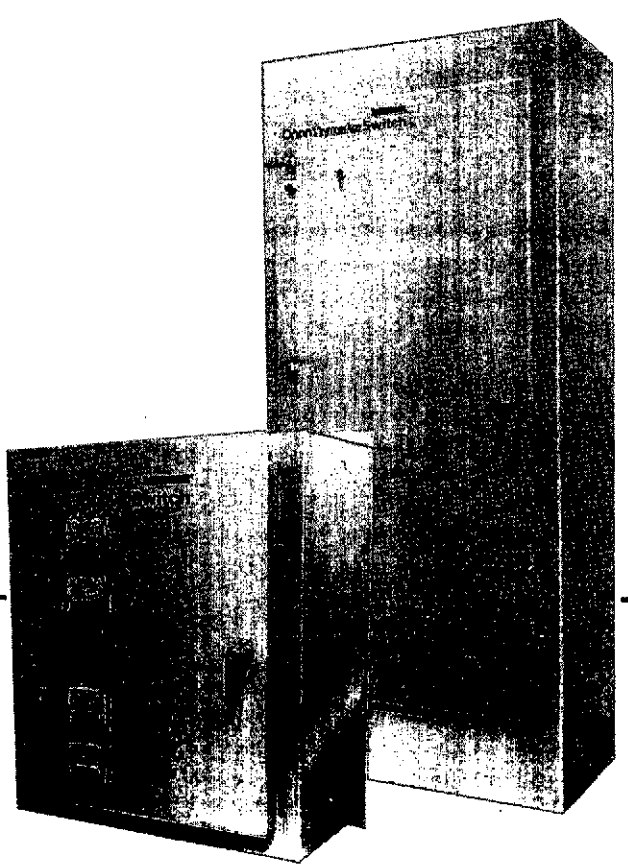
Onan

Service Manual

OT II

Transfer Switches



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Cummins Power Generation

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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.

⚠DANGER ***This symbol warns of immediate hazards that will result in severe personal injury or death.***

⚠WARNING ***This symbol refers to a hazard or unsafe practice that can result in severe personal injury or death.***

⚠CAUTION ***This symbol refers to a hazard or unsafe practice that can result in personal injury or product or property damage.***

High voltage in OT transfer switch components presents serious shock hazards that can result in severe personal injury or death. Read and follow suggestions.

Keep the transfer switch cabinet closed and locked. Make sure only authorized personnel have the cabinet and operational keys.

Due to the serious shock hazard from high voltages within the cabinet, all service and adjustments to the transfer switch must be performed only by an electrician or authorized service representative.

If the cabinet must be opened for any reason:

1. Move the operation selector switch on the generator set or Stop/Normal/Handcrank switch on the transfer switch (whichever applies) to Stop.
2. Disconnect the starting batteries of the generator set (remove the ground [-] lead first).
3. Remove AC power to the automatic transfer switch. If the instructions require otherwise, use extreme caution due to the danger of shock hazard.

Place rubber insulative mats on dry wood platforms over metal or concrete floors 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, or after consuming any alcohol or drug that makes the operation of equipment safe.

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Introduction

ABOUT THIS MANUAL

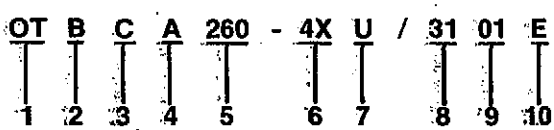
This manual contains service procedures for the OT II utility to genset automatic transfer switch. This includes models with either the Power Sentry or relay control and with two or three pole transfer switches. Separate sections cover control description and operation and transfer switch removal and replacement. Nonautomatic, genset to genset, and utility to utility OT II transfer switches do not share the same control. Because of this, use only the Transfer Switch Assembly section for service information on these models.

Use normal and necessary safety precautions before starting any service procedures. Identify all hazards by referring to the Safety Precautions printed inside the front cover and observe all warnings and cautions within the manual. Whenever troubleshooting, remember the generator set, transfer switch, and utility power source are all interdependent.

MODEL IDENTIFICATION

When it is necessary to contact a Distributor or the factory regarding the transfer switch, always supply the complete Model, Spec Number, and Serial Number as shown on the nameplate. Also, give the numbers of any options that may be listed on a label below the nameplate. The nameplate is located inside the cabinet door on the red plastic transfer switch cover.

The model number is made up of code segments that designate various features or options. The following typical model number is broken down to illustrate:



1. Series identification.
2. Number of poles.
   A - 2 pole.
   B - 3 pole.
3. Application
   A - Nonautomatic.
   B - Utility to utility.
   C - GenSet to utility.
   D - GenSet to genset.
4. Enclosure.
   A - NEMA 1.
   B - NEMA 3R.
   C - Open construction.
   D - Watertight NEMA 4.
5. Continuous ampere rating.
6. Voltage code.

60 Hz	50 Hz	Voltage	Phase
1	51	120	1
3	53	120/240	1
4	54	120/208	3
4X	54X	277/480	3
5D	55D	120/240	3
7	57	220/380	3
7X	57X	240/416	3
8	58	127/220	3
9X		347/600	3

7. Agency Certification
   U - Underwriters Laboratories, Inc.
   C - Canadian Standards Association
   N - None
8. Control Group
   31 through 34 - Power sentry
   56 through 58 - Relay control
   91 through 94 - Manual control
9. Meter Group
   1 - None.
   2 through 10 - Combination of AC voltmeter, AC ammeter, running time meter, and frequency meter.
10. Specification letter. Advances with production modifications.

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Power Sentry Control

INTRODUCTION

The Power Sentry control is a solid state electronic control designed for use with automatic transfer switches. Power input is taken from either of the two connected sources. Adjustable, plug-in type voltage sensor modules provide for several voltage sensing options. The time delays are also contained on a plug-in type module and are adjustable for application requirements.

All components for the Power Sentry control are mounted within a separate enclosure. A viewing window on the side of the enclosure allows the light array to be monitored during troubleshooting and testing. A wiring harness with plug-in connectors connects the control with the transfer switch.

DESCRIPTION

The Power Sentry control consists of the following major components:

- Transformer assemblies
- Mother board
- Voltage sensor modules
- Time delay module
- K12 Reversing contactor (Interposing Relay)
- C1 storage capacitor
- C12 filter capacitor

The sections that follow provide a general description of each component and how it functions.

Transformer Assemblies

Two sets of transformer assemblies (one for each power source) are mounted in the control as shown in Figure 1. Each assembly includes four transformers, mounting bracket, terminal block, and protective cover. The transformers step down the line voltage to approximately 40 VAC. The output from the transformers is supplied to the mother board rectifier bridges.

The transformer assemblies are not the same for every control, even through they may appear identical. Each transformer assembly must be used with the correct line voltage and phase or the control can be damaged when power is applied. For this reason, the transformer assemblies from different controls are not interchangeable unless the voltage codes are the same. However, all of the transformers ***within*** an assembly are interchangeable and the two transformer assemblies within the ***same control*** are interchangeable.

When replacing a transformer assembly, note that the transformer input leads will be wired with a line-to-line or line-to-neutral configuration, depending on the voltage and phase. Refer to the appropriate wiring diagram for correct hook-up.

Mother Board Assembly

The mother board assembly (Figure 1) is a printed circuit board that serves as a central terminal for all the input and output signals that flow through the control. It also provides a mounting point for the voltage sensing and time delay modules and the three control relays (K3, K4, and K5). Connections to the mother board are made through two terminal blocks (TB1 and TB2), two mating/locking pin connectors (J6 and J7), and three card edge connectors (J1, J2, and J3). The following sections describe the function of the major elements on the mother board.

J1, J2, and J3 Card Edge Connectors: Connectors J1 and J3 provide a mechanical/electrical connection point for the voltage sensor modules. Connector J1 corresponds to the Source 1 (normal) power source and J3 corresponds to the Source 2 (emergency) power source. Connector J2 provides a mechanical/electrical connection point for the time delay module.

K3, K4, and K5 Control Relays: The K3 two-wire run relay responds when the control signals for the set to run. De-energizing the K3 relay closes a set of contacts which sends a start signal to the generator set. The K4 Alternate source Failure relay is included on utility-to-utility or genset-to-genset installations. It is used to indicate when the alternate source is not within the voltage/frequency limits as determined by the voltage sensor. An externally mounted selector switch is used to set source priority. The K5 Auto/Manual Transfer relay (optional) is used to inhibit automatic retransfer of the transfer switch. This relay is energized by an externally mounted switch.

Light Array: A series of light emitting diodes are used to indicate the various control signals. Refer to Table 1 for a description of the control signals.

Mother Board Circuitry: The mother board circuitry serves several functions that are essential for control operation. A series of rectifier bridges receive the AC output from the transformer assemblies and rectify it. The rectified voltage is used as a reference input for the voltage sensors, a power source for the control electronics, and a power source for the reversing contactor. The circuitry for the rectifier bridges is shown in Figures 2A and 2B.

Figure 2A is a schematic of mother board 300-2109. Figure 2B is a schematic of mother board 300-2936. Because the revision level of the mother board in your transfer switch may not be the same as shown in Figures 2A and 2B, refer to the drawings that were shipped with the switch.

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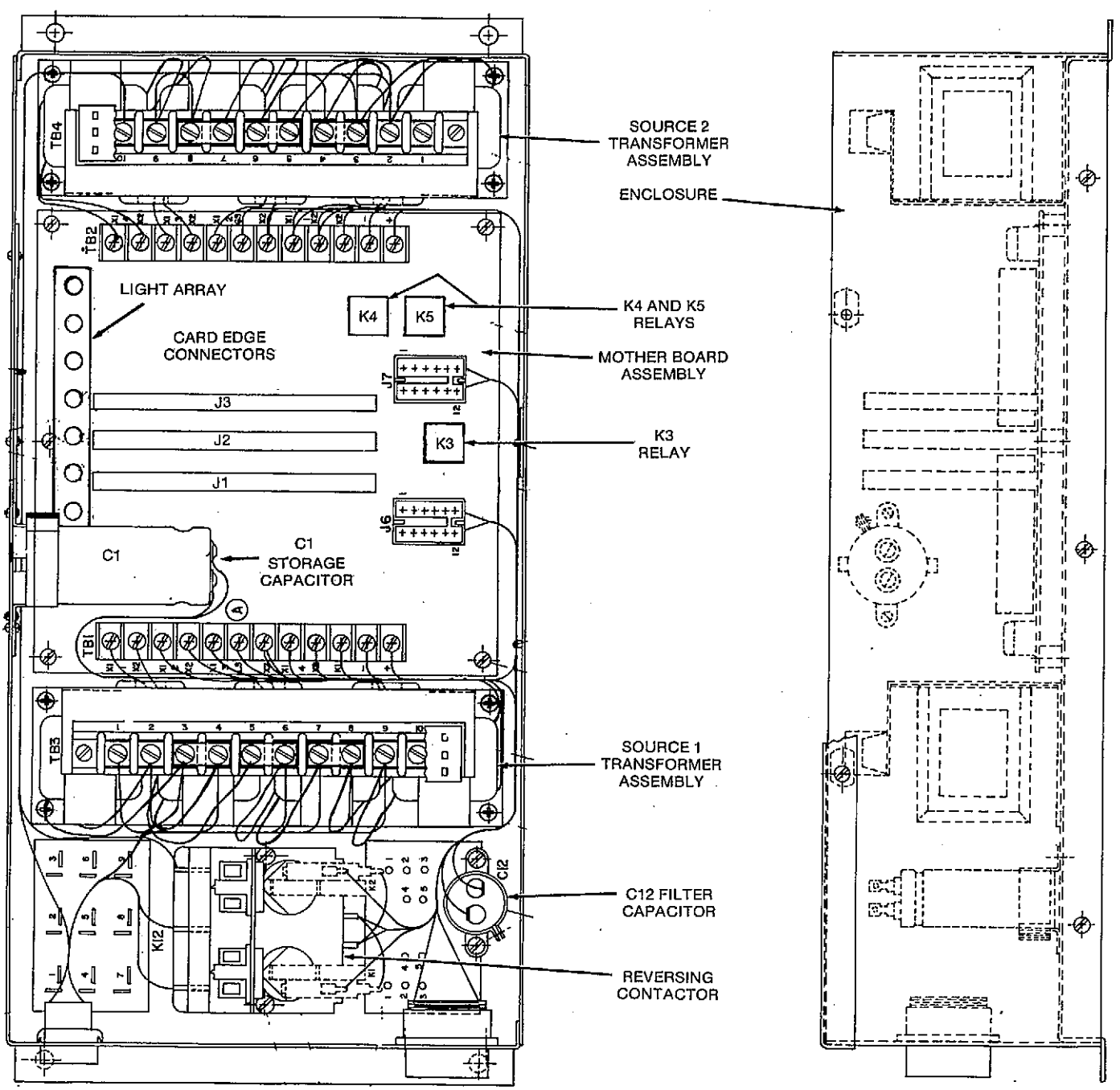

FIGURE 1. POWER SENTRY CONTROL

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A voltage regulator circuit receives the output from the rectifier bridges and regulates the voltage to a constant value. This circuit provides power for the K3 Two-Wire Run relay, K4 Backup Source Failure relay, K5 Auto/-Manual Transfer relay, voltage sensor module, and time delay module. The circuitry for the voltage regulator is shown in Figures 2A and 2B.

Several relay drive circuits are used as switches to energize the K12 (K1 and K2 relays) reversing contactor, K3 Two-Wire Start relay, and K4 Backup Source Failure relay. A signal from the time delay module switches on these circuits to drive their respective relays. These drive circuits are shown in Figures 2A and 2B.

Voltage Sensor Modules

The voltage sensors are plug-in modules that fit into the J1 and J3 card edge connectors on the mother board. The voltage sensors monitor the voltage sources (single or three phase) and provide an output signal (Source OK) when the source is within predetermined limits. Depending on the options selected, the sensors test for undervoltage, overvoltage and under/overfrequency. The Source OK output signal is latched on when all of the pickup requirements for voltage and frequency are satisfied. The Source OK output signal will remain on until the voltage or frequency goes beyond the dropout limits for longer than the corresponding dropout time delay.

Undervoltage sensing is accomplished by sensing all voltage phases, but responding only to the lowest one. Thus, all phases must be above the undervoltage pick-up point before undervoltage pickup will occur; while undervoltage dropout will occur when any of the phase voltages fall below the dropout point. A fixed dropout time delay (0.5 seconds) occurs before the Source OK output responds to an undervoltage condition. The sensor is calibrated and the undervoltage pickup and dropout points are adjusted with potentiometers (see Voltage Sensor Adjustments section). The pickup adjustment range is 85% to 100% of the nominal voltage. The dropout adjustment range is 75% to 98% of the pickup setting.

Overvoltage sensing is accomplished by monitoring the peak of the combined phase voltages so that the sensor essentially responds to the highest phase. The sensor is calibrated and the overvoltage limit is adjusted with potentiometers (see Voltage Sensor Adjustments section). The overvoltage adjustment range is 105% to 135% of the nominal voltage. The pickup point is fixed at 5% below the overvoltage limit point and is not adjustable. A time delay is also included which is adjustable from 0.5 to 120 seconds.

Over and underfrequency sensing is accomplished by sensing the source frequency and detecting when it is within a specific band. The pickup bandwidth is adjusted with a potentiometer (see Voltage Sensor Adjustments section). The pickup adjustment range is 4% to 20% of the nominal frequency. The dropout bandwidth is fixed at 5.0% wider than the pickup band. The pickup and dropout bands are centered about the nominal frequency. A time delay is also included which is adjustable from 0.1 to 15 seconds.

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TABLE 1

Power Sentry Control Light Array

Light ON	Indicates
Source 2 OK	Source 2 voltage is available and within the voltage and frequency settings of the voltage/frequency sensor.
Timing for Stop	Control is timing out for generator stop signal. At the end of the timing period, the 2 Wire Run lamp and the Timing for Stop light will go out.
Transfer Command	Control is signaling for transfer to Source 2 power source. The Source 2 OK lamp and the 2 Wire Run lamp will also be on.
Timing for Over-voltage Source 2	Control is timing out for overvoltage condition on Source 2. Overvoltage time delay is adjustable from 0 to 120 seconds; factory setting is 5 seconds. Source 2 OK light will stay on during timing out period. Does not operate if no overvoltage sensor.
Retransfer Command	Control is signaling for retransfer to Source 1 power source. The Source 1 OK light will also be on.
2 Wire Run	Control is signaling for the generator set to run.
Timing for Overvoltage Source 1	Control is timing out for overvoltage condition on Source 1. Overvoltage time delay is adjustable from 0 to 120 seconds; factory setting is 5 seconds. Source 1 OK light will stay on during timing out period. Does not operate if no overvoltage sensor.
Source 1 OK	Source 1 voltage is available and within the voltage and frequency settings of the voltage/frequency sensor.
Timing for Retransfer	Control is timing out for retransfer to Source 1 power source. At end of timing period, light will go out. Delay is adjustable from 0 to 32 minutes; factory setting is 15 minutes.
Timing for Transfer	Control is timing out for transfer to Source 2 power source. At end of timing period, light will go out. Delay is adustable from 0 to 120 seconds; factory setting is 2 seconds.

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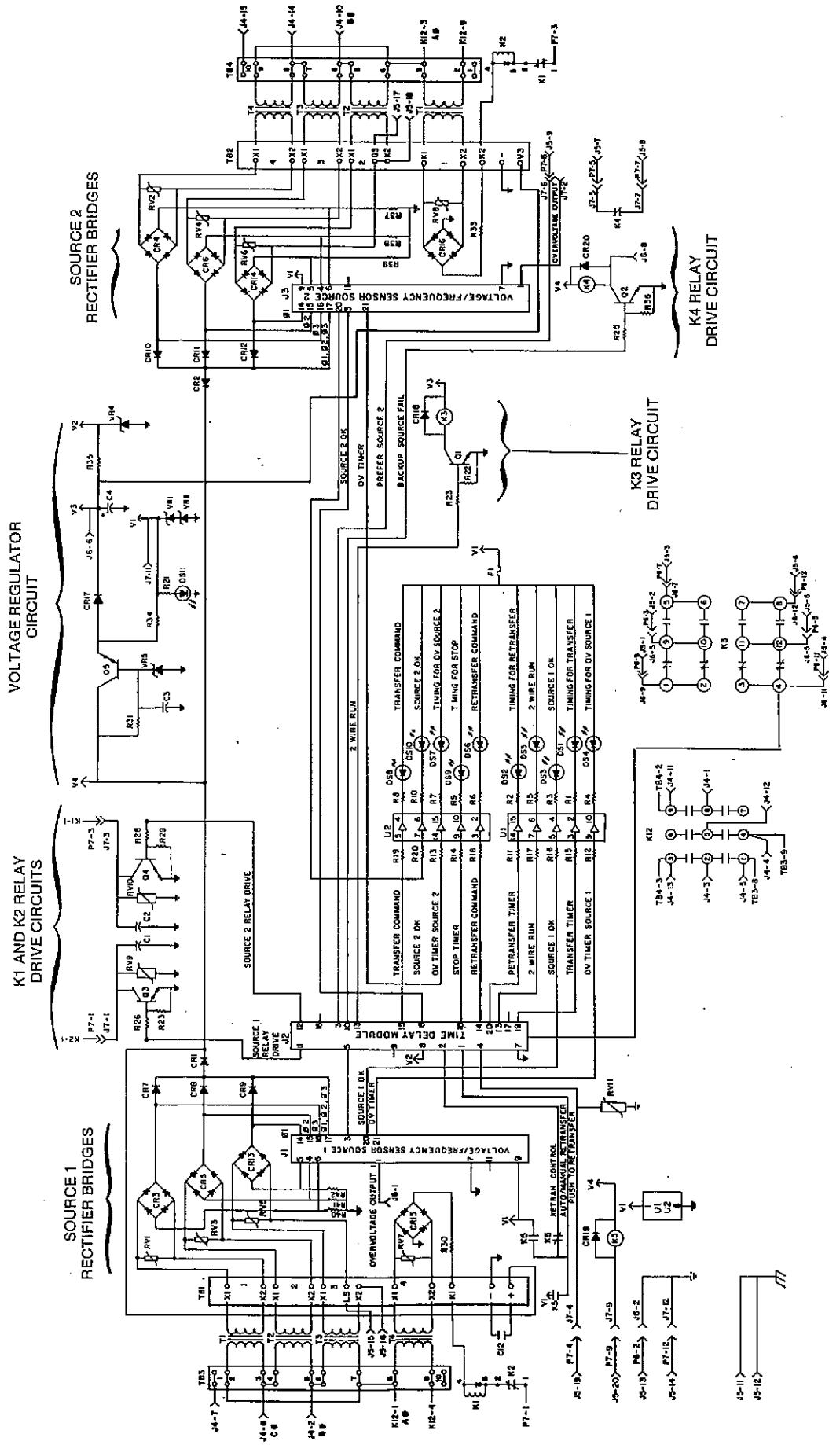

FIGURE 2A. CONTROL SCHEMATIC 300-2109

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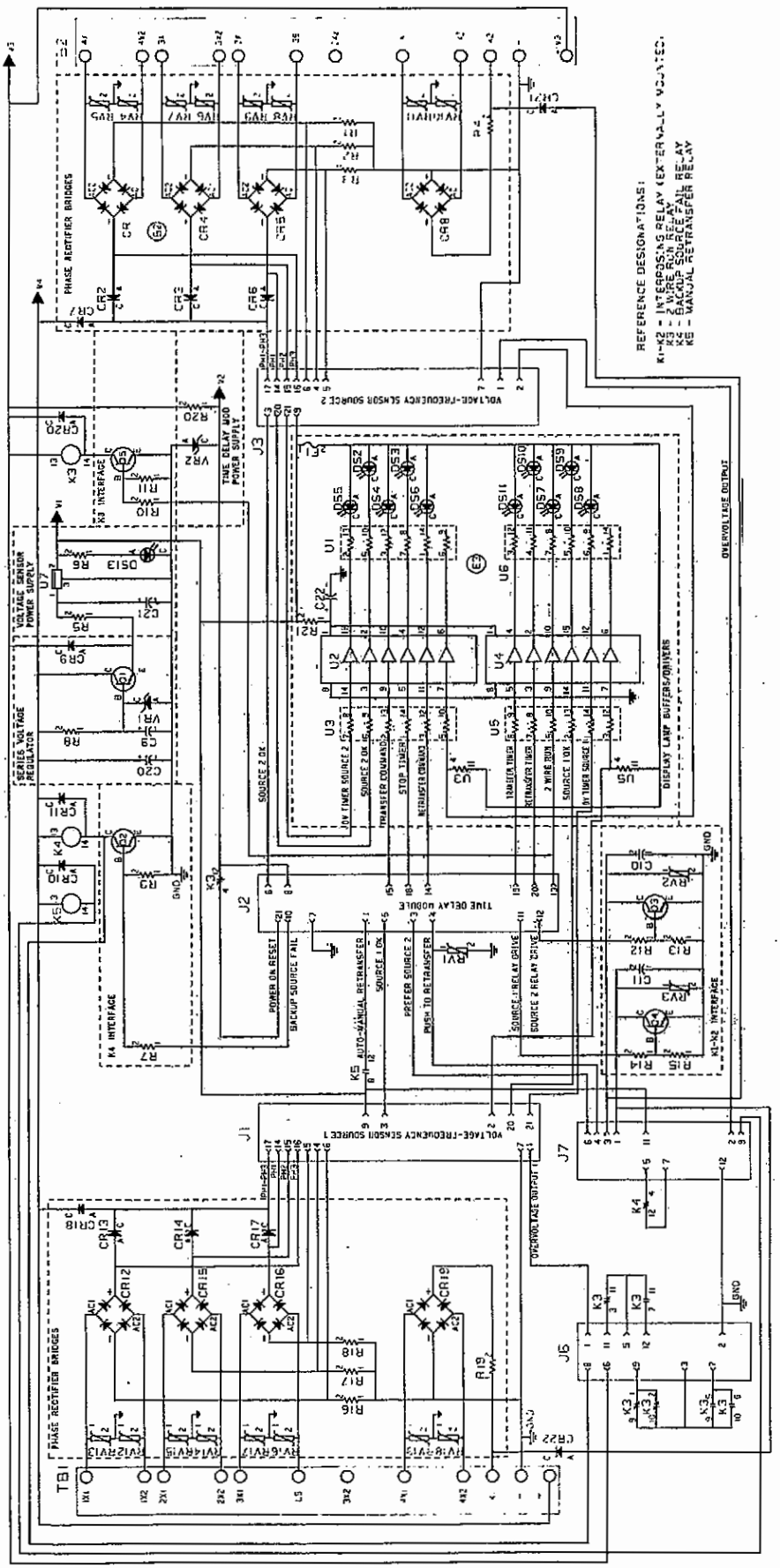

FIGURE 2B. CONTROL SCHEMATIC 300-2936

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Time Delay Module

The time delay module plugs into the J2 card edge connector on the mother board. The time delay module contains the timing circuits and associated logic that provide time delays for generator starting, load transfer, load retransfer, and generator stopping. The Source OK output signals are received from the voltage sensors. If the Source 1 OK signal is interrupted, the start time delay will begin timing out.

The start time delay, adjustable from zero to six seconds, begins timing if the input signal from the Source 1 voltage sensor is interrupted. If the signal returns during the timing out period, the timer will reset. If the signal does not return by the end of the delay period, the timer will signal for the generator set to start. The purpose of the delay is to prevent generator set start up when power interruptions of very short duration occur. The factory delay setting is for two seconds.

The transfer time delay, adjustable from zero to two minutes, begins timing as soon as the Source 2 voltage sensor signals that power is available. At the end of the delay, the timer will signal for the load to transfer to the generator set. The purpose of the delay is to allow the generator set to stabilze before the load is applied. The factory delay setting is for two seconds.

When the Source 1 power source returns and Source OK signals are received from both voltage sensors, the time delay module will respond to the preferred source. In utility-to-generator installations, Source 1 (normal) is recognized as the preferred source. In utility-to-utility or generator-to-generator installations, the preferred source is selected by setting an externally mounted selector switch.

The retransfer time delay, adjustable from zero to thirty-two minutes, begins timing as soon as the input signal from the Source 1 voltage sensor returns. At the end of the delay, the timer will signal for the load to transfer to the normal source. The purpose of the delay is to allow the normal power source to stabilize before the load is applied. The factory delay setting is for fifteen minutes.

The stop time delay, adjustable from zero to eight minutes, begins timing as soon as the retransfer timer signals for the load to transfer to the normal source. At the end of the delay, the timer will signal for the generator set to stop. The purpose of the delay is to allow the generator set to cool while running at no load. The factory delay setting is for five minutes.

Refer to the Time Delay Adjustments section for the time delay adjustment procedures.

K12 Reversing Contactor

The K12 reversing contactor (also called interposing relay - see Figure 1) consists of two separate relay coils (designated as K1 and K2 relays) and an interlocking set of relay contacts. The K1 and K2 relay contacts are used to connect line voltage to the linear actuator motor. If the transfer switch is connected to the Source 2 side and the Source 1 power source is available, closing the K1 contacts will energize the linear actuator motor and cause the load to transfer to the Source 1 side. If the transfer switch is connected to the Source 1 side and the Source 2 power source is available, closing the K2 contacts will energize the linear actuator and cause the load to transfer to the Source 2 side. A mechanical interlock prevents the K1 and K2 contacts from closing at the same time. An electrical interlock prevents the K1 and K2 relay coils from being energized at the same time. The K1 and K2 relay coils are driven by DC output voltage from the mother board rectifier bridges.

C1 Storage Capacitor

The C1 capacitor functions as an energy storage element. During power outages, the C1 capacitor holds the K3 Two-Wire Run relay energized while the start time delay times out. This avoids nuisance starting during short duration power outages.

C12 Filter Capacitor

The C12 capacitor functions as a filter capacitor to smooth out the output voltage from the mother board rectifier bridges. The integrated circuit design provides a rectified output voltage if either power source is available.

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OPERATION

The following section covers the operation of the Power Sentry control in a utility-to-genset installation. Source 1 is designated as the normal power source and Source 2 is designated as the emergency power source. The following situations and control responses are described:

- Normal Power Source Connected to Load
- Normal Power Source Interrupted
- Emergency Power Source Connected to Load
- Normal Power Source Restored

Some of the control commands can be verified by observing the mother board light array.

Normal Power Source Connected to Load

The Source 1 OK lamp will be on to indicate that the normal power source is within the voltage and frequency settings of the voltage sensor. The Retransfer Command lamp will also be on to indicate that the control is signaling for the load to be connected to the normal power source (retransfer). No other light array lamps will be on.

Normal Power Source Interrupted

An interruption in power can be defined as not only the complete loss of power but also as any situation where the voltage or frequency are outside the settings of the voltage sensor. The voltage sensor will respond to all power interruptions by blocking the Source 1 OK signal.

Source 1 Voltage Sensor: The undervoltage sensor will begin timing if the source fails or if the voltage falls below the drop-out setting. The undervoltage dropout time delay is factory set for 0.5 seconds and is not adjustable. Both the Source 1 OK lamp and the Retransfer Command lamp will remain on during the timing period. If the voltage returns during the 0.5 second delay, the sensor will reset itself. This short delay prevents the time delay module from responding during momentary dips in voltage.

The overvoltage sensor will begin timing if the source voltage rises above the dropout setting. The overvoltage dropout time delay is adjustable for 0.5 to 120 seconds and is factory set for 5 seconds. The Timing for Overvoltage Source 1, Source 1 OK, and Retransfer Command lamp will remain on during the timing period. If the voltage returns to normal during the timing period, the sensor will reset itself.

The over/underfrequency sensor will begin timing out if the source frequency rises above or falls below the dropout setting. The frequency dropout time delay is adjustable from 0.1 to 15 seconds. Both the Source 1 OK lamp and the Retransfer Command lamp will remain on during the timing out period. If the frequency returns to normal during the timing out period, the sensor will reset itself.

Start Time Delay: If the normal power source is still faulty after the voltage sensor has timed out, all light array lamps will go out and the start time delay will begin timing. The start time delay is adjustable from 0 to 6 seconds and is factory set for 2 seconds. All lamps will stay out while the start time delay is timing. The start time delay prevents generator set startup when a power interruption of very short duration occurs. If the normal power source returns during the timing out period, the start delay will reset.

After the start time delay has timed out, a run signal will be sent to the generator set. When the generator set starts, the 2 Wire Run lamp will light to indicate the control is signaling for the generator set to run. This lamp will stay on as long as the control is signaling for the generator set to run.

Source 2 Voltage Sensor: The Source 2 voltage sensor monitors the voltage output from the generator set. When the voltage rises above the pickup setting, the sensor will signal that the emergency power source is available. The Source 2 OK lamp will light and stay on as long as the emergency power source is within the voltage and frequency settings of the voltage sensor.

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Transfer Time Delay: The transfer time delay will begin timing as soon as the voltage sensor signals that Source 2 voltage is available. The transfer time delay is adjustable from 0 to 120 seconds and is factory set for 2 seconds. The Timing For Transfer lamp will light to indicate the transfer time delay is timing. The two second delay before transferring the load to the generator is to allow the generator voltage to stabilize.

After the transfer time delay has timed out, the control will signal for the load to transfer to the emergency source. The Transfer Command lamp will light and stay on as long as the control is signaling for transfer.

Emergency Power Source Connected to Load

The Source 2 OK lamp will be on to indicate that the emergency power source is within the voltage and frequency settings of the voltage sensor. The Transfer Command lamp will be on to indicate the control is signaling for the load to transfer to the emergency power source. The 2 wire Run lamp will be on to indicate the control is signaling for the generator set to run.

Normal Power Source Returns

The time delay module is programmed to identify the normal power source as the preferred power source. The return of normal power will initiate several control responses that will eventually cause the load to retransfer to the normal side.

Source 1 Voltage Sensor: The Source 1 voltage sensor monitors the normal power source. When the voltage and frequency rise above the pickup settings, the sensor will signal that Source 1 voltage is available. The Source 1 OK lamp will light and stay on as long as the normal source voltage is within the voltage and frequency settings of the voltage sensor.

Retransfer Time Delay: The retransfer time delay will begin timing as soon as the voltage sensor signals that Source 1 voltage is available. The retransfer time delay is adjustable from 0 to 30 minutes and is factory set for 15 minutes. The Timing For Retransfer lamp will light while the retransfer time delay is timing out. The 15 minute delay before transferring the load to the normal power source allows the normal line voltage to stabilize.

The stop time delay will begin timing as soon as the Retransfer Command lamp lights. The stop time delay is adjustable from 0 to 10 minutes and is factory set for 5 minutes. The Timing For Stop lamp will light while the stop time delay is timing out. The five minute delay before stopping is to allow the generator set to cool down while running at no load. When the stop time delay has timed out, the control will stop signaling for the generator set to run. The 2 Wire Run lamp and the Source 2 OK lamp will go out.

ADJUSTMENTS (Utility-to-GenSet)

The adjustments on the electronic modules are factory set and normally do not require field adjustment. If desired, the Pickup, Dropout and Time Delay settings may be adjusted to other than factory settings as outlined below. However, the calibration (Cal) adjustments should be changed only if the nominal voltage is significantly different than the nameplate rating, or when installing a replacement sensor module.

⚠CAUTION ***Haphazard setting of the module calibration (Cal) adjustments will result in abnormal operation of the transfer switch.***

⚠WARNING ***Accidental actuation of the linear motor can cause severe personal injury. Disable the motor before making adjustments.***

All adjustments are made by inserting a screwdriver through the small openings in the module panel and turning a potentiometer. Place the Motor Disconnect switch on the transfer switch in the ***manual*** or ***down*** position before making any adjustments. Return the switch to the up position after adjustments are complete.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Use extreme caution when making adjustments to avoid touching high-voltage components.***

Voltage Sensor Modules

A separate voltage sensor (see Figure 3) is used for each power source. The voltage sensor above the time delay module is for the emergency power source (source 2) and the sensor below the time delay module is for the normal power source (source 1).

Undervoltage Sensor: The standard voltage sensor modules monitor the Normal and Emergency power source for an undervoltage condition. The undervoltage range of adjustment is shown below. If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Dropout	75% to 98%	85%
Pickup	85% to 100%	95%

If necessary, the undervoltage sensor for either the Normal or Emergency sources may be calibrated as follows:

1. Ensure that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Pickup Band potentiometer.

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2. Turn the Undervoltage Pickup and Dropout potentiometers on the voltage sensor fully clockwise.
3. Turn the Undervoltage calibration (Cal) potentiometer fully clockwise. The Source OK lamp corresponding to source sensor being calibrated should be on (Source One OK-Normal source, Source 2 OK-Emergency source). Refer to Figure 4 for lamp location. If the Source OK lamp fails to come on, and the voltage sensor has a overvoltage sensing option, turn overvoltage Limit and Cal potentiometers fully clockwise.
4. Turn the Cal potentiometer counterclockwise until the Source OK lamps turns off.
5. Slowly turn the Cal potentiometer clockwise until the Source OK lamp just turns on again.

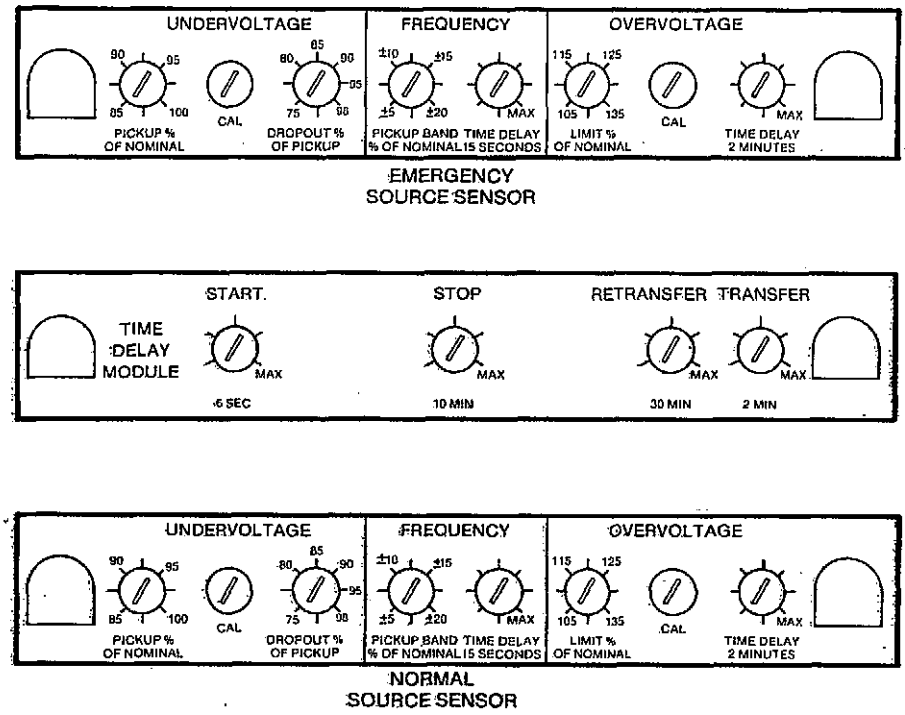

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FIGURE 3. VOLTAGE SENSORS AND TIME DELAY MODULES

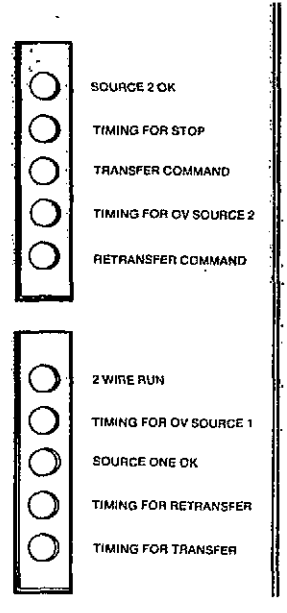

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FIGURE 4. CONTROL LAMPS

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6. The Undervoltage sensor is now calibrated. If the Overvoltage sensor was adjusted in Step 3, then recalibrate it by using the Overvoltage Sensor calibration procedure.

After calibration, reset the Pickup and Dropout potentiometers to the factory settings or to desired setting.

Overvoltage Sensor: The optional overvoltage sensor detects when the source voltage has exceeded the overvoltage limit.

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 3. Range of adjustments and factory settings are shown below.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Limit	105 to 135%	110%
Time Delay	0 to 2 minutes	5 seconds

The overvoltage pickup point is fixed at 5 percent below the Limit setting. The adjustable dropout Time Delay allows the control to ignore momentary overshoots in voltage.

If necessary, the Overvoltage sensor may be calibrated as follows:

If the Undervoltage sensor has not been calibrated, do so before proceeding.

1. Ensure that nominal voltage is present on all phases of the source being calibrated (Normal or Emergency). On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the Frequency Pickup Band potentiometer.
2. Turn the overvoltage Limit and Time Delay potentiometers fully counterclockwise.
3. Turn the Overvoltage Cal potentiometer fully clockwise. The Source OK lamp for the selected source should light (Figure 4).
4. Turn the Cal potentiometer counterclockwise until the Source OK lamp turns off.
5. Slowly turn the Cal potentiometer clockwise until the Source OK lamp just turns on again.

After calibration, reset the Overvoltage Limit and Time Delay potentiometers to the desired values.

Frequency Sensor: The optional frequency sensor detects when the source frequency is within an acceptable band. This band is centered about the nominal system frequency (50 or 60 hertz).

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 3. Range of adjustments and factory settings are shown below.

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Pickup Band	±4 to ±20%	±10%
Time Delay	0 to 15 Seconds	5 Seconds

The dropout bandwidth is always 2.5% wider (on each end) than the pickup bandwidth.

The adjustable dropout Time Delay allows the control to ignore momentary dips or rises in frequency.

Time Delay Module

The time delay module controls the following functions:

- Start time delay
- Stop time delay
- Transfer time delay
- Retransfer time delay

If other than factory setting is desired, align the slot on the potentiometer to the desired markings on the module panel. See Figure 3. Range of adjustments and factory settings are as follows:

FUNCTION	ADJUSTMENT RANGE	FACTORY SETTING
Start	0-6 seconds	2 seconds
Transfer	0-120 seconds	2 seconds
Retransfer	0-30 minutes	15 minutes
Stop	0-10 minutes	5 minutes

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Relay Control

INTRODUCTION

The relay control package is primarily an electromechanical control designed for use with OT II automatic transfer switches. This is an optional control that is used where the more complex Power Sentry control is not required. A loss of normal line voltage will cause a start signal to be sent to the standby generator set. Adjustable start and retransfer time delays and non-adjustable stop and transfer time delays are also available.

All components for the relay control are mounted within a separate enclosure. A wiring harness with plug-in connectors connects the control with the transfer switch.

DESCRIPTION

The relay control consists of the following major assemblies.

- K1/K2 Reversing Contactor (Interposing Relay)
- K3 Start Time Delay Relay
- K4 Retransfer Time Delay Relay
- K5 Line Voltage Relay
- K6 Generator Voltage Relay
- A10 Stop Time Delay
- A11 Transfer Time Delay
- T1 Line Side Transformer
- T2 Generator Side Transformer

The sections that follow provide a general description of each component and how it functions. Not all of the components described will be used in every application because of variations in the options and features selected. Refer to the appropriate schematic diagram to determine the correct parts listing for the transfer switch.

K1/K2 Reversing Contactor

The K1/K2 reversing contactor (also called interposing relay - see Figure 5) consists of two separate relay coils (designated as K1 and K2 relays) and an interlocking set of relay contacts. The primary function of the K1/K2 relay is to connect line voltage to the linear actuator motor. If the transfer switch is connected to the emergency side and the normal power source is available, closing the K1 contacts will energize the linear actuator motor and cause the load to transfer to the normal side. If the transfer switch is connectd to the normal side and the emergency power source is available, closing the K2 contacts will energize the linear actuator and cause the load to transfer to the emergency side.

The K1/K2 relay is designed so that it is not possible to connect the normal and emergency power source to the linear actuator at the same time. A mechanical interlock prevents the K1 and K2 contacts from closing at the same time. An electrical interlock prevents the K1 and K2 relay coils from being energized at the same time. The K1 relay is driven by line voltage from the normal side. The K2 relay is driven by line voltage from the emergency side.

In installations that do not have the optional start time delay (K3 relay), the K1 relay is also used to send a start signal to the generator set. When the normal power source is lost, the K1 relay drops out. This closes a set of contacts which signals the generator set to start.

K3 Start Time Delay Relay

The K3 Start Time Delay relay (see Figure 5) is used to send a delayed start signal to the generator set following loss of normal source power. This prevents the generator set from starting when power outages of very short duration occur. If normal power returns during the timing period, the relay will reset. The same relay is used for both two-wire and three-wire start systems. The time delay is adjustable from 1.5 to 15 seconds and begins timing following drop out. At the end of the timing period, the control will signal for the generator set to start.

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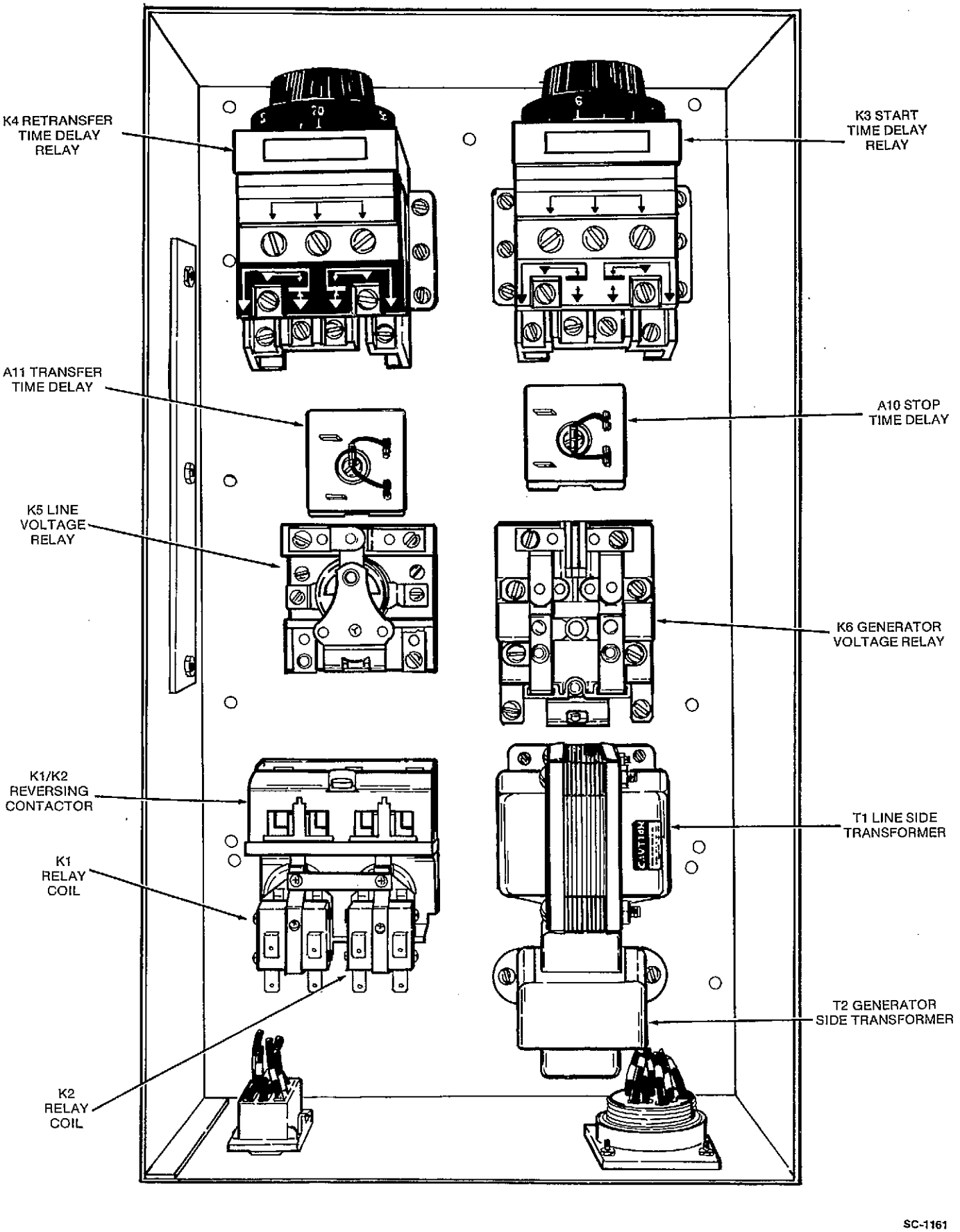

FIGURE 5. RELAY CONTROL

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K4 Retransfer Time Delay Relay

The K4 Retransfer Time Delay relay (see Figure 5) is used to delay transferring the load from the emergency side to the normal side when the normal power source returns. This allows the normal power source voltage to stabilize before the load is retransferred. The time delay is adjustable from 3 to 30 minutes and begins timing on pick-up. At the end of the timing period, the control will signal for the generator set to stop.

K5 Line Voltage Relay

The K5 Line Voltage relay (see figure 5) is used with transfer switches that have the optional time delay relays (start and retransfer). The K5 relay works in conjunction with the T1 Line Side transformer to provide single or all phase line loss sensing of the normal power source. Loss of normal line voltage in any phase will drop out all relays and initiate generator set starting. When the normal power source returns, normal line voltage energizes the K5 relay and closes the K5 contacts. This connects normal line voltage to the K4 Retransfer Time Delay which initiates load retransfer to the normal source.

K6 Generator Voltage Relay

The K6 Generator Voltage relay is used on transfer switches that have the optional time delay relays (start and retransfer). Line voltage from the emergency power source energizes the K6 relay. This closes a set of contacts and initates transfer of the load to the emergency side.

If the emergency source fails, the K6 relay also provides for immediate retransfer of the load to the normal side when the normal power source returns. Loss of emergency source power de-energizes the K6 relay and closes a set of contacts that bypass the K4 Transfer Time Delay. This allows the load to retransfer to the normal side as soon as the normal power source returns without waiting for the K4 relay to time out.

A10 Stop Time Delay

The A10 Stop Time Delay is a solid state device that is used to delay generator set stopping after the load has transferred to the normal power source. This gives the generator set time to cool while running at no load. The A10 time delay is connected in series with the K3 relay. When the load is retransferred, the A10 time delay keeps the K3 relay de-energized during the timing out period. This prevents the K3 relay from sending a stop signal to the generator set. The length of the delay period is determined by the value of the resistor that is connected across the timer terminals. The standard delay period is fixed at five minutes.

A11 Transfer Time Delay

The A11 Transfer Time Delay is a solid state device that is used to delay the load from transfering to the emergency side. This gives the emergency power source voltage time to stabilize before assuming the load. The A11 time delay is connected in series with the K2 relay. When the emergency power source becomes available, the A11 time delay keeps the K2 relay de-energized during the timing out period. This prevents the K2 relay from signaling for the load to transfer. The length of the delay period is determined by the value of the resistor that is connected across the timer terminals. The standard delay period is fixed at 0.5 seconds.

T1 Line Side Transformer

The T1 Line Side transformer is used to supply power and to initiate control response to loss of line voltage. The output voltage frm the T1 transformer is used to drive the K1, K3, and K4 relays. The T1 transformer is connected so that a voltage potential is created between the transformer output terminal and line A (or neutral if a single pole switch). One side of each relay (K1, K3, and K4) is connected to the transformer output terminal. The other side of each relay is connected to line A or the neutral conductor.

When used in conjunction with the K5 relay, the T1 transformer provides a single or all phase control response to loss of line voltage from the normal power source. Loss of normal line voltage in any phase will drop out all relays and initiate generator set starting.

T2 Generator Side Transformer

The T2 Generator Side transformer is similiar in function to the T1 transformer except it is connected to the generator side of the control. The output voltage from the T2 transformer is used to drive the K2 relay. The T2 transformer is connected so that a voltage potential is created between the transformer output terminal and line A (or neutral if a single pole switch). One side of the K2 relay is connected to the T2 transformer output terminal. The other side of the relay is connected to line A or the neutral conductor.

OPERATION

The following sections describe the operation of the relay control. This includes the following situations and the various control responses:

- Normal Power Source Connected to Load
- Normal Power Source Interrupted
- Emergency Power Source Connected to Load
- Normal Power Source Restored

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Figure 6 is a schematic of a typical three phase transfer switch with the start, transfer, retransfer, and stop time delay options. Refer to Figure 6 as the operational sequence of each component is described. Relay contact references normally open (NO) and normally closed (NC) refer to the position of the contacts when the relay is de-energized.

Normal Power Source Connected to Load

Under normal power conditions, the transfer switch will be closed to the normal side and the load will be powered by the normal power source. Line-to-line voltage from the normal side energizes the K5 Line Voltage relay and T1 Line Side transformer. Energizing the K5 relay closes the normally open K5 relay contacts (1 set). This connects the K4 Retransfer Time Delay relay, K3 Start Time Delay relay, and K1 Reversing Contactor relay to the T1 transformer output terminal. The other side of each relay is connnected to the normal line side. The output voltage from the T1 transformer energizes the K4, K3, and K1 relays.

Energizing the K4 relay closes the normally open K4 contacts (1 set). However, the closed K6 contacts parallel the K4 contacts so that the circuit is already complete (assuming that the generator set is not running).

Energizing the K3 relay opens the normally closed K3 contacts. This holds the start circuit open (two-wire start) so that the generator set does not start.

Energizing the K1 relay closes the normally open K1 contacts (3 sets) and opens the normally closed K1 contacts (1 set). Closing the normally open K1 contacts does not complete any circuits so that no additional components are energized. Opening the normally closed K1 contacts (1 set) opens the circuit between the K2 relay and the emergency power source. Since the generator set is not operating, the K2 relay is already de-energized. However, opening the K1 contacts provides an electrical interlock that prevents the K2 and K1 relays from energizing at the same time.

Normal Power Source Interrupted

If any phase of the normal power source is interrupted, either the K5 Line Voltage relay or the T1 Line Side transformer will de-energize. When this happens, the output voltage from the T1 transformer immediately terminates causing the K4 Retransfer Time Delay, K3 Start Time Delay relay, and K1 Reversing Contactor relay to de-energize. Both the K4 and K1 relay contacts immediately return to their de-energized positions. However, the K3 relay holds the normally closed K3 contacts open until the start time delay has timed out. At the end of the time delay, the K3 contacts close and a start signal is sent to the generator set.

When the generator set starts, it begins to supply line voltage to the emergency side of the transfer switch. However, since the load is still connected to the normal side, line voltage from the generator is not supplied to the load. Line-to-line voltage from the emergency side energizes the K6 Generator Voltage relay and the T2 Generator Side transformer. Energizing the K6 relay closes the normally open K6 contacts (one set) and opens the normally closed K6 contacts (one set). Opening the normally closed K6 contacts prevents the load from immediately transferring to the normal side when the normal power source returns. Retransfer will not occur until the K4 Retransfer Time Delay relay has timed out.

Closing the normally open K6 contacts connects the T2 transformer output terminal to the A11 Transfer Time Delay which is wired in series with the K2 Reversing Contactor relay. The other side of the K2 relay is connected to the emergency line side. The A11 time delay holds the K2 relay circuit open until the transfer time delay has timed out. At the end of the time delay, the circuit closes and output voltage from transformer T2 energizes the K2 relay.

Energizing the K2 relay closes the normally open K2 contacts (2 sets) and opens the normally closed K2 contacts (1 set). Opening the normally closed K2 contacts opens the K1 relay circuit. Since the normal power source is not available, the K1 relay is already de-energized. However, opening the K2 contacts provides an electrical interlock that prevents the K1 and K2 relays from energizing at the same time.

Closing the normally open K2 contacts connects line-to-line voltage from the emergency side to the linear actuator motor. This energizes the linear actuator and causes it to open the transfer switch on the normal side and close the transfer switch to the emergency side. When the transfer switch closes to the emergency side, the S6 auxiliary switch opens the linear actuator circuit which de-energizes the linear actuator motor, the T2 transformer, and the K2 relay. The K2 relay contacts return to their de-energized position. The transfer switch remains closed to the emergency side and the load is now powered by the generator set.

Emergency Power Source Connected to Load

Under emergency power conditions, the transfer switch will be closed to the emergency side and the load will be powered by the generator set. Line-to-line voltage from the emergency side energizes the K6 Generator Voltage relay and opens the normally closed K6 contacts. Holding the normally closed K6 contacts open prevents the load from immediately retransferring to the normal side when the normal power source returns.

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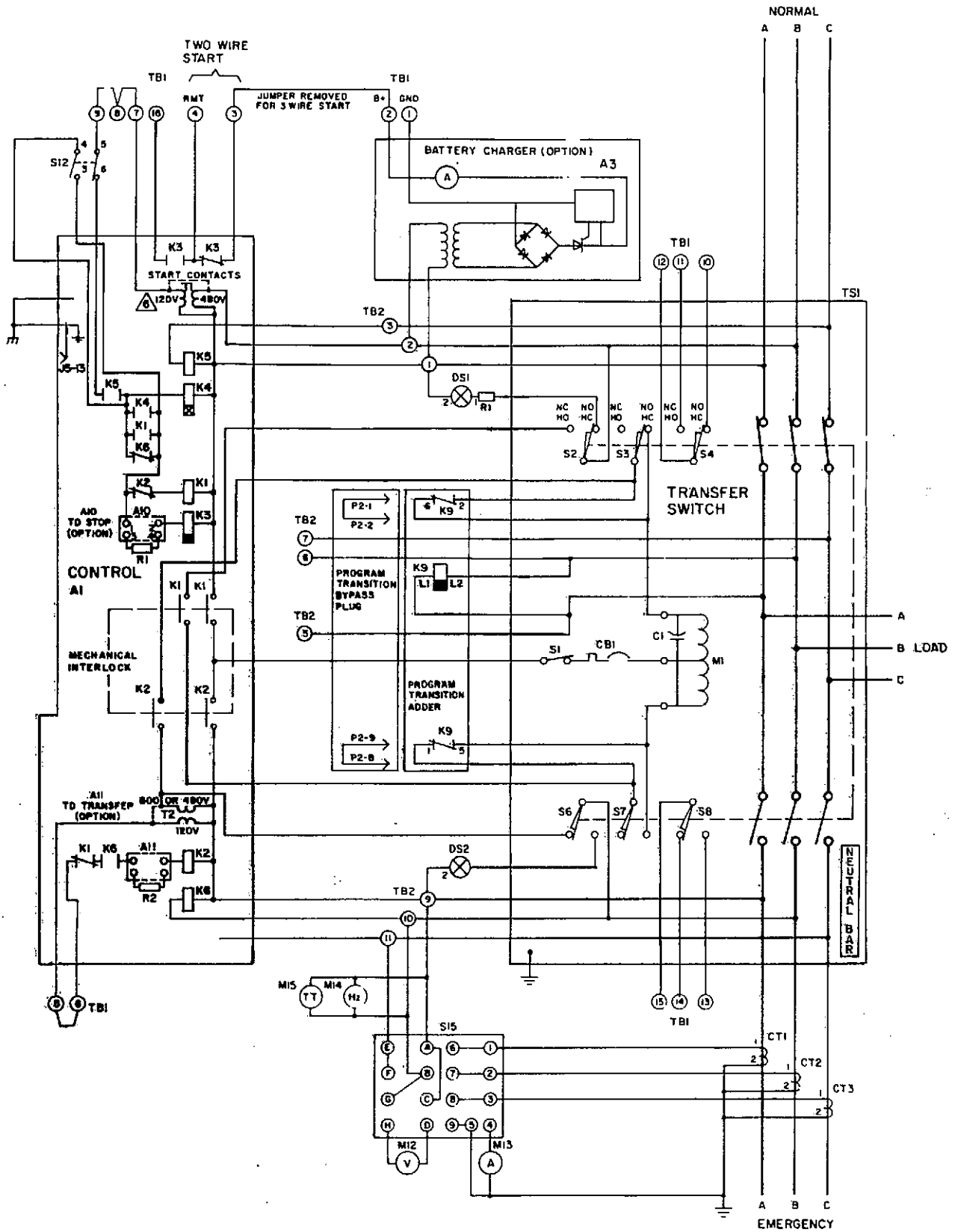

FIGURE 6. TYPICAL RELAY CONTROL SCHEMATIC

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Normal Power Source Restored

When the normal power source returns, line-to-line voltage from the normal side energizes the K5 Line Voltage relay and T1 Line Side transformer. Energizing the K5 relay closes the normally open K5 relay contacts (1 set). This connects the K4 Retransfer Time Delay relay to the T1 transformer output terminal. The other side of the K4 relay is connected to the normal line side.

Note that the K1 Reversing Contactor relay and K3 Stop Time Delay relay are not connected to the T1 transformer output terminal when K5 is energized. This is because the K6 relay (energized by the emergency power source) holds open the K6 contacts which opens the K1 and K3 relay circuit.

The output voltage from the T1 transformer energizes the K4 relay and causes it to begin timing out. When the retransfer time delay has timed out, the normally open K4 contacts close. This connects the T1 output terminal to the K1 Reversing Contactor relay and to the A10 Stop Time delay which is wired in series with the K3 Start Time Delay relay. The other side of the K1 and K3 relays is connected to the normal line side.

Output voltage from the T1 transformer energizes the K1 relay. This closes the normally open K1 contacts (3 sets) and opens the normally closed K1 contacts (1 set). Opening the normally closed K1 contacts opens the K2 relay circuit. Since the K2 relay is already de-energized, opening the K1 contacts provides an electrical interlock that prevents the K1 and K2 relays from energizing at the same time.

Closing the normally open K1 contacts connects line-to-line voltage from the normal side to the linear actuator motor. This energizes the linear actuator and causes it to open the transfer switch on the emergency side and then close the transfer switch to the normal side. When the transfer switch closes to the normal side, the S2 auxiliary switch opens the linear actuator circuit which de-energizes the linear actuator. The transfer switch remains closed to the normal side and the load is now powered by the normal power source.

The A10 Stop Time Delay holds the K3 relay circuit open until the stop time delay has timed out. At the end of the time delay, the circuit closes and output voltage from the T1 transformer energizes the K3 relay. The K3 contacts open the start circuit which sends a stop signal to the generator set.

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Options and Accessories

INTRODUCTION

This section covers the adjustment and service procedures for the options and accessories that are available with the OTII transfer switch. Separate installation instructions are furnished with each option. Refer to the appropriate instruction sheet for wiring connections and installation procedures. The location of each option is shown in Figure 7.

EXERCISER CLOCK

The exerciser clock is set by the factory to provide one-half hour of exercise each week. Onan recommends that the generator set be operated under load for 30 minutes each week to remove moisture and to keep a film of lubricating oil on the engine parts. Exercising for one long period is better than several short periods. The normal exercise period is from 12:00 to 12:30 pm on Saturdays. If this schedule is not satisfactory, the exerciser program may be changed using the following procedure.

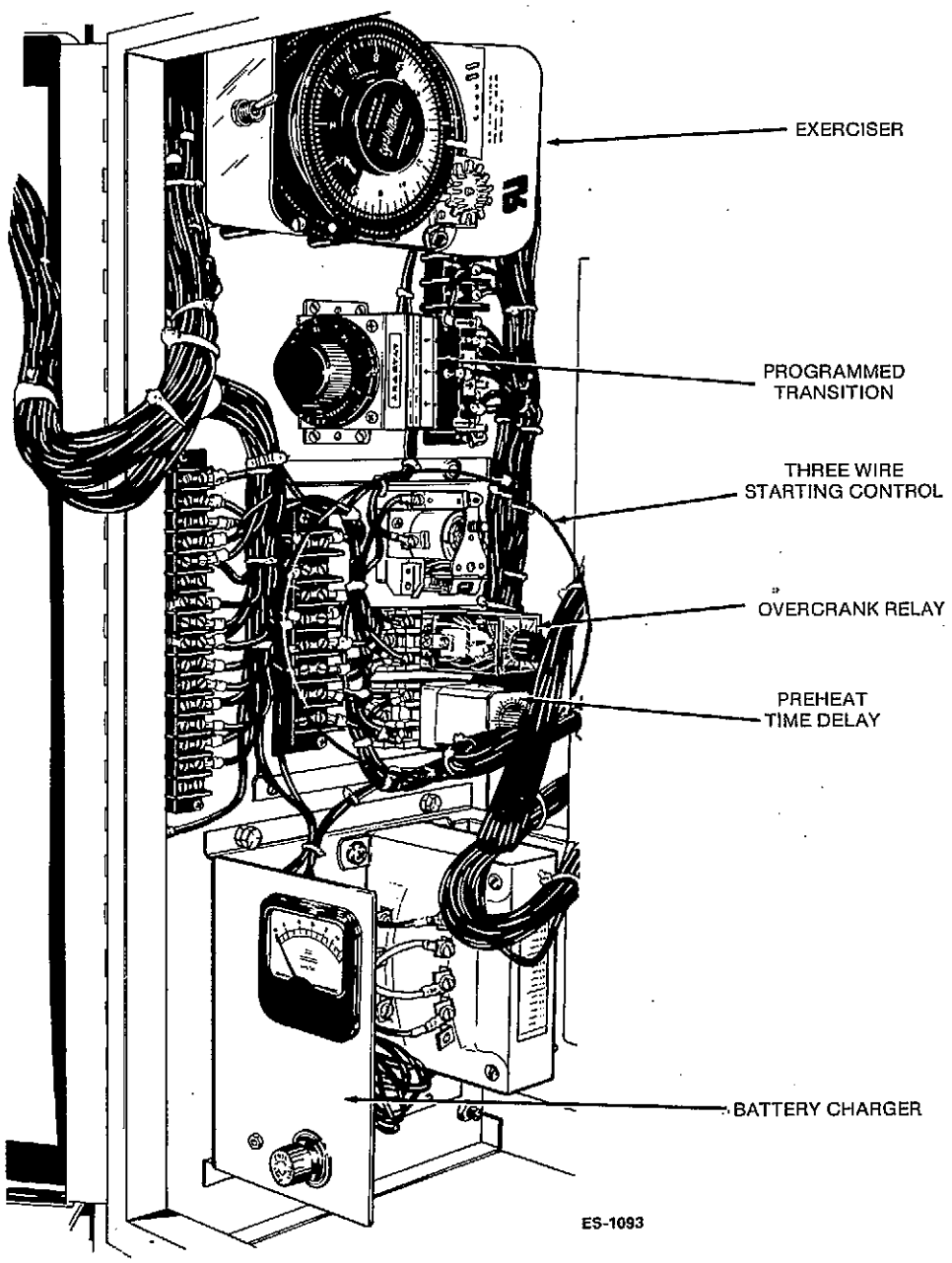

FIGURE 7. TYPICAL OPTIONS

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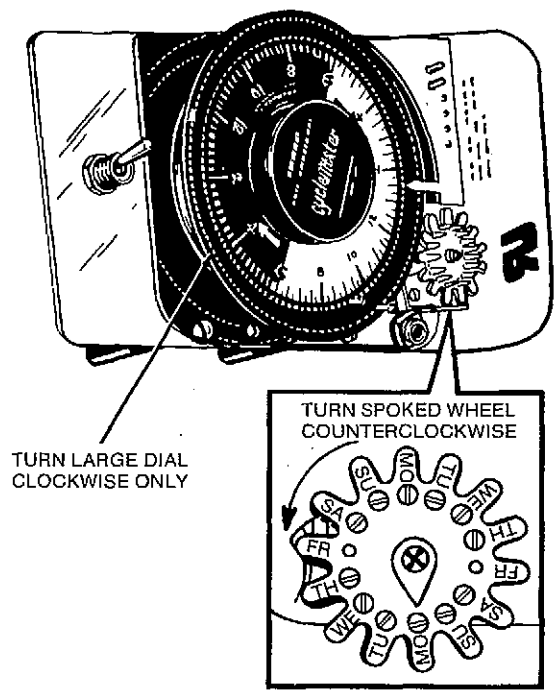
Disconnect both the normal and the emergency power source from the transfer switch before servicing. Turn the operation selector switch for the generator set to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

1. Open the transfer switch cabinet door.
2. To set the time of day you want the generator set to ***start,*** use the inside row of holes on the large dial (see Figure 8A). Install a trip pin (left-hand thread) in the hole that corresponds to the desired set starting time.
3. To set the time of day you want the generator set to ***stop,*** use the outside row of holes on the large dial. Install a trip pin in the hole that corresponds to the desired set stop time.
4. Install a trip pin in the small spoked wheel for each day that ***no*** exercise is desired.
5. Rotate the large dial clockwise until the correct time of day aligns with the pointer.
6. Rotate the small spoked wheel counterclockwise until the correct day aligns with the pointer.

Sixteen trip pins are supplied. Store any unused pins on the time pointer bracket.

7. Set the exerciser switch so that the generator set will exercise with or without load as desired.
8. Close the cabinet and reconnect the normal power source and emergency power source. Connect the negative battery cable to the starting battery and place the set operation selector switch in automatic or remote position.



NOTE: Trip pins are left-hand thread.

SC-1138

FIGURE 8A. EXERCISER CLOCK

ELECTRONIC EXERCISER CLOCK
(Field-Installed Option)

The electronic exerciser clock initiates generator set start/run cycles at programmable intervals and for programmable durations. It is a 7-day, 24-hour clock that can store and execute up to ten start/stop programs (exercise cycles).

Programming the exerciser clock requires setting the time of day and entering the exercise start and stop times.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Use extreme caution when making adjustments to avoid touching high-voltage components.***

Refer to the circled numbers in Figure 8B when reading the following instructions.

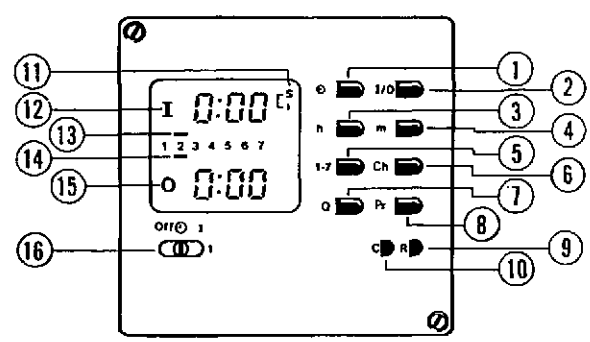


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FIGURE 8B. ELECTRONIC EXERCISER CLOCK

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To set the time of day:

1. If you are performing installation and setup, press the R button (9) with the tip of a ball point pen to reset all memory. Do not press the R button if you are only changing the time of day.
2. Press the clock button (1).
3. Press the h button (3) to set the hour of the day. The clock uses 24-hour (military) time.
4. Press the m button (4) to set the minutes of the hour.
5. Press the 1-7 button (5) to advance the indicator bar (13) over the desired day number. (Use the 1 to represent Sunday.)
6. Press the Pr button (8) to enter the time.

To set the exercise start time:

1. Slide the output selector switch (16) to the center position. The output selector switch has three positions. The Off position overrides the program and causes an exercise stop. The I position overrides the program and causes an exercise start. The center position selects program control.
2. Press the I/O button (2). An "I" (12) appears in the upper left display window. The "I" is a symbol for start time.
3. Press the h button (3) to set the start hour.
4. Press the m button (4) to set the start minute.
5. Press the 1-7 button (5) to advance the indicator bar (13) from 1 to 7 and back to 1. For each day to be selected for exercise, press the Q button (7) when the indicator is over the desired day number. (1 represents Sunday.)

To set the exercise stop time:

1. Press the I/O button (2). An "O" (15) appears in the lower left display window. The "O" is a symbol for stop time.
2. Press the h button (3) to set the stop hour.
3. Press the m button (4) to set the stop minute.
4. Press the 1-7 button (5) to advance the indicator bar (14) from 1 to 7 and back to 1. For each start time (selected in step 5 above), there must be a corresponding stop time. A program can start on day 2, pass through midnight, and stop on day 3 (for example); but there must be a stop time for every start time. Press the Q button (7) when the indicator is under the desired day number.
5. To enter the complete start/stop program, press the Pr button (8). If all program requirements have been satisfied, the display returns to the time of day. If the program requirements are not met, the display of the section that needs correction flashes on and off.

To enter more programs, repeat the two 5-step procedures. A maximum of ten programs can be entered. (The same programs can be repeated each day.)

The word "Full" appears in the display when the memory is full.

If the I/O button (2) is pressed and no program is to be entered, press the Ch button (6) and then the Pr button (8) to get out of the program mode.

To check the programs:

1. Press the Ch button (6). An "I" (12) and an "O" (15) are displayed.
2. Press the Ch button (6) again. The start and stop information for the first program is displayed.
3. Continued pressing of the Ch button (6) causes the display to sequence through all of the programs in memory. If ten programs have been entered, the word "Full" appears after the ten program display.
4. Press the Pr button (8) to return to the time-of-day display.

To change (edit) a program:

1. Press the Ch button (6) until the program you want to change appears in the display window.
2. Press the I/O button (2) to select start or stop time.
3. Press the h (3), m (4), or 1-7 (5) and Q (7) buttons to change the hour, minute, or day.
4. Press the Pr button (8) to enter the edited program and return to the time-of-day display.

To erase (clear) a program:

1. Press the Ch button (6) until the program to be erased is displayed.
2. Press the C button (10) with the tip of a ball point pen to clear the program.
3. Press the Pr button (8) to return to the time-of-day display.

PROGRAMMED TRANSITION

Three programmed transition time delays are available with OT II transfer switches. The delay period is adjustable from 0.5 to 5 seconds, 1.5 to 15 seconds, or 5 to 50 seconds, depending on the option selected. The time delay is set by the factory for two seconds. If this delay is not safisfactory, the timer can be adjusted using the following procedure.

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP, and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

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⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

1. Open the transfer switch cabinet door.
2. Turn the timer knob clockwise to increase the delay and counterclockwise to decrease the time delay (see Figure 9). Increments are marked on the knob.
3. Close the cabinet and reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.

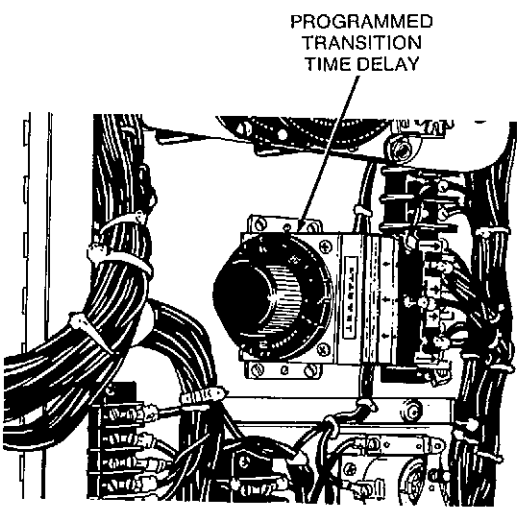

FIGURE 9. PROGRAMMED TRANSITION TIME DELAY

BATTERY FLOAT CHARGER

Battery float chargers with 2, 6 or 10 amp charging capacities are available for both 12 and 24 volt batteries. The permanently connected battery floats at a constant voltage. As the battery approaches the preset full charge voltage, the charging current automatically tapers to zero. This keeps the battery fully charged with no gassing and no overcharging.

The float voltage is set at the correct value by the factory and should not require adjustment. However, if the battery shows signs of being overcharged or undercharged, the float voltage can be adjusted. A high specific gravity, bubbling of electrolyte, and loss of water indicate a high float voltage. A low specific gravity indicates a low float voltage.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

To change the float voltage, a fully-charged battery, a hydrometer, a small screwdriver with insulated shank, and an accurate voltmeter (0.5% accuracy) are needed. Use the following procedures to adjust.

Turn the operation selector for the generator set to STOP; and disconect the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

1. Connect the fully charged battery to the generator set and verify charge condition with the hydrometer. A fully charged lead-acid battery will have a specific gravity of 1.260 at 77° F (25° C).
2. Connect the voltmeter directly to the battery terminals and measure the voltage.
3. Compare the voltage reading with the value shown in Table 1. If the voltage is above or below the recommended float voltage, open the cabinet door and adjust as specified in step 4. If the voltage is correct, proceed to step 5.

TABLE 1

Lead-Acid Batteries	
Battery Voltage	**Float Voltage**
12	13.3
24	26.6
Nickel-Cadmium Batteries Float Voltage Charge Per Cell	
1.38 to 1.45	
Example: Float charge for 10 cell battery should be 13.8 to 14.5 volts	

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4. Use a small screwdriver with insulated shank to turn the adjustment potentiometer (located behind charger panel-see Figure 10) counterclockwise to increase float voltage and clockwise to decrease float voltage. Adjust in small steps and wait five minutes for the voltage to stabilize before making additional adjustments.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Use care when making adjustments to avoid touching high voltage components.***

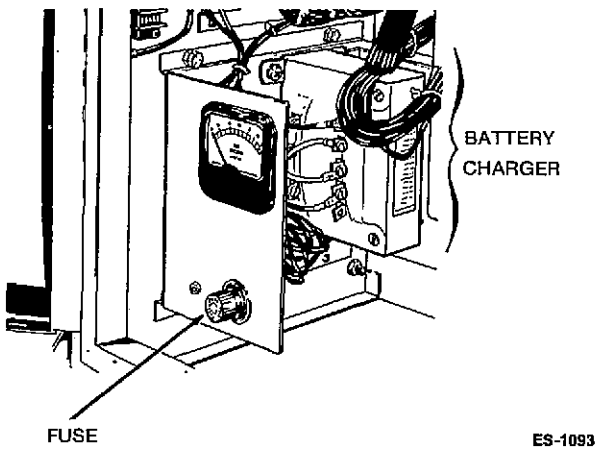

FIGURE 10. BATTERY CHARGER

5. When adjustments are complete, close the transfer switch cabinet door.
6. Disconnect the voltmeter from the battery terminals and disconnect the test battery from the generator set.
7. Reconnect the generator set starting battery and place the operation selector switch in automatic or remote position.

BATTERY TRICKLE CHARGER

A battery trickle charger with 300 ma charging capacity is available for 12 volt batteries. The trickle charger provides a constant rate of charge that can be adjusted from 5 to 300 milliamperes as required. An adjustment knob is mounted on the charger panel for setting the trickle charge rate.

The charge rate should be adjusted if the battery shows signs of being overcharged or undercharged. A high specific gravity, bubbling of electrolyte, and loss of water indicate overcharging. A low specific gravity indicate undercharging.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke or cause any spark or flame while servicing batteries.***

Use the following procedures to adjust the charging rate.

Turn the operation selector switch for the generator set to STOP. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

1. Open the transfer switch cabinet door and observe the charging rate on the battery charger ammeter (see Figure 10).

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Use care when making adjustments to avoid touching high voltage components.***

2. Turn the adjustment knob clockwise to increase the charge rate and counterclockwise to decrease the charge rate.
3. Close the transfer switch cabinet door and place the operation selector switch in the automatic or remote position.

TWO TO THREE WIRE CONVERTER

A two to three wire converter is available for converting a two wire start transfer switch to a three wire start system. The converter includes a Start-Disconnect relay, Overcrank relay, and might include a Preheat Time Delay depending on the options selected. Refer to Figure 11 for the location of each component. The time delays can be adjusted using the following procedures.

Disconnect both the normal and the emergency power source from the transfer switch before servicing. Turn the operation selector switch for the generator set to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the transfer switch control panel.

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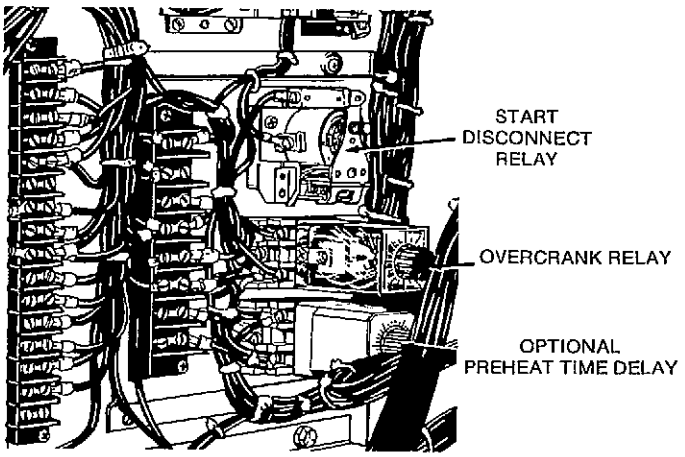

FIGURE 11. TWO TO THREE WIRE CONVERTER

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

Overcrank Relay

1. Open the transfer switch cabinet door.
2. Determine the overcrank time delay required. The standard overcrank relay has a range of 0.6 to 60 seconds. The optional relay with the Failed to Start contacts has a range of 6 to 60 seconds.
3. The relay adjustment settings are marked in increments that range from 0 to 100 percent. A 100 percent setting equals a 60 second delay, a 50 percent setting equals a 30 second delay, etc. Turn the knob clockwise to increase the delay and counterclockwise to decrease the delay.
4. If the optional preheat time delay is included, go on to the next section. If the preheat time delay is not included, close the cabinet door and reconnect the normal power source.
5. Connect the negative battery cable to the starting battery and place the set operation selector switch in the automatic position.

Preheat Time Delay

1. Open the transfer switch cabinet door.
2. Determine the preheat time delay required (Refer to the generator set Operators Manual). The preheat time delay has a range of 0.6 to 60 seconds.
3. The relay adjustment settings are marked in increments that range from 0 to 100 percent. A 100 percent setting equals a 60 second delay, a 50 percent setting equals a 30 second delay, etc. Turn the knob clockwise to increase the delay and counterclockwise to decrease the delay.
4. Close the cabinet door and reconnect the normal power source.
5. Connect the negative battery cable to the starting battery and place the set operation selector switch in the automatic position.

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Transfer Switch Assembly

GENERAL

This section covers the removal and replacement procedures for the transfer switch assembly. There are four separate switch assemblies within the OT II line; and each assembly corresponds to a particular ampere range. The four ampere range groups are 40-70-100 amperes, 150-260 amperes, 400 amperes, and 600-800-1000 amperes.

For servicing purposes, each transfer switch assembly can be separated into the following components:

- Linear Actuator
- Transfer Switch
- Auxiliary Switches

A separate section covers the removal and replacement procedures for each major component within a particular amp range.

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (40-70-100 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 40 to 100 Ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, & J3 - Refer to Figure 12) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
4. Remove the red and white actuator leads from the capacitor and the black lead from circuit breaker. Note the lead connections to the capacitor terminals.
5. Remove the socket head capscrews, flat washers, lock washers, and nuts that secure the actuator to the switch assemblies (see Figure 12). Note the ground wire connection to lower left capscrew.
6. Disengage actuator rod from switch handle and remove actuator from switch assembly.
7. Remove one of the hexhead capscrews and lock washers that secure the rod end assembly to the actuator rod.
8. Remove rod end assembly from actuator rod (see Figure 13) and slide rod out of the actuator.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor from the side opposite the ground brush (see Figure 13). Install the rod end assembly and tighten capscrew to 130 to 135 in-lbs (14.7 to 15.3 N•m).
2. Position actuator motor on switch assemblies so the load wires are at the bottom; and fit the rod assembly into the handle of the closed switch assembly.

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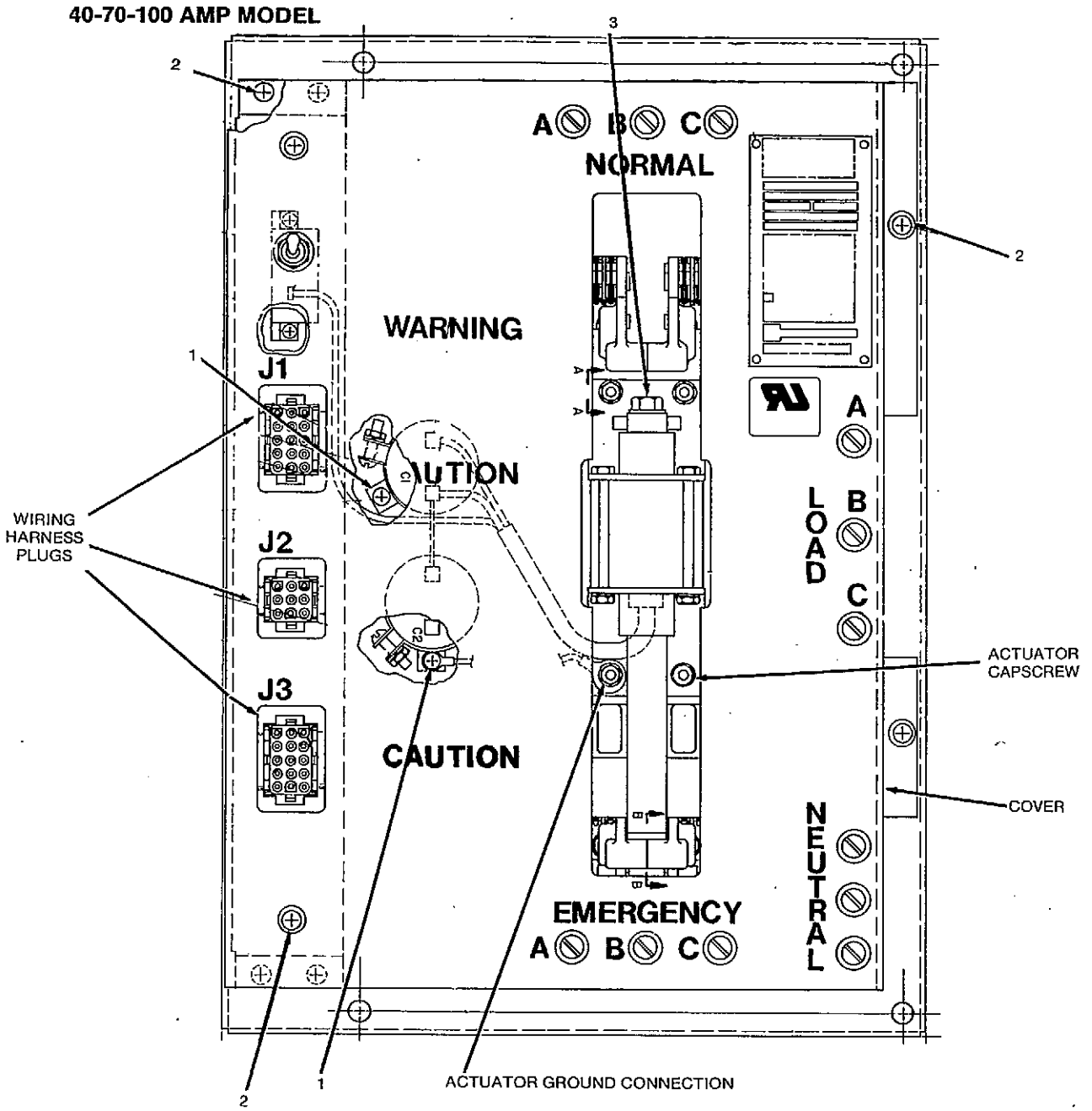
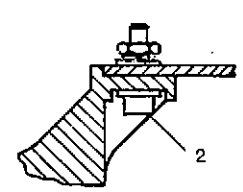


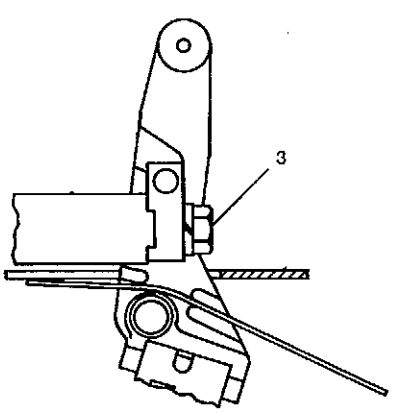
1 - TORQUE SHALL BE 15-20 IN. LBS.

2 - TORQUE SHALL BE 25-30 IN. LBS.

3 - TORQUE SHALL BE 130-135 IN. LBS.



SECTION A-A



SECTION B-B

FIGURE 12. TRANSFER SWITCH FRONT COVER

Power Generation

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40-70-100 AMP MODEL

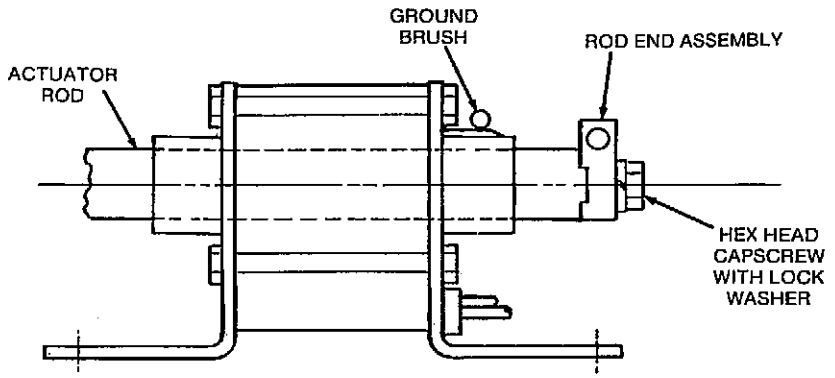

FIGURE 13. LINEAR ACTUATOR

3. Secure actuator motor to switch assemblies using socket head capscrews (4), flat washers (8), lock washers (4), and nuts (4). Be sure to reconnect ground wire to lower left screw (see Figure 12). Tighten capscrews to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.

⚠CAUTION ***Do not overtighten screws or the switch assembly can be damaged.***

4. Connect the black actuator lead wire to the circuit breaker; and the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor terminal with S3 lead wire.

   White Lead Wire - Connect to capacitor terminal with S7 lead wire.

   Transfer switches for voltage ranges 347, 380/416, 440/480 and 480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between one of the terminals on C1 and one of the terminals on C2. Connect red and white leads as described in previous section.

5. Use wire ties to hold actuator lead wires in place with rest of wiring harness.
6. Check operation of transfer switch and alignment of actuator rod by manually opening and closing both the normal and emergency switch assemblies.
7. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
8. Plug in the three control wiring harness plugs (J1, J2, and J3); and reconnect normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
9. Test switch for proper operation and close cabinet.

SWITCH ASSEMBLY REMOVAL AND REPLACEMENT (40-70-100 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

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The following procedures cover the removal and replacement of the switch assemblies for 40 to 100 Ampere switches.

Removing Switch Assembly (Normal or Emergency)

1. Remove the linear actuator as described in Linear Actuator Removal and Replacement section for 40 to 100 Ampere switches. Follow steps 1 - 6 in the Removing Actuator section.
2. Remove the round head machine screws, locking washers, and flat washers that secure the interlock bar to the interlock arms (see Figures 14 and 15); and remove the interlock bar.
3. Remove the pan head screws (2), locking washers, and flat washers that secure the handle assembly to the switch assembly; and lift off the handle assembly (see Figures 14 and 15).
4. Disconnect the control wiring leads from the jumper bus bars.
5. Remove the hex head machine screws, ring terminals, flat washers, lock washers, and nuts that secure the jumper bus bars (see Figures 14 and 15) to the load bus bars.
6. Remove the hex head machine screws and spring washers that secure the jumper bus bars to the switch assemblies; and lift off the jumper bus bars.
7. Remove the control wiring leads from the power source terminals (see Figure 16).
8. On ***front*** connect switches, loosen the lug terminal screws and remove the power source supply wires from the lug terminals.

   On ***rear*** connect switches, remove hex head capscrews, spring washers, flat washers, lock washers, and nuts that secure the contact straps (see Figure 16) to the rear connect straps.
9. Remove the two round head machine screws, locking washers, and flat washers that secure the switch assembly to the base; and lift off the switch assembly.

   ⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch lever to avoid cracking the switch lever.***

10. Remove the pan head screws that secure the left and right phase barriers and retainer barriers (see Figure 17) to the switch assembly; and lift out the phase barriers, retainer barriers, arc chutes, and arc chute barriers. Discard arc chutes and arc chute barriers.
11. On ***front*** connect switches, remove the round head machine screw, locking washer, ring terminal, lug terminal and U-strap, from the switch assembly (see Figure 16).

    On ***rear*** connect switches, remove the round head machine screw, flat washers, contact strap, locking washer, nut, and U-strap from the switch assembly (see Figure 16).

Replacing Switch Assembly

1. Apply a thin coat of electric joint compound to the mating surfaces of the U-strap before installing on replacement switch assembly.

   On ***front*** connect switches, install the U-strap (place square hole side up), lug terminal, ring terminal, locking washer, and round head machine screw on the replacement switch assembly. Tighten to 28 to 32 in-lbs (3.2 to 3.6 N•m) torque.

   On ***rear*** connect switches, install the U-strap, contact strap, flat washer (1 of 2), round head machine screw, flat washer (2 of 2), and nut on the replacement switch assembly. Tighten screw to 28 to 32 in-lbs (3.2 to 3.6 N•m) torque.
2. Install the arc chute barriers (new), arc chutes (new), retainer barrier, and left and right phase barriers; and secure to switch assembly with pan head screws (2).
3. Hold switch assembly in position on base and check the alignment of the auxiliary switch lever. When the switch assembly is ***closed,*** the auxiliary switch lever must be aligned vertically as shown in Figures 14 and 15). Move auxiliary switch lever as required to get correct alignment.
4. Secure switch assembly to base with round head machine screws (2), locking washers (2), and flat washers (2). Tighten screw to 25 to 30 in-lbs (2.8 to 3.4 N•m).

Power Generation

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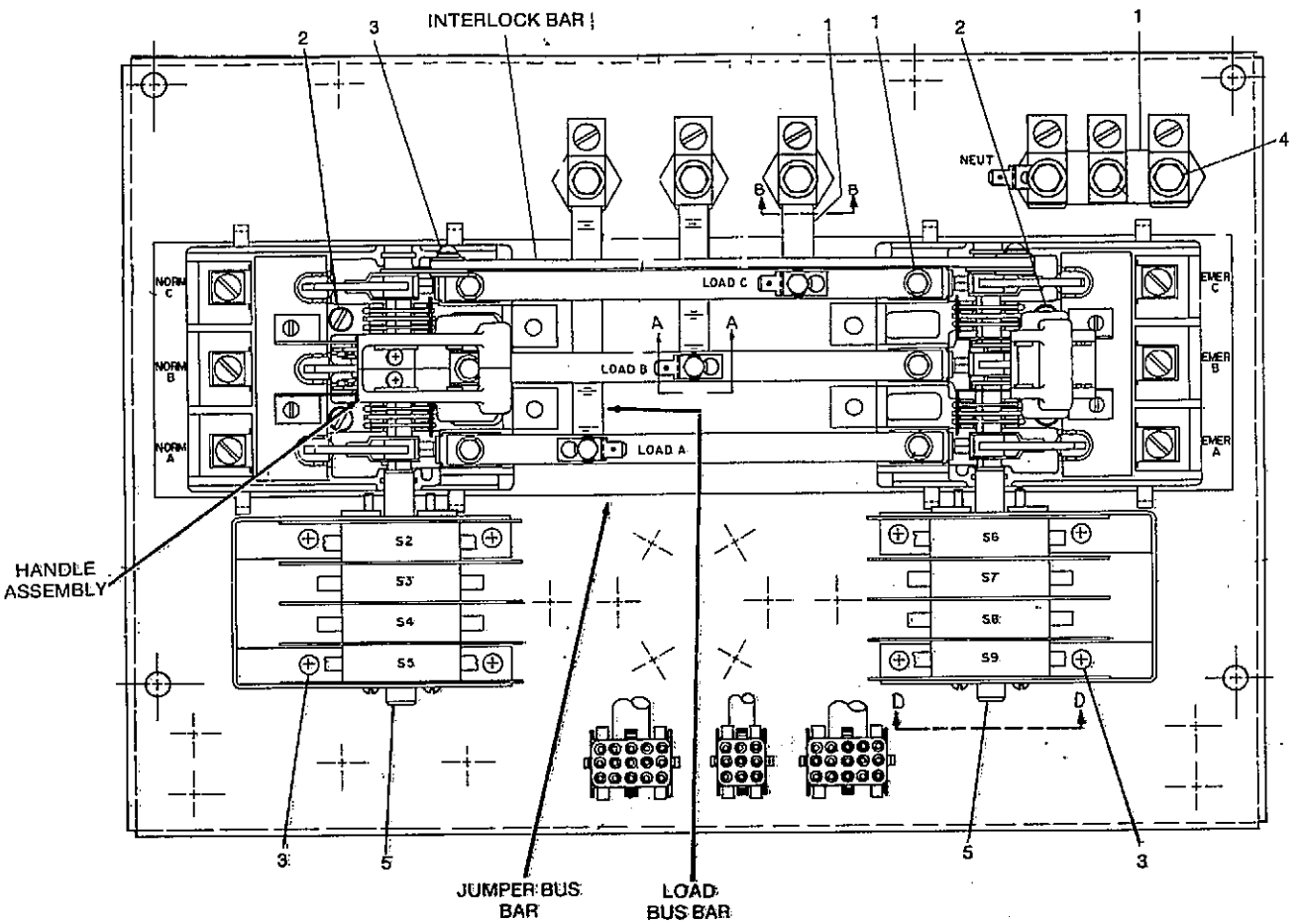
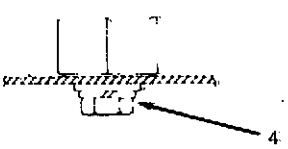
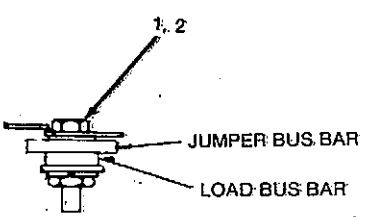
40-70-100 AMP MODEL

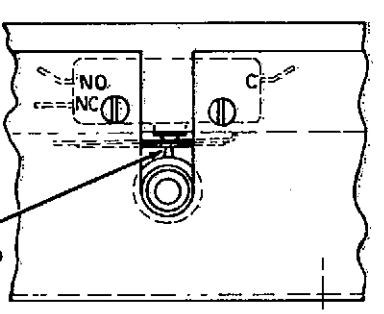




SECTION B-B



VIEW A-A



VIEW D-D
MAIN CONTACTS CLOSED

1 - PLACE THIN COAT (010 APPROX) OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE TO 25-30 IN. LBS.

3 - TORQUE TO 15-20 IN. LBS.

4 - TORQUE TO 70-75 IN. LBS.

5 - AUXILIARY SWITCH LEVER MUST TURN FREELY WITH OPERATION OF TRANSFER SWITCH.

FIGURE 14. FRONT CONNECT TRANSFER SWITCH ASSEMBLY

Power Generation

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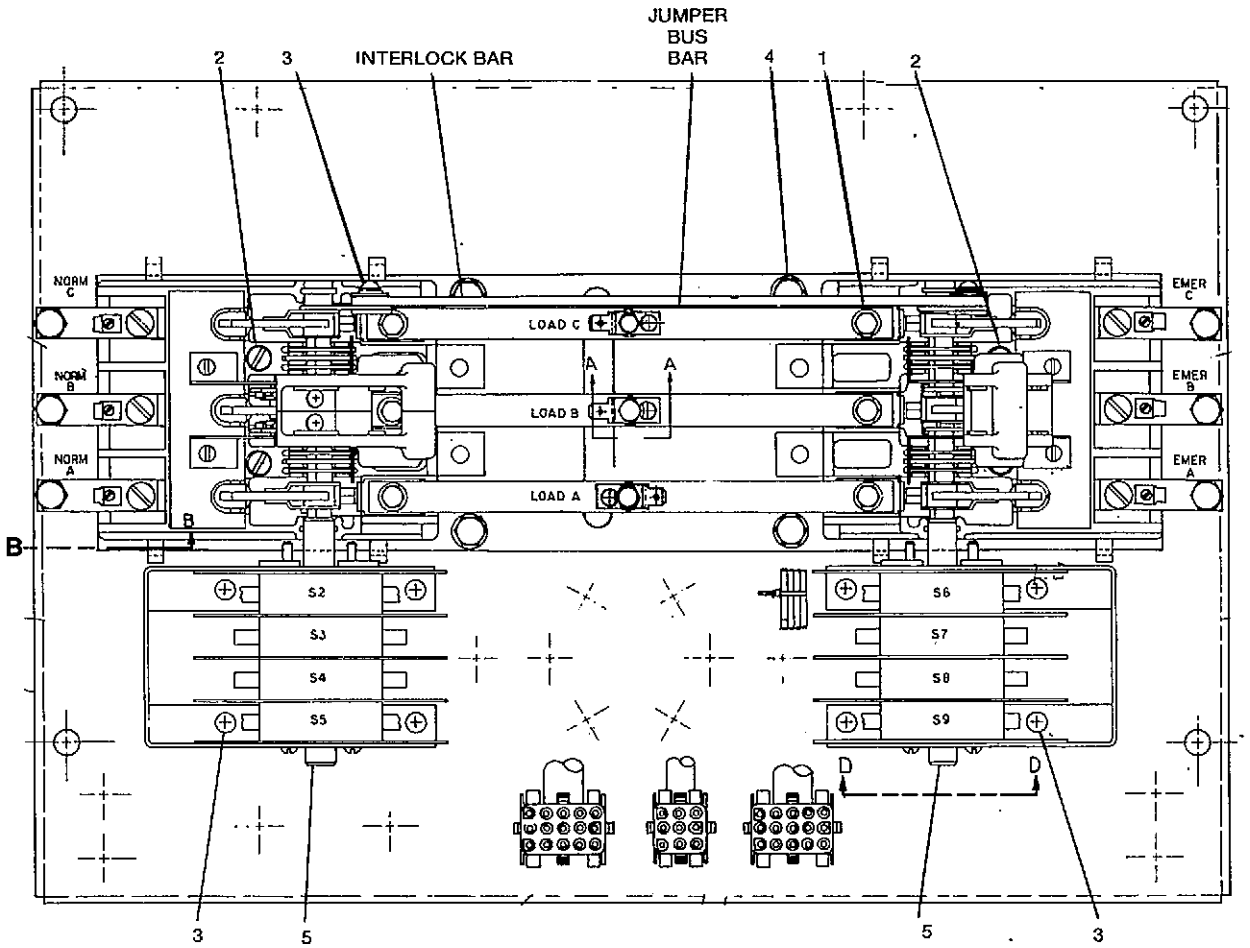
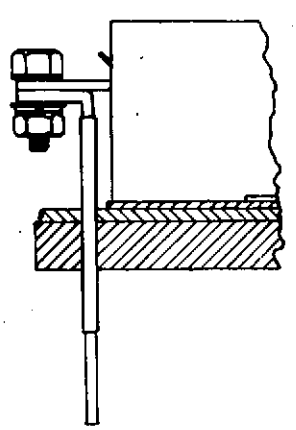
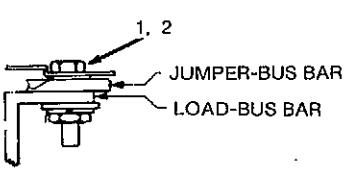
40-70-100 AMP MODEL



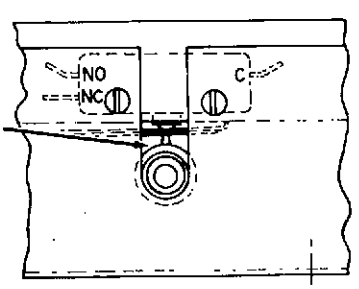


SECTION B-B



SECTION A-A

AUXILIARY SWITCH LEVER POSITION WHEN TRANSFER SWITCH IS CLOSED



VIEW D-D
MAIN CONTACTS CLOSED

1 - PLACE THIN COAT OF ELECTRICAL JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE TO 25-30 IN. LBS.

3 - TORQUE TO 15-20 IN. LBS.

4 - TORQUE TO 70-75 IN. LBS.

5 - AUXILIARY SWITCH LEVER MUST TURN FREELY WITH OPERATION OF TRANSFER SWITCH

FIGURE 15. REAR CONNECT TRANSFER SWITCH ASSEMBLY

Power Generation

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40-70-100 AMP MODEL

1 - APPLY THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING PARTS

2 - TORQUE TO 28 - 32 IN. LBS.

3 - TORQUE TO 16 - 20 IN. LBS.

4 - TORQUE TO 70 - 75 IN. LBS.

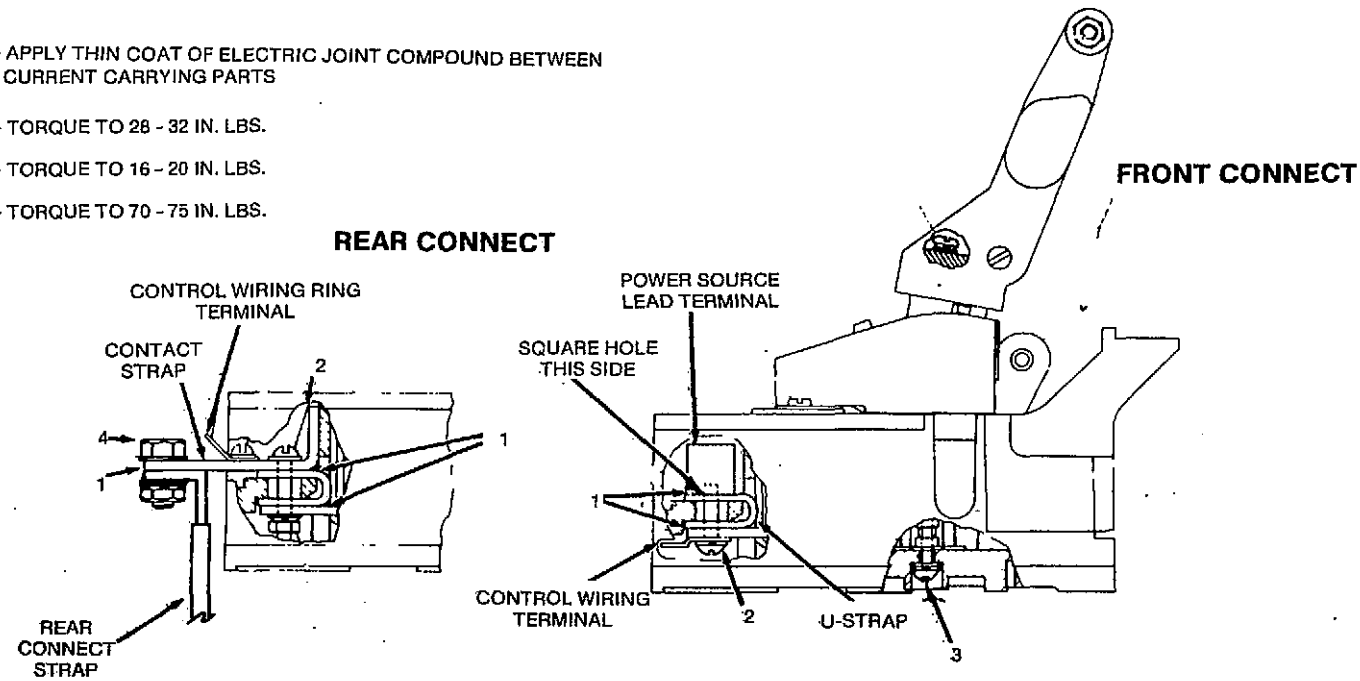

FIGURE 16. FRONT AND REAR CONNECT SWITCH ASSEMBLY

5. On ***front*** connect switches, install the power source supply wires and securely tighten the lug terminals.

   On ***rear*** connect switches, apply a thin coat of electric joint compound between the current carrying surfaces of the contact strap and rear connect strap (see Figure 16). Secure with hex head machine screw, spring washer, flat washer, lock washer, and nut. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
6. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A,B,C or EMER A,B,C for identification.
7. Apply a thin coat of electric joint compound between the mating surfaces of the jumper bus bars, braided strap connector, and load bus bars.
8. Install the jumper bus bars and secure to the switch assemblies with hex head machine screws and spring washers. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
9. Secure the jumper bus bars to each load bus bar using a hex head machine screw, ring terminal, flat washer, lock washer, and nut. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N •m) torque.
10. Connect the control wiring leads to the corresponding jumper bus bar terminal. Control wires are marked LOAD A,B,C, for identification.
11. Place the handle assembly in position on the switch assembly and secure with pan head screws (2), locking washers (2), and flat washers (2).
12. Install the interlock bar and secure to each interlock arm with a round head machine screw, locking washer, small flat washer, and large flat washer. Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.

Power Generation

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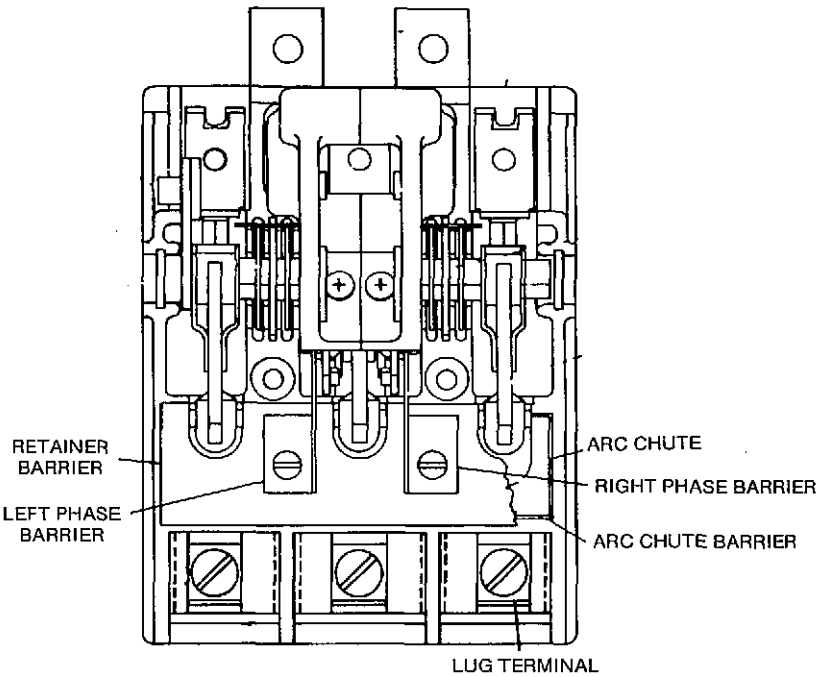

FIGURE 17. INSULATING BARRIERS AND ARC CHUTES

13. Replace the linear actuator as described in Linear Actuator Removal And Replacement section for 40 to 100 Ampere switches. Follow steps 2 through 8 in the Replacing Actuator section.
14. Test switch for proper operation and close cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (40-70-100 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch for 40 to 100 ampere switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, & J3 - Refer to Figure 12) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Remove the control wiring leads from the auxiliary switch terminals (see Figure 18).
4. Remove the round head machine screws that secure the auxiliary switch assembly bracket to the base.
5. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly.

⚠CAUTION ***Use care when disengaging switch lever from crossbar to avoid cracking the switch lever.***

Power Generation
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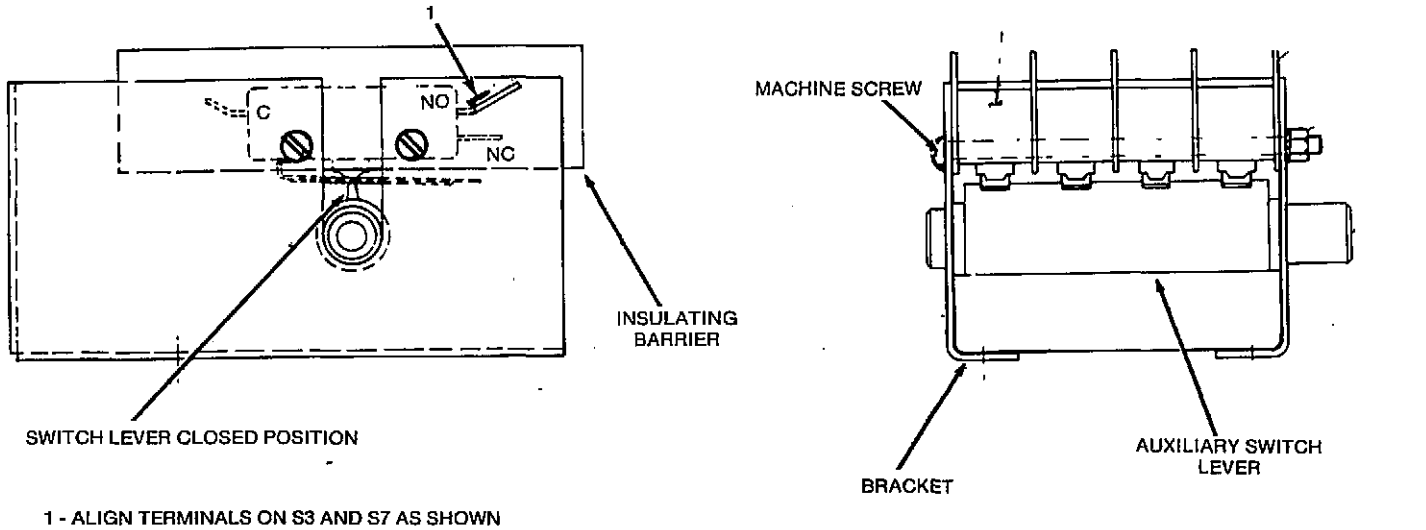
40-70-100 AMP MODEL



1 - ALIGN TERMINALS ON S3 AND S7 AS SHOWN

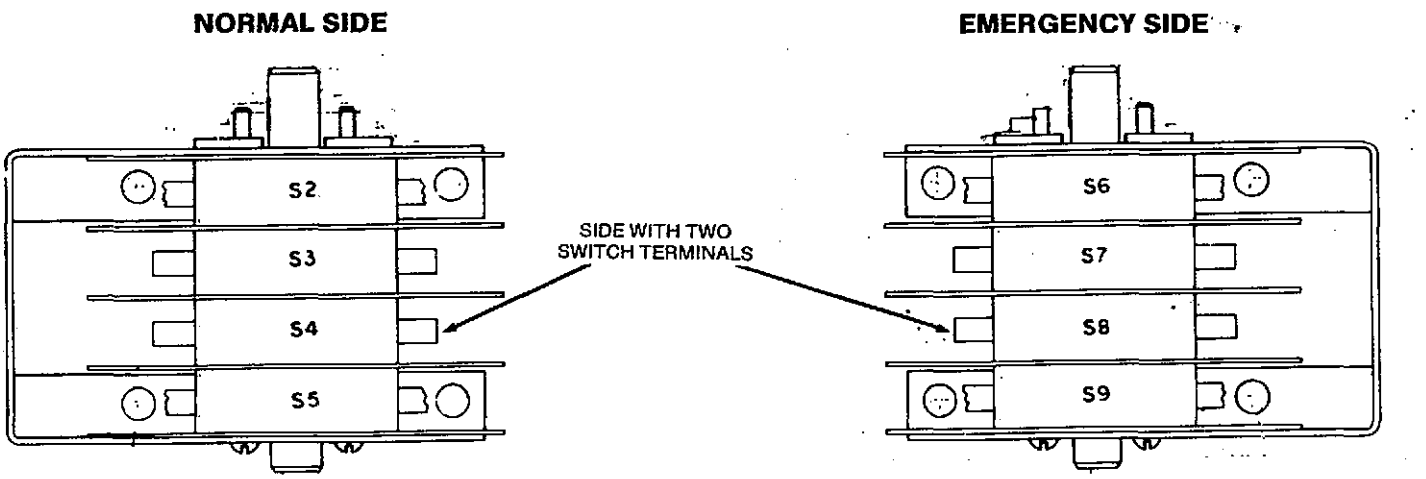


FIGURE 18. AUXILIARY SWITCHES

6. Remove the round head machine screws and nuts that secure the auxiliary switches to the bracket (see Figure 18); and lift out the four auxiliary switches, insulating barriers, and switch lever.

Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 18. Note that the end of the lever with the octagonal hole must engage the transfer switch cross bar when the auxiliary switch assembly is installed.
2. Install the auxiliary switches (4) and insulating barriers (5) in the bracket; and secure with round head machine screws (2) and nuts (2). Note that each switch must be assembled so the side with two terminals (see Figure 18) is facing the open end of the bracket.
3. Manually close the transfer switch that will be coupled to the auxiliary switch lever.
4. Hold the auxiliary switch assembly in position on the base (open end of bracket must face inward) and check alignment of the auxiliary switch lever. When the transfer switch assembly is ***closed,*** the auxiliary switch must be aligned as shown in Figure 18. Move auxiliary lever as required to get correct alignment.

Power Generation
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5. Secure bracket to base using round head machine screws and tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
6. Install control wiring leads on the corresponding switch terminals. Leads are marked with the terminal numbers (S2/N0, S7/NC, S9/C, etc.) for identification. Refer to Figure 18 for identification of auxiliary switch terminals.
7. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
8. Plug in the three control wiring harness plugs (J1, J2, J3,); and reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
9. Test switch for proper operation and close cabinet.

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (150-260 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for 150 - 260 Ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, & J3) - Refer to Figure 19) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Remove the screws and flat washers that secure the red plastic barrier to the switch base (see Figure 19); and lift out the barrier.
4. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
5. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
6. Disconnect the black actuator lead wire from the circuit breaker and disconnect the ground wire from the end of the actuator.
7. Remove the hex head capscrews, flat washers, and lock washers that secure the actuator to the switch assemblies (see Figure 19); and lift out the spacers (4) and barriers (2).
8. Disengage actuator rod from switch handle and remove actuator from switch assembly.
9. Remove one of the hex head capscrews and lock washers that secure the rod end assembly to the end of the actuator rod.
10. Remove rod end assembly from actuator rod (see Figure 20) and slide rod out of the actuator motor.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor (see Figure 20). Hold the actuator ground brush up slightly to allow passage of the actuator rod. Install the rod end assembly and tighten capscrew to 10 to 12 ft-lbs (13.6 to 16.3 N•m).

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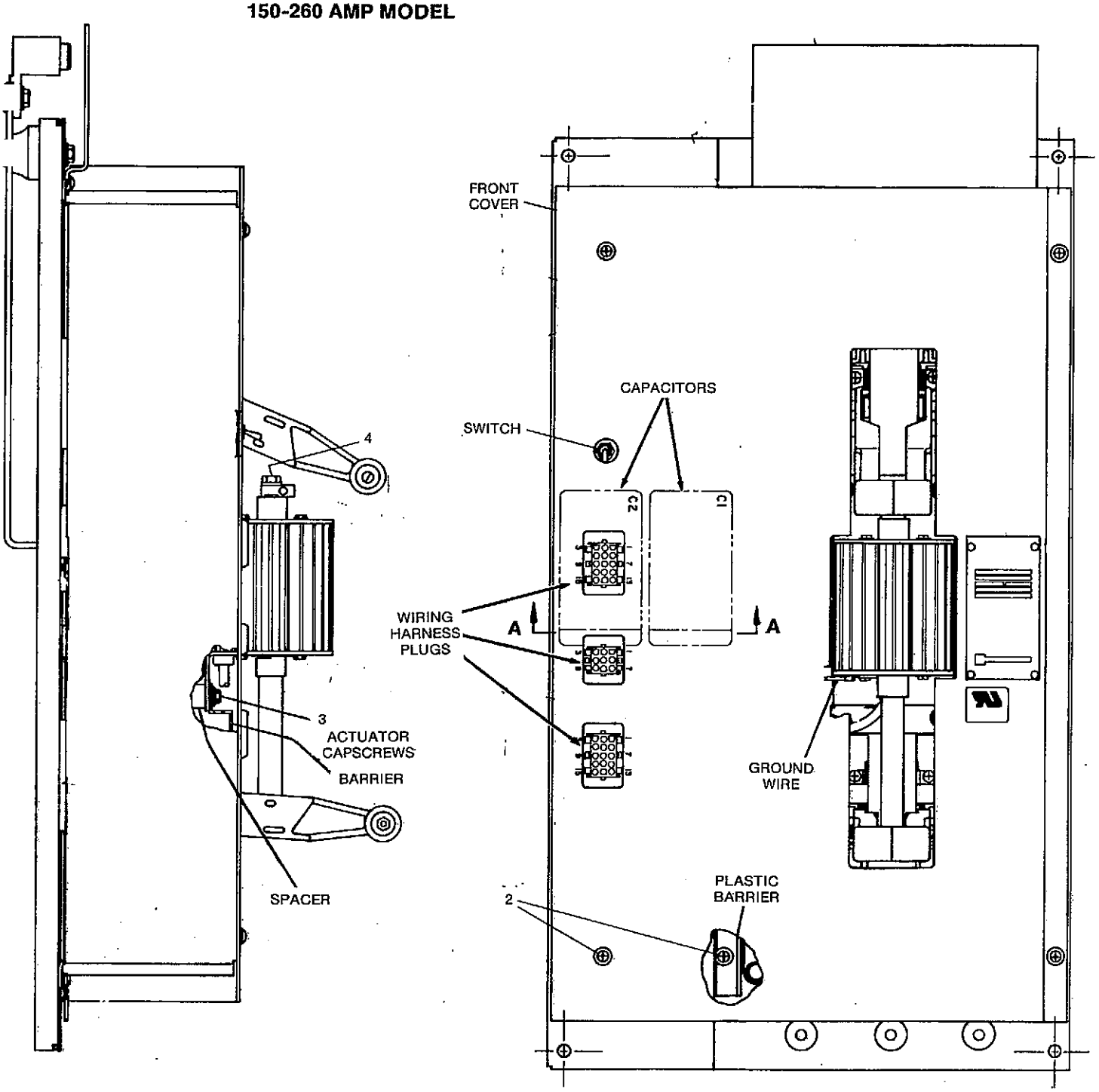
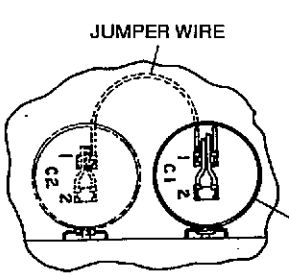
150-260 AMP MODEL





SECTION A-A

1 - TORQUE SHALL BE 10-15 IN-LBS FOR #6-32 SCREWS.

2 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS.

3 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS.

4 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS.

FIGURE 19. TRANSFER SWITCH FRONT COVER

Power Generation

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150-260 AMP MODEL

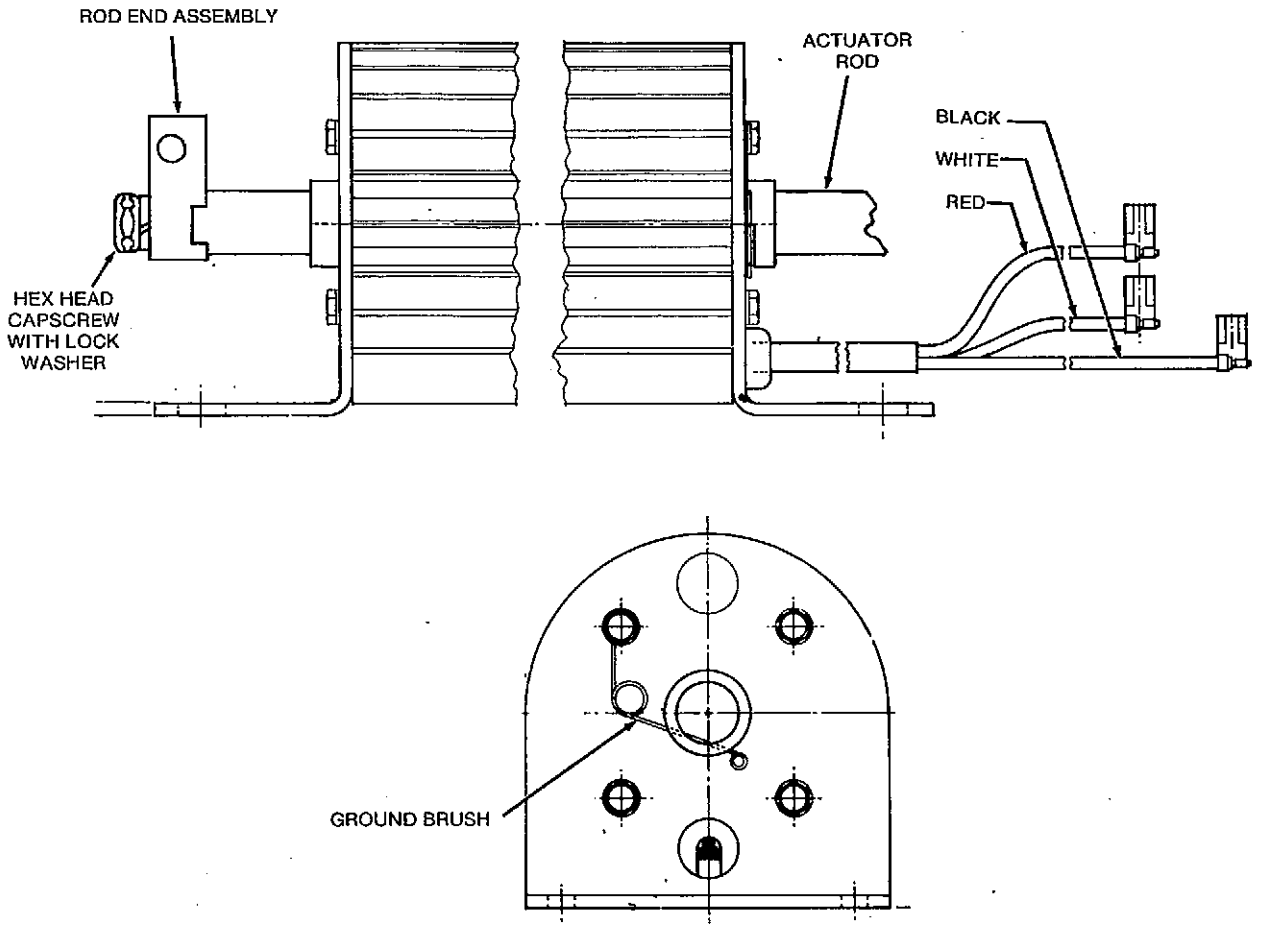

FIGURE 20. LINEAR ACTUATOR

2. Hold actuator motor in position over the switch assemblies so the lead wires are at the bottom; and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), flat washers (4), barriers (2), and spacers (4). Tighten capscrews to 70 to 75 in-lbs (7.9 to 8.5 N•m).
4. Connect the black actuator lead wire to the circuit breaker; and the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor C1 - Terminal 2.

   White Lead Wire - If one capacitor, connect to capacitor C1 - Terminal 1. If two capacitors, connect to capacitor C2 - Terminal 2.

   Transfer switches for voltage ranges 347, 380/416, 440/480 and 480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 1 on C1 and terminal 1 on C2.

5. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s).
6. Connect the ground wire to the end of the actuator. Use wire ties to hold actuator lead wires in place with rest of wiring harness.
7. Place the red plastic barrier in position and secure to the switch base with machine screws (2) and flat washers (2). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.

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8. Check operation of transfer switch and alignment of actuator rod by manually opening and closing both the normal and emergency switch assemblies.
9. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
10. Plug in the three control wiring harness plugs (J1, J2, and J3); and reconnect normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
11. Test switch for proper operation and close cabinet.

SWITCH ASSEMBLY REMOVAL AND REPLACEMENT (150 - 260 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the switch assemblies for 150 - 260 ampere switches.

1. Remove the linear actuator as described in Linear Actuator Removal and Replacement section for 150 to 260 Ampere switches. Follow steps 1 through 8 in the Removing Actuator section.
2. Remove the hex head capscrews, locking washers, and flat washers that secure the interlock bar to the interlock arm (Figures 21 and 22); and remove the interlock bar.
3. Remove the round head machine screws and mounting plate that secure the handle assembly to the switch assembly; and lift off the handle assembly (Figure 23).
4. Disconnect the control wiring leads from the jumper bus bars.
5. Remove the hex head capscrews, ring terminals, spring washers, flat washers, locking washers, and nuts that secure the jumper bus bars (see Figures 21 and 22) to the load bus bars.
6. Remove the hex head machine screws and spring washers that secure the jumper bus bars to the switch assemblies; and lift off the jumper bus bars.
7. Remove the control wiring leads from the power source terminals (see Figures 21 and 22).
8. On ***front*** connect switches, loosen the lug terminal screws and remove the power source supply wires from the lug terminals.

   On ***rear*** connect switches, remove the hex head capscrews, spring washers, flat washers, lock washers, and nuts that secure the contact strap (see Figure 22) to the rear connect strap.
9. Remove the four hex head capscrews, locking washers, and flat washers that secure the switch assembly to the base; and lift off the switch assembly.

⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch lever to avoid cracking the switch lever.***

10. Remove the two threaded hex spacers from the back of each switch assembly and save for reuse.
11. Remove the two round head machine screws that secure the interlock arm to the switch assembly; and lift off the interlock arm.

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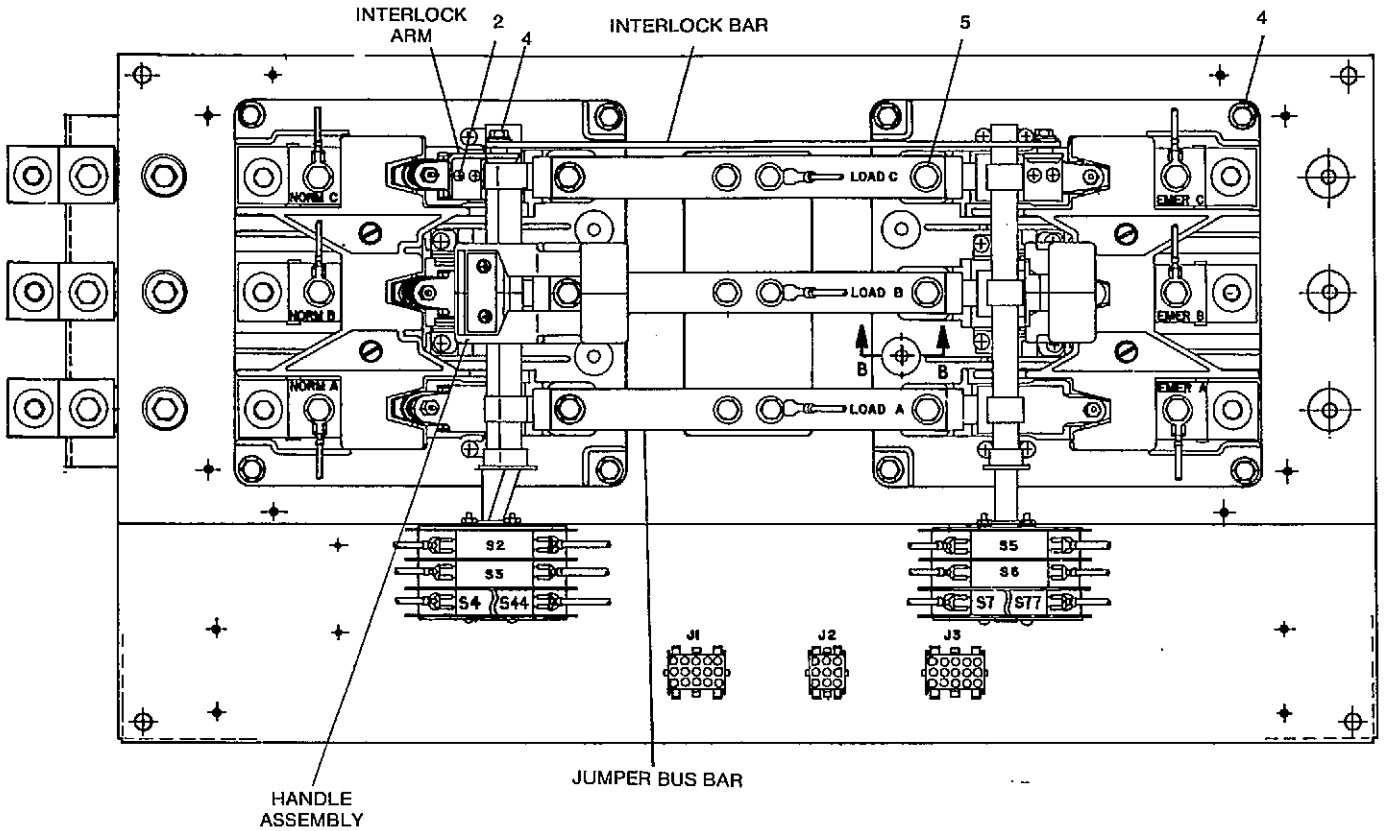
150-260 AMP MODEL



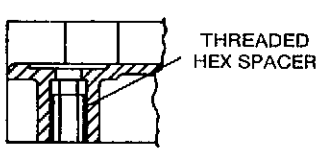
1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE SHALL BE 15-20 IN-LBS FOR #8-32 SCREWS

3 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

4 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

5 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS OR NUTS



SECTION B-B

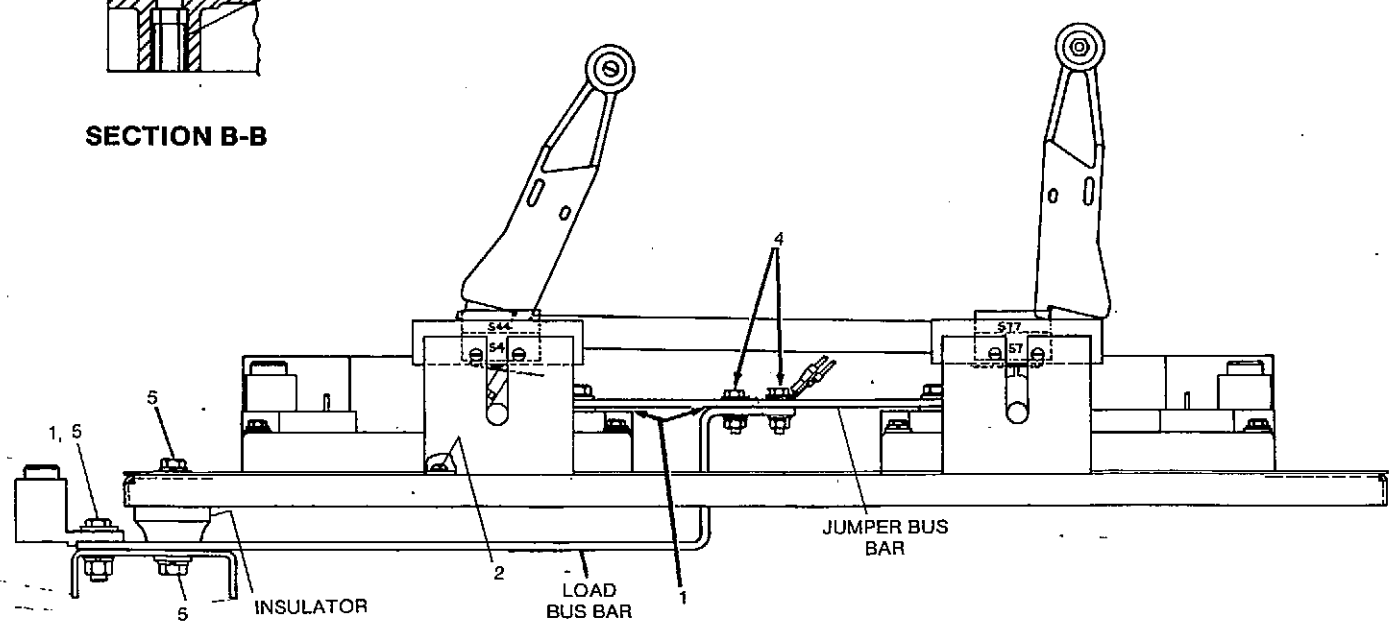


FIGURE 21. FRONT CONNECT TRANSFER SWITCH ASSEMBLY

Power Generation

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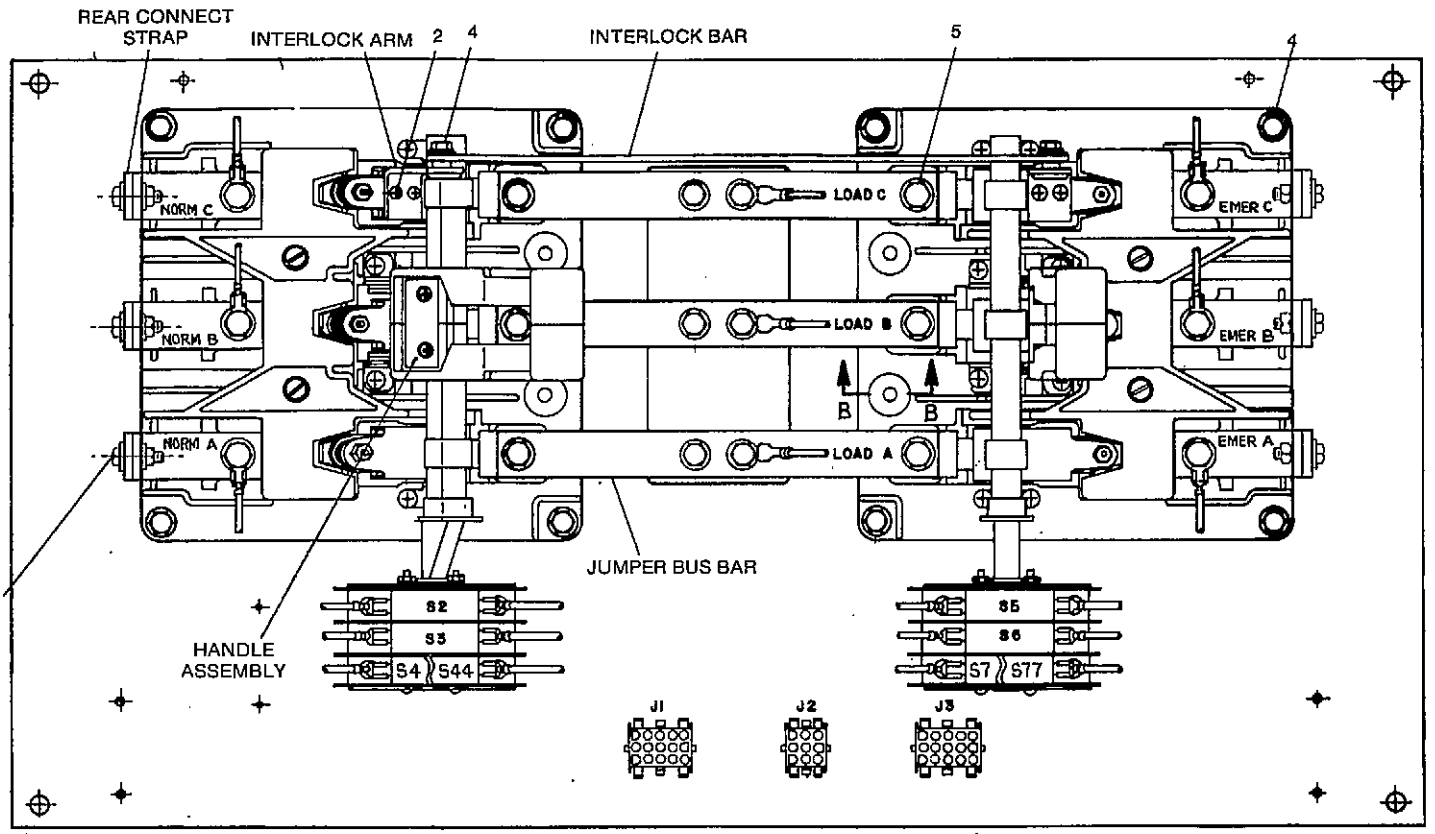
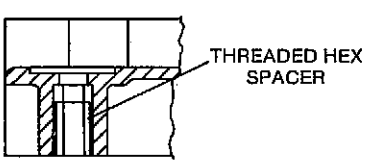
150-260 AMP MODEL





SECTION B-B

1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES.

2 - TORQUE SHALL BE 15-20 IN-LBS FOR #8-32 SCREWS.

3 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS.

4 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS.

5 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS OR NUTS.

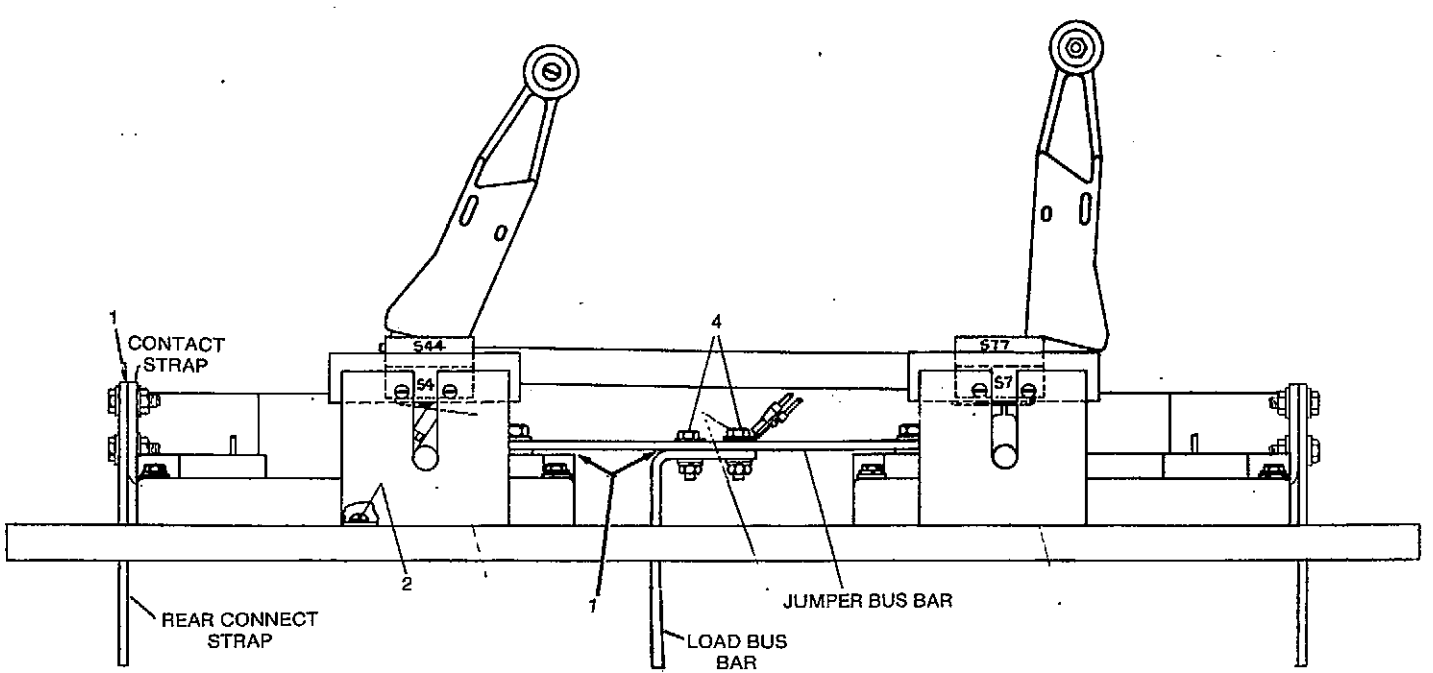


FIGURE 22. REAR CONNECT TRANSFER SWITCH ASSEMBLY

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150-260 AMP MODEL

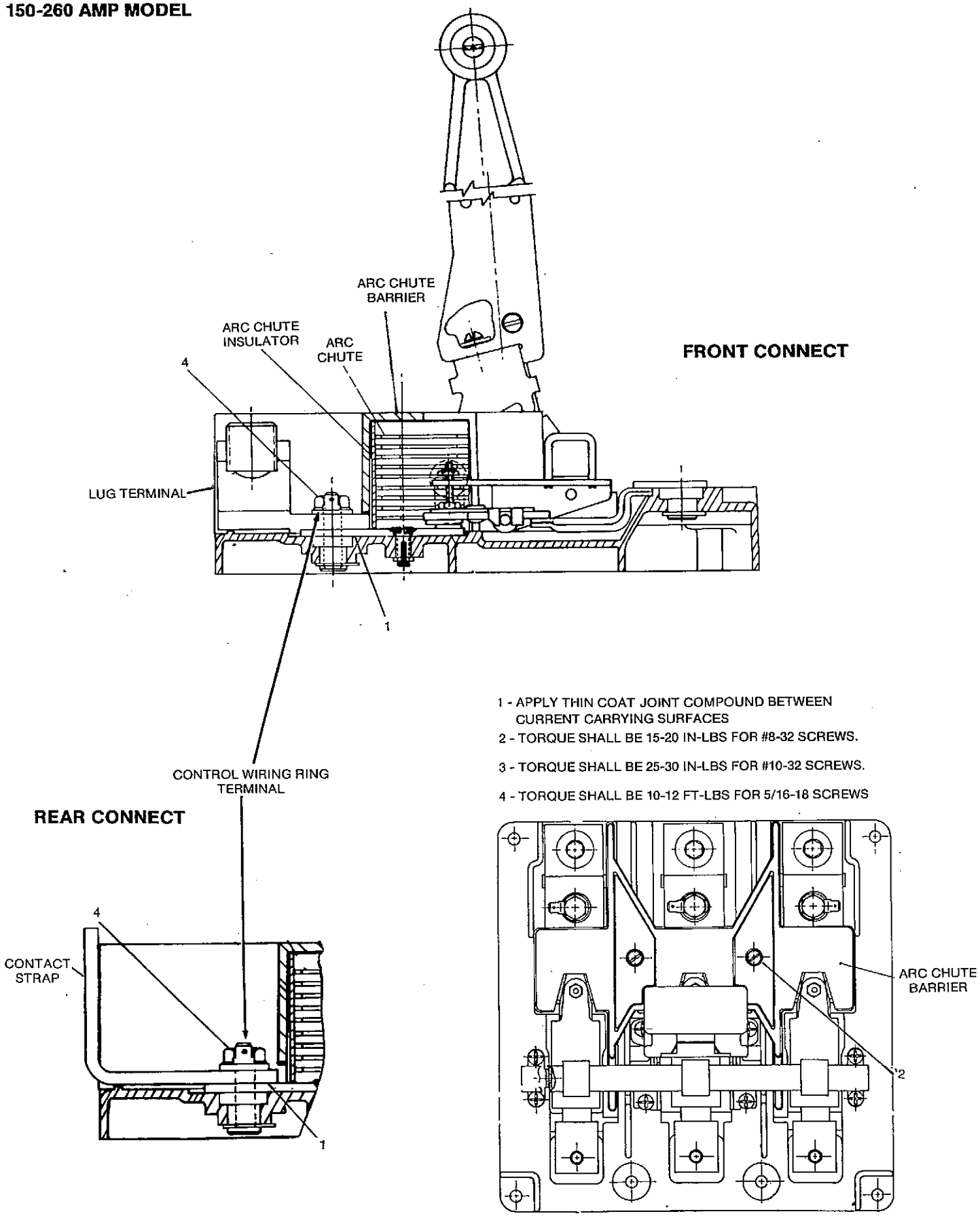

FIGURE 23. FRONT AND REAR CONNECT SWITCH ASSEMBLY

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12. Remove the round head machine screws, locking washers, and flat washers that secure the arc chute barrier (see Figure 23) to the switch assembly; and lift out the arc chute barrier, arc chutes, and arc chute insulators. Discard the arc chutes and arc chute insulators.
13. On ***front*** connect switches, remove the hex head capscrews, ring terminals, spring washers, and lug terminals from the switch assembly (see Figure 23).

    On ***rear*** connect switches, remove the hex head capscrews, ring terminals, spring washers, and contact strap from the switch assembly (see Figure 23).

Replacing Switch Assembly

1. Apply a thin coat of electric joint compound between the mating surfaces of the switch assembly and the lug terminal (front connect) or the switch assembly and contact strap (rear connect).

   On ***front*** connect switches, install the lug terminal and secure with hex head capscrews, ring terminal, and spring washer. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m).

   On ***rear*** connect switches, install the contact strap and secure the hex head capscrew, ring terminal, and spring washer. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.

2. Install the interlock arm and secure with hex head machine screws (2). Tighten screws to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
3. Install the arc chute insulators (new), arc chutes (new), and arc chute barrier; and secure with machine screws (2) locking washers (2) and flat washers. Tighten screws to 70 to 75 in-lbs (7.9 to 8.5 N•m).
4. Install the two threaded hex spacers in the back of each switch assembly.
5. Secure switch assembly to base with hex head capscrews (4), locking washers (4), and flat washers (4). Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
6. On ***front*** connect switches, install the power source supply wires and securely tighten the lug terminals.

   On ***rear*** connect switches, apply a thin coat of electric joint compound between the current carrying surfaces of the contact strap and rear connect strap (see Figure 22). Secure with hex head capscrew, spring washer, flat washer, locking washer, and nut. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
7. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A, B, C or EMER A, B, C for identification.
8. Apply a thin coat of electric joint compound between the current carrying surfaces of the jumper bus bars, the braided strap connectors, and load bus bars.
9. Install the jumper bus bars and secure to the switch assemblies with hex head capscrews and spring washers. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
10. Secure the jumper bus bars to each load bus bar using a hex head capscrew, ring terminal (lower row only), spring washer, and nut. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
11. Connect the control wiring leads to the corresponding jumper bus bar terminal. Control wires are marked LOAD A, B, C for identification.
12. Place the handle assembly in position on the switch assembly and secure with machine screws (2) and mounting plate.
13. Install the interlock bar and secure to each interlock arm with a hex head capscrew, locking washer, and flat washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
14. Replace the linear actuator as described in Linear Actuator Removal and Replacement section for 150 to 260 Ampere switches. Follow steps 2 through 10 in the Replacing Actuator section.
15. Test switch for proper operation and close cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (150 - 260 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

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⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch assembly for 150 to 260 Ampere switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, & J3 - Refer to Figure 19) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Remove the control wiring leads from the auxiliary switch terminals (see Figure 24).
4. Remove the round head machine screws that secure the auxiliary switch assembly bracket to the base.
5. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly.

⚠CAUTION ***Use care when disengaging switch lever from crossbar to avoid cracking the switch lever.***

6. Remove the round head machine screws and nuts that secure the auxiliary switches to the bracket (see Figure 24); and lift out the three auxiliary switches, insulating barriers, and switch lever.

Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 24.
2. Install the flat washers (4) insulating barriers (4), and auxiliary switches (3) in the bracket; and secure with round head machine screws (2) and nuts (2). Note that each switch must be assembled so the side with two terminals faces inward (see Figure 24) when the auxiliary switch assembly is installed on the base.
3. Hold the auxiliary switch assembly in position on base (side with two terminals must face inward) and secure bracket to base using round head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
4. Install control wiring leads on the corresponding switch terminals. Leads are marked with the terminal numbers (S2/NO, S5/NC, S7/C, etc.) for identification. Refer to Figure 24 for identification of auxiliary switch terminals.
5. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. Plug in the three control wiring harness plugs (J1, J2, J3); and reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.

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150-260 AMP MODEL

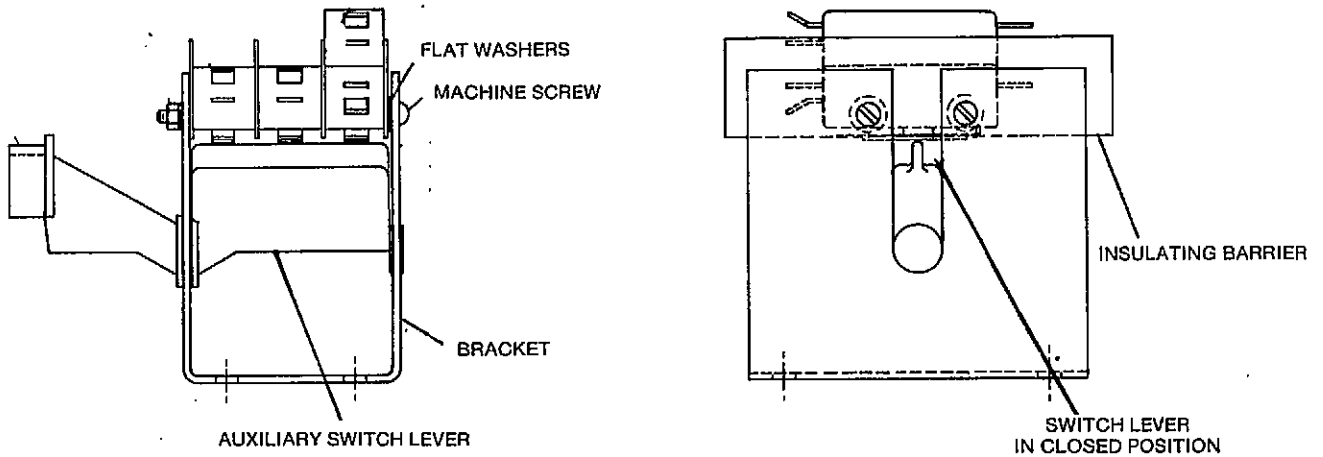

FIGURE 24. AUXILIARY SWITCHES

7. Test switch for proper operation and close cabinet.

LINEAR ACTUATOR REMOVAL AND REPLACEMENT (400 - Amperes - Spec E)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

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⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for the 400 Ampere (Spec E) switch.

Removing Actuator

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2 & J3 - Refer to Figure 25) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
4. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
5. Disconnect the black actuator lead wire from the circuit breaker and the ground wire from the end of the actuator.
6. Remove the hex head capscrews, flat washers, lock washers and nuts that secure the actuator to the switch assemblies (see Figure 25); and lift out the spacers (4) and barriers (2).
7. Disengage actuator rod from switch handle and remove actuator from switch assembly.
8. Remove one of the hex head capscrews and lock washer that secure the rod end assemblies to the end of the actuator rod.
9. Remove rod end assembly (see Figure 26) and slide actuator rod out of the actuator motor.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor (see Figure 26). Hold the actuator ground brush up slightly to allow passage of the actuator rod. Install the rod end assembly and tighten capscrew to 10 to 12 ft-lbs (13.6 to 16.3 N•m).
2. Hold actuator motor in position over the switch assemblies so the lead wires are at the bottom; and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), flat washers (4), barriers (2), and spacers (4). Tighten capscrews to 70 to 75 in-lbs (7.9 - 8.5 N•m).
4. Connect the black actuator lead wire to the circuit breaker; and the red and white actuator lead wires to the following capacitor terminals:

   Red Lead Wire - Connect to capacitor C1 - Terminal 2.

   White Lead Wire - If one capacitor, connect to capacitor C1 - Terminal 1. If two capacitors, connect to capacitor C2 - Terminal 2.

   Transfer switches for voltage ranges 347, 380/416, and 440/480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 1 on C1 and terminal 1 on C2.

5. Replace the capacitor end cap(s) and install the capacitor(s) in the bracket(s).
6. Connect the ground wire to the end of the actuator. Use wire ties to hold actuator lead wires in place with rest of wiring harness.
7. Check operation of transfer switch and alignment of actuator rod by manually opening and closing both the normal and emergency switch assemblies.

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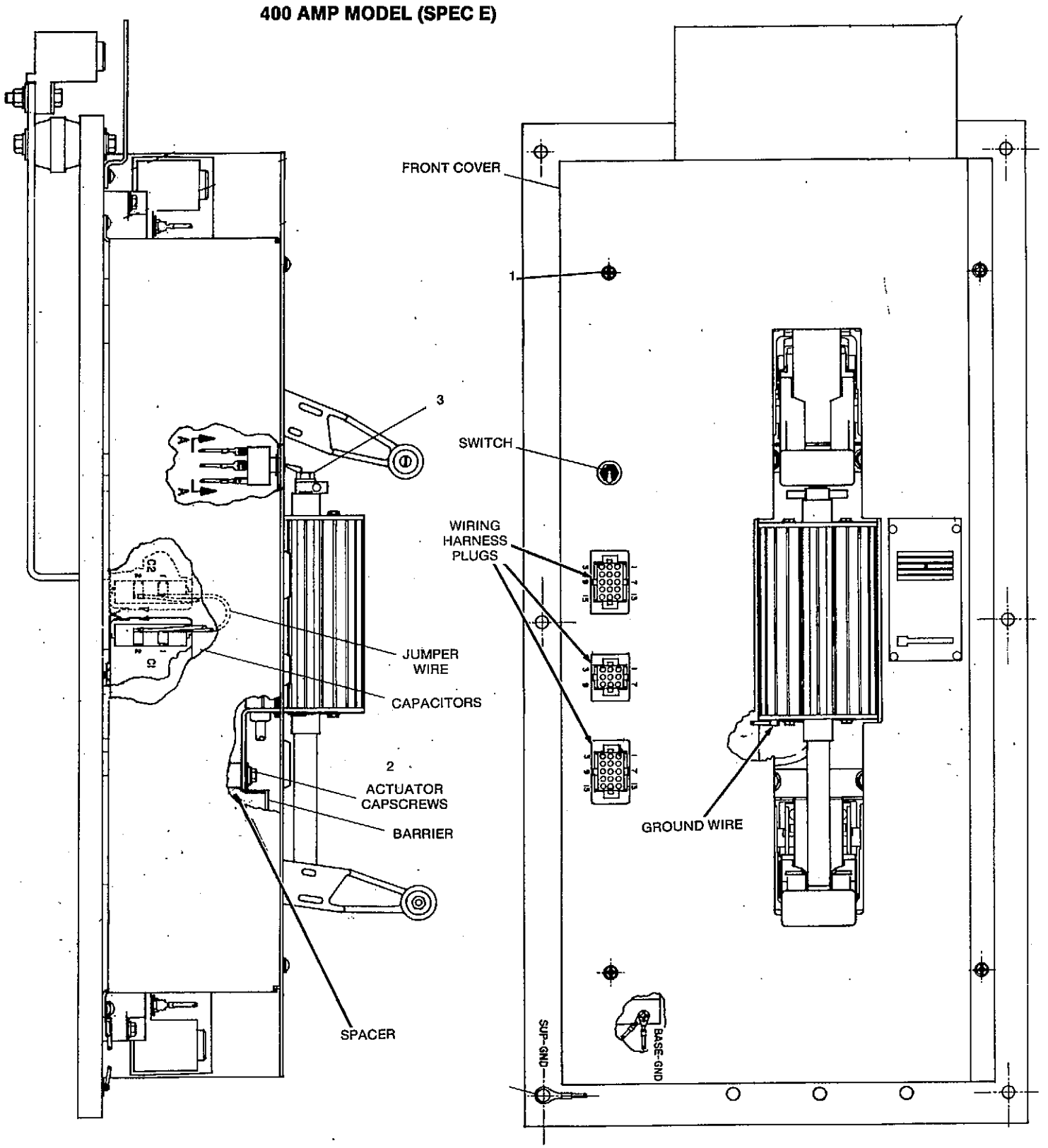

1 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

2 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

3 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS

FIGURE 25. TRANSFER SWITCH FRONT COVER

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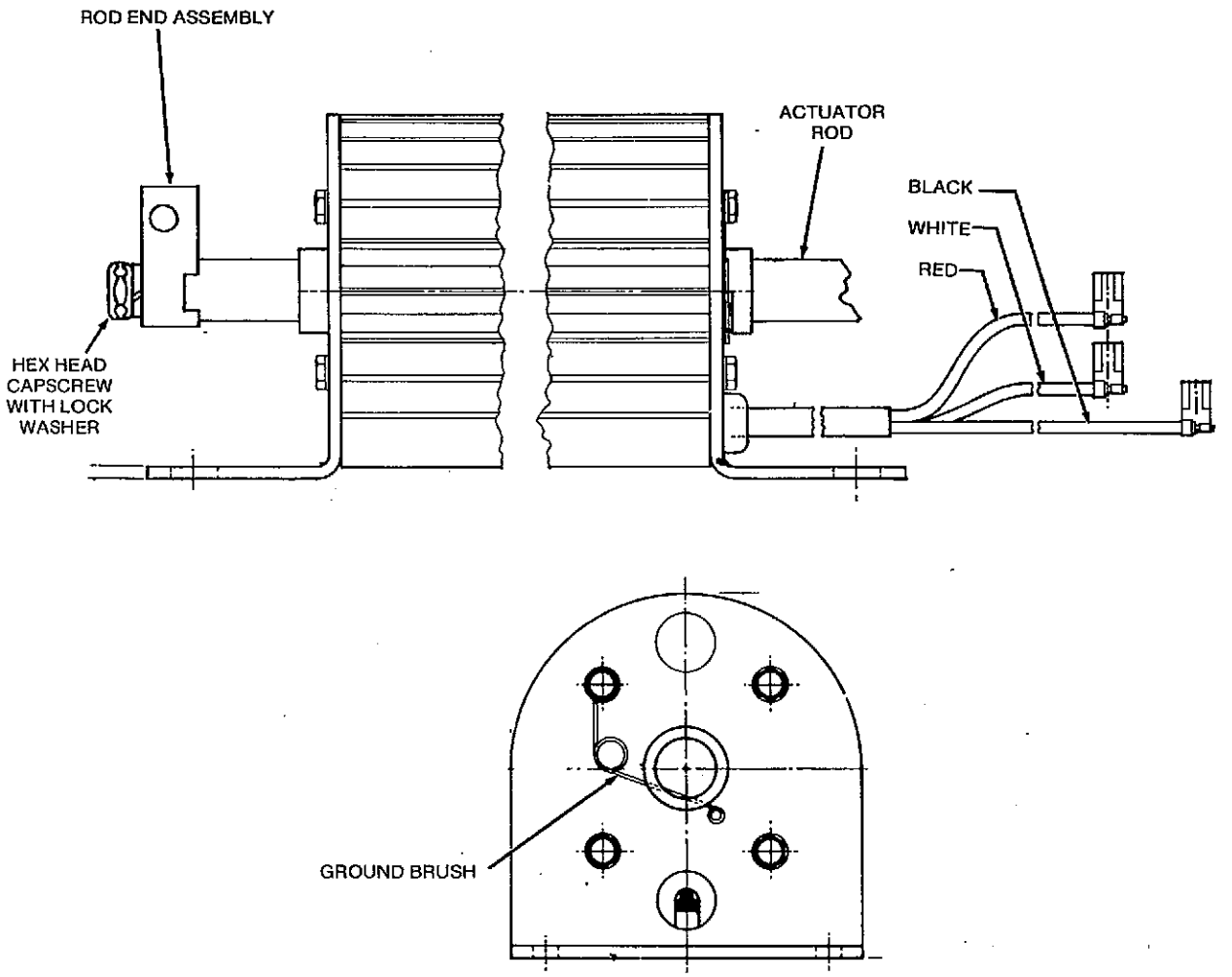

FIGURE 26. LINEAR ACTUATOR

8. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
9. Plug in the three control wiring harness plugs (J1, J2, and J3); and reconnect normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
10. Test switch for proper operation and close cabinet.

SWITCH ASSEMBLY REMOVAL AND REPLACEMENT (400 Amperes - Spec E)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel on two wire start systems and on the transfer switch control panel on three wire start systems.

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⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the switch assemblies for 400 Ampere (Spec E) switches.

Removing Switch Assembly (Normal or Emergency)

1. Remove the linear actuator as described in Linear Actuator Removal and Replacement section for 400 Ampere (Spec E) switches. Follow steps 1 through 7 in the Removing Actuator section.
2. Remove the hex head capscrews, locking washers, and flat washers that secure the interlock bar to the interlock arm (Figures 27 and 28); and remove the interlock bar.
3. Disconnect the control wiring leads from the jumper bus bars.
4. Remove the hex head capscrews, ring terminals, spring washers, flat washers, locking washers, and nuts that secure the jumper bus bars (see Figure 27 and 28) to the load bus bars.
5. Remove the hex head nuts and spring washers that secure the jumper bus bars to the switch assemblies; and lift off the jumper bus bars.
6. Remove the control wiring leads from the power source terminals (see Figures 27 and 28).
7. On ***front*** connect switches, loosen the lug terminal screws and remove the power source supply wires from the lug terminals.

   On ***rear*** connect switches, remove the hex head capscrews, flat washers, spring washers, and nuts that secure the contact strap (see Figure 28) to the rear connect strap.

8. Remove the four hex head capscrews, locking washers, and flat washers that secure the switch assembly to the base; and lift off the switch assembly.

⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch lever to avoid cracking the switch lever.***

9. Remove the hex head capscrews (used to secure jumper bus bars), locking washers, flat washers, spacer bushings, and jam nuts from the back of the switch assembly and save for reuse.
10. Remove the hex head capscrew and spring washer that secure the interlock arm to the switch assembly; and lift off the interlock arm.
11. Remove the nuts, locking washers, and flat washers that secure the arc chute barrier (see Figure 29) to the switch assembly; and lift out the arc chute barrier, arc chutes, and arc chute insulators. Discard the arc chutes and arc chute insulators.
12. Remove the shoulder screws and locking washers that secure the handle assembly to the switch assembly; and lift off the handle assembly (see Figure 29).
13. On ***front*** connect switches, remove the hex head capscrews, ring terminals, spring washers, and lug terminals from the switch assembly (see Figure 29).

    On ***rear*** connect switches, remove the hex head capscrews, ring terminals, spring washers, and contact strap from the switch assembly (see Figure 29).

14. Remove the two hex head machine screws (used to secure arc chute barrier), locking washers, flat washers, and nuts from the switch assembly. Save for reuse.

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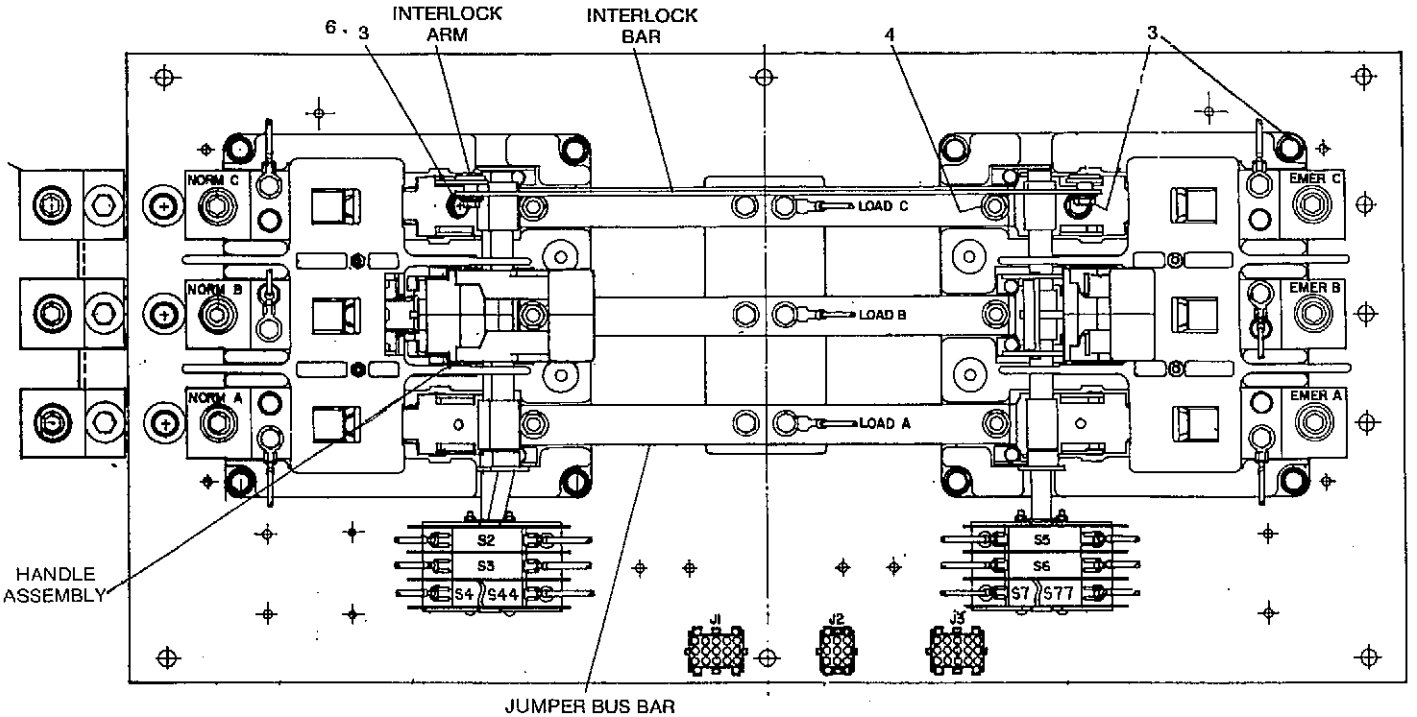
400 AMP MODEL (SPEC E)



1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

3 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

4 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS

5 - TORQUE SHALL BE 18-20 FT-LBS FOR 3/8-16 SCREWS

6 - PLACE A THIN COAT OF THREAD SEALANT TO THREADS OF SCREW THEN TORQUE AS NOTED

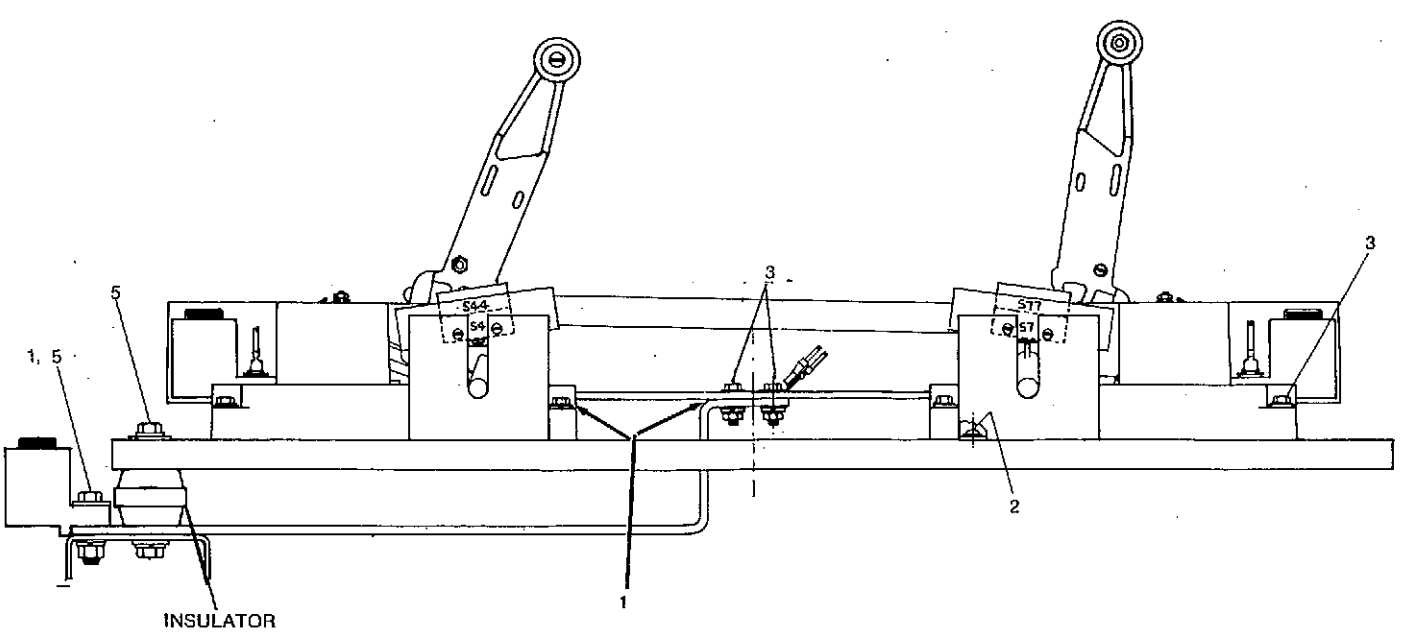


FIGURE 27. FRONT CONNECT TRANSFER SWITCH ASSEMBLY

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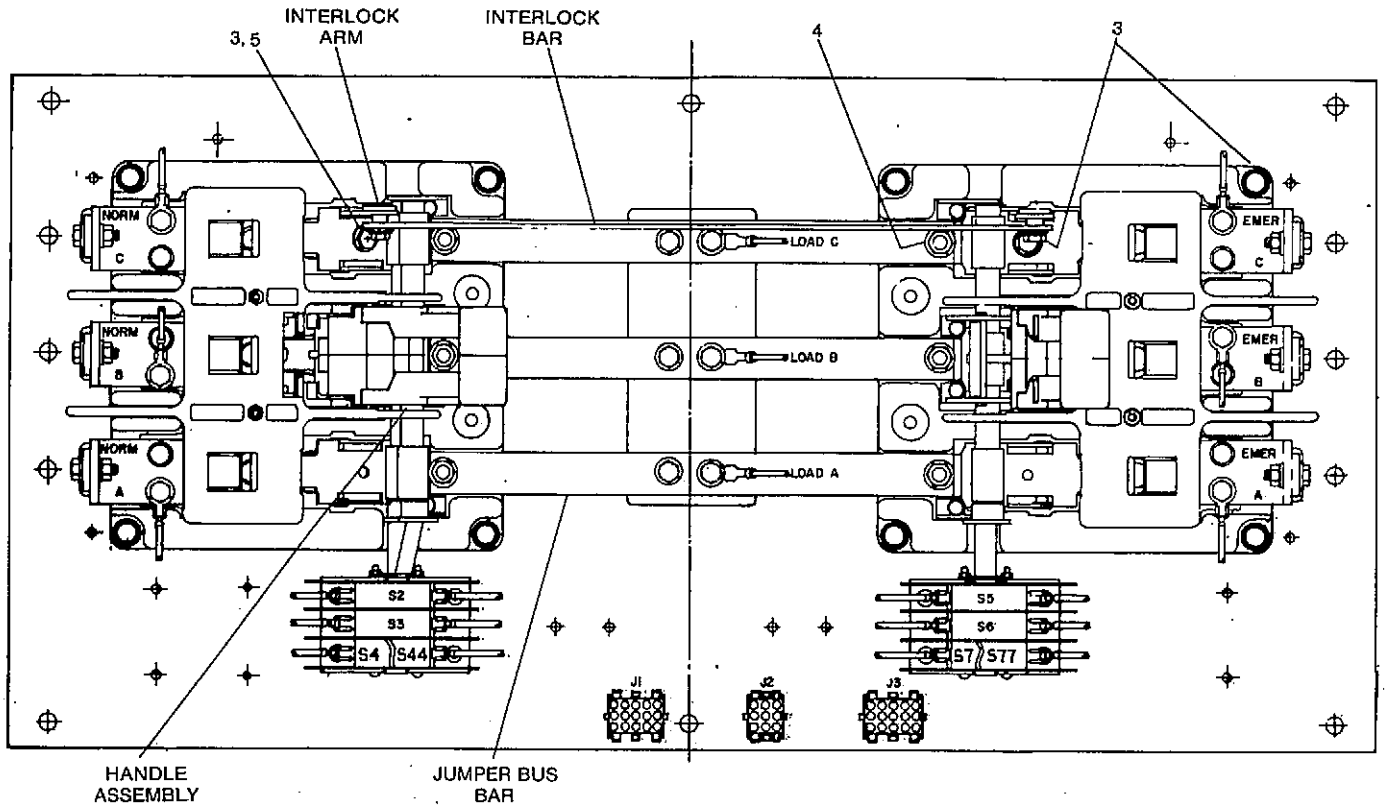
400 AMP MODEL (SPEC E)



1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES.

2 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

3 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS.

4 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS.

5 - PLACE A THIN COAT OF THREAD SEALANT TO THREADS OF SCREW THEN TORQUE AS NOTED

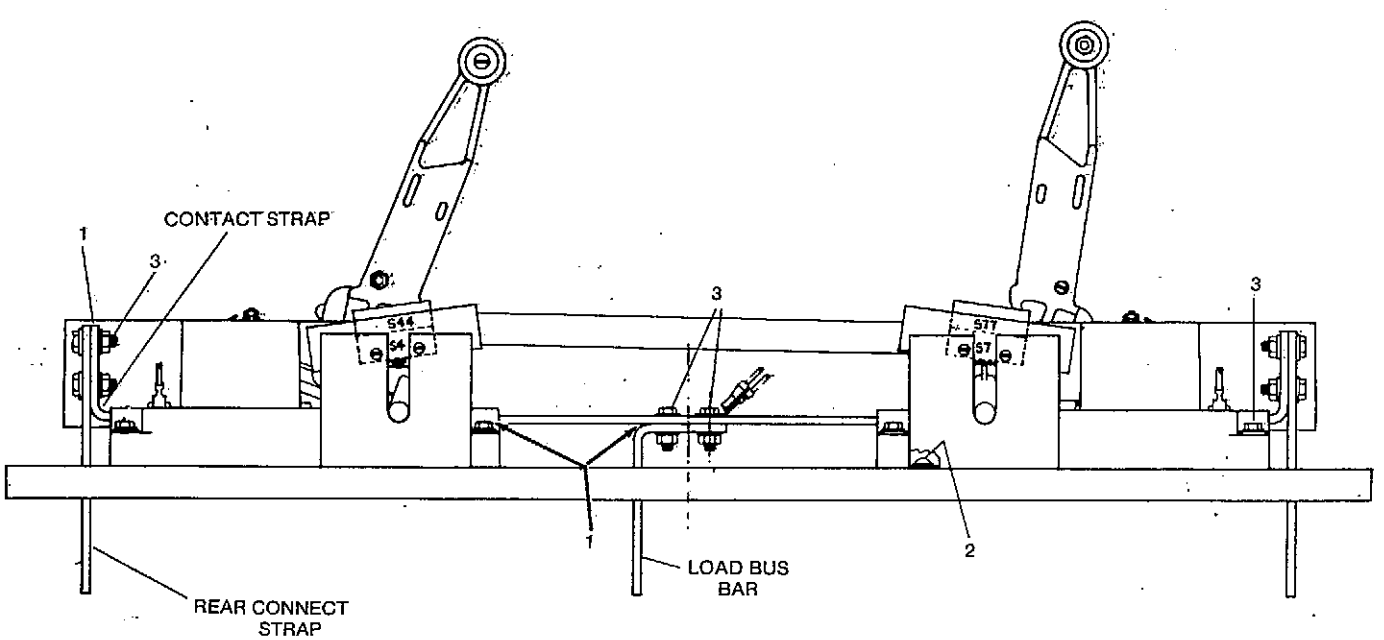


FIGURE 28. REAR CONNECT TRANSFER SWITCH ASSEMBLY

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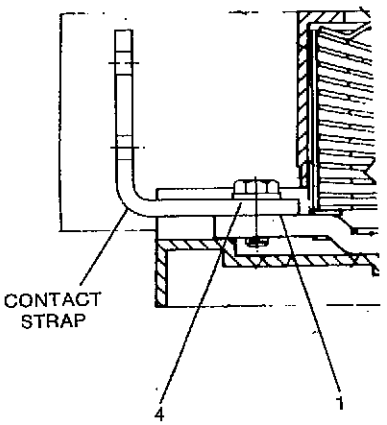
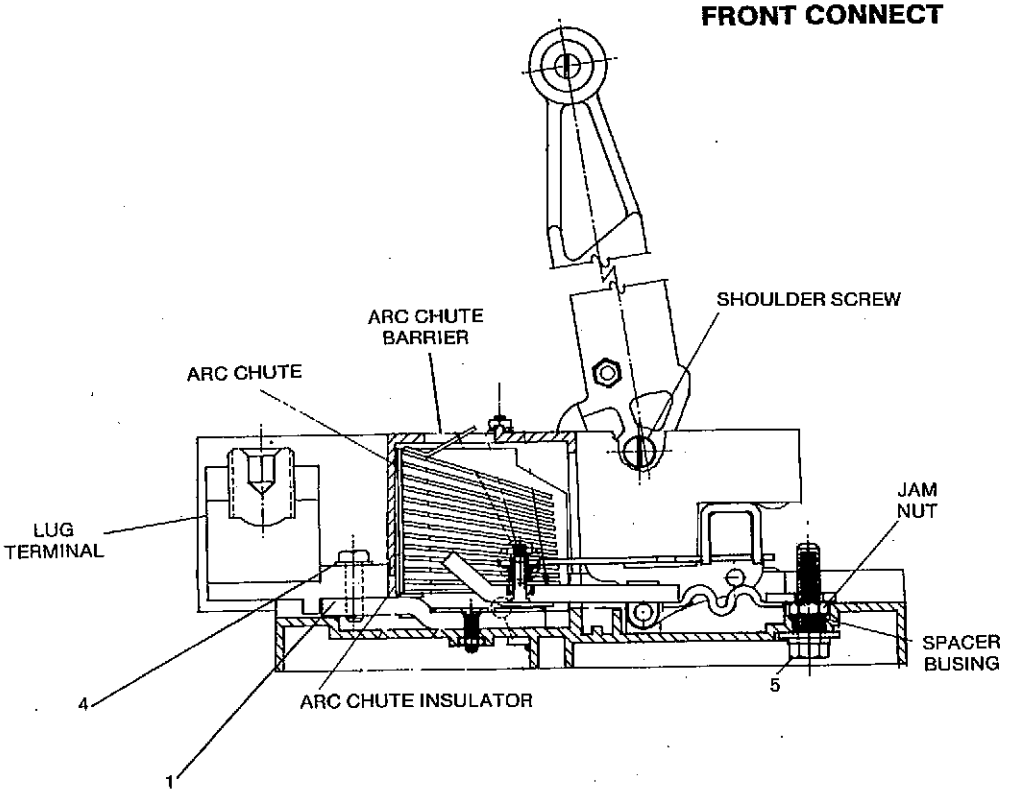
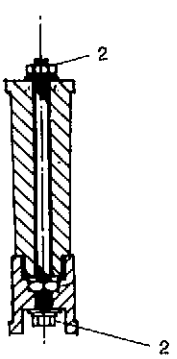
400 AMP MODEL (SPEC E)

REAR CONNECT

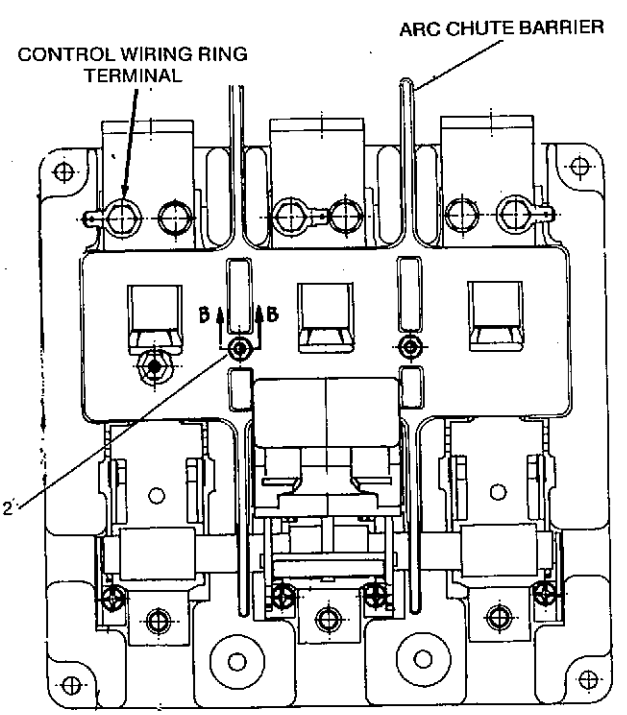


FRONT CONNECT





SECTION B-B



1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES.

2 - TORQUE SHALL BE 15-20 IN-LBS FOR #8-32 SCREWS

3 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

4 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

5 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS OR NUTS

FIGURE 29. FRONT AND REAR CONNECT SWITCH ASSEMBLY

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Replacing Switch Assembly (Normal or Emergency)

1. Apply a thin coat of electric joint compound between the mating surfaces of the switch assembly and the lug terminal (front connect) or the switch assembly and contact strap (rear connect).

   On ***front*** connect switches, install the lug terminal and secure with the hex head capscrews, ring terminal, and spring washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.

   On ***rear*** connect switches, install the contact strap and secure with hex head capscrew, ring terminal, and spring washer. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
2. Install the hex head machine screws (used to secure arc chute barrier), locking washers (2), flat washers (2), and nuts in the switch assembly base. Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
3. Place the handle assembly in position on the switch assembly and secure with shoulder screws (2) and locking washers (2).
4. Install the arc chute insulators (new), arc chutes (new), and arc chute barrier; and secure with nuts (2), locking washers (2) and flat washers (2). Tighten nuts to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
5. Apply thread sealant to the threads of the interlock arm capscrew. Install the interlock arm to the switch assembly and secure with capscrew and spring washer. Tighten to 70 to 75 in. lbs. (7.9 to 8.5 N•m) torque.
6. Install the hex head capscrews (used to secure the jumper bus bars), locking washers, flat washers, spacer bushings, and jam nuts in the switch assembly base. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
7. Secure switch assembly to base with hex head capscrews (4), locking washers (4), and flat washers (4). Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
8. On ***front*** connect switches, install the power source supply wires and securely tighten the lug terminals. On ***rear*** connect switches, apply a thin coat of electric joint compound between the current carrying surfaces of the contact strap and rear connect strap (see Figure 28). Secure with hex head capscrew, spring washer, flat washer, locking washer, and nut. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
9. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A,B,C or EMER A,B,C for identification.
10. Apply a thin coat of electric joint compound between the current carrying surfaces of the jumper bus bars, the braided strap connectors, and load bus bars.
11. Install the jumper bus bars and secure to the switch assemblies with hex head capscrews and spring washers. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m).
12. Secure the jumper bus bars to each load bus bar using a hex head capscrew, ring terminal (lower row only), spring washer, and nut. Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.
13. Connect the control wiring leads to the corresponding jumper bus bar terminal. Control wires are marked LOAD A,B,C for identification.

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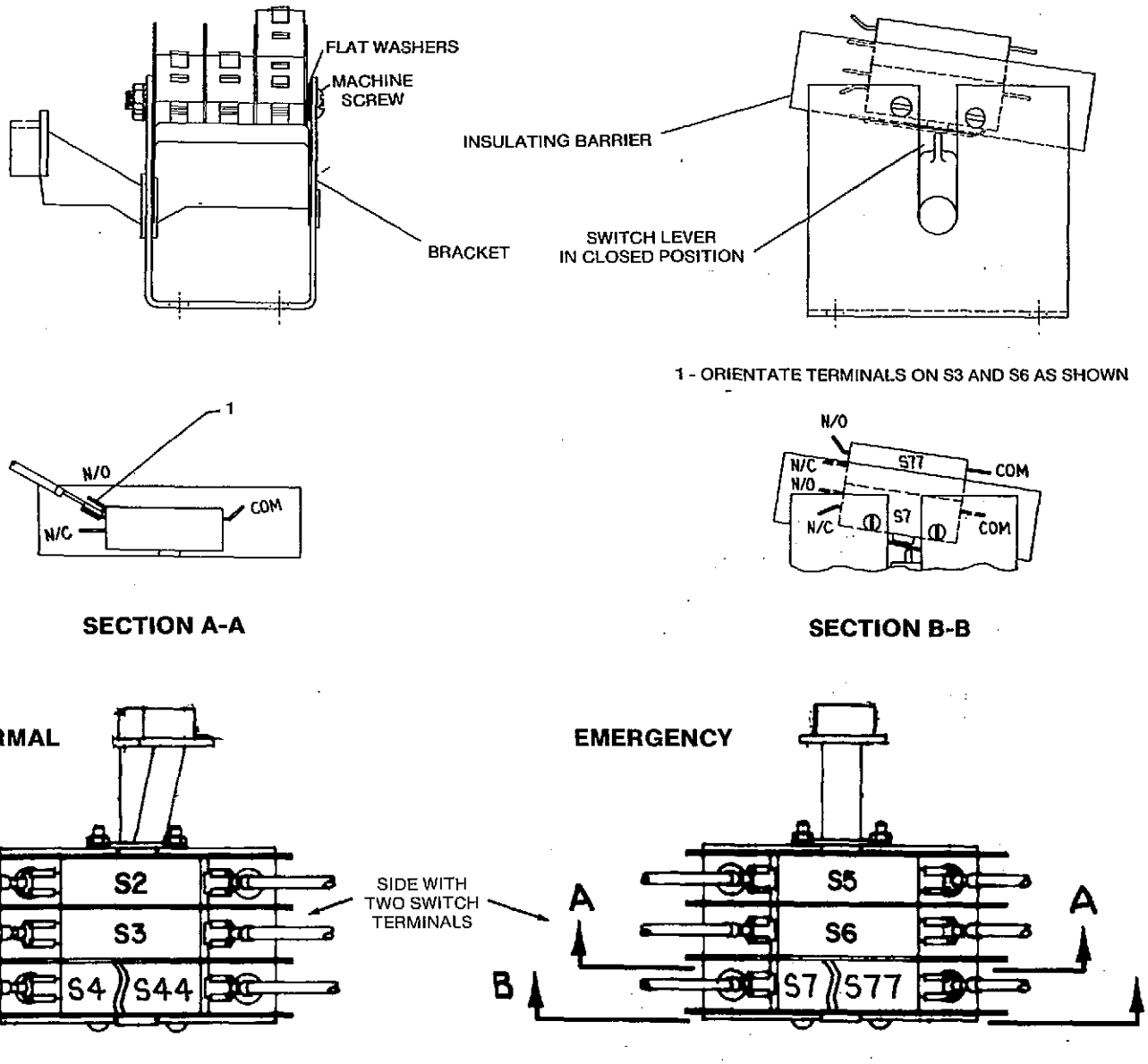

FIGURE 30. AUXILIARY SWITCHES

14. Install the interlock bar and secure to each interlock arm with a hex head capscrew, locking washer, and flat washer. Tighten to 70 to 75 in-lbs. (7.9 to 8.5 N•m) torque.
15. Replace the linear actuator as described in Linear Actuator Removal and Replacement section for 400 Ampere switches. Follow steps 2 through 9 in the Replacing Actuator section.
16. Test switch for proper operation and close cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (400 Amperes - Spec E)

Disconnect both the normal and emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

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⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator for the 400 Ampere (Spec E) switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2 & J3 - Refer to Figure 25) from the front cover.
2. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the cover.
3. Remove the round head machine screws that secure the plug bracket to the base. Push the plug bracket to the side to allow access to the auxiliary switches.
4. Remove the control wiring leads from the auxiliary switch terminals (see Figure 30).
5. Remove the round head machine screws that secure the auxiliary switch assembly bracket to the base.
6. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly.

⚠CAUTION ***Use care when disengaging switch lever from crossbar to avoid cracking the switch lever.***

7. Remove the round head machine screws, flat washers, and nuts that secure the auxiliary switches to the bracket (see Figure 30); and lift out the four auxiliary switches, insulating barriers, and switch lever.

Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 30.
2. Install the flat washers (4), insulating barriers (4), and auxiliary switches (3) in the bracket; and secure with round head machine screws (2) and nuts (2). Note that each switch must be assembled so the side with two terminals faces inward (see Figure 30) when the auxiliary switch assembly is installed.
3. Hold the auxiliary switch assembly in position on base (side with two terminals must face inward) and secure bracket to base with round head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
4. Install control wiring leads on the corresponding switch terminals. Leads are marked with the terminal numbers (S2/N0, S5/NC, S7/C, etc.) for identification. Refer to Figure 30 for identification of auxiliary switch terminals.
5. Place the plug bracket in position on the base and secure with round head machine screws (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
7. Plug in the three control wiring harness plugs (J1, J2, J3,); and reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
8. Test switch for proper operation and close cabinet.

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LINEAR ACTUATOR REMOVAL AND REPLACEMENT (600 (Spec E)-800-1000 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Use extreme caution when making adjustments to avoid touching high-voltage components.***

The following procedures cover the removal and replacement of the linear actuator for 600 (Spec E)-800-1000 Ampere switches.

Removing Actuator

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2 & J3 - Refer to Figure 31) from the front cover.
2. Remove the hex head capscrews, lock washers, and rod assemblies from the end of the actuator rod (see Figure 32); and slide rod out of the actuator motor.
3. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the switch base; and lift off the switch cover.
4. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
5. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
6. Disconnect the black actuator lead wire from the circuit breaker and the ground wire from the end of the actuator.
7. Remove the hex head capscrews, lock washers, and flat washers that secure the actuator to the switch assemblies (see Figure 31); and lift out the spacers (4) and actuator motor.

Replacing Actuator

1. Hold actuator motor and spacers (4) in position over the switch assemblies with the lead wires at the bottom.
2. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), and flat washers (4). Tighten capscrews to 70 to 75 in-lbs (7.9 to 8.5 N•m).
3. Connect the black actuator lead wire to the circuit breaker; and the red and white actuator lead wires to the following capacitor terminals.:

   Red Lead Wire - Connect to capacitor C1 - Terminal 2.

   White Lead Wire - If one capacitor, connect to capacitor C1 - Terminal 1. If two capacitors, connect to capacitor C2 - Terminal 2.

   Transfer switches for voltage ranges 190/200, 208, 347, 380/416, and 440/4890 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between terminal 1 on C1 and terminal 1 on C2.

4. Replace the capacitor end cap and install the capacitor in the bracket.
5. Connect the ground wire to the end of the actuator. Use wire ties to hold actuator lead wires in place with rest of wiring harness.
6. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
7. Insert the actuator rod into the replacement actuator motor (see Figure 32). Hold the actuator ground brush up slightly to allow passage of the actuator rod.

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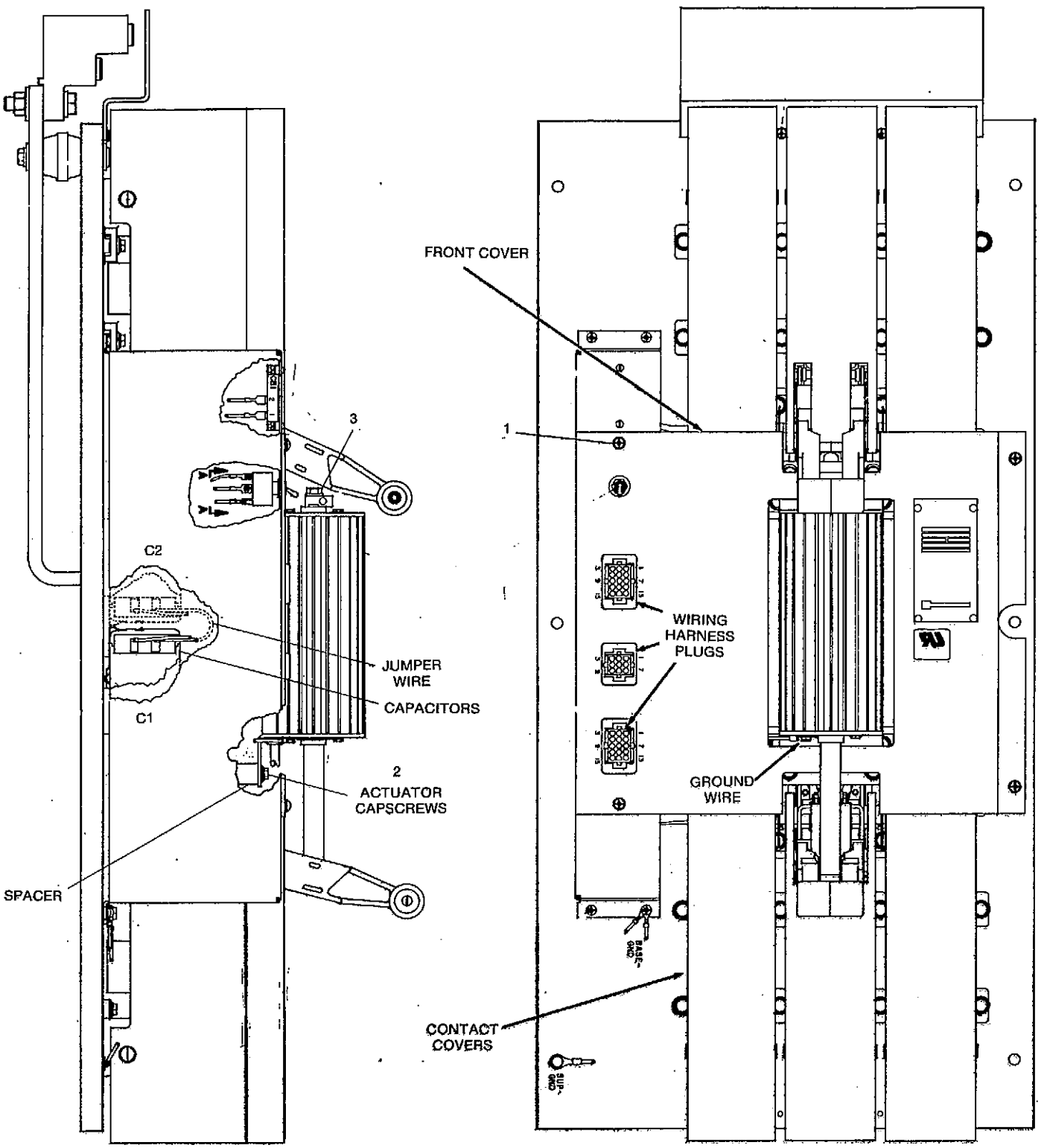
600 (Spec E)-800-1000 AMP SWITCH



1 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

2 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

3 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS

FIGURE 31. TRANSFER SWITCH FRONT COVER

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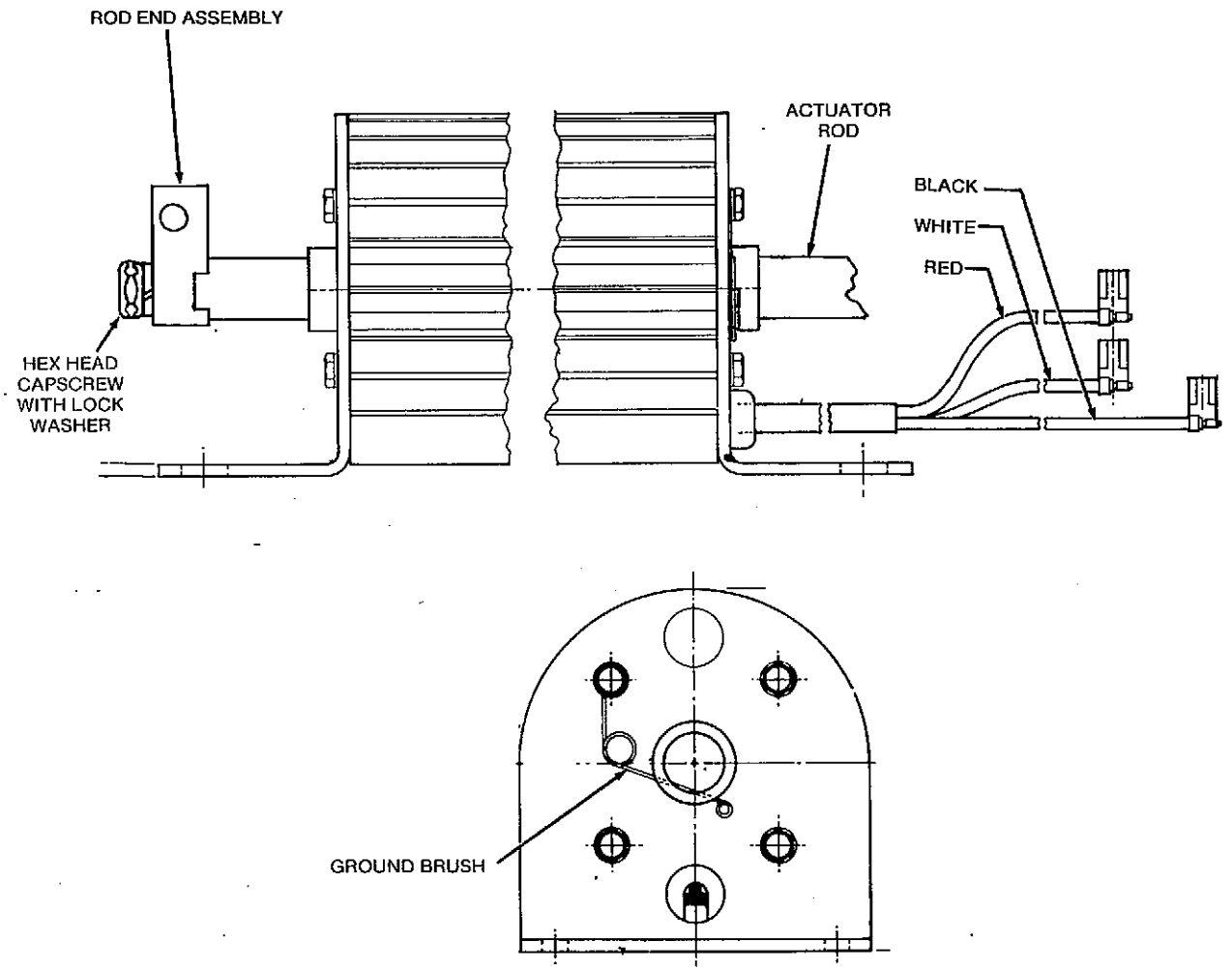

FIGURE 32. LINEAR ACTUATOR

8. Secure the rod end assemblies to the actuator rod with hex head capscrews (2) and lock washers (2). Tighten capscrews to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
9. Check operation of transfer switch and alignment of actuator rod by manually opening and closing both the normal and emergency switch assemblies.
10. Plug in the three control wiring harness plugs (J1, J2, and J3); and reconnect normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
11. Test switch for proper operation and close cabinet.

SWITCH ASSEMBLY REMOVAL AND REPLACEMENT (600 (Spec E)-800-1000 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

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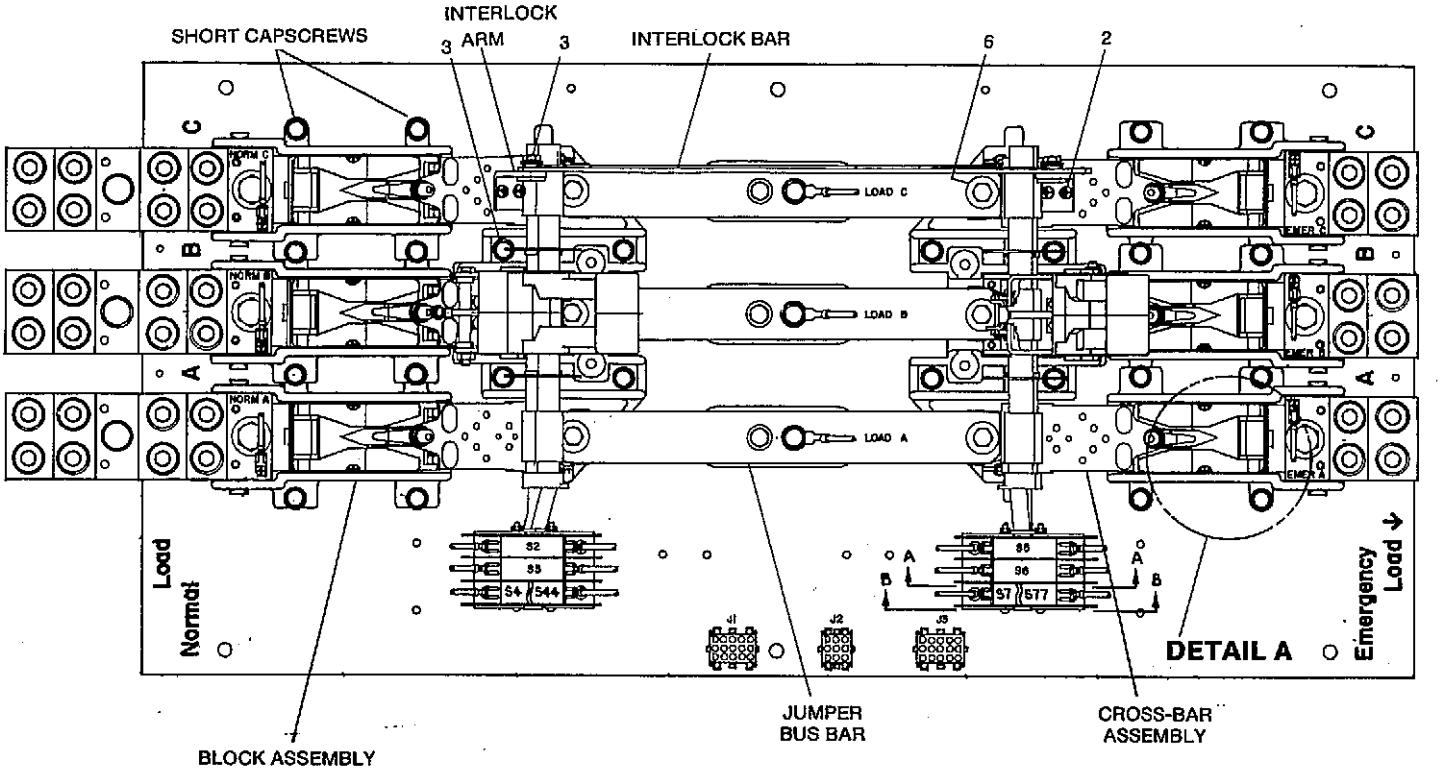
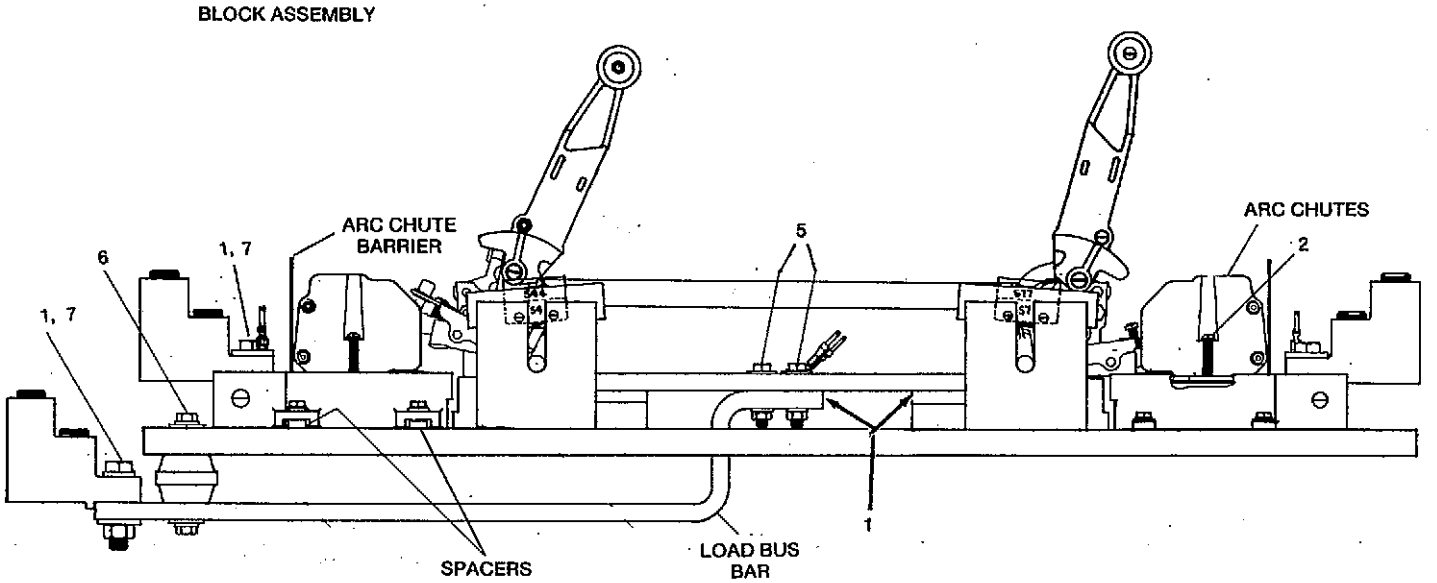
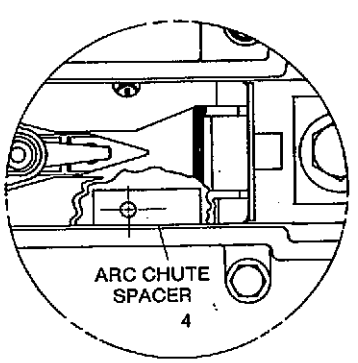
600 (SPEC E)-800-1000 AMP MODEL







DETAIL A

1 - PLACE THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE SHALL BE 15-20 IN-LBS FOR #8-32 SCREWS

3 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

4 - APPLY THIN COAT (.010 APPROX.) OF GLYPTOL BETWEEN ARC CHUTE SPACER AND ARC CHUTE PAPER BARRIER

5 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS

6 - TORQUE SHALL BE 10-20 FT-LBS FOR 3/8-16 SCREWS

7 - TORQUE SHALL BE 28-32 FT-LBS FOR 1/2-13 SCREWS

FIGURE 33. FRONT CONNECT TRANSFER SWITCH ASSEMBLY

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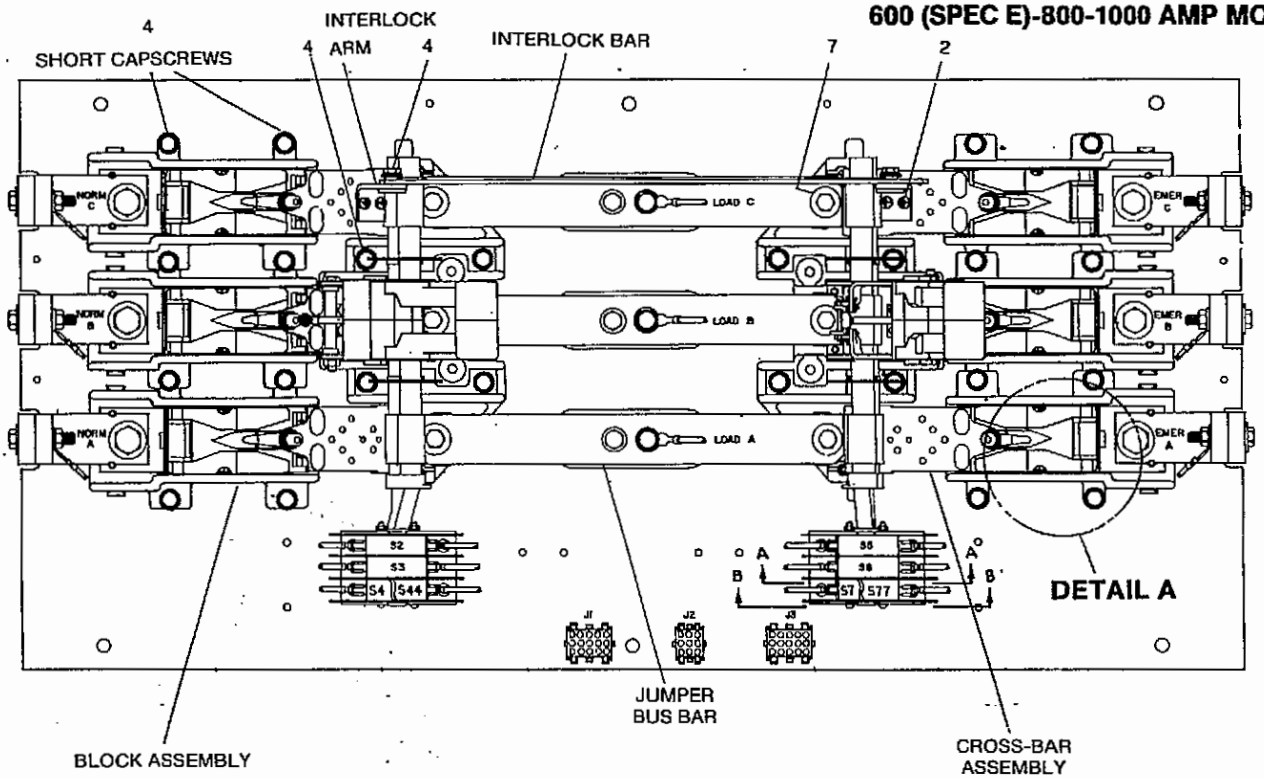

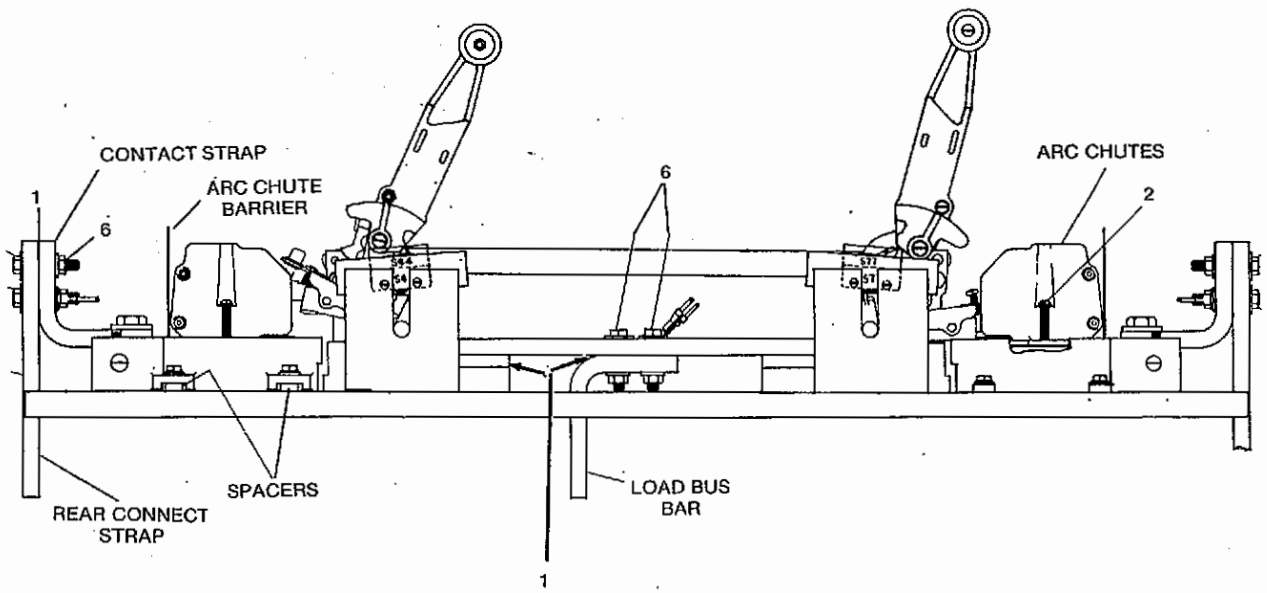

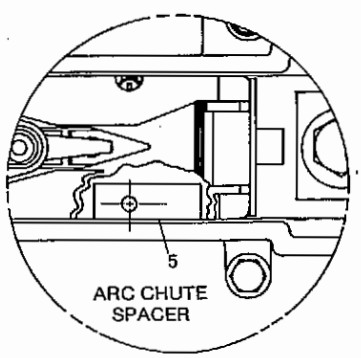

DETAIL A

1 - PLACE A THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE SHALL BE 15-20 IN-LBS FOR #8-32 SCREWS

3 - TORQUE SHALL BE 25-30 IN-LBS FOR #10-32 SCREWS

4 - TORQUE SHALL BE 70-75 IN-LBS FOR 1/4-20 SCREWS

5 - APPLY THIN COAT OF GLYPTOL BETYWEEN ARC CHUTE SPACER AND ARC CHUTE PAPER BARRIER

6 - TORQUE SHALL BE 10-12 FT-LBS FOR 5/16-18 SCREWS

7 - TORQUE SHALL BE 18-20 FT-LBS FOR 3/8-16 SCREWS

FIGURE 34. REAR CONNECT TRANSFER SWITCH ASSEMBLY

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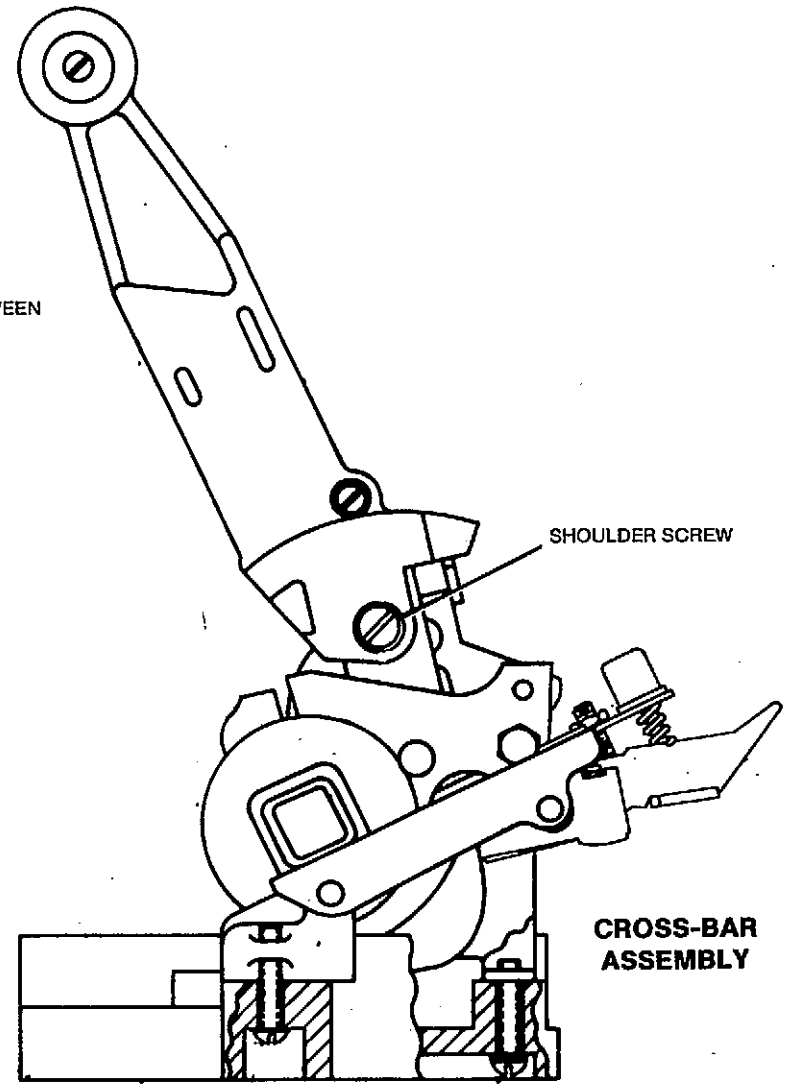
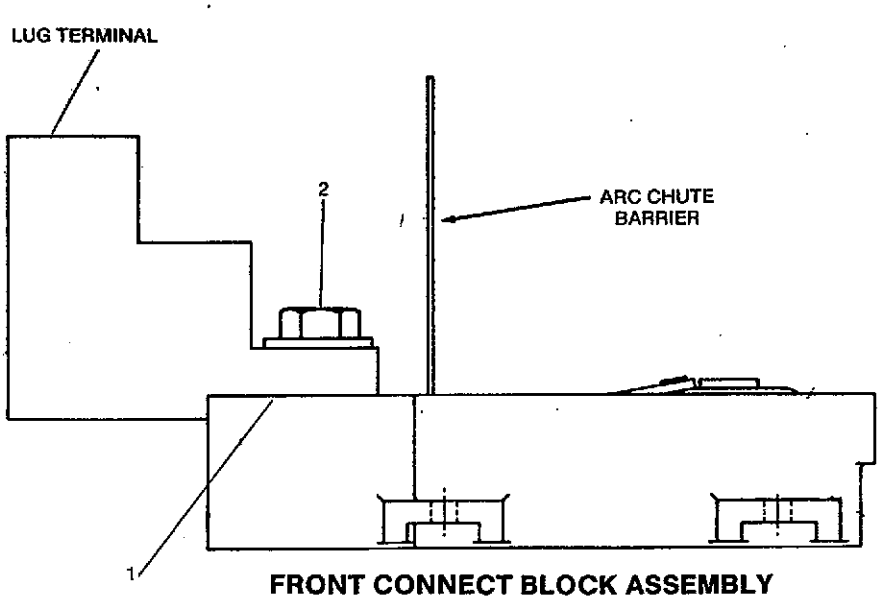
1 - PLACE A THIN COAT OF ELECTRIC JOINT COMPOUND BETWEEN CURRENT CARRYING SURFACES

2 - TORQUE SHALL BE 28-33 FT. LBS. FOR 1/2-13 SCREW





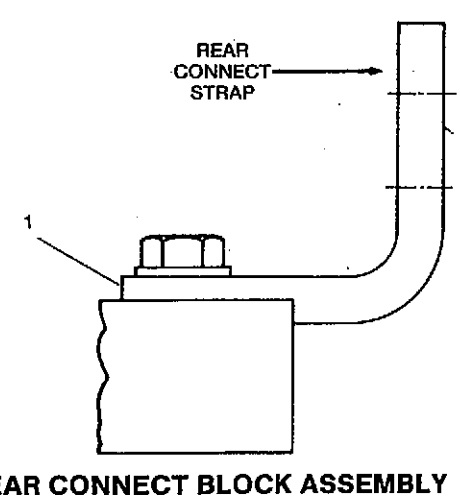


FIGURE 35. CROSS-BAR ASSEMBLY AND BLOCK ASSEMBLIES

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The following procedures cover the removal and replacement of the switch assemblies for 600 (Spec E)-800-1000 Ampere switches.

Removing Switch Assembly (Normal or Emergency)

1. Remove the linear actuator as described in Linear Actuator Removal and Replacement section for 600 (Spec E)-800-1000 Ampere switches. Follow step 1 through 7 in the Removing Actuator section.
2. Remove the red plastic contact covers by spreading them slightly at the bottom until they can be lifted off the contact assemblies.
3. Lift the arc chute covers off the arc chutes.
4. Remove the hex head capscrews, locking washers, and flat washers that secure the interlock bar to the interlock arm (Figures 33 and 34); and remove the interlock bar.
5. Disconnect the control wiring leads from the jumper bus bars.
6. Remove the hex head capscrews, ring terminals, flat washers, spring washers, and nuts that secure the jumper bus bars (see Figures 33 and 34) to the load bus bars.
7. Remove the hex head capscrews, spring washers, and bushings that secure the jumper bus bars to the switch assemblies; and lift off the jumper bus bars.
8. Remove the control wiring leads from the power source terminals (see Figures 33 and 34).
9. On ***front*** connect switches, loosen the lug terminal screws and remove the power source supply wires from the lug terminals.

   On ***rear*** coannect switches, remove the hex head capscrews, flat washers, spring washers, ring terminals and nuts that secure the contact strap (see Figure 34) to the rear connect strap.
10. Remove the hex head capscrews, lock washers, and flat washers that secure the block assemblies (see Figures 33 and 34) to the base; and lift off the block assemblies (note where spacers are used).
11. Remove the round head machine screws, locking washers, and flat washers that secure the arc chutes (see Figures 33 and 34) to the block assemblies; and lift out the arc chutes, arc chute barriers, and arc chute spacers. Discard the arc chute barriers, and spacers.
12. Remove the hex head capscrews, spring washers, and lug terminals (front connect) or contact straps (rear connect) from the block assemblies.
13. Remove the hex head capscrews, lock washers, and flat washers that secure the cross-bar assembly to the base: and lift off the cross-bar assembly.

    ⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch lever to avoid cracking the switch lever.***
14. Remove the shoulder screws and lock washers that secure the handle assembly to the cross-bar assembly; and lift off the handle assembly (see Figure 24).
15. Remove the two round head machine screws that secure the interlock arm to the cross-bar assembly; and lift off the interlock arm.

Replacing Switch Assembly (Normal or Emergency)

1. Install the interlock arm on the cross-bar assembly and secure with round head machine screws (2). Tighten screws to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.
2. Place the handle assembly in position on the switch assembly and secure with shoulder screws (2) and lock washers (2).
3. Secure cross-bar assembly to base with hex head capscrews (4), locking washers (4), and flat washers (4). Tighten to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.

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4. Apply a thin coat of insulating varnish (such as Glyptal™ 1201 or Dolf™ ER41) between arc chute spacer and arc chute barrier. Place the arc chute spacers (2), arc chute barrier, and arc chute in position on each block assembly; and secure with round head machine screws (2), lock washers (2) and flat washers (2). Tighten to 15 to 20 in-lbs (1.7 to 2.3 N•m) torque.

5. Apply a thin coat of electric joint compound between the mating surfaces of the block assembly and the lug terminal (front connect) or block assembly and rear connect strap (rear connect).

   On ***front*** connect switches, install the lug terminals on the block assemblies and secure with hex head capscrew and spring washer. Tighten to 28 to 33 ft-lbs (40.0 to 44.7 N•m) torque.

   On ***rear*** connect switches, install the rear connect straps on the block assemblies and secure with hex head capcrew and spring washer. Tighten to 28 to 33 ft-lbs (40.0 to 44.7 N•m) torque.

6. Place each block assembly in position on the base and secure with hex head capscrews (8), lock washers (8), and flat washers (8). Refer to (Figures 33 and 34) to determine where the spacers are required and where the short capscrews should be installed. Tighten capscrews to 70 to 75 in-lbs (7.9 to 8.5 N•m) torque.

7. On ***front*** connect switches, install the power source supply wires and securely tighten the lug terminals. On ***rear*** connect switches, apply a thin coat of electric joint compound between the mating surfaces of the contact strap and rear connect strap (see Figure 34). Secure with hex head capscrew, flat washers, spring washers, ring terminal and nut. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.

8. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A,B,C or EMER A,B, C for identification.

9. Apply a thin coat of electric joint compound between the mating surfaces of the jumper bus bars, the braided strap connectors, and load bus bars.

10. Install the jumper bus bars and secure to the switch assemblies with hex head capscrews, spring washers, and bushings. Tighten to 18 to 20 ft-lbs (24.4 to 27.1 N•m) torque.

11. Secure the jumper bus bars to each load bus bar with a hex head capscrew, ring terminal (lower row only), flat washer, spring washer and nut. Tighten to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.

12. Connect the control wiring leads to the corresponding jumper bus bar terminal. Control wires are marked LOAD A,B,C for identification.

13. Install the interlock bar and secure to each interlock arm with a hex head capscrew, locking washer, and flat washer. Tighten to 70-75 in-lbs (7.9 to 8.5 N•m) torque.

14. Place the arc chute covers in position over the arc chutes and replace the red plastic contact covers.

15. Replace the linear actuator as described in Linear Actuator Removal and Replacement section for 600 (Spec E)-800-1000 Ampere switches. Follow steps 1 through 10 in the Replacing Actuator section.

16. Test switch for proper operation and close cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (600 (Spec E)-800-1000 Amperes)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP; and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two wire start systems and on the transfer switch control panel for three wire start systems.

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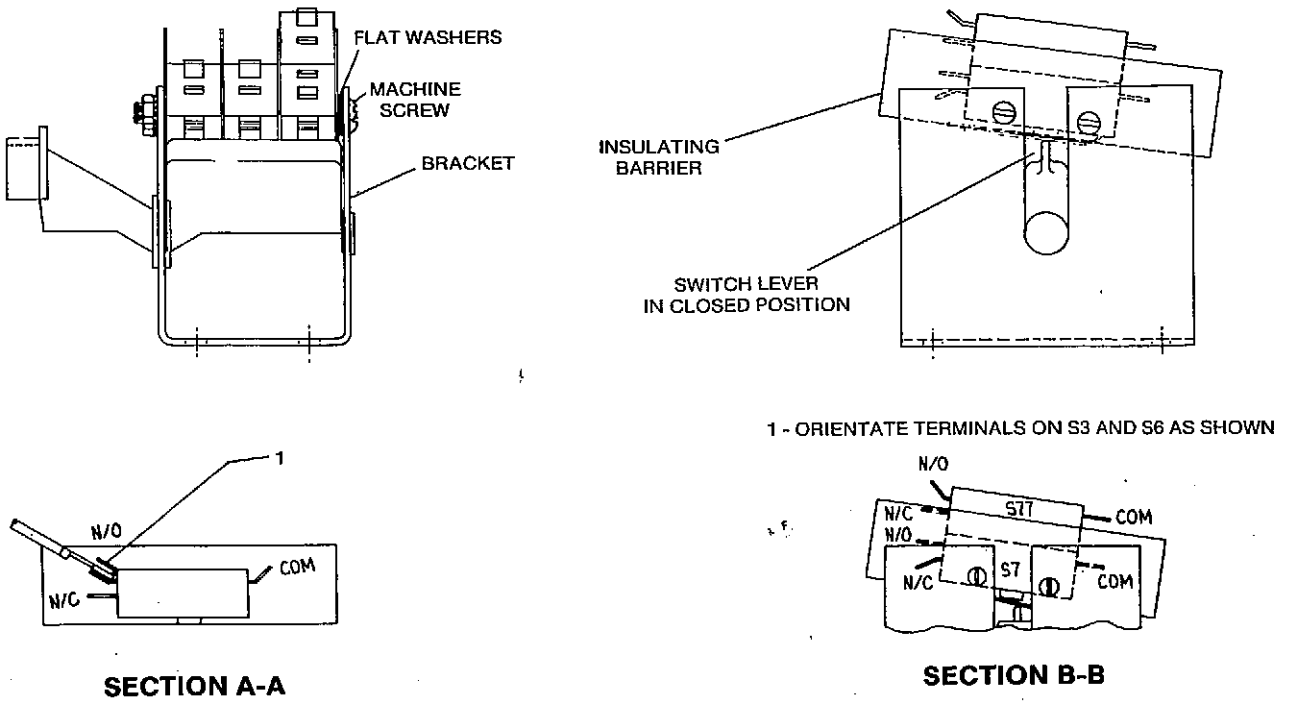

FIGURE 36. AUXILIARY SWITCHES

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch assembly for 600 (Spec E)-800-1000 Ampere switches.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, & J3 - Refer to Figure 31) from the front cover.
2. Remove the hex head capscrews, lock washers, and rod assemblies from the end of the actuator rod (see Figure 32); and slide rod out of the actuator motor.
3. Loosen and remove the four machine screws (with flat washers) that secure the red plastic switch cover to the base; and lift off the switch cover.
4. Remove the round head machine screws that secure the plug bracket to the base. Push the plug bracket to the side to allow access to the auxiliary switches.
5. Remove the control wiring leads from the auxiliary switch terminals (see Figure 36).

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6. Remove the round head machine screws that secure the auxiliary switch assembly bracket to the base.
7. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly.

⚠CAUTION ***Use care when disengaging switch lever from crossbar to avoid cracking the switch lever.***

8. Remove the round head machine screws, flat washers, and nuts that secure the auxiliary switches to the bracket (see Figure 36); and lift out the three auxiliary switches, insulating barriers, and switch lever.

Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 36.
2. Install the flat washers (4), insulating barriers (4), and auxiliary switches (3) in the bracket; and secure with round head machine screws (2) and nuts (2). Note that each switch must be assembled so the side with two terminals faces inward (see Figure 36) when the auxiliary switch assembly is installed.
3. Install the auxiliary switch assembly on the base (side with two terminals must face inward) and secure bracket to base using round head machine screws. Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
4. Install control wiring leads on the corresponding switch terminals. Leads are marked with the terminals numbers (S2/N0, S5/NC, S7/C, etc.) for identification. Refer to Figure 36 for identification of auxiliary switch terminals.
5. Place the plug bracket in position on the base and secure with round head machine screws (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
6. Place red plastic switch cover in position and secure with machine screws (4) and flat washers (4). Tighten to 25 to 30 in-lbs (2.8 to 3.4 N•m) torque.
7. Insert the actuator rod into the replacement actuator motor (see Figure 32). Hold the actuator ground brush up slightly to allow passage of the actuator rod.
8. Secure the rod end assemblies to the actuator rod with hex head capscrews (2) and lock washers (2). Tighten capscrews to 10 to 12 ft-lbs (13.6 to 16.3 N•m) torque.
9. Plug in the three control wiring harness plugs (J1, J2, J3); and reconnect the normal power source and emergency power source. If a generator set is the emergency power source, connect the negative battery cable to the starting battery and place operation selector switch in automatic or remote position.
10. Test switch for proper operation and close cabinet.

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LINEAR ACTUATOR REMOVAL AND REPLACEMENT (400-600 Amperes - Spec F)

Disconnect both the normal and the emergency power source from the transfer switch before servicing. If a generator provides standby emergency power, turn the operation selector switch to STOP, and disconnect the negative battery cable from the starting battery. The selector switch is located on the generator set control panel for two-wire start systems and on the transfer switch control for three-wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the linear actuator.

Removing Actuator

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, and J3 - refer to Figure 37) from the front cover.
2. Loosen and remove the ET machine screws that secure the red plastic switch cover to the transfer switch; and lift off cover.
3. Separate the actuator lead wires from the rest of the wiring harness; remove wire ties as required.
4. Remove the four ET screws (two on top and two on bottom) from the plug bracket. Do not pull bracket from transfer switch, but allow to hang loose. See Figure 37.
5. Pry the capacitor(s) loose from the bracket. Remove the end cap and disconnect the red and white actuator lead wires from the capacitor terminals.
6. Disconnect the black actuator lead from the circuit breaker and the ground wire from the end of the actuator.
7. Remove the hex head capscrews, flat washers, lock washers, and nuts that secure the actuator to the switch assemblies (see Figure 37).
8. Disengage the actuator rod from the switch handle and remove actuator from switch assembly.
9. Remove one of the hex head capscrews and lock washers that secure the rod end assemblies to the end of the actuator rod.
10. Remove rod end assembly (Figure 38) and slide actuator rod out of the actuator motor.

Replacing Actuator

1. Insert the actuator rod into the replacement actuator motor (see Figure 38). Hold the actuator ground brush up slightly to allow passage of the actuator rod. Install the rod end assembly and tighten capscrew 10 to 12 ft. lb. (13.6 to 16.3 N•m).
2. Hold actuator motor in position over the switch assemblies so the lead wires are at the bottom; and fit the rod assembly into the handle of the closed switch assembly.
3. Secure the actuator motor to the switch assemblies using hex head capscrews (4), lock washers (4), flat washers (4), and spacers (4). Tighten capscrews 70 to 75 in. lb. (7.9 to 8.5 N•m).

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400-600 AMP MODEL (SPEC F)

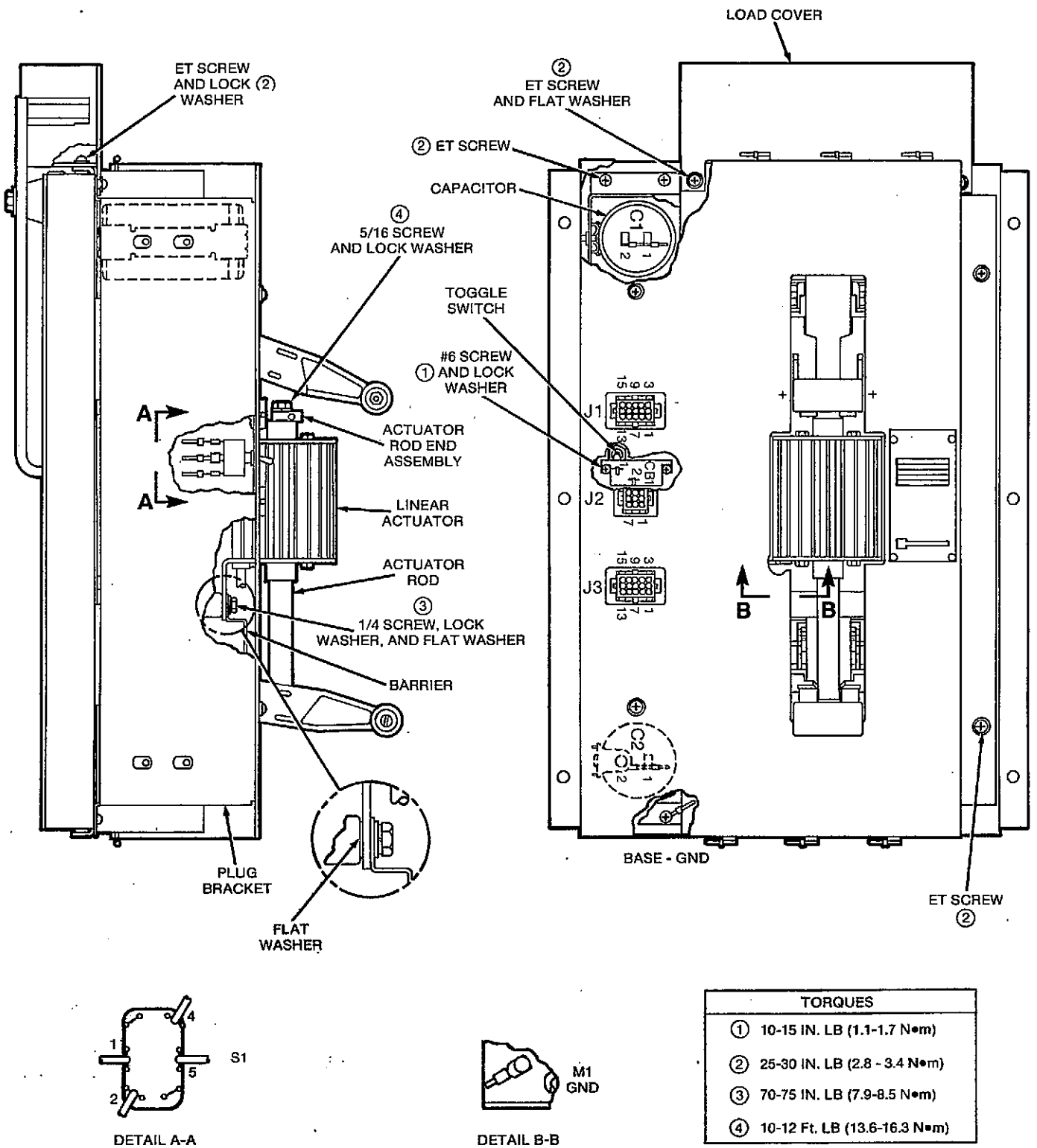

FIGURE 37. TRANSFER SWITCH FRONT COVER

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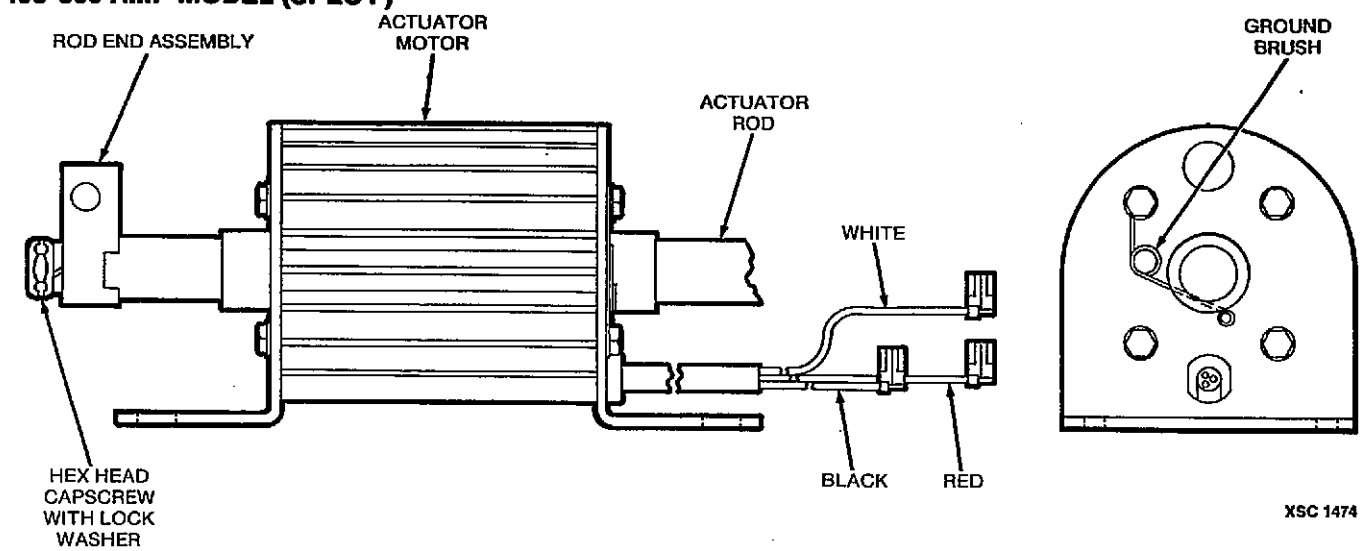

FIGURE 38. LINEAR ACTUATOR

4. Connect the black actuator lead wire to the circuit breaker; and the red and white actuator lead wires to the following capacitor terminals:

   White Lead Wire - Connect to capacitor C1-1 for switch with one capacitor, or connect to capacitor C2-2 for switch with two capacitors.

   Red Lead Wire - Connect to capacitor C1-2.

   Transfer switches for voltage ranges 347, 380/416, and 440/480 use two capacitors (C1 and C2) wired together in series. A single jumper wire is placed between 1 on C1 and terminal 1 on C2.

5. Replace the capacitor end cap(s) and install the capacitor(s) in the brackets of the plug bracket (Figure 36).
6. Connect the ground wire to the end of the actuator. Use wire ties to hold actuator lead wires in place with rest of wiring harness.
7. Mount the plug bracket on the transfer switch base with the four ET screws. Use a torque of 25 to 30 in. lb or 2.8 to 3.4 N•m.
8. Check operation of transfer switch and alignment of actuator rod by manually opening and closing both the normal and emergency switch assemblies.
9. Install the red plastic switch cover on the switch with the four ET screws. Tighten 25 to 30 in. lb (2.8 to 3.4 N•m) torque.
10. Plug in the three control wiring harness plugs (J1, J2, and J3), and reconnect normal power and emergency power sources. If a generator set is the emergency power source, connect the negative battery cable to the starting battery, and place the operation selector switch in automatic or remote position.
11. Test switch for proper operation and close cabinet.

SWITCH ASSEMBLY REMOVAL AND REPLACEMENT (400-600 Amperes - Spec F)

Disconnect both the normal and the emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP, and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two-wire start systems and on the transfer switch control panel for three-wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the switch assemblies for the 400 and 600 ampere Spec F OT transfer switches.

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400-600 AMP MODEL (SPEC F)

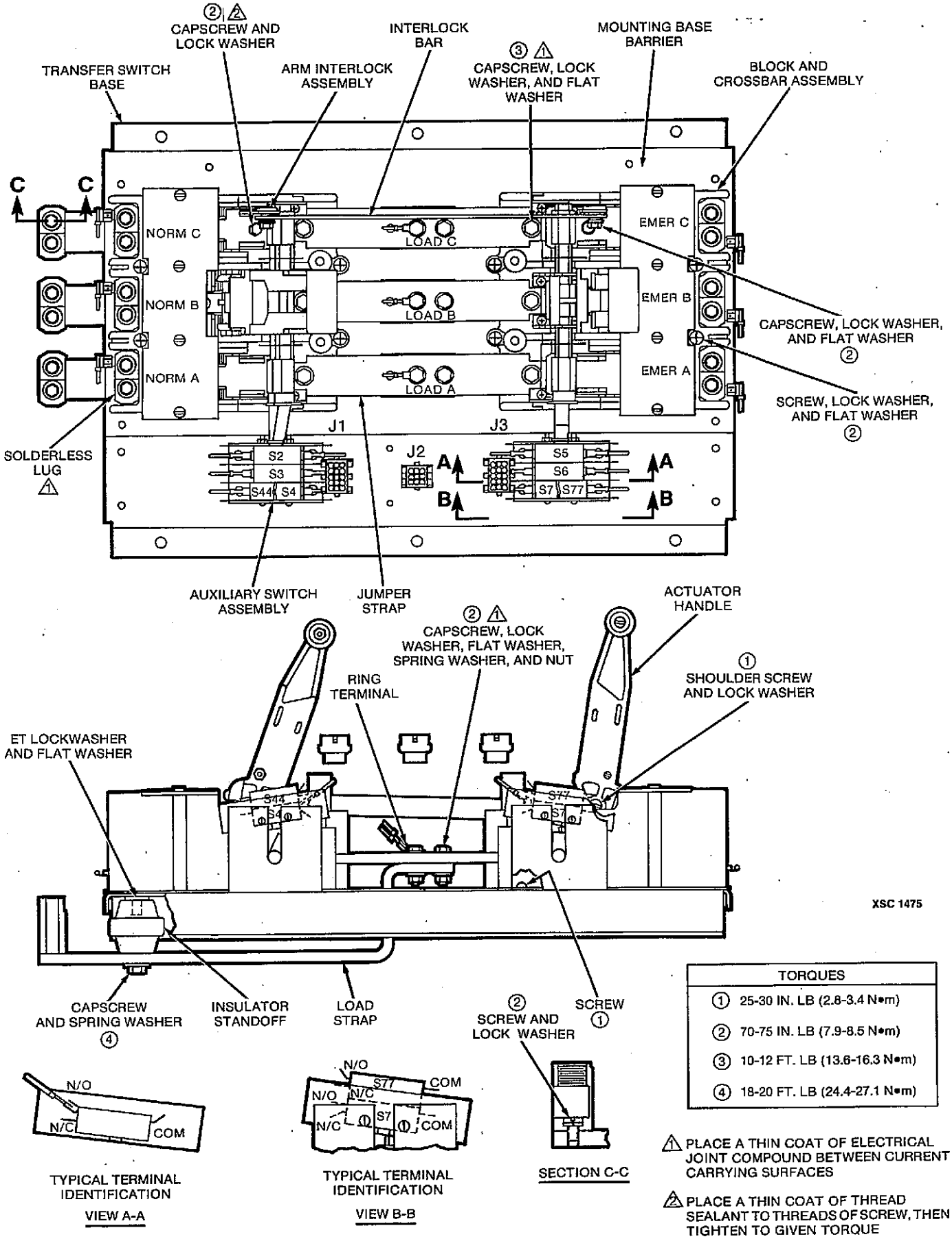

FIGURE 39. FRONT CONNECT TRANSFER SWITCH ASSEMBLY

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400-600 AMP MODEL (SPEC F)

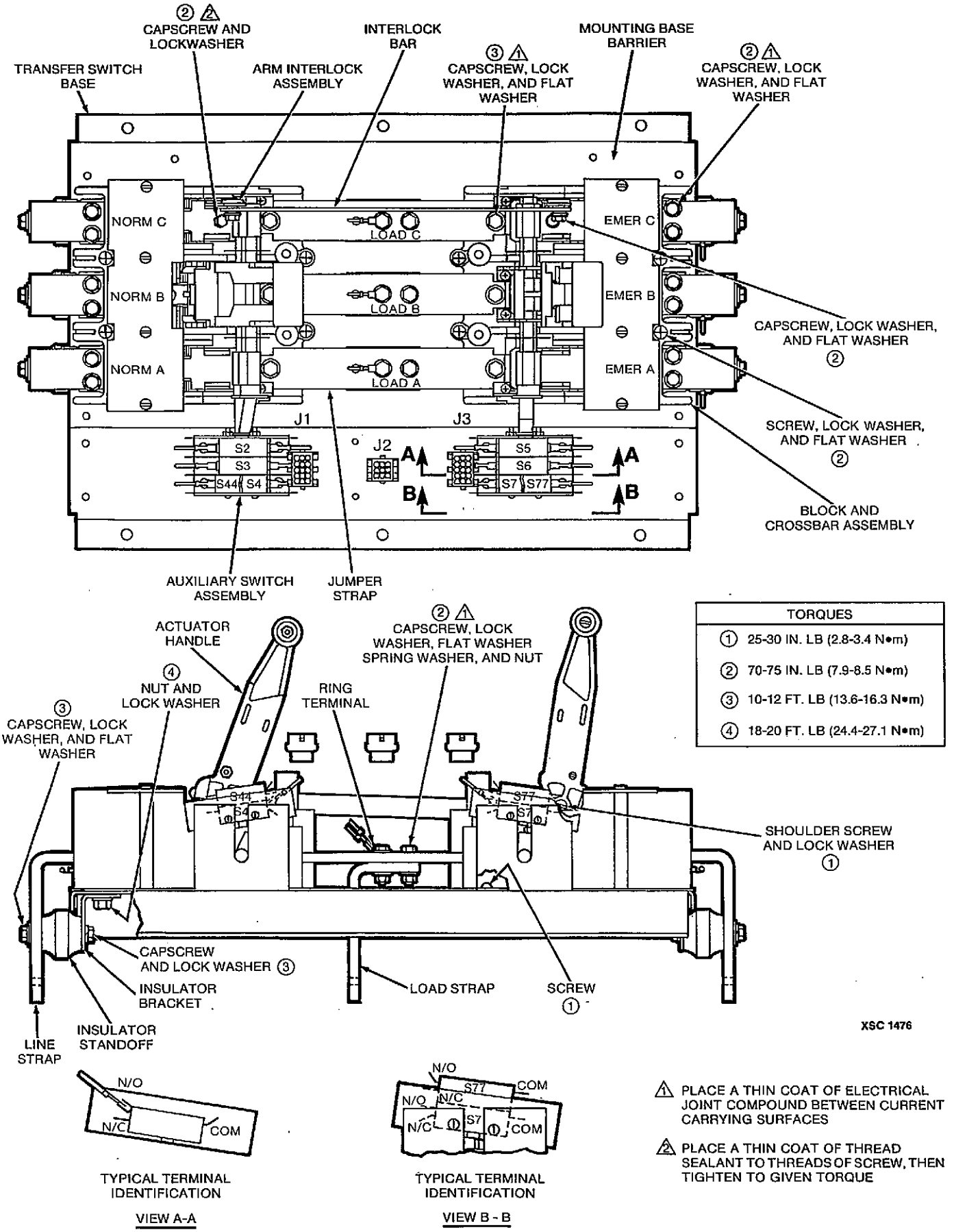

FIGURE 40. REAR CONNECT TRANSFER SWITCH ASSEMBLY

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400-600 AMP MODEL (SPEC F)

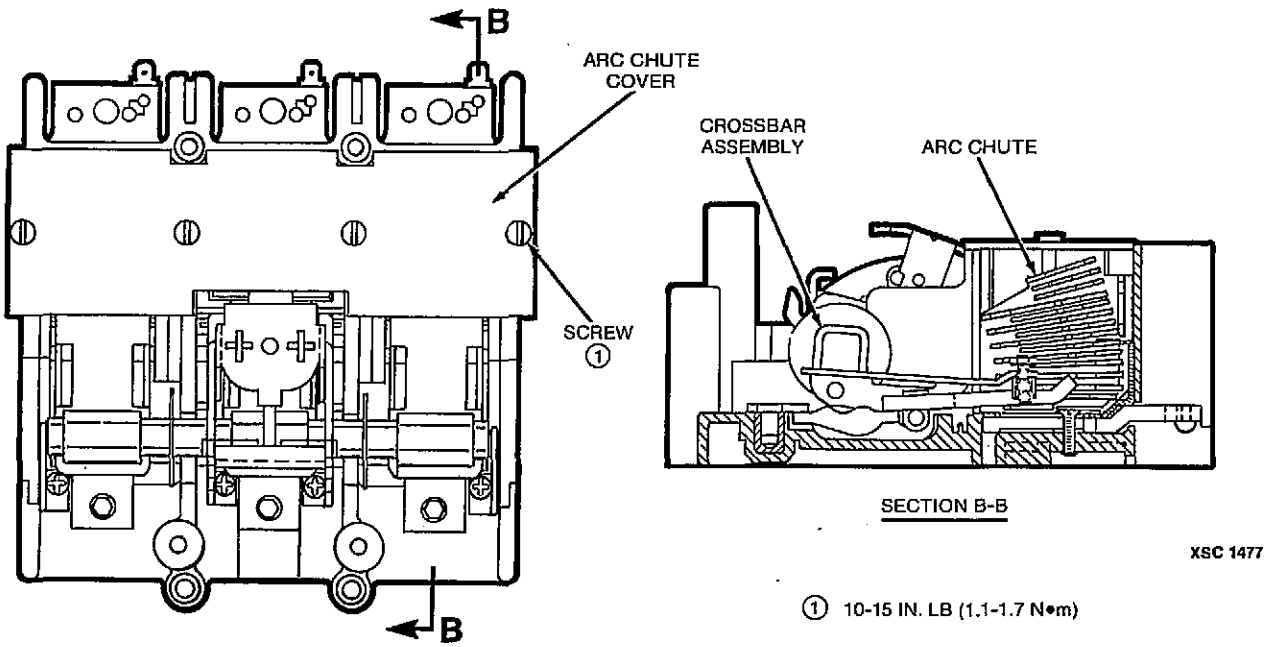

FIGURE 41. SWITCH ASSEMBLY

Removing Switch Assembly (Normal or Emergency)

1. Remove the linear actuator as described in Linear Actuator Removal and Replacement section of this supplement. Follow steps 1 through 10 in the Removing Actuator Section.
2. Remove the hex head capscrews, lock washers, and flat washers that secure the interlock bar to the interlock arm (Figures 39 and 40); and remove the interlock bar.
3. Disconnect the control wiring from the jumper bus bars.
4. Remove the round head shoulder screws and lock washers that secure the handle assembly to the switch assembly; and lift off handle assembly.
5. Remove the control wiring leads from the power source terminals (Figures 39 and 40).
6. On **front** connect switches, loosen the lug terminal screws and remove the power supply wires from the lug terminals. Then remove the solderless lugs from the switch assemblies.

   On **rear** connect switches, Remove the hex head capscrews, lock washers, and flat washers which secure the line straps to the switch assemblies. You can loosen the line strap from the insulator standoff to enable switch removal without complete removal of the line strap if you want; or you can remove the line strap completely.
7. Remove the hex head capscrews, ring terminals; spring washers, flat washers, lock washers, and nuts that secure the jumper strap to the load strap.
8. Remove the hex head capscrews, lock washers, and flat washers that secure the jumper straps to the switch assemblies; and lift off the jumper straps.
9. Remove the four screws, lock washers, and flat washers that secure the switch assembly to the base; and lift off the switch assembly.

   ⚠CAUTION ***Use care when removing the block and cross-bar assembly from the base. Carefully disengage the crossbar from the auxiliary switch lever to avoid cracking the switch lever.***
10. Remove the hex head capscrew and lock washer that secures the interlock arm assembly to the switch.
11. Remove the four screws and arc chute cover from the switch assembly (Figure 41). Then remove the arc chutes.

Replacing Switch Assembly (Normal or Emergency)

1. Install the arc chutes in the switch assembly, put on the arc chute cover, and secure with the pan head screws. Tighten 10 to 15 in. lb (1.1 to 1.7 N•m).
2. Apply thread sealant to the threads of the interlock arm capscrews. Mount the interlock arm on the switch assembly using torques as shown in Figure 39 or 40.

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3. Install the switch assembly on the transfer switch base with the screws, lock washers, and flat washers, carefully engaging the auxiliary switch lever. Tighten to a torque of 70 to 75 in. lb (7.9 to 8.5 N•m).
4. Apply a thin coat of electrical joint compound between the mating surfaces of the switch assembly and the lug terminals (front connect) or the switch assembly and line straps and load straps (rear connect).

   On **front** connect switches, install the lug terminal with the round head screw and lock washer. Tighten to a torque of 70 to 75 in. lb (7.9 to 8.5 N•m).

   On **rear** connect switches, mount the line strap with the capscrews, lock washers, and flat washers. Tighten 70 to 75 in. lb. (7.9 to 8.5 N•m) also tighten capscrew, lock washer, and flat washers which secure line straps to standoff insulators 10 to 12 ft lb (13.6 to 16.3 N•m). See Figure 40.
5. Secure the jumper straps to the switch assembly with the capscrews, lock washers, and flat washers. Make sure mating surfaces have a coating of electrical joint compound. Tighten capscrews 10 to 12 ft lb (13.6 to 16.3 N•m).
6. Secure the load straps to the jumper straps with the capscrews, lock washers, flat washers, spring washers, ring terminals, and nuts (Figures 39 and 40). Be sure to apply a thin coat of electrical joint compound between the current carrying surfaces. Tighten 70 to 75 in. lb. (7.9 to 8.5 N•m).
7. Install the actuator handle on the switch assembly with the shoulder screws and lock washers. Use a torque of 25 to 30 in. lb (2.8 to 3.4 N•m).
8. Connect the power source supply wires and load wires to the lug terminals (front connect switches) or the line and load straps (rear connect switches). Tighten lug terminals to the torque value silkscreened on the transfer switch cover.
9. Connect the control wiring leads to the corresponding power source terminals. Control wires are marked NORM A, B, C, or EMER A, B, C for identification.
10. Connect the control wiring leads to the corresponding jumper strap. Control wires are marked LOAD A, B, C for identification.
11. Install the interlock bar and secure to each interlock arm with a hex head capscrew and lock washer. See Figures 39 and 40 for proper torques.
12. Replace the linear actuator as described earlier in this supplement under Replacing Actuator.
13. Attempt to close both sides of the transfer switch. The interlock assembly must hold one side open so that only one side closes at a time.
14. Test switch for proper operation and close cabinet.

AUXILIARY SWITCH REMOVAL AND REPLACEMENT (400-600 Amperes - Spec F)

Disconnect both the normal and emergency power sources from the transfer switch before servicing. If a generator set provides standby emergency power, turn the operation selector switch to STOP, and disconnect the negative battery cable from the set starting battery. The selector switch is located on the generator set control panel for two-wire start systems and on the transfer switch for three-wire start systems.

⚠WARNING ***High voltages within the cabinet present an electrical shock hazard that can cause severe personal injury or death. Disconnect all sources of AC power from the transfer switch before servicing.***

The following procedures cover the removal and replacement of the auxiliary switch.

Removing Auxiliary Switch Assembly

1. Open the transfer switch cabinet door and unplug the three control wiring harness plugs (J1, J2, and J3 - refer to Figure 37) from the front cover.
2. Loosen and remove the four ET screws that secure the red plastic switch cover to the transfer switch, and lift off the cover.
3. Remove the four ET screws that secure the plug bracket (two on top and two on bottom - see Figure 37) and move plug bracket to the left. The bracket is still connected to the transfer switch by wires from the transfer switch.
4. Remove the control wiring leads from the auxiliary switch terminals (see Figure 42).
5. Remove the round head machine screws that secure the auxiliary switch assembly bracket to the base.
6. Disengage the auxiliary switch lever from the transfer switch crossbar and lift out the auxiliary switch assembly (have transfer switch closed to side you are removing auxiliary switch assembly).

   ⚠CAUTION ***Use care when disengaging switch lever from crossbar to avoid cracking the switch lever.***
7. Remove the round head machine screws, flat washers, and nuts that secure the auxiliary switches to the bracket (see Figure 42); and lift out the four auxiliary switches, insulating barriers, and switch lever.

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Replacing Auxiliary Switch Assembly

1. Place the auxiliary switch lever in the bracket as shown in Figure 42.
2. Install the flat washers (4), insulating barriers (4), and auxiliary switches (3) in the bracket; and secure with round head machine screws (2) and nuts (2). Note that each switch must be assembled so the side with two terminals faces inward (see Figure 42) when the auxiliary switch assembly is installed.
3. Hold the auxiliary switch assembly in position on base (side with two terminals must face inward) and secure bracket to base with round head machine screws. Tighten 25 to 30 in. lb (2.8 to 3.4 N•m).
4. Install control wiring leads on the corresponding switch terminals. Leads are marked with the terminal numbers (S2/N0, S5/NC, S7/C, etc.) for identification of auxiliary switch terminals.
5. Place the plug bracket in position on the transfer switch base and secure with the four ET screws (4). Tighten 25 to 30 in. lb (2.8 to 3.4 N•m).
6. Place red plastic cover in position and secure with the ET screws (4). Tighten 25 to 30 in. lb (2.8 to 3.4 N•m).
7. Plug in the three control wiring harness plugs (J1, J2, and J3); and reconnect the normal power and emergency power sources. If generator set is the emergency power source, connect the negative battery cable to the starting battery and place the operation selector switch in automatic or remote position.
8. Test transfer switch for proper operation and close cabinet.

400-600 AMP MODELS (SPEC F)

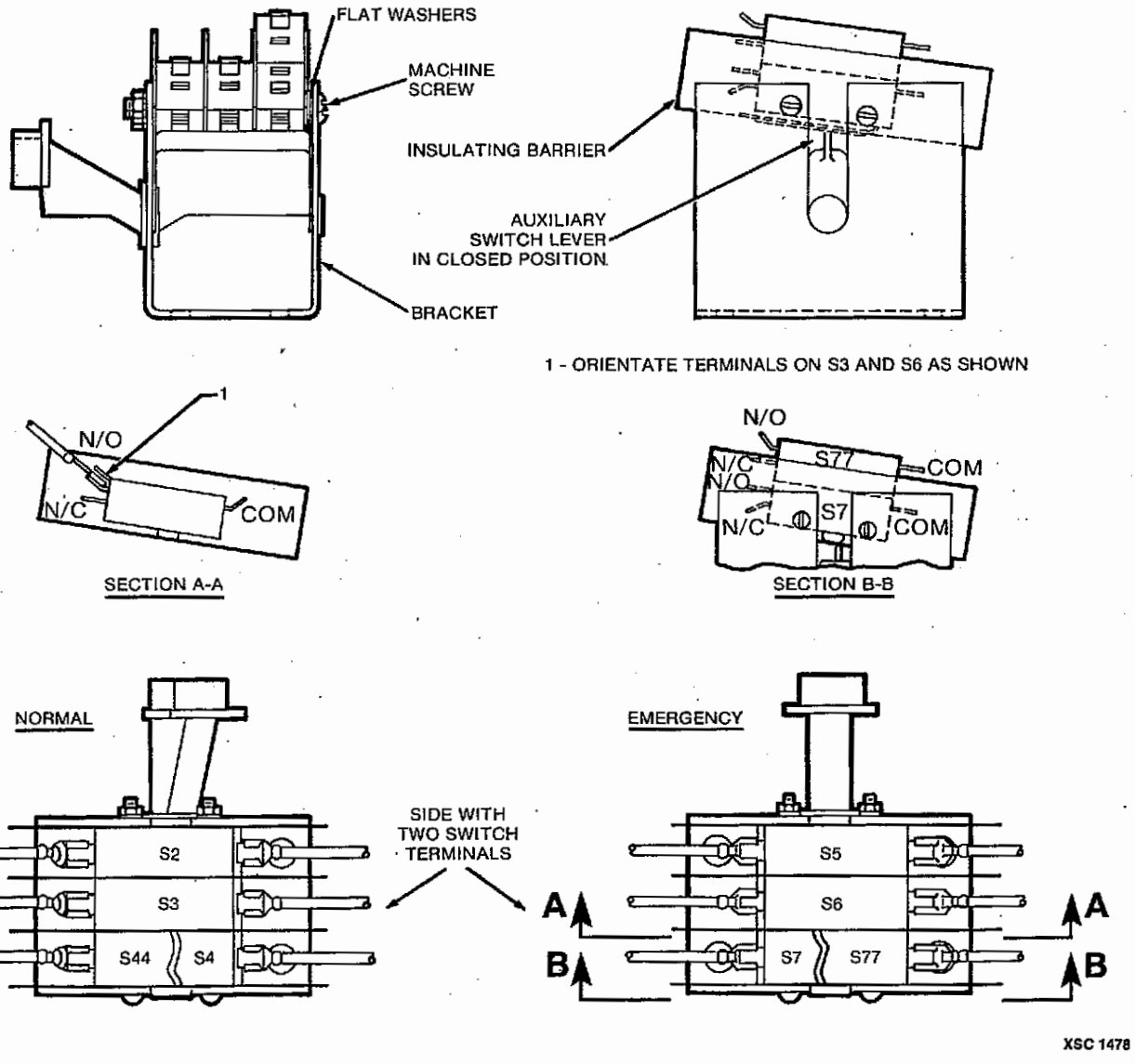

FIGURE 42. AUXILIARY SWITCHES

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Troubleshooting

This troubleshooting guide asks questions that can be answered with a "yes" or a "no." The numbers in the "yes" and "no" columns direct you to the next appropriate step. An "X" means that the step should reveal or correct the problem described. Proceed to the next step if necessary.

All reference points in the Power Sentry control are preceded by "P.S." For example, "P.S. TB2-3" refers to terminal 3 of terminal block 2 on the (A1) Power Sentry control.

Section I: 3-Phase Transfer Switch
Generator set starts and takes over the load whenever the Start/Stop/Remote switch is put in Remote.

Section II: 3-Phase Transfer Switch
Generator set starts during a power failure but transfer doesn't take place.

Section IIIA: 2-Wire Starting
Generator set doesn't start for a power failure, simulated power failure, or exercise.

Section IIIB: 3-Wire Starting
Generator set doesn't start for a power failure or simulated power failure using the key switch.

Section IV: Single-Phase Transfer Switch
Generator set starts during a power failure but transfer doesn't take place.

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⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***High voltages within the cabinet and the rear side of the cabinet door present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove all power sources before removing and replacing components.***

Section I: 3-Phase Transfer Switch

Generator Starts and Transfer Takes Place Whenever the Start/Stop/Remote Switch is Placed in Remote

	Yes	No
1. Is commercial voltage OK on all phases?	2	X
2. Is Source 1 OK light on?	39	3
3. Is approximately 40 VDC available at P.S. J1-16 to ground?	8	4
4. Is approximately 40 VAC available at P.S. TB1 1 x 1 to 1 x 2?	28	5
5. Is line to line voltage available at P.S. TB3-2 to 3?	29	6
6. Is line to line voltage available at TB2-1 to 3?	30	7
7. Check connections 5 and 6 on J3 and P3 (at the transfer switch).	X	X
8. Is approximately 40 VDC available at P.S. J1-15 to ground?	13	9
9. Is approximately 40 VAC available at P.S. TB1-2 x 1 to 2 x 2?	28	10
10. Is line to line voltage available at P.S. TB3-4 to 5?	31	11
11. Is line to line voltage available at TB2-2 to 3?	32	12
12. Check connections 2 and 6 on J3 and P3 (at the transfer switch).	X	X
13. Is approximately 40 VDC available at P.S. J1-14 to ground?	35	14
14. Is approximately 40 VAC available at P.S. TB1-3x1 to 3x2?	18	15
15. Is line to line voltage available at P.S. TB3-6 to 7?	33	16
16. Is line to line voltage available at TB2-1 to 2?	34	17
17. Check connections 2 and 5 on J3 and P3 (at the transfer switch).	X	X
18. Is approximately 40 VAC available at P.S. TB1 - 3x1 to LS?		19
19. Is approximately 40 VAC available at P.S. TB1 - 3x1 to S12-6?	20	21
20. Check connection 15 in P.S. J5 and P5.	X	X
21. Is approximately 40 VAC available at P.S. TB1 - 3x1 to S12-5?	22	23
22. Check S12-5 and 6 contact (should be closed).	X	X
23. Is approximately 40 VAC available at P.S. TB1 - 3x1 to TB1-8?	24	25
24. Check for the following:		
A. Loose or missing jumper TB1-8 to 9 (if no exerciser clock).	X	X
B. Exerciser clock in exercise mode.	X	X
C. Switch or exercise clock contact 4 to 5 (must be closed).	X	X
D. S16 (with/without load) for missing jumpers or bad contacts.	X	X
25. Is approximately 40 VAC available at P.S. JB1 - 3x1 to TB1-7?	26	27

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⚠WARNING ***High voltages within the cabinet and the rear side of the cabinet door present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove all power sources before removing and replacing components.***

Section I: 3-Phase Transfer Switch (Continued)

Generator Starts and Transfer Takes Place Whenever the Start/Stop/Remote Switch is Placed in Remote

	Yes	No
26. Check for loose or missing jumper TB1-7 to 8.	X	X
27. Check pin 16 in P.S. J5 and P5.	X	X
28. Replace mother board.	X	X
29. Check T1 transformer.	X	X
30. Check pins 5 and 6 in P.S. J4 and P4	X	X
31. Check T2 transformer.	X	X
32. Check pins 2 and 6 in P.S. J4 and P4; check jumpers on P.S. TB3.	X	X
33. Check T3 transformer.	X	X
34. Check the following:		
A. Pins 2 and 5 in P.S. J4 and P4.	X	X
B. Connection at K12-1.	X	X
C. Jumpers on P.S. TB3.	X	X
35. Is approximately 40 VDC (single phase) or 50 VDC (three phase) available at P.S. J1-17 to ground?	37	36
36. Check diodes CR7, CR8, and CR9 on mother board 300-2109.	X	X
Check diodes CR13, CR14, and CR17 on mother board 300-2936	X	X
37. Is 12 VDC available at P.S. J1-9 to ground?	38	28
38. Calibrate or replace the source one voltage sensor.	X	X
39. Is 12 VDC available at P.S. J1-3 to ground?	40	37
40. Try new time delay card.	X	X

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Section II: 3-Phase Transfer Switch

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
1. Is generator voltage proper on all phases?	2	X
2. Is Source 2 OK light on?	22	3
3. Is approximately 40 VDC available at P.S. J3-16 to ground?	8	4
4. Is approximately 40 VAC available at P.S. TB2 4x1 to 4x2?	26	5
5. Is line to line voltage available at P.S. TB4 - 8 to 9?	27	6
6. Is line to line voltage available at TB2 - 9 to 11?	28	7
7. Check pins 13 and 14 in J3 and P3.	X	X
8. Is approximately 40 VDC available at P.S. J3-15 to ground?	13	9
9. Is approximately 40 VAC available at P.S. TB2 - 3x1 to 3x2?	26	10
10. Is line to line voltage available at P.S. TB4 - 6 to 7?	38	11
11. Is line to line voltage available at TB2 - 10 to 11?	39	12
12. Check pins 10 and 14 in J3 and P3.	X	X
13. Is approximately 40 VDC available at P.S. J3-14 to ground?	29	14
14. Is approximately 40 VAC available at P.S. TB2 - 2x1 to 2x2?	18	15
15. Is line to line voltage available at P.S. TB4 - 4 to 5?	31	16
16. Is line to line voltage available at TB2 - 9 to 10?	47	17
17. Check pins 10 and 13 in J3 and P3.	X	X
18. Is approximately 40 VAC available at P.S. TB2 - 2x1 to GS?	26	19
19. Is there a jumper connecting TB1-5 to 6?	21	20
20. Add jumper or check operation of a transfer inhibit circuit.	X	X
21. Check pins 17 and 18 in P.S. J5 and P5.	X	X
22. Is Transfer Command light on?	32	23
23. Is Timing for Transfer light on?	45	24
24. Is 12 VDC available at P.S. J2-6 to ground?	45	25
25. Calibrate or try new generator side voltage sensor.	X	X

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⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***High voltages within the cabinet and the rear side of the cabinet door present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove all power sources before removing and replacing components.***

Section II: 3-Phase Transfer Switch (Continued)

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
26. Replace mother board	X	X
27. Check T4 transformer.	X	X
28. A. Check for proper jumpers on P.S. TB4.	X	X
B. Check connection at P.S. K12-3.	X	X
C. Check pins 13 and 14 in P.S. J4 and P4.	X	X
29. Is more than 40 VDC available at P.S. J3-17 to ground?	24	30
30. Check diodes CR10, CR11, and CR12 on mother board 300-2109.	X	X
Check diodes CR2, CR3, and CR6 on mother board 300-2926.	X	X
31. Check T2 transformer.	X	X
32. Is approximately 30 VDC available at P.S. K2 - 4 to 5?	49	33
33. Is the diode across the K2 coil shorted?	X	34
34. Is approximately 30 VDC available at P.S. K2-4 to ground?	40	35
35. Is approximately 40 VAC available at P.S. TB2 - 1x1 to 1x2?	26	36
36. Is line to line voltage available at P.S. TB4 - 2 to 3?	48	37
37. A. Check connections at P.S. K12-9 and P.S. K12-3.	X	X
B. Check pins 11 and 13 in J4, P4 and J3, P3.	X	X
C. Check switch S6 (40, 70, 100 amp)/S5 (above 100 amp) and connection at TB2-9.	X	X
38. Check transformer T3.	X	X
39. A. Check pins 10 and 14 in P.S. J4, P4.	X	X
B. Check for proper jumpers on P.S. TB4.	X	X
40. Is approximately 30 VDC available at P.S. K1-2 to ground?	42	41
41. Check lead from P.S. K2-5 to P.S. K1-2.	X	X
42. Is approximately 30 VDC available at P.S. K1-1 to ground?	44	43
43. Check P.S. K1 auxiliary switch.	X	X
44. Is approximately 12 VDC available at P.S. J2-12 to ground?	26	45
45. Try new time delay board.	X	X
46. Calibrate and/or try new generator side voltage sensor.	X	X
47. A. Check pins 10 and 13 in P.S. J4, P4.	X	X
B. Check for proper jumpers P.S. TB4.	X	X

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⚠WARNING ***Improper operation of the generator set presents a hazard that can cause severe personal injury or death. Observe all safety precautions in your generator set manuals.***

⚠WARNING ***High voltages within the cabinet and the rear side of the cabinet door present a shock hazard that can cause severe personal injury or death. Use extreme caution to avoid touching electrical contacts when the cabinet door is open. Remove all power sources before removing and replacing components.***

Section II: 3-Phase Transfer Switch (Continued)

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
48. Check T1 transformer.	X	X
49. Is K2 energized?	51	50
50. Try new K1, K2 reversing contactor.	X	X
51. Is line to line voltage available at P.S. K12 - 3 to 9?	53	52
52. A. Check pins 11 and 13 in J3, P3.	X	X
B. Check connection at TB2-9.	X	X
C. Check pins 11 and 13 in P.S. J4, P4.	X	X
D. Check switch S6 (40, 70, 100 amp)/S5 (above 100 amp).	X	X
53. Is line to line voltage available at K12 - 2 to 8?	55	54
54. Check K12 relay contacts.	X	X
55. Is line to line voltage available at linear motor black to red leads?	56	57
56. Check linear motor windings and capacitor assembly.	X	X
57. A. Check pins 1 and 3 in P.S. J4, P4.	X	X
B. Check pins 1 and 3 in J3, P3.	X	X
C. Check motor disconnect switch S1.	X	X
D. Check CB1.	X	X
E. Check switch S3.	X	X

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Section IIIA: 2-Wire Starting

Generator Set Doesn't Start During A Power Failure, Simulated Power Failure, or Exercise

	Yes	No
1. Will generator set start from its own control?	2	X
2. Is battery voltage available at TB1-3?	6	3
3. Is battery voltage available at TB1-2?	5	4
4. Check leads between generator set and transfer switch.	X	X
5. Check jumper between TB1-2 and 3.	X	X
6. Will generator set run if TB1-3 is jumpered to TB1-4?	7	4
7. Is the P.S. K3 relay de-energized?	8	9
8. A. Check for continuity from TB1-3 through P.S. J5, P5-1;	X	X
through P.S. J6, P6-9; to the K3 socket positions 1 and 2.	X	X
B. Check for continuity from TB1-4 through P.S. J5, P5-2	X	X
through P.S. J6, P6-3 to P.S. K3 socket positions 9 and 10.	X	X
9. Is 12 VDC available at P.S. J2-13 to ground?	11	10
10. Replace mother board.	X	X
11. Is 12 VDC available at P.S. J2-5 to ground?	13	12
12. Try new time delay card.	X	X
13. Is approximately 40 VAC available at P.S. TB1 - 3x2 to LS?	17	14
14. Is approximately 40 VDC (single phase) 50 VDC (3 phase) available at P.S. J1-14 to ground?	15	16
15. Replace mother board.	X	X
16. Try new line side voltage sensor.	X	X
17. Check S12-5 and 6 contact if testing with key switch.	X	X
18. Check exercise clock and S16 if exercising.	X	X

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Section IIIB: 3-Wire Starting

Generator Set Doesn't Start During A Power Failure, or Simulated Failure using Key Switch (No Exerciser Clock)

	Yes	No
1. Will engine crank from its own control?	2	X
2. Will engine crank if TB10-3 is grounded?	4	3
3. Check leads between generator set and transfer siwtch.	X	X
4. Will engine crank if TB1-3 is grounded?	6	5
5. A. Check K11-1 and 7; contact should be closed.	X	X
B. Check jumper on TB10-5 to 6 or operation of preheat relay K12.	X	X
C. Check K10-3 and 6; contact must be closed.	X	X
6. Will the engine crank if TB1-3 and 4 are jumpered?	8	7
7. Check for continuity to ground from TB1-4 through S13-1 and 2.	X	X
8. Is P.S. K3 de-energized?	9	10
9. A. Check for continuity from TB1-3 through P.S. J5, P5-1 through P.S. J6, P 6-9 to P.S. K3 socket position 1 and 2.	X	X
B. Check for continuity from TB1-4 through P.S. J5, P5-2 through J6, P6-3 to P.S. K3 socket positions 9 and 10.	X X	X X
10. Is 12 VDC available at P.S. J2-13 to ground?	12	11
11. Replace mother board.	X	X
12. Is 12 VDC available at P.S. J2-5 to ground?	14	13
13. Try new time delay card.	X	X
14. Is 40 VAC available at P.S. TB1 - 3x1 to LS?	15	16
15. Check operation of S12-5 and 6 contacts using key switch.	X	X
16. Is 40 VDC (single phase) 50 VDC (three phase) available at P.S. J1-14?	18	17
17. Try new line side voltage sensor.	X	X
18. Replace mother board.	X	X

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Section IV: Single-Phase Unit

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
1. Is generator voltage proper from phase to phase?	2	X
2. Is Source 2 OK light on?	22	3
3. Is approximately 40 VDC available at P.S. J3-16 to ground?	8	4
4. Is approximately 40 VAC available at P.S. TB2 -4x1 to 4x2?	26	5
5. Is line to line voltage available at P.S. TB4 - 8 to 9?	27	6
6. Is line to line voltage available at TB2 - 9 to 11?	28	7
7. A. Check pins 10 and 13 in J3, P3.	X	X
B. Check for jumper on TB2 - 10 to 11.	X	X
8. Is approximately 40 VDC available at P.S. J3-15 to ground?	13	9
9. Is approximately 40 VAC available at P.S. 3x1 to 3x2?	26	10
10. Is line to line voltage available at P.S. TB4 - 6 to 7?	38	11
11. Is line to line voltage available at TB2 - 9 to 10?	39	12
12. Check pins 10 and 13 in J3 and P3.	X	X
13. Is approximately 40 VDC available at P.S. J3-14 to ground?	29	14
14. Is approximately 40 VAC available at P.S. TB2 - 2x1 to 2x2?	18	15
15. Is line to line voltage available P.S. TB4 - 4 to 5?	31	16
16. Is line to line voltage available at TB2 - 9 to 10?	47	17
17. Check pins 10 and 13 in J3 and P3.	X	X
18. Is approximately 40 VAC available at P.S. TB2 - 2x1 to GS?	26	19
19. Is there a jumper connecting TB1 - 5 to 6?	21	20
20. Add jumper or check operation of a transfer inhibit circuit.	X	X
21. Check pins 17 and 18 in P.S. J5 and P5.	X	X
22. Is the Transfer Command light on?	32	23
23. Is the Timing for Transfer light on?	45	24
24. Is 12 VDC available at P.S. J2-6 to ground?	45	25
25. Calibrate or try new generator side voltage sensor.	X	X
26. Replace mother board.	X	X
27. Check T4 transformer.	X	X
28. A. Check for proper jumpers on P.S. TB4.	X	X
B. Check connections at P.S. K12-3.	X	X
C. Check pins 13 and 14 in P.S. J4 and P4.	X	X
29. Is more than 40 VDC available at P.S. J3-17 to ground?	24	30

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Section IV: Single-Phase Unit (Continued)

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
30. Check diodes CR10, CR11, and CR12 on mother board 300-2109.	X	X
Check diodes CR2, CR3, and CR6 on mother board 300-2936.	X	X
31. Check T2 transformer.	X	X
32. Is approximately 30 VDC available at P.S. K2 - 4 to 5?	49	33
33. Is diode across coil shorted?	X	34
34. Is approximately 30 VDC available at P.S. K2 - 4 to ground?	40	35
35. Is approximately 40 VDC available at P.S. TB2 - 1x1 to 1x2?	26	36
36. Is line to line voltage available at P.S. TB4 - 2 to 3?	48	37
37. A. Check connections at P.S. K12-9 and P.S. K12-3.	X	X
B. Check pins 11 and 13 in P.S. J4, P4 and J3, P3.	X	X
C. Check switch S6 (40,70,100 amp) /S5 (above 100 amp) and connection at TB2-9.	X	X
38. Check transformer T3.	X	X
39. Check pins 10 and 13 in P.S. J4, P4.	X	X
40. Is approximately 24 VDC available at P.S. K1-2 to ground?	42	41
41. Check lead from P.S. K2-5 to P.S. K1-2.	X	X
42. Is approximately 24 VDC available at P.S. K1-1 to ground?	44	43
43. Check P.S. K1 auxiliary switch.	X	X
44. Is approximately 12 VDC available at P.S. J2-12 to ground?	26	45
45. Try new time delay board.	X	X
46. Calibrate and/or try new generator side voltage sensor.	X	X
47. A. Check pins 10 and 13 in P.S. J4, P4.	X	X
B. Check for proper jumpers on P.S. TB4.	X	X
48. Check T1 transformer.	X	X
49. Is K2 energized?	51	50
50. Try new K1, K2 reversing contactor.	X	X

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Section IV: Single-Phase Unit (Continued)

Generator Set Starts During a Power Failure But Transfer Doesn't Take Place

	Yes	No
51. Is line to line voltage available at P.S. K12-3 to 9?	53	52
52. A. Check pins 11 and 13 in J3, P3.	X	X
B. Check connection at TB2-9.	X	X
C. Check pins 11 and 13 in P.S. J4, P4.	X	X
D. Check switch S6 (40,70,100 amp) /S5 (above 100 amp).	X	X
53. Is line to line voltage available at K12 - 2 to 8?	55	54
54. Check K12 relay contacts.	X	X
55. Is line to line voltage available at linear motor black to red leads?	56	57
56. Check linear motor windings and capacitor assembly.	X	X
57. A. Check pins 1 and 3 in P.S. J4, P4.	X	X
B. Check pins 1 and 3 in J3, P3.	X	X
C. Check motor disconnect switch S1	X	X
D. Check CB1.	X	X
E. Check switch S3.	X	X

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Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
1-800-888-ONAN
612-574-5000 International Use
Telex: 275477
Fax: 612-574-8087

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