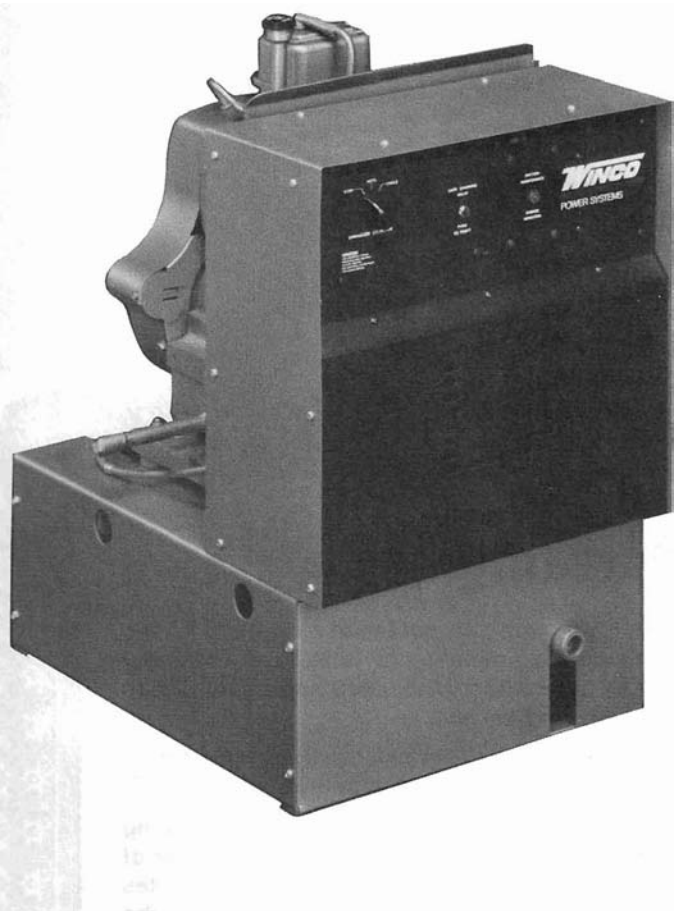
WINCO®
GENERATORS

AIR COOLED PACKAGE STANDBY APS5000 & APS8000

INSTALLATION, OPERATION, and MAINTENANCE INSTRUCTIONS



Attention: Read instructions carefully before attempting to install, operate or service this 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.

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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.

Limited Warranty

WINCO warrants for **one year** from date of shipment, it will repair or replace at its option, for the **original user,** the whole or any part of the product found upon examination by WINCO at its **factory** at 225 South Cordova Street, Le Center, Minnesota, or by any **factory-authorized service station** to be defective in material or workmanship under normal use and service.

For warranty service, return the product within **one year** from date of shipment, transportation charges **prepaid,** to the WINCO factory or to your nearest factory-authorized service station.

There is no other express warranty. To the extent permitted by law, any and all warranties, including those of merchantability and fitness for a particular purpose, are limited to one year from date of shipment, and liability for incidental or consequential damages or expenses is excluded. Some states do not allow limitations on the duration of an implied warranty, and some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights; you may have other rights which vary from state to state.

WINCO does not warrant engines or certain other component parts of the product since such items are warranted by their manufacturers.

WINCO does not warrant **alterations or repairs** which were not made by the WINCO factory or a factory-authorized service station and which affect the stability or reliability of the product.

WINCO does not warrant products which have been exposed to **misuse** and/or **negligence** or have been involved in an **accident.**

WINCO reserves the **right to change or improve** its products without incurring any obligations to make such changes or improvements on products purchased previously.

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 for permanent record of 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.

Description

The package standby engine-generator set includes all items necessary for a completely automatic standby power system as standard equipment (except the 12 volt engine cranking battery, available through local battery supplier).

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 system's performance and reliability.

This package power system is designed to automatically provide standby power to unattended loads during electrical outages. Upon an interruption of normal electrical service this package 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 fuel supply will be shut off and the engine magneto grounded by the start/run control circuit. The engine will stop and the load control circuit will retransfer the load back to normal commercial power source.

The package power system consists of three major parts:

1. A 40 amp automatic transfer switch (ATS)
2. A 5,000/8,000 watt (5 KW or 8KW) single bearing direct drive generator
3. A single cylinder, air cooled, LP/NG fuel engine (Model APS5000, 5KW) or a two cylinder, air cooled, LP/NG fuel engine (Model APS8000, 8KW).

The automatic transfer switch (ATS) is built into the junction box that is suspended over the chock mounted engine/generator assembly. The ATS consists of a four pole, double throw power contactor. Two poles are normally open (N.O.) and two poles are normally closed (N.C.). The contactor is electrically and mechanically interlocked. The ATS contains the power failure sensing circuitry, engine start/stop controls and load control/transfer equipment. An overcranking relay (O.C.R.) 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. A separate 4-5 amp charging circuit recharges the battery when the generator is operating. A control selector switch has three positions:

1. Stop—used whenever the unit is to be serviced and for emergency shut down.
2. Automatic—normal position for emergency standby service.
3. Check—this position enables the owner/operator to exercise and/or check the engine-generator set without transferring the load.

NOTE:	The unit will automatically transfer if a power outage occurs while running in an exercise mode.

Model APS5000 is a 5000 watt, 3600 rpm single bearing, direct drive, brush type, revolving armature generator. It is self excited (D.C. commutator) and inherently regulated to ± (plus or minus) 7%—no load to rated load.

Model APS8000 has the same construction and features except the power output is rated for 8000 watts. Either unit can be operated under any load within its rating without being damaged. The frequency regulation is maintained by the engine governor within three cycles variation (61.5 Hz—58.5Hz) from no load to rated load.

Each generator is equipped with an exciter cranking system (series D.C. motor) which acts as a high speed starter. This D.C. winding is also used as a D.C. generator excitation and charging the cranking battery.

The engine is equipped with a carburetor modified at the factory to operate on LP/NG vapor fuels. The fuel system can be adjusted for either LP (propane) vapor or NG (natural gas) operation. The engine operates at 3600 rpm and direct drives the generator by the engine's tapered (quill) crankshaft extension.

Unpacking

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 consignor'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.

CAUTION This unit is shipped without oil. See engine manufacturer's instruction manual for recommended oil requirements before initial starting.

1. Remove flex exhaust pipe taped inside of the carton.
2. Carefully dismantle the carton.
3. After inspecting the engine-generator for external physical damage, check for the following items packed inside the carton.
   a. Owner's manual, wiring diagram and parts list.
   b. Engine manufacturer's instruction manual.
4. Remove main frame hold down bolts (4).
5. Unit can now be lifted from shipping rails.

Specifications

Generator

Model	Watts	Volts	Amps	Hz	Ph	RPM	Insulation
APS5000	5,000	120/240	20.8	60	1	3600	Class F
APS8000	8,000	120/240	33.3	60	1	3600	Class F

Fuel Consumption

Natural Gas (1,000 BTU/CU FT)				LP Vapor (2,520 BTU/CU FT)		
Model	CF/HR	BTU/HR	#/HR	GAL/HR	CF/HR	BTU/HR
APS5000	125	125,000	7.1	1.7	61.0	153,000
APS8000	200	200,000	11.4	2.7	97.6	246,000

Required Tank Size for LP Vapor Withdrawal

Model APS5000

Tank Size	40 Gal.	50 Gal.	125 Gal.	350 Gal.
Tank Temp.	60°F (16°C)	30°F (0°C)	0°F (–18°C)	–20°F (–29°C)

Model APS8000

Tank Size	70 Gal.	80 Gal.	200 Gal.	700 Gal.
Tank Temp.	60°F (16°C)	30°F (0°C)	0°F (–18°C)	–20°F (–29°C)

Engine Specifications

NOTE: Refer to engine operating and maintenance instructions. This manual covers the generator 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.

General Safety Information

Despite the safe design of this generator, operating it imprudently, 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 or service 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. Do not allow anyone to operate the generator without proper instruction.
3. Avoid touching live terminals or receptacles.
4. Be extremely careful if operating this generator in rain or snow.
5. This generator must be properly grounded.
6. Hot engine parts, moving parts, and generator electrical output all can seriously injure the generator operator. The operator must use caution and remain alert when using this generator.
7. Keep all safety guard and power shields in position and tightly secured while equipment is operating.
8. When operating this generator, do not wear neckties, loose articles of clothing, or anything else that can be caught in moving parts.
9. Engine exhaust fumes are poisonous. Do not inhale them. Provide adequate ventilation for engine exhaust and fuel vapors that may leak through fittings or damaged pipes. Be sure generator itself is well ventilated for maximum performance and life.
10. The generator manufacturer recommends that only qualified electrical technicians be allowed to service (install, maintain, repair, or replace parts) this generator, and that only factory approved repair parts be used in it.

11. Do not work on this generator (or other potentially hazardous equipment) when fatigued.
12. Use extreme caution when working on electrical components. High generator output voltage can cause serious injury or death.
13. 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.
14. Keep a fire extinguisher near the generator. Extinguishers rated ABC by the NFPA are appropriate for this use. Consult your 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, be sure the operation selector switch is always in the stop position.

Before beginning the installation process recheck the rating of the generator set and its transfer switch rating. Be certain that they can handle the intended load and are compatible with the entrance voltage, phase and 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 for installation and service access
2. Location—close to fuel, exhaust outlet and electrical connections
3. Floor loading
4. Moisture and dirt
5. Heat and cold
6. Exhaust
7. Mounting generator system
8. Ventilation of room for engine and generator
9. Engine exhaust system and piping
10. Fuel installation
11. Engine service (oil and air cleaner checks)
12. Battery connection
13. Initial system start-up
14. Electrical connections

Space Required and Location

The space required should allow for ample working room around and in back of engine generator set. A general rule to follow is three (3) feet clearance. This allows service personnel to repair and remove engine or generator parts if service is needed.

The engine-generator should be placed near an outside wall as close to electrical service and fuel source as possible. This will reduce the cost of electrical 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 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 air-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 air flow. Where natural cross ventilation is inadequate, a thermostatically controlled fan may be required to boost circulation.

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 (32° F/0° C).

Exhaust

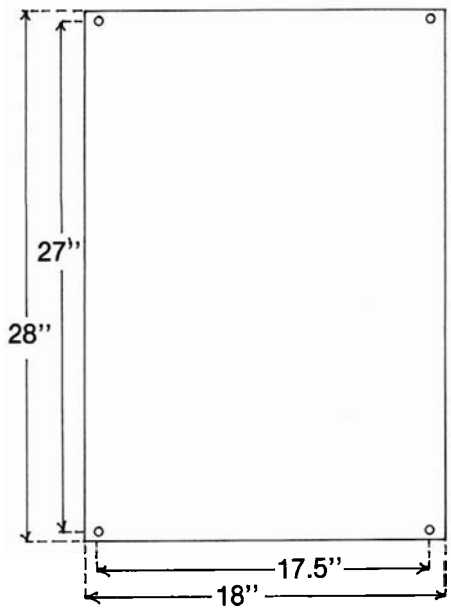
Exhaust gases from gasoline engines are extremely poisonous. Whenever an engine is installed indoors, the exhaust fumes must be vented to the outside. The engine should be installed at least two feet from any outside wall.

Carbon monoxide gas is deadly.

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. (See "Exhaust Installation.")

Mounting

Dimensional Outline (Reference Only)



CAUTION The unit's main frame should be bolted solidly 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

CAUTION Improper or inadequate ventilation will cause the engine to overheat. Providing adequate ventilation is the customer's responsibility. Engines damaged by overheating due to improper installation or abuse will not be repaired in warranty

The engines used in these standby generator systems require large quantities of fresh air to cool them. This ventilation air should be brought into the room from the outside in a sweeping flow. When an engine-generator is permanently installed in a closed room of a building, the engine must have an air inlet duct connected to the engine inlet shroud with a cross-section area of at least two square feet. (For example: 12 inches by 24 inches.) The hot air must be discharged from the room to prevent recirculation and overheating the engine. The hot air is generally discharged through a louvered opening in the wall and should be located above the cool air inlet, as the hotter air will rise.

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

Engine Exhaust and Piping

WARNING—Personal danger

Toxic fumes—engine exhaust gases are deadly and must be vented to the outside of any building.

Potential fire hazard. Consult NFPA.

Exhaust Installation (Refer to Figure 2)
Use black iron pipe for straight exhaust runs.

Fumes are poisonous.

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 should be used to minimize vibration transfer. It can be used horizontally, vertically, or at a slant, but keep it in a fairly straight line to prevent excessive strain on the welded end connections. (Do not use it as an elbow.)

Exhaust installations must 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, guarding to prevent fire must be installed around the pipe, as specified in the NFPA manual.

The size of the exhaust pipe to be used depends upon the length of the run. The engine exhaust hole is 1 inch NPT (F). To determine appropriate pipe size refer to the following chart.

	Length of Pipe Run			
	Up to 5 Ft.	5 to 25 Ft.	25 to 50 Ft.	Over 50 Ft.
Model APS5000 Pipe Size	1"	1¼"	1½"	Not Recommended
Model APS8000 Pipe Size	1¼"	1½"	2"	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, keep the restriction to a minimum. Generally, the use of two 45 degree elbows and a short connecting nipple is preferred over the use of a single 90 degree elbow.

If the exhaust line is over 5 feet long and the pipe rises above the engine, a condensation trap must also be installed to prevent engine damage. Water vapor (moisture) will condense in the cold piping and if improperly sloped, will flow back into the engine, causing rust damage inside the upper cylinder area. This is easily prevented by installing an ordinary pipe "T" or "Y" in the exhaust pipe at the lowest point of the trap. 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.

Propane (LP)/Natural Gas (NG) Fuel

CAUTION 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 marshall or gas supplier.

Fire hazard. All fuel runs should be installed by qualified fuel supplier.

Connect the fuel supply to the inlet of the fuel solenoid (see chart on page 5 for recommended line size). The pressure at the secondary demand regulator must be four to six ounces psi (per square inch) or 7 to 11 inches W.C. (water column).

CAUTION Be careful when sealing gas joints. Excessive sealing compound can be drawn into the solenoid, regulator or carburetor causing an engine malfunction.

Exhaust Installation

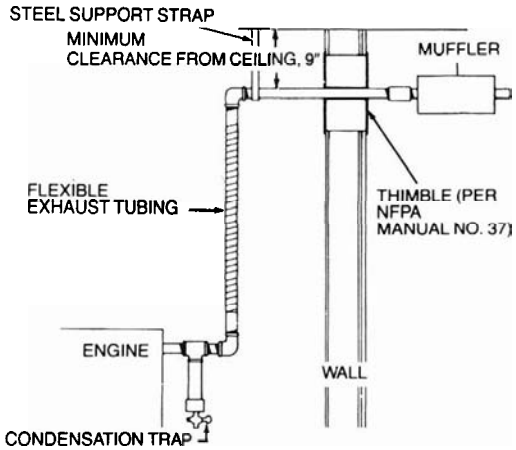


Figure 2
Exhaust Installation

Installing the Fuel Line

NOTE: 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.

Line Size

Warning: Personal Danger

Do not use galvanized pipe in fuel line runs. The galvanized coating can become eroded 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 the tables below for fuel line size, fuel consumption and recommended tank size. For distances of 50 feet and over, we recommend a two regulator fuel system. This is accomplished by installing a primary regulator at the tank which will reduce the tank pressure down to 10 to 15 lbs. A secondary regulator is installed close to the generator to further reduce the fuel pressure to the required six ounce operating pressure. When this two stage regulator system is used, a fuel line size of 3/8 inch is generally adequate for distances up to 300 feet from the primary to the secondary regulator.

The appropriate line size from the table below is then installed from the secondary regulator to the machine.

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

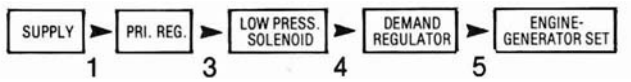
Length of Fuel Line	Fuel Line Size
Up to 25 Ft.	3/4" Pipe
25-100 Ft.	1" Pipe
Over 100 Ft.	**Not Recommended**—Use Two Regulator System

NOTE: Allow an additional 3 feet for each standard elbow. Do not use street ells.

Fuel Pressure

Correct fuel pressure cannot be stressed 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.

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.

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.

Lubrication

Before starting the engine, fill the crankcase 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 overemphasized. Engine failures resulting from inadequate or improper lubricant are considered abuse and are not covered by the engine manufacturer's warranty.

CAUTION In the following battery installation procedure, check to be sure the selector switch remains in the "Stop" position. *(See Figure 3.)*

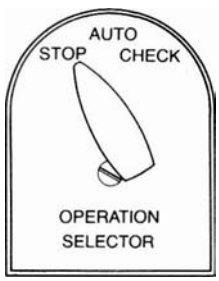


Figure 3

Installing the Battery

A twelve-volt battery rated 70 ampere hour or greater is required for proper starting performance.

Observe polarities: connect the positive (+) battery terminal to the (+) cable from the control panel; the negative (−) battery terminal is connected to the negative cable (ground) from the engine generator assembly.

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 the battery to remain in a discharged condition.

A fixed rate trickle charger, producing up to 40 MA is built into the control panel to keep the battery in top condition during standby periods. A small green light on the front panel is illuminated to indicate the proper operation of the charger. The charger has no control knob and requires no adjustment.

> NOTE: The trickle charger is not intended to recharge a battery which has become completely discharged. It is designed to produce just enough current to maintain the battery, if in good condition, at a state of full charge.

Initial Start Up

Prewire system check:

Before wiring the automatic transfer switch (ATS) 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 checklist to verify correct installation before starting the engine:

- Engine oil. Fill as required with correct grade and quantity.
- Unit mounting base
- Ventilation (air inlet duct, inlet and outlet louver sizes)
- Clearance on all sides for service and maintenance
- Proper fuel line material, size and safe, tight connections
- Gas regulator vented to the outside. Check for local code requirements.
- Fuel line protected and a moisture trap installed (may be required for NG)
- LP/NG pressure okay: 4-6 oz. (7-11" WC)
- Flexible exhaust connector installed
- Exhaust condensation trap installed
- Muffler installed and properly supported. Look closely for potential fire hazards in the exhaust support and wall or ceiling thimble areas of the exhaust system.
- Exhaust line must be 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

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

1. Move the ATS 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 troubleshooting section of this manual.
2. With the engine running smoothly check the no load voltage and frequency at Terminals G1 and G3 of the contactor switch. The voltage between G1 and G3 should be between 250 and 260 volts AC at a frequency of 61.5 to 62 Hertz (Hz). Hz is the symbol for cycles per second.

The voltage should also be checked between the hot terminals (G1 and G3) and the neutral/ground terminal to be certain of a balanced voltage output and a solid neutral connection. The voltage between G1 and Neutral (N) should be about one half of the line to line (G1 to G3) voltage or approximately 125 to 130 volts AC. The same approximate voltage should be found between Terminals G3 and Neutral (N) (125 to 130 volts AC).

> NOTE: The neutral/ground terminal bolt is located in bottom of the control panel.

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

After verifying that 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 must be done by a competent electrician and must conform to the national electrical code and comply with all state and local codes and regulations. Check with the authorities before proceeding!

> Be certain the operation selector switch on the front of the ATS control is in the "Stop" position and the main power switch is "Off." For your own protection verify these important safety precautions yourself with reliable instruments before proceeding.

Observe that the terminals on the power transfer switch are marked as follows:

The standby generator terminals are marked (G): "Hot" leads G1 and G3 are prewired at the factory to contactor terminals G1 and G3. Generator neutral (GN or G2) is prewired at the factory as a bonded neutral (grounded).

The load terminals are marked (T). T1 and T3 are "Hot."

The line terminals are marked (L). The load and line neutrals (TN or T2 and LN or L2) are normally bonded (connected) to the same factory ground stud in the bottom of the cabinet with GN (or G2).

> NOTE: Consult the manufacturer's customer service department if isolated neutral system is required.

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, the wire must be heavy enough to handle the full current rating of the main line circuit-breaker (or fuse) in the entrance (or sub-panel) protecting the contractor switch.

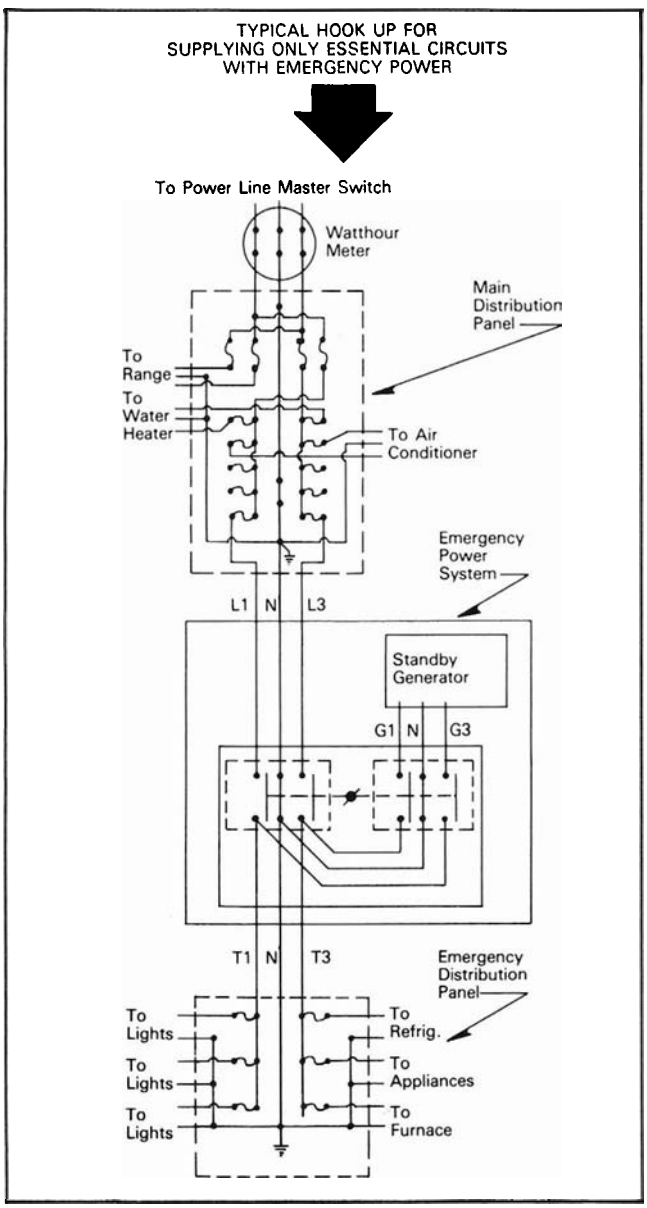
All wires should be installed in rigid or flexible conduit. (Knockouts are provided in the control box.)

Because of the many different types of service, feeder, and distribution equipment, no specific wiring instructions can be provided. In all cases it is essential that while the load is connected to the generator, there can be absolutely no feedback from the generator to the power line or from the power line to the generator. When properly installed, the normal ATS control and safety systems will eliminate all paths for feedback.

Connecting the Automatic Transfer Switch (ATS)

The automatic transfer switch connects the load (lights, furnace, outlets, etc.) to the normal power line during standby. When normal power fails, the ATS 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 retransfers the electrical load to the normal service and stops the engine.

To wire the automatic transfer switch into the existing wiring, first determine which circuits will be on the emergency load circuit. If the entire load



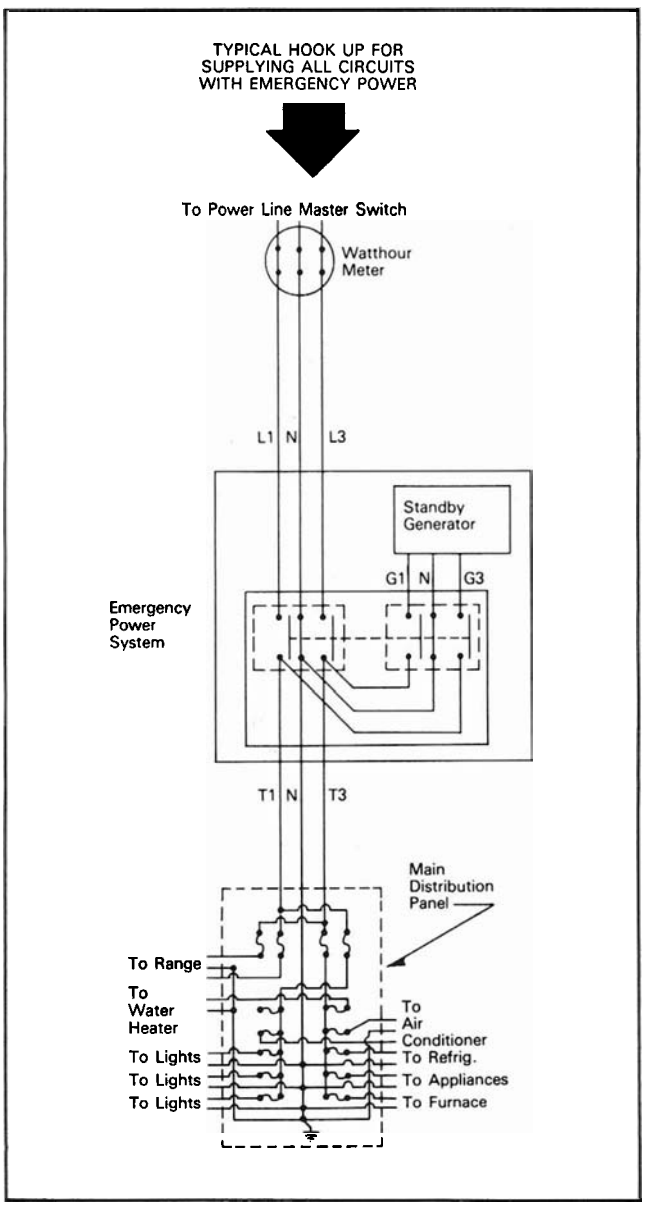


Figure 4—**Emergency Power Hook Ups**

is to be transferred, the transfer switch can be wired in directly after the watt-hour meter or main entrance providing the service entrance ampere rating is within the transfer switch's rated capability. In most cases the entrance will exceed the 40 amp transfer switch rating and will require a 40 amp load limiting circuit breaker to protect the transfer switch contacts if the entire entrance will be switched. Consult with your electrician and the applicable codes.

If only specific circuits are to be powered under emergency power failure conditions, an additional distribution panel designated Emergency Distribution Panel (EDP) must be installed.

All selected emergency circuits are removed from main distribution panels and re-installed in the emergency distribution panel. Suggested circuits—freeezer, refrigerator, furnace, emergency lights, sump pump, emergency outlet circuits, etc. Total load must not exceed generator (20.8 amp or 33.3 amp. See specifications or nameplate for rating) or 40 amp transfer switch rating.

A new emergency distribution panel (EDP) is wired to the main entrance panel through the automatic transfer switch. "Hot" leads L1 and L3 are connected from the ATS L1 and L3 terminals to a 40 amp, 230 volt, two pole circuit breaker in the main entrance panel. ATS terminals T1 and T3 are wired to the 230V bus in the emergency distribution panel. Line and load neutrals are connected to the generator neutral. Neutrals are identified by their white color and are marked GN or G2 for the generator, LN or L2 for the line and TN or T2 for the load.

The 40 amp circuit breaker in the main distribution panel should be large enough to power the entire emergency distribution panel under normal loads, but must 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 normal or power line operation to interim period to emergency or standby generator operation and back again to normal operation. The last part details plant exercising events.

Normal operation with power line energized:

1. Standby generator standing idle
2. The transfer switch contactor coil is de-energized. The line side contacts are spring loaded to a closed position, connecting electrical load to the power line.
3. Start/stop relay (S.S.R.) coil is energized directly by the 230 volt commercial power line. The S.S.R. normally closed (N.C.) engine start contacts are held open by the power line.

At the instant a power failure occurs:

1. The stop/start relay (S.S.R.) coil is de-energized.
2. The S.S.R. relay N.C. contacts close to apply a ground signal to:
   a. The gas solenoid through the closed contacts of the overcranking relay (O.C.R.). (O.C.R. contact terminals #6 and #7 are normally open (N.O.) when tripped.)
   b. The starting system is also controlled by the ground signal from the S.S.R. contact and O.C.R. terminals #6 and #7. This ground passes through the normally closed (N.C.) contacts of the stop cranking relay (S.C.R.) which will open to interrupt the cranking when the engine starts.
   c. This ground is also applied to the timing element (heater coil) of the overcranking relay (O.C.R.) to begin the cranking interval timing.
3. The gas solenoid valve opens to allow fuel to the engine carburetion system.
4. The engine cranks and starts.
5. When the engine starts, the generator voltage rises as it approaches operating speed. The generator voltage energizes the stop cranking relay (S.C.R.) coil. This opens the S.C.R. normally closed (N.C.) contacts to:
   a. Automatically disconnect the engine starting circuit.
   b. Disconnect the overcranking relay (O.C.R.) timing element to stop the cranking interval timer.
6. A set of N.O. contacts on the S.C.R. and a transfer delay relay (T.D.R.) allow the engine to reach full speed for approximately 20 to 45 seconds before the generator voltage is applied to actuate the transfer switch contactor.
7. The T.D.R. is a thermal timing device that begins timing when the generator voltage (115 V) is applied to the T.D.R. heater coil through the N.C. contacts of an auxiliary (AUX.) switch mounted on the transfer contactor. After timing out, the T.D.R. contacts close to apply power to the transfer switch contactor coil.
8. When energized, the transfer switch contactor opens the line contacts and closes the generator contacts to apply generator power to the load.
9. The N.O. contacts of the AUX. switch close to lock up the contactor coil.
10. The N.C. contacts of the AUX. switch open to de-energize the control ground signal on the T.D.R. heater element.

Generator powering the load:
The generator will continue to power the load until the commercial power is restored.

When the commercial power is restored:

1. The start/stop relay is re-energized.
   a. The N.C. contacts open the transfer contactor coil. This allows the contactor to return to its normal position (generator contacts open/line contacts closed/load supplied by the line).
   b. The N.C. contacts open the engine start/run circuit by interrupting the ground control signal to the fuel solenoid turning off the fuel. The N.O. half of this same contact set applies a ground to the engine magneto to kill the ignition as a backup shutdown to stop the engine.

Plant exercising:

1. When the engine is started in the "check" position, the engine will start automatically and the generator will produce normal voltage. The transfer prevent contact (N.C. on the S.S.R.) prevents the generator voltage from energizing the load transfer contactor coil. The load is not interrupted by any normal plant "exercise" mode.
2. When the optional automatic plant exerciser clock (E.C.) is installed, the unit will operate exactly like it is in the "check" mode except it will be programmed by the customer to start and stop automatically on a regular basis. Standard plant exerciser clock is a 14 day/15 minute interval timer. Any single or multiple combination of 15 minute off/on cycles can be programmed daily, weekly or bi-weekly by the owner.

NOTE: The generator will not carry the load unless the commercial service is interrupted or the main entrance circuit breaker is turned off. The generator will transfer immediately if a power failure occurs during a plant exercise period.

The Engine Start/Stop Circuit

The "stop" wire is connected to the engine magneto. The "start" wire is connected to the coil of the start solenoid. By grounding the "stop" wire, the engine is stopped; and by grounding the "start" wire it is cranked.

Refer to the simplified schematic diagram. Note that the revolving contact of the selector switch is grounded. When a contact is in the "stop" position, the stop wire is grounded; and when it is turned to the "check" position, the start wire is grounded and the engine is cranked.

When the power line is energized and the selector switch is turned to the "auto" position, the start/stop relay (S.S.R.) coil is energized by the commercial line power. The coil holds the armature (movable contact) in position against the normally open contact (N.O.) and completes the circuit between ground and the "stop" wire. When either leg of the power line fails, spring tension moves the S.S.R. armature so contact is made between ground and the "start" wire and cranks the engine.

Whenever the cranking circuit is energized, a circuit is also completed to the heating coil of the overcranking relay (O.C.R.). If the engine fails to start in about 45 to 75 seconds, this coil becomes hot enough to trip the O.C.R. thermal switch. This closes the fuel valve and disconnects the start solenoid coil and interrupts the cranking. The O.C.R. must be reset manually.

The Battery Charging Circuits

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.

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 generator set for several hours.

The second charging circuit is a 4 to 6 amp, non-adjustable type powered directly from the generator D.C. output at the commutator. This charging circuit is intended to provide an adequate charge rate to restore the energy used in starting the engine.

The load powered charging circuit is a non-adjustable, trickle charger. Components are mounted on a circuit board inside the front panel. The charge indicator is a green L.E.D. (light emitting diode) protruding through the panel. The transformer primary is connected to the load line through a self-resetting circuit breaker. The negative side of the battery circuit is grounded. This charger is serviced as a unit. If defective, it will be replaced as a unit.

Generator powered, fixed battery charging circuit is a non-adjustable type powered directly from the generator D.C. output at the commutator. Current limiting resistor(s) are provided. A reverse current blocking diode is used to prevent the battery from being discharged through the generator windings when the engine is not running. The negative side of this battery charging circuit is grounded to the generator set frame.

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 emergency 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 it 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.

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 commutator or slip ring is caused by oil and grit, flint, or other hard substance on the brush, or by the brush not being properly shaped to fit the commutator or slip rings. Remedy these defects by fitting the brushes to the commutator or 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 commutator or slip-rings.

Slip Rings

The three 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.

Commutator

Keep the commutator free from all dirt, including carbon (brush) dust. Use a lint-free cloth for this purpose. Commutator should be smooth and

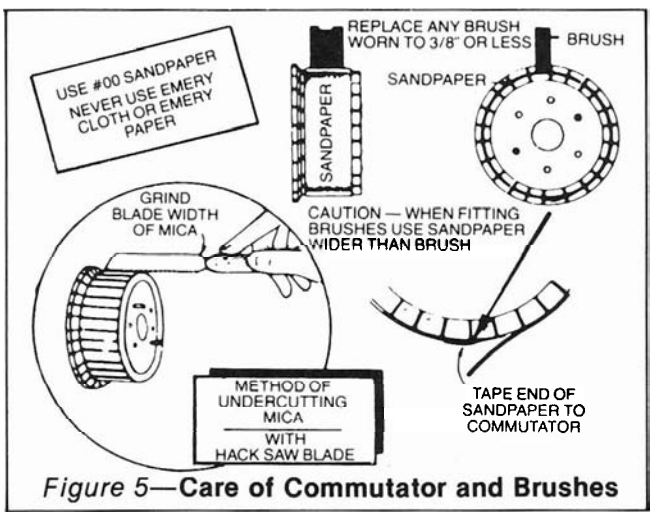


Figure 5—**Care of Commutator and Brushes**

shiny; its color should be in the copper to chocolate-brown range. If rough or black, polish with a commutator dressing stone or #00 sandpaper. Never use emery cloth on the commutator.

Hard mica is used as an insulator between the commutator bars. It is undercut about 1/32" below the surface of the bars. As the copper wears down, the mica, which is harder, forms ridges which cause the brushes to skip, resulting in poor contact. When this occurs, the armature should be removed from the unit, the commutator resurfaced, and the mica undercut by a qualified repairman.

Do not use lubricants of any type on the commutator. Lubricant(s) will cause sparking, poor contact, pitted bars, and will decrease the output of the generator.

Electrical Testing

Testing Generator Field for Opens and Grounds

1. Disconnect the battery
2. Disconnect the field leads from the D.C. brush holders.
3. Set multimeter to read resistance, and connect the meter leads to the field leads. The field resistance should be less than 15 ohms (shunt field) and less than 0.5 ohm (series field). If the field is open, the meter will read infinite resistance. Replace field coil 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 1 megohm) 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.

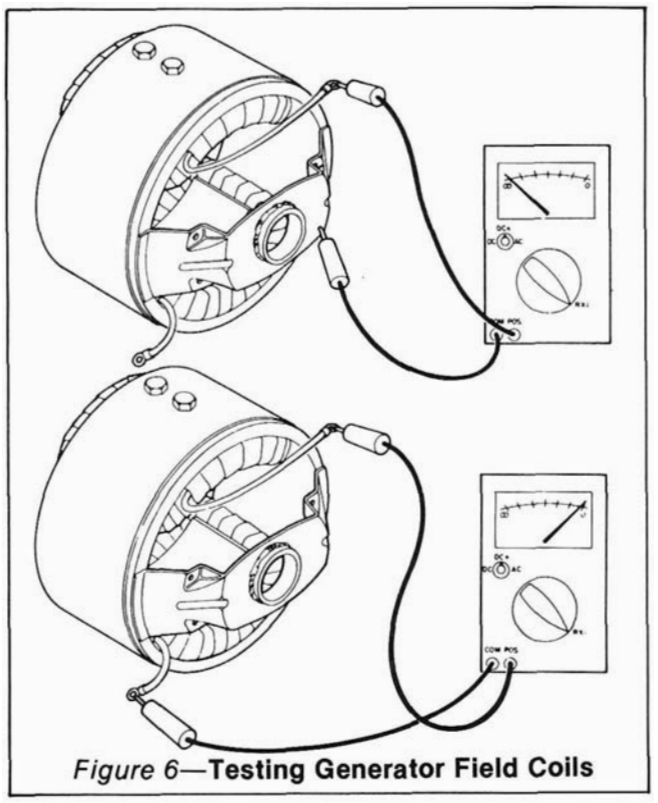


Figure 6—**Testing Generator Field Coils**

Testing Armature for Opens and Grounds

1. Disconnect the battery and 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 three slip rings and each bar of the commutator (one at a time) while observing the meter.

   If meter indicates continuity (zero ohms or any reading lower than infinite resistance), the armature is grounded. Dirt on the slip rings or commutator bars can cause grounding. Carefully clean the dirt off the slip rings and commutator bars (especially in the slots) 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.

   Finally check between rings #1 and #3. The resistance should total the sum of the readings from #1 to #2 plus #2 to #3.

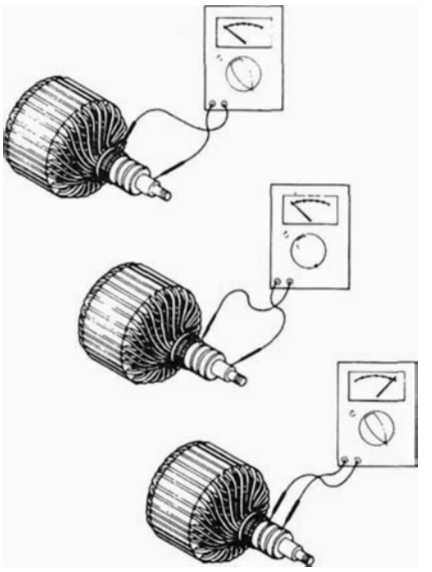


Figure 7
Testing Armature for Opens and Grounds

Testing Reverse Current Diode

The reverse current diode has two terminals. The diode is tested in the following manner. Connect one ohmmeter lead to the soldered terminal, and the other ohmmeter lead to the rectifier stud. A high or low resistance reading will be obtained. Reverse the meter leads, and an opposite reading

should be observed. A good diode (or rectifier) will have a low reading in only one direction. A defective diode will generally have a low reading in both directions.

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 should be considered defective and 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. Although maintenance free batteries require considerably less maintenance, periodic check of fluid level and terminal corrosion is still required for reliable operation.

Fuel and Exhaust Condensation Traps

Drain the traps at regular intervals to prevent moisture and exhaust condensation from overflowing into the engine.

NG/LP Fuel Adjustment

> **CAUTION** Do not make any fuel adjustment on fuel regulator, carburetor or governor until all fuel inlet pressure readings are in compliance with specifications. See fuel installation above.

Natural gas (NG): Most units are factory tested and adjusted on natural gas (NG). A yellow tag is attached with the actual test fuel and instructions for converting from NG to LP (and from LP to NG). Due to variations in NG fuel characteristics and BTU levels throughout the country, it may be necessary to readjust the carburetor fuel mixture at the bottom of the carburetor once the engine has been installed and serviced.

Propane (LP): LP adjustments are the same as NG.

> **CAUTION** Don't make fuel mixture adjustments on the unit when it is stopped or running no load. The mixture adjustment is only effective when the engine is operating under load.

Adjustment Procedures—Natural Gas (NG) or Propane (LP)

> NOTE: Counter-clockwise (CCW) adjustment of the fuel adjustment valve increases the fuel flow (richens mixture). CW rotation leans mixture.

1. Insure the unit is operating under 80% to 100% load or at the highest anticipated load.
2. Attach an AC voltmeter to monitor generator speed.
3. With an end wrench, loosen the locknut on the fuel mixture valve at the carburetor. With a large screwdriver, turn the adjusting needle valve screw either left or right. Observe the voltmeter, if it drops, turn the adjustment valve the opposite direction. Adjustments should be made very slowly. Adjust back and forth until the highest voltage is achieved. If the voltage is out of upper or lower limits, a governor adjustment will be necessary. (Consult the engine operator's manual for procedure.)
4. After a proper balance of engine speed and performance has been achieved, tighten the locking nut to hold the adjustment. Recheck the starting, running no load and running full load to insure no operational problems will occur. If properly adjusted, the unit will start and run reliably in all modes.

> **CAUTION** Under full load do not adjust the speed above 60 Hz. If a higher frequency is used, as the load is decreased, the frequency will go out of upper limits (61 to 62 Hz). The generator voltage will be too high at these speeds. This will shorten the life of light bulbs and may damage sensitive electronic equipment being powered by the generator. Always check the equipment nameplate or check with the manufacturer before powering delicate or sensitive devices on a new power source.

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 procedure is the same as the adjustment procedure described above. Plumb the new fuel supply line following the appropriate instructions. Be sure the inlet (supply) pressure is in the correct range. Excessive pressure is the most common LP (propane) error and inadequate pressure is the most common NG (natural gas) problem.

Troubleshooting Table

Symptom	Cause(s)	Corrective Action
Load will not transfer to generator during power line interruption.	Open transfer contactor coil	Test and replace coil.
	Defective auxiliary (electrical interlock contacts—right and left sides	Adjust or replace switch contacts.
	Defective stop cranking relay	Repair or replace.
	Defective transfer prevent relay	Repair or replace.
Engine will not stop cranking or overcranking relay (O.C.R.) pops out and shuts down engine after it starts.	Stop cranking relay out of adjustment	Adjust or replace.
	Defective stop cranking relay (S.C.R.)	Repair or replace; relay should trip between 50 and 75 seconds of continuous cranking.
	Defective O.C.R.	Repair or replace.
	Loose wire in stop cranking circuit	Repair.
Engine 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 in less than 50 seconds or does not trip after 60 seconds 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.
	Defective start solenoid (control box)	Check and replace.
	Defective or sticking D.C. brushes	Check for binding, wear and fit to commutator. Recondition if not seated properly. Replace brushes that have weak or burned springs.
Engine will crank in check but not in "auto".	Start/stop relay defective	Repair or replace.
Engine 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	Check for loose/broken connections or open coil. Repair or replace.
	Magneto grounded	Check magneto wiring for ground.
Engine will not stop with switch in "auto" position.	Loose or open wire between the line and start/stop relay coil	Set selector switch to the stop position. If engine does not stop short out the spark plug. Use a screwdriver with a well insulated handle. Repair or replace wire.
	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 dirty or corroded	Clean contacts or replace relay.
Sparking at the brushes.	Generator overloaded	Reduce load.
	Brushes not seated properly	Contour brushes. (See "Maintenance".)
	Slip rings rough or eccentric	Redress 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 L.E.D. charge indicator when the engine/ generator is not running.	Defective fuse. (Fuseholder is on upper front face of ATS cabinet.)	Check and replace if required.
	Other trickle charging components are mounted on a circuit board inside front panel of the cabinet. Check transformer, resistor, rheostat and millammeter.	Replace defective assembly as a unit unless defect is obvious.

Troubleshooting Table (continued)

Symptom	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 commutator or D.C. brushes	Repair or replace if defective.
	Dirty slip rings	Clean and polish. Use 00 sandpaper and crocus cloth—never emergy 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. Unlikely since unit has fields flushed with each electric start.
Output voltage too high.	Engine speed too high	See engine manual.
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 replaced by insulating at the point where the ground occurs.
	Short turns in armature	Replace arm.
No battery charging when generator is running.	Defective reverse current diode	Check and replace if required.
	Defective limiting resistor	Replace defective resistor.
	Loose or broken wiring in ATS cabinet under generator cover	Repair/replace wire or connection.
Battery discharges when generator set is not running.	Shorted reverse current diode	Replace if shorted out.
	Shorted battery or control wire	Repair or replace.

Replacement Parts List for Model APS5000

Ref. No.	Part No.	Description	Qty.
001	*	Nut—5/16-18	4
002	*	Capscrew—5/16-18 × 2¼	4
100		Engine (Tecumseh No. OH140-160063E)	1
111	53244-009	Pipe extension—⅜ NPT	1
112	21857	Coupling—⅜ NPT	1
201	61458	Cover	1
203	61457	Lower front panel	1
210	●	Back panel	1
240	●	Front panel	1
271A	61454	Panel support—left side	1
271B	61453	Panel support—right side	1
400	58380-005	Generator assembly	1
602	62331	Adapter plate	1
605	57963	Subframe assembly	1
610	61500	Base frame	1
611	20191	Shock mount	8
811	42942	Fuel solenoid—12 VDC	1
812	55559	Fuel regulator—Model KN	1
814	22239	Brass elbow	2
816	62386	Carburetor	1
820	22626	Close nipple—¾ NPT	2
821	81076	Elbow—¾ NPT	1
822	80941-003	Nipple—¾ NPT × 5	1
823	61465	Bracket assembly	1
824	23048-001	Fuel hose—½'' ID	1
825	81079	Nipple	1
826	24363	Elbow	1
827	453	Lock-nut	2
931	62437	Upper heat shield	1
932	62438	Lower heat shield	1

Refer directly to engine manufacturer.
●See Front & Back Panel Parts Lists, page ____.
* Standard hardware item, available locally.

Replacement Parts List for Model APS8000

Ref. No.	Part No.	Description	Qty.
001	*	Nut—5/16-18	4
002	*	Capscrew—5/16-18 × 2¼	4
100		Engine (Tecumseh No. OH180-180021C)	1
111	53244-009	Pipe extension—⅜ NPT	1
112	21857	Coupling—⅜ NPT	1
201	61458	Cover	1
203	61457	Lower front panel	1
210	●	Back panel	1
240	●	Front panel	1
271A	61454	Panel support—left side	1
271B	61453	Panel support—right side	1
400	61697-001	Generator assembly	1
602	62331	Adapter plate	1
605	61475	Subframe	1
606	91172-001	Spacer	1
610	61502	Base frame	1
611	20191	Shock mount	8
811	42942	Fuel solenoid—12 VDC	1
812	55559	Fuel regulator—Model KN	1
814	22239	Brass elbow	2
816	62386	Carburetor	1
820	22626	Close nipple—¾ NPT	2
821	81076	Elbow—¾ NPT	1
822	80941-003	Nipple—¾ NPT × 5	1
823	61465	Bracket assembly	1
824	23048-008	Fuel hose—½'' ID	1
825	81079	Nipple	1
826	24363	Elbow	1
827	453	Lock-nut	2
931	61810	Upper heat shield	1
932	62422	Lower heat shield	1

Refer directly to engine manufacturer.
●See Front & Back Panel Parts Lists, page ____.
* Standard hardware item, available locally.

ORDER REPLACEMENT PARTS THROUGH DEALER FROM WHOM PRODUCT WAS PURCHASED

Please provide following information:
- Model Number

Serial Number (if any)
Part Description and Number as shown in parts list.

If dealer cannot supply, order from:
WINCO
Parts Department
225 S. Cordova
LeCenter, MN 56057
Phone (612) 357-6821

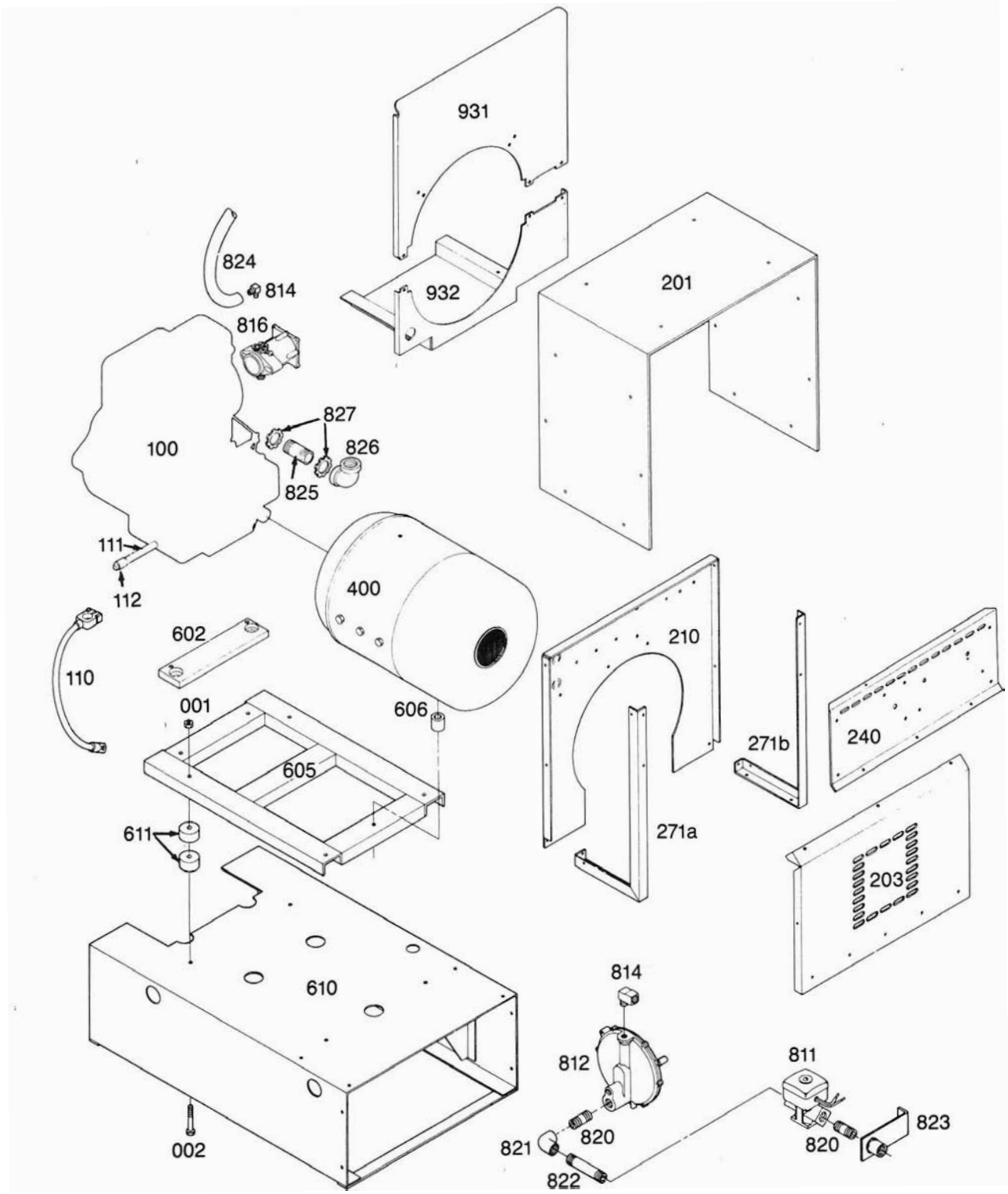


Figure 8
Models APS5000 & APS8000 Exploded View

Replacement Parts List for Model APS5000

Ref. No.	Part No.	Description	Qty.
001	*	Nut—5/16-18	4
002	*	Lockwasher—5/16 split	5
003	*	Capscrew—3/8-16 × 3/4	4
004	*	Capscrew—5/16-18 × 1 3/4	4
005	55224	Lockwasher—11/16 ext. tooth	1
006	23558	Washer—11/32 flat	1
007	23605	Hex nut—5/16-24	1
008	4637	Machine screw—#10-24 × 3/8	4
009	40746	Machine screw—#8-32 × 5/16	18
214	41984	Resistor—4 OHM, 50 W	1
250	54023-001	Diode assembly	1
401	55101	Fan	1
402	23197-007	Special arm retaining bolt	1
411	55258	End bracket	1
430	62344	Armature	1
432	55223	Bearing	1
441A	55422	Field coil (L)	1
441B	55422-001	Field coil (R)	1
442	23207	Pole shoe	2
443	23208	Pole shoe retainer	2
444	62521	Field shell & bracket weldment	1
446	41393	Brush—DC	2
447	23607	Brush—AC	6
455	23451	Stud	4
460A	55423	Brush rack assembly (L)	1
460B	55423-001	Brush rack assembly (R)	1
461	41744	Riveted brush rack (L)	1
462	23500	Brush holder	6
463	41221	Capacitor—AC	2
465	41744-001	Riveted brush rack (R)	1
466	41180	Capacitor—DC	1
491	61710-001	End cover	1

*Standard hardware item, available locally.

Replacement Parts List for Model APS8000

Ref. No.	Part No.	Description	Qty.
001	*	Nut—5/16-18	4
002	*	Lockwasher—5/16 split	5
003	*	Capscrew—3/8-16 × 3/4	4
004	*	Capscrew—3/8-18 × 1 3/4	6
005	40552	Lockwasher—11/16 int. tooth	1
006	23558	Washer—11/32 flat	1
007	23605	Hex nut—5/16-24	1
008	4637	Machine screw—#10-24 × 3/8	4
009	40746	Machine screw—#8-32 × 5/16	18
250	54729	Heat sink	1
401	23404	Fan	1
402	23197-013	Special arm retaining bolt	1
411	55258	End bracket	1
430	62379-001	Armature	1
432	50215	Bearing	1
441A	59146	Field coil (L)	1
441B	59146-001	Field coil (R)	1
442	42882	Pole shoe	2
443	61438	Pole shoe retainer	2
444	61699	Field shell & bracket weldment	1
446	47683	Brush—DC	2
447	55536	Brush—AC	9
455	51434	Stud	4
460A	52374	Brush rack assembly (L)	1
460B	52375-001	Brush rack assembly (R)	1
461	47684	Riveted brush rack (L)	1
462	59690	Brush holder	9
463	41221	Capacitor—AC	2
465	59847	Riveted brush rack (R)	1
466	41180	Capacitor—DC	1
473	59688	Barrier spacer	9
491	61710-001	End cover	1

*Standard hardware item, available locally.

ORDER REPLACEMENT PARTS THROUGH DEALER FROM WHOM PRODUCT WAS PURCHASED

Please provide following information:
- Model Number
  Serial Number (if any)
- Part Description and Number as shown in parts list.

If dealer cannot supply, order from:
WINCO
Parts Department
225 S. Cordova
LeCenter, MN 56057
Phone (612) 357-6821

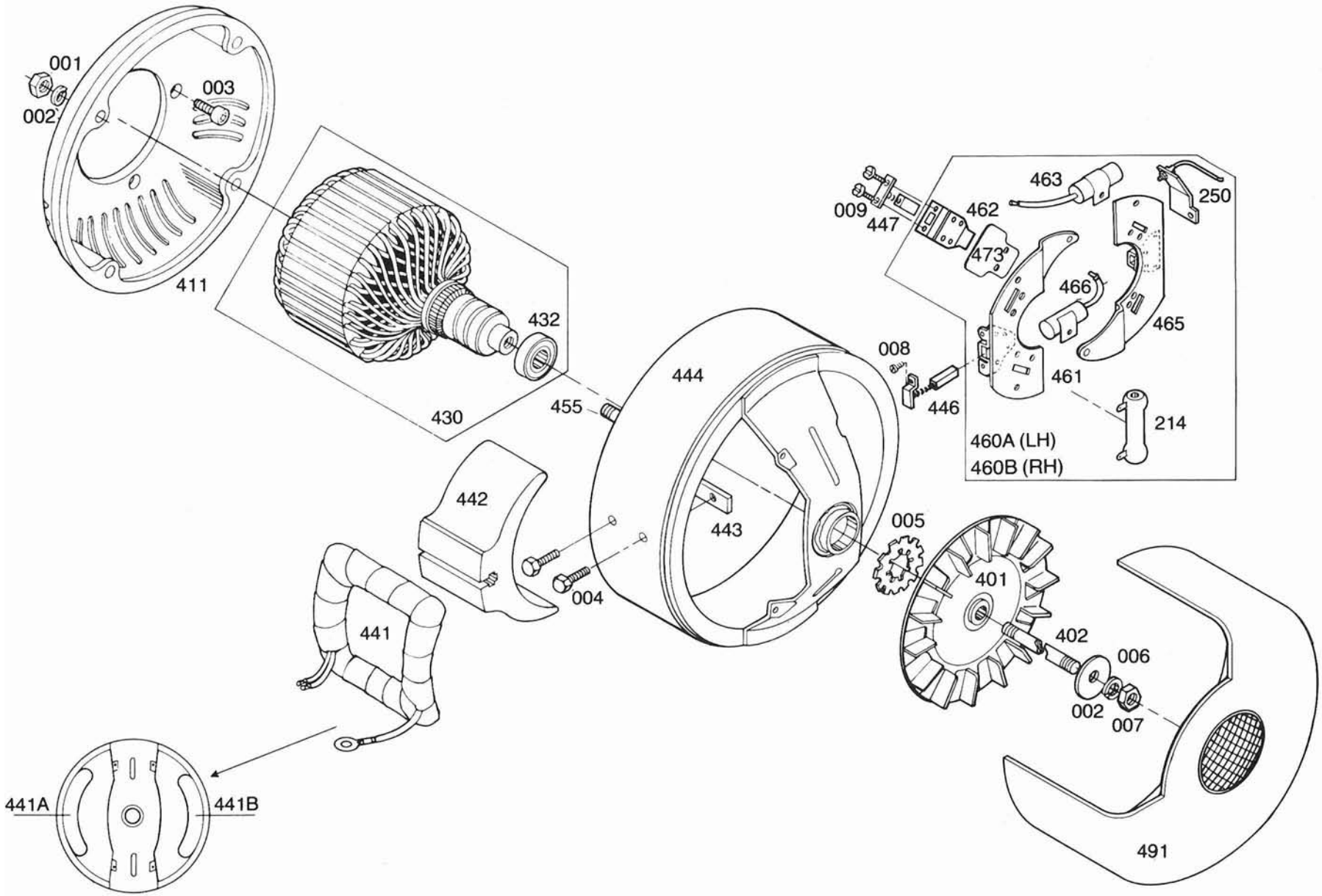


Figure 9
Models APS5000 & APS8000 Exploded View

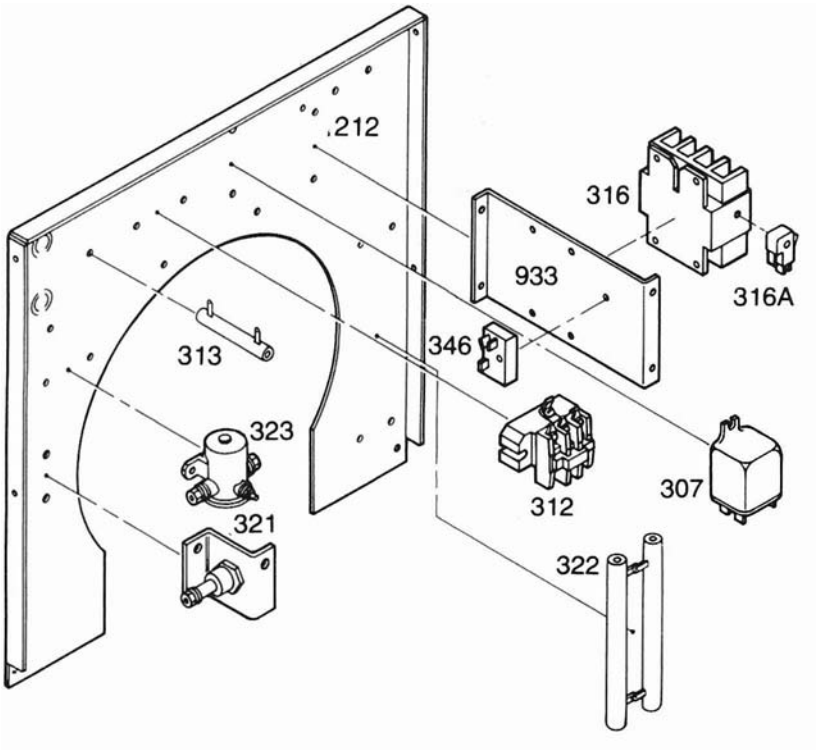


Figure 10
Models APS5000 & APS8000 Back Panel Assembly

Replacement Parts List for Models APS5000 and APS8000

Ref. No.	Part No.	Description	Qty.
212	61455	APS5000 Back panel only	1
	61559	APS8000 Back panel only	1
307	59944-006	Relay (S.S.R.) D.P.D.T. 240 vac	1
312	92065	Relay (S.C.R.) 240 vac	1
313	23635	Resistor 750 ohm variable	1
316	61694	Contactor 4 P.D.T. @ 40 amps (ATS)	1
316A	61695	Auxiliary switch (elect. interlock)	2
321	51060	Reverse current diode	1
322	54599*	Resistor 25 ohms/100 w	2
323	24601	Start solenoid	1
346	48525	Thermal delay timer (T.D.R.)	1
933	61587	Bracket	1

*Not used on Model APS5000.

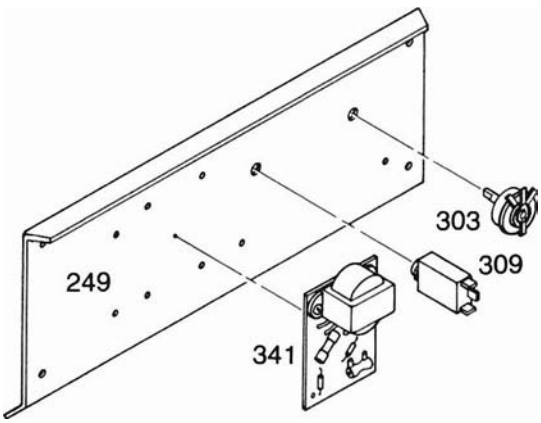


Figure 11
Models APS5000 & APS8000
Front Panel Assembly

Replacement Parts List for Models APS5000 and APS8000 Front Panel Assembly

Ref. No.	Part No.	Description	Qty.
249	61456	Front panel only	1
303	57946	Mode selector switch	1
309	48585	Thermal delay timer (O.C.R.)	1
341	61222	Trickle charger assembly	1

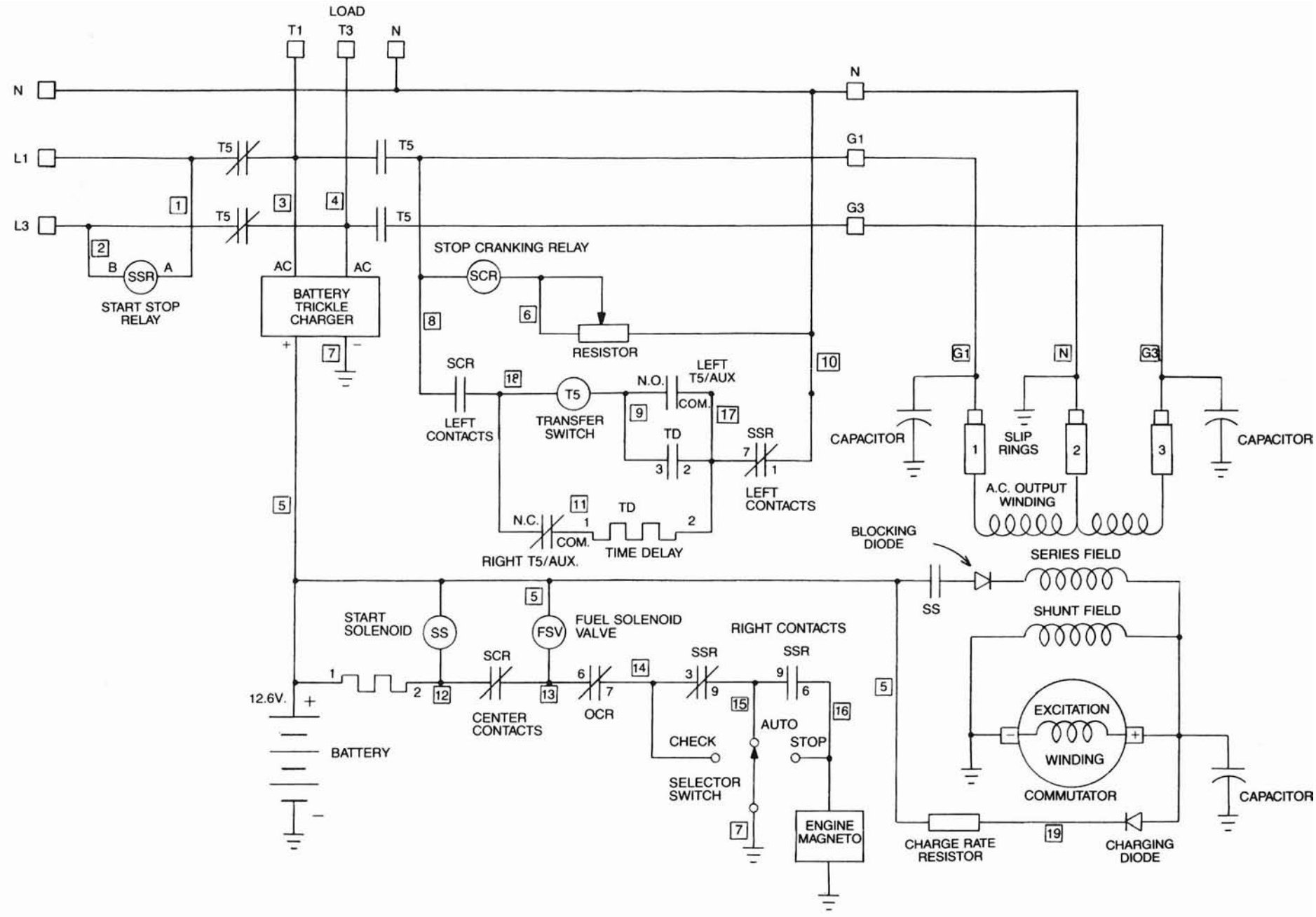


Figure 12

Models APS5000 & APS8000 Wiring Diagram

64573-001
515.00

60706U18 - OPM / IPL SUPPLEMENTAL INSTRUCTIONS P/N 60714-xxx
Attach this supplement and Schematic #B-64574
to OPM / IPL #60706-018 for models:

APS5000/C24	64569-000	APS8000/D24	64570-000
APS5000/D24	64569-001	APS8000/E24	64570-001

Changes to the base manual # 60706-018 are detailed by page as follows:

Page 3 - Feature enhancement

The ATS how has TWO (2) separate4 pole contactors, each rated @ 40 Amps - One contactor is for the Line side. The other is for the Generator side. Separate contactors allows a programmed load transition between generator and line power when the line is restored.

The engine control and OCR components are replaced with an electronic engine controller. The new engine controller has an engine a 10 second Start Delay, 5 - 12 second Cranking Cycles and a 3 minuteCool Down Delay programmed into the boardas **standard features.**

Illustrated Parts List changes

Note: Principle changes to these units are the upgrade to double contactors, electronic engine controllers and the Re-powering with B&S engines - 11HP for the APS5000 and 16HP Twin Cylinder Vanguard for the APS8000.

Page 18 - CUA - Complete Unit Assembly (See Above for CUA P/N's)

100	59158-000 B&S 252412 -5501-01	64529-000 B&S 303442 -0344-01	Engine - As Purchased
200	64575-000 APS5000/C24	64572-000 APS8000/D24	Control Box Assembly
200	64575-001 APS5000/D24	64572-001 APS8000/E24	Control Box Assembly
203	61457-001	61457-001	Lower Front Panel Assembly
400	58380-004	61697-002	Generator Assembly

Page 20 - GPA - Generator Parts Assembly

402		23197-018	Thru Bolt - 11-1/8
430	55317-001	61437-001	Armature
440	55421-003	61698-000	Field Shell & Coil Assy
443		42883-000	Pole Shoe Retainer
460B		52374-001	Brush Rack Assembly (R)