Onan®

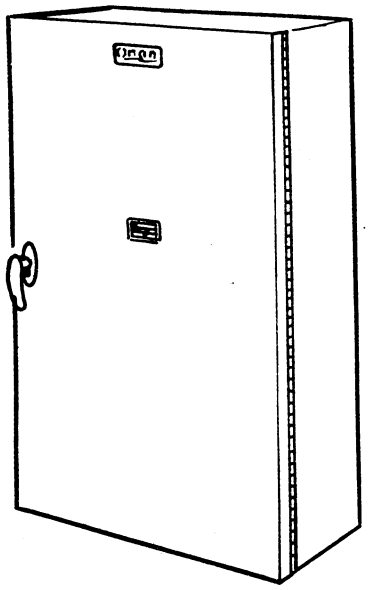
# OPERATORS MANUAL

FOR

SERIES

# LTE AND LTEU

## AUTOMATIC TRANSFER SWITCHES



30 THROUGH 200AMPERES

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# SAFETY PRECAUTIONS

This manual includes the following symbols to indicate potentially dangerous conditions to the operator or equipment. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

**WARNING** **Onan uses this symbol throughout this manual to warn of possible serious personal injury.**

**CAUTION** **This symbol refers to possible equipment damage.**

The automatic transfer switch has components with high voltages which present serious shock hazards. For this reason, read the following suggestions:

Keep the automatic transfer switch cabinet(s) closed and locked. Make sure authorized personnel only have the cabinet keys.

Always move the operation selector switch on the generator set or automatic transfer switch to "STOP", disconnect the starting batteries of the generator set, and remove AC line power to the automatic transfer switch before performing maintenance or adjustments of the automatic transfer switch (unless specified otherwise in the instructions - *then only using extreme caution* due to danger of shock hazard).

Before using the disconnect plug, if equipped, for de-energizing the control panel, be sure to place the operation selector switch on the generator set or automatic transfer switch to the "STOP" position. Otherwise, the generator set will start and energize the automatic transfer switch's generator.

Use rubber insulative mats placed on dry wood platforms over floors which are metal or concrete when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling any electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on the electrical equipment.

Do not work on this equipment when mentally or physically fatigued.

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*WARNING*

*TO AVOID POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE, A QUALIFIED ELECTRICIAN OR AN AUTHORIZED SERVICE REPRESENTATIVE MUST PERFORM INSTALLATION AND ALL SERVICE.*

# GENERAL INFORMATION

## AUTOMATIC TRANSFER SWITCHES

Onan automatic transfer switches are designed to operate with Onan electric generating sets and other Onan related equipment for standby service. The automatic transfer switch assures continuous power supply to a load either from the normal commercial power supply or from the emergency power source (generating set).

Onan standard cabinets meet requirements of the National Electrical Manufacturers Association (NEMA) for a "Type 1" cabinet: general purpose, indoor cabinet. Other type cabinets for outdoor use, etc. are available.

When contacting a dealer or the factory for information on operation or service of your automatic transfer switch, always furnish the complete model number, specification letter, and serial number as given on the nameplate. This information is needed to identify your automatic transfer switch among the basic and special types manufactured by Onan.

## MODEL NUMBER

Following is a typical model number with explanations of the different parts:

EXAMPLE: LTE60-53 or LTEUO60-3/1E

**LTE, LTEU** — Onan series automatic transfer switches for 3-wire remote start, 12-volt battery charging system.

LTEU automatic transfer switches are UL (Underwriters' Laboratories, Inc.) listed, indicated by the "U" in LTEU. Other switches are designated by LTE series.

**O** — LTEUO indicates optional cubicle mounting (no enclosed cabinet).

**60** — Ampere rating.

**5** — Tens digit 5 designates 50-hertz use only (LTE60-53 example). Number omitted designates 60-hertz use only (LTEUO60-3/1E example).

**3** — Units digit 3 designates voltage, wire and phase: 1 is 120 volt; 2 is 240 volt; 3 is 120/240 volt 1 phase; 4 is 120/208 volt 4 wire 3 phase; 5D is 120/240 volt 4 wire 3 phase delta, center tapped; 7 is 220/380 volt 4 wire 3 phase; 4X is 277/480 volt 4 wire 3 phase; 9X is 347/600 volt 4 wire 3 phase.

**/** — Diagonal separates basic model from specification.

**1** — Specification number which identifies optional equipment. Number "1" designates no options or basic as advertised.

**E** — Specification letter which advances with production modification.

**It is extremely important to note whenever a reference is made to particular specification letters, instructions apply to automatic transfer switches with these specification letter(s) only.**

## YOUR INSTRUCTION MANUAL

Since the manual contains the correct information for your automatic transfer switch, keep it handy and refer to it for installation and operation.

Throughout the text, front of the automatic transfer switch is the door side. Left and right are determined when facing the cabinet doors.

**A metric unit follows the U.S. customary unit in parentheses where applicable.**

# INSTALLATION

Onan recommends the automatic transfer switch installation be performed only by an experienced electrician observing all normal safety precautions and local electrical codes. Figure 1 shows a typical installation.

## LOCATING THE AUTOMATIC TRANSFER SWITCH

The point where the automatic transfer switch connects to the existing electrical circuit varies according to application and type of entrance switch. There must be a switch and fuses in the commercial line before the automatic transfer switch.

When a standby generating set protects the complete electrical service, install it between the main entrance switch and the distribution panel (Figure 2). If protection is limited to a single emergency distribution panel, cut into the circuit after the entrance switch fuses for the emergency distribution panel (Figure 3).

If the entrance switch is the compact type where branch and main fuses are in a single cabinet (such as used in most modern homes) cut into the main entrance between the meter and switch. Install an additional fused switch ahead of the automatic transfer switch (Figure 4).

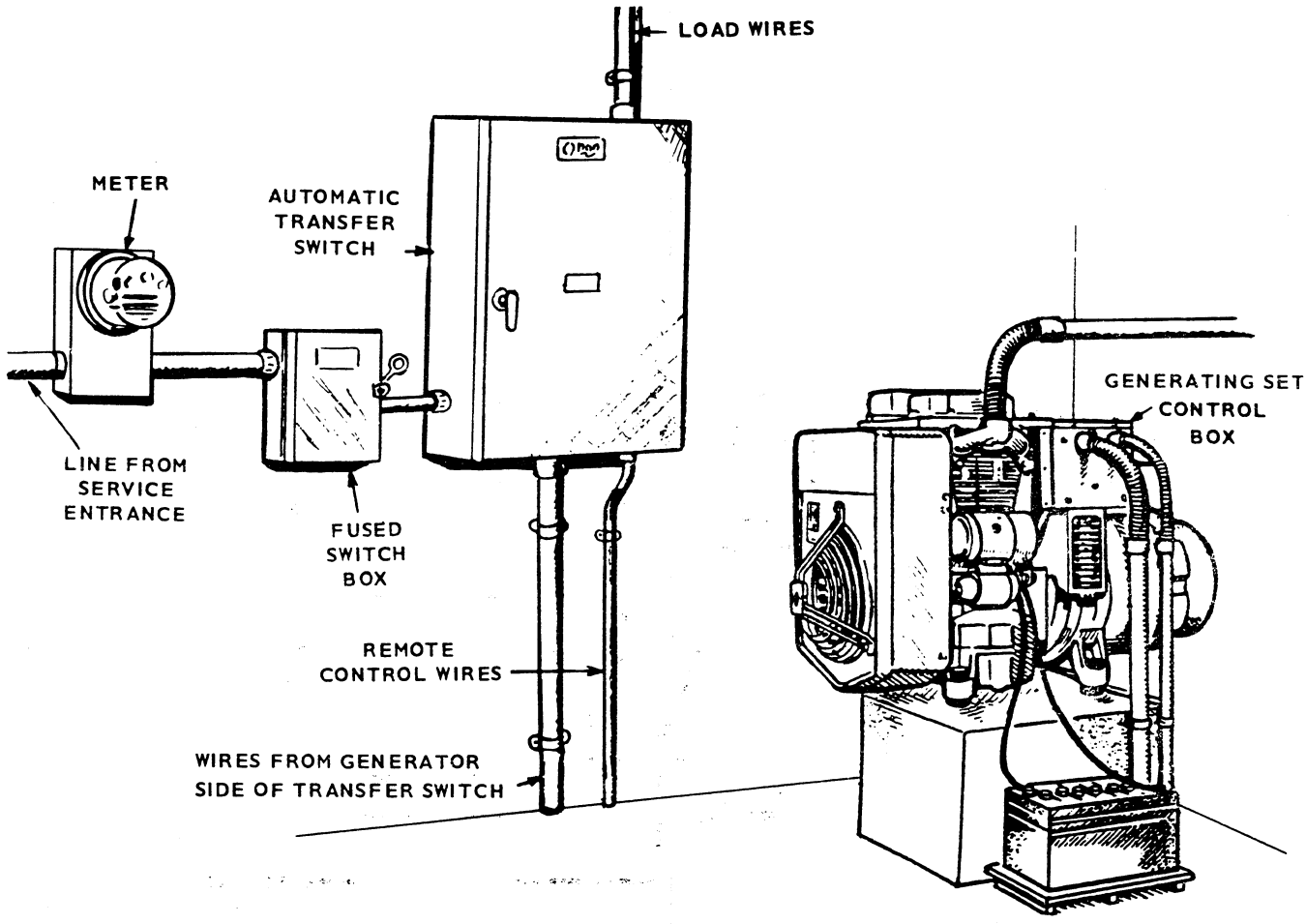



**FIGURE 1. TYPICAL AUTOMATIC TRANSFER SWITCH INSTALLATION**

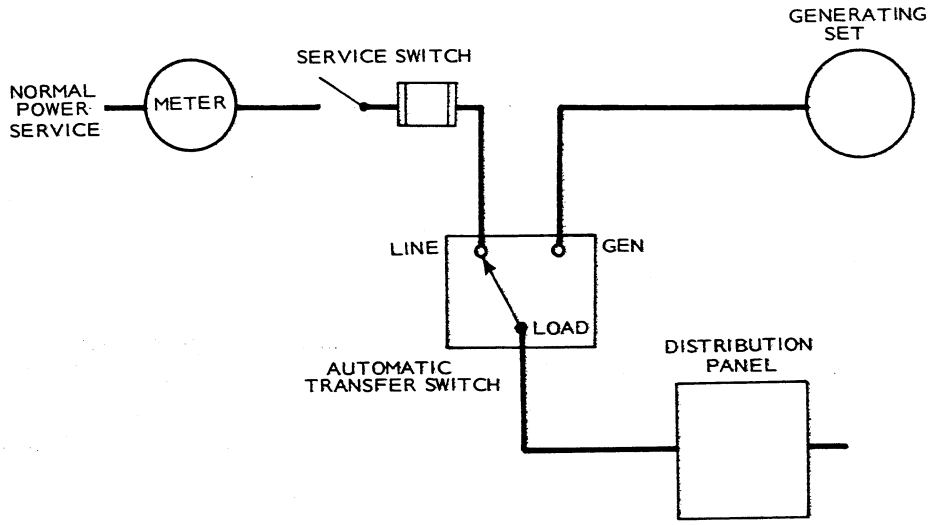



**FIGURE 2. PROTECTION FOR COMPLETE ELECTRICAL SERVICE**

## THREE-PHASE SERVICE AND A SINGLE-PHASE STANDBY

In some cases, emergency single-phase loads connected from one leg to ground of a four-wire, three-phase service can be protected by a single-phase generating set and automatic transfer switch. This is often done when all emergency lights are connected from one leg of the four-wire service to neutral The automatic transfer switch used for this service should be wired to the generating set with the leg of the commercial power to be protected by standby power connected to the line side of the switch. See Figure 5.

Wiring this type of automatic transfer switch can become a complicated procedure depending on the electrical service, the problems of three-phase balance and knowledge of the loads to be operated during a power failure. It should be attempted only with a thorough knowledge of the building's electrical service. If questions arise concerning the use or installation of an automatic transfer switch in this type of service, contact Onan furnishing full information.

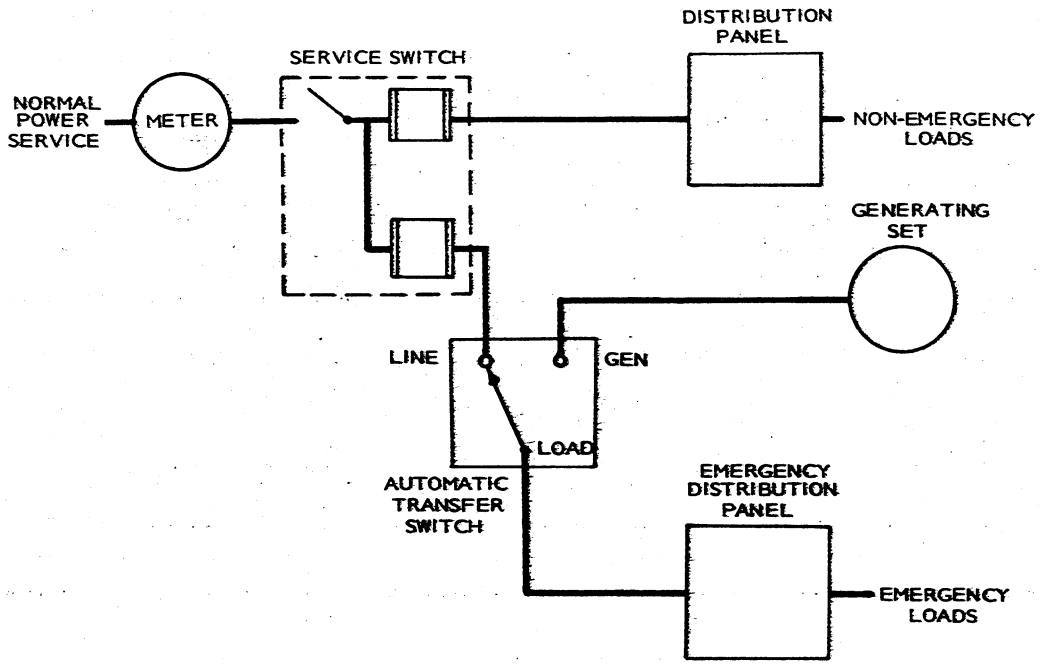



**FIGURE 3. LIMITED PROTECTION WITH AN EMERGENCY DISTRIBUTION PANEL**

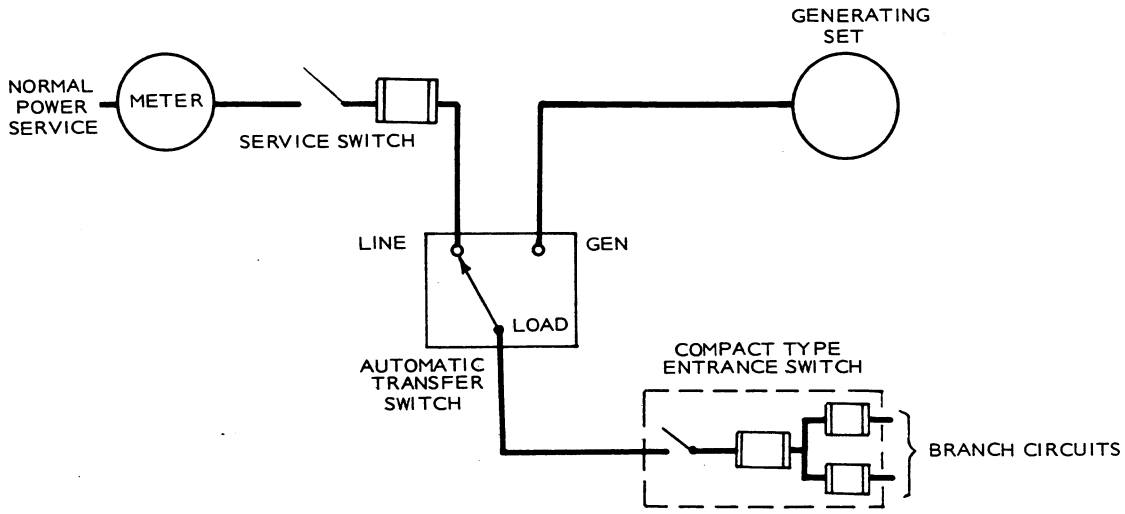



**FIGURE 4. INSTALLATION USING COMPACT ENTRANCE SWITCH**

## MOUNTING

The automatic transfer switch is normally supplied in a NEMA Type 1 box for indoor wall mounting. Protect it from excessive heat, moisture, dust and dirt. Mount the automatic transfer switch on a vertical wall, switchboard or other permanent support where it will not be subjected to excessive vibration. Secure it with bolts or screws through the holes provided in the back of box.

**CAUTION** **Extreme care should be exercised to keep drill chips and filings out of the relays, contacts and other parts of the automatic transfer switch when mounting it or connecting conduit. Also, screwdrivers should be used carefully to prevent damage to the resistors, coils and contacts.**

LTEUO automatic transfer switches are cubicle mounted (indicated by "O" in model number). The transfer switch is mounted on a panel with the control components mounted on a swing-out panel directly over it. Adequate clearance must be left on all sides of the cubicle mount for electrical connections.

## WIRING

Before wiring the automatic transfer switch, provide the commercial power line with a suitable switch and fuses (or circuit breakers) ahead of the transfer switch. Install and operate the generating set from its own controls before wiring the automatic transfer switch. Automatic transfer switch wiring can be accomplished in two steps:

1. Wire between automatic transfer switch and generating set.
2. Wire load from line, generating set and load to the

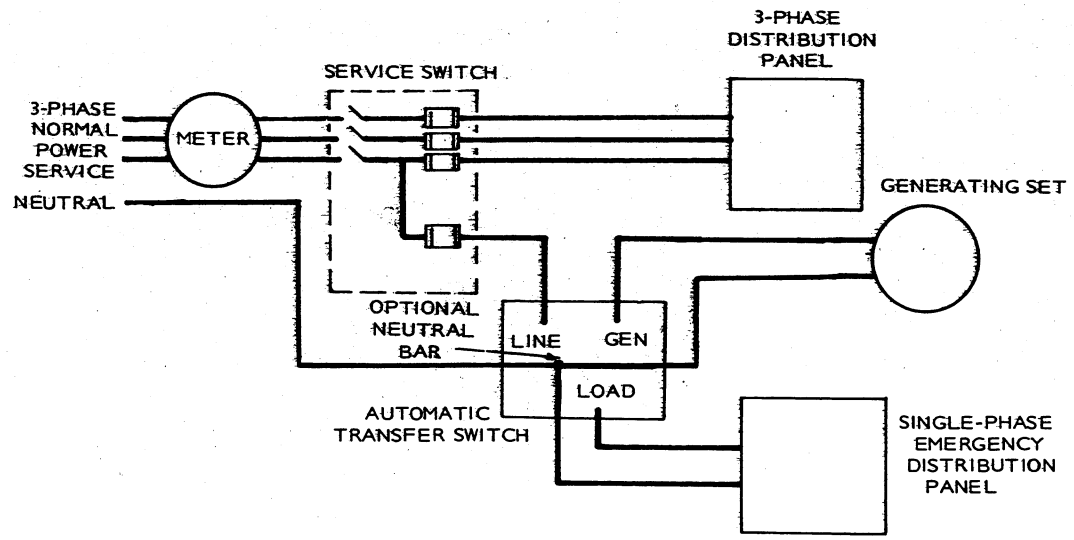



**FIGURE 5. THREE-PHASE SERVICE AND SINGLE-PHASE STANDBY SERVICE**

## TABLE 1. AUTOMATIC TRANSFER SWITCH WIRE CAPACITIES

| AUTOMATIC TRANSFER SWITCH (AMPERES) | | 30 | 60 | 100 | 200 |
|---|---|---|---|---|---|
| TERMINAL LUGS Number of Conductors and Size per Pole | Switch Pole* | ONE 14 to 6 | ONE 14 to 1/0 | ONE 14 to 1/0 | ONE 6 to 250MCM |
| | Optional Neutral Bar* | ONE 14 to 2 | ONE 14 to 2 | ONE 14 to 1/0 | ONE 6 to 250MCM |

* - Connectors compatible with copper and aluminum.

automatic transfer switch. If conduit is used, run the control (low voltage) and load wires in separate conduits.

Table 1 gives the type and maximum wire sizes the transfer switch will accept. Load wires connect to the transfer switches as shown in Figures 6 through 8.

**At the same time the wires are connected to the transfer switch, remove the shipping block on the transfer switch.**

**Control Wiring:** Four control wires connect the automatic transfer switch and electric generating set B+, 1, 2, 3. For runs up to 100 feet (30 m), use number 14 wire; for longer runs, use larger wire as specified in the electric generating set's operator's manual. If possible, code the wires using the color code (Figure 9) for uniformity. On diesels, a 5th wire labeled H is needed for preheat circuit.

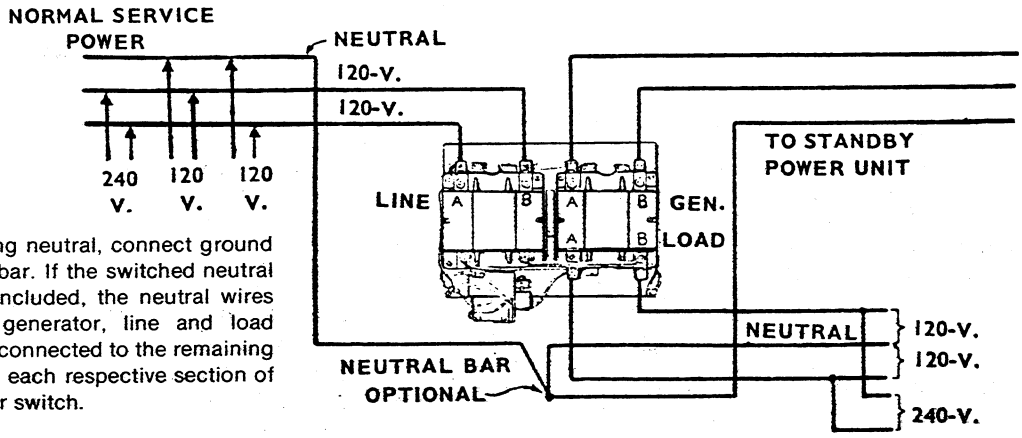



**FIGURE 6. 1-PHASE, 3-WIRE TRANSFER SWITCH CONNECTIONS**

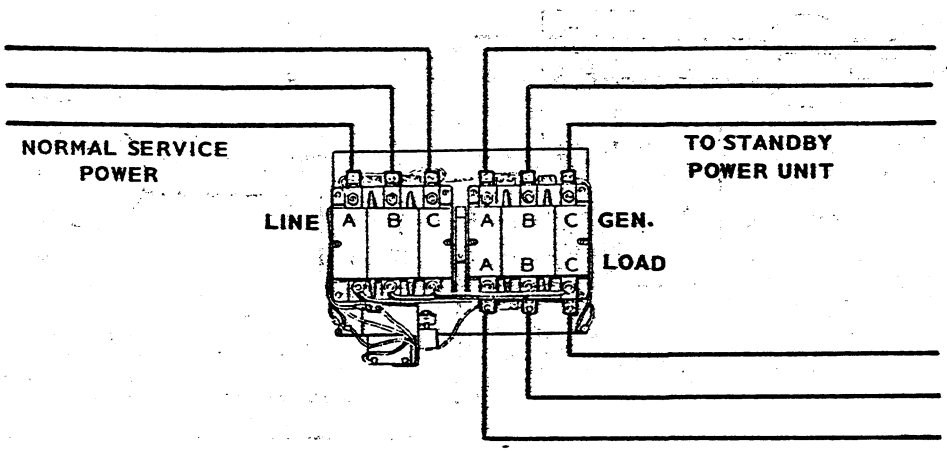



**FIGURE 7. 3-PHASE, 3-WIRE TRANSFER SWITCH CONNECTIONS**

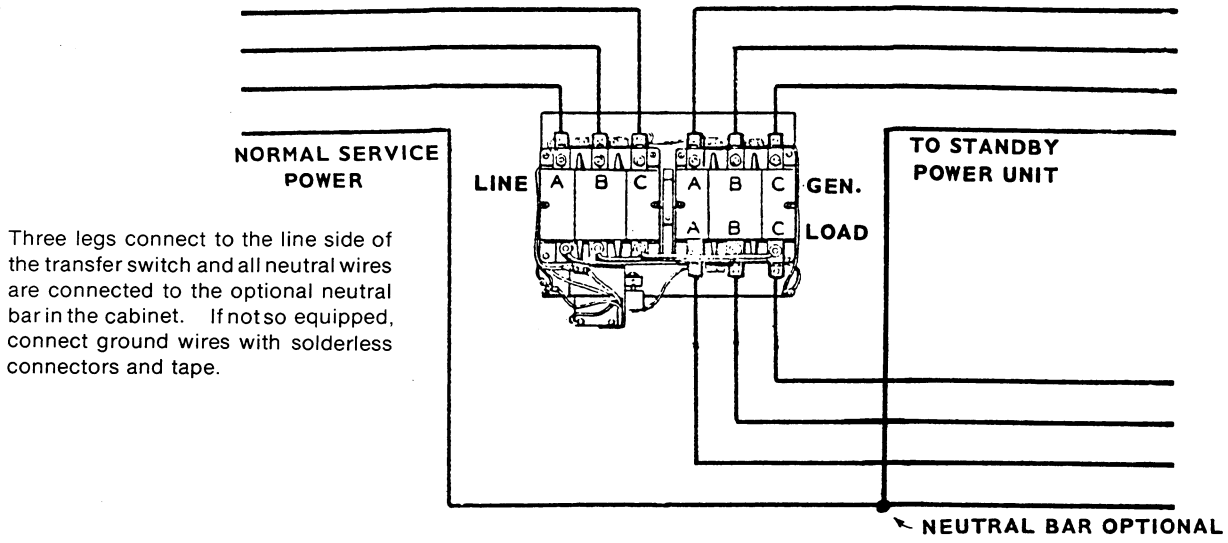



FIGURE 8. 3-PHASE, 4-WIRE TRANSFER SWITCH CONNECTIONS

**Area Protection or Remote Test Switch:** Located near the bottom of the control panel is a two-place terminal block. Remove the jumper between the two terminals and connect two number 14 wires between the terminals and a remote, single-pole, single-throw toggle switch or a normally-closed circuit of the area protection equipment.

## CHECKING PHASE RELATIONS OF A THREE-PHASE STANDBY

Phase rotation must be checked and corrected before any load can be added to the generating set. Use the following procedures:

1. Connect an Onan load-test panel, phase rotation meter or three-phase motor to the transfer switch load terminals. Connect power to the line side (normal) of the transfer switch and observe rotation. If rotation is wrong, reverse any two main phase leads on the line side of the transfer switch.

2. Connect the battery and start the generating set. Check the phase rotation of the generator lead connections on the transfer switch. If this phase rotation is different from that of the power line, reverse two of the generator leads on the transfer switch.

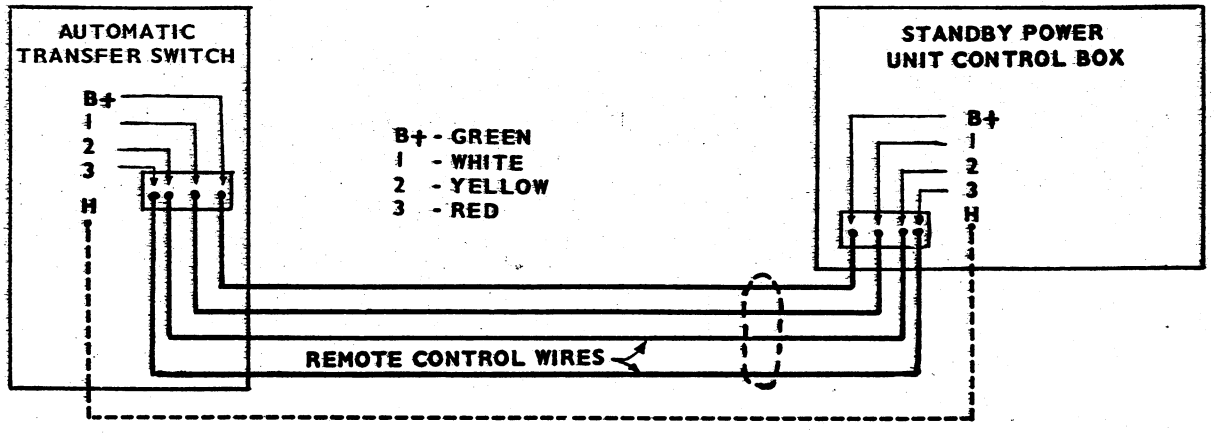



FIGURE 9. CONTROL WIRE CONNECTIONS FOR GENERATING SET

# OPERATION

The automatic transfer switch operation selector switch controls generating set operation in conjunction with the set's mounted control switch. The generating set control switch is spring-loaded to return to the normal center position; in this position the operation selector switch completely controls the generating set.

Before setting the automatic transfer switch for remote operation, set the operation selector switch at HAND CRANK. Start and stop generating set to assure proper operation. Set the switch at CHECK, the generating set should start and run but not take over the load. Stop the generating set and set the switch at AUTOMATIC. The automatic transfer switch is now ready for complete automatic operation and will start and assume the load if commercial power fails. To test the automatic operation, open the commercial power entrance switch or circuit breaker. The generating set should start and assume the load until commercial power returns, the generating set should then stop.

**Begin Spec B, 60 through 200 ampere LTE and LTEU automatic transfer switches have as standard a disconnect plug (Figure 10) for servicing, etc.**

**Before using the disconnect plug, be sure to place the selector switch on the automatic transfer switch to the STOP position. Neglect of this procedure results in generating set starting and energization of the automatic transfer switch's generator side.**

**WARNING** **Always move the operation selector switch in the automatic transfer switch cabinet to "STOP", disconnect starting batteries, and remove AC line power to the automatic transfer switch before performing any maintenance or adjustments. Otherwise, the automatic transfer switch presents a serious shock hazard.**

## CIRCUIT AND COMPONENTS

The basic automatic transfer switch includes:

1. Transfer switch mechanism, connects either the commercial or emergency power to the load.
2. Relays to start and stop the generating set and control the transfer switch.
3. A trickle charger which maintains starting batteries at full charge.

## 60, 100 AND 200 AMPERE MECHANICALLY HELD TRANSFER SWITCHES

This transfer switch (optional for 30 amperes) is electrically operated and connects the load to commercial or emergency power source. The current rating is determined by the transfer switch capacity.

Transfer switches contain two separate sets of main contacts. One set connects the commercial line to the load, the other connects the emergency power to the load. A pull-in coil (when energized by line power) pulls in the line-side contacts. A mechanical latch then locks the contacts closed and opens a microswitch that disconnects the pull-in coil. This eliminates hum during normal operation.

The trip coil (energized by generator output) releases the mechanical latch disconnecting the line-side contacts. These contacts must unlatch and drop out before the generator contacts can close. Power supplied to this coil also pulls in and holds the generator contacts closed. Both mechanical and electrical interlocks prevent contacts from closing at the same time.

The automatic transfer switch's basic circuit consists of three relays:

1. Start-stop relay.
2. Start disconnect and transfer switch pilot-relay.
3. Instant transfer relay.

In addition, it may contain some optional relays. The start-stop relay controls starting and stopping of the generating set. When the relay de-energizes, its contacts signal the engine control to start and run the set. The transfer switch pilot-relay controls the mechanical latch trip coil and the generator side of the transfer switch. When the pilot-relay energizes, it releases the latch and connects the coil that pulls in the generator side of the transfer switch.

The instant transfer relay controls the line side of the transfer switch and also the generator side. Whenever this relay is energized from line power, it breaks the circuit to the generator side and energizes the line side of the transfer switch.

Normally (with commercial power on) the transfer switch line side is closed. The start-stop relay and instant transfer relay are energized; the transfer switch pilot-relay is de-energized.

When commercial power fails, the start-stop and instant transfer relays de-energize. This closes the start-stop relay contact signaling the generating set to start. When voltage builds up, the transfer switch pilot-relay pulls in energizing the latch trip coil and generator-side coil. The main line contacts open,

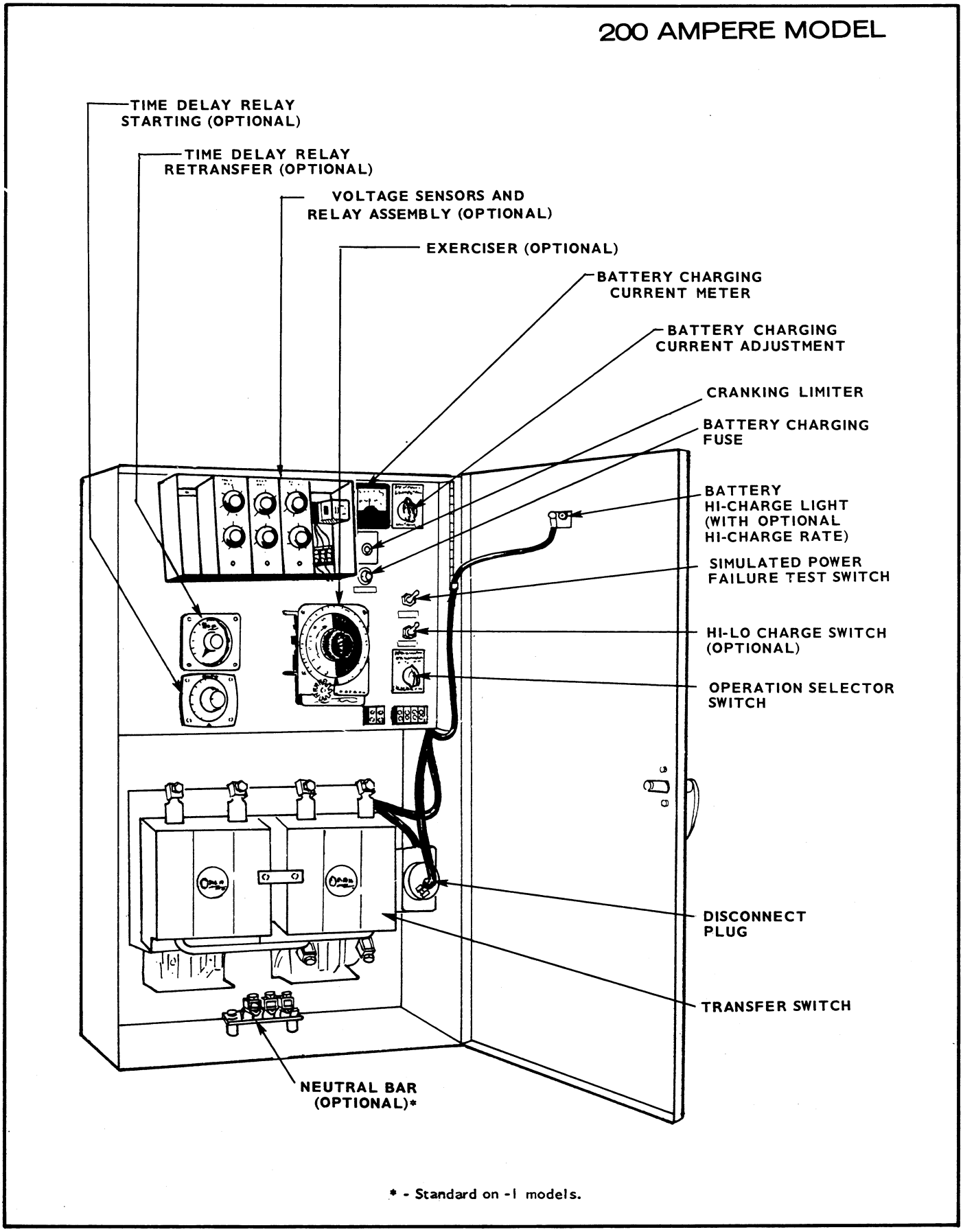



FIGURE 10. BEGIN SPEC B AUTOMATIC TRANSFER SWITCH WITH OPTIONS

generator contacts close and the generator supplies power to the load.

After starting, the generator output voltage increases and energizes the coil in start-disconnect relay to open its contacts. These contacts, in series with the generating set's starting circuit, open and break the starting circuit causing the set to stop cranking.

An adjustable resistor, in series with the start-disconnect relay coil, determines the voltage at which cranking is stopped.

When commercial power returns, the instant transfer relay closes which disconnects the generator side coil of the transfer switch and allows the line side to pull in immediately. At the same time, the start-stop

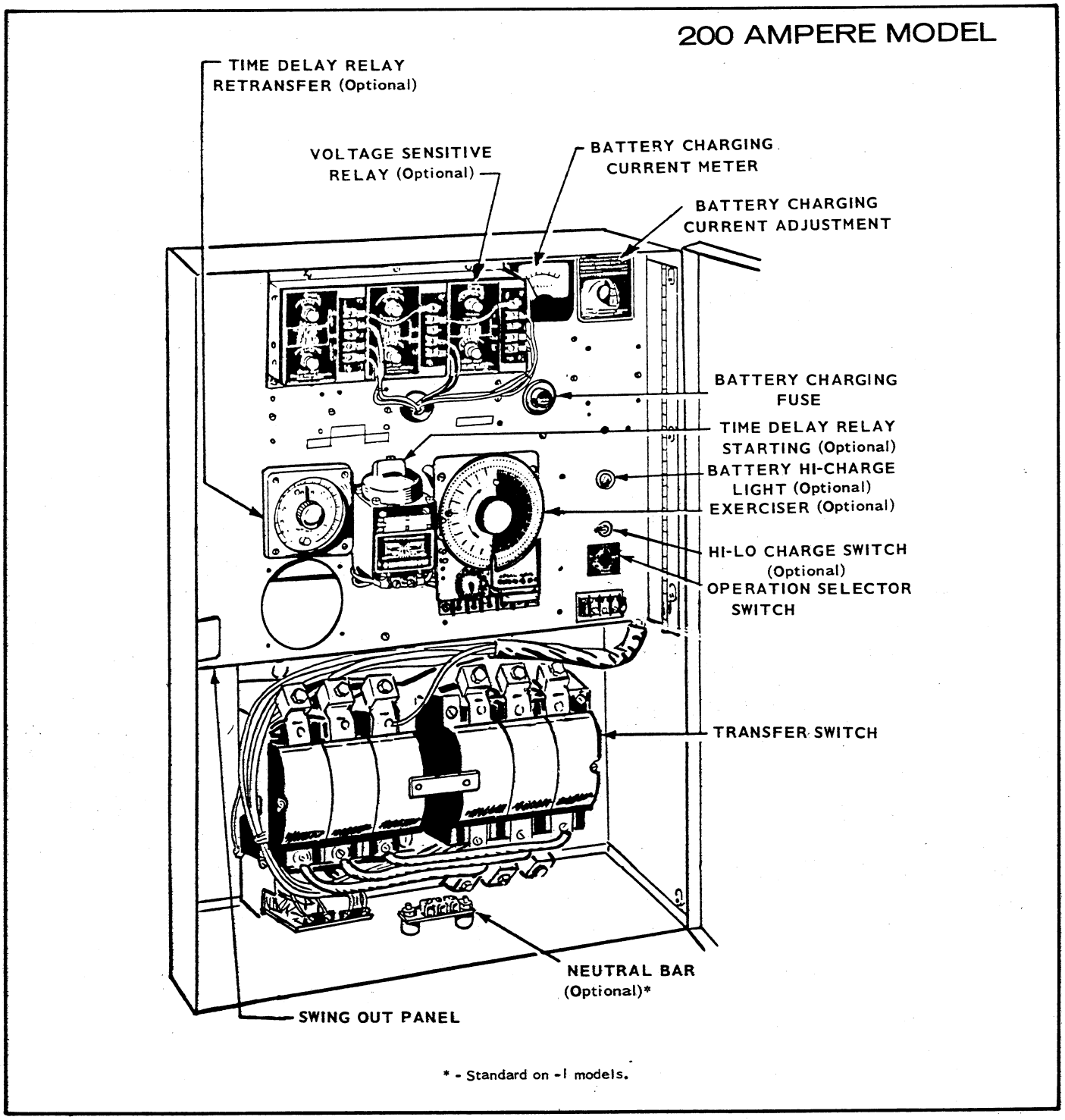



**FIGURE 11. SPEC A AUTOMATIC TRANSFER SWITCH WITH OPTIONS**

relay energizes to stop the generating set.

## 30 AND 60 (SPEC A 60-1) ELECTRICALLY HELD TRANSFER SWITCHES

Transfer switch contacts are electrically held; mechanical and electrical interlocks prevent line and generator contacts from closing at the same time. The instant transfer relay (for switching the load back to line immediately) is standard begin Spec B automatic transfer switches. Optional auxiliary contacts on the transfer switch are rated to 240 volts only.

When the normal power source (line voltage) drops quite low or fails, the main actuating coil of the transfer switch de-energizes opening the line contacts of the transfer switch which disconnects the load from the normal power source.

The contacts of the start-stop relay are connected to the generating set control circuit. One set of contacts is in the start circuit and the other set is in the stop circuit. Loss of the line voltage closes the start contacts which energize the starting circuit of the set.

After starting, the generator output voltage increases and energizes the coil in start-disconnect relay to open its contacts. These contacts, in series with the starting circuit, open and break the starting circuit to stop cranking.

During cranking, the cranking limiter is energized and allows the generating set to crank for approximately one minute. If it fails to start, the limiter will open to prevent further cranking. Manually reset the limiter if open.

A resistor, in series with the start-disconnect relay coil, adjusts the speed and voltage at which cranking is stopped. If the unit starts, generator voltage rises to normal, the generator transfer switch contacts close, and the generating set supplies power to the load through the generator-load contacts.

The generating set carries the load until the normal power is restored. When line voltage returns, the stop contacts of the stop-start relay close the stop circuit shutting down the generating set. As the set slows down, the voltage output drops. Then the generator side of the transfer switch opens allowing the line side to pull in. Using the instant transfer relay (standard beginning Spec B) when line voltage returns, the line contacts close immediately after the generator contacts open without waiting for the generator to slow down.

## 30 AMPERE (30-1) SINGLE-COIL, ELECTRICALLY HELD TRANSFER SWITCH

Options offered for the larger models are available with this switch except the instant transfer relay or mechanically held contacts. Contact design prevents simultaneous connection of the line and generator circuits to the load circuit.

During normal commercial line power operation, the transfer switch pull-in coil is energized holding the line contacts closed. The pull-in coil is energized by line power. The start disconnect relay is de-energized.

When commercial line power fails, the pull-in coil de-energizes also allowing generator-side contacts to close. The auxiliary switch on the main transfer switch closes the generating set's starting circuit through the closed contacts of the start-disconnect relay allowing the set to crank. The cranking limiter is energized and allows the generating set to crank for approximately one minute. If it fails to start, the limiter will open to prevent further cranking. Manually reset the limiter if open.

As the generator output voltage increases, the start disconnect relay energizes to break the starting circuit. The generating set assumes the load through the normally open contacts on start disconnect relay and the generator-side transfer switch contacts and continues to run until normal line power returns.

When normal line power is restored, line voltage is applied to the transfer switch pull-in coil closing the line-side contacts. The load is now supplied by commercial power. The auxiliary switch opens the start circuit and closes the stop circuit shutting down the set. The start disconnect relay de-energizes.

## CRANKING LIMITER

The cranking limiter is an electrically-operated thermal relay which protects the engine cranking circuit. The limiter is energized when the engine begins to crank and remains energized until the engine starts. If the engine does not start, a heating element in the limiter opens the cranking circuit after approximately one minute. The limiter must be manually reset before the engine will crank again.

## SIMULATED POWER FAILURE TEST SWITCH

This manually-operated switch starts the generating set and allows it to assume the normal load. The switch is normally *on* and will start the set when switched to *off*.

**The simulated power failure test switch is standard beginning with Spec B switches and includes a terminal block for connections to a remote test switch begin Spec C.**

## BATTERY CHARGER

A built-in battery charger consisting of a transformer, full-wave rectifier and resistors, keeps the starting batteries in a fully-charged condition. The charge rate (50 to 300 milliamp) is adjusted with a rheostat.

The trickle charger should be set to maintain the unit's batteries at full charge. For the first several weeks of operation, the rheostat should be set and the battery condition checked often. Adjust the charger

for a minimum charge rate that will maintain charge condition. Higher rates will shorten battery life. Large ambient temperature changes may require charger adjustment. Battery condition should be checked with a hydrometer.

**Setting Float Charge Rate:** For the following adjustments, a fully-charged battery, a hydrometer and an accurate voltmeter (½% accuracy) are needed. Onan recommends float voltages of: 13.3 volts for nominal 12-volt or 13.8 to 14.5 volts for 10-cell nickel-cadmium batteries.

**Bubbling of electrolyte, loss of water and high specific gravity indicate excessive float voltage. A drop in specific gravity indicates insufficient float voltage.**

1. Connect the fully-charged battery (verify charge condition with the hydrometer).
2. Connect the voltmeter directly to the battery terminals.
3. Measure the battery voltage. If voltage is above the recommended float voltage, proceed to Step 4. If the voltage is below the recommended float voltage, proceed to Step 6.
4. Decrease the float voltage in small increments by turning the battery charging current adjustment knob.
5. After five minutes, measure the battery terminal voltage again. If voltage is still high, repeat Steps 4 and 5 until voltage stabilizes at the recommended float voltage. Proceed to Step 9.
6. Note charge current rate on charge ammeter on control panel.
7. Increase float voltage in small increments by turning the battery charging current adjustment knob. Note increase in the charging current on the charge meter on the control panel.
8. In approximately one hour or when charge current has decreased to initial value noted in Step 6, recheck battery terminal voltage. Repeat Steps 6 through 8 until the battery terminal voltage stabilizes at the recommended float voltage.
9. Check the battery with a hydrometer and check the battery terminal voltage periodically during the first few weeks of operation. Readjust the float charge rate if necessary.

## OPERATION SELECTOR SWITCH

The operation selector switch controls the generating set from the automatic transfer switch. It has four positions:

*Check*. . .Generating set starts and runs but does not assume the load unless a power outage occurs. Use this position for unit exercising.

*Stop*. . .Shuts down the generating set and prevents it from starting. Use this position when servicing the generating set.

*Automatic*. . .Allows the set to start and assume the load if a power outage occurs. This is the normal operating position.

*Hand Crank*. . .Prevents automatic starting but allows starting and stopping at the set. Use this position for maintenance of the generating set.

## OPTIONAL EQUIPMENT

Only the most popular options are discussed here.

## MECHANICALLY HELD CONTACTS

Mechanically held contacts are standard on the transfer switch line side and can be specified on generator side from 60 to 200 amperes in capacity. For 30 ampere switches, they can be specified on line and generator sides.

## AUXILIARY CONTACTS

Extra single-pole, double-throw contacts are mounted on the transfer switch. Rating is: 6 amperes at 120 volts, 3 amperes at 240 volts and 1.5 amperes at 600 volts. Auxiliary contacts for 30 ampere automatic transfer switches are rated to 240 volts only.

## VOLTAGE SENSORS

The basic automatic transfer switch reacts *only to complete failure* (about 50 percent of nominal line voltage). Voltage sensors allow it to react to preset voltage drop and also higher than normal voltages.

**Adjustable Voltage Sensors:** Both pick-up and drop-out voltages are adjustable. In undervoltage application, voltage sensing is across the line. When line voltage falls to the drop-out point, a relay de-energizes starting the transfer to emergency power. When line voltage returns to the preset pickup voltage, the relay initiates the return to commercial power.

**TABLE 2. ADJUSTABLE VOLTAGE SENSING**

| UNDERVOLTAGE | | |
|---|---|---|
| **VOLTAGE SENSOR** | **UNIT STARTS (drop-out voltage)** | **UNIT STOPS (pick-up voltage)** |
| 300-0780* | 5 to 20% below pick-up voltage setting. | 75 to 100% of normal voltage. |
| 306-0210 | 2 to 20% below pick-up voltage setting. | 70 to 100% of normal voltage. |
| **OVERVOLTAGE** | | |
| **VOLTAGE SENSOR** | **UNIT STARTS (pick-up voltage)** | **UNIT STOPS (drop-out voltage)** |
| 300-0780* | 101 to 116% of normal voltage. | 5 to 20% below pick-up voltage. |
| 306-0210 | 100 to 115% of normal voltage. | 2 to 20% below pick-up voltage. |

* - Plug-in module, does not include relay or chassis.

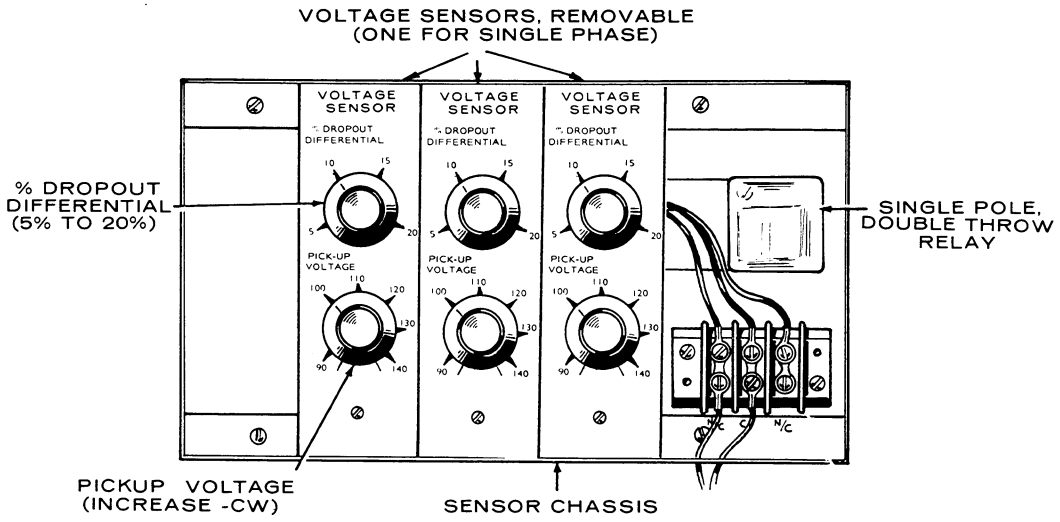



**FIGURE 12. 300-0780 VOLTAGE SENSORS IN SENSOR CHASSIS**

Overvoltage sensing is much the same, only that when the normal service voltage becomes excessively high, a relay opens initiating transfer to standby power. When the normal power source's voltage returns to normal, the relay closes and initiates retransfer of the load to the normal source.

**This type of voltage sensing is also used to disconnect the generating set from the load for low voltage (which could damage load equipment).**

Two types of adjustable voltage sensing are used, a 300-0780 voltage sensor plug-in module (in sensor chassis with relay, Figure 12) and 306-0210 voltage sensor (Figure 13).

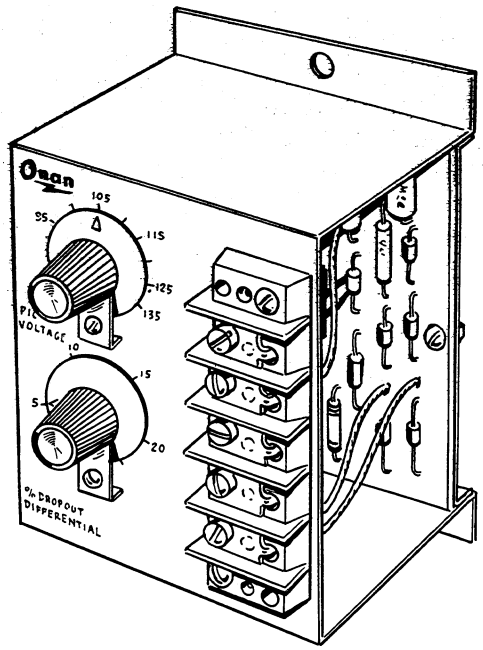



**FIGURE 13. 306-0210 VOLTAGE SENSOR**

Table 2 gives the adjustment ranges in percentages for the adjustable voltage sensing devices. The pick-up adjustment control is always set first, then the drop-out adjustment is set. Adjustments should be performed by qualified personnel only.

**Adjustable Voltage Sensor Settings:** Voltage sensors can be used for either undervoltage or overvoltage sensing on line or generator power supplies. Range of the settings for both types of solid state sensors is for a nominal 120-volt system. For higher voltage systems, the "PICK-UP VOLTAGE" knob readings are multiplied by the following multiplying factors.

| VOLTAGE | MULTIPLYING FACTOR |
|---|---|
| 120 | 1.0 |
| 208 | 2.0 |
| 240 | 2.0 |
| 480 | 4.0 |
| 600 | 5.0 |

**EXAMPLE:** For a nominal 208-volt voltage system, a "PICK-UP VOLTAGE" knob reading of 90 is equal to 180 volts (90 x 2.0).

**Undervoltage Sensor Settings:**

1. Turn the "PICK-UP VOLTAGE" knob to the desired pick-up voltage (voltage at which load is transferred from generating set to commercial power). Unless you have special equipment which can be damaged by slight voltage changes, a setting which gives pick-up at 90 percent of the nominal voltage is usually satisfactory. For example, 90 percent of 120 volts (for a 120-volt system) gives 108 volts for the knob setting.

   **The drop-out differential is determined by the pickup setting.**

2. Turn the "% DROP-OUT DIFFERENTIAL" knob

to the desired percent deviation below the pick-up voltage. This setting is the voltage at which the load is transferred from commercial power to the generating set. A setting of 15 percent is often satisfactory. For example, 15 percent of 108 volts (pick-up voltage from Step 1) is 16 volts. The drop-out voltage is then pick-up voltage minus the differential voltage, 108 - 16 = 92 volts.

**Overvoltage Sensor Settings:**

1. Turn the "PICK-UP VOLTAGE" knob to the desired pick-up voltage (voltage at which load is transferred from commercial power to the generating set). Unless you have special equipment which can be damaged by slight voltage changes, a setting which gives 113 percent of the nominal voltage is usually satisfactory. For example, 113 percent of 120 volts (for a 120-volt system) gives 135 volts for the knob setting.

**The drop-out differential is determined by the pick-up setting.**

2. Turn the "% DROP-OUT DIFFERENTIAL" knob to the desired deviation below the pick-up voltage. This setting is the voltage at which the load is transferred from the generating set to commercial power. A setting of 5 percent is often satisfactory. For example, 5 percent of 135 volts (pick-up voltage from Step 1) is approximately 7 volts. The drop-out voltage is then pick-up voltage minus the differential voltage, 135 - 7 = 128 volts.

**Nonadjustable Low Voltage Sensitive Relay:** Used only for undervoltage protection, these relays are preset to initiate transfer to standby power at 70 percent of normal voltage and back to normal power service at 90 percent (Figure 14).

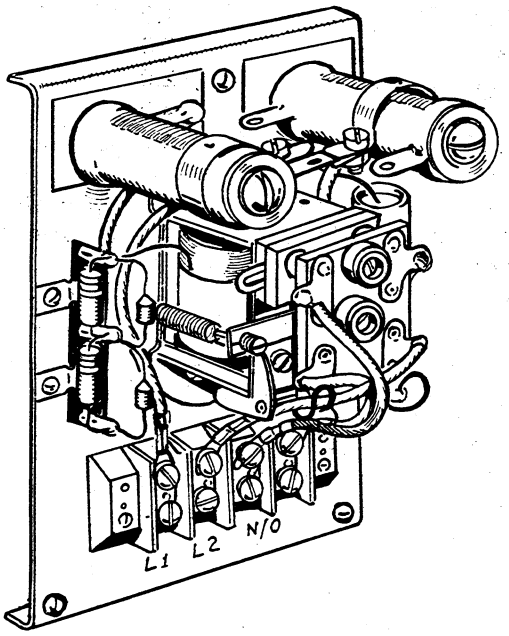



**FIGURE 14. NONADJUSTABLE UNDERVOLTAGE SENSITIVE RELAY**

## TIME DELAY RELAYS

A time delay is often required for one or more functions such as engine starting, load transfer to generating set, engine stopping and load retransfer to normal power source.

**Time delay settings for the adjustable time delays can vary depending on the type of application. However, the time delays are set at the factory. These settings should be adequate for most applications. See Table 3.**

**TABLE 3. TIME DELAY RELAY STANDARD SETTINGS (Unless Otherwise Specified in Order)**

| TIME DELAY | TYPE TIME DELAY | TIME RANGE | FACTORY SETTING (if any) |
|---|---|---|---|
| Starting | Agastat | 1.5 to 15 Sec. | 3 Sec. |
| | | 1 Sec. to 5 Min. | 30 Sec. |
| | | ★5 to 50 Sec. | 20 Sec. |
| | Amperite | 1.5 to 4.5 Sec. (fixed) | — |
| | | ★20 Sec. (fixed) | — |
| | | ★1 Min. (fixed) | — |
| Transfer | Agastat | 5 to 50 Sec. | 20 Sec |
| Retransfer | Motor Timer | 2 to 60 Min. | 10 Min. |
| Stopping | Motor Timer | 2 to 60 Min. | 10 Min. |
| | Amperite | 2 Min. (fixed) | — |

★ Delay for heating glow plugs on diesel sets.

**Time Delay on Starting:** Delays generating set starting after a power outage. It prevents generating set operation during very short power outages.

**Time Delay on Transfer:** Delays the transfer of the load to allow for engine warm-up.

**Time Delay on Retransfer:** Allows time for the returning normal power source to stabilize before connecting it to the load. The generating set supplies power during this period.

**Time Delay on Stopping (After Retransfer):** Allows the generating set to run for a few minutes under no load before shutdown. This stabilizes engine temperature, reducing distortion and wear.

**Types of Time Delay Relays:**

1. The Amperite time delays are nonadjustable and are used for a delay on generating set starting and delay on stopping the generating set after retransfer.
2. The Agastat delay relay shown in Figure 15 is adjustable. Three currently used Agastat relays are adjustable for unit starting, one from 1.5 to 15 seconds, one from 1 second to 5 minutes, and one from 5 to 50 seconds for diesel generating sets (heating of glow plugs). Another Agastat relay

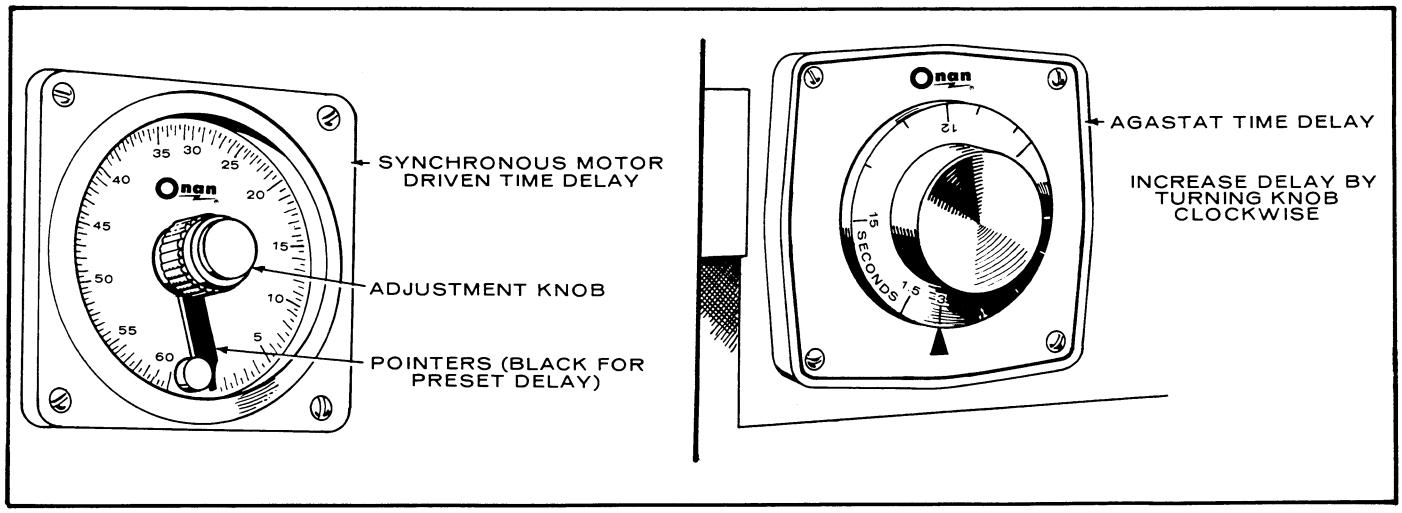



FIGURE 15. ADJUSTABLE TIME DELAYS

used for load transfer to the generating set is adjustable from 5.0 to 50 seconds.

To adjust the delay time, turn its knob clockwise to increase delay, counterclockwise to decrease the delay.

3. The synchronous motor-driven time delay relay (Figure 15) is adjustable from 2 to 60 minutes, for stopping generating set or retransfer of load to line after the normal power source returns.

The black pointer on the face of the relay indicates the preset delay while the red pointer indicates the delay time left in operation. Set the delay of the relay by turning the knob in the center of the dial. It can be changed with power on or off.

## EXERCISER

The exerciser automatically starts the generating set at regular intervals and allows it to run for a preset time (Figure 16). It may be ordered so the unit operates with or without normal load (depending on the installation). This assures emergency starting by keeping the fuel system filled and the batteries charged. In the event of a power failure while the unit is exercising at no load, the automatic transfer switch immediately switches the load to the generating set.

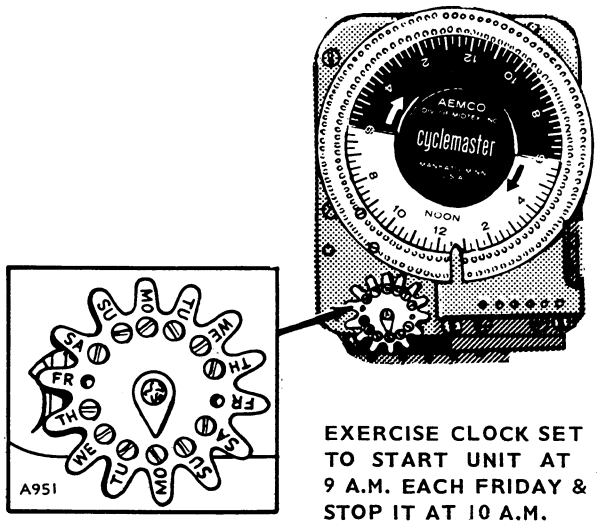
**After a power outage, reset the exerciser for correct time (exerciser operates only on normal power).**

### Exerciser Settings:

1. Install a trip pin (left-hand thread) in the inside row of holes on the large dial for the time of day you want the generating set to start.
2. Place a trip pin in the outside row of holes on the large dial to stop the generating set.

**Onan recommends settings which operate the generating set for at least 30 minutes each week. Exercising for one long period is better than several short periods.**

3. Install a trip pin in the small spoked wheel for every day *no* exercise is desired.




EXERCISE CLOCK SET TO START UNIT AT 9 A.M. EACH FRIDAY & STOP IT AT 10 A.M.

FIGURE 16. EXERCISER CLOCK

4. Rotate the large dial clockwise until the correct time is correctly aligned with the time pointer.
5. Align the small spoked wheel with the correct day at its pointer.

**Sixteen trip pins are supplied with the clock. Store unused pins on the time pointer bracket.**

## OVER-UNDER FREQUENCY RELAY

The over-under frequency relay, adjustable from 55 to 65 hertz is designed to operate on a nominal 60-hertz system. The under frequency knob on the left sets the lowest acceptable frequency and the over frequency knob on the right sets the highest acceptable frequency (Figure 17).

If the frequency of the power supply goes outside the set range, the relay initiates transfer of the load to the other power source.

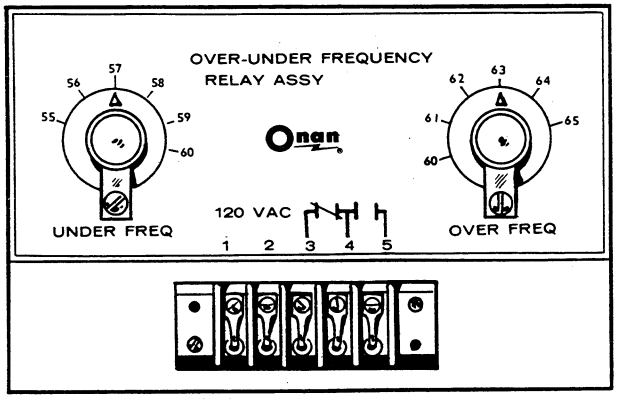



FIGURE 17. OVER-UNDER FREQUENCY RELAY

## SIGNAL LIGHTS AND ALARM TERMINALS

These are available as a warning of a power outage, the standby unit has started and is supplying the load, and other conditions important to your application.

## SCR AUTOMATIC BATTERY CHARGERS

Silicon controlled rectifier (SCR) battery chargers are available in two types. One type is strictly an automatic "float" charger with a maximum charge rate up to two amperes. It replaces the standard battery charger in the automatic transfer switch. The other type SCR battery charger, also designed for lead acid or nickel cadmium batteries, has a built-in equalize charge timer. This charger replaces the standard automatic transfer switch charging circuit.

The equalize charge timer, SCR battery charger provides automatic "float" charging with a maximum charge rate up to ten amperes. For fast charging, manually set the equalize charge timer for any time period up to 12 hours (most battery manufacturers recommend 24 hours of equalize charging every month). Setting the timer raises the charger's output voltage and maintains the high charging voltage for the selected time. After this period, the timer automatically switches back to float voltage.

**Nickel cadmium batteries do not require equalize charging.**

### Adjustment of 2-Ampere SCR Float Charger

**CAUTION** **The regulator was set at the factory and does not require adjustment. If for some reason in the future the regulator needs adjusting, be sure to use only the following procedure.**

For the following adjustments, a fully-charged battery, a hydrometer and an accurate voltmeter (½% accuracy) are needed. Onan recommends float voltages of: 13.3 volts for nominal 12-volt lead-acid batteries and 13.8 to 14.5 volts for 10-cell nickel-cadmium batteries.

During the first few weeks of operation, the batteries should be checked periodically with a hydrometer. A high specific gravity, bubbling of electrolyte and loss of water indicate excessive float voltage. A drop in specific gravity indicates insufficient float voltage.

1. Connect the fully-charged battery (verify charge condition with the hydrometer).
2. Connect the voltmeter directly to the battery terminals.
3. Measure the battery voltage. If voltage is above the recommended float voltage, proceed to Step 4. If the voltage is below the recommended float voltage, proceed to Step 6.
4. Insert a small screwdriver through the hole in the front panel of battery charger module. Turn counterclockwise in small increments to decrease the float voltage.
5. After five minutes, measure the battery terminal voltage again. If voltage is still high, repeat Steps 4 and 5 until voltage stabilizes at the recommended float voltage. Proceed to Step 9.
6. Note charge current rate on charge ammeter.
7. Insert a small screwdriver through hole in front panel of battery charger module. Turn clockwise in small increments to increase float voltage. Note increase in the charging current on the charge ammeter.
8. In approximately one hour or when charge current has decreased to initial value noted in Step 6, recheck battery terminal voltage. Repeat Steps 6 through 8 until the battery terminal voltage stabilizes at the recommended float voltage.
9. Check the battery with a hydrometer and check the battery terminal voltage periodically during the first few weeks of operation. Readjust the float charge rate if necessary.

**This float charger is not designed to recharge batteries quickly. A discharged battery must have a minimum voltage of four volts for battery charger operation.**

### Adjustment of 10-Ampere Equalize SCR Charger

Adjust the float and equalize voltages, according to the following directions (Figure 18).

1. Connect charger to fully charged battery.
2. Connect the high accuracy voltmeter to the battery terminals.
3. Equalize-charge battery until it gases. Use equalize charge timer.
4. Return timer to zero and wait until voltage stabilizes.
5. Turn float adjust potentiometer counterclockwise

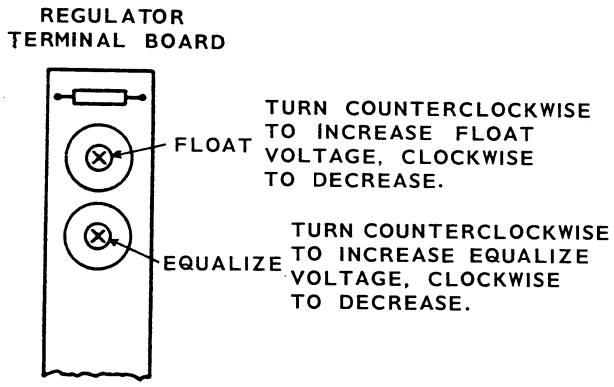



**FIGURE 18. ADJUSTMENT OF 10-AMPERE EQUALIZE SCR CHARGER**

to increase or clockwise to decrease float voltage. Adjust in small steps and wait for voltage to stabilize.

6. After float adjustment is complete, set timer to equalize charge and wait until charge current drops below 5 amperes.
7. If voltage goes above the desired equalize voltage, turn equalize-adjust potentiometer clockwise in small steps and wait until battery voltage drops and levels off at the desired voltage.
8. If current drops before reaching the desired voltage, turn equalize-adjust potentiometer counterclockwise in small steps and wait until current drops between each step.
9. Disconnect the high accuracy voltmeter.
10. Return timer to zero for float charging.

The recommended set voltages are 13.3 volts float and 14.2 volts equalize for 12-volt lead acid batteries. The recommended float charge voltage for nickel cadmium batteries is 1.38 to 1.45 volts per cell. EXAMPLE: float charge of a 10-cell battery should be 13.8 to 14.5 volts.

**Discharged battery must produce minimum of 4 volts to allow charger to operate.**

## SIGNAL LIGHTS AND ALARM TERMINALS

These are available as a warning of a power outage, the standby unit has started and is supplying the load, and other conditions important to your application.

# PARTS AND SERVICE INFORMATION

This automatic transfer switch is custom engineered and specially constructed. Optional equipment and special requirements demand particular circuits and components to perform the automatic functions. Because of the individuality of each automatic transfer switch and the variations of circuits and components, a parts list is not printed in this manual.

For these reasons, contact the dealer from whom you purchased this equipment for service and parts.

The wiring diagrams supplied contain a listing and location of parts (excluding hardware and switch parts) and should be kept with this manual.

Remember to give the complete model and serial number when requesting service or parts information.

Any shipments made are complete unless the packing list indicates items are backordered. Shipments are properly packed and in good order when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.

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