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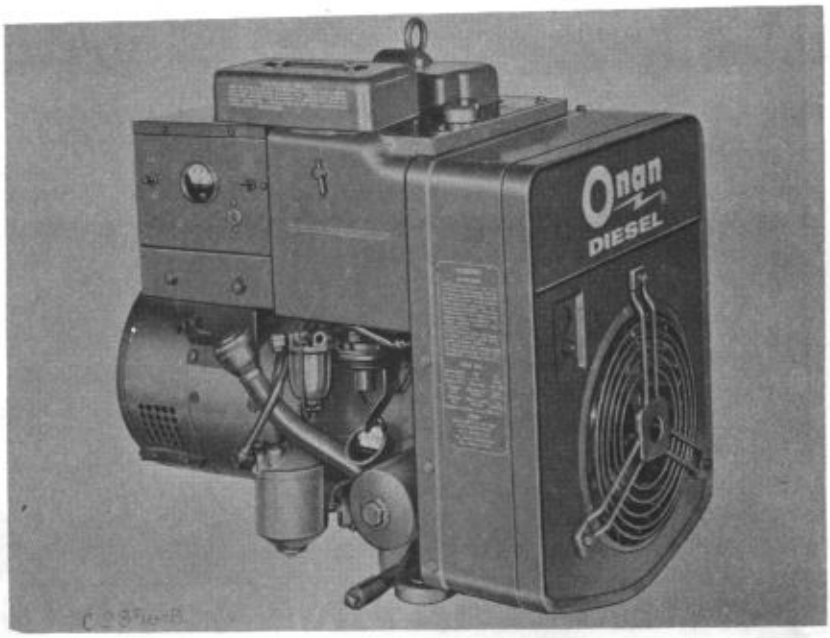
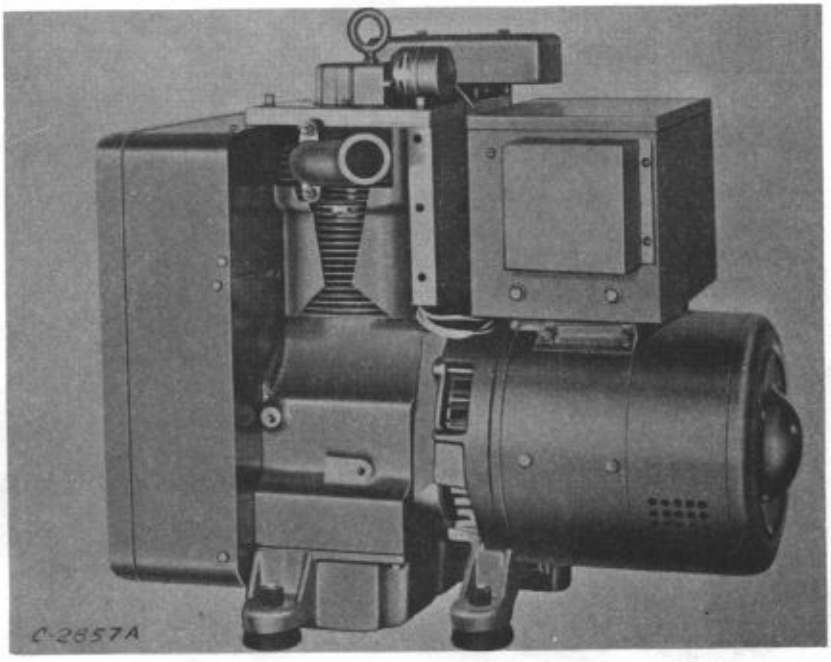
ONAN
ELECTRIC GENERATING PLANTS
DJA
SERIES

967-511 3AT69

MAJOR SERVICE MANUAL



DJA - LEFT FRONT VIEW



DJA - RIGHT REAR VIEW

DESCRIPTION

Each Onan DJA electric generating plant consists of an Onan diesel engine directly connected to an electric generator.

The Onan DJA engine is a vertical four-stroke, overhead-valve diesel. It is air-cooled and governor-equipped to maintain constant speed and output.

The 4-pole, self-excited generator is inherently regulated, and serves also as a starting motor for the diesel engine. The generator also supplies dc current to recharge the starting batteries.

Several control systems are available, so the plant may be started and stopped from the plant site or from a remote location. Automatic control systems are available which allow the plant to function independently of operator control for long periods of time.

Electrical output characteristics of the plant appear on the nameplate with the model designation and serial numbers. The plant model and specification numbers are separated by a diagonal line (/). The plant specification consists of a number, which indicates optional equipment as ordered by the purchaser, and a letter at the end, which is advanced to coincide with production modification by the manufacturer. Any communications to the manufacturer should include the plant model and Spec. number.

When discussing left side and right side in this manual, view the plant from the engine end of the plant, which is designated the front end.

SPECIFICATIONS

	205DJA* 3DJA
Nominal dimension of plant (inches)	
Height	26 - 3/16
Width	19 - 7/16
**** Length	28 - 11/16
Approximate weight (pounds)	350
Number cylinders (vertical inline)	1
Displacement (cubic inch)	30
Cylinder bore (inches)	3 - 1/4
Piston stroke (inches)	3 - 5/8
BHP at 1800 rpm	5.7
RPM (60 - cycle)	1800
RPM (50 - cycle)	1500
RPM (battery charger)	1750
Compression ratio	19:1
Governor (internal flyball type - externally adjustable)	Yes
Governor Regulation %	5
Battery voltage (ac plant)	12 - V
SAE Group 1H, 6 volt	Two
**Amp/Hr. SAE 20 hour	105 (Minimum)
Starting by exciter-cranking generator windings	Yes
Battery charge rate, amperes	2 - 5
***Oil capacity in U.S. quarts (refill)	2.5 qts.
Ventilation required (cfm at 1800 rpm)	
Engine (pressure cooling)	440
Generator	75
Combustion	16
Output rated at unity power factor load	1 - phase
Rating (output in watts)	
*50 - cycle ac service	2500
60 - cycle ac service	3000
24 - 30 -vdc battery charger	2500
32 - 40 - vdc battery charger	3000
AC voltage regulation ± %	10
AC frequency regulation in %	5
Revolving armature type generator	Yes
Rotating type exciter	Yes

*50 - cycle model

**Mobile or outdoor operation during ambient temperatures below 0°F, use 120 amp/hr rating.

***Plus 1/2 quart for new filter.

****2 - wire models (length of 3 - wire and 4 - wire models is 30-5/16 inches)

TABLE OF DIMENSIONS, CLEARANCES

All values in inches unless otherwise specified.

CAMSHAFT

Bearing journal diameter, front	2.500 - 2.505
Bearing journal diameter, rear	1.1875 - 1.1880
Bearing clearance limit	.0012 - .0037
End play, camshaft	.007 - .039
Cam tappet hole diameter (prior to Spec P)	.7505 - .7515
Cam tappet diameter (prior to Spec P)	.7475 - .7480
Cam tappet hole diameter	.8755 - .8765
Cam tappet diameter	.8725 - .8730

CONNECTING RODS

Large bearing bore diameter (w/o bearing)	2.1871 - 2.1876
Small bushing bore diameter (w/o bushing)	1.044 - 1.045
Distance, center of large bearing bore to small bushing bore	5.998 - 6.002
Piston pin bushing inside diameter (bushing reamed)	.9903 - .9906

CYLINDER

Cylinder bore	3 - 1/4
Cylinder diameter limits	3.2495 - 3.2505

CRANKSHAFT

Main bearing journal diameter	2.2437 - 2.2445
Connecting rod journal diameter	2.0597 - 2.0605
Connecting rod bearing clearance	.001 - .0033
End play, crankshaft	.010 - .015

PISTON

Piston clearance to cylinder wall*	.0015 - .0075
Ring groove width, top	.097 - .098
Ring groove width, 2nd	.0965 - .0975
Ring groove width, 3rd	.0965 - .0975
Ring groove width, 4th	.1880 - .1895

PISTON PIN

Length	2.753 - 2.738
Diameter	.9899 - .9901
Piston Clearance	Thumb Push Fit
Connecting rod bushing clearance	.0002 - .0007

PISTON RINGS

Ring Type	
Top	Compression
2nd	Compression
3rd	Compression
4th	Oil Control
Ring Width	
Top	.0925 - .0935
2nd	.0925 - .0935
3rd	.0925 - .0935
Ring end gap	.010 - .020

VALVE, INTAKE (Chrome-Cobalt Alloy Facing)

Stem diameter	.3405 - .3410
Clearance in guide	.0015 - .0030
Seat angle	42°
Valve clearance	.011

VALVE, EXHAUST (Chrome-Cobalt Alloy Facing)

Stem diameter	.3405 - .3415
Clearance in guide	.0030 - .0050
Seat angle	45°
Valve clearance	.008

VALVE GUIDE

Length	1-25/32
Outside diameter	.4690 - .4695
Cylinder head bore diameter	.467 - .468
Inside diameter (after reaming)	
Exhaust	.3445 - .3455
Intake	.3425 - .3435

VALVE SEATS (Chrome-Cobalt Alloy)

Valve seat bore	
Diameter	1.361 - 1.362
Depth (from cylinder head face)	.433 - .439
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 lb
Length, valve open	1.214
Load, valve open (prior to Spec P)	83 - 93 lb
Load, valve open (begin Spec P)	87.2 - 97.2 lb

* Clearance measured 90° from axis of piston pin and immediately below the oil ring groove.

ASSEMBLY TORQUES

The assembly torques given here will assure proper tightness without 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, with a wrench of normal length.

Specially designed Place Bolts (Fig. 1) 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.

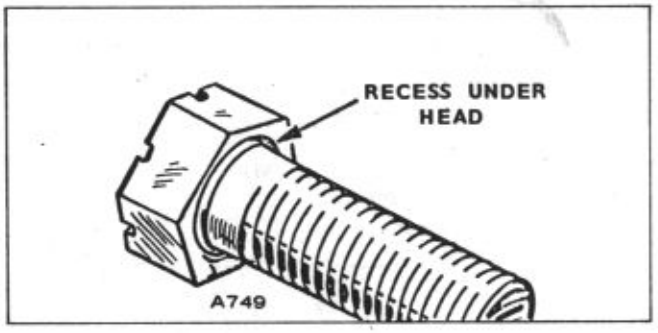


Figure I. Place Bolts

TORQUE SPECIFICATIONS (Foot Pounds)

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
Fuel Pump Mounting Screws	15 - 20
Gear Case Cover	15 - 20
Glow Plug	10 - 15
Injection Nozzle Mounting Screws	20 - 21
Injection Pump Mounting Screws	18 - 21
Intake Manifold	13 - 15
Oil Base Mounting Screws	32 - 38
Oil Filter	Hand Tight plus ¼ to ½ turn
Oil Pump Mounting Screws	15 - 20
Rear Bearing Plate	40 - 45
Rocker Arm Nut	4 - 10**
Thru-Rotor-Stud Nut	30 - 40
Rocker Arm Stud	35 - 40
Flicker Plunger Guide	25 - 28

*Exhaust nuts must be tightened evenly.

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

MAINTENANCE

The following maintenance is recommended to keep the plant in good operating condition. Neglect of routine servicing may result in failure of the plant at a time when it is urgently needed. The following chart is based upon favorable operating conditions. If the plant is operated under severe conditions in a dusty or dirty area, perform maintenance more often.

CRITICAL MAINTENANCE SCHEDULE

MAINTENANCE ITEMS	OPERATIONAL HOURS				
	200	500	1000	2000	5000
Check Slip Rings	x1				
Check Brushes	x2				
Check Commutator	x1				
Check Valve Clearance	*	x			
Clean Generator				x	
Grind Valves (If Required)				x	
Clean Rocker Box Oil Line Holes			x		
Replace Anti-Flicker Points				x	
Check Nozzle Opening Pressure					
Spray Pattern				x4	
General Overhaul (If Required)					x

x1 - Perform more often in extremely dusty conditions.
x2 - Replace collector ring brushes when worn to 5/16 in; replace commutator brushes when worn to 5/8 in.
x3 - Check the air cleaner often. (A) OIL-BATH TYPE: Throughly clean and put in fresh oil at least every 100 hours. (B) OIL-WETTED-FOAM TYPE: Carefully remove and wash in clean fuel every 50 hours. After cleaning, moisten with clean crankcase grade oil. Install new cartridge at least every 500 hours. Install a heavy duty air cleaner if nece ssary.
x4 - This service must be conducted by trained diesel injection equipment personnel with suitable test facilities. Omit this service until these conditions can be met.
* - Tighten head bolts and adjust valve clearance after first 50 hours on a new or overhauled engine.

TROUBLE-SHOOTING CHART

STARTING

POSSIBLE CAUSE	REMEDY
ENGINE WILL NOT TURN OVER	
Defective switch.	Replace.
Internal seizure	Turn engine over by hand, check, disassemble and repair.
Loose connections.	Tighten connections.
Engine oil too heavy for low temperature.	Change oil.
Battery discharged.	Recharge.
ENGINE CRANKS TOO STIFFLY	
Oil in crankcase too heavy for low temperature	Check oil specification, change oil.
Load connected.	Disconnect load.
Defective decompression release.	Check and adjust.
ENGINE TURNS BUT WILL NOT START	
Defective glow plug or preheater.	Repair or replace.
Defective fuel system.	See Fuel System Section.
Air in fuel system.	Bleed fuel system.
Faulty injection caused by dirty fuel or clogged fuel filter.	Replace with clean fuel, clean primary fuel filter and replace secondary fuel filter.
Poor compression.	See poor compression section.
Wrong timing.	Correct timing.
Poor quality fuel.	Drain, fill with fresh fuel.
ENGINE HARD TO START	
Restricted air intake.	Clean air cleaner.
Poor fuel.	Check fuel specification, change if necessary.
Incorrect timing.	Retime.
Worn or damaged fuel transfer pump.	Replace or rebuild pump.
Air leak in fuel lines.	Tighten all corrections, check for defects in lines.
Clogged fuel lines.	Clean fuel lines.
Clogged primary or secondary fuel filter.	Clean primary filter, replace secondary filter cartridge.
Fuel tank too far below engine.	Fuel tank must be no more than 6 ft. below engine.
DEFECTIVE BATTERY	
Hardened plates (sulfation) due to low charge after long period.	Replace battery, check new battery charge condition at frequent intervals.
Shorted cells.	
Loss of active material.	
Broken terminals.	
BATTERY DISCHARGED	
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.

OPERATION

POSSIBLE CAUSE	REMEDY
ENGINE MISFIRES AT ALL LOADS	
Poor compression.	See Poor Compression
Broken valve spring.	Replace.
Defective or dirty nozzle.	Clean nozzle or replace. Clean fuel system.
ENGINE MISFIRES AT LIGHT LOAD	
Faulty injection.	Inspect fuel system.
Poor compression.	See Poor Compression.
Poor fuel.	Replace with correct fuel.
ENGINE MISFIRES AT HEAVY LOAD	
Faulty injection.	Inspect fuel system.
Dirty air cleaner.	Clean.
Dirty fuel filter.	Clean primary filter, replace secondary filter cartridge.
LOW ENGINE POWER	
Restricted air intake.	Clean air cleaner.
High exhaust back pressure.	Inspect exhaust line for restrictions.
Thin air at high altitude or in hot weather.	Normal under these conditions.
Poor fuel.	Change to correct fuel.
Fuel line leaks.	Inspect fuel system.
Poor compression.	See Poor Compression.
Incorrect timing.	Adjust injection timing.

POSSIBLE CAUSE	REMEDY
DEFECTIVE NOZZLE (Usually Indicated by Defective Spray Pattern)	
Dirt in nozzle.	Clean nozzle.
Externally carboned nozzle.	Clean outside surface.
Worn nozzle or valve.	Replace or repair injection nozzle.
Incorrect nozzle opening pressure.	Using proper equipment, adjust nozzle pressure.
Dribble below opening pressure.	Clean nozzle and recheck. If it still dribbles, replace nozzle.
FUEL KNOCK	
Injection nozzle sticking.	Clean nozzle.
Injection nozzle spring broken.	Replace complete nozzle.
Air leaks in fuel lines.	Repair or replace.
Poor fuel.	Change to proper fuel.
Water in fuel.	Change fuel.
Sticking Nozzle Valve (usually caused by dirt or corrosion from fuel).	Clean nozzle – check filters and fuel quality.

OIL SYSTEM

POSSIBLE CAUSE	REMEDY
DILUTED OIL	
Leaky fuel transfer pump diaphragm.	Rebuild or replace pump.
Faulty cylinder oil control.	Inspect rings and cylinder walls.

POSSIBLE CAUSE	REMEDY
CRANKCASE SLUDGE	
Dirty oil filter.	Replace oil filter, adjust oil filter service periods.
Run for long idle periods.	Correct running procedures.
Sticking compression ring.	Replace.
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-	Replace pump.
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.
EXCESSIVE OIL CONSUMPTION, LIGHT BLUE SMOKY EXHAUST	
Worn or sticking piston rings.	Check compression. Clean or replace rings.
Defective breather valve.	Clean or replace.
Oil too light or diluted.	Replace with proper grade of oil. If diluted, check for cause.
Engine overheating.	See Cooling System.

EXCESSIVE 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 the valve or replace it.

GOVERNOR

ENGINE RACES (Stop Engine Immediately by Pushing Throttle Lever)	
Governor incorrectly adjusted.	See Governor System.
Linkage binding.	Clean or replace linkage.
ENGINE SPEED TOO LOW	
Governor incorrectly adjusted.	Adjust for proper speed.
Low engine power (will not reach governed speed).	Check for other causes.
HUNTING CONDITION	
Governor spring sensitivity too great.	Adjust sensitivity.
POOR SENSITIVITY	
Excessive wear in linkage.	Replace governor link age.
GOVERNOR ACTS SLOWLY	
Binding in linkage.	Clean and lubricate linkage.
NO GOVERNOR CONTROL	
Linkage disconnected.	Reconnect linkage.

FUEL SYSTEM

POSSIBLE CAUSE	REMEDY
BLACK SMOKY EXHAUST, EXCESSIVE FUEL CONSUMPTION	
The brown or black color in the exhaust is minute solid particles of pure carbon. A darker exhaust indicates a higher carbon content. The exhaust color may vary from a very light gray haze to a brown or black, which indicates incomplete combustion. Since combustion is never absolutely complete, the exhaust gases will never be invisible, but an increase may indicate trouble, especially if there is no apparent change in engine conditions.	
Engine over-loaded (a normal condition under over-load).	Reduce load.
Poor compression.	See Poor Compression.
Poor grade or dirty fuel.	Replace fuel.
Dirty air cleaner.	Clean.
Faulty injection timing.	Check timing.
Faulty injection pump or nozzle.	Check and rebuild, or replace as necessary.
EXCESSIVE FUEL CONSUMPTION	
Engine overloaded.	Reduce load.
Poor compression.	See Poor Compression.
Defective injection pump or nozzles	Repair or replace.

MISCELLANEOUS

DULL METALLIC THUD; IF NOT BAD, MAY DISAPPEAR AFTER FEW MINUTES OF OPERATION	
Loose crankcase 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.
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.
LIGHT POUNDING KNOCK	
Loose connecting rod bearing.	Replace bearings.
Low oil supply.	Add oil – check for cause.
Oil badly diluted.	Replace oil – check for cause.
POOR COMPRESSION	
Loose cylinder head.	Tighten.
Sticking rings or worn rings.	Replace rings, check cylinder condition.
Worn cylinder wall and piston.	Refinish cylinder and replace piston.
Leaky head gasket.	Replace head gasket.
Valves sticking.	See Sticking Valves.
Broken valve spring.	Replace spring, check valve condition.
Leaky nozzle gasket.	Replace gasket.
Leaky valves.	Regrind valves.
Burned valves and seats.	Regrind valves and seats. Replace if necessary.
Insufficient valve clearance.	Adjust clearance.

POSSIBLE CAUSE	REMEDY
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.
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 over size if necessary.
Coked or gummed oil on stem.	Clean or replace valve.
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.
WORN CONNECTING ROD, BUSHINGS AND BEARINGS	
Plant run with low oil.	Add oil, check cause of oil loss.
Badly diluted, dirty or wrong oil.	Change oil. Check cause of dilution. If dirty, check service periods.
Clogged oil passages.	Clean oil passages and drillings.

PISTON, CYLINDER AND RING WEAR	
Operated with dirty air cleaner.	Change air cleaner service periods.
Air leak between the 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 Cooling System.

GENERATOR

VOLTAGE LOW AT FAR END OF LINE, BUT NORMAL NEAR POWER PLANT	
Too small line wire for load distance.	Install larger or extra wires or reduce load.
ELECTRIC MOTOR RUNS TOO SLOWLY AND OVERHEATS AT FAR END OF LINE BUT OK IF USED NEAR POWER UNIT	
Too small line wire for load distance.	Install larger or extra wires or reduce load.
VOLTAGE UNSTEADY, BUT ENGINE NOT MISFIRING	
Speed too low.	Adjust governor to correct speed.
Loose connections.	Tighten connections.
GENERATOR OVERHEATING (Approximately 160°F higher than ambient)	
Overloaded.	Reduce load.
VOLTAGE DROPS UNDER HEAVY LOAD	
Engine lacks power.	See remedies of Engine Misfires At Heavy Load. Inspect, repair as necessary.
Faulty injection.	Clean the fuel system. Clean, adjust or replace parts necessary.
Dirty air cleaner.	Clean.
Restricted exhaust line.	Clean or increase size.

POSSIBLE CAUSE	REMEDY
ENGINE RUNS: VOLTAGE WON'T BUILD UP	
Poor brush contact.	Be sure 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 necessary parts.
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.	See Poor Brush Contact.
Brush rig out of position.	Line up properly.

UNSTEADY VOLTAGE WITH STEADY-RUNNING ENGINE	
Speed too low.	Adjust governor to correct speed.
Poor brush contact.	See that brushes seat well on commutator, are free in holders, are not worn too short and have good spring tension.
Loose connections.	Tighten connections.
Fluctuating load.	Correct any abnormal load conditions causing trouble.
FLICKERING LIGHTS	
Defective anti-flicker breaker points.	Check point gap and inspect points.
Anti-flicker resistor out of adjustment.	Adjust slider for minimum flicker at average load.

OPERATION

CRANKCASE OIL

Use an oil with the API designation DS that has passed the Series 3 Test and at least Sequences IIA and IIIA of the Automotive Manufacturer's MS Sequence Tests. (DM oil which has passed the Automotive Manufacturer's MS Sequence Tests and the MIL-L-2104B Test may also be used when ambient temperatures are lower than 30°F.) To reduce oil consumption to a normal level in the shortest time on a new or rebuilt "J" series diesel engine, use DM oil (passing the MS Sequence Tests) for the first fill only (50 to 100 hours); then change to the recommended oil.

TEMPERATURE	GRADE
Above 30°F	SAE 30
0°F to 30°F	SAE 10 W or 5W - 20
Below 0°F	SAE 5W - 20

During *break-in,* check oil level at least every eight (8) operational hours. Add oil if the level is at *low* on the dipstick. Never over-fill. This may cause oil to foam and enter the breather system.

RECOMMENDED FUEL

The type of fuel depends on operating conditions. Use No. 2 diesel fuel for best economy. Use No. 1 diesel fuel:

1. When ambient temperature is below 32°F
2. During long periods of light engine load
3. If preferred by user

Use a low sulfur content fuel having a pour point (ability to filter) of at least 10° below the lowest expected temperature. Keep fuel clean and protected from adverse weather. Leave some room for expansion when filling the tank. *Keep the fuel system clean.* The long life built into the injection system can be destroyed by one moment of carelessness.

BLEED FUEL SYSTEM (Initial Start)

Loosen the air bleed screw on top of the secondary filter (early models) or remove the fuel return line (late models). Operate the priming lever on the fuel transfer pump until bubbles cease to appear in the fuel. Tighten the bleed screw (early models) or connect the fuel return line (late models). **Important:** *If the fuel pump lobe on the camshaft is up, crank the engine one revolution to permit hand priming. When finished, return the priming lever to the disengaged position (inward) for normal operation.*

STARTING

Check the engine to make sure it has been filled with oil and fuel. If necessary to prime a *dry* fuel system return the transfer pump priming lever to the disengaged position after priming.

Important: *This unit has been run and tested for about 3 to 4 hours at the factory. Additional break-in time is required and will vary depending upon load conditions, oil used, etc. Load during break-in should be between 1/2 load and rated load, preferably near rated load for best results. This procedure results in faster break-in and lower oil consumption.*

1. When starting a cold engine in ambients above 55°F, pre-heat for 20 seconds.
2. Continue to hold pre-heat switch:
   a. Press the *start* switch.
3. Release start switch after engine starts and reaches speed.
4. Oil pressure should read at least 20 psi. (Pressure relief valve is not adjustable).

Important: On "contractor" model, depress preheat switch for one minute and then push start switch. Both switches must be engaged for starting.

Low temperatures may require additional preheating. If engine fails to start quickly, rest engine several seconds before successive attempts, apply preheat for 1 min. and repeat above starting procedures.

If the plant control has a re-set button, push it to re-set only after a shutdown resulting from oil pressure failure occurs. Find the cause before re-starting the engine.

The adjustable resistor slide tap (in the charging circuit) is set to give approximately 2-ampere charging rate. For applications requiring frequent starts, check battery specific gravity periodically and, if necessary, increase the charging rate slightly (move slide tap nearer ungrounded lead) until it keeps the battery charged. Adjust only when plant is stopped. Avoid overcharging.

If a separate automatic demand control for starting and stopping is used, adjust the charge rate for its maximum

4.5 amperes. This normally keeps battery charged even if starts occur as often as 15-minutes apart.

STOPPING

(1) Push *start-stop* switch to *stop* position.
(2) Release switch when plant stops. If stop circuit fails, close fuel valve.

PLANT REBUILDING

GENERAL

When engine disassembly is necessary - remove complete assemblies (tear down individual components like fuel pump, breaker mechanism, etc., as bench jobs). *Use special tools available.*

DISASSEMBLY

A. *Common sense* will dictate proper order of disassembly. As disassembly progresses, the order may be changed, as will become self-evident.

B. A suggested procedure would be as follows:
   1. Housings, shrouds, blower housing, air cleaner
   2. Flywheel - using puller or pry-bar method
   3. Gear Cover - protect oil seal from keyway damage.
   4. Crank Gear - use puller and gear puller ring.
   5. Loosen accessories such as fuel pumps, oil filter, starter, and generator.
   6. Control box and generator (lift all generator brushes) tag all wires for identification.
   7. Drain oil - discard oil removed.
   8. Cylinder head
   9. Valves, springs, rocker arms
   10. Camshaft and gear, rear bearing plate, oil pump
   11. Piston, connecting rod bearings
   12. Crankshaft
   13. Try to analyze reasons for any parts failure and necessity of the repair.
   14. Cleanliness and neat orderly work area makes the job easier to do.
   15. Use proper meters and gauges. Observe if cylinder requires boring, crankshaft needs grinding, or other major shop work necessary.
   16. Check generator and static exciter (if used). Use growler, test light (*buzzer*), or ohmmeter for armature or field coil shorts, grounds, or opens. Determine if commutator or slip rings need turning by lathe to true them up. Under-cut mica if necessary.

ASSEMBLY (USE GENUINE ONAN PARTS)

A. Engine assembling procedure is normally the reverse of disassembly - observing proper clearances of bearings, connecting rod, proper fitting and sizing of piston, rings, etc.

B. Follow proper recommended procedure for fit of valves, adjusting clearances, and torque of all special items. Use a torque wrench to assure proper tightness without danger of stripping threads.

C. As each internal engine part is assembled, use crank (or wrench) and turn over engine, making certain it turns freely. If tightness is noted after any operation you then know your last step is responsible.

D. As each internal engine part is assembled, coat it heavily with oil (the same grade to be used in the crankcase). During the first few critical moments of operation the engine will depend on this lubrication.

E. After you have the internal engine parts reassembled, the engine should turn over freely when cranked. If reasonable care and attention has been given, the engine will operate efficiently.

F. At this point, it is a matter of mechanically adding the outside accessory items to the block assembly. *Order of assembly is reverse of disassembly.*

G. When engine is complete, install generator and plant control. Check the tagged wires. Use wiring diagram to connect generator leads to control, and, from control to engine leads. All wires are marked for correct identification. If plant is to work properly, *wires must be connected correctly.*

H. The engine-generator is now ready for testing. Follow suggestions given on *Testing and Adjusting Plants.* Before final test and adjustments, run the plant about 15 minutes under light load to reach normal operating temperature.

ASSEMBLY SUGGESTIONS (Things to keep in mind during engine assembly)

A. *See Onan Tool Catalog (900-19)* - many items require a *special tool* for correct installation. Some of these tools are:
   1. Oil seal driver and guide, bearing driver
   2. Valve spring compressor, valve lock replacer, valve guide driver, and valve seat remover.
   3. Gear puller and gear puller rings
   4. Piston ring spreader and compressor
   5. Flywheel puller, pry bar, armature puller
   6. Torque wrench, Plastigauge (for correct bearing clearance)
   7. Load test panel, armature growler, gas pressure gage (or manometer)

B. Wet holes in crankcase (holes through crankcase) always use copper (gasket) washers.

C. Nuts, bolts and screws that do not require exact torque should be tightened snugly, then 1/4 extra turn.

D. Select proper length of any screw or bolt and position in hole. Make sure they do not *bottom.*

E. Gasket kits sometimes cover more than (1) engine. Therefore, select gasket of correct size and shape for part being used. Always use new gaskets.
F. When disassembling engine, *mike* bearing plate gasket thickness. Then select proper gasket thickness for correct end play.
G. When assembling crankshaft, make sure bearing thrust washers are in proper position supported by bearing stop pins. Use cup grease to hold in place.
H. When adjusting valve lash on J-Series, tap the rocker arm so it is straight when checking with feeler gage.
I. When installing gearcase cover, put a dab of grease on roll pin so governor cup can be aligned.
J. Crank gears are easier to remove and install if heated.
K. Service manual (for any specific model) should be read carefully for correct timing.
L. Allow some gear lash (approximately .005 in. in oil pump. *Do not install gears tightly against each other!*

TESTING AND ADJUSTING PLANTS

Preparation.

Check the following:

1. Put proper oil in crankcase.
2. Service the air cleaner
3. Connect the fuel line.
4. Connect the load.
5. Connect fully-charged battery.
6. Check ventilation for proper cooling.

OPERATION

1. Start engine.
2. Check oil pressure, adjust brush rig.
3. Run plant 15 minutes to bring up to operating temperature.
4. Check for oil leaks, loose electrical connections, tight fuel lines and tight exhaust connections.

ADJUSTMENTS

1. Adjust governor for speed and sensitivity.
2. Make sure meters are connected.
3. Check the output; volts, amps, watts, frequency.

IMPORTANT: For complete customer satisfaction repaint unit (Onan Green, spray can 525P137, or Onan White, spray can 525P216) and apply instructions from Kit 98-1100C or Marine Kit 98-1807.

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 group are included in the applicable section. When re-assembling, check each section for these special assembly instructions or procedures.

FLYWHEEL

Remove the blower housing. The flywheel is a tapered fit on the crankshaft. Improvise a puller, using at least a 7/16 in. bar, and drill two 7/16 in. holes 2-7/8 in. between centers. Loosen the flywheel mounting screw a few turns. Place bar against the flywheel screw and attach bar, using two 3/8-16 thread screws in the holes provided in flywheel. Alternately tighten the screws until flywheel is free.

Replacement flywheels are supplied without the timing markings because each flywheel must be fitted to its engine. The only accurate method of determining the top dead center (TDC) and port closing points is to measure the piston travel. This is a critical measurement and should be attemped only with accurate, dependable equipment.

With the flywheel mounted, remove the head and install a depth gauge over the piston. Rotate the flywheel to find the TDC position on the compression stroke and mark this point on the flywheel. Next, turn the flywheel counterclockwise until the piston drops exactly .102 in. from TDC. This is the port closing point, 17° BTDC. Mark it on the flywheel.

GEAR COVER

To remove the gear cover, detach the upper governor ball joint. Remove the governor speed adjustment nut and governor spring bracket.

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

Governor Shaft: The governor shaft is supported by two 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 outside of the gear cover. Remove the smaller bearing with an Easy-Out or similar tool. Press new bearings and oil seal into place.

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. See Fig. 3.

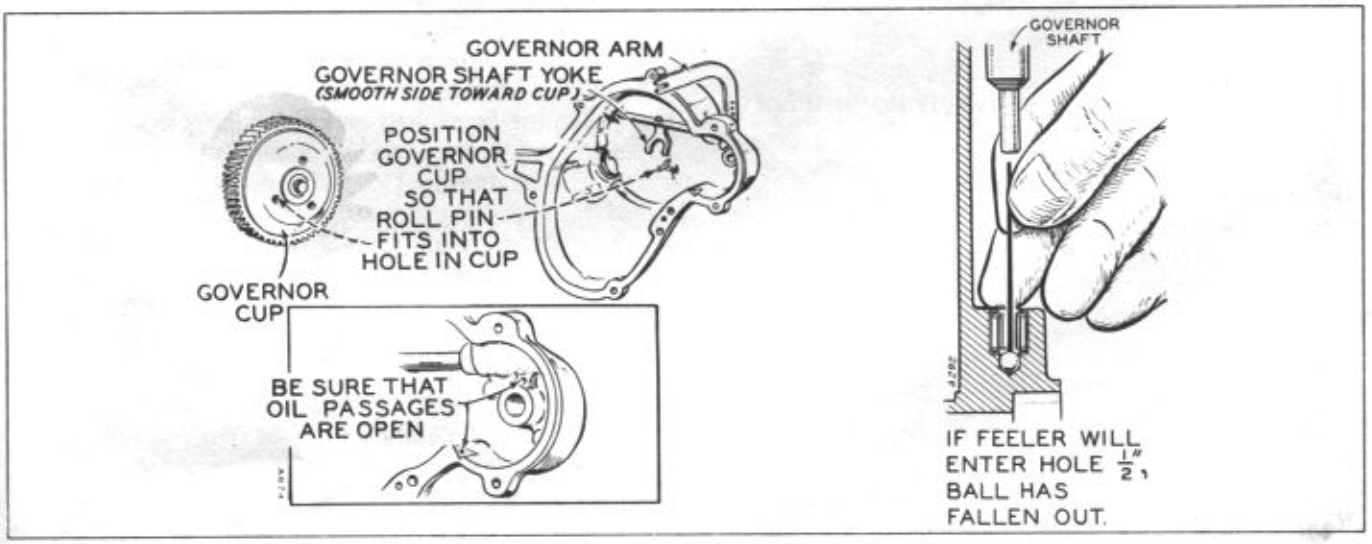


Figure 2. Gear Cover Assembly

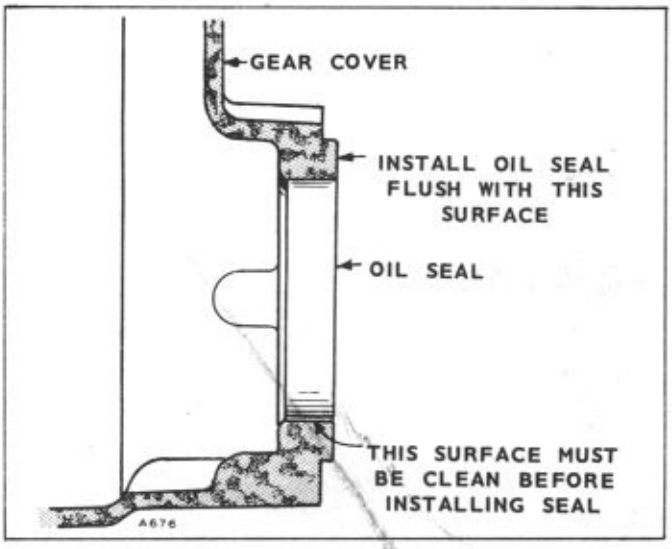


Figure 3. Gear Cover Oil Seal

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. 2). Later models have larger ball which will not fall out.
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. 2). 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 is not, replace the pin. Pin should be positioned with open end facing crankshaft seal.
4. Coat the oil seal lip with oil or grease. Set a piece of shim stock over the crankshaft keyway to protect the seal and install the gear cover. Torque the mounting screws to 15 to 20 foot pounds. Before tightening screws, be sure the stop pin is in the governor hole.

GOVERNOR CUP

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

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 in. to give the proper travel distance for the cup. (Fig. 4). If it is less, the engine may race; if more, the cup will not 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 cannot be removed without damaging the surface.

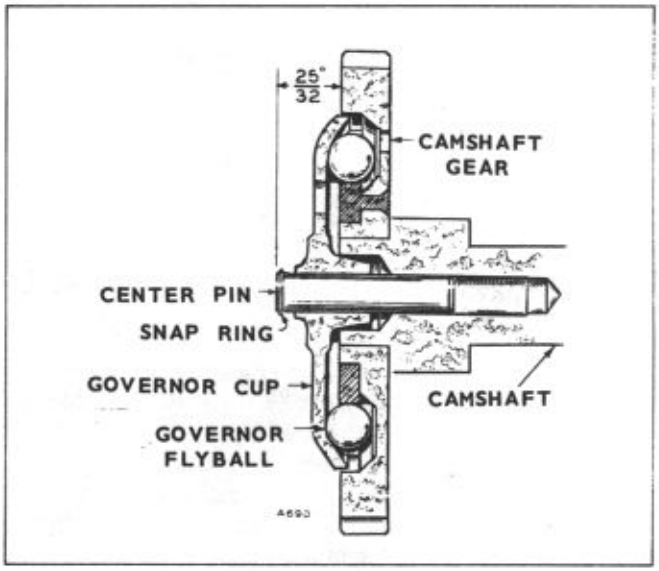


Figure 4. Governor Cup

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.

Installation: To install the governor assembly, tip the front of the unit upward. Set the flyballs in their recesses and position the governor cup on its shaft. Finally, brush with heavy grease and install the snap ring on the center pin.

CAMSHAFT

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

In addition to providing a means of opening and closing the valves, the camshaft operates the injection pump and fuel transfer pump.

Removal:

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

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. After installing a new camshaft, retime the injection pump to the engine.

Camshaft Gear: This gear is a pressed fit on the camshaft and drives it at 1/2 the crankshaft speed. 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.

Camshaft Bearings: The camshaft bearings should be replaced if the clearance to the camshaft is greater than specified, the bearings show cracks, breaks, burrs, excessive wear, or other defects. The camshaft-to-bearing clearance should be .0012 in. to .0037 in.. To check the rear bearing, remove the expansion plug at the rear of the crankcase.

Press new bearings into place (Fig. 5). 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 oil passages are aligned. Do not attempt to ream the bearings, as 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.

Installation, Camshaft Assembly:

1. Install the key and press the camshaft gear on its shaft.
2. Install the governor components.
3. Slide the thrust washer onto the shaft. Measure camshaft endplay; it should be .007 in. to .039 in.(Fig.6).
4. Lay the engine on side or end and insert the push rod tappets.
5. Install the camshaft assembly in the engine. Align the timing marks on the camshaft gear and crankshaft gear (Fig. 7).
6. Replace the push rods and fuel transfer pump.
7. When the engine is reassembled, install the injection pump, following the steps for Injection Pump Installation. This step is critical.

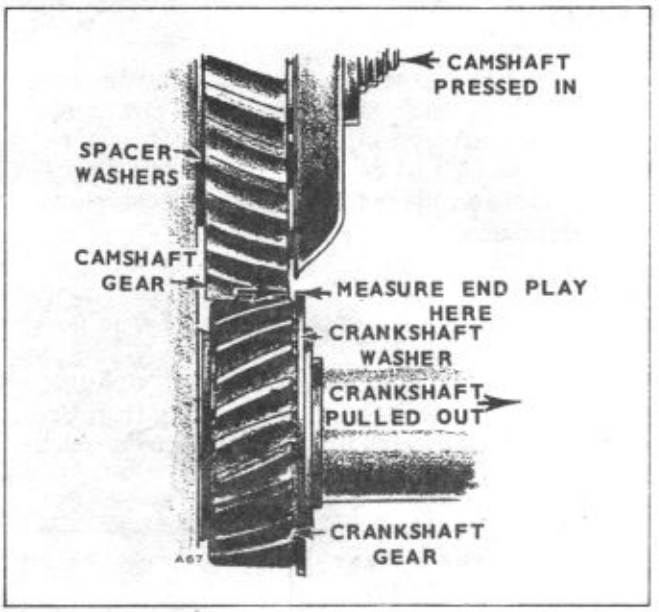


Figure 6. Camshaft Endplay

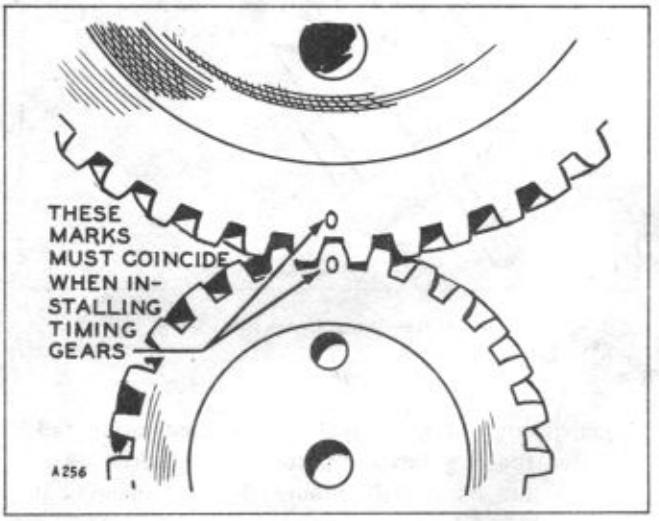


Figure 7. Timing Marks

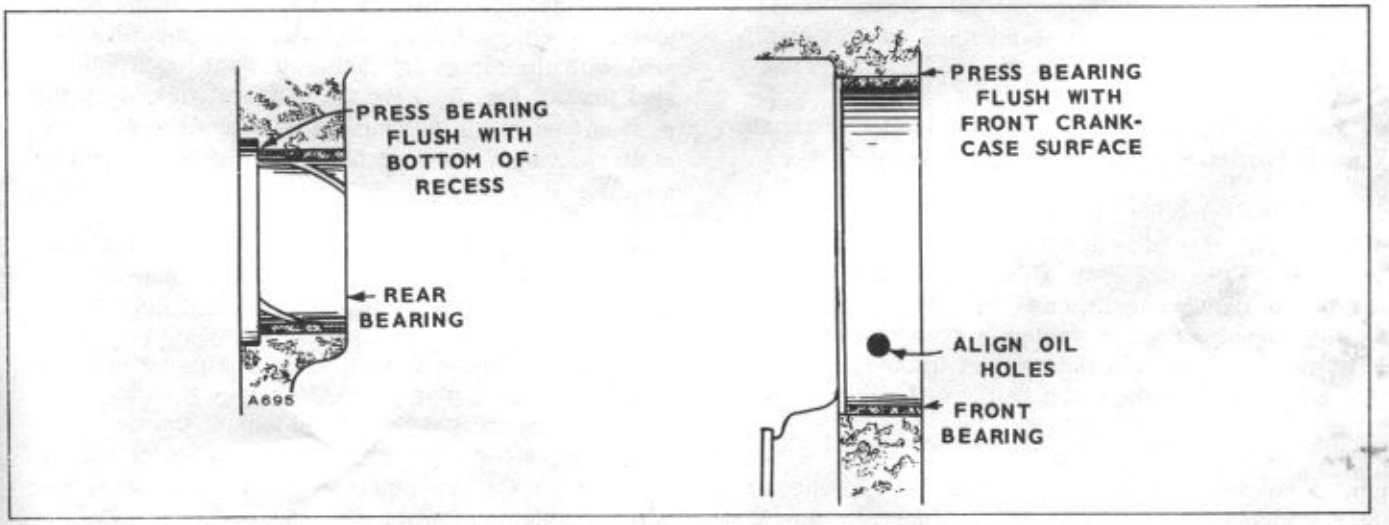


Figure 5. Camshaft Bearings

CRANKSHAFT

These engines use a counter-balanced, ductile iron crankshaft. To increase the shaft fatigue durability, all crankpin fillets are shot-peened during manufacture. The crankshaft rides on two lead-bronze bearings; the front one housed in the crankcase and the rear one in the bearing plate.

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. Use care not to damage teeth if the gear is to be re-used. (Fig. 8).

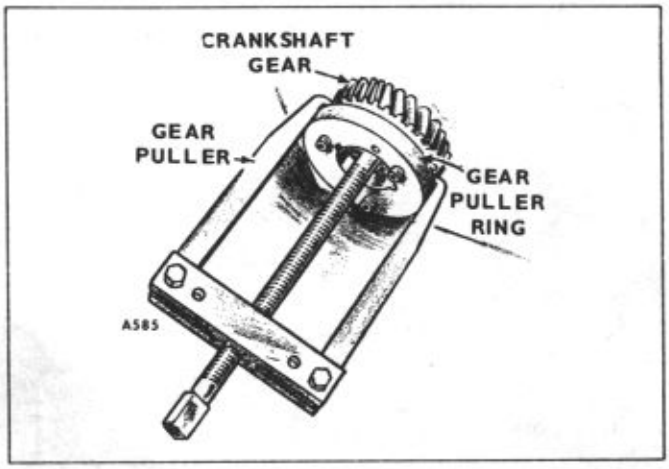


Figure 8. Removing Crankshaft Gear

3. Remove the oil pan, piston, and connecting rod.
4. Remove the rear bearing plate from the crankcase.
5. Remove the crankshaft through the rear opening in the crankcase.

Inspection: Clean the crankshaft and blow out all oil passages. Check 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 changes.

If journal dimensions are not within limits, or if the journals are scored, regrind the crankshaft.

Crankshaft Regrinding: Crankshaft grinding requires a trained, experienced operator working with precision equipment. Procedures which may be satisfactory for some spark-ignition engines may well be unsatisfactory for diesel applications, resulting in expensive failures. Onan emphasizes that if facilities or trained personnel are not available, the crankshaft may be sent to the factory.

Special procedures must be observed when re-working diesel crankshafts. In addition to machining, the crankshaft must be *shot-peened* and super-finished. Failure to *shot-peen* the crankpin fillets is likely to cause early failure. When the shaft is machined, follow this data and Fig. 9 to shot-peen each crank pin fillet.

1. Almen gage reading, .012-A.
2. Peen with .019 in. diameter cast steel shot.
3. Peen for 15 seconds on each crankpin fillet.
4. Mask off connecting rod bearing areas.

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

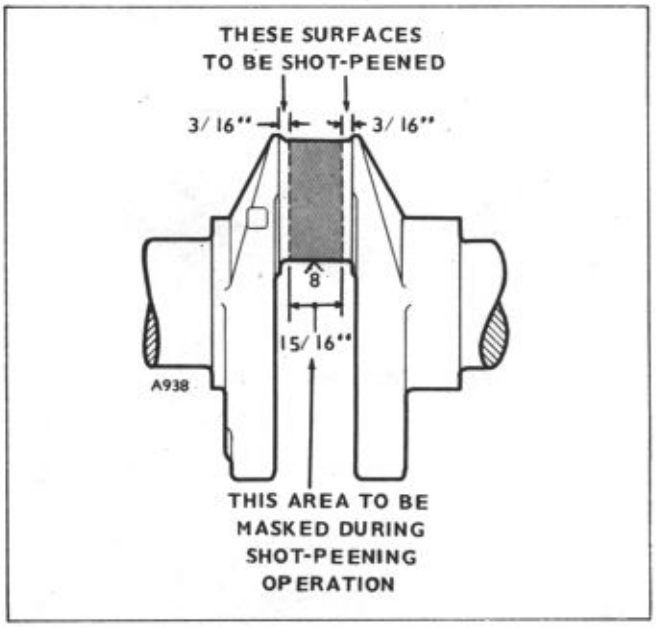


Figure 9. Shot-peening Crankshaft

Main Bearings: Replace main bearings if clearances are greater than limits, or if the bearings are worn, grooved or broken. Precision replacement bearing inserts and thrust washers are available for all main bearings. Do not ream the bearings. Align the oil holes and press the new bearings into the front and rear housings.

Rear Oil Seal: The rear oil seal is in the rear bearing plate. If damaged, drive it out from the inside of the plate. Using the oil seal installing tool, install a new seal with the rubber lip facing outward (open side of seal inward) Fig. 5. 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.

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. Do not attempt to drive a bearing into a cold block or rear bearing plate. (Fig. 10).
2. Install the thrust washers and locking pins.
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.

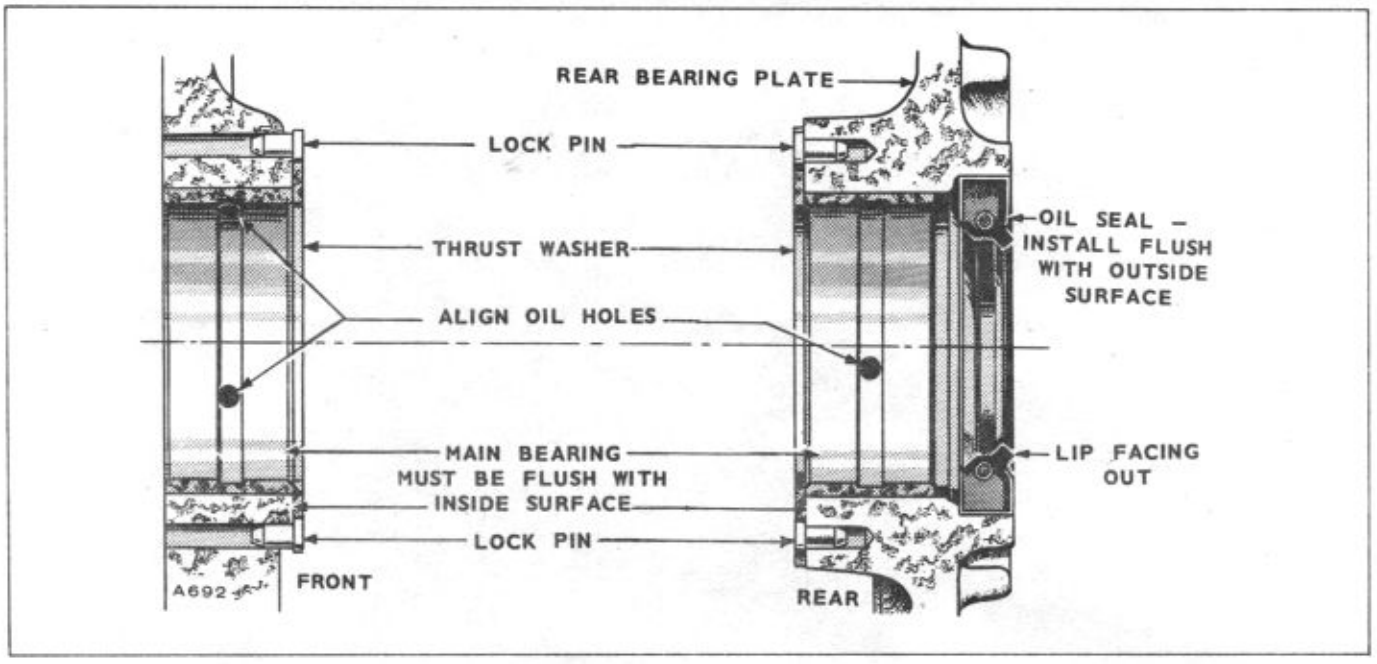


Figure 10. Main Bearing Installation

5. Heat the timing gear on an electric burner or oven to about 350°F. Install the key on the crankshaft, then drive the gear into place. Install the retaining washer and lock ring.
6. Check the crankshaft end play. Use enough rear bearing plate gaskets or shim and gaskets to provide .010 in. to .015 in. end play. If gaskets of more than .015 in. total thickness are required, use a steel shim of proper thickness and a thin gasket on each side of shim. This avoids excessive gasket compression and maintains bolt torque.
7. Install the piston assembly.

CRANKCASE

If the crankcase is replaced, a new set of injection pump shims will be furnished with the new crankcase. These must be used and, in addition, the injection pump must retimed to the engine. See Fuel System.

CYLINDER HEAD, VALVES

The cylinder head assembly has alloy-hardened faced valves, release-type rotators, alloy-hardened inserts, guides, rocker arms, injection nozzle and glow plug. The push rods run through shields. The head assembly contains a decompression mechanism.

MAINTENANCE

Check the valve clearances at regular intervals. (see Service Chart). In addition, clean the combustion chamber and valve seats at regular intervals. Readjust decompression mechanism after adjusting valves.

TESTING

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

To check compression, run the engine until thoroughly warm. Stop it and remove the injection nozzle. Insert the compression gauge in the injection nozzle 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.

Another quick check of valve condition is to listen at the intake manifold (air cleaner removed) and the exhaust outlet while the engine is turned over by hand. A hissing sound indicates a leaking valve. Be careful when using this test because there will always be a slight hissing during the start of each compression stroke as the intake valve finishes closing.

VALVE CLEARANCE

Check valve clearance when the engine is at room temperature (about 70°F). Allow at least two hours for engine to cool after operation.

1. Turn the flywheel until the cylinder is on its compression stroke. Use a socket wrench on the flywheel screw hex head.

   To determine if the cylinder is in its compression stroke, observe the action of the push rods as the engine is rotated in a clockwise direction. The exhaust valve push rod will be in its lowest position and the intake valve push rod will be moving downward. As the piston reaches top dead center, the flywheel timing mark should be aligned with the timing pointer and the valve push rods stationary.

2. Now turn the flywheel clockwise an additional 10 to 45 degrees. There is no timing mark for this position, so it must be estimated. With the piston located in this position, it will be in its power stroke with both valves completely closed.

3. To change the setting of valve clearance, adjust the locknut which secures the rocker arm to the cylinder head (see Fig. 11). Loosen the locknut to increase clearance and tighten it to reduce clearance.

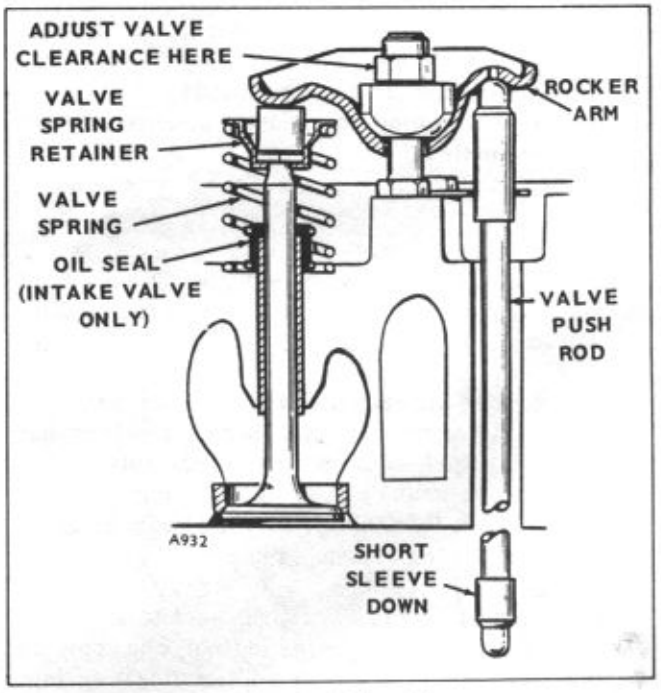


Figure 11. Setting Valve Clearance

4. After allowing engine to cool, check the clearance with a feeler gauge between the rocker arm and the valve (see Fig. 12). Increase or reduce the clearance until the proper gap is established. Correct valve clearance is .011 in. intake and .008 in. exhaust.

Compression of early (pre-Spec P) engines will indicate 300 to 350 psi. Starting with Spec P, compression tests should indicate 350-400 psi.

Compression reading will deviate from the above readings because of differences in cranking speed, altitude and ambient temperature conditions. Therefore, the specification is given only as a guide.

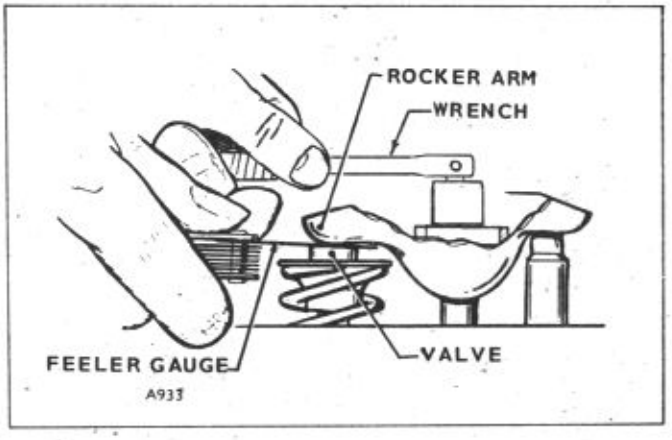


Figure 12. Checking Valve Clearance

DISASSEMBLY

1. Remove the decompression solenoid.
2. Remove the rocker box cover, fuel nozzle and connecting oil lines to the cylinder head.
3. Remove the intake and exhaust manifold.
4. Remove the cap screws holding the cylinder head to the cylinder block.
5. Remove the head. If it sticks, rap it sharply with a soft hammer. Do not use a pry.
6. Remove the rocker arms and push rods.
7. Using a valve spring compressor, disassemble the valve assemblies.

REPAIR

Thoroughly clean all components of the cylinder head assembly. Remove all the carbon deposits from the intake and exhaust ports and clean all gasket surfaces.

Valves: Remove all carbon and check each valve for burning, pitting or warped stem. Refinish valves that are slightly pitted or burned on an accurate valve grinder. Refinish intake valves to a 42° angle and exhaust valves to a 45° angle. If they are badly pitted or have a thin edge when refacing, 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 to the valve face and rotating it against the seat.

Valve Guides: Check valve guide to valve clearance, (see Table of Clearances). If the proper clearances cannot 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 in. from the rocker box side of the head. Ream the new valve guide to obtain the proper clearance.

Valve Seats: If the valve seats are pitted, refinish them. Using conventional seat grinding equipment, reface each seat to a 45° angle and a seat width of 3/64 in. to 1/16 in.. 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 #420B272 in a drill press (Fig. 13) to remove each valve seat. Adjust the tool to cut 1/64 in. from the edge of the seat. Oil the pilot to prevent it from seizing in the valve guide. Cut each seat down to a narrow rind on edges and bottom and break it out with a sharp tool. Be careful not to cut into the counterbore bottom.

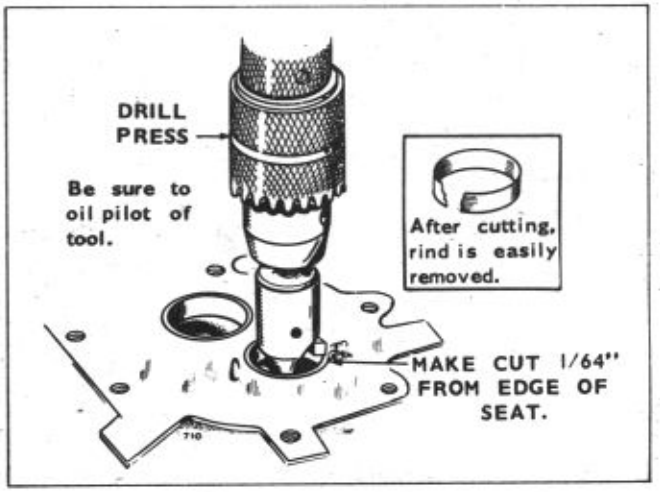


Figure 13. Removing Valve Seats

Thoroughly clean the valve seat counterbore and remove any burrs from the edges. If the counterbore is damaged, it will have to be remachined for an oversize seat. Oversize seats are available in .002 in, .005 in, .010 in. and .025 in.. Otherwise, install new standard-size seat inserts.

Drive the new valve seat inserts into place. Be certain that each seat rests solidly on the bottom of the counterbore at all points. To make installation easier, heat the cylinder head in an oven at 325°F for about 30 minutes and cool the valve seats in dry ice.

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

When the new seats are installed and faced, insert the valve into each and check the clearance from valve head to the face of the cylinder head. This must be at least .030 in.. If it is not, regrind the seat.

Valve Springs: Check the valve springs on an accurate compression scale. The valve spring load should register 45-49 lbs. closed; 83-93 lbs. open. Replace any weak, cracked or pitted spring, or one that has out-of-square ends.

INSTALLATION

1. Push a valve stem oil seal onto the intake valve guide and clamp in place. Then oil the inside surface of the seal.

   Important: *Units built before June of 1962 had no valve seals.*
2. Oil the stem of each valve lightly and insert into its own guide.
3. Check each valve for a tight seat with an air pressure type tester. If a tester is not 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 is not tight, regrind the valves.
4. Using a valve spring compressor, compress each valve spring and insert the valve spring retainer and retainer locks.
5. Install the head assembly and gasket to the cylinder block. Tighten the head bolts evenly to 44 to 46 ft. lbs. See Fig. 14 for proper tightening sequence.
6. Install the exhaust manifold, nozzles, glow plugs and oil lines. Tighten manifold nuts evenly to 13-15 lbs.
7. Install the valve stem caps.
8. Install the push rods, rocker arms and rocker arm nuts.
9. Set the valve clearance.Intake is .011 in; exhaust is .008 in..
10. Install and adjust the decompression mechanism.
11. Install the rocker cover. Remove the solenoid, dip plunger "O" ring in oil and reinstall when cover is on engine.

Important: *After the first 50 hours of operation, retighten the cylinder head bolts and check valve clearance. See Fig. 14.*

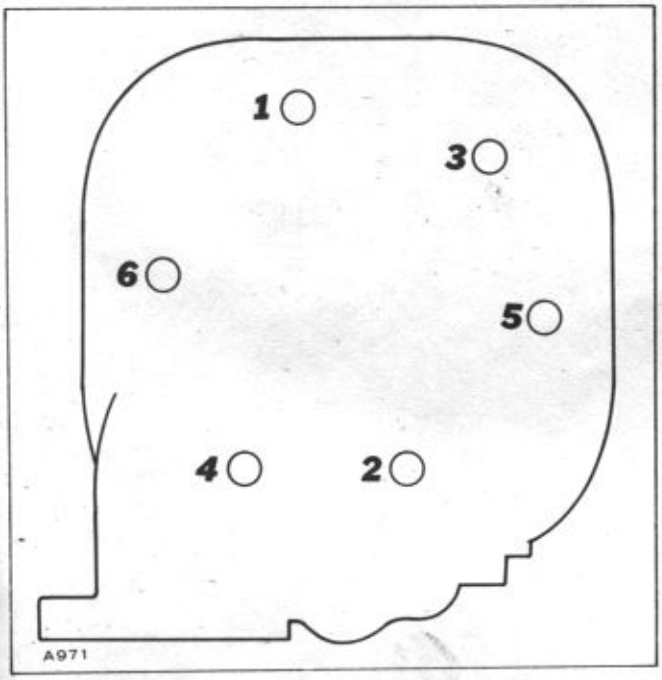


Figure 14. Bolt Tightening Sequence

DECOMPRESSION RELEASE

The decompression release mounts on the cylinder head with a solenoid on the rocker box cover. It holds the exhaust valve open to allow the engine to build up speed during starting before compression occurs, and to stop the plant. The mechanism holds the exhaust valve open when the solenoid is de-energized. If the release is defective, replace any worn parts; otherwise, adjust it, following the instruction below.

NOTE: Before adjusting the decompression mechanism, the valves must be set for the correct clearance.

Figure 15 shows the decompression release in detail. It must operate properly for dependable engine starting and stopping.

1. With the piston 10° to 45° past TDC on the power stroke, hold the arm in the decompression position (tension against spring). Turn the set screw so it just touches the exhaust rocker arm. The release arm must be tight against the snap ring during adjustment. Then turn the screw exactly one revolution clockwise. The original factory setting is marked with white or yellow paint.

   NOTE: If the screw is tightened more than one turn, the exhaust valve could hit the piston.

   Hold the set screw and lock it into position with the attached nut. Turn the nut hand tight plus 1/4 to 1/2 turn to lock the mechanism.

2. Release the mechanism to allow compression. Check the clearance between the screw and rocker arm. Insert a .008 in. feeler gauge between valve and rocker arm to take up valve clearance for this check. If there is no clearance, back off the set screw until it just clears the rocker arm.

   When reassembling the rocker cover, remove the solenoid, dip the plunger "O" ring in oil and reinstall when cover is on the engine. Align solenoid so terminal "SW" is above terminal "IGN".

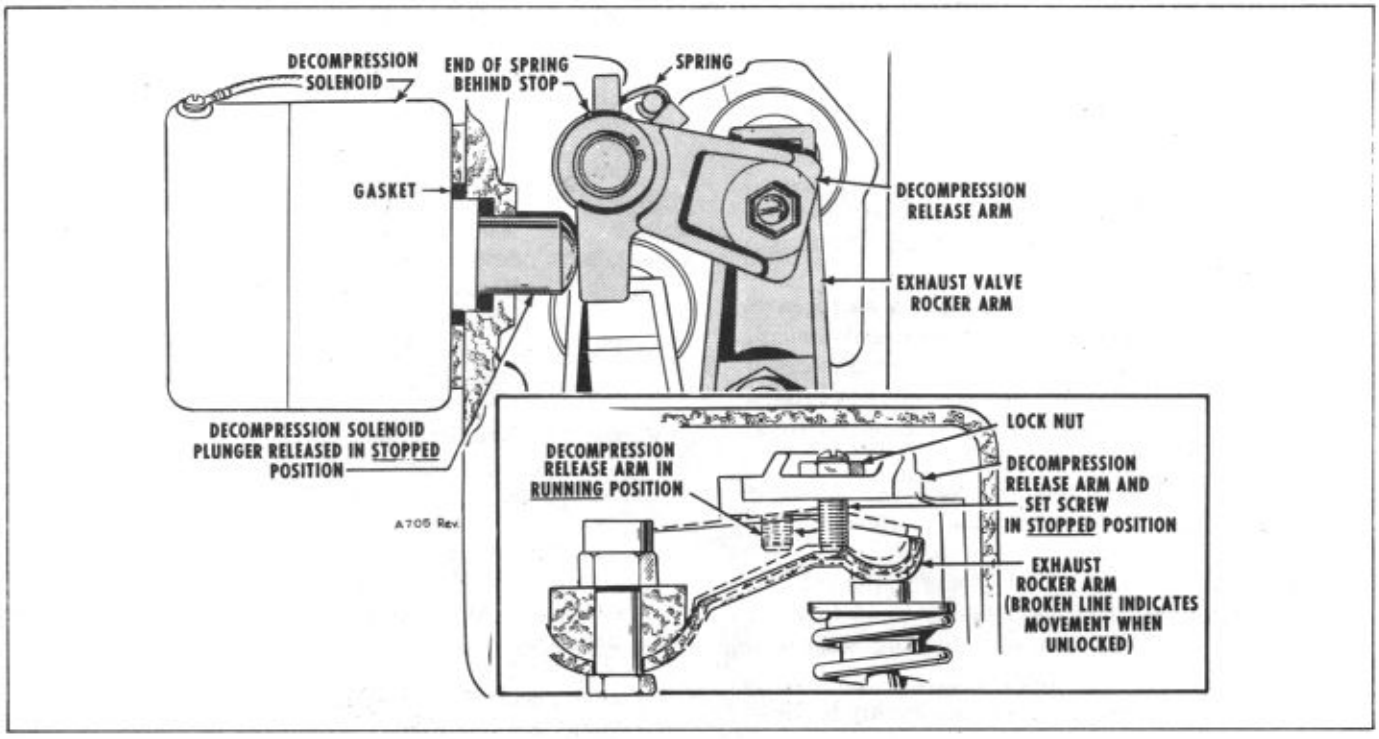


Figure 15. Decompression Release

PISTON, RINGS, CONNECTING ROD

This engine uses a cam-ground aluminum piston, tapered and fitted with three compression rings and an oil control ring. A full-floating piston pin connects the piston to its connecting rod. The pin is held in place with a snap ring at each end. The lower end of the connecting rod contains half-shell, precision bearings, and the upper end, semi-finished bushings.

Important: *Some engines are fitted with a .005 in. oversize piston and rings at the factory. These engines are marked with an E following the engine serial number.*

REMOVAL AND DISASSEMBLY

1. Drain the crankcase oil and remove the oil base.
2. Remove the cylinder head.
3. Remove the cap from the connecting rod and push the assembly through the top of the cylinder bore. Replace the cap and bearing inserts in the assembly.
4. Using a ring expander, remove the rings from the piston.
5. Remove the two retaining rings and push the piston pin from the piston.

CYLINDER

The cylinder wall should be free of scratches, pitting and scuffing. Check cylinder with an inside-reading micrometer for out-of-round and wear. The bore should measure between 3.2495 in. and 3.2505 in. and be less than .001 in. out-of-round.

If necessary, rebore the cylinder to fit the next available oversize piston. Pistons and rings are available in .005 in., .010 in., .020 in., .030 in. and .040 in. oversize. If the cylinder does not need refinishing, remove any existing ridge from the top of the wall with a fine stone.

PISTON

Clean thoroughly and inspect the piston. Clean the carbon from the ring grooves and be sure all oil holes are open. If the piston is badly scored or burred, loose in the cylinder, has badly worn ring grooves or otherwise is not in good condition, replace it.

Check the clearance 90° from the axis of the piston pin and below the oil control ring. Clearance should be .0055 in.-.0075 in., (Prior to Spec P, .0050 in.-.0070 in.). If not, replace the piston and check the cylinder for possible reconditioning.

PISTON PIN

The piston pin should be a thumb push fit into the piston at room temperature. If the pin is excessively loose, install a new one. If the condition is not corrected, install the next oversize pin. If the piston is worn enough that the oversize pin will not fit, replace it.

RINGS

Inspect each ring carefully for fit in the piston grooves and seating on the cylinder wall (Fig. 16). Fit each ring to the cylinder wall at the bottom of its travel, using the piston to square the ring in the bore. Check the gap with a feeler gage. It should be .010 in. to .020 in. If the gap is too small, file the butt ends of the rings. Do not use rings that need a lot of filing, as they will not seat right on the cylinder wall. If an oversize piston is used, use the correct oversize rings.

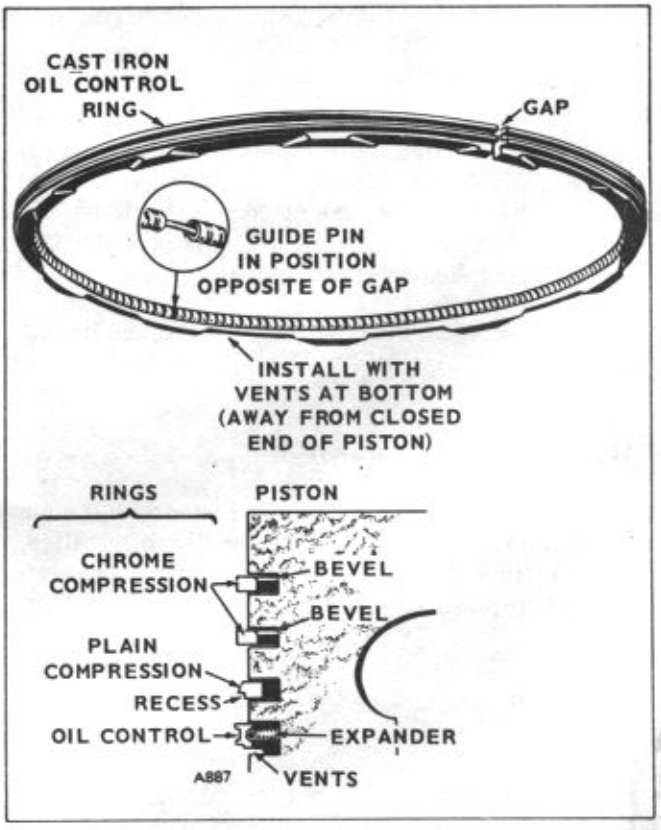


Figure 16. Piston Rings

CONNECTING ROD

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

If the bushings are excessively worn, press them out and install one new bushing from each side of the bushing bore. Press the new bushings only until flush with the sides of the rod to leave 1/16 in. to 7/64 in. oil groove in the center (Fig. 17).

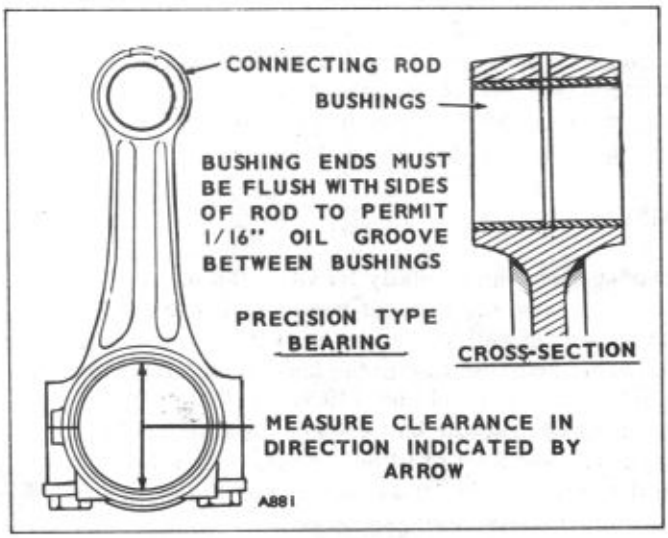


Figure 17. Connecting Rod Bushings

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.0033 in.,If necessary, replace with new standard or oversize precision bearings.

For information about the crankpin journals, see Engine Disassembly.

ASSEMBLY AND INSTALLATION

1. Install the connecting rod on the piston.with the pin and retaining rings. If new bushings were installed, make certain the ends are flush with the connecting rod to provide for the oil recess in the center.
2. Install the rings on the piston. 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 one fourth of the way around the piston from one another. No gap should be in line with the piston pin. Oil the rings and piston.Gap in oil ring expander must be approximately 180° from gap in oil ring.
3. Position a bearing half in the connecting rod. Be sure there is no dirt under the bearing. This could cause high spots and early bearing failure.
4. Oil the cylinder wall. Install the piston in the cylinder, using a suitable installer. The assembly should be installed with the stamp on the piston facing in the same direction as when removed. The notch on the piston should be on the front of the engine (Spec "P" and later).
5. Position the connecting rod on the crankshaft, 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.
6. Tighten the cap screws to the specified torque.
7. Crank the engine over by hand to see that the bearings are free.
8. Install the oil base with a new gasket.
9. Install the cylinder head using an even bolt-tightening sequence and specified torque.
10. Replace oil.

BREAK-IN PERIOD

Whenever a new piston or rings 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 30 minutes at 1/3 load and 2 to 3 hours at 2/3 load. Regular operation can then be resumed. Avoid light load operation during the following several hours for best ring seating to control oil.

COOLING SYSTEM

To remove the heat produced during operation, DJA generating plants use a pressure air cooling system. Blades

To remove the heat produced during operation, DJA generating plants use a pressure air cooling system. Blades on the engine flywheel draw air into the front of the engine housing and force the air past the cylinder and out the right side of the engine. A separate blower on the generator rotor draws air into the rear of the generator and forces it out through openings near the engine.

From the engine outlet, air can be ducted out of the area. An optional shutter assembly can be installed on the air outlet to improve engine temperature control.

MAINTENANCE

With a properly installed engine, maintenance should consist of cleaning the engine cooling area (fins on cylinder head) at regular intervals, normally every 1,000 hours but more often under dirty operating conditions.

OVERHEATING

The first sign is usually a dark exhaust smoke and loss of engine power, which results in a speed loss. This happens before the engine seizes, and results in a seized piston, or worse. At the first sign of speed or power loss the plant should be stopped, if possible, and the cause found.

The most probable causes of overheating are dirty cooling surfaces, operating without the engine air housing, poor air circulation, improper lubrication, wrong injection timing or engine over-loaded.

Piston rings and nozzles will generally stick before the piston seizes.

Caution: *The air housing, including the door, must be on when operating the engine. Overheating and permanent damage can result from as little as one minute of operation without it.*

Common installation problems leading to over-heating are as follows:

1. Installation with duct size too small for sufficient air flow.
2. Installation in small room with no ducts and insufficient air ventilation in the room.
3. Installation of air inlet and outlet ducts so air outlet feeds back to the inlet.

AIR SHUTTER (Optional)

The optional air shutter assembly is mounted at the engine air outlet on the right side of the cylinder shroud. A thermostatic element (Fig. 18) controls the shutters so they close and limit air flow when the engine is cold. When the air temperature reaches 120°F the power element plunger begins to move outward, opening the shutters until they are completely open by 140°F.

Shutter opening temperature is not adjustable, but to ensure complete opening, the power element plunger must contact the shutter roll pin at room temperature. To adjust this, loosen the power element mounting screws and slide the assembly until it touches the roll pin with the shutter closed.

Repair: If the shutter will not open, check the power element for defects or binding of the plunger. Be sure the shutter does not bind against the housing in any position.

To test the power element, remove it from the assembly and heat it. When the unit reaches about 120°F, the plunger should start to move out. Total movement should be at least 1/5". Do not overheat.

If the unit will not close, check for a weak return spring, binding in the nylon bearings or dirt in the power element plunger. If the nylon bearings are worn or bind, replace them. Remove the shutters and pull out the stub shaft. Push out the old and push in new bearings from the inside of the shutter housing. The large bearing surface serves as a spacer bushing, so must be on the inside of the housing. The shutters should be adjusted to obtain an end thrust clearance of not more than 1/32".

HIGH TEMPERATURE CUT-OFF

When optional automatic air discharge shutter is used, the shutter includes a high-temperature cut-off switch. This switch protects the plant if the shutter fails to open. The switch is in series with the governor solenoid. Switch is normally closed and opens at about 240°F. When it opens, the solenoid is de-energized, stopping the unit. The switch closes again at about 195°F.

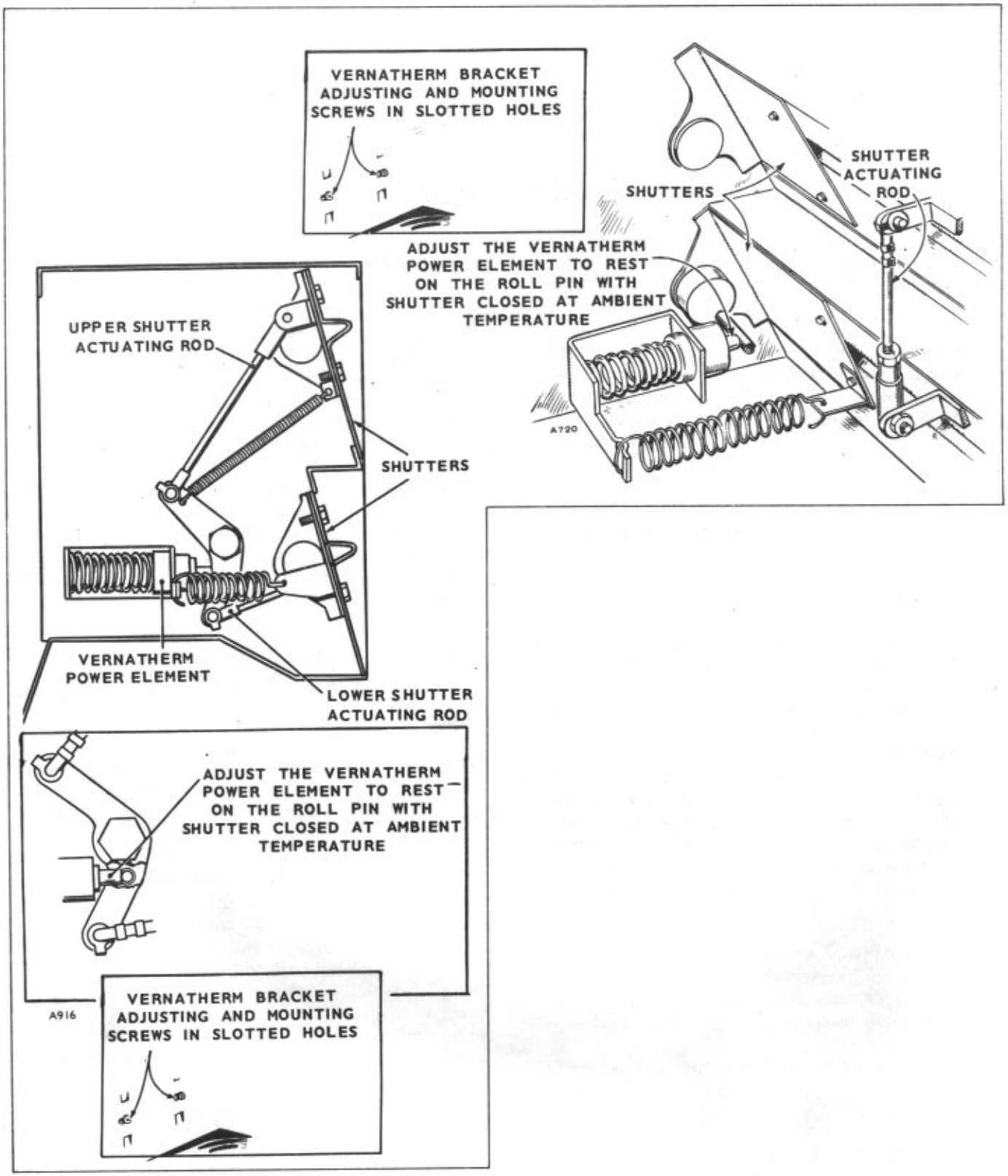


Figure 18. Air Shutter

FUEL SYSTEM

The diesel fuel system provides a means of filtering, transporting and delivering fuel in a fine spray to the engine cylinder at the correct time for ignition. The system consists of a primary fuel filter, fuel transfer pump, secondary fuel filter, injection pump and an injection nozzle. Fig. 19 shows the fuel system.

The diaphragm fuel transfer pump which operates directly off the engine camshaft, draws fuel from a supply tank and delivers it through two filters to the injection pump. The injection pump meters fuel and delivers it at high pressure to the injection nozzle at the correct time for ignition.

The injection nozzle opens at a set pressure, delivering fuel in a fine spray to the precombustion chamber for ignition.

Excess fuel is returned to the tank after each injection cycle by a fuel return line from the nozzle. An adapter combines the leak-off fuel with the flow-through fuel from the injection pump. A return line connected at this point returns the combined fuel back to the fuel supply tank.

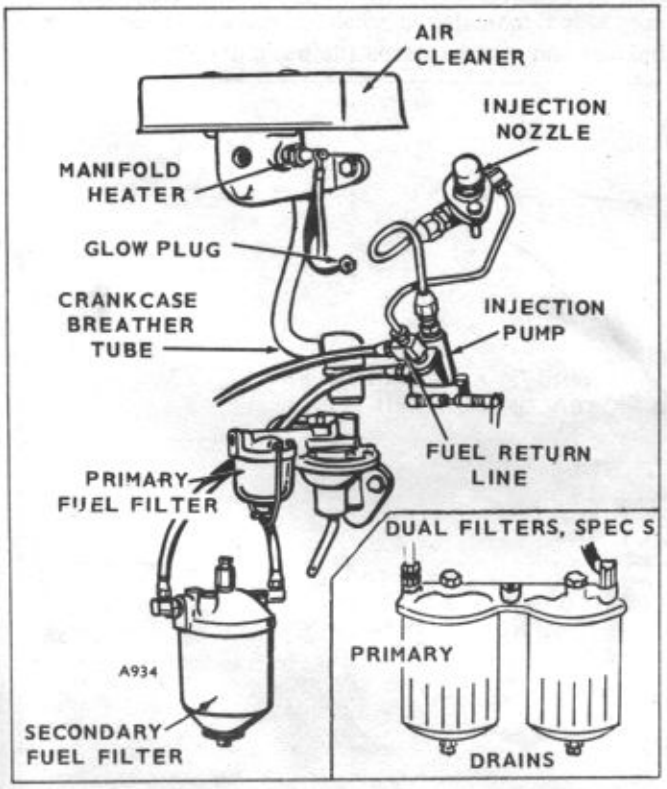


Figure 19. Diesel Fuel System

Caution: *A diesel engine cannot tolerate dirt in the fuel system. It is one of the major causes of diesel engine failure. A tiny piece of dirt in the injection system may stop your unit. When opening any part of the fuel system beyond the secondary fuel filter, place all parts in a pan of clean diesel fuel as they are removed. Before installing new or used parts, flush them thoroughly, and install while still wet.*

MAINTENANCE
FUEL FILTERS

Fuel filters are required for protection of the fuel injection system, even though good fuel handling practices are followed. It is absolutely necessary to use filters capable of removing micron-size particles from the fuel.

1. Two-stage filtration is supplied with Onan diesels, except for marine models. Boat manufacturers usually install the primary filter and water trap on marine units during installation.

2. The first stage of filtration is a 10-micron filter which has a replaceable cartridge, air bleed and drain valve. This filter is installed on the suction side of the fuel transfer pump and provides protection for the pump as well as the injection system when extremely adverse conditions are encountered, such as mobile installations or construction sites.

3. Fuel transfer pumps have a glass sediment bowl which traps water and sediment. If water or sediment are seen at this point (in continuing amounts), an additional filter and water trap should be installed at the supply outlet.

4. The final stage of filtration is accomplished with a 2-to 5-micron filter (particle sizes from 0.00080 to 0.000200 inch). Particles larger in size would eventually damage the injection equipment.

AIR CLEANER

Check the air cleaner after each 50 hours of operation. Wash the filter element in gasoline or diesel fuel. Moisten with clean oil of the same viscosity and grade as is in the crankcase. Dip and then squeeze dry. Replace element if it is damaged.

Starting with Spec S, a new fuel filtration system accommodates both primary and secondary fuel filters on a common mounting casting which is bolted to a newly-designed oil fill tube. The engine cannot be

run with either filter loose or missing, thus ensuring proper lubrication at all times.

The drains are located on the bottom of each filter housing. A damaged fitting may cause fuel leakage. To avoid damage, use two wrenches on each fitting when draining the filters. This will avoid the possibility of the upper drain fitting nut twisting away from the sheet metal housing.

In addition to regular service periods ,change the secondary fuel filter cartridge if the engine shows signs of starving from lack of fuel. Remove the secondary filter by removing the large screw in the center of the filter cover. Use care when replacing the filter cartridge to avoid getting dirt into the injection pump passages.

When replacing or cleaning filters, bleed the fuel system. Do this by opening the air bleed screw located on top of the secondary filter removal cap screw. Operate the hand priming lever on the transfer pump until no air bubbles flow from the bleed screw hole, then tighten the bleed screw. Return the priming lever to its original position (Fig.20).

Important: If the transfer pump cam lobe is on the high side, the priming lever will not operate the pump. Turn the engine one revolution before operating the priming lever.

FUEL TRANSFER PUMP

Fuel transfer pumps are automotive type, incorporating a diaphragm and check valves. These pumps are operated by a rocker arm which rides on an eccentric camshaft lobe. The diaphragm spring maintains required fuel pressure to the injection pump. Fuel pressure should be 3-1/4 to 4-1/2 psi.

If fuel does not reach the secondary filter, make the following checksbefore removing the pump.

1. Check the fuel tank and see that the shut-off valve is open.
2. Remove the fuel line from the transfer pump outlet and work the priming lever on the pump. Fuel should spurt out of the pump. If not, remove the pump for repair or replacement.

Testing: If the transfer pump delivers fuel, test it with a pressure gauge or manometer. Perform these tests before removing the pump from the engine. Remove the pump outlet and install the pressure gauge (Fig. 21).

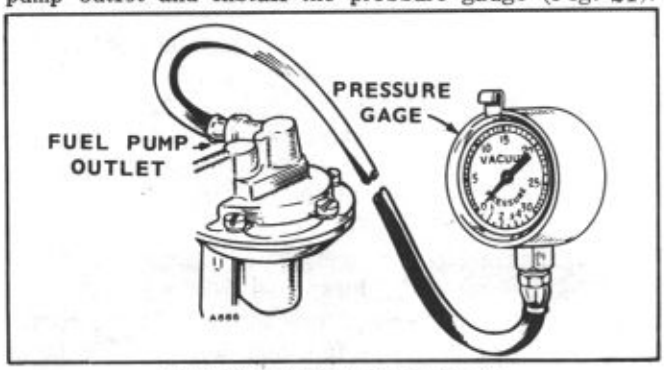


Figure 21. Fuel Pressure Gauge

Run engine at governed speed with fuel supplied by gravity feed. The pressure gauge should show 3-1/4 to 4-1/2 psi, with the gauge 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 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.

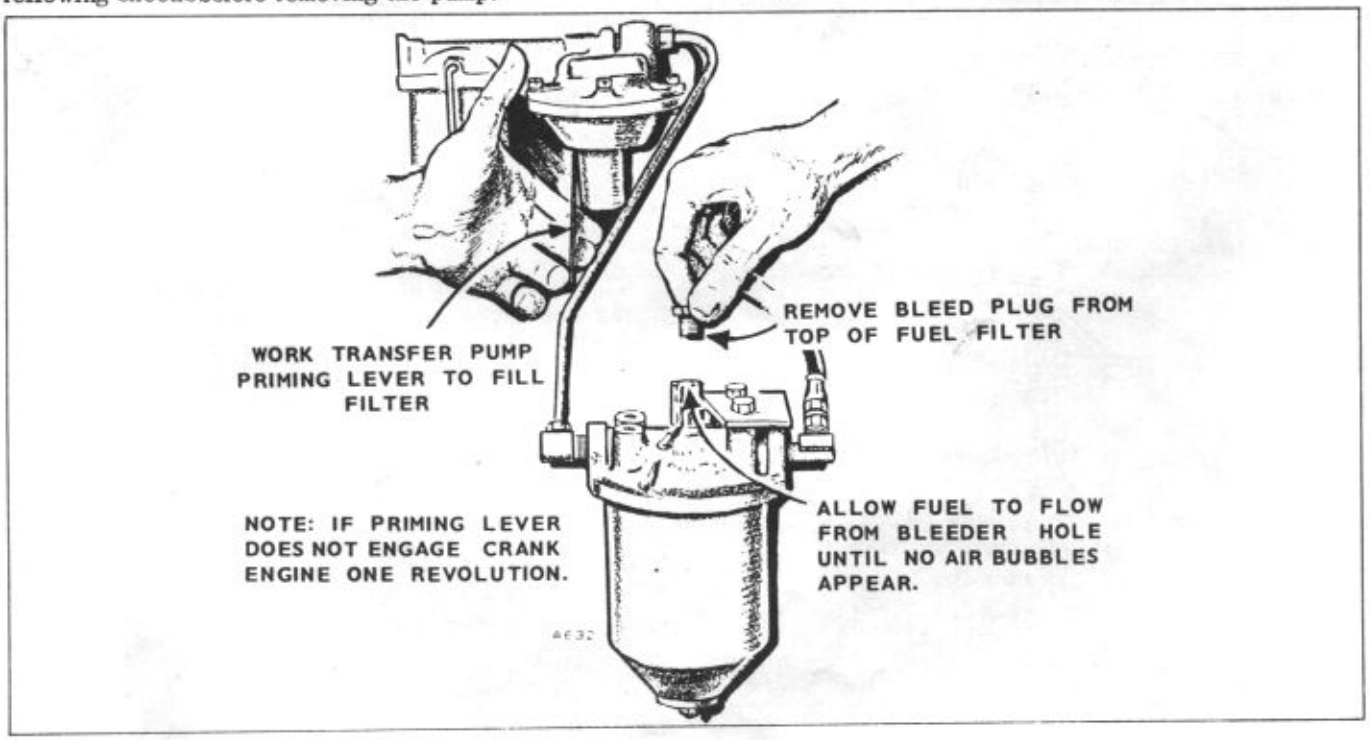


Figure 20. Bleeding Fuel System

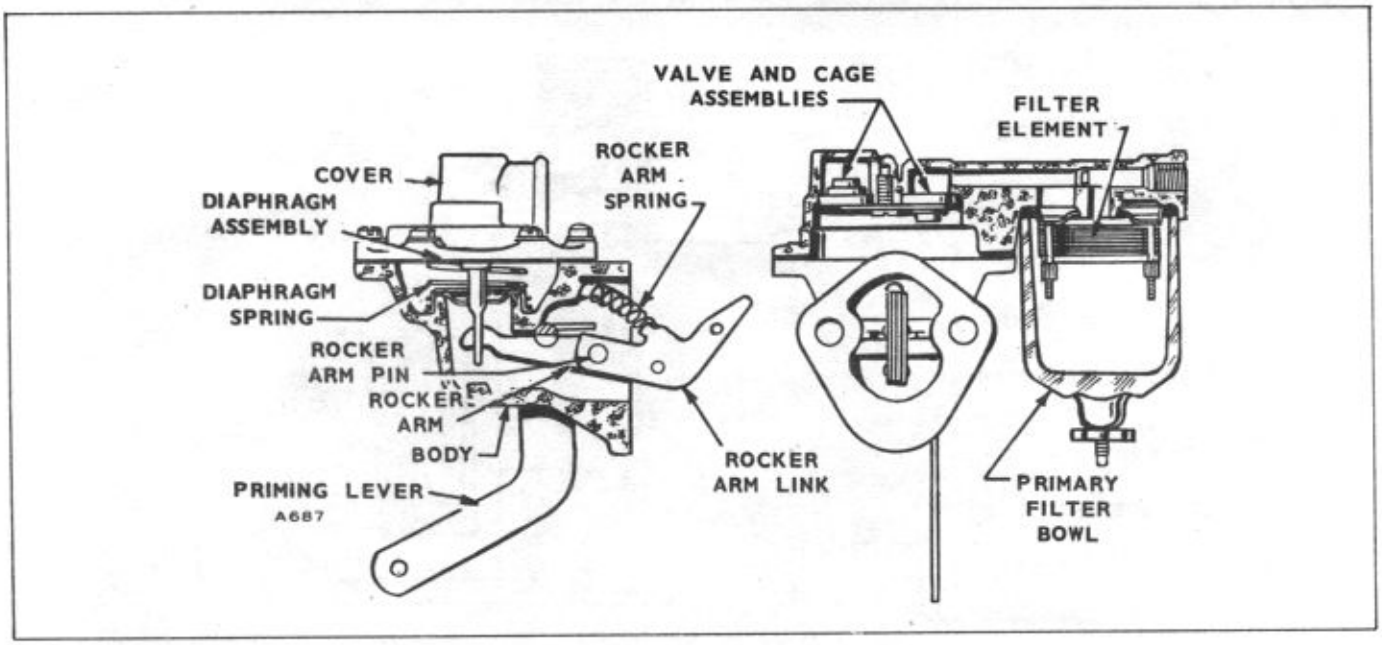


Figure 22. Fuel Transfer Pump

Figure 22 shows the fuel transfer pump. Refer to it for disassembly/assembly.

Fuel Pump Removal and Disassembly:

1. Remove the pump inlet and outlet lines. Remove the two cap screws holding the pump to the engine and lift it off.
2. Notch the pump cover and body with a file so they can be reassembled in the same relative positions and remove the six screws holding them together.
3. Tap the body with a screwdriver to separate the two parts. Do not pry them apart; this would damage the diaphragm.
4. Lift out the diaphragm assembly and diaphragm spring.

Repair: Transfer 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 fuel, check for diluted crankcase oil and replace.

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. Obtain replacement parts other than the repair kit from an original equipment parts distributor.

Assembly:

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 and hook it over the diaphragm pull rod. Align the rocker arm with the rocker arm pin hole and drive in the pin. The priming lever must be in its lowest position, as shown in Fig.21, when installing the rocker arm.

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

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 (if valves were removed.)

5. Assemble the cover to the body with notch marks lined up. Install the screws but do not tighten.

6. Push the rocker arm in full stroke and hold in this position to flex the diaphragm. **Important:** 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.

NOZZLE

The American Bosch injection nozzle is the conventional inward-opening, hydraulically-operated pintle type with adjustable opening pressure. It is factory adjusted to open at 1,900 to 1,950 psi. After several hundred hours of operation the nozzle pressure will decrease to approximately 1750 psi. Do not disassembly the nozzle or adjust nozzle pressure without proper test equipment. A nozzle pressure tester is essential to do this work.

1. PROTECTION COVER
2. PRESSURE ADJUSTING SCREW
3. GASKET
4. NOZZLE HOLDER
5. FUEL INLET STUD
6. PRESSURE ADJUSTING SPRING
7. LOCKNUT
8. SPINDLE ASSEMBLY
9. NOZZLE CAP NUT

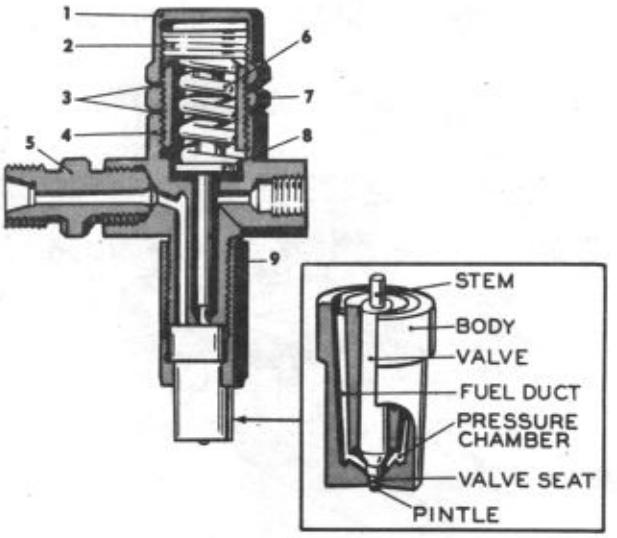


Figure 23. Injection Nozzle

OPERATING PRINCIPLE

Figure 23 shows the parts of the injection nozzle. Nozzle operation is as follows:

1. High pressure fuel from the injection pump enters the fuel inlet stud (5), flows down the drilled passage in the body of the nozzle holder (4).

2. Fuel enters the fuel duct and pressure chamber of the nozzle assembly. When the fuel pressure overcomes the pre-set pressure of the adjusting spring (6), the pintel is forced upward off its seat and a fine mist of fuel is injected into the pre-combustion chamber.

NOTE: Do not disturb the pressure adjusting spring (6) as it cannot be reset without proper equipment.

TROUBLE SHOOTING

If the cylinder is misfiring, it is reasonable to suspect that its nozzle is not operating properly.

Inspection: To inspect the nozzle spray pattern, remove the nozzle from the cylinder head. Crank the engine, let the nozzle spray into the air and watch the pattern. The spray should be cone shaped, with a solid-appearing center surrounded by cloudlike fog in which the spray is evenly atomized (Fig. 24). An apparent chattering of the nozzle is normal.

If streamers are visible, the pattern is badly distorted or the nozzle drips before it reaches opening pressure, it is defective, and must be cleaned or replaced.

Warning: *Do not let the nozzle spray against your skin. The fuel can penetrate flesh and cause a serious infection.*

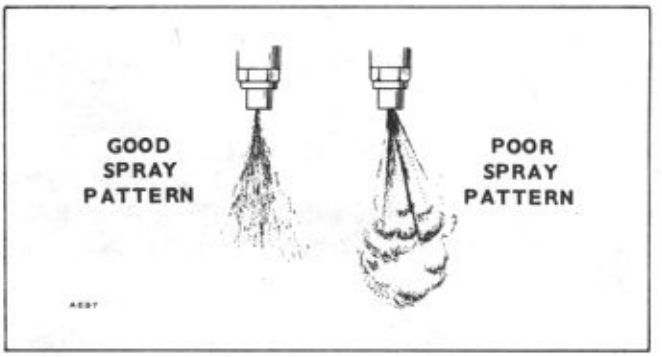


Figure 24. Nozzle Spray Pattern

If the spray pattern of the nozzle appears to be satisfactory, other areas should be explored, such as compression pressure, etc.

INJECTION NOZZLE TESTING AND ADJUSTMENT

Testing and adjustment can be performed only with a nozzle tester such as shown in Figure 25. Clean procedure is extremely important when disassembling injection equipment. Alwasys rinse in clean fuel before reassembling.

Opening pressure, leakage and spray pattern can be checked using this tester. If, when checking nozzles, any of the above malfunctions appear (except opening pressure), the nozzle valve and seat can be inspected with a magnifying glass for erosion, scoring, etc. If these conditions are present, and cleaning with solvent does not correct them, a new nozzle tip will be required. The opening pressure can then be set and spray pattern checked (See Fig. 24).

The nozzle opening pressure on a used nozzle should be set at 1750 psi.

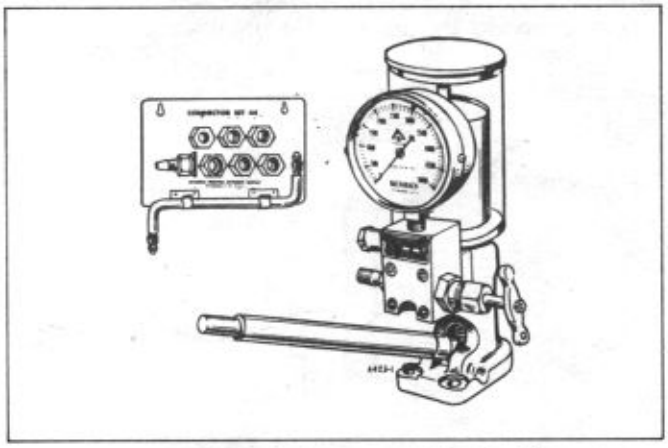


Figure 25. Nozzle Tester and Cleaning Kit

The nozzle tester (Part no. 420P184) and nozzle assembly cleaning kit (Part no. 420P208) are shown in the Onan Special Tool Catalog.

Never use hard or sharp tools, emery paper, grinding powder or abrasives of any kind.

Soak each nozzle in fuel to loosen dirt. Then clean the inside with a small strip of wood soaked in oil and the spray hole with a wood splinter. If necessary, clean the outer surfaces of the nozzle body with a brass brush, but do not attempt to scrape carbon from the nozzle surfaces. This can severely damage the spray hole. Use a soft oil-soaked rag or mutton tallow and felt to clean the nozzle valve.

Adjustment: To adjust the opening pressure, remove the nozzle from the engine. Remove the cap nut over the adjusting screw of the nozzle and install the nozzle on a static fuel nozzle testing fixture (it may be purchased from *Onan.*)Following the tester instructions, adjust the opening pressure to 1,750 psi by turning the adjusting screw (Fig.26). Turning it clockwise increases the pressure and turning counterclockwise decreases it. *Do not* try to adjust the pressure without a testing fixture.

Disassembly: When removing and disassembling nozzles, separate and label all nozzle components. Never interchange components between nozzles.

1. Remove nozzle assembly from the engine and remove the fuel inlet and return lines.
2. Clamp the nozzle holder body in a vise and remove the nozzle cap nut and nozzle.
3. Install the nozzle cap nut loosely to protect the lapped surface for the holder body.
4. If necessary to further disassemble the nozzle, reverse the pressure adjusting screw and lift out the spring and spindle assembly.

Cleaning:

Cleanliness is essential in cleaning nozzles. Work only in a clean room, on a clean work bench. Keep a pan of clean diesel fuel handy and have a supply of clean, lintfree wiping rags available.

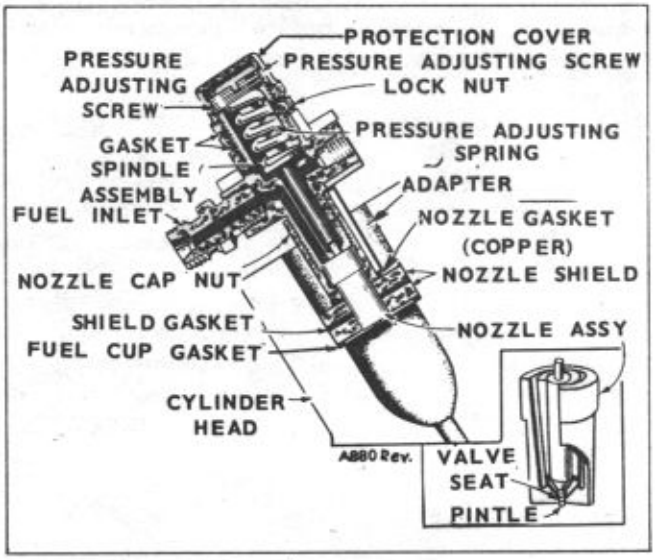


Figure 26. Nozzle Assembly

Important: *Onan offers a kit to aid nozzle cleaning. See the Onan Special Tool Catalog.*

Repair: If cleaning will not eliminate a nozzle defect, replace the nozzle or take it to an authorized service station. Do not attempt to replace nozzle parts, except for the nozzle and pintle assembly.

Assembly: Rinse both the valve and nozzle thoroughly before assembly and coat with oil. The valve must be free in the nozzle. Lift it about 1/3 out of the body. It should slide back to its seat without aid when the assembly is held at a 45° angle. If necessary, work the valve into its body with clean mutton tallow.

1. Remove all pressure on the nozzle spring by adjusting the pressure adjusting screw.
2. Clamp the nozzle holder body in a vise.
3. Set the valve in the body and set the nozzle over it.
4. Install the nozzle cap nut loosely.
5. Place the centering sleeve over the nozzle (Fig.27). for initial tightening. Then remove the centering sleeve to prevent it from binding between nozzle and cap nut and tighten the nozzle cap nut to specified torque.

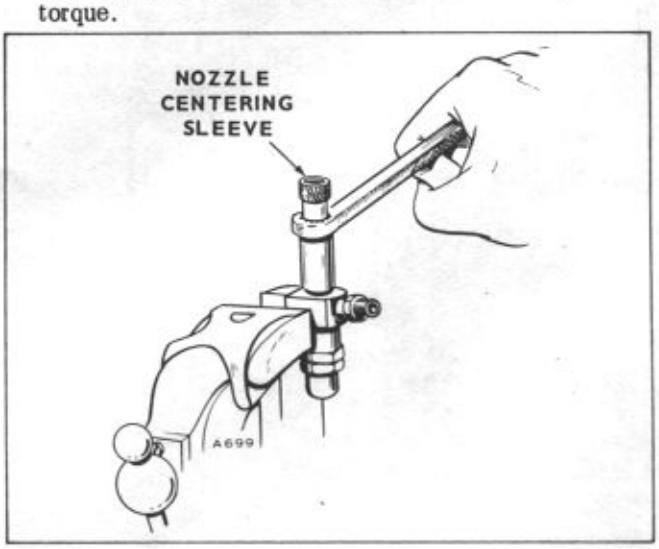


Figure 27. Tightening Nozzle Cap Nut

Installation: Before installing the injection nozzle in the engine, thoroughly clean the mounting recess.

A dirty mounting surface could permit blow-by, causing nozzle failure and a resulting power loss.

1. Install a new heat shield to head gasket in the cylinder head recess.
2. Install the heat shield, a new nozzle gasket and the nozzle adapter.
3. Insert the nozzle assembly into the recess. Do not strike the tip against any hard surface.
4. Install the nozzle flange and two cap screws. Tighten the cap screws alternately to avoid cocking the nozzle assembly. Tighten each cap screw to 20-21 ft. lbs.

INJECTION PUMP

The American Bosch Model PLB single-outlet pump is mounted on the left side of the engine crankcase. The camshaft operates the pump plunger, producing pressure to deliver fuel and open the injection nozzle. A control sleeve in the pump meters fuel by controlling the length of time the plunger port is closed in each stroke.

1. Model PLB-Figure 28 illustrates the injection pump cross section. When the piston is nearing the end of the compression stroke, the plunger has moved upward (lower line, Figure 28) closing the ports trapping fuel and forcing the delivery valve off its seat. The fuel flow is up past the delivery valve and delivery valve spring to the high pressure line leading to the injection nozzle. Injection continues until the helix passes and spills, which drops the pressure rapidly. Delivery valve action is to aid in dropping line pressure and keep fuel from draining out of the line, allowing a void between the injection pump and nozzle which would cause the nozzle not to open on the next firing cycle.

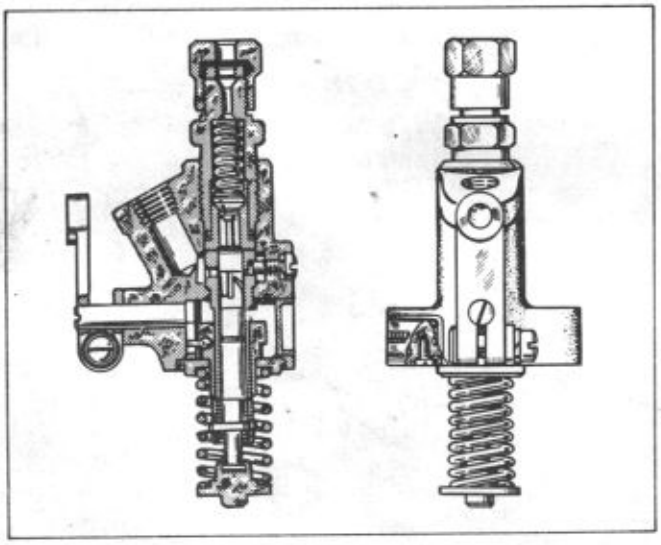


Figure 28. PLB. Injection Pump

Figure 29 shows the helix on the plunger.

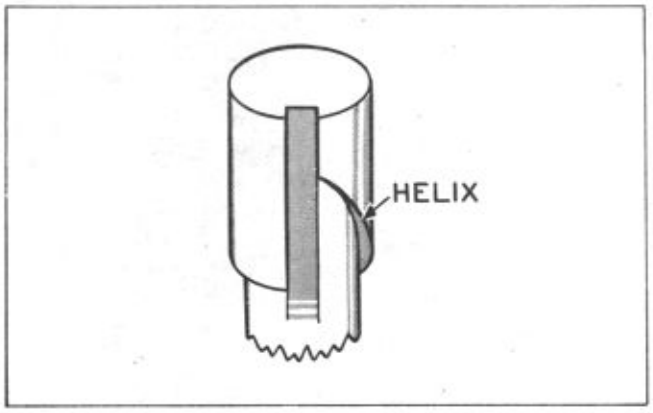


Figure 29. Plunger Helix

The amount of fuel delivered is controlled by rotating the plunger, thus changing the length of its effective pumping stroke. The distance the plunger travels is always the same because the cam lift never varies.

ONAN discourages field repair of the injection pump because of the exceptionally close tolerances between parts, and the specialized equipment necessary for repair. The injection pump is an expensive part of the unit and even a particle of dirt as fine as talcum powder could score its working surfaces. If the rest of the fuel system is in working order and fuel delivery is abnormal, remove the pump for replacement or repair. American Bosch maintains a world-wide repair service for these pumps.

Removal: Remove the pump inlet and outlet lines. Remove the two capscrews holding the pump to the engine and lift it off. Don't lose the shims. They time the injection pump to the engine. Cap all openings in the pump and fuel lines to keep dirt out of the fuel system.

Timing: Pump timing procedures determine the correct thickness of shims between pump and engine so port closing occurs at 17°BTC (before top center), and is marked PC on the flywheel. The control sleeve position controls port opening and is, in turn, controlled by the throttle setting.

Repair: Most fuel system troubles are not due to a faulty injection pump. Test the rest of the fuel system before condemning the injection pump.

PUMP TIMING

The most accurate method of injection pump timing is with a depth micrometer (Method 1). However, if a depth micrometer isn't available, time it by Flowing the pump (Method 2).

NOTE: The injection pump must be timed on the compression stroke, not the exhaust stroke.

METHOD 1. DEPTH MICROMETER METHOD

1. Install pump tappet in its recess and position flywheel on the port closing mark (PC) of the compression stroke.

2. Using a depth micrometer, measure the distance from the pump mounting pad on the crankcase to the tappet center (Fig. 30).

3. Subtract from the port closing dimension of the pump (1.670 in.) the depth obtained in Step 2. The result is the thickness of shims necessary to correctly time the pump.

NOTE: Shims thickness may vary from .006 in. to .052 in. If it does not fall within these limits, check camshaft and tappet for excess wear or improper assembly.

4. Select the correct shims for the required thickness.

5. Install the pump.

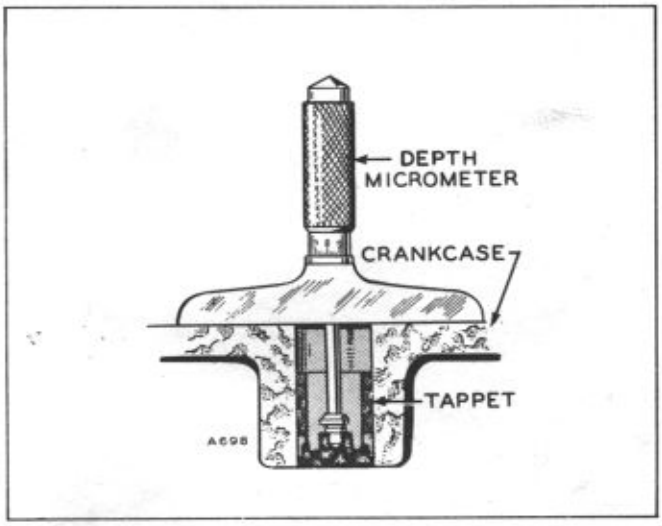


Figure 30. Depth Micrometer

METHOD 2. FLOWING THE PUMP

1. Install pump with .006 in. shims between pump and pad.

2. Loosen the delivery valve holder to relieve pressure on spring. (Fig. 31).

3. Rotate the flywheel to about 15° before the port closing (PC) point. Blow in the pump inlet and rotate the flywheel slowly clockwise until air stops coming out of the pump outlet. This is the port closing point.

4. Measure the distance from the point where port closing occurs to the PC mark on the flywheel. The Shim Thickness Chart Shows the thickness of shims to be added.

5. Install the pump.

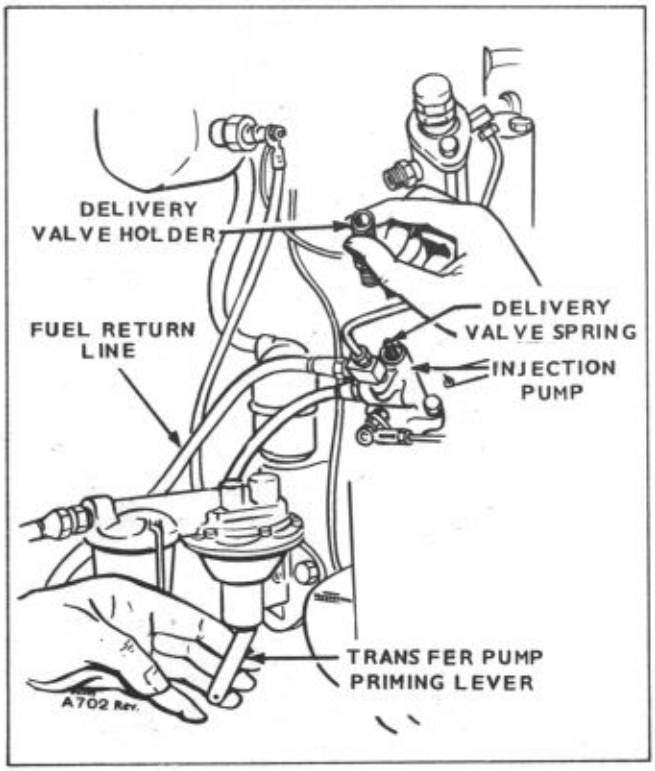


Figure 31. Loosening Delivery Valve Holder

METHOD 2. SHIM THICKNESS CHART

Distance Measured Step 4	Add These Shims	Distance Measured Step 4	Add. These Shims
.1"	.004	.7"	.028
.2"	.008	.8"	.032
.3"	.012	.9"	.036
.4"	.016	1.0"	.040
.5"	.020	1.1"	.044
.6"	.024	1.2"	.048
		1.3"	.052

INSTALLATION: Prior to mounting the injection pump to the cylinder block, follow steps 1 through 3.

1. Slide the shim or shims (Using proper thickness of shims for correct timing) over the pilot until they are flat on the pump flange (Fig. 32).

2. Dip the Seal ("O" ring) in engine lubricating oil.

3. Slide the seal over the pilot until tight against the shim or shims.

With shims and seal in place insert the pump into cylinder block mounting pad, and insert mounting screws. Torque the mounting screws (tighten alternately) to 18-21 ft. lbs.

Install the fuel inlet line and governor linkage. Bleed the pump and then install the fuel outlet line.

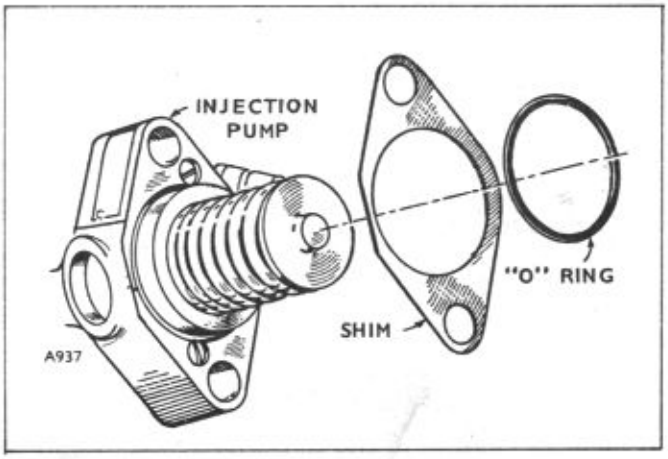


Figure 32. Shimming The Pilot

OIL SYSTEM

These engines have pressure lubrication to all working parts. The oil system includes oil intake cup, gear-type oil pump, by-pass valve, oil pressure gage, full-flow oil filter, and block passages and drillings to deliver oil throughout the engine (Fig.33). Oil is held in the oil base, drawn by the pump and delivered through the oil filter. Lines leading to the rocker housing, drillings through the block to crankshaft bearings and to front camshaft bearing, crankshaft passages to connecting rod bearings, and connecting rod passages to piston pin bushings complete the oil system plumbing.

The crankcase breather is included in this system because it aids oil consumption control.

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

MAINTENANCE

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

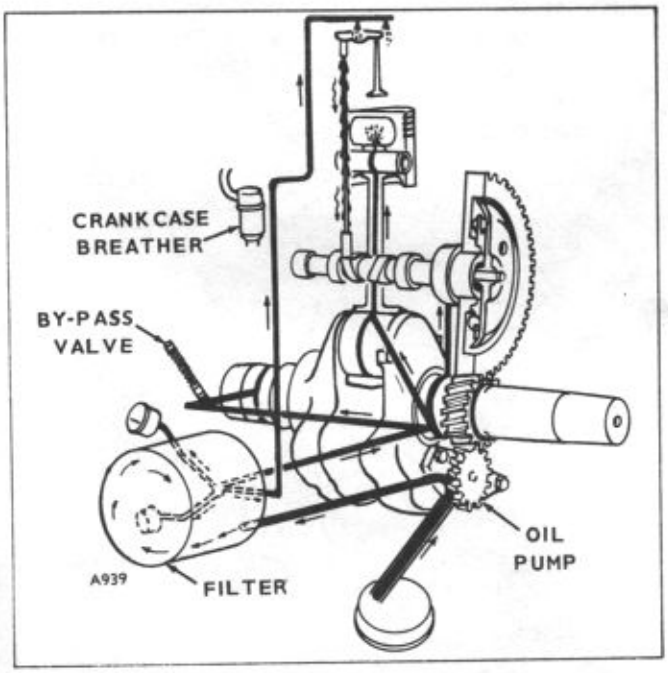


Figure 33. Pressure Oil System.

OIL PUMP

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

Removal:

1. Remove the gear cover and oil base. (See Engine Disassembly).
2. Unscrew the intake cup from the pump.
3. Remove the crankshaft lock ring and gear retaining washer.
4. Loosen the two cap screws holding the pump and remove pump.

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 cap screws 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 assembling the pump.

Installation: Before installing, fill the pump intake and outlet with oil to be sure it is primed. 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.

BY-PASS VALVE

Located on the outside of the rear bearing plate, the by-pass valve (Fig.34) controls oil pressure by allowing excess oil to flow directly back to the crankcase. Normally the valve begins to open at about 25 psi. It is not adjustable and normally requires 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 values given below:

Plunger Diameter	.3365 in. to .3380 in.
Spring Free Length	.2-5/16 - 1/16 in.
2.25 lb ± .11 lb at 1-3/16 in. (Compressed)	

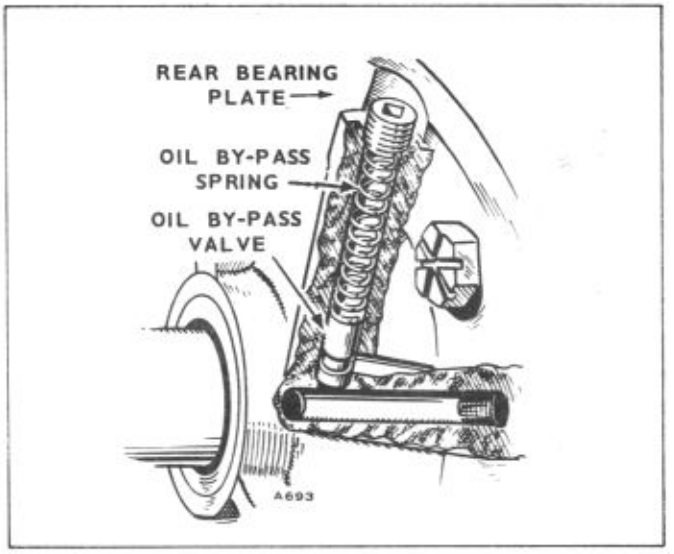


Figure 34. By-Pass Valve

OIL LINES

At overhaul time the rocker box oil line should be flushed with fuel and a fine wire used to clean the small holes (Fig.35). 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.

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

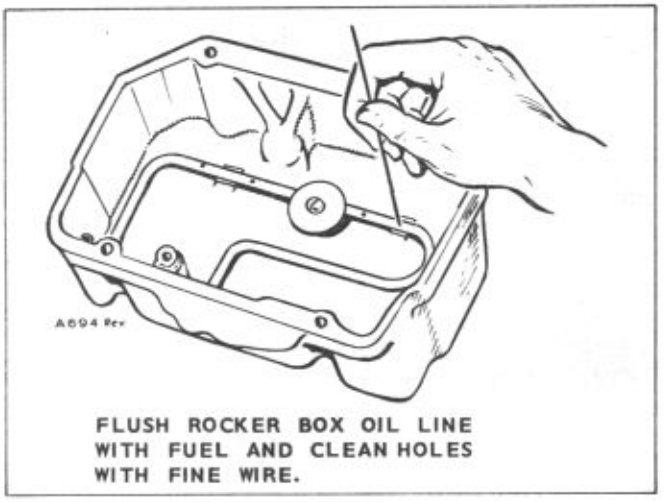


Figure 35. Cleaning Rocker Box Oil Line

GAUGE

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

OIL PRESSURE SWITCH

The non-adjustable oil pressure switch controls the decompression solenoid in the starting system, allowing it to energize only when the switch closes. This allows the engine to build up speed during starting before compression occurs. The switch closes at about 5 psi under increasing oil pressure.

NOTE: *This switch is not designed to be used as low oil pressure protection. It will not protect the engine against slowly decreasing oil pressure. The engine can be equipped with low oil pressure protection. See Low Oil Pressure Circuit. If the decompression solenoid won't energize, check switch operation by shorting oil pressure switch terminal to ground when engine has built up speed during starting. The solenoid should energize immediately and the engine should start.*

CAUTION: *If the engine starts, check immediately for oil pressure and shut the engine down if oil pressure doesn't build up within a few seconds. In this case it is lack of oil pressure that is causing faulty operation, not the switch.*

Emergency Relay (Time Delay): For plants with optional low oil pressure cut-off, this relay is supplied loose and mounted by customer. The relay used in conjunction with a 1-ohm, 10-watt resistor provides a 15- to 30-second time delay when starting, so the engine can build up sufficient oil pressure to open the low oil pressure cut-off switch. When oil pressure drops below 14 ± 1 psi, the relay stops the engine and prevents it from restarting until the reset button is pushed.

Centrifugal Switch: For plants with standard low oil pressure cut-off, this switch is mounted on the gear cover backplate and operates directly off the camshaft gear. Normally open, the switch closes when engine speed builds up to about 900 rpm. This allows engine to build up sufficient oil pressure and unit can be started.

For correct operation maintain the switch gap at .020 in. See Figure 36.

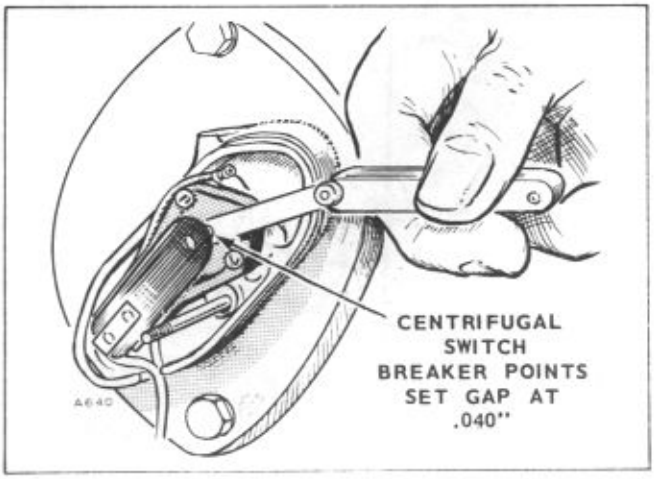


Figure 36. Breaker Points

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

DISASSEMBLY

Figure 37 will aid in disassembling the switch.

1. Disconnect the battery to prevent accidental shorts.
2. Remove the switch cover, revealing the point set.
3. Remove the point set assembly by removing the screws holding it to the plate. Pull out the plunger and plunger diaphragm.
4. Remove the centrifugal switch plate, revealing the cam and weight assembly.
5. Pull out the cam and weight assembly.

Caution: *Be careful not to lose the spacer mounted on the gear shaft behind the gear.*

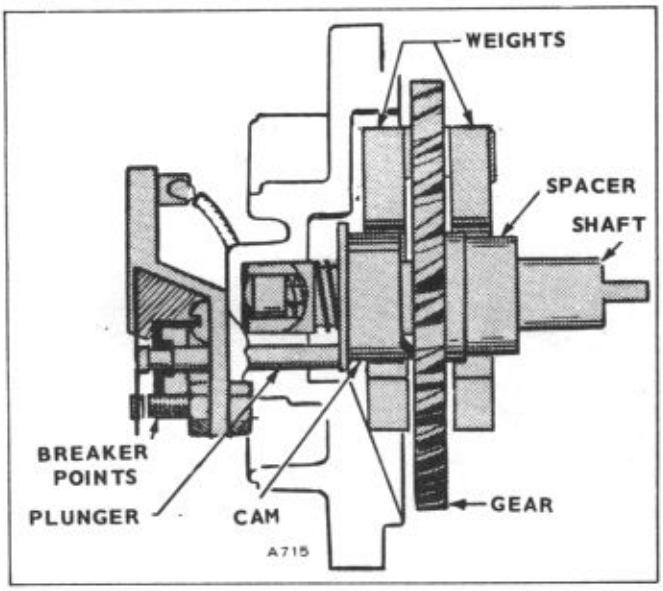


Figure 37. Centrifugal Switch Assembly

REPAIR

Thoroughly clean the gear and cam assembly, the bearing surfaces in the gear case and breaker plate, and oil trickle holes to these bearings. Check the oil spray hole in the gear case to be sure it is open.

Check for wear in the spacer, fibre plunger and the spring loaded shaft plunger. The spacer must be at least .35 in. long. If not, replace it immediately. Push the weights outward; they should move freely. If they don't, or if any part of the assembly is sticking or worn, replace the cam and weight assembly. If the cam is loose on the gear shaft, replace the assembly.

If the breaker gap cannot be maintained at .040 in., check the fibre plunger and spacer for wear.

ASSEMBLY

1. Install the spacer on the shaft and install the shaft assembly into the gear case. Match it with the cam gear.
2. Install the spring and plunger into the end of the shaft.
3. Install the breaker plate.
4. Install the plunger and diaphragm.
5. Install the breaker points on the breaker plate and set the gap at .040 in..
6. Install switch cover and reconnect battery.

CRANKCASE BREATHER

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

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 disk toward the engine. Figure 38 shows the crankcase breather.

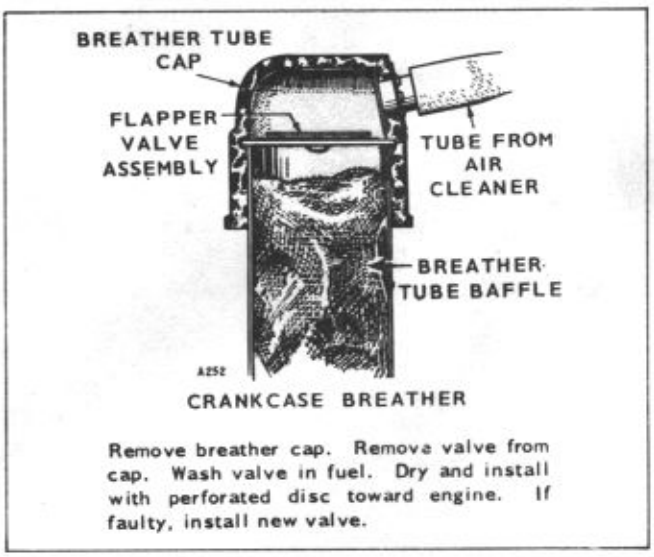


Figure 38. Crankcase Breather

Crankcase Breather Valve: This valve requires cleaning only. To clean, remove hose clamp, breather hose, breather cap clamp, and insulator valves (air cooled units only) to release breather cap and valve assembly. Wash the baffle in fuel, and re-install. Figure 39 shows the breather valve assembly. (Used on Spec "R" & later models).

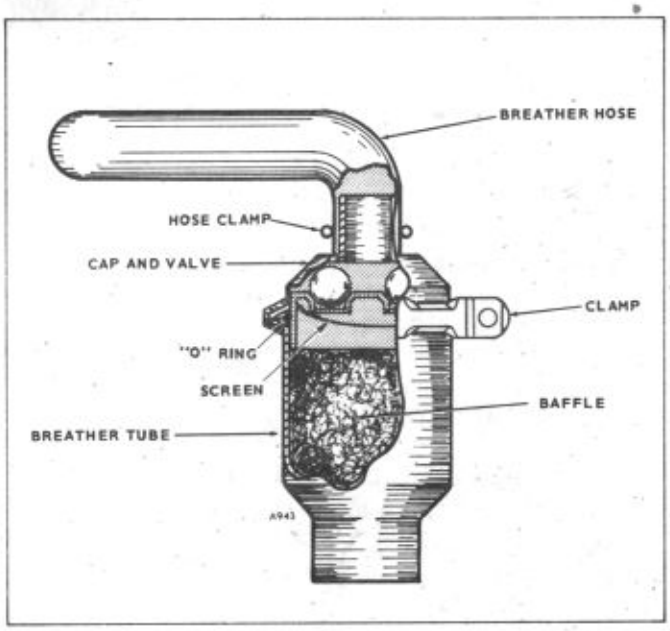


Figure 39. Breather Valve Assembly

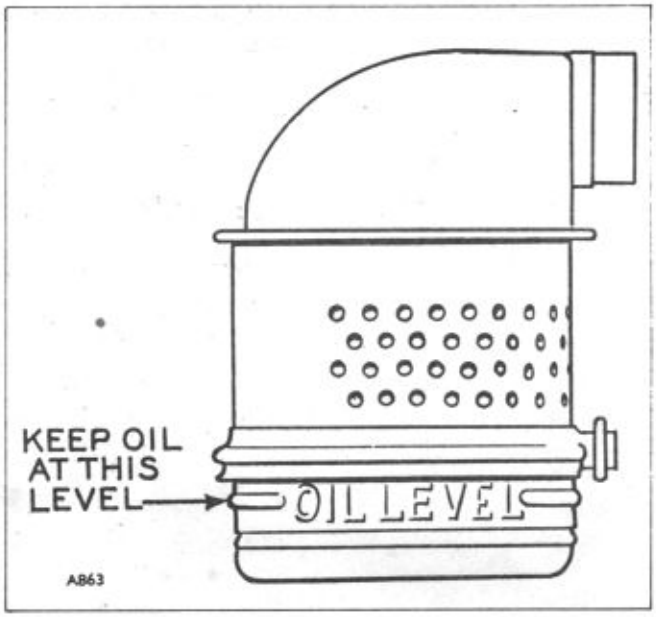


Figure 40. Oil Bath Air Cleaner

OIL BATH AIR CLEANER (Optional)

The optional Oil Bath Air Cleaner is used when the plant must be operated under very dusty or dirty conditions. It provides extra protection for the engine under these circumstances. The oil cup should be kept clean and filled as near as possible to the indicated level with fresh oil. Use the same SAE number as is in the crankcase. Do not overfill! Never allow the level of dirt accumulated in the bottom of the cup to reach one-half inch in depth. If the oil appears too thick or heavy to spray or circulate properly, change oil. The wire screen filtering element should need very little attention when the proper grade of oil is being used at the proper level. However, the bottom of the screen should be inspected whenever the cup is removed, and any accumulation of foreign material should be removed.

GOVERNOR SYSTEM

The purpose of a governor is to maintain a nearly constant engine speed during changes in power demands. A governor responds to these power demand changes by varying the throttle position.

GOVERNORS

The constant speed governor (Fig.41) maintains engine speed up to 1800 rpm. The speed-sensing device is a ball and cup mechanism on the camshaft gear. A yoke, resting on the cup, is connected to the governor arm which, in turn, is connected to the throttle lever. Any change in engine speed is transmitted from the cup to the yoke and on to the throttle.

Tension on the governor spring determines the speed at which the engine is governed. A stud screwed into the spring is used to vary the number of effective coils for getting the desired sensitivity - the speed drop from no load to full load (prior to Spec "R").

MAINTENANCE

Periodically lubricate the governor linkage with lubricating graphite or light non-gumming oil. During servicing, inspect the governor linkage for binding, or excessive slack or wear.

ADJUSTMENT

Adjust engine speed (rpm) by turning governor speed adjusting nut (Fig.42). Turn nut clockwise to increase speed, counterclockwise to decrease speed.

Sensitivity (no load to full load speed drop) is adjusted by turning the sensitivity adjusting ratchet nut accessible through hole in side of blower housing. If speed drops too much when full load is applied, turn the ratchet nut counterclockwise to increase spring tension and compensate for reduced rpm. An over-sensitive adjustment, approaching no speed drop when load is applied,

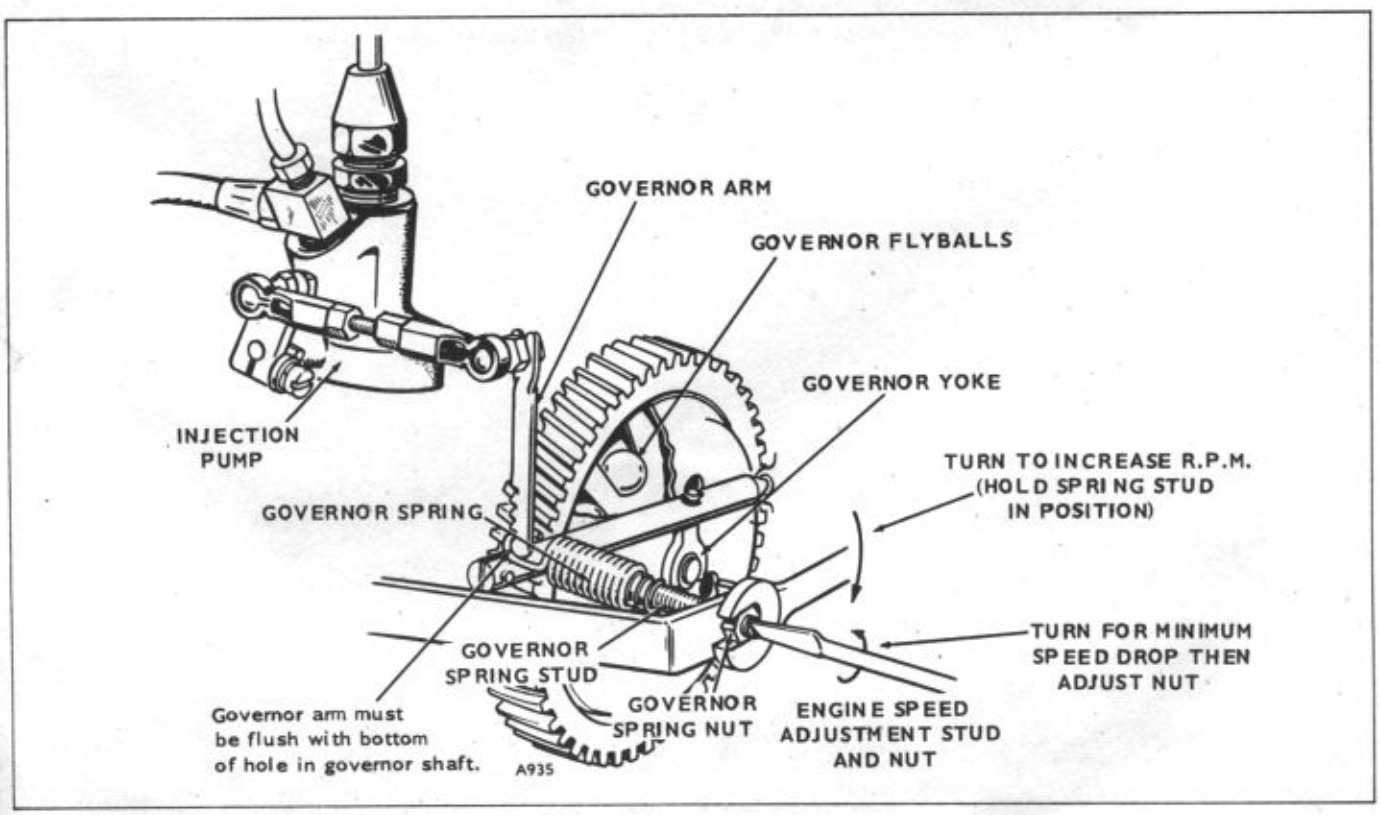


Figure 41. Governor Assembly (Prior to Spec "R")

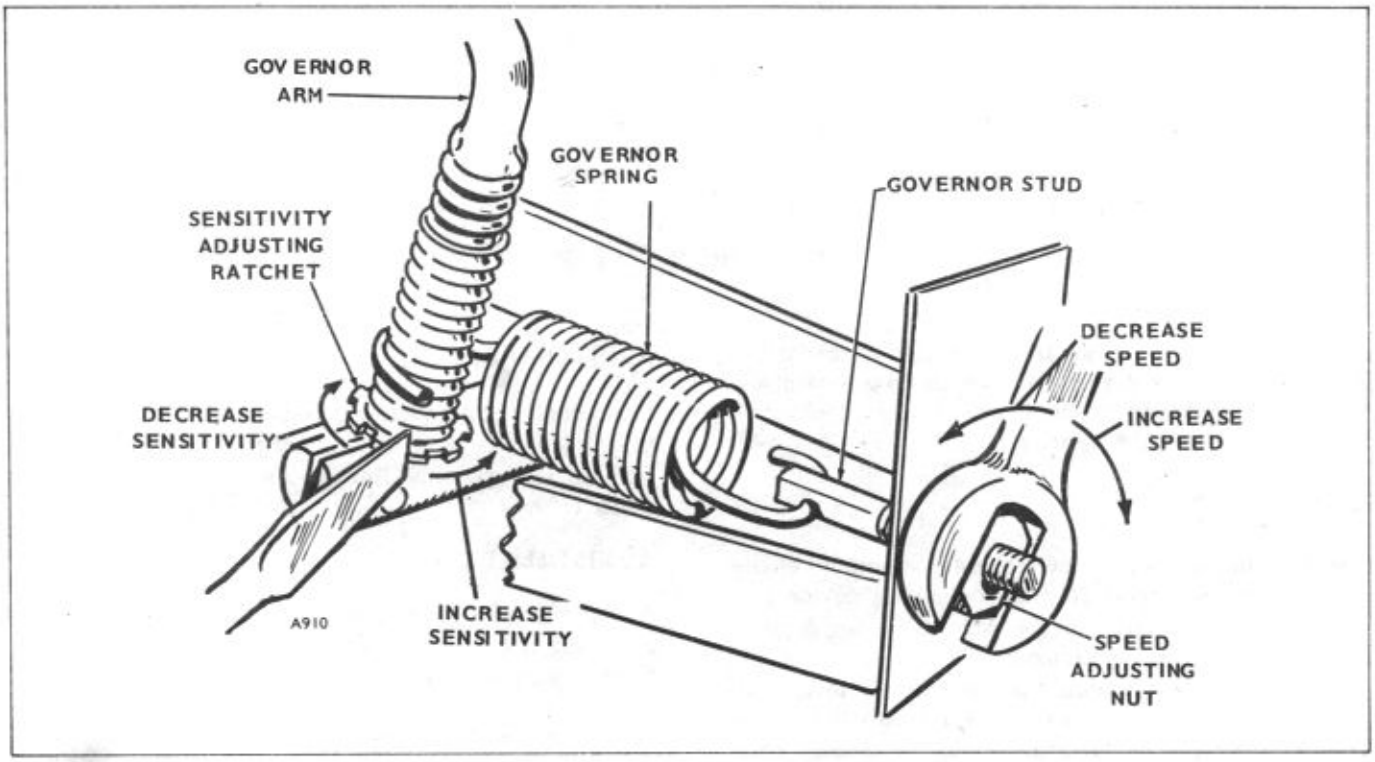


Figure 42. Governor Adjustments

may result in a hunting condition (alternate increase and decrease in speed). Adjust for maximum sensitivity without hunting. The use of a reed-type frequency meter will give the most accurate results. A mechanical tachometer can be used on the generator thru stud, but this is not generally as accurate. It should be possible to adjust for a sensitivity of less than 3 cps, and 2 cps is usually attainable.

After adjusting speed and sensitivity, secure speed stud lock nut and replace dot button in blower housing (air cooled units only).

The governor cup disassembly and assembly is discussed in Engine Disassembly.

GENERATOR, REVOLVING ARMATURE

The revolving armature generator is used on DJA 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. This section covers ac plants and serves as a guide for dc battery charging plants.

MAINTENANCE

Normal maintenance procedures include periodic inspection of the armature, ball bearing, collector rings and commutator, and the brushes, normally every 400 hours.

Brushes: To examine the brushes, remove the endbell band and cover (Fig. 43). Replace the brushes when they wear to the Onan name and part number. At this point there is about 5/8 in. of brush remaining. If the brush is not replaced, the slip rings or commutator will be damaged. All brushes must have at least a 50 percent seat. If they don't, sand as illustrated in Fig. 44.

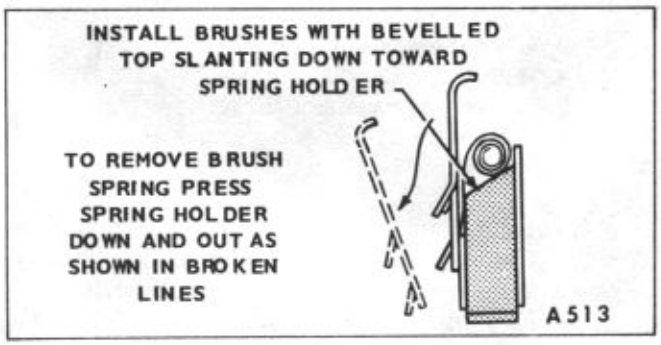


Figure 43. Brush Installation

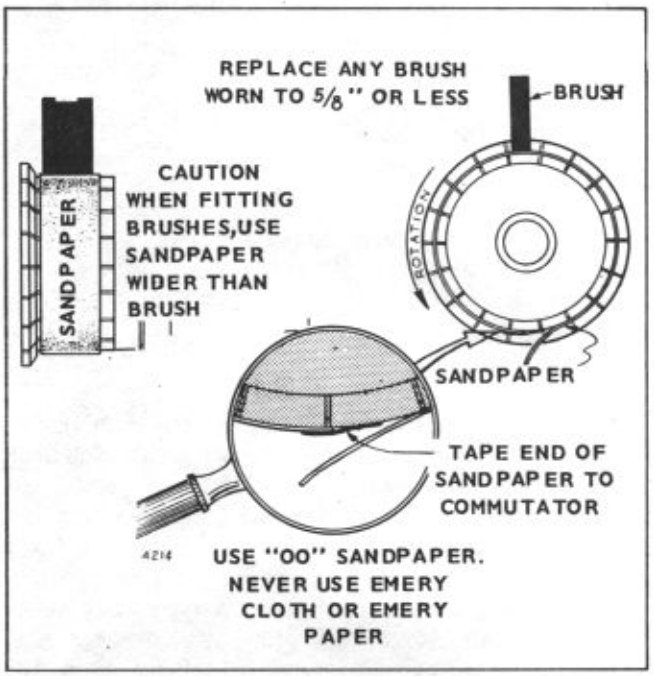


Figure 44. Seating Brushes

Generator Bearing: The generator bearing is prelubricated for its life and sealed. It requires no servicing.

Commutator And Collector Rings: The commutator must be clean and in good condition. If it is dirty, clean with paper or cloth. Do not use a cleaning solvent because it will destroy the film.

Check the mica between the commutator bars. If it is above the level of the bars, undercut it.

Anti-Flicker Points And Resistor: 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 points, crank the engine until the points are at full separation. Adjust the stationary contact to .025 in. gap. Retighten and check the gap. When breaker plunger guide and "O" ring are removed, dip "O" ring in oil before reinstalling. Tighten guide to 25 to 28 foot pounds. Figure 45 shows breaker point adjustment.

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 resistor for minimum flicker with the average load on the plant.

TESTING AND REPAIR

Most of the following tests can be performed without disassembling the generator. Clearly mark all leads disconnected, together with the point taken from.

Armature Testing: Before testing, remove all brushes from their holders.

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

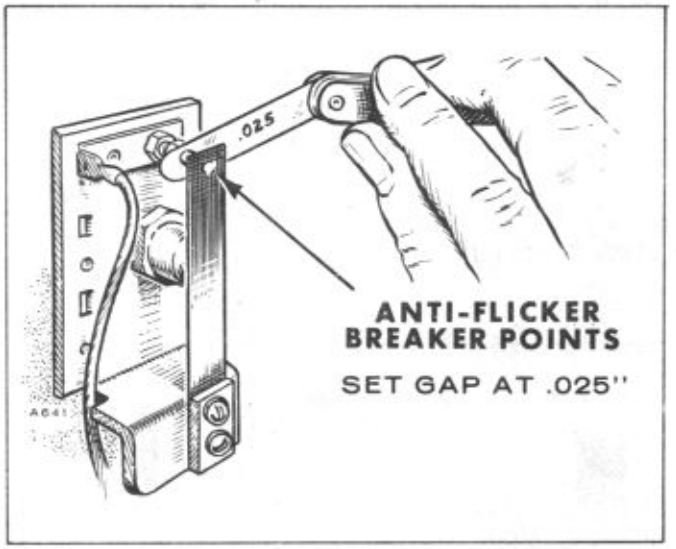


Figure 45. Setting Breaker Points.

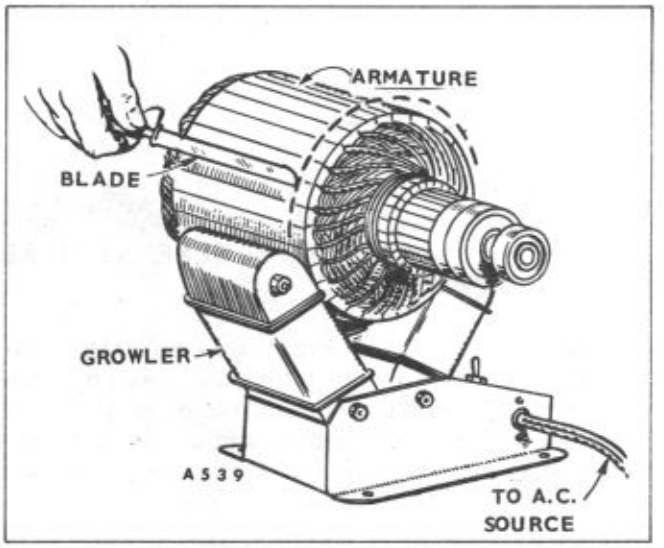


Figure 46. Testing With Growler

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

3. To test the armature for an open circuit in the dc windings, check continuity between all adjacent bars of the commutator. Open circuit problems can be seen, because they cause bar burring, arcing and poor cranking.

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

4. This test can only be performed with the generator disassembled and requires a growler. To test for shorts in the dc winding, place the armature in the growler. Operate the growler and pass a steel strip back and forth over and above the armature windings (Fig.46). 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.

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

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

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 and replace the defective coil.

1. With an ohmmeter or continuity lamp, check for grounding to the generator frame. Touch one prod to the coil terminals and the other to a clean, paint-free part of the frame. If grounding is indicated, separate the windings and check each.

2. Check the field winding resistance from F_2 in the control box to the F + connection on the generator (F + is connected to the positive brushes). Resistance should be 1.46 ohms on standard ac models. Other models will have the following resistances:

   2.06 ohms for 24-volt cranking
   3.80 ohms for 32-volt cranking
   0.80 ohms for transistor flicker
   5.14 ohms for 24-volt battery charger
   8.8 ohms for 32-volt battery charger

   If the windings are warm from running, the resistance will be slightly higher. If the resistance is high, check for an open circuit in one of the parallel windings, step 3, otherwise go to step 4.

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+.

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.47). Be careful not to injure the bars. After undercutting, remove any burrs formed on the bars. Cut the mica to about 1/32" under 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. Do not use turning centers on shaft because they probably have been damaged and are no longer true centers. Commutator and slip ring run-out should be less than .002 in..

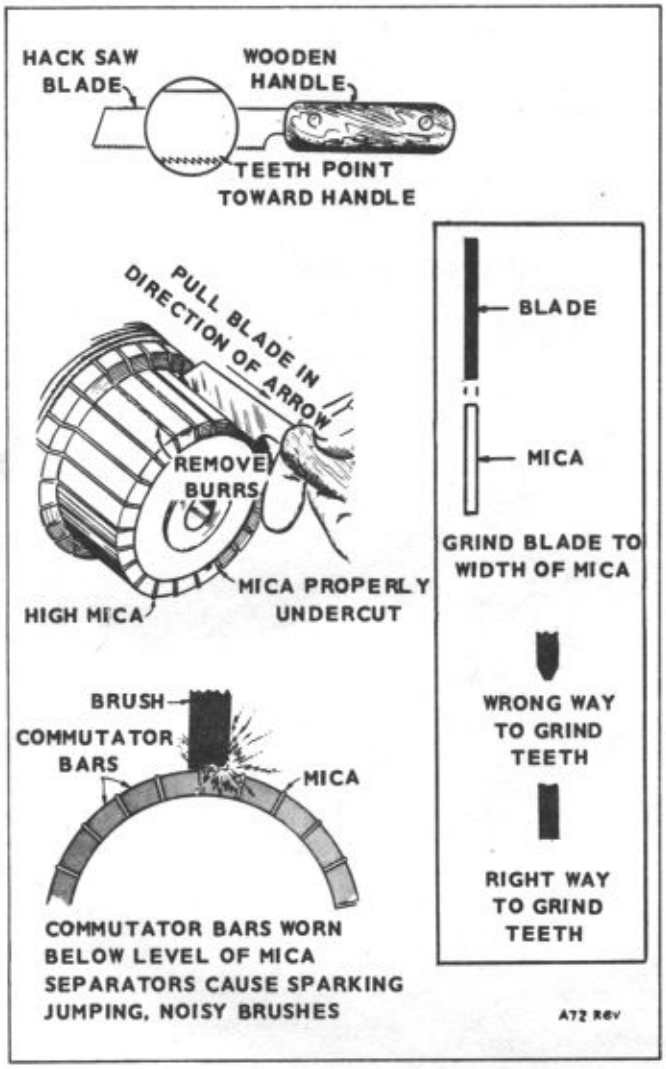


Figure 47. Undercutting Commutator Mica

Collector Rings: If the collector rings are grooved, out-of-round or rough, so good brush seating can't be maintained, remove the armature and refinish the rings in a lathe. Shield the ball bearing during refinishing.

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.

Brush Rig Alignment: The brush rig must be aligned in the neutral position. If it isn't sparking will occur. Normally the neutral position is identified by a yellow mark extending from the brush rig to the endbell. If the mark is lost, or a new brush rig installed, follow these instructions to find the neutral position:

1. With the end cover and band removed to allow access to the rig,
2. Start the unit.
3. Apply full rated load.
4. Allow unit to reach full operating temperature.
5. Inspect brushes; they must be seated across the brush face if we are to have an accurate setting.
6. Connect a voltmeter across the dc terminals.
7. Loosen the brush rig mounting screws and rotate the rig to get the highest voltage with full load.
8. Rotate the rig in one direction until the voltmeter reading starts to decrease. Mark this point. See Fig. 48.
9. Repeat Step 8 in the other direction.
10. Half the distance between the two marked points is the neutral position.

NOTE: If a voltmeter is not available, use the above procedure, but mark the point where arcing begins in each direction and set it at one half the distance. (This procedure is not as accurate as the procedure above.)

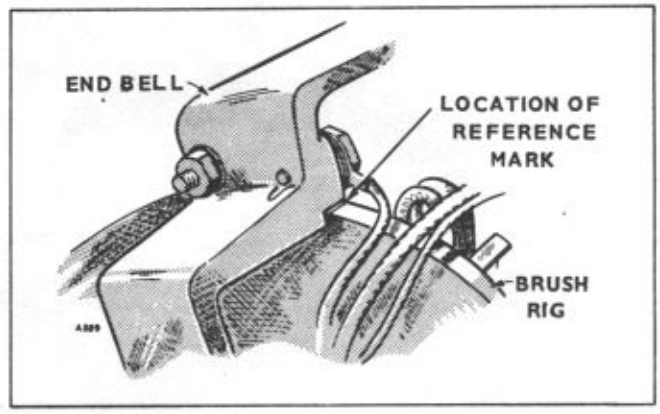


Figure 48. Brush Rig Alignment

GENERATOR ASSEMBLY PROCEDURES

WARNING

DO NOT tighten the armature or rotor thru stud before mounting the frame and bearing support. If this procedure is not followed, misalignment may occur, shortening the life of the rear main and outboard bearings. Also, cranking torque requirements could be doubled, resulting in damage to the commutator and dc brushes on revolving armature units.

Disassembly

1. The first step is to remove generator band and end bell cover. Remove all brush springs and lift the brushes from their holders.

2. Remove generator through-stud nuts. Hold both the end bell and frame assembly, since they are separate parts, and remove them as one assembly from the adapter. Screwdriver slots in the adapter provide for prying the frame loose. Be careful not to let the frame assembly rest or drag on the armature.
3. Remove baffle ring from adapter. Turn armature through-stud nut out to the end of the through stud. While pulling the armature outward with one hand, strike a sharp end-wise blow on the nut with a heavy soft-faced hammer to loosen the armature. If the armature does not come loose, strike the armature with a sharp downward blow in the center of the lamination stack with a lead or plastic hammer. Rotate the armature and repeat. Be careful not to hit the collector rings, commutator, bearing or windings.
4. Upon disassembly, all parts should be wiped clean and visually inspected.

Assembly

1. Clean and inspect all mating surfaces. Surfaces should be free of nicks and dirt.
2. Clean mating area between the generator shaft and the engine crank shaft with a thin film of lubricating oil molycoat, or equal.
3. Assemble the armature thru stud to the engine crankshaft with required torque.
4. Check to see that the key is in the crankshaft.
5. Slide armature over the thru stud and onto the crankshaft, being careful not to let the weight of the armature rest on the thru stud.
6. Install baffle ring, when used.
7. Assemble generator thru studs to the adapter with required torque.
8. Install the frame and bearing support. Tighten frame to required torque. NOTE: On "J" series with battery charging, make certain the B lead is run through the grommet in baffle ring and out the air discharge opening in the adapter.
9. NOW torque down the armature thru-stud nut. Because you have tightened the frame and bearing support before tightening the armature, you have the armature and frame in alignment.
10. Tap the bearing support in the horizontal and vertical plane with a lead hammer to relieve stresses on the components and then recheck the torque.
11. Reconnect the decompression solenoid and other leads to the engine.
12. Reinstall the battery cables.
13. Align the brush rig.

CONTROL SYSTEM

MAINTENANCE

Reliable operation of the electric plant depends heavily upon the performance of the controls, as they are the 'brains' of the plant, and must function properly to give dependable service. Connections should be periodically checked for tightness, as a loose connection can cause erratic performance.

The plant control system functions to control starting, stopping and battery recharging. It also provides emergency automatic stopping and engine pre-heating. The control system and control system defects can best be analyzed with the aid of the proper wiring diagram.

When using ONAN wiring diagrams, remember these points. The views shown are modified pictorials. 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, for example, 'Top View'. All relays are shown in the de-energized position. This section covers ac plants and serves as a guide for dc battery charging plants.

DJA generating plants use the generator as a starting motor and a decompression solenoid on the engine rocker box to control the engine. The control system includes the starting circuit, a battery-charging circuit with a reverse current relay, a pre-heating circuit, and the optional high air temperature cutoff. Figure 49 shows the starting cycle in pictorial form.

The oil pressure switch on this model is used as part of the starting system.

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

CONTROL COMPONENTS

STARTING AND STOPPING SYSTEM: The DJA starting system includes the start solenoid, dexompression solenoid and oil pressure switch: To stop the engine, the switch grounds the decompression solenoid relay, releasing the decompression solenoid which holds the exhaust valve open.

Decompression Solenoid: Mounted on the engine rocker box, the decompression solenoid controls a lever that holds the exhaust valve open. The solenoid contains 2 windings. Both are used to pull the plunger into the solenoid body. When the plunger hits bottom, it opens a set of contacts, de-energizing one coil while the other coil holds it in the energized position.

To test the solenoid operation, check plunger operation and current draw with 12-volt input to the solenoid. Current draw should be about 1 amp with the plunger fully in the solenoid body.

Decompression Solenoid Relay: This single-pole normally-open relay controls the decompression solenoid. It energizes during the engine starting cycle when the oil pressure switch closes, and is de-energized by

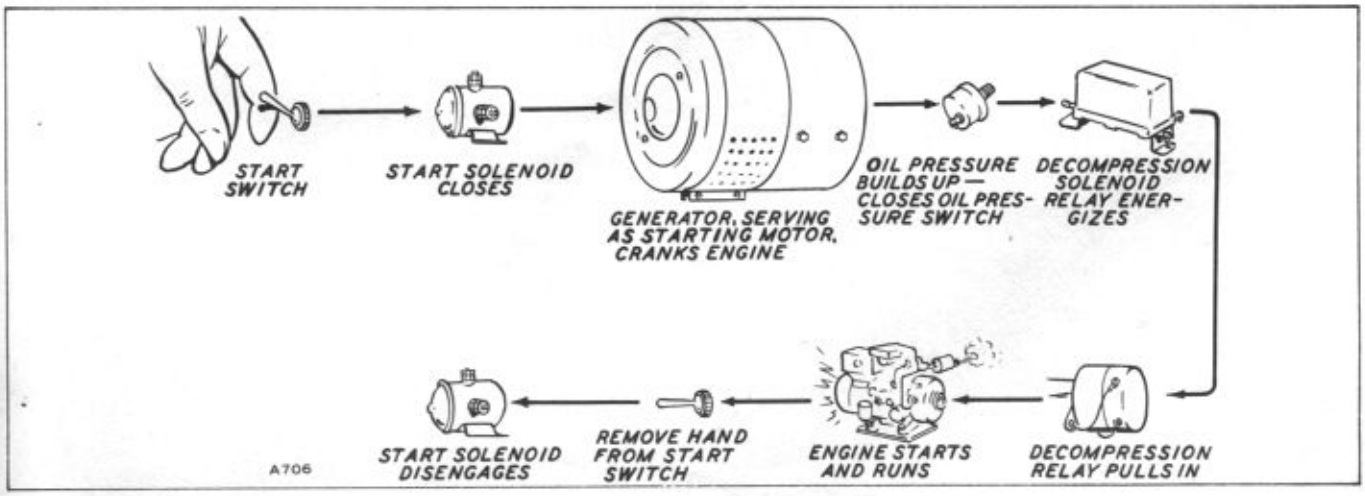


Figure 49. DJA Starting Cycle

pushing the stop switch. This is not a 12-volt relay, and is wired in series with a 15-ohm resistor.

To test the relay, check the contact operation with a lamp or ohmmeter as indicator and check the coil continuity. The relay should energize with 5 volts input.

Oil Pressure Switch: The non-adjustable oil pressure switch controls the decompression solenoid, allowing it to energize only when the switch closes. This allows the engine to build up speed during starting before compression occurs. The switch closes at about 5 psi under increasing oil pressure.

NOTE: This switch is not designed to be used as low oil pressure protection. It will not protect the engine against slowly decreasing oil pressure.

To check oil pressure switch operation, if the decompression solenoid won't energize, short to ground when engine has built up speed during starting. The solenoid should energize immediately and the engine should start.

CAUTION: If the engine starts, check immediately for oil pressure and shut the engine down if oil pressure doesn't build up within a few seconds. In this case it is lack of oil pressure that is causing faulty operation, not the switch.

Starting Solenoid: The starting solenoid controls the heavy currents required by the exciter starting motor. Test this solenoid for welded contacts across the main terminal or an open circuit in the coil.

Improper Use: If the start switch is released when an engine slows at the peak of the first compression stroke, the very large current passing through the solenoid may burn or weld the contacts. Be sure the engine is revolving when the START switch is released. Momentary flips of the START switch in an attempt to "jar" the engine over compression will only result in damage to the starting solenoid.

Battery Charging Circuit: Adjust the charge rate between 2 to 5 amps by moving the slider on the charge resistor.

The generator dc winding supplies current for the battery charging circuit. The current flows through the charge rate resistor, reverse current relay and charge ammeter to the battery.

Reverse Current Relay: 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.

Preheating Circuit: This circuit consists of a manifold heater to heat the engine intake air in the intake manifold and a glow plug to heat the pre-combustion chamber. Used for engine starting, the manifold heater and glow plug are wired in parallel and controlled by a pre-heat switch.

Check the heater by removing its lead, operating the preheat switch, and touching the lead to its terminal. If it sparks, there is continuity and the heater is working. If any components of this circuit fail, replace them. Do not attempt repairs on individual components. If there is still a question, check the component for heating.

SPECIAL TOOLS

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

Crankshaft Gear Pulling Ring	420A248
Diesel Nozzle Tester	420P184
Diesel Pintle, Nozzle Cleaning Tool Set (Includes injection nozzle centering tool)	420P208
Driver, Front Camshaft Bearing	420A252
Driver, Rear Camshaft Bearing	420B250
Driver, Rear Camshaft Bearing (JA)	420B264
Driver, Main Bearing Front and Rear	420B269
Driver, Valve Seat	420B270
Oil Seal Guide and Driver	420B250
Valve Seat Remover	420B272
Replacement Blades for 420B272	420B274
Wrench, Oil Filter - (For Purolator full flow filter)	420B268

WIRING DIAGRAMS

The wiring diagrams in this section are typical, and apply only to standard generating plants. Wiring diagrams for special models are available on request from the factory; send generator model, spec, and serial numbers with the request. Take this information from the ONAN nameplate.

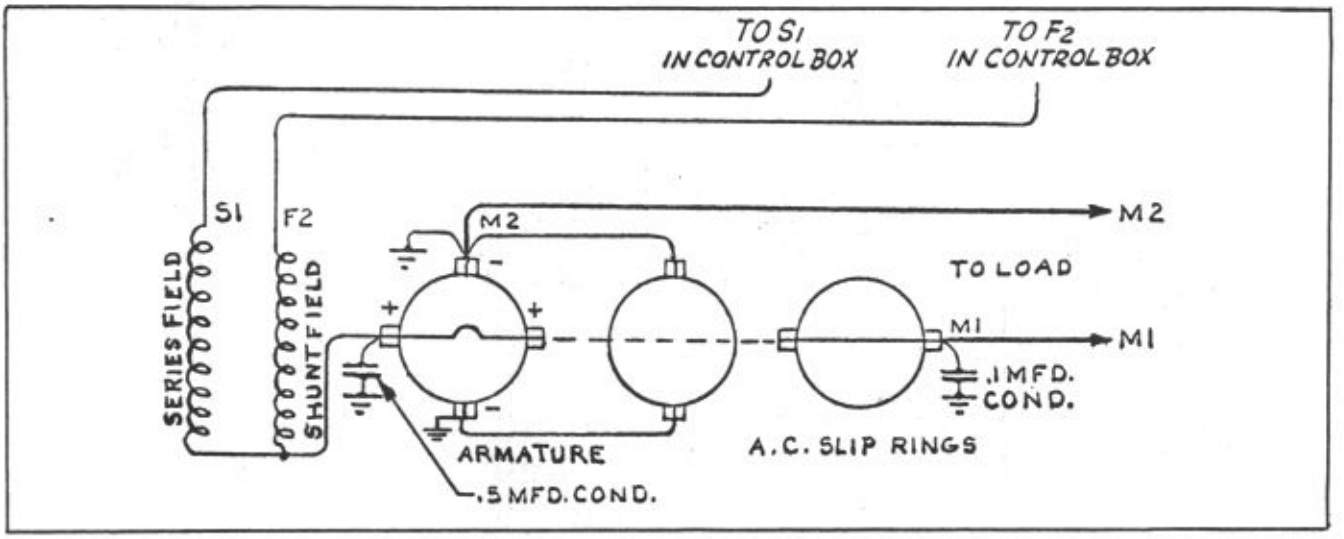
For revolving armature plants, select the generator wiring diagram with the proper phase and number of output wires.

Consult the following table for wiring diagram description and location.

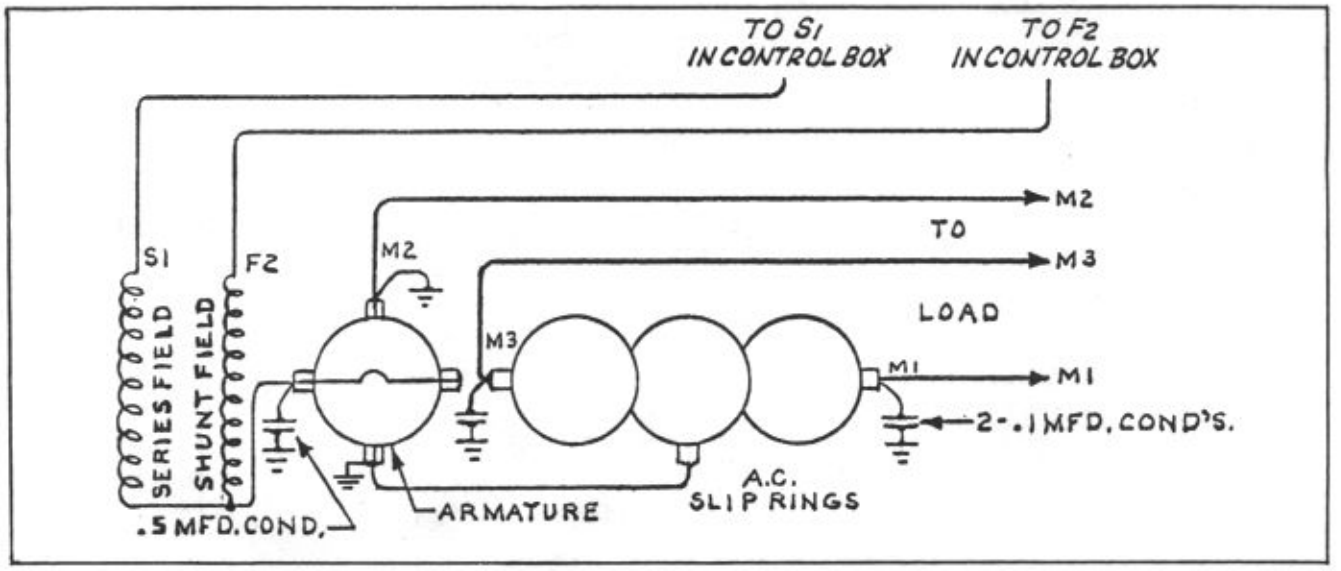
WIRING DIAGRAMS

TYPE OF UNIT	SPEC LETTER (S)	120 or 240 Volt 2 WIRE, SINGLE PHASE	120/240 Volt 3 WIRE, SINGLE PHASE	240 Volt 3 WIRE, THREE PHASE	120/208 Volt 4 WIRE, THREE PHASE	WIRING DIAGRAM NO.	PAGE
REMOTE START	A through R	x				610C181	56
	A through R				x	610C238	57
	A through R			x		610C273	58
	A through R		x			610C187	59
REMOTE START, DUAL PURPOSE	A through R	x				610C222	60
BATTERY CHARGERS 24 V and 32 V.	A through R					610C220	61
CONTRACTORS MODELS, ELECTRIC START	A through R	x				605B81	62
	A through R		x			605B82	63

GENERATOR WIRING DIAGRAMS



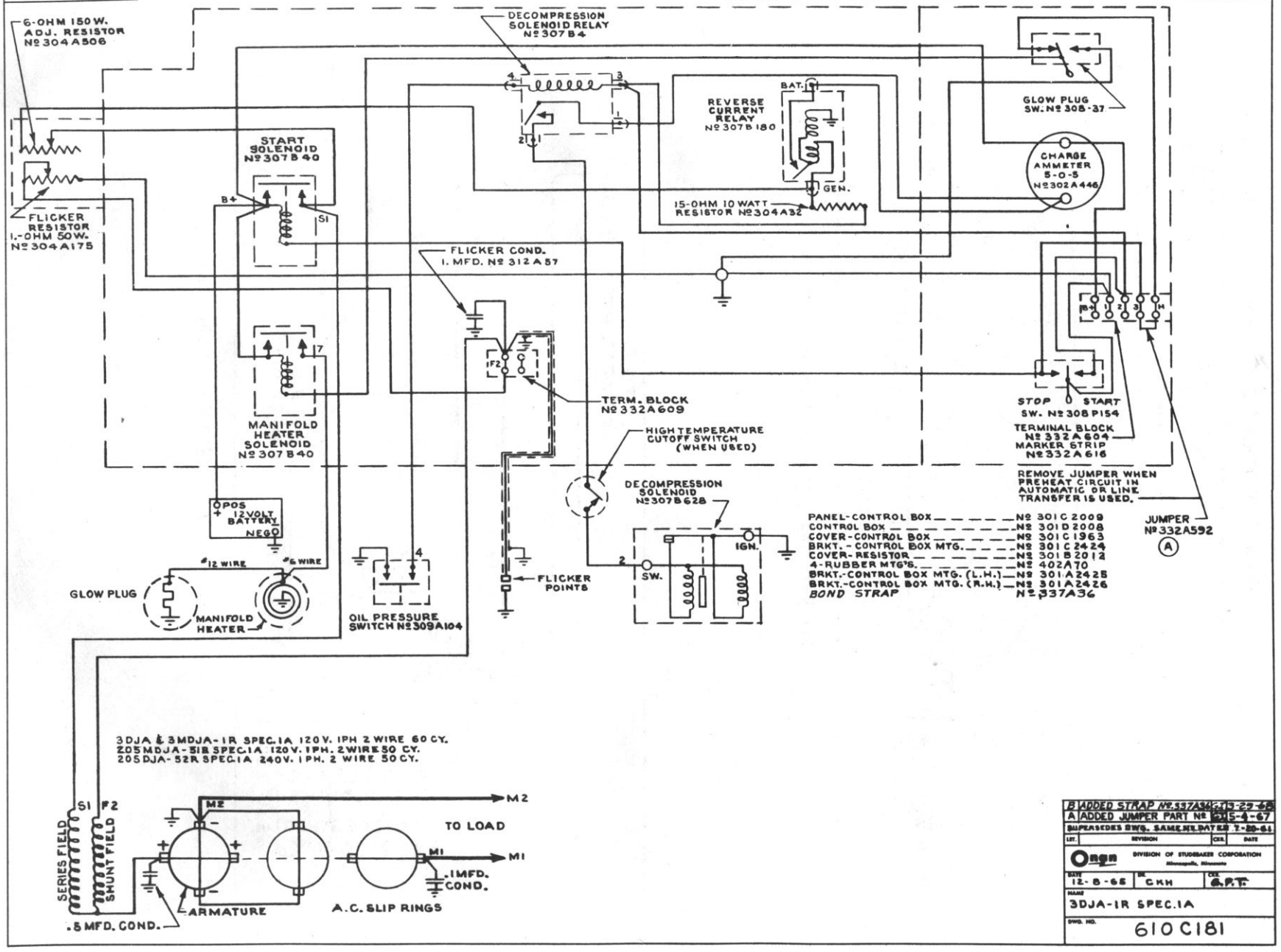
DJA Revolving Armature, 2-Wire, Single Phase



DJA Revolving Armature, 3-Wire, Single Phase

610 C181

205 DJA-52R/1A	205 MDJA-51R/1A	3MDJA-1R/1A	3DJA-1R/1A



B ADDED STRAP Nº 337 A 36 2-15-67
A ADDED JUMPER PART Nº 332 A 592 5-4-67
SUPERSEDES DWG. SAME NO. DATED 7-20-61

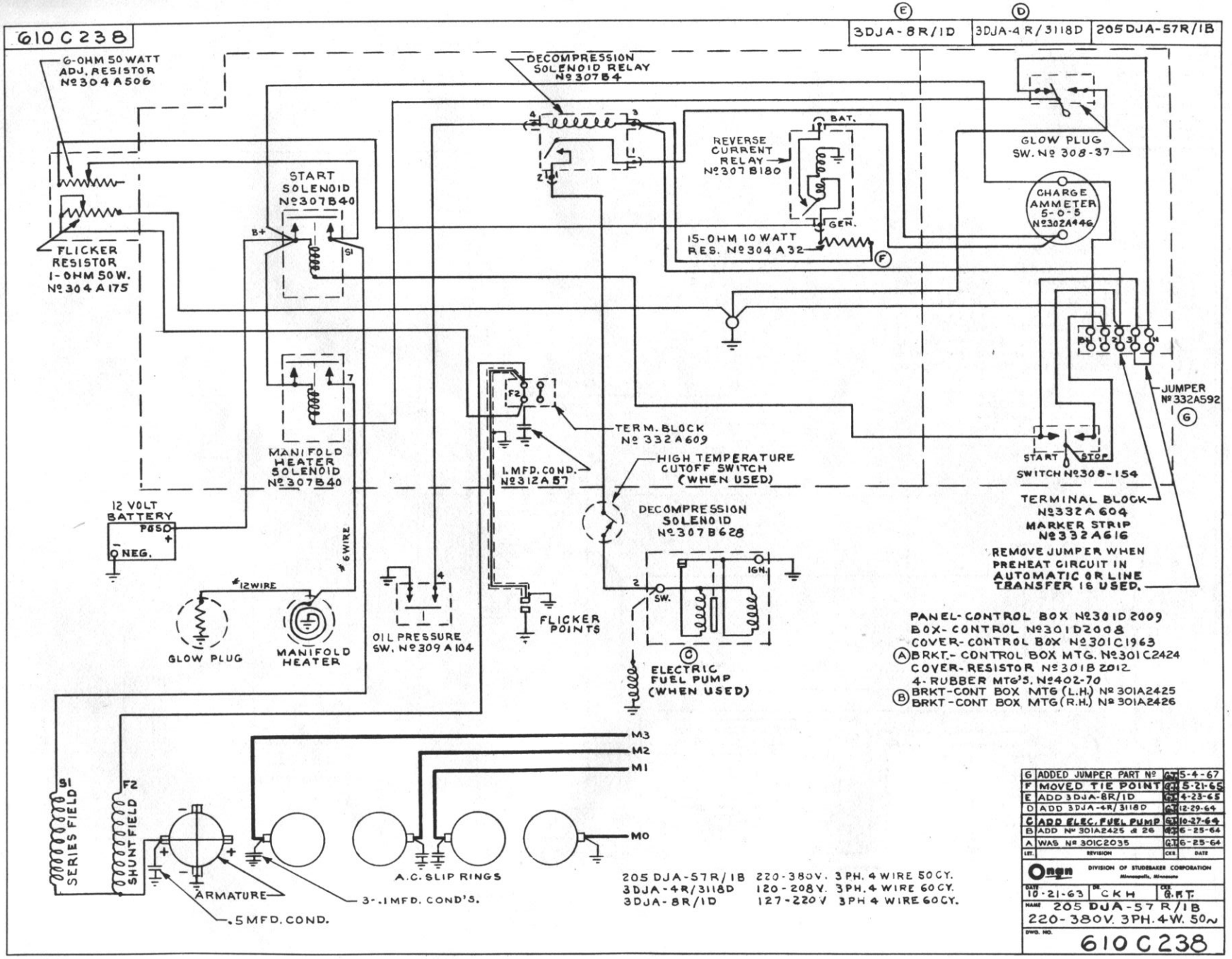
LET.	REVISION	CHK.	DATE

Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota

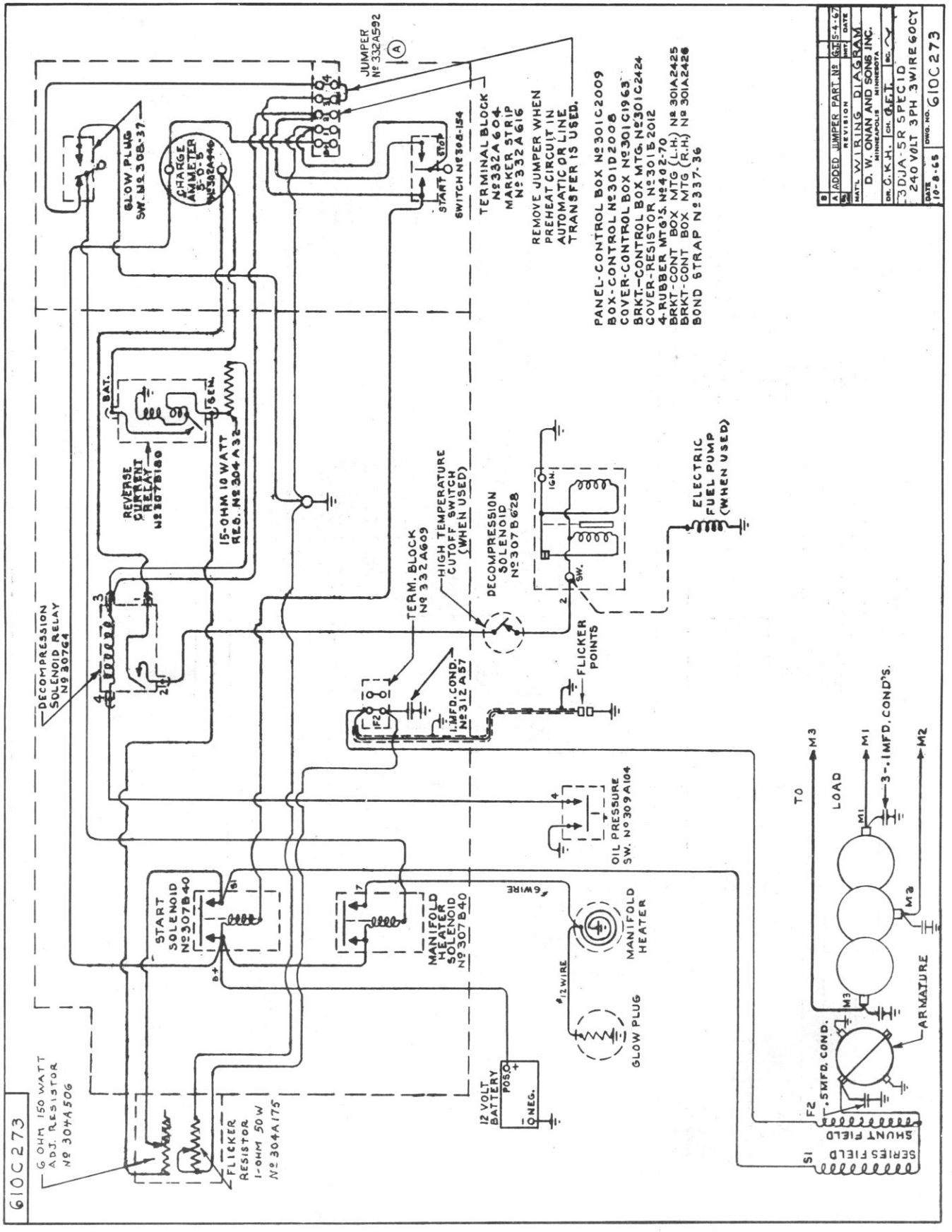
DATE	BR.	CHK.
12-8-66	CHH	G.P.T.

NAME: 3DJA-1R SPEC. 1A

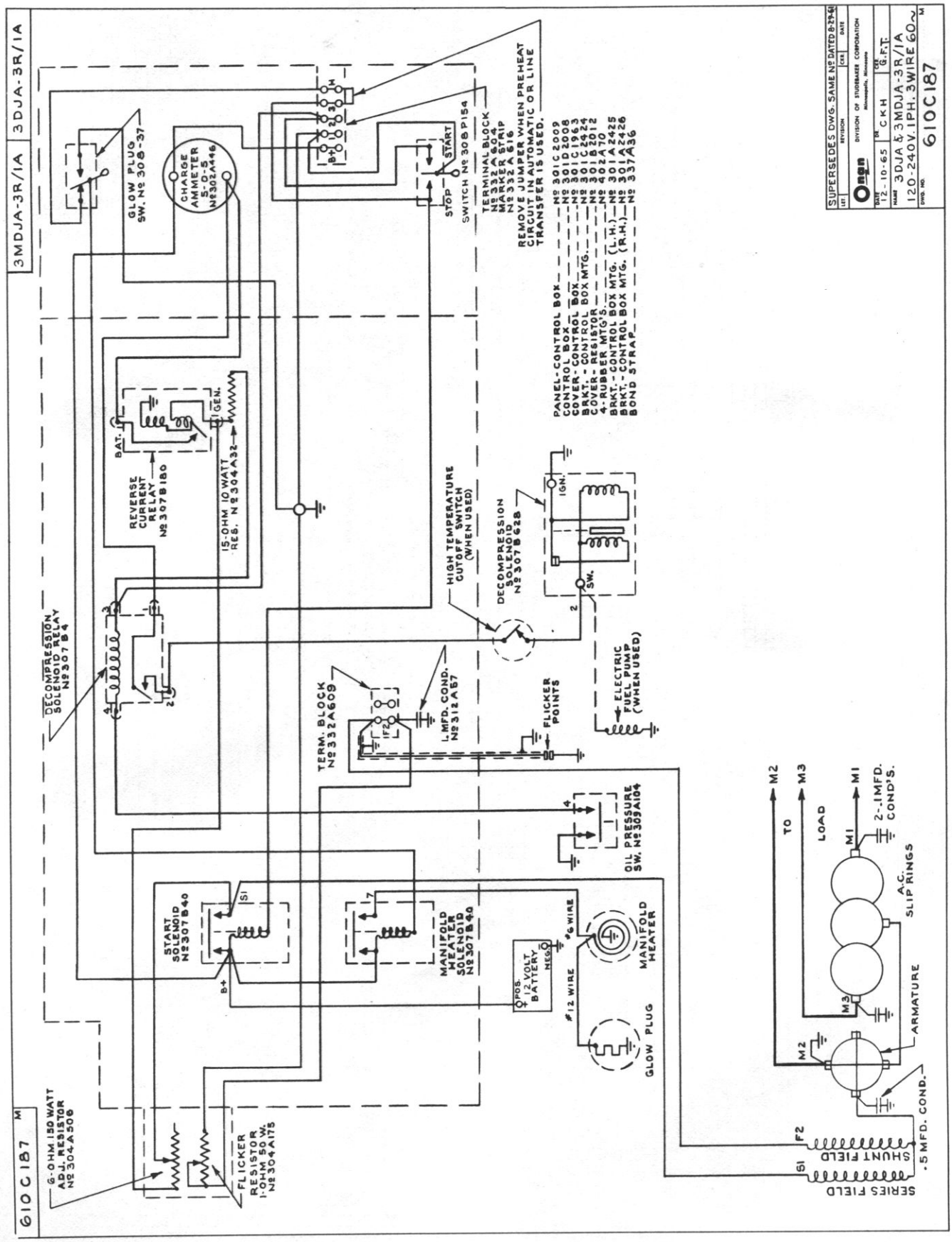
DWG. NO. 610 C181


610C238
3DJA-8R/1D
3DJA-4R/3118D
205DJA-57R/1B
6-OHM 50 WATT ADJ. RESISTOR Nº304A506
DECOMPRESSION SOLENOID RELAY Nº307B4
REVERSE CURRENT RELAY Nº307B180
BAT.
GEN.
GLOW PLUG SW. Nº 308-37
CHARGE AMMETER 5-0-5 Nº302A446
15-OHM 10 WATT RES. Nº304A32
START SOLENOID Nº307B40
FLICKER RESISTOR 1-OHM 50W. Nº304A175
MANIFOLD HEATER SOLENOID Nº307B40
TERM. BLOCK Nº 332A609
L.MFD. COND. Nº312A57
HIGH TEMPERATURE CUTOFF SWITCH (WHEN USED)
DECOMPRESSION SOLENOID Nº307B628
JUMPER Nº332A592
START
STOP
SWITCH Nº308-154
TERMINAL BLOCK Nº332A604
MARKER STRIP Nº332A616
REMOVE JUMPER WHEN PREHEAT CIRCUIT IN AUTOMATIC OR LINE TRANSFER IS USED.
12 VOLT BATTERY
POS.
NEG.
12 WIRE
6 WIRE
GLOW PLUG
MANIFOLD HEATER
OIL PRESSURE SW. Nº309A104
FLICKER POINTS
IGN.
SW.
ELECTRIC FUEL PUMP (WHEN USED)
PANEL-CONTROL BOX Nº301D2009
BOX-CONTROL Nº301D2008
COVER-CONTROL BOX Nº301C1963
(A) BRKT.-CONTROL BOX MTG. Nº301C2424
COVER-RESISTOR Nº301B2012
4-RUBBER MTG'S. Nº402-70
(B) BRKT-CONT BOX MTG (L.H.) Nº301A2425
(B) BRKT-CONT BOX MTG (R.H.) Nº301A2426
M3
M2
M1
M0
SI
SERIES FIELD
F2
SHUNT FIELD
ARMATURE
A.C. SLIP RINGS
3-.1MFD. COND'S.
.5MFD. COND.
205 DJA-57R/1B 220-380V. 3PH. 4 WIRE 50CY.
3DJA-4R/3118D 120-208V. 3PH. 4 WIRE 60CY.
3DJA-8R/1D 127-220V 3PH 4 WIRE 60CY.
G ADDED JUMPER PART Nº GT 5-4-67
F MOVED TIE POINT GT 5-21-65
E ADD 3DJA-8R/1D GT 4-23-65
D ADD 3DJA-4R/3118D GT 12-29-64
C ADD ELEC. FUEL PUMP GT 10-27-64
B ADD Nº 301A2425 & 26 GT 6-25-64
A WAS Nº 301C2035 GT 6-25-64
LET. REVISION CKR DATE
Onan DIVISION OF STUDEBAKER CORPORATION Minneapolis, Minnesota
DATE 10-21-63 BY CKH CKD G.M.T.
NAME 205 DJA-57R/1B
220-380V. 3PH. 4W. 50~
DWG. NO. 610C238

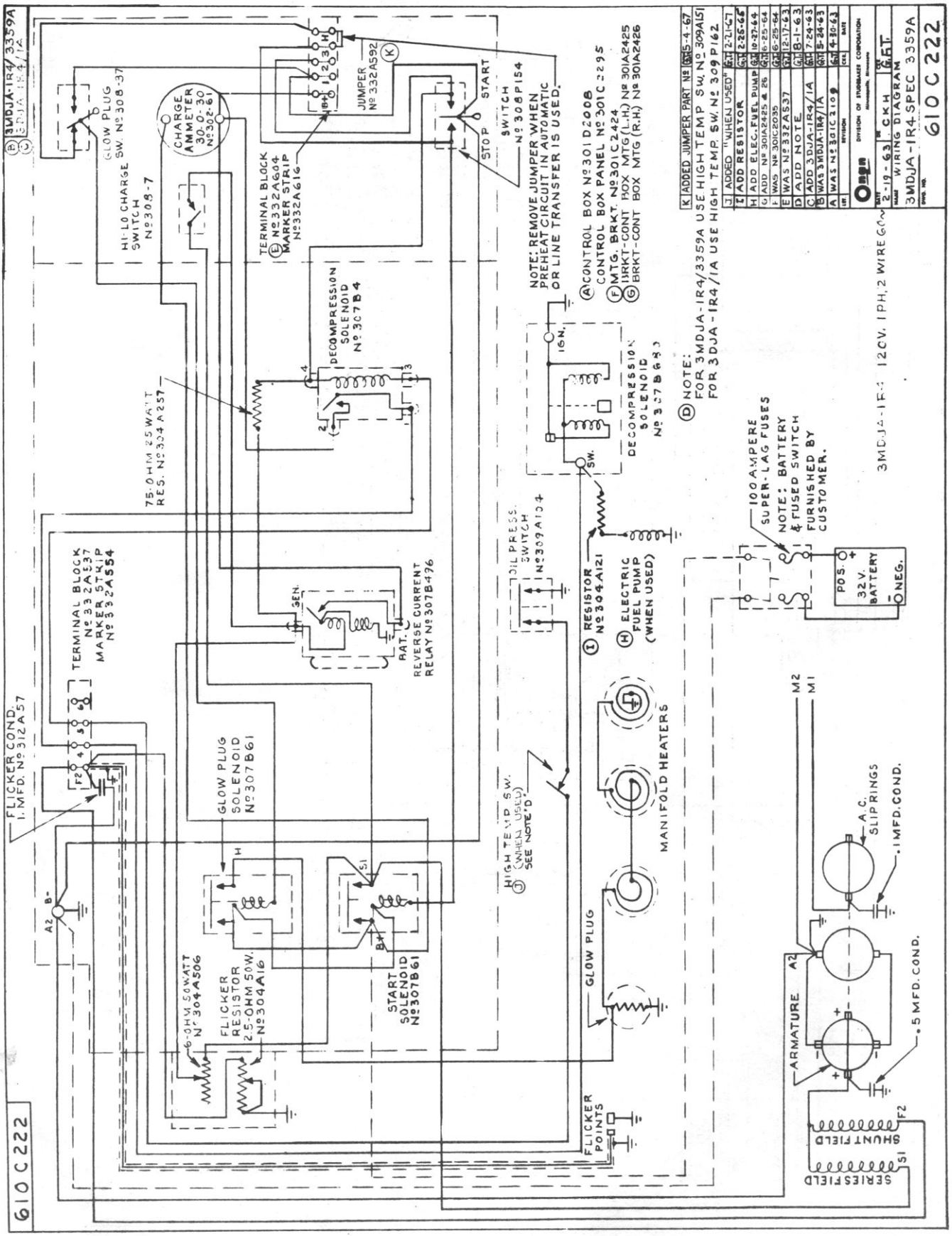
3 PHASE 3 WIRE, 240 VOLT



1 PHASE 3 WIRE

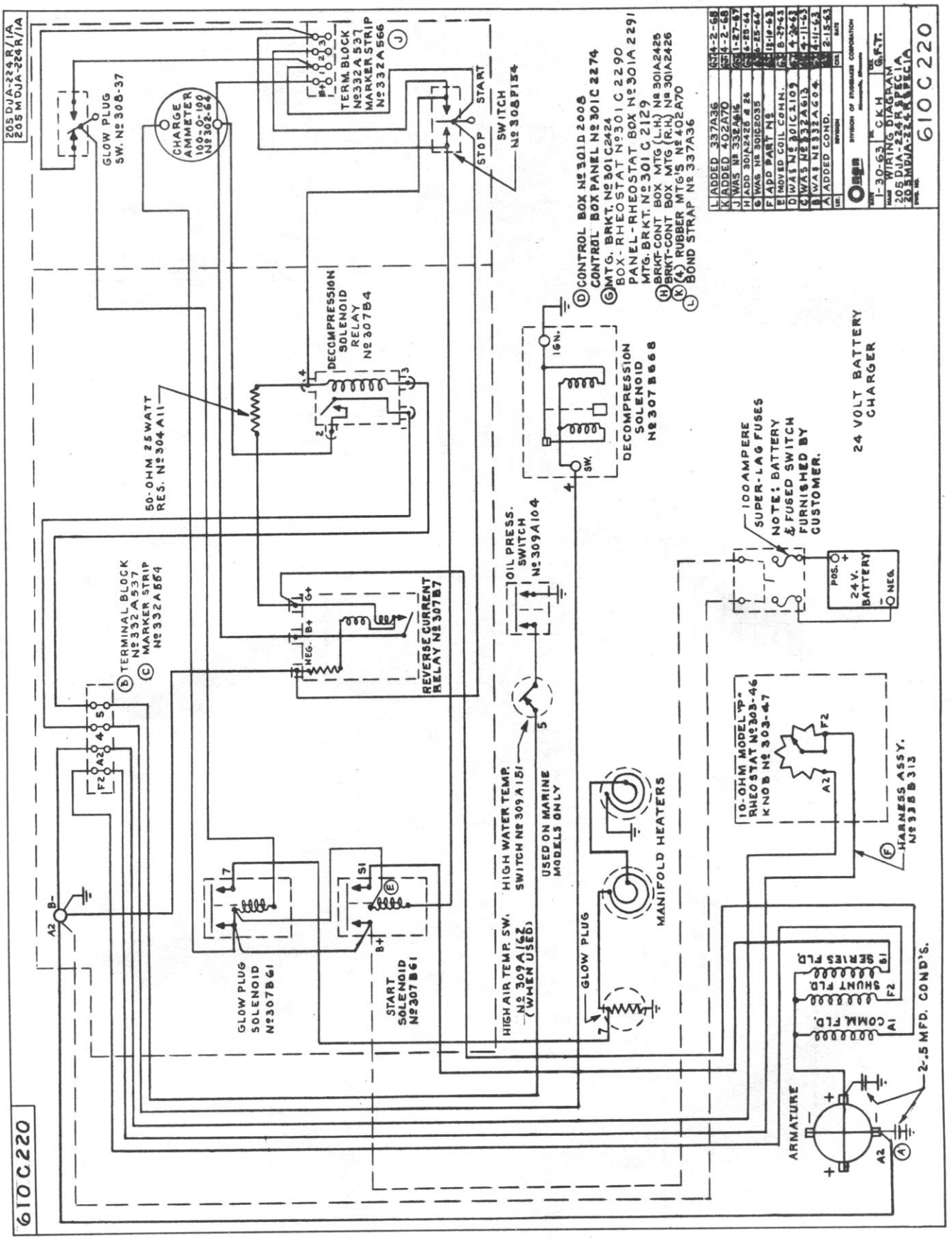


DJA WIRING DIAGRAM, DUAL PURPOSE PLANT
120-VOLT AC/32-VOLT DC

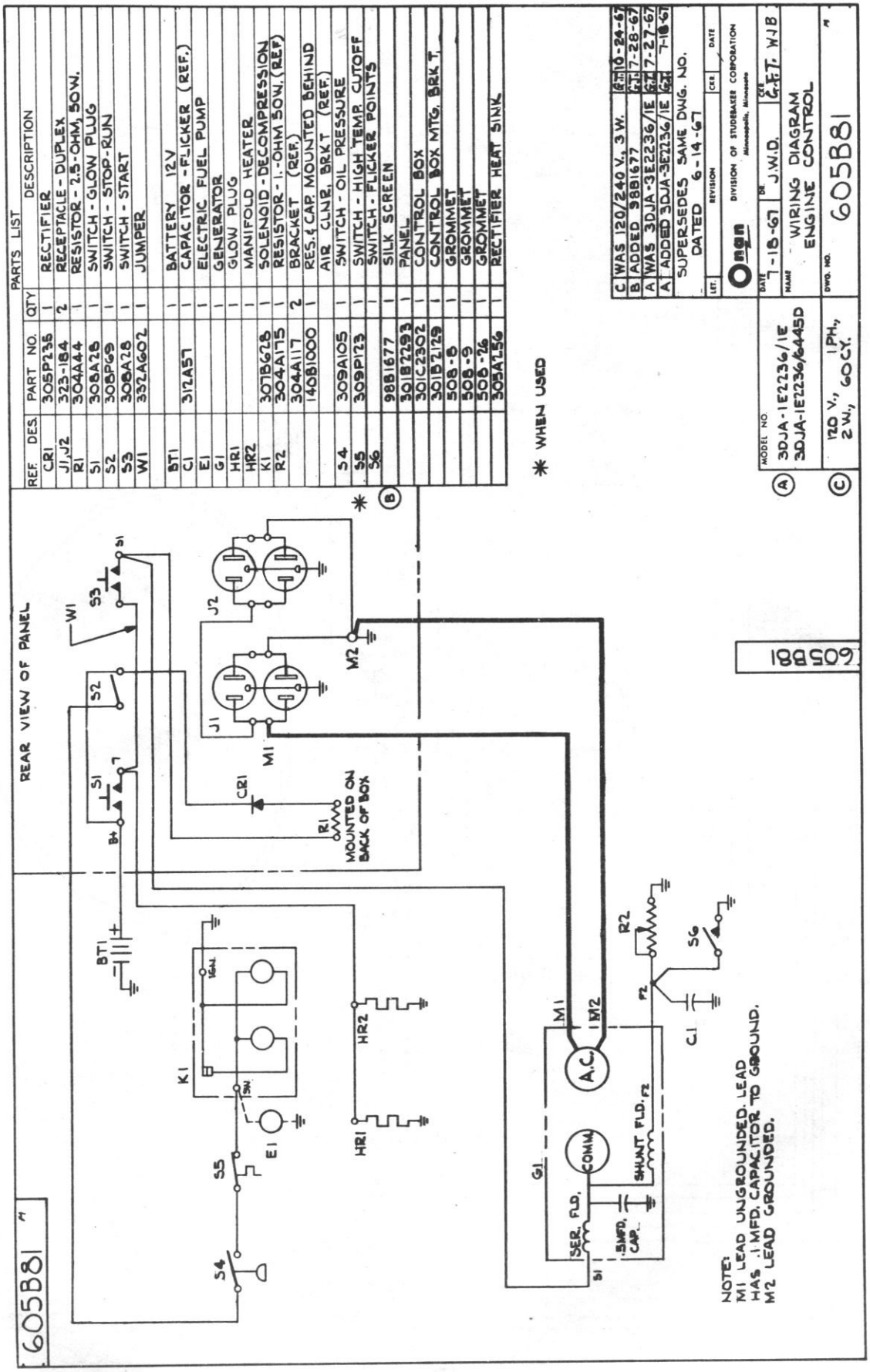


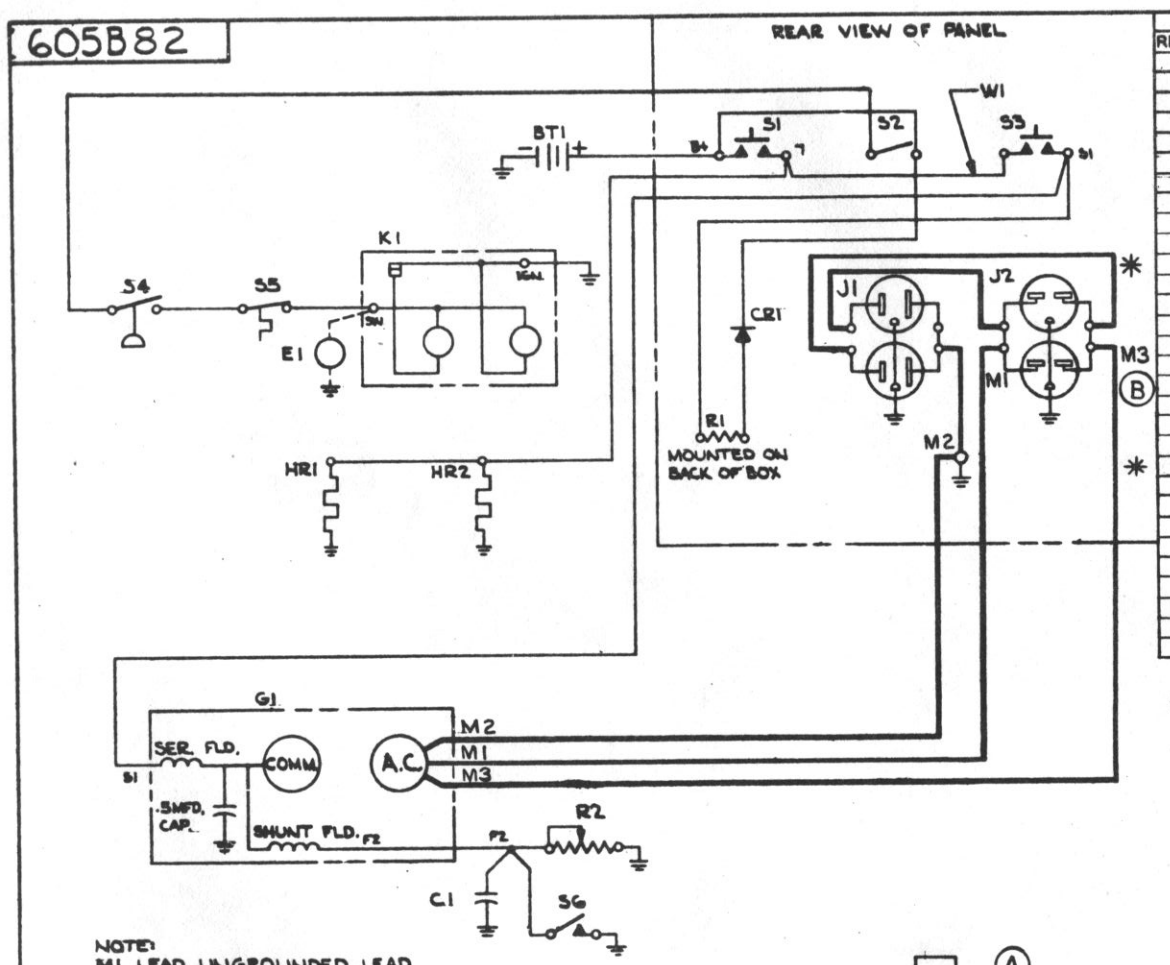
DJA WIRING DIAGRAM

24-VOLT AND 32-VOLT BATTERY CHARGER



DJA WIRING DIAGRAM (Contractors Model 3DJA-1E2236/)





NOTE:
M1 LEAD UNGROUNDED. LEAD HAS .1 MFD. CAPACITOR TO GROUND.
M2 LEAD GROUNDED.

PARTS LIST

REF. DES.	PART NO.	QTY	DESCRIPTION
CR1	305P235	1	RECTIFIER
J1	323-184	1	RECEPTACLE-DUPLEX 120 V.
J2	323-213	1	RECEPTACLE-DUPLEX 240 V.
R1	304A44	1	RESISTOR-2.5-OHM, 50 W.
S1	308A28	1	SWITCH-GLOW PLUG
S2	308P69	1	SWITCH-STOP-RUN
S3	308A28	1	SWITCH-START
W1	332A602		JUMPER
BT1		1	BATTERY 12V
C1	312A57	1	CAPACITOR-FLICKER (REF.)
E1		1	ELECTRIC FUEL PUMP
G1		1	GENERATOR
HR1		1	GLOW PLUG
HR2		1	MANIFOLD HEATER
K1	307B628	1	SOLENOID-DECOMPRESSION
R2	304A175	1	RESISTOR-1.-OHM 50W. (REF)
	304A52	1	RESISTOR-2-OHM,50W (50CY) (REF.)
	304A117	2	BRACKET (REF)
S4	309A105	1	SWITCH-OIL PRESSURE
S5	309P123	1	SWITCH-HIGH TEMP CUTOFF
S6		1	SWITCH-FLICKER POINTS
	98B1677	1	SILK SCREEN
	301B2293	1	PANEL
	301C2302	1	CONTROL BOX
	301B2129	1	CONTROL BOX MTG. BRKT.
	508-8	1	GROMMET
	508-9	1	GROMMET
	508-26	1	GROMMET
	305A256	1	RECTIFIER HEAT SINK

* WHEN USED

LET.	REVISION	CKD.	DATE
B	ADDED 304A52 FOR 50 CYCLE		1-4-68
A	ADDED 205 DJA		1-4-68

Onan — DIVISION OF STUDEBAKER CORPORATION, Minneapolis, Minnesota

605B82	(A)		
205DJA-53E2236/1R	MODEL NO. 3DJA-3E2236/1E	DATE 7-27-67	DR. CDR	CKD. G.F.T. W.I.B.
120/240 VOLT, 1 PH 3 W., 50 CY.	120/240V., 1PH., 3W., 60CY.	NAME WIRING DIAGRAM ENGINE CONTROL	
		DWG. NO. 605B82	