KS-5189, KS-5189-01, KS-5189-02, AND KS-5189-03 EMERGENCY LIGHTING RELAY SWITCHES REQUIREMENTS AND ADJUSTING PROCEDURES

CONTENTS PAGE

Figures

1. GENERAL

1.01 This section covers emergency lighting relay switches per KS-5189, KS-5189-01, KS-5189-02, and KS-5189-03. (See Fig. 1 and 2.)

1.02 This section is reissued to add the new design of the KS-5189-03.

- Revision arrows are used to emphasize the more significant changes. The Equipment Test List is affected.

1.03 Reference shall be made to Section 020-010-711 (covering General Requirements and Definitions) for additional information necessary for the proper application of the requirements listed herein.

1.04 ▶The KS-5189-03 has been designed with an undervoltage monitor to replace the undervoltage relays. The main contact has been replaced by the 909-type contactor or the 920-type contactor. The new KS-5189-03 is manufactured by Automatic Switch Company (ASCO).

1.05 The ASCO Catalog 214A304, undervoltage monitor, is designed to be used on a single-phase power source. This monitor has adjustable pickup and dropout settings. They provide high reliability, assured repetitive accuracy of response, and a long maintenance-free life. These monitors can be applied to voltage-critical loads with confidence that the product has been designed to industrial control standards.

1.06 The ASCO Catalog 214A293 undervoltage monitor is designed for use on a 3-phase power source. The monitor combines 3-phase undervoltage sensing and time delay on dropout into one unit utilizing a single output relay. Individual potentiometers are provided for readily adjusting the pickup, dropout, and time delay settings of

the monitor. The additional desirable feature of virtual zero differential about the dropout setting after initial energization has also been designed into this monitor.

1.07 The ac supply directly ahead of the emergency lighting relay switch shall be open, and the dc supply fuse at the fuse board shall be removed while making adjustments to the switch. (The small fuse on the lighting switch is in the circuit through the closing coil, and its removal does not take the voltage from the main contacts.) After adjusting, the ac and dc supplies may be reconnected for testing. Access to the undervoltage device may be accomplished by removing the relay cover.

1.08 The emergency lighting relay switch, for single-phase service, consists essentially of a contactor and undervoltage device. For operation on polyphase service, an undervoltage relay is connected across each additional phase as shown in Fig. 3. The contacts of the undervoltage relays are connected in series with the undervoltage device. The contacts of the undervoltage relays are closed when the voltage of the regular service is satisfactory. They open when the voltage is too low and release the undervoltage device which completes the circuit to operate the contactor and connect the emergency lights. The contactor locks close mechanically and in so doing de-energizes the closing coil. When the voltage of the regular service rises sufficiently, the undervoltage device again becomes energized and opens the contactor. On the early models, both battery and ground were fed through the contactor. At present, only the battery circuit is broken as shown in Fig. 3.

1.09** ***Asterisk: Requirements are marked with an asterisk (*) when to check for them would necessitate the dismantling or dismounting of apparatus or would affect the adjustment involved or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

2. REQUIREMENTS

UNDERVOLTAGE RELAYS

2.01 *Contacts and Brush Arm*

(a) When fully down, the plunger shall rest on the plunger stop screws, and there shall be a slight clearance between the plunger and the brush arm lever. The contacts shall be open.

To check for this clearance, proceed as follows. With the plunger resting on the plunger stop screws, move the brush arm with the finger from underneath.

(b) When the plunger is raised, the brush springs shall be approximately in the center of the button contacts. (See Fig. 4.)

(c) Button contacts shall make firm and approximately even contact with the associated spring contacts on the brush arm, but the pressure shall not be sufficient to cause binding of the spring contacts.

*2.02 *Operation*

(a) When ac supply of normal voltage range is applied, the plunger shall pull up and hold up and close the contacts.

To check the requirement, connect the ac supply to the relay switch. On the KS-5189-03 relay switch, see that the test switch or switches which are part of the relay switch are in the on position.

(b) When the voltage at any undervoltage relay coil fails, the plunger shall fall. When the plunger falls, it shall open the contacts.

To check the requirement, open the ac supply to the relay switch. On the KS-5189-03 relay switch, the ac supply may be disconnected by means of the test switch or switches which are part of the relay switch.

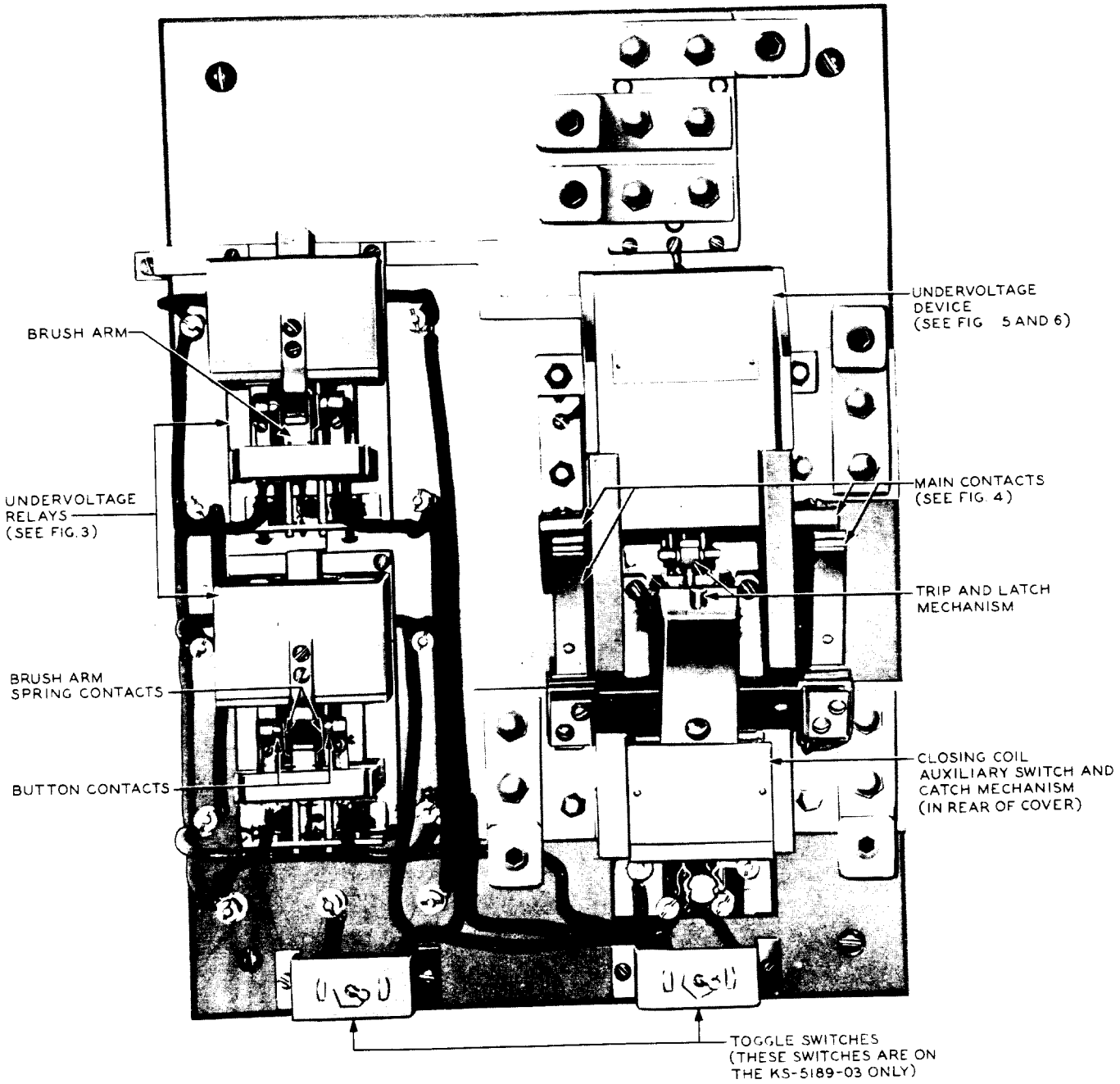

Fig. 1—Emergency Lighting Relay Switch for 3-Phase Service (Without Cabinet Old Version)

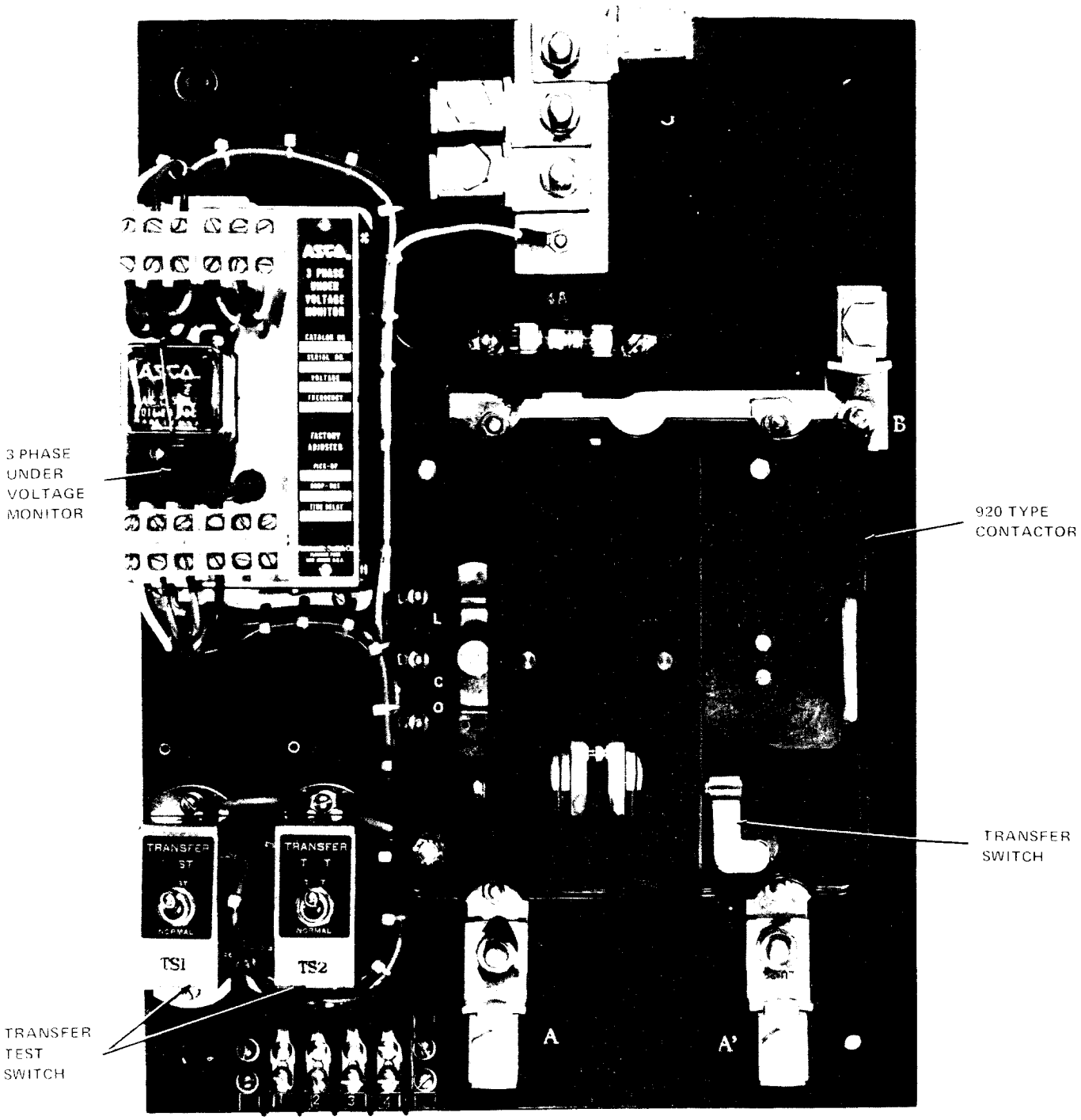

Fig. 2—Emergency Lighting Relay Switch for 3-Phase Service (New Version)

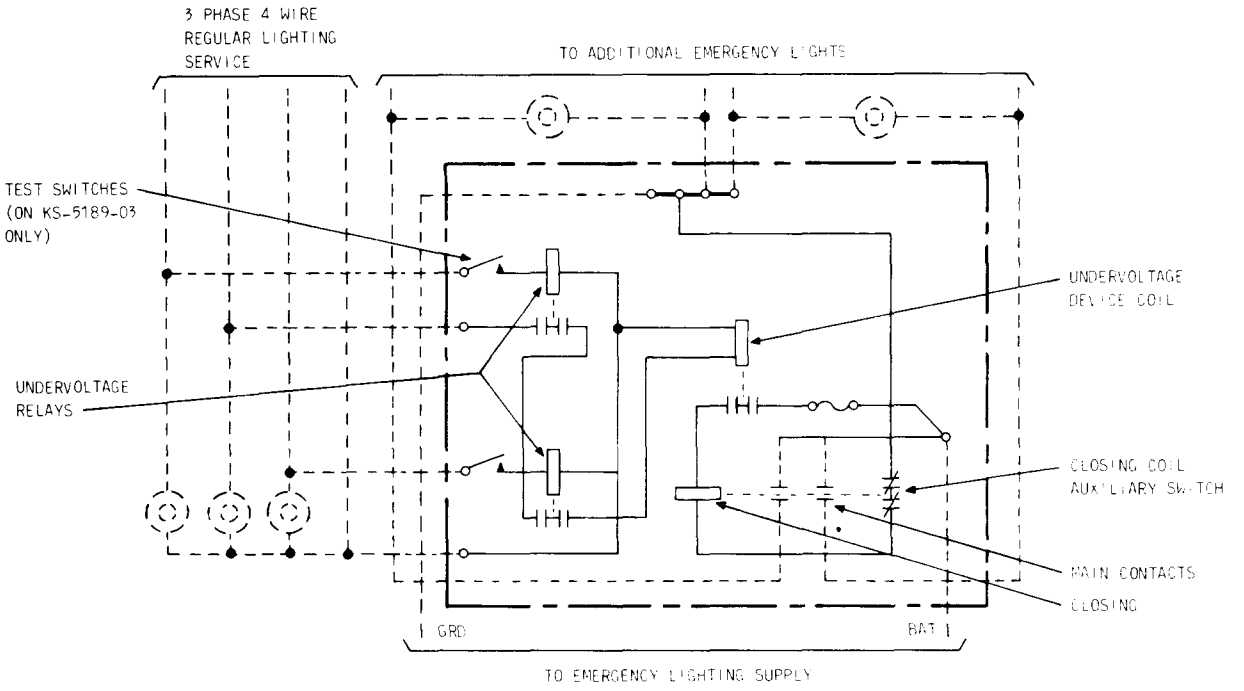

Fig. 3—Emergency Lighting Relay Switch Circuit Schematic (Old Version)

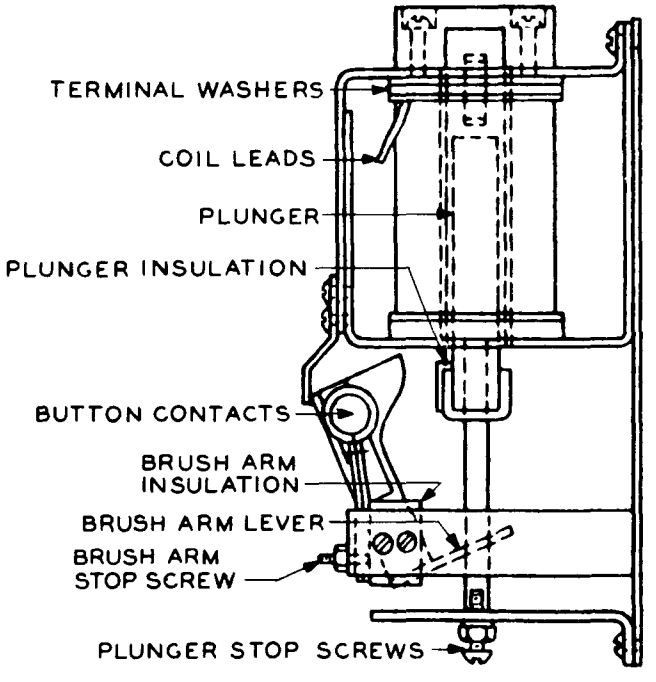

Fig. 4—Undervoltage Relay (Operated Old Version)

(c) When the voltage at the undervoltage relay coil falls below the following values, the plunger shall fall:

SERVICE	RELEASE VOLTAGE
230 volt, 1 phase, 3 wire	140
200 volt, 3 phase, 4 wire	70
115 volt, 1 phase, 2 wire	70

Note: A 120-volt coil is used for 115- and 200-volt services, the relay on the latter being connected across one side and neutral as in Fig. 3.

To check the above requirement, it will be necessary to insert a variable resistance in one ac lead at the relay switch.

▶UNDERVOLTAGE MONITOR

2.03 ***Single-Phase Operation:*** The single-phase undervoltage monitor is designed to energize the chassis mounted output relay whenever the voltage level exceeds the preset pickup point, and to de-energize the output relay whenever the

voltage level falls below the preset dropout point. The response time of the monitor on pickup is approximately 50 milliseconds. This is the total time measured from the instant the voltage attains the monitor preset pickup point until the making of the contacts on the output relay. The response time of the monitor on dropout is approximately 50 milliseconds. This is the total time measured from the instant the voltage falls below the monitor preset dropout point until the breaking of the contacts on the output relay. The continuous ratings are shown below:

RATINGS: (continuous duty)

Nominal Input Voltage	120, 208, 240, 440 or 480 Volts 50/60 Hz. (As Specified)
Maximum Input Voltage	125% of Nominal
Pickup Voltage Range of Adjustability	85% to 100% of Nominal
Dropout Voltage Range of Adjustability	80% to 95% of Pickup Voltage
Environmental Temperature Range	0°C to 45°C
Repetitive Accuracy of Response	± 2%
Volt-Ampere Burden of Monitor	2.5 VA
Transient Withstand	2000 volts for 200 micro-seconds
Output Relay:	
Contact Configuration	1 pole, n/o, double break
Continuous Current Rating	10 amperes
Voltage Rating for General Use	1 pole to load 10 amps @ 120 Vac
	6 amps @ 240 Vac
	3 amps @ 480 Vac
	2 amps @ 600 Vac
	2 pole to load 10 amps @ 480 Vac
	7.5 amps @ 600 Vac

ASCO Solid-State Voltage Monitors are insensitive to frequency over the range of 50 to 60 hertz respond to voltage levels only.

2.04 ***3-Phase Operation:*** The 3-phase undervoltage monitor is designed to energize the chassis mounted output relay, whenever the voltage level on all three phases exceeds the preset pickup point. The monitor will de-energize the output relay whenever the voltage level on any one or more phases falls below the preset dropout point and remains at this level until the time delay has expired. (See Fig. 5.) Should the voltage level of the low phase raise to a point slightly above the dropout setting before the time delay has expired, the monitor will reset itself automatically and give no indication of failure (virtual zero differential about the dropout setting). Should the voltage level remain below the dropout setting for the duration of the time delay, the output relay will de-energize and the voltage level on all three phases must be raised above the pickup setting before the monitor will automatically reset itself. The time delay is accurate and effective over the monitors entire range of adjustability. The continuous ratings are as follows:

RATINGS: (continuous duty)

Nominal Input Voltage	120/208, 240/416, 277/480 Volts, 3 phase, 4 Wire or 120, 208, 240, 440, 480 Volts, 3 Phase, 3 Wire, 50/60 Hz (As Specified)
Maximum Input Voltage Range	125% of Nominal
Under Voltage Pickup Range of Adjustability	85% to 100% of Nominal
Under Voltage Dropout Range of Adjustability	75% to 98% of Pickup Voltage
Time Delay (on Dropout) Range of Adjustability	0.1 to 6 seconds
Environmental Temperature Range	0°C to + 50°C
Repetitive Accuracy of Response	± 2%
Volt-Ampere Burden per Phase	2.0 VA
Transient Withstand	2000 volts for 200 micro-seconds
Output Relay:	
Contact Configuration	2 pole, double throw (6 terminals provided)
Continuous Current Rating	10 amperes
Voltage Rating for General Use	1 pole to load 10 amps @ 120 Vac 6 amps @ 240 Vac 3 amps @ 480 Vac 2 amps @ 600 Vac
	2 pole to load 10 amps @ 480 Vac 7.5 amps @ 600 Vac

Note: Double throw rating applies only when used with sources of same polarity.

ASCO Solid-State Voltage Monitors are insensitive to frequency, over the range of 50 to 70 hertz and respond to voltage levels only.

UNDERVOLTAGE DEVICE AND CONTACTOR MECHANISM

Main Contacts

2.05 Requirements of the main contacts are:

(a) In closing, the main contacts shall make in the following sequence:

(1) Carbon contact (when the switch is equipped with carbon contacts)

(2) Auxiliary metal contact

(3) Brush contact.

They shall open in the reverse order. (See Fig. 6.)

(b) The pressure on the brush contacts shall be approximately equal.

Gauge by sight or by feel.

(c) The contacts shall be free from burrs and shall not be discolored from overheating.

2.06 ***Undervoltage Device Contacts and Brush Arm***

(a) With the plunger down and resting on the plunger stop screws, there shall be a slight clearance between the plunger and the brush arm lever.

To check for clearance between the plunger and the brush arm lever, the plunger must be resting on the stop rods. Place a finger against the top and a screwdriver against the bottom edge of the brush arm and press against each alternately.

(b) The brush arm springs shall be approximately in the center of the button contacts with the plunger fully down and shall make firm and approximately even contact.

(c) When the plunger is fully raised, the contacts shall be open. (See Fig. 7.)

2.07 ***Contactor Mechanism***

(a) When the carrier arm is in the closed position, there shall be a clearance of approximately 1/32 inch between the tip of the latch and the bottom of the notch in the lock.

Gauge by sight.

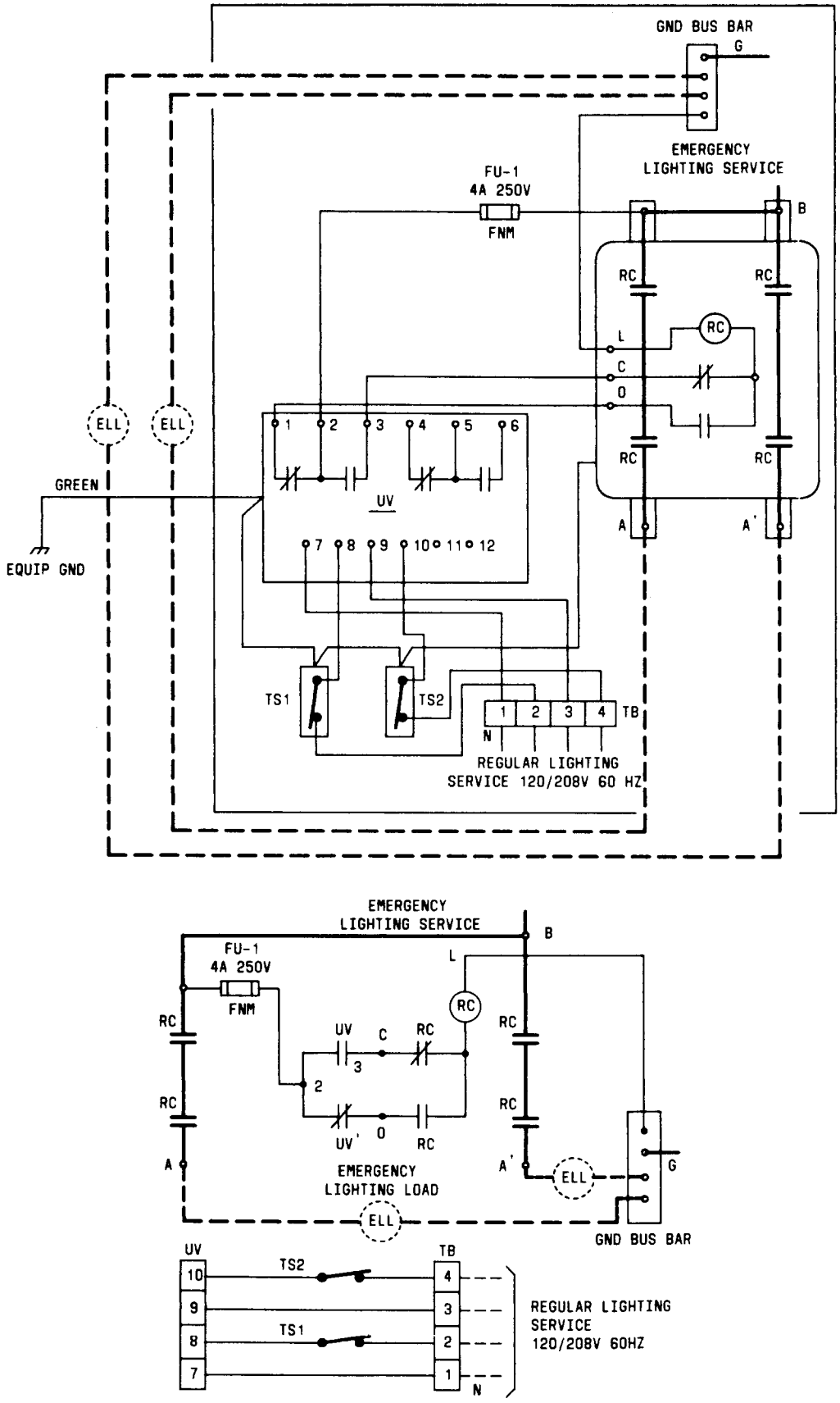

Fig. 5—3-Phase Emergency Lighting Relay Switch Circuit Schematic (New Version)

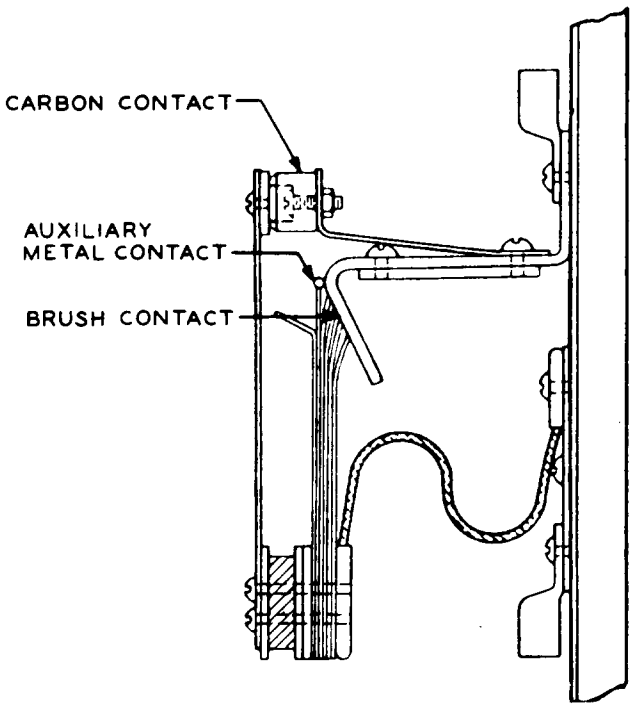

Fig. 6—Main Contacts (Old Version)

To check the requirement, hold down the lock and close the carrier arm manually.

(b) With the carrier arm held closed manually, as far as possible, there shall be a clearance of from 1/32 inch to 1/16 inch between the side of the latch and the edge of the notch in the lock.

Gauge by sight.

(c) With the lock held down and the carrier arm closed slowly manually, as or just after the carrier arm closes and locks up, the closing coil auxiliary switch shall open.

To check the requirement, listen for the release of the auxiliary switch or remove the cover and note that when the catch releases, the arm moves to the position shown in Fig. 9.

(d) As the carrier arm opens, the catch shall engage the auxiliary switch arm just before the carrier arm reaches the fully open position.

To check the requirement, release the lock and allow the carrier arm to open slowly.

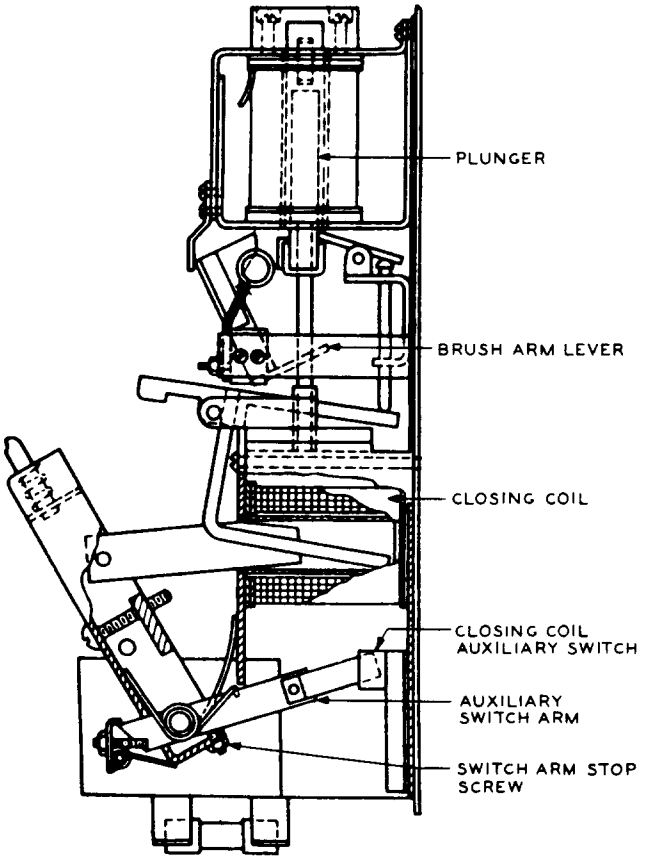

Fig. 7—Undervoltage Device and Contactor Mechanism (Main Contacts Open Old Version)

*2.08 *Test for Proper Operation*

(a) When the ac supply of normal voltage range is applied, the plunger shall pull up and hold up and open the button contacts and main contacts.

To check the requirement, connect the ac supply to the relay switch. On the KS-5189-03 relay switch, see that the test switch or switches which are part of the relay switch are in the on position.

(b) When the ac voltage across the coil fails, the plunger shall fall.

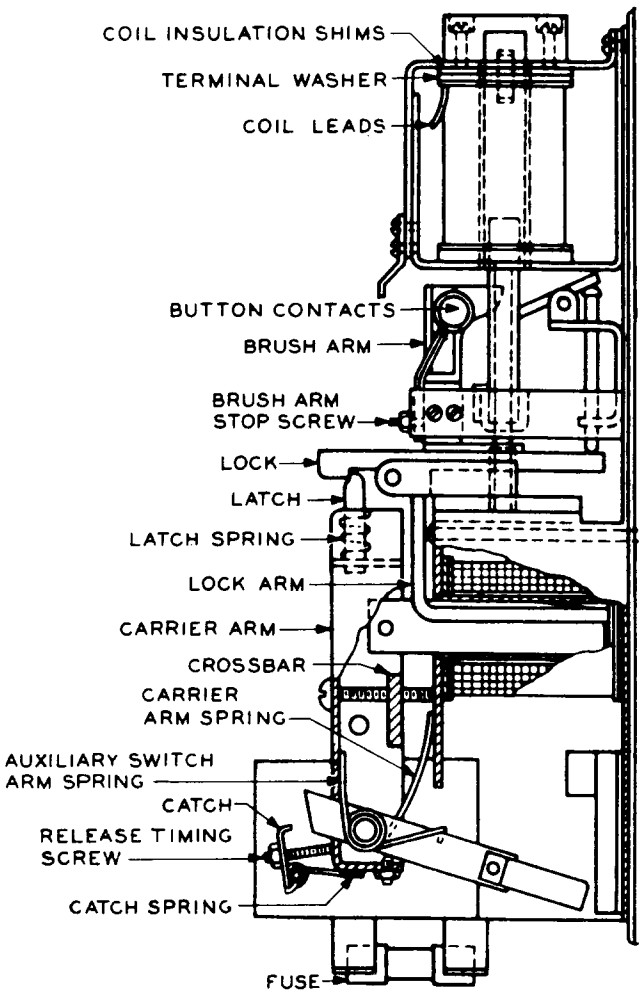

Fig. 8—Undervoltage Device and Contactor Mechanism (Main Control Closed, Old Version)

To check the requirement, disconnect the ac supply. On the KS-5189-03 relay switch, the ac supply may be connected or disconnected by means of the test switch or switches which are part of the relay switch.

(c) When the ac voltage across the coil terminals falls below the following values, the plunger shall fall:

SERVICE	RELEASE VOLTAGE
230 volt, 1 phase, 3 wire	140
200 volt, 3 phase, 4 wire	70
115 volt, 1 phase, 2 wire	70

Note: A 120-volt coil is used for 115- and 200-volt services, the relay on the latter being connected across one side and neutral as in Fig. 3.

To check the above requirement, it will be necessary to insert a variable resistance in one ac lead to the undervoltage device coil.

(d) When the plunger falls, it shall close the button contacts. The main contacts shall then close and lock up, and the auxiliary switch shall open.

To check the requirement, open the ac and dc supplies and slowly close the main contacts manually, holding down the lock to engage the latch. Connect the dc supply and note that the main contacts close and the emergency lights come on. Reconnect the ac service which should put out the emergency lights assuming, of course, that the ac voltage is normal. Repeat by opening and closing the ac circuit several times.

(e) The main contacts shall close and lock up when the following dc voltage is applied to the closing coil:

- 20 volts maximum for 20- to 28-Vdc service
- 40 volts maximum for 40- to 56-Vdc service.

To check this requirement, proceed as follows:

(1) Disconnect the ac and dc voltages. (See paragraph 1.07.)

(2) Insert a suitable variable resistor in the battery side of the dc line in series with the closing coil.

(3) Connect the dc voltmeter across the closing coil.

(4) Connect the dc supply. With the variable resistor, vary the voltage until the voltmeter reads 20 volts for the 20- to 28-volt operation and 40 volts for the 40- to 56-volt operation.

909- and 920-Type Contactors

2.09 The 909-type contactor is designed for single-phase operation, 30 amps and lower. The 920-type contactor (Fig. 9) is designed to be used on 30 through 225 ampere, single and 3-phase

circuits. The 909- and 920-type contactors are similar in operation but have different specifications.

2.10 *Test for Proper Operations:*

(a) When the ac supply of normal voltage range is applied, the contactor shall pull up, holdup, and open the main contacts. See that the transfer test switch or switches which are part of the relay switch are on.

(b) When the ac voltage across the coil fails, the conductor shall close. The ac supply may be connected or disconnected by means of the transfer test switch or switches which are part of the relay switch.

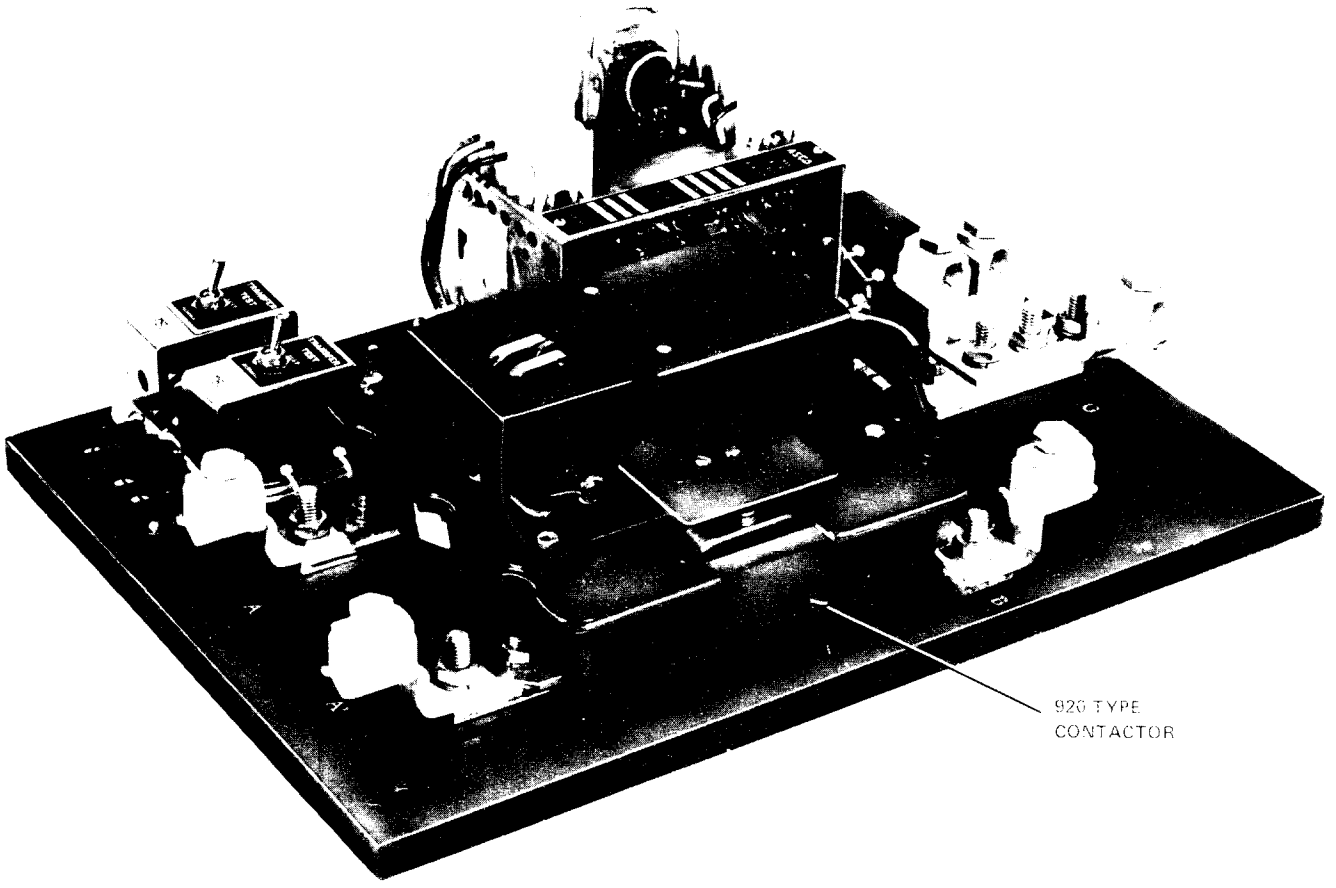

Fig. 9—920-Type Contactor Shown as KS-5189-03 Emergency Lighting Switch (New Version)

(c) When the ac voltage across the coil terminals falls below the following values, the contactor will close.

SERVICE	RELEASE VOLTAGE
230 volt, 1 phase, 3 wire	140
200 volt, 3 phase, 4 wire	70
115 volt, 1 phase, 2 wire	70

Note: A 120-volt coil is used for 115- and 200-volt services, the relay on the latter being connected across one side and neutral as in Fig. 3.

To check the above requirement, it will be necessary to insert a variable resistance in one ac lead to the undervoltage device coil.

(d) When the contactor operates, it shall close the contacts. The main contacts shall then

close and lock up, and the auxiliary switch shall open.

To check the requirement, open the ac and dc supplies and slowly close the main contacts manually, holding down the lock to engage the latch. Connect the dc supply and note that the main contacts close and the emergency lights come on. Reconnect the ac service which should put out the emergency lights assuming, of course, that the ac voltage is normal. Repeat by opening and closing the ac circuit several times.

(e) The main contacts shall close and lock up when the following dc voltage is applied to the closing coil:

- 20 volts maximum for 20- to 28-Vdc service
- 40 volts maximum for 40- to 56-Vdc service.

To check this requirement, proceed as follows. Disconnect the ac and dc voltages. (See paragraph 1.06.) Insert a suitable variable resistor in the battery side of the dc line in series with the closing coil. Connect the dc voltmeter across the closing coil. Connect the dc supply. With the variable resistor, vary the voltage until the voltmeter reads 20 volts for the 20- to 28-volt operation and 40 volts for the 40- to 56-volt operation.

*2.11 ***Temperature Measurements:*** With the voltage at any value available within the normal range, the temperature measured near the switch shall not exceed the following:

Undervoltage relays and undervoltage device coils	85C
Main contacts	90C

Temperature measurements should be taken only after the switch has been operated for at least 2 hours with the cover of the enclosing cabinet closed. Temperature measurements should be made with the switch connected to the power service.

Caution: Care should be exercised while taking temperature readings as the live parts have either line or battery voltage on them.

To check the temperature, hold the bulb of the thermometer against the surface of the part being measured by means of a felt pad, or equivalent, and observe the highest temperature indicated. Since the closing coil is energized only while the main contacts are closing and is de-energized as soon as the contacts lock up, temperature readings need not be made on this coil.

3. APPARATUS

3.01 *List of Tools, Gauges, Materials, and Test Apparatus*

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
206 or 207	30-degree offset screwdriver 90-degree offset screwdriver
417A	1/4-inch and 3/8-inch open double-end flat wrench
R-8210	1 1/2-inch screwdriver
AT-7825	4-inch E screwdriver
GAUGES	
R-1032	Detail 1 thermometer (or equivalent spirit-filled thermometer)
MATERIALS	
KS-2423	Cloth
-	Sandpaper 4/0
TEST APPARATUS	
-	Voltmeter, dc, Weston model 931, ranges 300/150/75/30V
—	Voltmeter, ac, Weston model 904, ranges 300/150V (or the replaced Weston model 528)

4. ADJUSTING PROCEDURES

UNDERVOLTAGE RELAYS

4.01 ***Contacts and Brush Arm:*** (Reqt 2.01)

(1) To obtain a clearance between the plunger and the brush arm lever, adjust the brush arm stop screw. If the contacts do not open, shape the springs supporting the button contacts.

(2) The pressure of the button contacts may be adjusted individually by loosening the associated screws and moving the buttons closer or farther away from the associated spring contact on the brush arm. Adjust the pressure so by slowly lowering the plunger it will just open the contacts by its own weight.

4.02 ***Tests for Proper Operation:*** (Reqt 2.02)—If the plunger does not pull up, check the connections, that the plunger or brush arm does not bind, and that the button contacts are not adjusted for too tight a fit. On the KS-5189-03 relay switch, make sure the test switch or switches are in the on position. Note whether the other undervoltage relay pulls up and, if it does, it is likely that the coil or connection to the relay in question is defective. A defective coil may be checked by placing the ac voltmeter across the terminals. If the voltage at the terminals is satisfactory, remove one lead from a terminal and connect the voltmeter in series with the coil and the terminal. No reading indicates an open circuit. The wire from the terminal is soldered to the coil wiring in the terminal washer at the end of the coil. Check that the circuit is not broken at this point and, if satisfactory and the trouble continues, replace the coil.

UNDERVOLTAGE MONITOR

4.03 ***Calibration (Single-Phase):*** (Reqt 2.03)

(1) Remove nameplate from monitor to expose the adjustment potentiometers.

(2) Rotate the pickup control (PU) to the maximum cw position.

(3) Rotate dropout control (DO) to maximum ccw position.

(4) Apply nominal input voltage to monitor as specified on nameplate. Output relay should be de-energized.

(5) Adjust input voltage until voltage is at the desired pickup point. Rotate pickup control slowly ccw until the output relay just picks up.

(6) Adjust input voltage until voltage is at the desired dropout point. Rotate dropout control slowly cw until the output relay just drops out.

(7) Check pickup and dropout settings by varying the input voltage.

(8) Replace the nameplate. The under-voltage monitor is now completely calibrated and ready for use.

4.04 ***Calibration (3 phase)*** (Reqt 2.04)

(1) Remove the nameplate from the monitor to expose the adjustment potentiometers.

(2) Rotate the pickup control (PU) to the maximum cw position.

(3) Rotate dropout control (DO) to maximum ccw position.

(4) Rotate time delay control (TD) to maximum ccw position.

(5) Apply nominal input voltage to monitor as specified on nameplate. Output relay should be de-energized.

(6) Adjust input voltage until voltage is at the desired pickup point. Rotate pickup control slowly ccw until the output relay just picks up.

(7) Adjust input voltage until voltage is at the desired dropout point. Rotate dropout control slowly cw until the output relay just drops out.

(8) Check pickup and dropout settings by varying the input voltage.

(9) Rotate the time delay control cw for approximately one half of a turn.

(10) Open the lead supplying power to phase A. The opening of the lead should be synchronized with the initiation of a timing device, such as a stop watch. When the output relay de-energizes, the elapsed time should be noted on the timing device. If the time delay is greater than the desired time, the time delay control should be rotated in the ccw direction. If the time delay is less than the desired time, the time delay control should be rotated in the cw direction. The time delay should be checked

after each adjustment is made. This process should be repeated until the time delay is at the desired value.

(11) ***Replace nameplate.*** The undervoltage monitor is now completely calibrated and ready for use.

UNDERVOLTAGE DEVICE AND CONTACT MECHANISM

4.05 ***Main Contacts:*** (Reqt 2.05)—After loosening the screws on the crossbar, the contacts may be adjusted so they line up and close in the proper sequence by moving or shaping the movable members. In closing, the laminated members of the brush will flex appreciably when in proper adjustment. If the contacts are dirty or pitted, smooth with sandpaper and wipe clean. If the springs or contacts are badly pitted or discolored from overheating, replace them.

4.06 ***Undervoltage Device Contacts and Brush Arm:*** (Reqt 2.06)

(1) Adjust the brush arm stop screw as required. In order to have the proper clearance and also to center the brush arm springs and button contacts, it may be necessary to shape the button contact supports in or out. Raise the plunger by hand to be sure that the button contacts open.

(2) The button contact pressure may be adjusted individually by loosening the associated screws and moving the buttons closer or farther away from the associated spring contact on the brush arm. Adjust the pressure so by slowly lowering the plunger it will just close the contacts by its own weight.

4.07 ***Contactor Mechanism:*** (Reqt 2.07)

(1) The relation between the tip and the notch is controlled by the lock arm which bears against the back of the closing coil case (Fig. 6). This adjustment should not change with use unless this arm becomes bent out of shape or the alignment of parts is changed.

(2) The carrier arm clearance is controlled by the screw through the crossbar and carrier arm. Unless the screw is equipped with a locknut, this setting is not adjustable and is set at the factory. However, it should not get out of adjustment. Move the latch in and out to be sure that it is free.

(3) If the auxiliary switch does not release, adjust the release by screwing in or out on the release timing screw. If the catch releases but the arm does not change its position, check whether the spring is broken and, if so, replace it.

(4) If the carrier arm does not open, check whether the spring is satisfactory. The auxiliary switch arm can be adjusted by lowering the small fuse panel and moving the switch arm stop screw which is at the bottom of the carrier arm.

4.08 ***Adjustments for Proper Operation:*** (Reqt 2.08)

(1) If the main contacts fail to pull up, check for loose connections and see that the fuses on the supply fuse board and the small fuse at the switch are not blown. Be sure that the button contacts on the undervoltage device make good contact. If necessary, remove the small fuse panel and check the auxiliary switch. The continuity of the circuit can be checked by inserting the dc voltmeter in series with the fuse at the switch. If the circuit is open, ascertain the cause and replace the closing coil if necessary.

(2) If the main contacts fail to close and lock up at the voltages specified in requirement 2.08(e), check to see that there are no binding parts and, if necessary, replace the relay switch.

4.09 ***909- and 920-Type Contactors:*** There are no adjustments on the 909- or 920-type contactors.

4.10 ***Adjustments for Proper Operation:***

(1) If the contacts fail to pull up, check for loose connections and check that the fuses on the supply fuse board or the small fuse at the switch are not blown. Be sure that the contacts on the undervoltage device make good contact.

If necessary, remove the small fuse panel and check the auxiliary switch. The continuity of the circuit can be checked by inserting the dc voltmeter in

series with the fuse at the switch. If the circuit is open, ascertain the cause and replace the closing coil, if necessary.

(2) If the relay contacts fail to close and lockup at the voltages specified in requirement ***2.10(e),*** check to see that there are no binding parts and, if necessary, replace the relay switch.

4.11 ***Temperature:*** (Reqt 2.11)—If the temperature exceeds the specified limits after other requirements of this section are met, replace the part or refer the matter to the supervisor.

Caution: Care should be exercised while taking temperature readings as the live parts have either line or battery voltage on them.