



## Repair Manuals for other Briggs & Stratton Engines:

270962 – Single Cylinder “L” Head

272147 – Single Cylinder OHV

272144 – Vanguard™ V-Twin OHV

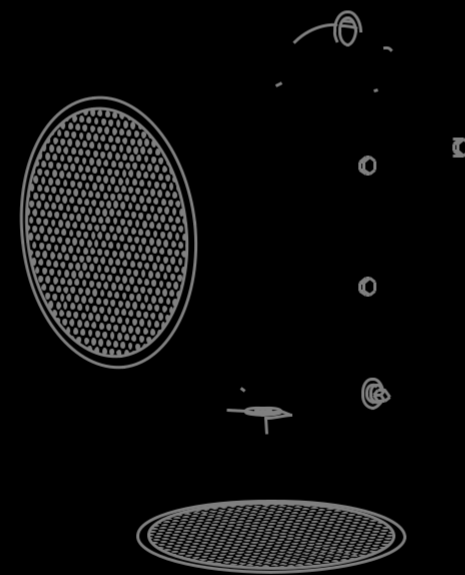
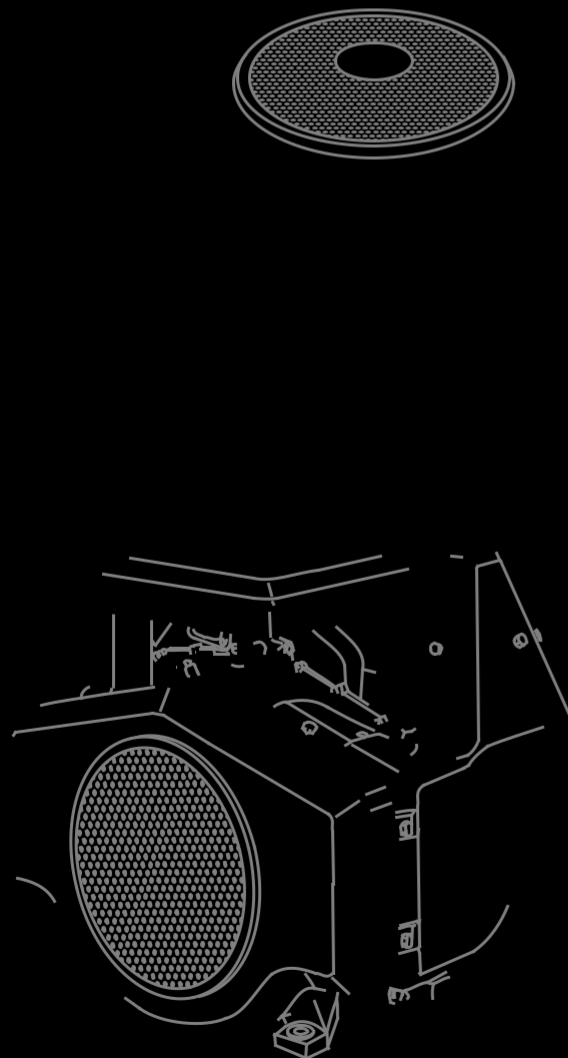
274008 – Intek™ Single Cylinder OHV

273521 – Intek™ V-Twin Cylinder OHV

Briggs & Stratton



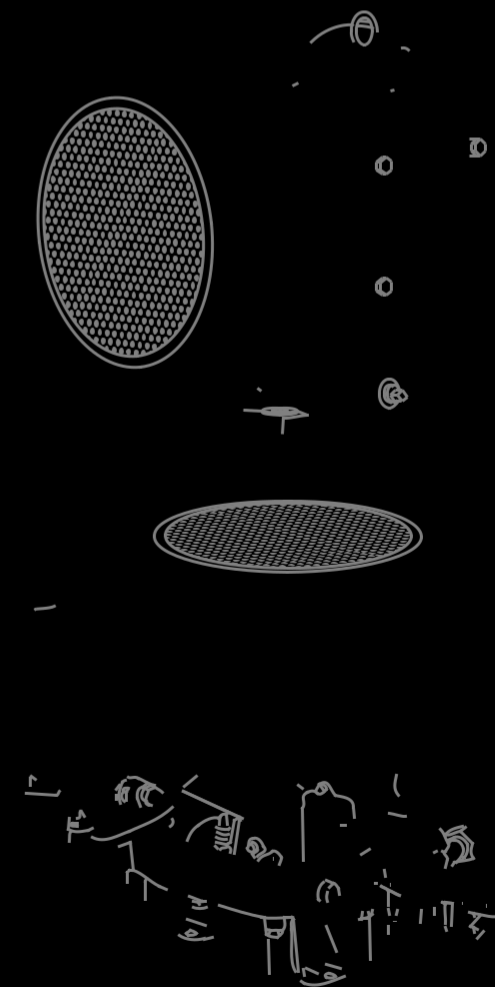
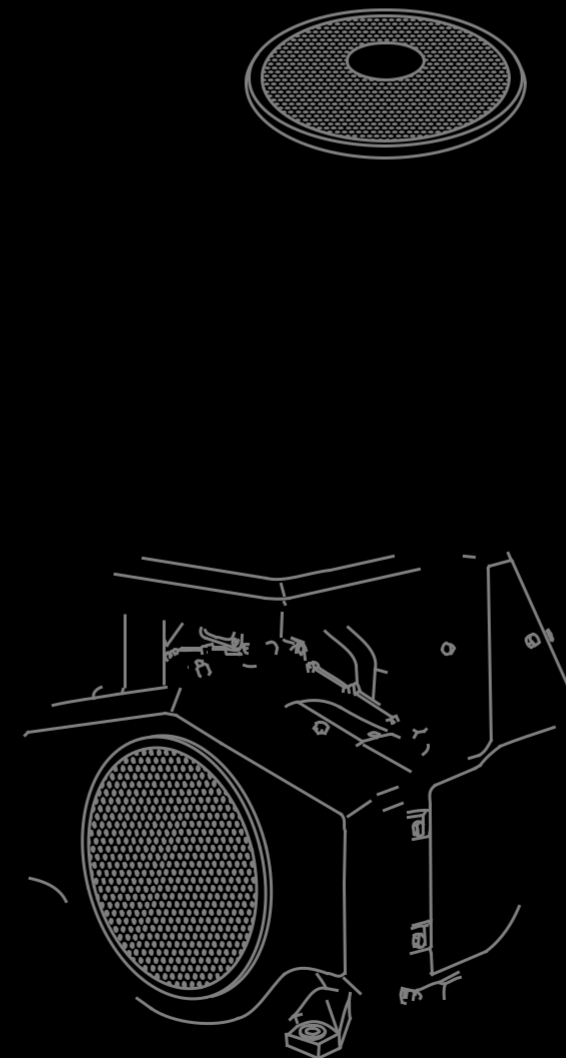
# Twin Cylinder “L” Head Repair Manual



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TWIN CYLINDER “L” HEAD REPAIR MANUAL

4/99



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## COMMON SPECIFICATIONS FOR OPPOSED TWIN CYLINDER ENGINES

Sleeve Bore Models: 400400, 400700, 402400, 402700, 404400, 404700, 422400, 422700, 462700

Aluminum Bore Models: 401400, 401700, 421400, 421700

### Common Specifications – All Model Series

Armature Air Gap	
Magnetron Ignition	.008" – .012" (0.20 – 0.30 mm)
Breaker Point Ignition	.010" – .014" (0.25 – 0.35 mm)
Crankshaft End Play	
Vertical Shaft Engines	.002" – .026" (0.05 – 0.66 mm)
Horizontal Shaft Engines	.004" – .012" (0.10 – 0.30 mm)
**Governed Idle Speed (all models)	1200 – 1400 RPM
Spark Plug Gap	.030" (0.76 mm)
Valve Clearance (Cold)	
<u>Springs Installed</u>	
Intake	.004" – .006" (0.10 – 0.15 mm)
Exhaust	.007" – .009" (0.17 – 0.22 mm)
<u>Without Springs</u>	
Intake	.006" – .008" (0.15 – 0.20 mm)
Exhaust	.009" – .011" (0.22 – 0.28 mm)

\*\* Top Governed Speed: See Briggs & Stratton Service Engine Sales Manual Microfiche MS-6255 or Sales Manual MS-4052

### Torque Specifications – All Model Series

Alternator (to cylinder)	20 in. lbs. (2.0 Nm)
Air Cleaner Base (to carb.)	25 in. lbs. (3.0 Nm)
Armature	25 in. lbs. (3.0 Nm)
Back Plate	150 in. lbs. (17.0 Nm)
Blower Housing	90 in. lbs. (10.0 Nm)
Breather	25 in. lbs. (3.0 Nm)
Carburetor (to manifold)	100 in. lbs. (11.0 Nm)
Carburetor Plug/Solenoid	100 in. lbs. (11.0 Nm)
Connecting Rod	190 in. lbs. (22.0 Nm)
Crankcase Cover/Sump	
Horizontal Crankshaft	
Crankcase Cover	225 in. lbs. (25.0 Nm)
Base	27 ft. lbs. (37.0 Nm)
Vertical Crankshaft	
Steel Cover Plate	250 in. lbs. (28.0 Nm)
Aluminum Cover Plate	27 ft. lbs. (37.0 Nm)
Sump	225 in. lbs. (25.0 Nm)
Cylinder Head	160 in. lbs. (18.0 Nm)
Fan Retainer	150 in. lbs. (17.0 Nm)
Flywheel	150 ft. lbs. (203.0 Nm)
Governor Control Bracket	35 in. lbs. (4.0 Nm)
Governor Lever Nut	100 in. lbs. (11.0 Nm)
Intake Manifold	90 in. lbs. (10.0 Nm)
Spark Plug	200 in. lbs. (22.0 Nm)
Starter Motor	160 in. lbs. (18.0 Nm)
Starter Motor Thru Bolts	50 in. lbs. (6.0 Nm)

## STANDARD AND REJECT DIMENSIONS – ALL MODEL SERIES

DESCRIPTION	STANDARD DIMENSION	REJECT DIMENSION
<b>Cylinder</b>		
Bore (All)	3.4365" – 3.4375" (87.28 – 87.31 mm)	3.4405" (87.38 mm)
Out of round: Aluminum Bore		.0025" (.06 mm)
Sleeve Bore		.0015" (.04 mm)
Main Bearing (Magneto)	1.379" – 1.380" (35.02 – 35.05 mm)	1.383" (35.12 mm)
Cam Bearing (Magneto)	.6252" – .6257" (15.88 – 15.89 mm)	.6275" (15.93 mm)
Valve Guide	.3145" – .3165" (7.98 – 8.04 mm)	.330" (8.38 mm)
Valve Stem	.310" (7.87 mm)	.308" (7.82 mm)
<b>Crankcase Cover</b>		
Main Bearing (PTO)	1.379" – 1.380" (35.02 – 35.05 mm)	1.383" (35.12 mm)
Cam Bearing (PTO)	.6252" – .6257" (15.88 – 15.89 mm)	.6275" (15.93 mm)
<b>Crankshaft</b>		
Crankpin	1.6235" – 1.6243" (41.23 – 41.25 mm)	1.622" (41.20 mm)
Magneto Journal	1.3776" – 1.3784" (34.99 – 35.01 mm)	1.376" (34.95 mm)
PTO Journal	1.3776" – 1.3784" (34.99 – 35.01 mm)	1.376" (34.95 mm)
<b>Camshaft</b>		
Journals	.624" – .625" (15.85 – 15.87 mm)	.623" (15.82 mm)
Lobes		
Intake 14, 16, 18, 20 HP	1.1525" – 1.1555" (29.27 – 29.35 mm)	1.150" (29.20 mm)
Intake 12.5 HP	1.0575" – 1.0605" (26.86 – 26.93 mm)	1.055" (26.80 mm)
Exhaust 12.5, 14, 16, 18 HP	1.1225" – 1.1255" (28.50 – 28.58 mm)	1.120" (28.45 mm)
Exhaust 20 HP	1.1525" – 1.1555" (29.27 – 29.35 mm)	1.150" (29.20 mm)
<b>Connecting Rod</b>		
Crankpin Bearing	1.625" – 1.6255" (41.27 – 41.28 mm)	1.627" (41.32 mm)
Piston Pin Bearing	.8007" – .8011" (20.34 – 20.35 mm)	.802" (20.37 mm)
<b>Piston Pin</b>	.8003" – .8005" (20.32 – 20.33 mm)	.799" (20.30 mm)
<b>Piston Pin Bearing (Piston)</b>	.8005" – .801" (20.33 – 20.35 mm)	.802" (20.37 mm)
<b>Piston Rings</b>		
Ring End Gap		
Aluminum Bore – Top & Center	.007" – .017" (.18 – .43 mm)	.035" (.90 mm)
Oil	.007" – .017" (.18 – .43 mm)	.045" (1.14 mm)
Cast Iron Bore – Top & Center	.007" – .017" (.18 – .43 mm)	.030" (.76 mm)
Oil	.007" – .017" (.18 – .43 mm)	.035" (.90 mm)
Ring Side Clearance (All)	.0035" – .006" (.09 – .15 mm)	.009" (.23 mm)



**English to Metric Conversion Table**

Fraction	Decimal	mm	Fraction	Decimal	mm
1/64	0.0156	0.3969	33/64	0.5156	13.0969
1/32	0.0312	0.7938	17/32	0.5312	13.4938
3/64	0.0469	1.1906	35/64	0.5469	13.8906
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.0781	1.9844	37/64	0.5781	14.6844
3/32	0.0938	2.3812	19/32	0.5938	15.0812
7/64	0.1094	2.7781	39/64	0.6094	15.4781
1/8	0.1250	3.1750	5/8	0.6250	15.8750
9/64	0.1406	3.5719	41/64	0.6406	16.2719
5/32	0.1562	3.9688	21/32	0.6562	16.6688
11/64	0.1719	4.3656	43/64	0.6719	17.0656
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.2031	5.1594	45/64	0.7031	17.8594
7/32	0.2188	5.5562	23/32	0.7188	18.2562
15/64	0.2344	5.9531	47/64	0.7344	18.6531
1/4	0.2500	6.3500	3/4	0.7500	19.0500
17/64	0.2656	6.7469	49/64	0.7656	19.4469
9/32	0.2812	7.1438	25/32	0.7812	19.8438
19/64	0.2969	7.5406	51/64	0.7969	20.2406
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.3281	8.3344	53/64	0.8281	21.0344
11/32	0.3438	8.7312	27/32	0.8438	21.4312
23/64	0.3594	9.1281	55/64	0.8594	21.8281
3/8	0.3750	9.5250	7/8	0.8750	22.2250
25/64	0.3906	9.9219	57/64	0.8906	22.6219
13/32	0.4062	10.3188	29/32	0.9062	23.0188
27/64	0.4219	10.7156	59/64	0.9219	23.4156
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.4531	11.5094	61/64	0.9531	24.2094
15/32	0.4688	11.9062	31/32	0.9688	24.6062
31/64	0.4844	12.3031	63/64	0.9844	25.0031
1/2	0.5000	12.7000	1	1.0000	25.4000

# Drill Size – Decimal Equivalent In Inches

60—.040	39—.0995	20—.161	1—.228	Q—.332
59—.041	38—.1015	19—.166	A—.234	R—.339
58—.042	37—.104	18—.1695	15/64—.2344	11/32—.3438
57—.043	36—.1065	11/64—.1719	B—.238	S—.348
56—.0465	7/64—.1094	17—.173	C—.242	T—.358
55—.052	35—.110	16—.177	D—.246	23/64—.3594
54—.055	34—.111	15—.180	E, 1/4—.250	U—.368
53—.0595	33—.113	14—.182	F—.257	3/8—.375
1/16—.0625	32—.116	13—.185	G—.261	V—.377
52—.0635	31—.120	3/16—.1875	17/64—.2656	W—.386
51—.067	1/8—.125	12—.189	H—.266	25/64—.3906
50—.070	30—.1285	11—.191	I—.272	X—.397
49—.073	29—.136	10—.1935	J—.277	Y—.404
48—.076	28—.1405	9—.196	K—.281	13/32—.4062
5/64—.0781	9/64—.1406	8—.199	9/32—.2812	Z—.413
47—.0785	27—.144	7—.201	L—.290	27/64—.4219
46—.081	26—.147	13/64—.2031	M—.295	7/16—.4375
45—.082	25—.1495	6—.204	19/64—.2969	29/64—.4531
44—.086	24—.152	5—.2055	N—.302	15/32—.4688
43—.089	23—.154	4—.209	5/16—.3125	31/64—.4844
42—.0935	5/32—.1562	3—.213	O—.316	1/2—.500
3/32—.0938	22—.157	7/32—.2188	P—.323	
41—.096	21—.159	2—.221	21/64—.3281	
40—.098				

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## In the Interest of Safety



This safety alert symbol indicates that this message involves personal safety. Words danger, warning and caution indicate degree of hazard. Death, personal injury and/or property damage may occur unless instructions are followed carefully.



You are not ready to operate this engine if you have not read and understood the following safety items. Read this entire owner's manual and the operating instructions of the equipment this engine powers.

The Briggs & Stratton engine is made of the finest material in a state-of-the-art manufacturing facility. Please understand that Briggs & Stratton sells engines to original equipment manufacturers. It also sells to others in the distribution chain who may sell to the ultimate consumer, an equipment manufacturer, another distributor or a dealer. As a result, Briggs & Stratton does not necessarily know the application on which the engine will be placed. For that reason, carefully read and understand the operating instructions of the equipment before you repair or operate it.

You should also understand that there are equipment applications for which Briggs & Stratton does not approve the use of its engines. Briggs & Stratton engines are not to be used on vehicles with less than 4 wheels. They include motor bikes, aircraft products and All Terrain Vehicles. Moreover, Briggs & Stratton does not approve of its engines being used in competitive events. FOR THAT REASON, BRIGGS & STRATTON ENGINES ARE NOT AUTHORIZED FOR ANY OF THESE APPLICATIONS. Failure to follow this warning could result in death, serious injury (including paralysis) or property damage.



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



DO NOT remove fuel tank cap nor fill fuel tank while engine is hot or running. DO NOT refuel indoors or in an unventilated area. (Allow engine to cool 2 minutes before refueling.)

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

DO NOT store, spill, or use gasoline near an open flame, nor near an appliance like a stove, furnace, or water heater that uses a pilot light or can create a spark.

DO NOT refuel indoors or in an unventilated area.

DO NOT operate or tip engine/equipment at such a severe angle that causes gasoline spillage.

DO NOT operate engine if gasoline is spilled or when smell of gasoline is present or other explosive conditions exist. (Move equipment away from spill and avoid any ignition until gasoline has evaporated.)

DO NOT transport engine with fuel in tank or fuel shut-off valve open.

DO NOT choke carburetor to stop engine, especially in an enclosed vehicle. (Whenever possible, gradually reduce engine speed before stopping.)

DO NOT tamper with governor springs, links or other parts to increase engine speed. (Run engine at speed set for equipment manufacturer.)

DO NOT check for spark with spark plug removed. (Use an approved tester.)

DO NOT run engine without blower housing or other safety shields removed when doing repairs.

DO NOT crank engine with spark plug removed. (If engine is flooded, place throttle in FAST and crank until engine starts.)

DO NOT strike flywheel with a hammer or hard object as this may cause flywheel to shatter in operation. (To remove flywheel, use Briggs & Stratton approved tools and procedures only.)

DO NOT operate engine without a muffler. (Inspect periodically and replace if worn or leaking. If engine is equipped with muffler deflector, inspect periodically and replace if necessary. Replacement parts must be same as on original equipment.)

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

DO NOT use this engine on any forest covered, brush covered, or grass covered unimproved land unless a spark arrester is installed on muffler. The spark arrester must be maintained in working order by the owner and/or operator. In the State of California the above is required by law (Section 4442 of the California Public Resources Code). Other states may have similar laws. Federal laws apply on federal lands.

DO NOT touch hot muffler, cylinder, or fins which can cause burns.

DO NOT start engine with air cleaner or air cleaner cover removed (or cover over carburetor air intake, if Sno/Gard engine).

DO NOT attempt to start engine with cutting blade loose or removed. (Blade must be tight, otherwise a kickback may occur.)



4 Prior to work, read and understand the section(s) of this manual that pertain to the job. Follow all safety warnings.

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

4 WEAR suitable eye protection (safety glasses, goggles or face shield when performing repair procedures).

4 PREVENT ACCIDENTAL STARTING by removing spark plug wire from spark plug when servicing engine or equipment. Disconnect negative wire from battery terminal if equipped with electric starting system.

4 REMOVE blower housing periodically and clean engine. Keep cylinder fins and governor parts free of dirt, grass and other debris which can affect engine speed.

4 USE fresh gasoline. Stale fuel can gum carburetor and cause leakage.

4 CHECK fuel lines and fittings frequently for cracks or leaks. Replace if necessary.

4 USE ONLY Genuine Briggs & Stratton Parts or their equivalent. The use of replacement parts which are not of equivalent quality may damage the engine.

## WARNING:

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.



## BRIGGS & STRATTON NUMERICAL IDENTIFICATION SYSTEM

All Briggs & Stratton engines have a unique numerical identification system. Each engine is identified by a Model, Type and Code number. Example:

422777      1125 01      99052115

This chart explains the numerical model designation system. It is possible to determine most of the important mechanical features of the engine by merely knowing the model number. Here is how it works.

FIRST DIGIT AFTER DISPLACEMENT		SECOND DIGIT AFTER DISPLACEMENT	THIRD DIGIT AFTER DISPLACEMENT	FOURTH DIGIT AFTER DISPLACEMENT
CUBIC INCH DISPLACEMENT	BASIC DESIGN SERIES	CRANKSHAFT, CARBURETOR, GOVERNOR	PTO BEARING, REDUCTION GEAR, AUXILIARY DRIVE, LUBRICATION	TYPE OF STARTER
6	0	0 - Horizontal Shaft	0 - Plain Bearing/DU Non)Flange Mount	0 - Without Starter
8	1	Diaphragm Carburetor		1 - Rope Starter
9	2	Pneumatic Governor	1 - Plain Bearing Flange Mounting	2 - Rewind Starter
10	3	1 - Horizontal Shaft	2 - Sleeve Bearing Flange Mounting	3 - Electric Starter Only 120 Volt Gear Drive
11	4	Vacu)Jet Carburetor	Splash Lube	4 - Electric Starter/Generator 12 Volt Belt Drive
12	5	Pneumatic Governor	3 - Ball Bearing Flange Mounting	5 - Electric Starter Only 12 Volt Gear Drive
13	6	2 - Horizontal Shaft	Splash Lube	6 - Alternator Only
16	7	Pulsa)Jet Carburetor	4 - Ball Bearing Flange Mounting Pressure	7 - Electric Starter 12 Volt Gear Drive With Alternator
17	8	Pneumatic or Mechanical Governor	Lubrication on Horizontal Shaft	8 - Vertical Pull Starter or Side Pull Starter
18	9		5 - Plain Bearing Gear Reduction (6 to 1) CW Rotation	
19	A to Z	3 - Horizontal Shaft Flo)Jet Carburetor	Flange Mounting	
22		Pneumatic Governor	6 - Plain Bearing Gear Reduction (6 to 1) CCW Rotation	
23		4 - Horizontal Shaft Flo)Jet Carburetor	7 - Plain Bearing Pressure Lubrication on Vertical Shaft	
24		Mechanical Governor	8 - Plain Bearing Auxiliary Drive (PTO) Perpendicular to Crankshaft	
25		5 - Vertical Shaft Vacu)Jet Carburetor	9 - Plain Bearing Auxiliary Drive Parallel to Crankshaft	
26		Pneumatic or Mechanical Governor		
28		6 - Vertical Shaft		
29		7 - Vertical Shaft Flo)Jet Carburetor		
30		Pneumatic or Mechanical Governor		
31		8 - Vertical Shaft Flo)Jet Carburetor		
32		Mechanical Governor		
35		9 - Vertical Shaft Pulsa)Jet Carburetor		
38		Pneumatic or Mechanical Governor		
40				
42				
46				

The type number identifies certain unique features such as the crankshaft or governor spring used on an engine.

The code number identifies the assembly date of the engine. In some instances it is necessary to know the code number as well as the model and type number when performing adjustments, repairs or ordering replacement parts for an engine. Here is how it works.

Example: 99052115

- The first two digits, 99, indicate the calendar year, 1999.
- The second two digits, 05, indicate the calendar month, May.
- The third two digits, 21, indicate the calendar month day.
- The last two digits, 15, indicate the assembly line or manufacturing plant.

## MAINTENANCE

Maintenance Schedule	5 Hours or Daily	25 Hours or Every Season	50 Hours or Every Season	100 Hours or Every Season	100-300 Hours
Check oil level♦	D				
Change oil (splash lube)		D Note 1			
Change oil (pressure lube)			D Note 1		
Change oil filter				D Note 1	
Change air cleaner pre-cleaner		D Note 2			
Change air cleaner cartridge				D Note 2	
Clean cooling system				D Note 2	
* Inspect/clean spark arrester (optional accessory)			D		
Replace spark plugs				D	
Replace in-line fuel filter				D	
Remove combustion chamber deposits					D

♦Change oil after first 5 hours, then after every 50 hours or every season.

**Note 1** Change oil every 25 hours when operating under heavy load or in high temperatures.

**Note 2** Clean more often under dusty conditions or when airborne debris is present. Replace air cleaner parts, if very dirty.

## Fuel And Oil Recommendations Gasoline

We recommend the use of clean, fresh, lead-free gasoline, and the use of BRIGGS & STRATTON GASOLINE ADDITIVE, PART #5041. Lead gasoline may be used if it is commercially available and if lead-free is not available. A minimum of 77 octane is recommended. The use of lead-free gasoline results in fewer combustion deposits and longer valve life.

**NOTE:** Some fuels, called oxygenated or reformulated gasolines, are gasolines blended with alcohols or ethers. Excessive amounts of these blends can damage the fuel system or cause performance problems. Do not use gasoline which contains Methanol.

If any undesirable operating symptoms occur, use gasoline with a lower percentage of alcohol or ether. We also recommend gasoline be purchased in small quantities, not more than a 30 day supply. FRESH gasoline minimizes gum deposits, and also will ensure fuel volatility tailored for the season in which the engine will be operated.

## Lubrication

Oil has four purposes. It cools, cleans, seals and lubricates. During normal operation, small particles of metal from the cylinder walls, pistons, bearings and combustion deposits will gradually contaminate the oil. Dust particles from the air also contaminate the oil forming an abrasive mixture which can cause wear to all of the internal moving parts of the engine, if the oil is not changed regularly. Fresh oil also assists in cooling. Old oil gradually becomes thick and loses its cooling ability as well as its lubricating qualities.

Two types of lubrication systems are available on Briggs & Stratton "L" head twin cylinder engines:

1. Splash Lube
2. Pressure Lube

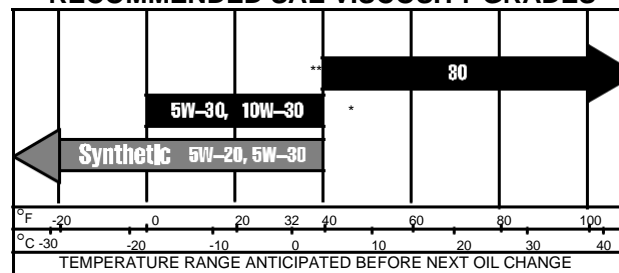
The splash lube system consists of a gear-driven oil slinger on vertical crankshaft models or a connecting rod dipper on horizontal crankshaft models.

The pressure lube system consists of a direct drive oil pump which supplies oil to all bearing journals. Model Series 400440, 400770, 402440, 402770, 404440, 404770, 422440, 422770 and 462770 engines are equipped with a pressure lubrication system with an attached or remote (optional) replaceable oil filter.

## Oil Recommendations

We recommend the use of a high quality detergent oil classified "For Service SE, SF, SG" such as Briggs & Stratton 30 weight oil Part #100005 or Part #100028. Detergent oils keep the engine cleaner and retard the formation of gum and varnish deposits. No special additives should be used with recommended oils.

### RECOMMENDED SAE VISCOSITY GRADES



\* Air cooled engines run hotter than automotive engines. Use of multi-viscosity oils (10W-30, etc.) above 40° F (4° C) will result in high oil consumption and possible engine damage. Check oil level more frequently if using these types of oil.

\*\* SAE 30 oil, if used below 40° F (4° C), will result in hard starting and possible engine bore damage due to inadequate lubrication.

## Change Oil – Splash Lube Engines

The crankcase capacity of twin cylinder engines without oil filters is approximately three pints.

**NOTE:** Early production engines had approximately 3-1/2 pint (1.65 liter) oil capacity. Use dipstick to check oil level.

**IMPORTANT:** DO NOT OVERFILL. Check and maintain oil level regularly. Change oil after first eight (8) hours of operation.

Thereafter, change oil every fifty (50) hours of operation. Change oil more often if engine is operated in dirty or dusty conditions or if engine is operated under heavy loads or in high ambient air temperatures.

Remove oil drain plug and drain oil while engine is still warm, Fig. 1 and Fig. 2. Replace drain plug.

Remove dipstick and refill slowly with new oil of proper service classification and viscosity grade. Refill to full mark on dipstick. When checking oil level, dipstick must be screwed all the way in for accurate readings. Start and run engine to check for oil leaks.

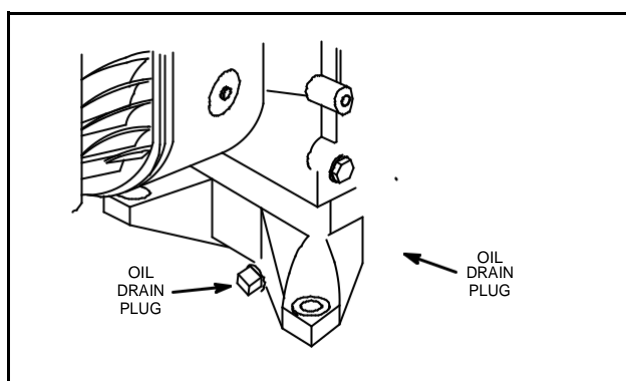


Fig. 1 – Horizontal Crankshaft Engine

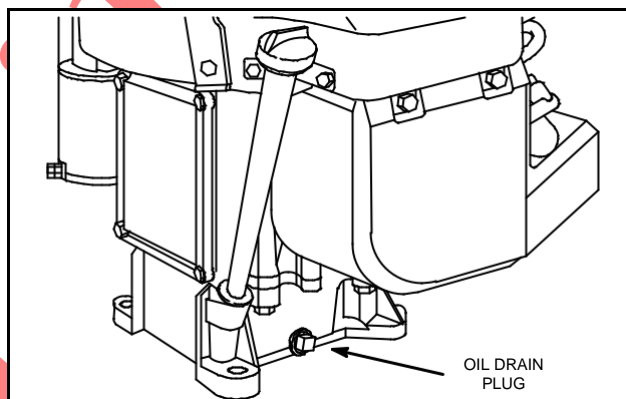


Fig. 2 – Vertical Crankshaft Engine

## Change Oil – Pressure Lube Engines

The crankcase capacity of pressure lube twin cylinder engines is approximately:

**3-1/2 Pints (1.65 liters) with filter**

**3 Pints (1.42 liters) without filter**

**IMPORTANT:** DO NOT OVERFILL. Check and maintain oil level regularly. Change oil after first five (5) hours of operation.

**NOTE:** When checking oil level, dipstick must be screwed all the way in for accurate readings.

Thereafter, change oil every fifty (50) hours of operation. Change oil more often if engine is operated in dirty or dusty conditions or if engine is operated under heavy loads or in high ambient air temperatures.

Remove oil drain plug and drain oil while engine is still warm, Fig. 1 and Fig. 2. Replace drain plug.

## Change Oil Filter

Replace oil filter every 100 hours of operation. Before installing new filter, lightly oil filter gasket with fresh clean engine oil. Screw filter on by hand until gasket contacts filter adapter. Tighten 1/2 to 3/4 turn more, Fig. 3.

Remove dipstick and refill slowly with new oil of proper service classification and viscosity grade. Start and run engine to check for oil leaks.

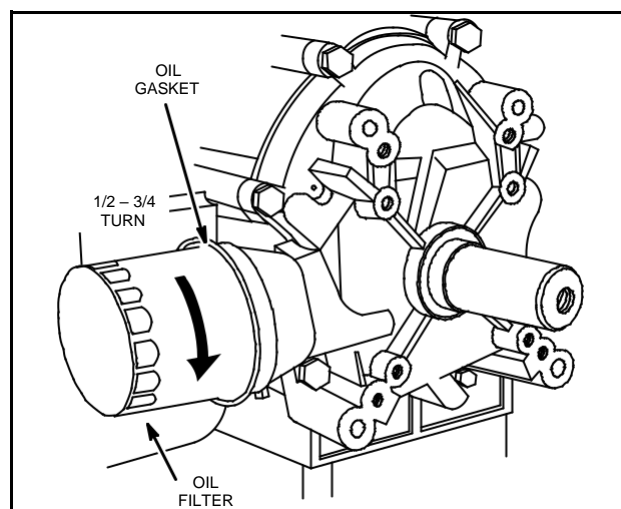


Fig. 3 – Install Oil Filter

**NOTE:** A shorter oil filter 2-1/2" (64.0 mm) is available for restricted access applications. Order Part #492932.

## Clean Cooling System

Grass particles, chaff or dirt can clog the air cooling system, especially after prolonged service in cutting dry grass or very dirty air. Continued operation with a clogged cooling system can cause severe overheating and possible engine damage. Fig. 4 shows the blower housing removed and areas to be cleaned. This should be a regular maintenance operation, performed yearly or every 100 hours, whichever comes first.

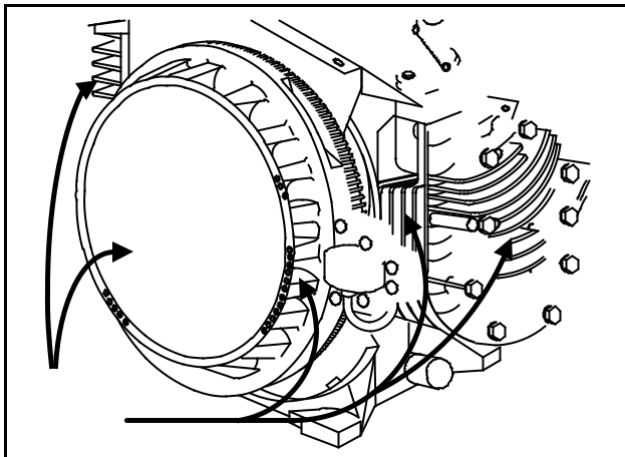


Fig. 4

## Replace Spark Plugs

Replace spark plugs every 100 hours of operation or every season, whichever occurs first. Replace spark plugs if electrodes are burned away, or the porcelain is cracked. Set spark plug gap at .030" (.76 mm) for all models, Fig. 5.

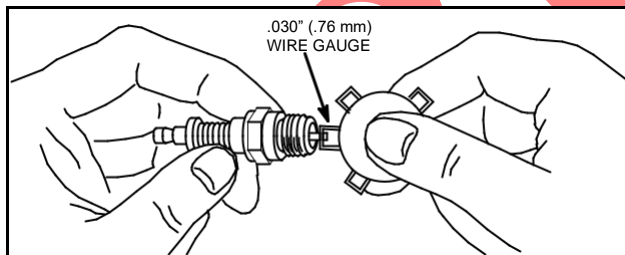


Fig. 5 – Adjusting Spark Plug Gap

**NOTE:** Do not blast clean spark plugs. Spark plugs should be cleaned by scraping or hand wire brushing and washing in a commercial solvent.

The spark plugs recommended for Briggs & Stratton twin cylinder engines are as follows:

Spark Plug Type	Champion	B&S Part No.
Standard Plug	J-19 LM	492167
Resistor Plug	RJ-19 LM	802592
Resistor Plug	RJ-12	394539

## Air Cleaner Maintenance



**WARNING:** NEVER OPERATE engine with air cleaner cover or air cleaner element removed! Fire may result.

A properly serviced air cleaner protects internal parts of the engine from dirt and dust particles in the air. If air cleaner instructions are not carefully followed, dirt and dust which should be collected in the cleaner, will be drawn into the engine. These particles are highly abrasive and will cause the piston rings and cylinder bore to wear quickly. As the rings and cylinder bore become worn, these abrasive particles enter the crankcase and contaminate the oil, forming an abra-sive mixture which will cause wear on all of the internal moving parts.

The air cleaner on every engine brought in for a check up or repair should be examined and serviced. If the air cleaner shows signs of neglect or damage, show it to the customer. Instruct the customer on proper care, to ensure long engine life.

**NOTE:** Replace air cleaner gaskets and mounting gaskets that are worn or damaged, to prevent dirt and dust entering engine due to improper sealing. Replace bent air cleaner mounting bracket.

## Service Dual Element Air Cleaner

Service/replace foam pre-cleaner at three month inter-vals or every 25 hours, whichever occurs first, Fig. 6 or Fig. 7. Replace cartridge every 100 hours or every season, whichever occurs first.

**NOTE:** Service/replace air cleaner more often under dusty conditions.

## To Service Pre-Cleaner

1. Remove knob(s) and cover.
2. Remove foam pre-cleaner by sliding it off the paper cartridge.
3. Wash foam pre-cleaner in liquid detergent and warm water.
  - a. Wrap foam pre-cleaner in cloth and squeeze dry.
  - b. Saturate foam pre-cleaner in engine oil. Squeeze to remove excess oil.
4. Install foam pre-cleaner over paper cartridge. Reassemble cover and screw knob(s) down tightly.

**NOTE:** Replace cup washer if damaged, Fig. 6 or Fig. 7.

## To Service Cartridge

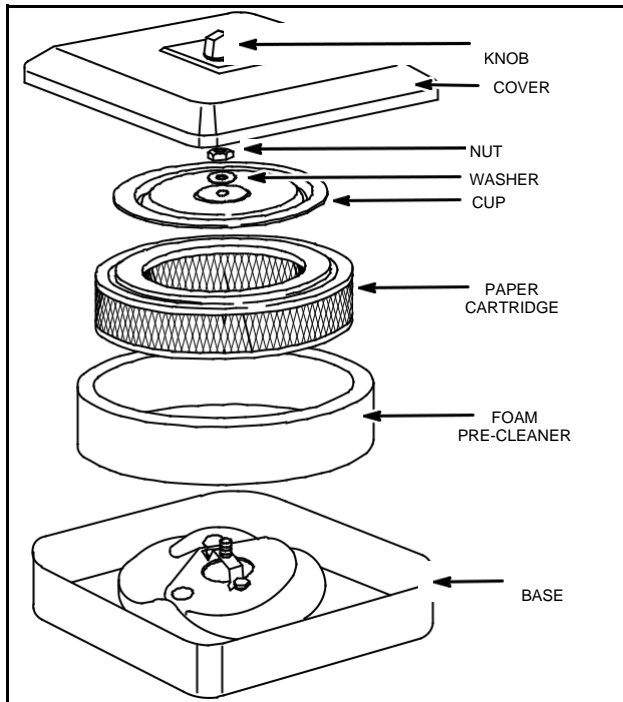
1. Remove knob(s) and cover, Fig. 6 or Fig. 7.
  - a. Remove and inspect cartridge. Replace if damaged or dirty.



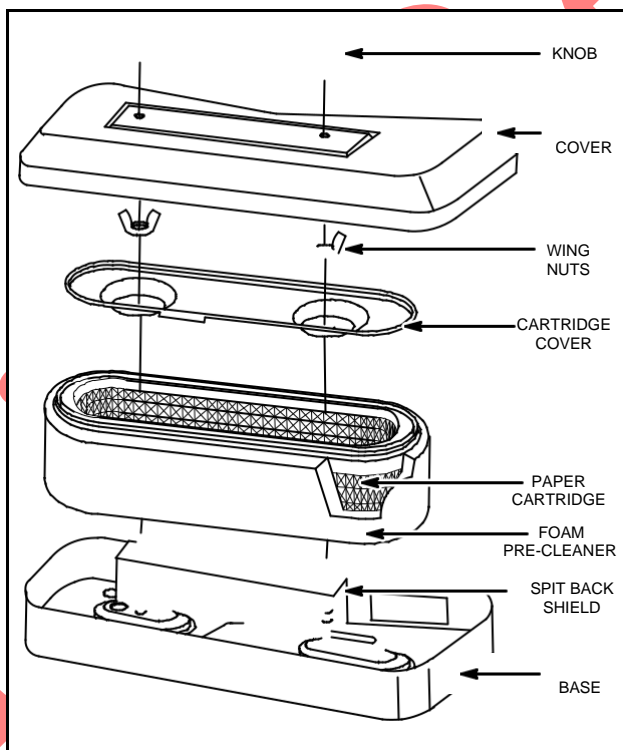
DO NOT use petroleum solvents, such as kerosene, to clean paper cartridge. They may cause cartridge to deteriorate. DO NOT oil paper cartridge. DO NOT use pressurized air to clean or dry paper cartridge.

b. Reinstall cartridge, cover plate, knob and pre-cleaner.

2. Reinstall air cleaner cover, Fig. 6 or Fig. 7.



**Fig. 6 – Air Cleaner, Horizontal Crankshaft Models (Typical)**



**Fig. 7 – Air Cleaner, Vertical Crankshaft Models (Typical)**

## Remove Combustion Chamber Deposits

Combustion chamber deposits should be removed every 100 – 300 hours or whenever cylinder heads are removed. See Section 5 for removal procedure.

Remove combustion chamber deposits from combustion chamber and around valves using a soft, hand wire brush or scraper. With piston at Top Dead Center, remove combustion chamber deposits from top of piston. Use care to prevent combustion chamber deposits from entering push rod or oil return cavity in cylinder.

Take care not to damage cylinder, top of piston, cylinder head and cylinder head gasket surfaces.

**NOTE:** Remove only the combustion chamber deposits. It is not necessary to remove the discoloration marks on the piston, valves and cylinder head. These marks are normal and will not affect engine operation.

Remove the loose deposits from around the top ring land area using compressed air or a soft bristle brush.



**WARNING: TO PREVENT** eye injury always wear eye protection when using compressed air.

## TROUBLESHOOTING

Most complaints concerning engine operation can be classified as one or a combination of the following:

1. Will not start
2. Hard starting
3. Lack of power
4. Runs rough
5. Vibration
6. Overheating
7. High oil consumption

**NOTE:** What appears to be an engine malfunction may be a fault of the powered equipment rather than the engine. If equipment is suspect, see Equipment Affecting Engine Operation.

## Systematic Check

If the engine will not start and the cause of malfunction is not readily apparent, perform a systematic check in the following order:

1. Ignition
2. Carburetion
3. Compression

This check-up, performed in a systematic manner, can usually be done in a matter of minutes. It is the quickest and surest method of determining the cause of failure. The basic check-up procedure is the same for all engine models, while any variation, by model, will be shown under the subject heading.

## Check Ignition (With Electric Starter)

**NOTE:** Magnetron ignition system requires a minimum of 350 RPM to produce spark.

1

With spark plugs installed, attach a #19368 ignition tester to each spark plug lead and ground the other end of the tester as shown in Fig. 8. Spin the flywheel rapidly with engine starter. If spark jumps the tester gaps, you may assume the ignition system is function-ing satisfactorily.



**WARNING: ON MAGNETRON** equipped engines, spark can still occur with a sheared flywheel key. A severe shock or kickback hazard may exist.

**NOTE:** Engines equipped with Magnetron ignition system will still display spark at tester with a partially or fully sheared flywheel key. A partially sheared flywheel key will affect ignition timing and engine performance.

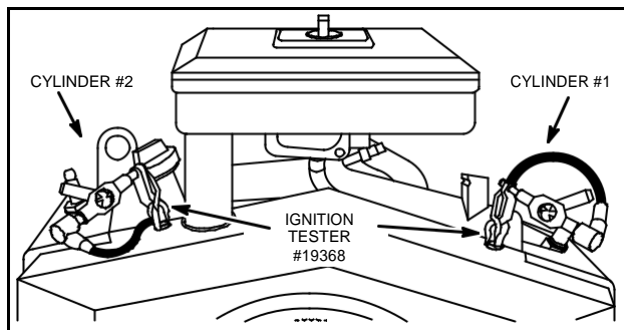


Fig. 8 – Checking Spark

If spark does not occur look for –

1. Improperly operating interlock system
2. Sheared flywheel key (breaker points only)
3. Incorrect breaker point gap (when so equipped)
4. Dirty or burned breaker points (when so equipped)
5. Breaker plunger stuck or worn (when so equipped)
6. Shorted ground wire (when so equipped)
7. Shorted stop switch (when so equipped)
8. Condenser failure (breaker points only)
9. Incorrect armature air gap
10. Armature failure
11. Worn cam bearings and/or camshaft (breaker points only)

## Check Ignition (Engine Running)

If engine runs but misses during operation, a quick check to determine if ignition is or is not at fault can be made by installing Tool #19368 ignition tester between the spark plug lead and each spark plug, Fig. 9. With the engine running, a spark miss will be readily apparent. If spark jumps gap at ignition tester regularly, and engine misses check for a fouled spark plug.

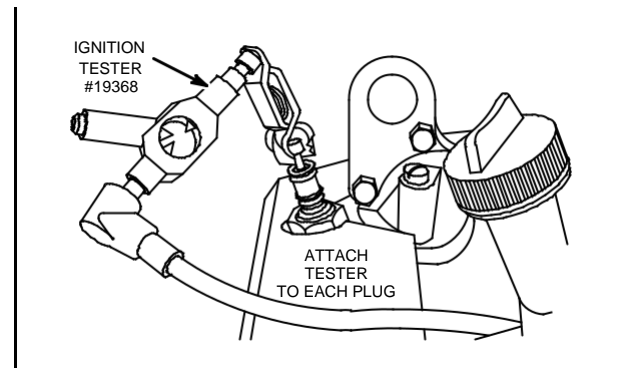


Fig. 9 – Running Check

## Checking For Fouled Spark Plug

To check for a fouled spark plug or a non-functioning cylinder, attach Tool #19368, ignition tester, between the spark plug lead and each spark plug. With engine running at top no load speed, ground one spark plug, Fig. 10. The engine should continue to run on the other cylinder. Repeat this test with the other cylinder. If the engine will not continue to run when making this test, the cylinder that is not grounded is not functioning and/or the spark plug is fouled. Install a new spark plug before proceeding. If miss continues, problem may be carburetion or compression. See Cylinder Balance Test.

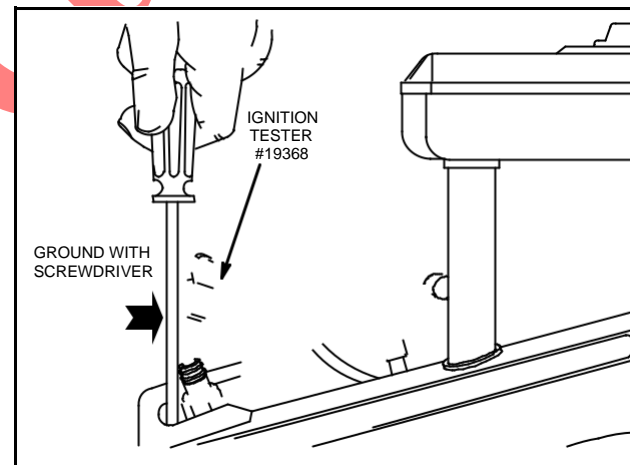


Fig. 10 – Checking for Fouled Plugs or Other Causes

## Check Carburetion

Before making a carburetion check, be sure the fuel tank has an ample supply of fresh, clean gasoline. Be sure that the shut-off valve, when equipped, is open and fuel flows freely through the fuel line. Inspect and adjust the needle valves. Check to see that the choke closes completely. If engine will not start, remove and inspect the spark plugs.

If plugs are wet, look for –

1. Over-choking
2. Excessively rich fuel mixture
  - a. See Section 3 for adjustment procedure.
3. Water in fuel
4. Float needle valve stuck open

### If plugs are dry, look for –

1. Leaking carburetor mounting gaskets
2. Gummy or dirty carburetor
3. Float needle valve stuck shut
4. Inoperative fuel pump
5. Defective anti-afterfire solenoid or wiring.

A simple check to determine if the fuel is getting to the combustion chamber through the carburetor is to remove either spark plug and pour a small quantity of gasoline through the spark plug hole. Replace the plug. If the engine fires a few times and then stops, look for the same conditions as for a dry plug.

### Check Compression

Briggs & Stratton does not publish any compression pressures, as it is extremely difficult to obtain an accurate reading without special equipment.

It has been determined through testing, a simple and accurate indication of compression can be made as follows:

Remove both spark plugs and insert a compression gauge into either cylinder (one cylinder at a time). Turn engine over with engine starter until there is no further increase in pressure. Record this reading. Repeat procedure on other cylinder and record that reading. The difference between both cylinders should not exceed 25%. More than 25% indicates loss of compression in the cylinder with lower pressure. See example.

#### Example:

	Cyl. #1	Cyl. #2	Diff.	% Diff.
Eng. #1	65 PSI	60 PSI	5 PSI	7.6%
Eng. #2	75 PSI	55 PSI	20 PSI	26.7%

### If compression is poor, look for –

1. Loose cylinder head bolts
2. Blown head gasket
3. Burned valves, valve seats and/or loose valve seats
4. Insufficient tappet clearance
5. Warped cylinder head
6. Warped valve stems
7. Worn bore and/or rings
8. Broken connecting rods

### Cylinder Leakdown Test

The cylinder leakdown tester, Tool # 19413, may be used to test the sealing capability of the compression components of each cylinder and quickly identify the problem component.

### Cylinder Balance Test

If the engine is hard starting, runs rough, misses or lacks power, perform a cylinder balance test to determine whether both cylinders are operating to their full potential.

### Tools Required

1. Tachometer, Tool #19200
2. Two #19368 Ignition Testers
3. Screwdriver with insulated handle

Attach ignition tester, Tool #19368, between the spark plug lead and each spark plug, Fig. 11.

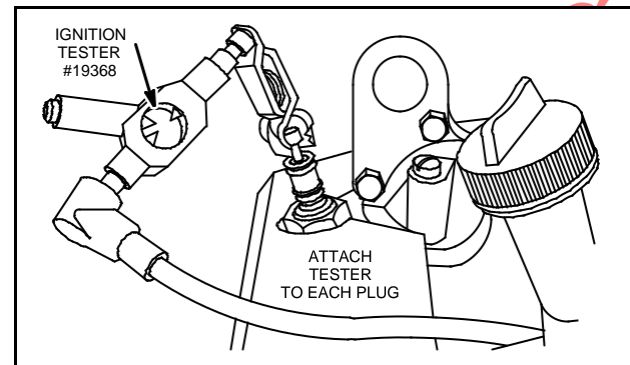


Fig. 11

Start and run engine running at top no load speed and note spark at ignition testers. If the spark is equal at both ignition testers, the problem is not ignition related. A spark miss will be readily apparent. Now note RPM of engine. Ground out one cylinder with screwdriver by contacting alligator clip on ignition tester and a good ground on engine, Fig. 12. Note RPM loss. Then ground out the other spark plug and note the RPM loss. If the difference between the two cylinders does not exceed 75 RPM, the amount of work the two cylinders are doing should be considered equal.

If the RPM loss is less than 75 RPM between cylinders and the engine runs poorly, the problem is common to both cylinders.

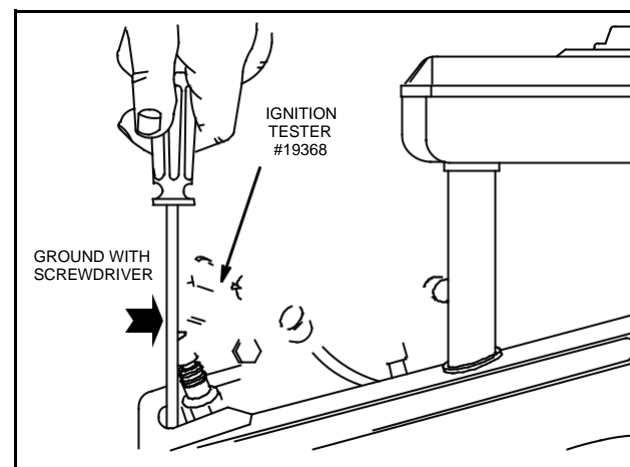


Fig. 12 – Cylinder Balance Test

### Things Which Affect Both Cylinders

1. Carburetion
2. Crankcase vacuum
3. Ignition timing – Magnatron Ignition
  - a. A partially sheared flywheel key will effect ignition timing and engine performance.



If the RPM loss is greater than 75 RPM, this indicates that the cylinder with the least RPM loss is the weakest of the two cylinders. Look to that cylinder for a problem. See Example.

#### **Example:**

Engine RPM – Both Cylinders = 3400 RPM  
 Engine RPM – #1 Cylinder Grounded = 3300 RPM  
 Engine RPM – #2 Cylinder Grounded = 3100 RPM  
 Conclusion: #1 cylinder is weakest of the two cylinders.

#### **Things Which Affect One Cylinder**

1. Spark plug
  - a. A fouled spark plug may indicate that the carburetor is out of adjustment.
2. Leak in spark plug wire
3. Head gasket
4. Intake manifold
  - a. A leak at either end of the intake manifold will only affect one cylinder, not both.
5. Valves
6. Rings
7. Piston
8. Cylinder

The cylinder balance test will also detect a cylinder that is not functioning. When grounding out one cylinder there will be no RPM loss. When the other cylinder is grounded out the engine will stop.

**NOTE:** A twin cylinder engine will run well on one cylinder as long as the power required for the application does not exceed the power produced by the one cylinder.

#### **Equipment Affecting Engine Operation**

Frequently, what appears to be a problem with engine operation, such as hard starting, vibration, etc., may be the fault of the equipment powered rather than the engine itself. Since many varied types of equipment are powered by Briggs & Stratton engines, it is not possible to list all of the various conditions that may exist. Listed are the most common effects of equip-

ment problems, and what to look for as the most common cause.

#### **Hard Starting, or Will Not Start**

1. Loose belt – a loose belt like a loose blade can cause a backlash effect, which will counteract engine cranking effort.
2. Starting under load – see if the unit is disengaged when engine is started; or if engaged, should not have a heavy starting load.
3. Check remote control assembly for proper adjustment.
4. Check interlock system for shorted wires, loose or corroded connections, or defective modules or switches.

#### **Engine Won't Stop**

1. Check equipment ignition stop switch.
2. Check for loose or disconnected equipment stop switch wire.

#### **Vibration**

1. Cutter blade bent or out of balance – remove and balance.
2. Mounting bolts loose – tighten.

#### **Power Loss**

1. Bind or drag in unit – if possible, disengage engine and operate unit manually to feel for any binding action.
2. Grass cuttings build-up under deck.
3. No lubrication in transmission or gear box.
4. Excessive drive belt tension may cause seizure.

#### **Noise**

1. Cutter blade coupling or pulley – an oversize or worn coupling can result in knocking, usually under acceleration. Check for fit, or tightness.
2. No lubricant in transmission or gear box.

# Section 2

## IGNITION

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2

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Lil' Red Barn

## SPECIFICATIONS FOR ALL OPPOSED TWIN CYLINDER ENGINE MODELS

Basic Model Series	Armature Air Gap	Flywheel Puller Part No.	Flywheel Nut Torque	
			Ft. Lbs.	Nm
400000, 460000	With Magnatron .008" to .012" (.20 to .30 mm) With Breaker Points .010" to .014" (.25 to .36 mm)	19203	150	203.0

BREAKER POINT IGNITION CONTACT POINT GAP: .020" (.51 mm)

CONDENSER CAPACITY: .18 TO .24 M.F.D.

See Section 1 For Spark Plug Maintenance and Specifications

## GENERAL INFORMATION

Briggs & Stratton Twin Cylinder engines use two types of flywheel ignition systems:

1. Magnatron – Two versions of armatures have been produced, NO TAG.
  - a. The composite type is a self-contained armature with transistor module.
  - b. Earlier versions have a replaceable Magnatron transistor module mounted on the ignition armature.

The composite style Magnatron armature must be replaced as an assembly.

The Magnatron module can only be installed on armatures originally equipped with Magnatron module.

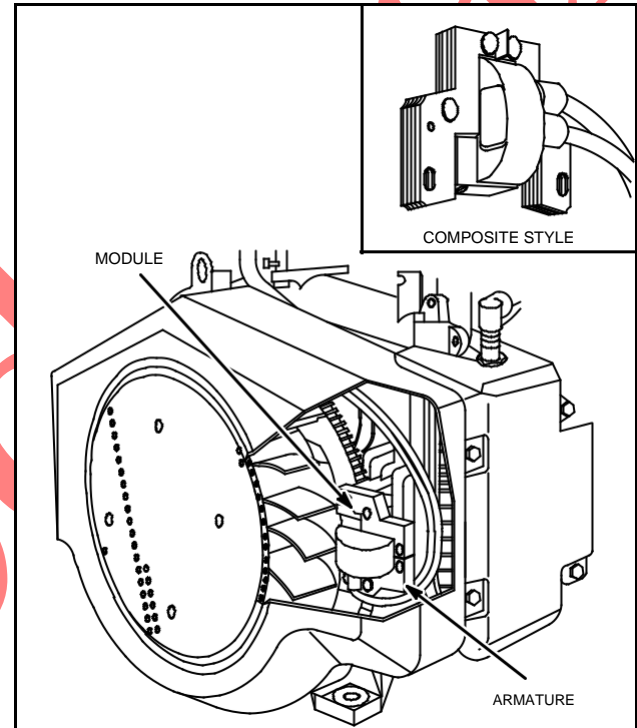


Fig. 1 – Magnatron Ignition

2. Twin cylinder engines with type number below 0500, were equipped with a flywheel magneto system consisting of an ignition armature and external breaker points and condenser mounted under a breaker box, NO TAG.

## ARMATURES

## Armature Testing – All Models

The condition of the ignition armature can be accurately diagnosed using ignition tester, Tool #19368, as described in "Troubleshooting" in Section 1.

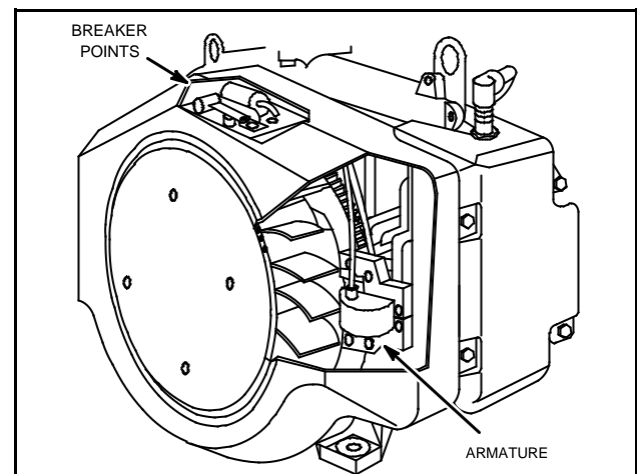


Fig. 2 – Breaker Point Ignition

## Remove Armature

**All Models** – The flywheel does not need to be removed to service ignition except to check the flywheel key.

### Remove Armature – Breaker Point Ignition

On engines with breaker points, it may be necessary to remove carburetor or carburetor and intake manifold. See Section 3 for removal procedure.

1. Remove spark plug leads and spark plugs.
2. Remove rotating screen and blower housing.
3. Remove armature primary wire from breaker points, Fig. 3.
4. Remove two armature mounting screws and lift off armature, Fig. 4.

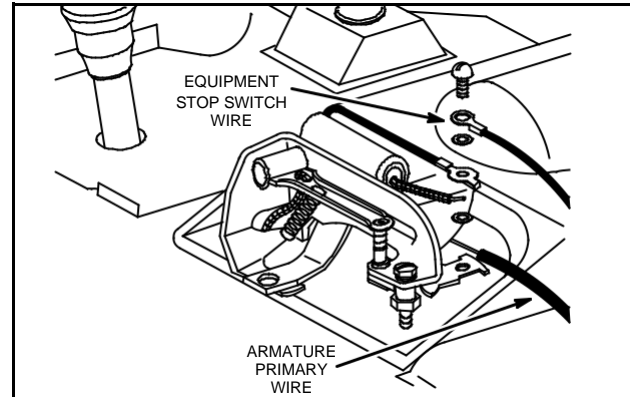


Fig. 3 – Remove Primary Wire

### Magnetron Ignition – Composite Style Armature

1. Remove spark plug leads and spark plugs.
2. Remove rotating screen and blower housing.
3. Remove armature screws and lift off armature, Fig. 4.
  - a. Disconnect stop switch wire at armature.

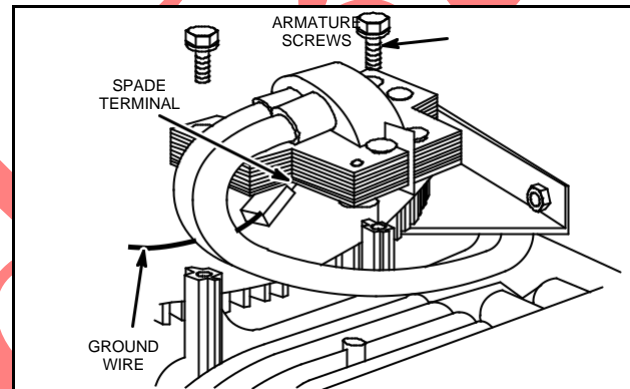


Fig. 4 – Remove Armature

### Magnetron Ignition – Armature With Magnetron Module

1. Remove spark plug leads and spark plugs.
2. Remove rotating screen and blower housing.
3. Remove armature ground wire from stop switch terminal, Fig. 5.
4. Remove armature screws and lift off armature, Fig. 5.

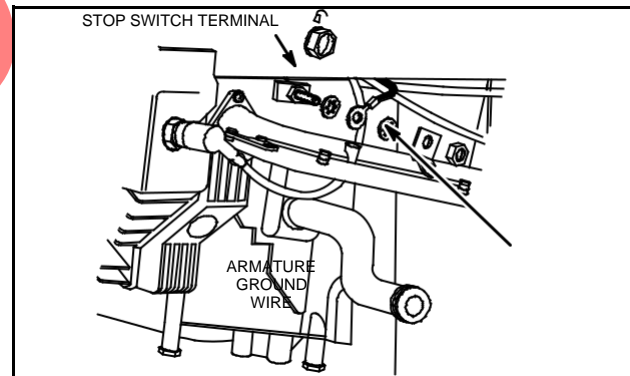


Fig. 5 – Stop Switch Terminal

### Remove Magnetron Module

1. Depress retainer and spring with 3/16" (4.5 mm) punch and remove wires.
2. Remove ground wire screw from armature lamination.

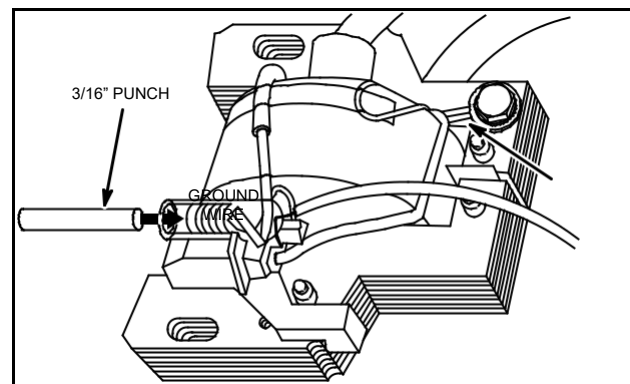


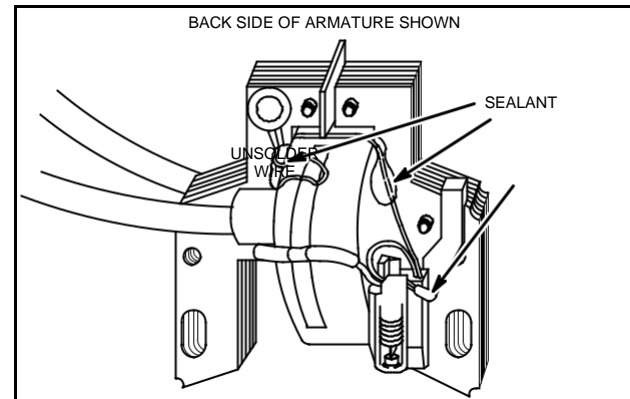
Fig. 6 – Remove Wires

3. Remove sealant and or tape holding wires to armature.
4. Unsolder and separate module wire and armature primary wire, Fig. 7.
5. Separate armature ground wire and module ground wire.

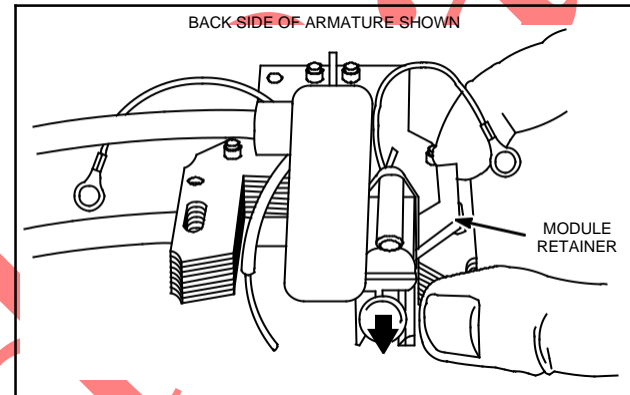
**NOTE:** Avoid damaging armature and module when unsoldering or soldering.

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6. Move all wires so module will clear armature and laminations.
7. Pry module retainer away lamination, Fig. 8.
8. Remove module.



**Fig. 7 – Separate Wires**



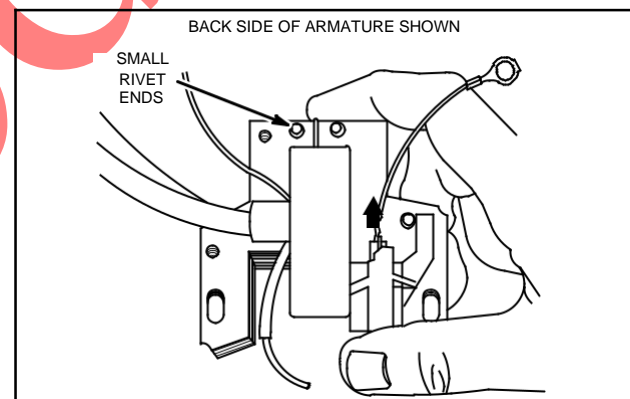
**Fig. 8 – Remove Module**

### Install Magnetron Module

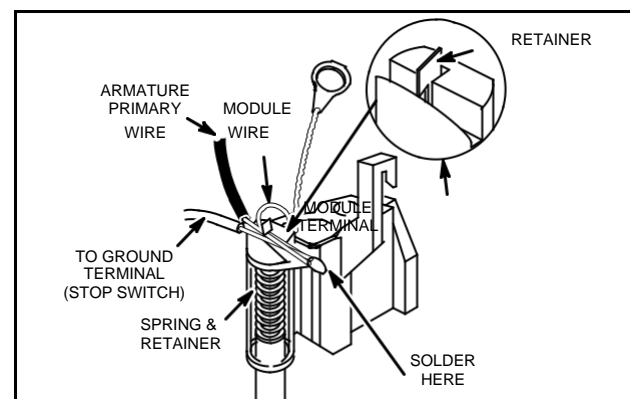
**NOTE:** Module can only be installed on armatures originally equipped with Magnetron .

The armature has a front side identified by the large rivet heads. The module is installed with the retainer on the back side (small rivet ends), Fig. 9.

1. Assemble module to back side of armature.
  - a. Make sure module retainer snaps over armature laminations.
2. Depress spring and retainer and install armature primary wire, module wire and ground wire from stop switch, Fig. 10.
3. Twist three wires together and solder with 60/40 Rosin core solder.



**Fig. 9 – Install Module**



**Fig. 10 – Install Wires in Module**



4. Twist armature ground wire and module ground wire together and route wires as shown.
5. Attach ground wires to armature lamination with ground screw, Fig. 11.
6. Seal wires to back of armature with Permatex No. 2 or similar sealer to prevent wires from vibrating and breaking.

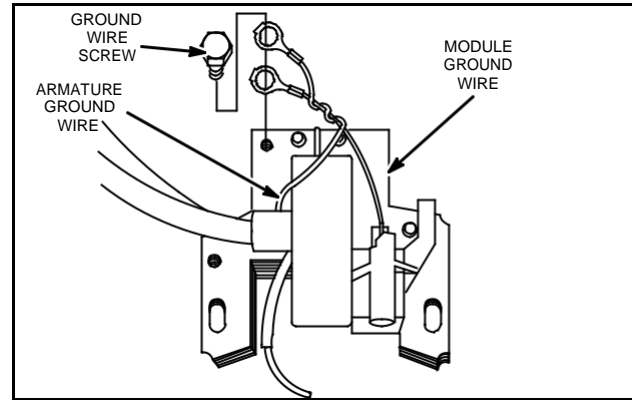


Fig. 11 – Attach Ground Wires

### Install Armature – All Models

Rotate flywheel so magnet is away from armature. Note position of spark plug wires in illustrations for the type of armature being installed, Fig. 12 or Fig. 13.

Install Magnetron armature on engine as shown in Fig. 12.

Magnetron composite style armatures have identifications on the coil casing for correct assembly.

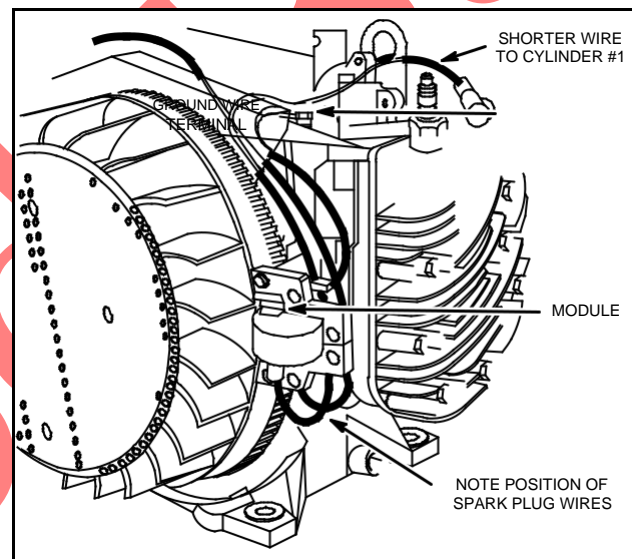


Fig. 12 – Install Armature – Magnetron

Install breaker point ignition armature as shown in Fig. 13. The right hand mounting screw holds the ground lead(s) on breaker point ignition systems.

Push armature away from flywheel and tighten one screw to hold armature away from flywheel.

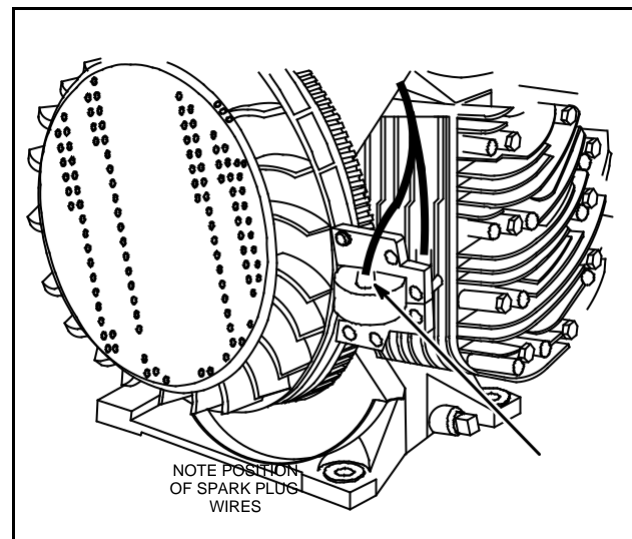


Fig. 13 – Install Armature – Breaker Points



## Adjust Armature Air Gap – All Models

1. Rotate flywheel until magnet is under armature laminations.
2. Place thickness gauge between magnet and armature laminations, Fig. 14.

**Magnetron Ignition:** .008"-.012"  
(.20 mm-.30 mm)

**Breaker Point Ignition:** .010"-.014"  
(.25 mm-.36 mm)

3. Loosen mounting screw so magnet will pull armature down against thickness gauge.
  - a. Torque screws to 25 in. lbs. (2.8 Nm).
4. Rotate flywheel to remove thickness gauge.

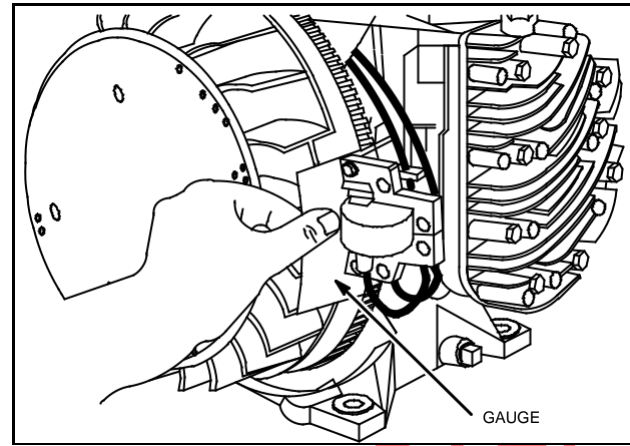


Fig. 14 – Adjust Air Gap

## Routing Ignition Wires

The ignition armature is mounted on No.1 cylinder. The short spark plug lead goes through opening between #1 breather and back plate, under intake manifold and around to #1 spark plug, Fig. 15. Magnetron ground wire, or armature primary wire (breaker points) uses same opening to stop switch terminal. Long spark plug lead is for #2 cylinder. Route through same opening in back plate, and under intake manifold to #2 spark plug, Fig. 15.

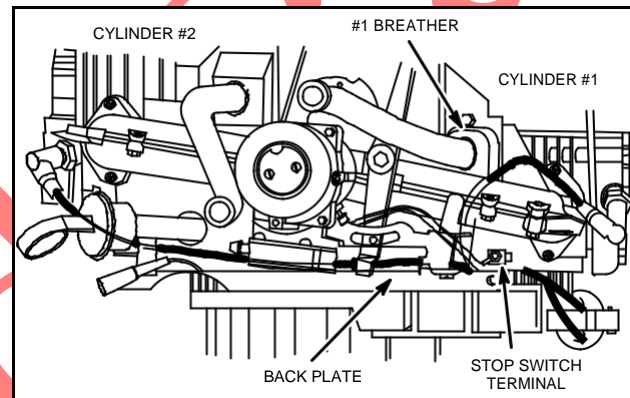


Fig. 15 – Typical Wire Routing

## BREAKER POINTS

### Remove Breaker Points

1. Remove screw and breaker point cover.
2. Remove condenser mounting screw.
3. Loosen lock nut, then adjusting screw, Fig. 16.
4. Remove breaker points and condenser.
5. Remove ground wire, condenser wire and primary wire.

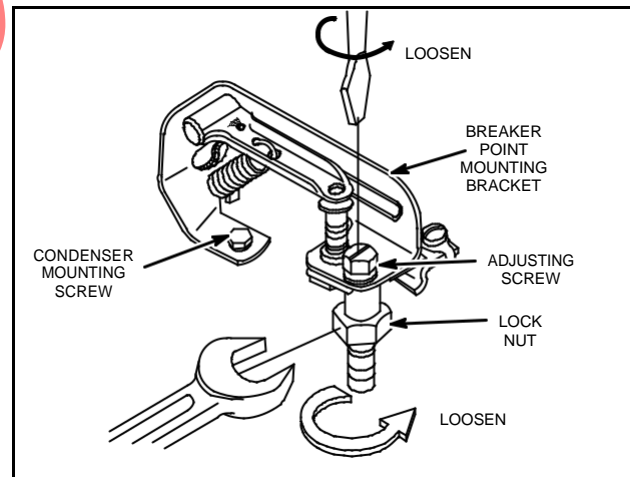


Fig. 16 – Remove Condenser and Points

### Check Breaker Point Plunger And Seal

Reject length of plunger is 1.115" (28.32 mm), Fig. 17.  
Replace plunger if worn if fiber tip is loose.  
Replace plunger seal if torn or leaking.

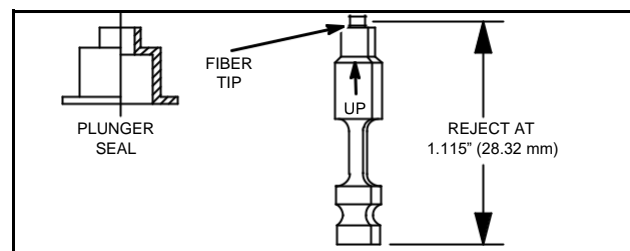


Fig. 17 – Check Plunger and Seal

### Install Plunger And Seal

1. Assemble seal to plunger.
2. Install plunger with fiber tip up, Fig. 18.
3. Slide seal over plunger boss until it contacts cylinder.

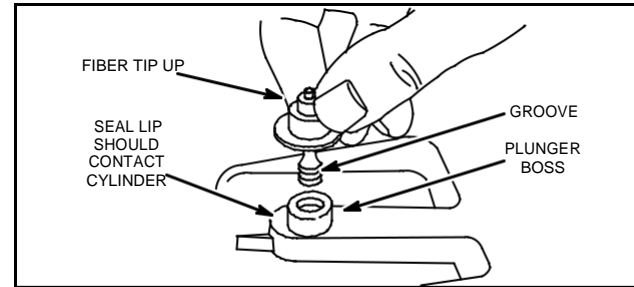


Fig. 18 – Install Plunger and Seal

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### Install Breaker Points

Place breaker point cover gasket on engine with tab to right of breaker plunger boss, Fig. 19.

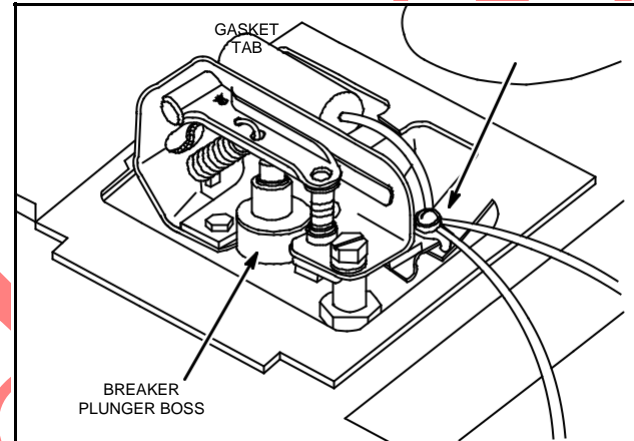


Fig. 19 – Install Cover Gasket

For ease of assembly, install ground wire, condenser wire and armature primary wire to point terminal before installing points, Fig. 20.

1. Turn locknut counterclockwise on adjusting screw until nut is at end of travel.
2. Turn breaker point adjustment screw clockwise until locknut touches cylinder.
3. Install condenser and mounting screw.

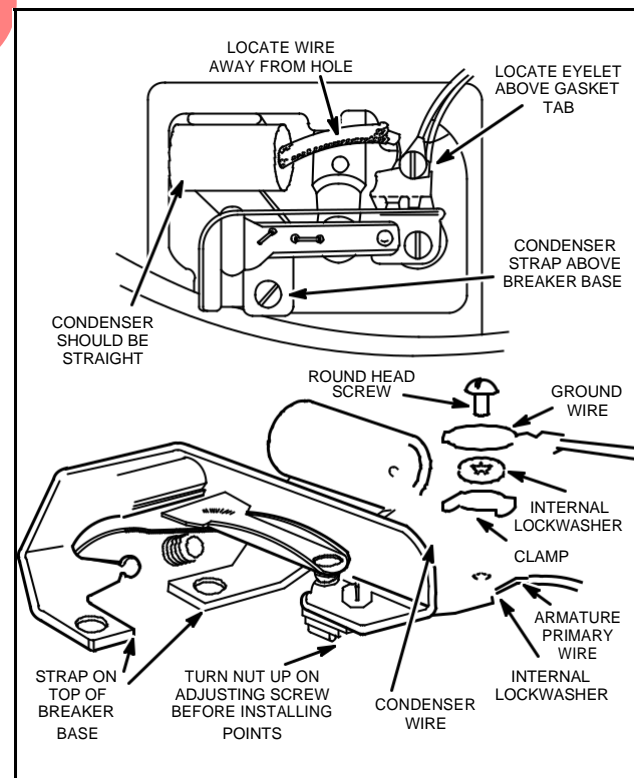


Fig. 20 – Install Breaker Points

## Adjust Breaker Points

1. Rotate crankshaft until points are at widest opening.
2. Turn breaker point adjusting screw clockwise to increase or counterclockwise to decrease point gap.
3. Set point gap at .020" (.51 mm).
4. Tighten locknut and recheck gap, Fig. 21.

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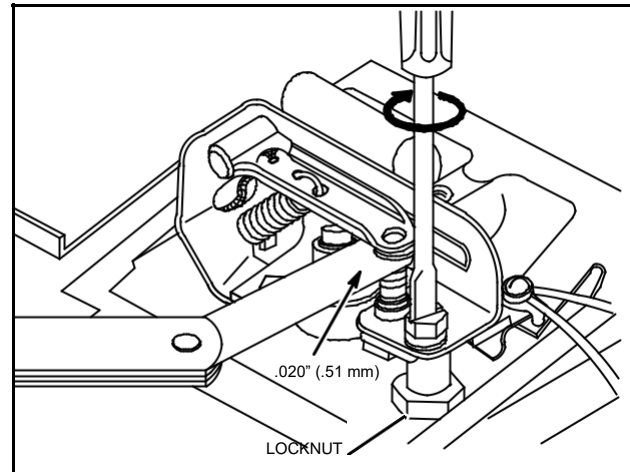


Fig. 21 – Adjust Point Gap

## Clean Breaker Points

To prolong breaker point life, clean points as follows: with points open, place a piece of clean lintless paper between the points. Rotate crankshaft until points close on paper. Pivot paper on points, Fig. 22, then turn crankshaft until points open. Repeat procedure until paper comes out clean. Do not pull paper out while points are closed, as dirt will pull off paper onto points.

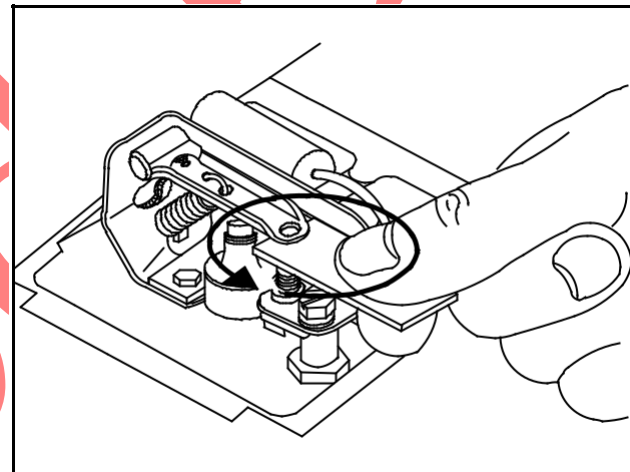


Fig. 22 – Clean Points

## Install Breaker Point Cover

Place Permatex or equivalent under armature primary wire and ground wire on breaker point cover, Fig. 23. Then put sealant on wires. Install breaker point cover, being sure wires are in notch of breaker point cover.

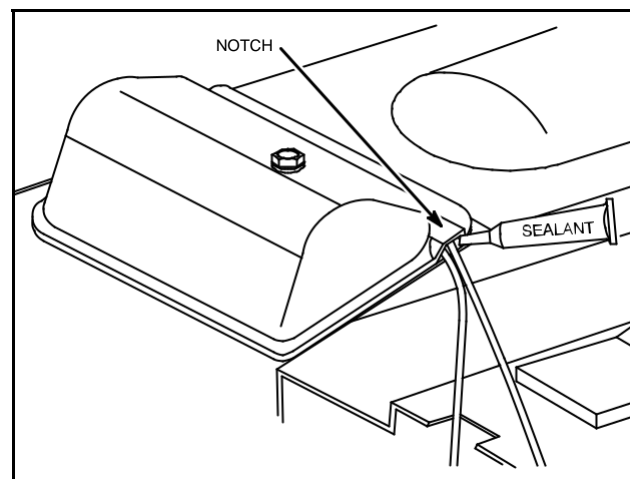


Fig. 23 – Install Cover and Sealant

## FLYWHEEL

### Remove Flywheel



**DO NOT** strike flywheel with a hard object or a metal tool as this may cause flywheel to shatter in operation. Always use approved flywheel removal tools.

### Remove Flywheel Nut – Pre Twin II (Type Nos. Under 1100)

Remove debris guard, or booster fan, if so equipped. Remove blower housing and rotating screen. Remove armature.

1. Place flywheel strap wrench, Tool #19433, around outer rim of flywheel, Fig. 24.
2. Remove flywheel nut using 1-1/4" socket, or use clutch wrench, Tool #19244, if engine is equipped with rewind starter.

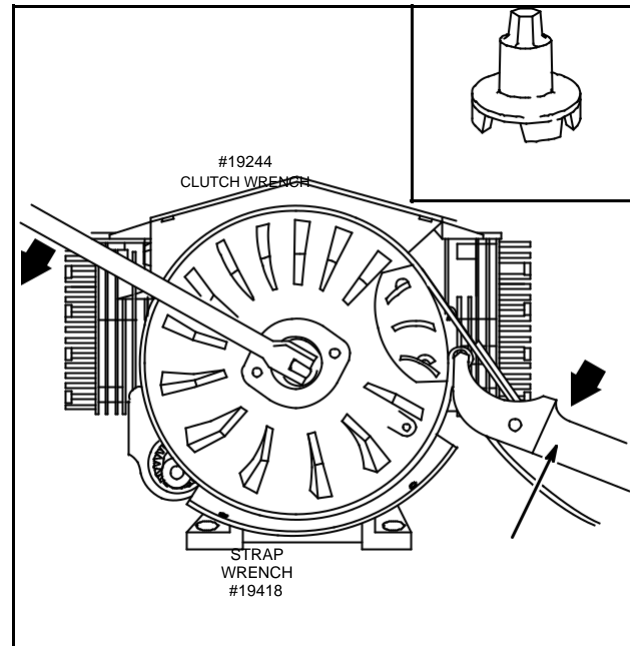


Fig. 24 – Remove Flywheel Nut

### Remove Flywheel Nut – Twin II (Type Nos. 1100 & Above)

Remove debris guard, or booster fan, if so equipped. Remove blower housing and rotating screen.

**NOTE:** Do not remove fan retainer.

1. Place flywheel holder, Tool #19321, on fan retainer with lugs of flywheel holder engaging slots on the fan retainer, Fig. 25.
2. Remove flywheel nut using 1-1/4" socket.

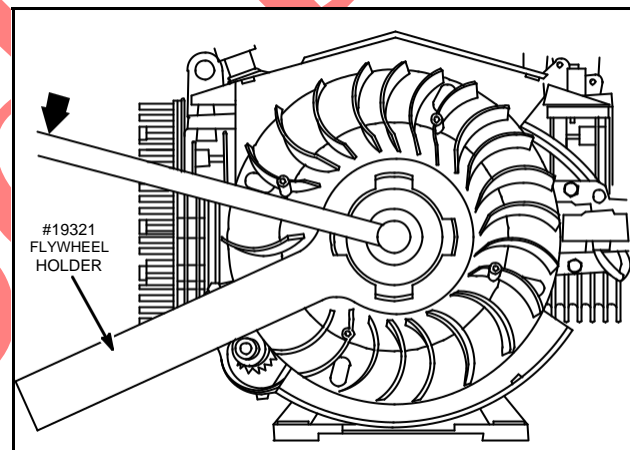


Fig. 25 – Remove Flywheel Nut

### Remove Flywheel – All Models

1. Reinstall flywheel nut. Turn nut down flush with top of threads.
2. Install flywheel puller, Tool #19203.
3. Tighten puller screws equally until flywheel loosens, Fig. 26.



**DO NOT** strike flywheel with a hard object or a metal tool as this may cause flywheel to shatter in operation. Always use approved flywheel removal tools.

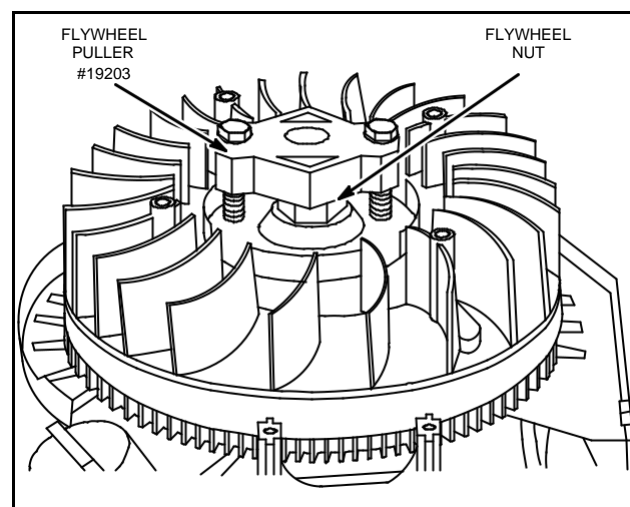


Fig. 26 – Remove Flywheel

## Inspect Flywheel Key, Keyways, Flywheel and Crankshaft

Check flywheel key for damage. Check flywheel for cracks, broken fins or keyway damage. Also check crankshaft keyways and taper for damage, Fig. 27. Replace crankshaft, if damaged.

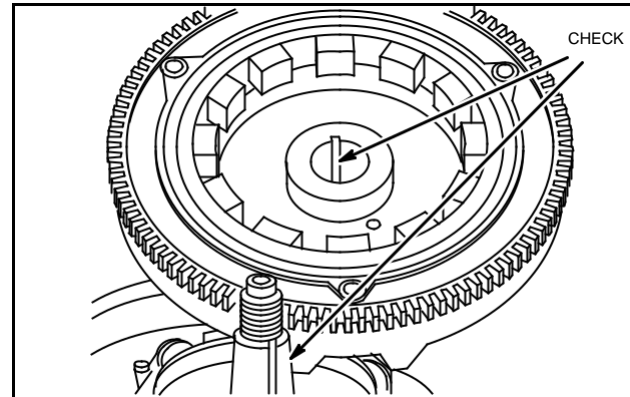


Fig. 27 – Check Flywheel and Crankshaft

## Install Flywheel – All Models



**CLEAN FLYWHEEL** and crankshaft taper removing all oil, dirt or grease.

1. Assemble flywheel to crankshaft and align keyways.
2. Insert flywheel key into crankshaft.

## Torque Flywheel Nut – Pre Twin II Models (Type Nos. Under 1100)

1. Install flywheel washer and nut or clutch.
2. Place flywheel strap wrench, Tool #19433, around outer rim of flywheel,
3. Torque flywheel nut or rewind clutch to 150 ft. lbs. (203 Nm), Fig. 28.
4. Re-install armature and adjust air gap.

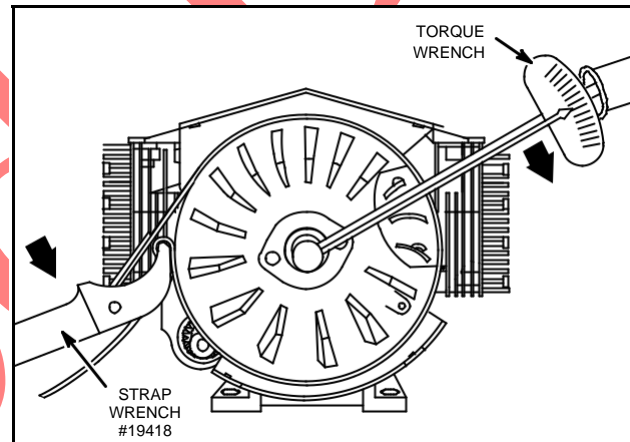


Fig. 28 – Torque Flywheel Nut – Pre Twin II

## Torque Flywheel Nut – Twin II Models (Type Nos. 1100 & Above)

1. Install flywheel washer and nut.
2. Place Tool #19321 on fan retainer with lugs of flywheel holder engaging the slots of the fan retainer.
3. Torque flywheel nut to 150 ft. lbs. (203 Nm), Fig. 29.

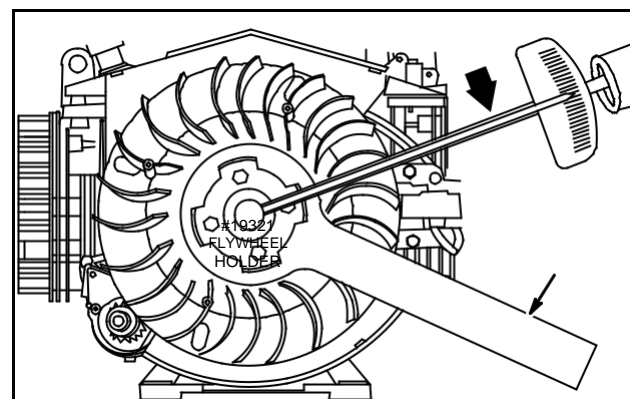


Fig. 29 – Torque Flywheel Nut – Twin II



### Flywheel Fan And Retainer (Type Nos. 1100 & Above)

The fan and retainer do not need to be removed unless fan or retainer is damaged or warped.

To remove fan, remove two fan retainer screws, fan retainer and fan.

To install fan, place fan on to flywheel, aligning recess in flywheel with boss on back of fan. Install fan retainer and screws, Fig. 30.

Torque screws to 150 in. lbs. (17.0 Nm).

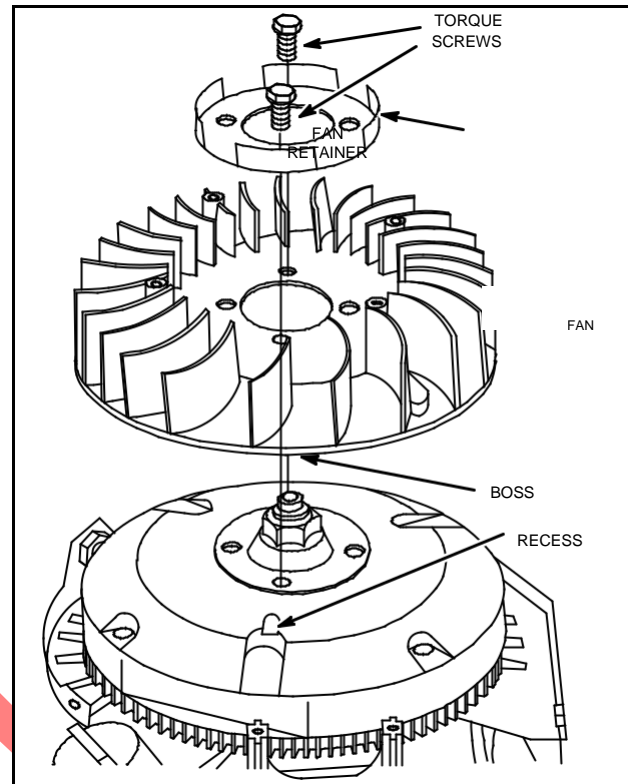


Fig. 30 – Installing Fan

### STOP SWITCHES

Various key and toggle stop switches have been provided by the Briggs & Stratton Corporation to meet various equipment manufacturers needs, Fig. 31.

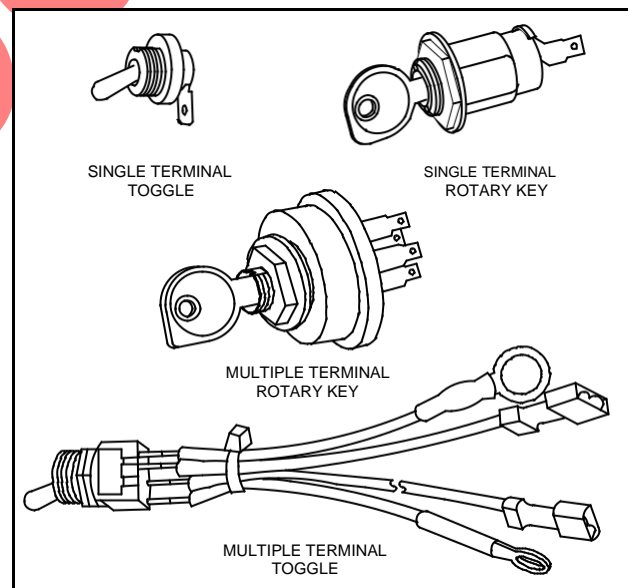


Fig. 31 – Stop Switches

## Equipment To Test Stop Switches

The Digital Multimeter, Tool Tool #19357 or #19390 is available from your Briggs & Stratton source of supply. The meter may be used to measure Volts, Ohms, or Amperes, Fig. 32.

### Testing With Digital Multimeter

1. Insert red test lead into **V  $\Omega$   $\rightarrow$**  receptacle in meter.
2. Insert black test lead into **COM** receptacle in meter.
3. Rotate selector to  **$\rightarrow$   $\parallel$   $\parallel$   $\parallel$**  position.
4. When meter test leads are attached to switch terminals, and switch is in "STOP" position, a continuous tone indicates continuity. With switch in "RUN" position, no tone indicates no continuity (incomplete circuit). An incomplete circuit will be displayed as "OL."

**NOTE:** Contact surfaces must be free of paint, rust or dirt.

### Check Single Terminal Toggle Switch

1. Disconnect stop switch wire from spade terminal.
2. Connect one meter lead to spade terminal and other lead to switch mounting surface or a good ground.
3. With switch in "OFF" position there should be continuity.
4. Move switch to "ON" position. There should be no continuity, Fig. 33.

### Check Multiple Terminal Toggle Switch

1. Disconnect solenoid wire from carburetor spade terminal.
2. Connect one meter test lead to carburetor solenoid wire terminal and other lead to starter switch terminal, Fig. 34.
3. With switch in "ON" position there should be continuity.
4. Move switch to "OFF" position. There should be no continuity.

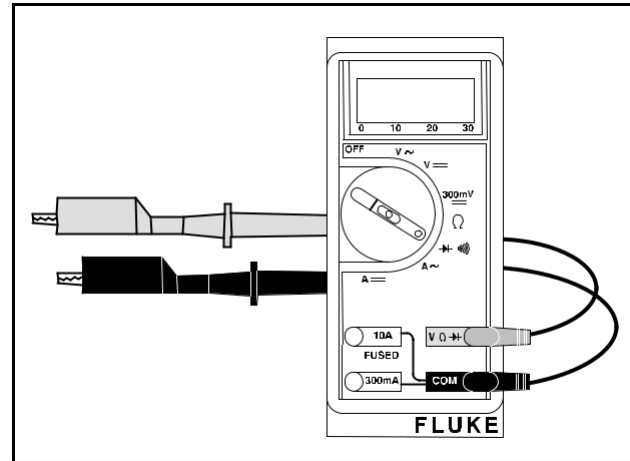


Fig. 32 – Digital Multimeter

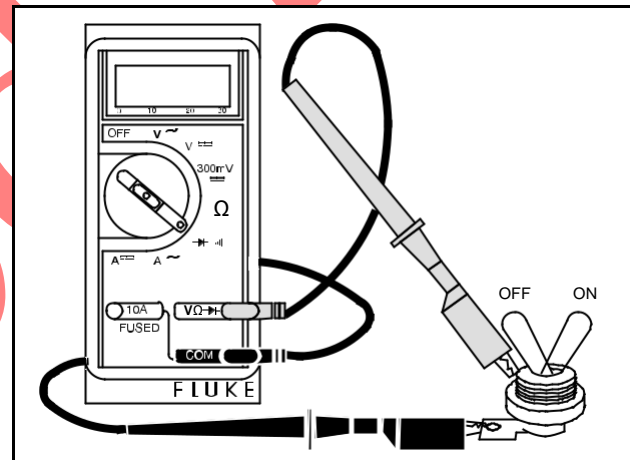


Fig. 33 – Checking Anti-Afterfire Solenoid Switch

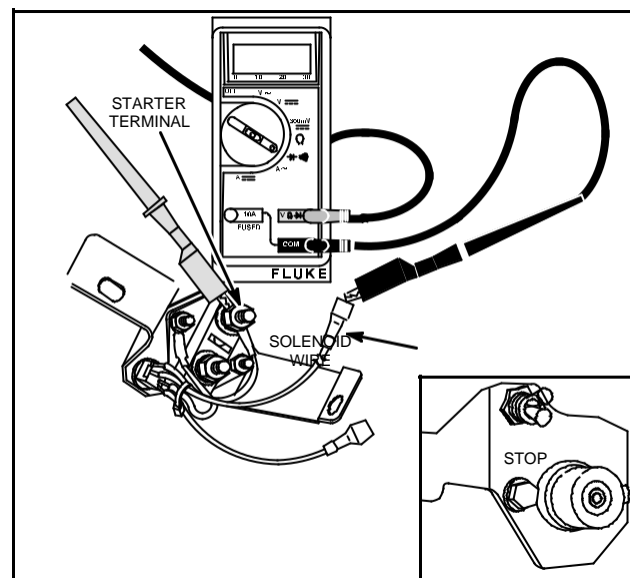


Fig. 34 – Checking Stop Switch



### Check Single Terminal Rotary Key Switch

1. Disconnect stop switch wire from spade terminal.
2. Connect one meter lead to spade terminal and other lead to switch mounting surface or a good ground.
3. With key in "OFF" position. There should be continuity.
4. Move key to "ON" position. There should be no continuity, Fig. 35.

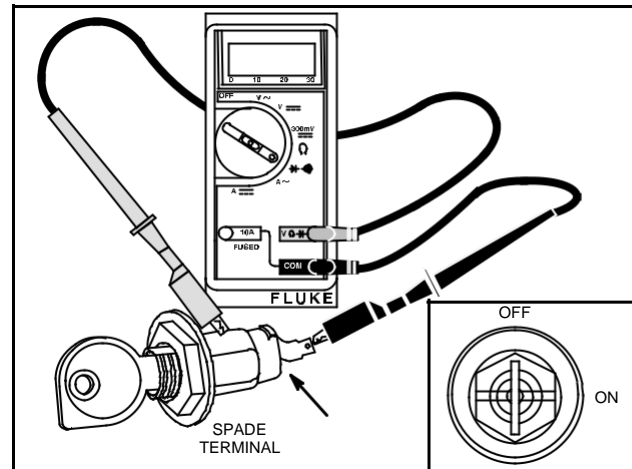


Fig. 35 – Check Rotary Stop Switch

### Check Multiple Terminal Rotary Key Switch – Anti-Afterfire Circuit

1. Disconnect equipment wiring harness from rotary key switch.
2. Connect one meter lead to battery terminal (B) and other lead to carburetor solenoid terminal, (L or S).
3. With key in "OFF" position there should be no continuity, Fig. 36.
4. With key in "RUN" and "START" position there should be continuity.

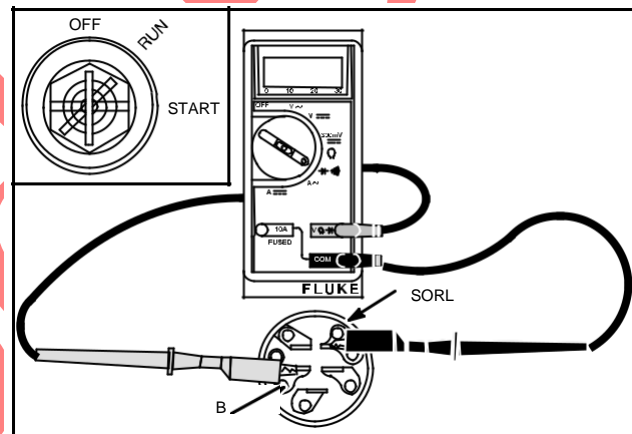


Fig. 36 – Checking Anti-Afterfire Solenoid Circuit

### Check Multiple Terminal Rotary Key Switch – Stop Switch Circuit

1. Connect one meter lead to stop switch terminal (M) and other lead to a good ground. If key switch is mounted to an insulated panel, use ground terminal (G), Fig. 37.
2. With key in "OFF" position there should be continuity.
3. With key in "RUN" and "START" position there should be no continuity, Fig. 37.

**NOTE:** Ground terminal (G) is grounded to switch case. If meter indicates continuity when key is in "RUN" and "START" position, switch is defective.

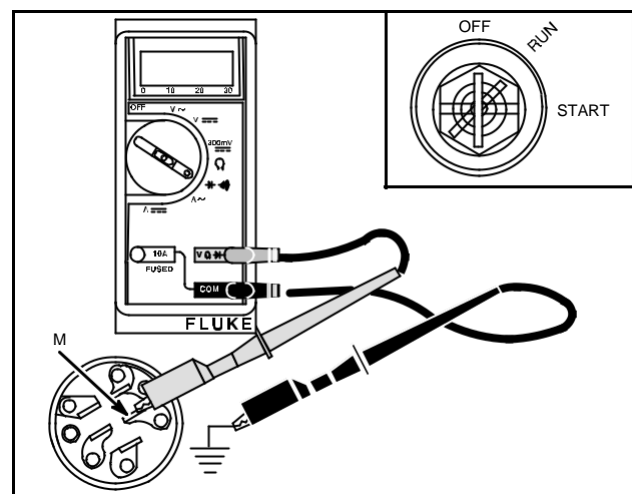


Fig. 37 – Checking Stop Switch Circuit

## Check Stationary Stop Switch

Stationary stop switch is located on governor control bracket.

1. Push down on wire retainer and remove stop switch wire.
2. Connect one meter lead to engine ground and other lead to stop switch wire retainer, Fig. 38.
3. Move control lever to "RUN" position. There should be no continuity.
4. Move control lever to "STOP" position. There should be continuity, Fig. 38.

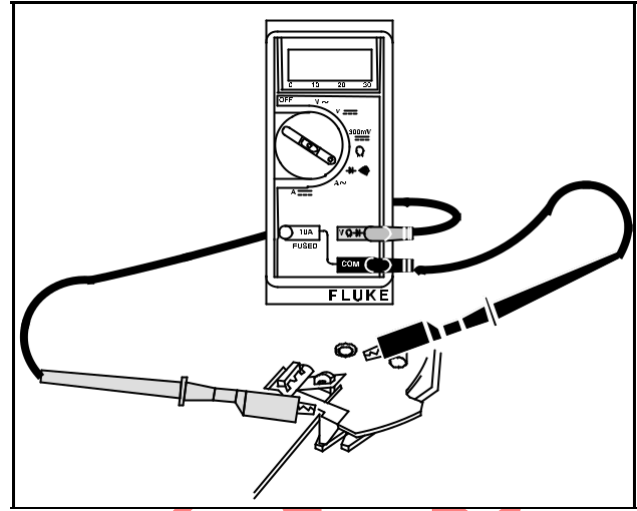
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Fig. 38 – Checking Stationary Stop Switch

# Section 3

## CARBURETION

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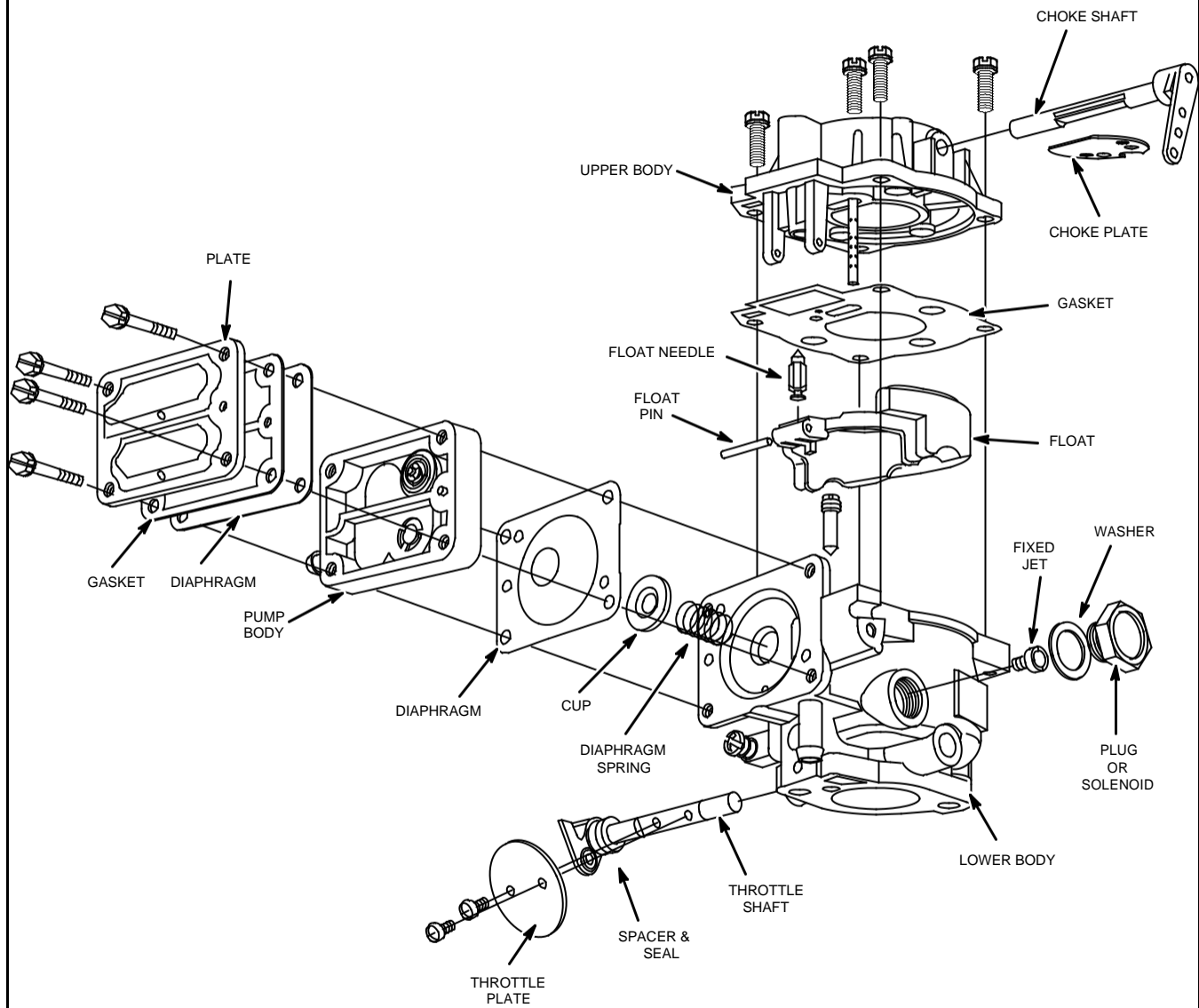


Fig. 1

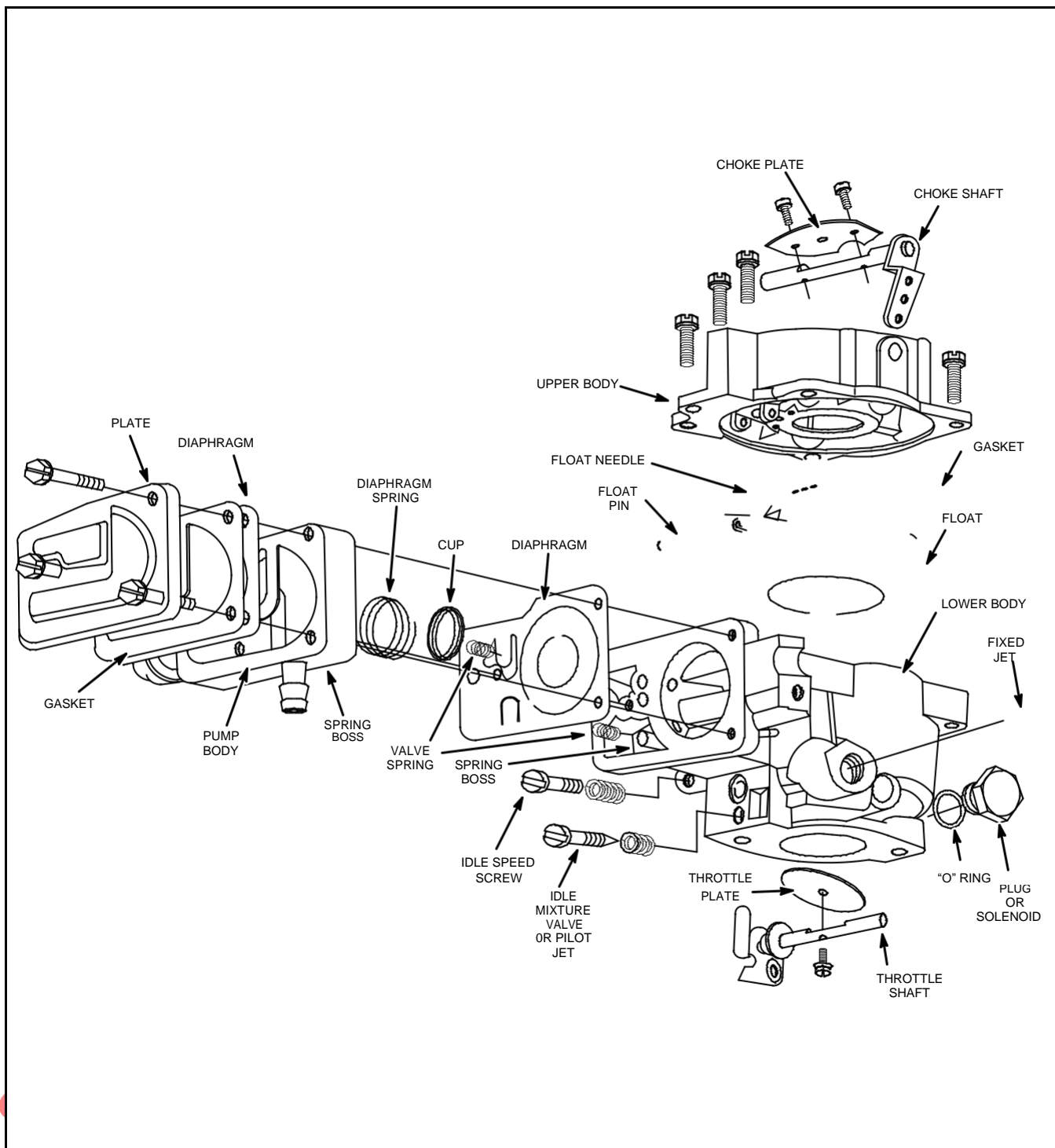


Fig. 2

**SEE SECTION 1 FOR AIR CLEANER MAINTENANCE PROCEDURES.**

### CARBURETOR STYLES

Briggs & Stratton Opposed Twin Cylinder engine models use three styles of two piece Flo-Jet down draft carburetors. All three styles incorporate an independent high speed fuel circuit and a separate idle speed fuel circuit.

An integral vacuum pulse type fuel pump allows remote fuel tank installations. The fuel pump will prime at 18" (46.0 cm) maximum lift. Fuel pump pressure is rated at 1.5 psi. (0.10 Bar).

Figures 3 – 6 show the major external differences between the three style carburetors.

### Current Style – Type Nos. 1100 And Above Engines Built After 98101500

The current style carburetor has no external adjustments other than idle speed. Components are NOT interchangeable with previous carburetors. The air cleaner base has two holes to accommodate the dual bowl vents and the throttle link is 1/16" (1.6 mm) longer.

#### IMPORTANT:

**Horizontal Crankshaft Engines:** The current style carburetor may be used to replace earlier style carburetors ONLY if the air cleaner base and throttle link are also replaced.

**Vertical Crankshaft Engines:** The current style carburetor may be used to replace earlier style carburetors ONLY if the throttle link is also replaced.

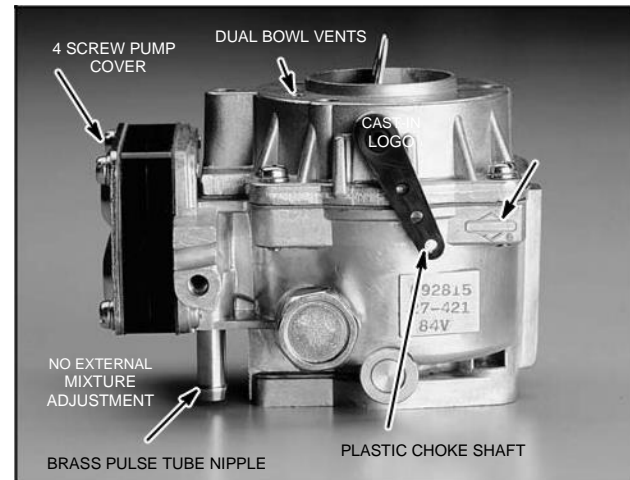


Fig. 3 – Current Style – Type Nos. 1100 And Above After 98101500

### Previous Style – Type Nos. 1100 And Above Engines Built Before 98101500

The previous style carburetor may be identified by a welch plug located above the idle mixture valve or pilot jet. Carburetors equipped with a pilot jet have no external adjustments other than idle speed.

The carburetor is equipped with fixed main jet or optional adjustable high speed mixture valve.

Fixed main jet carburetors may also be equipped with an optional anti-afterfire solenoid.

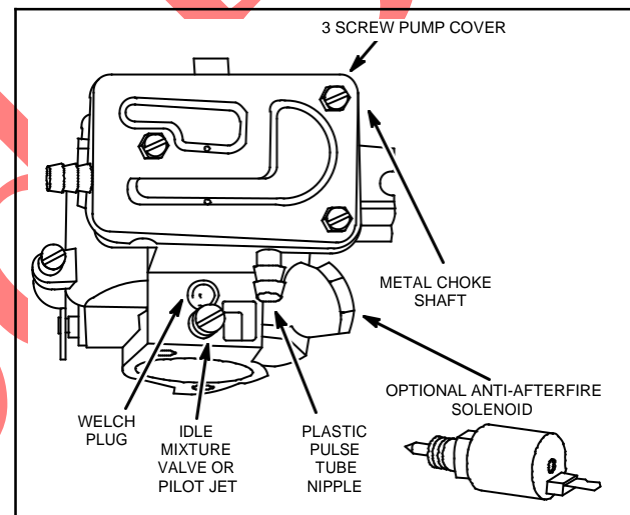


Fig. 4 – Type Nos. 1100 And Above Before 98101500

### Early Style – Type Nos. Under 1100

Early style carburetors have no welch plug above the idle mixture valve.

The carburetor is equipped with an adjustable high speed mixture valve or an optional fixed main jet screw.

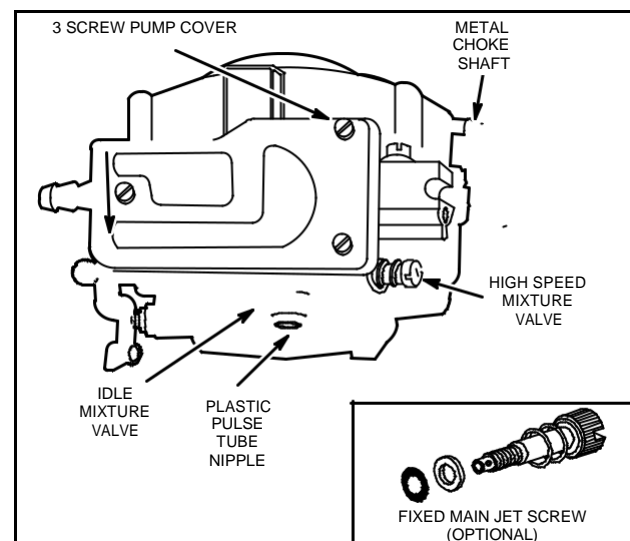


Fig. 5 – Early Style Type Nos. Under 1100

## Remote Fuel Pump Carburetor

Carburetors used for remote fuel pump applications are manufactured without integral pumps, Fig.6. The remote fuel pump is supplied by the equipment manufacturer.

Fuel pump pressure must not exceed 1.5 psi. (0.10 Bar).

**NOTE:Excessive fuel** pump pressure may result in an over rich carburetor mixture and, ultimately cylinder scoring and, or other engine damage resulting from crankcase oil dilution with gasoline.

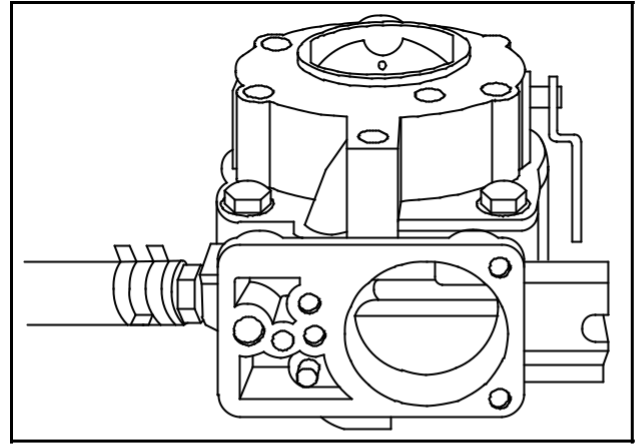


Fig. 6 – Remote Fuel Pump Carburetor

## INTAKE MANIFOLDS

Two different style intake manifolds have been used.

### Engine Type Nos. 1100 & Above

The current style is one piece cast aluminum or iron. Governor controls are mounted on the cylinder.

**NOTE:Current (Twin II)** manifolds are not interchangeable with previous manifolds. Twin II manifolds have no provision for mounting governor control brackets.

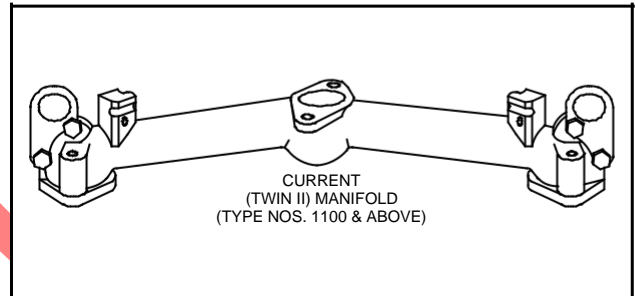


Fig. 7 – Current Style Intake Manifold

### Engine Type Nos. Under 1100

Two variations of early style manifolds were used; the first, was aluminum and was replaced by a one piece cast iron. This style manifold had the governor control bracket mounted on the manifold.

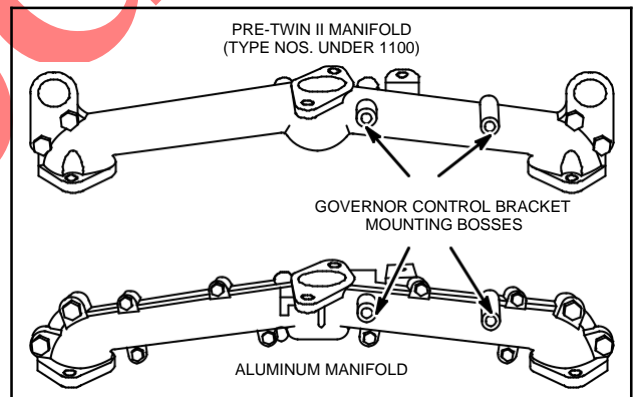


Fig. 8 – Early Style Intake Manifold

## REMOVE CARBURETOR

### Horizontal Crankshaft – Twin II (Type Nos. 1100 & Above)

Carburetor and intake manifold must be removed as an assembly, Fig. 9.

1. Remove air cleaner assembly.
2. Remove fuel and vacuum lines from carburetor fuel pump body.
3. Remove four mounting screws.
  - a. Lift manifold and disconnect throttle link from carburetor.

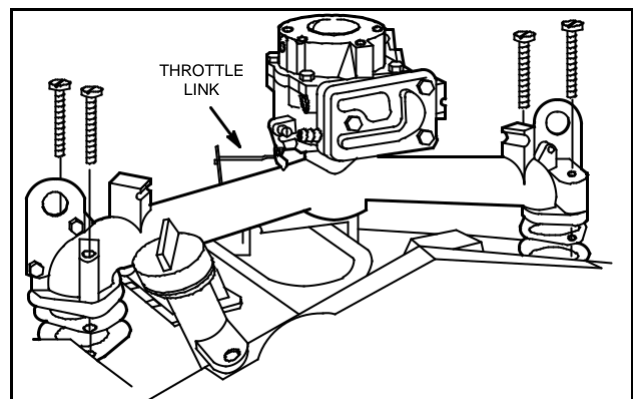


Fig. 9 – Remove Intake Manifold & Carburetor



4. Remove carburetor from intake manifold, Fig. 10. a. Discard gaskets.

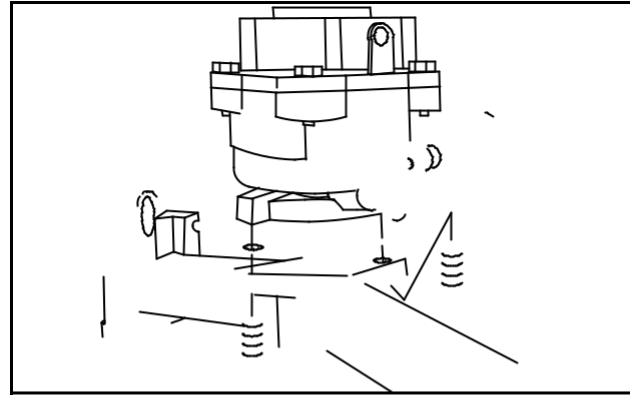


Fig. 10 – Remove Carburetor

### Horizontal Crankshaft Models – Pre-Twin II (Type Nos. Under 1100)

Carburetor and intake manifold must be removed as an assembly, Fig. 11.

1. Remove air cleaner assembly.
2. Remove fuel and vacuum lines from carburetor fuel pump body.
3. Remove four mounting screws.
4. Loosen governor lever nut and bolt.
5. Remove intake manifold and carburetor with governor lever and springs, Fig. 11.

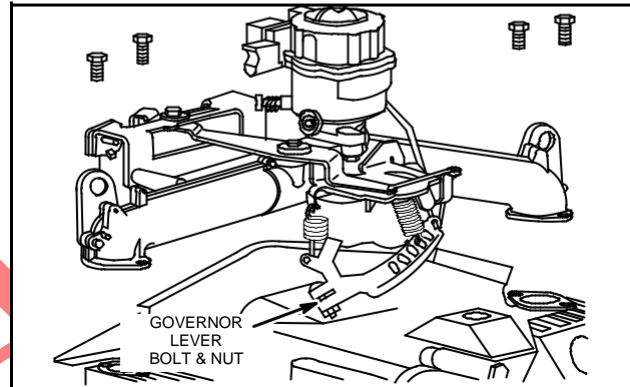


Fig. 11 – Remove Intake Manifold & Carburetor

6. Remove carburetor mounting screws.
7. Disconnect throttle link from governor lever, Then from carburetor, Fig. 12. a. Discard gaskets.

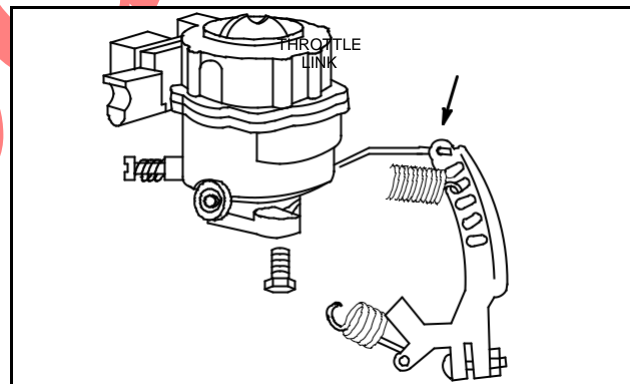


Fig. 12 – Disconnect Throttle Link

### Vertical Crankshaft – All Models

1. Remove air cleaner assembly.
2. Remove fuel and vacuum lines from carburetor fuel pump body.
3. Disconnect backlash spring, if equipped.
4. Remove carburetor mounting screws.
5. Lift carburetor and spacer and disconnect throttle link from carburetor. a. Discard gaskets.

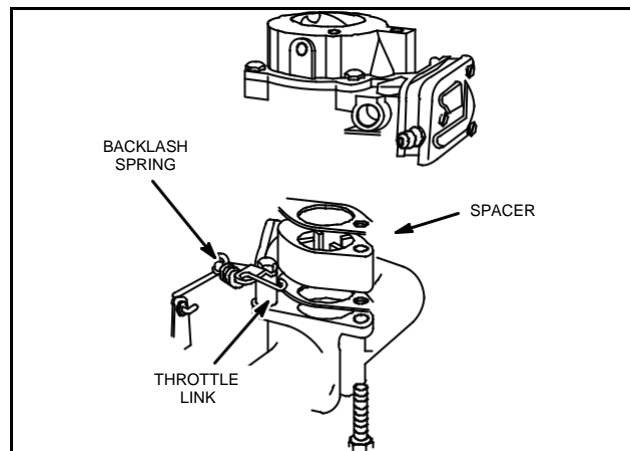


Fig. 13 – Remove Carburetor

## DISASSEMBLE CARBURETOR – ALL STYLES

The disassembly procedure for all style carburetors is similar enough that it can be considered the same. Refer to figures 1 and 2 for reference and the names of components.

Separate upper and lower carburetor body. Remove float and inlet needle. Remove idle jet, pilot jet or idle mixture valve, if equipped. Remove fixed jet plug, anti-afterfire solenoid or high speed mixture valve if equipped. Disassemble fuel pump. Discard "O"-rings, seals, gaskets and diaphragms. Mark choke and throttle plate before removing so that they may be installed in their original position. Remove choke and throttle plates. Remove throttle and choke shafts.

## INSPECT CARBURETOR – ALL STYLES

Check all moving parts for wear, nicks and burrs. Check float for leaks or damage. Check mixture valves for damage or burrs. Check all mating surfaces for nicks, burrs, foreign material, or cracks. Replace all worn or damaged parts.

## CARBURETOR CLEANING RECOMMENDATION



**WARNING: WEAR SUITABLE** skin protection when using cleaners. **FOLLOW** instructions on container.

1. Disassemble carburetor.
2. Remove and discard all old gaskets, seals and sealing material.
3. Use commercial carburetor cleaning solvents (such as Briggs & Stratton Spray Cleaner, Part #100041 or 100042) to clean carburetor parts and body.
4. When cleaning non-metallic parts (plastic, nylon, Minlon, etc.), do not leave in commercial carburetor cleaner more than 15 minutes.

**NOTE:** Parts containing rubber, such as seals, "O"-rings, inlet needles, seats or pump diaphragms should never be placed in commercial carburetor cleaner.



**WARNING: TO PREVENT** eye injury, always wear eye protection when using compressed air.

5. Use only compressed air (blowing in both directions) to clean out all openings and passages.

**NOTE:** Do not use wires, drills or any other devices to clean out metering holes or passages.

## CHECK THROTTLE, CHOKE SHAFT AND BODY FOR WEAR

1. Lay carburetor on flat surface and check throttle and choke shaft clearance as shown in Fig. 14.

Throttle shaft and choke shaft clearance must not exceed .010" (.25 mm).

2. Inspect throttle shaft and choke shaft for wear, Fig. 15.

Replace if worn.

If throttle shaft bushing is worn it should be replaced.

If choke shaft bearing is worn, the carburetor upper body must be replaced.

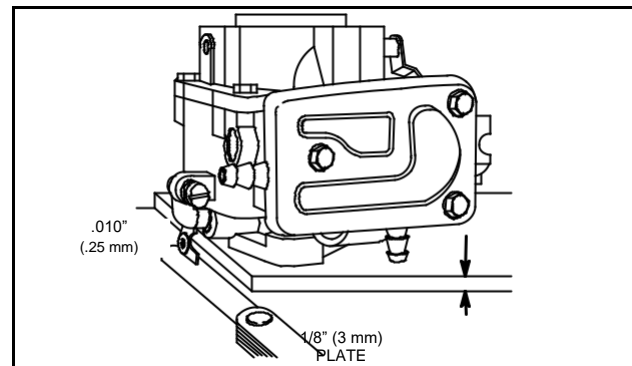


Fig. 14 – Check Throttle Shaft Wear

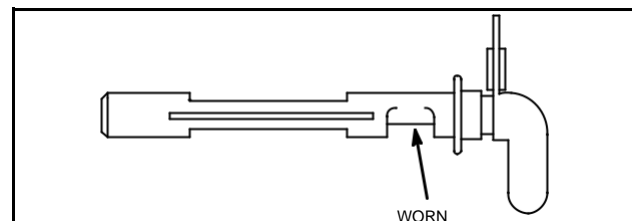
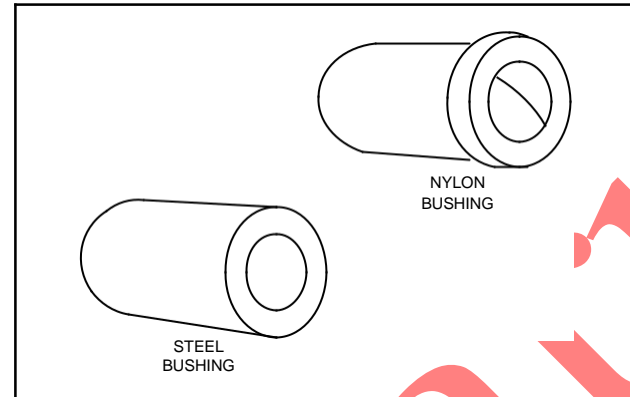


Fig. 15 – Check Throttle Shaft

Two style throttle shaft bushings are used on opposed twin cylinder carburetors, Fig. 16.

1. A replaceable split nylon bushing.
2. A replaceable steel bushing.

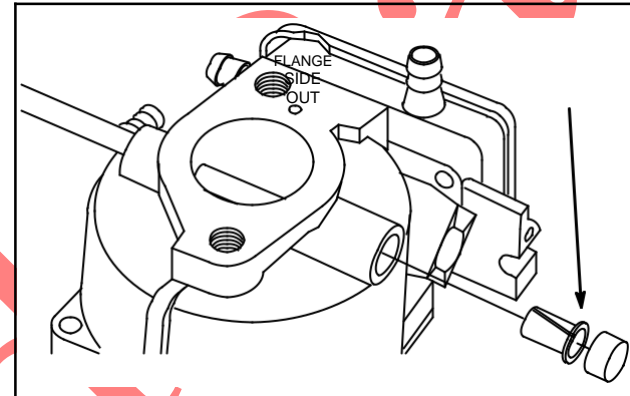
The bushings are not interchangeable.



**Fig. 16 – Throttle Shaft Bushings**

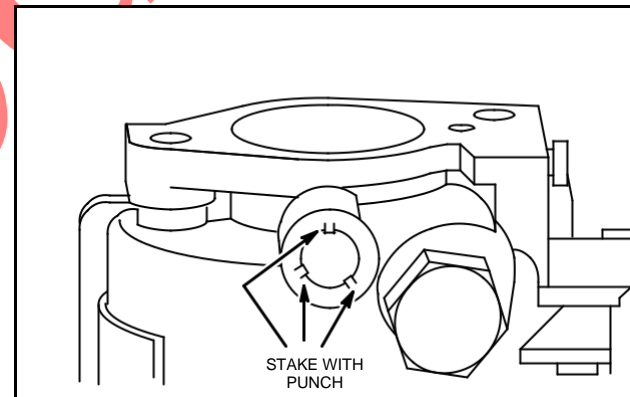
### Replace Nylon Throttle Shaft Bushings

1. Remove nylon bushing from throttle lever side of carburetor.
2. Drive out throttle shaft plug with long 3/16" (5 mm) punch.
  - a. Save plug.
3. Install new bushings with flange side out, Fig. 17.



**Fig. 17 – Replace Nylon Bushing**

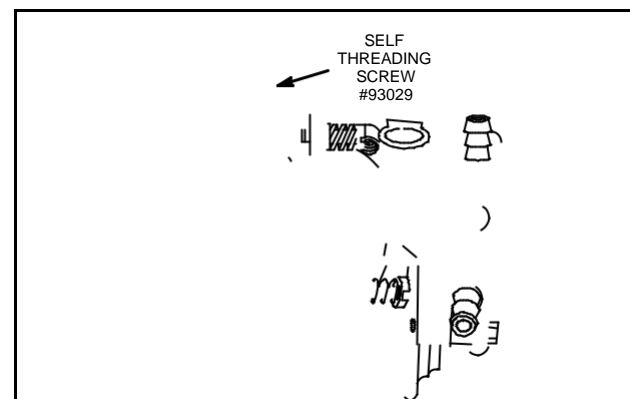
4. Re-install throttle shaft plug with 1/4" (6 mm) punch.
5. Stake in three places around plug with 1/8" (3 mm) punch, Fig. 18.
6. Apply sealant over plug to prevent air leaks.



**Fig. 18 – Install Plug**

### Replace Steel Throttle Shaft Bushings

1. Drive out throttle shaft plug with long 3/16" (5 mm) punch.
  - a. Save plug.
2. Thread self threading screw #93029 from #19165 flywheel puller into bushing 2-3 turns, then remove it, Fig. 19.



**Fig. 19 – Thread Bushing**

3. Assemble 1/4" x 20 nut, 1/4" flat washer and fuel tank spacer #94047 or #94038 to self threading screw.
4. Thread assembly into bushing.
5. Tighten nut until bushing is removed, Fig. 20.

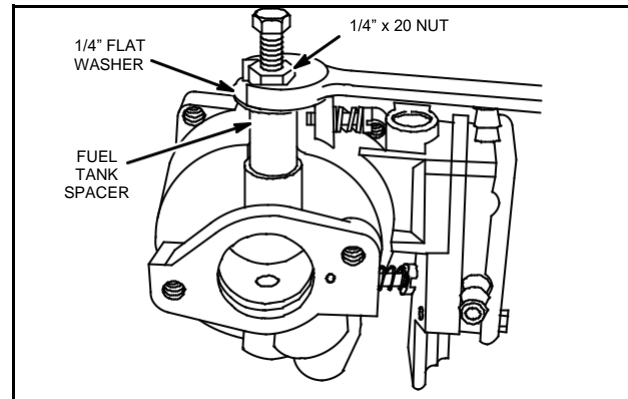


Fig. 20 – Remove Bushing

6. Install new bushing using bushing driver #19057.
  - a. Press in bushing until it bottoms.
7. Finish ream bushing with reamer #19056, Fig. 21.
  - a. Remove all chips.

Repeat procedure for other bushing.

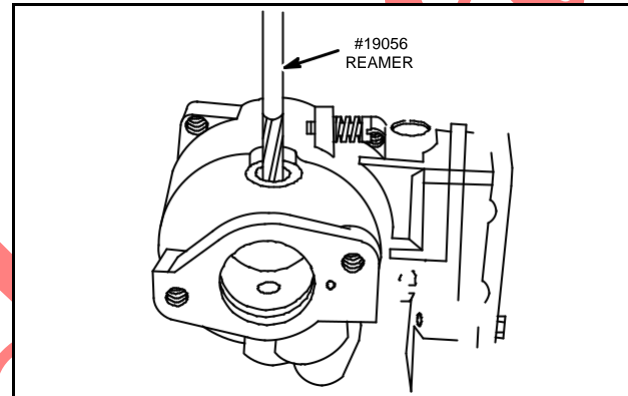


Fig. 21 – Ream Bushing

8. Re-install throttle shaft plug with 1/4" (6 mm) punch.
9. Stake in three places around plug with 1/8" (3 mm) punch, Fig. 22.
10. Apply sealant over plug to prevent air leaks.

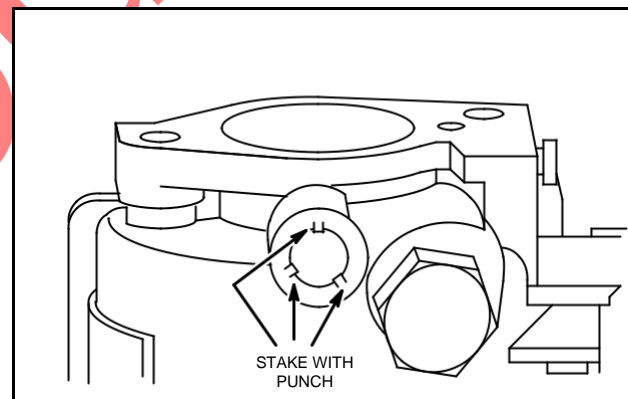


Fig. 22 – Install Plug

## REPLACE FUEL INLET SEAT

**NOTE:** The inlet seat on current style carburetors (engines built after 98101500) is NOT replaceable.

## Remove Inlet Seat – Engines Built Before 98101500

1. Thread self threading screw #93029 from #19165 flywheel puller into seat 3-4 turns, then remove it, Fig. 23.

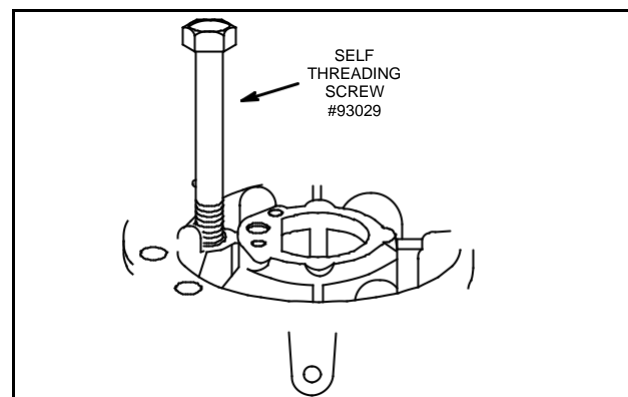


Fig. 23 – Thread Float Valve Seat

2. Assemble 1/4" x 20 nut, 1/4" flat washer and fuel tank spacer #94047 or #94038 to self threading screw.
3. Thread assembly into seat.
4. Tighten nut until seat is removed, Fig. 24.

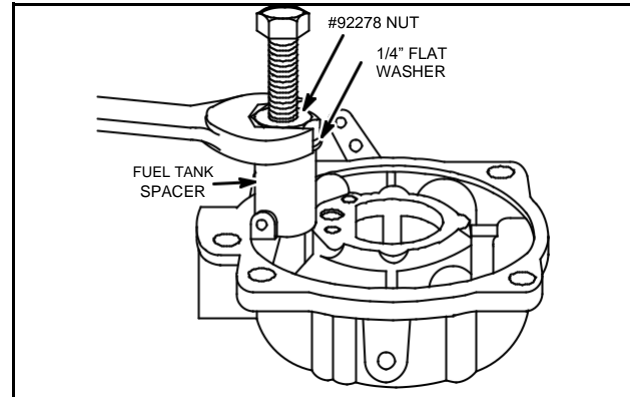


Fig. 24 – Remove Seat

### Install Inlet Seat – Engines Built Before 98101500

1. Insert new seat into carburetor body. a. Seat has a starting lead.
2. Press in seat with #19135 driver, Fig. 25.

**IMPORTANT:** TO ENSURE proper float level be sure seat is flush with carburetor body.

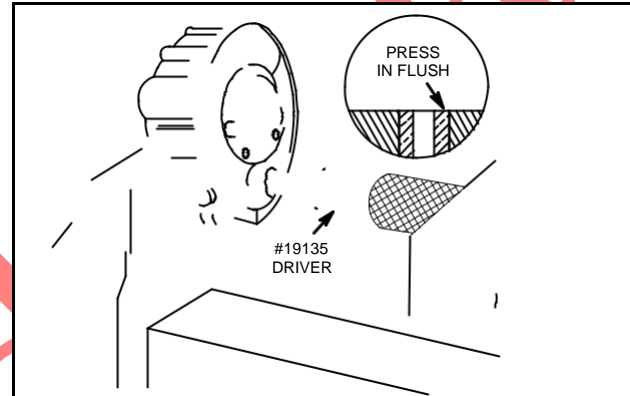


Fig. 25 – Install Seat

### ASSEMBLE CARBURETOR

#### Current Style – Type Nos. 1100 And Above Engines Built After 98101500

When assembling carburetor, use new new seals and gaskets.

1. Install choke shaft.
2. Insert choke plate into choke shaft with offset slot toward choke lever side.

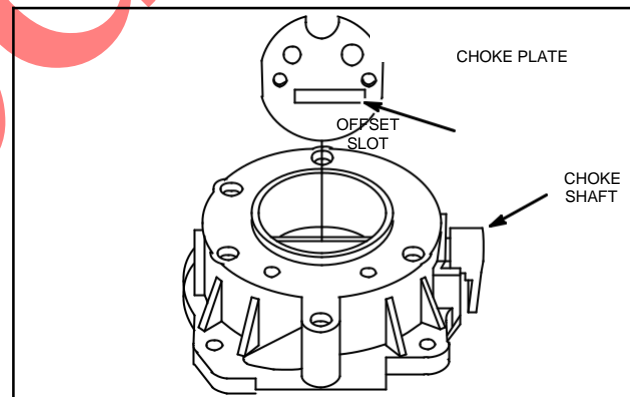


Fig. 26 – Install Choke Shaft

3. Assemble body gasket to upper body as shown. Be sure holes are aligned.

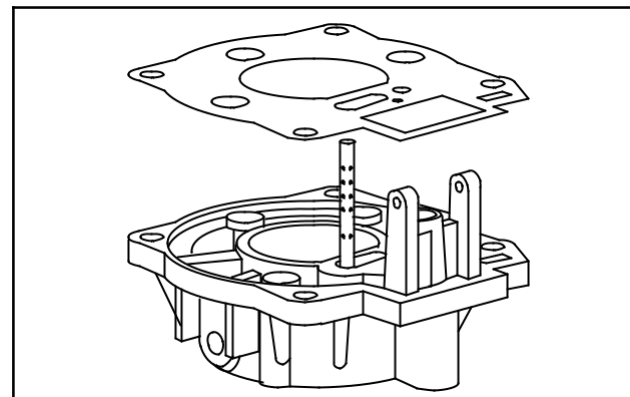


Fig. 27 – Assemble Body Gasket

4. Assemble fuel inlet valve to float and install float, Fig. 28.

**NOTE:** Float height is not adjustable.

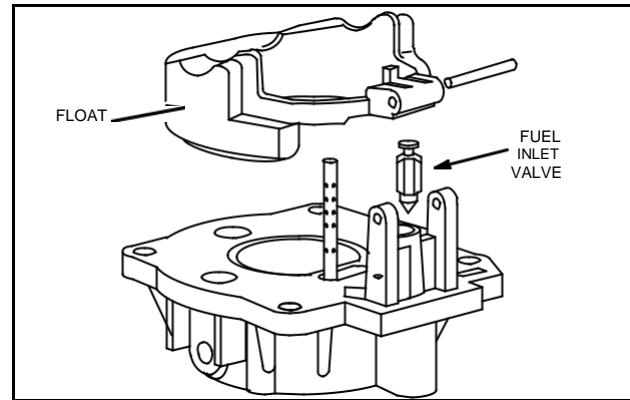


Fig. 28 – Install Float

5. Assemble new seal and spacer to throttle shaft and insert into carburetor body, Fig. 29.
  - a. Install throttle plate.

**NOTE:** Use **LOCTITE** 222 on screw threads.

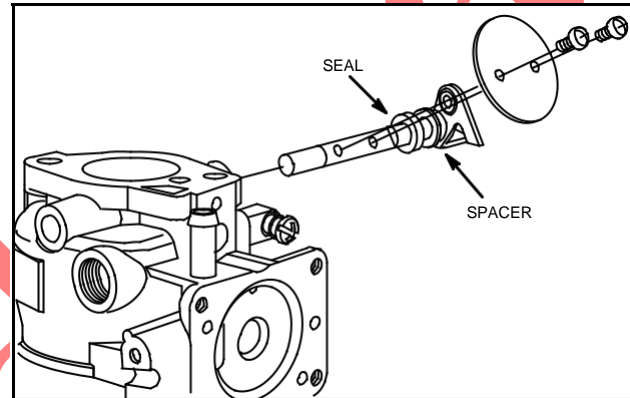


Fig. 29 – Install Throttle Shaft

6. Install idle jet.
7. Install fixed main jet, Fig. 30.

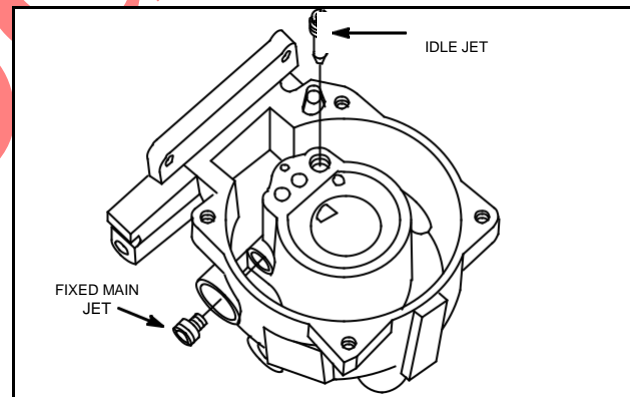


Fig. 30 – Install Jets

8. Assemble upper body to lower body, Fig. 31.
9. Install fixed main jet plug or fuel solenoid.
  - a. Torque to 100 in. lbs. (11.0 Nm).

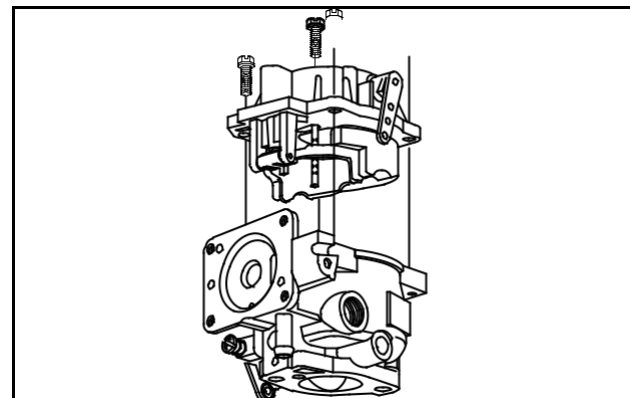


Fig. 31 – Install Upper Body



## Assemble Fuel Pump

**NOTE:** Check valves are not replaceable, Fig. 32.

3

10. Assemble Remaining components as shown, Fig. 33.
  - a. Torque pump cover to 20 in. lbs. (2.0 Nm).

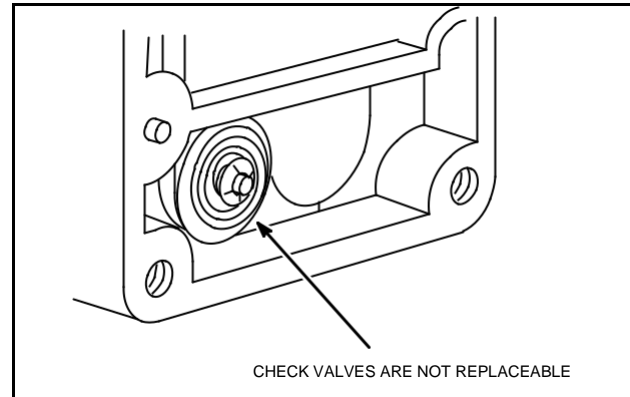


Fig. 32 – Assemble Check Valves

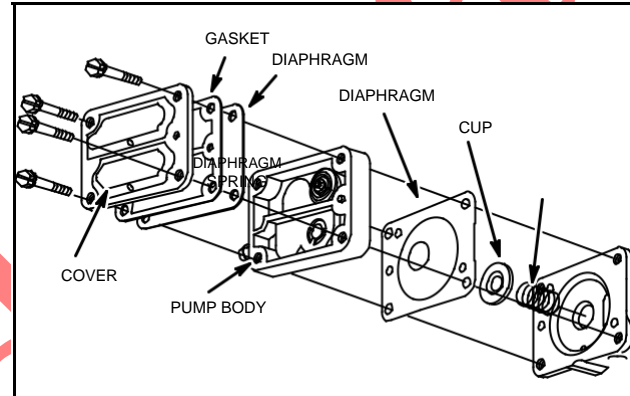


Fig. 33 – Assemble Fuel Pump

## ASSEMBLE CARBURETOR

### Engines Built Before 98101500

When assembling carburetor, use new new seals and gaskets.

1. Install choke shaft, Fig. 34.
2. Place choke plate on flat of choke shaft, with notch facing away from fuel pump and dimple down.

**NOTE:** Use LOCTITE 222 on screw threads.

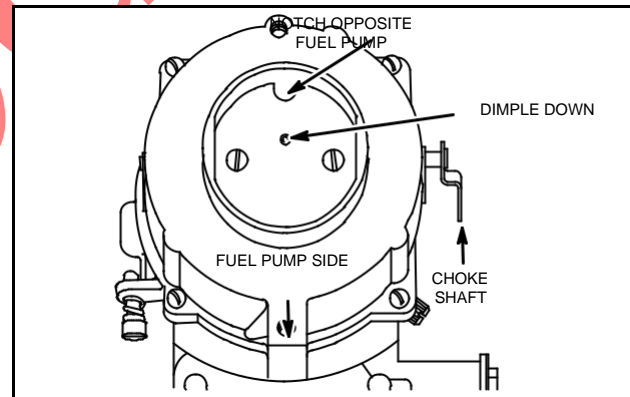


Fig. 34 – Install Choke Shaft

3. Assemble body gasket to upper body as shown, Fig. 35.

Be sure holes are aligned.

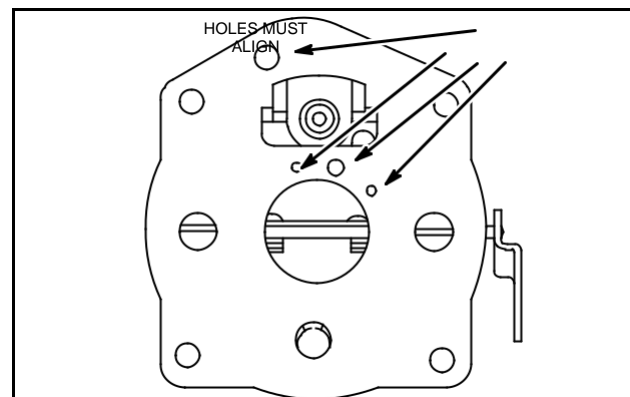


Fig. 35 – Assemble Body Gasket

4. Assemble spring to fuel inlet valve, Fig. 36.
5. Install float assembly in upper body.

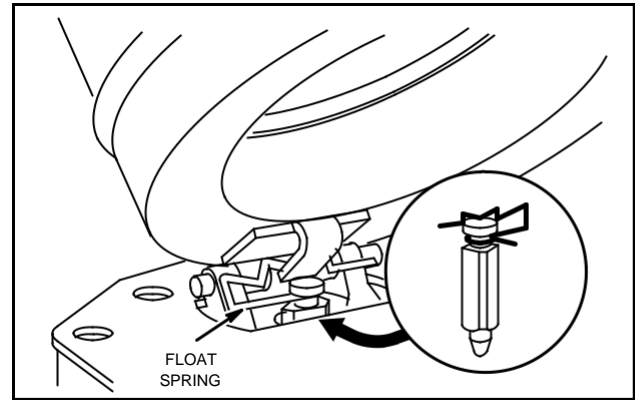


Fig. 36 – Install Float

6. Invert upper body and check float height, Fig. 37.
7. Float should be parallel to gasket surface.

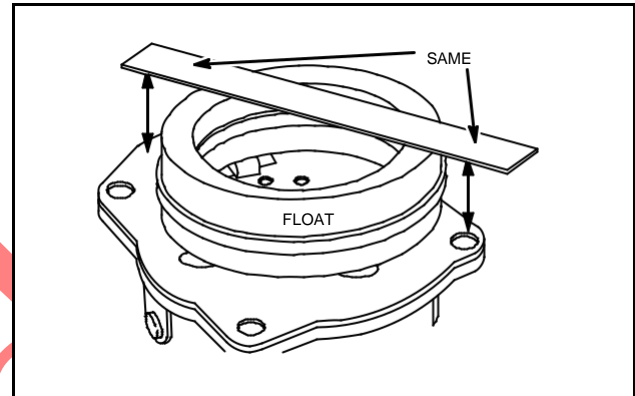


Fig. 37 – Check Float Height

8. Bend tang to adjust, if necessary, using needle nose pliers, Fig. 38.

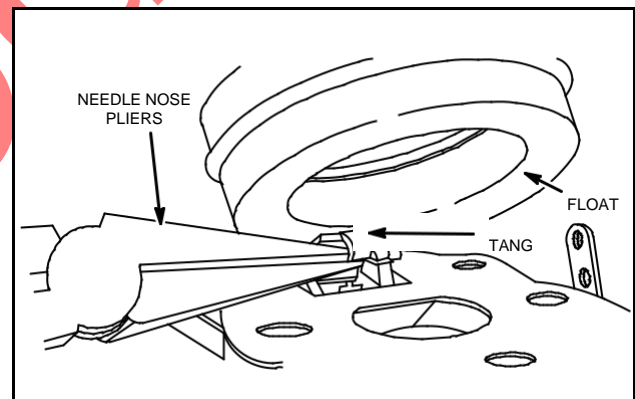


Fig. 38 – Adjust Float Height

9. Assemble new seal to throttle shaft and insert into carburetor body, Fig. 39.
  - a. Install throttle plate with dimples up, opposite idle port.

**NOTE:** Use **LOCTITE** 222 on screw threads.

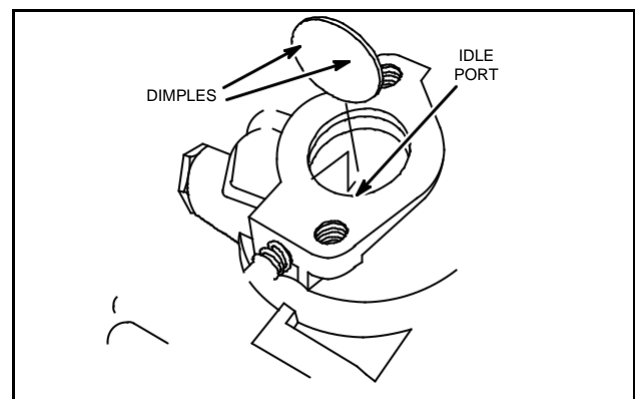


Fig. 39 – Install Throttle Shaft

10. Install idle mixture valve or pilot jet, If equipped.
11. Install fixed main jet and plug or solenoid, or high speed mixture valve, if equipped, Fig. 40.
  - a. Torque plug or solenoid to 100 in. lbs. (11.0 Nm).

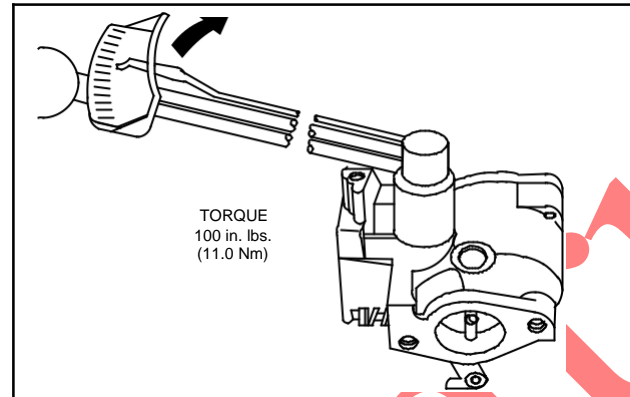


Fig. 40 – Install Fixed Main Jet

12. Install upper body assembly, Fig. 41.

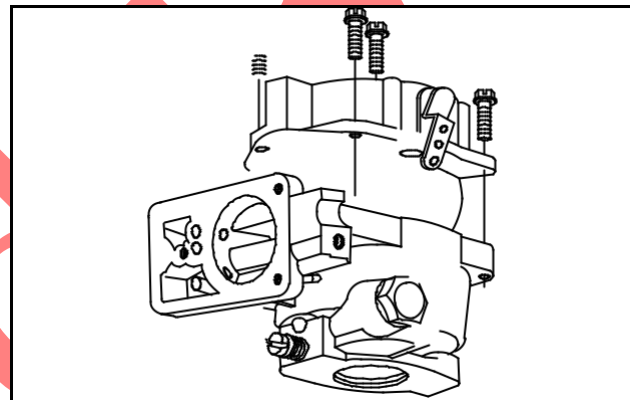


Fig. 41 – Install Upper Body

### Assemble Fuel Pump

1. Place a small dab of grease on diaphragm valve spring bosses to hold springs in position.
  - a. Assemble springs.
2. Assemble fuel pump components as shown.

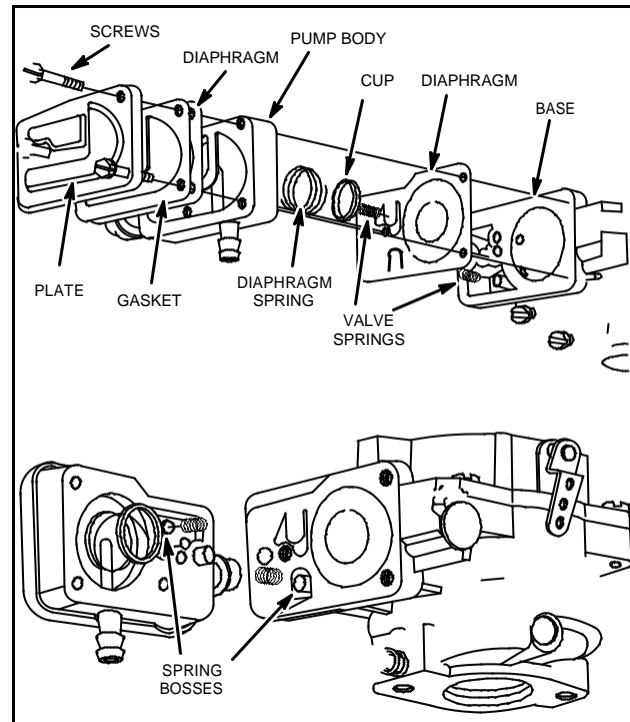


Fig. 42

## INSTALL CARBURETOR

To install carburetor and manifold or carburetor, see "Remove Carburetor," this section and assemble in reverse order of removal. Torque carburetor mounting screws to 100 in. lbs. (11.0 Nm). Torque intake manifold screws to 90 in. lbs. (10.0 Nm). Install fuel line and fuel pump pulse line. Make sure all connections are tight.

## INSTALL AIR CLEANER ASSEMBLY

**IMPORTANT:** ALL MODELS, breather tubes must be installed on filtered side of air cleaner element, Fig. 43. If breather tubes are incorrectly installed, premature engine wear will result.

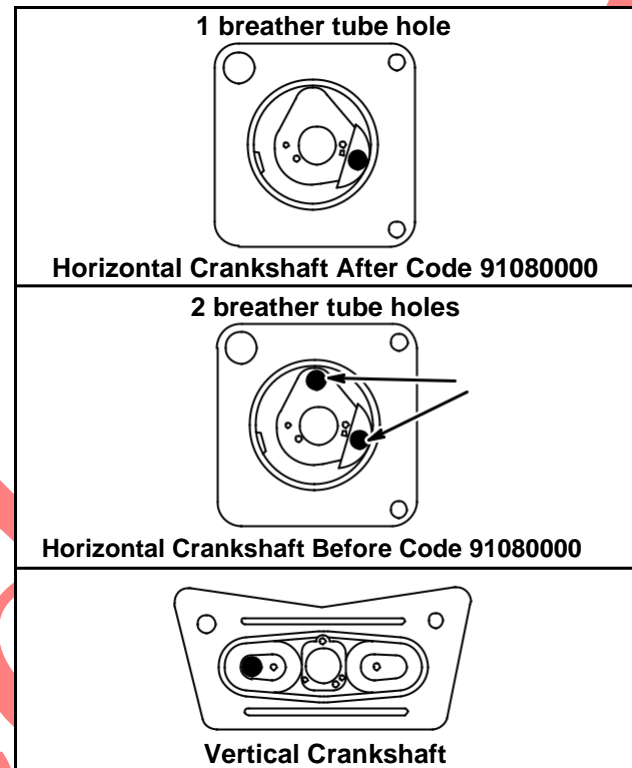


Fig. 43 – Breather Tube Locations

Install new air cleaner gasket on carburetor making sure that holes in gasket align with holes in carburetor. Install breather tube(s) in air cleaner base, Fig. 44.

**NOTE:** Breather tube installation will be easier if breather tube(s) are assembled to air cleaner base first.

Reassemble air cleaner as shown in section 1.



**WARNING: WHENEVER CARBURETOR** and manifold are removed, static governor adjustment should be checked! Misadjustment could result in engine overspeeding which could cause engine damage, property damage or personal injury.

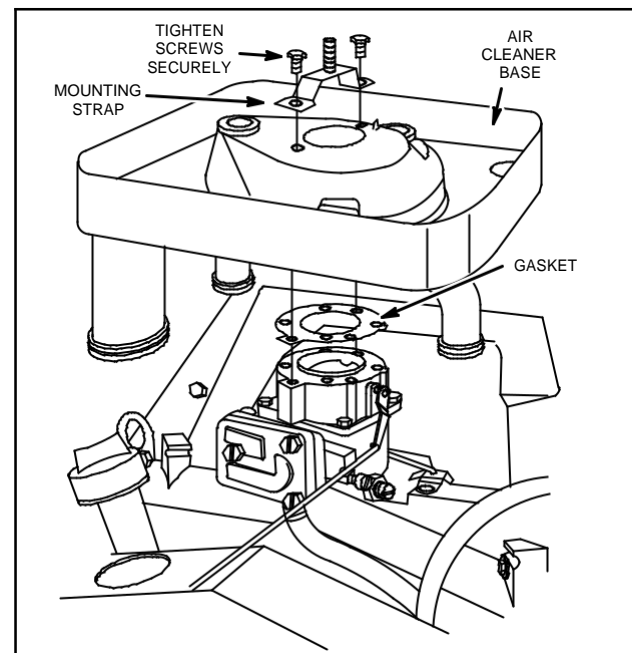


Fig. 44 – Install Breather Tubes

## ALL MODELS

### STATIC GOVERNOR ADJUSTMENT (Before Running Engine)

1. Loosen governor lever nut. Push on governor lever until throttle is wide open. **Do not bend governor link or distort governor lever.**
2. Rotate governor shaft counter-clockwise as far it will go, Fig. 45.
  - a. Torque governor nut to 100 in. lbs. (11.0 Nm).
3. Install throttle and choke control cables and check for proper operation.

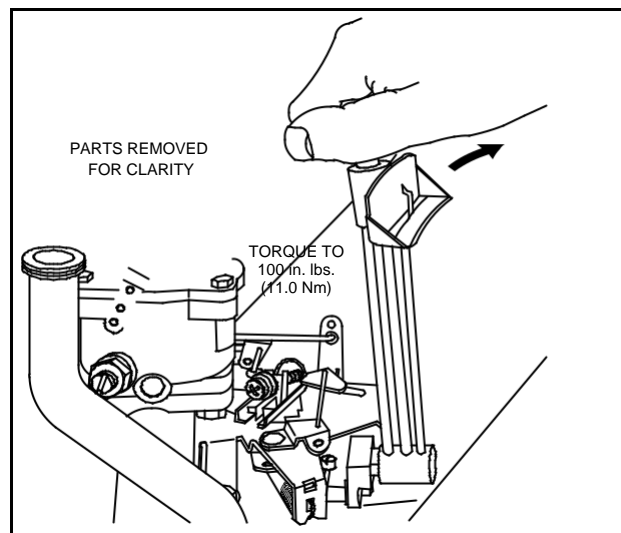


Fig. 45 – Static Governor Adjustment

### Initial Carburetor Adjustment – All Engines Equipped With Adjustable Mixture Valves

1. Turn idle mixture valve clockwise until it just seats. **DO NOT FORCE.** Turn valve counterclockwise 1-1/2 turns.
2. If carburetor is equipped with an adjustable high speed mixture valve, turn valve clockwise until it just seats. **DO NOT FORCE.** Turn valve counter-clockwise 1-1/2 turns.

This setting will permit the engine to start. Final adjustment will be made with the engine running, Fig. 46.

**NOTE:** Some early model carburetors are equipped with a fixed jet needle valve, **NO TAG.** Turn fixed jet needle in until it seats firmly. Backing needle out, will cause an excessively rich mixture.

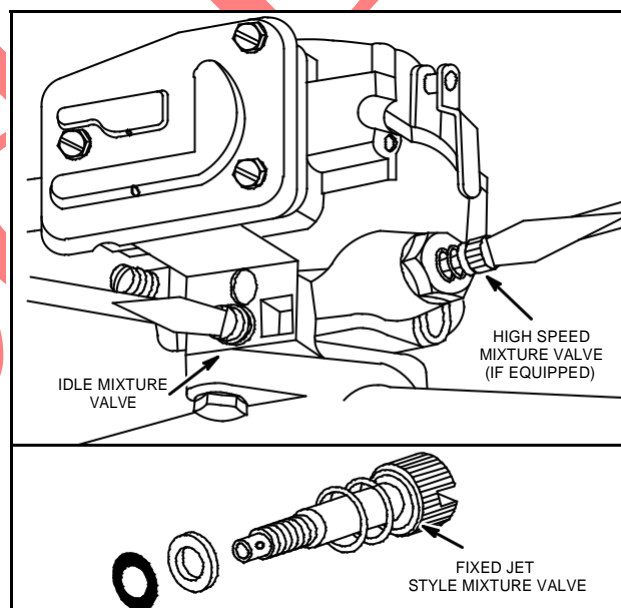


Fig. 46 – Initial Carburetor Adjustment

### Dynamic Governor Adjustment – Type Nos. 1100 And Above

ALL ADJUSTMENTS MUST BE MADE WITH THE AIR CLEANER INSTALLED.

The following tools are required when making governor adjustments, Fig. 47.

1. An accurate tachometer, such as Tool #19200 or #19389.
2. Tang bender, Tool #19352 or #19229.

Start and run engine for approximately 5 minutes to allow engine to warm up.

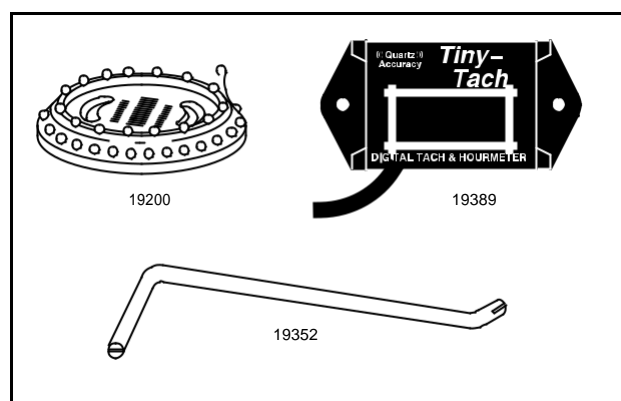


Fig. 47 – Governor Adjustment Tools

### Governed Idle Adjustment – Type Nos. 1100 And Above

1. Move control lever on equipment to SLOW position.

**NOTE:Engines equipped** with current style carburetor or carburetors with screw in pilot jet, proceed to step 6.

2. Hold throttle lever against idle speed screw and temporarily adjust idle to 1300 RPM, Fig. 48.

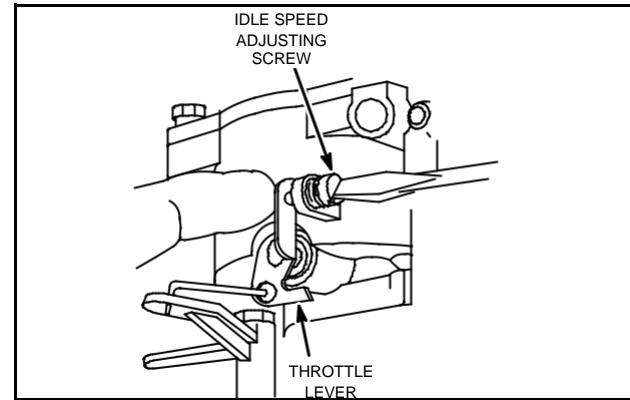


Fig. 48 – Adjust Idle Speed

3. While holding throttle lever against idle speed screw, turn idle mixture valve slowly clockwise until engine speed just starts to slow (Lean Mixture).
4. Still holding lever, turn valve slowly counterclockwise until engine speed just starts to slow (Rich Mixture).
5. Turn valve back to the midpoint between rich and lean, Fig. 49.

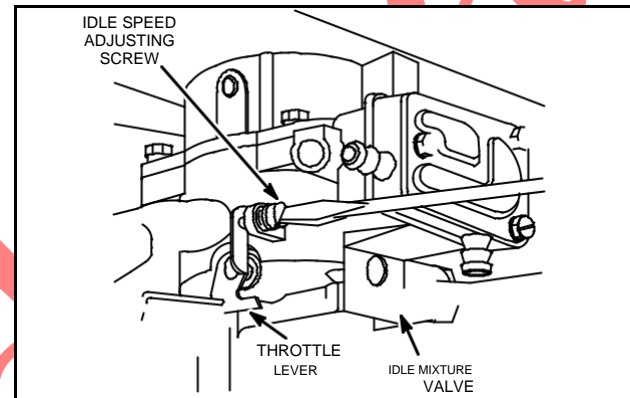


Fig. 49 – Adjust Idle Mixture

6. Hold throttle lever against idle speed screw, adjust idle speed to 1000 RPM.
7. Release throttle lever.
8. With tang bending tool, bend governed idle tang to obtain 1300 RPM, Fig. 50.

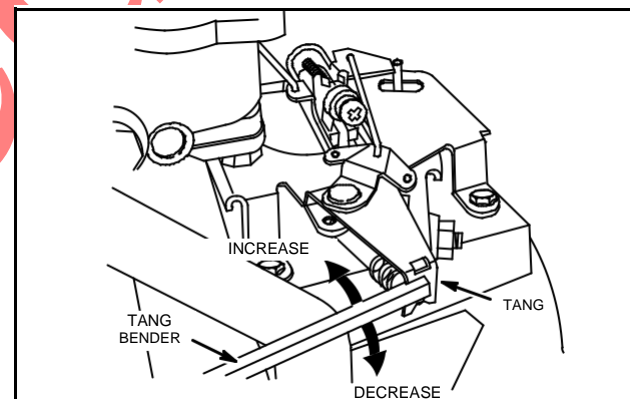


Fig. 50 – Adjust Governed Idle

### Final Adjustment – Type Nos. 1100 And Above High Speed Mixture (If Equipped)

**NOTE:Carburetors equipped** with a fixed high speed jet require no high speed adjustment.

1. Place equipment speed control in fast position
2. Turn high speed mixture valve slowly clockwise until engine speed just starts to slow. (Lean Mixture).
3. Turn mixture valve slowly counterclockwise until engine speed just starts to slow (Rich Mixture).
4. Turn mixture valve to midpoint between rich and lean, Fig. 51.

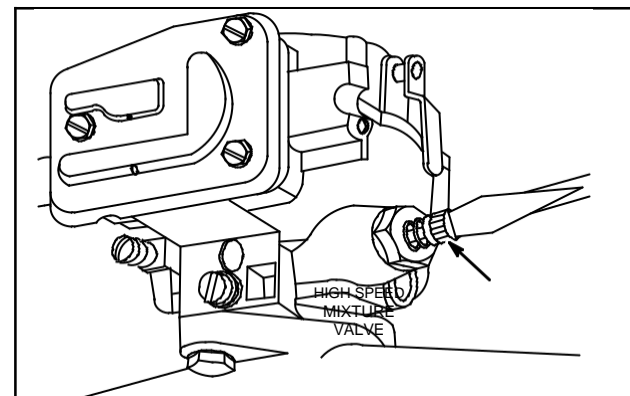


Fig. 51 – Adjust High Speed Mixture



## Dynamic Governor Adjustment – Type Nos. Below 1100

ALL ADJUSTMENTS MUST BE MADE WITH THE AIR CLEANER INSTALLED.

The following tools are required when making governor adjustments.

1. An accurate tachometer, such as Tool #19200 or #19389.
2. Tang bender, Tool #19352 or #19229.
3. A 1/8" (3 mm) diameter, 1" (25 mm) long metal rod. Start and run engine for approximately 5 minutes to allow engine to warm up.

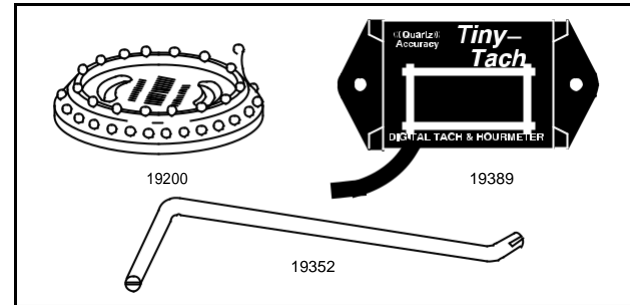


Fig. 52 – Governor Adjustment Tools

1. Place equipment speed control in idle position.
2. Hold throttle lever against idle speed screw and adjust idle speed to 1300 RPM,
3. While holding throttle lever against idle speed screw, turn idle mixture valve slowly clockwise until engine speed just starts to slow (Lean Mixture).
4. Turn mixture valve 1/2 turn counterclockwise.
5. Still holding lever against idle speed screw, adjust idle speed to 1000 RPM.
6. Release throttle lever.

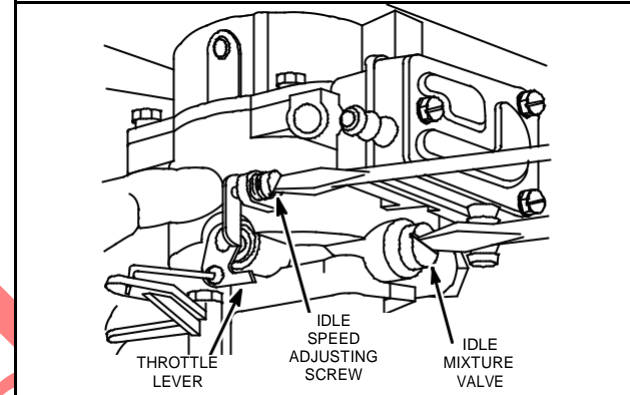


Fig. 53 – Adjust Idle Mixture

7. Move equipment speed control lever until 1/8" (3 mm) rod can be inserted through the 2 holes in the governor control plate, Fig. 54.
8. With tang bending tool bend governed idle tang to obtain 1300 RPM, Fig. 54.

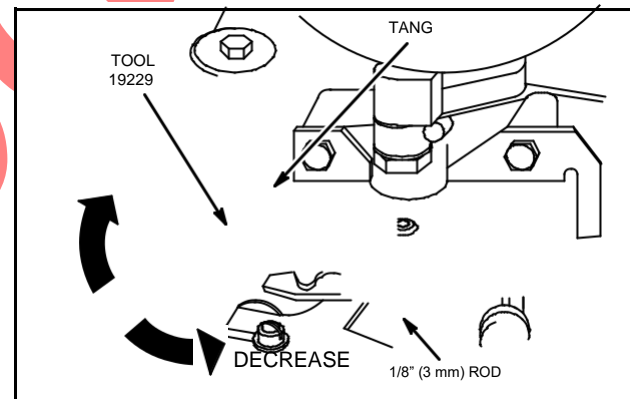


Fig. 54 – Adjust Governed Idle

## Final Adjustment – High Speed Mixture (If Equipped) – Type Nos. Below 1100

**NOTE:** Carburetors equipped with a fixed high speed jet require no high speed adjustment.

1. Place equipment speed control in fast position.
2. Turn high speed mixture valve slowly clockwise until engine speed just starts to slow (Lean Mixture).
3. Turn mixture valve 1/2 turn counterclockwise, Fig. 55.

**NOTE:** If the engine does not accelerate properly, readjust the high speed mixture valve approximately 1/8 turn counterclockwise (Rich Mixture).

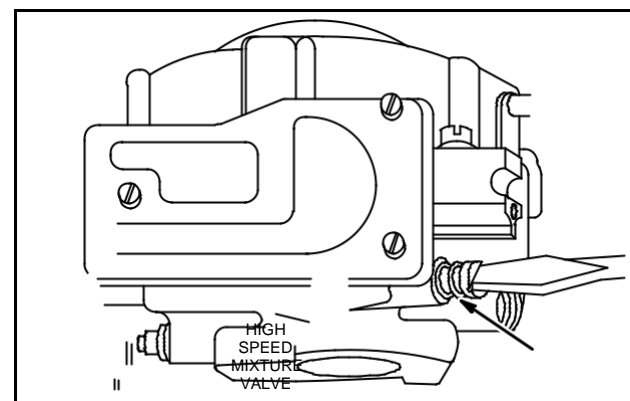


Fig. 55 – Adjust High Speed Mixture

### Fixed High Speed Jet Carburetors

If throttle response is poor or a hesitation occurs when the engine is accelerated, or when engaging an electric clutch, the following procedure can be used to determine if a lean mixture is the cause.

Partially close the choke. If the throttle response improves and, or, the hesitation disappears, it is an indication that a richer jet (Part #231500) can be substituted, Fig. 56.

Special high altitude jets are available. Consult the Illustrated Parts List for the correct part number.

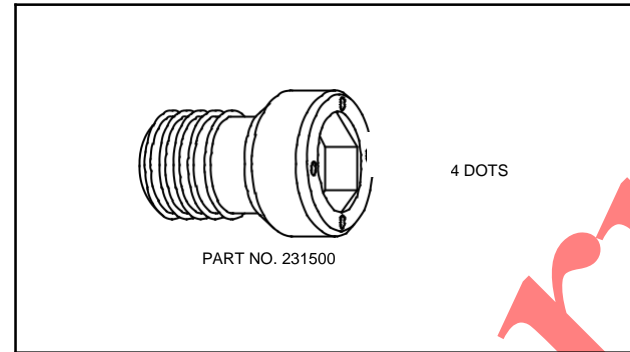


Fig. 56 – 231500 Fixed High Speed Jet

### Adjust Carburetor, Early Style (Dual Speed Generator – Welder Sets)

Engine must be installed in equipment and all equipment manufacturer controls installed ready to be used.

The carburetor adjustment procedure is the same as described in carburetor adjustment Pre-Twin II (page 18), except that when adjusting idle mixture the equipment switch must be in "Generator" mode. When adjusting the high speed mixture the equipment switch must be in "Weld" mode.

### ANTI-AFTERFIRE SYSTEM

Some carburetors are equipped with a fuel shut off solenoid controlled by the equipment ignition switch. When the equipment switch is in the "Off" position, the solenoid valve plunger closes, stopping fuel flow through the fixed main jet, Fig. 57. When the switch is in the "On" and "Start" position, the solenoid valve opens, allowing normal fuel flow, Fig. 58. Solenoid is operating properly if a click is heard when equipment ignition switch is turned "On" and "Off."

**NOTE:** If solenoid is not working (defective solenoid, defective ignition switch or broken solenoid wire), engine will start with great difficulty when cold. If engine is at operating temperature, engine will start and run, but will not develop full power.

**NOTE:** Fuel shut-off solenoid requires a minimum of 9 volts DC to function.

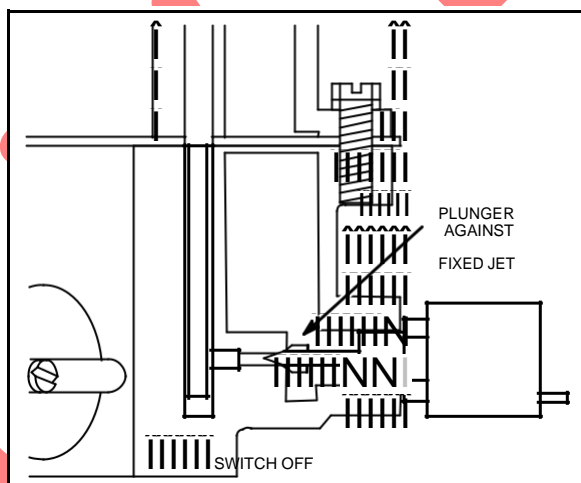


Fig. 57 – Solenoid Closed

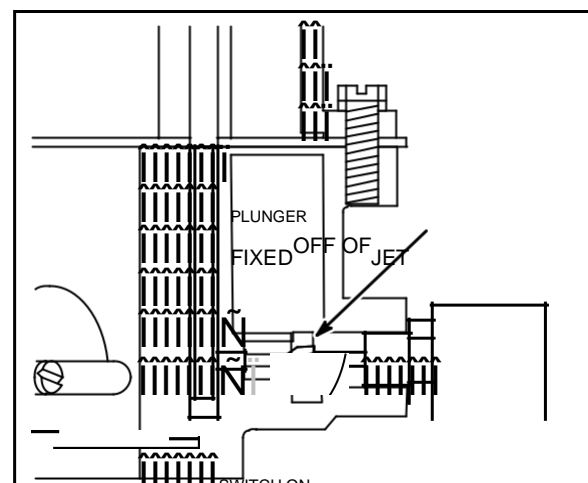


Fig. 58 – Solenoid Open

## Testing Solenoid

If solenoid does not click, the problem may be in equipment wiring or solenoid. To determine whether problem is with wiring or solenoid, perform the following tests in the order shown.

### Test Equipment

The digital multimeter, Tool #19390, is required to test the solenoid equipment wiring.

The following tests will be performed with the meter in the V  $\equiv$  (DC volts) position, Fig. 59.

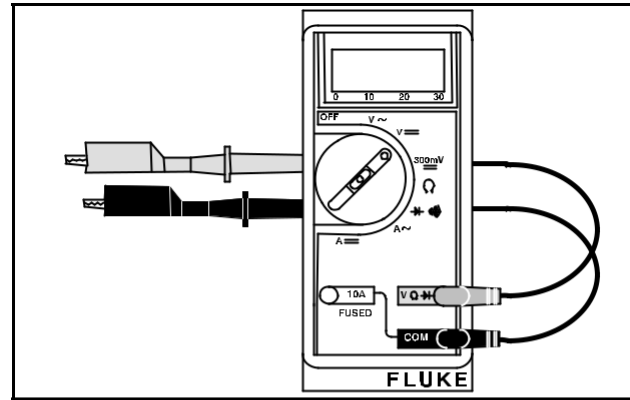


Fig. 59 – Digital Multimeter

### Testing Equipment Wiring

1. With keyswitch in OFF position, disconnect equipment wiring harness connector from solenoid.
2. Attach red meter test lead into equipment wiring harness connector.
3. Attach black test lead to a good ground, Fig. 60.
4. Turn keyswitch to ON position.
  - a. Meter should display battery voltage at connector.

If meter does not display battery voltage, problem is with wiring harness. Check for loose or broken wire. If meter displays battery voltage, test solenoid.

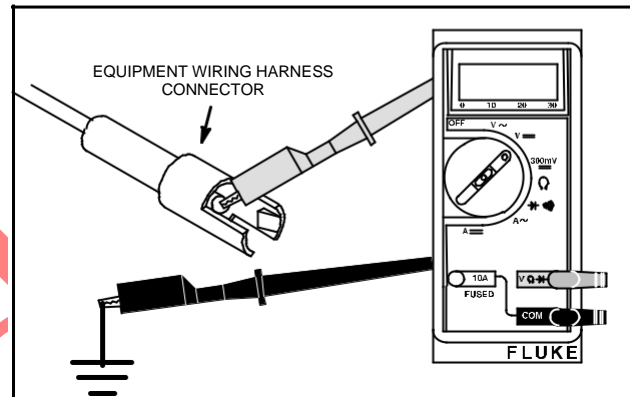


Fig. 60 – Test Equipment Wiring

### Testing Solenoid

1. Remove solenoid from carburetor.
2. Place either terminal of a 9 volt transistor battery on the solenoid connector and other terminal on body of solenoid, Fig. 61.
3. Plunger should retract freely.
4. When battery is removed, plunger should return freely.

Replace solenoid if plunger sticks or doesn't move.

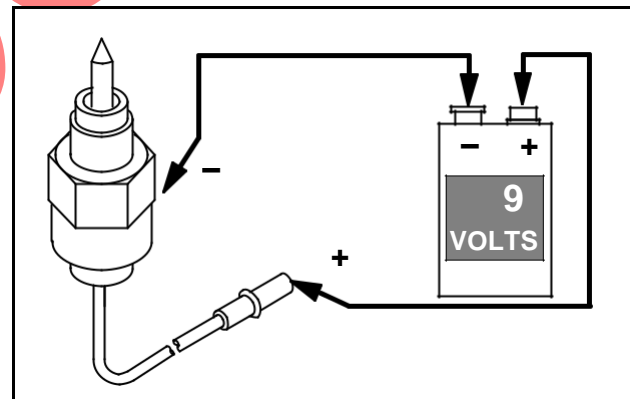


Fig. 61 – Test Solenoid

### Anti-Afterfire System Early Style Optional On 402700 Only, Before Code 80080112

Some models are equipped with an early style Anti-Afterfire System. The system consists of a vacuum valve and solenoid assembly and vacuum block assembly located in the air cleaner base. Crankcase vacuum is supplied to the vacuum valve assembly through a "Tee" fitting located in the fuel pump vacuum line. Electrical power to operate the vacuum valve solenoid is supplied through the equipment manufacturer's ignition switch, Fig. 62.

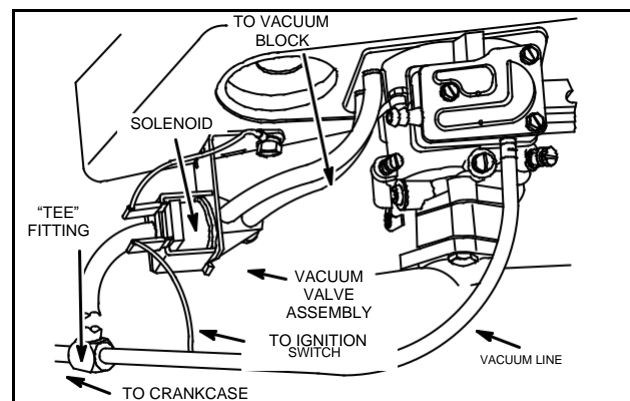


Fig. 62 – Early Anti-Afterfire

When the switch is in the start or run position, the vacuum valve assembly is energized. This opens the valve in the vacuum valve assembly and allows the carburetor float bowl to vent through the air cleaner. The carburetor float bowl vents through the vacuum block assembly and vacuum valve assembly, Fig. 63.

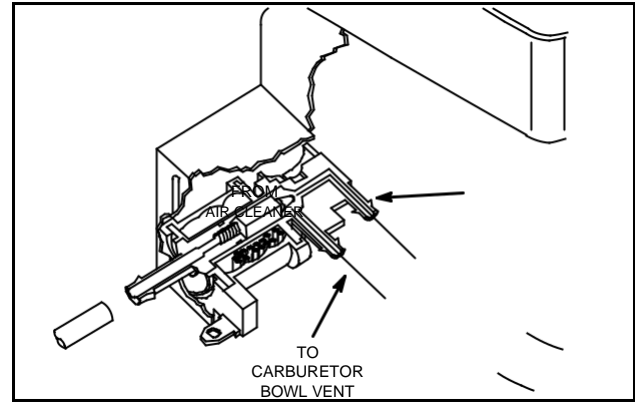


Fig. 63 – Anti-Afterfire Operation Running

### Check Anti-Afterfire Operation (Engine Running)

With engine in equipment and running, disconnect either electrical terminal on vacuum valve assembly. Engine should stop running with equipment ignition switch in the run position. Engine should not start until terminal is reconnected, Fig. 64.

**NOTE:** Choke must be in wide open position.

### Inspect Anti-Afterfire System (Loss of Vacuum)

Check all lines for cracks, loose connections, air leaks and proper routing. None of the lines should have sharp bends or kinks. Check gaskets and "O"-ring in vacuum block for leaks. Replace damaged or leaking gaskets or "O"-ring.

### Inspect Anti-Afterfire System (Electrical)

Check for loose or corroded ground wire connections, loose or corroded connections at vacuum valve and equipment ignition switch. Solenoid is operating properly if a click is heard when equipment ignition switch is turned "ON" and "OFF." Replace vacuum valve, if it does not click.

### Replacing Hoses

Service replacement hoses are available and can be cut to required length, Fig. 65.

A letter "D" drill (6.2 mm) is used to align gasket "O"-ring and vacuum block body during assembly, Fig. 66.

### INLINE FUEL FILTER SERVICE

Replace inline fuel filter yearly or every 100 hours, whichever occurs first. Replace filter if dirt or water are present. See illustrated parts list for correct fuel filter.

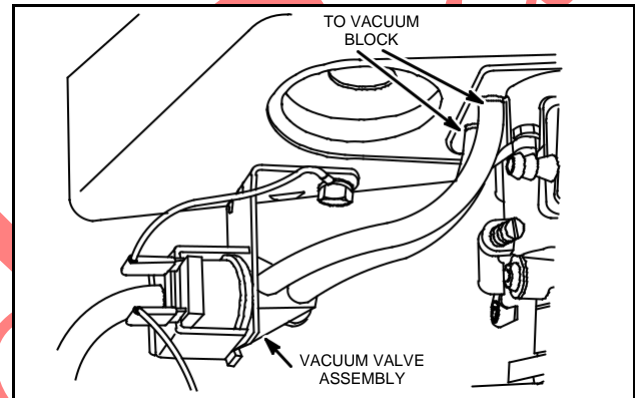


Fig. 64 – Anti-Afterfire Operation Stopped

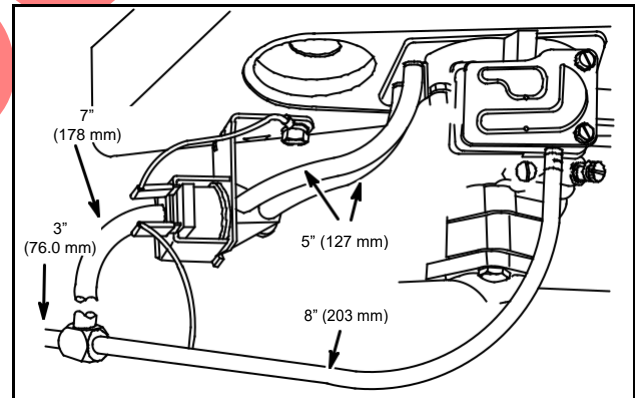


Fig. 65 – Hose Lengths

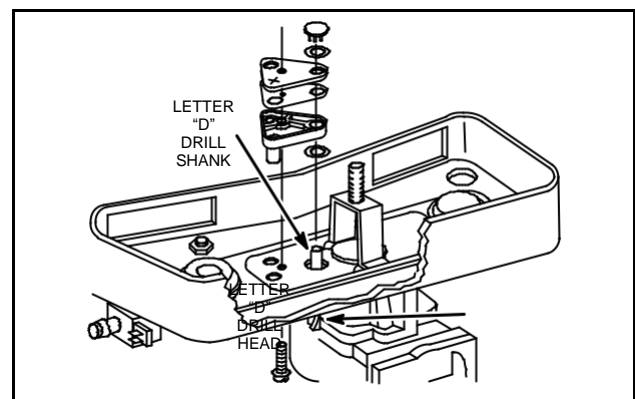


Fig. 66 – Assemble Vacuum Block

Lil' Red Barn

# Section 4

## GOV. CONTROLS & GOVERNOR

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## MECHANICAL GOVERNOR

### General Information

The purpose of the governor is to maintain, within certain limits, a desired engine speed, even though loads may vary. The governor spring tends to pull the throttle open. The force of the counterweights, which are operated by centrifugal force, tends to close the throttle. The engine speed at which these two forces balance is called the governed speed.

To comply with specific top governed speed limits, Briggs & Stratton supplies manufacturers with engines having an adjustable top speed limit, which is set to equipment manufacturers' specifications.

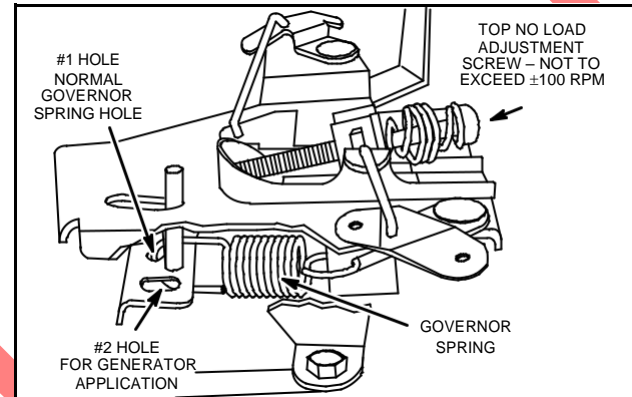
If a governor spring must be replaced, consult the appropriate Illustrated Parts Lists. Choose the proper governor springs by engine type number.

**CAUTION:** AFTER A new governor spring is installed, check engine top governed speed with an accurate tachometer.

4

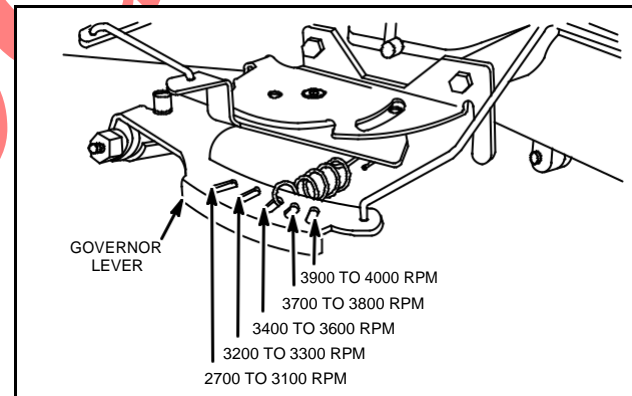
The governed speed on Twin II engines can be varied by changing governor springs or hole location, NO TAG.

**NOTE:** If Top No Load adjustment exceeds  $\pm 100$  RPM, the governor spring must be changed.



**Fig. 1 – Governor Spring, Twin II (Type Nos. 1100 & Above)**

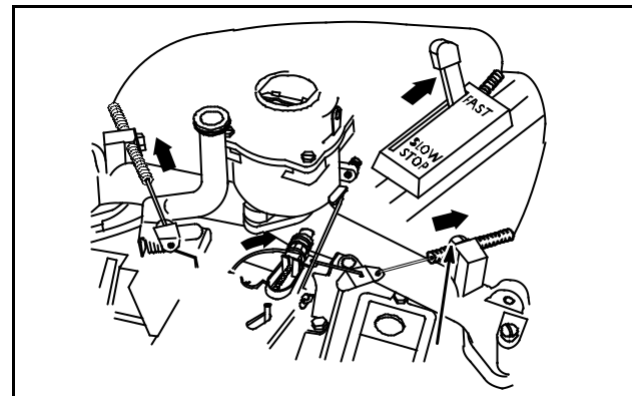
The governed speed on Pre-Twin II engines can be varied by changing governor spring tension and hole location, NO TAG.



**Fig. 2 – Governor Spring Position, Pre-Twin II (Type Nos. Below 1100)**

### Speed Regulation

Remote governor controls (supplied by equipment manufacturer) control engine speed by increasing or decreasing tension on governor spring(s) to obtain desired engine speed, Fig. 3.



**Fig. 3 – Remote Governor Control**

## Governed Idle

All Twin II twin cylinder engines equipped for remote control are equipped with governed idle. A detent in the equipment control provides governed idle when the equipment control is moved to the full slow position.

Pre-Twin II, twin cylinder engines equipped for remote control have provision for governed idle. Equipment manufacturer's control may or may not provide a detent for governed idle. Controls with detents permit the governor to maintain engine speeds under light loads with control in the detent position. Moving the remote control beyond the detent to the full slow position overrides the governed idle and closes the throttle to the fully closed position to prevent engine over-speeding, in the event of governor failure.

Remote controls without detents will provide governor control, depending on control setting, at all positions except full slow position.

## Remote Control Wire Travel

In order to make proper remote control adjustments, the travel of the remote control wire must be not less than 1-3/8" (35 mm) with controls mounted in equipment, Fig. 3.

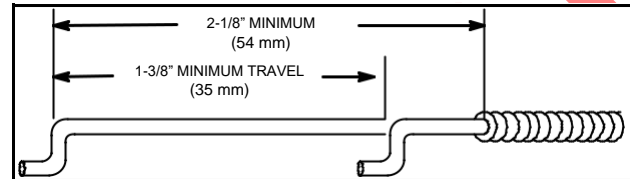


Fig. 4 – Control Wire Travel

## CONTROL ADJUSTMENTS

### Remote Control Adjustment – Twin II (Type Nos. 1100 & Above)

#### Horizontal Crankshaft

1. Loosen control casing clamp at governor control bracket, Fig. 5.
2. Move speed control lever to "FAST" position.
3. Move control casing and wire in direction shown by arrow until governor control swivel is at end of travel.
4. Tighten casing clamp screw.

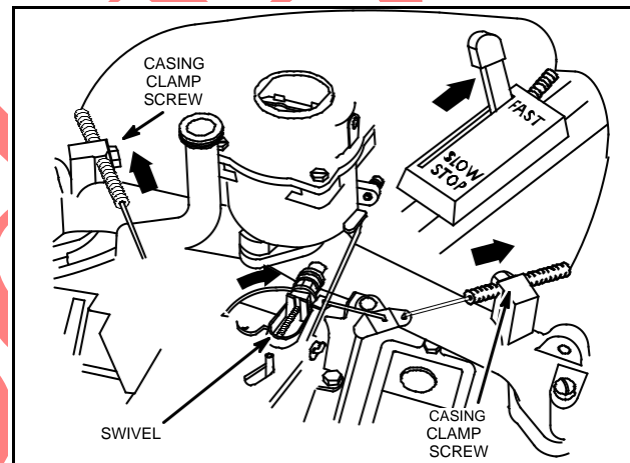


Fig. 5 – Remote Control – Twin II  
Horizontal Crankshaft (Type Nos. 1100 & Above)

#### Vertical Crankshaft

1. Loosen control casing clamp at governor control bracket, Fig. 6.
2. Move speed control lever to "FAST" position.
3. Move control casing and wire in direction shown by arrow until governor control swivel is at end of travel.
4. Tighten casing clamp screw.

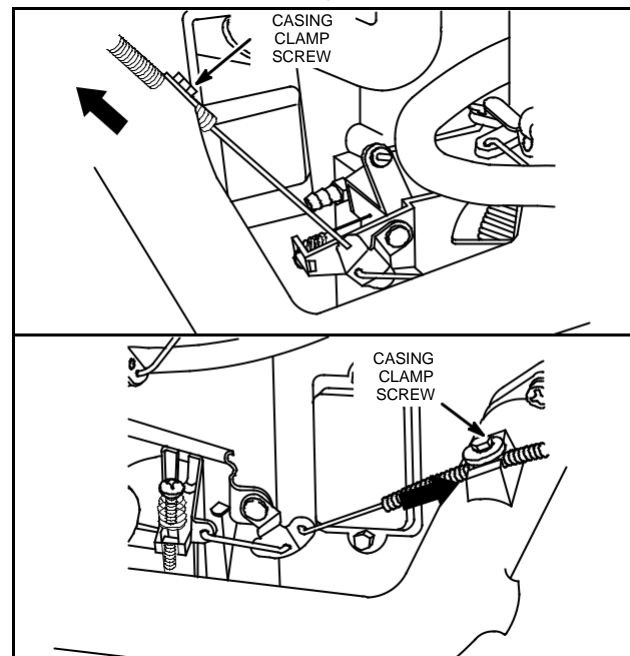


Fig. 6 – Remote Control – Twin II Vertical  
Crankshaft (Type Nos. 1100 & Above)

## Remote Control Adjustment – Pre-Twin II (Type Nos. Below 1100)

### Horizontal Crankshaft

1. Move speed control lever to full “SLOW” position.
2. Loosen control casing clamp at governor control bracket or intake manifold.
3. Move control casing and wire in direction shown by arrow, Fig. 7.

**NOTE:** Carburetor throttle must touch idle speed adjustment screw when control lever is in slowest position.

4. Tighten casing clamp screw.

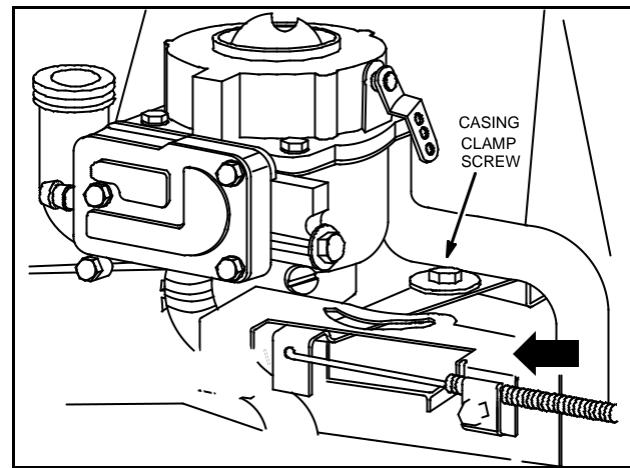


Fig. 7 – Remote Control Adjustment – Pre-Twin II Horizontal Crankshaft (Type Nos. Below 1100)

## Remote Control Adjustment – Pre-Twin II (Type Nos. Below 1100)

### Vertical Crankshaft

1. Move speed control lever to full “SLOW” position.
2. Loosen control casing clamp at governor control bracket or intake manifold.
3. Move control casing and wire in direction shown by arrow, Fig. 8.

**NOTE:** Carburetor throttle must touch idle speed adjustment screw when control lever is in slowest position.

4. Tighten casing clamp screw.

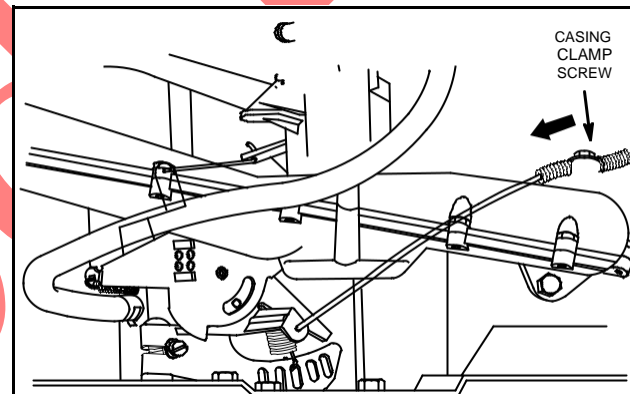


Fig. 8 – Remote Control Adjustment – Pre-Twin II Vertical Crankshaft (Type Nos. Below 1100)

## Choke Control Adjustment – All

1. Place choke control lever on equipment in “CHOKE” position.
2. Loosen control casing clamp screw.
3. Move control casing and wire until choke is completely closed.
4. Tighten casing clamp screw, Fig. 9.

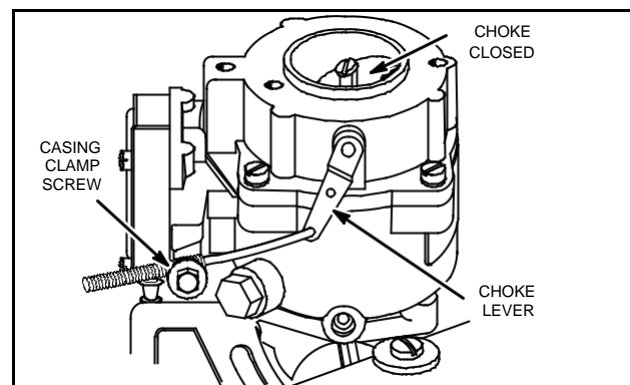


Fig. 9 – Adjust Choke

## MECHANICAL GOVERNOR

### Remove Governor Gear

The governor gear is located in the crankcase cover on horizontal crankshaft engines or in the sump on vertical crankshaft engines.

Drain oil and remove engine from equipment. Remove spark plugs.

1. To relieve cam gear bearing pressure on the cover or sump, rotate crankshaft until #1 cylinder intake valve is open.
  2. Remove rust, nicks and burrs from crankshaft PTO.
  3. Remove crankcase cover or sump, Fig. 10.
- Tap on side of cover or sump.

### Inspect Governor Gear

1. Check gear for damaged or worn teeth, Fig. 11.
2. Check thrust washer, governor weights and hinge pins for wear and burrs.
3. Check governor cup for wear and burrs. Replace as required.

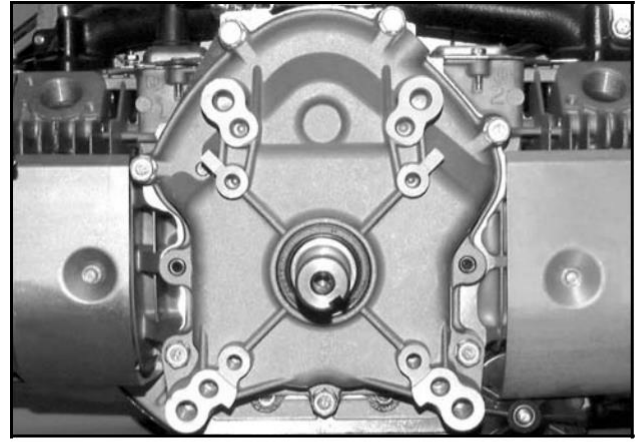


Fig. 10 – Remove Crankcase Cover Or Sump

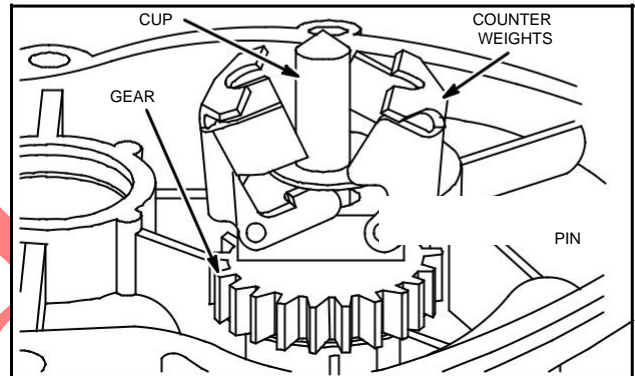


Fig. 11 – Governor Gear Assembly, Typical

### Remove Governor Shaft

**NOTE:** On Twin II engines the intake manifold/carburetor assembly and governor control must be removed before the governor shaft can be removed.

### Plain Bearing Engines

1. Rotate crankshaft until timing mark on gear is at about 10 o'clock position.
2. Loosen governor lever nut and remove governor lever, Fig. 12.

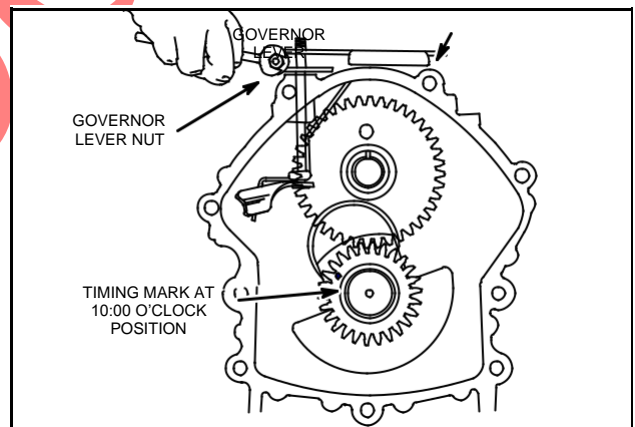


Fig. 12 – Remove Governor Lever, Plain Bearing

### Ball Bearing Engines

1. Rotate crankshaft until #2 counterweight is in position shown.
2. Loosen governor lever nut and remove governor lever, Fig. 13.

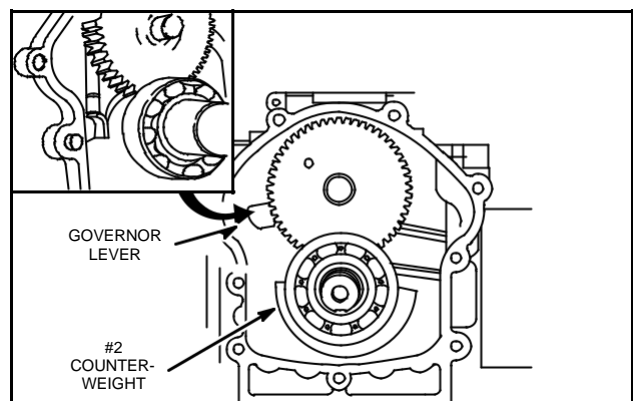


Fig. 13 – Remove Governor Lever, Ball Bearing Engines



Opposed twin cylinder engines have three (3) styles of bushings on the governor shaft, Fig. 14, Fig. 15 and Fig. 16. They are not interchangeable.

### Remove Governor Shaft – Twin II (Type Nos. 1100 & Above)

1. Remove “E” ring from governor shaft, Fig. 14.
2. Slide governor shaft down into cylinder and remove.

If governor shaft hits crankshaft, rock crankshaft back and forth to obtain clearance.

Check governor shaft for wear and/or burrs. Make sure governor paddle is not loose on shaft. Replace if necessary.

### Remove Governor Shaft – Pre-Twin II (Type Nos. Below 1100)

1. Remove from top of governor shaft, Fig. 15.
2. Remove lower “E” ring.
3. Slide governor shaft down into cylinder and remove.

If governor shaft hits crankshaft, rock crankshaft back and forth to obtain clearance.

Check governor shaft for wear and/or burrs. Make sure governor paddle is not loose on shaft. Replace if necessary.

### Remove Governor Shaft (Early Style)

1. While pushing up on governor shaft, remove “E” ring and thick washer, Fig. 16.
2. Lower shaft into cylinder.

If governor shaft hits crankshaft, rock crankshaft back and forth to obtain clearance.

Check governor shaft for wear and/or burrs. Make sure governor paddle is not loose on shaft. Replace if necessary.

### Replace Governor Shaft Bushing – Twin II (Type Nos. 1100 & Above)

1. Remove governor shaft oil seal.
2. Use self threading screw from #19165 flywheel puller and one (1) #94349 hardened washer from 19332 tool kit, Fig. 17.
3. Install washer on screw and insert into governor shaft bushing.
4. Place a 3/4” socket over governor shaft bushing,
5. Install a 1/4” flat washer and 1/4 x 20 nut.
6. Tighten nut.

Continue tightening until bushing is removed, Fig. 17.

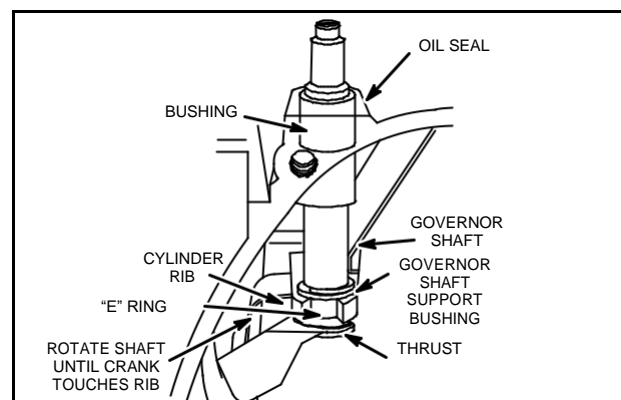


Fig. 14 – Governor Shaft Assembly (Twin II)

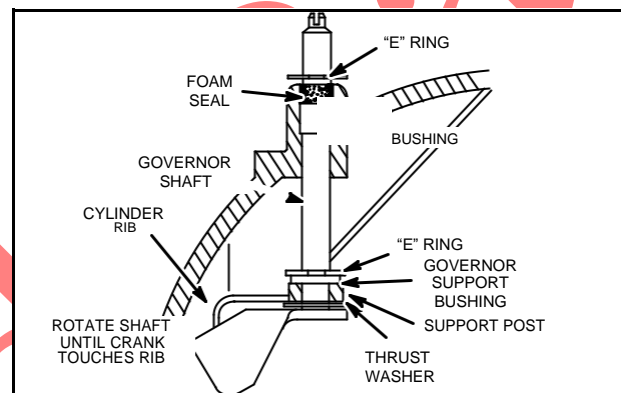


Fig. 15 – Governor Shaft Assembly Pre-Twin II

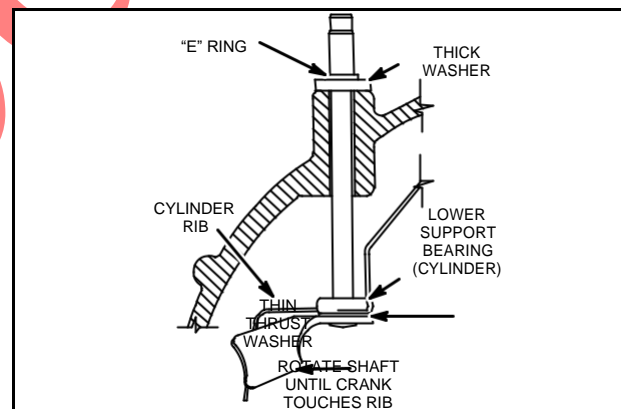


Fig. 16 – Governor Shaft Assembly (Early Style)

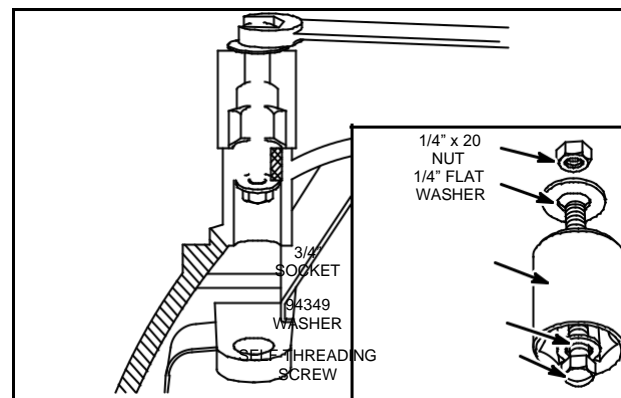


Fig. 17 – Remove Bushing

7. Temporarily, install governor shaft. Do not install "E" ring.
8. Using governor shaft as a pilot, install new bushing using Tool #19129.
9. Press bushing in until it bottoms, Fig. 18.

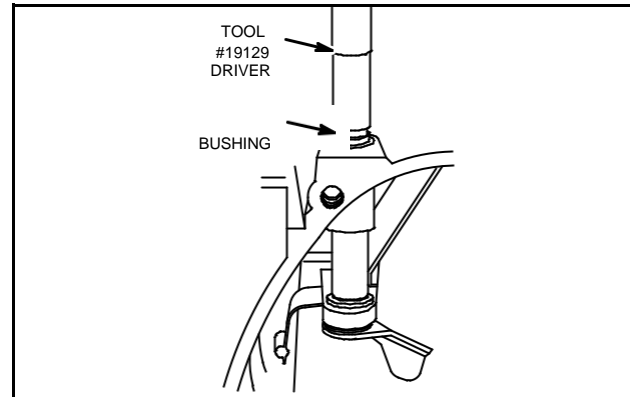


Fig. 18 – Install Bushing

### Install Governor Shaft – Twin II (Type Nos. 1100 & Above)

1. Install governor shaft support bushing.
2. Assemble thrust washer to governor shaft and insert governor shaft through lower and upper bushings. Fig. 19.
3. Install "E" ring.
4. Install a new oil seal in cylinder block.
5. Reassemble governor lever to governor shaft. **DO NOT** tighten nut at this time.
6. Push governor paddle against cylinder rib, Fig. 19.

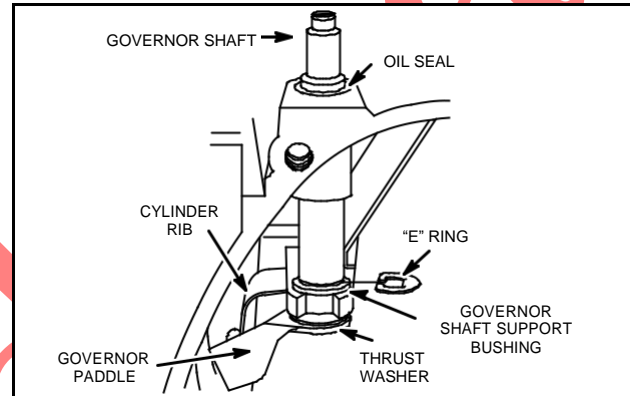


Fig. 19 – Governor Shaft Assembly (Twin)

### Replace Governor Shaft Bushing – Pre-Twin II (Type Nos. Below 1100)

1. Drive out worn bushing from crankcase side with a 3/8" (9.5 mm) rod.
2. Install new bushing using Tool #19204 to press bushing in until it bottoms, Fig. 20.

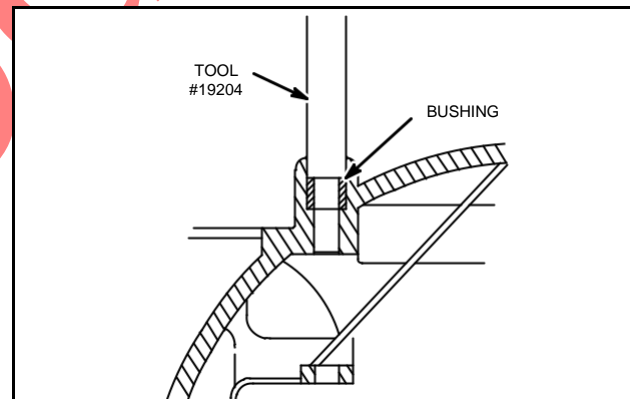


Fig. 20 – Replace Bushing

### Install Governor Shaft – Pre-Twin II (Type Nos. Below 1100)

1. Install governor shaft support bushing.
2. Assemble thrust washer to governor shaft and insert governor shaft through lower and upper bushing.
3. Install lower "E" ring.
4. Install new foam seal.
5. Install upper "E" ring.
6. Reassemble governor lever to governor shaft. **DO NOT** tighten nut at this time.
7. Push governor paddle against cylinder rib, Fig. 21.

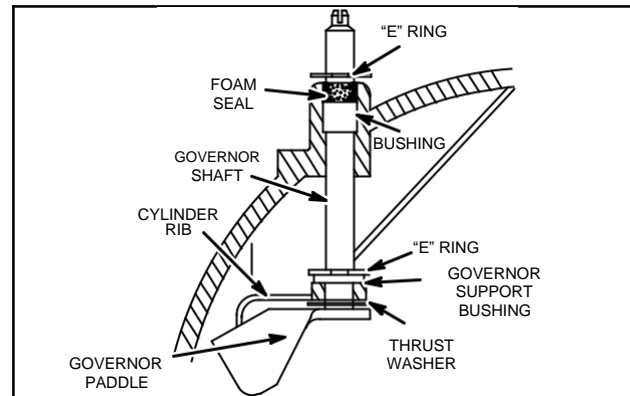


Fig. 21 – Governor Shaft Assembly (Pre-Twin II)



## Install Governor Shaft (Early Style)

Early style twin cylinder governor shaft bearings are an integral part of the cylinder and are not replaceable. If bearings are worn, replace cylinder.

1. Assemble thrust washer to governor shaft and insert governor shaft through lower support and cylinder bearing, Fig. 22.
2. Install thick thrust washer and "E" ring.
3. Reassemble governor lever to governor shaft. **DO NOT** tighten nut at this time.
4. Push governor paddle against cylinder rib, Fig. 22.

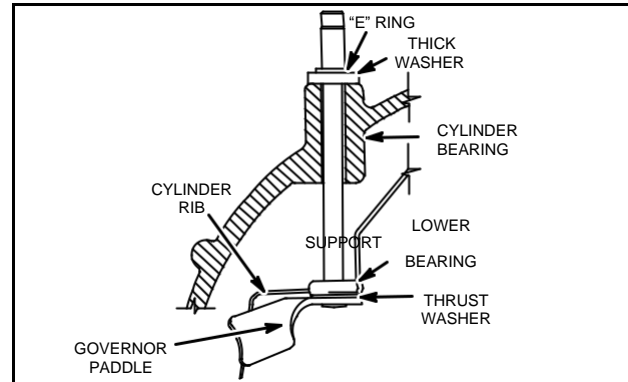


Fig. 22 – Governor Shaft Assembly (Early Style)

## Install Governor Gear

1. Install thrust washer, governor gear, spring retainer and governor cup, Fig. 23.
2. Rotate the governor gear on the shaft to be sure it is free and the weights and cup are in the proper location so that they will be able to move freely without binding.

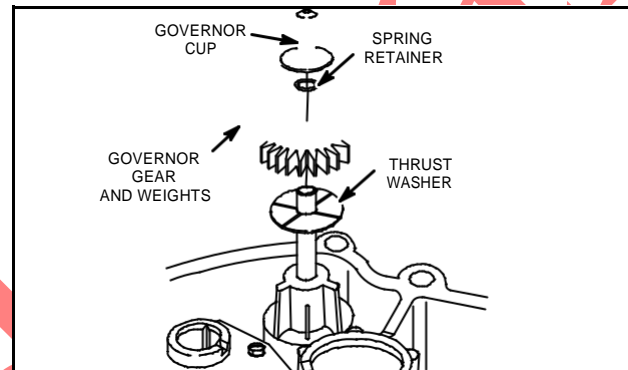


Fig. 23 – Install Governor Gear

## Install Crankcase Cover Or Sump

1. Rotate crankshaft until #1 intake valve is wide open.
2. Install crankcase cover or sump with new gasket.
3. To engage governor gear (horizontal or vertical crankshaft models) and oil slinger (vertical crankshaft models) rock crankshaft back and forth.
4. Torque cover or sump bolts to 225 in. lbs. (25.0 Nm), Fig. 24.

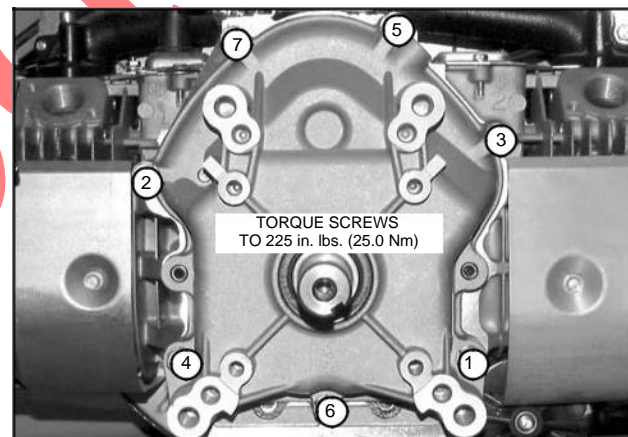


Fig. 24 – Torque Screws



**WARNING: BEFORE STARTING** or running engine, static adjustment of the governor must be completed! Failure to make the static adjustments first could result in engine overspeeding which may result in engine damage, property damage or personal injury.

## STATIC GOVERNOR ADJUSTMENT

1. With governor lever nut loose, push governor lever counter-clockwise as far as it will go (wide open throttle) and hold in this position.
2. Rotate governor shaft counter-clockwise as far as it will go, Fig. 25.

Torque governor nut to 100 in. lbs. (11.0 Nm). A 7/16" crowfoot socket may be required on ducted engines.

See procedure below for dual speed or 1800 RPM generators.

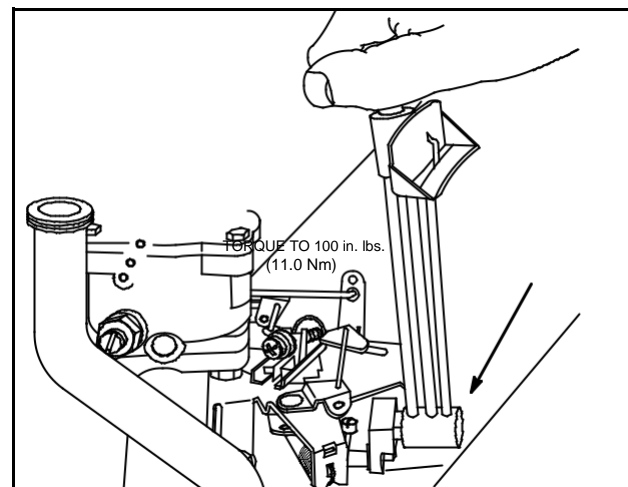


Fig. 25 – Static Governor Adjustment

Dual speed controls or 1800 RPM Generators, have a throttle restrictor to limit throttle travel, Fig. 26. Move restrictor out to allow throttle to move to wide open throttle position for governor adjustment. After governor lever is torqued, move governor lever to close throttle so restrictor will snap back to its normal position.

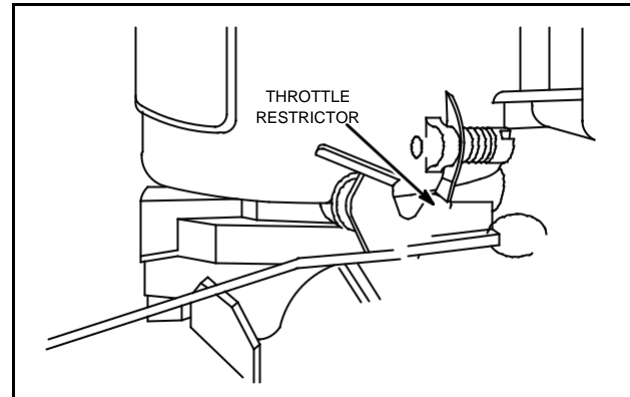


Fig. 26 – Throttle Restrictor

4

## DYNAMIC GOVERNOR ADJUSTMENT

### General Information – All Models

**NOTE:** Carburetor mixture adjustments must be made before adjusting governed idle and top no load RPM.

Assemble remote controls and check for proper adjustment.

The following tools are required when making governor adjustments, Fig. 27:

1. Tachometer, Tool #19200 or #19389.
2. Tang bender, Tool #19229 or #19352.

Start and run engine for approximately 5 minutes to allow engine to warm up.

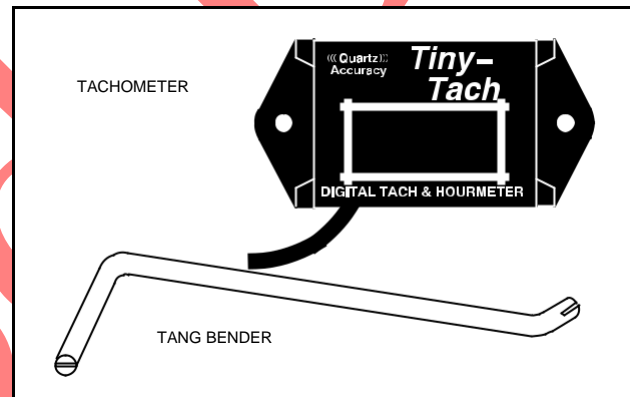


Fig. 27 – Governor Adjustment Tools

### Remote Speed Control – Twin II (Type Nos. 1100 & Above)

1. Move control lever to "SLOW" position.
2. Bend governed idle tang to obtain 1300 RPM, Fig. 28.

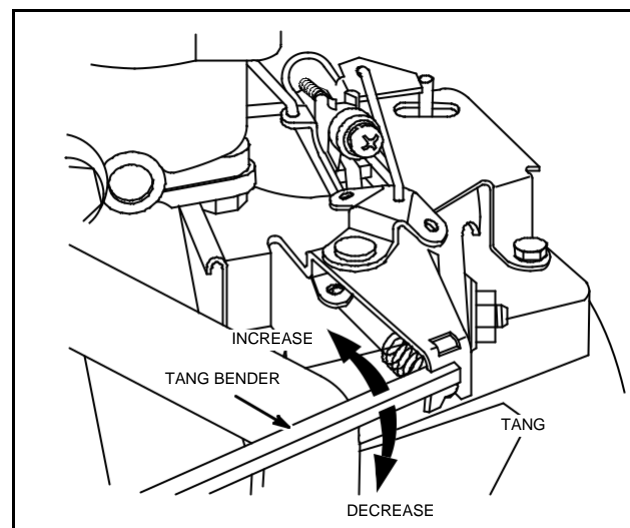


Fig. 28 – Adjust Governed Idle

3. Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number. See Example, Fig. 29.

MAXIMUM RPM			
Model	Type	Trim	RPM
422437	0015	01	3400
422437	0015	02	3400
422437	0016	01	3400
422437	0019	01	3400
422437	0020	01	3400
422437	0021	01	3400
422437	0021	02	3400
422437	0022	01	3700
422437	0022	02	3700

Fig. 29 – Engine RPM

4. Move control lever to “FAST” position and check engine RPM.
5. Turn Top-No-Load adjustment screw to obtain specified RPM, Fig. 30.

**NOTE:** Top-No-Load adjustment screw range is  $\pm 100$  RPM. To increase or decrease engine RPM beyond this range, change governor spring.

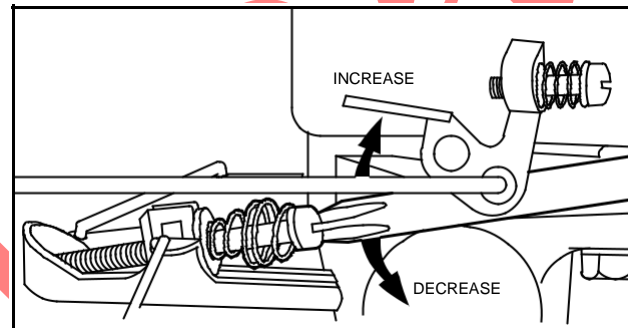


Fig. 30 – Top-No-Load Adjustment Screw

### Fixed Speed Adjustable – Generator – Twin II (Type Nos. 1100 & Above)

1. Disconnect speed regulator knob from bracket and loosen knob to end of threads.
2. Push adjustment rod in as far as it will go.
3. While holding rod in, bend governed idle tang to obtain 1300 RPM, Fig. 31.

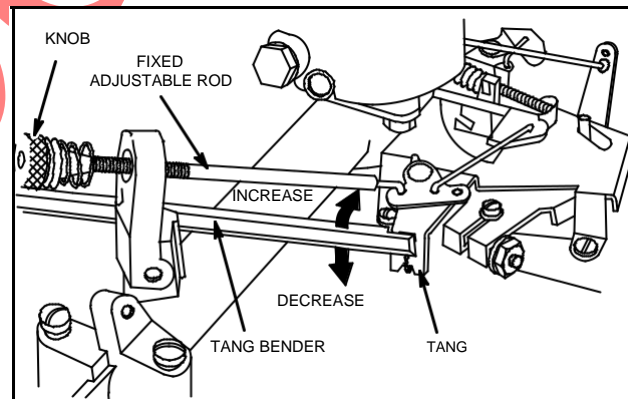


Fig. 31 – Adjust Governed Idle

4. Pull adjustment rod out to end of travel.
5. While holding rod in this position, adjust Top-No-Load adjustment screw, Fig. 32, to obtain Top-No-Load RPM for the generator type shown in Table 1.

Table 1

Generator Type	Top-No-Load RPM	Regulated RPM
3600 RPM 60 Cycle	4300 RPM	3700 RPM
3000 RPM 50 Cycle	3600 RPM	3100 RPM
1800 RPM 60 Cycle	2200 RPM	1875 RPM

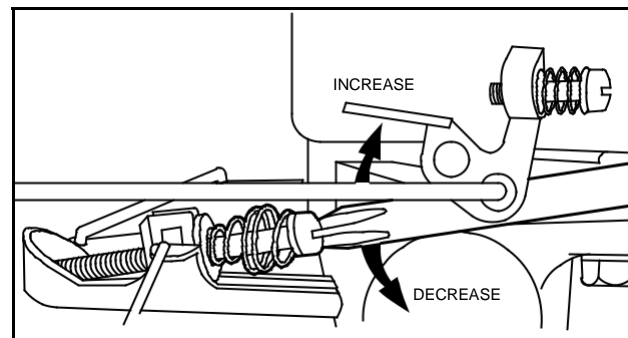


Fig. 32 – Top-No-Load Adjustment Screw

6. Re-attach regulator knob to bracket. Adjust speed regulator knob, NO TAG, to obtain Regulated RPM for the generator type shown in Table 1.

**NOTE:** Final adjustment should be made with generator loaded to rated capacity or manufacturers specifications.

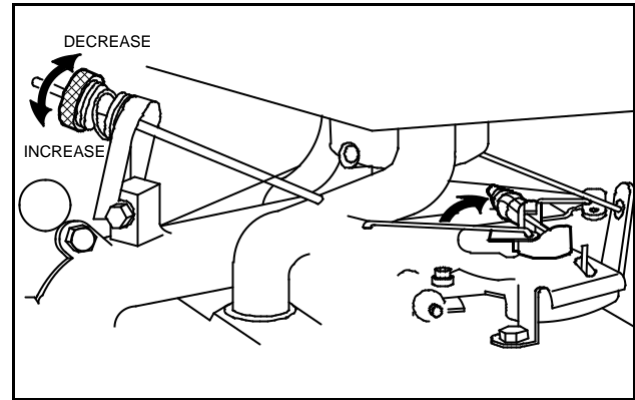


Fig. 33 – Adjusting Regulated RPM

### Remote Speed Control – Pre-Twin II (Type Nos. Below 1100)

1. Move remote throttle control lever until a 1/8" (3 mm) rod can be inserted through two (2) holes in governor control plate, Fig. 34.
2. Bend governed idle tang to obtain 1300 RPM.
3. Remove 1/8" (3 mm) rod. Engine RPM should not change.

If engine RPM changes, check remote control adjustment.

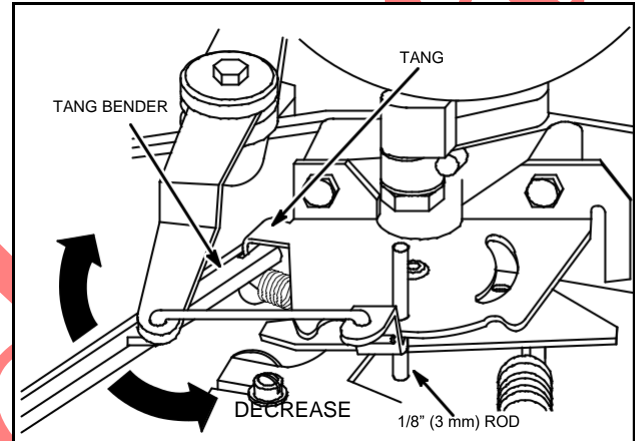


Fig. 34 – Adjust Governed Idle

4. Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.
5. Check governor spring hole position for proper location for engine RPM, Fig. 35.

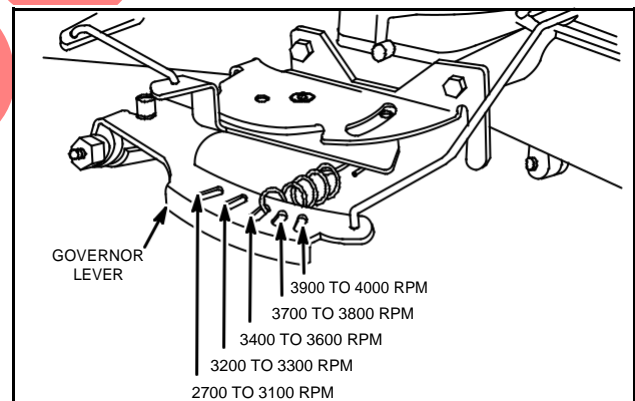


Fig. 35 – Governor Spring Position

6. Move control lever to "FAST" position and check engine RPM.
7. Bend tang to obtain specified Top-No-Load RPM, Fig. 36.

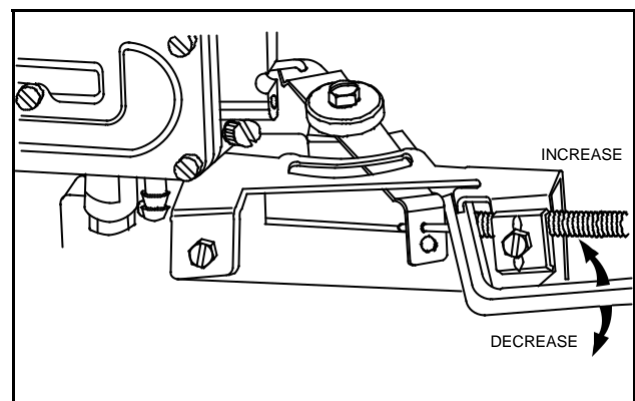


Fig. 36 – Adjust Top-No-Load

### Constant Speed – Pre-Twin II (Type Nos. Below 1100)

1. Loosen constant speed locking screw and washer and move control lever until a 1/8" (3 mm) rod can be inserted through two (2) holes in governor control plate, Fig. 37.
2. Bend governed idle tang to obtain 1300 RPM.
3. Remove rod.
4. Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.

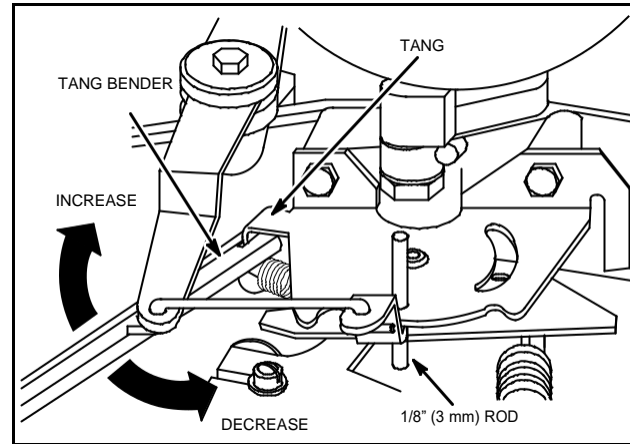


Fig. 37 – Adjust Governed Idle

5. Check governor spring location for proper hole location by RPM, Fig. 38.

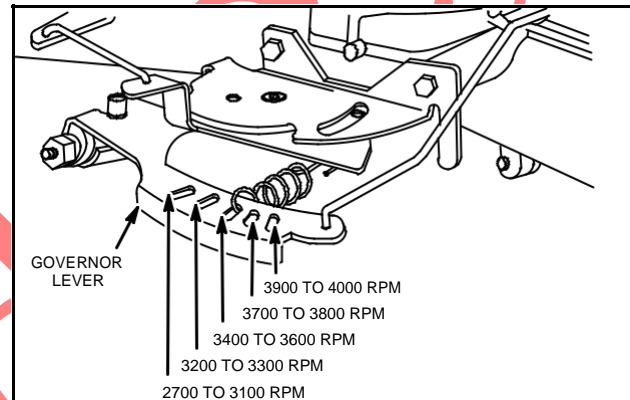


Fig. 38 – Governor Spring Position

6. Move lever to obtain specified Top-No-Load RPM.
7. Tighten lock screw and washer, Fig. 39.
8. Bend tang until it touches speed control lever.

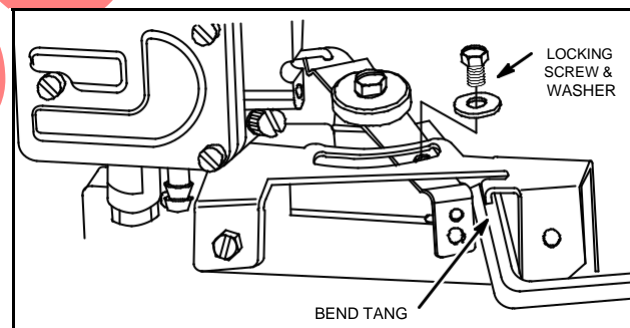


Fig. 39 – Adjust Top-No-Load

### Fixed Speed Adjustable – Pre-Twin II (Type Nos. Below 1100)

1. Turn speed regulator nut counterclockwise until a 1/8" (3 mm) rod can be inserted through two (2) holes in governor control plate, Fig. 40.
2. Bend governed idle tang to obtain 1300 RPM.
3. Remove rod.
4. Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.
5. Check governor spring location for proper hole location by RPM, Fig. 38.

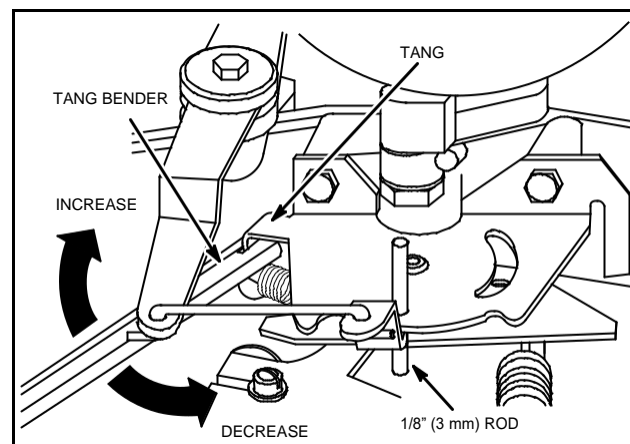


Fig. 40 – Adjust Governed Idle



6. Turn speed regulator nut clockwise until Top-No-Load RPM is obtained.
7. Bend tang until it touches speed control lever.

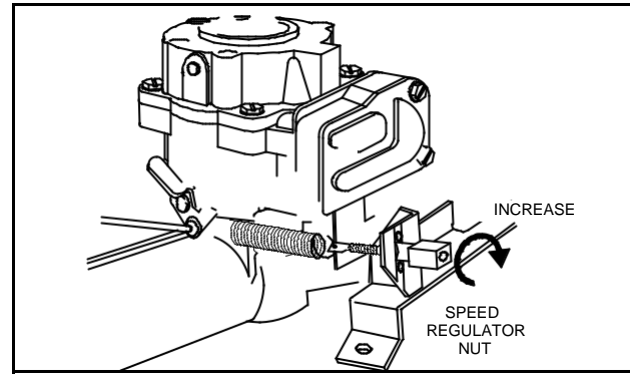


Fig. 41 – Adjust Top-No-Load

### Dual Speed Control – Pre-Twin II (Type Nos. Below 1100)

1. Refer to Equipment Manufacturers Service Manual and Operating Instructions for operating procedures and adjustment of parts supplied by Manufacturers of control system.
2. Disconnect governed idle spring and main governor spring. With machine set in low speed position, start engine and adjust speed regulator nut to obtain 1850 RPM, No-Load, Fig. 42.

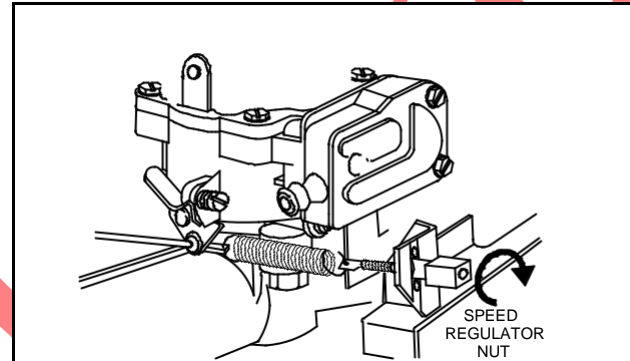


Fig. 42 – Adjust Low Speed

3. Stop engine and reinstall governed idle spring. Stop engine.
4. Start engine and bend governed idle tang to obtain 1875 RPM, No-Load, Fig. 43.
5. Stop engine.
6. Reinstall main governor spring in #3 governor lever hole, Fig. 43.

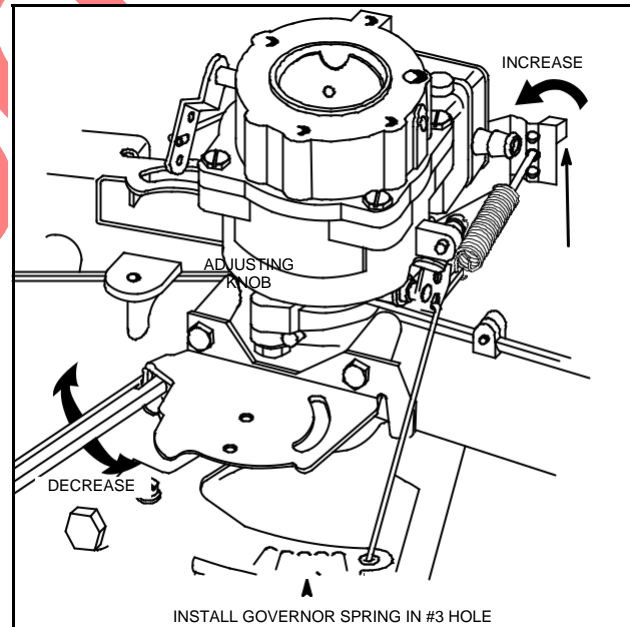


Fig. 43 – Adjust High Speed

7. Start engine in "FAST" position and adjust tang, Fig. 44, to obtain Top-No-Load RPM specified by Equipment Manufacturer.

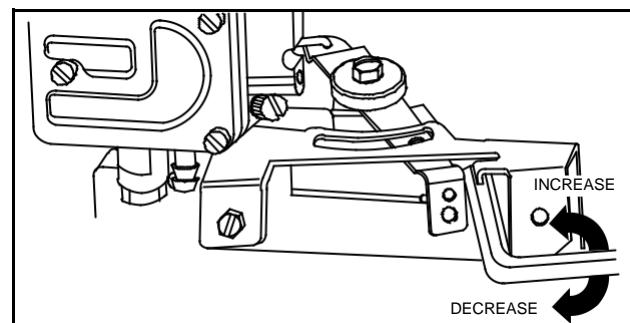


Fig. 44 – Adjust Top-No-Load Speed



### 1800 RPM Generator – Pre-Twin II (Type Nos. Below 1100)

1. Disconnect governed idle spring and start engine. Turn speed regulating nut to obtain 1850 RPM, Top-No-Load RPM, Fig. 45.
2. Stop engine.

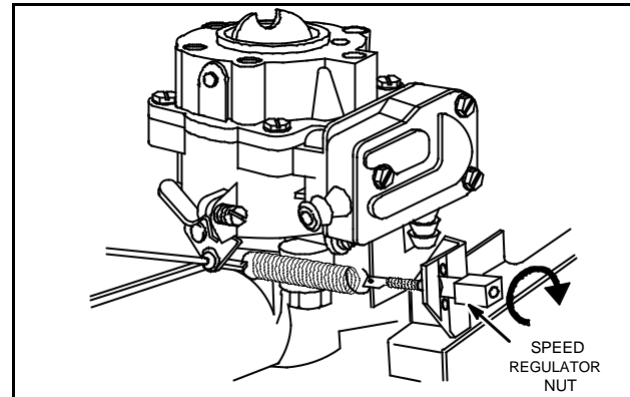


Fig. 45 – Adjust Low Speed

4

3. Reinstall governed idle spring and start engine.
4. Bend governed idle tang to obtain 1875 RPM. Top-No-Load RPM, Fig. 46.

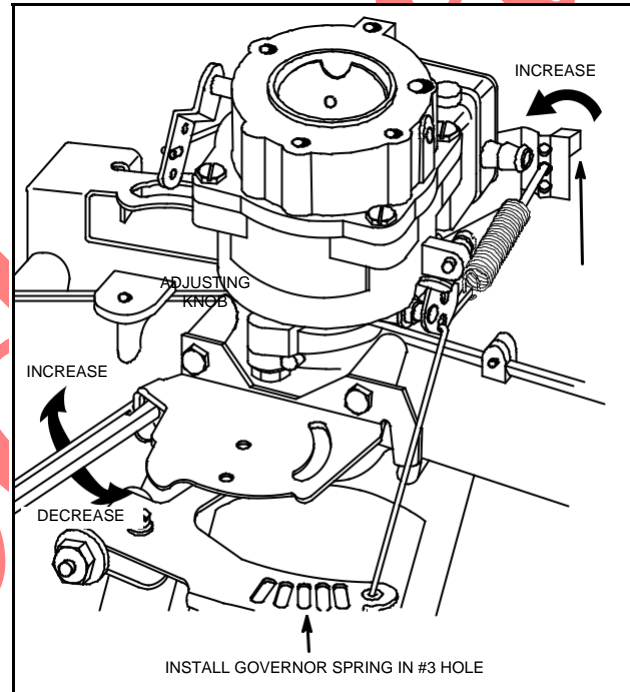


Fig. 46 – Adjust High Speed

# Section 5

## COMPRESSION

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## GENERAL INFORMATION

Compression testing information and procedures are described in "Troubleshooting" in Section 1.

Cylinders and cylinder heads are numbered as shown in Fig. 1.

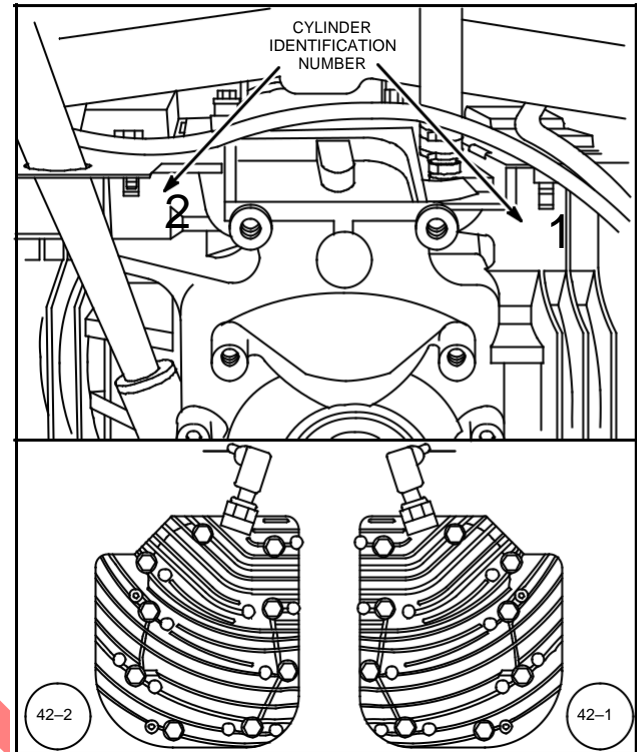


Fig. 1 – Cylinder Number Location

## CYLINDER HEAD REMOVAL

1. Disconnect spark plug wires and remove spark plugs. Remove blower housing.
2. Remove cylinder air guides and cylinder shields, Fig. 2 and Fig. 3.

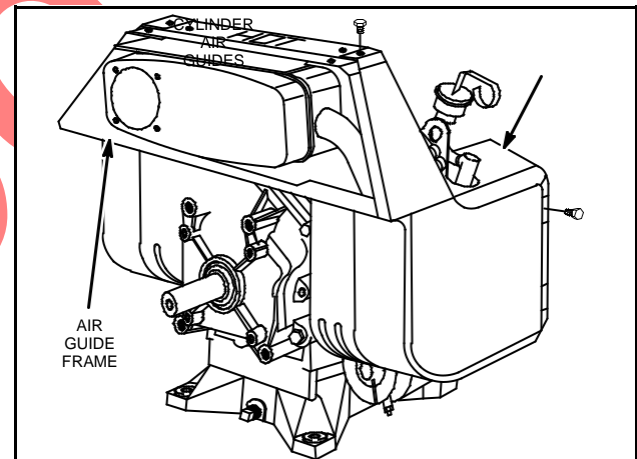


Fig. 2 – Cylinder Ducting

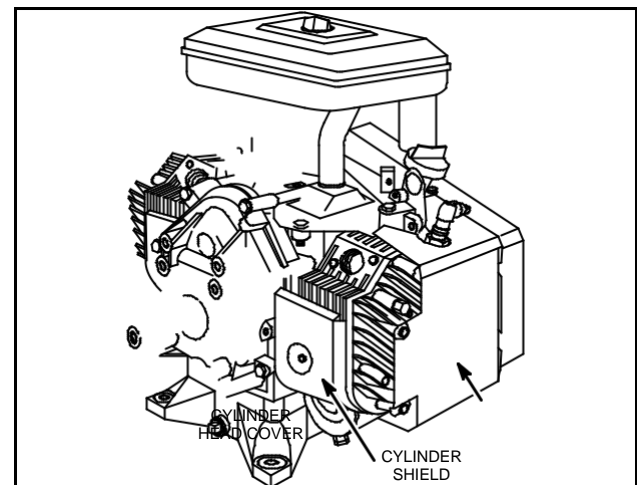
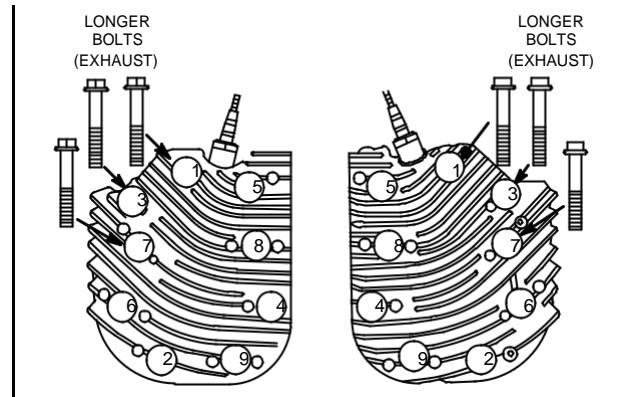


Fig. 3 – Non-Ducted Engine

3. Remove nine (9) head bolts from each cylinder head, Fig. 4.
4. Remove cylinder heads and gaskets. Discard old gaskets.

**NOTE:** Some models use three (3) longer head bolts located around the exhaust valve area. Note the position of these bolts so that they may be correctly reassembled.

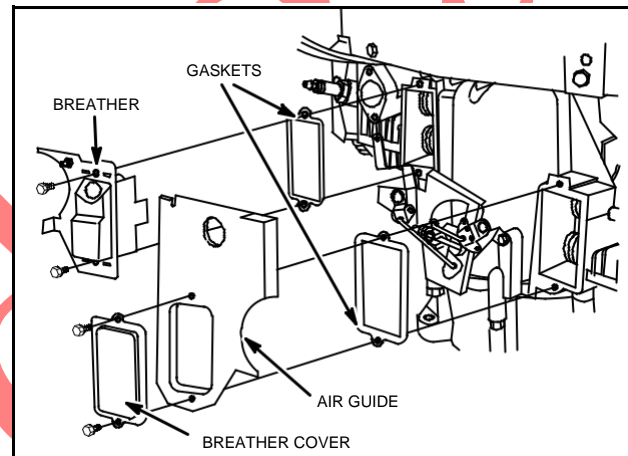
Inspect cylinder head for broken fins or cracks. Repeat procedure for other cylinder head and cylinder.



**Fig. 4 – Remove Head Bolts**

## REMOVING VALVES

1. Disconnect fuel line and fuel pump pulse line to carburetor.
2. Remove air cleaner assembly, intake manifold and carburetor, Section 3.
3. Remove air guide, breather cover and breather(s), Fig. 5 and Fig. 6.
4. Remove dipstick assembly on horizontal crankshaft models with one breather.

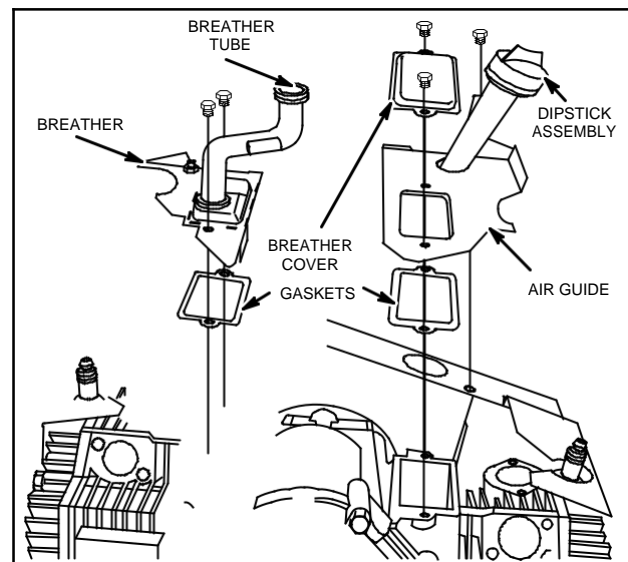


**Fig. 5 – Removing Breather Vertical Crankshaft Engines**

**NOTE:** Horizontal crankshaft twin cylinder engines manufactured after 91080000 have only one breather valve and breather tube: for #1 cylinder, Fig. 6.



**WARNING: WHENEVER CARBURETOR** and manifold are removed, static governor adjustment must be checked! See Section 4. Mis-adjustment could result in engine over-speeding which could cause engine damage, property damage or personal injury.



**Fig. 6 – Removing Breather Horizontal Crankshaft Engines – Current Style**

## Valve Spring Retainers

Fig. 7 shows the two styles of valve spring retainers used.

**NOTE:**When removing valves and valve springs, identify parts to prevent interchanging.



**WARNING: VALVE SPRINGS** are under high pressure! Hold shop rag around spring and loosen spring compressor slowly to release pressure from spring. Wear eye protection when working with valve springs.

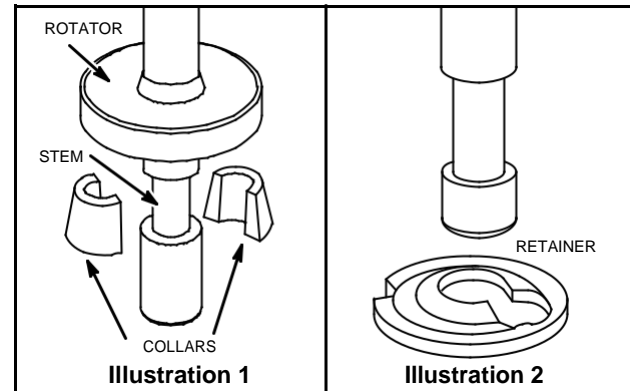


Fig. 7 – Valve Spring Retainers

**NOTE:**Remove valves from one cylinder at a time.

5

## Remove Exhaust Valve

1. Rotate flywheel so that both valves to be removed are fully closed with piston at TDC compression stroke.
2. Insert one jaw of Valve Spring Compressor, Tool #19063, between wall of valve tappet chamber and exhaust valve spring. The other jaw goes below valve spring retainer.
3. Tighten compressor until spring is fully compressed and remove split retainers.
4. Remove exhaust valve from guide. Then, remove exhaust valve spring and compressor, Fig. 8.

**NOTE:**Exhaust valve springs are dyed RED. DO NOT MIX.

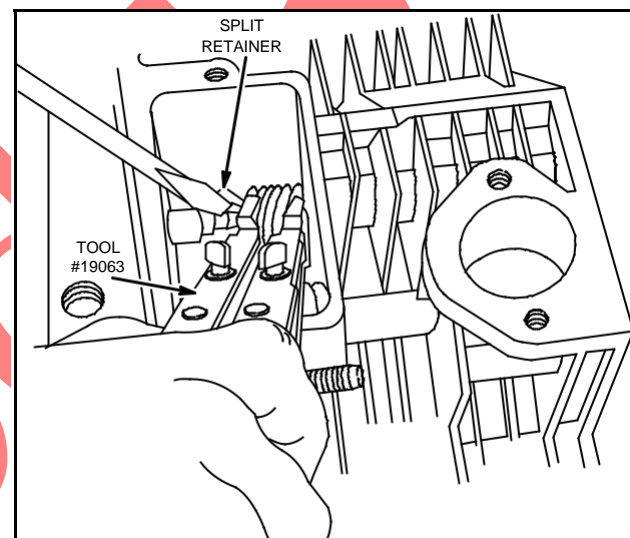


Fig. 8 – Removing Retainers – Exhaust

## Remove Intake Valve

1. Insert one jaw of Valve Spring Compressor, Tool #19063, between intake valve spring and retainer. The other jaw is placed on outside wall of valve tappet chamber around intake valve guide, Fig. 9.
2. Tighten compressor until spring is fully compressed and remove spring retainer.
3. Remove intake valve from intake valve guide. Then, remove intake valve spring and discard intake valve seal. DO NOT REUSE OLD SEALS. Repeat procedure for other cylinder.

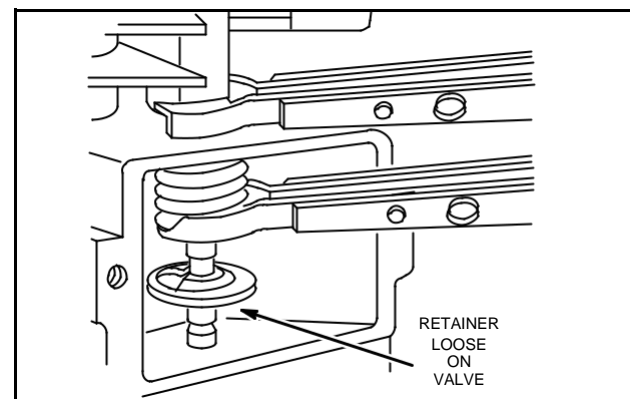


Fig. 9 – Removing Retainer – Intake

## VALVE GUIDES

### Check Valve Guides

Check valve guide bushings for wear using reject gauge Tool #19151, Fig. 10. If gauge enters guide  $5/16"$  (8 mm) or more, guide must be repaired or replaced.

### Valve Guide Repair Kit #19232

Valve guides may be reconditioned using Valve Guide Repair Kit, #19232. The methods used to recondition valve guides depend on valve guide material (alumi-num, brass or sintered iron).

### Repair Aluminum Valve Guides Counterbore Reaming

1. Insert pilot guide bushing, #19234 and counter-bore reamer, #19231 into worn valve guide.
2. Place new service bushing, Part #231218 on pilot bushing next to reamer.
3. Mark reamer level to  $1/16"$  (1.6 mm) above top edge of service bushing, Fig. 11.

4. Lubricate reamer with Stanisol or kerosene.
5. Turn reamer clockwise until mark on reamer is flush with top of guide bushing, Fig. 12.

DO NOT REAM THROUGH GUIDE.

6. Continue to turn reamer clockwise while removing reamer from guide.
  - a. Flush out all chips.

7. Using bushing driver, #19204, press in new bush-ing until it bottoms.

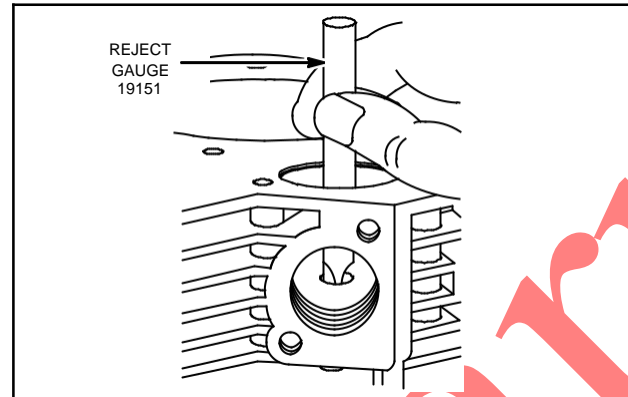


Fig. 10 – Check Valve Guide

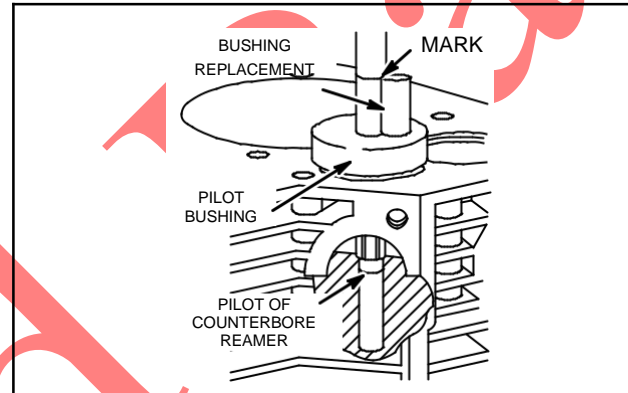


Fig. 11 – Mark Reamer

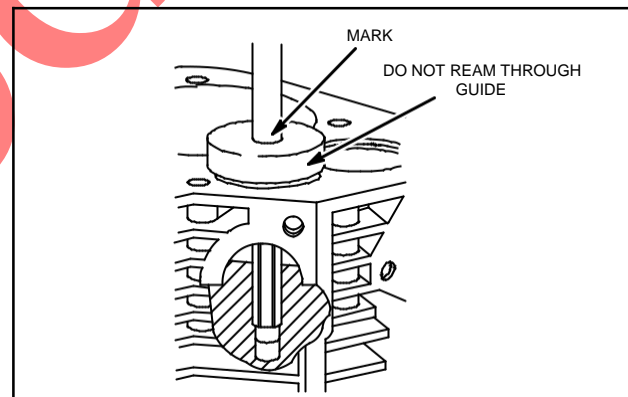


Fig. 12 – Counterbore Valve Guide

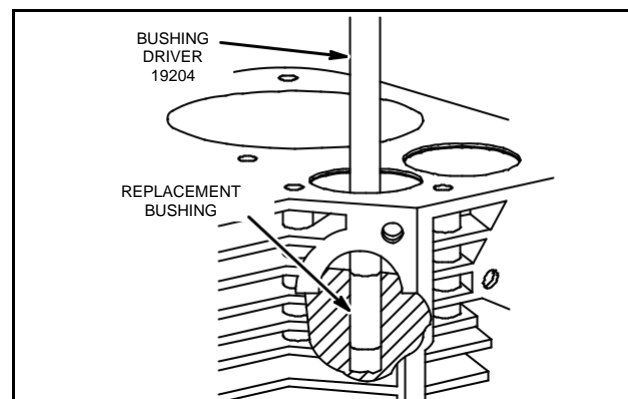


Fig. 13 – Install Bushing



## Finish Reaming

1. Finish ream guide with reamer #19233, and pilot guide #19234, Fig. 14.
  - a. Lubricate reamer with Stanisol or kerosene.
2. Ream clockwise through entire guide into valve tappet chamber,
3. Keep turning reamer clockwise when removing reamer from guide.
  - a. Flush out all chips.

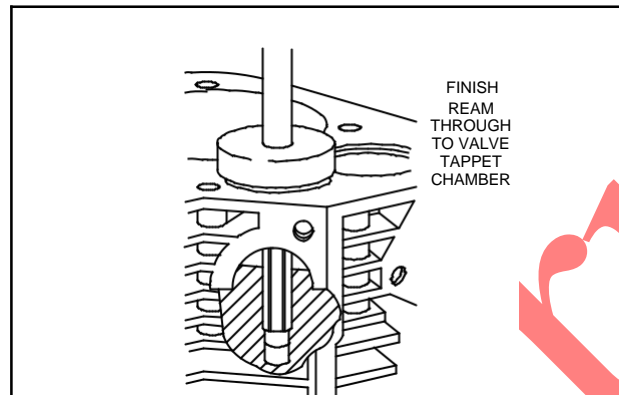


Fig. 14 – Finish Ream

## Replace Brass or Sintered Iron Valve Guides Remove Bushing

Brass or sintered iron valve guide bushings are replaceable as follows:

1. Lubricate tap Tool #19264 and valve guide bushing with engine oil or kerosene.
2. Using a tap wrench, turn tap clockwise into valve guide bushing approximately 1/2" (13 mm). DO NOT turn tap more than 1" (25.4 mm) deep.
3. Remove tap and clean chips from bushing threads, Fig. 15.

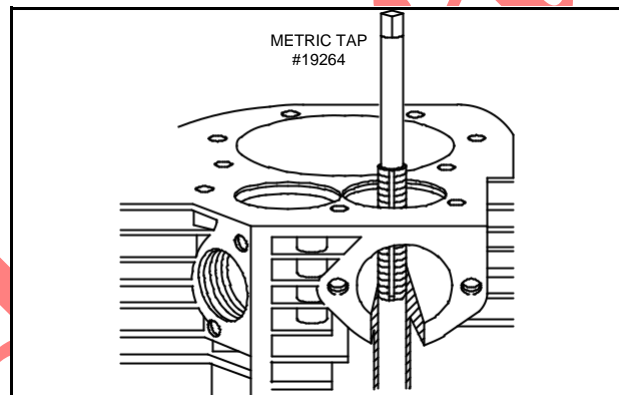


Fig. 15 – Thread Bushing

4. Thread Nut, Tool #19239, up until it touches head of Puller Screw, Tool #19238.
5. Place Puller Washer, Tool #19240, over valve seat, keeping it centered. Lubricate puller screw with Stanisol or kerosene and thread puller screw into bushing until it bottoms, Fig. 16.

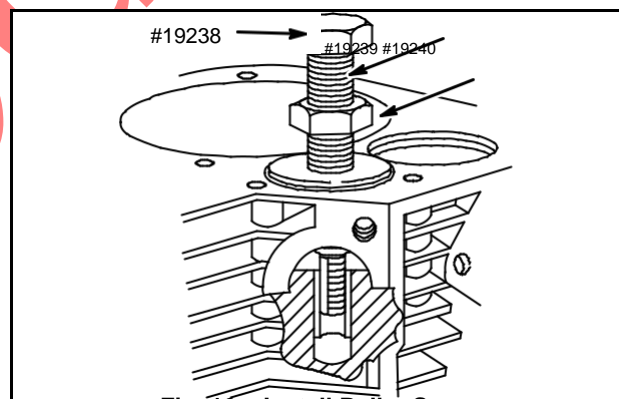


Fig. 16 – Install Puller Screw

6. Hold hex head of puller screw from turning and turn hex nut down on puller washer. Continue turning nut until bushing is removed, Fig. 17.

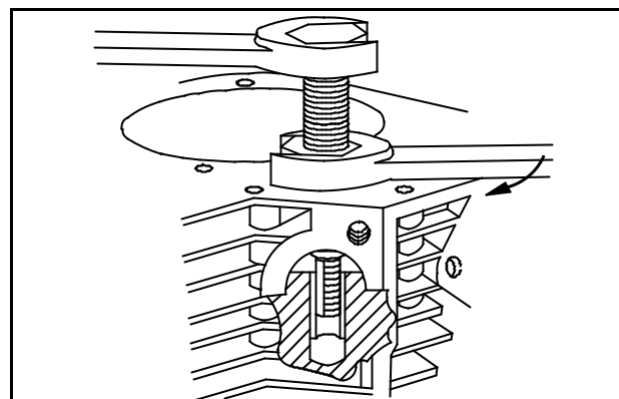


Fig. 17 – Remove Bushing

## Valve Guide Bushing Identification

See Fig. 18 to identify bushing that has been removed. Then select correct replacement bushing shown.

### Special Instructions

Two grooves on replacement bushing, #231218, go down.

Replacement bushing #230655 or #261961 can be installed either way.


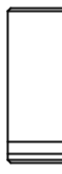



(.366" (9.3 mm) O.D.) BRASS	(.367" (9.32 mm) O.D.) BRASS	(.379" (9.63 mm) O.D.) BRASS	(.440" (11.18 mm) O.D.) GRAY	(.441" (11.2 mm) O.D.) COPPER
				
USE 231218	USE 231218	USE 230655	USE 261961	USE 261961

Fig. 18 – Bushing Identification

### Install Bushing

- Using bushing driver, #19204, press in new bushing until it bottoms, Fig. 19.

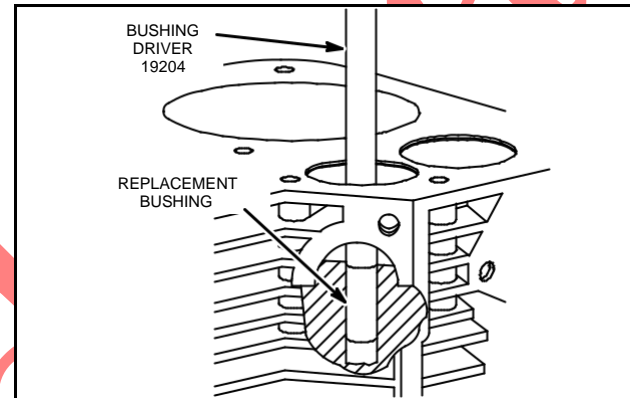


Fig. 19 – Install Bushing

### Finish Reaming

**NOTE:** Bushing #230655 does not require finish reaming, however it is recommended to ensure that the entire guide is clean and free of foreign material.

- Finish ream guide with reamer #19233, and pilot guide #19234, Fig. 20.
  - Lubricate reamer with Stanisol or kerosene.
- Ream clockwise through entire guide into valve tappet chamber, Fig. 20.
- Keep turning reamer clockwise when removing reamer from guide.
  - Flush out all chips.

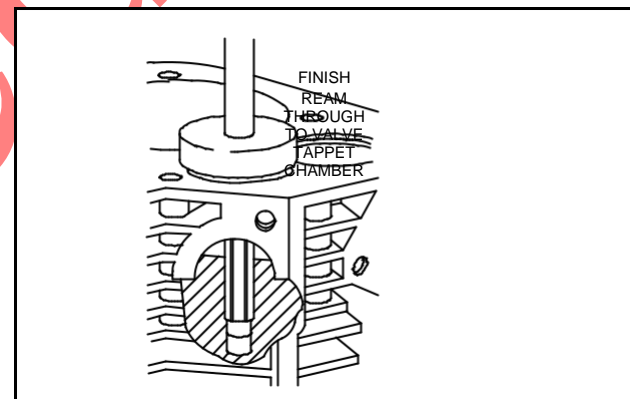


Fig. 20 – Finish Ream

### REFACE VALVES AND SEATS

Valve faces may be resurfaced to:

**Intake: 30°**

**Exhaust: 45°**

See Fig. 21 for dimensions for intake and exhaust valves.

**NOTE:** In most instances it is more economical to replace the valves than to reface them.

Lap valves and seats with valve lapping tool, #19258 and valve lapping compound, Tool #94150.

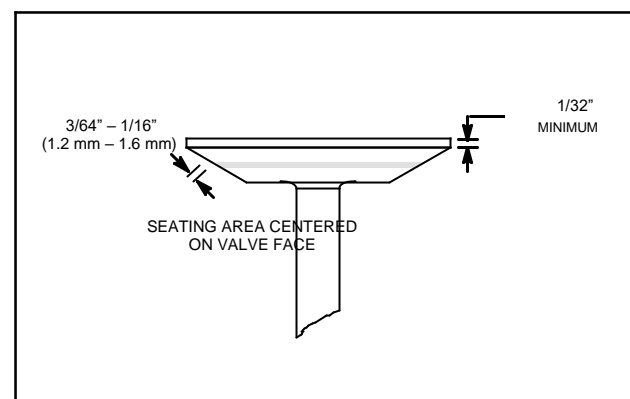


Fig. 21– Valve Dimensions

Intake valve seats may be reconditioned using valve seat cutter tool #19237. Use 30° cutter for intake.

If valve seat is wider than dimension shown in Fig. 22, a narrowing cutter should be used to ensure that contact area of valve seat is centered on face of valve as shown in Fig. 21.

- a. Use a 45° cutter to narrow seat from bottom and a 15° cutter to narrow seat from top, Fig. 22.

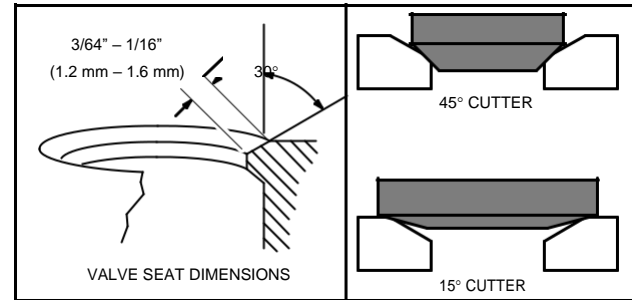


Fig. 22 – Intake Valve Seat Dimensions

Exhaust valve seats may be reconditioned using valve seat cutter tool #19237. Use 45° cutter for exhaust.

If valve seat is wider than dimension shown in Fig. 22, a narrowing cutter should be used to ensure that contact area of valve seat is centered on face of valve as shown in Fig. 21.

- a. Use a 60° cutter to narrow seat from bottom and a 30° cutter to narrow seat from top, Fig. 23.

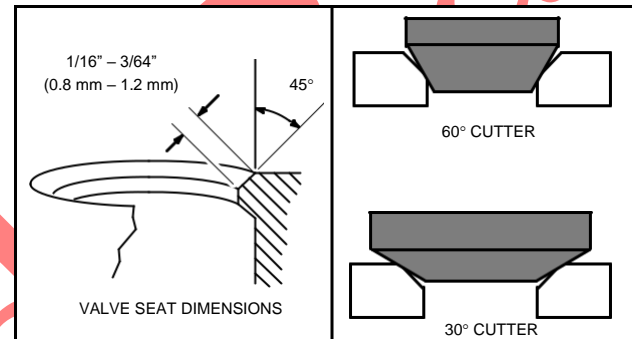


Fig. 23 – Exhaust Valve Seat Dimensions

### Inspect Valve Seats

Check valve seat inserts for tightness. If seat can be rotated or moved up and down, check seat with .005" (.13 mm), feeler gauge, Fig. 24. If .005" feeler gauge cannot be inserted, peen seat with punch as shown, Fig. 24.

If valve seat insert is burned or damaged it may be replaced using Valve Seat Puller Kit #19138. Refer to chart for correct replacement seat and puller nut.

**NOTE:** Replace cylinder if a .005" feeler gauge enters between outside diameter of valve seat and cylinder.

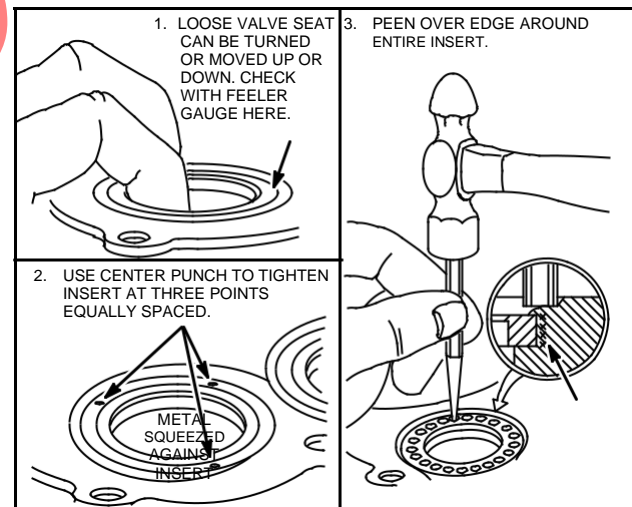


Fig. 24 – Peening Valve Seat

### Remove Valve Seat

1. Use valve seat puller, Tool #19138, Fig. 25, to remove valve seat insert.
  - a. Puller body must not rest on valve seat insert.
2. Tighten bolt until insert is free of cylinder.

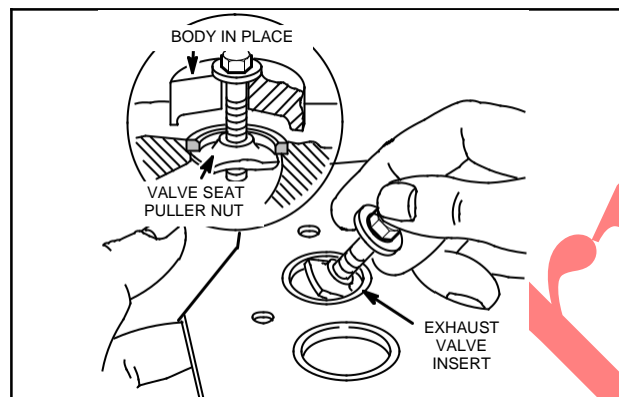


Fig. 25 – Installing Valve Seat Puller

### Install Valve Seat

Select proper valve seat insert from chart.

1. Place drive pilot, Tool #19127, in valve guide.
2. Place new insert on seat counterbore with radius down. Use old insert as a spacer between new seat and insert driver, Tool #19136.
3. Drive seat insert in until it bottoms, Fig. 26. Top of insert will be slightly below cylinder head gasket surface.
4. Peen new seat insert, Fig. 24.

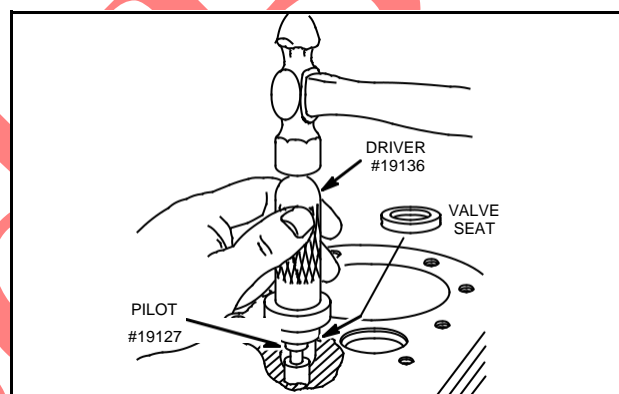


Fig. 26 – Install Valve Seat

### Valve Seat Inserts

Model Series	Intake	Exhaust	Puller Assy. #	Puller Nut
401400 Before Code No. 80072812	211661	213316 *21612	19138	19141, ALL
401400 After Code No. 80072712	261463	213316 *21612	19138	INTAKE NONE EXHAUST 19141
401700 Before Code No. 80092612	211661	213316 *21612	19138	19141, ALL
401700 After Code No. 80092512	261463	213316 *21612	19138	INTAKE NONE EXHAUST 19141
400400, 400700, 402400, 402700, 404400, 404700, 421400, 421700, 422400, 422700, 462700	261463	213316 *21612	19138	INTAKE NONE EXHAUST 19141

\*Requires special tools to install

## Installing Part #21612 Exhaust Valve Seat Insert

1. Modify Tool #19131 counterbore cutter as shown, Fig. 27.
2. With old valve seat insert removed, install pilot Tool #19127 into exhaust valve guide.

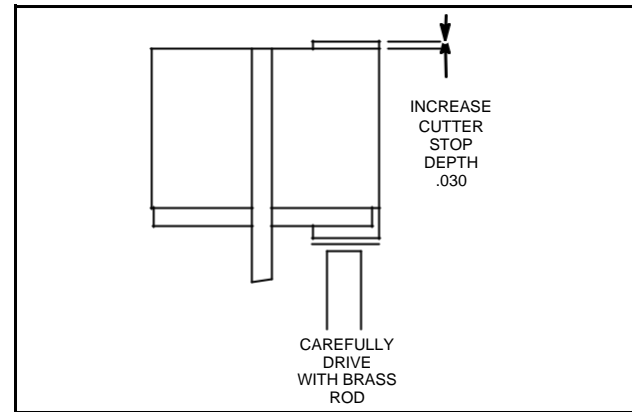


Fig. 27 – Modify Tool #19131

3. Assemble Tool #19131 counterbore cutter to Tool #19129 shank.
4. Counterbore the cylinder by hand until the stop on cutter touches cylinder, Fig. 28. Do not force the counterbore to one side or it will cut oversize.
  - a. Lubricate with Stanisol or kerosene.
5. Remove all chips.

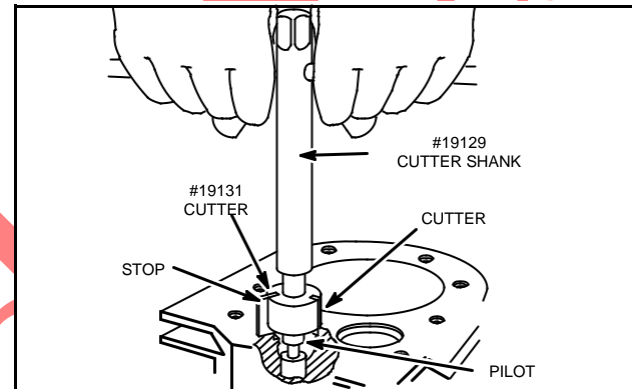


Fig. 28 – Counterboring for Valve Seat

6. Place drive pilot, Tool #19127, in valve guide.
7. Place #21612 insert on seat counterbore with radius down. Use old insert as a spacer between new seat and insert driver, Tool #19136.
8. Drive seat insert in until it bottoms, Fig. 29.

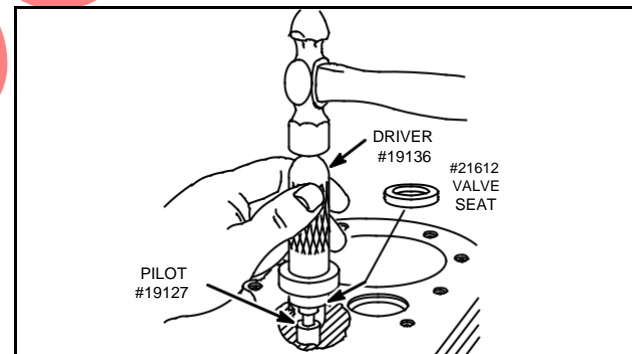


Fig. 29 – Install Valve Seat

9. Peen new seat insert, Fig. 30.

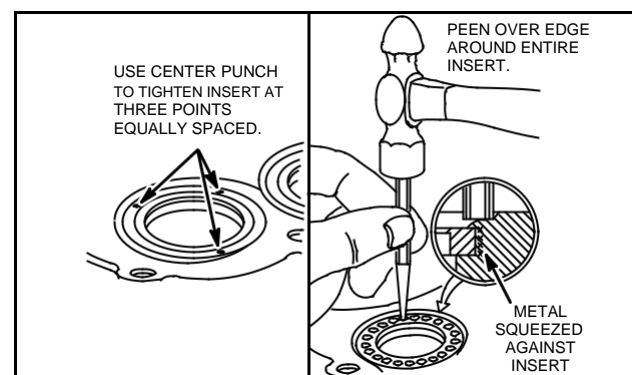


Fig. 30 – Peening Valve Seat

## CHECK AND ADJUST VALVE CLEARANCE

Turn crankshaft until piston is 1/4" (6.35 mm) past Top Dead Center, compression stroke, for cylinder being checked. See specifications below.

1. If clearance is less than specified, grind end of valve stem to obtain proper clearance.
2. If clearance is too much, replace valve or cut valve seat to obtain proper clearance. See Reface Valves and Seats, this Section. Repeat for other cylinder.

**NOTE:** Always check clearances while engine is cold.

### VALVE CLEARANCES

MODEL SERIES		INTAKE		EXHAUST	
		Min.	Max.	Min.	Max.
All Twin Cylinder Engines	Springs Installed	.004" (.1 mm)	.006" (.15 mm)	.007" (.18 mm)	.009" (.23 mm)
	Without Springs	.006" (.15 mm)	.008" (.2 mm)	.009" (.23 mm)	.011" (.28 mm)

## INSTALL VALVES

**Important:** Valve stems and valve guides must be free of foreign material and burrs or valve sticking may occur, causing short valve life and burning.

### Install Intake Valve and Seal

1. Coat valve stems with valve guide lubricant, Tool #93963, and install in intake valve guide until stem just starts to enter valve tappet chamber, Fig. 31.

**NOTE:** Be sure valve guide lubricant, Part #93963, is not on valve face, seat or retainer grooves.

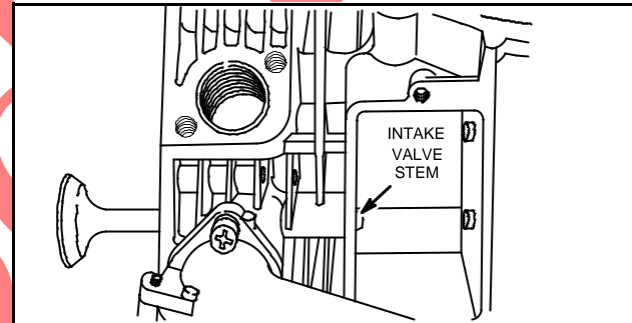


Fig. 31

2. Place new valve stem seal, valve spring and valve spring retainer in valve spring compressor, Tool #19063 and compress completely.
  - a. Metal side of valve stem seal faces valve spring.
  - b. Large hole in retainer should face toward tightening screws.
3. Insert compressed spring, seal and retainer into valve tappet chamber.
4. Push valve stem through valve stem seal and large hole in valve spring retainer.
5. Lift up on compressor to engage small hole of retainer on shoulder of valve stem and slowly release spring compressor until jaw contacting retainer is free.
6. Lift out compressor. Repeat for other cylinder. Rotate crankshaft to check for proper valve opening and closing.

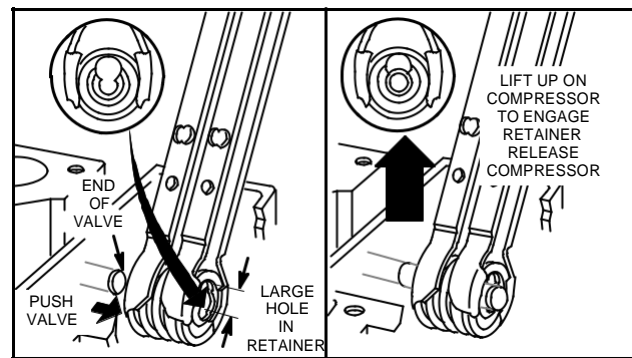


Fig. 32 – Installing Intake Valve



## Install Exhaust Valve

Coat valve stem with valve guide lubricant, Tool #93963.

1. Place exhaust valve spring and rotator or retainer into valve spring compressor, Tool #19063, and compress spring completely.
2. Insert compressed spring into valve tappet chamber and slide coated exhaust valve stem in through exhaust valve guide, through spring and rotator or retainer until valve seats.
3. Hold spring against cylinder head side of valve tappet chamber and insert split valve keepers in valve stem retainer grooves, Fig. 33.
  - a. A light coat of grease will help hold keepers on stem.
4. Move spring down onto keepers and while keeping light downward pressure on keepers, slowly release valve spring compressor.
5. Repeat for second cylinder. Rotate crankshaft to check for proper valve opening and closing.

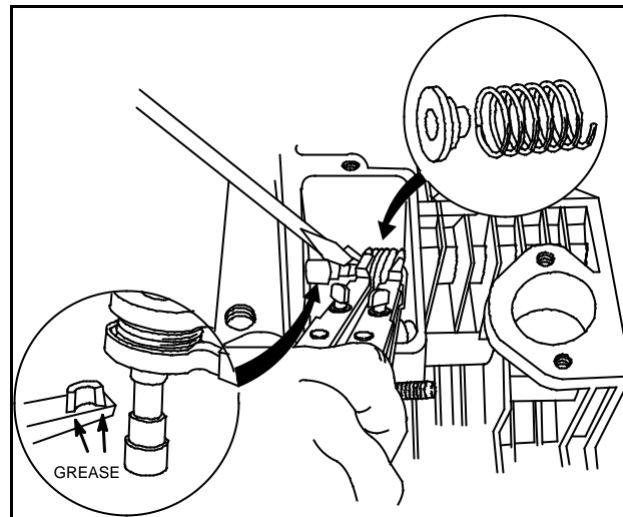


Fig. 33 – Installing Exhaust Valve

## INSTALL CYLINDER HEADS

Some models use three (3) longer head bolts located around the exhaust valve area. Note the position of these bolts so that they may be correctly reassembled. If a short bolt is used in the wrong position, it may not engage enough threads. A long bolt in the wrong position may bottom on fins, either breaking the fins or leaving the cylinder head loose. Install long bolts around the exhaust valve area of the cylinder head, torque sequence 1, 3, 7, Fig. 34.

1. Assemble cylinder heads with new head gasket and cylinder head screws in correct location.
2. Apply anti-seize lubricant, #93963 to threads of head bolts. **DO NOT USE SEALER OF ANY KIND ON GASKETS.**
3. Torque head bolts in 40 in. lbs. (5.0 Nm) increments, in sequence shown, to 160 in. lbs. (18.0 Nm).

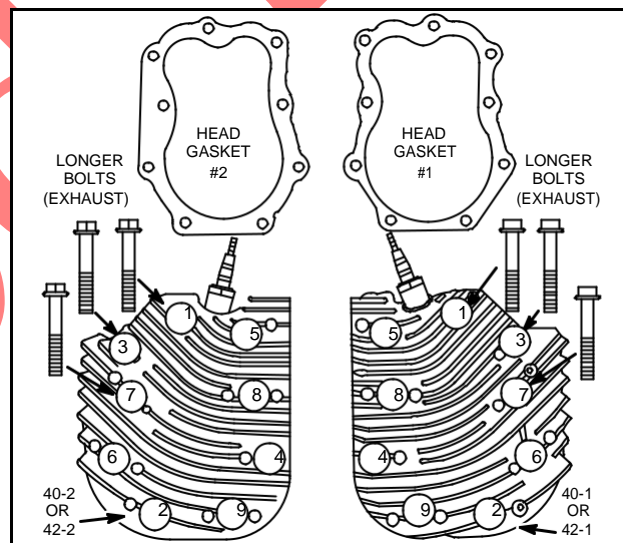


Fig. 34 – Head Nos. and Torque Sequence

## INSTALL BREATHERS

1. Using new gaskets, install breather(s), air guide and breather cover.
2. Install intake manifold and carburetor. Torque manifold screws to 90 in. lbs. (10.0 Nm). See Section 3.
3. Install air cleaner assembly, making sure that breather tube(s) are installed in correct holes in air cleaner base. See Section 3.

**NOTE:** Breather tube installation will be easier if tube(s) are assembled to air cleaner base first.

4. Install cylinder air guides and cylinder shields.
5. Install fuel line and fuel pump pulse line. Make sure all connections are tight.
6. Install spark plugs and wires.



**WARNING: WHENEVER CARBURETOR and manifold are removed, static governor adjustment must be checked! See Section 4. Misadjustment could result in engine over-speeding which could cause engine damage, property damage or personal injury.**

# Section 6A

## REWIND STARTERS

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### REMOVE REWIND STARTER

The rewind starter assembly used on Twin Cylinder Horizontal crankshaft engines is illustrated in Fig. 1. Rewind starter assembly is held on blower housing with four (4) studs, nuts and lock washers.

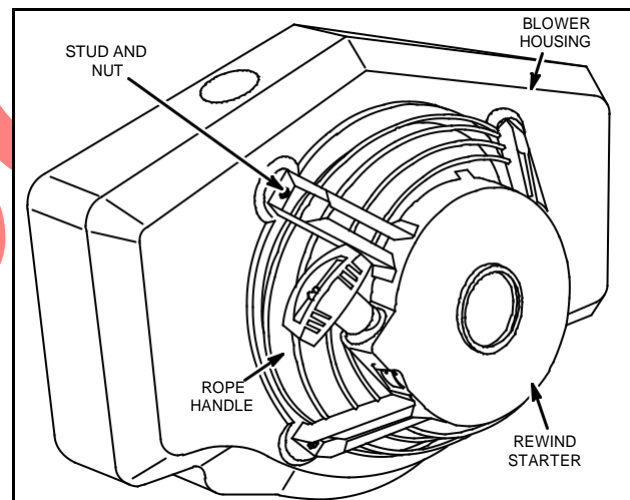


Fig. 1 – Rewind Starter

### DISASSEMBLY

#### Remove Spring

1. Pull rope handle and rope out part way and tie a temporary knot.
2. Pull rope pin and rope out of handle and untie knot.
3. Untie temporary knot and allow rope to rewind into rewind housing.
4. Grasp end of rope in knot cavity and remove rope, Fig. 2.

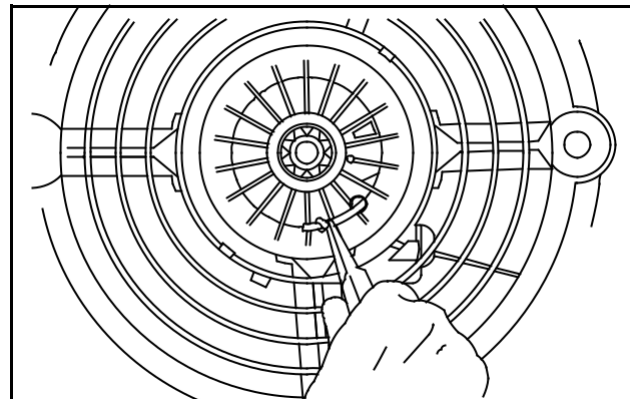


Fig. 2 – Remove Rope

5. Grasp outer end of spring with pliers and pull out of housing as far as possible, Fig. 3.
6. Turn spring 1/4 turn and remove from pulley or bend one of the tangs with Tool #19229 and lift out starter pulley to disconnect spring.

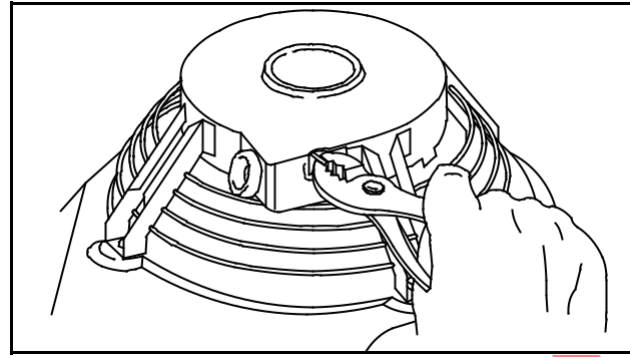


Fig. 3 – Remove Spring

## ASSEMBLY

### Install Spring

1. Clean rewind housing, pulley and rewind spring in solvent. Wipe clean with cloth.
2. Straighten spring to allow easier installation and restore tension. Oil spring.
3. Insert either end of spring through slot in starter housing and hook into pulley, Fig. 4.

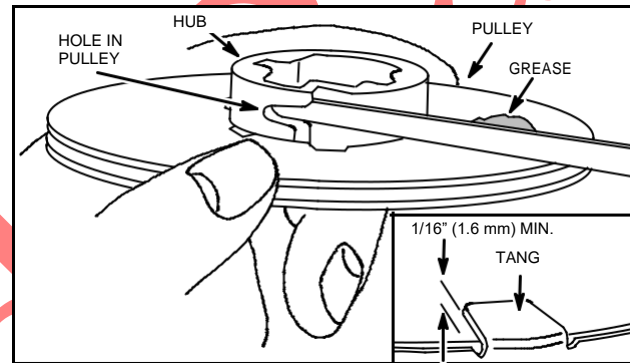


Fig. 4 – Install Spring

4. Place a dab of grease on pulley, Fig. 4, and ratchet spring and ratchet spring adapter, Fig. 5.
5. Set ratchet spring, ratchet spring adapter and pulley into rewind housing and bend tang down, Fig. 4. Tang bender, Tool #19229, can be used to adjust tang gap, Fig. 4. Pulley must be fully depressed when measuring tang gap.

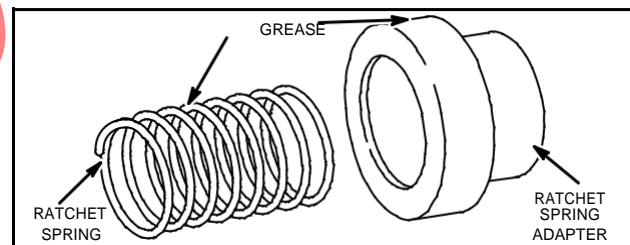


Fig. 5 – Lubricate Adapter

**NOTE:** If tang breaks, use alternate unused tangs to hold pulley.

### Wind Spring

1. Place a 3/4" (19.0 mm) square piece of stock into center of pulley hub or make rewind tool similar to one shown in Fig. 6.
2. Grasping stock with a wrench, wind pulley counterclockwise until spring is wound tight.
3. Back off pulley one turn, or until hole in pulley for rope knot and eyelet in blower housing are in alignment, Fig. 8. Spring should be securely locked in smaller portion of tapered slot in starter housing, Fig. 7.

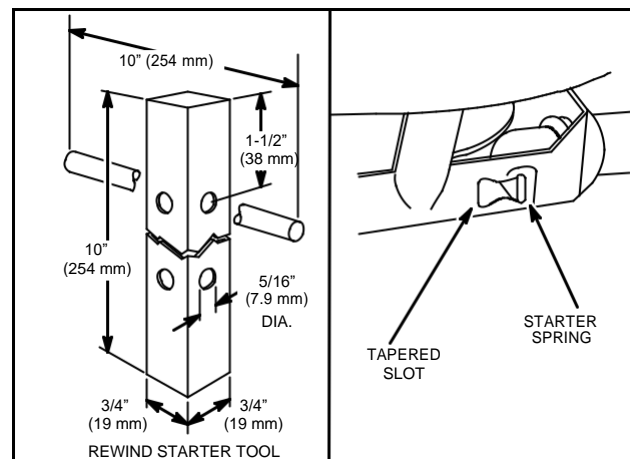


Fig. 6

Fig. 7

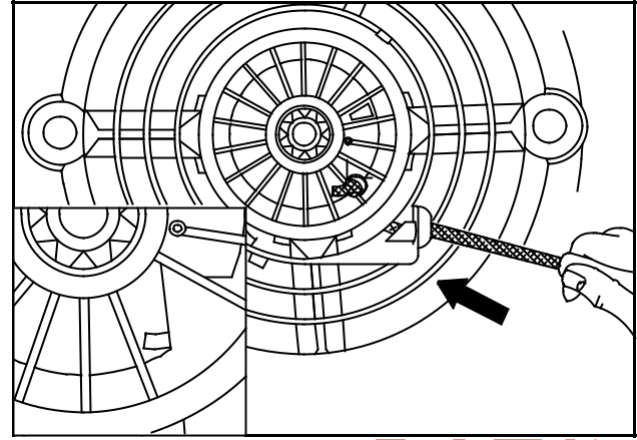


Fig. 8 – Inserting Rope

### Install Rope

1. Inspect rope. Replace if frayed.
2. Insert rope through handle and tie a figure eight knot, Fig. 8, Fig. 9.
3. Insert pin through knot and pull tightly into handle, Fig. 10. ALWAYS SEAL BOTH ENDS OF KNOT.

A rope inserter tool may be made by using a piece of music wire or spring wire, and forming it as shown in Fig. 11. If re-using old rope, burn pulley end of rope with a match. Wipe with waste cloth, using caution, while it is still hot, to prevent swelling and unraveling.

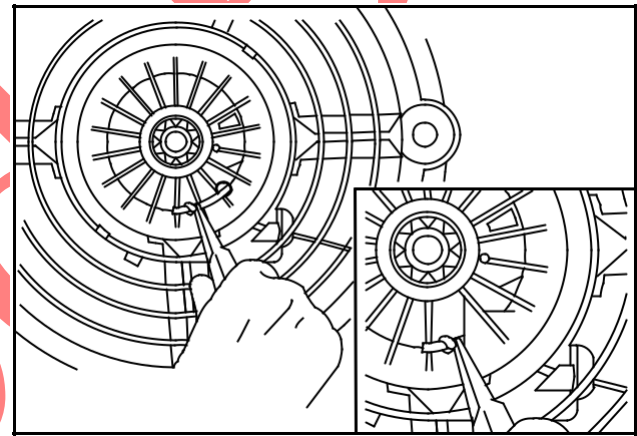


Fig. 9 – Tie Knot

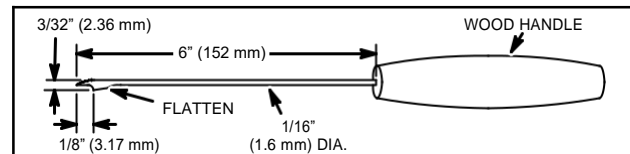


Fig. 10 – Rope Inserter

**NOTE:** Check parts list to be sure new rope is the correct diameter and length.

4. Thread rope through rope eyelet in housing and out pulley hole, Fig. 8.
5. Tie a knot in rope and pull tight. Position knot so it can be pulled down into knot cavity, Fig. 11.

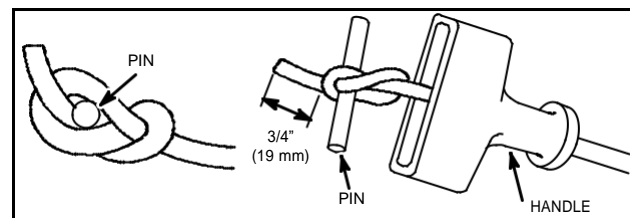


Fig. 11 – Install Rope

6A

## Starter Clutch

If necessary, the sealed clutch can be disassembled by using a screwdriver or wedge to pry the retainer cover from the housing, as shown in Fig. 12. Fig. 13 shows disassembled starter clutch.

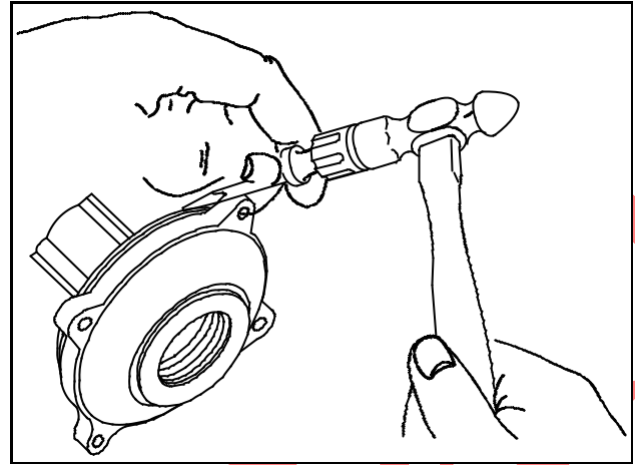


Fig. 12 – Disassembling Sealed Clutch

1. Do not oil balls or ball cavity area in clutch housing.
2. Place one drop of engine oil on end of crankshaft before replacing clutch assembly on crankshaft.
3. Torque clutch to same specification as flywheel nut.

**NOTE:** Clean ratchet by wiping with cloth only.

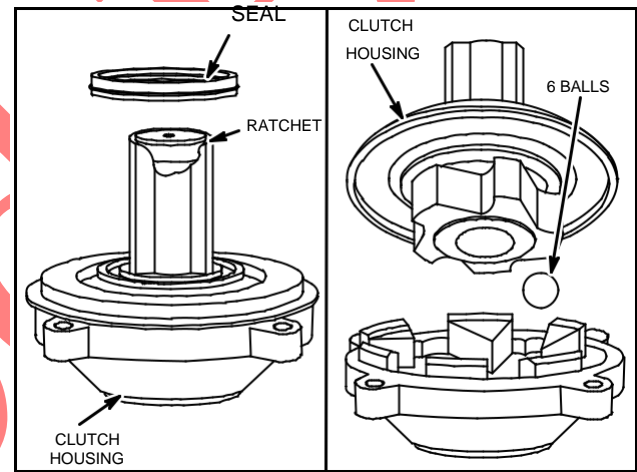


Fig. 13 – Sealed Clutch Assembly

# Section 6B

## ELECTRIC STARTERS

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6B



## GENERAL INFORMATION

This starter motor uses a gear type engagement method, similar to an automobile starter. When the starter motor is activated, the pinion gear engages a ring gear attached to the engine flywheel and cranks the engine.

### Starter Location

Fig. 1 and Fig. 2 show typical starter motor locations.

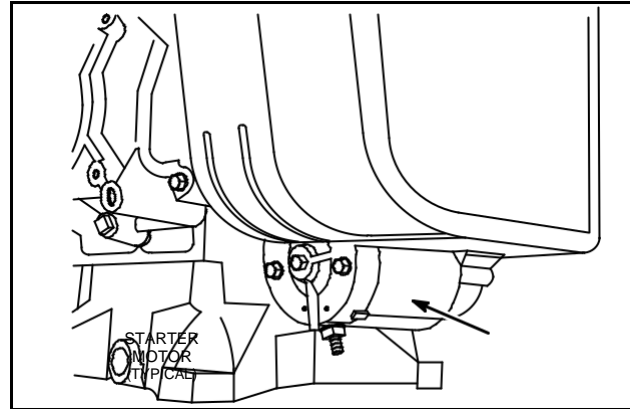


Fig. 1 – Horizontal Crankshaft Engines

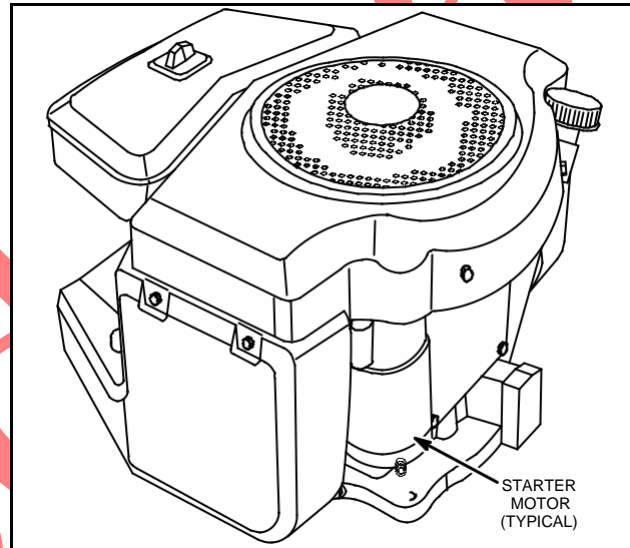


Fig. 2 – Vertical Crankshaft Engines

### Starter Identification

Briggs & Stratton Twin Cylinder engines have used three styles of 12V starters. Current style starters have a molded plastic, stamped steel or aluminum brush end cap and long starter housing, Fig. 3 and Fig. 4.

Early style starters had a die cast brush end cap and short housing, Fig. 5.

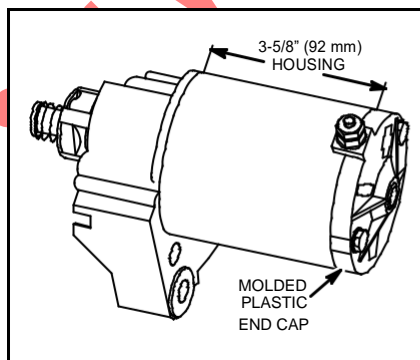


Fig. 3 – Current Style Starters

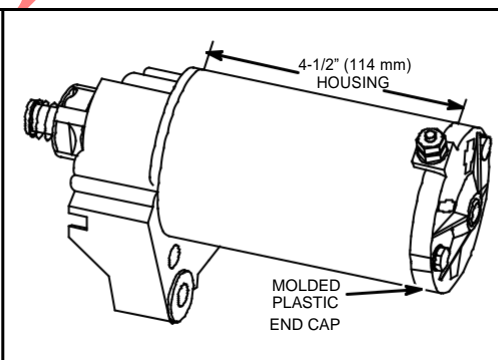


Fig. 4 – Current Style Starters

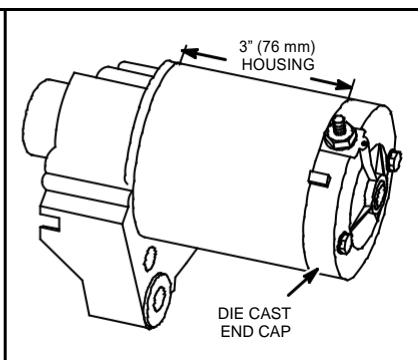


Fig. 5 – Early Style Starters

## TROUBLESHOOTING

**NOTE:** If a starting problem is encountered, the engine itself should be thoroughly checked to eliminate it as the cause of starting difficulty. It is a good practice to check the engine for freedom of rotation by removing the spark plugs and turning the crankshaft over by hand.



**WARNING: DO NOT** crank engine with spark-plug(s) removed! Firing of the spark plug may ignite gasoline vapor exiting spark plug hole(s).

### 1. Engine Cranks Slowly –

- Additional load affecting performance (see note above).
- Discharged battery.
- Faulty electrical connection (battery circuit).
- Discharged battery (see alternators).
- Dirty or worn starter motor commutator, bearing, weak magnets, etc.
- Worn brushes or weak brush spring.
- Wrong oil viscosity for temperature expected.

- Battery leads too long or wire too small.
- Battery too small.

### 2. Engine Will Not Crank –

- Faulty safety interlocks.
- Discharged or defective battery.
- Faulty electrical connections.
- Faulty starter motor switch (open circuit).
- Open circuit in starter motor.
- Brushes sticking, etc.
- Faulty solenoid.

### 3. Starter Motor Spins; But Does Not Crank Engine –

- Sticking pinion gear due to dirt.
- Damaged pinion or ring gear.
- Battery faulty or damaged.
- Incorrect rotation due to reversed motor polarity – all motors rotate counterclockwise viewed from pinion gear.

### 4. Starter Motor Spins; Will Not Stop –

- Defective starter switch.

## TEST EQUIPMENT

The following is a list of equipment recommended to test and repair starter motors.

### Digital Multimeter

The Digital Multimeter is available from your Briggs & Stratton source of supply. Order as Tool #19390 or #19464. The meter may be used to read volts, ohms, amperes and test diodes (rectifiers) when test leads are inserted in the appropriate receptacle, Fig. 6.

The Digital Multimeter will withstand DC input of 10 – 20 Amps for up to 30 seconds. When checking current draw of 12 volt starter motors, the DC Shunt, Tool # 19359, is required.

**NOTE:** The Digital Multimeter is equipped with two fuses to prevent damage to the meter in the event that the input limits are exceeded. If the meter displays a reading of 0.00 when testing DC output, check fuses in meter. Refer to FLUKE 23 Operators Manual for procedure for checking fuses. Replacement fuse is available from your Briggs & Stratton source of supply. Order Part No. 19449.

### DC Shunt

Use with Digital Multimeter. The DC Shunt is required when checking starter motor current draw on 12 volt starter motors. Order as Tool #19359, Fig. 7.

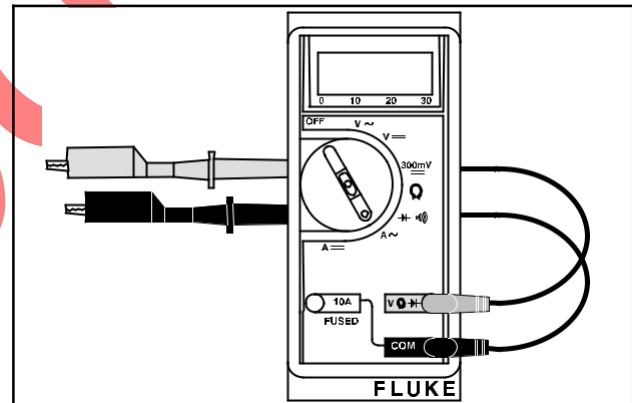


Fig. 6 – Digital Multimeter

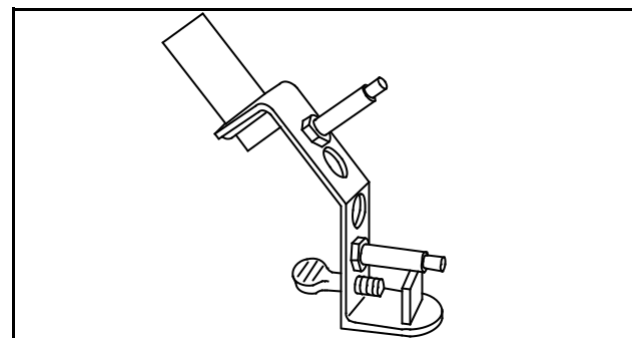


Fig. 7 – DC Shunt – Tool No. 19359

## Tachometer

A tachometer is available from your Briggs & Stratton source of supply. Order as Tool #19200. The tachometer measures from 800 to 50,000 revolutions per minute (RPM), Fig. 8.

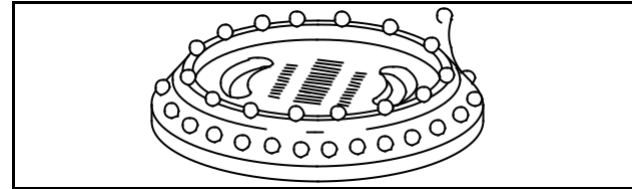


Fig. 8 – Tachometer

## Starter Motor Test Bracket

A starter motor test bracket may be made as shown in Fig. 9. Tachometer may be mounted to test bracket.

A growler or armature tester is available from an Automobile Diagnostic Service supplier.

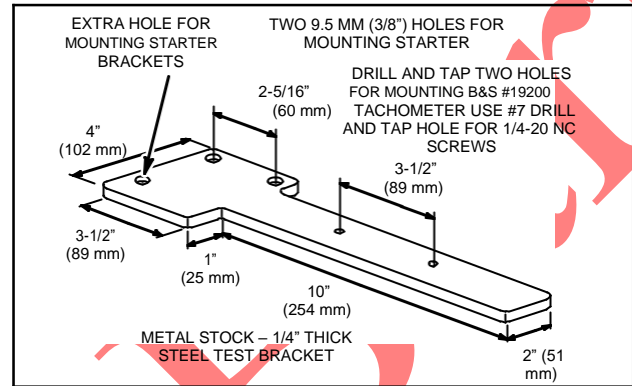


Fig. 9 – Starter Motor Test Bracket

## STARTER MOTOR

**NOTE:** It is recommended that the starter motor be removed from the engine when testing starter motor performance.

## Removing Starter Motor

Remove blower housing and flywheel from engine. Refer to Section 2 for flywheel removal procedure. Remove two (2) starter motor mounting screws. Assemble starter motor to test bracket (Fig. 9), and clamp test bracket in vise, Fig. 10.

**IMPORTANT:** DO NOT clamp motor housing in a vise or strike with a steel hammer. Starter motors contain two ceramic magnets which can be broken or cracked if the motor housing is hit, deformed or dented.

**NOTE:** A fully charged 12 volt battery is required.

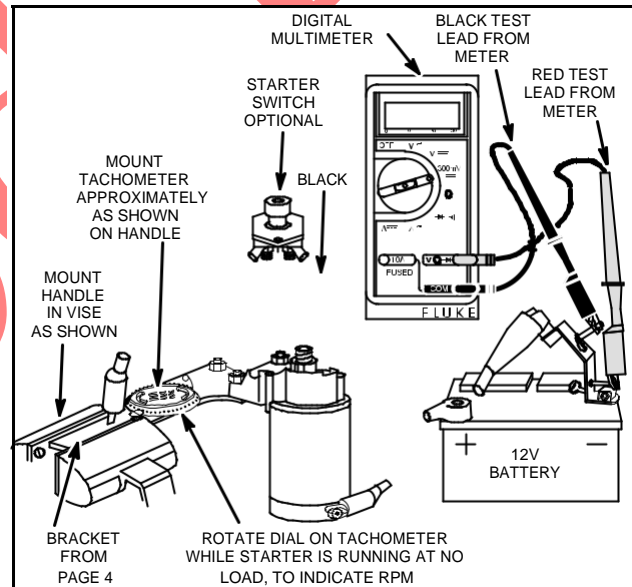


Fig. 10 – Testing 12 Volt Starter Motor  
Digital Multimeter & DC Shunt

## Testing Starter Motor

1. The DC Shunt **MUST** be installed on the **negative** (–) battery terminal as shown in Fig. 10.
2. Insert RED test lead into VW receptacle in meter and connect to RED post terminal on shunt.
3. Insert BLACK test lead into COM receptacle in meter and connect to BLACK post terminal on shunt.
4. Rotate selector to 300MV position.
5. Note length of starter motor housing as shown on page 1 and refer to Fig. 11 for specifications for motor being tested. Activate the starter motor and note reading on meter and tachometer (RPM). A starter motor in good condition will be within specifications listed.

Motor Length	Minimum Motor RPM	Maximum Amperes
3" (76 mm)	6500	18
3-5/8" (92 mm)	6500	18
4-1/2" (114 mm)	6500	35

Fig. 11 – Volt Starter Motor Specifications

If 12 volt starter motor does not perform satisfactorily, see Conditions Affecting Starter Motor Performance.

## Conditions Affecting Starter Motor Performance

1. Binding or seized starter motor bearings.
2. A shorted, open or grounded armature.
  - a. Shorted armature (insulation worn and wires touching one another), will be indicated by low or no RPM and excessive current draw.
  - b. Open armature (wire broken), will be indicated by low or no RPM and excessive current draw.
- c. Grounded armature (wire insulation worn and wire touching armature lamination or shaft). Will be indicated by excessive current draw or no RPM.
3. A defective starter motor switch.
4. Weakened magnets.
5. Starter drive dirty or binding.

## STARTER DRIVE

### Checking Starter Motor Drive

When the starter motor is activated, the pinion gear should engage the flywheel ring gear and crank the engine. If the starter motor drive does not react properly, inspect the helix and pinion gear for freedom of operation.

The pinion must move freely on the helix for correct starter operation. If any sticking occurs, this must be corrected.

Twin cylinder starters use three styles of starter pinion gear retainer mechanisms, Fig. 12, Fig. 13, Fig. 14.

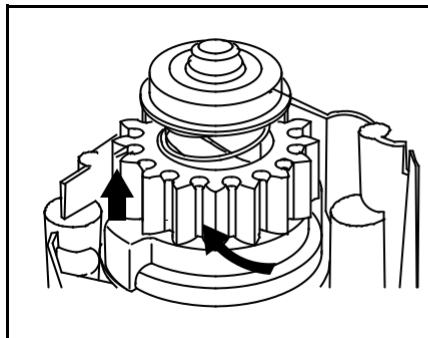


Fig. 12 – C-ring Style

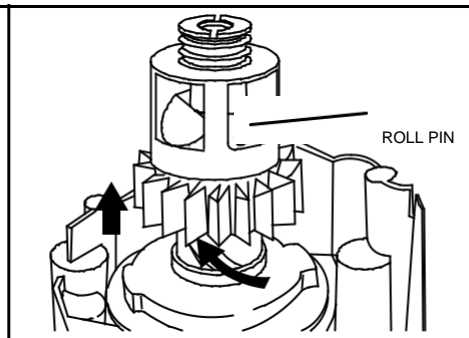


Fig. 13 – Roll Pin Style

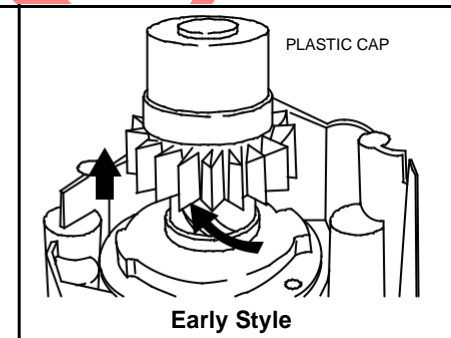


Fig. 14 – Roll Pin Style With Plastic Cap

6B

### Disassemble Starter Motor Drive – C-ring Style

**WARNING:** TO PREVENT eye injury always wear eye protection when removing C-ring.

1. Place counterbore side of Tool #19436 over retainer and align drive pins with open end of C-ring, Fig. 15.

**IMPORTANT:** IF RETAINER has a notch as shown, DO NOT align drive pins with notch. If necessary, rotate notch away from open end of C-ring.

2. Place palm of hand over tool and push down evenly on tool to compress spring washer.
3. While applying pressure, turn knurled knob clockwise until C-ring pops off. Discard C-ring.

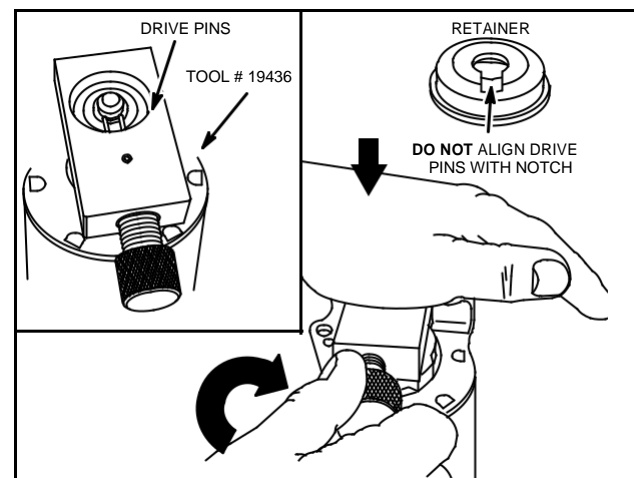
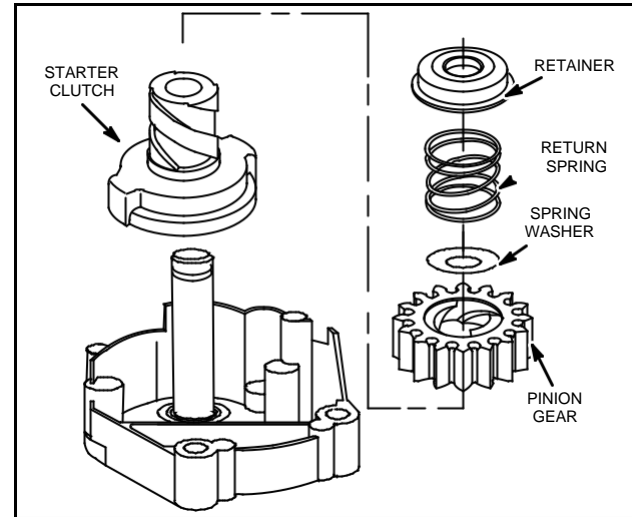


Fig. 15 – Removing C-ring

4. Remove retainer, return spring, spring washer, pinion gear, and starter clutch, Fig. 16.

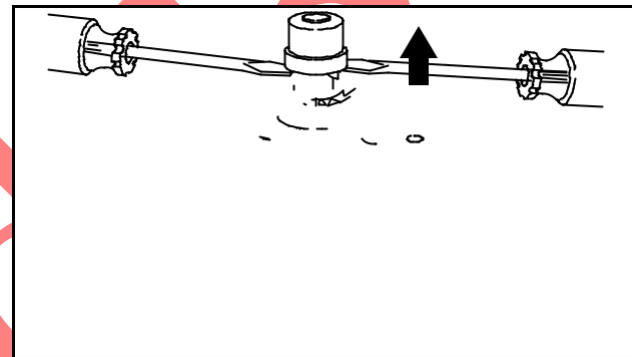


**Fig. 16 – Removing Starter Drive**

### Disassemble Starter Motor Drive – Roll Pin Style

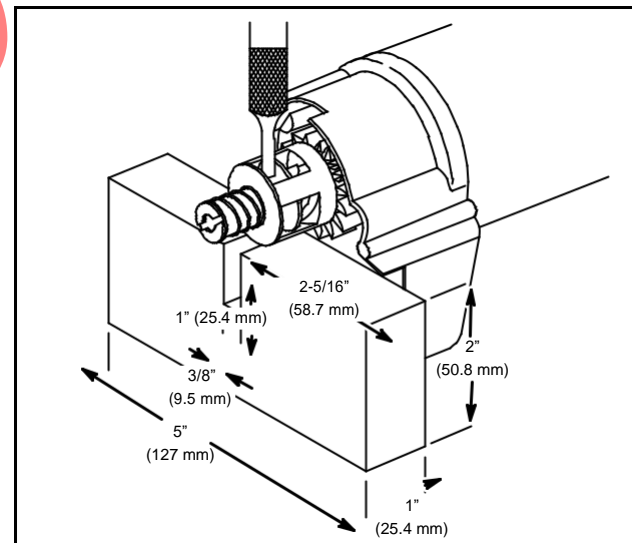
If starter is equipped with a plastic cap, it must be removed before removing roll pin.

1. Carefully pry the plastic cap off the retaining cup using two screwdrivers, Fig. 17.



**Fig. 17 – Removing Cap Assembly**

2. Place starter drive retainer on support block, Fig. 18 and drive out roll pin with a 5/32" (4 mm) pin punch to remove starter drive retainer.



**Fig. 18 – Disassemble Starter Drive Roll Pin Style**

### Inspect Starter Drive – All

The pinion gear should be inspected for damaged teeth. Pinion gear must move freely on helix. The parts may be washed in a solvent such as Stanisol or Varsol .

The starter drive assembly is available from your Briggs & Stratton source of supply if required.

**NOTE:** Do not oil or grease helix or starter gear. See Fig. 19, Fig. 21 and Fig. 22, for proper location of parts.



### Assemble Starter Drive – C-ring Style

1. Assemble starter clutch to starter shaft and rotate clutch until it drops into place, Fig. 19.
2. Install pinion gear with beveled side of teeth up. Then install return spring making sure spring is in recess of starter gear.
3. Install spring washer with concave side up. Install retainer.

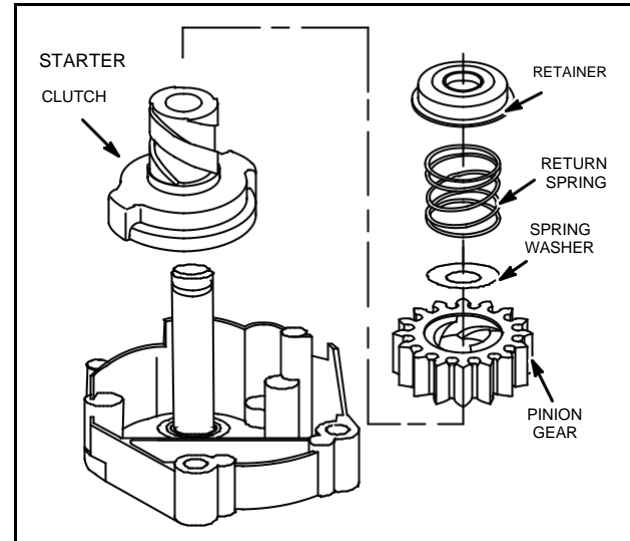


Fig. 19 – Assembling Starter Drive

4. Place C-ring over chamfered end of shaft. Align one of the slots of Tool #19345 with open end of C-ring, Fig. 20.
5. Press or drive C-ring on until it snaps into groove in shaft.

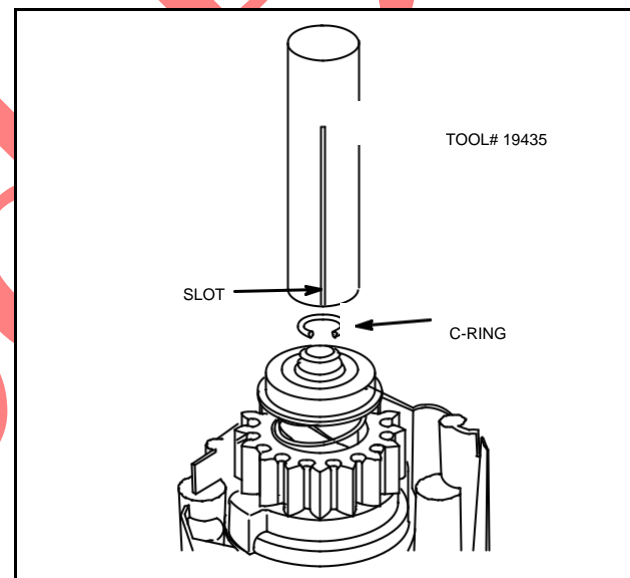


Fig. 20 – Installing C-ring

### Assemble Starter Drive – Roll Pin Style

1. Assemble starter clutch to starter shaft and rotate clutch until it drops into place.
2. Install pinion gear with chamfered edge of pinion gear teeth away from motor, Fig. 21.
3. Assemble thrust washer and clutch retainer assembly on armature shaft.
4. Press or drive NEW roll pin through retainer slot and hole in armature shaft, Fig. 18. Roll pin should be centered in armature shaft within 1/32" (0.8 mm).

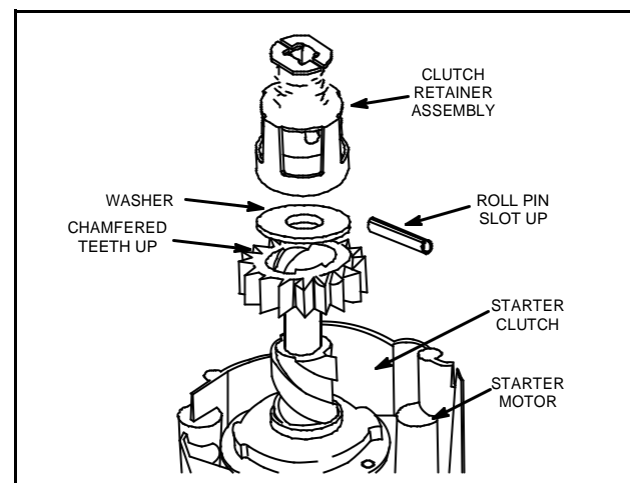


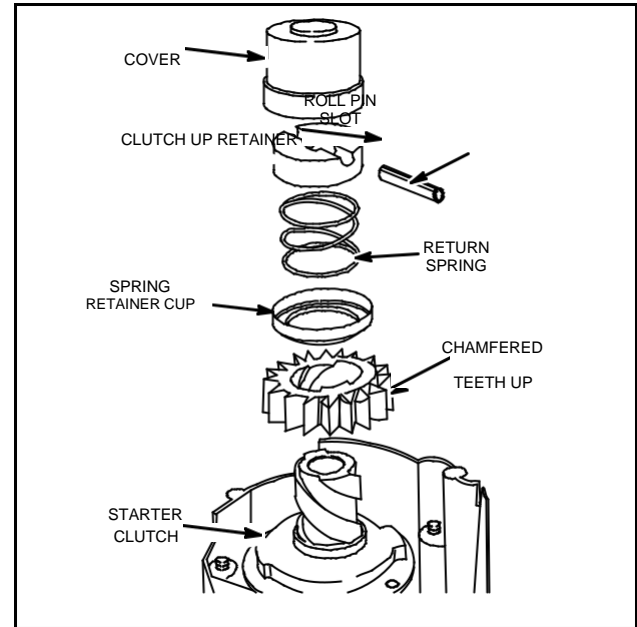
Fig. 21 – Assembling Starter Drive – Roll Pin Style

6B



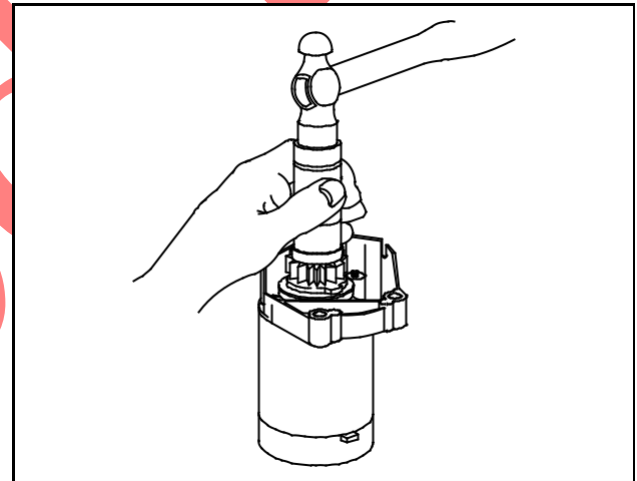
### Assemble Starter Drive – Roll Pin Style With Plastic Cap

1. Assemble starter clutch on armature shaft and rotate clutch until it drops into place.
2. Install pinion gear with chamfered edge of pinion gear teeth away from motor, Fig. 22.
3. Assemble spring retainer cup, return spring and clutch retainer on armature shaft.
4. Press or drive NEW roll pin through retainer slot and hole in armature shaft, Fig. 22. Roll pin should be centered in armature shaft within 1/32" (0.8 mm).



**Fig. 22 – Assembling Starter Drive – Roll Pin Style With Plastic Cap**

5. To install plastic cap, use a socket approximately the same diameter as the plastic cap, for a driver as shown in Fig. 23. Press cap in position. Cap should lock in position when properly assembled.



**Fig. 23 – Installing Plastic Cap**

## STARTER MOTOR

### Disassemble Starter Motor

**IMPORTANT:** DO NOT clamp motor housing in a vise or strike with a steel hammer. Starter motors contain two ceramic magnets which can be broken or cracked if the motor housing is hit, deformed or dented.

**NOTE:** For ease of re-assembly, mark starter housing and end caps before disassembly.

See Fig. 24 for typical starter shown as an exploded view.

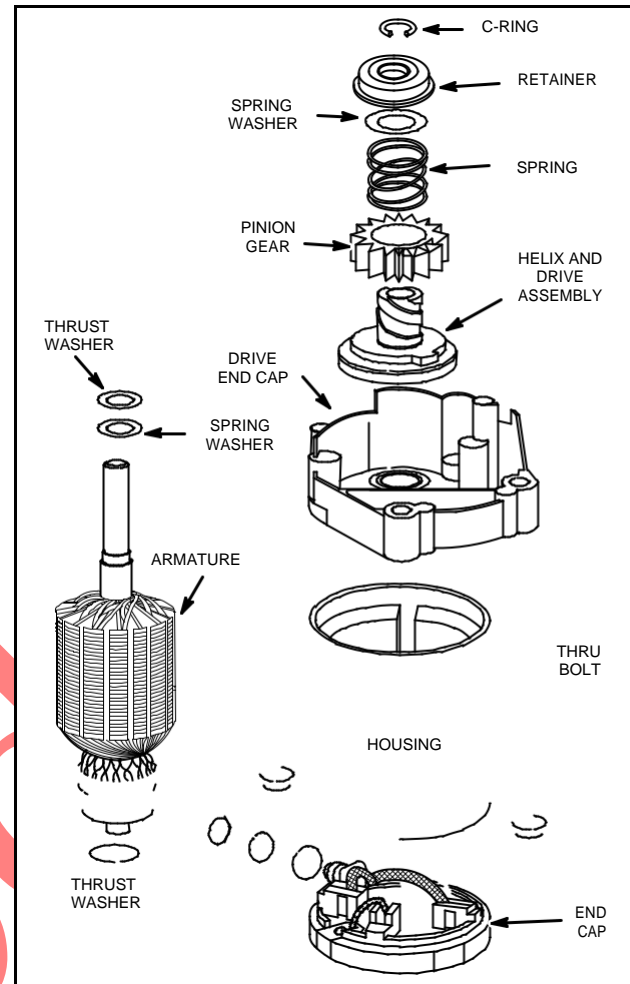


Fig. 24 – Exploded View – Starter (Typical)

1. Remove starter drive.
2. Remove thru bolts. Drive end head assembly can now be removed.
3. Inspect bushing for wear or damage. Replace if worn or damaged.
4. Hold the armature and commutator end cap against a work surface while sliding housing off the armature, Fig. 25.

**NOTE:** This allows the armature to remain in the end cap for inspection of brush contact to the commutator.

5. Remove end cap and brush retainer with brushes. Replace end cap if bushing is worn or damaged.

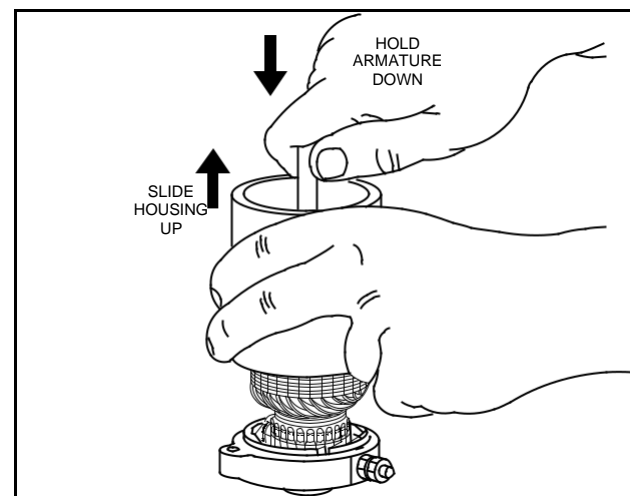


Fig. 25 – Removing Motor Housing

### Inspect Armature Commutator

The armature commutator may be cleaned with fine sandpaper. **DO NOT** use emery cloth. Commutator may be machined to no less than 1.230" (31.24 mm), Fig. 26.

Slots between commutator bars should be cleaned with a hack saw blade after cleaning or machining, Fig. 26. The slots can also be cleaned using an aerosol carburetor cleaner or compressed air.

The armature should be checked for shorts with a growler.

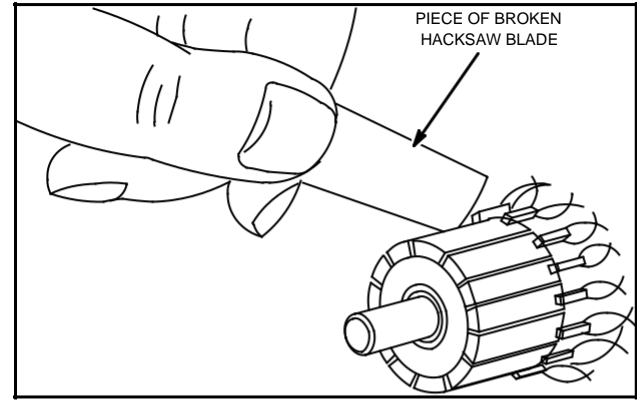


Fig. 26 – Cleaning Commutator

### Inspect Brushes

The brushes should be checked for proper seating, weak brush springs, dirt, oil or corrosion. Brush spring pressure should be strong enough to ensure good brush contact with armature. Check to be sure brushes are not sticking in their holders.

Minimum brush dimension is 1/4" (6 mm), Fig. 27.

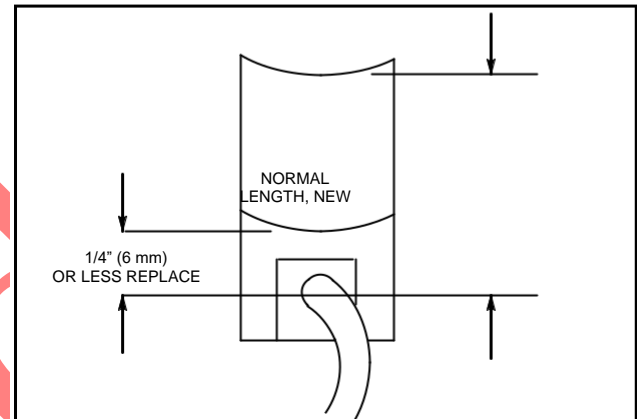


Fig. 27 – Checking Brushes

### Replace Brushes

Three different style brush end caps are used. Refer to Fig. 28, Fig. 29 and Fig. 30 for correct location of brushes and brush leads. Note order of assembly for insulators, washers and screws or nuts.

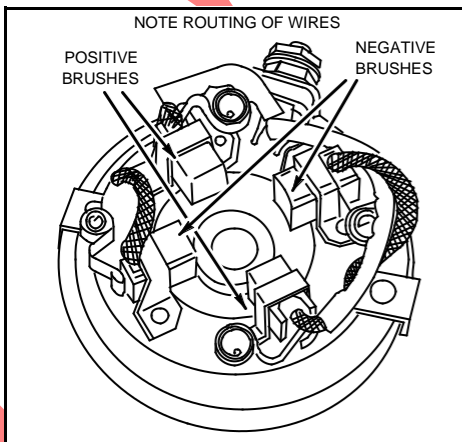


Fig. 28 – Flat Coil Spring

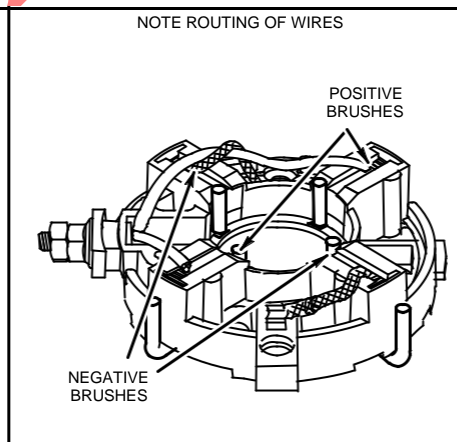


Fig. 29 – Compression Spring

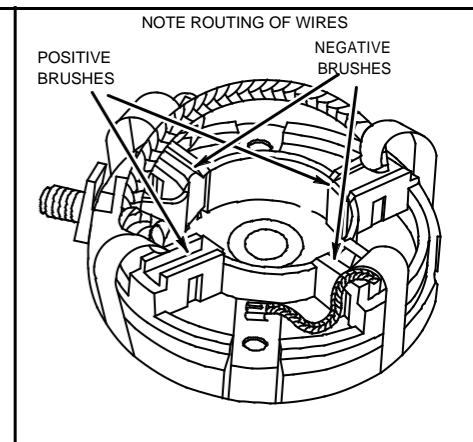


Fig. 30 – Compression Spring

## ASSEMBLE STARTER MOTOR

When all parts have been inspected, lightly lubricate bearings in both end caps with #20 oil.

**NOTE:** On brush end cap with flat coil brush spring, install armature on to brush end cap before installing brushes.

1. Place brush in holder.
2. Position coil spring over tab as shown in Fig. 31.
3. While holding spring on tab, use a screwdriver and bend spring counterclockwise and position over end of brush, Fig. 31. Then push spring down firmly over tab.

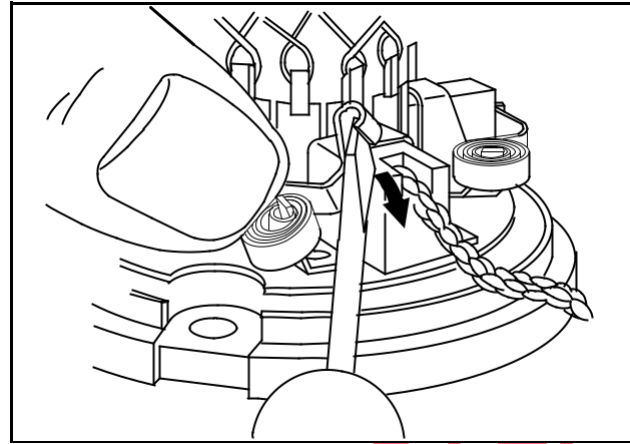


Fig. 31 – Installing Brushes, Flat Coil Spring Type

On end caps with compression type springs, insert brushes in their proper holders, Fig. 32 and Fig. 33. A brush retainer should be used to hold brushes clear of armature commutator.

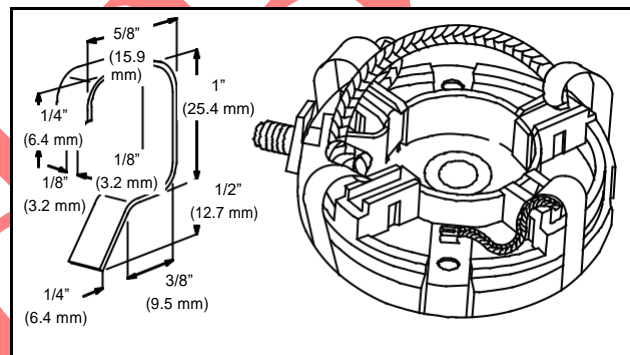


Fig. 32 – Compression Spring Type Brush Holders

4. Brush retainers can be made from scrap pieces of rewind starter springs as shown in Fig. 32 or Part No. 26634 control wire or similar material, Fig. 33.

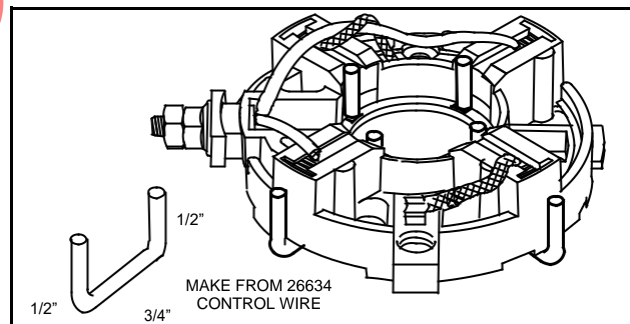


Fig. 33 – Compression Spring Type Brush Holders

5. Install armature in brush end cap, Fig. 34, and remove brush retainers.

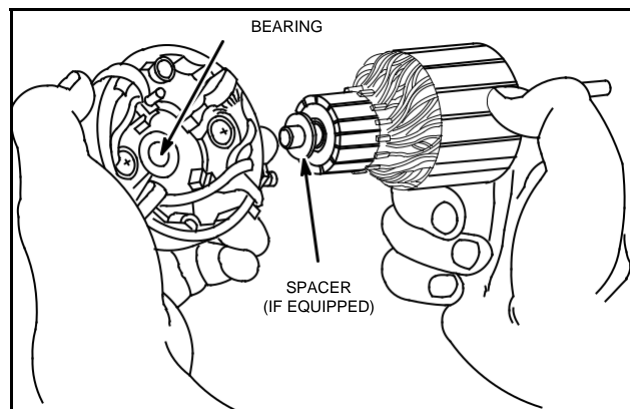
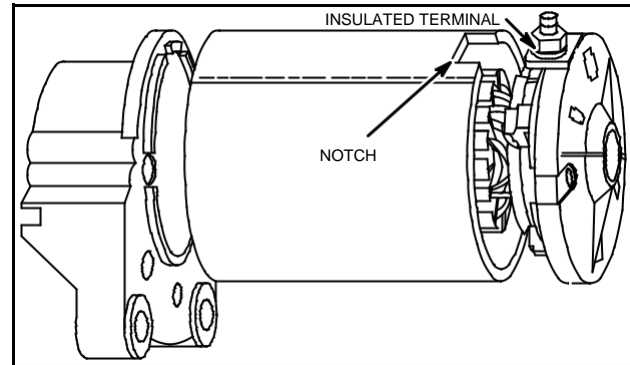


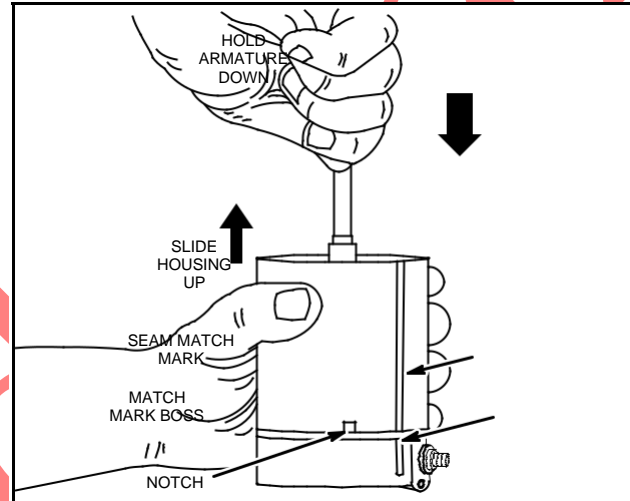
Fig. 34 – Assembling Armature to End Cap Typical

**NOTE:**Some starter housings have a large notch which indexes over the insulated terminal, Fig. 35.



**Fig. 35 – Assemble Starter**

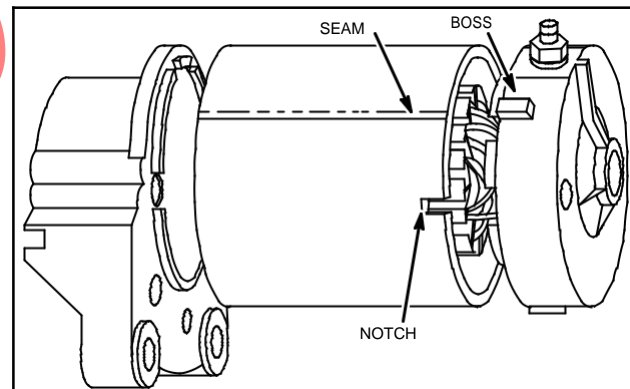
6. While pushing down on armature and brush end cap, slide starter housing down until large notch indexes with insulated terminal boss, Fig. 36. DO NOT damage magnets in starter housing.



**Fig. 36**

**NOTE:**Some starters have a small identification notch on starter housing which faces brush end cap.

7. While pushing down on armature and brush end cap, slide starter housing over armature.
8. Align seam on housing with boss on brush end cap, Fig. 37. DO NOT damage magnets in starter housing.

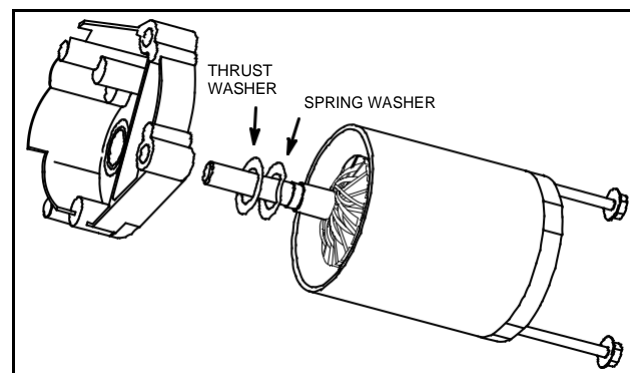


**Fig. 37 – Assemble Starter**

### Install Drive End Cap

1. Assemble spring washer and thrust washer to armature shaft, Fig. 38.
2. Install drive end cap.  
Torque screws to 50 in. lbs. (6.0 Nm).
3. Install starter motor.  
Torque screws to 140 in. lbs. (16.0 Nm).

**NOTE:**Early style starters used one or more .012" (.3 mm) thrust washers to obtain armature end play of .006"/.038" (.15 mm/.96 mm).



**Fig. 38 – Install Drive End Cap (Typical)**

## REPLACE RING GEAR

To replace a worn or damaged flywheel ring gear, proceed as follows.

1. Mark the center of the rivets holding the ring gear to flywheel, with a center punch.
2. Drill out the rivets using a 3/16" drill.
3. Remove ring gear and clean epoxy from flywheel.
4. Attach new gear to flywheel using four screws and locknuts provided with gear, Fig. 39.

**NOTE:** Epoxy is not required to hold replacement ring gear.

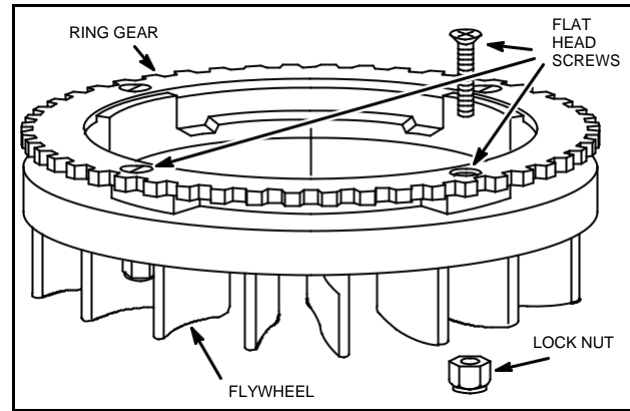


Fig. 39 – Replacing Ring Gear

## BATTERY INFORMATION

The battery used to operate starter motors on Briggs & Stratton Twin Cylinder engines is 12 volt, lead acid, wet cell type. This type is available as a wet charge or dry charge battery. The wet charged maintenance-free battery is filled with electrolyte and sealed at the time of manufacture. The level of electrolyte cannot be checked.

The dry charge battery, Fig. 40, is manufactured with fully charged plates. Electrolyte must be added at the time that the battery is placed in service. Before activating a dry charge battery, read and follow the manufacturer's recommended procedure.

**WARNING:** WEAR EYE protection when servicing the battery! Avoid skin contact! If contact does occur, flush with cold water and consult a physician immediately.

**CAUTION:** BEFORE SERVICING battery, disconnect negative (-) battery cable first, then positive (+) cable. Arcing which could cause a fire, can occur when cables are improperly disconnected.

**WARNING:** BATTERIES PRODUCE hydrogen, an explosive gas! Do not store or charge a battery near an open flame or devices which utilize a pilot light or can create a spark igniting a fire or explosion.

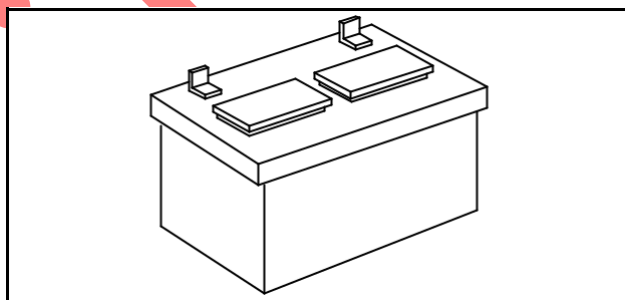


Fig. 40 – Typical Dry Charge Battery

## Installation

1. Before installing battery, connect all equipment to be operated, Fig. 41.
2. Place battery in holder with flat base. Tighten holder down evenly until snug. DO NOT over-tighten.
3. Connect positive terminal to positive post FIRST to prevent sparks from accidental grounding. Tighten connectors securely.
4. Then, connect negative terminal to negative battery terminal. Tighten connectors securely.

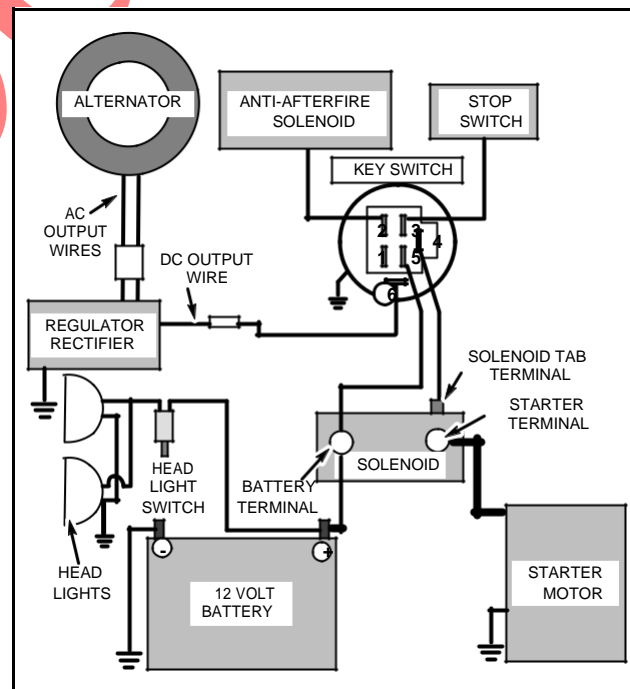


Fig. 41 – Typical 12 V Wiring Diagram

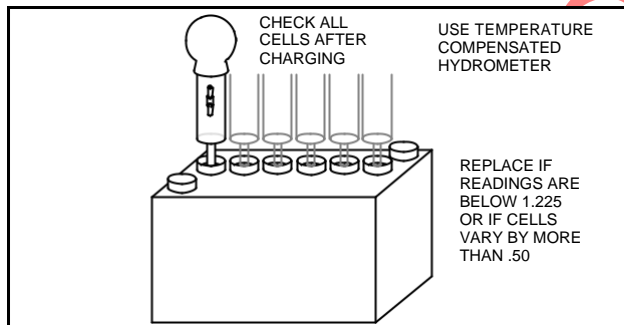


## Checking Battery

1. Physical check – clean if necessary.
  - a. Corrosion
  - b. Dirt
  - c. Terminal and clamps secure and in good condition
2. Bring battery to full charge.  
**DO NOT EXCEED CHARGE RATE** of 1/10 AMPERE for every ampere of battery rating! **CONSULT BATTERY MANUFACTURER** for **CHARGE REC-OMMENDATIONS**. Overcharging may cause battery failure.
  - a. Use a taper charge (automatically reduces charge rate).
  - b. Fill battery cells with distilled water or tap water after charging (for batteries that have been in service).

**NOTE:** If battery gets “Hot” to the touch or is spitting acid (gassing), unplug charger periodically.

3. With battery fully charged, check specific gravity readings of each cell with a Battery Hydrometer and record readings, Fig. 42. Readings should be above 1.250 (compensating for temperature). If specific gravity readings varied .50 or if all cells read less than 1.225, replace battery.



**Fig. 42 – Checking 12 V Battery Cells  
(Lead Acid, Wet Cell, With Fill Caps)**

## Testing Battery

Use Digital Multimeter, Tool #19357 or #19390.

Set meter to read DC Volts.

Attach RED meter test clip to positive (+) battery terminal. Attach BLACK meter test lead to negative (-) battery terminal. With ignition switch “OFF,” press starter button. If ignition switch and starter switch are the same switch, disconnect wires from spark plugs and ground ignition using two Ignition Testers, Tool #19368. Turn switch to “START.” METER SHOULD DISPLAY 9 VOLTS OR MORE WHILE CRANKING ENGINE. If less than 9 volts, replace battery.

**DO NOT CRANK STARTER** for more than 15 SECONDS without allowing starter to COOL at least 2 MINUTES. The starter motor could be damaged.

## Battery Recommendations

These battery size recommendations are based on minimum temperature expected and correct weight of oil being used. See Section 1.

30 Amp. Hr. -6° C (+20° F) or higher  
 40 Amp. Hr. -20° C (-5° F) or higher  
 50 Amp. Hr. -26° C (-15° F) or higher

## Battery Cable Recommendations

These cable sizes are based on total length of cable from battery positive post to starter switch or solenoid, and to starter plus ground return to battery negative post.

#6 AWG – 4 ft. (1.21 m) or less  
 #5 AWG – 5 ft. (1.52 m) or less  
 #4 AWG – 6 ft. (1.82 m) or less

# Section 7

## ALTERNATORS

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## ALTERNATOR IDENTIFICATION

The alternator systems installed on Briggs & Stratton Twin Cylinder Engines can easily be identified by the color of the stator output wires and connector.

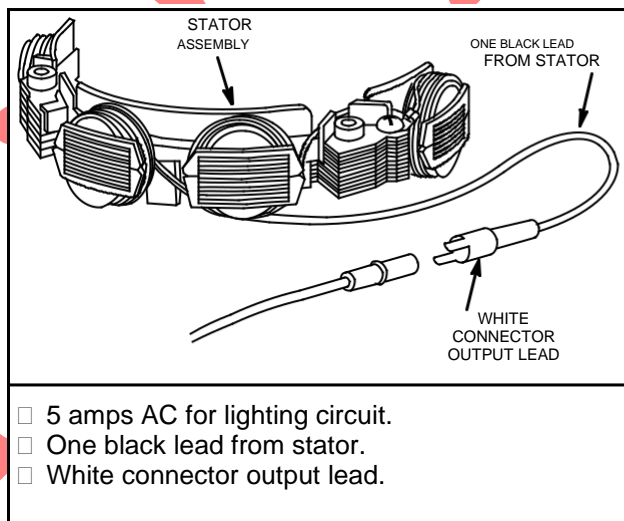
Table No. 1 provides a means of identifying the various alternator systems. Refer to test page for output specifications and test procedure.

**NOTE:** All output figures are rated at 3600 RPM.

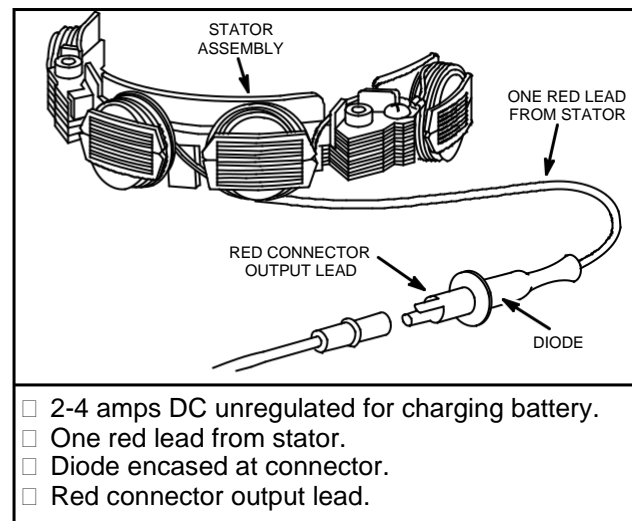
**TABLE NO. 1**

Fig.	Alternator Type	Stator Output Wire(s) Color	Connector Color	Alternator Output (at 3600 RPM)	Test Page
Fig. 1	AC Only	Black	White	5 Amps AC (Lights) Unregulated	6
Fig. 2	DC Only	Red	Red	2-4 Amps + DC (Charging) Unregulated	6
Fig. 3	Dual Circuit	Red Black	White	2-4 Amps + DC (Charging) 5 Amps AC (Lights) Unregulated	7
Fig. 4	Tri-Circuit	Black	Green	5 Amps + DC (Charging) 5 Amps – DC (Lights)	8
Fig. 5	Regulated 5 Amp	Black	Green	*1-5 Amps + DC (Charging) Regulated	10
Fig. 5	Regulated 9 Amp	Black	Green	*1-9 Amps + DC (Charging) Regulated	10
Fig. 6	Regulated 10 Amp	2-Black	Yellow	* 1-10 Amps + DC (Charging) * Regulated	10
Fig. 6	Regulated 13 Amp	2-Black	Yellow	* 1-13 Amps + DC (Charging) * Regulated	10
Fig. 6	Regulated 16 Amp	2-Black	Yellow	* 1-16 Amps + DC (Charging) * Regulated	10
Fig. 7	Quad Circuit	2-Black	Yellow	1-8 Amps + DC (Charging) Regulated 8 Amps – DC (Lights) Unregulated	14

\* Alternator output is determined by flywheel alternator magnet size.



**Fig. 1 – AC Only Stator**



**Fig. 2 – DC Only Stator**

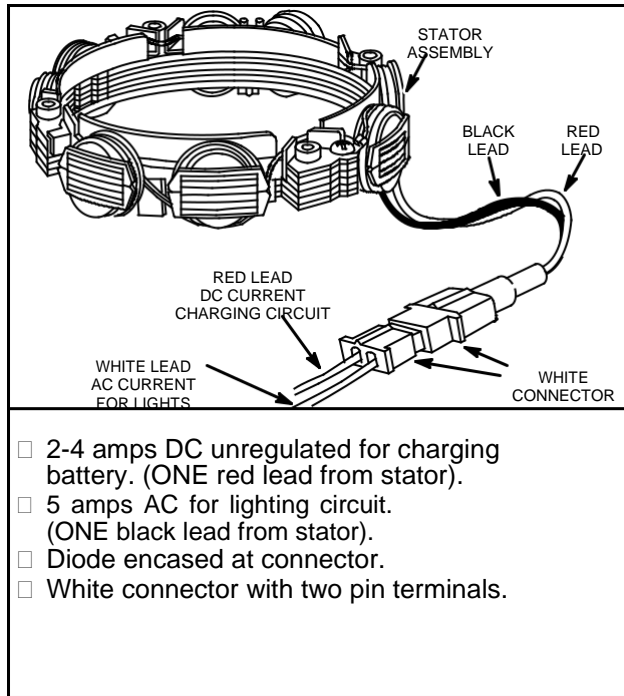


Fig. 3 – Dual Circuit Stator

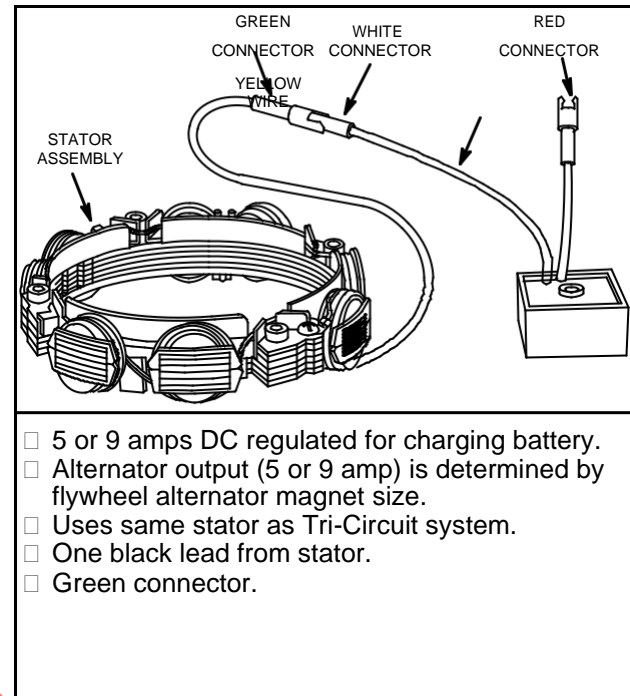


Fig. 5 – 5 or 9 Amp Regulated Stator

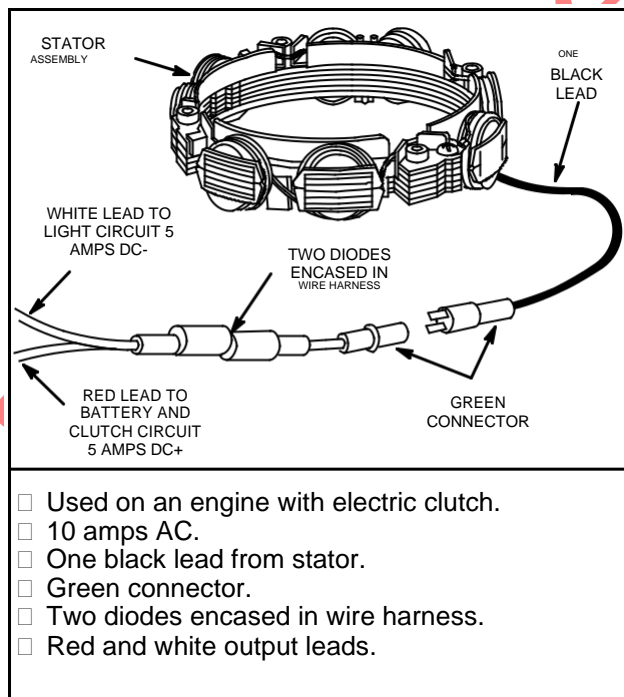


Fig. 4 – Tri-Circuit Stator

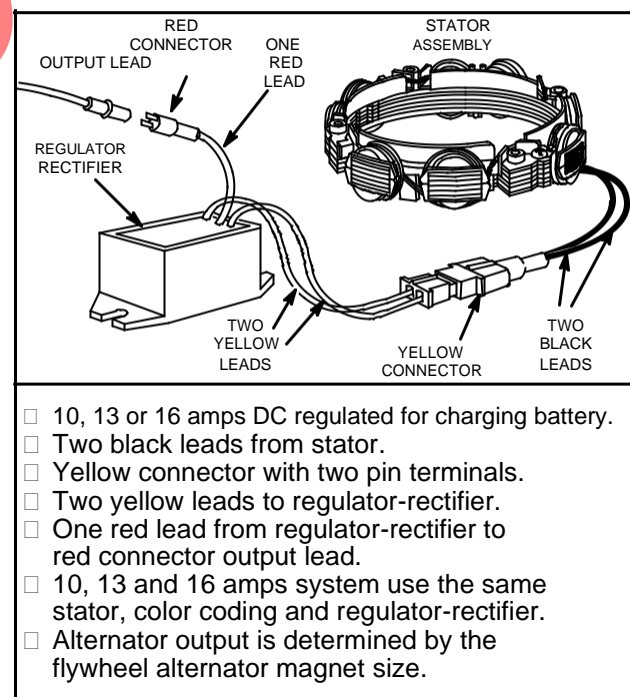
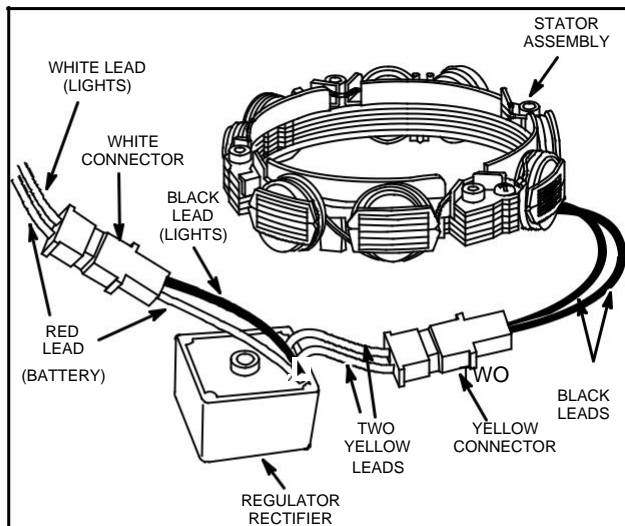
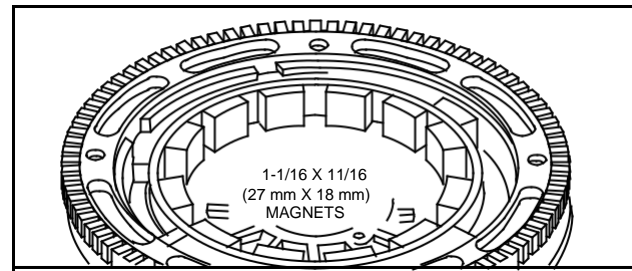


Fig. 6 – 10, 13, or 16 Amp Regulated Stator

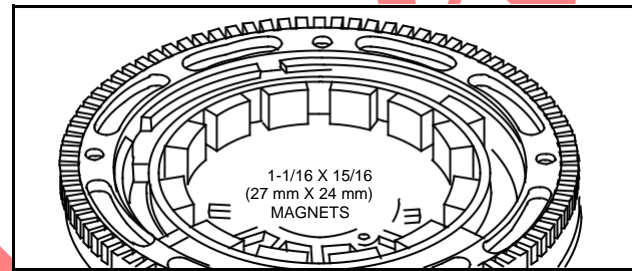


- ☐ 16 amps AC from stator to regulator-rectifier. Two black leads from stator.
- ☐ Yellow connector with two pin terminals.
- ☐ Two yellow leads to regulator-rectifier.
- ☐ One red lead from regulator-rectifier to white connector (regulated, 8 amps + DC).
- ☐ One black lead from regulator-rectifier to white connector (unregulated, 8 amps – DC).
- ☐ Quad circuit system uses the same stator as the 10, 13 and 16 amps regulated system.
- ☐ Alternator output is determined by the flywheel alternator magnet size.

**Fig. 7 – Quad-Circuit Stator**



**Fig. 9 – Medium Magnet**



**Fig. 10 – Large Magnet**

TWIN II Flywheels (with Nylon Fans) have either the small or large magnets. Table 2 identifies the magnet size to be used with a specific alternator system.

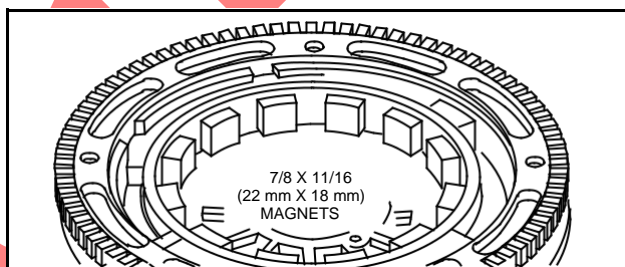
**TABLE NO. 2**

Alternator Style	Small Magnet	Medium Magnet	Large Magnet
AC Only	<input type="checkbox"/>		
DC Only	<input type="checkbox"/>		
Dual Circuit	<input type="checkbox"/>		
Tri-Circuit	<input type="checkbox"/>		
Regulated 5 Amp	<input type="checkbox"/>		
Regulated 9 Amp			<input type="checkbox"/>
Regulated 10 Amp	<input type="checkbox"/>		
Regulated 13 Amp		<input type="checkbox"/>	
Regulated 16 Amp			<input type="checkbox"/>
Quad Circuit			<input type="checkbox"/>

**NOTE:** Medium or large magnet flywheels should not be used with the AC only, DC only, Dual Circuit and Tri-Circuit alternator systems.

## FLYWHEEL IDENTIFICATION

Twin Cylinder Flywheels have a single ring of magnets which provide the magnetic field for the various alternator systems. There are three (3) sizes of flywheel magnets. The size of the magnet determines the alternator output, Fig. 8, 9 and 10.



**Fig. 8 – Small Magnet**



## TROUBLESHOOTING

The following list is provided to aid you in diagnosing problems with alternator systems.

COMPLAINT	POSSIBLE CAUSES
"Battery not charging"	<ul style="list-style-type: none"> <li><input type="checkbox"/> Engine RPM too low.</li> <li><input type="checkbox"/> Defective battery.</li> <li><input type="checkbox"/> Loose or corroded battery ground leads.</li> <li><input type="checkbox"/> Loose or corroded battery charge leads.</li> <li><input type="checkbox"/> Open, shorted or grounded wires between output connector and battery.</li> <li><input type="checkbox"/> Defective diode (open or shorted).</li> <li><input type="checkbox"/> Defective or improperly grounded regulator-rectifier.</li> <li><input type="checkbox"/> Diode installed incorrectly (reversed).</li> <li><input type="checkbox"/> Damaged battery (shorted battery cells).</li> <li><input type="checkbox"/> Excessive current draw from accessories.</li> <li><input type="checkbox"/> Low magnetic flux or damaged alternator magnets.</li> </ul>
"Battery in state of overcharge"	<ul style="list-style-type: none"> <li><input type="checkbox"/> Severe battery vibration (missing or broken tie down straps).</li> <li><input type="checkbox"/> Battery rate of charge not matched to alternator output.</li> <li><input type="checkbox"/> Damaged battery (shorted battery cells).</li> <li><input type="checkbox"/> Defective regulator.</li> <li><input type="checkbox"/> One OHM resistor shorted or grounded (Tri-Circuit system only).</li> </ul>
"Headlamps not working"	<ul style="list-style-type: none"> <li><input type="checkbox"/> Inline fuse "blown" (if equipped).</li> <li><input type="checkbox"/> Defective headlamps.</li> <li><input type="checkbox"/> Loose or corroded wires.</li> <li><input type="checkbox"/> Open, shorted or grounded wires between output connector and headlamps.</li> <li><input type="checkbox"/> Light switch defective.</li> <li><input type="checkbox"/> Defective diode Tri-Circuit system (open or shorted – white output lead side).</li> <li><input type="checkbox"/> Low magnetic flux or damaged alternator magnets.</li> </ul>
"Electric clutch not working" (Tri-Circuit Alternator)	<ul style="list-style-type: none"> <li><input type="checkbox"/> Inline fuse "blown" (if equipped).</li> <li><input type="checkbox"/> Loose or corroded wires.</li> <li><input type="checkbox"/> Open, shorted or grounded wires between output connector and electric clutch.</li> <li><input type="checkbox"/> Defective diode (open or shorted – red output lead side).</li> <li><b>NOTE: Battery will also not charge.</b></li> <li><input type="checkbox"/> Defective electric clutch switch.</li> <li><input type="checkbox"/> Open, shorted or grounded clutch circuit.</li> <li><input type="checkbox"/> Low magnetic flux or damaged alternator magnets.</li> </ul>

### TEST EQUIPMENT

The following equipment is recommended to test and repair alternators.

#### Digital Multimeter And DC Shunt

The Digital Multimeter is available from your Briggs & Stratton source of supply. Order as Tool #19357 or #19390. The meter may be used to read volts, ohms or amperes, and test diodes, when leads are inserted in the appropriate receptacle, Fig. 11.

The Digital Multimeter will withstand DC input of 10 – 20 Amps for up to **30** seconds. When checking DC output on 16 Amp regulated system, use the DC shunt,

Tool #19359, to avoid blowing fuse in meter, Fig. 12.

**NOTE:** The Digital Multimeter is equipped with two fuses to prevent damage to the meter in the event that the input limits are exceeded. If the meter displays a reading of 0.00 when testing DC output **A** (—), check fuses in meter. Refer to FLUKE 23 Operators Manual for procedure for check-ing fuses. Replacement fuse is available from your Briggs & Stratton source of supply. Order Part No. 19449.



## ALTERNATOR OUTPUT TESTING

When checking alternators make the tests in the following sequence.

1. Test alternator output.
  2. Test diode(s) or regulator-rectifier (if equipped).
- Connect meter test leads before starting engine. All output tests are performed with engine running. Diode test is performed with engine **NOT** running.

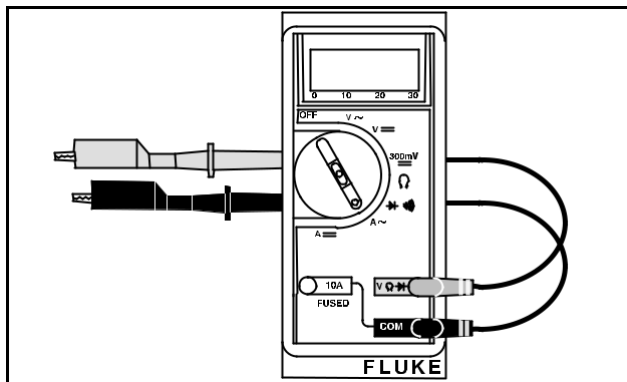


Fig. 11 – Digital Multimeter

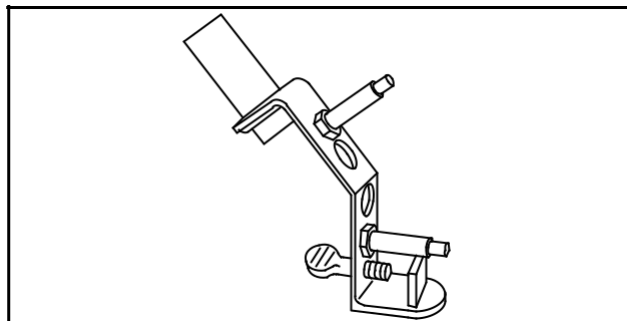


Fig. 12 – DC Shunt – Tool No. 19359

**NOTE:** Before testing the alternator's output (volts, amps), first use an accurate tachometer and temporarily adjust the engine speed to the RPM specified in the test instructions.



**WARNING:** UPON COMPLETION of the alternator output test, always readjust the engine rpm to its correct top no load governed speed! Otherwise engine may exceed safe operating speed which could cause personal injury. Correct speed is found in the Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052.

### AC ONLY ALTERNATOR

The AC alternator provides current for headlights only. Current for the lights is available as long as the engine is running. The output depends upon engine speed. 12 volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 14 volts at 3600 RPM, so the brightness of the light changes with the engine speed.

### AC Output Test

1. Insert RED test lead into  $V\Omega \rightarrow$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $V\sim$  (AC volts) position.
4. Attach RED test lead clip to AC output terminal, Fig. 13.
5. Attach BLACK test lead clip to engine ground.
6. With engine running at 3600 RPM, AC output should be no less than 14 volts.

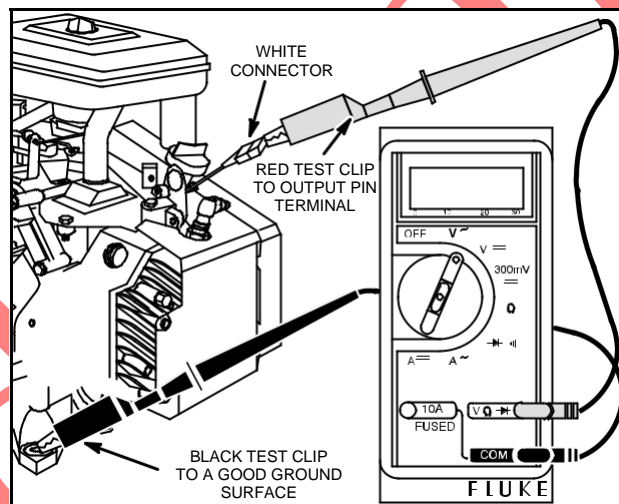


Fig. 13 – Testing AC Output

### DC ONLY ALTERNATOR

The DC alternator provides DC current for charging a 12 volt battery. The current from the alternator is unregulated and is rated at 3 amps. The output rises from 2 amps at 2400 RPM to 3 amps at 3600 RPM.

Recommended battery sizes range from 30 ampere hour for warm temperature service to 50 ampere hour in coldest service.

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE THE TEST IN THE FOLLOWING SEQUENCE:

### Alternator Output Test

1. Insert RED test lead into 10 A receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $A\sim$  (DC amps) position.
4. Attach RED test lead clip to DC output terminal, Fig. 14.
5. Attach BLACK test lead clip to positive (+) battery terminal.
6. With engine running at 3600 RPM, output should be between 2 – 4 amps DC.
  - a. Output will vary with battery voltage. If battery voltage is at its maximum, output will be approximately 2 amps.
7. If no or low output is found, test diode.

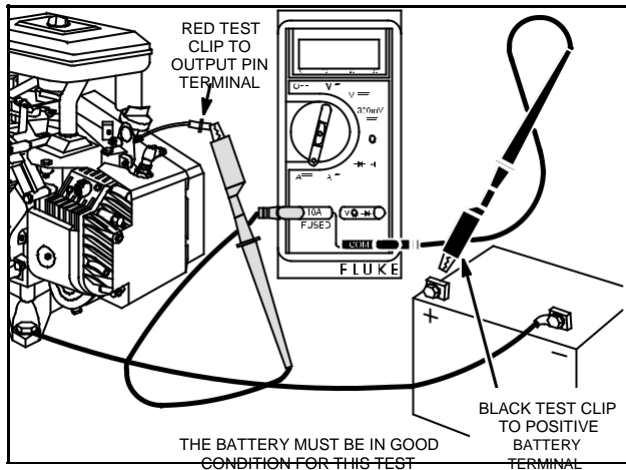


Fig. 14 – Testing DC Output

### Diode Test

In the Diode Test position, the meter will display the forward voltage drop across the diode(s). If the voltage drop is less than 0.7 volts, the meter will “Beep” once as well as display the voltage drop. A continuous tone indicates continuity (shorted diode). An incomplete circuit (open diode) will be displayed as “OL.”

1. Insert RED test lead into  $V\Omega\rightarrow$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $\rightarrow$  (Diode Test) position.
4. Attach RED test lead clip to point “A” and Black test lead clip to point “B,” Fig. 15. (It may be necessary to pierce wire with a pin as shown.)
  - a. If meter “Beeps” once, diode is OK.
  - b. If meter makes a continuous tone, diode is defective (shorted). Replace.
  - c. If meter displays “OL,” proceed to step 5.
5. Reverse test leads.
  - a. If meter “Beeps” once, diode is installed back-wards.
  - b. If meter still displays “OL,” diode is defective (open). Replace.
6. If diode tests OK, check stator for bare wires or other obvious defects. If grounded leads are not visible, replace the stator.

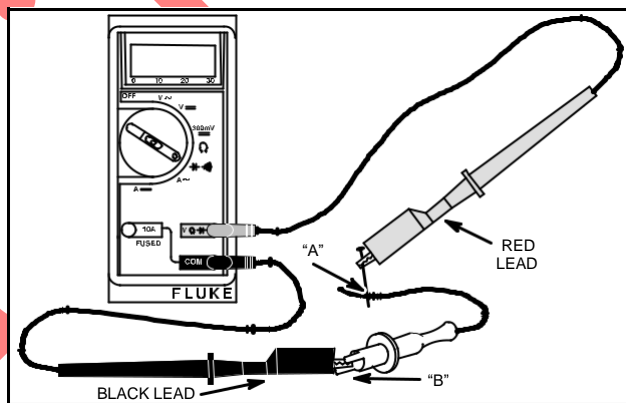


Fig. 15 – Testing Diode

**NOTE:**Service replacement diode harnesses are available. Use Rosin Core solder when installing new harness. Use shrink tubing or tape all connections. DO NOT USE CRIMP CONNECTORS.

### DUAL CIRCUIT ALTERNATOR

Dual circuit alternators use a single polarized plug with two pins. One pin is for charging the battery and the second is for the AC light circuit.

The dual circuit alternator provides DC current for battery charging and an independent AC circuit for headlights. The battery is not used for lights, so lights are available even if the battery is disconnected or removed.

Current for lights is available as long as the engine is running. The output depends upon engine speed, so brightness of the lights changes with engine speed. 12 volt lights with a total rating of 60 to 100 watts may be used. With lights rated at 70 watts, the voltage rises from 8 volts at 2400 RPM to 14 volts at 3600 RPM.

The current from the DC side of the alternator is unregulated and is rated at 3 amps. The output rises from 2 amps at 2400 RPM to 3 amps at 3600 RPM.

WHEN CHECKING THE ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

### Alternator Output Test

1. Insert RED test lead into 10 A receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $A$  (DC amps) position.
4. Attach RED test lead clip to DC output pin in connector, Fig. 16.
5. Attach BLACK test lead clip to positive (+) battery terminal.

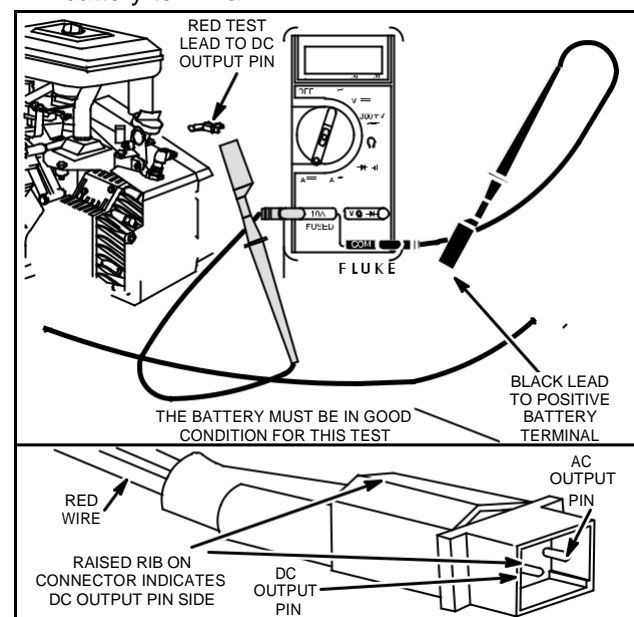


Fig. 16 – Testing DC Output

6. With engine running at 3600 RPM output should be between 2 – 4 amps DC.
  - a. Output will vary with battery voltage. If battery voltage is at its maximum, output will be approximately 2 amps.
7. If no output or low output is found, test diode.

### Diode Test

In the Diode Test position, the meter will display the forward voltage drop across the diode(s). If the voltage drop is less than 0.7 volts, the meter will “Beep” once as well as display the voltage drop. A continuous tone indicates continuity (shorted diode) An incomplete circuit (open diode) will be displayed as “OL.”

1. Insert RED test lead into  $V\Omega \rightarrow$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $\rightarrow$  (Diode Test) position.
4. Attach RED test lead clip to point “A” and BLACK test lead clip to point “B,” Fig. 17. (It may be necessary to pierce wire with a pin as shown.)
  - a. If meter “Beeps” once, diode is OK.
  - b. If meter makes a continuous tone, diode is defective (shorted). Replace.
  - c. If meter displays “OL,” proceed to step 5.
5. Reverse test leads.
  - a. If meter “Beeps” once, diode is installed back-wards.
  - b. If meter still displays “OL,” diode is defective (open). Replace.
6. If diode tests OK, check stator for bare wires or other obvious defects. If grounded leads are not visible, replace the stator.

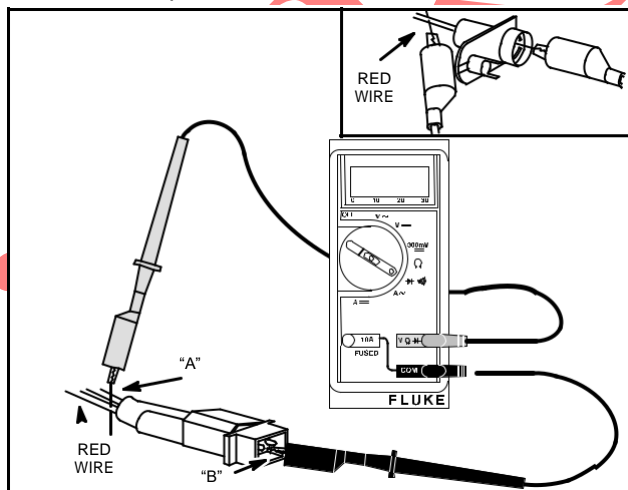


Fig. 17 – Testing Diode

**NOTE:**Service replacement diode harnesses are available. Use Rosin Core solder when installing new harness. Use shrink tubing or tape all connections. DO NOT USE CRIMP CONNECTORS.

### AC Output Test

1. Insert RED test lead into  $V\Omega \rightarrow$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $V\sim$  (AC volts) position.
4. Attach RED test lead clip to AC output terminal, Fig. 18.
5. Attach BLACK test lead clip to engine ground.

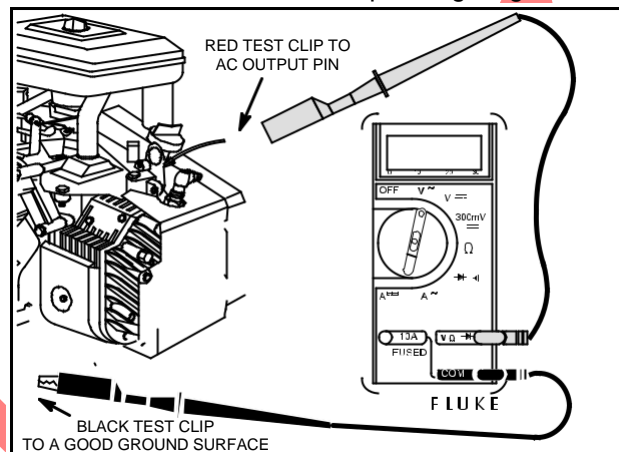


Fig. 18 – Testing AC Output

1. With engine running at 3600 RPM output should be no less than 14 volts AC.
2. If no output or low output is found, replace stator.

### TRI-CIRCUIT ALTERNATOR

The Tri-Circuit alternator provides alternating current through a single output lead and connector to a wiring harness containing two diodes.

One diode rectifies the AC current to 5 Amps – (negative) DC for lights. The second diode rectifies the AC current to 5 Amps + (positive) DC for battery charging and external loads, such as an electric clutch.

**NOTE:**Some equipment manufacturers supply the diodes as an integral part of the equipment wiring harness.

A 1 Ohm 20 Watt resistor is placed in series with the (+) DC charging lead, limiting the charging current to approximately 3 amps when the clutch is not engaged. When the clutch is engaged the resistor is bypassed allowing full output to the battery and clutch.

**NOTE:**The 1 Ohm 20 Watt resistor is supplied by the equipment manufacturer.

The battery is not used for the lights, so lights are available even if the battery is disconnected or removed. Current for the lights is available as long as the engine is running. The output depends upon engine RPM, so the brightness of the lights changes with engine speed.

WHEN CHECKING THE ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

### Alternator Output Test

1. Insert RED test lead into  $V\Omega$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $V\sim$  (AC volts) position.
4. Attach RED test lead clip to output terminal, Fig. 19.
5. Attach BLACK test lead clip to engine ground.

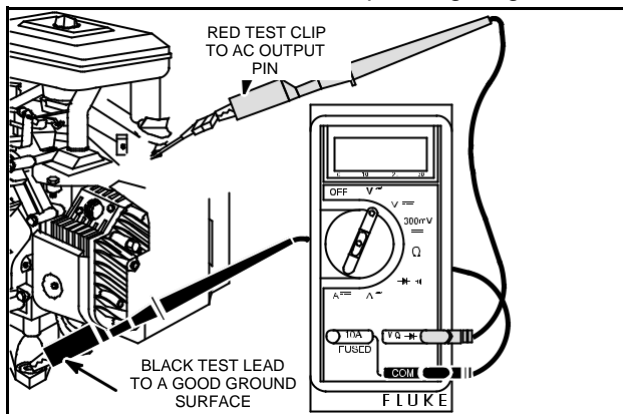


Fig. 19 – Testing Alternator Output

6. With engine running at 3600 RPM, output should be no less than 28 Volts AC.
7. If no output or low output is found, replace stator.
8. If alternator output is good, test diodes located in wiring harness.

### Diode Test

**NOTE:** One diode is for the charging circuit and the other diode is for the lighting circuit.

In the Diode Test position, the meter will display the forward voltage drop across the diode(s). If the voltage drop is less than 0.7 volts, the meter will “Beep” once as well as display the voltage drop. A continuous tone indicates continuity (shorted diode). An incomplete circuit (open diode) will be displayed as “OL.”

### Charging Circuit (Red Wire)

1. Insert RED test lead into  $V\Omega$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $\rightarrow$  (Diode Test) position.
4. Attach BLACK test lead clip to point “A,” Fig. 20. (It may be necessary to pierce wire with a pin as shown.)
5. Insert RED test lead probe into harness connector.
  - a. If meter “Beeps” once, diode is OK.
  - b. If meter makes a continuous tone, diode is defective (shorted). Replace.
  - c. If meter displays “OL,” proceed to step 6.

6. Reverse test leads.
  - a. If meter “Beeps” once, diode is installed back-wards.
  - b. If meter still displays “OL,” diode is defective (open).

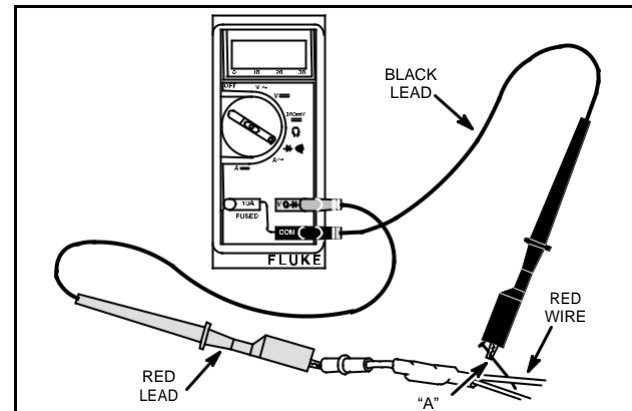


Fig. 20 – Diode Testing – Charging Circuit  
Lighting Circuit (White Wire)

1. Insert RED test lead into  $V\Omega$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $\rightarrow$  (Diode Test) position.
4. Attach RED test lead clip to point “A,” Fig. 21. (It may be necessary to pierce wire with a pin as shown.)
5. Insert BLACK test lead probe into harness connector.
  - a. If meter “Beeps” once, diode is OK.
  - b. If meter makes a continuous tone, diode is defective (shorted). Replace.
  - c. If meter displays “OL,” proceed to step 6.
6. Reverse test leads.
  - a. If meter “Beeps” once, diode is installed back-wards.
  - b. If meter still displays “OL,” diode is defective (open).

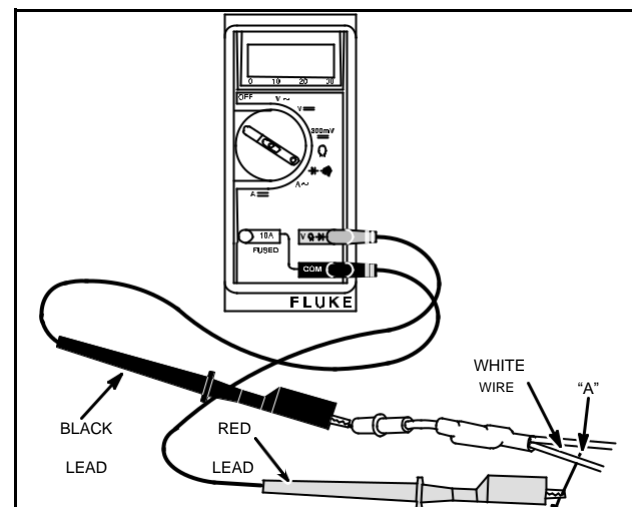


Fig. 21 – Diode Testing – Lighting Circuit



**NOTE:**Service replacement diode harnesses are available.

## 5 & 9 AMP REGULATED ALTERNATOR

The 5 & 9 amp regulated alternator systems provide AC current through a single lead to the regulator-rectifier. The regulator-rectifier converts the AC current to DC, and regulates current to the battery. The charging rate will vary with engine RPM and temperature.

Alternator output (5 or 9 amp) is determined by the flywheel alternator magnet size. The stator and regulator-rectifier are the same for the 5 & 9 amp system.

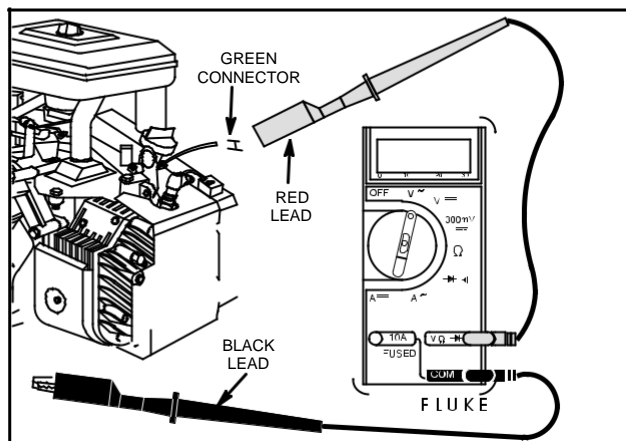
The 5 & 9 amp regulated system and the Tri-Circuit system use the same stator.

**WHEN CHECKING ALTERNATOR COMPONENTS, MAKE TESTS IN THE FOLLOWING SEQUENCE:**

### Alternator Output Test

Temporarily, disconnect stator wire harness from regulator-rectifier.

1. Insert RED test lead into  $V\Omega \rightarrow +$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $V\sim$  (AC volts) position.
4. Attach RED test lead clip to output terminal, Fig. 22.
5. Attach BLACK test lead clip to engine ground.



**Fig. 22 – Testing AC Output**

6. With the engine running at 3600 RPM, AC output should be no less than:  
**28 Volts AC – 5 Amp System**  
**40 Volts AC – 9 Amp System**
7. If no or low output is found, replace the stator.

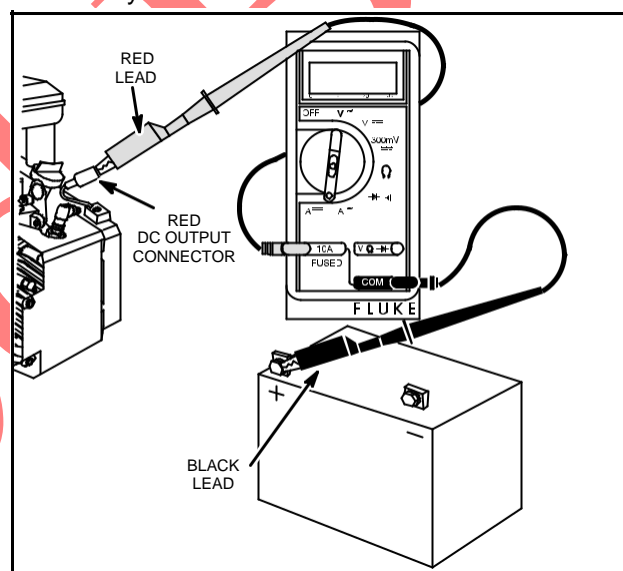
### Test Regulator-Rectifier

**NOTE:**Regulator-rectifier will not function unless it is grounded to engine. Make sure the regulator-rectifier is securely mounted to engine.

When testing regulator-rectifier for amperage output, a 12 volt battery with a minimum charge of 5 volts is required. There will be no charging output if battery voltage is below 5 volts.

**NOTE:**Connect test leads before starting engine. Be sure connections are secure. If a test lead vibrates loose while engine is running, the regulator-rectifier may be damaged.

1. Insert RED test lead into 10 A receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $A\equiv$  (DC amps) position.
4. Attach RED test lead clip to DC output terminal on regulator-rectifier, Fig. 23.
5. Attach BLACK test lead clip to positive (+) battery terminal.



**Fig. 23 – Testing Regulator-Rectifier**

6. With the engine running at 3600 RPM. The output should be:  
**\* 3 – 5 Amps – 5 Amp System**  
**\* 3 – 9 Amps – 9 Amp System**

\* Depending upon battery voltage and/or current draw on system.

7. If no or low output is found, be sure that regulator-rectifier is grounded properly and all connections are clean and secure. If there is still no or low out-put, replace the regulator-rectifier.

## 10, 13 OR 16 AMP REGULATED ALTERNATOR

The 10, 13 or 16 amp regulated alternator system provides AC current through two output leads to the regulator-rectifier. The regulator-rectifier converts the AC current to DC, and regulates the current to the battery. The charging rate will vary with engine RPM and temperature.

Alternator output (10, 13 or 16 Amp) is determined by flywheel alternator magnet size. Therefore, stator and regulator-rectifier are the same for the 10 and 16 amp system.

WHEN CHECKING THE ALTERNATOR COMPONENTS, MAKE THE TESTS IN THE FOLLOWING SEQUENCE:

### Alternator Output Test

1. Insert RED test lead into  $V \Omega \rightarrow$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $V \sim$  (AC volts) position.
4. Insert RED and BLACK test lead probes into out-put terminals in yellow connector, as shown in Fig. 24. (Meter test clip leads may be attached to either terminal.)

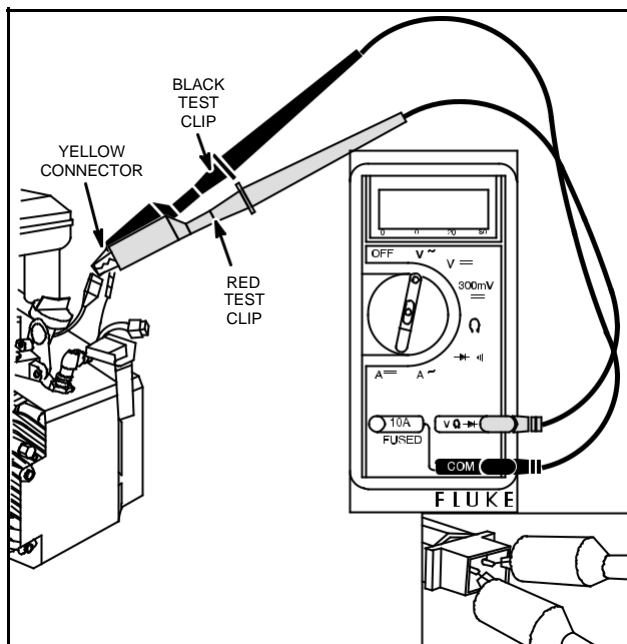


Fig. 24 – Testing AC Output

5. With the engine running at 3600 RPM, output should be no less than:

\* 20 Volts – 10 Amp System

20 Volts – 13 Amp System

\* 30 Volts – 16 Amp System

\* If alternator output test indicates a 16 Amp system, see special instructions for testing regulator-rectifier.

6. If no or low output is found, check for bare wires or any other obvious defects. If “shorted” leads are not visible, replace the stator.

### Regulator-Rectifier Test

**NOTE:**The Digital Multimeter will withstand DC input of 10 – 20 Amps for up to 30 seconds. When checking DC output of 16 Amp

regulated system, use DC Shunt, Tool #19359, to avoid blowing fuse in meter. See special instructions for installation procedure on 16 Amp system, page 12.

**NOTE:**Regulator-rectifier will not function unless it is grounded to engine. Make sure the regulator-rectifier is securely mounted to engine.

When testing regulator-rectifier for amperage output, a 12 volt battery with a minimum charge of 5 volts is required. There will be no charging output if battery voltage is below 5 volts.

**NOTE:**Connect test leads before starting engine. Be sure connections are secure. If a test lead vibrates loose while engine is running, the regulator-rectifier may be damaged.

### Testing Regulator-Rectifier 10 & 13 Amp System

1. Insert RED test lead into 10 A receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to  $A \sim$  (DC amps) position.
4. Attach RED test lead clip to DC output terminal on regulator-rectifier, Fig. 25.
5. Attach BLACK test lead clip to positive (+) battery terminal.

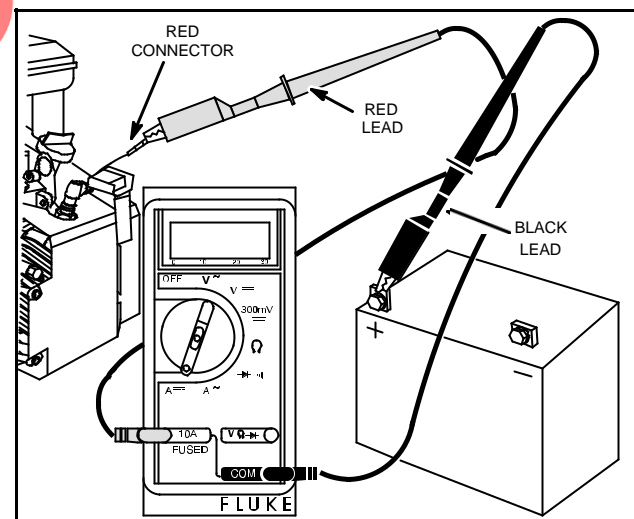


Fig. 25 – Testing Regulator-Rectifier

6. With the engine running at 3600 RPM. The output should be:

\* 3 – 10 Amps – 10 Amp System

\* 3 – 13 Amps – 13 Amp System

\* Depending upon battery voltage and/or current draw on system.

7. If no or low output is found, be sure that regulator-rectifier is grounded properly and all connections



are clean and secure. If there is still no or low output, replace the regulator-rectifier.

### Testing Regulator-Rectifier 16 Amp System

To avoid blowing fuse in meter when testing DC output of 16 Amp system the DC Shunt, Tool #19359, is required.

The DC Shunt **must** be installed on the **negative** (-) terminal of the battery, Fig. 26. All connections must be clean and tight for correct amperage readings.

1. Install shunt on negative battery terminal.
2. Insert RED test lead into  $V \Omega \rightarrow$  receptacle in meter and connect to RED post terminal on shunt, Fig. 26.
3. Insert BLACK test lead into COM receptacle in meter and connect to BLACK post terminal on shunt.
4. Rotate selector to **300mV** position.
5. With the engine running at 3600 RPM. The output should be:

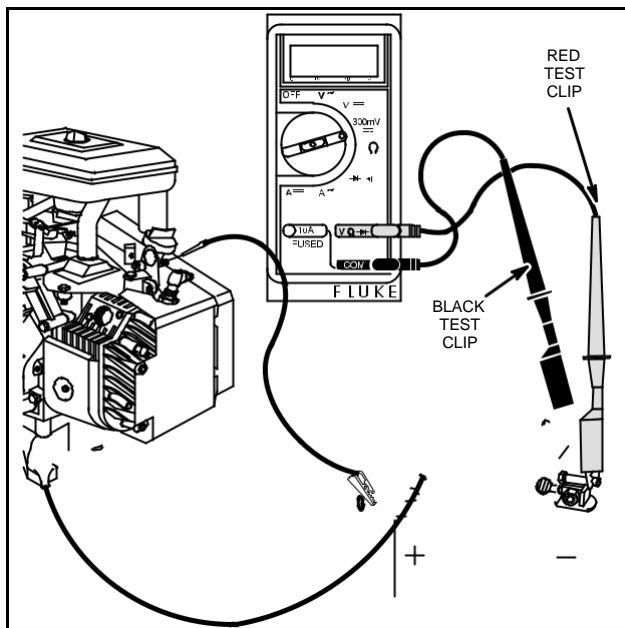


Fig. 26 – Testing Regulator-Rectifier 16 Amp System With DC Shunt

\* 3 – 16 Amps – 16 Amp System

\* Depending upon battery voltage and/or current draw on system.

6. If no or low output is found, be sure that regulator-rectifier is grounded properly and all connections are clean and secure. If there is still no or low output, replace the regulator-rectifier.

### Regulator-Rectifier With Charge Indicator

Regulator-rectifier Part #493219 is used by some equipment manufacturers that have a charging indicator light instead of an ammeter. In addition to the red DC output wire, the regulator-rectifier is equipped with a blue wire which is used to activate a charging indicator light when battery voltage is below 12 volts.

The charging indicator light should light when the key switch is in the ON position; engine not running. With engine running, the charging indicator light should go out, indicating that the charging circuit is operating, providing that battery voltage is above 12 volts.

The charge indicator light and all wiring is supplied by the equipment manufacturer. See typical wiring diagram, page 13.

DC charging output values and test procedures are the same as those listed for the 10 amp or 16 amp system.

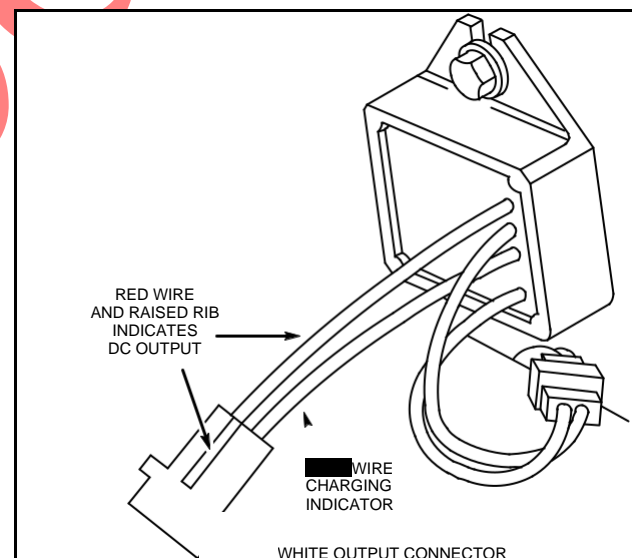
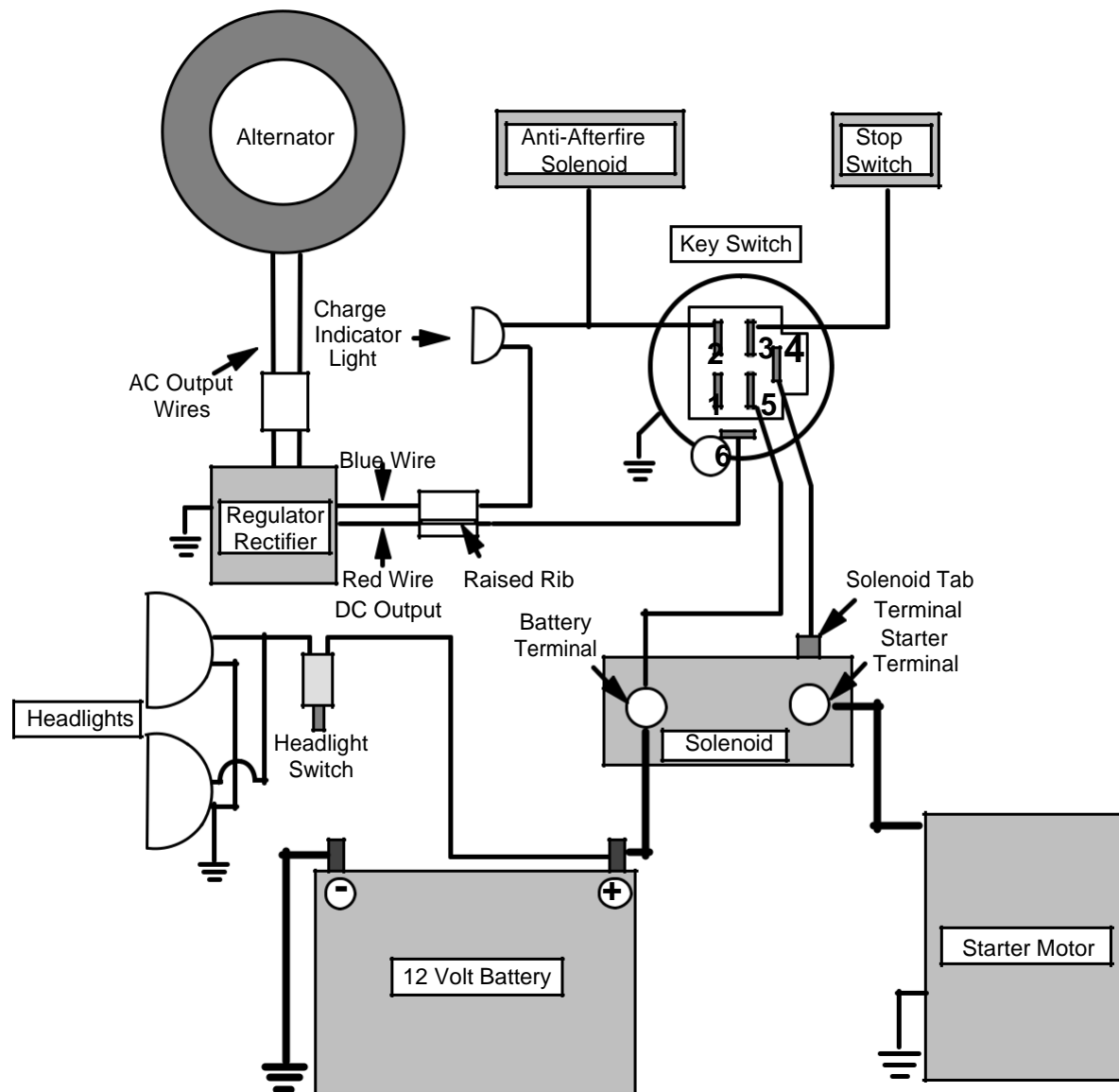


Fig. 27 – Part #493219 Regulator-Rectifier

## Typical 16 Amp Regulated Alternator Wiring Diagram – 6 Pole Switch With Charge Indicator Light



Key Switch Test	
Switch Position	Continuity
1. OFF	* 1 +3+6
2. RUN	2 +5+6
3. START	2 +4+5
* Terminal 1 Grounded Internally to Key Switch Case	

Terminal No.	Function
1	To Ground (used only with insulated panel)
2	To Carburetor Solenoid
3	To Stop Switch Terminal on Engine
4	To Solenoid (tab terminal)
5	To Battery (battery terminal on solenoid)
6	To Alternator (DC Output)

## Testing Charge Indicator

It is important that the test procedure be done in a systematic manner to identify whether the problem is related to the regulator-rectifier or the charging indicator wiring system. Follow test procedure in the sequence listed.

A known good battery is required for this test.

BEFORE TESTING THE CHARGING INDICATOR SYSTEM, TEST THE ALTERNATOR AND REGULATOR-RECTIFIER FOR CORRECT OUTPUT.

**NOTE:** Output values are the same as the 10 amp and 16 amp system.

### Symptom – Indicator Light Will Not Light – Key Switch On – Engine Not Running

A jumper wire is required for this test.

Make sure key switch is in OFF position before connecting jumper wire.

**IMPORTANT:** Before disconnecting output harness from connector, mark or identify the charging indicator wire in the output harness. If jumper wire contacts charging output wire during test while key switch is in ON position, wiring harness may be damaged.

1. Disconnect output harness at white connector.
2. Attach one end of jumper wire to a good ground.
3. Attach other end of jumper wire to charge indicator terminal in output harness connector, Fig. 28.
  - a. Turn key switch to ON position.
  - b. If bulb lights, charge indicator wiring system is OK. Replace regulator-rectifier.
  - c. If bulb does not light, replace bulb.
  - d. If new bulb does not light, the problem must be a broken wire (open circuit) in charging indicator circuit. Refer to typical wiring diagram, page 13.

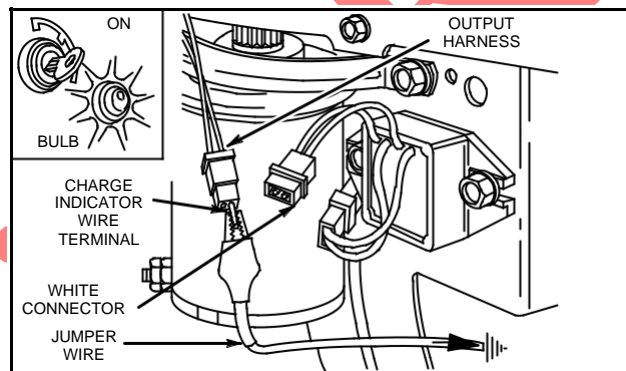


Fig. 28 – Testing Charge Indicator

### Symptom – Indicator Light Stays On – Engine Running

**NOTE:** Indicator light will remain on if battery voltage is below 12 volts.

1. Check indicator light wiring.
  - a. If wiring is grounded, light will remain on when engine is running.
  - b. If wiring is OK, replace regulator-rectifier.

## QUAD CIRCUIT ALTERNATOR

The quad circuit alternator system provides AC current through two output leads to the regulator-rectifier. The regulator-rectifier converts AC current to DC and provides regulated current (8 amps + DC) for charging the battery and unregulated current (8 amps – DC) for lighting. The charging rate will vary with engine RPM and temperature.

**NOTE:** The quad circuit and 10 – 16 amp regulated system use the same stator.

WHEN CHECKING ALTERNATOR COMPONENTS, MAKE TESTS IN THE FOLLOWING SEQUENCE:

### Alternator Output Test

1. Insert RED test lead into  $V\Omega$  receptacle in meter.
2. Insert BLACK test lead into COM receptacle in meter.
3. Rotate selector to V~ (AC volts) position.
4. Attach RED test lead clip to one of the output pins in the yellow connector, Fig. 29.
5. Attach BLACK test lead clip to the other output pin. (Test lead clips may be attached to either output pin.)
6. With engine running at 3600 RPM, AC output should be no less than 30 volts AC.
7. If no or low output is found, replace stator.

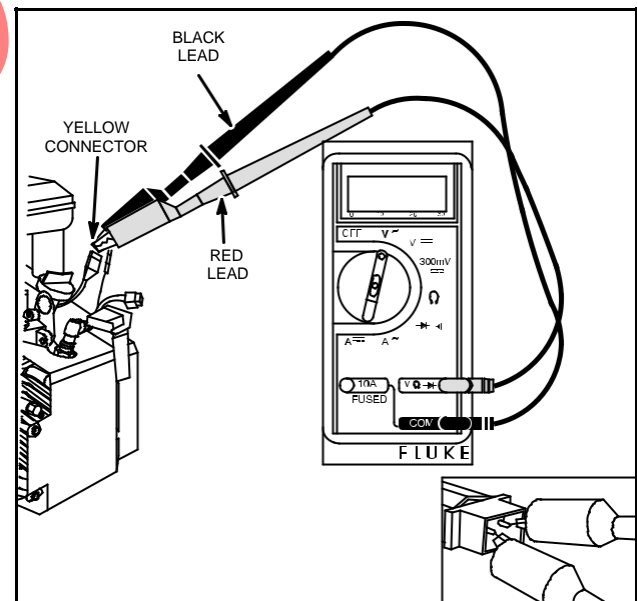


Fig. 29 – Testing AC Output

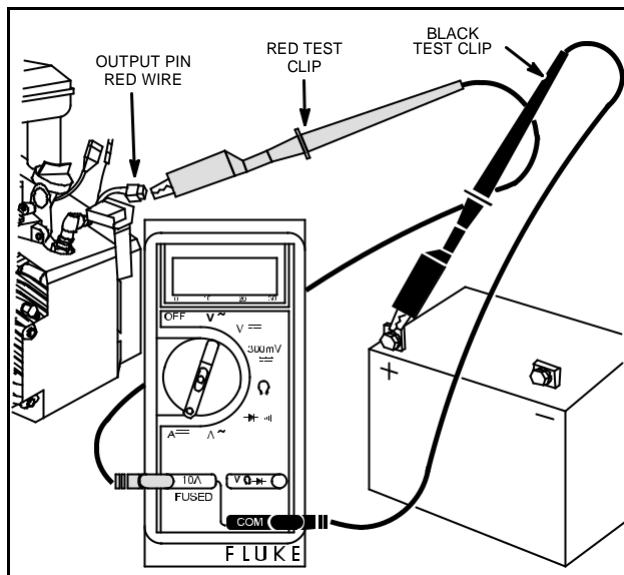
### Testing Regulator-Rectifier Test Charging Circuit (+DC)

**NOTE:** Regulator-rectifier will not function unless it is grounded to engine. Make sure the regulator-rectifier is securely mounted to engine.

When testing regulator-rectifier for amperage output a 12 volt battery with a minimum charge of 5 volts is required. There will be no charging output if battery voltage is below 5 volts.

**NOTE:** Connect test leads before starting engine. Be sure connections are secure. If a test lead vibrates loose while engine is running, regulator-rectifier may be damaged.

1. Insert RED test lead into 10 A receptacle in meter.
2. Inset BLACK test lead into COM receptacle in meter.
3. Rotate selector to **A** (DC amps) position.
4. Attach RED test lead clip to charging output pin (red wire), Fig. 30.
5. Attach BLACK test lead clip to positive (+) battery terminal.



**Fig. 30 – Testing Regulator Output**

6. With engine running at 3600 RPM output should be 3 to 8 amps.

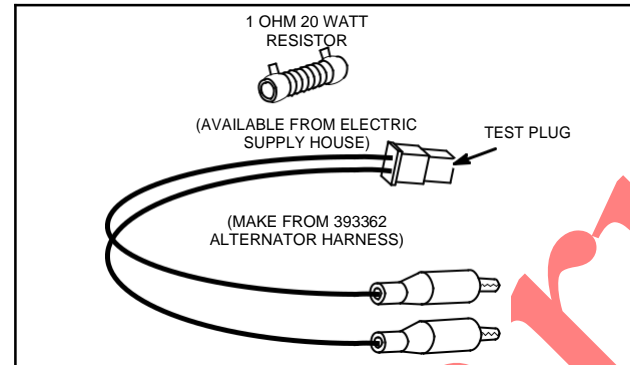
Amperage will vary with battery voltage, for example, if battery voltage was below 11 volts output reading would be approximately 8 amps. If battery voltage is at its maximum, the amperage will be less.

7. If no output or low output is found, replace regulator-rectifier.

### Test Lighting Circuit (-DC)

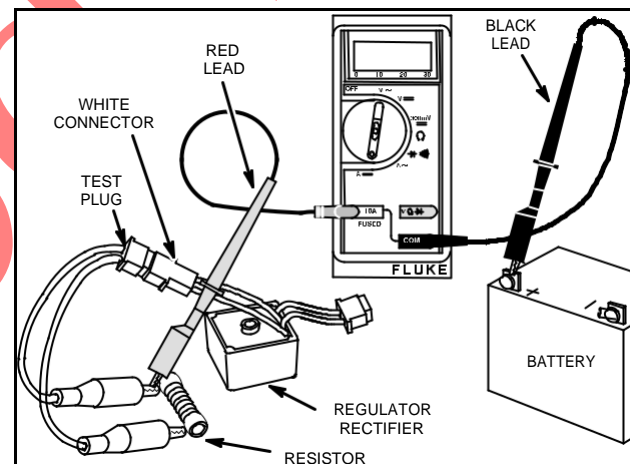
The black wire from the regulator-rectifier provides 8 amps (-) DC and is used only for lighting. If the headlights do not operate, make sure that the problem is not with the bulbs, wiring and/or light switch.

To test the lighting circuit the following tools are required Fig. 31.



**Fig. 31 – Test Equipment**

1. Insert RED test lead into 10 A receptacle in meter.
2. Inset BLACK test lead into COM receptacle in meter.
3. Rotate selector to **A** (DC amps) position.
4. Connect test harness to output connector and attach alligator clips to 1 ohm 20 watt resistor as shown in Fig. 32.
5. Attach RED test lead clip to resistor, and BLACK test lead clip to positive (+) battery terminal.



**Fig. 32 – Testing Lighting Circuit**

6. With engine running at 3600 RPM output on the meter should be approximately 8 amps.
7. If no output or low output is found, replace the regulator-rectifier.

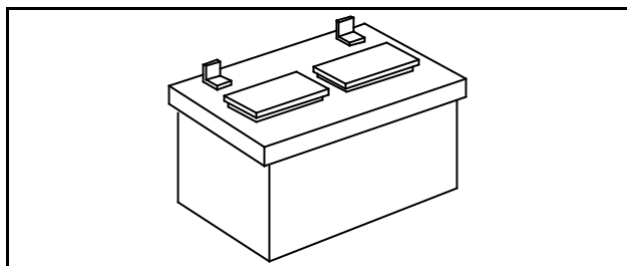


**CAUTION: CONDUCT TEST AS QUICKLY AS POSSIBLE. RESISTOR GETS HOT!**

### BATTERIES

The battery supplied by equipment manufacturers used with Briggs & Stratton Twin Cylinder Engines is of the 12 volt, lead acid-wet cell type. This type is available as a maintenance free or dry charge battery.

The maintenance-free battery is filled with electrolyte at the time of manufacture. The level of electrolyte can not be checked, Fig. 33.



**Fig. 33 – Typical Wet Charge Battery**

The dry charged battery is manufactured with fully charged plates. Electrolyte must be added at the time that the battery is placed in service. Before activating a dry charged battery, read and follow the manufacturer's recommended procedure.

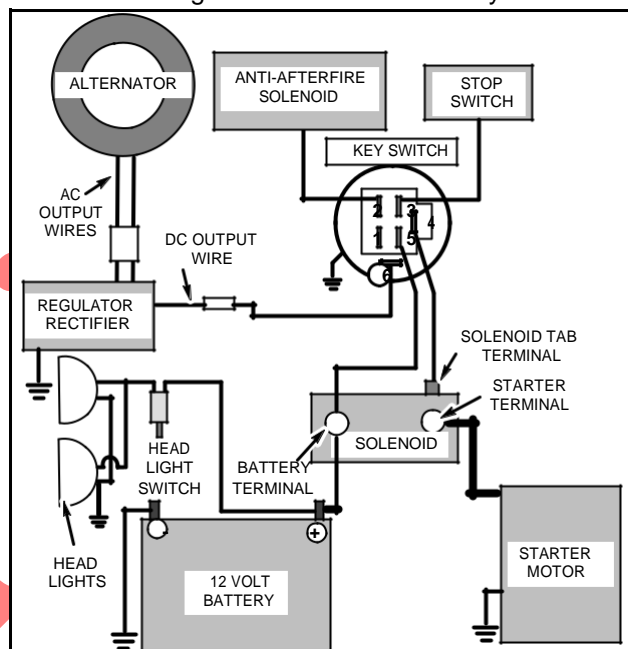
Recommended battery sizes range from a minimum 30 ampere hour for warm temperature service to 50 ampere hour in coldest service.



**WARNING: BATTERIES PRODUCE HYDROGEN, AN EXPLOSIVE GAS.** Do not store, charge or use a battery near an open flame or devices which utilize a pilot light or can create a spark.

### Installation

1. Before installing battery, connect all equipment to be operated. Fig. 34.
2. Place battery in holder with a flat base. Tighten hold downs evenly until snug. **DO NOT** over tighten.
3. Connect positive terminal to positive post **FIRST** to prevent sparks from accidental grounding. Tighten connectors securely.
4. Connect negative terminal to negative battery terminal. Tighten connectors securely.



**Fig. 34 – Typical 12 V Wiring Diagram**

### Checking Battery

1. Physical check – clean if necessary.
  - a. Corrosion
  - b. Dirt
  - c. Terminal and clamps (secure – good conditions)

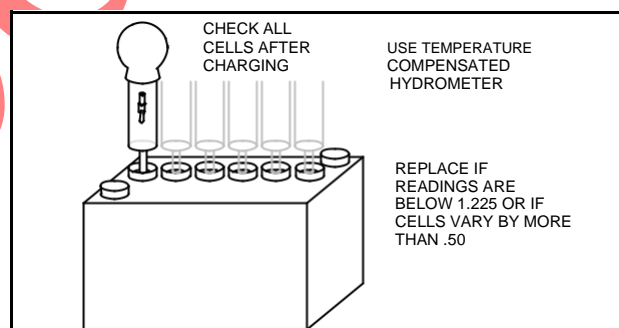
2. Bring battery to full charge.

**DO NOT EXCEED CHARGE RATE OF 1/10 AMPERE** for every ampere of battery rating! **CONSULT BATTERY MANUFACTURER** for charging **REC-OMMENDATIONS**. Over charging may cause battery failure.

- a. Use a taper charge (automatically reduces charge rate).
- b. Fill battery cells with distilled water or tap water (unless maintenance free type) after charging (for batteries that have been in service).

**NOTE:** If battery gets "hot" to the touch or is spitting acid (gassing) excessively, unplug charger periodically.

3. With battery fully charged, check specific gravity readings (unless maintenance free type) of each cell with a Battery Hydrometer and record readings (Fig. 35).



**Fig. 35 – Checking 12 V Battery Cells (Lead Acid, Wet Cell, With Fill Caps)**

All readings should be above 1.250 (compensating for temperature). If specific gravity readings varied .50 or if **ALL** cells read less than 1.225, replace battery.

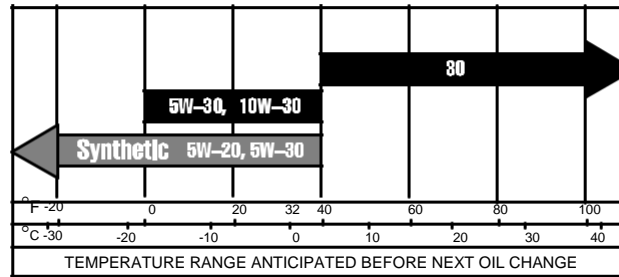
# Section 8

## LUBRICATION

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### OIL RECOMMENDATIONS



Use a high quality detergent oil classified "For Service SE" or higher. Use no special additives with recommended oils.

### DESCRIPTION

Two types of lubrication systems are available on Briggs & Stratton "L" head twin cylinder engines:

1. Splash Lube
2. Pressure Lube

The splash lube system consists of a gear driven oil slinger on vertical crankshaft models or connecting rod dipper(s) on horizontal crankshaft models.

The pressure lube system consists of a direct drive oil pump which supplies oil to all bearing journals. Model Series 400440, 400770, 402440, 402770, 404440, 404770, 422440, 422770 and 462770 engines are equipped with a pressure lubrication system with an attached or remote (optional) replaceable oil filter.

### Change Oil – Splash Lube Engines

The crankcase capacity of twin cylinder engines without oil filters is approximately three pints.

**NOTE:** Early production engines had approximately 3-1/2 pint (1.65 liter) oil capacity. Use dipstick to check oil level.

**IMPORTANT:** DO NOT OVERFILL. Check and maintain oil level regularly. Change oil after first eight (8) hours of operation.

Thereafter, change oil every fifty (50) hours of operation. Change oil more often if engine is operated in dirty or dusty conditions or if engine is operated under heavy loads or in high ambient air temperatures.

Remove oil drain plug and drain oil while engine is still warm, Fig. 1 and Fig. 2. Replace drain plug. Remove dipstick and refill slowly with new oil of proper service classification and viscosity grade. Refill to full mark on dipstick. When checking oil level, dipstick must be screwed all the way in for accurate readings. Start and run engine to check for oil leaks.

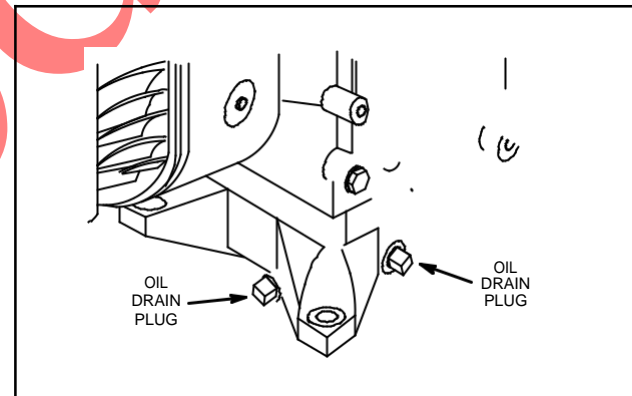


Fig. 1 – Horizontal Crankshaft Engine

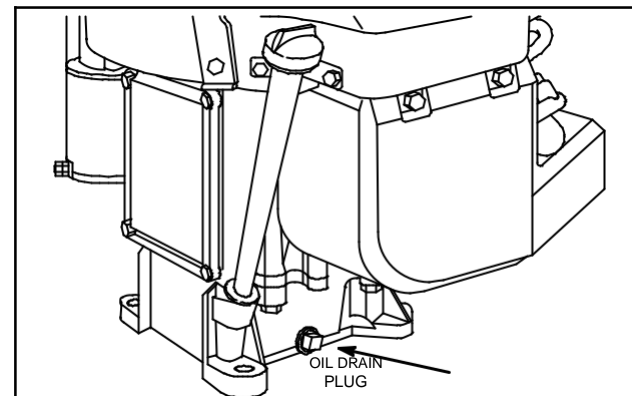


Fig. 2 – Vertical Crankshaft Engine

### Change Oil – Pressure Lube Engines

The crankcase capacity of pressure lube twin cylinder engines is approximately:

**3-1/2 Pints (1.65 liters) with filter**

**3 Pints (1.42 liters) without filter**

**IMPORTANT:** DO NOT OVERFILL. Check and maintain oil level regularly. Change oil after first five (5) hours of operation.

**NOTE:** When checking oil level, dipstick must be screwed all the way in for accurate readings.

Thereafter, change oil every fifty (50) hours of operation. Change oil more often if engine is operated in dirty or dusty conditions or if engine is operated under heavy loads or in high ambient air temperatures. Remove oil drain plug and drain oil while engine is still warm, Fig. 1 and Fig. 2. Replace drain plug.

### Change Oil Filter

Replace oil filter every 100 hours of operation. Before installing new filter, lightly oil filter gasket with fresh clean engine oil. Screw filter on by hand until gasket contacts filter adapter. Tighten 1/2 to 3/4 turn more, Fig. 3.

Remove dipstick and refill slowly with new oil of proper service classification and viscosity grade. Start and run engine to check for oil leaks.

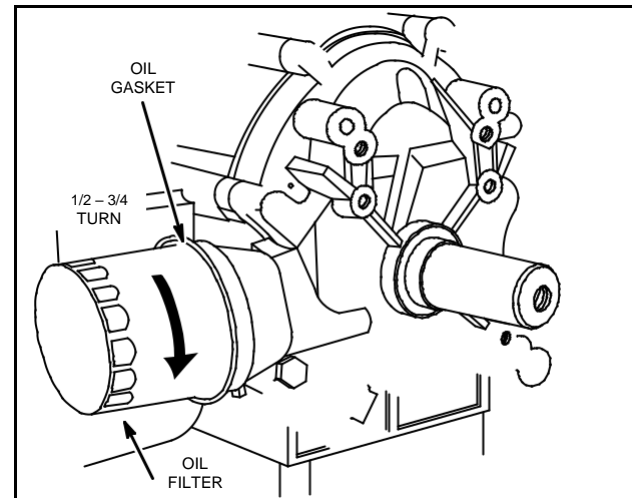


Fig. 3 – Install Oil Filter

### OIL FILL TUBE AND DIPSTICK

The oil fill tube and the dipstick are equipped with “O”-rings and/or a grommet for proper sealing, Fig. 4.

**NOTE:** A leak at the seal between the tube and sump, or at the seal at the upper end of the dipstick, can result in a loss of crankcase vacuum and a discharge of oil or smoke through the muffler.

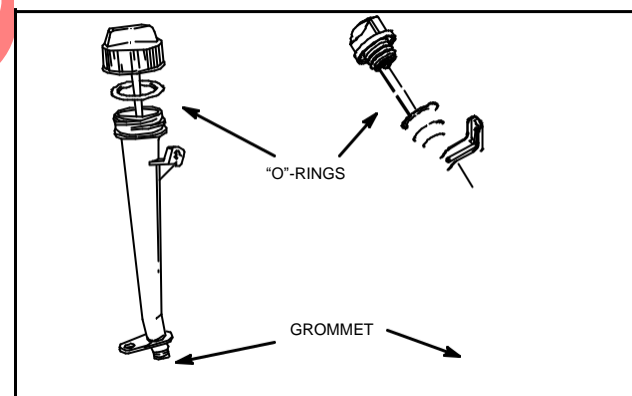


Fig. 4 – Oil Fill Tube And Dipstick (Typical)

### CRANKCASE BREATHER

The engine utilizes a breather valve to control and maintain a vacuum in the crankcase. The breather vents crankcase vapors through the air cleaner.

Horizontal crankshaft twin cylinder engines manufactured after 91080000 have only one breather valve and breather tube: for #1 cylinder, Fig. 5.

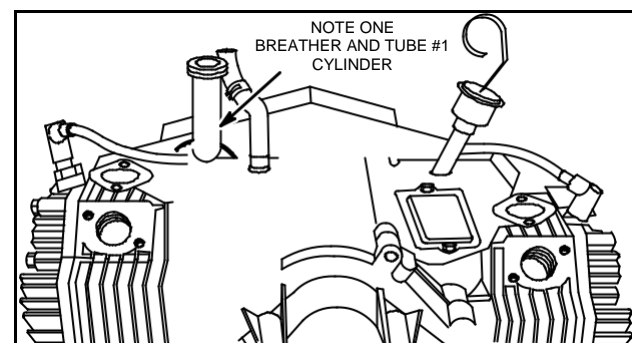
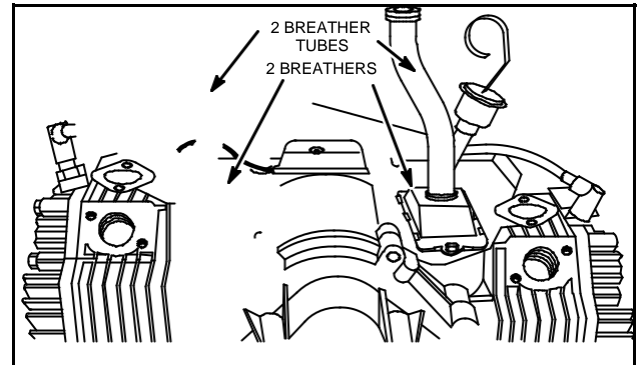


Fig. 5 – Horizontal Crankshaft Models  
After Date Code 91080000

Horizontal crankshaft twin cylinder engines manufactured before 91080000 have a breather valve in each cover assembly and two (2) breather tubes, Fig. 6.

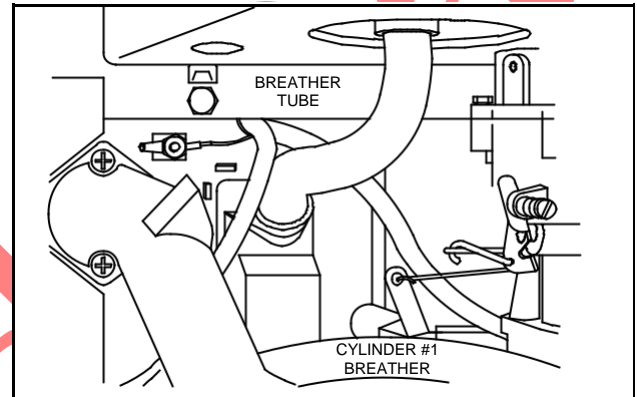


**Fig. 6 – Horizontal Crankshaft Models Before Date Code 91080000**

Vertical crankshaft twin cylinder engines have only one breather valve and breather tube: for #1 cylinder, Fig. 7.

### Remove Breather

Before tappet and breather valve assemblies can be removed for inspection, the air cleaner, carburetor and intake manifold must be removed. See Section 3. On horizontal crankshaft engines with two breathers, it is necessary to remove the dipstick tube before the air guide can be removed from #2 cylinder, Fig. 6.

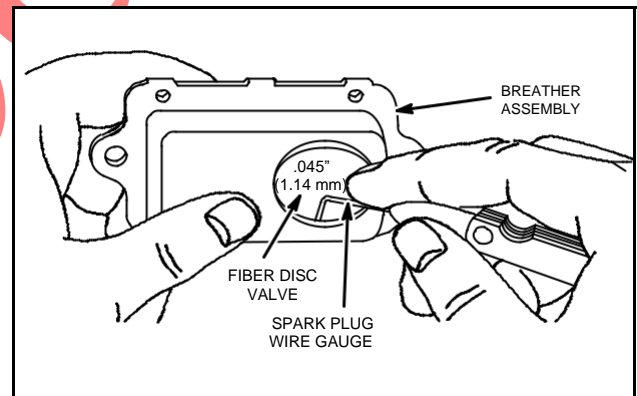


**Fig. 7 – Vertical Crankshaft Models (Typical)**

### Check Breather

If the fiber disc valve is stuck or binding, the breather must be replaced. A .045" (1.14 mm) wire gauge should not enter the spacer between the fiber disc valve and body, Fig. 8.

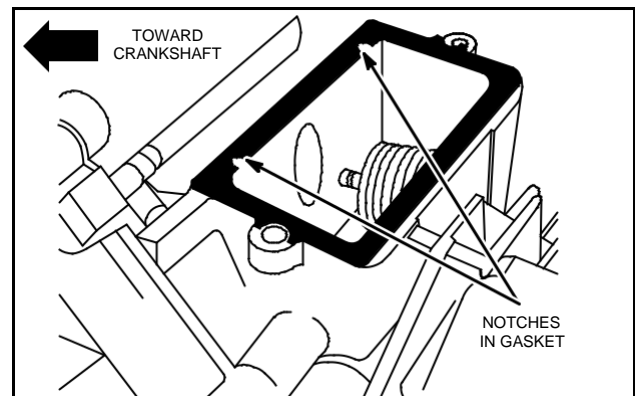
DO NOT USE FORCE ON FIBER DISC.



**Fig. 8 – Checking Breather**

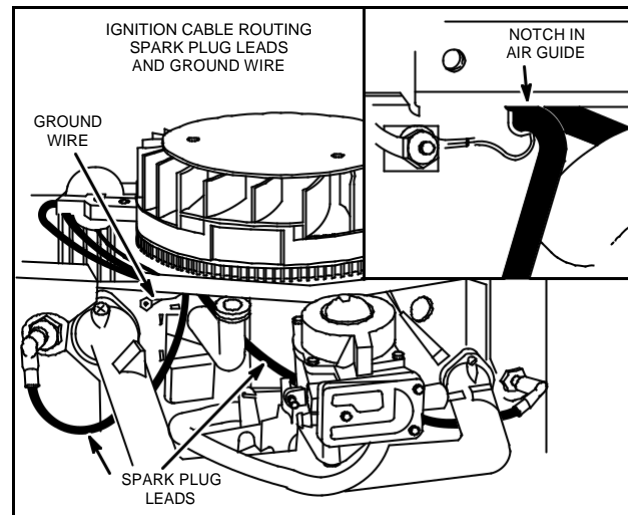
### Installing Breathers – General

Install new breather gasket(s) with notches facing crankshaft, Fig. 9.



**Fig. 9 – Gasket Location**

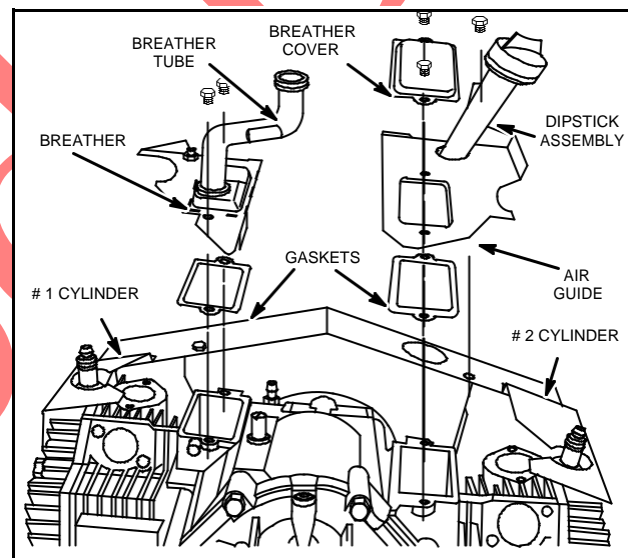
Route the spark plug leads and ground and primary (breaker point engines) wire through the notch in air guide, # 1 cylinder side, Fig. 10.



**Fig. 10 – Routing of Ignition Wires**

### **Install Breather – All Vertical Crankshaft Models & Horizontal Crankshaft Models After Code 91080000**

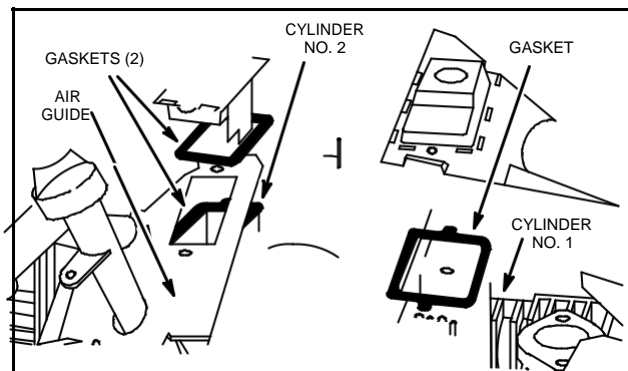
Install one gasket between valve chamber and air guide, #2 cylinder. Then install cover. To install breather, place one gasket between the valve chamber and breather, #1 side, Fig. 11.



**Fig. 11 – Installing Breathers After Date Code 91080000**

### **Install Breathers – Horizontal Crankshaft Models Before Code 91080000**

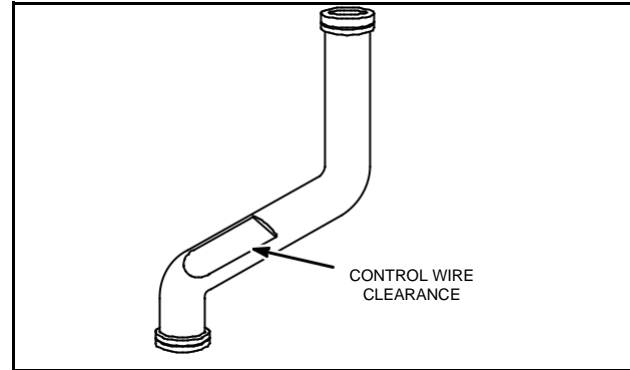
Install one gasket between valve chamber and breather, #1 side. To install #2 cylinder breather, place one gasket between the valve chamber and air guide. Place second gasket between air guide and breather, Fig. 12.



**Fig. 12 – Installing Breathers Before Date Code 91080000**

### Inspect Breather Tube(s)

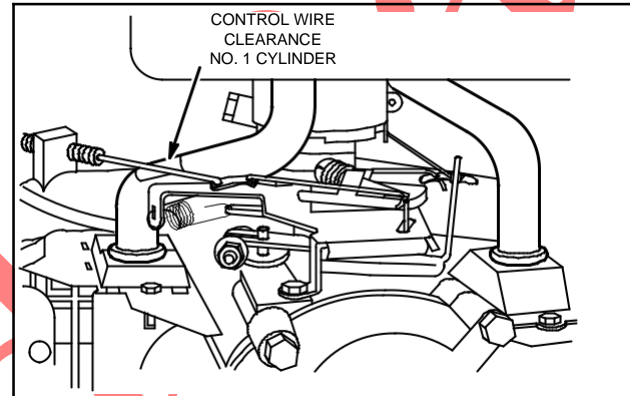
Breather tube(s) should be checked for cracks, holes or hardening. Replace, if damaged. Breather tube(s) on current (Twin II) horizontal crankshaft models can be identified by a molded flat area for remote control wire clearance, Fig. 13.



**Fig. 13 – Current Breather Tube(s)  
(Type Nos. 1100 & Above)**

Assemble breather tubes as shown in Fig. 14.

**NOTE:**On horizontal crankshaft engines, breath-er tube installation will be easier if breather tube(s) are assembled to air cleaner base first.



**Fig. 14 – Breather Tube Installation (Current)**

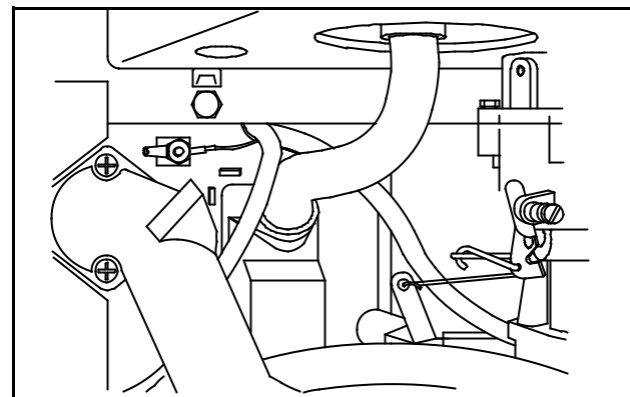
Breather tubes on Pre-Twin II horizontal crankshaft models are marked "Air Cleaner Side." Assemble as shown in Fig. 15.

**NOTE:**Early production breather tubes are not marked. If the breather tubes become kinked when lower air cleaner body is installed, tubes are upside down.



**Fig. 15 – Pre Twin II Horizontal Crankshaft  
(Type Nos. Below 1100)**

Vertical crankshaft breather tube installation shown in, Fig. 16.



**Fig. 16 – Breather Tube Installation  
Vertical Crankshaft**

Install breather tubes on filtered side of air cleaner element, Fig. 17. If breather tubes are incorrectly installed, premature engine wear will result.

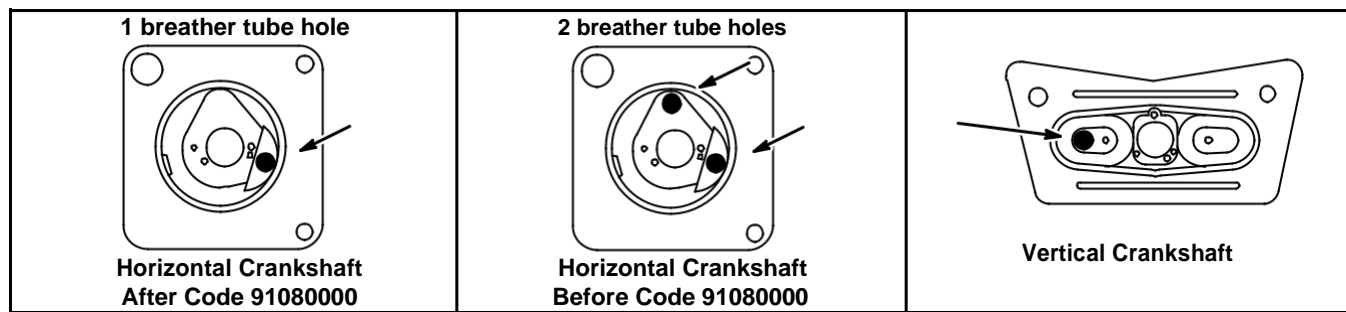


Fig. 17 – Breather Tube Installation

## SPLASH LUBE

### Horizontal Crankshaft Models – Oil Dipper

In a splash lubrication system, the oil dipper is attached to the connecting rod. On every crankshaft revolution, the dipper dips into the oil reservoir in the engine sump splashing oil on the internal moving parts.

#### Special Notes For Horizontal Crankshaft Splash Lube Engines:

**Engines with a Top-No-Load speed above 2400 RPM:** Install only one oil dipper on #1 connecting rod, Fig. 18. Use **ONLY** dipper part #222480. Engine models 421000 and 422400 manufactured before code date 92072000 were not originally equipped with this dipper. It is recommended that the oil dipper be replaced with dipper part # 222480 in all 421400 and 422400 engines at the time of major servicing or overhaul. When installing dipper part #222480 in these engines, the oil trough must be removed (if so equipped).

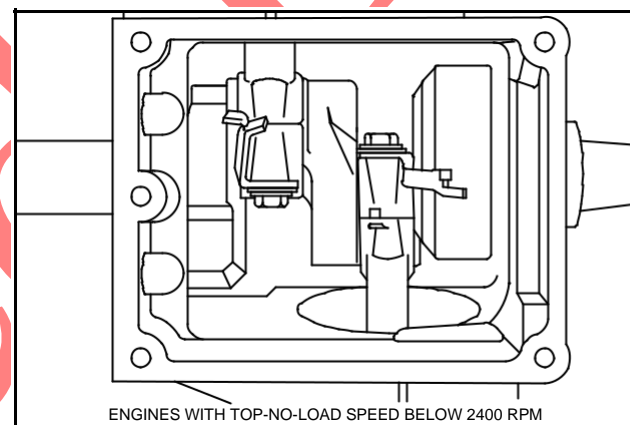


Fig. 18 – Dipper Location

**Engines with a Top-No-Load speed below 2400 RPM:** Engines with a Top No Load speed below 2400 RPM require 2 oil dippers. Install **ONLY** oil dipper Part #222480 on # 1 connecting rod. Install **ONLY** dipper Part #223053 on #2 connecting rod, Fig. 18.

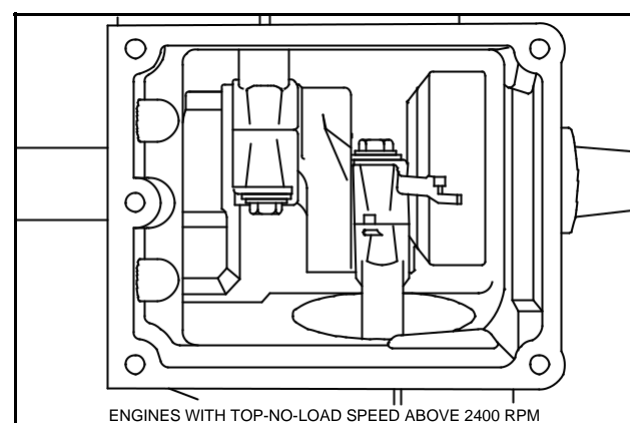


Fig. 19 – Dipper Location

### Install Oil Dipper

Oil dipper is installed as shown in Fig. 18 or Fig. 19.

Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.

**NOTE:**Engines equipped with Oil Gard use only **one** oil dipper part #222480; attached to #1 connecting rod.



### Oil Trough – Model Series 421400, 422400

Model Series 422400 manufactured before 89030000, and Model Series 421400 were equipped with an oil trough, with the dipper on #1 connecting rod, Fig. 20.

When replacing oil dipper with dipper #222480, the oil trough must be removed.

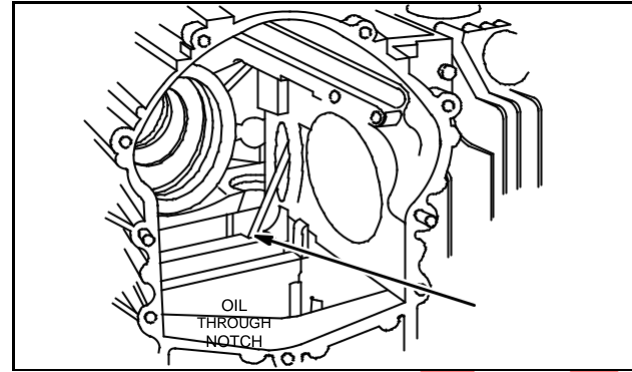


Fig. 20 – Oil Trough

### Vertical Crankshaft Models – Oil Slinger

In an oil slinger lubrication system, the oil slinger is driven by the engine camshaft, providing oil to the internal moving parts, Fig. 21.

#### Inspect Oil Slinger

Check oil slinger gears for broken paddles, cracked or chipped teeth and freedom of movement. Replace if damaged, Fig. 21.

The oil slinger is attached to the sump, Fig. 22.

**IMPORTANT:** When installing oil sump, governor gear, oil slinger assembly, on engine, rock crankshaft back and forth to ensure governor gear and oil slinger are meshed with cam gear. If governor gear and oil slinger are not meshed properly, engine failure may occur due to overspeeding or lack of lubrication.

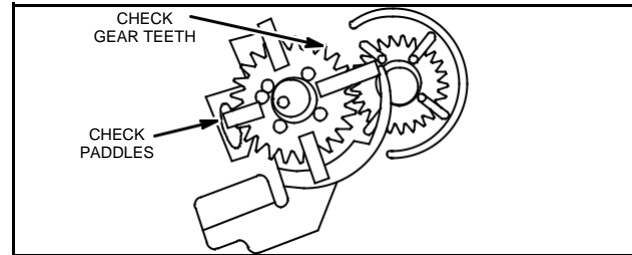


Fig. 21 – Slinger Assembly

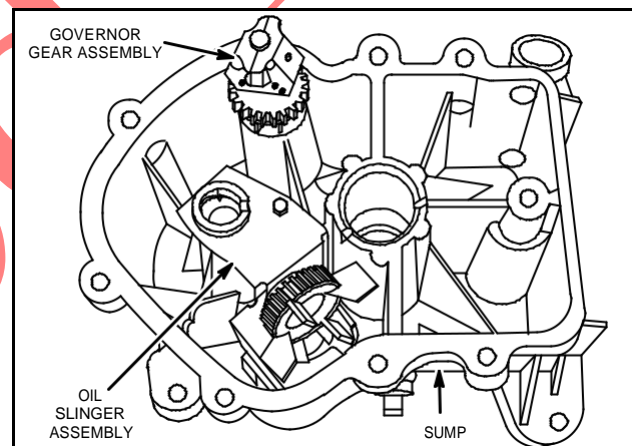


Fig. 22 – Oil Slinger Location

### OIL GARD

Oil Gard is a low oil warning system, available as an option, for splash lube, horizontal crankshaft, twin cylinder engines. It consists of a special sump base with a removable sensor which activates a warning device and/or, stops the engine, if a low oil condition occurs, Fig. 23. A 12 volt battery is required to operate the Oil Gard system.

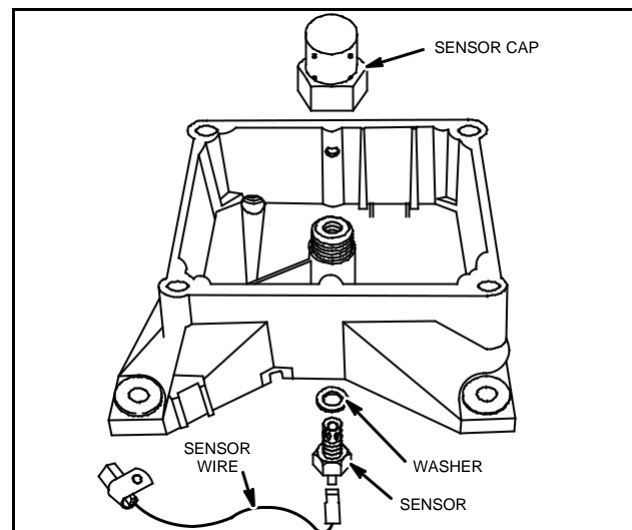


Fig. 23 – Oil Gard System

The sensor acts as a current limiting device in series with the 12 volt battery and warning device and/or stop switch. The sensor screws into a boss in the sump base and has a protective cap with metering holes that regulate the amount of crankcase oil that contacts the sensor. This prevents the warning device and/or, stop switch from being accidentally activated due to sudden changes of oil levels due to agitation or angle of operation, Fig. 24.

**NOTE:Engines equipped** with Oil Gard use only one dipper; attached to #1 connecting rod.

**NOTE:The warning** device and all related wiring is supplied by the equipment manufacturer.

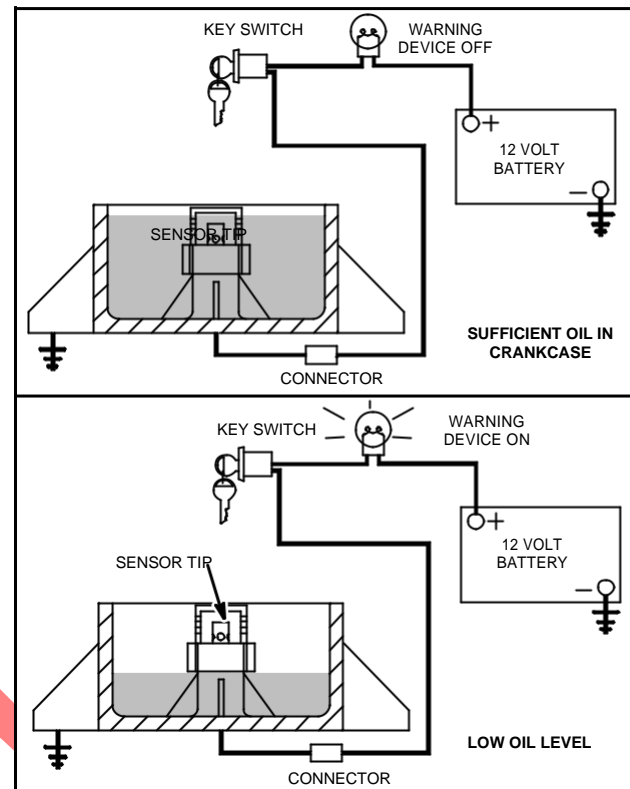


Fig. 24 – Typical Wiring Diagram

### Testing Oil Gard

Use Digital Multimeter, Tool #19390, or #19464. The Digital Multimeter is available from your Briggs & Stratton source of supply. The meter may be used to read volts, ohms or amperes, Fig. 25.

Engine must be stopped and at room temperature (60°F (15.5° C) or higher). Place equipment ignition switch in off position.

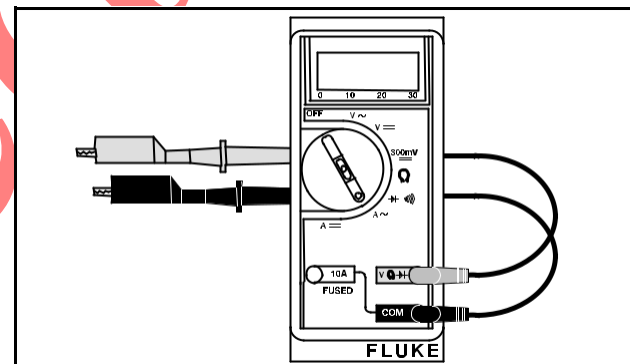


Fig. 25 – Digital Multimeter

1. Insert red test lead into receptacle in meter.
2. Insert black test lead into COM receptacle in meter.
3. Rotate selector to position.
4. Disconnect sensor wire at connector.
5. Connect one meter lead to sensor wire and other meter lead to ground, Fig. 26.
6. A meter reading of 50-80 ohms indicates that sensor is good.
7. If meter reading is below 50 ohms, replace sensor.
8. If meter reading shows continuity, check for a pinched and/or grounded sensor wire. Repair or replace sensor wire as required.
9. If meter reading is over 80 ohms, check connections for dirt or corrosion. Clean and retest. If meter reading is still over 80 ohms, replace sensor.

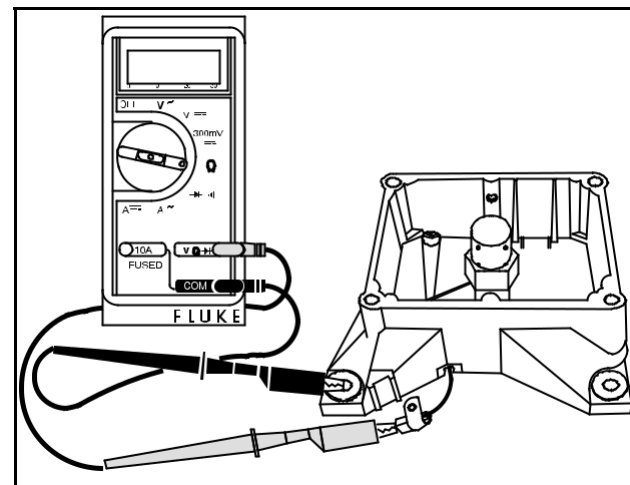


Fig. 26 – Oil Gard Sensor Test

## PRESSURE LUBE

Engine Models 400440, 400770, 402440, 402770, 404440, 404770, 422440, 422770 and 462770, are equipped with a full pressure lubrication system with an oil filter.

A direct drive oil pump supplies lubrication to all bearing journals at 10-50 psi (.0.7-3.4 Bar), Fig. 27, Fig. 29.

The oil pump draws oil through a screened pick up in the engine base and pumps the oil through the oil filter. The filtered oil flows through oil galleries (passages) in the crankcase cover or sump where it is distributed to the PTO bearing and cam gear bearing.

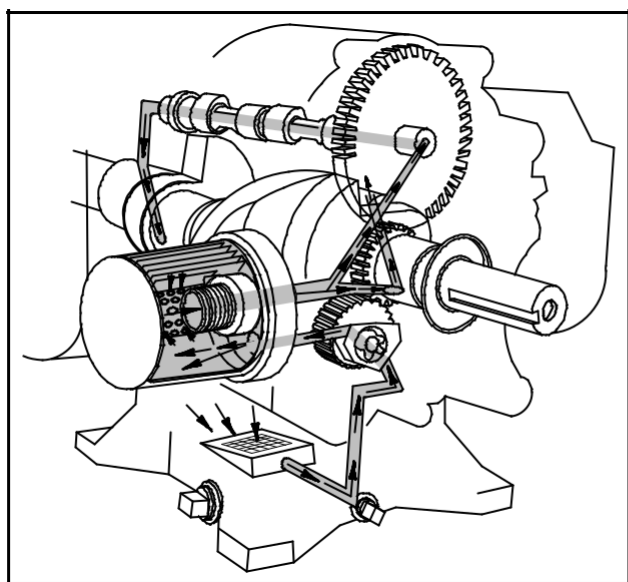
An oil gallery in the cam gear connects to the oil gallery on the magneto side of the cylinder, lubricating the magneto bearing.

Oil galleries in the crankshaft supply oil from the main bearings to the crank pins, lubricating the connecting rods, Fig. 28, Fig. 30.

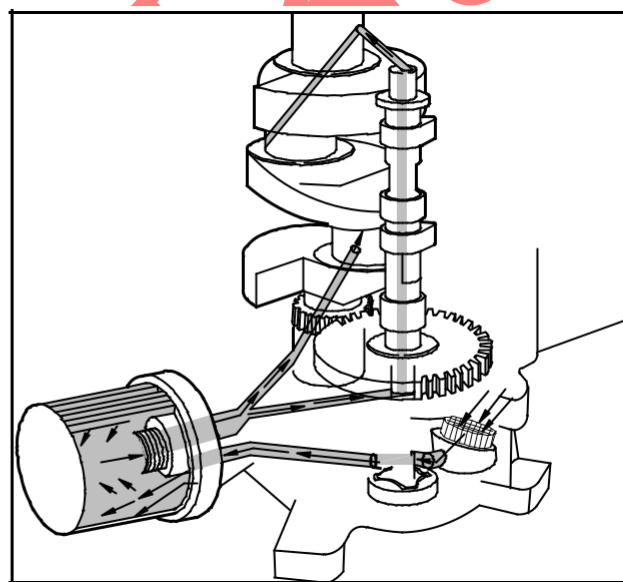
Engine oil pressure will vary with oil viscosity, ambient air temperature differences, operating temperatures and engine load. Follow the oil recommendation in General Information, Section 1, page 5.

Oil filters are available through your Briggs & Stratton source of supply. Order Part #491056.

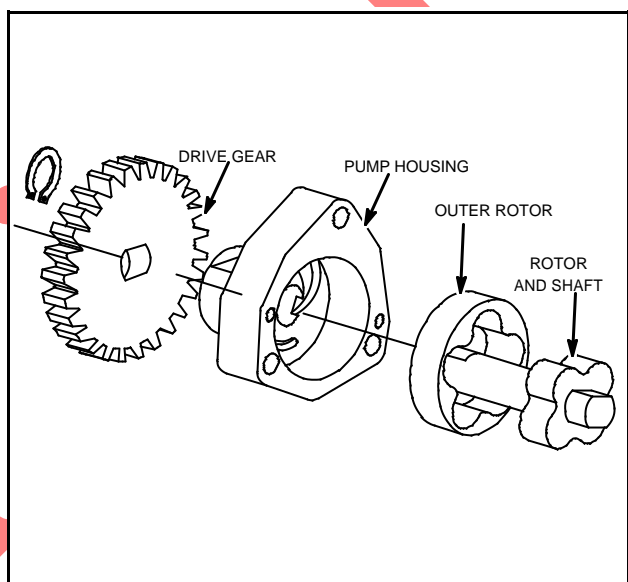
A shorter oil filter (2-1/2" (6.4 mm)) is available for restricted access applications. Order Part #492932.



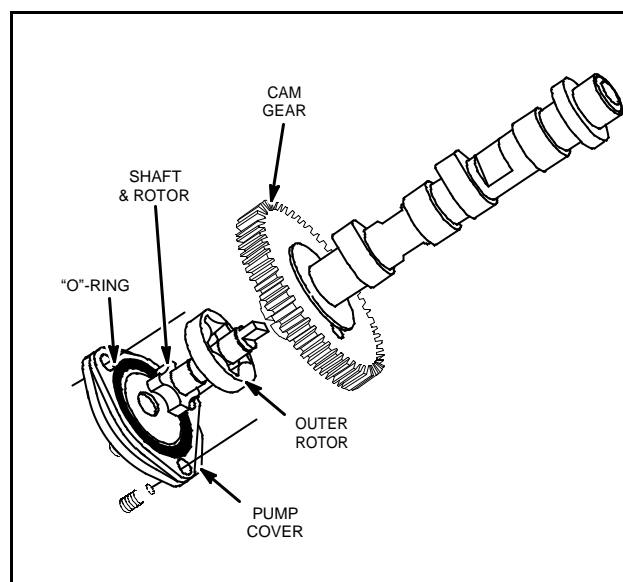
**Fig. 27 – Full Pressure Lubrication System  
Horizontal Crankshaft**



**Fig. 28 – Full Pressure Lubrication System  
Vertical Crankshaft**



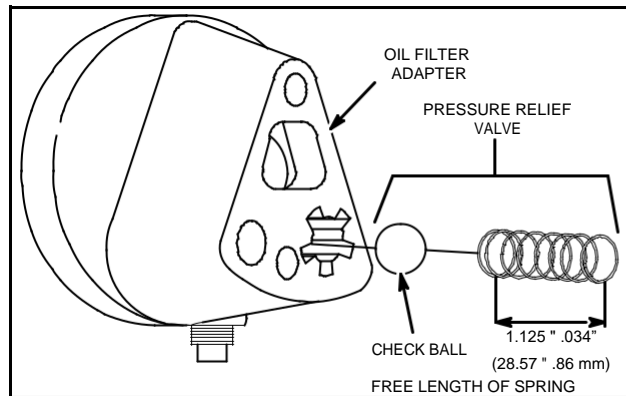
**Fig. 29 – Oil Pump Horizontal Crankshaft**



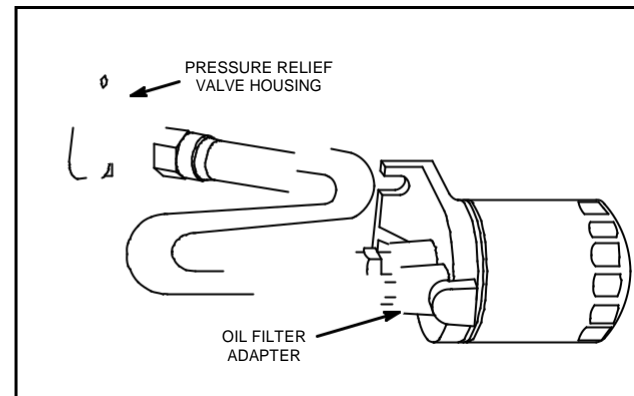
**Fig. 30 – Oil Pump Vertical Crankshaft**

A pressure relief valve located in the oil filter adapter, Fig. 31, or optional remote oil filter adapter, Fig. 32, limits the maximum oil pressure in the system.

Examine pressure relief valve seat for proper seating. Seat must have no nicks or burrs. Pressure relief valve spring length is  $1.125" \pm .034"$  ( $28.6 \pm .86$  mm). Replace spring if length is greater, or less than this tolerance, Fig. 31.



**Fig. 31 – Pressure Relief Valve**



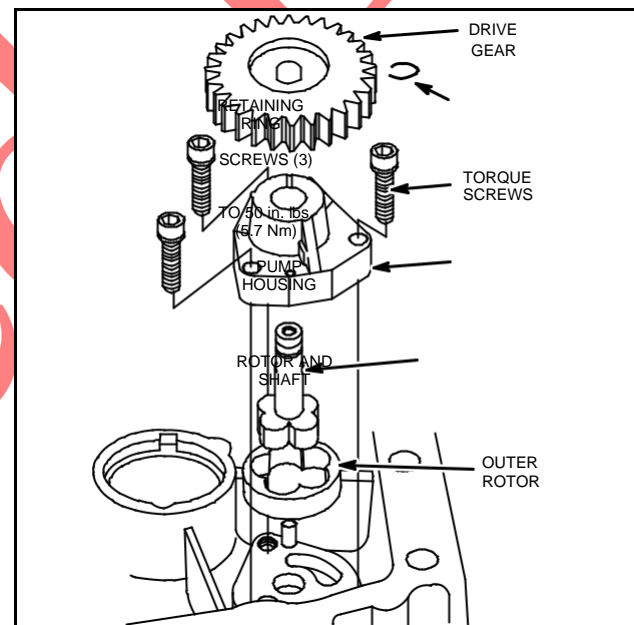
**Fig. 32 – Optional Remote Filter**

## INSPECT OIL PUMP

### Horizontal Crankshaft Models

1. With crankcase cover removed, examine oil pump drive gear for worn, chipped or cracked teeth. Replace gear if any of these conditions are found.
2. Remove the drive gear retaining ring and drive gear.
3. Remove the three (3) pump mounting screws.
4. Remove the pump assembly and check the rotors and shaft, Fig. 33.

If any obvious damage or excessive wear is noted, replace the pump assembly. Torque pump mounting screws to 50 in. lbs. (6.0 Nm). The oil pump is virtually trouble free and requires very little service.



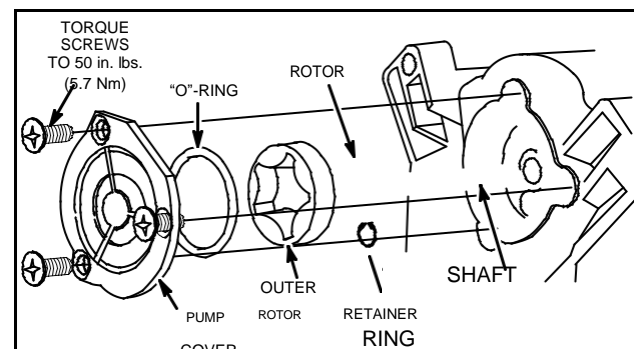
**Fig. 33 – Remove Oil Pump  
Horizontal Crankshaft Models**

### Vertical Crankshaft Models

The oil pump rotors can be inspected and/or replaced without removing the sump.

1. Remove 3 pump cover screws and cover.
2. Remove rotor and shaft assembly and outer rotor, Fig. 34.
3. Check rotors and shaft for any obvious wear and/or damage. Replace as necessary.

If pump housing is worn or damaged, replace sump. Check "O"-ring in pump cover. Replace if damaged. Torque pump cover screws to 50 in. lbs. (6.0 Nm). The oil pump is virtually trouble free and requires very little service.



**Fig. 34 – Remove Oil Pump  
Vertical Crankshaft Models**

### Oil Pressure Switch (Optional)

A 1/8" NPTF plug in the oil filter adapter can be removed to install an optional oil pressure switch. When the oil pressure drops below approximately 5 PSI (.35 Bar), the switch may be used to activate a warning device and/or stop the engine, Fig. 35. The warning device and all wiring is supplied by the equipment manufacturer.

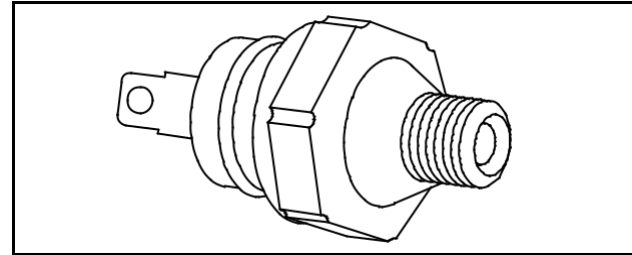


Fig. 35 – Oil Pressure Switch

Remove pressure switch for testing. Connect one continuity tester lead to the switch terminal and the other tester lead to the metal body of the switch, Fig. 36. The tester should indicate continuity when no pressure is applied to the switch. The switch should open (no continuity) when approximately 4.5 PSI (0.3 Bar) is applied. Replace the switch if test results are not to specification.

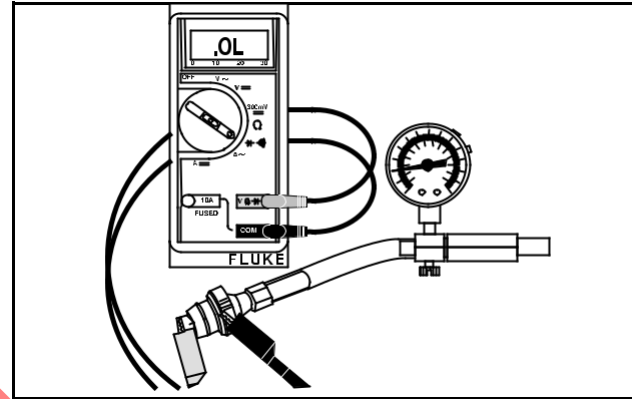


Fig. 36 – Checking Pressure Switch

### Testing Oil Pressure

1. Oil level must be between the LOW and FULL mark on dipstick. If oil level is low, check for leaks and add to FULL mark.
2. Remove pressure switch or 1/8" NPTF plug in oil filter adapter.
3. Install oil pressure gauge, Fig. 37.
4. Start and run engine for approximately 5 minutes.
5. Check oil pressure at 3000 RPM.

**Oil Pressure @ 70° F (21° C): 10-50 psi  
(0.7-3.5 Bar)**

See chart below for troubleshooting guide.

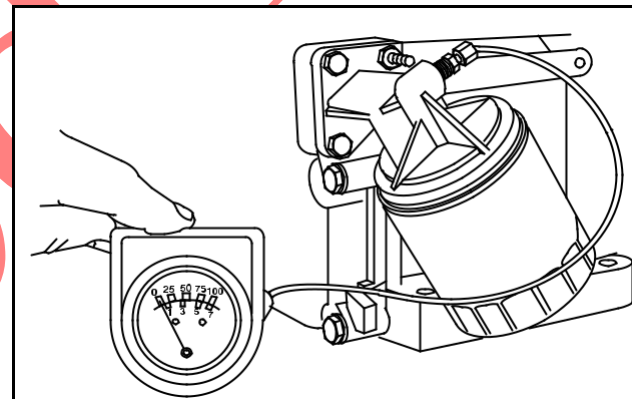


Fig. 37 – Checking Oil Pressure (Typical)

Low Oil Pressure
Engine RPM Too Low
Wrong Viscosity or Diluted Oil
Low Oil Level
Broken Pressure Relief Spring
Missing Pressure Relief Plunger
Worn Bearings
Damaged Or Defective Oil Pump

High Oil Pressure
Wrong Viscosity Oil
Plugged Oil Galleries
Stuck Pressure Relief Plunger



### Oil Cooler (Optional)

Some models are equipped with an optional oil cooler, Fig. 38. The oil cooler is mounted on the cylinder cover plate. Filtered oil is routed through the oil cooler through two oil lines from a special oil filter adapter. Forced air from the flywheel fan flows through the oil cooler fins dissipating heat from the engine oil.

The oil filter adapter and the oil supply line to the oil cooler are equipped with a 1/8" NPTF fitting if a pressure switch and oil pressure gauge is used.

The oil cooler fins should be checked periodically for debris and cleaned with compressed air or a soft bristle brush.

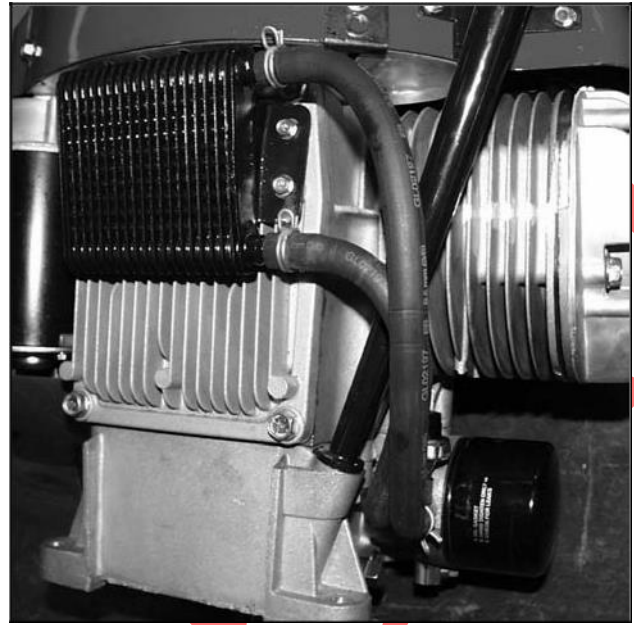


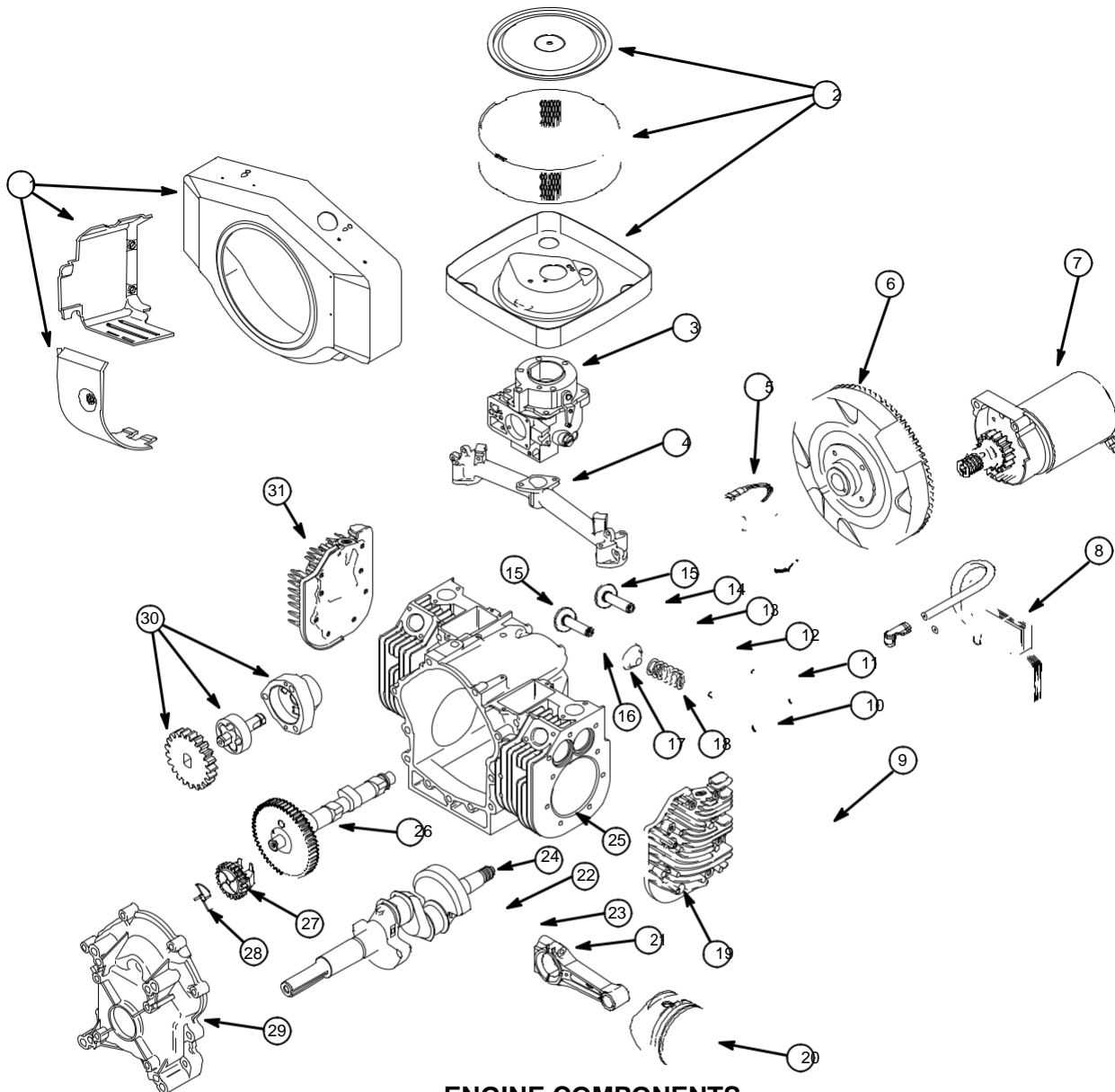
Fig. 38 – Oil Cooler (Optional)



Lil' Red Barn

## Section 9

# ENGINE DISASSEMBLY



### ENGINE COMPONENTS

- |                         |                            |                         |
|-------------------------|----------------------------|-------------------------|
| 1. Cylinder Shield      | 12. Valve Seal             | 22. Connecting Rod Bolt |
| 2. Air Cleaner Assembly | 13. Intake Valve Spring    | 23. Washer              |
| 3. Carburetor           | 14. Intake Valve Retainer  | 24. Crankshaft          |
| 4. Intake Manifold      | 15. Valve Tappet           | 25. Cylinder Assembly   |
| 5. Alternator           | 16. Exhaust Valve Keeper   | 26. Camshaft            |
| 6. Flywheel             | 17. Exhaust Valve Retainer | 27. Governor            |
| 7. Starter Motor        | 18. Exhaust Valve Spring   | 28. Thrust Washer       |
| 8. Magneto Armature     | 19. Cylinder Head #2       | 29. Crankcase Cover     |
| 9. Cylinder Head Bolts  | 20. Piston                 | 30. Oil Pump            |
| 10. Exhaust Valve       | 21. Connecting Rod         | 31. Cylinder Head #1    |

## ENGINE DISASSEMBLY

Drain oil and remove engine from equipment. Remove exhaust system, air cleaner assembly, intake manifold and carburetor assembly. See Section 3. Remove blower housing, air guides, cylinder shields, cylinder heads and valves. See Section 5. Remove flywheel and armature. See Section 2.

1. Remove the following parts, Fig. 1.
  - a. Alternator
  - b. Starter Motor
  - c. Backplate
2. Remove engine base (horizontal shaft).  
Remove cylinder cover plate (vertical shaft).
3. Remove any carbon or ridge at the top of cylinder bores to prevent breaking rings when removing piston and connecting rod assemblies.
4. Remove No. 2 connecting rod cap and push connecting rod and piston assembly out of cylinder, Fig. 2.
  - a. Reassemble cap to rod to prevent interchanging.
5. Repeat for other cylinder.

**NOTE:** Remove any rust, paint or burrs from PTO end of crankshaft before removing crank-case cover or sump to prevent damaging bearing.

### Remove Crankshaft – Plain Bearing Models

1. Remove crankcase cover or sump.
2. Rotate crankshaft until timing marks line up, Fig. 3.
3. Remove camshaft making sure valve tappets are clear of lobes.
4. Remove crankshaft.
  - a. Remove tappets.

**NOTE:** Support crankshaft during removal to prevent damage to magneto bearing.

### Remove Crankshaft – Ball Bearing Models

1. Remove crankcase cover.
2. Rotate crankshaft until timing marks line up.
  - a. Timing mark on crankpin and cam gear will be aligned when #2 crankpin is rotated to approximately 10 o'clock position, Fig. 4.
3. Pull crankshaft and cam gear out until cam gear teeth disengage teeth on crankshaft gear.
4. Then, remove camshaft making sure tappets are clear of lobes.
5. Remove crankshaft.
  - a. Remove tappets.

CLEAN ALL SURFACES OF GASKET MATERIAL. REMOVE OIL SEALS AND THOROUGHLY CLEAN COMPONENTS IN SOLVENT. ORGANIZE COMPONENTS, KEEPING PARTS WHICH ARE AN ASSEMBLY TOGETHER.

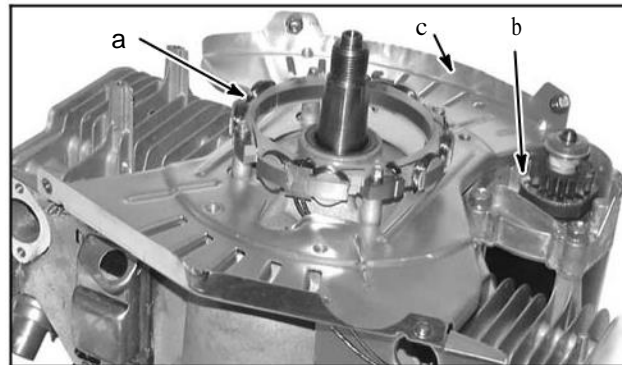


Fig. 1 – Remove Alternator, Starter & Backplate

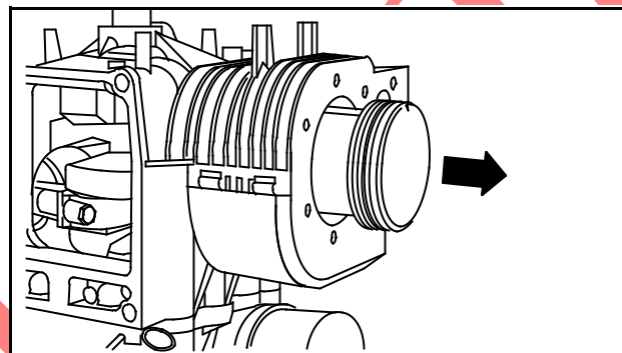


Fig. 2 – Remove Connecting Rod & Piston

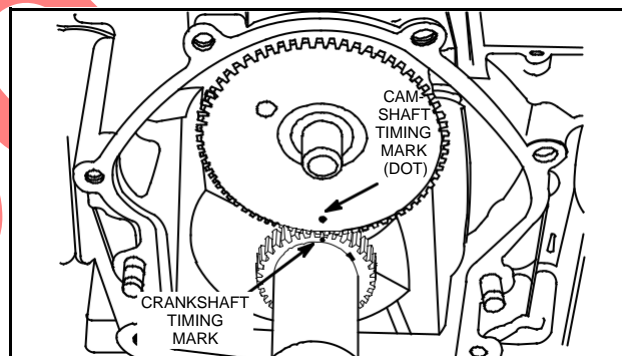


Fig. 3 – Remove Crankshaft – Plain-Bearing Models

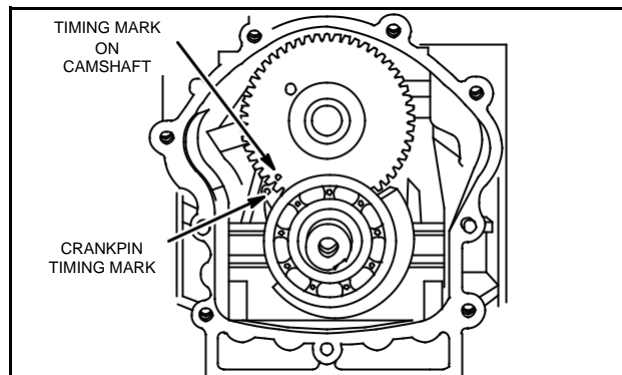


Fig. 4 – Remove Crankshaft – Ball Bearing Models

# Section 10

## CYLINDERS & BEARINGS

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## CHECK CYLINDER

Check cylinder for cracks, stripped threads or broken fins. Check cylinder bores for damage or scoring.

Use telescoping gauge, Tool #19404, and dial caliper, Tool #19199, or inside micrometer to determine the size of the cylinder bore. Measure at six (6) points at right angles as shown in Fig. 1. See specifications below.

If the cylinder bore is more than .003" (.08 mm) oversize, or .0015" (.04 mm) out of round on cast iron sleeve cylinders, or .0025" (.06 mm) out of round on aluminum bore cylinders, it must be resized.

### STD. BORE SIZE DIAMETER

	Max.	Min.
ALL MODELS	3.4375" (87.31 mm)	3.4365" (87.29 mm)

**NOTE:** If cylinder bores are within specification and show no signs of scoring or other damage, new piston rings may be installed, providing the cylinder bores are reconditioned to restore the proper cross hatch pattern in the cylinder bores. The proper cylinder cross hatch ensures proper lubrication and piston ring break in. Refer to Page 4, "Cylinder Finish" (Cross Hatch) for correct procedure for installing cross hatch.

## Resizing Cylinders

ALWAYS RESIZE TO EXACTLY .010" (.25 mm), .020" (.51 mm) OR .030" (.76 mm) OVER STANDARD SIZE AS SHOWN IN TABLE NO. 1. IF THIS IS DONE ACCURATELY, THE STOCK OVERSIZE RINGS AND PISTONS WILL FIT PERFECTLY AND PROPER CLEARANCES WILL BE MAINTAINED.

Cylinders can be resized with a rigid hone such as Briggs & Stratton Part #19205 for aluminum bore cylinders, or Part #19211 for cast iron sleeve cylinders. Contact your Briggs & Stratton source of supply. Use the stones and lubrication recommended by the hone manufacturer to produce the correct cylinder wall finish for the various engine models.

**NOTE:** Automatic transmission fluid is an acceptable honing oil. Another acceptable honing oil can be made by mixing 4 parts No. 30 weight oil with 1 part kerosene.

If a boring bar is used, a hone must be used after the boring operation to produce the proper cylinder wall cross hatch. See Cylinder Finish (Cross Hatch).

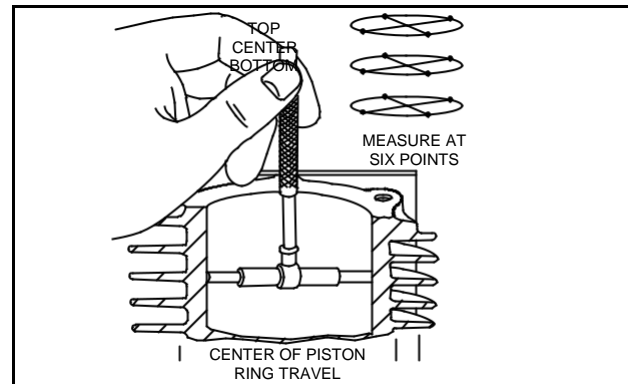


Fig. 1 – Check Cylinder Bore

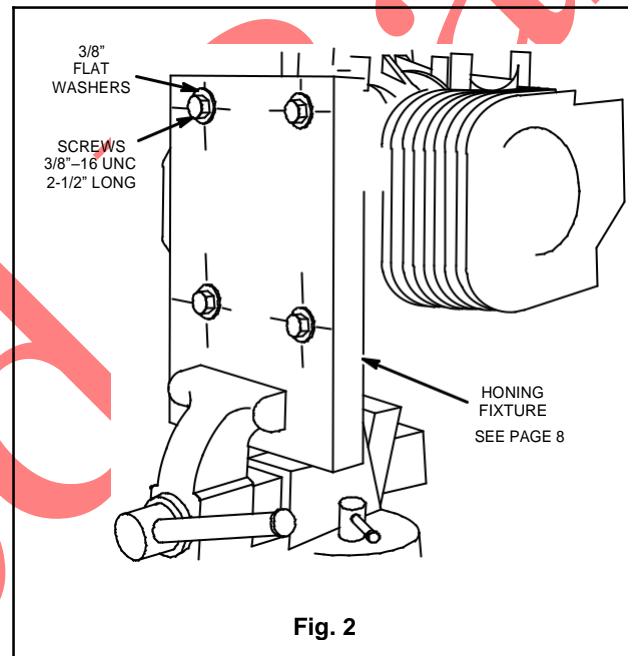


Fig. 2

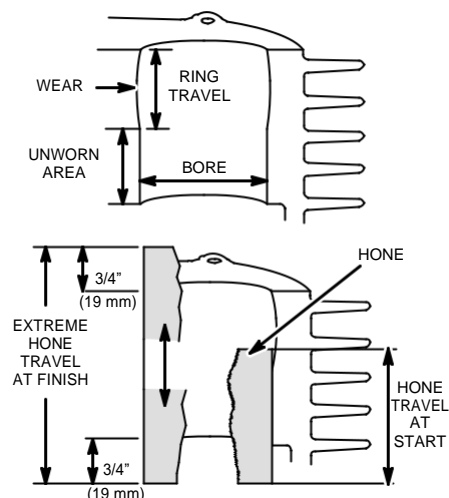


Fig. 3

Honing is done with a variable speed 1/2", portable drill and a honing fixture. See page 8 for dimensions to make your own honing fixture.

Check cylinder bores at top and bottom for burrs. Remove burrs to prevent damage to hone.

Use four (4) 2-1/2" long, 3/8"-16 UNC hex head screws with 3/8" flat washers and fasten cylinder to honing fixture, Fig. 2.

1. Clamp honing fixture and cylinder securely in a vise at a convenient work height. Place hone drive shaft in chuck of portable drill and tighten.
2. Cut a wood block and place inside cylinder to prevent hone from extending further than 3/4" (19.0 mm) to 1" (25.0 mm) below cylinder bore.
3. Place hone in middle of cylinder bore.
4. Tighten adjusting knob until stones fit snugly against cylinder wall. DO NOT FORCE.
5. Connect drive shaft to hone. Be sure that cylinder and hone are centered and aligned with drive shaft and drill spindle.
6. Lubricate hone as recommended by hone manufacturer. The recommended drill speed is 300 to 700 RPM MAXIMUM and 40-60 strokes per minute. Because cylinder bores normally wear only in the area of ring travel, the cylinder bore will be round above and below ring travel, Fig. 3.
7. Start drill and, as hone spins, move it up and down at the bottom of the cylinder bore. Gradually increase the length of the strokes until hone travels full length of cylinder bore, Fig. 3. Lubricate hone frequently to prevent build up on stones.

Be sure that hone does not extend more than 3/4" to 1" from top or bottom of cylinder or stones may be damaged.

As cutting tension decreases, stop hone and tighten adjusting knob following hone manufacturers recommendations. Check cylinder bore frequently with a micrometer or dial caliper, Tool #19199, and telescoping gauge, Tool #19198.

**NOTE:** On cast iron sleeve cylinders, Model Series 400400, 400700, 402400, 402700, 404400, 404700, 422400, 422700, 462770 change from rough stones to finishing stones, when within .0015" (.04 mm) of desired size. See Cylinder Finish (Cross Hatch).

### Cylinder Finish (Cross Hatch)

The finishing stones are used after the cylinder bore has been resized to within .0015" (.04 mm) of the desired size or when reconditioning a cylinder bore. The finishing stones will produce the correct cross hatch necessary for proper lubrication and piston ring rotation. The correct cross hatch angle is approximately 45 degrees, Fig. 4.

It is recommended that the cylinder bores be reconditioned to restore the cross hatch when new piston rings are to be installed in a cylinder that is within specification. Be careful not to hone oversize or it will be necessary to resize the cylinder.

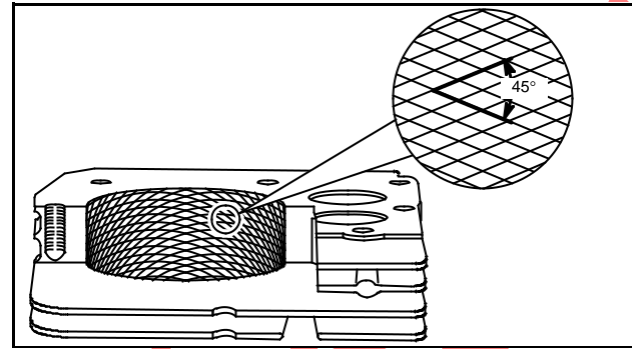


Fig. 4 – Cross Hatch

### Cleaning

**It Is Most Important That The Entire Cylinder And Crankcase Be Thoroughly Cleaned After Honing.**

Honing grit is highly abrasive and will cause rapid wear to all of the internal components of the engine unless it is completely removed.

1. Wash the cylinder and crankcase carefully in a solvent such as kerosene or commercial solvent.
2. Thoroughly wash cylinder and crankcase using a stiff brush with soap and hot water.
3. Rinse thoroughly with hot running water. Repeat washing and rinsing until all traces of honing grit are gone.

**NOTE:** When cylinder and crankcase have been thoroughly cleaned, use a clean white rag or napkin and firmly wipe the cylinder bore. If honing grit is present it will appear as a gray residue on rag. If any honing grit is evident, re-wash and rinse entire cylinder and crankcase and check again. When there is no trace of honing grit on rag, the cylinder is properly cleaned. On cast iron bore models, oil the cylinder bore to prevent rusting.

### MAIN BEARINGS

To meet different Original Equipment Manufacturers application needs, Briggs & Stratton twin cylinder engines have been built using three types of main bearings:

1. Ball Bearing
2. Plain Bearing
3. DU Bearing

**NOTE:** See Sec. 11 for ball bearing removal and installation.



## Check Plain Bearings

Plain main bearings should be repaired if scored or if plug gauge, Tool #19219, will enter bearing. Try gauge at several locations in bearing, Fig. 5. If gauge is not available, refer to reject specifications shown below.

### MAIN BEARING REJECT SIZE

Model Series	PTO Bearing	Magneto Bearing
ALL MODELS	1.383" (35.13 mm)	1.383" (35.13 mm)

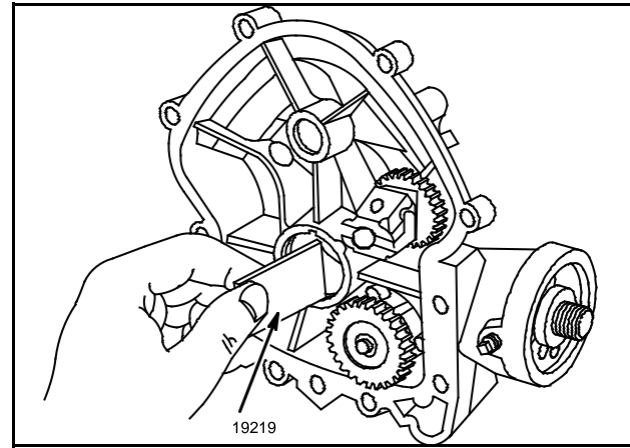


Fig. 5 – Checking Bearing

## Repairing Plain Main Bearings – Mag or PTO

Plain main bearings are an integral part of the cylinder, crankcase cover or sump. The bearing must be counterbore reamed and a replacement DU bearing pressed in.

To repair magneto bearing, remove oil seal from cylinder and sump or crankcase cover. Place pilot guide bushing, Tool #19220, in sump or crankcase cover bearing, or to repair PTO bearing, place pilot guide bushing in magneto bearing, Fig. 6.

Assemble sump or crankcase cover on cylinder. Be careful that pilot guide bushing does not fall out. Install reamer guide bushing, Tool #19222, Fig. 6. The reamer guide bushing and pilot guide bushing will center counterbore reamer with opposite bearing.

Place counterbore reamer, Tool #19224, on reamer pilot, Tool #19223, and insert through reamer guide bushing and cylinder until tip of reamer pilot enters guide bushing, Fig. 6.

The end of the reamer pilot is threaded 7/16-14 UNC to allow use of one or more large valve springs, flat washers and wing nut to provide spring pressure to pull counterbore reamer through the bearing being repaired, Fig. 7.

**NOTE:** On engines with a ball bearing on the PTO end of crankshaft, use a plain bearing crankcase cover to hold pilot guide bushing, while reaming magneto bearing.

Turn reamer clockwise with a steady even pressure until it is completely through the bearing. Lubricate reamer with kerosene or Stoddard solvent.

Remove sump or crankcase cover from cylinder and remove reamer pilot and counterbore reamer. Do not remove through reamed out bearing. Clean chips from cylinder and remove reamer and pilot guides.

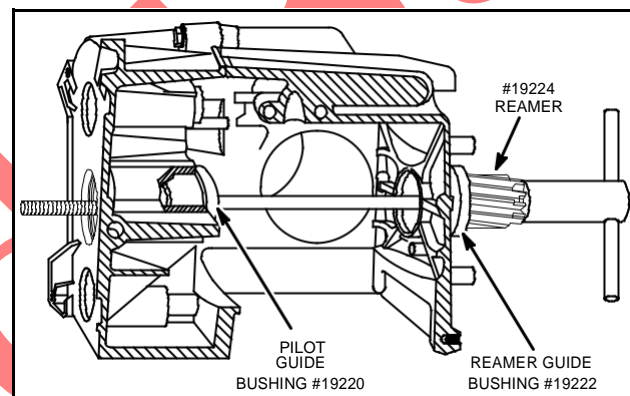


Fig. 6 – Counter Bore Reaming

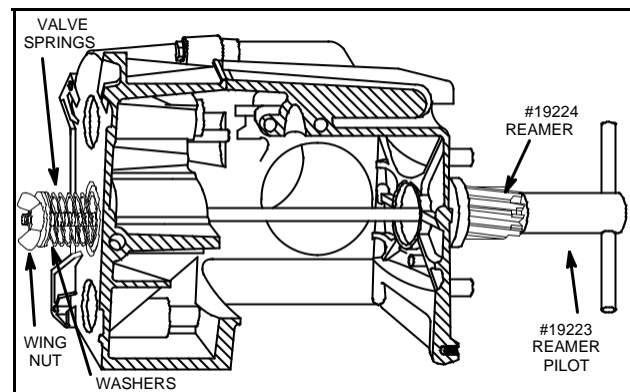


Fig. 7 – Spring Loading Reamer

## Check DU Bearings

DU main bearings should be replaced if damaged or if plug gauge, Tool #19219, will enter bearing. Try gauge at several locations in bearing, Fig. 5. If gauge is not available, refer to Table No. 2 for reject dimensions.

## Remove DU Bearings – All Models

Place cylinder, sump or crankcase cover on cylinder support, Tool #19227, with 1-5/8" (41.3 mm) opening toward bearing to be removed. Place bushing driver, Tool #19226, in bearing and press into recess of cylinder support, Fig. 8.

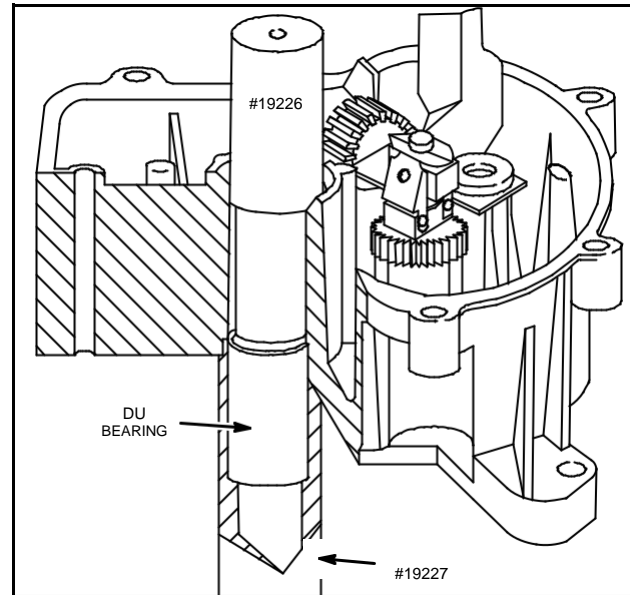


Fig. 8 – Remove DU Bearing (Typical)

## Install DU Mag Bearing – All Models

**NOTE:** Engine models 400440, 402440 404440 and 422440 have a full pressure lubrication system. Engines manufactured before date code 89730000 were equipped with DU bearings with a machined oil reservoir, Fig. 11. Refer to illustrated parts list for correct bearing number by model and date code.

Place cylinder on cylinder support, Tool #19227, with 1-5/8" (41.3 mm) opening toward bearing to be installed. Fig. 9. Place DU bearing against counter-bored bearing, making sure that oil holes align. Insert bearing driver, Tool #19226, into DU bearing and press in until the DU bearing is 1/8" (3.0 mm) from thrust face of cylinder, Fig. 9.

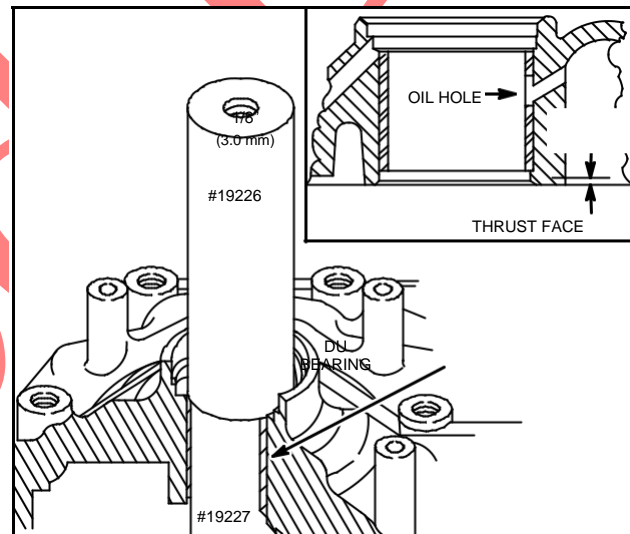


Fig. 9 – Pressing DU Bearing

**NOTE:** Be sure oil hole in DU bearing is aligned with oil hole in cylinder bearing.

To prevent bearing from turning, stake bearing from both sides with 1/4" (6.3 mm) round pin punch, Fig. 10.

## Install Oil Seal – Mag Side – All Models

Install oil seal with the sealing lip facing the inside of the engine. Use cylinder support, Tool #19227, and press in new oil seal until flush with cylinder.

Always install new oil seals whenever engine is disassembled for major servicing or when repairing or replacing bearings. Always use the correct seal protector to prevent damaging oil seal.

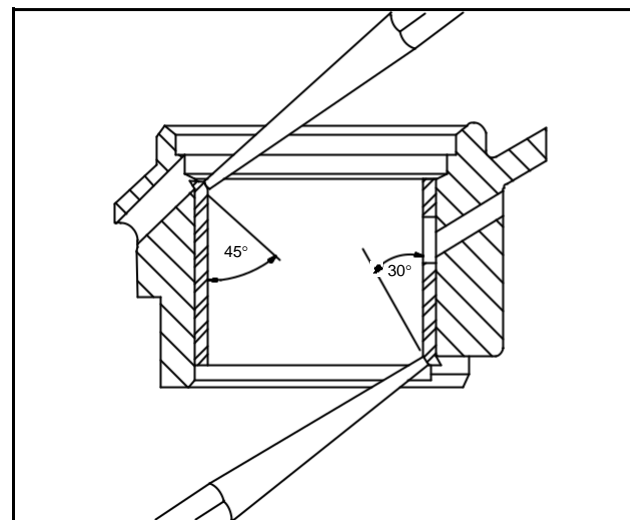


Fig. 10 – Staking Bearing

## Install DU PTO Bearing – Horizontal Crankshaft Models

**NOTE:** Engine models 400440, 402440 404440 and 422440 have a full pressure lubrication system. Engines manufactured before date code 89730000 were equipped with DU bearings with a machined oil reservoir, Fig. 11. Refer to illustrated parts list for correct bearing number by model and date code.

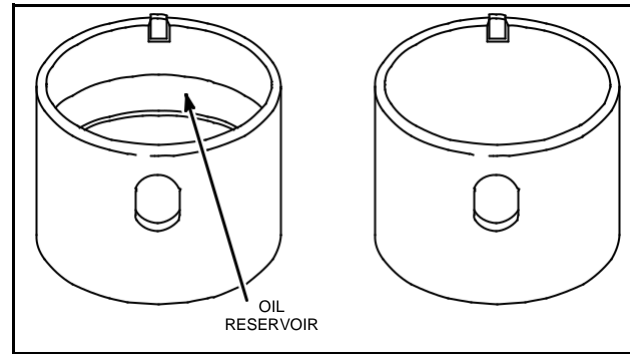


Fig. 11 – Pressure Lube DU Bearing

Place sump on cylinder support, Tool #19227, with 1-5/8" (41.0 mm) opening toward bearing to be installed. Place DU bearing on counterbored bearing, aligning oil hole in DU bearing with oil hole in crankcase cover. Insert bearing driver, Tool #19226, into DU bearing and press in until edge of DU bearing is 1/8" (3.0 mm) below thrust face, Fig. 12.

**NOTE:** Be sure oil hole in DU bearing is aligned with oil hole in bearing.

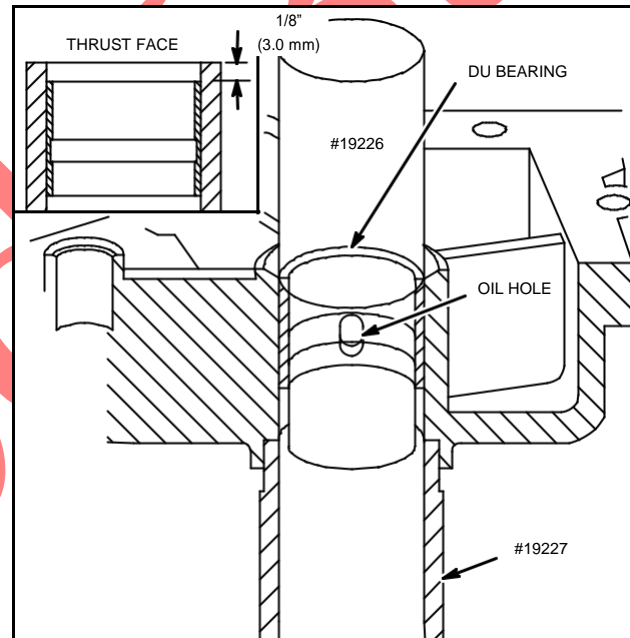


Fig. 12 – Press PTO Bearing

To prevent bearing from turning, stake from both sides with 1/4" round pin punch, Fig. 13.

## Install Oil Seal – PTO – Horizontal Crankshaft Models

Install oil seal with the sealing lip facing the inside of the engine. Use cylinder support, Tool #19227, and press in new oil seal until 1/16" (1.6 mm) below boss on crankcase cover.

Always install new oil seals whenever engine is disassembled for major servicing or when repairing or replacing bearings. Always use the correct seal protector to prevent damaging oil seal.

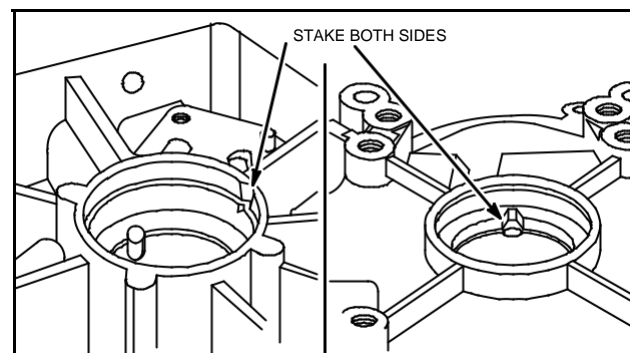


Fig. 13 – Staking Bearing

### Install DU PTO Bearing – Vertical Crankshaft Models

**NOTE:DU bearing**, Part #231180, for vertical crankshaft engines must be installed with 3/4" (19.0 mm) offset toward thrust face, Fig. 14.

1. Place sump on cylinder support, Tool #19227, with 1-5/8" (41.3 mm) opening toward bearing to be installed.
2. Place DU bearing on counterbored bearing.

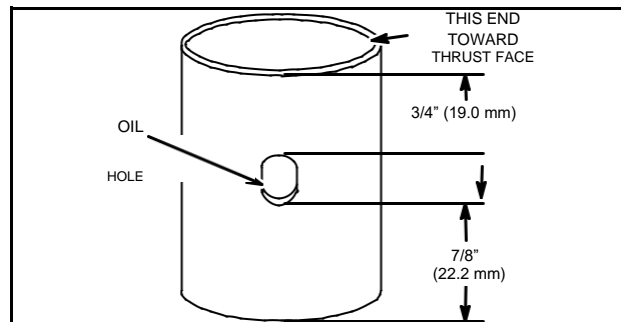


Fig. 14 – DU Bearing Part #231180

**NOTE:On pressure lube models** 400700, 402770, 404770 and 422770 make sure oil hole in DU bearing is aligned with oil hole in sump.

3. Insert bearing driver, Tool #19226, into DU bearing and press in until edge of DU bearing is 1/32" (.8 mm) below thrust face on pressure lube engines or 5/32" (4.0 mm) below thrust face on splash lube engines, Fig. 15.

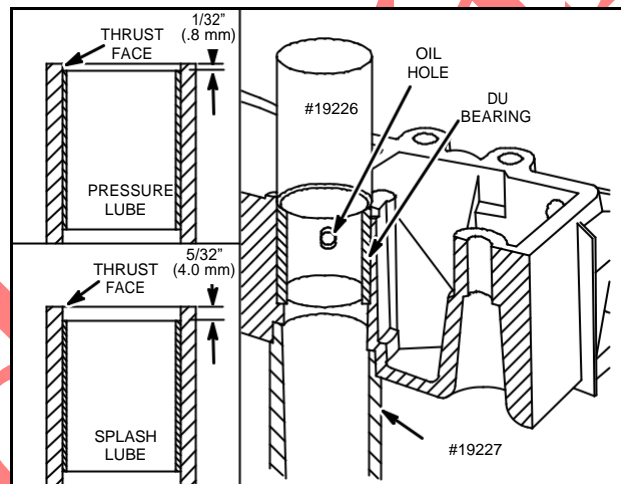


Fig. 15 – Press PTO Bearing

4. To prevent bearing from turning stake bushing as shown in Fig. 16.

### Install Oil Seal – PTO – Vertical Crankshaft Models

Install oil seal with the sealing lip facing the inside of the engine. Use cylinder support, Tool #19227, and press in new oil seal until flush with sump.

Always install new oil seals whenever engine is disassembled for major servicing or when repairing or replacing bearings. Always use the correct seal protector to prevent damaging oil seal.

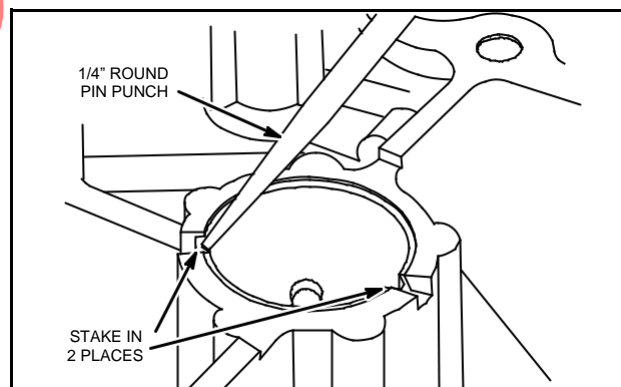


Fig. 16 – Staking Bearing

## Honing Fixture

**Material:**

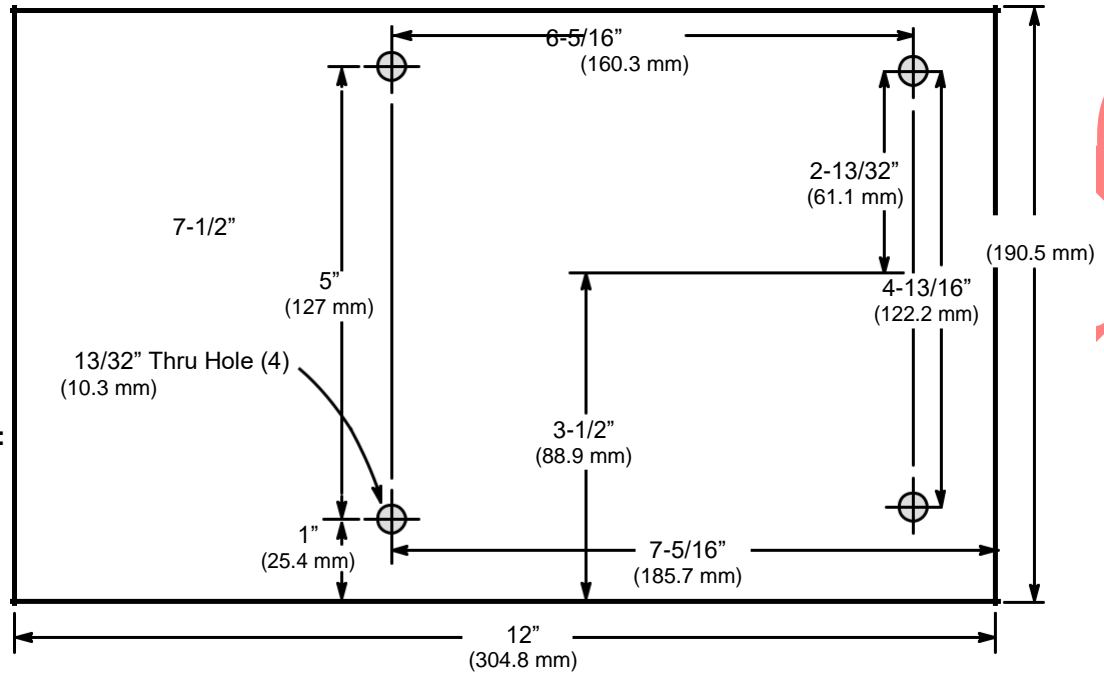
Wood 2" x 8"  
12" long

**Material:**

Wood 50.8 mm x  
203.2 mm  
304.8 mm long

**Cylinder Mounting  
Hardware**

**Fasteners Required:**  
4 Hex Head Machine  
Screws-3/8-16 UNC  
2-1/2" long, 4 Flat  
Washers 3/8" I.D.



# Section 11

## CRANKSHAFTS & CAMSHAFTS

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### CHECK CRANKSHAFT – ALL MODELS

Shown below are the reject sizes of the various wear points of the crankshaft. Fig. 1 shows the various points to be checked on the crankshaft. Discard crankshaft if worn or scored. Keyways should be checked to be sure they are not worn or spread. Remove burrs from keyway edges to prevent scratch-ing the bearing. Check oil galleries (passages) for blockage or obstructions on pressure lube crankshaft.

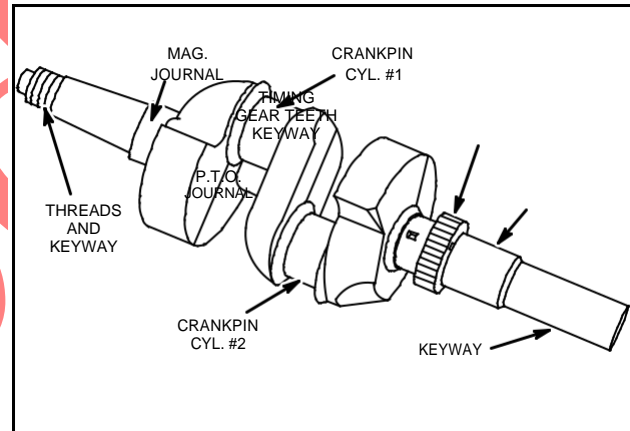


Fig. 1 – Crankshaft Check Points

### CRANKSHAFT REJECT SIZES

Model Series	PTO Journal	Mag. Journal	Crankshaft Crankpin
ALL MODELS	1.376" (34.95 mm)	1.376" (34.95 mm)	1.622" (41.2 mm)

Check timing gear teeth for chipped or cracked teeth and keyway for wear. Replace timing gear, if damaged.



Crankshaft crankpin may be re-ground for .020" (.51 mm) undersize connecting rods. See Illustrated Parts List for correct part number for undersize

connecting rods. See specifications below for crankshaft grinding dimensions. Complete instructions are included with the undersize connecting rods.

### CRANKSHAFT GRINDING DIMENSIONS

Conn. Rod Number	Dim. A In. (mm)	Dim. R In. (mm)	Dim. T In. (mm)
393714 492911	1.6043/ 1.6039 (40.75/ 40.74)	.180/ .170 (4.57/ 4.32)	1.080/ 1.076 (27.43/ 27.33)
397158 491839	1.6043/1.60394 (0.75/40.74)	.180/ .170 (4.57/ 4.32)	1.142/ 1.138 (29.0/ 28.9)
498541	1.6043/ 1.6039 (0.75/40.74)	.180/ .170 (4.57/ 4.32)	1.228/ 1.232 (31.19/ 31.29)

### Check Ball Bearings

Ball bearings must rotate freely. If any rough spots are felt the ball bearing must be replaced.

### Remove Ball Bearings

The ball bearing is a press fit on the crankshaft. If ball bearing is to be replaced, use an arbor press, Fig. 2, or an axle or bearing puller, Fig. 3.

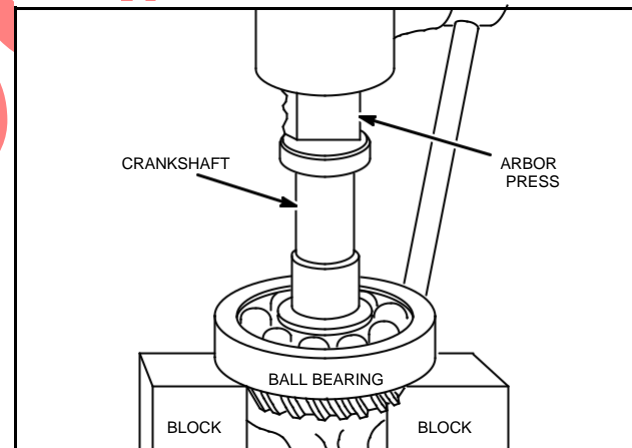


Fig. 2 – Remove Ball Bearing

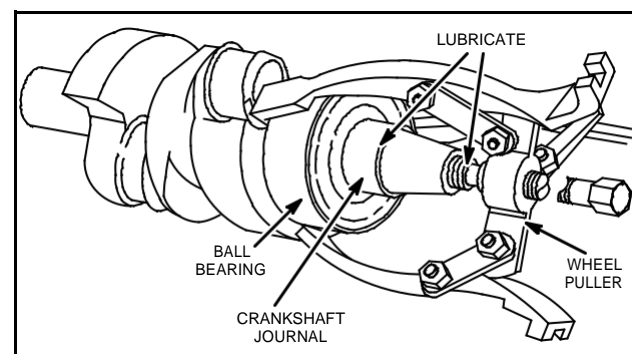


Fig. 3 – Remove Ball Bearing

**NOTE:** Do not re-use ball bearings that have been pressed or pulled off the crankshaft. The bearing races are usually damaged during removal.

After the bearing has been removed, rough spots on the journal should be polished with emery cloth (500 grit). Break down new emery cloth by rubbing several times over the edge of a piece of steel before using for polishing.

Polish crankshaft until polish lines are uniform over entire journal, Fig. 4. It is important that crankshaft journal be thoroughly cleaned. Wash journal with a solvent such as kerosene to remove emery residue.

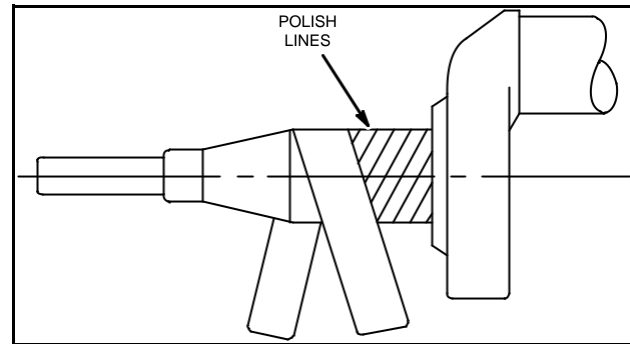


Fig. 4 – Polish Journal

### Install Ball Bearings

1. Heat bearing in hot oil (250° F (120° C) max). Bearing must not rest on the bottom of the pan in which it is heated.
2. Place crankshaft in vise with bearing side up. When bearing is quite hot it will become a slip fit on the bearing journal.
3. Grasp bearing with the shield down (if equipped) and thrust it down on the crankshaft, Fig. 5. The bearing will tighten on the shaft while cooling. DO NOT QUENCH.

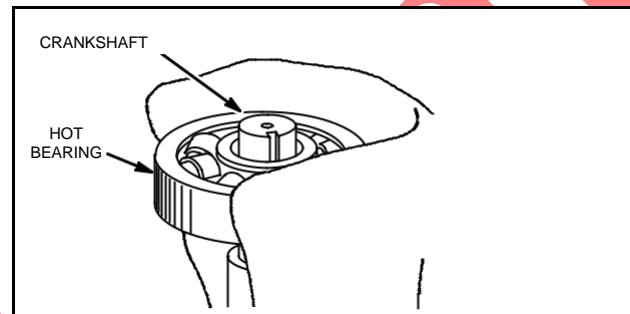


Fig. 5 – Installing Ball Bearing

**NOTE:** Engines manufactured after 1992 and service replacement ball bearings are not equipped with a bearing shield.

If ball bearing is equipped with a bearing shield, install bearing so that shield faces crankshaft crankpin.

### CRANKSHAFT END PLAY

Crankshaft end play is .002" (.05 mm) to .026" (.66 mm) on vertical crankshaft engines and .004" (.10 mm) to .012" (.30 mm) on horizontal crankshaft engines with one .015" (.4 mm) gasket in place. If end play is less than .002" (.05 mm), which could be the case if a new crankcase cover or sump is used, additional gaskets .005" (.13 mm), .009" (.23 mm) or .015" (.4 mm) may be added to obtain correct end play.

If end play is more than .026" (.66 mm) for vertical crankshaft engines or .012" (.30 mm) on horizontal crankshaft engines, with one .015" (.4 mm) gasket in place, install thrust washer, Part #222951, Fig. 6. Install thrust washer on PTO end of crankshaft, plain bearing engines or magneto end of crankshaft on engines with ball bearing on PTO side only. Then adjust end play as described in previous paragraph.

**NOTE:** Thrust washer part #222951 cannot be used on double ball bearing engines.

Vertical crankshaft engines manufactured after 93122000 are equipped with a .030" (.76 mm) thinner timing gear. If a cylinder, crankshaft or sump is being replaced it may be necessary to change the timing gear if the correct end play cannot be obtained with standard gaskets or a thrust washer. Order timing gear Part #262989.

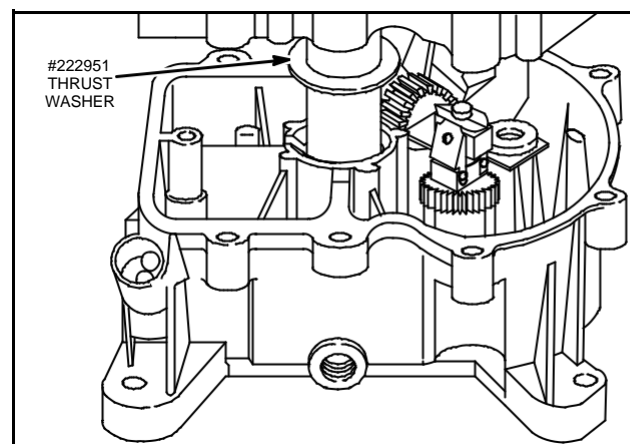


Fig. 6 – Correcting Crankshaft End Play

## CHECKING CAMSHAFT

Inspect gear teeth for wear and nicks, Fig. 7. Camshaft, camshaft journals and lobe rejection sizes are shown below. Check oil gallery for blockage or obstructions on pressure lube camshaft.

**NOTE ALL MODELS:** Camshaft bearing reject dimension is .6275" (15.93 mm) for both cylinder (magneto) side and crankcase cover or sump (PTO). If cam bearing is worn, the cylinder or crankcase cover or sump must be replaced.

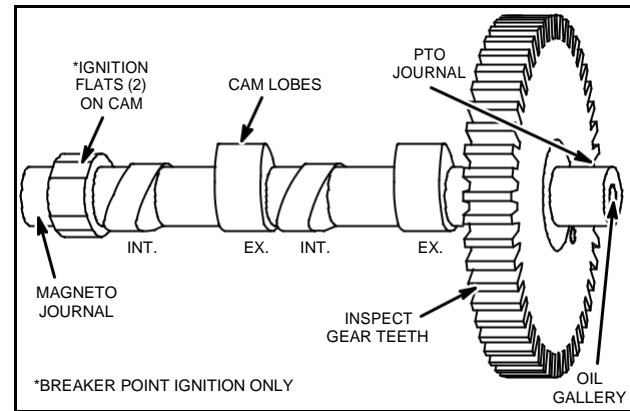


Fig. 7 – Camshaft Check Points

## CAMSHAFT REJECT SIZES

Basic Model Series	Camshaft Journal	Cam Lobes	
		Int.	Ex.
404400, 404440, 404700, 404770	.623" (15.82 mm)	1.055" (26.8 mm)	1.120" (28.45 mm)
400400, 400440, 400700, 400770, 401400, 401700, 402400, 402440, 402700, 402770, 421400, 421700, 422400, 422440, 422700, 422770	.623" (15.82 mm)	1.150" (29.21 mm)	1.120" (28.45 mm)
462770	.623" (15.82 mm)	1.140" (28.95 mm)	1.140" (28.95 mm)

# Section 12

## PISTONS – RINGS – RODS

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### GENERAL INFORMATION

It is recommended that new piston rings be installed whenever the engine is disassembled for major servicing or overhaul, providing that cylinder bores are within specification.

**IMPORTANT:** Opposed twin cylinder engines manufactured after date code 00121200 use pistons with narrower ring grooves and thinner piston rings. Pistons and piston rings used in engines manufactured after date code 00121200 may be used on engines manufactured before code date 00121300 only as an assembly.

Measure cylinder bores before checking pistons and rings. See Section 10. If cylinder bore(s) require re-sizing it will not be necessary to check pistons and rings since a new oversized piston assembly will be used.

If the cylinder bore is more than .003" (.08 mm) oversize, or .0015" (.04 mm) out of round on cast iron sleeve cylinders, or .0025" (.06 mm) out of round on aluminum bore cylinders, it must be resized.

### REMOVE PISTON AND CONNECTING ROD

When servicing pistons, rings, piston pins or connecting rods, make sure that each connecting rod, piston, piston pin and ring set be kept as a set for the cylinder from which it was removed. Mark each set, before removing from the engine.

To remove the piston and connecting rod from the engine, remove the connecting rod cap. Remove any carbon or ridge at the top of the cylinder bore: this will prevent breaking the rings. Push the piston and rod out through the top of the cylinder.

**NOTE:** Connecting rod locks are not used in twin cylinder engines. Special thin washers are used under the connecting rod cap screws.

### Piston Identification

Briggs & Stratton twin cylinder engines use die cast aluminum cylinder blocks with either aluminum bore cylinders or cast iron sleeve cylinders. The two different cylinder bore materials require different ring sets and piston assemblies.

**THEY ARE NOT INTERCHANGEABLE.**

Model Series 401400, 401700, 421400 and 421700 have aluminum bore cylinders.

Model Series 400400, 400700, 402400, 402700, 404400, 404700, 422400, 422700 and 462770 have cast iron sleeve cylinders.

For correct part numbers for ring sets and piston assemblies, refer to Illustrated Parts List. Select correct ring sets or piston assemblies by Model Series.

Pistons designed for cast iron sleeve cylinders have a shiny finish. Early pistons were marked with the letter "L" on the top of the piston, Fig. 1. Pistons designed for aluminum bore cylinders are unmarked and have a dull finish as well as a slight discoloration in the piston pin area, Fig. 1.

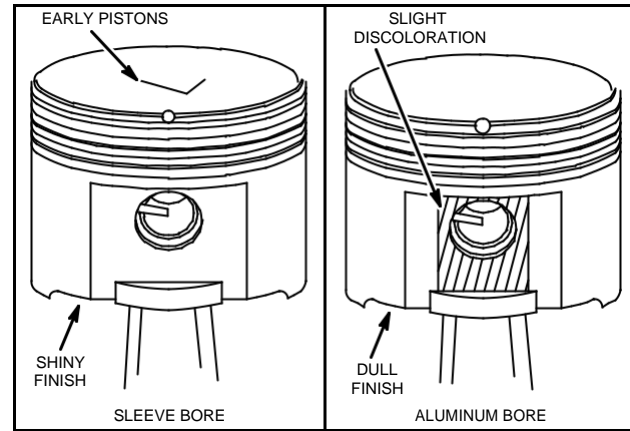


Fig. 1 – Piston Variations

### Remove Connecting Rod

To remove connecting rod from piston, remove piston pin locks with needle nose pliers, Fig. 2. Piston pin is a push fit in piston and rod but deposits may build up on piston pin and require the piston pin to be pressed out.

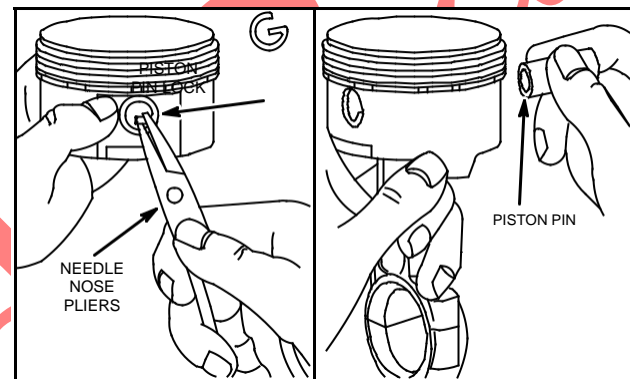


Fig. 2 – Removing Rod

### Remove Rings

Remove rings one at a time as shown in Fig. 3. Use piston ring expander, Tool #19340, to prevent ring distortion. Never remove or install rings by hand.

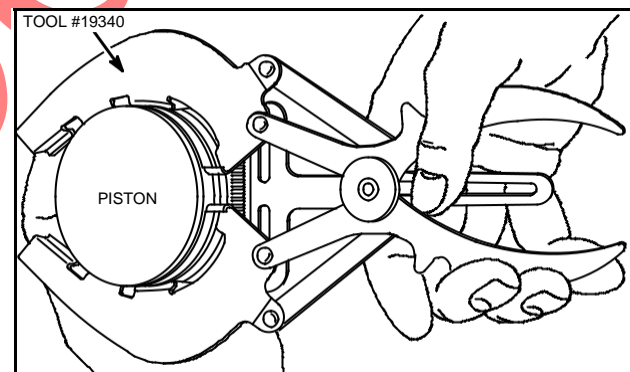


Fig. 3 – Removing Rings, Tool #19340

## CHECKING PISTONS & RINGS

### Check Piston

If the cylinder bore is to be resized, there is no reason to check the piston and rings, since a new oversized piston assembly will be used.

However, if the cylinder is within specification and not to be resized, and the piston shows no signs of wear or scoring, the piston should be checked.

To do so, clean carbon from top two ring grooves. Place a NEW ring in each ring groove. If a .009" (.23 mm) or larger feeler gauge can be inserted at any point around either ring groove (all models), the ring groove is worn and the piston should be replaced, Fig. 4.

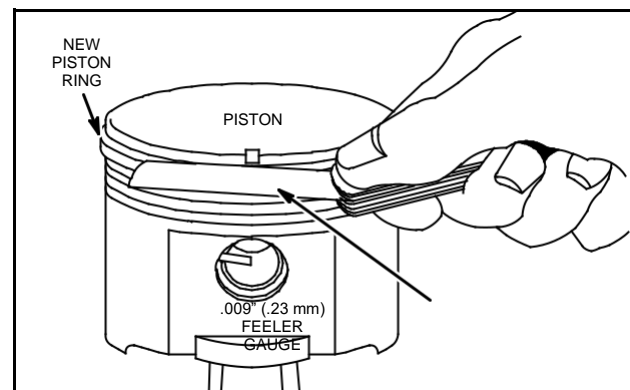


Fig. 4 – Checking Ring Grooves

## Check Rings

To check rings, first clean all carbon from the end of the rings. Insert old rings one at a time, approximately one inch down into the cylinder bore.

Check ring end gap with feeler gauge, Fig. 5. If ring end gap is greater than shown in Table No. 1, the ring is worn and should be replaced.

A worn ring will usually show scratches caused by abrasives and/or have a shiny appearance. Also, the top and bottom edges of the ring may be extremely sharp. Never reuse worn piston rings.

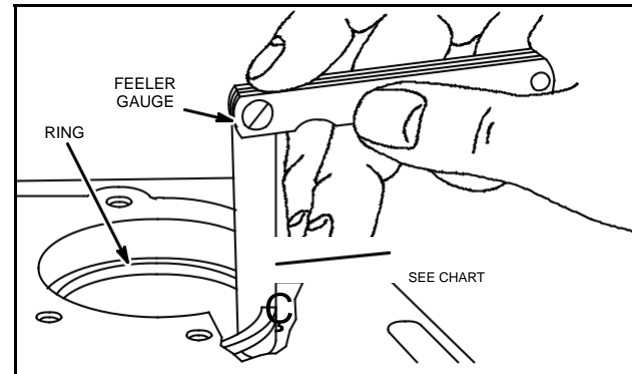


Fig. 5 – Checking Ring Gap

### Ring End Gap Rejection Size

Basic Model	Compression Ring	Oil Ring
Series		
401400, 401700, 421400, 421700	.035" (.89 mm)	.045" (1.14mm)
400400, 400440, 400700, 400770, 402400, 402440, 402700, 402770, 404400, 404440, 404700, 404770, 422400, 422440, 422700, 422770, 462700	.030" (.76mm)	.035" (.89mm)

**NOTE:** If new piston rings are going to be installed in a cylinder that is within specification, the cylinder bore should be reconditioned, using a rigid hone with finishing stones, to restore the proper cross hatch angle in the cylinder bores. The proper cylinder cross hatch ensures proper lubrication and piston ring rotation. See Section 11, Cylinder Finish (Cross Hatch), for procedure for applying cross hatch to cylinder bore.

## Check Piston Pin and Piston Pin Bore

If piston pin is worn .0005" (.01 mm) out of round or below reject sizes shown in Table No. 2, it should be replaced. If piston pin bore Fig. 6 is worn above reject sizes, Table No. 2, oversize piston pin .005" (.13 mm) is available. See Illustrated Parts List.

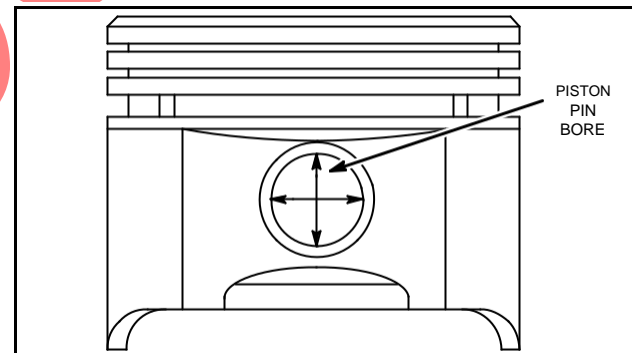


Fig. 6 – Checking Piston Pin Bore

### Piston Pin & Piston Pin Bore Reject Sizes

ModelSeries	PistonPin	PistonPin Bore
ALLMODELS	.799" (20.29 mm)	.802" (20.37mm)

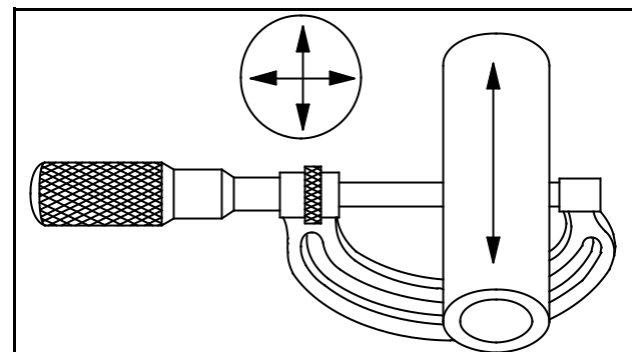


Fig. 7 – Check Piston Pin



## Check Connecting Rod

Check connecting rod bearings, Fig. 8. See reject sizes below.

If crankpin bearing is scored or worn the connecting rod must be replaced.

### Connecting Rod Reject Size

Model Series	Crankpin Bearing	Piston Pin Bearing
ALL MODELS	1.627" (41.32 mm)	.802" (20.37 mm)

**NOTE:** .020" undersize connecting rods are available for use on a reground crankpin journal. See illustrated parts list.

## ASSEMBLE PISTON & CONNECTING ROD

**NOTE:** Connecting rod locks are not used in twin cylinder engines. Special thin washers are used under the connecting rod cap screws.

**Engine Models 400000-422000:** Assemble No. 1 rod to piston with notch in piston facing flywheel side of engine and oil hole in connecting rod facing up, Fig. 9.

Assemble No. 2 rod to piston with notch in piston facing flywheel side of engine and oil hole in connecting rod facing down, Fig. 9.

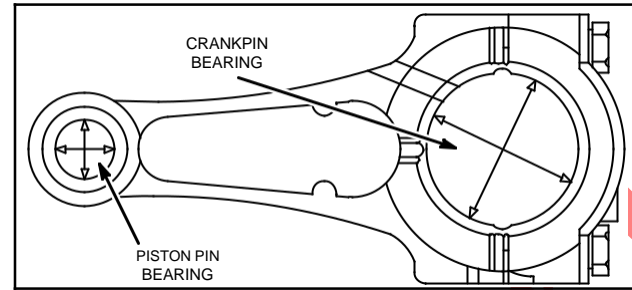


Fig. 8 – Checking Rod Bearings

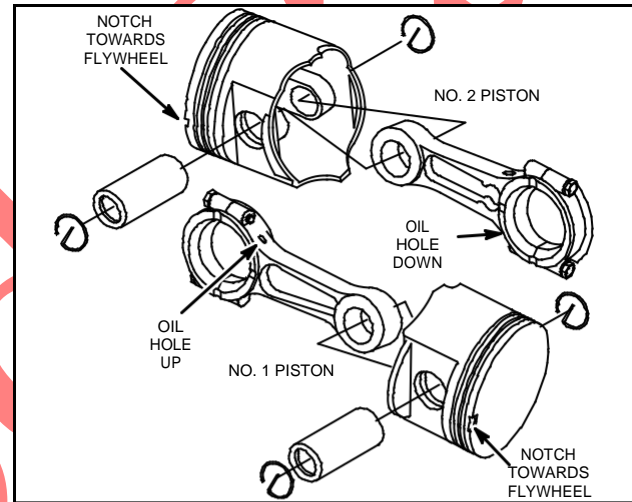


Fig. 9 – Models 400000 – 420000 Connecting Rod

**Engine Model 462770:** Assemble connecting rods to pistons with notches in pistons facing flywheel side and relief area on crankpin end of rod and oil hole facing cam gear, Fig. 10.

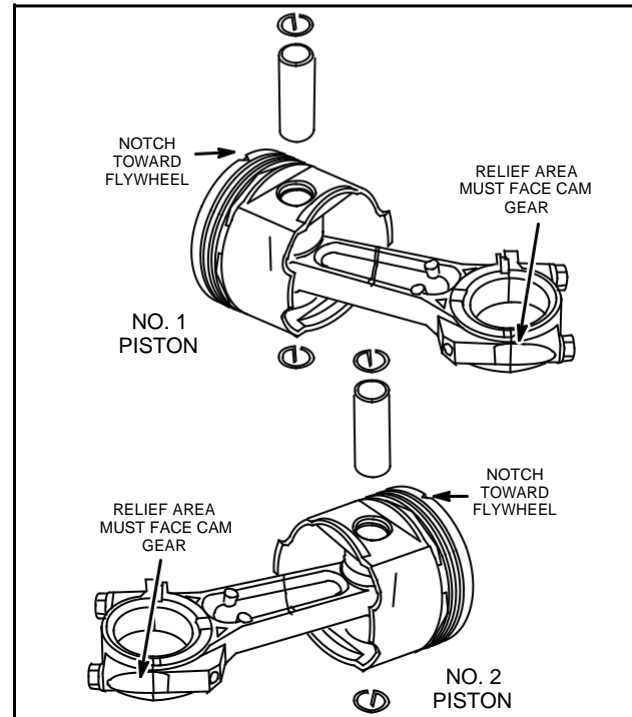


Fig. 10 – Model 462770 Connecting Rod

The piston pin is a slip fit in both piston and connecting rod. Oil piston pin. Place a piston pin lock in groove on one side of piston. Insert piston pin from opposite side of piston until pin stops against piston pin lock, Fig. 2 Use a needle nose pliers to assemble piston pin lock in lock groove. Be sure both locks are firmly set in grooves.

### Assemble Rings to Piston

Use ring expander, Tool #19340, when installing piston rings.

**IMPORTANT:** All Models 400000, 420000 and pressure lube Model 460770 are equipped with an oil ring and polygonal expander as shown in Fig.11. Install expander and oil ring first. The second compression ring has a dot mark which must face the top of piston. Install center ring, then, top ring.

Splash lube Models 460700 are equipped with an oil ring with a coil expander as shown in Fig. 12. Install coil expander and oil ring first. The second compression ring has a dot mark which must face the top of piston. Install center ring, then, top ring.

### Install Piston and Connecting Rod Assembly

Oil piston rings, piston skirt and inside of ring compressor. Place ring compressor, Tool #19230, over piston with projections on compressor towards connecting rod, Fig. 13.

Place piston and ring compressor upside down on bench and push down until head of piston and edge of ring compressor are even. Tighten ring compressor until rings are fully compressed. Then loosen ring compressor very slightly so that compressor can be rotated on skirt while holding connecting rod.

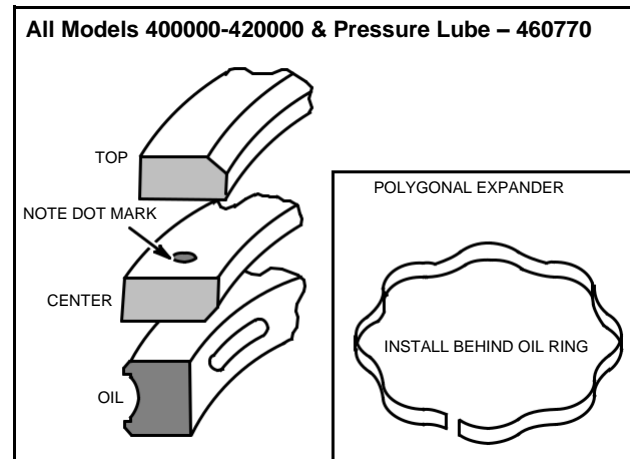


Fig. 11 – Piston Ring Installation

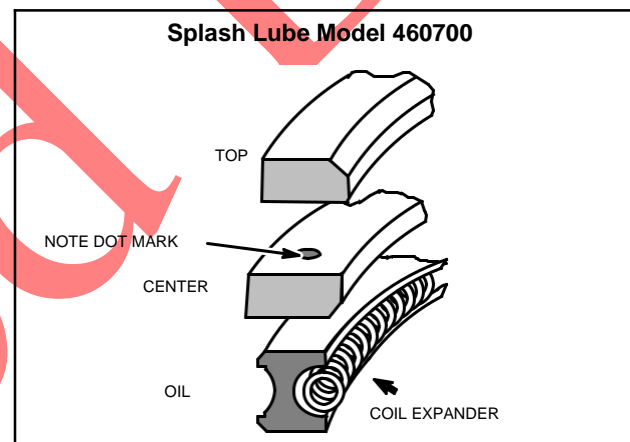


Fig. 12 – Piston Ring Installation

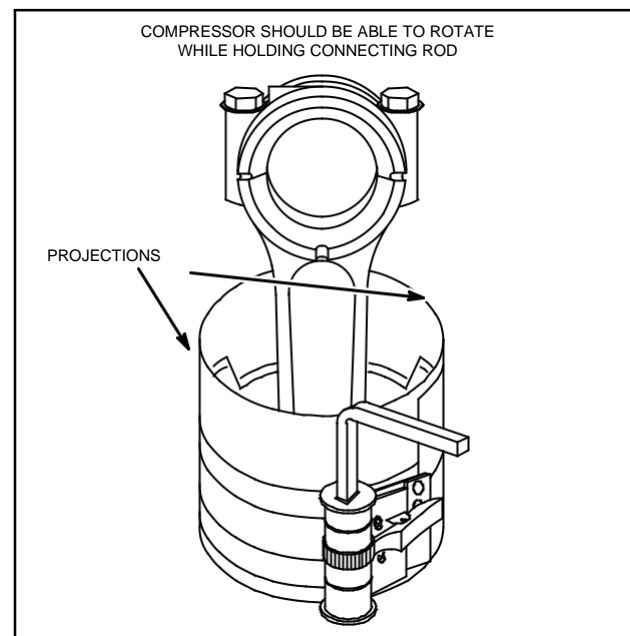


Fig. 13 – Compressing Rings

**NOTE: Briggs & Stratton** opposed twin cylinder engines use pistons with offset piston pins. The notch on the piston must face the flywheel side of engine, Fig. 14.

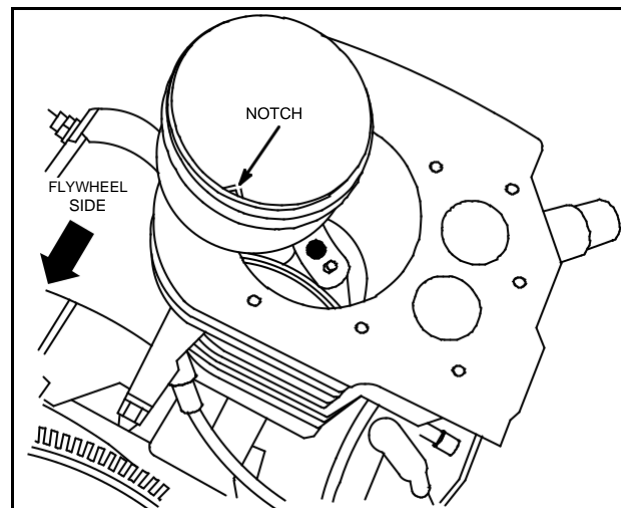


Fig. 14

Thoroughly clean and then oil cylinder bore. Rotate crankshaft until crankpin journal is at bottom of stroke. This allows complete entry of compressed rings, piston and connecting rod assembly, when pushed into cylinder, Fig. 15.

Clean and oil crankshaft crankpin. Pull connecting rod against crankpin and install rod cap. Make sure match marks are together. Install rod screws and washers.

Repeat procedure for other piston and connecting rod assembly.

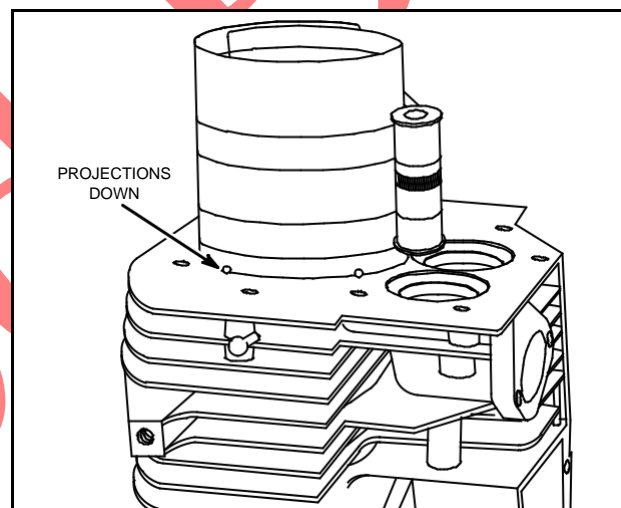


Fig. 15 – Install Piston Assembly

**NOTE: ENGINE MODELS 400000 – 420000:** With piston and connecting rod assemblies installed, the oil hole in the #1 connecting rod must face toward the cam gear. The oil hole in the #2 connecting rod must face away from the cam gear, Fig. 16.

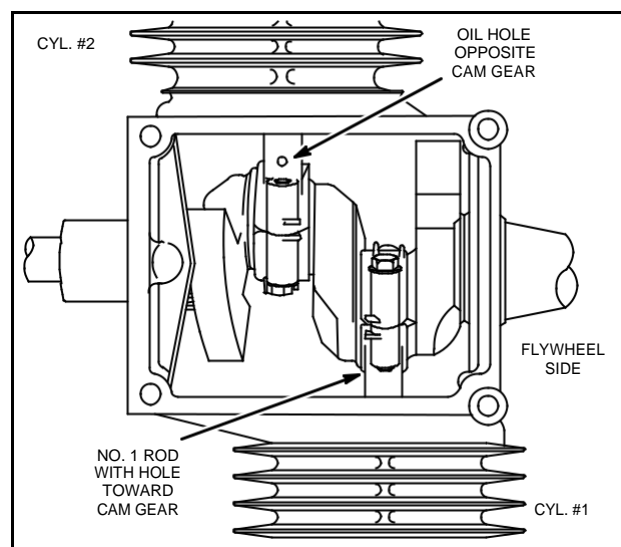


Fig. 16 – Installing Connecting Rods – Models 400000-420000

**NOTE: ENGINE MODELS 462770:** With piston and connecting rod assemblies installed, make sure the machined relief areas on the connecting rod and cap are together and facing cam gear, Fig. 17.

### Special Notes For Horizontal Crankshaft Splash Lube Engines:

#### Engines with a Top-No-Load Speed Above 2400 RPM:

Install only one oil dipper on #1 connecting rod, Fig. 18. Use **ONLY** dipper part #222480. Engine models 421000 and 422400 manufactured before date code 92072000 were not originally equipped with this dipper. It is recommended that the oil dipper be replaced with dipper part # 222480 in all 421400 and 422400 engines at the time of major servicing or overhaul. When installing dipper part #222480 in these engines, the oil trough must be removed (if so equipped).

#### Engines with a Top-No-Load Speed Below 2400 RPM:

Engines with a Top-No-Load speed below 2400 RPM require 2 oil dippers. Install **ONLY** oil dipper part #222480 on # 1 connecting rod. Install **ONLY** dipper part #223053 on #2 connecting rod, Fig. 19.

**NOTE: Engines equipped with Oil Gard** use only one oil dipper part #222480, attached to #1 connecting rod.

Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.

### Torque Connecting Rods

Torque connecting rod screws, using torque wrench, Tool #19197 or #19393, to 190 in. lbs. (21.5 Nm), Fig. 18 or Fig. 19. Rotate crankshaft two (2) revolutions to check for binding. Connecting rod should also be free to move sideways on crankpin.

**NOTE: Failure to** use a torque wrench can result in loose connecting rods causing break-age, or tight connecting rods causing scoring.

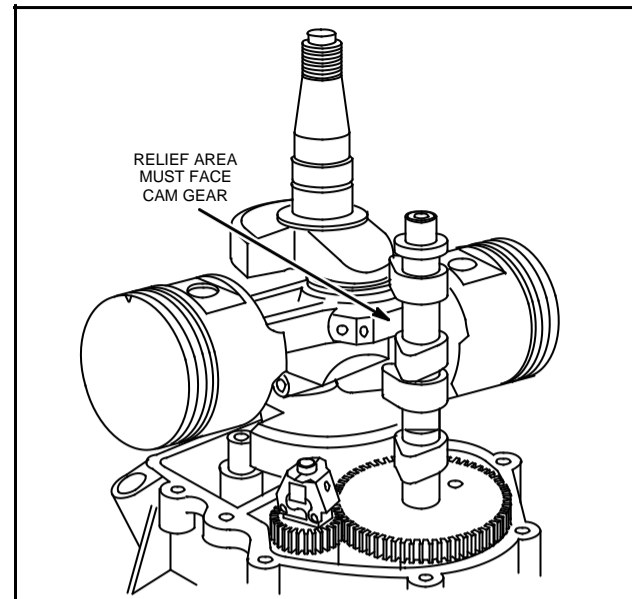


Fig. 17 – Installing Connecting Rods – Model 462770

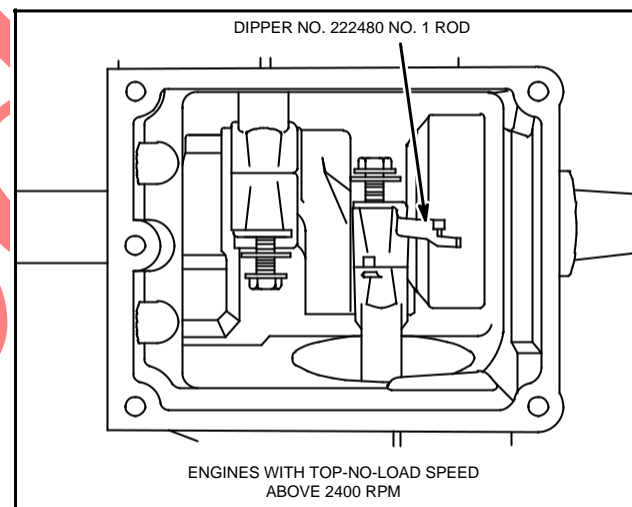


Fig. 18 – Dipper Location

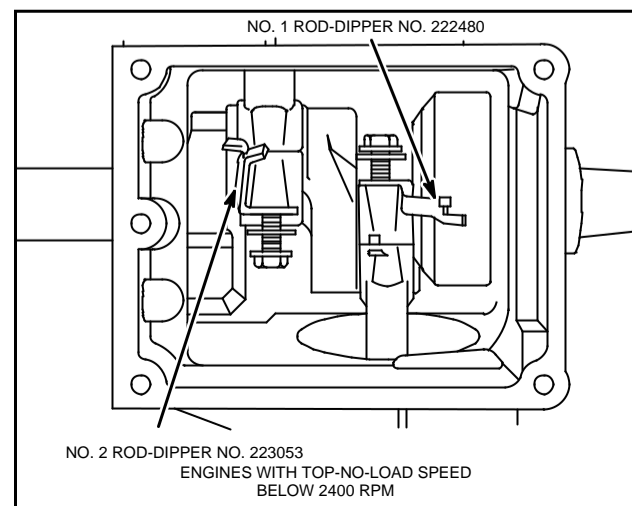


Fig. 19 – Dipper Location

Lil' Red Barn

# Section 13

## Engine Assembly

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## INSTALL CRANKSHAFT

### Install Crankshaft And Camshaft – Plain Bearing Models

Lubricate crankshaft, tappets, camshaft journals and lobes with engine oil. Assemble timing gear to crankshaft.

1. Install tappets.
2. Install crankshaft into cylinder.
3. Align timing marks and install camshaft, Fig. 1.

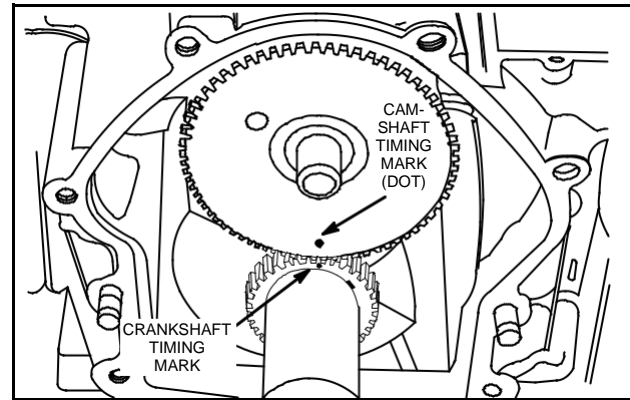


Fig. 1 – Install Crankshaft – Plain Bearing Models

### Install Crankshaft And Camshaft – Ball Bearing Models

Lubricate crankshaft, tappets, camshaft journals and lobes with engine oil.

**NOTE:** On ball bearing crankshafts, the gear teeth are covered by the ball bearing. The timing mark is located on the #2 crankpin.

1. Install tappets.
2. Align timing mark on #2 crankpin with timing mark on camshaft and insert both into cylinder.

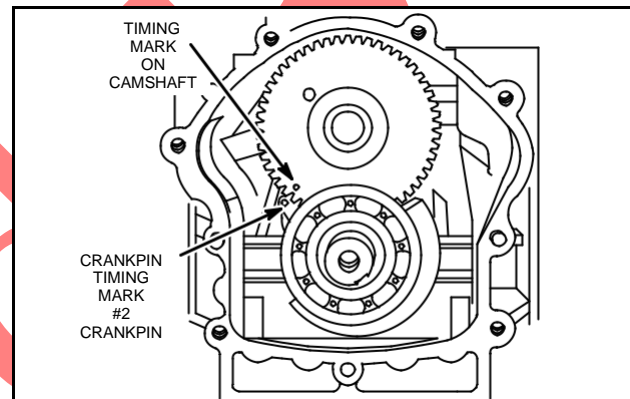


Fig. 2 – Install Crankshaft – Ball Bearing Models

## INSTALL PISTON AND CONNECTING ROD

**NOTE:** Install #1 piston and connecting rod first.

1. Oil piston rings, piston skirt, and compress rings with Ring Compressor, Tool #19230, Fig. 3.
  - a. Place piston and ring compressor upside down on bench with projections on compressor facing up.
  - b. Tighten ring compressor evenly until rings are fully compressed.
  - c. Then loosen ring compressor very slightly so that compressor can be rotated on piston skirt while holding connecting rod.

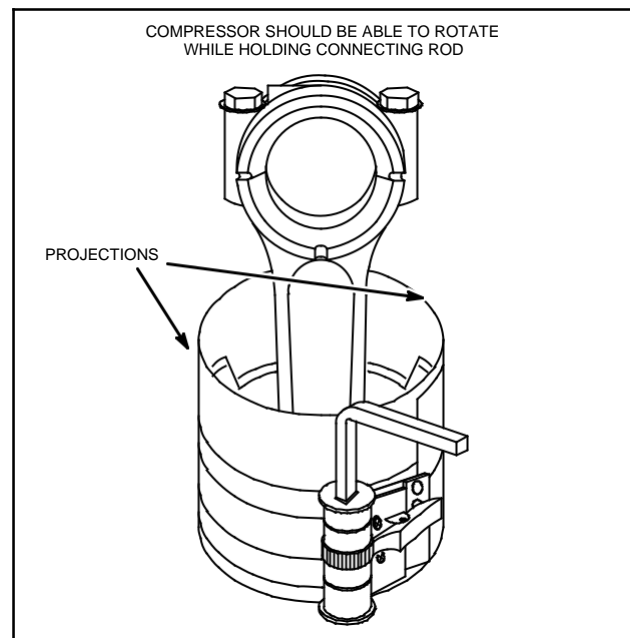


Fig. 3 – Compressing Rings

2. Lubricate cylinder bores and crankpin and rotate crankshaft until it is at bottom of stroke.
3. Install #1 piston with notch on piston toward flywheel side, Fig. 4.
  - a. Push piston down by hand until connecting rod is seated on crankpin.
4. Assemble connecting rod cap to rod with match marks aligned.
5. Install rod screws and washers.

Repeat procedure for other piston and connecting rod assembly.

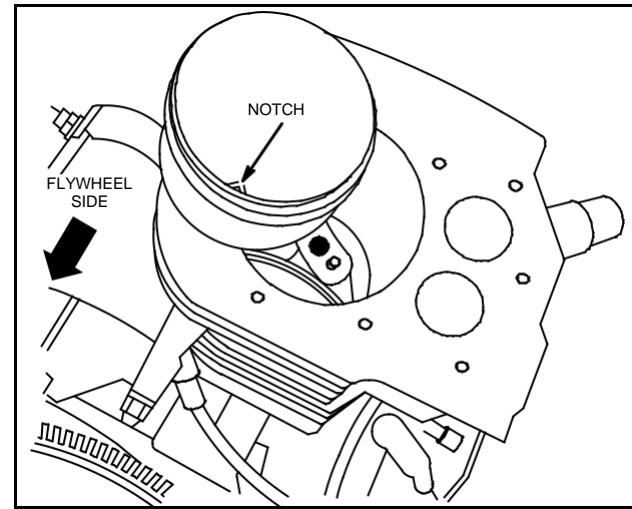


Fig. 4 – Install Piston And Connecting Rod

**NOTE:ENGINE MODELS 400000 – 420000:** With piston and connecting rod assemblies installed, the oil hole in the #1 connecting rod must face toward the cam gear. The oil hole in the #2 connecting rod must face away from the cam gear, Fig. 5.

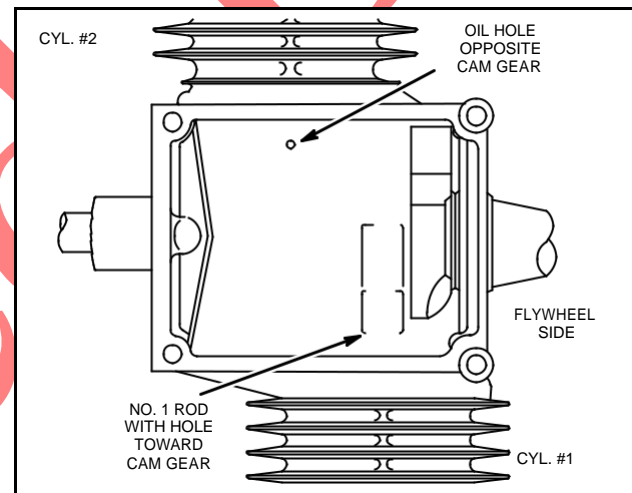


Fig. 5 – Installing Connecting Rods – Models 400000-420000

**NOTE:ENGINE MODELS 462770:** With piston and connecting rod assemblies installed, make sure the machined relief areas on the connecting rod and cap are together and facing cam gear, Fig. 6.

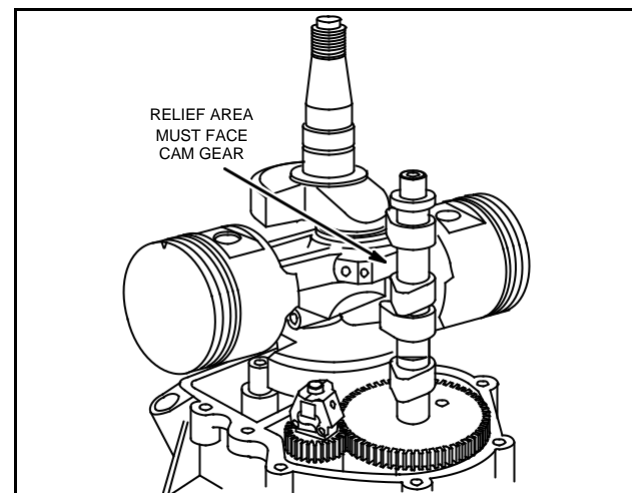


Fig. 6 – Installing Connecting Rods – Model 462770

## Special Notes For Horizontal Crankshaft Splash Lube Engines:

### Engines with a Top-No-Load Speed Above 2400 RPM:

Install only one oil dipper on #1 connecting rod, Fig. 7. Use **ONLY** dipper part #222480. Engine models 421000 and 422400 manufactured before date code 92072000 were not originally equipped with this dipper. It is recommended that the oil dipper be replaced with dipper part #222480 in all 421400 and 422400 engines at the time of major servicing or overhaul. When installing dipper part #222480 in these engines, the oil trough must be removed (if so equipped).

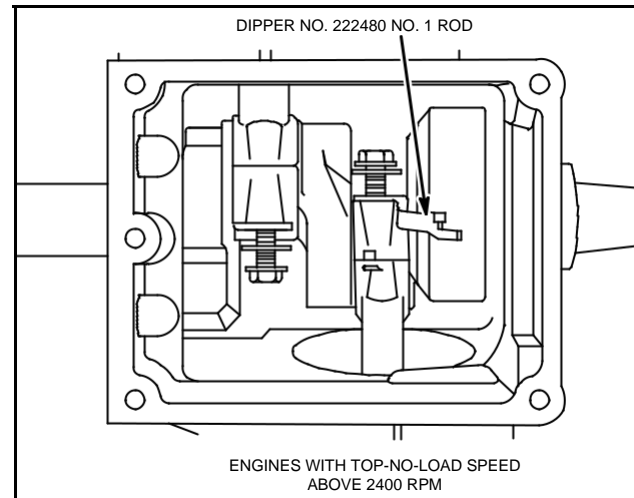


Fig. 7 – Dipper Location

### Engines with a Top-No-Load Speed Below 2400 RPM:

Engines with a Top-No-Load speed below 2400 RPM require 2 oil dippers. Install **ONLY** oil dipper part #222480 on # 1 connecting rod. Install **ONLY** dipper part #223053 on #2 connecting rod, Fig. 8.

**NOTE:**Engines equipped with Oil Gard use only one oil dipper part #222480, attached to #1 connecting rod.

Refer to Service Engine Sales Manual Microfiche, MS-6225 or the Service Sales Manual, MS-4052 for Top-No-Load RPM by engine model and type number.

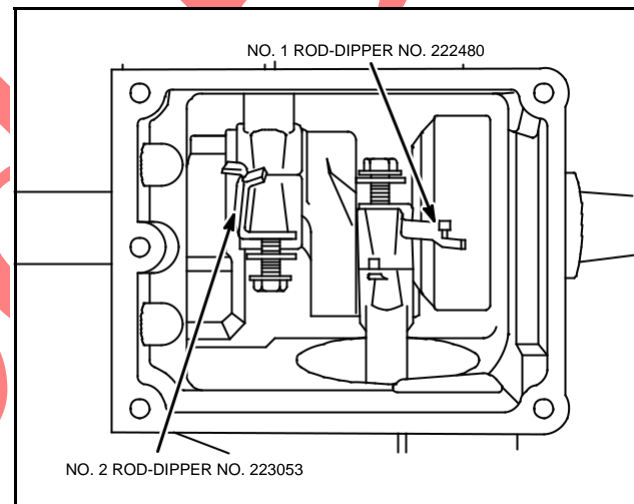


Fig. 8 – Dipper Location

## Torque Connecting Rods

1. Torque connecting rod screws 190 in. lbs. (21.5 Nm), Fig. 9.
2. Rotate crankshaft two (2) revolutions to check for binding.
  - a. Connecting rod should also be free to move sideways on crankpin.

**NOTE:**Failure to use a torque wrench can result in loose connecting rods causing break-age, or tight connecting rods causing scoring, Fig. 9.

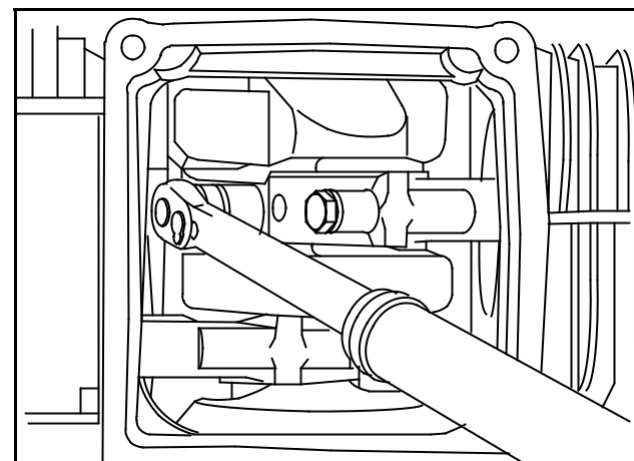


Fig. 9 – Torque Connecting Rods

## INSTALL CRANKCASE COVER OR SUMP

1. Install crankcase cover or sump with new gasket.
2. To engage governor gear (horizontal or vertical crankshaft models) and oil slinger (vertical crankshaft models) rock crankshaft back and forth.
3. Torque screws to 225 in. lbs. (25.0 Nm), Fig. 10.

## Install Base – Horizontal Crankshaft

1. Install cylinder base with new gasket.
  - a. Torque screws to 27 ft. lbs. (37.0 Nm).

## Install Cylinder Cover – Vertical Crankshaft

1. Install aluminum cylinder cover with new gasket.
  - a. Torque screws to 27 ft. lbs. (37.0 Nm).
2. Install steel cylinder cover with new gasket.
  - a. Torque screws to 225 in. lbs. (25.0 Nm).

## Crankshaft End Play

Crankshaft end play is .002" (.05 mm) to .026" (.66 mm) on vertical crankshaft engines and .004" (.10 mm) to .012" (.30 mm) on horizontal crankshaft engines with one .015" (.4 mm) gasket in place. If end play is less than .002" (.05 mm), which could be the case if a new crankcase cover or sump is used, additional gaskets .005" (.13 mm), .009" (.23 mm) or .015" (.4 mm) may be added to obtain correct end play.

If end play is more than .026" (.66 mm) for vertical crankshaft engines or .012" (.30 mm) on horizontal shaft engines, with one .015" (.4 mm) gasket in place, install thrust washer, Part #222951, Fig. 11. Install thrust washer on PTO end of crankshaft, plain bearing engines or magneto end of crankshaft on engines with ball bearing on PTO side only. Then adjust end play as described in previous paragraph.

**NOTE:** Thrust washer part #222951 cannot be used on double ball bearing engines.

## GENERAL ASSEMBLY

1. Install back plate.
  - a. Torque screws to 150 in. lbs. (17.0 Nm).
2. Install alternator, Fig. 12.
  - a. Torque screws to 20 in. lbs. (2.0 Nm).
3. Install starter motor.
  - a. Torque screws to 160 in. lbs. (18.0 Nm).

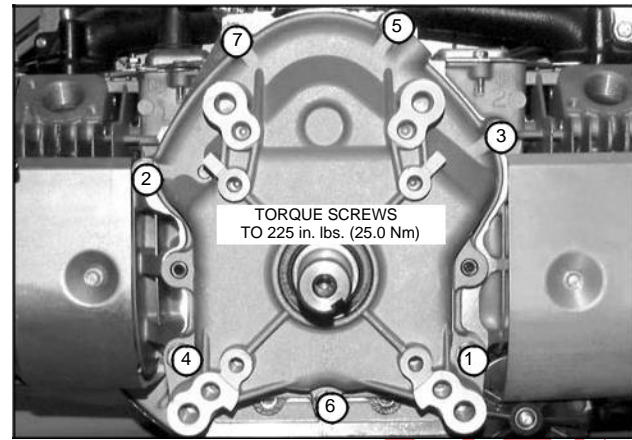


Fig. 10 – Torque Screws

Vertical crankshaft engines manufactured after 93122000 are equipped with a .030" thinner timing gear. If a cylinder, crankshaft or sump is being replaced it may be necessary to change the timing gear if the correct end play cannot be obtained with standard gaskets or a thrust washer. Order timing gear Part #262989.

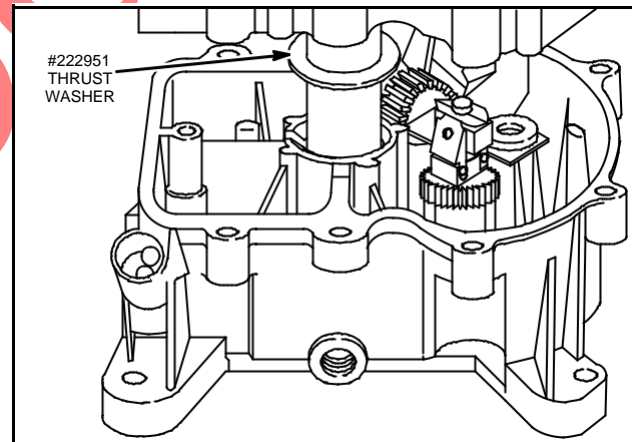


Fig. 11 – Correcting Crankshaft End Play

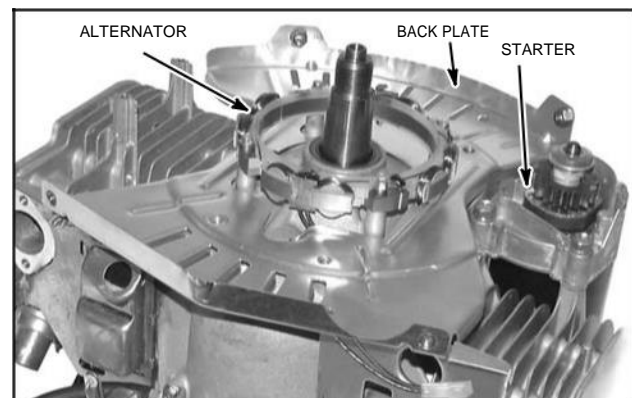


Fig. 12 – Install Alternator



## INSTALL FLYWHEEL – ALL MODELS



**CLEAN FLYWHEEL** and crankshaft taper removing all oil, dirt or grease.

1. Assemble flywheel to crankshaft and align keyways.
2. Insert flywheel key into crankshaft.

### Torque Flywheel Nut – Pre Twin II Models (Type Nos. Under 1100)

1. Install flywheel washer and nut or clutch.
2. Place flywheel strap wrench, Tool #19433, around outer rim of flywheel.
3. Torque flywheel nut or rewind clutch to 150 Ft. Lbs. (203 Nm), Fig. 13.
4. Re-install armature and adjust air gap.

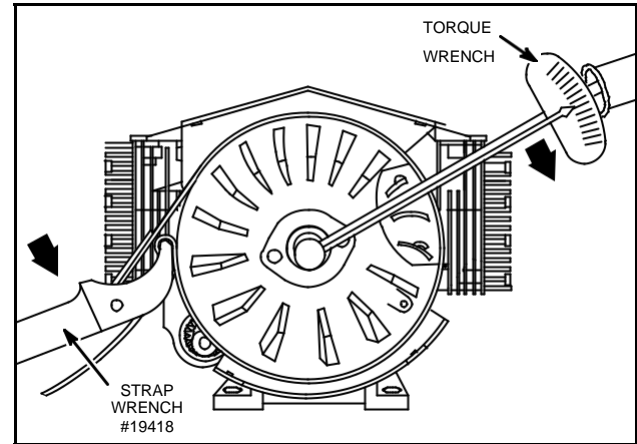


Fig. 13 – Torque Flywheel Nut – Pre Twin II

### Torque Flywheel Nut – Twin II Models (Type Nos. 1100 & Above)

1. Install flywheel washer and nut.
2. Place Tool #19321 on fan retainer with lugs of flywheel holder engaging the slots of the fan retainer.
3. Torque flywheel nut to 150 Ft. Lbs. (203 Nm), Fig. 14.

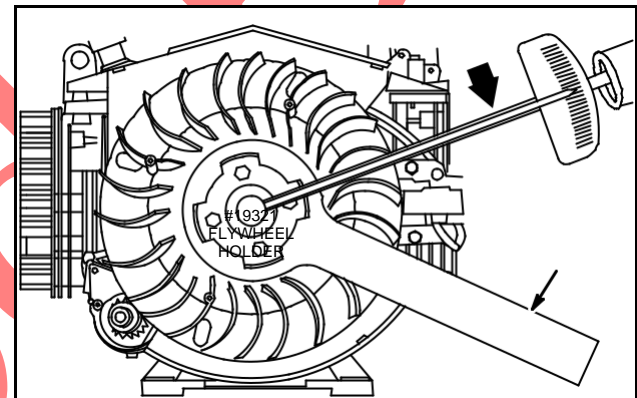


Fig. 14 – Torque Flywheel Nut – Twin II

## Install Armature – All Models

Rotate flywheel so magnet is away from armature. Note position of spark plug wires in illustrations for the type of armature being installed, Fig. 15 or Fig. 16.

Install Magnatron armature on engine as shown in Fig. 15.

Magnatron composite style armatures have identifications on the coil casing for correct assembly.

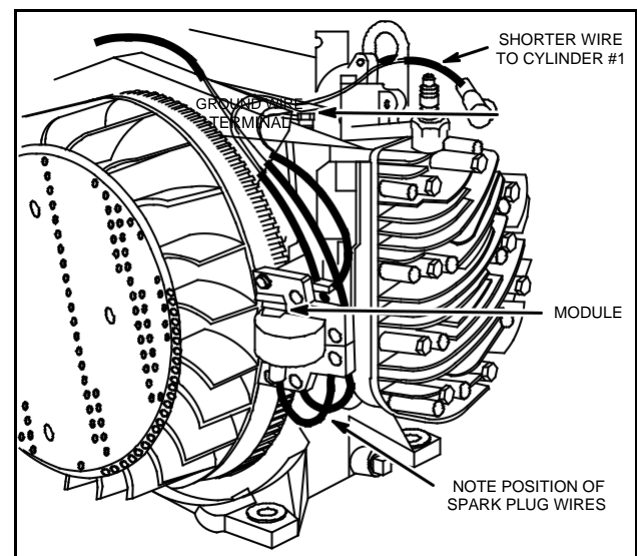


Fig. 15 – Install Armature – Magnatron

Install breaker point ignition armature as shown in Fig. 16. The right hand mounting screw holds the ground lead(s) on breaker point ignition systems.

Push armature away from flywheel and tighten one screw to hold armature away from flywheel.

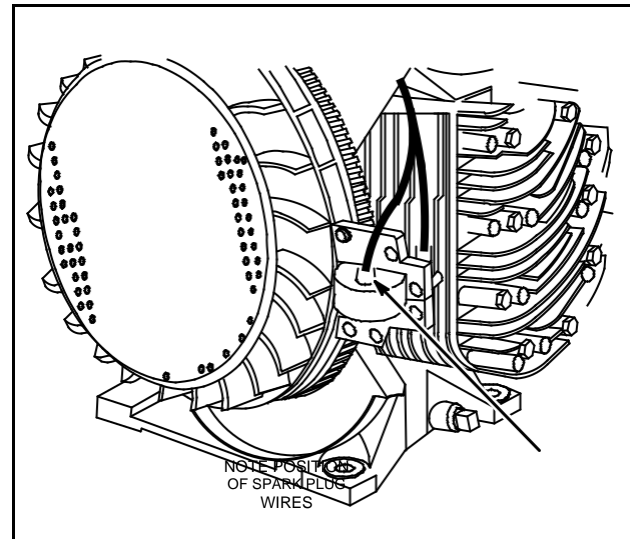


Fig. 16 – Install Armature – Breaker Points

### Adjust Armature Air Gap – All Models

1. Rotate flywheel until magnet is under armature laminations.
2. Place thickness gauge between magnet and armature laminations, Fig. 17.

**Magnetron Ignition:** .008"-.012"

(.20-.30 mm)

**Breaker Point Ignition:** .010"-.014"

(.25 mm-.36 mm)

3. Loosen mounting screw so magnet will pull armature down against thickness gauge.
  - a. Torque screws to 25 in. lbs. (3.0 Nm).
4. Rotate flywheel to remove thickness gauge.

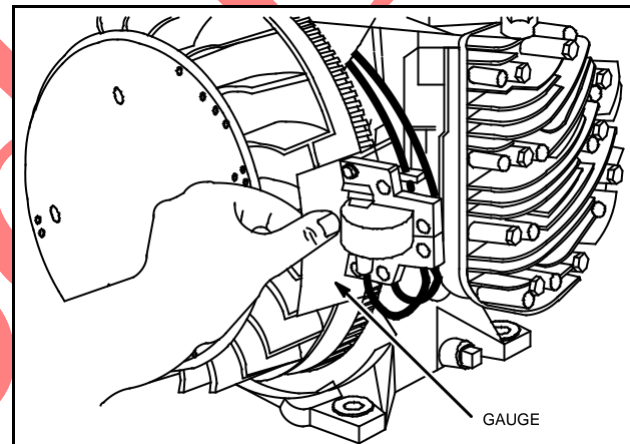


Fig. 17 – Adjust Air Gap

If engine is equipped with breaker points, see Section 2 for installation and adjustment procedure.

### CHECK VALVE CLEARANCE

Turn crankshaft until piston is 1/4" (6.35 mm) past Top Dead Center, compression stroke, for cylinder being checked. See specifications below.

1. If clearance is less than specified, grind end of valve stem to obtain proper clearance.
2. If clearance is too much, replace valve or cut valve seat to obtain proper clearance. See Reface Valves and Seats, Section 5. Repeat for other cylinder.

### VALVE CLEARANCES

MODEL SERIES		INTAKE		EXHAUST	
		Min.	Max.	Min.	Max.
All Twin Cylinder Engines	Springs Installed	.004" (.1 mm)	.006" (.15 mm)	.007" (.18 mm)	.009" (.23 mm)
	Without Springs	.006" (.15 mm)	.008" (.2 mm)	.009" (.23 mm)	.011" (.28 mm)



## INSTALL VALVES

### Install Intake Valve and Seal

1. Coat valve stem with Valve Guide Lubricant #93963 and install in intake valve guide until stem just starts to enter valve tappet chamber, Fig. 18.

**NOTE:** Be sure valve guide lubricant, Part #93963, is not on valve face, seat or retainer grooves.

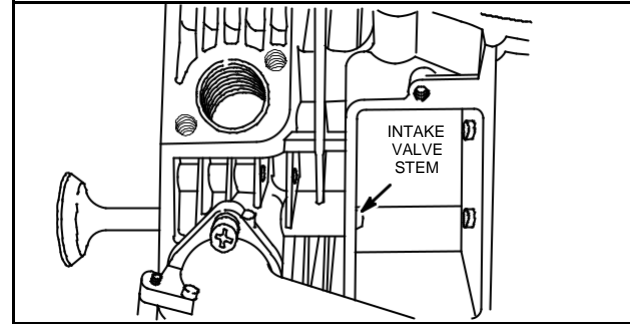


Fig. 18

2. Place new valve stem seal, valve spring and valve spring retainer in valve spring compressor, Tool #19063, and compress completely.
  - a. Metal side of valve stem seal faces valve spring.
  - b. Large hole in retainer should face away from jaws.
3. Insert compressed spring, seal and retainer into valve tappet chamber.
4. Push valve stem through valve stem seal and large hole in valve spring retainer, Fig. 19.
5. Lift up on compressor to engage small hole of retainer on shoulder of valve stem and slowly release spring compressor until jaw contacting retainer is free.
6. Lift out compressor. Repeat for other cylinder. Rotate crankshaft to check for proper valve opening and closing.

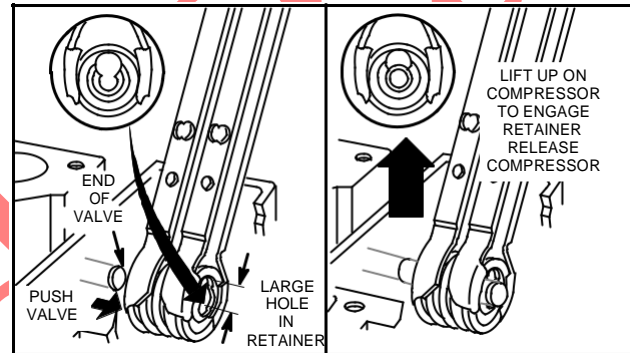


Fig. 19 – Installing Intake Valve

### Install Exhaust Valve

Coat valve stem with Valve Guide Lubricant #93963.

1. Place exhaust valve spring and rotator or retainer into valve spring compressor, Tool #19063, and compress spring completely.
2. Insert compressed spring into valve tappet chamber and slide coated exhaust valve stem in through exhaust valve guide, through spring and rotator or retainer until valve seats.
3. Hold spring against cylinder head side of valve tappet chamber and insert split valve keepers in valve stem retainer grooves, Fig. 20.
  - a. A light coat of grease will help hold keepers on stem.
4. Move spring down onto keepers and while keeping light downward pressure on keepers, slowly release valve spring compressor.
5. Repeat for second cylinder. Rotate crankshaft to check for proper valve opening and closing.

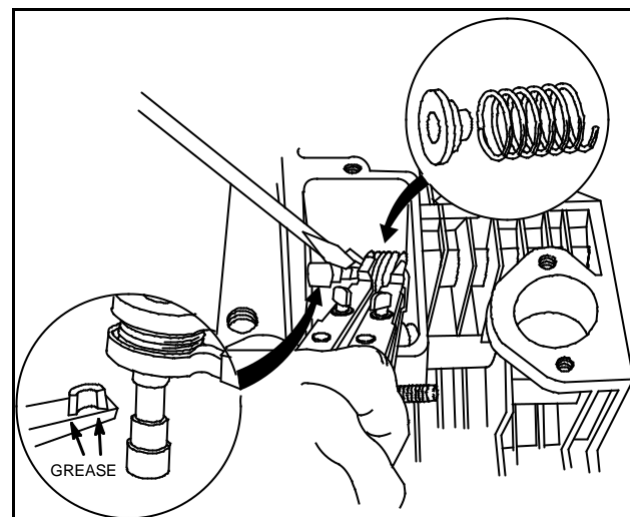


Fig. 20 – Installing Exhaust Valve

## INSTALL CYLINDER HEADS

Some models use three (3) longer head bolts located around the exhaust valve area. If a short bolt is used in the wrong position, it may not engage enough threads. A long bolt in the wrong position may bottom on fins, either breaking the fins or leaving the cylinder head loose. Install long bolts around the exhaust valve area of the cylinder head, torque sequence 1, 3, 7, Fig. 20.

1. Assemble cylinder heads with new head gasket and cylinder head screws in correct location.
2. Apply Valve Guide Lubricant, #93963 to threads of head bolts. **DO NOT USE SEALER OF ANY KIND ON GASKETS.**
3. Torque head bolts in 40 in. lbs. (5.0 Nm) increments, in sequence shown, to 160 in. lbs. (18.0 Nm).
4. Install cylinder head covers and cylinder shields.
  - a. Torque screws to 25 in. lbs. (3.0 Nm).

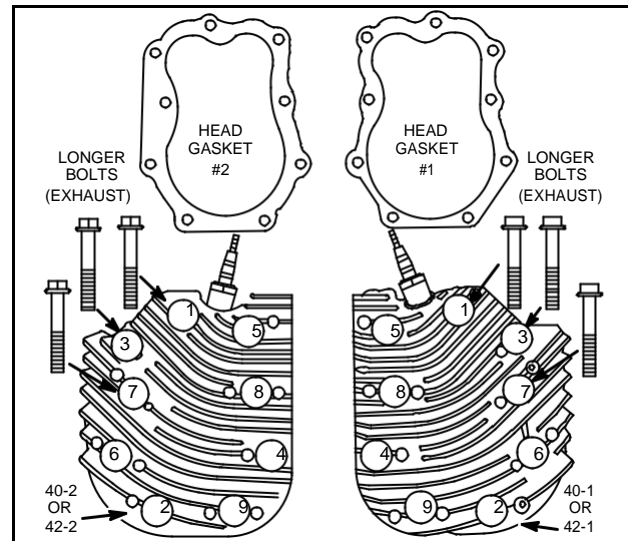


Fig. 21 – Head Nos. and Torque Sequence

## GENERAL ASSEMBLY

1. Assemble governor lever to governor shaft. **DO NOT** tighten nut at this time.
2. Install governor control bracket, Fig. 22.
  - a. Torque screws to 35 in. lbs. (4.0 Nm).

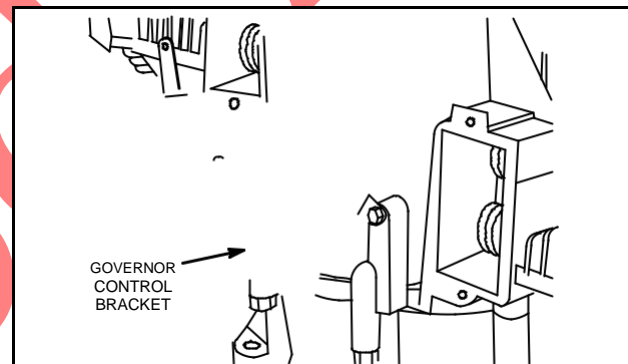


Fig. 22 – Install Governor Lever And Control Bracket

## Install Breather – All Vertical Crankshaft Models & Horizontal Crankshaft Models After Code 91080000

Install new breather gasket(s) with notches facing crankshaft.

**NOTE:** On horizontal crankshaft models, install new dipstick tube seal in cylinder before installing air guide.

1. Install gasket between valve chamber and air guide, #2 cylinder, then install cover.
2. Install breather and gasket #1 side, Fig. 23.
  - a. Torque screws to 25 in. lbs. (3.0 Nm).
3. Assemble breather tube to breather.

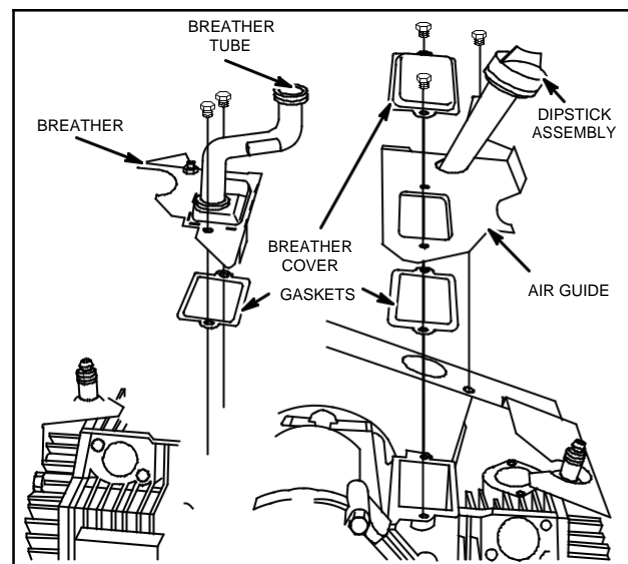


Fig. 23 – Install Breather And Air Guide

## Install Breathers – Horizontal Crankshaft Models Before Code 91080000

Install new dipstick tube seal in cylinder before installing air guide.

1. Install gasket between valve chamber and breather, #1 side.
2. Install one gasket between the valve chamber and air guide, #2 side.
3. Install second gasket between air guide and breather, #2 side.
  - a. Torque screws to 25 in. lbs. (3.0 Nm).
4. Assemble breather tubes to breathers

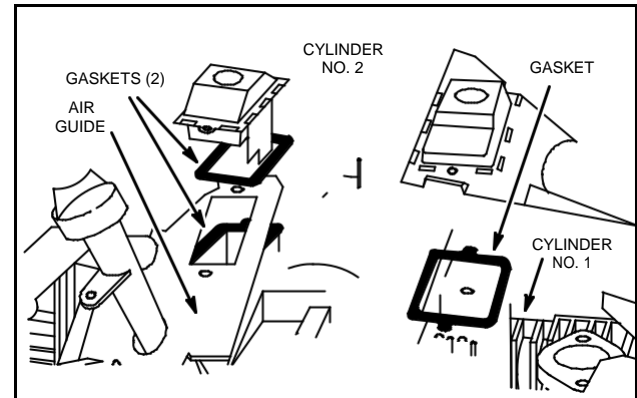


Fig. 24 – Install Breathers And Air Guide

## GENERAL ASSEMBLY

1. Route the spark plug leads and ground and primary (breaker point engines) wire through the notch in air guide, # 1 cylinder side, Fig. 25.
2. Assemble linkage to governor lever and throttle lever.
3. Install intake manifold and carburetor assembly.
  - a. Torque screws to 90 in. lbs. (10.0 Nm).
4. Install blower housing.
  - a. Torque screws to 90 in. lbs. (10.0 Nm).
  - b. Vertical Crankshaft: Install oil fill tube with new seal.
5. Install fuel pump pulse line.
6. Install air cleaner base with new gasket
  - a. Torque screws to 25 in. lbs. (3.0 Nm).
7. Assemble air cleaner.

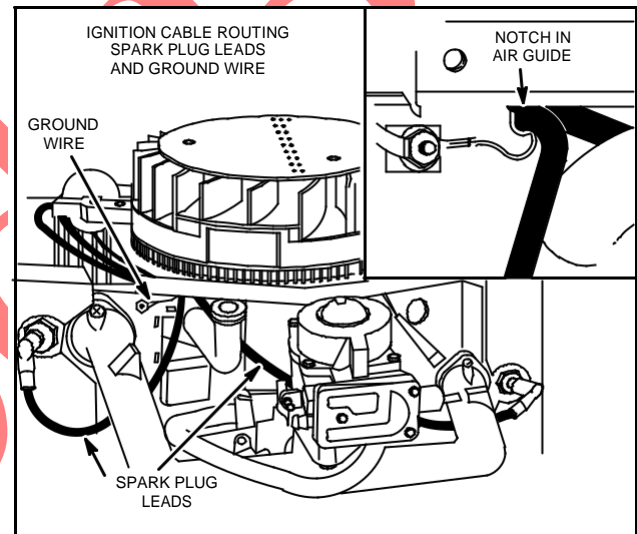


Fig. 25 – Wire Routing

**IMPORTANT:** Install breather tubes on filtered side of air cleaner element, Fig. 26. If breather tubes are incorrectly installed, premature engine wear will result.

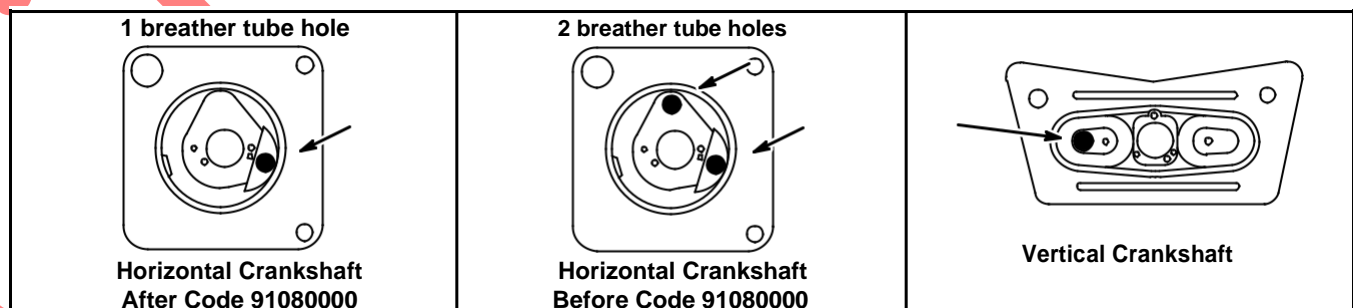


Fig. 26 – Breather Tube Installation



**WARNING: BEFORE STARTING** or running engine, static adjustment of the governor must be completed! Failure to make the static adjustments first could result in engine overspeeding which may result in engine damage, property damage or personal injury.

### STATIC GOVERNOR ADJUSTMENT

1. With governor lever nut loose, push governor lever counter-clockwise as far as it will go (wide open throttle) and hold in this position.
2. Rotate governor shaft counter-clockwise as far as it will go, Fig. 27.
  - a. Torque governor nut to 100 in. lbs. (11.0 Nm).

**SEE SECTION 3 FOR CARBURETOR ADJUSTMENT PROCEDURE.**

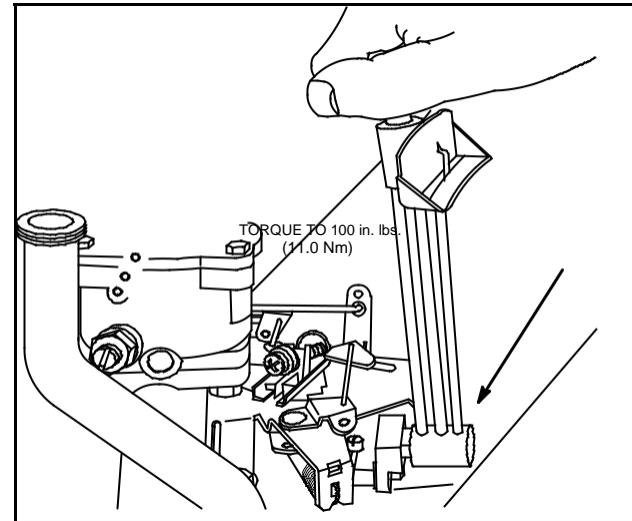


Fig. 27 – Static Governor Adjustment

Lil' Red Barn

# Section 14

## MUFFLERS

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### GENERAL INFORMATION

Fig. 1 shows typical Briggs & Stratton mufflers used on twin cylinder engines. Muffler styles "A", "C", and "D" are normally used on non-ducted engines. Some mufflers, such as "C" and "D," are installed by the Original Equipment Manufacturer (OEM) using their mounting brackets. Muffler style "B" is used on ducted engines.

**NOTE:** To meet various OEM requirements, many twin cylinder engines are shipped without mufflers.

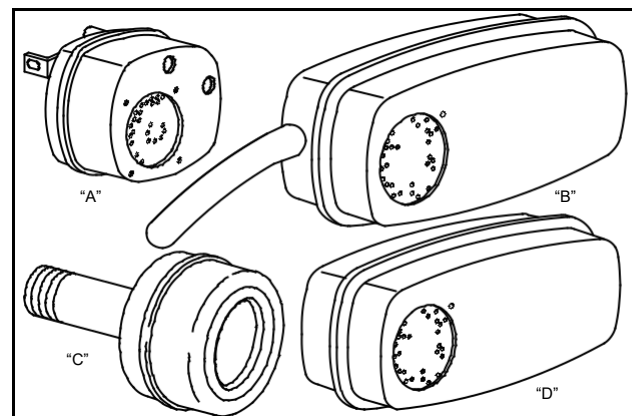


Fig. 1 – Typical Mufflers



## REMOVE MUFFLER

### Horizontal Crankshaft Ducted Engines

1. Remove cylinder air guide assemblies, Fig. 2.
2. Remove four (4) hex head cap screws, Fig. 3.
3. Lift off muffler assembly, Fig. 4.

**NOTE:** Use **penetrating** oil to loosen seized exhaust pipes and exhaust nipples.

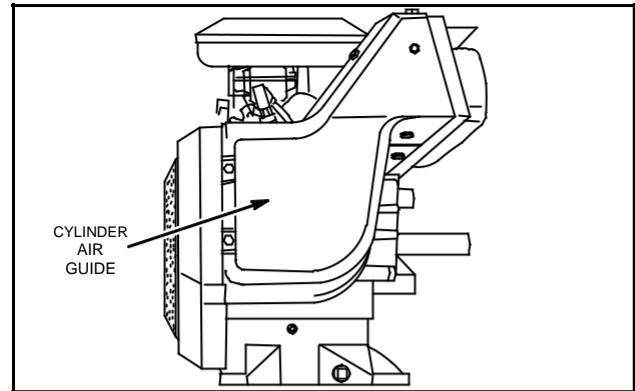


Fig. 2 – Remove Cylinder Air Guides

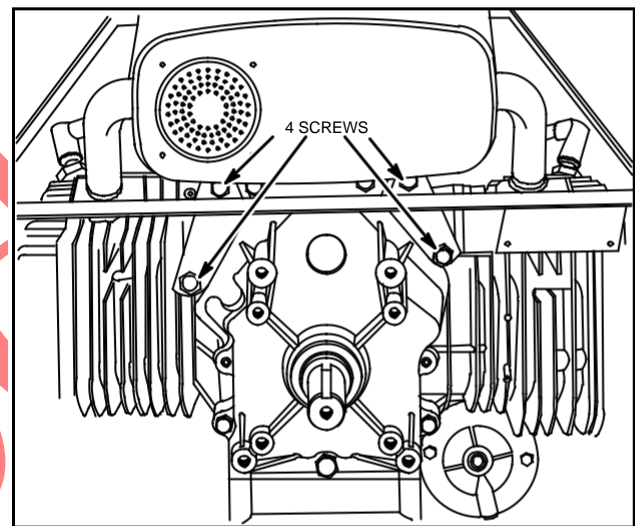


Fig. 3 – Bracket Mounting Screws

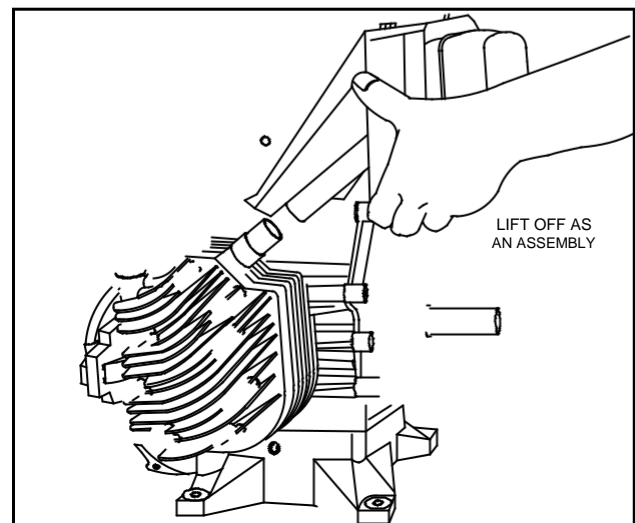


Fig. 4 – Removing Muffler Assembly

### Remove Exhaust Nipples (If Equipped)

Remove exhaust nipples by loosening lock nuts first and then turn out nipples. Penetrating oil may be required to loosen and prevent galling exhaust port threads, Fig. 5.

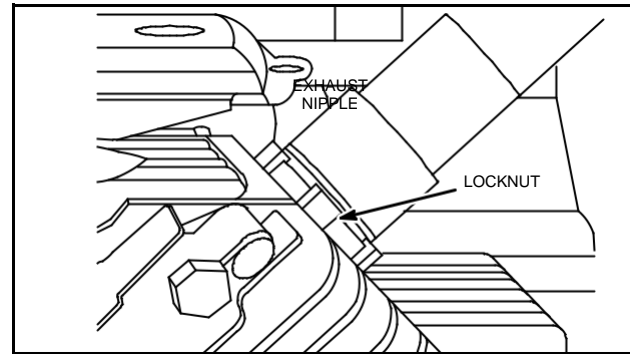


Fig. 5 – Exhaust Nipple

### Remove Port Liners (If Equipped)

Remove two (2) cap screws, port liners and gasket, Fig. 6. Penetrating oil may be required to loosen and prevent galling port liner mounting threads.

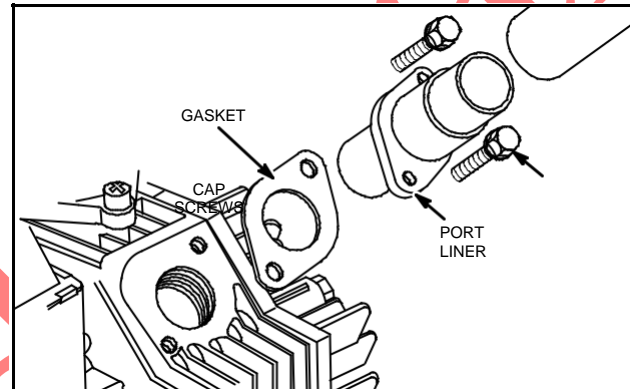


Fig. 6 – Removing Port Liners

Muffler is held to muffler mounting bracket with four (4) screws, Fig. 7. Penetrating oil may be required to prevent muffler mounting screw threads from stripping.

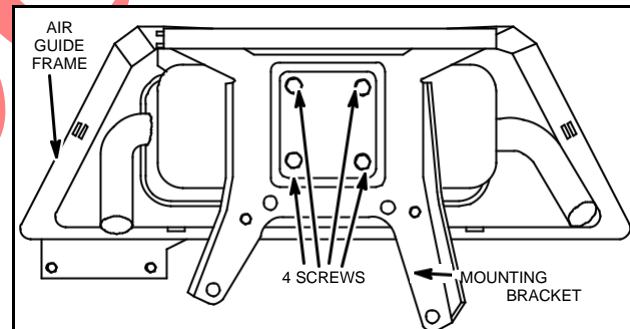


Fig. 7 – Remove Muffler

## REMOVE MUFFLER

### Vertical Crankshaft Ducted Engines

1. Remove six (6) screws holding top plate to cylinder air guides, Fig. 8.

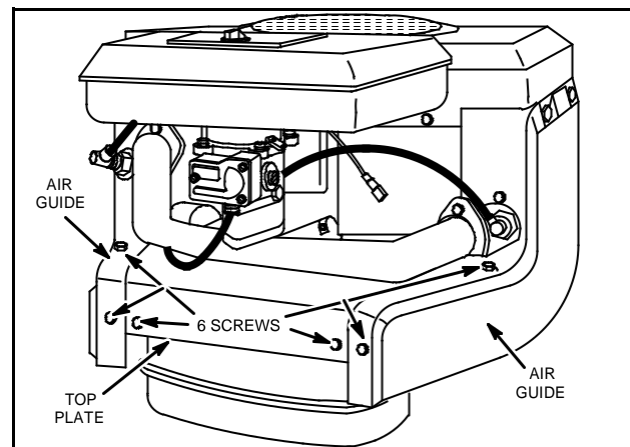
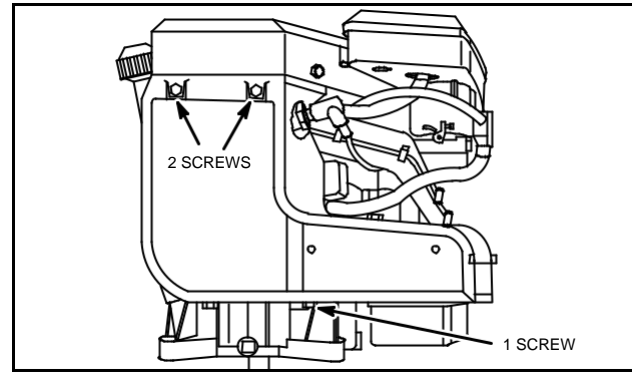


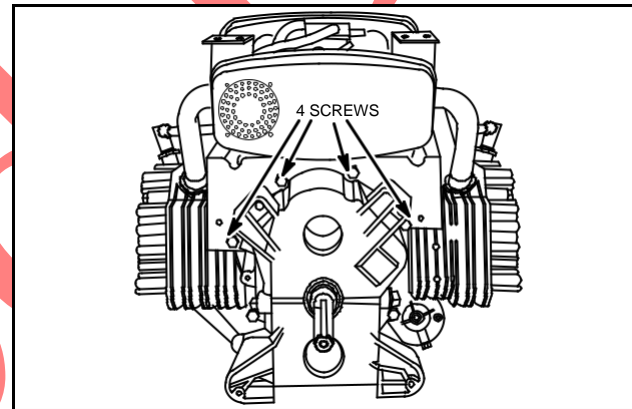
Fig. 8 – Loosen Top Plate

2. Remove two (2) screws at top edge of cylinder air guides and one screw from bottom of each air guides, Fig. 9.



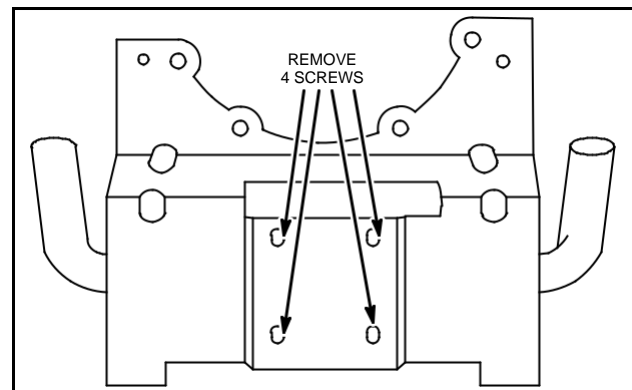
**Fig. 9 – Remove Air Guides**

3. Air guides and top plate can now be removed.



**Fig. 10 – Remove Muffler Assembly**

4. Remove four (4) hex head cap screws, Fig. 11.



**Fig. 11 – Remove Muffler**

5. Remove muffler assembly, Fig. 10.

### Remove Exhaust Nipples (If Equipped)

Remove exhaust nipples by loosening lock nuts first and then turn out nipples. Penetrating oil may be required to prevent galling exhaust port threads, Fig. 12.

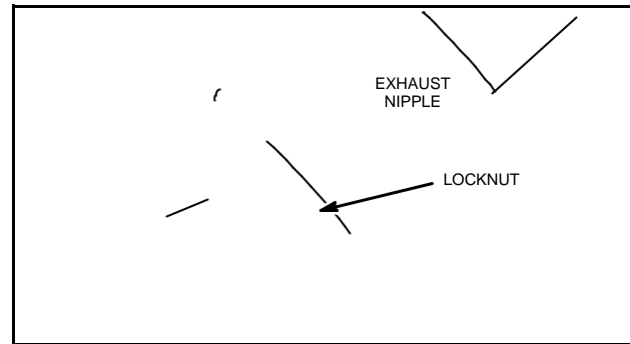


Fig. 12 – Exhaust Nipple

### Remove Port Liners (If Equipped)

Remove two (2) cap screws, port liners and gasket, Fig. 13. Penetrating oil may be required to loosen and prevent galling port liner mounting threads.

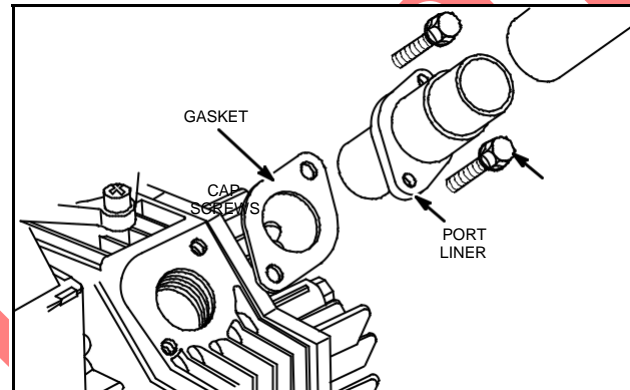


Fig. 13 – Removing Port Liners

## INSPECT EXHAUST SYSTEM

### All Models

Check muffler mounting bracket and/or muffler adapt-ers for cracked welds or breakage. Check muffler(s) for split seams, loose internal parts or cracked welds. Replace any damaged parts with new Original Equip-ment Parts.

## ASSEMBLE EXHAUST SYSTEM

### All Ducted Engine Models

Use Valve Lubricant (Part #93963) on all exhaust system threads to prevent galling of threads and permit easier disassembly, should it be required.

### Install Exhaust Nipple

1. Install lock nut on nipple with tangs toward shoulder, Fig. 14.
2. Thread nipple into exhaust port finger tight.
3. Tighten lock nut securely, not more than two (2) threads should be showing, Fig. 14.

### Install Exhaust Port Liners

1. Install port liner, new gasket and cap screws, Fig. 15.
2. Torque cap screws to 90 in. lbs. (10.0 Nm).

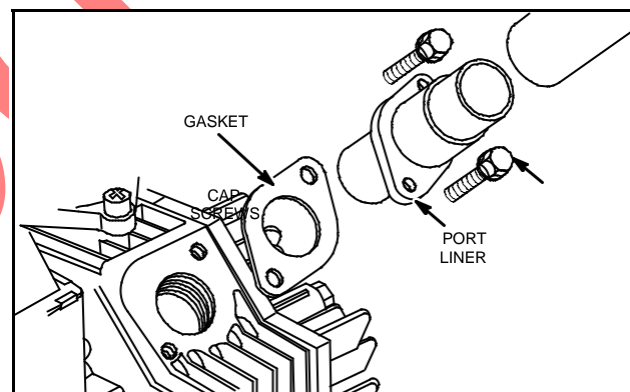


Fig. 14 – Install Port Liners

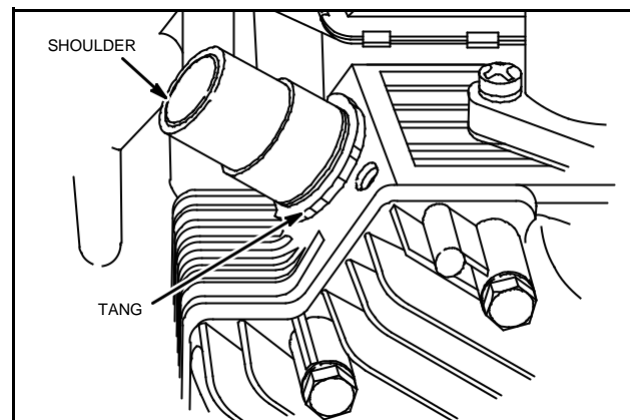


Fig. 15 – Exhaust Nipple Installed

### Install Muffler and Mounting Bracket

1. Assemble muffler to mounting bracket loosely with four (4) cap screws.
2. Install muffler assembly on engine sliding muffler pipes onto exhaust nipples or port liners.
3. Install four (4) screws through muffler mounting bracket into crankcase cover or sump, torquing screws to 225 in. lbs. (25.0 Nm).
4. Torque muffler screws to 80 in. lbs. (9.0 Nm).

### Install Air Guides – Horizontal Crankshaft Models

For ease of assembly, it is best to start all screws holding air guides and shields before tightening any screws. This will permit easy alignment of all screw holes and parts.

1. Place heat shield (optional) and rear insert on air guide frame, Fig. 16, and start two (2) screws.
2. Install #1 and #2 cylinder air guides and align holes to start screws.
3. Tighten all 16 screws.

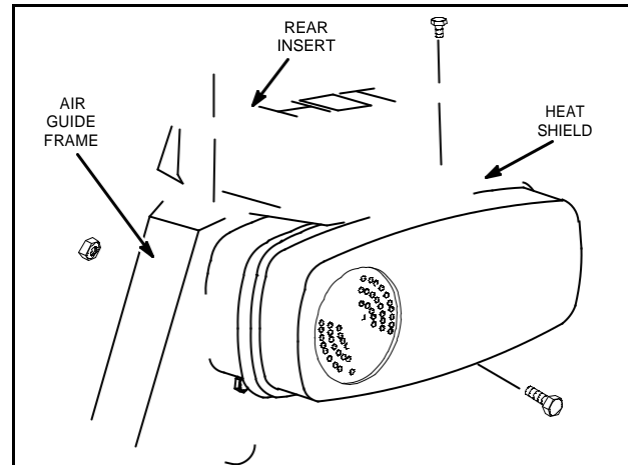


Fig. 16 – Install Ducting

### Install Air Guides and Top Plate – Vertical Crankshaft Models

For ease of assembly, it is best to start all screws holding air guides and shields before tightening any screws. This will permit easy alignment of all screw holes and parts.

1. Lay top plate on muffler assembly.
2. Install #1 and #2 cylinder air guides and install twelve screws loosely to permit alignment.
3. Tighten twelve screws securely, Fig. 17.

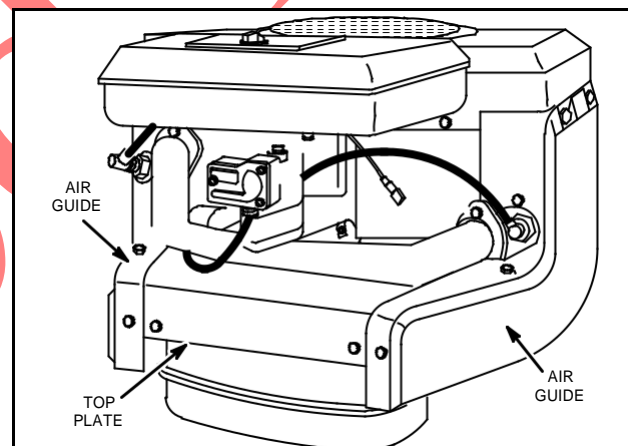


Fig. 17 – Install Top Plate and Cylinder Air Guide

## ASSEMBLE EXHAUST SYSTEM

### All Non Ducted Engine Models

Use Valve Lubricant (Part #93963) on all exhaust system threads to prevent galling of threads and permit easier disassembly, should it be required.

### Install Cylinder Air Guides And Shields

1. Assemble cylinder shield locating tabs in slots of cylinder air guide, Fig. 18.
2. Install assembly on engine starting all screws loosely to permit easy alignment of holes.

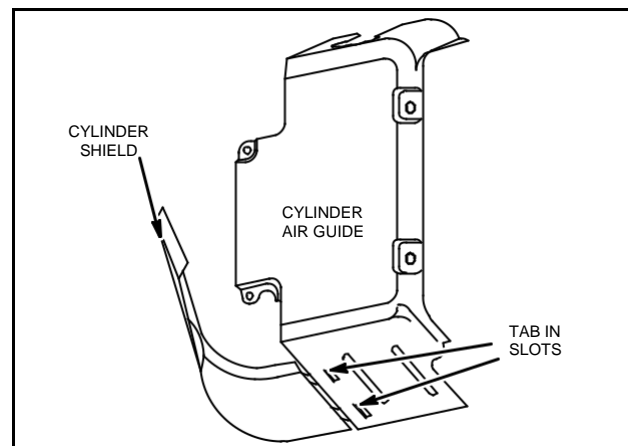
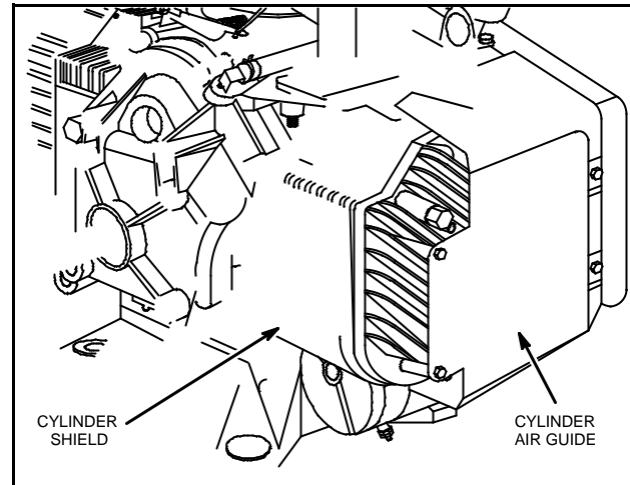


Fig. 18 – Assemble Shields and Air Guides

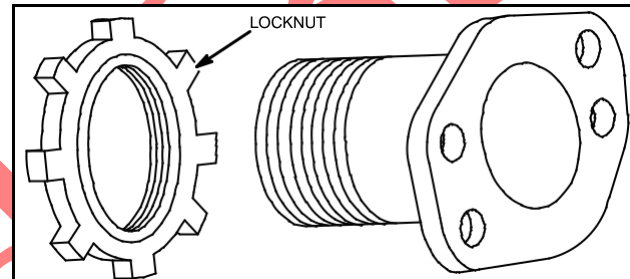
3. Tighten all screws securely. Repeat for other cylinder, Fig. 19.



**Fig. 19 – Install Cylinder Shield and Air Guides**

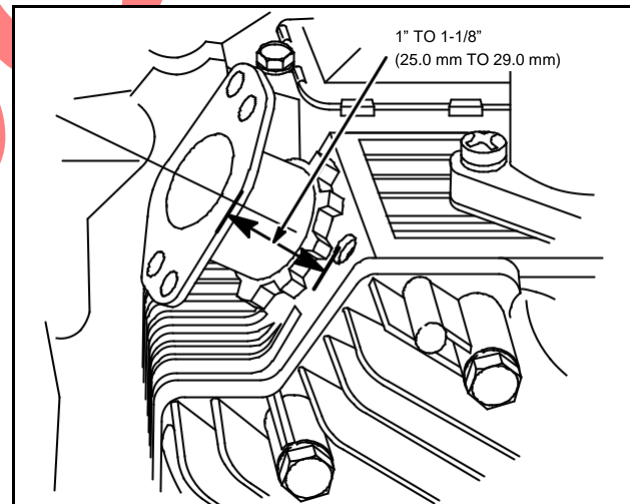
### Install Muffler Adapters

1. Install lock nut on muffler adapter, Fig. 20.
2. Thread adapter into exhaust port finger tight. Do not tighten lock nut at this time.



**Fig. 20 – Lock Nut**

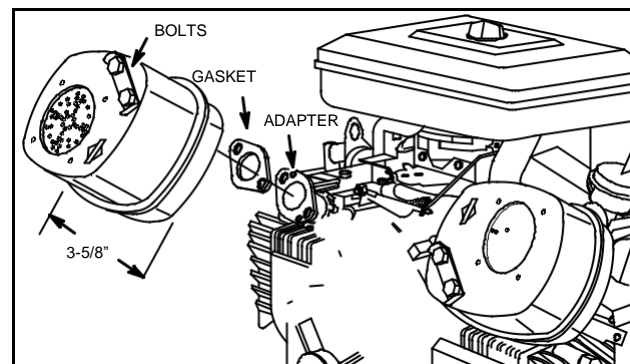
3. Flange should be 1" to 1-1/8" (25.0 mm to 29.0 mm) from cylinder face, Fig. 21. Tighten lock nut after muffler is installed and positioned.



**Fig. 21 – Measure Adapter**

### Install Large Lo-Tone Mufflers

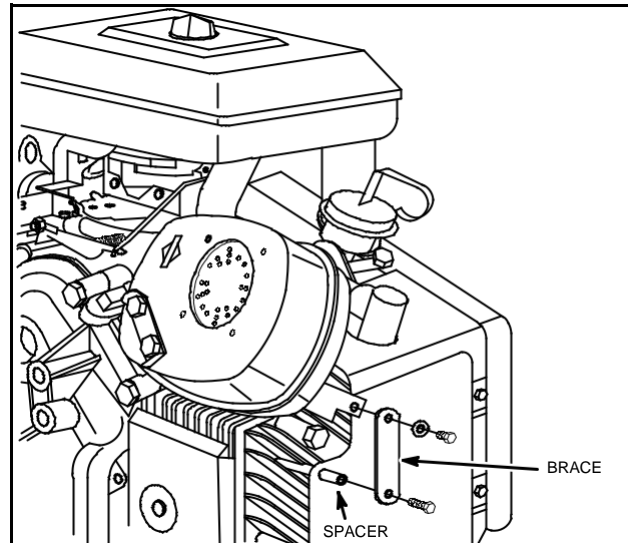
1. Install muffler with new gasket, two shoulder bolts and lock, Fig. 22.
2. Torque shoulder bolts to 170 in. lbs. (19.0 Nm) and bend up lock tabs.



**Fig. 22 – Install Large Lo-Tone Mufflers**

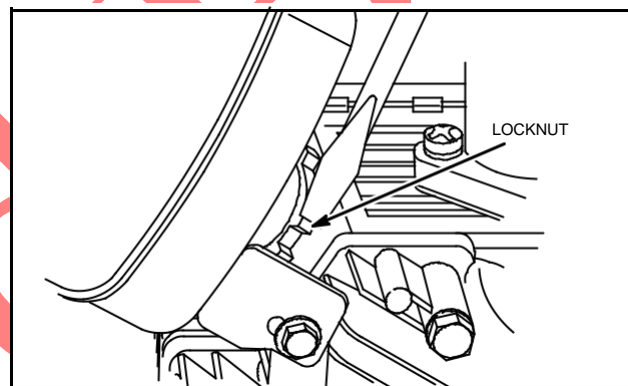


3. Install muffler brace straps and spacers, Fig. 23.



**Fig. 23 – Install Brace**

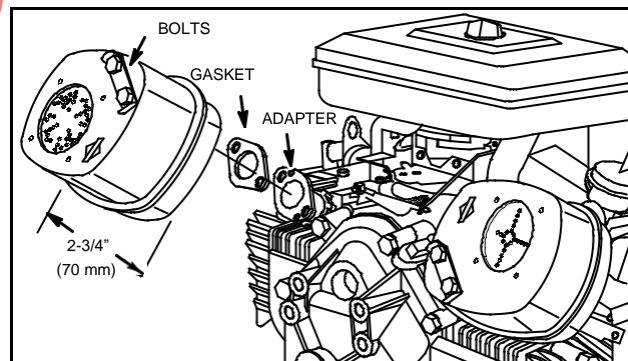
4. Tighten muffler adapter lock nuts, Fig. 24.



**Fig. 24 – Lock Nuts**

### Install Small Lo-Tone Mufflers

1. Install muffler with new gasket, two shoulder bolts and lock, Fig. 25.
2. Torque shoulder bolts to 100 in. lbs. (11.0 Nm) and bend up lock tabs.
3. Rotate muffler and adapter to desired location and tighten lock nut securely, Fig. 24.



**Fig. 25 – Install Small Lo-Tone Muffler**

### ENGINE COMPONENTS

- |                         |                            |                         |
|-------------------------|----------------------------|-------------------------|
| 1. Cylinder Shield      | 12. Valve Seal             | 22. Connecting Rod Bolt |
| 2. Air Cleaner Assembly | 13. Intake Valve Spring    | 23. Washer              |
| 3. Carburetor           | 14. Intake Valve Retainer  | 24. Crankshaft          |
| 4. Intake Manifold      | 15. Valve Tappet           | 25. Cylinder Assembly   |
| 5. Alternator           | 16. Exhaust Valve Keeper   | 26. Camshaft            |
| 6. Flywheel             | 17. Exhaust Valve Retainer | 27. Governor            |
| 7. Starter Motor        | 18. Exhaust Valve Spring   | 28. Thrust Washer       |
| 8. Magneto Armature     | 19. Cylinder Head #2       | 29. Crankcase Cover     |
| 9. Cylinder Head Bolts  | 20. Piston                 | 30. Oil Pump            |
| 10. Exhaust Valve       | 21. Connecting Rod         | 31. Cylinder Head #1    |
| 11. Intake Valve        |                            |                         |