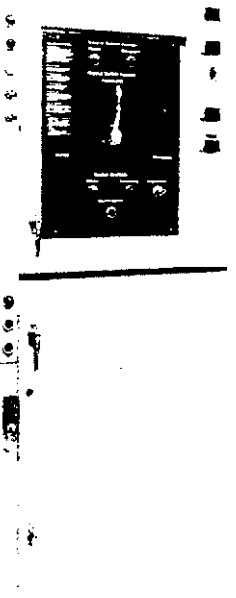
McGRAW-EDISON

Onan

Operators Manual

BT

Transfer Switch



Utility-to-GenSet
Automatic Control

962-0108
(SPEC A)
6-83
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Power Generation

Safety Precautions

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

WARNING ***Onan uses this symbol throughout the text to warn of possible injury or death.***

CAUTION ***This symbol is used to warn of possible equipment damage.***

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

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

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

Do not open the transfer switch cabinet unless qualified to service the transfer switch and related systems. High voltage components within the cabinet present a serious electrical shock hazard. For this reason, only a qualified service person such as an electrician or an Onan service representative should open the cabinet for servicing.

The automatic transfer switch may be isolated for service or testing without disconnecting the load from the power source. Follow the bypass/isolation procedures covered in other sections of this manual. When servicing other components within the switch cabinet, always 1) move the operation selector switch on the generator set to *STOP*; 2) disconnect the generator set starting batteries; and 3) remove normal AC power. When adjustment procedures require that AC power be connected, use extreme caution to avoid touching exposed terminals which might carry high voltage currents.

Table of Contents

Introduction

ABOUT THIS MANUAL

This manual provides information for installing and operating the Onan BT bypass-isolation transfer switch. A troubleshooting guide is also included which describes the corrective procedures the operator can follow if a malfunction occurs. Study this manual carefully and observe all warnings and cautions. The operator should become familiar with all operation procedures that apply to the BT switch. This will protect the operator and the equipment and help ensure proper switch operation.

BT BYPASS-ISOLATION TRANSFER SWITCH

The BT bypass-isolation transfer switch combines an automatic transfer switch, manual bypass switch, and drawout isolation mechanism into a single unit. The result is a unique package that allows a greater degree of protection from power interruptions. The following sections explain how each of these mechanisms function.

Transfer Switch Function

A transfer switch is an essential part of a standby or emergency power system. The normal power source (usually the utility) is backed up by an emergency power source such as a standby generator set. The transfer switch connects the load to one of the two power sources.

Under normal conditions, the load is supplied with power from the normal source as diagramed in Figure 1. If the normal power source is interrupted, the load is transferred to the emergency power source. When the normal power source is restored, the load is retransferred to the normal power source. The transfer and retransfer of the load between two separate power sources is the most basic function of the transfer switch.

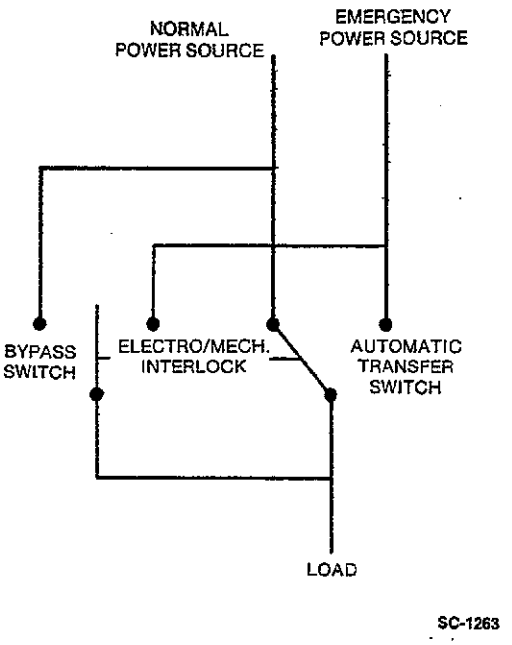

FIGURE 1. BT TRANSFER SWITCH

Automatic Operation: To insure a rapid response to a power interruption, the transfer switch is designed for automatic operation. This is an important feature in installations where essential services are provided. The automatic transfer switch eliminates the need for operator involvement and greatly reduces the response time by automatically performing all of the following functions:

- Senses the interruption of the normal power source
- Starts the standby generator set (emergency power source)
- Transfers the load to the emergency power source
- Senses when the normal power source is restored
- Retransfers the load to the normal power source
- Stops the standby generator set

Bypass Switch Function

To provide an extra measure of protection, a manual bypass switch is incorporated with the automatic transfer switch. The bypass switch allows the operator to manually connect the load to the available power source (see Figure 1) and bypass the automatic transfer switch. The automatic transfer switch can then be serviced or even removed without causing a power interruption. This gives a greater measure of protection than is provided by the automatic transfer switch alone.

Drawout Isolation Mechanism

The drawout isolation mechanism allows the automatic transfer switch to be easily withdrawn for testing or service. The transfer switch is mounted on rails and connected to the load and power source through special isolation contacts. Turning an external crank handle withdraws the transfer switch to permit testing or service. If necessary, the switch can be lifted from its rails and removed from the cabinet.

MODEL IDENTIFICATION

Identify your model by referring to the Model and Specification number as shown on the nameplate. Electrical characteristics are shown on the lower portion of the nameplate. It is located inside the cabinet door on the control box cover.

If it is necessary to contact a dealer or the factory regarding the transfer switch, always give the complete Model, Spec, and Serial number as listed on the nameplate. Also give the number(s) of any options that may be listed on a label below the nameplate. This information is necessary to properly identify your unit among the many types manufactured.

A typical model number with explanation is given below.

BT	B	C	A	400	-	4X	U	/	31	01	E
1	2	3	4	5		6	7		8	9	10

1. Basic model series.
   BT indicates BT Bypass transfer switch series.
2. Number of switched conductor poles.
   B-indicates 3-pole.
3. Basic control group.
   C-indicates utility to standby generator.
4. Enclosure type.
   A-indicates general purpose NEMA 1.
5. Ampere rating.
6. Voltage code and frequency
   4X or 54X (50 Hz) = 277/480, 3-phase, 4-wire.
7. Agency Certification.
   U-Underwriters' Laboratories, Inc.
8. Control option group number.
9. Meter option group number.
10. Specification letter; advances with production modification.

WARNING

INCORRECT SERVICE OR REPLACEMENT OF PARTS MIGHT RESULT IN SEVERE PERSONAL INJURY AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

Installation

CHOOSING THE LOCATION

The following factors should be considered when selecting a location for the transfer switch.

- Standard enclosure is a NEMA Type 1 cabinet and requires an indoor location.
- Cabinet doors are front opening and require a specified amount of clearance (Table 1) to open fully.
- Power cables should only enter the cabinet in the areas specified in the outline drawing.
- A separate conduit is required for control system wiring between the generator set and transfer switch control.
- There must be a switch and fuses or circuit breaker in the commercial power line before the transfer switch.
- Make provisions for lighting and convenience receptacles to allow for servicing.
- Select a flat and level mounting surface that is vibration-free. Avoid hot, moist, or dusty locations.

The approximate cabinet dimensions are given in Table 1. Refer to the outline drawing for exact dimensions.

TABLE 1
APPROXIMATE CABINET DIMENSIONS

Switch Amp Rating	Height (H)	Width (W)	Depth W/Door - Closed (D)	Depth W/Door - Open
400	90 IN. (2286 mm)	32.75 IN. (832 mm)	26 IN. (660 mm)	54.5 IN. (1385 mm)
800	90 IN. (2286 mm)	48 IN. (1219 mm)	33.12 IN. (841 mm)	59.12 IN. (1502 mm)
1000	90 IN. (2286 mm)	48 IN. (1219 mm)	33.12 IN. (841 mm)	59.12 IN. (1502 mm)

MOUNTING REQUIREMENTS

Place the shipping box so the cabinet is standing upright and then carefully open and remove the shipping box. Check the entire unit for completeness and general condition. All transfer switches are shipped complete, properly packed, and in working condition when delivered to the transportation company. Any claim for loss or damage in transit should be filed promptly against the transportation company making the delivery.

Two steel rails (see Figure 2) are attached to the bottom of the cabinet for mounting purposes. Use 3/8 inch mounting studs to anchor the cabinet to the floor. Refer to the outline drawing for the correct spacing. When the mounting studs are properly spaced, a large flat washer will overlap the mounting rail. Use six mounting studs to secure the 400 Amp model. Use eight mounting studs to secure the 800 and 1000 Amp models.

Hoist the cabinet into position using appropriate lifting equipment. The two eyebolts at the top of the cabinet may be used as attachment points for the lifting equipment.

WARNING ***Transfer switch cabinet is heavy and can cause serious injury if dropped. Keep hands and feet clear while lifting cabinet.***

Place a flat washer and nut on each stud and tighten securely. The floor must be flat or the cabinet may be distorted when the mounting nuts are tightened.

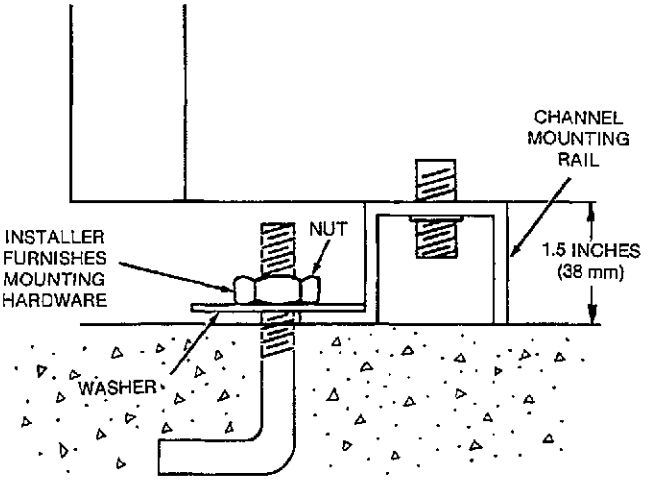

FIGURE 2. MOUNTING HARDWARE

WIRING RECOMMENDATIONS

Before wiring is started, make sure the generator set is serviced for operation, then test the generator set from its own controls. Stop and take precautions to prevent the generator set from starting (including removing the starting battery cables).

WARNING ***Take precautions against accidental starting of the generator set including disconnecting the battery cables before performing wiring procedures. Failure to follow this procedure may result in serious personal injury or death.***

General

Make all wiring openings ***only*** in the area specified in the outline drawing.

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

If using nonflexible conduit between transfer switch and generator set, install at least 2 feet (61 cm) of flexible conduit between the generator set and nonflexible section to absorb vibration. Run control circuit wiring in separate conduit from the AC power cables to avoid inducing currents that could cause problems within the control.

Generator Set and Load Connections

Use wires of sufficient size to carry the rated current to connect the generator set to the transfer switch and the transfer switch to the load. Make connections to the transfer switch terminals as shown in Figures 3 and 4. The lug terminals for 400 Ampere switches will accept two copper or aluminum conductors ranging in size from #2 to 500 MCM. The lug terminals for 800 and 1000 Ampere switches will accept four copper or aluminum conductors ranging in size from #2 to 600 MCM. Match the generator set phase rotation to the normal line phase rotation when making connections.

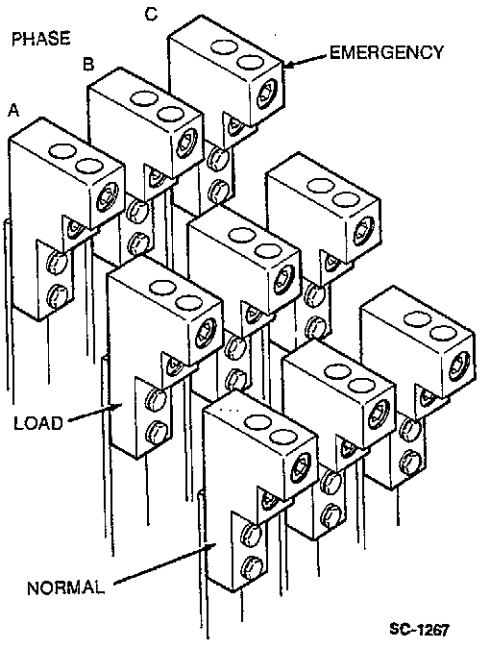

FIGURE 3. TERMINAL LUGS FOR 400 AMP TRANSFER SWITCH

For transfer switches with the optional AC Ammeter, route each of the generator output wires through one of the three current transformers as shown in Figure 5. The wire must pass once (1 primary turn) through the current transformer for proper meter operation.

A neutral bar is provided for connecting the neutral wire if used.

Control Connections

Route all control wires in a separate conduit from the load wires to avoid induced currents.

Two Wire Remote Start-Stop Connections: Use three wires to connect the remote start terminal block in the generator set control (water cooled sets) to terminal block TB1 (see Figure 6) on the transfer switch. Use number 16 wire for distances up to 100 feet (30 metres) with a maximum resistance of 0.5 ohm per line. Connect the following terminals:

Generator Remote Start Terminal Block		**Transfer Switch Terminal Block TB1**
REMOTE	connect to	#4
B+	connect to	#2
GND (ground)	connect to	#1

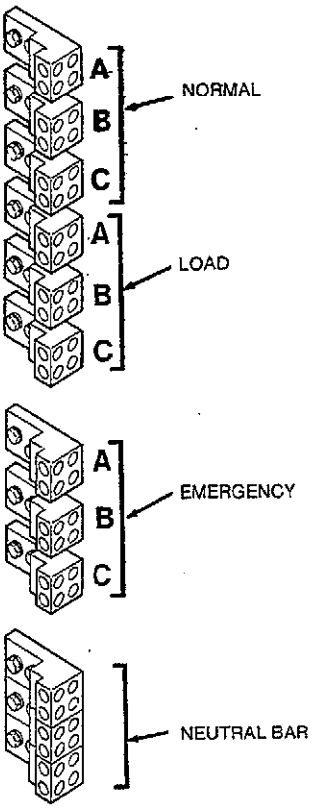

FIGURE 4. TERMINAL LUGS FOR 800 AND 1000 AMP SWITCHES

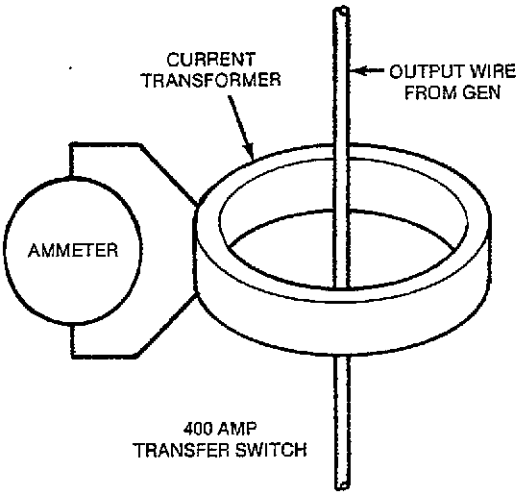

FIGURE 5. CURRENT TRANSFORMER

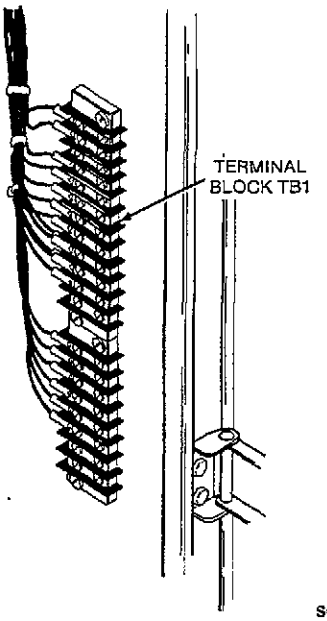

FIGURE 6. TERMINAL BLOCK TB1

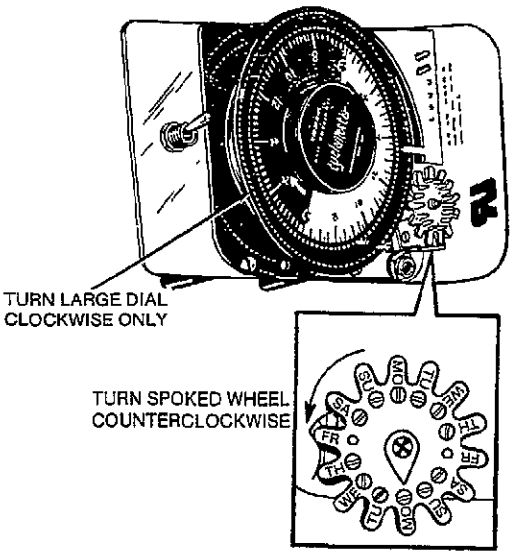

FIGURE 7. EXERCISER

Auxiliary Contacts (if used): Auxiliary contacts are located on the normal and emergency sides of the transfer switch for external alarm or control circuitry. Connections for auxiliary contacts can be made on terminal block TB1 terminals 13 through 18. The contacts have ratings of 10 amperes at 480 VAC. The list below shows the position (open or closed) of the auxiliary contacts when the transfer switch is in the center position. Moving the transfer switch to the normal or emergency side only affects the auxiliary contacts on that side.

NORMAL AUXILIARY CONTACT	EMERGENCY AUXILIARY CONTACT
TB1-13 — N/O	TB1-16 — N/O
TB1-14 — N/C	TB1-17 — N/C
TB1-15 — COM	TB1-18 — COM

Cleaning Cabinet

After mounting and wiring of cabinet are completed, clean the interior with a vacuum cleaner to remove any chips, filings, or dirt from the cabinet interior and components.

ADJUSTMENTS

Make the adjustments described in the following sections as required.

WARNING ***Take precautions against accidental starting of the generator set including disconnecting the battery cables before adjusting exerciser clock. Failure to follow this procedure may result in serious personal injury or death.***

Exerciser Clock Settings (if Equipped)

Check exerciser. It normally has a factory program for one-half hour exercise once per week (12:00 to 12:30 p.m. on Saturdays).

To Change Exerciser Program:

1. On the large dial, install a trip pin (left-hand thread) in the inside row of holes for the time of day you want the generator set to start. See Figure 7.
2. On the large dial, install a trip pin (left-hand thread) in the outside row of holes for the time you want to stop the generator set exercise period.

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

3. Install a trip pin (left-hand thread) into the small spoked wheel for every day no exercise is desired.

To Set Exerciser for Correct Day and Hour:

1. Rotate the large dial clockwise until the correct time of day aligns with the pointer.
2. Turn 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.

Programmed Transition (if Equipped)

The programmed transition time delay is attached to the plastic shield (see Figure 8) that covers the transfer switch. It is normally set by the factory for a two second delay.

Depending on the model, the programmed transition either has a time delay range of 0.5 to 5.0 seconds, 1.5 to 15 seconds, or 5 to 50 seconds (three timers are available). To adjust, turn the knob clockwise to increase the delay and counterclockwise to decrease the delay. The time increments are marked on the knob.

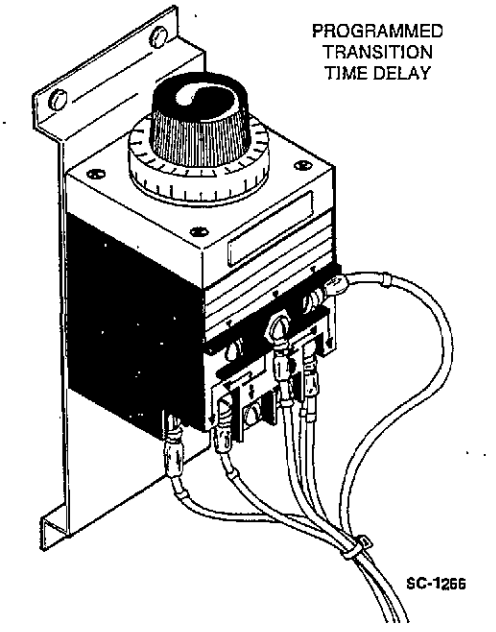

FIGURE 8. PROGRAMMED TRANSITION

Switch Positions

Set all switches as described in the following sections.

Operation Selector Switch: Move the Operation Selector switch on the generator control panel to STOP.

Exciser (if equipped): Move the switch on the exerciser to WITH LOAD or WITHOUT LOAD, depending on whether you want the generator set to exercise with or without a load applied. Selecting WITH LOAD results in load transfer during the exercise period. Close cabinet door when set.

Bypass Switch: Move the Bypass switch handle on the front of the cabinet to AUTOMATIC.

Test/Normal/Retransfer Switch: Move the key-operated Test/Normal/Retransfer switch on the transfer cabinet to NORMAL.

AC Power Connection

Connect AC line power to the automatic transfer switch by closing the service entrance switch or main circuit breaker. The green normal source available light on the cabinet front should light.

WARNING ***Connecting AC power to the transfer switch will energize many of the load circuits. To avoid serious personal injury or death from electrical shock, all load circuit wiring must be completely installed.***

ELECTRONIC CONTROL SETTINGS

The adjustment 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. 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 may result in abnormal operation of the transfer switch.***

Complete all installation procedures before making adjustments to the Time Delay Module or the Voltage Sensor Modules. All adjustments are made by inserting a screwdriver through the small openings in the module panel.

WARNING ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***

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 9. Range of adjustments and factory settings are as follows:

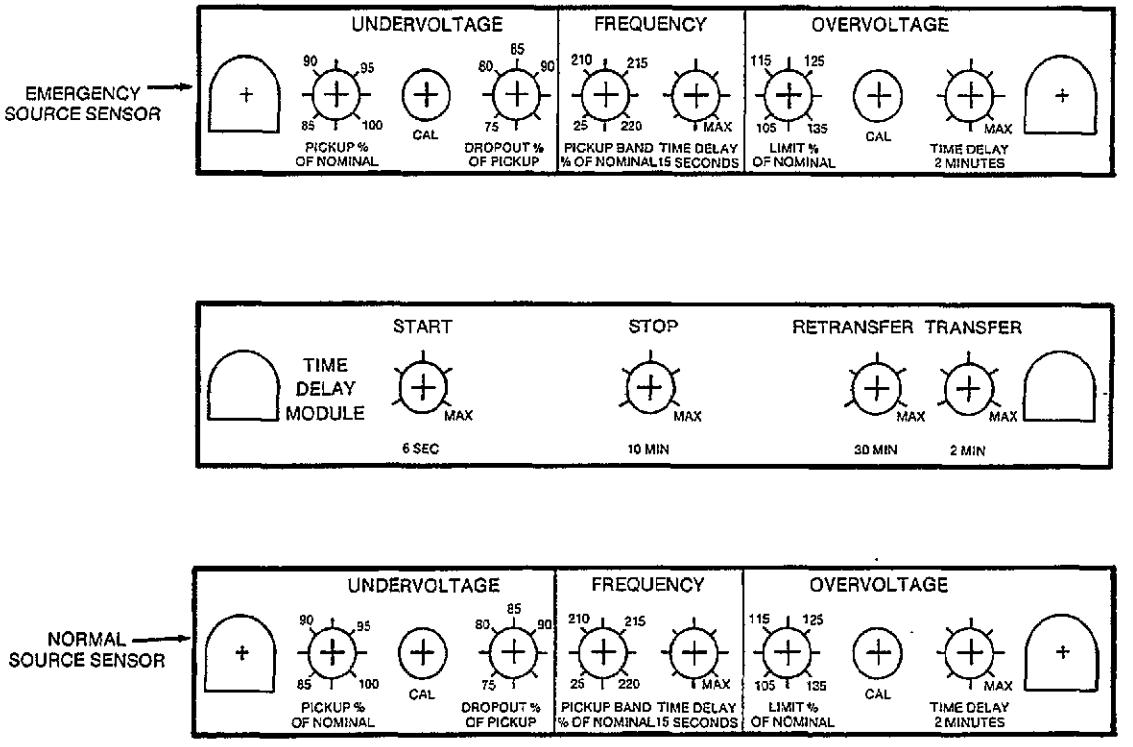

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FIGURE 9. TIME DELAY MODULE AND VOLTAGE SENSORS

DELAY	ADJUSTMENT	FACTORY SETTING
Start	0-6 seconds	2 seconds
Transfer	0-120 seconds	2 seconds
Retransfer	0-32 seconds	15 minutes
Stop	0-8 minutes	5 minutes

Voltage Sensor Modules

A separate voltage sensor (see Figure 9) 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%

A separate voltage sensor is used for each power source. Calibrate the undervoltage sensor using the following procedure.

1. To calibrate the normal source undervoltage sensor (source 1), the green normal source available light should be on.
2. Turn and hold the Source Select switch to the normal source and move the bypass switch handle to the normal source position.
3. Turn the undervoltage pickup and dropout potentiometers on the voltage sensor fully clockwise.
4. Turn the undervoltage calibration (CAL) potentiometer fully clockwise. The Source 1 OK lamp (Source 2 OK for emergency source)should be on (see Figure 10). If the Source OK lamp fails to come on and the voltage sensor has an overvoltage sensing option, turn the overvoltage LIMIT and CAL potentiometers fully clockwise.
5. Turn the CAL potentiometer counterclockwise until the source OK lamp turns off.
6. Slowly turn the CAL potentiometer clockwise until the Source OK lamp just turns on again.

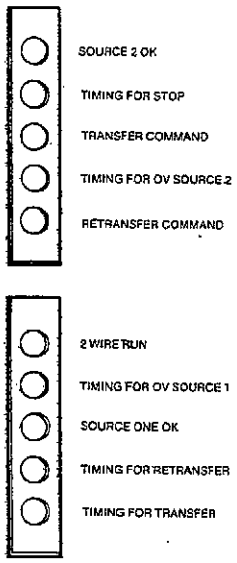

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FIGURE 10. CONTROL LAMPS

7. The undervoltage sensor is now calibrated. If the overvoltage sensor was adjusted in step 4, then recalibrate it using the overvoltage sensor calibration procedure.
8. Reset the Pickup and Dropout potentiometers to the factory settings or to the desired settings.
9. To calibrate the emergency source undervoltage sensor (source 2), emergency source voltage must be available. Use the Engine Start Switch (located on transfer switch control panel) to start the generator set. The emergency source available lamp should go on.
10. Follow steps 3 through 8 to calibrate the emergency source undervoltage sensor.
11. Turn the Engine Start switch off and move the bypass switch handle to the automatic position.

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 9. 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 overrides 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. To calibrate the normal source overvoltage sensor (source 1), the green normal source available light should be on. On voltage sensors with the frequency sensing option, the source frequency must be within the limits set by the FREQUENCY PICK-UP BAND potentiometer.
2. Turn the Source Select switch to the normal source and move the bypass switch handle to the normal source position.
3. Turn the overvoltage LIMIT and TIME DELAY potentiometers on the voltage sensor fully clockwise.
4. Turn the overvoltage calibration (CAL) potentiometer fully clockwise. The Source 1 OK lamp (Source 2 OK for emergency source) should be on (see Figure 10).
5. Turn the CAL potentiometer counterclockwise until the Source OK lamp turns off.
6. Slowly turn the CAL potentiometer clockwise until the Source OK lamp just turns on again.
7. Reset the OVERVOLTAGE LIMIT and TIME DELAY potentiometers to the factory settings or to the desired settings.
8. To calibrate the emergency source overvoltage sensor (source 2), emergency source voltage must be available. Use the Engine Start switch to start the generator set. The emergency source available lamp should go on.
9. Follow steps 3 through 7 to calibrate the emergency source overvoltage sensor.
10. Turn the Engine Start switch off and move the bypass switch handle to the automatic position.

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 9. 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.

CHECKOUT PROCEDURES

The following sections cover several checkout procedures for verifying that the transfer switch and generator are operational.

Battery Charger (Optional)

Refer to the generator set operators manual for the proper procedures for connecting the starting batteries. Once connected, check the battery charger ammeter (located inside transfer switch cabinet) to verify that the charger is operating.

WARNING ***Use care when opening cabinet door. High voltages within cabinet and rear side of cabinet door present a serious electrical shock hazard which could cause serious personal injury or death.***

Overcrank Test

Test the generator set overcrank relay using the following procedure:

1. Disconnect the positive lead from the starter. Insulate lead so it cannot touch metal frame.
2. Move the operation selector switch on the engine control to *REMOTE.*
3. Move the Test/Normal/Retransfer switch to TEST. Fault or overcrank lamp on engine control should light at the end of crank period (usually factory set at 75, ±15 seconds).
4. Move the Test/Normal/Retransfer switch to *NORMAL.*
5. Move the generator set operation selector switch to *STOP.*
6. Reconnect positive lead to starter.
7. Move the generator set operation selector switch to *REMOTE.*

Starting Test

Test the generator set starting system using the following :

1. Move selector switch on engine control to *RUN.* Generator set should start and run.
2. Move selector switch to *REMOTE.* Generator set should stop.

Transfer Switch Test

Make the following test with a load applied to verify that the complete system (switch, control, and generator) is operational. A momentary interruption in power will occur when the load is transferred to the emergency source during testing.

1. If optional exerciser is included, open cabinet and move the With Load/Without Load selector switch to the *WITH LOAD* position.

WARNING ***Use care when opening cabinet door. High voltages within cabinet and rear side of cabinet door present a serious electrical shock hazard which could result in serious personal injury or death.***

2. Verify that the bypass switch handle is in the *AUTOMATIC* position.
3. Move the Test/Normal/Retransfer switch to the *TEST* position. The generator set should start and the load should transfer to the emergency source after the preset time delays elapse. The red Emergency Source and Transfer-Switch-Position lamps should be *ON.*
4. Check the operation of the AC meters on the cabinet (if equipped) to verify that the meters are functioning properly.
5. Move the Test/Normal/Retransfer switch to the *NORMAL* position. The load should retransfer to the Normal Source and the generator set should stop after the preset time delays elapse. The green Normal Source and Transfer-Switch-Position lamps should be *ON.*

Bypass Switch Test

Make the following tests to verify that the bypass switch and interlock system is operational. Begin test with generator set off and load supplied by normal power source. Note that some tests will result in momentary power interruptions.

Same Source Bypass Test:

1. Turn and hold the Source Select switch to the normal source and move the bypass switch handle to the normal source position.
2. Turn the key operated Drawout Release switch and hold against the tension of the spring return. Turn the drawout crank handle counterclockwise until the amber test light comes on and then release the Drawout Release switch.
3. If the bypass switch is operational, no power interruption should occur. The green Bypass Switch-Position light should be ON and the green Transfer-Switch-Position light should be ON.
4. Turn the key operated Drawout Release switch and hold against the tension of the spring return. Turn the drawout crank handle clockwise until the limit of rotation is reached.
5. Release the Drawout Release switch and push the Reset switch. The green Transfer-Switch-Position light should be *ON.*
6. Move bypass switch handle to the automatic position.

Dead Source Bypass Test:

1. With the generator set off, turn and hold the source select switch to the emergency power side and attempt to move the bypass switch handle to the emergency side.
2. The interlock mechanism should prevent the load from transferring to a dead source.

Opposite Source Bypass Test:

1. With the bypass switch in the *AUTOMATIC* position, move the engine start switch to the *RUN* position. The generator set should start and the red Emergency Source light should come on. Allow the generator set to run for a few minutes before going to step 2.
2. Turn and hold the Source Select switch to the emergency source and move the bypass switch handle to the emergency source position. A momentary interruption in power will occur during transfer.
3. Verify that the red Bypass-Switch-Position light is ON.
4. Move bypass switch handle to the *AUTOMATIC* position. A momentary interruption in power will occur during retransfer.
5. Allow generator set to run for 5 minutes and then turn engine start switch to *STOP.*

Description

GENERAL

This section describes the standard and optional items or features of the automatic transfer switch, bypass switch, cabinet, and control. It should be noted that the control is for generator sets with two wire starting systems (Onan water-cooled sets).

INDICATOR LAMPS

Six indicator lamps are used to show power source availability, transfer switch position, and bypass switch position. Refer to Figure 11 for the location of each lamp.

Normal Source Available (Green): Indicates normal power source is available.

Emergency Source Available (Red): Indicates emergency power source is available.

Transfer Switch Position (Green): Indicates automatic transfer switch is in normal power position.

Transfer Switch Position (Red): Indicates automatic transfer switch is in emergency power source position.

Bypass Switch Position (Green): Indicates the bypass switch is in the normal power source position.

Bypass Switch Position (Red): Indicates the bypass switch is in the emergency power source position.

A single amber indicator light is used to indicate when the transfer switch has been drawn out to the test position.

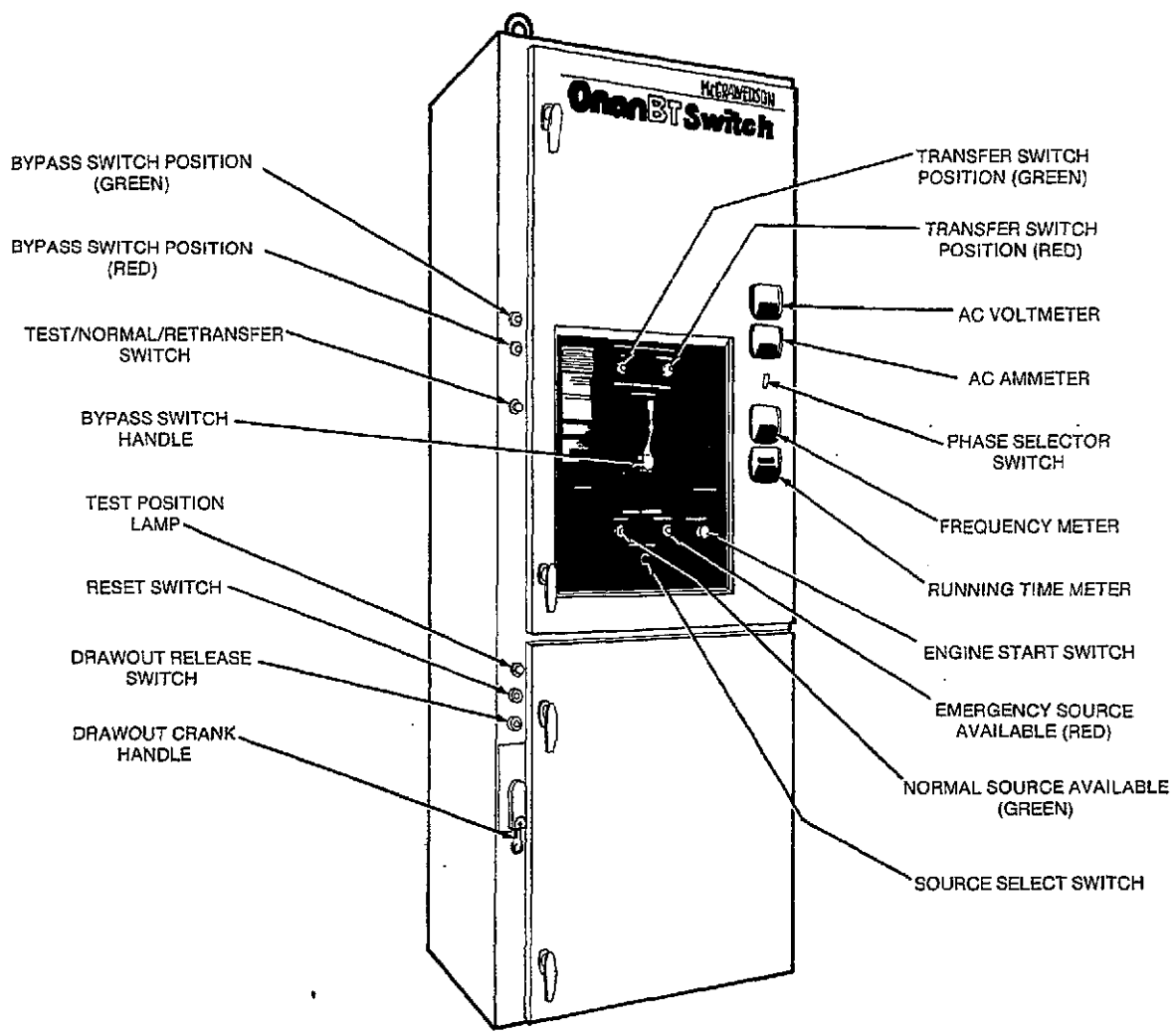

FIGURE 11. 400 AMP BT TRANSFER SWITCH

METERS

Onan has meter options as operating indicators of the emergency power source. These include an AC voltmeter, AC ammeter, frequency meter, and running time meter. Figure 11 shows the location of these optional meters.

AC Voltmeter: The voltmeter measures line-to-line voltage of the emergency power source. For three-phase voltages, a selector switch is included.

AC Ammeter: The ammeter measures the line currents of the emergency source output. For three-phase systems, a selector switch is included.

Frequency Meter: This meter measures the output frequency of the emergency power source in hertz.

Running Time Meter: A running time meter records the time the generator set has run in hours and tenths of an hour.

SWITCHES

The following sections explain the purpose and function of the various switches on the cabinet. Refer to Figure 11 for location.

Test/Normal/Retransfer Switch

This switch has three positions and has the capability to simulate a power outage for test purposes. In the *NORMAL* position, the automatic transfer switch is set for automatic operation. Moving the switch to *TEST* sends a start signal to the generator set. The generator set will start and assume load for as long as the switch is in this position.

Moving the switch back to *NORMAL* causes load transfer back to the normal power source, after the retransfer time delay expires (see Control System section for time delay description). To avoid the delay and have instant retransfer of load to the normal power source, the switch can be moved to the spring-return position *RETRANSFER*.

Bypass Switch and Source Select Switch

The Bypass switch is used in conjunction with the Source Select switch. The Source Select switch controls an interlock device. The interlock prevents the bypass switch from connecting the load to a dead source or to both sources at the same time. To operate the Bypass switch, the Source Select switch must first be turned to the source that will be connected to the load. This releases the interlock and makes it possible to turn the Bypass switch handle.

Drawout Release Switch and Reset Switch

The Drawout Release switch is used when the transfer switch is to be drawn out for testing or service. Turning the key operated Drawout Release switch causes the transfer switch to go to the center position and releases the drawout crank handle. When testing or service is complete, turning the Drawout Release switch allows the transfer switch to be reconnected. After reconnection, pushing the Reset switch returns the transfer switch to the same position as the bypass switch.

Additional Switches

Engine Start Switch: Key operated switch allows generator set to be started from the transfer switch cabinet.

Phase Selector Switch: Selects generator phase for AC voltmeter and AC ammeter reading.

CONTROL SYSTEM

The control system operates as the overall supervisor for the transfer switch and generator set. The following sections cover the various functions of the control.

Starting Circuit

The starting circuit is one of the basic supervisory functions of the control system. When a power outage occurs, a start and run signal is sent to the generator set. When power is restored, a stop signal is sent to the generator set.

A two wire starting circuit is used with the BT automatic transfer switch. Operation of a two-wire starting circuit can be thought of as a single pole, single throw switch. A closed switch signals the generator set to start and run. An open switch signals the generator set to stop. The generator set starting battery provides the operating voltage.

Time Delays

Start Time Delay: This delay, adjustable from zero to six seconds, provides a factory-set, two-second delay before the generator set is allowed to start. It starts timing the moment of normal power interruption. If the duration of power interruption exceeds the delay time, the BT signals the generator set to start. The purpose of the start time delay is to prevent the generator set from starting when power interruptions of very short duration occur.

Transfer Time Delay: The transfer time delay begins the moment generator voltage and frequency reach the pick up settings of the control. At the end of the transfer delay, the transfer switch is allowed to operate, transferring the load to the emergency power source. This brief time delay (factory setting of two seconds) allows the generator set to stabilize before load is applied. It has a time range adjustable from zero to two minutes.

Retransfer Time Delay: This time delay, set for 15 minutes at the factory, begins the moment normal line voltage and frequency return. At the end of the delay, the transfer switch is allowed to retransfer the load to the normal power source. The delay allows the normal power source to stabilize before retransfer. It has a time range adjustable from 0 to 32 minutes.

Stop Time Delay: The stop time delay, adjustable from zero to eight minutes, is factory set for five minutes. It begins timing when the load is retransferred to the normal power source. At the end of the stop time delay, the stop signal is sent to the generator set. The purpose of this time delay is to allow the generator set to cool while running at no load.

Voltage Sensing

Undervoltage Sensing: If the monitored source voltage falls to the drop-out point, a signal is made to transfer the load to the other power source. The sensors are set to pick up at 95 percent of the nominal voltage and drop out at 85 percent of the pickup setting. The pickup setting is adjustable from 85 to 100 percent of the nominal voltage, and the drop-out setting is adjustable from 75 to 98 percent of the pickup setting.

If you want to connect load to the normal power source, for example, the normal source voltage would have to be 95 percent of the nominal voltage. Once connected, the voltage sensor would not signal for a drop of load unless normal voltage fell below 85 percent of the pickup setting.

Frequency Sensing: Optional frequency sensing for the Normal and Emergency power source detects when frequency is within an adjustable bandwidth (±4 to ±20%). If the frequency goes above or below the bandwidth, the automatic transfer switch will initiate transfer of load to the other source. An adjustable dropout time delay allows the control to ignore momentary dips or rises in frequency.

Overvoltage Sensing: Optional overvoltage sensing of all lines is available along with undervoltage and frequency sensing.

The overvoltage sensing limit is adjustable from 105 to 135 percent of the nominal voltage, and is factory set at 110 percent. The overvoltage pickup point is fixed at 5 percent below the limit setting. An adjustable time delay overrides momentary overshoots in voltage.

Programmed Transition (Optional)

Programmed transition is an optional feature of BT transfer switches. Programmed transition is the capability of the transfer switch to assume a mid-transition position, for an adjustable interval of time, when the load is neither connected to the normal power source nor to the emergency power source. This feature allows residual voltages in a motor load to decay to an acceptable level before transition is completed. The length of time that the transfer switch is in the midposition can be adjusted from 0.5 to 5 seconds, 1.5 to 15 seconds, or 5 to 50 seconds, depending on the timer option. The proper adjustment is a function of the motor and its connected load.

Exerciser (Optional)

The exerciser initiates generator set starting and exercising for preset intervals. It is a fourteen-day, twenty-four hour clock. A large dial divides the twenty-four hour day into fifteen-minute intervals. A smaller spoked dial divides two weeks into one-day segments. Placement of trip pins in the dial faces determine exercise periods.

Preferably, the generator set should have load during the exercise periods. However, the *WITH LOAD/ WITHOUT LOAD* selector switch on the exerciser gives you the option of exercise load conditions. The *WITH LOAD* position means the generator set will assume any loads (during exercise periods) that normally are supplied through the transfer switch from the normal power source.

Battery Float Charger (Optional)

Battery chargers are available for 12-volt and 24-volt battery systems. For 12 volts, the battery charger system is available either as a 2-ampere or 10-ampere charger. For 24 volts, the battery charger option is available either as a 2-ampere or 6-ampere charger. All are voltage regulated to "float charge" the battery continuously without damage to the battery. As the battery approaches full charge, the charging current automatically tapers to zero amperes or to steady-state load on the battery. The chargers can be used with either lead acid or nickel cadmium batteries.

TRANSFER SWITCH

The transfer switch does the work of opening and closing the contacts that transfer the load between normal and emergency power. The transfer switch is a set of multipole, single throw, electromechanical switches, that are mechanically interlocked to prevent simultaneous closing to both power sources. The principal parts of the transfer switch discussed here are the contact assemblies, linear actuator, auxiliary contacts, and isolation mechanism.

Contact Assemblies

The contact assemblies actually make and break the current flow. When closed to either the normal or emergency power source, these contacts are mechanically held. A mechanical interlock prevents the contact assemblies from closing to both power sources at the same time.

Series BT transfer switches are multipole switches which open and close more than one current path, or pole, with a common switching means.

Linear Actuator

The linear actuator moves the contact assemblies from the normal power source to the emergency power source and back again as required. The linear actuator is a linear induction motor that acts upon an actuator rod, which moves the contact assemblies. Operation of the linear actuator is electrical and is initiated automatically with automatic transfer switches.

Auxiliary Contacts

Auxiliary contacts are provided on both the normal and emergency side of the transfer switch. They are actuated by the operation of the transfer switch during transfer and retransfer. The auxiliary contacts have current ratings of 10 amperes at 480 VAC.

ISOLATION MECHANISM

The drawout-isolation mechanism allows the transfer switch to be isolated for testing or service. The transfer switch is mounted on rails and may be drawn out by turning an external crank handle. A special set of isolation contacts permits the transfer switch to be disconnected from the AC circuitry as required.

When the transfer switch is drawn out to the test position, the load and power sources are disconnected from the transfer switch. However, the transfer switch control continues to receive AC power from whatever source is supplying the load. This permits the operator to test the various control functions such as the start circuit, time delays, etc.

When the transfer switch is fully drawn out, the transfer switch and control are fully isolated from the load and all power sources. If necessary, the cabinet can be opened and the complete transfer switch assembly can be lifted from the rails for service.

A key operated interlock limits operation of the drawout-isolation mechanism to authorized personnel. No load break will occur when the transfer switch is drawn out if the bypass switch is set correctly (see bypass switch description).

BYPASS SWITCH

The bypass switch allows the operator to manually connect the load directly to the available power source and bypass the transfer switch. This avoids an interruption in power when the transfer switch is drawn out for testing or service. An interlock system prevents the load from being connected to a dead source or to two sources at the same time.

Bypass Switch Handle

The bypass switch handle has three positions: 1) automatic, 2) normal, 3) emergency. Turning the switch handle to automatic places the bypass switch in the center position and makes the load connection dependent on the position of the automatic transfer switch. The bypass switch must be in this position for automatic transfer switch operation. Turning the switch handle to normal or emergency manually connects the load to that source.

Interlock System

The interlock system prevents the operator from connecting the load to a dead source or to two sources at the same time. Before turning the bypass switch handle, the Source-Select switch must be turned to the source that will be connected to the load. If the automatic transfer switch is already connected to the same source, the operator will be able to move the bypass switch handle without load interruption. This operation is called bypassing to the **same** source.

If the automatic transfer switch is not connected to the same source, turning the Source-Select switch to the opposite source will cause a short power interruption. Turning the bypass switch handle to the desired source will restore power. This operation is called bypassing to the **opposite** source.

If AC voltage is not present at the source selected, the interlock will prevent the operator from moving the bypass switch handle to that source. This avoids an interruption in power by preventing the operator from bypassing to a **dead** source.

Operation

AUTOMATIC TRANSFER SWITCH OPERATION

For emergency standby use, the BT switch should be set for automatic operation. Place the following control switches in the positions indicated. Refer to the generator set operators manual for instructions on placing the generator set on automatic operation.

Test/Normal/Retransfer Switch - NORMAL

Bypass Switch Handle - AUTOMATIC

Run/Stop/Remote Switch - REMOTE (Generator Set Control)

AUTOMATIC TRANSFER SWITCH TEST

This procedure allows the operator to test the automatic transfer switch and control without actually transferring the load to the generator set. This avoids a momentary interruption in power during the testing period.

During the test, the load is connected to the normal source through the bypass switch. This allows the transfer switch to be drawn out to the test position. Verify that the load is connected to the normal source before beginning the test. Use the following procedures to test:

1. Turn the Source Select switch to the **normal** source and move the bypass switch handle to the **normal** source position (see Figure 12). Release the Source Select switch.

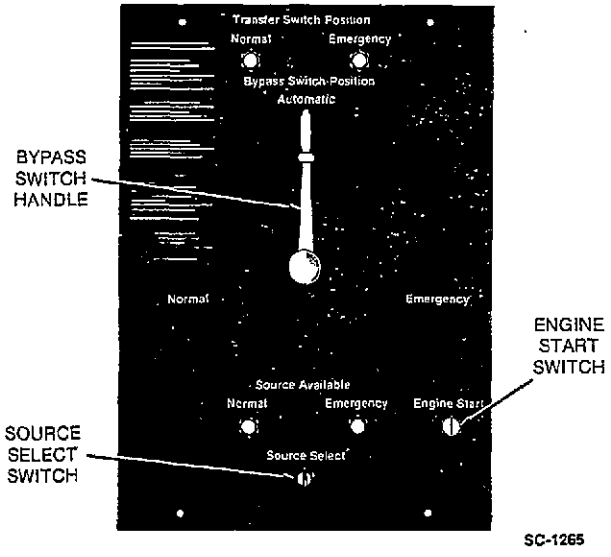

FIGURE 12. BYPASS SWITCH

2. Turn the key-operated Drawout Release switch and hold against the tension of the spring return. Turn the drawout crank handle counterclockwise until the test light comes on and then release the Drawout Release switch.
3. Move the Test/Normal/Retransfer switch to *TEST*. The generator set should start after the start time delay (factory setting of 2 seconds) and assume the load after the transfer time delay (factory setting of 2 seconds). (Note: Load does not actually transfer to generator set)
4. At the completion of the test period, move the Test/Normal/Retransfer switch to *NORMAL*. The load should retransfer to the normal source after the retransfer time delay (factory setting of 15 minutes) and the generator set should stop after the stop time delay (factory setting of 5 minutes). The load can be retransferred to the normal source immediately by turning the Test/Normal/-Retransfer switch to *RETRANSFER*.
5. Turn the key operated Drawout Release switch and hold against the tension of the return spring. Turn the drawout crank handle clockwise to the limit of its rotation.
6. Release the Drawout Release switch and then push the Reset button.
7. Move the bypass switch handle to the automatic position to return transfer switch to automatic operation.

This test verifies that the generator set starting system and transfer switch control are fully operational.

ISOLATING THE TRANSFER SWITCH FOR SERVICE

The operator can manually bypass the load to the normal source or to the emergency source if it is necessary to isolate the transfer switch for servicing. If bypassing the load from the normal source to the emergency source, start the generator set before proceeding. A key operated Engine Start switch is located on the cabinet (see Figure 12) for this purpose. Turning the Engine Start switch will initiate the generator set start sequence. Use the following procedures to isolate:

1. Turn the Source Select switch to the source that will be connected to the load. If bypassing to the opposite source, the power will be momentarily interrupted.
2. While holding the Source Select switch, move the bypass switch handle to the source to be connected to the load.

3. Release the Source Select switch. The load is now bypassed and the automatic transfer switch may be isolated for service without load interruption.
4. Turn the key operated Drawout Release switch and hold against the tension of the return spring. Turn the drawout crank handle counterclockwise to the limit of its rotation.
5. Release the Drawout Release switch. The lower cabinet door may be opened to service the transfer switch as required.

To Reconnect the Transfer Switch:

1. Turn the key operated Drawout Release switch and hold against the tension of the return spring. Turn the drawout crank handle clockwise to the limit of its rotation.
2. Release the Drawout Release switch and then push the Reset button.
3. Move the bypass switch handle to the automatic position to return the transfer switch to automatic operation. If the generator set was connected to the load, wait five minutes before turning the Engine Start switch to normal. This is to allow the generator set to cool while running at no load.

EXERCISE

Onan recommends running the generator for at least 30 minutes once each week with at least 50 percent load (if possible). If you do not have an optional exerciser, use the Test/Normal/Retransfer switch to exercise the generator set each week. Move the Test/Normal/Retransfer switch to the *TEST* position to simulate a power interruption. This will cause the generator set to start and to assume the load for as long as the switch is in the *TEST* position.

The optional exerciser has preselected exercise periods and exercises the generator set automatically with or without load, depending on its switch position, *WITHOUT LOAD* or *WITH LOAD*. If the normal power source has an interruption while the generator set is exercised without load, the automatic transfer switch will transfer the load to the generator set.

Troubleshooting

POWER OUTAGE OCCURS, BUT GENERATOR SET DOES NOT START

1. Check for overcrank condition.
2. Check generator set control panel. The operation selector switch on the generator set control panel should be set at *REMOTE*.
3. Check generator set. Start with start-stop controls on generator set. If it does not crank, check starting batteries. If it cranks but does not start, check fuel supply.

GENERATOR SET STARTS DURING NORMAL POWER SERVICE

1. Check generator set control panel. The operation selector switch on the generator set control panel should be set at *REMOTE*.
2. Check Test/Normal/Retransfer switch to make sure it is set at *NORMAL* position.
3. Check exerciser clock schedule to see if generator set is scheduled for exercise period.
4. Check the line voltage to make sure it is normal on all phases.
5. Momentary voltage dips might cause voltage sensors to initiate generator set starting. If problem persists, contact authorized service personnel. Voltage sensing settings might have to be changed.

GENERATOR SET DOES NOT EXERCISE (IF EQUIPPED WITH EXERCISER)

1. Check generator set control panel. The operation selector switch on the generator set control panel should be set at *REMOTE*.
2. Check generator set. Start with start-stop controls on generator set. If it does not crank, check the starting batteries. If it cranks but does not start, check the fuel supply.
3. Exerciser clock may be set incorrectly or not operating properly. Contact authorized service personnel for assistance.

GENERATOR SET STARTS BUT DOES NOT ASSUME LOAD

1. Check output voltage of the emergency power source.
2. Check bypass switch position. The bypass switch handle must be in the *AUTOMATIC* position for automatic transfer switch operation.
3. Check to see if automatic transfer switch is withdrawn for testing or service. If transfer switch is not operable, use manual bypass switch to connect load to source.

NO TRANSFER OF LOAD TO NORMAL POWER FROM GENERATOR SET

1. Check line voltage to make sure it is normal. Otherwise, retransfer will not occur.
2. The retransfer time delay period might not have expired. Wait a few moments.
3. Check bypass switch position. The bypass switch handle must be in the *AUTOMATIC* position for automatic transfer switch operation.
4. Check to see if automatic transfer switch is withdrawn for testing or service. If transfer switch is not operable, use manual bypass switch to connect load to source.
5. Manually initiate retransfer by turning the Test/Normal/Retransfer switch to *RETRANSFER.*
6. Stop the generator set with the start-stop switch. When the generator set stops, the transfer switch will transfer load to the normal power source if voltage is normal.

GENERATOR SET CONTINUES TO RUN AFTER RETRANSFER OF LOAD TO NORMAL POWER

Stop time delay function could be problem. Stop generator set with start-stop switch.

BATTERY CHARGER FAILS TO CHARGE (IF EQUIPPED)

Battery charger fuse may require replacement. Contact authorized personnel for assistance.

BATTERY LOSES WATER

Battery charger float voltage could be too high (if equipped with battery charger). Contact authorized service personnel for assistance.

BATTERY LOSES CHARGE

Battery charger float voltage could be too low (if equipped with battery charger). Contact authorized service personnel for assistance.

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