WINCO®
GENERATORS

PACKAGE STANDBY 20 KW LPG/NG

80781-4 Block Heater 1000 w/230 v

INSTALLATION, OPERATION, and MAINTENANCE INSTRUCTIONS

63889-0 Block Heater Instal. LP/NG
63767-0 LP/NG Fuel System
63945-0 LPG Fuel System
53879-0 Fuel Strainer
63821-0 Fuel System Kit

This manual covers models:
APS20000-B
APS20000-4/B
APS20000-17/B
APS20000-BX
APS20000-4/BX
APS20000-17/BX
APS20000-C
APS20000-4/C
APS20000-17/C

Attention: Read instructions carefully before attempting to install, operate or service the WINCO generator. Protect yourself and others by observing all safety information and additional instructions included with this equipment. Failure to comply with instructions could result in personal injury and/or property damage. Retain instructions for future reference.

Index

NOTE: This instruction book covers only the generator, **not** the engine. See the engine manufacturer's operator's manual regarding any problems pertaining to the engine.

Testing Policy

Before any generator is shipped from the factory, it is fully checked for performance. The generator is loaded to its full capacity, and the voltage, current, and frequency are carefully checked. A test card with this data is filed by unit serial number of permanent record for performance.

Rated output of generators is based on factory tests of typical units, and is subject to, and limited by, the temperature, altitude, fuel, and other conditions specified by the manufacturer of the applicable engines.

Introduction

The package standby engine-generator set includes all items necessary for a completely automatic standby power system as standard equipment. The components are mounted on one common skid base, connected and wired. The entire package is then tested to insure proper operation of all components and the total systems performance and reliability.

Description

This packaged power system is designed to automatically provide standby power to unattended loads during electrical outages. Upon an interruption of normal electrical service, this packaged power system's electrical control circuits will automatically start the engine. The generator will produce electrical power and the automatic transfer switch (ATS) will automatically transfer the electrical loads to the engine-generator set. Upon restoration of normal electrical service, the emergency transfer switch will sense return of the normal commercial power. The engine fuel supply and ignition will be shut off automatically and the engine will stop. The load control circuit will retransfer the load back to normal commercial power source.

The packaged power system consists of three major parts:

1. A 125 amp automatic transfer switch (ATS).
2. A 20,000 watt (20 KW) direct drive generator.
3. A four cylinder, water-cooled, LP/NG fueled engine.

The automatic transfer switch (ATS) consists of two double pole, electrically and mechanically interlocked power contactors. The ATS contains the power failure sensing circuitry, engine start/stop controls, load control/transfer equipment. An overcranking relay stops the start sequence if the engine fails to start in approximately one minute (to protect the battery and starter). A battery trickle charger is provided during normal electrical service. The control selector switch has three positions:

A. Stop—used whenever the unit is to be serviced and for emergency shut down.
B. Automatic—normal position for emergency standby service.
C. Check—this position enables the owner/ operator to exercise and/or check the engine-generator set without transferring the load, unless a power outage occurs.

The generator is a 20 KW (20,000 Watt), 3600 rpm direct drive, brush type, revolving armature design. The generator is self excited and inherently regulated to +/− (plus or minus) 7%—no load to rated load. It can be operated under any load within its rating without being damaged. The frequency regulation is maintained by the engine governor within 3 cycles variation (61.5 Hz - 58.5 Hz) no load to rated load.

The engine is water-cooled and equipped with a standard alternator charging system. The engine is also equipped with an automotive type starter and a LP/NG vapor fuel carburetor. The fuel system can be adjusted for either LP (propane) vapor or NG (natural gas) operation. The engine operates at 3600 rpm and drives the generator through a flex disc drive system attached directly to the flywheel.

Specifications

Generator

Model	Watts	Volts	Amps	Hz	Ph	RPM	Insulation
APS20000-B*	20,000	120/240	83.3	60	1	3600	Class F
APS20000-4/B*	20,000	120/208	55.6	60	3	3600	Class F
APS20000-17/B*	20,000	120/240	48.2	60	3	3600	Class F
APS20000-BX*	20,000	120/240	83.3	60	1	3600	Class F
APS20000-4/BX*	20,000	120/208	55.6	60	3	3600	Class F
APS20000-17/BX*	20,000	120/240	48.2	60	3	3600	Class F
APS20000-C	20,000	120/240	83.3	60	1	3600	Class F
APS20000-4/C	20,000	120/208	55.6	60	3	3600	Class F
APS20000-17/C	20,000	120/240	48.2	60	3	3600	Class F

*This manual covers limited production /B & /BX models with special generator adapter housings. (See parts list for parts notes.) Be sure to mention complete model and serial number when ordering parts.

Engine Specifications

Ford 1.1 Liter, water-cooled engine. This manual covers the generator and transfer switch portion of these units. See the separate engine instruction manual for engine-related problems, detailed engine information and engine warranty.

CAUTION Be sure to check the engine oil level frequently, as specified in the engine manual.

The engine manufacturer has established an excellent world-wide engine service organization; engine service is very likely available from a nearby authorized dealer or distributor; check the yellow pages of the telephone directory under "engines," or ask the dealer from whom you purchased the power plant.

The rated power of each engine-generator is subject to, and is limited by, the temperature, altitude and all other ambient conditions specified by the engine manufacturer. Engine power will decrease 3½% for each 1000 ft. above sea level, and will decrease an additional 1% for each 10 degrees Fahrenheit above 60 degrees Fahrenheit.

Fuel Consumption

Natural Gas (1,000 BTU/CU ft)		
CU'/hr	BTU/hr	#/hr
465	465,000	19.4

LP Vapor (2,520 BTU/CU ft)		
Gal/hr	CU'/hr	BTU/hr
4.6	165.9	418,264

Recommended tank size for LP Vapor operating at various temps.

60°F/16°C	32°F/O°C	0°F/-18°C	-20°F/-29°C
110 Gal.	200 Gal.	500 Gal.	1,500 Gal.

Unpacking Instructions

NOTE: When unpacking the generator set, be sure to inspect it carefully for freight loss or damage. If loss or damage is noted at the time of delivery, require that the person making the delivery make note of the loss or damage on the freight bill, or affix his signature under the consigner's memo of the loss or damage. Contact the carrier for claim procedures.

When loss or damage is noted after delivery, segregate the damaged material, and contact the carrier for claim procedures.

"CONCEALED DAMAGE" is understood to mean damage to the contents of a package which is not in evidence at the time of delivery by the carrier, but which is discovered later. The carrier or carriers are responsible for merchandise lost or damaged in transit. The title to goods rests with the consignee when generators are shipped FOB factory, and only the consignee can legally file claims.

Unpacking

1. Remove box strapped to the top of the crate.
2. Carefully dismantle crate.
3. After inspecting the engine-generator for external physical damage, check for the following items packed inside the cardboard box:
   a. Flex Exhaust
   b. Mounting Bracket
   c. Bag of Hardware
   d. Muffler
   e. Heat Shields
   f. Installation instructions
4. Locate the engine exhaust pipe is strapped to the battery tray support.
5. Remove main frame hold down bolts, (4).
6. Unit can now be removed from shipping pallet.

Safety Information

CAUTION Indicates any condition or practice, which if not strictly observed or remedied, could result in damage or destruction of the equipment.

Indicates any condition or practice, which if not strictly observed, COULD RESULT IN personal injury or possible LOSS OF LIFE.

Despite the safe design of this generator, neglecting its maintenance, or being careless with it can cause serious injury or death. This generator is powerful enough to deliver a fatal electric shock. Allow only a responsible and capable person to operate this generator.

1. Installing and wiring a home-standby generator installation is not a "do-it-yourself" project. Consult a qualified, licensed electrician or contractor. The installation must comply with all national, state, and local codes.
2. NEVER allow anyone to operate the generator without proper instruction.
3. NEVER touch live terminals or receptacles.
4. ALWAYS properly ground this engine generator set.
5. ALWAYS use caution and remain alert when using this generator. Hot engine parts, moving parts, and generator output all can seriously injure the generator operator.
6. ALWAYS keep all safety guards and power shields in position and tightly secured while equipment is operating.

7. NEVER wear neckties, loose articles of clothing, or anything else that can be caught in moving parts when operating this generator.
8. ALWAYS provide adequate ventilation for engine exhaust and fuel vapors that may leak through fittings or damaged pipes. Engine exhaust fumes are deadly. Do not inhale them. Be sure the generator itself is well ventilated for maximum performance and life.
9. ALWAYS use only qualified electrical technicians to service (install, maintain, repair, or replace parts) in this generator. Use only factory approved repair parts when repairing this unit.
10. NEVER work on this generator (or other potentially hazardous equipment) when fatigued or under the influence of alcohol or other drugs.
11. ALWAYS use extreme caution when working on electrical components. High generator output voltage can cause serious injury or death.
12. ALWAYS keep the generator and the area around it clean. Remove all material that can create slippery conditions, such as grease, water, ice, and snow. Also, remove oily rags and other flammable material from the area.
13. ALWAYS keep a fire extinguisher near the generator. Extinguishers rated ABC by the NFPA are appropriate for this use. Consult the local fire department if you have questions regarding fire extinguisher ratings. Keep the extinguisher properly maintained and be familiar with its proper use.

Installation

Before proceeding with the installation check your incoming service (voltage and phase) to be sure it matches your generator. Below is a table of the voltage reading for each of the different connecting patterns.

Single Phase	
120 Volts L1 - N 120 Volts L3 - N	240 Volts L1 - L3

Three Phase WYE	
120 Volts L1 - N 120 Volts L2 - N 120 Volts L3 - N	208 Volts L1 - L2 208 Volts L2 - L3 208 Volts L3 - L1

Three Phase Delta	
120 Volts L1 - N 120 Volts L2 - N 208 Volts L3 - N	240 Volts L1 - L2 240 Volts L2 - L3 240 Volts L3 - L1

If your incoming power is:	Your generator model should be:
120/240 Single Phase 120/208 Three Phase WYE 120/240 Three Phase Delta	APS20000-C APS20000-4/C APS20000-17/C

If these do not match or you have a question contact the dealer from which you purchased the unit.

Before proceeding with the installation, be sure the operation selector switch is always in the STOP position.

Also, before beginning the installation process, recheck the rating of the generator set, associated control panel, and switch/gear. Be certain they can handle the intended load and are compatible with the current ratings. Plans for installation should be prepared with proper attention to mechanical and electrical engineering detail to assure a satisfactory system installation. The information in this manual is offered as a guide to finalizing your installation plans. The installation sequence is summarized below:

Plan the Installation:

1) Space required
2) Location
3) Floor loading
4) Moisture and dirt
5) Heat and cold
6) Exhaust

Mounting generator system
Ventilation of room for engine and generator
Engine exhaust system and piping
Fuel installation
Engine service (oil and air cleaner checks)
Battery connection
Initial system start-up
Electrical connections

Plan the Location (Refer to fig. 2 for typical installation)

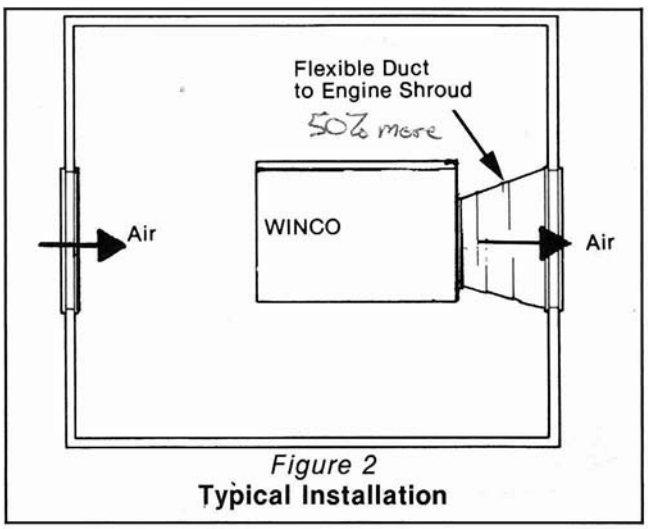


Figure 2
Typical Installation

Space Required
Minimum room size must allow for three (3) feet of service, operation and maintenance access on 3 sides. The fourth side (radiator end) must be near an outside wall to simplify ducting the hot radiator discharge outside.

Location
Locate as close to electrical service and fuel source as possible. This will reduce the cost of electrical and fuel runs. Position the unit to keep the exhaust runs as short as possible. Protection from adverse weather conditions must be provided without restricting adequate ventilation for cooling. Planning now will eliminate costly errors that will have to be corrected later at a considerably higher expense.

Floor Loading
Floor type and loading should be taken into consideration when installing an engine-generator set.

Moisture and Dirt
All electrical equipment should be protected from excessive moisture. Failure to do so will result in deterioration of the insulation and will result in short circuits and grounds.

Foreign materials such as dust, sand, lint and abrasive materials have a tendency to cause excessive wear, not only to the engine parts, but also to the generator parts, particularly the brushes. It is, therefore important that the unit be installed in a reasonably clean location for best service.

Heat and Cold
All engines give off considerable heat when they are running. Since the engines used on these generators are all water-cooled, it is important that the temperature of the room in which they are located does not exceed 105 degrees Fahrenheit while operating. Automatic louvers in doors, windows and/or walls are required to assist in providing adequate fresh air flow.

Engines start most easily when they are not subjected to extreme cold. Engine-generators which are installed to operate automatically preferably should be located where the temperature does not fall below freezing. If installation is in a very cold environment it is advisable to install an engine block heater on the unit.

Exhaust
Exhaust gases from gasoline engines are extremely poisonous. Whenever an engine is installed indoors, the exhaust fumes must be vented to the outside.


Carbon Monoxide Gas

Remember that the exhaust fumes from any gasoline (or any other internal combustion type) engine are very poisonous if discharged in a closed room, but are not dangerous when well mixed in outside air. If the power plant is installed indoors, you must make provisions to carry the engine exhaust gas safely outdoors, as instructed in the following section, "exhaust installation."

Mounting

CAUTION The unit's main frame should be bolted solid to a 4 to 6 inch thick cement pad. The engine-generator is mounted on a sub-frame which is shock-mounted with special neoprene pads on the main frame. This allows the engine-generator to vibrate without affecting the control panel which is mounted on the main frame.

Do not shock mount the main frame. Engine vibration will be transmitted to the control panel causing erroneous start/stop cycles and premature control failure.

Ventilation of Room, Engine and Generator
This is an internal combustion water-cooled engine. This unit is equipped with a radiator which uses a pusher fan to cool the coolant. Therefore it will be necessary to duct the hot air discharge out of the building. The hot air discharge duct should be made of sheet metal with a flexible duct connection installed. (See Figure 2)

The flexible section is installed to allow vibration and flex movement of the engine. The air discharge duct should be air tight to the outside. The discharge end of the duct should have a screen or some other device to keep rodents out. Louvers can be used with satisfactory results.

Cool air inlet opening should be 1½ times as large as the radiator air out duct. The extra inlet area is needed to minimize restriction and to provide combustion air for the engine. This inlet should ideally be opposite the hot air exhaust, sweeping a flow of air across the entire machine. In addition to cooling the engine and providing fresh air this sweeping air flow will discharge any engine exhaust or fuel that may leak into the room, to the outside.

Thermostatically controlled vent in the roof or high wall can be added to help cool the upper area. These vents would be optional.

NOTE: Local weather conditions should be considered when choosing the type of louver.

Engine Exhaust and Piping
Engine exhaust adapter ('J' Pipe) Installation. The engine "J" pipe, mounting bracket and heat shield have been shipped loose, refer to the instructions

packed with them for installation of these parts.

Exhaust Piping

Personal Danger - Toxic Fumes

Engine exhaust gases are deadly and must be vented to the outside of any building.

Potential fire hazard, consult NFPA.

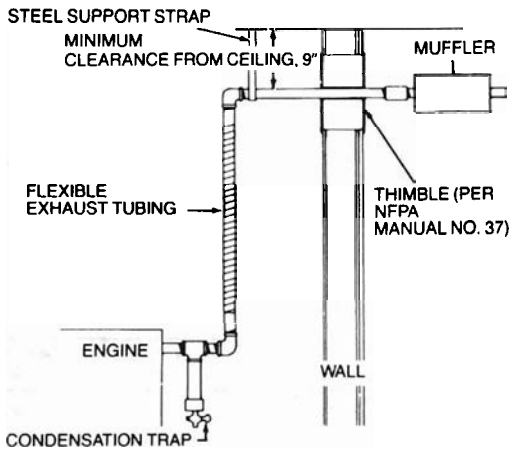


Figure 3
Exhaust Installation

Exhaust Installation - Refer to figure 3.
Use black iron pipe for straight exhaust runs. Use flexible metal exhaust hose if needed.

Personal Danger—Poisonous Fumes

Do not use galvanized pipe or electrical conduit. When heated by engine exhaust, these galvanized coatings give off potentially hazardous fumes.

Pipe running horizontally must be adequately supported by steel straps. Noise transfer can be kept to a minimum at the point of attachment.

Flexible exhaust tubing must be used to reduce engine vibration transfer to the exhaust and minimize stress on the exhaust manifold. It can be used horizontally, vertically, or at a slant, but must be kept fairly straight to prevent excessive strain on the welded end connections (do not use the flex exhaust connector as an elbow).

All exhaust installation should conform to state and local codes. Refer to NFPA (National Fire Protection Association) manual No. 37 for specific information. If the exhaust pipe passes through a wall or ceiling constructed of combustible material, the exhaust must be isolated or guarded to prevent fires, as specified in the NFPA manual.

The size of the exhaust pipe to be used depends upon the length of the exhaust run. The engine exhaust hole is 1½ inch NPT. To determine appropriate pipe size, refer to the following chart:

50'-100' 3½"

	LENGTH OF EXHAUST PIPE RUN			
	up to 5 ft.	5 to 25 ft.	25 to 50 ft.	Over 50 ft.
SIZE	1½" pipe	2" pipe	2½" pipe	not recommended

Exhaust pipe extension diameter must be as large or larger than engine exhaust port. See that the pipe extension is leakproof and runs in a straight line or with a minimum of sharp bends. Always slope the exhaust line downward away from the engine to prevent moisture condensation from entering the engine. If a turn must be made, use of 45 degree elbows are recommended.

If the exhaust pipe rises above the engine, a condensation trap should also be installed to prevent moisture from running into the engine and possibly damaging it. This is easily accomplished by installing an ordinary pipe "t" or "y" in the exhaust pipe as shown in fig. 1. At the lowest point of the exhaust pipe, install a short length of pipe pointing downward, and provide it with a drain plug to permit the accumulated moisture to drain out. Drain the trap at regular intervals to prevent it from becoming full and overflowing into the engine. Support the exhaust pipe two feet from the exhaust opening on the manifold; any length of pipe over two feet, (if not supported), may break the manifold casting.

Fuel Installation

Size and location of fuel system—The fuel supply should be as close as possible to the engine. This will reduce the installation cost of fuel runs. Refer to fuel section for proper installation requirements.

The information in this manual is offered to assist you in providing the proper fuel for your engine, however at all times, this information is only provided to inform you of the engine's requirements and assist in making you aware of the decisions you must make. In no case should the instructions or information provided be interpreted to conflict with any local, state or national codes. If in doubt, always consult your local fire marshal or gas supplier.

Propane (LP)/Natural Gas (NG) Fuel

The engine-generator sets are properly adjusted before they leave the factory. A tag is attached to the unit that specifies the fuel, natural gas (NG) or propane vapor (LP), that the unit was set up and tested on. A slight adjustment may be necessary on NG, depending on local BTU content. This adjustment will be discussed later.

Fire Hazard

All fuel runs should be installed by a qualified fuel supplier.

Installing The Fuel Line

Connect the fuel supply to the inlet of the fuel solenoid (see table for recommended line size). The pressure at the demand regulator must be 4 to 6 ounces PSI (per square inch) or 7 to 11 inches W.C. (water column).

CAUTION: When making gas connections be careful not to get excess sealing compound in the fuel line. Pipe joint compound can be drawn into the carburetor causing poor performance and hard starting.

Line Size

Personal Danger

Do not use galvanized pipe in fuel line runs. The galvanized coating can become erroded and flake off, causing possible obstructions in the regulator or fuel valve. The results could range from inoperative engine start to hazardous fuel leaks.

Unit location will determine the size of fuel line that is required to supply the engine with a constant fuel pressure. Refer to table 1 for fuel line size, fuel consumption and recommended tank size. For distances of 50 feet and over, we recommend a two regular fuel system. This is accomplished by installing a regulator at the tank which will reduce the tank pressure down to, 10-15 lbs. A second regulator is then installed as close as reasonably possible to the generator which reduces the fuel pressure down to 6 oz. It is then possible to use a 3/8 inch line from the tank to the second regulator for distances up to 300 feet. The appropriate line size from table 1 is then installed from the second regulator to the machine. Remember all pressure regulators installed must be capable of providing a minimum of 500,000 BTU per hour constantly at the input pressure you are utilizing. This 500,000 BTU per hour must also be at a constant pressure of 4 to 6 oz to the generators demand regulator. A drop in pressure to the demand regulator may cause the engine to hunt for the proper speed under load, or the engine may starve for fuel and not generate the full rated output.

Size of pipe normally required for generators operating on NG/LP gas:

Up - 30 ft.	30 - 100 ft.	Over 100 feet
1" pipe	1¼" pipe	not recommended use two regulator system

NOTE: Allow an additional 3 feet for each standard elbow. Do not use street ells. On very short runs a reservoir should be constructed of a 3 ft. section of 2" pipe with reducing bushings at both ends.

Fuel Pressure

Correct fuel pressure cannot be emphasized enough. The most common cause for inoperative systems is an inadequate or incorrect fuel pressure. Performance of the engine is in direct relation to the correctness of the fuel system. Shown below is a block diagram of a typical LP or NG installation.

Two Regulator Fuel System

Single Regulator Fuel System

Ref. Nos. 1 through 3 are fuel lines supplied by customer. (Shaded Area)
Ref. Nos. 4 and 5 are fuel lines already installed on your engine generator set.
Tables 1, 2, and 3 show fuel pressure readings at each reference in the system.

Table 1—**Fuel Pressure for LP Single Regulator**

	Ref. No. 1	Ref. No. 2	Ref. No. 3	Ref. No. 4	Ref. No. 5
Unit Off	Tank PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	0
Starting	Tank PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	(–) 1½ In. (WC)
No Load	Tank PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	(–) 1½ In. (WC)
Full Load	Tank PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	N/A

Table 2—**Fuel Pressure for LP Two Regulator System**

	Ref. No. 1	Ref. No. 2	Ref. No. 3	Ref. No. 4	Ref. No. 5
Unit Off	Tank PSI	10-15 Lbs.	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	0 0
Starting	Tank PSI	10-15 Lbs.	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	(–) 1½ In. (WC)
No Load	Tank PSI	10-15 Lbs.	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	(–) 1½ In. (WC)
Full Load	Tank PSI	10-15 Lbs.	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	N/A

Table 3—**Fuel Pressure for Natural Gas**

	Ref. No. 1	Ref. No. 2	Ref. No. 3	Ref. No. 4	Ref. No. 5
Unit Off	Line PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	0
Starting	Line PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	(+) 5 In. (WC) 2-2½ Oz.
No Load	Line PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	
Full Load	Line PSI	NA	7-11 In. 4-6 Oz.	7-11 In. 4-6 Oz.	N/A

Notice the tables give two units of measuring fuel pressure. The first is with a pressure gauge calibrated in ounces per square inch. The second and most accurate is the use of a water manometer. A manometer is calibrated in inches of water column.

Engine Service

Lubrication

Before starting the engine, check oil level. If low, fill with the proper weight/grade of oil, as recommended by the engine manufacturer's maintenance instructions. The necessity of using the correct oil, and keeping the crankcase full cannot be over emphasized.

The governor on this engine-generator set has been filled with oil at the factory, check the oil level prior to operating. Simply remove the oil level pipe plug on the end of the governor, if the oil is up to this level, reinstall the plug securely. If the oil is not up to this level, additional oil must be added. The fill hole for adding oil is located on the top of the governor just behind the belt pulley. Fill the governor through this fill hole until oil starts to run out of the oil level plug hole on the end of the governor. Use the same grade of oil as used in the crank case.

Connecting the Battery

CAUTION In the following battery installation procedure, check to be sure the selector switch remains in the "stop" position. (See figure 4.)

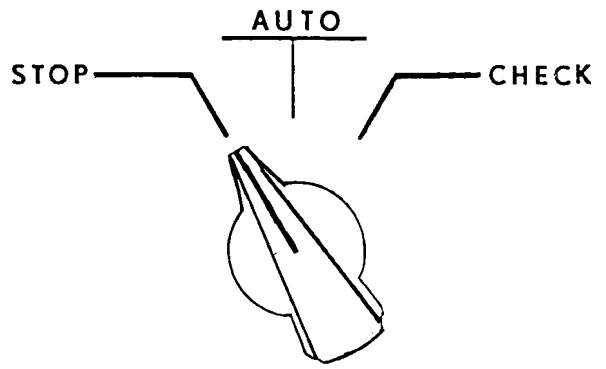


Figure 4
Operation Selector

A twelve-volt battery rated 435 CCA or larger has been supplied with this engine/generator set. This battery should be fully recharged before using. Observe polarities: Always connect the positive (+) battery terminal to the (+) cable from the control panel first. Then connect the negative (−) battery terminal to the negative cable (ground) from the engine-generator set.

All connections must be clean and tight. Check the electrolyte (fluid) in the battery periodically to be sure it is above the plates. Never allow a battery to remain in a discharged condition.

A nonadjustable trickle charger, producing up to 40 MA is built into the control panel to keep the battery in top notch condition during standby periods. An L.E.D. Light is provided to allow the operator to tell at a glance if the trickle charger is working properly.

NOTE: The trickle charger will not recharge a battery which has become discharged. It is designed only to provide enough current to maintain a battery in a fully charged condition.

Initial Start-up

Prewire System Check:

Before wiring the electrical transfer switch to the commercial line and load circuits, the installation and operation of the engine-generator set should be checked to insure proper fuel, exhaust, engine and generator operation.

Use the following check list to verify correct installation before starting the engine.

- Engine Oil. Fill as required grade/qty.
- Unit mounting base.
- Ventilation (louver size, inlet/outlet).
- Clearance on all sides.
- Proper fuel line material, size and connections.
- Gas regulator vented to the outside (check for local code requirements).
- Fuel line protected.
- LP/NG pressure O.K. 4-6 Oz. (7-11" WC).
- Proper size and slope on exhaust line.
- Flexible exhaust connector installed.
- Condensation trap installed.
- Muffler installed and properly supported—look closely for potential fire hazards in the mounting system.
- Exhaust line free of excessive elbows and restrictions.
- Battery of proper voltage and ampere hour rating.
- Check carefully for negative ground polarity.
- Battery connections clean and tight.
- Battery fully charged.
- Radiator properly vented to the outside.

After completing the above checklist, the engine-generator set is ready for the initial start-up test.

1. Set selector switch to the "check" position; the engine-generator will crank and start automatically. If the engine fails to start, return selector switch to the "stop" position and refer to the trouble-shooting section of this manual.
2. With the engine running smoothly, check the no load voltage and frequency at terminals T1 and T3 of the transfer switch. The voltage between T1 and T3 should be between 250 and 260 volts AC at a frequency of 61 to 61.5 hertz (Hz). Hz is the symbol for cycles per second.

NOTE: The neutral/ground terminal bolt is located on the back wall of the control panel.

T1 to N 125-130 vac
T3 to N 125-130 vac

NOTE: If for any reason during the checkout procedure the voltage and frequency are not correct, turn the selector switch to the "stop" position and refer to the trouble-shooting procedures.

After verifying the voltage and frequency are correct, turn the selector switch to the stop position. The unit is now ready to be connected to commercial line power and load circuits.

Electrical Connections

All wiring should be done by an experienced electrician, and should conform to the national electrical code and with state and local regulations. Check with the authorities before proceeding.

Turn the operation selector switch on the front of the control to the "stop" position and turn the main power switch off before proceeding. For your own protection verify this very important safety precautions yourself with a reliable instrument before proceeding.

Observe that the terminals on the power transfer switch are marked as follows: (see fig. 5)

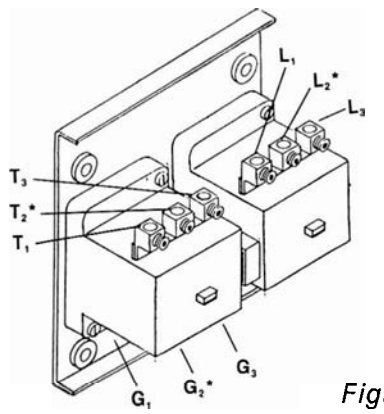


Figure 5

***Three Phase Units Only**

The load terminals are marked (T): T1 and T3 are "hot"—N is neutral and is connected to the neutral lug. T2 is used on three phase units as the third hot load lead.

The line terminals are marked (L): L1 and L3 are "hot"—N is neutral and is connected to the neutral lug. L2 is used on three phase units as the third hot line lead.

The standby generator terminals are marked (G): "HOT" leads G1 and G3 are prewired at the factory to contractor terminals G1 and G3 and N is prewired at the factory to the neutral lug for all single phase units. For three phase units G2 is also prewired at the factory to G2 on the contractor. No further electrical connections are required.

The load current carrying wires (L) and (T) must be sized to handle the maximum load current without excessive voltage drop. By code it must be heavy enough to handle the full current rating of the main line circuit-breaker (or fuse) in the entrance (or subpanel) protecting the contractor switch.

NOTE: NEC requires that circuit protection be provided for 125 AMP contractor switches in the transfer switch.

All wires should be installed in rigid or flexible conduit. (Knockouts are provided in the control box.)

Because of the many different types of service, feeder, and distribution equipment, no specific wiring instructions can be provided. When the load is connected to the generator, there must be absolutely no feedback from the generator to the power line or from the power line to the generator during any operating condition. When correctly connected, the design of the control prevents a possibility of feedback. Improper installation can, however, create a serious hazard. Two typical examples are shown in figure 6 and 7.

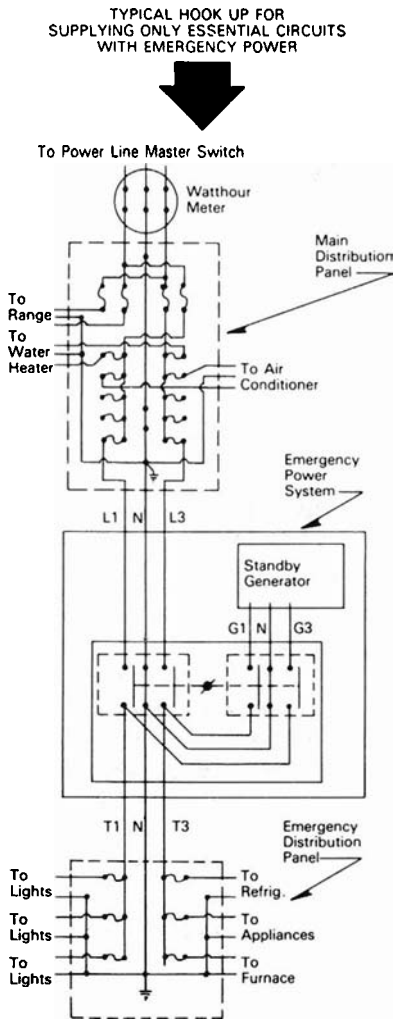


Figure 6

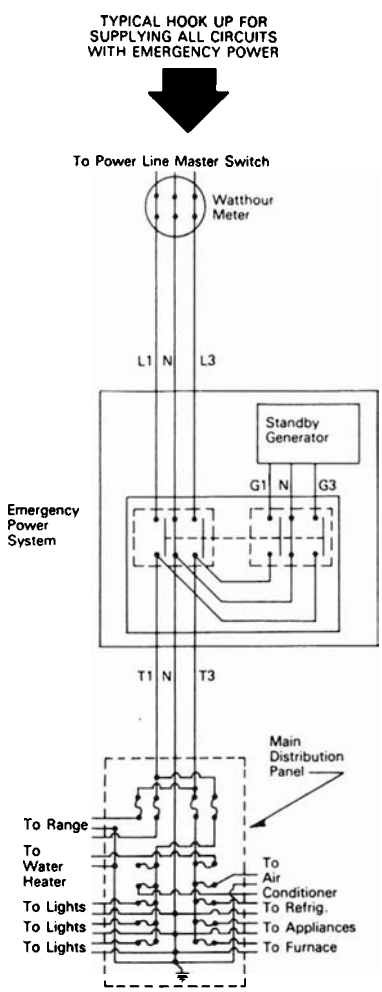


Figure 7

Connecting the Transfer Switch

NOTE: This connection procedure and the examples in figures 6 and 7 are single phase panels. When installing a three phase unit, remember a G2 lead has been added to the center contractor terminal and you must add a T2 and L2 to the instructions below.

The electrical transfer switch connects the load (lights, furnace, outlets, etc.) to the normal power line during standby. When normal power fails, the automatic transfer switch starts the engine-generator set, disconnects the power line and then connects the load to the standby generator set. When normal power is restored, the automatic switch stops the engine and retransfers the load.

To wire the automatic transfer panel into the existing wiring, first determine which circuits will be on the emergency load circuit. If the entire load is to be transferred, the transfer switch can be wired in directly after the watt-hour meter.

If only specific circuits are to be powered under emergency power failure conditions, an additional distribution panel designated "emergency distribution panel" must be installed.

All selected emergency circuits are removed from main distribution panels and re-installed in the emergency distribution panel. Suggested circuits—freezer, refrigerator, furnace, emergency lights, sump pump, emergency outlet circuits, etc. Total load must not exceed generator or transfer switch rating.

The emergency distribution panel is wired to the main panel through the automatic transfer switch. L1 and L3 are connected to the main panel 230 volt breaker. N is neutral. T1 and T3 are connected to 230V buss in the emergency distribution panel.

The main panel circuit breaker should be large enough to power the entire emergency distribution panel under normal loads, but should not exceed the contact current rating of the automatic transfer switch or generator.

Operation

Functional Operation of Electrical Control

The operation of an automatic emergency transfer control will be explained in three parts.

1. The load transfer circuit
2. The engine control circuit
3. The battery charging circuit

Transfer of the Load

The following sequence of events occurs during the transfer of the load from (A) normal or power line operation to (B) interim period to (C) emergency or standby generator operation and (D) back again to normal operation.

A. *Normal operation with power line energized:*
Standby generator standing idle. The line contractor (right side) is energized by the commercial line holding the line side contacts closed, connecting load, lights, refrigerator, etc. to the commercial power line.

B. *At the instant a power failure occurs:*
1. The load is disconnected from the power line.
2. The stop/start relay (SSR) starts the engine (explained in section 2).

C. *Generator powering the load:*
The stop cranking relay (SCR) normally closed (NC) contacts operate to automatically disconnect the engine starter. The generator side contactor (left side) will close and power the connect load.

D. *When the commercial power is restored:*
1. The start/stop relay stops the engine and opens the generator side contactor coil.
2. The generator contactor returns to its normal open position and closes the electrical interlock (TSG/AUX).
3. This permits the line side contactor to close, transferring the load back to the power line.

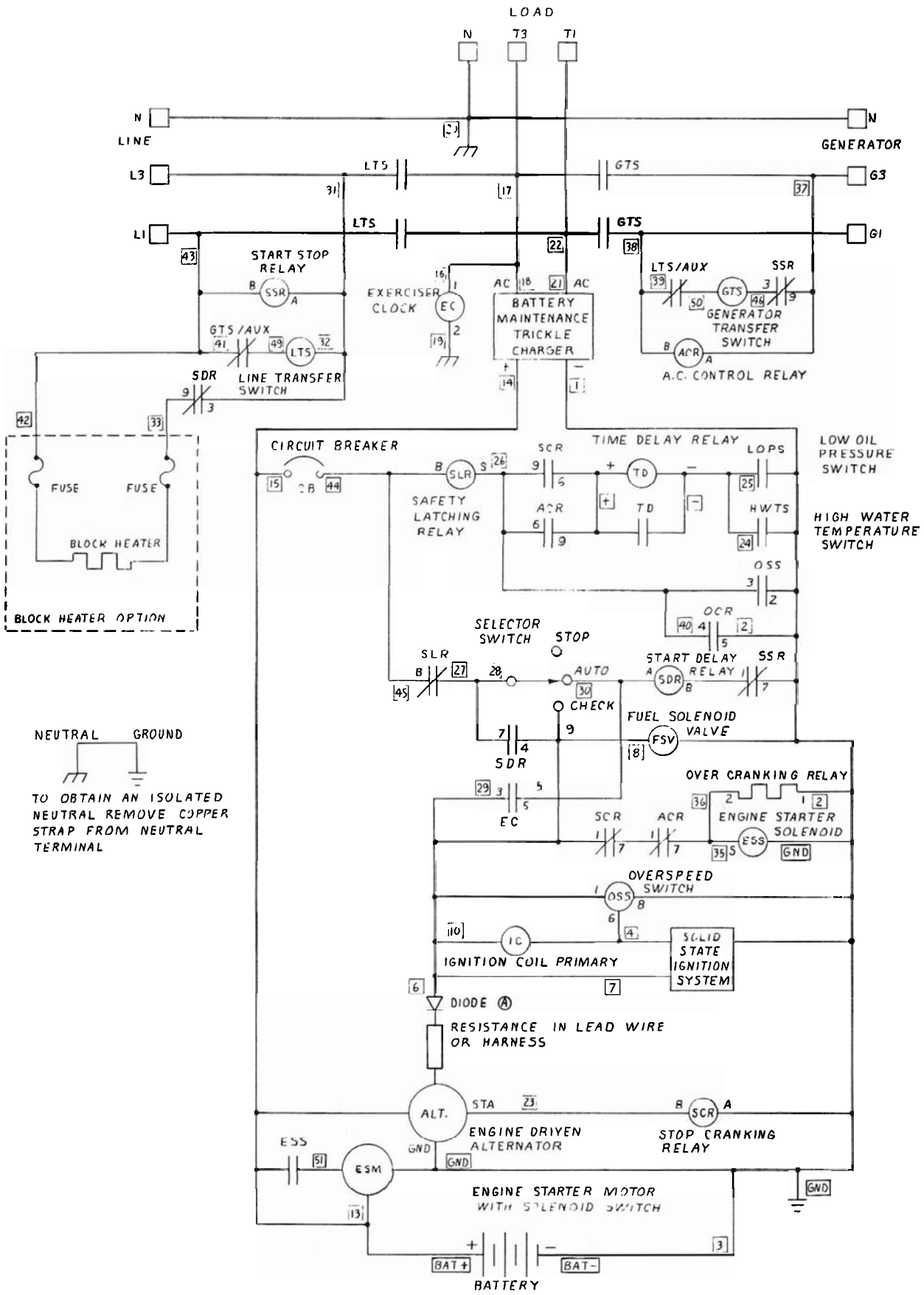
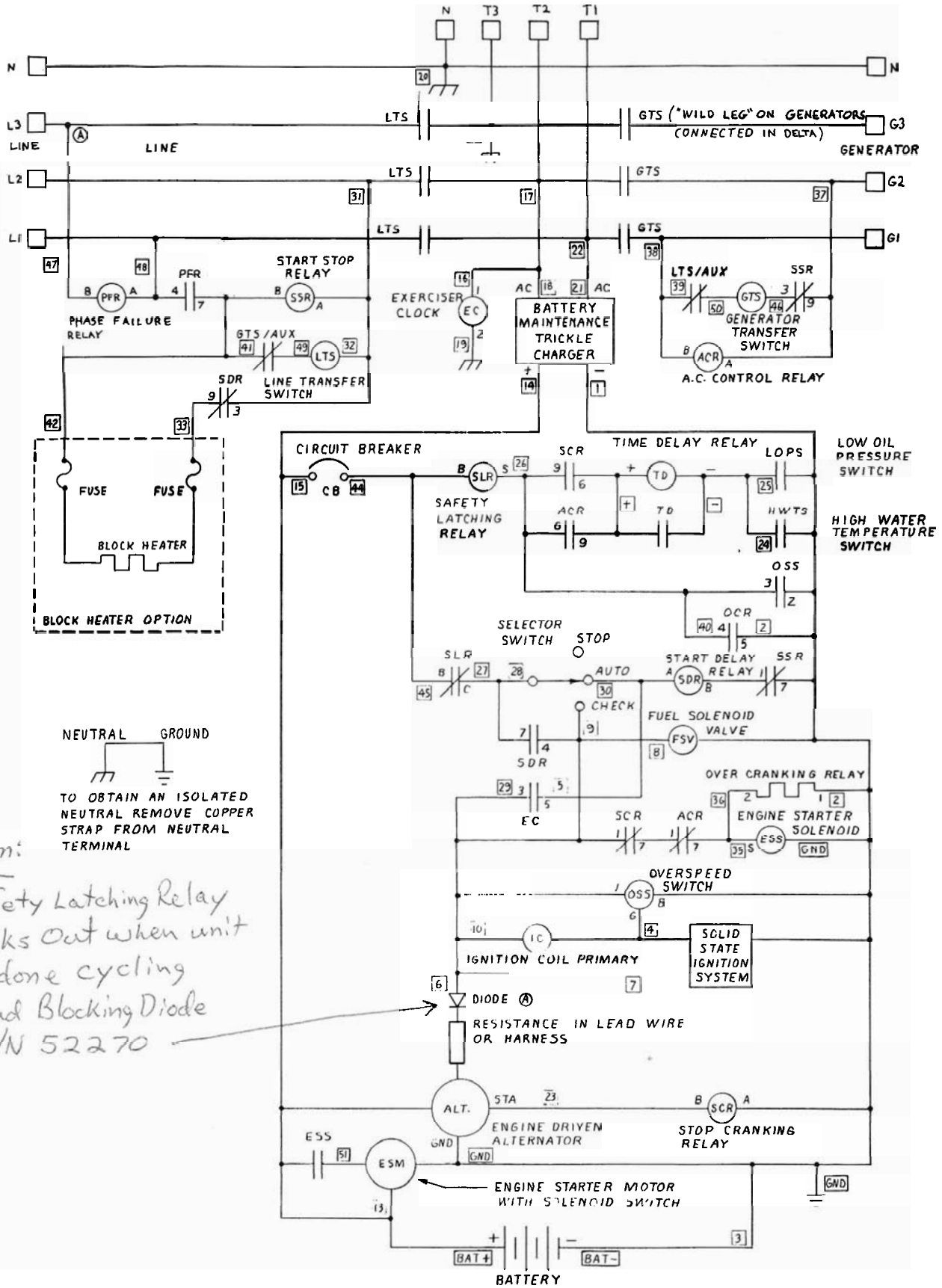


Figure 8—**Wiring Diagram**



Symptom:

Safety Latching Relay kicks out when unit is done cycling

= Bad Blocking Diode P/N 52270

Figure 9—**Wiring Diagram (3) Phase**

The Engine Start/Stop Circuit

All cranking functions must have positive 12V DC power applied in order to operate. Each safety shutdown applies a ground signal to the safety latching relay coil in order to trip it and cause power to both the fuel solenoid and the ignition system to be disconnected.

When the normal power source is energized and the selector switch is in the "auto" position the stop-start relay (SSR) coil is energized opening a normally closed (NC) contact connected in series with the 12V DC start delay relay (SDR). As long as the SSR remains energized the SDR will not begin the start delay timing cycle.

When normal power fails, the NC contact on the SSR closes. This completes the 12V DC circuit to the SDR and it begins the start delay timing cycle. The SDR timing cycle is adjustable 3 to 300 seconds. Factory setting is about 10 to 15 seconds. If during this time period the normal power should return, the SSR will reenergize and the unit will never attempt to start. Once the timing cycle has elapsed, the SDR will close a normally open (NO) set of contacts. This will apply 12V positive power to the fuel solenoid, overspeed switch circuit, solid state ignition module and the start solenoid. Whenever the start solenoid is energized, the overcranking timer circuit is also connected, (heater coil in the overcranking relay) (OCR). If the engine fails to start in about 45 to 75 seconds, this OCR coil becomes hot enough to trip the OCR thermal switch. This closes a NO contact in the OCR and applies a ground to the coil of the safety latching relay (SLR), energizing the SLR and opening a set of NC contacts to the selector switch. All cranking functions will disengage until both the OCR and the SLR are manually reset.

Each unit is equipped with two cranking disconnect systems or stop cranking relays (SCR). The primary stop cranking signal is received from the battery charging alternator on the engine. A pulsing DC signal is picked up at the AC (tach) tap on the alternator as it starts to spin up to speed. This increase in speed is in direct relation to the engine coming up to proper speed. This signal energizes the primary stop cranking relay (SCR). A set of NC contacts in the SCR are opened, disconnecting the start solenoid and the OCR thermal strip. In addition, a set of NO contacts are closed to arm the low oil pressure (LOP) and high water temperature (HWT) safety shutdowns. The secondary stop cranking signal is accomplished by sensing for generator output voltage with a 240 V AC relay wired across G1 and G3 of the main generator. This AC control relay (ACR) operates a set of NC contacts in series with the SCR contacts to disconnect the starter and a set of NO contacts in parallel to arm the LOP and HWT safety shutdowns.

A 20 second solid state time delay relay (TD) in installed between the LOP, HWT switches and the SLR coil. This will allow the engine to build up oil pressure to start-up. During a hot restart it will allow the water in the engine block to circulate before a safety shut down occurs. If the oil pressure fails to build up to minimum levels or the engine is still overheated after this 20 second time period the respective safety switch will complete a ground to the SLR coil and energize the SLR. This will open a NC contact in the 12V power supply to the selector switch and shut the complete system down. The unit cannot be restarted until the SLR has been manually reset.

Each engine generator set is also equipped with a solid state overspeed switch (OSS). If at any time the engine should exceed 4200 RPM, either on start up or while running, the OSS will ground the SLR coil and the unit will shut down.

Remember, in all cases of emergency shutdown the SLR will have to be manually reset before the engine can be restarted.

Refer to the simplified schematic diagram (Figure 4A) for additional details and specific wire numbers.

The Battery Charging Circuits

> **CAUTION** Before completing the installation, be sure the battery has been brought up to a fully charged condition by an external charger or by operating the engine alternator for several hours.

This generator system uses two separate battery charging circuits: the first is powered by the transfer switch "load" terminals and provides a small trickle charge to keep good batteries at their peak starting performance. This charger is not intended to recharge a discharged or dead battery and may not provide enough current to bring a new dry-charged or quick-charged battery to a fully charged condition.

This load powered, nonadjustable, static trickle charging circuit is mounted on a printed circuit board. It produces approximately 40Ma of current. A small LED is built into the charger and is located on the front panel. When the LED is lit the charger is operating properly.

The second charging circuit is the engine alternator which operates any time the engine is running. A small resistor is installed in the field circuit to reduce the charging output while the engine is cranking. This is done to allow for proper operation of the SCR. When the SCR operates, this resistor is bridged out of the circuit by means of a set of NO contacts or SCR. This will allow the alternator to operate at full capacity.

ATS Operational Check

Normal standby position for control operation selector function switch is "auto." Unless this switch is in the automatic position, the unit will not start automatically when a power failure occurs.

After all wiring has been completed, recheck all connections to make sure they are clean and tight. Then test as follows to demonstrate the operation of the controls:

1. Turn on the main power switch. Power should again be available on all distribution circuits.

2. Turn the selector switch to the "auto" (automatic) position. (The engine should not attempt to start at this time.)
3. Pull the main line switch to simulate a power failure. The engine generator will start and supply electricity to the connected load.
4. Restore commercial power (main line switch on). The generator controls will stop the engine and automatically transfer the load back to the power line.
5. With the commercial power left on, turn the ATS selector switch to the "check" position. The engine will start and continue to run but the control will not transfer the load. This feature enables the owner to check the operation of the generator without transferring the load (unless an outage occurs while in the "check" position).
6. With the power left on, turn the selector switch back to "auto." The engine will stop.
7. Again pull the power line switch. The engine will start and supply electricity to the emergency load. Now turn the selector switch to "stop" and the engine will stop. No power is supplied to the load. The entire panel is de-energized. This feature enables the operator to change oil and check the engine at any time, even during a power failure. Under these conditions, the panel can also be safely serviced by maintenance personnel.

Fuel Adjustments

After the engine is running, apply the total connected electrical load. For proper adjustment of the fuel mixture control on the carburetor, it is necessary to have the generator loaded to its capacity or to the maximum amount for which it will be used. Check the operation of the engine carefully to see that is runs smoothly. If it does not, a slight adjustment may be necessary to compensate for the different fuel or operating conditions. Refer to LP/NG adjustment in maintenance section.

After all operational checks have been completed and the unit is determined operational, turn the selector switch to "auto" position. This will enable your unit to come on line automatically should a power failure occur.

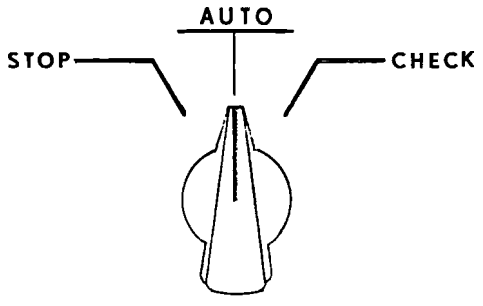


Figure 10
Operation Selector

Maintenance

General Information

The main components of the generator are: field frame, field coils, armature, brushes, brush holder assembly, end brackets, armature, armature- mounted cooling fan, and control box.

Before performing any maintenance on the engine or generator, place the selector switch on the control panel to the "stop" position.

Engine Maintenance

Refer to the engine instruction manual for instructions and procedures for normal/routine engine maintenance. Service/maintenance items include regular oil and oil filter changes as well as the prestart or daily oil level checks. Air cleaner must be checked more frequently under dusty conditions. The engine will require the greatest share of the maintenance and service attention, but will give the excellent performance designed into it when properly cared for.

Generator Maintenance

Brushes

Under ordinary circumstances, brushes will operate for long periods without requiring replacement. They should be inspected after the first 1000 hours of operation, and after every 100 hours of operation thereafter. Remove brushes one at a time and check for length; be sure that each moves freely in the brush holder. Brushes should be replaced when worn down to 3/8". Replace brushes in complete sets, never singly. When replacing brushes, be careful to reconnect the lead wires properly.

Poor contact (or "skipping") between brush and slip ring is caused by oil and grit, flint, or other hard substances on the brush, or by the brush not being properly shaped to fit the slip rings. Remedy these defects by fitting the brushes to the slip-ring curvature. Place #00 sandpaper under the brushes with the abrasive side to the brushes, and work it back and forth until the brushes are the same shape as the slip-rings.

Slip Rings

The four continuous copper rings located at the end of the armature are the power collector rings. For proper generator output, the surface of the slip rings must have a highly polished finish. Under sustained use, it is advisable to check and occasionally polish the ring surfaces with a crocus cloth to maintain the finish.

Electrical Testing

Testing Generator Field for Opens and Grounds

1. Disconnect the battery.
2. Disconnect field leads from rectifier.
3. Set multimeter to read resistance, and connect

the meter leads to the field leads. If the field is open, the meter will read infinite resistance. Replace field if it is open.

4. Connect one meter lead to the field shell (the other lead still connected to one of the field leads). If meter indicates continuity (zero ohms or any reading lower than infinite resistance) the field is grounded and should be replaced.
5. If the fields are grounded, cut the connector between the two coils and retest to determine which coil is grounded.

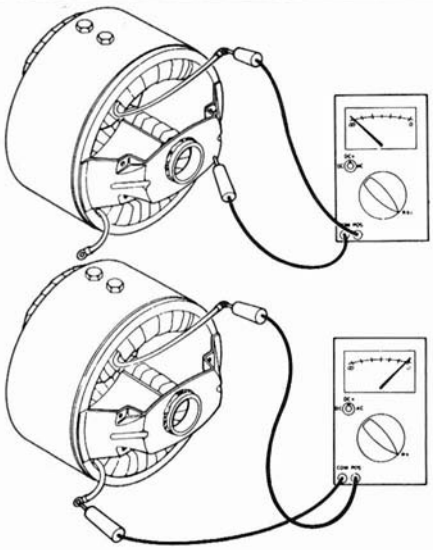


Figure 11 —**Testing Generator Field Coils**

Testing Armature for Opens and Grounds

1. Remove all brushes.
2. Ground test:
   Set multimeter to read resistance, holding one meter lead against a clean spot on the armature shaft. Touch the other lead to each of the four slip rings of the armature (one at a time) while observing the meter.

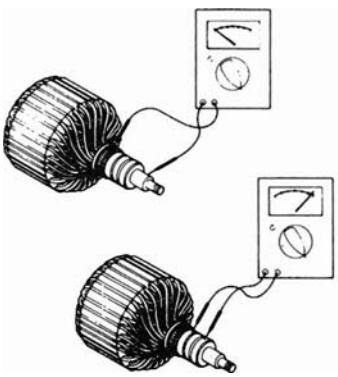


Figure 12
Testing Armature for Opens and Grounds

If meter indicates continuity (zero ohms or any reading lower than infinite resistance), the armature is grounded. Dirt on the slip ring bars can cause grounding. Carefully clean the dirt off the slip rings if grounding was indicated, then recheck it. Replace the armature if it is grounded.

3. Testing for opens:
   (Meter still set to read resistance). Holding one meter lead on surface of collector ring #1, touch other meter lead to surface of collector ring #2 while observing the meter. Meter should indicate continuity (low resistance). If not (i.e. if meter indicates infinite resistance) part of armature windings are open and armature should be replaced.
   Check for open between collector rings #2 and #3 in same manner as you did between rings #1 and #2.

Testing Rectifiers

The field excitation rectifier is a full-wave bridge rectifier. This type of rectifier has four terminals, two AC, a DC positive, and a DC negative. The rectifier is tested in the following manner. Connect one ohmmeter lead to the positive DC terminal, and the other lead to each of the AC terminals in turn. A high or low resistance reading will be obtained. Reverse the meter leads, and an opposite reading should be observed. Now check from the negative terminal each of the AC terminals, using the same procedures as above. Check each terminal to the case, and no resistance reading should be observed.

If a battery-powered test light is used, follow the procedures described above. If the rectifier is good, the light will come on in one direction only.

If the rectifier fails any of the above tests, it is defective and must be replaced.

Condenser Testing

Condensers are built into the generator circuit to minimize radio interference during operation. If a condenser shorts out, it blocks the generator output. To determine whether a condenser is shorted, turn off the engine-generator, disconnect the lead wire from the brush holder to which the condenser is connected, turn the engine-generator back on and check the output. If the generator then provides power, the condenser was at fault and should be replaced. If the generator did not provide power after the lead wire was disconnected, the problem was not caused by that condenser. Reconnect the lead wire.

Battery

Check the electrolyte (battery fluid) periodically to insure the fluid level is above the plates. Never allow the battery to remain in a discharged condition.

Exhaust Condensation Traps

Drain the trap at regular intervals to prevent exhaust condensation from overflowing into the engine.

Governor

The governor on this engine generator set has been

preset and filled with oil. The oil level should be checked weekly to insure the proper operation of this unit. The oil level is checked by removing the oil level plug on the end of the governor. If the oil is not up to this level additional oil must be added through the oil fill hole located on top of the governor just behind the drive pulley. Be sure to retighten the oil level plug securely.

To adjust the governor speed loosen the jam nut on the stop screw on the top of the governor. With a frequency meter attached to the engine adjust the screw in or out until the proper speed is obtained.

CAUTION Do not adjust the full load speed above 59 to 60 Hz. Adjusting the full load speed any higher will allow the no load speed to exceed the upper limits as the load is reduced. Now retighten the jam nut to prevent the governor from coming out of adjustment.

Electronic Overspeed Relay Adjustment

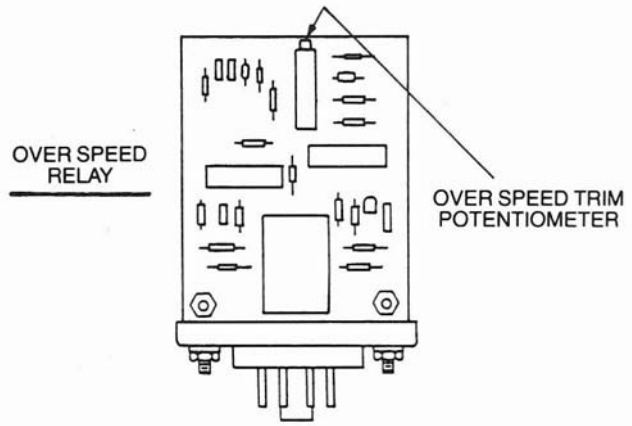


Figure 13
Electronic Overspeed Relay Adjustment

The overspeed relay is factory set to operate at 67 hertz, (approximately 4000 RPM). If normal operating conditions requires changing this setting, use the following procedures.

CAUTION Adjustments should be made by a qualified electrical technician.

To increase the overspeed shut down frequency, turn adjustment screw counter clockwise. To decrease the overspeed shut down frequency, turn adjustment screw clockwise.

CAUTION Adjust trim pot, ½ turn at a time, and record direction and number of turns.

After making adjustment, start the unit. Manually increase or decrease engine speed as required to check generator frequency at overspeed engine shut down. If further adjustment is needed, stop the engine, make the adjustment, and recheck engine shut down frequency as described above.

NG/LP Fuel Adjustment

CAUTION Do not make any fuel adjustments on carburetor or governor until all pressure readings are in compliance with specifications. See fuel pressure charts (Tables 1, 2, and 3)

Natural gas (NG): Due to variations in NG fuel characteristics and Btu levels throughout the country, it may be necessary to readjust the carburetor fuel mixture once the engine has been installed and serviced.

CAUTION Never make a carburetor mixture adjustment on a unit when it is stopped or running no load. Mixture adjustment is only effective when the engine is operating under load.

Adjustment Procedures—Natural Gas (NG)

1. Insure the unit is operating under an 80 to 100% load or at the highest anticipated load.
2. Attach a frequency meter to monitor Hz.
3. With an end wrench turn the load adjustment valve either left or right. Observe the Hz meter, if it drops, turn the adjustment valve the opposite direction. Adjustments should be made very slowly. Adjust back and forth until the highest Hz can be achieved. If the Hz is out of upper or lower limits, a governor adjustment will be necessary.
4. To adjust the governor loosen the jam nut on the adjustment screw located on the top of the governor. Then turn the adjustment screw in or out until the desired speed is obtained. Again watch the Hz meter as you adjust the screw. Under a load of 80 to 100% capacity you should achieve a 59 to 60 Hz reading. When this reading is obtained retighten the jam nut.

CAUTION Under full load do not adjust the Hz above 60. If a higher Hz reading is used, as the load is decreased the Hz will go out of upper limits (61 to 62 Hz).

Propane (LP)

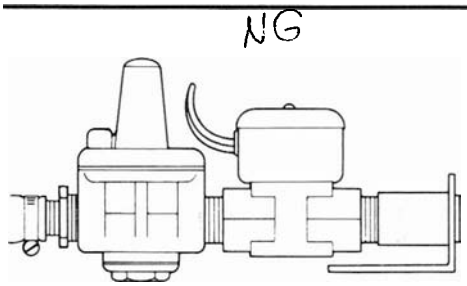


Figure 14—**Natural Gas (NG)**

Adjustment—Propane (LP)—a generator set fueled by LP will normally require no adjustment. If for some unforeseen reason the machine should require adjustment, follow the same procedure for NG.

Fuel Type Conversion—NG to LP or LP to NG
If after the unit has been purchased it should become necessary to change the type of fuel used, the following procedures are provided:

1. To convert from natural gas (NG) to propane (LP) Fig. 14 to Fig. 15.
   a. Turn off the fuel supply valve.
   b. Remove the fuel line from the carburetor at the demand regulator.
   c. Remove the cap on the upright column of the regulator. This will expose the pressure spring adjusting screw. Back off the spring adjusting screw so there is just enough room to replace cover. Replace the cover.
   d. Invert the regulator so it is positioned as shown in Fig. 15.
   e. Reconnect the fuel line at the regulator.
   f. Remove the 1/8 NPT plug (on solenoid side of regulator) and install fuel pressure meter (or manometer). See Ref. "A" on Figure 15. Turn the selector switch to "check". The engine will crank and the fuel solenoid valve will open. Observe the incoming pressure. The pressure reading should be between 4 to 6 ounces (see column 4 of table 1).
   g. If pressure is correct, remove meter (or manometer) and 1/8 NPT fitting from the solenoid side of the regulator and install it on the carburetor side of the demand regulator.
   h. Turn selector switch to the check position. This will energize the starting system. With the engine running at no load, you should read a negative (−) 1½ inch water column (W.C.) on a manometer. If you are using a PSI meter with no neg side, you should get no reading at all, or the meter may bounce lightly at zero.
   i. You are now ready to make the final fuel adjustments on the carburetor. Refer to adjustment above.

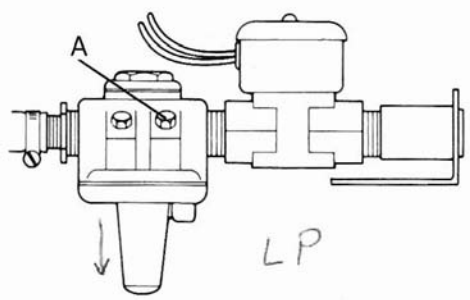


Figure 15
~~Natural Gas (NG)~~

2. Converting from propane (LP) to natural gas (NG) Fig. 15 to Fig. 14.
   Although this is a fairly simple operation, there are procedures that must be followed closely to achieve proper engine performance. This procedure normally requires a manometer or low pressure fuel gauge to make an accurate adjustment. A step by step procedure is provided below:
   a. Turn off fuel supply valve.
   b. Disconnect fuel line from the carburetor at the demand regulator.
   c. Invert the regulator so that it is positioned as shown in Fig. 14.
   d. Reconnect the fuel line to the regulator.
   e. Remove the 1/8 NPT plug (on solenoid side of regulator) and install fuel pressure meter or manometer. See Ref. "A" in Fig. 15. Turn the ATS selector switch to "check". The engine will crank and the fuel solenoid valve will open. Observe the incoming pressure. The pressure reading should be between 4 to 6 ounces (column 4 of table 1).
   f. If pressure is correct, remove meter (or manometer) and replace plug on 1/8 NPT on the solenoid side of the regulator and install meter on the carburetor side of the demand regulator.
   g. Remove cap on the upright column of regulator. This will expose the spring adjusting screw. Turn this screw all the way out (CCW) and back in about 8 turns. The plug should be approximately half way down for the initial starting position.
   h. Turn selector switch to "check" position. This will energize the starting system. Although the regulator may not be exactly at the optimum position, the engine should start. Adjust the spring adjusting plug to obtain a positive (+) 5 inch water column (WC) or 2.5 to 3 oz. PSI reading on the carburetor side of the regulator with the engine running at no load.
   i. You are now ready to make the final fuel adjustment on the carburetor. Refer to adjustment procedure above.

UNIT #- 63700-005	ARMATURE-	0.130 OHMS
SS SPEC- 1510 APS20000/B, /BX, /C	FIELD-	21.00 OHMS
WIRING - 63784-000		
UNIT #- 63700-006	ARMATURE-	0.032 OHMS
SS SPEC- 1511 APS20000-4/B, /BX, /C	FIELD-	26.50 OHMS
WIRING - 63845-000		
UNIT #- 63700-007	ARMATURE-	0.070 OHMS
SS SPEC- 1512 APS20000-17/B, /BX, /C	FIELD-	26.50 OHMS
WIRING - 63845-000		

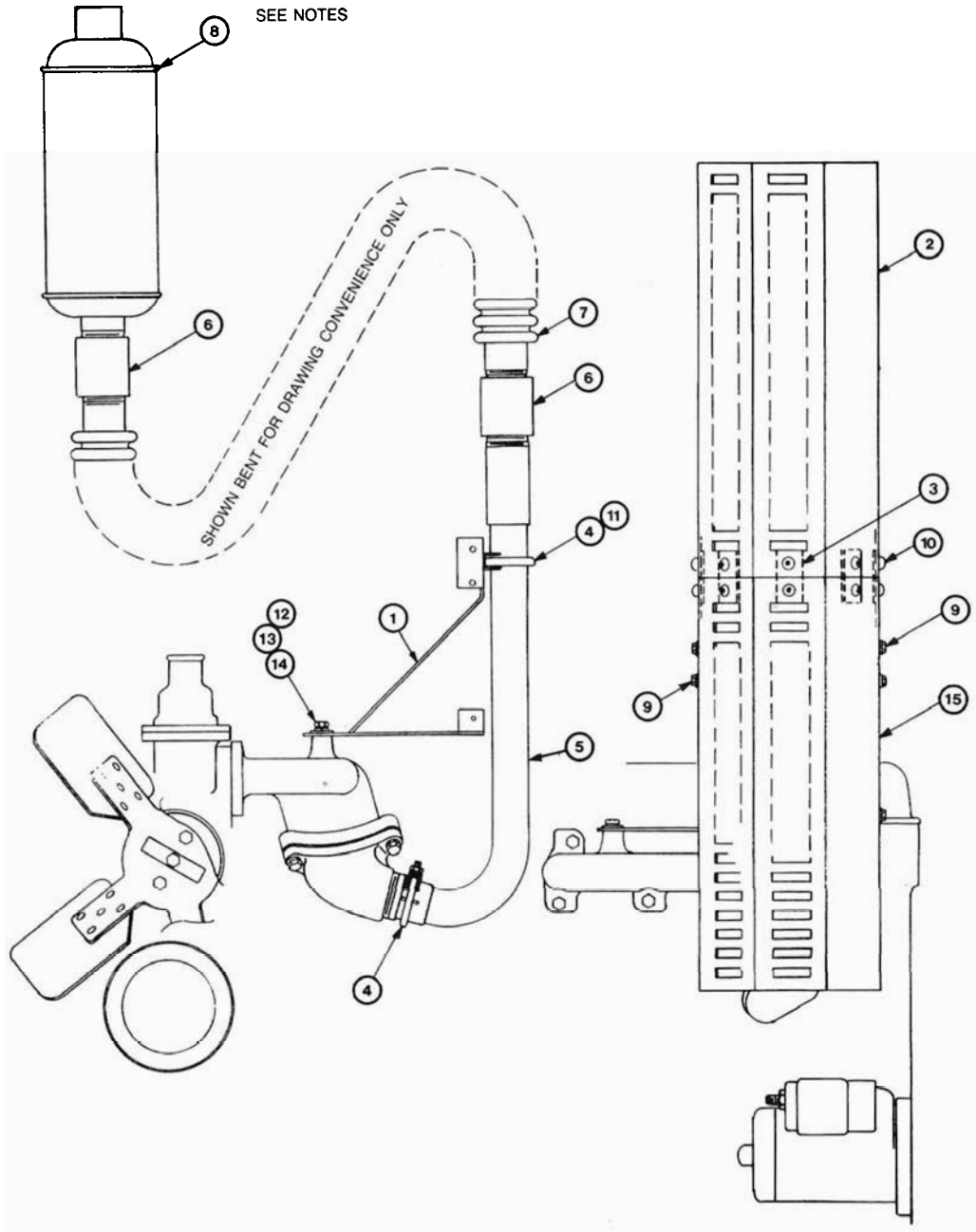
RESIDUAL VOLTAGE - 7.0 VAC
12 VDC EXCITATION - 200 VAC

Trouble Shooting Chart

Symptom	Possible Cause(s)	Corrective Action
Generator will not crank when power is off with selector switch in "auto" or "check."	Low or dead battery.	Check fluid level and specific gravity.
	Loose or dirty terminal connections.	Clean and tighten connections.
	Battery not large enough	70 ampere hour (minimum) battery required.
	Overcranking relay tripped	Reset red button on front panel.
	Defective overcranking relay	If relay trips is less than 50 sec. or does not trip after 60 sec. replace relay.
	Defective selector (check/auto/stop)	Check for good connections. Replace.
	Defective stop cranking relay	Check for broken wires, dirty or pitted contacts. Repair or replace.
	Start/stop relay defective	Check for broken wires, dirty or pitted contacts. Repair or replace.
	Defective start solenoid at starter	Check and replace.
	Defective safety latching relay	Reset. If it won't stay reset check the four safety shutdowns. Repair or replace as required.
Generator will crank in check but not in "auto."	Start/stop relay defective	Repair or replace.
	Start delay relay defective	Repair or replace as required.
Generator cranks but engine will not start.	Incorrect fuel pressure	Fuel pressure to the unit must be 4 to 6 oz. or 7 to 11 inches water column.
	Defective engine ignition system	Refer to engine operator's manual.
	Defective fuel solenoid valve coil	Check for loose/broken connections or open. Repair or replace.
	Defective power lead to engine coil.	Check wire No. 23 for 12VDC power to ballast register while cranking.
Unit starts but stops with SLR tripped out. Reset SLR	Defective 20 sec. timer in LOP and shutdown. Refer to Operation section	Replace.
	Possible overspeed failure	Check engine for 3600 RPM operation. Repair or replace as required.
Engine will not stop with switch in "auto" position, and normal power available.	Faulty alternator regulator. Disconnect "S" lead and retest	Repair or replace as required.
	Defective start/stop relay coil	Test for 240 volts on coil. Relay should be energized by the commercial line. Replace if defective.
	Start/stop relay N.O. contacts defective	Repair or replace relay.
Load will not transfer to generator during power line interruption.	Open generator side contactor coil.	Test and replace coil.
	Defective LTS/AUX (electrical interlock contacts)	Adjust or replace switch contacts.
Engine will not stop cranking.	Defective over cranking relay	Repair or replace; relay should trip between 50 and 75 seconds after continuous cranking.
	Defective stop cranking relay (S.C.R.) See "Operation" for system explanation. See wiring diagram for location.	Repair or replace as required.
	Loose wire in stop cranking circuit.	Repair.

Trouble Shooting Chart (Continued)

Symptom	Possible Cause(s)	Corrective Action
No output or low output voltage	Open or shorted armature	Replace armature.
	Open or shorted field coil(s)	Replace field coil(s).
	Generator operating below correct speed	Generator must be operated at 3600 RPM +/−90 RPM for proper output voltage.
	Generator overloaded	Reduce load to generator nameplate.
	Short circuit in the load	Disconnect the load. Check voltage at receptacle. Check motors, appliances and load leads for short circuits. Repair short.
	Loose (or broken) wires or connections in the control box	Remove panel cover and check all wiring and connections. Tighten and/or repair where necessary.
	Defective rectifier	Test rectifier. Replace if defective.
	Dirty slip rings	Clean and polish. Use 00 sandpaper and crocus cloth, never emery paper.
	Brushes binding in holders	Check brushes for swelling; replace defective brushes; clean brush holders.
	Loss of residual magnetism	Check output voltage with sensitive meter. If very low (i.e. ½ volt) flash fields with 12VDC battery.
Output voltage too high	Engine speed too high	Reset governor to 61.5 Hz no load.
Generator overheating	Generator overloaded	Reduce load.
	Armature rubbing pole shoes	Check bearing condition. Check field shell bearing bracket alignment.
	Poor ventilation	Clear inlet and outlet air vents of debris. If unit is housed, insure at least 2 ft. clearance on all sides and that inlet and outlet vents are of adequate size.
	Short circuit in fields	Repair or replace—open or shorted fields should be replaced. Grounded fields may be repaired by insulating at the point where the ground occurs.
	Short turns in armature	Replace arm.
Sparking at the brushes	Generator overloaded	Reduce load.
	Brushes not seated properly	Contour brushes (see "Maintenance").
	Slip rings rough or eccentric	Redness slip rings (see "Maintenance").
	Brushes sticking in brush rack	Remove brushes and inspect and correct problem.
	Brushes worn down shorter than 3/8 inch	Replace brush—NOTE: Always replace brushes a full set at a time.
No battery charging when generator is running.	Engine alternator defective	Check and replace if required.
Battery discharges when generator set is not running.	Shorted battery charger	Replace if shorted out.
	Shorted battery or control wire	Repair or replace.
Battery trickle charger LED is not lit.	Check trickle charger for 120V AC input and 12 to 14VDC output.	Replace if defective.



NOTES:

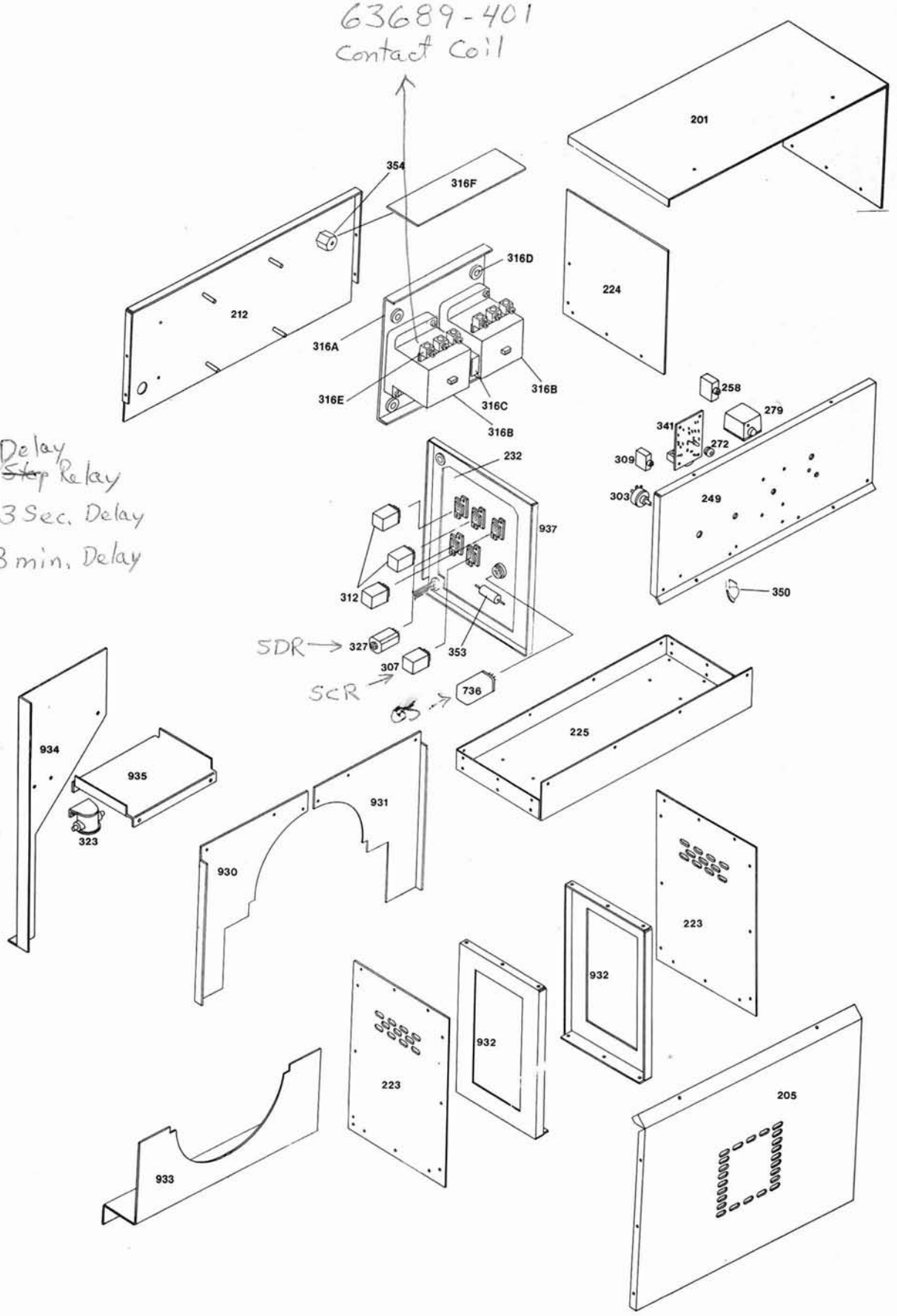
1. This drawing has been prepared to instruct customer how parts provided are to be fitted together, but does not necessarily represent or provide material for an approved exhaust installation.
2. Slots have been provided for adjustment of parts to insure a vertical exhaust system.
3. Flexible exhaust pipe, Item 7, should be mounted directly above exhaust pipe assembly, Item 5, in a vertical position.
4. The muffler, Item 8, should be mounted outside the structure housing the generator set.
5. Exhaust pipe between flexible exhaust and muffler should be as short as possible with as few bends as possible and these with as large a radius as possible.

PARTS LIST			
ITEM	PART NO.	QTY.	DESCRIPTION
1	C-63834	1	Mounting Bracket
2	C-63842	1	Heat Shield
3	A-61611-1	5	Splice Plate
4	A-93489-5	2	Exhaust Clamp
5	B-63825	1	Exhaust Pipe Assembly
6	A-81739-1	2	1-½" Coupling
7	B-80518-1	1	Flexible Exhaust Pipe
8	C-61620	1	Muffler
9	A-55440	5	¼-20 x ½ Self Tapping Screw
10	A-21698-1	10	#10 x 3/8 Sheet Metal Screw
11	526	2	5/16 Flat Washer
12	A-96002-20	2	M8 x 1.25 x 20 Hex Head Bolt
13	A-93341-8	2	M8 Split Lockwasher
14	A-63841-8	2	M8 Flat Washer
15	C-63838	1	Heat Shield
16	B-63983-1	1	Instruction Drawing
17	A-642	1	Bag
18	A-100,047-617	1	Carton

EXHAUST SYSTEM COMPONENTS

63021 = 63821-200 Exhaust Parts
63825 J-Pipe
63754 Duct Adapter

63689-401
Contact Coil



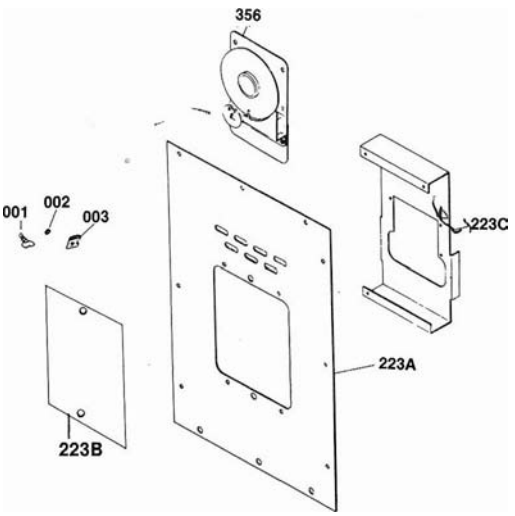
Start Delay Relay
1% = 3 Sec. Delay
100% = 3 min. Delay

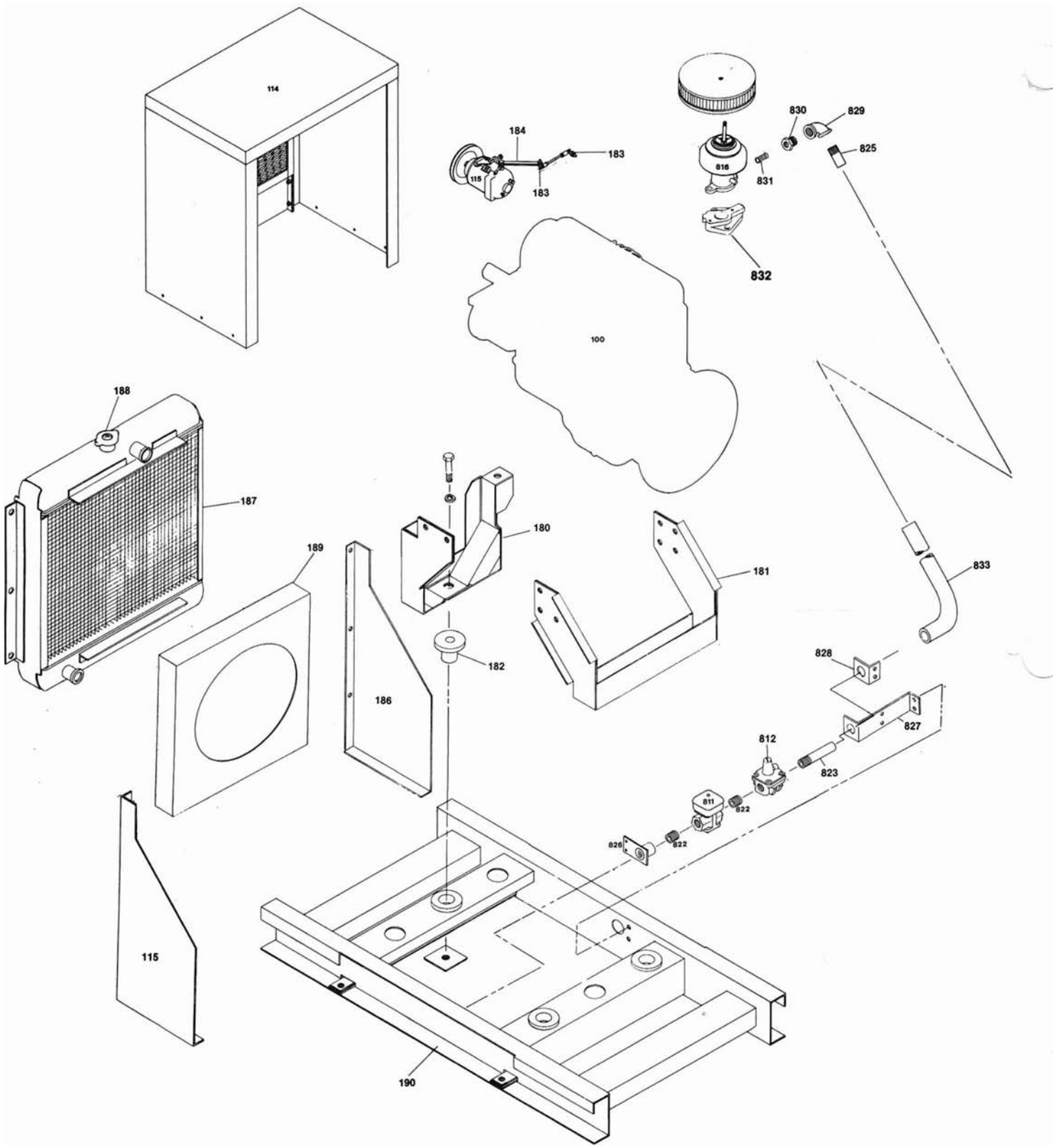
Repair Parts List

Ref. No.	Part No.	Description	IL#	/C* Qty.	-4/C* Qty.	-17/C* Qty.
200A	63782-400	CONTROL BOX ASSY. - 1 PH	2	1	1	1
200B	63790-400	CONTROL BOX ASSY. - 3 PH	2	1	1	1
201	63829-000	COVER (TOP)	2	1	1	1
205	63711-001	LOWER FRONT PANEL	2	1	1	1
212	63715-000	REAR PANEL ASSY.	2	1	1	1
223	63712-000	SIDE COVER	2	1	1	1
224	63831-400	RELAY COVER (UPPER LEFT)	2	1	1	1
225	61294-000	BOTTOM PANEL	2	1	1	1
232	63780-400	CIR. BD. & LEAD ASY	2	1	1	1
249	63740-000	FRONT PANEL	2	1	1	1
258	91286-000	CIR. BKR. 15A-1PL	2	1	1	1
279	91688-400	LATCHING RELAY ASSY	2	1	1	1
303	57946-000	SELECTOR SWITCH	2	1	1	1
307	59944-005	RELAY-6 VDC 3PDT	2	1	1	1
309	48585-000	(OCR) OVER CRK RELAY	2	1	1	1
312	59944-012	RELAY 240VAC DPDT	2	2	3	3
316	63697-400	CONTACTOR SW. ASSY. - 1PH	2	1		
316	63698-400 125Amp	CONTACTOR SW. ASSY. - 3PH 82579-400	2		1	1
316A	63696-000	BACKING PLATE 200Amp 3Ø	2	1	1	1
316B	63690-000	CONTACTOR SWITCH - 125A	2	2	2	2
316C	63693-001	INTERLOCK KIT	2	1	1	1
316D	50755-000	GROMMET 5/16 ID x 3/4	2	4	4	4
316E	63708-000	TERM LUG #2/0-6W	2	4	4	4
316F	63786-001	TERM IDENTIFICATION PLT	2	1	0	0
316E	63786-002	TERM IDENTIFICATION PLT	2	0	1	1
327	92753-000	START DELAY TIMER	2	1	1	1
323	80980-000	START SOLENOID 12VDC	2	1	1	1
341	61222-000	TRICKLE CHARGER ASY	2	1	1	1
350	08778-000	KNOB	2	1	1	1
353	~~71205-001~~	TIME DELAY RELAY 64013-0	2	1	1	1
354	94378-000	STAND-OFF UNSULATOR	2	1	1	1
736	71837-009	OVERSPEED SWITCH	2	1	1	1
930	63717-000	CLOSURE PANEL	2	1	1	1
931	63716-000	CLOSURE PANEL	2	1	1	1
932	63709-000	BOX SUPPORT	2	2	2	2
933	63741-000	BOTTOM CLOSURE PANEL	2	1	1	1
934	63710-000	BAT. TRAY SUPPORT	2	1	1	1
935	61615-000	BATTERY TRAY	2	1	1	1
937	63742-000	MOUNTING BRACKET	2	1	1	1
N.I.	95867-000	RELAY H.D. BAIL	2	3	3	3
N.I.	63781-400	CONTROL HARNESS ASY. - 1PH	2	1	1	1
N.I.	63854-400	CONTROL HARNESS ASY. - 3PH	2	1	1	1

Ref. No.	Part No.	Description	IL#	/C* Qty.	-4/C* Qty.	-17/C* Qty
1	91682-000	STUD-1/4 TURN	3	2	2	2
2	91684-000	RETAINER	3	2	2	2
3	91683-000	RECP 1/4 TURN	3	2	2	2
223C	62636-000	MOUNTING BRACKET	3	1	1	1
223B	62638-001	COVER PLATE	3	1	1	1
223A	63713-000	SIDE COVER	3	1	1	1
356	23641-000	EX. CLOCK 115V	3	1	1	1

use 64600-001

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Repair Parts List

Ref. No.	Part No.	Description	IL#	/C* Qty.	-4/C* Qty.	-17/C* Qty.
N.I.	60706-052	OPM-OP/PARTS MANUAL	0	1	1	1
100	63803-401	ENGINE-FORD 1.1 L.	1	1	1	1
114	63819-401	RAD. SHROUD INSTALL.	1	1	1	1
115	63807-000	GOVERNOR ASSY.	1	1	1	1
180	63797-000	FRONT ENG SUPT WELD	1	1	1	1
181	63796-000	GEN MTG BRKT WELD	1	1	1	1
182	92327-000	SHOCK MOUNT	1	3	3	3
183	63650-000	BALL JOINT	1	2	2	2
184	63808-000	GOVERNOR ROD	1	1	1	1
185	63745-002	RADIATOR SUPPORT	1	1	1	1
186	63745-001	RADIATOR SUPPORT	1	1	1	1
187	63340-000	RADIATOR ASSY.	1	1	1	1
188	92713-000	RADIATOR CAP	1	1	1	1
189	63747-000	FAN SHROUD	1	1	1	1
190	63662-000	BASE ASSY. WELDED	1	1	1	1
811	42942-000	SOLENOID GAS VALVE	1	1	1	1
812	50248-000	REGULATOR	1	1	1	1
816	63771-401	CARBURETOR	1	1	1	1
822	22626-000	P.NPL 3/4NPT X CLOSE	1	2	2	2
823	63772-000	P.NPL 3.4NPTX8	1	1	1	1
825	81084-000	P.NPL 3/4NPTX3	1	1	1	1
826	55931-000	BRACKET ASSY.	1	1	1	1
827	63763-000	BRACKET	1	1	1	1
828	63764-000	BRACKET	1	1	1	1
829	50244-000	EL-PIPE 3/4NPT	1	1	1	1
830	63788-000	PIPE REDUC. 3/4 X 3/8	1	1	1	1
831	53244-001	P.NPL 3/8NPT X 1	1	1	1	1
832	63737-000	ADAPTER-MACHINED	1	1	1	1
833	49409-000	HOSE - 32"	1	2	2	2
N.I.	22097-001	BAT. CABLE #4 39"	1	2	2	2
N.I.	63804-000	ENGINE OIL DRAIN FITTING	1	1	1	1
N.I.	50245-000	HOS. CLMP.1 9/16-1.25	1	2	2	2
N.I.	63822-000	UPPER HOSE-RAD 1.25ID	1	1	1	1
N.I.	63823-000	LOWER HOSE-RAD 1.25 6"	1	1	1	1
N.I.	63844-000	HARNESS ASSY.	1	1	1	1

52270 Blocking Diode to Alt. → 60 ohms

80781-4 Blck Htr. 230V/1000W [(80781-3 Blk Htr 1000W/115V) All others Units Not APS20000]

80518-1 1½" Flex Exhaust x 18"

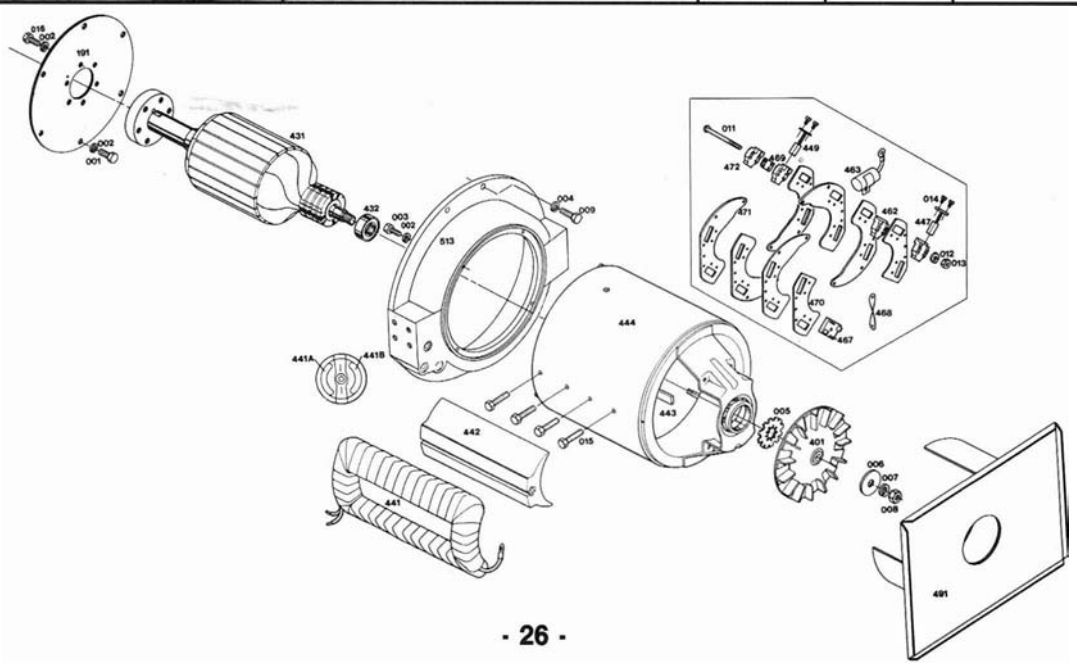
81138 Fuel Strain Relief

Carb - Impco # CA50-564 w/Air Cleaner

7" Air Element FI-5

Repair Parts List

Ref. No.	Part No.	Description	IL#	/C* Qty.	-4/C* Qty.	-17/C* Qty.
1	96002-020	HHCS M8-1.25 X 20MM	4	6	6	6
2	00480-000	LOCKWASHER 5/16 SPLT	4	6	6	6
3	91546-003	HHCS 5/16-18X1.25	4	4	4	4
4	93341-010	L. WSHR-METRIC 10MM	4	2	2	2
5	97627-001	FL WSHR .687X1.25	4	1	1	1
6	97627-000	FL WSHR .531X1.25	4	1	1	1
8	09549-000	HX JM LOCKNUT 1/20-20	4	1	1	1
9	94282-040	HHCS M10-1.5X40MM	4	2	2	2
11A	21977-000	RHMS 8-32X2.25	4	4	4	4
11B	44342-000	RHMS 8-32X3	4	4	4	4
12	06376-000	LOCKWASHER #8 SPLIT	4	10	10	10
13	05113-000	HEX NUT #8-32	4	10	10	10
14	40746-000	BIND.HMS 8-32X5/16	4	28	28	28
15	43781-000	HHCS 7/16-20X1.75	4	8	8	8
16	96000-002	HHCS 3/8-16X1	4	6	6	6
17	00481-001	LOCKWASHER 3/8 SPLT	4	6	6	6
18	00480-001	LOCKWASHER 5/16 SPLT	4	4	4	4
191	63861-000	DRIVE DISK*	4	2	2	2
~~286~~ 467	53976-000	RECTIFIER	4	1	1	1
401	23404-000	FAN ASSY.	4	1	1	1
432	59062-000	NOTCHED BEARING	4	1	1	1
431A	63802-001	ARM/DRIVE HUB (-3)*	4	1		
431B	63850-001	ARM/DRIVE HUB (-4)*	4		1	
431C	63850-002	ARM/DRIVE HUB (-17)*	4			1
433	50742-000	SLIP RING-2 RINGS	4	2	2	2
440A	63936-000	FLD SHL & COIL ASSY - 1PH	4	1		
440B	63936-000	FLD SHL & COIL ASSY - 3PH	4		1	1
441A	52563-000	FIELD COIL - 1Ph*	4	1		
441B	52563-001	FIELD COIL - 1Ph*	4	1		
441A	63938-000	FIELD COIL - 3Ph*	4		1	1
441B	63938-001	FIELD COIL - 3Ph*	4		1	1
442	43473-000	POLE SHOE ASSY.	4	2	2	2
443	63937-000	POLE SHOE RETAINER*	4	2	2	2
444	97288-000	FLD RING & BRKT ASY	4	1	1	1
447	24981-000	BRUSH ASSY.	4	12	16	16
449	53949-000	BRUSH ASSY.	4	2	0	0
460A	54242-000	BR RACK ASSY - 1PH (RT)	4	1		
460B	54242-001	BR RACK ASSY - 1PH (LF)	4	1		
460A	63940-000	BR RACK ASSY - 3PH (RT)	4		1	1
460B	63940-001	BR RACK ASSY - 3PH (LF)	4		1	1
462 ↑	23500-402	BRUSH HOLDER	4	12	16	16
463 467	41221-000	AC CAPACITOR ASSY.	4	3	3	3
468	41387-008	GROUND STRIP	4	7	7	7
469	23532-000	FIBER SPACER	4	10	10	10
470	52559-000	BRUSH HOLDER SPACER	4	2	2	2
471	53975-000	BR. HLDR. MTG PLATE	4	6	6	6
472	23500-400	BRUSH HOLDER	4	2	0	0
491	61668-000	END COVER ASSY.	4	1	1	1
513	63886-400	ADAPTER BRACKET	4	1	1	1



Glossary of Electrical Terms

AC: Alternating Current. Standard household electricity, supplied by the power company alternates 60 times (Cycles) each second. Alternating current frequency is measured in HERTZ (Hz).

ACR: AC Cranking Relay. Secondary stop cranking relay.

Ampere. The unit of electric current flow. One ampere will flow when one volt is applied across a resistance of one ohm.

Armature. An armature consists of an armature winding and an armature core.

ATS: Automatic Transfer Switch. That portion of the complete system which transfers the power from normal source to emergency source.

Brush. A conducting element which maintains sliding electric contact between a stationary brush holder and the collector rings on the armature. It conducts AC current to the receptacle in the control panel.

Collector Rings. The continuous copper rings on the end of the armature on which the brushes slide.

DC: Direct Current. This is the type of current produced by batteries.

FS: Fuel Solenoid. 12 VDC device used to shut the fuel off to the engine.

Field Coils. The stationary coils mounted in the metal shell which is being supplied with DC current for excitation.

Generator. A machine which transforms mechanical energy into electrical energy.

GTS: Generator Transfer Switch. An electrically held contactor used to transfer power from the generator to the load.

GTS/AUX: Generator Transfer Switch Auxillary Contacts. This electrical interlock is used to prevent the generator contactor from engaging while the line side contactor is engaged.

LP: Liquid Propane. Is used to identify the type of fuel the engine-generator set has been tested with. In this case liquid propane vapor was utilized.

LED: Light Emitting Diode. A light or indicator used to show that some function is operating properly.

LTS: Lineside Transfer Switch. An electrically held contactor used to power the load from a normal power source.

LTS/AUX: Lineside Transfer Switch Auxillary Contacts. This electrical interlock is used to prevent the line contactor from engaging while the generator contactor is engaged.

NG: Natural Gas. Is used to identify the type of fuel the engine-generator set was tested on. In this case natural gas was utilized.

Ohm. A unit of electrical resistance. One volt will cause a current of one ampere to flow through a resistance of one ohm.

Rectifier. A device for changing alternating current into direct current.

SCR: Stop Cranking Relay. Primary stop cranking relay receives its signal for the battery charging alternator on the engine.

SDR: Start Delay Relay. Delays the SSR from starting the engine generator set for a specific number of seconds.

SSR: Stop/Start Relay. This relay actually starts and stops the engine-generator set upon receipt of certain commands.

Volt. A unit of electrical potential.

Watt. A unit of electric power. In direct current equals volts times amperes. In alternating current equals volts times amperes for single phase power. 1000 watts equals 1 kilowatt.