TM 9-3431-254-14&P

DEPARTMENT

OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL INCLUDING REPAIR PARTS LIST

FOR

WELDING MACHINE

MODEL GCC-300W

(3431-01-032-6289)

HEADQUARTERS,

DEPARTMENT OF THE ARMY

August 1984

Safety Warnings

Although welding equipment and processes are not particularly hazardous, there are certain safety practices the user must follow to protect himself and others from injury, These practices are outlined in American National Standard Z49.1 entitled: SAFETY IN WELDING AND CUTTING; and in the following warnings. The user must also closely follow the installation, operation, and maintenance instructions contained in this manual.

It is assumed that anyone using this welding equipment has had extensive training in welding practices. Anyone not having this training shouldn't attempt to weld.

INSTALLATION OF EQUIPMENT - Electrical equipment shall be installed and maintained in accordance with the National Electrical Code, NFPA70, and local codes. Ground all power supply and auxiliary enclosures to an adequate electrical ground, such as an approved building ground, cold water pipe, or ground rod. Have only qualified electricians do electrical installation, troubleshooting and maintenance work on welding equipment. Always use welding cable for the ground return circuit from the work to welder - never use pipes carrying gas or flammable liquids. For engine-driven equipment used indoors, pipe the exhaust gases to a suitable exhaust duct or to the outdoors. Never locate engine exhaust near an air conditioner intake.

VENTILATION - Provide ventilation in accordance with American National Standard Z49. 1, Section 8. Adequate ventilation must be provided for operator safety when welding lead, zinc, beryllium copper, cadmium, and other materials that may produce toxic fumes. DO NOT weld in locations close to chlorinated hydrocarbon vapors coming from decreasing, cleaning, or spraying operations. The heat or rays from the arc can react with solvent vapors to form phosgene, a highly toxic gas; and other irritating products. Do not weld on containers which have held toxic materials, without exercising all proper precautions.

ELECTRIC MOTOR-DRIVEN OR TRANSFORMER TYPE WELDERS . Be sure that the disconnect switch or circuit breaker is in the OFF position before doing any installation or maintenance work inside the welding equipment, or on the service lines to the equipment.

ENGINE-DRIVEN WELDERS - Secure engine-generator canopy doors in the UP position by tying them to each other or to the lifting eye to prevent them from falling accidentally. Always shut unit down before removing the fuel tank cap and filling the tank. Do not completely fill the tank, because heat from the engine and/or generator may expand the fuel enough to cause it to overflow and possibly ignite. If fuel spillage does occur, wipe up all fuel before starting the engine. If spillage is excessive, and penetrates the welder enclosure or canopy, remove enough components to permit complete cleanup. Open canopy doors (if unit has them) and blow compressed air over the equipment to clear away the fumes.

When servicing the battery, do not smoke, cause sparking, or use open flame near the battery, as it gives off flammable hydrogen gas.

Exercise care in working around the engine when it is in operation, to prevent injury from rotating fans, belts, pulleys or from hot exhaust system components.

OPERATORS PERSONAL PROTECTION . Wear dry gloves, jackets or sleeves, and aprons of chrome leather, safety shoes, welding helmet, and any other necessary articles to prevent injury from arc burns. Always protect your eyes by wearing a welding helmet fitted with a double lens; a colored, arc-ray lens inside, and a clear glass lens on the outside (see table below). Protect the eyes of personnel in the area by use of opaque, non-reflecting and non-flammable screens.

MAX. ARC AMPS	LENS SHADE NO.
Below 30 Amperes	6
30 to 75 Amperes	8
75 to 200 Amperes	10
200 to 400 Amperes	12
400 and over	14

Suggested Lens Shades for Arc Welding and Cutting

WARNING: Do not use ordinary gas welding goggles. These goggles do not provide sufficient eye protection.

In case of eyeburn, obtain professional medical attention immediately. For temporary treatment, apply a drop of 2% Butyn solution to eyes at two-hour intervals, or applications of sweet oil at hourly intervals, for as long as acute burning sensation persists. Always wear safety glasses with side shields, when in a welding area. Grinding and chipping, and cleaning of slag from the welds, pose a safety hazard.

Safety Warnings

OPERATING PRECAUTIONS - Avoid contact with electrode and ground circuits, taking care to insulate yourself from ground. Use rubber mat or drywood when welding in damp locations or on metal floors. Do not weld items lying on a concrete floor (concrete can explode when hot). Do not loop an energized cable around your body.

Use only fully insulated electrode holder. Maintain holder, ground clamp and welding cables in good condition. Make certain all connections are tight and that any cable couplings or splices are fully insulated. Do not simultaneously touch electrode holders connected to two welding machines, or contact other personnel with energized electrode or holder. Never dip electrode holder in water to cool it, or lay down on ground surface. Do not use a welding current in excess of rated cable capacity, as the cables will overheat.

DO NOT use a welding machine to thaw frozen water pipes. The possibility exists, when this is attempted, to cause fires, explosions and/or damage to the welder.

WARNING

Do not operate in an enclosed area without adequate ventilation.

Do not use highly volatile fuels to cold-start this engine.

Make sure that no loose bars, tools, parts, etc., are in or on any part of the engine as they could cause serious damage to the engine, generator, or personal injury to anyone standing nearby.

Do not use flammable cleaning materials, gasoline, naptha, etc., to clean unit. Do not use chemically treated cleaning rags to clean terminal blocks, or electrical components.

FIRE PREVENTION AND PROTECTION - Do not weld in locations with a flammable atmosphere, such as produced by degreasing, cleaning, or spraying operations; or in atmospheres containing explosive vapors, gases, mists, or dusts.

Do not weld near combustible materials. Provide a fire watch operator, if necessary. Do not strike an arc on a compressed gas cylinder, or on containers in which flammable materials have been stored. Portable fire extinguishers shall be provided end maintained.

FOR DETAILED SAFETY INFORMATION (Always refer to latest issue)

1. ANSI Z87.1, Practice for Occupational and Educational Eye and Face Protection.
2. ANSI Z41.1, Standard for Men's Safety-Toe Footwear.
3. NFPA 70, National Electrical Code.
4. AWS A6.0-65, Safe Practices for Welding and Cutting Containers that Have Held Combustibles.
5. OSHA 29CFR1910, Occupational Safety and Health Standards.
6. ANSI Z49.1, Safety in Welding and Cutting.

30 August 1984

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2, located in the back of this manual direct to: Commander, US Army Armament, Munitions and Chemical Command, ATTN: DRSMC-MAS, Rock Island, IL 61299. A reply will be furnished directly to you.

Operator, Organizational, Direct Support and General Support Maintenance Manual Including Repair Parts List for:

Welding Machine
Model GCC-300W
(NSN 3431-01-032-6289)

NOTE

This manual is published for the purpose of identifying an authorized commercial manual for the use of the personnel to whom this equipment is issued.

Manufactured by: Hobart Brothers Company
600 W. Main St.
Troy, Ohio 45373

Procured under Contract No. DAAA09-78-C-2082

INSTRUCTIONS FOR REQUISITIONING PARTS

NOT IDENTIFIED BY NSN

When requisitioning parts not identified by National Stock Number, it is mandatory that the following information be furnished the supply officer.

1 - Manufacturer's Federal Supply Code Number - 28835

2 - Manufacturer’s Part Number exactly as listed herein.

3 - Nomenclature exactly as listed herein, including dimensions, if necessary.

4 - Manufacturer’s Model Number - GCC-300W

5 - Manufacturer’s Serial Number (End Item).

6 - Any other information such as Type, Frame Number, and Electrical Characteristics, if applicable.

7 - If DD Form 1348 is used, fill in all blocks except 4, 5, 6, and Remarks field in accordance with AR 725-50.

Complete Form as Follows:

(a) In blocks 4, 5, 6, list manufacturer’s Federal Supply Code Number - 28835 followed by a colon and manufacturer’s Part Number for the repair part.

(b) Complete Remarks field as follows:

Noun: (nomenclature or repair part)
For: NSN : 3431-01-032-6289
Manufacturer: Hobart Brothers Company
600 W. Main St.
Troy, Ohio 45373
Model: GCC-300W
Serial: (of end item)

Any other pertinent information such as Frame Number, Type, Dimensions, etc.

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SAFETY WARNINGS

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Instructions

RECEIPT OF EQUIPMENT

Check the equipment received against the invoice to make certain that the shipment is complete and undamaged. If the equipment has been damaged in transit, notify the carrier (railroad, trucking company, etc.) at once and file a claim for damages.

Give the MODEL, SPECIFICATION and SERIAL numbars of the equipment, and a full description of the parts in error. Refer to EQUIPMENT IDENTIFICATION on front sheet of this manual for an explanation of the specification numbers.

Best results with this equipment will be obtained ONLY if the responsible operating and maintenance personnel have access to this manual, and are familiar with the instructions contained herein.

Generally, it is good practice to move the equipment to the site of installation before uncrating. Use care in uncrating in order to avoid damage to the equipment when bars, hammers, etc., are used. A lifting eye which extends through the top of the cabinet has been provided to facilitate handling with a crane or hoist.

DESCRIPTION OF EQUIPMENT

The Model GCC-300-W gasoline. engine-driven welding generator is a self-contained unit, mounted on a welded steel frame. The unit is a single operator system, designed for constant current, or constant voltage welding. The unit is covered by a sheet metal canopy, bolted directly to the frame. The canopy has doors enclosing the generator section, but the engine compartment is open at the sides, with a cover over the top. The control panel is at the generator end of the unit The revolving fields of the generator are axially mounted on a single heavy duty shaft, supported by a ball bearing at the exciter end and by the engine coupling at the drive end.

GENERATOR

The generator is air cooled by a shaft-mounted fan which draws air through the exciter end and circulates the air through the interior of the generator. Air flow is also directed over the stability- reactor and output rectifier. The welding generator is a three-phase alternating current wye connected unit. The output of the welding generator is rectified to direct current and stabilized by a ballast resistor, or a stability reactor, depending upon the mode of welding.

EXCITER

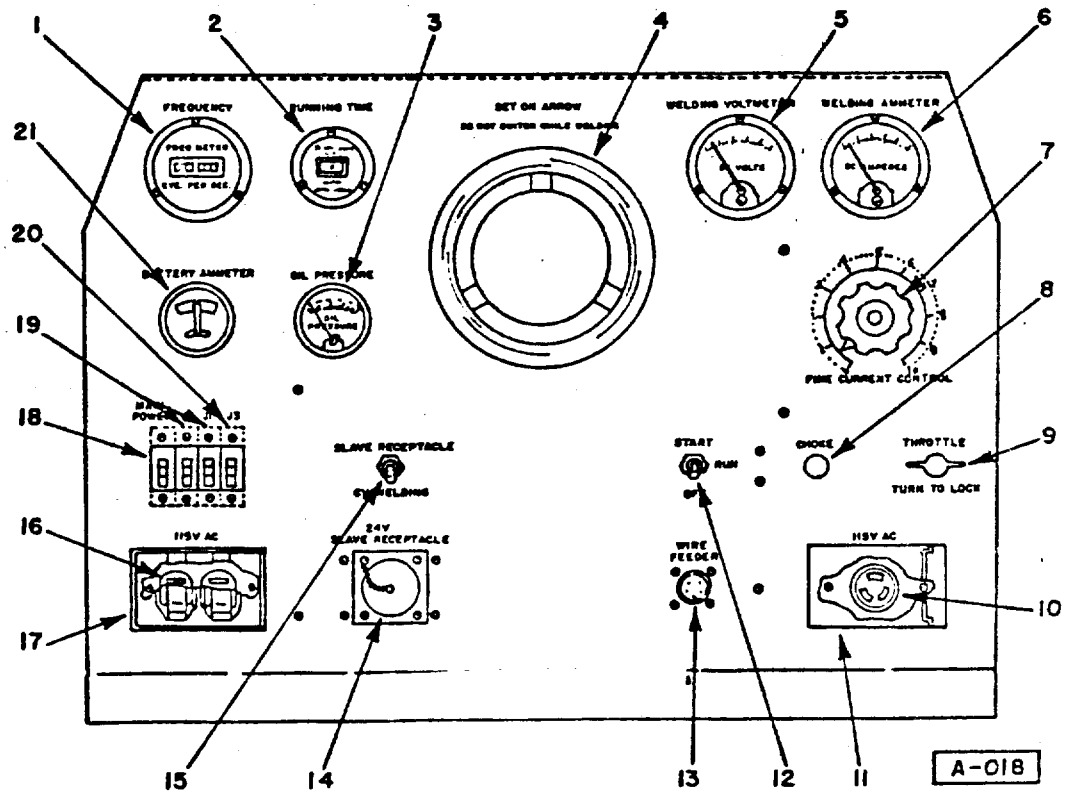
The exciter, or auxiliary generator whose output provides power to a bridge rectifier for excitation of the welding generator, service power for the contactor control and voltage regulator, and to the auxiliary power receptacles on the generator control panel.

ENGINE

The engine used in this unit is an air-cooled Industrial Gasoline engine, Model V-465D. It isdirectly coupled to the welding generator shaft by a flexible coupling.

IDENTIFICATION

The welding generator unit has an identification plate attached to the control panel, below on the left-hand side. The unit is identified as to SPEC number, by the dash (-) number which follows it, as explained on the front sheet of this manual. The engine identification number will be found on the engine nameplate attached to the air shroud of the engine. When ordering spare parts or communicating about this machine, be sure to specify the engine serial number, engine type, unit specification and serial numbers. Left- and right-hand sides of the unit are determined when facing the control panel.



1. Frequency Meter
2. Hour Meter
3. Oil Pressure Gauge
4. Range Switch
5. Welding Voltmeter
6. Welding Ammeter
7. Fine Current Control
8. Choke Control
9. Engine Throttle
10. Twist-Lock Receptacle (115 V AC)
11. Receptacle Cover
12. Start
13. Wire Feeder Receptacle
14. Slave Receptacle
15. Toggle Switch
16. Duplex Receptacle (115 V AC)
17. Receptacle Cover
18. Circuit Breaker (40 amperes)
19. Circuit Breaker (15 amperes]
20. Circuit Breaker (20 amperes)
21. Battery Ammeter

Control Panel
Figure 1

CONTROLS, INSTRUMENTS AND OUTLETS

FREQUENCY METER (1) - Registers the frequency of the voltage supplied to the receptacles (both the duplex receptacle, and the twist-lock receptacle) on the front panel.

HOUR METER (2) - Registers the operational time of the unit. Records cumulative number of hours that the engine has been in operation. Use the hour meter to schedule periodic maintenance and inspections.

OIL PRESSURE GAUGE (3) - The gauge indicates the oil pressure of the engine. The scale of the gauge is 0 to 75 psi (0 to 517 kPa). At 1800 RPM, the oil pressure should read 45 to 50 psi (310 to 345 kPa) when the engine is at operating temperature:

RANGE SWITCH (4) - This is the *coarse current control,* with five detent positions and is used in the constant current mode only. Clockwise rotation increases current, counterclockwise rotation decreases current.

CONTROLS, INSTRUMENTS AND OUTLETS (Continued)

WELDING VOLTMETER (5) - This is a single-scale meter, calibrated 0 to 100 volts. Prior to striking the welding arc, the voltmeter will register open-circuit voltage, and arc voltage when the welding arc is being sustained.

WELDING AMMETER (6) - This is a *single-scale* meter, calibrated 0 to 800 amperes, and will indicate welding current.

FINE CURRENT CONTROL (7) - This control operates in both constant current and constant voltage to permit vernier adjustment of welding current. Clockwise rotation increases welding current and counterclockwise rotation decreases current.

CHOKE CONTROL (8) - Pull choke control knob "out" when starting a cold engine, and push it "in" gradually as the engine warms up. Push it all the way in, as soon as the engine will run smoothly without being choked. It may require choking even if engine is warm.

ENGINE THROTTLE (9) - Pull OUT to idle the engine, Shove IN to obtain operating RPM. Control handle may be turned to lock in position at any setting desired. When shutting the engine down, always pull the throttle control handle all the way OUT.

AUXILIARY POWER OUTLETS

a. TWIST-LOCK Receptacle (10) - Provides 115-volt, 4-kVA AC power. Circuit is protected by a circuit breaker (CB4) of 20-ampere value. A receptacle cover protects the receptacle when not in use.

b. STANDARD DUPLEX Receptacle (16) - Provides 115-volt, 4-kVA AC power. Circuits to the separate outlets of the receptacle are protected by circuit breakers (CB2 and CB3) from overload. The duplex receptacles have covers provided for protection when the receptacles are not in use.

> **NOTE: Full auxiliary power output is available only when the generator is turning at 1800 RPM. The engine driving this generator should be governed to within ± 3% of the specified generator speed (1800 RPM).**

START/RUN/OFF Switch (12) - Place in START position to crank the engine for starting. When engine has commenced to fire and has attained the running mode, piece switch in RUN position. For engine shutdown, place switch in OFF position.

WIRE FEEDER CONTROL RECEPTACLE (13) - When unit is used with a wire electrode feeder, the control and power connections to the wire feeder are made to this raceptacle.

> **CAUTION: Before a wire feeder is connected to this unit, be sure that electrical wiring and functions of such a unit am compatible, otherwise damage to the generator circuit as well as the wire feeder may occur.**

SLAVE RECEPTACLE (14) - Source of 24-volt power for user's requirements. Use in conjunction with the Toggle Switch, below.

TOGGLE SWITCH (15) - This switch selects the power output mode, when the selection of 24-volt output power from the Slave Receptacle or welding current from the terminals is to be made. Place the switch in SLAVE RECEPTACLE position for supply of 24-volt power. Place the switch in CV WELDING position when desiring to use the machine for welding.

CIRCUIT BREAKERS (18-19-20) - Four circuit breakers located on the front panel protect the auxiliary/exciter circuit from overloads. Two breakers are rated at 15 amperes and protect the standard duplex outlet. Another breaker is rated at 20 amperes and protects the Twistlock outlet while the fourth breaker (Main Breaker) is rated at 40 amperes and protects the entire auxiliary power supply circuitry from cumulative overloading.

BATTERY CHARGING AMMETER (21) - This meter indicates the charge or discharge current through the battery for all engine electrical requirements except the starter. Under normal operating conditions, the ammeter should indicate 5-10 amperes positive. If the battery has been damaged, or heavily discharged, the meter will indicate a much greater current.

> **NOTE: The following welding terminals are located on a panel on the left-hand side of the generator.**

NEGATIVE WELDING TERMINAL - A common connection which connects to the WORK (material being welded) by the WORK lead, See Figure 2.

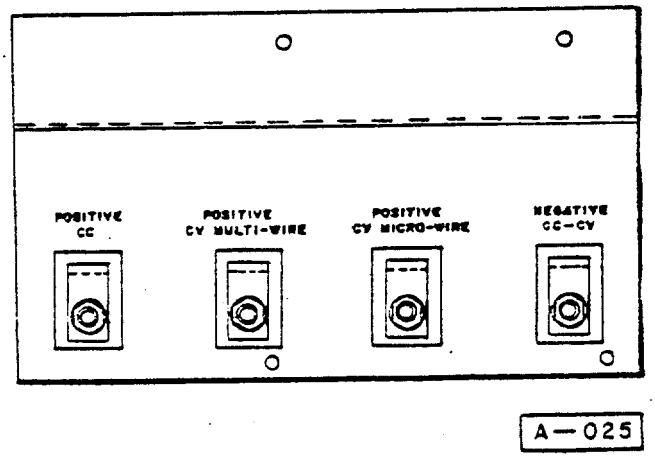
CONTROLS, INSTRUMENTS AND OUTLETS (Continued)

POSITIVE MICRO-WIRE TERMINAL - For semi-automatic and automatic welding processes using micro-wire.

POSITIVE MULTIWIRE TERMINAL - For semi-automatic and automatic welding processes using Fabco or Tubular wire.

POSITIVE SHIELDED METAL ARC WELDING TERMINAL - For “Stick” welding in the CC mode. Fasten electrode lead to this terminal.

NOTE: To obtain “reverse” welding polarity, simply reverse the connections to the positive and negative terminals.

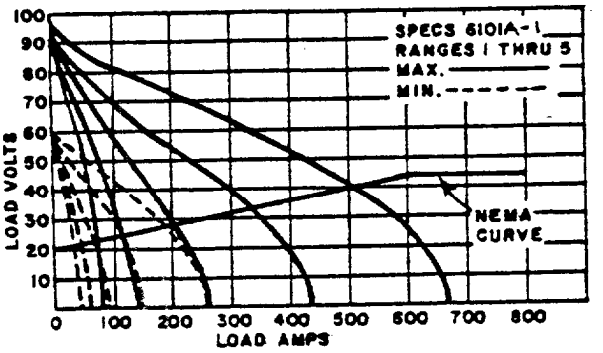


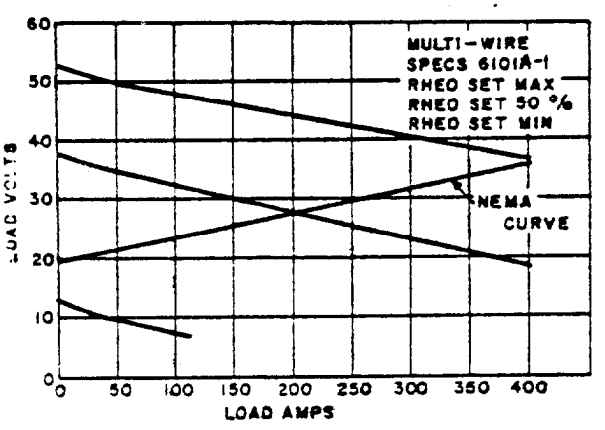
Welding Terminals
Figure 2

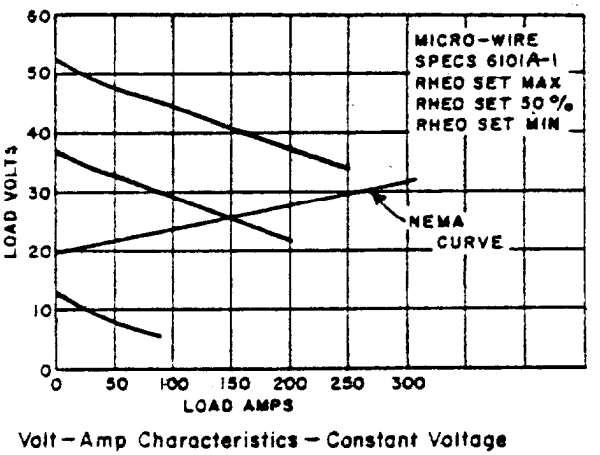
MODE SELECTOR SWITCH - This control is not shown on the front panel view (Figure 1), but it is located below the control panel, on the right-hand side of the lower panel. This handle, when in the UP position, places the machine in CC mode, and when in DOWN position, in CV mode.

CONTACTOR CONTROL - This item is not shown, but is a timer used to control the length of meltback time to prevent wire electrode from “freezing’” to the weld puddle.

VOLTAGE REGULATOR – The voltage regulator, not shown, maintains the exciter voltage to within ± 5%.







Welding Generator Electrical Characteristics
Figure 3

SPECIFICATIONS

Welding Generator and Exciter

	Volts	Amperes	Kilowatts	Duty Cycle	RPM
Welding CC (DCSP or DCRP)	32 DC	300	9.6 kW	100%	1800
Welding CV Multi-Wire Micro-Wire	32 DC	less than 250 / more than 250	9.6 kW	100%	1800
Auxiliary AC Single Phase 60 Hz	115 AC	35	4 kVA	100%	1800

Table 1

V-465D

Displacement	Brake Horsepower	RPM	Oil System	Fuel System
177 cu. in. (2901 cm^3)	47.5	1800-1840	7 qts. (6.6 liters)	Gasoline 15 gallons (U.S.) (56.8 liters)

Table 2

INSTALLATION

LOCATION

For best operating characteristics and longest unit life, take care in selecting an installation site. Avoid locations exposed to high humidity, dust, high ambient temperature, or corrosive fumes. Moisture can condense on electrical components, causing corrosion or shorting of circuits. Dirt on components helps retain this moisture and also increases wear on moving parts.

Adequate air circulation is needed at all times in order to assure proper operation. Provide a minimum of 12 inches (305 mm) of free air space at both front and rear of the unit. Make sure that the ventilator openings are not obstructed.

SAFETY

Refer to additional installation instructions under SAFETY WARNINGS in this manual.

INDOOR INSTALLATION

If unit is to be operated inside a building, make certain there is adequate ventilation to carry off escaping exhaust fumes and to provide an ample supply of oxygen.

INDOOR INSTALLATION (Continued)

Place unit so that exhaust fumes are carried out of the building using the shortest exhaust pipe extensions possible and one with the fewest possible number of bends. Exhaust back pressure can seriously affect engine efficiency. Minimum inside diameter of exhaust extension should be 2-1/8 inches (54 mm).

All exhaust connections must be gastight

Provide at least 2 feet (610 mm) of space on all sides of unit for ventilation and servicing.

PORTABLE INSTALLATION

All exhaust connections must be gastight.

Provide at least 2 feet (610 mm) of space on all sides of unit for ventilation and servicing.

The engine of the welding machine must be placed at the tongue end of the portable mounting for proper balance. If leads, etc., are to be stored on the unit. they must be forward of the axle to maintain proper balance of loading on the tongue end of the unit.

> NOTE: The unit should be operated in as near a normal horizontal position as possible and never at a tilt greater than 15° from horizontal.

INITIAL PREPARATION FOR USE

1. Open canopy doors on sides of the generator compartment. Latch the doors in the open position by use of the safety latches provided.

2. Inspect unit thoroughly to be sure it is in proper working order. Check all fuel and wire connections to be certain they are secure. Tighten any loose screws. nuts, or bolts. Check closely for any damage which may have occurred in transit.

3. Remove all special tags from the machine, read carefully and follow any special directions they may carry. Keeps tags with manual for future reference.

4. Check that oil pan drain plug is closed. Fill engine with the correct type of oil as specified in the engine manual.

5. Make certain that all air passages and cooling fins are free from foreign matter. Use dean, dry compressed air to blow dirt and dust out of cooling passages and control cabinet, 25 psi (172 kPa) maximum pressure.

6. The storage battery is shipped dry charge from the factory. Proper steps to install electrolyte must be taken before use.

7. Attach battery cables to poles of battery as indicated on wiring diagram. The negative (-) pole should be grounded to the frame of the unit in a secure manner.

> WARNING: Connect proper battery cable clamp to the positive (+) battery post first, then the other cable clamp to the negative (-) post.

> CAUTION: A short circuit to rectifier is created if a battery is installed with polarity reversed. Current can flow from positive terminal of battery through negative and positive rectifiers and into heat sink. From heat sink a completed circuit exists back to negative battery terminal. Full battery voltage will be impressed on rectifiers, in the alternator. The resulting high current will damage rectifiers and/or wiring harness. See Engine Diagram for correct battery connection.

8. Pump gasoline into fuel tank using care not to spill fuel on canopy or engine. Be sure air vent on fuel tank is open. Observe SAFETY WARNINGS when filling fuel tank.

9. Check to be certain that there are no obstructions in any rotating parts.

10. Check to be certain that none of the oil connections on the engine show leaks.

> NOTE: There is only one point of lubrication on this generator. DO NOT lubricate the generator bearing at this time. See MAINTENANCE section for frequency of greasing the generator bearing.

GROUNDING

The frame of this unit should be grounded for personnel safety. Where grounding is mandatory under state or local codes, it is the responsibility of the user to comply with all applicable rules and regulations. Where no state or local codes exist it is recommended that the National Electrical Code be followed.

These requirements and recommendations apply to rubber-tire mounted equipment as well as other equipment. In addition to the usual function of protecting personnel against the hazard of electrical shock due to fault in the equipment grounding serves to discharge the static electrical charges which tend to build up on the surface of rubber-tire mounted equipment.

WARNING

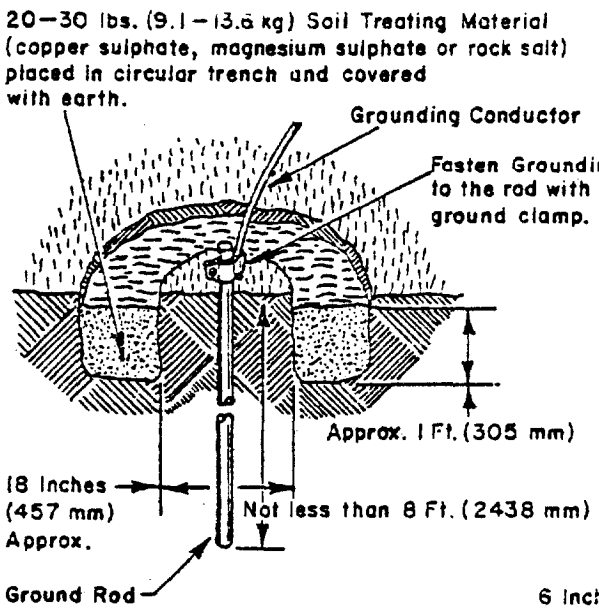
These static charges can cause painful shock to personnel, and can lead to the erroneous conclusion that an electrical fault exists in the equipment.

If a system ground is not available, the unit's frame must be connected to a driven ground rod (see Figures 4 and 5) or to a water pipe that enters the ground not more than 10 feet (3048 mm) from the unit. The ground wire must be No. 8 size or heavier.

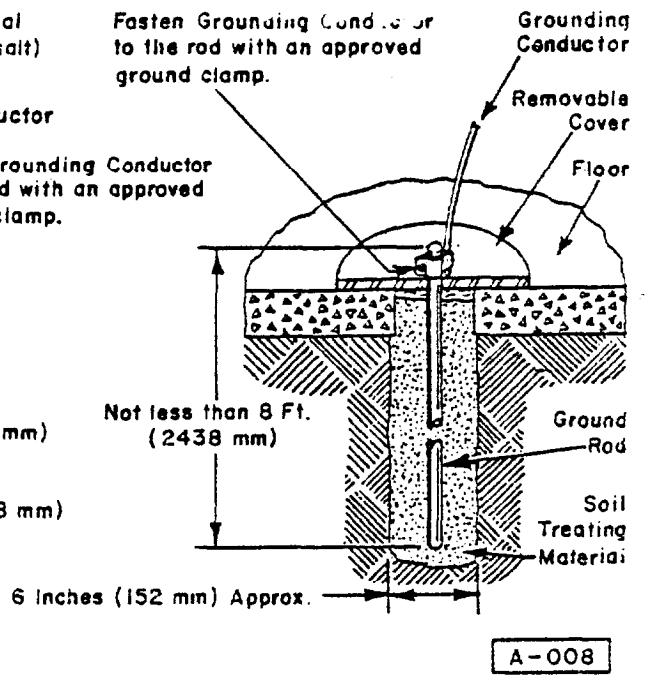
NOTE: The ground wire must be as short as possible in order to produce the most efficient installation.

TREATING AN OUTSIDE GROUND - The soil treating materials are placed in a circular trench around the rod, but not in direct contact. The crystals are gradually dissolved by surface waters and the solution is carried into the most useful area of earth surrounding the electrode (rod). Flood the trench several times when making original installation. See Figure 4.

TREATING AN INSIDE GROUND - Reduce the diameter of the hole to 6 inches (152 mm), pour soil treating material in around the rod. Add enough water to dissolve 8 pounds (3.62 kg) of soil treating material. Flood the hole every 6 months and replace the soil treating material when it is all dissolved. See Figure 5.



Outside Ground
Figure 4



Inside Ground
Figure 5

UNIT DIMENSIONS

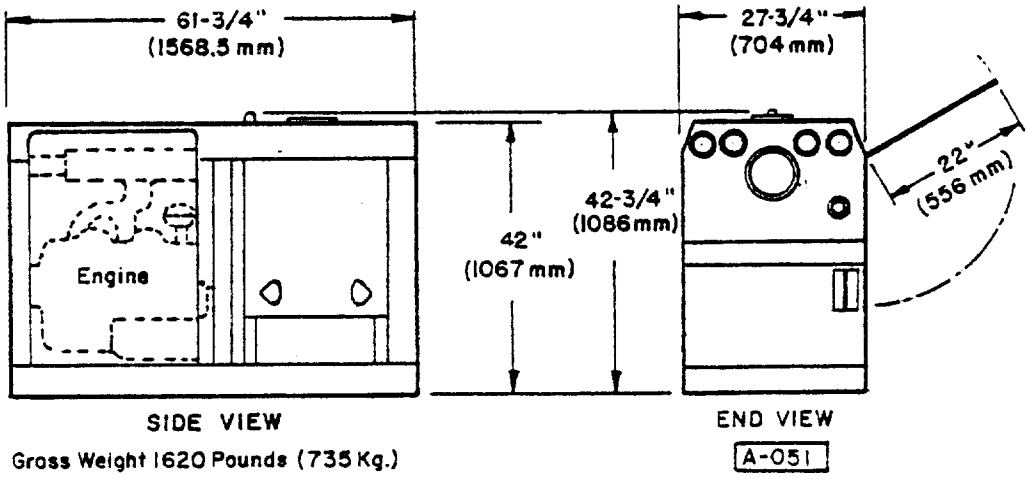
The unit dimentions are shown in Figure 6. The unit frame is drilled and tapped for 3/8-16 UNC bolts for mounting. The unit should be firmly attached to a support base to prevent movement during operation.

WELDING LEADS

Table 3 shows welding lead sizes recommended for various lengths of leads. The footage shown includes complete welding circuit, both electrode and work leads.

TRANSPORTING MACHINE WITH A FORKLIFT TRUCK

To transport the machine with a forklift truck, run a chin through the lifting eye of the machine and wrap it around the tines of the forklift truck. Then hook the chain to itself. Once this is done, you are ready to transport the machine with the forklift truck.



Outline Dimensions
Figure 6

Welding Current Amperes	LENGTH OF LEAD CIRCUIT IN FEET (AND METERS) TOTAL OF BOTH ELECTRODE AND WORK LEADS												
	60 (18M)	100 (31M)	125 (38M)	150 (46M)	175 (53M)	200 (61M)	225 (69M)	250 (76M)	275 (83M)	300 (91M)	350 (107M)	400 (122M)	500 (152M)
100	No. 4	No. 4	No. 4	No. 4	No. 2	No. 2	No. 2	No. 2	No. 1	No. 1	1/0	1/0	2/0
150	No. 2	No. 2	No. 2	No. 2	No. 1	No. 1	1/0	1/0	2/0	2/0	3/0	3/0	4/0
200	No, 2	No. 2	No. 2	No. 1	1/0	1/0	2/0	2/0	3/0	3/0	4/0	4/0	–
250	No. 2	No. 2	No. 1	1/0	2/0	2/0	3/0	4/0	–	–	–	–	–
300	No. 1	No. 1	1/0	2/0	3/0	3/0	4/0	–	–	–	–	–	–

Suggested Copper Welding Lead Size Guide
Table 3

OPERATION

PRESTARTING INSTRUCTIONS

In all probability, the welding unit will be moved from one location to another many times during its lifetime of service. Therefore, reference to INITIAL PREPARATION FOR USE is suggested each time the unit is moved prior to using it.

1. **Check the supply of fuel and crankcase oil. See Engine Operating Manual.**

2. **Inspect the unit thoroughly to be sure it is in proper working order. Check all fuel line and wire connections to be certain they are secure. Tighten any loose screws, nuts or bolts.**

3. **Wipe off the entire unit and clean the air passages, control box and hard-to-reach places with compressed air not over 25 psi (172 kPa).**

> **WARNING: Make sure that no loose bars, tools, parts, etc., are in or on any part of the engine as they could cause serious damage to the engine, generator, or personal injury to anyone standing nearby.**

4. **If the unit is operated indoors, make sure that an exhaust line is properly connected to the engine exhaust system, and discharges out of doors. Avoid short bends or reduction in line size in exhaust pipes, and locate the unit so as to necessitate the shortest possible exhaust line to insure the least amount of back-pressure on the engine. Back-pressure can cause engine damage and loss of power.**

5. **Attach welding leads, as described under INITIAL PREPARATION FOR USE: Observe Table 3 and determine that welding leads are proper size for amperage being used for welding.**

> **NOTE: Read *NEW ENGINE BREAK-IN* information in ENGINE STARTING AND OPERATING INSTRUCTIONS.**

STARTING THE ENGINE

1. **Carefully read and follow Safety Warnings in front of this manual and instructions in preceding section entitled: INITIAL PREPARATION FOR USE.**

2. **Open fuel shutoff valve at fuel tank.**

3. **Pull choke knob "out" if engine is cold. Turn ignition switch fully to the right until engine starts, then let switch return to center position. Adjust choke setting to keep engine running smoothly and push choke "in" all the way, as soon as possible.**

> **CAUTION: Unnecessary use of choke shortens engine life considerably. Crank engine no longer than 15 seconds at a time, and wait a short period of time between cranking attempts, to allow starting motor to cool.**

4. **Check engine for low oil pressure, leaks, or malfunctioning parts. If oil pressure is not sufficient – at least 8 psi (55 kPa) after 10 seconds, stop the engine to determine cause. Minimum oil pressure is 8 psi (55 kPa) in idling mode. Observe precautions listed under STARTING AND STOPPING THE ENGINE, in the Engine Starting and Operating Instructions.**

WELDING

After all Prestarting Instructions have been carried out, the controls for using the generator may be set, and welding accomplished. Follow the procedures below for various types of welding available with this machine.

SHIELDED METAL ARC WELDING

1. **Attach a welding lead to the "work" and to the Positive CC terminal. Attach a welding lead to the Negative CC-CV terminal. See Table 3 for correct lead sizes. These connections are for "stick" welding DCSP. Transpose these connections for DCRP.**

2. **Start engine and bring to rated RPM.**

3. **Set the Range Switch to the desired amperage range. Be certain that switch is in detent position so that arrow on switch coincides with arrow on panel.**

4. **Insert correct electrode in electrode holder.**

5. **Set Fine Current Control at minimum setting.**

6. **Set Mode Switch to CC.**

SHIELDED METAL ARC WELDING (Continued)

7. Set Toggle Switch to CV welding.

8. Strike arc.

9. Adjust Fine Current Control if required.

10. If Range Switch must be adjusted, break arc. Do not change setting of Range Switch while welding.

MICRO-WIRE WELDING [UP to .045 inch (1.143 mm) solid wire at 250 amperes]

1. Attach a welding lead to the work end to the NEGATIVE CC-W terminaL Attach a lead to the wire feeder and to the POSITIVE CV MICRO-WIRE terminal

> **CAUTION: Be certain to check circuit compatibility for wire feeders. Damage to welding generator circuits and wire feeder may result if circuits are incompatible.**

2 Connect control leads between wire feeder and Wire Feeder Receptacle.

3. Plug wire feeder power leads to 115-V AC duplex receptacle on the Control Panel, if wire feeder is equipped with standard AC plug.

4. Set MODE SWITCH to CV welding mode.

5. Set Toggle Switch to CV welding.

6. connect shielding or cooling accessories which may be used with certain types of welding guns.

7. Start generator engine, adjust Throttle to produce rated operating RPM.

8. Proceed with welding as instructed in wire feeder manual.

MULTI-WIRE WELDING [.045 inch (1.143 mm) and larger diameters at welding currents over 250 amperes]

1. Attach a welding lead to the work and to the NEGATIVE CC-CV terminal. Attach a lead to the wire feeder and to the POSITIVE CV MULTI-WIRE terminal.

2. Make certain that the correct guides and wire feed rolls are installed in the wire feeder for the diameter of wire electrode to be used.

3. Proceed as in steps 2 through 8 preceding.

DRAWING AUXILIARY POWER

Electric power may be drawn from the receptacles on the control panel, at any time that the generator is operating at rated RPM.

VOLTAGE REGULATION

The output voltage will be maintained within 5% by the voltage regulator. if load is added or removed, any resulting voltage increase or decrease will be recovered within one second.

STOPPING THE ENGINE

1. Break the welding arc.

2. Pull the engine throttle control OUT from the panel as far as it will go. Engine will reduce RPM. Move the START-RUN-OFF Switch to OFF position.

3. Allow engine to cool sufficiently, then check coolant and crankcase oil level. If engine oil is to be changed, it can be done most effectively while engine is still warm.

4. After engine has cooled completely, fill the fuel tank. See SAFETY WARNINGS at front of this manual for precautions that should be taken when filling the fuel tank.

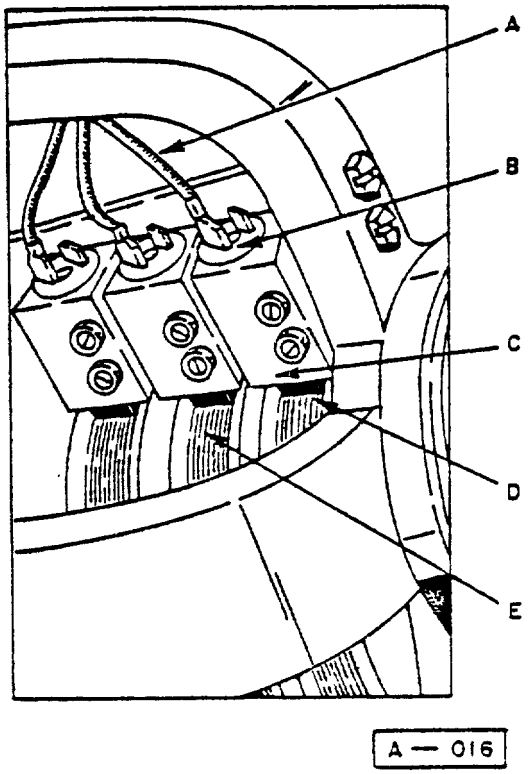
STORAGE

NIGHTLY - After operation, the following steps should be taken before storing the welding machine for short periods of time.

1. Close fuel shutoff valve at the tank, and cover unit with a tarpaulin, if stored outdoors.

2. Clean up around work area. Put all tools, parts, and supplies in their proper places.

3. Disconnect welding leads from machine. Coil them and store away in their place.



Exciter/Auxiliary Brushes
Figure 7

LOSS OF MAGNETISM

If generator fails to build up voltage after attaining full RPM (1800-1825 RPM), it may be caused by the exciter having lost its residual magnetism in shipping or moving the unit Verify this loss of magnetism by measuring the A-C exciter output voltage at the receptacle. If less than 6 volts, proceed as follows:

Shut engine down. Replace 4-ampere fuse in the automatic field-flashing circuit. (See Connection Diagram.) Restart the engine to remagnetize the generator.

SLIP RING CLEANING

If the slip rings get dirty, clean them while they are rotating, by using a wooden stick to apply a piece of heavy canvas to them.

WARNING: Do not use a metal rod to apply the canvas.

RANGE SWITCH MAINTENANCE

Due to a tight fit of the switch housing, burred contacts or congealed grease, operation of the switch may become stiff or totally impaired. The switch will have to be dismantled to inspect and dean it. Proceed as follows to service the switch. See Figure 8 for details and callouts found in the text.

NOTE: It is not necessary to disconnect the wiring from the switch. Do not remove the switch assembly from the front panel as a complete assembly, but remove it by disassembling, as follows:

1. Remove three screw (1), and take the handwheel assembly (2) off from the switch.

2. Remove the snap-ring (3) and washer (4). Snap-ring pliers will be needed to remove the snap-ring.

3. Slide the front-plate assembly (5) (which includes plate, lugs, bushing and also the contact mount and actuating screws) off from the post (8) on the back plate. This post extends, through the switch, and Protrudes out through the front panel (6).

4. Clean the internal parts of the switch, removing congealed grease, preferably using a non-f!ammable solvent.

5. Check for and remove any burrs which may be found on the switch contacts (7), using a fine file or suitable sandpaper.

6. Apply a light coat of grease recommended for use on electrical equipment, and reassemble the switch. Follow the above sequence in reverse, to reassemble the switch. See Figure 8.

ADVERSE WEATHER PRECAUTIONS (Continued)

OPERATION IN SALTWATER AREAS

a. CANOPY - Wash canopy regularly to remove salt film. **Repaint any damaged places and** oil the side panel hinges regularly.

b. COVERING -To protect generator as much as **possible from salt water atmosphere, keep the side panels** on the canopy **closed. It is advisable to keep the unit covered with** a **tarpaulin, if available, while not in operation. Salt water should be wiped from the engine, and all terminals and connections in the electrical system wiped dry. Keep all linkage oiled.**

c. BRUSHES - The brushes of the exciter should be inspected regularly to **make certain that they are free in the holders. Lift the brushes in the brushholders about every two days to insure their freedom to slide within the holder. Wipe dry all the parts that can be reached, and use compressed air, if available, to dry the parts of the generator that cannot otherwise be reached. See MAINTENANCE for brush care.**

d. BATTERY TERMINALS - Thoroughly clean the battery terminals and connections. Coat terminals and connections with petroleum jelly to retard corrosion.

MAINTENANCE

NOTE: Check the Starting and Operating Instructions for the Model V-465D Air-Cooled Engines, furnished with this manual for all engine-related maintenance.

A proper preventive maintenance program consisting of a **schedule of inspection and cleaning is the basis of good welding machine care, and the key to long, untroubled operation.**

INSPECTION

A periodic inspection of the equipment should be established and maintained. The following inspections and time periods are recommended.

EVERY DAY – Check all power cables and hoses for cuts and other damage. Repair any damage immediately to prevent shorts, damage spreading, etc.

Check for oil or fuel leaks. Check oil pressure at 1800 RPM. If oil pressure is less than 15 psi (103 kPa), shut off **engine and check for defective oil pump, filter or clogged oil lines.**

Check battery ammeter. Charging rate with fully charged battery should be 2 to 3 amperes at 1800 RPM.

ONCE A WEEK - Check tightness of all electrical *connections.* If arcing has occurred at any connection, recondition it **and, if it's a power cable connection,** cover **mating surfaces with a light, uniform coat of electrical joint compound before reassembling. Electrical joint compound is available in 5 oz. (141.8 g) tubes part no. 903170).**

EVERY MONTH - Check generator for amperage and voltage output. If generator fails to build up voltage after starting, the exciter may have lost its residual **magnetism. Refer to instructions under LOSS OF MAGNETISM.**

CLEANING

The unit should be cleaned periodically, as required. Do not allow a dust buildup to occur on the unit. Do not **operate the unit if moisture accumulation or condensation has occurred. Use clean, dry compressed air, with a pressure not to exceed 25 psi (172 kPa), to clean dust and dry moisture from surfaces and terminal blocks.**

WARNING: Do not use flammable cleaning materials, gasoline, naptha, etc., to clean unit. Do not use chemically treated cleaning rags to clean terminal blocks, or electrical components.

Blow out generator windings with compressed air, not over 25 **psi (172 kPa) pressure or remove with a suction type cleaner with a non-metallic nozzle. If windings should become slightly damp, use space heaters or electric light bulbs to effectively dry out the windings. If dampness is excessive, apply external heat under a canvas cover, well vented. Heating should not exceed 194°F (90°C).**

LUBRICATION

WELDING GENERATOR - The generator end bearing is the only point on this generator requiring lubrication. This bearing is packed with enough grease when the unit leaves the factory to last 6 to 8 months under the most severe use. Greasing twice yearly is sufficient for the bearing under normal use. Pressure fittings are not recommended because grease, under pressure, may go through the bearing grease seal and onto the commutator, causing poor commutation and possible damage to the commutator.

Dirt causes more ball bearing failures than any other thing. Dirt may get into the grease when the bearing cap is removed for inspection. Therefore, it is not advisable to inspect the bearing more often than about twice yearly, and then before removing the bearing cap, always wipe it absolutely clean.

Remove as much old grease as possible and wash out cap and bearing with kerosene, MIL-PD-680. DO NOT use gasoline. Fill the clean bearing cap about 1/3 full of high quality ball bearing grease. Work as much grease as possible into the bearing. Place cap into position and bolt-tightly. (MIL-L-10924)

> WARNING: Do not use gasoline or other highly flammable solvents for cleaning bearings.

> CAUTION: Do not overlubricate or allow lubricant to become contaminated. Do not use ordinary cup grease or graphite based lubricants.

Manufacturer has available a special ball bearing grease (part no. 4141 32) in one-lb. (0.45 kg) containers.

ENGINE - Refer to Engine Manual for specifics on lubrication.

EXCITER/AUXILIARY BRUSHES

INSPECTION - Every three months (weekly during heavy usage in dust-laden air) remove the covers from the exciter/auxiliary brushes. They are located at the control panel end of the generator. If the brushes are worn unevenly or are shorter than 7/16 inch (11 mm), replace all 3 brushes.

> NOTE: Under normal use, the slip rings will turn a dark brown color.

> CAUTION: Don't allow any of the brushes to wear far enough that the lead imbedded in the brush can rub on the slip rings.

INSTALLATION - Refer to Figure 7

1. Disconnect leads (A) from connectors on brushholder caps (B).

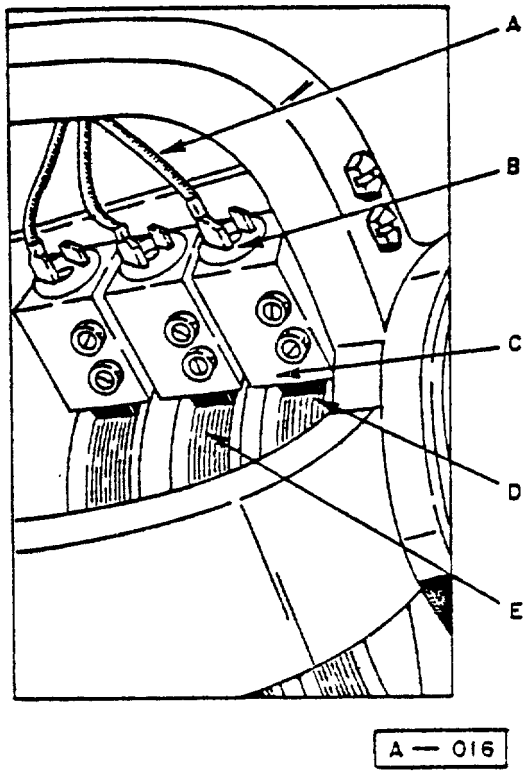
2. Lift brush (D)) from brushholder (C) for inspection. If brushes are worn unevenly, or are shorter than 7/16 inch (11 mm), replace them.

3. Inspect slip rings whenever brushes are removed for servicing brushes or brushholders. Note surface condition of rings. Surface should appear smooth and clean. Scoring or roughness of slip rings may be caused by grit or abrasive substance in brushes, or by oil on the rings Moderately rough slip rings can be smoothed by holding grade 00 flint paper against their surface while the rings are revolving slowly. If the rings are badly scored, the unit must be sent to an overhaul facility for repair. After cleaning slip rings, blow dirt and grit out of the unit with compressed air. Do not use over 25 psi (172 kPa) air pressure to blow dirt out.

4. Slip new brushes into brushholder guides, and piece caps on top, and screw them into the guides to a "bottomed" position. The spring attached to the brush will determine the pressure at which the brush contacts the slip rings.

5. To fit new brushes to the slip rings, lay a strip of No. 00 sandpaper, smooth side down, on slip ring surface, and draw sandpaper in the direction of rotation of the slip ring, lifting the brush on the return stroke. Continue until the brushes have same curvature as the slip rings. Blow all carbon dust out of the machine using not over 25 psi (172 kPa) air pressure.

> CAUTION: When removing the lead wires, do so one at a time and replace each brush accordingly, to insure that the lead wires are put back onto the proper brushes.



Exciter/Auxiliary Brushes
Figure 7

LOSS OF MAGNETISM

[f generator fails to build up voltage after attaining full RPM (1800-1825 RPM), it may be caused by the exciter having lost its residual magnetism in shipping or moving the unit Verify this loss of magnetism by measuring the A-C exciter output voltage at the receptacle. If less than 6 volts, proceed as follows:

Shut engine down. Replace 4-ampere fuse in the automatic field-flashing circuit. (See Connection Diagram.) Restart the engine to remagnetize the generator.

SLIP RING CLEANING

If the slip rings get dirty, clean them while they are rotating, by using a wooden stick to apply a piece of heavy canvas to them.

WARNING: Do not use a metal rod to apply the canvas.

RANGE SWITCH MAINTENANCE

Due to a tight fit of the switch housing, burred contacts or congealed grease, operation of the switch may become stiff or totally impaired. The switch will have to be dismantled to inspect and dean it. Proceed as follows to service the switch. See Figure 8 for details and callouts found in the text.

NOTE: It is not necessary to disconnect the wiring from the switch. Do not remove the switch assembly from the front panel as a complete assembly, but remove it by disassembling, as follows:

1. Remove three screw (1), and take the handwheel assembly (2) off from the switch.

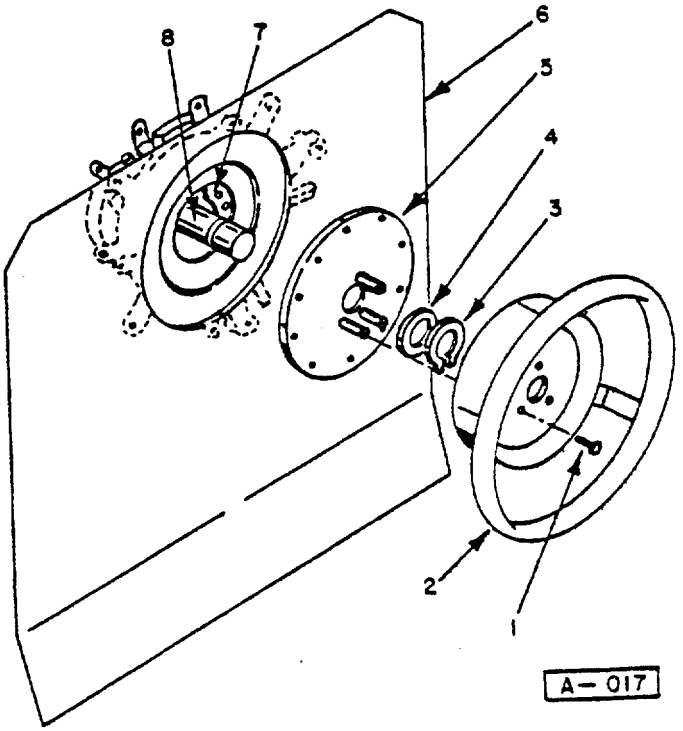
2. Remove the snap-ring (3) and washer (4). Snap-ring pliers will be needed to remove the snap-ring.

3. Slide the front-plate assembly (5) (which includes plate, lugs, bushing and also the contact mount and actuating screws) off from the post (8) on the back plate. This post extends, through the switch, and Protrudes out through the front panel (6).

4. Clean the internal parts of the switch, removing congealed grease, preferably using a non-f!ammable solvent.

5. Check for and remove any burrs which may be found on the switch contacts (7), using a fine file or suitable sandpaper.

6. Apply a light coat of grease recommended for use on electrical equipment, and reassemble the switch. Follow the above sequence in reverse, to reassemble the switch. See Figure 8.



Range Switch Dismantling
Figure 8

TROUBLESHOOTING

The following chart contains information which can be used to diagnose and correct unsatisfactory operation or failure of the various components of the machine. Each symptom of trouble is followed by a list of probable causes and pro-cedure to correct them.

TROUBLE	POSSIBLE CAUSE	REMEDY
ENGINE	see Engine Instruction Book and Parts List	
Engine will not start	a Engine ignition problem	a. See Engine Manual.
	b. Overspeed relay control board malfunction	b. Refer to Control Box Malfunction, page 18, for detailed troubleshooting instructions.
Engine starts but won't continue in operation	a. Faulty ignition switch	a. Replace ignition switch
	b. Timer Board malfunction	b. Same as b. above.
	c. Overspeed relay control may be causing engine to stop, due to increase in engine speed after break-in.	c. Readjust engine no load operating speed.
WELDING GENERATOR		
No output	a. Loose connection	a. Check connections completely.
Generates less than 10 volts	a. Open circuit in revolving field coils	a. Replace coil(s).
	b. Engine speed too slow	b. increase engine speed to 1800-1840 RPM - no load.
	c. Brush and slip rinq dirty	c. Check brushes and clean slip rings.
	d. Defective rheostat	d. Replace or repair.
	e. Range Switch positioned between setting	e. Adjust to detent position.
	f. Range Switch defective	f. Repair or replace.
	9. Defective wiring	9. Check and repair.
	h. Shorted diode	h. Check and replace defective diode.
	i. Lose of residual magnetism	i. Replace fuse. See LOSS OF MAG-NETISM.
No voltmeter reading - no ammeter reading	a. Faulty voltmeter	a. Check connections and replace meter if necessary.
	b. Faulty ammeter	b. Check connections or replace meter.
	c. Generator does not "build-up" (loss of magnetism)	c. Replace fuse. See LOSS OF MAG-NETISM.

TROUBLE	POSSIBLE CAUSE	REMEDY
No voltmeter reading - no ammeter reading (continued)	d. Faulty regulator board	d. Refer to Control Box Malfunction, page 18, for detailed troubleshooting instructions.
Voltage too high	a. Engine overspeeding	a. Check engine RPM; should read 1825-1840 (no load).
	b. Faulty regulator board	b. Same as d. above.
Voltage too low	a. Engine running underspeed	a. Check engine RPM.
	b. One or more revolving field coils shorted	b. Replace defective coils.
Operator gets shock when welding generator is touched. Operator gets shock when ground cable, work or work table is touched.	a. Welding generator not grounded	a. Ground welding generator chassis.
	b. Work table and work not grounded	b. Ground work and work table to plant ground.
Abnormal current fluctuation, voltage nearly constant	a. Irregular wire feed speed	a. See welding head manual.
	b. Inadequate shielding of arc by "flux or gas	b. Increase shielding by trial and error. See welding head manual.
	c. Wire feed rate too slow	c. Increase wire feed. See wire bum-off rate charts.
	d. Too much shielding gas	d. Decrease by trial and error. See welding head manual.
	e. Loose cable connections	e. Check for overheated connections and tighten.
	f. Welding contact tube (tip) on wire feeder makes poor contact with electrode	f. Check contact tube hole size and replace with proper tube.
Contactor fails to open	a. Contactor contacts sticking	a. Clean contacts.
Line contactor fails to close	a. Faulty Control Board	a. Refer to Control Box Malfunction, page 18, for detailed troubleshooting instructions.
Contactor chatters	a. Line leads too small	a. Use larger leads.
	b. Low line voltage	b. Check line voltage.

CONTROL BOX MALFUNCTION TROUBLESHOOTING INSTRUCTIONS

The control box used on the GCC-300-W is composed of several printed circuit boards. However, troubleshooting is no more difficult than troubleshooting conventional control circuits. Do not overlook the obvious. As in the case of all electrical equipment loose connections are the primary cause of malfunction, both internal and external to the welding machine. In general, the things to look for are: bad grounding connections, worn contact tubes (tips), dirty cable liners, shorted control cables, wrong control settings, blown fuses, worn contactors, and misconnection from wire feeding equipment.

The only equipment needed to property detect problems in this control box is a simple volt-ohm meter. If the control box is suspected of being the cause of a problem, first check the fuse on the top of the control box, If it is blown replace with a 10 ampere fuse.

1. ENGINE WON'T START

& Check to see if the relay on top of the control box is closing. *If not* check with volt-ohm meter (VOM) to make sure that 12 volts DC power is present on pin # 10 (yellow-wire), with the ignition switch in the RUN position, and in the START position. Also check pin # 12 (brown wire) for 12 volts DC with the ignition switch in the START position. If these tests show 12 volts DC at these points, the malfunction is probably in the control box, which should be exchanged. No *attempt* should be made to repair the box.

2. ENGINE STARTS BUT WILL NOT CONTINUE TO RUN

a. Using a VOM, check for 12 volts DC current between the positive terminal on the ignition coil, and ground during starting, and after the ignition switch is released to the RUN position. There should be 12 volts DC between the coil and ground for a minimum of 10 seconds after the engine starts. *If not,* the control box timer board is probably malfuctioning. If there is 12 volts DC at this point, check the engine oil pressure and low oil pressure switch for proper operation.

3. CONTACTOR WILL NOT CLOSE

a. Using a VOM, measure the voltage between the contactor coil and ground. This value should be 115 volts DC If you have no voltage, but have 115 volts AC at the receptacles, the contactor control board is probably faulty. Replace the control box assembly.

b. If there is 115 volts DC between the contactor coil and ground, the contactor coil is probably faulty. Replace contactor.

4. NO AC VOLTAGE

a. Check fuse in field flashing circuit on control panel. If fuse is blown, replace with 4 ampere fuse.

b. Measure voltage between exciter positive slip ring and ground while starting. It should be 12 volts DC; if not, the voltage regulator board is probably faulty. Replace the control box assembly.

c. If there is 12 volts DC between the slip ring and ground. the exciter is not building up, and there is probably nothing wrong with the control box. See Loss of Magnetism.

5. HIGH AC VOLTAGE

a. Adjust the voltage regulator by removing the control box cover and adjusting' the potentiometer in the upper right-hand and corner of the control box. If this does not bring the AC voltage down, the voltage regulator is probably faulty, and the control box assembly should be replaced.

IMPORTANT: IF CONTROL IS MALFUNCTIONING AS DETERMINED BY THE TROUBLESHOOTING INSTRUCTIONS IN THIS TECHNICAL MANUAL, ORDER A REPLACEMENT FROM THE FACTORY AND RETURN THE DEFECTIVE BOX, FREIGHT PREPAID, FOR APPLICABLE EXCHANGE CREDIT.

SOLID STATE ELECTRONIC CONTROL MODULE EXCHANGE SERVICE POLICY

Because of the definite superiority of certain solid. state control components over conventional electro-mechanical relays and regulators,

product lines now incorporate solid-state controls for applications in which they may be used to advantage. To facilitate tasting and servicing, these control components and circuits have been assembled as modules on printed circuit boards, mounted in such a manner as to be quickly and easily removed. Electrical connections to other components of the unit are by means of plug-in or "Faston" connectors.

In recognition of the fact that most users of this equipment lack the facilities and specially trained personnel nessary to service and repair solid-state electronic equipment, the manufacturer has established a control module exchange service plan.

Under the Control Module Exchange Plan, the owner of the equipment may exchange the entire module in which fault has developed for a new or factory rebuilt replacement A standard exchange price has been established for each module design which applies, without regard to the amount of repair required to the original turned in, which is applied against the cost of the replacement Exchange prices for specific modules may be determined by contacting an authorized distributor or by writing to the factory, giving the SPECIFICATION, MODEL, and SERIAL numbers of the unit in which the module is installed.

This Exchange Plan applies only to specified solid-state control components and circuity which have failed due to electrical fault or normal deterioration resulting from use and age. The plan does not cover parts which have been physically damaged through accident or abuse, or to which unauthorized repairs have been made or attempted.

Parts List

EQUIPMENT IDENTIFICATION - An identification plate on the unit's control panel shows its model number, serial number, and specification number. Whenever ordering parts or making inquiries, furnish all these numbers.

NOTE: A "specification number" must have a "dash number" suffix (-1, -2, -3, etc.) in order to be a complete number.

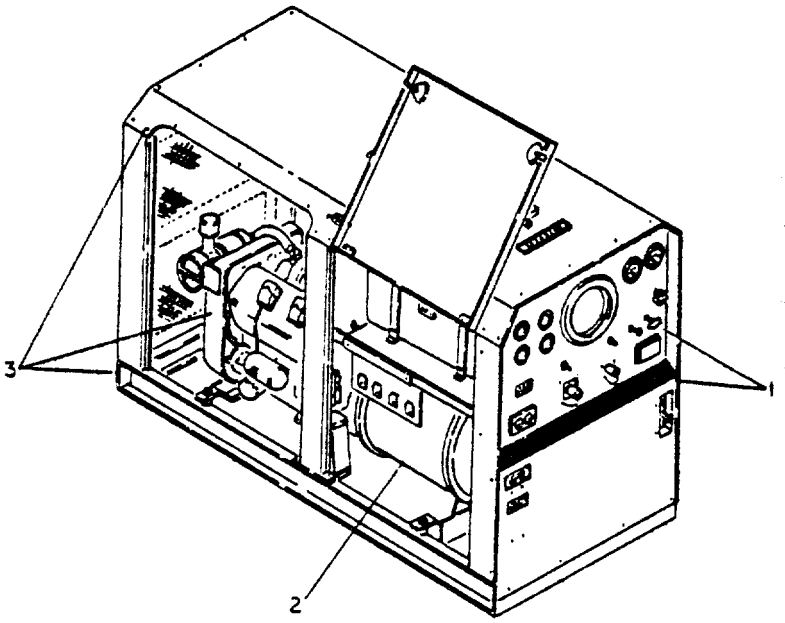
HOW TO USE THIS PARTS LIST - The part name listings may be indented to show part relationships as indicated In the following example.

Fig. No.	Item No.	Part No.	Nomenclature	Units per Assembly	Application Code
1 -		123456	Assembly (Not Shown)	1	
	1	234567	. A detail of assembly	1	
	2	345678	. A sub-assembly	1	
	3	456789	. . A detail of sub-assembly (Item 2)	1	
	4	567891	. . A sub-assembly of Item 2	1	
	5	678910	. . . A detail of sub-assembly (Item 4)	1	

Locate the specification number below that appears on your unit, and note the "APPLICATION CODE" letter adjacent to it. (If no application code appears below, the parts list is applicable to only the one specification number that appears below.)

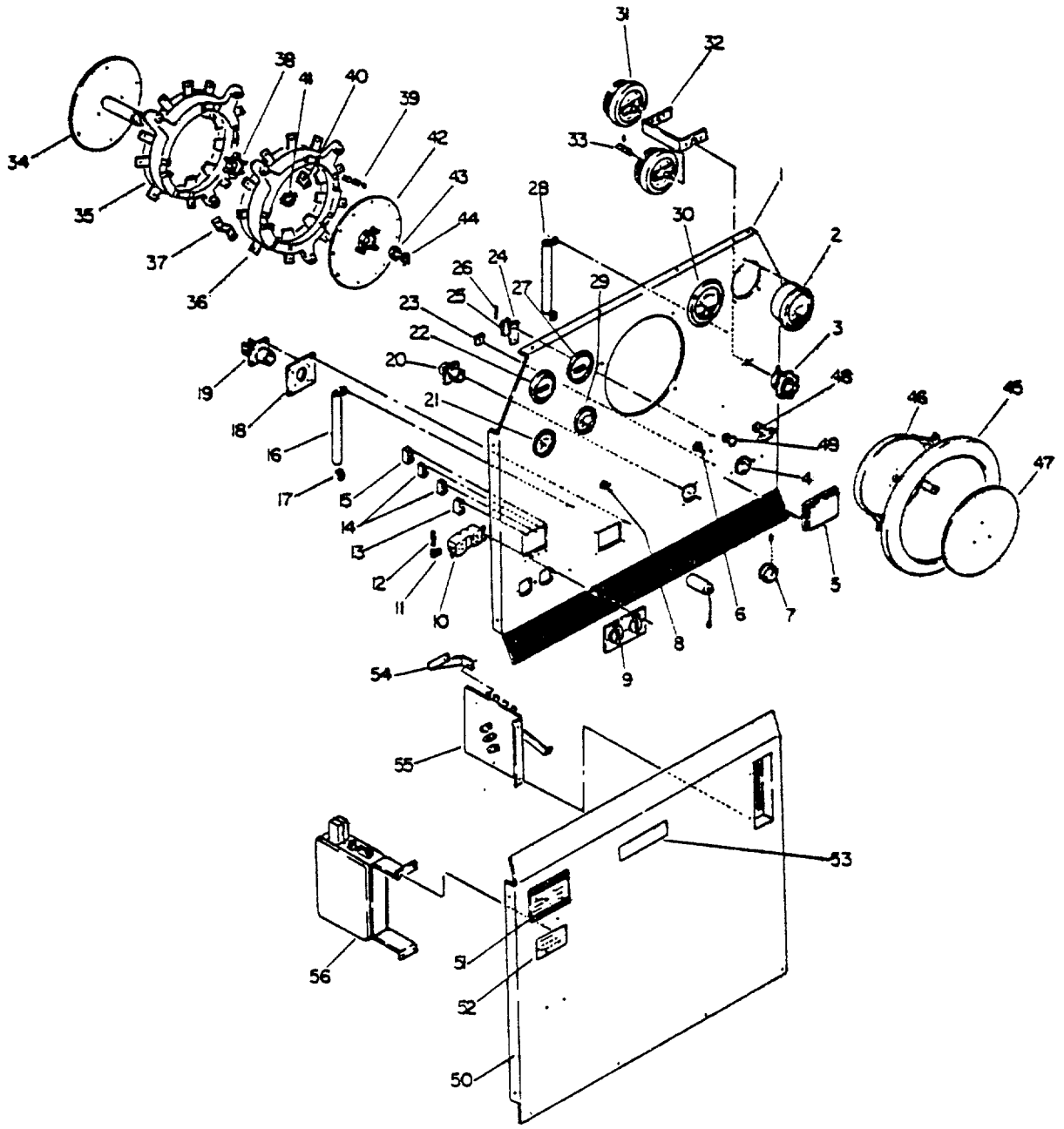
SPECIFICATION NUMBER

6101A-1



CC/CV Welding Machine
Figure A-1

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-1		6101A-1	CC/CVR WELDINGMACHINE	REF.
	1	NO NUMBER	.CONTROL PANELS, UPPER END LOWER (FOR DETAILS SEE FIG. A-2)	REF.
	2	NO NUMBER	.GENERATOR GROUP (FOR DETAILS SEE FIG. A-3)	REF.
	3	NO NUMBER	.FRAME AND CANOPY GROUP (FOR DETAILS SEE FIG. A-4)	REF.

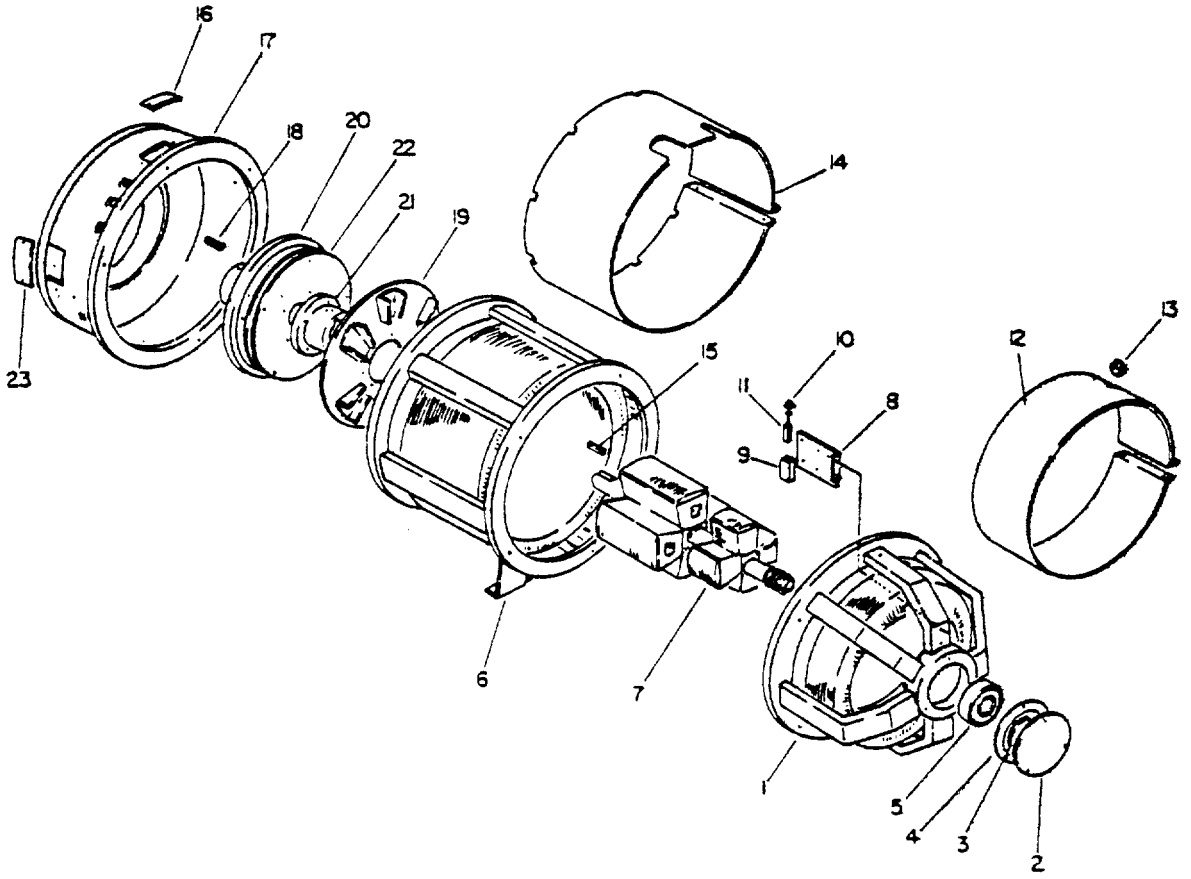


Control Panel Group
Figure A-2

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-2		491102	PANEL - CONTROL, ASSEMBLY	1
	1	491066	.PANEL	1
	2	400641-8	.AMMETER - DC,SINGLE SCALE, 0-800 V60741	1
	3	AAW-835A	.KNOB - RHEOSTAT V92701 NO. 4103AX	1
	4	50GH-937-0	.RECEPTACLE - 3 WIRE V83315	1
	5	404278	.COVER - RECEPTACLE V81703, NO. WPC-5FS	1
	6	402662	.SWITCH - TOGGLE V73559, NO. 2GK71-73	1
	7	404875	.CAP AND CHAIN - ASSEMBLY V07497, NO. 9760-18	1
	8	404856	.SWITCH - TOGGLE V15605, NO. 8860 K5	1
	9	404277	.COVER - RECEPTACLE, DUPLEX V81703, NO. WPDC	1
	10	402670	.RECEPTACLE - DUPLEX, 3 WIRE V81091, VO.5250T	1
	11	W-10051-8	.CLAMP - PLASTIC V81074	1
		16DA-4137	.SPACER	1
	12	490874	.CAPACITOR-5uF,400 V DC	1
	13	404889-3	.CIRCUIT BREAKER - 40 AMP V74193, NO. AMI-A3A	1
	14	404889-1	.CIRCUIT BREAKER - 15 AMP V74193, NO. AMI-A3-A	2
	15	404889-4	.CIRCUIT BREAKER - 20 AMP V74193, NO. AMI-A3-A	1
	16	W-2974L	.RESISTOR - 100 W, 50 OHM V44655, NO. 0959	1
	17	400078	.BRACKET - MOUNTING	2
	18	490831	.BOARD - INSULATING	1
	19	405561	.RECEPTACLE V98410, NO. 11674728	1
	20	405574	.RECEPTACLE - AMPHENOL V14894, NO. MS3100R	1
	21	402889-1	.AMMETER - BATTERY V09527, NO. 4015	1
	22	W-9916-13	.METER - FREQUENCY V31356	1
	23	404065-3	.RECTIFIER - SILICON V04713 NO. VK447	1
	24	358951	.INSULATOR - FLASHING KIT	1
	25	490581-3	.BOARD - FLASHING, ASSEMBLY	1
	26	400782-2	..FUSE - 4 AMP	1
	27	W-9917-4	.METER - HOUR, RUNNING TIME V74400	1
	28	CW-1150	.RESISTOR - DISCHARGER V44655	1
	29	DW-6080	.GAUGE - OIL PRESSURE V81082	1
	30	400642-4	.VOLTMETER - DC, SINGLE SCALE 0-100 V60741	1
		490921	.RHEOSTAT - ASSEMBLY	1
	31	AW-590	..RHEOSTAT - 150 WATT, 200 OHM	2
	32	359576	..BRACKET - MOUNTING RHEOSTAT	1
	33	359577	..ADAPTER - RHEOSTAT TO RHEOSTAT	1
		359578	SWITCH - RANGE, ASSEMBLY	1
	34	351316	.PLATE - BACK MOUNTING	1
	35	430548-4	.RING - CONTACT	1
	36	430548-2	.RING - CONTACT	1
	37	357083	.BAR - BUS	5
	38	366589	.HUB - DRIVING	1
	39	AW-459	.CATCH - FRICTION BALL	1
		366798	.CONTACT -MOVABLE, ASSEMBLY	2
	40	SW-218A	..CONTACT	2
	41	410541	..SPRING	1
	42	490463	.PLATE - FRONT	1
	43	SW-167-1	.WASHER - THRUST	1
	44	16DA-4249-8	.WASHER - SPRING	1
		SW-231	.HANDWHEEL - RANGE SWITCH ASSEMBLY	1

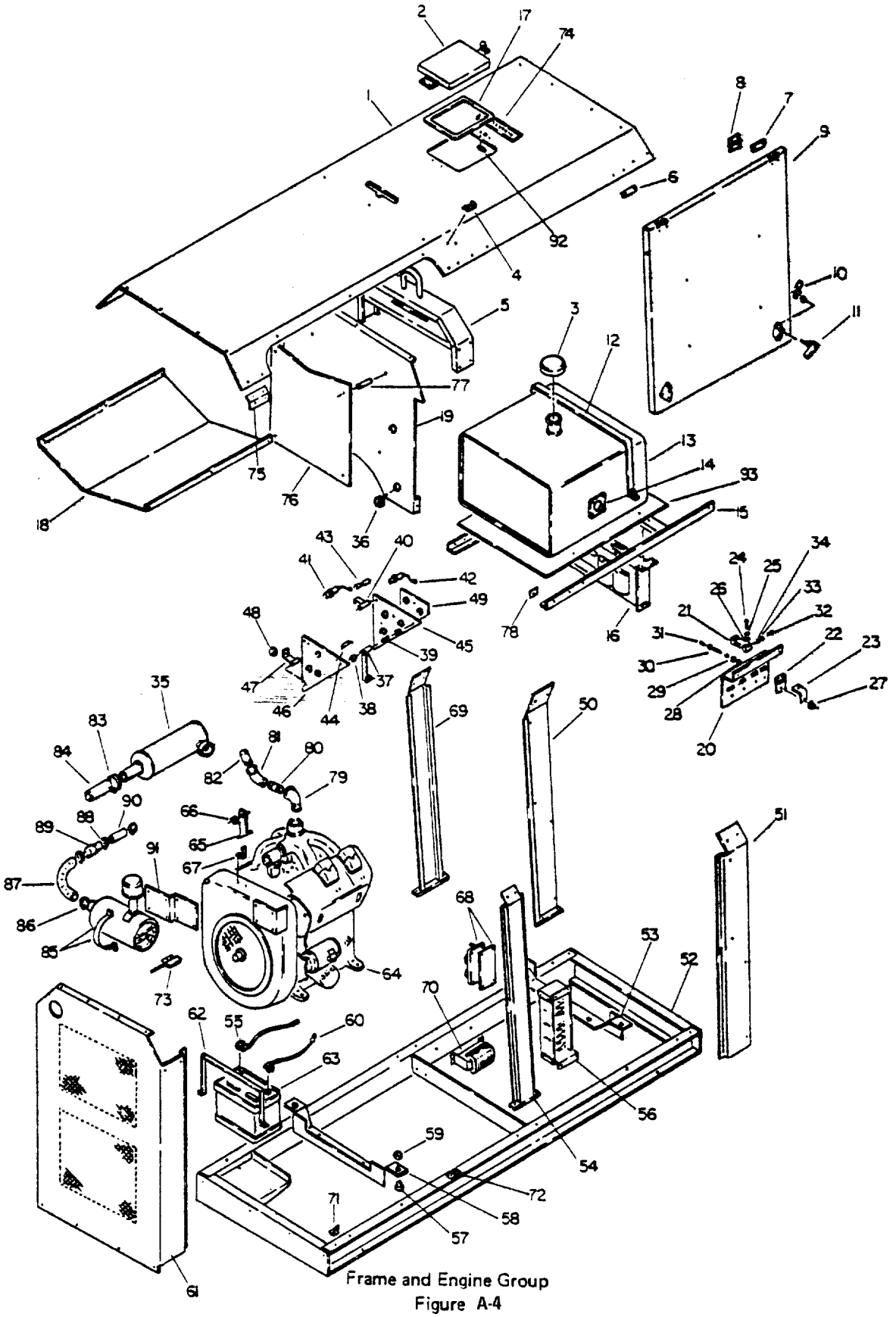
FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-2	45	SW-102A	HANDLE - RUBBER	1
	46	SW-299	PLATE	1
	47	404955	NAMEPLATE - RANGE,COARSE CURRENT	1
	48	HF-1458	ROD-THROTTLE V77574	1
		W-10981	CLAMP-THROTTLE ROD	1
	49	HF-400-0	CONTROL-CHOKE V77910	1
	50	491099	PANEL-REAR,LOWER	1
	51	404042-1	NAMEPLATE-IDENT	1
	52	490915	NAMPLATE-INDENT.GOV'T	1
	53	405660	LABEL-IDENT. GEN	1
	54	491176	BRACKET - SELECTOR SW	1
	55	491178	SWITCH - SELECTOR ASSEMBLY (FOR DETAILS SEE FIG.A-5)	1
	56	490779	BOX-CONTROL, ASSEMBLY	1
		400647-8	FUSE-ABC, 10 AMP	REF.
		401564-5	PLUG-ON CONTROLS V00779, NO.1-480438-0	1

NOT ILLUSTRATED



Generator Group
Figure A-3

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-3		490995-3	GENERATOR-300 A, AC ASSEMBLY	1
	1	356773-31	HOUSING -EXCITER, ASSEMBLY	1
	2	357520	CAP- BEARING	1
	3	5CW-96	SPACER-BEARING	1
	4	CW-1160	GASKET-BEARING	1
	5	W-11521-2	BEARING-BALL	1
	6	356773-35	HOUSING-GEN.ASSEMBLY	1
	7	359210	ARMATURE -ASSEMBLY	1
		358642	BRACKET-BRUSHHOLDER ASSEMBLY	1
	8	358880	BRACKET	1
	9	402530	GUIDE-BRUSHHOLDER	3
	10	402531	CAP-BRUSHHOLDER	3
	11	402788	BRUSH-AC	3
	12	356265	COVER-EXCITAR	1
	13	351683	GROMMET-LEAD HOLE VI1702	2
	14	490337	COVER- GENERATOR	1
	15	C-31	KEY -ARMATURE	1
	16	359952	COVER-HOLE, FLYWHEEL HOUSING	1
	17	490793-1	HOUSING-FLYWHEEL	1
	18	60GJ-18	KEY-COUPLING	1
		490806	FAN AND COUPLING-ASSEMBLY	1
	19	359537	FAN	1
	20	490692	FLYWHEEL	1
		359575-2	FLANGE -DRIVING, ASSEMBLY	1
	21	355897	HUB-COUPLING	1
	22	AAW-1323	DISC-FLEXIBLE COUPLING	2
		490910-1	CABLE-BONDING, INT	1
	23	491121	COVER-HOLE. FLYWHEEL HOUSING	1



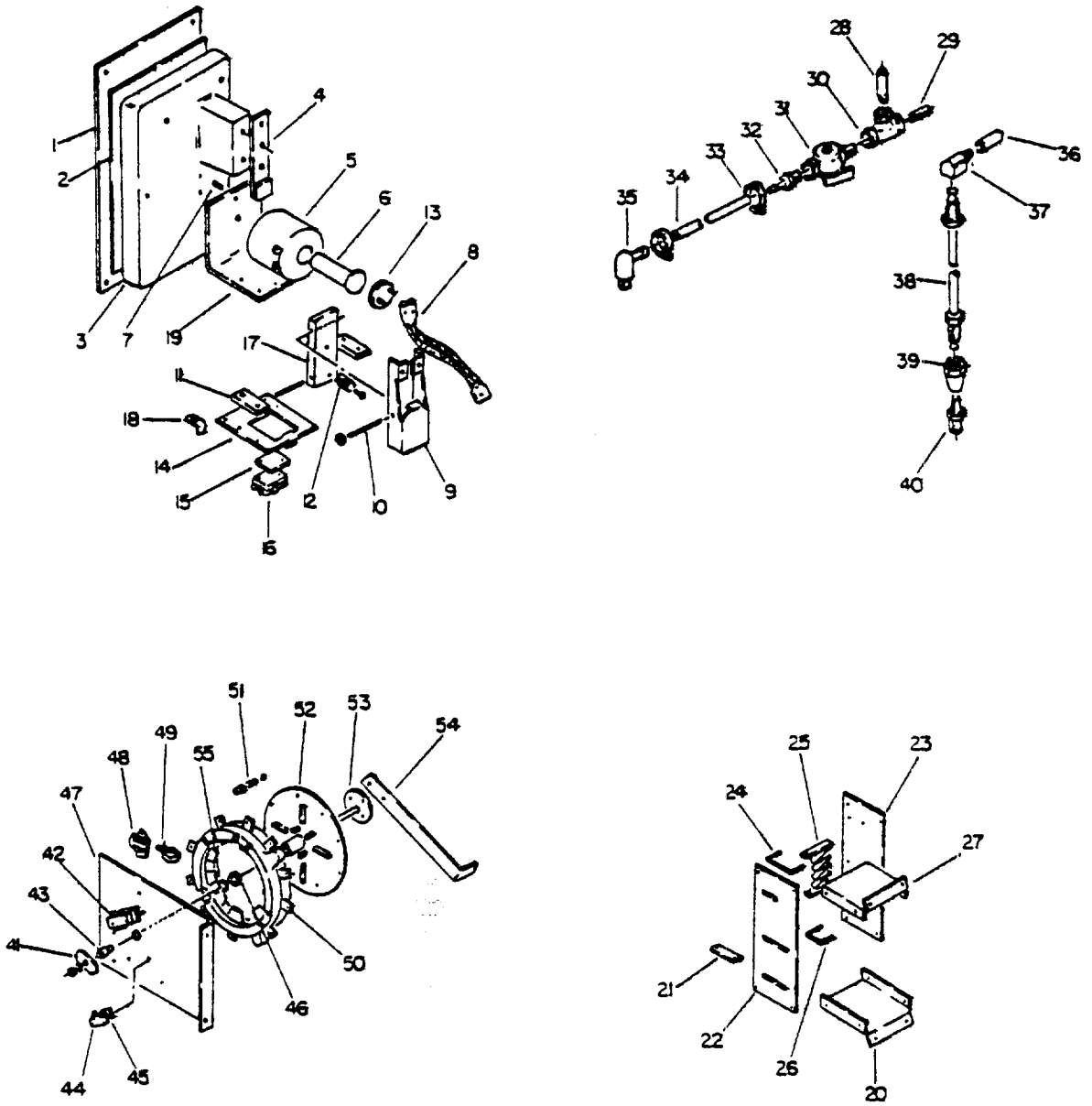
Frame and Engine Group
Figure A-4

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-4	1	49116	TOP-CANOPY	1
	2	491190	COVER-CAP, FUEL TANK	1
	3	351978	CAP-FUEL TANK	1
	4	490863	CATCH-DOOR, ASSEMBLY	2
	5	491082-1	YOKE-LIFTING, ASSEMBLY	1
	6	490174	PLATE-HINGE, UPPER	4
	7	490175	PLATE-HINGE, LOWER	4
	8	490040	HINGE-DOOR	4
	9	491118	DOOR-SIDE, LEFT	1
	10	HF-567	LATCH-DOOR	4
	11	491104	HANDLE-DOOR, LATCH	4
		50NH-270	SPACER-DOOR, LATCH	4
	12	490083	STRAP-FUEL TANK	2
	13	491096	TANK-FUEL, ASSEMBLY	1
	14	358836	GAUGE - FUEL	1
	15	491090	SUPPORT-FUEL TANK	1
	16	490258	REACTOR-CONTROL	1
	17	491184-1	GUARD-EDGE, TRIM	1
	18	491115	SHIELD-HEAT, ENGINE	1
	19	491114	SHIELD-HEAT, COMP	1
		490842	PANEL-TERMINAL, ASSEMBLY	1
	20	490841	PANEL-TERM. OUTPUT	1
	21	4DW-77	SHUNT-800 A 50 MV ASSEMBLY	1
	22	5CW-975	BUSHING	4
	23	5CW-974	BAR-BUS (L SHAPED)	4
	24	NO NUMBER	SCREW-1/2-13 X 1-1/4 HHC, ST	2
		NO NUMBER	SCREW- 1/2-13 X 3/4 HHC, ST	2
	25	NO NUMBER	WASHER-LOCK, 1/2 STEEL	9
	26	NO NUMBER	WASHER-STEEL CAD. PLATED	4
	27	NO NUMBER	NUT-1/2-13, HEX, FLANGE, STEEL	4
	28	NO NUMBER	WASHER-BAKELITE	8
	29	NO NUMBER	WASHER-FLAT, 1/2 ST	5
	30	NO NUMBER	SCREW-1/2-13, HHCS, (DRILLED FOR ITEM 30)	1
	31	NO NUMBER	SCREW-6-32X3/16, RD.HD.MH.ST	1
		NO NUMBER	SCREW-1/2-13 X 1-3/4 HHC. ST	3
	32	NO NUMBER	SCREW-8-32 X 3/8 RD. HD. MH. ST	2
	33	NO NUMBER	WASHER-#8, LOCK, STD	2
	34	NO NUMBER	WASHER-#8, FLAT BRASS	2
	35	NO NUMBER	MUFFLER-(SUPPLED W/ENGINE)	REF.
	36	402037-13	GROMMET V02231 NO. M-40-B	4
		491167	RECTIFIER-OUTPUT ASSEMBLY	1
	37	491162	BRACKET-MTG., LONG	1
	38	A-25	WASHER-INSULATING	12
	39	6FW-5651	BUSHING	6
	40	356189	BRACKET-MTG. SHORT	1
	41	W-10931-3	DIODE-POSITIVE BASE V58849 NO. R5330	3
	42	W-10933-3	DIODE-NEGATIVE BASE V58849 NO. S5330	3
	43	361182-5	SLEEVING-POSITIVE BASE	3
		491253	BAR-BUS, RECT	1
	NOT ILLUSTRATED			

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-4	44	405485-1	CAPACITOR-1 uF,400V DC, V14655, NO. DPMS 4P1	1
	45	490870	PLATE-RECT. OUTPUT NEG	1
	46	490869	PLATE-RECT. OUTPUT, POS	1
	47	490877	BRACKET-MOUNTING	1
	48	A-28	SPACER-MOUNTING	2
	49	490871	INSULATOR-LEAD	1
	50	491083	PANEL-SIDE, RIGHT	1
	51	491084	PANEL-SIDE, LEFT	1
	52	491111	FRAME-MOUNTING	1
	53	491077	BAR-MOUNTING GEN	1
	54	491085	BRACE-DOOR, LEFT ASSEMBLY,	1
	55	12CW-1915-20	CABLE-BATTERY, NEG	1
	56	491182	RESISTOR-BALLAST ASSEMBLY (FOR DETAILS SEE FIG. A-5)	1
	57	12CW-2234	MOUNT -SHOCK V16238 NO. J256-3	4
	58	491078	SUPPORT -ENGINE ASSEMBLY	1
	59	16DW-335	WASHER-CUP	4
	60	12CW-1914-3	CABLE-BATTERY, POS.	1
	61	491071	PANEL-FRONT, ASSEMBLY	1
	62	491123	HOLDDOWN-BATTERY	1
	63	402087-1	BATTERY-V72560 NO. 1980031	1
-		490910-2	CABLE-BONDING, EXT	1
	64	405532	ENGINE-WISC.	1
	65	490886	BRACE-THROTTLE	1
	66	402037-6	GROMMET-V02231 NO.G-1068	1
	67	J-336	CLAMP	1
	68	430547	CONTACTOR-ASSEMBLY (FOR DETAILED SEE FIG.A-5)	1
	69	491086	BRACE-DOOR, RT. ASSEMBLY	1
	70	491164	REACTO R-STABILITY	1
	71	491122	ANGIE-MTG. FRONT PANEL	2
	72	405663	LABEL-OIL FILTER (ON FRAME)	1
-		351541	LABEL-CAUTION FAN	1
	73	490891	GUARD-ALTERNATER	1
-		AW-1233	LABEL-LUBE	1
	74	76B-1149	LABEL-FUEL	1
	75	491072	BRACE-CANOPY	2
-		50MS-306	CLAMP	1
-		405668	DIAGRAM-GEN,. LAMINATED	1
-		405664	DIAGRAM-ENGINE, LAMINATED	1
-		490923	LINKAGE-THROTTLE	1
	76	491160	SHIELD-HEAT, MANIFOLD	1
	77	25MS-328	SPACER-HEAT SHIELD	4
-		357080-3	SLEEVING - CHOKE	1
	78	491188	PLATE - SEL. SW. BRACE (MTG. ON LEG OF CONTROL REACTOR)	1
-		491117	DOOR-RIGHT	1
-		361182-11	SLEEVING-THROTTLE	1
	79	405777	ELBOW-STREET 90° V31510	1
	80	402063-5	NIPPLE-PIPE	1

- NOT ILLUSTRATED

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-4	81	405776	ELBOW-45° V31510	1
	82	405778	PIPE-EXHAUST	1
	83	404154-11	CLAMP-EXHAUST	1
	84	491173	PIPE-EXHAUST	1
	85	NO NUMBER	AIR CLEANER & CLAMPS- (SUPPLIED W/ENGINE)	1
	86	W-10869-7	CLAMP-HOSE,	2
	87	358140-4	HOSE-AIR CLEANER	1
	86	W-10869-3	CLAMP-HOSE	2
	89	405779	ADAPTER-HOSE	1
	90	490018-3	HOSE -AIR CLEANER	1
	91	491120	SUPPORT-AIR CLEANER	1
	92	402809	RECEPTACLE -CANOPY	1
	93	491174	SHIELD-HEAT, FUEL TANK	1



Selector Switch, Contactor, Ballast Resister, FuelLine Group
Figure A-5

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-5		430547	CONTRACTOR-350 A DC ASSEMBLY (FOR NHA SEE FIG. A-4, ITEM 68)	REF.
	1	490420	.PLATE-MOUNTING	1
	2	430258	.INSULATOR-CONTRACTOR	1
	3	430259	.BASE-CONTRACTOR	1
	4	430141	.TIP-CONTACT	1
	5	DATA-3165	.COIL-300 A	1
	6	370704	.POLEPIECE	1
		356089-3	.CONTRACTOR-SUB-ASSEMBLY	1
	7	16DA-954-2	..PIN-SPRING	1
	8	430139	..LEAD-PIGTAIL	1
	9	370711	..SUPPORT-CONTACT MOVING	1
	10	430172-1	..PIN-SUPPORT	2
	11	430146	..SUPPORT-ARMATURE	2
	12	400562-8	..SPRING-TAIL	2
	13	430265	..CONTACT-TOP ASSEMBLY	1
	14	370708	..PLATE-MOUNTING MICRO SWITCH	1
	15	370714	..INSULATOR-MICRO SWITCH	1
	16	402070	..SWITCH-MICRO	1
	17	370710	..PLATE-ARMATURE	1
	18	430145	..STOP-PLATE ARMATURE	1
	19	370706	..FRAME,CONTACTOR	1
		491182	RESISTOR-BALLAST, ASSEMBLY (FOR NHA SEE FIG. A-4, ITEM ITEM 56)	REF
	20	491181	.BRACKET -MOUNTING, BOTTOM	1
	21	350855	.BAR-BUS	2
	22	350854	.BOARD-RIGHT	1
	23	490442	.BOARD-LEFT	1
	24	350849	.U-BOLT-LONG	2
	25	350853	.RESISTOR-BALLAST	3
	26	12CW-1693	.U-BOLT-SHORT	2
	27	491168	.BRACKET-RESISTOR, TOP	1
		490890	LINE-FUEL, ASSEMBLY	1
	28	W-10750-8	.NIPPLE-PIPE	1
	29	W-10902-1	.PLUG-PIPE	1
	30	W-11608-2	.TEE-PIPE	1
	31	402265	.VALVE-1/4 TURN, SHUT OFF, V79470 NO. 6824	1
	32	402927-2	.CONNECTOR-MALE	1
	33	W-10869-14	.CLAMP-HOSE	2
	34	355325-11	.HOSE-RUBBER, 5/8 OD X 5/16 ID	1
	35	405091-1	.ELBOW-MALE, BARBED	1
		490898	LINE-OIL	1
	36	W-10119-1	.COUPLING-PIPE	1
	37	W-10888-2	.ELBOW-MALE	1
	38	353630-3	.TUBING-ST. 1/4" DIA. ASSEMBLY	1
	39	W-10883-0	.CONNECTOR-FEMALE	1
	40	W-10886-1	.CONNECTOR-MALE	1

NHA NEXT HIGHEST ASSEMBLY

FIG. NO.	ITEM NO.	PART NO.	NOMENCLATURE	UNITS PER ASSEMBLY
A-5		491178	SWITCH-SELECTOR, ASSEMBLY (FOR NHA SEE FIG. A-2, ITEM 55)	REF.
-		491177	.SUMMARY-CABLE	1
		491170	.SWITCH-SELECTOR ASSEMBLY	1
	41	405753	..ACTUATOR-SWITCH	2
	42	405755	..SWITCH-MICRO	1
	43	389092	..BUSHING	1
	44	402668	..SWITCH-MICRO	2
	45	369095	..INSULATOR-SW. 1/4	2
	46	SW-167-1	..WASHER-THRUST	1
	47	490717	..PLATE-BACK	1
		366798	..CONTACT-MOVABLE SA	3
	48	SW-218A	...CONTACT	2
	49	410541	...SPRING	1
	50	430548-2	..RING-CONTACT	1
	51	AW-459	..CATCH-FRICTION BALL	1
	52	368805	..PLATE-FRONT	1
	53	369094	..SHAFT-ACTUATOR	1
	54	491171	..HANDLE-SWITCH	1
	55	16DA-4249-8	..RING-SNAP, EXT.	1

NHA NEXT HIGHEST ASSEMBLY
- NOT ILLUSTRATED

MANUFACTURER'S CODES

Explanation

The following list is a compilation of vendor code with names and addresses for suppliers of purchased parts listed in this publication. The codes are in accordance with the Federal Supply Codes for Manufacturers Cataloging Handbook H4-2, and are wranged in numerical order. Vendor codes are inserted in the nomenclature column of the parts list directly following the item name and description. They are eesily recognized because each code number is preceded by a "V" (for vendor). The manufacturer's pert number follows immediately after the code number.

CODE	VENDOR'S NAME AND ADDRESS
00779	Amp Inc. P. O. Box 3608 Harrisburg, Pennsylvania 17105
02231	Anchor Rubber Company 840 S. Patterson Blvd. Dayton, Ohio 45402
04713	Motorola Semiconductor Products Inc. 5005 East McDowell Rd. Phoenix, Arizona 85008
07497	Amphenol Corporation Amphenol Cable Division 6235 S. Harlem Avenue Chicago, Illinois
09393	Rochester Gauges Inc. of Texas P.O. Box 20180 Dallas, Texas 75220
09527	Faria, Thomas G. Faria Road Uncasville, Connecticut 06382
11702	Syracuse Rubber Products Inc. 500 S. Huntington Syracuse, Indiana 46567
14655	Cornell & Dubilier Electric Corporation 50 Paris Street Newark, New Jersey 07101
14894	Bendix Automotive Service Division of Bendix Corporation South Bend, Indiana

CODE	VENDOR'S NAME AND ADDRESS
15605	Cutler-Hammer 1391 W. St.Paul Avenue Milwaukee, Wisconsin 53233
16238	Lord Manufacturing Company Inc. Sterling Road South Lancaster, Massachusetts 01561
31356	J-B-T Instruments Inc. 424 Chapel Street P. O. Box 1818 New Haven, Connecticut 06508
31510	Main Line Supply Co. Inc 805 E. Third Street Dayton, Ohio 45402
44655	Ohmite Manufacturing Company 3601 W. Howard Street Skokie, Illinois 60076
58849	Syntron Company 1938 Black Street Homer City, Pennsylvania 15748
60741	Triplett Electrical Instrument Company Harmon Road Bluffton, Ohio 45817
73559	Carling Electric Inc. 505 New Park Avenue West Hartford, Connecticut 06110
74193	Heinemann Electric Company 2612 Brunswick Pike Trenton, New Jersey 08802
74400	Hobbs Division Stewart Warner Corporation Yale Blvd. and Ash Street Springfield, Illinois 62705
77574	Richland Auto Part Company Inc. 151 Distl. Avenue Mansfield, Ohio 44903
77910	Shakespeare Products Division of Shakespeare Company Inc. 241 E. Kalamazoo Avenue Kalamazoo, Michigan 49001

CODE	VENDOR'S NAME AND ADDRESS
79470	The Weatherhead Compeny 300 East 131st Street Cleveland, Ohio 44108
81074	Holub Industries Inc. 414 HI-Center Sycamore, Illinois 60178
81082	Electric Auto Lite Company Lebanon Road Cincinnati, Ohio 45241
81091	Pass & Seymour Inc. Solvay Station Syracuse, New York 13209
81703	Mulberry Metal Products Inc. 2199 Stanley Terrance Union, New Jersey 07083
83315	Hubbel Corporation 407 E. Hawly Mundelein, Illinois 60060
91929	Honeywell, Inc., Micro Div. 11 W. Spring Street Freeport, Illinois 61032
92701	Harry Davies Company 700 N. 27th Camden, New Jersey
98410	E.T.C. Inc. 990 E. 67th Street Cleveland, Ohio 44103
16764	Delco Remy Division General Motors Corp. 2401 Columbus Avenue P.O. BOX 2439 Anderson, IN 46011
19728	Prestolite Co. 511 Hamilton St. P.O. Box 931 Toledo, OH 43601

NUMERICAL INDEX

EXPLANTION

THE PURPOSE OF THIS INDEX IS TO ASSIST THE USER IN FINDING THE ILLUSTRATION AND DESCRIPTION OF A PART WHEN THE PART NUMBER IS KNOWN. PART NUMBERS ARE ARRANGED IN APLPHA-NUMERICAL SEQUENCES. THUS, ANY PART NUMBER BEGINNING WITH THE LETTER A WOULD BE LOCATED AT OR NEAR THE TOP OF THE INDEX LIST. LIKEWISE A PART NUMBER 9 WOULD BE LISTED NEAR THE END OF THE LIST AND FAR BELOW A PART NUMBER 1000. THE FIGURE NUMBER AND ITEM NUMBER LOCATION OF THE PART IS DIRECTLY OPPOSITE THE PART. IF THE PART IS USED IN MORE THAN ONE PLACE, EACH LOCATION IS LISTED COMMENCING WITH THE FIRST LOCATION THE PART IS LISTED.

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12CW-1914-3	A- 4-60
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12CW-2234	A- 4-57
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16DA-954-2	A- 5-7
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351316	A- 2-34
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351978	A- 4-3
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355897	A- 3-21
356089-3	A- 5-
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356265	A- 3-12
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356773-35	A- 3-6
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357083	A- 2-37
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358680	A- 3-8
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358951	A- 2-24
359210	A- 3-7
359537	A- 3-19
359575-2	A- 3-
359576	A- 2-32
359577	A- 2-33
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359952	A- 3-16
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361182-11	A- 4-
366589	A- 2-38

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369095	A-5-45
370704	A-5-6
370706	A-5-19
370708	A-5-14
370710	A-5-17
370711	A-5-9
370714	A-5-15
4DW-77	A-4-21
400078	A-2-17
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400641-8	A-2-2
400642-4	A-2-30
400647-8	A-2-
400782-2	A-2-26
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402037-6	A-4-66
402037-13	A-4-36
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404278	A-2-5
404856	A-2-8
404875	A-2-7
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405668	A-4-
405753	A-5-41
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THE FOLLOWING ITEMS WERE ADDED TO UPDATE THE NUMERICAL INDEX:

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3AY-84	A-2-
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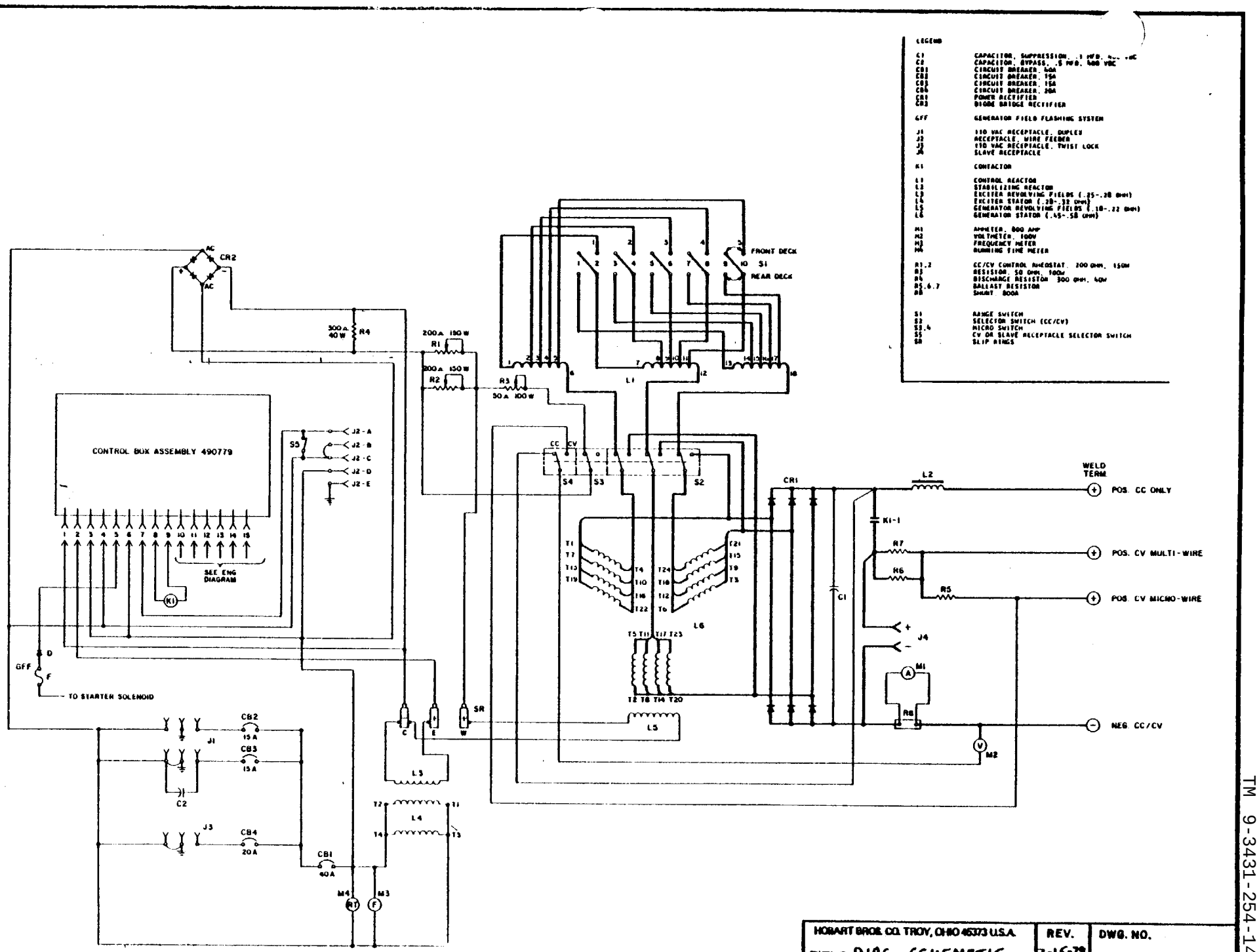
Diagrams

1. Note the model and specification number shown on the equipment nameplate.
2. Locate these numbers in the model and specification number columns below.
3. Use only those diagrams and instructions that are applicable.

MODEL NO.	SPECS NO.	CONNECTION DIAGRAM	SCHEMATIC DIAGRAM	ENGINE DIAGRAM	OUTLINE DIMENSION
GCC-300-W	6101A-1	490781	490780	490807	491172



HOBART BROS. CO. TROY, OHIO 45373 U.S.A.	REV.	DWG. NO.
TITLE DIAG, SCHEMATIC GCC-300-W	2-15-79	490780

TM 9-3431-254-14&P

Figure A-6. Diagram, Schematic

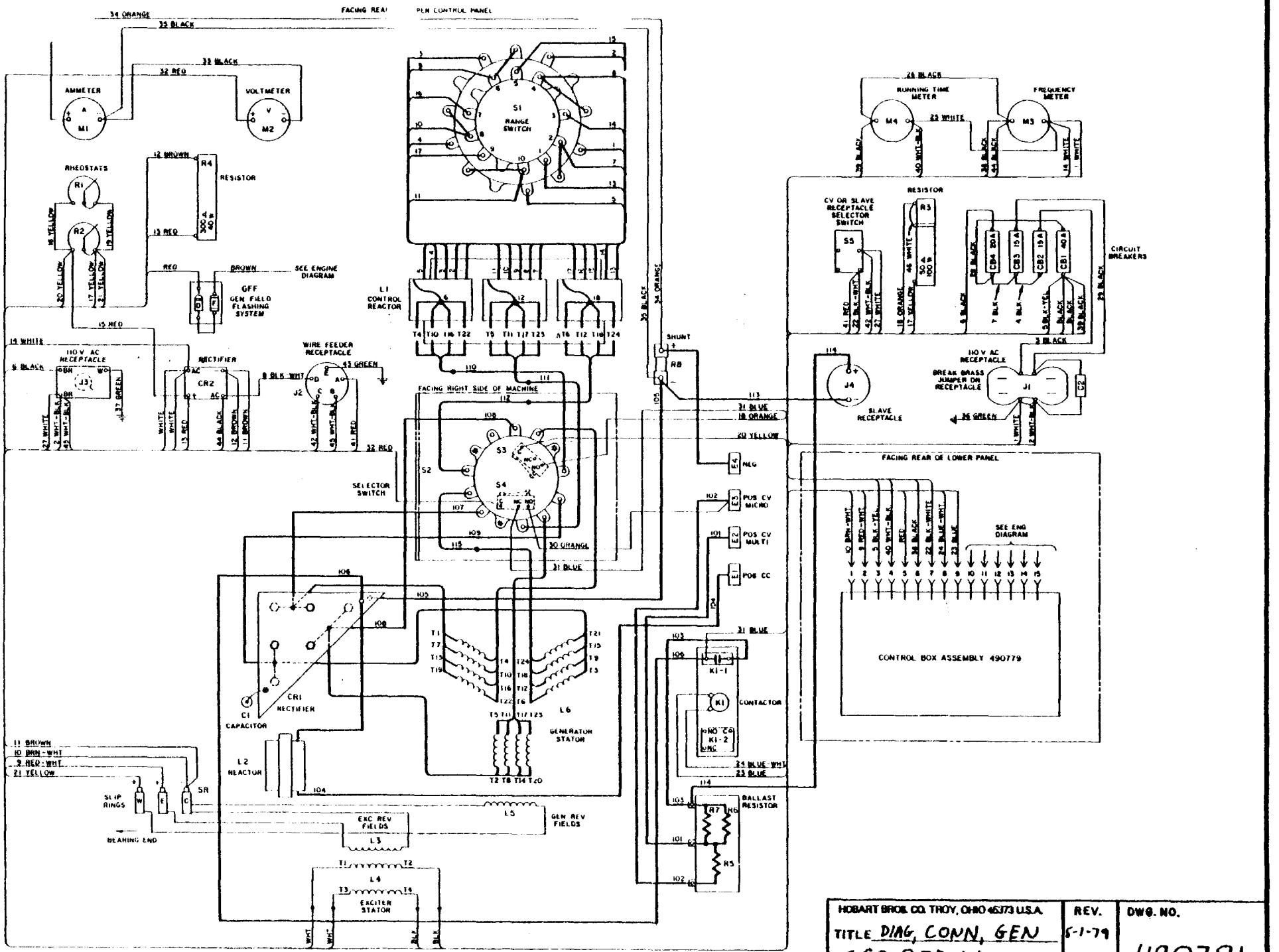


Figure A-7. Diagram, Conn, Gen

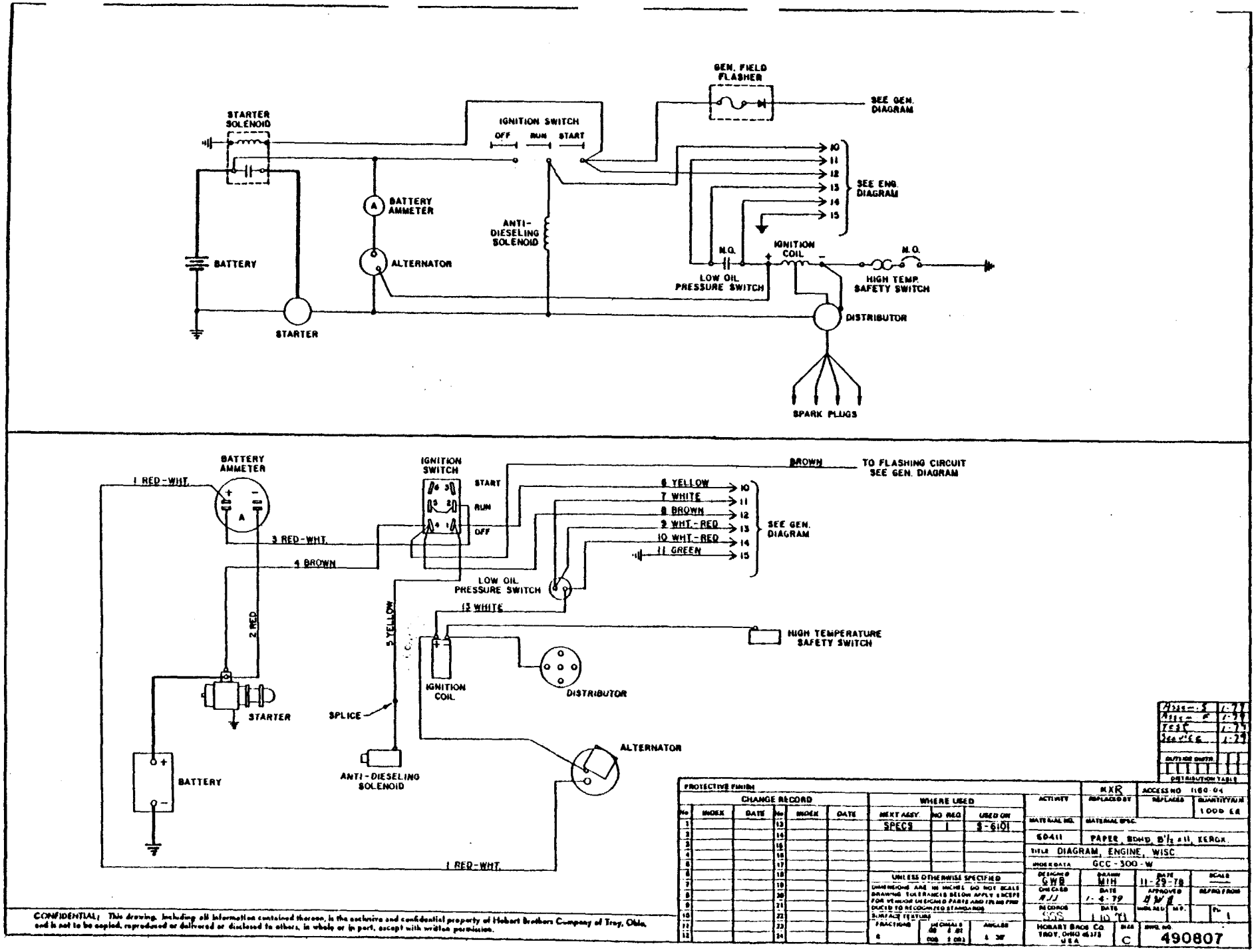
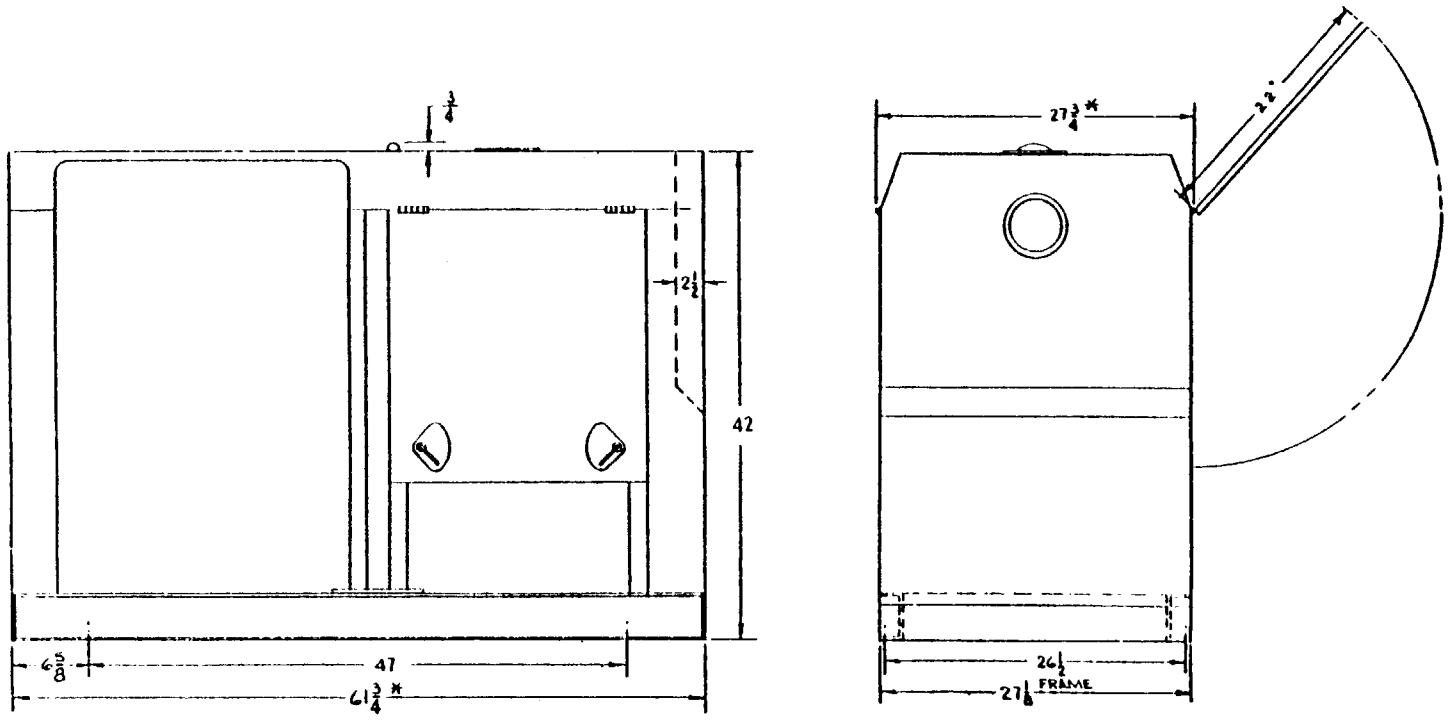


Figure A-8. Diagram, Engine



HOBART BROS. CO. TROY, OHIO 45373 U.S.A.	REV.	DWG. NO.
TITLE LAYOUT, DIM., GCC-300-W	—	491172

Figure A-9. Layout, Dim.

APPENDIX B

BOOK OF INSTRUCTIONS

4 Cylinder
Valve - In - Head Engines

READ THE *STARTING AND 0PERATING INSTRUCTIONS* THOROUGHLY BEFORE STARTING A NEW ENGINE. BECOME ACQUAINTED WITH THE ENGINE COMPONENTS; THEIR LOCATION, MAINTENANCE AND ADJUSTMENT REQUIREMENTS.

Models

V-465D	3-3/4" Bore - 4" Stroke 177 cu. in. Displacement
V-461D	3-1/2" Bore - 4" Stroke 154 cu. in. Displacement
V-460D	

IMPORTANT

READ THESE INSTRUCTIONS CAREFULLY

All points of operation and maintenance have been covered as carefully as possible but if further information is required, inquiries sent to the factory will receive prompt attention.

When writing the factory ALWAYS GIVE THE MODEL, SPECIFICATION AND SERIAL NUMBER of engine referred to.

STARTING AND OPERATING OF NEW ENGINES

Careful breaking in of a new engine will greatly increase its life and result in trouble-free operation. A factory test is not sufficient to establish the polished bearing surfaces, which are so necessary to the proper performance and long life of an engine. Neither is there a quick way to force the establishment of good bearing surfaces. These can only be obtained by running a new engine carefully and under reduced speeds and loads for a short time, as follows:

First, be sure the engine is filled to the proper level with a good quality of engine oil, see “Grade of Oil” chart.

Before a new engine is put to its regular work, the engine should be operated at low idle speed (1000 to 1200 R.P.M.) for one half hour, without load. The R.P.M. should then be increased to engine operating speed, still, without load, for an additional two hours.

If at all possible, operate the engine at light loads, for a period totaling about eight hours, before maximum load is applied. This will greatly increase engine life.

The various bearing surfaces in a new engine have not been glazed, as they will be with continued operation, and it is in this period of "running in,” that special care must be exercised, otherwise the highly desired glaze will never be obtained. A new bearing surface that has once been damaged by carelessness will be ruined forever.

Our engine warranty is printed on the inside back cover of this manual. Read it carefully.

For Your Own Record

THIS MANUAL IS FOR MY MODEL. . . . . ENGINE

SPEC. NO. . . . . SERIAL No. . . . . .

THE ABOVE INFORMATION, WHICH WILL BE FOUND ON THE INSTRUCTION PLATE ATTACHED TO THE AIR SHROUD OF THE ENGINE, SHOULD BE FILLED IN. YOUR PROMPT ATTENTION TO THIS MATTER WILL MAKE IT CONVENIENT FOR YOU IN THE FUTURE, AS THIS INFORMATION MUST BE GIVEN WHEN ORDERING ENGINE REPAIR PARTS.

MO-630-11

SAFETY PRECAUTIONS

- Never fill fuel tank while engine is running or hot; avoid the possibility of spilled fuel causing a fire.
- Always refuel slowly to avoid spillage.
- When starting engine, maintain a safe distance from moving parts of equipment
- Do not start engine with clutch engaged.
- Do not spin hand crank when starting. Keep cranking components clean and free from conditions which might cause the crank jaw to bind and not release properly. Oil periodically to prevent rust.
- Never run engine with governor disconnected, or operate at speeds in excess of 3000 R.P.M. load.
- Do not operate engine in a closed building *unless* the exhaust is piped outside. This exhaust contains carbon monoxide, a poisonous, odorless and invisible gas, which if breathed causes serious illness and possible death.
- Never make adjustments on machinery while it is connected to the engine, without first removing the ignition cables from the spark plugs. Turning the machinery over by hand during adjusting or cleaning might start the engine and machinery with it, causing serious injury to the operator.
- Precaution is the best insurance against accidents.

Keep this book hardy at all times, familiarize yourself with the operating instructions.

KEEP ENGINE CLEAN
PREVENT OVERHEATING

This engine is cooled by a flow of air from a combination fan-flywheel, encased in a sheet metal shrouding. The air is divided and directed by ducts and baffle plates to insure uniform cooling of both banks of cylinders. ***If dirt and chuff are allowed to accumulate in the cylinder shrouding or in the V between cylinder banks,*** the flow of cooling air will be restricted, creating an overheating condition, which could result in costly repairs.

The rotating screen, illustrated in *Fig.* B-2, is recommended for engines operating in dusty and dirty conditions. The screen deflects foreign materials away from the air intake opening and helps maintain maximum cooling efficiency. ***Keep rotating screen clean.*** Even a small section of screen clogged up with dirt will restrict the intake of cooling air enough to bring about an overheating condition.

With reference to Figures B1 and B2; follow these few cleaning and maintenance instructions to insure trouble free and satisfactory engine performance.

1. Cylinder head covers can be removed by releasing snap clips and unscrewing wing nut. Clean out all dirt and chaff from interior of shroud and from between fins of cylinders and heads.
2. Remove dirt and chaff from cylinder heat deflectors at manifold ports.
3. Keep space between cylinder banks clean.
4. Replace this oil filter cartridge every other oil change. If operating conditions are extremely dusty replace cartridge every oil change. See *Oil Filter* instructions Page B-11.
5. Rotating screen must be kept clean. Accumulated dirt caked on screen will restrict cooling.
6. Read instructions on air cleaner regarding its care. The entire air cleaner should be removed from the engine at least once a year, and washed in a solvent to clean out dirt gathered in the back fire trap and filter element.
7. The collector type pre-cleaner must be emptied of accumulated dirt frequently, depending on dust conditions. Do not use oil or water in pre-cleaner, this must be kept dry.
8. Do not allow shrouding to become damaged or badly dented as this will retard air flow.

Never operate engine with air shrouding removed.

Every 4 to 8 hours, depending on dust conditions, check air cleaner and change oil. *See Page* B-13.

Every 8 hours check crankcase oil level. Keep filled to ***full*** mark on oil gauge saber, but no more. ***Every 50 hours*** drain crankcase and refill with fresh oil. *See Lubrication, Pages* B-9 and B-10.

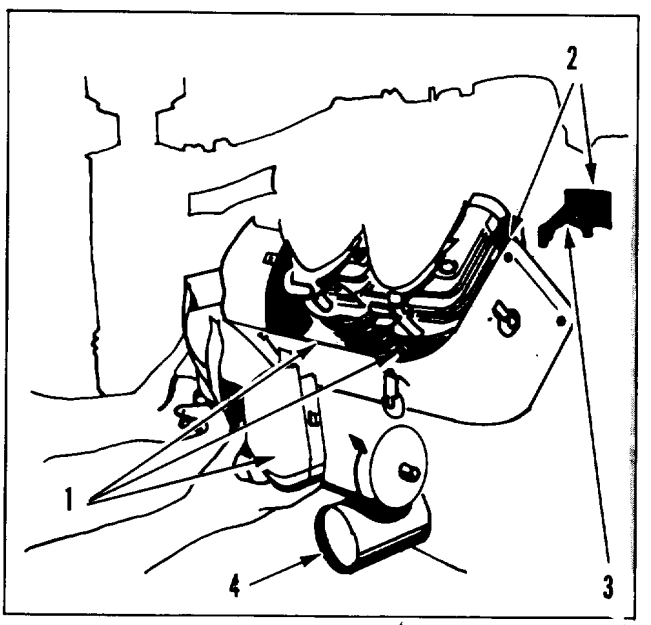


Fig. B-1 277793-C

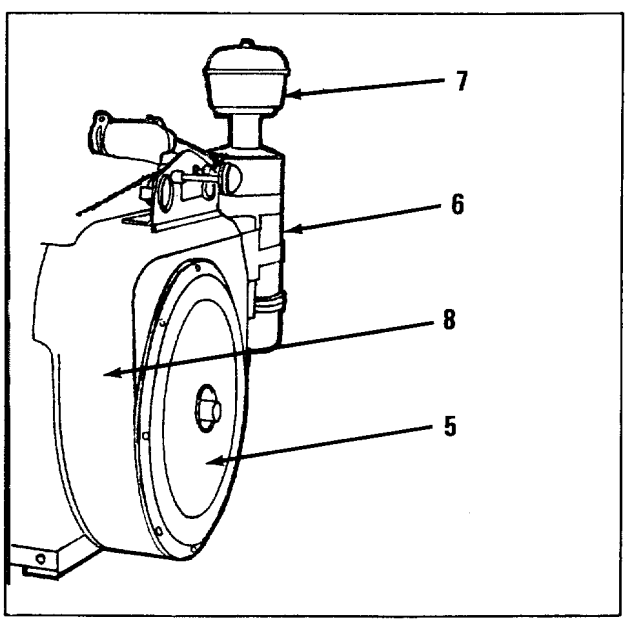


Fig. B-2 281380C

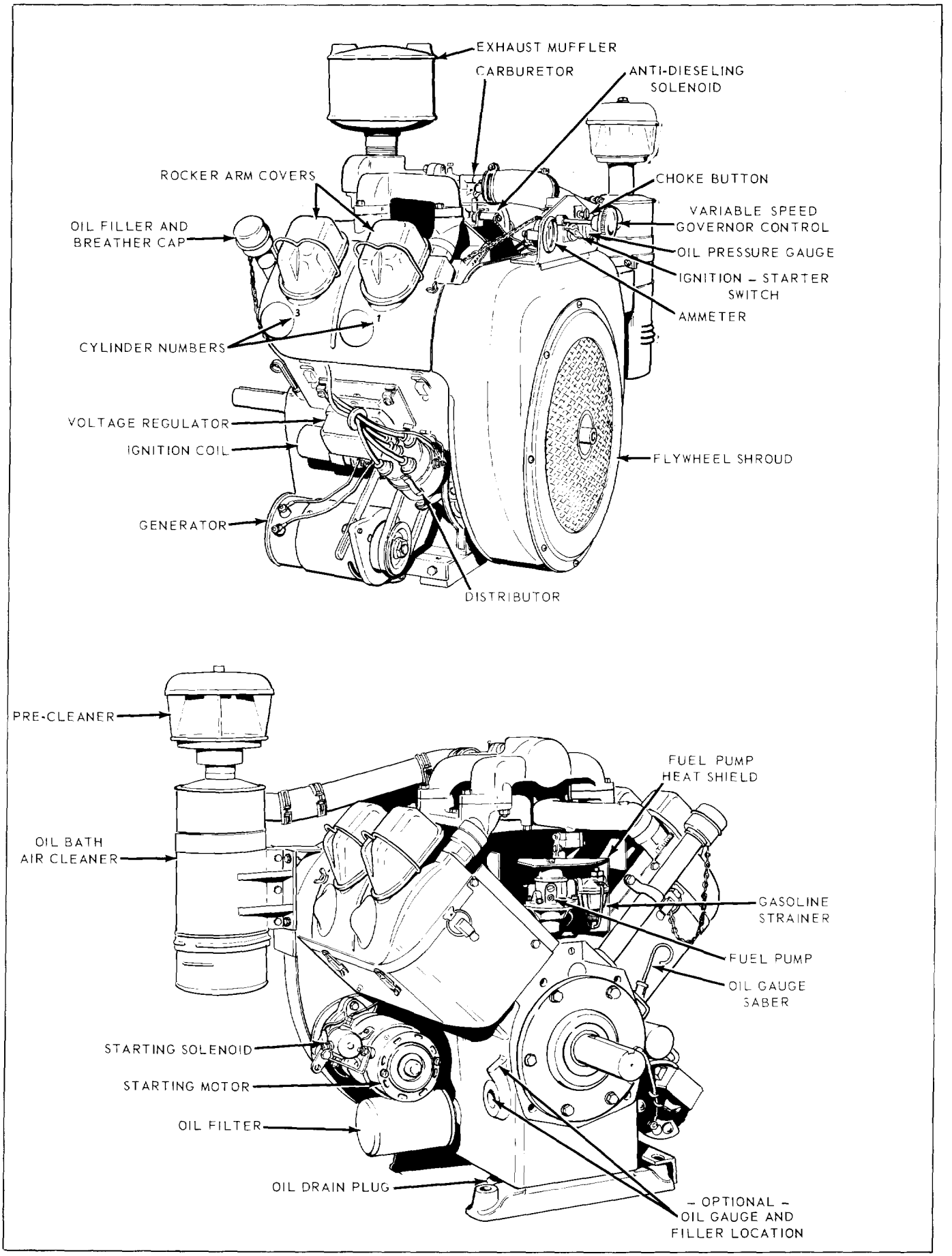
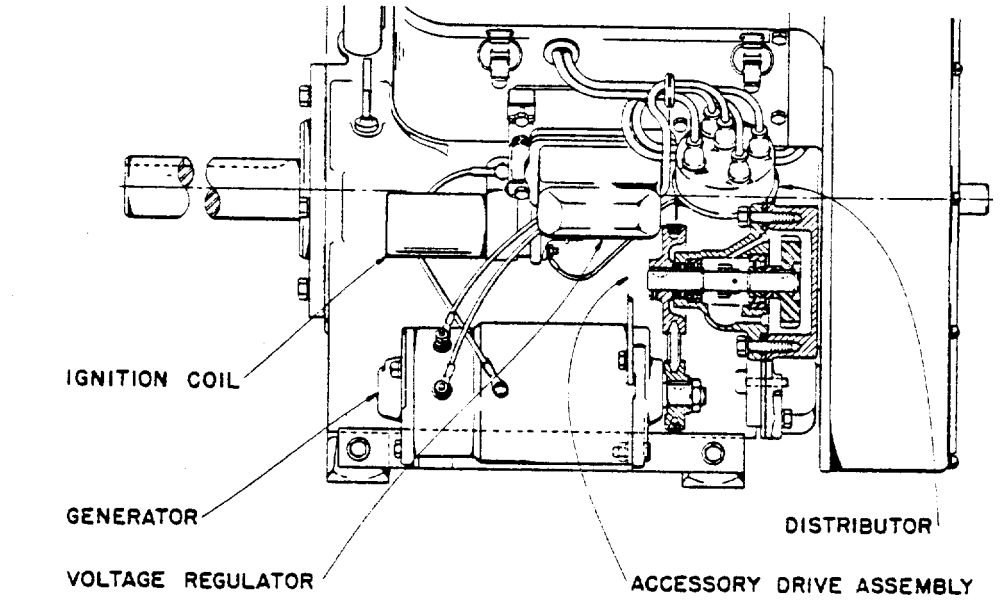

EXHAUST MUFFLER
CARBURETOR
ANTI-DIESELING SOLENOID
ROCKER ARM COVERS
CHOKE BUTTON
VARIABLE SPEED GOVERNOR CONTROL
OIL FILLER AND BREATHER CAP
OIL PRESSURE GAUGE
IGNITION – STARTER SWITCH
AMMETER
CYLINDER NUMBERS
VOLTAGE REGULATOR
IGNITION COIL
FLYWHEEL SHROUD
GENERATOR
DISTRIBUTOR
PRE-CLEANER
FUEL PUMP HEAT SHIELD
OIL BATH AIR CLEANER
GASOLINE STRAINER
FUEL PUMP
OIL GAUGE SABER
STARTING SOLENOID
STARTING MOTOR
OIL FILTER
OIL DRAIN PLUG
– OPTIONAL – OIL GAUGE AND FILLER LOCATION

Fig. B-3



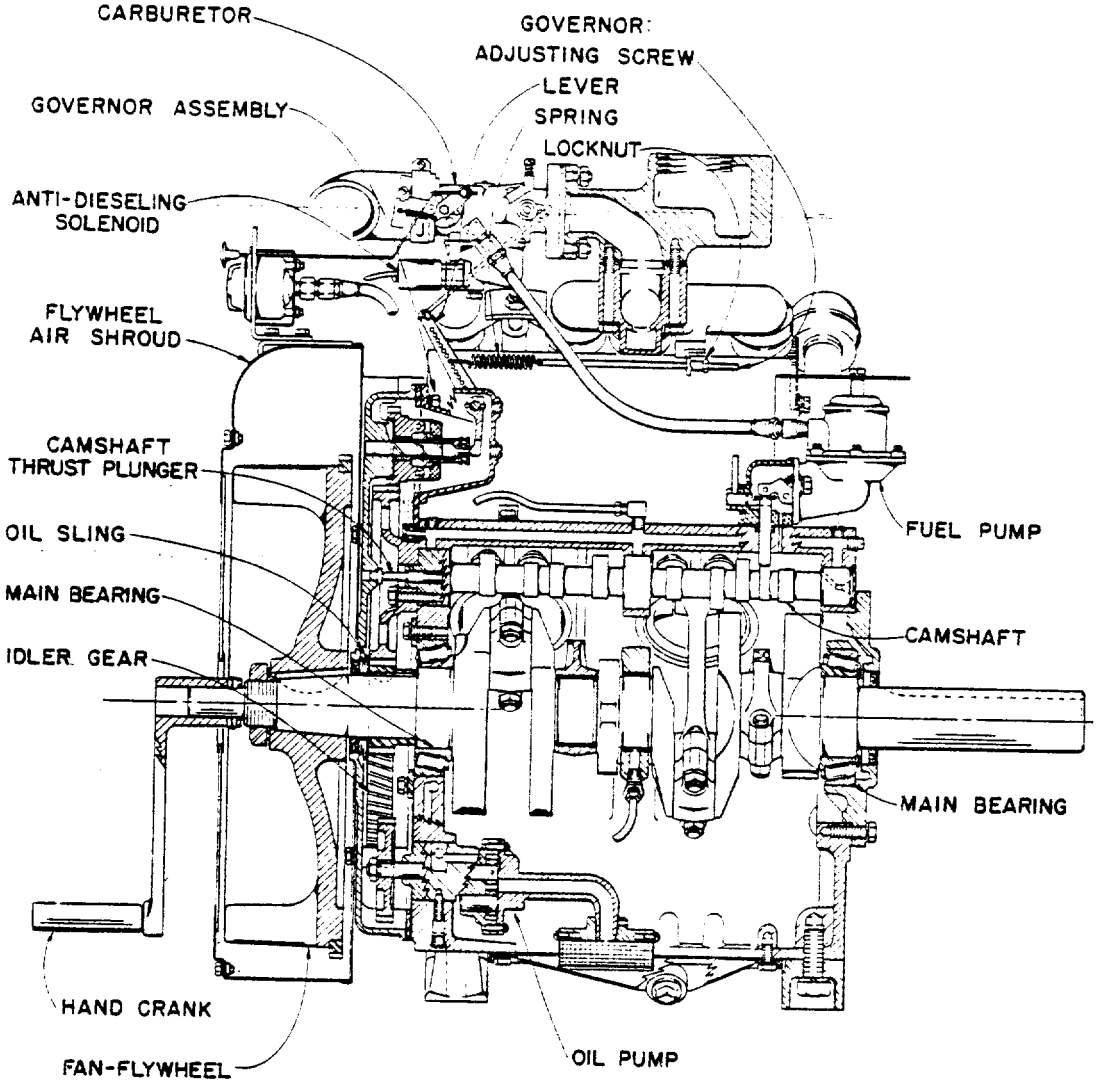


Fig. B-4

SECIONAL VIEWS OF ENGINE

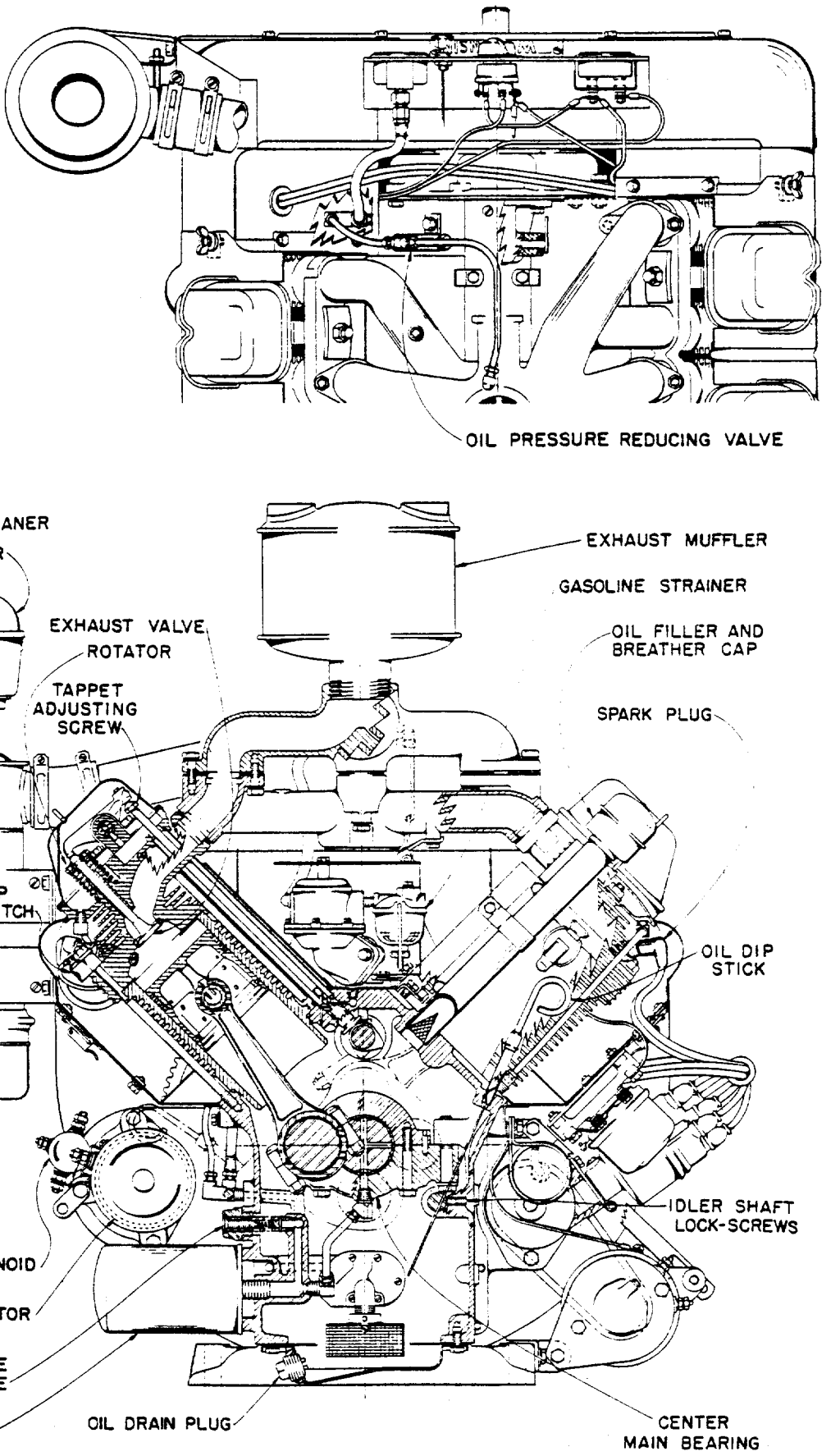


Fig. B-5

MODELS V-460D, V-461D AND V-465D

GENERAL INFORMATION AND DESIGN

These engines are of the four cycle type, in which each of the four operations of *suction, compression, expansion* and *exhaust* requires a complete stroke. This gives one power stroke per cylinder for each two revolutions of the crankshaft.

COOLING

Cooling is accomplished by a flow of air, circulated over the cylinders and heads of the engine, by a combination fan-flywheel encased in a sheet metal shroud. The air is divided and directed by ducts and baffle plates to insure uniform cooling of all parts.

Never operate an engine with any part of the shrouding removed, because this will retard the air cooling.

Periodically, remove the cylinder head shrouding and clean out all the dust and chaff which may have collected between the fins of the cylinder barrels and cylinder heads. Dirt deposits between the cooling fins and in the shrouding will retard the flow of air and cause the engine to overheat. *See Page* B-5.

CARBURETOR

The proper combustible mixture of gasoline and air, is furnished by a balanced carburetor, giving correct fuel to air ratios for all speeds and loads.

IGNITION

The spark for ignition of the fuel mixture is directed from the coil to the spark plugs, at the proper time, by a distributor. Electric starter and generator are furnished with distributor ignition.

Magneto ignition can be furnished in place of distributor, when specified. The high tension magneto used, is fitted with an impulse coupling that provides a powerful spark for easy starting.

LUBRICATION SYSTEM

A gear type pump provides pressurized lubrication to the connecting rod bearings, camshaft bearings, tappets, valve train and to an oil spray nozzle in the gear cover, The spray nozzle lubricates the governor and gear train. The oil expelled from these areas form a mist which lubricates the cylinder walls and the anti-friction crankshaft bearings.

All of the circulated oil passes thru a *full-flow oil filter.* Crankcase impurities are collected in the filter element, thereby minimizing friction and reducing wear to critical moving parts of the engine.

GOVERNOR

A governor of the centrifugal flyball type controls the engine speed by varying the throttle opening to suit the load imposed upon the engine. All engines are equipped with either fixed speed governors, a *variable speed regulator* to control the governed speed of the engine, or an idle control.

ROTATION

The rotation of the crankshaft is clockwise when viewing the flywheel or cranking end of the engine. This gives *counter-clockwise* rotation when viewing the power take-off end of the engine. The flywheel end of the engine is designated *the front end, and the* power take-off end, *the rear end* of the engine.

HORSEPOWER CHART

R.P.M.	V-460D V-461D	V-465D
1600	40.9	41.6
1800	45.6	47.5
2000	50.2	52.4
2200	53.8	56.7
2400	56.8	60.0
2600	58.4	63.0
2800	60.2	64.5
3000	60.5	65.9

HORSEPOWER

The horsepower given in the above chart is for an atmospheric temperature of 60° Fahrenheit, at sea level, and at a Barometric pressure of 29.92 inches of mercury.

For each inch lower Barometer reading, deduct 3½% from above horsepower.

For each 10° higher temperature, there will be *a* reduction in horsepower of 1%.

For each 1000 ft. altitude above sea level, there will be a reduction in horsepower of 3½%.

The friction in new engines cannot be reduces to the ultimate minimum during the regular block test, but engines will develop at least 85 per cent of maximum power when shipped from the factory. The power will increase as friction is reduced during a few days of operation. The engine will develop approximately 95% of power shown on chart when friction is reduced to a minimum.

For continuous operation, limit to 80% of horsepower shown, as a safety factor.

INSTRUCTIONS FOR STARTING AND OPERATING

LUBRICATION

Before starting a new engine, fill crankcase with the correct grade of lubricating oil, as specified in "Grade of Oil" chart. Fill through the breather tube opening with 6 *quarts* of oil, and check level by means of the oil gauge saber. When replacing oil filter, an additional 1 quart of oil is required.

For run-in of new engines, use same oil as recommended in *Grade of Oil Chart.*

The standard *oil gauge saber* is located on the left hand side, below the oil filler-breather tube. *See Fig. 1.* When specified, a saber can be furnished on the opposite side, behind the starting motor.

High grade oil of the body suited to the requirements of your engine is the most important single item in the economical operation of the unit, yet it is the cheapest item of operating cost. *Select your oil solely on* quanlity and suitability - never on price - for no one thing is so sure to bring abut unsatisfactory performance and unnecessary expense as incorrect lubrication. High-grade highly refined oils, arresponding in body to the S. A. E. Viscosity Numbers listed in *Grade of Oil Chart* will prove economical and assure long engine life.

SERVICE CLASSIFICATION OF OIL

In addition to the S. A. E. Viscosity grades, oils are also classified according to severity cf engine service, Use oils classified by the American Petroleum Institute as Service MS, *SD* or SE. *These types* of oil are for engines performing under unfavorable or severe operating conditions such as: high speeds, constant starting and stopping, operating in extreme high or low temperatures and excessive idling.

GRADE OF OIL

SEASON OR TEMPERATURE	GRADE OF OIL
Spring, Summer or Fall + 120°F to + 40°F	MIL-L-46152 SAE 30
Winter + 40°F to + 15°F + 15°F to 0°F Below Zero	MIL-L-46152 SAE 20-20W SAE 10W SAE 5W-20
Use oils classified as Service MS, SD or SE	
Crankcase Capacity	6 Qts.
Additional for Oil Filter	1 Qt.

For run-in *of new* engines, use same oil as recom mended in *Grade of Oil Chart.*

Follow summer recommendations in winter if engine is housed in warm building.

Check oil level, every 8 hours*of operation.*

The old *oil should be drained and fresh oil added after* every 50 hours *of* operation.

To drain oil, remove drain plug in oil pan at oil filter side. Oil should be drained while engine is hot, as it will then flow more freely.

FUEL

The fuel tank should be filled with a *good* quality gasoline, free from dirt and water. Some of the poorer grades of gasoline contain gum which will deposit on valve stems, piston rings, and in tie Various small passages in the carburetor, causing serious trouble in operating and in fact might prevent the engine from operating at all.

Use only reputable, well known brands *of* REGULAR GRADE gasoline.

The gasoline should have an octane rating of at least 90. Low octane gasoline will cause the engine to detonate, or *knock,* and if operation is continued under this condition, cylinders will score, valves will burn, pistons and bearings will be damaged, etc.

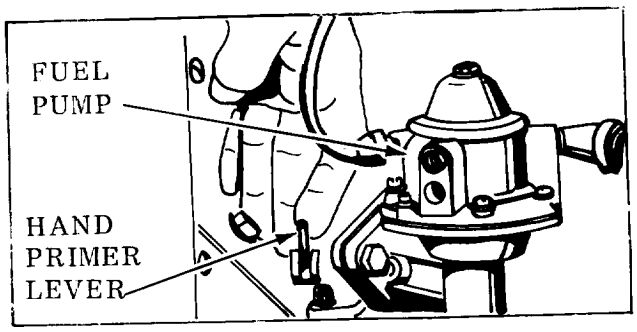


Fig. B-6 83622C

Be sure that air vent in tank cap is not plugged - this would impede the flow of fuel to the carburetor.

FUEL PUMP and PRIMING (Fig. B-6)

The diaghragm type fuel pump is actuated by an eccentric on the camshaft, as illustrated in cross sectional view of engine, page B-7.

Hand Primer for hand crank *engine is* furnished as an option, and is a necessary function when starting a new engine for the first time, or when enigine has been out of operation for a period of time. Gravity feed and electric start engines do not require hand priming.

When priming, a distinct resistance of the fuel pump diaghragm should be felt when moving the hand lever up and down. If this does not *occur, the* engine should be turned over one revolution so that the fuel pump drive cans will be rotated from its upper position which prevents movement of the pump rocker arm.

Assuming the gasoline strainer is empty, approximateiy 25 strokes of the primer lever are required to fill the bowl. See Fig. B-6. After strainer bowl is full, an addtional 5 to 10 strokes are required to fill the carburetor bowl. When carburetor is full the hand primer lever will move more easily.

STARTING

ELECTRIC STARTING MOTOR

A 12 volt starting motor with an attached starting solenoid is provided as standard equipment on this model engine, unless otherwise specified.

Do not oil Bendix drive. Keep screw threads clean and if necessary, lubricate with powdered graphite.

STARTING PROCEDURE

1. Check crankcase oil level and fuel supply. Open fuel valve.
2. Disengage clutch, if furnished.
3. New engines require priming refer to "Fuel Pump" paragraph for instructions.
4. Set throttle about l/2 open if variab!e speed governor control is furnished, with a two-speed control, start in full load position.
5. Turn *ignition-starting switch to 'start'* position and at the same time pull out choke button only sufficient to start the engine. Release choke button to open position after engine starts, but re-

choke if it tends to stop. *Even a* hot engine requires *a* momentary *choking when* starting. when engine starts release switch to 'run' position.

If flooding should occur, continue cranking with the starting motor, but with choke open (choke button in).

After engine starts; allow it to warm up a few minutes before applying load, as prescribed in 'Warm-Up *Period'* paragraphs.

New engines; started for the first time, should be "run-in" gradually to insure trouble-free service and long engine life. Refer to "Starting and operation of New Engine" instructions, on page B-3, for correct running-in procedures.

WARM-UP PERIOD

The engine should be allowed to warmup to operating temperature before load is applied. This requires only a few minutes of running at moderate speed. Racing *an engine* or *gunning it,* to hurry the warm-up period, *is very destructive* to the polished wearing surfaces on pistons, rings, cylinders, bearings, etc., as the proper oil film on these various surfaces cannot be established until the oil has warmed up and become sufficiently fluid. This is especially important on new engines and in cool weather.

Racing an engine by disconnecting the *governor,* or by doing anything to interfere with the governed control engine speed, *is extremely dangerous.* Tine governor is provided as a means for controlling the engine speed to suit the load applied, and also as a safety measure to guard against excessive speeds, which not only overstrain all working parts, but which might cause wrecking of the engine and possible injury to bystanders.

All parts of the engine are designed to safely withstand any speeds which might normally be required, but it must be remembered that the stresses setup in rotating parts increase with the square of the speed. That means that if the speed is doubled, the stresses will be quadrupled, and if the speeds are trebled, the stresses will be nine times as great.

Strict adherence to the *preceding instructions* cannot *be too strongly urged, and greatly* increased engine life will result as a *reward for these easily applied recommendations.*

STOPPING ENGINE

To stop engine; turn ignition-starting switch to 'off' position.

If the engine has been running hard and is hot, do not stop it abruptly from full load, but remove the load and allow engine to run idle at 1000 to 1200 R.P.M. for three to five minutes, depending on how hot the engine has been. This will reduce the internal temperature of the engine much faster, minimize valve warping, and of course the external temperature, including the manifold and carburetor will also reduce faster, due to air circulation from the flywheel.

One of the main troubles caused by the abrupt shutting off of a hot engine is *vapor lock.* This will result in hard starting, which can be overcome by choking the engine when cranking or waiting until the engine has cooled off sufficiently to overcome the vapor lock.

ANTI-DIESEL VALVE

High compression engines have a tendency to occasionally diesel, after the ignition has been shut off. To rectify this condition, an unti-dieseling solenoid valve is provided to assure immediate stopping. When the ignition is turned off, the solenoid becomes de-energized and releases a valve that shuts off the fuel supply in the carburetor, thus stopping the engine. CAUTION: *Engine* will *not operate if ignition wire from anti-diesel solenoid to starting switch is disconnected.*

If solenoid is removed from carburetor for same reason, use a new fibre washer in reassembly, and tighten to 100 inch pounds torque.

OIL FILTER

A *full-flow* oil filter is furnished on this model of engine as standard equipment. Since all of the circulated oil passes thru the filter, it is very important that it be serviced regularly in order to function properly.

When the filter element becomes clogged, the oil bypasses the filter material by means of a relief valve located in the top of the oil filter. See Fig. B-7. As a result, there is no variation in oil pressure to indicate that the oil filter is clogged anti requires replacement. The *oil filter should be replaced after* every *other* oil *change. If operating conditions are* extremely dusty, replace filter *after every oil change.*

The oil filter is easily removed by unscrewing it from its mounting pad on the side of the crankcase. Refer to "Oil Filter" in disassembly instructions. Wnen reassembling a new filter, add a film of oil to the face of the rubber gasket at the base - turn filter to a snug fit, then ½ turn more. *Do* not *over-tighten.*

Pour 1 additional quart of oil into crankcase when replacing oil filter. Use only a Wisconsin oil filter, specially designed for this model of engine. *Refer to parts* list for correct service *part number.*

BREATHER CAP

The crankcase is ventilated thru a breather cap mounted to the top of the oil filler tube, as illustrated in Fig. B-7. At every oil change, it is recommended that the cap be cleaned by washing in kerosene.

OIL PRESSURE AND ADJUSTMENT

HIGH PRESSURE SYSTEM

Oil supplied to the center main and connecting rod bearings, at 40 to 45 P.S.I. gauge pressure (was 50) P.S.I.), is controlled by a pressure relief valve, properly adjusted at the factory. Readjustment, when necessary, must be made while engine is running. Refer to Fig. B-7 and the following instructions:

The oil pressure relief valve is located beneath the starting motor and next to the oil filter. The stub end of the valve is closed off by an expansion *plug. Re*move plug from the end of the valve, then, with a

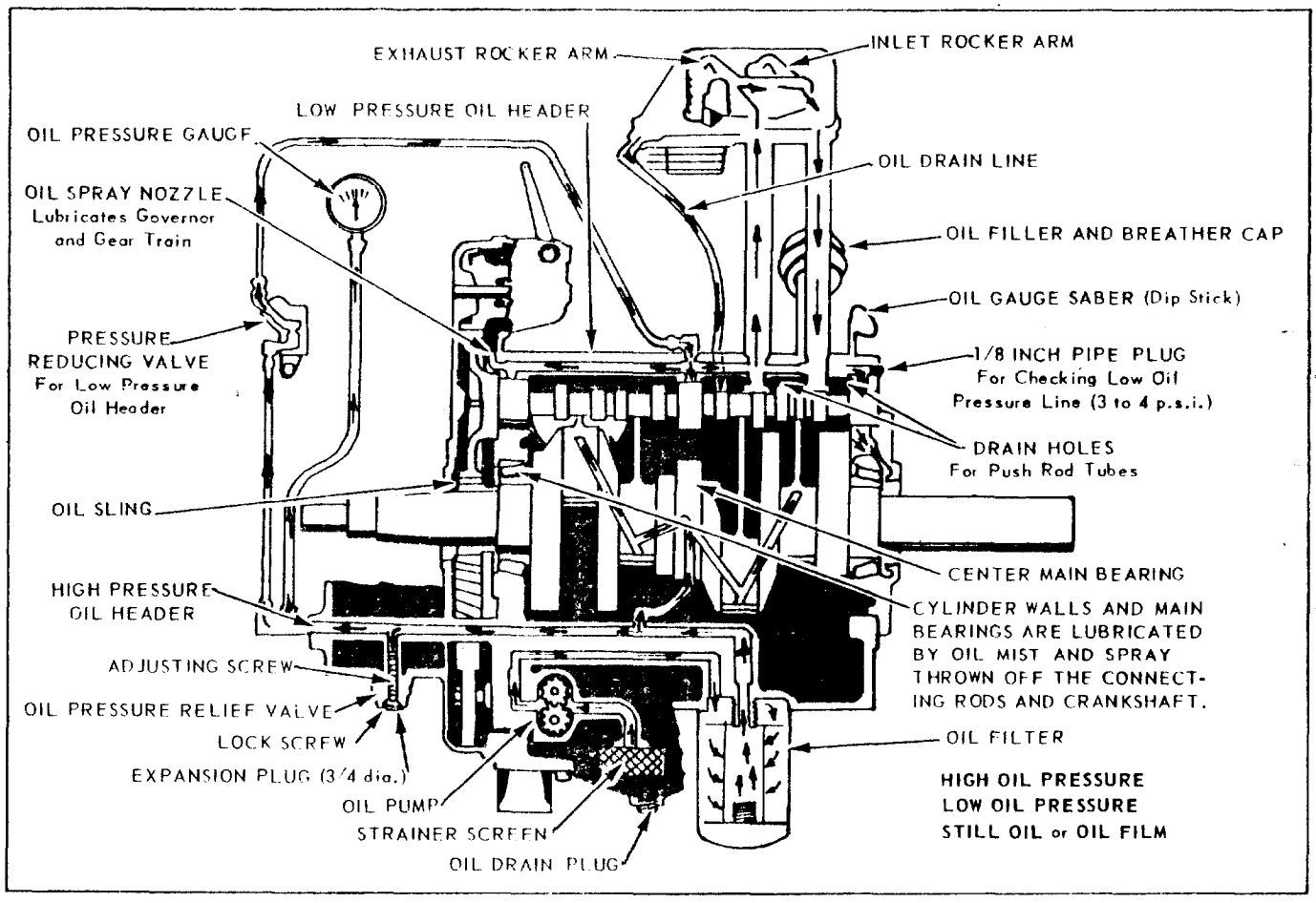


Fig. B-7 LUBRICATION SYSTEM 274443C-1

3/16 Allen wrench, remove the outer lock *screw*. With the same wrench, adjust spring tension by means of the adjusting screw; turn clockwise to increase gauge pressure, counter-clockwise to reduce pressure.

NOTE: With engine running at 1800 R.P.M. and engine oil hot, adjust oil pressure 40 to 45 P.S.I. Idle engine at 1000 R.P.M., and if oil pressure falls below 15 P.S.I., check for irregularities in the oil pump, bearings and oil connections.

After adjustment is made, mount *outer lock screw* firmly in place. Use a new 3/4 inch expansion plug to seal off any oil which may by-pass the screw threads.

LOW PRESSURE SYSTEM

The upper, or low pressure*oil* header, supplies oil to the camshaft bearings, tappets, valve train and governor-gear train nozzle at 3 to 4 P.S.I., thru a pressure reducing valve from the main or high *pressure oil header.* This pressure is not registered on a gauge, but can be checked by connecting a low pressure *gauge* to the 1/8" pipe tap located at the take-off end of the engine above the camshaft plug. Operate the engine at 1800 R.P.M. when making this check.

The pressure*reducing valve,* mounted on the crankcase in front of No. 2 cylinder beneath the air duct of No. 2-4 bank, is pre-set by the manufacturer *(not adjustable).* If valve becomes faulty it should be replaced with a completely new unit.

CENTER MAIN BEARING (V-465D)

Beginning with serial No. 4904657, a *shell* type center main bearing replaces the roller bearing, and lubrication to the connecting rod bearings is modified as follows: Oil pressure to the rods is channeled thru the crankshaft by means of an oil line correction to the center *main bearing* instead of thru a collet on the crankshaft gear. See Fig- B-7.

AIR CLEANER

The oil bath air cleaner, illustrated in Fig. B-8, must be serviced frequently, depending on the dust conditions in which the engine is operated.

Service *daily* or twice a day if engine is operating in very dusty conditions. Once each *week;* in comparatively clean conditions.

Remove oil cup from bottom of air cleaner and clean thoroughly. Add the same grade of oil as used in the crankcase, to the level *line* indicated on the oil cap. Detailed instructions are printed on the air cleaner.

Operating the engine *under dusty conditions* without oil in the air *cleaner or with* dirty oil, may wear out *cylinders, pistons, rings and* bearings in a *few days time, and result* in costly repairs.

Once a year,oftener if conditions are severe, remove air cleaner from engine and soak in solvent to clean out accumulated dirt from element. Caution: Do not clean with gasoline, naptha or benzine.

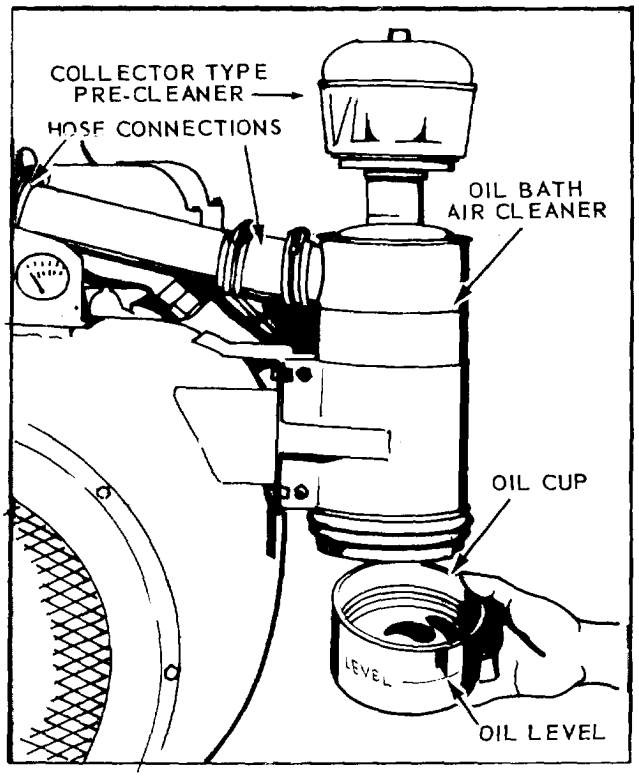


Fig. B-8 277798C

PRE-CLEANER

The collector type pre-cleaner, mounted to the top of the air cleaner as illustrated in Fig. B-8, removes the larger dirt and dust particles before the air reaches the main air cleaner.

Clean bowl regularly of accumulated dust and dirt. Do *not use oil or water in pre-cleaner, this* must be kept dry.

Daily attention to the air cleaner and pre-cleaner is one of the most important considerations in prolonging engine life.

GASOLINE STRAINER

The gasoline strainer is very necessary to prevent sediment, dirt and water from entering the carburetor and causing trouble or even complete stoppage of the engine. This strainer has a glass bowl and should be inspected frequently, and cleaned if dirt or water are present.

To remove sediment bowl, loosen nut below bowl and swing wire bail to one side, see Fig. B-9. There will be less danger of breaking the gasket if the bowl is given a twist as it is being removed. Clean bowl and screen thoroughly. Replace gasket if it has become damaged or hardened. Repair kits are available for service replacement, refer to parts list in rear of manual.

CARBURETOR ADJUSTMENT

The main metering jet in the carburetor is of the fixed type, that is, it requires no adjustment. The idle needle should be adjusted for best low speed operation, while carburetor throttle is closed by hand. For illustrations and more information, see Carburetor

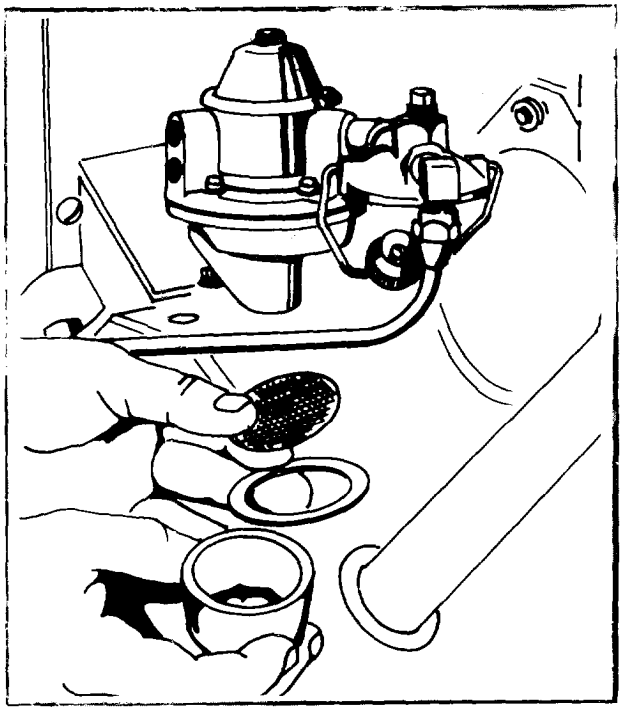


Fig. B-9 83619C-1

Manufacturer's Instruction Bulletin in the back of this manual.

IGNITION SYSTEM

A battery ignition system is standard equipment on this model of engine. The distributor is of the automatic advance type and it is driven off an engine speed shaft through a pair of two to one ratio gears, thus driving the distributor rotor at *one* half engine speed in a counter-clockwise direction *when* viewed from above.

The running spark advance of the engine is 23° and the distributor is fully advanced at 2000 R.P.M.

Engine must be running at 2000 R.P.M. or *over, when* checking or adjusting *spark advance.*

NOTE: The distributor, generator, regulator and ignition coil furnished are products of either the Delco-Remy Company or *Prestolite* Company It is suggested that when replacement of any of these parts becomes necessary, that the replaced parts be *of the same* manufacture as the other components.

TIMING

FIRING ORDER

The *firing order* of *the* cylinders is 1-3-4-2, and the battery type distributor rotates at one-half engine speed, as is the case with conventional *'in line'* engines. The intervals between the firing of the cylinders is 180°. No. 1 cylinder is the one nearest to *the* flywheel in the left bank of cylinders, when viewed from the flywheel end of the engine. No. 3 cylinder is the other cylinder in this bank. No. 2 cylinder *is the* one nearest to the flywheel in the right bank of cylinders and No. 4 is the other cylinder in this bank. *The*

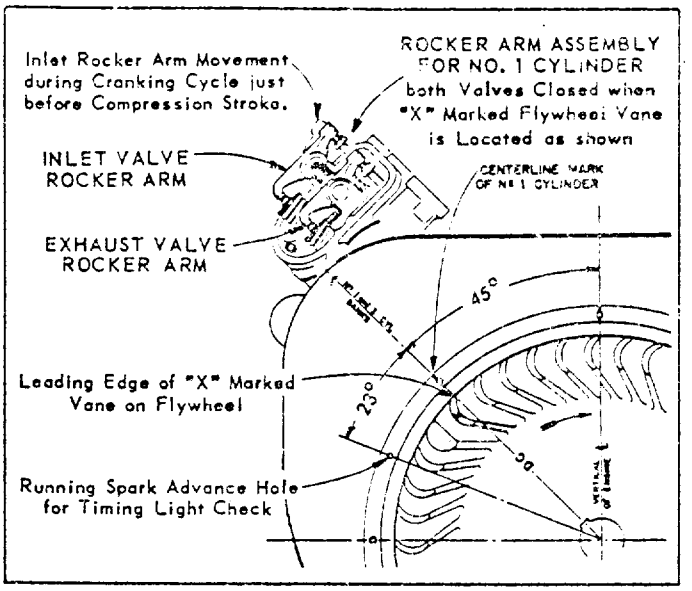


Fig. B-10

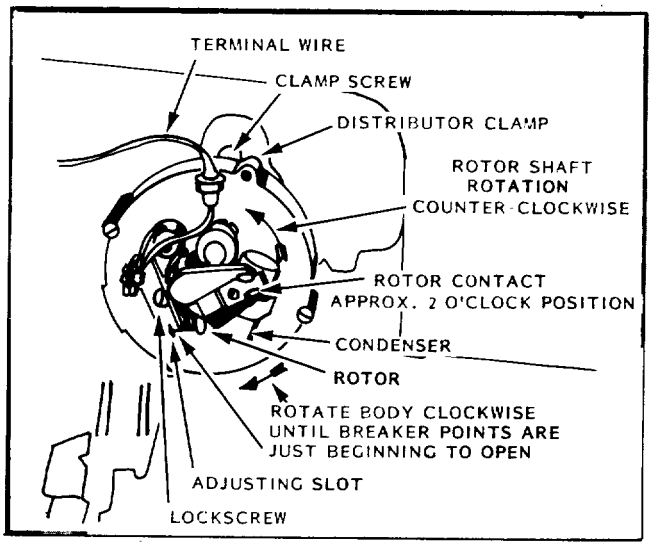


Fig. B-11 DELCO-REMY DISTRIBUTOR 313023C

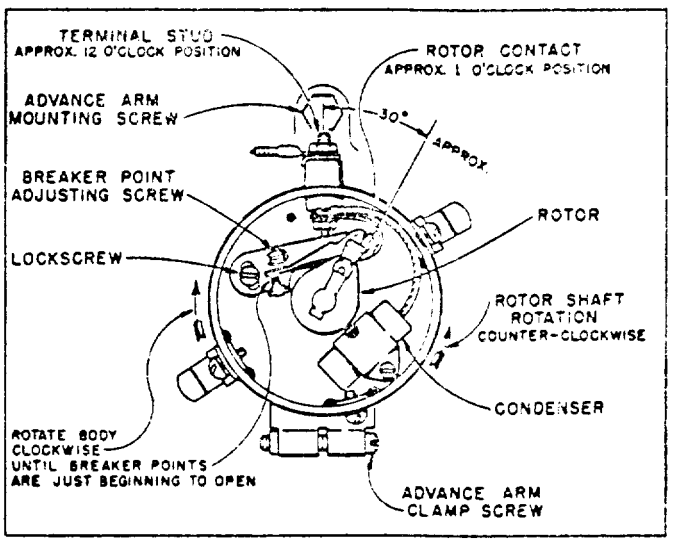


Fig. B-12 PRESTOLITE DISTRIBUTOR

cylinders are numbered from 1 to 4 on the cylinder head covers.

TIMING MARKS (Refer to Fig. B-10)

Remove screen over flywheel air intake opening by taking out the screws holding screen in place. This will expose the timing marks on flywheel shroud, also the vane on flywheel marked by an 'X' and the letters 'DC'.

NOTE: On engines equipped with a rotating screen attached to the flywheel, the leading edge of the 'X' marked vane is identified by an 'I' stamped on the outer rim of the screen, thereby not requiring removal of the rotating screen when timing the engine.

TIMING INSTRUCTIONS: The No. 1 piston must be on top dead center of the compression stroke before distributor can be mounted. With reference to Fig. B-10, this can be accomplished as follows:

1. Remove rocker arm cover from No. 1 cylinder bank.
2. Turn engine over with hand crank until the inlet valve opens and then closes.
3. Continue turning the engine over until the leading edge of the 'X' marked vane on the flywheel is in line with the centerline mark of the No. 1 and 3 cylinder-banks.
4. **DISTRIBUTOR TIMING:** With the No. 1 piston now on TDC of the compression stroke, refer to Fig. B-11 for the revised Delco-Remy distributor or Fig. B-12 for Prestolite, and mount distributor as follows:
   a. Before mounting distributor to housing, take off distributor cap, remove rotor and dust cover.
   b. Hold distributor with face up and terminal wire or terminal stud, away and in a 12 o'clock position as shown. Mount rotor on shaft and turn until the rotor contact points in an approximate 2 o'clock position as illustrated in Fig B-11, or 1 o'clock position as in Fig. B-12.
   c. Assemble distributor to housing, properly meshing the gears while retaining the terminal wire or stud in an approximate 12 o'clock position.
   d. Mount distributor clamp to drive housing, Fig. B-11, but do not tighten screw. If applicable, as per Fig. B-12, tighten advance arm mounting screw to the drive housing.
   e. Adjust breaker point gap to 0.020 inch maximum opening, see 'Distributor Maintenance'.
   f. With the clamp screw loose, turn distributor body slightly in a counter-clockwise rotation so that breaker points are firmly closed. Then turn distributor body in a clockwise rotation until breaker points are just beginning to open. At this point a slight resistance can be felt as the breaker point cam strikes the breaker arm.
   g. Tighten clamp screw. The No. 1 cylinder is now ready to fire in the retarded position.

The breaker point gap of 0.020 of an inch should be checked and adjusted per paragraph (e), before distributor body is set and locked in place, as per paragraphs (f) and (g), because any change in gap opening will affect the ignition advance. Mount dust cover and distributor cap.

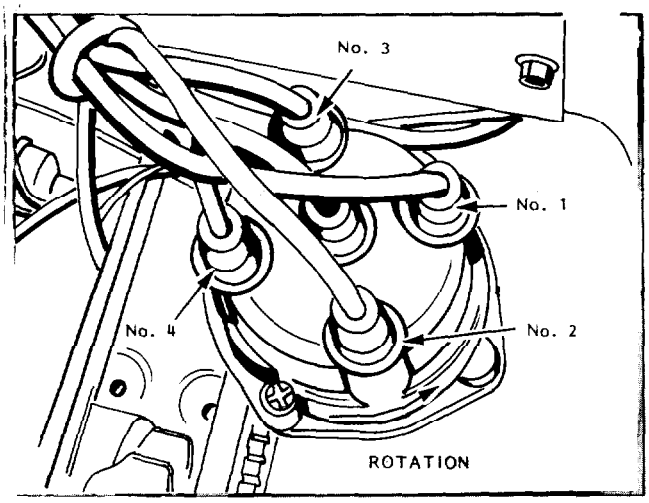


Fig. B-13 DELCO-REMY DISTRIBUTOR MOUNTING 313024C

If care is exercised in the preceding instructions, the spark timing should be accurate enough for satisfactory starting, however, ***checking spark advance*** with a ***neon lamp,*** as described in *"Neon Lamp Timing"* ***is necessary.***

The ***No. 1 terminal tower*** for the ***Delco-Remy*** distributor is located in an approximate 2 o'clock position on the distributor cap, as illustrated in *Fig.* **B-13,** and in an approximate 1 o'clock location for the ***Prestolite*** distributor. The terminal sequence is ***1-3-4-2*** in a counter-clockwise direction. Mount ignition cables to spark plugs of like numbers, with the center terminal tower connected to the ignition coil. *See Wiring Diagram, Fig* **B-15.** The cylinder shroud covers are marked for spark plug identification.

NEON LAMP TIMING (Fig. B-14)

The *engine should be timed to the 23° advanced position at not less than 2000 R.P.M.* Check timing with a neon lamp as shown in *Fig.* **B-14** insert a small screw driver into the No. 1 terminal tower on the distributor cap, making contact with the spark plug wire terminal.

Connect the red terminal clip, from a conventional type timing lamp, to the metal portion of the screw driver. One of the other two timing lamp wires is connected to the battery, and the other to ground.

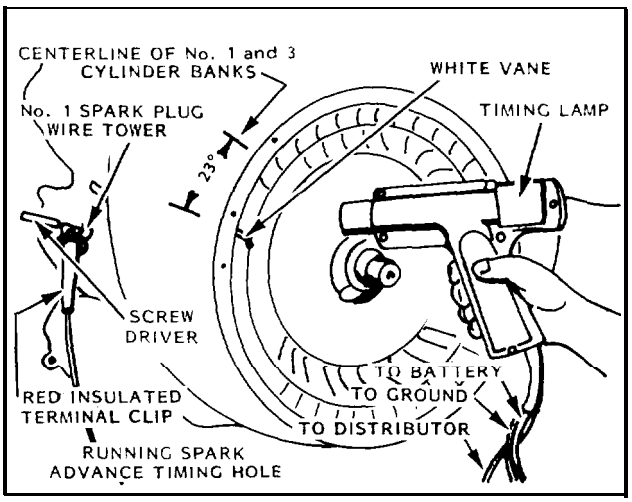


Fig. B-14 277786C

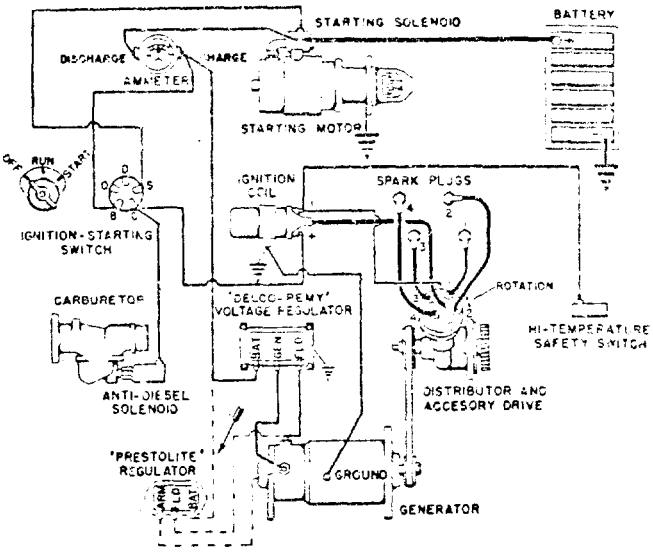


Fig. B-15
DISTRIBUTOR IGNITION - WIRING DIAGRAM

Chalk or paint the end of the **'X'** marked vane on the flywheel, white. Then with the engine operating at ***2000 R.P.M.*** or over, allow the flash from the neon lamp to illuminate the whitened vane. At the time of the flash, the leading edge of the vane should line up with the ***running spark advance timing hole*** on the flywheel shroud, *see Fig* **B-14.** If it does not, the distributor ***clamp screw*** should be loosened and the distributor body turned slightly clockwise or counter-clockwise, as required, until the ***white flywheel vane*** matches up with the ***advance timing hole.*** Be sure ***clamp screw*** is then carefully tightened.

If the engine is running below ***2000 R.P.M.*** when timing, the automatic advance in the distributor will not be in the *"full advance position"* and thus the timing would not be accurate.

DISTRIBUTOR MAINTENANCE

The normal breaker point gap is ***0.020 inch*** at full separation and can be adjusted in the following manner, with reference to *Fig's* **B-11** *or* **B-12;** Turn engine over by means of the starting crank until the distributor breaker arm ***rubbing block*** is on a high point of the ***cam.*** Loosen the stationary contact ***lockscrew*** very slightly and insert a feeler gauge between the points. By means of a screw driver inserted into the ***adjusting slot*** of the ***Delco-Remy*** distributor or by the ***adjusting screw*** of the ***Pestolite*** distributor, open or close points as required until a slight drag is felt when sliding feeler gauge between the points. Tighten lockscrew and recheck gap.

Every 50 hours of operation, the oiler on the side of the ***Pestolite*** distributor base should have 3 to 5 drops of medium engine oil added. The old style ***Delco-Remy*** distributor has a built-in oil reservoir. Every 200 hours of operation, remove oil plug in base and refill with No. 20W oil. Seal plug in reassembly. The ***new style Delco-Remy*** distributor does not have an external oil plug, since it is self-lubricated by oil in the accessory drive housing.

Every 100 hours, apply 3 to 5 drops of light engine oil (10W), to the felt in the top of the cam sleeve, and 1 or 2 drops to the breaker arm pivot.

Every 200 hours, add a small amount of high melting point grease to breaker arm rubbing block, or oil the cam wick.

Avoid excessive lubrication. oil that may get on the contact points will cause them to burn.

GENERATOR

A 12 volt, 17 amp. generator is furnished as standard equipment, unless otherwise s;pecified. The generator is manufactured by either the Delco-Remy Company or Prestolite Company.

Every 50 hours of operation, add 3 to 5 drops of medium engine oil into the oil cap at both ends of the generator.

ELECTRICAL WIRING CIRCUITS

Beginning with engine serial No. 3979807, the standard wiring circuits for all electrical equipment is for ***negative ground*** **polarity,** instead of the previously furnished positive ground.

The wiring diagram, Fig. B-15, illustrates a negative ground circuit. To wire equipment that has a positive ground polarity; reverse terminal connections at the ammeter, coil and battery. *Be* ***sure polarity*** of **generator and** ***regulator*** is ***known*** when re-wiring.

Do *not use* positive ground generator and regulator in a negative ground circuit, or vice versa. Polarity does not affect starting motor, coil and distributor.

MAGNETO TIMING

For engines furnished with magneto ignition in place of distributor ignition, timing is accomplished in the following manner:

1. Expose timing marks on flywheel and shroud. Refer to *'Timing Marks'* paragraphs on page B-14.
2. Position No. 1 piston on compression stroke, as per *'Timing Instructions'* paragraphs on Page B-14.
3. With No. 1 piston on compression stroke turn engine over past top dead center, until the **leading** ***edge*** of the 'X' marked vane on the flywheel is in line with the vertical centerline mark on the shroud, as shown in Fig. B-16. Leave flywheel in this position (flywheel keyway will be on top).
4. Remove ***inspection hole*** plug, located in gear cover at magneto mounting flange.
5. Assuming the magneto is removed from the engine; set magneto for spark discharge to the No. 1 terminal. This is accomplished by use of a short stiff length of wire placed into the No. 1 terminal socket and bent to within 1/8 inch of the magneto frame. Then turn the magneto gear in a clockwise rotation, tripping the impulse coupling, until a spark is observed between the wire and frame. Retain gear in this position.
6. Place gasket on flange and mount magneto to engine, meshing the gears so that when magneto is assembled, the gear tooth marked with an 'X' will be visible through the lower half of the ***inspection*** hole in gear cover. See *Magneto Timing Diagram, Fig.* B-16. Securely tighten nut and capscrew for mounting magneto.

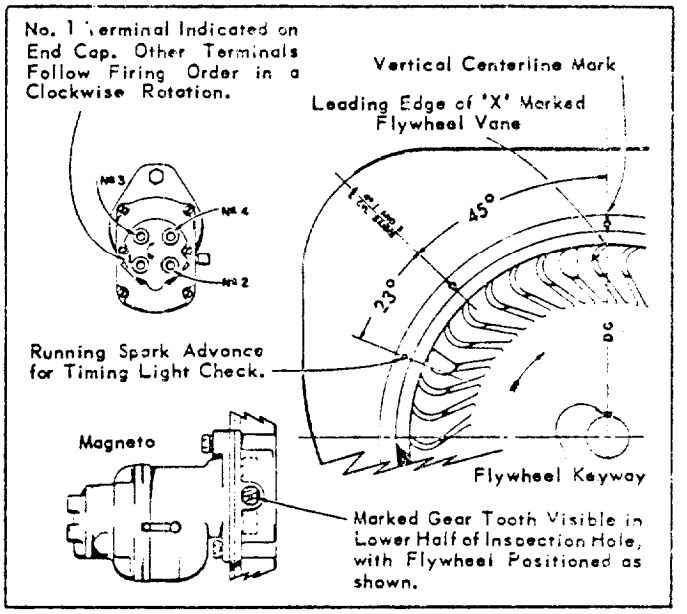


Fig. B-16
MAGNETO TIMING DIAGRAM

The No. 1 terminal is identified on the magneto cap. The terminals follow the proper firing order of 1-3-4-2 in a clockwise direction viewing the cap end. The leads from the magneto should be connected to spark plugs of corresponding numbers, see *Firing Order* paragraph Page B-13 and Wiring Diagram, Fig. B-17.

When magneto is properly timed the impulse coupling will snap when the 'DC' - 'X' marked vane of the fly**wheel** lines up with the mark on flywheel, which indicates the centerline of the No. 1 and 3 cylinders. This can be checked by turning crankshaft over slowly by hand. The impulse will also snap every 180° of flywheel rotation thereafter.

The running spark advance is 23°. To check timing with a **neon light,** the advance is indicated by a hole on the flywheel shroud, 23° before ***centerline*** of the No. 1 and 3 cylinders. See *Fig.* B-16.

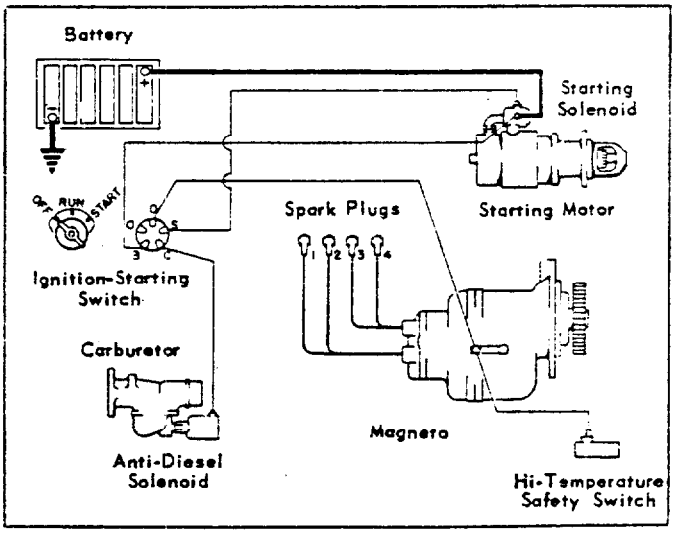


Fig. B-17
MAGNETO IGNITION - WIRING DIAGRAM

The magneto is driven at crankshaft speed in clockwise direction when viewing gear end of magneto. The magneto distributor rotor turns at half engine speed.

Magneto breaker point gap is 0.015 inch at full separation. If the ignition spark becomes weak after continued operation, the breaker points may have to be readjusted or replaced. Refer to Manufacturer's Bulletin in rear of manual for service and adjustment of breaker points.

IGNITION SPARK (Fig. B-18)

If difficulty is experienced in starting the engine or if engine misses firing, the strength of the ignition spark may be tested as follows: Disconnect the cables from all towers on the distributor cap, except the center coil tower. Insert a stiff piece of wire or metal rod into one of the sockets. Hold the terminal for this tower 1/8 inch from the wire or rod, as shown in Fig. B-18. Turn engine over slowly, two complete revolutions with the hand crank and watch for a spark to discharge during the cranking cycle.

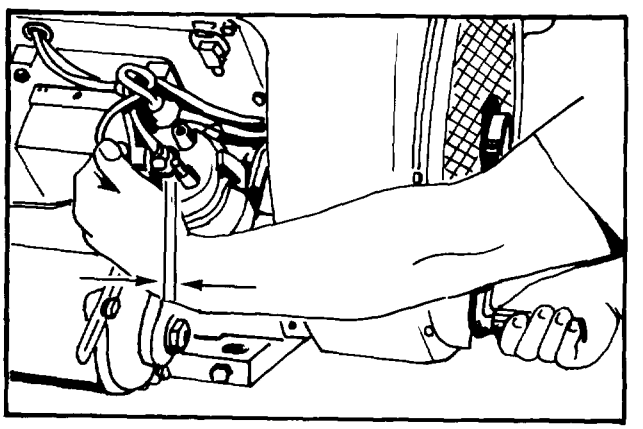


Fig. B-18 27779C

Repeat this check with each of the other ignition cables. A good spark at each of the towers will eliminate the ignition coil and distributor as the source of trouble. If there is a weak spark, or none at all, check breaker point opening for 0.020 inch gap. It may be necessary to install a new condenser, or the ignition coil may be faulty.

SPARK PLUGS (Fig. B-19)

The spark plugs should be removed periodically, cleaned and re-gapped. Approximately every 350 hours of operation, replace spark plugs with new plugs of correct heat range, like Champion 14 mm, No N-12Y or equal.

The width of the gap between the points of the two electrodes must be very carefully and precisely set, because incorrect settings will have an adverse affect on engine operation. Check spark plug gap with a wire type gauge and regap as shown in Fig. B-19.

Spark plug gap - 0.030 of an inch.

Use a new gasket when mounting either old or new plugs and thoroughly clean threads in cylinder head before installation. Tighten spark plugs to 22 foot pounds torque. If torque wrench is not available,

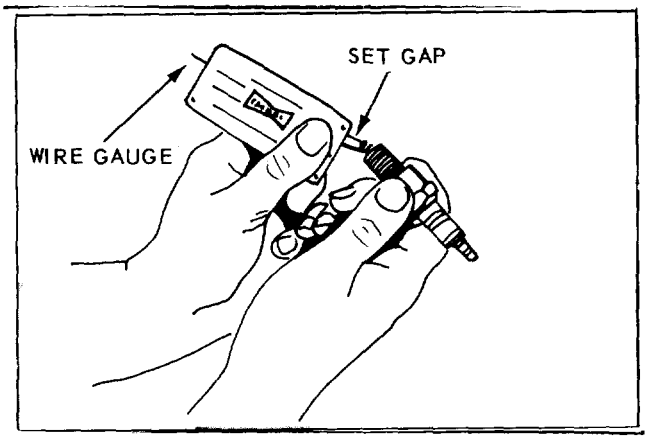


Fig. B-19 277779C

tighten plug until it begins to seat on the gasket, then turn 1/2 to 3/4 of a turn more.

RESTORING COMPRESSION

On a new engine or on one which has been out of operation for some time, the oil may have drained off the cylinder so that compression will be weak. This may cause difficulty in starting. To remedy this condition, remove the spark plugs and squirt about a fluid ounce of crankcase oil through the spark plug hole into each cylinder.

Turn the engine over several times with the starting crank to distribute the oil over the cylinder walls. Then reassemble spark plugs and compression should be satisfactory.

VALVE TAPPET ADJUSTMENT (Fig. B-20)

The clearance between the valve and rocker arm, with the tappet in its lowest position (valve completely closed) and the engine cold:

Inlet -0.008 inch
Exhaust - 0.014 inch

The rocker arms can be identified as follows: When facing the side of the engine, the exhaust rocker arm

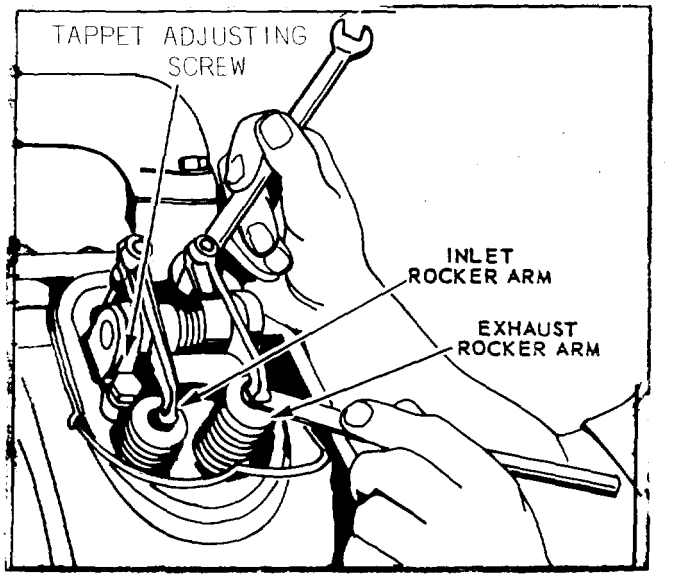


Fig. B-20 27444C

is to the right in the cylinder head and the *inlet rocker arm* to the left.

Measure the clearance between the top of the valve and the nose of the rocker arm with a feeler gauge, as shown in *Fig.* B-20. By means of a ½ inch tappet wrench, turn the *tappet adjusting screw* clockwise to decrease valve clearance and counter-clockwise to increase the clearance.

The sequence in which the tappets are adjusted is determined by the 1-3-4-2 firing order. Start by adjusting No. 1 inlet valve clearance first, then by just a short turn of the crank, No. 3 inlet can be adjusted. Return to No. 1 cylinder and adjust the exhaust clearance, then adjust the No. 3 exhaust.

The same procedure applies to the No. 2 and No. 4 bank of cylinders, starting with No. 4 inlet valve. Mark each rocker arm with chalk as adjustment is completed, to prevent repetition. With spark plugs removed, turning crankshaft is made easier.

ROCKER ARM COVERS (Fig. B-21)

When reassembling rocker arm covers, after timing or valve tappet adjustment, *carefully* replace the cover gaskets to prevent oil leaks.

If oil does appear around the rocker arm covers, reassemble in the following manner:

1. Check gasket face surface of rocker arm cover, at the rounded end, for paint accumulation, *see Fig.* B-21. Scrape off any paint that forms a hump. Smooth scraped area with emery cloth or steel wool.
2. Clean gasket faces on the cylinder head and rocker arm covers.
3. Spread a thin coat of perma-tex into the rocker arm cover, to hold gasket in place. This will prevent gasket slippage or deformation when mounting cover to cylinder head.
4. Use new gaskets. Old gaskets harden, take a "set" and will very likely leak.

GOVERNOR

OPERATION

The centrifugal flyball governor rotates on a stationary pin pressed into the upper part of the timing gear cover. The governor is driven off the camshaft gear and turns 1/8 faster than crankshaft speed.

Flyweights are hinged to lugs on the drive gear. Hardened pins on the flyweights bear against a flanged sliding sleeve, moving it back and forth as the flyweights move in or out. The motion of the sleeve is transmitted through a ball thrust bearing to the governor lever, which in turn is connected to the carburetor throttle lever. A spring connected to the governor lever tends to hold the governor flyweights to their *inner* position, also to hold the carburetor throttle open. As the engine speed increases, centrifugal force in the flyweights acts against the spring and closes the throttle to a point where the engine speed will be maintained practically constant under varying load conditions. This speed can be varied to

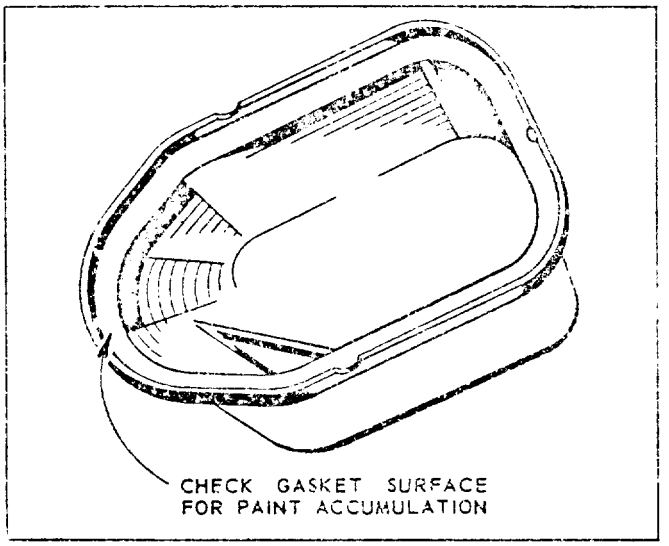


Fig. B-21

suit conditions by adjusting the governor spring tension.

GOVERNOR ADJUSTMENT (Fig. B-22, Fig. B-23)

The governor rod connection to the carburetor must be very carefully adjusted for length, otherwise the governor will not function properly and cause the engine to surge badly. With the engine at rest, the governor spring will keep the flyweights *in*, and the control rod must be of such length as to hold the carburetor throttle wide open at that point.

With the *control rod* disconnected from the *governor lever*, as illustrated in *Fig.* B-22, push the rod toward the carburetor as far as it will go. This will put the *carburetor throttle lever* in a wide open position. The governor lever should then be moved as far as possible in the same direction. Holding both parts in the above position, the rod should be screwed in or out of the *swivel block* on the carburetor, until the bent end of the rod will register with *hole* in lever, then screw rod in one more turn. The extra turn will shorten

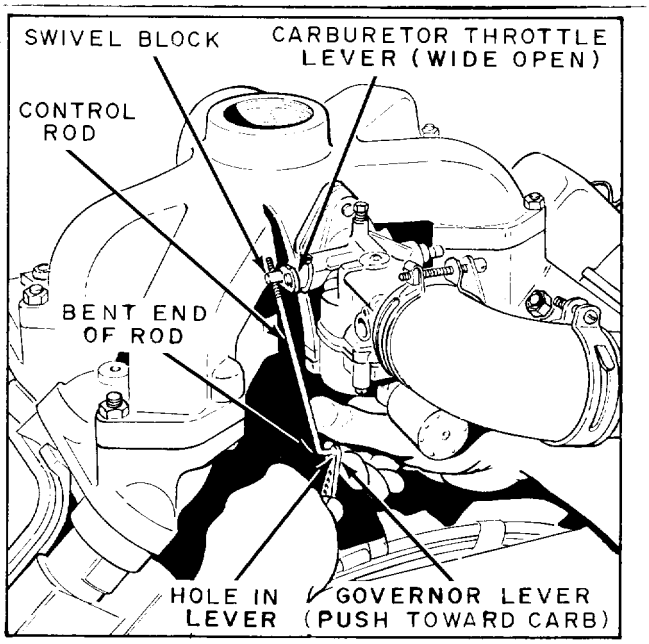


Fig. B-22

277796C

FULL LOAD R.P.M.	NO LOAD R.P.M.	HOLE NO.
1500	1635	3
1600	1825	4
1700	1855	4
1800	2000	5
1900	2055	5
2000	2200	6
2100	2230	6
2200	2375	7
2300	2440	7
2400	2545	8
2500	2695	9
2600	2745	9
2700	2810	9
2800	2935	10
2900	3065	11
3000	3175	12

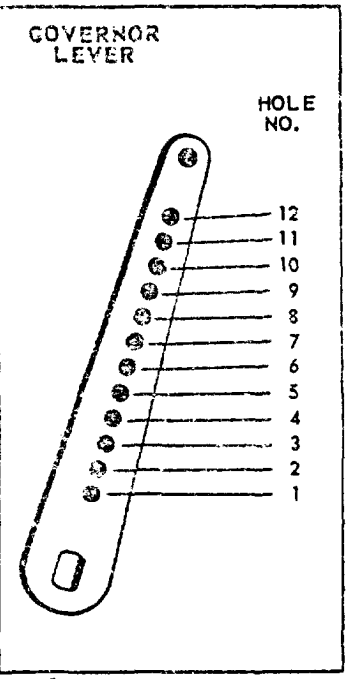


Fig. B-23

the linkage slightly and will enable the carburetor throttle lever to bounce back from the stop pin rather than jam against the pin, when a load is suddenly applied to an idling engine. This will eliminate excessive wear on the threads in the carburetor throttle swivel block.

The governor lever, Fig. B-23, is furnished with 12 holes for attaching the governor spring. It is very important that the spring is hooked into the proper hole to suit the speed at which the engine is to be operated. The Governor Lever Chart shows the full load and no load speeds of the engine and the hole corresponding thereto, for either a fixed speed, a variable speed or two speed (over-center idle control) governor. Note that the full load speed is less than the no load speed and this must be taken into consideration when readjusting the governor. As an example; if the engine is to be operated at 2000 revolutions per minute under load, the spring should be hooked into the 6th hole in the governor lever and the spring tension adjusted, by means of the adjusting screw, to run 2200 R.P.M. under no load. The speed at full load will then be approximately 2000 revolutions per minute.

A tachometer or revolution counter should be used against the crankshaft to check speed while adjusting the governor spring tension. Tightening the adjusting screw locknut will give higher speeds, while loosening the locknut will lower the spring tension and reduce the R.P.M.

CLUTCH AND REDUCTION UNITS

CLUTCH POWER TAKE-OFF (Fig. B-24)

The clutch available on this engine is of the dry disc type. No oil should be put into the clutch housing, but grease gun fittings are provided for periodic bearing lubrication. The housing bearing should be greased every fifty hours of operation and the clutch throwout

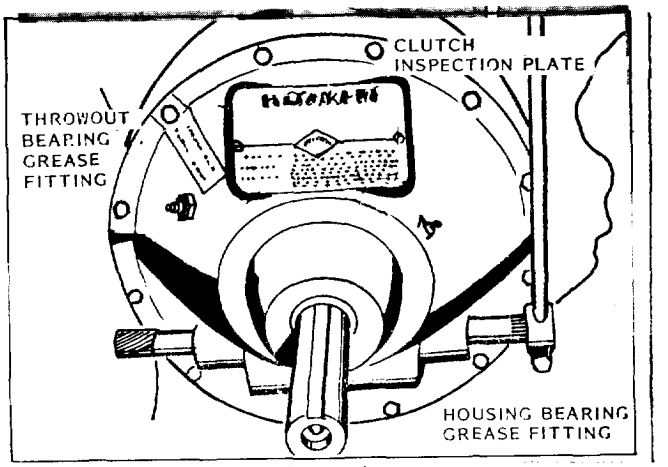


Fig. B-24 226229C

bearing greased every day before starting. Use general (lube) grease, MIL-L-10924.

Rockford PTA-4856 units have a sealed pilot bearing and require no external lubrication. Obsolete PTA-4819 units have a pilot bearing grease fitting at the end of the drive shaft and are lubricated same as the housing bearing.

CLUTCH ADJUSTMENT (Fig. B-25 or Fig. B-26)

If the clutch begins to slip it should be readjusted, otherwise it will become overheated and damaged. First, remove the clutch inspection plate and release the clutch operating lever. For the Rockford clutch, turn engine over by means of the hand crank until the clutch adjustment lock is visible thru the inspection opening in the clutch housing, see Fig. B-25. The clutch must be held stationary, either by means of a drift punch wedged in place as shown, or by some convenient method of keeping the take-off shaft from turning. Loosen screw holding the adjustment lock in place. Insert a screw driver in one of the notches and turn the adjusting ring in a counter-clockwise direction, one notch at a time, until a very firm pressure is required to engage the clutch with the operating lever. Tighten adjusting lock screw and mount inspection cover.

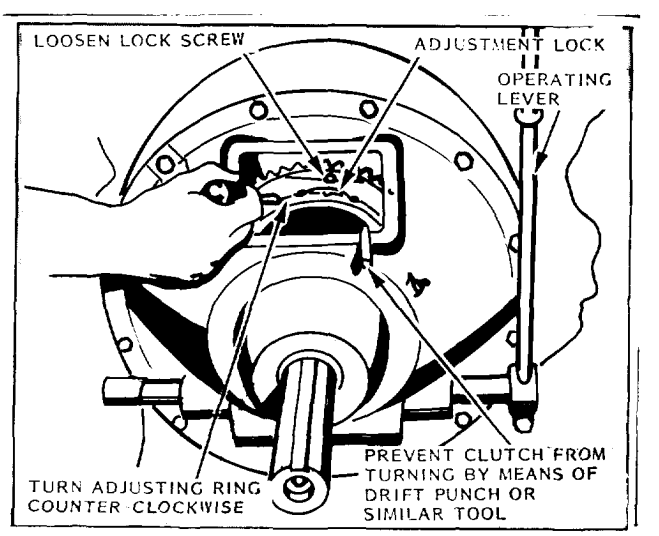


Fig. B-25 226227C

ROCKFORD CLUTCH ADJUSTMENT

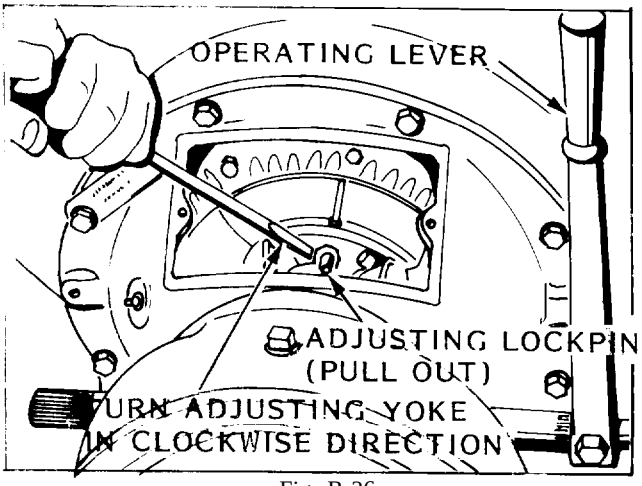


Fig. B-26 104578C
TWIN DISC CLUTCH ADJUSTMENT

For the Twin Disc clutch, pull adjusting lockpin out and insert a piece of 1/16" diameter wire into the hole on the side of the lockpin to keep pin in outer position, See Fig. B-26. Turn the adjusting yoke in a clockwise direction as shown, or wedge a screw driver into the adjusting yoke and against the side of the inspection hole opening to keep yoke from turning, and then turn the take-off shaft counter-clockwise. Tighten yoke enough so that the operating lever requires a distinct pressure to engage. Remove wire from lockpin and trim adjusting yoke slightly, to allow lockpin to snap into hole in floating plate.

A new clutch requires several adjustments until friction surfaces are worn in. Do not let a new clutch slip, this may ruin the friction surfaces.

CLUTCH REDUCTION UNIT (Fig. B-27)

The clutch in the clutch reduction units is of the dry disc type, the same as is used in the power take-off units. Therefore, no oil should be put in the clutch housing.

The throwout bearing should be lubricated once a day before starting. Add grease to fitting thru opening on side of housing, as illustrated in Fig. B-27, using the same type grease as used in the clutch power take-off units. Twin Disc units have an external grease fitting for the throwcut bearing.

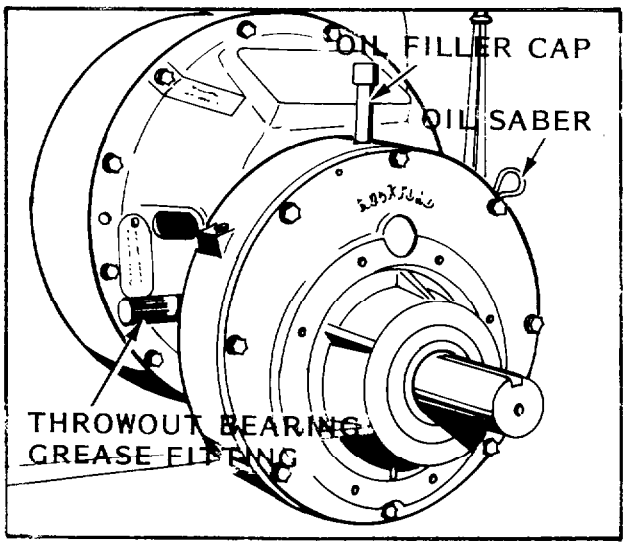


Fig. B-27 226226C
ROCKFORD CLUTCH REDUCTION UNIT

The shifter shaft should be lubricated periodically if external oil fittings are provided for this purpose.

The reduction unit is operated in oil and the gear case oil level must be maintained to the oil saber gauge mark or plug opening, see Fig. B-27. In Twin Disc units, high grade transmission oil S.A.E. No. 90 to No. 110 Viscosity must be used. For Rockford units, use No. 30 S.A.E. crankcase oil. Change oil every 2000 hours of service, while unit is warm.

If clutch slips, heats, or operating lever jumps our, the clutch, must be adjusted. Release clutch operating lever and remove hand hole plate. The clutchu in the clutch reduction units is the same as is used in the clutch power take-off units. Refer to "Clutch Adjustment" paragraph for adjustment of the clutch in the Twin Disc and Rockford clutch reduction in units. A new clutch generally requires several adjustments until the friction surfaces are worn in.

HIGH TEMPERATURE SAFETY SWITCH (Fig. B-28)

The high temperature safety switch is mounted on the cylinder head near the No. 4 spark plug. This safety switch will automatically stop the engine when head temperatures become critically high.

If an extreme cylinder head temperature causes the switch to automatically short out the ignition system and stop the engine, a waiting period of about 5 minutes will be required before the switch has cooled off sufficiently to allow the engine to be resatrted. An overheated engine will score the cylinder walls, burn out connecting rod and crankshaft bearings, also warp pistons and valves. The cause of the overheating condition will have to be remedied before the engine is restarted. See Engine Overheats paragraph in Troubles. Causes and Remedies section.

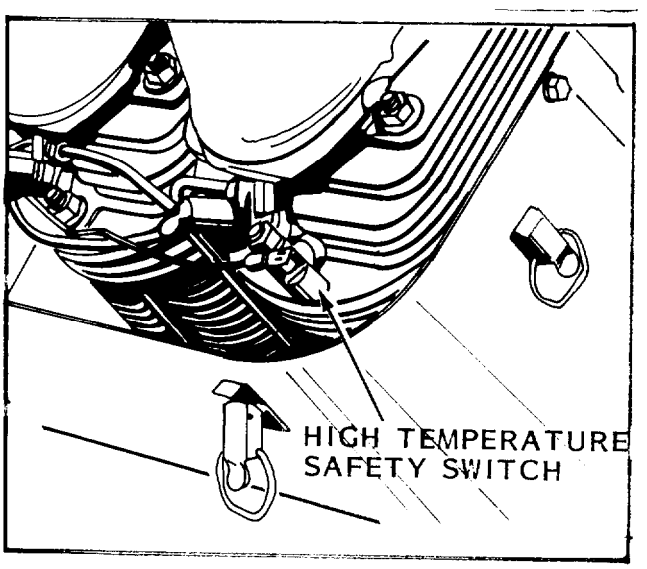


Fig. B-28

TROUBLES - CAUSES AND REMEDIES

Three prime requisites are essentia1 to starting and maintaining satisfactory operation of gasoline engines. They are:

1. A proper fuel mixture in the cylinder.

2. Good compression in the cylinder.

3. Good spark, properly timed, to ignite the mixture.

If all three of these conditions do not exist, the engine cannot be started. There are other factors which contribute to hard starting such as too heavy a load for the engine to turn over at a low starting speed, a long exhaust pipe with high back pressure, etc. These conditions may affect starting, but do not necessarily mean the engine is improperly adjusted.

As a guide to locating any difficulties which might arise, the following causes are listed under the three headings: Fuel Mixture, Compression, and Ignition. In each case, the causes of trouble are given in the order in which they are most apt to occur. If a remedy is apparent, no remedy is suggested.

STARTING DIFFICULTIES

FUEL MIXTURE

No fuel in tank, shut-off closed or cap vent plugged.

Fuel pump diaphragm worn out or punctured.

Carburetor not choked sufficiently, especially if engine is cold. See 'Starting Procedure', Page B-10.

Water, dirt, or gum in gasoline interfering with free flow of fuel to carburetor.

Anti-diesel solenoid valve, at carburetor, inoperative.

Check operation of valve A solenoid 'click' should be heard when ignition switch is turned to start position. If not;

Check "for disconnected, loose or broken wire.

Remove solenoid from carburetor - clean plunger and seat with solvent. Check plunger for spring tension.

Replace solenoid valve if the above does not rectify the problem.

Poor grade or stale gasoline that will not vaporize sufficiently to form the proper fuel mixture.

Carburetor flooded, due to excessive choking. See 'Starting Procedure', Page B-10.

Dirt or gum holding float needle valve in carburetor open. This condition will be indicated if fuel continues to drip from carburetor with engine standing idle. Often, tapping the float chamber of the carburetor very lightly will remedy this trouble. Do not strike carburetor with any metal tool.

If due to flooding, too much fuel entered the cylinder in attempting to start the engine, the mixture will most likely be too rich to burn. In that case, starting may be accomplished by continued cranking with the carburetor choke open.

To test for clogged fuel line, loosen fuel line nut at carburetor slightly. If line is open, fuel should drip out at loosened nut.

If the starter is 'dead' or is unable to turn the engine over, check battery and cable connections at the battery, starting motor, and starting switch; also check for broken or frayed cables. Test starting switch and starting motor and replace or repair if necessary.

COMPRESSION

If the engine has proper compression, considerable resistance will be encountered in turning the engine over with the starting crank. If this resistance is not encountered, compression is faulty. Following are some reasons for poor compression:

Cylinder dry due to engine having been out of use for some time See 'Restoring Compression', Page B-17.

Loose or broken spark plug. In this case, a hissing noise will be heard in cranking engine, due to escaping gas mixture on compression stroke.

Damaged cylinder head gasket or loose cylinder head. This will likewise cause hissing noise on compression stroke.

Valve stuck open due to carbon or gum on valve stem.

Valves adjusted with insufficient clearance under valve stems. See 'Valve Tappet Adjustment' Page B-17.

Piston rings stuck due to carbon accumulation.

Scored cylinders. This will require reboring the cylinders and fitting with oversize pistons and rings, or replacement of complete cylinder barrels.

IGNITION

No spark may be attributed to the following:

Ignition cable disconnected from coil, distributor, or spark plugs. Cables wet.

Broken ignition cables, causing short circuits.

Spark plug insulators broken. Plugs wet or dirty.

Spark plug point gap wrong. See Page B-17.

Condensation on spark plug electrodes.

Breaker points pitted or fused. Breaker arm sticking.

Distributor condenser leaking or grounded.

Spark timing wrong. See 'Timing', Page B-13.

ENGINE MISSES
Spark plug gap incorrect. See Page B-17.

Worn and leaking ignition cables.

Weak spark or no spark in one of the cylinders.

Loose connection at ignition cable.

Distributor breaker points pitted, worn or incorrect gap. See 'Distributor Timing', Page B-14.

Water in gasoline.

Poor compression. See 'Compression' page B-21.

Sticky valves.

ENGINE SURGES OR GALLOPS

Carburetor flooded.

Governor spring hooked into wrong hole in lever. Governor rod incorrectly adjusted. See 'Governor Adjustment', Page B-18.

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

Gasoline vaporized in fuel lines, due to excessive heat around engine (Vapor Lock). See 'Stopping Engine', Page B-11.

Vapor lock in fuel lines or carburetor due to using winter gas (too volatile) in hot weather.

Air vent hole in fuel tank cap plugged. Engine scored or stuck due to lack of oil.

Ignition troubles. See 'Ignition', Page B-21.

Wire from anti-diesel solenoid to starting switch disconnected or damaged.

ENGINE OVERHEATS

Crankcase oil supply low, Replenish immediately.

Ignition spark timed wrong. See 'Neon Lamp Timing', Page B-15.

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins on cylinder or head.

Engine operated in confined space where cooling air is continually recirculated, consequently becoming too hot.

Carbon in engine.

Dirty or incorrect grade of crankcase oil.

Restricted exhaust.

Engine operated while detonating due to low octane gasoline, or heavy load at low speed.

ENGINE KNOCKS

Poor grade of gasoline or of low octane rating. See 'Fuel', Page B-10.

Engine operating under heavy load at low speed.

Carbon or lead deposits in cylinder head.

Spark advanced too far. See 'Neon Lamp Timing', Page B-15.

Loose or burnt out connecting rod bearing.

Engine overheated due to causes under previous heading.

Worn or loose piston pin.

ENGINE BACKFIRES THROUGH CARBURETOR

Waterr or dirt in gasoline.

Engine cold.

Poor grade of gasoline.

Sticky inlet valves.

Overheated valves.

Spark plugs too hot. See 'Spark Plugs', Page B-17.

Hot carbon particles in engine.

LOW or NO OIL PRESSURE

Oil pressure gauge. defective.

Oil line to gauge clogged up.

Crankcase oil supply low.

Faulty oil pump.
- Gears worn or broken.
- Cover worn.
- Loose cover or body.
- Gasket damaged.

Faulty relief valve,

Clogged or leaky oil line connections.

Strainer screen clogged up.

Oil too thin due to dilution or too light of grade used.

Worn rod bearings.

HIGH OIL PRESSURE

Oil pressure gauge defective.

Oil too heavy.

Faulty relief valve.

Clogged pressure line.

INSTRUCTIONS FOR PROTECTING ENGINES FOR WINTER OR SHORT STORAGE PERIODS

To protect the cylinders, pistons, rings and valves and keep them from rusting and sticking, a half and half mixture of kerosene and good engine oil, (the same kind of oil as used in the crankcase of the engine), should be injected into the pipe tap opening on the intake manifold while the engine is warm and running at moderate speed. About a quarter of a pint is necessary, or enough so that a heavy bluish smoke will appear at the exhaust. The ignition switch should then be shut off and the engine stopped. This fogging operation will leave a coating of oil on the above mentioned parts, protecting them from the atmosphere.

Drain crankcase oil while the engine is warm, as the oil will flow more freely than when cold.

Drain fuel lines, carburetor, fuel pump and tank of all gasoline, to prevent lead and gum sediment from in-

terfering with future operation. Gasoline fumes from gradual evaporation is a dangerous fire hazard.

The air cleaner should be thoroughly cleaned of all oil and accumulated dust, and the sediment removed from the oil cup at the bottom of the cleaner.

Tape or otherwise seal off the air cleaner or carburetor intake, as well as the exhaust and breather openings, for the duration of the storage period.

The outside of the engine, including the cooling fins on the cylinders and heads, should be thoroughly cleaned of all dirt and other deposits.

All exposed unpainted metal parts should be coated with grease or heavy oil.

Before starting the engine after the storage period, remove crankcase drain plug so that any condensation which may have collected may be drained before new crankcase oil is added. It is highly recommended that the crankcase bottom cover be removed and scrubbed of all sediment which may have collected there. When reassembling the bottom cover, a new gasket should be used.

Fill crankcase with the correct grade of oil to the full mark on the saber. Do not use any oil heavier than SAE No. 30. Also be sure to put oil to the proper level in the air cleaner. (Refer to Lubrication and Air Cleaner.)

It is advisable to use new spark plugs at the beginning of the operating interval, especially if the engine has given considerable service.

Refuel engine and follow the starting instructions as shown on preceding pages of this manual.

It is suggested that machines be stjored inside a building. If this is not possible, protect the engine from the weather by a proper covering.

DISASSEMBLY AND REASSEMBLY O F ENGINE

Engine repairs should be made only by a mechanic who has had experience in such work. When disassembling the engine, it is advisable to have several boxes available so that parts belonging to certain groups can be kept together. Capscrews of various lengths are used in the engine, therefore great care must be exercised in reassembly so the right screw will be used in the proper place.

Tighten the capscrews and nuts of the manifolds, cylinder heads, gear cover, oil pan, connecting rods, cylinder barrels, main bearing plate and the spark plugs to the specified torque readings indicated in the paragraphs of reassembly, relative to these parts.

While the engine is partly or fully dismantled, all of the parts should be thoroughly cleaned. Use all new gaskets and 'O' rings in reassembly, and lubricate all bearing surfaces.

The following procedure is for complete disassembly of an engine. As disassembly progresses, the order may be altered somewhat, as will be self-evident to the mechanic. Reassembly of the engine should be made in the reverse order.

TESTING REBUILT ENGINE

An engine that has been rebuilt with new connecting rod shell bearings and having cylinders rebored or replaced, and fitted with new pistons, rings and valves, should go through a thorough "run-in" period before any load is applied to it.

The engine should be started and allowed to run for about one-half hour at about 1200 to 1400 R.P.M. without load. The R.P.M. should then be increased to engine operating speed, still without load, for an additional three and one-half to four hours.

The proper "running-in" of the engine will help to establish polished bearing surfaces and proper clearances between the various moving parts and thus add years of trouble free service to the life of your engine.

ACCESSORIES

Remove clutch or clutch reduction unit if engine is equipped with either of these accessories.

AIR CLEANER can be removed as a complete unit when flywheel shroud is removed. Disconnect tubing and elbow connection from carburetor to air cleaner.

CONTROL PANEL can remain on flywheel shroud, but disconnect: ignition wires from anti-diesel solenoid, starting solenoid, choke wire at carburetor, hose at oil pressure gauge, variable speed control, ignition wires at coil and voltage regulator (battery terminal).

OIL FILTER is removed by tapping side of cartridge with a mallet to break the seal. Then pierce can with screw driver or similar pointed tool to serve as a handle for unscrewing filter from case. Place a pan under the filter to catch oil leakage when filter is removed. Refer to "Oil Filter", Page B-11, for replacement instructions.

STARTING MOTOR is removed by disconnecting ignition wires at solenoid and taking out the three capscrews holding starter to flange on gear cover. Note: The rubber Bendix cover will drop off when flywheel shroud is removed.

FLYWHEEL (Fig. B-29, Fig. B-30)

After the flywheel screen has been removed, drive out the starting crank pin in the crankshaft and straighten out the bent tabs on lockwasher. By means of a 2¼" socket power wrench or 2¼" offset box wrench, as shown in Fig. B-29, remove flywheel nut. Strike the handle of the wrench a sharp blow with a soft hammer to loosen nut. Do not use an open end, monkey or pipe wrench.

The flywheel is mounted to a taper on the crankshaft. Take a firm hold on the flywheel fins, pull outward and at the same time strike the end of the crankshaft several times with a babbitt hammer, see Fig. B-30. The flywheel will slide off the taper of the crankshaft. Do not use a hard hammer as it may ruin the crankshaft and bearings. Remove Woodruff key from crankshaft.

***In* reassembly; be** sure the Woodruff key is in position on the shaft and that the keyway in the flywheel is

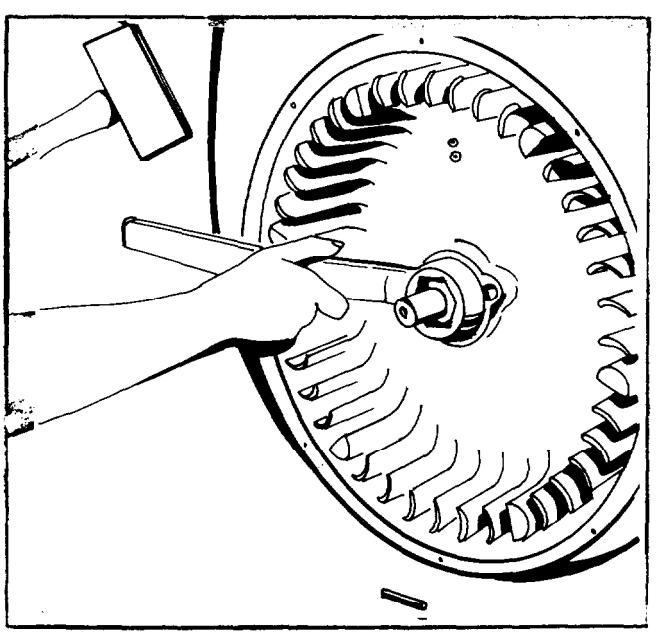


Fig. B-29 277787C

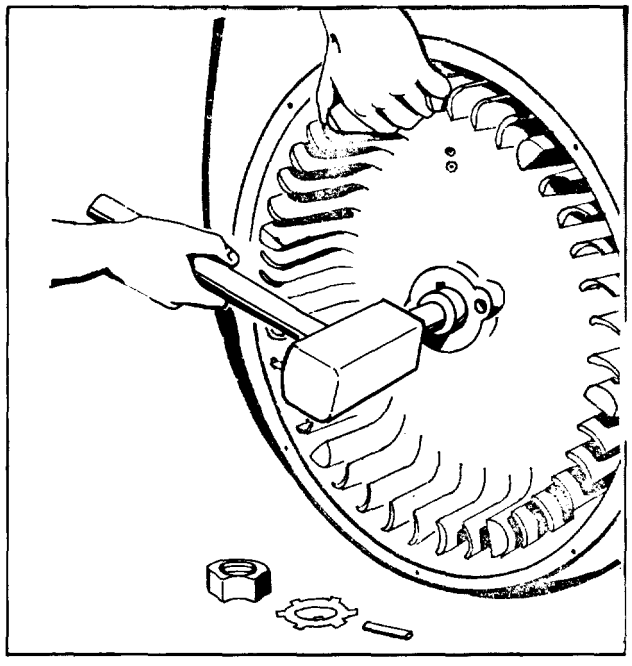


Fig. B-30 277788C

lined up accurately with the key. After mounting; seat flywheel on crankshaft taper by slipping a piece of pipe over the end of the crankshaft and against the hub of the flywheel, and striking the end of the pipe a sharp blow with a hammer.

FLYWHEEL SHROUD (Fig. B-31)

Remove cylinder head covers by dis-engaging 3 clips and taking out the thumb screw.

Disconnect No. 2 and No. 4 spark plug wires and hi-temperature switch wire. Slip wires thru grommet in shroud.

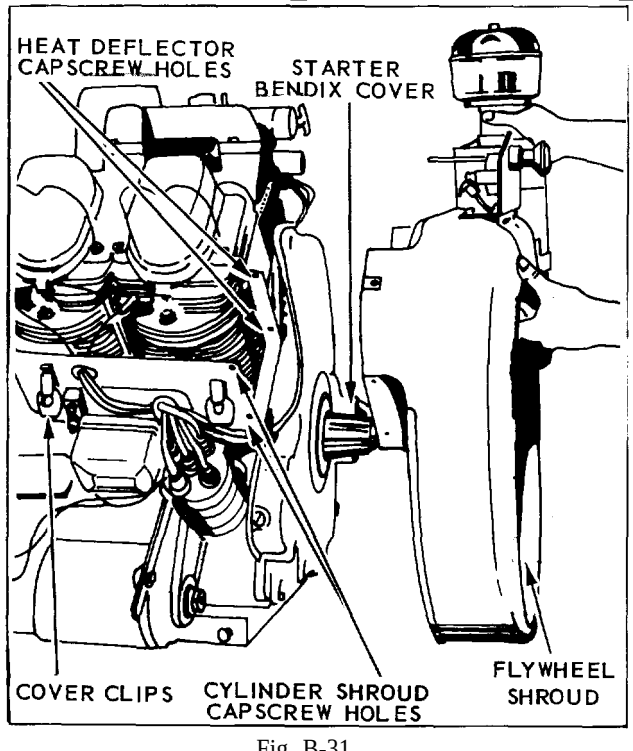


Fig. B-31 277799C

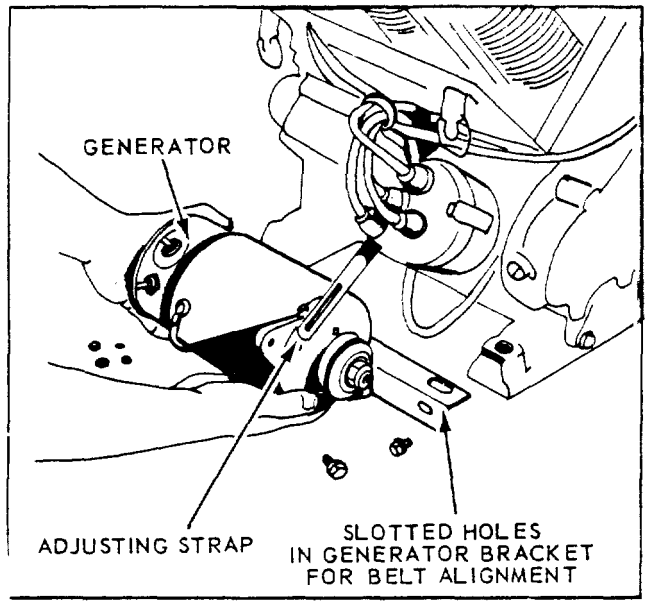


Fig. B-32 277791C

Take out the following capscrews: 4 from flywheel shroud to cylinder shrouds, 4 from heat deflectors and 6 from inside flywheel shroud to gear cover. The flywheel ***shroud,*** air cleaner and control panel assembly can be removed as illustrated in Fig. B-31.

in *reassembly;* insert rubber Bendix cover between flywheel shroud and starter pad on gear cover.

GENERATOR (Fig. B-32)

Disconnect ignition wires *from* field and armature terminals. Take out the capscrew holding the adjusting strap to generator. By taking cut the 2 capscrews which hold the bracket to the engine supports, the generator can be removed as shown in *Fig.* B-32.

Note that the holes in the generator bracket are slotted for belt alignment in reassembly.

DISTRIBUTOR AND ACCESSORY DRIVE (Fig. B-33)

Disconnect ignition wire at distributor and take off distributor cap, leaving high tension cables in place. Remove 2 capscrews holding the accessory drive housing to the gear cover. As illustrated in *Fig.* B-33, the distributor and accessory drive housing can be withdrawn from the gear cover as a complete-unit.

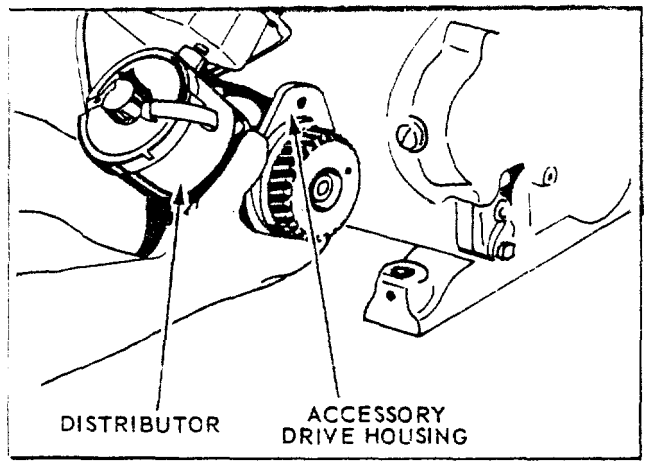


Fig. B-33 277790C

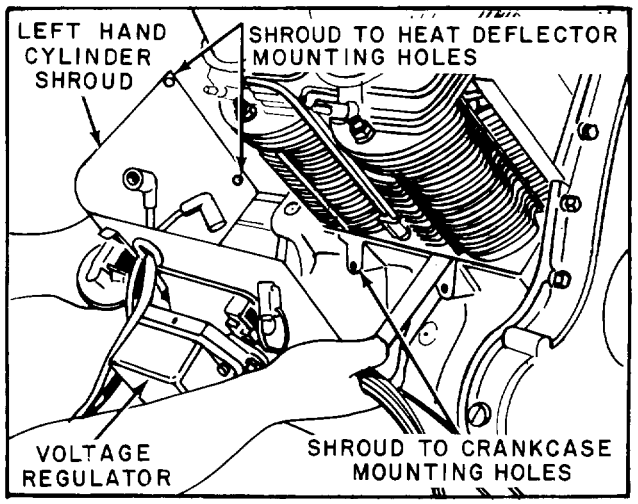


Fig. B-34 277800C

CYLINDER SHROUDING (Fig. B-34)

Remove ignition coil and generator adjusting strap from left hand side of engine. Disconnect No. 1 and No. 3 wires at spark plugs and remove spark plug wire clamps at top of governor housing. Take out the 2 capscrews which attach the cylinder shroud to the heat deflector at the take-off end of the engine and the 2 screws mounting the shroud to the crankcase. The left hand cylinder shroud with voltage regulator and spark plug wires attached can be removed as shown in *Fig.* B-34. Right hand cylinder shroud is removed in like manner.

MANIFOLD AND CARBURETOR (Fig. B-35)

Disconnect fuel line at carburetor and control rod at governor lever. Unhook governor spring and remove the 4 nuts and clamp washers which secure the manifold to the cylinder heads. The two manifold branches, carburetor and speed control bracket assembly can be lifted off as a complete unit. *See Fig.* B-35.

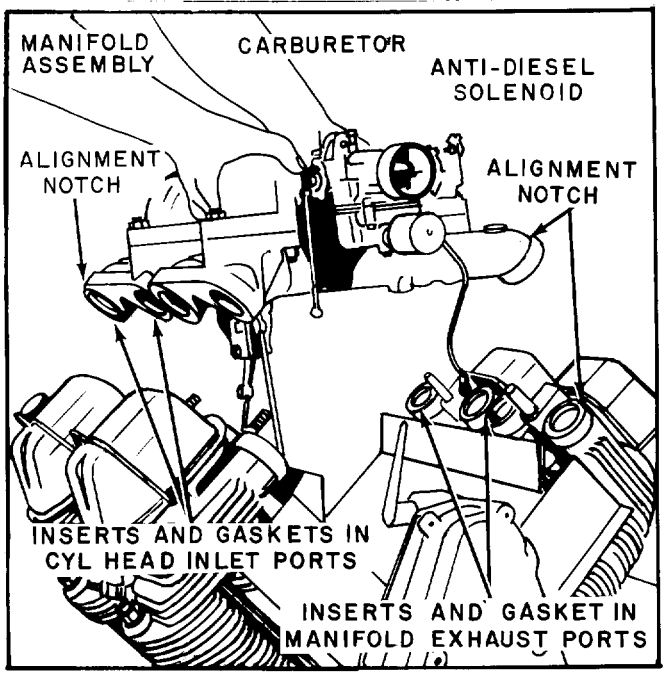


Fig. B-35 277792C

Note that the exhaust manifold gaskets and inserts will remain in the cylinder head ports, whereas the inlet gaskets will stay in the manifold ports. New gaskets should be mounted accordingly in reassembly.

To prevent restriction in ports because of misalignment between the manifold and cylinder heads, there is a cast notch on top of the No. 2 and the No. 3 inlet ports of the manifold. These notches are to match up with a similar notch on the inlet port of the cylinder heads in reassembly. Tighten manifold to cylinder head nuts to *25 foot pounds torque.* The upper to lower manifold nuts are tightened to *15 ft. lbs. torque* and the anti-diesel solenoid mounted to the carburetor is tightened to *100 inch pounds torque.*

FUEL PUMP

Loosen screw on heat deflector at fuel pump. Remove 2 capscrews holding pump adapter to crankcase. Swing heat deflector bracket to one side and remove complete pump adapter and strainer assembly.

GOVERNOR

Remove the 2 bottom screws holding the governor housing to the gear cover and spacer plate. Top 2 screws were removed when spark plug wire clamps were taken off. After removing governor housing, the gear and flyweight assembly can be slipped off shaft in gear cover.

In reassembly; refer to *"Governor Adjustment"* in *'Operating Instruction Section'* of manual, for setting engine operating speed.

GEAR COVER (Fig. B-36)

Remove capscrews from front face of gear cover and 2 screws from rear at No. 2 cylinder. Tap gear cover

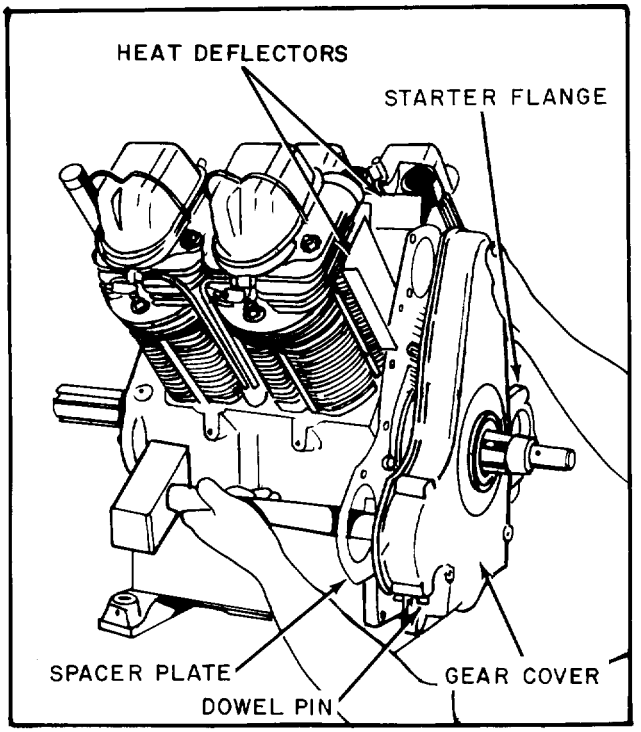


Fig. B-36 277785C

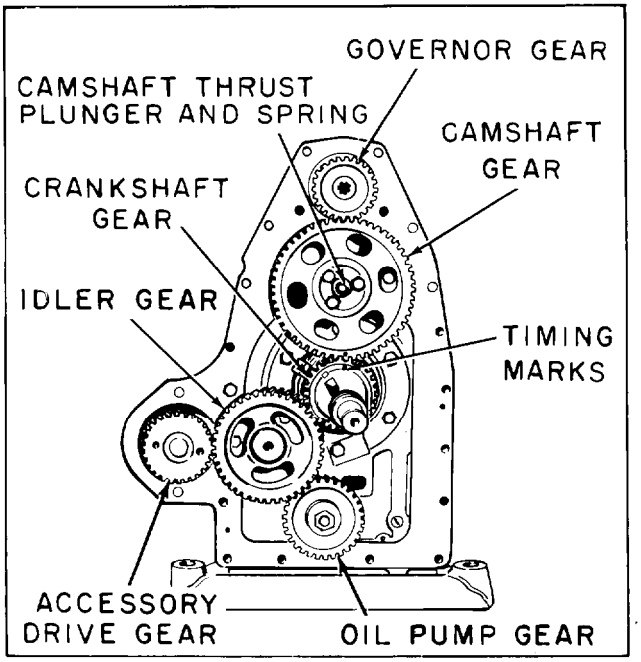


Fig. B-37 277784C

alternately, from starter flange to accessory drive housing opening, and remove as illustrated in Fig. B-36. .Note that dowel pins will remain in cover. Cylinder heat deflectors can now be removed.

In reassembly; tighten gear cover capscrews to 18 foot pounds torque.

GEAR TRAIN (Fig. B-37)

With the removal of gear cover and oil sling, the gear train will be exposed as shown in Fig. B-37. Remove camshaft thrust plunger and spring to prevent their being lost.

Future reference can be made to Fig B-37 when assembling crankshaft and camshaft, as accurate location of the timing marks is" essential for proper engine operation.

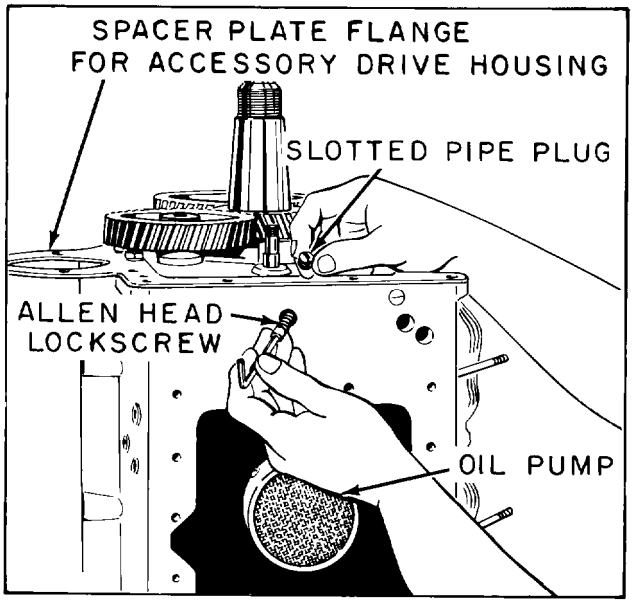


Fig. B-38 277782C

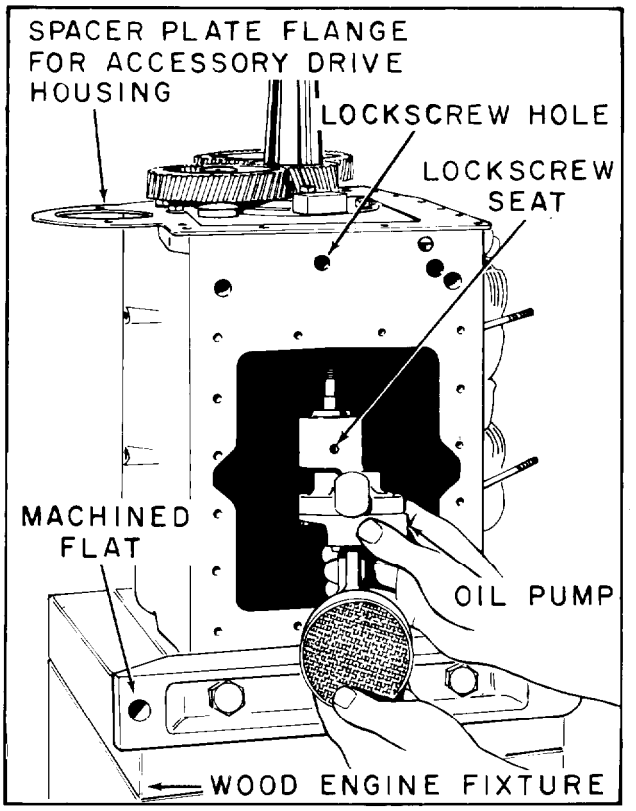


Fig. B-39 277783C

ENGINE SUPPORTS AND OIL PAN (Fig.B-39)

Use a work bench with a clearance hole of at least 2¼ inches in diameter for the engine crankshaft to extend thru, and tip the engine over to rest on the main bearing plate — or, if convenient, construct an engine fixture by making a box from 2 x 6 lumber as illustrated in Fig. B-39. Make the box about 16 inches square x 8 inches high with a 2¼ inch clearance hole in the top, and open at the bottom.

With engine tipped over on tak-off end, remove engine supports and oil pan. In reassembly; use a new gasket underneath oil pan, mount with oil drain toward side opposite flange on spacer plate for accessory drive housing, and tighten capscrews to 18 foot pounds torque.

Mount engine supports with machined flats toward flange side of spacer plate where accessory drive housing is mounted. Use Perma-tex on capscrews for both engine supports and oil pan. Tighten capscrews for engine supports to 40 foot pounds torque.

OIL PUMP (Fig. B-38, Fig. B-39)

Remove locknut and driver gear from shaft. If gear is too tight to remove by hand, use a pulley; hammering on end of shaft to loosen gear will damage pump.

Take out slotted pipe plug from bottom of crankcase, and with a 5/32 inch Allen wrench, remove lockscrew as shown in Fig. B-38. Withdraw the oil pump from inside the crankcase, as illustrated in Fig. B-39. If pump fits too tight to remove by hand, tap front of pump housing (not shaft), with hammer and brass rod.

In reassembly; be sure lockscrew seat in pump housing lines up with lockscrew hole in crankcase.

SPECIAL FEATURE

individual cylinder *heads,* barrels, pistons and *rings* con be removed *for* replacement without a *major* en-*gine disassembly, by means of a special piston sleeve.*
Refer to Fig's. B-40, B-42, B-43 **and**
Cylinder Head, Cylinder Barrel paragraphs.

CYLINDER HEAD (Fig. B-40, Fig. B-41)

Remove rocker arm cover by means of a screw driver wedged under the bail wire. Take off the 4 nuts and washers from cylinder barrel studs. Lift cylinder head and rocker arm assembly off cylinder. The oil drain line will slip out of adapter in crankcase. Pull out push rods and rod housings. See Fig. B-40.

In *reassembly;* place a new 'O' ring under collar of push rod housing. Press collar end of tube into tap pet hole by hand; do not drive tubes in place with a hammer. Use new 'O' ring for push rod housing to recess in cylinder head. Spread a light film of grease on cylinder head gasket so it will stick in plats during reassembly. Place new 'O' ring on oil drain tube.

Note: When reassembling cylinder heads on a complete overhaul, it will be necessary to square up the inlet and exhaust port flanges with those of the manifold. see Fig. B-41. Place a parallel steel bar across the ports and tap the heads lightly with a rubber mallet to rotate them until they are square. Turn cylinder head nuts to a snug fit and re-check alignment.

Torque cylinder head nuts alternately and in 3 steps. First 8, then 15, and finally 20 *foot* pounds *torque.*

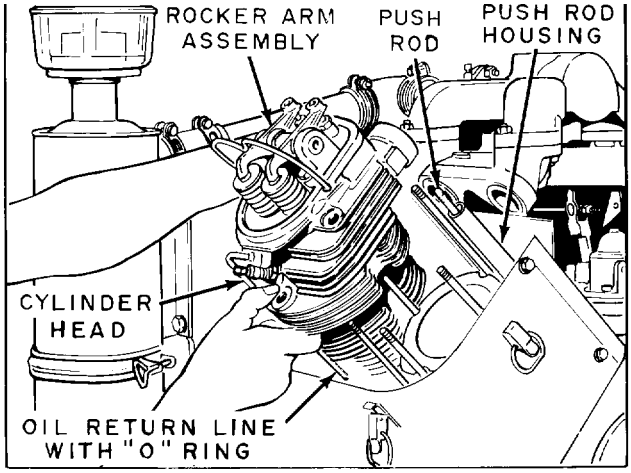


Fig. B-40 277801C

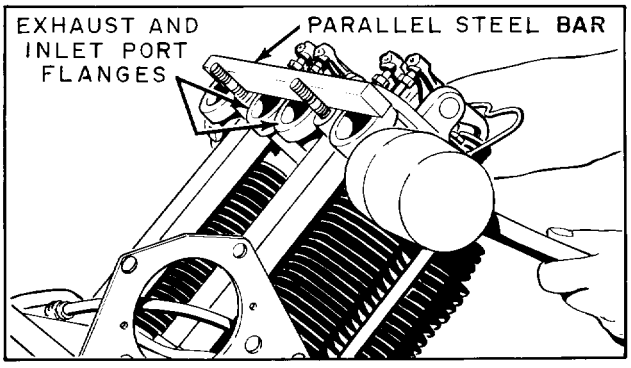


Fig. B-41 277794C

Rocker arm assembly can be left bolted to the cylinder head, unless head or rocker arms need replacing.

CYLINDER BARREL (Fig. B-42, Fig. B-43)

Turn crankshaft over until piston, in the cylinder barrel that is to be replaced, is at the top of its stroke. *Remove;* top cylinder stud (flanged) on Model V-461D, or hold down clip as used on Model V-465D. The remaining studs can be disassembled after cylinder is taken off.

in reassembly; place a new gasket at bottom of cylinder barrel. It will be necessary to compress the piston rings in order to slip the cylinder over the piston, as shown in Fig. B-43. A *piston sleeve can* be made from the lower portion of a scrap cylinder. The sleeve is 2¼ inches long with a 7/8 inch wide slot. The inside diameter is tapered from the middle to the bottom;

3.750" to 4.000 for V-465D
3.500" to 3.750 for V-461D, V-460D

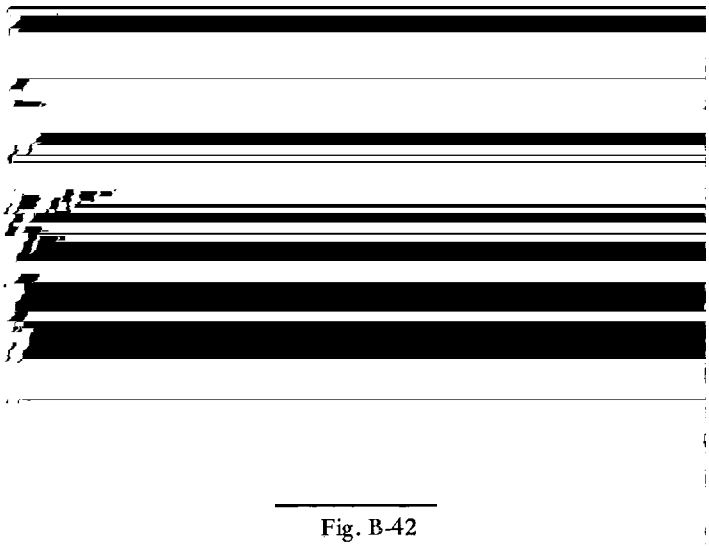


Fig. B-42

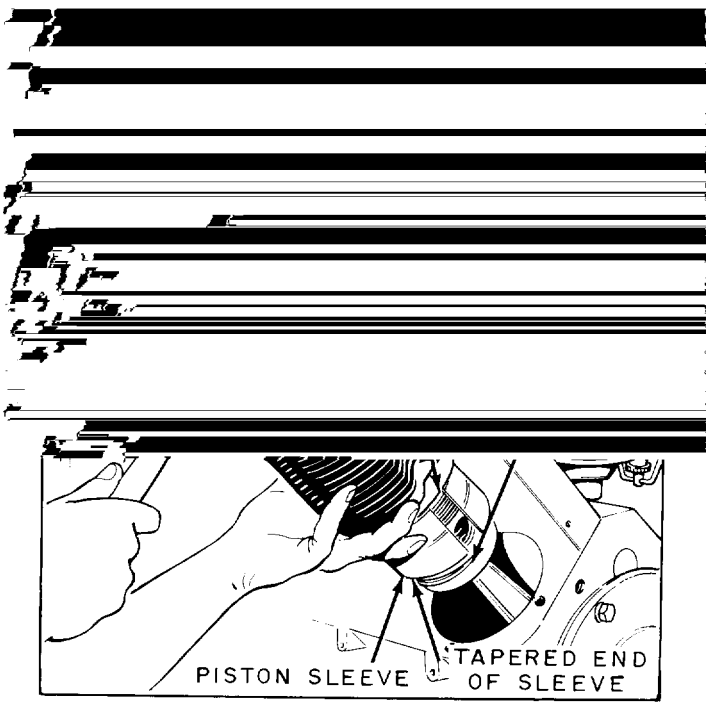


Fig. B-43 277795C

Slip sleeve over and slightly below top of piston. Extension of piston out of sleeve will act as a pilot for mounting cylinder. Lubricate cylinder bore and press barrel on to piston and against sleeve. Force piston into bore by tapping cylinder barrel with a rubber mallet, as illustrated in Fig. B-43. When bottom ring of piston is securely in cylinder, lower sleeve and remove thru slot. Continue to press barrel over piston until it is snug against crankcase. Mount cylinder studs and remainder of parts per 'Cylinder Head' paragraphs of reassembly.

CYLINDER, PISTON and CONNECTING ROD

(Fig. B-44, Fig. B-45)

After removing cylinder heads and before attempting to loosen connecting rod caps, it is advisable to hold down both banks of cylinder barrels, lest they become loosened and damaged when rotating the crankshaft. This can be accomplished by means of a steel retainer bar and the cylinder hold down studs, as shown in Fig. B-44.

Insert a drift punch in crankshaft crank pin hole, and turn shaft over so that the nuts for the No. 1 connecting rod cap are accessible. Take off the 2 nuts, loosen and remove connecting rod cap by tapping lightly on the end of the bolts. Use a brass rod so as not to upset bolt threads. Remove cylinder retainer bar and withdraw cylinder barrel, piston and connecting rod, as illustrated in Fig. B-44. Place cap on rod immediately so that it will not be mismatched in reassembly. Remove No. 3 cylinder assembly, and then do likewise with the No. 2 and 4 cylinder bank.

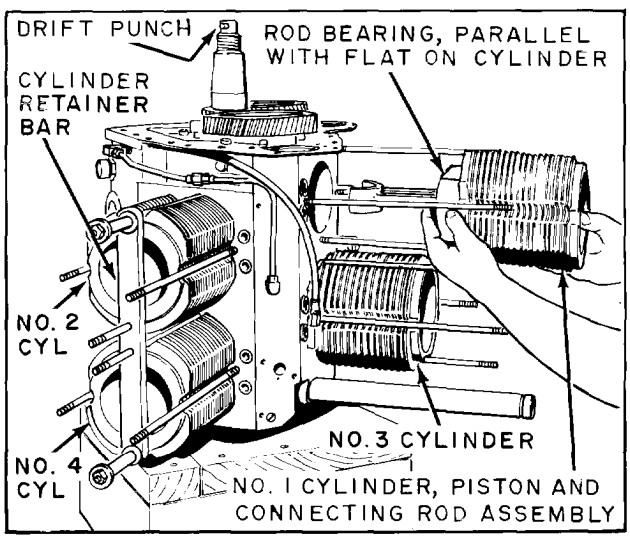


Fig. B-44 277804C

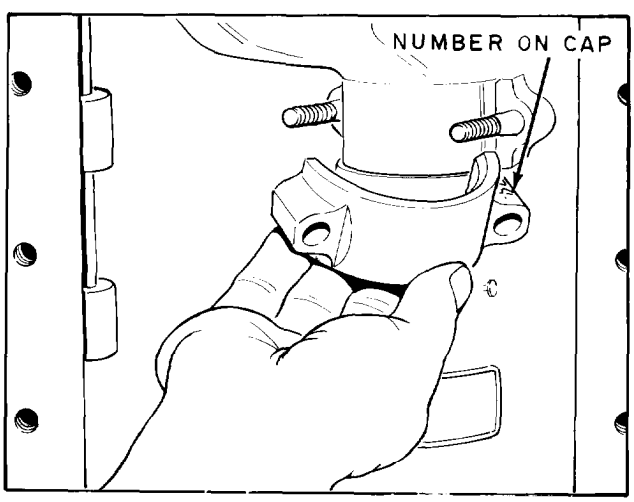


Fig. B-45 281382C

Identical numbers are stamped on the side of the rod with its corresponding cap. These numbers must be on the same side of the connecting rod in reassembly. See Fig. B-45. Install new nuts on connecting rod bolts and torque to 32 foot pounds.

Cylinder barrels should be put back on the crankcase in the same location they were removed from. Use a new gasket at bottom of barrel. Clean all dirt and chaff from between fins and bottom of flange.

If the cylinders are worn more than .005 inch oversize, they should be reground and fitted with oversize pistons and rings. This work should be done by an authorized service station.

If in the opinion of the service station attendant, a chrome re-ring is necessary, use
piston ring set indicated in Parts List Section.

PISTON RINGS (Fig's. B-46, B-47, B-48)

If a ring expander tool is not available, install rings by placing the open end of the ring on piston first, as shown in Fig. B-46. Spread ring only far enough to slip over piston and into correct groove, being careful not to distort ring. Assemble bottom ring first and work upward, installing top ring last. The outer diameter of the too compression ring is chrome plated. Mount scraper ring with scraper edge down, otherwise oil pumping and excessive oil consumption will result. Refer to Fig. B-47 for correct placement of rings for the V-460D, V-461D and V-465D.

PISTON (Fig. B-48, Fig. B-49)

The piston skirt is cam-ground to an elliptical contour. Clearance between the piston and cylinder must be measured at the bottom of the piston skirt thrust face. Refer to Chart, Fig. B-48, for proper clearance. The thrust face on the piston skirt is 90° from the axis of the piston pin hole.

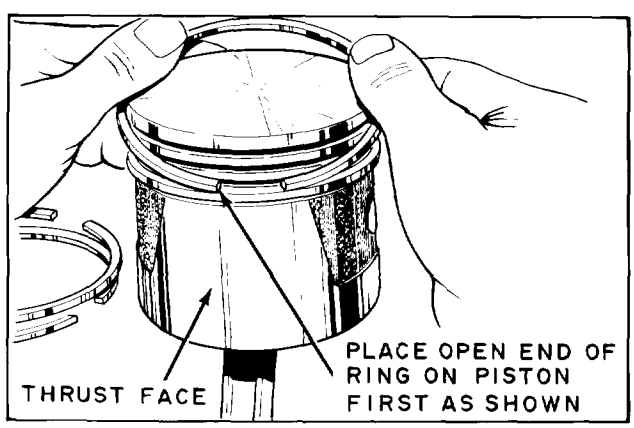


Fig. B-46 71152C

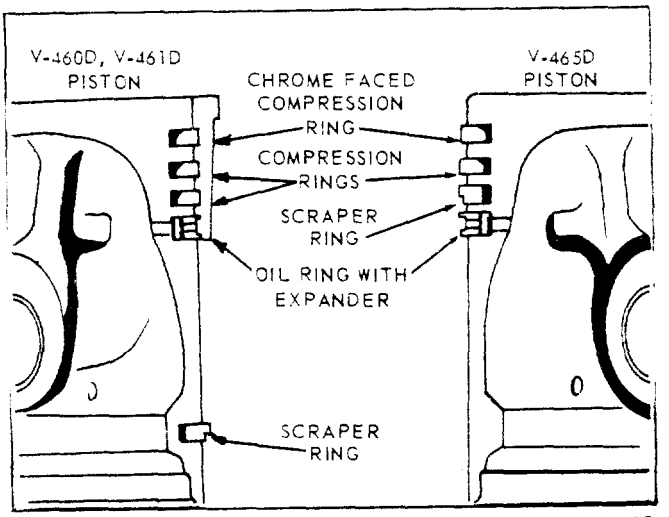


Fig. B-47 313025C

CYLINDER BORE	Models V-460D, V-461D 3.498 to 3.499"	Model V-465D 3.748 to 3.749"
PISTON TO CYLINDER AT PISTON SKIRT THRUST FACES		.0025 to .003"
PISTON RING COMPRESSED GAP		.008 to .024"
PISTON RINGS – SIDE CLEARANCE IN GROOVES		.002 to .004"
CONNECTING ROD TO CRANK PIN – SIDE CLEARANCE		.008 to .016"
CONNECTING ROD SHELL BEARING TO CRANK PIN		.0005 to .0018"
PISTON PIN TO CONNECTING ROD BUSHING		.0005 to .0011"
PISTON PIN TO PISTON		.0000 to .0008" tight
CENTER MAIN SHELL BEARING TO CRANKSHAFT JOURNAL		.0013 to .0038"

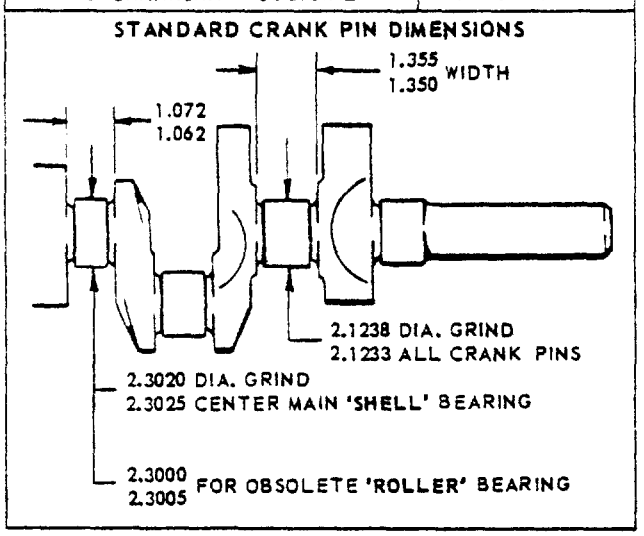


Fig. B-48 PISTON, RING AND ROD CLEARANCE CRANKPIN AND CENTER BEARING DIMENSIONS

Piston and connecting rod is sub-assembled to the cylinder barrel and the complete unit is mounted to the crankcase. Lubricate the piston assembly and cylinder walls with No. 30 S.A.E. oil, and stagger the ring gaps 90° around the piston. Use a standard

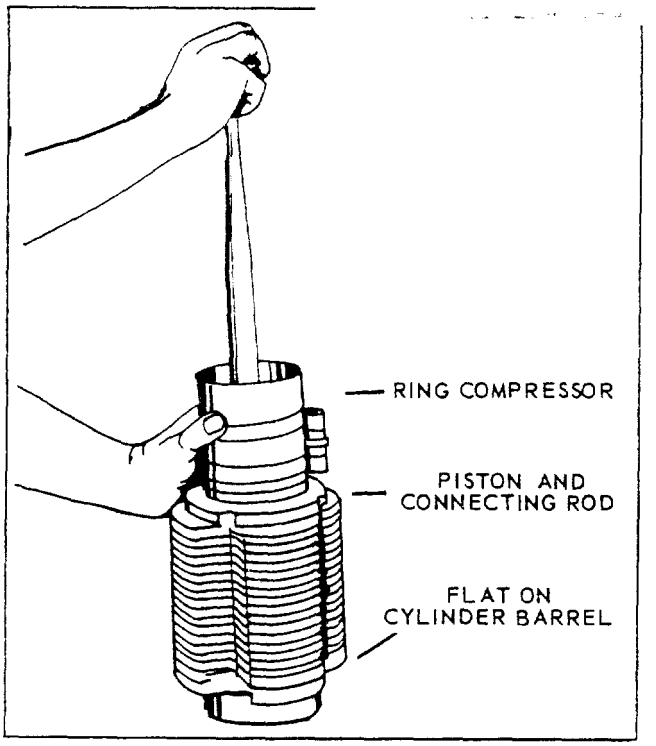


Fig. B-49 277789C

automotive type ring compressor, and insert rod end into cylinder from cylinder head end. Note: Rod bearing should be parallel to flats at base of cylinder barrel for correct assembly to crankshaft, see Fig. B-44. Gently tap piston into cylinder and to bottom of bore. Use the wooden handle end of hammer, as shown in Fig. B-49.

VALVES (Fig. B-50)

Replace valves that are burned or pitted. A leaky valve can usually be determined by a 'hissing' noise in the exhaust or intake manifold when cranking the engine slowly by hand.

The exhaust valves are furnished with positive type rotators. Refer to Parts Section for mounting. The valve rotates slightly each time it opens, and thereby prevents the build up of foreign deposits on the valve face and stem.

Valve grinding should be done by an authorized service dealer, since he has the necessary equipment and experience to do a good job. To remove valves; use a standard automotive valve lifter as illustrated in Fig. B-50, and remove spring seat locks. Release valve lifter and take out valve, spring and exhaust rotator or spring seat.

The valve face is ground at 45° to the vertical center line of the valve stem and the valve seat insert should also be ground at a 45° angle. After grinding, valves and inserts should be lapped with a suitable lapping compound or they will leak due to improper seating, within the first few hours of operation. While lapping, occasionally lift the valves and reset them

in a different position to insure a uniform seat which will show entirely around the valves. After valves have been lapped in evenly, remove and wash both valves and head thoroughly with kerosene and reassemble.

Valve guides in the cylinder head are replaceable. The valve stem has a clearance of .002" to .004" in the guide. When the clearance becomes .006", the guide should be driven out and a new guide pressed in place. Allow 1/32" to 1/64" clearance between the valve guide boss and the bottom of the valve guide shoulder. Check guide for .3440 /.3445" I.D. after pressing in place. Ream if necessary.

VALVE SEAT INSERTS are not replaceable, due to method of installing. If seat inserts become worn and ground down to the extent that the seats are wider than the valve face, replace cylinder head.

ROCKER ARM ASSEMBLY (Fig. B-50)

Very little wear will occur to the rocker arms as long as they are adequately lubricated. If replacement is necessary, remove the complete rocker arm bracket assembly, shown in Fig. B-50, from the cylinder head. Take out shaft setscrew from bottom of bracket with a 1/8" Allen wrench, and tap shaft out toward set screw end of bracket, using a brass rod.

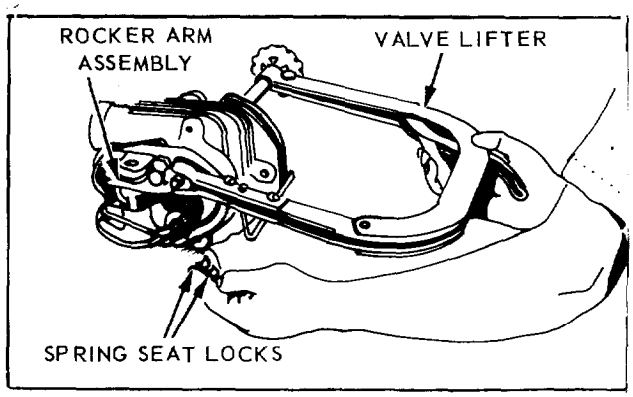


Fig. B-50 277775C

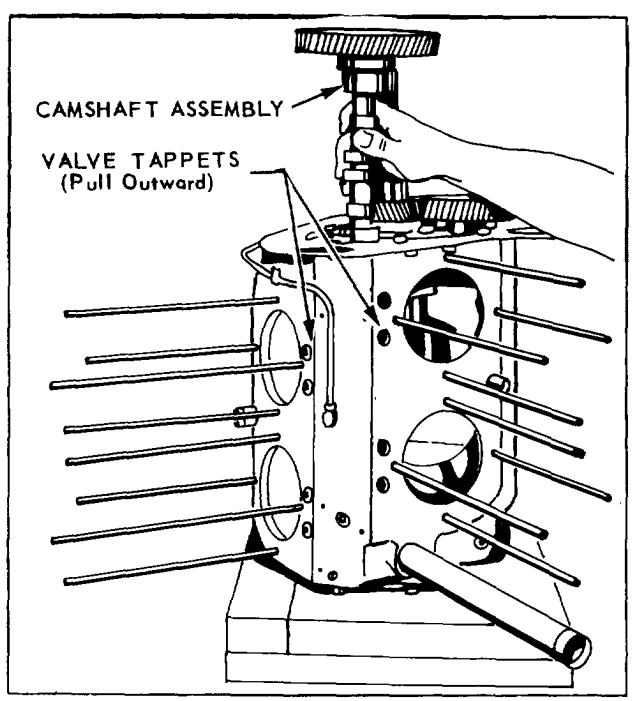


Fig. B-51 277803C

In reassembly be sure set screw seat in shaft is lined up with tapped hole in bracket. After tightening set screw in place, prick punch threads to prevent screw from falling out. Lubricate shaft so that rocker arm bearings won't operate 'dry' when engine is started.

CAMSHAFT (Fig. B-51, Fig. B-52)

Pull tappets outward to clear lobes while camshaft is being removed. Withdraw tappets from inside the crankcase. In reassembly, clean and lubricate tappets. Insert thrust plunger and spring into end of camshaft, as these hold shaft in place endwise. See Fig. B-52.

The camshaft gear has offset mounting holes to provide accurate assembly for valve timing. The gear can only be out on the correct way for matching up the timing mark with that of the crankshaft. See Fig. B-52.

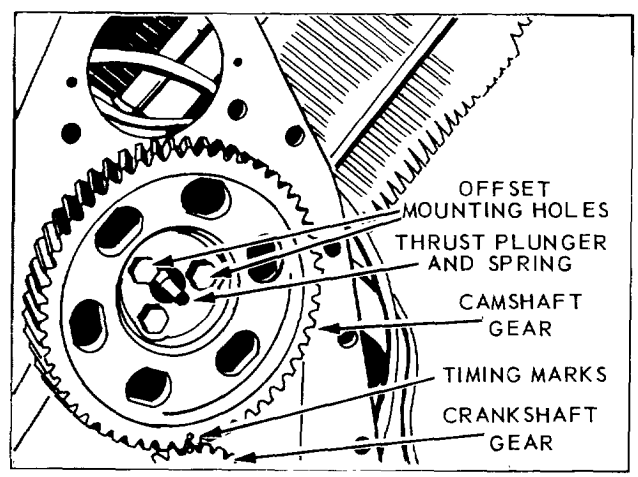


Fig. B-52 277794C

CENTER MAIN BEARING (Fig. B-53, Fig. B-54) **V-465D**

Note: Beginning with engine serial No. 4904657, a shell type center main bearing replaces the split roller bearing. The bearing and hanger assemblies are not interchangeable for service replacement unless the complete crankshaft assembly is changed and the crankcase modified.

The following instructions apply to the current production engines with shell center main bearing. Refer to Page B-33 for overhaul procedures relative to the now obsolete roller type center main bearing and crankshaft oil collet.

Caution: Do not attempt to remove crankshaft from engine without first removing center bearing hanger.

With reference to Fig. B-53, disconnect oil pressure line at center bearing hanger and at oil header behind filter, by using a 1/2 inch hex tubing nut wrench, Remove hanger to case screws and washers. Then loosen and back out cap to hanger screws about 1/2 inch. Tap screw heads lightly and alternately with a hammer to break cap away from hanger body.

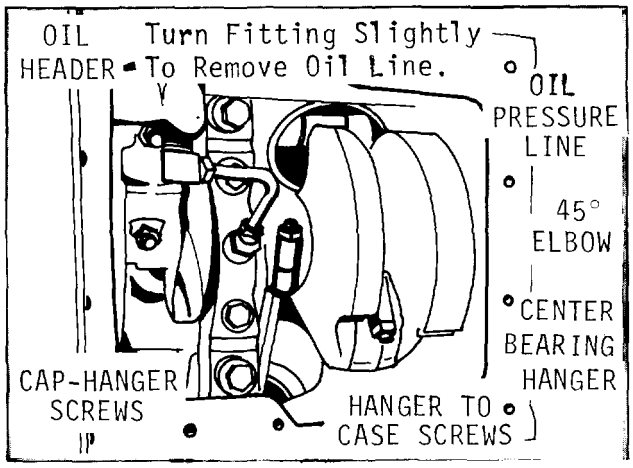


Fig. B-53 329160C

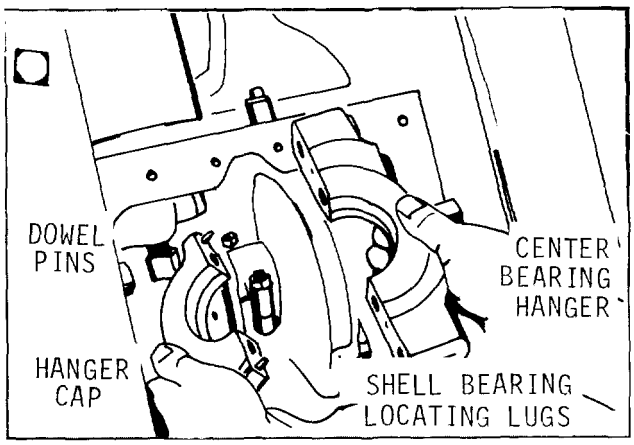


Fig. B-54 329161C

Do not pry cap and body apart. Separate and remove hanger and cap with shell bearing from crankcase.

Check bearing and crankshaft journal for visible wear - *see Clearance Chart,* Fig. B-48. If clearance approaches .005 inch, replace shell bearing with suitable undersize.

In reassembly: Clean thoroughly and apply a film of oil to the bearing surfaces. Mount center main bearing after crankshaft is assembled to crankcase and end play is set.

Dowel pins in cap are off-center so that when hanger is mounted to cap, the locating lug on both bearing halves, will be on the same side. See Fig. B-54. Assemble hanger so that 45° oil line elbow is facing toward oil header side of case as illustrated in Fig.B-53.

Draw cap to hanger screws finger tight until the two dowels are just entering holes. With a hand wrench, alternately turn each screw 1/2 to 3/4 turns to evenly pull cap tight to hanger body. Torque screws 32 to 35 foot pounds.

Secure bearing hanger to crankcase after crankshaft end play is set. Install capscrews and washers, torque to 60 foot pounds.

Be sure oil fitting passages are clean. Connect oil line from header to bearing hanger.

MAIN BEARING PLATE and CRANKSHAFT (Fig. B-55)

Remove main bearing plate, gaskets and shims from take-off end of engine. Slip a length of pipe over the gear end of the crankshaft and with the assistance of another person, withdraw the shaft thru the main bearing plate opening, as illustrated in Fig. B-55. Removal of crankshaft with center hearing hanger assembled to it applies only to the obsolete split roller bearing, Caution: It will be necessary to rotate the crankshaft so that counterweights clear the center main bearing hanger lugs in crankcase.

In reassembly: Holes for the main bearing plate are off-set for correct mounting. Assemble main bearing plate, gaskets and shims, and torque cap screws to 32 foot pounds. Check end play and add or remove gaskets to give the necessary .002 to .004 inch movement, with engine cold.

IDLER GEAR AND SHAFT (Fig. B-55, Fig. B-58)

A tapped hole in the side of the crankcase contains 2 setscrews for locking idler shaft in place. See Fig. B-55. Remove screws with a 5/32" Allen wrench. Disassemble shaft and gear from case by means of the 3/8"-16 tapped puller hole in end of idler shaft.

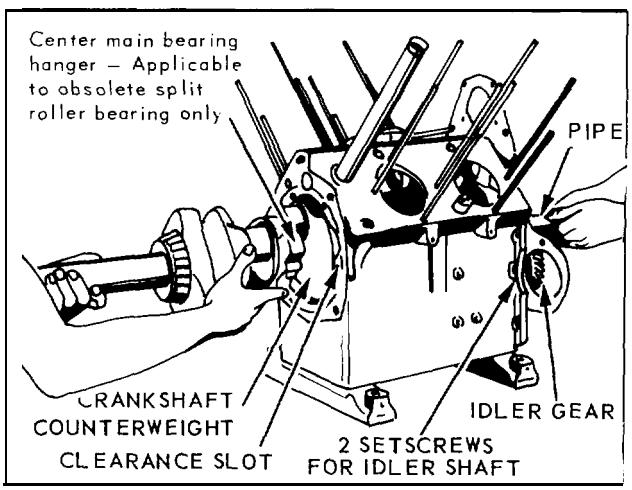


Fig. B-55 277806C

In reassembly; be sure oil groove in shaft is facing up. Drive shaft into crankcase with soft metal hammer and maintain a .003 to .004 inch clearance between idler gear and shoulder of shaft, see Fig. B-58. Lock shaft in place with the 2 Allen set screws.

OIL PRESSURE RELIEF VALVE (Fig. B-7, Fig. B-56)

If it becomes necessary to remove the oil pressure relief valve, illustrated in Fig. B-56, either for cleaning or replacement; first unscrew hex adapter and remove expansion plug from adapter. With a 3/16 inch Allen wrench, remove outer adjustment lockscrew, see Fig. B-7. Insert a ¼ inch rod into the cross hole in valve body and turn counter-clockwise for removal Do not use a pipe wrench or pliers to remove valve body.

In reassembly; use new 'O' ring in valve body and apply sealer to threads of hex adapter. Assemble ex-

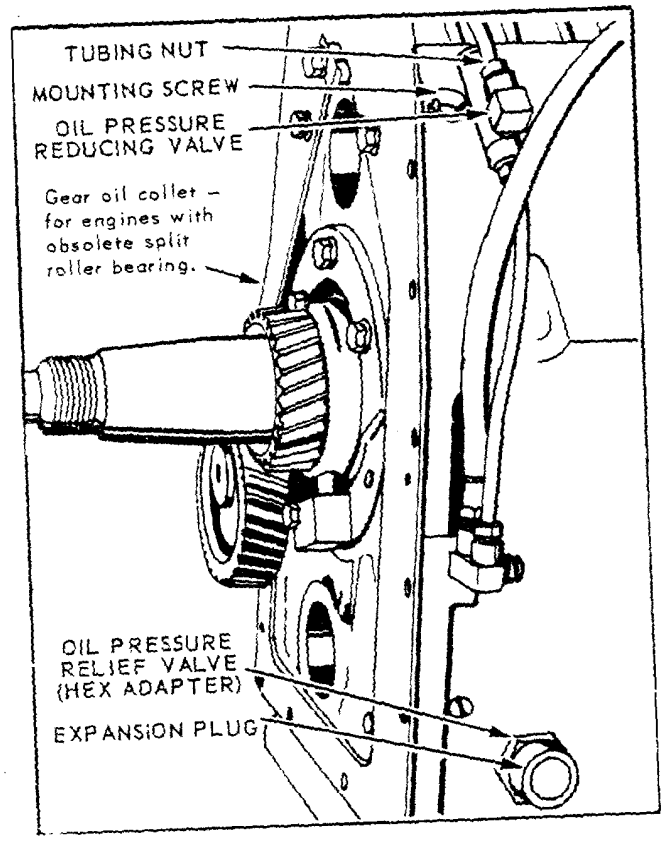


Fig. B-56 277780C

pansion plug after adjusting pressure as per "Oil Pressure Adjustment" instructions at front of manual.

OIL PRESSURE REDUCING VALVE (Fig. B-56)

To replace the oil pressure reducing valve, loosen the 4 oil line nuts at the valve and at the fittings on top and side of crankcase. Remove valve mounting capscrew and lift valve away from crankcase. The oil lines will become unseated without being deformed.

In reassembly; hold valve in proper location but do not mount. Place oil lines in position and engage tubing nuts 2 to 3 turns. Secure valve in place with capscrew and then tighten tubing nuts.

ASSEMBLY and DISASSEMBLY PROCEDURE with obsolete ROLLER type CENTER MAIN BEARING

(Engines previous to serial No. 4904657)

With reference to Fig, B-57, remove oil coupling from crankshaft oil collet. Take out the adapter mounting screw and slip oil coupling out of collet. In reassembly; use new 'O' ring seals at both ends of the coupling and on the shoulder extending into the crankcase. Lubricate 'O' rings for ease in assembly.

Remove the center main bearing hanger to crankcase mounting screws and spacers. Tip case back on engine supports and remove main bearing plate, gaskets and shims. Slip a length of pipe over the gear end of the crankshaft and with the assistance of another person, withdraw crankshaft with center bearing thru the main bearing plate opening, as illustrated in Fig. B-55.

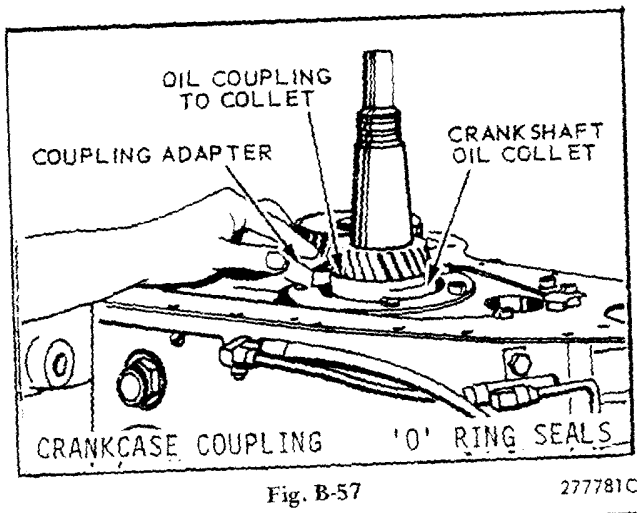


Fig. B-57 277781C

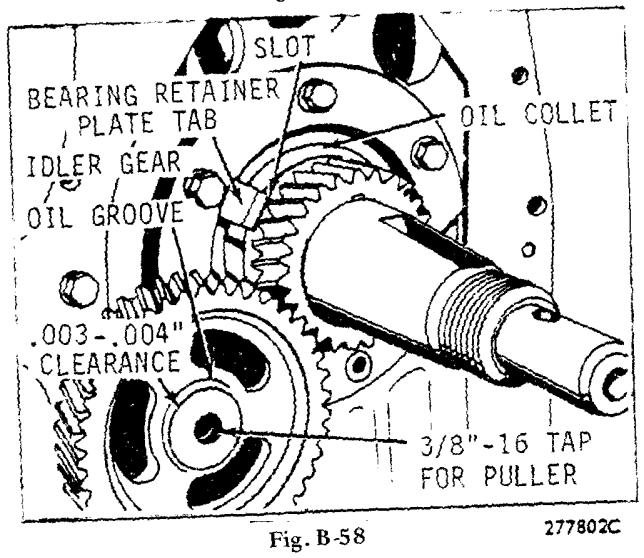


Fig. B-58 277802C

Caution: It will be necessary to rotate the crankshaft so that counterweights clear the lugs in the crankcase for the center main bearing, and the lugs on the center bearing hanger will have to line up with the clearance slots in the crankcase face.

In reassembly; rotate crankshaft oil collet so that slot engages with tab on bearing retainer plate, as illustrated in. Fig. B-58. Mount main bearing plate, gaskets and shims, and torque capscrews to 32 foot pounds. Check end play and add or remove gaskets to give the necessary .002 to .004 inch movement,

Center main bearing (roller type) can be disassembled in the following manner: Loosen and back out bearing hanger capscrews approximately 1/2 inch. Tap capscrew heads lightly and alternately with a hammer, as illustrated in Fig. B-59, to break cap away from hanger body. Do not pry cap and body apart. Remove capscrews and separate hanger and cap from bearing. Take off retaining ring from outer bearing race and remove bearing halves and rollers from crankshaft.

In reassembly; coat inside of bearing halves with a low melting point grease or petroleum jelly. Do not use a standard lubricating grease. With reference to Fig. B-60, press 16 rollers into the grease of each of the bearing halves; assemble to crankshaft and clip

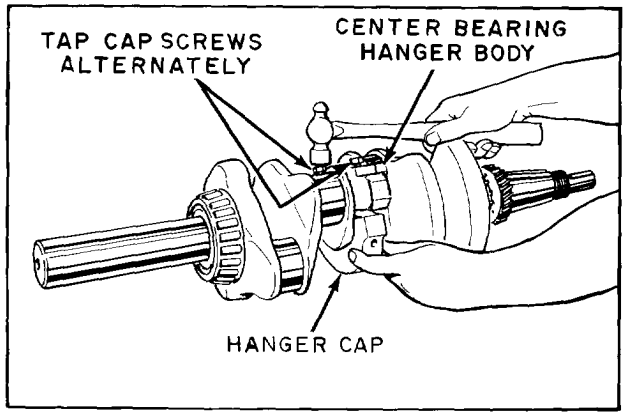


Fig. B-59 277776C

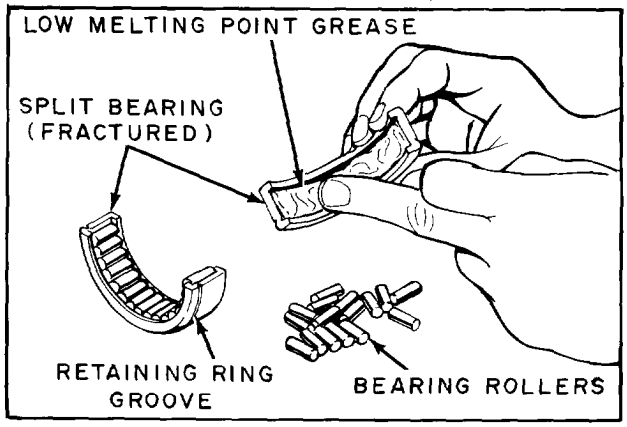


Fig. B-60 277778C

together with retaining ring. The ring must overlap both mating edges of the bearing. Insert shouldered dowel pin into either hole of the bearing race and place the hanger body against the bearing so the dowel slips into the dowel pin hole, see Fig. B-61. Hold hanger body against bearing, place cap in position and draw the capscrews finger tight until the 2 dowels are just entering holes. With a hand wrench, alternately turn each screw ½ to ¾ turns to evenly draw cap tight to hanger body. Torque capscrews to 40 foot pounds, alternately in 3 stages; 15, 30 and 40 ft/lbs. A few squirts of oil in the hanger cap oil hole will help to dissolve the bearing grease.

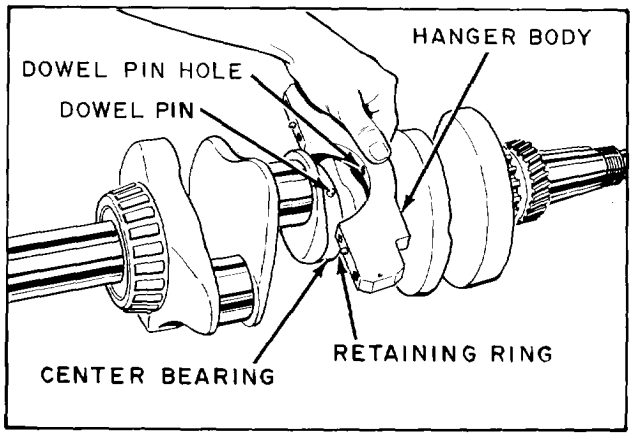


Fig. B-61 277777C

Secure bearing hanger to crankcase after crankshaft end play is adjusted. Note: Beginning with engine serial No. 4052826, the capscrews for mounting the bearing hanger to crankcase were lengthened to 3 inches, and a spacer added under the screw heads, see Fig. B-62. Thus all 4 screws for the center main bearing hanger assembly are the same, minimizing the possibility of improper assembly. Install hanger capscrews, with spacers, finger tight and position bearing hanger so that there is a minimum of .040 inch clearance between the sides of the bearing hanger and crankshaft cheeks. Tighten hanger to crankcase capscrews, 60 foot pounds torque.

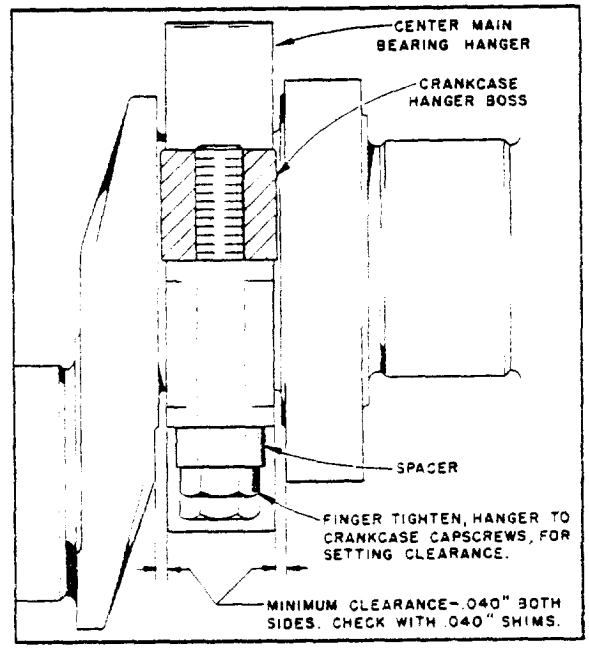


Fig. B-62

BEARING HANGER CLEARANCE
(For obsolete center main roller bearing)

REPAIR PARTS LIST

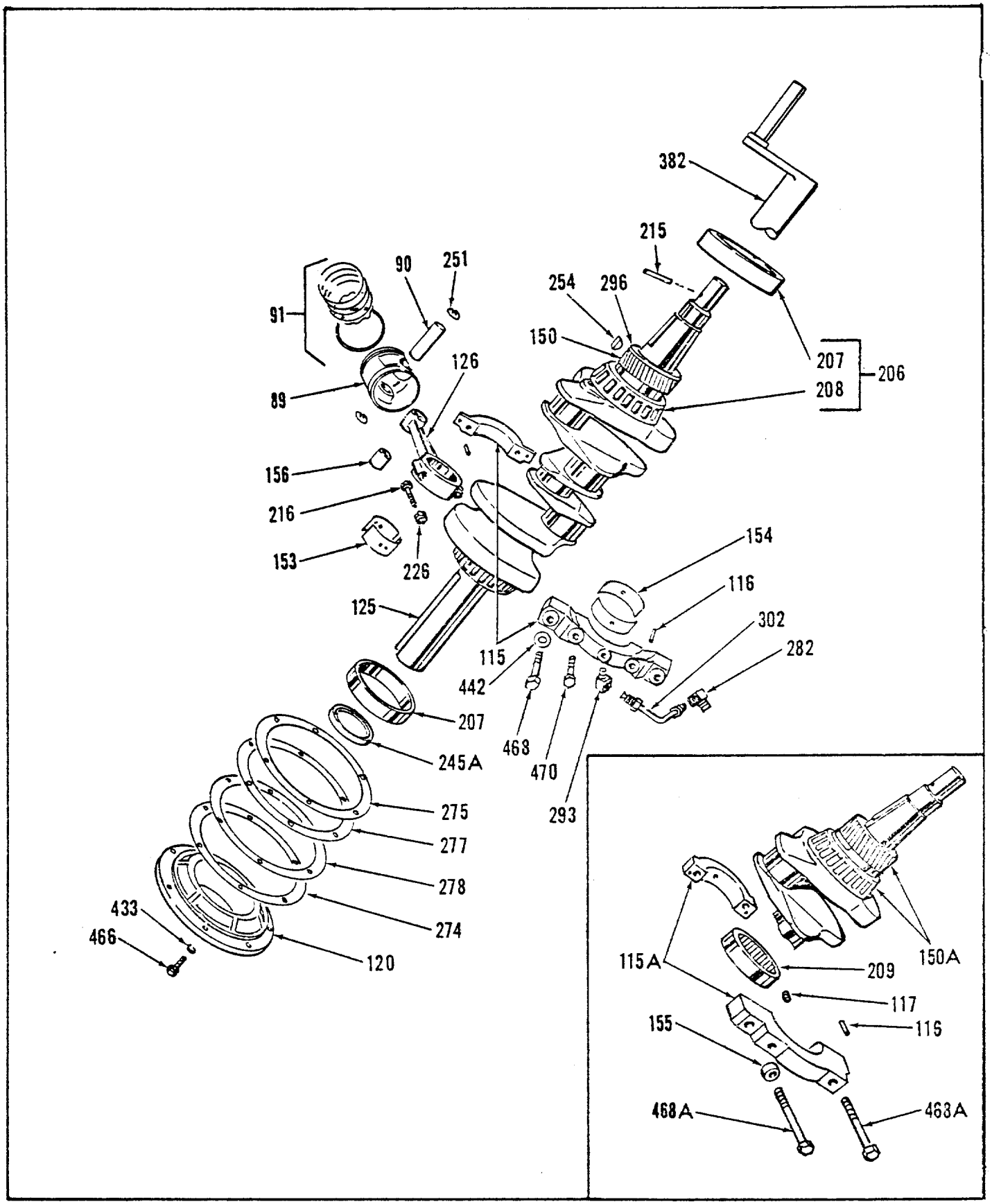
READ THESE INSTRUCTIONS BEFORE ORDERING PARTS

The MODEL, SPECIFICATION and SERIAL NUMBERS of your engine, shown on the name plate prominently located on the engine, MUST BE GIVEN WHEN ORDERING PARTS.

COPY THE ABOVE SPECIFIED INFORMATION INTO THE SPACES PROVIDED BELOW SO THAT IT WILL BE AVAILABLE TO YOU WHEN ORDERING PARTS.

TO INSURE PROMPT AND ACCURATE SERVICE, THE FOLLOWING INFORMATION MUST ALSO BE GIVEN.

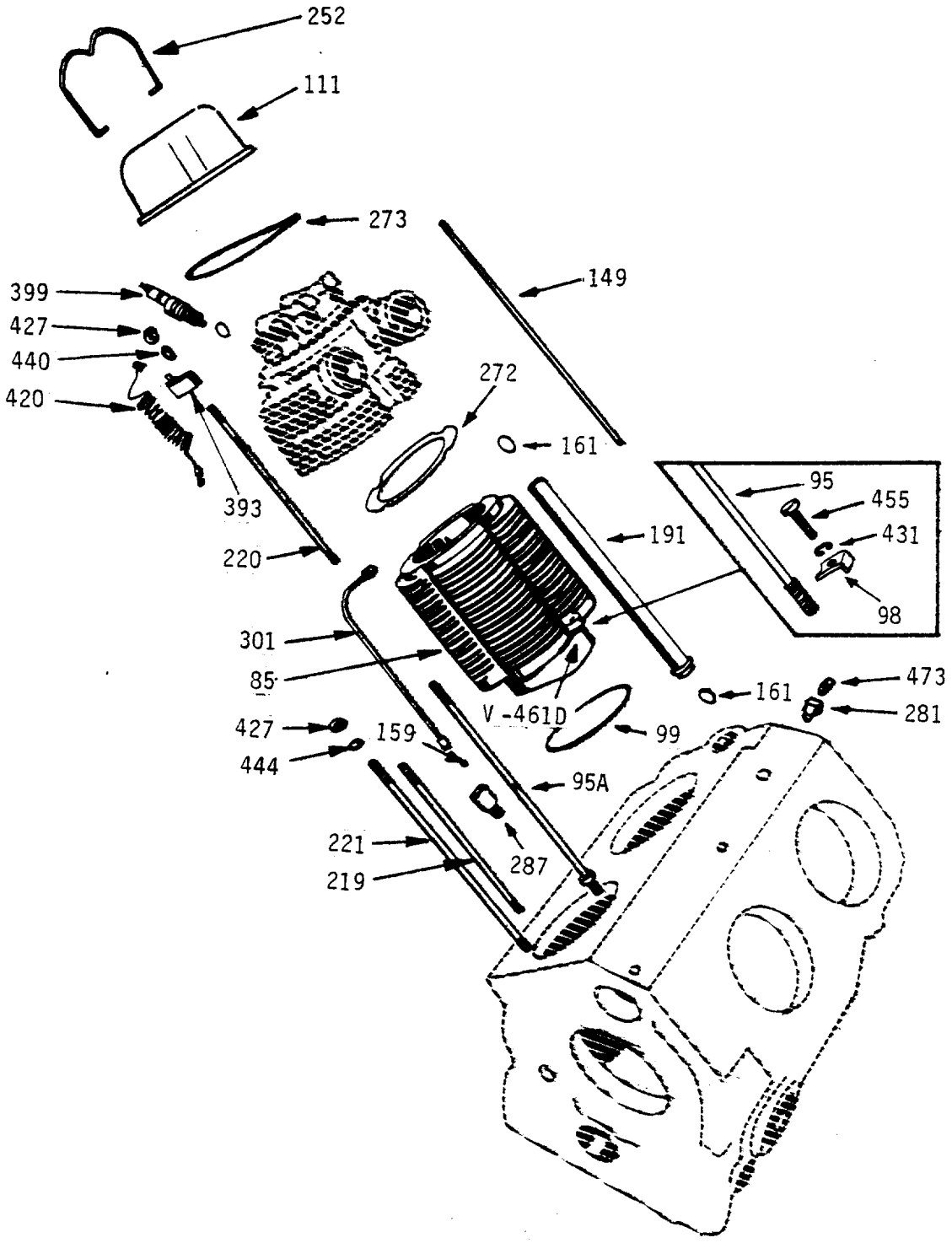
1. State exactly, quantity of each part and part number.
2. State definitely, whether parts are to be shipped by express, freight or parcel post.
3. State exact mailing address.



281153C-2

FIG. B-63. CRANKSHAFT, PISTON AND CONNECTING ROD GROUP

Parts are identified by reference number. See parts list for correct part number.



281154C-2

FIG. B-64. CYLINDER AND HEAD GROUP

Parts are identified by reference number. See parts list for correct part number.

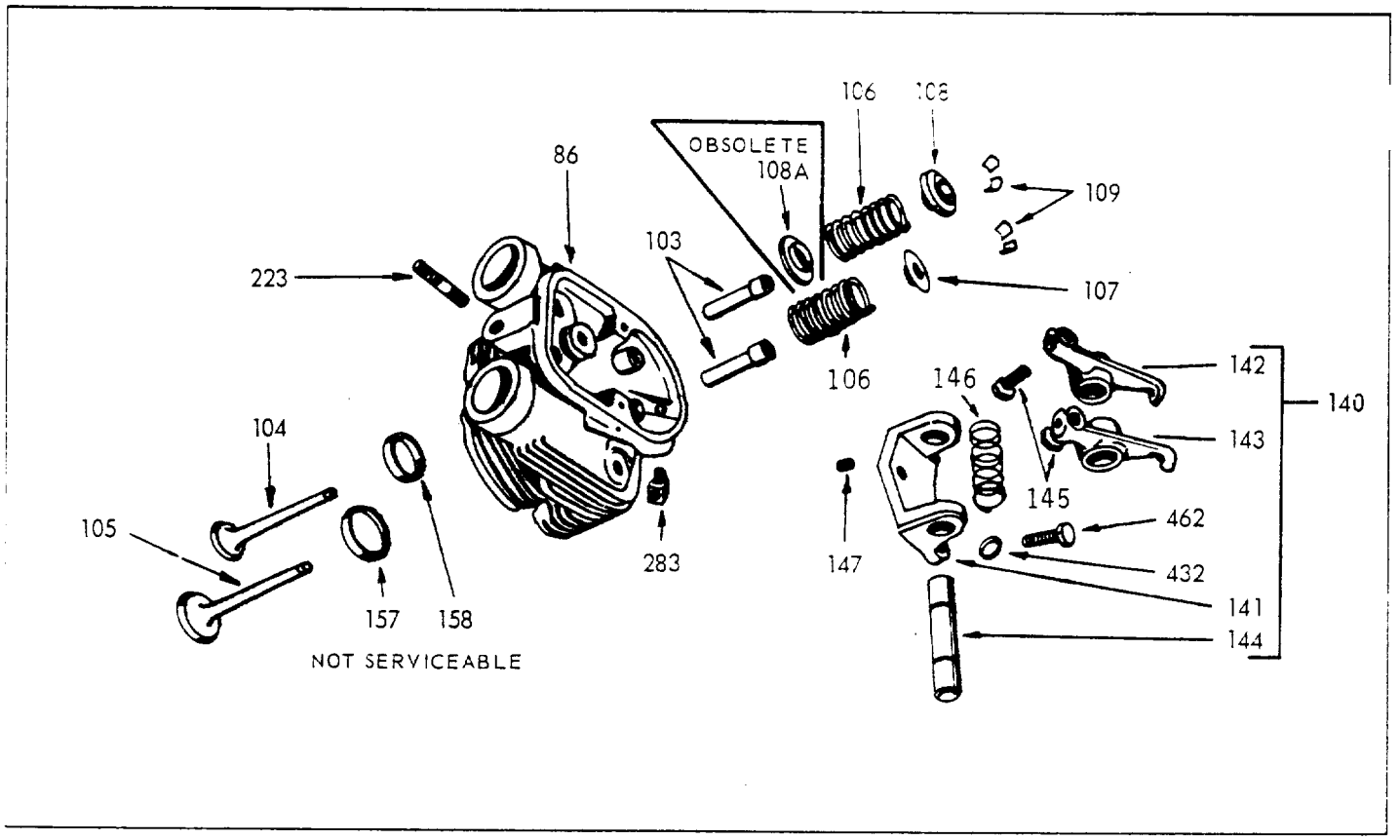
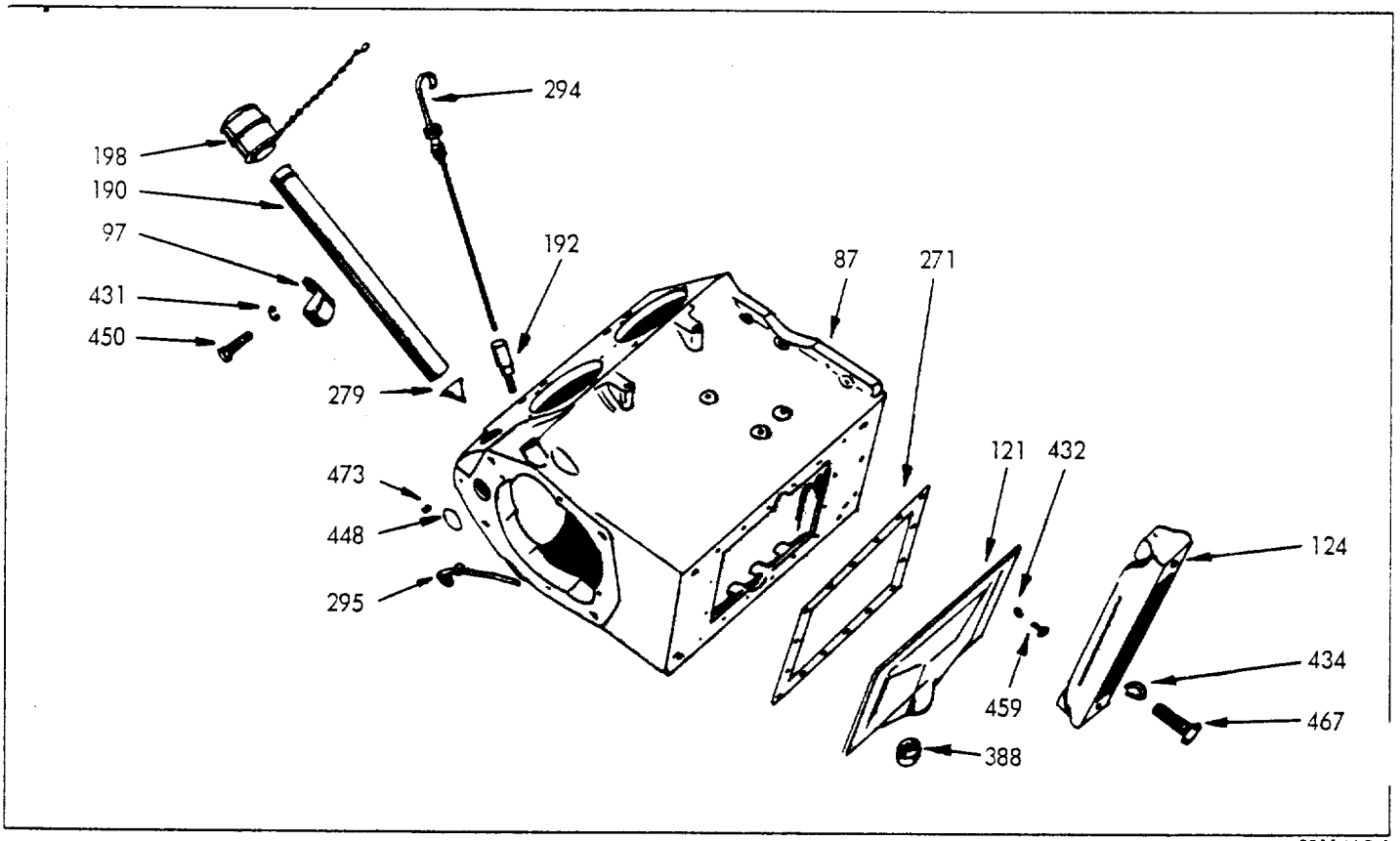


FIG. B-65. CYLINDER HEAD AND ROCKER ARM ASSEMBLIES

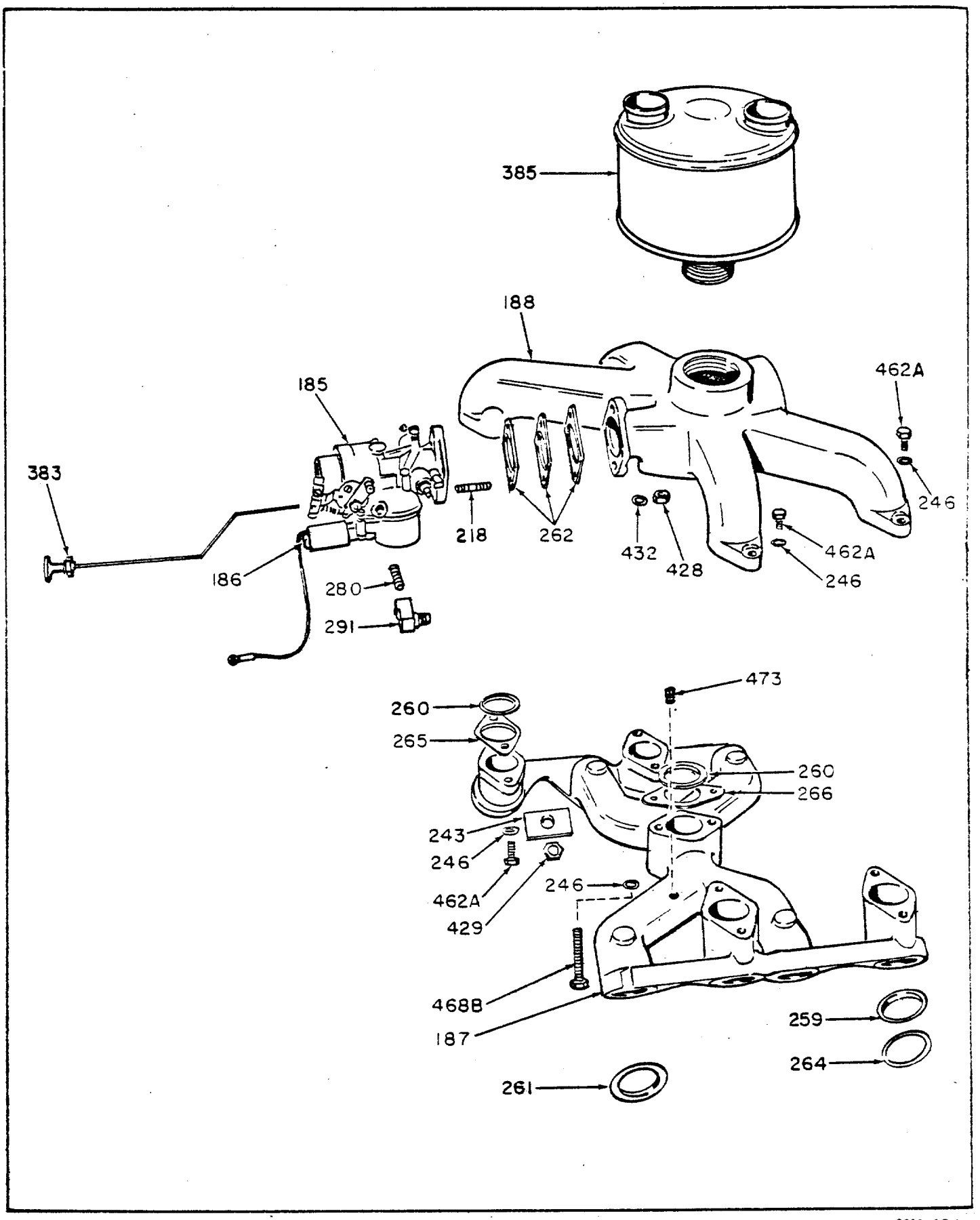
281142C-1



281146C-1

FIG. B-66. CRANKCASE AND OIL PAN GROUP

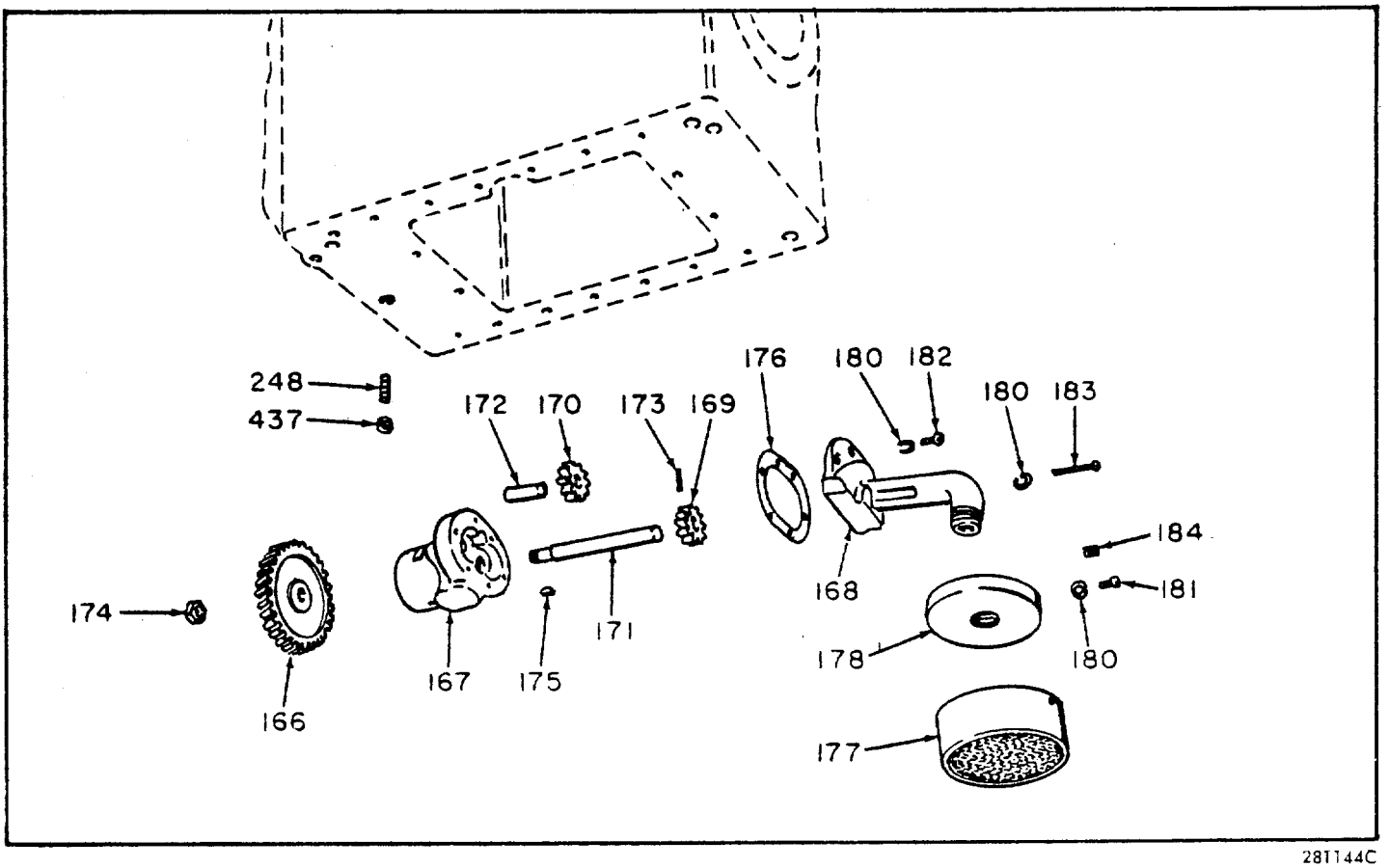
Parts are identified by reference number. See parts list for correct part number.



281149C-1

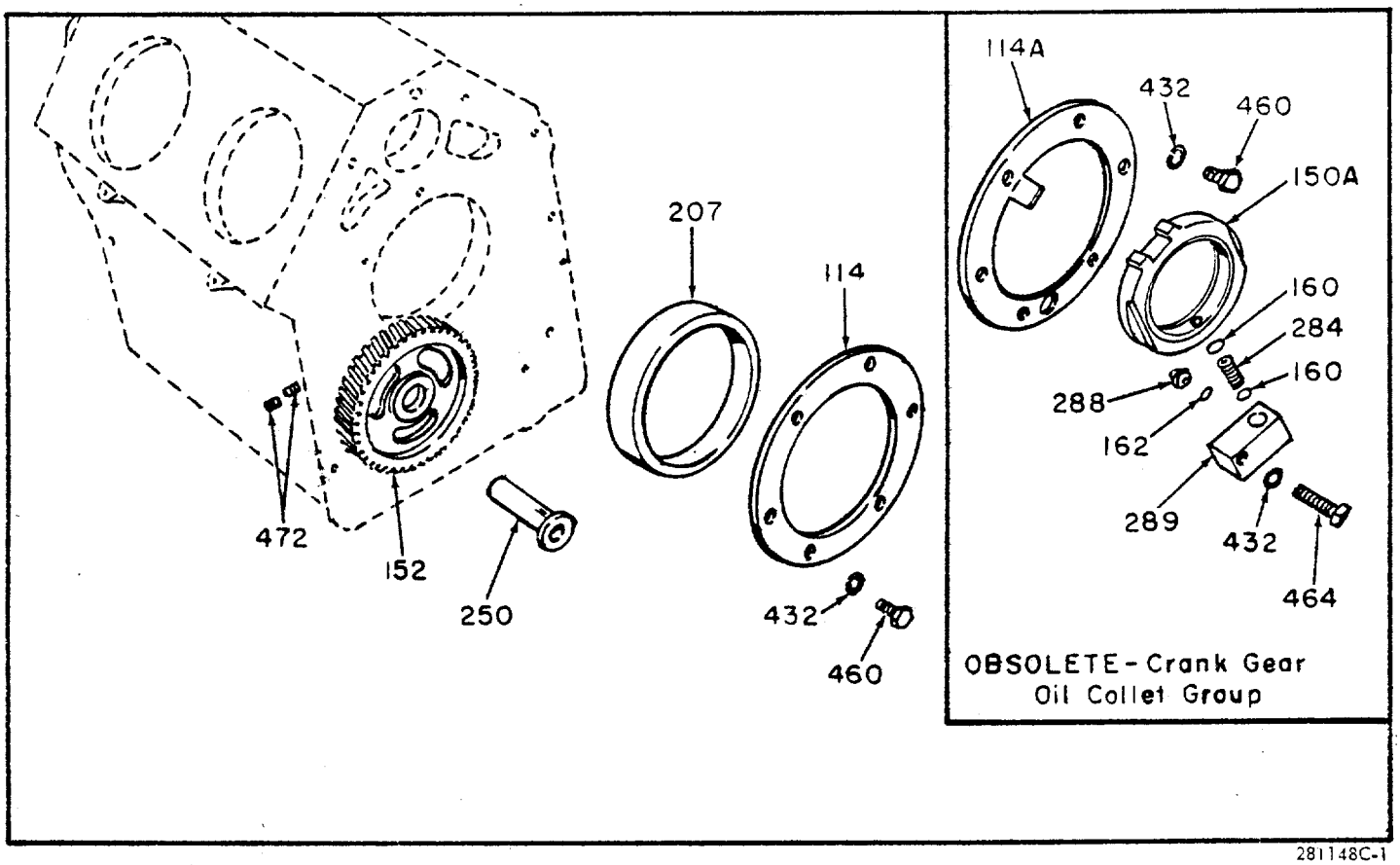
FIG. B-67. CARBURETOR AND MANIFOLD GROUP

Parts are identified by reference number. See parts list for correct part number.



281144C

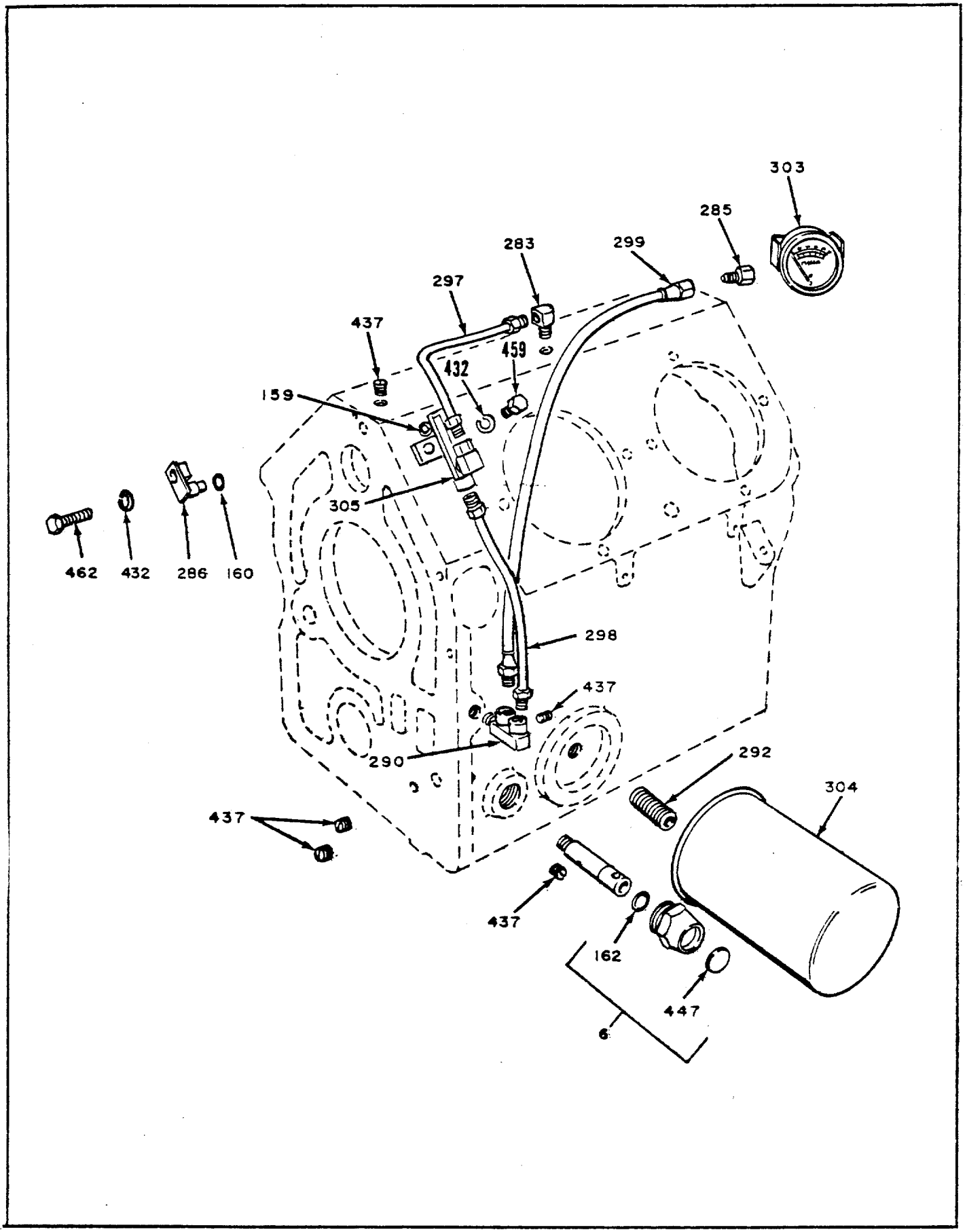
FIG. B-68. Ref. No. 165, OIL PUMP ASSEMBLY



281148C-1

FIG. B-69. IDLER GEAR, BEARING RETAINER AND OIL COLLET GROUP

Parts are identified by reference number. parts list for correct part number.



281145C

FIG. B-70. OIL LINES PRESSURE VALVE RELIEF VALVE AND OIL FILTER
Parts are identified by reference number. See parts list for correct part number.

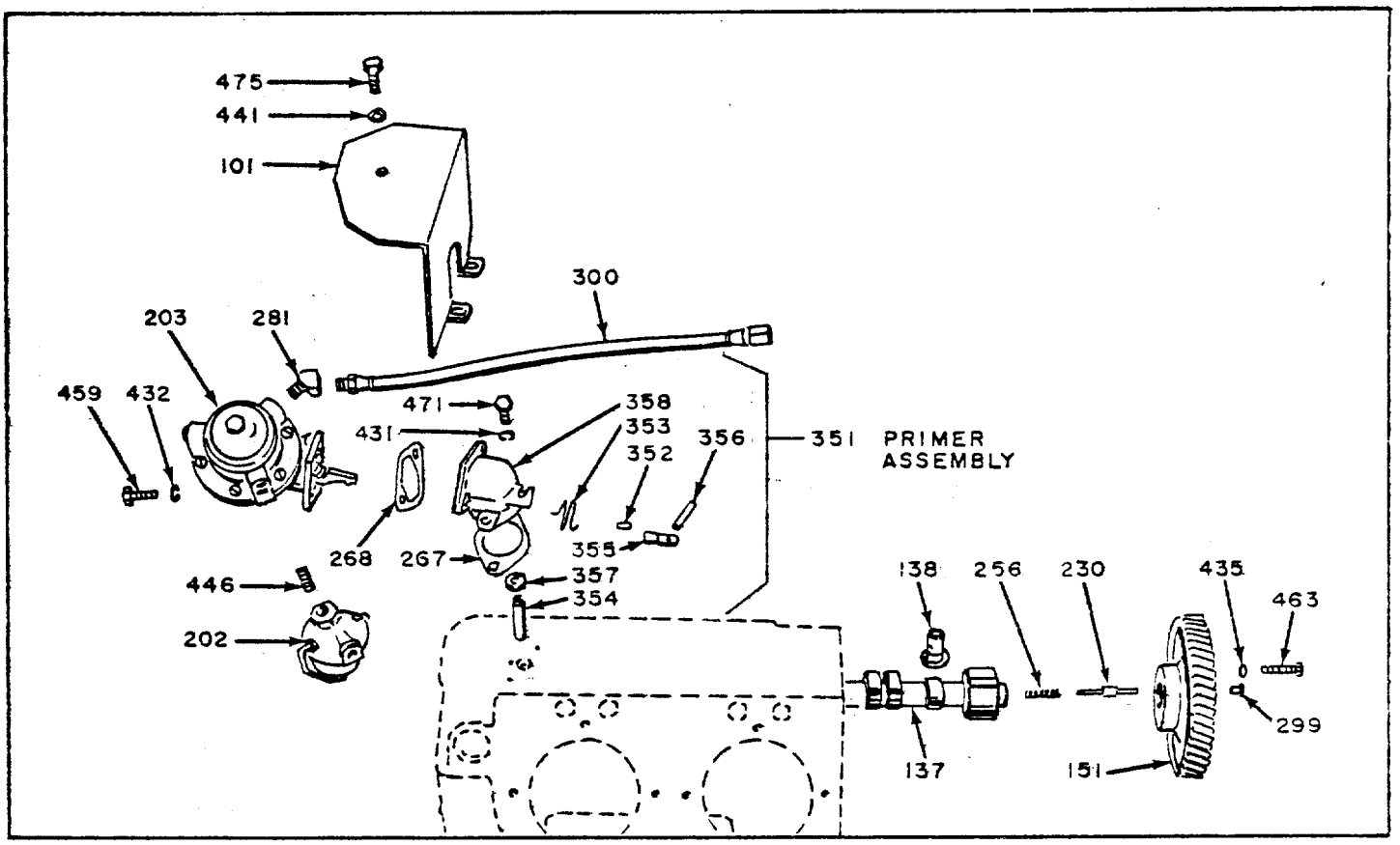


FIG. B-71. CAMSHAFT AND FUEL PUMP MOUNTING GROUP

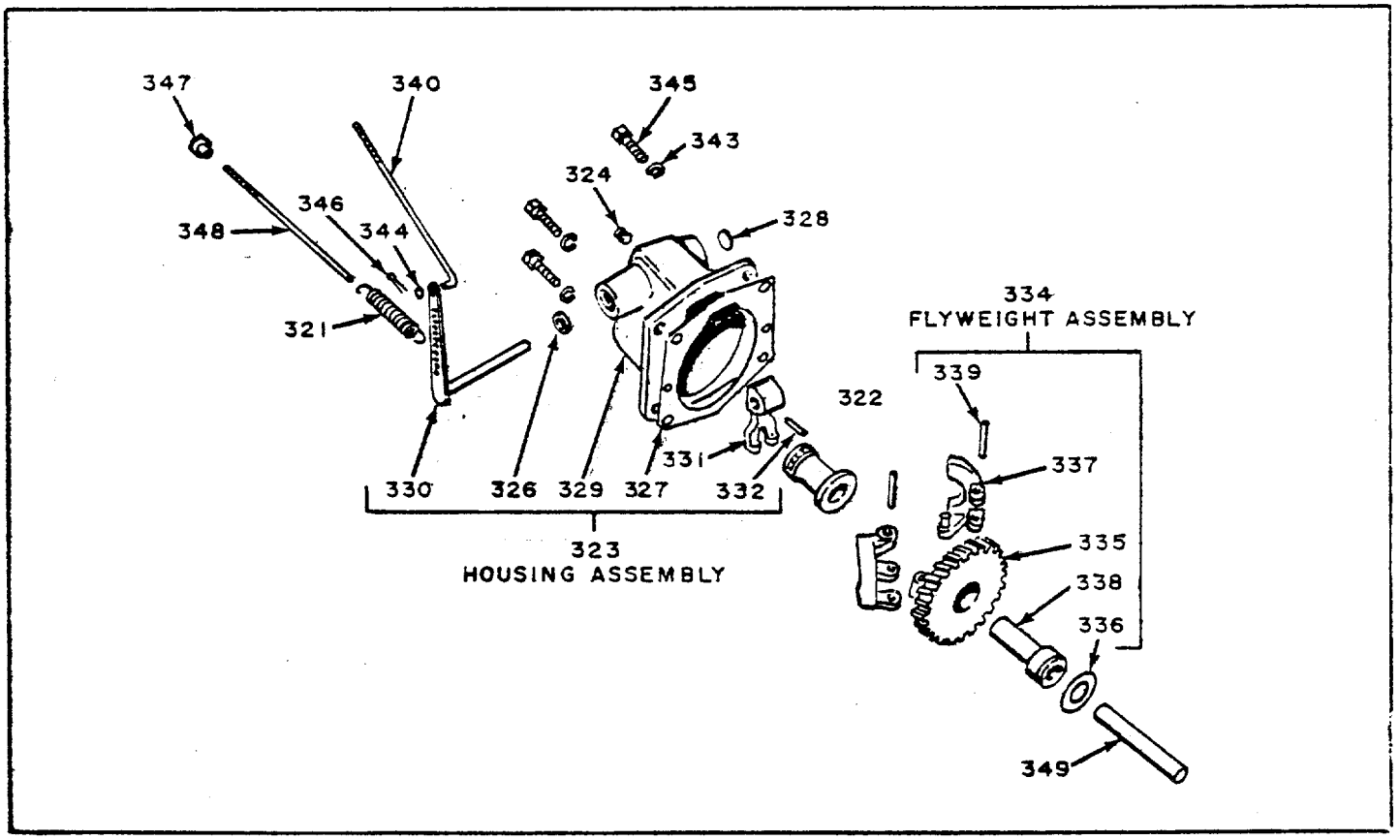


FIG. B-72. Ref. No. 320, GOVERNOR ASSEMBLY

Parts are identified by reference number. See parts list for correct part numbers.

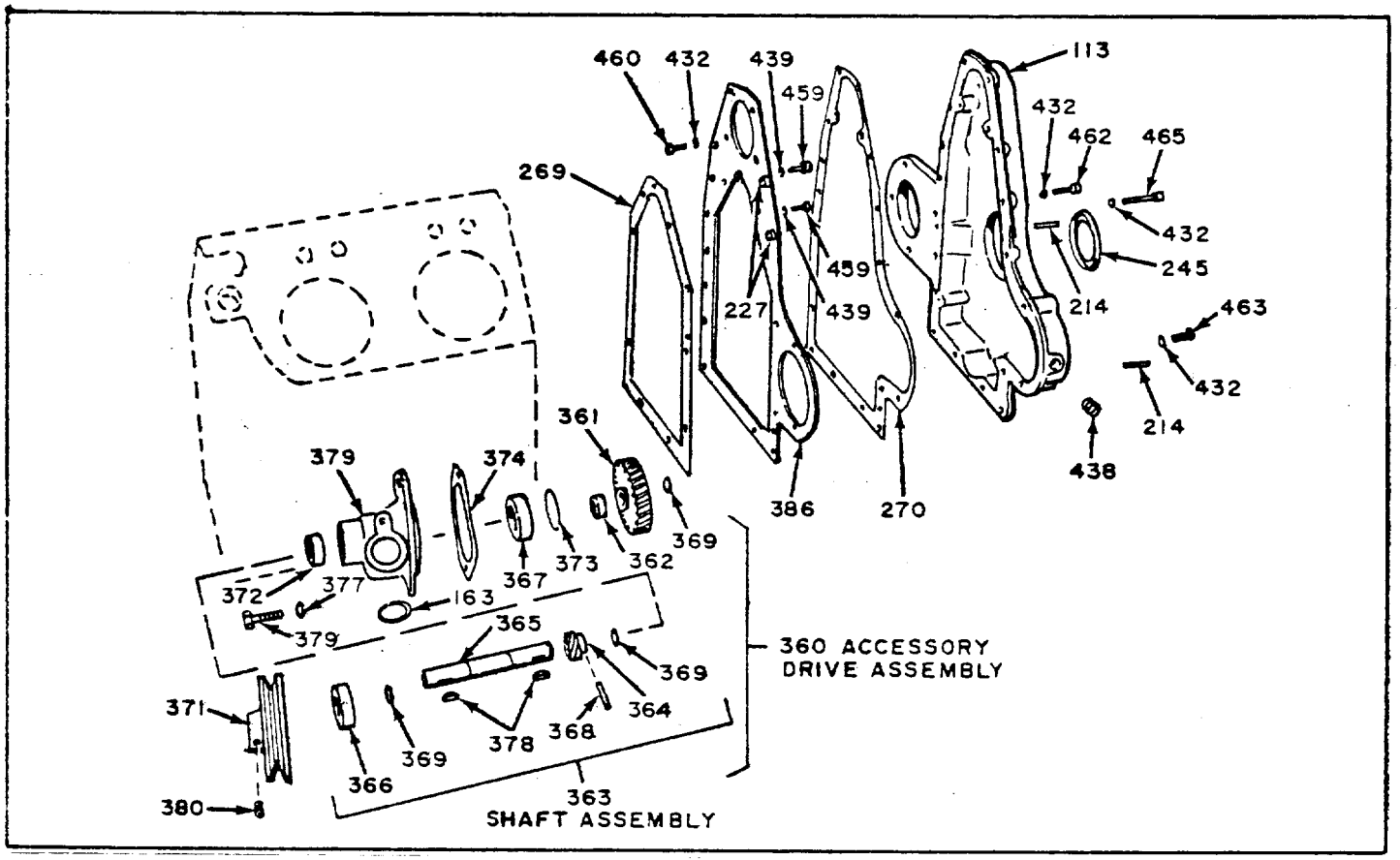


FIG. B-73. GEAR COVER AND ACCESSORY DRIVE ASSEMBLY

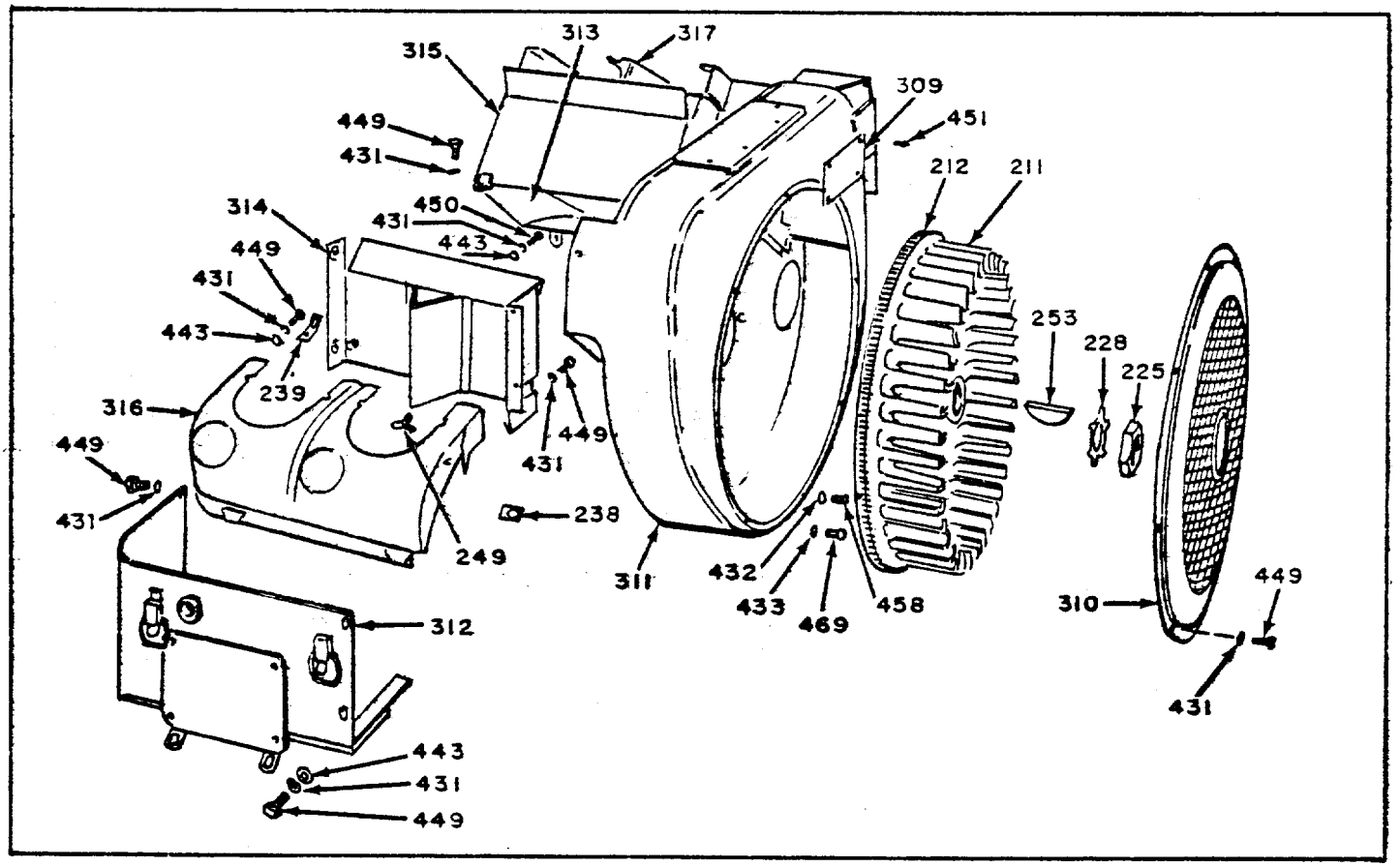


FIG. B-74. FLYWHEEL AND AIR SHROUDING GROUP
Parts are identified by reference number. See parts list for correct part number.

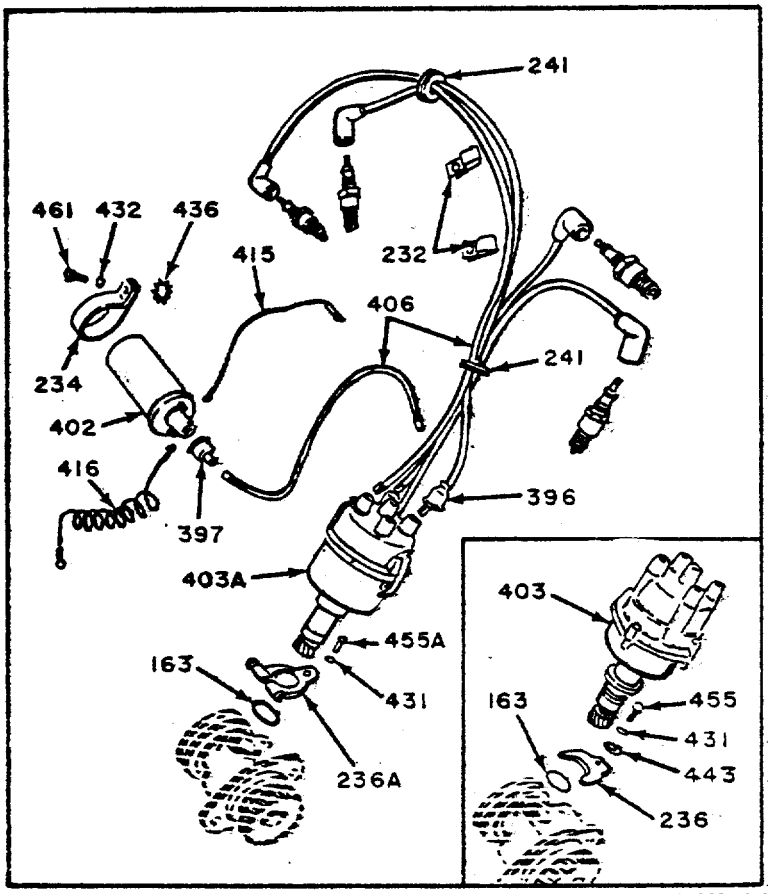


FIG. B-75. DISTRIBUTOR AND COIL

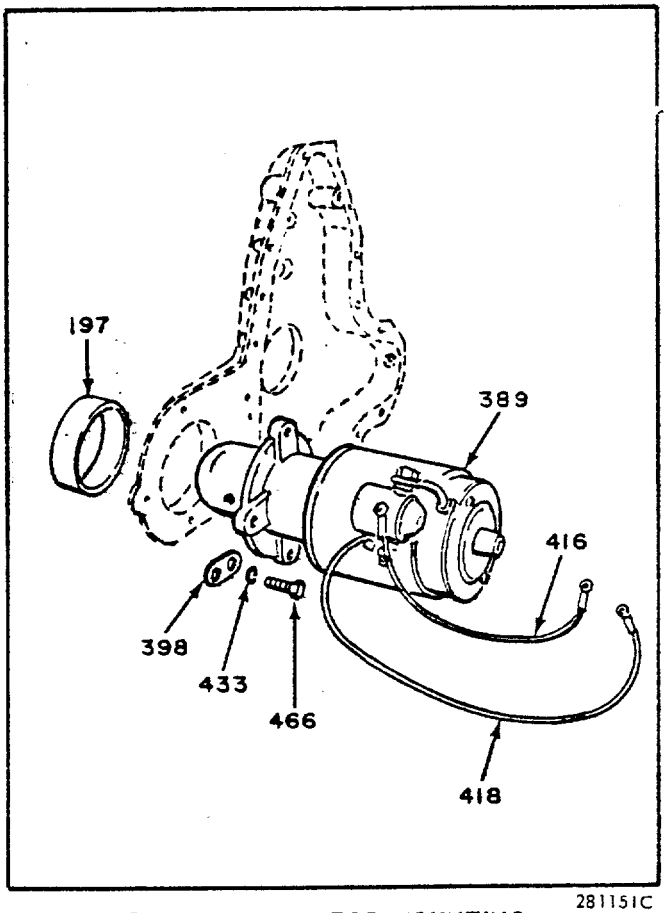


FIG. B-76. STARTING MOTOR MOUNTING

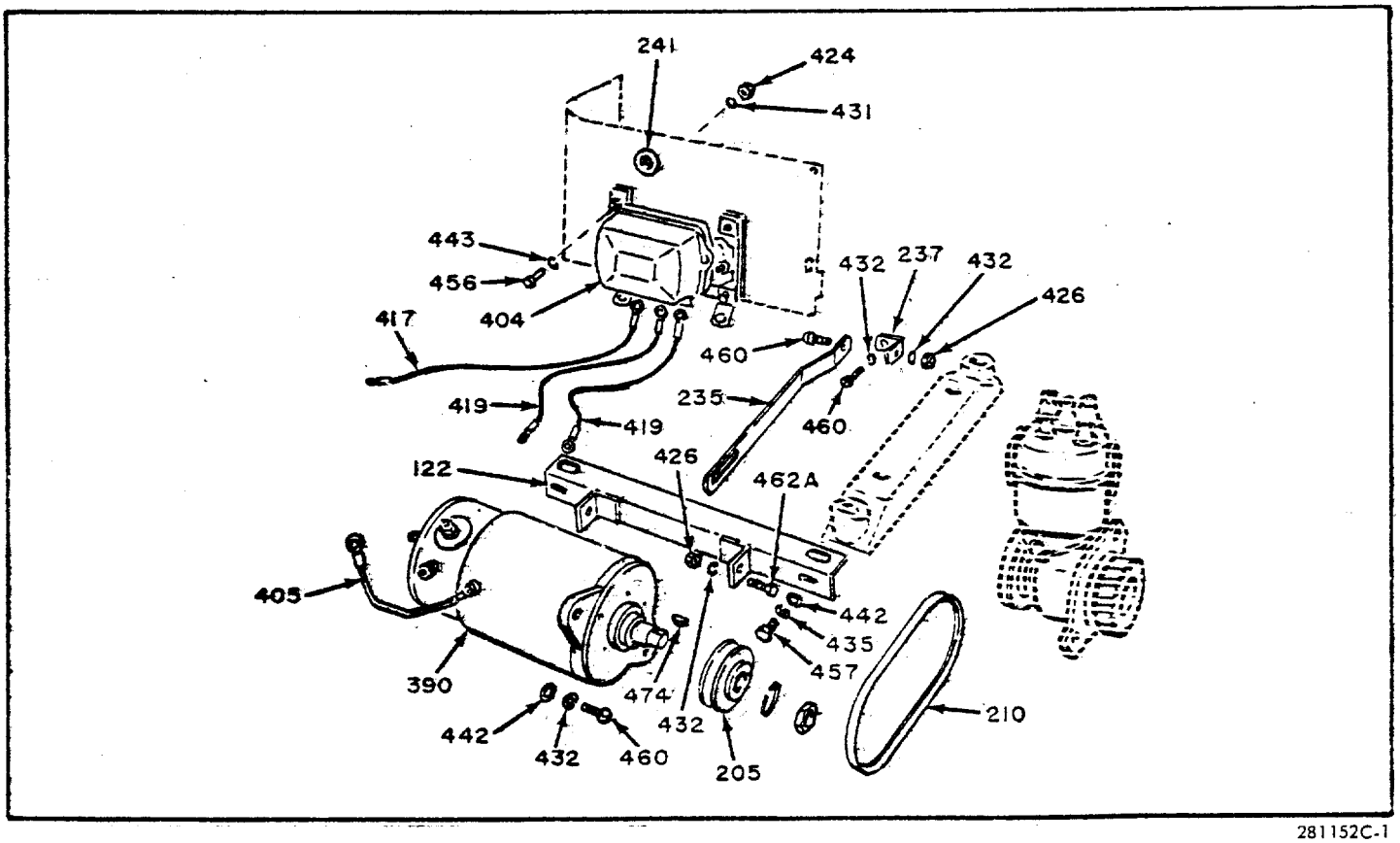
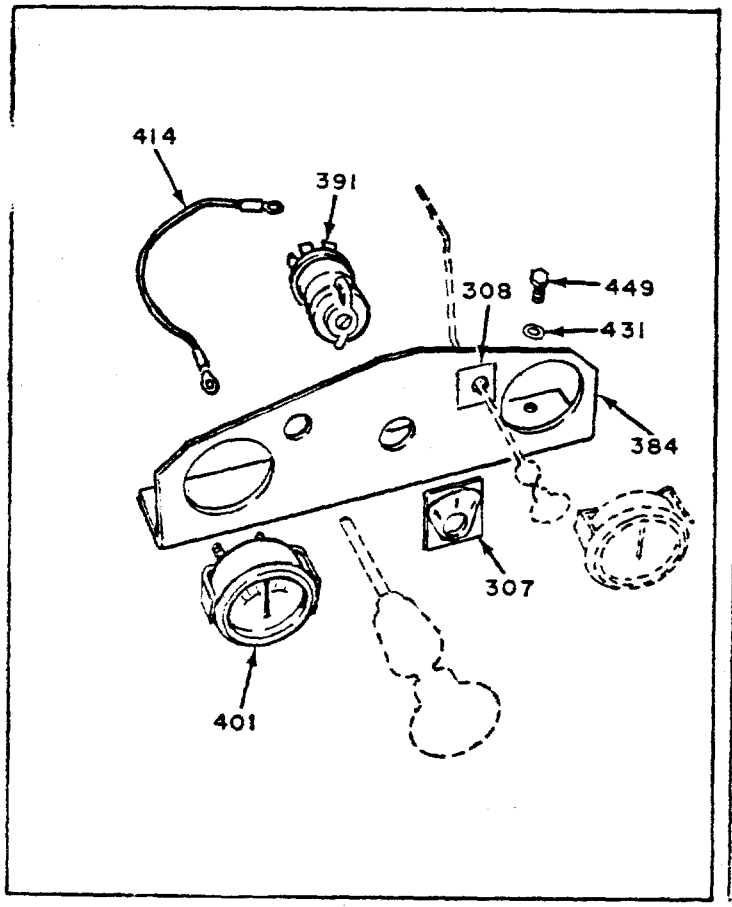


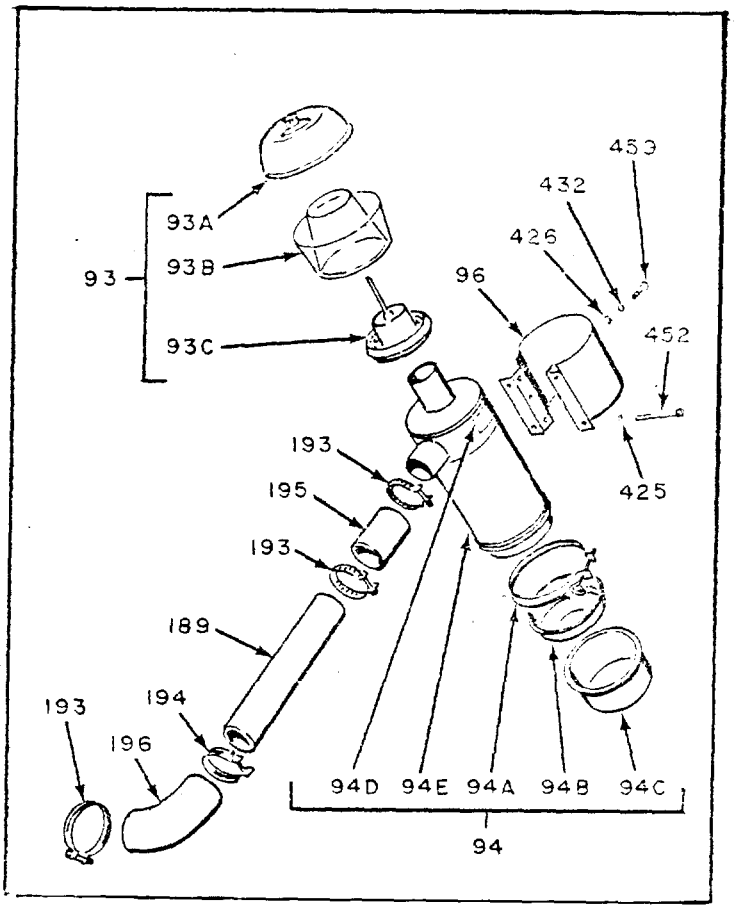
FIG. B-77. GENERATOR AND REGULATOR MOUNTING GROUP

Parts are identified by reference number. See parts list for correct part number.



281213C-1

FIG. B-78. CONTROL PANEL GROUP



281215C

FIG. B-79. AIR CLEANER GROUP

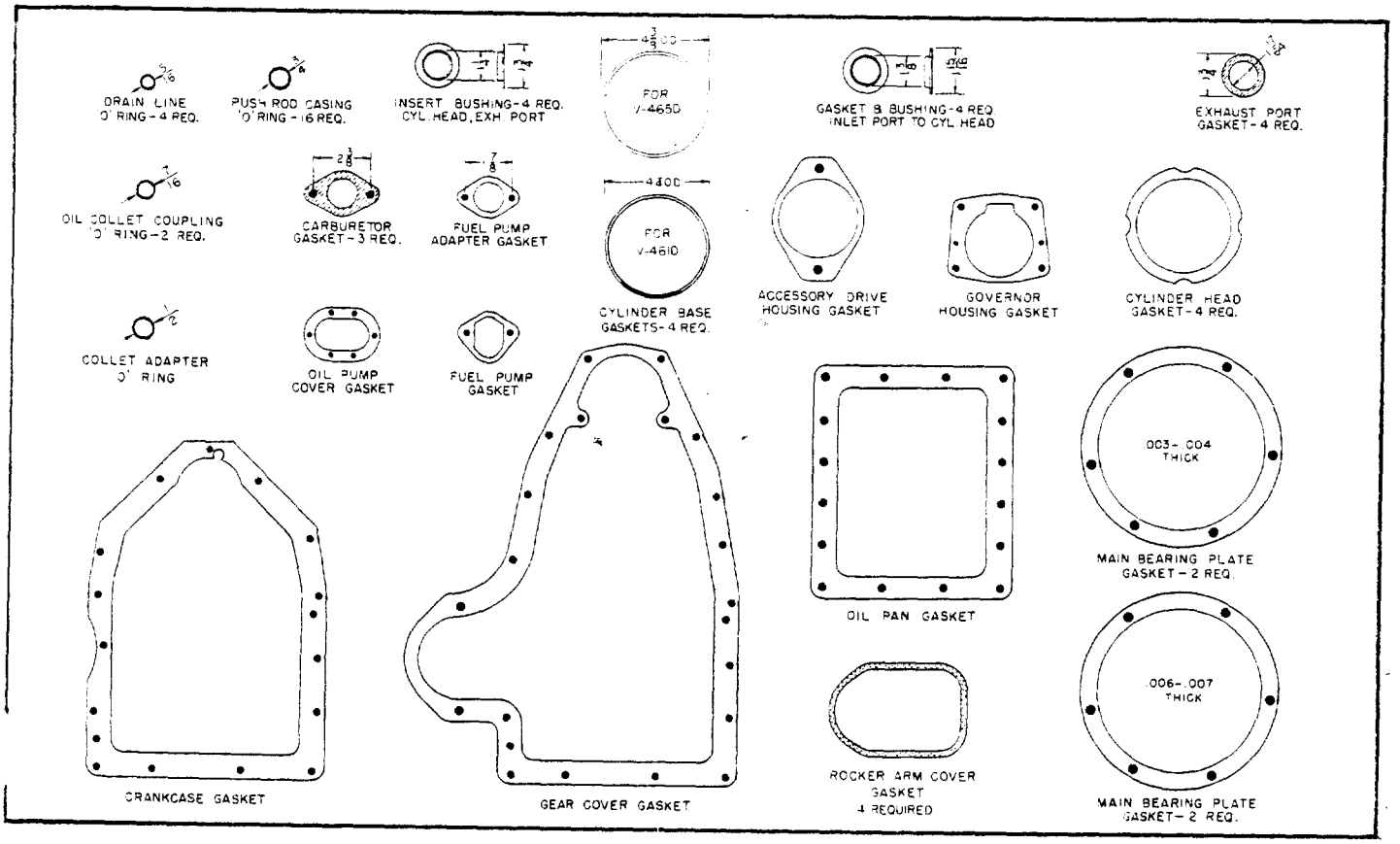


FIG. B-80. Ref. No. 257, ENGINE GASKET SET

Parts are identified by reference number. See parts list for correct part number.

PARTS LIST

FOR STANDARD ENGINE

Models V-465D, V-461D, V-460D

ACCESSORIES COMMONLY SUPPLIED ON THESE ENGINE MODELS BEGIN ON PAGE B-56

* NOTE: If weights differ, V-461D weight is shown first.

REF. NO.	PART NUMBER: MODELS V-460D, V-461D	PART NUMBER: MODEL V-465D	DESCRIPTION	NO. REQ.	*NET WEIGHT: LBS.	*NET WEIGHT: OZ.
85	AA-99	AA-111	**CYLINDER BARREL**	4	11	8
					12	8
86	AB-105-S1	AB-105A-S1	**CYLINDER HEAD ASSEMBLY**, consisting of:	4	6	8
			1 Head; 2 AD-44B Guides; 1 AE-88D Valve; 1 AE-89 Valve; 2 AF-51 Springs; 1 AG-26A Seat; 1 AG-41 Rotator; 2 AH-19 Locks; 1 HG-150E Insert; 1 HG-264 Insert; 1 PC-532 Stud; 1 RF-1319 Elbow			
			NOTE: Order Rocker Arm assembly separately.			
87	See Fig. B-81	See Fig. B-81	**CRANKCASE ASSEMBLY**, includes:	1	37	
			1 LJ-300M Tube; 1 ME-137-1 Brg. cup; 2 PA-291 Pins; 8 PF-18 Plugs; 1 RC-91 Screen; 1 RF-1319 Elbow; 2 RF-1377A Fitting; 1 RF-1420 Fitting; 1 RF-1423 Nipple; 1 RF- Tube; 1 RJ- Saber; 1 RV-34A Valve; 1 SA-58 Plug; 1 XK-1 Plug			
			NOTE: Beginning with engine serial No. 4904657 the basic standard crankcase part number became **BA-55-E** for Model **V-465D**, and **BA-55-C** for Model **V-461D** (modified lubrication system). Previous to the above serial No.: **BA-55-B** is required for **V-465D**, and **BA-55** for **V-461D, V-460D.**			
			Special machining is indicated by a number stamped on the crankcase in the location shown in Fig. B-81. Add this number to the basic crankcase part number. Order by complete number and by giving the Model. Specification and Serial Numbers of the engine.			
89	DB-223	DB-232	**PISTON**, camaround, standard size **NOTE:** Pistons are also furnished .010", .020", .030" oversize.	4		15
90	DE-76	DE-80	**PISTON PIN**, standard size **NOTE:** Piston Pins are available .005" and .010" oversize.	4		4
91	DR-48-A	DR-60	**PISTON RING SET**, standard size (for 4 pistons) DR-48, replaced by DR-48-A.	1	1	
	DR-49		**TRI-CROMERE-RING SET**, standard size **NOTE:** Ring Sets are available .010", .020" and .030" oversize.		1	
93	LO-115-A (PBH00-0453)	LO-127-A (PBH00-0234)	**PRE-CLEANER**, Donaldson Co. Service Parts:	1	1 2	8 8
93A	22-P10-3587	22-P-20648	Cover Assembly	1		
93B	22-P-20115	22-P-20227	Body	1		
93C	22-P10-3589	22-P-20650	Sleeve Assembly	1		
94	LO-159-4-S1 (FGA05-2522)	LO-185-S1 (FGA06-0022)	**OIL BATH AIR CLEANER**, Donaldson Co. Service Parts:	1	5 6	0 0
94A	22-P-2706	22-P-2691	Clamp Assembly			
94B	22-P-17242	22-P-17702	Inner Oil Cup			
94C	22-P-17244	22-P-17703	Outer Oil Cup			
94D	SD-161	SD-161	Decal			
94E	- - - -	- - - -	Body Assembly — not serviced separately LO-90-5-S1 Air Cleaner, No. A-552, for V-460D and V-461D engines previous to Serial #3477983. Replaced by LO-159-4-S1 (Interchangeable). **22-P-8723** Oil Cup Assembly must be used on LO-90-5-S1 for service.			

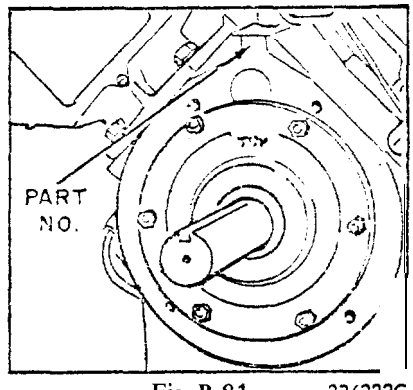


Fig. B-81 226222C

PARTS LIST
Models V-465D and V-460D, V-461D

REF. NO.	PART NUMBER MODELS V-460D, V-461D	PART NUMBER MODEL V-465D	DESCRIPTION	NO. REQ.	*NET WEIGHT LBS.	*NET WEIGHT OZ.
95		PC-531	**STUD** for cylinder, head and rocker arm bracket mounting (top center) 11-5/16" long	4		4
95A	PC-531A		**STUD,** 11-5/16" with flanged end. For V-461D engines beginning with Serial No. 3685187	4		4
			PC-531 for V-461D engines previous to Serial No. 3685187.			
96	PG-512	PG-456-B	**STRAP** for mounting air cleaner	1	2	
					2	8
97	–	PG-1212	**CLAMP** for oil filler tube	1		4
98	–	PG-1230	**CLIP** for cylinder hold down	4		1
99	QD-841	QD-839	**GASKET** for cylinder base	4		1
			JK-65 'O' Ring for V-461D, replaced by QD-841.			
101	–	SE-286	**HEAT SHIELD** for fuel pump	1	1	

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

NOTE: Beginning with engine serial number 4904657 for model V-465D, the method of lubricating the connecting rod bearings changed from a crankshaft gear oil collet with roller type center main bearing to a shell center main bearing containing a pressure oil line from the oil header. Component parts are **not interchangeable** and are referred to in the parts list as being used with the **"shell"** type center bearing or obsolete **"roller"** type center bearing.

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
103	AD-44-B	**VALVE STEM GUIDE,** inlet and exhaust	8		2
104	AE-88-D	**VALVE,** exhaust, **stellite seat**	4		3
105	AE-89	**VALVE,** inlet	4		3
106	AF-51	**VALVE SPRING**	8		2
107	AG-26-A	**SEAT** for valve spring, inlet	4		1
108	AG-41	**VALVE ROTATOR,** exhaust	4		1
108A	AG-35 (Obsolete)	**ROTATOR,** exhaust (not available) Used on V-461D previous to Serial No. 4602108. **For replacement:** use **AG-40** guide in its place, and **AG-41** rotator at rocker end, in place of AG-26-A seat.	4		
109	AH-19	**LOCK** for valve spring seat	16		1
111	AN-41-S1	**COVER** for rocker arm (includes gasket)	4		8
113	BD-108-S1	**GEAR COVER ASSEMBLY** Includes: 1 XK-3 Plug; 1 PF-52 Button; 1 PH-496C Oil seal; 1 TC-388-1 Shaft	1	18	
114	BG-352	**BEARING RETAINER PLATE,** flywheel end, with **shell** type ctr. bearing	1		10
114A	BG-253-A	For **oil collet** and **roller** ctr. bearing	1		10
115	BG-353-A	**CENTER MAIN BEARING HANGER ASSEMBLY** for **shell** type bearing Includes:	1	4	
116		**PA-368** Dowel pins	2		1
–		**XD-176** Screws (Ref. 470) BG-353, replaced by BG-353-A.	2		1
		NOTE: The hanger assembly is furnished **LESS** the shell bearing. Refer to reference number **154** for part number of the standard size and the undersize shell bearings available.			
115A	BG-346-S1	**CENTER MAIN BEARING HANGER ASSEMBLY** for obsolete **roller** bearing	1	4	
	BG-304-S1	For **V-460D,** but BG-346-S1 can be used in its place. Both assemblies include:			
116		**PA-368** Dowel pins	2		1
117		**PA-376** Bearing dowel pin	1		1
–		**XD-83** Screws (Ref. 468A) **NOTE:** Hanger assembly does not include center main bearing.	2		1
120	BG-308-S2	**MAIN BEARING PLATE ASSEMBLY,** std., Take-off end Includes: 1 ME-137-1 Bearing cup; 1 PH-496B Oil seal	1	9	8
121	BH-155-E	**OIL PAN**	1	2	
122	BI-354-A	**BRACKET** for **Prestolite** generator	1	1	8
	BI-354-B	For **Delco Remy** generator		1	6
124	BK-72A-1	**ENGINE SUPPORT**	2	6	2

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Net Wt Lb	Net Wt Oz
25	See Fig. B-82	**CRANKSHAFT ASSEMBLY**..... Includes: 2 ME-168 Bearings 1 GA- Gear 1 PL-156 Key 1 HA-137-S Shell Brg. 1 RK-179C Oil sling	1	62	

NOTE: The basic crankshaft part number (raised letters on side of No. 2 counterweight), is **CA-75-C** for engines with **shell** center bearing, or **CA-75** with obsolete **roller** type center bearing. Dash numbers are added to the basic part number to identify special machining at the take-off end. The dash (—) number will be found stamped on the cheek facing the take-off end of the shaft, as illustrated in Fig B81 Order by **complete part number,** (dash number added to basic number) and by giving the **model, specification** and **serial** numbers of the engine.

CAUTION: Engines equipped with hydraulic pump require a hardened crankshaft gear **GA-49-A,** identified by a 1/16" wide groove around the gear hub. When ordering crankshaft with hardened gear, add an **S4** behind the crankshaft part number.

CA-75-C series crankshaft can be used in place of **CA-75** series by changing over to the **shell center bearing assembly** and **modifying crankcase** for an internal oil pressure line.

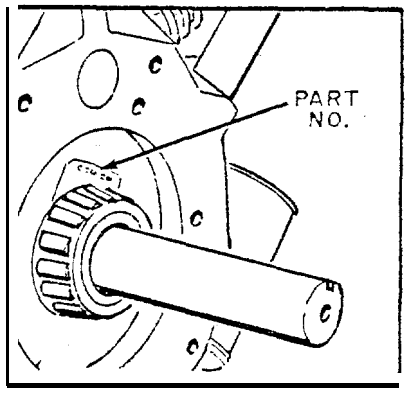


Fig. B-82. 71057C

26	DA-71-A-S1	**CONNECTING ROD ASSEMBLY**..... Includes: 1 HG-131C Bushing 2 PD-247 Nuts 2 PB-146-2 Bolts DA-71-S1, replaced by DA-71A-S1.	4	1	12

NOTE: The connecting rod is furnished **LESS** the shell bearings. Refer to reference number **153** for part number of the standard size and the undersize shell bearings available.

37	EA-132	**CAMSHAFT**..... EA-116-B, replaced by EA-132.	1	4	
38	F-67-B	**VALVE TAPPET**..... F-67, replaced by F-67-B.	8		2
40	FX-166-A	**ROCKER ARM** and **BRACKET ASSEM.** Consisting of:	4	1	4
41		**FX-166** Bracket.....	1		7
42		**FX-167A-S1** Rocker arm assem. (exhaust) Includes: PI-194 Adj. screw.	1		4
43		**FX-168A-S1** Rocker arm assembly (inlet) Includes: PI-194 Adj. screw.	1		4
44		**FX-169-A** Rocker arm shaft.....	1		3
45		**PI-194** Tappet adjusting screw	2		1
46		**PM-185** Shaft spring.....	1		1
47		**XE-73** Lockscrew for rocker arm shaft, ¼"-20 x 5/8" long, Allen socket head.....	1		1

Ref No.	Part Number	Description	No. Req	Net Wt Lb	Net Wt Oz
14	FX-170	**PUSHROD**.....	8		2

NOTE: Beginning with **engine serial No. 5075776,** the gear train was changed to utilize the same gears as is used on the model VG4D engine. Gears are not interchangeable unless all five gears, crankshaft, camshaft, idler, governor and accessory drive gears are replaced.

15	GA-49-A	**CRANKSHAFT GEAR** for engines with **shell** type center main bearing and beginning with serial No. 5075776..... **GA-49** standard production gear — use GA-49A for service. **GA-48-A** Beginning with serial No. 4904657 to serial No. 5075775.	1	2	
15	GA-44-A-S1	**CRANKSHAFT GEAR** and **OIL COLLET** Used with obsolete **roller** ctr. bearing. Consisting of: 1 GA-44-A Gear 1 Oil collet and seal	1	2	
51	GB-46	**CAMSHAFT GEAR** Beginning with engine serial No. 5075776..... **GB-46-B** Previous to engine serial No. 5075776.	1	3	
52	GC-28	**IDLER GEAR** Beginning with engine serial No. 5075776..... **GC-28-B** Previous to engine serial No. 5075776.	1	2	4
53	HA-120D-S	**SHELL BEARING** (2 halves)..... For **connecting rod,** standard size. **NOTE:** The following undersize shell bearings are also available. **HA-120D-S1**.....(.001" undersize) **HA-120D-S2**.....(.002" undersize) **HA-120D-S10**.....(.010" undersize) **HA-120D-S20**.....(.020" undersize) HA-120-S etc., replaced by HA-120D-S etc.	4		3
54	HA-137-S	**SHELL BEARING** (2 halves)..... For **center main bearing,** std. size. **NOTE:** The following undersize shell bearings are also available. **HA-137-S1**.....(.001" undersize) **HA-137-S2**.....(.002" undersize) **HA-137-S10**.....(.010" undersize) **HA-137-S20**.....(.020" undersize)	1		4
55	HF-627	**SPACER** for obsolete **roller** center bearing-hanger to crankcase screws	2		1
56	HG-131-C	**PISTON PIN BUSHING**..... HG-131B, replaced by HG-131-C.	4		1
57	- - - -	**VALVE SEAT INSERT,** inlet — not recommended for service replacement..	4		
58	- - - -	**VALVE SEAT INSERT,** exhaust — not recommended for service replacement	4		
59	K-52	**'O' RING,** 3/16" I.D. x 5/16" O.D..... 1-for oil pressure reducing valve. 4-for oil drain lines.	5		1

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
50	K-53	'O' RING, 5/16" I.D. X 7/16" O.D. ..... 1-for governor spray fitting. 2-for oil coupling to collet - used with obsolete roller ctr. bearing.	3		1
61	K-55	'O' RING, 3/4" O.D. ..... For push rod casing at both ends.	16		1
62	K-56	'O' RING, 3/6" I.D. x 1/2" O.D. ..... 1-for pressure relief valve. 1-for collet adapter to crankcase-seal with obsolete roller ctr. bearing.	2		
63	K-59	"O' RING, 1-1/16" I.D. X 1-5/16" O.D. For distributor mounting.			1
65	K-111-B	OIL PUMP ASSEMBLY complete	1	4	2
		NOTE: Beginning with serial No. 5190840, K-111-B oil pump with 1/2" wide internal gears replaces K-111.A and K-111 with 3/8" wide gears. Pumps are interchangeable as a unit. Non-interchangeable gears and related parts are noted by oil pump part number.			
		Pump assemblies consist of:			
166		GD-94C Oil Pump Drive Gear (external)	1		.1
67		KA-61D-1-S1 Body assembly for K-111B Includes: KC-59-2 Gear, KD-122 Shaft. KA-61C-S1(K-111A, K-111), for replacement order KA-61D-1-S1 and KC-59-1.	1		
168		KB-46 Cover	1		
169		KC-59-1 Drive Gear (inner) for K-111B	1		1
		KC-56A (3/8" wide) for K-111A, K-111			1
70		KC-59-2 Drive gear for K-111B	1		1
		KC-56A (3/8" wide) .499-.498" I.D. ... For K-111A oil pump.			1
		KC-56A-1 (3/8" wide) .501> .5005" I.D. For K-111 oil pump.			1
171		KD-121-S2 Drive Shaft for K-111B ..... Includes: KC-59-1 Gear	1		6
		KD-121A-S1 with KC-56A Gear For K-111A, K-111 oil pumps.			
172		KD-122 Stub Shaft, .500-.4995" O.D. . For K-ill B, K-111 oil PUMPS.			2
		KD-122A, .4973-.4970" O.D. ..... For K-111A oil PUMP.			2
173		PA-64 Pin, 1/8" dia. x 3/4" long, for drivergear	1		
174		PD-195 Jam Lock nut, 7/16"-20 thread, forgearmounting	1		1
175		PL-137 Key, No. 1 Woodruff for drive gear	1		1
176		QD-535-A Cover gasket	1		1
177		RD-125-A Screen	1		2
178		RD-126-A Screen adapter	1		4
		OIL PUMP STANDARD HARDWARE			
180		PE-14 Lockwasher, NO. 10 spring lock 6-for cover 2-for screen	8		1
181		XA-7 Screw for screen, No. 10-32 thrd. x 3/8" long steel round head.	2		1
182		XA-8 Screw for cover, No. 10-32 thread x 1/2" long steel round head.	4		1
183		XA-56 Screw for cover, No. 10-32 thread x 1-1/4" long steel round head.	2		1
184		XE-61 Set screw for screen adapter ... No. 10-32 thread x 3/16" long.	1		1

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
85	Z-77-B-S1	CARBURETOR ASSEMBLY ..... Zenith outline No. 12708. Wisconsin assembly includes: Anti-diesel solenoid valve, 3 QC-12-A gaskets, 2 PC-171 studs. LQ-37 Repair Kit for carburetor.	1	3	
		NOTE: Specify part number or model designation, stamped on carburetor, where ordering replacement carburetor or Parts. See carburetor bulletin in back of manual for service parts list.			
186	YC-83A-S1	ANTI-DIESEL SOLENOID VALVE ..... Mounted in carburetor bowl. Includes PK-162 locking tab.	1		4
187	LD-257C-S1	MANIFOLD ASSEMBLY, lower-inlet Includes: 4 XD-17B Screws xx- 1 Plug LD-257A-S1 and LD-257B-S1, replaced by LD-257C-S1.	1	4	9
188	LD-258D-S1	MANIFOLD ASSEMBLY, upper-exhaust Includes: 2 XD-162 Screws 4 XD-17-B screws LD-258B-S1, replaced by LD-258D-S1.	1	6	
189	LJ-131	TUBE for air cleaner connection	1	1	6
190	LJ-300-M	OIL FILLER TUBE ..... LJ-300-AD, replaced by LJ-300-M.	1		2
191	LJ-392-A	PUSH ROD CASING ASSEMBLY ..... Consisting of: HF-585 Collar LJ-392 Casing	3		3
192	RF-1495-B	TUBE for standard RJ-173 dip stick	1		1
	RF-1495-C	For RJ-173-A (starter side)			1
		LJ-415 Tube for obsolete RJ-163 .	1		1
		Install dip stick tubes with 'Loctite'.			
193	LK-24	HOSE CLAMP, 2-1/4" I.D. ..... For air cleaner connection — at carburetor and air cleaner ends.	3		1
194	LK-9	HOSE CLAMP, 2-3/8" I.D. ..... For air cleaner tube to elbow.	1		1
195	LL-30-A	RUBBER HOSE ..... For air cleaner tube.	1		2
196	LL-89	RUBBER ELBOW ..... For air cleaner tube.	1		6
197	LL-146	RUBBER SLEEVE ..... For starter Bendix housing.	1		2
198	LQ-60-1	OIL FILLER and BREATHER CAP ...	1		6
20:	LP-19-B	FUEL STRAINER	1		6
		LQ-32 Repair Kit (bowl, gasket, screen]			2
20:	LP-38E-2-S1	FUEL PUMP with gasket (low dome style (LP-38E-S1 pump with cover rotated)	1	1	8
		LQ-46 Repair Kit, see ML-34 Repair Instructions in rear section of manual	1		2
		LP-38-3-S1 (high dome style pump) ... Replaced by LP-38E-2-S1.		1	.1
		LQ-30 Repair Kit for obsolete LP-38-3-S	1		2

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
205	MD-390	**PULLEY** for generator	1		6
206	ME-168	**MAIN BEARING ASSEMBLY** (both ends) Consisting of:	2	2	8
207	*	**ME-137-1** Bearing cup			
208	*	**ME-168-1** Bearing cone * Not sold separately.			
209	ME-169 Std. Size	**ROLLER BEARING**, center main (Obsolete) used in conjunction with collet for oil distribution.	1		12
	ME-169-S30	.030" undersize bearing assembly			12
210	MH-184-A	**GENERATOR BELT** MH-184, replaced by MH-184-A.	1		3
211	NC-194-S1	**FLYWHEEL ASSEMBLY**, standard Includes:	1	51	
212		GH-43 Ring gear	1	2	10
		NOTE: Because of the variations in flywheels; for mounting rotation screens, stub shafts, etc. only the standard ring gear flywheel is listed. Therefore, give Model, Specification and Serial Numbers of engine when ordering new flywheel.			
214	PA-291	**DOWEL PIN** for gear cover	2		1
215	PA-334	**PIN** for cranking	1		1
216	PB-146-2	**CONNECTING ROD BOLT**	8		2
218	PC-171	**STUD**, 5/16" x 1-5/16" long For carburetor mounting.	2		1
219	PC-529	**STUD** for cylinder and head mounting, 3-3/8" long, for outer boss of No. 1, 2 and 3 cylinders	3		3
220	PC-529-A	**STUD** for cylinder, head and Hi-Temp. switch mounting, 3-11/16" long, for outer boss of No. 4 cylinder	1		3
221	PC-530	**STUD** for cylinder and head mounting, 10" long, for middle head bosses	3		4
223	PC-532	**STUD** in cylinder head for manifold mounting, 7/16" x 2-3/8" long	4		2
225	PD-193-2	**NUT** for flywheel mounting	1		10
226	PD-247	**LOCKNUT**, 3/8"-24 thread For connecting rod bolt. PD-200, replaced by PD-247.	8		1
227	PD-228	**FASTENER** for spacer plate	2		1
228	PE-85	**LOCKWASHER** for flywheel nut	1		1
229	PF-52	**BUTTON** for camshaft thrust plunger	1		1
230	PF-101	**THRUST PLUNGER** for cam shaft	1		1
232	PG-314	**CLAMP** for ignition wires PG-1042, replaced by PG-314.	2		1
234	PG-556-B	**CLAMP**, 2-7/64" I.D. for YF-41A coil **PG-556**, 2-11/64" I.D. for YF-38A	1		4 4

Ref. No.	Part Number	Description	No. req	lbs	oz
235	PG-792-8	**ADJUSTING STRAP** for generator	1		6
236	PG-1205	**CLAMP** for YF-34 Delco-Remy distributor on engines beginning with Serial No. 4420865.	1		4
236A	PG-543A-1	**CLAMP** for YF-10-A Prestolite distributor and obsolete YF-25 Delco-Remy distributor. PG-920 A, replaced by PG-543A-1.	1		2
237	PG-959	**BRACKET** for generator adjusting strap	1		1
238	PG-1039	**SPEED NUT** for cylinder head cover thumbscrews	2		1
239	PG-1050	**BRACKET** for heat defl. (L. H. side)	1		1
241	PH-198	**RUBBER GROMMET** 2-in shroud for ignition wires. 1-for grouping ignition wires at distr.	3		1
	PH-442	**WASHER** (rubber faced) not illustrated For cylinder head cover thumb screw.	2		1
243	PH-484	**CLAMP WASHER** for manifold mounting	4		1
245	PH-496-C	**OIL SEAL**, crankshaft (in gear cover) PH-496B was used.	1		2
245A	PH-496-B	**OIL SEAL** for crankshaft (T. C. end) - PH-496, replaced by PH-496B.	1		2
246	PH-501	**PLAIN WASHER** (special), for manifold mounting	10		1
248	PI-143-B	**LOCKSCREW** for oil pump	1		1
249	PI-148	**THUMB SCREW** for cylinder head covers to shroud (use with PH-442 washer)	2		1
250	PJ-105-3	**STUD**, 2-3/8" lg., for GC-28 idler gear Beginning with eng. serial No. 5075776. **PJ-105-D**, 2-5/8" lg., for GC-28B gear Previous to engine serial No. 5075776.	1		4 6
251	PK-37-A	**RETAINING RING** for piston pin PK-37, replaced by PK-37-A.	8		1
252	PK-138	**WIRE BAIL** for rocker arm cover	4		1
253	PL-145	**WOODRUFF KEY** (special), flywheel mtg	1		1
254	PL-156	**WOODRUFF KEY**, No. 91 For crank shaft gear.	1		1
256	PM-108	**SPRING** for camshaft thrust plunger	1		1
257	Q-32-C	**ENGINE GASKET SET** with 'O' rings. (See illustration, page 43) Q-32A, Q-32B, replaced by Q-32-C.	1	1	
	Q-34-A	**GASKET SET** for valve grinding Consisting of: 4 JK-52, 4 QB-85-B, 4 QD-757-B, 8 JK-55, 4 QC-66, 4 QD-758, 4 QB-83 Q-34, replaced by Q-34-A.	1		4
259	QB-83	**INSERT BUSHING**, 1¼" I. D. x 1¾" O.D. For exhaust port in cylinder head.	4		1

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref No.	Part Number	Description	No. Req.	Net Lb	Wt Oz
260	QB-85	**INSERT BUSHING**, 1-3/8" I.D. x 1¾" O.D 4-for exhaust, upper to lower manifold gasket. 1-for upper to lower manifold, center flange.	5		1
261	QB-85-B	**GASKET** with **INSERT** . . . . . For inlet manifold port to cylinder head. QB-85-A, QC-65, replaced by QB-85-B.	4		1
262	QC-12-A	**GASKET** for carburetor flange . . .	3		1
264	QC-66	**GASKET**, 1¼" I.D. x 1¾" O. D. . For exhaust port in cylinder head.	4		1
265	QC-67	**GASKET**, exhaust, upper to lower manifold	4		1
266	QC-70	**GASKET** for upper to lower manifold, center flange	1		1
267	QD-67	**GASKET** for fuel pump adapter	1		1
268	QD-538-A	**GASKET** for fuel pump mounting .	1		1
269	QD-633-1	**GASKET** for spacer plate to crankcase	1		1
270	QD-634	**GASKET** for gear cover to spacer	1		1
271	QD-635-A	**GASKET** for oil pan	1		1
272	QD-757-B	**GASKET** for cylinder head . QD-757, replaced by QD-757-B.	4		1
273	QD-758	**GASKET** for rocker arm cover . .	4		1
274	QD-761	**GASKET**, main bearing plate—.003" thick	2		1
275	QD-761-A	**GASKET**, main bearing plate—.006" thick	2		1
277	QF-93	**SHIM** for main bearing plate—.006" thick Used in V-460D engines only.	3		1
278	QF-93-A	**SHIM** for main bearing plate—.014" thick	1		1
279	RC-91	**SCREEN** for oil filler tube	1		1
280	RF-934-1	**PIPE NIPPLE**, 1/8" x 1" long, in carburetor fuel inlet	1		1
281	RF-1096	**ELBOW**, 45° . . . . . 1-in fuel pump outlet. 1-for low oil pressure check (on engines with bell housing at T.O. end)	2		1
282	RF-1299	**ELBOW** in header for oil pressure line to center bearing hanger	1		1
283	RF-1319	**MALE ELBOW**, 1/8" P. T. x 1/4" inverted flare tubing nut . . . . . 4-in cylinder heads for oil return line. 1-in top of crankcase.	5		1
284	RF-1368	**COUPLING** for **obsolete** crankshaft oil collet	1		1
285	RF-1374	**ADAPTER FITTING** for oil line to gauge	1		1
286	RF-1514	**OIL SPRAY ELBOW** for governor . . . . RF-1375-A, replaced by RF-1514.	1		1
287	RF-1377-A	**"Y" FITTING** for oil return line to case RF-1377, replaced by RF-1377A.	2		1
288	RF-1378	**COUPLING** for **obsolete** oil collet adapter	1		1
289	RF-1392	**ADAPTER** for **obsolete** oil collet couplings	1		2
290	RF-1420	**FITTING** for oil line connections to case	1		2
291	RF-1421	**ELBOW** in carburetor fuel inlet	1		1
292	RF-1423	**NIPPLE** for oil filter mounting	1		2
293	RF-1511	**ELBOW**, 45° in center bearing hanger For oil pressure line.	1		1
		NOTE: Beginning with engine serial No. 4802236 the oil dip stick, used in conjunction with a formed adapter tube, replaces dip stick with straight adapter and those mounted directly in to case, but is not interchangeable for service. **Order by part number** indicated on blade of dip stick.			
294	RJ-173	**DIP STICK** (19" long) below oil filler **RJ-163** (obsolete) 8-7/8" long blade **RJ-159D** (10" long) to serial #3655793	1		5 3 4
295	RJ-173-A Optional	**DIP STICK** (6-1/4" long) at starter side **RJ-163A** (obsolete) 3-5/8" long blade **RJ-159J** (9" long) to serial #3655793	1		3 2 2
296	RK-179-C	**OIL SLING** for crankshaft (Beginning with serial #4904657) 2 .021" I.D. **RK-179B** (previous to serial #4904657) 2.001" I.D.	1		2 2
297	RM-845-A	**OIL LINE**, 1/4" x 8½" long, with nuts Reducing valve to upper oil header.	1		2
	RM-850-A	**OIL LINE**, ¼" tubing, 7½" long, with nuts Oil header to reducing valve. RM-1122B, replaced by RM-850-A.	1		2
299	RM-1049-E	**FLEXIBLE HOSE**, 19" long, with fittings For header to oil pressure gauge.	1		9
300	RM-1049-K	**FLEXIBLE HOSE**, 13" long, with fittings For fuel line, pump to carburetor.	1		6
301	RM-1351-A	**OIL RETURN LINE**, cylinder to case, Includes: JK-52 'O' ring. RM-1351-S1, used previous to Serial No. 3477845 (not available) — use 2 RM-1351-A and 1 RF-1377-A.	4		2
302	RM-1513-A	**OIL LINE**, 5/16" tubing with nuts . . Oil header to center bearing hanger.	1		2
303	RS-56	**OIL PRESSURE GAUGE**	1		5
304	RV-38-S3	**OIL FILTER CARTRIDGE** (3 pack)	1	1	
305	RV-41-A-S1	**OIL PRESSURE REDUCING VALVE** . With JK-52 'O' ring, for engines beginning with Serial No. 3488820. RV-41 and RV-38-B for engines to and including Serial No. 3488819, for replacement use **RV-41-A-S2** (includes oil lines).	1		4

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
306	RV-34-A	**OIL PRESSURE RELIEF VALVE ASS'Y.**	1		6
307	SD-255	**TAG** for YC-27-B ignition starting switch	1		1
308	SD-265	**TAG** for choke instructions	1		1
309	SD-312	**ENGINE NAMEPLATE** **NOTE:** When ordering name plate, give Model, Specification Number and Serial Number for correct stamping.	1		1
310	SE-48	**SCREEN** for flywheel shroud	1	1	
311	SE-239-A	**FLYWHEEL SHROUD**	1	16	8
312	SE-240-B	**CYLINDER SHROUD,** L.H. side	1	1	12
313	SE-240-A	**CYLINDER SHROUD,** R.H. side	1	1	12
314	SE-241-4	**HEAT DEFLECTOR,** L.H. side. SE-241, replaced by SE-241-4.	1	1	12
315	SE-241-A	**HEAT DEFLECTOR,** R.H. side	1	1	12
316	SE-242	**CYLINDER HEAD COVER,** L.H. side	1	1	2
317	SE-242-A	**CYLINDER HEAD COVER,** R.H. side	1	1	2
320	T-89-M-S2	**GOVERNOR ASSEMBLY,** beginning with serial #5356806 (gear bushing deleted)	1	3	8
		T-89 F-S2 for serial #5075776 to #5356805, replaced by T-89M-S2 interchangeable as a complete unit.			
		T-89F-S1 previous to serial #5075776 (for wide face gear train). Use **T-89M-S1** for replacement.		3	8
		Assemblies consist of:			
321		**PM-173** Governor spring	1		1
322		**TC-391-D** Thrust sleeve and bearing. For T-89M-S2 governor.	1		5
		TC-391-B for **obsolete** T-89F-S1 and T-89F-S2 governor.			3
323		**TC-395-S7 HOUSING ASSEMBLY**	1	2	
		Consisting of:			
324		**PF-18A** Pipe plug — 1/8" slotted	2		1
326		**PH-571** Oil seal — replaces PF-118 Retainer and PH-318-A Seal	1		1
327		**QD-615A** Housing gasket	1		1
328		**SA-52** Plug — 1/2" expansion	1		1
329		**TC-395** Housing (order TC-395-S7)	1	1	14
330		**TC-398** Cross shaft and lever	1		2
331		**VB-151** Yoke	1		3
332		**XH-1** Pin for yoke — No. 0 x 3/4" long taper	1		1
334		**TC-405-L GEAR & FLYWEIGHT ASS'Y.** For T-89M-S2 governor.	1	1	
		TC-405 For **obsolete** T-89F-S2 gov. for replacement use **TC-405L**			
		TC-405-B For **obsolete** T-89 F-S1 gov. for replacement use **TC-405M**		1	
		Assemblies consist of:			
335		**GD-100A-3** Gear for TC-405-L	1		12
		GD-100A For **obsolete** TC-405			8
		GD-100B For **obsolete** TC-405B			7
336		**PH-313A** Bushing washer	1		1
337		**TC-322D-S1** Flyweight assembly Includes TC-328D Thrust pin.	2		3
338		**TC-389A-1 (obsolete)** Gear bushing For TC-405 and TC-405B.	1		2
339		**PA-442** Flyweight roll pin	2		1
340		**VE-549-B** Control rod to carburetor	1		1
		GOVERNOR STANDARD HARDWARE			
343		**PE-4** Lock washer, 5/16", for housing	4		1
344		**PH-332** Washer, 1/8" I.D. x 5/16" O.D. between control rod and lever	1		1
345		**XD-16** Screw, 5/16"-18 x 7/8" hex. hd. For governor housing.	4		1
346		**XI-32** Cotter pin, 3/64" dia. x 3/8" long, for control rod	1		1
		NOTE: The following parts are not included in T-89-etc. for service.			
347		**PD-173A** Adjusting screw nut	1		1
348		**PI-145** Adjusting screw (6-3/4" long)	1		2
349		**TC-388-1** Governor shaft	1		3
351	TF-96-16 Optional	**ADAPTER-PRIMER** assem. for fuel pump Consisting of:	1	1	
352		**JK-50** "O" Packing ring	1		1
353		**PM-145** Spring	1		1
354		**TA-111D** Plunger, also order TA-116	1		1
355		**TA-114-S1** Shaft with JK-50 packing	1		1
356		**TA-115** Handle	1		1
357		**TA-116** Cap	1		1
358		— — — Adapter, order complete TF-96-16 Adapter-primer assembly.			
358	TF-96-20	**ADAPTER** (less primer) Includes:	1		3
354		**TA-111D-1** Plunger (2-15/32" long)	1		1
360	TF-122Y-2	**ACCESSORY DRIVE ASSEMBLY,** engines beginning with serial No. 5075776 **TF-122H-1,** previous to engine serial No. 5075776.	1	7	
		Assemblies consist of:			
361		**GD-120** Drive gear (for TF-122Y-2)	1		14
		GD-120A (for TF-122H-1 assembly)			14
362		**IF-470** Spacer for drive gear	1		1
363		**IJ-320-G** Drive shaft assembly	1	1	4
		Consists of:			
364		**GF-90** Gear for distributor drive	1		2
365		**JD-362-1** Shaft	1		10
366		**ME-112** Bearing, No. 1623-NS	1		3
367		**ME-139** Bearing, No. 1633-NS	1		4
368		**PA-408** Pin for distributor gear, 1/8" x 7/8" long, roll pin PA-281, 1/8" x 7/8" taper pin, replaced by PA-408.	1		1
369		**PK-108** Lockring	3		1
371		**AD-363-1** Drive pulley	1	1	
372		**PH-541** Oil seal (Replaces PH-274)	1		1
373		**PK-107** Lock ring for bearing, in housing	1		1
374		**QD-616** Gasket for housing	1		1
375		**TB-141C-S1** Housing assembly Includes: JK-59 "O" Ring PH-541 Oil seal Replaces TB-130A-1-S1, TB-141-S2.	1	3	8

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Wt Lb	Wt Oz
415	YL-352-11	**IGNITION WIRE ASSEMBLY**..... Ignition coil to **Prestolite** distributor. **NOTE:** Coil wire is an integral part of YF-34. See **Delco-Remy** Distributor Parts List for service number.			1
416	YL-352-26	**IGNITION WIRE ASSEMBLY**..... 1-for starter solenoid to switch. 1-for coil to ignition switch.	2		1
417	YL-352-26	**IGNITION WIRE** for **Prestolite** . . . . Regulator to ammeter (batt. term.) **YL-352-30** with **Delco-Remy** regulator.	1		1
418	YL-353A-27	**IGNITION WIRE ASSEMBLY**..... Ammeter to solenoid.	1		1
419		**IGNITION WIRE ASSEMBLY**.....			
	YL-352-11	For generator to regulator (field term.)	1		1
	YL-355-10	For generator to regulator (arm. term.)	1		1
420	YL-357-42	**IGNITION WIRE ASSEMBLY**..... Safety switch to distributor.	1		1
		MISCELLANEOUS STANDARD HARDWARE			
	HF-637	**SPACER**, fuel pump defl. (not illust.)	1		1
424	PD-77	**NUT**, 1/4"-20 thread, hexagon steel - For voltage regulator mounting.	2		1
425	PD-198	**LOCKNUT**, 1/4"-20 thread..... For air cleaner strap.	2(V-461D) 3(V-465D)		
426	PD-78	**NUT**, 5/16"-18 thread, hexagon steel 2-for generator mounting. 1-for generator adjusting strap. 3-for air cleaner strap to shroud.	6		1
427	PD-252	**NUT**, 3/8"-16 thread, hex. (grade 5) . . . For cylinder studs.	16		1
428	PD-205	**NUT**, 5/16"-24 thread (Seez-proof) . . 2-for carburetor mounting. 10-for manifold, upper to lower branch. (obsolete) used for stud mounting.	2		1
429	PD-207	**NUT**, 7/16"-20 thread (Seez-proof) . . . . For manifold to cylinder heads.	4		1
431	PE-3	**LOCKWASHER**, 1/4" spring lock..... 2-for fuel pump adapter. 8-for flywheel screen. 26-for air shrouding. 4-for control panel. 1-for distributor clamp. 4-for mounting voltage regulator. 1-for heat defl. bracket (L.H. side). 1-for oil tube clamp (V-465D). 4-for cyl. hold down clips (V-465 D).	51		1
432	PE-4	**LOCKWASHER**, 5/16" spring lock..... 4-for air cleaner strap to shroud. 16-for oil pan. 4-for air shroud to gear cover. 18-for gear cover and spacer to case. 2-for fuel pump mounting. 2-for carburetor mounting. 6-for bearing ret. plate — flywheel end. (Continued)	68		1
		1-for brg. plate and (obsolete) collet coupling adapter. 1-for governor oil spray elbow. 1-for generator adjusting strap bracket. 8-for rocker arm bracket mounting. 2-for generator mounting screws. 2-for generator adjusting strap. 1-for oil press. red. valve. 1-for ignition coil clamp.			
433	PE-5	**LOCKWASHER**, 3/8" spring lock ..... 6-for main bearing plate — T.O. end. 3-for starting motor mounting.	9		1
433	PE-80-A	**LOCKWASHER**, 3/8" internal tooth . . . For air shroud to gear cover.	2		1
434	PE-37	**LOCKWASHER**, 5/8" Positive..... For engine supports to crankcase.	4		1
435	PE-46	**LOCKWASHER**, 5/16" external tooth 3-for mounting camshaft gear. 2-for generator bracket.	5		1
436	PE-75	**LOCKWASHER**, 5/16" IET..... For coil clamp and ground wire.	1		1
437	PF-18	**PIPE PLUG**, 1/8" slotted, steel . . . . 2-for upper oil header. 1-for oil pump lockscrew hole. 4-for lower oil header. 1-for oil line fitting in case.	8		1
438	XK-3	**PIPE PLUG**, 3/8" square head..... For timing hole in gear cover.	1		1
439	PH-14	**WASHER**, 5/16" I.D. x 19/32" O. D., plain, copper..... For spacer plate to case, upper R.H.	1		1
440	PH-22-A	**WASHER**, 3/8" I.D. x 11/16" O.D. x 3/32" thick, plain, hardened steel . . . For cyl. head at Hi-temperature switch.	1		1
441	PH-30	**WASHER**, 1/4" I.D., plain, copper..... For fuel pump heat shield.	1		1
442	PH-77-A	**WASHER**, 5/16" I.D. x 5/8" O. D., plain, steel..... 1-for generator adjusting strap. 2-for generator bracket mounting.	3		1
442 A	PH-79	**WASHER**, 7/16" I.D. (hardened)..... For center **shell bearing** hanger mtg.	2		1
443	PH-84	**WASHER**, 1/4" I.D. x 1/2" O.D. x 1/16" thick steel..... 4-for cylinder shrouds to air shroud. 2-for R.H. cylinder shroud to case. 1-for cylinder shroud clip to pump. 4-for voltage regulator mounting. 1-for Delco-Remy distr. clamp.	12		1
444	PH-513	**WASHER**, 13/32" I.D. x 13/16" O.D. x 1/8" thick, steel, hardened..... For cylinder head mounting.	15		1
446	RF-794	**PIPE NIPPLE**, 1/8" x 3/4" long..... For fuel strainer mounting.	1		1

INTERCHANGEABLE PARTS for Models V-465D and V-460D, V-461D

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
447	SA-13	PLUG, 3/4" expansion For oil pressure relief valve.	1		1
448	SA-58	PLUG, 1-3/8" expansion For camshaft end hole.	1		1
449	XA-33	SCREW, 1/4"-20 thread x 3/8" long, indented hexagon head 8-for flywheel screen. 3-for heat deflectors to case. 4-for cylinder shroud to heat deflectors 4-for heat deflectors to shroud. 4-for cylinder shroud to air shroud. 4-for control panel. 1-for heat defl. brxt. (L.H side).	28		1
450	XA-34	SCREW, 1/4"-20 thread x 1/2" long. Indented hexagon head 2-for R.H. cylinder shroud to case. 1-for all tube clamp (V-465D).	3		1
451	XA-67	SCREW, No. 4 x 1/4" long stove-head, self-tapping sheet, metal For mounting name plate.	4		1
452	XA-74	SCREW, 1/4"-20 thread x 2-1/4" long, steel round head (2 req'd. for V-461 D). For air cleaner strap clamp.	3		1
455	XD-7	SCREW, 1/4"-20 thread x 1" long, hexagon head 4-for cylinder hold down clips. 1-for Delco-Remy distr. clamp.	5		1
455A	XD-4	SCREW, 1/2" long, for Prestolite clamp			1
456	XD-8	SCREW, 1/4"-20 x 1-1/4" long, hex. hd. For Delco-Remy voltage regulator mtg	4		1
	XD-9	SCREW, 1/4"-20 X 1-1/2" long For Prestolite regulator mtg.			1
457	XD-13	SCREW, 5/16"-18 x 1/2" long, hex. hd. For generator bracket.	2		1
458	XD-172	SCREW, 5/16"-18 thread x 1/2" long, 1/8" thick, hexagon head For flywheel shroud to gear cover. XD-13-1, replaced by XD-172.	4		1
459	XD-14	SCREW, 5/16"-18 x 5/8" long, hex. hd. 16-for oil pan. 2-for fuel pump mounting. 4-for cleaner strap mounting. 4-for spacer plate to case. 1-for oil pressure red valve.	27		1
460	XD-15	SCREW, 5/16"-18 x 3/4" long hex. hd. 3-for generator adjusting strap. 2-for spacer plate to gear cover. 6-for bearing retainer plate - fan end.	11		1
461	XD-16	SCREW, 5/16"-18 thread x 7/8" long, hexagon head for coil clamp	1		1
462	XD-14	SCREW, 5/16"-18 x 5/8" long, hex. hd. For RF-1514 gov. oil spray elbow.	1		1
		XD-17 (1" long) for obsolete RF-1375A gov. oil spray elbow			1
462A	XD-17-B	SCREW, 5/16"-18 thread x 7/8" long, hexagon head (S.A.E. grade 5) 2-for generator to bracket. 8-for upper to lower manifold.	10		1
463	XD-19	SCREW, 5/16"-18 thread x 1-1/4" long, hexagon head 3-for camshaft gear. 8-for gear cover to crankcase.	11		1
464	XD-21	SCREW, 5/16"-18 thread x 1-1/2" long, hexagon head For (obsolete) collet coupling adapter.	1		1
465	XD-22	SCREW, 5/16"-18 thread x 1-3/4" long, hexagon head For gear cover mounting.	2		1
466	XD-29	SCREW, 3/8"-16 thread x 1-1/4" long, hexagon head 6-for main bearing plate — T.O. end. 3-for starter motor mounting.	9		1
467	XD-52	SCREW, 5/ thread x 1-3/4" long, hexagon head For mounting engine supports.	4		2
468	XD-130	SCREW, 7/16"-14 thread x 2-1/4" long, hexagon head (S.A.E. grade S) For shell bearing hanger to case.	2		2
468A	XD-83	SCREW, 7/16"-14 x 3" long, hex. hd. For obsolete roller type center bearing 2-for center bearing cap to hanger. 2-for center bearing hanger to case. Replaces XD-146(2-3/4" long) but add 2 HF-627 spacers (hanger to case).	4		1
468B	XD-162	SCREW, 5/16"-18 thread x 2-1/2" long, hexagon head (S.A.E. grade 8) Upper to lower manifold (c'tr. flange). FC-171 studs, replaced by XD-162.	2		2
469	XD-171	SCREW, 3/8"-16 x 1/2" long, hex. hd. For flywheel shroud to gear cover. XD-114-1, replaced by XD-171.	2		1
470	XD-176	SCREW, 3/8"-16 thread X 2-1/2" long, hexagon head (S.A.E. grade 8) For center shell bearing cup to hanger.	2		2
471	XD-175	SCREW, 1/4"-20 x 7/8" long, hex. hd. For fuel pump adaptor mounting.	2		1
472	XE-55	SCREW, 5/16"-18 thread x 3/8" long, Allen head set For locking idler stud.	2		1
473	XK-1	PIPE PLUG, 1/8" square head 1-for upper header on case face. 1-for inlet manifold tap.	2		1
474	- - -	KEY, No. 5 Woodruff Furnished with generator.	1		1
475	PB-190	DOME BOLT, fuel pump, ¼"-28 x 1¼" lg. For heat shield support. (Replaces bolt furnished with pump)	1		1

FIG. B-83. FUEL STRAINER ASSEMBLIES

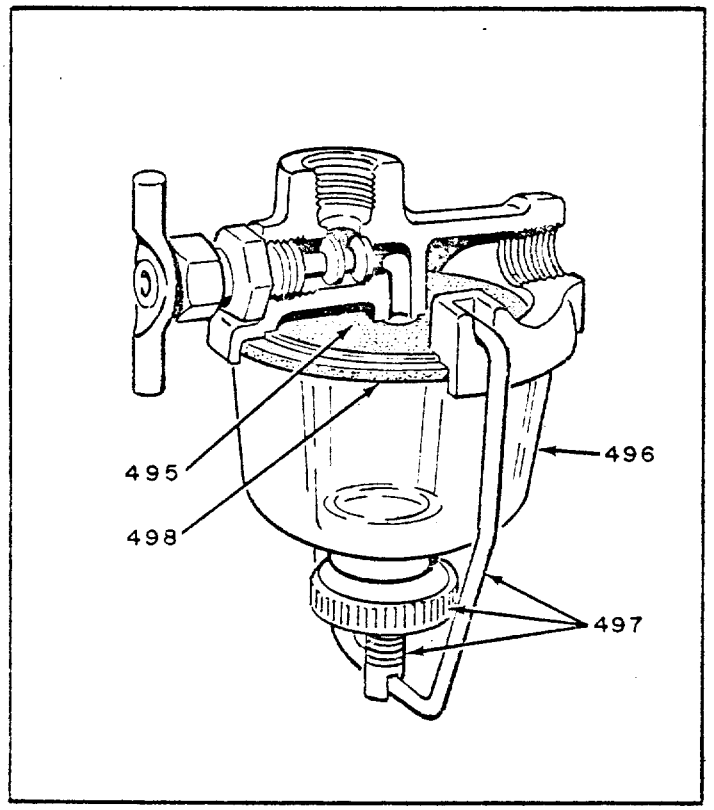
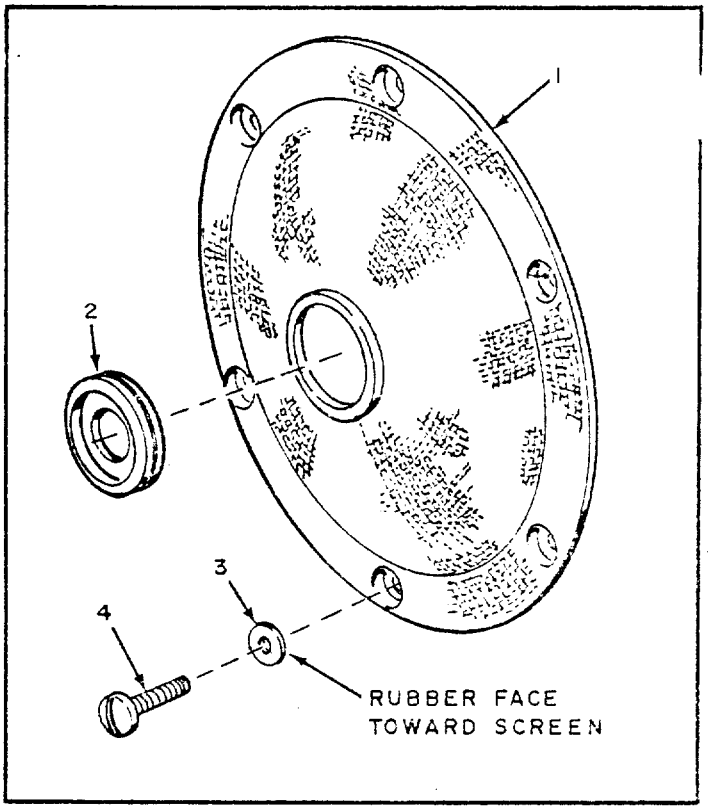


FIG. B-84. ROTATING SCREEN



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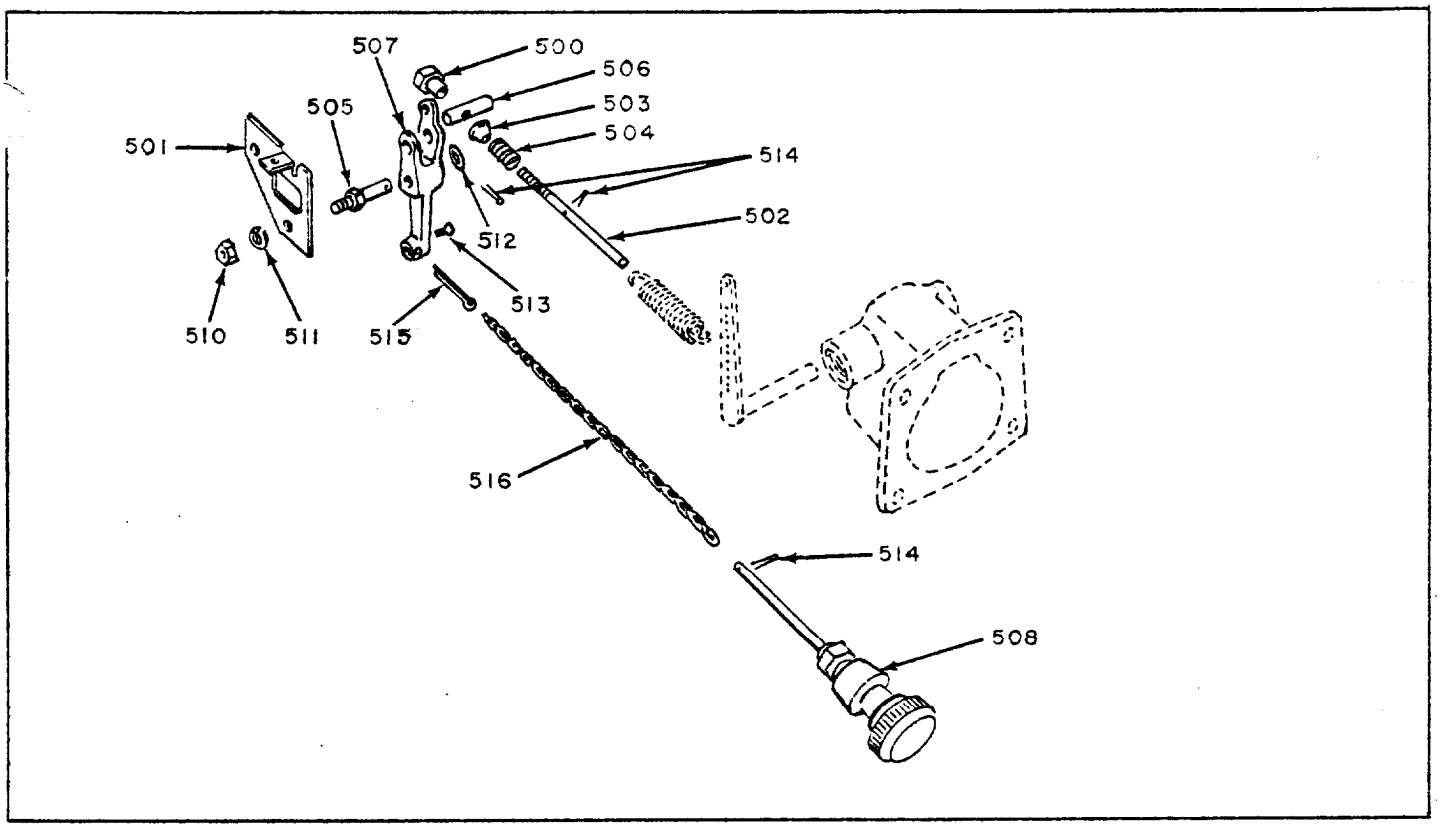
Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb	Net Wt. Oz
	LP-19	FUEL STRAINER ASSEMBLY ..... (With shut-off valve in cover, and glass bowl). Tillotson No. OW-418-T.	1		8
	LP-19-A	FUEL STRAINER ASSEMBLY .... (With shut-off valve in cover, and metal bowl). Tillotson No. OW-449-T.	1		7
	LP-19-B	FUEL STRAINER ASSEMBLY ... (Without shut-off valve in cover, and glass bowl). Tillotson No. OW-444.	1		6
	LP-19-C	FUEL STRAINER ASSEMBLY ..... (Without shut-off valve in cover, and metal bowl). Tillotson No. OW-476-T.			
		The following serviceable parts are interchangeable for all the above fuel strainers.			
495	*	FILTER SCREEN	1		1
496	*	GLASS BOWL	1		2
	75-06137	METAL BOWL	1		1
497	75-OW-447	CLAMP WIRE and THUMB NUT ASSEMBLY	1		1
498	*	BOWL GASKET (Wisconsin No. O D-653)	1		1
	LQ-32	GLASS BOWL REPAIR KIT			
		* Parts included in LQ-32 Repair Kit.			

Ref. No.	Part Number	Description	No. Req.	Net Wt. Lb	Net Wt. Oz
		PER SK-1334			
1	SE-205A-S2	ROTATING SCREEN ASSEMBLY ..... Consisting of:	1	3	8
2		PH-426 Grommet	1		1
3		PH-442 Washers	6		1
		SE-205-A Screen	1	3	
4		XA-104 Lok-Thread screws . .	6		1
		THE FOLLOWING REPLACE STANDARD PARTS:			
	NC-194-1-S1	FLYWHEEL ASSEMBLY ..... Includes GH-43 Ring Gear and tapped holes for mounting rotating screen.	1		
	U-226-A	STARTING CRANK ASSEMBLY	1		

FIG. B-85. TT-90 VARIABLE SPEED GOVERNOR CONTROL ASSEMBLY



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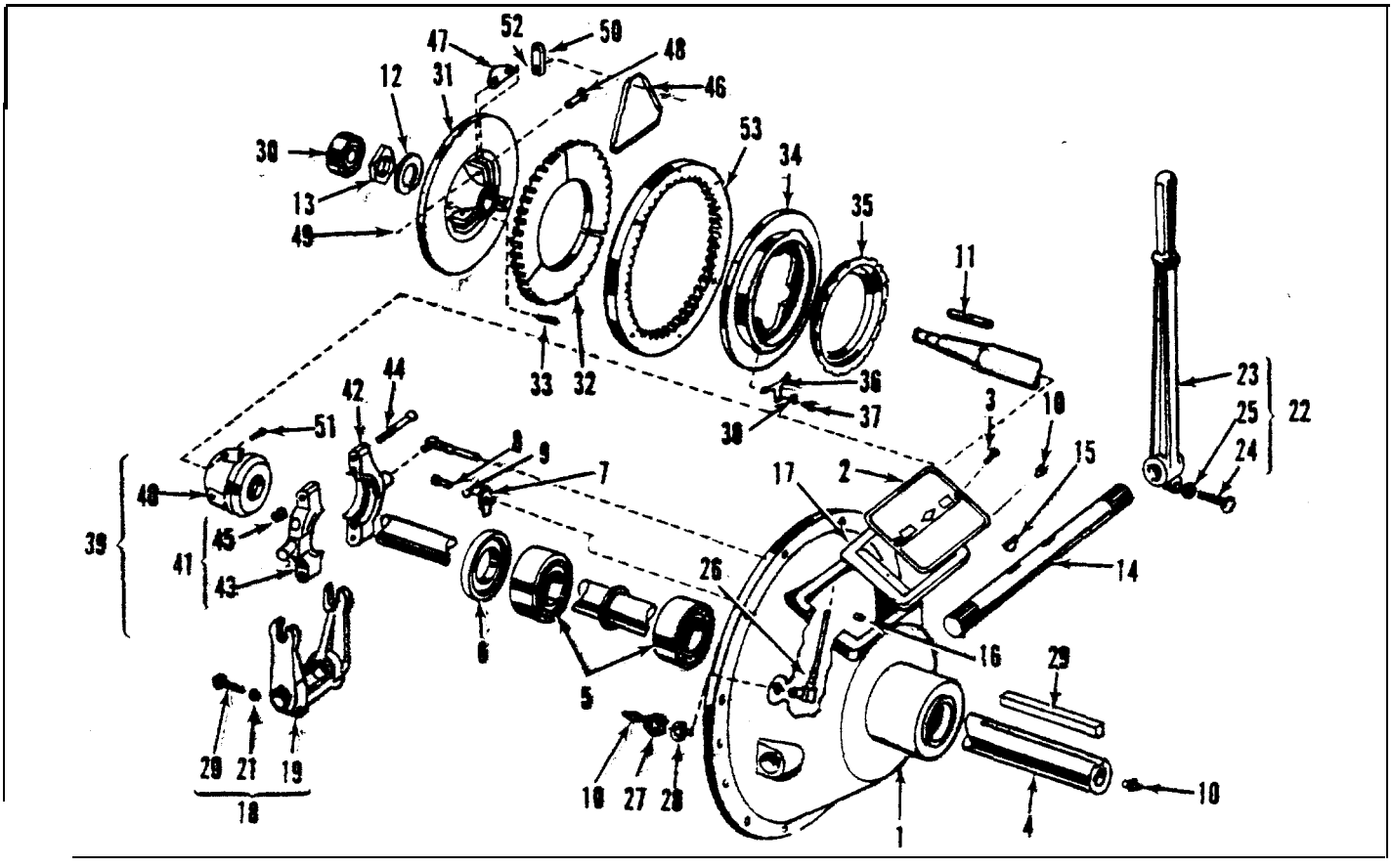
Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
500	PD-173-A	**LOCKNUT** for adjusting screw ..... (Part of standard engine. Not part of this assembly.)	1		1
501	PG-914-A	**BRACKET** for control lever	1		4
502	PI-145-3	**ADJUSTING SCREW,** 6-3/4" long	1		2
503	PK-121	**RETAINER** for adjusting screw spring	1		1
504	PM-111	**SPRING** for adjusting screw	1		1
505	TC-365-F	**FULCRUM PIN** for lever support	1		1
506	TC-368-G	**PIN** for adjusting screw swivel	1		1
507	VB-134-D	**VARIABLE SPEED LEVER**	1		4
508	VE-527-W	**CONTROL**	1		8

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
		STANDARD HARDWARE			
510	PD-77	**NUT,** 1/4"-20 thread, hexagon steel ..... For fulcrum pin to bracket.	1		1
511	PE-3	**LOCKWASHER,** 1/4" Positive ..... For fulcrum pin to bracket.	1		1
512	PH-77-A	**PLAIN WASHER,** 5/16" I.D. x 5/8" O.D. x 1/16" thick steel ..... For variable speed lever.	1		1
513	XA-80	**SCREW,** 8-32 thread x ¼" lg., round hd. For cotter pin in lever.	1		1
514	XI-1	**COTTER PIN,** 1/16" x 1/2" long ..... 1-for variable speed lever pin. 1-for adjusting screw spring. 1-for chain at control.	3		1
515	XI-7	**COTTER PIN,** 3/32" x 3/4" long ..... For chain at lever.	1		1
516	PN-100-26	**No. 1/0 GALVANIZED SAFETY CHAIN** 26 links long. For control to lever.	1 pc		2

FIG. B-86. No. WC-328-A POWER TAKE-OFF ASSEMBLY



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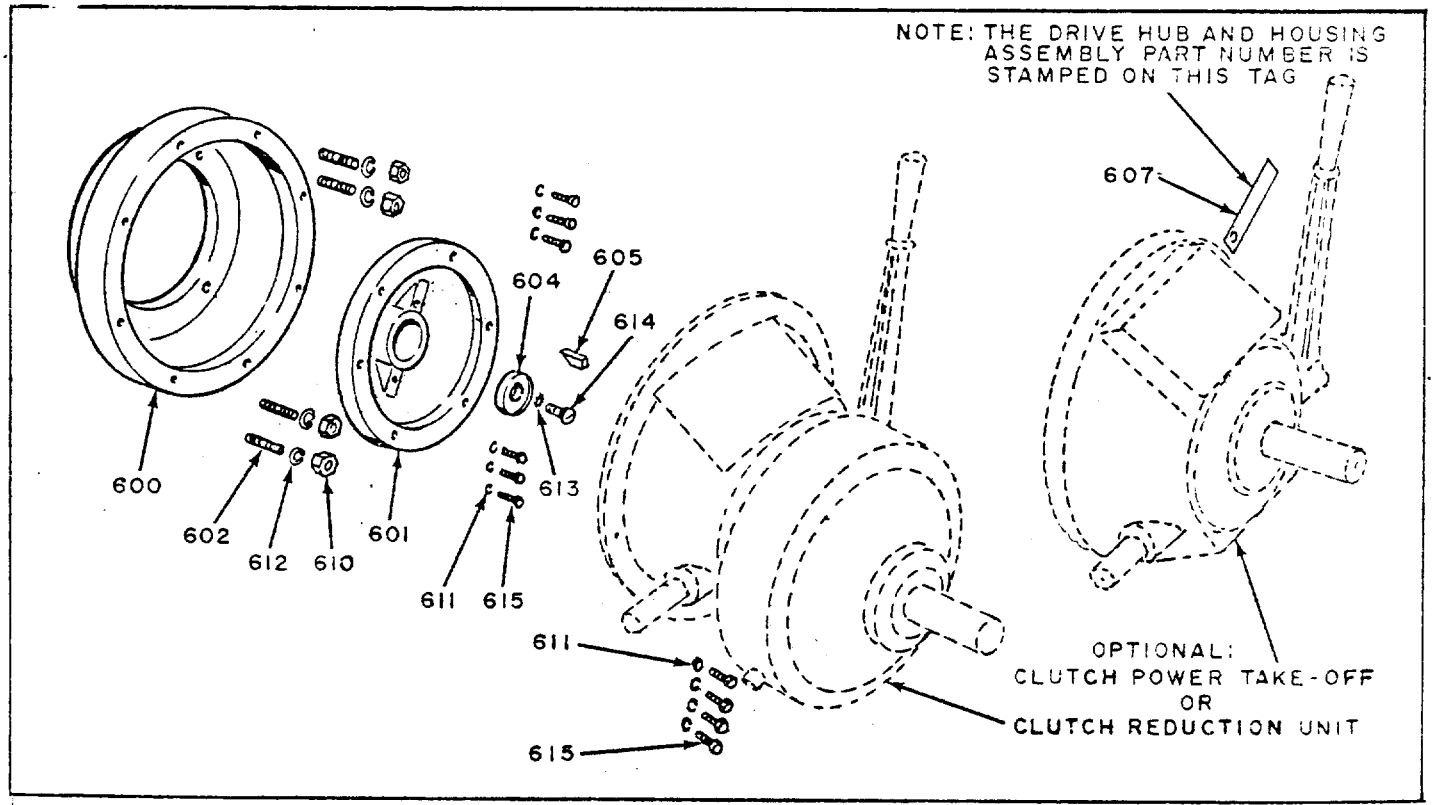
NOTE: Code number 63, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req.
	63-PTA-4M141	**10 USING ASSEM.** less clutch (PTA-4856) 63-PTA-4M56 (PTA-4819). Consisting of:	1
1	63-PT-300-30	**HOUSING,** No. 4 S.A.E. (PTA-4856).. 63-PT-300-19 (PTA-4819).	1
2	63-PT-1593	**INSTRUCTION PLATE**	1
3	63-PT-347	**SCREW,** 1/4"-20 x 3/8" rd. hd. instr. plate	2
4	63-PT-1068	**DRIVE SHAFT**	1
5	ME-188	**MAINBEARING**	2
6	63-PT-1059	**BEARING RETAINER**	1
7	63-PT-44	**LOCKPLATE**	1
8	63-PT-349	**SCREW,** 5/16"-18 x 1/2", hex. lock plate	1
9	63-PT-350	**LOCKWASHER,** 5/16", for lock plate	1
10	63-PT-1012	**GREASE FITT.** (1 in shaft of PTA-4819)	2
	63-PT-989	**PIPE PLUG,** 1/8" (in shaft of PTA-4856)	1
11	63-PT-808-1	**DRIVE KEY**	1
12	63-PT-718-1	**LOCKWASHER** for clutch body	1
13	63-PT-706	**NUT** for clutch body	1
14	63-PT-200	**YOKE SHAFT**	1
15	63-PT-351	**KEY** for yoke, No. 15 Woodruff	2
16	63-PT-744	**SET SCREW,** 5/16"-18 x 1/4" flat point. For grease hole plug.	1
17	63-PT-770	**GASKET** for instruction plate	1
18	63-UPT-81	**CLUTCH YOKE ASSEM.** Consisting of:	1
19		CLUTCH YOKE	1
20	63-PT-352	SCREW, 3/8"-16 x 1¼" hexagon head	2
21	63-PT-353	LOCK WASHER, 3/8"	2
22	63-UPT-769	**SHIFTER LEVER ASSEM.** Consisting of:	1
23		SHIFTING LEVER	1
24	63-PT-604	SCREW, 3/8"-16 x 1½" hexagon head	1
25	63-PT-353	LOCKWASHER, 3/8"	1
26	63-PT-1026-3	**GREASE TUBE ASSEMBLY**	1
27	63-CL-4355	**JAM NUT,** 5/8"-18, for grease tube	1
28	63-PT-359	LOCKWASHER, for jam nut	1
29	63-PT-1001	**KEY** (for take-off shaft), 1/4" sq. x 1-7/8"	1
30	ME-203	**PILOT BEARING,** sealed (PTA-4856) ME-192 (PTA-4819)	1
	63-CLA-2175-35	**CLUTCH ASSEMBLY, 8" Model HE** Consisting of:	1
31	63-CL-8512-10	CLUTCH BODY	1
32	63-CL-7039-1	FACING, Amco No. 796 (Set of 3 segs.)	1
33	63-CL-8575	SEPARATOR SPRING	3
34	63-CL-8513-1	PRESSURE PLATE	1
35	63-CL-8515-1	ADJUSTMENT NUT	1
	63-CL-11905	**ADJUSTMENT NUT PLATE** (not illust.)	1
36	63-CL-9216	ADJUSTMENT LOCK	1
37	63-CL-8807-1	SCREW for adjustment lock	1
38	63-CL-3468	LOCKWASHER for adjustment lock.	
39	63-UCL-4-8611-1	**RELEASE SLEEVE and BEARING ASSEM.** Consisting of:	1
40	63-CL-8611-1	RELEASE SLEEVE	1
41	63-UCL-7-7392	RELEASE BEARING ASSEMBLY Consisting of:	1
42		BEARING HALF (not serviced sep.)	1
43		BEARING HALF (not serviced sep.)	1
44	63-CL-3335-1	SCREW, 5/16"-24 x 1¼" hexagon head	2
45	63-CL-7356	ELASTIC STOP NUT, 5/16"-24 thread	2
46	63-CL-9464	**LEVER SPRING SET**	1
47	63-CL-8556-1	LEVER	3
48	63-CL-8484	CLEVIS PIN for lever to body	3
49	63-CL-7107	RETAINING RING for lever clevis pin	3
50	63-CL-8557	CONNECTING LINK	6
51	63-CL-8400	CLEVIS PIN for connecting link	6
52	63-CL-7130	RETAINING RING for link clevis pin	6
53	63-CL-6965	DRIVING RING	1

FIG. B-87. WW-165 DRIVE HUB AND HOUSING ASSEMBLY FOR CLUTCH POWER TAKE-OFF AND CLUTCH REDUCTION UNITS



The above assembly is suitable for mounting the following Clutch Power Take-Off and Clutch Reduction Units. 229451C-A

WISCONSIN MOTOR PART NUMBER	MANUFACTURER'S PART NUMBER	DESCRIPTION	REDUCTION RATIO	ROTATION AT TAKE-OFF SHAFT
WC-328-A	ROCKFORD **PTA-4856**	Clutch Power Take-Off	- - - -	Enginewise
WC-329	ROCKFORD **GRA-4812**	Clutch Reduction Unit	**2.77 to 1**	Counter-Enginewise
WC-330	ROCKFORD **GRA-4813**	Clutch Reduction Unit	**2.00 to 1**	Counter-Enginewise
WC-360	TWIN DISC **C108-E3.6-RG4**	Clutch Reduction Unit	**3.60 to 1**	Enginewise

REFER TO ROCKFORD OR TWIN DISC ILLUSTRATIONS FOR PARTS LIST OF CLUTCH POWER TAKE-OFF AND CLUTCH REDUCTION UNITS.

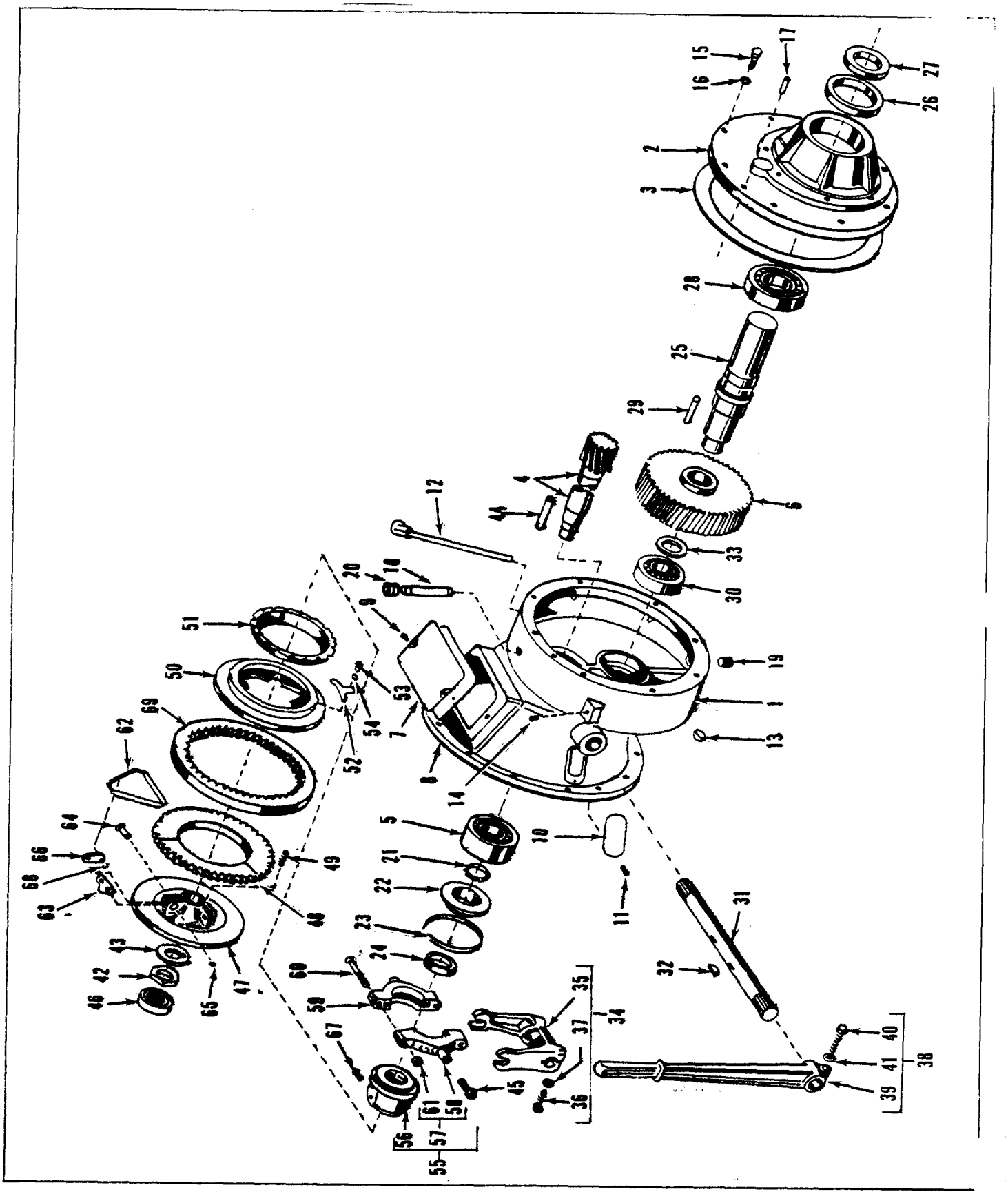
NOTE: Engines equipped with a Clutch Power Take-Off or Clutch Reduction Unit require a special crankshaft, **CA-75-1-S1.**

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
	WW-165	**DRIVE HUB** and **HOUSING ASSEMBLY** Consisting of the following parts:			
600	**BO-205**	**HOUSING** for drive hub (No. 4 S.A.E.) ..	1	40	
601	**NC-163-2**	**DRIVE HUB**	1	15	
602	**PC-464**	**STUD** for housing to crankcase mounting	4		3
604	**PH-489**	**RETAINER** for drive hub	1		2
605	**PL-150-1**	**KEY** for drive hub	1		1
607	**SD-79-B**	**ASSEMBLY NUMBER TAG**	1		1
		STANDARD HARDWARE			
610	**PD-15**	**NUT**, 5/8"-18 thread, hexagon steel .... For mounting housing to crankcase.	4		1

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
611	**PE-5**	**LOCKWASHER**, 3/8" Positive ..... 6-for mounting clutch to drive hub. 12-for mounting unit to housing. (Not part of WW-165 Assembly.)	18		1
612	**PE-37**	**LOCKWASHER**, 5/8" Positive ..... For mounting housing to crankcase.	4		1
613	**PE-86**	**LOCKWASHER**, 1/2" Countersunk ..... For mounting hub retainer.	1		1
614	**XC-59**	**SCREW**, 1/2"-13 thread x 1-1/4" long, socket flat head ..... For mounting hub retainer.	1		1
615	**XD-29**	**SCREW**, 3/8"-16 thread x 1-1/4" long, hexagon head ..... 12-for mounting unit to housing. 6-for mounting clutch to drive hub. (Not part of WW-165 Assembly.)	18		1
	RF-1096	**ELBOW** for checking oil press. (not illustrated) in oil header, upper crankcase face.			

FIG. B-88. CLUTCH REDUCTION UNIT ASSEMBLIES

No's. WC-329 and WC-330,
Adaptable to WW-165 Drive Hub and Housing Assembly



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Parts are identified by reference number. See parts list for correct part number.

CLUTCH REDUCTION UNIT ASSEMBLIES

ROCKFORD PART NO.	WISCONSIN PART NUMBER	REDUCTION RATIO
GRA-4812	WC-329	2.77 to 1
GRA-4813	WC-330	2.00 to 1

PARTS LIST

NOTE: Code number 63, prefixed to the part number is a vendor identification. When ordering parts, please use number with code as shown.

Rockford Assembly No. (with Clutch)	Rockford Assembly No. (less Clutch) Ref. No. 1 to 46	REF. No. 1 Housing	REF. No. 2 Cover	REF. No. 3 Cover Gasket	REF. No. 4 Drive Gear and Shaft	REF. No. 5 Drive Shaft Bearing	REF. No. 6 Driven Gear
GRA-4812	GRA-4M12	* GR-851	* GR-101-3	63-GR-111	63-GR-852-1 (18 teeth)	ME-200 (was GR-856)	63-GR-853 (50 teeth)
GRA-4813	GRA-4M13	* GR-851	* GR-101-3	63-GR-111	63. GR-852-2 (23 teeth)	ME-200 (was GR-856)	63-GR-853-2 (46 teeth)

* Not serviced individually — order 63- UGR- 1-851 Housing and Cover Assembly.

THE FOLLOWING PARTS ARE IDENTICAL FOR THE ABOVE ASSEMBLIES EXCEPT WHERE NOTED

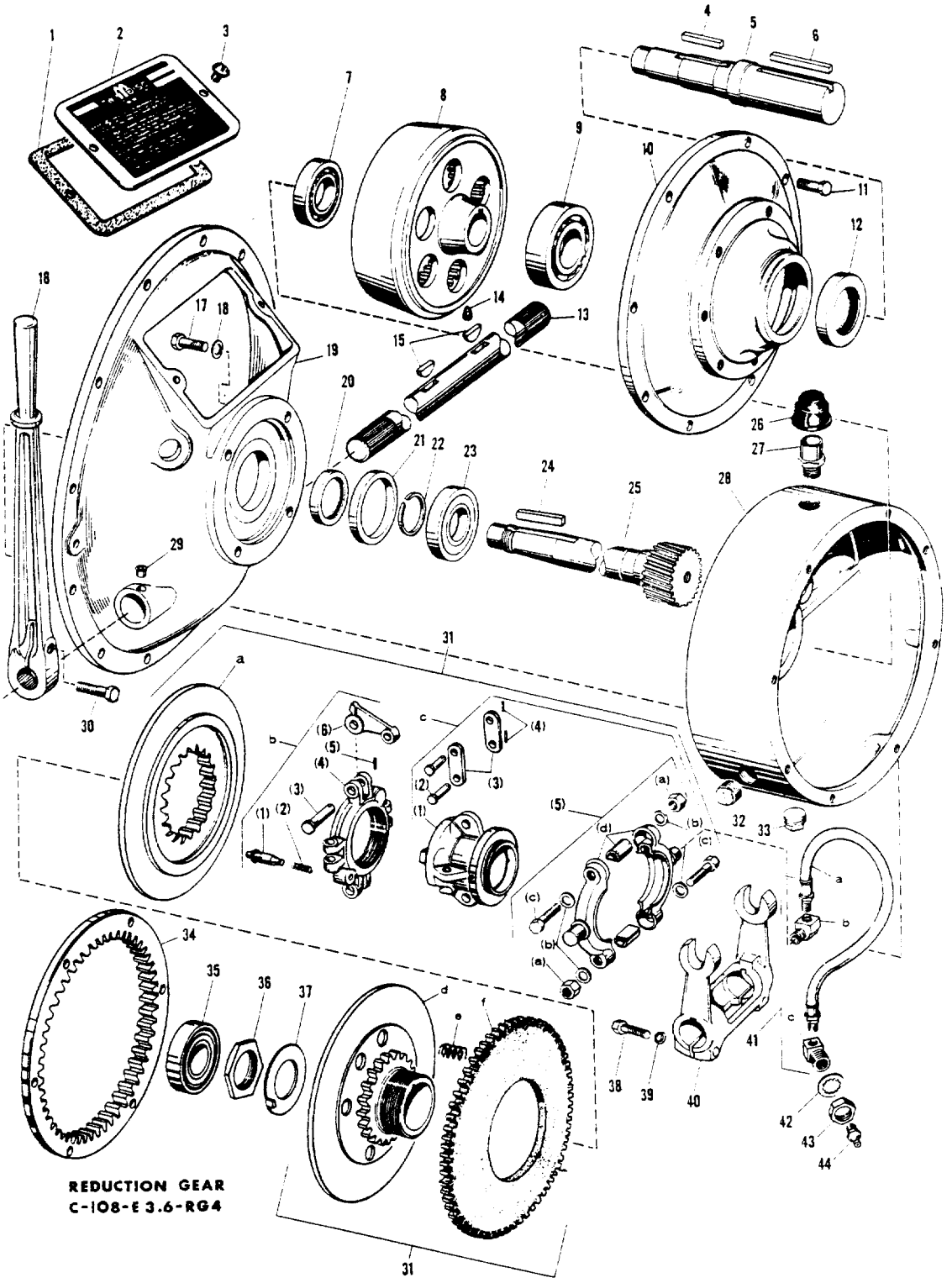
Ref No	Part Number	Description	No. Req
7	63-PT-1593	INSTRUCTION PLATE	1
9	63-PT-347	SCREW, 1/4"-20 x 3/8" round head For instruction plate.	2
10	63-PT-819	LUBRICATION COVER (when specified)	1
11	63-PT-576	SCREW, No. 10-24 x 3/8" round head For lubrication cover, (on older models)	1
13	63-GR-117	OIL LEVEL PLUG, 3/8" P.T.	1
15	63. PT-469	SCREW, 3/8"-16 x 1" hexagon head For mounting cover to housing.	8
16	63-PT-353	LOCKWASHER, 3/8", for cover to housing	8
17	63-GR-114	DOWEL PIN, 3/8" x 1" long	1
18	63-GR-753	OIL FILLER, 3/8" pipe nipple	1
19	63-GR-117	OIL DRAIN PLUG, 3/8" P.T.	1
20	63-GR-236	CAP for oil filler pipe	1
21	63-PT-189	SNAP RING for drive shaft bearing	1
22	63-GR-855	SEAL RETAINER for drive shaft	1
23	63-GR-243	SNAP RING for bearing, in housing	1
24	63-GR-758	OIL SEAL for drive shaft	1
25	63-GR-854	OUTPUT SHAFT	1
26	63. GR-105	SEAL RETAINER for output shaft	1
27	63-GR-232-2	OIL SEAL for output shaft	1
28	ME-199	BEARING for output shaft (was GR-762)	1
29	63-GR-106	KEY for driven gear	1
30	ME-201	BEARING for output shaft [was GR-857)	1
31	63-PT-200	YOKE SHAFT	1
32	63. PT-351	KEY for yoke, No. 15 Woodruff	2
33	63-GR-877	WASHER for driven bear	1
34	63-UPT-811	CLUTCH YOKE ASSEMBLY Consisting of:	1
35		CLUTCH YOKE	1
36	63-PT-352	SCREW, 3/8"-16 x 1½" hexagon head	2
37	63-PT-353	LOCKWASHER, 3/9"	2
38	63-UPT-769	SHIFTER LEVER ASS EMBLY. Consisting of:	1
39		SHIFTER LEVER	1
to 41	63-PT-604 / 63-PT-353	SCREW, 3/8"-16 x 1½" hexagon head .... / LOCKWASHER, 3/8"	1
42	63-PT-706	NUT for clutch body	1

Ref. No.	Part Number	Description	No. Req
43	63-PT-718-1	LOCKWASHER for clutch body	1
44	63-PT-808-1	DRIVE KEY	1
45	63. PT-1060	GREASE FITTING for release bearing, Lincoln No. 5007	1
46	ME-202	PILOT BEARING (was GR-862)	1
	63-CLA-2175-7A	CLUTCH ASSEMBLY, 8" MODEL HE Consisting of: cf. No. 47 to 69	1
47	63-CL-8512-10	CLUTCH BODY	1
48	63-CL-7039-1	FACING, Amco No. 796 (3 segments)	1
49	63-CL-8575	SEPARATOR SPRING	3
50	63-CL-8513-1	PRESSURE PLATE	1
51	63-CL-8515-1	ADJUSTMENT NUT	1
	63-CL-11905	ADJUSTMENT NUT PLATE (not List.)	1
52	63-CL-9216	ADJUSTMENT LOCK (replaces CL-8516)	1
53	63-CL-8807-1	SCREW, 1/4"-20 x 3/8" hexagon head For adjustment lock, (replaces CL-3917-1)	1
54	63-CL-3468	LOCKWASHER, 1/4" Shakeproof For adjustment lock.	1
55	63-UCL-3-8611-1	RELEASE SLEEVE and BEARING ASSEMBLY. Consisting of:	1
56	63-CL-8611.1	RELEASE SLEEVE	1
57	63. UCL-4-7392	RELEASE BEARING ASSEMBLY. Consisting of:	1
58		BEARING HALF (not serviced sep.)	1
59		BEARING HALF (not serviced sep.)	1
60	63-CL-3335-1	SCREW, 5/16"-24 x 1¼" hexagon head	2
61	63-CL-7356	ELASTIC STOP NUT, 5/16"-24 thread	2
62	63-CL-9464	LEVER SPRING SET	1
63	63. CL-8556-1	LEVER	3
64	63-CL-8484	CLEVIS PIN for lever to body	3
65	63-CL-7107	RETAINING RING for lever clevis pin	3
66	63-CL-8557	CONNECTING LINK	6
67	63-CL-8400	CLEVIS PIN for connecting link	6
68	63-CL-7130	RETAINING RING for link clevis pin	6
69	63-CL-6965	ORIVING RING	1
	63-GR-230	KEY for output shaft (not illustrated)	1

FIG. B-89. CLUTCH REDUCTION UNIT ASSEMBLY

WISCONSIN No. WC-360 – TWIN DISC No. C108-E3.6-RG4

Adaptable to WW-165 Drive Hub and Housing Assembly



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Parts are identified by reference number. See parts list for correct part number.

TWIN DISC CLUTCH REDUCTION UNIT ASSEMBLY

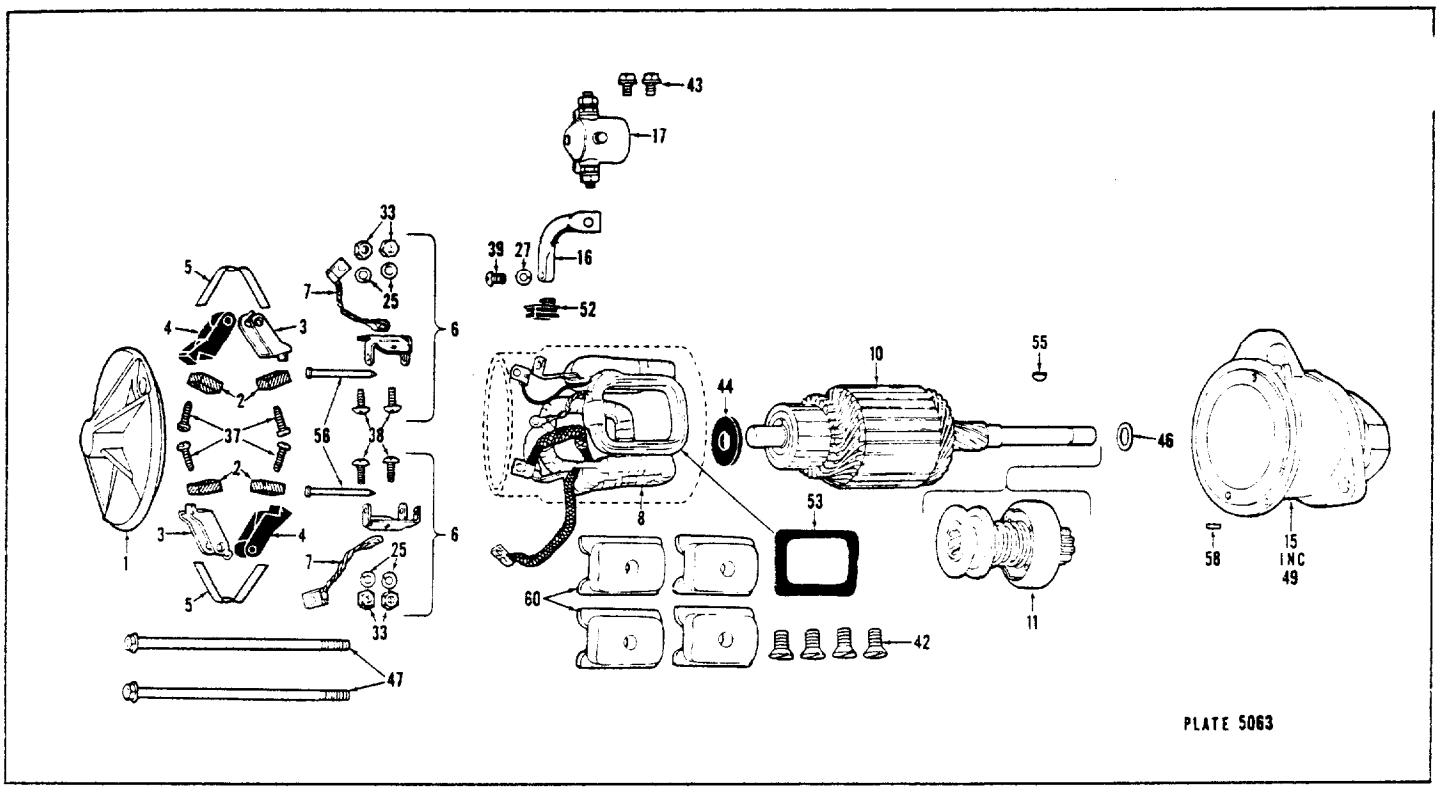
TWIN DISC PART NO.	PART NO.	REDUCTION RATIO	ROTATION
C-108-E3.6-RG4	WC-360	3.6 to 1	Enginewise

PARTS LIST

NOTE: Code number 78, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req.
1	78-A1339	GASKET, plate, specification	1
2	78-1965R	PLATE, specification	1
3	78-M2023F	SCREW, cap, button-head, 1/4-20 x 1/2	2
4	78-M2032AZ	KEY, 3/8 x 3/8 x 1-5/8	1
5	78-A3115	SHAFT, counter	1
6	78-M2033T	KEY, 1/2 x 1/2 x 2-7/8	1
7	78-M166	BALL BEARING	1
8	78-A5001	GEAR, internal, shaft, counter	1
9	78-M178	BALL BEARING	1
10	78-8533	PLATE, cover	1
11	78-M2002U	SCREW, cap, hex-head, 3/8-16 x 1	8
12	78-M510	SEAL, oil, shaft, counter	1
13	78-2757	SHAFT, operating	1
14	78-M2039J	SETSCREW, half-dog-point, 1/2-13 x 3/4	1
15	78-M2022Z	KEY, Woodruff #15	2
16	78-3799	LEVER, hand	1
17	78-M2006H	SCREW, cap, hex-head, 5/8-11 x 1-1/2	4
18	78-M2046AF	WASHER, lock, 5/8-inch	4
19	78-7583	HOUSING, clutch	1
20	78-M105B	SEAL, oil, shaft, clutch	1
21	78-2510	SPACER	1
22	78-2923	RING, snap	1
23	78-M171	BALL BEARING	1
24	78-M2032X	KEY, 1/4 x 1/4 x 1-7/8	1
25	78-A3113	SHAFT, clutch (and pinion)	1
26	78-M639B	BREATHER, oil	1
27	78-2830A	PIPE, breather, oil	1
28	78-8531	HOUSING, gear	1
29	78-M503	FITTING, operating shaft (was M102 oil cup)	2
30	78-M2004R	SCREW, cap, hex-head, 1/2-13 x 3/4	1
31	78-XA5079	CLUTCH, C-108, assembly	1
a	78-A3169	PLATE, floating	1
b	78-A-60	YOKE, adjusting	1
(1)	78-2245	PIN, lock, adjusting	1
(2)	78-115	SPRING, pin, lock, adjusting	1
(3)	78-B1538D	PIN, lever, finger (was B1621D)	4
(4)	78-1990	YOKE, adjusting	1
(5)	78-B1535C	PIN, cotter (was M1927AD roll pin)	4
(6)	78-103F	LEVER, finger	4
c	78-S-385	SLEEVE, sliding, assembly	1
(1)	78-2137A	SLEEVE, sliding	1
(2)	78-B1537D	PIN, link, lever (was B1927D)	8
(3)	78-119B2	LINK, lever	8
(4)	78-B1535B	PIN, cotter (was M1927AB roll pin)	8
(5)	78-X117C8	COLLAR, split, assembly	1
(a)	78-M1930F	NUT, hex., 3/8-24	2
	78-120C8	SHIM	2
(c)	78-M2002BB	SCREW, cap, 3/8-24 (was M2002AS)	2
(d)	78-117C8	COLLAR, split (not serviced separately)	1
d	78-A3177	PLATE, hub-and-cock	1
e	78-1473	SPRING, release	6
f	78-6479	PLATE, driving	1
32	78-M2051AD	PLUG, pipe, square-head, 3/4-inch	1
33	78-M2051AD	PLUG, pipe, square-head, 3/4-inch	1
34	78-5805	RING, driving	1
35	78-M163	BALL BEARING, pilot	1
36	78-2727	NUT, hub	1
37	78-A1587	WASHER, lock	1
38	78-M2002AG	SCREW, cap, hex-head, 3/8-16 x 1-1/2	2
39	78-M2046S	WASHER, lock, 3/8-inch	2
40	78-1037	FORK, throwout	1
41	78-A1663	HOSE, flexible, assembly	1
a	78-M1292A	HOSE, flexible	1
b	78-M1284	FITTING, 90-degree	1
c	78-M1283	FITTING, straight	1
42	78-M2046AF	WASHER, lock, 5/8-inch	1
43	78-M2027AN	NUT, jam, 5/8-18	1
44	78-M268	FITTING, hydraulic, 1/8-inch	1

FIG. B-90. YA-42 (12 Volt) STARTING MOTOR

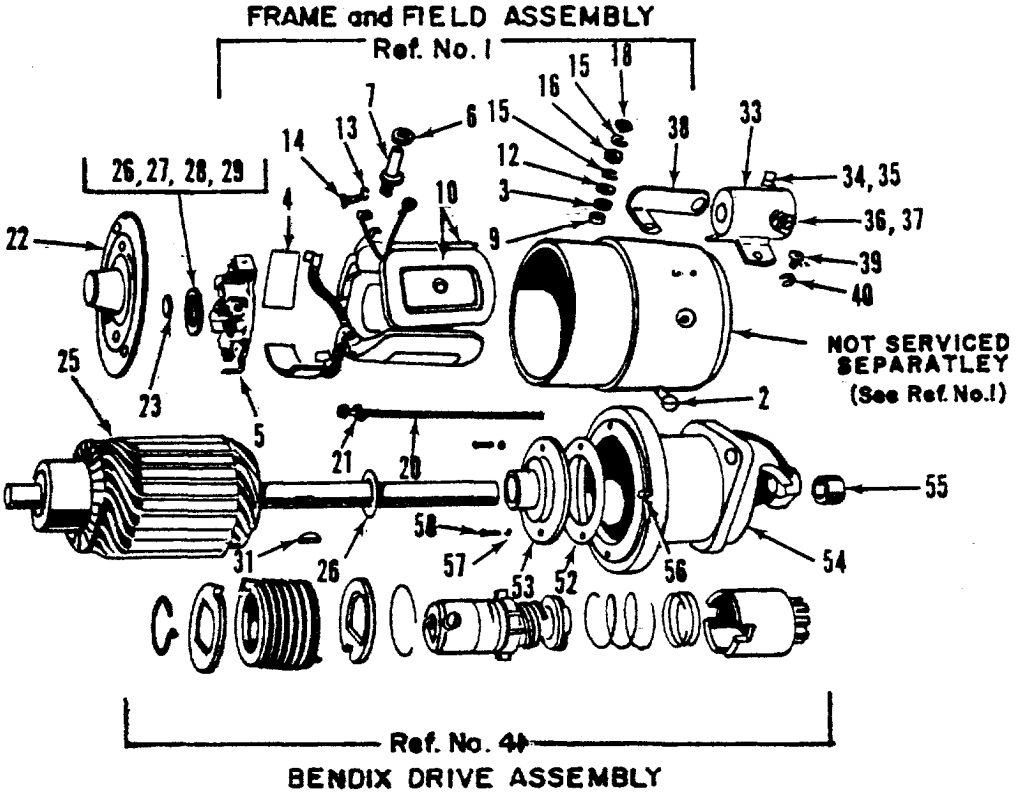


NOTE: Code number 18, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req.
1	18-1928966	FRAME, C.E. (Includes bushing)	1
2	18-1906945	BRUSH	4
3	18-1926617	BRUSH HOLDER [grounded]	2
4	18-1938587	BRUSH HOLDER (Insulated)	2
5	18-1926622	SPRING, brush	2
6	18-1928015	SUPPORT (pkg.) BRUSH HOLDER Includes Ref. Nos. 7, 25, 33, 38, 56.	2
7	18-1926605	LEAD, brush qround	2
8	18-1937548	FIELD COIL ASSEMBLY (4 coils)	1
10	18-1947996	ARMATURE	1
11	18-1958452	DRIVE ASSEMBLY (Service by complete replacement) use Eclipse 28-A3491.	1
15	18-1958451	DRIVE HOUSING, includes Ref. No. 49..	1
16	18-1935706	CONNECTOR, switch	1
17	18-1467	MAGNETIC SWITCH	1
25	18-453435	LOCKWASHER, brush support attaching screw	4
27	18-453435	LOCKWASHER, field lead attach. screw to connector	1
33	18-120361	NUT, brush support attaching screw	4
37	18-1926648	SCREW, brush attaching	4
38	18-274738	SCREW, brush support attaching	4

Ref, No.	Part Number	Description	No. Req,
39	18-453478	SCREW, field lead attach. to connector	1
42	18-1913960	SCREW, pole shoe	4
43	18-1917084	SCREW, Switch attaching	2
44	18-833602	WASHER, thrust - C.5.	1
46	18-1853917	THRUST WASHER, D.E..	1
47	18-1926625	THRU BOLT	2
49	18-810620	BUSHING, D.E. (not illustrated)	1
52	18-1926604	GROMMET (in field frame)	1
53	18-1927853	INSULATOR, field coil	4
55	18-124546	WOODRUFF KEY, D.E.	1
56	18-1926600	PIN, brush holder	2
58	18-809593	DOWEL PIN, D.E.	1
60	18-1931129	POLE SHOE	4
		THE FOLLOWING PARTS ARE NOT ILLUSTRATED:	
	18-1958453	CENTER BEARING PLATE Includes	1
	18-1880471	BUSHING, center bearing	1
	18-132900	SCREW, center bearing plate attaching	4
	18-1962276	LOCKWASHER, center bearing plate attaching	4
	18-1947777	OIL SEAL - center bearing	1
	18-802694	WICK - C.E.	1

FIG. B-91. YA-26-A (12 Volt) STARTING MOTOR - Prestolite No. MHA-7004 (Replaces MDY-7006)



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NOTE: Code number 28, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code.

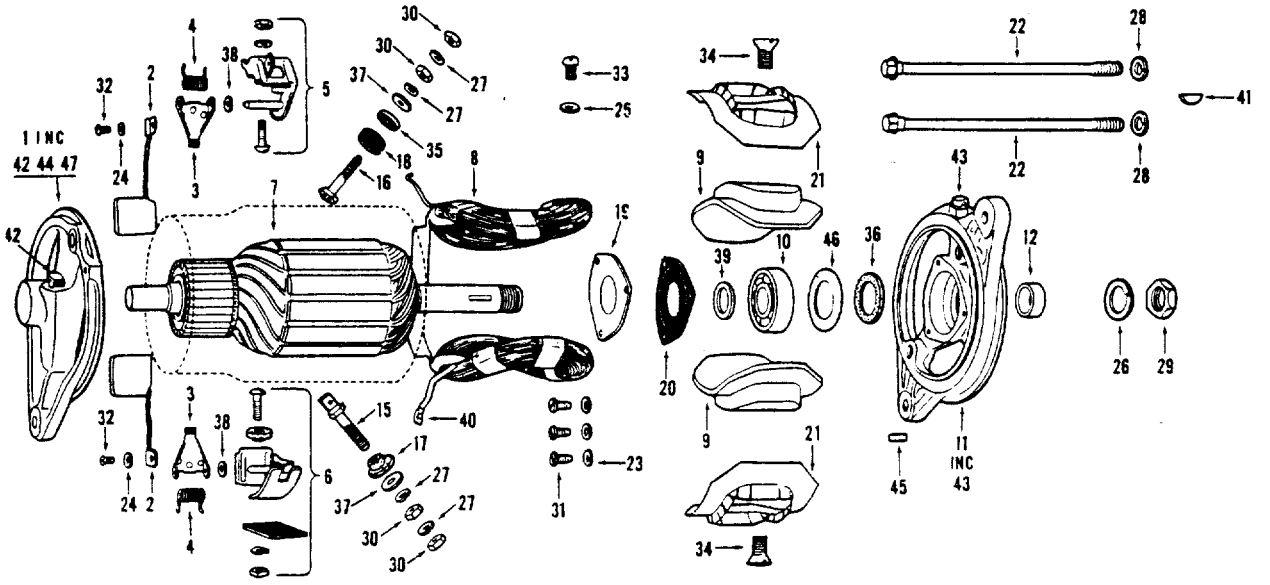
Ref. No.	Part Number	Description	No. Req.
1		FRAME and FIELD ASSEMBLY includes:	1
2		SCREW for pole shoe	4
3	**	INSULATING WASHER for terminal stud	1
4		INSULATION for field connection	2
5	28-MDL-1064	BRUSH PLATE ASSEMBLY Includes:	1
	*	GROUNDED BRUSH	2
	28-MZ-19S	BRUSH SPRING SET	1
6	**	INSULATING WASHER for term. stud(inner)	1
7	**	TERMINAL STUD	1
9	**	INSULATING BUSHING for terminal stud	1
10	28-MDU-200SAS-1	FIELD COIL PKG. Includes:	1
	*	BRUSH	1
12	**	PLAIN 'WASHER, 5/16", for terminal stud	1
13		LOCKWASHER, No. 8, for terminal stud	1
14		SCREW for terminal stud and ground lead No. 8-32 thread x 5/16" long round head.	1
15		LOCKWASHER, 5/16", for terminal stud	2
16		NUT for term. stud, 5/16"-18 thread, hex.	1
17		SCREW for brush plate mtq. (not illust.)	3
18		NUT for term. stud, 5/16"-18 thread, hex.	1
20	28-GJ-20S	THRU BOLT PKG.	1
21		LOCKWASHER, 1/4", for thru bolt	2
22	28-MDT-1002	COMMUTATOR END HEAD ASSEMBLY	1
23		FELT for end head	1
25	28-MDL-2048C	ARMATURE ASSEMBLY	1
26	***	THRUST WASHER, 1/32" thick, for armature 1-Internal-for commutator end	2
27	***	THRUST WASHER, 3/64" thick (use as req'd)	
28	***	THRUST WASHER, .080" thick (use as req'd)	-
29	***	THRUST WASHER, 1/16" thick (use as req'd)	-
31		KEY for mounting Bendix, Woodnuff No. 6.	1
33	28-SAW-4201	SOLENOID STARTING SWITCH	1
34		TERMINAL NUT, No. 0-32 thread, hex	1
35		TERMINAL LOCKWASHER, No. 10	1
36		TERMINAL NUT, 5/16"-24 thread, hex.	2
37		TERMINAL LOCKWASHER, 5/16"	2
38	28-SS-6R	CONNECTOR for solenoid switch	1
39		SCREW or solenoid switch mounting No. 10-32 thread x 1/4" long, round head.	2
40		LOCKWASHER for solenoid mounting No. 10 Snakeproof.	2
41	28-EB8-40A	BENDIX DRIVE use Eclipse 28-A3491	1
52	28-MDL-73	GASKET for bearing plate	1
53	28-MDL-2080A	BEARING ASSEMBLY, intermediate.	1
54	28-P5-1375D	PINION HOUSING ASSEMBLY, includes:	1
55	28-MG-77A	BRONZE BEARING for pinion housing.	1
56		DOWEL Pin.	1
57		LOCKWASHER, No. 10, for bearing plate	2
58		SCREW for bearing plate mounting No. 0-32 thread x 7/16" Long round head.	2

* 28-MDL-2012CS BRUSH SET
** 28P90-711 TERMINAL STUD PKG.
*** 28-P90-263 ARMATURE THRUST WASHER PKG.

NOTE: Items less part number are not serviced separately.

FIG. B-92. 12 Volt-17 Amp GENERATOR

YB-62-B (Negative Ground) Delco-Remy No. 1102343
YB-62 (Positive Ground) Delco-Remy No. 1102225



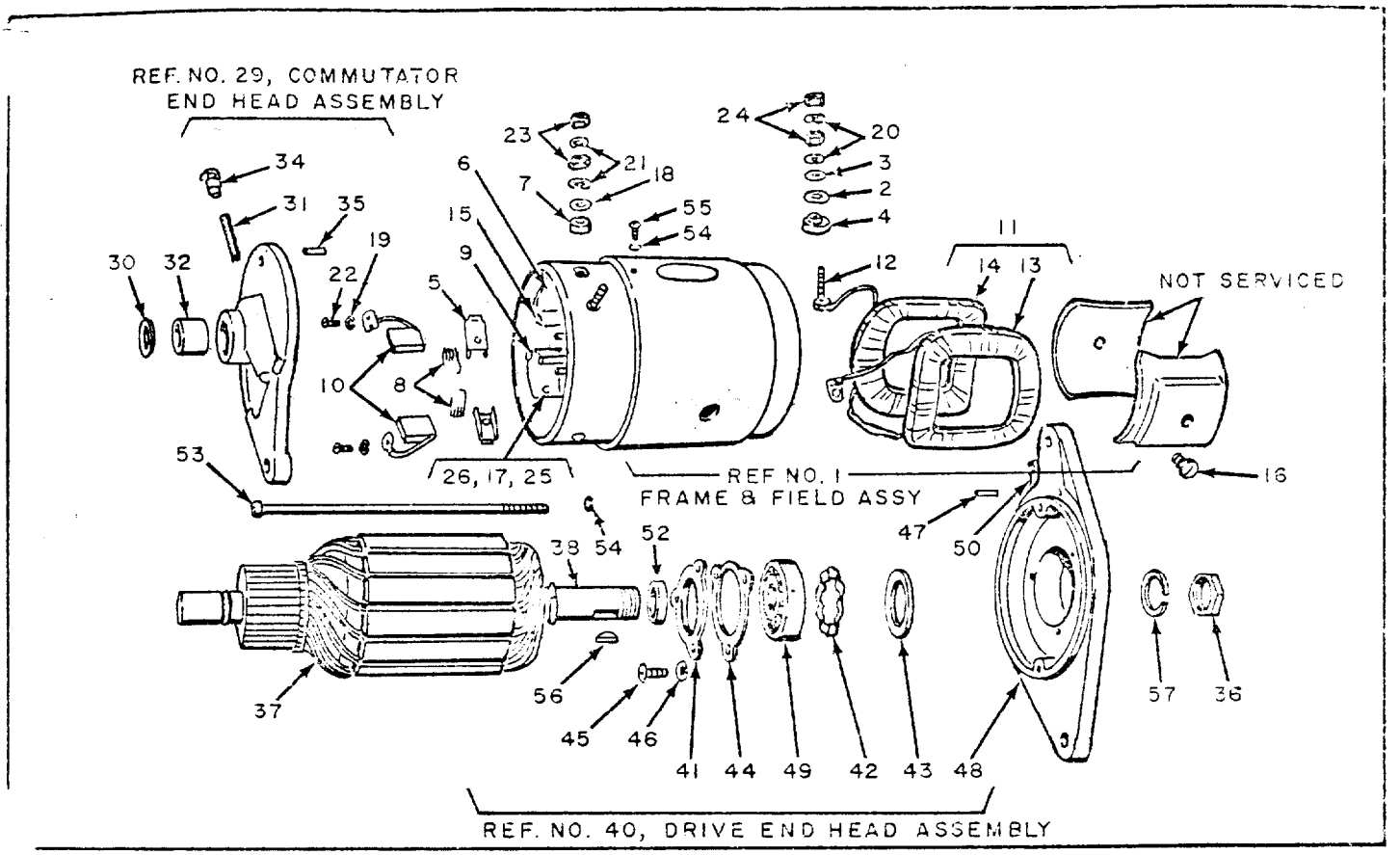
NOTE: Code number 18, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number YB-62-B	Part Number YB-62	Description	No. Req.
1	18-1946595	18-1935696	FRAME, commutator end ..... Includes: Ref. Nos. 42, 44, 47,48.	1
2	18-1932506	18-1932506	BRUSH	2
3	l8-1944373	18-1878183	BRUSH ARM	2
4	18-1908829	18-1908829	BRUSH SPRING	2
5	18-1925378	18-1922288	GROUND BRUSH HOLDER PKG.	1
6	l8-1925379	18-1922289	INSULATED BRUSH HOLDER PKG.	1
7	18-1935778	18-1952297	ARMATURE	1
8	18-1922701	18-1936388	FIELD COIL SET ..... Includes: Ref. Nos. 16 and 40.	1
9	18-1939902	18-1912725	POLE SHOE	2
10	18-954378	18-954378	BALL BEARING, D.E.	1
11	18-1873830	18-1873830	FRAME, D. E., Includes: Ref. 43	1
12	18-817224	18-817224	COLLAR, D.E.	1
15	18-1923284	18-1921369	STUD, armature terminal	1
16	18-1858749	18-1921860	STUD, field terminal (to brush)	1
17	–	18-1921362	BUSHING, armature terminal	1
18	18-1858749	l8-1885090	BUSHING, field terminal	1
19	18-1911263	18-1911263	PLATE, bearing retainer, D.E. . .	1
20	18-1912008	18-1912008	GASKET, bearing retainer plate	1
21	18-1912073	18-1912073	INSULATION, field coil	2
22	18-809763	18-809763	THRU BOLT	2
23	–	18-1880781	LOCKWASHER, bearing ret. plate	3
24	18-456413	18-1904377	LOCKWASHER, brush lead screw	2

Ref. No.	Part Number YB-62-B	Part Number YB-62	Description	No. Req.
25	18-9421423	18-120380	LOCKWASHER (top of field frame)	1
26	18-1915265	18-1888439	LOCKWASHER, shaft nut, D.E.	1
27	18-1914579	18-1904661	LOCKWASHER, terminal stud . .	4
28	18-9421424	18-120638	LOCKWASHER, thru bolt	2
29	18-1915172	18-1911324	NUT, shaft, D.E.	1
30	18-121743	18-121743	NUT, terminal stud	4
31	18-1914580	18-1904370	SCREW, bearing retainer plate . . .	3
32	18-453460	18-132688	SCREW, brush lead	2
33	18-225577	18-225577	SCREW (top of field frame)	1
34	18-1913960	18-1843646	SCREW, pole shoe	2
35	18-1858753	18-1858753	WASHER, insulating, field term. .	1
36	18-809961	18-809961	WASHER, felt, D.E.	1
37	18-826319	18-1881409	WASHER, plain, terminal stud	2
38	–	18-1857412	WASHER, brush arm spacer	2
39	18-809945	18-809945	WASHER, spacer, D.E.	1
40	–	18-200382	TERMINAL CLIP	1
41	18-124545	18-124545	WOODRUFF KEY, D.E.	1
42	18-125609	18-125609	OILER, C.E.	1
43	18-125609	18-1880641	OILER, D.E.	1
	18-823551	–	WICK, D. E. (not illustrated)	1
44	18-809062	18-809062	DOWEL PIN, C.E.	1
45	18-809593	18-809593	DOWEL PIN, D.E.	1
46	l8-819104	18-819104	PLATE, felt washer retainer, D.E.	1
47	18-1947350	18-804080	OIL WICK, C.E.	1
48	18-1911097	18-1911097	PLUG, C.E. (not illustrated).	1

FIG. B-93. YB-60-A Neg. Grd. 12 V., 17 AMP. GENERATOR – Prestolite GJY-7401SN
YB-60 Pos. Grd. 12 V., 17 AMP. GENERATOR – Prestolite GJY-7401S

(Service parts are interchangeable on both generators)



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NOTE: Code number 28, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code

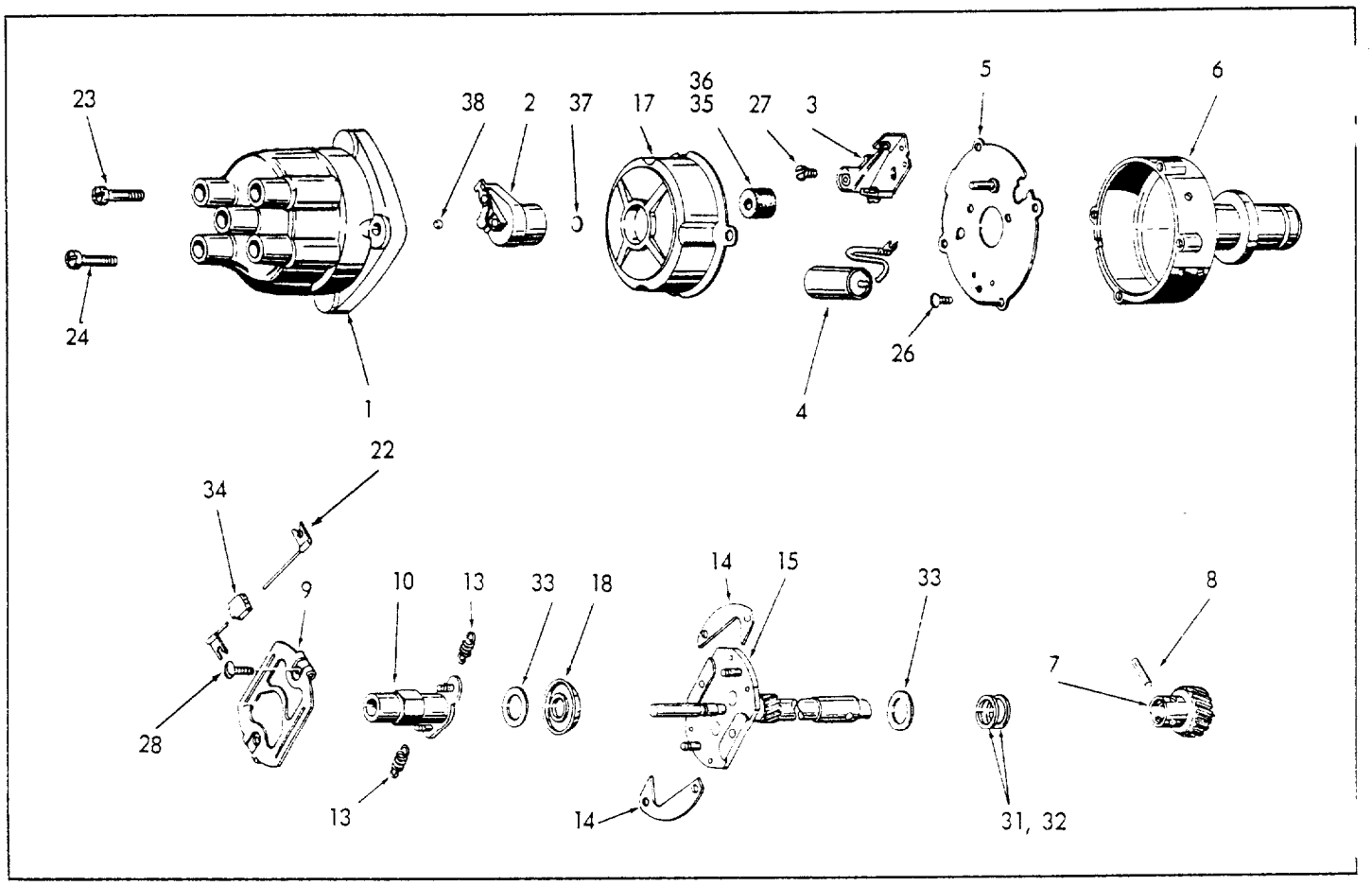
Ref. No.	Part Number	Description	No. Req.
1		FRAME and FIELD ASSEMBLY includes:	1
2	*	WASHER, ins., field term.	1
3	*	WASHER, plain, field term.	1
4	*	BUSHING, ins., field term.	1
5	**	BRUSH ARM	2
6	*	INSULATION, brush holder	1
7	*	BUSHING, ins., arm. term.	1
8	**	BRUSH SPRING	2
9	*	HOLDER for ground brush	1
10	28-GJC-2012AS	BRUSH SET for service	1
11	28-GJP-1005C	FIELD COIL ASSEMBLY, consisting of:	1
12	*	STUD for field terminal, 10-32	1
13		FIELD COIL, right	1
14		FIELD COIL, left	1
15	*	HOLDER – term., ins. brush	1
16		POLE SHOE, screw	2
17	*	BUSHING, ins. pr. holder rivet	1
18	*	PLAIN WASHER, arm. term.	1
19		LOCK WASHER, No. 8, br. screw	2
20		LOCKWASHER, No. 10, fld. term.	2
21		LOCKWASHER, 1/4", arm. term.	2
22		SCREW, brush head, 8-32 x 1/4"	2
23		NUT, arm. term., 1/4-28	2
24		NUT, field term., 10-32	2
25		RIVET, ins. brush holder	1
26		RIVET, grd. brush holder	2
29	28-GJO-2002	COMMUTATOR END HEAD ASSEMBLY . . Consisting of:	1
30		BEARING COVER	1
31		FELT WICK	1
32	28-GJC-38A	BRONZE BEARING	1
33		OIL RETAINER (not illustrated)	1
34	28-X-3326	OILER	1
35		DOWEL PIN	1
36	28-P90-33	NUT & WASHER PKG.	1
37	28-GGW-2030F	ARMATURE ASSEMBLY, includes:	1
38		SNAP RING	1
40	28-GJR-1003B	DRIVE END HEAD ASSEMBLY . . . . . Consisting of:	1
41		BEARING RETAINER	1
42		RETAINER for felt washer	1
43	28-GG-164	FELT WASHER	1
44	28-GEE-27	GASKET for retainer	1
45		SCREW, retainer, 10-32 x 1/2	3
46		LOCKWASHER, retainer, No. 10	3
47		DOWEL PIN	1
48		DRIVE END HEAD	1
49	28-X-295A	BALL BEARING, No. 203	1
50	28-X-2961	OILER	1
52	28-GR-32	RETAINER, D.E.	1
53	28-GY-20S	THRU BOLT PKG.	1
54		LOCKWASHER, thru bolt and grd.	3
55		SCREW, ground, 1/4-28 x 5/16	1
56		KEY, Woodruff No. 5	1
57		LOCKWASHER, shaft, D.E.	1

* 28-P90-338 TERMINAL STUD & PARTS PKG.

** 28-P90-32 BRUSH ARM & SPRING PKG.

NOTE: Items less part number are not serviced separately.

FIG. B-94. YF-34 DISTRIBUTOR – Delco-Remy No. 1112695

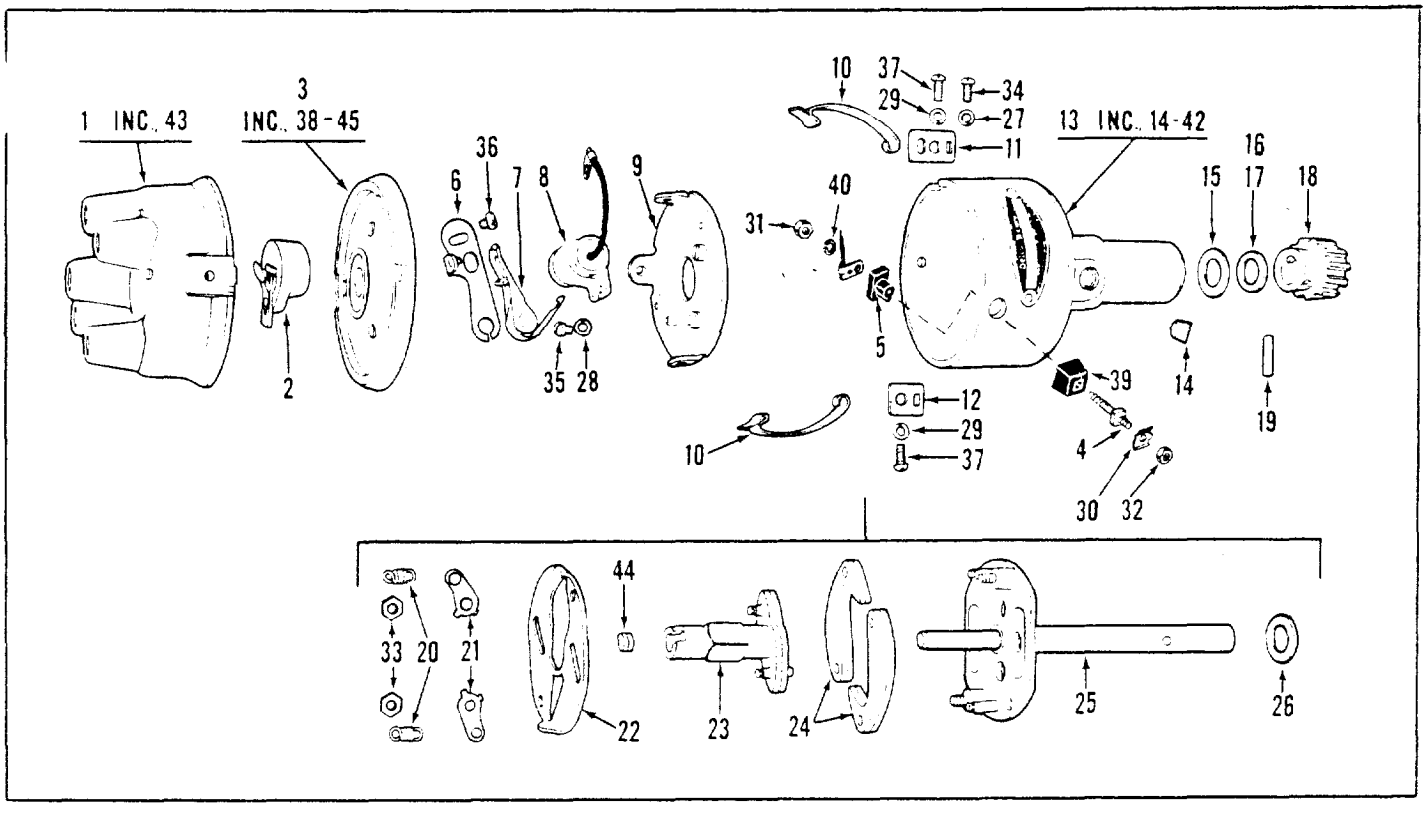


NOTE: Code number 18, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req.
1	18-1960833	CAP ASSEMBLY includes Ref. Nos. 23, 24, 38	1
2	18-1954566	ROTOR	1
3	18-1954557	CONTACT POINT SET	1
4	18-1928111	CONDENSER	1
5	18-1960814	BREAKER PLATE	1
6	18-1964208	HOUSING ASSEMBLY Includes Ref. No. 18	1
7	18-1970035	GEAR	1
8	18-9417392	PIN for gear mounting	1
9	18-1954548	PLATE for flyweight hold down	1
10	18-1970505	CAM AUTOMATIC and BREAKER	1
13	18-1970504	SPRING for flyweight	2
14	18-1880902	FLYWEIGHT	2
15	18-1970032	MAIN SHAFT and WEIGHT PLATE	1
17	18-1960325	HOUSING COVER	1
18	18-1950569	SEAL for housing	1
22	18-1954563	PRIMARY WIRE ASSEMBLY	1
23	18-1954571	SCREW for mounting cap (8-32)	1
24	18-1957573	SCREW for mounting cap (10-32)	1
26	18-453461	SCREW for breaker plate support	2
27	18-1914916	SCREW for contact adjustment	1
28	18-453647	SCREW for hold down plate mounting	2
31	18-810074	GEAR SHIM (.005") as needed	
32	18-1912129	GEAR SHIM (.010") as needed	
33	18-811912	SPACER WASHER 1-for gear 1-for weight plate	2
34	18-1960824	GROMMET in housing for primary wire	1
35	18-1961088	WICK	1
36	18-1963858	RETAINER for wick	1
37	18-1963555	CAM FELT WICK	1
38	18-1938193	CARBON BUTTON for cap	1

FIG. B-95 YF-25-S1 DISTRIBUTOR (Obsolete) — No. 1112596

Optionally Used On V-460D and V-461D Engines Previously To Serial No. 4427547



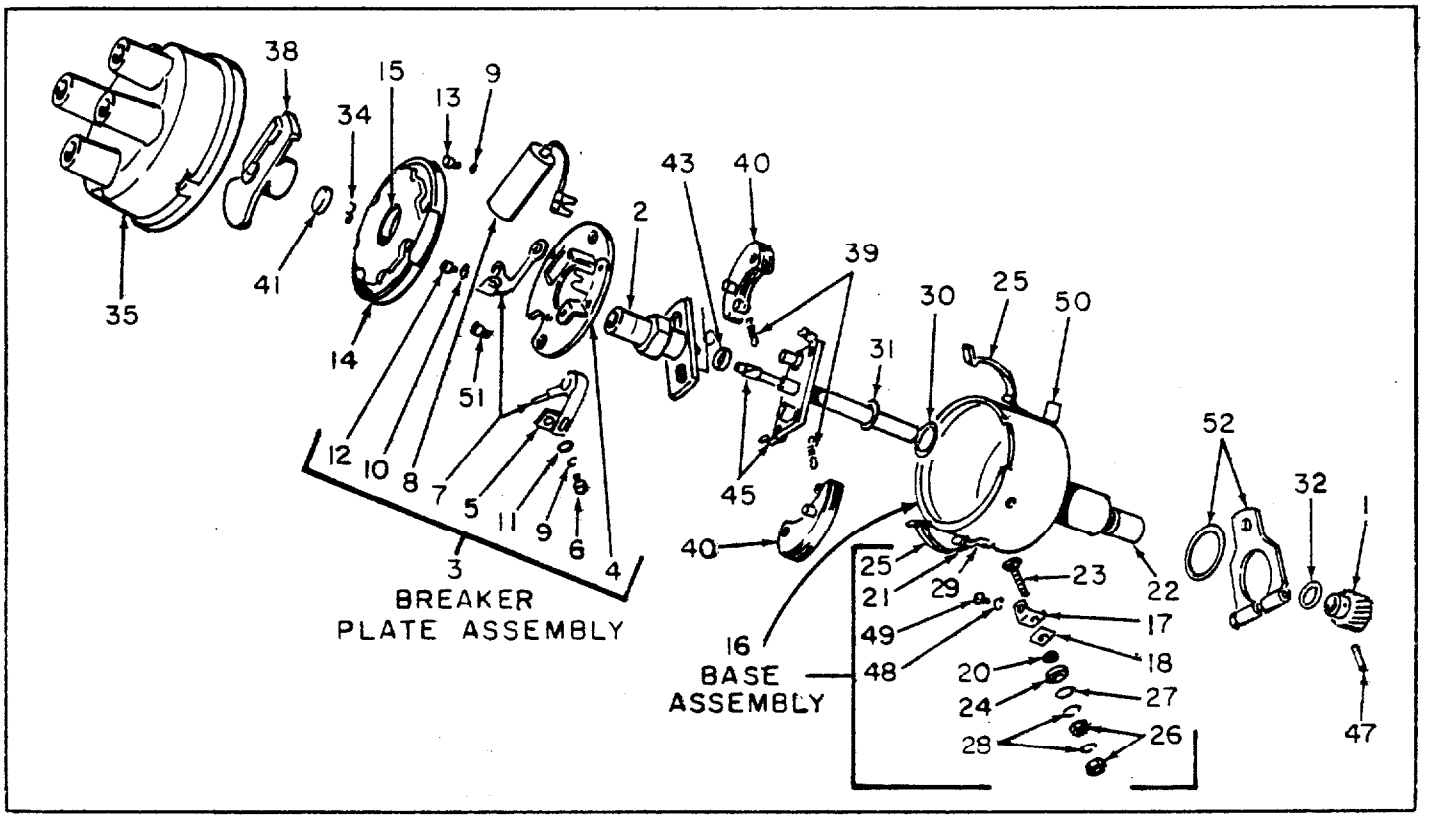
NOTE: Code number 18, prefixed to the part number, is a vendor identifcation. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req.
1	18-811735	CAPASSEMBLY	1
		Includes:	
43	18-1938193	CARBON BUTTON (not illustrated)	1
2	18-820445	ROTOR	1
3	18-1900119	HOUSINGCOVERASSEMBLY	1
		Includes:	
38	18-1889966	GASKET(notillustrated)	1
45	18-1914309	FELT SEAL (not illustrated)	1
4	18-1916806	TERMINALSTUD	1
5	18-1916805	BUSHING for terminal stud (inside)	1
	18-1855720	CONTACTPOINTSET	1
		Consisting of:	
6	18-1848038	CONTACT POINT and SUPPORT	1
7	18-813238	BREAKERARM	1
8	18-1928111	CONDENSER replaces 18-1 869704	1
9	18-1847643	BREAKERPLATE	1
10	18-1889967	SPRINGCLIPforcap	2
11	18-1889999	SUPPORT for cap spring clip and locator	1
12	18-1847289	SUPPORT forcapspringclip	1
13	18-1947954	HOUSINGASSEMBLY	1
		Includes:	
14	18-125947	PIPEPLUG	1
42	18-1909003	BUSHING(notillustrated)	1
15	18-811912	SPACERWASHERforgear	1
16	18-810074	GEARSHIM(.005")asneeded	
17	18-810078	GEARSHIM(.010")asneeded	
18	18-1881717	GEAR	1
19	18-1862218	PIN for gear mounting	1
20	18-1883121	SPRING for flyweight	2
21	18-1885558	LOCKWASHER for hold down plate	2
22	18-1885557	PLATE for flyweight hold down	1
23	18-1942038	CAMAUTOMATIC and BREAKER	1
24	18-1921271	FLYWEIGHT replaces 18-1873637	2
25	18-1947952		1
26	18-811912	SPACER WASHER for weight plate	1
27	18-453299	LOCKWASHER for breaker plate screw	1
28	18-453299	LOCKWASHER for condenser mtg. screw	1
29	18-453299	LOCKWASHER for spring clip support	3
30	18-1914144	LOCKCLIP for terminal stud	1
31	18-817363	NUT for terminal stud (inside)	1
32	18-120622	NUT for terminal stud (outside)	1
33	18-1923540	NUT for hold down plate mounting	2
34	18-453418	SCREW for breaker plate support	1
35	18-453304	SCREW for condenser mounting	1
36	18-1914916	SCREW for contact adjustment	1
37	18-453461	SCREW for spring clip support	2
39	18-1914142	INSULATING BUSHING for terminal stud, (outside)	1
40	18-1904376	LOCKWASHER for terminal stud (inside)	1
44	18-1963555	CAM FELT WICK replaces 18-81 9639	1

FIG. B-96. YF-10C-S1 DISTRIBUTOR – No. IAD-6004-2N

YF-10A-S1 (Obsolete) No's. IAD-6004-2F **YF-10B-S1 (Less Condenser)** IAD-6004-26

NOTE: YF-10C-S1 Replaces YF-10A-S1. All Parts are Identical Except Spring Set for Governor Weights, as Noted.



NOTE: Code number 28, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code 187616

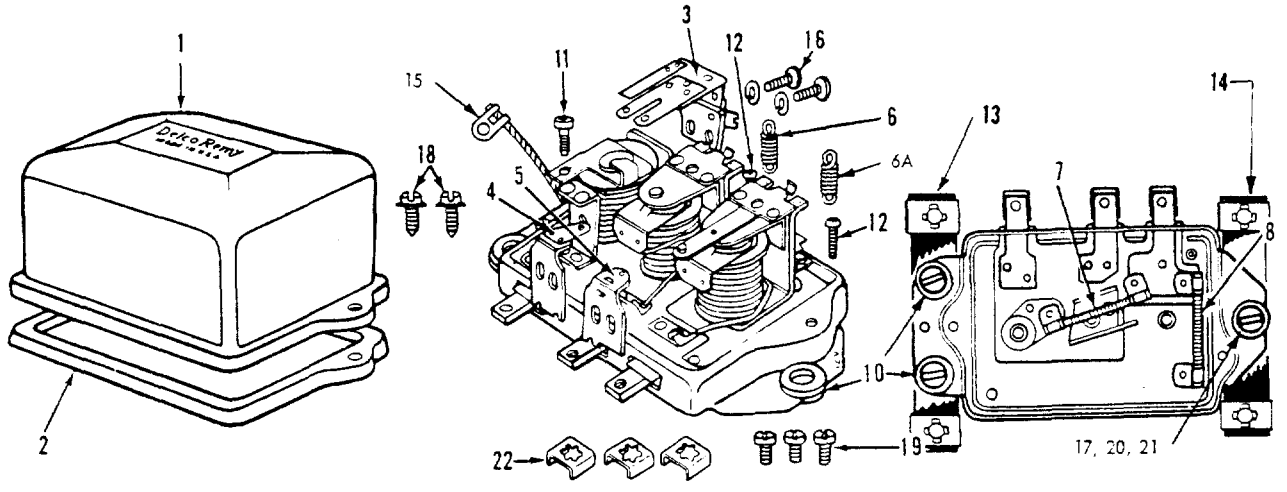
No.	Part Number	Description	eq.
1	****	FOLLOWER GEAR	1
2	28-IAD-1100LE1	CAM and STOP PLATE, 4 cyl., L. H.	1
3	28-IAD-2004	BREAKER PLATE ASSEMBLY, includes:	1
4		BREAKER PLATE	1
5		SPRING CLIP for contact arm	1
6		SCREW, spring clip, #6-32 x 5/16", hex. hd.	1
7	28-IGS-2224LB	BREAKER CONTACT SET	1
7	28-1BB-2042SS1	CONDENSER (for YF-10C-S1, YF-10A-S1)	1
9		LOCKWASHER, No. 6 — 2-for condenser mtg. 1-for spring clip.	3
10		PLAIN WASHER for contact lockscrew, #8	1
11		PLAIN WASHER for spring clip screw, #6	1
12		LOCKSCREW for breaker contact — #8-32 thread x 3/16" long fillister head.	1
13		SCREW for condenser mounting — #6-32 thread x 5/32" long, fillister head.	1
14	28-IAD-2015	DUST COVER ASSEMBLY, includes:	1
15		FELT WASHER	1
16		BASE ASSEMBLY, includes:	1
17	**	CONNECTOR for terminal stud	1
18	**	INSULATOR for terminal stud	1
19	***	BRACKET for breaker plate (Not illust.)	2
20	**	INSULATING BUSHING for terminal stud	1
21	***	BRACKET for cap spring	2
22	*	BRONZE BEARING	2
23	**	TERMINAL STUD	1
24	**	INSULATING WASHER for terminal stud	1
25	***	CLAMP SPRING for cap	2
26		NUT for terminal stud, #10-32 thread	2
27		PLAIN WASHER for terminal stud, #10	1
28		LOCK WASHER for terminal stud, #10	2
29	***	RIVET for clamp spring	4

Ref. No.	Part Number	Description	No. eq.
30	*	THRUST WASHER (inner) for drive shaft	1
31	*	THRUST WASHER (outer) for drive shaft	1
32	*	THRUST WASHER for drive shaft (lower)	1
34		SNAPRING for cam	1
35	28-IG-1324D	DISTRIBUTOR CAP ASSEMBLY includes: PLUNGER CONTACT and SPRING	1 1
38	28-IG-1657R	ROTOR	1
39	28-IGC-203S	SPRING SET, governor weights (YF-10C-S1) 28-IGC-200S (for YF-10A-S1, YF-10B-S1)	1 1
40	28-IGC-2168LS	GOVERNOR WEIGHT SET	2
41	*****	FELT WICK for cam sleeve	1
42	28-IGS-32S	CAP PLUG PKG. for vent hole (not illust.)	1
43	*	CAM SPACER	1
44	*****	FELT WICK (not illustrated)	1
45	28-IGS-1180L	DRIVE SHAFT	1
47	*	PIN for gear	1
48		LOCKWASHER for connector screw, #6	1
49		SCREW for connector — #6-32 thread x 3/16" long, round head.	1
50	28-X-1590	OILER	1
51		SCREW for breaker plate mounting — #10-32 thread x 5/16" long, fillister head.	2
52	PG-543-A	ADVANCE ARM ASSEMBLY	1
	*	28-P90-390 Distr. Shaft Bearing & Parts Pkg.	
	**	28-P90-337 Terminal Stud & Parts Pkg.	
	***	28-P90-429 Cap Clamp Spring Pkg.	
	****	28-P90-427 Distr. Shaft Gear & Parts Pkg.	
	*****	28-P90-728 Wick and Washer Pkg.	

NOTE: Parts less part number are not serviced separately.

FIG. B-97.12 Volt-17 Amp CURRENT-VOLTAGE REGULATOR

YJ-41-D (Negative Ground) No. 119257
YJ-41 (Positive Ground) No. 1119152-D



Parts are identical for both regulators, except for **contact** and **support** as noted, and polarity.

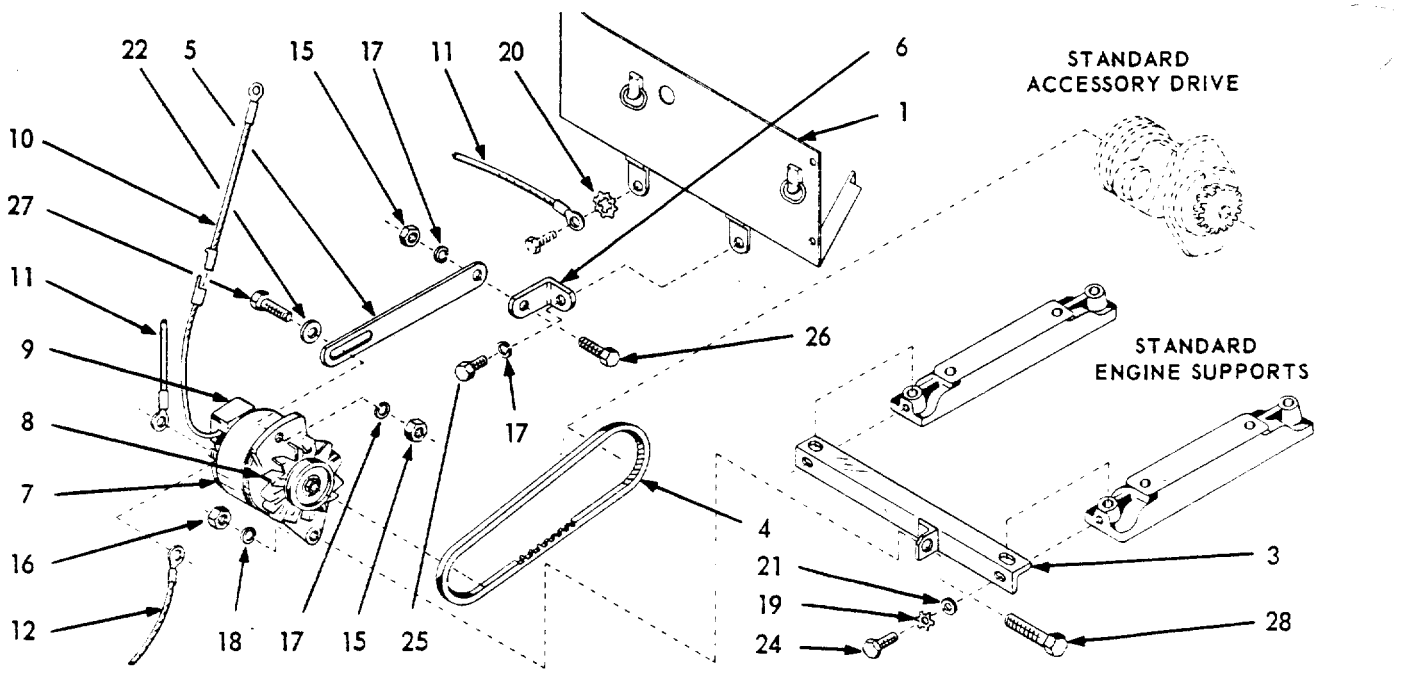
NOTE: Code number 18, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Port Number	Description	No. Req.
1	18-1931886	COVER	1
2	18-1931887	GASKET, cover	1
3	18-1939646	RELAY ARMATURE	1
4, 5	18-1945732 18-1948328	CONTACT and SUPPORT (combined nit) For YJ-41-D (1119257) For YJ-41 (1119152-D)	1
6	18-1912176	SPRING, current regulator armature	1
6A	18-1949142	SPRING, voltage regulator armature	1
7	18-1910174	RESISTOR, 'F' terminal to ground	1
8	18-1910174	RESISTOR, 'F' terminal to relay	1
10	18-1879663	GROMMET (rubber) in base	3
11	18-1912159	ADJUSTING SCREW, relay armature	1
12	18-1944590	SCREW, regulator armature adjusting	2
13	18-1911034	RUBBER SHOCK MOUNT, long (4 hole)	1
14	18-1911028	RUBBER SHOCK MOUNT, short (3 hole)	1
15	18-1933941	GROUND LEAD ASSEMBLY	1
16	18-1924764	SCREW and LOCKWASHER, relay armature attaching	2
17	18.1874495	LOCKWASHER, Shock mount attach. screw	3
18	18-1943385	SCREW, cover	2
19	18-1878502	TERMINAL SCREW	3
20	18-124818	NUT, Shock mount attaching	3
21	18-273484	SCREW, Shock mount attaching	3
22	18-1878503	TERMINAL CLAMP	3

FIG. B-98. YB 69 ALTERNATOR MOUNTING

BELT DRIVEN – FOR MODEL V-465D

Standard equipment in place of Generator on V-465D engines beginning with Serial No. 5734200.



Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
		SPECIAL ENGINE PARTS REQUIRED			
1	SE 240	**CYLINDER SHROUD,** L.H. side	1	1	4
2	YL 376-27	**IGNITION WIRE ASSEMBLY** Ammeter to solenoid, #10 gage with terminals – 27" long (Not illustrated).	1		2
		ALTERNATOR MOUNTING PARTS			
3	BI 379	**BRACKET,** alternator support	1	2	
4	MH 184A	**BELT,** alternator drive	1		3
5	PG 1182	**STRAP,** alternator adjusting	1		8
6	PG 1183	**BRACKET,** adjusting strap	1		3
7	YB 69	**ALTERNATOR ASSEMBLY** Includes:	1	8	4
8		**MD 405** Driven pulley	1		8
9		**YJ 53** Regulator	1		6
10		**YL 392** Wire assembly (regulator to coil)	1		1
		NOTE: Refer to Form MY-93-3 for Alternator Service and Parts Instructions.			
11	YL 353-12	**GROUND WIRE** Alternator to coil strap.	1		1
12	YL 377-30	**IGNITION WIRE ASSEMBLY** Alternator to Ammeter #10 gage with terminals – 30" long.	1		2
		STANDARD HARDWARE			
15	PD 78	**NUT,** 5/16"-18 thread, hexagon steel For adjusting strap.	2		1
16	PD 81	**NUT,** 1/2"-13 thread, hex. steel For Alternator mounting.	1		1

Ref. No.	Part Number	Description	No. Req	Net Wt. Lb	Net Wt. Oz
17	PE 4	**LOCKWASHER,** 5/16" spring lock 1-for adjusting strap bracket 2-for adjusting strap	3		1
18	PE 7	**LOCKWASHER,** 1/2" spring lock For Alternator mounting.	1		1
19	PE 46	**LOCKWASHER,** 5/16" external tooth For Alternator bracket to supports.	2		1
20	PE 75	**LOCKWASHER,** 3/16" I.D. internal-external tooth (galvanized) For mounting ground wire to crankcase.	1		1
21	PH 77A	**WASHER,** 5/16" I.D. x 5/8" O.D., plain, steel For Alternator bracket to supports.	2		1
22	PH 209B	**WASHER,** 1/2" O.D. plain steel For adjusting strap at alternator.	1		1
24	XD 14A	**SCREW,** 5/16"-18 thread x 5/8" long, hexagon head (S.A.E. grade 5) For Alternator bracket to supports.	2		1
25	XD 15	**SCREW,** 5/16"-18 x 3/4" long, hex. hd. For adjusting strap bracket.	1		1
26	XD 17B	**SCREW,** 5/16"-18 thread x 7/8" long, hexagon head (S.A.E. grade 5) For adjusting strap at bracket.	1		1
27	XD 169	**SCREW,** 5/16"-18 thread x 1-1/1" long, hexagon head (S.A.E. grade 5) For adjusting strap at alternator.	1		1
28	XD 170	**SCREW,** 1/2" x 13 x 2-1/4" long, hexagon head For Alternator mounting.	1		2

MODEL 87A8 **CARBURETOR**

OPERATION and SERVICE

DESCRIPTION

The 87-Series is a horizontal carburetor with a concentric fuel bowl. It is a "balanced" carburetor, because all air for fuel chamber and metering well ventilation and idling must come through the air cleaner. Air cleaner restrictions have a minimum influence on the fuel-air ratio when a carburetor is thus "balanced".

The main jet and discharge jet are centrally located. The metering well which completely surrounds the discharge jet is in the center of the fuel bowl assembly. This construction permits extremely high angle operation in any direction.

The venturi, which is part of the throttle body casting, measures the volume of air that passes through the carburetor. In selecting the venturi size, the smallest size that will permit full power development should be used.

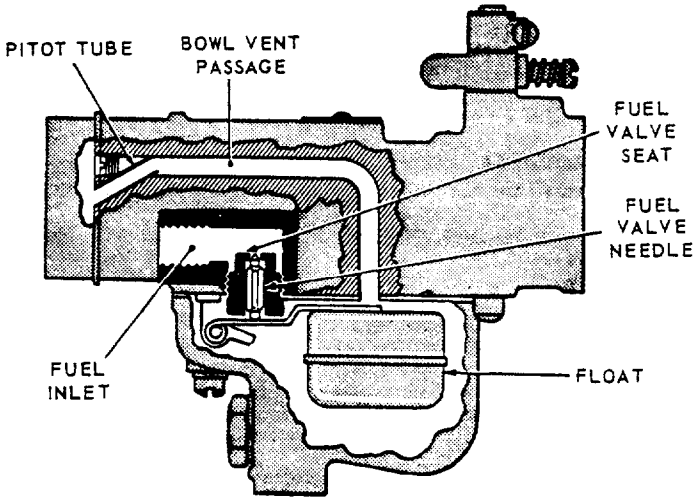


Fig. B-99. FUEL SUPPLY SYSTEM

OPERATION

FUEL SUPPLY SYSTEM (Fig. B-99)

Fuel under normal pressure entering the float chamber through the fuel valve seat is controlled by the twin float which, moving on its axle, closes the needle valve when the fuel reaches the proper level in the bowl.

IDLE SYSTEM (Fig. B-100)

At idling speeds the throttle plate is almost closed, thus a very high suction exists at the edge of the throttle plate where the idle discharge holes are located. All fuel for idling and part throttle operation is supplied through the main jet. Fuel from the float chamber flows through the main jet into the metering well. Fuel for idling is drawn from this well through the calibration, or metering orifice, in the center of the idling jet. As the fuel reaches the idling channel it is mixed with air which is admitted through a calibrated orifice in the channel from the inside of the air intake to form an emulsion. This emulsion is discharged into the air stream, to form the idling mixture, through two holes one of which is controlled by the idle adjusting needle. Turning the adjusting needle counter-clockwise (out) permits more of the emulsion to reach the air stream and make the idling mixture richer while turning the needle in (clockwise) cuts off the amount of the emulsion reaching the air stream and makes the mixture leaner.

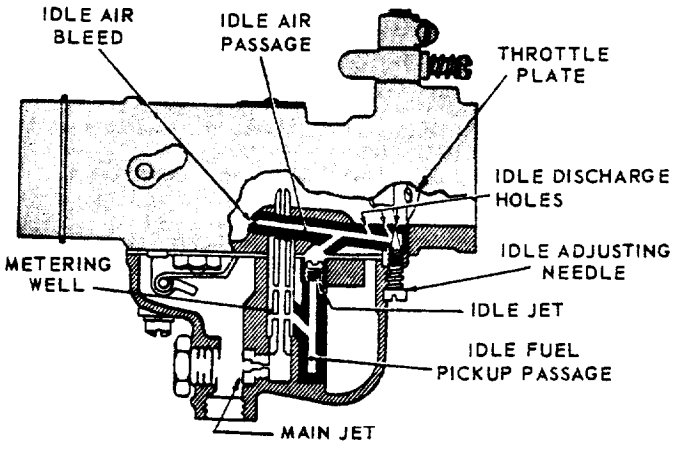


Fig. B-100. IDLE SYSTEM

HIGH SPEED SYSTEM (Fig. B-101)

As the throttle is opened, the suction on the idling system diminishes, but the increased volume of air entering the engine through the venturi creates sufficient vacuum (suction) on the discharge jet to draw an emulsion of fuel and air from the metering well which receives its fuel from the main jet and its air from the well vent. The flow characteristics of the discharge jet are influenced by the size, location, and number of holes in the sides of that part of the jet which is in the metering well, as well as by the sizes of the discharge jet orifice, the size of the main jet, and the size of the well vent. The well vent is located in the air intake and permits air to enter the top of the metering well around the outside of the discharge jet. The flow of fuel through the main jet is controlled by the size of main jet opening.

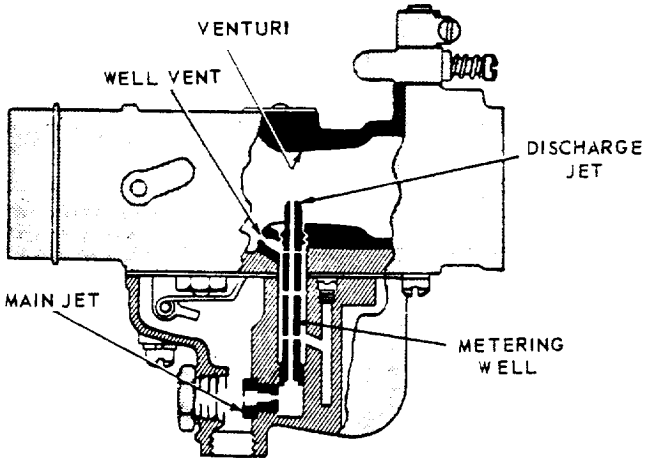


Fig. B-101. HIGH SPEED SYSTEM

CHOKE SYSTEM (Fig. B-102)

Starting a cold engine requires a much richer mixture of fuel and air. Moving the choke lever to close the choke plate restricts the air entering the carburetor (except at the pitot tube, Fig. B-99, to the bowl vent) and increases the suction on the idling system which makes the mixture richer.

STARTING THE ENGINE

Before cranking the engine, the carburetor throttle should be opened a little to expose both idle discharge holes to suction. The choke should be fully closed until the engine starts, then opened a little to prevent stalling from being over-choked, then when the engine is fully warmed up the choke can be returned to wide open position and the throttle closed to the idling position.

ADJUSTMENTS

Adjust the throttle stop screw to obtain the desired idling speed by turning screw in (clockwise) to increase speed and out (counter-clockwise) to decrease engine speed.

Adjust the idle adjusting needle to obtain smooth idling of the engine at idling speed. Turn the needle out (counter-clockwise) to make the mixture richer, and in (clockwise) to make it leaner.

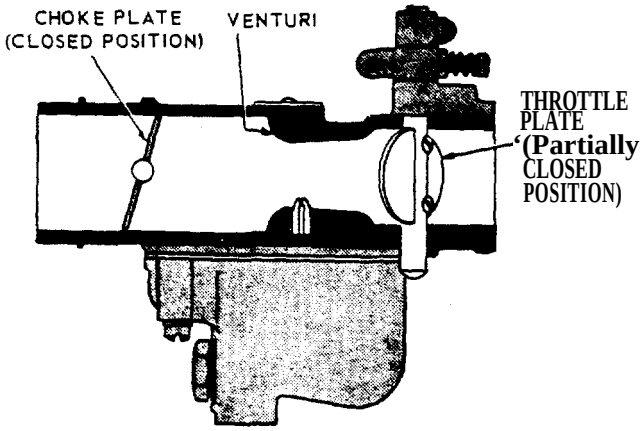


Fig. B-102. CHOKE SYSTEM

SERVICE AND REPAIR PROCEDURE

IDENTIFYCARBURETOR

Check the numbers on the metal identification disc pinned to the top of the throttle "body or indented in it. The plain number is the sssembly number, the number with the letter "L" pre-fexed to it is
part number for the complete assembly.

Exploded view (Page B-75)

The exploded view identifies the serviceable component parts of the carburetor and shows their relationship to the complete assembly. Use the key numbers on the exploded view to identify and locate parts when performing both the disassembly and assembly operations.

DISASSEMBLY

SEPARATE CARBURETOR BODIES

Remove the three bowl assembly screws (45, 46) and separate fuel bowl (39) from throttle body (26).

DISASSEMBLE FUEL BOWL

1. Remove the main jet plug (43) and fibre washer (42), using a 9/16" open end wrench.
2. Remove the main jet (41) and fibre washer (40), using Zenith Tool No. C161-83 main jet wrench.
3. Remove the Idle Jet (38), using a small screwdriver.
4. Remove the bowl drain plug (44).

DISASSEMBLE THROTTLE BODY

1. Remove the float axle (35) by pressing against the end with the blade of a screwdriver.
2. Remove the float {36).
3. Remove the fuel valve needle (31), using the fingers.
4. Remove the fuel bowl to throttle body gasket (37).
5. Remove the main discharge jet (32), using a small screwdriver.
6. Remove the fuel valve seat (31) and fibre washer (30), using Zenith Tool No. C161-85.
7. Remove the idle adjusting needle (17) and spring (18). ,

CLEANING

Thoroughly clean all metal parts in Metalclene or Speedclene and rinse in cleaning solvent. Blow out all passages in throttle body and fuel bowl with reduced air pressure. Be sure all carbon deposits have been removed from throttle bore and idle discharge holes. Reverse the flow of compressed air throaugh all passages to insure the removal of all dirt. NEVER USE A DRILL OR WIRE TO CLEAN OUT JETS OR IDLE HOLES.

INSPECTION OF PARTS

1. Float Assembly – Replace if loaded with gasoline, damaged or if float axle bearing is worn excessively. Inspect float lever for wear at point of contact with fuel valve needle. Replace if wear is excessive.
2. Float Axle – Replace if any wear has occurred on the bearing surface.
3. Fuel Valve (Needle & Seat) Assembly - Replace as a complete unit. Wear of any of these parts can seriously affect the operation of the float.
4. Idle Adjusting Needle – Inspect tapered end of the needle to make sure it is smooth and free of grooves. Replace if pitted or grooved.
5. Gaskets, Seal and Retainer – Replace all gaskets, throttle shaft seal and retainer each time the carburetor is overhauled.
6. Check Specifications. Verify the correctness of the following parts. Numbers will be found on the parts. Main Jet, Idling Jet and Fuel Valve.

REASSEMBLY

ASSEMBLY OF THROTTLE BODY

1. Install the fuel valve seat (31) and fibre washer (30), using Zenith Tool No. C161-85.
2. Install the main discharge jet (32), using a small screwdriver.
3. Install fuel valve needle in seat (31), followed by float (36) and float axle (35). NOTE: Insert tapered end of float axle (35) into float bracket on side opposite slot and push through the other side. Press float axle (35) into slotted side until the axle is centered in bracket.
4. FLOAT SETTING
   a. Fuel Level. Check position of float assembly (36), for correct measurement to obtain proper fuel level by using a depth gage. NOTE: Do not bend, twist, or apply pressure on the float body.
   b. With bowl cover assembly (26) in an inverted position, viewed from free end of float (36), the float body must be centered and at right angles to the machined surface. The float setting is measured from the machined surface (no gasket) of float bowl cover to top side of float body at highest point- This measurement should be 31/32", plus or minus 1/32".
   c, Bending Float Lever. To increase or decrease distance between float body (36) and machined surface (26) use long nosed pliers and bend lever close to float body. NOTE; Replace with new float if position is off more than 1/16".
5. Install throttle body to fuel bowl assembly gasket (37) on machined surface of throttle body (26).
6. Install idle adjusting needle (17) and spring (18). Screw needle IN (clockwise) until it seats lightly against the idle discharge hole, then back it out 1½ turns as a preliminary idle adjustment.

REASSEMBLE FUEL BOWL

1. Install the main jet (41) and fibre washer (40), using Zenith Tool No. C161-83 main jet wrench.
2. Install the main jet hex plug (43) and fibre washer (42), using a 9/ 16" open end wrench.
3. Install the idle jet (38), using a small screwdriver.
4. Install the bowl drain plug (44).

REASSEMBLE CARBURETOR BODIES

Install the three bowl assembly screws (45, 46) through the fuel bowl and into the throttle body and draw down firmly and evenly.

SPECIAL TOOLS

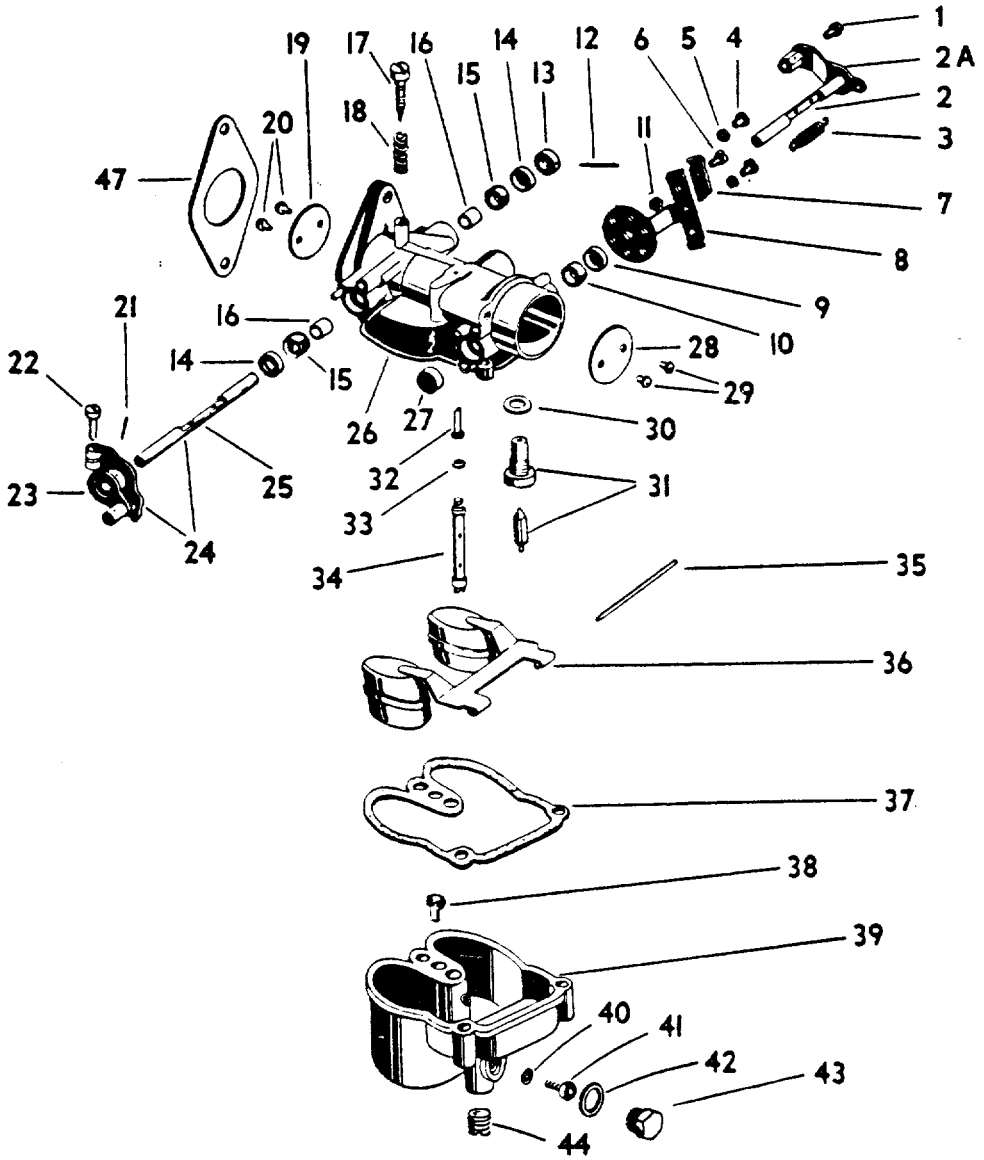
The special tools recommended are:

1. C161-83 Main Jet Wrench.
2 C161-85 Fuel Valve Seat Wrench.

FIG. B-103. CARBURETOR PARTS LIST

CARB. REF. NO.	ZENITH ASSEM. NO.	WISCONSIN PART NO.	WIS. ENGINE MODEL
1	11288	L-57	VP4D
2	11532	L-57-1	VG4D
3	12347	L-57-B	VG4D
4	13401	L-57-E	VG4D
5	13714	L-57-G	VH4D

CARB. REF. NO.	ZENITH ASSEM. NO.	WISCONSIN PART NO.	WIS. ENGINE MODEL
14	12708	LZ-77-S1	V-460D
		LZ-77B-S1	V-461D, V-465D
15	12825	LZ-77C-S1	V-465D
		(w/Auto-Choke)	V-461D



Refer to Engine Parts List for V-461D, V-465D Fuel Bowl Solenoid Valve.

NOTE:
Parts are identical for all carburetors, except those identified by carburetor Ref. No.

Item No.	Part Number	Description	No. Req.
1	93-T858-7	SCREW, Lever Swivel for 1, 2, 3, 4, 5, 14	1
2	93-C105-3	SHAFT – CHOKE for 1, 2, 3, 4, 5, 14	1
	93-C105-302	SHAFT – CHOKE for 15	1
2A	93-C106-2	LEVER – CHOKE for 1, 2, 3, 4, 5, 14	1
–	93-T2258	NUT – CHOKE LEVER for 1, 2, 3, 4, 5, 14	1
–	93-T-41-10	LOCKWASHER, Choke Lever Nut	1
3	93-C112-12	SPRING – CHOKE LEVER for 1, 2, 3, 4, 14	1
	93-C112-21	SPRING – CHOKE LEVER for 5	1

Item No.	Part Number	Description	No. Req.
4	93-C140-58	SCREW, Bracket for 1, 2, 3, 4, 5, 14	2
5	93-T41-8	LOCKWASHER, Bracket for 1, 2, 3, 4, 5, 14	2
6	93-T858-8	SCREW – TUBE CLAMP for 1, 2, 3, 4, 5, 14	1
7	93-C110-7	CLAMP – BRACKET for 1, 2, 3, 4, 5, 14	1
8	93-C109-60	BRACKET – CHOKE for 1, 2, 3, 4, 5, 14	1
9	93-C131-4x2 †	RETAINER – CHOKE SHAFT PACKING For 1, 2, 3, 14, 15.	1
10	93-T57-4 †	WASHER – CHOKE SHAFT PACKING For 1, 2, 3, 14, 15.	1

PARTS LIST
L-57, L-77 Series

Model 87A8 ZENITH CARBURETOR

Item No.	Part Number	Description	No Req
11	93-T2158	NUT, Clamp Screw for 1, 2, 3, 4, 5, 14	1
12	93-C63-9	PIN, Washer Retaining for 1, 2, 3, 14, 15	1
13	93-C130-4	WASHER, Shaft Thrust for 1, 2, 3, 14, 15	1
14	93-T52-57 †	RETAINER, Throttle Shaft Packing (One required for 4, 5)	2
15	93-T48-9 †	SEAL, Throttle Shaft (One additional for 4, 5)	2 1
16	93-C9-75	BUSHING, Throttle Shaft	2
17	93-C46-49 †	NEEDLE, Idle Adjusting	1
18	93-C111-155	SPRING, Adjusting Needle	1
19	93-C21-42	PLATE, Throttle	1
20	93-T31555-4 †	SCREW, Throttle Plate	2
21	N. S. S.	ROLL PIN, Throttle Lever	1
22	93-T858-10	SCREW, Lever Stop	1
23	93-CR27-241 93-CR27-241-1 93-CR27-307 93-CR27-451	LEVER and STOP, Throttle for 1, 2, 4 LEVER and STOP, Throttle for 14, 15 LEVER and STOP, Throttle for 3 LEVER and STOP, Throttle for 5	1 1 1 1
24	93-C29-1037 93-C29-1429 93-C29-1386 93-C29-1688 93-C29-1886	SHAFT and LEVER, Throttle for 1, 2 SHAFT and LEVER, Throttle for 3 SHAFT and LEVER, Throttle for 14, 15 SHAFT and LEVER, Throttle for 4 SHAFT and LEVER, Throttle for 5	1 1 1 1 1
25	N. S. S.	SHAFT, Throttle	1
Not Illust.	93-T52-24	WASHER – THROTTLE LEVER SPACER For 14, 15	1
26	N. S. S.	BODY, Throttle	1
27	93-CR37-1x1 †	PLUG, Choke Shaft Hole for 1, 2, 3, 4, 5, 14 (One additional in Throttle Shaft Hole for 4, 5)	1 1
28	93-C102-113 93-C102-123 93-C102-129	PLATE, Choke for 1, 2, 3, 4, 5 PLATE, Choke for 14 PLATE, Choke for 15	1 1 1
29	93-T31555-4 †	SCREW, Choke Plate	2
30	93-T56-20 †*	FIBER WASHER, Fuel Valve Seat	1
31	93-C81-17-35 † 93-C81-66-35 †	VALVE and SEAT, Fuel for 1, 2, 3, 14. 15 VALVE and SEAT, Fuel for 4, 5	1 1
32	93-C66-96-40 93-C66-104-42 93-C66-104-45 93-C66-124-40	JET, Discharge for 1 JET, Discharge for 2, 3, 4 JET, Discharge for 14, 15 JET, Discharge for 5	1 1 1 1
33	93-T56-73 †*	FIBER WASHER, Well	1
34	93-C76-50-1	WELL, Metering	1
35	93-C120-18 † 93-C120-81 †	AXLE, Float for 1, 2, 3, 14, 15 AXLE, Float for 4, 5	1 1
36	93-C85-97	FLOAT ASSEMBLY	1
37	93-C142-55 †*	GASKET, Bowl to Body	1
38	93-C52-2-12	JET, Idle	1
39	93-B3-98A 93-B3-129A	BOWL, Fuel for 1, 2, 3, 4 BOWL, Fuel for 5, 14, 15	1 1
40	93-T56-24 †*	FIBER WASHER, Main Jet	1
41	93-C52-7-29 93-C52-7-34 93-C52-7-38 93-C52-7-41	JET, Main for 5 JET, Main for 1 JET, Main for 2, 3, 4 JET, Main for 14, 15	1 1 1 1
42	93-T56-23 †*	FIBER WASHER, Passage Plug	1
43	93-C138-24	PLUG, Main Passage	1
44	93-T91-1	PLUG, 1/8" Pipe (Bowl Drain)	1
45	93-T3015S8-14	SCREW, Bowl to Body (Long)	2
46	93-T3015S8-9	SCREW, Bowl to Body (Short)	1
47	QC-12-A †	GASKET, Flange (Zenith C141-4-6)	3
(Not Illust.)	93-C162-71	AUTO. CHOKE ASSEMBLY for 15	1
	93-B190-30A	AUTO. CHOKE ADAPTER ASS EM. for 15	1
	93-C146-25	AUTO. CHOKE ADAPTER GASKET for 15	1
	93-C181-296	GASKET SET	1
	LQ-37	REPAIR KIT for 1, 2, 3, 14, 15	1
	93-K2212	REPAIR KIT for 4, 5	1

† Parts Included in Repair Kit

* Gasket Set

N. S. S. Not Sold Separately

NOTE: The Idle Air Bleed Bushing and Well Vent Bushing are calibrated parts of the Throttle Body (Item 26) and are not readily removable.

YB-69 ALTERNATOR

Engine Model V-465D

5PECIFICATIONS

VOLTS - 12	VENTILATED - Yes	RATED OUTPUT - 37 Amperes
BRUSHES - 2	CONTROL - Voltage Regulator	ROTATION - Clockwise at drive end

LUBRICATION - Bearings are pre-lubricated. No additional lubrication necessary.

PRECAUTIONS:

Observe proper polarity when installing battery; negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator.

As a precautionary measure, disconnect ground battery terminal when charging battery in vehicle. Connecting charger in reverse will destroy, the rectifier diodes in the alternator.

Do Not, under any circumstances, short the field terminal of the alternator to ground, as permanent damage to the regulator may occur.

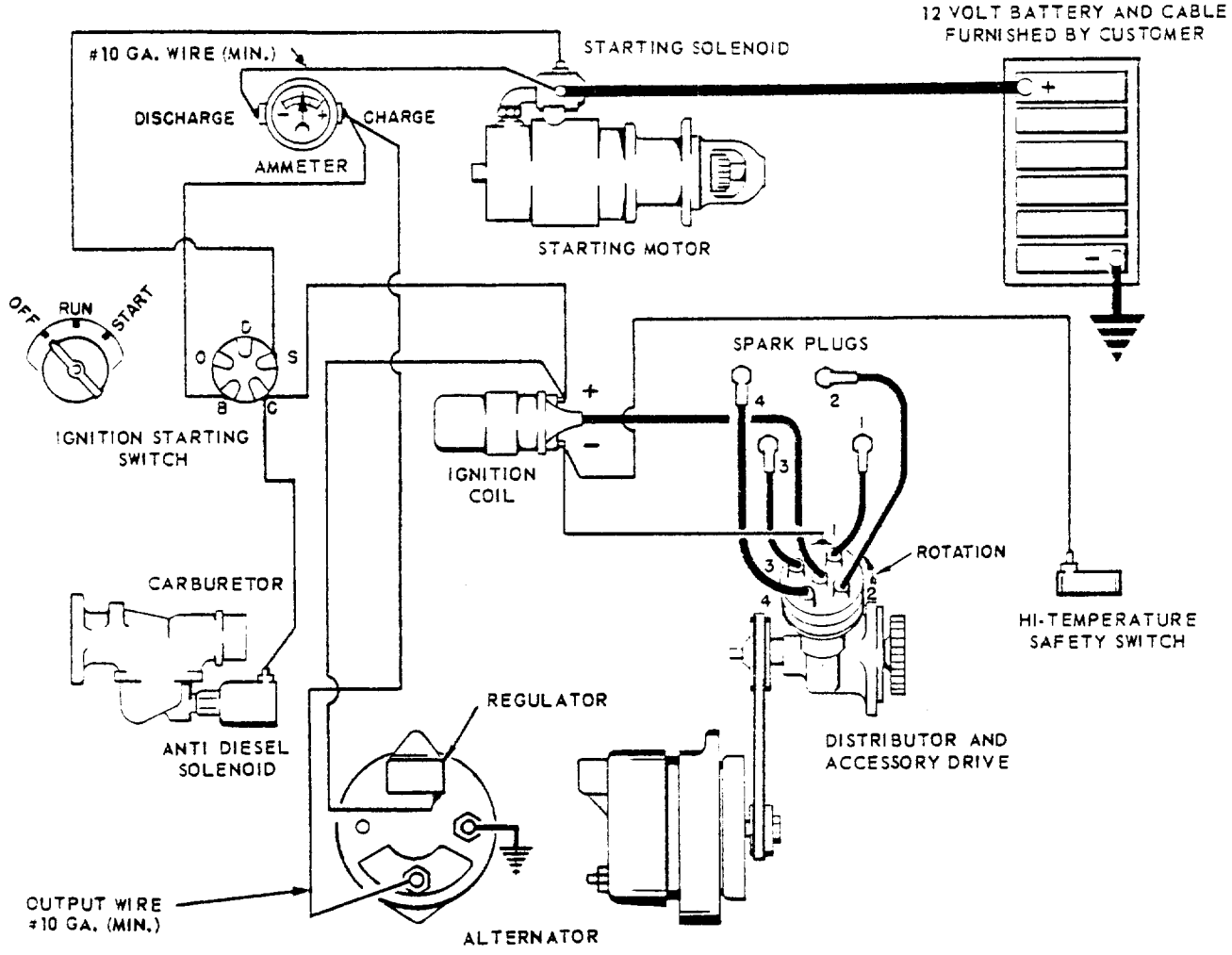
Do Not, remove the alternator from the vehicle without first disconnecting the grounded battery cable.

Do Not, operate engine with battery disconnected, or disconnect the alternator output lead while the alternator is operating, as damping effect of the battery will be lost. The voltage will rise to an extreme value and permanent damage to the regulator may occur.

Do Not, disconnect the voltage regulator while the alternator is operating, because the large voltage transient that occurs when disconnection takes place may damage the regulator.

Caution: Output wires from Alternator to Ammeter, and from Ammeter to battery terminal on starting solenoid must be of sufficient size for charging 37 amps. Use No. 10 gage stranded wire, or larger.

FIG. B-104. *WIRING DIAGRAM*



YB 69 ALTERNATOR

Part No. RA 12N451

SERVICE INSTRUCTIONS - In Motorola Automotive Products Inc., RA Series Alternator Systems, 25-49 Service Manual. MOTOROLA AUTOMOTIVE PRODUCTS INC., 9401 W. GRAND AVE., FRANKLIN PARK, ILLINOIS.

SERVICE PARTS - Except for Drive Pulley, Ref. 3, and Regulator, Ref. 29, all other Alternator components should be ordered from a Motorola Automotive Products Distributor or Dealer.

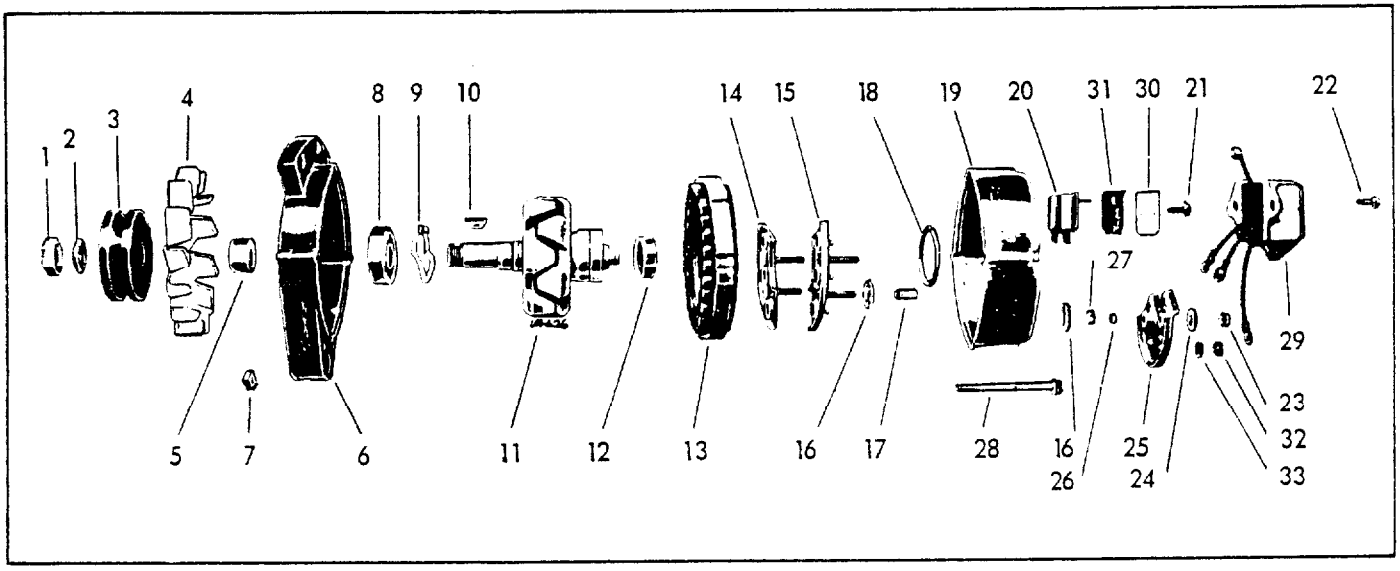


FIG. B-105

Ref No	Motorola Part No.	Description	No Req
1	20-136	NUT, pulley mounting, 5/8-18 thread, hex.	1
2	20-5	WASHER, splitlock, 5/8"	1
3	MD 405 Wisconsin Part No.	PULLEY, drive	1
4	7-8	FAN, normal rotation (clockwise)	1
5	20-92	SPACER, fan and pulley, 7/16"	1
6	14-1	HOUSING, front	1
7	20-3	NUT, square, No. 10-32 thread	4
8	11-21	BEARING, front	1
9	11-3	RETAINER, front bearing	1
10	20-7	WOODRUFF KEY, No. 5	1
11	12-1	ROTOR ASSEMBLY	1
12	11-23	BEARING, (No. 202) sealed	1
13	13-1	STATOR ASSEMBLY	1
14	1-2	DIODE ASSEMBLY, rectifying, negative (black printing)	1
15	1-1	DIODE ASSEMBLY, rectifying, positive (red printing)	1
16	15-3	INSULATING WASHER, No. 10 x 3/4 O.D.	5
17	15-1	INSULATOR SLEEVE, nylon, 19/32" long	2
18	11-25	RETAINER, rear bearing	1
19	14-18	HOUSING, rear	1
20	3-1	BRUSH ASSEMBLY	1
21	20-32	SCREW, tapping, No. 8 x 1/2"	2
22	20-99	SCREW, tapping, No. 10 x 1/2" (with lockwasher)	3
23	20-33	LOCKNUT, hex., No. 10-24 thread	6
24	15-4	INSULATING WASHER, No. 10 x 1/2" O.D.	1
25	1-29	DIODE ASSEMBLY, isolation	1
26	15-2	INSULATOR SLEEVE, nylon, 3/32" long	1
27	20-34	NUT, hex., No. 10-24 thread	2
28	20-1	BOLT, machine, No. 10-32 x 2-7/8" long	4
29	YJ 53 Wisconsin Part No.	REGULATOR, Model 8RF 2011A	1
30	3-6	COVER, brush holder	1
31	3-13	SHIELD, dust	1
32	20-146	NUT, terminal, 1/4"-20 thread, hex.	1
33	20-62	WASHER, terminal, 1/4" split-lock	1

Magneto Service Instructions

No. Y-128-S1 –
For Engine Models V-461D and V-465D

GENERAL DESCRIPTION

Type FM-X4B7D Magneto is designed and engineered to provide quick easy starting and maximum dependability of operation with minimum service. The compact alnico magnetic rotor assures an intensely hot spark under most operating conditions.

SERVICE PROCEDURE

The first step in magneto field servicing is to examine the magneto for corroded high tension towers, broken wires, or high tension wires not pushed far enough into the magneto tower to make good contact.

Then test the ignition spark while the engine is being cranked. Hold the ignition wire 1/4 in. away from the engine block. If a strong spark is observed, the magneto is not the cause of the engine malfunction. If no spark is seen, proceed with servicing the magneto.

SERVICING BREAKER POINTS

Remove the end cap cover, distributor rotor and the end cap. Then inspect the breaker points for pitting, oxidation and shorting. If points are worn or shorted, they should be replaced.

To remove the point set, take out the breaker arm terminal screw releasing the breaker arm spring, coil lead and condenser lead. Remove the fulcrum pin snap ring and slide the breaker arm off the fulcrum pin. Remove the contact support locking screws and lift off the contact support.

The installation of new points is the reverse of the removal. After the points have been installed, they should be adjusted to the correct clearance of *0.015 inch* at high point of cam. Be sure the points are clean and bright before adjusting them. Insert a screwdriver in the slot of the support bracket and pivot it between the two small bosses on the bearing support until the desired clearance is obtained. Then clean the points again before sealing the magneto.

FIELD SERVICE NOT RECOMMENDED

The cam wick, if dry or hard, should be replaced with a new factory impregnated wick. Other than this the Type FM-X4B7D Magneto does not require field lubrication. No attempt should be made to oil or grease the magneto bearings. The magneto lubricant should be replaced only during the overhaul of the magneto by an authorized service station using recommended lubricant and factory engineered parts.

Coil and condenser replacement while simple are not recommended unless adequate test equipment is available. Under no circumstances should any attempt be made to remove the magnetic rotor from the housing unless specific instructions for releasing the shaft are available.

TIMING THE MAGNETO TO THE ENGINE

If the magneto has been removed from the engine for servicing, the operator must follow the engine manufacturer's instructions for timing the magneto to the engine. Refer to '*Magneto Timing*' in engine instruction manual. When installing the magneto on the engine, be sure the magneto is properly attached and that the housing to engine gasket is in good condition.

SPECIAL DRIVE GEAR

The magneto is equipped with a special drive gear mounted directly on the impulse coupling. If it is necessary at any time to remove the drive gear, special care must be exercised in reassembly. It is possible to be off 180° in mounting the gear, with relation to the correct location of the timing mark on the gear.

Assemble gear as follows: Remove magneto end cap cover and turn distributor rotor until it is in firing position for No. 1 cylinder, as illustrated in Fig. B-106. Retain rotor in this position and fit the drive gear to the impulse coupling lugs so that the prick punch mark on front of gear is located as shown.

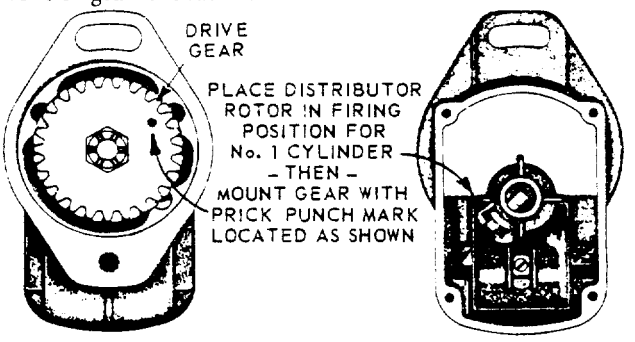
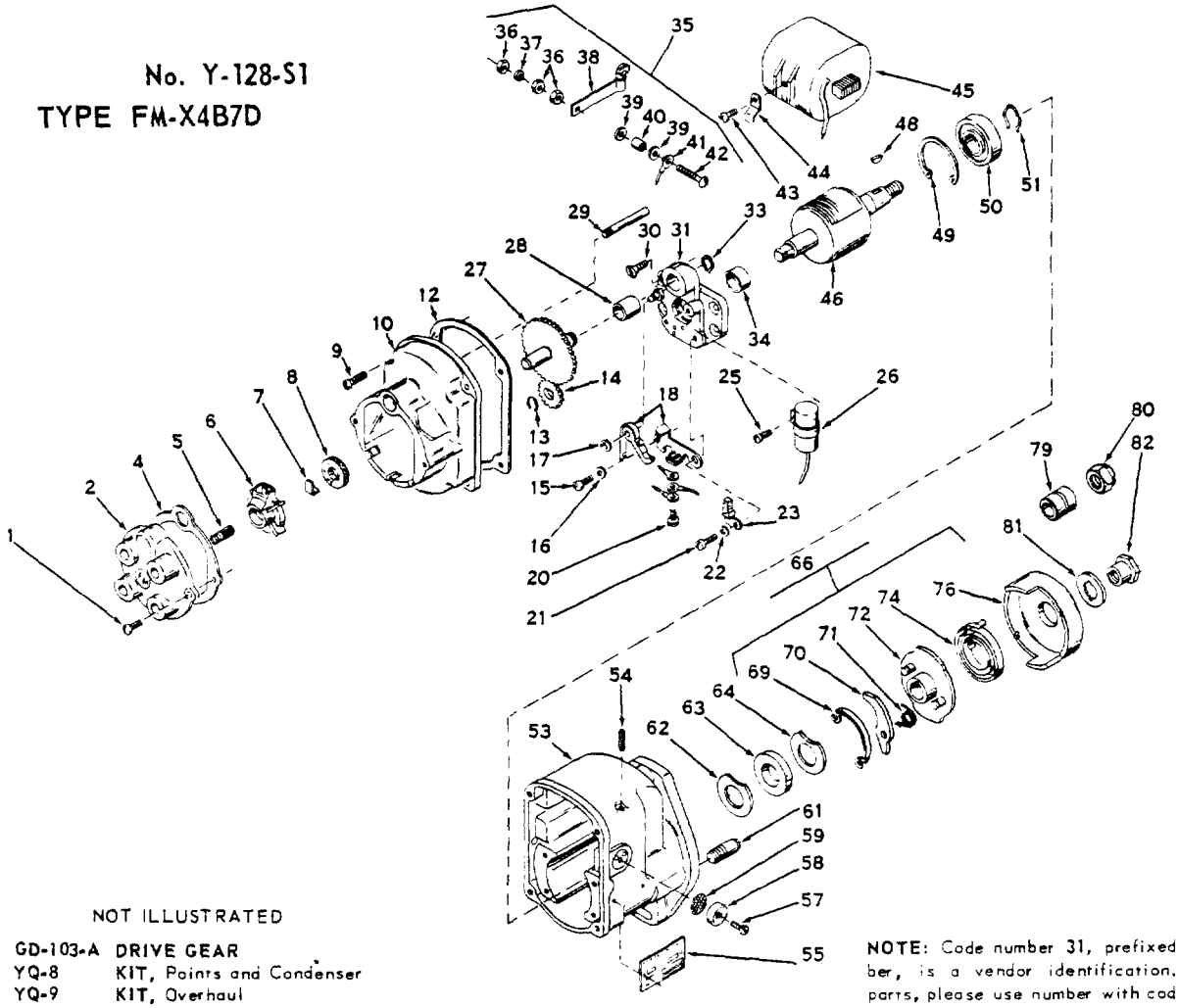


Fig. B-106. DRIVE GEAR MARKING AND ASSEMBLY

FIG. B-107. MAGNETO PARTS LIST

No. Y-128-S1
TYPE FM-X4B7D



NOT ILLUSTRATED

GD-103-A DRIVE GEAR
YQ-8 KIT, Points and Condenser
YQ-9 KIT, Overhaul

NOTE: Code number 31, prefixed to the part number, is a vendor identification. When ordering parts, please use number with code as shown.

Ref. No.	Part Number	Description	No. Req
1	31-8S9D	SCREW, cover, 8-32x9/16	2
2	31-W800	COVER, end cap	1
4	31-B682	GASKET, end cap cover	1
5	31-E2460B	BRUSH and SPRING	1
6	31-M2765	DISTRIBUTOR ROTOR	1
7	31-A2766	SPRING CLIP, rotor	1
8	31-G2501	SEAL, shaft	1
9	31-10814D	SCREW, end cap, 10-24x7/8	4
10	31-GY2430	END CAP	1
12	31-H2498	GASKET, end cap	1
13	31-D1498	SNAPRING, rotor gear	1
14	31-Q5952	ROTOR GEAR	1
15	31-6S6U	SUPPORT SCREW, 6-32x3/8	1
16	31-D2458	WASHER, support screw, #6	1
17	31-C1498G	SNAPRING, tulcrum pin	1
18	31-A2437A	POINT SET—clockwise	1
20	31-6S6Z	TERMINAL SCREW, 6-32x3/8	1
21	31-8S6U	SUPPORT SCREW, 8-32x3/8	1
22	31-B5969	WASHER, support screw, #8	1
23	31-G2788	CAM WICK—clockwise	1
25	31-8S5NA	SCREW, condenser, 8-32x5/16	1
26	31-AXMR2433	CONDENSER	1
27	31-Y5939	SHAFT and GEAR, distributor	1
28	31-D5950C	BEARING, distributor	1
29	31-J983A	LEAD ROD	1
30	31-8S6G	SUPPORT SCREW, 8-32x3/8	4
31	31-X4631	SUPPORT, bearing	1
33	31-G1498	SNAPRING, distributor shaft	1
34	31-A5950A	BEARING, cam end	1
35	31-12514C	SWITCH, assembly	1
36	31-8N1	NUT, switch screw	3
37	31-8LW5	LOCKWASHER, switch screw	1

Ref. No.	Part Number	Description	No. Req.
38	31-M2514	INSULATED LEVER	1
39	31-C6018	INSULATING WASHER	2
40	31- K2457A	INSULATING BUSHING	1
41	31- J2499A	WIRE assembly	1
42	31-8S14N	SCREW, switch, 8-32 x 7/8	1
43	31-6S4U	SCREW, clip, 6-32 x 1/4	1
44	31-D6120	COIL CLIP	1
45	31-R2477C	COIL	1
46	31-PZ2480	MAGNETIC ROTOR	1
48	31-3K1	KEY	1
49	31-B1498B	SNAPRING, bearing	1
50	31-C5949	BEARING, drive end	1
51	31-B1498D	SNAPRING, shaft	1
53	31-XU2425	HOUSING	1
54	31-31SS14A	SET SCREW, coil — 5/16-24 x 7/8	2
55	31-A195	NAMEPLATE	1
57	31-6S4U	SCREW, cover, 6-32 x 1/4	2
58	31-B6030A	VENT COVER	1
59	31-C6032B	VENT SCREEN	2
61	31-S2568	STOP PIN, pawl	1
62	31-A2492C	WASHER, seal (inner)	1
63	31-G3861	SAFT SEAL	1
64	31-A2492A	WASHER, seal (outer)	1
66	31-UU2563C-18	COUPLING, complete (18° lag angle)	1
69	31-A1498J	LOCK SPRING, pawl	1
70	31-Q2566	COUPLING PAWL	
71	31-S5963	PAWL SPRING	2
72	31-S2563-18	HUB, assembly (18° lag angle)	1
74	31-E2565	COUPLING SPRING	1
76	31-AZ5957	COUPLING SHELL	1
79	31-F2572	GEAR BUSHING	1
80	31-M2570	COUPLING NUT	1

PARTS LIST
L-57, L-77 Series

MODEL 87A8 CARBURETOR

Item No.	Part Number	Description	Req.
11	93-T2158	NUT, Clamp Screw for 1, 2, 3, 4, 5, 14	1
12	93-C63-9	PIN, Washer Retaining for 1, 2, 3, 14, 15	1
13	93-C130-4	WASHER, Shaft Thrust for 1, 2, 3, 15	1
14	93-T52-57 †	RETAINER, Throttle Shaft Packing (One required for 4, 5)	2
15	93- T48-9 †	SEAL, Throttle Shaft (One additional for 4, 5)	2 1
16	93-C9-75	BUSHING, Throttle Shaft	2
17	93-C46-49 †	NEEDLE, Idle Adjusting	1
18	93-C111-155	SPRING, Adjusting Needle	1
19	93-C21-42	PLATE, Throttle	1
20	93-T31555-4 †	SCREW, Throttle Plate	2
21	N. S. S.	ROLL PIN, Throttle Lever	1
22	93-T858-10	SCREW, Lever Stop	1
23	93-CR27-241 93-CR27-241-1 93-CR27-307 93-CR27-451	LEVER and STOP, Throttle for 1, 2, 4 LEVER and STOP, Throttle for 14, 15 LEVER and STOP, Throttle for 3 LEVER and STOP, Throttle for 5	1 1 1 1
24	93-C29-1037 93-C29-1429 93-C29-1386 93-C29-1688 93-C29-1886	SHAFT and LEVER, Throttle for 1, 2 SHAFT and LEVER, Throttle for 3 SHAFT and LEVER, Throttle for 14, 15 SHAFT and LEVER, Throttle for 4 SHAFT and LEVER, Throttle for 5	1 1 1 1 1
25	N. S. S.	SHAFT, Throttle	1
Not Ill.	93-T52-24	WASHER - THROTTLE LEVER SPACER For 14, 15	1
26	N. S. S.	BODY, Throttle	1
27	93-CR37-1x1 †	PLUG, Choke Shaft Hole for 1, 2, 3, 4, 5, 14 (One additional in Throttle Shaft Hole for 4, 5)	1 1
28	93-C102-113 93-C102-123 93-C102-129	PLATE, Choke for 1, 2, 3, 4, 5 PLATE, Choke for 14 PLATE, Choke for 15	1 1 1
29	93-T31555-4 †	SCREW, Choke Plate	2
30	93-T56-20 †	FIBER WASHER, Fuel Valve Seat	1
31	93-C81-17-35 † 93-C81-66-35 †	VALVE and SEAT, Fuel for 1, 2, 3, 14, 15 VALVE and SEAT, Fuel for 4, 5	1 1
32	93-C66-96-40 93-C66-104-42 93-C66-104-45 93-C66-124-40	JET, Discharge for 1 JET, Discharge for 2, 3, 4 JET, Discharge for 14, 15 JET, Discharge for 5	1 1 1 1
33	93-T56-73 †	FIBER WASHER, Well	1
34	93-C76-50-1	WELL, Metering	1
35	93-C1 20-18 † 93-C120-81 †	AXLE, Float for 1, 2, 3, 14, 15 AXLE, Float for 4, 5	1 1
36	93-C85-97	FLOAT ASSEMBLY	1
37	93-C142-55 †	GASKET, Bowl to Body	1
38	93-C52-2-12	JET, Idle	1
39	93-83-98A 93-83-129A	BOWL, Fuel for 1, 2, 3, 4 BOWL, Fuel for 5, 14, 15	1 1
40	93- T56-24 † *	FIBER WASHER, Main Jet	1
41	93-C52-7-29 93-C52-7-34 93-C52-7-38 93-C52-7-41	JET, Main for 5 JET, Main for 1 JET, Main for 2, 3, 4 JET, Main for 14, 15	1 1 1 1
42	93-T56-23 † *	FIBER WASHER, Passage Plug	1
43	93-C138-24	PLUG, Main Passage	1
44	93-T91-1	PLUG, 1/8" Pipe (Bowl Drain)	1
45	93-T30158-14	SCREW, Bowl to Body (Long)	2
46	93-T30158-9	SCREW, Bowl to Body (Short)	1
47	QC-12-A †	GASKET, Flange (Zenith C141-4-6)	3
(Not Illust.)	93-C162-71	AUTO. CHOKE ASSEMBLY for 15	1
	93-8190-30A	AUTO. CHOKE ADAPTER ASSEM. for 15	1
	93-C146-25	AUTO. CHOKE ADAPTER GASKET for 15	1
	93-C181-296	GASKET SET	1
	LQ-37	REPAIR KIT for 1, 2, 3, 14, 15	1
	93-K2212	REPAIR KIT for 4, 5	1

† Parts included in Repair Kit

* Gasket Set

N. S. S. Not Sold Separately

NOTE: The Idle Air Bleed Bushing and Well Vent Bushing are calibrated parts of the Throttle Body (Item 26) and are not readily removable.

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Commander
US Army Armament, Munitions and Chemical Command
ATTN: DRSMC-MAS (R)
Rock Island, IL 61299

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

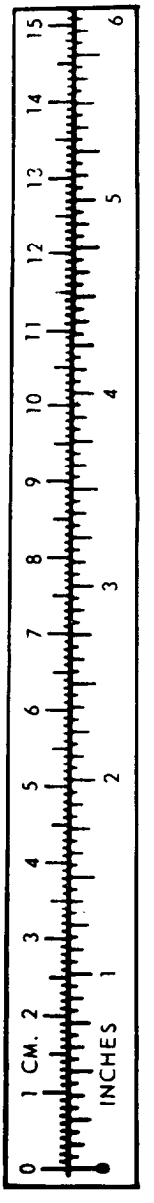
TEMPERATURE

$5/9\ (^0F - 32) = {}^0C$
212^0 Fahrenheit is equivalent to 100^0 Celsius
90^0 Fahrenheit is equivalent to 32.2^0 Celsius
32^0 Fahrenheit is equivalent to 0^0 Celsius
$9/5\ C^0 + 32 = F^0$

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	**Miles per Hour**	0.621



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