SERVICE MANUAL

FOR

ONAN ELECTRIC GENERATING PLANTS

SERIES

MJA
MJB
MJC

Onan

968-500

Price $1.00

DIVISION OF
STUDEBAKER CORPORATION
2515 University Avenue S.E.,
Minneapolis 14, Minnesota

Printed U.S.A.

Important !

ALWAYS give these numbers when ordering repair parts or requesting service information for your unit !

MODEL AND SPEC.NO.

SERIAL NO.

Write in numbers shown on plant nameplate.

INTRODUCTION

This manual contains information for proper maintenance, servicing and overhaul of MJA, MJB, and MJC series electric generating plants. It doesn't include installation and operation instructions. Unless otherwise stated, these instructions apply to all standard plants of the MJA, MJB, and MJC series. Some details may not apply to special models with modification specified by the purchaser. However, by using the instructions and recommendations given in this manual as a general guide, the MJA, MJB, or MJC generating plant can be properly maintained and repaired.

You will, of course, be using this manual primarily for reference when servicing MJA, MJB, and MJC generating plants. This is what it was designed for. But, in addition, ONAN recommends that you study the whole manual. It will help to acquaint you with the plants you'll be working on and save time later on in servicing.

If possible, use a parts catalog with the service manual. The parts catalog will give you a good picture of assembly and disassembly and help identify plant components. Since the first and most important part of repair work is correct diagnosis of the trouble, trouble-shooting charts are included throughout this manual to aid diagnosis. Because of the variety of engines, generators, and controls discussed in this manual, some sections don't apply to all models. If a section or paragraph applies only to certain models, this is stated at the beginning of the section. Check this before beginning repair.

Throughout this manual, the flywheel end of the engine will be called the "Front" and the fuel pump side designated the "Left Side".

ONAN MODEL NUMBERING SYSTEM

TYPICAL MODEL: 5MJB-1R/96B

MODEL- 5 MJB-1 R / 96 B

SEE NOTE- 1 2 3 4 5 6 7

NOTE

1 - Plant Capacity in Kilowatts - For Example: 3 - 3KW
305 - 3.5KW
5 - 5KW

2 - Plant Series

3 -

60 Cycle Code	Electrical Output Volts	Phase	No. of Wires
1	120	1	2
2	240	1	2
3*	120/240	1	3
4	120/208	1	3
5	240	3	3
5D (delta)	120/240	3	4

50 added to code designates 50 cycle i.e. 1 becomes 51.

4 - Type of Starting — R - Remote E - Electric M - Manual

5 - Diagonal Line - Separates Basic Model from Specification Number and Letter.

6 - Specification Number - Denotes Customer Requested Deviations from Standard Model.

7 - Specification Letter - Advances with ONAN changes.

* - 5 MJB -- Some models have generators reconnectible for either code 1, 2, or 3; these models are designated 3C.
- 705 MJB & MJC -- All Code 3 models are reconnectible for either code 1, 2, or 3. See the plant operators manual.

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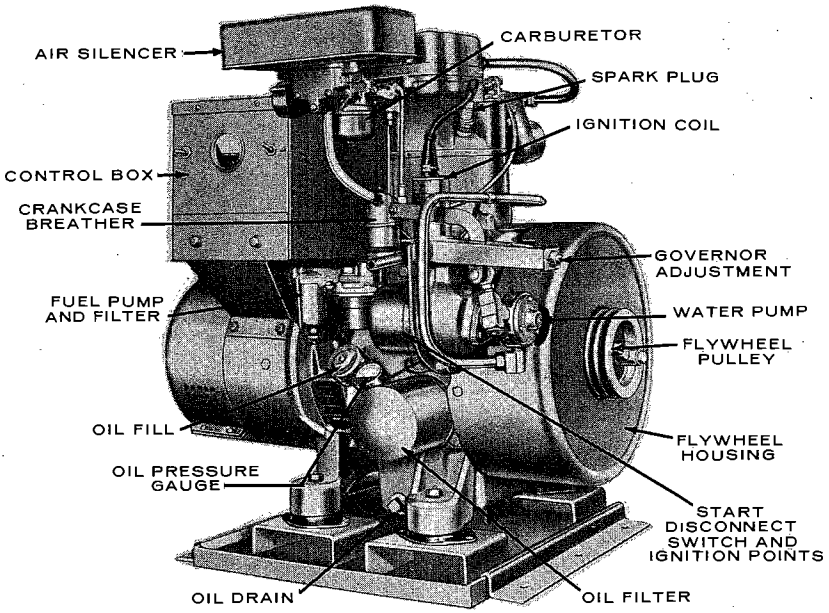
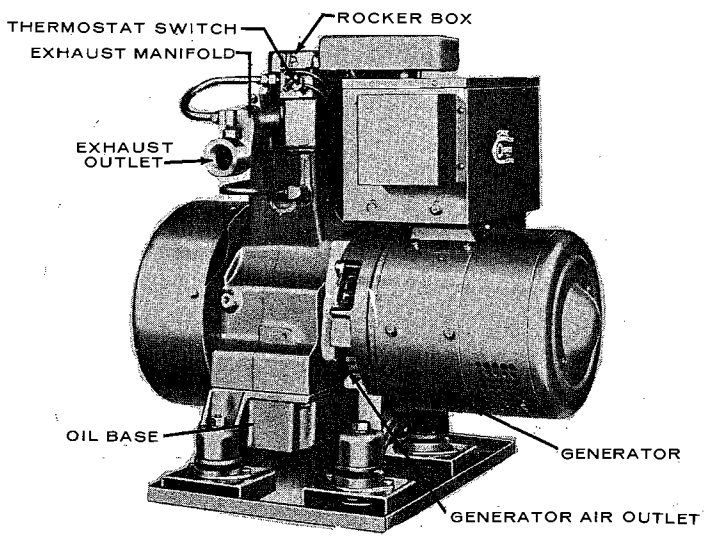


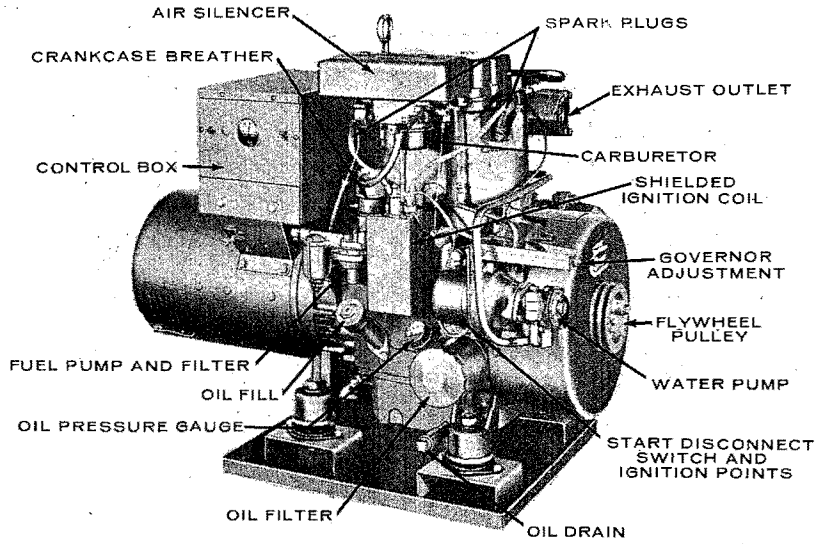
EARLY MODEL

MODEL MJA-LEFT FRONT VIEW



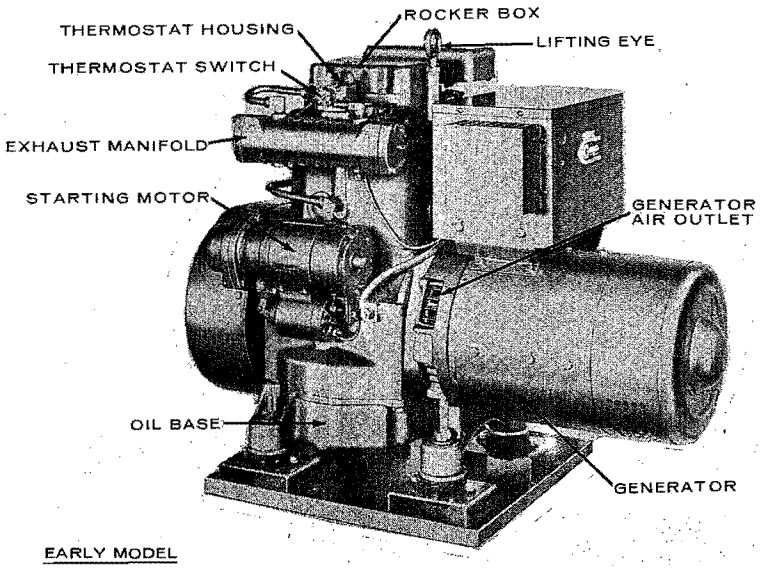
EARLY MODEL

MODEL MJA-RIGHT REAR VIEW



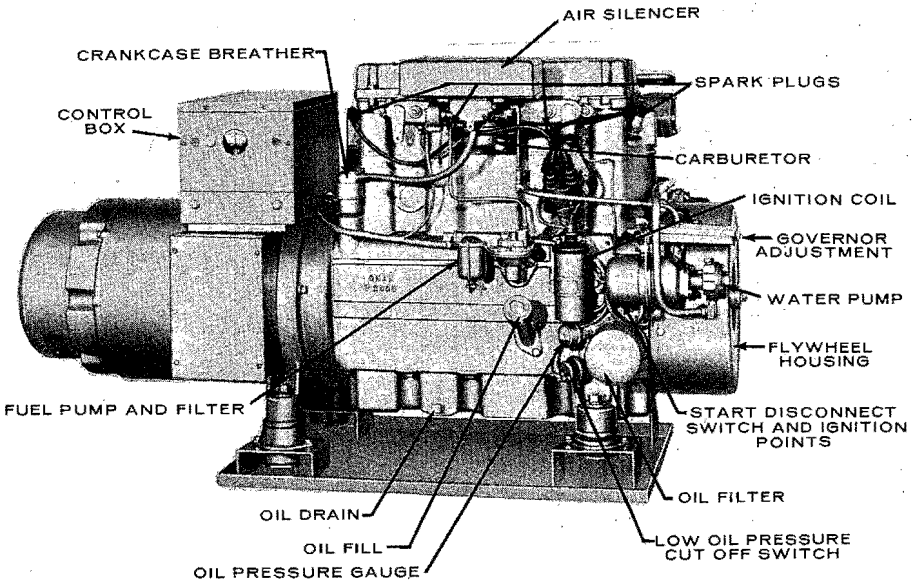
EARLY MODEL

MODEL MJB-LEFT FRONT VIEW



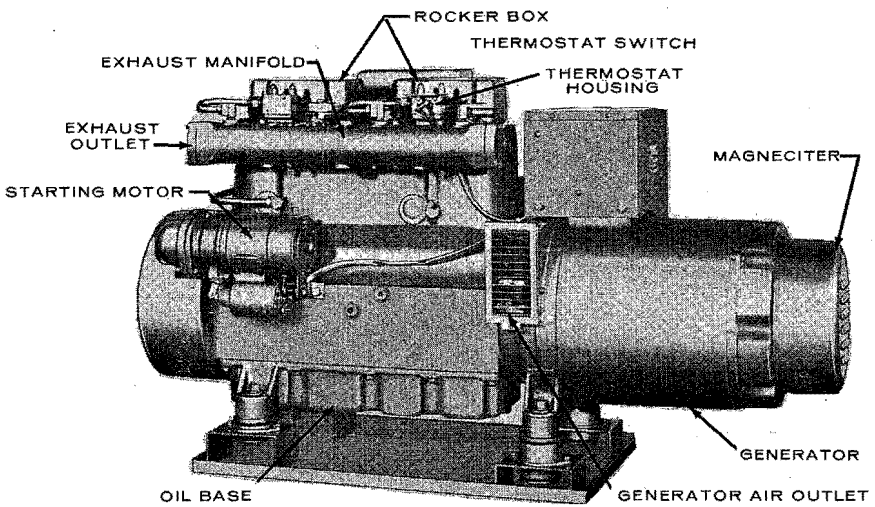
EARLY MODEL

MODEL MJB- RIGHT REAR VIEW



EARLY MODEL

MODEL MJC- LEFT SIDE VIEW



EARLY MODEL

MODEL MJC- RIGHT SIDE VIEW

2. PERIODIC SERVICE CHART

Use the following chart as a guide to servicing requirements. Remember, neglect of routine servicing could cause plant failure when it's urgently needed.

The chart is based on units operating under favorable conditions - proper installation, recommended fuel and oil normal load... If the operating conditions are unfavorable, adjust the service periods accordingly.

PERIODIC SERVICE CHART

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS						SEE SECTION
	8	100	200	500	1000	5000	
Inspect Plant Generally	x						
Check Fuel Supply	x						3.2.1
Check Oil Level	x						3.5.1
Clean Governor Linkage		x†					3.4.1
Service Air Cleaner (Silencer)			x†				3.2.6
Change Crankcase Oil		*	x				3.5.1
Clean Crankcase Breather			x				3.5.7
Clean and Adjust Spark Plugs			x				3.3.5
Check Breaker Points			x				3.3.2 3.3.3 3.3.4
Check Battery Electrolyte Level			x				
Empty Fuel Sediment Bowl			x				3.2.2
Check Valve Clearance	•			x			
Inspect Generator Brushes				x			4.2.1 5.1.1
Inspect Water Pump Impeller (Neoprene)				x			3.1.1 3.1.3.2
Clean Build-up Relay Contact (02SX Magneciter Only)				x			4.2
Replace Oil Filter		▲	x				3.5.6
Clean Carburetor				x			3.2.5
Clean Rocker Box Oil Line Holes					x		3.5.4
Clean Combustion Chamber					x		3.2.1 3.7.1
Grind Valves					x		3.7.4
Clean Generating Plant					x		
Complete Reconditioning						x	

† Service more often under extreme dust conditions.

* If engine is operating in extremely low temperature; for short operating periods; with highly leaded gasoline; or in extremes of dust and dirt, then change oil every 100 hours instead of every 200 hours.

▲ Change the filter more often if, because of freezing temperatures or extreme dust conditions, the oil becomes so black and dirty the markings on the level indicator can't be seen through the oil.

• Tighten head bolts and adjust valve clearance after first 50 hours on a new or overhauled engine.

3. THE ENGINE

The generating plants in this manual use a 4-stroke cycle, vertical in-line, valve in head, spark ignition, gasoline fueled engine with a cooling system of the pressure circulating liquid cooled type.

In all cases, the speed is governor controlled at 1800 rpm for 60 cps output generating plants.

One, two, and four cylinder generating plants are included in the same manual because of the great similarity between them. Unless otherwise specified, all instructions and procedures apply to one, two, and four cylinder engines.

NOTE: All dimensions, clearances, and wear limits are included in Sect 9.

ENGINE DATA

Model Series	MJA	5MJB	705 MJB	10MJC	15MJC
Number cylinders (vertical in-line)	1	2	2	4	4
Displacement (cubic inch)	30	60	60	120	120
Cylinder bore	3-1/4	3-1/4	3-1/4	3-1/4	3-1/4
Piston Stroke	3-5/8	3-5/8	3-5/8	3-5/8	3-5/8
RPM (for 60 cycle)	1800	1800	1800	1800	1800
Compression ratio 6.5 to 1 for gasoline fuel	yes	yes	yes	yes	yes
Exhaust connection (pipe tapped)	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2
Stellite faced exhaust valve(s)	yes	yes	yes	yes	yes
Valve rotators on intake and exhaust	yes	yes	yes	yes	yes
Connecting rod bearings are tri-metal replaceable	yes	yes	yes	yes	yes
Main bearings are leaded bronze; precision type for replacement (quantity used)	2	2	2	3	3
Battery ignition	yes	yes	yes	yes	yes
Battery voltage (ac plant)	12-v	12-v	12-v	12-v	12-v
Battery size (ac plant): SAE group 1H	two in series	two in series	two in series	two in series	two in series
Amp/hr, SAE 20-hr (nominal)	105	105	105	105	105
Starting by solenoid shift starting motor	no	yes●	yes	yes	yes
Starting by exciter cranking	yes	no●●	no	no	no
Centrifugal Start-Disconnect Switch	no†	no†	yes	yes	yes
Battery charge rate amperes (normal)	2	2	2	2	2
Charge ammeter scale	5-0-5	5-0-5	5-0-5	5-0-5	5-0-5
*Oil capacity in U.S. quarts (refill)	2.5	3	3	6	6
Cooling water flow (gallons per minute)	4	4	4	4	4
Water cooled exhaust manifold	no	yes	yes	yes	yes
Drip pan and molded vibration mounts	yes	yes	yes	yes	yes
Maximum recommended power take-off from front pulley at any load	2 hp	2 hp	2 hp	2 hp	2 hp
Power take-off limit at rated load	1/2 hp	1 hp	1 hp	2 hp	2 hp
High temperature cut-off	yes	yes	yes	yes	yes
Total cu. ft. per min. of air required	84	77	197	155	155
Generator cooling air (CFM at 1800 rpm)	75	60	180	120	120
Combustion air (CFM at 1800 rpm)	9	17	17	35	35
Air cleaner - flame arrester	dry	dry	dry	dry	dry
Choke for gasoline fuel	elec-tric	elec-tric	elec-tric	elec-tric	elec-tric
Gasoline fuel lift (maximum feet)	8	8	8	8	8

† - Centrifugal switch is used with safety cut-off but not for start-disconnect.

* - Plus 1/2 quart for new filter.

● - Beginning with Spec F; ●● - Prior to Spec F.

TROUBLE-SHOOTING CHART 1, THE ENGINE

TROUBLE	POSSIBLE CAUSE	REMEDY
Engine will not crank	Battery discharged.	See Trouble-Shooting Chart 7.
	Control circuit defective.	See Sect 6.
	Internal seizure.	Disassemble engine and repair.
	Engine oil too heavy for operation in low temperature.	See Sect 3.5.1 for oil recommendations.
	Defective connections between battery and starter.	See Sect 3.6.2.
	REVOLVING ARMATURE GENERATOR (Exciter Cranked) Poor brush contact on generator.	See Sect 5.
	SEPARATE STARTING MOTOR MODELS Starting motor defective.	See Trouble-Shooting Chart 7.
Engine cranks too slowly	Oil in crankcase too heavy for low temperature.	See Sect 3.5.1 for oil recommendations.
	Discharged battery.	See Trouble-Shooting Chart 7.
	Corroded battery connections or defective battery cable.	See Sect 3.6.2.
Engine cranks but won't start	Fuel system faulty. No fuel in tank.	Refill tank.
	Filter screen clogged.	Clean filter Sect 3.2.2.
	Water in fuel.	Replace fuel.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Engine cranks but won't start (Cont.)	Fuel system faulty (Cont.) No gasoline at carburetor. Defective fuel pump.	See Trouble-Shooting Chart 3.
	Ignition system faulty.	See Trouble-Shooting Chart 4.
	Carburetor choked too much.	Check choke adjustment Sect 3.2.4.
	Air intake restricted.	Clean air cleaner Sect 3.2.6.
	Exhaust system clogged.	See Sect 3.2.7.
	Poor compression.	See Trouble-Shooting Chart 8 and Sect 3.7.2
	Poor fuel.	Change fuel.
	Wrong timing.	Retime.
	Engine flooded.	Correct operating procedures or adjust choke.
Engine hard to start	Restricted air intake.	Clean air cleaner Sect 3.2.6.
	Poor fuel.	Change fuel.
	Defective ignition system. Incorrect timing.	See Trouble-Shooting Chart 4.
	Defective fuel pump.	Repair or replace fuel pump - For tests see Sect 3.2.3.1.
	Poor compression.	See Trouble-Shooting Chart 8 and Sect 3.7.2

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Engine misses and backfires but fails to start	Water in gasoline.	Change fuel.
	Air leaks around intake manifold.	Inspect all gaskets on manifold.
	Improper firing order (JC).	Inspect ignition distributor system.
	Ignition timing incorrect.	Retime ignition.
	Moisture on breaker points.	Clean distributor.
Engine races (stop engine immediately by pushing throttle lever)	Too much fuel caused by: Disconnected governor mechanism.	
	Defective governor.	See Sect 3.4 and Trouble-Shooting Chart 5
	Incorrect governor adjustment.	
Engine stops unexpectedly	Emergency shutdown circuit operated.	Check low oil pressure and high air temperature switches, if used.
	Vapor lock in fuel line, fuel pump or carburetor.	Allow engine to cool, check for possible overheating, Sect 3.1.2
	Defective ignition.	See Trouble-Shooting Chart 4.
	Lack of fuel.	Refill tank.
	Internal seizure.	To test, crank by hand disassemble and repair.
	Excessive crankcase pressure, caused by clogged breather.	Remove and clean breather.
Low engine power	Restricted air intake.	Clean air cleaner.
	High exhaust back pressure.	Check back pressure Sect. 3.2.7.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Low engine power (Cont.)	Poor fuel.	Change fuel, Sect 3.2.1.
	Poor compression.	Check compression, Sect 3.7.2 and Trouble-Shooting Chart 8.
	Defective ignition (engine not firing on all cylinders).	See Trouble-Shooting Chart 4.
	Incorrect ignition timing.	See Trouble-Shooting Chart 4.
	Improper choke operation.	See Sect 3.2.4.
	Heavy carbon deposits in cylinders.	Clean cylinders, See Sect 3.2.1.
	Faulty carburetion.	See Trouble-Shooting Chart 3.
Engine misses at light load	Spark plug gaps too narrow.	Set at .025.
	Intake air leak.	Inspect intake manifold and carburetor.
	Faulty ignition system.	See Trouble-Shooting Chart 4.
	Uneven compression.	See Sect 3.7.2.
	Spark plugs defective.	See Sect 3.3.5.
	Clogged carburetor idle jet.	Clean carburetor.
	Defective high tension cable.	Inspect and replace if necessary.
Engine misfires at heavy load	Spark plug gap too wide.	Adjust to .025.
	Clogged carburetor.	Clean carburetor, Sect 3.2.5.
	Clogged fuel screen.	Clean, Sect 3.2.2.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Engine misfires at heavy load (cont.)	Valve lash too tight.	Adjust lash, Sect 3.7.1.
	Defective ignition system.	See Trouble-Shooting Chart 4.
Engine backfires	Lean fuel mixture.	Adjust carburetor, Sect 3.2.5.
	Clogged fuel screen.	Clean, Sect 3.2.2.
	Poor fuel.	Change fuel, Sect 3.2.2.
	Spark too late.	Time ignition.
	Leaking intake valve.	Check compression See Sect 3.7.2.
	Improper firing order (JC).	Inspect ignition distributor system (correct order 1-2-4-3).
Excess oil consumption, light blue smoky exhaust	Poor compression.	See Trouble-Shooting Chart 8 and Sect 3.7.2.
	Crankcase oil too light or diluted.	Change to correct oil Sect 3.5.1. If diluted, See Trouble-Shooting Chart 6.
	Engine misfiring.	See Engine Misfiring, this chart.
	Excess oil in crankcase.	Drain to full level.
	Engine overheating.	See Sect 3.1.2.
	Defective intake valve stem oil seal.	Replace, Sect 3.7.
	Worn intake valve, guide or valve stem.	Replace, Sect 3.7.
	Faulty ignition.	See Trouble-Shooting Chart 4.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Excess oil consumption, no increase in smoke	Oil leak from oil base or connections.	Inspect engine, check for clogged crankcase breather.
	Leaky crankshaft oil seals.	Inspect oil seals, Sect 3.9.2.2 and Sect 3.9.5.5 Check for clogged crankcase breather.
Black, smoky exhaust, excessive fuel consumption, fouling of spark plugs with black soot, possible lack of power under load	Fuel mixture too rich.	Adjust carburetor Sect 3.2.5.
	Choke not open.	See Sect 3.2.4.
	Clogged air intake.	Clean air cleaner, Sect 3.2.6.
Dull, metallic thud, if not bad may disappear after few minutes of operation	Loose crankshaft bearing.	Replace bearing.
Sharp, metallic thud, especially when cold engine first started.	Low oil supply.	Add oil.
	Oil badly diluted.	Replace oil.
Tapping sound, clacking, light clicking	Valve clearance too great.	Check valve clearance Sect 3.7.1.
	Broken valve spring.	Replace valve spring.
Metallic knock under no load conditions and when stopping	Worn connecting rod bearings.	Replace bearings.
Hollow clicking sound with engine cool and under load.	Loose piston.	Check piston clearance.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Light pounding knock	Loose connecting rod bearing.	Replace bearings.
	Low oil supply.	Add oil - check for cause of low oil, Sect 3.5.
	Oil badly diluted.	Replace oil.
Pinging sound when engine is suddenly or heavily loaded	Carbon in cylinder.	Remove carbon.
	Spark too early.	Adjust breaker points. Retime spark if necessary. Sect 3.3.3 and 3.3.4.
	Wrong spark plug.	Install correct spark plug Sect 3.3.5.
	Valve hot.	Adjust valve clearance. Sect 3.7.1.
	Fuel stale or low octane.	Use good, fresh fuel.
	Lean fuel mixture.	Clean and adjust carburetor. Sect 3.2.5.
	Engine hot.	Check air circulation.
Engine overheats (See Sect 3.1.2)	Defective ventilating system.	Check ventilators and ducts.
	Defective installation.	Inspect complete installation including ducts etc.
	Improper lubrication.	Check oil system.
	Late ignition timing.	Retime ignition.
	Fuel mixture too lean.	Adjust carburetor, Sect 3.2.5.
	Generator overloaded.	Inspect electrical load.

TROUBLE-SHOOTING CHART 1, THE ENGINE (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Low oil pressure	See Trouble-Shooting Chart 6	
Spark plug fouled in short periods of time on gasoline operation	Wrong spark plug gap.	Clean spark plugs and set at 0.025"
Speed fluctuations or incorrect speed	See Trouble-Shooting Chart 5 and Sect 3.4.	

3.1 Cooling System

The cooling system on the MJA, MJB and MJC generating plants is a liquid coolant, pressure circulating, open type system that uses raw coolant (city water, sea water . . .).

NOTE: Factory installed heat exchangers for a closed type system are available as an optional feature and are discussed separately in Sect 3.1.4.

In a raw water cooling system, water enters the pump located on the front left side of the engine. The pump delivers the water to the bottom of the cylinder jacket and it flows up the jacket and out an opening in the cylinder head controlled by the thermostat. For engine warm-up, when the thermostat is closed, a by-pass from the cylinder block entrance to the thermostat cover allows water flow. In addition, a notch in the thermostat allows some water flow through the cylinder jacket and heads. From the thermostat, water passes through the water cooled exhaust manifold (except on MJA) and out of the engine cooling system.

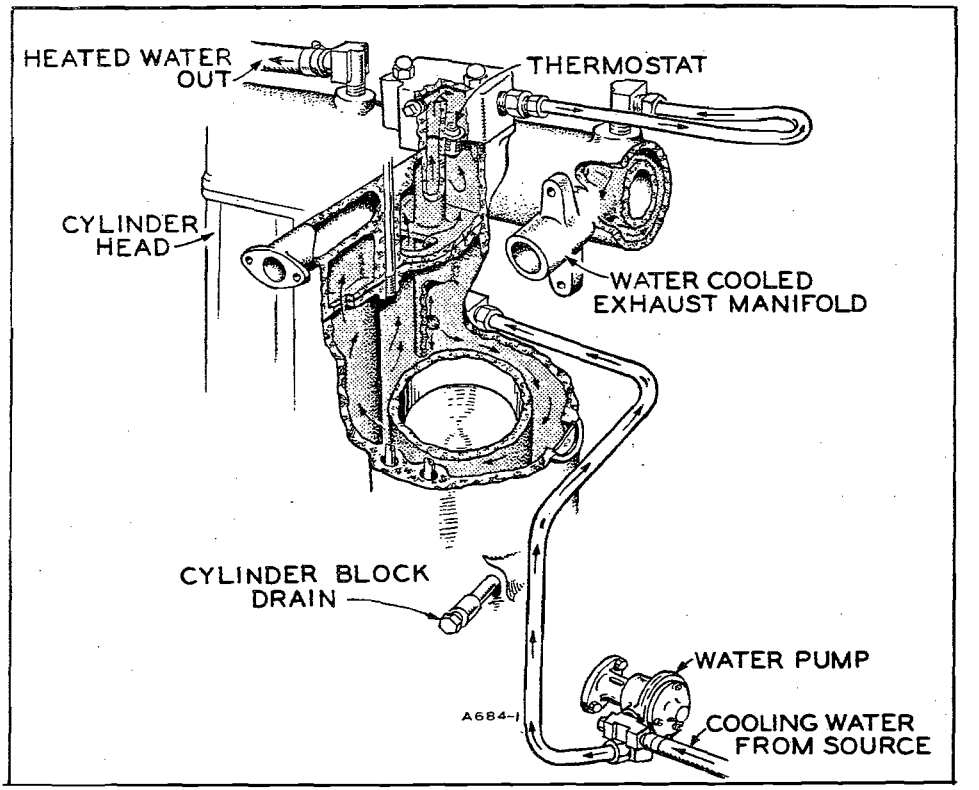


FIG 3.1.A - CROSS SECTION, MJB COOLING SYSTEM

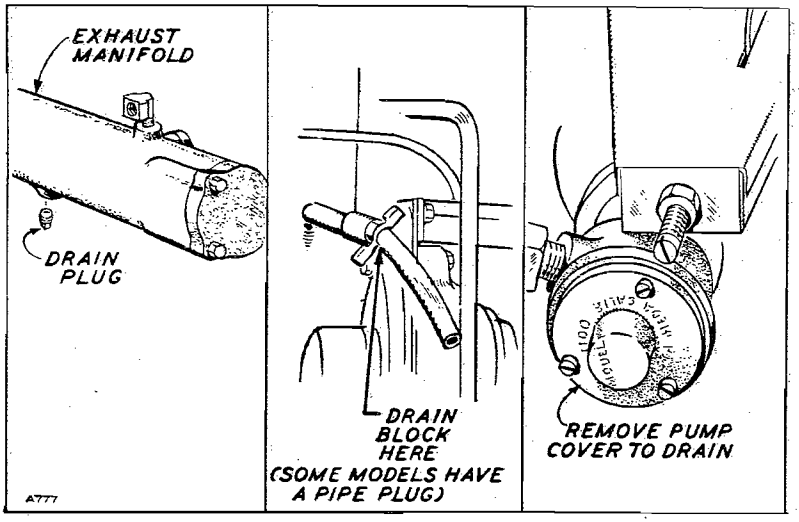


FIG 3.1.B - DRAINING ENGINE COOLING SYSTEM

3.1.1 MAINTENANCE

Cooling system maintenance should include periodic inspection for leaks, inspection of the rubber pump impeller and periodic flushing and cleaning. See the service chart for inspection and service periods.

The rubber impeller, because of continuous flexing, deteriorates with time and must eventually be replaced. If, however, the impeller fails after short service (usually under 500 hours) check for possible defects (Sect 3.1.3.2).

Only when clean can the cooling system do its work well. Scale slows down heat absorption and restricts water flow. Flush the system at least once a year and more often if operation indicates clogged passages or overheating. To flush the engine, remove the thermostat, Fig 3.1.C, and the water pump cover. Restrict the pump opening partially so the cylinder block fills with water. Attach the flushing gun nozzle to the thermostat opening and fill the block with water, then apply air pressure. Repeat the process until water coming from the block is clean.

3.1.2 TESTING

The cooling system can be tested for 2 abnormal conditions: (1) insufficient water flow and (2) air leaks.

1. To measure water flow, install a tank of known quantity at the water outlet. Run the engine until the thermostat opens and then measure the length of time necessary to fill the tank. From this obtain the flow in gallons per minute (GPM). Minimum values are

given in the engine data section, Sect 3. If water flow is below minimum, check pump operation and inspect the passages and water lines for clogging.

2. Air leaks are an important cause of premature impeller failure. To test for air in the cooling system, run the engine, insert the cooling system outlet into a tank of water and watch for bubbles. If bubbles appear, inspect the cooling system thoroughly to find the source.

3.1.3 REPAIR

Whenever making repairs on the cooling system, tighten all connections thoroughly. Permatex or use thread sealing compound on all threaded connections. This is especially important because of the damage air can cause.

All water lines should be 1/2" inside diameter or larger. Long runs of pipe or hose need larger inside diameter to reduce resistance. Remember, the final test is always correct water flow.

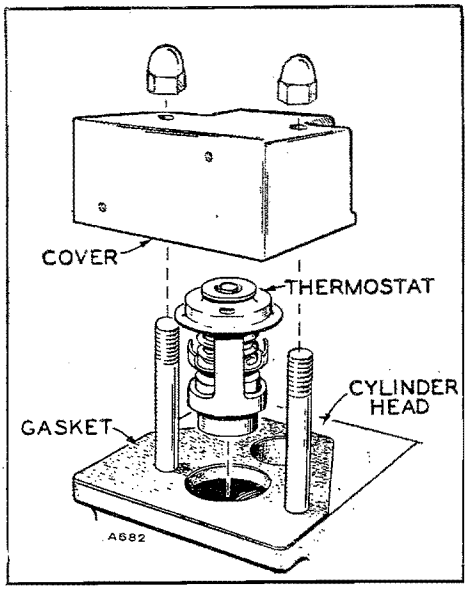


FIG 3.1.C - THERMOSTAT REMOVAL

3.1.3.1 Thermostat. - A thermostat is located on the right side of each cylinder head, connected by tubing to the water cooled manifold. If the thermostat is damaged by corrosion or other causes, replace it.

Check the thermostat opening and closing with a thermometer in a water bath. The thermostat should start to open when the water temperature reaches 145° F and be fully open at 165° F. Lift it out of the water and it should close in a short time. If the thermostat doesn't operate properly, replace it.

3.1.3.2 Water Pump. - The water pump is a positive-displacement, rubber-impeller type located on the upper left corner of the gear cover. This applies to pump having plain-type bearings.

A. Disassembly

1. Loosen the pump's end plate screws and remove the end plate.
2. Pull the impeller and shaft out with a pair of pliers.
3. If further disassembly is necessary, remove the pump from the engine by loosening the 2 capscrews on its mounting base.

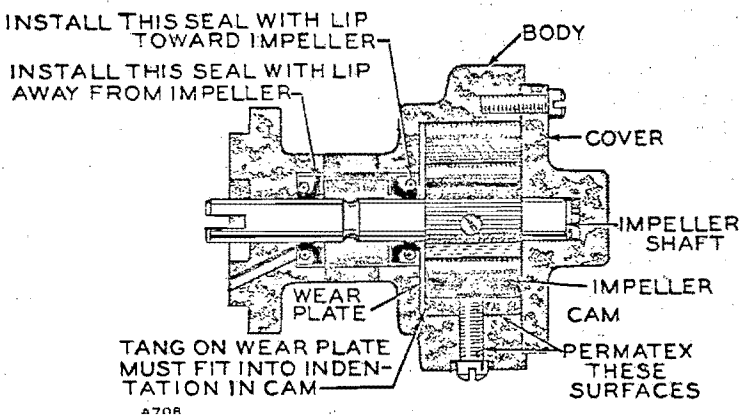


FIG 3.1.D - RUBBER IMPELLER WATER PUMP

4. Loosen the set screw on the side of the pump 3 or 4 turns and tap it lightly to free the cam from the pump body. Lift out the cam and wear plate.
5. Drive the 2 waterseals out from the drive end of the pump. NOTE: Remove these only if they are to be replaced.

B. Repair. - Most water pump failure is caused by the rubber impeller. If the impeller fails, check for pock marks on its end surfaces. These are a sign of air in the cooling system (Sect 3.1.2) which reduces pump lubrication and causes overheating.

If the cam, wearplate, or end cover show excessive wear, replace them. If the pump leaks water along its shaft, replace the water seals.

C. Assembly. - Before beginning assembly, clean all old permatex from the inside surfaces of the pump body and from the cam and wear plate.

1. Install both seals in the body with lips pointing in opposite directions.
2. Drop the wear plate in the body with tanged side out.
3. Permatex top surface and back face of cam and install with cam screw. Permatex the screw threads and line up the hole in the cam with the tang on the wear plate.
4. Install the shaft and impeller assembly.
5. Install the gasket and end cover with screws.

3.1.4 HEAT EXCHANGER COOLING (Optional)

ONAN Heat Exchanger cooling is available either factory installed or as a kit for customer installation. A completed heat exchanger installation contains 2 water systems, the closed water system and raw water sys-

tem, Fig 3.1.E. The closed water system continuously recirculates water through the engine water jacket, expansion tank, exhaust manifold, centrifugal pump, and one side of the heat exchanger. The raw water system uses the engine-mounted, rubber-impeller pump to draw sea or city water and circulate it through the heat exchanger, then discharges the water.

CAUTION: When planning to install any brand of heat exchanger other than ONAN approved, or any keel cooler, consult the factory or an ONAN distributor. To insure an adequate installation, the engine cooling system must be modified.

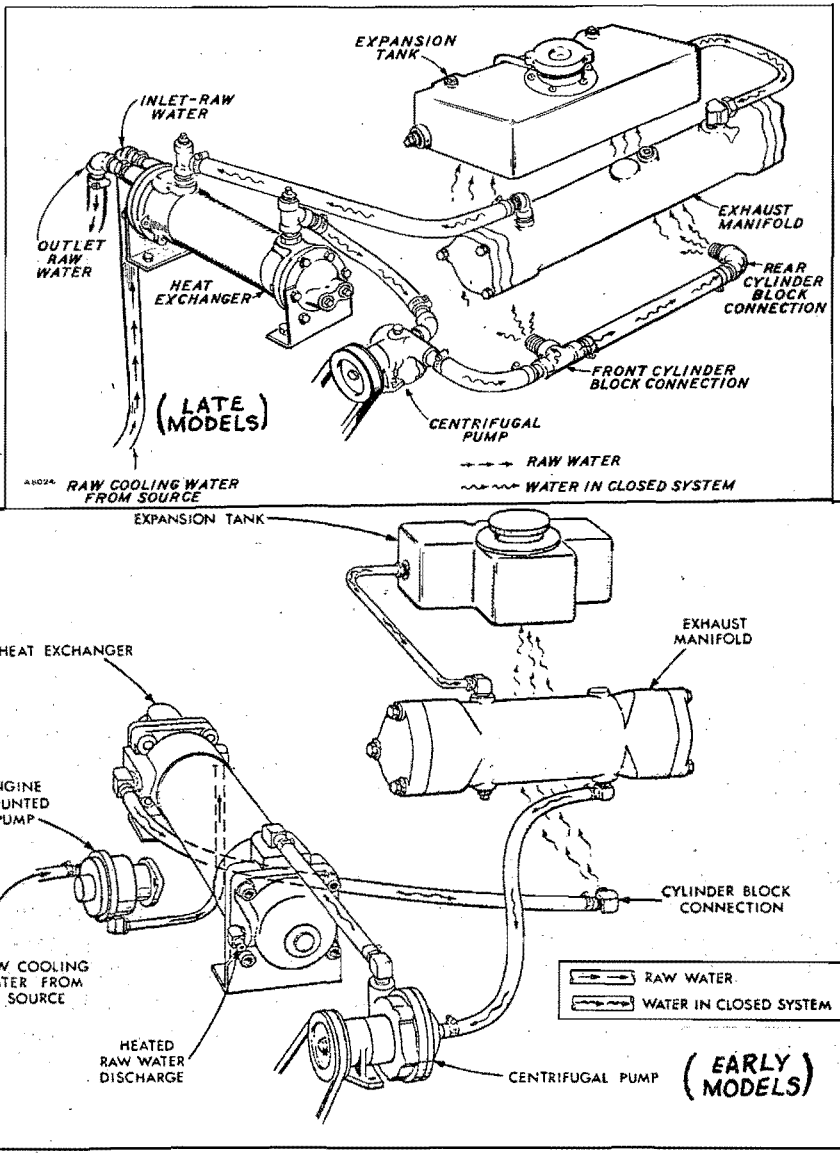


FIG 3.1.E - PICTORIAL MJC HEAT EXCHANGER COOLING SYSTEM

3.1.4.1 Maintenance. - Maintain the closed water system the same as an automotive radiator cooling system. Clean and flush it once a year and use an anti-freeze if there is danger of freezing. Use a rust inhibitor in the expansion tank (closed water system).

In the sea water system, check periodically for air leaks, rubber impeller wear or damage, and restricted lines.

The raw water side of the heat exchanger is protected from corrosion by a zinc pencil mounted on a pipe plug in one end of the heat exchanger. Inspect the pencil at least every 2 months and replace if deteriorated to less than 1/2 original size, Fig 3.1.G.

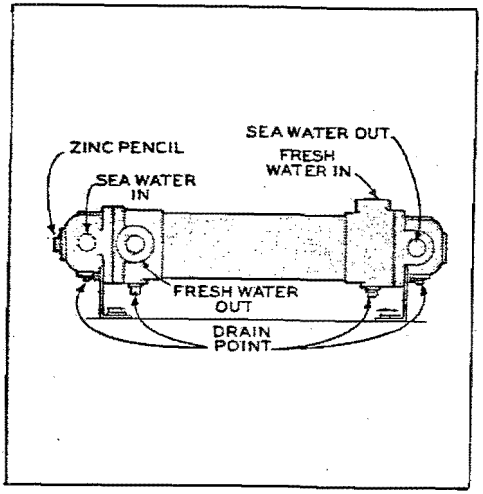


FIG 3.1.F - DRAINING HEAT EXCHANGER

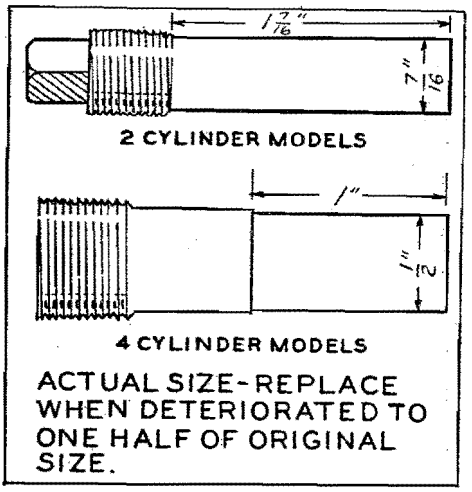


FIG 3.1.G - ZINC PENCILS

3.1.4.2 Cleaning. - Clean and flush the cooling system at least once a year and more often if conditions warrant. To clean the closed water system, drain and refill with radiator cleaner. When chemical cleaning is completed, according to the cleaner manufacturer's instructions, flush the cooling system to wash out deposits loosened by the chemical cleaning.

Flush the engine water jacket as discussed in Sect 3.1.1.2 except that the hose from engine water jacket to heat exchanger should be removed for the water outlet. Flush both closed water side and raw water side of the heat exchanger. Remove the rubber impeller pump cover to flush the raw water side. Also flush the water cooled exhaust manifold. When flushing is completed, check the system thoroughly for leaks uncovered by the cleaning operations.

3.1.4.3 Repair and Testing, Raw Water System. - Test for air leaks and insufficient water flow as described in Sect 3.1.2. Repair of the rubber impeller pump was covered in Sect 3.1.3.2.

3.1.4.4 Heat Exchanger Repair. - The heat exchanger should never require any repair under normal service conditions. However, if it should become clogged, remove the ends and clean out the tubes.

3.1.4.5 Centrifugal Pump Repair. - The centrifugal fresh water pump is mounted on the heat exchanger bracket. If it should leak, or the bearings require replacement, disassemble it and replace the worn components.

Pump Disassembly

1. Remove the water inlet from the pump and remove the 6 screws holding the end cover to the pump.

2. Unscrew the impeller from the shaft counterclockwise when facing the impeller.

3. Remove the pump body by unscrewing the single capscrew that clamps the pump body to the pedestal.

4. Remove the retaining ring and drive the bearing assembly out of the pedestal.

5. To remove the water seal, drive it out of the pump body.

Replace the worn components. When replacing the water seal, check the wear plate pressed into the impeller and replace it if necessary. To assemble the pump, reverse the disassembly procedure.

3.1.4.6 Thermostats and Expansion Tank. - On the MJA and MJB, the expansion tank serves as the thermostat housing. On the MJC, it houses the thermostat for the front 2 cylinders.

To remove the expansion tank, remove the 2 capscrews extending down through the tank. For thermostat testing and repair, see Sect 3.1.3.1. When reinstalling the tank, be sure all connections are tight.

Check the expansion tank fill cap. This is a pressurized cap, designed to hold 12-15 psi. The correct cap, good gaskets and smooth gasket surfaces are essential to prevent loss of water.

TROUBLE-SHOOTING CHART 2, COOLING SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
Overcooling Outlet temperature less than 140°	Thermostat stuck open.	Replace thermostat, Sect 3.1.3.1.
Overheating NOTE: If the unit overheats, the high water temperature switch stops it before damage would occur	Lack of cooling water*	Refill and check for cause of loss.
	Centrifugal water pump not functioning*	Check pump belt and impeller.
	Rubber impeller water pump not functioning.	Repair or replace pump.
	Water passages restricted.	Clean and flush cooling system.
	Thermostat stuck closed.	Replace thermostat.
	Water lines too small or too long.	Replace water lines.
	Improper lubrication.	Change to proper oil.
	Generator overloaded.	Reduce load.
Rubber impeller pump failure	Impeller damaged.	Replace impeller.
	Impeller drive damaged.	Replace drive shaft. Inspect oil spray hole and drip hole in gear cover.
	Water lines restricted or of improper size.	Replace with larger lines.
Premature rubber impeller failure (under 500 hours of operation)	Air leak in cooling system. (check for pock marks on impeller end surfaces).	Replace impeller, repair air leaks. See Sect 3.1.2 for air leak test.
	Cavitation (vacuum forming in water pump when suction draw is excessive).	Replace impeller, use larger water inlet line.

* - Heat Exchanger Models Only.

TROUBLE-SHOOTING CHART 2, COOLING SYSTEM (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Premature rubber impeller failure (under 500 hours of operation) (Cont.)	Continued operation with with dirty or silted cooling water.	
Loss of cooling water* in fresh water system*	Expansion tank pressure cap defective.	Replace.
	Centrifugal water pump seals defective.	
	Blown head gasket.	Replace gasket.

* - Heat Exchanger Models Only.

3.2 Fuel System

Standard MJA, MJB, and MJC engines use a gasoline, carbureted, fuel system, to deliver a mixture of fuel and air to the combustion chamber. The fuel system draws fuel from a tank, delivers it through the filter and fuel pump, and to the carburetor float chamber. Air passing through the carburetor venturi section draws fuel from the float chamber.

All fuel system components are described in the following paragraphs. Select the components that apply to your plant.

3.2.1 FUELS

Use a "regular" grade of gasoline. They don't require premium gasolines. One of the most important things to consider is the content of Tetra Ethyl Lead in the fuel. Premium fuels contain more lead than regular, but the lead quantity also varies between brands of fuel. In the constant speed operation to which generating plants are subject, the build up of deposits in the combustion chambers is proportional to the amount of lead in the gasoline. So, more lead means more deposits and more frequent head removal for cleaning. On plants that require frequent combustion chamber cleaning, the period between cleaning can often be increased by changing fuel.

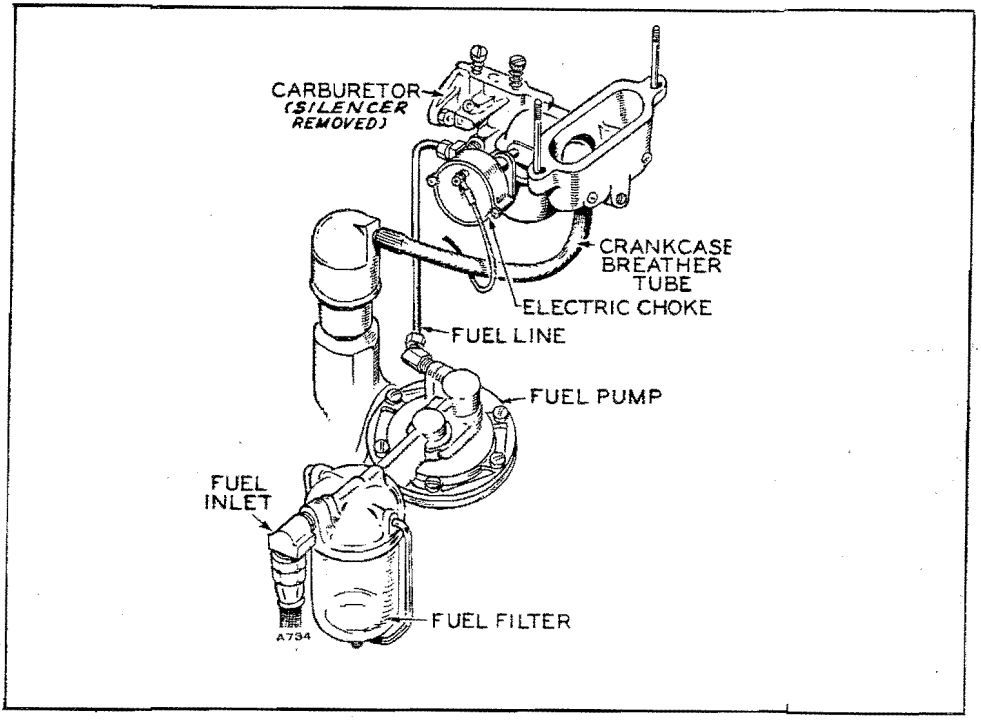


FIG 3.2.A - GASOLINE FUEL SYSTEM

If fuel is stored for any great length of time, it can oxidize and form gums — the fuel becomes stale. ONAN recommends changing fuel stored as often as every season to insure fresh fuel, especially where there is a great change in weather between seasons.

3.2.2 MAINTENANCE

On gasoline fuel systems, periodic maintenance should consist of cleaning the fuel strainer, cleaning or replacing the air silencer, Sect 3.2.6, carburetor adjustment, and complete carburetor cleaning. For service periods, see the periodic service chart.

To clean the fuel strainer, remove the fuel sediment bowl and the screen (Fig 3.2.B) and thoroughly wash the screen. At the same time, remove the carburetor float bowl and clean it. Reassemble and check for leaks.

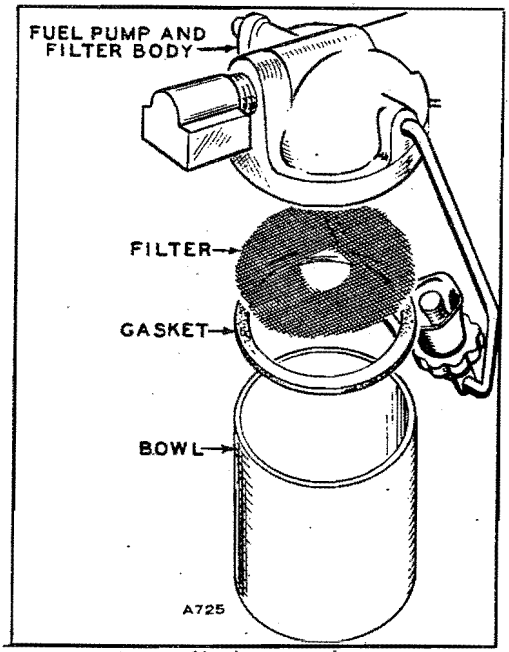


FIG 3.2.B - FUEL STRAINER

3.2.3 FUEL PUMP (Gasoline Fuel System)

The fuel pump is located on the left side of the engine near the rear. If fuel doesn't reach the carburetor, make the following checks --

-- Check the fuel tank and see that the shut-off valve is open.

-- Remove the fuel line from the pump outlet and crank the engine over several times. Fuel should spurt out of the pump. If not, remove the pump for repair or replacement.

3.2.3.1 Testing. - If the fuel pump delivers fuel, test it with a pressure gauge or manometer. Perform these tests before removing the pump from the engine. Disconnect the pump outlet line and install the pressure gauge, Fig 3.2.C.

Test the valves and diaphragm by operating the priming lever a few times and watching the pressure. It shouldn't drop off rapidly after priming has stopped.

Next, run the engine at governed speed on the fuel remaining in the carburetor and measure the fuel pump pressure developed. Pressure

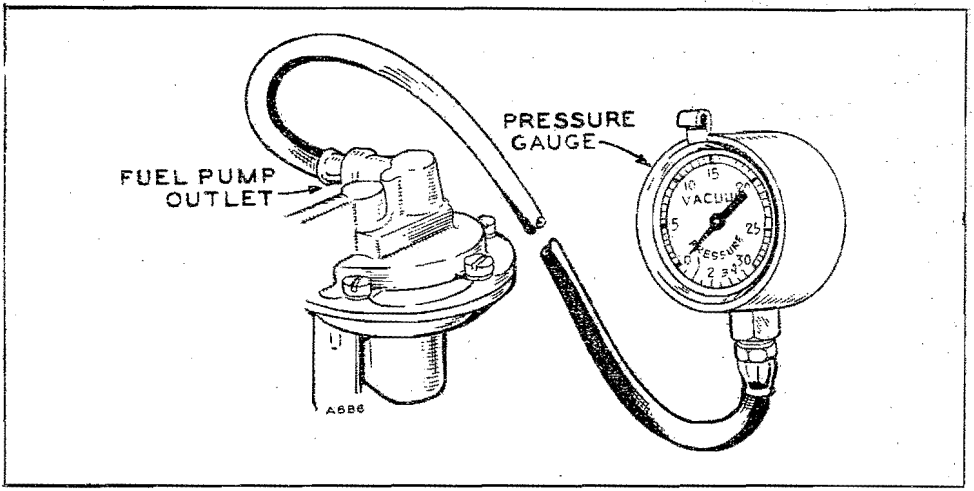


FIG 3.2.C - MEASURING FUEL PUMP PRESSURE

should be between 2 and 3 psi with the gauge held 16 in. above the fuel pump.

A low pressure reading indicates extreme wear in one part or some wear in all parts, and the pump should be overhauled or replaced. If the reading is above maximum, the diaphragm is is probably too tight or the diaphragm spring too strong. This can also be caused by fuel seeping under the diaphragm retainer nut and between the diaphragm layers, causing a bulge in the diaphragm. Overhaul the pump and replace the defective parts.

Low pressure with little or no pressure leak after pumping stops indicates a weak or broken spring or worn linkage and in most cases the pump should be replaced.

3.2.3.2 Removal and Disassembly.-

1. Remove the pump inlet and outlet. Remove the 2 capscrews holding the pump to the engine and lift it off.

2. Notch the pump cover and body with a file so they can be assembled in the same relative position, and remove the 6 screws holding them together.

3. Tap the body with a screwdriver to separate the 2 parts. Don't pry them apart — this would damage the diaphragm.

4. Remove the screws holding the valve plate to the cover and lift out the valve and cage assemblies.

5. Drive out the rocker arm hinge pin.

6. Remove the rocker arm, spring and link.

7. Lift out the diaphragm assembly and diaphragm spring.

3.2.3.3 Repair. - Fuel pump failure is usually due to a leaking diaphragm, valve or valve gasket. A kit is available for replacement of these parts. Because the extent of wear cannot be detected by the eye, replace all parts in the kit. If the diaphragm is broken or leaks, check for diluted crankcase oil.

Occasionally, failure is due to a broken or weak spring or wear in the linkage. In this case, replace the worn parts or install a new pump.

3.2.3.4 Assembly, Fuel Pump. -

1. When installing a new diaphragm, soak it in fuel before assembling, Insert the diaphragm spring and soaked diaphragm into the pump body.

2. Insert the link and rocker arm into the body, hook it over the diaphragm pull rod. Align the rocker arm with the rocker arm pin hole and drive in the pin.

3. Compress the rocker spring and install between the body and rocker arm.

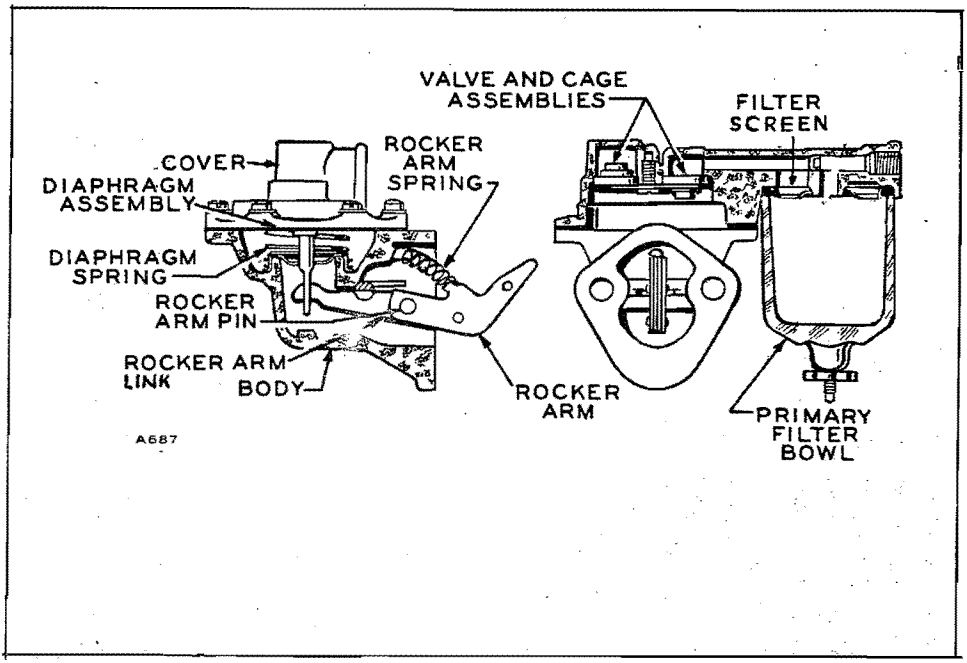


FIG 3.2.D - CROSS SECTION, FUEL PUMP

AVERAGE CHOKE SETTINGS

AMBIENT TEMP.-F.	CHOKE TO BODY MJA	MJB	MJC
68	1 64	3 16	0
72	3 64	7 32	1/64
76	1/16	1/4	3/64
80	3/32	9/32	1/16
84	7/64	5/16	3/32
88	1/8	11/32	7/64
92	9/64	3/8	1/8
96	11/64	13/32	9/64
100	13/64	7/16	11/64

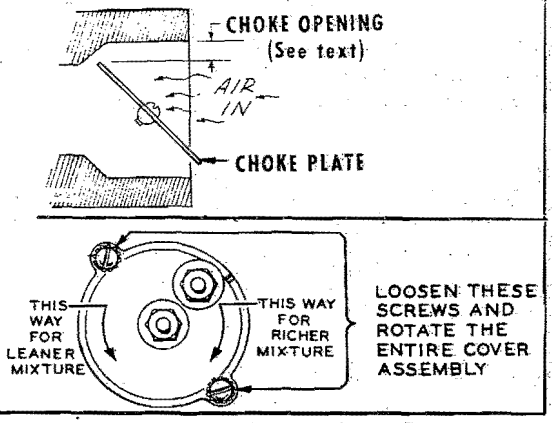


FIG 3.2.E - ADJUSTING AUTOMATIC CHOKE

4. Insert the valve cages, gaskets and valve cover plate. Position the inlet valve with spring showing and the outlet valve with spring in the cover recess.

5. Assemble the cover to the body with notch marks lined up. Install the screws but don't tighten.

6. Push the rocker arm in full stroke and hold in this position to flex the diaphragm. NOTE: The diaphragm must be flexed or it will deliver too much fuel pressure.

7. Tighten the cover screws alternately and securely, then release the rocker arm.

8. Install the pump on the engine and repeat the pressure test, Sect 3.2.3.1.

3.2.4 CHOKE (Gasoline Fuel System)

Remote starting models of generating plants use an automatic electric choke, Fig 3.2.A. An electric element controls the automatic electric choke. Before the plant starts, the choke is closed. When the plant has started, the generator supplies current to the heating element which heats the choke's bi-metal coil. As this coil heats, it winds tighter, opening the choke plate.

3.2.4.1 Adjustment, Electric Choke. - Under normal operation, adjust the choke so the distance measured between the choke plate and carburetor throat, Fig 3.2.E, is as shown in the table with the engine cold. Use the straight shank end of a drill bit to measure the gap. The upturned air cleaner must be removed for choke adjustment. To adjust the choke, loosen the 2 screws on the endplate and rotate the cover assembly.

Under extreme temperature conditions, it may be necessary to readjust the choke for best operation. For more choking, turn the cover clockwise, for less choking, turn it counterclockwise.

3.2.4.2 Disassembly and Repair, Electric Choke. - If the choke does not operate, or won't maintain its adjustment, disassemble it for repair. If it won't close, check for binding, incorrect adjustment, or incorrect assembly of the coil. If it won't open after the plant starts, check for heating. The choke should be warm to the touch within a minute or 2 of plant starting.

To disassemble the choke, remove the 2 screws holding the cover and lift the cover off. Then remove the spring. If necessary, remove the choke housing by loosening the single clamp screw on the housing.

If the choke won't heat properly, check for a broken heating coil or high resistance electrical connections. Check the coil resistance with an ohmmeter. With the element at room temperature, resistance should be about 5 - 6 ohms for 12 volt models and about 25 ohms for 24 volt models. If the coil is defective, replace the thermostat cover.

The bi-metal spring must be installed as shown in Fig 3.2.F. If installed backwards, it will hold the choke closed as the coil heats, flooding the engine.

3.2.4.3 Assembly, Electric Choke. -

1. Install the choke housing, clamp it in place, and install the fiberglass insulation in the housing.

2. Install the spring, Fig 3.2.F. Be sure it winds in the proper direction — clockwise starting from the center.

3. Install the cover plate. Be sure the fork in the plate straddles and holds the outer end of the coil.

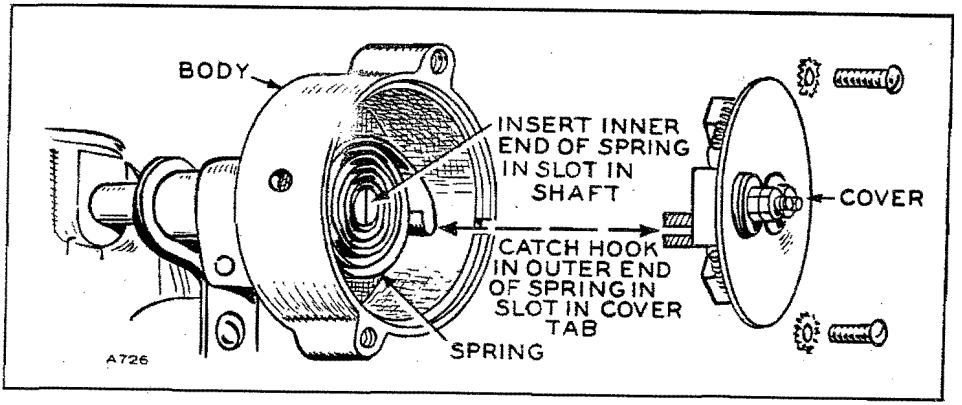


FIG 3.2.F - INSTALLING COVER ON ELECTRIC CHOKE

4. Adjust the choke, Sect 3.2.4.1.

5. Attach the electrical connection, and reinstall the air silencer adapter and air housing.

3.2.5 CARBURETOR GASOLINE

The gasoline carburetor is a horizontal draft type, with an upturned intake horn (air silencer adapter). The carburetor consists of 3 major sections — the bowl and float, the idle circuit, and the load circuit.

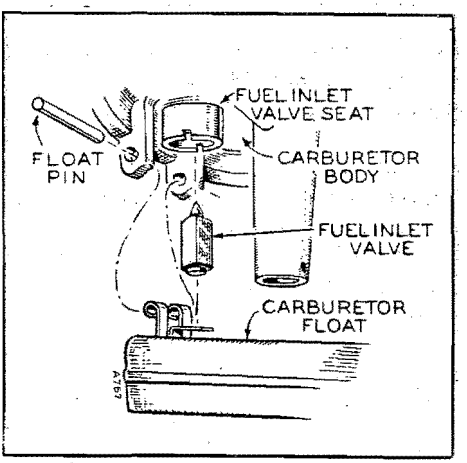


FIG 3.2.G - INLET VALVE

Fuel enters the carburetor through the inlet valve, Fig 3.2.G, and passes into the float chamber. To control the fuel level in the bowl, the float closes the inlet valve when fuel reaches a certain height, and opens it when the fuel level drops.

The idle circuit, Fig 3.2.H, supplies fuel during no load operation and for small loads. Since the throttle plate is nearly closed at no load, the intake manifold vacuum is high and the pressure difference between the manifold and float chamber causes fuel to flow through the idle circuit. The pressure difference draws fuel up through the hollow center of the main adjusting needle, through passages in the carburetor body to the idle port. Bleed holes in the main adjusting needle allow air to bleed in and mix with the fuel. When the throttle is almost completely closed, the fuel passes out through the idle port, controlled by the idle

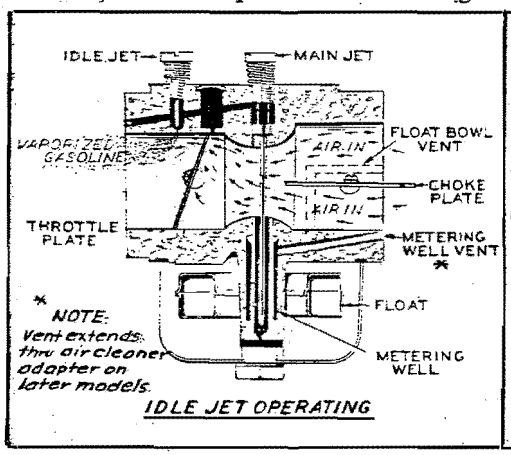


FIG 3.2.H - CARBURETOR IDLE CIRCUIT

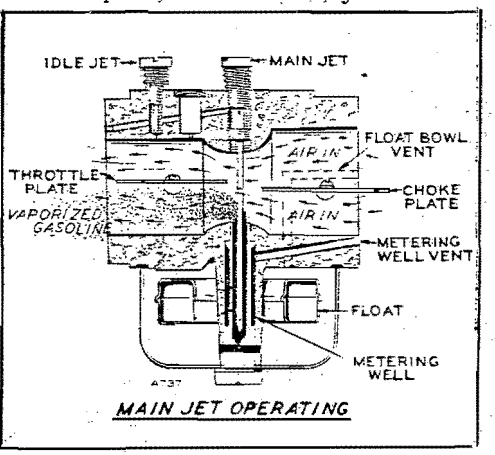


FIG 3.2.I - CARBURETOR LOAD CIRCUIT

adjusting needle. As the throttle is opened to increase power, it gradually exposes the idle transfer port and fuel is drawn out through this port also.

As the engine governor opens the throttle farther, under increased load, the increased air flow through the carburetor produces a low pressure at the venturi (narrow section of the carburetor throat). This pressure drop draws fuel up the main nozzle to be mixed with air at the nozzle opening. This is the load circuit, Fig 3.2.I; the main adjust needle controls its fuel delivery.

At the same time, because the throttle is open, the manifold vacuum decreases so the idle circuit becomes less effective. In a certain range, the two circuits blend, both delivering fuel, but as load is increased, the load circuit takes over.

Whenever load is increased, with the load circuit in operation, the governor opens the throttle to deliver more fuel. The main nozzle won't immediately deliver this increased fuel because of the jet controlled by the adjusting needle. To prevent a power lag when load is increased, a metering well around the outside of the nozzle delivers fuel until the main jet can catch up with the increased demand.

3.2.5.1 Adjustment, Gasoline Carburetor. - Adjusting the carburetor means obtaining the correct fuel-to-air mixture for smooth, efficient operation. The carburetor should be adjusted in 2 steps — first the idle adjustment, and then the load adjustment.

NOTE: If the carburetor is completely out of adjustment so the engine won't run, open both needle valves 1 to 1-1/2 turns off their seats to permit starting. Don't force the needle valves against their seats. This will bend the needle.

Before adjusting the carburetor, be sure the ignition system is working properly and the governor is adjusted. Then allow the engine to warm up.

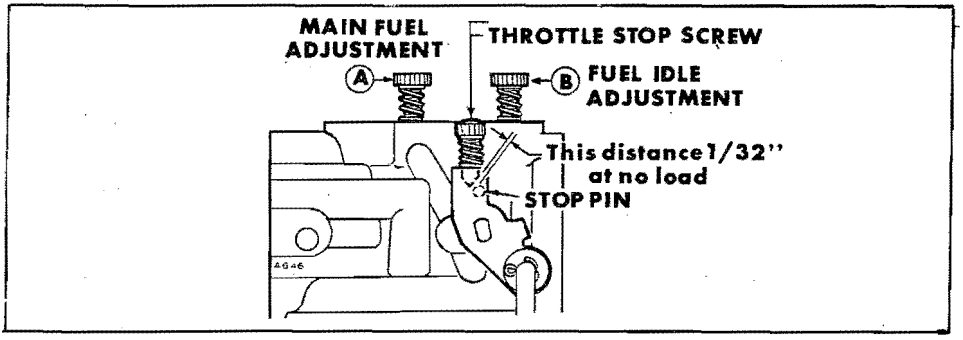


FIG 3.2.J - GASOLINE CARBURETOR ADJUSTMENTS

1. With no load on the generator, turn the idle adjustment out until the engine speed drops slightly below normal. Then turn the needle in until speed returns to normal.

2. Apply a full load to the generator.

3. Carefully turn the main adjustment in until speed drops slightly below normal. Then turn the needle out until speed returns to normal.

ALTERNATE METHOD. USE WHEN THERE IS NO LOAD ADJUSTMENT POSSIBLE

1. Start the plant and allow it to warm up.

2. Push in on the governor mechanism to slow the plant down to about 400 - 500 rpm.

3. Set the idle adjustment screw for even operation (so the engine is firing on all cylinders and running smoothly).

4. Release the governor mechanism to allow the engine to accelerate. If the engine accelerates evenly and without a lag, the main adjustment is correct. If not, adjust the needle outward about 1/2 turn and again slow down the engine and release the mechanism. Continue until the engine accelerates evenly and without a time lag after releasing the governor.

With the carburetor and governor adjusted, set the throttle stop screw, Fig 3.2.J, to allow 1/32 in. clearance to the stop pin with the plant operating at no load. This prevents excessive hunting when a large load is suddenly removed.

3.2.5.2 Removal and Disassembly. -

1. Remove the fuel line, governor linkage and electric choke wire.

2. Remove the 2 carburetor mounting nuts and pull off the carburetor.

3. Remove the air silencer adapter from the carburetor.

4. Remove the 2 screws that mount the choke heating coil to the carburetor and pull off the coil assembly.

5. Remove the float bowl nut and pull off the bowl.

6. Remove the float pin and float.

7. Lift out the float valve and unscrew its seat.

8. Remove the no load adjusting needle.

9. Remove the load adjusting needle and spring.

10. Remove the throttle plate screws and the plate and pull out the throttle shaft.

11. Remove the choke plate screws and plate and pull out the choke shaft.

3.2.5.3 Cleaning and Repair. - To clean the carburetor, soak all components thoroughly in a good carburetor cleaner, following the cleaner manufacturer's instructions. Be sure all carbon is cleaned from the carburetor bore, especially in the area of the throttle valve. Blow out the passages with compressed air. If possible, avoid using wire to clean out the passages.

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. Invert the carburetor body and measure the float level, Fig 3.2.K.

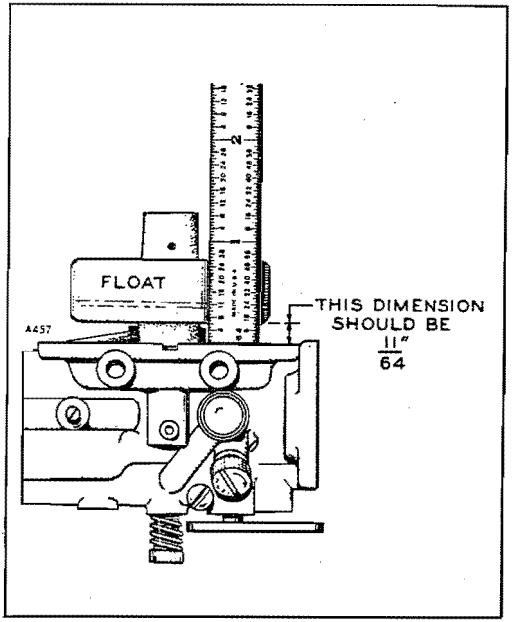


FIG 3.2.K - MEASURING CARBURETOR FLOAT LEVEL

If necessary, bend the small lip that the intake valve rides on to adjust float level.

Check the choke and throttle shafts for excessive side play and replace if necessary. Don't remove the coating on the throttle shaft. This is teflon, used to reduce wear and friction between the shaft and carburetor body.

3.2.5.4 Assembly and Installation. -

1. Install the throttle shaft and valve, using new screws and lockwashers. Install as shown in Fig 3.2.H and with bevel mated to the carburetor body. On valve plates marked with the letter "C", install with mark on side toward idle port when viewed from flange end of carburetor. To center the valve, back off the stop screw, close the

throttle lever, and seat the valve by tapping it with a small screwdriver; then tighten the 2 screws.

2. Install choke shaft and valve. Center the valve in the same manner as the throttle valve (step 1). Use new screws and lockwashers.

3. Install the main nozzle, making sure it seats in the body casting.

4. Install the intake valve seat and valve.

5. Install the float and float pin. Center the pin so the float bowl doesn't ride against it.

6. Check the float level with the carburetor casting inverted. See Fig 3.2.K and Sect 3.2.5.3.

7. Install the bowl ring gasket, bowl and bowl nut. Make sure that the bowl is centered in the gasket, and tighten the nut securely.

8. Install the load adjusting needle with its spring. Turn in until it seats and back out 1 to 1-1/2 turns.

9. Install the idle adjusting screw finger tight. Then back out 1 to 1-1/2 turns.

10. Reinstall the choke coil and adjust according to Sect 3.2.4.1.

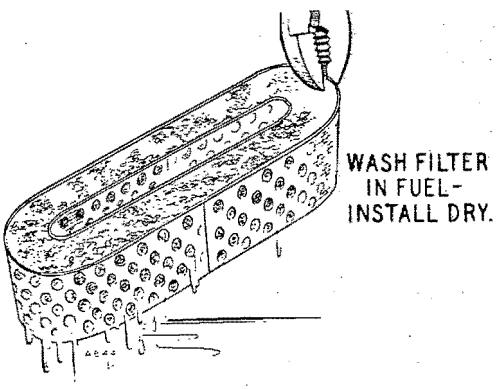
11. Install the air horn assembly and gasket.

12. Install the carburetor on the engine and connect the gasoline inlet, governor mechanism, breather hose, and choke.

13. Install the air silencer.

3.2.6 AIR SILENCER

The metal filter element serves also as a flame arrester. Do not substitute with non-metal. Clean it regularly and assemble dry. Replace the element if damaged.



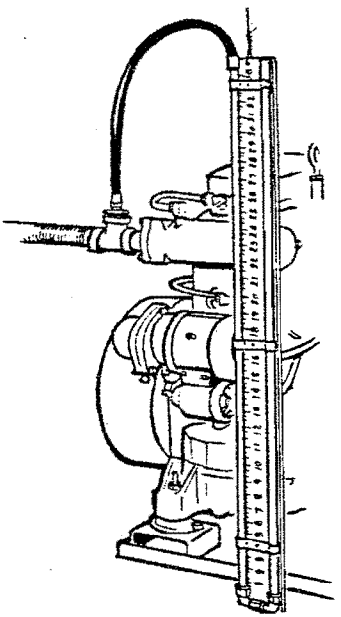
3.2.L AIR SILENCER

3.2.7 EXHAUST SYSTEM

The exhaust system is normally supplied by the user, and installed in the field. However, the importance of correct exhaust system cannot be over emphasized. A poor or clogged system can cause low power, overheating and eventual damage. The effect of a poor exhaust system is to increase the back pressure at the engine, reducing efficiency. If excessive back pressure is suspected, check it according to the procedure below.

3.2.7.1 TESTING. - Install an adapter or tee in the exhaust line next to the manifold. Connect a manometer or pressure gauge to the adapter. If there is a condensation trap next to the manifold, this can be used for the manometer connection. Run the plant under full load and observe the manometer. See Fig 3.2.M for maximum values. If the reading is higher, the exhaust system should either be disassembled and cleaned or altered to reduce back pressure.

NOTE: Back pressure readings can be taken at no load and maximum values are shown below, but this isn't as accurate as full load readings. Take the back pressure readings at full load whenever possible.



	UNITS OF MEASUREMENT	FULL LOAD	NO LOAD
1 OR 2 CYL.	INCHES OF WATER	27	5.1
	INCHES OF MERCURY	2	3/8
	OUNCES	15.6 OZ	2.9 OZ
4 CYL.	INCHES OF WATER	27	4.7
	INCHES OF MERCURY	2	1/3
	OUNCES	15.6 OZ	2.7 OZ

FIG 3. 2. M - MEASURING EXHAUST BACK PRESSURE

TROUBLE-SHOOTING CHART 3, FUEL SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
No gasoline to carburetor	Vapor lock in fuel line or pump.	Allow engine to cool; check for possible overheating.
	Defective fuel pump.	See Sect 3.2.3.1.
	Restricted fuel line.	Clean or replace.
	Clogged fuel strainer.	Clean, Sect 3.2.2 — adjust service periods and check source of contamination.
Flooding	Overchoking.	Adjust or repair choke.
	Incorrect adjustment of carburetor float level.	See Sect 3.2.5.3.
Electric choke won't open	Incorrect adjustment — defective heating element.	See Sect 3.2.4.
	Incorrectly installed bi-metal spring.	See Fig 3.2.F.
	Binding choke shaft.	Disassemble and repair.
Excessive Fuel Consumption	Generator overloaded.	Reduce load.
	Poor compression.	See Sect 3.7.2.
	Carburetor out of adjustment.	Adjust carburetor.
Power Lag When Load is Increased	Metering well vent restricted.	Clean carburetor. Clean extended air passage through air cleaner adapter and gasket (late models).

3.3 Ignition System

All models (MJA, MJB, MJC) are equipped with a 12 volt battery ignition system. The function of this system is to provide a spark in each cylinder at the correct time to ignite the fuel air mixture. All systems use suppressed ignition components to minimize radio interference. The 4 cylinder model (MJC) uses a battery ignition system with dual breaker points and ignition coils.

3.3.1 TESTING

The most complete test for an ignition system is to check the final result -- spark on the spark plugs. Remove each plug in turn, reinstall the ignition wire to that plug and hold the plug base against a piece of bare engine metal. Then crank the engine and watch the spark. A good blue spark indicates a healthy ignition system, a weak or yellow spark or no spark, a poor ignition system. The defect can be caused by defective breaker points, coil, condenser, or wiring. A good spark on all but 1 cylinder indicates a defective spark plug or defective high tension wire.

3.3.2 MJA IGNITION SYSTEM

This ignition system, Fig 3.3.A, uses a conventional automotive 12 volt coil, battery ignition to fire the single spark plug. Except for the coil, the system is similar to the ignition system for the 2 cylinder MJB models. For information on maintenance, timing, breaker points, condenser, or coil see MJB IGNITION SYSTEM, Sect 3.3.3.

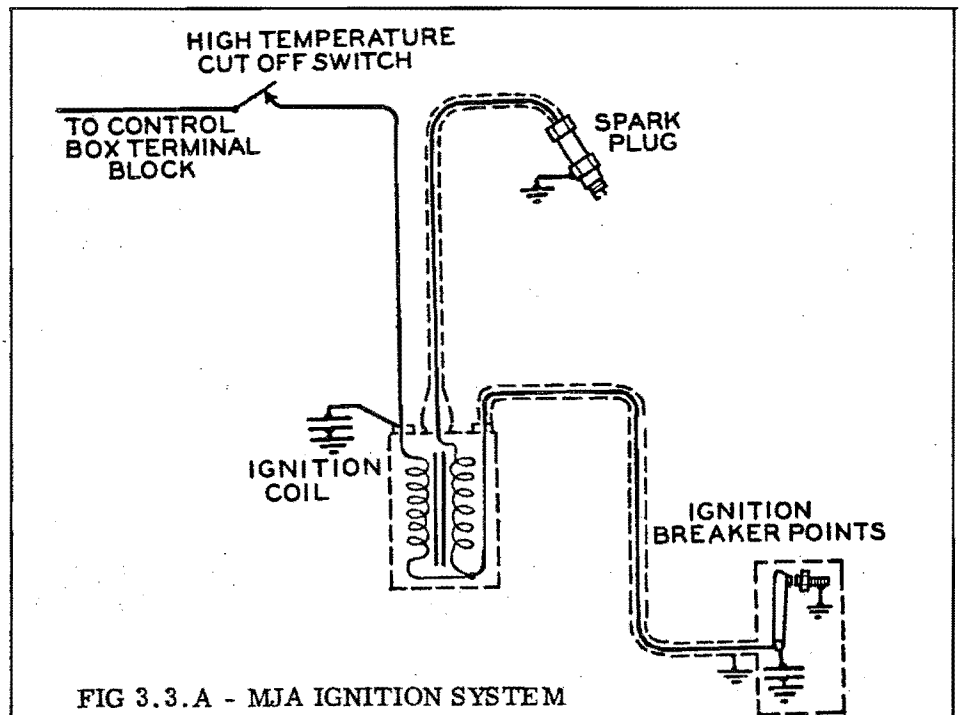


FIG 3.3.A - MJA IGNITION SYSTEM

3.3.3 MJB IGNITION SYSTEM

This ignition system uses a single 4 volt coil, battery ignition to fire both spark plugs simultaneously; this means one spark plug fires on the exhaust stroke while the other is firing at the end of the compression stroke. A spark advance on the breaker point mechanism advances the spark from 5° ATC (after top center) when cranked to 25° BTC (before top center) when running at rated speed and using gasoline.

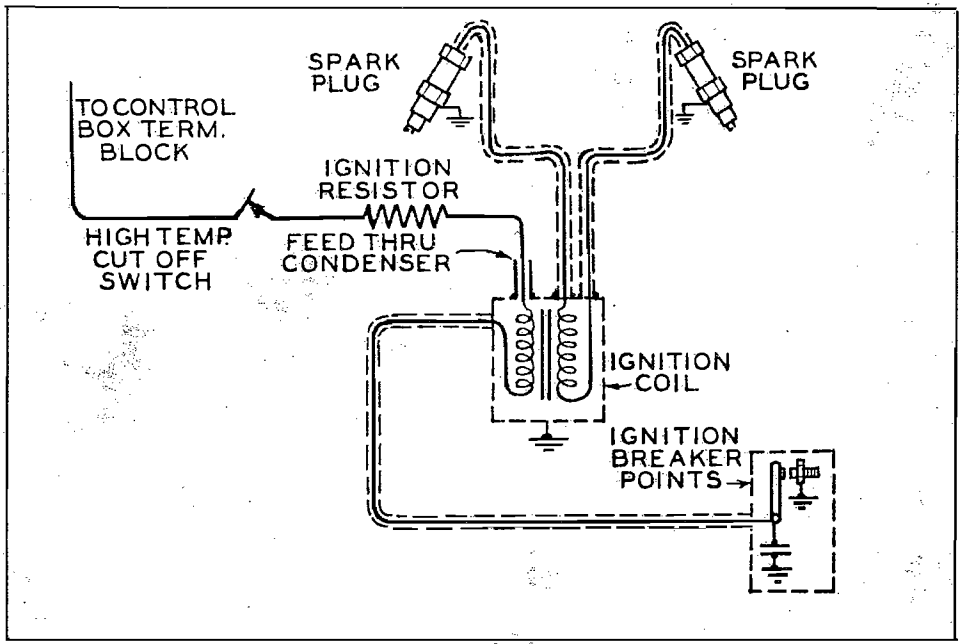


FIG 3.3.B - MJB IGNITION SYSTEM

3.3.3.1 Maintenance. - Operating with a weak spark is detrimental to the generating plant, so periodic service is extremely important. Periodic maintenance should include -

-- checking the ignition breaker point gap.

-- checking and cleaning spark plugs.

-- inspecting both the low and hi tension wiring.

-- checking the ignition timing.

To adjust the breaker gap, rotate the crankshaft clockwise until the 55° ATC mark on the flywheel matches the timing pointer (Fig 3.3.C). This is the point of maximum breaker opening.

The maximum gap should be .020 in.; check it with a feeler gauge. If the gap isn't correct, loosen the adjustment screw and move the stationary contact. Retighten the screw and recheck the gap.

When adjusting the points, check to be sure they are clean and not pitted. If necessary, clean the points with paper or gauze tape. If they are defective or excessively pitted, replace them - See Sect 3.3.3.3. For spark plug inspection see Sect 3.3.5. To check ignition timing, see Sect 3.3.3.2.

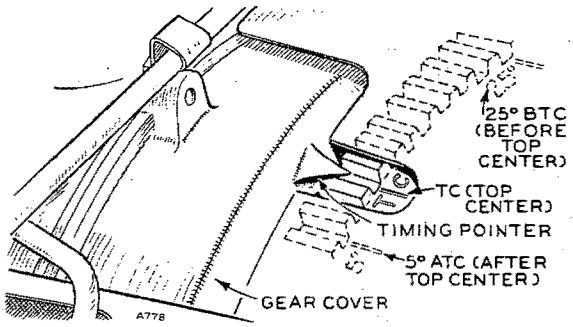


FIG 3.3.C - FLYWHEEL TIMING MARKS AND THE TIMING POINTER

3.3.3.2 Timing. - The engine can be timed either stopped or running at rated speed. With the engine stopped, timing should be set for ignition at 5° ATC; with the engine running at rated speed, 25° BTC. Always adjust the breaker point gap before timing the ignition.

A. Timing Procedure, Plant Stopped (gasoline fuel).

1. Remove the breaker points' cover, disconnect the lead to the ignition points and install a continuity test lamp and battery so the lamp lights when the points are closed.

2. Rotate the flywheel clockwise until the TC mark on the flywheel approaches the timing indicator, (Fig 3.3.C).

3. Then slowly rotate the flywheel clockwise until the light goes out indicating that the points have opened. This is the ignition point. If timing is correct, ignition will occur at 5° ATC.

4. If ignition timing isn't correct, align the 5° ATC mark and the timing pointer, then loosen the breaker plate capscrews and rotate the plate so the light goes out. Rotating clockwise advances timing, counterclockwise retards it.

5. Retighten the plate and check timing, step 3. If timing isn't correct, again adjust the plate. Otherwise reconnect the ignition lead and replace the cover.

B. Timing Procedure, Plant Running

1. Install an automotive timing light on either of the spark plug leads.

2. Run the engine at rated speed and check timing with the light. If timing is incorrect, loosen the breaker plate mounting screws and correct it by rotating the plate. Rotating clockwise advances timing, counterclockwise retards it. Retighten the plate before rechecking the timing point.

3. Adjust the timing, retighten the breaker plate and then recheck the ignition point.

If the ignition point can't be adjusted to specifications, either the timing gear or camshaft gear is incorrectly installed or the centrifugal advance mechanism is defective, and the breaker mechanism must be disassembled for repair.

3.3.3.3 Breaker Points. - The ignition breaker points, Fig 3.3.D, operate from a cam located on the timing or start-disconnect gear. This gear, in turn, is driven by the camshaft gear.

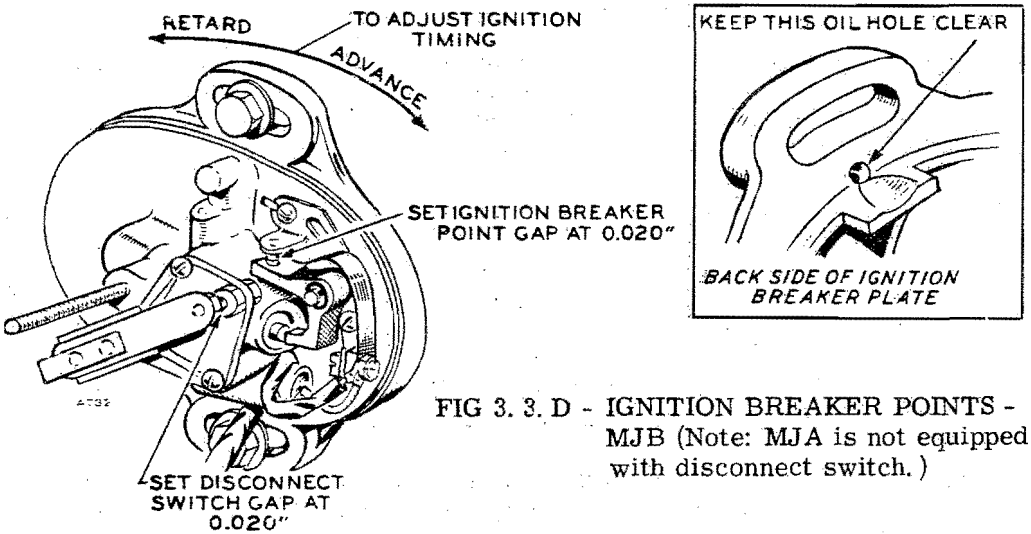


FIG 3.3.D - IGNITION BREAKER POINTS - MJB (Note: MJA is not equipped with disconnect switch.)

A. Disassembly

1. Disconnect the battery to prevent accidental shorts.

2. Remove the point set cover and disconnect the wires from the start-disconnect switch (if used) and the ignition breaker points.

3. Remove the 2 capscrews holding the breaker plate assembly and pull off the plate.

4. Pull out the cam and weight assembly. Be careful not to lose the spacer mounted on the gear shaft.

5. To disassemble the breaker plate assembly, remove the condenser and points and pull out the plunger and plunger diaphragm.

B. Repair. - Thoroughly clean the gear and cam assembly. The weights should move freely in and out without catching in either end position. Inspect the gear ramp for notches or other defects. If any part of the cam, weight and gear assembly sticks, the complete assembly must be replaced. Inspect the weight springs, and compare them against the data in Fig 3.3.E. If the cam is loose on the gear shaft, the complete assembly must be replaced. Clean and inspect the bearing surfaces in the breaker plate and gear case; be sure to clean the oil trickle holes into these bearings. Check the oil spray hole in the gear case to be sure it is open, Fig 3.10.A. If the breaker points won't maintain the proper gap, check for excess wear in both the cam and the ignition breaker plunger.

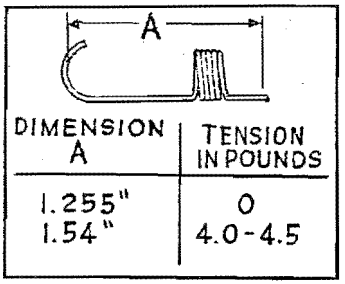


FIG 3.3.E - CENTRIFUGAL WEIGHT SPRING DATA

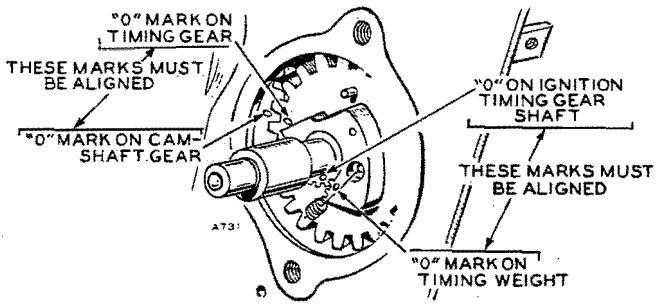


FIG 3.3.F - TIMING MARKS ON TIMING CAM, GEAR, AND CAMSHAFT

C. Assembly

1. Install springs on the weight assemblies. Install the cam on the gear shaft, being sure to align the timing marks, (Fig 3.3.F) and install the cam spring.

2. Install the spacer and thrust washer on the gear shaft assembly, and install the assembly into the gear case. Match the timing marks on the timing gear and camshaft gear (Fig 3.3.F).

3. Install the spring and plunger on the end of the shaft.

4. Install the breaker plate. Install the ignition plunger and diaphragm and diaphragm cup, Fig 3.3. G.

5. Install the start-disconnect (when used) diaphragm and plunger, and install the start-disconnect breaker points.

6. Adjust the start-disconnect breaker point gap (if used) to .020 in.

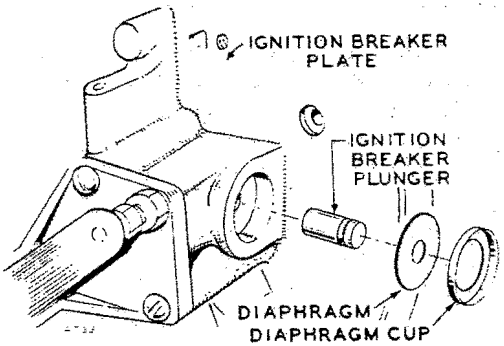


FIG 3.3.G - INSTALLING IGNITION PLUNGER

7. Install the ignition breaker points and adjust the gap, Sect 3.3.3.1.

8. Time the ignition, Sect 3.3.3.2.

3.3.3.4 Condenser. - The .3 mfd condenser mounted on the breaker plate aids primary field breakdown when the points open and prolongs the life of the breaker points by reducing the arc across them. A defective condenser causes a weak spark and rapid breaker point wear. Use a standard commercial condenser checker to test the condenser for leakage, openings or grounding. If no tester is available, check for shorts or defective leads and replace the condenser if you suspect it has defects.

3.3.3.5 Coil. - If spark is weak or there is no spark, and the breaker points are clean and properly adjusted, test the coil for possible defects. As a general test of the coil, disconnect the spark plug lead(s), ground one (if 2 leads), and hold the lead (second lead if dual terminal coil) 1/4 inch from the engine. Then crank the engine. A good spark indicates the coil is operating.

Further tests of the coil are as follows:

1. With an ohmmeter check the resistance of the coil windings. Normal resistance readings range from .5 - 2 ohms for the primary winding and from 4000 - 10000 ohms for the secondary winding. Extremely low resistance usually indicates a shorted winding and extremely high resistance usually indicates an open in the winding.

   WARNING: The 4 volt coils (MJB, MJC) can be tested on a 6 volt tester. However, a 12 volt tester will destroy the coil in a few seconds.

2. When a coil passes all the above-mentioned tests and fails to operate, it should then be tested on any one of the popular make coil and winding testers for which test data is available.

3.3.4 MJC IGNITION SYSTEM

The MJC generating plant uses a suppressed battery ignition system with dual breaker points to produce and distribute spark to 4 cylinders (Fig 3.3.H).

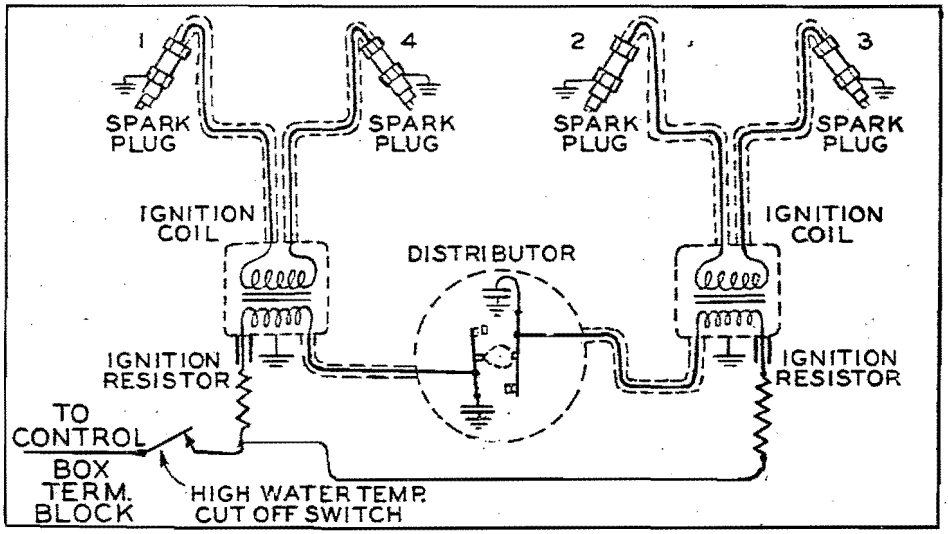


FIG 3.3.H - MJC IGNITION SYSTEM

The ignition system includes 2 ignition coils, distributor with spark advance and 2 sets of breaker points, and spark plugs. Breaker point set no. 1 fires cylinders 1 and 4; point set no. 2 fires cylinders 2 and 3. See Fig 3.3.I.

3.3.4.1 Maintenance. - Periodic maintenance of the MJC ignition system should include oiling the distributor, cleaning and adjusting the breaker points, checking ignition timing, cleaning and adjusting the spark plugs, and general inspection of the ignition system wiring.

At regular intervals, add 3 to 5 drops of medium engine oil to the oiler on the distributor. Add 1 drop of light engine oil to the breaker arm hinge pin and 3 to 5 drops to the centrifugal weight pivots. Wipe grease lightly on each lobe of the breaker cam. Don't over lubricate the distributor.

To adjust the breaker points, remove the distributor cap and rotate the crankshaft to get maximum breaker gap. The gap should be .017 - .022 in. At the same time, inspect the points for dirt or pitting.

Dirty points can be cleaned with tape and carbon tetrachloride. But if the points are excessively pitted, they must be replaced.

3.3.4.2 Timing. - Ignition timing means adjusting the dsitributor so the spark for each cylinder fires at the correct time for maximum power (25° BTC of each compression stroke).

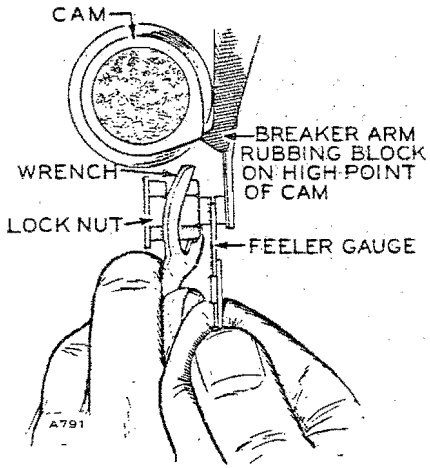


FIG 3.3.I - MEASURING DISTRIBUTOR BREAKER GAP

The MJC ignition system may be timed either with the engine stopped or running. But before timing the ignition, be sure both sets of breaker points are clean and properly adjusted. Breaker point set no. 1 opens to fire cylinders 1 and 4 while point set no. 2 opens to fire cylinders 2 and 3.

A. Timing Procedure, Engine Stopped.

1. Disconnect the low voltage lead to the distributor and connect a test lamp and battery so the lamp lights when the no. 1 set of breaker points are closed.
2. Remove the spark plug from #1 cylinder and rotate the flywheel clockwise until air is forced out of the spark plug hole.
3. Continue rotating the flywheel slowly until the test lamp goes out, indicating that the breaker points have opened. This is the ignition point. If the TC mark on the flywheel and the ignition timing pointer are aligned, timing is correct, otherwise the distributor will have to be adjusted.
4. To correct timing, align the flywheel TC mark and the timing pointer. Then loosen the distributor body and rotate it (clockwise if ignition occurred early and counterclockwise if late), until the light goes out.
5. Retighten the distributor body in the new position and recheck the timing, step 3. If timing still doesn't occur at the correct point, repeat step 4.
6. The no. 2 set of points should be properly timed to open if the gap is correct (.017 - .022 in.) and no. 1 set of points has been properly adjusted. However, they may be checked for proper timing by placing a timing mark on the flywheel 180° from the TC mark. Then repeat steps 1 - 5 substituting cylinder 2 for cylinder 1 and the new timing mark for TC. Later flywheels have BC (Bottom Center) mark.

B. Timing, Engine Running

1. Install an automotive timing light on the spark plug for cylinder #1; following the manufacturer's instructions.

2. Run the plant at rated speed. Aim the flashing timing light toward the flywheel.
3. If the timing pointer on the gear cover indicates 25° BTC, timing is correct. Otherwise, loosen the distributor body clamp and rotate the distributor body to adjust timing. If timing is early (25° mark to the right of the pointer) rotate the distributor clockwise to retard the ignition point. Tighten the distributor in its mount and recheck timing with the light.
4. The no. 1 set of breaker points fires cylinders 1 and 4. Breaker point set no. 2 fires cylinders 2 and 3 and should be properly timed to open if the gap is correct (.017 - .022 in.). The timing may be checked by placing a timing mark on the flywheel 180° from the 25° BTC mark (155° ATC). Then repeat steps 1 - 3 substituting cylinder 2 for cylinder 1 and the new timing mark for 25° BTC.

NOTE: If the relative position of the timing marks doesn't remain steady, the distributor is probably defective. This can be caused by pitted or misaligned breaker points, incorrect breaker point spring tension, worn or loose breaker plate or a worn distributor shaft or bushing.

3.3.4.3 Distributor. - The distributor serves 3 functions. It contains and opens the breaker points at the proper time, contains an automatic spark advance mechanism, and serves the two coils which supply high voltage to the spark plugs.

A. Testing. - The cam dwell, firing a single point, is a mean of 321 degrees. Since this is not readable on most meters the point opening should be adjusted .017 - .022 inches. See Sect 3.3.4.1.

Thoroughly inspect the breaker points and check to be sure the movable contact turns freely on its pivot.

Using a spring scale, measure the tension of the points as they break contact. Tension should be 17 to 20 ounces. If it is greater, it causes excess wear; if less, the contact will bounce. See step 9, sub sect D, distributor assembly, to adjust tension.

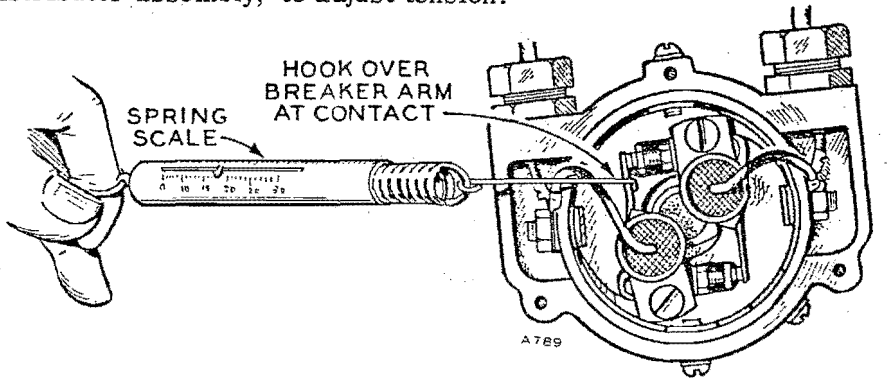


FIG 3.3.J - MEASURING CONTACT SPRING TENSION

E. Removal and Disassembly

1. Remove the distributor cap by removing the 3 mounting screws.

2. Remove the two primary leads from the distributor terminals.

3. Remove the two coil leads from the breaker point cover adapter.

4. Record the position of the distributor body for easier assembly.

5. Remove the distributor hold down capscrew and pull the distributor out of the crankcase.

6. Remove the 3 screws holding the breaker plate to the distributor housing and loosen the primary lead mounting terminals.

7. Lift the breaker arms off their hinges.

8. Rotate the breaker plate counterclockwise about 45° and pull it out of the distributor body.

9. Remove the 2 centrifugal advance springs.

10. Remove the spring clip (cam retaining spring) holding the cam to the drive shaft and lift out the cam. The weights are now free and can be lifted out.

11. If necessary, press the 2 bronze bearings out of the distributor body. To check for bearing wear, see Repair, next sub-section.

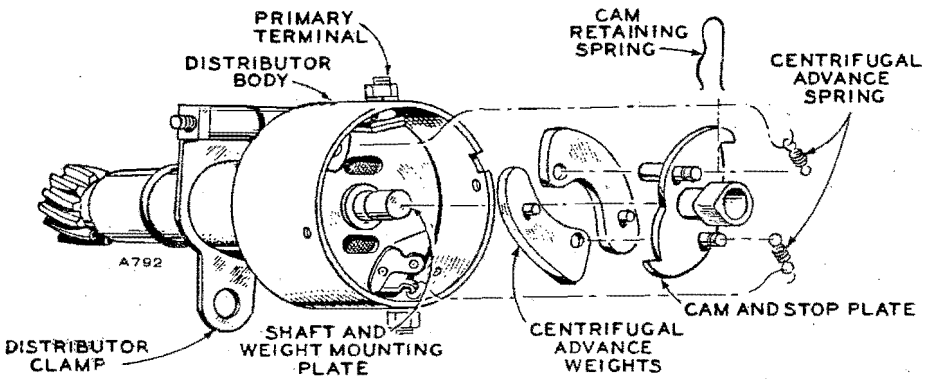


FIG 3.3.K - DISTRIBUTOR CENTRIFUGAL ADVANCE MECHANISM

C. Repair. - Clean all disassembled components except the condenser, breaker points and bushings in light cleaning solvent. When dry, inspect all components. Inspect the centrifugal advance component for signs of wear and replace any that appear worn or otherwise damaged. Inspect the cam and shaft for wear or score marks. If either is scored, replace it.

To check for excess bearing wear, set the drive shaft into the body and measure the side play at the top of the cam with a dial indicator. Mount the indicator on the distributor body, and measure the side play that occurs when you pull the shaft directly away from the indicator with a force of about 5 pounds. Side play should be less than .005 in. If not, the bearings must be replaced. But, because of the great care that should be exercised during replacement and special driver required to correctly size the bearings, ONAN doesn't recommend field replacement of bronze shaft bearings unless the required equipment is available. This can be done by an authorized service station.

D. Assembly, Distributor

1. Install the shaft assembly with the upper drive shaft thrust washer in the distributor body.

2. Install the lower drive shaft thrust washer and drive gear. Install a pin through the drive gear and shaft and peen it into place.

3. Check the drive shaft end play. It should be between .003 in. and .010 in. If end play is too small, tap the lower end of the distributor drive shaft lightly with a soft hammer to increase play. If it is too great, check the thrust washer installation or reinstall the gear.

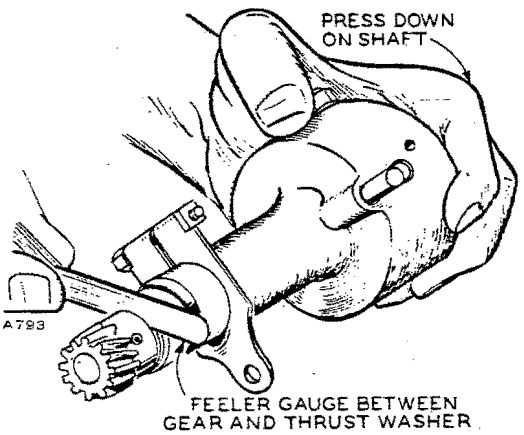


FIG 3.3.L - CHECKING DISTRIBUTOR SHAFT END PLAY

4. Set the centrifugal advance weights into place and install the cam. Be sure the pivots on the cam fit into the hole in each weight.

5. Secure the cam with the spring clip and install the weight springs.

6. Install and secure the breaker plate.

7. Mount the breaker arms on their pivots and place the control spring end between the end of the terminal stud and the square metal washer. Then tighten the primary terminals.

8. Align the contacts so they make contact near the center. To do this, bend the stationary contact bracket, not the breaker arm.

9. After aligning the points, check the tension of the breaker spring with a spring scale hooked on the arm at the contact and held at right angles to the contact surfaces (Fig 3.3.J). Tension should be 17 to 20 oz. If not, adjust it by loosening the screw holding the end of the contact spring and installing spacing washers or sliding the end of the spring in or out.

10. Rotate the drive shaft to obtain maximum breaker gap and set the gap for .020 in. (Fig 3.3.I).

E. Installation, Distributor. - If you know the position of the distributor when removed and the crankshaft wasn't moved after distributor removal, the distributor can be installed in exactly the same position. After installing, perform steps 3, 4, 5, and 6 below.

But if the exact position of both distributor body and rotor weren't recorded or the crankshaft was rotated, follow the complete procedure below.

1. Remove the spark plug from #1 cylinder. Place a finger over the spark plug hole and rotate the flywheel clockwise until the cylinder builds up pressure. Continue rotating until the TC mark of the flywheel aligns with the timing pointer.

2. While holding the distributor in the position shown in Fig 3.3.M and the points in an open position, push the distributor into its mounting hole. It may be necessary to rotate the distributor slightly to position and mesh the distributor and camshaft gears.

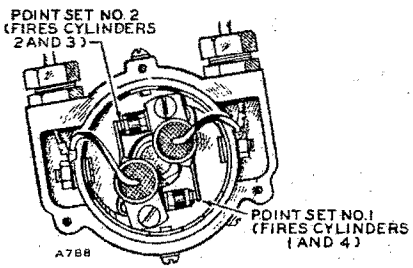


FIG 3.3.M - DISTRIBUTOR INSTALLATION POSITION

3. Install the distributor clamp screw.

4. Connect the coil leads to the breaker point cover adapter. See Sect 3.3.H.

5. Connect primary leads to distributor terminals.

6. Time ignition system. See Sect 3.3.4.2.

3.3.4.4 MJC Ignition Coils. - The MJC generator uses two suppressed ignition coils mounted on the intake manifold. Normal ignition coil maintenance should include inspecting and tightening the terminals and cleaning them if necessary.

A quick check for possible coil failure can be made by simply disconnecting the high tension spark plug leads (cyl. 1 or 4 for coil nearest cyl. 1 -- cyl. 2 or 3 for other coil) See Fig 3.3.H. Then hold the end of the leads 1/4 inch from bare engine metal and crank the engine. A spark between the lead end and the engine indicates the coil is operating, although it (one coil or the other) may be weak, which could only be checked on a tester or by checking resistances. No spark indicates that the coil, points, or control circuit to the coil is defective. Before condeming the coil if there is no spark, check hi tension lead for voltage while cranking the plant and inspect the breaker points.

For further tests of the coil see no. 1 and 2 under Sect 3.3.3.5.

3.3.4.5 MJC Ignition Condensers. - The two condensers are mounted in a vertical position inside the distributor. If they are suspected of being defective, see Sect 3.3.3.4 for testing, and replace if necessary. Capacitance should be .3 mfd.

3.3.5 SPARK PLUGS.

MJA, MJB, and MJC generating plants use aviation type spark plugs equipped to accept suppressed ignition leads. Fouled spark plugs indicate they are too cold. Consult the plant parts catalog for the factory recommended plug. Remove, clean, and inspect the plugs at regular intervals. If they are in good shape, they can be cleaned on a commercial plug cleaner and regapped. The spark plug gap should be set at .025 inch for gasoline fuel.

When spark plug electrodes become excessively worn or if the plugs are damaged, replace them.

When replacing or reinstalling spark plugs, always install new gaskets.

TROUBLE-SHOOTING CHART 4, - IGNITION SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
No spark	No voltage to ignition system.	Check control system Sect 6.
	Defective breaker points.	Inspect points for dirt, burning, pitting. Check clearance.
	Defective high tension leads.	Replace.
	Defective spark plugs.	Replace.
	High resistance in primary leads.	Replace.
	Defective ignition coil.	Replace.
Weak, Yellow Spark - usually causing hard starting	Dirty, burned or pitted breaker points.	Clean or replace the points.
	Defective ignition condenser.	Test and replace if defective
	High resistance in primary circuit.	Clean all connections and inspect the wiring.
	Defective spark plugs.	Replace.
	Weak ignition coil.	Replace.
Excessively Burned or Pitted Ignition Points	High voltage.	Be sure correct voltage batteries are used.
	Dirty or oily points.	Keep points clean at all times - don't over oil cam and pivot.
	Breaker gap too small.	Adjust.
	Defective ignition condenser.	Check the condenser on a commercial tester.
	Using the wrong ignition condenser.	Use only the condenser specified.

TROUBLE-SHOOTING CHART 4 - IGNITION SYSTEM (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Weak or No Spark on Some Cylinders — usually indicated by engine missing	Defective hi-tension leads.	Replace.
	Defective spark plug.	Clean or replace.
Oil Fouled Spark Plugs	Worn rings or pistons.	Check compression, Sect 3.7.2.
	Worn valve stems or guides.	Check clearance, Sect 3.7.
	Weak battery.	See Sect 3.6.2.
	Faulty ignition wires.	Replace.
	Faulty distributor points (MJC).	See Sect 3.3.4.1.
	Weak ignition coil.	Test and replace if necessary.
	Too cold a plug.	Replace with hotter plugs.
Gas Fouled Plugs (dry black fluffy deposit)	Excessive choking.	See Trouble-Shooting Chart 3 - Choke Won't Open.
	Too rich a fuel mixture.	Adjust carburetor.
	Prolonged periods of no load operation.	Check optional procedure.
	Too cold a spark plug.	Change to hotter plugs.
Burned Spark Plugs (dry, shiny, glossy deposits on insulator or possibly cracked insulator.	Too lean a fuel mixture.	Adjust carburetor.
	Poor engine cooling.	Check cooling system, See Sect 3.1.2.

TROUBLE-SHOOTING CHART 4 - IGNITION SYSTEM (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Burned Spark Plugs (dry, shiny. glossy deposits on insulator or possibly cracked insulator) (Cont.)	Poorly seated valves.	Check compression Sect 3.7.2.
	Improper timing.	Retime the ignition.
	Too hot a spark plug.	Change to colder plugs.
	Improper plug installation.	Be sure seals and threads are clean and gaskets good, use only recommended torque.
	Compression leakage through the spark plug.	Be sure seats, gaskets, are in good condition.

3.4 Governor System

The governor system controls engine speed and the speed drop under load. The system consists of a governor cup with steel flyballs on the camshaft; a yoke, shaft, and arm; governor spring and adjusting screw; and linkage to the carburetor throttle lever.

Differing engine speeds change the position of the governor cup on its shaft. This change is transmitted by the shaft, arm, and linkage to the carburetor throttle lever. Engine speed is controlled by the tension on the governor spring. Sensitivity — the speed drop from no load to full load — is controlled by the number of spring coils used. More coils used give less speed drop from no load to full load — more sensitivity.

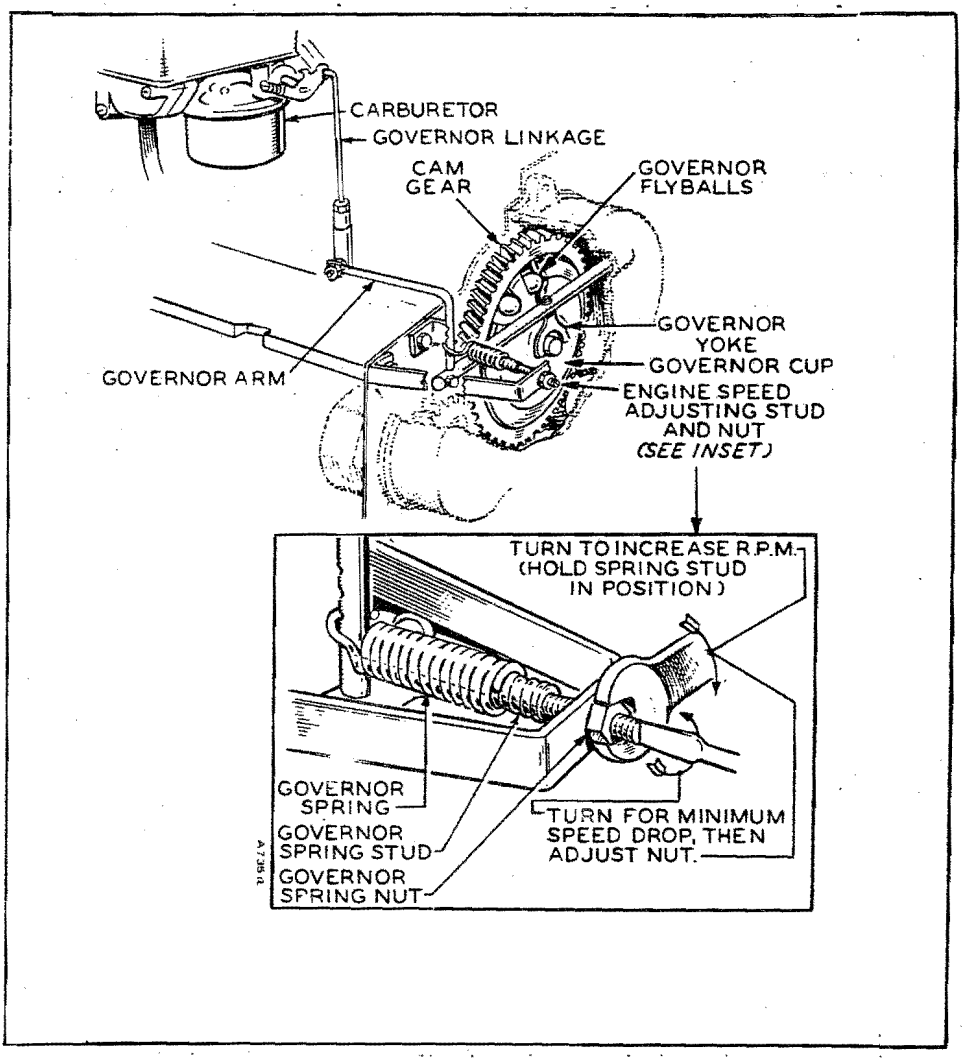


FIG 3.4.A - GOVERNOR SYSTEM, MJB, INCLUDING ADJUSTMENT

3.4.1 MAINTENANCE

Periodically clean and check for wear. Do not lubricate plastic type socket ball joints. Use lubricating graphite on other joints.

3.4.2 ADJUSTMENTS

Both the governed speed and the governor sensitivity can be adjusted with the stud and nut on the front of the engine air housing.

3.4.2.1 Speed Adjustment. - To adjust the engine's governed speed, hold the governor spring stud in position and adjust the governor spring nut with a wrench. For accurate speed adjustment, use a reed type frequency meter on the generator's ac output. A mechanical tachometer can be used, but this usually isn't as accurate. Set speed within the range shown in Fig 3.4.B.

3.4.2.2 Sensitivity Adjustment. - To adjust the governor sensitivity, turn the governor spring stud; counterclockwise gives more sensitivity, — less speed drop. If the governor is too sensitive, a hunting condition occurs (alternate increasing and decreasing speed). Adjust for range in Fig 3.4.B. After sensitivity adjustment, the speed will require readjustment.

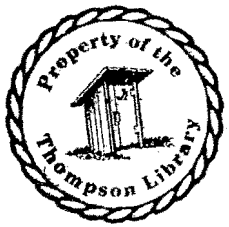
If the governor is either too sensitive or not sensitive enough and can't be adjusted with the stud, the sensitivity can be coarsely adjusted by moving the point where the spring attaches to the governor arm. Moving this point farther from the governor shaft decreases the governor's sensitivity.

Plant Model	Nominal output freq. (cps)	Max. allowable freq. (cps)	Min. allowable freq. (cps)	Freq. preferred - no load to full load	Max. freq. spread-no load to full load	Preferred freq. spread -no load to full load
Revolving Armature	60	63 (1890)	59 (1770)	61-59 (1830-1770)	3 (90)	1.5 (45)
	50	52 (1560)	48 (1440)	51-49 (1530-1470)	3 (90)	1 (30)
Revolving Field	60	64 (1920)	57 (1770)	61-59 (1830-1770)	3 (90)	2 (60)
	50	54 (1620)	47 (1410)	51-49 (1530-1470)	3 (90)	1 (30)

Numbers in parentheses are plant speed in rpm.
FIG. 3.4.B - FREQUENCY AND SPEED TABLE

TROUBLE-SHOOTING CHART 5, GOVERNOR SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
Speed too high (engine races)	Governor incorrectly adjusted.	Adjust for proper speed.
	Governor yoke installed backwards.	Turn so machined side of yoke touches governor cup.
	Governor cup improperly installed.	See Sect 3.10.3.
	Linkage binding.	Clean or replace linkage.
Speed too low	Governor incorrectly adjusted.	Adjust for proper speed.
	Low engine power (won't reach governed speed).	See Trouble-Shooting Chart 1.
"Hunting" condition	Governor spring sensitivity too great.	Adjust sensitivity.
	Carburetor out of adjustment.	Adjust carburetor.
Poor sensitivity	Excessive wear in linkage.	Replace governor linkage.
Governor acts slowly	Binding in linkage.	Clean and lubricate linkage.
No governor control	Linkage disconnected.	Reconnect linkage.



3.5 Oil System

All working parts of the engine are pressure lubricated. The oil system includes an oil intake cup, gear type oil pump, by-pass valve, oil pressure gauge, full-flow oil filter, and crankcase passages and drillings. Oil is held in the oil base, drawn by the pump, and delivered through the oil filter. Lines to the rocker housing, drillings in the crankcase to crankshaft and camshaft bearings, crankshaft passages to connecting rod bearings and connecting rod spray holes complete the oil system plumbing.

Because it helps to control oil consumption, the crankcase breather is included in this system.

Normal oil pressure should be 25 psi or higher when the engine is at operating temperature. If pressure drops below 20 psi at half throttle or governed speed, inspect the oil system for faulty components.

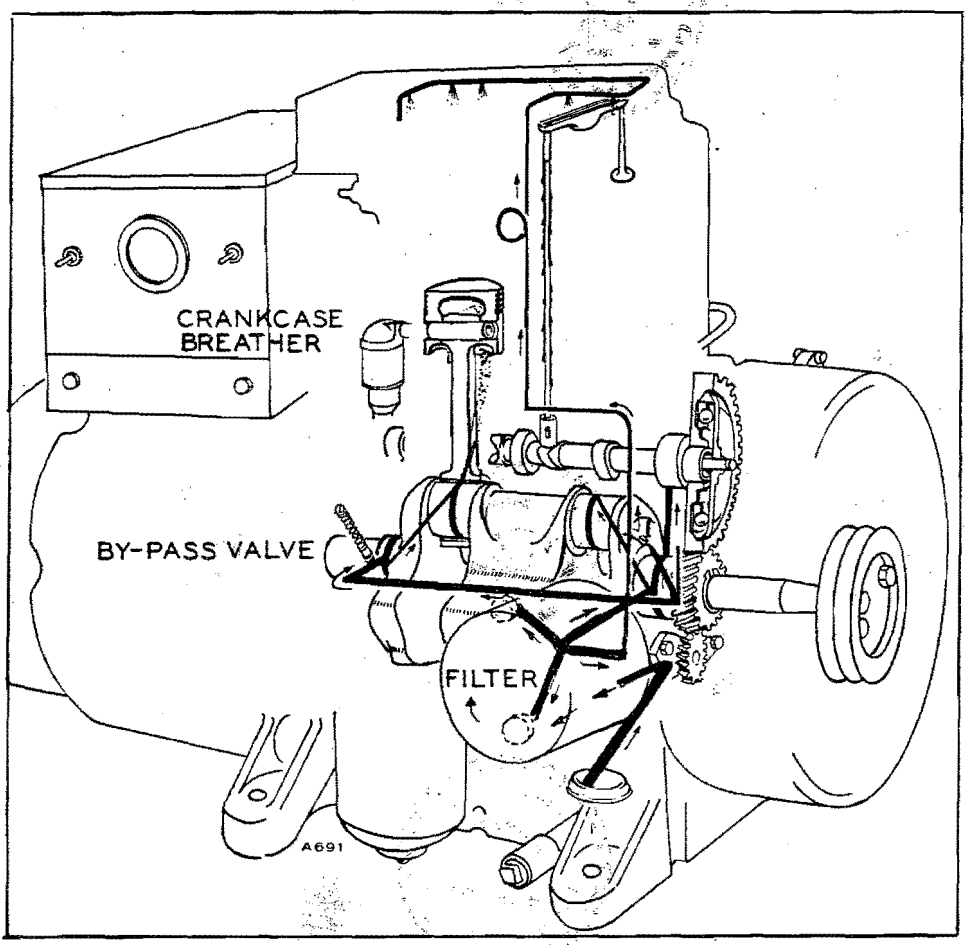


FIG 3.5.A - OIL SYSTEM

3.5.1 MAINTENANCE

Periodic oil system maintenance should include changing crankcase oil, cleaning the crankcase breather (Sect 3.5.7), cleaning rocker box oil lines (Sect 3.5.4), and replacing the oil filter (Sect 3.5.6). Consult the periodic service chart for service periods.

Always use a heavy duty detergent oil classified by A.P.I. for service "DG" or "MS/DG". Use the proper SAE number for the expected ambient temperatures. Do not use service "DS" oil.

Above 30°F	SAE 30
Below 30°F	SAE 5W-20

3.5.2 OIL PUMP

The oil pump is mounted on the crankcase behind the gear cover and is driven by the crankshaft gear.

3.5.2.1 Removal

1. Remove the gear cover (Sect 3.10.2) and oil base.
2. Unscrew the intake cup from the pump.
3. Remove the crankshaft lock ring and gear retaining washer.
4. Loosen the two capscrews holding the pump and remove the pump.

3.5.2.2 Repair. - Except for the gaskets, component parts of the pump are not individually available. If the pump is defective or excessively worn, replace it. Disassemble the pump by removing the two capscrews holding the pump cover to the body. Inspect for excessive wear in gears and shafts. To improve pump performance, adjust the gear end clearance by changing the gasket thickness between the pump body and cover. Use the thinnest gasket that permits free movement of the pump shaft. Oil all parts when reassembling the pump.

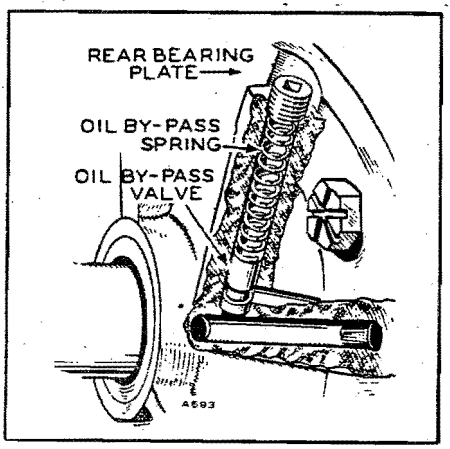


FIG 3.5.B - BY-PASS

3.5.2.3 Installation. - Before installing, fill the pump intake and outlet with oil for priming. Mount the pump on the engine, and adjust for .005" lash between the pump gear and

crankshaft gear. Mount the intake cup on the pump so it is parallel to the bottom of the crankcase.

3.5.3 BY-PASS VALVE

Located on the outside of the rear bearing plate, the by-pass valve controls oil pressure by allowing excess oil to flow directly back to the oil pan. Normally, the valve begins to open about 25 psi. It is non-adjustable and normally needs no maintenance.

To determine if high oil pressure is caused by the plunger sticking closed or low oil pressure by the plunger sticking open, clean and inspect the valve.

To remove the valve, unscrew the recessed plug in the rear bearing plate, and lift out the spring and plunger assembly. Determine proper valve operation by checking the spring and plunger against the following values:

Plunger Diameter	.3365" to .3380"
Spring	
Free Length	2-5/16 ± 1/16"
Force at 1-3/16"	2.225 ± .11 lbs.

3.5.4 OIL LINES

The rocker box oil line should be flushed with fuel and the small holes cleaned with fine wire at regular intervals. Clean out all other oil lines and drillings with compressed air whenever the engine is disassembled or overhauled. Reach the oil gauge passage by removing the oil filter mounting plate.

All external oil lines, the rocker box oil line and the internal oil line to the rear bearing are replaceable, if damaged.

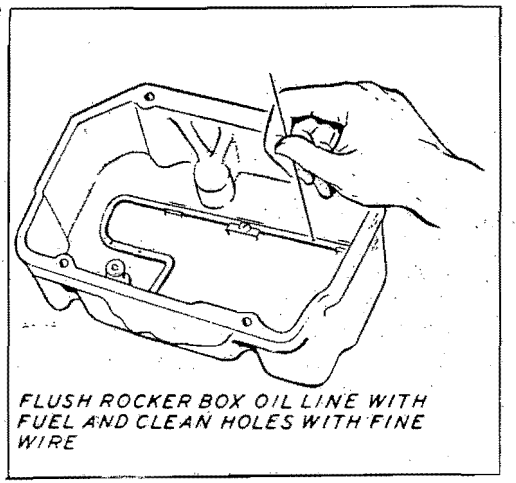


FIG 3.5.C - ROCKER BOX OIL LINE

3.5.5 GAUGE

The oil pressure gauge is located on the lower front corner of the cylinder block. If it is faulty, replace it. Remove it with a wrench, and screw in a new gauge. Before replacing, check for a clogged oil passage behind the gauge.

3.5.6 OIL FILTER

The full-flow filter is mounted on the filter plate at the left front corner of the crankcase. It requires periodic replacement normally every 200 hours of operation. Remove the filter by turning counterclockwise with both hands or a filter wrench. Oil the new gasket and then install a new filter; turn it hand tight plus 1/4 to 1/2 turn.

3.5.7 CRANKCASE BREATHER

The crankcase breather, located in the rear left corner of the crankcase maintains a partial vacuum in the crankcase during operation to control oil loss and ventilate the crankcase. It includes a metal filter packed into the tube on the crankcase, a rubber cap with flapper valve, and hose connecting it to the engine air horn.

NOTE: The MJC does not have a flapper valve.

To disassemble, remove the rubber cap from the crankcase tube and pry the valve out of the cap. Wash the valve in fuel at regular intervals and if defective, replace it. At the same time pull the baffle out of the breather tube and clean it. Install the valve with the perforated disc toward the engine.

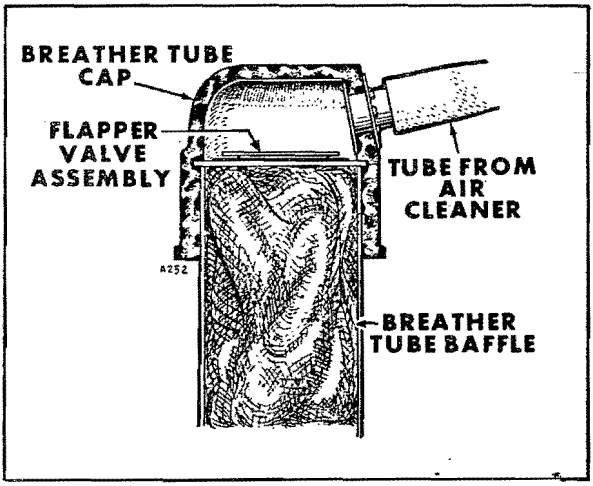


FIG 3.5.D - CRANKCASE BREATHER

TROUBLE-SHOOTING CHART 6. OIL SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
Diluted oil	Leaky fuel pump diaphragm	Rebuild pump
	Worn compression rings or scored cylinders	Inspect rings and cylinder walls
Sludge in crankcase	Dirty oil filter	Replace oil filter; adjust oil filter service periods
	Run for long periods at idle	Review operating procedures
Excess oil consumption, light blue smoky exhaust	Worn or sticking piston rings	Check compression. Clean or replace rings
	Defective breather valve	Clean valve
	Oil too light or diluted	Replace with proper grade of oil — if diluted check for cause
	Engine overheating	See Sect 3.1
Excess oil consumption; no change in exhaust	Leaking oil seals	Inspect crankshaft front and rear oil seals
	Leaky oil base gasket	Check for leaks around gasket. Replace if necessary
	Defective breather valve	Clean valve, Sect 3.5.7
Low oil pressure	Worn bearings	Rebuild engine
	Oil by-pass stuck open	Clean by-pass valve
	Oil supply low	Add oil. Check cause of oil consumption
	Worn oil pump	Install new pump

TROUBLE-SHOOTING CHART 6, OIL SYSTEM (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Low oil pressure (Cont.)	Defective oil gauge	Replace gauge
High oil pressure	Oil by-pass stuck closed	Clean
	Oil too heavy	Replace with lighter oil
	Clogged oil passages	Clean all lines and oil passages

3.6 Starting System

MODELS: MJB AND MJC, (EXCEPT 5MJB, PRIOR TO SPEC F)

NOTE: For MJA and earlier 5MJB see generator, revolving armature.

These models use a separate 12-volt starting motor, mounted on the right hand side of the engine, to drive the flywheel. It is a conventional automotive starting motor with solenoid shift and an over-running clutch. The motor is controlled by the start solenoid in the control box. When the control box solenoid is energized, the solenoid on the starter operates, shifting the pinion to engage the flywheel ring gear and feeding current to the starting motor. Disconnecting the starter at end of starting cycle varies according to model – on 705MJB and MJC the centrifugal switch closes and on 5MJB the start-disconnect relay is energized. The over-running clutch protects the starter armature from overspeeds.

3.6.1 MAINTENANCE

Periodically check the starting circuit wiring for loose or dirty connections. Inspect the starter commutator and if it is dirty, clean with #00 sandpaper. Check the brushes for excessive wear and reduced seating on the armature.

3.6.2 TESTING

Poor cranking performance can be caused by a faulty starting motor, defective battery, insufficient capacity battery, or high resistance in the starting circuit.

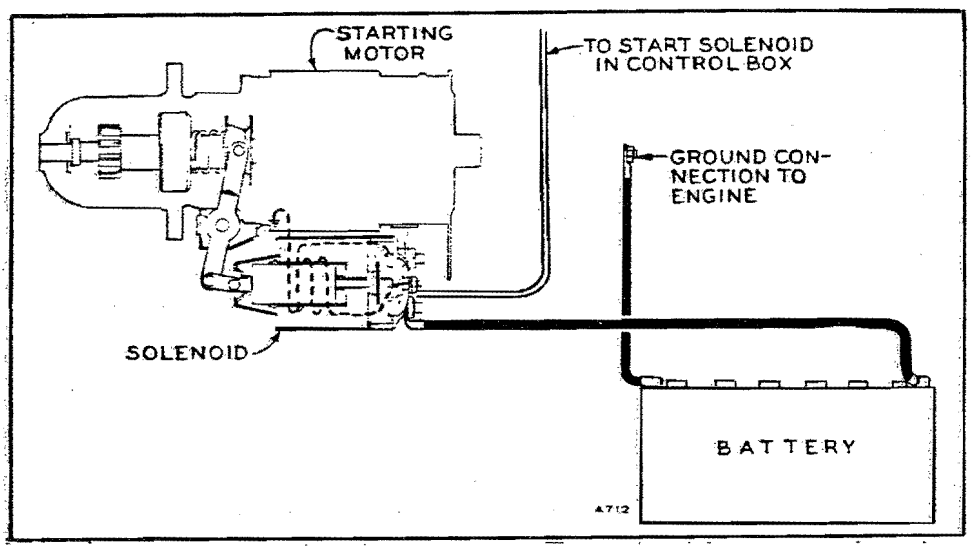


FIG 3.6.A - PICTORIAL STARTING MOTOR AND BATTERY

Check the charge condition of the battery with a hydrometer. Specific gravity should be between 1.290 and 1.225. If not, recharge the battery. If the battery won't recharge, replace it.

With the starting motor operating, check the voltage drops (1) from the battery ground terminal post (not the cable clamp) to the cylinder block (2) from the cylinder block to the starting motor frame and (3) from the battery positive post to the battery terminal stud on the solenoid. Normally, each of these should be less than 0.2 volts. If extra long battery cables are used, slightly higher voltage drops may result. Thoroughly clean all connections in any part of the circuit showing excessively high voltage drops.

If starting motor tests are required, remove the motor from the plant and test it on a bench. Test the free running voltage and current. Limits are given in the Table of Clearances and Limits (sect 9).

Using a spring scale and torque arm, test the stall torque, Fig 3.6.B. The torque will be the product of the spring scale reading and length of the arm in feet.

If free running speed is low, and a high current draw with low stall torque exists, check for tight, dirty, or worn bushings, bent armature shaft, or loose field pole screws allowing armature to drag, shorted armature, or grounded armature or field.

A low free speed with low torque and low current draw indicates an open field winding, high internal resistance due to poor connections, defective leads, dirty commutator, broken or worn springs, worn brushes, or scored, worn, or dirty commutator.

High free speed with low developed torque and high current draw indicates shorted fields. Since there is no easy way to detect shorted field coils, replace and check for improved performance.

The voltage drop across the solenoid on the starting motor should be less than 1.50 volts. If more, remove it for repair.

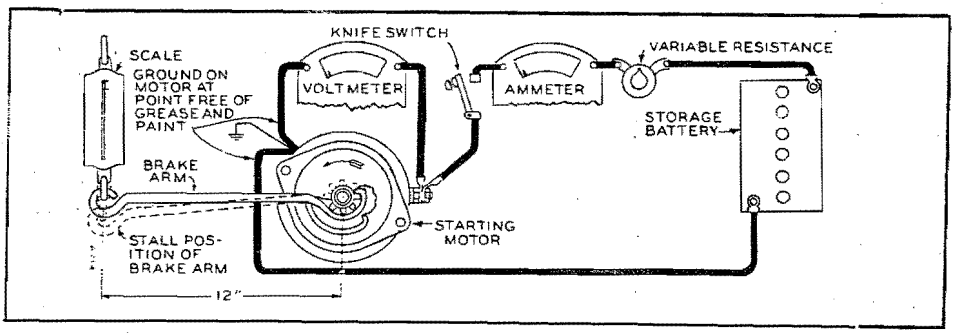


FIG 3.6.B - STARTING MOTOR STALL TORQUE TEST

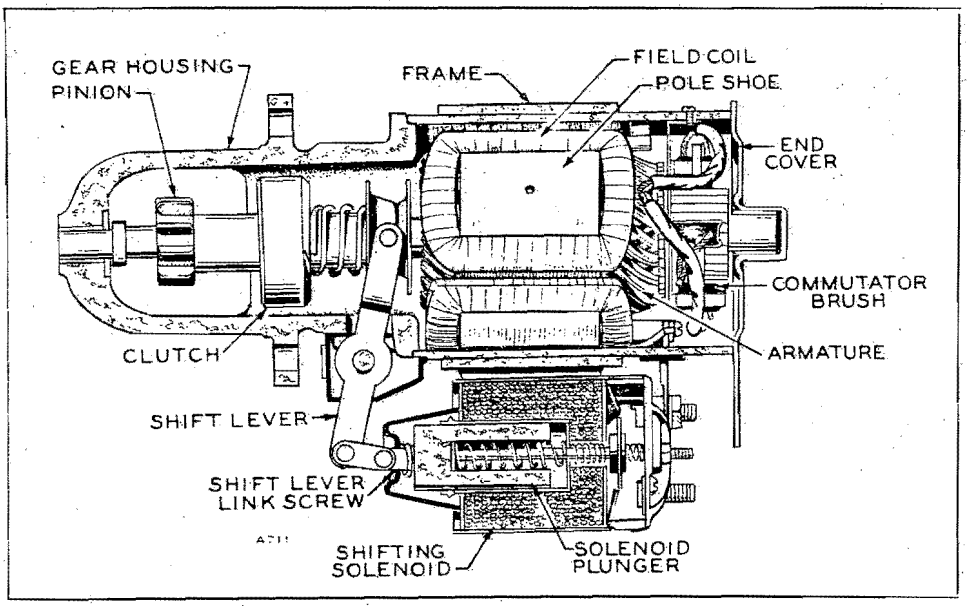


FIG 3.6.C - CROSSECTION, STARTING MOTOR

3.6.3 REMOVAL AND DISASSEMBLY, STARTING MOTOR

1. Remove connections to control box and battery at the shifting solenoid.

2. Remove nut holding rear mounting plate to engine.

3. Remove two nuts and capscrews holding starting motor to the starting motor flange and pull out the motor.

4. Remove the link pin holding the shift lever to the solenoid plunger and remove the shift lever center pin.

5. Remove the thru bolts from the commutator end of the motor. Pull off the end cover and lift the brushes off their seats.

6. Pull the cast housing from the front end of the motor and lift the armature and clutch out of the motor frame.

7. To remove the over-running clutch from the armature, drive the retainer away from lockring near the front end of the shaft, remove the lockring and pull the assembly off. Don't attempt to disassemble the clutch assembly.

8. If necessary to service the solenoid, remove the 4 capscrews and

electrical connection holding it to the motor frame. Remove the 2 screws on the rear of the solenoid to reach the switch contacts.

9. On early models only, if it is necessary to remove the starting motor flange (Fig 3.6.E), watch for shims between the flange and crankcase surface. Save any shims, they must be reinstalled to position the starter correctly.

3.6.4 REPAIR, STARTING MOTOR

3.6.4.1 Armature. - Inspect the armature for mechanical defects before checking for grounds or shorted coils.

To test for grounds, use a 12 volt test lamp and check between each segment of the commutator and the shaft. Don't touch probes to the commutator brush surfaces; this will burn the smooth surfaces.

A growler is necessary to test for shorted coils. With the armature in the growler, run a steel strip over the armature surfaces. If a coil is shorted, the steel strip will become magnetized and vibrate. Rotate the armature slightly and repeat the test. Do this for one complete revolution of the armature. If the armature has a short or ground, replace it.

If the commutator is only dirty or discolored, clean it with very fine sandpaper. Blow the sand out of the motor after cleaning. If, however, it is scored, rough or worn, turn it down in a lathe.

3.6.4.2 Field Coils. - Using a 120-volt test lamp and probes, check the field coils for grounding to the motor frame or open circuit. Inspect all connections to be sure they are properly clinched and soldered. Inspect the insulation for evidences of damage. The only way to check for field coil shorts is to use the test in sect 3.6.2.

3.6.4.3 Bearings. - If either the front or rear bearings show excessive wear, replace them. Drive the old bearings out, and using an arbor press and the proper arbor, press new bearings into place.

3.6.4.4 Brushes. - Check the brushes for wear or improper seating. They should slide freely in their holders. Check the brush spring tension with a spring scale. To change spring tension, twist the spring at the holder with long nosed pliers.

If brushes are excessively worn, replace them.

Some brushes are soldered to the field coil lead. Unsolder the lead and open the loop in the field coil lead. Insert the new brush pigtail completely into the loop and clinch before resoldering. A good soldering job is necessary to insure good contact and low voltage drop across the connection.

3.6.4.5 Over-Running Clutch. - Clean the clutch thoroughly but don't dip in solvent. It can't be repacked with grease.

It should slide easily on the armature shaft with no binding. Turn the pinion; it should rotate smoothly, but not necessarily freely. Reverse the direction a few times and it should instantly lock and unlock. Replace the clutch if operation is defective or pinion is worn or damaged.

3.6.4.6 Shifting Solenoid. - Check to be sure plunger moves freely in coil. Measure the pull-in coil current draw by connecting a battery, voltmeter and ammeter to the control terminal and the terminal to the motor. Measure the hold in coil draw from the control terminal to ground. Inspect the switch for corrosion and clean the contacts if necessary. Replace the solenoid if the current draw isn't within limits when cleaned.

3.6.5 ASSEMBLY, STARTING MOTOR

Before assembling, soak the bronze bearings in oil. They are absorbent bearings, designed to hold up to 25% of their own weight in oil. Be sure the felt oil pad is in the outer end of the commutator end bearing.

When the motor is assembled, check the armature end play. It should be between .005" and .030". Adjust end play by adding or removing washers on the commutator end of the armature.

Before installing, check the pinion clearance. Proper clearance is important to insure starter engagement. Press on solenoid core to shift

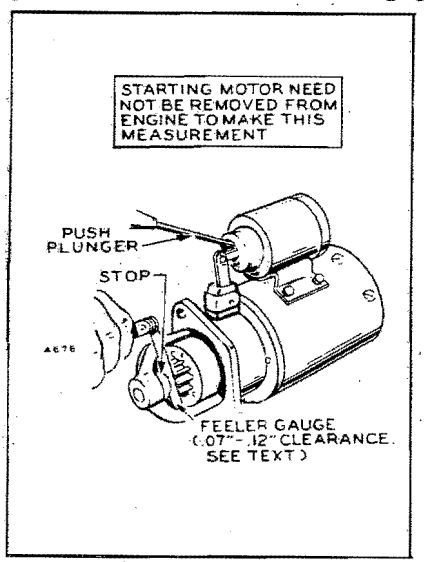


FIG 3.6.D - MEASURING PINION CLEARANCE

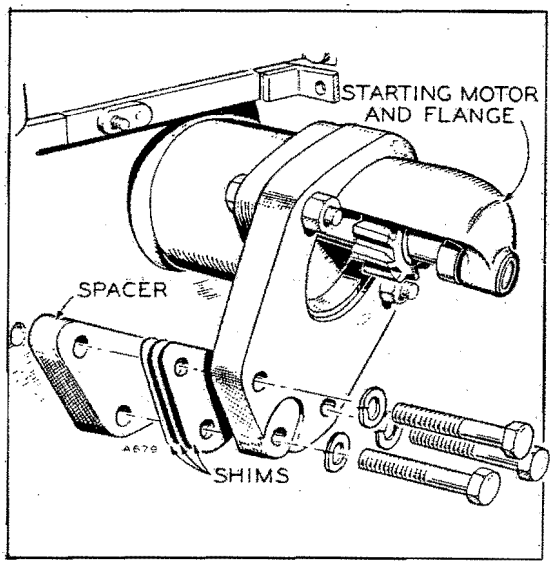


FIG 3.6.E - INSTALLING STARTER AND FLANGE

the pinion into full mesh and measure the clearance between pinion and pinion stop, Fig 3. 6. D. This should be between . 07" and . 12" (as near . 07" as possible). Adjust the link screw on the end of the solenoid plunger for proper clearance.

NOTE: On plants built before March, 1962, it was necessary to maintain the gap between ring gear and starter pinion in the relaxed position at less than 1/8" to insure starter engagement. When installing these motors, check this gap. If it is too great, a shim kit is available to reduce it, (Fig 3.6.E).

TROUBLE-SHOOTING CHART 7, STARTING SYSTEM

TROUBLE	POSSIBLE CAUSE	REMEDY
Starter motor doesn't turn — high current draw	Grounded switch, terminal, or fields	Replace any grounded component.
	Frozen shaft bushings.	Replace bushings, check armature shaft.
Starting motor doesn't turn — no draw current	Defective control circuit.	See Sect 6
	Open armature coils.	Replace armature.
	Open field circuit.	Replace field coils.
	Broken or weakened brush springs.	Install new brush springs.
	High mica, worn brushes.	Refinish commutator, replace brushes.
	Open solenoid.	Replace.
Slow starter speed	Discharged battery.	Recharge battery.
	Defective battery.	Replace battery, check cause for failure
	High resistance in starting circuit.	Clean and retighten all connections.
	Dirty commutator.	Clean or refinish commutator.
	Poor brush contact.	Reseat or replace brushes.

TROUBLE-SHOOTING CHART 7 (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Slow starter speed (cont.)	Worn bearings.	Replace bearings.
	Burned solenoid contacts.	Replace.
	Open or shorted field windings.	Replace windings.
Battery discharged	Defective charging circuit	See Sect 6
	Defective starting circuit	Check starter circuit
	Excessive use of starter	Adjust starting procedures, check for causes of hard starting
	Dirt and electrolyte on top of battery causing constant drain.	Clean battery top.
	Defective battery.	Replace.
Defective battery†	Hardened plates (sulfation) due to low charge after long period. Shorted cells. Loss of active material. Broken terminals.	Replace battery, check new battery charge condition at frequent intervals.
Starter won't engage flywheel	Defective ring gear or pinion.	Replace ring gear or pinion.
	Pinion clearance too great (early models only).	Adjust pinion clearance (Fig 3.6.D).
	Incorrect starter position (early models only).	Adjust position with shims, Sect 3.6.5.

† - When a battery fails, don't be satisfied just replacing it. Find the cause of the failure and make the necessary repairs.

3.7 Cylinder Heads and Valves

Each cast iron cylinder head assembly contains valves, valve seat inserts and guides, rocker arms, and spark plugs. The valve assemblies are operated by pushrods running through the cylinder block to the camshaft. Exhaust valves are stellite faced, and ride on stellite seat inserts; all valves have release type rotators.

3.7.1 MAINTENANCE

Check the valve clearances at regular intervals (see service chart for periods). In addition, clean the combustion chambers and inspect the valve and valve seats at regular periods.

Always check the valve clearance while the engine is at room temperature (approximately 70°F). Turn the flywheel so the cylinder for the valve to be checked is 10° to 45° past the TDC position of the compression stroke. Adjust the clearance, with the rocker arm nut, (Fig 3.7.A). For valve clearance values, see the valve clearance table (Fig 3.7.B).

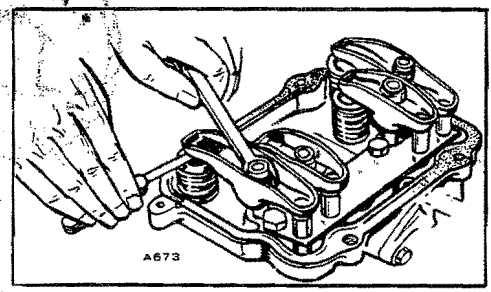


FIG 3.7.A - ADJUSTING VALVE CLEARANCE

	MJA	MJB Prior to Spec D	MJB Beginning Spec D	MJC
INTAKE	.019	.010	.014	.015
EXHAUST	.023	.010	.018	.020

FIG 3.7.B - VALVE CLEARANCE CHART
(Engine at 70°F Room Temperature)

3.7.2 TESTING

The cylinder compression test can be used to determine the condition of valves, pistons, piston rings and cylinders.

To check compression, run the engine until thoroughly warm. Stop it, and remove all spark plugs. Insert the compression gauge in a spark plug hole, crank the engine, and note the reading. To check for piston blow-by, squirt a small amount of SAE 50 oil into the cylinder and repeat the check. An increase in compression with oil in the cylinder indicates piston blow-by.

Compression of a standard new engine cranking at about 300 rpm is about 110 psi. Compression should be fairly uniform, normally with

less than 10 psi difference between the highest and lowest cylinder, taken at the same cranking rpm. Excessively high readings indicate carboned combustion chambers.

Compression readings will deviate considerably from the above readings because of differences in cranking speed, altitude and ambient temperature conditions. Therefore the specification is given only as a guide. The best indication of leakage is the pressure difference between cylinders or a compression increase when oil is added to the cylinder.

3.7.3 DISASSEMBLY - NOTE: Valves, tappets, rocker arms and pushrods should be kept in order and returned in same order.

1. Drain the engine coolant.

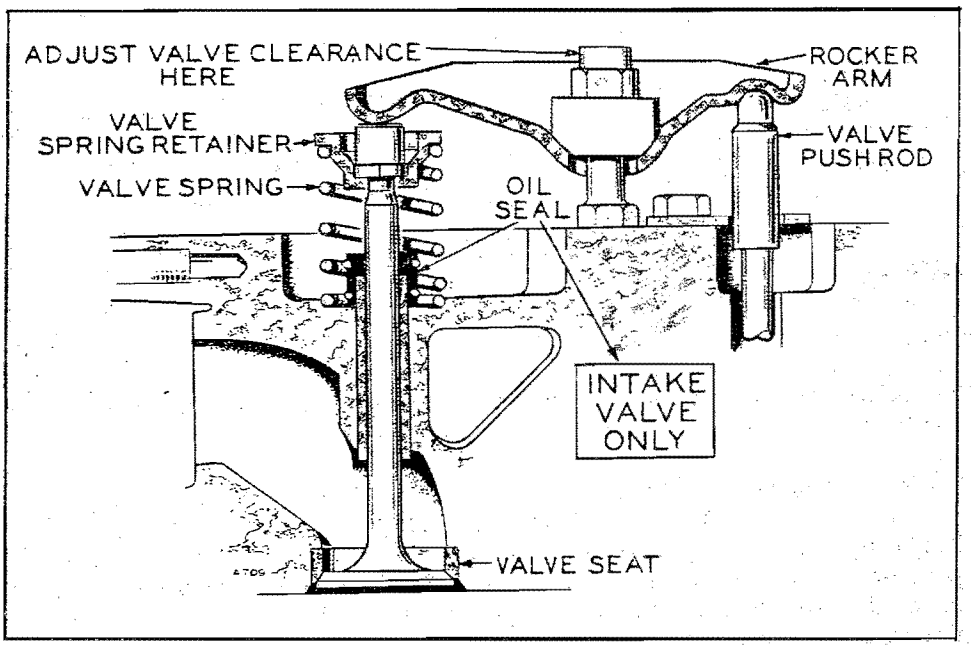


FIG 3.7.C - CROSS SECTION, VALVE ASSEMBLY

2. Remove the rocker box cover, spark plugs and connecting oil and water lines to the cylinder heads.

3. Remove the intake and exhaust manifold.

4. Remove the capscrews holding each cylinder head to the cylinder block.

5. Remove each head. If it sticks, rap it sharply with a soft hammer. Don't use a pry.

6. Remove the rocker arms and pushrods.

7. Using a valve spring compressor, disassemble the valve assemblies.

3.7.4 REPAIR

Thoroughly clean all components of the cylinder head assemblies. Remove all the carbon deposits from the combustion chambers and clean all gasket surfaces.

3.7.4.1 Valves. - Remove all carbon and check each valve for burning, pitting or warped stem. Valves that are slightly pitted or burned, refinish on an accurate valve grinder to a 45^{o} angle. But, if they are badly pitted, or will have a thin edge when refaced, replace them.

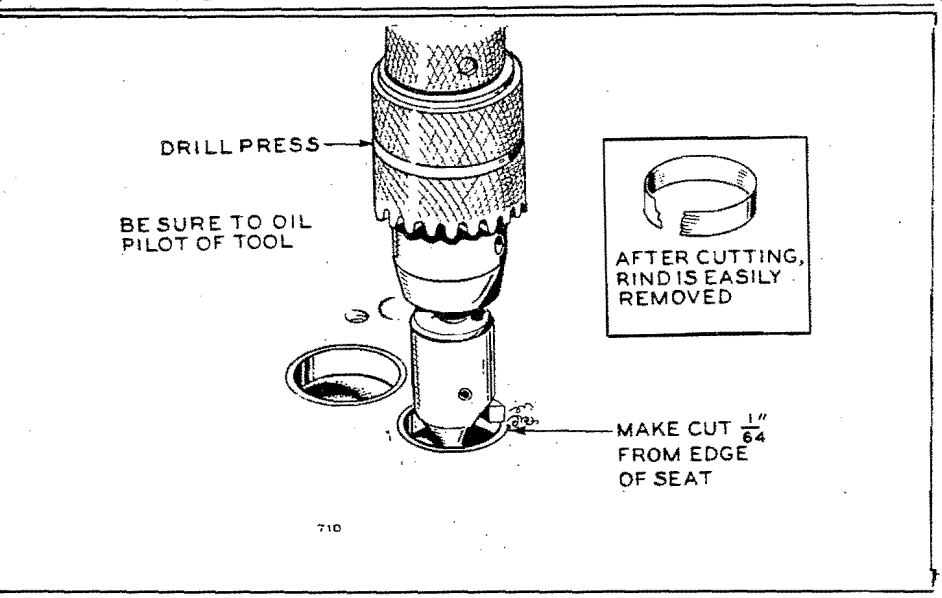
Check refinished valves for a tight seat to the valve seat with an air pressure type testing tool or by applying Prussian Blue on the valve face and rotating it against the seat.

3.7.4.2 Valve Guides. - Check valve-guide-to-valve clearance, Sect 9. If the proper clearances can't be obtained by replacing the valves, replace the valve guides. Drive the old valve guides into the valve chambers. Drive new guides in until they protrude 11/32" from the rocker box side of the head. Ream the new valve guide to obtain the proper clearance, Sect 9.

3.7.4.3 Valve Seats. - If the valve seats are pitted, refinish them. Using conventional seat grinding equipment, reface each seat to a 45^{o} angle and a seat width of 3/64 to 1/16 inch. You should be able to reface each seat several times before it becomes necessary to replace it.

If, however, the valve seats are loose or cannot be refaced, replace them.

Use ONAN tool #420A272 in a drill press (Fig 3.7.D) to remove each valve seat. Adjust the tool to cut 1/64 inch from the edge of the seat.



G 3.7.D - CUTTING OUT VALVE SEAT WITH ONAN TOOL 420A272

l the pilot to prevent it from seizing in the valve guide. Cut each seat wn to a narrow rind on edges and bottom and break it out with a sharp ol. Be careful not to cut into the counterbore bottom.

oroughly clean the valve seat counterbore and remove any burrs from e edges. If the counterbore is damaged, it will have to be remachined r an oversize seat. Oversize seats are available in .002 in., .005 in., 10 in. and .025 in. Otherwise, install new standard size seat inserts.

ive the new valve seat inserts into place. Be certain that each seat sts solidly on the bottom of the counterbore at all points. To make stallation easier, heat the cylinder head in an oven at 325°F for about 2 hour and cool the valve seats in dry ice.

ce each new seat to a 45° angle and width of approximately 3/64 in. e finished seat face should contact approximately center of the valve e. Use Prussian Blue on each valve face to check this. Make any rections on the seat, not the valve face.

'.4.4 Valve Springs. - Check the valve springs on an accurate com- ssion scale. Valve spring data is given in Sect 9. Replace any ing that is weak, cracked or pitted or has ends out of square.

.5 INSTALLATION

Push a valve stem oil seal onto each intake valve guide and clamp in place. Then oil the inside surface of each seal.
NOTE: Plants built before June 1962 had no valve seals.

2. Oil the stem of each valve lightly and insert each in it's own guide.

3. Check each valve for a tight seat with an air pressure type tester. If a tester isn't available, make pencil marks at intervals on the valve face and observe if the marks rub off uniformly when the valve is rotated part of a turn in the seat. If the seat isn't tight, regrind the valves.

4. Using a valve spring compressor, compress each valve spring with its spring retainer in place and insert the retainer locks.

5. Coat both sides of head gasket with Permatex No. 3 (pliable sealer) Install the head assembly and gasket to the cylinder block. Tighten the head bolts to 44 to 46 lb. ft. following the sequence in Fig 3.7.1

   NOTE: Four-cylinder models; observe this special procedure to align the two heads and prevent air leaks.

   A. Assemble the heads and gaskets to the block and install the cap screws, but don't tighten.
   B. Install the intake manifold to the heads and tighten the nuts to 13-15 lb. ft.
   C. Tighten the cylinder head capscrews to 44 to 46 lb. ft. following the sequence in Fig 3.7.E.

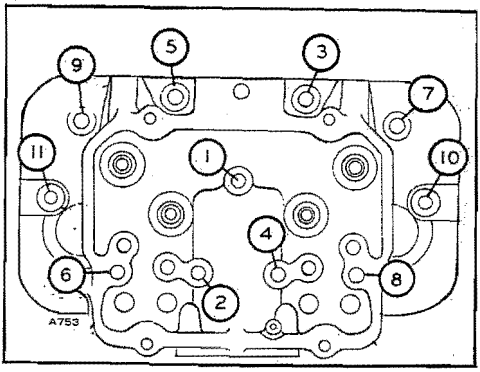


FIG 3.7.E - CYLINDER HEAD BOLT TIGHTENING SEQUENCE MJB, MJC

6. Install the manifold, oil lines, water lines, spark plugs, and carburetor.

7. Install the valve stem caps.

8. Install the pushrods, rocker arms, and rocker arm nuts.

9. Set the valve clearance, Fig 3.7.B.

   NOTE: After the first 50 hours of operation, retighten the cylinder head bolts and check valve clearance.

10. Reinstall the rocker box cover.

11. Reinstall the thermostat assembly and refill the cooling system.

TROUBLE-SHOOTING CHART 8. CYLINDER HEADS AND VALVES

TROUBLE	POSSIBLE CAUSE	REMEDY
Poor compression	Leaky head gasket or spark plug gasket.	Replace gasket.
	Valves sticking.	See Sticking Valves, this chart.
	Broken valve spring.	Replace spring, check valve condition.
	Leaky valves.	Regrind valves.
	Burned valves and seats.	Regrind valves and seats.
	Insufficient valve clearance.	Adjust clearance.
Valve breakage	Weak valve springs.	Replace weak springs.
	Excessively strong valve springs.	Replace springs.
	Worn guides which set up thrust action.	Replace guides.
	Excessive valve clearance.	Adjust valve clearance.
Valve burning	Close valve clearance.	Re-adjust valve clearance.
	Weak springs.	Replace springs.
	High temperatures, causing valve stretch.	Check for engine overheating.
	Valve seat or face off center.	Regrind seat, replace valve.
	Loose valve seat inserts.	Replace seats. Rebore and use oversize if necessary.

TROUBLE-SHOOTING CHART 8. CYLINDER HEADS AND VALVES (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Valve burning (Cont.)	Improper cooling of valve seats or guides due to clogged cooling system.	Refer to Sect 3. L. l. Maintenance
	Coked or gummed oil on stem.	Clean or replace valve.
Sticking valves	Incorrect valve clearance.	Adjust valve clearance.
	Weak or broken springs.	Replace springs.
	Dirty, scored or gummy guides.	Clean or replace valves and guides.
	Incorrect clearance between valve and guide.	Correct clearance.

3.8 Pistons, Connecting Rods & Cylinders

MJ generating sets use tapered aluminum pistons which are fitted with 2 compression rings and an oil control ring. Full floating piston pins connect the piston to its connecting rod. The pins are held in place with a snap ring at each end. The lower end of each connecting rod contains half shell, precision bearings and the upper end, a semi-finished bushing.

NOTE: Some generating plants are fitted with .005" oversize pistons at the factory. These plants are marked with an E following the plant serial number. Use standard size rings for these pistons.

3.8.1 REMOVAL AND DISASSEMBLY

On 2 and 4 cylinder engines, the connecting rod and cap are stamped for installation in the proper cylinder. When removing piston assemblies, check the marking so each can be reinstalled in the proper cylinder and keep all components of each piston assembly together.

1. Drain the crankcase oil and remove the oil base.

2. Drain the water jacket and remove the cylinder heads.

3. Clean carbon deposit from top of each cylinder.

4. Remove the cap from each connecting rod and push the assembly through the top of the cylinder bore. Replace the cap and bearing inserts in the proper assembly.

5. Using a ring expander, remove the rings from each piston.

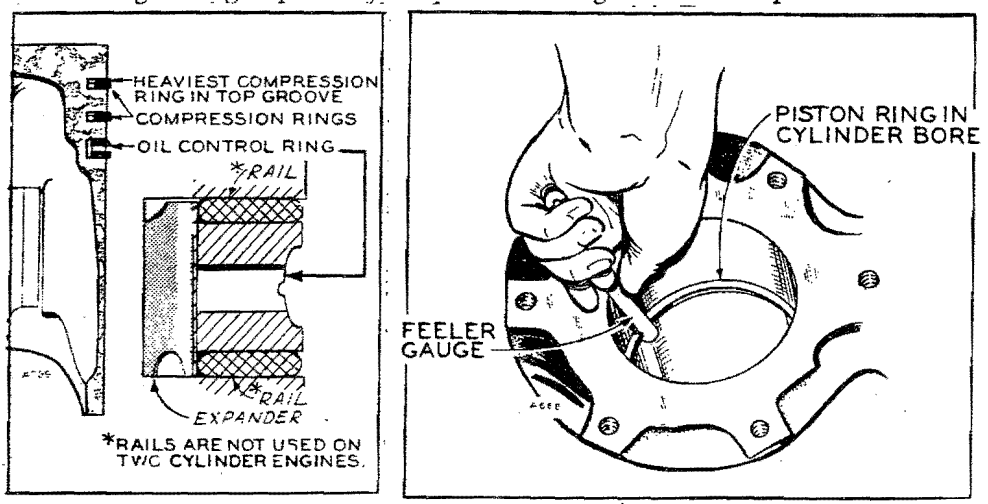


FIG 3.8.A - PISTON RINGS, LOCATION & GAP

6. Remove the 2 retaining rings and push the piston pin from each piston.

3.8.2 CYLINDERS

The cylinder walls should be free of scratches, pitting and evidence of wear. Check each with an inside reading micrometer for out-of-round or taper. Standard bore diameter is 3.2495" to 3.2505".

If necessary, rebore the cylinder to fit the next available oversize piston. Pistons and rings are available in .010", .020", and .030" oversize.

If the cylinders don't need refinishing, remove any existing ridges from the top of the wall with a fine stone.

3.8.3 PISTONS

Thoroughly clean and inspect each piston. Clean the carbon from the ring grooves and be sure all oil holes are open. If any piston is badly scored or burred, loose in the cylinders, has badly worn ring grooves or otherwise isn't in good condition, replace it.

Check clearance to the cylinder by inserting each piston in its cylinder. Check the clearance 90^{o} from the axis of the piston pin and 3/8" below the oil control ring. Clearance should be .0012 to .0032 in. If not, replace the piston and check the cylinder for possible reconditioning.

3.8.4 PISTON PINS

Each piston pin should be a thumb push fit into its piston at room temperatures. If the pin is excessively loose, install a new one. If the condition isn't corrected, install the next oversize pin. If the piston is worn enough that the oversize pin won't fit, replace the piston.

3.8.5 RINGS

Inspect each ring carefully for fit in the piston grooves and seating on the cylinder wall. Fit each ring to the cylinder wall at the bottom of its travel, using a piston to square the ring in the bore. Check the gap with a feeler gauge. It should be .010" to .020". If the gap is too small, file the butt ends of the rings. Don't use rings that need a lot of filing, they won't seat right on the cylinder walls. If oversize pistons are used, use the correct oversize rings.

3.8.6 CONNECTING RODS

Clean the connecting rods and check each for defects. Check the connecting rod bushings for proper clearance with the piston pin. Clearance should be .0002 in. to .0007 in.

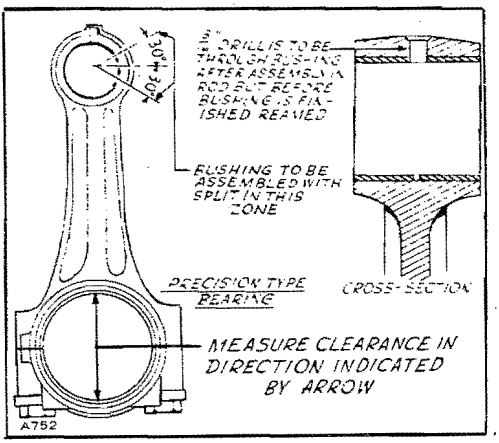


FIG 3.8.B - CONNECTING ROD

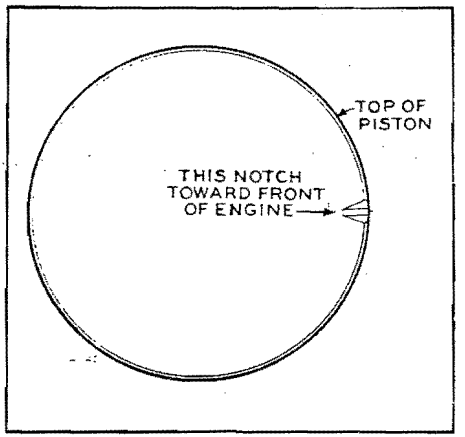


FIG 3.8.C - TOP OF PISTON

If the bushing is excessively worn, press it out and install a new bushing. Fig 3.8.B. After installation, drill the bushing with a 3/16" drill through the counterbored hole in the connecting rod top. Finally, ream the bushing to the proper size.

3.8.7 CONNECTING ROD BEARINGS

Inspect the connecting rod bearings for burrs, breaks, pitts and wear. Measure the clearance between bearings and the crankshaft journal. The clearance should be .001 in. to .003 in. If necessary, replace with new standard or undersize precision bearings.

For information about the crankpin journals, see sect 3.9.5.

3.8.8 ASSEMBLY AND INSTALLATION

1. Install the connecting rods on each piston with pins and retaining rings. Install so the connecting rod oil spray hole is on the same side as the "V" notch in each piston. Check rod to piston alignment with an aligning fixture.

2. Install all rings on each piston. Tapered type rings will be marked "TOP" or identified in some other manner. Place this mark toward the closed end of the piston. Space the ring gaps 1/3 of the way around the piston from one another. No gap should be in line with the piston pin. Oil the rings and pistons.

3. Position a bearing half in each connecting rod. Be sure there is no dirt under the bearing. This could cause high spots and early bearing failure.

4. Oil the cylinder walls. Install each piston in the proper cylinder using a ring compressor tool. Each assembly should be installed

with the "V" mark on the piston toward the front of the engine.

5. Position each connecting rod on the crankshaft and oil the journal and install its rod cap with bearing half. When installing the rod cap, position so the raised witness mark on the forging matches the mark on the connecting rod (Fig 3.8.D).

6. Tighten the cap screws to the specified torque.

7. Crank the engine over by hand to see that all bearings are free.

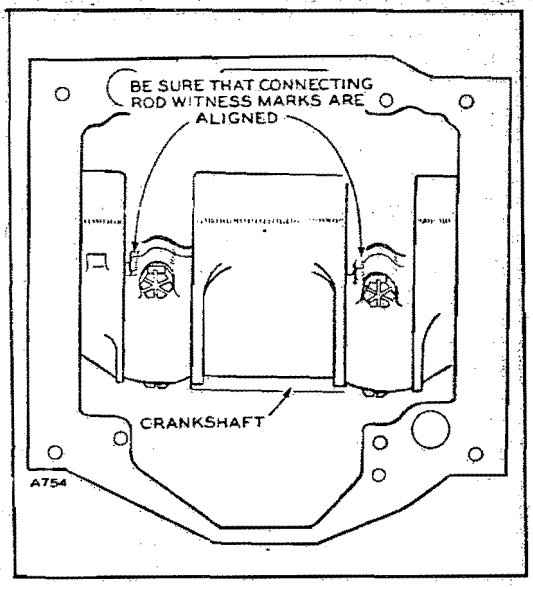


FIG 3.8.D - CONNECTING ROD, WITNESS MARK

8. Reinstall the oil base with a new gasket.

9. Reinstall the cylinder heads, sect 3.7.3.5.

10. Replace oil and coolant.

3.8.9 BREAK-IN PERIOD

Whenever new rings or pistons are installed or the cylinder refinished, the engine must be run-in before regular operation can be resumed. Run the engine for 15 - 20 minutes at no load, about 1/2 hour at 1/3 load and 2 - 3 hours at 2/3 load. Then regular operation can be resumed.

TROUBLE-SHOOTING CHART 9. PISTONS, CONNECTING RODS, AND CYLINDERS

TROUBLE	POSSIBLE CAUSE	REMEDY
Poor compression	Loose cylinder heads.	Tighten.
	Sticking rings. Worn rings.	Replace rings, check cylinder condition.
	Worn cylinder walls and pistons.	Refinish cylinders, replace pistons.
	Leaky head gasket.	Replace head gasket.
Piston and cylinder and ring wear	Operated with dirty air cleaner.	Change air cleaner service periods.
	Air leak between air cleaner and engine.	Repair leaks.
	Faulty cylinder oil control.	Check rings.
	Engine run on low or dirty oil.	Add or replace oil. Check cause of loss. If dirty, adjust service periods.
	Overheating.	See Trouble-Shooting Chart 2.
Worn connecting rod, bushings, and bearings	Engine run with low oil.	Add oil, check cause of oil loss.
	Badly diluted, dirty or wrong grade of oil.	Change oil. Check cause of dilution. If dirty, check service periods.
	Clogged oil passages.	Clean oil passages and drillings.

3.9 Engine Disassembly

If engine disassembly is necessary, observe the following order (i.e. Flywheel, Gear Cover ...). As disassembly progresses, the order may be changed somewhat as will be self-evident.

The engine assembly procedure is the reverse of disassembly. Any special assembly instructions for a particular component are included in the applicable section. When reassembling check each section for these special assembly instructions or procedures.

3.9.1 FLYWHEEL

Remove the flywheel guard. The flywheel is a tapered fit on the crankshaft. Remove the flywheel mounting screw. Remove the 2 capscrews holding the pulley and remove the pulley. Replace the flywheel mountin screw part way and install the pulley over the screw. Tighten the pulle capscrews to pull the flywheel.

3.9.1.1 Ring Gear. - To remove the ring gear, if damaged, saw part way through, then break it using a cold chisel and heavy hammer.

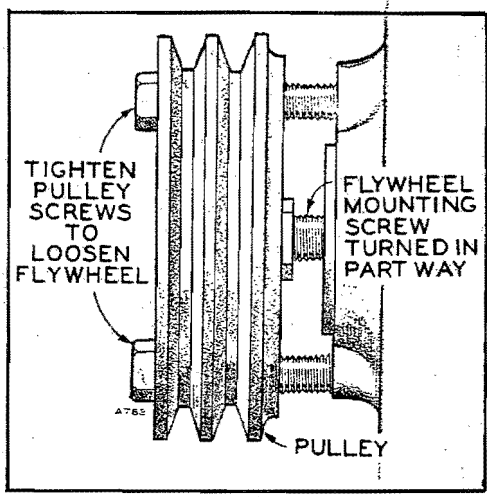


FIG 3.9.A - PULLING FLYWHEEL

To install a new ring gear, place it in an oven heated to 380 - 400° F for 30 to 40 minutes. CAUTION: DON'T HEAT WITH A TORCH! When heated properly, the ring will fall into place on the flywheel. If it doesn't go on all the way by itself, drive it into place with a hammer. Do it fast and don't damage the gear teeth. The ring will contract rapidly and may shrink to the flywheel before it is in place. If this occurs, a new ring gear may be required.

3.9.2 GEAR COVER

To remove the gear cover, detach the governor ball joint and remove the ignition breaker points (start-disconnect switch), plate and gear.

Remove the water pump connections. Remove the screws holding the gear cover to the crankcase. To loosen the gear cover, tap it with a soft hammer.

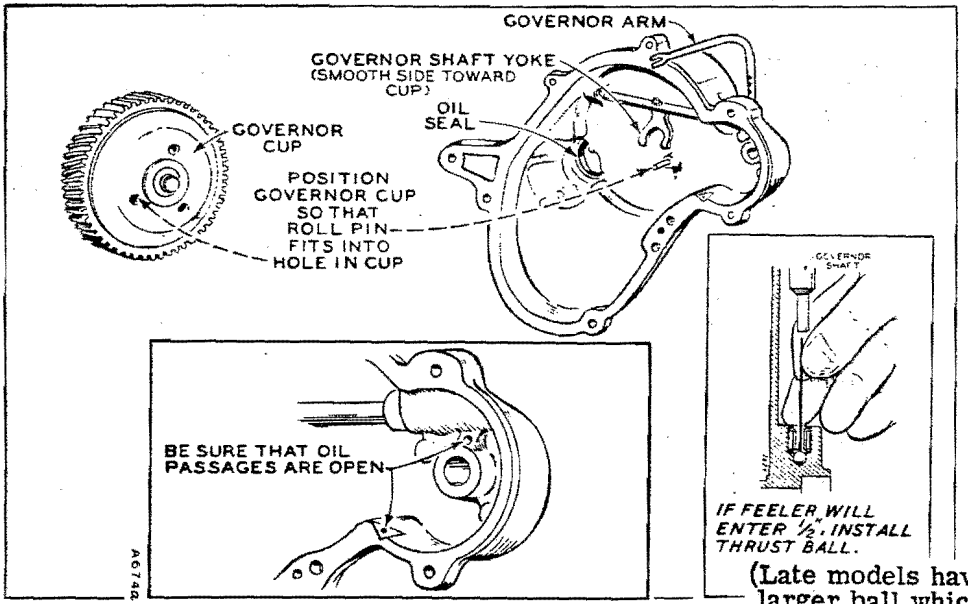


FIG 3.9.B - GEAR COVER INSTALLATION

3.9.2.1 Governor Shaft. - The governor shaft is supported by 2 sets of needle bearings. To remove the shaft, remove the yoke and pull the shaft from the gear cover. If the shaft is binding, clean the bearings, if loose, replace the bearings. To remove the larger bearing, drive both bearing and oil seal out from the inside of the gear cover. Remove the smaller bearing with an Easy-Out or similar tool. Press new bearings and oil seal into place.

3.9.2.2 Gear Cover Oil Seal. - Replace the oil seal if damaged or worn. Drive the old seal out from inside the gear cover. Lay the cover on a board so the seal boss is supported. Using an oil seal driver, insert the new seal from the inside with rubber lip toward outside of gear cover (open side of seal inward) and drive it flush with the outside surface. During gear cover installation, use the driver to protect the oil seal.

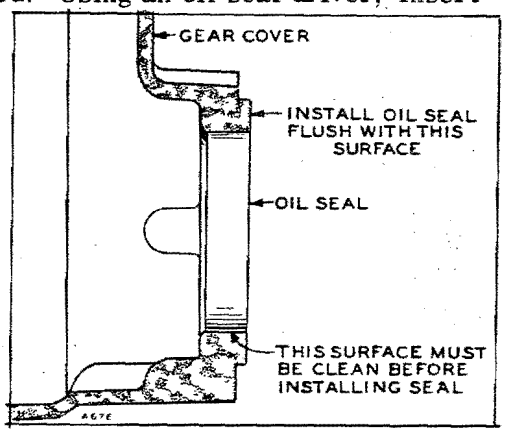


FIG 3.9.C - GEAR COVER OIL SEAL

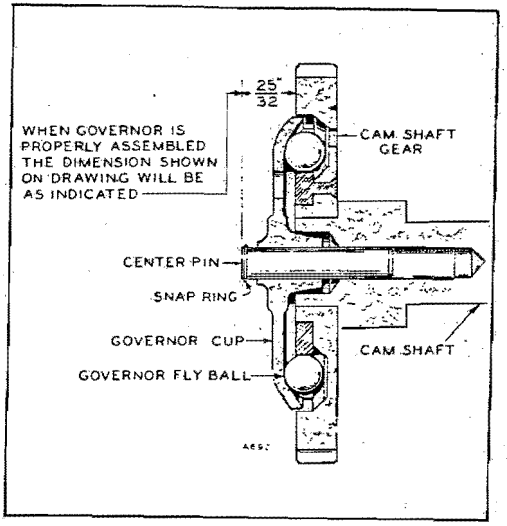
3.9.2.3 Assembly, Gear Cover. -

1. Work the governor shaft to check for binding and see that the governor-shaft-end-thrust ball is in place (Fig 3.9.B).

2. Turn governor yoke so the smooth side is toward governor cup.
3. Turn the governor cup so the stop pin in the gear cover will fit into one of the holes in the cup surface, Fig 3.9.B. Measure the distance from the end of the stop pin to the mounting face of the cover. It should be 25/32 in. If it isn't, replace the pin.
4. Use the oil seal driver or a piece of shim stock over the crankshaft keyway to protect the oil seal and install the gear cover. Tighten the mounting screws to specified torque. Before tightening the screws, be sure the stop pin is in the governor cup hole.
5. Install and retime the ignition points (start-disconnect centrifugal switch on MJC). Sect 3.3.

3.9.3 GOVERNOR CUP

To remove the governor cup, remove the snap ring from the camshaft center pin and slide the cup off. Be sure to catch the 10 flyballs that will fall out when the cup is removed.



3.9.3.1 Repair. - Replace any flyballs that have flat spots or grooves. Replace the cup if the race surface is grooved or rough. The governor cup must be a free spinning fit on the camshaft center pin, but should be replaced if excessively loose or wobbly.

Check the distance the center pin extends from the camshaft gear. This distance must be 25/32 to give the proper travel distance for the cup. If it is less, the engine may race; if more, the cup won't hold the balls properly. If the distance is too great, drive or press the center pin in. If it is too small, replace the pin; it can't be removed without damaging the surface. In some cases, if the distance is too small, the head of the governor cup can be ground to give the necessary 7/32 in. travel distance.

3.9.3.2 Installation. - To install the governor assembly, tip the front of the plant upward. Set the flyballs in their recesses and position the governor cup on its shaft. Finally, install the snap ring on the center pin.

3.9.4 CAMSHAFT

The camshaft is a 1-piece machine forging, driven through gears by the crankshaft. It rides on sleeve bearings pressed into the crankcase.

In addition to opening and closing the valves, the camshaft operates the fuel pump and, on MJC plants, drives the distributor.

3.9.4.1 Removal. -

1. Remove the rocker arms and pushrods from the valve chambers.
2. Remove the fuel pump from the engine.
3. On MJC, remove the distributor, Sect 3.3.
4. Remove the crankshaft gear retaining washer by removing the lock ring on the crankshaft.
5. Lay the engine on side to avoid dropping tappets and remove the camshaft assembly as a group. If necessary, pry it out using a screwdriver between the camshaft gear and crankcase.
6. Remove the push rod tappets. These can be removed only from the camshaft end of the pushrod holes.

3.9.4.2 Repair. - If a lobe has become slightly scored, dress it smooth with a fine stone. If the camshaft is badly worn or scored, replace it. For information about the center pin, see Sect 3.9.3.

3.9.4.3 Camshaft Gear. - This gear is a pressed fit on the camshaft and drives it at 1/2 the crankshaft speed. The camshaft gear drives the ignition timing (start-disconnect switch on 4 cylinder) gear on 2 cylinder models. To remove the gear, use a hollow tool or pipe that will fit inside the gear bore and over the center pin. Press the camshaft out of the gear bore. Be careful not to damage the center pin.

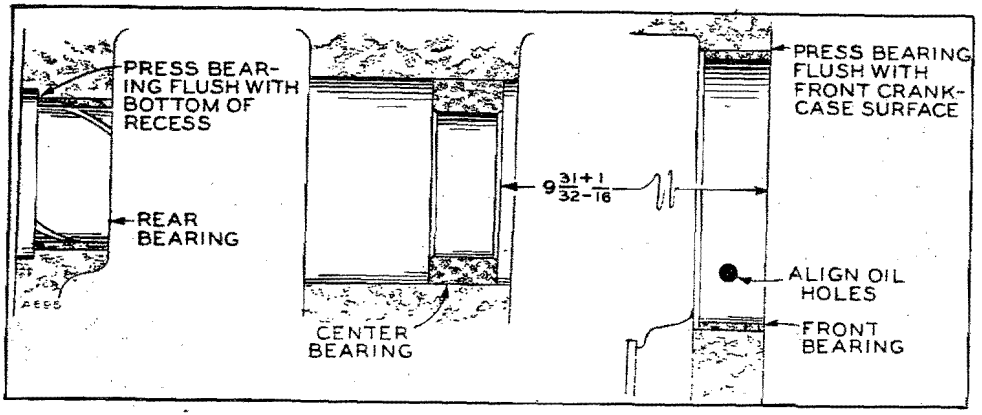


FIG 3.9.E - CAMSHAFT BEARING INSTALLATION

3.9.4.4 Camshaft Bearings. - The camshaft bearings should be replaced if the clearance to the camshaft is greater than specified; or if the bearings show cracks, breaks, burrs, excessive wear, or other defects.

The camshaft to bearing clearance should be .0012" to .0037". To check the rear bearing, remove the expansion plug at the rear of the crankcase.

Press new bearings into place, Fig 3.9.E. Press the rear bearing flush with the bottom of the expansion plug recess. Press the front bearing in flush with the crankcase front surface so the crankcase and bearing oil passages are aligned. Don't attempt to ream the bearings, they are a precision type. After the rear bearing is installed, insert a new expansion plug in the recess, using sealing compound, and expand it into place with sharp blows at its center.

3.9.4.5 Installation, Camshaft Assembly. -

1. Install the key and press the camshaft gear on its shaft.
2. Install the governor components, Sect 3.9.3 on the camshaft.
3. Slide the thrust washer onto the shaft.
4. Lay the engine on side or end and insert the pushrod tappets.
5. Install the camshaft assembly in the engine. Align the timing marks on the camshaft gear and crankshaft gear, Fig 3.9.G.

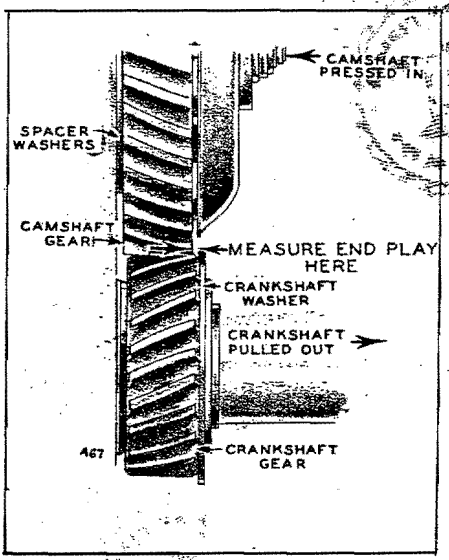


FIG 3.9.F - MEASURING CAMSHAFT ENDPLAY

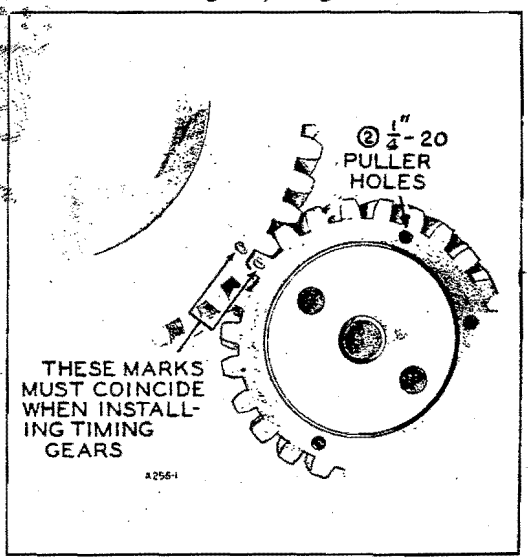


FIG 3.9.G - ALIGNING TIMING GEARS

6. Replace the pushrods and fuel pump.

7. On MJC, install and retime the distributor, Sect 3.3.

3.9.5 CRANKSHAFT

These engines use a counter-balanced, ductile iron crankshaft. The 1 and 2 cylinder crankshafts ride on 2 lead-bronze bearings, the front one housed in the crankcase and the rear one in the bearing plate. The 4-cylinder model MJC, uses an additional split center main bearing.

3.9.5.1 Removal. -

1. Remove the lock ring and retaining washer in front of the crankshaft gear.

2. Pull off the crankshaft gear. It has 2 1/4-20 UNC tapped holes for attaching a gear pulling ring (ONAN tool 420A248). Use care not to damage teeth if the gear is to be reused.

3. Remove the oil pan and the piston-and-connecting rod assemblies.

4. 4-CYLINDER ONLY. Remove the bearing cap from the center main bearing.

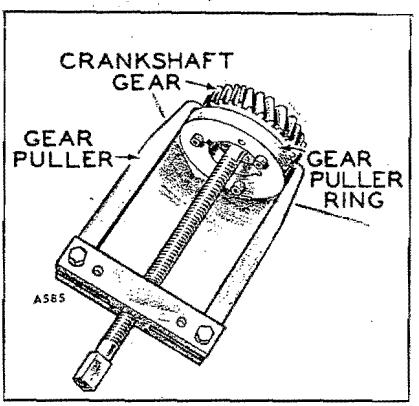


FIG 3.9.H - REMOVING CRANKSHAFT GEAR

5. Remove the rear bearing plate from the crankcase. Note that gaskets here adjust crankshaft endplay.

6. Remove the crankshaft through the rear opening in the crankcase. (4-Cylinder Only. Catch the upper half of the main bearing support as it slides off its mounting surface).

3.9.5.2 Inspection. - Thoroughly clean the crankshaft and blow out all oil passages with compressed air. Check all journals for out-of-round, taper, grooving or ridges. Pay particular attention to ridges or grooves on either side of the oil hole areas. Unusual conditions here often point to previous neglect of oil cleanliness precautions.

If the journal dimensions are not within the limits or the journals are scored, re-machine the crankshaft.

3.9.5.3 Crankshaft Re-Machining. - Crankshaft machining requires a trained and experienced operator and suitable equipment for handling crankshafts with precision.

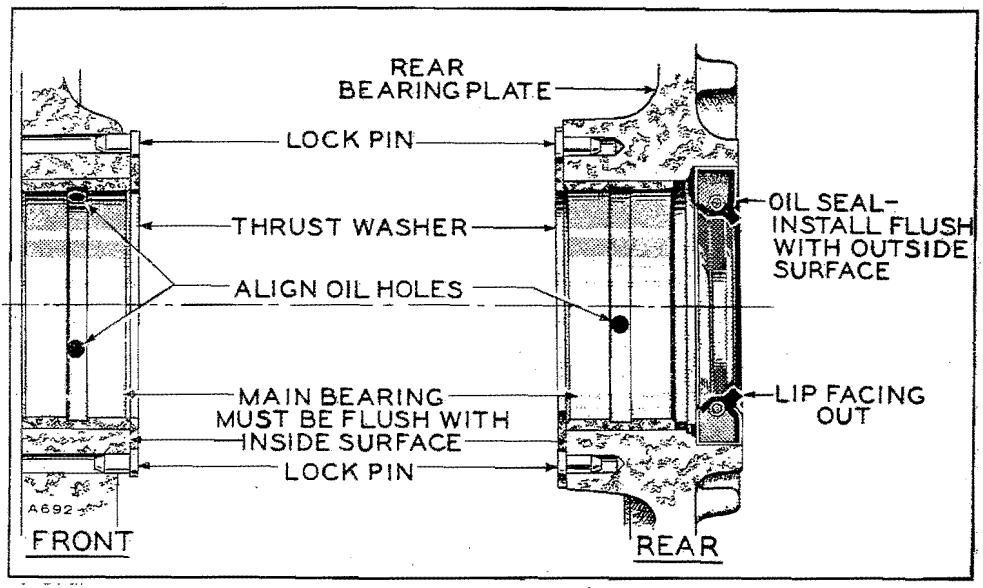


FIG 3.9.I - MAIN BEARING INSTALLATION

Undersize bearings and connecting rods are available to rework the shaft to .010", .020", and .030" undersize.

3.9.5.4 Bearings, Main. - If the main bearings' clearances are greater than the limits, Sect 9, the bearings are worn, grooved or broken, replace them. Precision replacement bearing inserts and thrust washers are available for all main bearings. Don't attempt to ream the bearings.

Align the oil holes and press the new bearings into the front and rear housings. Insert the center bearing on the MJC when the crankshaft is reinstalled.

3.9.5.5 Oil Seal, Rear. - The rear oil seal is in the rear bearing plate. If damaged, drive it out from the inside of the plate. Apply fibrous or stiff cup grease to the inner surface of new seal. This provides a better seal and protects the seal during installation. Using the oil seal installing tool, install the new seal with the rubber lip facing outward (open side facing in), Fig 3.9.J. Drive the new seal flush with the rear surface of the bearing plate. Leave the seal installer on during bearing plate installation to protect the oil seal.

3.9.5.6 Installation. - After each installation step, check the crankshaft to be sure it is not frozen into place.

1. Press the front and rear main bearings into place, aligning the bearing and bearing housing oil holes. Don't attempt to drive a bearing into a cold block or rear bearing plate.

2. Install the thrust washers and locking pins. Heavily oil thrust washers to hold them in place.

3. Oil the bearing surfaces and install the crankshaft from the rear of the crankcase, through the rear bearing plate hole.

4. Mount and secure the rear bearing plate. Use new gaskets.

5. Heat the timing gear on an electric burner or oven to about 350°F. Install on the crankshaft and drive into place. Install the retaining washer and lockring.

6. 4-CYLINDER ONLY. Set the upper half of the center main housing on the crankshaft and rotate it into place. Be sure it is installed with the side marked **FRONT** toward the crankshaft gear. Set the 2 positioning dowels on the upper bearing mount. Install the center main bearing cap and torque the bolts to 97 - 102 lb. ft., Fig 3.9.J.

7. Check the crankshaft end play. Use enough rear bearing plate gaskets to provide .010" to .015" end play.

8. Install piston assemblies as per Sect 3.8.

3.9.6 CRANKCASE

If, on the 4-cylinder models, the center main bearing support requires replacement, the whole crankcase must be replaced or returned to the factory to have a new housing fitted.

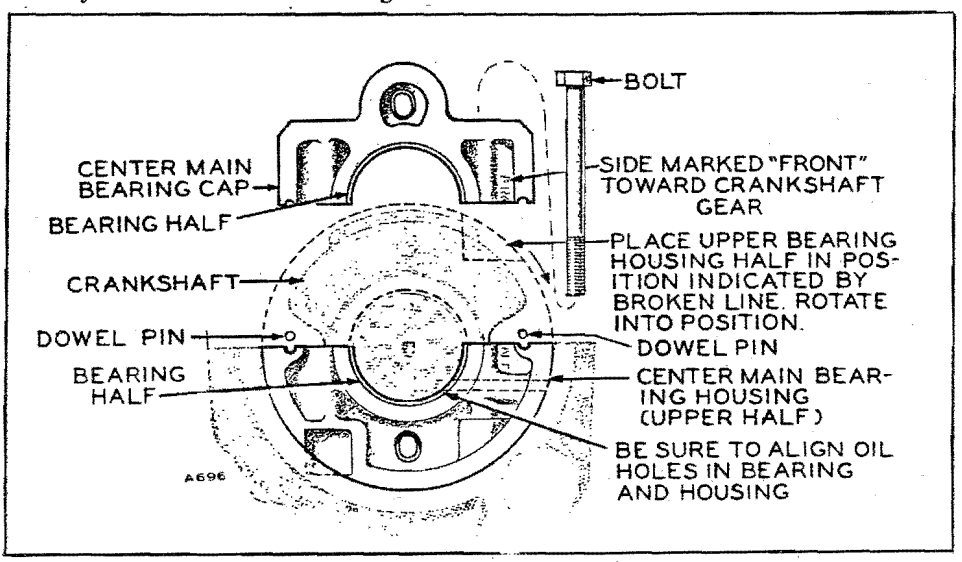


FIG 3.9.J - CENTER MAIN BEARING (MJC ONLY)

MODELS 705MJB AND MJC

These generating plants use a 4-pole revolving field generator with static exciter (Magneciter) to excite the field and regulate the plant's ac output.

The generator is mounted to the engine crankcase through the engine-to generator adapter. The rotor is directly connected — a tapered fit with key — to the engine crankshaft. A ball bearing, housed in the generator endbell, supports the outboard (collector ring) end of the rotor. The endbell is in turn, supported by studs through the stator assembly to the adapter. Because of its construction, the generator can't be removed from the engine as a complete unit.

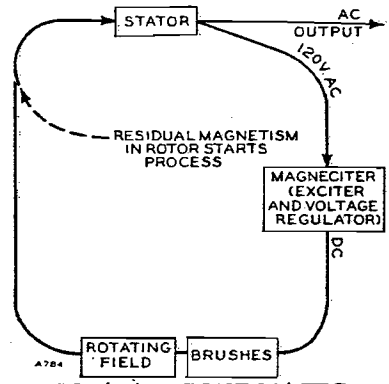


FIG 4.A - SCHEMATIC, ALTERNATOR AND EXCITER

The generator's ac output is drawn from the stator windings which also supply 120 volts to the static exciter. This 120 volts is from either a 120 volt winding or a special 120 volt tap on high voltage generators i.e. 480 volt. An additional stator winding supplies power for the plant's battery charging system.

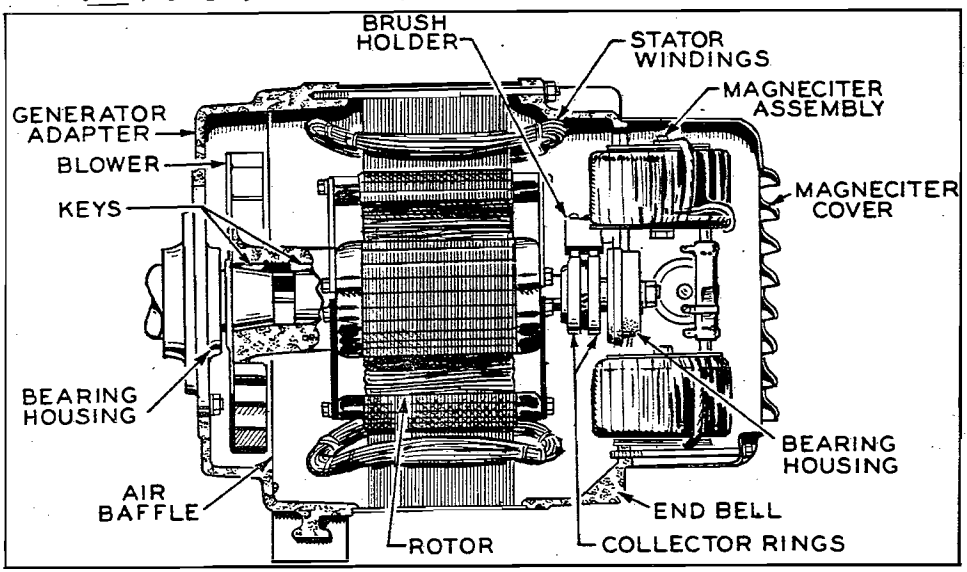


FIG 4.B - REVOLVING FIELD GENERATOR CROSS SECTION

To aid servicing and repair, all output leads from the generator and connections to the exciter are marked with metal tags. The lead and terminal markings are noted on the plant wiring diagram, see Section 10.

Magneciter is the trade name of ONAN'S static exciter system. As the name implies, it has no moving parts but uses magnetic amplifiers and rectifiers to supply direct current to the alternator's revolving field and regulate the ac output.

Because it is a relatively new development, a brief description of the Magneciter's operation is given here to aid understanding and repair.

The Magneciter functions as a power supply for the revolving field and a voltage regulator. By regulating the amount of current to the field, it controls the ac output of the generator. Here is how it works.

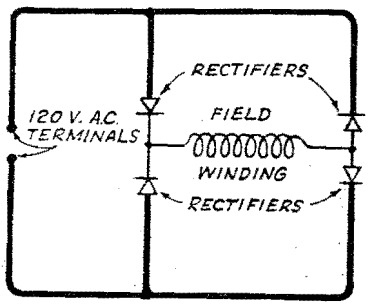


FIG 4.C - POWER SUPPLY

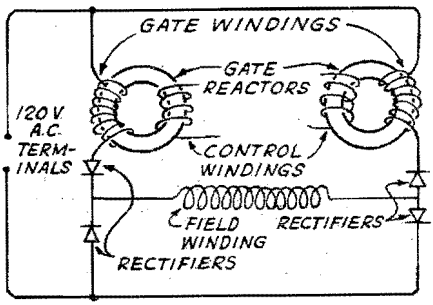


FIG 4.D - POWER SUPPLY WITH GATE REACTORS

The circuit shown in Fig. 4.C is the power supply. It's full wave rectifier made up of 2 half wave rectifiers and supplies direct current to the field. In order to regulate the generator output voltage, some form of control over the current flowing in the field is necessary. Two gate reactors provide this control (Fig. 4.D).

Each gate reactor is a metal doughnut shaped core with 2 windings, an output or gate winding and a control winding. The amount of current the reactor allows to flow in the gate winding is dependent on the amount of magnetism in the core. The current flow increases —(the gate opens)— when there is more magnetism in the core, until finally when the core is saturated, (the gate is all the way open) the reactor then does not oppose current flow. Since the rectifiers allow current in the gate winding to flow in only 1 direction, it can act only to magnetize the core. If the magnetism in the core were decreased this would reduce the current flow through the gate winding. That is the purpose of the control windings.

When current flows in the control windings, it decreases the magnetism in the core, reducing the current flow in the gate winding. Therefore, the control regulates the current in the generators' field, which controls the generator's output. More de-magnetizing current in the control winding, less current in the gate winding and generator field and a lower output voltage.

Next, we must introduce a regulator so that the current in the control windings will depend on the voltage output of the generator. The regulator must allow little or no current flow up to a certain output voltage and a large flow above that voltage. That is the purpose of the circuit shown in Fig. 4.E. This circuit uses rectifiers, to allow the current to flow in only one direction, and a control reactor. The control reactor

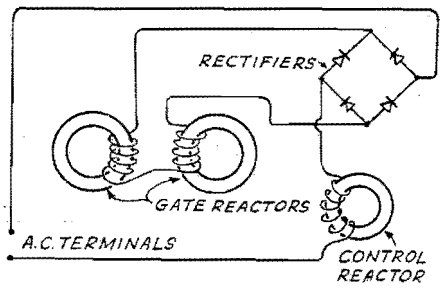


FIG 4.E - CONTROL CIRCUIT

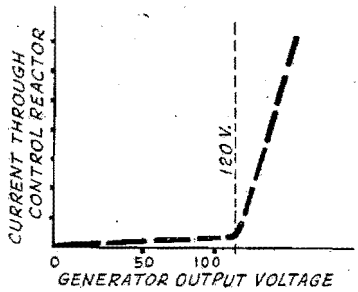


FIG 4.F - CONTROL REACTOR CHARACTERISTICS

is the voltage sensitive control of the regulator. Its characteristics are shown in Fig. 4.F. Below the proper voltage, little current flows through the reactor, so little current flows in the control windings. This allows full current to the field windings. When the reactor saturates magnetically, it suddenly allows a lot of current to flow through the control windings, reducing the current to the field windings. This reduces the generators' output voltage, which, in turn reduces the current through the control reactor and control windings back to the set requirements. The regulator then holds voltage at a pre-set level determined by the control reactor.

This is the basic circuit, but some refinements have been added. Compounding windings on each large reactor, help to retain voltage control through changes in load and an output voltage control resistor allows adjustment of the output voltage by changing the voltage across the control reactor (Fig. 4.G).

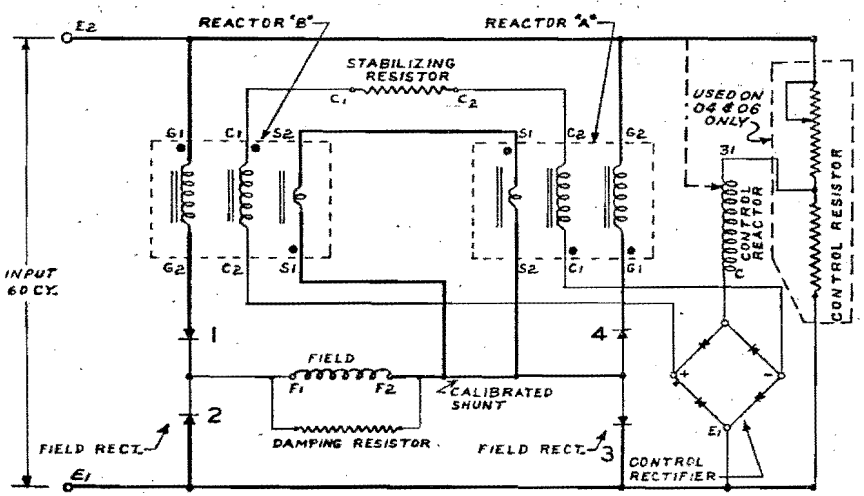


FIG 4.G - TYPICAL MAGNECITER CIRCUIT

4.1 ADJUSTMENTS

OUTPUT VOLTAGE. - It's possible, by means of controls in the magneciter, to make small changes in the generator output voltage. DON'T use these controls to increase generator output above the rated voltage (i.e. 120 V, 240 V).

On models with an 02SX Magneciter (See nameplate) adjust the voltage by changing the tap used on the control reactor, C_1, C_2, or C_3. The voltage difference between each of the taps is abour 4% of the output voltage and C_1 gives the highest voltage. At the factory, the connection was made to C_2.

On the 04SX and 06SX Magneciter, an adjustable tapped resistor controls the voltage output. It is adjustable over a range of about 5 percent with the highest voltage when the tap is moved to the top of the resistor.

4.2 MAINTENANCE

The generator normally needs little care other than periodic inspection of the exciter, ballbearing, collector rings and brushes every 1000 hours. However, 02SX exciters require build-up relay cleaning every 500 hours.

4.2.1 BRUSHES. - To examine the brushes, brush springs, and slip rings, remove the exciter cover at the rear end of the generator. Note that the exciter mounts on a hinged plate. Remove the screws from the

right side of the plate and swing the assembly outward. To remove the brush holders, unscrew the 4 machine screws on the end-bell near the ballbearing. Replace the brushes when they wear to about 5/16" long. Don't use a substitute brush that may look identical. It might have entirely different electrical characteristics.

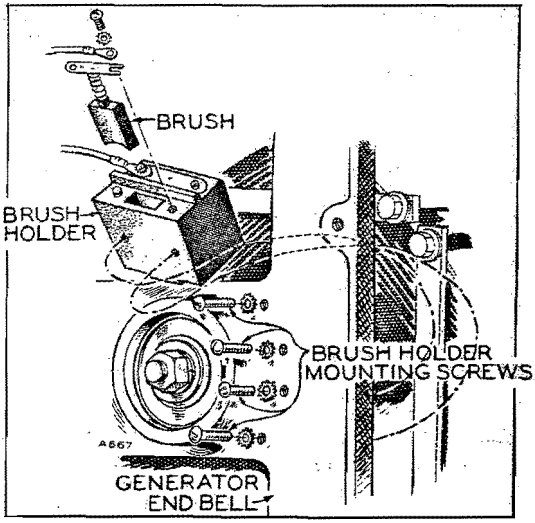


FIG 4.H - REMOVING BRUSHES

4.2.2 GENERATOR BEARING. - The generator bearing is prelubricated for life and sealed. It requires no servicing.

4.2.3 EXCITER. - Except for the 02SX the exciter contains no moving parts. Periodically blow out any dust and make certain that all components and connections are secure.

A build-up relay was used on the 02SX models. Early models had open relays and later model relays were enclosed in metal shields. The relay contacts should be cleaned regularly. Carefully wipe the relay contacts with paper to remove any non-conducting film or dirt.

4.2.4 COLLECTOR RINGS. - The collector rings must be clean and free of scratches, burrs and marks. If necessary, use no. 00 sandpaper to clean the surface. Never use emery cloth or other conducting abrasives.

4.3 TESTING AND REPAIR

If repair work is necessary on the generator, it should be performed by a competent electrician who is familiar with operation of electric generating equipment.

4.3.1 TROUBLE-SHOOTING. - In the event of abnormal generator output voltage, observe the following procedures.

4.3.1.1 No Voltage Build Up. - First remove the exciter cover and with the plant running, operate the residual reset button on the Magneciter. On the 02SX exciter, the build-up relay automatically performs this function. Check its operation and contacts.

NOTE: Early 04SX and 06SX models had no reset button. On these models place jumpers momentarily from G_1 to G_2 of each reactor simultaneously with the plant running.

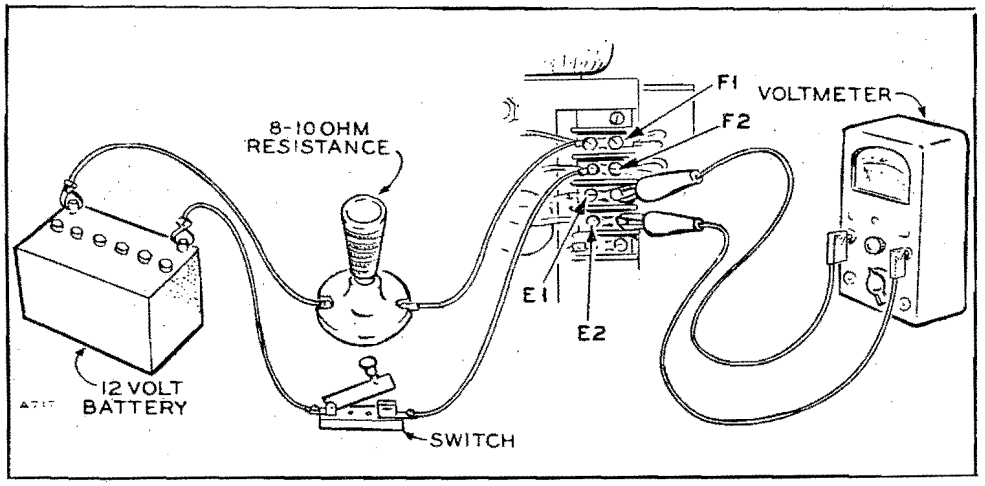


FIG 4.1 - FLASHING THE FIELD. SEE SECT 4.3.1.1

If output voltage won't build up after pushing the reset button, flash the field. To flash the field connect a voltmeter across the ac output. Then run the plant and touch the leads of a 12 volt battery in series with an 8-10 ohm current limiting resistor to the exciter-to-brush leads... positive (+) to F_1 and negative (—) to F_2. If the resistor weren't used, battery current could destroy the Magneciter rectifiers. Watch the voltmeter. If voltage builds up to normal, the trouble was due to lost residual in the field. If the voltmeter indicates a low voltage, the Magneciter is probably defective (See Sect 4.3.3 and the Magneciter trouble-shooting chart for repair). If there is no voltage output with the battery connected to F_1 and F_2, trouble is in the alternator (See Sect 4.3.2 for testing and repair).

4.3.1.2 Under-Voltage Condition. - Either the alternator or Magneciter could be defective. But, the defect is probably in the Magneciter so check it first, using Sect 4.3.3 and the Magneciter trouble-shooting chart.

4.3.1.3 Over-Voltage or Fluctuating Voltage. - If the engine is operating at the correct speed, trouble is most likely in the Magneciter. See Sect 4.3.3and the Magneciter trouble-shooting chart.

4.3.2 ALTERNATOR TESTING. - Most alternator testing can be performed without disassembling the generator.

4.3.2.1 Rotor Continuity Tests. - Remove the brushes so none touches the collector rings.

1. Using an ohmmeter, test for grounding between each slip ring and the rotor shaft.

2. Test for short or open circuit in the rotor winding, by measuring the winding resistance between the slip rings. It should measure between 6 and 6.5 ohms for the MJB and between 2.5 and 3 ohms for the MJC (at 70°F). If an accurate ohmmeter isn't available, check the rotor for open circuit or grounding with a dc test lamp (Fig. 4.J).

Replace the rotor if it is grounded, or has an open circuit or short.

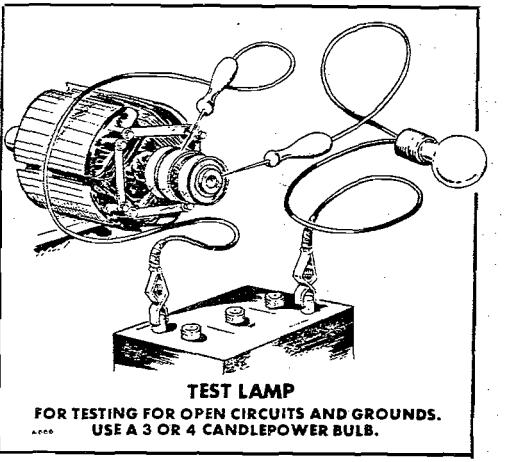


FIG 4.J - CONTINUITY TEST LAMP

4.3.2.2 Stator Continuity Tests. - Disconnect the generator output leads in the control box. Use the wiring diagrams in Sect 10 to determine the output lead coding.

1. Using either the test lamp or an ohmmeter, check each winding of the stator for grounding to the laminations or frame.

   NOTE: Some generators have ground connections to the frame. Check the wiring diagrams.

2. Using an accurate ohmmeter, test the resistance of each stator winding. Compare the resistances obtained. All windings of equal output voltage should indicate about the same resistance. An unusually low reading indicates a short; a high reading an open circuit.

   If the ohmmeter required for this test isn't available, check for open circuits with the test lamp.

If any windings are shorted, open-circuited or grounded, replace the stator assembly. Before replacing the assembly, check the leads for broken wires or insulation and replace any defective lead. If this does not correct the fault, replace the assembly. It isn't practical to attempt to rewind a defective stator except in a competent rewinding shop.

4.3.2.3 Battery Charging Winding Tests. - Remove the lead from the battery polarity reconnection block to ammeter at the ammeter. Install a dc voltmeter between the lead and ground. At governed engine speed, the average dc output should be 7 to 9 volts. If the output is incorrect, test for open circuit or grounding in the leads and windings. If leads are defective, replace them. If the winding is defective, replace the stator.

4.3.2.4 Collector Rings. - If the collector rings are grooved, out-of-round, pitted or rough so that good brush seating can't be maintained, remove the rotor, Sect 4.4, and refinish the rings in a lathe. Remove or shield the ballbearing during refinishing.

4.3.2.5 Ballbearing. - If the ballbearing becomes noisy, worn or otherwise defective, replact it. Remove the old ballbearing with a gear puller and drive or press a new one into place.

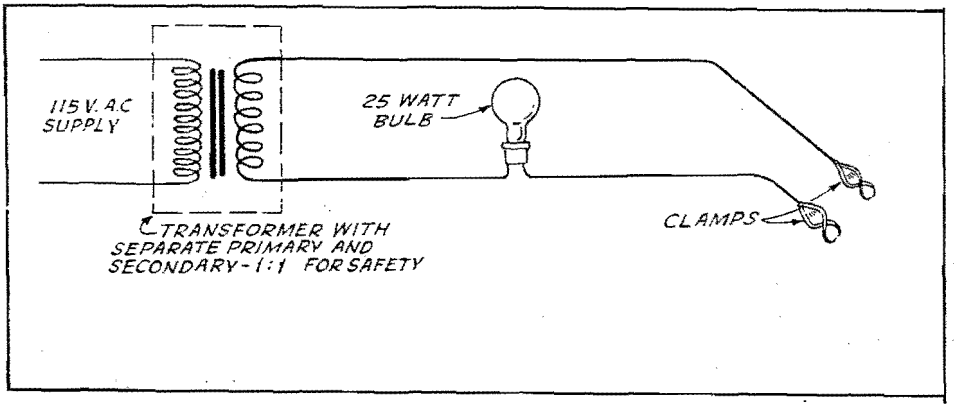


FIG 4.K - 115 V CONTINUITY TEST LAMP (Use for testing Magneciter)

4.3.3 MAGNECITER TESTING AND REPAIR. - If generating failure is traced to the Magneciter, see the Magneciter trouble-shooting chart. Perform tests on the components with either an ohmmeter or a 115 volt test lamp (Fig. 4.K).

Always isolate the component being tested by removing its leads. Before testing, make certain that no part of the Magneciter is grounded. Use the tests in the following sections to determine whether the components are functioning properly. Replace any components found defective.

4.3.3.1 Reactors. - Test the control reactor with an ohmmeter, using the resistance values in the Table of Resistances (Fig. 4.L). Use the following method to test each gate reactor:

1. Make certain that no part of the Magneciter is grounded.

2. Isolate the gate winding (G_1, G_2) by disconnecting one lead from its point of connection and the control winding by disconnecting both leads (C_1, C_2) from their points of connection.

   CAUTION: The accuracy and reliability of resistance values depends on the accuracy of the ohmmeter used. Reliable readings such as found between G_1 and G_2 can't be accurately read with a multimeter.

MODEL OF MAGNECITER	CONTROL REACTOR		LARGE REACTOR		BUILD-UP RELAY COIL
	C to 31	C to 1	C_1 to C_2	G_1 to G_2	
02SX1N1A		14.0	5.0	1.0	525 -- 50
04SX1N1A & B	12.5		11.0	1.77	None
06SX1N1A & B	12.5		5.5	.66	None

FIG. 4.L - TABLE OF RESISTANCES, MAGNECITER

3. Connect one test lead to G_1 and the other to G_2 and observe the light bulb.

4. With the test leads still connected to the gate winding leads, short across leads C_1 and C_2 and again observe the bulb.

5. Connect one test lead to the control winding lead and the other test lead to one of the gate winding leads and observe the bulb.

RESULTS

1. Reactor is serviceable if bulb is dark for steps 3 and 5 but bright for step 4.

2. Reactor is defective if bulb lights with low intensity for step 3 indicating presence of a short in either gate winding or control winding. If bulb lights at all during step 5 the control and gate winding are shorted together. If bulb fails to light in step 4 there is very likely an open circuit in either the gate winding or control winding.

If any reactor is defective, replace it.

4.3.3.2 Rectifiers. - Test each rectifier believed to be defective by isolating it and measuring the resistance first in one direction, then in the other. If the rectifier is operating properly, one reading will be much higher than the other. If the 115 volt test lamp is used, first touch the tester probes together and observe the brightness of the bulb. Then touch them across the rectifier. If the bulb lights brightly or not at all, the rectifier is defective. If it lights dimly, this indicates that the rectifier is passing current in only 1 direction and is functioning properly. Replace any rectifier found defective.

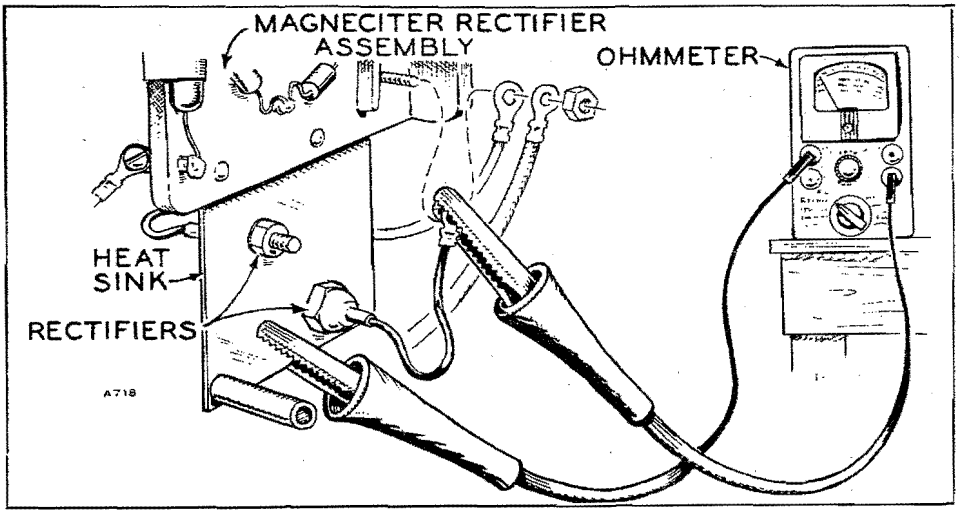


FIG 4.M - TESTING FIELD RECTIFIER

4.4 DISASSEMBLY, GENERATOR

1. Disconnect the battery so the plant won't accidentally start.

2. Remove the exciter cover and open the exciter. This reveals the thru-rotor-stud nut.

3. Remove the 4 machine screws on the endbell near the ballbearing and lift out the brush holders, (Fig. 4.H).

4. Disconnect leads E_1 and E_2 from the static exciter input terminals.

5. Remove the lead from the tapped adjustable resistor in the generator air outlet opening.

6. Remove the leads from control box to the ignition system, choke, start disconnect switch, etc. on the engine.

7. Lock the rotor with a screwdriver through the blower opening and loosen the thru-rotor-stud nut.

8. Remove the hex nuts from the rim of the end bell.

9. Pull the end bell and Magneciter off the generator. Use a crowbar to pry it loose if necessary.

10. Slide the stator assembly off its studs. Don't let it rest on the rotor. Slots are provided in the adapter casting for a prying tool.

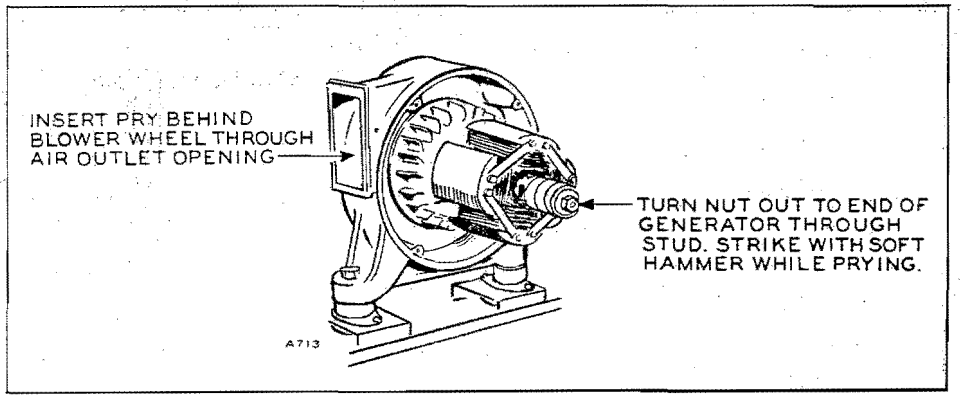


FIG 4.N - REMOVING ROTOR

11. Remove the 4 screws holding the air baffle and remove the baffle.

12. Slide the rotor and blower assembly off the thru-rotor-stud (Fig. 4.N)

13. Remove the ballbearing from the rotor with a gear puller.

4.5 ASSEMBLY, GENERATOR

1. Press the ballbearing on the rotor shaft as far as it will go.

2. Wipe both the crankshaft stub and the tapered section of the rotor shaft clean and install the rotor and blower assembly.

3. Install the air baffle and secure with screws. Place so the rubber grommet is near air outlet.

4. Install the thru-rotor-stud nut but don't tighten.

5. Check the rotor run-out at the rear end of the shaft (Fig. 4.O). Run-out must be less than .012". Excessive run-out may be caused by dirt or a nick on the taper of either the rotor or crankshaft. If not, correct by tapping ballbearing. Don't hit the collector rings.

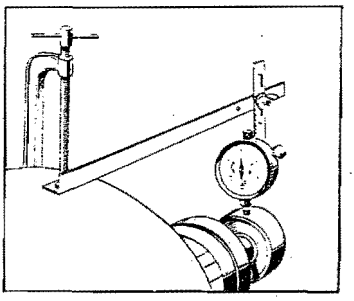


FIG 4.O - CHECKING ROTOR RUN-OUT

6. Install the stator assembly. A locating pin on the engine-to-generator adapter aids positioning. When installing the stator, feed lead B_1 through the rubber grommet in the air baffle. Leads E_1 and E_2 should lead to the rear of the stator through a notch between

the outer wrapper and laminations. Extend all other leads out of the generator through the notch in the engine to generator adapter.

7. Install the bearing stop clip on the ballbearing.

8. Install and secure the endbell. The ballbearing stop clip should fit into the notch in the ballbearing mount on the endbell.

9. Tighten the thru-rotor-stud nut to 55 to 60 lbs-ft.

10. Reconnect the leads to the ignition system and other equipment on the engine.

11. Install lead B_1 on the adjustable resistor.

    CAUTION: Check this lead to see that it is short and keep it away from the blower. If necessary when installing a new stator or leads, cut it shorter and reinstall the connector.

12. Install E_1 and E_2 on the Magneciter terminals E_1 and E_2.

13. Install the brushes and brush holders.

14. Close the Magneciter, secure with 2 capscrews and install the end cover.

TROUBLE SHOOTING CHART 10, REVOLVING FIELD GENERATOR

TROUBLE	PROBABLE CAUSE	REMEDY
Engine runs but voltage won't build up	Residual magnetism gone	See Sect 4.3.1 for trouble shooting.
	Dead short in load.	Inspect load and correct.
	Magneciter defective.	See Trouble-Shooting-Chart 11 - Magneciter
	Open circuit, ground or short in stator.	Test as per Sect 4.3.2 Replace if necessary.
	Open circuit, ground or short in revolving field.	Test as per Sect 4.3.2 Replace if necessary.
Current unsteady but engine speed not fluctuating	Loose connection.	Clean and tighten connections.
	Poor brush contact.	Reseat or replace brushes. Clean slip rings.
Frequency drops under heavy load	Low engine power.	See Trouble-Shooting Chart 1 - Engine
	Poor governor adjustment.	Adjust engine governor Sect 3.4
Voltage drops under heavy load, little frequency change.	Defective Magneciter.	See Trouble-Shooting Chart 11 - Magneciter
Generator won't deliver rated current.	Unbalanced load on lines.	Adjust load.
	Defective Magneciter.	See Trouble-Shooting Chart 11 - Magneciter
	Defective field windings.	Test and replace if defective
Generator overheats.	Overloaded.	Reduce Load.
	Partial short in load.	Correct short.
	Poor ventilation.	Increase ventilation.

TROUBLE SHOOTING CHART 10 (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
Incorrect output voltage.	Voltage control on wrong tap (02SX).	
	Incorrect adjustment of output control resistor (04SX and 06SX).	See Section 4.1.
	Engine governor set wrong speed.	Check engine speed, adjust governor.
	Defective Magneciter	See Trouble-Shooting Chart 11 - Magneciter
Noise in generator.	Defective bearing.	Replace.
	Collector rings out of round.	Turn down in lath.

TROUBLE SHOOTING CHART 11, MAGNECITER

Troubles are listed in advancing order, from no output voltage to a rated but fluctuating output voltage. The relationship between trouble and cause is not always consistent from model to model, so the following information must be used as a guide, not an absolute rule.

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Generator will not build up voltage.	Circuit breaker in "off" or "tripped" position	Reset and close breaker
	Open in circuit breaker	Stop plant and check breaker continuity
	No AC power to Magneciter	Check AC voltage at E_1-E_2 with the plant operating* Voltage should be five per cent of the rated voltage. If not, check continuity from E_1-E_2 back to the generator
	Contacts dirty in Build-up Relay of 02SX1N1A	Stop plant. Clean by drawing hard surfaced paper between contacts
	Partial loss of residual in Rotor	With plant operating*, place a jumper across G_1-G_2 until voltage begins to build-up. Then remove
	Pair of Field Rectifiers (either 1 & 4 or 2 & 3)open	Test rectifiers and replace if defective
	Both Field Rectifiers 2 and 3 shorted	Test rectifiers and replace if defective
Output voltage slow to build up. Circuit breaker opens in about five seconds	Either Field Rectifier 2 or 3 shorted	Test rectifiers and replace if defective
Output voltage slow to build up and five per cent below rated voltage after build up. Voltage regulation poor.	Either Field Rectifier 1 or 4 shorted	Test Rectifier and replace if defective

* - Be cautious when trouble shooting on an operating plant.

TROUBLE SHOOTING CHART 11 (Cont.)

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Output voltage slow to build up and higher than rated voltage after build up	Open circuit in one or more Control Rectifier	Test rectifier and replace if defective. Check soldered connections to rectifiers
Output voltage slow to build up and ten to twenty per cent above rated voltage after build up	Open in one Field Rectifier	Test rectifiers and replace if defective
	Open circuit in Gate winding G_1-G_2 of Reactor A or B	If Field Rectifiers 1 and 2 check okay, check continuities of Gate windings G_1-G_2
Output voltage builds up normally but less than rated voltage after build up	Shorted winding in Control Reactor	Test Control Reactor and replace if defective
Output voltage builds up normally with slightly less than rated voltage at no load and low voltage at full load	Compound winding S_1-S_2 installed backward or has open circuit.	Check wiring diagram for polarity of Compound windings through Reactors A and B and test for continuity
Output voltage builds up normally but 20 per cent above rated voltage after build up. Voltage regulation poor.	Compound winding S_1-S_2 installed backward through one Reactor (A or B)	Check wiring diagram for polarity of Compound winding through Reactor A or B
Output voltage builds up normally but is twenty five per cent above rated voltage after build up	Open circuit in Control Rectifier bridge	Check continuity from the junction of Control Rectifiers 1 and 2 to the junction of Control Rectifiers 3 and 4
Output voltage builds up normally but 125 to 150 per cent above rated voltage after build up	Shorted turn in gate winding G_1-G_2 of Reactor A or B	Test Reactors A and B for shorted turns and replace if defective
Output voltage builds up normally but 150 to 200 per cent above rated voltage after build up. No regulation possible	Control winding C_1-C_2 of Reactor A or B polarized incorrectly	Check circuit connections of both Reactors A and B
	Shorted turn in Control winding C_1-C_2 of Reactor A or B	Test Reactors A and B for shorted turn and replace if defective
	Relay inoperative	Check coil continuity; replace if defective
	Open in Control Circuit	Check continuity from E_1 to E_2 through Control Circuit

5. REVOLVING ARMATURE GENERATOR

MODELS: 3MJA, 4MJA and 5MJB

The revolving armature generator is used on these generating plants. It is a 4-pole, self-excited generator with inherent regulation. The generator serves as a starting motor and furnishes dc current to recharge the batteries during operation.

The generator field contains shunt windings and series windings (a few turns of heavy wire wound on the same forms as the shunt windings). The series windings act as the starting motor field. The shunt windings are the working field, they produce the magnetic field in which the armature turns to produce useful output.

NOTE: Beginning Spec F, 5MJB plants use a separate automotive starter rather than the series winding in the generator. To provide fast voltage buildup, these models use an auxiliary series winding (on two of the generator field coils) which is energized by the battery during starting.

The generator's armature contains both ac output windings and dc windings to supply the field and battery charging circuit.

The generator is mounted to the engine through the engine-to-generator adapter and the armature is directly connected (a tapered fit) to the crankshaft. The outboard end of the generator rides on a ball bearing housed in the endbell. Because of its construction the generator can't be removed as a unit.

Generator leads are marked with metal tags for identification. Lead and terminal marking codes are noted on the plant wiring diagrams, Sect 10.

5.1 MAINTENANCE

Normal maintenance procedures include periodic inspection of the armature, ball bearing, collector rings and commutator, and the brushes normally every 500 hours. In addition, the generator should be blown clean with compressed air every 1000 hours.

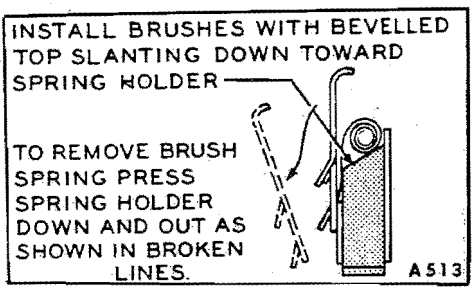


FIG 5.A - BRUSH INSTALLATION

5.1.1 BRUSHES. - To examine the brushes, remove the endbell band and cover. Replace the brushes when they wear to about 1/2 in. long. All brushes must have at least a 50 percent seat. If they don't sand as illustrated in Fig. 5.B

5.1.2 GENERATOR BEARING. - The generator bearing is prelubricated for its life and sealed. It requires no servicing.

5.1.3 COMMUTATOR AND COLLECTOR RINGS. - The commutator must be clean and in good condition. If it is dirty, clean with No. 00 sandpaper. Check the mica between the commutator bars. If it is above the level of the bars under cut it (Sect 5.3.3).

For collector ring maintenance see Sect 5.3.4

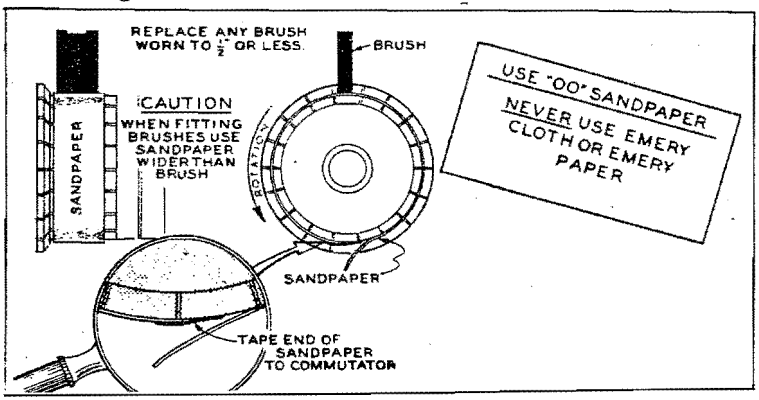


FIG 5.B - SEATING BRUSHES

5.1.4 ANTI-FLICKER BREAKER POINTS AND RESISTOR (3MJA models). - The anti-flicker breaker points are located on the left rear corner of the engine crankcase. The camshaft opens these points on every power stroke to add a resistor in series with the generator field windings. To adjust the breaker points, crank the engine until the points reach maximum separation. Loosen and turn the stationary contact to set the gap at .025 in. Retighten and recheck the gap.

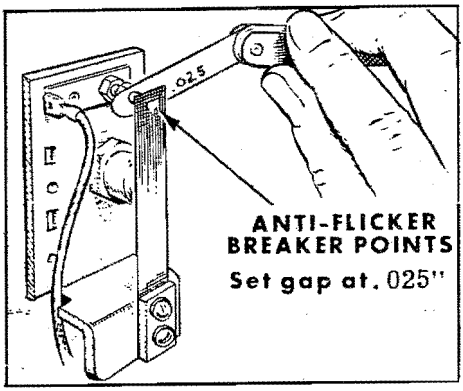


FIG 6.C - ANTI-FLICKER BREAKER POINT GAP

4MJA models have a transistorized anti-flicker circuit. The transistor shorts the flicker resistor (rather than the plunger and breaker points used on 3MJA models) which will give long life to the breaker points because current to its points is very low. The breaker points are used only to control the transistor.

The adjustable flicker resistor is located on the right side of the control box. If flicker becomes excessive, adjust the resistor by moving its slider. Adjust it for minimum flicker with the average load on the plant.

5.2 ADJUSTMENTS

The engine governor controls generator output frequency. At the same time, engine speed determines generator output voltage, so voltage can be adjusted over a small range by adjusting the governor mechanism. The voltage drop from no load to full load operation is determined by the engine governor sensitivity.

To adjust output voltage slightly, within the range shown in Fig. 5.D, adjust the governor, Sect 3.4.2. This also changes the plant output frequency, so be sure the the frequency stays within the maximum and minimum limits shown in Fig. 3.4.B for revolving armature generators.

The voltage drop from no load to full load can be adjusted to within the range shown in Fig. 5.D by adjusting the governor sensitivity.

Nominal output	Voltage Max - (at no load)	Voltage Min - (at full load)	Preferred voltage spread no load to full load	Preferred drop no load to full load
120	126	110	4	118-114
240	252	220	8	236-228
120/240	126	110	4	118-114
240	252	220	8	236-228
120/208	228	198	8	214-206

FIG. 5.D VOLTAGE MAXIMUMS, MINIMUMS AND VOLTAGE DROPS

5.3 TESTING AND REPAIR

Most of the following tests can be performed without disassembling the generator.

5.3.1 ARMATURE TESTING. - Before testing remove all brushes from their holders.

1. Using a test lamp, Fig. 4.J, or ohmmeter, check the ac winding for an open circuit between the slip rings. If an open circuit is found, replace the armature.

2. Test both the slip rings and commutator for grounding to the shaft.

3. Test the armature for an open circuit in the dc windings by checking continuity between all adjacent bars of the commutator.

   Touch the probes to 2 adjacent bars and check for continuity. Move each probe over 1 bar and again check. Continue around the commutator. Adjacent bars that don't show continuity indicate an open armature winding.

4. Test for shorts in the dc armature winding. This test can only be performed with the generator disassembled and requires a growler. Place the armature in the growler, operate the growler and pass a steel strip back and forth above the armature windings (Fig. 5.E). If the strip is magnetically attracted to the armature at any point, a short is indicated. After testing in one position, rotate the armature slightly and repeat the test. Do this for one complete revolution.

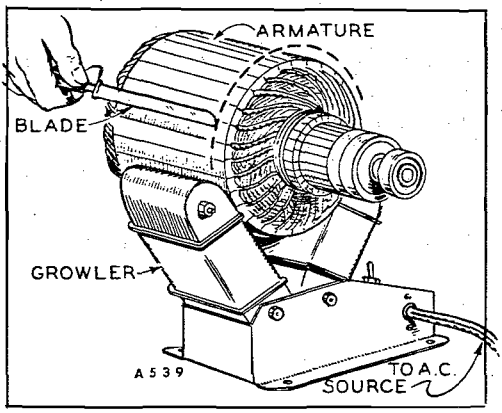


FIG 5.E - TESTING ARMATURE FOR SHORTS WITH A GROWLER

If the test indicates a short circuit in the dc windings be sure the commutator is clean. Carbon dust, dirt and grease between the bars or slip rings could cause a short.

If any of the tests above show that the armature is defective, replace it.

5.3.2 FIELD WINDING TESTS. - The following tests can be performed without disassembling the generator, but the field coil leads must all be disconnected from their terminal points: brush rig, control box, and external connections. If a defective coil is found, disassemble the generator (Sect 5.4) and replace the defective coil.

1. With the field leads disconnected, use an ohmmeter or continuity lamp to check for grounding to the generator frame. Touch one prod to each coil terminal in turn and the other to a clean, paint-free part of the frame. If the test indicates grounding, separate the windings and check each.

2. Check the field winding resistance from the negative commutator brushes (from F_2 when used) to the F+ (or F_1) connection on the generator (F+ is connected to the positive brushes) with all commutator brushes lifted off their seats. See Resistance Table (Fig. 5.H) for correct values. If the windings are warm from running, the resistance will be slightly higher than specified. If the resistance is high, check for an open circuit in one of the parallel windings, step 3, otherwise go directly to step 4.

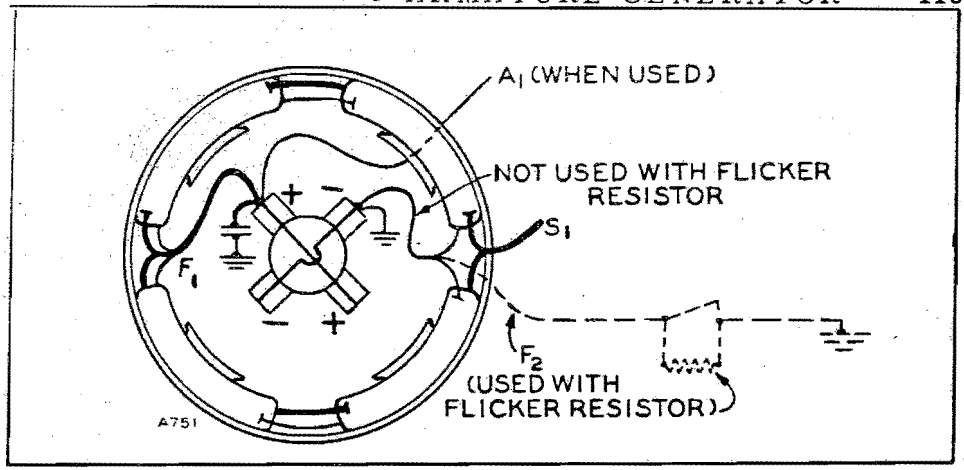


FIG 5.F - SCHEMATIC, REVOLVING ARMATURE GENERATOR

3. Separate the parallel field windings (at F+) and check each for open circuit.

4. *Check for open circuit in the series winding with ohmmeter. Touch probes to lead S_1 and connection F+. If there is an open circuit isolate each coil and check it.

5. *Test for short circuit between the starter windings and the shunt windings. Before doing this separate all windings at F+.

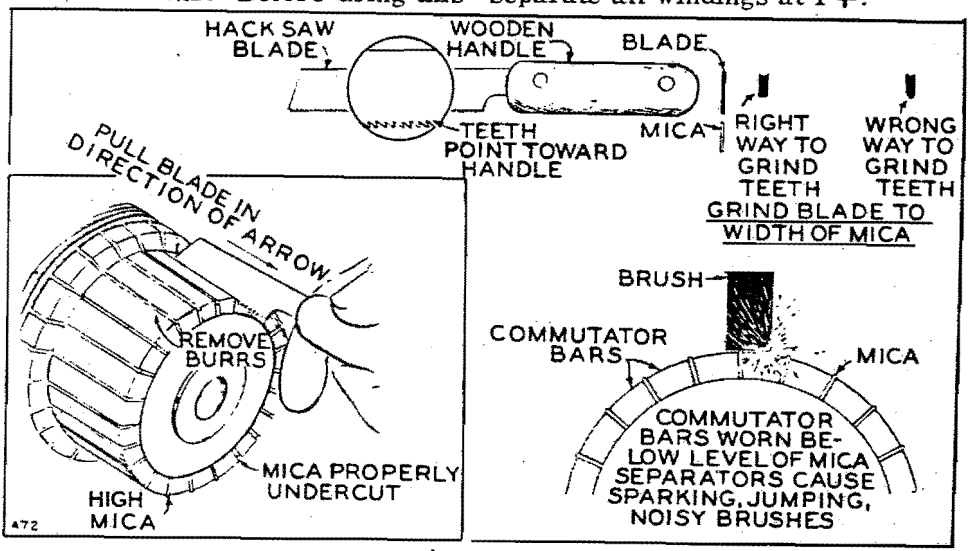


FIG 5.G - UNDERCUTTING COMMUTATOR MICA

* Doesn't apply to 5MJB Beginning Spec F

Generator Model (See Nameplate)	DC Voltage Output at Winding (no load) (Volts)	Total Field Winding Resistance (Ohms)	Resistance Each Coil (Ohms)
3MJA ac model 24-Volt Cranking	24-28 (60 Cy.)	2.065	2.065
MJA ac model 12-Volt Cranking	Spec A Only 15 (50 Cy.) 21 (60 Cy.)	1.46	1.46
	Begin Spec B 21	0.8	0.8
4MJB, 5MJB ac model 12-Volt Cranking	27	1.7	1.7

FIG 5. H - REVOLVING ARMATURE FIELD RESISTANCES AND DC VOLTAGE OUTPUT

6. (4 and 5 MJB beginning Spec F only) To test the auxiliary winding, (Fig. 5.F) check continuity between S_1 and F_1. Resistance should be less than 1 ohm.

5.3.3 COMMUTATOR REPAIR. - The commutator bars wear down with use so eventually the mica between them extends over the tops of the bars and causes sparking and noisy brushes. When the mica on any part of the commutator is touching the brushes it must be undercut. A suitable undercutting tool can be made from a hacksaw blade (Fig 5.G). Cut the mica to about 1/32" under the bars. Be careful not to injure the bars. After undercutting remove any burrs formed on the bars.

If the commutator is grooved, out-of-round, or otherwise damaged, refinish it. Turn it in a lathe and then undercut the mica as described above. Shield the ball bearing during refinishing.

5.3.4 COLLECTOR RINGS. - If the collector rings are grooved, out-of round or rough so that good brush seating can't be maintained, remove the armature (Sect 5.4) and refinish the rings in a lathe. Shield the ball bearing during refinishing.

5.3.5 BALL BEARING. - If the ball bearing becomes noisy, worn or otherwise defective, replace it. Remove the old ball bearing with a gear puller and drive or press a new one into place.

5.3.6 BRUSH RIG ALIGNMENT. - The brush rig must be aligned in the neutral position. If it isn't, sparking occurs. Normally, the neutral position is identified by a chisel mark on the brush rig (Fig 5.I). If the mark is lost or a new brush rig installed, follow these instructions to find the neutral position:

1. With the generator end cover and band removed to allow access to the rig, connect a voltmeter across the dc terminals.

2. Then start the unit and apply full rated load.

3. Loosen the brush rig mounting screws and rotate the rig to get the highest voltage.

4. Rotate the rig in one direction until the voltmeter reading starts to decrease. Mark this point.

5. Repeat step 4 in the other direction.

6. Half the distance between the two marked points is the neutral position.

NOTE: If a voltmeter isn't available, use the above procedure but mark the point where arcing begins.

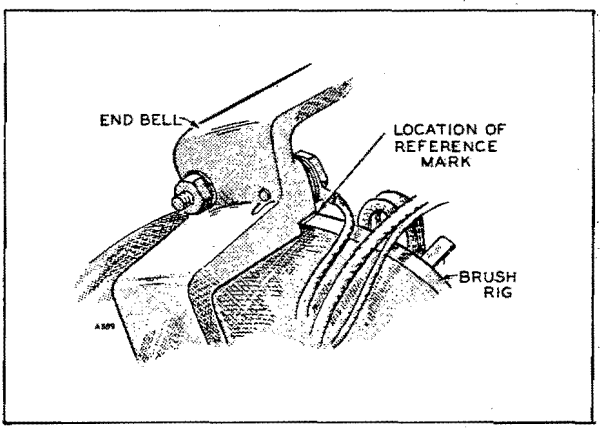


FIG 5.1 - BRUSH RIG ALIGNMENT

5.4 DISASSEMBLY, GENERATOR

1. Remove the battery cables, and leads to the engine.

2. Remove the endbell cover and band.

3. Remove the brush springs (Fig 5.A).

4. Loosen the thru-armature-stud nut in the center of the rear bearing.

5. Remove the thru-generator-stud nuts on the endbell.

6. Slide the endbell, brush rig, and frame off as one assembly. Be careful not to drag the frame on the armature.

7. Remove the screws holding the blower baffle to the engine-to-generator adapter and remove the baffle.

8. Slide the armature and blower assembly off the stud. To loosen the assembly from the crankshaft, tap the threaded end of the stud several times with a soft hammer.

   NOTE: If the above procedure doesn't loosen the armature assembly, tap down wards on the outboard end of the armature shaft, rotate it 1/2 turn and repeat. Don't hit the commutator, collector rings or bearing.

9. If necessary to remove field coils, remove the pole shoes by removing the capscrews holding each to the frame.

5.5 ASSEMBLY, GENERATOR

1. Reinstall any poleshoes and field coils removed.

2. Install the armature and blower assembly and install the stud nut.

3. Check for armature run-out (Fig 5. J). Run-out should be less than .012".

   Excessive run-out may be caused by dirt or a nick on the taper of either the rotor or crankshaft. If not, correct by tapping the high side of the shaft near the ball bearing. Don't hit the ball bearing, commutator, or collector rings.

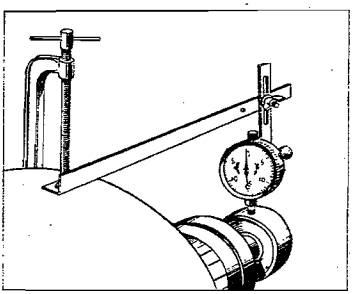


FIG 5.J - CHECKING ARMATURE RUNNOUT

4. Install the blower baffle and secure with screws.

5. Install the bearing stop on the ball bearing.

6. Install the field frame and endbell assembly and secure. Be sure generator output wires feed through the slot in the front of the frame.

7. Tighten the thru-armature-stud nut to 30 - 40 lb. ft.

8. Reconnect leads to the engine.

9. Reinstall the battery cables.

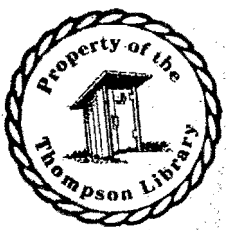
10. Align the brush rig (Sect 5.3.6).

TROUBLE-SHOOTING CHART 12. REVOLVING ARMATURE GENERATOR

TROUBLE	POSSIBLE CAUSE	REMEDY
Engine runs but voltage does not build up	Poor brush contact.	See that brushes seat well, are free in their holders, are not worn too short, and have good spring tension.
	Open circuit, short circuit, or ground in generator.	Replace parts necessary.
	Residual magnetism lost.	Remagnetize the field.
Noisy and excessive arcing of brushes	Rough commutator.	Turn down. Undercut mica between bars.
	Dirty commutator.	Clean.
	Brushes not seating properly.	Replace.
	Brush rig out of position.	Line up properly.
Generator overheating (approximately 160°F higher than ambient)	Brush rig out of position	Adjust.
	Overloaded.	Reduce load.
Voltage drops under heavy load	Engine lacks power.	See remedies, Engine lacks power, Trouble-Shooting Chart 1

TROUBLE SHOOTING CHART 12 (Cont.)

TROUBLE	POSSIBLE CAUSE	REMEDY
Voltage unsteady but engine not misfiring	Speed to low.	Adjust governor to correct speed.
	Poor brush contact (or poor commutation).	See that brushes seat well on commutator, are free in their holders, are not worn too short, and have good spring tension.
	Loose connections.	Tighten connections.
	Fluctuating load.	Correct any abnormal load condition causing trouble.
Flickering lights	Defective anti-flicker assembly (1 cylinder only).	See Sect. 5.1.4
	Engine misfiring.	See Trouble Shooting Chart 1.



6. CONTROL SYSTEM

The plant control system controls starting, stopping, battery recharging and provides a means of emergency automatic stopping. The control system and control system defects can best be analyzed with the aid of the proper wiring diagram (Sect. 10).

When using ONAN wiring diagrams, remember these points. The views shown are modified pictorial. Components are shown in their actual positions and normally the top view of each component is shown, for terminal location. Dotted lines show the edges of the control box and indicate the direction from which it is being viewed, i.e. "Top View". All relays are shown in the de-energized position.

Plant control systems are divided into 2 main types, revolving armature plants and revolving field plants. These plants are operated by Remote start ("R" appears in model, -R).

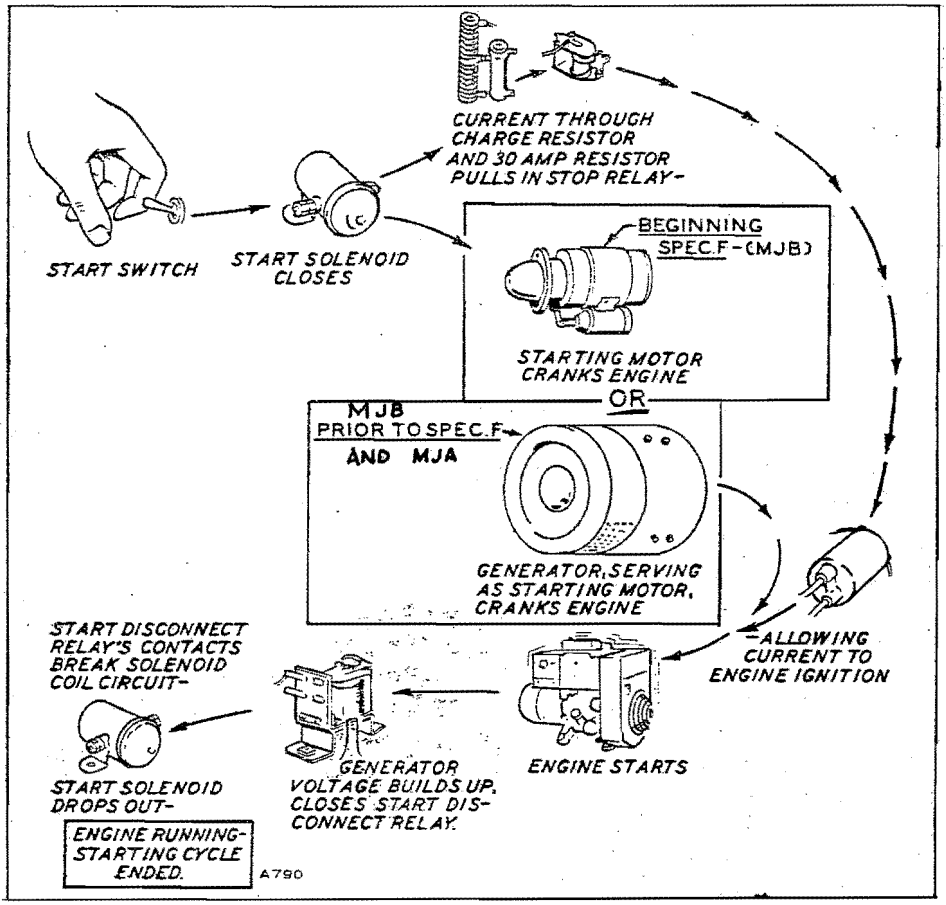


FIG 6.A - STARTING CYCLE REVOLVING ARMATURE - REMOTE START

6.1 MAINTENANCE

Periodically check all connections and contacts in the control system. Blow out accumulated dust with low pressure air. The breaker point gap of the engine mounted centrifugal switch will have to be checked at regular intervals, see periodic service chart. This gap should be set at .020".

NOTE: This switch is not used on MJA and 5MJB models except with optional low oil pressure cut-off. Revolving field plants use the switch to disconnect the starter and as a time delay device with optional low oil pressure cut-off.

Because of the basic differences between the control system for MJA, 5MJB (Prior Spec F), and 5MJB (Begin Spec F) models and the control system for 705MJB and MJC models, they will be discussed separately.

6.2 TESTING AND REPAIR

MODELS: REVOLVING ARMATURE MODELS 5MJB-R (Prior to Spec F) and MJA-R

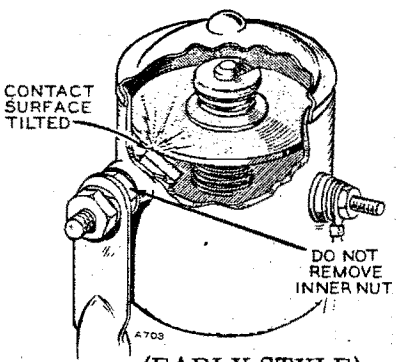
These generating plants use the generator as a starting motor. The control system includes the starting circuit, a battery charging circuit with reverse current relay and optional high temperature and low oil pressure cut-offs.

MODELS: REVOLVING ARMATURE MODELS 5MJB-R (Begin Spec F)

These generating plants use a separate automotive type starting motor. The control system includes the starting circuit, a battery charging circuit with reverse current relay and optional high temperature and low oil pressure cut-offs.

If any component of the control system fails, replace it. Normally, it isn't worthwhile to attempt repairs on individual relays, etc.

6.2.1 STARTING AND STOPPING - The starting system for these models includes the start solenoid, stop relay, and start-disconnect relay (MJB only). Fig. 6.A shows a starting cycle. To stop the engine, the stop switch grounds the stop relay, breaking the ignition coil circuit.



(EARLY STYLE)

FIG 6. B - OVERTIGHTENED START SOLENOID CONNECTIONS

6.2.1.1 Starting Solenoid. - The starting solenoid controls the heavy currents required by the exciter starting motor. If it appears defective, test it for welded contacts across the main terminals or an open circuit in the energizing coil.

If the solenoid sticks energized (contacts welded together) check for the following conditions --

-- Excessive tightening of the main connection terminals (Fig 6.B) on the solenoid. This tilts the contact surfaces inside the solenoid, causing burning and welding. All current models have epoxy-filled solenoid switches to eliminate cocking of contact surfaces (Fig 6.B), as are all current replacement parts. The epoxy-filled solenoids are identified by two part numbers stamped on the bottom; the early style solenoids have only one number stamped on the housing.

-- Improper use. If the start switch is released when an engine slows at the peak of the first compression stroke, the large current passing through the solenoid may burn or weld the contacts.

6.2.1.2 Stop Relay (#307B253) - This relay controls voltage to the ignition coil. When energized it closes the ignition coil circuit. During starting, the stop relay pulls in at the same time as the start solenoid. The generator's dc output maintains it energized throughout operation. To stop, the stop button grounds the relay, which de-energizes, opening the ignition coil circuit.

NOTE: This is a 6 volt relay and must be used in series with the 30 ohm voltage dropping resistor.

To test this relay, check the coil resistance (it should be about 30 ohms), inspect the contacts, and check contact operation when voltage is applied to the coil. If the contacts are dirty, they can be cleaned with hard paper or gauze moistened with carbon tetrachloride.

6.2.1.3 Start-Disconnect Relay (#306A28) - The start-disconnect relay is energized by the generator dc output, so it pulls in when the output builds up to 10 or 11 volts and remains energized throughout plant operation. When the relay pulls in, it opens the circuit to the start solenoid coil, opening that solenoid to break the starting circuit. To test this relay, inspect the contacts, check the coil resistance (it should be 20 to 24 ohms) and check contact operation when the plant starts.

6.2.2BATTERY CHARGING CIRCUIT - The generator dc windings supply current for the battery charging circuit. The current flows through the reverse current relay, charge ammeter and the adjustable charge rate resistor, located outside the control box.

The battery charge rate can be adjusted between 2 and 5 amps by moving the slider on the charge resistor.

6.2.2.1 Reverse Current Relay (#307B180) - This relay allows current flow only from the generator to the battery and opens when current

attempts to flow in the other direction. To test the relay, isolate it by removing the generator connection (GEN). Check for continuity between the battery and generator terminals. Continuity here indicates that the relay contacts are welded together. Measure the resistance from the generator terminal to ground. This should be approximately 112 ohms.

6.2.3 AUTOMATIC EMERGENCY STOPPING. - There are 2 parts to the emergency automatic stopping system, a high temperature cut-off switch and an optional low oil pressure cut-off circuit.

NOTE: When the generating plant is used with Line Transfer or Automatic Demand Controls and one of the emergency stopping devices operates, the plant will stop and then crank until the control's cranking limiter opens.

6.2.3.1 High Water Temperature Cut-Off Switch. - This switch, located on the rear of the cylinder head, is in the ignition circuit. Normally closed, it opens at 200°F ± 5°, breaking the ignition circuit and stopping the engine. The switch closes again at 160°F ± 7°.

6.2.3.2 Low Oil Pressure circuit (Optional) - This circuit includes a non-adjustable low oil pressure switch and centrifugal switch located on the engine and a latching relay (5MJB prior to Spec F only) in the control box. The MJA and 5MJB (Begin Spec F) models have an emergency relay to perform the function of the latching relay on the earlier MJB models. See Sect. 6.3.3.4

If low oil pressure occurs, the pressure switch closes completing the relay coil circuit. This operates the relay disconnecting engine ignition system, which stops the plant. The centrifugal switch is required to prevent operation of the relay during the plant starting cycle, before oil pressure builds up.

a. Low oil pressure switch - see Sect. 6.3.3.3

b. Latching relay 5MJB-R (Prior to Spec F) - This relay is designed so that when energized, it latches in the energized position and can only be released by pushing the reset button. Latching is accomplished in the following manner. Coil A (Fig 6.C) energizes when the oil pressure switch closes. This operates the relay, disconnecting engine ignition system, which stops the plant. With the contacts energized, current flows through Coil B. When Coil A de-energizes, Coil B, supplied by the battery, holds the relay in the energized position. When the reset button is pushed, it breaks the circuit through Coil B and the relay assumes its normal position.

To test this relay in the circuit, operate the plant and short the oil pressure switch to ground. This should energize the relay, shutting

down the plant. If the plant doesn't shut down, check both coils with an ohmmeter. Resistance of each should be 50 ohms. If the relay won't latch, check the contacts in series with Coil B.

c. Emergency relay MJA and 5MJB (Begin Spec F) - See Sect 6.3.3.4

d. Centrifugal switch - The centrifugal switch is open when the plant is stopped. During the starting cycle, it closes when the plant speed reaches about 900 rpm. The gap, with the plant stopped should be maintained at .020 in. For a complete description and repair instructions, see Sect. 3.3.2.3 and 6.3.1.4.

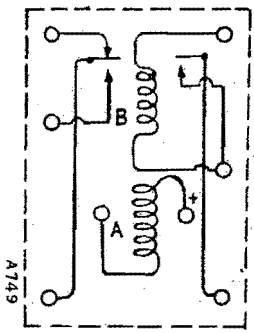


FIG 6.C - LOW OIL PRESSURE LATCHING RELAY

6.3 TESTING AND REPAIR

MODELS: 705 MJB-R, MJC-R

The control systems of these models use a separate starting motor and a rectifier and alternator battery charging system. A separate winding in the generator acts as battery charging alternator (see Sect. 4.3.2.3). Optional high temperature cut-off and low oil pressure cut-off circuits are available. On the MJB-R and MJC-R (Revolving Field Models), an engine mounted centrifugal switch serves as start-disconnect.

If any component of the control circuit fails, replace it. Normally it isn't worth-while to attempt repair of relays etc. If relay contacts are dirty, they can be cleaned by pulling hard paper or gauze soaked in carbon tetracloride between the contacts.

6.3.1 STARTING AND STOPPING SYSTEM. - The starting system includes start ignition relay, ignition relay, starting solenoid, and the centrifugal switch. It controls the solenoid-shift, over-running clutch, starting motor and the ignition coil circuit. Fig 6.D shows the start cycle.

To stop the engine, the stop switch grounds the ignition relay, which opens the circuit to the ignition coil.

6.3.1.1 Start Ignition Relay (#307B597). - This relay, with metal cover, is energized at the beginning of the start cycle by the start switch. It de-energizes when the centrifugal switch closes, completing the start cycle.

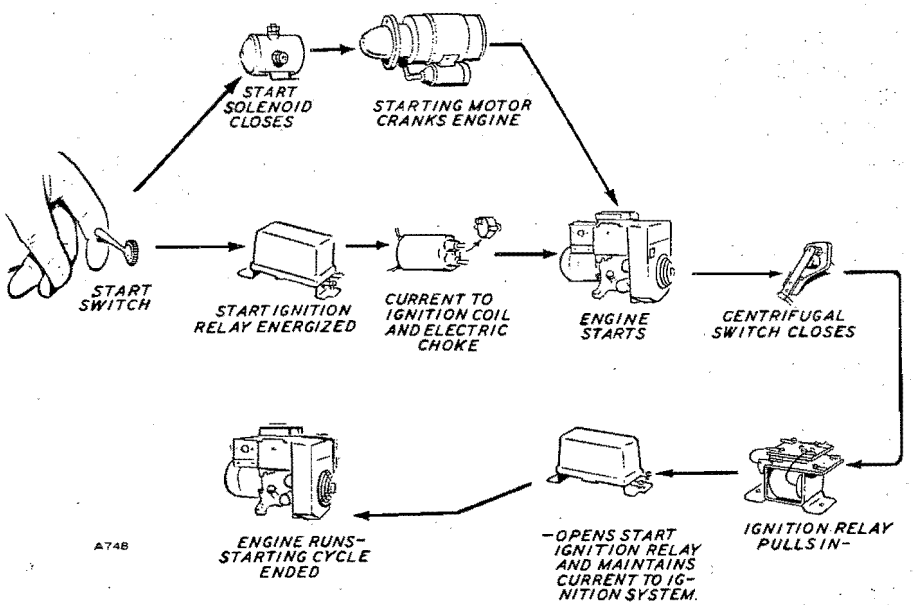


FIG 6.D - STARTING CYCLE, REVOLVING FIELD, REMOTE START

Test the relay by checking contact continuity, energized and de-energized, and coil resistance. Coil resistance is about 76 ohms.

6.3.1.2 Ignition Relay (#307B623). - This relay is normally energized throughout plant operation. It energizes, when the centrifugal switch ending the starting cycle closes, and maintains the current to the engine ignition system. To test the relay, inspect the contacts, check the continuity of each set of contacts, and measure the coil resistance. Coil resistance is about 15 ohms.

CAUTION: This is a 6 volt relay and in the control circuit it is in series with a 15 ohm dropping resistor.

6.3.1.3 Centrifugal Switch. - The centrifugal switch is mounted on the gearcover backplate with the ignition breaker points, and operates directly off the camshaft gear. Normally open, the switch closes when the engine speed builds up about 900 rpm.

For correct operation maintain the switch contact gap at .020 in. (Fig 6.E)

Check the contacts for dirt or pitting when adjusting the gap. Clean the contacts with paper or replace it if badly pitted.

In an emergency, if the centrifugal switch won't operate, the engine can be run by shorting the switch leads when the engine starts.

For disassembly and repair of the timing gear and switch operating mechanism, see Sect. 3.3.

6.3.1.4 Starting Solenoid (#307B40). - This solenoid is the same as that described in Sect. 6.2.1.1.

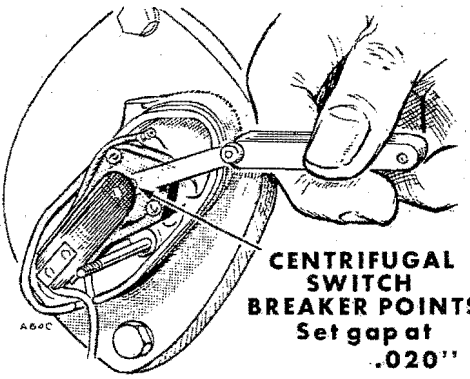


FIG 6.E - ADJUSTING CENTRIFUGAL SWITCH GAP

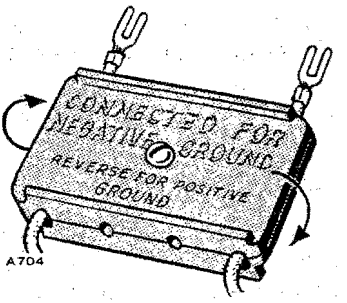
6.3.2 BATTERY CHARGING CIRCUIT. - This circuit includes the adjustable charge resistor, rectifier, and ammeter. It converts ac current supplied by the generator charging winding to dc and delivers it through the ammeter to the battery. The normal charge rate is about 2 amps and the maximum 5 amps. If any current drawing accessories such as electric fuel pumps are installed, their current draw must be subtracted from the maximum battery charging current and also for the charge rate registered on the plant ammeter. To adjust the charge rate, move the tap on the adjustable resistor in the generator air outlet.

WARNING: Connecting battery with the wrong polarity will damage the charging circuit within a minute or two. If the adjustable charge resistor is eliminated or shorted, both the circuit and the generator charging winding will be damaged in a few seconds of operation.

For information about the generator charging winding, see Sect 4.3.4.1.

6.3.2.1 Rectifier (#305-235). - The rectifier converts the ac produced by the generator charging winding to dc and also acts as a reverse current relay. Incorrect battery polarity can destroy the rectifier. If the battery polarity is to be changed, reverse the battery polarity reconnection block in the control box.

NOTE: If you aren't sure which battery polarity to use, check this block before connecting the batteries.



TO REVERSE DISCONNECT WIRES FROM TERMINALS, TURN THIS BLOCK BOTTOM SIDE UP AND RECONNECT WIRES.

FIG 6. F - POLARITY RECONNECTION BLOCK - IN CONTROL BOX

Test the rectifier with an ohmmeter or 12 volt test lamp. If it is operating correctly, resistance will be very high in one direction and low in other direction.

6.3.2.2 Adjustable Resistor. - This resistor is located in the generator blower outlet and has a total resistance of 2 ohms. It includes both a fixed section and an adjustable section. The fixed section determines the maximum charging current and must always be in the circuit to protect the components.

6.3.3 AUTOMATIC EMERGENCY STOPPING. - There are 2 parts to the emergency automatic stopping system, a high temperature cut-off switch and an optional low oil pressure cut-off circuit.

NOTE: When the generating plant is used with Load Transfer or Automatic Demand Control, and one of the emergency stopping devices operates, the plant will stop, and then crank until the control's cranking limiter operates.

6.2.3.1 High Water Temperature Cut-Off Switch. - This switch, located on the rear of the cylinder head, is in the ignition circuit. Normally closed, it opens at 200°F ± 5°, breaking the ignition circuit and stopping the engine. The switch closes again at 160°F ± 7°.

6.3.3.2 Low Oil Pressure Circuit (Optional). - This system includes a non-adjustable low oil pressure switch, emergency relay, and a 1 ohm - 10 watt resistor in series with the emergency relay. It functions to shut the plant down if oil pressure falls below 14 psi, and prevents it from restarting until the operator pushes the reset button on the control box.

NOTE: The low oil pressure circuit is designed to shut down the plant if oil pressure is not sensed by the low oil pressure switch within 15 seconds after the centrifugal switch has closed. If the plant automatically shuts down, determine and correct the cause and then restart by pushing the reset button on the emergency relay. The reset button will not reset until it has cooled sufficiently.

6.3.3.3 Low Oil Pressure Switch.- The switch is located on the oil filter adapter plate below the oil filter. It is normally closed and opens when the pressure builds up or the plant starts. If oil pressure falls below 14 psi, the switch closes, energizing the emergency relay. To test the switch, check continuity with the plant stopped and running.

6.3.3.4 Emergency Relay - This relay is a mechanical type switch which is opened when the oil pressure switch senses low pressure and closes. When the circuit is closed, 12 volts is impressed upon a heat-

ing element on the relay, a solder connection holding the spring loaded contacts is broken, and the contacts separate to open the circuit. The open circuit breaks the flow of current to the ignition system, stopping the engine. The relay may be checked for proper operation by connecting 12 volts across the terminals connecting the two ends of the heating element.

CAUTION: The heating element will get red hot when it is exposed to 12 volts. Exercise caution when performing this check. If the reset button does not pop out, remove and replace the relay.

6.3.3.5 Resistor (1 ohm - 10 watt). - This resistor is placed in series with the emergency relay to delay automatic opening of the relay 15 seconds after the closing of the low oil pressure switch. This aids in preventing false stops due to an oil filter change or slow oil circulation in the system.

7. ASSEMBLY TORQUES

The assembly torques given here will assure proper tightness with out danger of stripping threads. If a torque wrench isn't available, estimate the degree of tightness necessary for the stud, nut, or screw. Be careful not to strip threads. Use reasonable force only and a wrench of normal length.

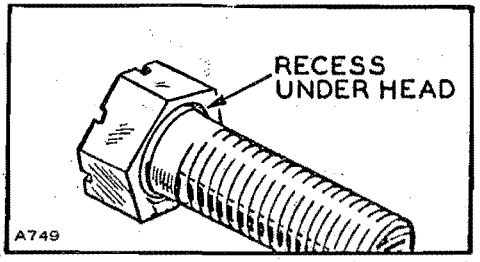


FIG 7.A - PLACE BOLT

Specially designed Place Bolts (Fig 7.A) don't require a lockwasher or gasket. Don't attempt to use a lockwasher with these bolts, it will defeat their purpose. Check all studs, nuts and screws often and tighten as needed to keep them from working loose.

TORQUE SPECIFICATIONS (lb. ft.)

Center Main Bolt (MJC)	97-102
Connecting Rod Bolt	27-29
Cover-Rocker Box	8-10
Cylinder Head Bolt	44-46
Exhaust Manifold Nuts	13-15
Flywheel Mounting Screw	65-70
Hub to Flywheel Nuts (MJC)	17-21
Fuel Pump Mounting Screws	15-20
Gear Case Cover	15-20
Intake Manifold (MJC)	13-15
Oil Base Mounting Screws (MJB and MJC)	45-50
Oil Base Mounting Screws (MJA)	32-38
Oil Bath Air Cleaner Bracket (Optional)	5-6
Oil Filter	Hand Tight —1/4 to 1/2 Turn
Oil Pump Mounting Screws	15-20
Rear Bearing Plate	40-45
Rocker Arm Nut	4-10*
Rocker Arm Stud	30-35
Spark Plug	25-30
Thru-Rotor-Stud Nut	
Revolving Armature	30-40
Revolving Field	55-60

* - This torque is due to friction between the threads only and locks the nuts in place. The rocker arm nuts adjust valve lash.

8. SPECIAL TOOLS

These tools are available from ONAN to aid service and repair work.

Crankshaft Gear Pulling Ring	420A248
Driver, Front Camshaft Bearing	420A252
Driver, Rear Camshaft Bearing	420A251
Driver, Center Camshaft Bearing (MJC ONLY)	420B254
Driver, Main Bearing Front and Rear	420B269
Driver, Valve Seat	420B270
Oil Seal Guide and Driver	420B250
Valve Seat Remover	420B272
Replacement Bits for 420B272	420B274
Wrench, Oil Filter - (For Purolator full flow filter)	420P268

9. TABLE OF CLEARANCES

All values in inches unless otherwise specified.

CAMSHAFT	
Bearing Journal Diameter, Front	2.2500 - 2.2505
Bearing Journal Diameter, Rear	1.1875 - 1.1880
Bearing Journal Diameter, Center (MJC ONLY)	1.2580 - 1.2582
Bearing Clearance Limit	.0012 - .0037
End Play, Camshaft	.007 - .039
Cam Tappet Diameter	.7475 - .7480
Cam Tappet Hole Diameter	.7505 - .7515
CONNECTING RODS	
Large Bearing Bore Diameter	2.1871 - 2.1876
Small Bushing Bore Diameter (without bushing)	1.044 - 1.045
Piston Pin Bushing Inside Diameter (bushing reamed)	.9903 - .9906
Distance Ctr. Large Bearing Bore to Small Bushing Bore	5.998 - 6.002
Clearance, Large Bearing to Crankshaft	.001 - .003
CYLINDER	
Cylinder Bore	3-1/4
Cylinder Diameter Limits (honed)	3.2495 - 3.2505
CRANKSHAFT	
Main Bearing Journal Diameter (MJA, MJB)	2.2440 - 2.2445
Crankshaft Main Bearing Clearance (MJA, MJB)	.0014 - .0049
Main Bearing Journal Diameter (MJC)	2.2430 - 2.2435
Crankshaft Main Bearing Clearance (MJC)	.0024 - .0049
Connecting Rod Journal Diameter	2.0600 - 2.0605
Connecting Rod Bearing Clearance	.001 - .003
End Play, Crankshaft	.010 - .015
PISTON	
Piston Clearance to Cylinder Wall (3/8" down from oil ring)	.0012 - .0032
Ring Groove Width, Top	.096 - .097
Ring Groove Width, 2nd	.0955 - .0965
Ring Groove Width, 3rd	.1880 - .1895
PISTON PIN	
Length	2.738 - 2.753
Diameter	.9899 - .9901
Piston Clearance	Thumb Push Fit
Connecting Rod Bushing Clearance	.0002 - .0007

All values in inches unless otherwise specified.

PISTON RINGS	
Ring Type	
Top	Compression
2nd	Compression
3rd	Oil Control
Ring Width	
Top	.0925 - .0935
2nd	.0930 - .0935
3rd	.1860 - .1865
Piston Ring End Gap	.010 - .020
STARTING MOTOR	
Rotation	Counterclockwise
Pinion Clearance to Pinion Stop (solenoid plunger bottomed)	.07 - .12
Pinion Rest Position - Distance from Pinion Housing Mounting Face to Outer Edge of Pinion	1-9/32 - 1-15/32
Armature End Play	.005 - .030
Test Specifications	
No Load	10 Volts - 80 Amps 5000 RPM Min.
Stall Torque	4 Volts - 420 Amps 7.8 lb. ft. Min.
Brush Spring Tension	32 - 40 ounces with new brushes
VALVE, INTAKE	
Stem Diameter	.3405 - .3415
Clearance in Guide	.001 - .003
Seat Angle	45°
Valve Clearance (MJA)	.019
Valve Clearance (MJB)	See Fig 3.7.B
Valve Clearance (MJC)	.015
VALVE, EXHAUST (stellite faced)	
Stem Diameter	.3405 - .3415
Clearance in Guide	.0025 - .0045
Seat Angle	45°
Valve Clearance (MJA)	.023
Valve Clearance (MJB)	See Fig 3.7.B
Valve Clearance (MJC)	.020
VALVE GUIDE	
Length	1-25/32
Outside Diameter	.4690 - .4695
Cylinder Block Bore Diameter	.467 - .468
Inside Diameter (after reaming) Exhaust	.344 - .345
Intake	.342 - .343

All values in inches unless otherwise specified.

EXHAUST VALVE SEATS (stellite)	
Valve Seat Bore Diameter (standard)	1.361 - 1.362
Seat Outside Diameter	1.364 - 1.365
Seat Width	3/64 - 1/16
Seat Angle	45°
Available Oversizes	.002 .005 .010 .025
VALVE SPRINGS	
Free Length	1-7/8
Length, Valve Closed	1.528
Load, Valve Closed	45 - 49 lbs
Length, Valve Open	1.214
Load, Valve Open	83 - 93 lbs

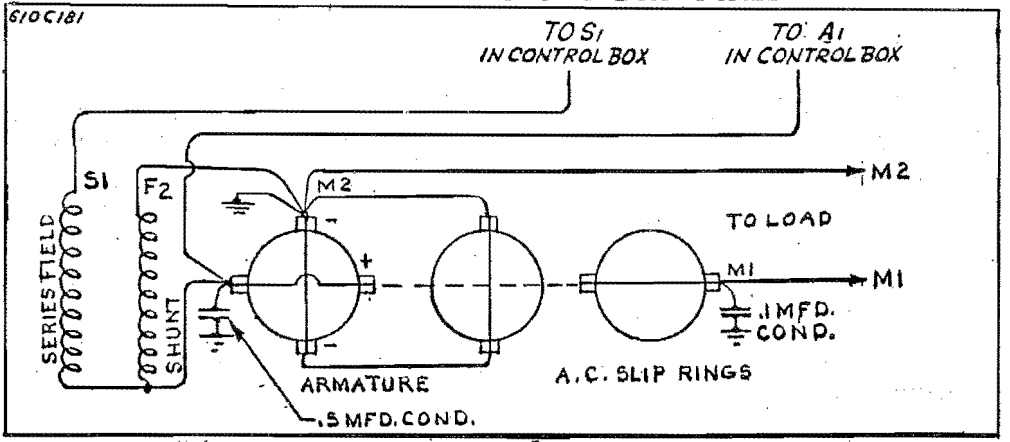
10. WIRING DIAGRAMS

The wiring diagrams on the following pages are typical and apply only to standard MJ series generating plants. Wiring diagrams for special models are available on request from the factory; send the plant spec. and serial numbers with the request.

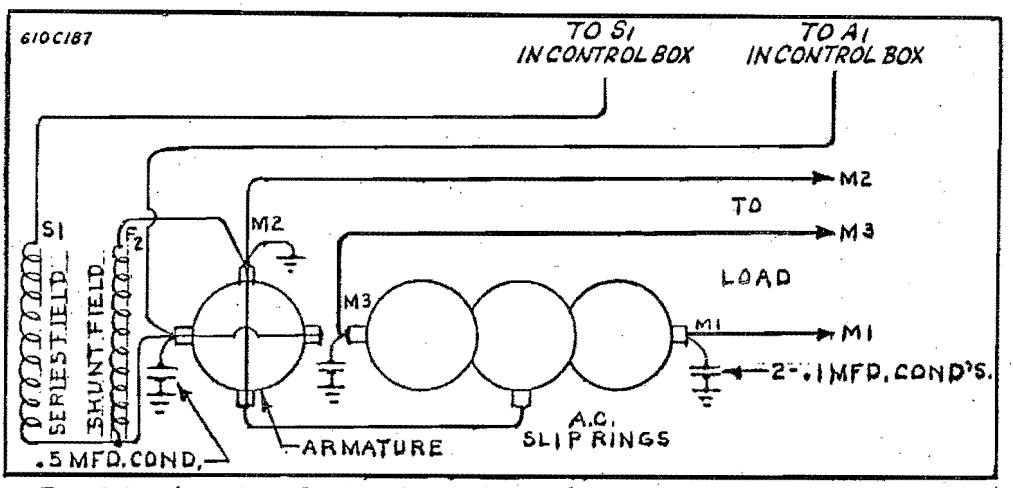
For revolving field plants, select the generator wiring diagram according to the model, phase, and number of output wires. Select the Magneciter wiring diagram from the Magneciter model number on the plant nameplate.

For revolving armature plants, select the generator wiring diagram with the proper phase and number of output wires.

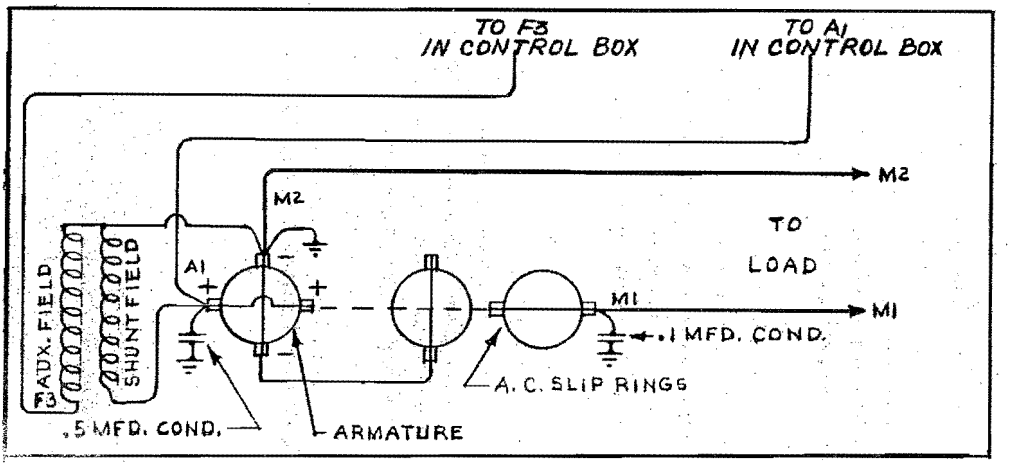
Control wiring diagrams show the standard control circuit in schematic without the optional low oil pressure circuit. There are special control diagrams with the optional low oil pressure circuit.



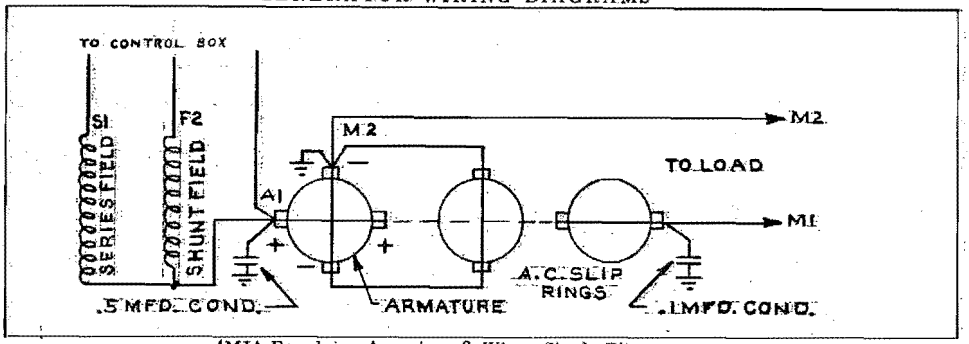
Revolving Armature 2-wire, Single Phase (5MJB prior to spec F, 3 MJA)



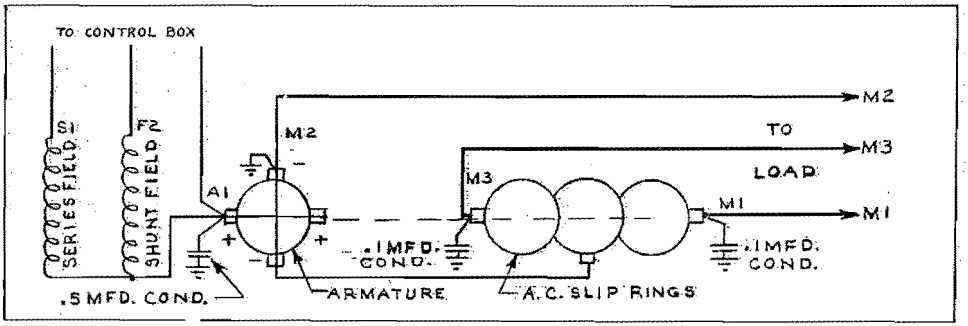
Revolving Armature 3-wire, Single Phase (5MJB prior to spec F, 3 MJA)



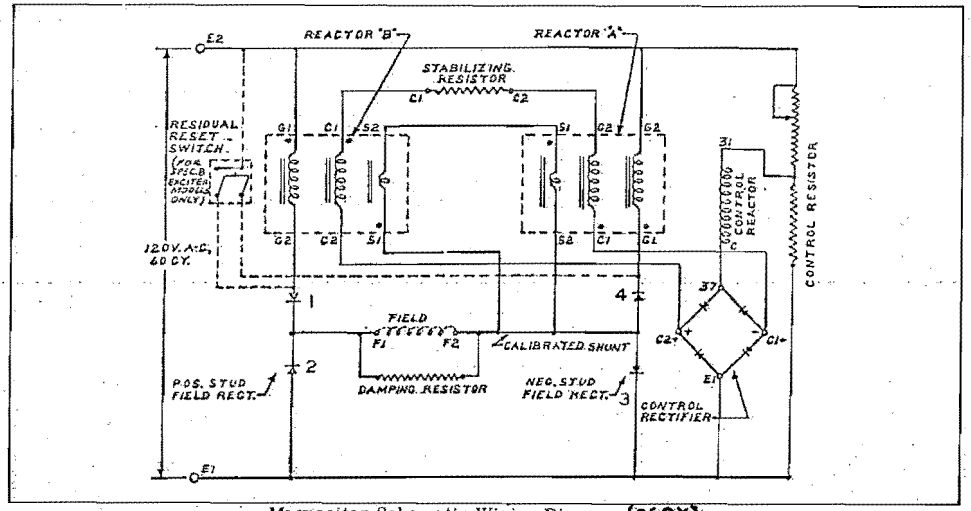
Revolving Armature 2-wire, Single Phase (5MJB only, begin spec F)



4MJA Revolving Armature 2-Wire, Single Phase

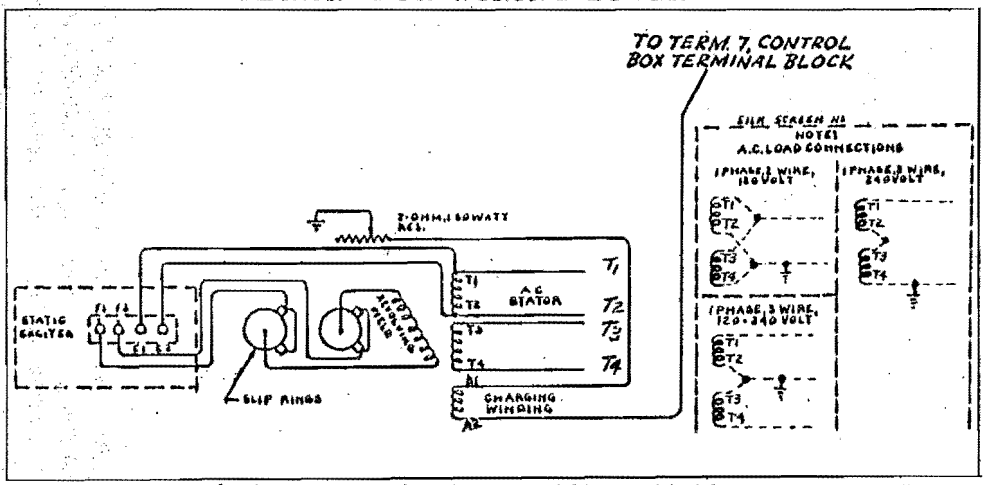


4MJA Revolving Armature 3-Wire, Single Phase

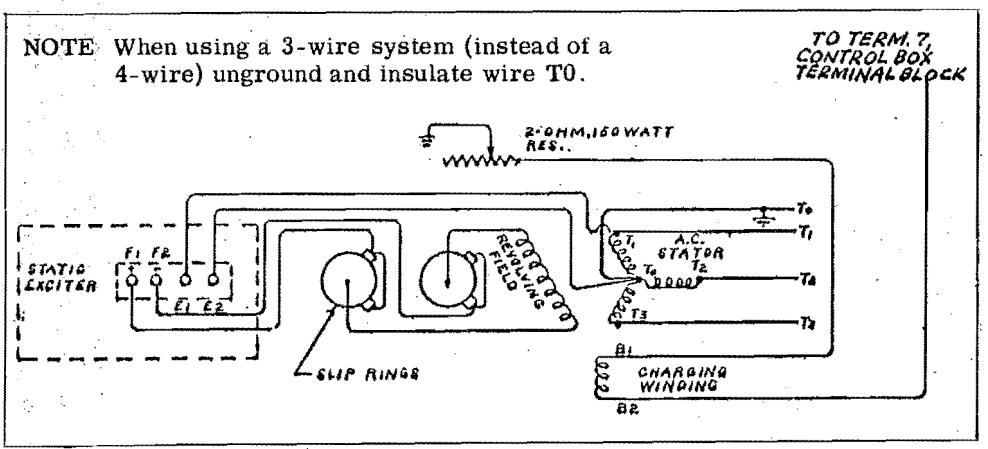


Magneciter Schematic Wiring Diagram (06SX)

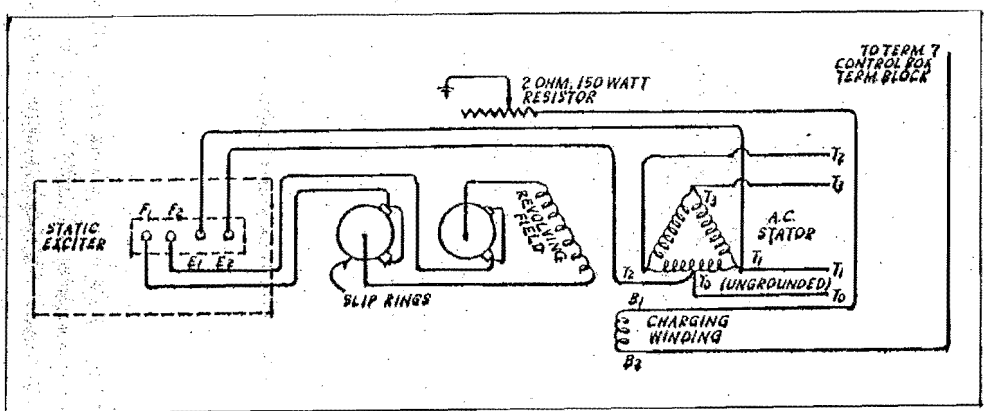
GENERATOR WIRING DIAGRAMS



Revolving Field (3R) Reconnectible for 120, 240 or 120-240 Volts, Single Phase



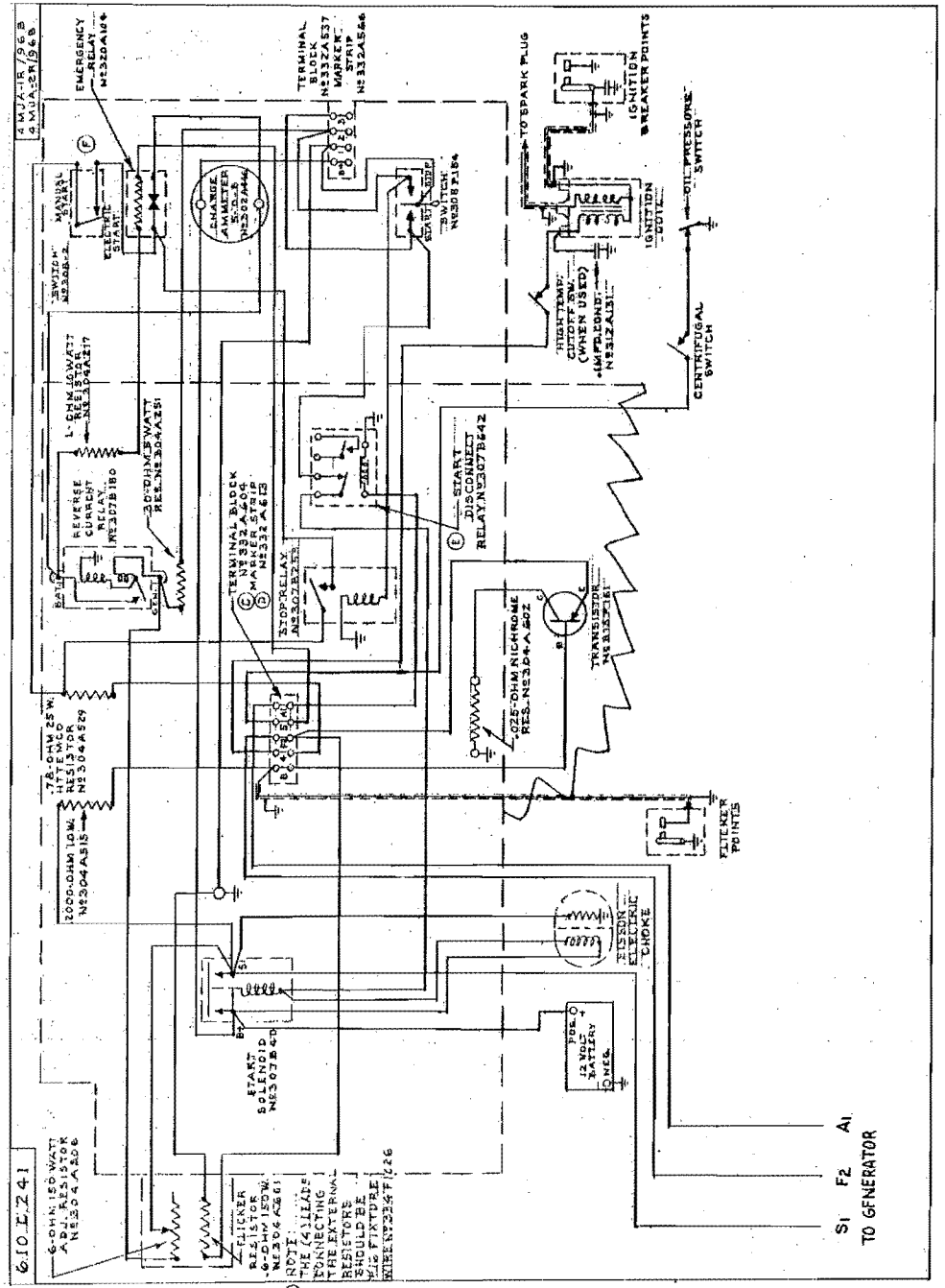
Revolving Field (4R) 120-208 Volts, Wye Wound, 4-wire, 3 Phase



Revolving Field (5DR) 120-240 Volts, Delta Wound, 4-wire, 3 Phase

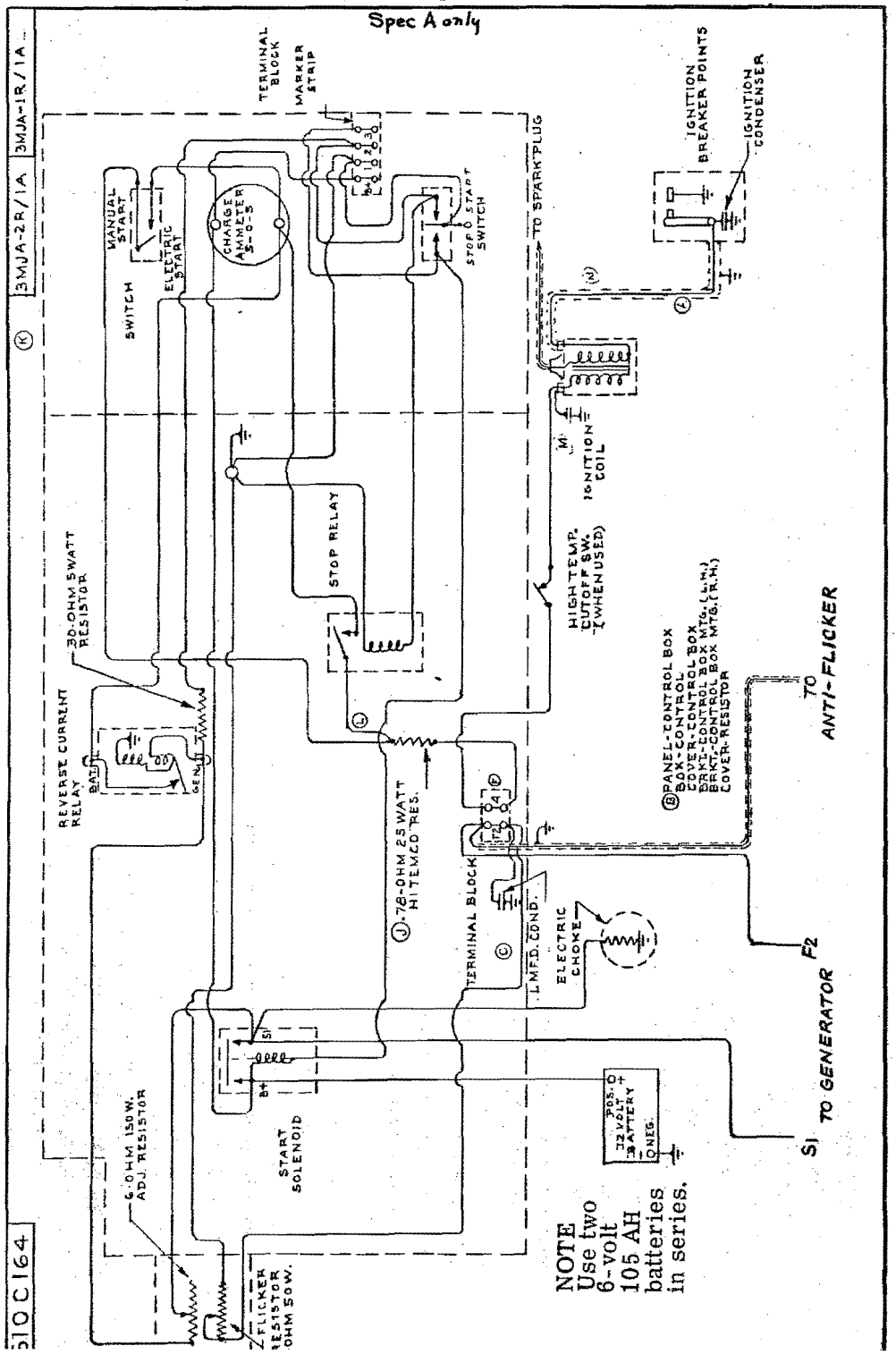
(With low oil pressure circuit)

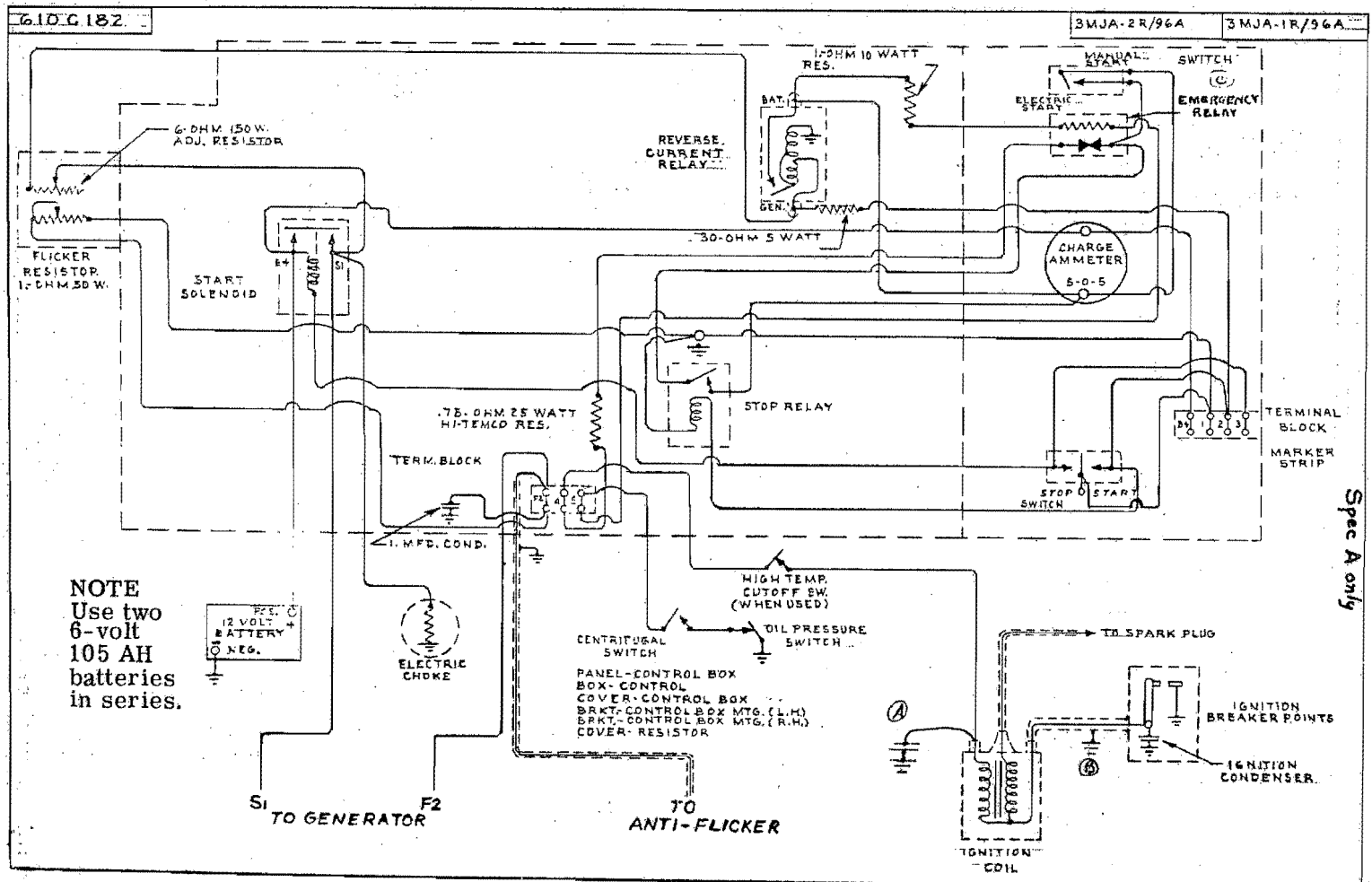
Begin Spec B



MJA CONTROL WIRING DIAGRAM

(No low oil pressure circuit)



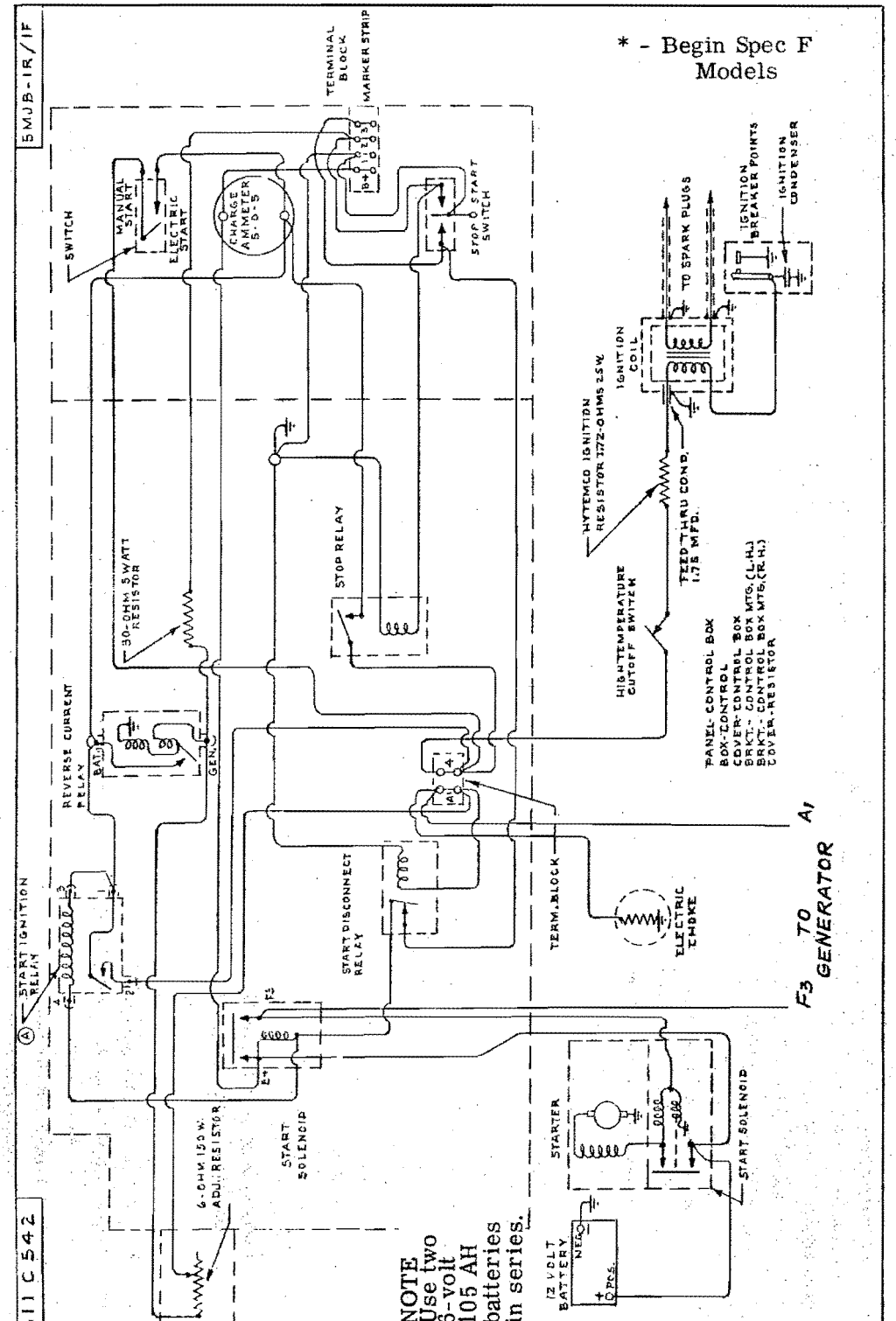


NOTE
Use two 6-volt 105 AH batteries in series.

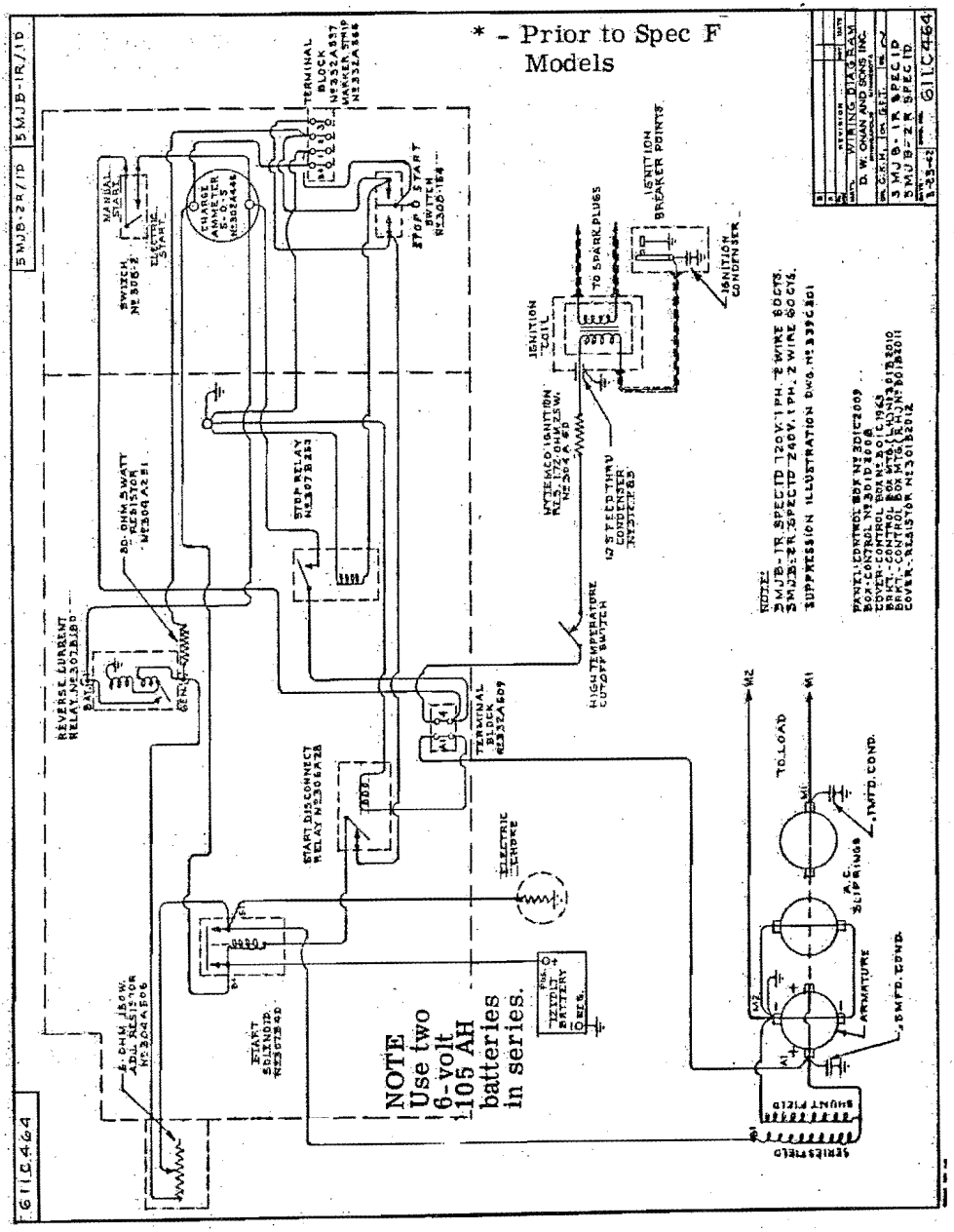
Spec A only

(With low oil pressure circuit)

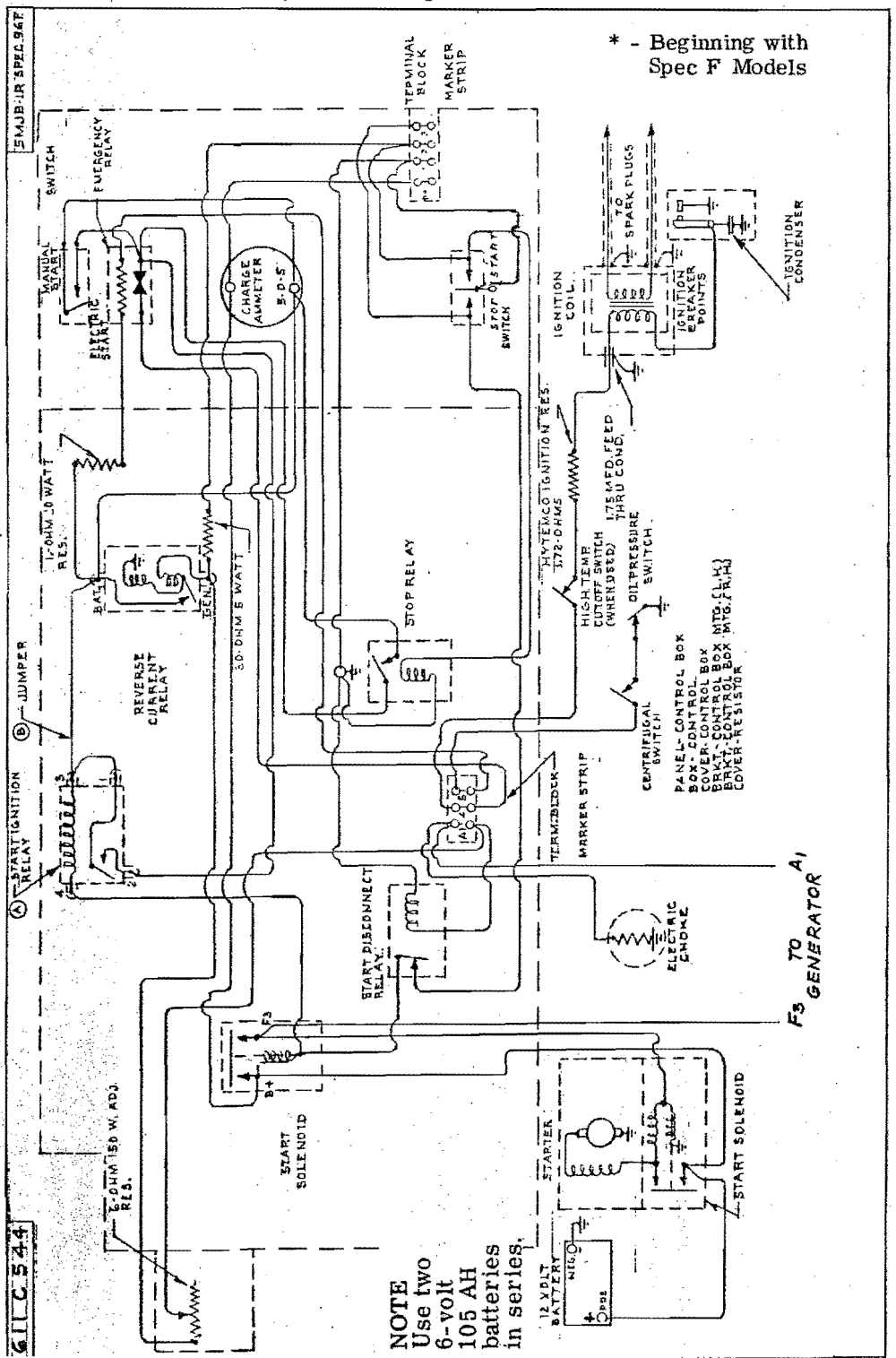
5MJB CONTROL WIRING DIAGRAM
(No low oil pressure circuit *)



5 MJB CONTROL WIRING DIAGRAM
(No low oil pressure circuit*)

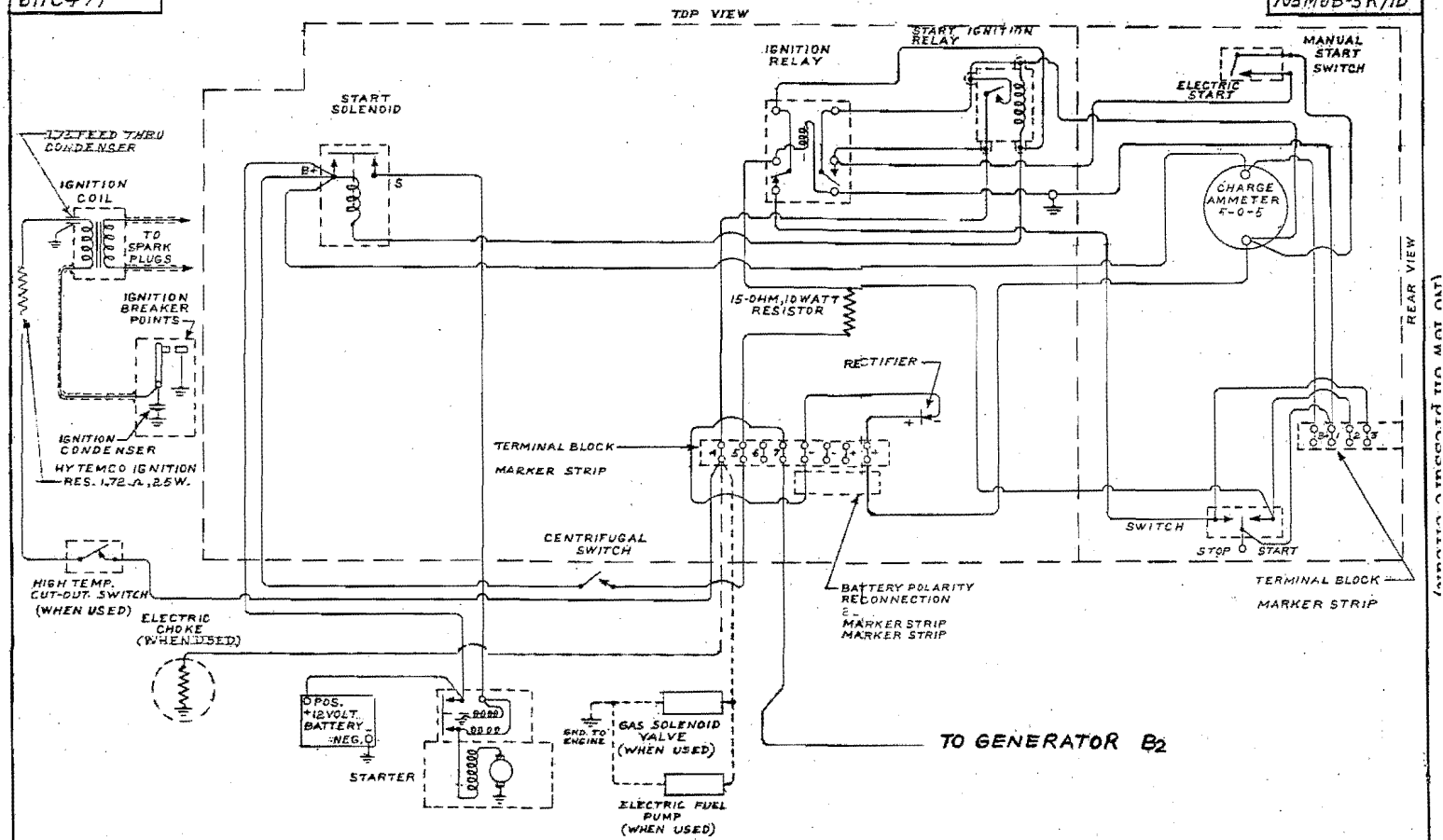


5MJB CONTROL WIRING DIAGRAM
(With low oil pressure circuit*)

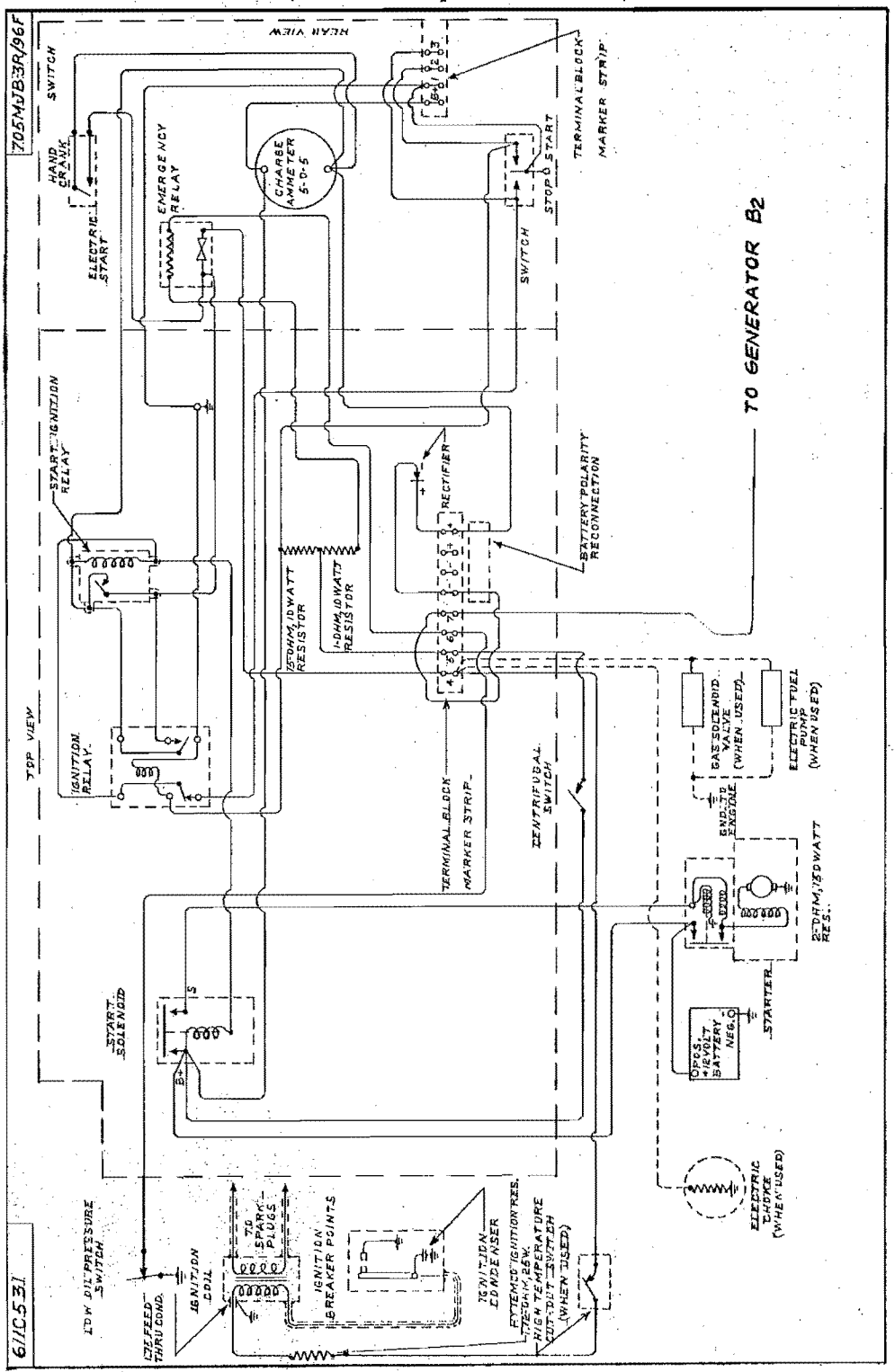


611C471

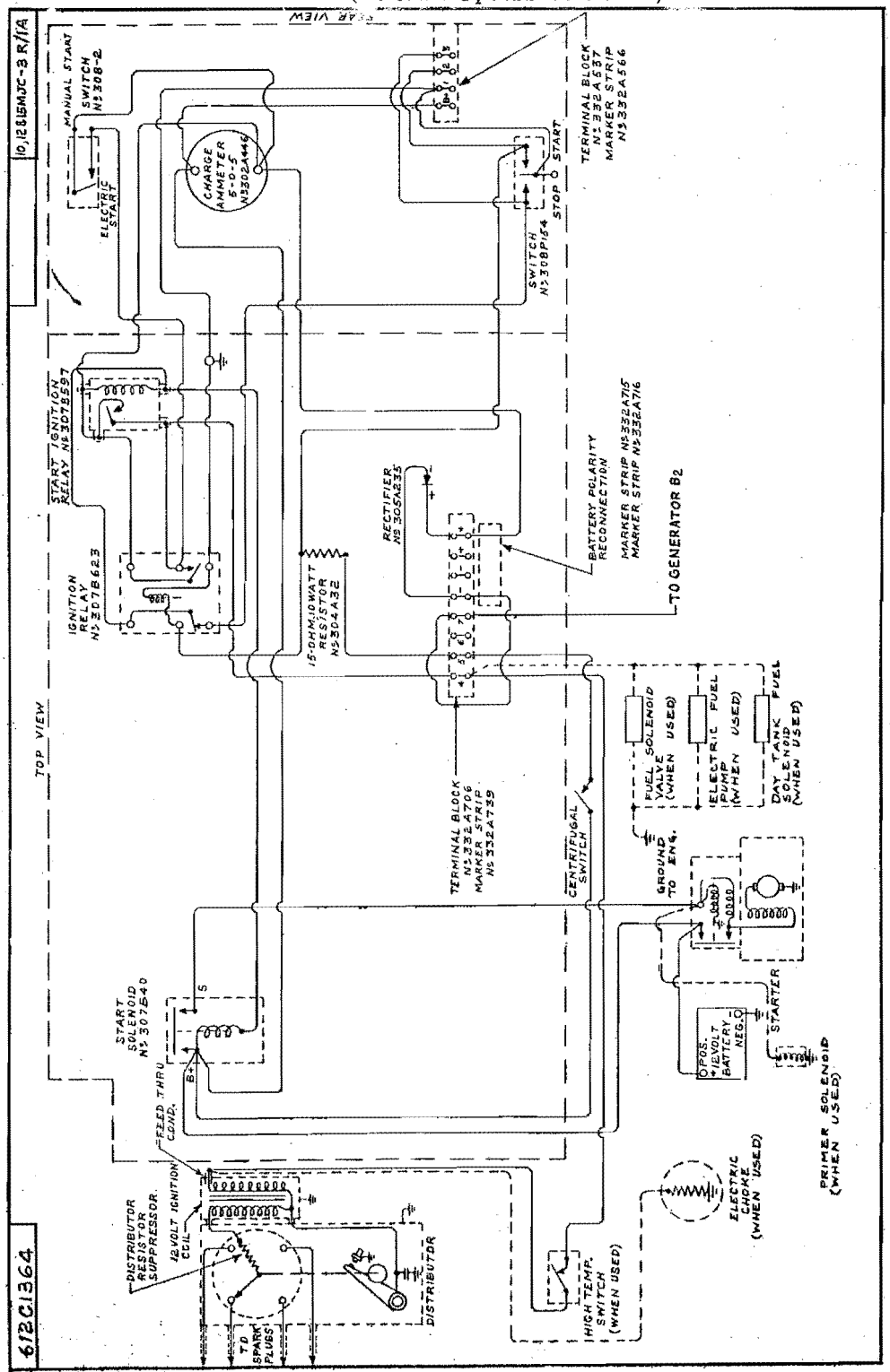
705MJB-3R/ID



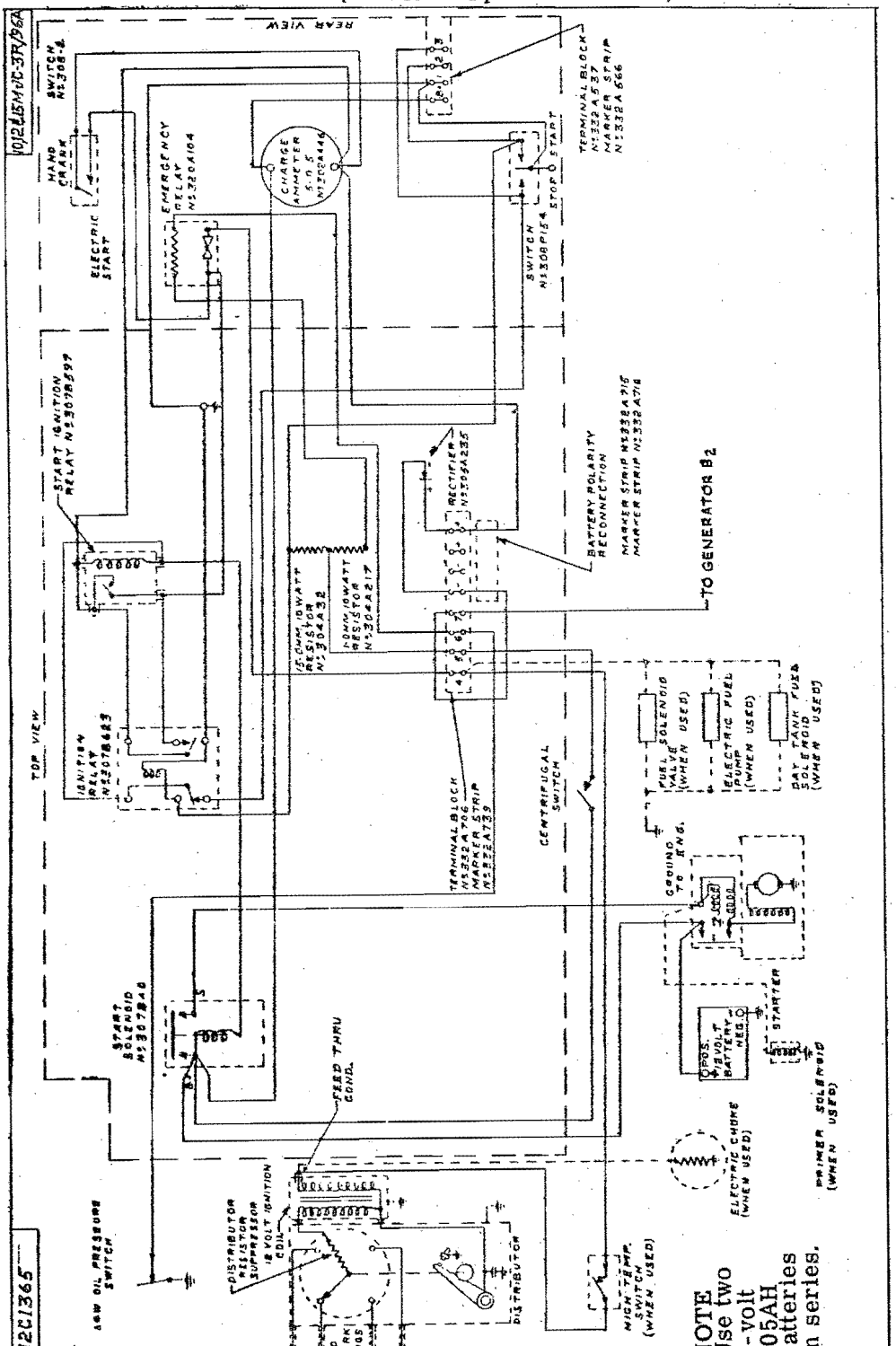
705 MJB CONTROL WIRING DIAGRAM
(With low oil pressure circuit)



(No low oil pressure circuit)

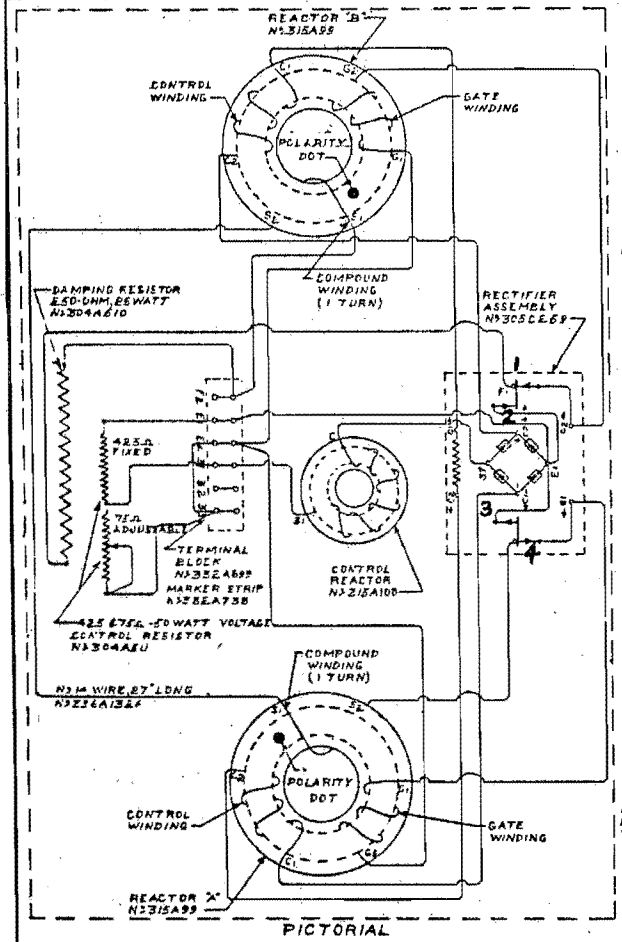


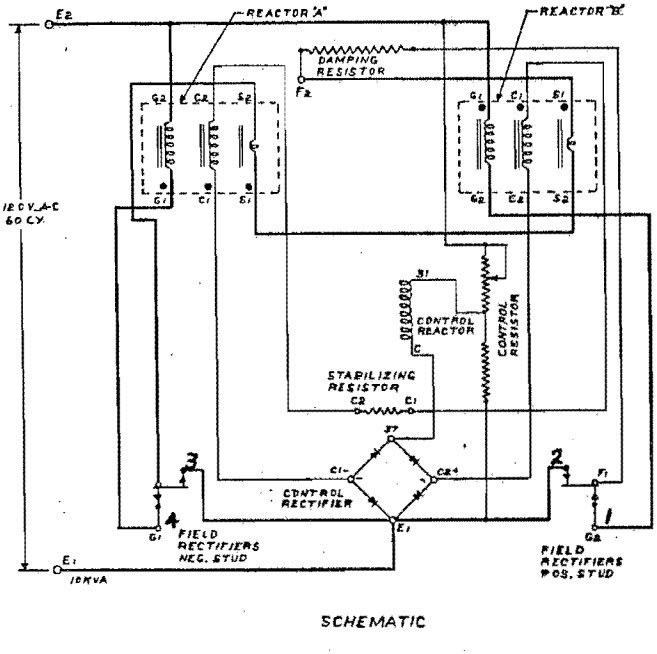
MJC CONTROL WIRING DIAGRAM
(With low oil pressure circuit)



625C367

04SXINIA





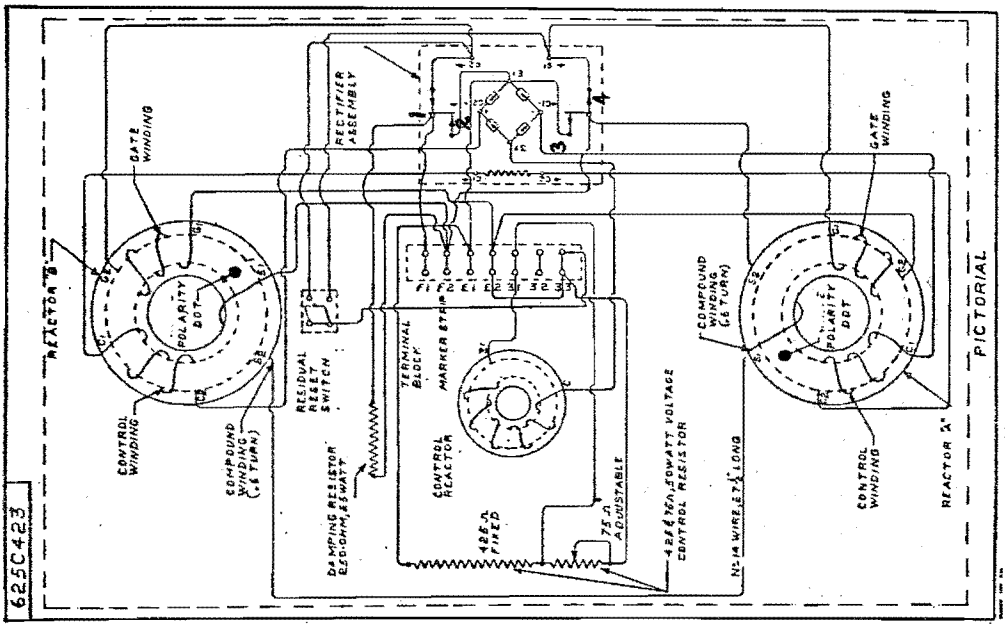
SCHEMATIC

NOTE:
ASSY. EXCITER PANEL & BKT. N°2E348153
COVER N°C24C164
ASSY. DWG. N°207C15

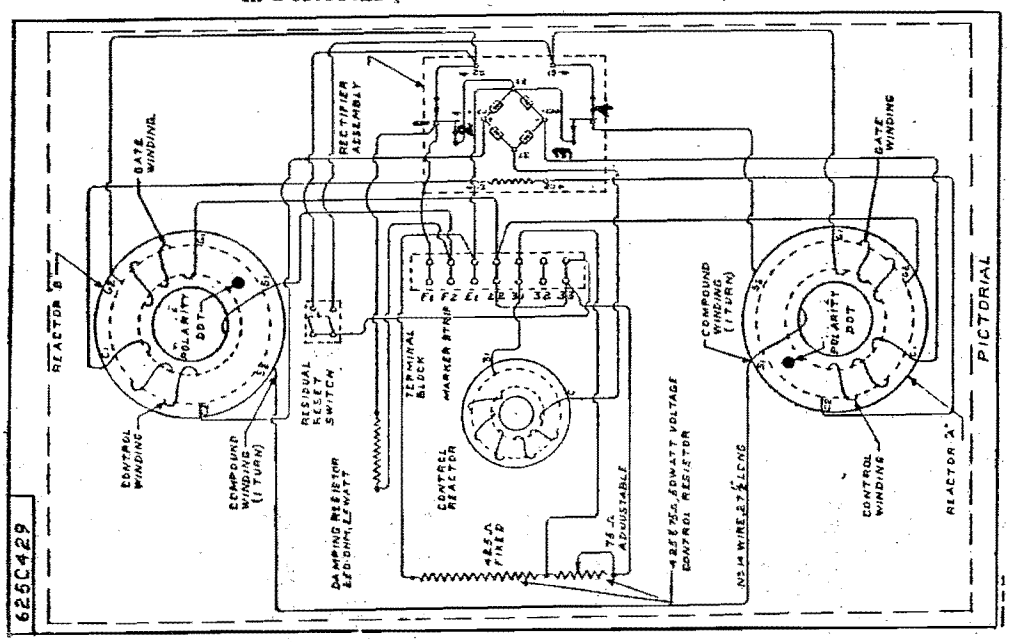
NOTE:
LOCATION OF POLARITY DOTS - WHEN RECTIFIER ASSY. IS TOWARDS YOU, POLARITY DOTS WILL BE TO THE RIGHT OF EACH REACTOR. MOUNTED ON GEN. - THE DOTS WILL BE ON TOP OF EACH REACTOR.

WIRING DIAGRAM
For Onan 04SX Magneciter Used on 705MJB plants for Spec C thru F models.

06SX Spec B Static Exciter Wiring Diagram in Pictorial (With residual reset switch)



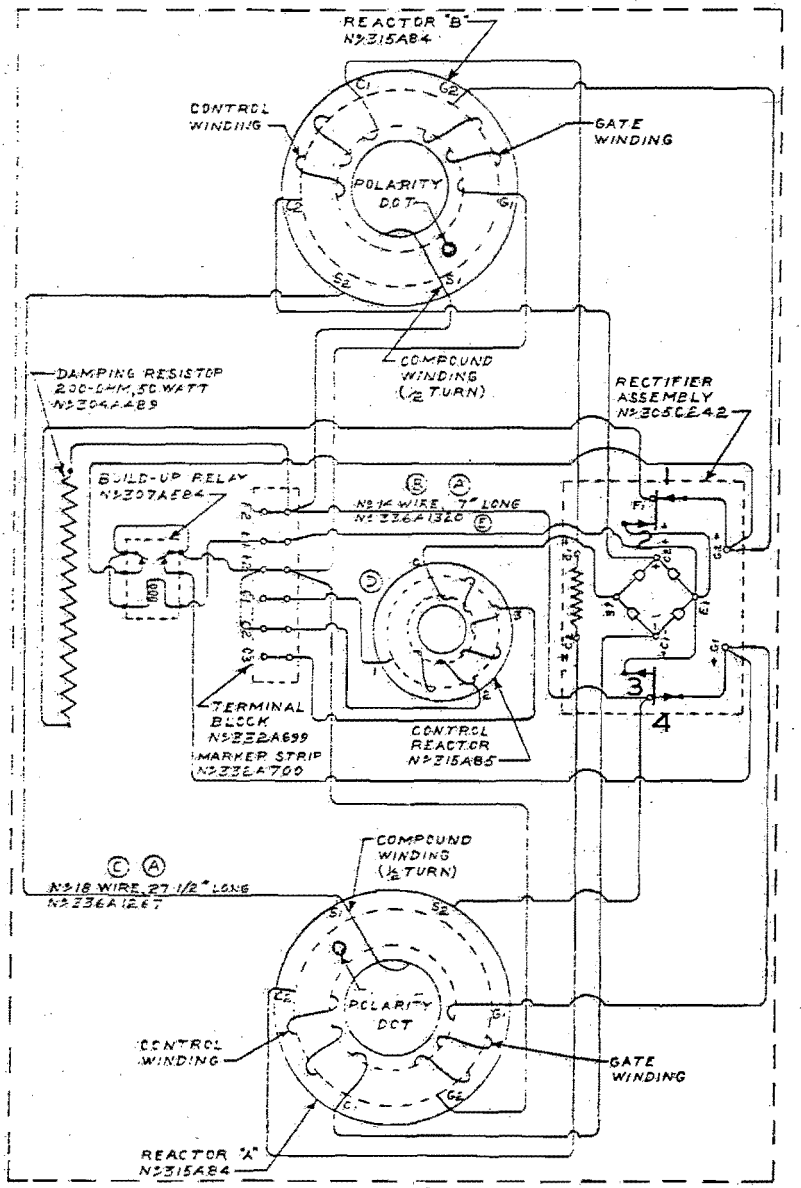
04SX Spec B Static Exciter Wiring Diagram in Pictorial (With residual reset switch)



Used on 705MJB Spec A and Spec B.

6250292

02SXINIA



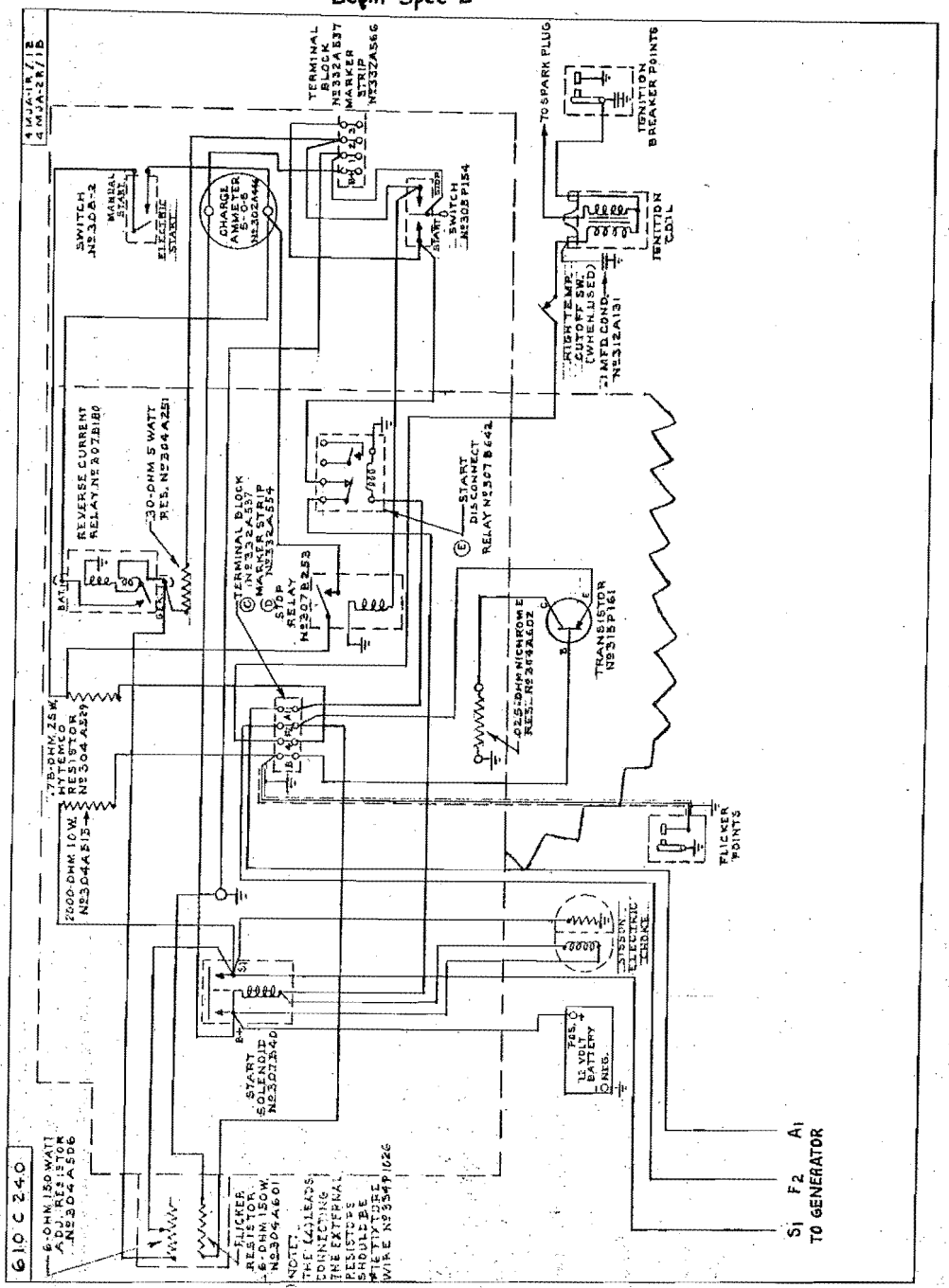
PICTORIAL

NOTE:
LOCATION OF POLARITY DOTS-WHEN RECTIFIER ASSY. IS TOWARDS YOU, POLARITY DOTS WILL BE TO THE RIGHT OF EACH REACTOR. MOUNTED ON GEN.- THE DOTS WILL BE ON TOP OF EACH REACTOR.

MJA CONTROL WIRING DIAGRAM

(No low oil pressure circuit)

Begin Spec B



If you need help with your old Onan, visit the “Smart Guys” at The Stak. They have many years of experience and they are happy to help.
http://www.smokstak.com/forum/forumdisplay.php?f=1