Onan®

OPERATOR'S/SERVICE MANUAL AND PARTS CATALOG

FOR

BF

SERIES

180 AMP. AC WELDER

MODELS

5.0 BF-341E/*

5.0 BF-343E/*

*SPECIFICATIONS 5277A AND 8474A

965-1003

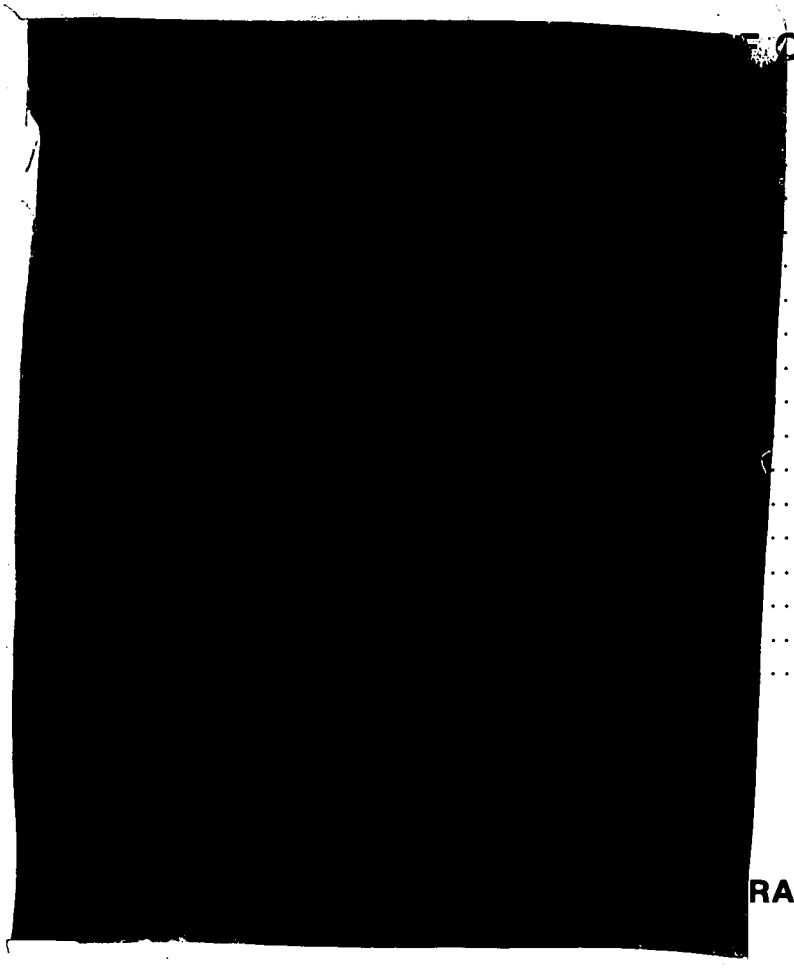
9A73

Printed in U.S.A.

180 AMP. WELDER

BF

SERIES



E CONTENTS

RANTY CARD ATTACHED TO UNIT.

KEEP THIS MANUAL HANDY SO IT CAN BE EASILY REFERRED TO WHEN ORDERING PARTS, MAKING ADJUSTMENTS, ETC.

GENERAL INFORMATION

The BF welder is a complete engine driven, alternating current arc welding machine. It consists of a two-cylinder gasoline engine directly connected to an electric generator and mounted to a sturdy carrying frame. The welder controls and AC output receptacles are located in the control box that is mounted on the generator end of the unit. An optional two-wheeled dolly is available if the unit must be moved frequently.

The welder is rated 180 amperes, 25 volts, alternating current at 50% duty cycle. Auxiliary alternating current is available and output is 120 volts or 120/240 volts, rated 5000 watts, 60 hertz at 100% duty cycle. AC output is available at any time although at reduced output when the welding current is being used. This AC output is convenient for emergency lighting, running power tools, etc., when working at locations away from AC power line sources.

When instructions in this manual refer to a specific model of welder, identify the model by referring to the model and specification designation as shown on the unit nameplate.

How to interpret model and specification number.

5.0 BF - 341 E / 1 A

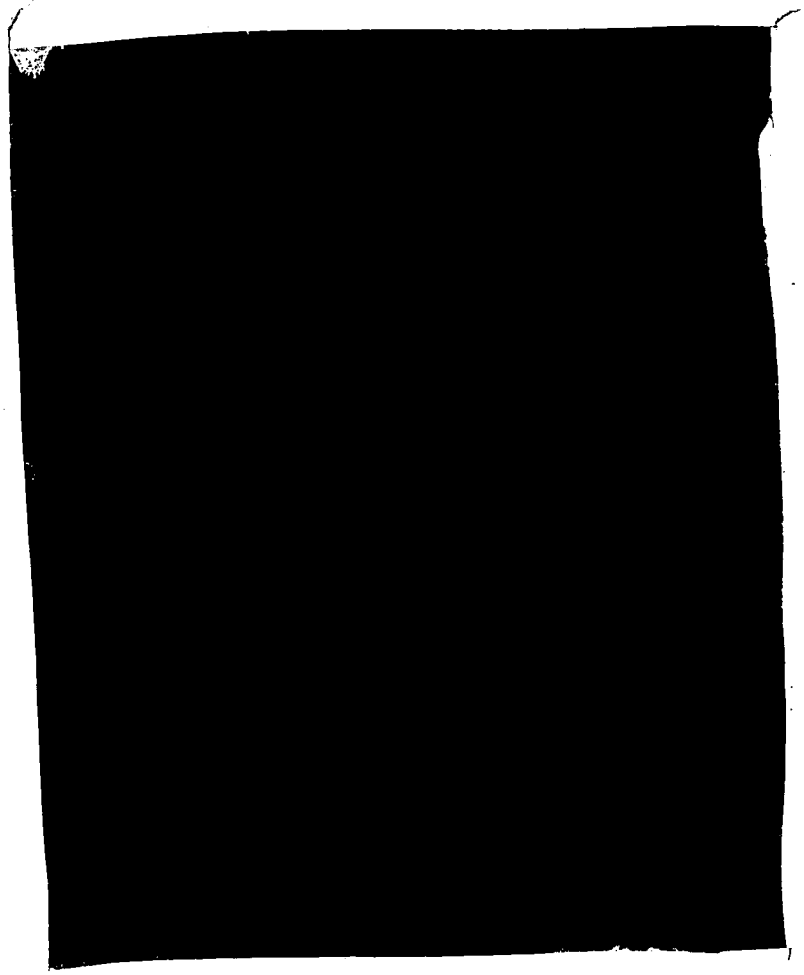
1 2 3 4 5

1. Indicates Kilowatt rating and factory code for general identification.
2. Factory code for AC voltage output: code 341 indicates 120 volts, AC; 343 indicates 120/240 volts, AC.
3. Specific type: E - Electric starting at welder only.
4. Factory code for optional equipment supplied.
5. Specification letter advances with factory production modification.

WARNING **This symbol is used throughout the manual to warn of possible personal injury.**

CAUTION **This symbol refers to possible unit damage.**

Before operating any welder, become thoroughly familiar with the safety precautions that follow!



SAFETY PRECAUTIONS

ALWAYS EMPLOY PRECAUTIONARY MEASURES DURING ARC WELDING OPERATIONS TO ENSURE MAXIMUM PERSONAL SAFETY AND THE SAFETY OF NEARBY PERSONNEL.

- **Operate And Maintain The Machine And Its Equipment Properly.**

  Do not overload the cables. Do not use worn or poorly connected cables. Do not allow the welding cables to contact hot metal, water, oil or grease. Prevent cables from becoming a stumbling hazard by keeping them in order and out of the way.

  Use electrode holders that are completely insulated. Do not use holders with defective jaws.

  Do not use the welder without grounding the frame or the case. Do not ground to pipelines carrying gases of flammable liquids. Be sure the conductors can safely carry the grounding current.

  Keep all connections clean and tight.

  Do not use an electric welder on an engine unless both the engine's battery cables and alternator wires are disconnected.

- **Take Precautions Against Electric Shock.**

  NEVER work in a damp area without suitable insulation against shock.

  NEVER stand in water or on a wet floor or use wet gloves when welding.

  ALWAYS dry out the work pieces or bench if there is any evidence of moisture.

  OPEN power circuits before inspecting machines.

  ALWAYS turn off the machine when leaving the work.

- **Do Not Weld Near Inflammable Materials.**

  NEVER weld in or near EXPLOSIVE ATMOSPHERES.

  Clean any container that has held combustible or flammable materials by approved or prescribed methods. A very small amount of residual gas or liquid can cause a serious explosion. When the contents of the container is unknown, use an explosimeter.

  Use carbon dioxide or nitrogen to ventilate a container. NEVER USE OXYGEN.

  When the container has held a gas or liquid that readily dissolves in water, perform the following:

  1. Flush the container several times with water and a wetting agent (e.g., a low powered detergent). Then, fill with as much water as the work permits.
  2. Provide a vent or opening in the container to allow the release of air pressure.

  When the container has held a gas or liquid that does not readily dissolve in water, proceed as follows:

  1. Clean the container with steam or a cleaning agent and purge all air with a gas such as carbon dioxide or nitrogen.
  2. Use steam to clean out light material.
  3. To clean out heavy grease or oil, use a strong caustic soda solution.
  4. Before welding on the container, PURGE ALL AIR with a gas such as carbon dioxide or nitrogen.

  Wear goggles and gloves when cleaning with steam or caustic soda.

  Always clean the container in a well ventilated area, away from any open flame.

  When scraping or hammering heavy sludge or scale, use a WET, spark resistant tool.

  Always keep head and arms as far away from the work as possible.

- **Never Weld On Hollow (Cored) Castings That Have Not Been Properly Vented.**

- **Never Pick Up Hot Metal With Bare Hands.**

- **Do Not Weld In Confined Areas Without Adequate Ventilation.**

- **Never Wear Frayed, Flammable Or Otherwise Inadequate Clothing When Welding. Keep Clothing Dry.**

  Avoid wearing light colored or open shirts that allow arc rays to penetrate and expose parts of the body to ultra-violet rays. Do not wear flammable cotton fabrics when arc welding. Wear heavy shoes, tightly laced.

  To prevent severe burns from splatter and molten metal, wear leather or asbestos gloves at all times protecting the hands and wrists. When welding in vertical and overhead positions, wear ear shields under helmet and leather sleevelets, apron, and leggings.

- **Use Eye Protection At All Times.**

  ALWAYS wear safety goggles under the welding helmet. Keep the helmet, hand shields, and face shield in good condition. Replace defective equipment.

  All arc welding produces intense ultra-violet and infra-red radiation. When welding in open areas, provide portable non-reflecting screens to protect nearby personnel from arc rays.

SPECIFICATIONS

Nominal Dimensions	
Height	29-1/2"
Width	22"
Length	34"
Weight in Pounds (approx.)	
Skid mounted, electric	325
Fuel	*Gasoline
Number of Cylinders	2
Cylinder Bore	3-1/8"
Cylinder Stroke	2-5/8"
Displacement (cu. in.)	40.3
Maximum BHP (at 3600 rpm)	16
Governor	Adjustable, mechanical flyball
Fuel Pump	Pulse Design
Ignition, Electric Start	Battery
Mounted Fuel Tank Capacity (U.S. gallons)	5.6
Oil Capacity (U.S. quarts)	2
Generator	
Welder Output - Maximum Amperes (50% duty cycle)	180
AC Auxiliary Watts Output (120 or 120/240 volts, single-phase, 100% duty cycle)	5000
Battery Size	
Nominal Battery Voltage	12
Number Used	One
Ampere/Hour SAE 20 Hr. Minimum	32
Approx. Battery Dimensions for Battery Rack	7-3/4" L x 5-1/8" W x 7-3/8" H

* - Non-leaded or regular grade. See *OPERATION* section for special instructions.

TUNE-UP SPECIFICATIONS

Tappets (Cold) Intake	.008*
Exhaust	.013*
Breaker Point Gap (Full Separation)	.025
Spark Plug Gap	.025
Ignition Timing (Engine Running or Static)	21° BTC (HOT) 25° BTC (COLD)

* - ± .001"

DIMENSIONS AND CLEARANCES

All dimensions and clearances given at room temperature of 70° F.
All values in inches unless otherwise specified.

	Minimum	Maximum
CAMSHAFT AND CRANKSHAFT		
Crankshaft Main Bearing Journal to Bearing Clearance	0.0025	0.0038
* Crankshaft End Play	0.006	0.012
Camshaft Bearing to Camshaft	0.0015	0.0030
Camshaft End Play	0.003	
* Crankshaft Rod Journal to Rod Bearing	0.0020	0.0033
Connecting Rod End Play	0.002	0.016
Timing Gear Backlash	0.002	0.003
Oil Pump Gear Backlash	0.002	0.005
PISTON AND CYLINDER		
Piston Pin in Piston	0.0002	0.0004
Piston Pin in Rod	0.0002	0.0007
* Piston Ring Gap in Cylinder	0.010	0.020
Piston Clearance in Cylinder - Measured .10 Below Oil Control Ring, 90° from Pin	0.001	0.003
Cylinder Bore - Standard Size	3.1245	3.1255
Crankshaft Main Bearing Journal - Standard Size	1.9992	2.0000
Crankshaft Rod Bearing Journal - Standard Size	1.6252	1.6260
TAPPETS AND VALVES		
* Valve Seat Width	1/32	1/8
* Valve Face Angle	44°	
* Valve Seat Angle	45°	
Valve Stem to Guide - Intake	0.0010	0.0025
Valve Stem to Guide - Exhaust	0.0035	0.0040
Tappet to Cylinder Block Clearance	0.0015	0.0030
Tappet Adjustment (Cold)		
* Intake	0.007	0.009
* Exhaust	0.012	0.014

* - Frequently used overhaul values.

ASSEMBLY TORQUES

ASSEMBLY TORQUES

Assembly torques as given here require the use of a torque wrench. These assembly torques assure proper tightness without danger of stripping the threads. If a torque wrench is not available, estimate the degree of tightness necessary for the stud, nut or screw being installed and tighten accordingly. Do not strip the threads. Check all studs, nuts and screws often. Tighten as needed to prevent them from working loose.

BOLT TORQUE	FT. - LB.
Gearcase Cover	8 - 10
Cylinder Head Stud Nuts (Cold)	14 - 16
Rear Bearing Plate Screws	25 - 27
Starter Mounting Bolts	18 - 20
Connecting Rod Bolt	14 - 16
Flywheel Cap Screw	35 - 40
Other 5/16" Cylinder Block Stud and Nuts	8 - 10
Oil Base	18 - 23
Manifold Mounting Stud Nuts	6 - 9
Oil Pump	7 - 9

INSTALLATION

Normally, the BF welder is not permanently mounted; thus no installation instructions are necessary. However, if the welder is to be used in a permanent location or mounted in a vehicle, use the following recommendations as a guide.

VENTILATION

Welders generate considerable heat during operation. Therefore, when operating in any small enclosure, provide separate, unobstructed air inlet and outlet openings (minimum area of 3-1/2 square feet each). Position the openings to prevent recirculation of heated air:

- Locate the inlet opening as close as possible to the front of the engine blower.
- Provide an outlet opening toward the generator end, somewhat higher than the inlet opening.

EXHAUST

When mounting extension exhaust pipes to the engine, use a piece of flexible tubing between the extensions and the engine. Fit the mufflers to the outer end of the exhaust pipes.

WARNING **Engine exhaust can be deadly! Never operate the welder inside a building or confined area without piping exhaust gases outside the enclosure.**

MOBILE MOUNTING

Installing the welder in a vehicle requires special attention. Rough roads and sharp corners produce considerable strain on the welder mounting bolts. Extra vehicle floor support may be necessary to prevent the bolts from disengaging. Use pipe clamps or u-bolts when securing the welder frame to the floor.

The welder can operate at a maximum tilt of 15° sideways, 30° front to rear.

OPERATION

PRE-START INFORMATION

When the unit is to be used for welding, always connect the welding cables to the power terminals on the panel before starting. It is not necessary to observe polarity in making ground connections between welder and the work. Welding current selection may be made with the unit running but not under load.

WARNING **Do not, under any circumstances, touch the terminals of the welder while it is operating! Although the voltage is not high, it can cause severe shock with possible serious consequences! Stop the unit before making connections.**

INITIAL START

Check the engine to make sure it has been filled with oil and fuel. See the recommendations below.

CRANKCASE OIL:

Be sure the crankcase has been filled to the *FULL* mark with an American Petroleum Institute (API) designation SE oil of the viscosity recommended on the nameplate. If the SE oil is not available, an SD or SD/CC oil may be used. See *PERIODIC MAINTENANCE* section for complete lubrication recommendations.

If oils with these designations are not yet available, use an oil with the API designation MS, MS/DG or MS/DM which has passed all the Automotive Manufacturer's Sequence Tests and the MIL-L-2104B Tests. Do not use an oil with the API designation ML or DS.

Recommended Fuel: Use clean, fresh, regular grade, automotive gasoline. Do not use highly leaded premium fuel.

For new engines, the most satisfactory results are obtained by using nonleaded gasoline. For older engines that have previously used leaded gasoline, heads must be taken off and all lead deposits removed from engine before switching to nonleaded gasoline.

CAUTION **If lead deposits are not removed from engine before switching from leaded to nonleaded gasoline, preignition could occur causing severe damage to the engine.**

WARNING **Never add fuel to welder while it is running.**

On cold starts, set the idle lever in the idle position to the right to start. The idle lever is located adjacent to the governor yoke control shaft. Set manual choke as necessary for weather conditions.

ELECTRIC STARTING:

1. Adjust choke according to temperature conditions.
2. Move ignition switch to *ON*.
3. Push *START* switch, located on rear side of control box, firmly. If unit does not start within a few seconds, release the *START* switch and wait a few seconds before reattempting to start. If unit does not start after two attempts, open the choke and repeat starting sequence.
4. After unit starts, adjust choke to best running position. Gradually adjust choke control as unit warms up.

The battery charge voltage is regulated to supply a nominal 1.5amp charge rate at full rpm.

APPLYING LOAD

Allow the engine to warm up thoroughly at idle speed before applying a heavy welding load. Set the idle lever at weld position before applying a load. The welder is thermally protected and self-regulating. Although the welder can be loaded to full nameplate rating for initial operation, it is recommended it be loaded only 80% of rated capacity for first few hours.

Controlled break-in with the proper oil and a conscientiously applied maintenance program helps assure satisfactory welder service for hundreds of hours.

After 25hours of operation, drain the initial oil while the engine is still hot.

STOPPING

Move ignition switch to *STOP* or *OFF* position. If ignition switch is left in the *ON* position when unit is not running, battery will discharge.

WELDING CURRENT CONTROL

The control panel contains a current selector handle that can be turned to any one of the dial positions for the required welding amperage (Figure 1). Make sure the handle snaps firmly into place when making the desired amperage selection. On some models, an optional rheostat is provided for fine current control.

CAUTION **Considerable heat is generated by the reactor assembly inside the welder control box. Always keep the engine and control cover installed on the unit to properly direct air to the control box. NEVER WELD WITH THE ENGINE AND CONTROL COVER REMOVED.**

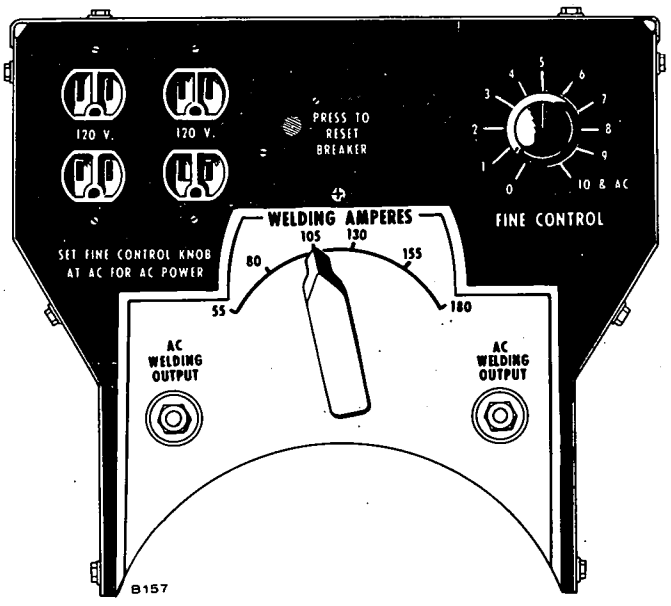


FIGURE 1. CONTROL PANEL

WELDING CABLE SIZE

Keep the welding cables as short as possible. Check all connections for tightness. Table 1 lists the cable size for current draw and cable length.

When welding with long cables, avoid allowing the cables to form coils. A coil of cable produces a magnetic field that can lower the generator output. If you have excess cable on the floor, tape the cables together at short intervals and arrange them in "snake" fashion to take up the slack.

CAUTION **Do not change the amperage tap (control handle) while the power is being used for welding or pipe thawing. The sudden connection break can produce an arc within the control box and cause serious damage to the switching members or other components in the control circuit.**

TABLE 1. RECOMMENDED WELDING CABLE SIZE

AC POWER AMPERES	TOTAL CIRCUIT LENGTH IN FEET					
	100	150	200	250	300	400
75	6	4	3	3	2	1
100	4	3	3	2	1	1/0
150	3	2	1	1/0	2/0	3/0
200	2	1	1/0	2/0	3/0	4/0

AUXILIARY AC POWER

The welders are available with either 120-volt AC, 5KW auxiliary power or 120/240-volt AC, 5KW auxiliary power. The 120-volt model is equipped with two 120-volt duplex receptacles with each outlet (4) rated at 15amps. Although a total of 42amps is available, no more than 15amps may be drawn from any individual outlet.

The three outlets of the 120/240-volt model are rated at 20 amperes each. Draw no more than 20 amps from any individual outlet.

Use of auxiliary power is not recommended while welding current is being used. If necessary, however, a low wattage trouble light may be connected without undue loss of welding power. The governor control lever must be in the WELD position for both weld and auxiliary power. On models with the optional rheostat for fine current, turn pointer knob to the "10 & AC" position.

Using auxiliary power during welding operation causes a voltage drop when the arc is struck and during actual welding.

OUT-OF-SERVICE PROTECTION

Protect an engine that is to be out-of-service for more than 30 days as follows:

1. Run engine until thoroughly warm.
2. Turn off fuel supply and run until engine stops.
3. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
4. Remove spark plugs. Pour 1ounce (two tablespoons) of rust inhibitor (or SAE50 oil) into each cylinder. Crank engine over a few times. Reinstall spark plugs.
5. Service air cleaner.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlets to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Disconnect the battery and follow standard battery storage procedure.
10. Provide a suitable cover for the entire unit.

HIGH AMBIENT TEMPERATURES

1. See that nothing obstructs air flow to and from the plant.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.

LOW AMBIENT TEMPERATURES

1. Use correct SAE oil for existing temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move the unit to a warm location or apply external heat until oil flows freely.
2. Use fresh fuel. Protect against moisture condensation.
3. Keep fuel system clean and batteries in a well charged condition.

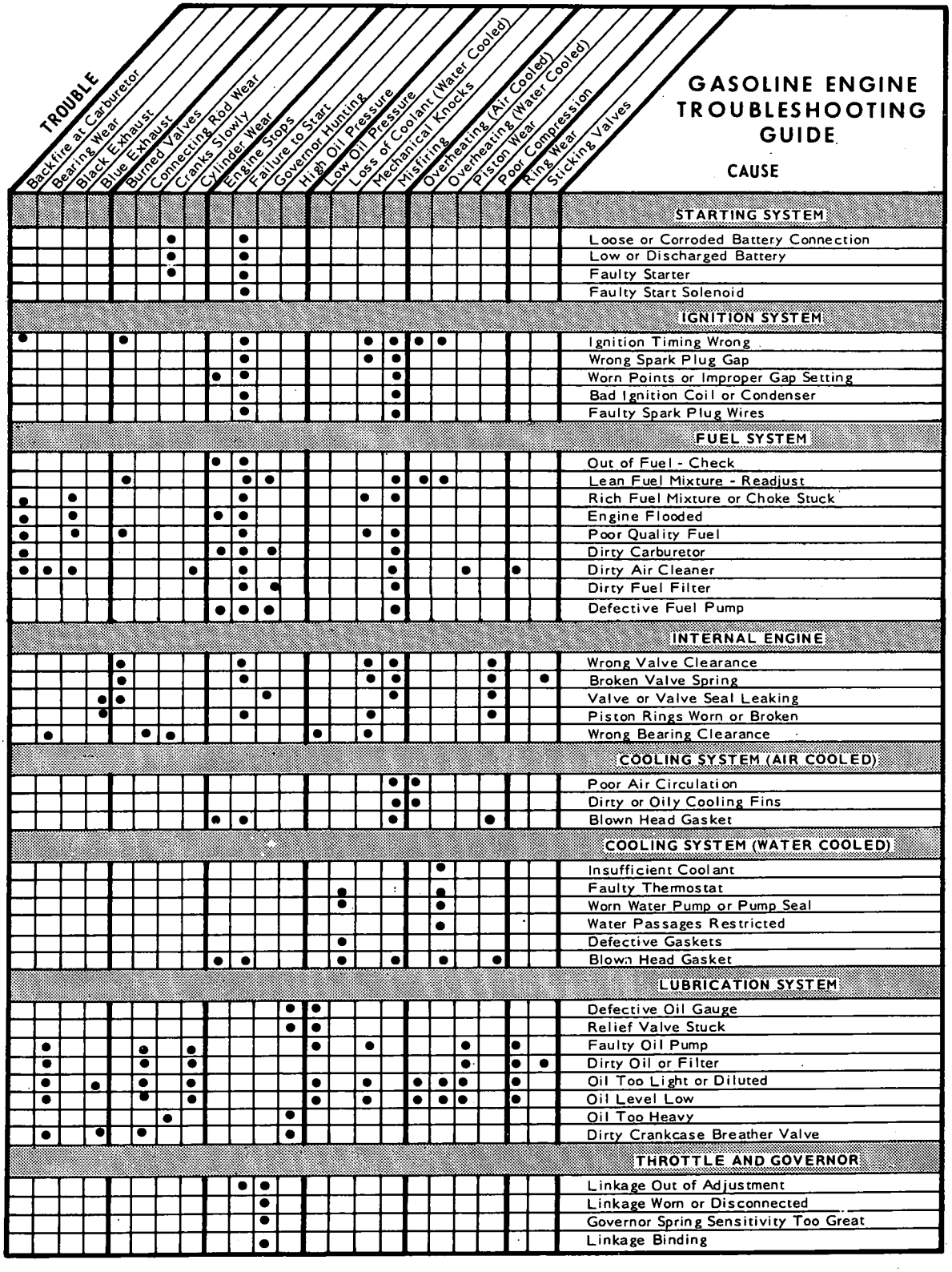
EXTREMELY DIRTY OPERATING CONDITIONS

1. Keep unit clean. Keep cooling system clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 40 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.

HIGH ALTITUDE

For operation at altitudes over 2500 feet above sea level, close carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio (refer to *FUEL SYSTEM* section). Maximum power will be reduced approximately 4 percent for each 1000 feet above sea level after the first 1000 feet.

ENGINE TROUBLESHOOTING



PERIODIC MAINTENANCE

AIR CLEANER

If air cleaner becomes too dirty, engine will not receive sufficient air to run properly. Symptoms: Loss of power, flooding, hard starting and overheating.

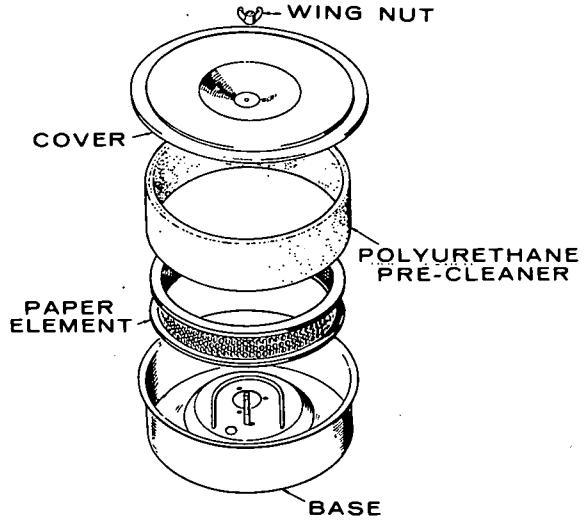
The BF engine is equipped with a paper element and a polyurethane pre-cleaner that must be removed, cleaned and oiled every 25 hours of operation, or more often under extremely dusty conditions.

1. To clean polyurethane pre-cleaner, wash in water and detergent. Remove excess water by squeezing like a sponge and allow to dry thoroughly. Distribute three tablespoons of SAE 30 engine oil evenly around the pre-cleaner. Knead into pre-cleaner and wring out excess oil.
2. Depending on conditions in which the welder is operating, the inner paper element should be replaced whenever it becomes excessively dirty.

CAUTION **Never run the engine with the air cleaner removed. Dirt will enter the engine and score the cylinders.**

CRANKCASE BREATHER

The crankcase breather valve maintains crankcase vacuum. No maintenance is generally required. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, clean baffle and valve in a suitable solvent (Figure 2).



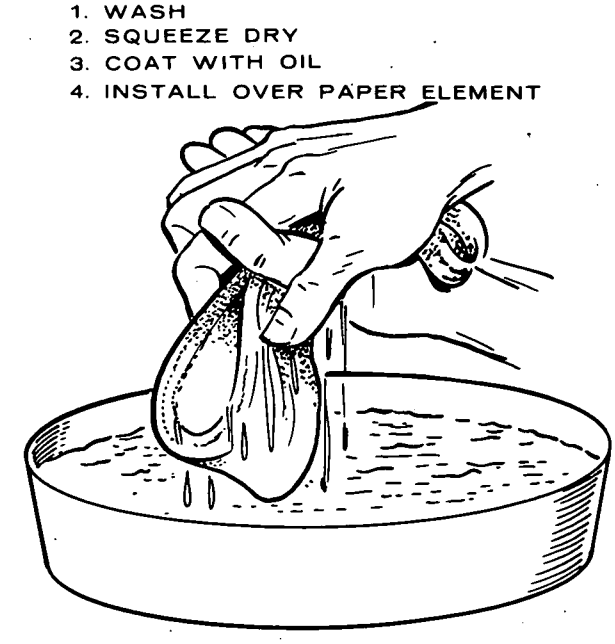


FIGURE 2. AIR CLEANER ASSEMBLY

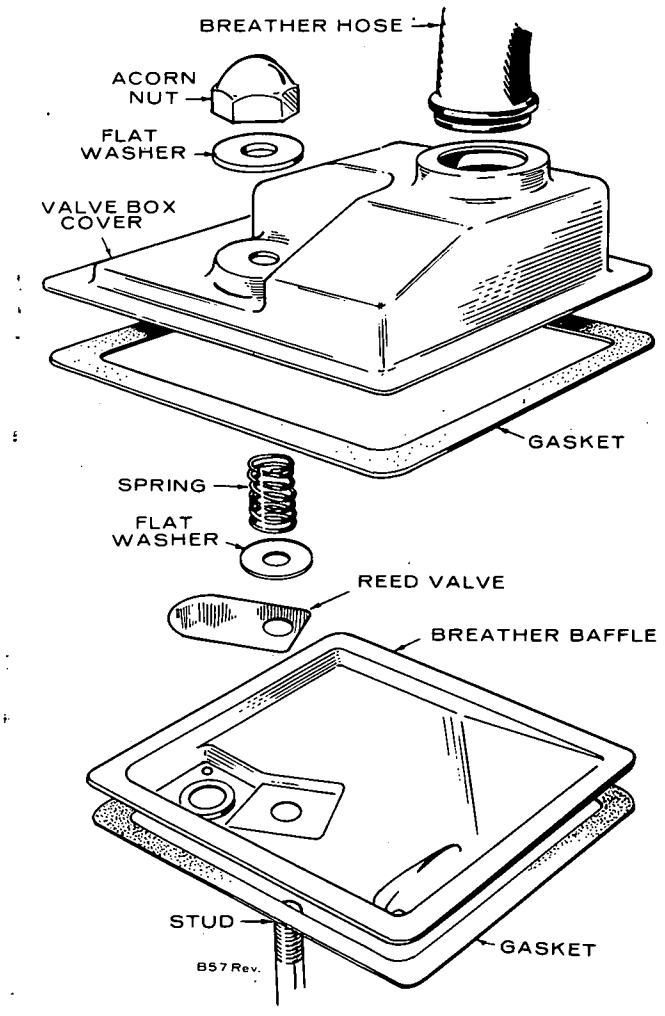


FIGURE 3. CRANKCASE BREATHER

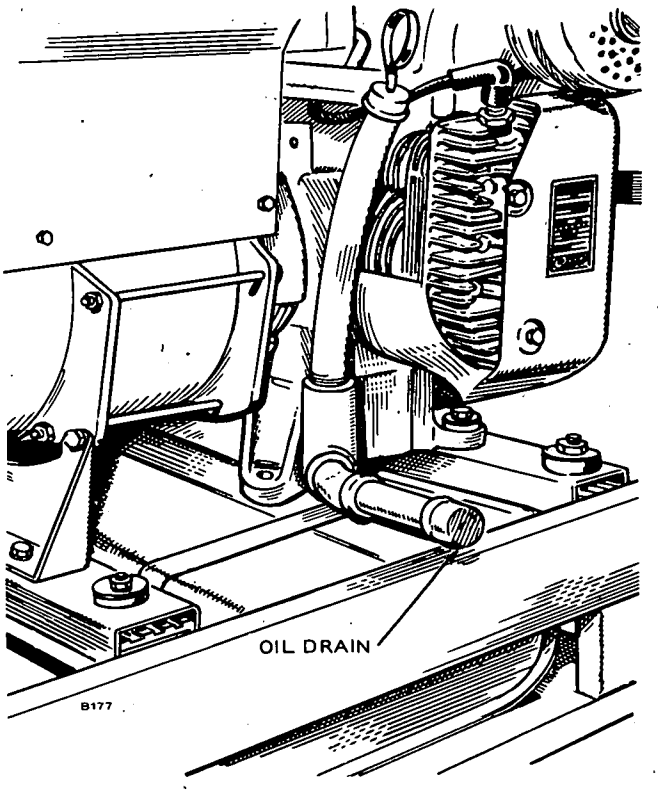


FIGURE 4. OIL DRAIN LOCATION

CRANKCASE OIL

Change crankcase oil every 50 operating hours and only when the engine is warm. (*Exception:* Drain initial oil fill at 25 operating hours.)

To drain, remove the 1/2-inch pipe cap on the side of the oil base (Figure 4). After oil drains, replace the pipe cap and refill crankcase with 4 pints (4-1/2 if equipped with filter) of a good quality detergent oil. Oil must meet or exceed the API (American Petroleum Institute) designation SE or SE/CC; this oil was formerly designated 2S MS, MS/DG or MS/DM.

For temperatures above 30°F, use SAE 30 oil; for temperatures below 30°F, use 5W30 or 10W.

In extremely dusty conditions or in very cold weather, change oil at least every 25 hours of operation.

CAUTION **Do not overfill crankcase. Do not use service DS oil. Do not mix brands nor grades of motor oil.**

Cooling System: Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

CAUTION **Plugged or clogged cooling fins can cause overheating and engine damage.**

Spark Plugs: Check, clean and reset spark plugs every 100 operating hours. Replace spark plugs that show signs of fouling or electrode erosion.

PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance lowers operating costs and lengthens the service life of the welder. Use the following schedule as a guide.

However, actual operating conditions under which a unit operates should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the crankcase oil, the filters, etc., frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest Onan Service Center.

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	50	100	200	400	1000
Inspect Overall Engine	x					
Check Oil Level	x					
Service Air Cleaner		x1				
Change Crankcase Oil		x1				
Check Battery Electrolyte Level		x				
Check Spark Plugs			x			
Clean Breather Valve				x		
Check Breaker Points				x		
Clean Fuel System				x		
Replace Air Cleaner Element				x1		
Remove Carbon and Lead Deposits					x2	
Check Valve Clearance					x2	
Inspect Valves, Grind If Necessary						x2
Complete Reconditioning (If Required)						x2

x1 - Perform more often in extremely dusty conditions.

x2 - For detailed maintenance, contact an Onan Service Center.

ADJUSTMENTS

CARBURETOR

The carburetor has a main fuel (high speed) adjustment and an idle fuel adjustment. The main adjustment affects operation under heavy load conditions (Figure 5). Idle adjustment affects operation under light or no load conditions. Under normal circumstances, factory carburetor adjustments should not be disturbed. If the adjustments have been disturbed, turn needles off their seats, 1 to 1-1/4 turn to permit starting. Then, readjust them for smooth operation.

CAUTION **Damage will result if the needle is forced against its seat. The needle does not completely shut off fuel when turned fully in.**

Before final adjustment, allow the engine to reach normal operating temperature. Make the idle adjustment under no load. Open the main jet until the engine runs smooth under acceleration with no load. Slightly more fuel may be needed when sudden load is applied (open about 1/4 turn further).

Set the throttle stop screw (located on carburetor throttle lever) with no load connected and while running at a low speed setting. Turn the screw to give approximately 1/32-inch clearance between the screw and pin.

If the engine develops a "hunting" condition (alternate increase and decrease of engine speed), try correcting by opening the main adjusting needle a little more. Do not open more than 1/2 turn beyond the maximum point of power.

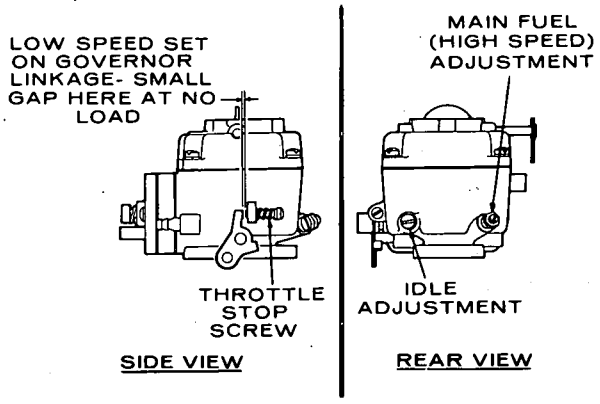


FIGURE 5. CARBURETOR ADJUSTMENT

BREAKER POINTS (Cold Setting)

To maintain maximum engine efficiency, change the breaker points every 200 hours of operation. Proceed as follows when the engine is cold:

1. Remove the four screws and cover of the control box.
2. Disconnect the wire lead that runs from the control box to the ignition coil.
3. Remove the seven fasteners as shown in Figure 6, then remove the front panel.
4. Loosen both screws holding the lifting eye. Then, remove one of the screws and swing lifting eye out of the way to gain access to the breaker box.

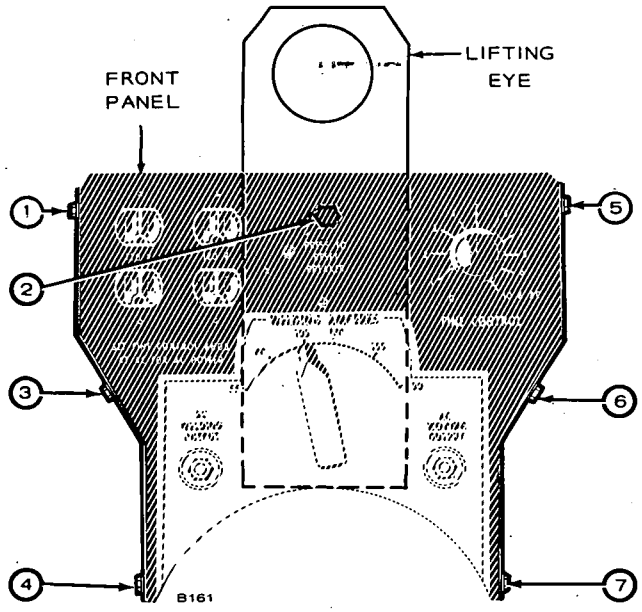


FIGURE 6. REMOVING FASTENERS

5. Remove the two screws and the cover on the breaker box.
6. Remove the two spark plugs so engine crankshaft can be easily rotated by hand. Check condition of spark plugs at this time.
7. Remove mounting nut (A) and pull the points out of the box just far enough so screw (B) can be removed and the leads disconnected. See Figure 7.

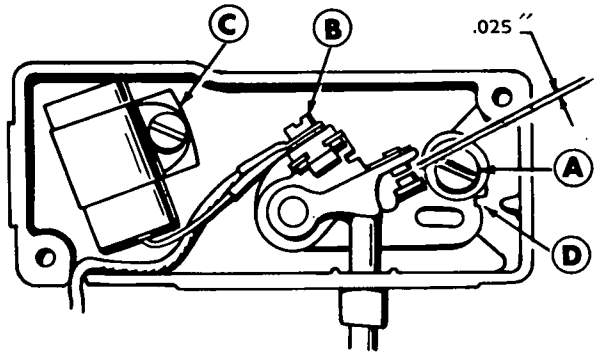


FIGURE 7. BREAKER POINT SETTING

8. Remove screw (C) and replace condenser with a new one.
9. Replace points with a new set but do not completely tighten mounting nut (A).
10. Rotate the engine crankshaft clockwise (facing flywheel) by hand until the 25° BTC mark on the blower housing aligns with mark on the flywheel. Turn another 1/4 turn (90°) to ensure points are fully open.
11. Using a screwdriver inserted in notch (D) on the right side of the points, turn the points until the gap measures .025" with a flat thickness gauge. (Be sure feeler is clean.) Tighten mounting nut and recheck gap. (See note.)
12. Reassemble control box.

Note: An alternate method of setting the points is to use a continuity light and adjust the points to begin separating at 25° BTC (engine cold) or 21° BTC (engine hot).

GOVERNOR ADJUSTMENT

Engine speed is governor-controlled and preset at the factory. Proper governor adjustment is one of the most important factors in maintaining the power and speed desired from the engine.

These engines are adapted for use where a double range of speed settings is desired. Engine speed is controlled at idle (approximately 2200 to 2300 RPM) and maximum (approximately 3600 RPM) by simply shifting the governor control lever up for high speed and down for idle (Figure 8).

The design of the governor gives an automatic decrease in sensitivity when the speed is increased resulting in good stability at both speeds.

Before making governor adjustments, run the engine about 15 minutes to reach normal operating temperature. If the engine is being run with the throttle wide open, either the governor is not properly adjusted or the engine is overloaded. It is difficult to determine if after long usage the governor spring has become fatigued. After properly making all other adjustments, if the regulation is still erratic, install a new spring.

Use a tachometer as a reliable instrument for checking engine speed when making governor adjustment.

Check the governor arm, linkage, throttle shaft, and lever for a binding condition or excessive slack and wear at connecting points. A binding condition at any point causes the governor to react slowly and produce poor regulation. Excessive looseness causes a hunting condition and erratic regulation. Work the arm back and forth manually several times with the engine in idle. If either of these conditions exists determine the trouble and adjust or replace parts as needed.

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle arm is adjusted by rotating the ball joint. Adjust length so that with the engine stopped and tension on the governor spring, the lower stop on the carburetor throttle lever is 1/32" from the stop pin. This setting allows immediate control by the governor after starting and synchronizes travel of the governor arm and the throttle shaft.

105 amperes

Procedure: This gives the procedure only briefly. Refer to the details on each subject herein.

1. Adjust the carburetor main jet for the best fuel mixture at full load operation.
2. Adjust the carburetor idle needle with no load connected.
3. Adjust the length of the governor linkage.
4. Check the governor linkage and throttle shaft for binding or excessive looseness.
5. Adjust the governor spring tension for nominal engine speed at no-load operation.
6. Check the rpm drop between no-load and full-load operation and adjust the governor sensitivity as needed.
7. Recheck the speed adjustment.
8. Set the carburetor throttle stop screw.

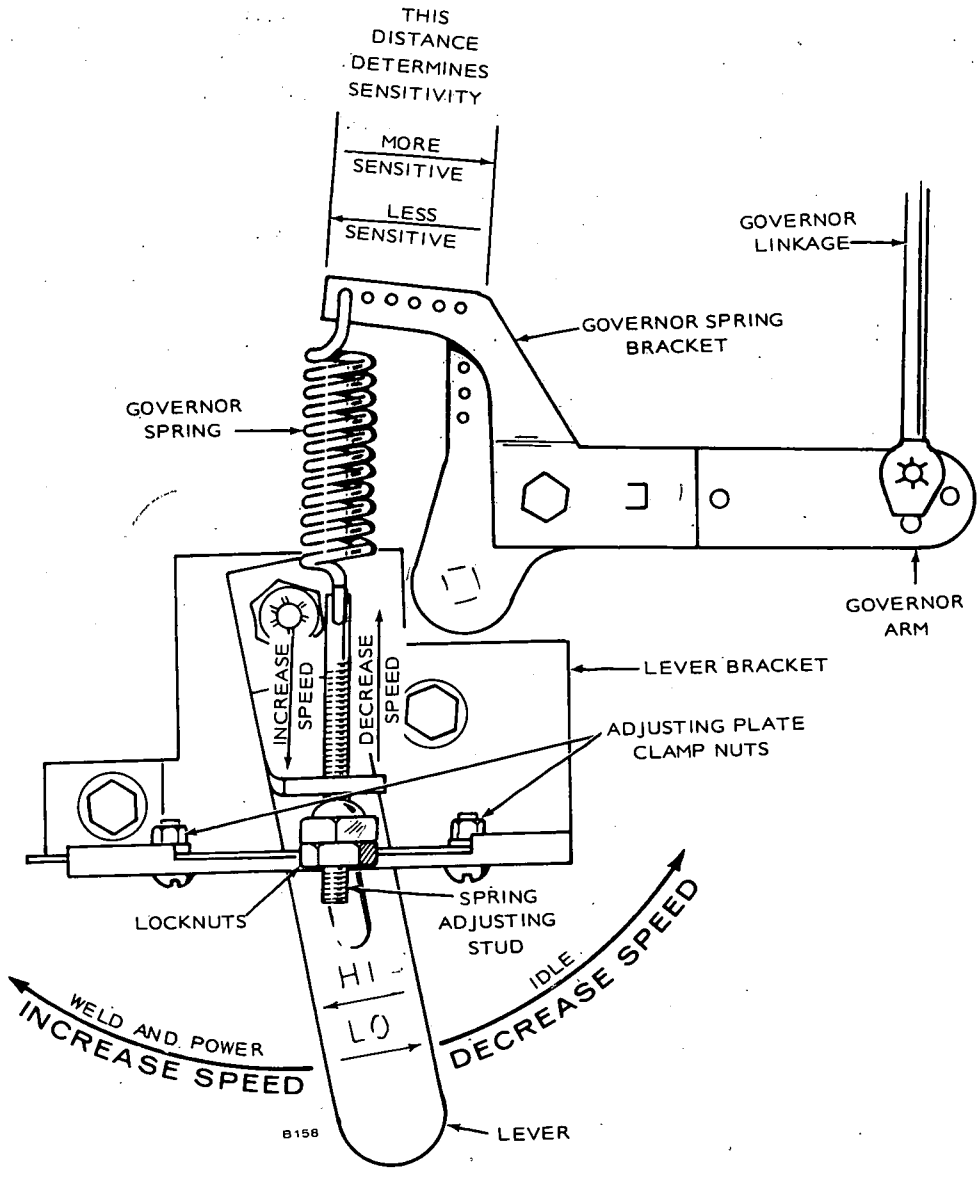


FIGURE 8. GOVERNOR ADJUSTMENTS

Approximately 3600 rpm is the recommended maximum full load speed for continuous operation. The speed must agree with the load requirements.

Speed Adjustment: The speed at which the engine operates is determined by the tension applied to the governor spring. Increasing spring tension increases engine speed; decreasing spring tension decreases engine speed. The no-load speed of the engine should be slightly higher than the speed requirements of the connected load.

If a speed adjustment is needed, turn the speed adjusting nut in to increase the speed or out to decrease the speed.

The sensitivity of the governor depends on the position of the arm end of the governor spring. A threaded stud on the governor arm provides for adjustment. To increase sensitivity, move the governor spring toward the governor shaft by turning the screw in; to decrease sensitivity, move the governor spring away from the governor shaft by turning the screw out.

OPERATOR MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS			
	8	50	100	200
Inspect Welder	x			
Check Breaker Points				x
Check Oil Level	x			
Clean Air Cleaner		x1		
Clean Governor Linkage		x1		
Check Spark Plugs			x	
Change Crankcase Oil		x		
Clean Crankcase Breather				x
Clean Fuel System				x
Check Battery			x	

x1 - Perform more often in extremely dusty conditions.

CRITICAL MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS		
	200	500	1000
Check Collector Rings		x1	
Check Brushes		x2	
Remove Carbon & Lead	x3		
Check Valve Clearance	x		
Clean Carburetor		x	
Clean Generator		x	
Grind Valves (if required)		x	
General Overhaul (if required)			x

x1 - Perform more often in extremely dusty conditions.

x2 - Replace brushes when worn to 5/16" or less.

x3 - The frequency of carbon or lead deposit removal will vary with operating conditions. Frequent short operating periods, consistently cool operation, use of highly leaded gasoline, etc. are some causes of more rapid formations of combustion deposits. Remove deposits as experience indicates the necessity. Always install new gaskets.

For any abnormalities in operation, unusual noises from engine or generator, loss of power, overheating, etc., contact your dealer.

FUEL SYSTEM

CARBURETOR CLEANING AND INSPECTION

To clean the carburetor, soak all components thoroughly in a good carburetor cleaner, following the manufacturer's instructions. Be sure to remove all carbon from carburetor bore, especially in the area of the throttle valve. After soaking, clean out all passages with filtered, compressed air.

Check the adjusting needles and nozzle for damage. If the float is loaded with fuel or damaged, replace it. The float should fit freely on its pin without binding.

Check the choke and throttle shafts for excessive side play and replace if necessary.

Carburetor repair and gasket kits are available from your nearest Onan Parts Center.

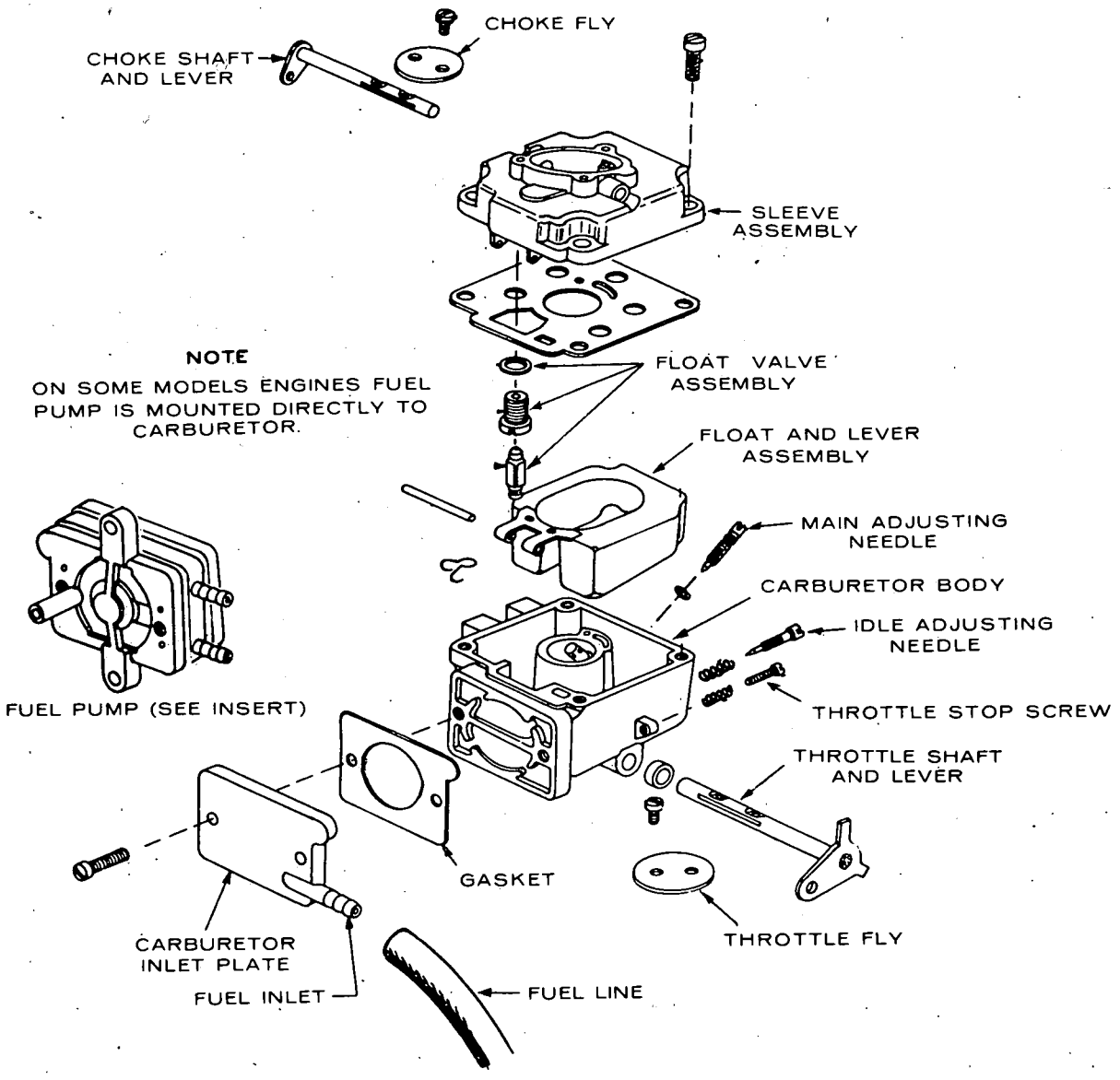


FIGURE 9. EXPLODED VIEW OF CARBURETOR

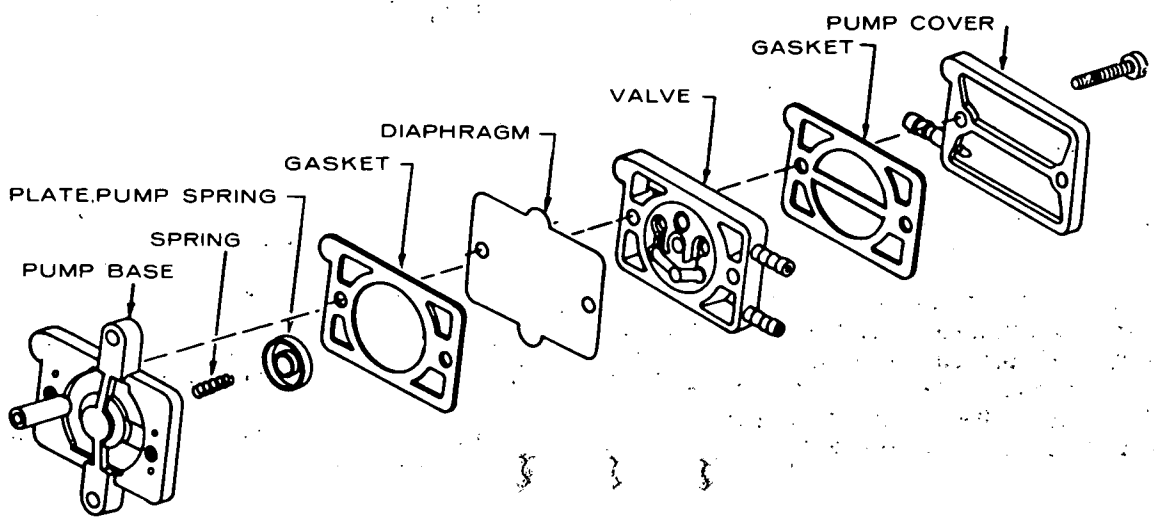


FIGURE 10. EXPLODED VIEW OF FUEL PUMP

CARBURETOR DISASSEMBLY AND REPAIR

Removal:

1. Remove air cleaner and hose.
2. Disconnect governor and throttle linkage, choke control and fuel line from carburetor.
3. Remove the four intake manifold capscrews and lift complete manifold assembly from engine.
4. Remove carburetor from intake manifold.

Always work on carburetor in clean conditions.

Replacing Needle and Valve Seat:

1. Remove four screws from top of carburetor and lift off float assembly.
2. Invert float assembly as shown in Figure 11.
3. Push out pin that holds float to cover.
4. Remove float and set aside in a clean place. Pull out needle and spring.
5. Remove valve seat and replace with a new one, making sure to use a new gasket.
6. Install new bowl gasket.
7. Clip new needle to float assembly with spring clip. Install float.

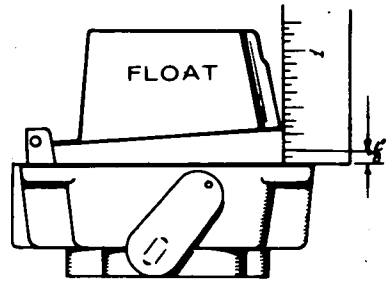


FIGURE 11. FLOAT ADJUSTMENT

Carburetor Float Adjustment:

1. Invert float assembly and casting.
2. With the float resting lightly against the needle and seat, there should be 1/8 inch clearance between the bowl cover gasket and the free end of the float.
3. If it is necessary to reset the float level, bend the float tangs near the pin to obtain a 1/8 inch clearance (Figure 11).

Fuel Pump Disassembly:

1. Remove vacuum line and fuel line.
2. Remove the two fuel pump attaching screws.
3. Grasp pump and carefully pull apart. Diaphragm, plunger, return spring, pump body and mounting gaskets will now be loose.
4. Internal fuel pump parts are available in a repair kit. Check Parts Catalog for correct part number.

CAUTION **Use care when reassembling pump; all parts must be perfectly aligned.**

IGNITION SYSTEM

In order to receive satisfactory performance from the ignition system, all components must be in good condition and the spark must be properly timed. Hard starting, low power and erratic operation can often be caused by faulty ignition. If poor ignition is suspected, the first thing to do is to determine if the ignition system is actually at fault. A simple operational test will determine this.

IGNITION TEST

Remove the high tension leads from the spark plugs (Figure 12) and hold the end terminal approximately 3/16 inch from a clean metal part of the engine. Crank the engine to produce a spark. If a sharp, snappy spark occurs, the trouble apparently is not in the coil, condenser, or breaker points although it could be in the spark plugs. If there is no spark or one that is weak or yellowish in color, ignition trouble is indicated.

High Tension Leads: Inspect ignition leads for cracks or breaks in the insulation that may weaken the current before it reaches a plug. A high tension wire touching metal at some point may make operation unsatisfactory.

Spark Plug: Engine misfire or generally poor operation is often caused by a spark plug in poor condition or with the wrong gap setting. Remove the spark plugs and carefully check for the following conditions:

- Porcelain insulator cracked or coated with oil.
- Electrodes burned or worn away.
- Wrong gap setting (Figure 13).

If the porcelain insulator is cracked or broken or if the electrodes are badly worn or burned, replace the spark plug with a new one.

If not, it can probably be restored to good operating condition by the following steps:

1. Degrease wet or oily plug and dry thoroughly.
2. File center electrode to a flat surface.
3. Adjust gap to .025". Use a round wire gauge for more accurate measurement.
4. Install plug. Tighten to torque value of 15-20 ft. pounds.

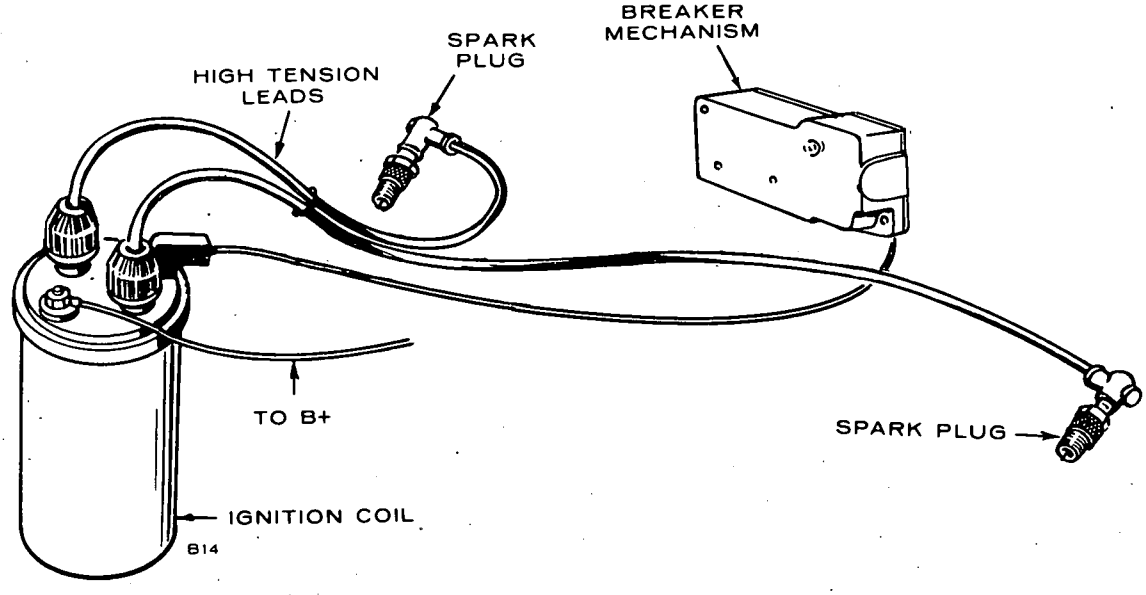


FIGURE 12. IGNITION SYSTEM

IGNITION

The ignition coil is not grounded with battery ignition. The spark occurs at the collapse of battery current when the points are open.

Spark advance for the BF Welder is 25° before top center when the engine is cold. Correct engine timing is stamped on the cylinder block near the breaker box.

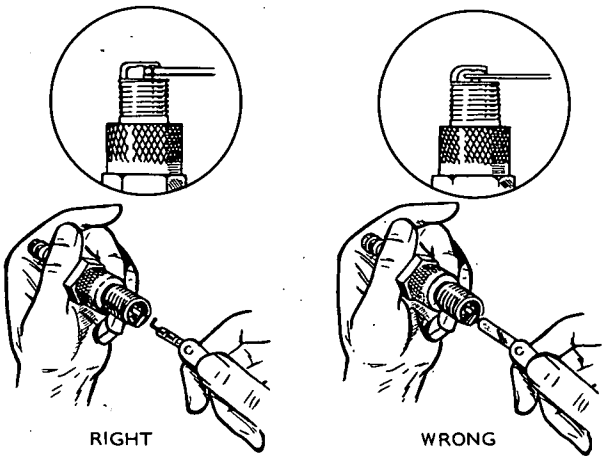


FIGURE 13. SETTING SPARK PLUG GAPS

STARTING SYSTEM

The BF Welder is equipped with an American Bosch electric starter. Normally, the starter requires little or no service other than possible brush replacement. If the starter should require major service or overhaul, the following information is provided.

STARTER DISASSEMBLY

1. Remove the thru-bolts and separate the end gap, housing and armature.
2. Disassemble the drive assembly and the drive end cap by loosening the self-locking nut. See Figure 14.

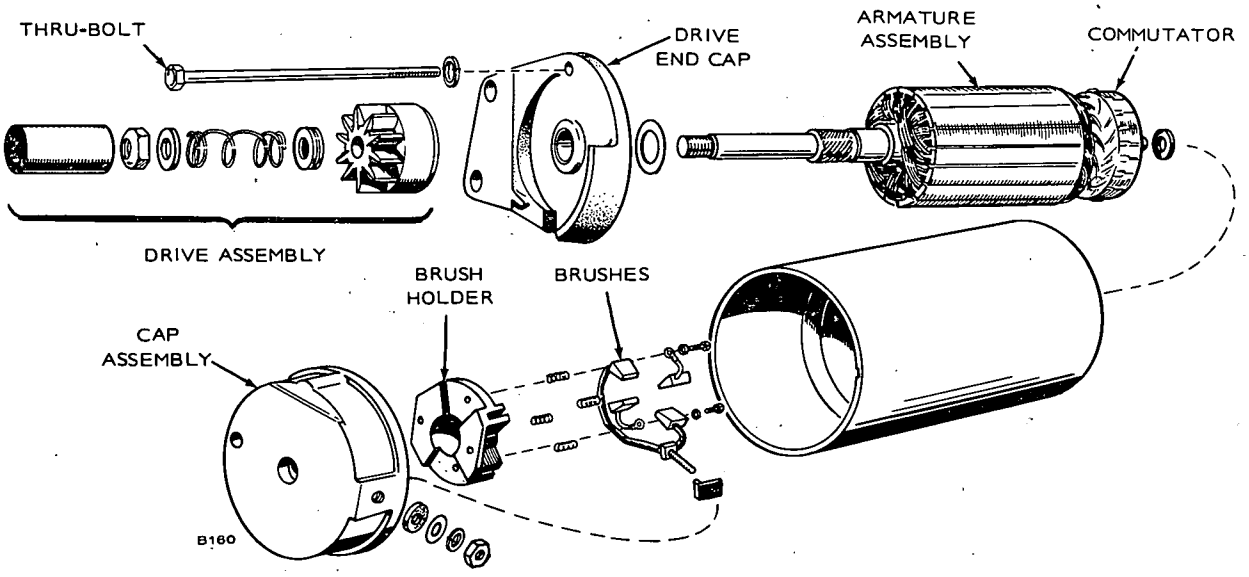


FIGURE 14. STARTER EXPLODED VIEW

BRUSH REPLACEMENT

If brushes are worn to less than .35 inch, replace them with factory recommended brushes (Figure 15). Other brushes may appear the same but have entirely different electrical characteristics.

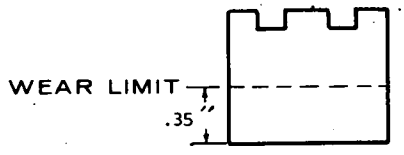


FIGURE 15. STARTER BRUSH WEAR LIMIT

GROUNDED ARMATURE TEST

Use a test lamp set for detecting grounds in the armature. Touch one probe to the commutator and the other probe to the core. If the lamp lights, the armature is grounded and must be replaced.

SHORT CIRCUIT TEST

Use a growler for locating a short in the armature. Place the armature in the growler and hold a thin steel blade (eg., hacksaw blade) parallel to the core and just above it while slowly rotating the armature. A shorted armature causes the blade to vibrate and to be attracted to the core. If the armature is shorted, replace it.

OPEN CIRCUIT TEST

The most likely place to check for an open circuit is at the commutator riser bars. Inspect for loose connections on the points where the conductors are joined to the commutator bars.

STARTER ASSEMBLY

Reassembly is the reverse of disassembly. When reassembling, wipe off any dirty parts with a clean cloth or blow clean using filtered compressed air.

Bearings must not be immersed in cleaning fluid. These parts should be cleaned with a brush dipped in clean engine oil.

Apply SAE 10W-30 oil on the armature shaft, spline and bearings.

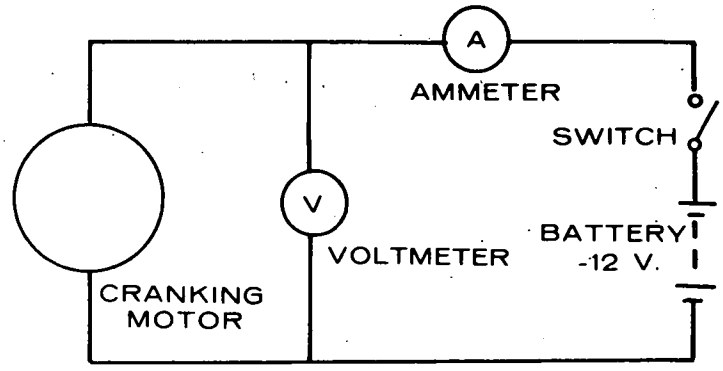


FIGURE 16. NO-LOAD TEST

NO LOAD TEST

Perform a no-load test on the reassembled starter by connecting the starting motor as shown in Figure 16. The values for the test are as follows:

Battery Voltage ..... 12 Volts
RPM ..... 4800-6000 rpm
Maximum Current Draw..... 32 Amperes

If the starter fails to meet these values in the no load test, inspect the following:

- Annealed brush springs
- Improperly seated brushes
- Insufficient armature end play
- Shorted, grounded or open armature
- Poor electrical connection
- Tight or worn bearings

The voltage applied to the cranking motor during test or during normal operation should never exceed the rated voltage or the motor (12 Volts DC, nominal). Otherwise, the magnets in the motor may become demagnetized.

CAUTION **1. Before installing the starter motor, make sure starter motor and engine mounting surface are free of dirt or oil to ensure good electrical contact.**

2. When tightening attaching bolts and nut, starter gear should be held into ring gear to assure proper backlash.

3. Do not operate starter motor more than 30 seconds or serious damage may result. Starter motors are not designed for continuous operation.

4. If the engine will not rotate when trying to start, do not operate the starter motor more than 10 seconds in this stall condition.

5. Wire between battery and starting motor must be tightened securely.

Precautions to be Taken After Starter Service:

1. The shaft of the cranking motor and the central axis of the engine must be parallel and the mounting bolts should be tightened so that cranking motor does not shift when starting. When tightening is incomplete or any foreign material exists at the mating surface, damage such as cracking the housing may occur.
2. When a cranking motor is used, the following cranking time should be observed:
   a. Do not put the cranking motor in continuous operation for more than 20 seconds.
   b. Give 30 seconds of rest time between each 20-second cranking cycle.
   c. Do not repeat step b more than 5 times. If the engine does not start, there may be some other cause for non-start and this must be inspected.
3. If the engine does not crank, do not leave the starter in a stall (locked rotor) condition longer than 10 seconds.
4. This cranking motor requires no oiling but when it is dismantled, lubrication should be done as instructed in *Disassembly Section.*

ENGINE DISASSEMBLY

VALVE SYSTEM

Properly seated valves are essential to good engine performance. The aluminum cylinder heads are removable for valve servicing. Do not use a pry to loosen the cylinder head; rap sharply on the edge with a soft faced hammer, taking care not to break any cooling fins. A conventional type valve spring lifter may be used when removing the valve spring locks, which are of the split type. Clean all carbon deposits from the cylinder heads, piston tops, valves, guides, etc. If a valve face is burned or warped, or the stem worn, install a new valve. Refer to Figure 17.

Worn valve stem guides may be replaced from inside the valve chamber. Valve locks are split, tapered type, the smaller diameter of which must face toward the valve head. Tappets are also replaceable from the valve chamber, after first removing the valve assemblies.

The valve *face* angle is 44°. The valve *seat* angle is 45°. This 1° interference angle results in a sharp seating surface between the valve and the top of the valve seat. The interference angle method of grinding valves minimizes face deposits and lengthens valve life.

The valves should not be hand lapped, if at all avoidable, because the sharp contact may be destroyed. This is especially important where stellite faced valves and seats are used. Valve faces should be finished in a machine to 44°. Valve seats should be ground with a 45° stone and the width of the seat band should be 1/32-inch to 3/64-inch wide. Grind only enough to assure proper seating.

Remove all grinding compound from engine parts and place each valve in its proper location. Check each valve for a tight seat, using an air pressure testing tool. If such a tool is not available, make pencil marks at intervals across the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat.

Lightly oil the valve stems and assemble all parts removed.

The positive type valve rotocaps prolong valve life and decrease valve repairs. When functioning properly, the valve is rotated a fraction of a turn each time it opens. While at open position, the valve must rotate freely, but in only one direction. If rotocaps are faulty, install new rotocaps.

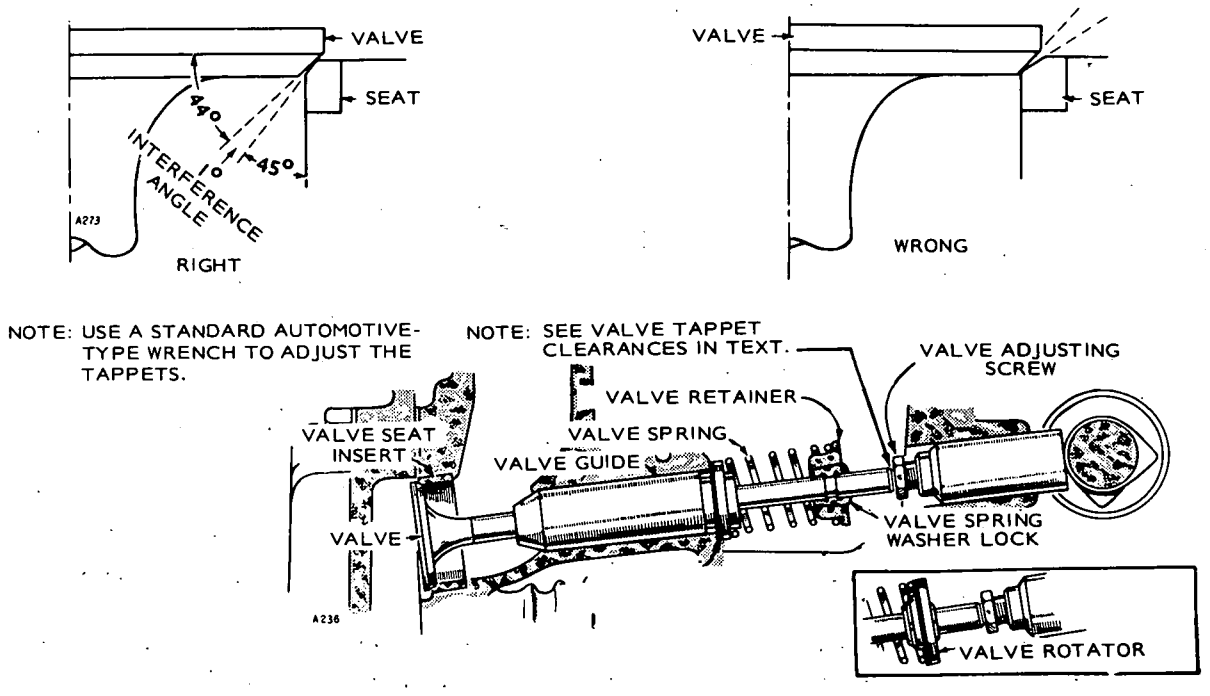


FIGURE 17. VALVE SYSTEM

Tappet Adjustment: The engine is equipped with adjustable valve tappets. The valve tappet clearance should be checked and adjusted at least every 400 operating hours or when poor engine performance is noticed. Adjust the valve clearance only when engine is at ambient temperature. Proceed as follows:

1. Remove all parts necessary to gain access to valve tappets.
2. Remove spark plugs to ease the task of turning the engine crankshaft over by hand.
3. Use the engine flywheel to turn the crankshaft over slowly by hand until the left hand intake valve opens and closes. Continue turning the flywheel until the TC mark is on the top and lined up with the TC mark on the gear cover. Both valves should be closed. This should place the left hand piston at the top of its compression stroke, the position it must be in to get proper valve adjustment for the left cylinder.
4. For the intake valve, a .007" thickness gauge should pass freely between valve stem and tappet, a thicker .009" gauge should not.
5. For the exhaust valve, a .012" thickness gauge should pass freely between the valve stem and the tappet, a thicker .014" gauge should not.
6. To correct the valve clearance, use a 7/16" open end wrench to turn the adjusting screw for the correct clearance. The screw is self-locking and will stay where it is set. A 9/16" open end wrench is required to hold the tappet while turning the adjusting screw.
7. To adjust valves on the right hand cylinder, turn engine one complete revolution and again line up mark on the flywheel and the TC mark on the gear cover. Then follow adjustment procedure given for left hand cylinder.
8. Replace all parts removed in Step 2. Tighten all screws securely. Torque manifold bolts to specified torque.

FLYWHEEL

Removing the flywheel is a relatively simple process, but the following procedure must be followed to avoid damage to the gear case and possible injury to the operator.

1. Turn the flywheel mounting screw outward about two turns.

WARNING **Do not remove the screw completely. It acts as a restrainer when the flywheel snaps loose. If the flywheel is not held by the screw, the spring action in the wheel will cause it to fly off with great force that can cause injury to the operator.**

2. Install flywheel puller on the flywheel.
3. Alternately turn until the wheel snaps loose on the shaft.

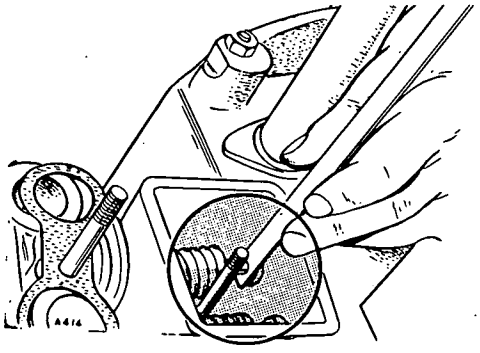


FIGURE 18. VALVE CLEARANCE

CAUTION **Do not use a screwdriver or similar tool, or pry behind the flywheel against the gear case. The gear case cover is die-cast material and will break if undue pressure is applied in this manner.**

4. Unscrew the puller from the flywheel, remove the flywheel mounting screw and washer and pull the flywheel off the shaft. Do not drop the wheel. A bent or broken fin will destroy the balance. Always use a steel key for mounting the flywheel.

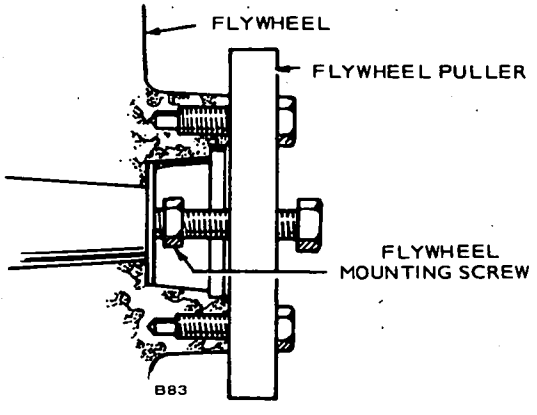


FIGURE 19. BLOWER WHEEL PULLEY

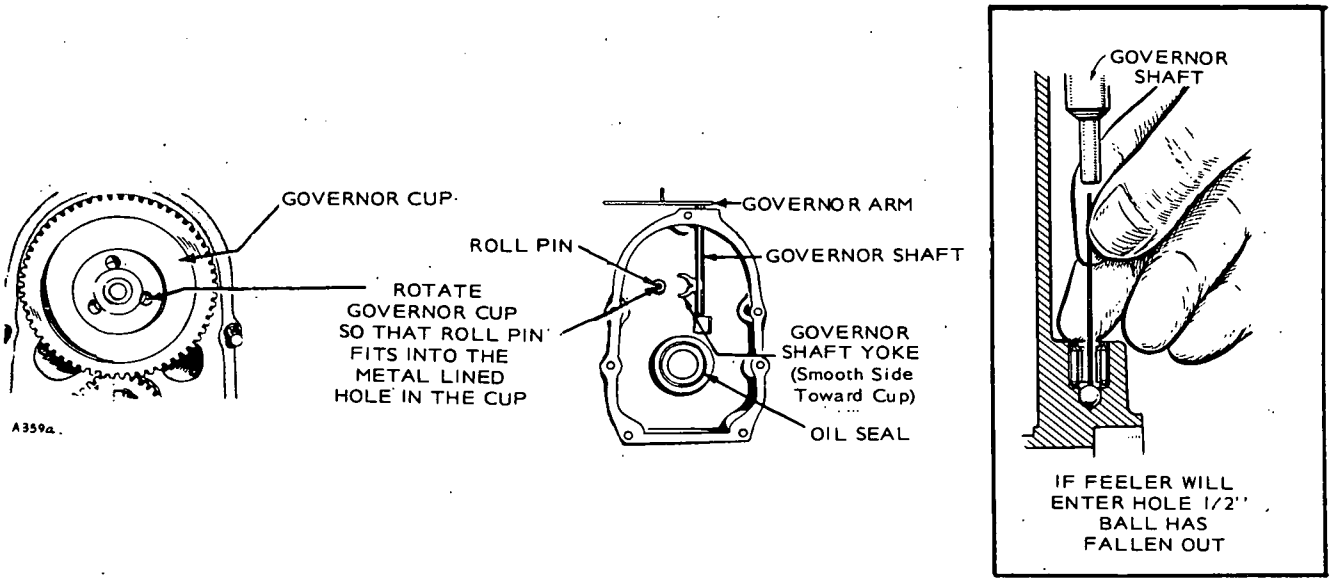


FIGURE 20. GEAR COVER ASSEMBLY

GEAR COVER

After removing the mounting screws, tap the gear cover gently with a soft faced hammer to loosen it.

When installing the gear cover, make sure that the pin in the gear cover engages the metal lined (smooth) hole in the governor cup. Turn the governor cup so that the metal lined hole is at the three o'clock position. The smooth side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal. Adjust the roll (stop) pin to protrude to a point 3/4" from the cover's mounting surface.

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin. Catch the flyballs while sliding the cup off (Figure 21).

Replace with a new part, any flyball which is grooved or has a flat spot; the ball spacer if its arms are worn or otherwise damaged; and the governor cup if the race surface is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but without any excessive play.

When installing the governor cup, tilt the engine so the gear is up, put the flyballs in place (equally spaced) and install the cup and snap ring on the center pin.

The camshaft center pin extends out 3/4" from the end of the camshaft. This distance provides an in and out travel distance of 7/32" for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less (the engine will race especially at no load) remove the center pin and press in a new pin or grind off the hub of the cup as required. The camshaft center pin cannot be pulled outward or removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

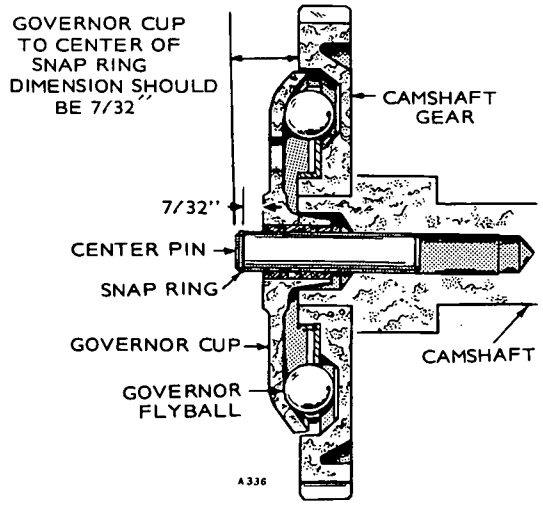


FIGURE 21. GOVERNOR CUP DETAIL

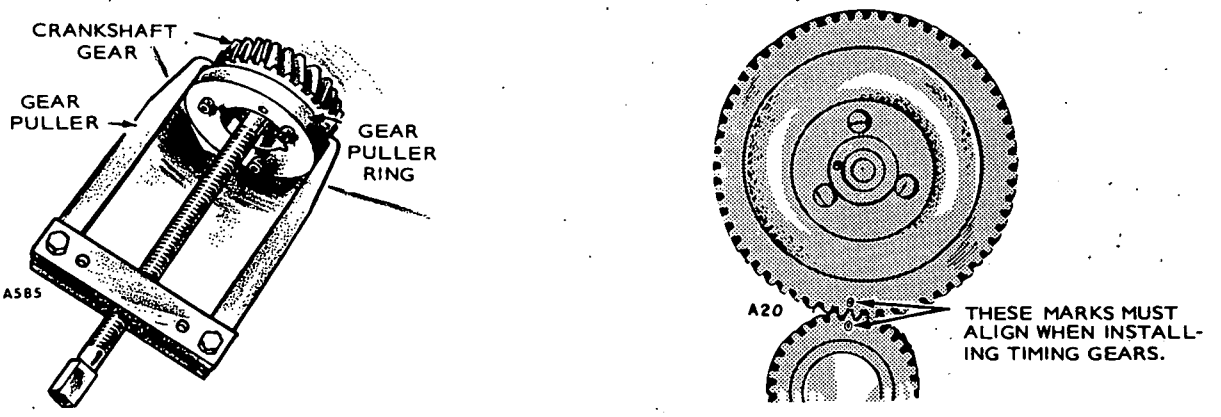


FIGURE 22. TIMING GEAR REMOVAL AND INSTALLATION

TIMING GEARS

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, always install both gears new.

To remove the crankshaft gear, first remove the snap ring and retainer washer, then attach the gear pulling ring using two No. 10-32 screws (Figure 22). Tighten the screws alternately until both are tight. Attach a gear puller to the puller ring and proceed to remove the gear.

The camshaft and gear must be replaced as an assembly. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Then remove the operating plunger for the breaker points and tappets.

Each timing gear is stamped with "O" near the edge. The gear teeth must mesh so that these marks exactly coincide when the gears are installed in the engine. When installing the camshaft gear and shaft assembly, be sure that the thrust washer is properly in place behind the camshaft gear. Then install the crankshaft retaining washer and lock ring.

PISTONS AND CONNECTING RODS

Observe the following procedure when removing pistons and connecting rods from the engine.

1. Drain oil.
2. Remove the cylinder head and oil base pan from the engine.
3. Remove the ridge from the top of each cylinder with a ridge reamer before attempting piston removal (Figure 23).

CAUTION **Forcing the piston from the cylinder before reaming may cause damage to the piston lands.**

4. Turn the crankshaft until the piston is at the bottom of its stroke and remove the connecting rod bolts. Lift the rod bearing cap from the rod and push the rod and piston assembly out through the top of the cylinder using a hammer handle. Avoid scratching the crankpin and cylinder wall when removing the piston and rod.

Mark each piston and rod assembly so they can be returned to their respective cylinders after overhaul. Keep connecting rod bearing caps with their respective rods.

5. Remove the piston rings from the piston with a piston ring spreader as shown in Figure 24. Remove the piston pin retainer and push the piston pin out.

Remove dirt and deposits from the piston surfaces with an approved cleaning solvent. Clean the piston ring grooves with a groove cleaner. Care must be taken not to remove metal from the groove sides.

CAUTION **Do not use a caustic cleaning solvent or wire brush for cleaning pistons.**

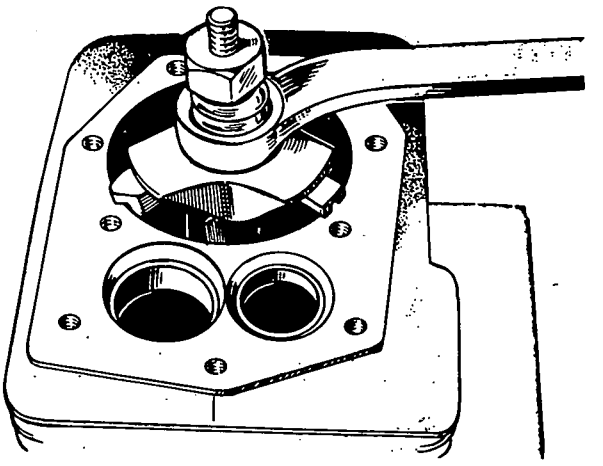


FIGURE 23. REMOVING RIDGE FROM THE CYLINDER

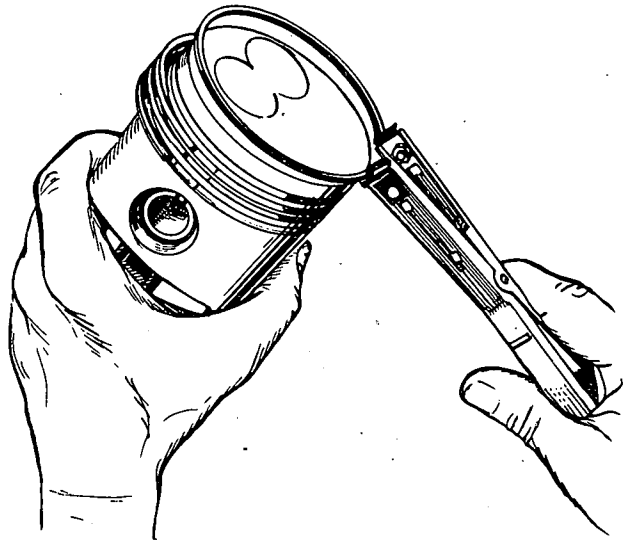


FIGURE 24. REMOVING PISTON RINGS

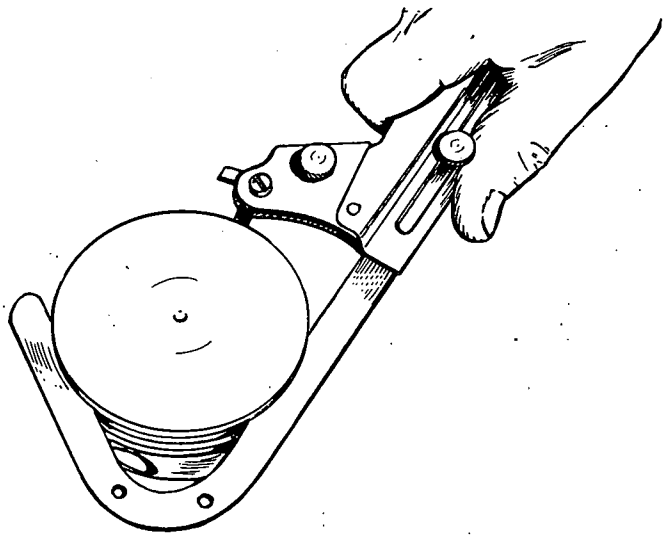


FIGURE 25. PISTON GROOVE CLEANING

When cleaning the connecting rods in solvent, include the rod bore. Blow out all passages with compressed air.

INSPECTION:

The following text contains inspection procedures concerning pistons and connecting rods.

1. Piston Inspection:
   a. Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring lands using a new ring and feeler gauge as shown in Figure 26. Replace the piston when the side clearance of the top compression ring reaches 0.008 inch.
   b. Replace pistons showing signs of scuffing, scoring, worn ring lands, fractures or damage from preignition. Excessive piston wear near the edge of the top ring land indicates preignition.

2. Connecting Rod Inspection:
   a. Replace connecting rod bolts or nuts with damaged threads. Replace connecting rods with deep nicks, signs of fractures, scored bores or bores out of round more than 0.002 inch.
   b. Use a new piston pin to check connecting rod for wear. A push fit clearance is required and varies from engine to engine. If a new piston pin falls through a dry rod pin bore as a result of its own weight, replace the rod.

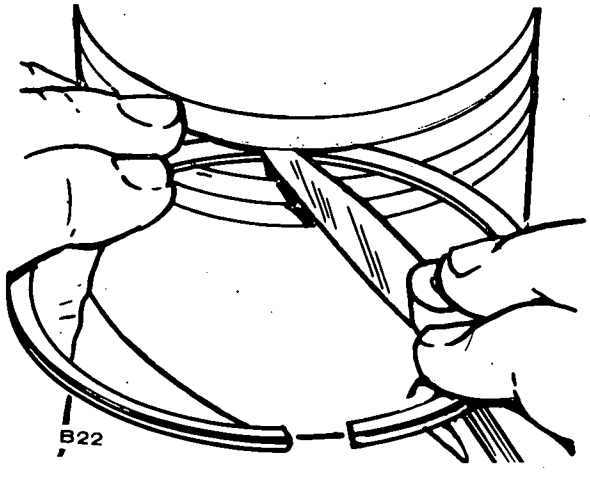


FIGURE 26. CHECKING RING SIDE CLEARANCE

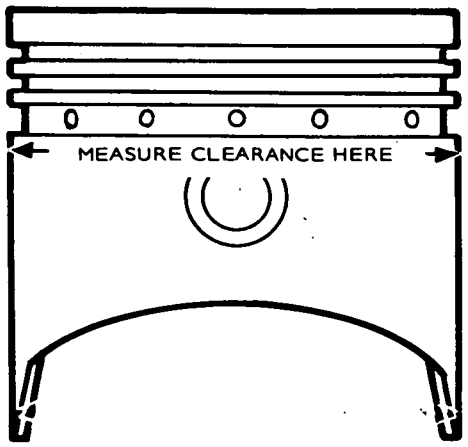


FIGURE 27. MEASURING PISTON CLEARANCE

3. Fitting Pistons:
   a. Proper piston tolerances must be maintained for satisfactory operation.
   b. Measure the piston to cylinder clearance as shown in Figure 27 to be sure the total clearance follows specifications.

2. Fitting Piston Rings:
   a. Install the piston ring in the cylinder bore. Invert the piston and push the ring to the end of ring travel, about halfway into the bore, which trues the ring end gap. Check the gap with a feeler gauge as shown in Figure 28.
   b. The practice of filing ring ends to increase the end gap is not recommended. If the ring end gap does not meet specifications, check for the correct set of rings and the correct bore size. A cylinder bore that is 0.001 inch under size will reduce the end gap 0.003 inch.

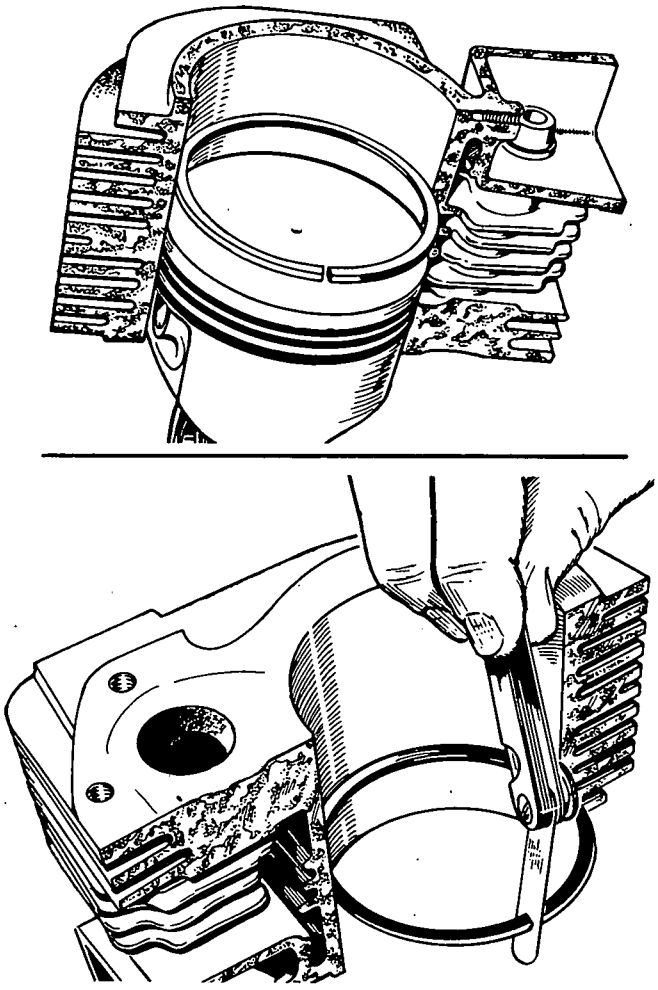


FIGURE 28. POSITIONING OF PISTON RING AND MEASURING OF END GAP

CYLINDER BLOCK

1. Make a thorough check for cracks. Minute cracks may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light motor oil. Wipe the part dry and immediately apply a coating of zinc oxide (white lead) dissolved in wood alcohol. If cracks are present, the white coating will become discolored at the defective area.
2. Inspect the cylinder bore for scoring. Check the Welsh plugs for a tight, even fit and the fins for breakage.
3. Check the cylinder bore for taper, out of round and wear, with a cylinder bore gauge, telescope gauge or inside micrometer (Figure 29). These measurements should be taken at four places - the top and bottom of piston ring travel.
4. Record measurements taken lengthwise at the top and bottom of the piston travel as follows:
   a. Lengthwise of the block, measure and record as "A" the diameter of the cylinder at the top of the cylinder where greatest ring wear occurs.
   b. Also, lengthwise of the block, measure and record as "B" the cylinder diameter at the piston skirt travel.
   c. Crosswise of the block, measure and record as "C" the diameter of the top of the cylinder at the greatest point of wear.
   d. Measure and record as "D" the diameter at the bottom of the cylinder bore and crosswise of the block.
   e. Reading "A" compared to reading "B" and reading "C" compared to reading "D" indicates cylinder taper.

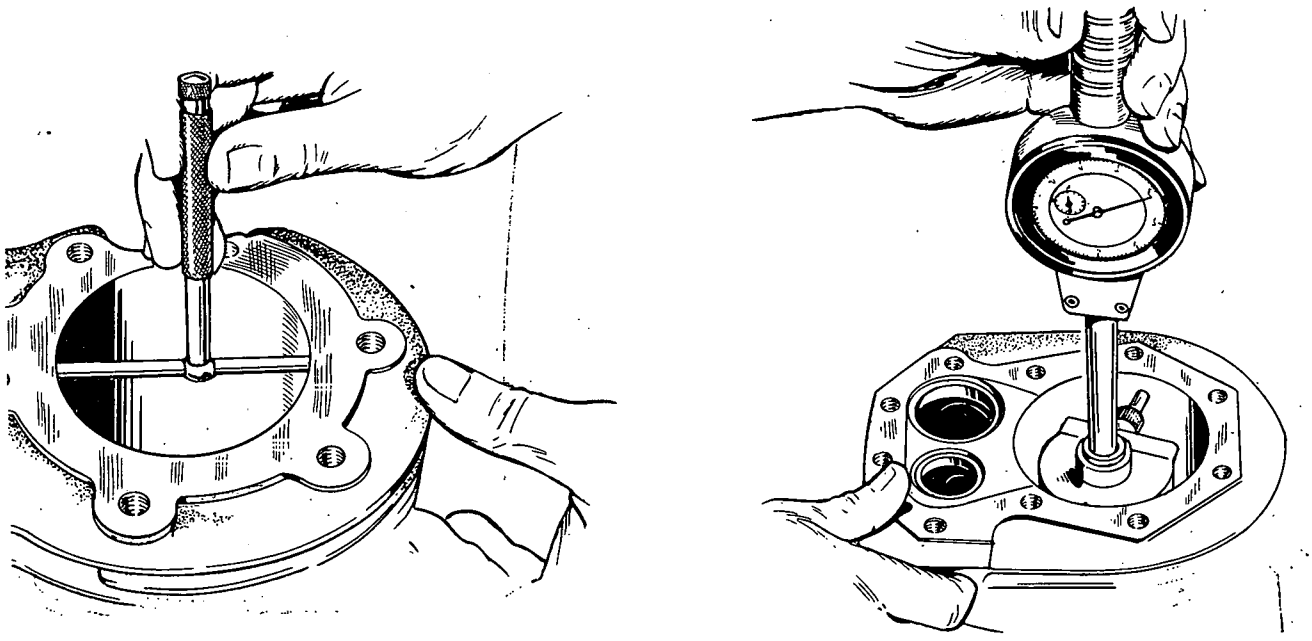


FIGURE 29. METHODS OF MEASURING THE DIAMETER OF A CYLINDER

f. If cylinder taper exceeds 0.005 inch, rebore and hone to accomodate the next oversize piston. Reading "A" compared to reading "C" and reading "B" compared to reading "D" indicates whether or not the cylinder is out of round. If the out of round exceeds 0.002 inch, the cylinders must be rebored and honed for the next oversize piston. A reboring machine is used when going to oversize pistons. The following repair data covers honing to oversize by use of a hone.

Repair:

1. A hone can be used to refinish a cylinder.
2. Anchor the block solidly for either vertical or horizontal honing. Use either a drill press or heavy-duty drill which operates at approximately 250 to 450 rpm.
3. Connect drill to hone and start drill. Move the hone up and down in the cylinder approximately 40 cycles per minute. Usually the bottom of the cylinder must be worked out first because it is smaller. Then when the cylinder takes a uniform diameter, move the hone up and down all the way through the bore. Follow the hone manufacturer's recommendations for wet or dry honing and oiling the hone.
4. Check the diameter of the cylinder regularly during honing. A dial bore gauge is the easiest method but a telescoping gauge can be used. Check the size at six places in the bore: measure twice at the top, middle and bottom at 90 degree angles.
5. The crosshatch formed by the scratching of the stones should form an angle of 23 degrees. This can be achieved by moving the hone up and down in the cylinder about 40 cycles per minute.
6. Clean the cylinder block thoroughly with soap, water and clean rags. A clean white rag should not be soiled on the wall after cleaning is complete. Do not use a solvent or gasoline since they wash the oil from the walls but leave the metal particles.
7. Dry the crankcase and coat it with oil.

CRANKSHAFT

Inspect the bearing journals. If they are scored and cannot be smoothed out by dressing down, replace the crankshaft.

Whenever making major repairs on the engine, always inspect the drilled passages of the crankshaft. Clean them to remove any foreign material and to assure proper lubrication of the connecting rods.

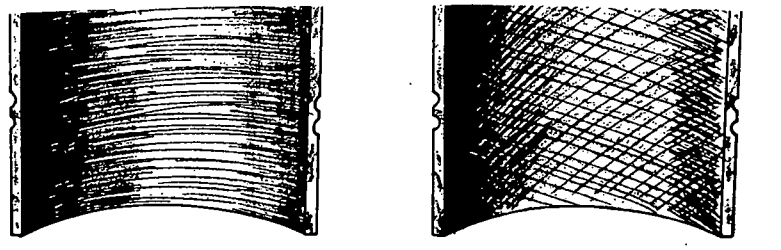


FIGURE 30. CROSSHATCHING

BEARINGS (Figures 31-33)

Removing camshaft or crankshaft bearings requires complete disassembly of the engine. Use a press or a suitable drive plug to remove the bearings. Support the casting to avoid distortion and avoid damaging the bearing bore during removal and installation. Use oil on the bearings to reduce friction when installing and again lubricate with oil after installing.

New camshaft bearings are precision type that *do not* require line reaming or line boring after installation. Coat the bearing with SAE20 oil to reduce friction. Place the bearing on the crankcase over the bearing bore with the elongated hole in proper position and narrow section facing out (except bores without oil holes install with bearing groove at the top). Be sure to start the bearing straight. Press the front bearing in flush with the outside end of the bearing bore. Press the rear bearing in flush with the bottom of counterbore which received the expansion plug (see Figure 31).

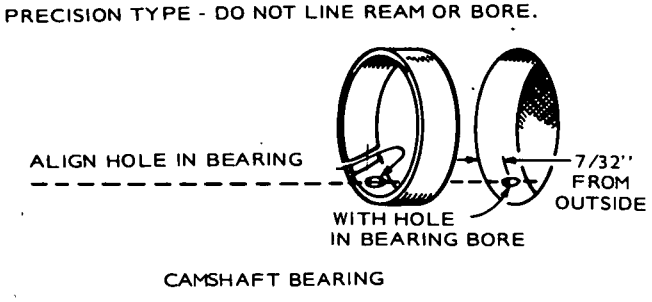


FIGURE 31. CAMSHAFT BEARING

Crankshaft main bearings are precision type that do not require line reaming or line boring after installation. They are available in standard size and .002" undersize. Expand the bearing bore by placing the casting in hot water or in an oven heated to 200°F.

CAUTION **If a torch is used, apply only a little heat.**

To ease assembly, cool the precision bearing to shrink it. Align the oil hole(s) in the bearing with the oil hole(s) in the bearing bore. The oil passage must be at least 1/2 open. Lubricate bearings with SAE20 oil before installing. The cold oiled precision bearing should require only light taps to position it with a driving tool. If head of lock pin is damaged, use side cutters or Easy Out tool to remove and install new pin. Apply oil to thrust washer (one used with each bearing) to hold it in place while installing the crankshaft. Oil grooves in thrust washers must face the crankshaft and washers must be flat (not bent). The two notches on each washer must fit over the two lock pins to prevent riding on the crankshaft.

Original front bearing uses a separate thrust washer. Replacement front bearing is a one piece assembly with thrust washer part of the bearing. Do not use a separate thrust washer when installing this replacement part. See Figures 32 and 33.

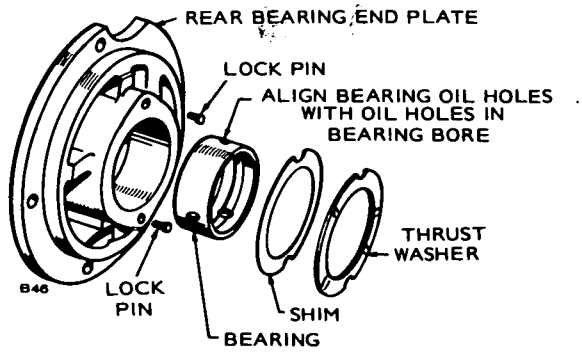


FIGURE 32. BEARINGS FOR REAR BEARING PLATE

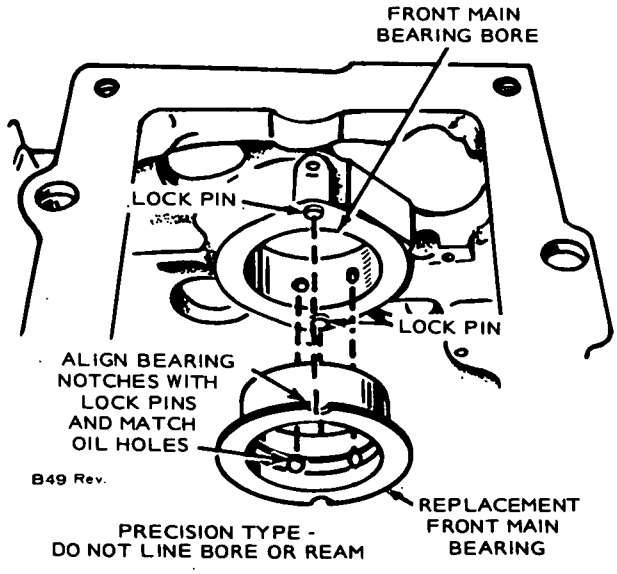


FIGURE 33. FRONT MAIN BEARING INSTALLATION

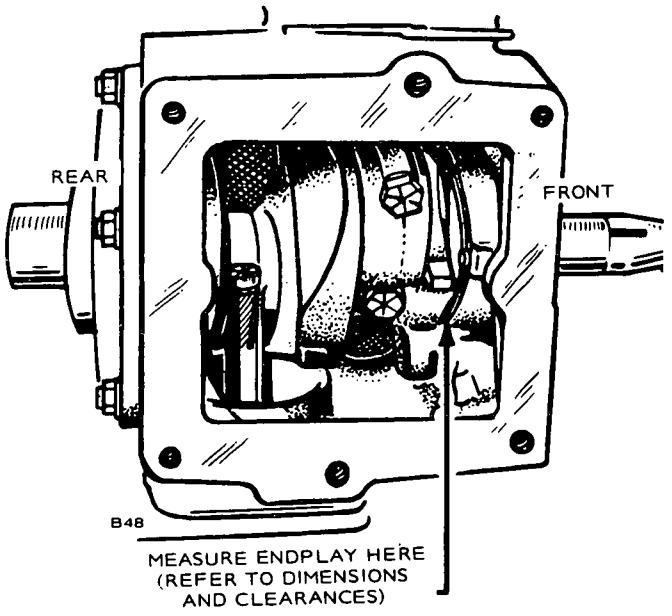


FIGURE 34. CRANKSHAFT ENDPLAY

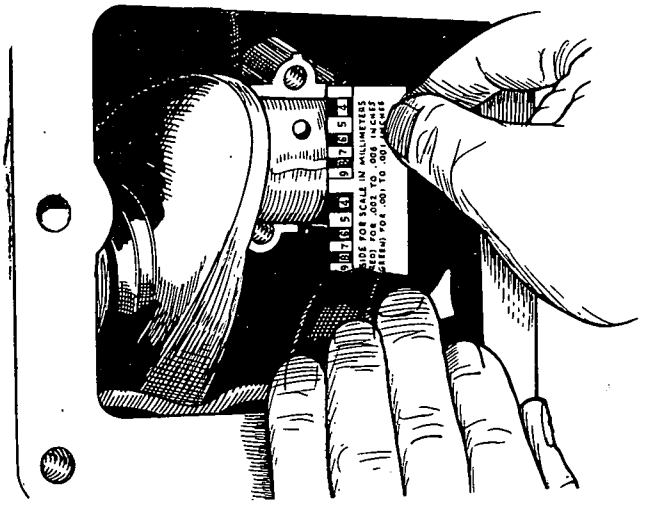


FIGURE 35. MEASURING BEARING CLEARANCE

CRANKSHAFT ENDPLAY

After the rear bearing end plate has been tightened using the torque recommended in Assembly Torques check the crankshaft endplay as shown in Figure 34. If there is too much endplay (see *Dimensions and Clearances* for minimum and maximum endplay), remove the rear bearing end plate and add a shim between the thrust washer and plate. Reinstall the end plate making sure the thrust washer and shim notches line up with the lock pins. Torque and recheck endplay of the crankshaft.

Checking Bearing Clearance with Plastigauge:

1. Make certain that all parts are marked or identified so that they are reinstalled in their original positions.

2. Place a piece of correct size Plastigauge in the bearing cap the full width of the crankshaft rod surface about 1/4 inch off center (Figure 35).

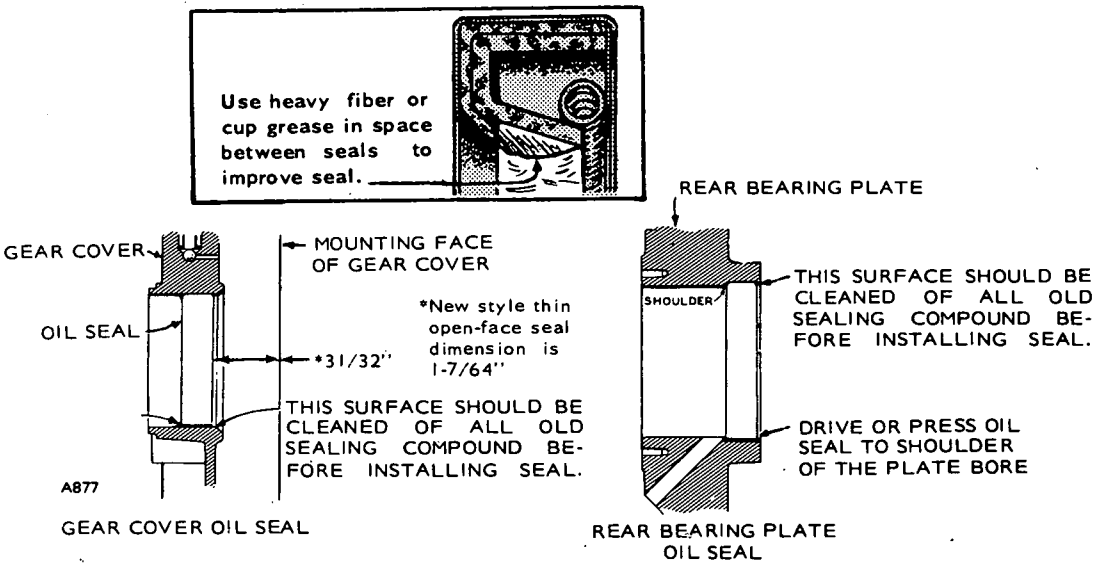


FIGURE 36. GEAR COVER AND REAR BEARING PLATE OIL SEALS

3. Rotate the crank about 30 degrees from bottom dead center and reinstall the bearing cap; tighten the bolts to the torque specified in Assembly Torques. Do not turn the crankshaft.
4. Remove the bearing cap. Leave the flattened Plastigauge on the part to which it has adhered and compare the widest point with the graduations on the Plastigauge envelope to determine bearing clearance.

OIL SEALS (Figure 36)

The bearing plate must be removed to replace the oil seal. Drive the oil seal out from the inside.

Before installing the seals, fill the space between lips with a multi-purpose grease. This will improve sealing.

When installing the gear cover oil seal, tap the seal inward until it is 31/32" from the mounting face of the cover.

When installing the bearing plate oil seal, tap the seal into the bearing plate bore to bottom against the shoulder in the plate bore. Use a seal expander or place a piece of shim stock around the end of the crankshaft, when replacing the bearing plate to avoid damaging the seal. Remove the shim stock as soon as the plate is in place.

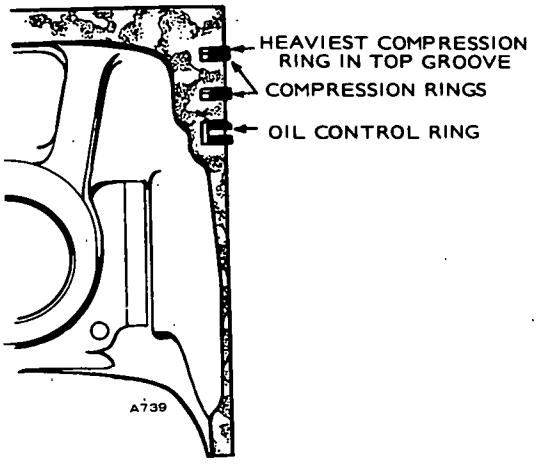


FIGURE 37. PISTON RINGS

ASSEMBLY

1. Lubricate all parts with engine oil.
2. Position piston on its respective rod and install the pin.
3. Install the rings on the pistons starting with the oil control ring (Figure 37). Use a piston ring spreader to prevent twisting or excessive expansion of the ring. Some oil control rings and all compression rings have a dot or the word "top" on one side of the ring to indicate which side faces the top of the piston. Unmarked piston rings can be installed either way. If the oil control ring has a coil expander, install the expander first and then close until the coil ends butt. The joint should be 180 degrees from the gap of that ring.

INSTALLATION OF PISTON IN CYLINDER

1. Turn the crankshaft to position the number one rod bearing journal at the bottom of its stroke.
2. Lubricate the number one piston assembly and inside of the cylinder. Compress the rings with a ring compressor as shown in Figure 38.
3. Position the piston and rod assembly in the cylinder block.

The connecting rod numbers should always face away from the camshaft or bottom side of engine.

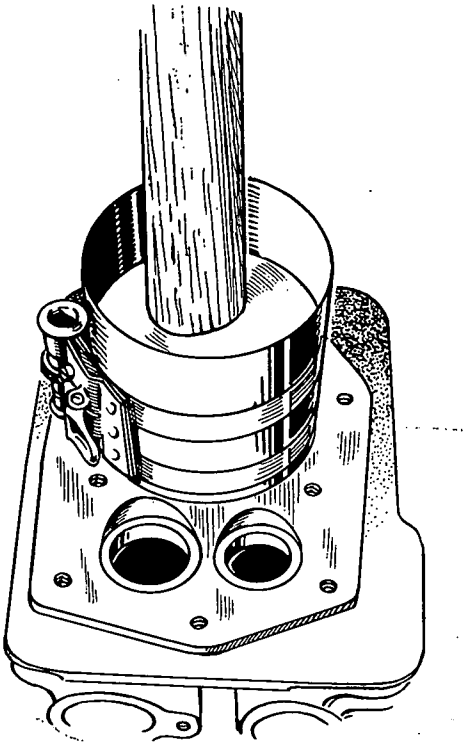
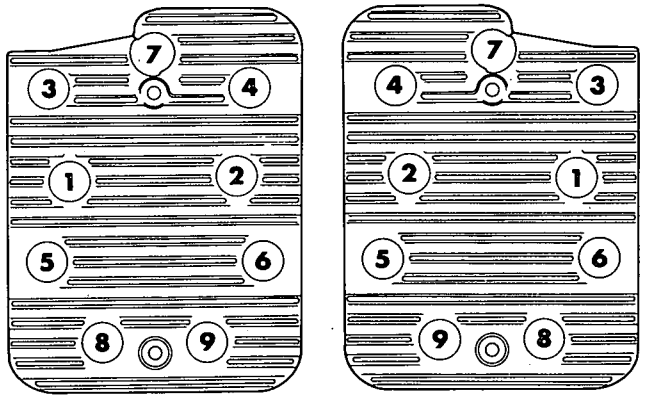


FIGURE 38. INSTALLING PISTON

4. Tap the piston down into the bore with the handle end of a hammer until the connecting rod is seated on the journal (Figure 38). Install the bearing cap on the rod with the witness marks and stamped reference numbers matching the marks on the rod. Install and tighten the bolts to the specified torques.

   The bearing cap must be tapped several times to properly align it with the rest of the connecting rod. Clearance varies on the journal if this is not done.

   Install the remaining pistons and rods in the same manner. Crank the engine over by hand to see that all bearings are free.
5. Install the oil base with a new gasket.
6. Install the cylinder heads and torque 14-16 ft. lb.
7. Replace oil and break-in engine.



NO.1 CYLINDER NO.2 CYLINDER

FIGURE 39. CYLINDER HEAD TORQUE SEQUENCE

CYLINDER HEADS

Remove the cylinder heads for cleaning if poor engine performance is noticed.

1. Use a 1/2 inch socket wrench to remove cylinder head nuts. Lift heads off.

CAUTION **Do not remove heads when they are hot. Warpage may occur.**

2. After removing heads, clean out all carbon deposits. Be careful not to damage the outer sealing edges where gaskets fit. The heads are made of aluminum and can be damaged by careless handling.
3. Use new head gaskets and clean both the heads and the cylinder block thoroughly where the head gaskets rest.
4. Place heads in position and follow head torque tightening sequence shown in Figure 39. Start out tightening all nuts to 5 ft-lb, then 10 ft-lb, etc., until all nuts are torqued 14-16 ft-lb.
5. Recheck torque before engine has run a total of 50 hours.

GENERATOR MAINTENANCE

GENERATOR REVOLVING FIELD

The generator uses a 2 pole revolving field with an exciter winding to excite the field and regulate the AC output (Figure 40).

The generators AC welding output comes from the stator windings that also supply 120 volts, or 120/240 volts, AC, depending on model. An additional winding supplies power for battery charging system.

To aid servicing and repair, all output leads from the generator are marked. The lead and terminal markings are shown on the welder wiring diagram.

MAINTENANCE

The generator normally requires little care other than periodic inspection of the bearing, collector rings and brushes every 500 hours.

BRUSHES

After approximately 500 hours of operation, remove the generator brushes and inspect for wear, scoring and general conditions.

To remove the brushes, remove the generator fan guard and the fan. The brush guide is now accessible and can be detached by removing the attaching screws in the end bell. Before removing the brushes from the guide, tag the leads 5 and 6 as shown by the markings on the side of the brush holder. See Figure 41. Unscrew the brush retaining screws and pull the brushes from the guide.

The brush faces should have a smooth, coppery cast to them, with no deep grooves present. If serious grooves are noted, the slip rings should be inspected to determine the cause for corrective purposes. If slip ring dressing is required, your nearest qualified electric motor or generator service shop is best equipped to handle this job.

If brushes appear to be in satisfactory condition, and are at least 5/16 inch in length, replace them in the guide from which they were removed. Work the brushes up and down in the guide to be sure there is no sticking or binding. If they bind, clean out the guide with air pressure or a small bristle brush until the brushes slide freely in the guide. Replace the brush retainer screws.

If brushes are worn to less than 5/16 inch length, replace with new brushes. See Figure 41 for comparison scale.

When replacing brushes, do not use a substitute brush. It may look identical but may have entirely different electrical characteristics.

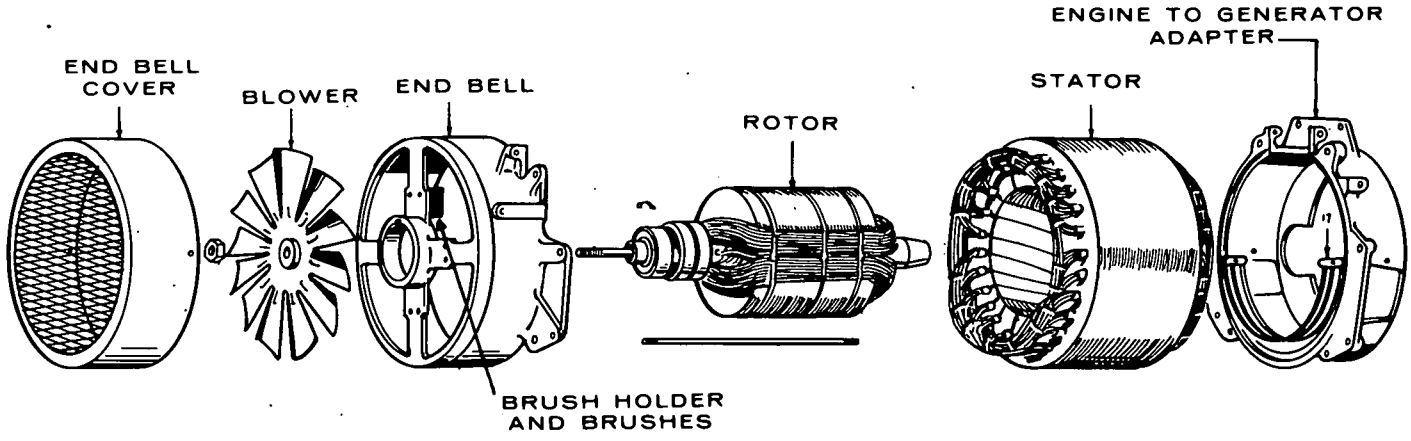


FIGURE 40. GENERATOR ASSEMBLY

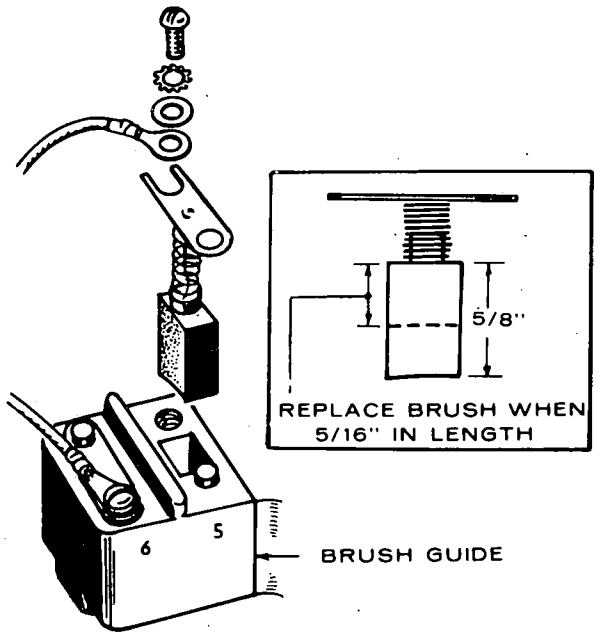


FIGURE 41. GENERATOR BRUSH REMOVAL

GENERATOR BEARING

This bearing is prelubricated and double-sealed. For maximum reliability, replace during a general overhaul.

COLLECTOR RINGS

Slip (collector) rings may have a dark brown appearance. This is normal and consists of a thin lubricating film which aids in the life of brushes and slip rings. Do not remove the film.

The collector rings must be clean and free of scratches, burrs and marks. If cleaning is necessary, use No. 240 sandpaper to clean the surface. Never use emery cloth or other conducting abrasives.

TROUBLESHOOTING

Unsatisfactory or erratic operation of the generator can, in most cases, be isolated quite simply. Under or over voltages can usually be traced to improper governor operation causing over, under, and fluctuating engine speeds. If a fault condition persists, checking the entire electrical system with a continuity tester or ohmmeter, may be required. The tests that follow can be performed without disassembly of the generator.

WARNING **Do not perform troubleshooting tests with the generator running. Serious injury to the operator and damage to the test instruments can result.**

LOSS OF WELDING POWER

1. Remove control box cover screws (at base of cover) and lift off cover.
2. Visually check the rotary switch wiper blade and contact points for burned areas. If questionable contacts are observed, attach one lead of ohmmeter to left hand welding terminal stud; turn switch handle to contact to be tested. Touch the other ohmmeter head to the reactor lead where it is clamped to the switch terminal. A low (less than 2 ohms) resistance reading should be obtained on the meter if there is a good contact in the switching members. A high resistance indicates poor contact. If cleaning the contact and wiper blade does not restore the contact, switch replacement may be necessary. See *Control Box* section.
3. If switch checks out satisfactorily, examine all leads, terminals, and screw connections visually for opens or shorts. A point-to-point check with the ohmmeter will indicate any open circuit.
4. If all connections appear good, isolate the diode (see *Control Box* section) attached to the small circuit board back of the control panel. Check the diode with the ohmmeter by alternately reversing the leads. If the diode passes current in one direction and not the other, the diode is probably good.

A bad diode will cause the ignition to short and stop the engine. A marginal diode may operate sufficiently well to enable the engine to run but will not deliver enough current to excite the generator (flash the field). If there is any doubt as to the condition of the diode, replace it. When replacing make sure that the arrow on the new diode points in the same direction as the one removed.

5. Isolate the small resistor from the diode and test with the ohmmeter. Resistance should measure 2.7 ohms ± 5%.
6. Remove the end bell cover and cooling fan. Check the brushes. Check all connections for shorts or opens with ohmmeter.
7. Isolate the two diodes from the end bell frame by removing the attaching nuts. Test as in Step 3. Replace if marginal.
8. If loss of welding power is noticed only in the upper ampere ranges, it is very possible that the electrolytic capacitors are at fault. An ohmmeter will indicate if the capacitor is shorted but will not indicate if the capacitor is open or has changed value. Unless a special capacitor test is available, substitution of capacitors known to be good is the quickest way of determining the condition of the suspect capacitors. Observe polarity closely when replacement is made.
9. Further tests of excitation and load windings are possible only after dismantling the generator. It is suggested that this be performed only by a qualified electric motor and generator service shop.

LOSS OF AUXILIARY POWER

1. Start the check-out procedure by pressing the reset button(s) on the circuit breaker(s). If the button appears to reset, start the engine to determine whether auxiliary power is now available. If circuit breaker again opens, the circuit is either overloaded or a short circuit is causing the breaker to trip. Measure the load being drawn. Total load should not exceed 5KW. Check appliance, tool, or cord plugs for shorts.
2. If no evidence of fault is found with the circuit breaker, proceed with applicable steps 1 through 9 preceding.

CONTROL BOX

The rear side of the control panel contains the switching members and connections to the reactor transformer. Also, a small panel on the lower part of the control panel mounts a diode and resistor that provide a DC pulse for generator excitation buildup.

If troubleshooting an inoperative generator indicates replacement of the diode and/or resistor is necessary, certain precautions should be taken to avoid heat damage to the new diode. After unsoldering the lower lead of the diode to be removed, clean any excess solder off the terminal board post. Make a loop in the diode lead and fit to the solder terminal. Allow enough room between the solder joint and the diode body to allow a small nose pliers to grasp the lead. The pliers will act as a heat sink to absorb the heat applied by the soldering iron. Make the solder joint quickly to avoid overheating the solder joint. Secure opposite lead to the threaded stud along with the resistor lead. When replacing the resistor, the use of reasonable care in soldering will suffice.

If, through accident or misuse, the selector switch becomes damaged or burned, and replacement is necessary, the following procedure should be followed for switch replacement.

1. Disconnect and tag all leads from the control box to the generator.
2. Remove all bolts and screws that attach the control box to the generator frame and lift the assembly off the generator.
3. Use a small pin punch to drive the roll pin from the selector handle and pull the handle off the shaft.
4. With the aid of a snap-ring pliers remove the snap ring from the selector shaft.
5. Remove the receptacle and circuit breaker mounting screws from panel front. Unscrew the nuts and washers from the terminal studs on the front of the terminal studs on the front of the control panel. Remove the 1/4-20 machine bolt from the top-center of the control panel and pull the panel off.
6. The wiper blade, tension spring and operating shaft may now be slid out of the switch assembly as a unit. This will release the copper connector bar and terminal stud which should also be removed.
7. The squeeze type connectors that secure reactor leads x1 through x7 to the selector terminals must be removed with a hack-saw, bolt cutters or other suitable means. If it is determined that this is impossible, the stranded leads may be severed next to the connector. This method is not recommended unless absolutely necessary because shortening the lead will make handling more difficult.
8. Clean the leads with sandpaper and tape any frayed or broken insulation or slide a new glass fiber sleeve over the lead if the insulation is beyond repair. Replace the identifying marker (x1, x2, etc.) on the sleeve.
9. The leads are reassembled to the new selector panel with screw type connectors. See *Parts List.* Before reassembly, tin or flex any bare copper wires. Insert wire and terminal pin and tighten securely. Flow solder into the connector and wires with either a low flame torch or large soldering copper. This will assure a good, permanent electrical bond.
10. Replace any other parts as necessary and reassemble the new switch in the reverse order of disassembly. When replacing the switch handle, do not overlook replacing the spacer washer under the snap ring.

PARTS CATALOG

This catalog applies to the standard 180 ampere welder as listed in the Data Table below. Parts are arranged in groups of related items and each part is identified by a reference with a corresponding reference description. Part illustrations are typical. Unless otherwise mentioned in the description, parts are interchangeable between models. Right and left sides are determined by *facing* the engine end of the unit.

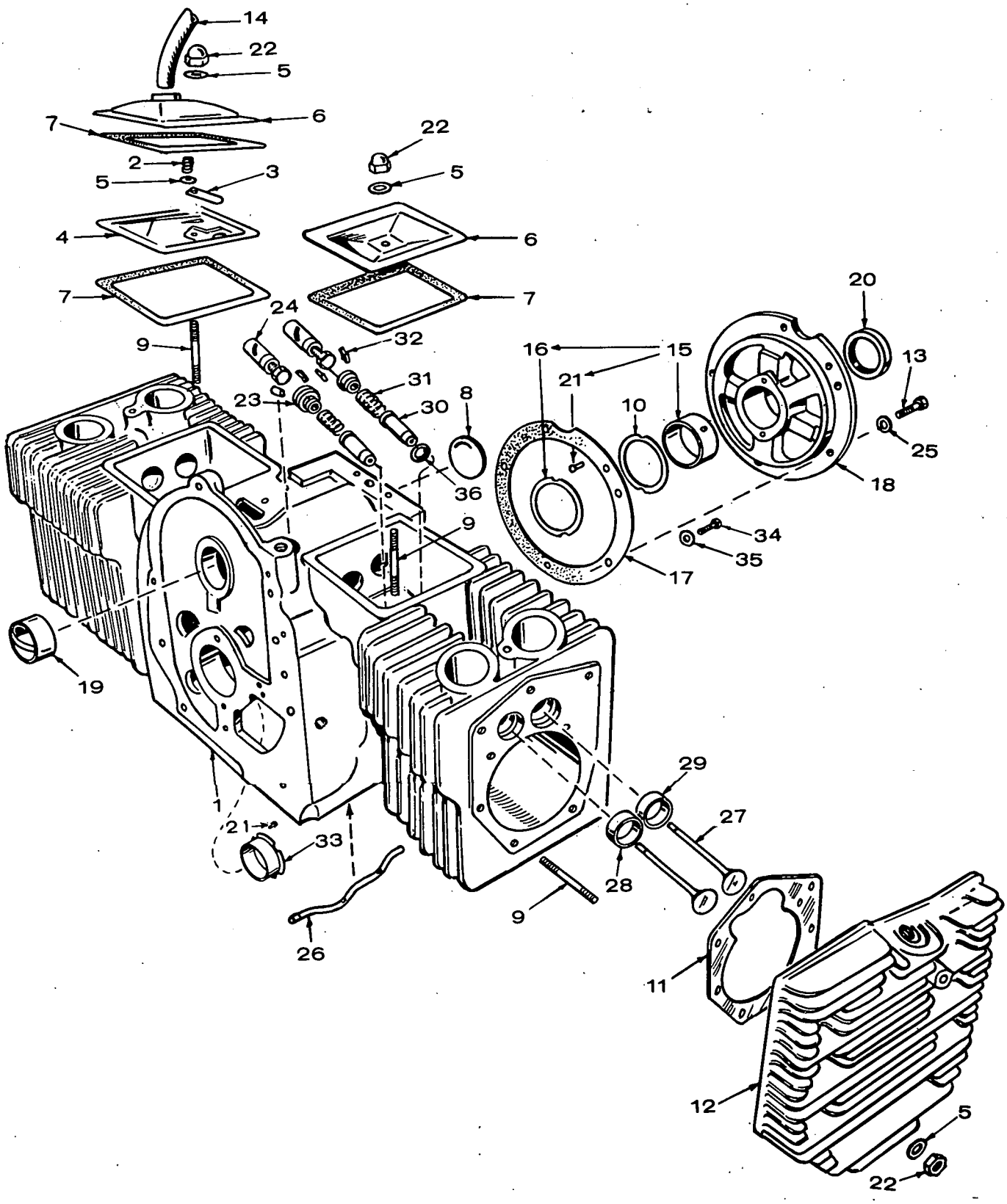
WELDER DATA TABLE

MODEL NO. AND SPECIFICATION	ELECTRICAL DATA						
	A.C. OUTPUT (For Welding)			A.C. OUTPUT, 1 Phase (Available continuously when not welding)			
	Amps	Volts	Duty Cycle	Watts	Volts	Hertz	Phase
5.0BF - 341E/*	180	25	50%	5000	120/240	60	1
5.0BF - 343E/*	180	25	50%	5000	120	60	1

* - The Specification Letter Advances (A to B, B to C, etc.) with manufacturing changes.

NOTE: Hertz is a unit of frequency equal to one cycle per second.

CYLINDER BLOCK GROUP

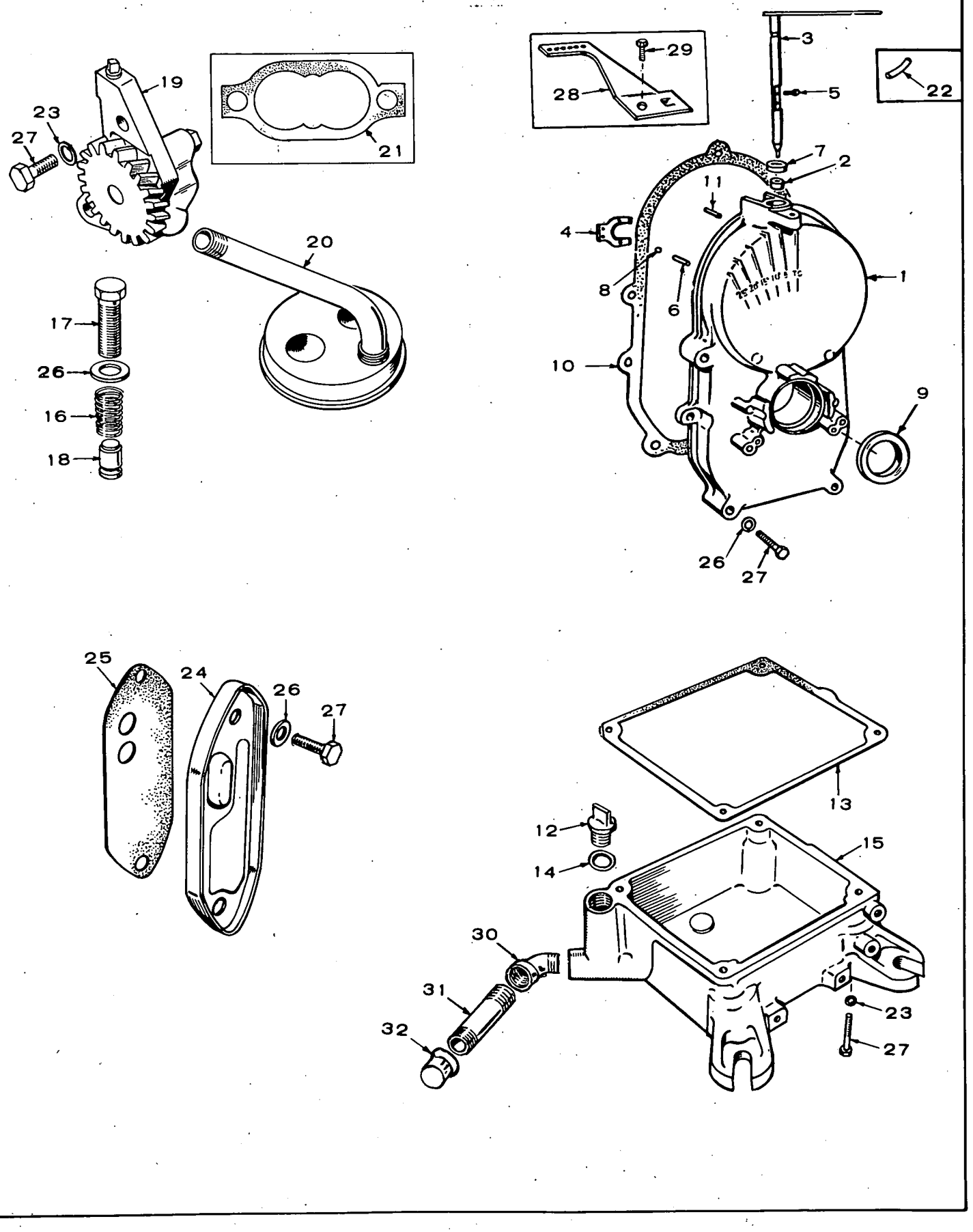


REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	110-2214	1	Block Assembly, Cylinder (Includes Parts Marked *)
2	123-1174	1	Spring, Breather Valve
3	123-1175	1	Valve, Breather
4	123-1173	1	Baffle, Breather
5	WASHER, FLAT		
	526-0018	1	Breather Valve (1/4 ″ - Steel)
	526-0063	2	Valve Compartment Cover (1/4 ″ Copper)
	526-0122	18	Cylinder Head Screws (5/16 ″ - Steel)
6	COVER, VALVE COMPARTMENT		
	110-1878	1	Cover with Opening for Breather Tube (L.H.)
	110-1879	1	Cover without Opening for Breather Tube (R.H.)
7	110-1921	3	Gasket, Valve Cover
8	517-0048	1	*Plug, Camshaft Expansion
9	STUD		
	520-0424	6	Cylinder Head (5/16 x 2-5/16 ″)
	520-0759	12	Cylinder Head (5/16 x 2-1/16 ″)
	520-0757	2	Valve Compartment Cover (1/4 x 2-1/16 ″)
10	104-0776	As Req.	*Shim, Rear Bearing Plate (.005 ″)
11	110-1920	2	Gasket, Cylinder Head
12	HEAD, CYLINDER		
	110-1924	1	Right Side (#2 Cylinder)
	110-1925	1	Left Side (#1 Cylinder)
13	800-0051	5	*Screw, Hex Cap (3/8-16 x 1-1/4 ″) - Bearing Plate Mounting
14	123-1176	1	Tube, Breather
15	BEARING, CRANKSHAFT - REAR		
	101-0420	1	*Standard
	101-0420-02	1	.002″ Undersize
	101-0420-10	1	.010″ Undersize
	101-0420-20	1	.020″ Undersize
	101-0420-30	1	.030″ Undersize
16	104-0575	2	▲*Washer, Crankshaft Bearing Thrust
17	101-0415	1	*Gasket, Bearing Plate
18	101-0439	1	*Plate, Rear Bearing (Excludes Bearing)
19	101-0367	2	*Bearing, Camshaft (Precision)
20	509-0041	1	*Seal, Bearing Plate
21	516-0072	4	*Pin, Main Bearing Stop
22	NUT		
	110-0445	18	Cylinder Head (Hex - (5/16-24)
	866-0001	2	Valve Compartment Cover (Acorn - 1/4-20)
23	110-0893	4	Retainer, Valve Spring
24	TAPPET, VALVE		
	115-0006	4	Standard
	115-0006-01	4	.001 ″ Oversize
	115-0006-02	4	.002 ″ Oversize
	115-0006-05	4	.005 ″ Oversize
25	850-0050	5	*Washer, Lock (3/8 ″) - Rear Bearing Plate
26	120-0706	1	*Tube, Crankcase Oil
27	VALVE		
	110-1808	2	Intake
	110-1809	2	Exhaust
28	INSERT, VALVE SEAT - EXHAUST		
	110-0245	2	*Standard
	110-0245-02	2	.002 ″ Oversize
	110-0245-05	2	.005 ″ Oversize
	110-0245-10	2	.010 ″ Oversize
	110-0245-25	2	.025 ″ Oversize
29	INSERT, VALVE SEAT – INTAKE		
	110-0197	2	*Standard
	110-0197-02	2	.002 ″ Oversize
	110-0197-05	2	.005 ″ Oversize
	110-0197-10	2	.010 ″ Oversize
	110-0197-25	2	.025 ″ Oversize
30	110-1807	4	*Guide, Valve
31	110-0539	4	Spring, Valve
32	110-0639	8	Lock, Valve and Spring Retaining
33	BEARING, CRANKSHAFT – FRONT		
	101-0432	1	*Standard
	101-0432-02	1	.002″ Undersize
	101-0432-10	1	.010″ Undersize
	101-0432-20	1	.020″ Undersize
	101-0432-30	1	.030″ Undersize
34	806-0027	2	Screw (3/8-16 x 3/4 ″) - Cylinder Block
35	526-0066	2	Washer (3/8 ″), Copper - Cylinder Block
36	110-0068	2	*Gasket, Valve Guide (Intake)

* - Included in Cylinder Block Assembly.

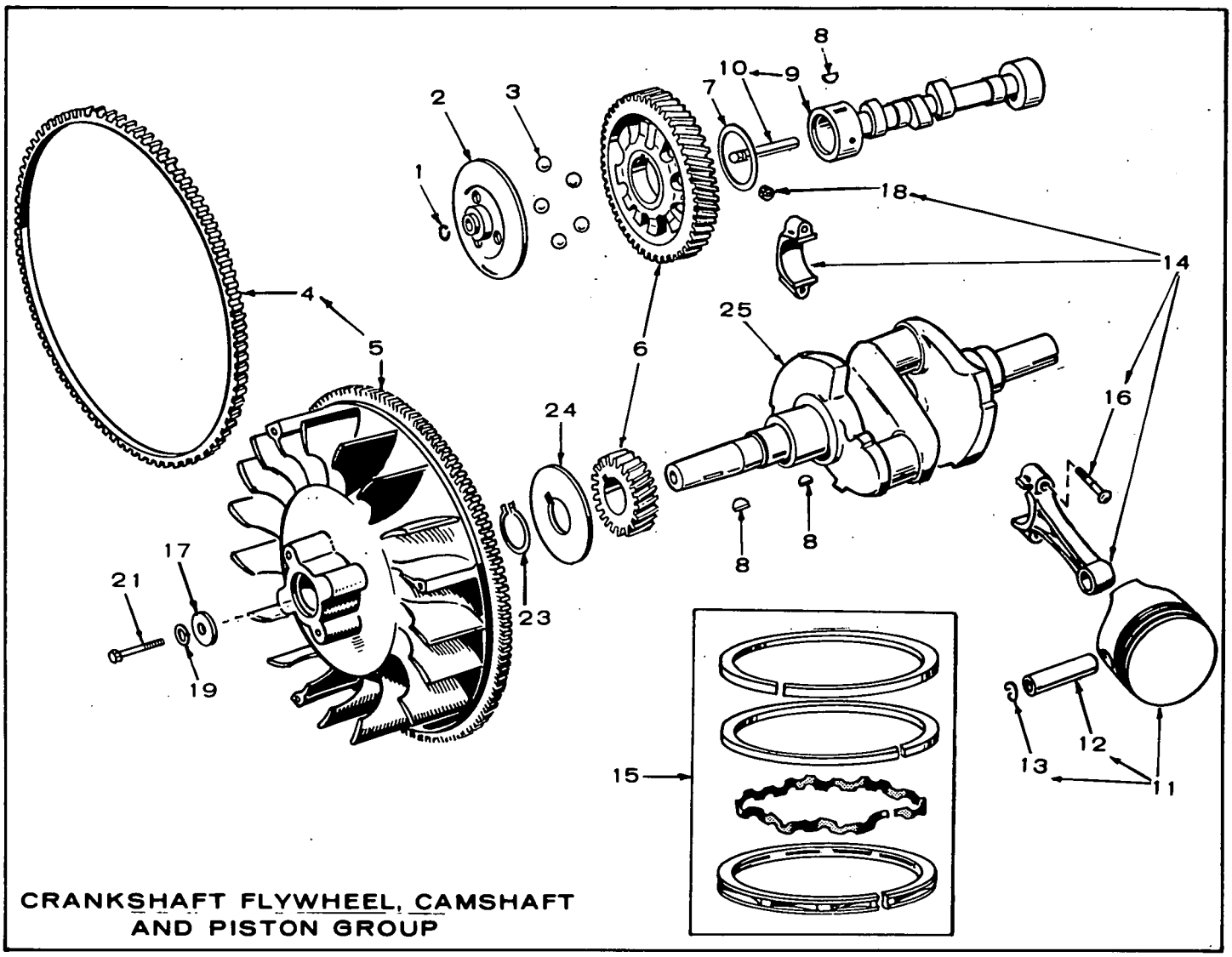
▲ - Use one only with rear bearing on units with flange type front bearing.

GEAR COVER, OIL BASE AND OIL PUMP GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	103-0396	1	Cover Assembly, Gear (Includes Parts Marked *)
2	510-0105	1	*Bearing, Governor Shaft
3	150-1349	1	*Shaft and Arm Assembly - Governor
4	150-1187	1	*Yoke, Governor Shaft
5	815-0046	2	*Screw, Yoke Retaining
6	516-0130	1	*Pin, Governor - Cup Stop
7	509-0008	1	*Seal, Oil - Governor Shaft
8	510-0014	1	*Ball, Bearing - Governor Shaft
9	509-0040	1	*Seal, Gear Cover
10	103-0408	1	Gasket, Gear Cover Mounting
11	516-0011	2	Pin, Gear Cover (5/16 x 1-1/8 ″)
12	102-0753	1	Plug, Oil Fill
13	102-0693	1	Gasket, Oil Base Mounting
14	102-0612	1	Gasket, Oil Fill Plug
15	102-0694	1	Base, Oil
16	120-0140	1	Spring, Oil By-Pass Valve
17	801-0050	1	Screw, Oil By-Pass (3/8-24 x 1 ″)
18	120-0398	1	Valve, Oil By-Pass
19	120-0491	1	Pump, Oil - Complete (**NOTE**: Components not sold separately)
20	120-0709	1	Intake, Oil Pump (Includes Cup, Screen and Pipe)
21	120-0161	1	Gasket Kit, Oil Pump
22	149-1299	1	Tube, Fuel Pump Vacuum
23	WASHER, LOCK		
	850-0050	4	Oil Base Mounting (3/8 ″)
	850-0040	2	Oil Pump Mounting (1/4 ″)
24	122-0359	1	Cover, Oil Filter Pad
25	122-0321	1	Gasket, Oil Filter Pad Cover
26	WASHER, FLAT		
	526-0065	7	(5) Gear Cover Mounting (2) Oil Filter Pad Cover Mtg. (Copper - 5/16 ″)
	526-0066	1	Oil Pressure Relief Valve Screw (Copper - 3/8 ″)
27	SCREW, HEX CAP		
	800-0028	2	Oil Filter Pad Cover Mounting (5/16-18 x 1 ″)
	800-0056	4	Oil Base to Block (3/8-16 x 2-1/2 ″)
	800-0032	4	Gear Cover Mounting (5/16-18 x 1-3/4 ″)
	800-0034	1	Gear Cover Mounting (5/16-18 x 2-1/4 ″)
	800-0007	2	Oil Pump Mounting (1/4-20 x 1 ″)
28	150-1073	1	Arm, Manual Governor
29	815-0194	1	Screw (10-32 x 3/8 ″)
30	505-0248	1	Elbow (1/2 x 45°), Street
31	505-0176	1	Nipple (1/2 x 3-1/2 ″)
32	505-0158	1	Cap (1/2 ″), Pipe

* - Included in Gear Cover Assembly.

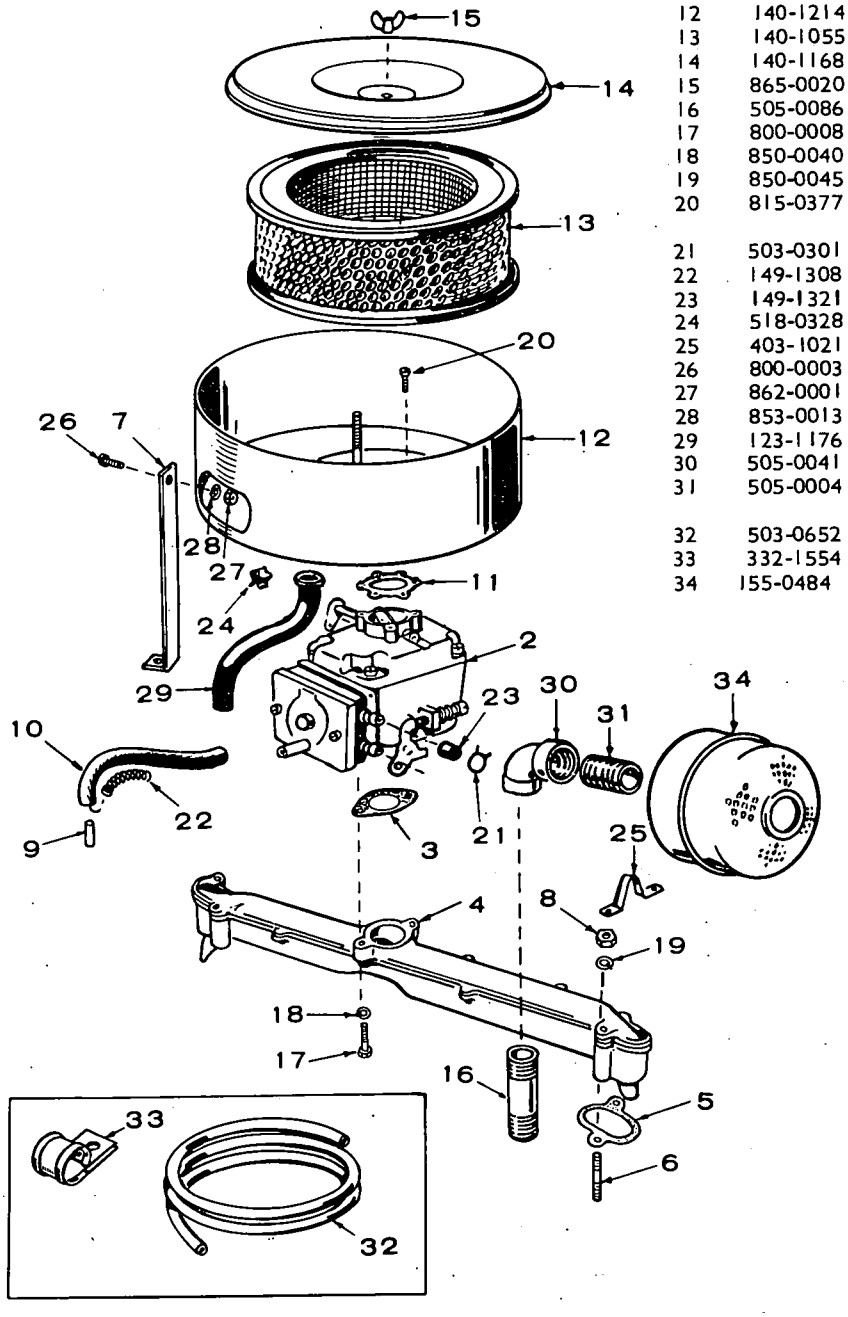


CRANKSHAFT FLYWHEEL, CAMSHAFT AND PISTON GROUP

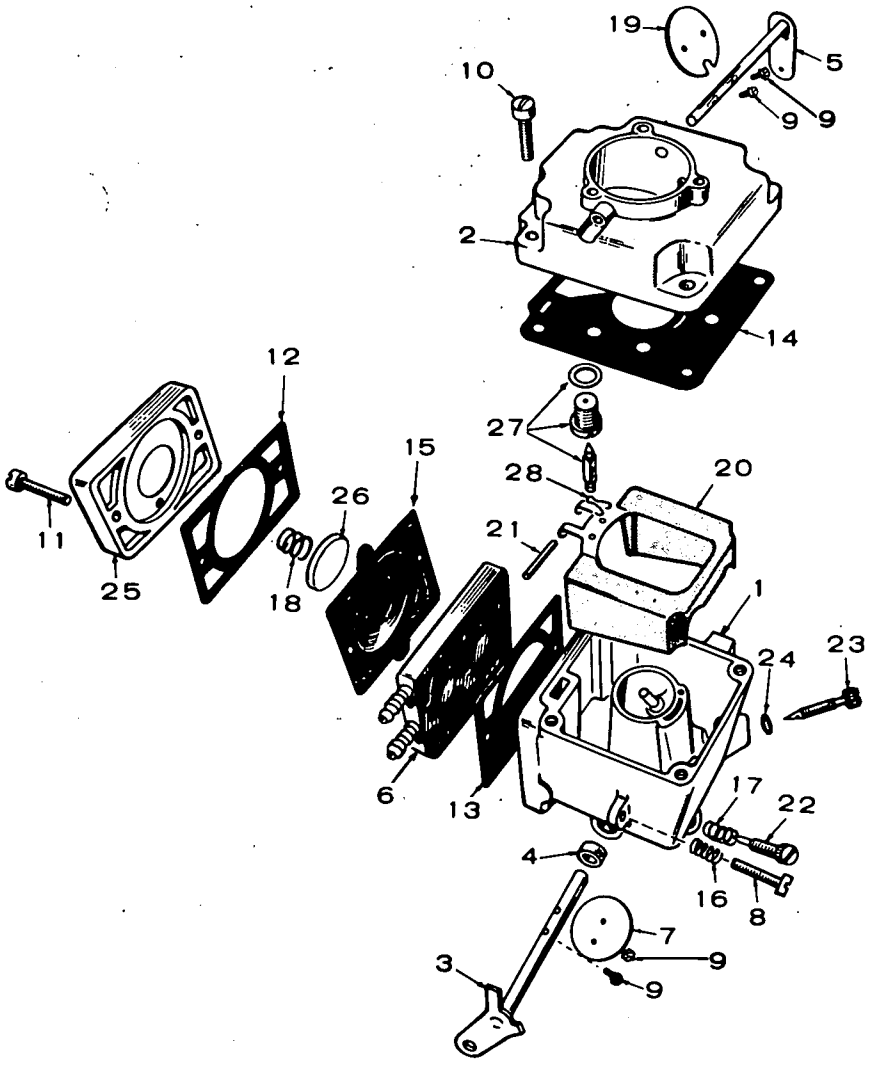
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150-0078	1	Ring, Camshaft Center Pin
2	150-0612	1	Cup, Governor
3	510-0015	5	Ball, Fly - Governor
4	104-0779	1	Gear, Ring - Flywheel
5	134-2431	1	Flywheel (Includes Ring Gear)
6	105-0353	1	Gear Set, Timing (Includes Camshaft and Crankshaft Gears)
7	105-0004	1	Washer, Camshaft Gear Thrust
8	KEY		
	515-0001	2	Camshaft Gear Mounting (1) Crankshaft Gear Mounting (1)
	515-0002	1	Flywheel Mounting
9	105-0388	1	Camshaft (Includes Center Pin)
10	150-0075	1	Pin, Camshaft Center
11	PISTON AND PIN		
	112-0123	2	Standard
	112-0123-05	2	.005 ″ Oversize
	112-0123-10	2	.010 ″ Oversize
	112-0123-20	2	.020 ″ Oversize
	112-0123-30	2	.030 ″ Oversize
	112-0123-40	2	.040 ″ Oversize
12	112-0122	2	Pin, Piston
13	518-0311	4	Ring, Piston Pin Retaining

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
14	ROD ASSEMBLY, CONNECTING		
	114-0225	2	Standard
	114-0225-10	2	.010 ″ Undersize
	114-0225-20	2	.020 ″ Undersize
	114-0225-30	2	.030 ″ Undersize
15	RING SET; PISTON		
	113-0159	2	Standard
	113-0159-05	2	.005 ″ Oversize
	113-0159-10	2	.010 ″ Oversize
	113-0159-20	2	.020 ″ Oversize
	113-0159-30	2	.030 ″ Oversize
	113-0159-40	2	.040 ″ Oversize
16	114-0228	4	Bolt, Connecting Rod (Special)
17	526-0017	1	Washer (7/16 ″) - Flywheel Mounting
18	870-0137	4	Nut, Locking - Connecting Rod Cap
19	850-0055	1	Washer, Lock (7/16 ″) - Flywheel Mounting
21	104-0170	1	Screw, Hex Cap (7/16-14 x 4 ″) - Flywheel Mounting
23	518-0014	1	Lock, Crankshaft Gear Washer
24	104-0043	1	Washer, Crankshaft Gear Retaining
25	104-0849	1	Crankshaft

FUEL SYSTEM GROUP



REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
2	142-0531	1	Carburetor Assembly (See Separate Group for Components)
3	145-0438	1	Gasket, Carburetor
4	154-1468	1	Manifold, Intake
5	154-1446	2	Gasket, Intake Manifold
6	520-0758	4	Stud (5/16-18 x 2-1/2 ″)
7	140-1198	1	Support, Air Cleaner
8	862-0015	4	Nut (5/16-18)
9	149-1299	1	Tube, Vacuum
10	503-0644	1	Hose, Vacuum
11	140-1215	1	Gasket, Air Cleaner
12	140-1214	1	Housing, Air Cleaner
13	140-1055	1	Element, Air Cleaner
14	140-1168	1	Cover, Air Cleaner Housing
15	865-0020	1	Nut, Wing (1/4-20)
16	505-0086	1	Nipple, Short (1 x 2-1/2 ″)
17	800-0008	2	Screw (1/4-20 x 1-1/4 ″)
18	850-0040	2	Washer, Lock (1/4 ″)
19	850-0045	4	Washer, Lock (5/16 ″)
20	815-0377	3	Screw, Round Head (10-32 x 3/8 ″)
21	503-0301	3	Clamp, Hose (7/16 ″)
22	149-1308	1	Spring, Vacuum Hose Support
23	149-1321	1	Cap, Fuel Fitting
24	518-0328	2	Clip, Cable
25	403-1021	1	Lifting Bracket
26	800-0003	1	Screw (1/4-20 x 1/2 ″)
27	862-0001	1	Nut (1/4-20)
28	853-0013	1	Washer, (1/4 ″) Shakeproof ET
29	123-1176	1	Tube, Breather
30	505-0041	2	Elbow, Exhaust (1 ″ x 90°)
31	505-0004	2	Nipple, Exhaust Close (1 ″ x 1/2 ″)
32	503-0652	1	Line, Fuel
33	332-1554	1	Clamp, Fuel Line (Insulated)
34	155-0484	2	Muffler



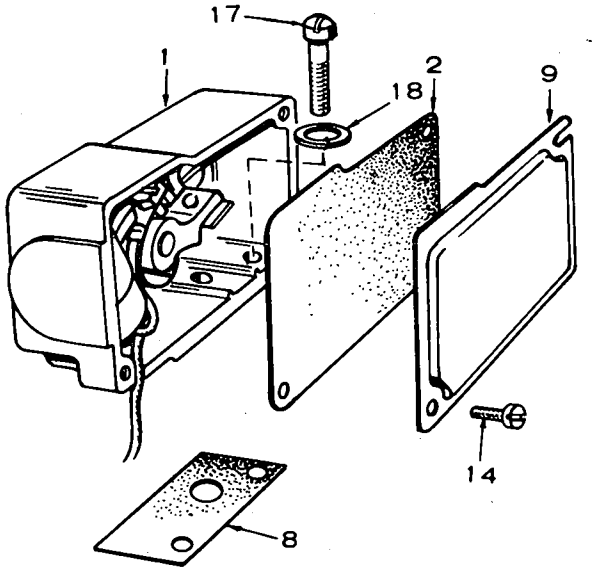
CARBURETOR PARTS GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	142-0531	1	Carburetor Assembly, Complete
1	142-0532	1	Body Assembly, Lower
2	142-0533	1	Sleeve
3	142-0534	1	* Shaft Assembly, Throttle
4	142-0535	1	**Packing, Shaft
5	142-0536	1	Shaft Assembly, Choke
6	142-0537	1	*Plate Assembly, Valve
7	142-0538	1	Fly, Throttle
8	142-0064	1	Screw, Throttle Adjusting
9	142-0334	4	*Screw, Fly
10	142-0539	4	Screw, Bowl Cover
11	142-0540	2	Screw, Fuel Pump
12	142-0541	1	**Gasket, Cover to Valve
13	142-0542	1	**Gasket, Pump Body
14	142-0543	1	**Gasket, Body
15	142-0555	1	*Diaphragm, Fuel Pump
16	142-0544	1	Spring, Throttle Adjusting
17	142-0282	1	*Spring, Idle Needle

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
18	142-0545	1	*Spring, Pump Diaphragm
19	142-0546	1	Fly, Choke
20	142-0547	1	Float and Lever Assembly
21	142-0548	1	*Shaft, Float Lever
22	142-0016	1	*Idle Needle
23	142-0549	1	Power Needle Assembly
24	142-0550	1	O-Ring
25	142-0551	1	Cover, Fuel Pump
26	142-0552	1	*Plate, Fuel Pump Spring
27	142-0553	1	*Valve Assembly, Float
28	142-0554	1	Clip, Float Valve
	142-0556	1	*Gasket Set (Includes parts marked **)
	142-0557	1	Repair Kit (Includes parts marked *)

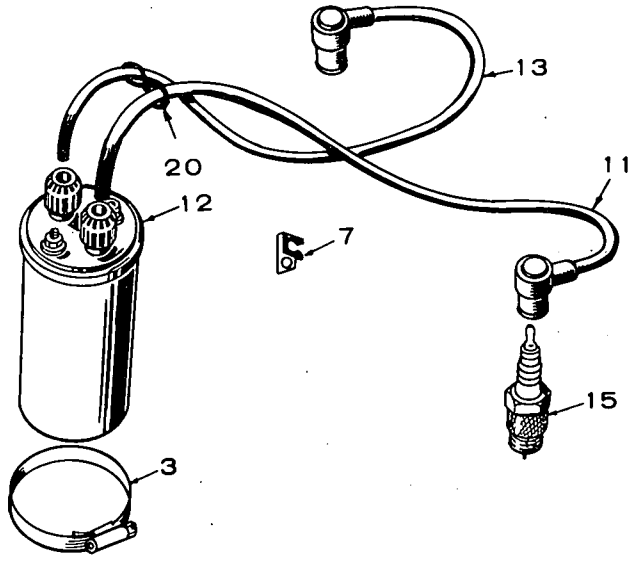
* - Included in the 142-0557 Repair Kit.
** - Included in the 142-0556 Gasket Set.

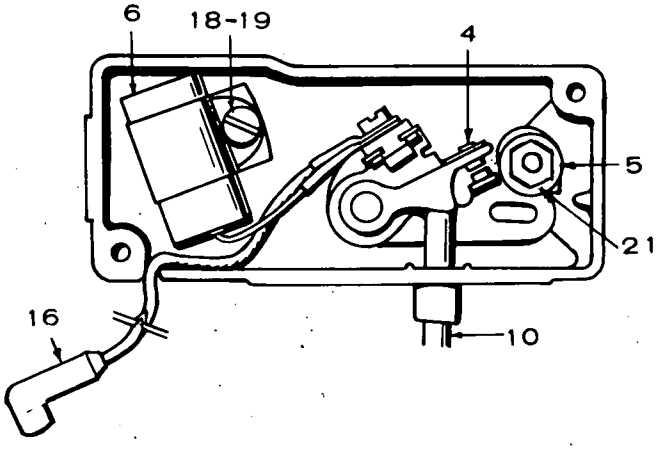
IGNITION GROUP



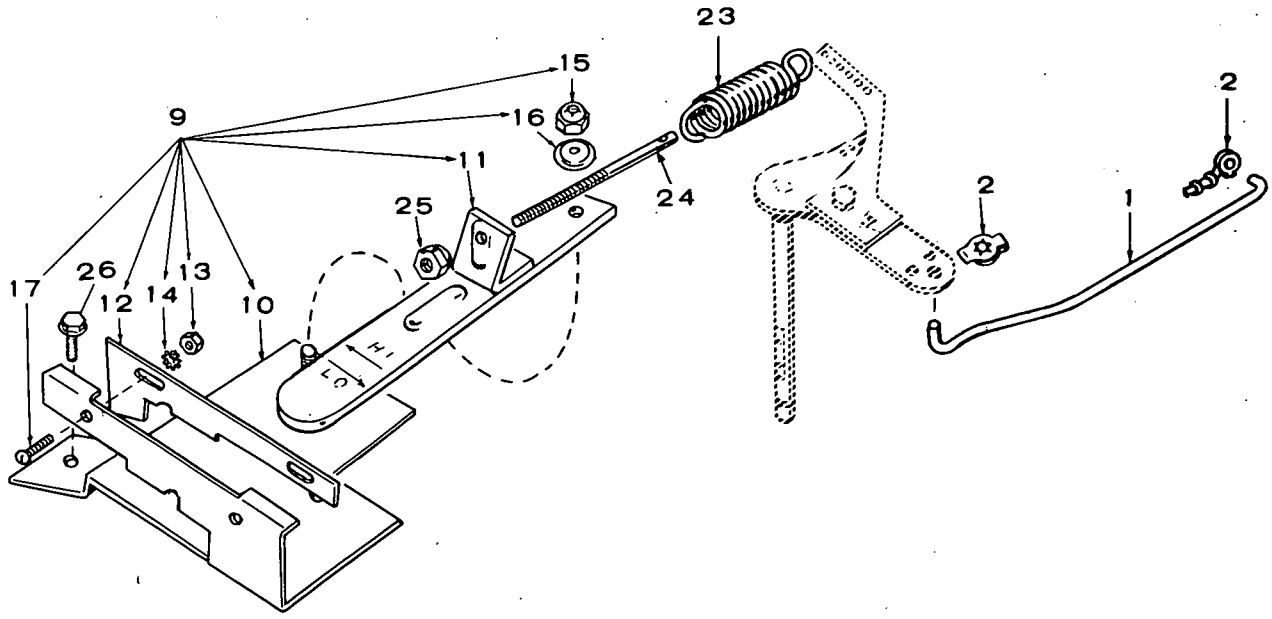
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	160-1155	1	Box Assembly, Breaker (Includes Parts Marked *)
2	160-1148	1	Gasket, Breaker Box Cover
3	503-0365	1	Clamp, Coil Mounting
4	160-1154	1	*Point Set, Breaker
5	815-0046	1	*Screw, Pan Head (8-32 x 3/8 ″) - Point Set
6	312-0069	1	*Condenser, Breaker Points
7	167-0188	1	Clip, Spark Plug Cables
8	160-1150	1	Gasket, Breaker Box Mounting
9	160-1149	1	Cover, Breaker Box
10	160-1151	1	Plunger
11	167-1462	1	Cable, Spark Plug (16-3/4 ″)
12	166-0535	1	Coil, Ignition
13	167-1463	1	Cable, Spark Plug (19 ″)
14	815-0352	2	Screw, Pan Head (8-32 x 3/8 ″) - Breaker Box Cover Mounting
15	167-0241	2	Plug, Spark
16	336-2132	1	*Lead Assembly, Points to Coil
17	815-0373	2	Screw (1/4-20 x 5/8 ″) - Breaker Box Mounting
18	WASHER, LOCK		
	850-0040	2	Breaker Box Mounting (1/4 ″)
	850-0025	1	*Breaker Points and Condenser Mounting (#8)
19	815-0358	1	*Screw, Pan Head (8-32 x 3/8 ″) - Condenser Mounting
20	509-0035	1	"O" Ring (11/16 O.D.) - Spark Plug Cables
21	870-0221	1	*Nut (#8) - Point Set Mounting

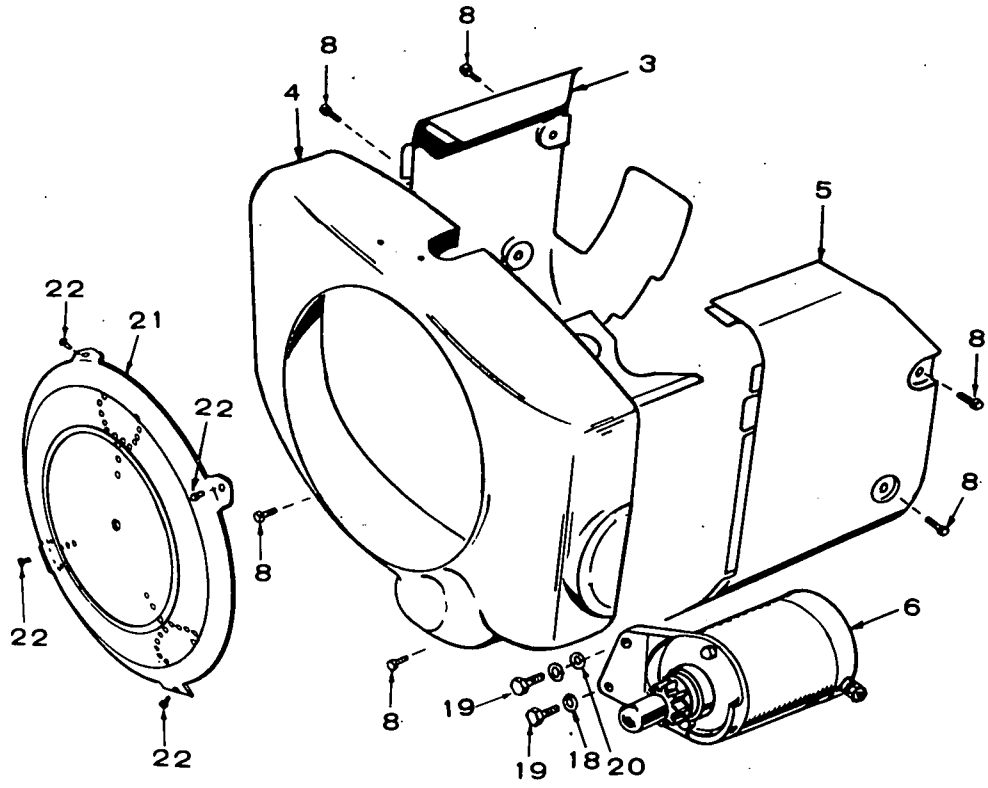
* - Included in Breaker Box Assembly.





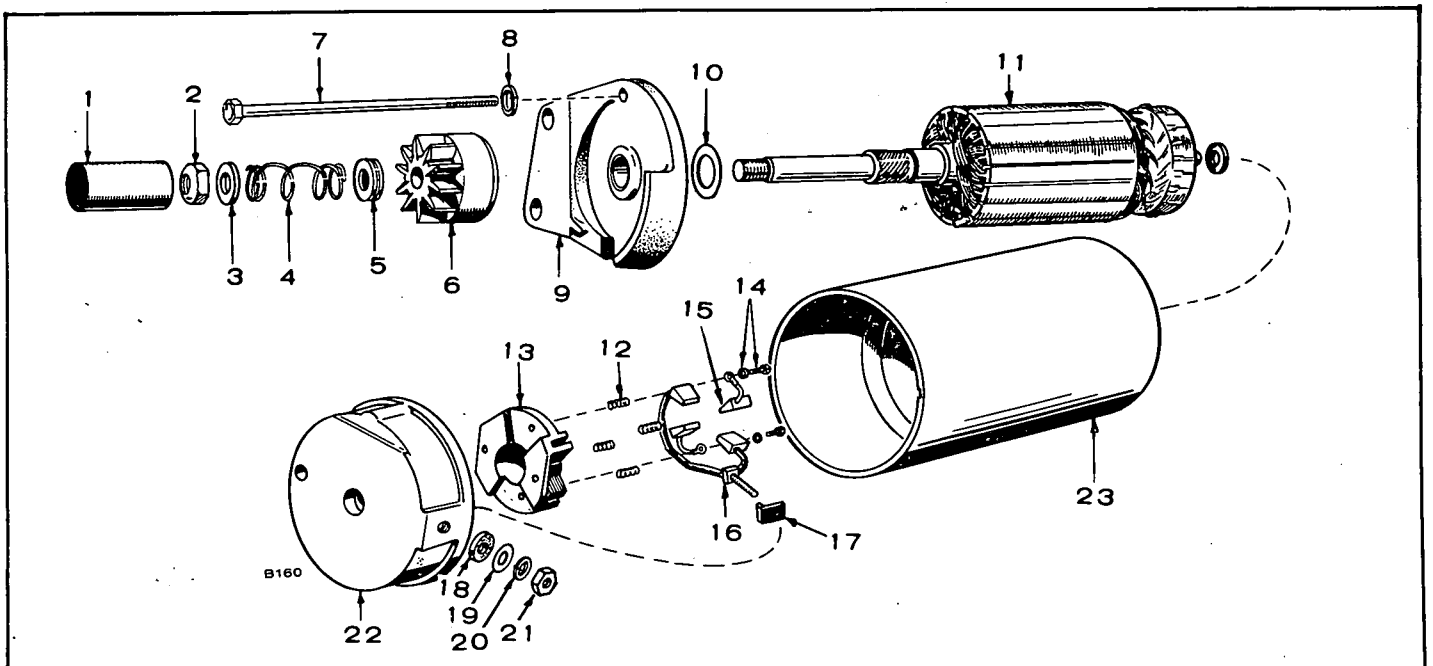
GOVERNOR, STARTER AND BLOWER HOUSING GROUP





REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	150-1350	1	Rod, Governor Control
2	CLIP, GOVERNOR CONTROL ROD		
	518-0004	1	Carburetor End
	870-0278	1	Governor End
3	134-2382	1	Housing, Cylinder Air - Left
4	134-2708	1	Housing, Blower
5	134-2675	1	Housing, Cylinder Air - Right
6	191-0933	1	Motor, Starting - See Separate Group for Components
8	SCREW, HEX HEAD (1/4-20 x 7/16 ″)		
	815-0261	3	Blower Housing Mounting
	815-0261	4	Cylinder Air Housing Mtg.
9	152-0127	1	Control Assembly, Speed (Includes Parts Marked *)
10	152-0143	1	*Bracket, Variable Speed Governor
11	152-0134	1	*Lever, Adjusting
12	152-0110	1	*Plate, Adjusting
13	860-0008	2	*Nut (#8-32)
14	853-0005	2	*Washer, Shakeproof ET (#8)
15	870-0065	1	*Nut, Lock (1/4-20)
16	152-0041	2	*Washer, Tension
17	812-0077	2	*Screw (8-32 x 3/8 ″), Round Head - Speed Control
18	850-0045	2	Washer (5/16 ″), Lock - Starting Motor Mounting
19	800-0028	2	Screw (5/16-18 x 1 ″) - Starter Motor Mounting
20	526-0113	1	Washer (5/16 ″) - Starter Motor Mounting (Top Hole)
21	134-2606	1	Guard, Screen
22	815-0378	4	Screw, Hex Cap W/Lockwasher (#14 x 1/2 ″)
23	150-0098	1	Spring Governor
24	150-1023	1	Stud, Governor Adjusting
25	870-0200	1	Nut, Governor Adjusting (10-32)
26	821-0009	1	Screw, Lock (1/4-20 x 3/8 ″)

* - Included in Speed Control Assembly.



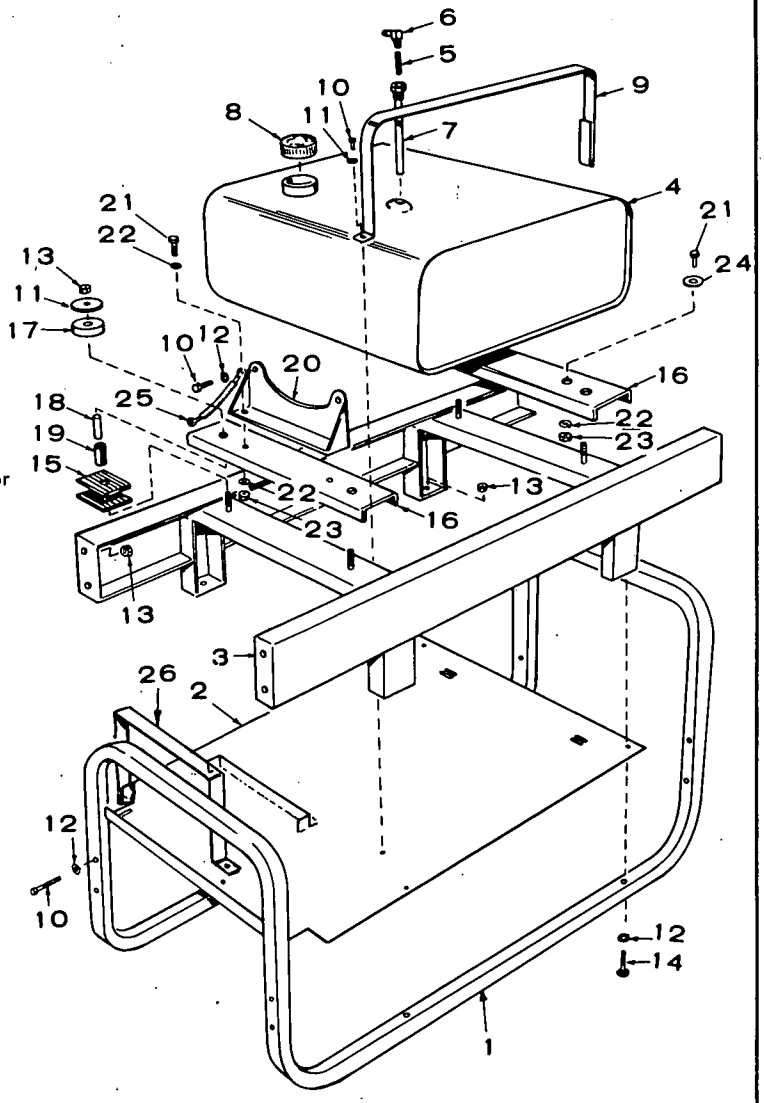
STARTING MOTOR PARTS GROUP

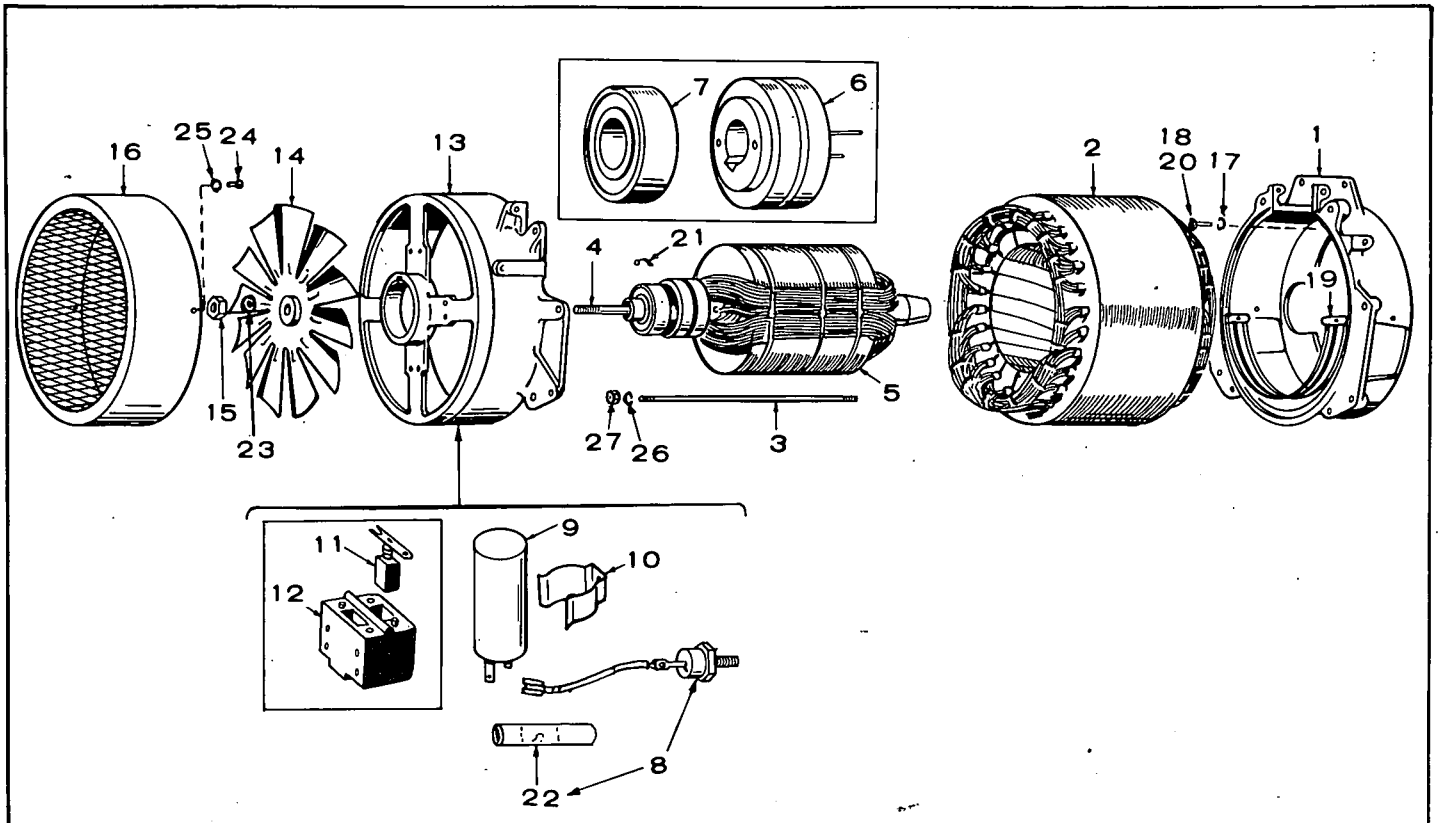
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	191-0933	1	Motor, Starting (Complete)
1	191-1034	1	Cover, Dust
2	191-1045	1	Nut, Stop
3	191-1046	1	Washer, Stop Nut
4	191-1035	1	Spring, Anti-drift
5	191-1047	1	Spacer, Dust Cover
6	191-1036	1	Drive Assembly
7	191-1048	2	Screw, Hex Cap - Starter Through
8	850-0040	2	Washer, Lock
9	191-1037	1	Cap Assembly, Drive End
10	191-1038	1	Washer, Armature Thrust
11	191-1039	1	Armature
12	★	4	+*Spring, Brush
13	★	1	+Brush Holder
14	★	2	+Screw and Lockwasher - Brush and Brush Holder Mounting
15	★	2	+*Brush, Ground
16	★	1	+*Stud and Brush Assembly, Input
17	★	1	+Bushing, Insulation - Input Stud
18	★	1	+Washer, Insulation - Input Stud
19	★	1	+Washer, Flat - Input Stud
20	★	1	+Washer, Lock - Input Stud
21	★	1	+Nut, Securing - Input Stud
22	191-1040	1	Cap Assembly, Commutator (Includes parts marked +)
23	★	1	Housing, Starter Motor
	191-1041	1	Repair Kit, Brush, Spring and Stud (Includes parts marked *)

+ - Included in the 191-1040 Cap Assembly.
* - Included in the 191-1041 Brush, Spring and Stud Kit.
★ - Not Sold Separately.

CARRYING FRAME AND MOUNTING GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	403-1052	1	Frame, Carrying
2	403-1056	1	Pan, Fuel Tank & Battery
3	403-1055	1	Support, Frame
4	159-1015	1	Tank, Fuel (5.5 Gallon)
5	149-0072	1	Screen, Fuel Strainer
6	502-0313	1	Elbow
7	159-1018	1	Tube Assembly, Pick-Up
8	159-0007	1	Cap, Fuel Tank
9	403-1057	2	Band, Fuel Tank
10	SCREW, HEX HEAD		
	800-0031	8	(5/16-18 x 1-1/2 ″) - Frame Support Mounting
	815-0335	2	(#10 x 1/2 ″) - Fuel Tank Pan Mounting
	800-0005	2	(1/4-20 x 3/4 ″) - Fuel Tank Band
	800-0026	2	(5/16-18 x 3/4 ″) - Generator Support Bracket
11	WASHER		
	526-0021	2	(1/4 ″) - Fuel Tank Band
	526-0076	4	(5/16 ″) - Support Channel Mounting
12	WASHER, LOCK		
	850-0046	12	(5/16 ″) - Frame Support Mounting
	850-0046	2	(5/16 ″) - Generator Support Bracket
13	NUT, HEX		
	862-0015	12	(5/16-18) - Frame Support Mounting
	870-0048	4	(5/16-18) - Support Channel Mounting
14	816-0102	4	Bolt (5/16-18 x 1-1/2 ″), Carriage - Frame Support Mounting
15	402-0192	8	Cushion, Square Rubber
16	403-1059	2	Channel, Support
17	402-0131	4	Cushion, Round Rubber
18	402-0424	4	Spacer, Shock Mounting
19	402-0423	4	Sleeve, Shock Mounting
20	403-1060	1	Bracket, Generator Support
21	SCREW, MOUNTING		
	800-0048	2	(3/8-16 x 3/4 ″) - Generator End
	800-0051	2	(3/8-16 x 1-1/4 ″) - Engine End
22	850-0048	4	Washer (3/8 ″), Lock
23	862-0003	4	Nut (3/8-16)
24	526-0250	2	Washer (3/8 ″ I.D. x 1 ″ O.D.) Engine Mounting
25	337-0094	1	Strap, Ground
26	416-0651	1	Band, Battery Hold-Down

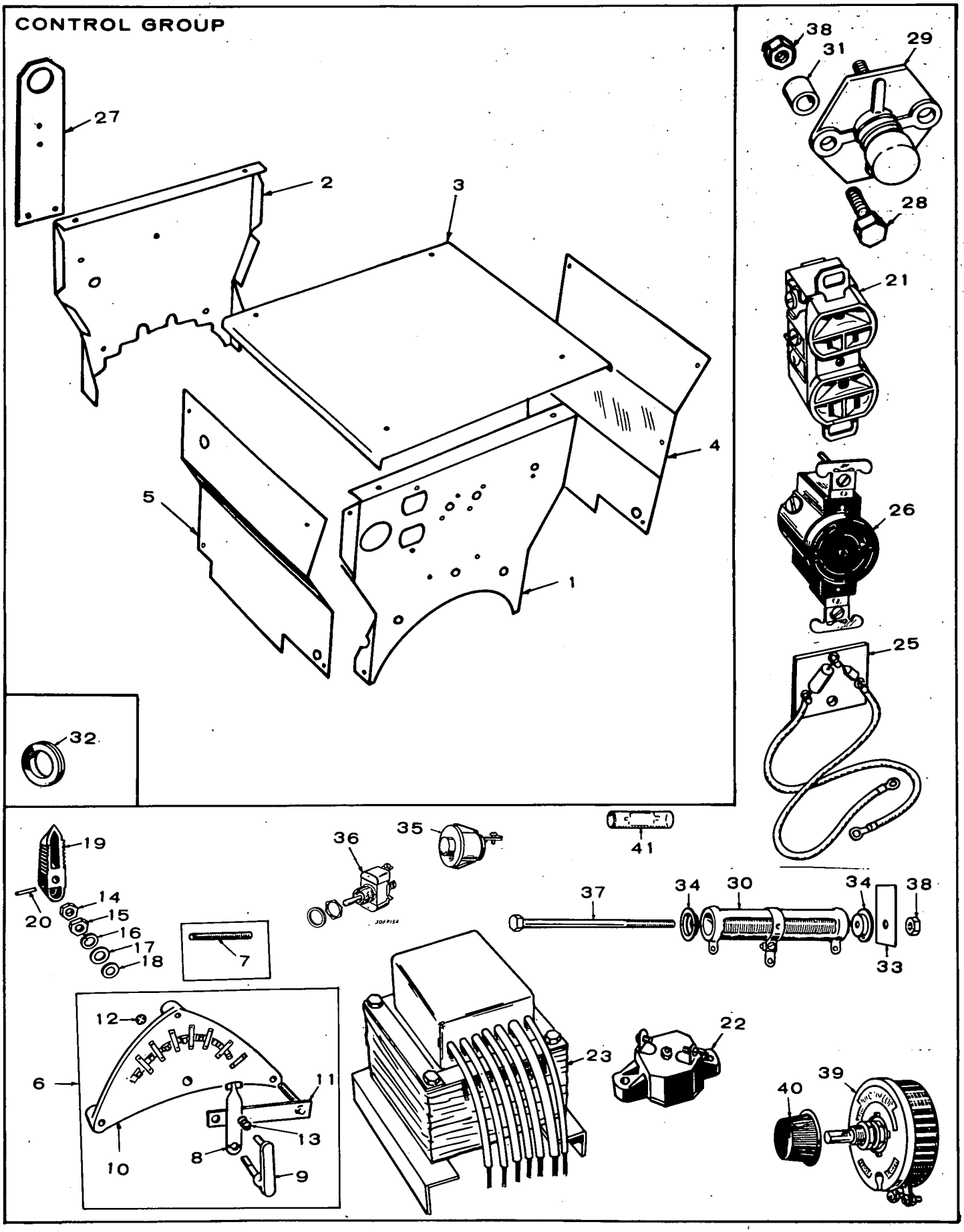




GENERATOR GROUP

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	231-0176	1	Adapter, Generator to Engine
2	STATOR, WOUND		
	220-1500	1	120 Volt AC
	220-1501	1	120/240 Volt AC
3	520-0706	4	Stud, Generator Through
4	520-0705	1	Stud, Rotor Through
5	201-1625	1	Rotor, Wound
6	204-0109	1	Ring, Collector
7	510-0047	1	Bearing, Rotor (Double Sealed and Pre-lubricated)
8	305-0492	3	Rectifier Assembly (Includes Connector)
9	356-0035	2	Capacitor
10	518-0271	2	Clip, Capacitor Mounting
11	214-0059	2	Brush, Generator
12	212-1064	1	Holder, Brush
13	211-0182	1	Bell, End
14	205-0083	1	Fan, Alternator
15	870-0203	1	Nut, Rotor Through Stud
16	234-0305	1	Cover, Fan
17	850-0050	4	Washer (3/8 ″), Lock - Adapter Mounting
18	800-0050	4	Screw (3/8-16 x 1 ″) - Adapter Mounting
19	232-2131	1	Guard, Generator Adapter
20	821-0010	2	Screw (1/4-20 x 1/2 ″) - Guard Mounting
21	232-0596	1	Clip, Bearing Stop
22	332-0556	3	Connector
23	850-0055	1	Washer (7/16 ″), Lock
24	812-0148	2	Screw (1/4-20 x 1/2 ″), Round Head - Fan Cover Mounting
25	850-0040	2	Washer (1/4 ″), Lock
26	850-0045	4	Washer (5/16 ″), Lock
27	862-0015	4	Nut (5/16-18)

CONTROL GROUP



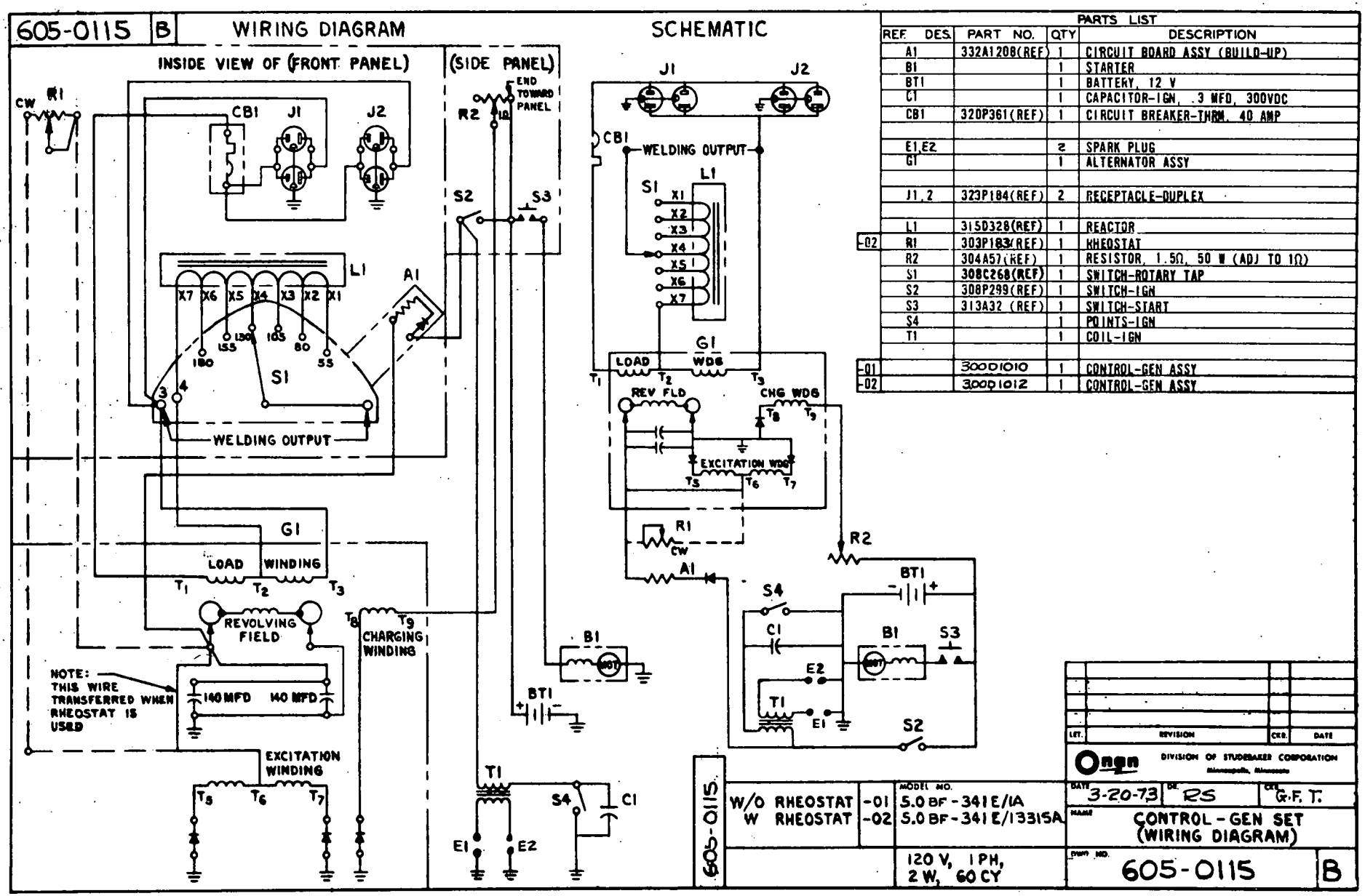
REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
1	PANEL, CONTROL BOX - FRONT		
	301-3367	1	Units with 120 Volt AC, Without Rheostat
	301-3365	1	Units with 120 Volt AC, With Optional Rheostat
	301-3366	1	Units with 120/240 Volt AC, Without Rheostat
	301-3363	1	Units with 120/240 Volt AC, With Optional Rheostat
2	301-3677	1	Panel, Control Box - Rear
3	301-3361	1	Panel, Control Box - Top
4	301-3358	1	Panel, Control Box - Left Side
5	301-3360	1	Panel, Control Box - Right Side
6	308-0268	1	Switch, Rotary Tap (Includes Parts Marked *)
7	308-0283	1	Stud, Ground
8	308-0265	1	*Blade, Rotary Tap Switch
9	308-0261	1	*Arm, Rotary Tap Switch
10	308-0287	1	*Plate, Rotary Tap Switch
11	308-0267	1	*Jumper, Rotary Tap Switch
12	518-0283	1	*Ring, Grip - Rotary Tap Switch
13	308-0271	1	*Spring, Rotary Tap Switch
14	871-0028	2	Nut, Hex Brass - Jam (3/8-16) - Grounding Stud
15	871-0029	3	Nut, Hex Brass - Full (3/8-16) - Grounding Stud
16	850-0050	2	Washer, Lock (3/8) - Grounding Stud
17	526-0059	2	Washer, Flat - Brass - Grounding Stud
18	508-0150	2	Washer, Insulating - Grounding Stud
19	303-0165	1	Knob, Rotary Tap Switch
20	516-0178	1	Pin, Rotary Tap Switch Knob
21	RECEPTACLE, DUPLEX		
	323-0184	2	Units with 120 Volt AC
	323-0707	1	Units with 120/240 Volt AC
22	BREAKER, CIRCUIT		
	320-0361	1	40 Ampere
	320-0360	1	25 Ampere - Units with 120/240 Volt AC
23	315-0328	1	Reactor Assembly
25	332-1208	1	Board Assembly, Circuit
26	323-0856	1	Receptacle, Twistlock - Units With 120/240 Volt AC
27	403-0971	1	Bracket, Lifting
28	819-0089	2	Screw (1/4-20 x 1-1/4 ''), Pan Head - Start Switch Mounting
29	313-0032	1	Switch, Start
30	304-0051	1	Resistor, Adjustable
31	301-2404	2	Spacer, Start Switch Mounting
32	GROMMET, CONTROL BOX PANEL		
	508-0002	1	For 1/2 '' Hole
	508-0008	1	For 13/16 '' Hole
33	304-0292	1	Insulator, Resistor Mounting
34	304-0427	2	Washer, Centering - Resistor Mounting
36	308-0299	1	Switch, Stop
37	812-0165	1	Screw, Resistor Mounting
38	NUT, HEX		
	870-0232	3	(1/4-20) (1) Resistor Mounting (2) Start Switch Mounting
	870-0221	2	(#8 x 32) Resistor Mounting
39	303-0183	1	Rheostat (Optional)
40	303-0032	1	Knob, Rheostat (Optional)
41	332-0556	1	Connector, Lead (Units with Rheostat)
42	812-0075	2	Screw (8-32 x 1/4 ''), Round Head - Resistor Mounting

* - Parts included in the 308-0268 Rotary Tap Switch.

SERVICE KITS AND MISCELLANEOUS

NOTE: For other kits, refer to the group for the part in question.

REF. NO.	PART NO.	QTY. USED	PART DESCRIPTION
	168-0123	1	Gasket Kit, Carbon Removal
	168-0124	1	Gasket Kit, Engine
	522-0273	1	Overhaul Kit
	CABLE ACCESSORY KIT (Includes Cables, Clamps and Helmet)		
	316-0032	1	20 FOOT Cables
	316-0043	1	40 FOOT Cables



PARTS LIST				
REF. DES.	PART NO.	QTY	DESCRIPTION	
A1	332A1208(REF)	1	CIRCUIT BOARD ASSY (BUILD-UP)	
B1		1	STARTER	
BT1		1	BATTERY, 12 V	
C1		1	CAPACITOR-IGN, .3 MFD, 300VDC	
CB1	320P361(REF)	1	CIRCUIT BREAKER-THRM. 40 AMP	
E1,E2		2	SPARK PLUG	
G1		1	ALTERNATOR ASSY	
J1,2	323P184(REF)	2	RECEPTACLE-DUPLEX	
L1	315D328(REF)	1	REACTOR	
-02 R1	303P183(REF)	1	RHEOSTAT	
R2	304A57(REF)	1	RESISTOR, 1.5Ω, 50 W (ADJ TO 1Ω)	
S1	308C268(REF)	1	SWITCH-ROTARY TAP	
S2	308P299(REF)	1	SWITCH-IGN	
S3	313A32 (REF)	1	SWITCH-START	
S4		1	POINTS-IGN	
T1		1	COIL-IGN	
-01	300D1010	1	CONTROL-GEN ASSY	
-02	300D1012	1	CONTROL-GEN ASSY	

W/O RHEOSTAT	-01	MODEL NO. 5.0 BF-341E/1A	
W RHEOSTAT	-02	5.0 BF-341E/13315A	
605-0115		120 V, 1 PH, 2 W, 60 CY	

LET.	REVISION	CKD.	DATE

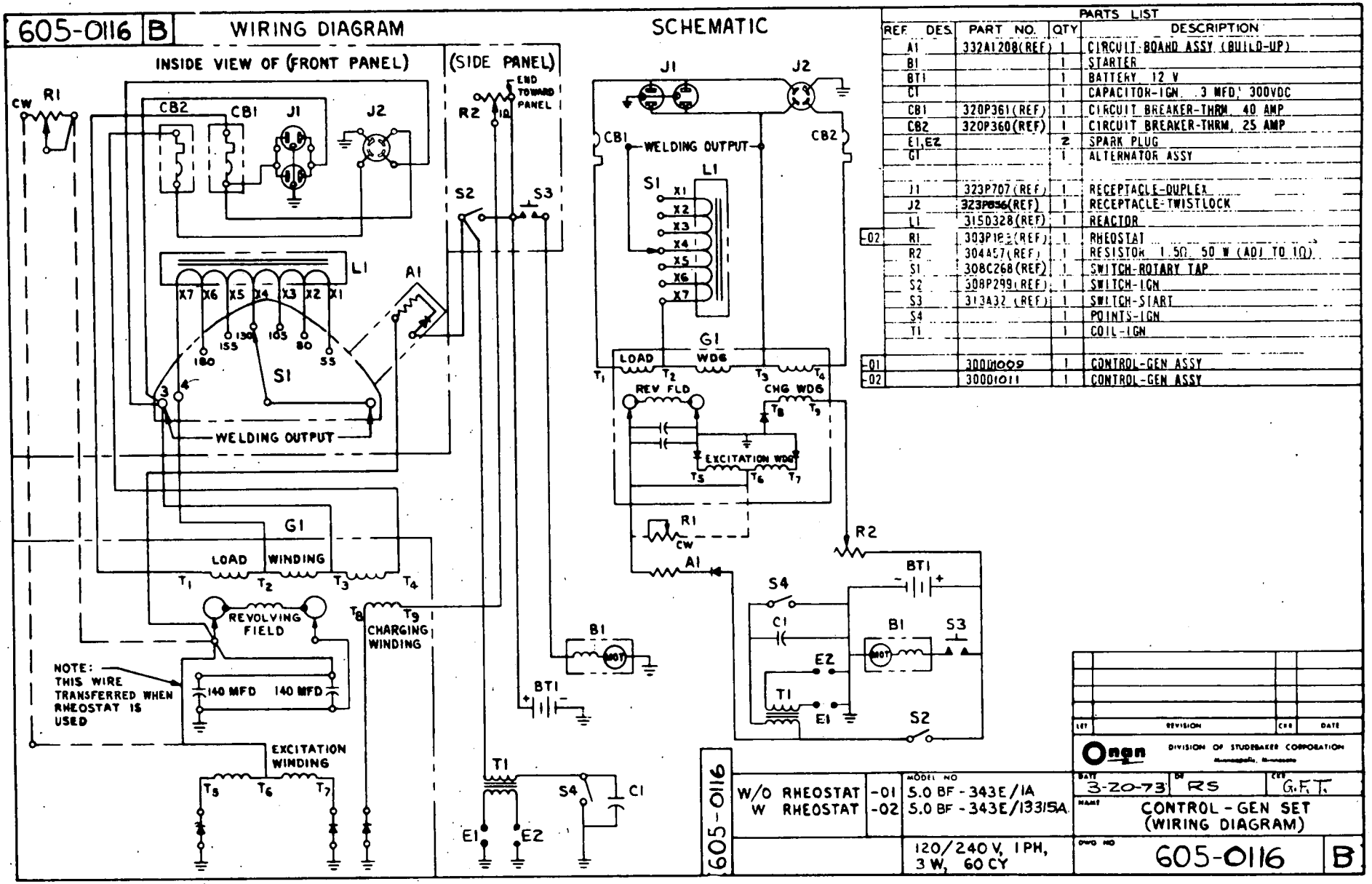
Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota

DATE 3-20-73 DR. RS CKD. G.F.T.

NAME CONTROL-GEN SET (WIRING DIAGRAM)

DWG NO. 605-0115 B

FORM 8A090



PARTS LIST

	REF. DES.	PART NO.	QTY	DESCRIPTION
	A1	332A1208(REF)	1	CIRCUIT BOARD ASSY (BUILD-UP)
	B1		1	STARTER
	BT1		1	BATTERY, 12 V
	C1		1	CAPACITOR-IGN. .3 MFD, 300VDC
	CB1	320P361(REF)	1	CIRCUIT BREAKER-THRM. 40 AMP
	CB2	320P360(REF)	1	CIRCUIT BREAKER-THRM. 25 AMP
	E1,E2		2	SPARK PLUG
	G1		1	ALTERNATOR ASSY
	J1	323P707(REF)	1	RECEPTACLE-DUPLEX
	J2	323P856(REF)	1	RECEPTACLE-TWISTLOCK
	L1	315D328(REF)	1	REACTOR
-02	R1	303P183(REF)	1	RHEOSTAT
	R2	304A57(REF)	1	RESISTOR 1.5Ω, 50 W (ADJ TO 10Ω)
	S1	308C268(REF)	1	SWITCH-ROTARY TAP
	S2	308P299(REF)	1	SWITCH-IGN
	S3	313A32 (REF)	1	SWITCH-START
	S4		1	POINTS-IGN
	T1		1	COIL-IGN
-01		300M1009	1	CONTROL-GEN ASSY
-02		300D1011	1	CONTROL-GEN ASSY

LET	REVISION	CHK	DATE

Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota

W/O RHEOSTAT	-01	MODEL NO 5.0 BF-343E/1A	DATE 3-20-73 BY RS CHK G.F.T.
W RHEOSTAT	-02	5.0 BF-343E/133/5A	NAME CONTROL-GEN SET (WIRING DIAGRAM)
		120/240 V, 1PH, 3 W, 60 CY	DWG NO 605-0116 B

605-0116

CUSTOMER SERVICES

OWNER'S WARRANTY SERVICE - ENGINE DRIVEN ELECTRIC GENERATOR SETS, SEPARATE GENERATORS, INDUSTRIAL ENGINES

QUALITY OF PRODUCT

Onan products are engineered and designed to perform as stated on product nameplate and published specification. With proper installation and operation, regular maintenance and periodic repair service, the equipment will provide reliable service.

GENERAL WARRANTY PRACTICES

All Onan-manufactured engine-driven electric generator sets, separate generators, and industrial engines are sold with a full one-year warranty. This warranty is issued only to the original user and promises satisfactory performance of the product when properly installed, serviced, and operated under normal conditions, according to the manufacturer's instructions. The text of the Onan published warranty appears in the Onan Operator's Manual sent with the product.

Warranty Registration: A Warranty Registration card accompanies each Onan Product. This card must be properly filled out and returned to the Onan Factory in order to qualify for warranty consideration as covered in this bulletin. When requesting warranty repair work you must provide the purchase date, Onan model, and serial number of the equipment.

Warranty Authorization: Warranty service must be performed by Onan Factory or Onan Authorized Distributors or their Approved and Registered Service Dealers. A complete listing of these Onan Authorized Parts and Service Centers is provided in our brochure F-115, a copy of which is supplied with each Onan Product. These Onan Authorized Service Centers have trained service personnel, parts stock, and the necessary facilities and tools for the service and repair of Onan equipment.

Material Allowances: Onan will allow credit or furnish free of charge to the Onan Authorized Service Station or his Approved Service Dealer, all genuine Onan parts used in a warranty repair of these products which fail to perform as warranted.

Labor Allowance: Onan will allow warranty repair credit to the Onan Authorized Parts and Service Center and his Approved Dealer at straight time labor when the cause of failure is determined to be defective material or factory workmanship. This labor allowance will be based on the factory's standard time schedule of published flat rate labor allowances, or, otherwise a time judged reasonable by the factory. Repair work not covered by warranty will be charged to the owner. The Onan's Warranty practice does not provide for allowance of expenses such as start-up charges, communication charges, transportation charges, travel time and/or mileage, unit removal or installation expense, cost of fuel, oil, normal maintenance adjustments, tune-up adjustments or parts maintenance items, and does not cover incidental or consequential damages.

Administration: Warranty of Onan Products is administered through Onan Authorized Distributors in whose territory the equipment is located. These Distributors and their Approved or Registered Onan Service Dealers are authorized to make settlement of all customer warranty claims within the limits of the manufacturer's warranty policy as described herein.

Onan reserves the right to change warranty practices without prior notice.

MAINTENANCE

A Planned Preventive Maintenance Program is extremely important if you are to receive efficient operation and long service life from your Onan unit. Neglecting routine maintenance can result in premature failure or permanent damage to your equipment. The Onan Operator's Manual sent with the product contains recommended maintenance schedules and procedures.

Maintenance is divided into two categories:

1. Operator Maintenance . . . . . performed by the operator.
2. Critical Maintenance . . . . . performed only by qualified service personnel.

Regular maintenance will help you avoid sudden and costly repairs in the future. Adequate evidence of this scheduled maintenance must be offered when applying for a warranty claim.

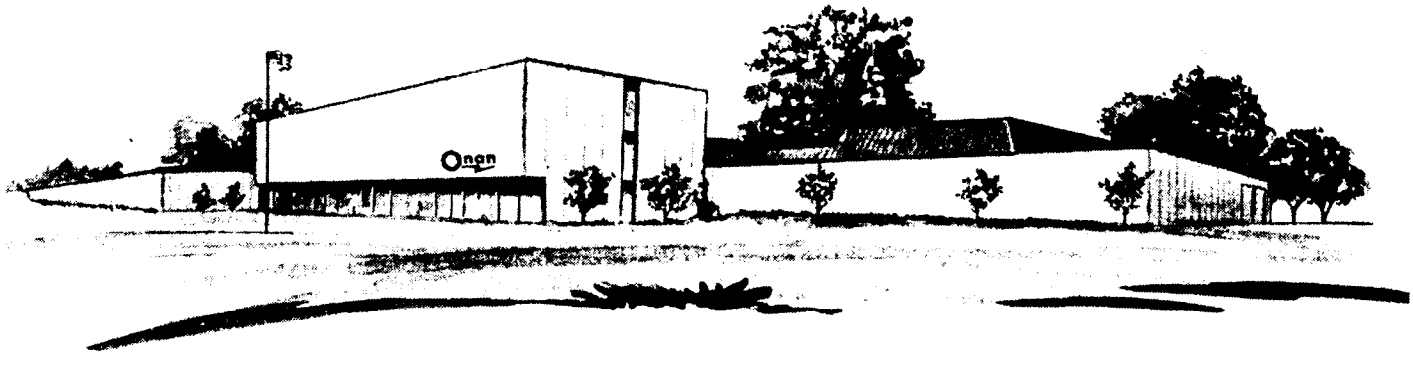
INSTALLATION

Installation is extremely important and all Onan Products should be installed in accordance with the manufacturer's recommendations. If the owner experiences any difficulty with such items as mounting, ventilation, exhaust location, fuel lines, wiring, etc., he should immediately contact the company from whom he purchased the equipment so that corrective action can be taken. Although the Onan Authorized Distributor and his Approved or Registered Service Dealers may be able to remedy certain installation difficulties, such repair work is not considered Onan warranty and there will be a charge for this service.

Onan

Minneapolis, Minnesota 55432

MSS-22B
Replaces 23B054 and MSS-22A
Rev. 7-2-73



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