. Retest.



(c) Place the stop switch control in "START" position and pull starter. There should be a spark. If no spark occurs, check for broken wires, shorts, grounds, or defective kill switch.

18. Remove spark tester and fasten wire to spark plug.



19. Start the engine.

NOTE: If spark occurs and engine does not start, check for a sheared flywheel key.

20. Clean your work area and return tools and equipment to their proper places.

Illustrations courtesy of Briggs & Stratton Corporation

Magnetron® Retrofit Installation Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed when installing the Magnetron® ignition system. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and reassembly.

Yes	No		Disassembly
___	___	1.	Read *Briggs & Stratton Service and Repair Instructions.*
___	___	2.	Wear proper safety equipment.
___	___	3.	Select proper tools and equipment.
___	___	4.	Disconnect the spark plug wire and remove spark plug.
___	___	5.	Cut armature primary and stop switch wires.
___	___	6.	Remove dust cover, breaker points, condenser and plunger.
___	___	7.	Remove screws and armature.
			Reassembly
___	___	8.	Install module.
___	___	9.	Insert spring and wire clip.
___	___	10.	Connect armature ground and module wires.
___	___	11.	Fasten armature to cylinder.
___	___	12.	Route stop switch wire from module.
___	___	13.	Install flywheel.
___	___	14.	Torque flywheel hex hut to specification.
___	___	15.	Set flywheel/armature air gap to specification.
___	___	16.	Install screen, blower housing.
___	___	17.	Test spark.
___	___	18.	Remove spark tester and connect spark plug wire.
___	___	19.	Start engine.
___	___	20.	Clean work area and return tools and equipment to proper places.

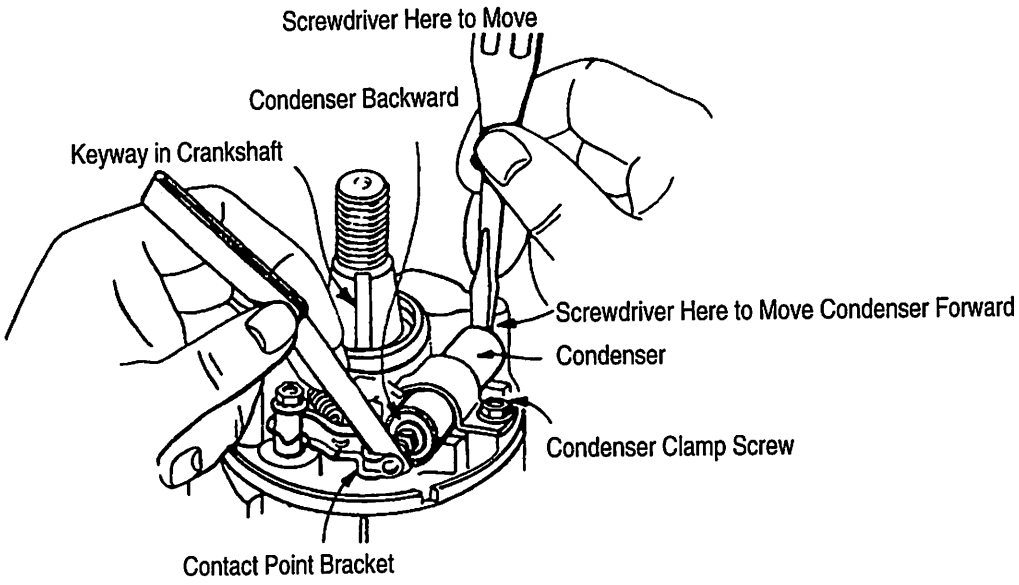
Student's Signature _____ Instructor's Signature _____ Date _____

Installing Breaker Points and Condenser

Step-by-Step Procedure

Introduction

As a small engine mechanic, you must know how to remove and replace breaker points and condensers. This unit will cover tools and supplies that are needed and a step-by-step procedure for removing and installing breaker points and condensers. This unit also shows how to check the ignition system.



Installing Breaker Points and Condenser

Step-by-step Procedure

Unit Objectives

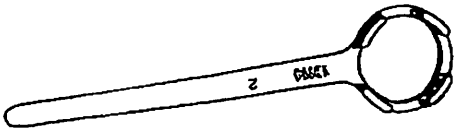
After completion of this unit, you should be able to identify special tools and their appropriate use, identify ignition parts and their use, properly install points and check out the ignition system. This will be evidenced through your ability to properly install points and condenser.

Specific Objectives

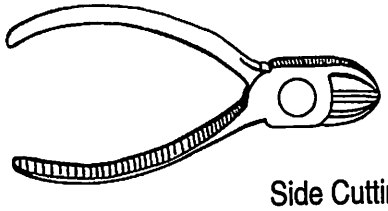
After completing this unit, you should be able to:

1. Identify special tools and their use.
2. Identify ignition parts and their use.
3. Demonstrate the ability to install points and condensers.
4. Demonstrate the ability to test the ignition system.

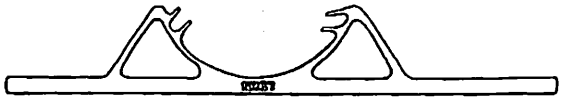
A. Tools and Supplies



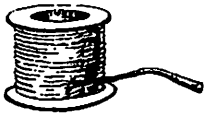
Starter Clutch Wrench



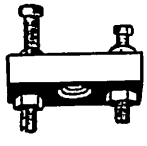
Side Cutting Pliers



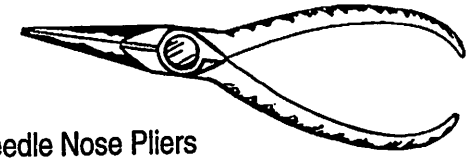
Flywheel Holder



60-40 Solder

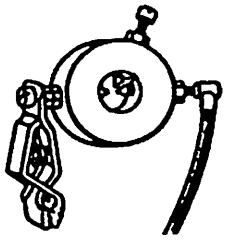


Flywheel Puller

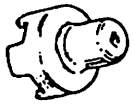


Needle Nose Pliers

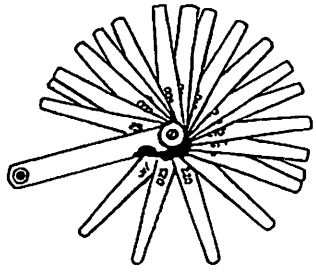
Slot Head Screwdriver



Spark Tester



Starter Clutch Wrench



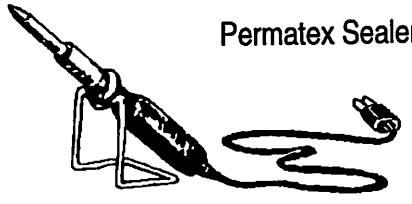
Feeler Gauge

Plunger Plug

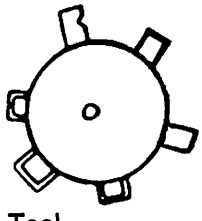
Pocket Knife

Penetrating Oil

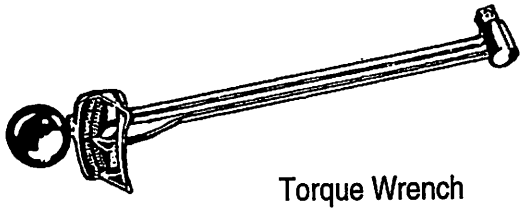
Permatex Sealer



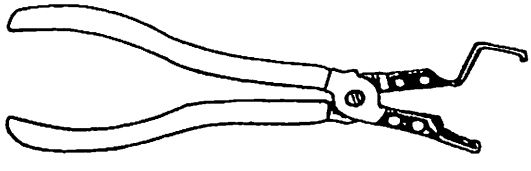
Soldering Iron



Spark Plug Gap Tool

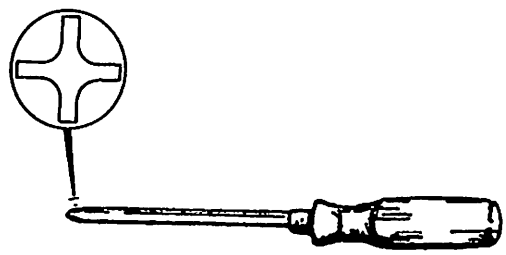


Torque Wrench

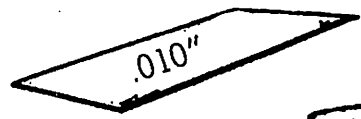


Condenser Spring Compressor

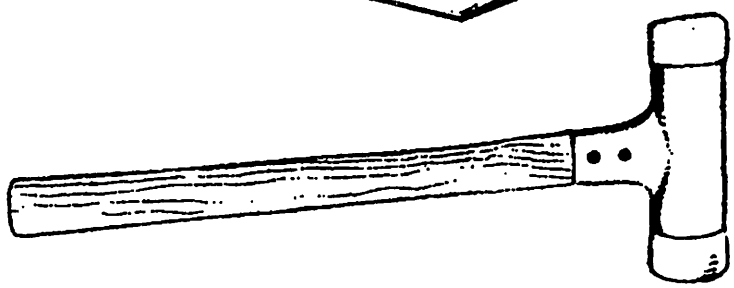
Breaker Points and Condenser



Phillips Screwdriver

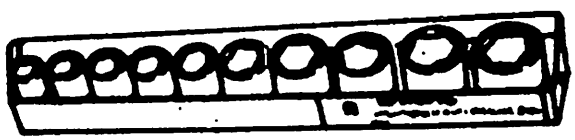


Shim Stock

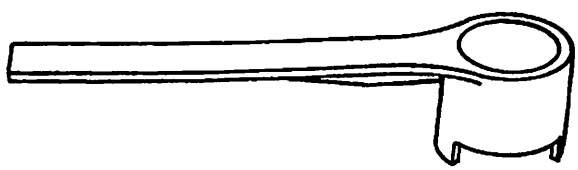


Mallet

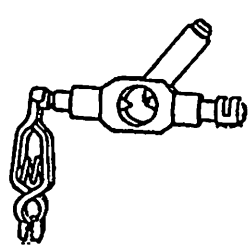
Box Wrench



Socket Set

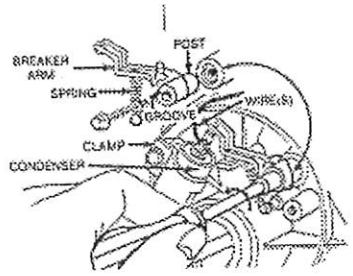


Flywheel Holder



Spark Tester

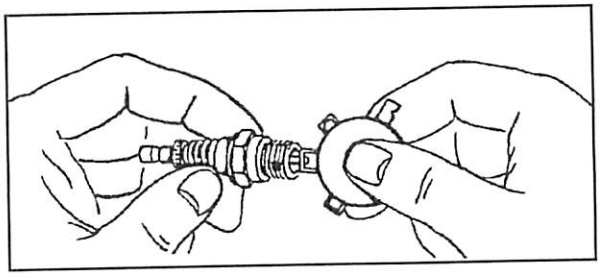
B. Step-by-Step Procedure for Installing Breaker Points and Condenser



Testing and Disassembly

1. Read operator's manual and *Briggs & Stratton's Service and Repair Instructions.*

2. Organize your tools and work bench. Use an engine holder to secure engine for disassembly. Place parts, nuts and bolts in containers for safekeeping.



3. Follow all safety procedures.

4. Disconnect wire. Remove and clean spark plug. Clean spark plug with a penknife or wire brush and solvent and set gap at .030" (0.75 mm) for all models. If electrodes are burned away, or if the porcelain is cracked, replace with a new plug. Do not use abrasive cleaning machines.

NOTE: The plugs recommended for Briggs & Stratton engines are as follows:

R-CJ-8

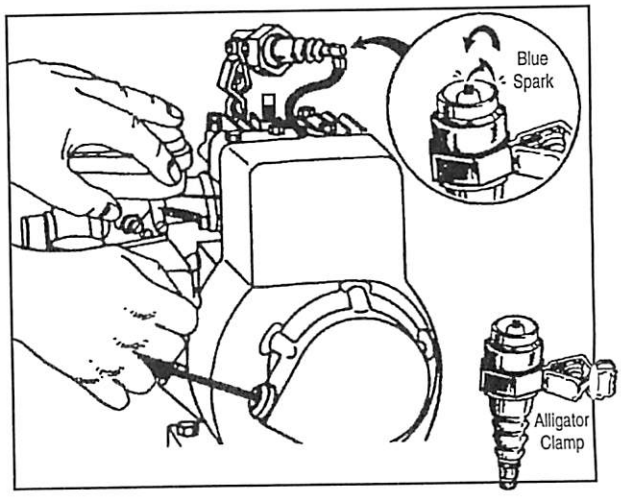
Resistor — Spark plug number

Part Number		
1-1/2" Plug	2" Plug	Manufacturer
CJ-8 J-19LM*	J-8C J-19LM	Champion
RCJ-8 RJ-19LM*	RJ-8C	Champion Resistor
235 245	295 306	Autolite Autolite Resistor
3/4"	13/16"	Spark Plug Wrench (deep socket)

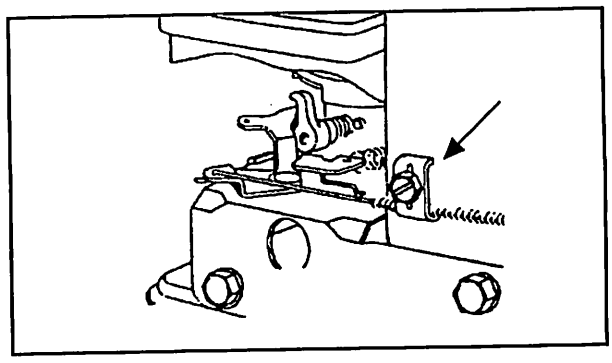
NOTE: Use resistor spark plug to suppress ignition signals.

5. Using a test plug, connect the high-tension lead to the test plug and ground test plug to the cylinder head bolt.

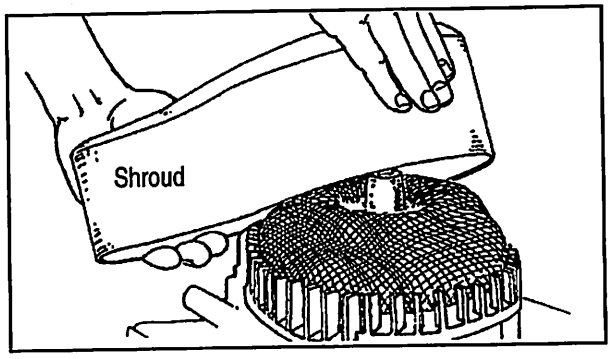
   Crank the engine 2 to 3 times and observe the spark at the test plug. The spark should jump the gap and should be a bright blue color. This indicates the ignition system is functioning properly.



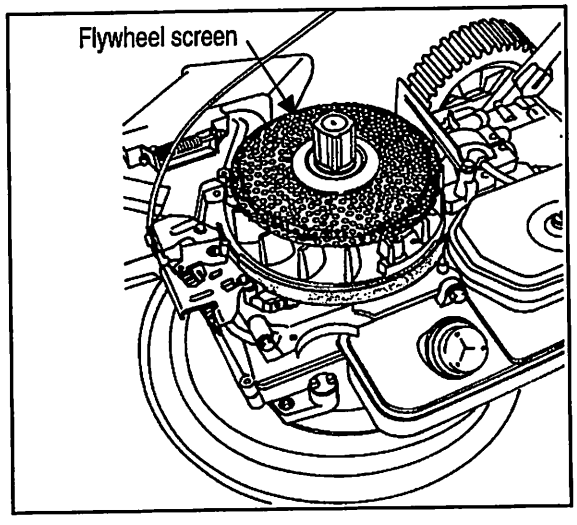
6. Unscrew the bolt to the throttle cable clamp and remove throttle cable.



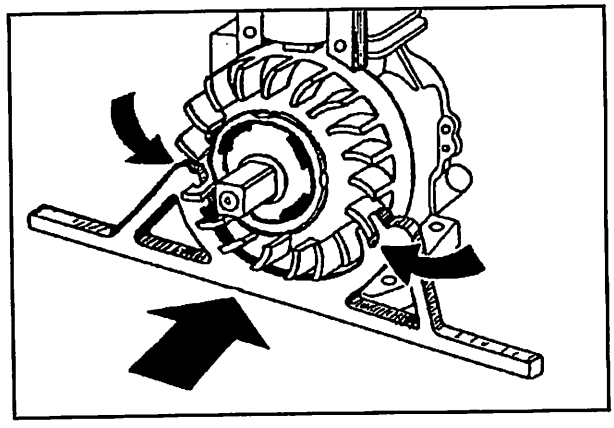
7. Remove flywheel shroud using a 7/16" socket. There will be three bolts on the flywheel shroud.



8. Remove flywheel screen from flywheel.

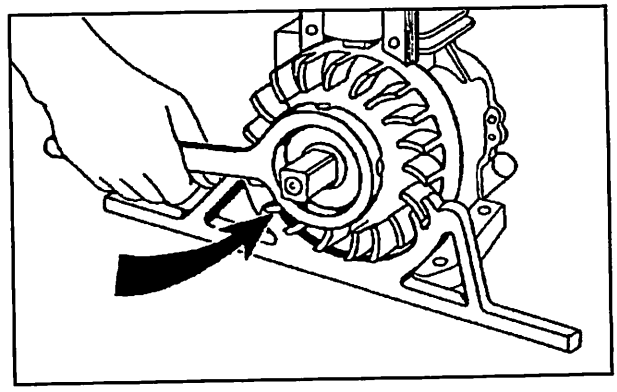


9. Place flywheel holder securely on flywheel.



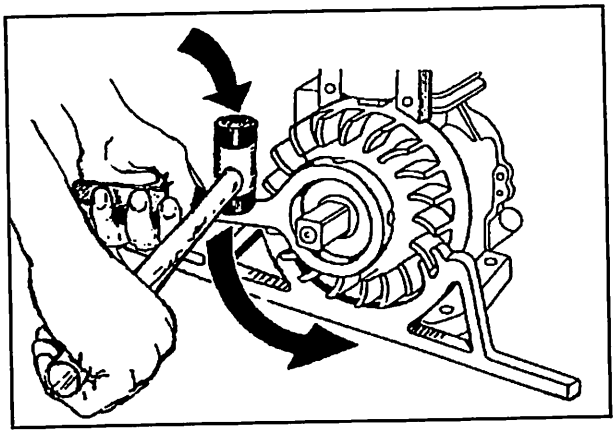
Illustrations courtesy of Briggs & Stratton Corporation

10. Place starter clutch wrench securely on starter clutch.



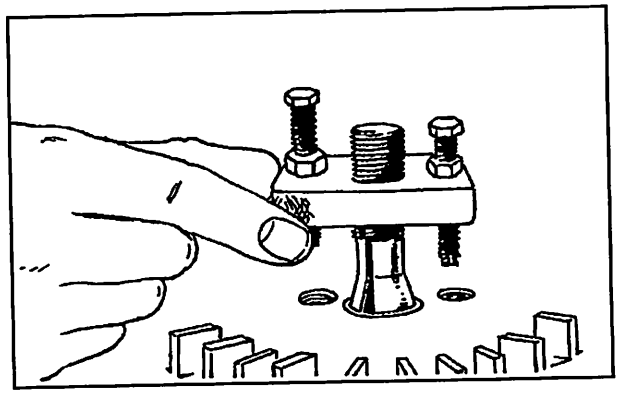
11. Tap wrench handle with mallet to loosen and remove starter clutch.

    NOTE: Use penetrating oil around flywheel to help loosen.



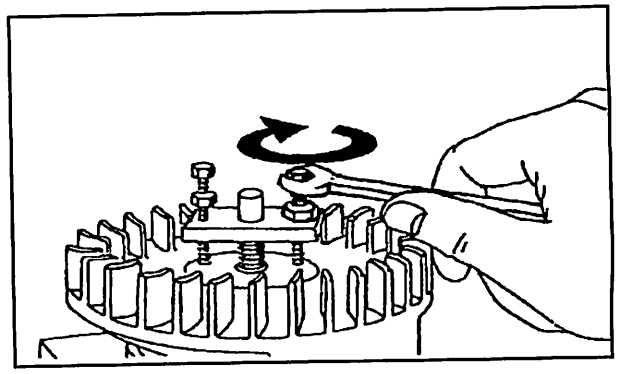
12. Place flywheel puller on flywheel.

    NOTE: Always turn magnet away from the armature so you can easily remove the flywheel.

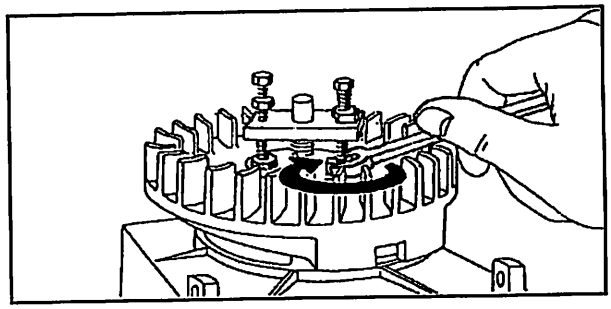


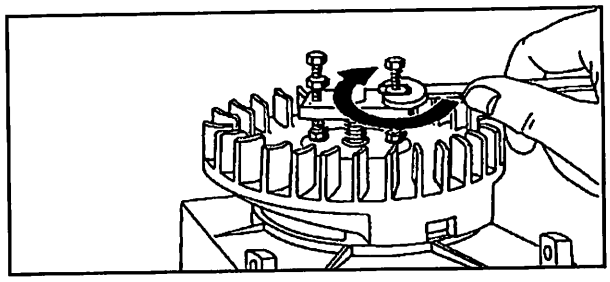
13. Fasten flywheel puller to flywheel with the two self-tapping screws.

    NOTE: Alternate between the self-tapping screws when tightening. Complete one to two turns at a time to insure proper alignment with flywheel holes. Make sure you thread self-tapping screws into flywheel as far as they can go.

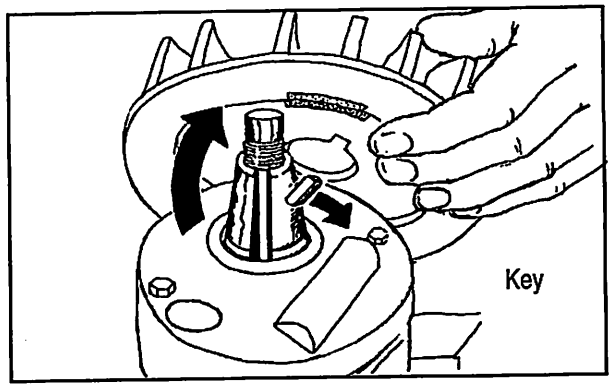


14. Turn the two bottom nuts tightly against flywheel.





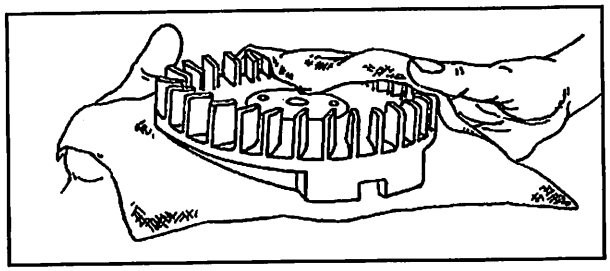
15. Alternately turn the two top nuts to loosen flywheel.



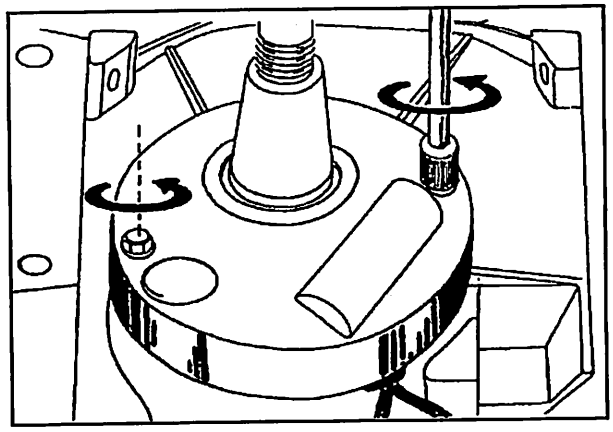
16. Remove and inspect flywheel and key.

NOTE: If the magnet is rusty, clean with emery cloth and cleaner brush. Do not drop.

NOTE: Check condition of flywheel keyway and magnet. Check key closely for damage. If damaged, replace with new key.



17. Wrap flywheel in a shop towel to prevent magnet from picking up bolts and nuts.

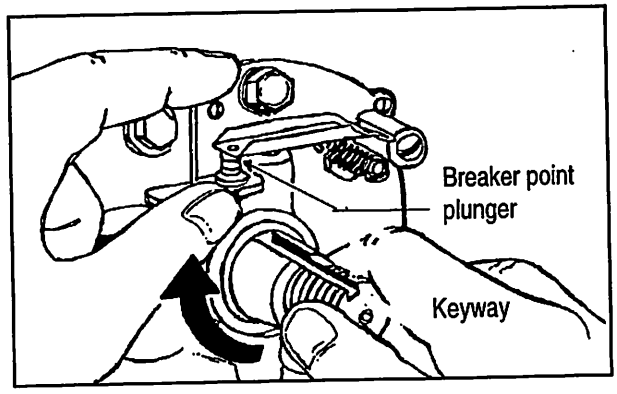


18. Remove breaker point dust cover.

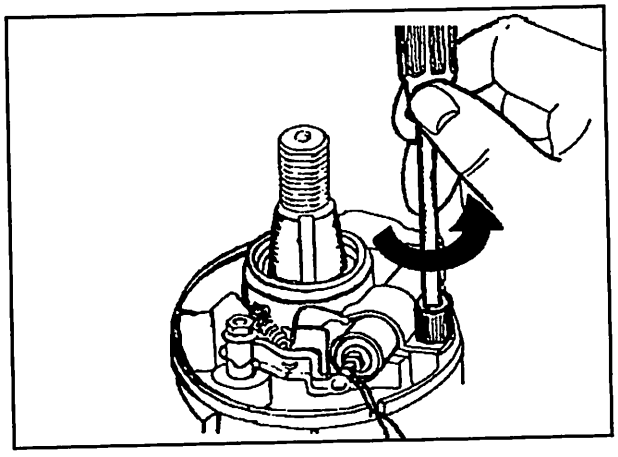
NOTE: Dust cover may "stick" at site of wire entrance. Remove carefully to prevent bending cover.

Illustrations courtesy of Briggs & Stratton Corporation

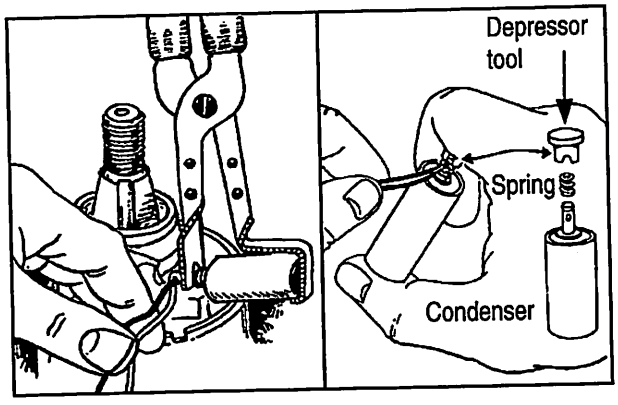
19. Rotate crankshaft clockwise with your hand until the key way is in line with breaker point plunger. **At this point the cam is at its highest position.** Points are installed at the highest position of the cam.



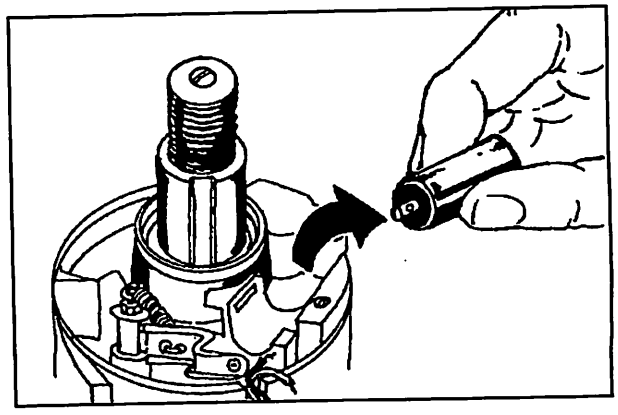
20. Remove bolt and clamp over the condenser.



21. While compressing the spring, pull the two wires out of the hole in the condenser. Use either of the two methods illustrated.



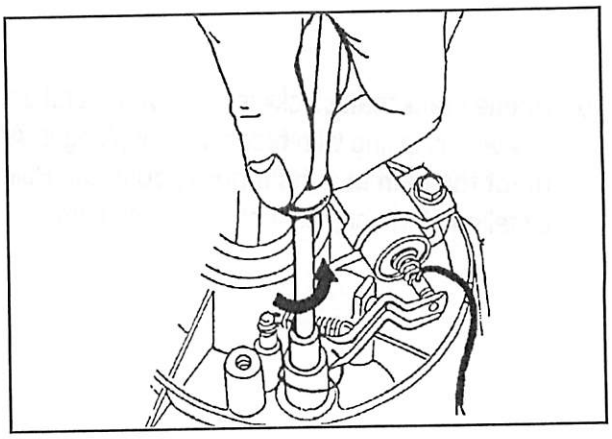
22. Remove and discard the condenser.



Illustrations courtesy of Briggs & Stratton Corporation

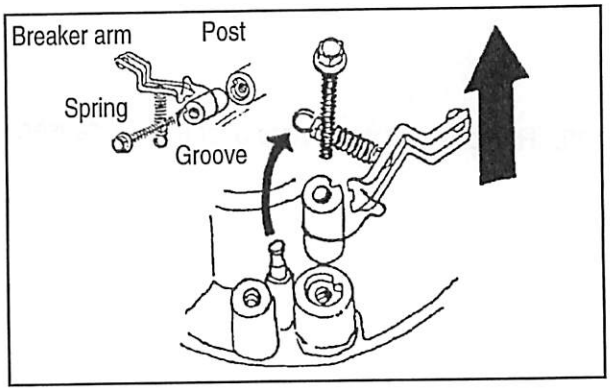
23. Loosen mounting bolt and remove the movable contact point.

NOTE: When mounting bolt is loosened, the contact point loses its tension.

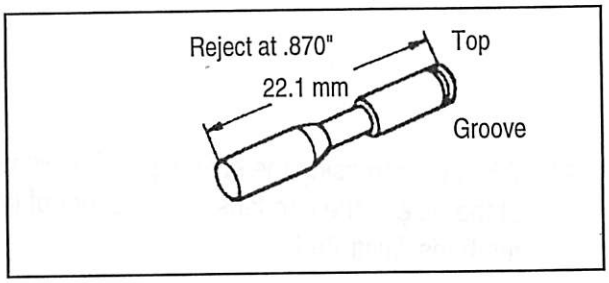


24. Lift spring from post and remove mounting bolt, contact point, mounting post and spring.

NOTE: Keep the mounting bolt. Always replace old contact points with a new set.



25. Remove and inspect the breaker point plunger.

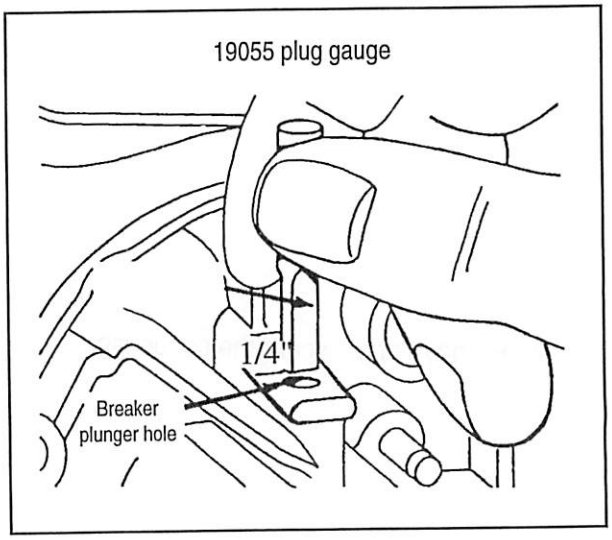


26. Check breaker point plunger hole.

NOTE: A worn breaker point plunger hole can cause oil to leak past the plunger and contaminate the breaker points, causing them to burn.

NOTE: To check the plunger hole for wear, use Tool #19055. If the flat end of the plug gauge will enter plunger hole 1/4" or more, the hole must be rebushed.

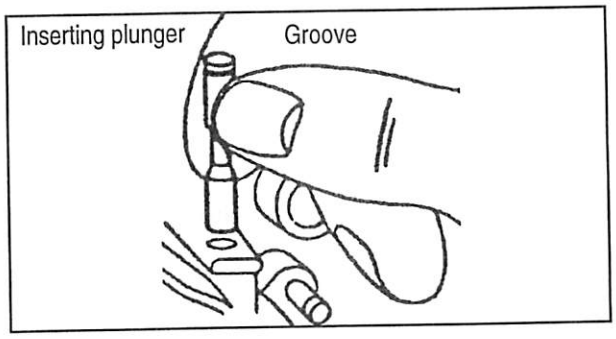
NOTE: When breaker point plunger hole is worn beyond tolerance, install Magnetron® instead of rebushing breaker point plunger hole.



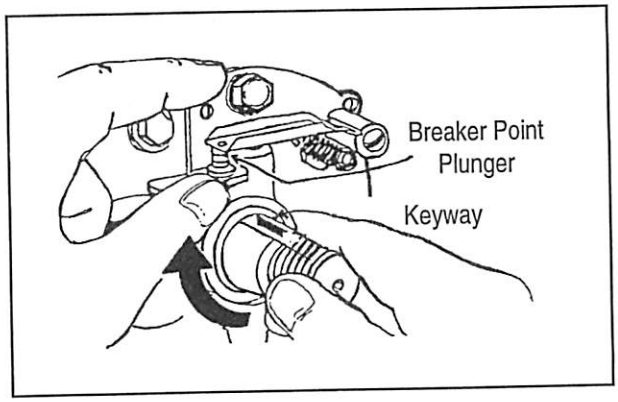
Illustrations courtesy of Briggs & Stratton Corporation

Reassembly

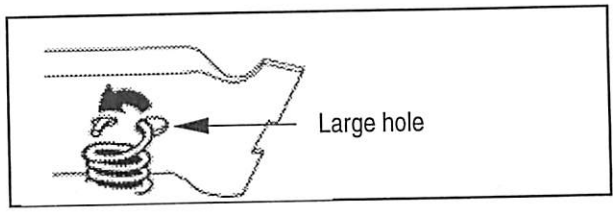
27. Insert the breaker point plunger **with the groove side up** before installing the breaker point assembly.



28. **Before installing the points recheck the position of the crankshaft.** Make sure keyway aligns with breaker point plunger hole. This will ensure the cam is at its highest position.

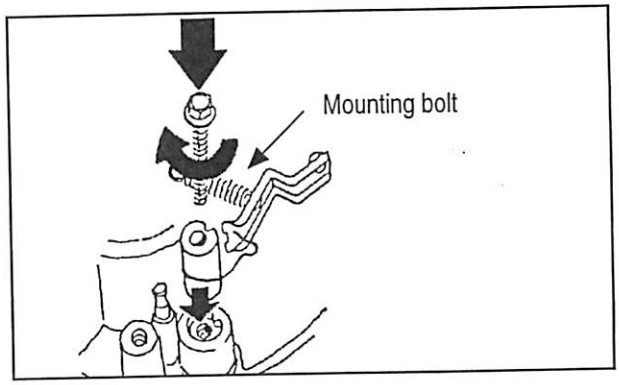


29. Install new movable contact point. Hook open loop of spring through large hole, then through small hole.

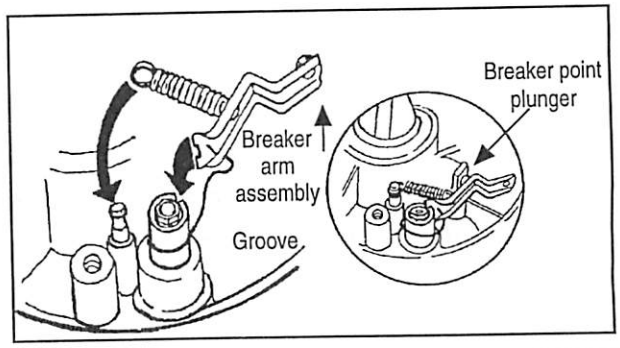


30. Place mounting bolt into post and tighten.

NOTE: Handle movable points carefully to prevent breaking wire connection to post.

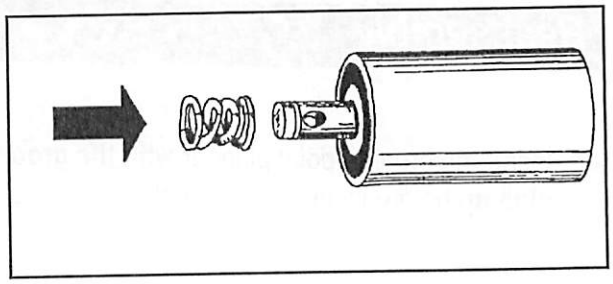


31. To install the breaker arm assembly, first place the contact point arm into the groove in mounting post. Hold arm in place while using needle nose pliers to hook the closed loop of the spring onto the anchor post. Push breaker arm up and over the breaker point plunger. Check and tighten mounting bolt. See illustration.



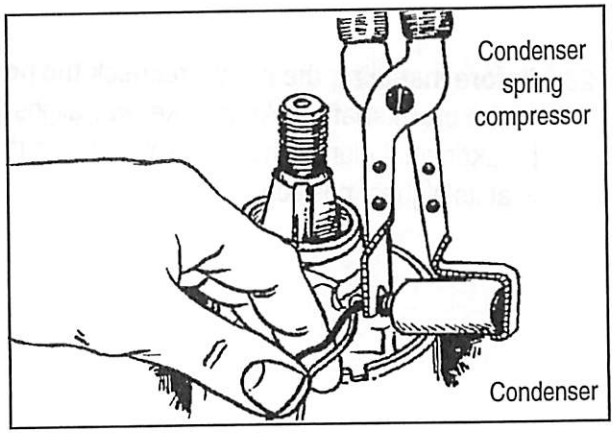
Illustrations courtesy of Briggs & Stratton Corporation

32. Place spring on condenser and hold it in place.

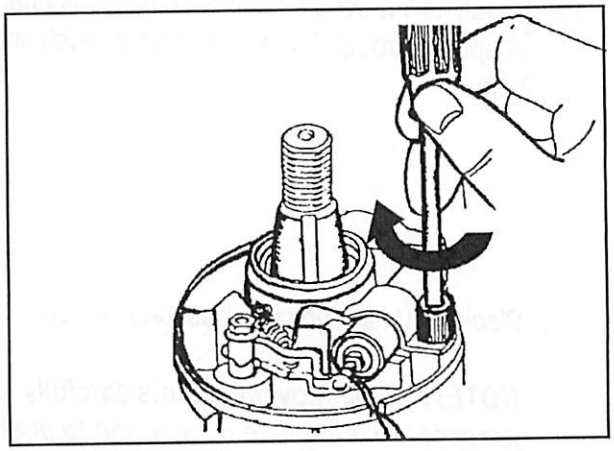


NOTE: Flatten wire ends around fixed point.

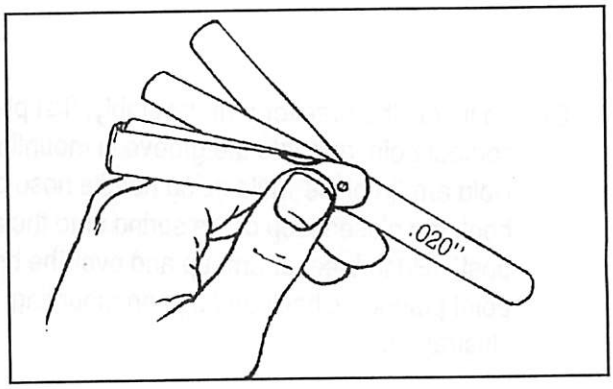
33. Compress spring and slip the two wires into the hole on condenser.



34. Install new condenser and clamp in place. Tighten the clamp bolt.



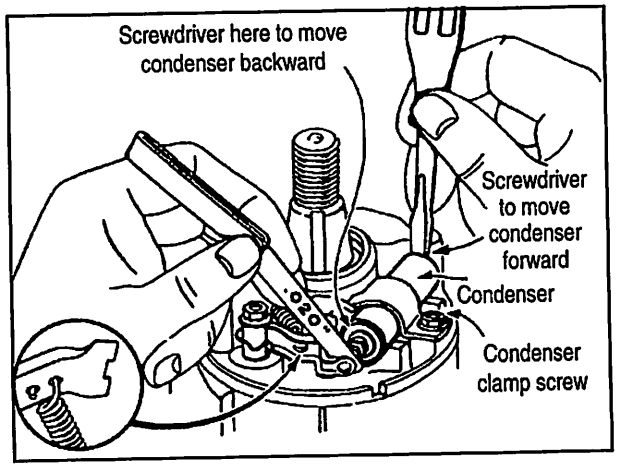
35. Select correct size feeler gauge.



NOTE: Make sure the crankshaft keyway is lined up with the breaker plunger.

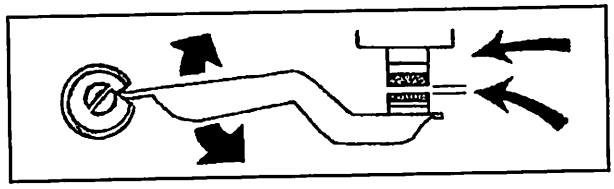
Illustrations courtesy of Briggs & Stratton Corporation

36. Tighten the condenser clamp. Place feeler gauge between contact points, push condenser forward with a screwdriver and **set the points at .020**. Make sure condenser clamp is secured.

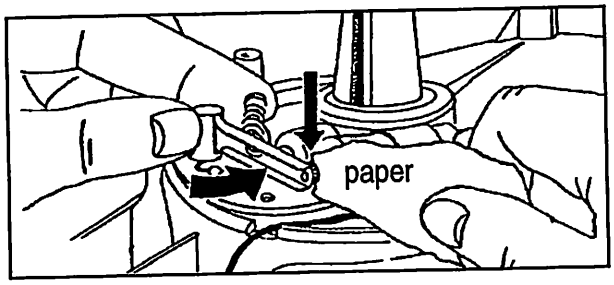


NOTE: The condensor should move back and forth to properly set points.

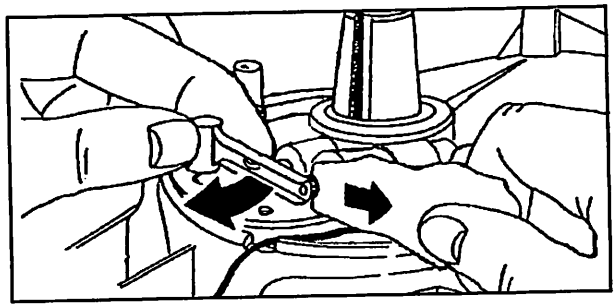
37. Make sure the two contact points fit squarely together, and not at an angle. Adjust the movable contact points, if necessary.



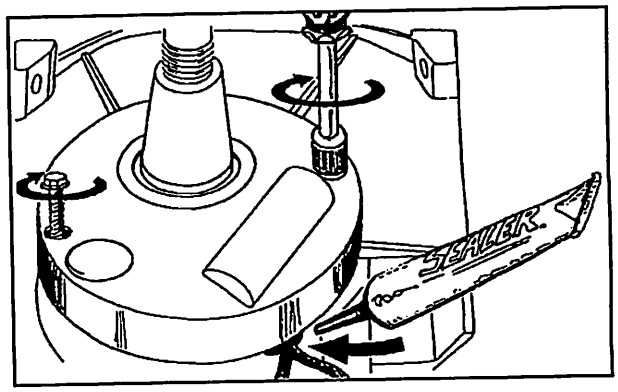
After the breaker point gap has been set at .020", rotate the crankshaft until the points are closed. Lift the breaker arm and insert a clean piece of paper. Release the breaker arm and draw the paper back and forth to clean the points.



38. Open breaker points to remove paper so it will not tear or leave dirt on breaker points.

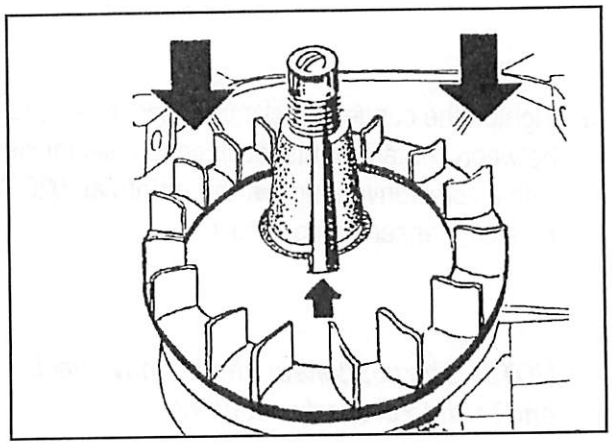


39. Place sealer around wiring. Replace dust cover and bolts on the points and condenser.

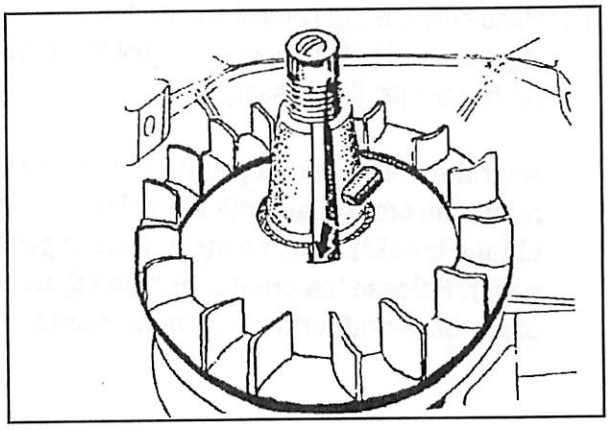


Illustrations courtesy of Briggs & Stratton Corporation

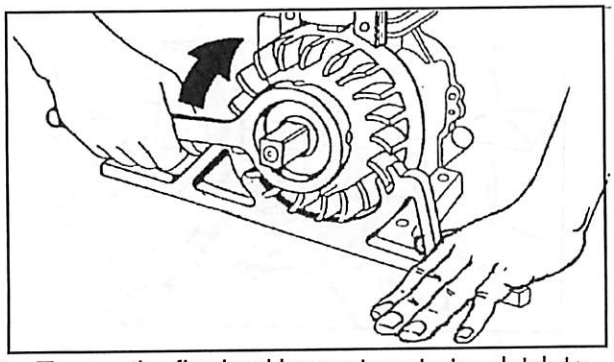
40. Place flywheel on crankshaft and line up the keyway.

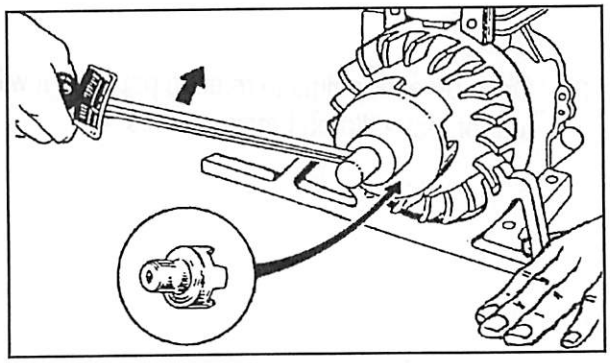


41. Place flywheel key in keyway.



42. Place flywheel holder on flywheel and starter clutch wrench on starter clutch. While holding the flywheel holder, tighten starter clutch.





43. Torque the flywheel hex nut or starter clutch to specification. See chart for flywheel torque.

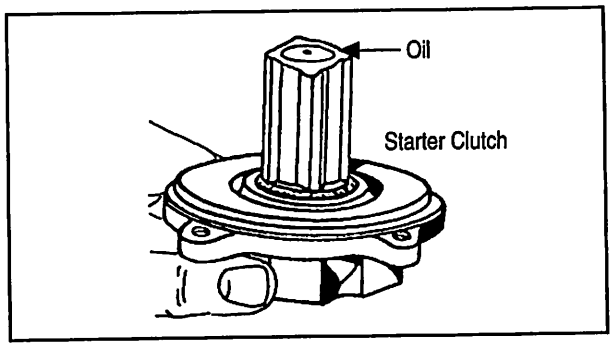
CAUTION: FAILURE TO APPLY PROPER TORQUE MAY RESULT IN A SHEARED FLYWHEEL KEY. This can produce a kickback when starting engine.

Flywheel Torque

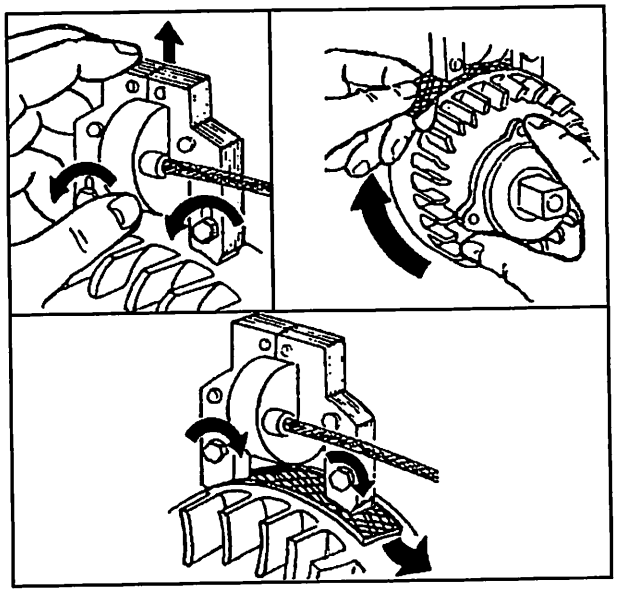
Basic Model Series	Ft. Lbs.	Mkg.
600000, 80000, 90000, 110000	55	7.9
100000, 130000	60	8.3
140000, 170000, 190000 220000, 250000	65	9.3
233400, 243400, 326400, 4000000, 420000	145	20.0

Illustrations courtesy of Briggs & Stratton Corporation

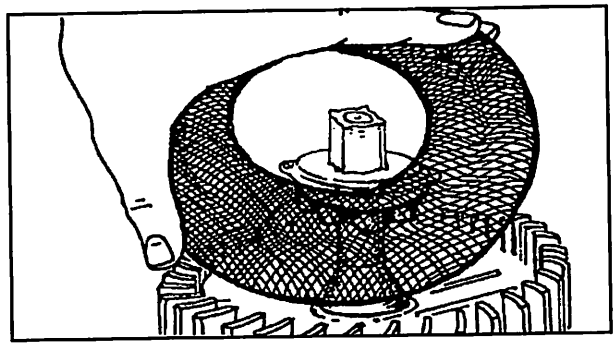
44. Add a drop or two of oil to the hole in the starter clutch. This will keep the crankshaft stub lubricated and prevent squealing and seizing.



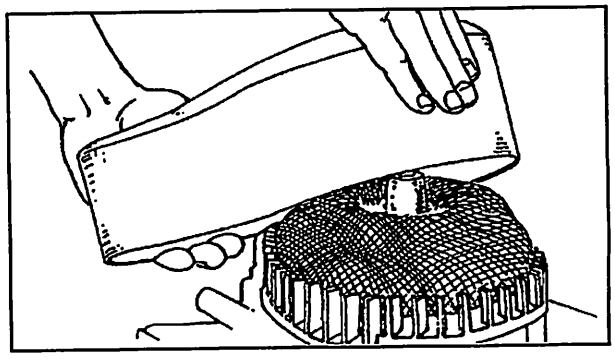
45. Check air gap by loosening the two armature bolts, inserting .010 shim stock between flywheel and armature, and rotating the flywheel until magnets pull armature down to shim stock. Tighten armature bolts and remove shim stock.



46. Attach flywheel screen over starter clutch.

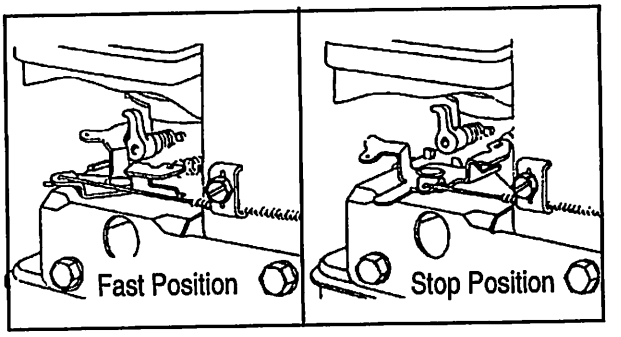


47. Replace flywheel shroud and tighten the bolts. Reconnect throttle cable if necessary.

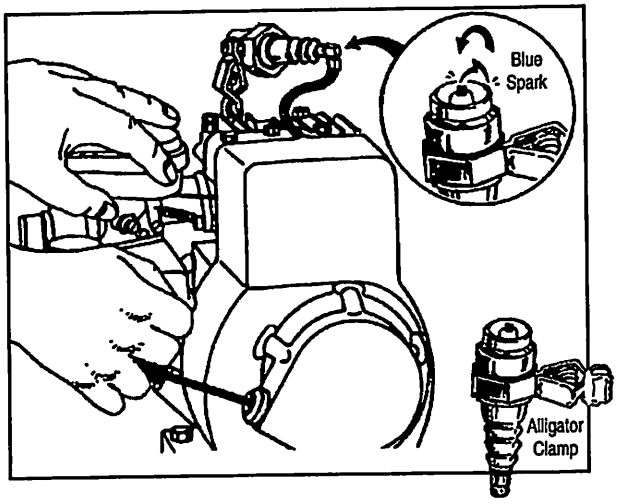


Illustrations courtesy of Briggs & Stratton Corporation

48. Replace throttle cable and adjust.

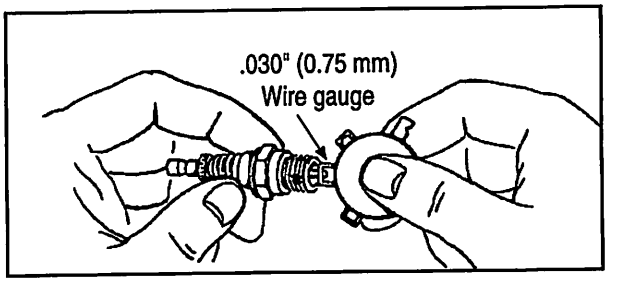


NOTE: Using a test plug, rotate flywheel a minimum of 350 RPM and observe the spark. The spark should be a bright blue color. If the spark is blue and jumps the .166" tester gap, the system is functioning satisfactorily.



49. Gap spark plug to .030" gap and install.

NOTE: Always use a wire gauge.



50. Crank the engine to see if it runs properly.

CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear before starting it.

51. Clean your work area and return tools and equipment to their proper places.

Installing Breaker Points and Condenser Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed in Installing Breaker Points and Condenser. Compile your evaluation of the student (trainee) by transferring the appropriate "yes/no" rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and assembly.

Yes	No		Ignition System Disassembly
___	___	1.	Read *Briggs & Stratton's Service and Repair Instructions.*
___	___	2.	Organize your tools and work bench.
___	___	3.	Follow all safety procedures.
___	___	4.	Disconnect wire; remove and clean spark plug.
___	___	5.	Use test plug to see if ignition system is functioning properly.
___	___	6.	Remove throttle cable.
___	___	7.	Remove flywheel shroud.
___	___	8.	Remove flywheel screen from flywheel.
___	___	9.	Place flywheel holder securely on flywheel.
___	___	10.	Place starter clutch wrench securely on starter clutch.
___	___	11.	Loosen and remove starter clutch.
___	___	12.	Place flywheel puller on flywheel.
___	___	13.	Fasten flywheel puller to flywheel.
___	___	14.	Turn two bottom nuts tightly against flywheel.
___	___	15.	Alternately turn the two top nuts to loosen flywheel.
___	___	16.	Remove and inspect flywheel and key
___	___	17.	Wrap flywheel in a shop towel.
___	___	18.	Remove breaker point dust cover.
___	___	19.	Rotate crankshaft clockwise until key way is in line with breaker point plunger.
___	___	20.	Remove bolt and clamp over the condenser.
___	___	21.	While compressing the spring, pull the two wires out of the hold on the condenser.
___	___	22.	Remove and discard the condenser.
___	___	23.	Loosen mounting bolt and remove the movable contact point.
___	___	24.	Lift spring from post and remove mounting bolt, contact point, mounting post and spring.
___	___	25.	Remove and inspect the breaker point plunger.
___	___	26.	Check breaker point plunger hole.
___	___	27.	Insert the breaker point plunger with the groove side up.
___	___	28.	Recheck the position of the crankshaft.
			Ignition System - Reassembly
___	___	29.	Install new movable contact point.
___	___	30.	Place mounting bolt into post and tighten.
___	___	31.	Install the breaker arm assembly.

Yes	No		
___	___	32.	Place spring on condenser and hold it in place.
___	___	33.	Compress spring and slip the two wires into the hole on condenser.
___	___	34.	Install new condenser.
___	___	35.	Select correct size feeler gauge.
___	___	36.	Tighten the condenser clamp.
___	___	37.	Make sure the two contact points fit squarely together.
___	___	38.	Open breaker points to remove paper so it will not tear or leave dirt on breaker points.
___	___	39.	Place sealer around wiring. Replace dust cover.
___	___	40.	Place flywheel on crankshaft and line up the key way.
___	___	41.	Place flywheel key in key way.
___	___	42.	Place flywheel holder on flywheel and starter clutch wrench on starter clutch. Tighten starter clutch.
___	___	43.	Torque the flywheel hex nut or starter clutch to specification.
___	___	44.	Add a drop or two of oil to the hole in the starter clutch.
___	___	45.	Check air gap. Tighten armature bolts and remove shim stock.
___	___	46.	Attach flywheel screen over starter clutch.
___	___	47.	Replace flywheel shroud and tighten the bolts.
___	___	48.	Replace throttle cable and adjust.
___	___	49.	Gap spark plug to .030" gap and install.
___	___	50.	Crank the engine to see if it runs properly.
___	___	51.	Clean work area and return tools and equipment to their proper places.

Student's Signature _____ Instructor's Signature _____ Date _____

Specifications For All Popular Briggs & Stratton Engines

1. Spark plug gap: .030"
2. Condenser capacity: .18 to .24 MFD.
3. Breaker point gap: .020"

Engine Specifications for Briggs and Stratton Engines

Contact Point Gap:	.020 All Models
Spark Plug Gap:	.030 All Models
Condenser Capacity:	.18 to .24 MFD All Models
Idle Speed for Aluminum Engines:	1750 RPM. (60000-250000 model series)

Personal Engine Data For Ordering Parts

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
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Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Specifications for all Popular Briggs & Stratton Engines

1. Spark plug gap: .030"
2. Condenser capacity: .18 to .24 M.F.D.
3. Break point gap: .020"

Basic Model Series	Armature		Flywheel Puller Tool No.	Flywheel Holder Tool No.	Flywheel Torque
	Two-Leg Air Gap Inches	Three-Leg Air Gap Inches			Ft-Lbs
Aluminum Cylinders					
6B, 8B, 6000, 8000	.006 - .010	.012 - .016	19069	19167	55◆
82000, 92000, 93000, 94000, 110000, 120000	.006 - .010		19069	19167	55◆
100700	.006 - .010		19069	19167	55◆
100200, 100900, 130000	.010 - .014	.012 - .016	none	none	65◆
140000, 170000, 190000	.010 - .014	.012 - .016	19165	none	65◆
220000, 250000*	.010 - .014		19203•	none	65◆
280000	.010 - .014		19203	19321	65◆
Cast Iron Cylinders					
N, 5, 6, 8		.012 - .016	none	19167	55◆
9, 14			19068 or 19203	none	65◆
19, 23, 23A, 191400 231400			19068 or 19203	none	115◆
19D, 23C, 23D, 193400 200400, 233400	.010 - .014	.022 - .026	19068 or 19203	none	115◆
240000, 3000000, 320000	.010 - .014		19068 or 19203	none	145◆

◆ Use 19244 starter clutch wrench on rewind starter engines.
• Use 19203 on Model Series 250000 built after 1975 and all Model Series 220000.
* Use 19165 on Model Series 250000 built 1975 and before.

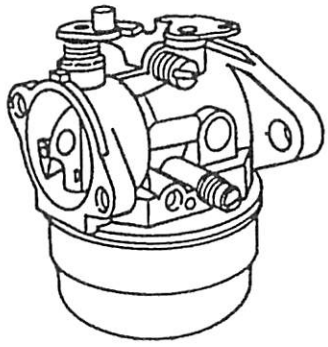
Courtesy of Briggs & Stratton Corporation

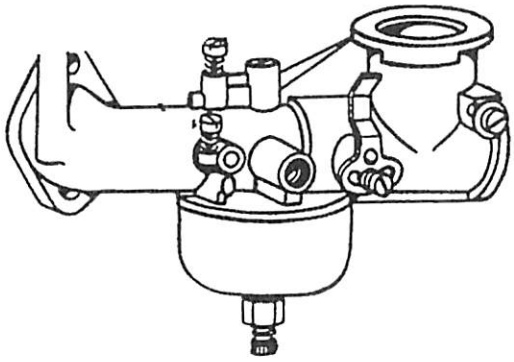
10-7652-S

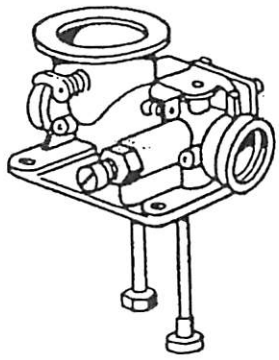
STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Carburetor Service and Repair





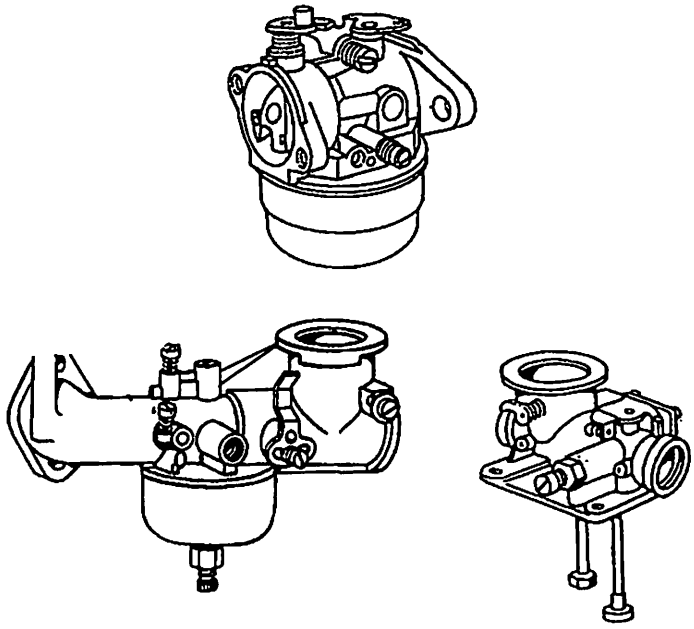


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

MODULE 2

Carburetor Service and Repair



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

Instructional Materials Laboratory Staff:

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Lori Holliday, Word Processor III

Special thanks for information and illustrations:

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American Association for Vocational Instructional Materials

Appreciation is expressed to:

Dan Hostetler, Boonville, Missouri, Harold Bossaler, Columbia, Missouri, Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Carburetor Service and Repair

Unit Objectives

After completing this unit, the student should be able to identify carburetor types and their components. The student should be able to identify and service air filters. The student should also be able to remove, service, and replace Walbro, Flo-Jet, Pulsa-Jet, and Vacu-Jet carburetors. This knowledge will be evidenced through the student's ability to properly service these carburetors, fuel filters, and air cleaners.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify types of air and fuel filters.

2. Identify small engine carburetor parts and their uses.

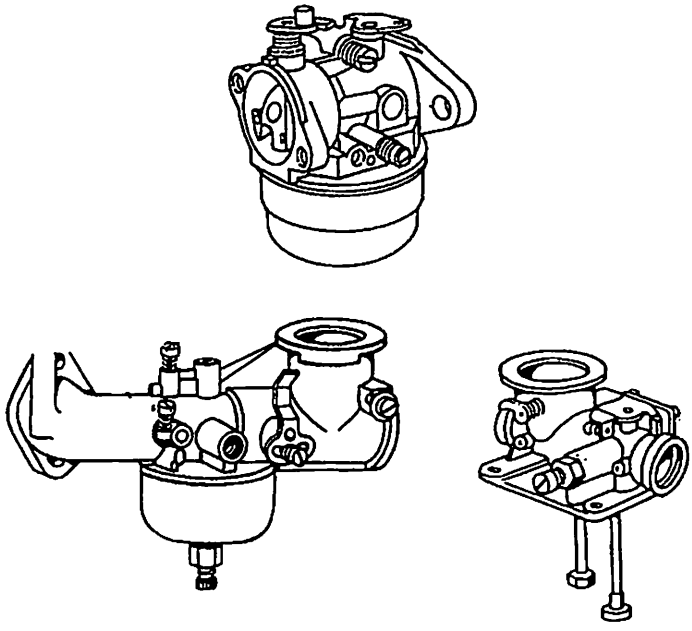
3. Demonstrate the ability to:
   a. Service air cleaners.
   b. Service and repair Walbro carburetors.
   c. Service and repair Flo-Jet carburetors.
   d. Service and repair Pulsa-Jet carburetors.
   e. Service and repair Vacu-jet carburetors.

Carburetor Service and Repair

Introduction

The purpose of the carburetor is to properly mix fuel and air into the combustible mixture necessary to make ignition occur in a small engine. The carburetor does this by vaporizing the fuel, mixing it with the proper portion of air, and delivering this correct mix to the cylinder for ignition. Economical fuel consumption and smooth engine operation require a correctly-adjusted and properly-maintained carburetor.

The carburetor is part of a fuel delivery system which also includes the air cleaner, fuel tank, and gas line.



Important Safety Notice

The procedures used in this manual are effective in performing the service operation. Through out the manual are various safety procedures and cautions that must be followed to prevent personal injury.
The University and author cannot assume the responsibility for any changes, errors or omissions. Always consult the approved service manual for specific information.

In the Interest of Safety

This symbol means ***WARNING or CAUTION.*** Personal injury and property damage may occur unless instructions are followed carefully.

WARNING

DO NOT run engine in an enclosed area. Exhaust gases contain carbon monoxide, an odorless and deadly poison.

DO NOT check for spark with spark plug or spark plug wire removed. Use an approved tester.

DO NOT crank engine with spark plug removed. If engine is flooded, place throttle in "Fast" position and crank until engine starts.

DO NOT smoke when filling fuel tank.

DO NOT FILL FUEL TANK while engine is running. Allow engine to cool for two minutes before refueling.

DO NOT operate engine if gasoline has been spilled. Move machine away from the spill and avoid creating any ignition until the gasoline has evaporated.

DO NOT STORE, SPILL, OR USE GASOLINE NEAR AN OPEN FLAME or devices such as a stove, furnace, or water heater which utilize a pilot light or devices which can create a spark.

DO NOT refuel indoors or in any area that is not well ventilated. Outdoor refueling is preferred.

DO NOT OPERATE ENGINE WITHOUT A MUFFLER. Inspect periodically and replace if defective.

DO NOT operate engine with an accumulation of grass, leaves, dirt, or other combustible material in the muffler area.

DO NOT use an engine on any forest covered, brush covered, or grass covered unimproved land unless a spark arrestor is installed on the muffler.

DO NOT run engine with air cleaner or cover removed.

CAUTION

DO NOT run engine at excessive speeds. This may result in injury.

DO NOT tamper with governor springs, governor links, or other parts which may increase the governed engine speed.

DO NOT tamper with the engine idle speed selected by the original equipment manufacturer.

DO NOT touch hot mufflers, cylinders, or fins as contact may cause burns.

DO NOT place hands or feet near moving or rotating parts.

TO PREVENT ACCIDENTAL STARTING when servicing the engine or equipment, always remove the spark plug or wire from the spark plug. Disconnect negative wire from battery terminal if equipped with a 12-volt starting system.

DO pull starter cord slowly until resistance is felt. Then pull cord rapidly to avoid kickback and prevent hand or arm injury.

DO use fresh gasoline. Stale fuel can cause leakage.

A. Tools and Materials Needed to Service the Air Cleaner and Carburetor

Tools

Standard and Phillips screwdrivers (4" and 6")
Open end wrenches (1/4 x 5/16"; 3/8 x 7/16"; and 9/16 x 1/2")
Nut drivers (1/4"; 5/16"; 3/8"; and 7/16")
Feeler gauges (.002)
Ballpeen hammer
Oil fill tube
Steel rule
Pliers
Set of sockets (3/8" and ratchet)
Special Briggs and Stratton carburetor screwdrivers
Parts cleaning brush
Parts scraper or putty knife
Tachometer
Needle-nose pliers
#19057 Briggs and Stratton brushing driver
Safety glasses

Supplies

Air filter and gasket
Penetrating oil
Detergent (soap)
O-ring
Cleaning solvent
Carburetor cleaner
Gasoline
Carburetor repair kit (needle and seat and gaskets)
Diaphragm
Metal container for carburetor cleaner
Parts cleaning pan
Shop towels
30W oil

Reference Manuals

Operator's manual
Briggs & Stratton Service and Repair Manual

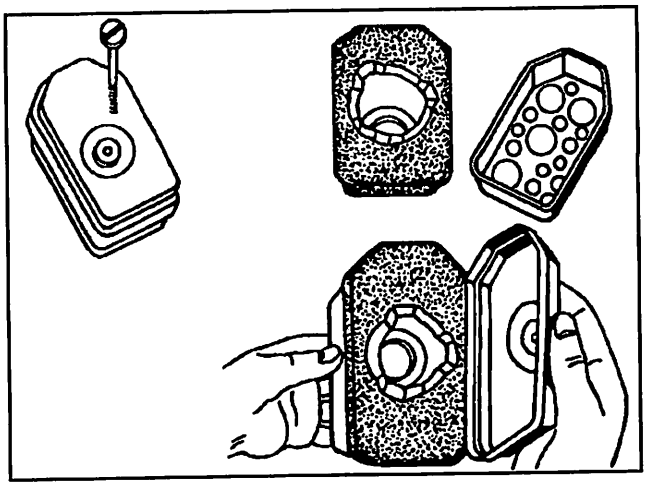
B. Step-By-Step Procedure for Servicing an Oil Foam Air Cleaner

1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

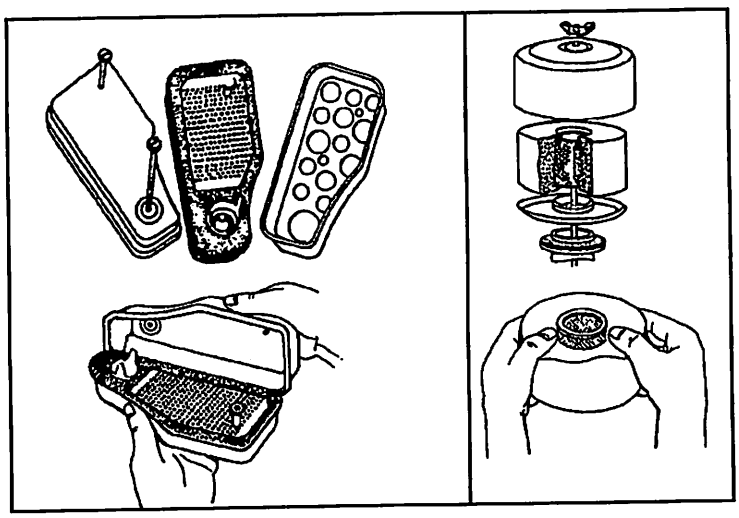
CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

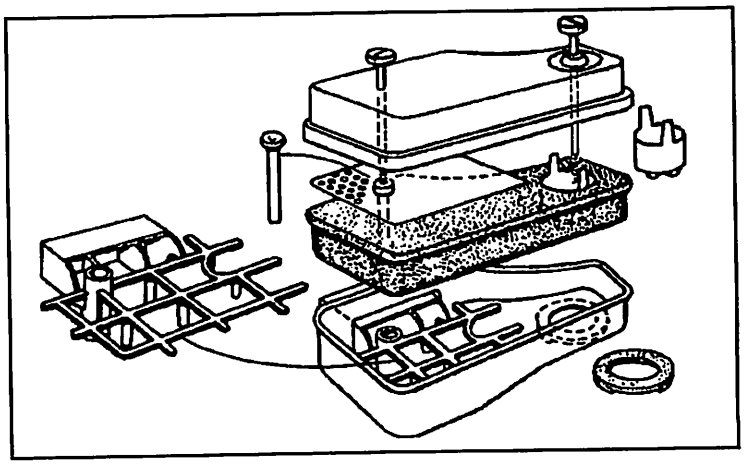
2. Disconnect the spark plug wire.

3. Clean area around the air cleaner.



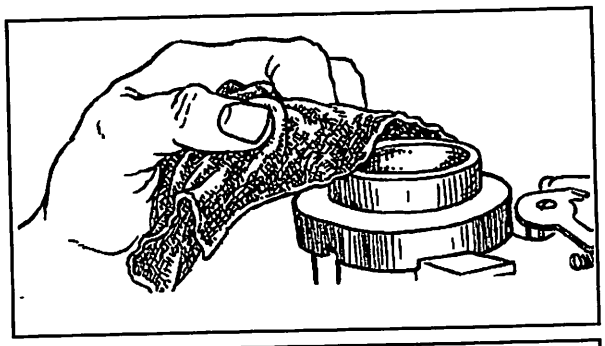
4. Remove the air cleaner.





Illustrations courtesy of Briggs & Stratton Corporation

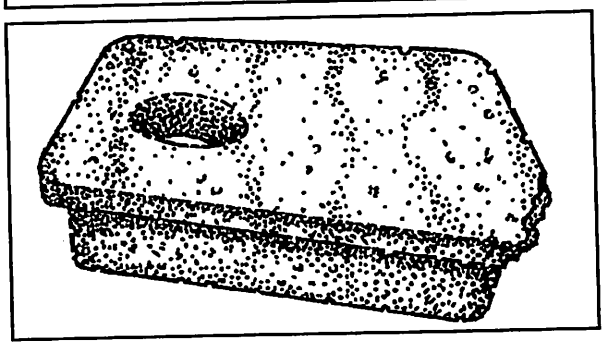
5. Cover carburetor air intake.



6. Disassemble air cleaner.

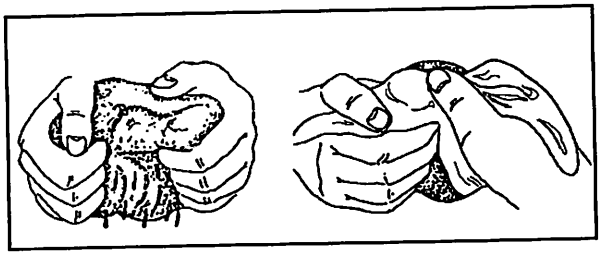
7. Check condition of filter element and other air cleaner parts.

Note: Polyurethane filters become brittle and will crumble. Replace filter when this condition exists.



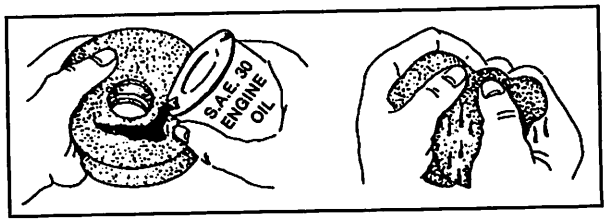
8. Clean filter element using liquid detergent and hot water.

9. Dry the filter element.

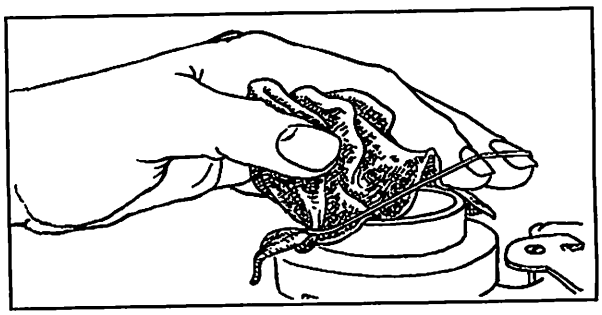


10. Saturate filter element with engine oil.

11. Squeeze to remove excess oil.

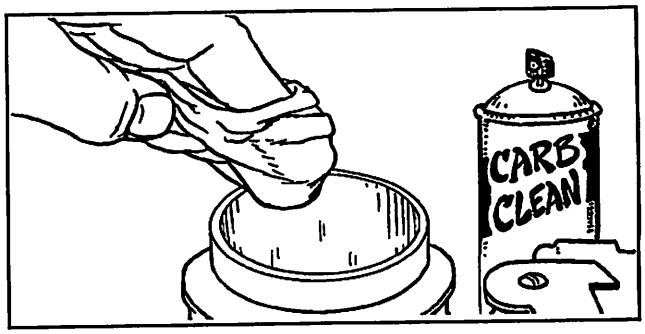


12. Remove protective cover from the carburetor intake.

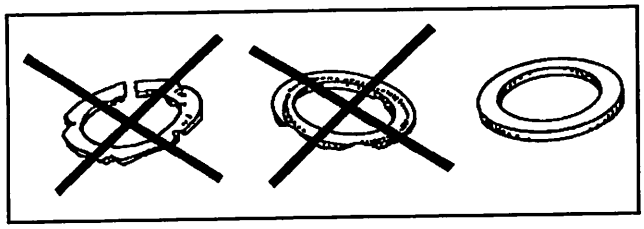


Illustrations courtesy of Briggs & Stratton Corporation

13. Clean the carburetor intake with soft cloth and solvent.



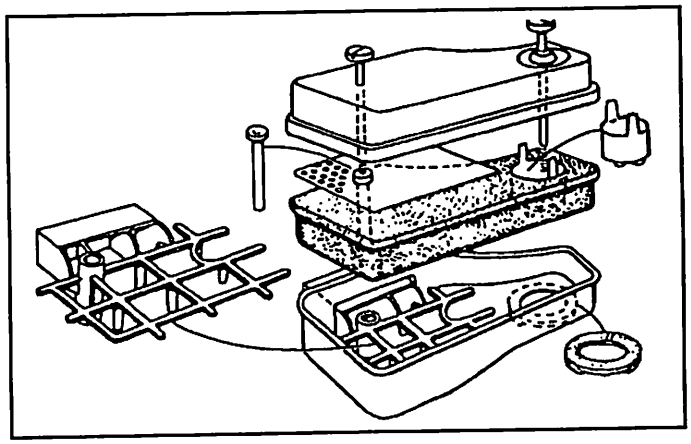
14. Replace air cleaner gaskets that are worn or damaged.



Note: Clean and reoil air cleaner element every 25 hours or at three month intervals under normal conditions. Clean every few hours under extremely dusty conditions.

15. Reassemble air cleaner and tighten the cover securely with screw or wing nut.

16 Reconnect spark plug wire.



Illustrations courtesy of Briggs & Stratton Corporation

Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

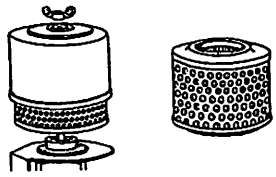
Yes	No	Servicing an Oil Foam Air Cleaner
___	___	1. Read operator's manual.
___	___	2. Disconnect spark plug wire.
___	___	3. Clean area around air cleaner.
___	___	4. Remove air cleaner.
___	___	5. Cover carburetor air intake.
___	___	6. Disassemble air cleaner.
___	___	7. Check condition of filter element.
___	___	8. Clean filter element.
___	___	9. Dry filter element.
___	___	10. Saturate filter element with engine oil.
___	___	11. Squeeze to remove excess oil.
___	___	12. Remove protective cover from intake.
___	___	13. Clean carburetor intake.
___	___	14. Replace air cleaner gaskets.
___	___	15. Reassemble air cleaner.
___	___	16. Reconnect spark plug wire.

_____ Student's Signature

_____ Instructor's Signature

_____ Date

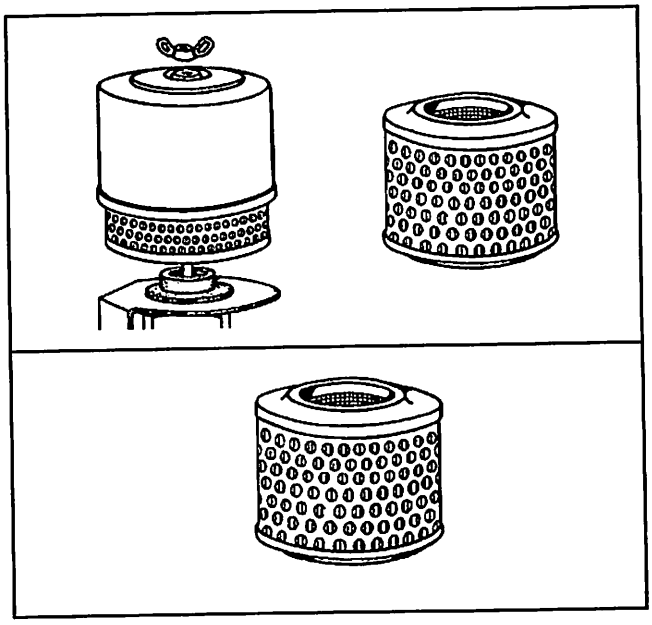
C. Servicing a Cartridge Air Cleaner (Round)



1. Always read the operator's manual and *Briggs & Stratton Service and Repair Manual.*

⚠ ***CAUTION: Wear proper safety equipment.***

2. Disconnect the spark plug wire.



3. Clean area around the air cleaner.

4. Remove wing nut and cover.

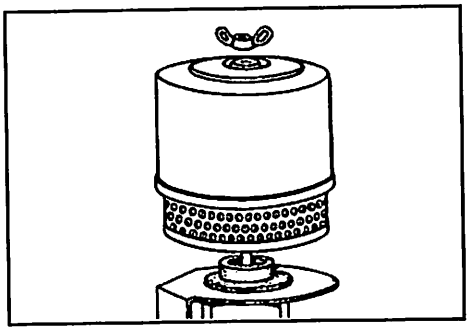
5. Carefully remove air cleaner from engine and disassemble.

6. Check condition of filter element and other parts of air cleaner.

7. To clean cartridge, tap top or bottom on a flat surface or wash in a non-sudsing detergent and flush from the inside until water is clear. After washing, air dry thoroughly before using.

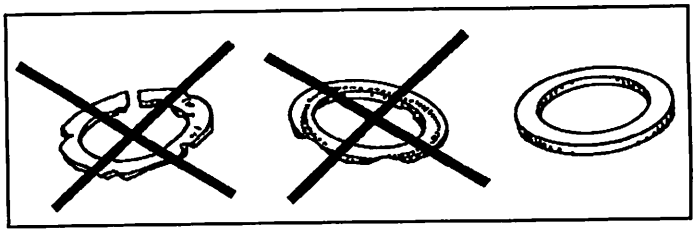
Note: Do not oil.

⚠ ***CAUTION: Do not use pressurized air to clean dry cartridge.***



8. Reassemble air cleaner.

9. Check air cleaner gasket and replace if worn or damaged.



10. Carefully install air cleaner on engine and reconnect the spark plug wire.

Illustrations courtesy of Briggs & Stratton Corporation

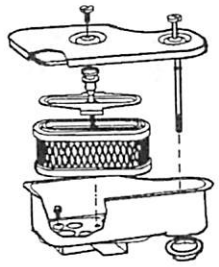
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing a Cartridge Air Cleaner (Round)
___	___	1. Read operator's manual.
___	___	2. Disconnect the spark plug wire.
___	___	3. Clean area around the air cleaner.
___	___	4. Remove wing nut and cover.
___	___	5. Remove air cleaner and disassemble.
___	___	6. Check condition of filter.
___	___	7. Clean filter cartridge.
___	___	8. Reassemble air cleaner.
___	___	9. Check air cleaner gasket.
___	___	10. Install air cleaner. Reconnect spark plug wire.
___	___	11. Reassemble air cleaner.
___	___	12. Clean carburetor intake.
___	___	13. Replace air cleaner gaskets.
___	___	14. Install air cleaner. Reconnect spark plug wire.

Student's Signature _____ Instructor's Signature _____ Date _____

D. Servicing a Reverse Air Flow Cartridge Air Cleaner



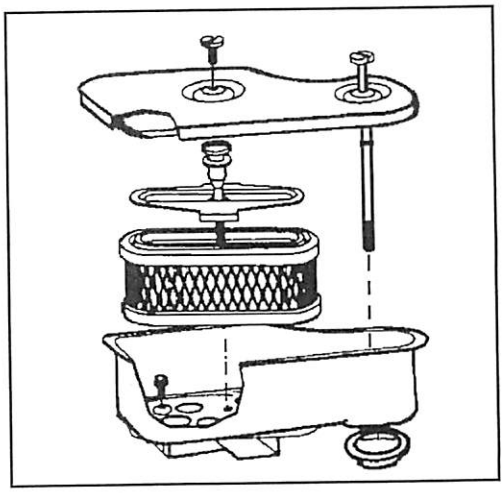
1. Always read the operator's manual and *Briggs and Stratton Service and Repair Manual.*

⚠ ***CAUTION: Wear proper safety equipment.***

2. Disconnect the spark plug wire.

3. Clean area around air cleaner.

Disassembly



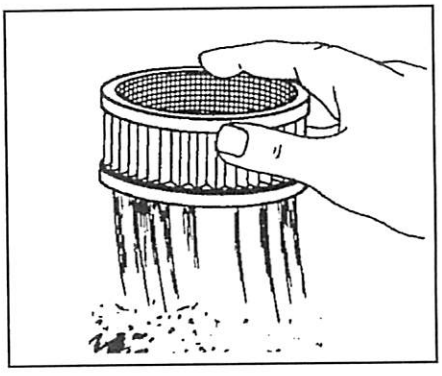
4. Remove air cleaner stud, cover screw, cover, and gasket. Replace gasket if worn or damaged.

5. Remove plate screw, washer, and plate.

6. Remove cartridge and clean body of air cleaner.

Note: Place a protective cover over the carburetor intake.

7. Clean cartridge by tapping gently on a flat surface.



8. If the cartridge is very dirty, it should be replaced or washed in a low-sudsing detergent and warm water.

⚠ ***WARNING: Do not use petroleum solvents, such as kerosene, to clean cartridge. Do not oil cartridge.***

9. Rinse thoroughly from the outside until water is clear.

10. Dry thoroughly before using.

Illustrations courtesy of Briggs & Stratton Corporation

Reassembly

11. Reassemble air cleaner.

Note: If air cleaner stud is bent, straighten or replace with a new one.

12. Remove the protective cover from carburetor intake and clean intake with a lint-free cloth and solvent.

13. Replace worn or damaged air cleaner gaskets.

14. Carefully install air cleaner on engine and reconnect the spark plug wire.

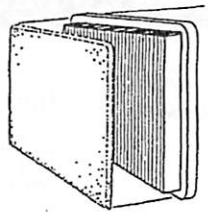
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing a Reverse Air Flow Cartridge Air Cleaner
___	___	1. Read the operator's manual.
___	___	2. Disconnect the spark plug wire.
___	___	3. Clean area around air cleaner.
___	___	4. Remove air cleaner stud, cover screw, cover, gasket.
___	___	5. Remove plate screw, washer, and plate.
___	___	6. Remove cartridge and clean body of air cleaner.
___	___	7. Clean cartridge.
___	___	8. Replace cartridge if too dirty.
___	___	9. Rinse cartridge.
___	___	10. Dry cartridge.
___	___	11. Reassemble air cleaner.
___	___	12. Remove cover from carburetor intake and clean.
___	___	13. Replace worn or damaged air cleaner gaskets.
___	___	14. Install air cleaner. Reconnect the spark plug wire.

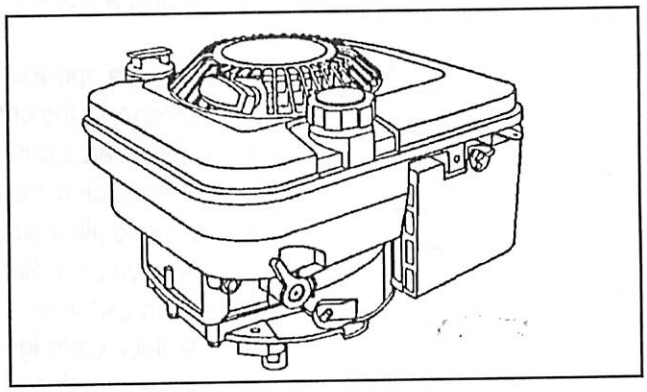
Student's Signature _____ Instructor's Signature _____ Date _____

E. Servicing a Flat Cartridge (Vertical Crankshaft) Air Cleaner



1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

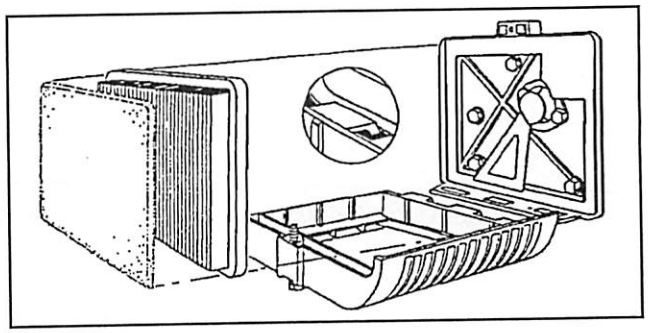
⚠ ***CAUTION: Wear proper safety equipment.***



2. Disconnect the spark plug wire.

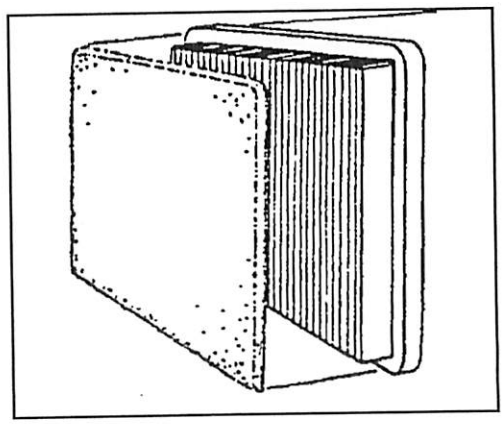
3. Clean area around air cleaner before removing.

Disassembly



4. Loosen cover screw and remove cover. Clean for reassembly.

5. Carefully remove cartridge and foam pre-cleaner (when equipped).



6. Clean cartridge by tapping gently on a flat surface. If very dirty, replace the cartridge and pre-cleaner or clean as follows:

   a. Wash cartridge and pre-cleaner in a low- or non-sudsing detergent and warm water solution.
   b. Rinse thoroughly with flowing water from inside out until water is clear.
   c. Allow cartridge and pre-cleaner to stand and air dry thoroughly before using.

Illustrations courtesy of Briggs & Stratton Corporation

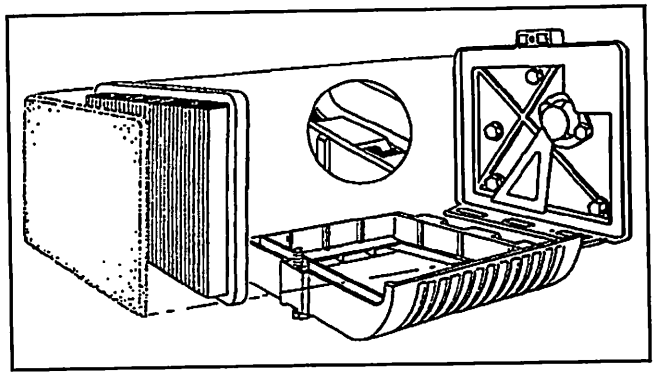
CAUTION: DO NOT OIL CARTRIDGE OR USE PRESSURIZED AIR TO CLEAN OR DRY CARTRIDGE.

**** Petroleum solvents are not to be use to clean the cartridge.***

7. Air Cleaner Maintenance
   a. Service pre-cleaner, if so equipped, every 25 hours or every season, whichever occurs first.
   b. Service cartridge every 100 hours or every season, whichever occurs first, if equipped with pre-cleaner.
   c. Service cartridge every 25 hours or every season, whichever occurs first, if NOT equipped with pre-cleaner.

Note: Service more often under dusty conditions.

   d. Loosen screw and tilt cover as illustrated.
   e. Carefully remove foam pre-cleaner when so equipped.



8. Install pre-cleaner and cartridge in cover; insert tabs on cover into slots in bottom of base, tilt cover up and fasten screw securely to base.

9. Reconnect the spark plug wire.

Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing a Flat Cartridge (Vertical Crankshaft) Air Cleaner
___	___	1. Read operator's manual.
___	___	2. Disconnect the spark plug wire.
___	___	3. Clean area around air cleaner before removing.
___	___	4. Remove cover. Clean for reassembly.
___	___	5. Remove cartridge and foam pre-cleaner.
___	___	6. Clean cartridge.
___	___	7. Service air cleaner.
___	___	8. Install new pre-cleaner and cartridge in cover.
___	___	9. Reconnect spark plug wire.

Student's Signature _____ Instructor's Signature _____ Date _____

F. Servicing a Flat Cartridge (Horizontal Crankshaft) Air Cleaner

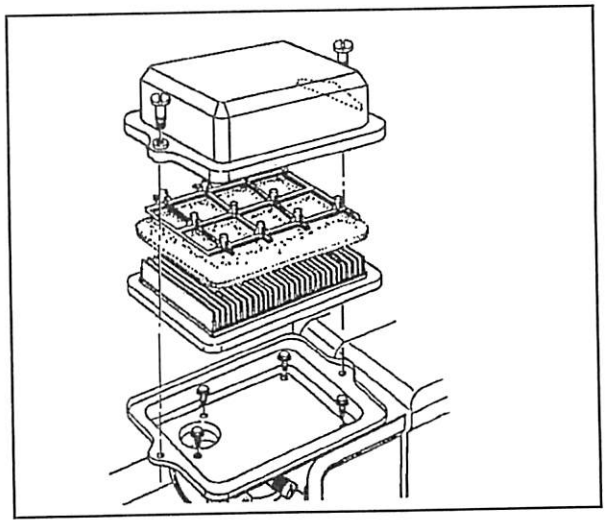
1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

⚠ ***CAUTION: Wear proper safety equipment.***

2. Disconnect spark plug wire.

3. Clean area around air cleaner before removing.

Disassembly



4. Service air cleaner. Loosen two screws and remove cover.

5. Carefully remove pre-cleaner (if equipped) and cartridge.

6. Clean air cleaner housing and carburetor intake.

7. Clean cartridge by tapping gently on a flat surface. If very dirty, replace cartridge and pre-cleaner or clean as follows:

   a. Wash cartridge and pre-cleaner in a non-sudsing detergent and warm water solution.
   b. Rinse thoroughly with flowing water from mesh side until water is clear.
   c. Wrap foam pre-cleaner in cloth and squeeze dry.
   d. Saturate foam pre-cleaner in engine oil. Squeeze to remove excess oil.
   e. Dry thoroughly before using.

⚠ ***CAUTION: Petroleum solvents, such as kerosene, should not be used to clean cartridge. They may damage the cartridge. Do not oil cartridge. Do not use pressurized air to clean or dry cartridge.***

Note: With dual element air cleaner, service pre-cleaner (if equipped) every 2 hours or every season, whichever occurs first.

Service cartridge every 100 hours or every season, whichever occurs first, if equipped with pre-cleaner.

Service cartridge every 25 hours or every season, whichever occurs first, if NOT equipped with pre-cleaner.

Service more often under dusty conditions.

Illustrations courtesy of Briggs & Stratton Corporation

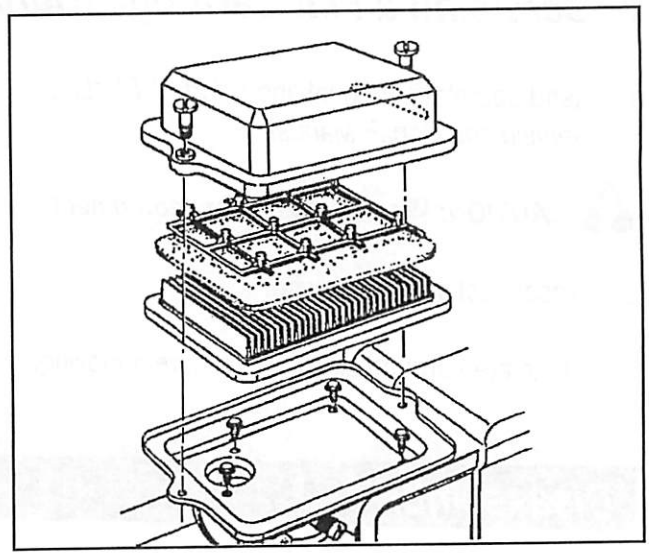
Reassembly

8. Service air cleaner.
   a. Loosen screw and tilt cover as illustrated.
   b. Carefully remove foam pre-cleaner when so equipped.

9. Install pre-cleaner and cartridge in base plate.

10. Install cover plate and tighten screws securely.

11. Reconnect spark plug wire.



Illustrations courtesy of Briggs & Stratton Corporation

Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing a Flat Cartridge (Horizontal Crankshaft) Air Cleaner
___	___	1. Read operator's manual.
___	___	2. Disconnect spark plug wire.
___	___	3. Clean area around air cleaner.
___	___	4. Service air cleaner.
___	___	5. Remove pre-cleaner and cartridge.
___	___	6. Clean air cleaner housing and carburetor intake.
___	___	7. Clean cartridge.
___	___	8. Service air cleaner.
___	___	9. Install pre-cleaner and cartridge.
___	___	10. Install cover plate.
___	___	11. Reconnect spark plug wire.

_____ Student's Signature

_____ Instructor's Signature

_____ Date

G. Servicing an Oil Bath Air Cleaner

1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

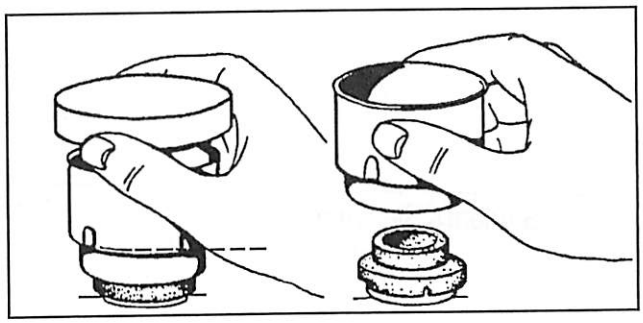
⚠ ***CAUTION: Wear proper safety equipment.***

2. Disconnect spark plug wire.

3. Clean area around the air cleaner before removing.

Disassembly

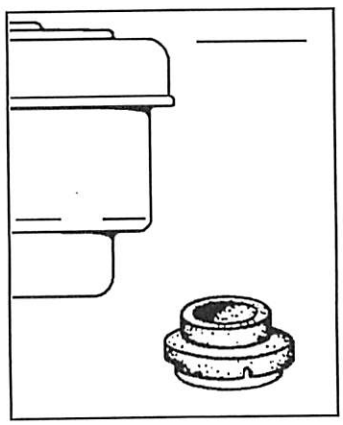
4. Service air cleaner.
   a. Remove air cleaner cover.
   b. Remove air cleaner bowl and pour out old oil.
   c. Wash air cleaner with solvent and refill with the same type of oil used in the crankcase.



⚠ ***CAUTION: Do not over fill with oil.***

⚠ ***WARNING: Safety goggles and rubber gloves should always be worn when working with solvents and commercial carburetor cleaners.***

5. Replace air cleaner gaskets if worn or damaged.



⚠ ***CAUTION: Do not over fill with oil.***

Reassembly

6. Carefully install air cleaner on engine and reconnect spark plug wire.

Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing an Oil Bath Air Cleaner
___	___	1. Read operator's manual.
___	___	2. Disconnect spark plug wire.
___	___	3. Clean area around the air cleaner before removing.
___	___	4. Service air cleaner.
___	___	5. Replace air cleaner gaskets.
___	___	6. Install air cleaner.
___	___	7. Reconnect spark plug wire.
___	___	

_____ Student's Signature

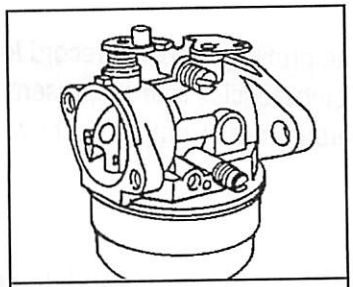
_____ Instructor's Signature

_____ Date

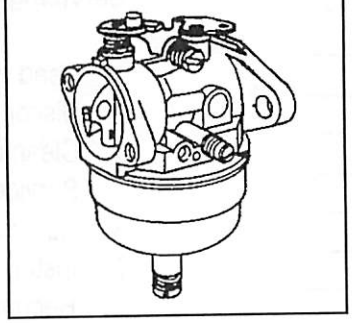
H. Servicing Briggs and Stratton Walbro One-Piece Flo-Jet Carburetor

Note: There are two basic versions of this type carburetor:

- ***a. Fixed high-speed main jet.***
- ***b. Adjustable high-speed main jet.***



Fixed Main Jet Carburetor

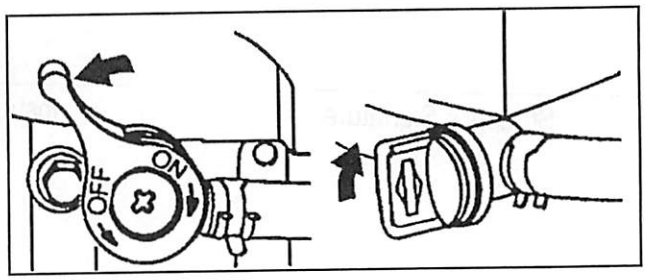


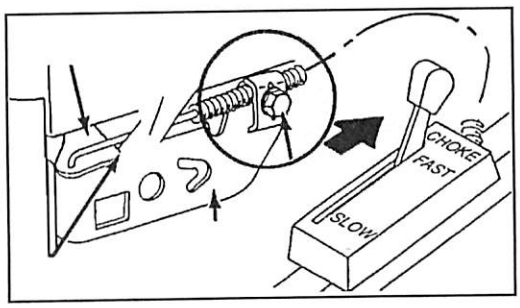
Adjustable Main Jet Carburetor

1. Read operator's manual and *Brigg's and Stratton Service and Repair Manual.*
2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.
3. Wear proper clothing and safety equipment.

Observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.

Disassembly

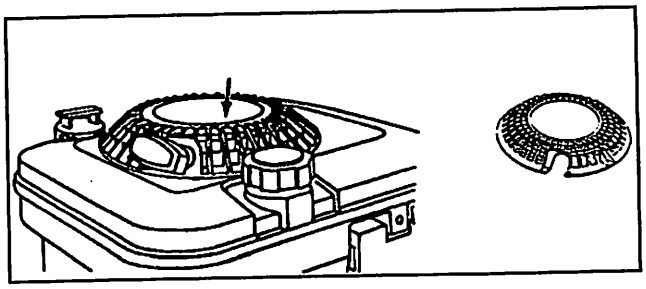




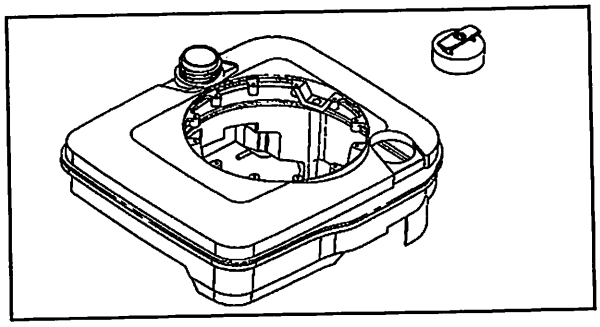
4. Disconnect spark plug wire and place in V-Notch on engine.
5. Turn the fuel petcock to OFF position.
6. Inspect carburetor and fuel tank for signs of air leakage.
7. Remove remote control.

Illustrations courtesy of Briggs & Stratton Corporation

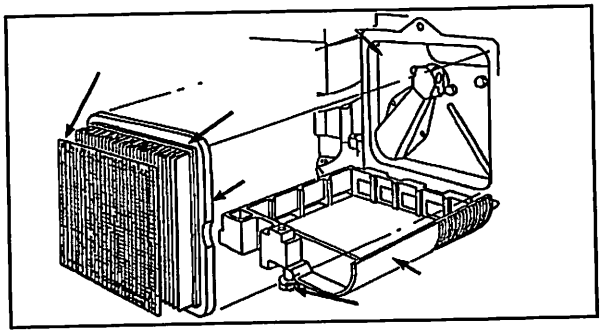
8. Use screwdriver to remove the static guard.



9. Remove tank assembly.
   a. Remove oil cap.
   b. Remove fuel line from fuel tank.
   c. Remove primer line from carburetor (not installed on all models).
   d. Remove tank assembly.

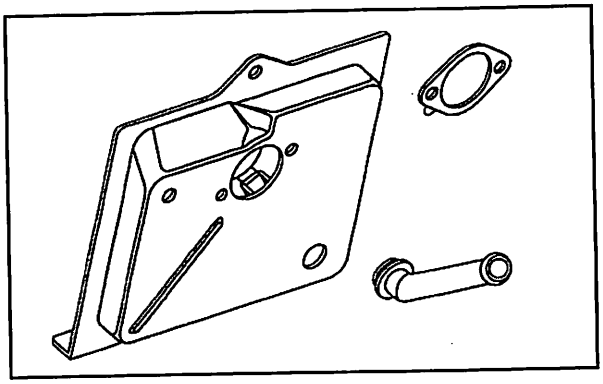


10. Remove air cleaner and back plate.



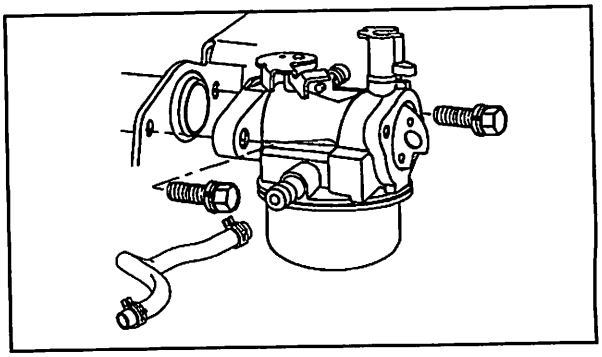
11. Remove gasket and venting grommet from the back plate.

12. Inspect gasket and venting grommet for damage and proper seal.



13. Remove two mounting bolts from carburetor and engine. Check O-ring for damage.

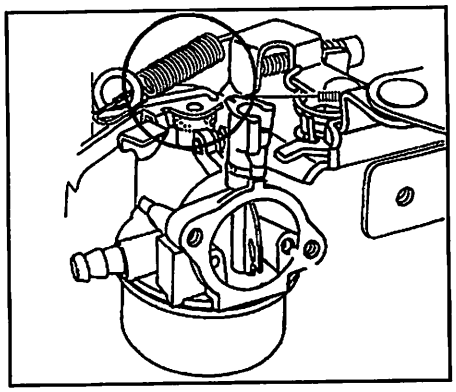
14. Remove fuel line from carburetor.



Illustrations courtesy of Briggs & Stratton Corporation

15. Disconnect governor linkage from carburetor and remove carburetor. Tilt carburetor to remove linkage.

Note: Removal of Welch plug, choke and throttle shaft were omitted in this procedure. They can be repaired or replaced, if needed.

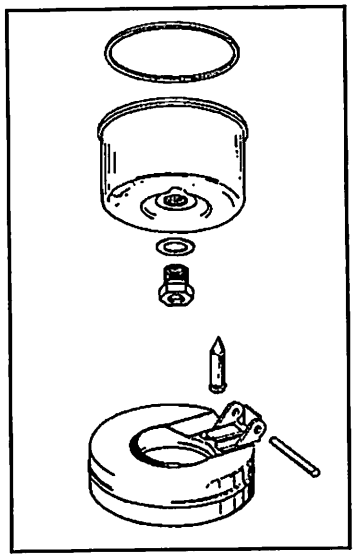


16. Remove bowl nut and/or high-speed needle nut and fiber washer.

17. Remove float bowl and bowl gasket from carburetor.

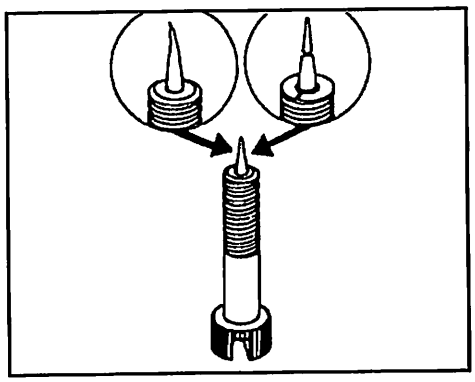
⚠ ***WARNING: Remove gasoline from bowl and store in an approved container.***

18. Remove float hinge pin, float, and inlet valve.

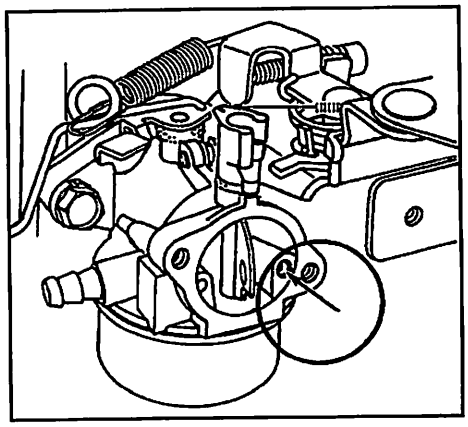


19. Remove idle mixture screw with spring and observe condition. Do not remove idle speed screw unless you see a problem.

Note: On Model Series 120000 engines the bowl nut may be removable fixed jet.

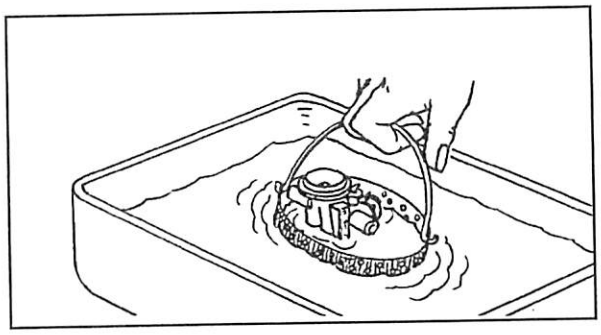


20. Adjust for high altitude compensation, if needed, by removing main jet air bleed.



Illustrations courtesy of Briggs & Stratton Corporation

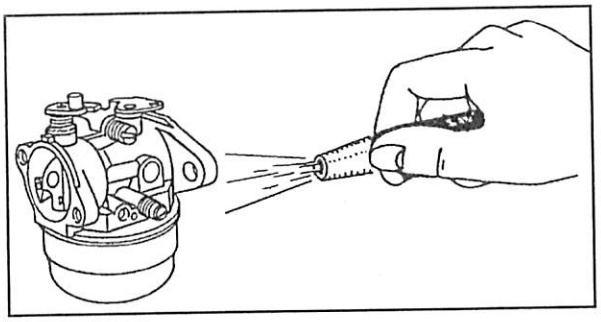
21. Clean and inspect carburetor. After cleaning, inspect for wear, damage, cracks, or plugged openings. Replace body if any of the above conditions exist.



Note: Inspect idle mixture needle for bent needle point or a groove in tip of needle. Replace if bent or grooved.

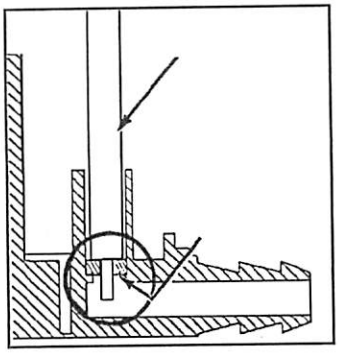
Note: Use a good commercial grade carburetor cleaner.

22. Use compressed air to clean carburetor parts.



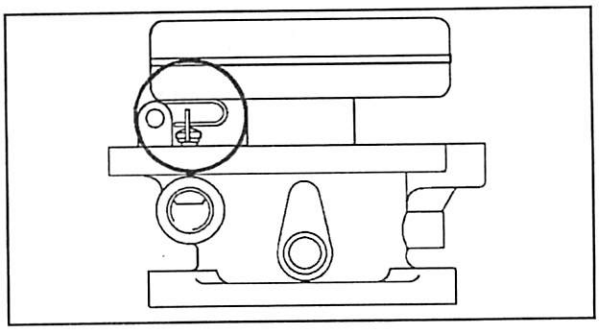
Reassembly

23. Install inlet needle seat with GROOVE DOWN using Tool #19057 Bushing Driver, until seated.



Note: The inlet needle seat should only be replaced when carburetor is flooding or not functioning properly. Always replace needle and seat as a unit.

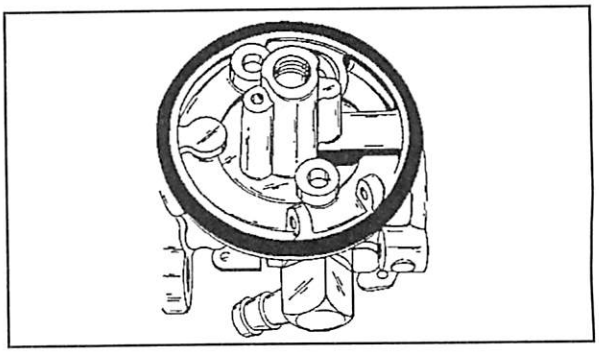
24. Install inlet needle on float and install assembly on carburetor body. Insert float hinge pin and center pin.



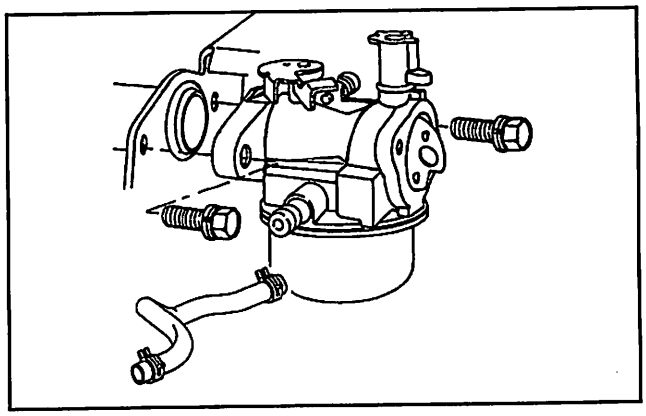
Note: Float height is not adjustable.

Note: Complete repair kits are available.

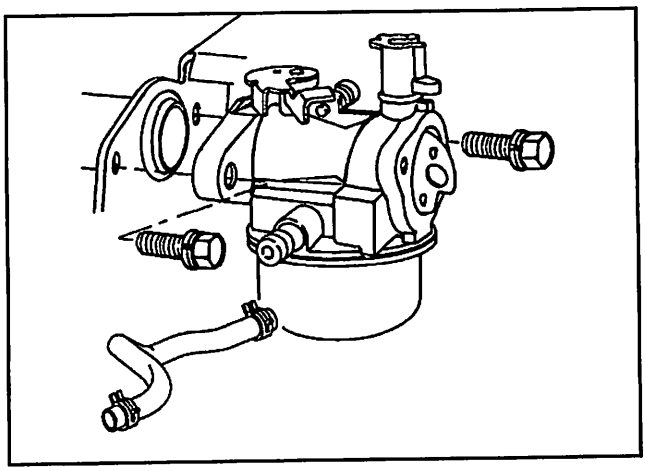
25. Install rubber gasket on carburetor and lay float bowl on body. Place fiber washer on bowl nut and torque to 50 inch-lbs. torque.



26. Install carburetor and fuel line.
    a. Install O-ring seal on fuel intake pipe and attach the governor link to the throttle lever.
    b. Install fuel line on carburetor and fuel tank.
    c. Ease carburetor onto fuel intake pipe and install two mounting screws.
    d. Torque screws to 90 inch-lbs.
    e. Open fuel line and check for leaks.



27. Perform initial adjustment.
    a. Install idle speed screw and spring.
    b. Install idle mixture screw and spring.
    c. Turn idle speed screw in until it just touches needle seat. Back out screw 1 and 1/4 turn to permit engine to start.
    d. Turn idle mixture screw in until it just touches needle seat. Back out screw 1 and 1/4 turn to permit engine to start.

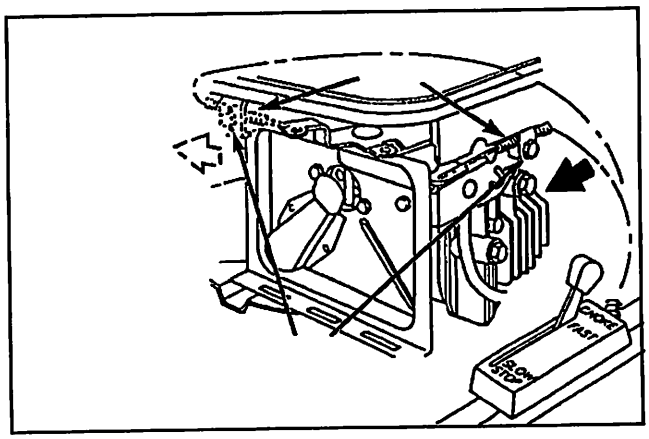


Note: On carburetors with adjustable high-speed needle, turn high-speed adjustment needle clockwise until it just touches needle seat. Then back off 1 and 1/4 turn.

28. Reconnect the spark plug wire.

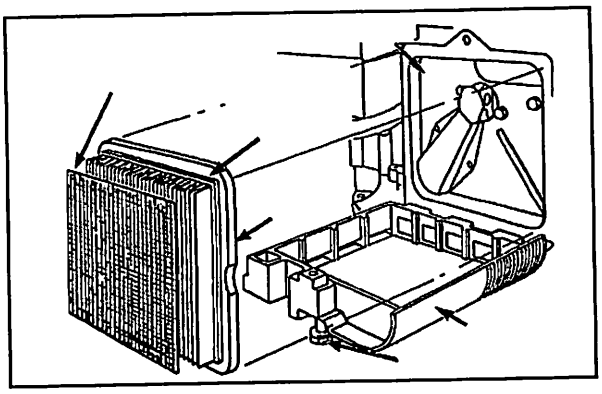
⚠ ***CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.***

29. Install remote control.
    a. Move remote control lever B to "Choke" position.
    b. Loosen casing clamp screw "A."
    c. Hold remote control lever in "Choke" position while moving casing and wire "C" to left end of travel until choke valve is closed. Tighten casing clamp screw "A."
    d. Check operation of controls.

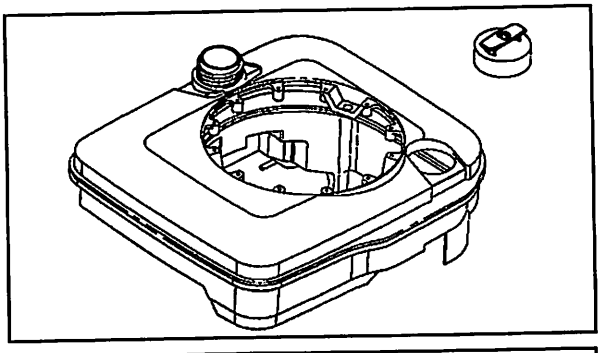


Illustrations courtesy of Briggs & Stratton Corporation

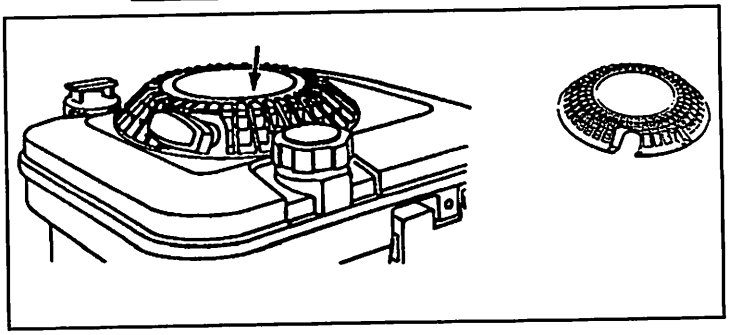
30. Install air cleaner.
    a. Insert venting elbow into back plate and install on engine with three screws.
    b. Install pre-cleaner and cartridge in cover.
    c. Insert tabs on cover into slots in bottom of base plate. Tilt cover up and fasten securely to base with one screw.



31. Install tank assembly.
    a. Fuel line.
    b. Oil cap.



32. Install static guard on tank assembly.



33. Perform final carburetor adjustment.
    a. Turn idle speed screw in until it touches needle seat and back off 1 and 1/4 turns.
    b. Turn idle mixture screw in until it touches needle seat and back off 1 and 1/4 turns.
    c. On carburetors with adjustable high-speed needle, turn high-speed adjustment needle clockwise until it just touches needle seat. Then back off 1 and 1/4 turns.

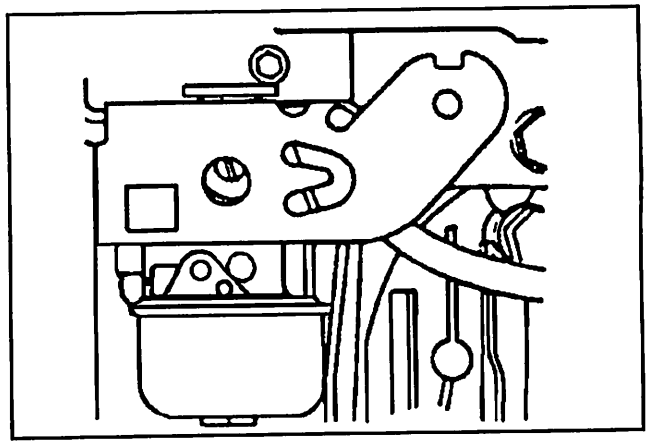
34. Perform RPM adjustments.
    a. Run engine at normal operating speed for five minutes.
    b. Move idle speed screw to idle position.
    c. Turn idle speed screw to obtain 1750 RPM minimum. The idle speed should be set with a tachometer.
    d. Turn idle mixture screw clockwise slowly until engine just begins to slow down.
    e. Turn idle mixture screw counterclockwise direction until engine begins to slow down.
    e. Turn idle mixture screw clockwise to a smooth operating point between rich and lean mixture.

Note: On carburetors with adjustable high-speed needle, move speed control to fast position. Adjust high-speed mixture needle in the same way as the idle mixture screw.

35. Move speed control from idle to high-speed position. The engine should accelerate smoothly. If adjustment is needed. open idle mixture screw 1/8 turn.

Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

36. Clean your work area and return tools to their proper places.



Note: DO NOT ADJUST TOP NO-LOAD SCREW (Pre-set at factory).

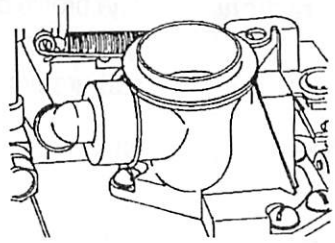
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Briggs and Stratton Walbro One-Piece Flo-Jet Carburetor
		Disassembly
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Wear proper safety equipment.
___	___	4. Disconnect spark plug wire.
___	___	5. Turn fuel petcock to OFF position.
___	___	6. Inspect carburetor and fuel tank for air leakage.
___	___	7. Remove remote control.
___	___	8. Remove the static guard.
___	___	9. Remove tank assembly.
___	___	10. Remove air cleaner and back plate.
___	___	11. Remove gasket and venting grommet.
___	___	12. Inspect gasket and venting grommet.
___	___	13. Remove two mounting bolts from carburetor and inspect.
___	___	14. Remove fuel line from carburetor.
___	___	15. Remove carburetor.
___	___	16. Remove bowl nut, high-speed needle nut, fiber washer.
___	___	17. Remove float bowl and bowl gasket.
___	___	18. Remove float hinge pin, float, inlet valve.
___	___	19. Remove idle mixture screw with spring.
___	___	20. Adjust for high altitude compensation.
___	___	21. Clean and inspect carburetor.
		Reassembly
___	___	22. Use compressed air to clean carburetor.
___	___	23. Install inlet needle seat.
___	___	24. Install inlet needle, float pin, center pin on carburetor body.
___	___	25. Install gaskets on carburetor.
___	___	26. Install carburetor and fuel line.
___	___	27. Perform initial adjustment.
___	___	28. Reconnect the spark plug wire.
___	___	29. Install remote control.
___	___	30. Install air cleaner.
___	___	31. Install tank assembly.
___	___	32. Install static guard on tank assembly.
___	___	33. Perform carburetor adjustment.
___	___	34. Perform RPM adjustments.
___	___	35. Adjust speed control.
___	___	36. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

I. Step-By-Step Procedure in Servicing Pulsa-Jet, Vacu-Jet All Temperature Automatic Choke



1 Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

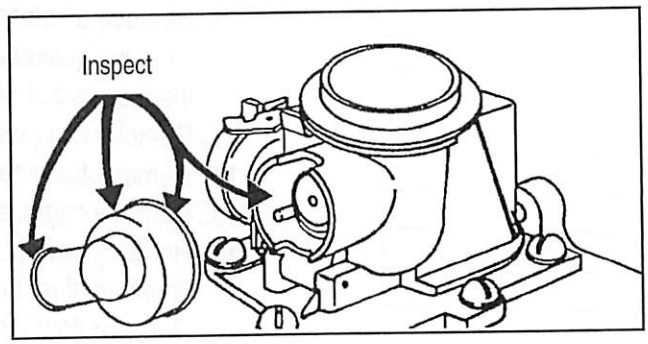
CAUTION: Wear proper safety equipment. Remove rings, watches, necktie, and jewelry.

Disassembly

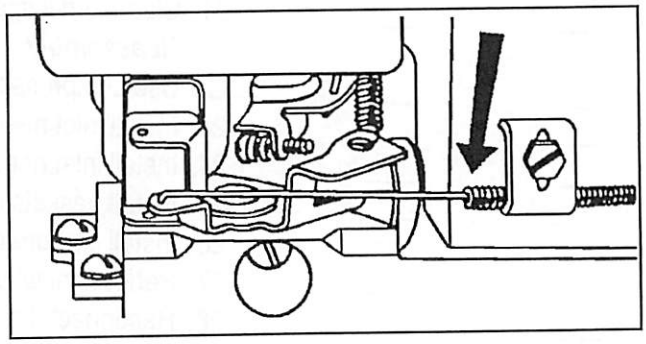
3. Disconnect spark plug wire.

4. Remove air cleaner.

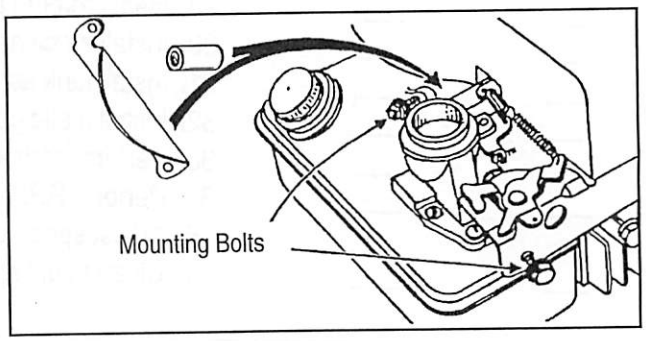
5. Inspect carburetor, rubber elbow, and bi-metal spring cavity for signs of leaks or damage.



6. Remove remote control.

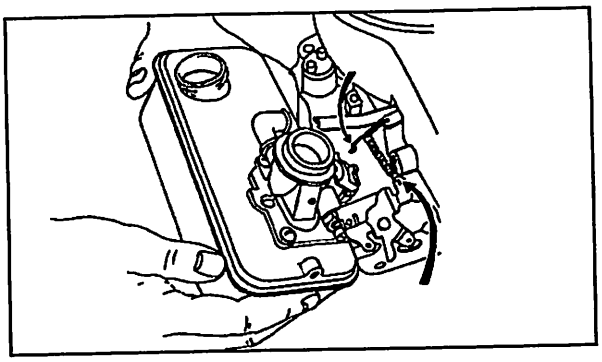


7. Remove two mounting bolts from the carburetor and engine.

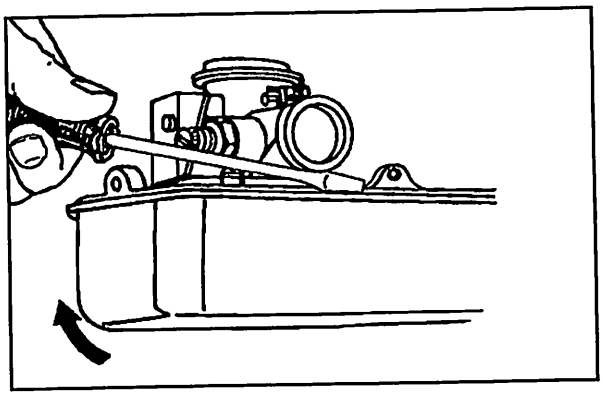


Illustrations courtesy of Briggs & Stratton Corporation

8. Remove carburetor and fuel tank assembly from end of fuel intake tube and turn carburetor to free governor link.

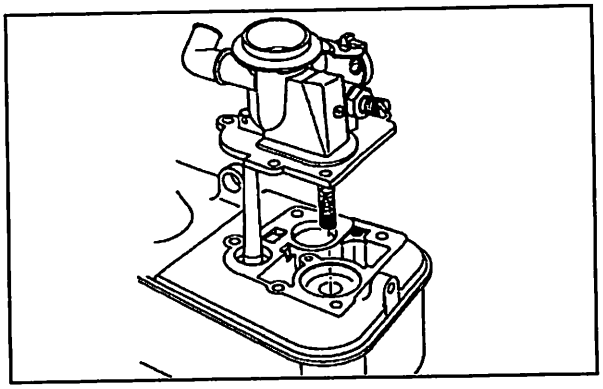


9. Remove five screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.

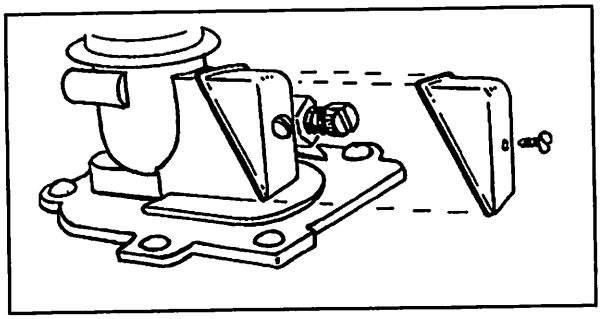


10. Remove carburetor from fuel tank.

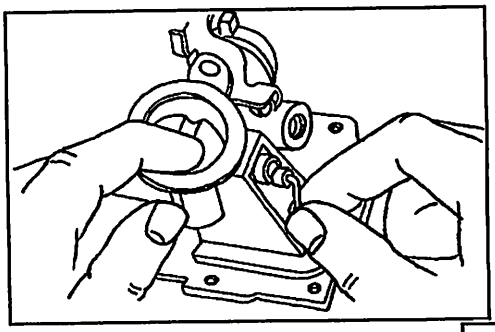
Note: Carburetor must be removed slowly to prevent damage to diaphragm.



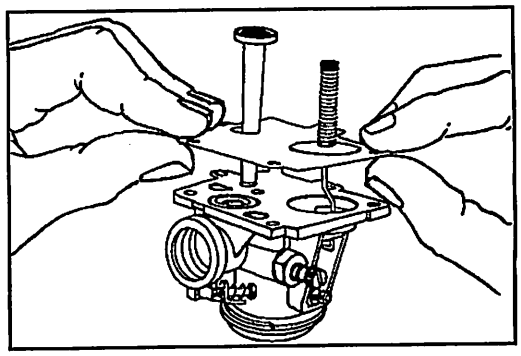
11. Loosen screw and remove choke link cover.



12. Slide choke link out of choke shaft lever to free diaphragm.

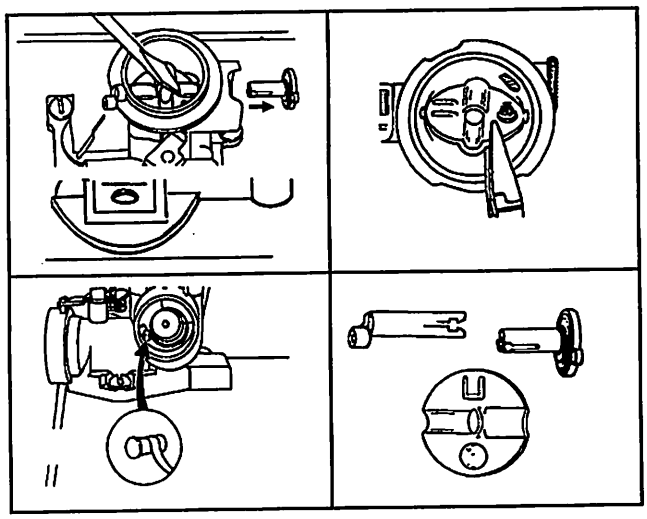


13. Remove diaphragm.
    a. Hold carburetor body upside down and guide choke link through hole.
    b. Inspect the diaphragm for punctures or cracks.

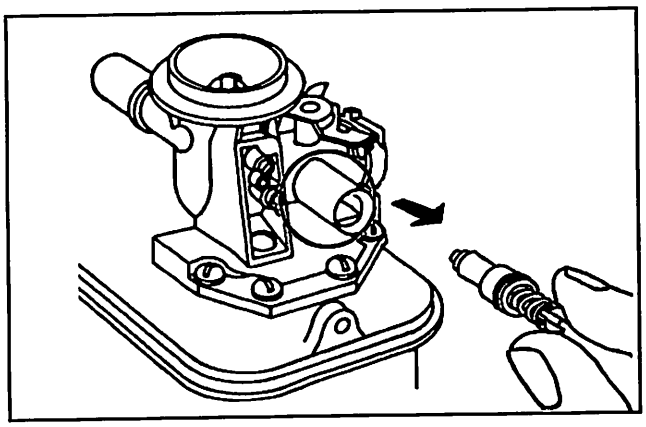


14. Disassemble choke.
    a. Use screwdriver to apply pressure on end of bi-metal spring shaft and slide out.
    b. Repeat procedure for removing choke shaft. Remove choke plate.
    c. Inspect shaft, choke plate and bi-metal spring for excessive wear or damage. Replace if necessary.

Note: Scrape off the flared portion before removing the bi-metal spring and shaft assembly.

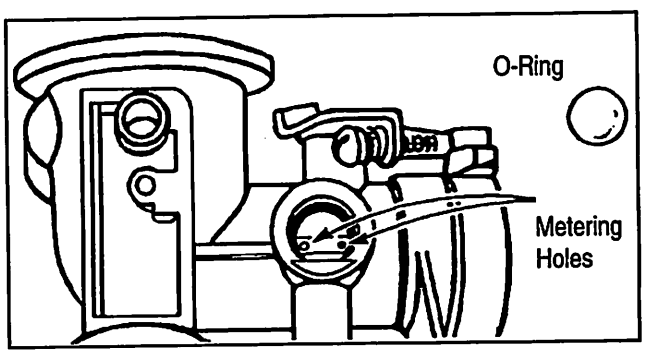


15. The needle valve and seat are one unit on a Minlon carburetor. To remove valve and seat unit, rotate needle valve assembly 4 to 5 turns in a counterclockwise direction. Grasp assembly with pliers and pull out.



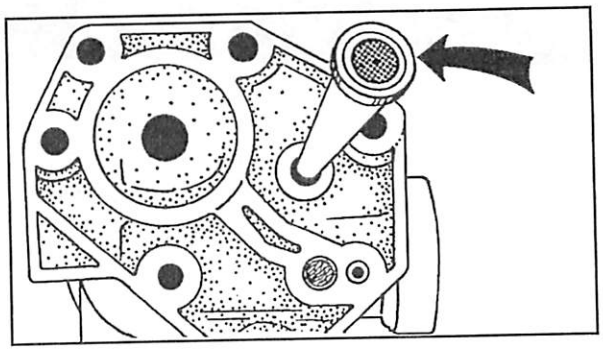
16. Remove O-ring and inspect. Inspect metering holes and air passage in carburetor for dirt or obstructions. Use compressed air to clean out passages.

Note: Do not use sharp objects to clean metering holes.

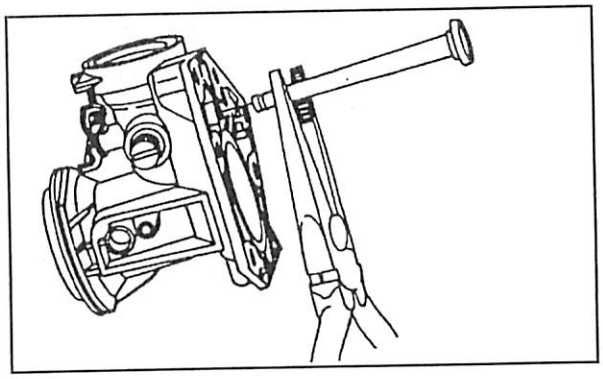


Illustrations courtesy of Briggs & Stratton Corporation

17. Without removing fuel pipes from carburetor body, inspect screen for gum deposits and dirt. Clean screen with a solvent and air dry. Remove pipe only when being replaced.

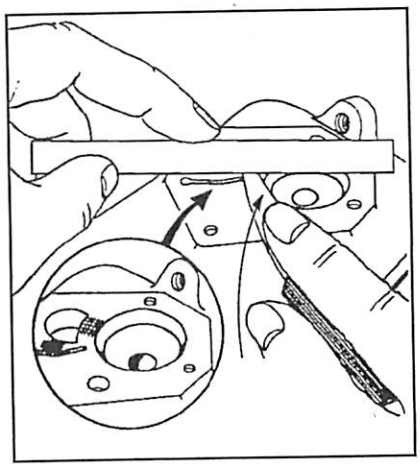


18. The fuel pipe on Minlon carburetors is a "snap fit" design. To remove, use needle nose pliers and force out.



19. Inspect top surface of fuel tank for flatness. If the machined surface on tank is not flat, gasoline can enter the vacuum chamber by passing between the machined surface and diaphragm.

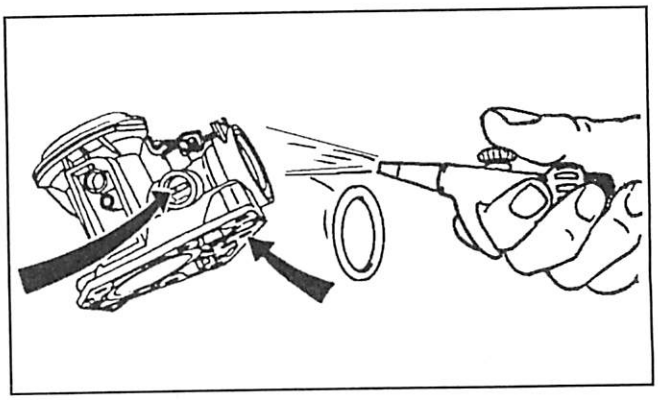
Note: A .002 feeler gauge should not fit between the straight edge and machined surface (see illustration). Tank should be replaced if gauge will enter.



20. Clean Minlon carburetor, tank and metering holes with a solvent and compressed air.

Note: Check O-rings for wear or damage.

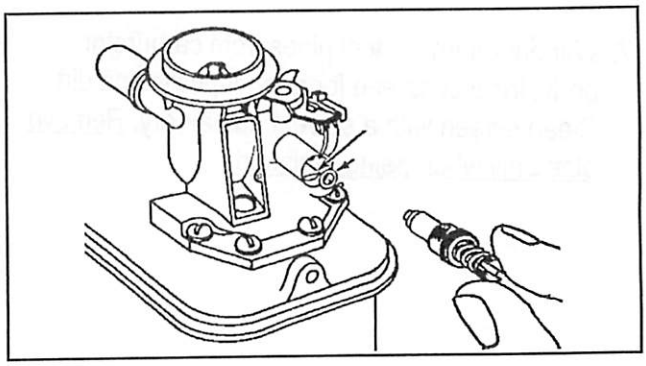
WARNING: If carburetor cleaner is used, do not exceed 15 minutes of contact as it will damage carburetor components.



Illustrations courtesy of Briggs & Stratton Corporation

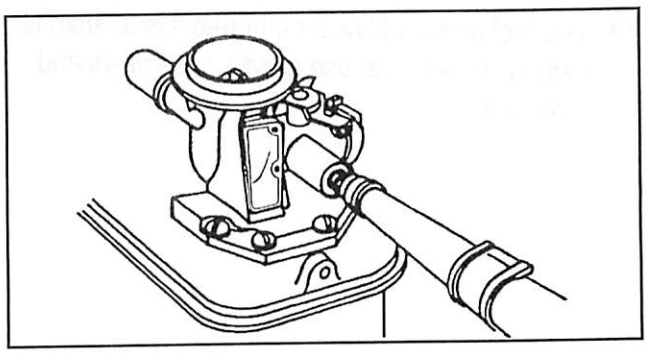
Reassembly

21. Install O-ring and needle valve assembly. Make sure that the flat surface on valve seat lines up with flat surface in carburetor body.

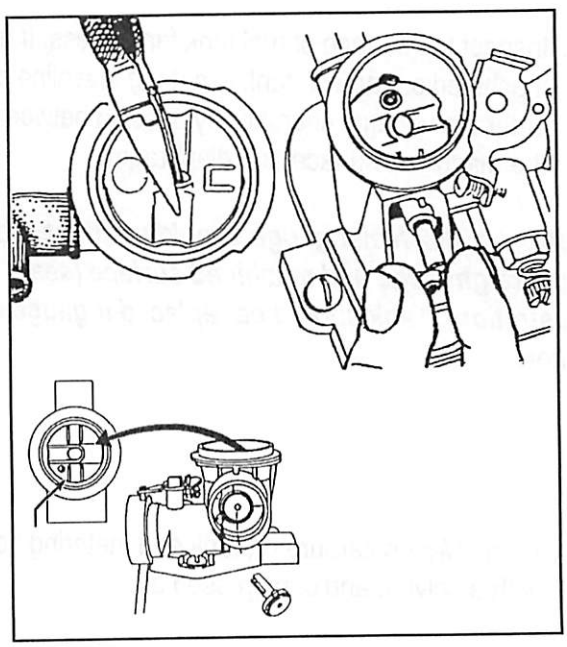


22. Use an oil fill tube or similar tool to firmly seat valve. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.

NOTE: All carburetor adjustments must be made with the air cleaner on engine.

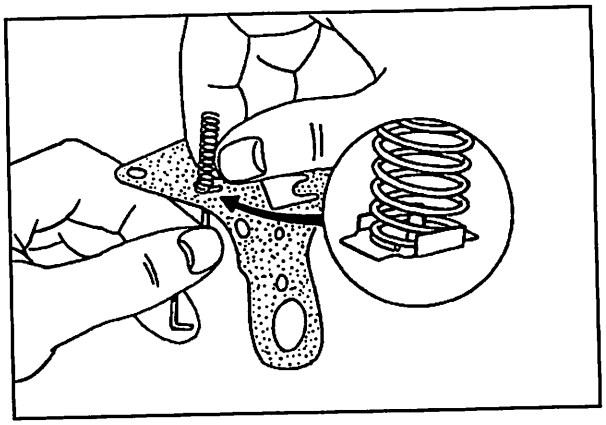


23. Place choke plate in carburetor (closed position) by using needle nose pliers. Insert shaft into carburetor until notch slides on choke plate. Place spring loop on anchor post and slide shaft on the choke plate until it locks in position.

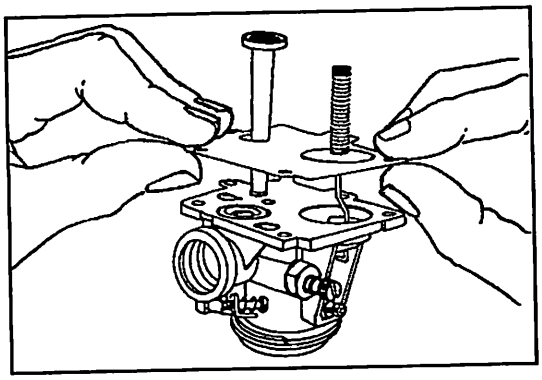


Illustrations courtesy of Briggs & Stratton Corporation

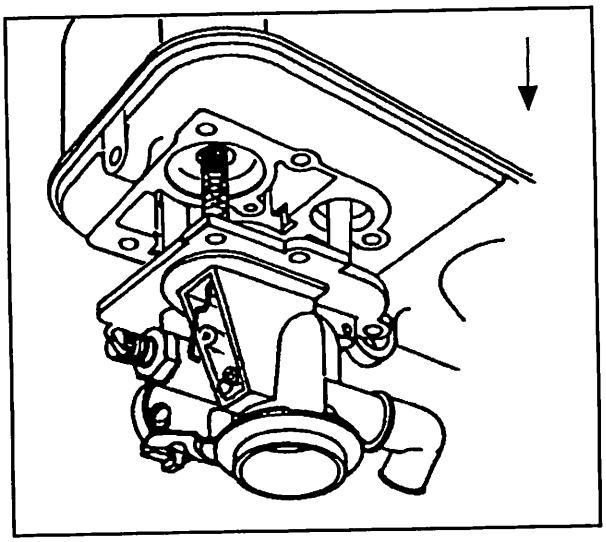
24. In installing a new diaphragm, assemble choke spring to diaphragm. Make sure spring is in clip on both sides.



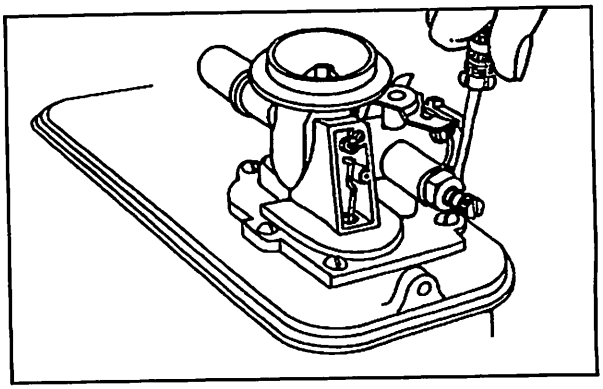
25. Holding carburetor body upside down, place spring and cap in fuel pump well on carburetor body. Place diaphragm on body while guiding choke link through hole.



26. Still holding carburetor upside down, lower tank onto carburetor and guide choke spring into spring well. To prevent damage to the diaphragm, align holes in carburetor, diaphragm, and fuel tank.

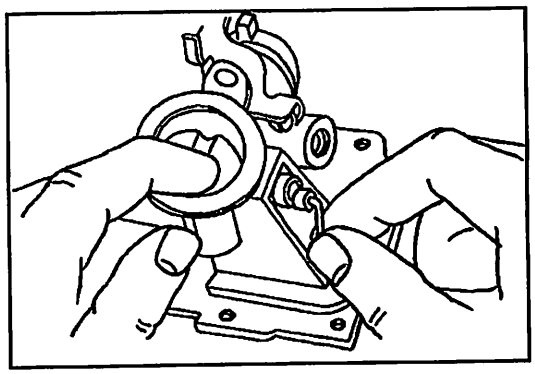


27. Holding carburetor and tank together, turn assembly right side up. Thread screws into tank top about two turns. DO NOT TIGHTEN.

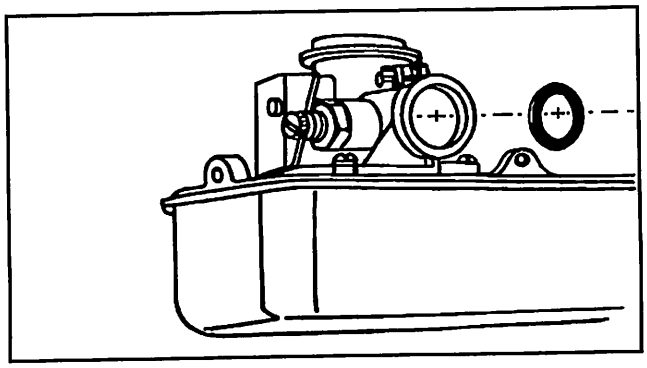


Illustrations courtesy of Briggs & Stratton Corporation

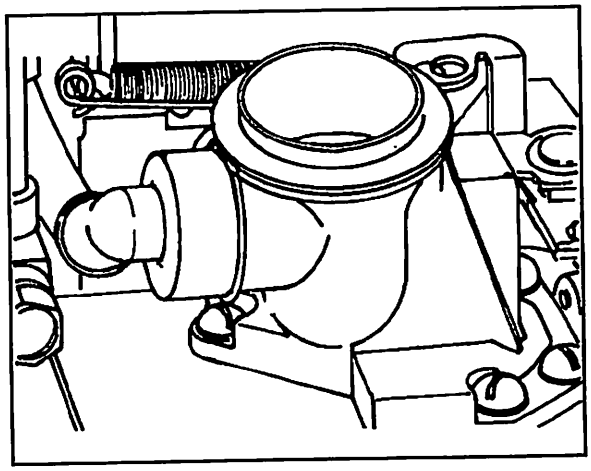
28. Move choke plate to an "over-center" position to place diaphragm in pre-loaded condition. Insert choke link into shaft and replace choke link cover.



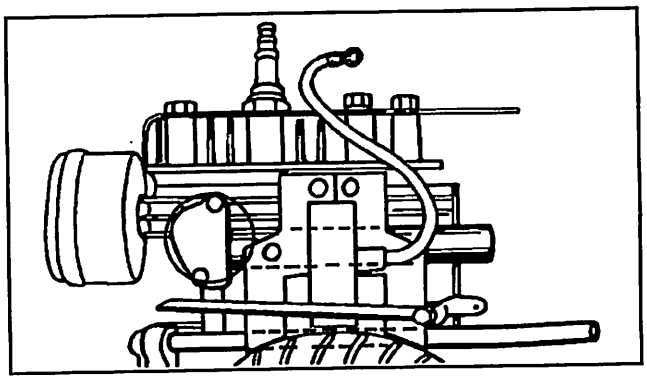
29. Check O-ring for a proper seal. The carburetor is sealed to the intake tube with an O-ring. Always replace O-ring when carburetor doesn't seal with the intake tube. Apply a light film of oil to the O-ring to prevent damage when carburetor is installed on engine.



30. Inspect the rubber elbow (breather tube grommet) for damage and proper seal.

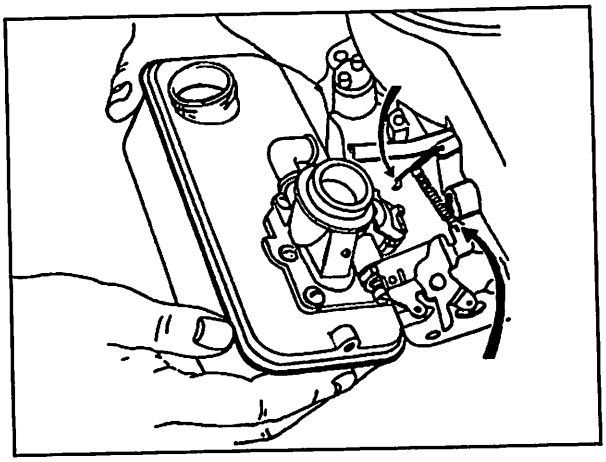


31. Check fuel intake tube gasket and tighten bolts securely before installing carburetor.

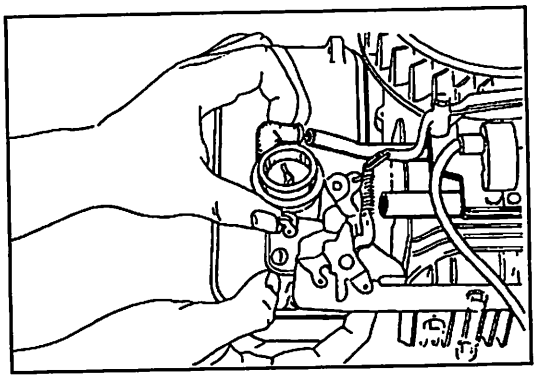


Illustrations courtesy of Briggs & Stratton Corporation

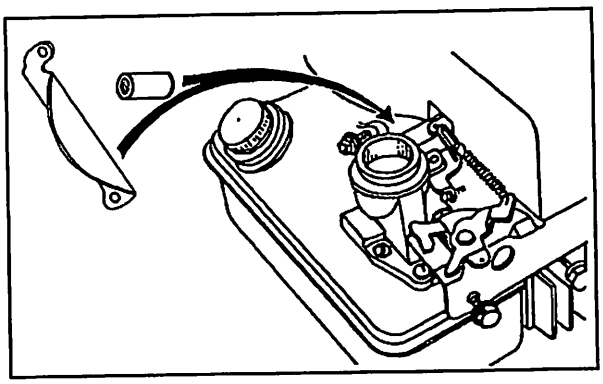
32. Install carburetor and tank assembly onto engine and attach the governor link to throttle lever.



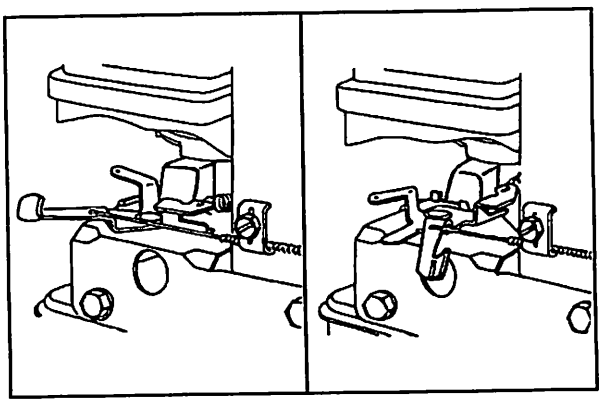
33. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the rubber elbow.



34. Attach bolt to carburetor, add spacer and blower housing part. Mount carburetor to engine. Install air cleaner.



35. Install remote control assembly. The control lever should move from "Stop" position to "Choke" or "Start" position.



Illustrations courtesy of Briggs & Stratton Corporation

36. The control wire should have a minimum travel of 1 and 3/8 inch. With this adjustment made, set in "choke" or "start" position and tighten mounting screw.

37. Reconnect the spark plug wire.

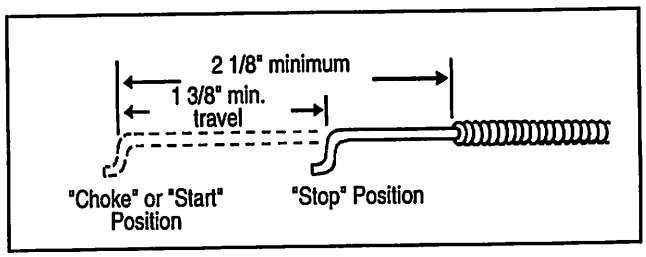
CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear.

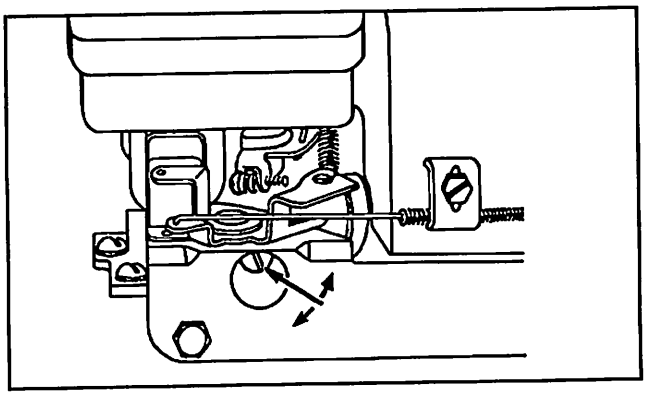
38. Start engine and warm up to operating temperature. (Tank should be 1/4 full or more.)

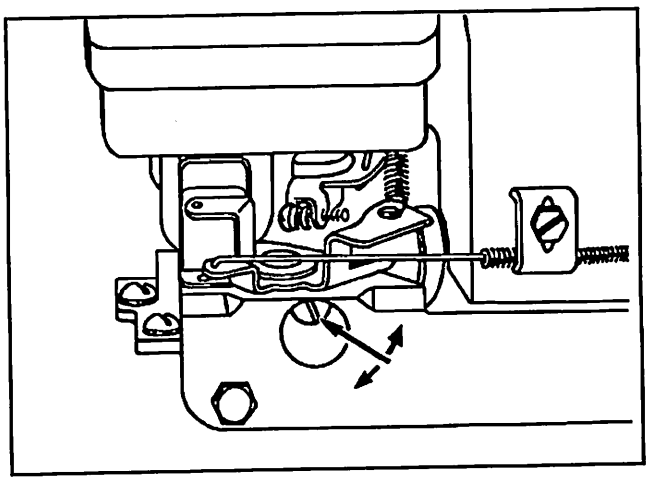
39. Perform initial carburetor adjustment.
    a. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.
    b. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
    c. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
    d. Turn needle clockwise to a smooth operating point between rich and lean mixture.

Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

40. Adjust idle speed.
    a. Turn idle speed adjustment screw counterclockwise until screw does not touch stop block when valve is closed.
    b. Holding valve closed, turn screw clockwise until it just touches stop block.
    c. Turn screw clockwise 1 and 1/2 more turns for initial setting.
    d. Start engine and allow to run until engine is warm. Adjust needle valve.
    e. Move remote control lever to "Idle" and hold idle speed adjustment screw against the stop block. Check speed with tachometer and adjust to 1750 RPM.







Illustrations courtesy of Briggs & Stratton Corporation

Small Engine Carburetor Service and Repair Competency Profile

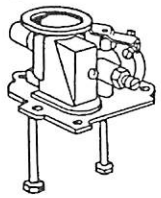
Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Pulsa-Jet, Vacu-Jet All Temperature Automatic Choke
		Disassembly
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Disconnect spark plug wire.
___	___	4. Remove air cleaner.
___	___	5. Inspect carburetor.
___	___	6. Remove remote control.
___	___	7. Remove mounting bolts from the carburetor and engine.
___	___	8. Remove carburetor and fuel tank assembly.
___	___	9. Remove five screws from carburetor.
___	___	10. Remove carburetor from fuel tank.
___	___	11. Loosen screw and remove choke link cover.
___	___	12. Slide choke link out of choke shaft.
___	___	13. Remove diaphragm.
___	___	14. Disassemble choke.
___	___	15. Remove valve and seat on Minlon carburetor (if equipped).
___	___	16. Remove O-ring and inspect.
___	___	17. Clean screen.
___	___	18. Remove fuel pipe on Minlon carburetor (if equipped).
___	___	19. Inspect fuel tank.
___	___	20. Clean Minlon carburetor (if equipped).
		Reassembly
___	___	21. Install O-ring and needle valve assembly.
___	___	22. Seat needle valve.
___	___	23. Place choke plate in carburetor.
___	___	24. Install a diaphragm.
___	___	25. Place spring and cap in fuel pump well on carburetor body.
___	___	26. Install carburetor and guide choke spring into spring well.
___	___	27. Thread screws into tank top about two turns.
___	___	28. Insert choke link into shaft and replace choke link.
___	___	29. Check O-ring for a proper seal.
___	___	30. Inspect the rubber elbow.
___	___	31. Check fuel intake tube gasket.
___	___	32. Install carburetor and tank assembly.
___	___	33. Slip carburetor into place.
___	___	34. Mount carburetor to engine.
___	___	35. Install remote control assembly.

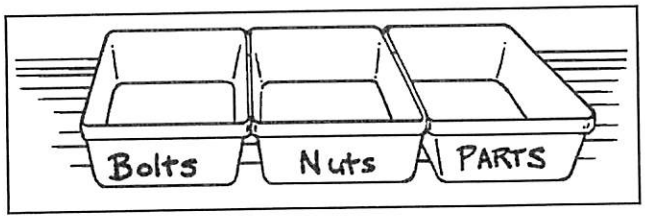
Yes	No	
___	___	36. Check/adjust remote control assembly.
___	___	37. Reconnect the spark plug wire.
___	___	38. Start engine and warm up to operating temperature.
___	___	39. Perform initial carburetor adjustment.
___	___	40. Adjust idle speed.

Student's Signature	Instructor's Signature	Date

J. Step-By-Step Procedure for Servicing Pulsa-Jet (Suction Feed)Carburetor and Fuel Tank Assembly with Automatic Choke



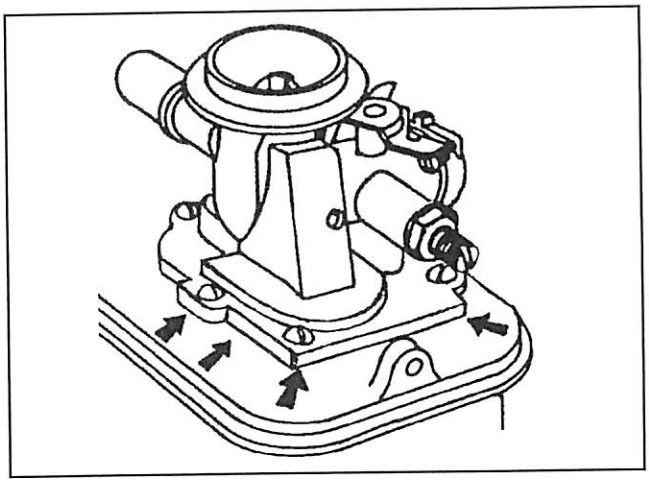
1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*
2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.
3. Wear proper clothing and safety equipment.



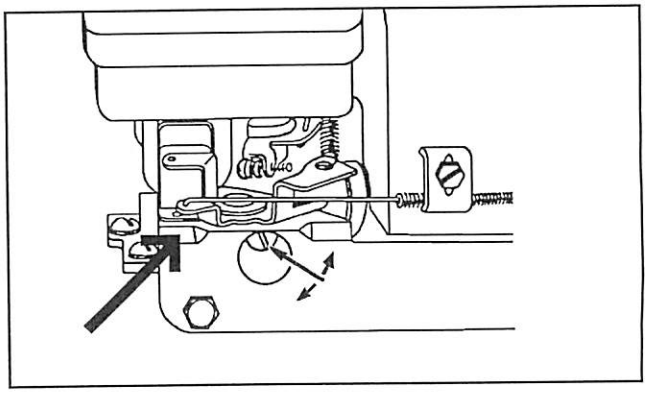
⚠ ***Observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.***

Disassembly

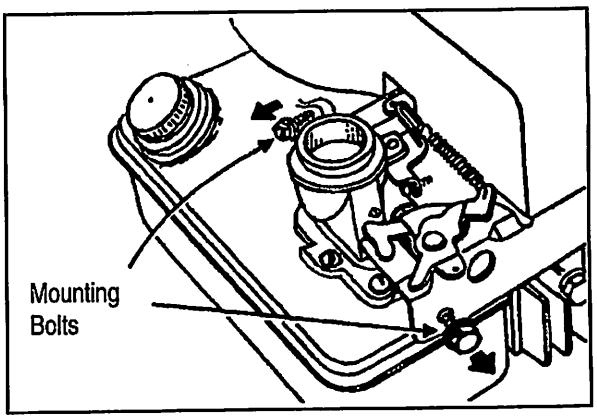
4. Disconnect spark plug wire.
5. Remove air cleaner.
6. Inspect the carburetor and fuel tank for signs of air leakage.



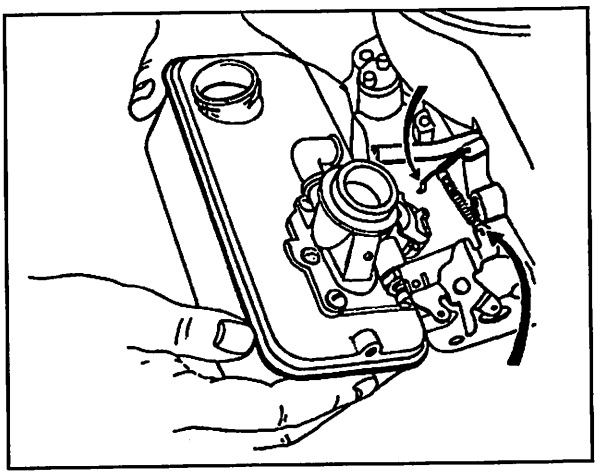
7. Remove remote control.



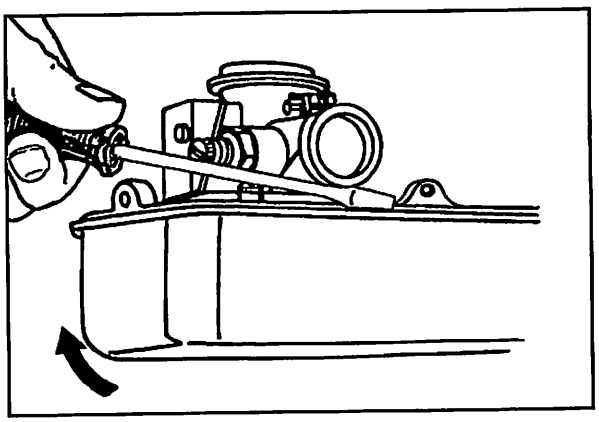
8. Remove mounting bolts from the carburetor and engine.



9. Remove carburetor and fuel tank assembly from end of fuel intake tube and turn carburetor to free governor link.

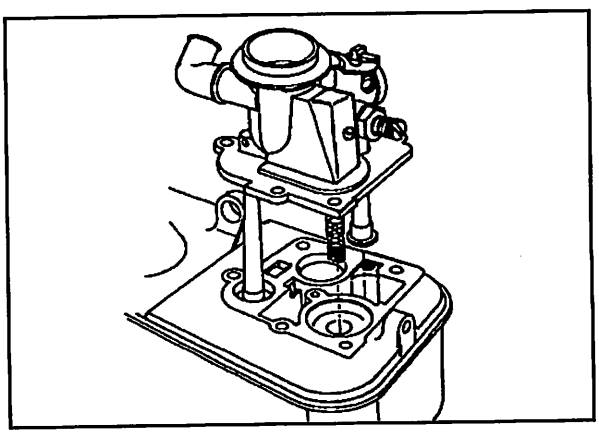


10. Remove screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.



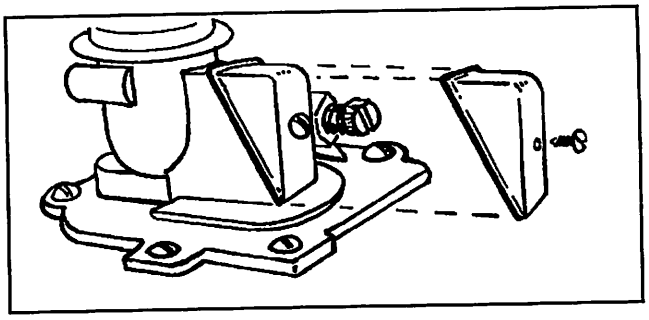
11. Remove carburetor from fuel tank.

Note: Carburetor must be removed slowly to prevent damage to diaphragm.

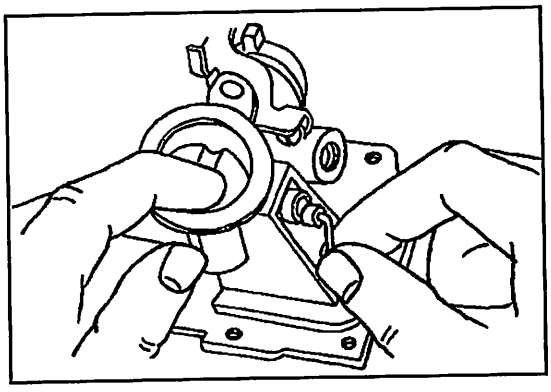


Illustrations courtesy of Briggs & Stratton Corporation

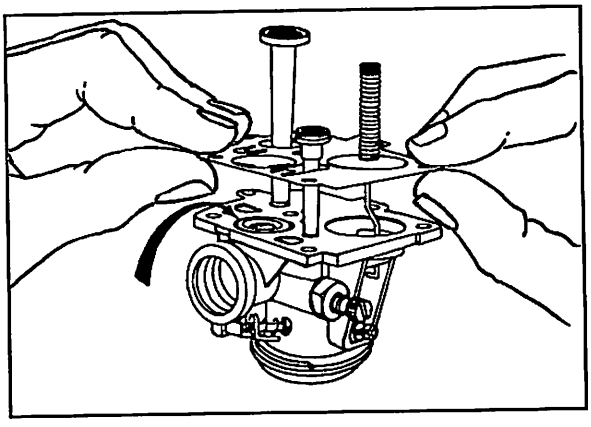
12. Loosen screw and remove choke link cover.



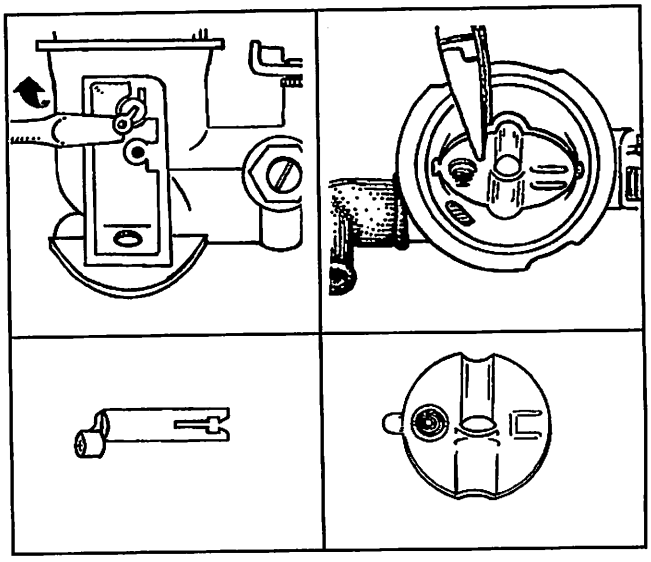
13. Slide choke link out of choke shaft lever. (This will free diaphragm.)



14. Remove diaphragm.
    a. Hold carburetor body upside down and guide choke link through hole.
    b. Inspect the diaphragm for punctures and cracks.

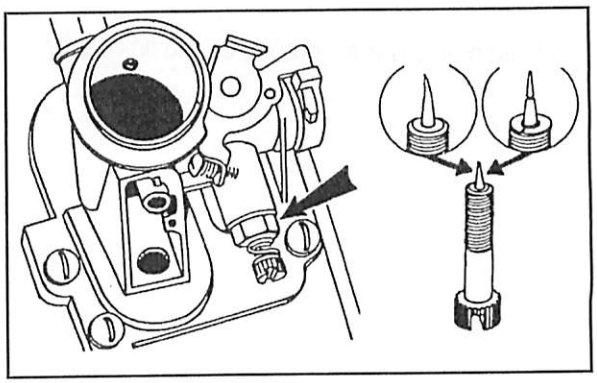


15. Disassemble choke.
    a. Use a screwdriver to slide the choke shaft from the choke plate
    b. Remove choke plate with needle-nose pliers.
    c. Inspect shaft and plate for excessive wear or damage and replace if necessary.



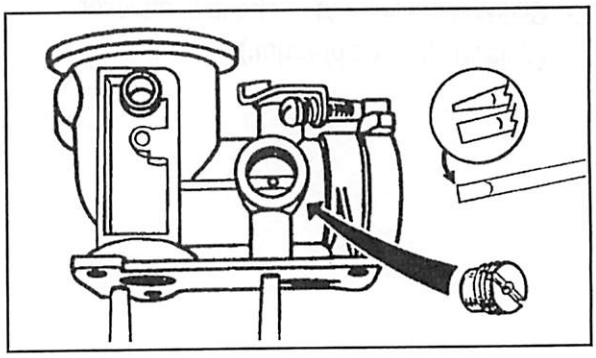
Illustrations courtesy of Briggs & Stratton Corporation

16. Loosen nut to remove needle valve. Inspect needle for damage.



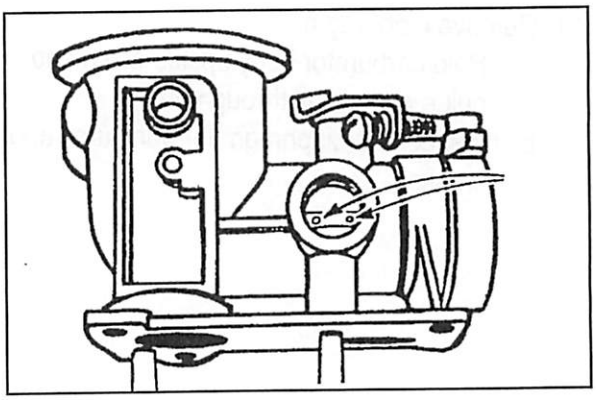
17. Remove brass seat using a special carburetor screwdriver. Inspect seat for damage.

Note: A needle valve kit includes both the needle and the seat. If either is damaged, both must be replaced.



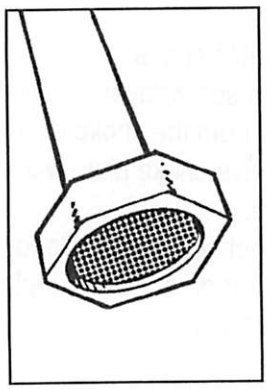
18. Inspect metering holes and air passages in the carburetor for dirt or obstructions. Use compressed air to clean out passages.

Note: Do not use sharp objects to clean metering holes.



19. Inspect screens for gum deposits and dirt without removing the fuel pipes from carburetor body. Clean screens with a solvent and air dry. Remove pipes only if they are being replaced.

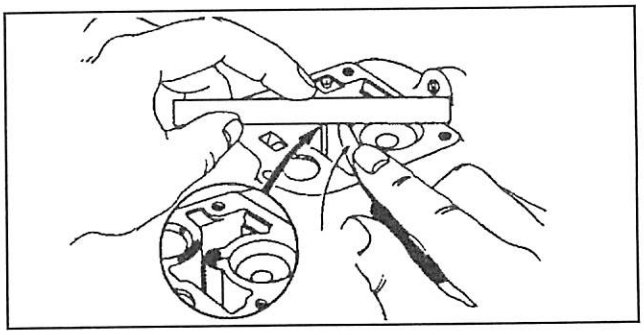
Note: Fuel pipes are threaded into the carburetor body. If they must be replaced, use a socket wrench to loosen and remove. Do not over torque new pipes. When removing the fuel pipes, support pipe shaft near the carburetor body to prevent breakage.



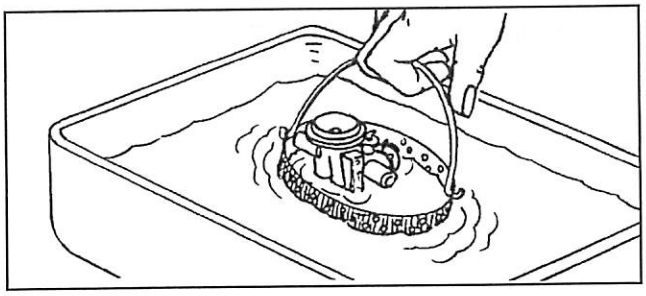
Illustrations courtesy of Briggs & Stratton Corporation

20. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.

Note: A .002" feeler gauge should not fit between the straight edge and machined surface. Tank should be replaced if gauge will enter.



21. Clean the fuel system. Gummy or dirty fuel tanks, lines and carburetors should be cleaned in a carburetor cleaner. Do not soak diaphragm, gaskets, or nylon parts in the carburetor cleaner.

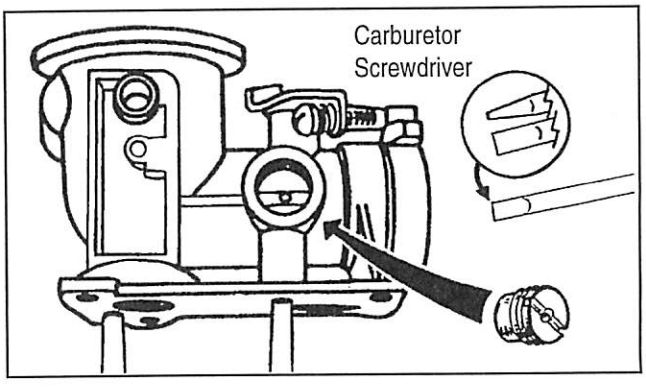


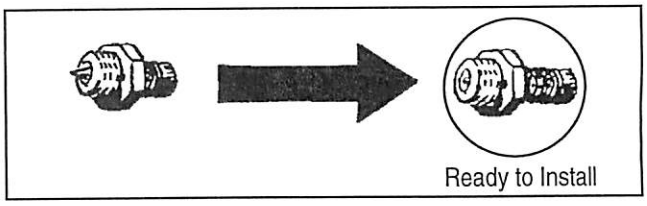
22. Use compressed air to clean carburetor parts.

Reassembly

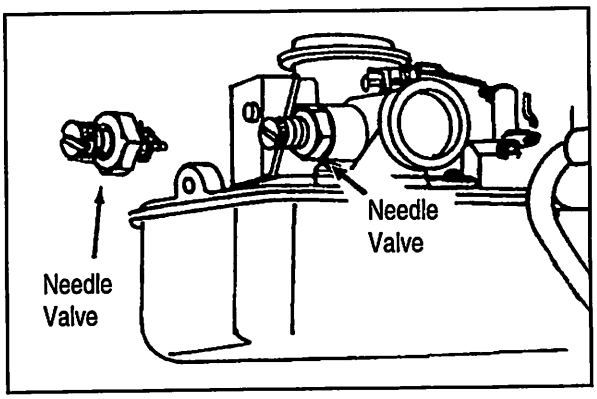
23. Install needle valve seat in carburetor and tighten securely.

Note: New needle valve kits arrive with the needle protruding. Before installing, screw the needle in until it is flush with the threads. This prevents damage to the new needle and seat.

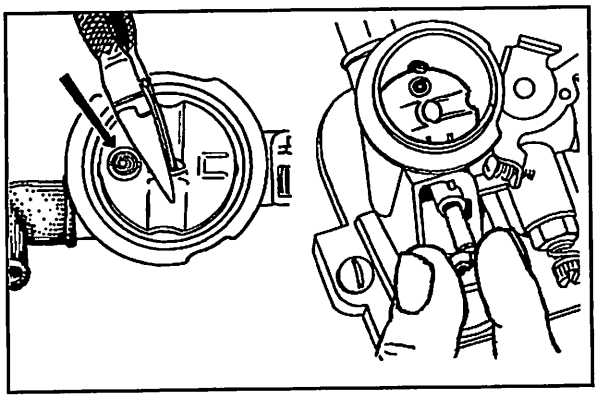




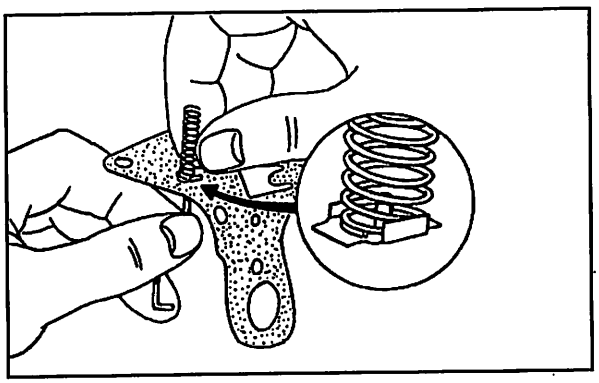
24. Insert the needle valve into seat and turn clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed before making final adjustments.



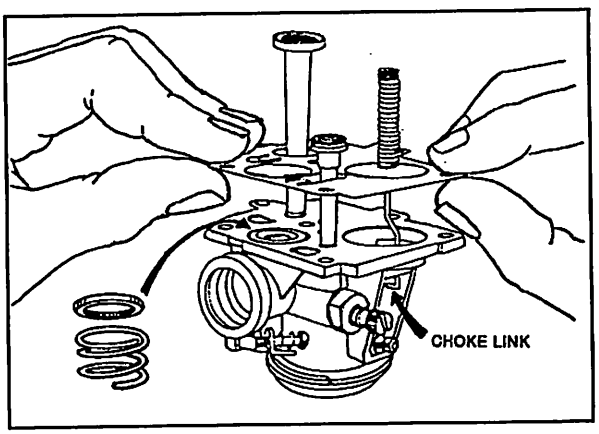
25. Install choke plate in carburetor so poppet valve spring is visible (full choke position). Then insert choke shaft and push in place on the plate.



26. If installing a new diaphragm, assemble choke spring to diaphragm. Make sure spring is in clip on both sides.

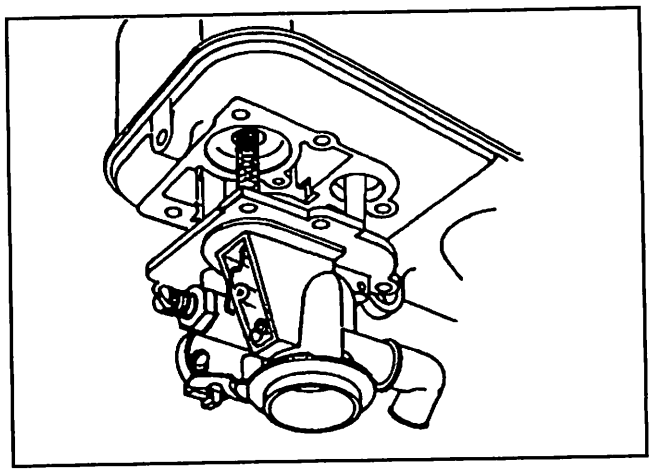


27. Holding carburetor body upside down, place spring and cap in fuel pump well on carburetor body. Place diaphragm on body while guiding choke link through hole.

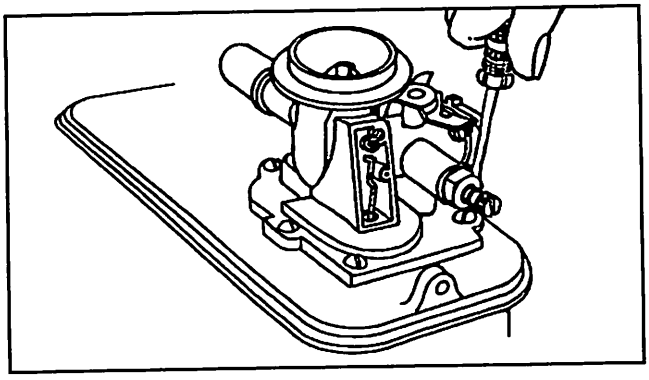


Illustrations courtesy of Briggs & Stratton Corporation

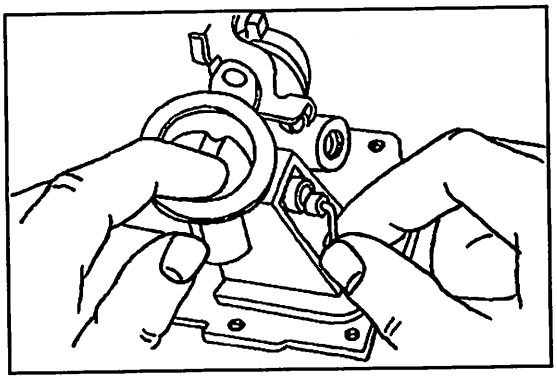
28. Still holding carburetor upside down, lower tank onto carburetor and guide choke spring into spring well. To prevent damage to the diaphragm, align holes in carburetor, diaphragm, and fuel tank.



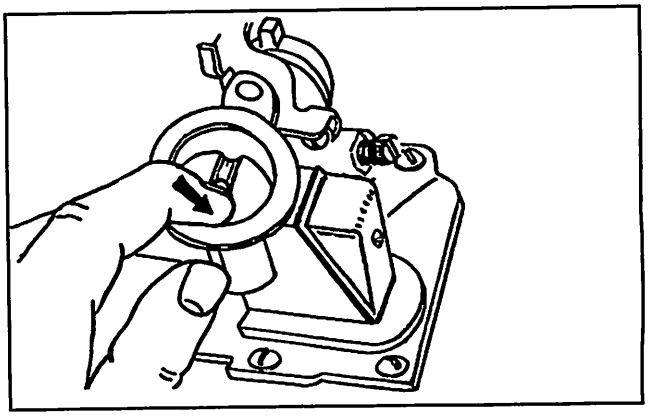
29. Holding carburetor and tank together, now turn assembly right side up. Thread screws into tank top about two turns. DO NOT TIGHTEN.



30. Move choke plate to an "over-center" position to place diaphragm in preloaded condition. Insert choke link into shaft and replace choke link cover.

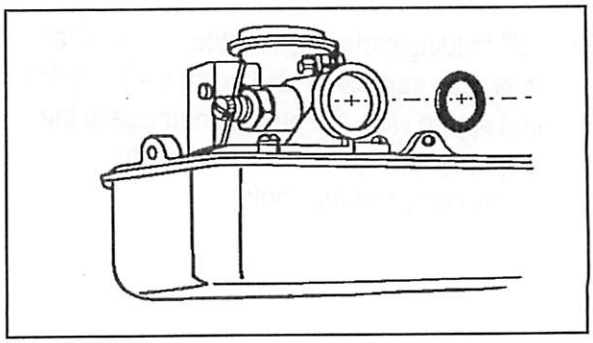


31. Test for proper choke hook up by pressing down on the choke plate. Choke should open and close automatically when properly installed. Securely tighten screws to tank in a staggered sequence.

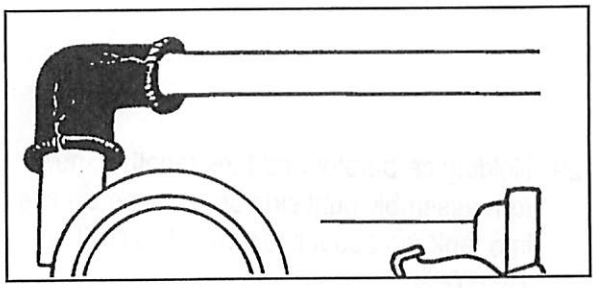


Illustrations courtesy of Briggs & Stratton Corporation

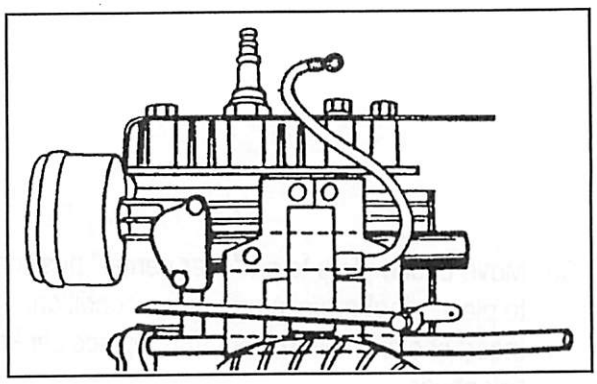
32. Check O-ring for a proper seal. The carburetor is sealed to the intake tube with an O-ring. Always replace O-ring when carburetor doesn't seal with the intake tube. Apply a light film of oil to the O-ring to prevent damage when carburetor is installed on engine.



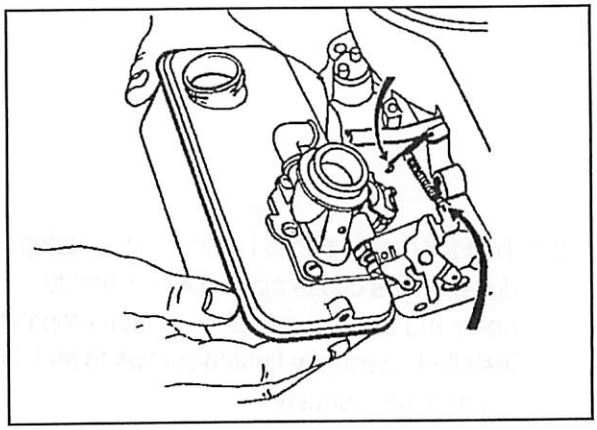
33. Inspect the venting elbow (breather tube grommet) for damage and proper seal.



34. Check fuel intake tube gasket and tighten bolts securely before installing carburetor.

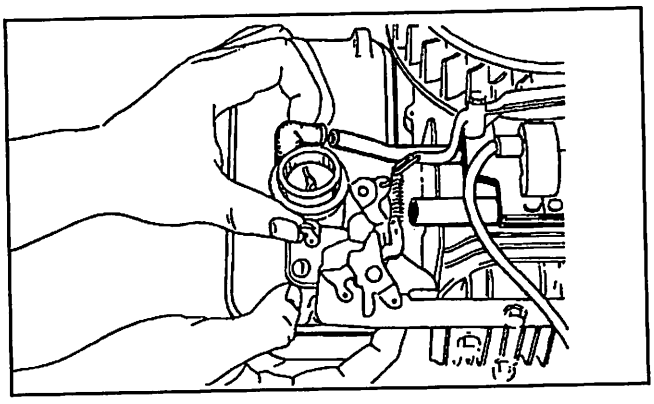


35. Install carburetor and tank assembly onto engine and attach the governor link to throttle lever.

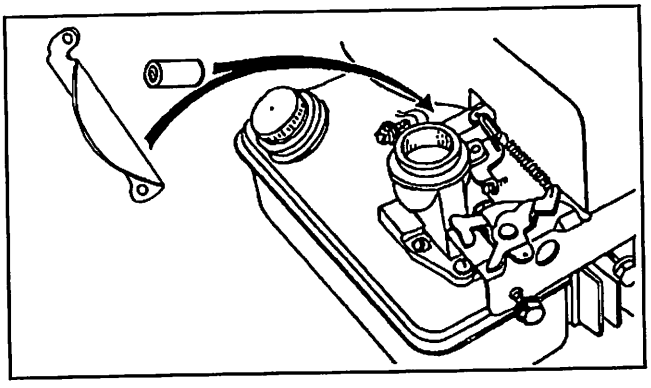


Illustrations courtesy of Briggs & Stratton Corporation

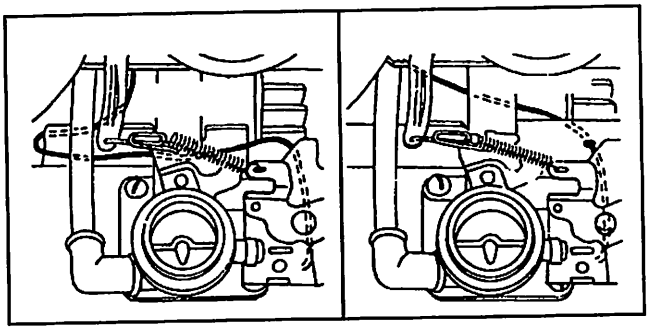
36. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the venting elbow.



37. Attach bolt to carburetor. Add spacer and blower housing part. Mount carburetor to engine.

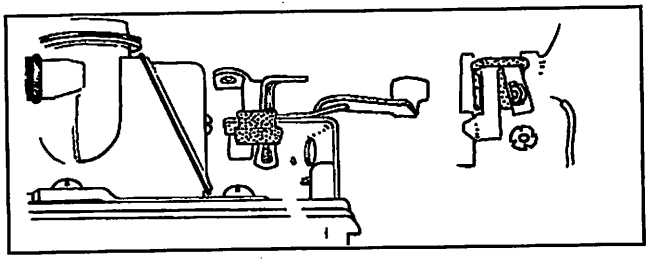


38. Route ground wire from ignition to switch.

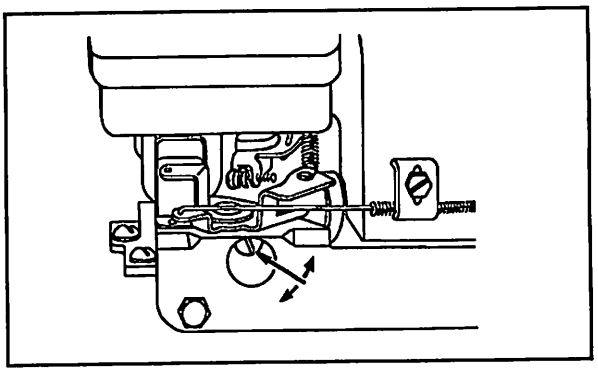


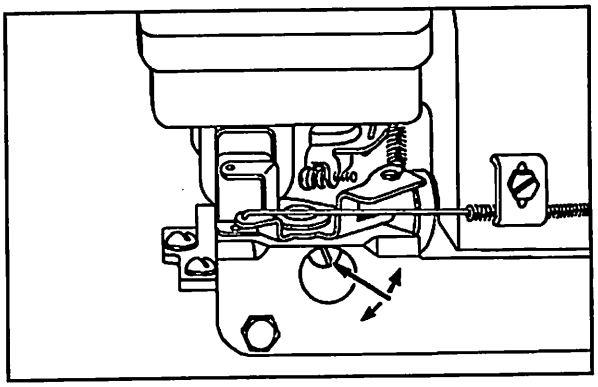
39. Hook up ground wire to switch.

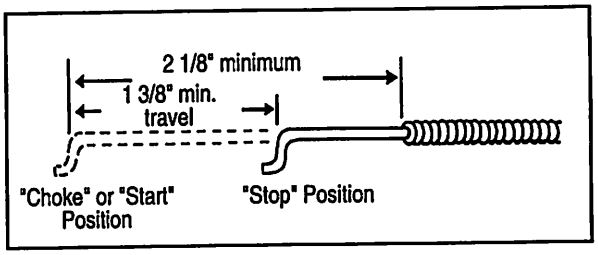
40. Install air cleaner.



41. Install remote control assembly. The control wire should move from "Stop" position to "Choke" or "Start" position.







42. The control wire should have a minimum travel of 1 and 3/8." With this adjustment made, set in "Choke" or "Start" position and tighten mounting screw.

43. Reconnect the spark plug wire.

CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.

44. Start engine and warm up to operating temperature. (Tank should be full of fuel.)

45. Run engine at normal operating speed and make the following adjustments to obtain the proper fuel mixture:
    a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
    b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
    c. Turn needle clockwise to a smooth operating point between rich and lean mixture.

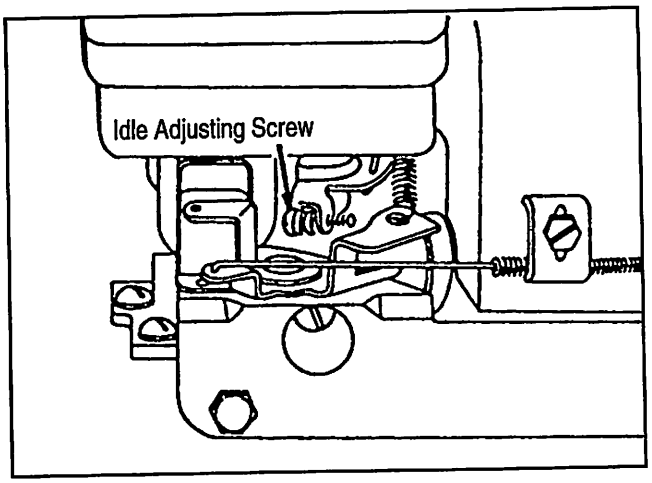
Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

Illustrations courtesy of Briggs & Stratton Corporation

46. Adjust idle speed by turning idle adjusting screw until a fast idle is obtained (1750 RPM). The idle speed should be set with a tachometer.

47. Clean your work area and return tools to their proper places.

Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.



Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly with Automatic Choke
		Disassembly
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Wear proper safety equipment.
___	___	4. Disconnect spark plug wire.
___	___	5. Remove air cleaner.
___	___	6. Inspect carburetor and fuel tank.
___	___	7. Remove remote control.
___	___	8. Remove mounting bolts from the carburetor and engine.
___	___	9. Remove carburetor and fuel tank assembly.
___	___	10. Remove screws from carburetor.
___	___	11. Remove carburetor from fuel tank.
___	___	12. Loosen screw and remove choke link cover.
___	___	13. Slide choke link out of choke shaft lever.
___	___	14. Remove diaphragm.
___	___	15. Disassemble choke.
___	___	16. Loosen nut to remove needle valve.
___	___	17. Remove brass seat.
___	___	18. Inspect metering holes and air passages.
___	___	19. Inspect screens for gum deposits and dirt.
___	___	20. Inspect top surface of fuel tank.
___	___	21. Clean the fuel system.
___	___	22. Use compressed air to clean carburetor parts.
		Reassembly
___	___	23. Install needle valve seat.
___	___	24. Insert the needle valve into seat.
___	___	25. Install choke plate in carburetor.
___	___	26. Install choke spring to diaphragm.
___	___	27. Place spring and cap in fuel pump.
___	___	28. Lower tank onto carburetor.
___	___	29. Thread screws into tank top.
___	___	30. Insert choke link into shaft and replace choke link cover.
___	___	31. Test for proper choke hook up.
___	___	32. Check O-ring for a proper seal.
___	___	33. Inspect the venting elbow.
___	___	34. Check fuel intake tube gasket.

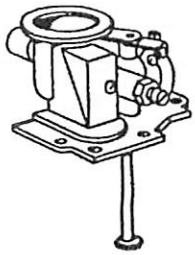
Yes	No	
___	___	35. Install carburetor and tank assembly.
___	___	36. Install fuel intake tube, O-ring, breather tube.
___	___	37. Mount carburetor to engine.
___	___	38. Route ground wire from ignition to switch.
___	___	39. Hook up ground wire to switch.
___	___	40. Install air cleaner.
___	___	41. Install remote control assembly.
___	___	42. Adjust control wire.
___	___	43. Reconnect the spark plug wire.
___	___	44. Start engine and warm up to operating temperature.
___	___	45. Adjust carburetor mixture.
___	___	46. Adjust idle speed.
___	___	47. Clean your work area.

_____ Student's Signature

_____ Instructor's Signature

_____ Date

K. Step-By-Step Procedure for Servicing Minlon (Vacu-Jet) Carburetor



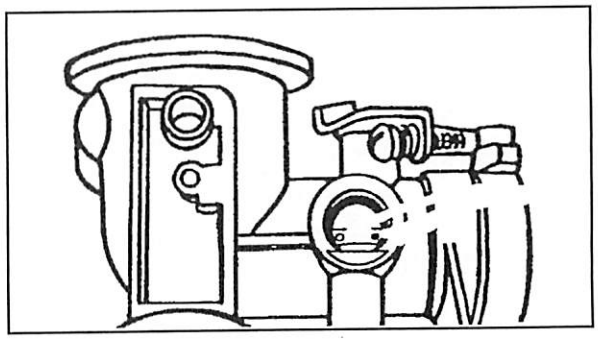
Disassembly

1. Follow steps of procedure numbers 1 through 15 of Section I, "Servicing Pulsa-Jet (Suction Feed) Carburetors."

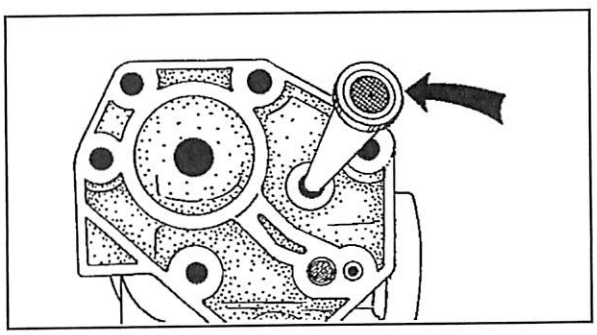
2. The needle valve and seat are one unit on a Minlon carburetor. To remove unit, rotate needle valve assembly 5 and 1/2 turns in a counterclockwise direction. Grasp assembly and pull out.

Note: Do not use sharp objects to clean metering holes.

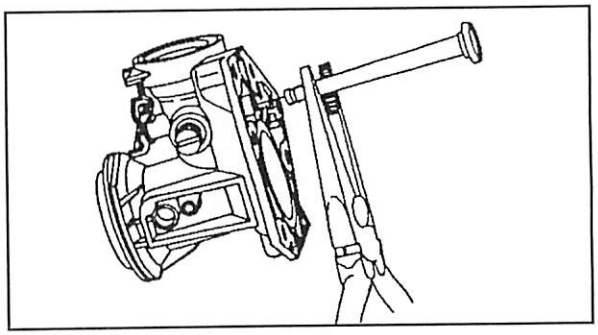
3. Inspect metering holes and air passage in carburetor for dirt or obstructions. Use compressed air to clean out passages.



4. Without removing fuel pipes from carburetor body, inspect screen for gum deposits and dirt. Clean screen with a solvent and air dry. Remove pipe only when being replaced.

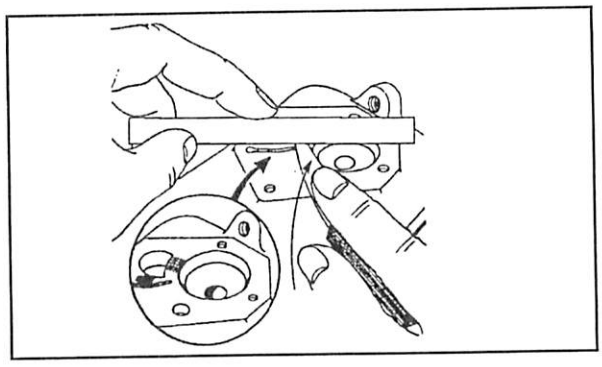


5. The fuel pipe on Minlon carburetors is a "snap-fit" design. To remove, use needle nose pliers and force out.



Illustrations courtesy of Briggs & Stratton Corporation

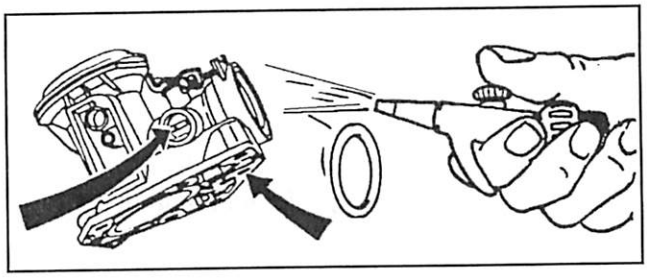
6. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.



Note: A .002 feeler gauge should not fit between the straight edge and machined surface. (See illustration.) Tank should be replaced if gauge will enter.

7. Clean Minlon carburetor and metering holes with a solvent and compressed air.

8. Use compressed air to dry carburetor parts.

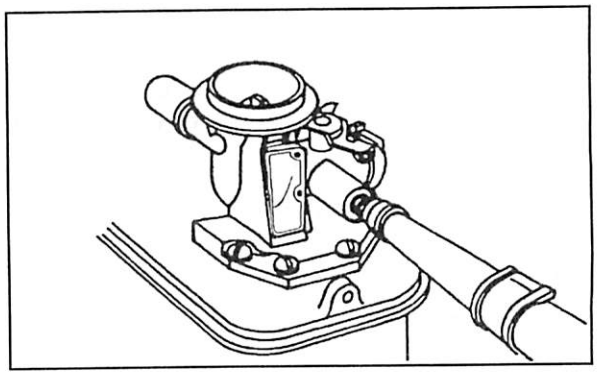


Note: Do not use a cloth rag, as lint could become trapped in carburetor parts.

⚠ ***CAUTION: If carburetor cleaner is used, DO NOT EXCEED 15 MINUTES contact time as it will damage minlon.***

Reassembly

9. Install needle valve assembly. Make sure the flat surface on valve seat lines up with flat surface in carburetor body. Use an oil fill tube or similar tool to firmly seat valve. Turn needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.



10. Follow steps of procedure numbers 27 through 45 of Section I, "Servicing Pulsa-Jet (Suction Feed) Carburetor."

Note: All carburetor adjustments must be made with the air cleaner on engine.

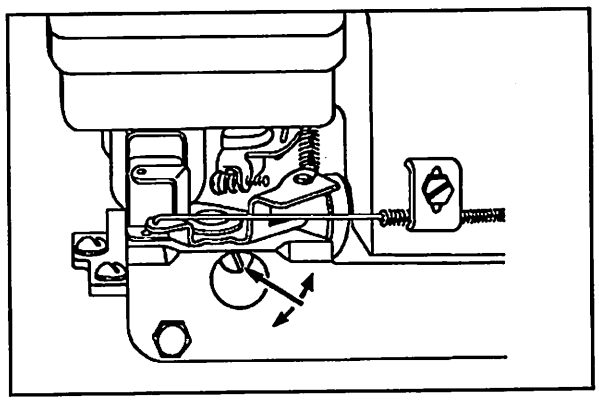
11. Start engine and warm up to operating temperature. (Tank should be full of fuel.)

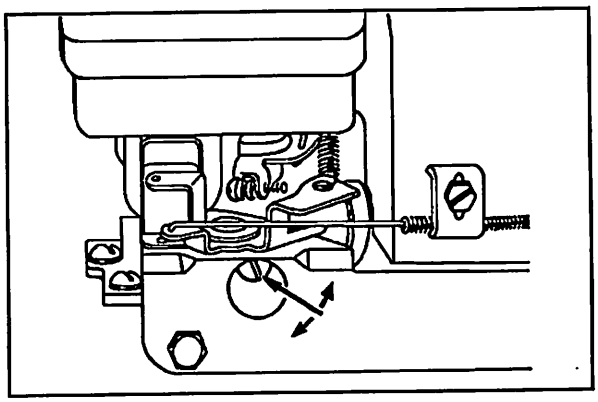
12. Run engine at normal operating speed and make the following adjustments to obtain the proper fuel mixture:
    a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
    b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
    c. Turn needle clockwise to a smooth operating point between rich and lean mixture.

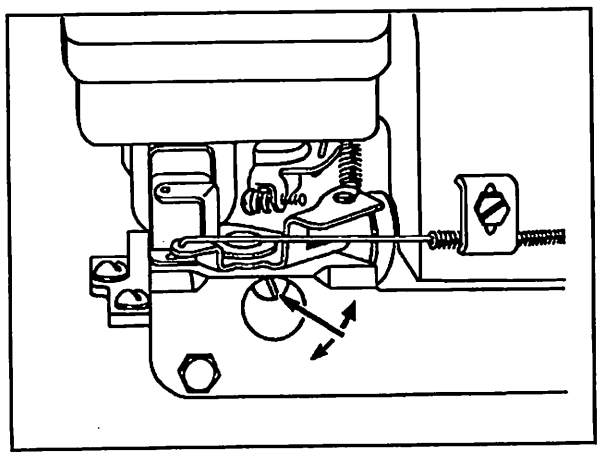
Note: If engine does not accelerate properly, the carburetor should be readjusted, usually to a slightly richer mixture.

13. Adjust idle speed.
    a. Turn idle speed adjustment screw counterclockwise until the screw does not touch the stop block when valve is closed.
    b. Holding valve closed, turn screw clockwise until it just touches the stop block.
    c. Turn screw clockwise 1 and 1/2 more turns which gives you initial setting.
    d. Start engine and allow to run long enough until engine is warm. Adjust needle valve as required.
    e. Move remote control to "Idle" and hold idle speed adjustment screw against the stop block. Check speed with tachometer and adjust to 1750 RPM.

14. Clean your work area and return tools to their proper places.







Illustrations courtesy of Briggs & Stratton Corporation

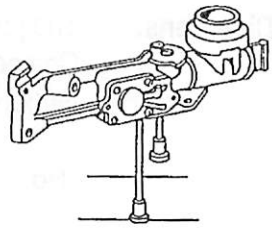
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Minlon (Vacu-Jet) Carburetor
		Disassembly
___	___	1. Steps of procedure numbers 1 through 15 of Section C, "Servicing Pulsa-Jet (Suction Feed) Carburetors."
___	___	2. Remove needle valve and seat from Minlon carburetor, if equipped.
___	___	3. Inspect metering holes and air passage in carburetor for dirt or obstructions.
___	___	4. Clean screen with a solvent and air dry.
___	___	5. Remove Minlon carburetor fuel pipe, if equipped.
___	___	6. Inspect the top surface of the fuel tank.
___	___	7. Clean Minlon carburetor and metering holes with a solvent and compressed air.
___	___	8. Dry carburetor parts.
		Reassembly
___	___	9. Install needle valve assembly
___	___	10. Steps of procedure numbers 27 through 45 of Section C, "Servicing Pulsa-Jet (Suction Feed) Carburetor."
___	___	11. Start engine and warm up to operating temperature.
___	___	12. Adjust carburetor mixture.
___	___	13. Adjust idle speed.
___	___	14. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

L. Step-By-Step Procedure for Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly

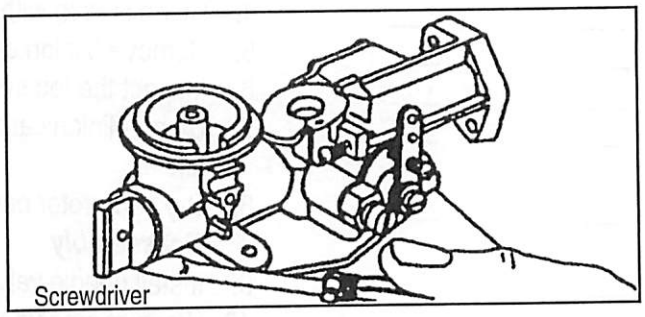


Disassembly

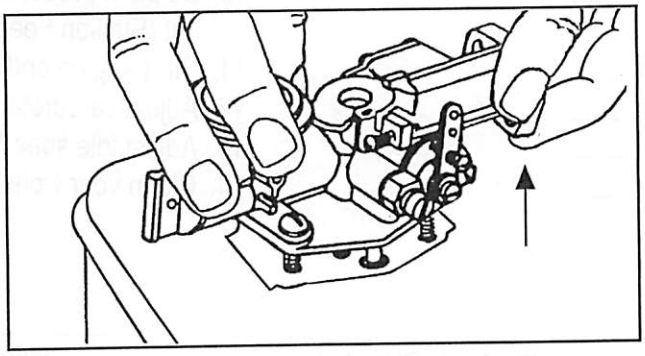
1. Follow steps of procedure numbers 1 through 8 of Section J, "Servicing Pulsa-Jet (Suction Feed) Carburetor with Automatic Choke."

2. While holding carburetor and tank assembly, remove governor control and spring.

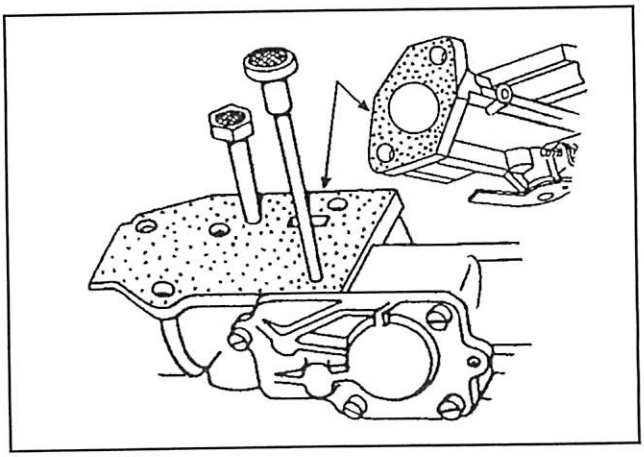
3. Remove screws from carburetor. Use a screwdriver as illustrated to loosen carburetor from tank.



4. Slowly remove carburetor from fuel tank.

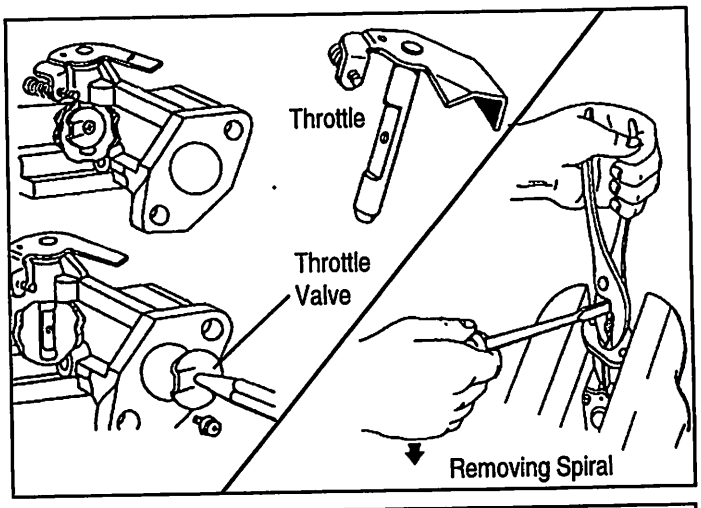


5. Inspect gasket surface of carburetor. Replace with new gasket.

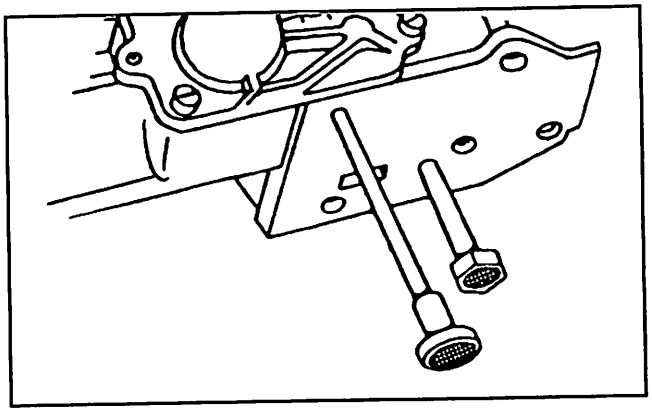


Illustrations courtesy of Briggs & Stratton Corporation

6. Replace worn throttle, if needed.
   a. Remove spiral. Fasten carburetor in a viseand grasp spiral firmly with a pair of pliers. Place a screwdriver under ledge of pliers (as shown). Using edge of vise, push down on screwdriver handle to pry out spiral.
   b. Use a Phillips screwdriver to remove the throttle valve and screw. The throttle can now be lifted out.

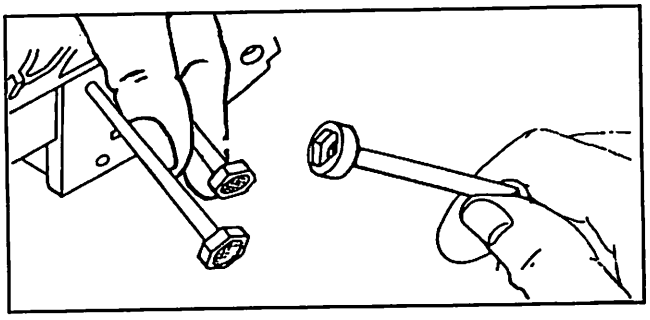


7. Inspect the screens for gum deposits and dirt without removing the fuel pipes from carburetor body. Clean the screens with a solvent and air dry. Remove pipes only if they are being replaced.

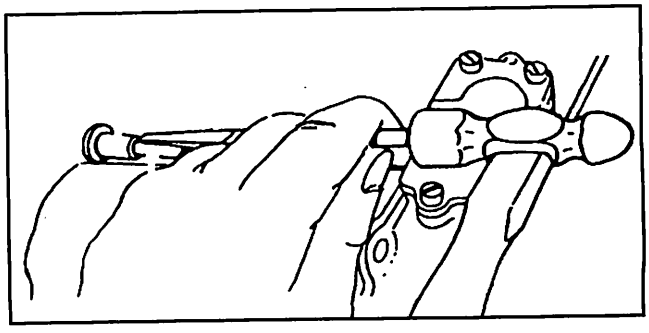


8. Nylon fuel pipes are threaded into the carburetor body. If they must be replaced, use a socket wrench to loosen and remove. Do not over torque when inserting new pipes. No sealer is required.

Note: When removing the fuel pipes, support pipe shaft near the carburetor body to prevent breakage.



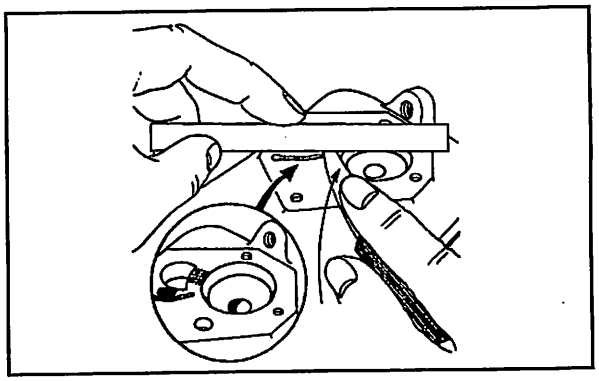
9. When brass pipes are used, only the screen housing is replaced. Place fuel pipe in a vise and pry off the brass housing with a screwdriver. Remove screen housing only if it is being replaced.



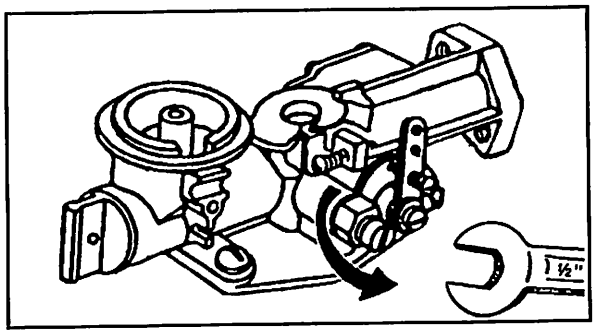
Illustrations courtesy of Briggs & Stratton Corporation

10. Inspect the top surface of the fuel tank for flatness. If the machined surface on the tank is not flat, it is possible for gasoline to enter the vacuum chamber by passing between the machined surface and diaphragm.

Note: A .002" feeler gauge should not fit between the straight edge and machined surface (see illustration). Tank should be replaced if gauge will enter.

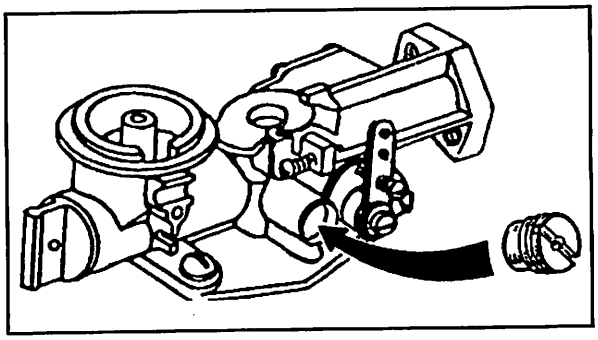


11. Loosen nut to remove needle valve. Inspect needle for damage (see illustration).



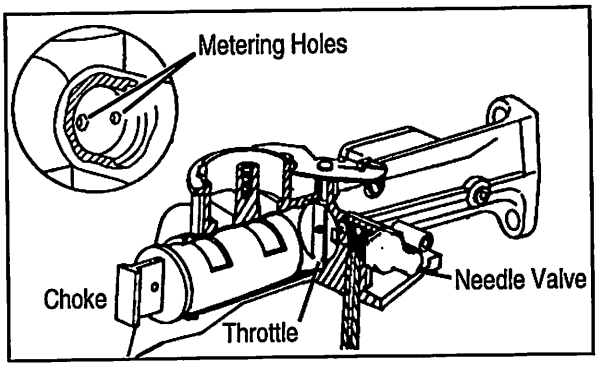
12. Remove brass seat, using a special carburetor screwdriver. Inspect seat for damage.

Note: Needle valve kit includes both the needle and the seat. If either is damaged, both must be replaced.



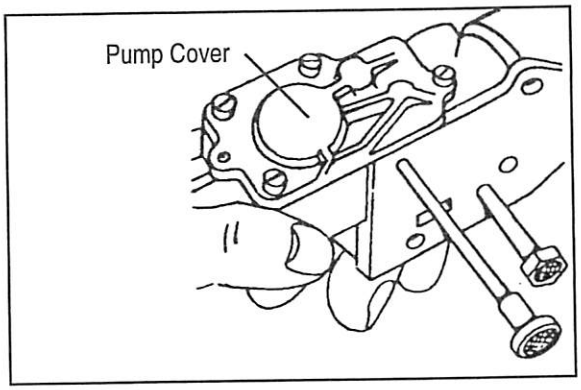
13. Inspect metering holes and air passages in the carburetor for dirt or obstructions. Use compressed air to clean out passages.

Note: Do not use sharp objects to clean metering holes.



Illustrations courtesy of Briggs & Stratton Corporation

14. Remove screws from fuel pump cover. Remove diaphragm, spring, and cap. Inspect diaphragm for cracks and punctures.

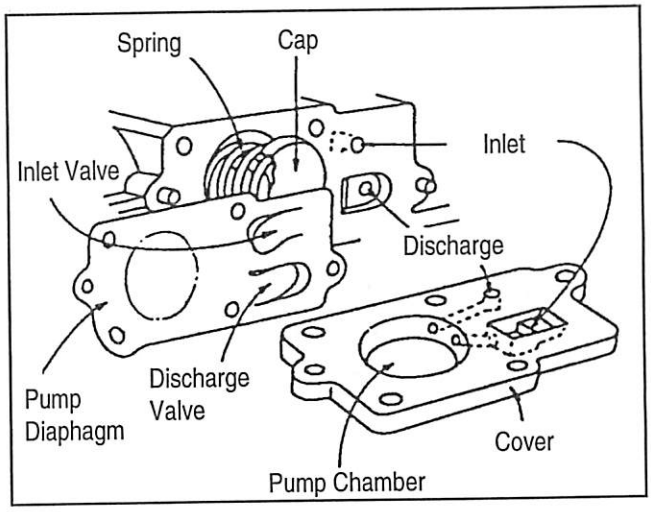


15. Clean the fuel system. Gummy or dirty fuel tanks, lines, and carburetors should be cleaned in a carburetor cleaner.

WARNING: Do not soak diaphragm, gaskets, or nylon parts in the carburetor cleaner.

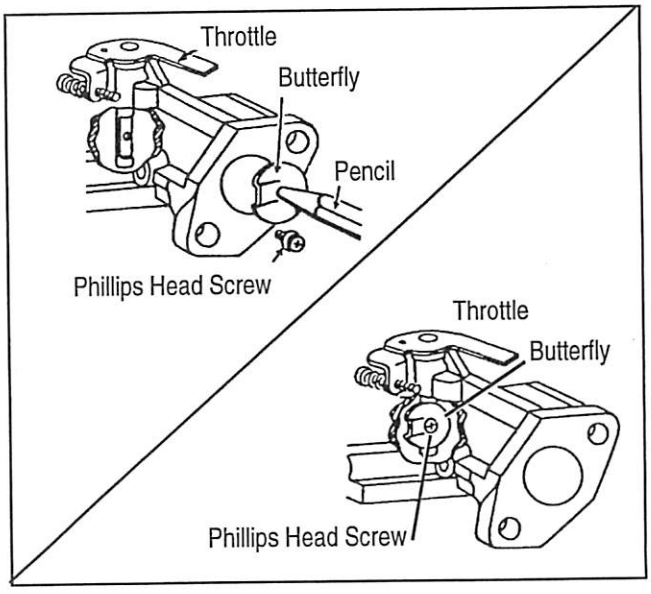
16. Use compressed air to clean carburetor parts.

Note: Do not use a cloth rag, as lint could become trapped in carburetor parts.

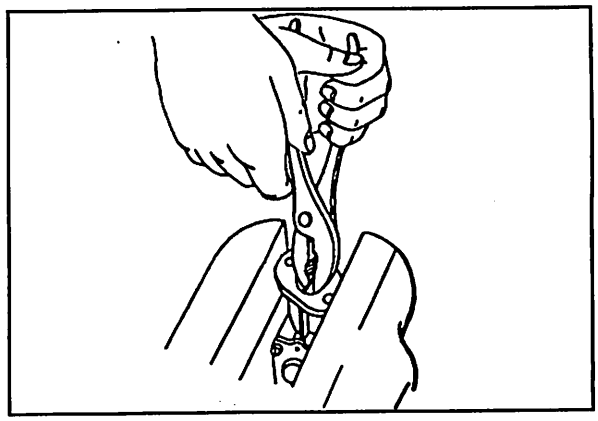


Reassembly

17. Install throttle in carburetor. Guide the throttle valve in place and tighten screw securely.

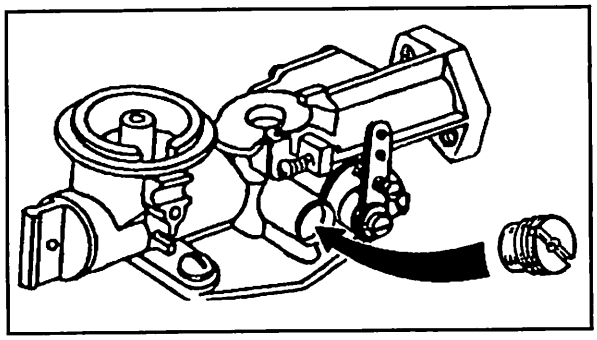


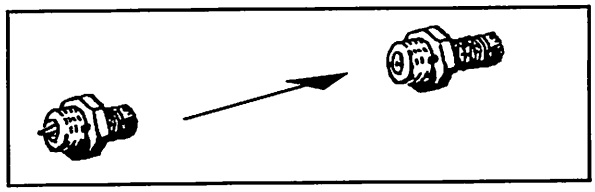
18. Install spiral in carburetor. Use a vise to hold carburetor and slowly twist spiral in carburetor. Top of spiral must be flush or 1/32" below carburetor flange.



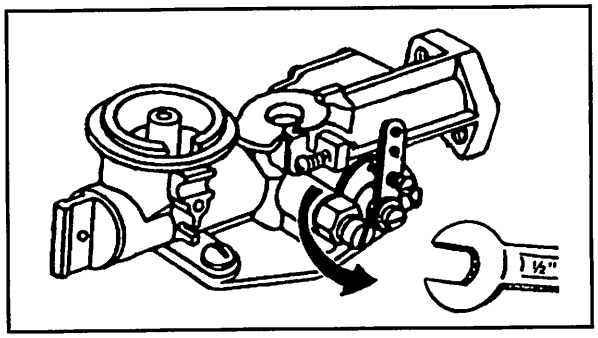
19. Install needle valve seat in carburetor and tighten securely.

Note: New needle valves from kits arrive with the needle protruding. Before installing, screw the needle out until it is flush with the threads. This prevents damage to the new needle and seat.





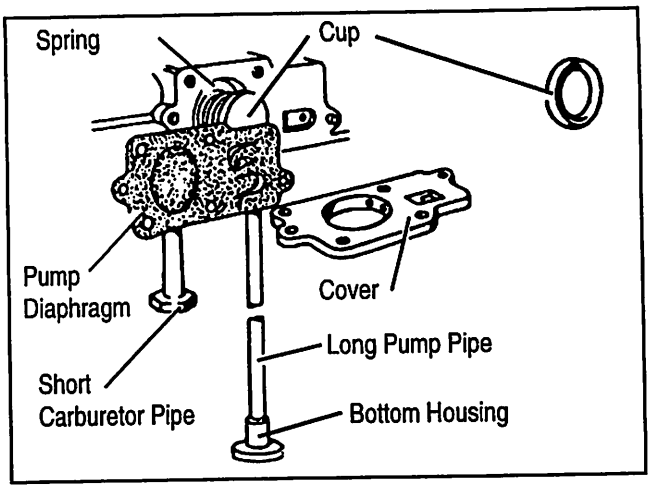
20. Insert the needle valve into seat and tighten nut securely. Turn the needle valve clockwise to close it. Then open 1 and 1/2 turns. This will permit engine to be started and warmed up before making final adjustments.



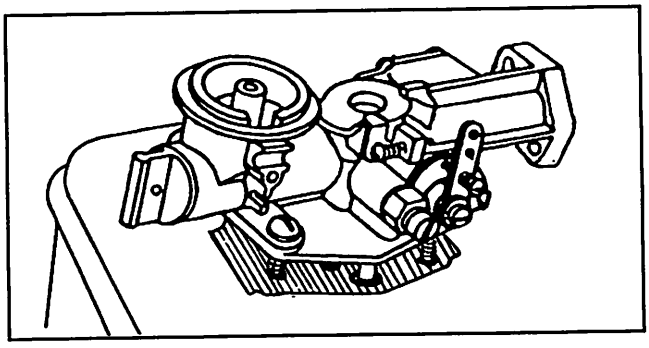
Illustrations courtesy of Briggs & Stratton Corporation

21. To reassemble pump, place spring and cup in carburetor body. Insert diaphragm and cover. Tighten the screws in a staggered sequence to insure a good seal.

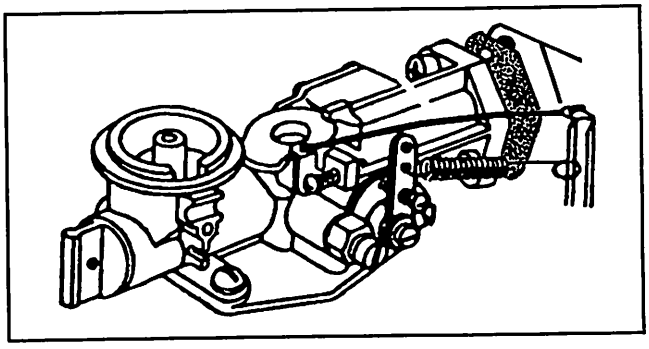
Note: Always install a new diaphragm when servicing carburetor.



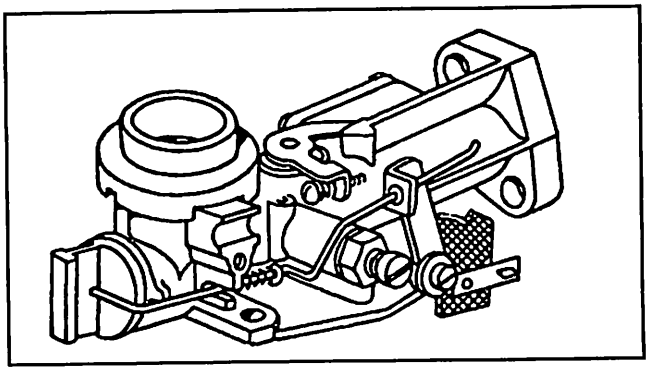
22. Place gasket on fuel tank. Install carburetor onto fuel tank and tighten screws securely.



23. Place gasket on carburetor. While holding carburetor in place, hook up governor control and spring. Thread screws into engine and tighten securely.

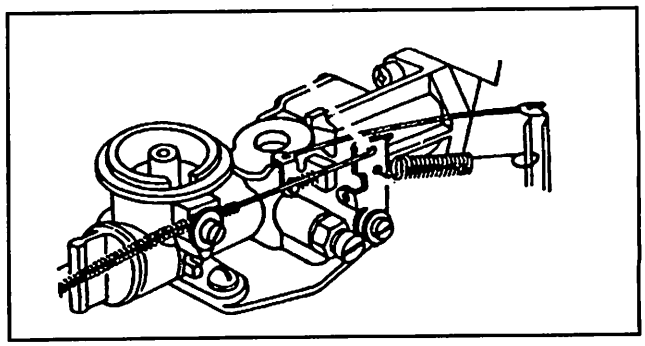


24. On models equipped with a stop switch, install the ground wire.

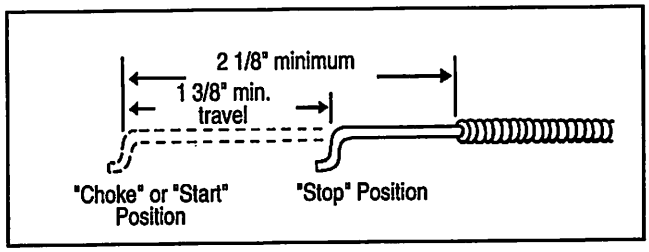


Illustrations courtesy of Briggs & Stratton Corporation

25. Install remote control assembly.



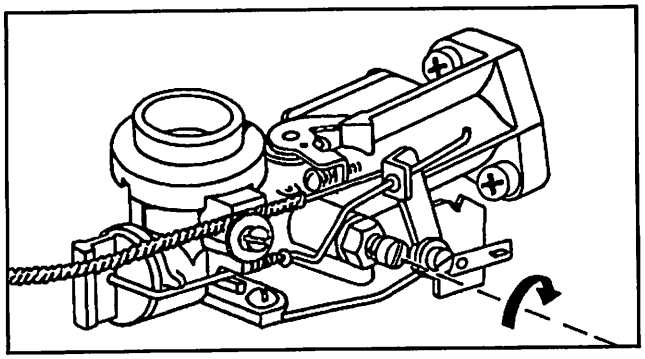
26. The control wire should have a minimum travel of 1 and 3/8." Adjust remote control lever to "Stop" position and tighten mounting screws.



27. Reconnect spark plug wire.

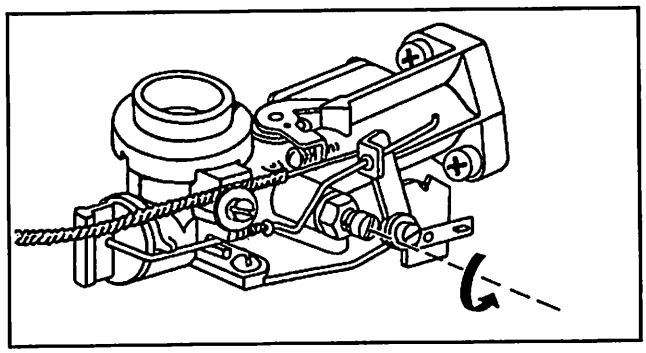
28. Install air cleaner.

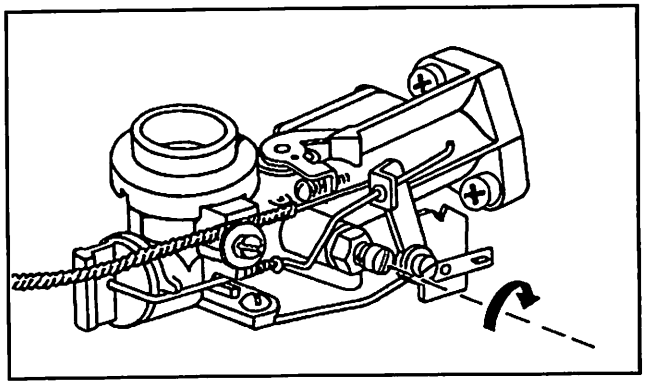
29. Start engine and warm up to operating temperature. Tank should be full of fuel.



30. Place governor speed control in "Fast" position and make the following adjustment to obtain the proper fuel mixture:
    a. Turn needle valve in, clockwise, until engine begins to miss (lean mixture).
    b. Slowly turn needle valve out, counterclockwise, until engine runs unevenly (rich mixture).
    c. Turn needle valve clockwise to a smooth operating point between rich and lean mixture.

Note: If engine does not accelerate properly, the carburetor should be readjusted to a slightly richer mixture.

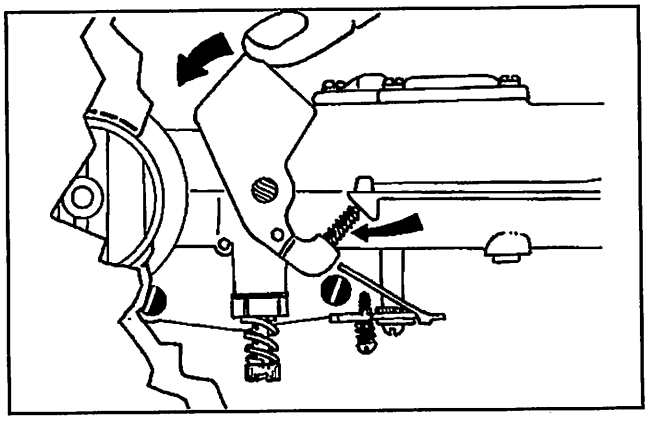




Illustrations courtesy of Briggs & Stratton Corporation

31. Adjust idle speed.
    a. Rotate throttle counterclockwise and hold against the stop.
    b. Adjust idle speed adjustment screw to 1750 RPM. The idle speed should be set with a tachometer.

32. Clean your work area and return tools to their proper place.



Illustrations courtesy of Briggs & Stratton Corporation

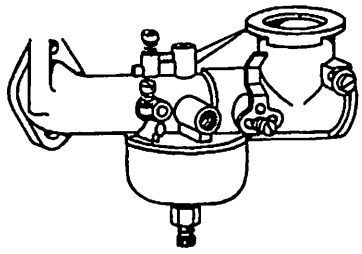
Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	
		Servicing Pulsa-Jet (Suction Feed) Carburetor and Fuel Tank Assembly
		Disassembly
___	___	1. Steps of procedure numbers 1 through 8 of Section K, "Servicing Pulsa-Jet (Suction Feed) Carburetor with Automatic Choke."
___	___	2. Remove governor control and spring.
___	___	3. Remove screws from carburetor.
___	___	4. Remove carburetor from fuel tank.
___	___	5. Inspect gasket surface of carburetor.
___	___	6. Replace worn throttle, if needed.
___	___	7. Inspect screens for gum deposits and dirt.
___	___	8. Replace nylon fuel pipes, if needed.
___	___	9. Replace screen housing.
___	___	10. Inspect the top surface of the fuel tank.
___	___	11. Remove needle valve.
___	___	12. Remove brass seat.
___	___	13. Inspect metering holes and air passages.
___	___	14. Remove screws from fuel pump cover.
___	___	15. Clean the fuel system.
___	___	16. Use compressed air to clean carburetor parts.
		Reassembly
___	___	17. Install throttle in carburetor.
___	___	18. Install spiral in carburetor.
___	___	19. Install needle valve seat in carburetor.
___	___	20. Insert needle valve into seat.
___	___	21. Reassemble pump.
___	___	22. Place gasket on fuel tank.
___	___	23. Place gasket on carburetor.
___	___	24. Install the ground wire.
___	___	25. Install remote control assembly.
___	___	26. Adjust remote control.
___	___	27. Reconnect spark plug wire.
___	___	28. Install air cleaner.
___	___	29. Start engine and warm to operating temperature.
___	___	30. Adjust for proper fuel mixture.
___	___	31. Adjust idle speed.
___	___	32. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

O. Step-By-Step Procedures for Servicing a Large One-Piece Flow-Jet Carburetor



1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

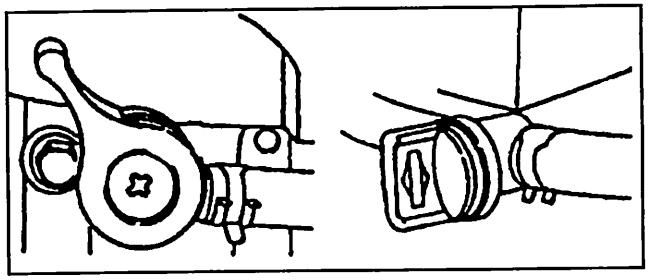
2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

⚠ ***CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.***

3. Disconnect spark plug wire.

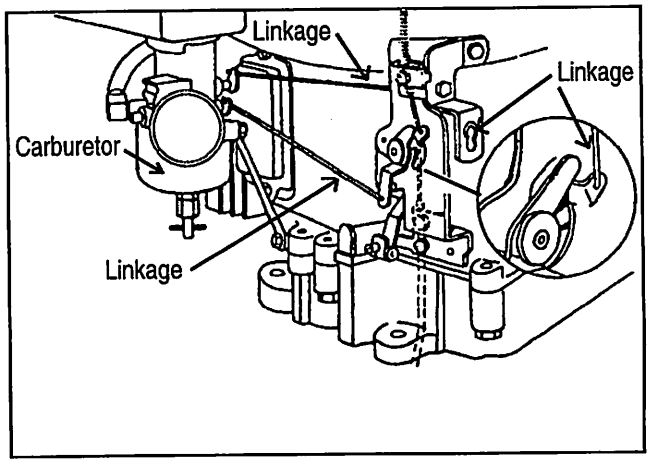
4. Inspect carburetor fuel tank and fuel line for signs of leakage.

5. Remove air cleaner.



6. Turn the fuel petcock to off position at tank and disconnect fuel line to carburetor.

7. Observe carburetor linkage and make a careful drawing of the linkage.



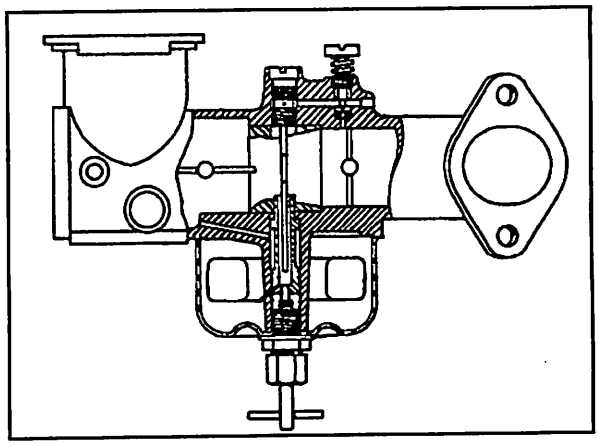
8. Remove carburetor linkage and carburetor from engine.

Illustrations courtesy of Briggs & Stratton Corporation

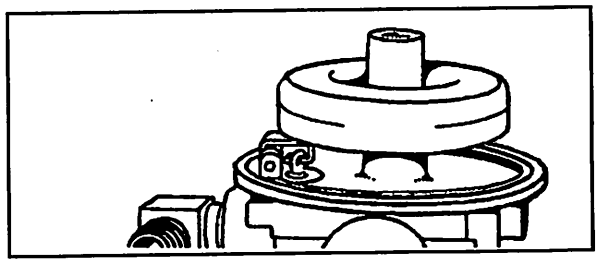
9. Remove idle needle valve. Place in a systematic order of reassembly. Inspect needle valve.

10. Remove high-speed needle valve assembly from float bowl.

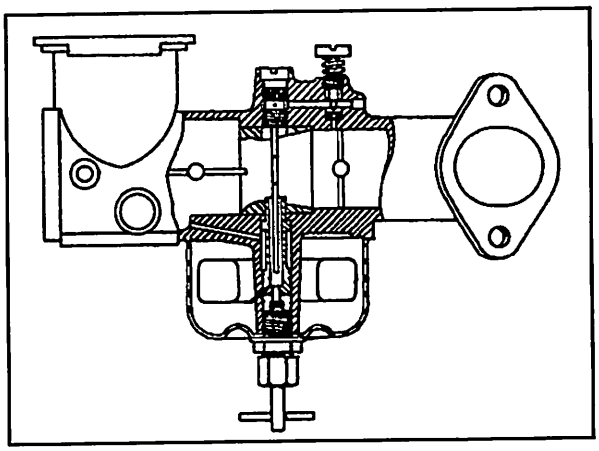
11. Remove float bowl. Observe condition of bowl gasket.



12. Remove float pin to remove float and float needle. Observe condition of float needle.

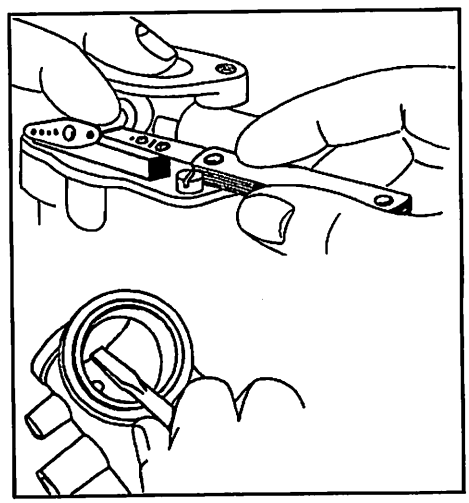


13. Remove high-speed jet and nozzle from carburetor. Use special screwdriver B & S #19280 for easy removal of jet and nozzle.



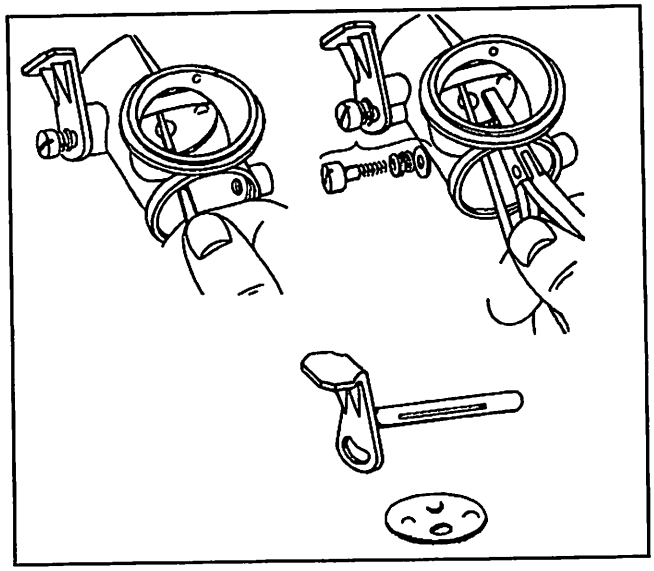
14. Check throttle shaft and bushings for wear. Wear between throttle shaft and bushings should not exceed .010."

15. Remove Welch plug.

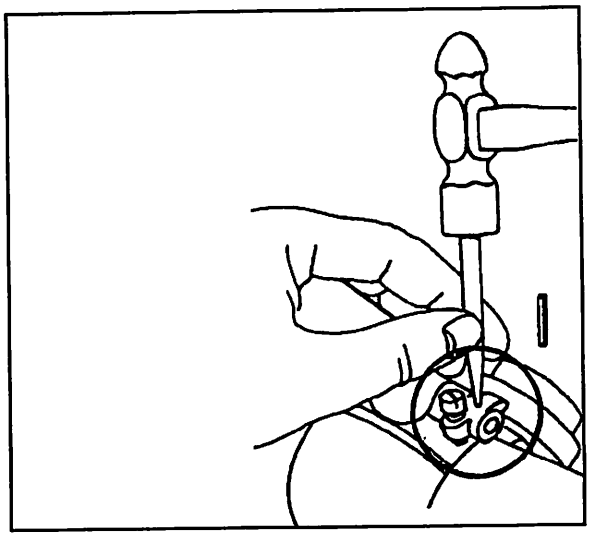


Illustrations courtesy of Briggs & Stratton Corporation

16. Remove choke valve. Illustration shows removal of nylon choke shaft.

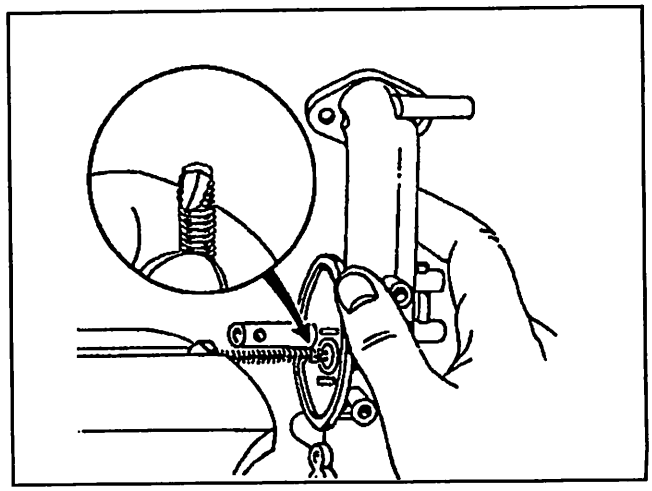


17. Remove throttle shaft and bushings (do not remove unless changing throttle or bushings).
    a. Using a pin punch, drive out pin holding throttle stop to shaft.
    b. Remove throttle valve.
    c. Pull out throttle shaft.



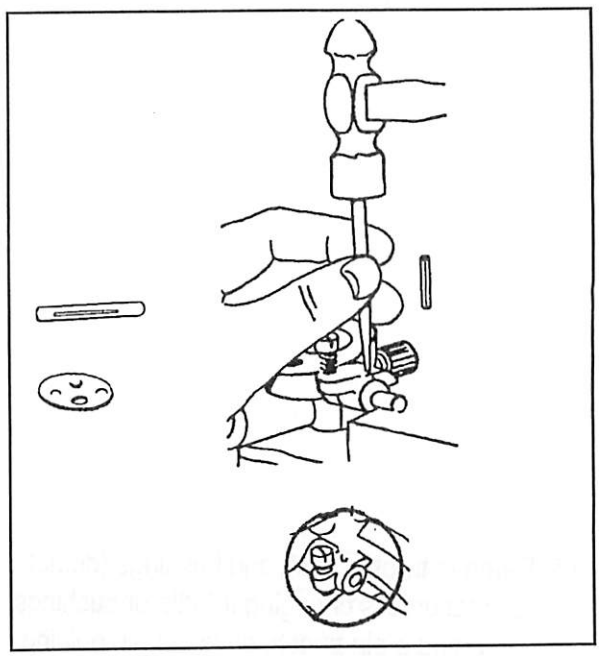
18. Use a 1/4-20 tap and screw or a screw extractor to remove pressed-in seat in carburetors equipped with a removable Viton inlet seat. See illustration.

19. Clean carburetor with solvent. Use compressed air to dry carburetor and parts.



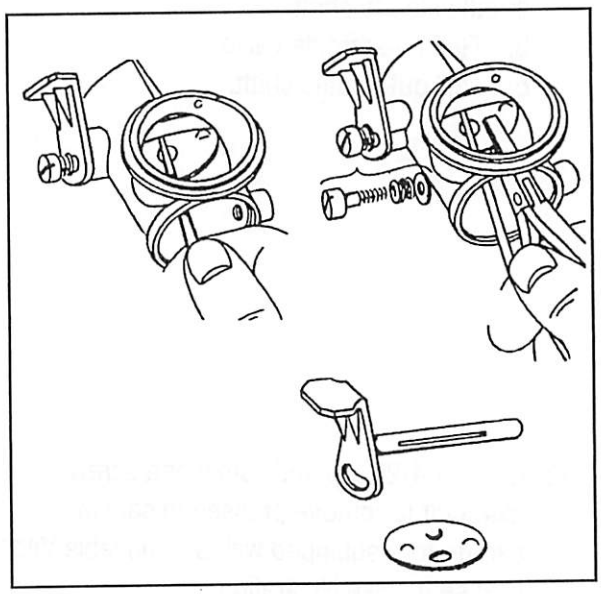
Reassembly

20. Install throttle shaft and bushing.
    a. Install throttle shaft and throttle valve.
    b. Place throttle stop on shaft.
    c. Use a pin punch to drive in pin.



21. Install choke shaft and choke valve.
    a. Install nylon choke shaft.
    b. Install screw, spring, and washer as illustrated.
    c. Install choke valve using needle nose pliers.

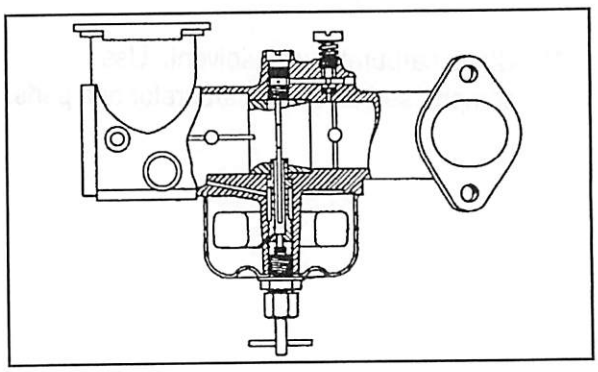
Note: Make sure the choke is working properly.



22. Install new Welch plug.
    a. Press in new Welch plug.
    b. Install plug by pounding it into place and use a sealer around the edge.

Note: Seal of Welch plug is very important as it prevents entry of dirt into the engine.

23. Install high-speed jet and nozzle in carburetor.

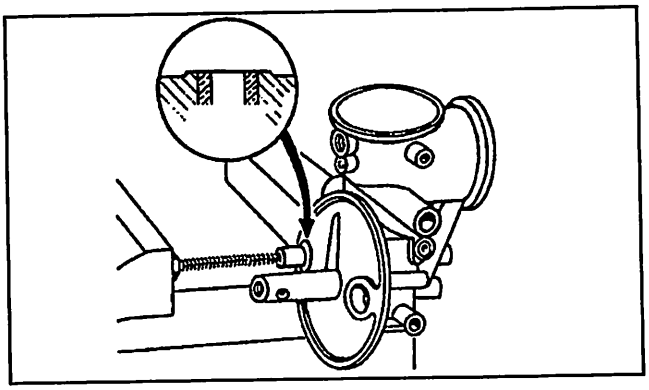


Illustrations courtesy of Briggs & Stratton Corporation

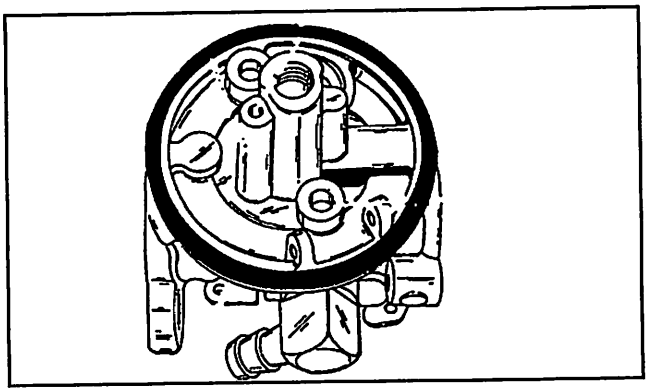
24. Install pressed-in float valve seat.

Note: On carburetors with removable Viton inlet seat.

- ***a. Press new seat flush with body using screw extractor and old seat as driver.***
- ***b. Use care to ensure seat is not pressed below body surface.***

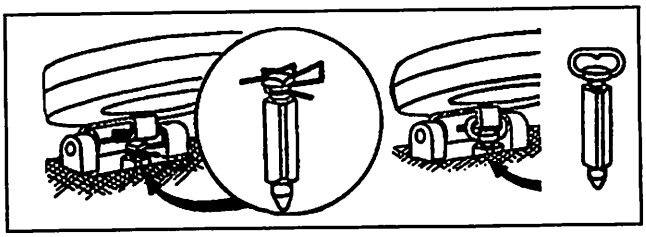


25. Install new bowl gasket.

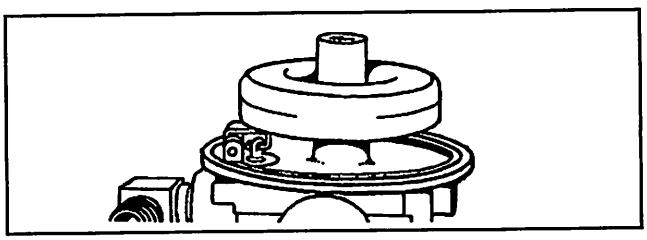


26. Install float needle to float.

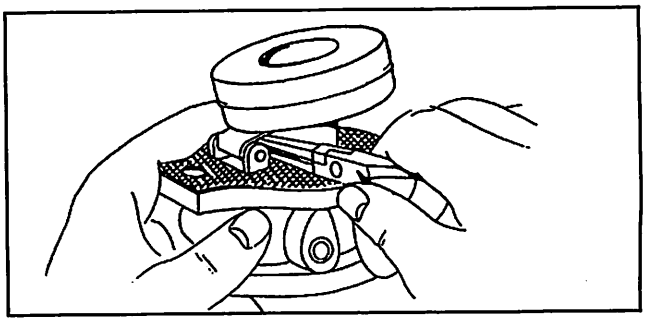
27. Install needle valve with open end of hook or spring facing away from venturi.



28. Confirm that float is parallel to the body mounting surface.

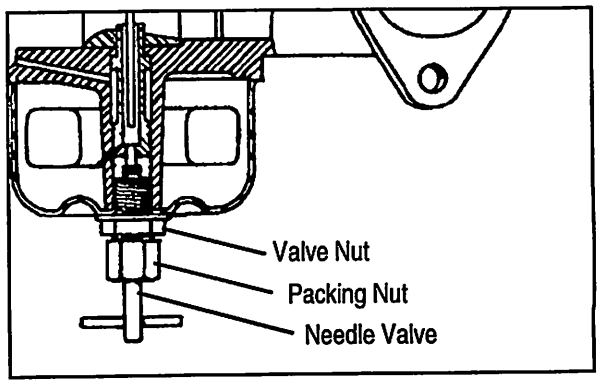


29. Bend the tank on the float until they are parallel. Do not press on float to adjust.



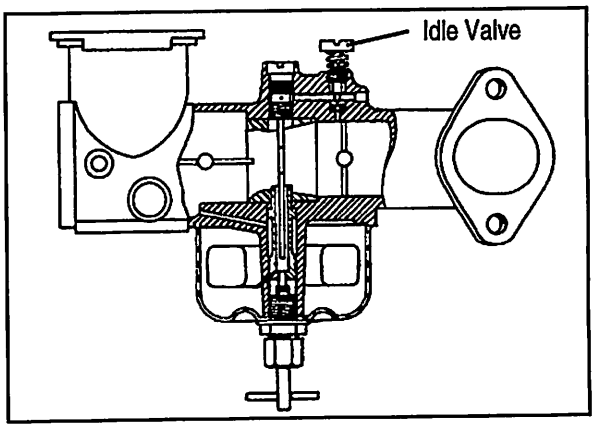
30. Install float bowl gasket and high-speed needle valve assembly.
    a. Tighten valve nut to secure float bowl. Do not tighten packing nut.
    b. Turn needle valve in until it just seats and then back off 1 and 1/2 turns.

Note: Final adjustment will be made when engine is running.



31. Install idle needle valve. Turn idle needle valve in until it just seats and then back off 1 1/2 turns.

Note: Final adjustment will be made when engine is running.



32. Install carburetor on engine. Make sure you have used the proper procedure in hooking up the carburetor linkage. Observe your notes.

33. Connect fuel line to carburetor and turn to "On" position. Check fuel line and carburetor for signs of leakage.

34. Install air cleaner and connect spark plug wire.

Note: All carburetor adjustments must be made with air cleaner installed.

35. Perform initial carburetor adjustment.
    a. Start engine and run to warm up.
    b. Place speed control level to "Fast" position.
    c. Turn high-speed needle valve clockwise until engine slows (lean mixture).
    d. Turn high-speed needle valve counterclockwise until engine slows (rich mixture).
    e. Turn high-speed needle valve to midpoint between rich and lean until engine runs smoothly.

Illustrations courtesy of Briggs & Stratton Corporation

36. Adjust idle speed.
    a. Rotate throttle counterclockwise and hold against stop.
    b. Adjust idle speed screw to obtain 1750 RPM.
    c. Holding throttle against idle stop, turn idle valve in (lean) and out (rich).
    d. Set idle valve to midpoint between rich and lean.
    e. Recheck idle RPM.
    f. Release throttle.

Note: If engine does not accelerate properly, the carburetor should be adjusted, usually to a slightly richer mixture.

37. Return tools and materials to their proper places.

Initial Carburetor Adjustment All Models
Turns Open From Seat

Needle Valve	Idle Valve
1-1/2	1-1/4

Small Engine Carburetor Service and Repair Competency Profile

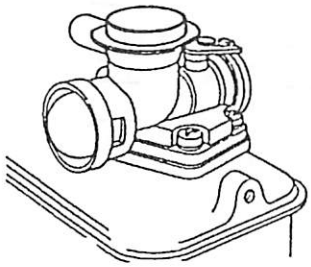
Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing a Large One-Piece Flow-Jet Carburetor
		Disassembly
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Disconnect spark plug wire.
___	___	4. Inspect carburetor fuel tank and fuel line.
___	___	5. Remove air cleaner.
___	___	6. Disconnect fuel line to carburetor.
___	___	7. Observe carburetor linkage.
___	___	8. Remove carburetor linkage and carburetor.
___	___	9. Remove idle needle valve.
___	___	10. Remove high-speed needle valve assembly from float bowl.
___	___	11. Remove float bowl.
___	___	12. Remove float and float needle.
___	___	13. Remove high-speed jet and nozzle.
___	___	14. Check throttle shaft and bushings for wear.
___	___	15. Remove Welch plug.
___	___	16. Remove choke valve.
___	___	17. Remove throttle shaft and bushings.
___	___	18. Remove pressed-in seat in carburetors equipped with a removable Viton inlet seat.
___	___	19. Clean carburetor with solvent.
		Reassembly
___	___	20. Install throttle shaft and bushing.
___	___	21. Install choke shaft and choke valve.
___	___	22. Install new Welch plug.
___	___	23. Install high-speed jet and nozzle in carburetor.
___	___	24. Install pressed in float valve seat.
___	___	25. Install new bowl gasket.
___	___	26. Install float needle to float.
___	___	27. Install needle valve.
___	___	28. Confirm float is parallel to the body mounting surface.
___	___	29. Bend the tank on the float until they are parallel.
___	___	30. Install float bowl gasket and high-speed needle valve assembly.
___	___	31. Install idle needle valve.

Yes	No	
___	___	32. Install carburetor on engine.
___	___	33. Connect fuel line to carburetor and turn to "On" position.
___	___	34. Install air cleaner and connect spark plug wire.
___	___	35. Perform initial carburetor adjustment.
___	___	36. Adjust idle speed.
___	___	37. Return tools and materials

Student's Signature _____ Instructor's Signature _____ Date _____

P. Step-By-Step Procedures for Servicing Briggs and Stratton Pulsa-Prime Carburetor Model Series 95900 to 95999

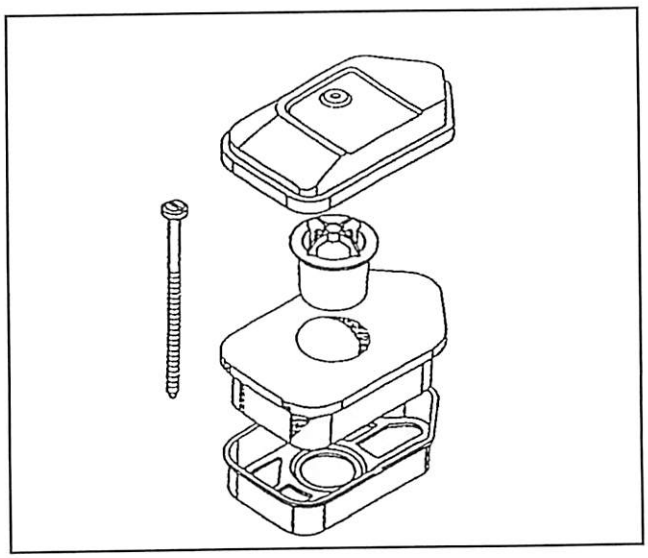


1. Read operator's manual and *Briggs & Stratton Service and Repair Manual.*

2. Organize your work station. When disassembling carburetor, place bolts, nuts, and parts in containers for safekeeping.

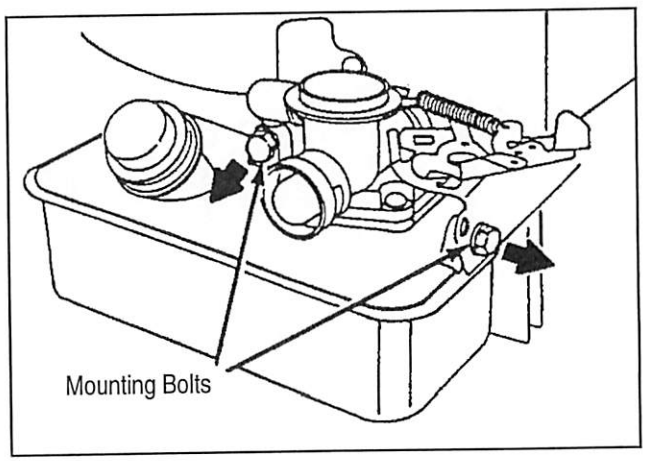
⚠ ***CAUTION: Wear proper safety equipment and observe this symbol as a WARNING OR CAUTION. Personal injury may occur unless instructions are followed carefully.***

Disassembly



3. Disconnect spark plug wire and place in V-notch on engine.

4. Remove air filter and disassemble for cleaning.



5. Remove throttle control cable from starter housing.

6. Remove carburetor and tank.
   a. With mounting bolts removed slowly ease carburetor off intake tube.
   b. Tilt the carburetor slightly to disengage linkage.
   c. Remove venting elbow and inspect for proper seal.

Note: Always observe the carburetor linkage and make a drawing.

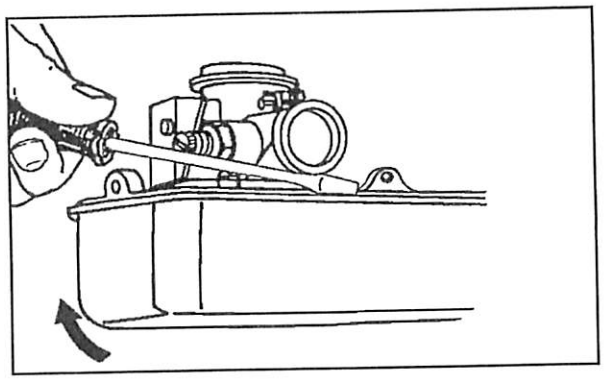
Illustrations courtesy of Briggs & Stratton Corporation

7. Observe carburetor for signs of leakage.

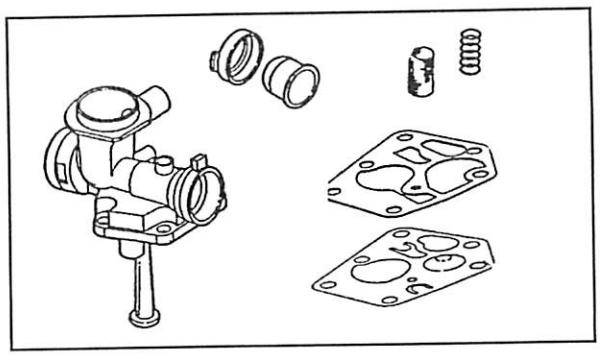
8. Remove fuel from tank.

CAUTION: Use approved containers for storage of gasoline.

9. Remove carburetor from tank. Use a screwdriver, as illustrated, to loosen carburetor from tank.

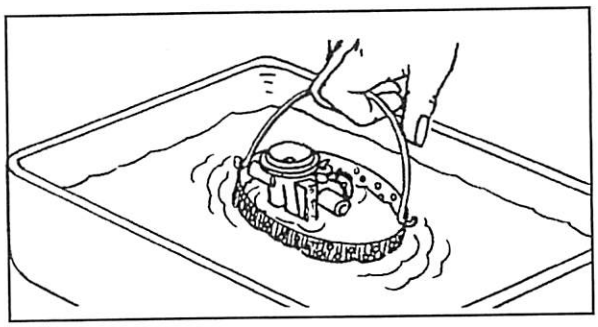


10. Check condition of primer bulb, diaphragm gaskets, and spring. Remove screen jet and check the fuel pipe screen.



11. Clean carburetor parts and tank. Use an approved cleaning solvent. Use compressed air to dry and finish cleaning all carburetor parts and tank.

Note: Do not soak diaphragm, gaskets, nylon, or rubber parts in the carburetor cleaner.

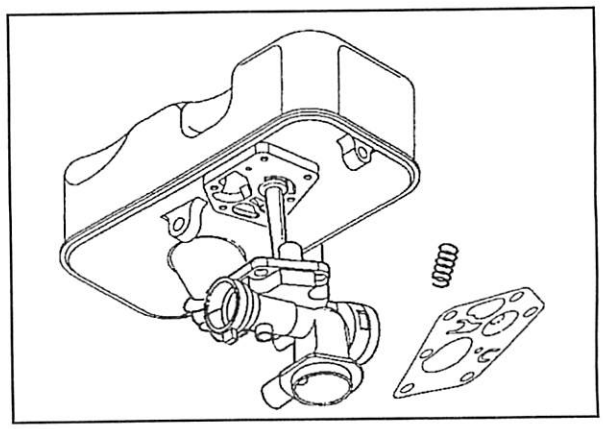


Reassembly

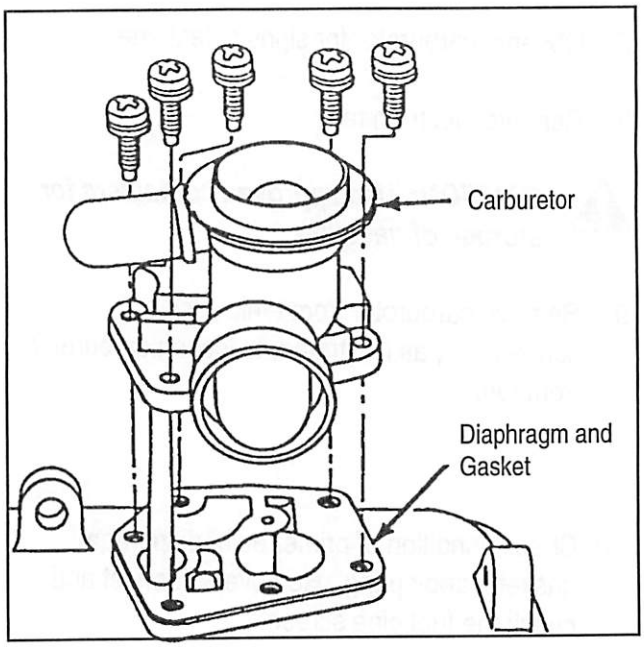
12. Install screen jet filter on fuel intake pipe.

13. Holding carburetor body upside down, place spring in pump well on carburetor body. Holding spring place diaphragm over spring and slowly move carburetor fuel pipe into tank.

Note: Make sure spring is in pump well.

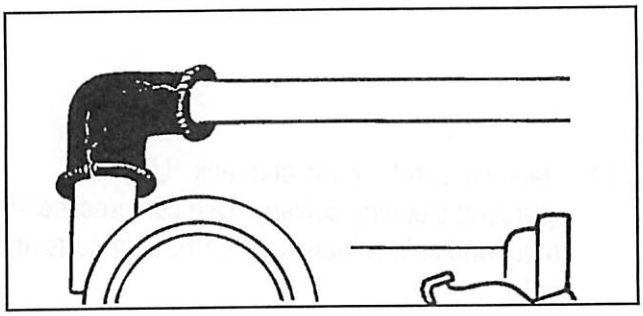


14. Return carburetor to upright position. Install the five screws and tighten.

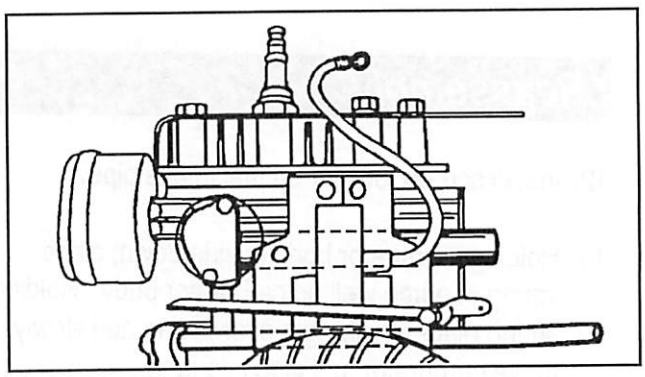


15. Check fuel intake tube seal.

16. Check venting elbow (breather tube grommet) for damage and proper seal.

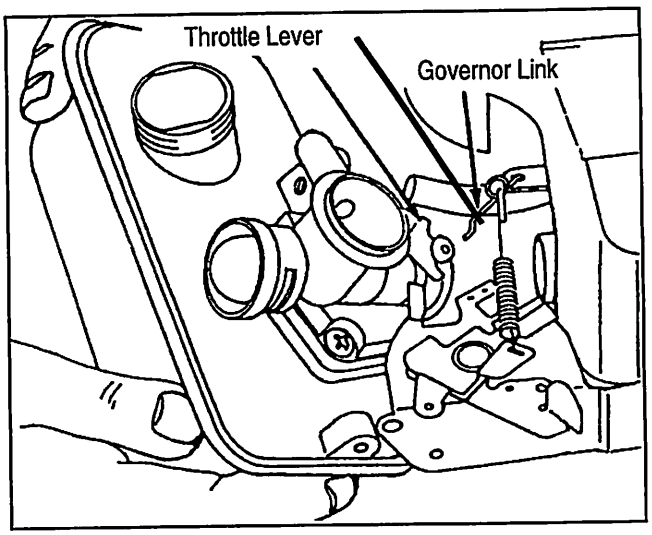


17. Before installing carburetor, check fuel intake tube gasket and tighten bolts securely.



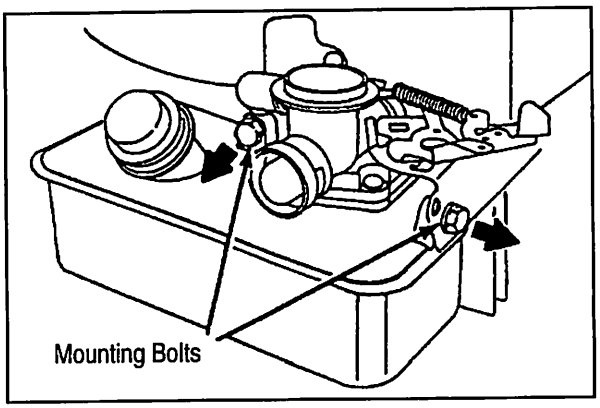
Illustrations courtesy of Briggs & Stratton Corporation

18. Install carburetor and tank assembly onto engine and attach the governor link to the throttle lever.



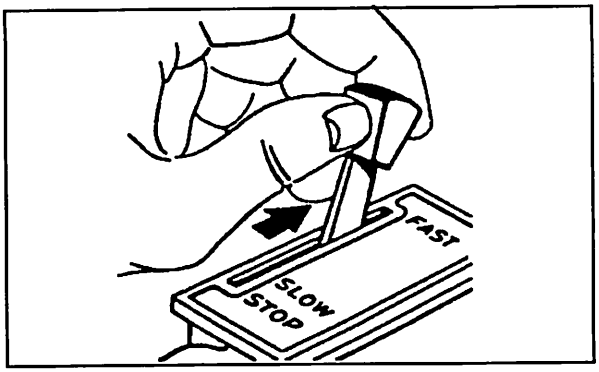
19. Slowly slip carburetor into place, making sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with venting elbow.

20. Attach bolt to carburetor. Mount carburetor to engine.



21. Install air cleaner.

22. Install remote control assembly. The remote control lever should move from "Stop" position to "Fast" position.



Illustrations courtesy of Briggs & Stratton Corporation

23. The remote control wire should have a minimum travel of 1 and 3/8" when mounted on engine.

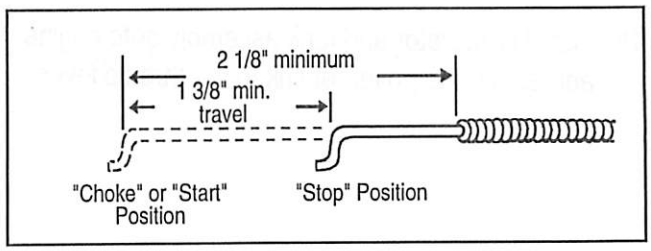
24. Reconnect spark plug wire.

CAUTION: Check with your instructor before starting engine. Make sure area under and around engine is clear before starting.

Note: The Pulsa Prime Carburetor has no adjustments. A primer bulb has been added to eliminate the need for a choke. The primer bulb injects fuel directly into the throttle of for quick starting with a cold engine. The Pulsa Prime Carburetor has no idle system and no air/fuel adjustment. The governor system controls the speed of the engine. This carburetor has a fixed-speed jet that provides fuel throughout the engine operating range.

25. Place remote control in start position and crank engine. Warm to operating temperature.

26. Clean your work area and return tools to their proper places.



Small Engine Carburetor Service and Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks performed when servicing or repairing small engine carburetors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Briggs and Stratton Pulsa-Prime Carburetor Model Series 95900 to 95999
		Disassembly
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Disconnect spark plug wire.
___	___	4. Remove air filter for cleaning.
___	___	5. Remove throttle control cable from starter housing.
___	___	6. Remove carburetor and tank.
___	___	7. Observe carburetor for signs of leakage.
___	___	8. Remove fuel from tank.
___	___	9. Remove carburetor from tank.
___	___	10. Check condition of primer bulb, diaphragm gaskets, and spring.
___	___	11. Clean carburetor parts and tank.
___	___	12. Install screen jet filter on fuel intake pipe.
___	___	13. Place spring in pump well on carburetor body.
___	___	14. Install the five carburetor screws and tighten.
___	___	15. Check fuel intake tube seal.
___	___	16. Check venting elbow.
___	___	17. Check fuel intake tube gasket.
		Reassembly
___	___	18. Install carburetor and tank assembly onto engine and attach the governor link to the throttle lever.
___	___	19. Slip carburetor into place.
___	___	20. Mount carburetor to engine.
___	___	21. Install air cleaner.
___	___	22. Install remote control assembly.
___	___	23. Adjust remote control assembly.
___	___	24. Reconnect spark plug wire.
___	___	25. Start engine. Warm to operating temperature.
___	___	26. Clean your work area.

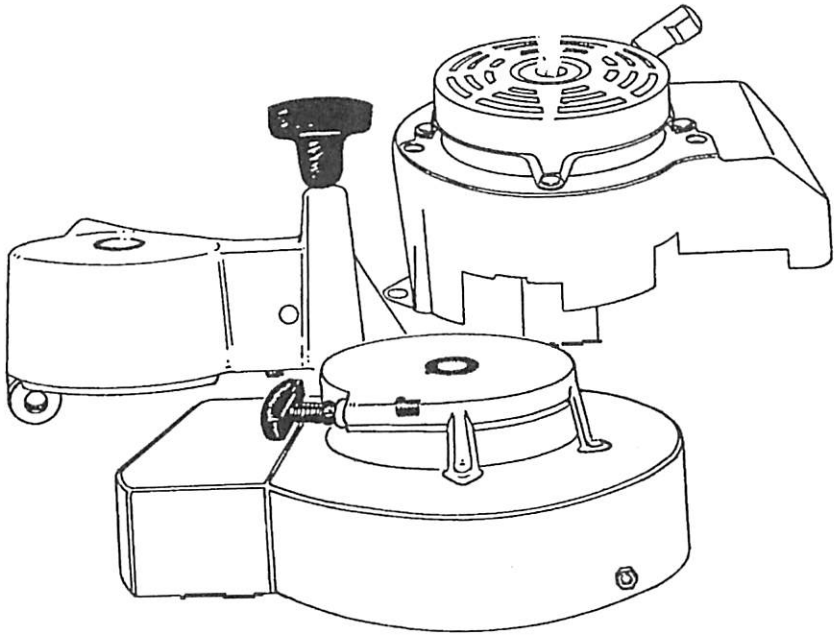
Student's Signature _____ Instructor's Signature _____ Date _____

10-7653-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Rewind Starters

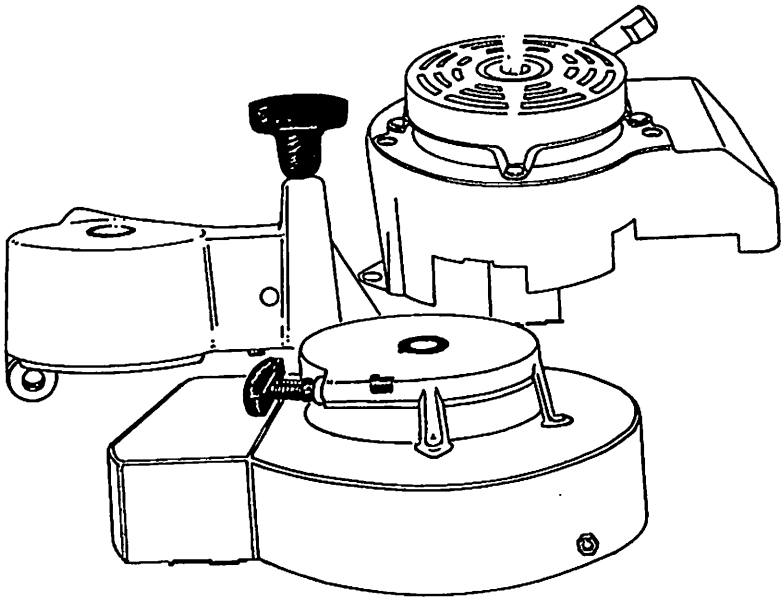


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

MODULE 3

Rewind Starters



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

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American Association for Vocational Instructional Materials

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Dan Hostetler, Boonville, Missouri, Harold Bossaler, Columbia, Missouri, Dr. Milo Spurgeon, Columbia, Missouri for their contributions to this manual.

References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Rewind Starters

Unit Objectives

After completing this unit, the student should be able to remove and replace a starter, replace a starter rewind spring, replace a starter rope, service a starter clutch, and service a vertical pull starter. Competencies will be demonstrated through the student's ability to properly service and repair small engine starters.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify the types of small gas engine starters.

2. Identify the starter parts.

3. Demonstrate the ability to:

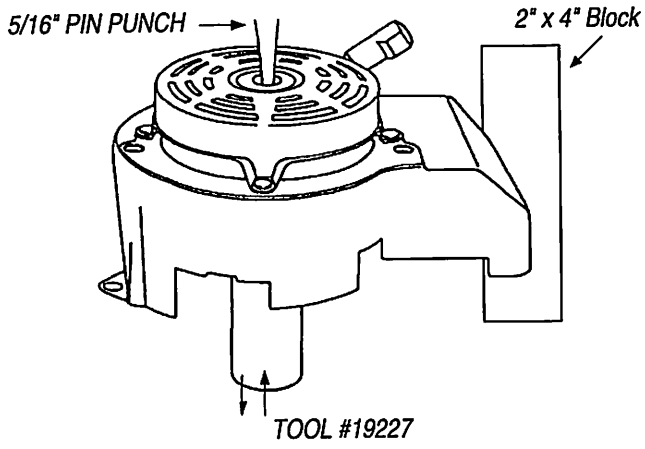
   a. Remove, disassemble, service, reassemble, and test a starter.
   b. Replace a starter rewind spring.
   c. Replace a starter rope.
   d. Service a vertical pull starter.
   e. Service a starter clutch assembly.

Rewind Starters

Step-by-step Procedure

Introduction

The purpose of the starter is to crank the engine. Most operators fail to maintain good maintenance procedures of small engines and the starter becomes overworked. Starter maintenance can be minimized by keeping your small engine in good running condition. Information in this unit will help expand your knowledge in servicing rewind starters on small engines.



A. Tools and Supplies Needed to Service Starters

Tools

Socket set (3/8" ratchet, Sockets 3/8", 5/16", 1/4"
Nut drivers 1/4", 3/8", 5/16"
Slot head screwdriver, 4" and 6"
5/8" pin punch
Cylinder support
Tang tool
Rawhide mallet
Rope inserter tool
Needle nose pliers
Scratch awl
C-clamp, 6"
Bench vice
Rewind starter tool (3/4" x 9" square tubing)
Starter clutch wrench and torque adapter
Putty knife
Knife
Safety glasses
2" x 4" block 12" long
Flywheel holder

Supplies

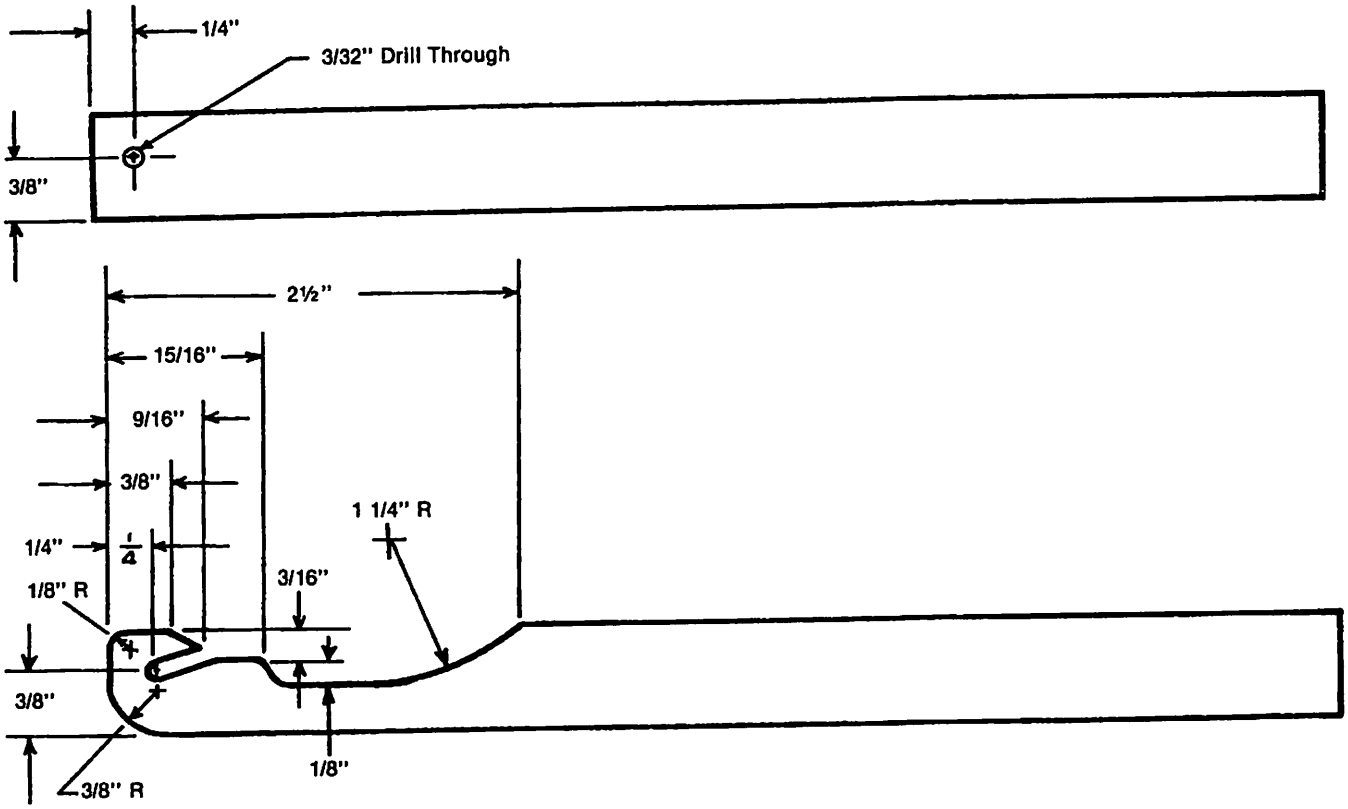
Parts cleaning pan
Petroleum solvent
Shop towels
Penetrating oil
Matches
Nylon bumpers
Starter rope
Starter spring
Multi-purpose grease
Gloves

Special Starter Tools

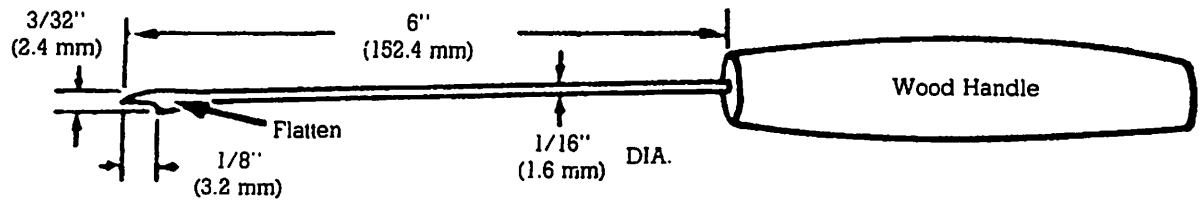
Starter Tang Tool

Used for lifting tangs on Windup Starters

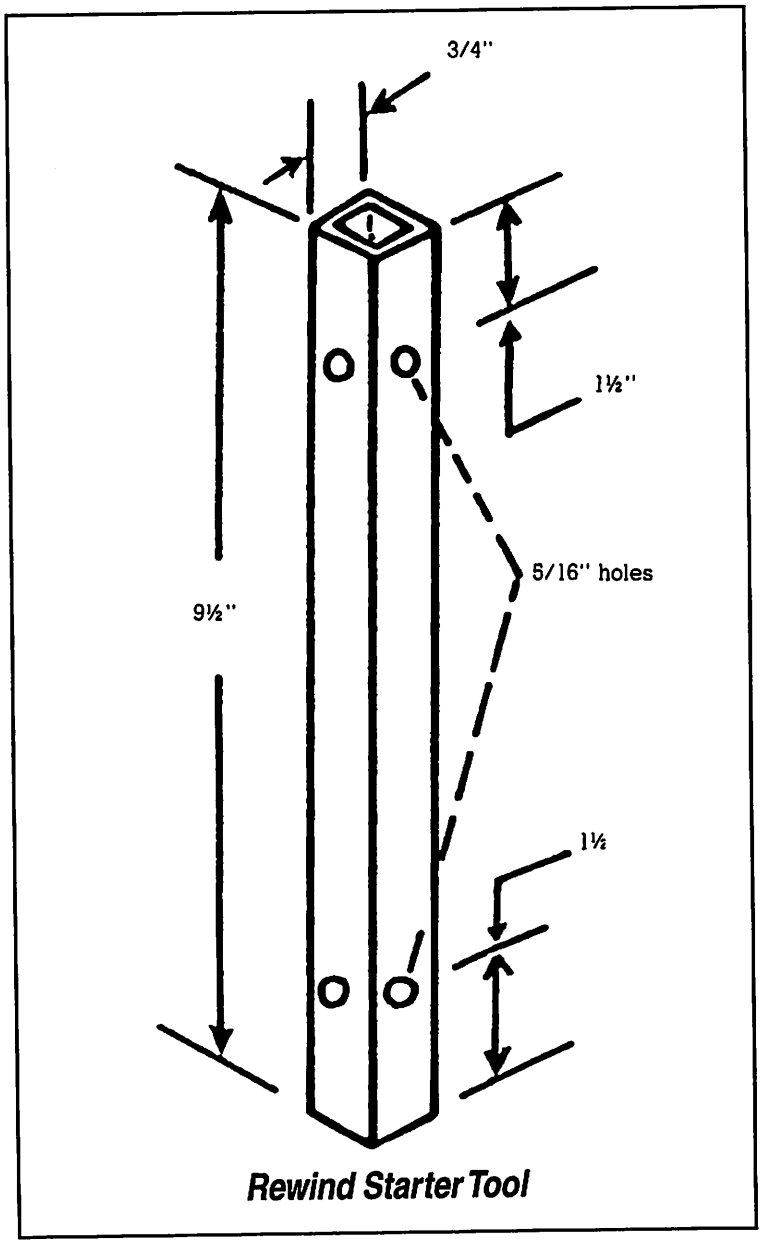
1. Material required is 7 1/2" length of 5/8" square stock steel.
2. Drill 3/32" hole as indicated in the drawing.
3. Cut and grind to dimensions as shown in the drawing



Special Starter Tools That Can Be Made In Your Shop



Rope Inserter

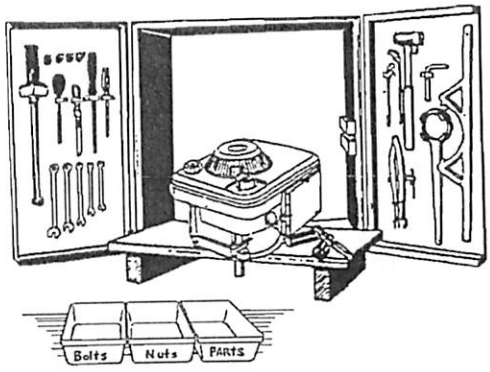


Rewind Starter Tool

B. Servicing Model Series 120000 Quantum Power Rewind Starter

Quantum Power Rewind Starter

1. Read operator's manual and *Briggs & Stratton Service and Repair Instructions for Quantum Rewind Starter.*

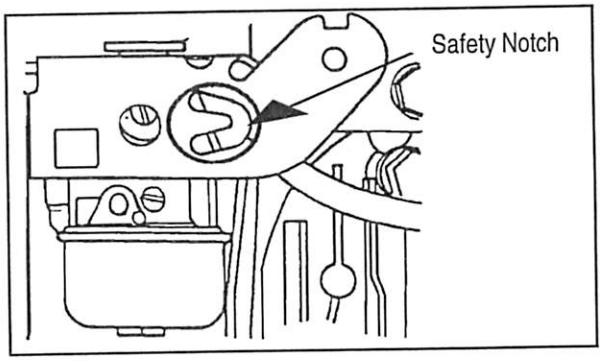


2. Wear proper clothing and safety equipment.

CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

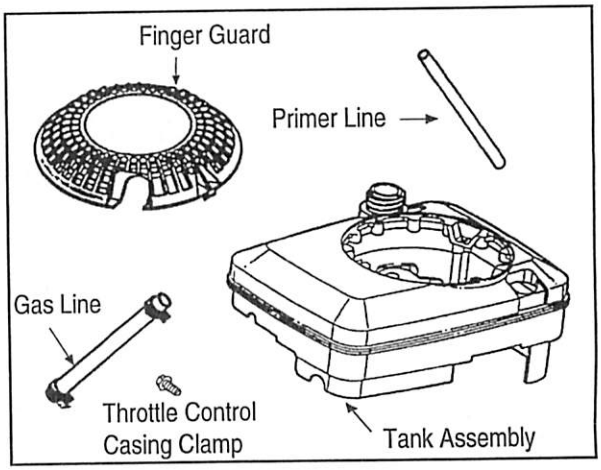
4. Disconnect the spark plug wire and place in the safety notch on the engine.



Disassembly

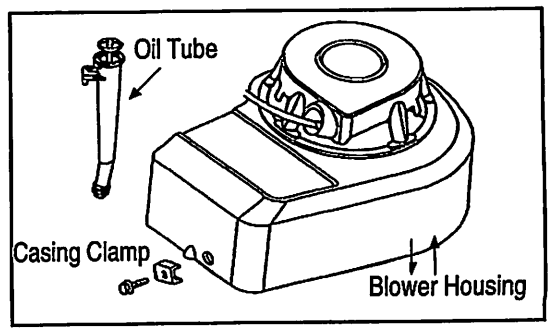
5. Remove tank assembly.

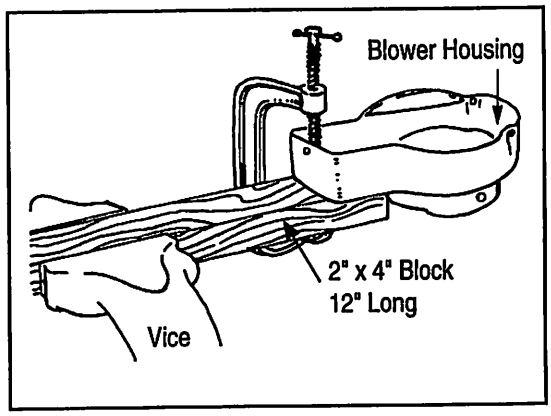
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.



Illustrations courtesy of Briggs & Stratton Corporation

6. Remove blower housing, oil tube and casing clamp.





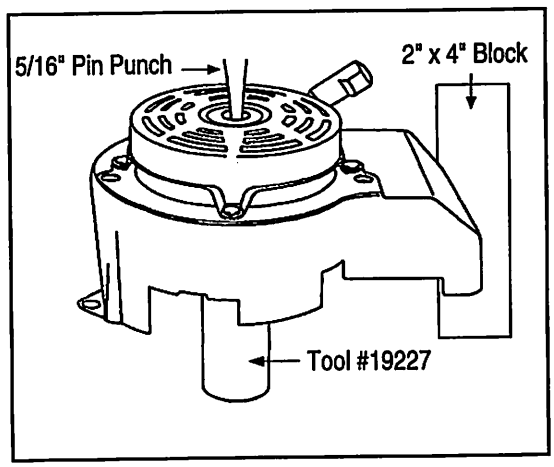
7. Place a 2" x 4" x 12" wood block in a vice, as shown. Use a 6" C-clamp to hold blower housing. This keeps both hands free to work on the starter.

CAUTION: Pulley, spring and spring retainer are serviced as an assembly. DO NOT ATTEMPT TO REMOVE SPRING RETAINER FROM PULLEY.

8. Pull starter rope out as far as it will go. Place a screwdriver in one of the openings of the blower housing to hold spring tension.

9. Pull pulley end of rope out and untie knot at end of rope. Remove rope and handle from starter. Remove screwdriver and slowly release pulley to release spring tension.

10. To disassemble starter, remove roll pin holding the starter together. CAUTION: The underside of the starter must be supported when removing the roll pin. Support blower housing with a cylinder support and a 2" x 4" block and drive out roll pin with a 5/16" diameter pin punch.



Note: On early engines the starter housing must be removed from blower housing by drilling out the pop rivets.

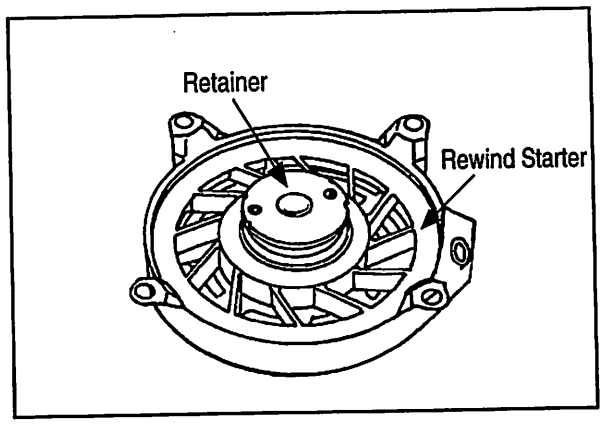
Note: A 5/16" valve works well in removing the roll pin.

WARNING: ALWAYS wear eye protection to prevent eye injury while disassembling and reassembling starters.

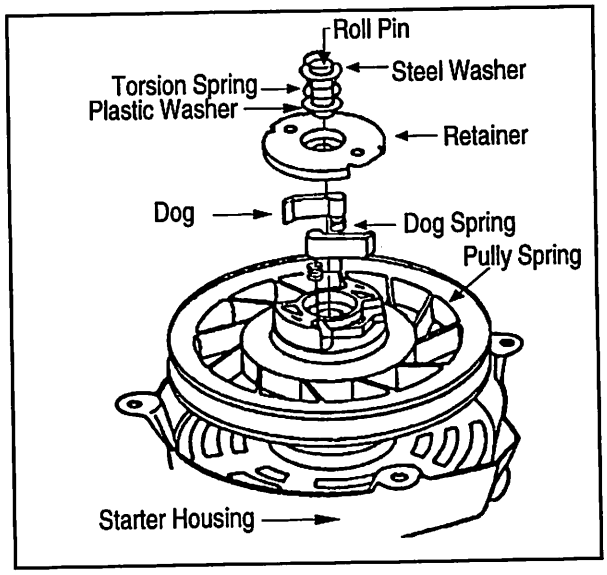
Illustrations courtesy of Briggs & Stratton Corporation

11. Holding rewind starter and retainer, remove blower housing from support tool. Place starter upside down on the work bench and lift off retainer. See illustration.

Note: Blower housing has been removed from starter assembly.

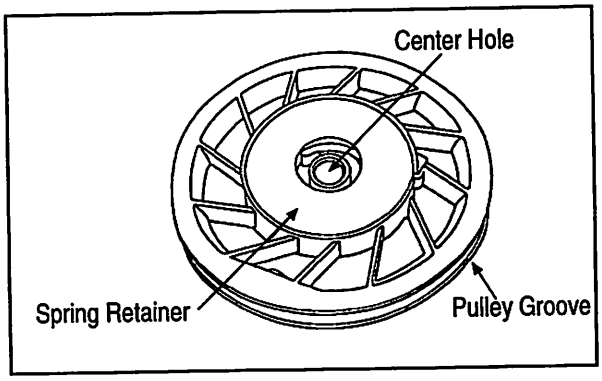


12. With the center roll pin removed, the starter can be disassembled and any service part can be replaced. When reassembling the starter, grease the rewind spring and replace the spring and roll pin with a new one.



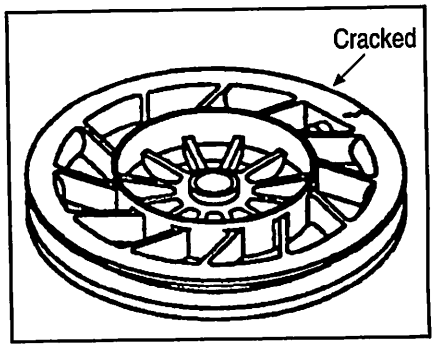
13. Lift off pulley and spring assembly.

Note: Plastic washer is used on pulley.

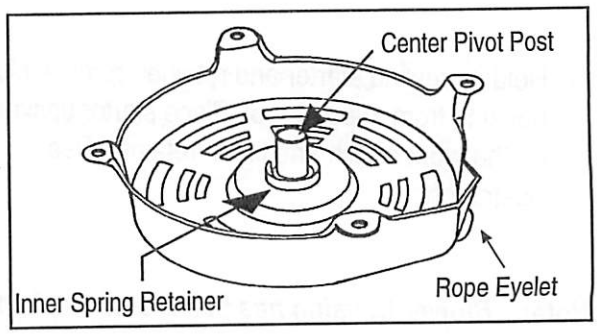


14. Inspect pulley for cracks, rough edges or burrs in pulley grove. Replace if damaged or worn.

Note: Pulley and spring assembly are purchased as a unit.

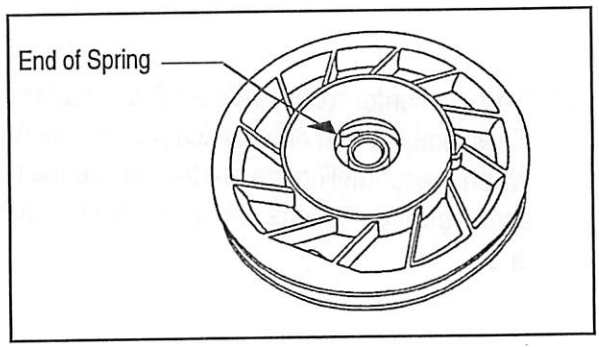


15. Inspect the starter housing for wear or burrs at rope eyelet, center pivot post and at inner spring retainer. Replace if worn.

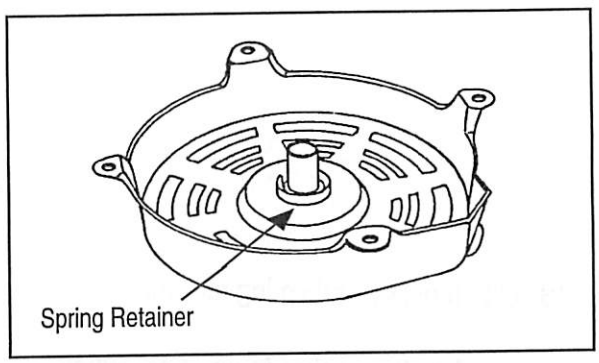


Reassembly

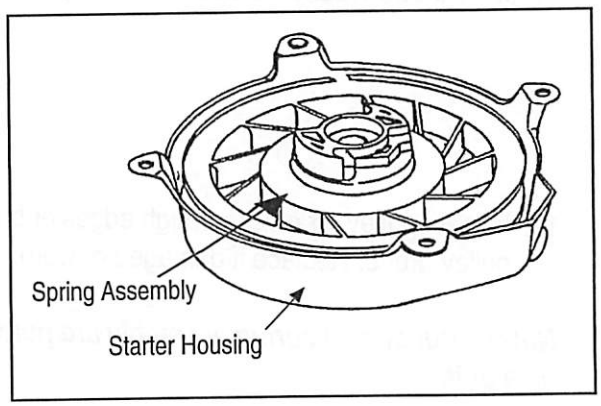
16. Locate free end of spring in pulley. Locate spring retainer in starter housing.



17. Line up free end of spring with spring retainer in housing and assembly pulley in housing.

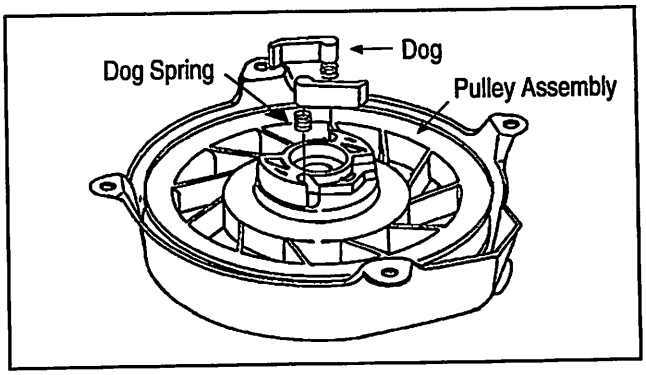


18. Install spring assembly in starter housing and rotate pulley COUNTER-CLOCKWISE until spring engages retainer.



Illustrations courtesy of Briggs & Stratton Corporation

19. Install dogs and dog spring in pulley assembly.

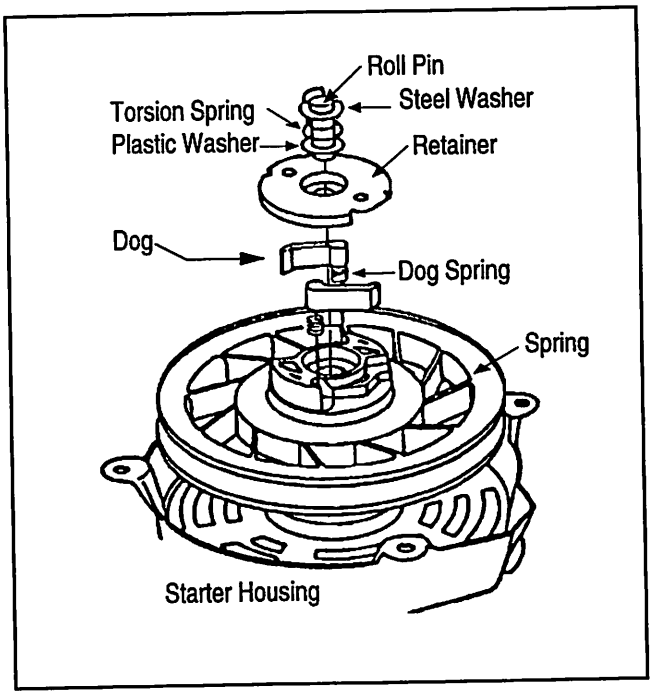


20. Place retainer on pulley with pierced holes between dogs and stops on pulley.

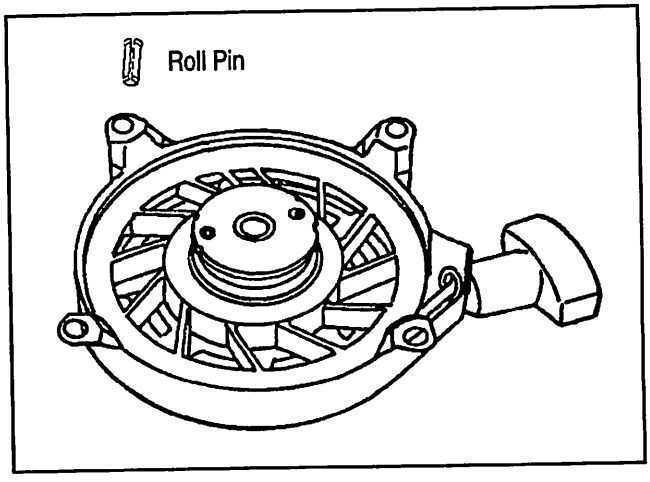
Note: See illustration for correct order of reassembly.

21. Place plastic washer in center of retainer.

22. Place steel washer and torsion spring on new roll pin and start pin in center hole.

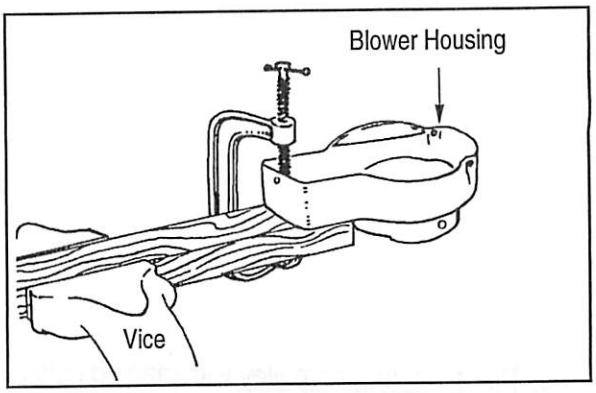


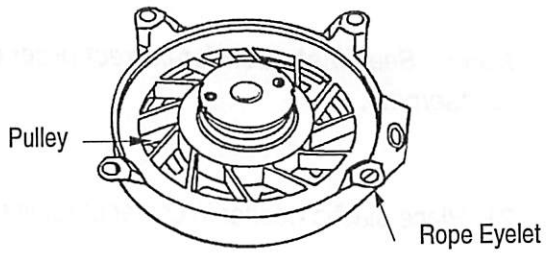
23. Press or drive roll pin in until pin is flush with retainer.



Installing Rope

24. Place a 2" x 4" x 12" block of wood in a vice. Use a 6" C-clamp to hold blower housing and starter. Wind spring and pulley COUNTERCLOCKWISE until spring is tight.

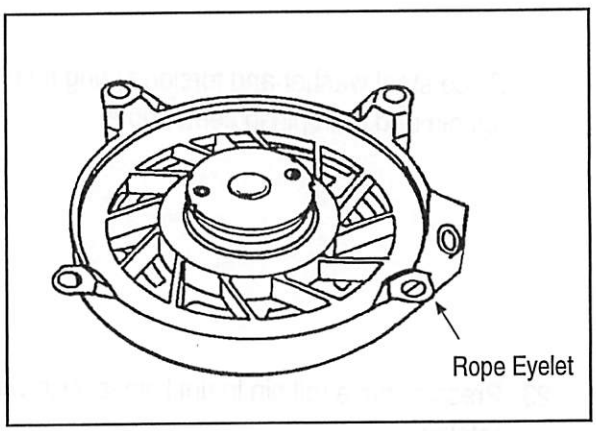




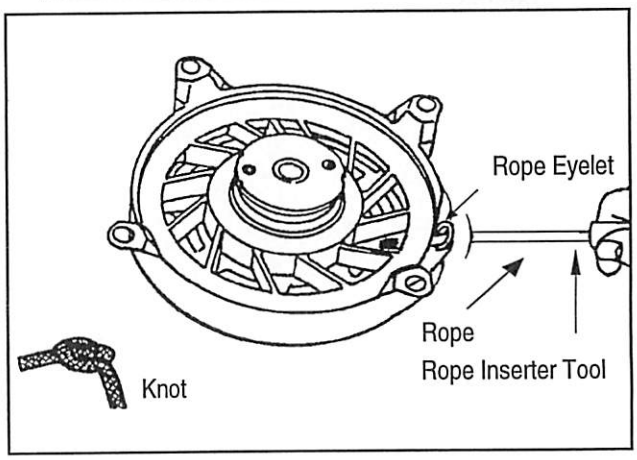
25. Holding tension on spring, adjust pulley until rope eyelet in housing and rope hole in pulley are in line. Place a screwdriver between the spikes to hold spring tension.

    Burn both ends of the nylon rope with a match. Wipe with a cloth—use caution while rope ends are still hot. Burning the rope ends prevents swelling and unraveling.

Note: When installing a new rope, check the parts list to be sure correct diameter and length rope are used.

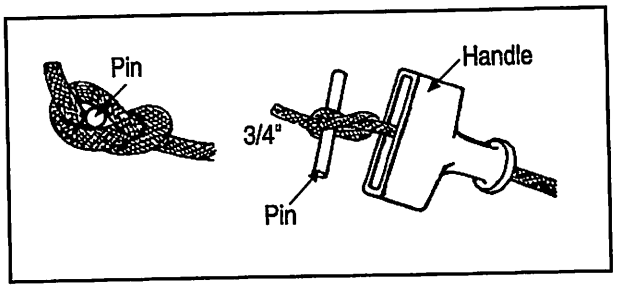


26. Using a rope inserter tool, install the rope end through eyelet and pulley hole. Tie a single overhand knot and pull rope into cavity.



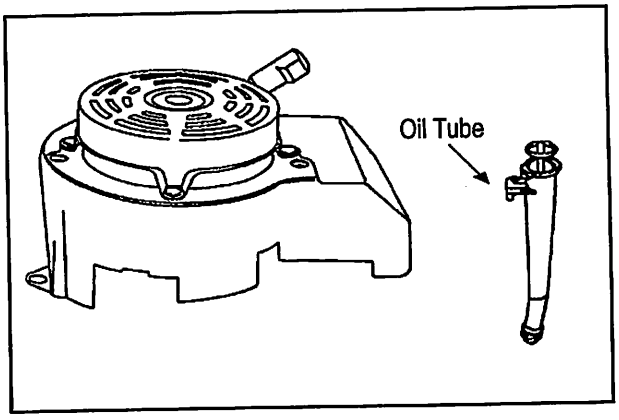
Illustrations courtesy of Briggs & Stratton Corporation

27. Install handle and remove screwdriver. Slowly let pulley and spring unwind.



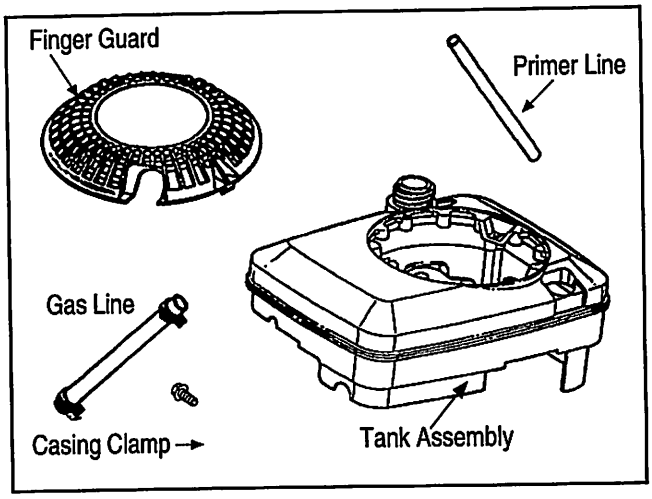
28. Install blower housing and oil tube. Check O-ring and make sure it snaps into place.

Note: Check operation of starter.



29. Install tank assembly

    a. Finger guard.
    b. Gas line.
    c. Primer line (if available).
    d. Throttle control casing clamp.



30. Reconnect the spark plug wire.

31. Clean your work area and return tools to their proper places.

32. See your instructor.

Rewind Starters Service And Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate "yes/no" rating.

NOTE: Profile can be used as repair procedure for servicing and repairing starters.

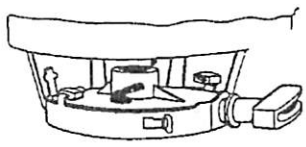
Starters Service and Repair/ Disassembly/Reassembly

Yes	No	Model 120000 Quantum Power Rewind Starters
		Disassembly
____	____	1. Rear operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Disconnect the spark plug wire.
____	____	5. Remove tank assembly (if applicable).
____	____	6. Remove blower housing from engine.
____	____	7. Secure blowing housing.
____	____	8. Secure spring tension.
____	____	9. Remove rope.
____	____	10. Disassemble starter.
____	____	11. Remove blower housing from support tool.
____	____	12. Replace starter parts, as necessary.
____	____	13. Lift off pulley and spring assembly.
____	____	14. Inspect pulley for cracks and rough edges.
____	____	15. Inspect starter housing for wear or burrs.
		Reassembly
____	____	16. Place spring retainer in starter housing.
____	____	17. Align spring, spring retainer and assembly pulley.
____	____	18. Install spring assembly.
____	____	19. Install dogs and dog spring.
____	____	20. Place retainer on pulley.
____	____	21. Place plastic washer.
____	____	22. Place steel washer and torsion spring.
____	____	23. Install roll pin.
____	____	24. Secure Blower housing and starter.
____	____	25. Adjust pulley.
____	____	26. Install rope.
____	____	27. Install handle.
____	____	28. Install blower housing and oil tube. Check operation of starter.
____	____	29. Install tank assembly.
____	____	30. Reconnect spark plug.
____	____	31. Clean work area.

Student's Signature _____ Instructor's Signature _____ Date _____

C. Rewind Starters

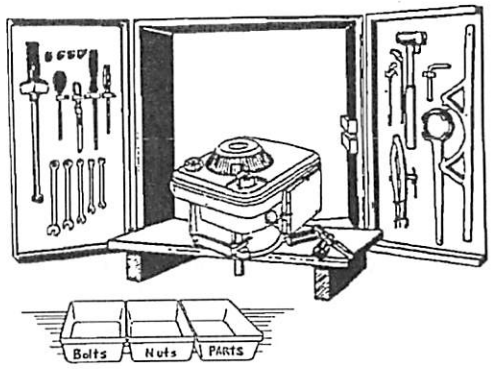
Model Series 60000, 80000, 90000, 100200, 100900 and 110000



1. Read operator's manual and *Briggs and Stratton Service and Repair Instruction-Rewind Starter.*

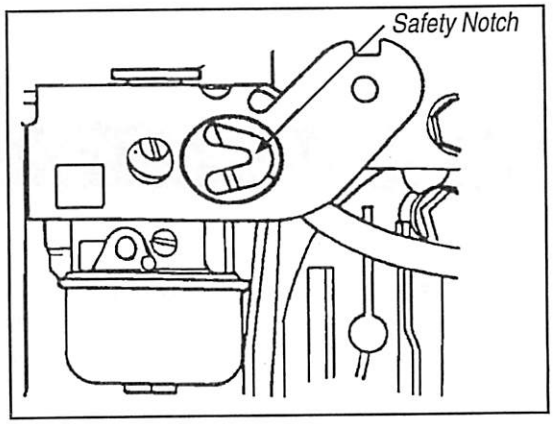
2. Wear proper clothing and safety equipment.

CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.



3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Disconnect the spark plug wire and place in the safety notch on the engine.

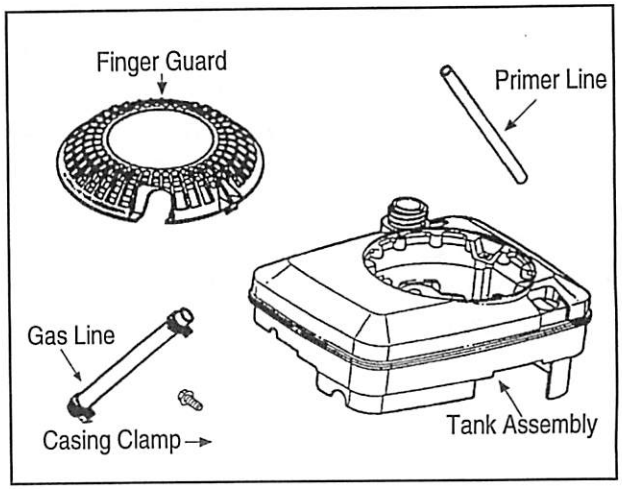


Disassembly

5. Remove tank assembly

   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.

Note: Skip Step 5 if your engine does not have a tank assembly.

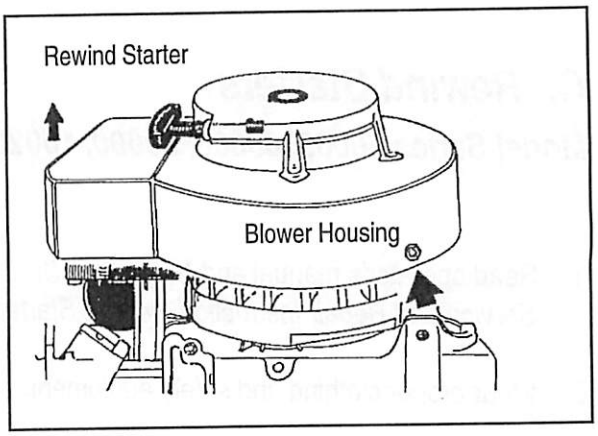


Illustrations courtesy of Briggs & Stratton Corporation

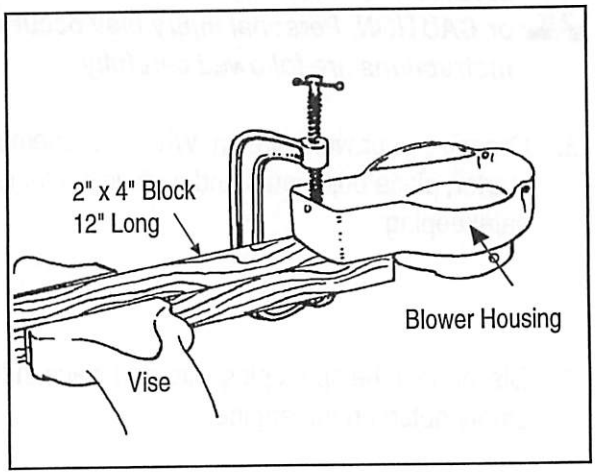
6. Remove blower housing from engine.

   a. Throttle control casing clamp.
   b. Oil tube (if available).

Note: On some models the casing clamp will not be attached to blower housing.



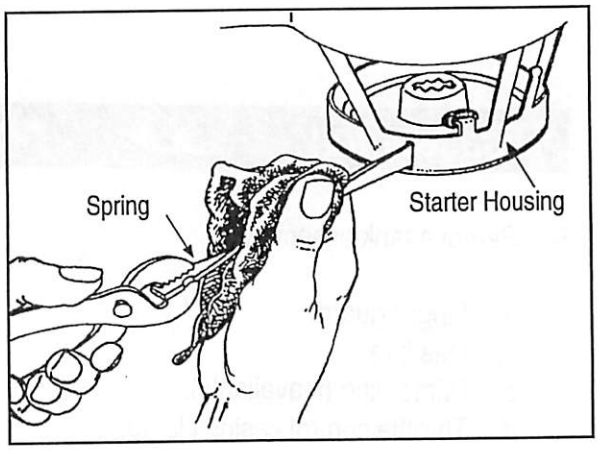
7. When working on a rewind starter you need to have both hands free. Place a 2" x 4" block 12 inches long in a vise. Secure the housing with a "C" clamp.



Removing Rope

8. Pull starter rope all the way out and lock the pulley using the winding tool. Cut rope at starter pulley and remove rope. Using the winding tool, slowly relax spring.

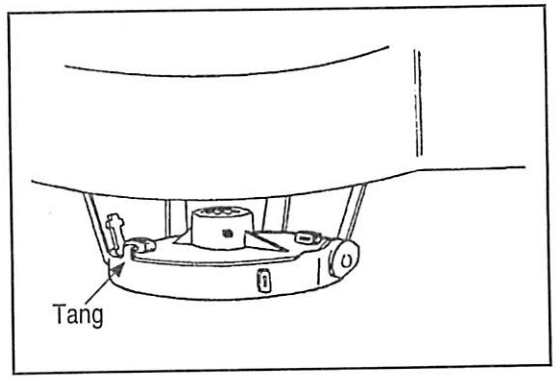
9. Firmly grasp the spring anchor tip with pliers. Pull the spring from the housing until the spring stops. Rotate the spring 90 degrees and unhook the anchor tip from the pulley. Remove spring. Clean the spring with a shop towel as you remove.



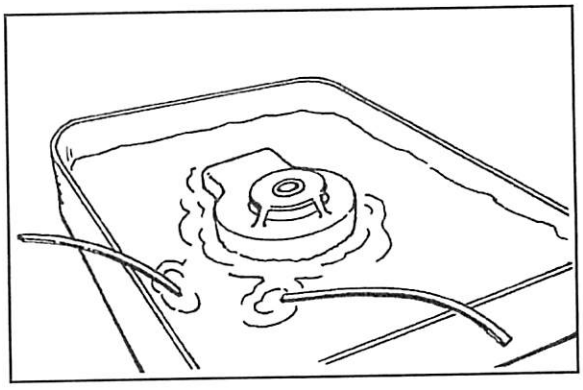
CAUTION: Use caution in removing the pulley and spring assembly if the spring anchor tip is broken or missing.

Illustrations courtesy of Briggs & Stratton Corporation

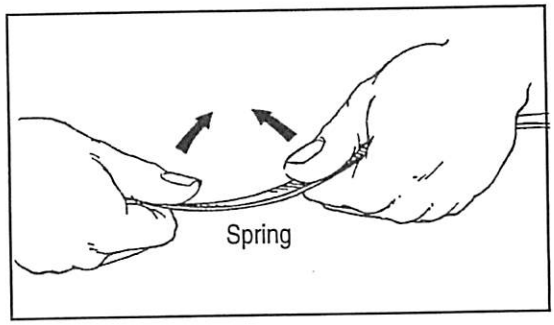
10. With the spring removed, use a tang bending tool to bend up only one tab to free the pulley. Remove pulley and clean starter housing.



11. Clean starter housing pulley and spring in solvent and wipe dry.

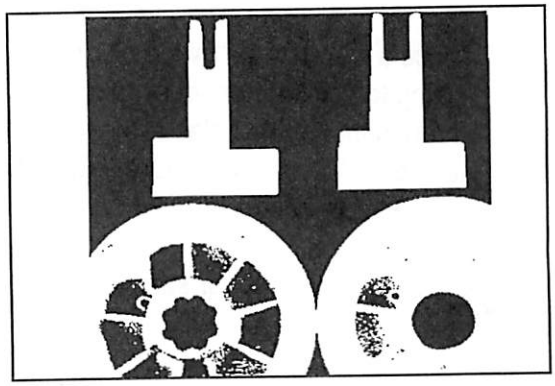


12. Straighten spring to allow easier installation and restore tension. Oil the spring. Replace it if damaged.



Reassembly

13. The new starter pulley is wider to accept the additional length of rope needed to comply with current regulations. This pulley also has a new locking-style cavity to accept the rope knot. A simple overhand knot is now used to secure the rope into the rope knot cavity. New pulleys can be interchanged with older model pulleys.



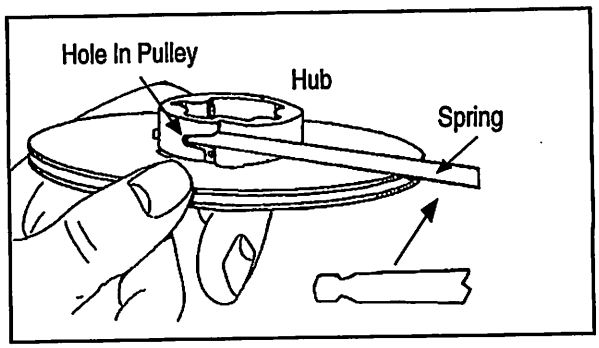
Narrow Groove
Old Pully

Wide Groove
New Pully

Illustrations courtesy of Briggs & Stratton Corporation

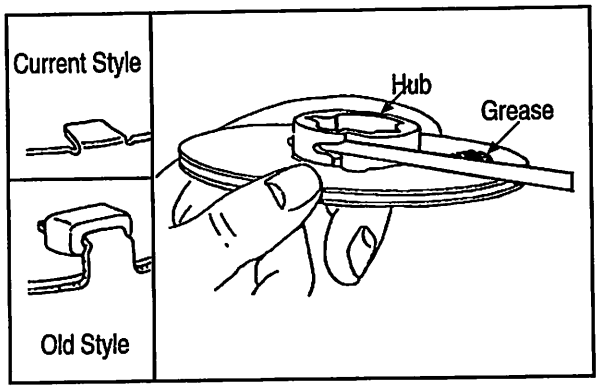
14. Insert either end of spring through slot in blower housing. Hook the end of spring into pulley hub.

Note: The pulley is shown outside the housing to allow a full view of the spring anchor slot.

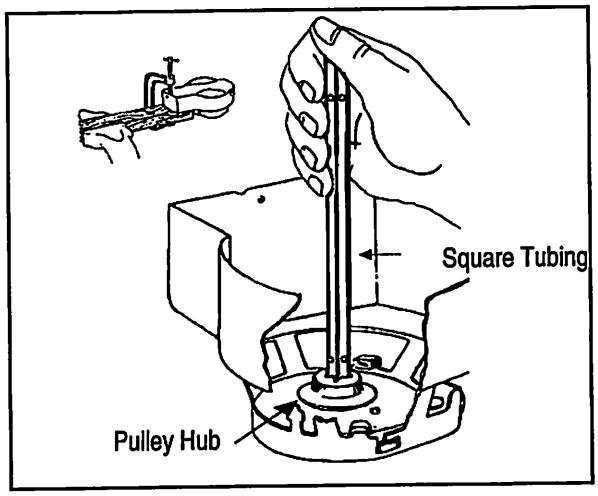


15. Place a small amount of grease on the pulley. Place pulley into housing with the spring facing the blower housing. Bend the tang down. Adjust tang gap as shown. Make sure pulley is fully depressed into blower housing when measuring tang gap.

Note: Do not remove nylon bumper from old style tang when replacing metal pulley with nylon pulley. Replace nylon bumpers if worn.



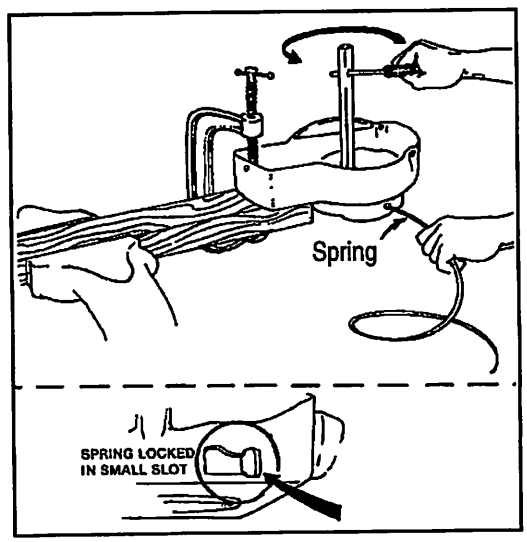
16. With starter housing secured, place the 3/4" square tubing into the center of the pulley hub for winding starter.



17. Place a 2" x 4" x 12 " wood block in a vise. Use a C-clamp to hold starter housing. Place screwdriver through one of the holes at the top end of the square tubing and wind pulley COUNTERCLOCKWISE until spring is tight.

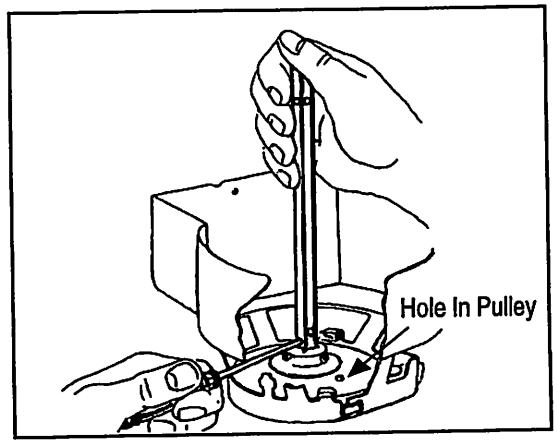
⚠ ***CAUTION: Wear safety glasses.***

Note: Spring should be securely locked in smaller portion of tapered hole. (See illustration.)



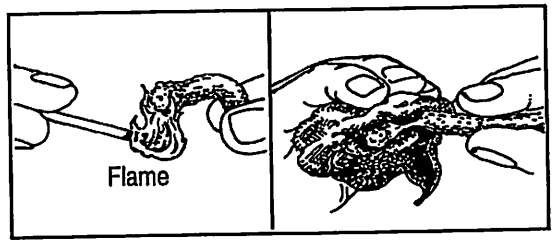
Illustrations courtesy of Briggs & Stratton Corporation

18. Hold square tubing securely and back off the pulley one turn or until hole in pulley for rope and eyelet inblower housing are in alignment. Secure this position by relocating the screwdriver through one of the holes at the bottom of the tubing.

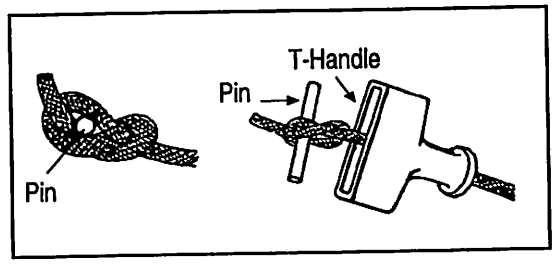


19. In selecting new rope, use parts number for correct length and diameter of rope.

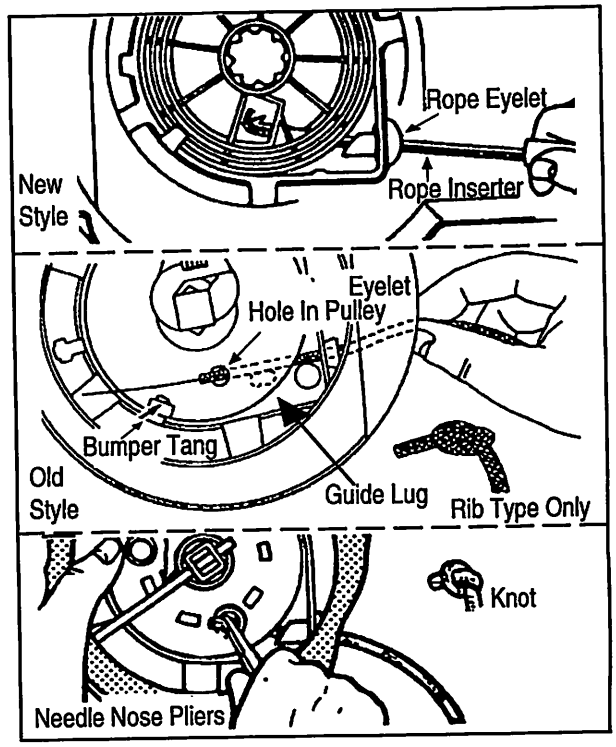
20. Singe the end of nylon rope with a match flame. While rope is hot, wipe it with a cloth to prevent swelling and fraying.



21. Insert rope through T-handle and loosely tie a figure eight knot. Place the pin through the knot and pull it tightly into handle.

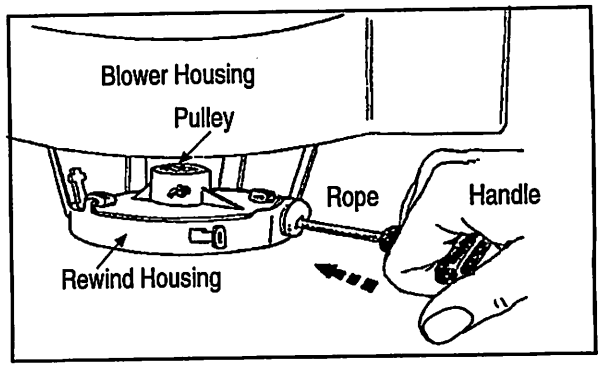


22. Use a rope inserter tool to thread rope through rope eyelet in housing and out the pulley hole. Tie a knot in rope and pull it tightly into knot cavity.



23. Remove square tubing to release spring tension and allow rope to slowly rewind onto pulley.

Note: It may be necessary to cut about six inches off the starter rope for it to fully rewind.



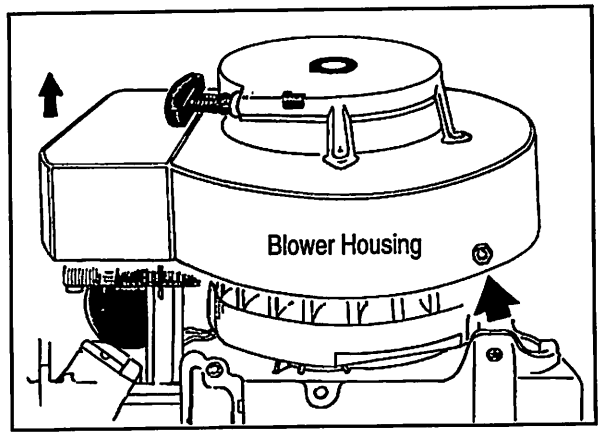
24. Install blower housing on engine.

25. Reconnect the spark plug wire.

26. Start engine several times to be sure starter is operating correctly.

27. Clean your work area and return tools to their proper places.

28. See your instructor.



Illustrations courtesy of Briggs & Stratton Corporation

Rewind Starters Service And Repair Competency Profile

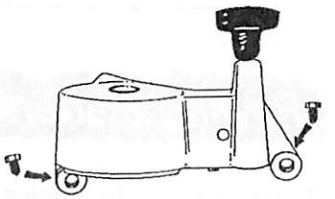
Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate "yes/no" rating.

Note: ***Profile can be used as repair procedure for servicing and repairing starters.***

Starters Service and Repair Model 60000, 80000, 90000, 100200, 100900, and 110000 Rewind Starters

Yes	No	
		Disassembly
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Disconnect the spark plug wire.
____	____	5. Remove tank assembly (if applicable).
____	____	6. Remove blower housing from engine.
____	____	7. Secure blowing housing.
____	____	8. Remove rope.
____	____	9. Remove anchor spring.
____	____	10. Remove pulley.
____	____	11. Clean starter housing pulley.
____	____	12. Service anchor spring.
		Reassembly
____	____	13. Secure rope to pulley.
____	____	14. Install spring assembly.
____	____	15. Secure pulley to blower housing.
____	____	16. Secure starter housing.
____	____	17. Wind pulley counterclockwise until spring is tight.
____	____	18. Align pulley and blower housing.
____	____	19. Double-check proper rope size.
____	____	20. Singe end of rope with flame.
____	____	21. Insert rope into T-handle.
____	____	22. Insert rope into rope eyelet.
____	____	23. Release spring tension.
____	____	24. Install blower housing on engine.
____	____	25. Reconnect spark plug.
____	____	26. Start engine several times to check performance.
____	____	27. Clean work area.

Student's Signature _____ Instructor's Signature _____ Date _____

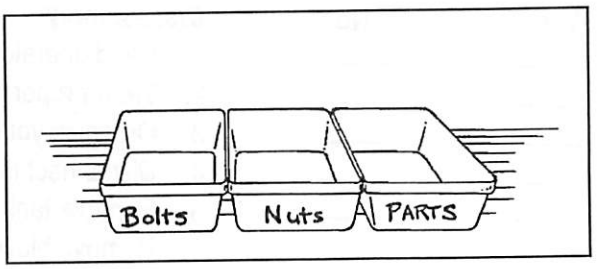


D. Servicing Vertical Pull Starter

1. Read operator's manual and Briggs & Stratton Service and Repair Instruction.

2. Wear proper clothing and safety equipment.

⚠ ***CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.***



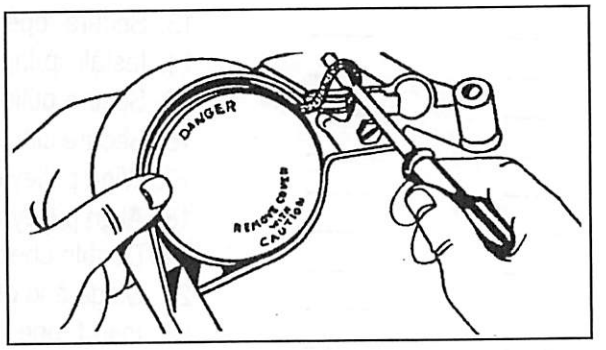
3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Disconnect the spark plug wire and place in the safety notch on the engine.

5. Remove starter from engine.

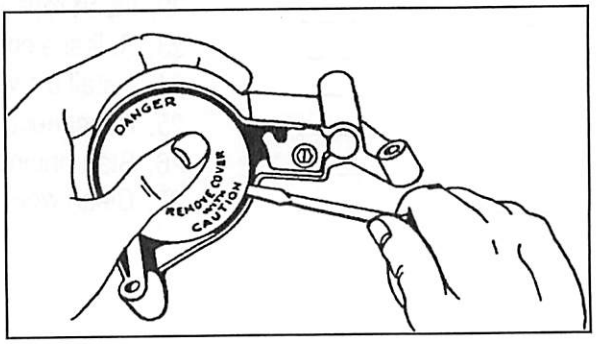
Disassembly

6. Remove tension from rope. Use a screwdriver to lift the rope up 10 to 12 inches. Wind the rope and pulley 2 or 3 turns COUNTERCLOCKWISE to release spring tension.



⚠ ***CAUTION: Do not pull rope with pulley cover removed, unless the spring is released.***

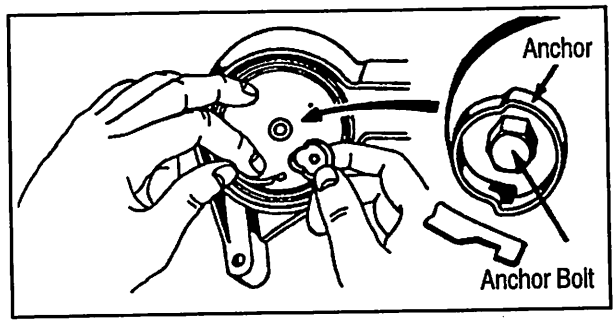
7. Remove cover with a screwdriver.



⚠ ***CAUTION: Read warning on cover and wear safety glasses.***

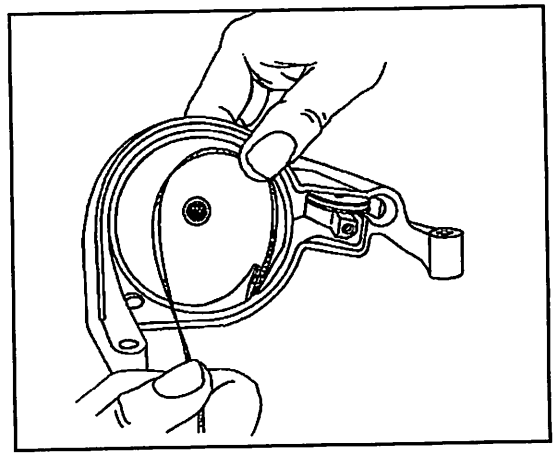
Illustrations courtesy of Briggs & Stratton Corporation

8. Remove anchor bolt and spring anchor to loosen pulley assembly from housing.

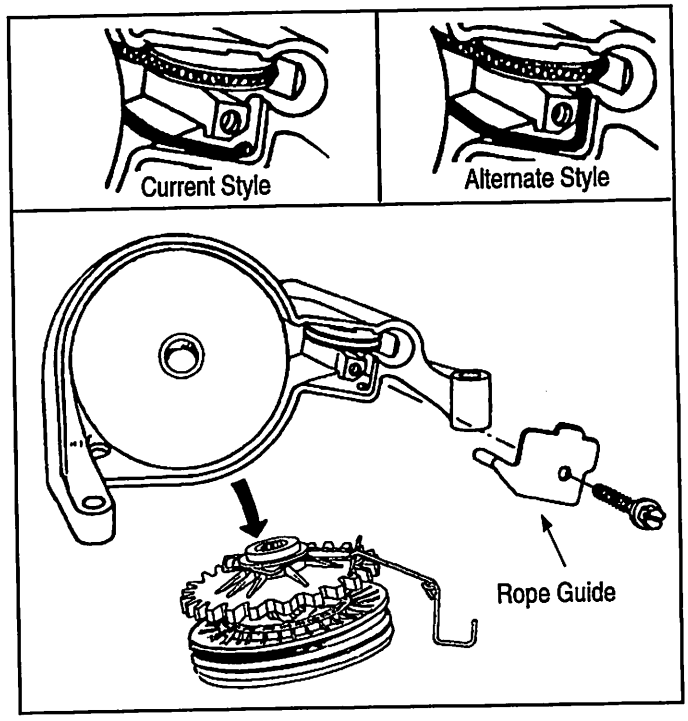


9. Carefully unwind spring, remove and inspect for breakage. (If spring is not being removed, always replace pulley cover after removing the anchor bolt and spring anchor.)

CAUTION: Wear safety glasses.

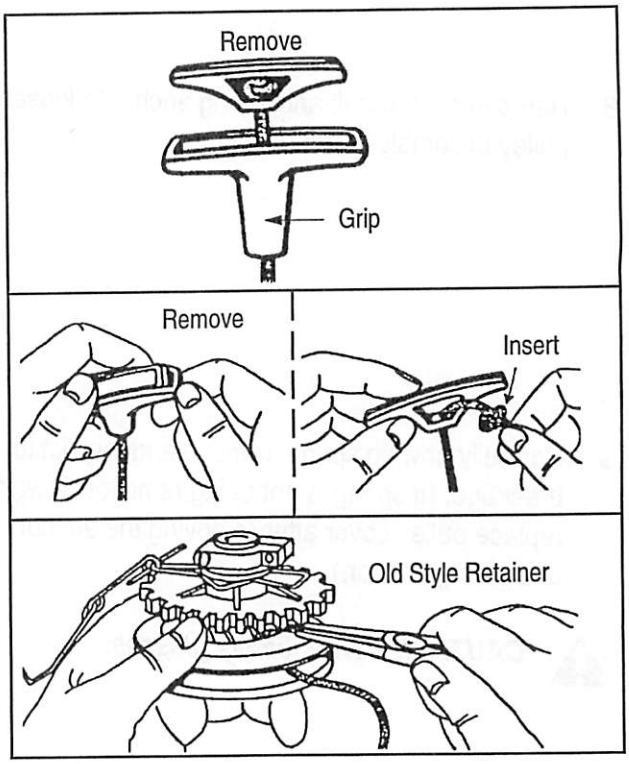


10. Remove rope guide. (Before removing pulley from housing, note position of the link for reassembly.) Slowly remove pulley assembly from housing.



11. Remove insert from handle and untie knot. Unwind rope from pulley. Grasp knotted end with needle nose pliers and remove rope.

12. Clean all dirty or oily parts in solvent.

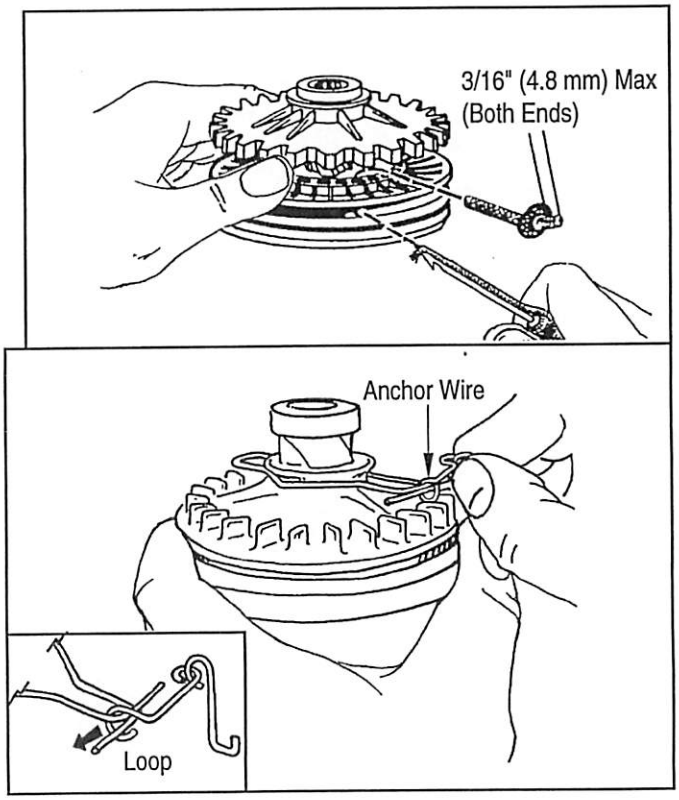


Reassembly

13. Insert new rope into the pulley, using the rope inserter tool. Tie small knot, heat seal knot and pull back into pulley. Make sure rope does not interfere with gear assembly.

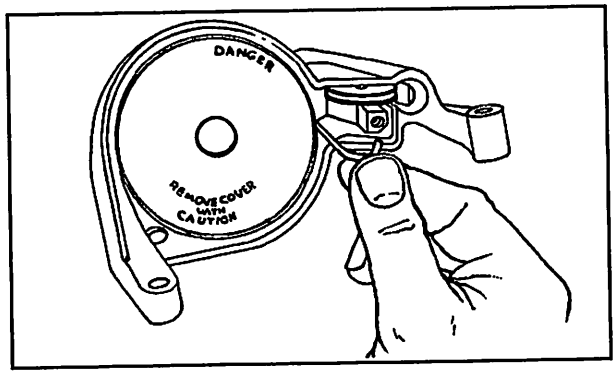
Note: Forty-eight inches of Number 4 rope will be needed.

14. When installing the break spring, note the position of the loop on the anchor wire. The rounded portion should point toward the teeth of the gear.



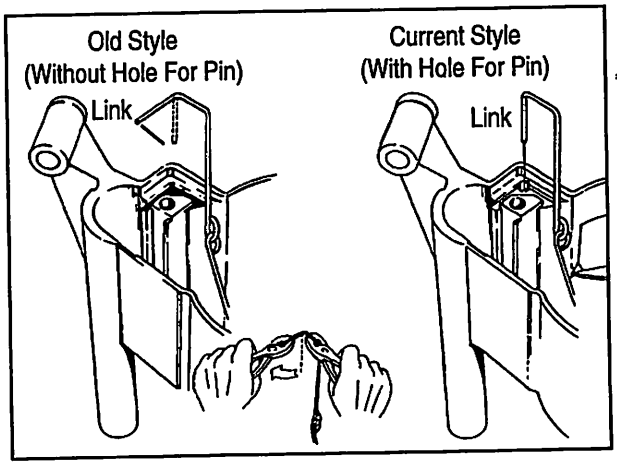
Illustrations courtesy of Briggs & Stratton Corporation

15. Holding the link, install pulley assembly into housing.

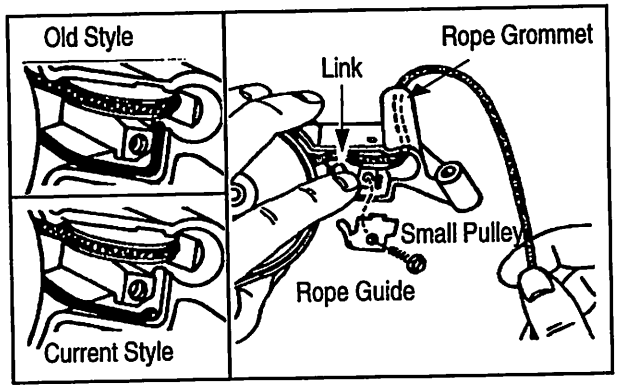


16. Using appropriate illustration, install link into housing. (Older link styles may be modified as illustrated.)

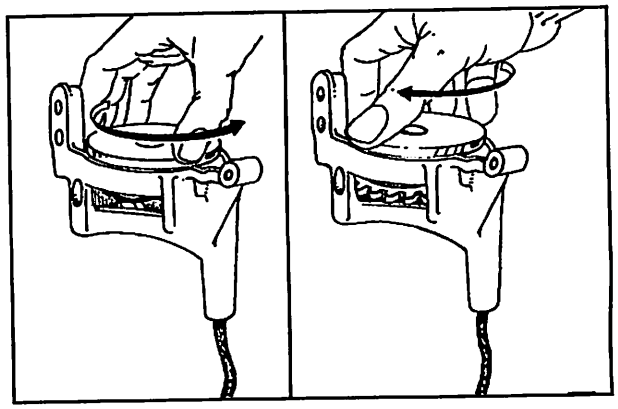
Note: With plier or vice bend link pin 90 to Horizontal Position so it will lie flat on shaded surface, if required.



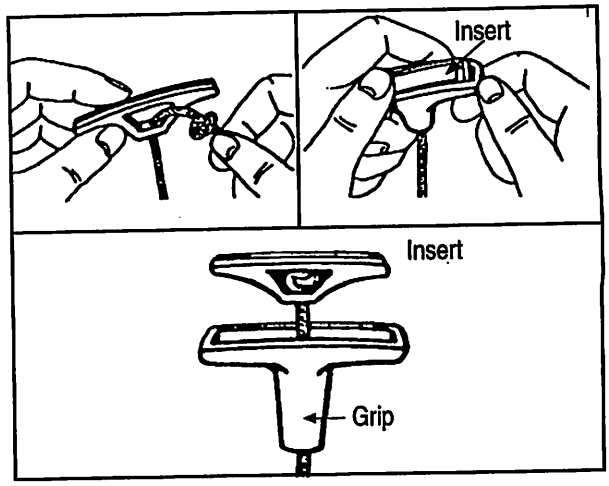
17. Lead rope over small pulley and through rope grommet. Install rope guide.



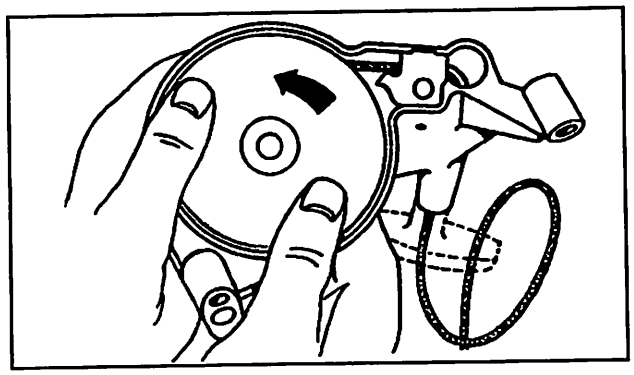
18. Check the link for proper friction by manually rotating pulley assembly. The gear should move to both extremes of its travel; if not, replace the link assembly.



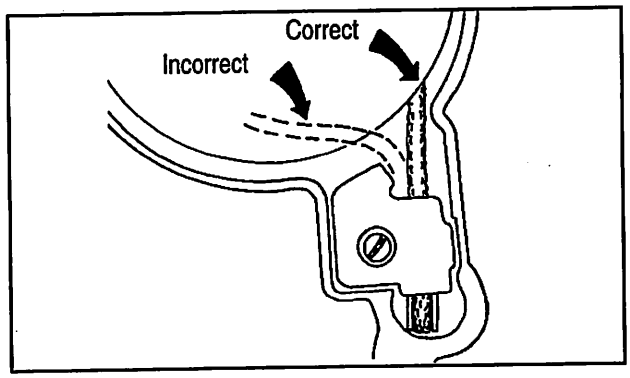
19. Thread rope through grip and into insert. Tie a small tight knot and heat seal to prevent loosening. Pull knot into pocket and snap insert into grip.



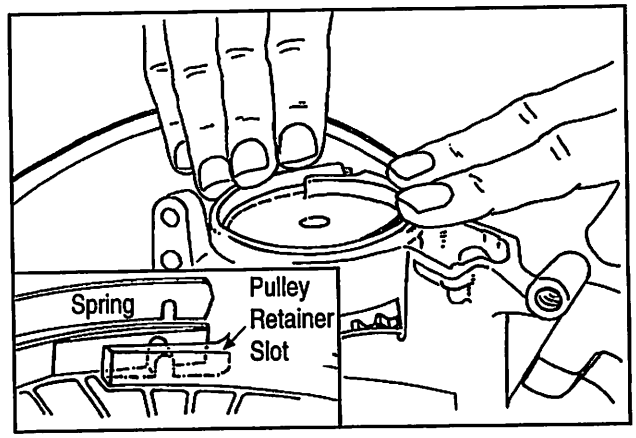
20. Wind pulley in a COUNTERCLOCKWISE direction until rope is fully retrieved.



21. Check position of rope. It should not be touching the rope guide.

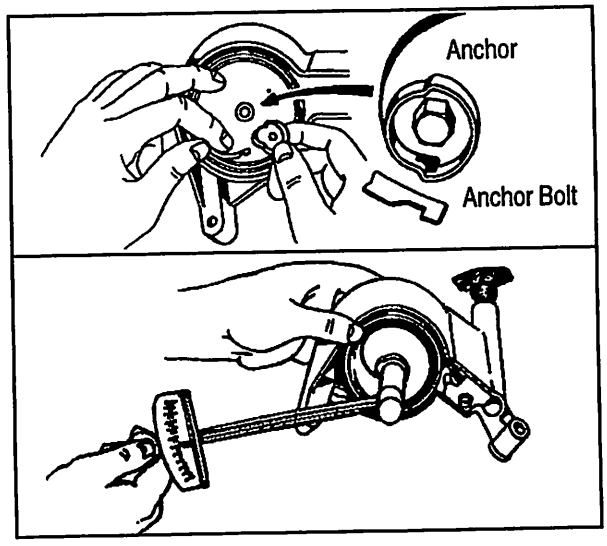


22. Secure starter in vice. Oil the spring lightly. Install spring by hooking end in pulley retainer slot and wind spring into housing.

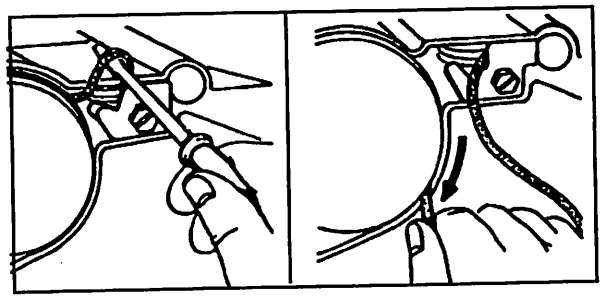


Illustrations courtesy of Briggs & Stratton Corporation

23. Hook end of spring to anchor and install bolt. Torque to 75-90 inch-pounds and replace cover.



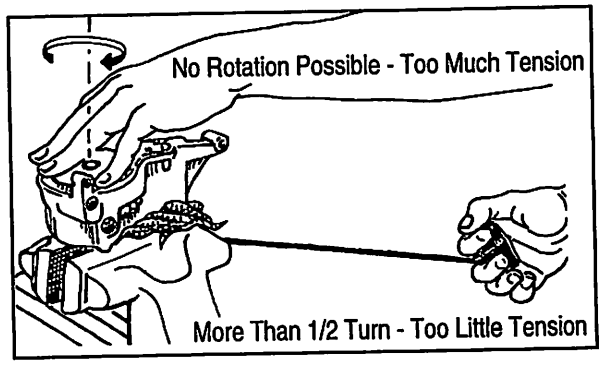
24. To wind starter spring, pull approximately one foot of rope out of pulley. Wind rope in a CLOCKWISE direction two to three turns around pulley to secure proper spring tension.



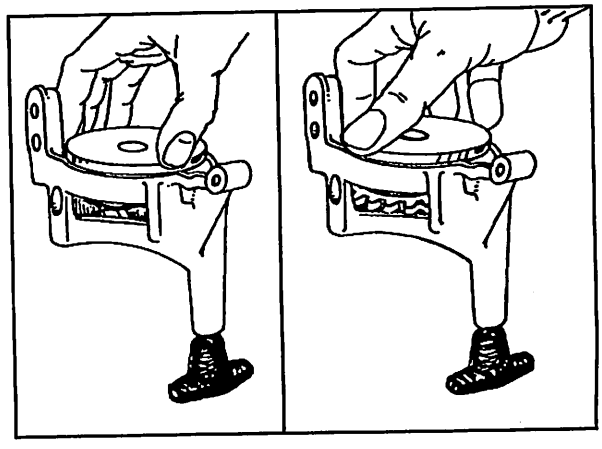
25. Check spring tension.

    a. *Too little spring tension.* When rope will not fully retract, wrap rope around pulley one more turn in a CLOCKWISE direction.

    b. *Too much spring tension.* Pull the rope out so that it is fully extended and hold lightly. Rotate the pulley clockwise. The pulley should rotate no more than 1/2 turn. If pulley cannot be rotated, the spring is wound too tight. Unwind the rope one turn at a time until proper spring tension is obtained.



26. Before installing the starter assembly on engine, check for proper operation. Hold starter assembly, pull rope and observe movement of the gear. The gear should move in and out.



Illustrations courtesy of Briggs & Stratton Corporation

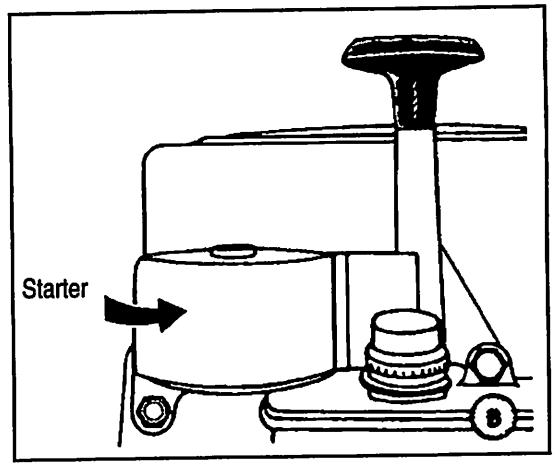
27. Install starter assembly on engine. Check operation by pulling starter rope. Pulley gear should engage the flywheel.

28. Reconnect the spark plug wire.

29. Start engine several times to be sure starter is operating correctly.

30. Clean your work area and return tools to their proper places.

31. See your instructor.



Illustrations courtesy of Briggs & Stratton Corporation

Rewind Starters Service And Repair Competency Profile

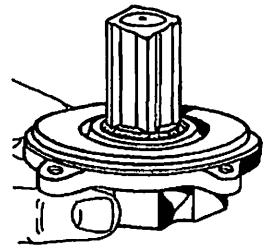
Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate "yes/no" rating.

Note: ***Profile can be used as repair procedure for servicing and repairing starters.***

Yes	No	Vertical Pull Starters
		Disassembly
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize work station.
____	____	4. Disconnect spark plug wire.
____	____	5. Remove starter from engine.
____	____	6. Remove tension from rope and spring.
____	____	7. Remove cover.
____	____	8. Remove anchor bolt and spring anchor.
____	____	9. Remove and inspect spring.
____	____	10. Remove rope guide.
____	____	11. Remove rope from handle and pulley.
____	____	12. Clean dirty parts.
		Reassembly
____	____	13. Install new rope.
____	____	14. Install starter spring.
____	____	15. Install pulley.
____	____	16. Install link into housing.
____	____	17. Install rope and rope guide.
____	____	18. Check link for proper friction.
____	____	19. Install rope.
____	____	20. Wind pulley in counterclockwise direction until rope is retrieved.
____	____	21. Check position of rope.
____	____	22. Install spring.
____	____	23. Attach spring to anchor and install bolt.
____	____	24. Wind starter spring.
____	____	25. Check spring tension.
____	____	26. Check for proper operation.
____	____	27. Install starter assembly.
____	____	28. Reconnect spark plug.
____	____	29. Start engine to determine proper operation.
____	____	30. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

E. Servicing the Starter Clutch



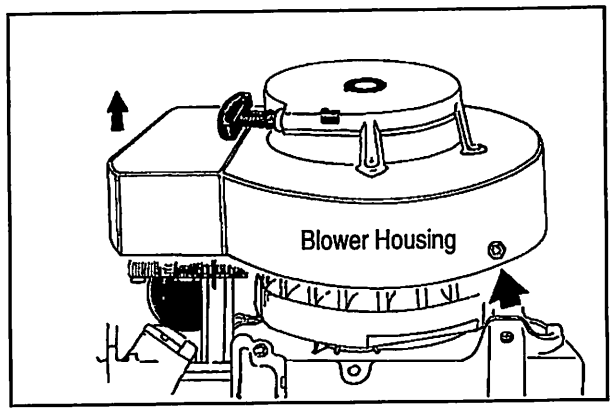
1. Read operator's manual and *Briggs & Stratton Service and Repair Instruction.*

2. Wear proper clothing and safety equipment.

CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

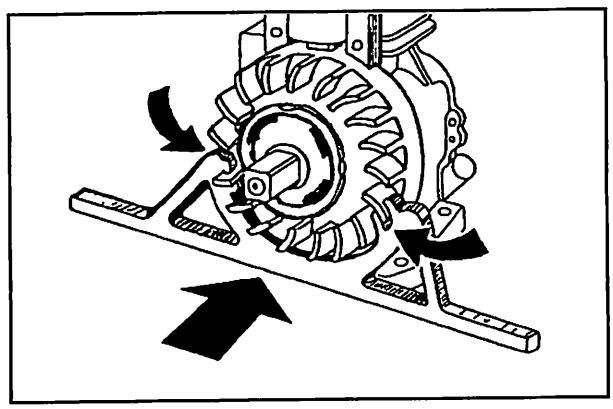
3. Organize your work station. When disassembling the starter, place bolts, nuts and parts in containers for safekeeping.

4. Using 7/16" socket remove Blower Housing and screen.

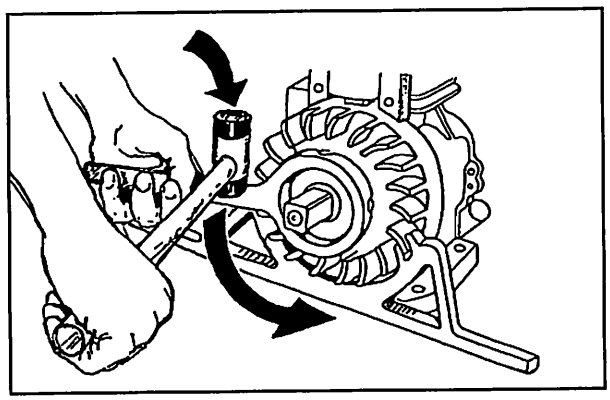


5. Place flywheel holder securely on flywheel.

Note: Always push flywheel holder all the way back so you won't break the flywheel fins.

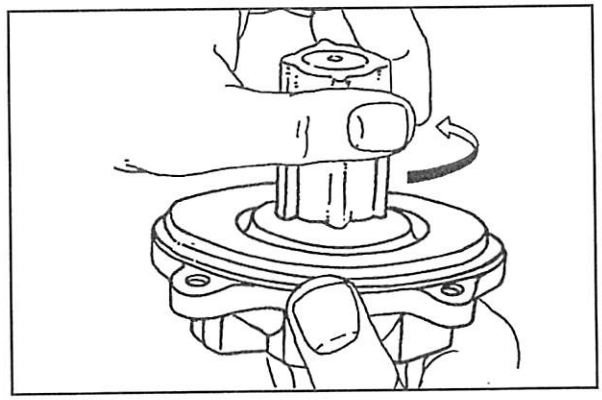


6. Place starter clutch wrench securely on starter clutch. Tap wrench handle with mallet to loosen and remove starter clutch.

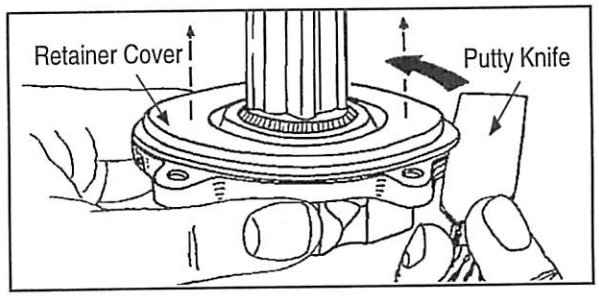


Illustrations courtesy of Briggs & Stratton Corporation

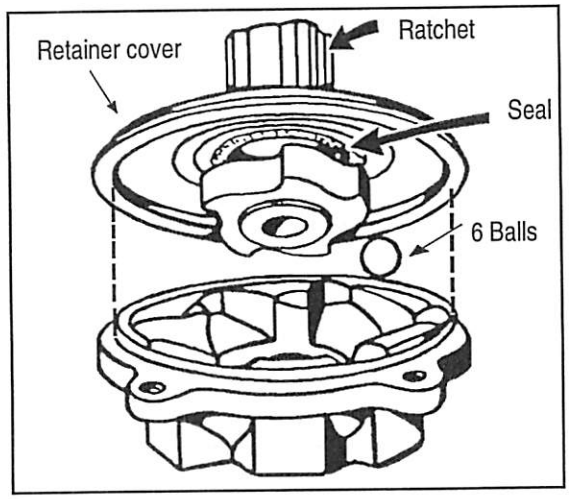
7. Rotate starter clutch assembly. The clutch should ratchet and the ball bearings should rattle in housing.



8. Insert a thin-bladed putty knife under the edge of the retainer cover as illustrated. Loosen evenly by prying up all the way around the cover.

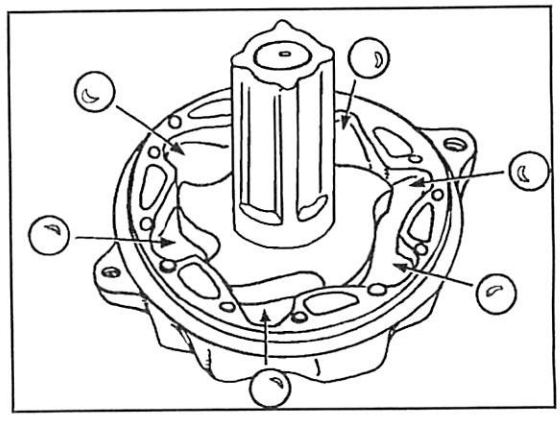


9. Remove retainer cover, ratchet and six ball bearings. Clean in solvent. Check condition of seal and replace, if necessary.



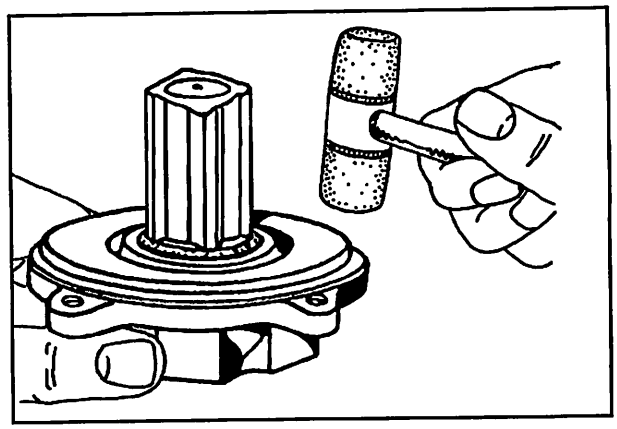
Reassembly

10. Place ratchet in clutch housing and drop in the six ball bearings, as illustrated.



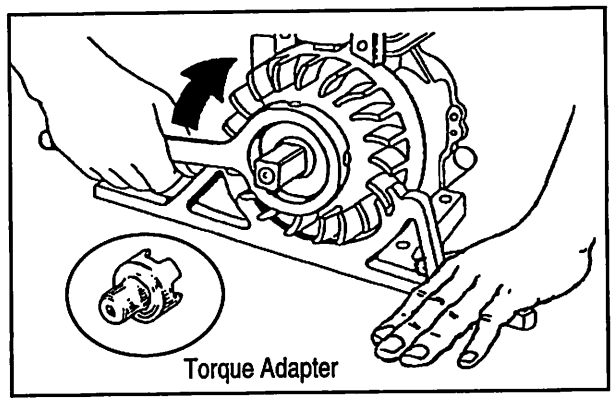
Illustrations courtesy of Briggs & Stratton Corporation

11. Replace retainer cover and use plastic face hammer to attach cover to clutch housing.



12. When installing the starter clutch, place one drop of engine oil on the crankshaft. Use torque adapter and tighten clutch to 55 foot-pounds. Replace flywheel screen and shroud (blower housing).

Note: DO NOT run engine without screen screws assembled to clutch.



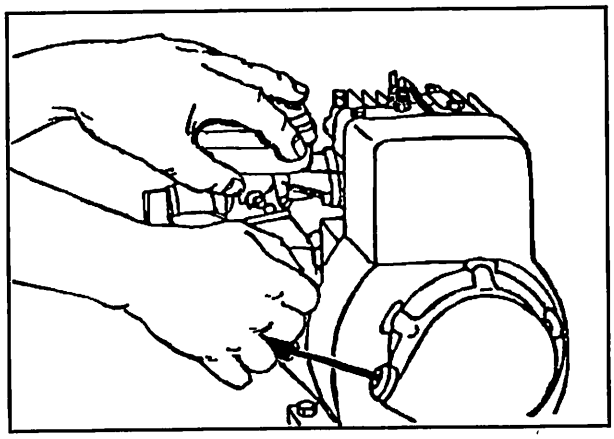
13. To check operation of clutch, pull on starter rope. Clutch should engage the starter and rope should retract fully.

14. Reconnect the spark plug wire.

15. Start engine several times to be sure starter and clutch are operating correctly.

16. Clean your work area and return tools to their proper places.

17. See your instructor.



Illustrations courtesy of Briggs & Stratton Corporation

Rewind Starters Service And Repair Competency Profile

Directions: The profile provides a record for student, instructor, and/or industry representative. Competencies listed represent tasks to be performed when servicing and repairing rewind starters. Compile your evaluation by checking the appropriate "yes/no" rating.

Note: ***Profile can be used as repair procedure for servicing and repairing starters.***

Yes	No	Starter Clutch
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Remove flywheel shroud and screen.
____	____	5. Place flywheel shroud and screen.
____	____	6. Remove starter clutch.
____	____	7. Inspect starter clutch for proper operation.
____	____	8. Remove retainer cover, ratchet, and ball bearings.
____	____	9. Clean and check condition of starter clutch parts.
____	____	10. Reassemble starter clutch.
____	____	11. Replace retainer cover.
____	____	12. Install starter clutch and torque to 55 foot-pounds.
____	____	13. Check clutch operation.
____	____	14. Reconnect the spark plug wire.
____	____	15. Start engine several times to be sure starter and clutch are operating correctly.
____	____	16. Clean your work area.

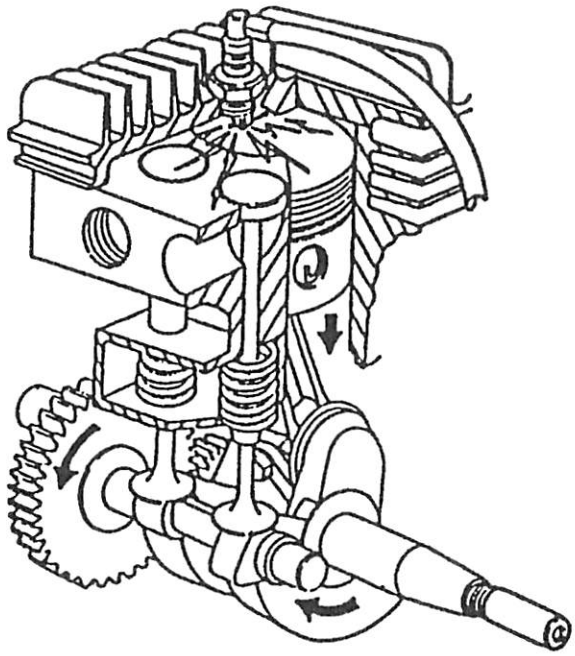
Student's Signature _____ Instructor's Signature _____ Date _____

10-7654-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Compression Valve Service and Repair

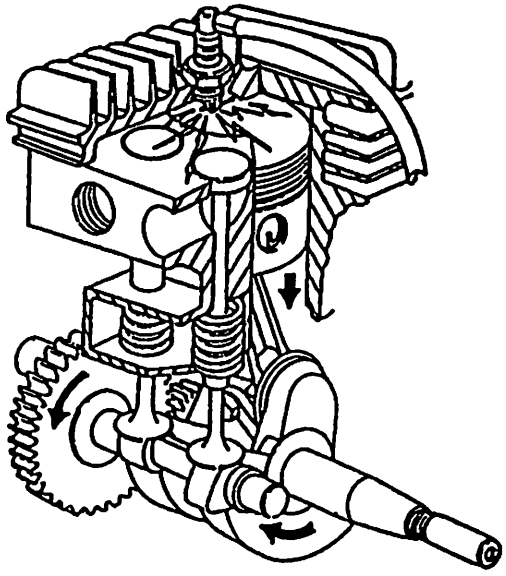


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

MODULE 4

Compression Valve Service and Repair



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

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References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Compression
Valve Service and Repair

Unit Objectives

After completion of this unit, the student should be able to inspect and service the valve train of a small engine. The student should also be able to identify valve tools and their uses. This knowledge will be evidenced through the student's ability to properly install and service valves.

Specific Objectives

After completion of this unit, the student should be able to:

1. Identify valve tools and their uses.

2. Identify parts of the valve train.

3. Demonstrate the ability to:
   a. Check compression
   b. Remove cylinder head
   c. Remove the valves
   d. Disassemble the valve train
   e. Inspect the valve assembly
   f. Replace the valve guide
   g. Reface valve seats
   h. Replace valve seats
   i. Install valves and adjust valve-tappet clearance
   j. Install the cylinder head

Compression
Valve Service and Repair

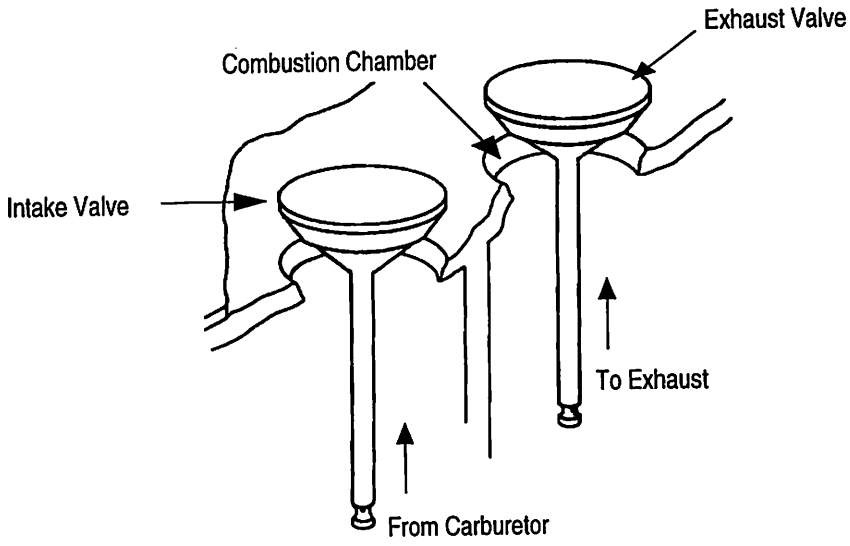
Introduction

Valves play an important role in how an engine operates. They must operate precisely, yet withstand tremendous pressures and temperatures.

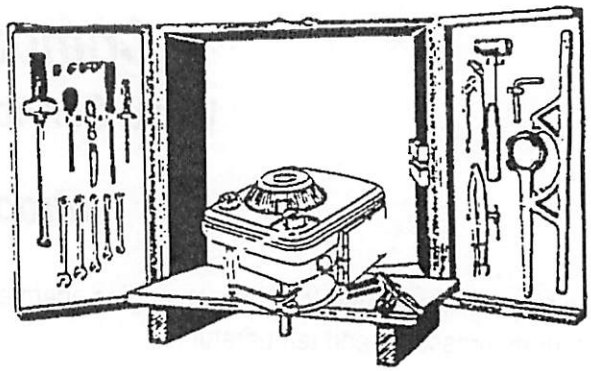
Valves typically must seal well enough to withstand pressures up to 500 pounds per square inch. The exhaust valves are exposed to such temperatures under load that they operate red-hot. High temperature exhaust gases pass over these valves increasing the temperature even more. The intake valves, often less than an inch away, are not subject to these high temperatures. Typically, these valves are cooled by the incoming fuel mixture.

Valves operate in a dirty environment. Under normal operating conditions the valves, seats, and guides must be inspected for carbon build up, wear, and damage. Carbon deposits may form on the valve or seat preventing the valve from seating properly. As a result, the valves become pitted, burned, or warped. Even a moderate amount of valve damage will result in the need for an overhaul.

There are many techniques in servicing valves in a 4-cycle engine. Typical service procedures for valve train maintenance are covered here. You may find it necessary to use only a portion, or add to, these steps.



A. Tools and Materials Needed to Service and Repair Valves



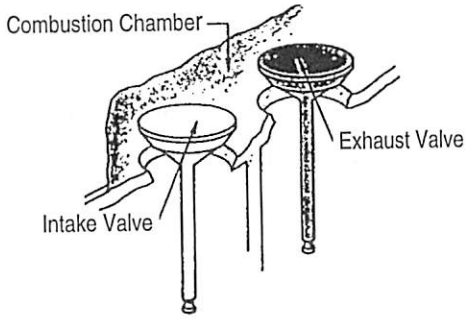
Tools

Socket wrenches (1/4" through 9/16")
Wire brush
Valve spring compressor
Valve lapping tool
Valve seat puller kit (Briggs & Stratton #19138)
Valve-seat cutter kit
Valve grinder
Feeler gauge
Torque wrench and socket set (3/8" through 9/16"-3/8" drive, and a 3/4" or 11/16" spark plug socket)
Slot-head screwdriver (6" regular)
Phillips-head screwdriver (6")
Pocket knife
Micrometer (0" to 2" and 0" to 6")
Spark plug wire gauge
Putty knife
Fine flat file
Valve guide reject gauge (Briggs and Stratton #19122)
Valve guide bushing counter bore reamer (Briggs & Stratton #19064)
Valve guide driver (Briggs & Stratton #19065)
Reamer guide bushing (Briggs & Stratton #19191)
Try square
Ballpeen hammer
Metal punch
Metal plate
Steel rule

Supplies

Prussian blue
Lapping compound
Cleaning solvent
30W oil
Led-Plate
Shop towels
Hand cleaner
Emery cloth
Small engine parts as needed
Penetrating oil

B. Step-By-Step Procedure for Servicing Valves



1. Read operator's manual and *Briggs and Stratton Service and Repair Manual.*

2. Wear proper clothing and safety equipment.

CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

Checking Compression

4. Disconnect spark plug wire.

5. Drain oil from crankcase.

6. Disconnect remote throttle control linkage.

Note: Be sure to note throttle and choke connections; sketch the linkage on paper.

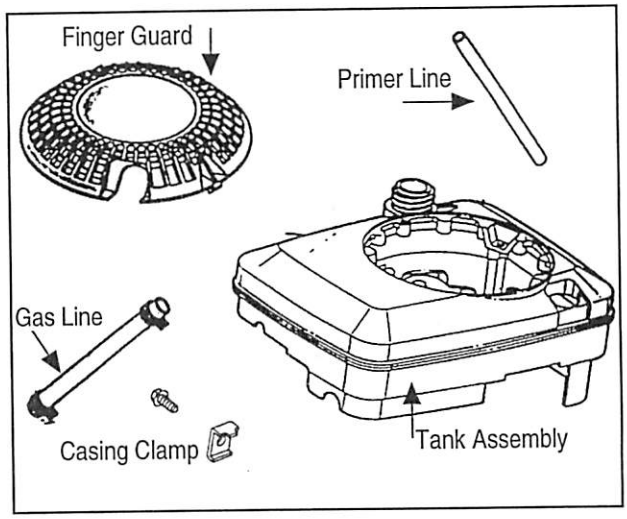
7. Remove engine from implement or vehicle.

Note: Disconnect fuel lines from engine if remote fuel tank is used.

8. Mount engine on a suitable stand.

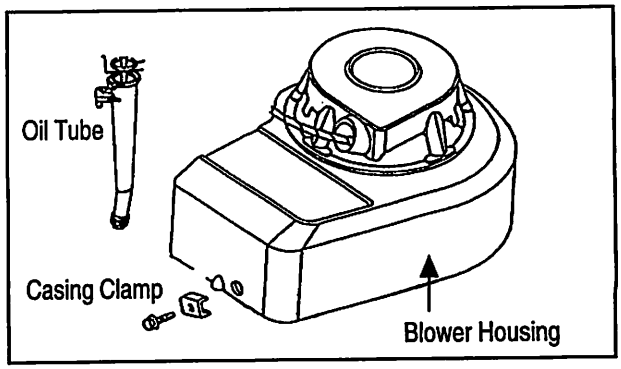
Note: Some smaller engines are easier to disassemble on a work bench.

9. Remove tank assembly.
   a. Finger guard.
   b. Gas line.
   c. Primer line (if available).
   d. Throttle control casing clamp.

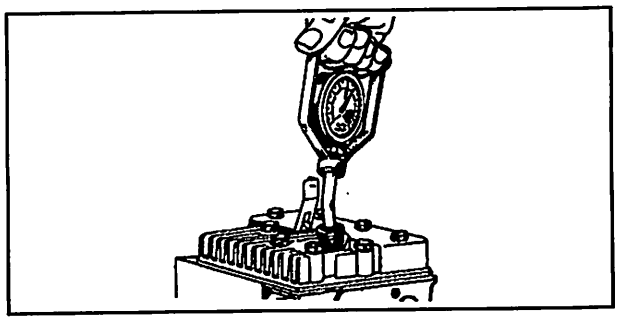


10. Remove blower housing, oil tube, and casing clamp.

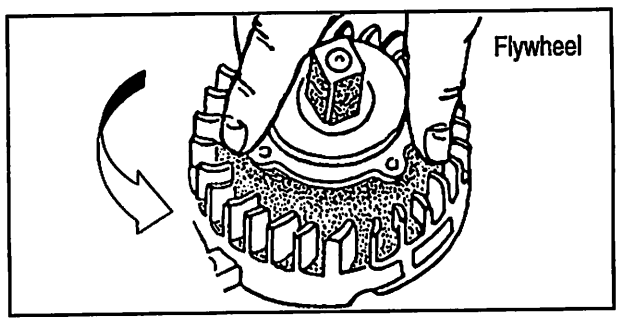
Note: On some models the casing clamp will not be attached to blower housing.



11. Test Compression.
    a. Screw the compression gauge hand-tight into the spark plug hole.
    b. Pull the engine over until the needle on the gauge stops advancing.
    c. Note the reading on the gauge. It should be a minimum of 90 PSI (pounds per square inch). This indicates upper cylinder compression is sufficient for starting the engine. Lower pressures indicate excessive wear or defect.



Note: If a compression gauge is not available, check compression by manually spinning the flywheel counterclockwise against the compression stroke. A sharp rebound indicates compression is satisfactory. Slight or no rebound indicates poor compression.



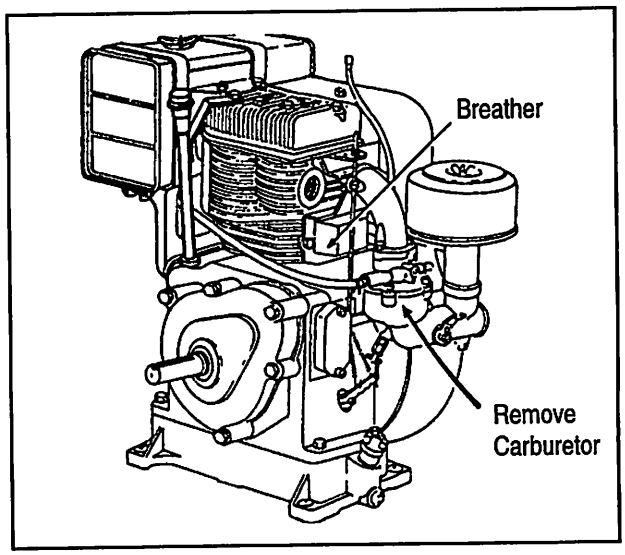
Note: Briggs & Stratton does not publish compression pressures, as it is extremely difficult to obtain accurate readings.

12. Remove exhaust pipe and muffler.

13. Remove the spark plug.

Note: Use a spark plug wrench to avoid breaking the spark plug.

14. Remove carburetor from engine. On some models the carburetor must be removed to have access to valve cover plate or breather.

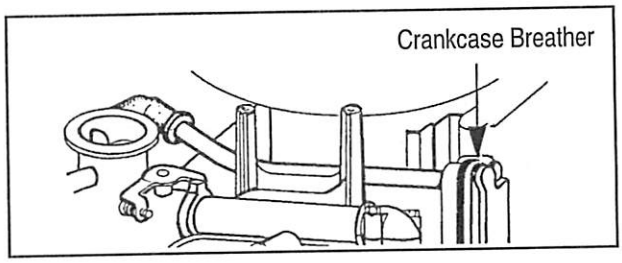


CAUTION: Before removing carburetor, note position of governor linkage for reassembly.

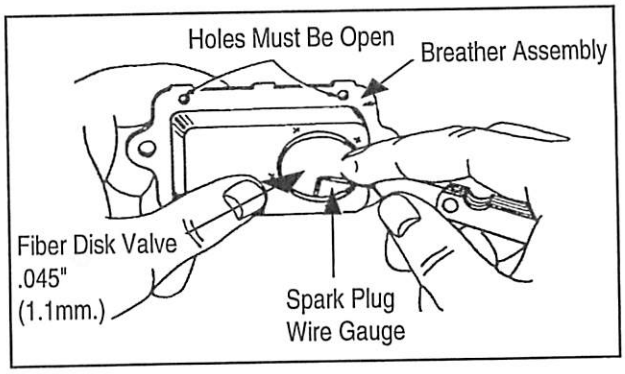
Illustrations courtesy of Briggs & Stratton Corporation

15. Remove crankcase breather or valve cover plate (usually located behind the carburetor).

CAUTION: *Handle breather with care.*

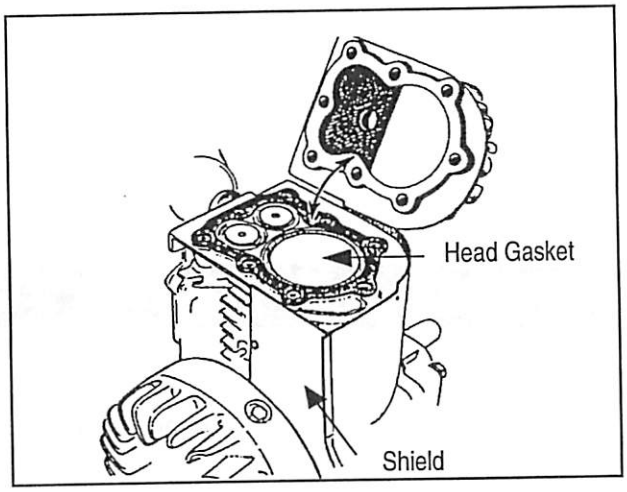


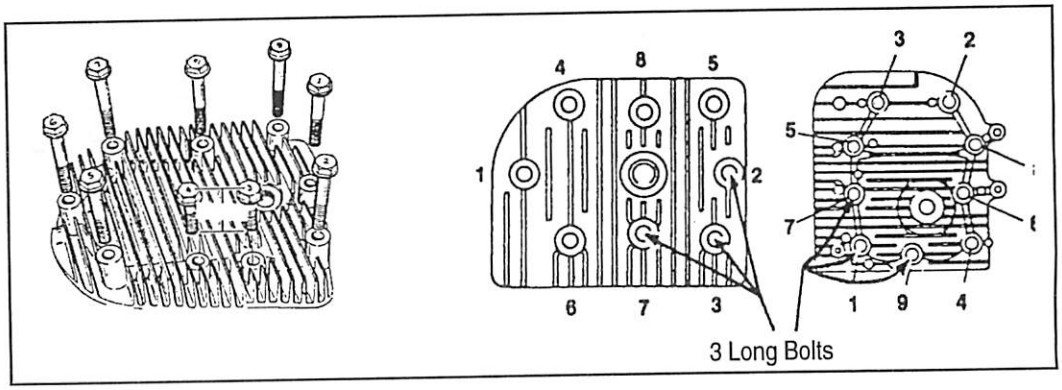
16. Check breather clearance using a .045" wire gauge. The wire gauge should not enter the space between the fiber disc valve and body. Do not apply force when checking with wire gauge.



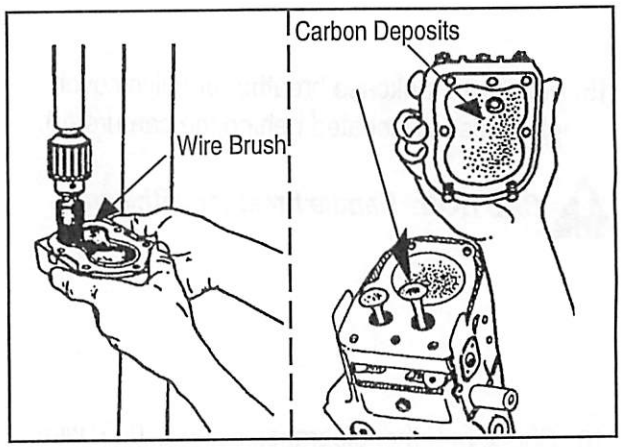
Removing the Cylinder Head

17. Remove the cylinder head bolts with a socket wrench.
    a. Note length of bolts so you can properly reassemble them in the right position.
    b. Remove cylinder head gasket and shields. See illustration.

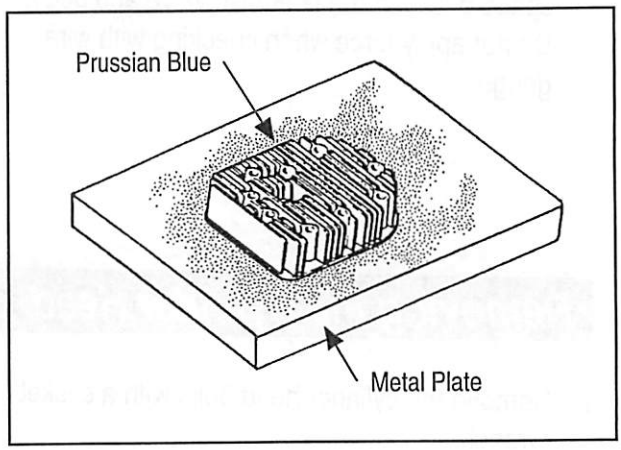




18. Clean the carbon from the cylinder head, piston, and area around valve seats using a putty knife and wire brush. Aluminum is soft—be careful to avoid scratching machined surface.



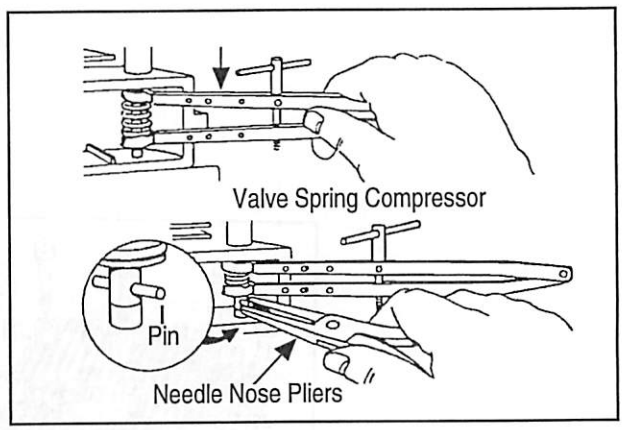
19. Check cylinder head for warpage.
    a. Use a thick metal plate that has a true surface.
    b. Apply a thin layer of Prussian blue to plate and place the head (gasket-side) down on the plate.
    c. Move the head back and forth 2 to 3 times.
    d. Remove and check to see if bluing has transferred to all contact surfaces of cylinder head.
    e. Replace cylinder head if required.



Removing the Valves

20. Remove Prussian blue from head using a clean dry cloth.

21. Clean all removed parts with solvent and store in an organized manner for reassembly.



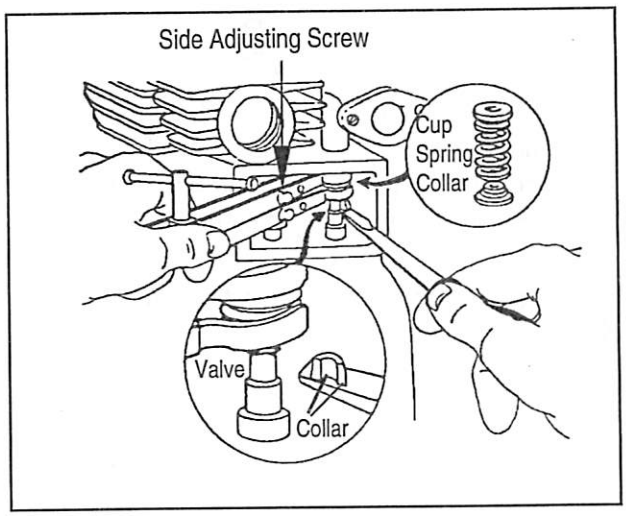
Illustrations courtesy of Briggs & Stratton Corporation

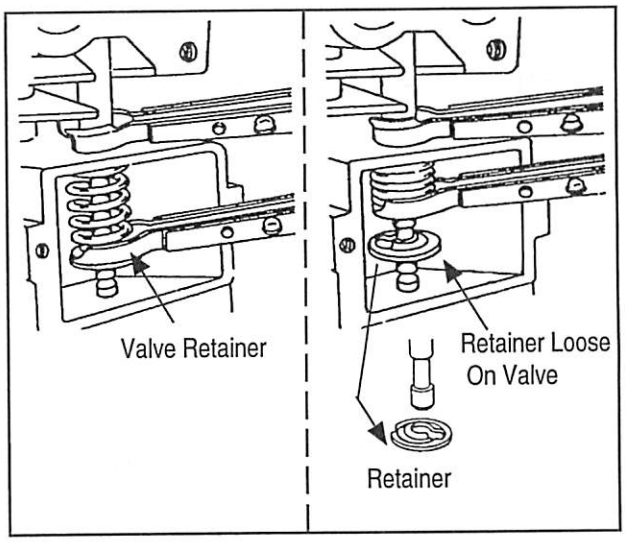
22. Remove valves.
    a. Adjust compressor jaws until they just touch the top and bottom of the valve chamber.
    b. Push the compressor in until the upper jaw slips over the upper end of the spring.
    c. Tighten the jaws to compress the spring.
    d. Remove pin or collars and lift out valve.
    e. Remove compressor and spring.

Note: If spring slips through jaws, re-insert, then tighten jaws using side adjusting screws before compressing spring

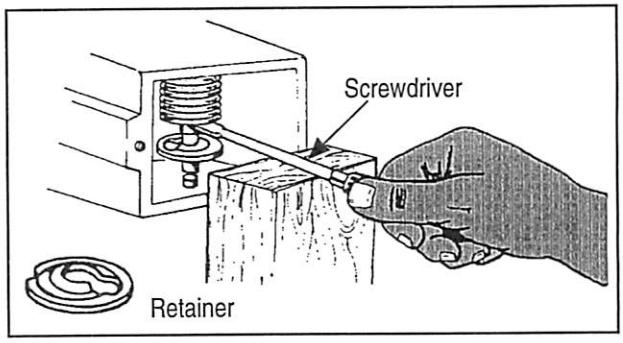
Note: Always identify the valves and springs so they may be replaced in the same position.

Note: An alternative way to remove valves using retainers. In this method, slip the upper jaw of the compressor over the top of the valve chamber and lower jaw between spring and retainer. Compress the spring and remove the retainer. Remove the valve, compressor, and spring. (See illustrations.)



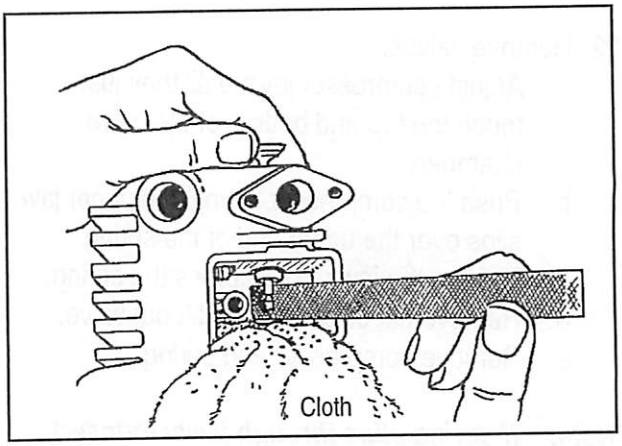


23. Another alternative way to remove valves using retainers. Compress the valve spring with a screwdriver. Rotate the notch (on retainer) 90 degrees from top center. Place screwdriver in corner of valve chamber and press up on spring to remove retainer.

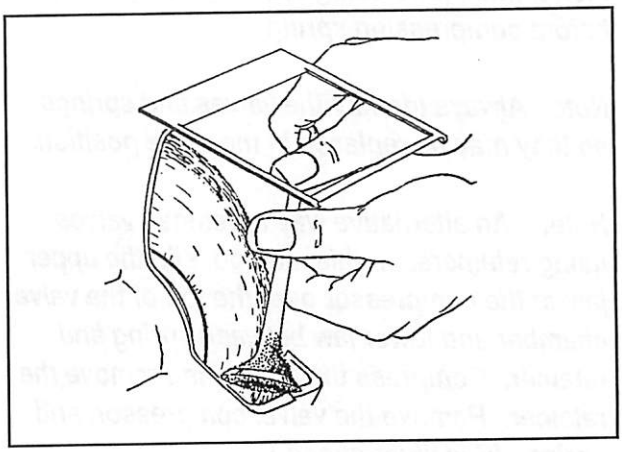


24. File away burrs on the valve-stem if valves do not remove easily. Use a fine flat file to remove burrs from valve-stem to prevent damage to valve guide. Do not over file. Place a cloth in the valve chamber to prevent metal filings from falling into crankcase.

CAUTION: Do not use force to remove valves.

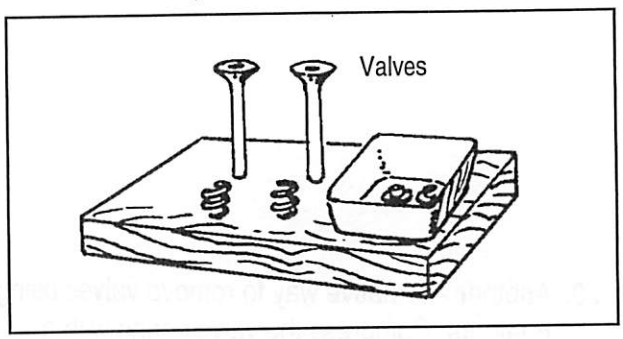


25. Remove carbon deposits from valves with a wire brush or brush wheel. Carburetor cleaner may be used to remove gum deposits from valve stems and accessories.



26. Label the valves and springs for reassembly.

Note: The exhaust spring is heavier than the intake spring in some engines.

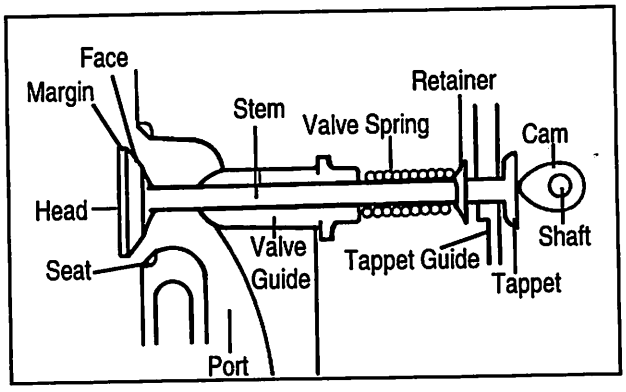


Illustrations courtesy of Briggs & Stratton Corporation

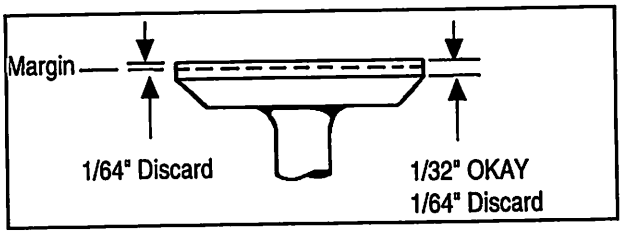
Inspecting Valves and Accessories

27. Note position of parts of the valve train on your engine.

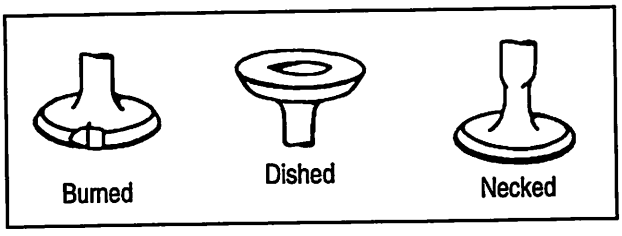
Note: Before proceeding with valve repair, check the cylinder and bearings. The engine may be too worn to repair.



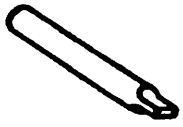
28. Inspect the valve head for proper margin. When the margin of the valve is 1/64" or less after refacing, it should be replaced.

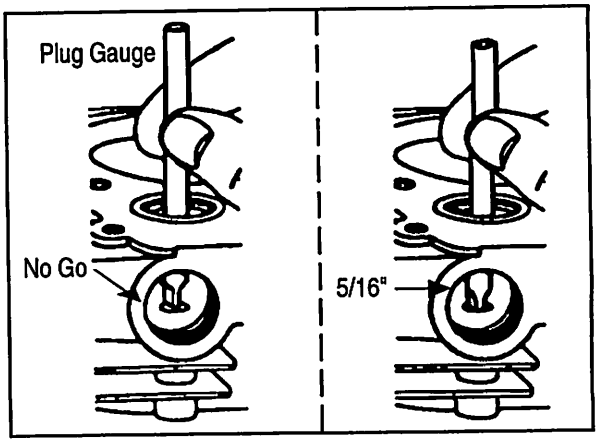


29. Examine the valves for warps, nicks, worn stems, burns, dishing, necking, or cracks.



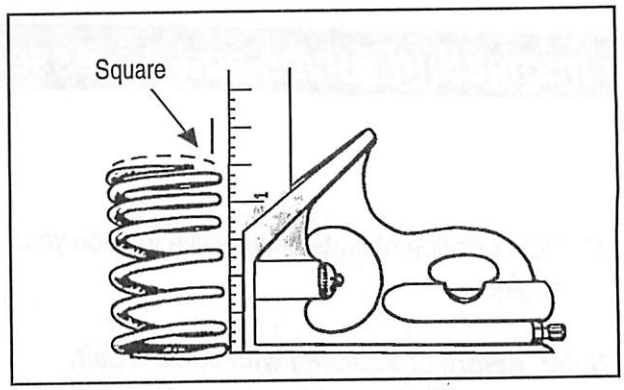
30. Clean the valve guide with a solvent and check for wear.
    a. Insert the flat end of the plug gauge in the valve guide.
    b. If the plug gauge enters the valve guide, the valve guide is worn and should be replaced.


Plug Gauge 19122



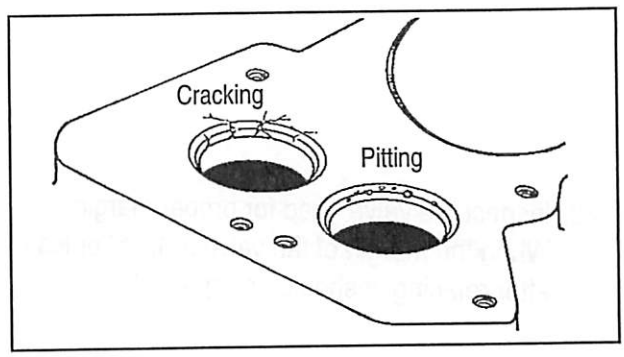
31. Inspect the valve spring.
    a. Check that valve spring is square at the top and bottom.
    b. Inspect the valve spring for distortion, pits, and cracks.

Note: Valve spring condition is determined by comparing the spring to a new one. If the old spring is weaker, it will be shorter and will usually lean to one side. Replace any worn springs.



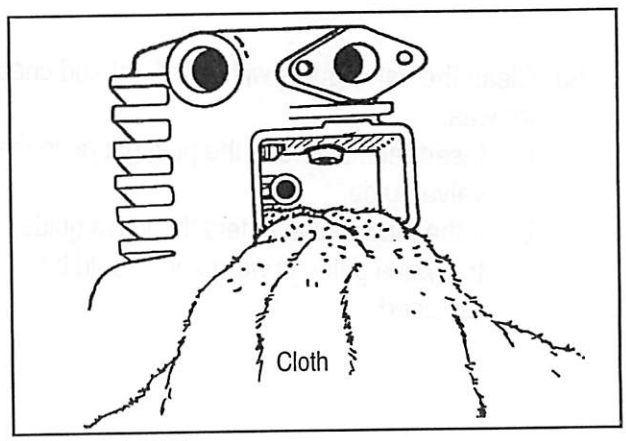
32. Inspect the valve seats for cracks and pitting.

Note: Valve seat width should be 3/64 to 1/16 inch. If the seat is wider, a narrowing cutter should be used. Always replace a valve or seat that is badly burned. Replace valve when the margin is 1/64 inch or less.



Replacing the Valve Guide

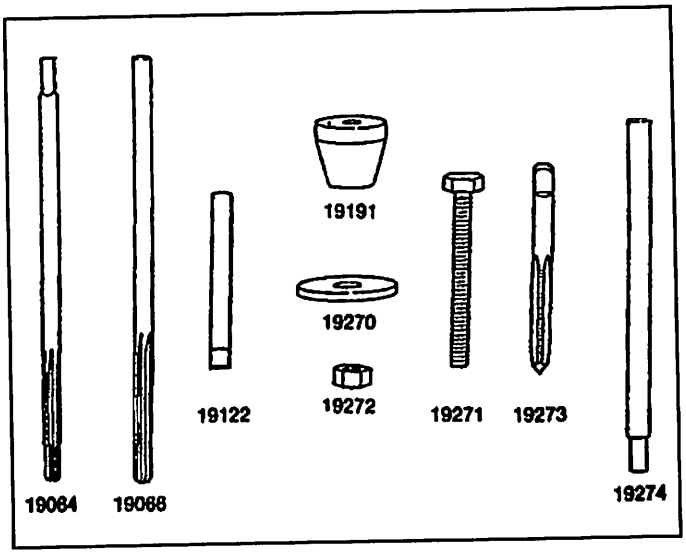
33. Protect the engine from metal cuttings by placing a clean cloth in the valve chamber.



Illustrations courtesy of Briggs & Stratton Corporation

34. Select the proper size reamer. You will need the following Briggs and Stratton tools:

#19269	Valve guide repair kit (1/4" valve guides)
#19064	Counter bore reamer
#19066	Finish reamer
#19122	Plug gauge
#19191	Reamer guide bushing
#19270	Puller washer
#19271	Puller screw
#19272	Hex nut
#19273	Tap 7 mm
#19274	Bushing driver

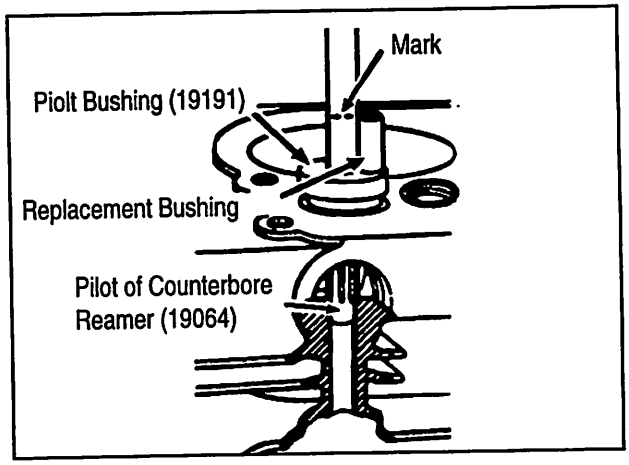


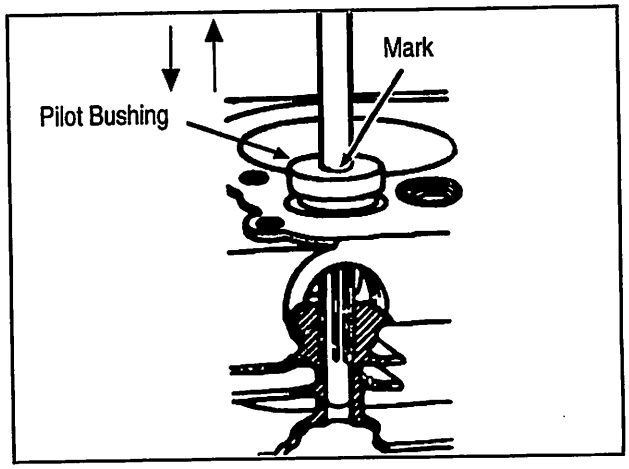
Repair valve guides - Module Series 6B, 8B, 60000, 80000, 90000, 100000, 110000, 120000, 130000.

35. Ream the cylinder block to accommodate the valve-guide bushing.
    a. Place pilot of counter bore reamer #19064 in valve guide.
    b. Install pilot bushing #19191 over counter bore reamer and lower pilot bushing to rest in valve seat.
    c. Hold replacement valve guide bushing #63709 on top of pilot bushing next to reamer.
    d. Make a mark on reamer 1/16" above top of replacement bushing.

Note: Use a "T" handle wrench for hand drilling. Drill press is not recommended unless you can be sure it is absolutely square.

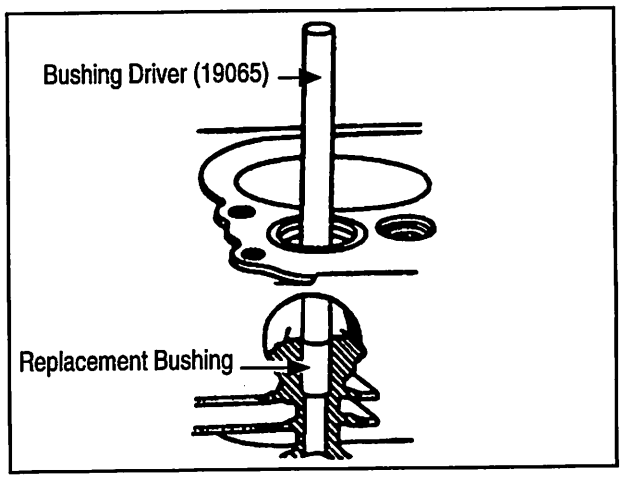
    e. Ream out valve guide until mark on counter bore reamer is level with top of pilot bushing. (See illustration.)
    f. Lubricate reamer with kerosene or equivalent lubricant.





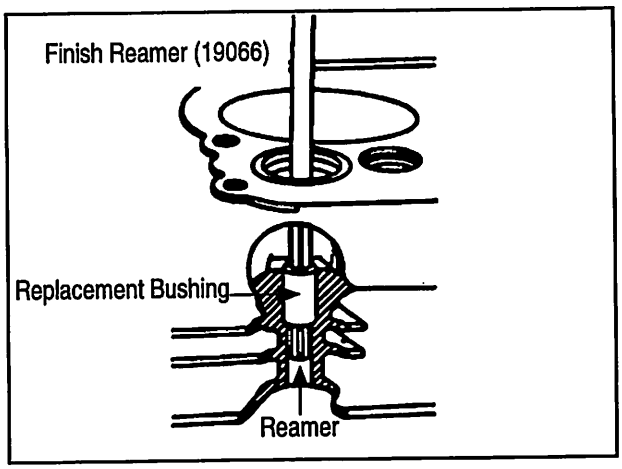
36. Place replacement bushing in reamed-out hole. Press replacement bushing down with valve guide bushing driver #19065 until it is flush with the top of the hole.

Note: For easier installation, chill bushing in freezer for an hour. The bushing will become tight when it reaches the temperature of the block.



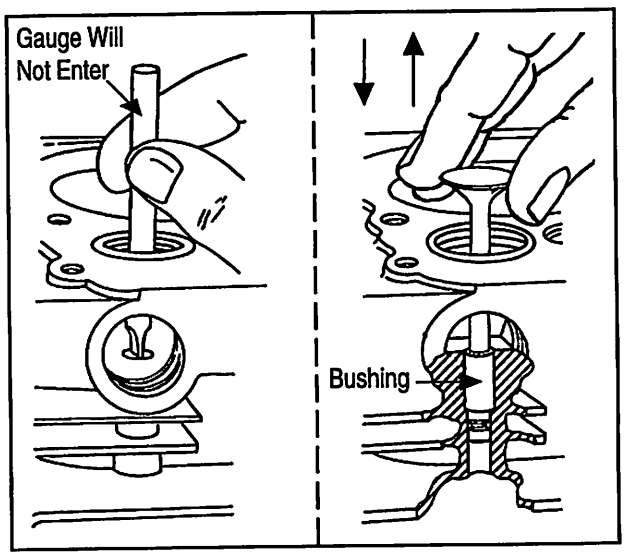
37. Finish reaming the replacement bushing with a valve guide bushing finish reamer #19066. Lubricate reamer with kerosene.

Note: Do not finish ream until bushing has warmed to same temperature as block.



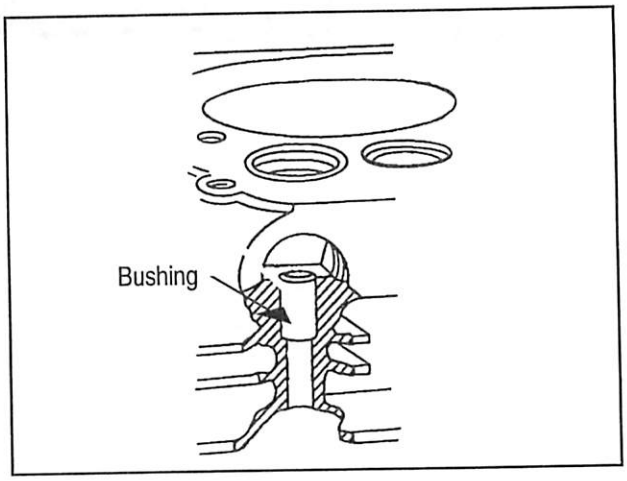
38. Use compressed air to remove metal clippings.

39. Check dimension and condition of the newly reamed guide. See that there are no burrs or pieces of metal left.



Illustrations courtesy of Briggs & Stratton Corporation

40. Lubricate the valve-guide bushing with crankcase oil.



Refacing The Valves

Note: Steps 41 through 50 are to be used when valve grinding equipment is available. Local machine shops provide valve grinding service.

41. Dress the grinding wheel when glazed or surface is irregular. Use a diamond-tipped dressing tool.

42. Adjust the valve grinder for grinding at the proper face angle.

Note: Most valves on small engines are ground at a 45-degree angle. Some engine models have a 30-degree angle. Check engine specifications before doing any machine work.

43. Place the valve in the grinder chuck and tighten securely. Make sure that it is straight and will not wobble.

44. Check for proper position of valve face so that it makes proper contact with the grinding wheel. Move the valve in and out before starting the grinder while observing its position. Set the machine so the wheel will not contact the valve stem.

45. Start grinder and make sure the cutting oil is flowing properly.

46. Move the valve face up to the wheel and start grinding lightly. Take light cuts and continue until the grinding sound is regular. Check your progress often.

47. Stop the grinder and remove the valve from the grinding wheel. Check the face width. If the margin is less than 1/64" (less than one half the thickness of a new valve margin), discard the valve.

48. Clean the valve with a petroleum solvent.

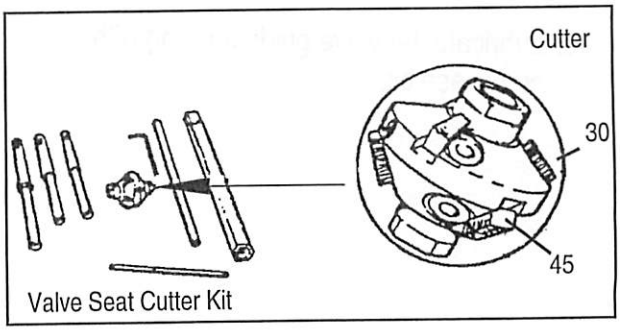
49. Place valves in a storage rack for reassembly.

50. Determine valve seat angle.
    a. Take the exhaust valve and mate the valve face against the intake valve face.
    b. If both valve stems are parallel to each other, both seats should be cut at a 45-degree angle.
    c. If both valve stems are not parallel to each other, the exhaust valve seat should be cut at a 45-degree angle, and the intake should be cut at a 30-degree angle.

Refacing the Valve Seats

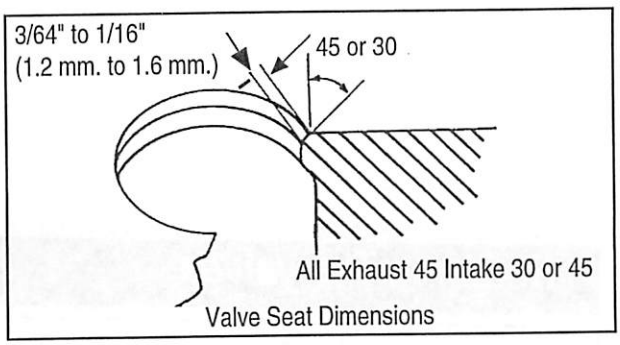
Note: All exhaust valves have a 45-degree angle.

51. Select appropriate valve seat cutter. Valve seats are cut using a Neway Valve Seat Cutter #19237. Exhaust valves are cut at a 45-degree angel and intake valves are cut at 30-degrees. Some intake seats are 45 degrees. Check engine specifications.



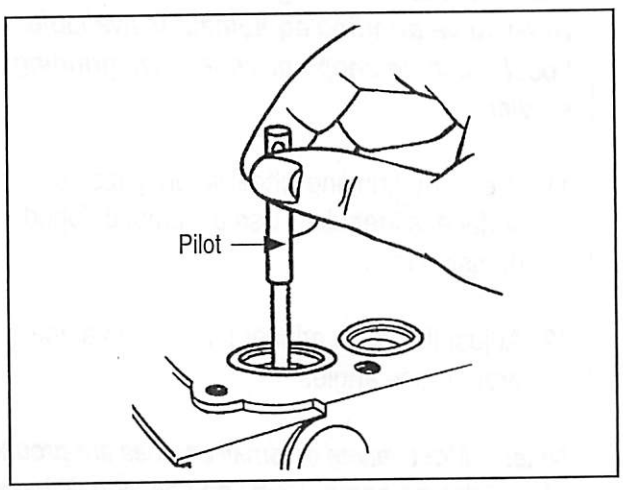
Valve Seat Cutter Kit

52. Check valve seat dimensions. Valve seat width should be 3/64 to 1/16."

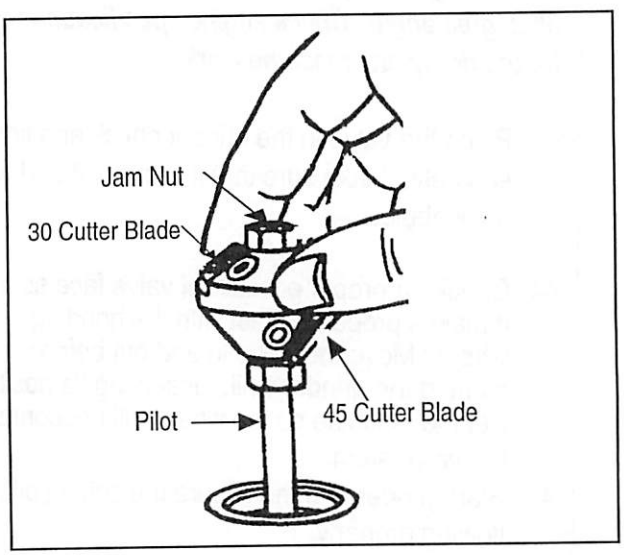


Valve Seat Dimensions

53. Install pilot in the valve guide. The pilot aligns itself with the unworn portion of the guide and will produce a near perfect alignment.



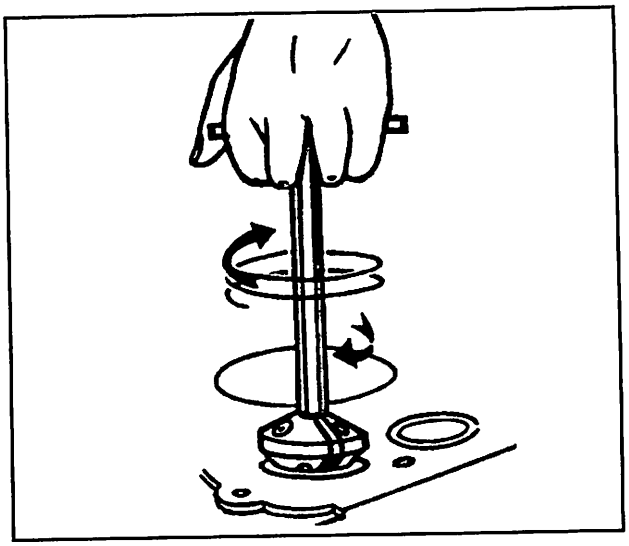
54. Place 45-degree cutting head over pilot. The cutting head is a precision tool with tungsten carbide blades. Handle with care.



Illustrations courtesy of Briggs & Stratton Corporation

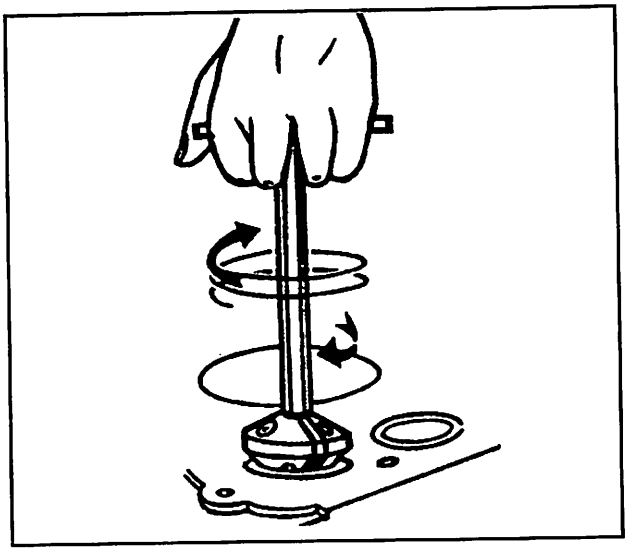
Note: Do not drop cutter head on the pilot as it will break cutters and/or nick valve seat.

55. Reface the valve seat.
    a. Place the T-handle on the cutter head.
    b. Press down slightly on the T-handle and turn one to two turns in a clockwise direction.
    c. Make a visual check of the valve seat surface.
    d. Continue one to two more turns using very light pressure.



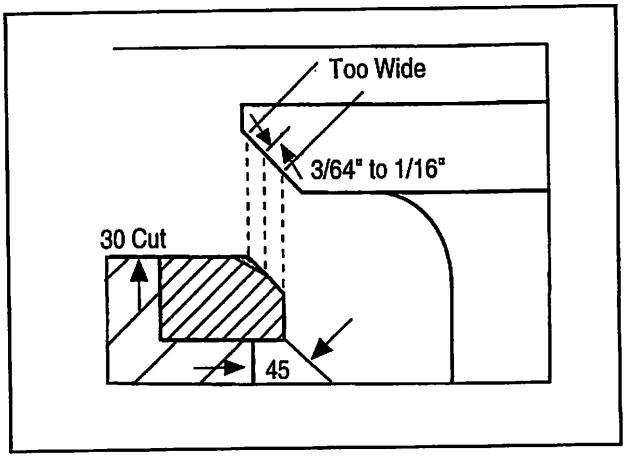
Note: Your finish cut should be a smooth satin finish.

56. Remove chatter marks. (If a large amount of material is removed from the seat or if the cutter blades are somewhat dull, chatter marks can occur on the newly-cut seat surface.)
    a. Place a piece of wax paper on paper towel between the cutting head and the valve seat.
    b. With a steady pressure on the cutting head, rotate the head 5 or 6 times. The paper will prevent the cutters from removing a large amount of material, but it will allow the tips of the cutters to shave the seat and remove the chatter marks, leaving behind a smooth seat surface.

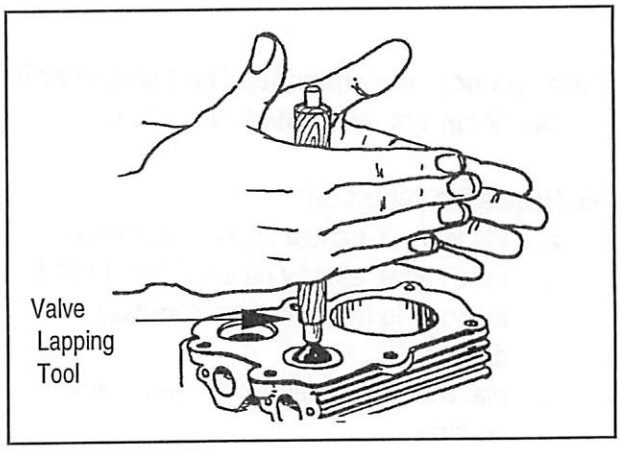


57. Check valve seat for condition and width.

Note: If the seat is too wide, turn the valve seat cutter over and trim the width with the 30-degree angle cutter. Valve seat width should be 3/64" to 1/16."



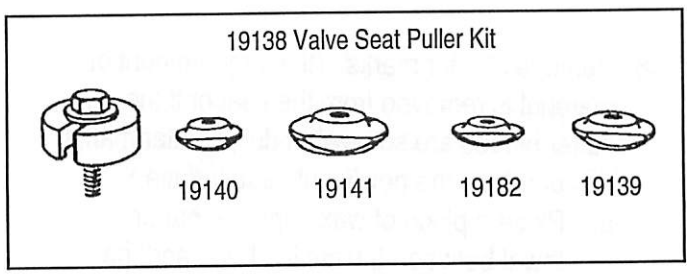
58. Lap the valve to the seat.



Replacing Valve Seats

59. Obtain Briggs and Stratton Valve Seat Puller Kit #19138.

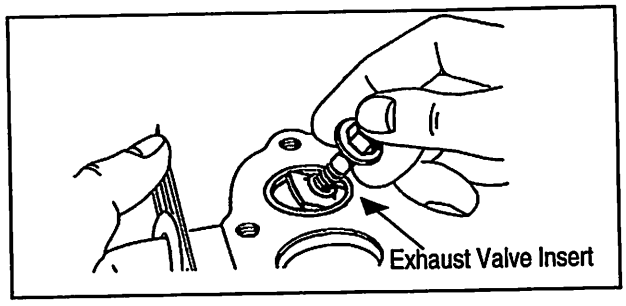
Note: Cast iron cylinder models must be counter-bored to allow installation of the intake valve seat insert.



Basic Model Series	Insert * Puller Assembly	Puller Nut
Aluminum Cylinder		
6B, 8B	19138	19140 Ex. 19182 In.
60000, 8000	19138	19140 Ex. 19182 In.
82000, 92000, 94000, 95000, 11000	19138	19140 Ex. 19182 In.
100200, 100900,130000	19138	19182 Ex. 19139 In.
120000	None	None
140000,170000,190000	19138	19141
220000, 250000, 280000	19138	19141 Ex.
Cast Iron Cylinder		
N, 5, 6	19138	19140
8	19138	19140
9	19138	19139
14, 19,190000	19138	19141
23, 200000, 230000	19138	19141
240000	19138	19141
300000, 320000	19138	19141 Ex.

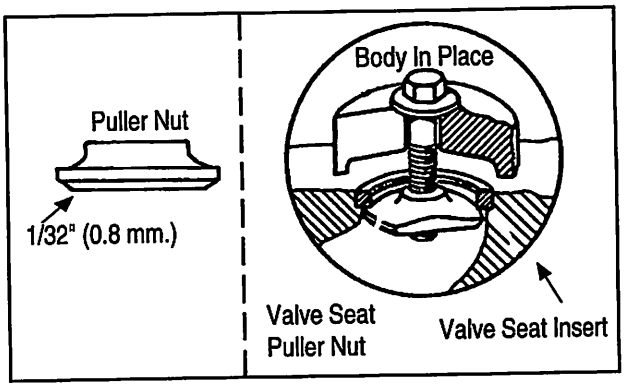
Illustrations courtesy of Briggs & Stratton Corporation

60. Select the proper size puller nut using the valve seat puller as a reference. Place the puller nut under the valve seat insert. (See illustration.)

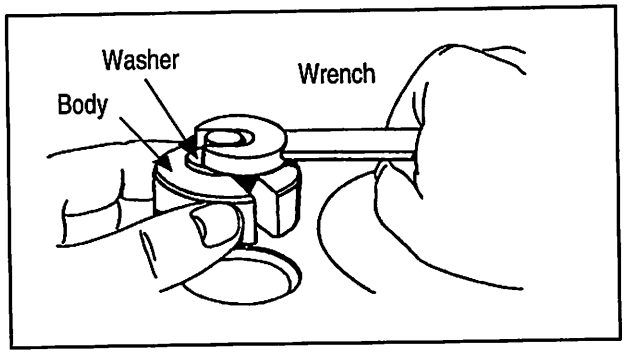


Note: On aluminum cylinder models, it may be necessary to grind the puller nut until the edge is 1/32" thick in order to get the puller nut under the valve insert. (See illustration.)

61. Place the puller body on top of the cylinder block and slide under bolt. Make sure puller body does not rest on the valve seat insert. (See illustration.)

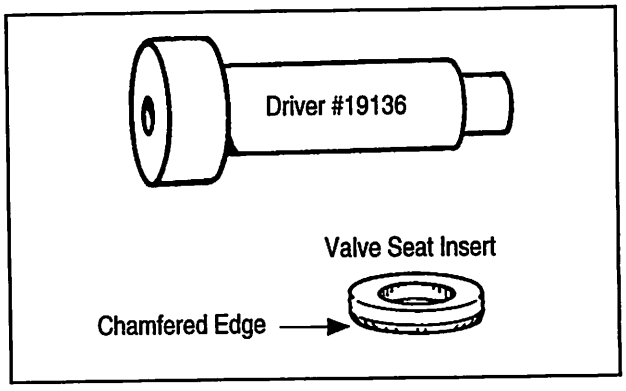


62. Turn the 5/16" bolt with a wrench until seat insert is pulled out of the block.



63. Select the correct pilot and driver for installing the valve seat.

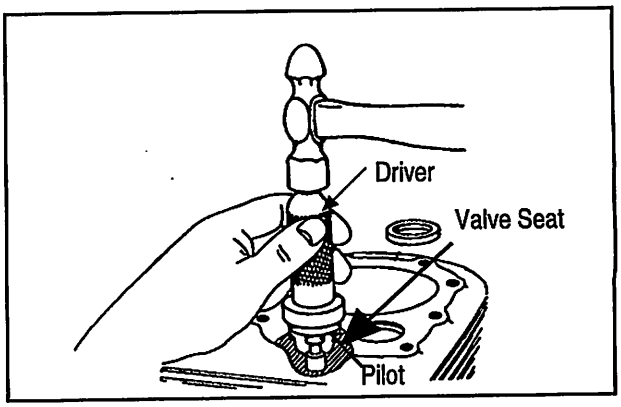
64. Select the proper valve seat insert. Note one side of the seat insert is chamfered at the outer edge. This side should be inserted into the cylinder.



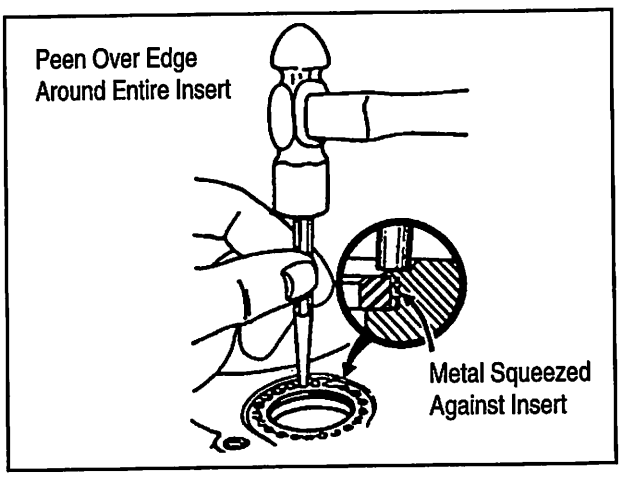
Illustrations courtesy of Briggs & Stratton Corporation

65. Insert the pilot into the valve guide.

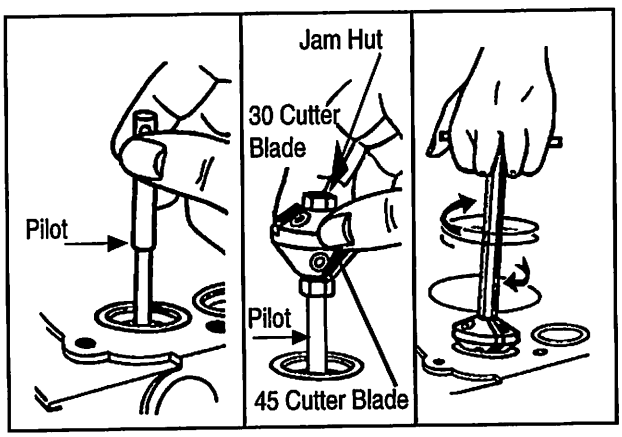
Note: On aluminum cylinders use the old insert as a spacer between the driver and the new insert. Drive the valve insert into place until it bottoms. The top of the insert will be slightly below cylinder and gasket surface.



66. Stake over the edge of cylinder block around entire insert using a metal punch. Metal should be squeezed against the insert.

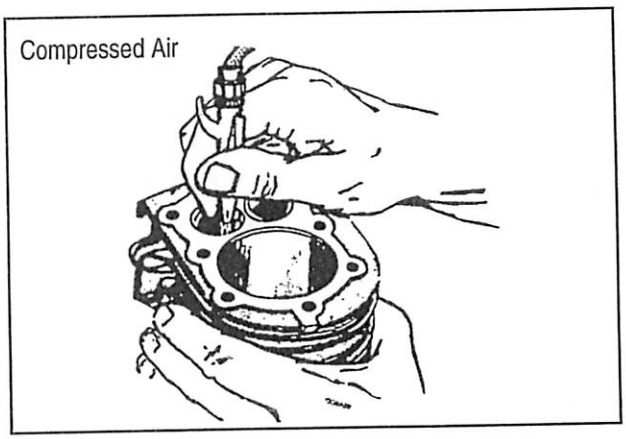


67. Prepare the valve seat.
    a. Lightly face the seats at a 45-degree angle using the valve seat cutter.
    b. Install the pilot in the valve guide.
    c. Install the cutter head on the pilot.
    d. Place the T-handle on the cutter head.
    e. Press down slightly on the T-handle and turn one to two turns in a clockwise direction.
    f. Make a visual check of the valve seat surface.
    g. Continue one to two more turns using very light pressure.
    h. Check valve seat for condition and width.



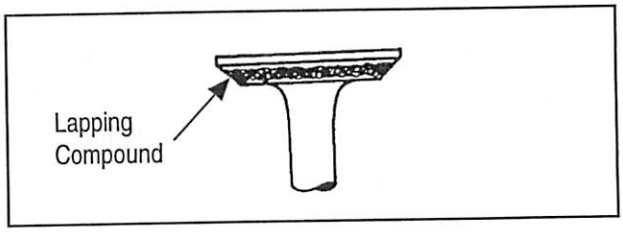
Illustrations courtesy of Briggs & Stratton Corporation

68. Thoroughly clean grinding compound from valves and seats using cleaning solvent and compressed air.



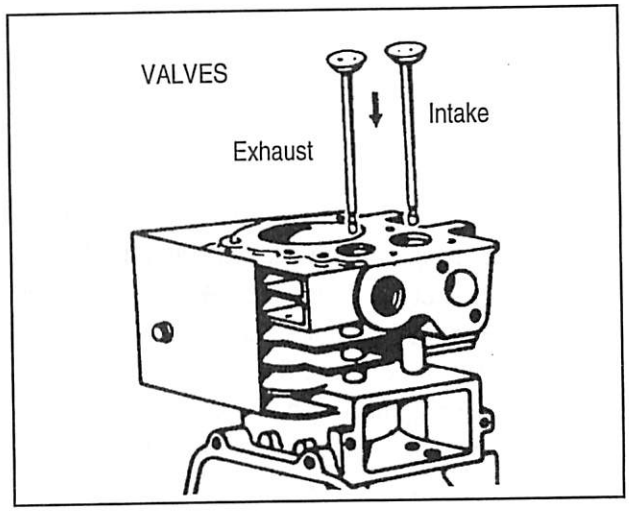
Lapping the Valves

69. Apply a thin coat of lapping compound (carborundum paste) to the valve face.



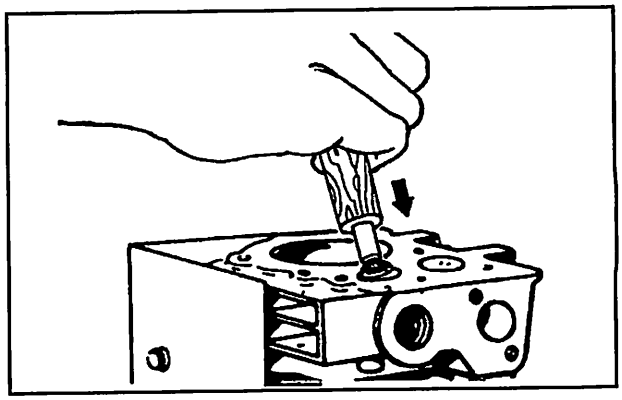
70. Insert valve into the cylinder block.

Note: Make sure to use the proper valve. The intake and exhaust valves are different sizes.



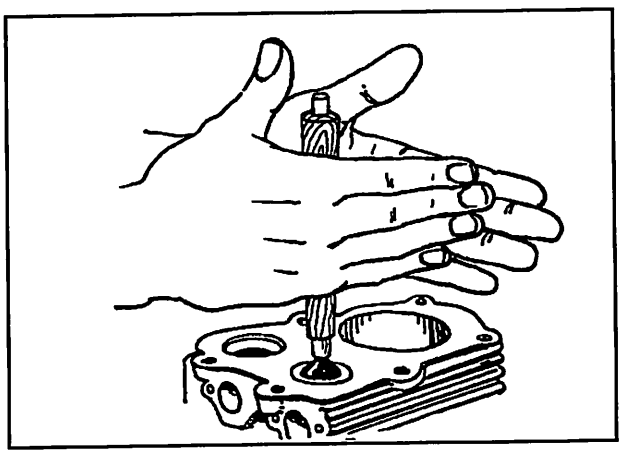
71. Place the lapping tool on the head of the valve.

Note: It has a suction cup to hold the valve and a spring-loaded cap so you can apply constant and uniform pressure.

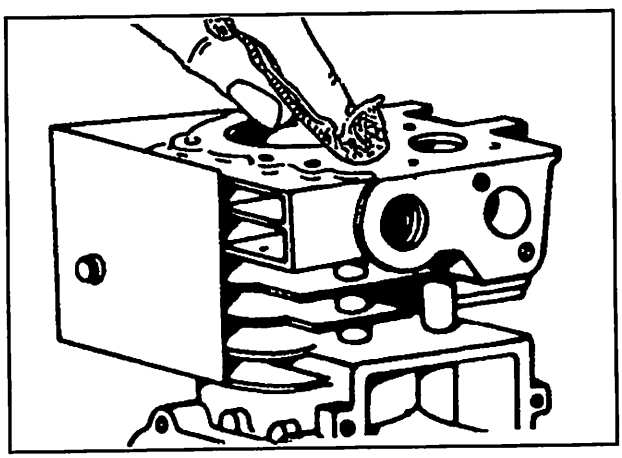


72. Rotate the valve back and forth on the seat.

Note: DO NOT rotate the valve all the way around 360 degrees. Work the valve back and forth, a very short distance, approximately 20 degrees on each turn.



73. Inspect the seat impression.
    a. After lapping the valve, remove the valve and wipe off the excess compound.
    b. Inspect the impression left by the lapping compound. Make sure it is of equal width all the way around the valve. If this is evident, there is no need to check the valve with machinist's ink. If there are gaps in the impression or if it does not have an equal width all the way around, the valve is warped or bent and should be replaced.



CAUTION: Any amount of lapping compound left in your engine will get into lubricating oil and grind away vital parts.

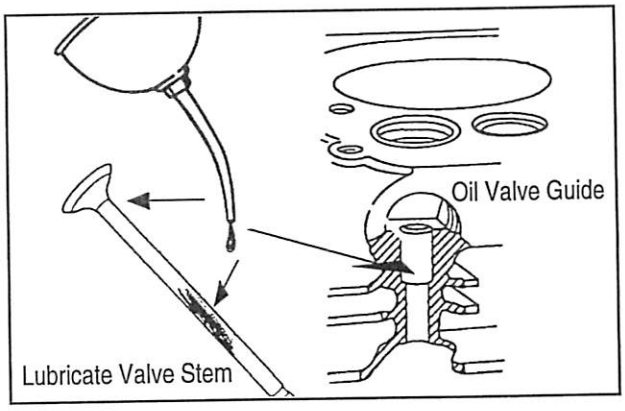
Illustrations courtesy of Briggs & Stratton Corporation

Installing Valves and Adjusting Valve-Tappet Clearance

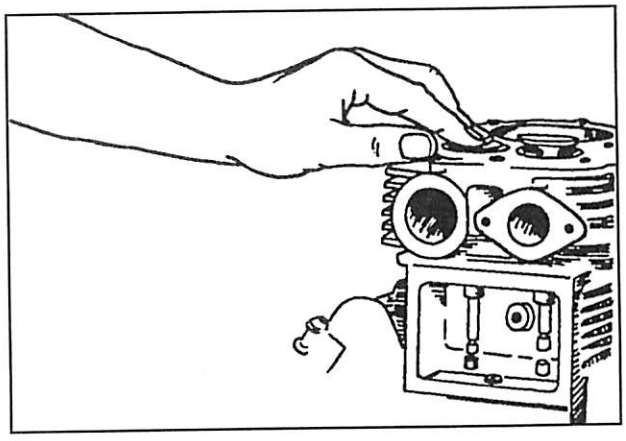
74. Apply crankcase oil or "Led-Plate" to valve stems and guides before installing.

***Note:** The "Led-Plate" grease provides long term lubrication for extended valve guide and stem life.*

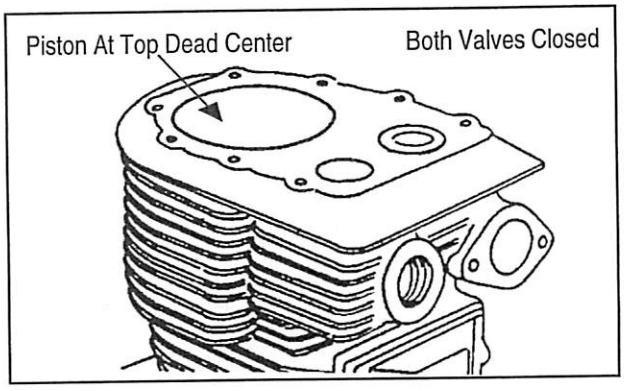
***CAUTION:** "Led-Plate" contains lead. Wash hands thoroughly after use.*



75. Place the valve in the cylinder block.



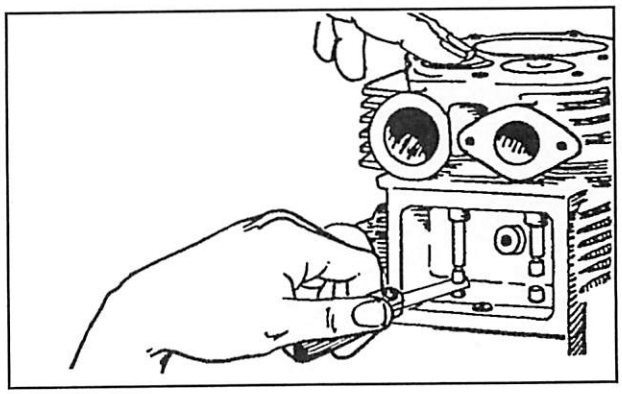
76. Turn the crankshaft to top-dead-center at the end of compression stroke. This will assure both valves are closed and without any pressure on the tappets.



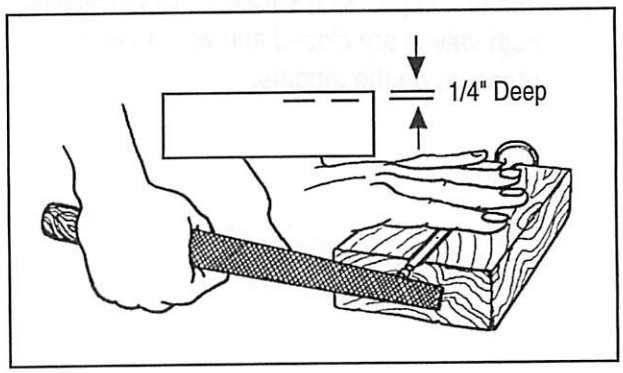
77. Determine the recommended valve-tappet clearance in your operator's manual. Illustration is for aluminum engines only.

	Basic Model Series	Idle Speed	Armature Air Gap		Valve Clearance	
			Two Leg	Three Leg	Intake	Exhaust
ALUMINUM	60000*, 68*	1750	.006, .010	.012, .016	.005, .007	.007, .009
	80000, 81000, 82000, 8B	1750	.006, .010	.012, .016	.005, .007	.007, .009
	90000, 91000, 92000, 93000, 94000 95000	1750	.006, .010		.005, .007	.007, .009
	100200,100900	1750	.010, .014	.012, .016	.005, .007	.007, .009
	100700	1750	.006, .010		.005, .007	.007, .009
	110000	1750	.006, .010		.005, .007	.007, .009
	120000	1750	.006, .010		.005, .007	.007, .009
	130000	1750	.010, .014		.005, .007	.009, .011
	170000,171700*	1750	.010, .014		.005, .007	.009, .011
	190000,191700● 192700,193700●	7150	.010, .014 .010, .014		.005, .007	.009, .011
	220000,250000	1750	.010, .014		.005, .007	.009, .011
	280000	1750	.010, .014		.005, .007	.017, .019
CAST IRON	23, 230000	1200	.010, .014	.022, .026	.007, .009	.017, .019
	240000	1200	.010, .014		.007, .009	.017, .019
	300000	1200	.010, .014		.007, .009	.017, .019
	320000	1200	.010, .014		.007, .009	.017, .019

78. Check the valve-tappet clearance with a feeler gauge. There should be a slight drag as you move the feeler gauge between the valve stem and tappet. (Check the clearance before installing the spring).

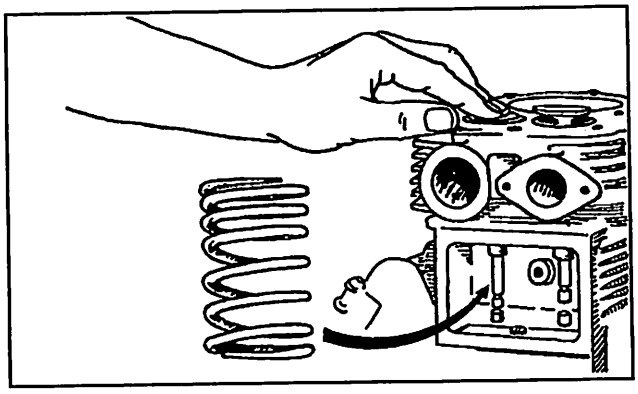


79. Grind stems and adjust valves.
    a. Make sure that stems are ground square with a grinding wheel. The use of a V-block or some commercial valve stem grinder will produce good results.
    b. Adjust valves by placing the piston 1/4" past top dead center on the power stroke. At this point, check the valve tappet clearance for both valves, and compare this to the specifications in the *Service and Repair Instruction Manual.*



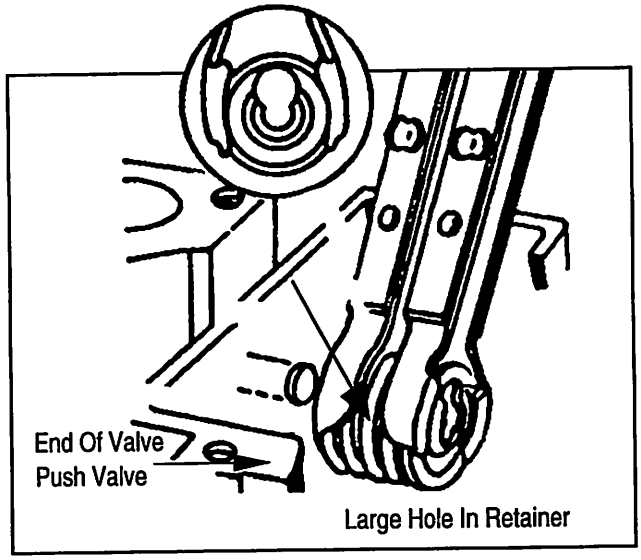
Illustrations courtesy of Briggs & Stratton Corporation

80. Observe the winding before compressing each spring. One end of spring should be wound closer together. The more closely wound part of spring should be installed toward head of valve. The stronger spring always goes to the exhaust valve.

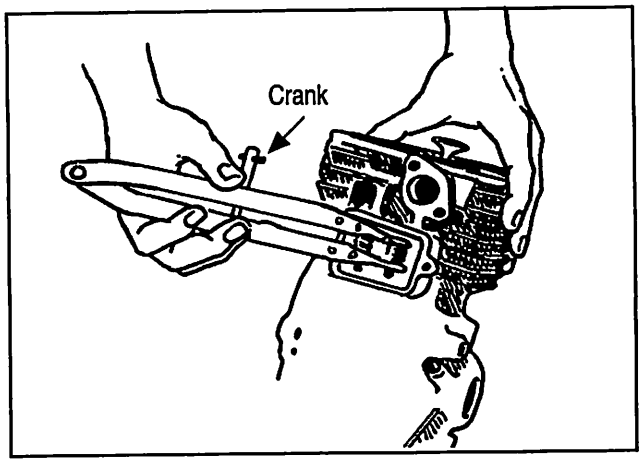


81. Compress retainer and spring in compressor when installing self-lock retainer. Note that large hole in retainer should be toward front of valve chamber.

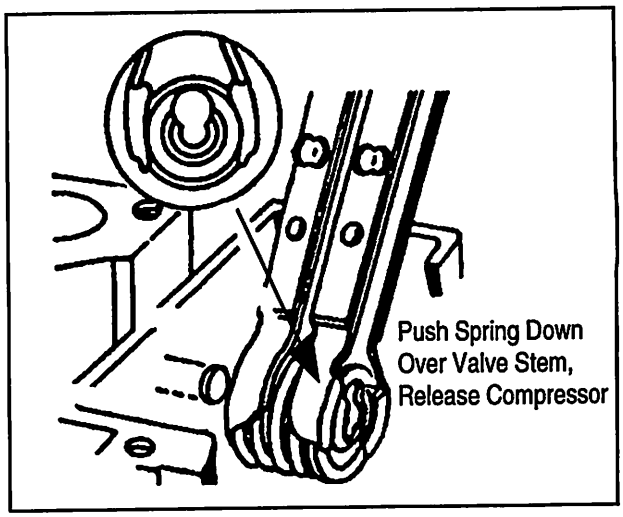
NOTE: Some retainers have a notch in the rim opposite the large hole.



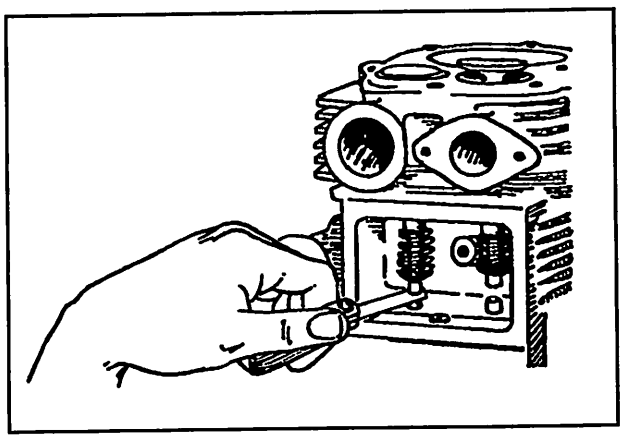
82. Insert compressed spring and retainer into valve chamber.



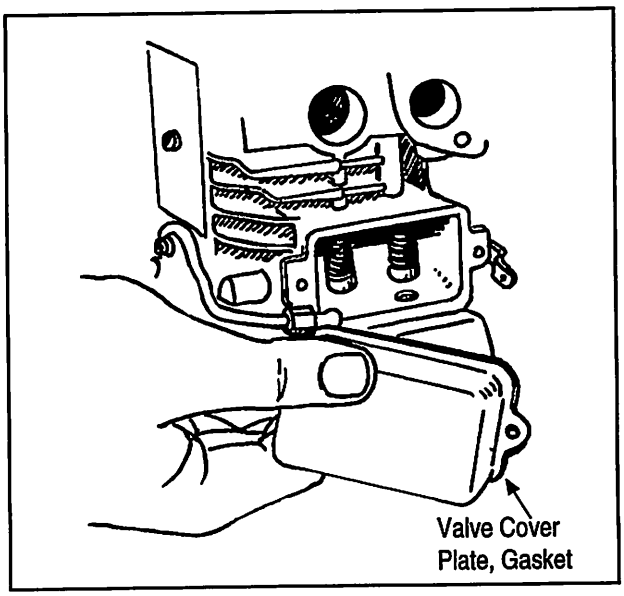
83. Insert valve stem.
    a. Insert valve stem through large hole in retainer slot and move compressor so as to center small hole of valve retainer slot onto valve stem shoulder.
    b. Release spring tension and remove compressor.
    c. Check to be sure spring is straight.



84. Rotate crankshaft two complete turns and recheck valve clearance.



85. Install valve-cover plate (breather).

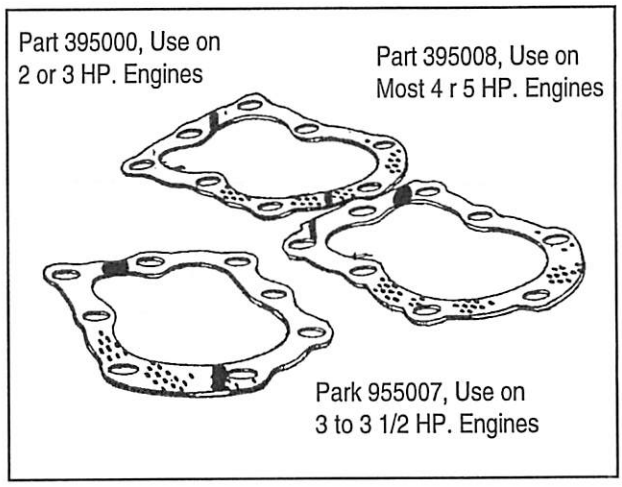


Illustrations courtesy of Briggs & Stratton Corporation

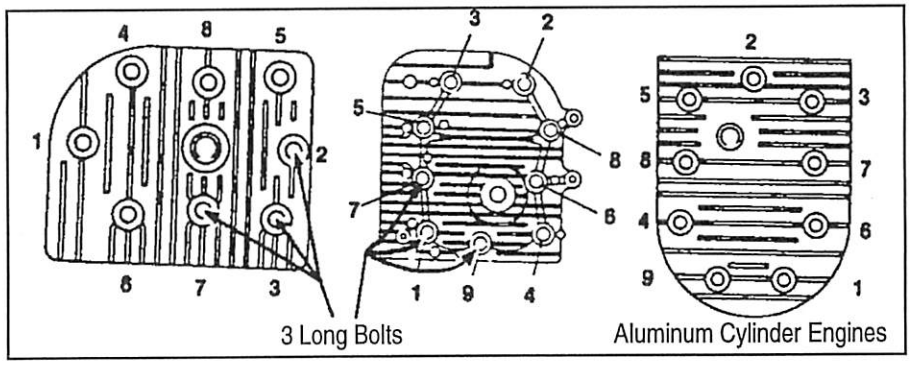
Installing the Cylinder Head

86. Check piston, cylinder, valves, and cylinder head for cleanliness.

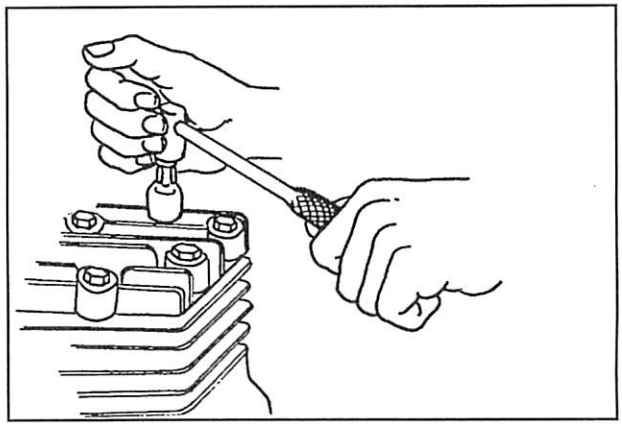
87. Install new head gasket and place cylinder head on cylinder block.



88. Install all cylinder head bolts snugly. Do not tighten. Check to see if head bolts are in correct position. Remember, some cylinder head bolts are longer than others.



89. Tighten head bolts according to procedures given by operator's manual.



Illustrations courtesy of Briggs & Stratton Corporation

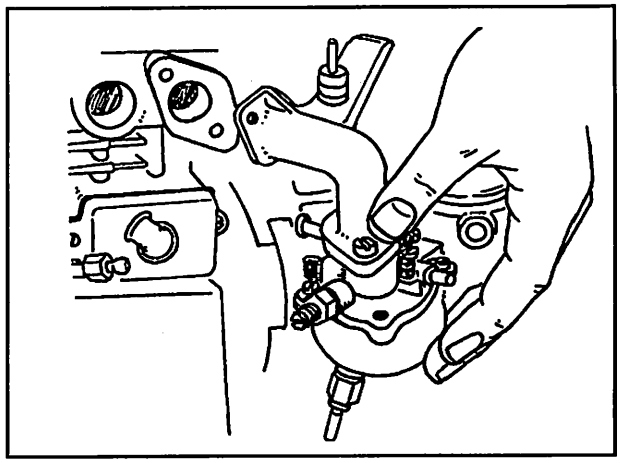
90. Torque head bolts to specifications.

Note: How to convert foot-pounds to inch-pounds.

To Convert	Into	Operations
Foot-pounds	Inch-pounds	multiply by 12
Inch-pounds	foot-pounds	divide 12

Aluminum	Torque Specifications		
Basic Model Series	Flywheel Nut Ft. Lbs.	Cylinder Head InLbs.	Conn. Rod In. Lbs.
6B, 60000	55	140	100
8B, 80000, 8100, 8200	55	140	100
92000, 94000	55	140	100
100000	60	140	100
110000	55	140	100
130000	60	140	100
140000	65	165	165
170000, 171700	65	165	165
190000, 191700	65	165	165
220000, 250000	65	165	190

91. Install carburetor on engine and properly hook up linkage.



92. Install exhaust pipe and muffler.

93. Install blower housing.

94. Install tank assembly and connect gas line.

95. Install engine on implement or vehicle and hook up remote controls.

96. Service crankcase. Check engine specifications for amount of oil.

97. Install spark plug and check proper gap.

Illustrations courtesy of Briggs & Stratton Corporation

Compression - Valve Service and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. The competencies listed below represent the tasks to be performed in Valves Service and Repair. Compile your evaluation of the student (trainee) by transferring the appropriate "yes/no" rating.

NOTE: This profile can be used as repair procedure for disassembly, repair and reassembly.

Yes	No	
		Checking Compression
___	___	1. Read operator's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize your work station.
___	___	4. Disconnect spark plug wire.
___	___	5. Drain oil from crankcase.
___	___	6. Disconnect remote throttle control linkage.
___	___	7. Remove engine from implement or vehicle.
___	___	8. Mount engine on a suitable stand.
___	___	9. Remove tank assembly.
___	___	10. Remove blower housing, oil tube, and casing clamp.
___	___	11. Test Compression.
		Removing Cylinder Head
___	___	12. Remove exhaust pipe and muffler.
___	___	13. Remove the spark plug.
___	___	14. Remove carburetor from engine.
___	___	15. Remove crankcase breather or valve cover plate.
___	___	16. Check breather clearance.
___	___	17. Remove the cylinder head bolts.
___	___	18. Clean the carbon from the cylinder head, piston, and area around valve seats.
___	___	19. Check cylinder head for warpage.
___	___	20. Remove Prussian blue from head.
___	___	21. Clean all removed parts with solvent and store.
		Removing the Valves
___	___	22. Remove valves.
___	___	23. Compress the valve spring with a screwdriver.
___	___	25. Remove carbon deposits from valves.
___	___	26. Label the valves and springs for reassembly.
___	___	27. Note position of parts of the valve train.
___	___	28. Inspect the valve head for proper margin.
		Inspecting the Valves and Accessories
___	___	29. Examine the valves for damage.
___	___	30. Clean the valve guide and check for wear.
___	___	31. Inspect the valve spring.

Yes	No	
		Replacing the Valve Guide
___	___	32. Inspect the valve seats for cracks and pitting.
___	___	33. Protect the engine from metal cuttings.
___	___	34. Select the proper size reamer.
___	___	35. Ream the cylinder block to accommodate the valve-guide bushing.
___	___	36. Place replacement bushing in reamed-out hole.
___	___	37. Finish reaming.
___	___	38. Remove metal clippings.
___	___	39. Check dimension and condition of the newly reamed guide.
___	___	40. Lubricate the valve-guide bushing.
___	___	41. Dress the grinding wheel.
		Refacing the Valves
___	___	42. Adjust the valve grinder for grinding at the proper face angle.
___	___	43. Place the valve in the grinder chuck and tighten securely.
___	___	44. Check for proper position of valve face so that it makes proper contact with the grinding wheel.
___	___	45. Start grinder and make sure the cutting oil is flowing properly.
___	___	46. Move the valve face up to the wheel and start grinding lightly.
___	___	47. Stop the grinder and remove the valve from the grinding wheel. Check the face width.
___	___	48. Clean the valve with a petroleum solvent.
___	___	49. Place valves in a storage rack for reassembly.
		Refacing Valve Seats
___	___	50. Determine valve seat angle.
___	___	51. Select appropriate valve seat cutter.
___	___	52. Check valve seat dimensions.
___	___	53. Install pilot in the valve guide.
___	___	54. Place 45-degree cutting head over pilot.
___	___	55. Reface the valve seat.
___	___	56. Remove chatter marks.
		Replacing Valve Seats
___	___	57. Check valve seat for condition and width.
___	___	58. Lap the valve to the seat.
___	___	59. Obtain Valve Seat Puller Kit.
___	___	60. Select the proper size puller nut using the valve seat puller as a reference.
___	___	61. Place the puller body on top of the cylinder block and slide under bolt.
___	___	62. Turn the 5/16" bolt with a wrench until seat insert is pulled out of the block.
___	___	63. Select the correct pilot and driver for installing the valve seat.
___	___	64. Select the proper valve seat insert.
___	___	65. Insert the pilot into the valve guide.
___	___	66. Stake over the edge of cylinder block around entire insert using a metal punch.
___	___	67. Prepare the valve seat.
___	___	68. Clean grinding compound from valves and seats.

Yes	No	
		Lapping the Valves
___	___	69. Apply lapping compound to the valve face.
___	___	70. Insert valve into the cylinder block.
___	___	71. Place the lapping tool on the head of the valve.
___	___	72. Rotate the valve back and forth on the seat.
___	___	73. Inspect the seat impression.
___	___	74. Apply crankcase oil or "Led-Plate" to valve stems and guides.
___	___	75. Place valve in the cylinder block.
___	___	76. Turn the crankshaft to top-dead-center at the end of compression stroke.
___	___	77. Determine recommended valve-tappet clearance.
___	___	78. Check the valve-tappet clearance with a feeler gauge.
___	___	79. Grind stems and adjust valves.
___	___	80. Observe the winding before compressing each spring.
___	___	81. Compress retainer and spring in compressor when installing self-lock retainer.
___	___	82. Insert compressed spring and retainer into valve chamber.
___	___	83. Insert valve stem.
___	___	84. Rotate crankshaft two complete turns to recheck valve clearance.
___	___	85. Install valve-cover plate.
		Installing the Cylinder Head
___	___	86. Check piston, cylinder, valves, and cylinder head for cleanliness.
___	___	87. Install new head gasket and place cylinder head on cylinder block.
___	___	88. Install all cylinder head bolts.
___	___	89. Tighten head bolts.
___	___	90. Torque head bolts to specifications.
___	___	91. Install carburetor on engine and properly hook up linkage.
___	___	92. Install exhaust pipe and muffler.
___	___	93. Install blower housing.
___	___	94. Install tank assembly and connect gas line.
___	___	95. Install engine on implement or vehicle and hook up controls.
___	___	96. Service crankcase.
___	___	97. Install spark plug and check proper gap.

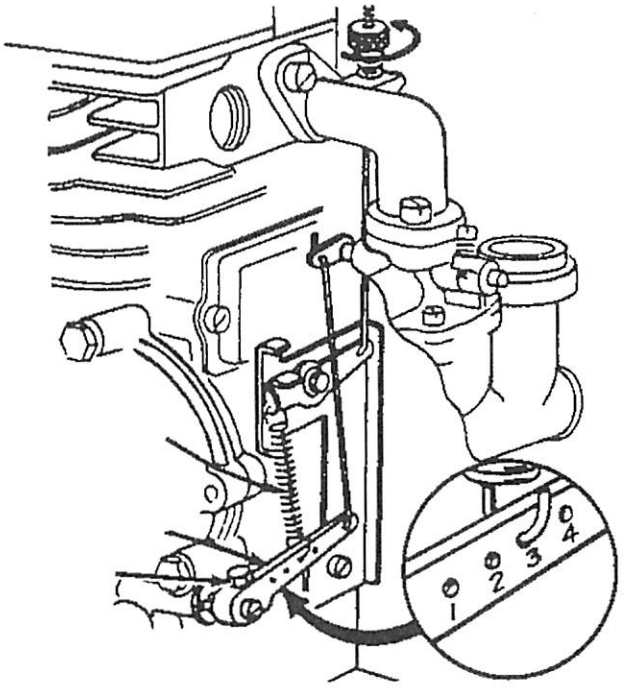
Student's Signature _____ Instructor's Signature _____ Date _____

10-7655-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Governors

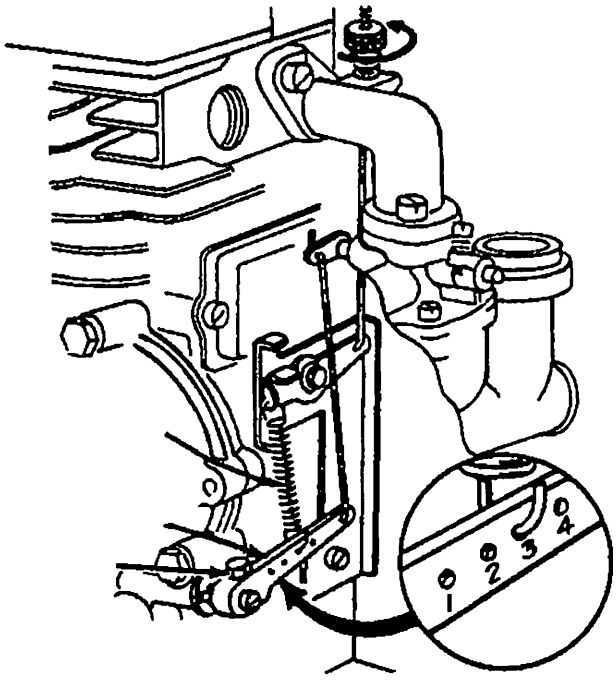


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

Module 5

Governors



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

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References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Governors
Adjustment and Repair

Unit Objectives

After completing this unit, you should know the purpose of the governor system and be able to identify its components. You should also be able to adjust and repair the governor system. This knowledge will be demonstrated through your ability to properly service and repair the governor.

Specific Objectives

After completing this unit, you should be able to:

1. List two purposes of the governor system.
2. List two types of governor systems.
3. Identify the parts of the governor system.
4. Demonstrate the ability to:
   a. Inspect, adjust and repair the air vane governor.
   b. Inspect and adjust external parts of the mechanical governor.

Governors

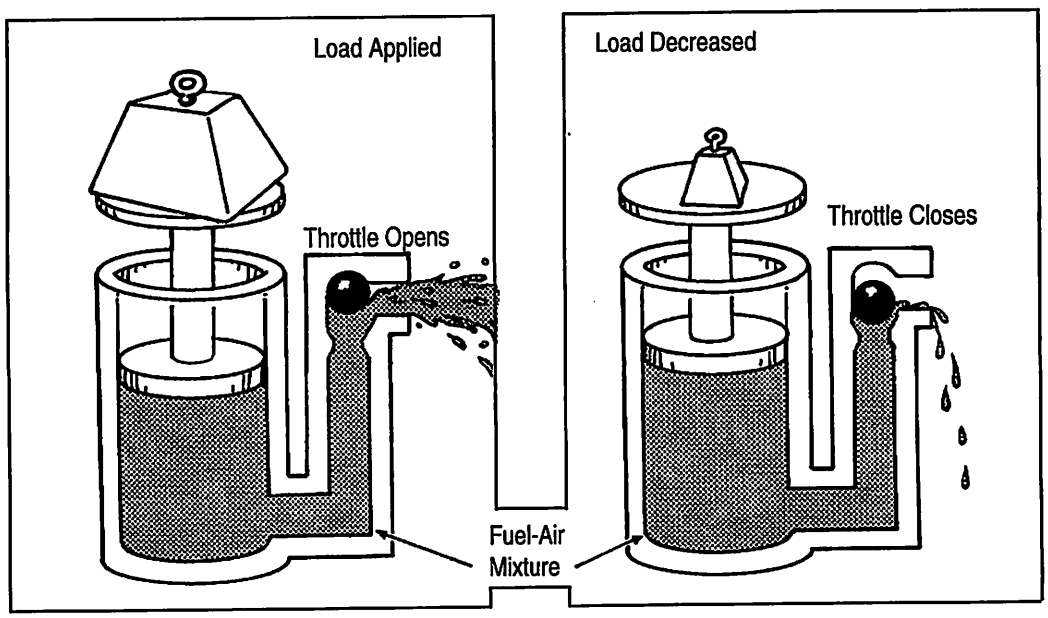
Adjustment and Repair

Introduction

The governor on a small engine serves two purposes: It keeps the engine operating at a constant speed in spite of load demands and prevents the engine from running above a predetermined speed set by the manufacturer.

The governor controls the speed of the engine by automatically adjusting the amount of fuel-air mixture fed through the carburetor. As the load increases, the governor opens the throttle valve to provide a greater fuel-air mixture allowing the engine to increase its power and maintain a constant speed. When the load decreases, the governor closes the throttle valve. Less fuel to the engine reduces the horsepower output while maintaining a constant speed.

This unit covers special tools, needed supplies, and a detailed step-by-step procedure for adjusting and servicing governors.



A. Special Tools and Materials Needed to Adjust and Repair Governors

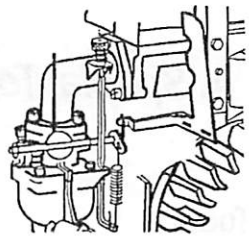
Tools

Open-end wrenches (3/8" through 1/2")
Long-nose pliers (7")
Combination pliers (7")
Tachometer
Screwdriver
Nut drivers (1/4", 5/16", 3/8", and 7/16")
Safety glasses
Screwdriver torque wrench
Oil seal protector kit #19334

Supplies

Cleaning solvent
Shop towels
Small pan
Penetrating oil

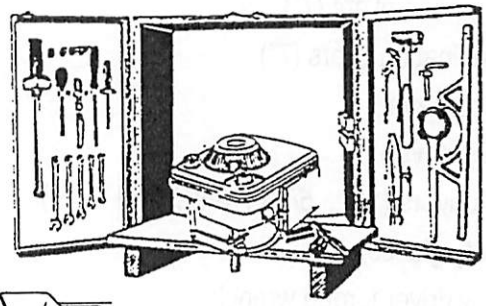
B. Step-By-Step Procedure for Adjusting and Repairing Air Vane Governors

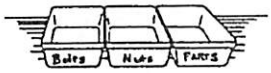


1. Read operator's manual and Briggs and Stratton ***Service and Repair Instructions.***

2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.





Check Governor

4. Disconnect spark plug wire.

5. Drain oil from crankcase.

6. Disconnect remote throttle control linkage.

Note: Be sure to note throttle and choke connections. Sketch the linkage on paper for later reference.

7. Remove engine from implement or vehicle.

Note: If remote fuel tank is used, disconnect fuel line from engine.

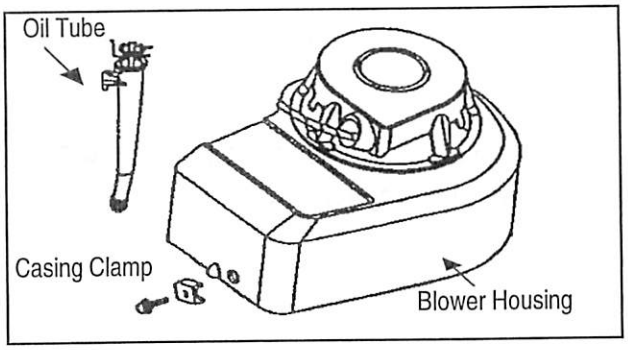
8. Mount engine on a suitable stand.

Note: Some smaller engines are easier to disassemble on a work bench.

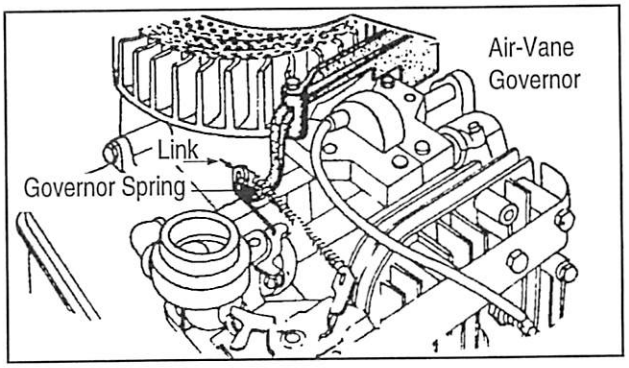
Illustrations courtesy of Briggs & Stratton Corporation

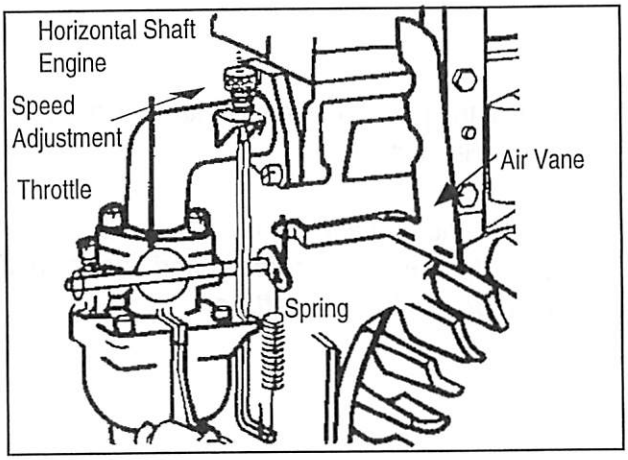
Disassembly

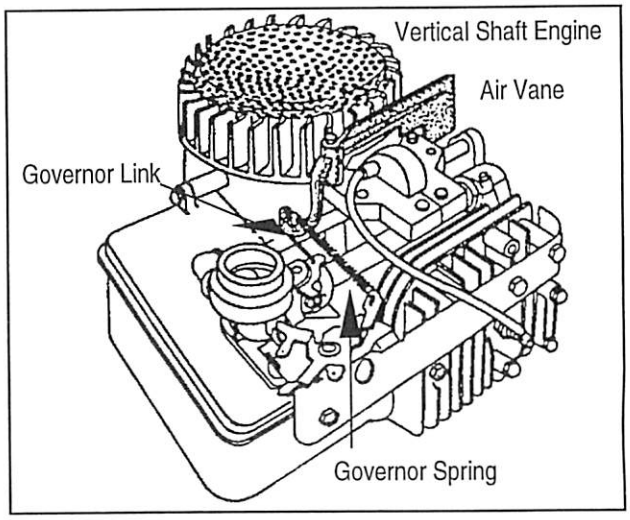
9. Remove the blower housing to access the air vane governor. Inspect the air vane governor and spring. The air vane should be parallel to the crankshaft. Improper spring tension will pull the air vane to one side.



10. Observe the operation of the air vane governor and spring. The air vane is connected by linkage to the throttle valve in such a way that when it moves, the throttle valve opens or closes. The air vane is also connected by a spring to the throttle control. When the engine is stopped, the throttle valve is open by spring tension.



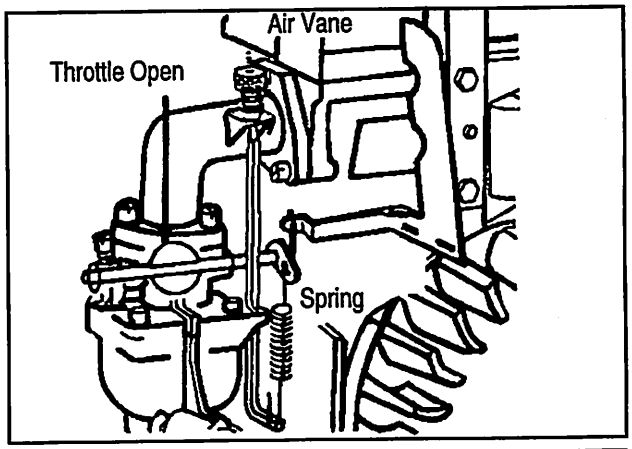


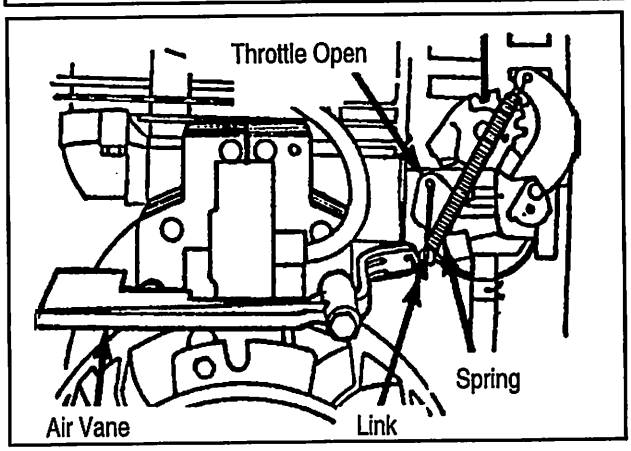


11. Check the position of the air vane when the engine is not running.

Note: The governed speed can be varied by changing the spring tension.

ENGINE NOT RUNNING

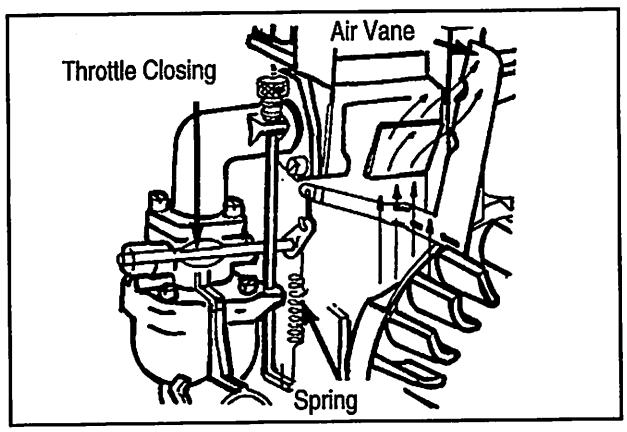


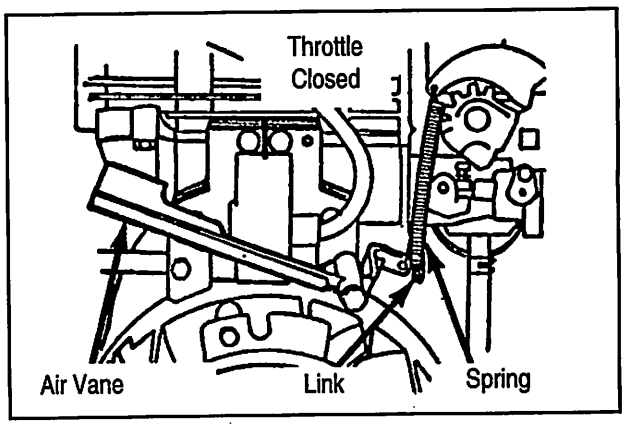


12. Check the position of the air vane when the engine is running.

Note: As the air vane moves, the throttle closes. This reduces engine speed back to that selected by the throttle setting.

ENGINE RUNNING

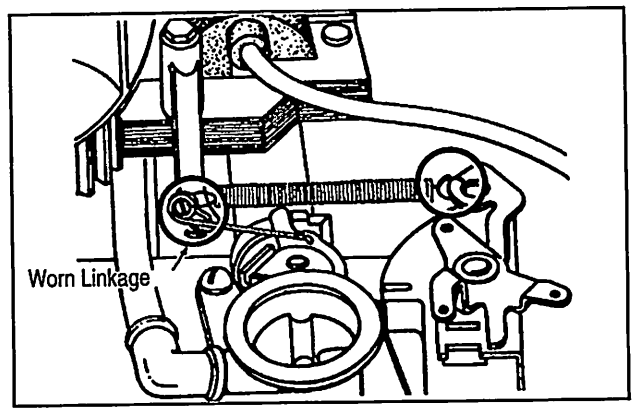




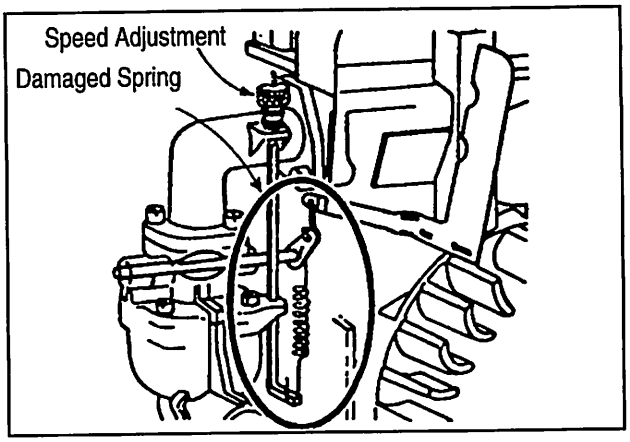
Illustrations courtesy of Briggs & Stratton Corporation

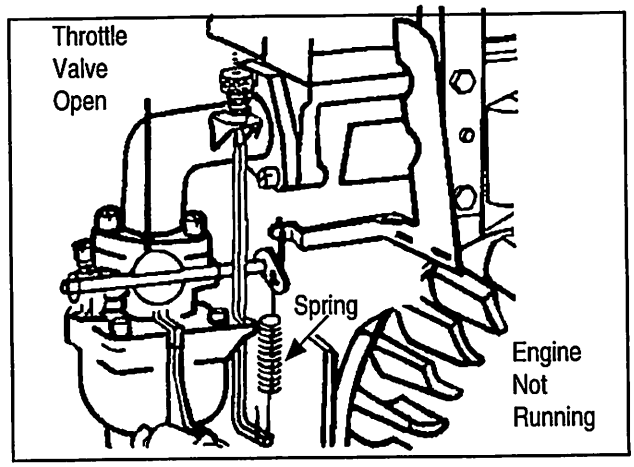
13. Check the condition of the governor linkage. Check for bent links and worn connections. Check the air vane for cracks and freedom of movement.

Note: Make sure the governor spring is installed correctly.

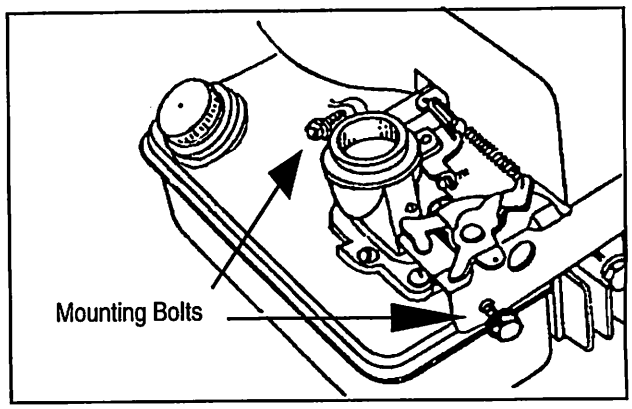


14. Check to see if the throttle valve is open when the engine is stopped. It should be completely open when the engine is stopped.

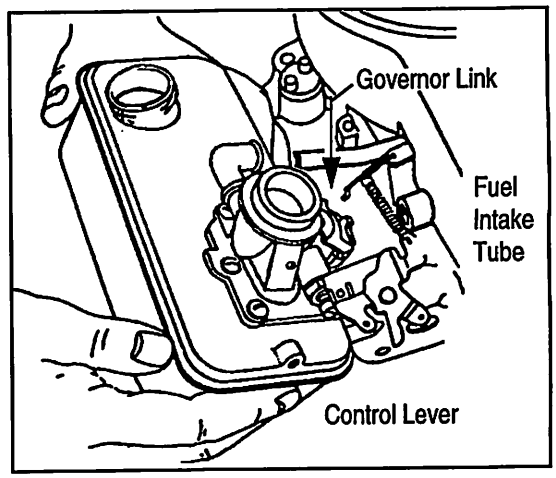




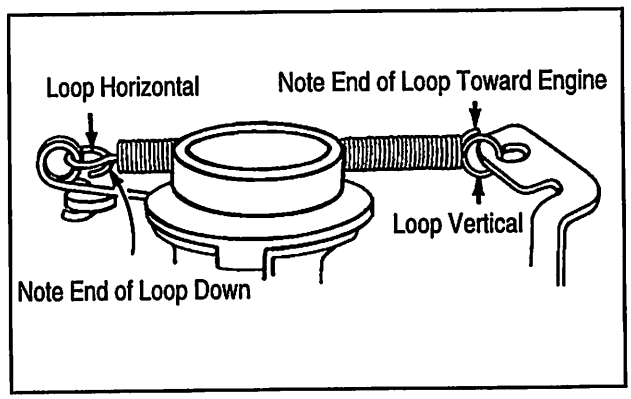
15. Remove carburetor to free the governor link. Do not use pliers to force the link free. Remove the mounting bolts from the carburetor and engine.



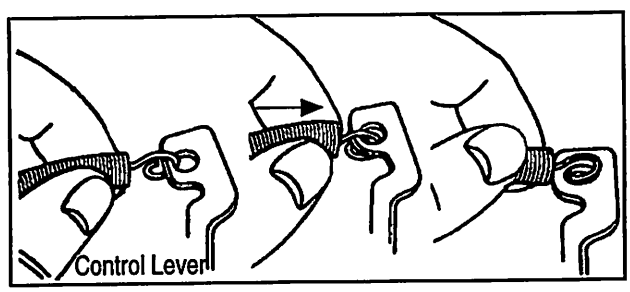
16. Remove the fuel tank assembly from the end of fuel intake tube and turn the carburetor to free governor link.



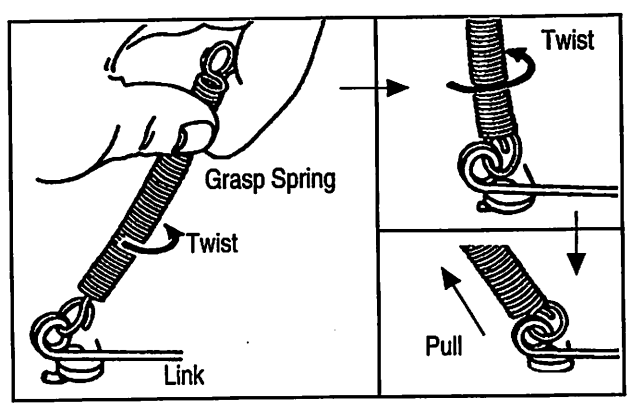
17. Observe how the spring is attached to the governor and control lever. Remove link and spring from the air vane.



18. Remove spring from control lever.
    a. Twist spring toward engine until end of loop can be pushed under lever.
    b. Push spring forward.
    c. Twist spring toward engine until end of loop snaps out of hole in lever.

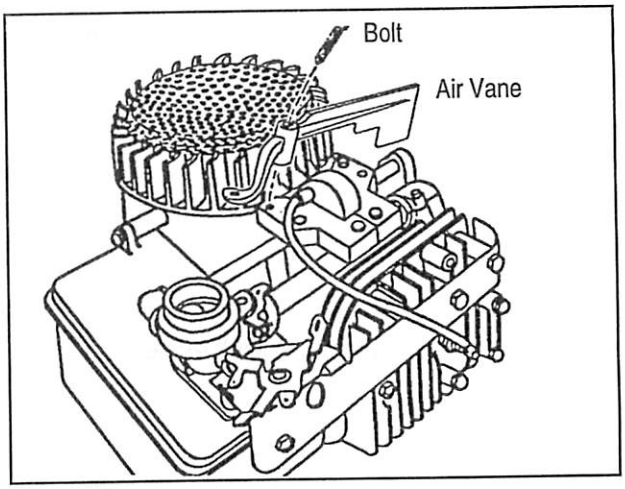


19. Remove spring from eyelet in link. Grasp spring and twist to open loop and pull out..

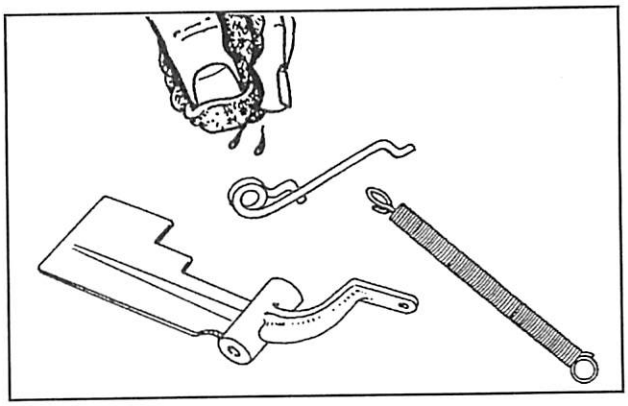


Illustrations courtesy of Briggs & Stratton Corporation

20. Remove bolt to free air vane governor from engine. Inspect air vane and replace if necessary.

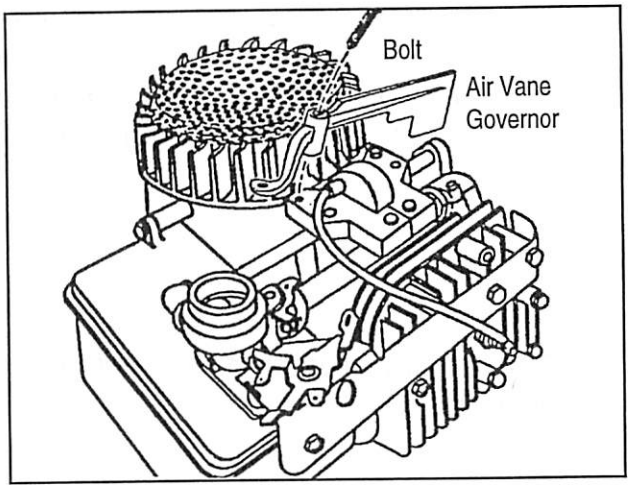


21. Clean governor assembly with solvent.

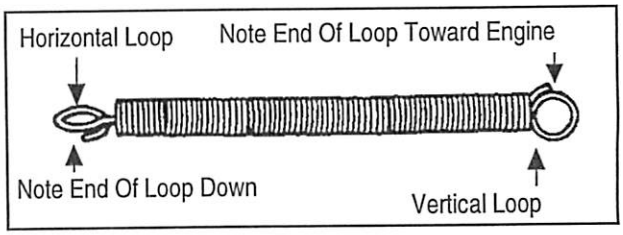


Reassembly

22. Install air vane governor and tighten bolt.

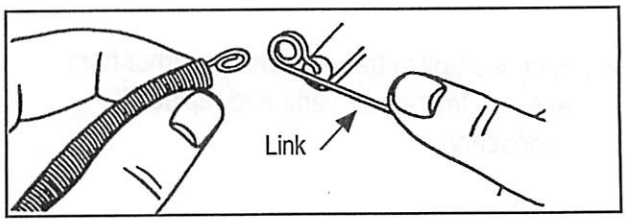


23. Select the proper governor spring. (See operator's manual.)

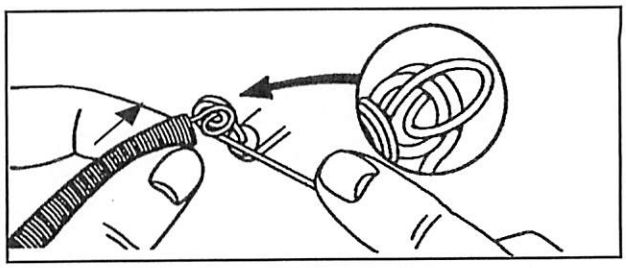


Illustrations courtesy of Briggs & Stratton Corporation

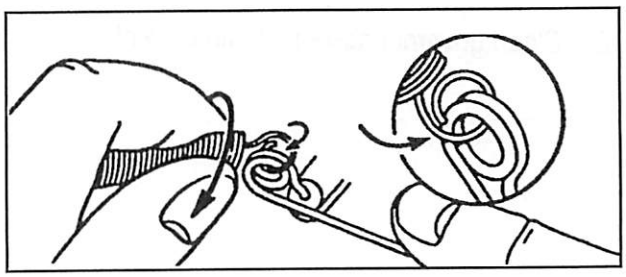
24. Install link on air vane. Steady link with finger and grasp spring as shown.



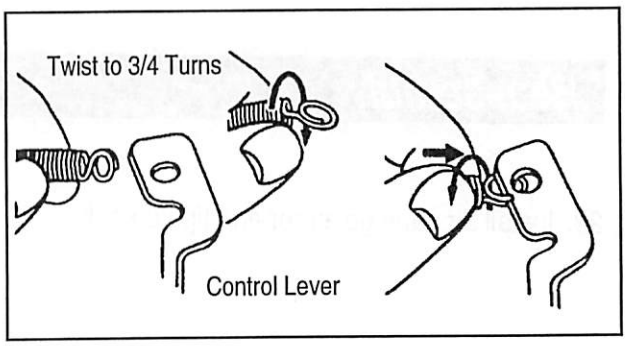
25. Assemble end of loop into link eyelet.



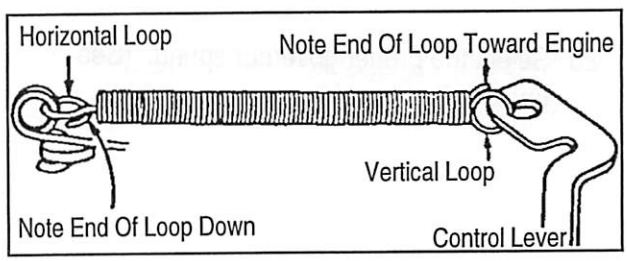
26. Twist spring toward you until eyelet snaps into link.



27. Connect spring to control lever.
    a. Grasp end of spring, and twist spring 3/4 turn toward engine until end of loop is up as shown.
    b. Insert end of loop into hole and twist spring toward you until end of loop snaps into hole.



28. Check for proper position of new spring. (See illustration.)



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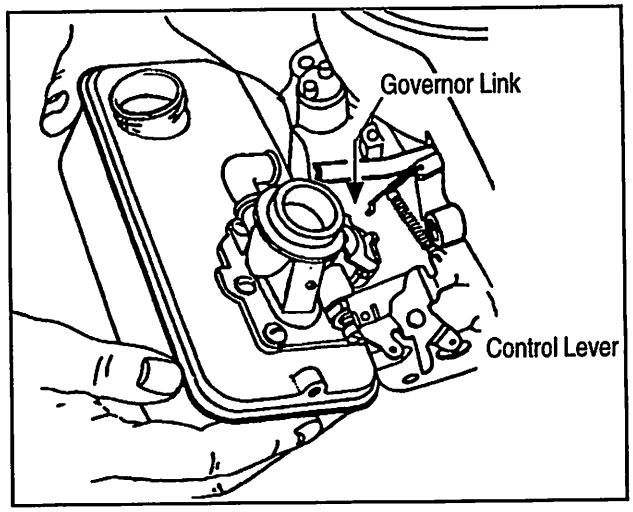
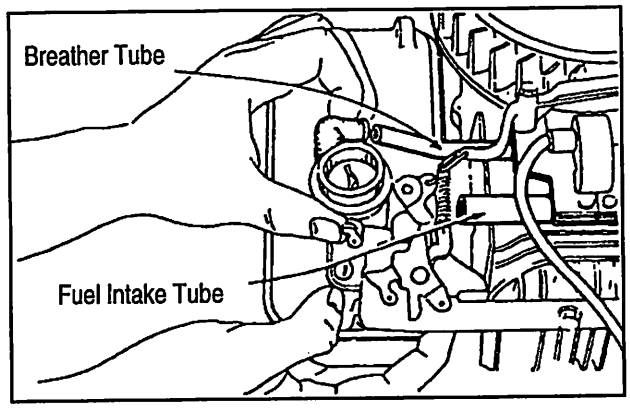
29. Install governor link to carburetor.

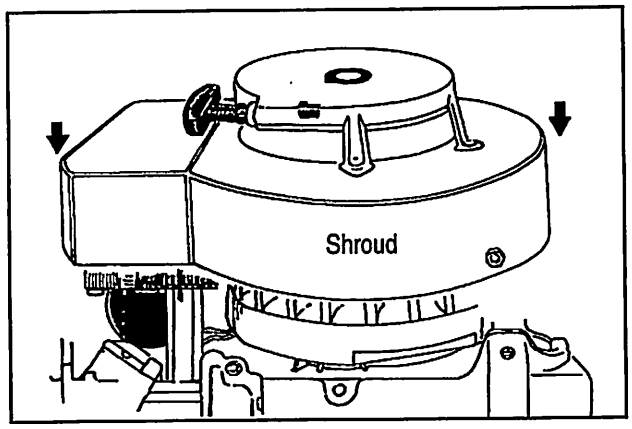


30. Install carburetor into place slowly. Make sure the fuel intake tube is aligned with the carburetor at the O-ring and the breather tube is aligned with the venting elbow. Replace mounting bolts.



31. Install the shroud on the engine.

32. Install engine on implement and reconnect gas line.



33. Reconnect the spark plug wire.

34. Refill the engine with new oil. Use a high quality detergent oil 10W-30 or 30W. No additives should be used. See oil capacity chart.

35. Reconnect the remote throttle control linkage.

36. Start engine and run at about one-half throttle until engine reaches normal operating temperature before checking with tachometer.

37. Check the top governed speed with an accurate tachometer. Refer to chart for top governed speed. Always adjust top governed speed at least 200 rpm lower then speed shown in chart..

Note: A tachometer is a device for measuring and indicating the rotational speed of an engine.

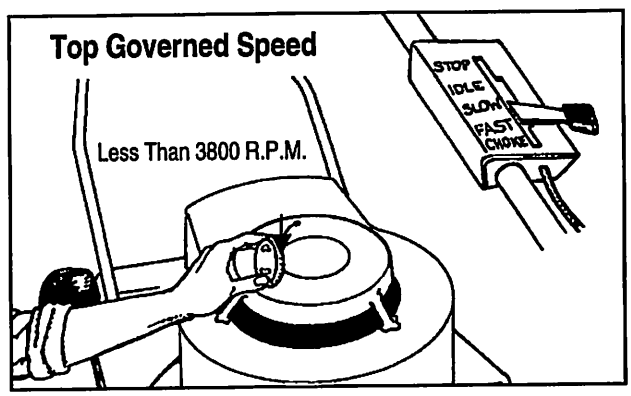
38. Use a tachometer to check no-load idle speed. Adjust the idle speed to 1750 rpm.

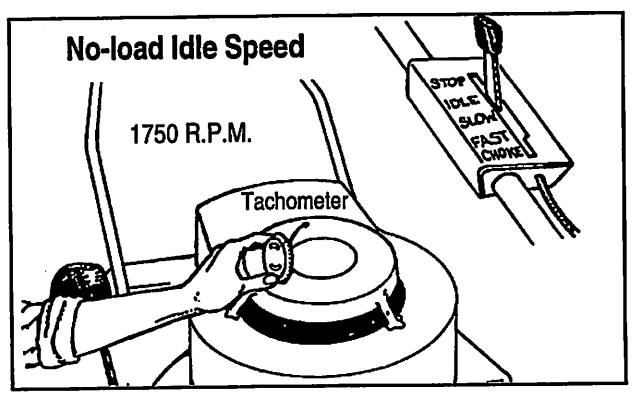
39. Clean your work area and return tools and equipment to their proper places.

OIL CAPACITY CHART

BASIC MODEL SERIES	Capacity Pints
Vertical Crankshaft Aluminum Cylinders	
60000, 80000, 90000, 100700, 110000, 120000	1-1/4
100900, 130000	1-3/4
140000, 170000, 190000	2-1/4
220000, 250000, 280000	3
Horizontal Crankshaft Aluminum Cylinders	
60000, 80000, 100200, 130000	1-1/4
140000, 170000, 190000	2-3/4
220000, 250000	2-1/2
Horizontal Crankshaft Cast Iron Cylinders	
9, 14, 19, 190000, 200000	3
230000, 240000, 300000, 320000	4

Blade Length	Maximum Rotational RPM
18"	3800
19"	3600
20"	3400
21"	3250
22"	3100
23"	2950
24"	2800
25"	2700





Illustrations courtesy of Briggs & Stratton Corporation

Governor Adjustment and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Adjusting and Repairing Air Vane Governors
		Disassembly
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Disconnect spark plug wire.
____	____	5. Drain oil from crankcase.
____	____	6. Disconnect remote throttle control linkage.
____	____	7. Remove engine from implement or vehicle.
____	____	8. Mount engine on a suitable stand.
____	____	9. Remove blower housing to access the air-vane governor.
____	____	10. Observe operation of the air-vane governor and spring.
____	____	11. Check position of the air vane when the engine is stopped.
____	____	12. Check position of the air vane when the engine is running.
____	____	13. Check condition of the governor linkage.
____	____	14. Check for open throttle valve when the engine is stopped.
____	____	15. Remove carburetor and free governor link.
____	____	16. Remove fuel tank assembly to free governor link.
____	____	17. Remove governor link and spring from the air vane.
____	____	18. Remove spring from control lever.
____	____	19. Remove spring from eyelet in link.
____	____	20. Remove bolt to free air vane governor from engine.
____	____	21. Clean governor assembly with solvent.
		Reassembly
____	____	22. Install air vane governor and tighten bolt.
____	____	23. Select the proper governor spring.
____	____	24. Install link on air vane.
____	____	25. Assemble end of loop into link eyelet.
____	____	26. Twist spring until eyelet snaps into link.
____	____	27. Attach spring to control lever.
____	____	28. Check proper position of new spring.
____	____	29. Install governor link to carburetor.
____	____	30. Slip carburetor into place.
____	____	31. Install shroud on engine.
____	____	32. Install engine and reconnect gas line.
____	____	33. Reconnect spark plug wire.
____	____	34. Refill the engine with new oil.
____	____	35. Reconnect remote throttle control linkage.
____	____	36. Start and warm engine.
____	____	37. Check the top governed speed with an accurate tachometer.
____	____	38. Check no-load idle speed.
____	____	39. Clean your work area.

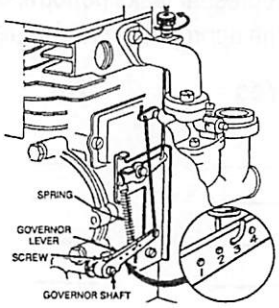
_____
Student's Signature

_____
Instructor's Signature

_____
Date

C. Step-By-Step Procedure for Servicing Mechanical Governors

(Aluminum Engine model number 6B, 8B, 60000, 80000, and 140000)



1. Read operator's manual and *Briggs and Stratton Service and Repair Instructions.*

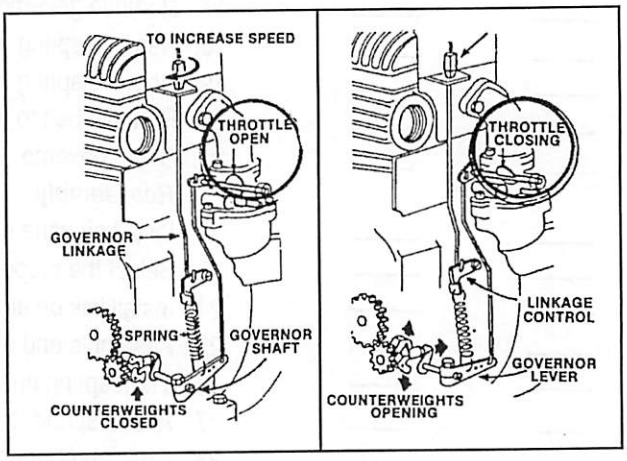
2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed.

3. Organize your work station.

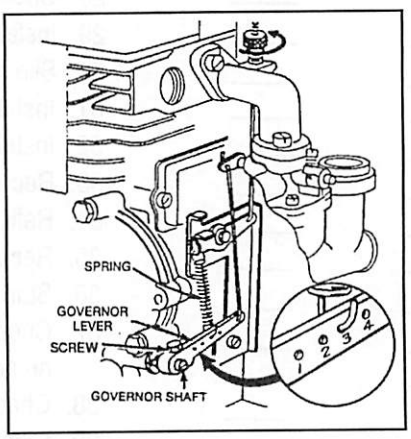
Check Governor

4. Disconnect spark plug wire.

5. Study component location on the mechanical governor before disassembly.

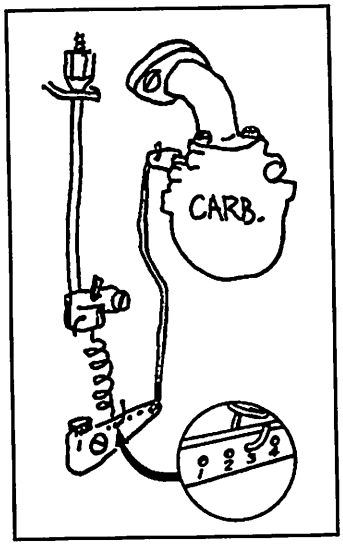


6. Inspect the mechanical governor for worn linkage or damaged governor spring. Manually check linkage for freedom of operation. Check to see if the throttle valve is open when the engine is stopped. The throttle valve should be completely open when the engine is stopped.



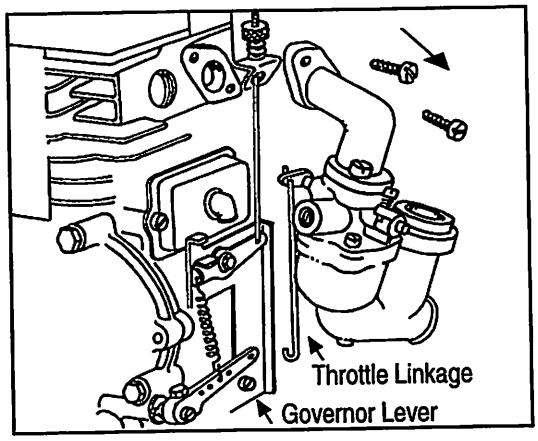
Illustrations courtesy of Briggs & Stratton Corporation

7. Draw a sketch of the governor linkage before removal. Be sure to note position of the spring in governor lever. This is very important for proper reassembly.

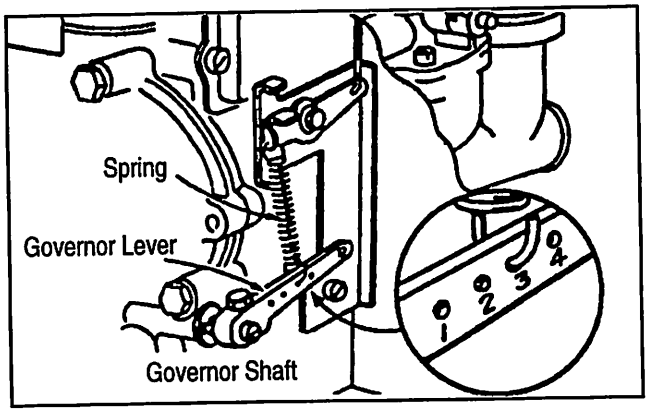


8. Remove mounting bolts from carburetor. Slowly position carburetor to free throttle linkage. Unhook linkage from governor lever.

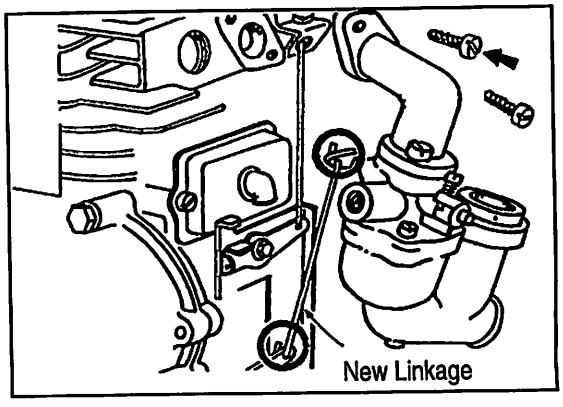
⚠ ***CAUTION: Do not use pliers to remove or install the governor linkage.***



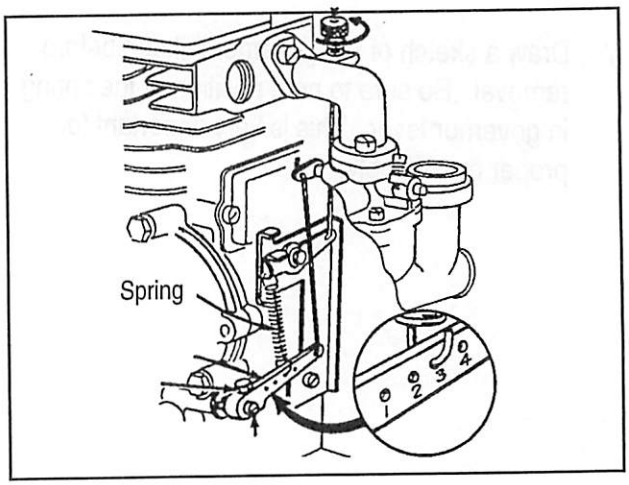
9. Remove spring from governor lever and linkage control.



10. Install new linkage onto carburetor and governor lever. Remount carburetor to engine and tighten bolts securely.

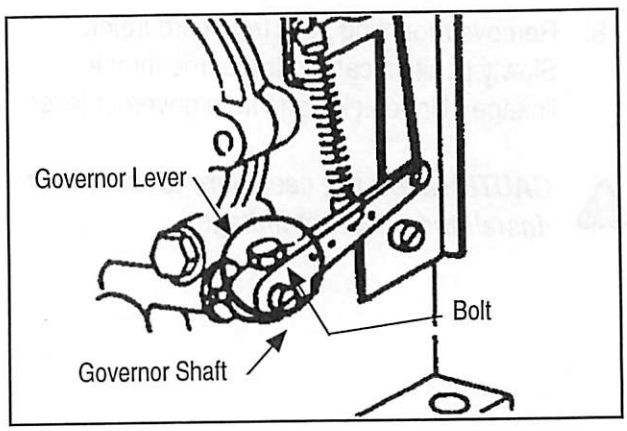


11. Install a new spring onto linkage control and in third hole in governor lever. A new spring will change top governed speed. Check new speed with a tachometer.



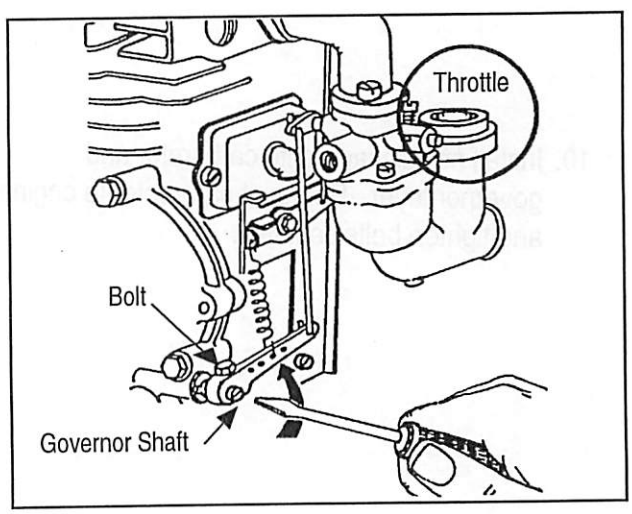
12. Loosen bolt holding governor lever to governor shaft. Do not remove bolt.

⚠ ***CAUTION: The governor shaft can slide inside the engine when the governor lever bolt is loosened. Make sure you secure the governor shaft when making adjustments. (A spring clip may be used.)***



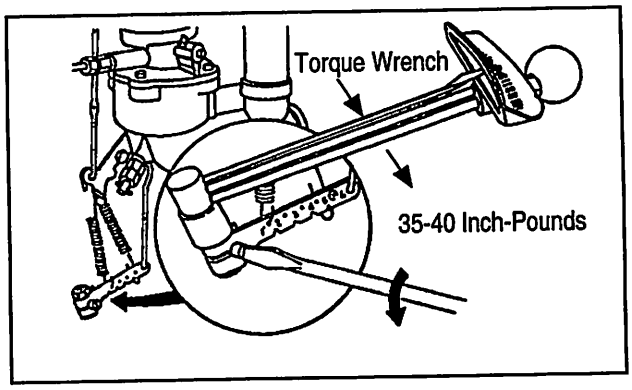
Reassembly

13. Adjust governor lever.
    a. Open throttle to high-speed position by placing throttle control completely against stop.
    b. Hold throttle in this position.
    c. Use a screwdriver to turn governor shaft counterclockwise as far as it will go.

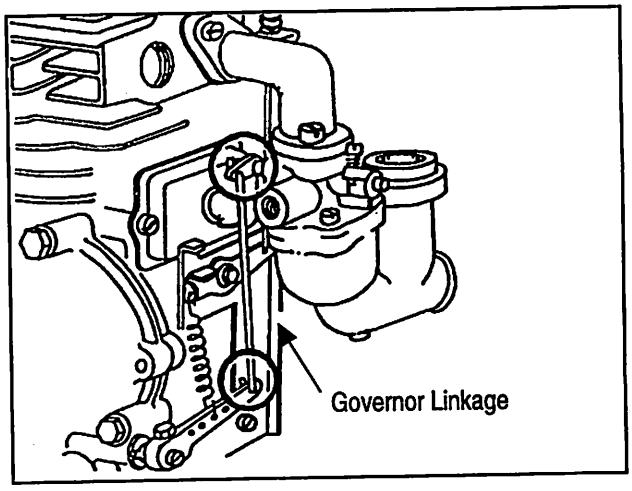


Illustrations courtesy of Briggs & Stratton Corporation

14. Torque bolt holding governor lever to 35-45 inch-lbs.



15. Manually check governor linkage for any binding. Use a good penetrating oil to correct any problems.

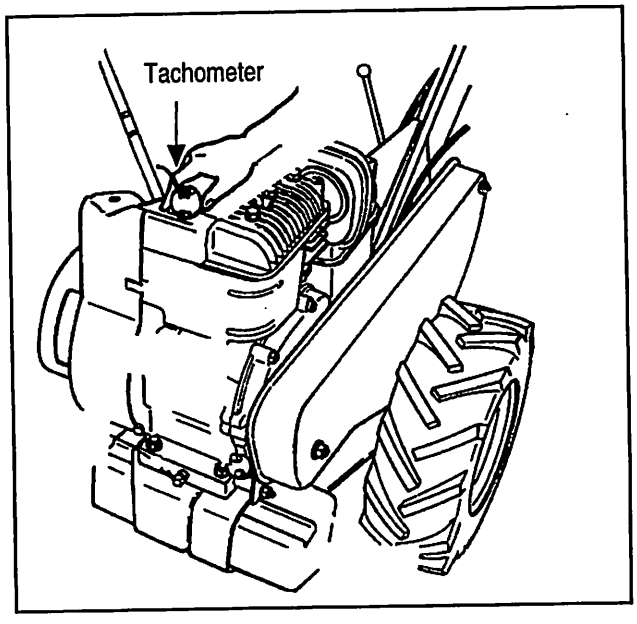


16. Reconnect spark plug wire.

17. Start engine and warm to operating temperature.

18. Check the no-load idle speed with a tachometer. The throttle control should be in the closed position. Adjust the no-load idle speed by adjusting the idle-stop screw. The idle-stop screw should be adjusted to 1750 rpm.

19. Check the no-load high-idle engine speed with a tachometer. Move the throttle control to full-open and the engine speed should remain constant. Check the recommended speed in your operator's manual.



No-load high speed		
Tiller	3200	r.p.m.
Generator	3200	r.p.m.
Pump	2700	r.p.m.

Illustrations courtesy of Briggs & Stratton Corporation

20. Adjust the governor if the engine does not come up to speed or overspeeds.
    a. Recheck steps 11-14.
    b. Check for binding in governor linkage.
    c. Check governor spring. It may be too loose if the spring has lost its tension.
    d. Check remote control lever for adjustment.

21. Check for surging.
    a. If surging occurs when changing from one load to another, check to see if the spring is too tight.
    b. If a substantial drop in rpm occurs when load is increased, the spring may be too loose.

22. Check for engine overspeed.
    a. Check spring tension.
    b. Check throttle linkage for binding and adjustment.

23. Clean your work area and return tools to their proper places.

24. See your instructor.

Illustrations courtesy of Briggs & Stratton Corporation

Governor Adjustment and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Servicing Mechanical Governors
		Disassembly
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Disconnect spark plug wire.
____	____	5. Study governor component location.
____	____	6. Inspect governor.
____	____	7. Draw a sketch of the governor linkage.
____	____	8. Remove mounting bolts from carburetor.
		Reassembly
____	____	9. Remove spring from governor lever and linkage control.
____	____	10. Install new linkage onto carburetor and governor lever.
____	____	11. Install a new spring onto linkage control and in third hole in governor lever.
____	____	12. Loosen bolt holding governor lever to governor shaft.
____	____	13. Adjust governor lever.
____	____	14. Torque bolt holding governor lever.
____	____	15. Check governor linkage for binding.
____	____	16. Reconnect spark plug wire.
____	____	17. Start engine and allow it to warm up.
____	____	18. Check the no-load idle speed with a tachometer.
____	____	19. Check the no-load high-idle engine speed.
____	____	20. Adjust the governor, if needed.
____	____	21. Check for surging.
____	____	22. Check for engine overspeed.
____	____	23. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

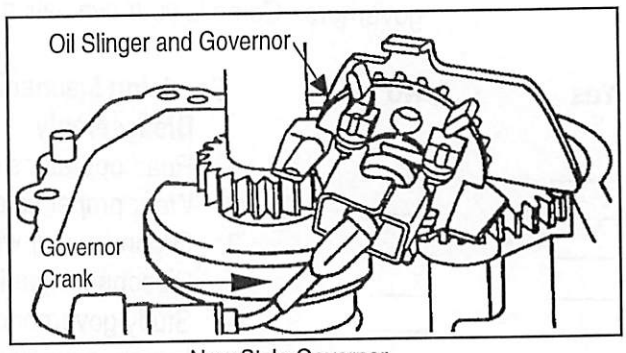
D. Step-By-Step Procedure for Servicing Mechanical Governor

(New Style) Aluminum Model Series 91700, 94500, 94900, 111700, 113900, 114700, 114900

1. Read operator's manual and *Briggs and Stratton Service and Repair Instructions.*

2. Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed.

3. Organize your work station.



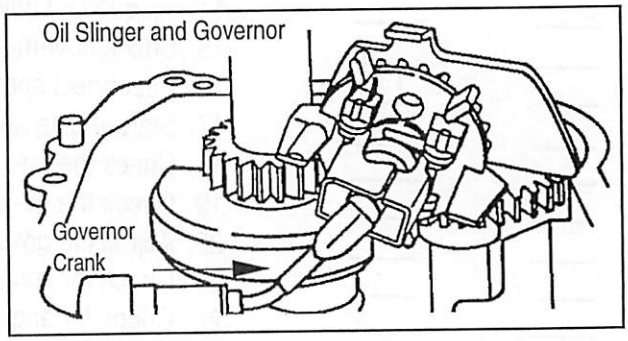
New Style Governor

Disassembly

4. Disconnect spark plug wire.

5. Study mechanical governor component location before disassembly. Note that the governor gear is part of the oil slinger assembly.

Note: Oil sump is removed from illustration.

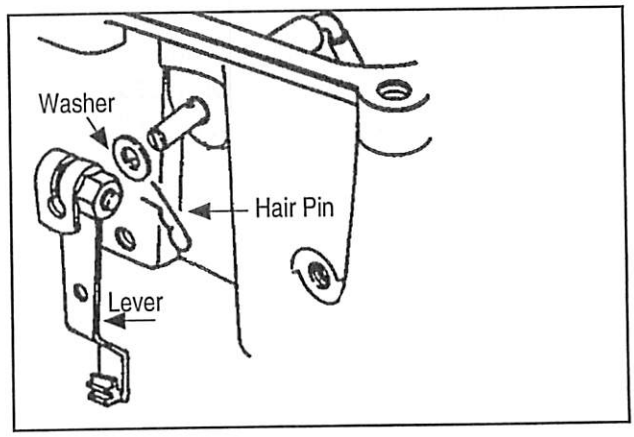


6. Inspect the mechanical governor for linkage wear or governor spring damage. Observe the amount of play in the governor shaft.

Illustrations courtesy of Briggs & Stratton Corporation

Disassembly

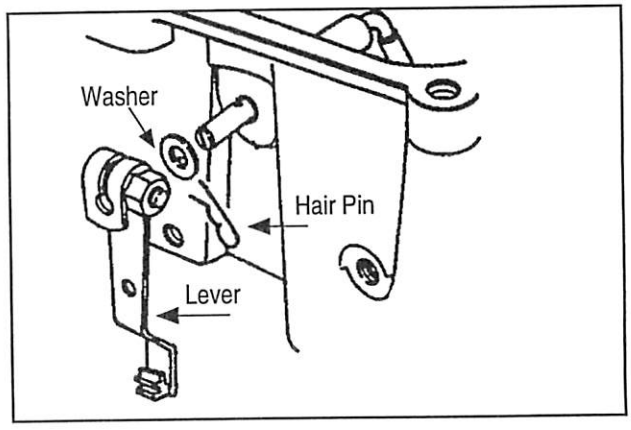
7. Service the governor.
   a. Remove the engine sump.
   b. Draw a sketch of the governor linkage before removal. Be sure to note position of spring in governor lever. This is very important for reassembly.
   c. Remove governor crank and carefully remove governor linkage.
   d. Remove hair pin and washer from governor crank.
   e. Use emery paper to remove any paint or burrs from governor crank.
   f. Remove governor crank.
   g. Clean and inspect all governor parts. Replace all damaged or worn parts.



8. Replace governor shaft bushing.
   a. Press old governor shaft bushing out of cylinder.
   b. Press new bushing into cylinder until housing is 1/16 inch above outside surface of cylinder.
   c. Use tool #19058 to finish ream bushing. Use kerosene or other lubricant to make a smooth finish.

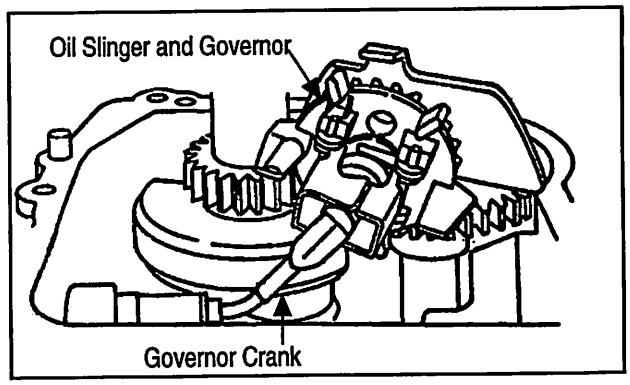
Reassembly

9. Assemble governor.
   a. Install the governor crank. See illustration.
   b. Place washer onto the governor crank and install hair pin.
   c. Install governor lever onto governor crank and tighten bolt and nut.
   d. Turn crank until paddle contacts governor cup on oil slinger.
   e. Snap governor link into the retainer on the governor lever.

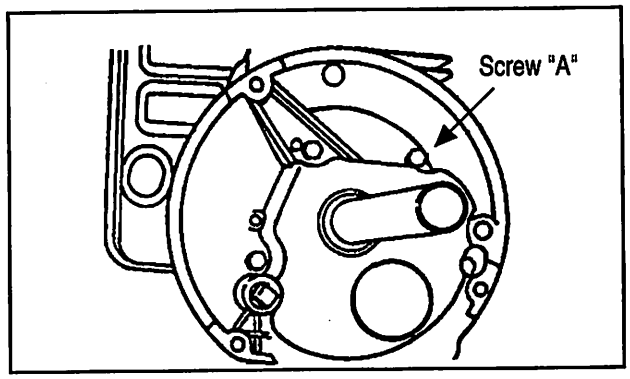


Illustrations courtesy of Briggs & Stratton Corporation

f. Install new gasket.
g. Install sump. (Use seal protector #19334 when installing the engine's sump base over thecrankshaft.)
h. Place a non-hardening sealant on Screw "A" and install sump screws to seal the sump. Torque screws to 90 inch-lbs.



10. Adjust the governor.
    a. Move the throttle control to full open position.
    b. Turn the governor crank counterclockwise (with a screwdriver) as far as it will go and while holding governor crank. Torque governor bolt nut to 35 to 45 inch-lbs.

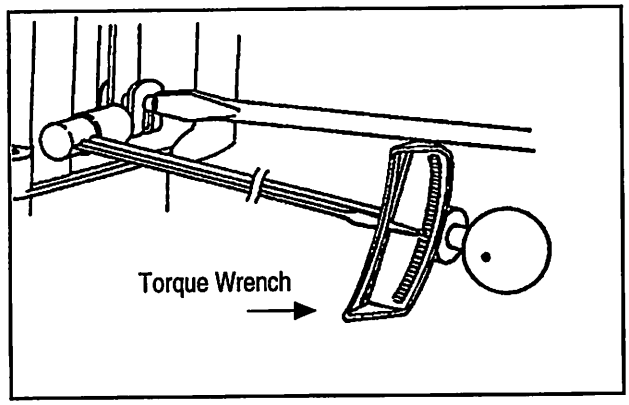


11. Check governor linkage for binding.

12. Reconnect spark plug wire.

13. Refer to steps 17-22 if adjustment is necessary.

14. Clean your work area and return tools to their proper places.



Illustrations courtesy of Briggs & Stratton Corporation

Governor Adjustment and Repair Competency Profile

Directions: This profile provides a record for student, instructor, and industry representative. Competencies listed represent tasks performed when adjusting and repairing small engine governors. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	NO	Servicing Mechanical Governor (New Style)
____	____	1. Read operator's manual.
____	____	2. Wear proper safety equipment.
____	____	3. Organize your work station.
____	____	4. Disconnect spark plug wire.
____	____	5. Study mechanical governor component location.
____	____	6. Inspect the mechanical governor.
____	____	7. Service the governor.
____	____	8. Replace governor shaft bushing.
____	____	9. Assemble governor.
____	____	10. Adjust the governor.
____	____	11. Check governor linkage for binding.
____	____	12. Reconnect spark plug wire.
____	____	13. Repeat steps 17-22 if adjustment is necessary.
____	____	14. Clean your work area.

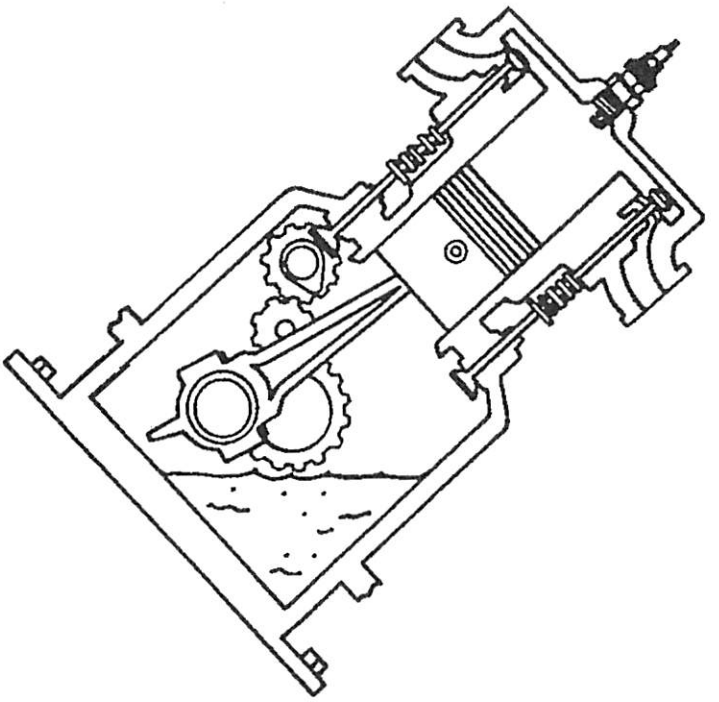
Student's Signature	Instructor's Signature	Date

10-7656-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Lubricating Small Engines

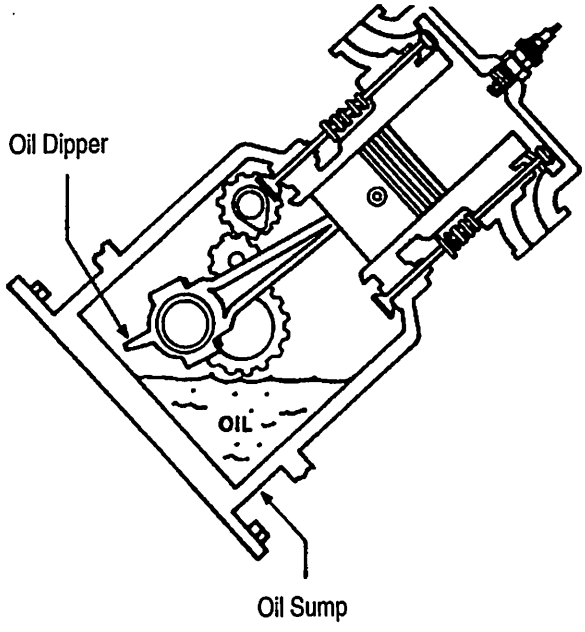


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

Module 6

Lubricating Small Engines



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

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References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Lubricating Small Engines

Unit Objectives

After completing this unit the student should be able to select the type and grade of oil to use in a four-cycle engine. The student should also be able to properly inspect the lubrication system and remove and replace the oil. This knowledge will be evidenced through the ability to properly service the lubrication system.

Specific Objectives

After completing this unit, the student should be able to:

1. Identify the correct type and grade of oil.

2. Demonstrate the ability to:
   a. Check the breather for proper clearance.
   b. Check the venting elbows and tubes for proper fit.
   c. Check the oil in the crankcase.
   d. Check the oil in the gear reduction case.
   e. Check the O-ring for proper seal.
   f. Properly change the oil in a four-cycle engine.
   g. Check the engine for oil leaks.

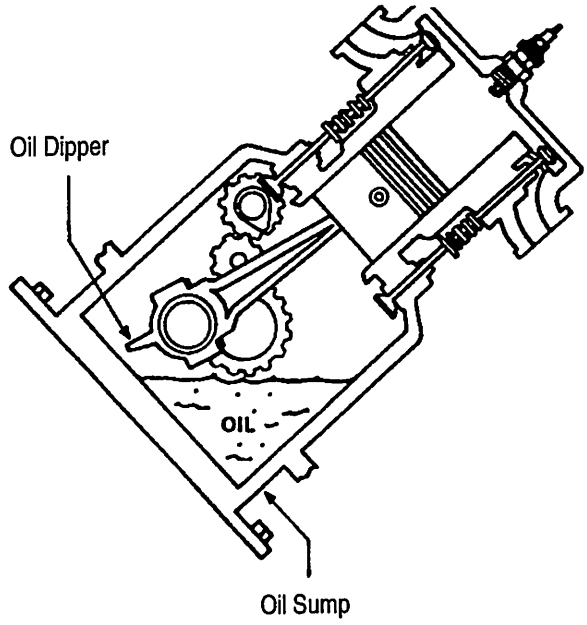
Lubricating Small Engines

Introduction

Oil is essential in engine operation. It lubricates, seals, cleans, removes heat, and reduces corrosion. Engine life depends on how well the engine is lubricated. Because of the high cost of replacing or overhauling a small engine, it is important to know how to properly service these powerplants. Charts are provided at the end of this unit for recording service information.

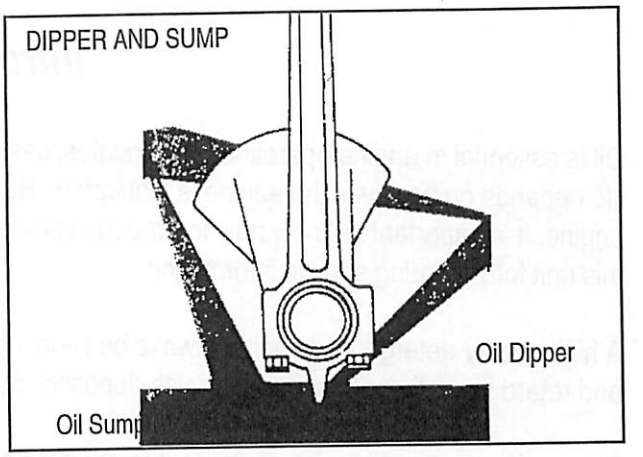
A high quality detergent oil should always be used in a small engine. Detergent oils keep the engine cleaner and retard formation of gum and varnish deposits. Special oil treatments should not be added to an engine.

Proper oil selection is also an important factor in small engine maintenance. Oil has two specification ratings. The first is the American Petroleum Institute (API) classifications of SC, SD, SE, or SF. The second is the Society of Automotive Engineers (SAE) viscosity rating, SAE 30 for example. When choosing lubricants for your engine, always refer to your service manual for recommended oil ratings.

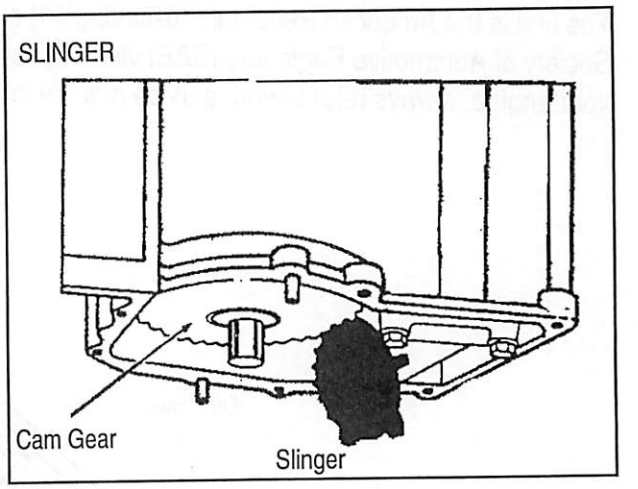


How the Lubrication System Works

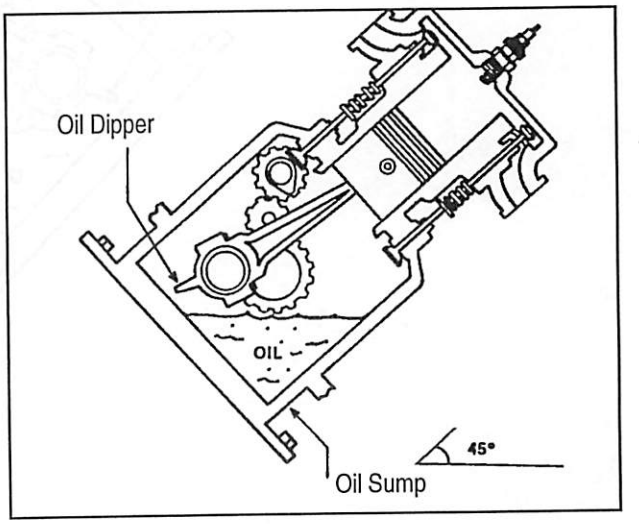
All four-cycle engines are lubricated from an oil reservoir. Two common methods of lubrication used in Briggs and Stratton engines are:



- *Dipper and Sump.* As the crankshaft turns, oil is picked up from the sump by the dipper which is attached to the rod bearing cap. The oil is splashed to all moving parts in the crankcase.



- *Slinger.* Oil is picked up from the oil sump by a rotating slinger and oil is splashed to all moving parts inside the crankcase. The oil slinger is driven by the cam gear.



Both lubrication systems are effective under normal operating conditions. However, when an engine is tilted at an angle greater than 45 degrees, oil in the crankcase is shifted to one side. Therefore, do not to run an engine at this angle for extended periods.

A. Tools and Materials Needed in Lubricating Small Engines

Tools

Safety glasses

Slot-head screwdriver (8")

Standard screwdriver (8")

Combination pliers (7")

End wrenches (7/16", 1/2", 9/16", and 5/8")

Funnel with flexible spout

Drain pan

Container for old oil

Wire feeler gauge

Supplies

Container for cleaning parts

Shop towels

Oil as recommended

Solvent

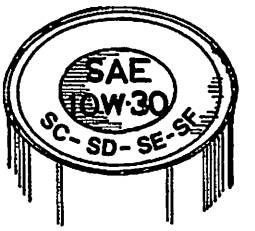
Hand cleaner

New breather gasket

Gasket for oil-fill plug

O-ring for oil-fill tube

B. Step-By-Step Procedure in Checking and Adding Oil to the Lubrication System



1. Read operator's manual and Briggs and *Stratton Service and Repair Instructions.*

2. Wear proper clothing and safety equipment.

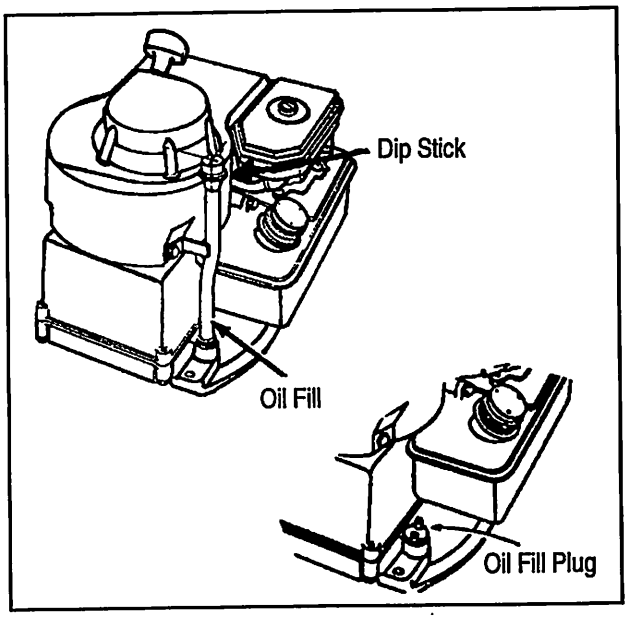
CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

4. Disconnect spark plug wire from spark plug and place wire in V-notch on engine.

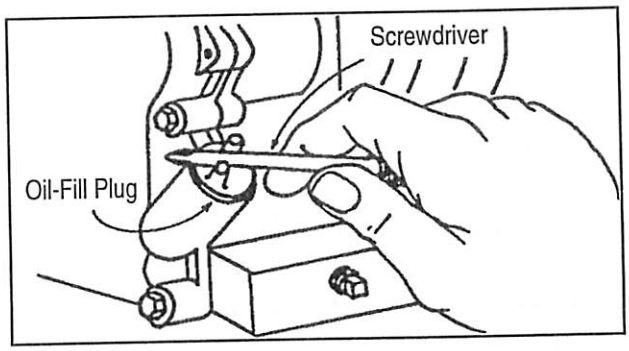
5. Locate the crankcase oil-fill plug on your engine.

Note: On small tractors it will be necessary to raise the hood to locate the crankcase oil-fill plug. A dipstick may be attached to the filler plug on the crankcase or to a cap on the filler neck. Some engines do not have a dipstick and the oil-fill plug is located on the oil sump.

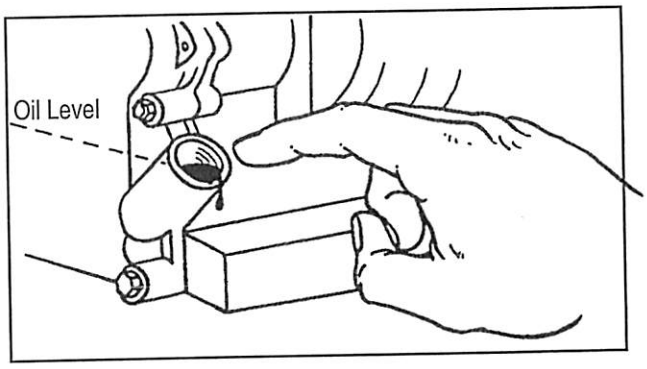


Illustrations courtesy of AAVIM

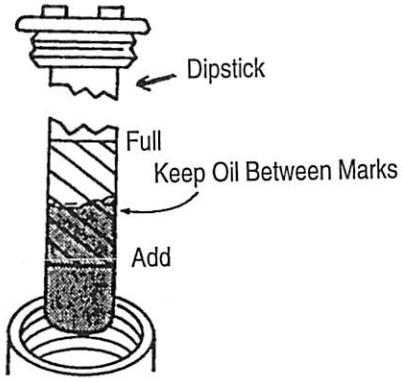
6. Remove crankcase oil-fill plug with a screwdriver.



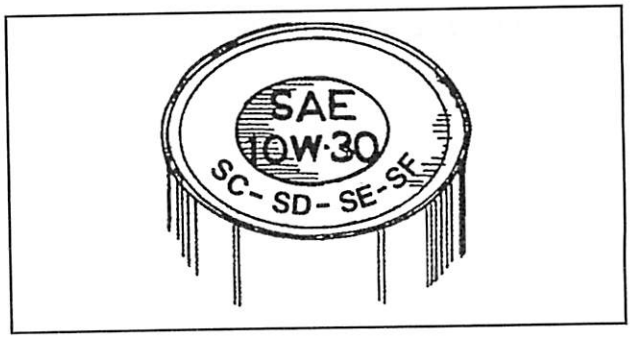
7. Check oil level in crankcase
   a. Place engine in level position.
   b. If your engine does not have a dipstick, check to see if oil comes to top of filler hole or to a place that indicates full oil level.



   c. If your engine has a dipstick, remove and wipe it with a clean rag. Reinsert dipstick and check oil level. Some dipsticks must be screwed or pushed in for accurate reading. Keep oil level between "full" and "add" lines.



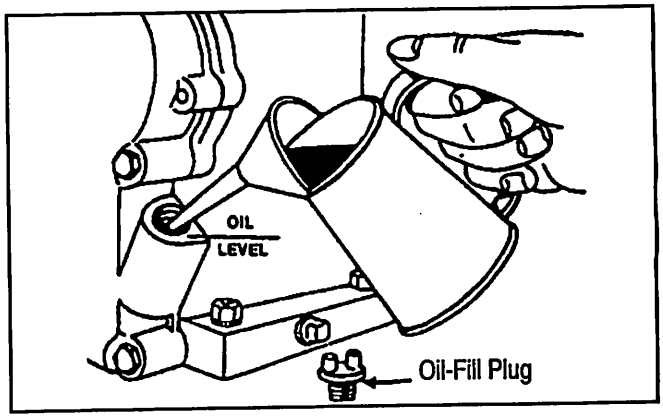
8. Check operator's manual for crankcase oil recommendations. Use a high quality detergent oil such as "10W-30" or 30 weight classified "For Service SC, SD, SE, or SF." Classification markings are on the container.

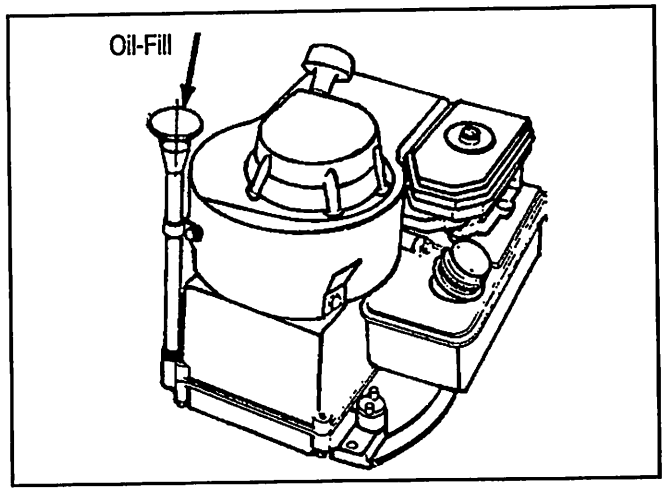


Illustrations courtesy of Briggs & Stratton Corporation

9. Add oil in crankcase filler plug or dipstick opening (if needed) until oil reaches the full mark. Do not overfill. Replace oil-fill plug or dipstick.

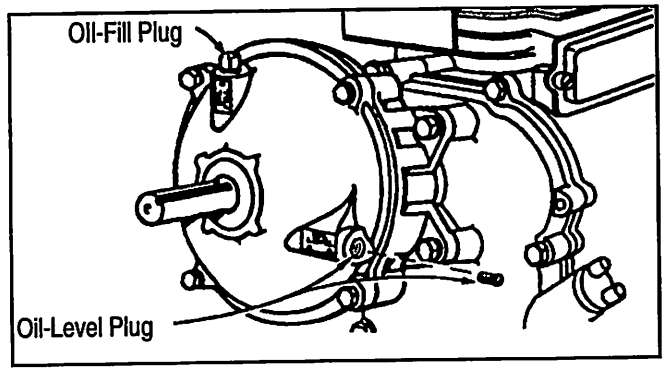
Note: Steps 10, 11, and 12 are appropriate for the models illustrated. Cast iron engines and other models will differ. (See operator's manual.)





10. Check oil level in the gear reduction case (if equipped).
    a. Place engine in level position.
    b. Remove oil-level plug in lower half of gear cover.
    c. Oil should be level with the opening when plug is removed.

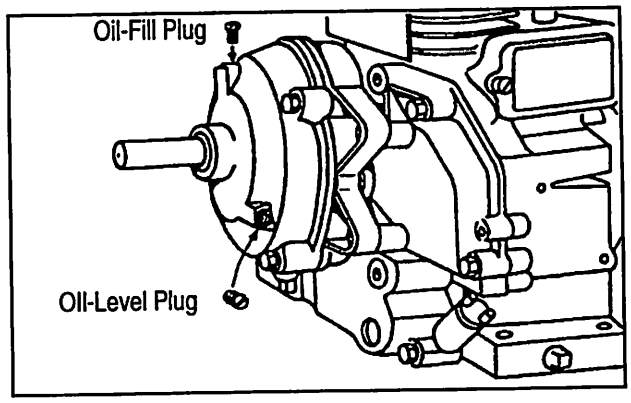
Note: Gear reduction oil is generally replaced every 100 hours of operation.



6 To 1 Gear Reduction Models
6,8, 60000, 80000, 100000, & 130000

Illustrations courtesy of Briggs & Stratton Corporation

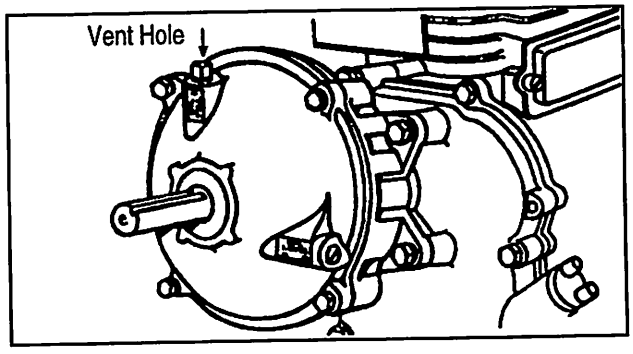
11. Add gear reduction case oil (if needed).
    a. Remove gear reduction case oil-filler plug and oil-level plug.
    b. Add SAE 10W-30 or crankcase oil to upper oil-fill plug until oil runs out of lower opening.



(Gear Reduction) Aluminum Engines
Models 140000, 170000, & 190000

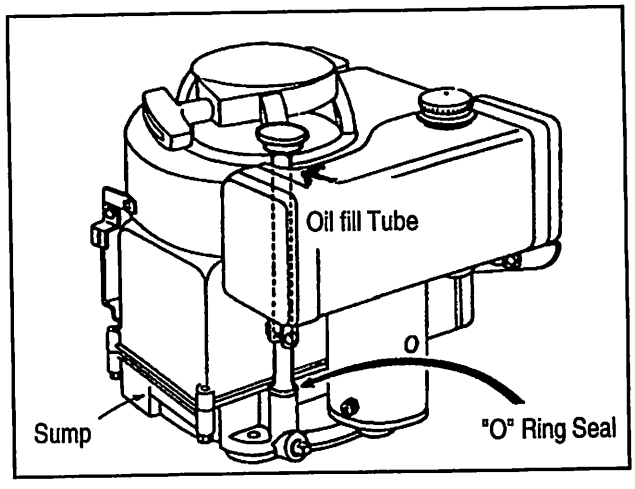
12. Replace both gear reduction case plugs. The oil-filler plug has a vent hole and must be placed in the top opening. The oil-level plug has no vent hole.

Note: To drain gear reduction case, remove oil level plug and oil fill plug. Loosen the four screws holding gear case cover. Replace cover screws and torque to 85 inch-lbs. Replace oil level to recommended level and oil fill plugs.

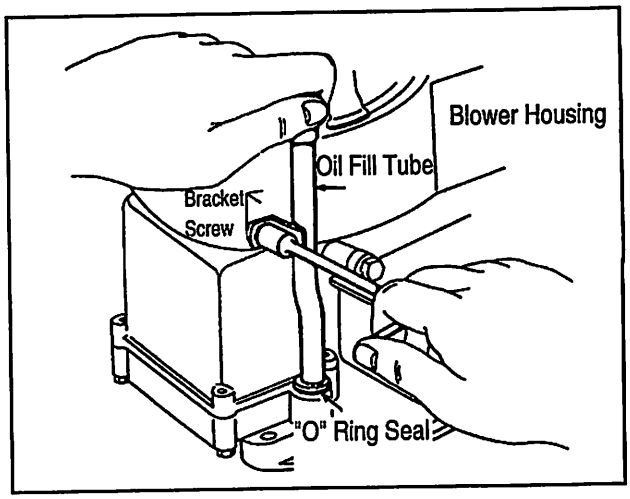


13. Check O-ring seal between crankcase oil-fill tube and sump for oil leakage.

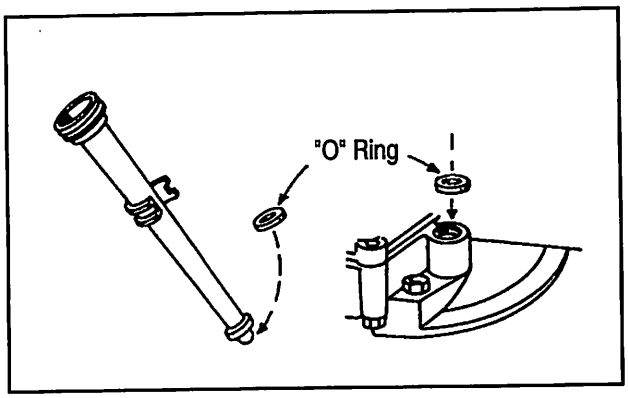
Note: A poor fit will result in a loss of crankcase vacuum and a discharge of smoke through the muffler.



14. Remove damaged O-ring (if needed).
    a. Remove gas tank (on some models).
    b. Remove bracket screw from blower housing.
    c. Pull up on the oil-fill tube and remove from sump.
    d. Remove damaged O-ring seal from oil-fill tube.
    e. Clean tube and around sump with solvent.

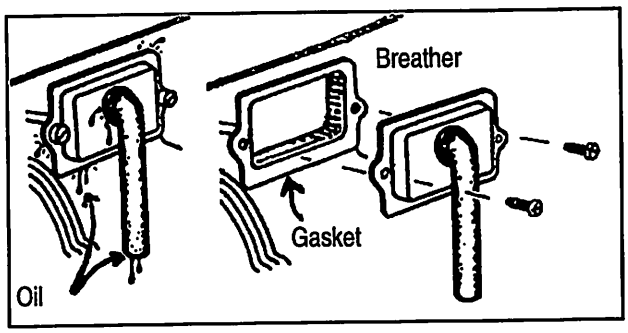


15. Install new O-ring (if needed).
    a. Place O-ring into groove in sump. (On some models the O-ring should be placed in groove on oil-fill tube.)
    b. Push oil-fill tube downward into sump.
    c. Tighten bracket screw to blower housing to secure the tube.



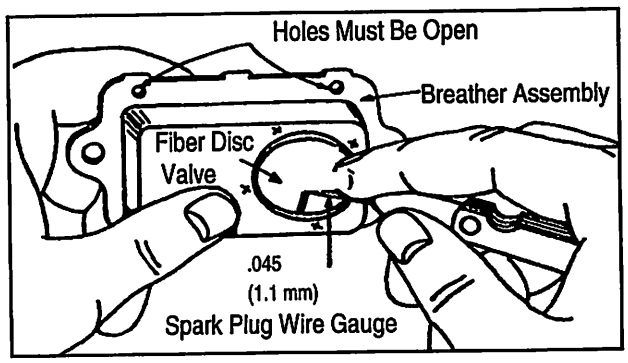
16. Check breather for signs of oil leakage.

Note: A fiber disc valve in the breather limits the direction of air flow caused by movement of the piston. Air can flow out of the crankcase but the disc valve prevents the return flow of air. This maintains a vacuum in the crankcase.



17. Remove breather from engine and check for proper clearance.

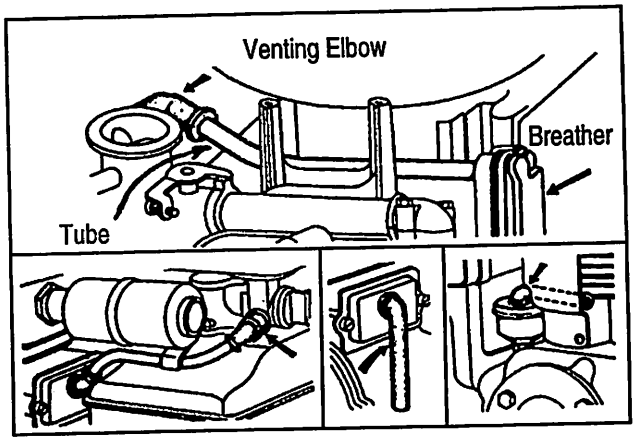
Note: A new breather should be installed if a .045 wire gauge will enter the space between fiber disc valve and body. Do not apply force when checking with wire gauge. (See illustration.)



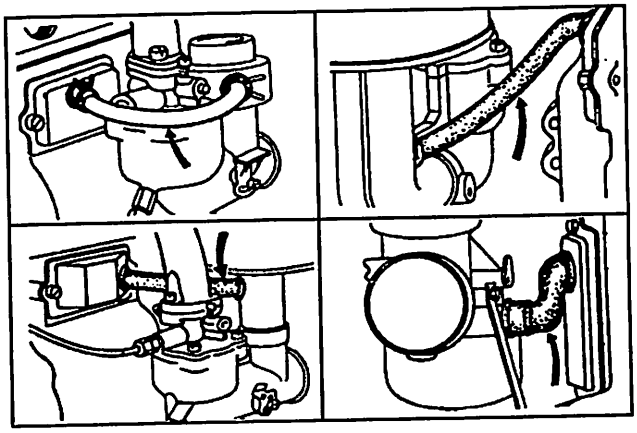
Illustrations courtesy of Briggs & Stratton Corporation

18. Inspect venting elbows for loose fit and damaged tubes. Replace if necessary.

Note: It is very important to have a good seal at all venting elbows to prevent dirt from entering the crankcase.



19. Check for oil leaks and level.
    a. Reconnect spark plug wire.
    b. Start engine and run for 10 minutes or until engine reaches operating temperature.
    c. Check for oil leaks.
    d. After engine has cooled somewhat, check oil level.



20. Clean your work area and return tools to proper places.

Note: Properly dispose of oily rags to avoid spontaneous combustion. Seal any partially used oil cans to protect oil from dirt.

Lubricating Small Engines Competency Profile

Directions: This profile provides a record for student, instructor and industry representative. These competencies represent tasks performed when servicing and repairing small engines. Compile your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Checking and Adding Oil to the Lubrication System
___	___	1. Read operator's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize work station.
___	___	4. Disconnect spark plug wire.
___	___	5. Locate the crankcase oil-fill plug.
___	___	6. Remove crankcase oil-fill plug.
___	___	7. Check oil level in crankcase.
___	___	8. Check oil recommendations.
___	___	9. Add oil.
___	___	10. Check oil level in the gear reduction case.
___	___	11. Add gear reduction case oil.
___	___	12. Replace both gear reduction case plugs
___	___	13. Check O-ring seal for oil leakage.
___	___	14. Remove damaged O-ring (if needed).
___	___	15. Install new O-ring (if needed).
___	___	16. Check breather for signs of oil leakage.
___	___	17. Remove breather from engine and check for proper clearance.
___	___	18. Inspect venting elbows for loose fit and damaged tubes.
___	___	19. Check for oil leaks and proper level.
___	___	20. Clean your work area.

Student's Signature _____ Instructor's Signature _____ Date _____

C. Step-by-Step Procedure in Changing Crankcase Oil (4-Cycle Engines).

1. Read operator's manual and Briggs and Stratton Service and Repair Instructions.

2. Wear proper clothing and safety equipment.

CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

3. Organize your work station.

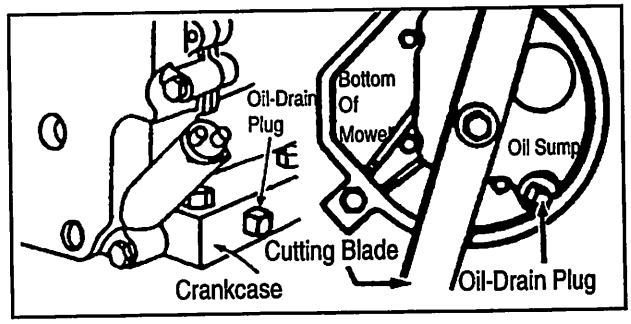
4. Start engine and run for 10 minutes or until it has reached normal operating temperature.

Note: More contaminants are removed with the oil change when oil is hot.

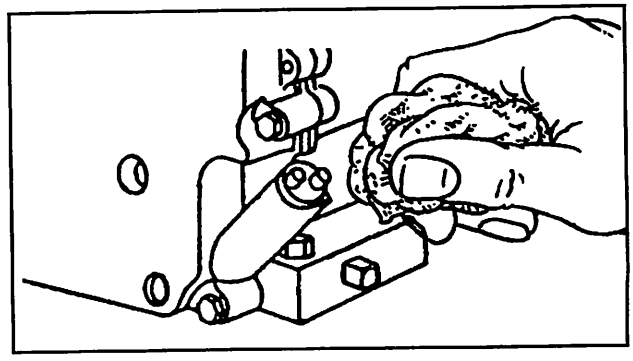
5. Stop engine and disconnect spark plug wire. Place spark plug wire in V-notch.

6. Locate drain plug.

Note: On most engines the drain plug will be located on the bottom of the oil sump or on the edge of crankcase. On some engines the oil is drained through the filler neck.



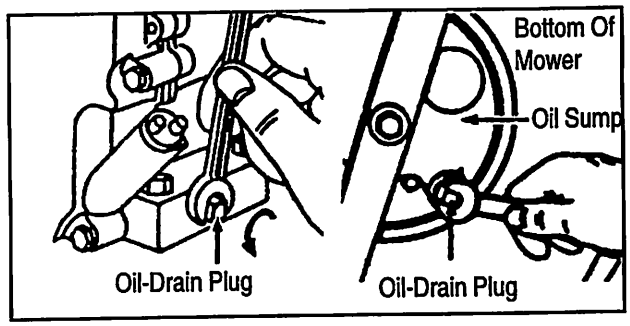
7. Remove dirt and oil around drain plug using a solvent.



8. Remove drain plug with appropriate wrench.

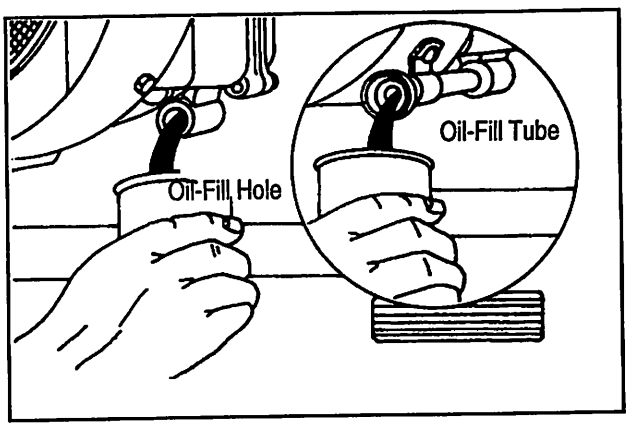
Note: Do not use pliers. Pliers will round off corners of drain plug.

9. Place engine on level surface and allow oil to drain for about five minutes. Replace drain plug.



10. Refill crankcase with new oil. Refer to operator's manual for correct oil amount.

Note: Use a high quality detergent oil classified "For Service SC, SD, SE, or SF." Detergent oil keeps engine cleaner and retards formation of gum and varnish deposits. Nothing should be added to the oil. See chart on page 19 for recommended SAE viscosity grades. See oil capacity chart for Briggs and Stratton engines on this page. (10W-40 oil may be used if 10W-30 is not available. A synthetic oil having 5W-30 or 5W-40 viscosity may also be used.)



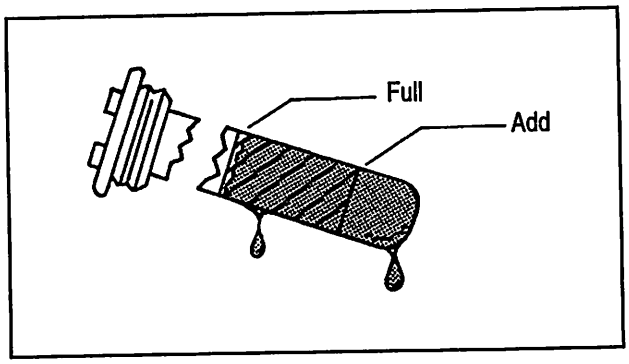
Oil Capacity Chart

Basic Model Series Vertical Crankshaft Aluminum Cylinders	Capacity/Pints
60000, 80000, 90000, 100700, 110000, 120000	1-1/4
100900, 130000	1-3/4
140000, 170000, 190000	2-1/4
220000, 250000, 280000	3
Horizontal Crankshaft Aluminum Cylinders	
60000, 80000, 100200, 130000	1-1/4
140000, 170000, 190000	2-3/4
220000, 250000	2-1/2
Horizontal Crankshaft Cast Iron Cylinders	
9, 14, 19, 190000, 200000	3
230000, 240000, 300000, 320000	4

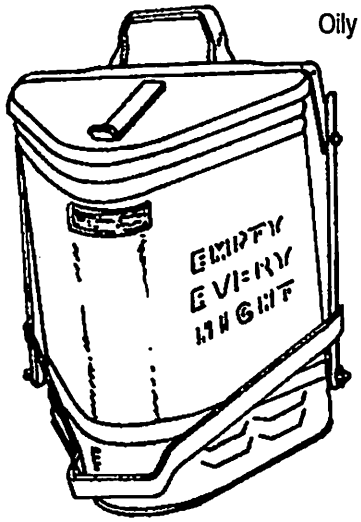
11. Check for oil leaks.
    a. Reconnect spark plug wire.
    b. Start engine.
    c. Run engine until it has reached operating temperature.
    d. Check for oil leaks.

Illustrations courtesy of Briggs & Stratton Corporation

12. Check oil level.
    a. Stop engine.
    b. Allow engine to cool somewhat.
    c. Recheck oil level. If oil is not to the "full" line, add oil until it reaches that level. Do not overfill.



13. Clean your work area and return tools to proper places. Properly dispose of oily rags to avoid spontaneous combustion. Properly seal any partially used oil containers to protect oil from dirt.



Oily Rag Storage Container

Lubricating Small Engines Competency Profile

Directions: This profile provides a record for student, instructor and industry representative. These competencies represent tasks performed when servicing and repairing small engines. *Compile* your evaluation by checking the appropriate "yes/no" rating.

Yes	No	Changing the Crankcase Oil (4-Cycle Engines).
___	___	1. Read operator's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize your work station.
___	___	4. Warm engine.
___	___	5. Disconnect spark plug wire.
___	___	6. Locate drain plug.
___	___	7. Remove dirt and oil around drain plug.
___	___	8. Remove drain plug.
___	___	9. Drain oil. Replace drain plug.
___	___	10. Refill crankcase with new oil.
___	___	11. Check for oil leaks.
___	___	12. Check oil level.
___	___	13. Clean your work area.

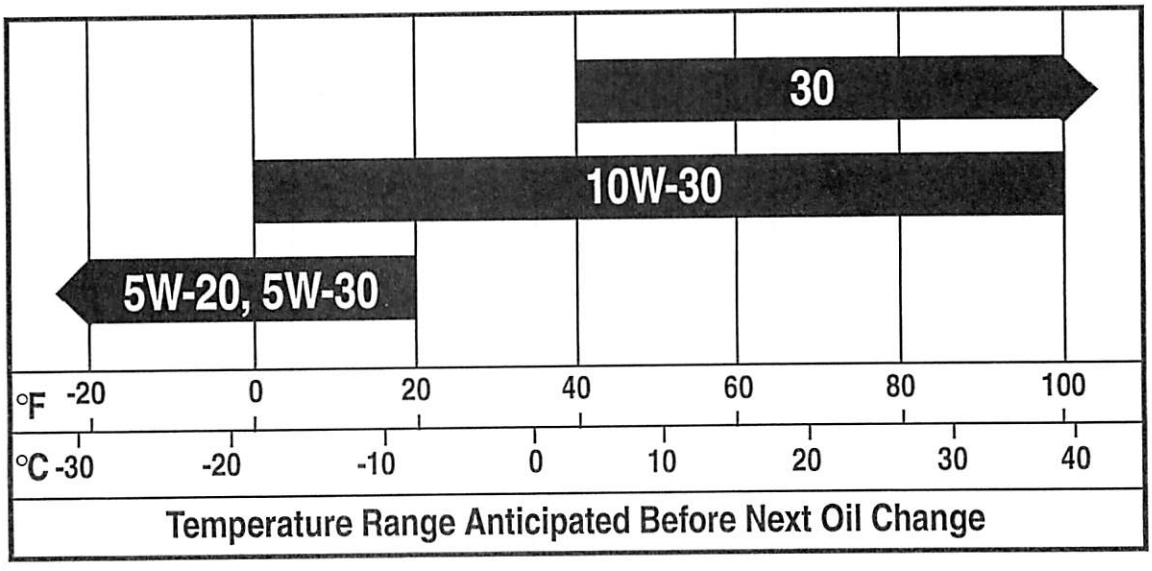
Student's Signature _____ Instructor's Signature _____ Date _____

Troubleshooting The Lubrication System

If engine starts but consumes oil excessively, check the following:

- ☐ Crankcase breather clogged
- ☐ Piston burned or warped
- ☐ Cylinder bore worn
- ☐ Piston rings worn
- ☐ Engine overheating
- ☐ Wrong oil used
- ☐ Oil diluted by rich mixture

Recommended SAE Viscosity Grades



Lubrication Service Chart

Keep a record of oil changes on your small engines.

Change oil after first five hours of operation.

Thereafter change oil every 25 hours of operation.

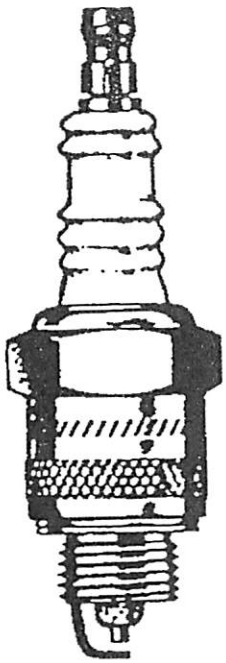
Equipment Model Number	Date Oil Changed	Hours of Operation	Type of Oil Used

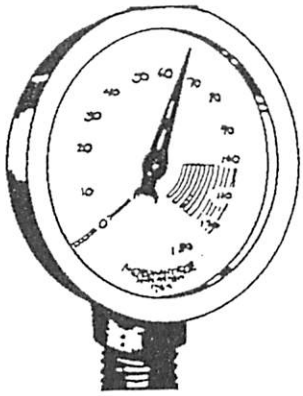
10-7657-S

STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Troubleshooting Small Engines





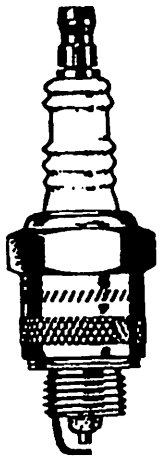
- Carburetion
- Compression
- Spark Plug
- Ignition

Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

Module 7

Troubleshooting Small Engines



- Carburetor
- Spark Plug
- Ignition
- Compression

Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engine Carburetor Service and Repair, Second Edition.

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References

Service and Repair Manual, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, -Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine kService Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book Company, St. Louis, Missouri.

Troubleshooting Small Engines

Unit Objectives

After completion of this unit, the student should be able to troubleshoot the four basic engine systems: ignition system, spark plug condition, fuel system, and compression. This knowledge will be evidenced through the ability to properly troubleshoot small engines.

Specific Objectives

After completion of this unit, you should be able to:

1. List the safety cautions while troubleshooting small engines.
2. List requirements for an engine to run properly.
3. List the four basic tests of the troubleshooting procedure.
4. Demonstrate the ability to:
   a. Troubleshoot the fuel system.
   b. Troubleshoot the ignition system.
   c. Check spark plug condition.
   d. Troubleshoot engine compression.

Troubleshooting Small Engines

Introduction

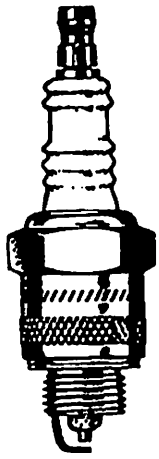
An engine must have compression, fuel, and ignition in order to start and run. Troubleshooting is the process of locating and eliminating sources of trouble in the engine which prevent starting and running requirements.

Take a systematic approach when you troubleshoot a small engine. Observe the easiest things first. Before making any adjustments or corrections on the engine, carefully check oil level, fuel in the tank and carburetor, loose blade, air filter contamination, and cooling fin blockage. Also, check all parts to make sure they are securely mounted. After these checks have been made you are ready to perform the four basic engine tests:

1. Check fuel supply to the combustion chamber.
2. Check the ignition system.
3. Check the spark plug.
4. Check compression.

Before attempting to troubleshoot a small engine, always follow safety procedures and remove any unsafe material from your work area.

This unit covers special tools and supplies needed, a detailed step-by-step procedure for performing the four basic engine tests in troubleshooting, and reference tables of suggested repair procedures.



A. Tools and Materials Needed in Testing the Four Basic Engine Systems

Tools

Common 8" screwdriver

Phillips screwdriver (6")

Spark plug sockets (13/16", 3/4", and 5/8")

Drive ratchet (3/8")

Adjustable wrench (6")

Combination wrenches (1/2", 7/16", 9/16", and 3/4")

Combination pliers

Long nose pliers

Tester tool

Wire brush

Knife

Wire feeler gauge

Ignition file

Compression gauge

Safety glasses

Supplies

Shop towels

Hand cleaner

Note: Additional tools will be needed for suggested repair procedures listed in the Troubleshooting Tables. Tool lists are located in the front of each Step-By-Step Procedure Manual.

B. Step-By-Step Procedure for Performing the Four Basic Engine Tests

Note: ***Use the Four Basic Engine Tests to diagnose an engine problem. All four tests should be performed. After the problem area has been identified, refer to Table I through Table IX which list possible specific problems and repair procedures.***

Check Fuel Supply

1. Read operator's manual and *Briggs and Stratton Service and Repair Instructions.*

2. Wear proper clothing and safety equipment.

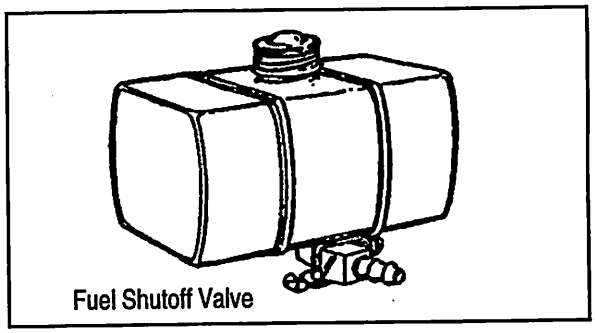
⚠ ***CAUTION: Observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.***

3. Organize your work station.

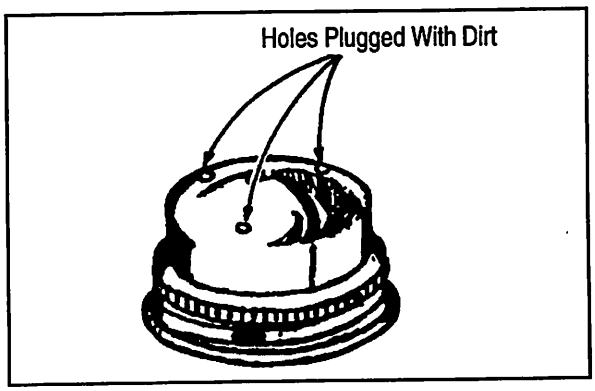
4. Determine if fuel is entering combustion chamber.
   a. Close the choke.
   b. Remove the spark plug and place the plug wire in a grounded position.
   c. Place your thumb or finger over the spark plug hole.
   d. Pull the starter 2 to 3 times. Your finger will be wet if fuel is getting to the combustion chamber.
   e. If finger is dry, check further for a fuel problem.
   f. Install spark plug and spark plug wire.

5. Check for fuel in the fuel tank.

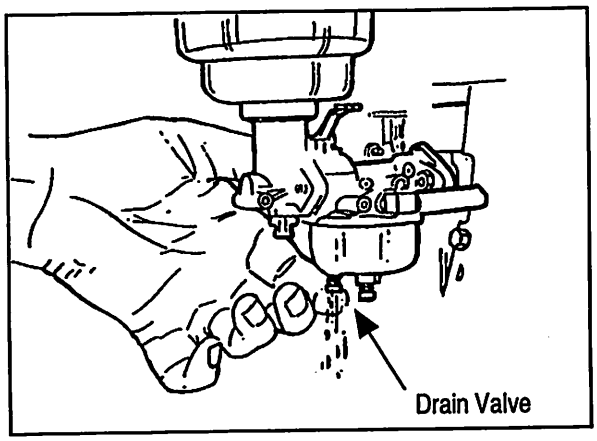
6. Check to see if fuel shut-off valve is closed.



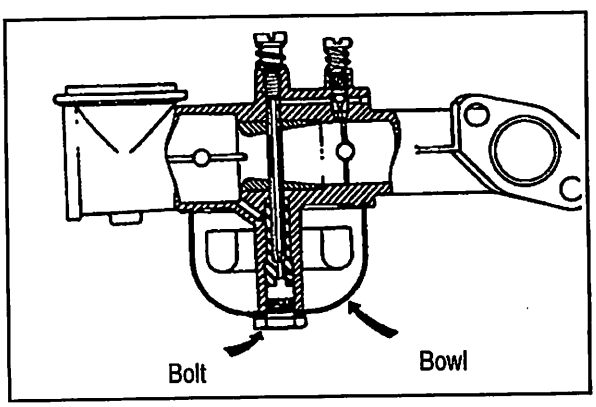
7. Check for plugged fuel tank cap vents. A plugged vent will cause excessive vapor pressure to build up in the tank and result in engine stoppage.



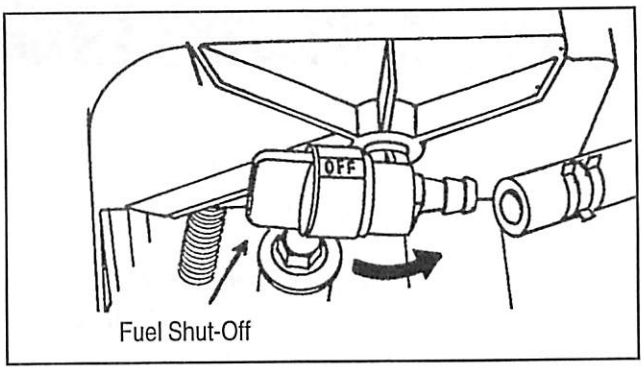
8. Check carburetor equipped with a bowl drain valve.
   a. Press the valve and let a small amount of fuel drain into a container.
   b. When fuel drains from valve, this indicates that fuel is getting from the tank to the carburetor.



9. Check carburetor not equipped with a drain valve.
   a. Remove bowl from the carburetor.
   b. Loosen bolt or nut from bowl drain and check for gas in the bowl.

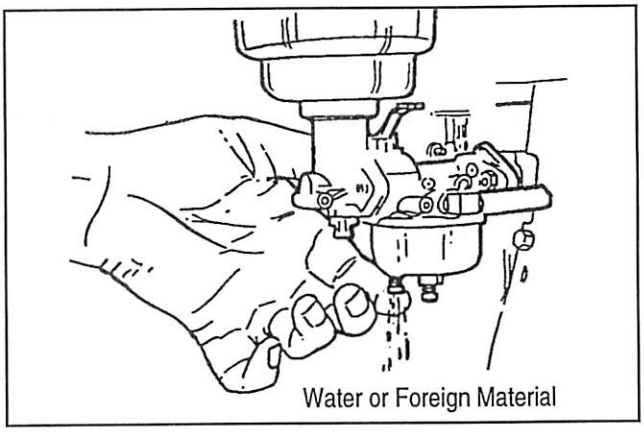


10. Check for fuel obstruction from the tank to the carburetor.
    a. Verify that fuel shut-off valve is closed.
    b. Remove and inspect fuel shut-off valve and strainer.

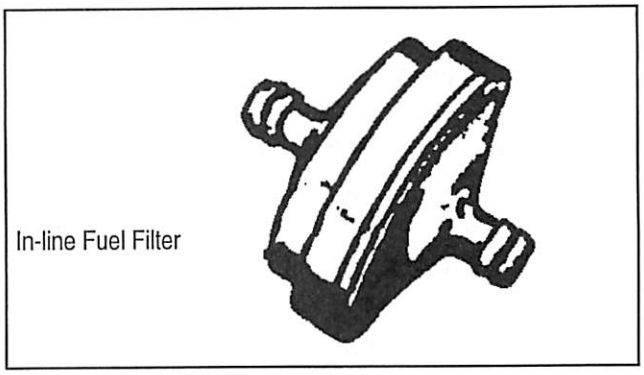


Fuel Shut-Off

11. Check for foreign matter or water in fuel. If water or foreign material is present, the carburetor will need to be serviced.


Water or Foreign Material

12. Check fuel filter for clogged element. If dirty, remove and replace with a new in-line filter.


In-line Fuel Filter

Test Ignition System

1. Read operator's manual and Briggs and Stratton Service and Repair Manual.

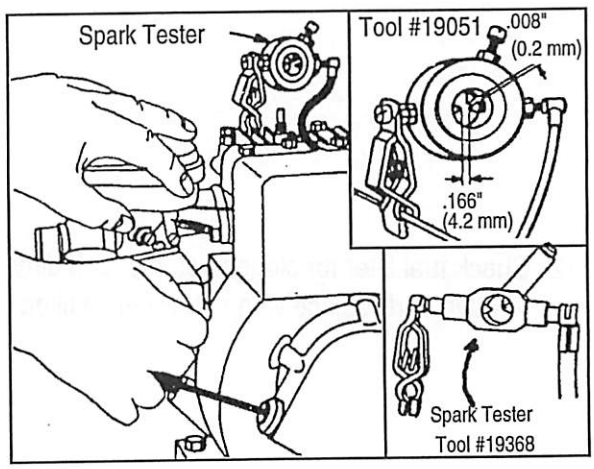
WARNING: Wear proper safety equipment and observe this symbol as a WARNING or CAUTION. Personal injury may occur unless instructions are followed carefully.

2. Organize your work station.

WARNING: Do not remove spark plug when checking ignition.

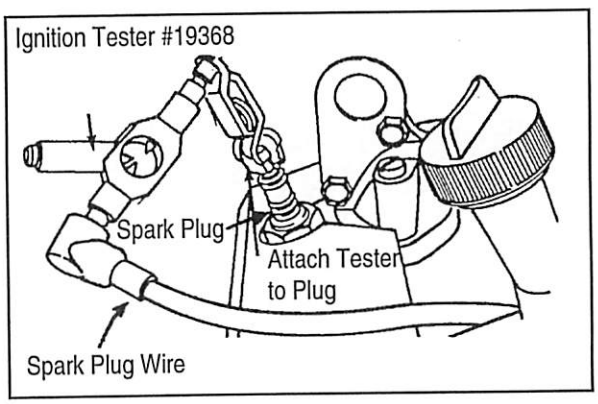
WARNING: Do not test ignition when fuel vapor is present.

3. Check for spark at spark plug.
   a. Use Briggs and Stratton test tools #19051 or 19368.
   b. Connect the spark plug wire to the long terminal of spark tester.
   c. Ground test to engine using the alligator clip.
   d. Crank the engine 2 to 3 times and observe the spark at the test plug. The spark should jump the gap and should be a bright blue color. This indicates the ignition system is functioning properly. A spark that does not jump the tester gap indicates you have an ignition problem.



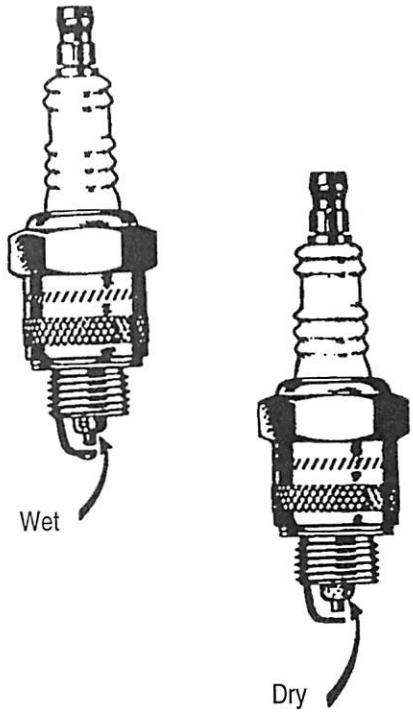
Note: Engines equipped with <u>Magnetron Ignition the flywheel must rotate at least 350 RPM to properly test ignition</u>.

4. Check engine for a spark miss.
   a. Place test tool #19051 or #19368 in series with engine spark plug and spark plug wire.
   b. Start engine to check engine miss.
   c. A miss usually indicates the spark plug is fouled or faulty. Replace with a new spark plug.

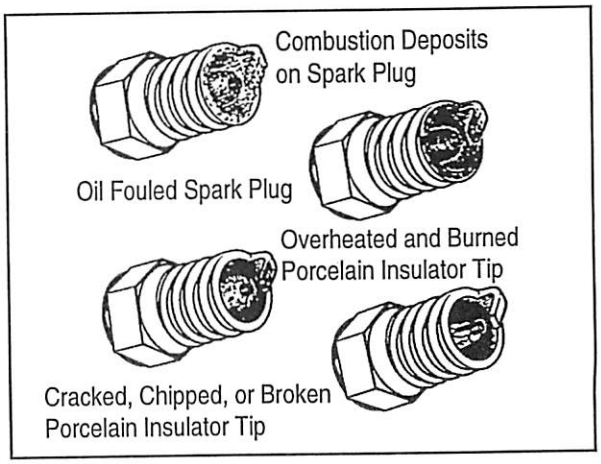


Check the Spark Plug

1. Wear proper safety equipment.
2. Read operator's manual.
3. Organize your work station.
4. Use compressed air to blow away the dirt around the plug before removing the spark plug. Remove the spark plug and secure the spark plug wire.
5. Inspect spark plug. If the plug is wet with fuel, this indicates that fuel is getting to the combustion chamber.
6. Inspect spark plug. If the plug is dry, this indicates a fuel system problem.

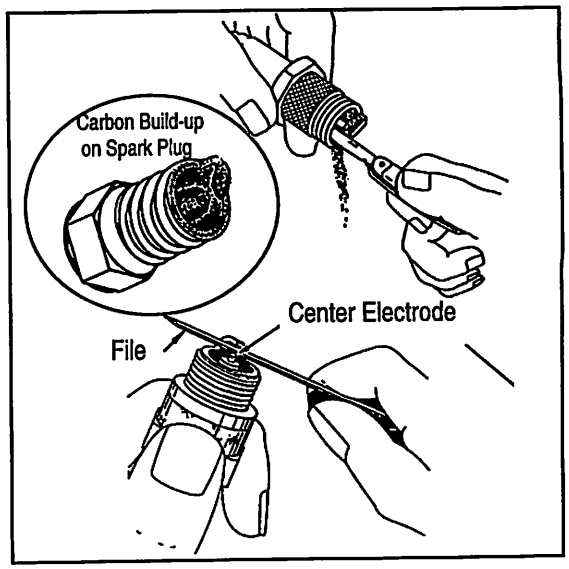


7. Inspect spark plug for fouling or damage. Spark plugs with combustion or oil deposits, burned or cracked insulators, or damaged electrodes should be replaced.

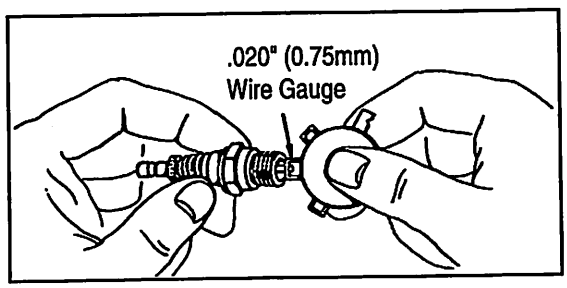


8. Service spark plugs with slight carbon build-up Clean plug to remove carbon.

Note: Do not use an abrasive cleaning machine to clean spark plugs.



9. Check the spark plug gap. Regap the plug to engine specifications.



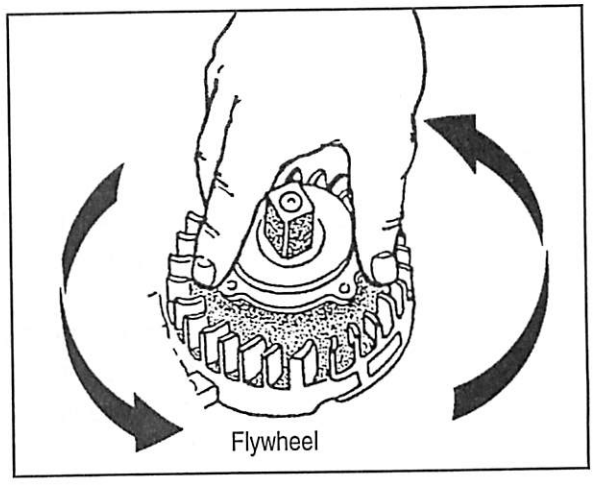
Checking Compression

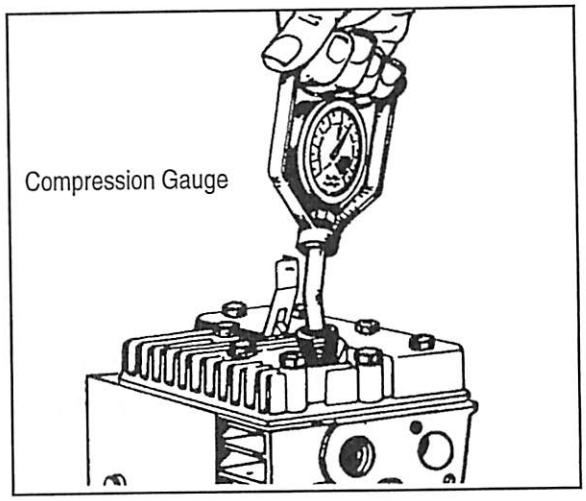
1. Wear proper safety equipment.
2. Read operator's manual.
3. Organize your work station.
4. Remove the spark plug wire from the spark plug and secure.
5. Test compression stroke.
   a. Manually spin the flywheel counter-clockwise against the compression stroke.
   b. A sharp rebound indicates satisfactory compression.
   c. Slight or no rebound indicates poor compression.
6. Verify compression test.
   a. Remove spark plug wire from spark plug and secure.
   b. Pull starter rope slowly and observe the compression.
   c. Resistance to the pull of the starter indicates there is compression.
7. Check the engine compression with a compression gauge.
   a. Crank the engine over at least six times and read the compression gauge.

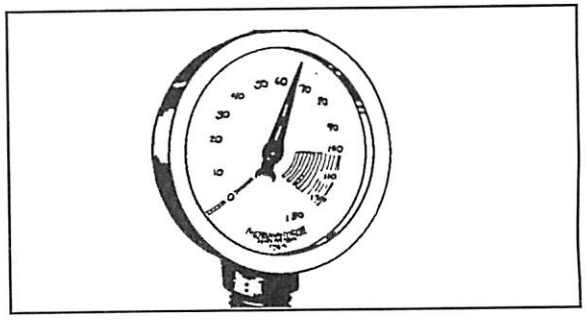
Note: For satisfactory operation the minimum gauge reading should read above 60-psi on most engines.

Note: Briggs and Stratton does not publish any compression pressures, as it is extremely difficult to obtain an accurate reading.

Engine	Through 4.5 hp	Above 4.5 hp
4 cycle engine	65-75 psi	over 70 psi


Flywheel


Compression Gauge



Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in troubleshooting small engines. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Troubleshooting Small Engines
		Check Fuel Supply
___	___	1. Read operator's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize your work station.
___	___	4. Determine if fuel is entering combustion chamber.
___	___	5. Check for fuel in the fuel tank.
___	___	6. Check to see if fuel shut-off valve is closed.
___	___	7. Check for plugged fuel tank cap vents.
___	___	8. Check carburetor equipped with a bowl drain valve.
___	___	9. Check carburetor not equipped with a drain valve.
___	___	10. Check for fuel obstruction from the tank to the carburetor.
___	___	11. Check for foreign matter or water in fuel.
___	___	12. Check fuel filter for clogged element.
		Test Ignition System
___	___	1. Read operator's manual.
___	___	2. Organize your work station.
___	___	3. Check for spark at spark plug.
___	___	4. Check engine for a spark miss.
		Check the Spark Plug
___	___	1. Wear proper safety equipment.
___	___	2. Read operator's manual.
___	___	3. Organize your work station.
___	___	4. Remove spark plug and secure the spark plug wire.
___	___	5. Inspect spark plug to determine if fuel is entering combustion chamber.
___	___	6. Inspect spark plug to see if fuel is not entering combustion chamber.
___	___	7. Inspect spark plug for fouling or damage.
___	___	8. Service spark plugs with slight carbon build-up
___	___	9. Regap the plug to engine specifications.
		Checking Compression
___	___	1. Wear proper safety equipment.
___	___	2. Read operator's manual.
___	___	3. Organize your work station.
___	___	4. Remove the spark plug wire.
___	___	5. Test compression stroke.
___	___	6. Verify compression test.
___	___	7. Check the engine compression with a compression gauge.

Student's Signature _____ Instructor's Signature _____ Date _____

Troubleshooting Charts

Table I
Engine Will Not Start or Starts with Difficulty

Problem	Repair Procedure	Refer To Step-By Step Manuals
1. Switch in "kill" or "stop" position	Move remote control switch to "start" or "run" position.	Module 1
2. Fuel shutoff valve closed	Open shutoff valve.	Module 2
3. Out of fuel	Fill the fuel tank with fresh gasoline.	Module 7
4. Fuel tank cap clogged	Remove tank cap and clean the vent holes.	Module 7
5. Fuel filter clogged	Remove filter and replace with a new one.	Module 7
6. Fuel line clogged	Remove fuel line and replace with a new one or use air to clean old line.	Module 7
7. Water in fuel	Remove carburetor and fuel tank assembly. Drain and clean the tank assembly. Remount carburetor and fill tank with clean, fresh gasoline. Remove spark plug and dry water from electrode and replace.	Module 2
8. Stale gas in tank	Drain the tank and clean the carburetor. Remove spark plug and clean stale gas from electrode and replace. Fill tank with clean, fresh gasoline.	Module 2
9. Carburetor fuel pipes clogged	Remove carburetor tank assembly. Remove carburetor from tank. Clean fuel pipe screens and tank. Remount carburetor and fill tank with clean, fresh gasoline.	Module 2
10. Engine flooded	Remove air cleaner, clean and service. Check and service choke. Remove the spark plug and dry excess gas from the electrode. Install spark plug and air cleaner.	Module 2

Table I (continued)

Problem	Repair Procedure	Refer To Step-By-Step Manuals
11. Hot Restart	Check the spark plug to determine if a flooded condition exists. Check, clean and service the air cleaner. Check for a damaged adjusting needle, O-ring, or loose needle and seat. Check the RPM of the engine. The primary cause for hot restart is a rich or flooded condition.	Modules 1 & 2
12. Choke valve not closing in carburetor	Adjust remote control cable. The choke valve should be completely closed.	Module 2
13. Carburetor out of adjustment	Adjust needle valve.	Module 2
14. Carburetor throttle will not open far enough	Check remote control lever. Check for binding in cable linkage, and check for unhooked governor spring.	Module 2
15. No spark	Check ignition and flywheel key.	Module 1
16. Fouled spark plug	Clean or replace spark plug. Regap to specifications.	Module 1
17. Poor compression	The following should be checked: a) valves, b) blown head gasket, c) cylinder.	Module 4
Note: The following list should be used in checking the performance of Automatic Choke Briggs & Stratton Engines.		
18. Engine underchoked		
a. Carburetor adjusted too lean	Turn needle valve slowly counterclockwise with engine running in "fast" position.	Module 2
b. Fuel pipe check valve inoperative	Remove carburetor and fuel tank assembly. Clean (Vacu-Jet only) screen on the fuel pipe and make sure check ball is free. If screen and ball cannot be cleaned, remove and replace.	Module 2

Table I (continued)

Problem	Repair Procedure	Refer To Step-By-Step Manuals
c. Bent air cleaner stud	Replace air cleaner stud bolt.	Module 2
d. Sticking choke shaft	Spray carburetor cleaner on choke and choke shaft. It may be necessary to install a new choke shaft.	Module 2
e. Choke spring damaged or too short	Replace choke spring.	Module 2
f. Diaphragm not preloaded	Move choke plate to an "over-center" position and install choke linkage.	Module 2
19. Engine overchoked a. Carburetor adjusted too rich	Turn needle valve slowly clockwise with engine running in "fast" position.	Module 2
b. Bent air cleaner stud	Replace air cleaner stud bolt.	Module 2
c. Sticking choke shaft	Spray carburetor cleaner on choke and choke shaft.	Module 2
d. Ruptured diaphragm	Replace diaphragm.	Module 2
e. Choke spring stretched	Replace choke spring.	Module 2
f. Needle valve seat loose	Tighten needle valve seat.	Module 2
20. Governor faulty	Repair or replace. Check linkage and adjust.	Module 5
21. Carburetor jet clogged	Service carburetor and air cleaner.	Module 2
22. Armature air gap incorrect	Check the correct air gap setting and adjust.	Module 1
23. Vapor lock	Cool down the engine. Check engine for proper ventilation and cooling.	Module 7

Table I (continued)

Problem	Repair Procedure	Refer To Step-By-Step Manuals
24. Sheared flywheel key	Check condition of crankshaft and flywheel. Install new flywheel key.	Module 1
25. Poor compression	Run a compression check to determine faulty parts of the engine.	Module 4
26. Carburetor loose on engine	Check and tighten the bolts holding the carburetor in place.	Module 2
27. Ignition switch defective	Install new ignition switch.	Module 1
28. Spark plug		
a. No spark	Service spark plug.	Modules 1 & 7
b. Porcelain cracked	Service spark plug.	Modules 1 & 7
c. Wire disconnected from spark plug	Service spark plug.	Modules 1 & 7

Table II - Engine Kickbacks or Hard to Start

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Loose or thrown belt	Check for proper alignment. Replace belt on pulley.	Module 8
2. Loose blade	Check blade for proper installation and torque bolt to 45-60 foot pounds.	Module 8
3. Kickback	Check breaker-point gap. Check ignition timing. Check for a partially sheared key. Check air gap.	Module 1

Table III - No Ignition

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Ignition switch in "off" position	Turn ignition switch on.	Module 1 & 7
2. Ignition wire broken or grounding out	Inspect ignition wires, replace or reconnect.	Module 1
3. Ignition switch faulty	Remove wires from switch. If you have a spark, the switch is faulty. Replace switch.	Module 1
4. Spark plug defective	Replace the spark plug with plug recommended by manufacturer. Use wire gauge to gap plug correctly.	Module 1
5. Solid-state ignition module is faulty	Test solid-state module. Replace if necessary. Check air gap. Check leads for grounding loose connections.	Module 1
6. Breaker points	Check breaker points. Replace with pitted.	Module 1
7. Condenser faulty	Check condenser with a tester. Replace if necessary.	Module 1
8. Ignition coil faulty	Check ignition coil with a tester. Replace if necessary.	Module 1
9. Sheared flywheel key	Replace with new flywheel key.	Module 1
10. Stop switch grounded	Check wiring and switch.	Module 1
11. Operator presence control bar defective	Replace control bar.	Module 7

Table IV - Weak Ignition Spark

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Spark plug gap incorrect	Regap plug.	Module 1
2. Wrong spark plug	Replace spark plug using manufacturer's recommendations.	Module 1
3. Wet spark plug	Remove spark plug and dry.	Module 1
4. Breaker points gapped incorrectly	Use a flat feeler gauge and regap points.	Module 1
5. Magneto (armature) air gap too wide	Set air gap.	Module 1
6. Defective coil	Check coil and replace if required.	Module 1
7. Defective condenser	Check condenser; replace if required.	Module 1
8. Flywheel magnets have lost magnetism	Replace flywheel.	Module 1
9. Defective solid state module	Check and replace if necessary.	Module 1

Table V - Engine Misses

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Water in fuel	Drain the complete fuel system and service the carburetor.	Module 2
2. Spark plug defective	Replace spark plug and set gap correctly.	Module 1
3. Spark plug fouled	Clean and regap the spark plug.	Module 1
4. Pitted magneto breaker points	Install new points.	Module 1
5. Armature faulty	Have armature tested and replace if needed.	Module 1
6. Kill switch wire worn and is making contact with engine ground	Replace wire.	Module 1
7. Improper valve clearance	Adjust valves to correct clearance.	Module 4
8. Sheared flywheel key	Check crankshaft and flywheel. Replace with new key.	Module 1

Table VI - Low Compression

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Head gasket blown or leaking	Replace head gasket and torque head bolts to specifications.	Module 4
2. Loose head bolts	Check head bolts and torque to specifications.	Module 4
3. Loose spark plug	Check spark plug and torque to specifications.	Module 1
4. Valves sticking or not seating properly	Inspect the valves, seats, and guides. Replace or recondition as required.	Module 4
5. Valve clearance incorrect	Check intake and exhaust valve for proper clearance.	Module 4
6. Worn cylinder or rings	Check cylinder and rings for wear. Recondition or replace as needed.	Module 4
7. Broken valve spring	Remove breather and check valve springs. Replace as needed.	Module 4
8. Breather loose or not functioning properly	Install new gasket and tighten breather securely. Check the breather fiber disc valve for proper clearance.	Module 2

Table VII - Engine Lacks Power

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Valves not seating properly	Clean carbon from the valves and reseat. Reset the valve tappet clearance.	Module 4
2. Valve tappet clearance incorrect	Check the valve tappet clearance.	Module 4
3. Valve spring weak	Replace valve spring.	Module 4
4. Timing incorrect	Check timing. Line up keyway with breaker plunger.	Module 1
5. Spark plug defective	Replace spark plug and regap.	Module 1
6. Breaker points gapped incorrectly	Regap points using a flat feeler gauge.	Module 1
7. Choke out of adjustment	Check choke for open and closed position.	Module 2
8. Carburetor out of adjustment	Reset high speed and idle adjustment.	Module 2
9. Fuel line clogged	Check fuel line for obstructions.	Module 1
10. Dirty air cleaner	Clean and service air cleaner.	Module 2
11. Clogged muffler	Remove and replace with a new muffler.	Module 8
12. Throttle set incorrectly	Check remote controls to carburetor.	Module 2
13. Poor compression	Check for blown head gasket, loose spark plug, burned valves, or worn bore and rings.	Module 4
14. Defective governor	Check governor for proper adjustment. Replace or repair.	Module 5
15. Spark plug wire defective or loose	Adjust spark plug wire terminal or replace wire.	Module 1
16. Head bolts loose	Check all head bolts and torque to specifications.	Module 4

Table VIII - Engine Overheating

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Engine dirty and/or cooling fins blocked	Thoroughly clean the rotating screen, and cooling fins.	Module 8
2. Overloaded engine	Check the horsepower of the engine. You may need a larger engine.	Module 8
3. Governor out of adjustment	Adjust governor to correct speed. Use a tachometer to determine proper speed.	Module 5
4. Engine out of time	Check timing. Check for damaged key in flywheel.	Module 1
5. Piston or rings fitted too tight	Check rings and piston for proper clearance.	
6. Lack of oil in crankcase	Check the oil level in the crankcase.	Module 6
7. Carbon deposit on cylinder head	Remove head and clean out carbon deposits.	Module 4
8. Clogged exhaust system	Remove and replace with a new muffler.	Module 8
9. Carburetor out of adjustment	Adjust carburetor to specifications.	Module 2
10. Air flow obstructed	Remove shroud and clean.	Module 8
11. Cooling fins clogged	Clean cooling fins.	Module 8
12. Shroud or air baffles missing	Replace missing parts.	Module 8

Table IX - Engine Runs Unevenly and/or Surges

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Governor out of adjustment or binding	Check governor for binding or dirt. Replace or repair the governor.	Module 5
2. Vent holes clogged in gas cap	Clean vent holes or replace with a new cap.	Modules 2 & 7
3. Carburetor out of adjustment	Check needle valve setting and float level.	Module 2
4. Blocked fuel line	Clean fuel line, tank, inlet needle and seat in carburetor.	Modules 2 & 7
5. Engine vibrates	Check for bent crankshaft and/or mower blade out of balance.	Module 8
6. Choke out of adjustment	Clean and adjust linkage. Check for ruptured diaphragm, and burr on throttle shaft or choke plate.	Module 2
7. Intermittent spark	Check ignition. Check wires for poor connection. Check ignition switch.	Module 1
8. Wrong governor spring	Replace with correct governor spring.	Module 5
9. Worn internal governor parts	Check and replace worn parts.	Module 5
10. Fuel supply low to empty	Fill fuel tank with fresh gasoline.	Module 2
11. Air cleaner dirty	Clean air cleaner.	Module 8
12. Over loading engine	Reduce engine load.	Module 1

Table X - Engine Knocks and is Noisy

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Loose blade	Torque to specifications.	Module 8
2. Flywheel loose	Check flywheel and key; torque to specifications.	Module 1
3. Loose or worn connecting rod	Check connecting rod for damage. Torque bolts as required or replace.	
4. Starter clutch noisy	Service starter clutch or replace.	Module 3
5. Flywheel screen hitting blower housing	Check for proper clearance and remount screen.	Module 3
6. Carbon in the combustion chamber	Remove cylinder head and clean carbon from head and top of cylinder.	Module 4
7. Lack of oil in crankcase	Check oil level in crankcase.	Module 6

Table XI - Engine Vibrating

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Blade out of balance or loose	Sharpen and balance blade and torque to specifications.	Module 8
2. Bent crankshaft	Check crankcase and replace if necessary.	Module 8
3. Engine not securely mounted to equipment	Tighten all mounting bolts securely.	Module 8
4. Carburetor out of adjustment	Check carburetor for proper adjustment.	Module 2

Table XII - Engine Will Not Stop

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Engine keeps running	Check ignition stop switch.	Module 1
2. Stop switch wire not connected to kill switch	Check kill switch.	Module 1

Table XIII - Starter Rope Hard to Pull

Problem	Repair Procedure	Refer To Step-By-Step Manuals
1. Flywheel brake is on when operator presence control bar is released	Depress operator presence control bar to upper handle before pulling on starter rope.	
2. Blade adapter sheared	Install new blade adapter.	Module 8
3. Crankshaft bent	Install new crankshaft.	
4. Starter rope is binding	Service starter.	Module 3

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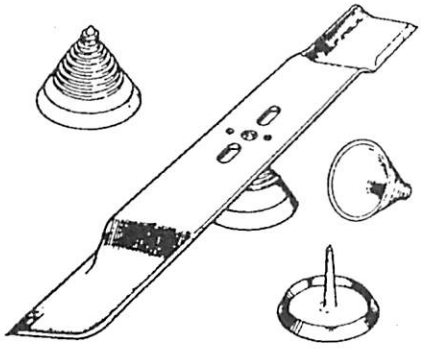
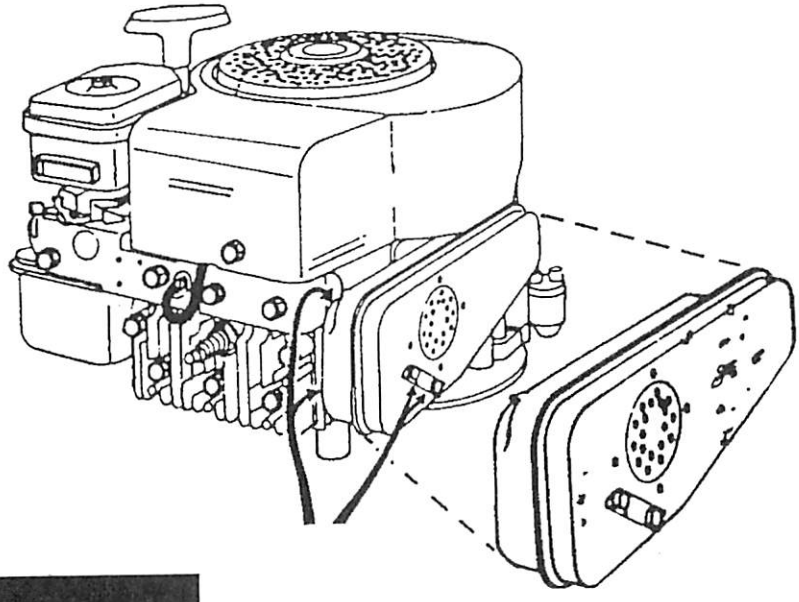
STEP-BY-STEP PROCEDURE

SMALL ENGINE SERVICE AND REPAIR

Operation and Maintenance of Small Engines



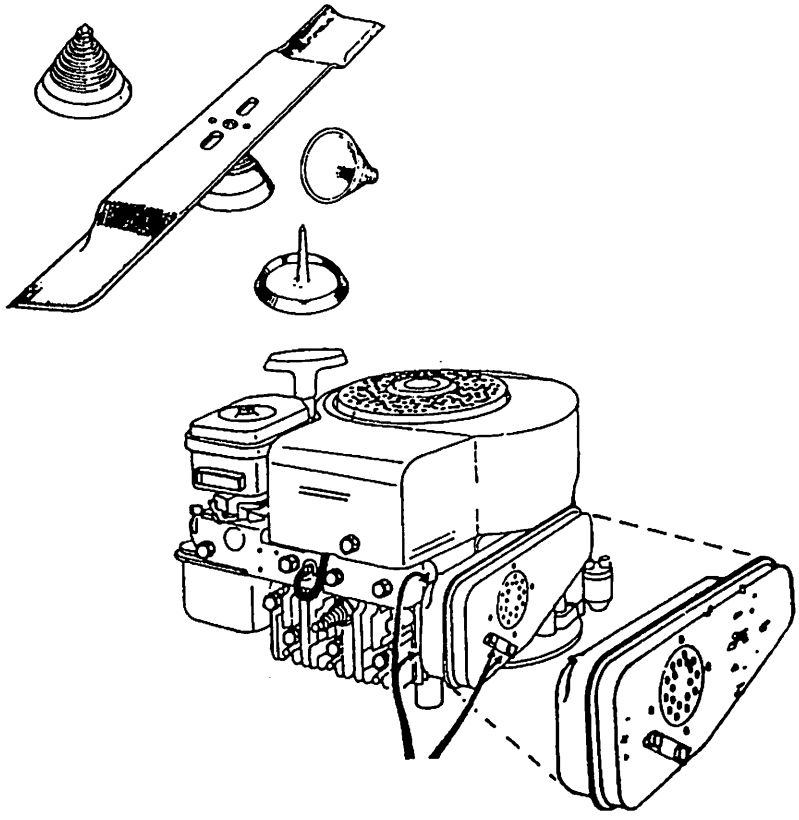


Revised Edition

INSTRUCTIONAL MATERIALS LABORATORY
UNIVERSITY OF MISSOURI-COLUMBIA
COLUMBIA, MISSOURI

Module 8

Operation and Maintenance of Small Engines



Prepared by: Amon Herd

Preface

This manual is designed to bring the student or home owner to a minimum performance level in properly servicing a small engine's ignition system. These step-by-step procedures include illustrations clarifying each procedure. The accompanying performance task list may be used as an evaluation or as a quick reference of repair procedures.

For many years those responsible for teaching small engine repair have needed materials that are basic, readable and usable. Although this series was written primarily for adult education, it can become a vital teaching tool in any program through live demonstrations and classroom instruction.

The author, Amon Herd, brings to this new series many years of small engine experience. Amon's "hands on" knowledge comes from twenty-five years of classroom teaching and small engine repair.

Acknowledgments

Appreciation is extended to those individuals who contributed time and talents in the development of Small Engines, Second Edition.

Instructional Materials Laboratory Staff:

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References

Service and Repair Instructions, Briggs and Stratton Corporation, Milwaukee, Wisconsin.

Small Engines Operation Maintenance and Repair, J. Howard Turner, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gas Engines, Alfred C. Roth, The Goodheart-Wilcox Company, Inc., South Holland, Illinois.

Small Engines Operation And Service, Jay Webster, American Technical Publishers, Chicago, Illinois.

Air Cooled Engine Mechanics Training Manual, Engine Service Association, 710 N. Plankinton, Milwaukee, Wisconsin.

Fuels and Lubricants, Harold Parady and Thomas Colvin, American Association for Vocational Instructional Materials, Athens, Georgia.

Small Gasoline Engine, Operation, Repair and Maintenance, St. Paul, Minnesota, Hobar Publications.

Small Engine Mechanics, William Crouse and Donald Anglin, McGraw-Hill Book company, St. Louis, Missouri.

Operation and Maintenance of Small Engines

Unit Objectives

After completion of this unit, the student should be able to safely operate and maintain a small engine. This knowledge will be demonstrated by the ability to properly follow maintenance procedures.

Specific Objectives

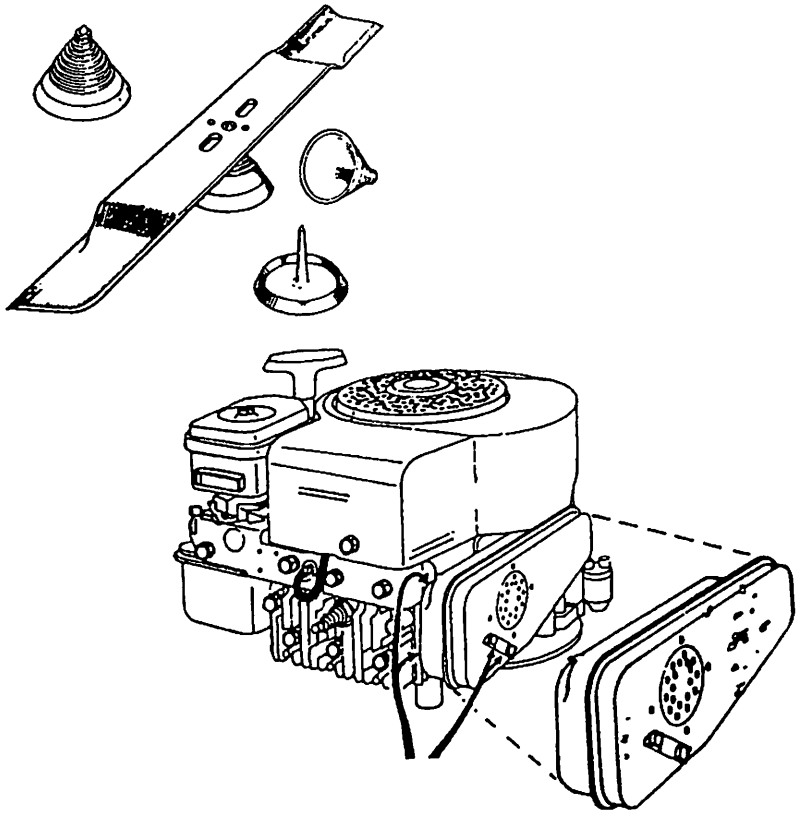
After completion of this unit, you should be able to:

1. Demonstrate a working knowledge of small engine operation safety procedures, particularly those involving use of a lawn mower.
2. Demonstrate a working knowledge of operation and basic maintenance of a small engine.
3. Demonstrate the procedure for servicing a cutting blade.
4. Demonstrate the procedure for servicing a small engine muffler.
5. Demonstrate the procedure for servicing and adjusting "System 2" and "System 4" CPSC compliance engines.
6. Demonstrate the procedure for servicing small engine ignition stop switches.

Operation and Maintenance of Small Engines

Introduction

Proper operation and maintenance of a small engine will ensure long engine life. The owner of a small engine will save both time and money by performing simple and routine maintenance chores. A properly serviced small engine is also safer than one that has had haphazard maintenance.



A. Tools and Materials Needed in Maintenance and Compliance Procedures

Tools

Gloves
Safety glasses
Gear puller
Adjustable end 8" wrench
Mallet
Torque wrench with 3/8" drive
3/8" drive socket set
Open end wrenches (1/4", 5/16", 3/8", 7/16", 1/2", 5/8" and 9/16")
Oil can with flexible spout
Grease gun
Standard 6" screwdriver
Putty knife
Parts brush
Pen knife
Ball-peen hammer
Punch
Pipe wrench
Yardstick (straight edge)
Steel rule
Siphon
Power grinder (6")
File
Blade balancer
Nut drivers (1/4", 3/8", 7/16", and 1/2")
Longnose pliers (6 1/2")
Phillips screwdrivers (4" and 6")
Round and flat filler gauge
Spark plug tester
Wire brush
Torque wrench with 3/8" drive
Ignition file
Power grinder (6")
Mill file (10")
Blade balancer
Cleaning pan
Hand sprayer
Container for oil
Fire extinguisher (dry chemical)
Oil can

Supplies

Penetrating oil
Emery paper
Shop towels
Number 2 grease
Muffler and gasket
Blade adapter
Anti-seizing compound
Woodruff key
SAE 30 oil
Stabil (or equivalent)
Light grease
Paint brush
Fresh gasoline

Tools and Materials Needed to Service and Adjust "System 2" and "System 4" CPSC Compliance Engines

Ratchet (3/8") with 5/16" and 7/16" sockets
Slot head screwdriver (6")
Nut drivers (1/4" and 5/16")
Pliers (8")
Combination wrench (5/16")
Brake adjustment gauge #19256 Briggs & Stratton
Tang bending tool #19229 Briggs & Stratton
Shop towels
Penetrating oil

B. Step-By-Step Procedure For Safe Lawn Mower Operation

1. Read the operator's manual and become familiar with the controls.
2. Always start the engine outdoors, never in an enclosed area.
3. Always stop engine and let it cool before refueling.
4. Always stop engine and remove spark plug wire before working on the engine or mower deck.
5. Do not touch any part of a running engine or engine that has just been stopped because most components will be hot enough to cause severe skin burns.
6. Never remove or alter safety devices.
7. Tighten all nuts, bolts and screws often to make sure mower is in safe operating condition.
8. Do not alter engine governor speeds.
9. Always turn off the engine when adjusting mower cutting height.
10. Verify that the drive control (on self-propelled machines) is disengaged before starting the engine. Never stand in front of a self-propelled machine as the drive unit may accidentally engage and cause the machine to lurch forward.
11. Keep hands and feet away from all operating parts (especially the blade).
12. Always use safety glasses when sharpening the mower blade.
13. Always use approved containers to store fuel. Never smoke or allow sparks or open flame near the fuel.
14. Do not operate without a muffler or tamper with the exhaust system.
15. Check area to be mowed and remove any obstructions before starting engine. People, children or pets should be kept away from the mowing area.
16. Never allow children to operate the mower.
17. Always mow during daylight hours.
18. Verify that any mower deck washout port is closed when mowing.
19. Wear long trousers and safety shoes while mowing. Do not wear tennis or open-toed shoes.
20. Never leave a running mower unattended.
21. Always follow the contour of the slope when mowing slopes or terraces. Never mow up and down the slope.
22. Never mow wet grass.
23. Always mow using a forward motion.

Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintaining and operating lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Procedure For Safe Lawn Mower Operation
___	___	1. Read the operator's manual.
___	___	2. Start the engine outdoors.
___	___	3. Stop the engine and let it cool down before refueling.
___	___	4. Remove spark plug wire before working on mower.
___	___	5. Do not touch any part of a hot engine.
___	___	6. Do not remove or alter safety devices.
___	___	7. Tighten all nuts, bolts and screws often.
___	___	8. Do not alter engine governor speeds.
___	___	9. Turn off the engine when adjusting cutting height.
___	___	10. Verify drive control (on self-propelled machines) is disengaged before starting the engine.
___	___	11. Keep hands and feet away from operating parts.
___	___	12. Use safety glasses when sharpening mower blade.
___	___	13. Use approved containers to store fuel.
___	___	14. Do not tamper with exhaust system.
___	___	15. Check area to be mowed and remove any obstructions.
___	___	16. Never allow children to operate mower.
___	___	17. Mow during daylight hours.
___	___	18. Verify washout port is closed when mowing.
___	___	19. Wear long trousers and safety shoes while mowing.
___	___	20. Do not leave a running mower unattended.
___	___	21. Follow the contour of the slope when mowing slopes.
___	___	22. Never mow wet grass.
___	___	23. Mow using a forward motion.

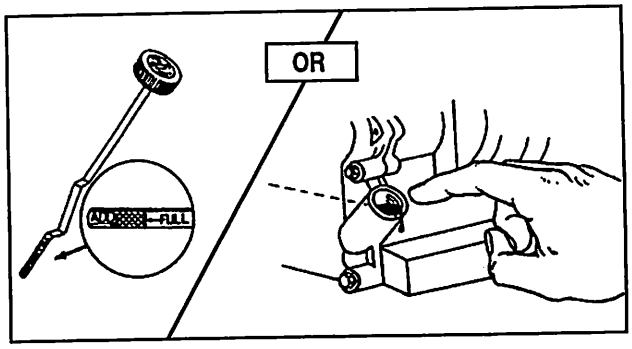
Student's Signature _____ Instructor's Signature _____ Date _____

C. Step-By-Step Procedure For Operating Small Engines

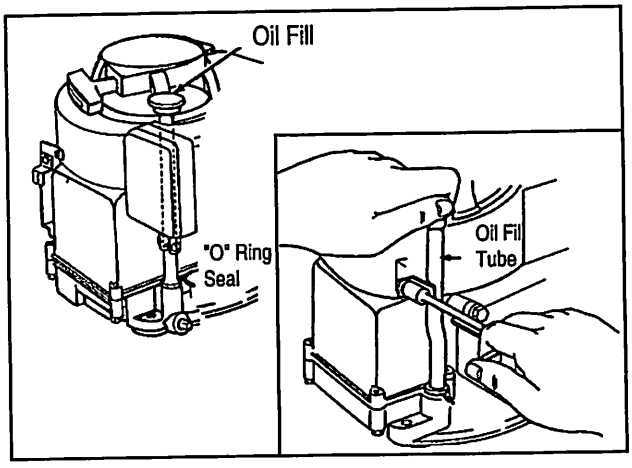
1. Read and understand operator's manual.

2. Follow safety procedures when operating a small engine. Consult the operator's manual for specific safety rules.

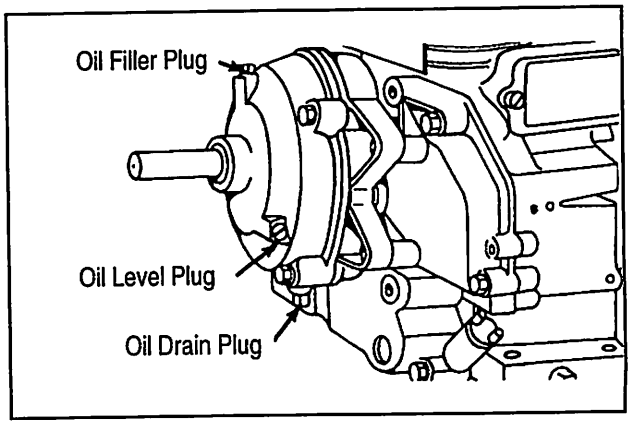
3. Check crankcase oil level each time engine is refueled. Use a high quality detergent oil classified "For Service SC, SD, SE or SF." Nothing should be added to the recommended oil.



4. Check the oil dipstick assembly for a good fit. The O-ring should seal the lower end of the filler tube. A leak at the seal will result in a loss of crankcase vacuum and cause a discharge of smoke through the muffler.

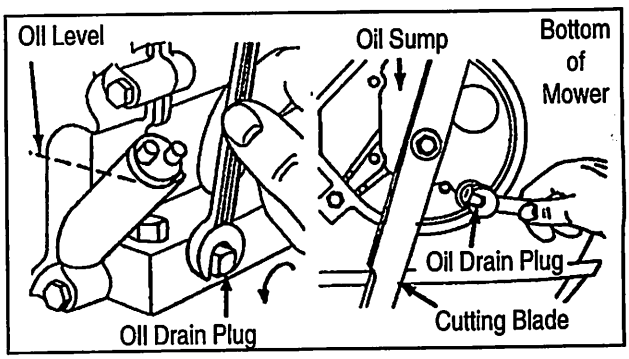


5. Check the gear reduction case oil level at the beginning of the season (if equipped). Change oil in the gear reduction case every 100 hours of operation.

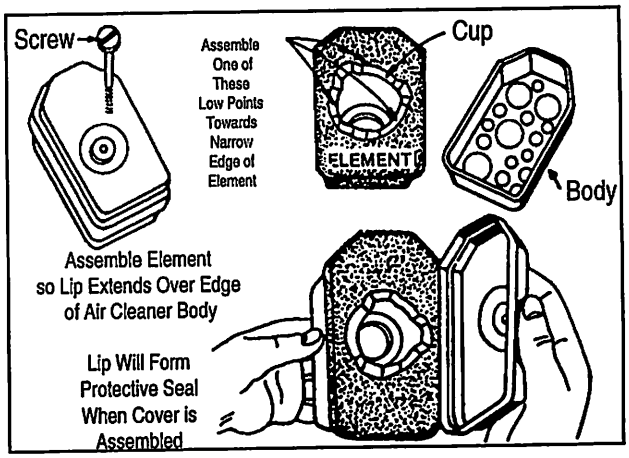


Illustrations courtesy of Briggs & Stratton Corporation

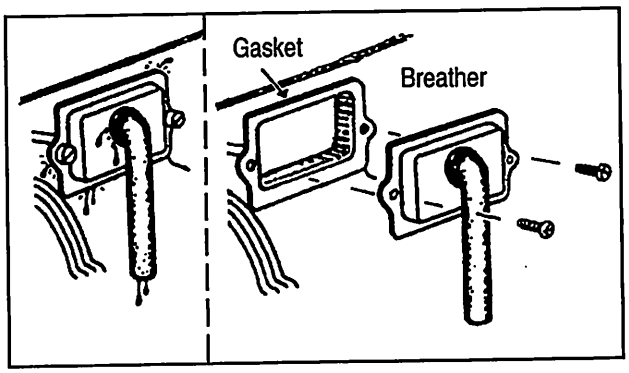
6. Change oil in new or rebuilt engines after first eight hours of operation. The oil, thereafter, should be changed each season or every fifty hours of operation. Oil should be changed every twenty-five hours of operation under heavy use or dusty conditions.



7. Check the air cleaner filter before using the engine. Clean and oil the foam element every 25 hours of operation. Service daily under dusty conditions.

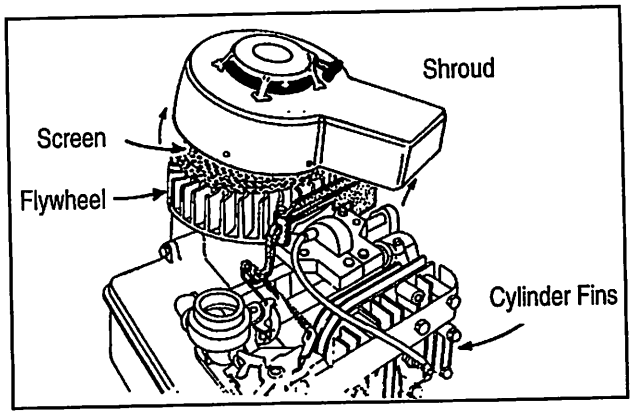


8. Check breather for signs of oil leakage during engine operation. Tighten screws securely to prevent oil leakage or replace breather.

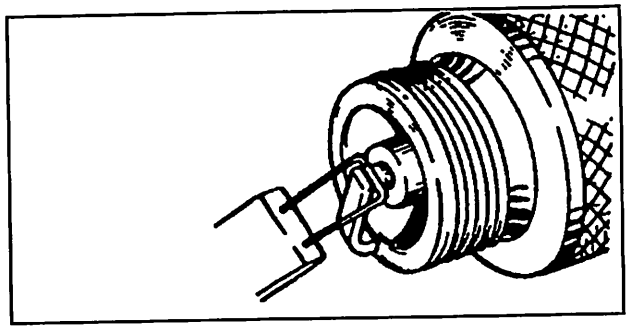


Illustrations courtesy of Briggs & Stratton Corporation

9. Clean debris and grease from cylinder fins, flywheel and screen. This should be done every 50 hours of operation.



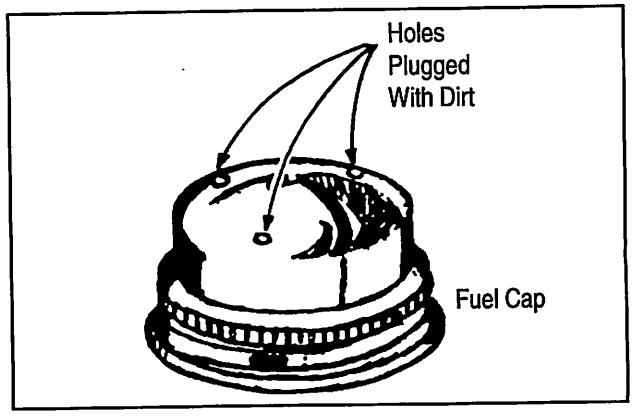
10. Clean and regap the spark plug to .030" every 100 hours of operation. Use a round wire gauge to assure accurate reading.



11. Operate the engine so it does not overload.

Note: Overloading small engines is a common abuse which can cause severe damage to the engine. For example, do not mow extremely tall or wet grass. Damage resulting from overloading includes: engine overheating, excessive bearing wear, loss of power and low compression, and burned valves.

12. Check and clean fuel cap vent holes when necessary. Plugged vents cause pressure to build up; the flow of gas is stopped resulting in engine shut down.

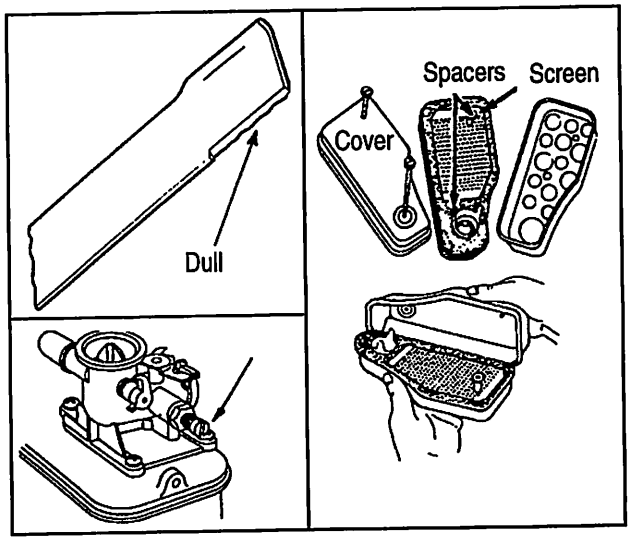


13. Change the fuel filter yearly. Remove and replace with a new in-line filter in any flexible fuel line. A clogged filter will stop the flow of gas.

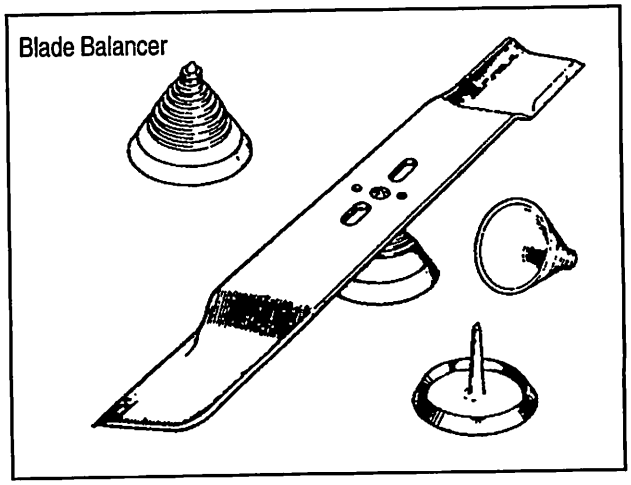
14. Oil wheel axles and height adjusting linkage with a few drops of SAE 30 oil every 10 hours of operation.

15. Clean the outside of the engine and remove grass clippings from the mower deck after each operation while the engine is still warm.

16. Monitor the operation of your mower. When the engine uses more fuel than usual, check for the following:
    a. Dull mower blade.
    b. Dirty air cleaner.
    c. Out of adjustment carburetor.

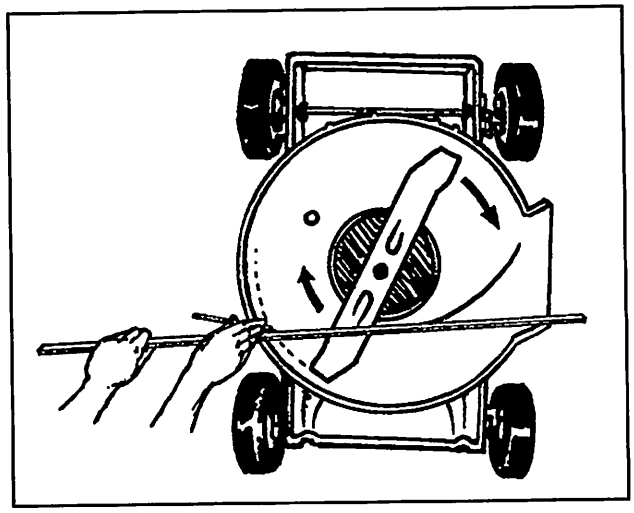


17. Sharpen and balance mower blade as needed. Do not use a bent blade.



Illustrations courtesy of Briggs & Stratton Corporation

18. Check for engine vibration. If the engine vibrates, check for a bent blade using the following steps:
    a. Disconnect the spark plug wire.
    b. Tilt the mower base to approximately 45-degrees and secure.
    c. Place a straight edge across the bottom of the mower base.
    d. Rotate blade until one end strikes the straight edge. Mark the point of contact with a pencil.
    e. Rotate the blade again until the other end strikes the straight edge and mark second contact point.
    f. The marks should be within approximately 1/8" of each other. If the marks are more than 1/8" apart, the blade is bent and should be replaced.



Maintenance Procedures Competency Profile

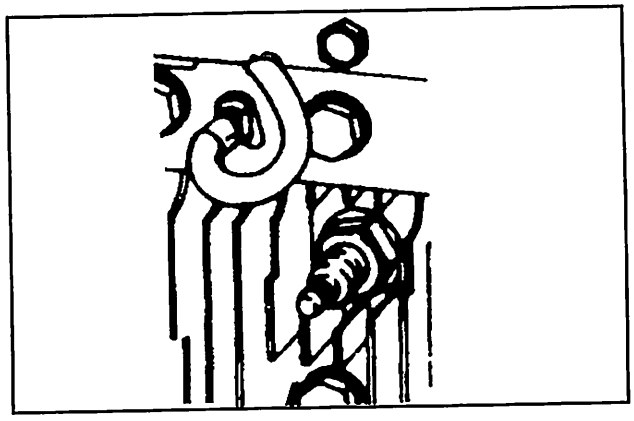
Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Operating Small Engines
___	___	1. Read and understand operator's manual.
___	___	2. Follow safety procedures.
___	___	3. Check crankcase oil level.
___	___	4. Check the oil dipstick assembly for a good fit.
___	___	5. Check gear reduction case oil level at the beginning of the season.
___	___	6. Change oil in new or rebuilt engines after eight hours of operation.
___	___	7. Check the air cleaner filter before using the engine.
___	___	8. Check breather for signs of oil leakage during engine operation.
___	___	9. Clean debris and grease from cylinder fins, flywheel and screen.
___	___	10. Clean and regap the spark plug at .030" every 100 hours of operation.
___	___	11. Operate the engine so it does not overload.
___	___	12. Check and clean fuel cap vent holes when necessary.
___	___	13. Change the fuel filter yearly.
___	___	14. Oil wheels and height adjusting linkage.
___	___	15. Clean the outside of the engine.
___	___	16. Monitor the operation of mower.
___	___	17. Sharpen and balance mower blade as needed.
___	___	18. Check for engine vibration.

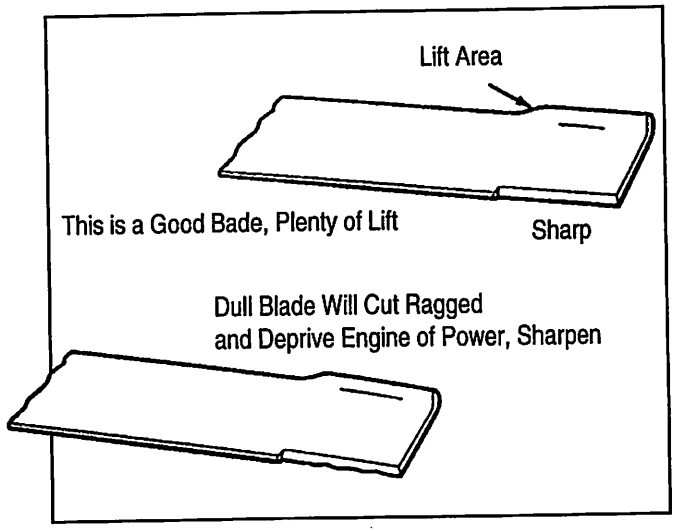
Student's Signature _____ Instructor's Signature _____ Date _____

D. Step-By-Step Procedure For Servicing Cutter Blade

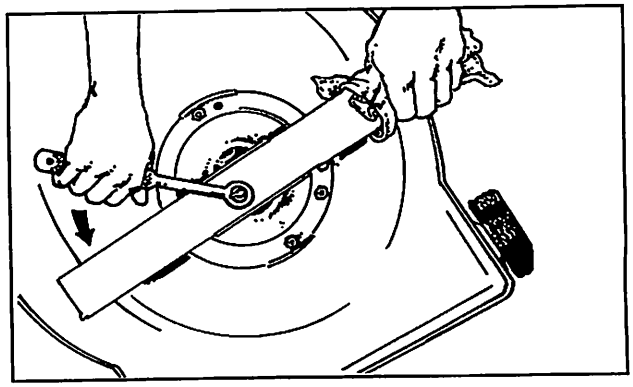
1. Read your owner's manual.
2. Wear proper safety equipment.
3. Organize your work station. When disassembling, place bolts, nuts, and parts in containers.
4. Disconnect spark plug wire and place in V-notch. On older models, tape spark plug wire to shroud to prevent accidental starting.



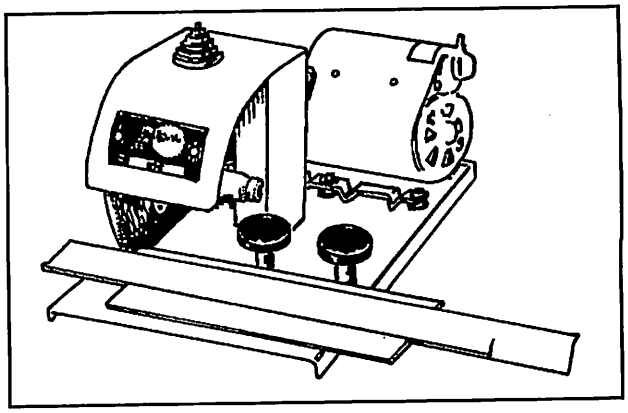
5. Examine blade periodically for sharpness, wear, or damage. If the blade is worn or bent, it should be replaced. (See illustration.)



6. Grasp end of blade using a thick rag or gloves and remove bolt, washer, and blade.

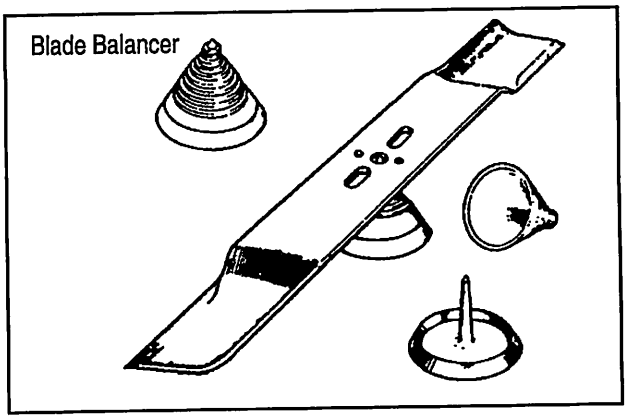


7. Sharpen blade's cutting edges on a power grinder. Sharpen top side of blade and maintain the original cutting angle. Finish cutting edges with a file.

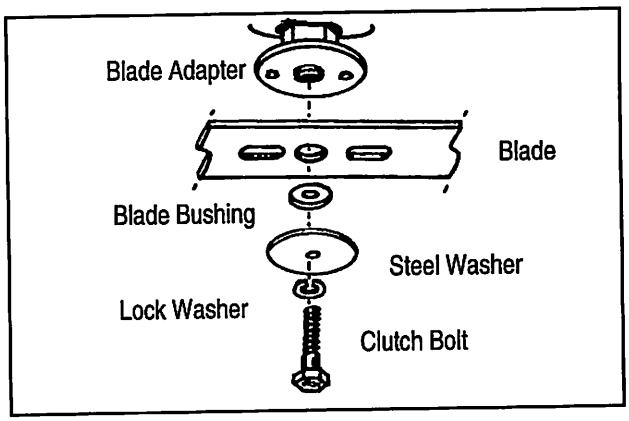


8. Balance the blade after sharpening.

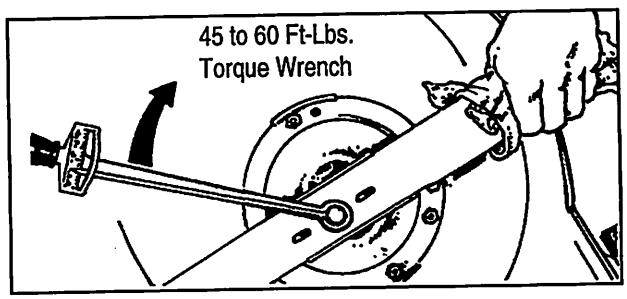
Note: An inexpensive blade balancer can be purchased at a hardware store.



9. Install sharp, balanced blade and blade assembly. Some models may vary in blade installation.



10. Torque bolt to 45-60 foot-pounds. After blade is completely installed, recheck for bent blade.



11. Install spark plug wire. Start engine and check blade balance. If there is vibration, repeat blade balancing procedure.

12. Return all tools to their proper places and clean the work area.

Maintenance Procedures Competency Profile

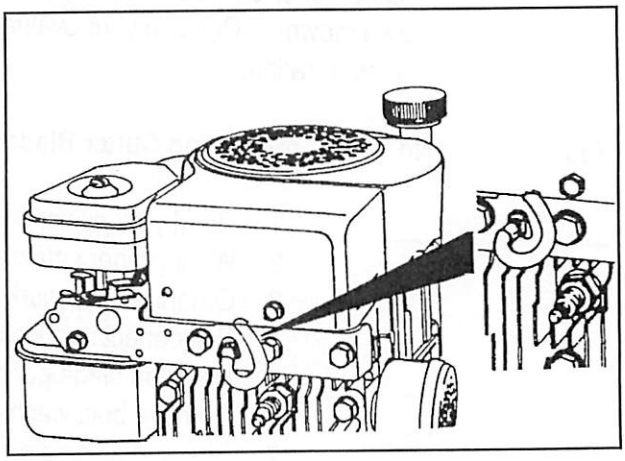
Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Servicing Cutter Blade
___	___	1. Read your owner's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize your work station.
___	___	4. Disconnect spark plug wire and place in V-notch.
___	___	5. Examine blade periodically for sharpness, wear, or damage.
___	___	6. Remove bolt, washer, and blade.
___	___	7. Sharpen blade's cutting edges.
___	___	8. Balance the blade after sharpening.
___	___	9. Install sharp, balanced blade and blade assembly.
___	___	10. Torque bolt to 45-60 foot-pounds.
___	___	11. Install spark plug wire. Start engine and check blade balance.
___	___	12. Clean the work area.

Student's Signature _____ Instructor's Signature _____ Date _____

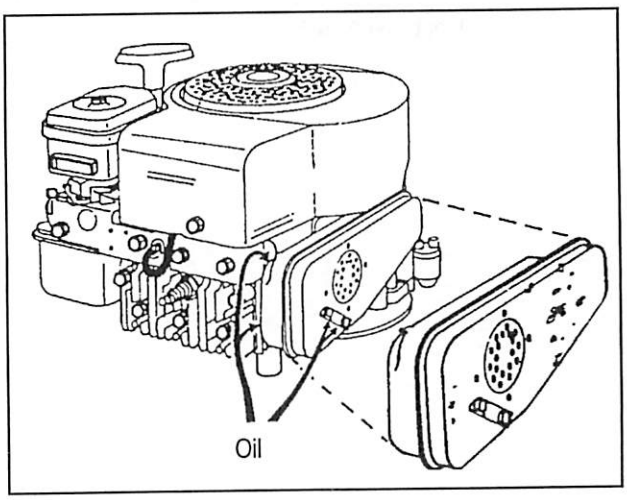
E. Step-By-Step Procedure For Servicing Mufflers

Note: Perform all procedures detailed in your owner's manual. Certain procedures are not recorded here because of equipment variation.



1. Read operator's manual.
2. Wear proper safety equipment.
3. Organize your work station. When disassembling, place bolts, nuts, and parts in containers.
4. Secure engine to be serviced and disconnect spark plug wire. Secure the spark plug wire in the V-notch or tape the wire in place on older models.

Bolt-On Muffler



5. Inspect the condition of the muffler to be replaced.
6. Squirt a few drops of penetrating oil on bolt threads prior to removing muffler bolts. Let it set overnight to loosen rust.

Note: Replace mufflers before they rust through. Check periodically by squeezing cold muffler barrel with your hand. If barrel is soft, replace muffler. Do not touch a hot muffler. Mufflers get very hot even if engine has run only a few seconds. Touching a hot muffler can cause severe skin burns.

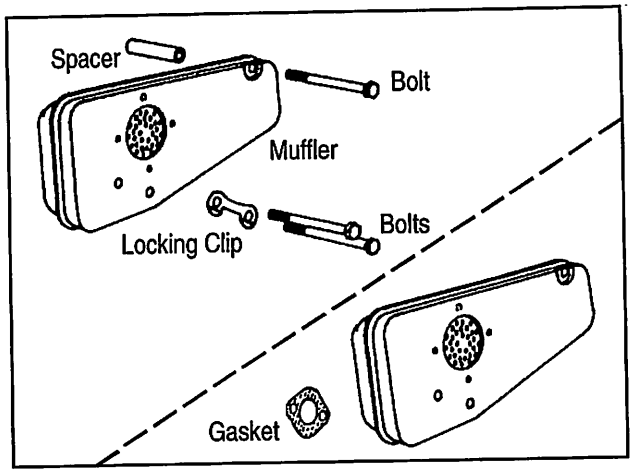
Illustrations courtesy of Briggs & Stratton Corporation

7. Remove muffler bolts.

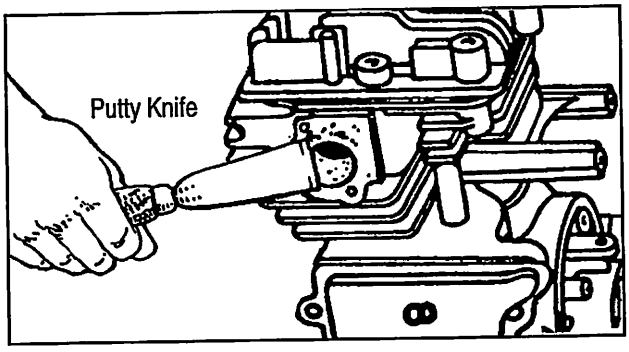
8. Remove muffler and gasket.

CAUTION: Be careful not to twist off bolts in block.

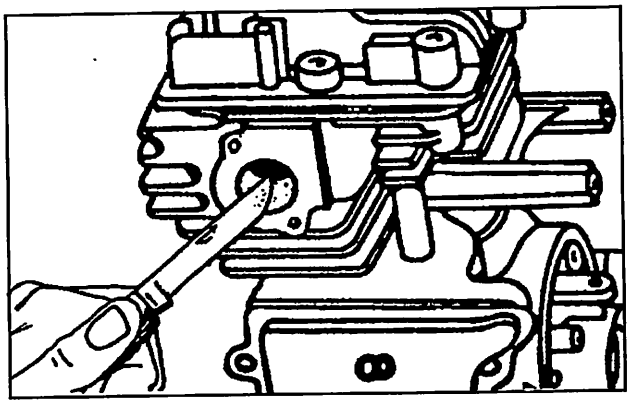
Note: Some bolts have locking clips which must be separated from the bolt heads.



9. Clean gasket residue from block.



10. Clean exhaust port and bolt holes.



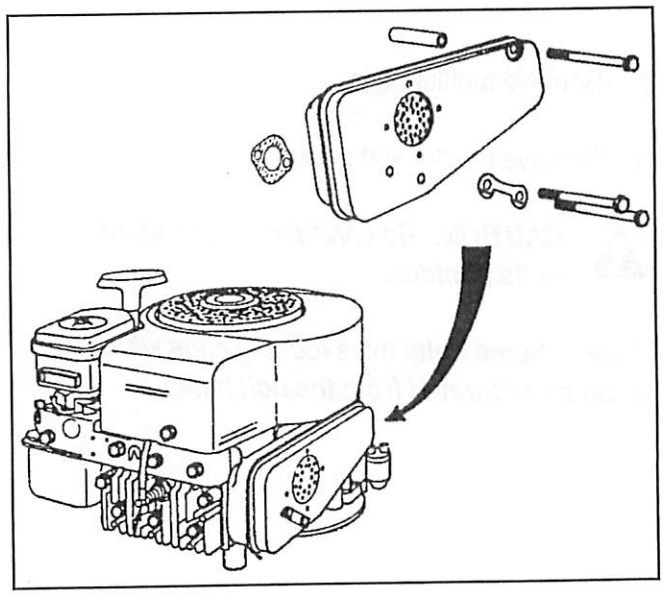
Illustrations courtesy of Briggs & Stratton Corporation

11. Install new gasket, muffler, and bolts.

12. Return engine and tools to proper places and clean work area.

⚠ ***CAUTION: Do not over tighten bolts.***

Note: The wrong size muffler will cause the engine to perform improperly. Always follow manufacturer's specifications when replacing the muffler.

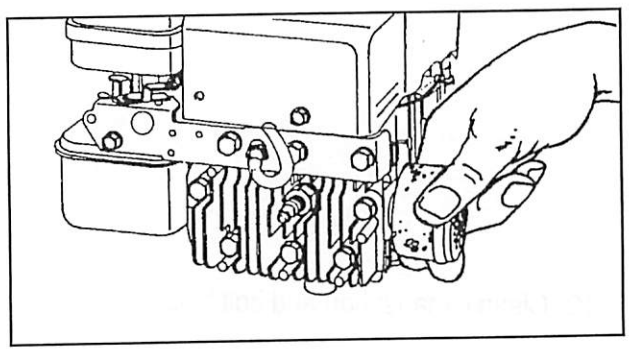


Pipe Thread Muffler

13. Secure engine to be serviced and disconnect and secure the spark plug wire.

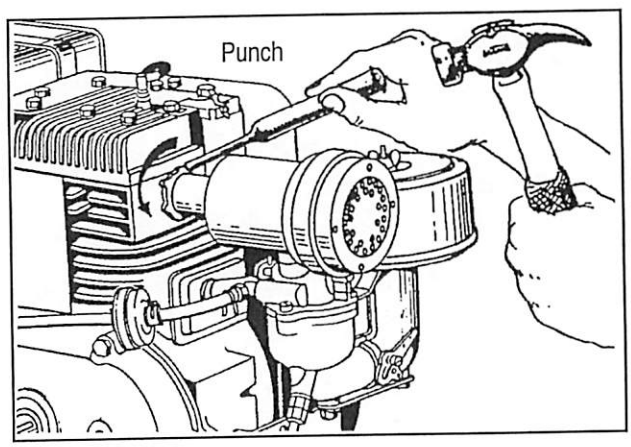
14. Inspect the condition of the muffler to replaced.

Note: Replace mufflers before they rust through.



15. Squirt penetrating oil on muffler pipe threads to loosen rust before replacing muffler. The penetrating oil should be applied and let set overnight..

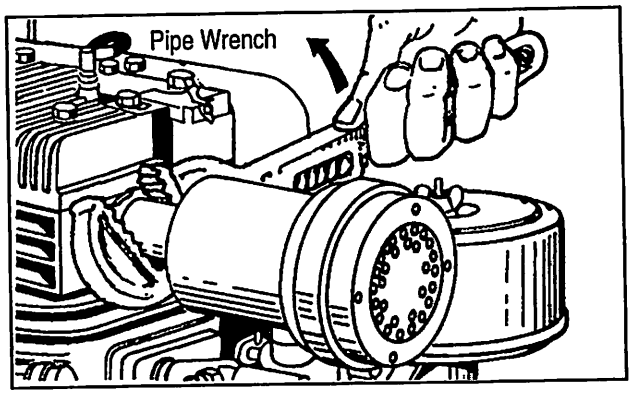
16. Tap locknut loose using a punch and hammer (on some models).



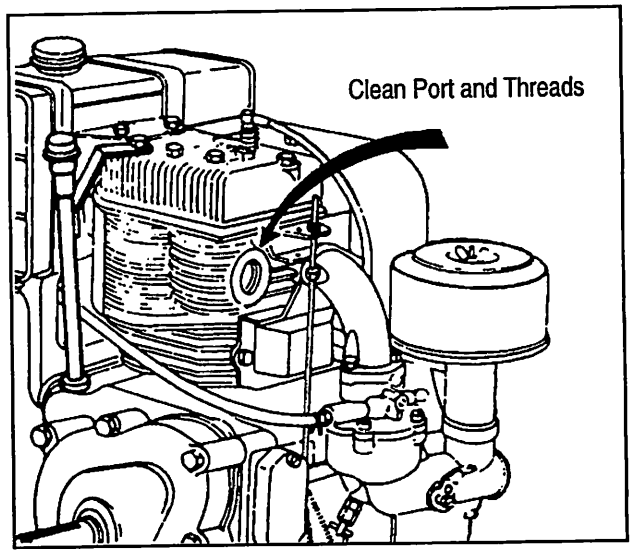
Illustrations courtesy of Briggs & Stratton Corporation

17. Place pipe wrench on muffler pipe as illustrated.

18. Apply steady pressure on wrench until pipe turns in block. Continue turning until muffler is removed.

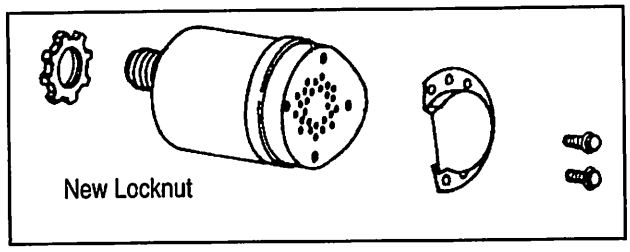


19. Inspect and clean exhaust port and threads.



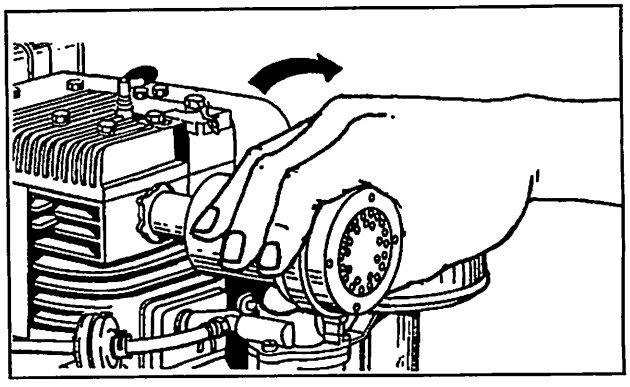
20. Install new locknut and muffler. Lubricate thread with anti-seizing compound.

Note: The wrong size muffler will cause the engine to perform improperly. Always follow manufacturer's specifications when replacing the muffler.



21. Tighten muffler pipe firmly in block (hand tighten only).

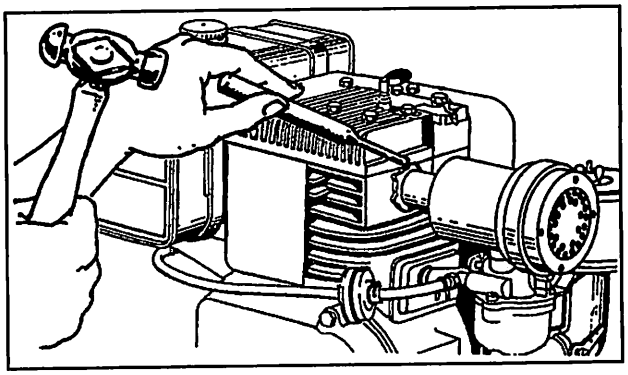
Note: On some mufflers a locknut is not used.



Illustrations courtesy of Briggs & Stratton Corporation

22. Tighten locknut with punch and hammer (on some models).

23. Return engine and tools to their proper places and clean work area.



Illustrations courtesy of Briggs & Stratton Corporation

Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Servicing Mufflers
___	___	1. Read operator's manual.
___	___	2. Wear proper safety equipment.
___	___	3. Organize your work station.
___	___	4. Secure engine to be serviced and disconnect spark plug wire.
		Bolt-On Muffler
___	___	5. Inspect the condition of the muffler to be replaced.
___	___	6. Squirt a few drops of penetrating oil on bolt threads.
___	___	7. Remove muffler bolts.
___	___	8. Remove muffler and gasket.
___	___	9. Clean gasket residue from block.
___	___	10. Clean exhaust port and bolt holes.
___	___	11. Install new gasket, muffler, and bolts.
___	___	12. Clean work area.
		Pipe Thread Muffler
___	___	13. Secure engine to be serviced and disconnect the spark plug wire.
___	___	14. Inspect condition of the muffler to replaced.
___	___	15. Squirt penetrating oil on muffler pipe threads.
___	___	16. Tap loose locknut using a punch and hammer.
___	___	17. Place pipe wrench on muffler pipe.
___	___	18. Remove muffler.
___	___	19. Inspect and clean exhaust port and threads.
___	___	20. Install new locknut and muffler.
___	___	21. Tighten muffler pipe firmly in block.
___	___	22. Tighten locknut.
___	___	23. Clean work area.

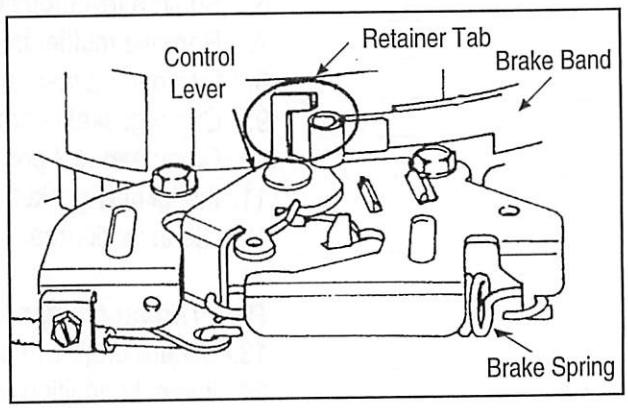
Student's Signature _____ Instructor's Signature _____ Date _____

F. Step-By-Step Procedure For Servicing and Adjusting "System 2" and "System 4" CPSC Compliance Engines

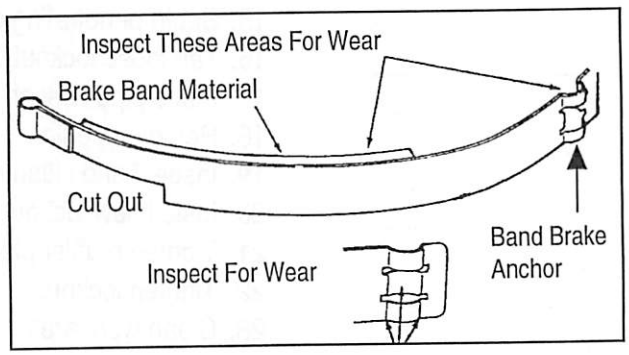
1. Wear proper safety equipment.
2. Read operator's manual.
3. Select proper tools and equipment.
4. Organize your work station.
5. Remove starter assembly and throttle cable.

Remove, Inspect and Reinstall Brake Band

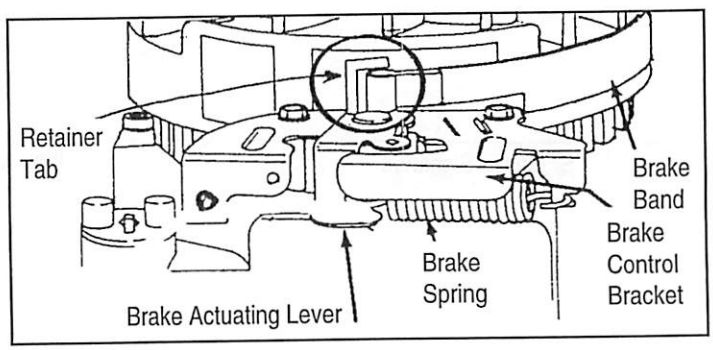
6. Remove the brake band.
   a. Disconnect the brake spring.
   b. Use the tang bending tool to bend the retainer tab on the brake control bracket.
   c. Remove the brake band.



7. Inspect the brake band. If damaged or distorted, replace the brake band. Also inspect the band pad for damage. Do not attempt to reuse or reshape a distorted or damaged brake band.



8. Reinstall the brake band with the "cut out" section above the brake control bracket. Place brake band over retainer tab and bend tab to lock band in place.



9. Reconnect the brake spring.

Maintenance Procedures Competency Profile

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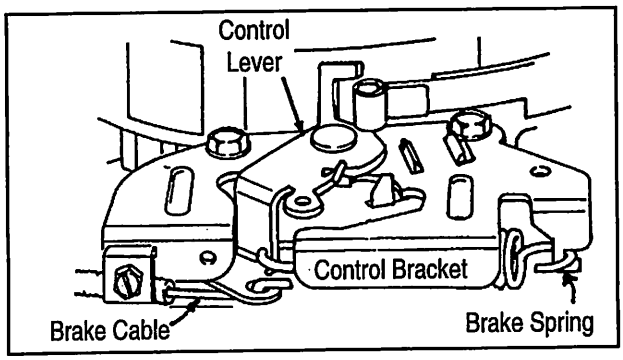
Yes	No	Adjusting "System 2" and "System 4" CPSC Compliance Engines
___	___	1. Wear proper safety equipment.
___	___	2. Read operator's manual.
___	___	3. Select proper tools and equipment.
___	___	4. Organize your work station.
___	___	5. Remove starter assembly and throttle cable.
___	___	6. Remove the brake band.
___	___	7. Inspect the brake band.
___	___	8. Reinstall the brake band.
___	___	9. Reconnect the brake spring.

Student Signature _____ Instructor Signature _____ Date _____

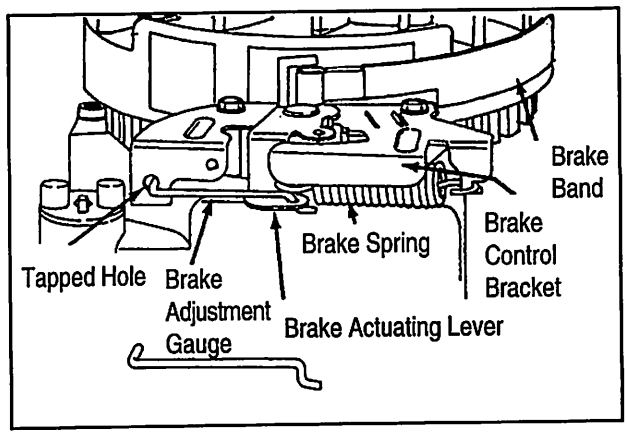
G. Step-By-Step Procedure For Adjusting the Brake for "System 2" and "System 4" CPSC Compliance Engines

1. Remove brake cable.
   a. Release brake spring from brake control bracket.
   b. Move brake actuating lever back.
   c. Slip cable out of brake mechanism.



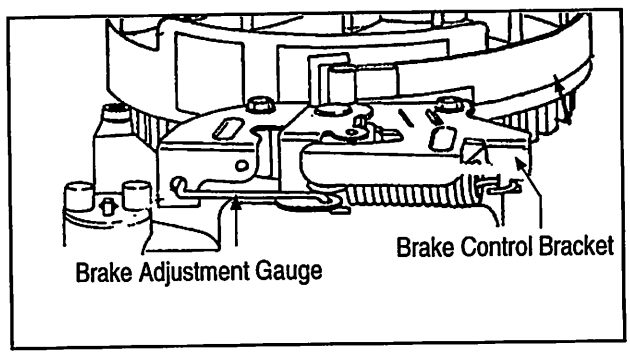
2. Adjust brake.
   a. Place one end of the gauge into the control cable hole of the brake actuating lever.
   b. Move the actuating lever sideways until the 90-degree end of the gauge can be inserted into the tapped hole of the brake control bracket.

Note: The brake adjustment gauge #19256 is available from Briggs and Stratton.

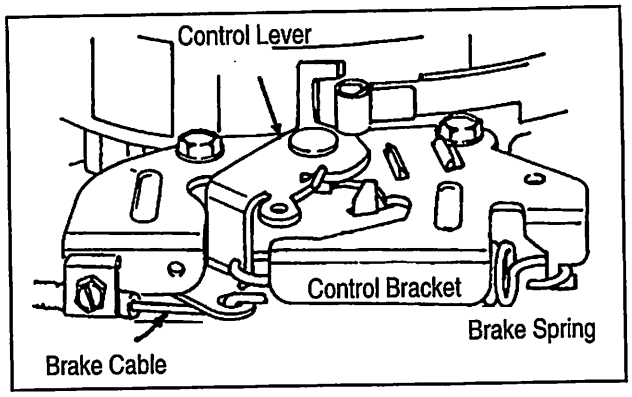


   c. Move the brake control bracket sideways until the 90-degree bend of the brake adjustment gauge can slide "in and out" with a slight amount of friction against the inner surface of the tapered hole.
   d. Tighten the brake control bracket without loosing the friction.
   e. Remove the brake adjustment gauge.

3. Install control cable to the brake control bracket.



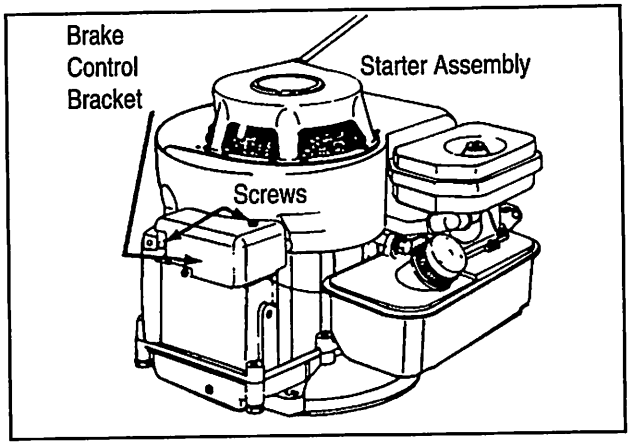
4. Reconnect spring to brake mechanism. Check switch.



5. Install starter assembly and brake control cover.

6. Start engine and check safety system.

Note: The blade must stop within three seconds upon release of a blade control.



Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Adjusting the Brake for "System 2" and "System 4" CPSC Compliance Engines
___	___	1. Remove brake cable.
___	___	2. Adjust brake.
___	___	3. Install control cable to the brake control bracket.
___	___	4. Reconnect spring to brake mechanism. Check switch.
___	___	5. Install starter assembly and brake control cover.
___	___	6. Start engine and check safety system.

Student's Signature _____ Instructor's Signature _____ Date _____

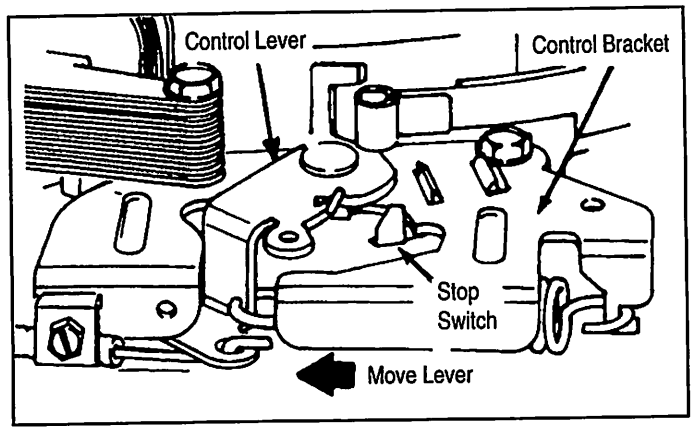
H. Step-By-Step Procedures For Servicing Ignition Stop Switches

1. Wear proper safety equipment.

2. Read operator's manual.

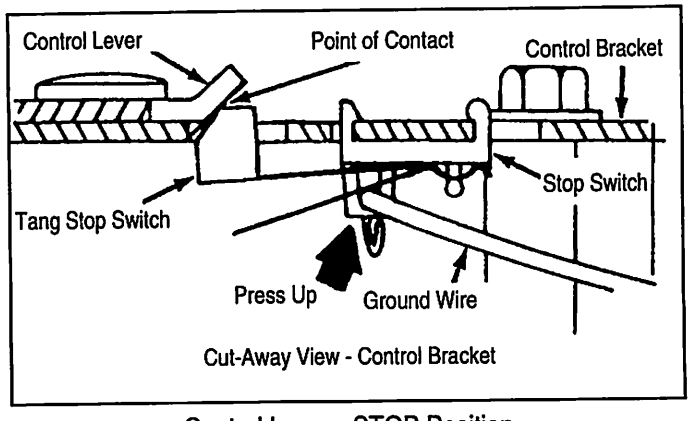
3. Select proper tools and equipment.

4. Check stationary mechanical stop switch.
   a. Move control lever away from stop switch using the safety control on the mower handle or by moving control lever at engine.



Control Lever, RUN Position

5. Release control lever completely. The control lever at the engine must contact the tang stop switch. To adjust the stop switch it may be necessary to adjust the control bracket.



Control Lever - STOP Position

Maintenance Procedures Competency Profile

Directions: This profile provides a record for student, instructor, and/or industry representative. Competencies listed below represent the tasks to be performed in maintenance procedures on lawn mowers. Compile your evaluation of the student (trainee) by checking the appropriate "yes/no" rating.

Yes	No	Servicing Ignition Stop Switches
___	___	1. Wear proper safety equipment.
___	___	2. Read operator's manual.
___	___	3. Select proper tools and equipment.
___	___	4. Check stationary mechanical stop switch.
___	___	5. Adjust control lever.

Student's Signature _____ Instructor's Signature _____ Date _____

Small Engine Service Chart

To ensure trouble-free and long-life service, your equipment will require frequent maintenance. Use the following schedule to maintain your small engine.

Maintenance Procedure	Refer to Manual No.	Begin Season	Each Use	As Required	10 Hours	25 Hours	50 Hours	100 Hours	100-300 Hours
1. Check oil in crankcase	Module 6	X	X						
2. Change oil in crankcase	Module 6	X				X			
3. Check oil in gear reduction case	Module 6	X						X	
4. Check and clean air filter	Module 2	X				X			
5. Check and clean cooling system	Module 8	X						X	
6. Clean and regap spark plug .30"	Module 1	X						X	
7. Remove carbon deposits from combustion chamber	Module 4								X
8. Check muffler	Module 8	X					X		
9. Oil wheels and height adjustment linkage	Module 8	X			X				
10. Clean debris from engine and mower deck	Module 8	X	X						
11. Check from any loose screws, bolts and other parts	Module 8	X	X						
12. Adjust carburetor	Module 2			X					
13. Check or change points	Module 1			X					
14. Sharpen & balance mower blade	Module 8	X		X					
15. Check mower deck for damage and wheels for uniform height	Module 8	X	X						

Comparison of Small Engine Hours to Vehicle Miles

The above service chart is given in hours of operation. To better illustrate what this means in engine wear, the following table shows a comparison between the hours of operation of a small engine and the miles traveled by a vehicle such as an automobile. The ratio commonly used is: One engine hour equals forty miles. When making comparisons, use the following table or multiply hours of operation by forty.

Engine Hours	Vehicle Miles
25	1000
50	2000
100	4000
250	10,000
500	20,000
1000	40,000

Small Engine Maintenance Record

This chart is for you to keep a record of maintenance on your small engine.

Maintenance Procedure	Date Completed					

Engine Specifications
for Briggs and Stratton Engines

Contact Point Gap: .020 All Models
Spark Plug Gap: .030 All Models
Condenser Capacity: .18 to .24 MFD All Models
Idle Speed for Aluminum Engines: 1750 R.P.M.
(60000-250000 model series)

Personal Engine Data for Ordering Parts

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Equipment: _____
Model Number: _____
Type Number: _____
Code Number: _____

Torque Value Conversions

(Foot-Pounds to Inch Pounds)

Ft-Lb	In-Lb	Ft-Lb	In-Lb	In-Lb	Ft-Lb	In-Lb	Ft-Lb
1	12	40	480	1	.08	60	5.00
2	24	50	600	2	.17	80	6.66
3	36	60	720	3	.25	100	8.33
4	48	70	840	4	.33	200	16.66
5	60	80	960	5	.42	300	24.99
6	72	90	1060	6	.50	400	33.33
7	84	100	1200	7	.58	500	41.65
8	96	110	1320	8	.67	600	50.00
9	108	120	1440	9	.75	700	58.31
10	120	130	1560	10	.83	800	66.64
20	240	140	1680	20	1.67	900	74.97
30	360	150	1800	40	3.33	1000	83.33

Metric Torque Value Conversions

Ft-Lb	In-Lb	Ft-Lb	In-Lb	In-Lb	Ft-Lb	In-Lb	Ft-Lb
1	1.36	40	54	1	.113	60	6.78
2	2.7	50	68	2	.226	80	9.04
3	4.1	60	81	3	.339	100	11.3
4	5.4	70	95	4	.452	200	23
5	6.8	80	108	5	.565	300	34
6	8.1	90	122	6	.678	400	45
7	9.5	100	136	7	.791	500	56
8	10.8	110	149	8	.904	600	68
9	12.2	120	163	9	1.02	700	79
10	13.6	130	176	10	1.13	800	90
20	27	140	190	20	2.26	900	102
30	41	150	203	40	4.52	1000	113

Suggested Maximum Torque Values for Fasteners of Different Materials

Bolt Size	Low Carbon Steel in-lbs	18-8 St St in-lbs	Brass in-lbs	Silicon Bronze in-lbs	Aluminum 24ST-4 in-lbs	316 St St in-lbs	Monel in-lbs
2-56	2.2	2.5	2.0	2.3	1.4	2.6	2.5
2-64	2.7	3.0	2.5	2.8	1.7	3.2	3.1
3-48	3.5	3.9	3.2	3.6	2.1	4.0	4.0
3-56	4.0	4.4	3.6	4.1	2.4	4.6	4.5
4-40	4.7	5.2	4.3	4.8	2.9	5.5	5.3
4-48	5.9	6.6	5.4	6.1	3.6	6.9	6.7
5-40	6.9	7.7	6.3	7.1	4.2	8.1	7.8
5-44	8.5	9.4	7.7	8.7	5.1	9.8	9.6
6-32	8.7	9.6	7.9	8.9	5.3	10.1	9.8
6-40	10.9	12.1	9.9	11.2	6.6	12.7	12.3
8-32	17.8	19.8	16.2	18.4	10.8	20.7	20.2
8-36	19.8	22.0	18.0	20.4	12.0	23.0	22.4
10-24	20.8	22.8	18.6	21.2	13.8	23.8	25.9
10 32	29.7	31.7	25.9	29.3	19.2	33.1	34.9
1/4"-20	65.0	75.2	61.5	68.8	45.8	78.8	85.3
1/4"-28	90.0	94.0	77.0	87.0	57.0	99.0	106.0
5/16"-18	129	132	107	123	80	138	149
5/16"-24	139	142	116	131	86	147	160
3/8"-16	212	236	192	219	143	247	266
7/16"-24	232	259	212	240	157	271	294
7/16"-14	338	376	317	349	228	393	427
7/16"-20	361	400	327	371	242	418	451
1/2"-13	465	517	422	480	313	542	584
1/2"-20	487	541	443	502	328	565	613
9/16"-12	613	682	558	632	413	713	774
9/16"-18	668	752	615	697	456	787	855
5/8"-11	1000	1110	907	1030	715	1160	1330
5/8"-18	1140	1244	1016	1154	798	1301	1482
3/4"-10	1259	1530	1249	1418	980	1582	1832
3/4"-16	1230	1490	1220	1382	958	1558	1790
7/8"-9	1919	2328	1905	2140	1495	2430	2775
7/8"-14	1911	2318	1895	2130	1490	2420	2755
1"-8	2832	3440	2815	3185	2205	3595	4130
1"-14	2582	3110	2545	2885	1995	3250	3730
	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs	ft-lbs
1 1/8"-7	340	413	337	383	265	432	499
1 1/8"-12	322	390	318	361	251	408	470
1 1/4"-7	432	523	428	485	338	546	827
1 1/4"-12	396	480	394	447	308	504	575
1 1/2"-8	732	888	727	822	570	930	1084
1 1/2"-12	579	703	575	851	450	732	840