March 13, 1983

MR. A.E. CHAFFEE

SUBJECT: NRC Requested Documents

Enclosed are copies of the following documents requested by the NRC:

1. "Instruction Manual, Combustion Engineering, Inc., Reactor Trip Circuit Breaker Switchgear, San Onofre Unit 2, CENPD Specification No. 1370-ICE-3008-01, MFD. BY UNIT ELECTRIC CONTROL, INC., MAITLAND, FLORIDA."

2. "Instruction Manual, Combustion Engineering, Inc., Reactor Trip Circuit Breaker Switchgear, San Onofre Unit 3, CENPD Specification No. 1370-ICE-3008-01, MFD. BY UNIT ELECTRIC CONTROL, INC., MAITLAND, FLORIDA."

These documents are provided in response to item "II.a Tech Man. on Switchgear" on the "Paper" attachment to the NRC-prepared agenda.

W.C. MOODY

WCM:kmw

cc: H.B. Ray
J.M. Price
CDM

150

INSTRUCTION MANUAL

COMBUSTION ENGINEERING, INC.

REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR

SAN ONOFRE - UNIT 3

CENPD SPECIFICATION NO. 1370-ICE-3008-01

MFD. BY UNIT ELECTRIC CONTROL, INC.

MAITLAND, FLORIDA

8023-944-351-0

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CONTROL DEVICES

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Model S105-850 Current Level Controller.....Dwg. No. 700-S105-850

Dayton Electric Manufacturing Company
Model 2E174 Thermostat.....Bulletin 5S1789

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General Electric Type AK-25.....Bulletin GEK-7302

General Electric Type AK-25.....Bulletin GEI-50299

General Electric Type AK-25 Renewals.....Bulletin GEF-4149

General Electric Type AK-25 Elementary & Connection Diagram.....Drawing 8052-B13.2

SWITCHES AND LAMPS

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General Electric Type SBM Switch Renewals.....Bulletin GEF-4167

General Electric Type CR-2943 Switch.....Bulletin 100

Micro Switch Type PTP Switch.....Bulletin K-5

General Electric Type ET-16 Lamp.....Bulletin GEH-3500

General Electric Type ET-16 Lamp Renewals.....Bulletin GEF-4326

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Buchanan 600V Terminal Block.....Dwg. C-616508

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8052-A1.0.....One Line Diagram

8052-E1.3 & 8052-E2.2.....Arrangement & Details

8052-E3.3.....Wiring Diagram Section 01

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8052-E5.3.....Wiring Diagram Section 03

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8052-B1.1.....Heater Elementary

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8052-B5.3.....DC Elementary TCB-2

8052-B6.3.....DC Elementary TCB-3

8052-B7.3.....DC Elementary TCB-4

8052-B8.3.....DC Elementary TCB-5

8052-B9.3.....DC Elementary TCB-6

8052-B10.3.....DC Elementary TCB-7

8052-B11.3.....DC Elementary TCB-8

8052-B12.2.....DC Elementary TCB-9

8052-B13.2.....AK-2-25 Elementary & Connections

DESCRIPTION OF SYSTEM

The equipment covered by these instructions consists of a rigid, free standing, enclosed switchgear assembly, complete with buses, drawout air circuit breakers and other components required by the system design.

The equipment is to be used for controlling and monitoring power to a 3-phase, 4-wire, half-wave, silicon controlled rectifier network that is sequentially phase fired with the load connected line to neutral.

INSTALLATION INSTRUCTIONS

NOTE: For prolonged storage in unheated areas or areas subject to high humidity, the space heater circuits must be energized from a 120/208 volt single phase source. The equipment is shipped in a plastic wrapping for protection during storage from dust, moisture and other contaminants. Care should be taken to see that this covering is kept intact.

The equipment shall be installed on a level foundation and shall be bolted or welded to the floor as shown on the Arrangement Drawings, (8052-E1.3, 8052-E2.2).

Welding shall consist of a total of six (6) 3/8 inch by four (4) inch long fillet welds equally spaced along the front base channel and six (6) similar welds along the rear base channel.

UNIT ELECTRIC CONTROL

INSPECTION METHOD SHEET #	
PREPARED BY:	F. Abbes
APPROVED BY:	G. Schrod
DATE APPROVED:	7/21/1975

SHOP ORDER #: 8052 & 8053

PROJECT: Combustion Engineering, Inc. (RTSG)

DRAWING: 00000-ICE-3008 REV. #

NAME: Test Program

ITEM #	CHARACTERISTIC TO BE INSPECTED	ACCEPT DATE	REJECT DATE	REPAIRED DATE
1.	Bench tests shall be performed prior to installation in the switchgear. These will include the following: 1) Check for mechanical defects in assembly or mechanical defects in operation (opening and closing contacts). 2) Check electrical wiring and operation where applicable, while monitoring contacts			
2.	Hi-Potential Test per C.E. Spec. Section 5.10.1 on all equipment except that low current monitors and heater thermostats will be disconnected for this test.			
3.	Point to Point Continuity Tests will be performed on all wiring with a bell or buzzer set to verify conformance to the wiring diagram.			
4.	System Operational Tests will be performed under a procedure determined by C.E. and U.E.C. These tests will be performed at U.E.C.			
5.	The Environmental and Seismic integrity of the units covered by this specification is certified in Wyle Laboratories Test Report #42835-1, Rev. A, dated January 13, 1975. Therefore Environmental and Seismic testing is not required.			

UNIT ELE[illegible] CONTROL, INC. MAITLAND FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	QUANTITY REV.	QUANTITY TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
				Furnish 30 copies of operating and maintenance instructions and 30 copies of spare parts lists for each different type of equipment.		
				NOTE: Certificate of Compliance required		
1	9			Circuit Breaker, type AK-25, Drawout type, 3-pole, 600V AC, 600 amp trip, electrically operated shunt trip coils, 125V DC control, dual magnetic overcurrent trip per pole, undervoltage trip coil (instantaneous), electric closing mechanism-dead front mounted, mechanical interlock, with 10 auxiliary contacts, 5 N.O. & 5 N.C.	G.E.	
2	12			Low current monitoring device rated 120V, 60 Hz, input 0-600A, sensing 0-20A, complete with current transformers in Item 3 (U-01, U-02, U-04 & U-05)	American Aerospace Controls	700-S105-950

CERTIFIED AS BUILT

REVISIONS			
1	10-27-75	3	1-13-76
2	12-3-	4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker Switchgear
CENPD Specification 1370-ICE-3[illegible] 01

BILL OF MATERIAL

DRN [illegible] CHKD [illegible]

SHT 1 of 9 S[illegible] D. 8053

UNIT ELEC[illegible]IC CONTROL, INC. MAITLAND, FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	QUANTITY REV.	QUANTITY TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
3	12			Current transformers for low current metering device (Included with Item 2, DO NOT DUPLICATE, (U-01B, U-02C, U-04C & U-05B)	American Aerospace Controls	
4	4			Pushbutton 4 N.O., contacts with red button & silver ring (U-01B, U-02B, U-04B & U-05B)	Micro Switch	PTP43FF
5	1			Pushbutton 1 N.O., 1 N.C. contacts with red button & silver ring (U-03B)	Micro Switch	PTP43B
6	1			Pushbutton 1 N.O., 1 N.C. contacts with green button & silver ring (U-03B)	Micro Switch	PTP46B
7	4			Clear cover with wire seal provision	UEC	

REVISIONS

1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker [illegible]bcar
CENPD Specification 1370 IC[illegible]-01

BILL OF MATERIAL

DRN	[illegible]	[illegible]	CHKD	[illegible]	[illegible]
SHT 2 of			S.O. 6053		

UNIT ELE CONTROL, INC. MAITLAND FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	REV.	TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
8	9			Indicating light, type ET-16 with red color cap & 2000 ohm resistor (U-01B, U-01D, U-02B, U-02C, U-03C, U-04B, U-04C, U-05B & U-05D)	G.E.	0116B6708G3E
9	9			Indicating light, type ET-16, with green color cap & 2000 ohm resistor (U-01B, U-01D, U-02B, U-02C, U-03C, U-04B, U-04C, U-05B & U-05D)	G.E.	0116B6708G3D
10	10			Space Heater, 250W, 240V AC	Chromalox	OT-1025
11	4			Thermostat, DPST	Dayton	2E174
12	N/U					

REVISIONS			
1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker Switchgear
CENPD Specification 1370-ICE-[illegible]01

BILL OF MATERIAL

DRN [illegible] CHKD [illegible]

SHT [illegible] of [illegible] S.O. 8053

UNIT ELEC[illegible] CONTROL, INC. MAITLAND FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	REV.	TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
13	39			Terminal Board, 30A, 600V, 12-pole with cover	Buchanan	616508-6
14	18			Fuse Block, 2-pole, 250V	G.E.	8421-3
15	18			Fuse, 30A, 250V	Buss or equal	NON30
16	18			Fuse, 10A, 250V	Buss or equal	NON10
17	N/U					
18	4000'			#14 - 41 strand wire, type SIS	Delco or equal	

REVISIONS			
1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker Switchgear
CENPD Specification 1370-ICE-[illegible]-01

BILL OF MATERIAL

DRN	[illegible]	CHKD	✓	[illegible]
SHT 4 of		S[illegible] NO. 8053		

UNIT ELEC[illegible] CONTROL, INC. MAITLAND FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	REV.	TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
19	100'			#10 - 7 strand wire, type SIS	Delco or equal	
20	1500			Ring tongue terminals with insulated ferrules for #14 wire, #10 stud	ETC	B537-10
21	100			Ring tongue terminals with insulated ferrules for #10 wire, #10 stud	ETC	C528-10
22	22			Copper Bar, 1/4" x 2" x 12' long, round edge		
23	1			Glastic, UTR, 3/4" x 3' x 6' sheet	Glastic Corp.	

REVISIONS			
1	8-25-75	3	
2	1-15-	4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker Sw[illegible]hgear
CENPD Specification 1370-ICE-[illegible]-01

BILL OF MATERIAL

DRN [illegible] CHKD [illegible]

SHT 5 of [illegible] NO. 8053

ITEM NO.	QUANTITY ORIG.	QUANTITY REV.	QUANTITY TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
24	24			Insulators, 1" Rosite	Rostone Corp.	(UEC Stock)
25	18			Threaded Rod, 5/16" dia. x 4' long		
26	3			Glastic channel, 1177-2A, 33-15/16" long	Glastic Corp.	
27	24	-6	18	Compression Lug, 350 MCM, 2-hole, 3/8 bolt	T & B	60265
28	16	-4	12	Compression Lug, 250 MCM, 2-hole, 3/8 bolt	T & B	60254
29	20			T-Handle, Locking	Corbin	15766

REVISIONS			
1	10-27	3	
2	1-13-76	4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker [illegible]chgear
CENPD Specification 1370-ICE-3008-01

BILL OF MATERIAL

DRN [illegible] C [illegible]

SHT 6 of [illegible] SO NO. 8053

ITEM NO.	QUANTITY ORIG.	QUANTITY REV.	QUANTITY TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
30	5			Locking Handle, 3 point latch, type 2	National	68-0339CH
31	60			ITE Concealed Hinge	ITE	C36970
32	3			4" x 5.4# Channel Iron, 20' lengths		
33	30'			P-4000 Unistrut	Unistrut	P-4000
34	3			1/4" x 1" Hot Rolled Steel Flat Bar, 20' lengths		
35	1			3/8" x 3" x 4" Angle, 20' length		

REVISIONS			
1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker S[illegible]tchgear
CENPD Specification 1370-ICE[illegible]8-01

BILL OF MATERIAL

DRN [illegible] CHKD [illegible]

SHT 7 of [illegible] NO. 8053

ITEM NO.	QUANTITY ORIG.	QUANTITY REV.	QUANTITY TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
36	7			Paint, UEC Std. White (interior), gallon	Amer-Flint	118-600
37	5			Paint, ANSI-61 Gray (exterior), gallon	Amer-Flint	118-1047
38	4			Plexiglas, 1/8" x 3-5/8" x 4"		UEC Stock
39	1			3/8" x 2-1/2" C.R.S. Flat Bar, 5' length		UEC Stock
40	N/U					
41	250			Bolt, 3/8-16 x 1" long, grade 5 high strength steel (with nuts)		

REVISIONS			
1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker S[illegible]chgear
CENPD Specification 1370-ICE-[illegible]8-01

BILL OF MATERIAL

DRN [illegible] CHKD [illegible]

SHT 8 of [illegible] S O. 8053

UNIT ELEC CONTROL, INC. MAITLAND FLORIDA 32751

ITEM NO.	QUANTITY ORIG.	REV.	TOTAL	DESCRIPTION	MFG.	CAT. OR STYLE NO.
42	50			Bolt, 1/2-13 x 1-1/2" long, grade 5 high strength steel (with nuts)		
43	9			Position Switch, 2 stage type SBM, with mounting & operating hardware, 2 N.O. 2 N.C. contacts	G.E.	SBM10AR416
44	9			Push-button station, two unit, momentary contacts. Top legend engraved "CLOSE", bottom legend engraved "TRIP"	G.E.	CR2943AA102A

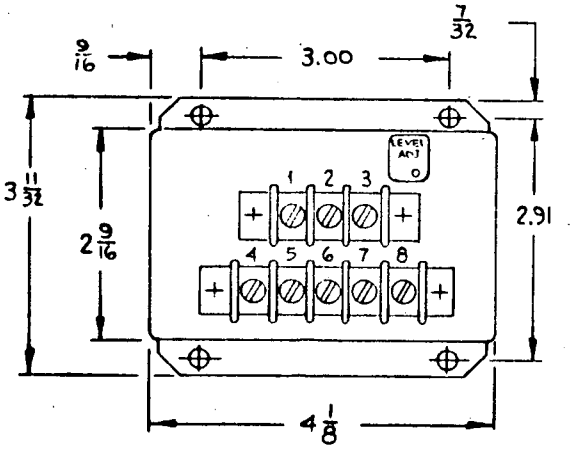
REVISIONS

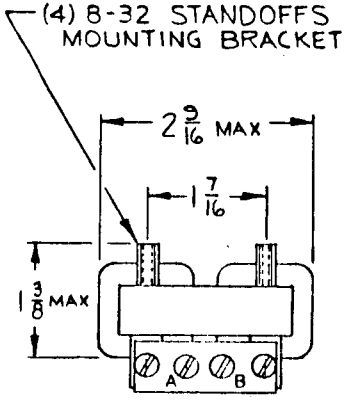
1	1-13-76	3	
2		4	

Combustion Engineering, Inc. SAN ONOFRE - UNIT 3
Windsor, Connecticut
Reactor Trip Circuit Breaker Switchgear
CENPD Specification 1370-ICE[illegible]P-01

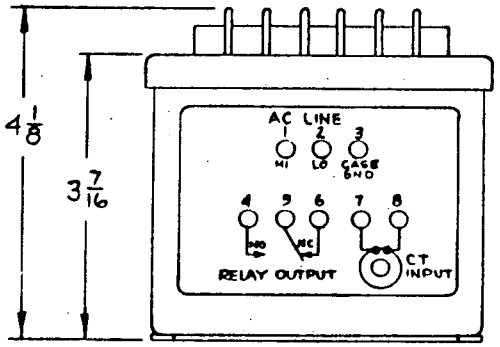
BILL OF MATERIAL

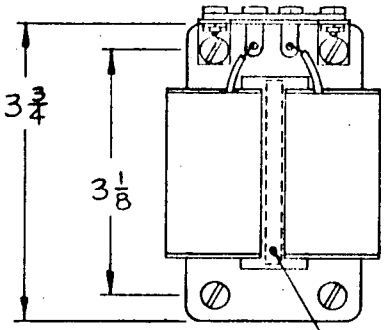
DRN		CHKD		
SHT 9 of 9		S[illegible]0.8053		





CURRENT TRANSFORMER





MINIMUM OPENING FOR BUS BAR – 5/16 WIDE BY 2 1/8 LONG

Wiring Instructions —

Connect Terminal #7 to Terminal #A
Connect Terminal #8 to Terminal #B
Connect AC line voltage to Terminals 1 and 2

700-S105-850 A REV

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	REVISED	8-20-74	

A.C. CURRENT LEVEL CONTROLLER

MODEL S105-850

Input Current Range	0 to 600 Amps RMS
Set Point	Current Level Trip Point Adjustable from 4 Amps to 20 Amps
Set Point Repeatability	±400 mA Max
Reset	Automatic, 4 Amps below set point
Output	Relay SPDT, 10 Amp Contacts @ 28 VDC or 240 VAC
Line Supply Voltage	105 to 130 VAC
Frequency Range	47-63 HZ
Supply Burden	6 Watts Typical
Response	500 Milli Sec
Temperature Range Operating	0°C to +70°C
Temperature Range Storage	-55°C to +85°C

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ON FRACTIONS DECIMALS ANGLES	DRAFTSMAN J. SULTON	DATE 7-25-74	AMERICAN AEROSPACE CONTROLS, INC. FARMINGDALE, L. I., NEW YORK
MATERIAL —	CHECKED		
TREATMENT —	ENGINEER	7-25-74	TITLE A.C. CURRENT LEVEL CONTROLLER
FINISH —	APPROVED	7-25-74	SIZE B / DWG NO 700-S105-850 / REV A
	SCALE 2:3		

OPERATING INSTRUCTIONS
LINE VOLTAGE
ELECTRIC HEAT THERMOSTAT
MODEL 2E174 Double Pole Disconnect

FORM 5S1789

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

AUG. 1972

GENERAL INFORMATION

The Model 2E174 Electric Heat Thermostat is designed for use on all types of electric heating installations such as cable heat, baseboards, wall insert heaters, etc. Its narrow operating differential and the ability of its fully exposed knob to sense both radiant heat and room air temperature make this control ideal for use on such installations.

The Model 2E174 is intended for use on 240 and 277 volts where local codes require that a double pole disconnect thermostat be used.

Dial Setting: Knob may be set anywhere between 40° and 85°F. by simply turning knob so that indicator on the knob points to the desired setting.

The knob may be turned past 40° to the "OFF" position to obtain temporary shutdown of the heating equipment for short periods of time such as on weekends, vacations, etc. If wired as in Fig. 1, turning knob to "OFF" position will break both sides of line.

NOTE: Only one side of line is broken during normal cycling of this thermostat.

SPECIFICATIONS

Electrical Rating:
22 A. (5000W.) 240V. A.C.
18 A. (5000W.) 277V. A.C.

Switch Action: Open on rise

Range: 40° to 85°F.

Differential: ½°F.

Contact Structure: Double pole disconnect

INSTALLATION

If the heating equipment manufacturer has made provisions or recommendations for the location of this control, then follow those instructions. If not, the following suggestions should be observed.

1. The control should be mounted in the wall, approximately five feet from the floor, as near as possible to the center of the controlled area.
2. It should be mounted on a partitioning wall, not on an outside wall.
3. It should be mounted as far as possible from undesirable sources of heat and cold such as:
   a. Windows and doors
   b. Direct rays from sun
   c. Hot water or cold water pipes
   d. Adjoining outside walls

See back of sheet for Wiring.

WIRING

wiring should be done according to local and national ical codes. Follow wiring instructions provided by actor or heater manufacturer.

The thermostat has been designed to fit into any standard 2" x 4" rectangular conduit, sheathed cable or armored cable box. A deep type box should be used.

1. Make electrical connections to line and load terminals as required. All connections must be tight.
   a. **Fig. 1**—This diagram shows the normal wiring method for this thermostat. This method must be used wherever local codes require that both sides of line be broken when knob is turned to "OFF" position.
   b. **Fig. 2**—This diagram shows how this double pole disconnect thermostat may be wired to serve as a single pole thermostat. When wired in this manner, only one side of line will be broken when knob is turned to "OFF" position.
2. Mount switch into switch box with screws "C" and "D".
3. Remove dial "A" by grasping dial at top and pulling forward gently.
4. Attach cover with screws "B", tightening the screws so cover is flush with wall.
5. Snap on dial "A".

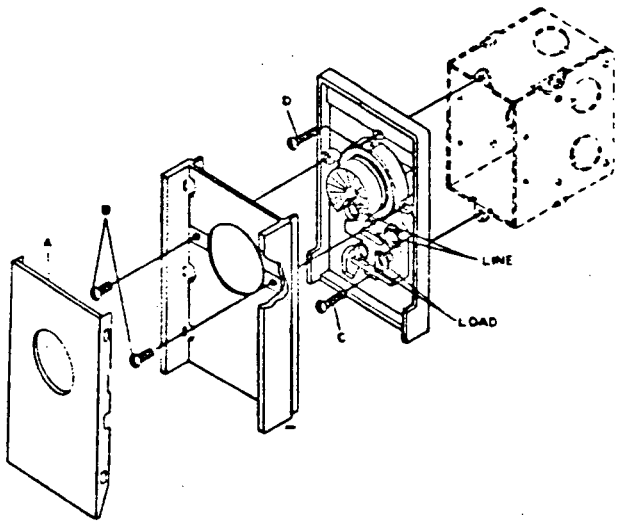


Fig. 1 — Normal Wiring Method. (Breaks both sides of line in "OFF" position)

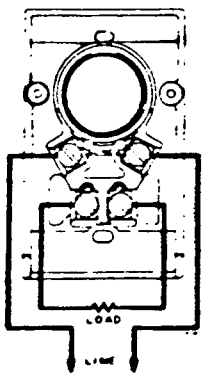
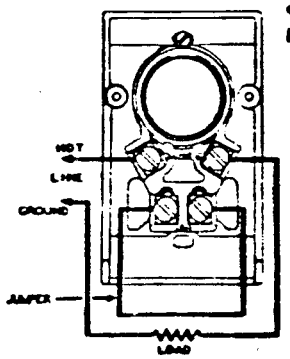


Fig. 2 — Wired For Single Pole Operation (Breaks only one side of line in "OFF" position)



NOTE: INSTALL JUMPER BETWEEN LOAD TERMINALS BY RUNNING JUMPER BEHIND THERMOSTAT

CUT-OFF SWITCH

Figure 7.

As explained under "Operation", the function of the cut-off switch is to de-energize the "X" contactor coil and energize the "Y" relay coil as the breaker mechanism moves from the opened to the closed position.

The switch is operated by the movement of a mechanism link against the switch actuator (6). This causes the actuator and movable contact assembly (4) to rotate counterclockwise about pin (7), opening the "bb" contacts (8) and closing the "aa" contacts at (9). Overtravel of the actuator (6) beyond the point of making contact at (9) is absorbed by spring (5) which couples the movable contact (4) to the actuator. Spring (3) resets the switch after the breaker contacts open and the breaker mechanism resets.

The point at which the cutoff switch operates during the breaker closing cycle is after the spring charged mechanism has been driven over-center. This assures that the cutoff switch cannot operate too early in the breaker closing cycle, thus the X and Y relays are de-energized and energized, respectively, at the proper time and the circuits anti-pump feature is maintained. When the closing mechanism is driven over-center, the force of the previously charged closing springs is released, closing the breaker.

REPLACEMENT

The cut-off switch is located above the breaker mechanism. It is fitted between the upper portions of the steel side plates that make up the mechanism frame. A raised horizontal ridge on each side of the molded body of the switch fits into a corresponding groove in each of the steel side plates. A round head screw on each side fastens the switch and side plate together. Replacement of the switch is accomplished by the following procedure:

1. Remove the cover on the top of the switch by taking out the two screws which hold it in place.
2. After taking careful note of the connection arrangements, disconnect the leads from the switch terminals.
3. Remove the two screws, one on each side, which fasten the switch to the mechanism side plates. Note that the one on the right hand side also holds a wiring cleat and spacer which serves to hold the wires clear of the link connecting the mechanism and the breaker position indicator.
4. Remove the front escutcheon from the breaker.
5. Slide the cut-off switch out from between the steel side plates by pulling straight forward.
6. Mount the replacement switch by reversing the order of procedure.

CLOSING SWITCH

Figure 8.

The closing switch is mounted on the upper flange of the closing solenoid coil. A hole in the escutcheon (3) permits access to the switch button (4). When the button is pressed, movable contact (5) deflects and impinges upon stationary contact (2). This energizes the "X" relay coil which seals itself in, and, in turn, energizes the closing solenoid.

REPLACEMENT

1. Remove escutcheon (3).
2. Disconnect leads from switch terminals.
3. Deflect the left end of hinge (7) to the left so that the movable contact (5) may be disengaged from the switch assembly.
4. Removal of the two screws (10) from speednuts (9) completes the disassembly of the switch.
5. Reassembly with new parts is a matter of reversing the described procedure. In reassembling, be sure the tab on the left end of hinge (7) is bent to the right far enough to avoid any possibility that movable contact (5) might become free of the assembly.

SHUNT TRIP DEVICE

Figure 9.

The shunt trip device is mounted underneath the horizontal cross frame member, just to the left of the front escutcheon. It is composed of a magnet, coil and armature. The armature has an extended arm or striker (11) which bears against the trip paddle (12) on the trip shaft when the coil (8) is energized. This displaces the trip latch in the breaker mechanism, opening the breaker contacts.

The trip device is generally activated by a remote switch or relay which closes the shunt trip coil circuit.

In order to avoid unnecessary heating of the coil of the device, an auxiliary switch "a" contact is wired in series with the coil. This prevents the energization of the coil if the breaker is open.

REPLACEMENT

The entire shunt trip device may be dismounted by disconnecting the coil leads and removing nuts (1). However, the only part of the device that might conceivably need replacement during the life of the breaker is the coil (8). This

9. Rotate the retaining spring clips to the locked position, making sure that each clip is in its proper recess, and replace the device cover.

"Y" RELAY

As described under "Operation", the "Y" relay is a permissive relay which limits to one the number of breaker closures possible on one closing signal.

On drawout breakers, the "Y" relay mounting bracket is fastened to the right hand side member of the breaker frame by two mounting screws. On terminal board breakers, it is fastened to the rear side of the terminal board support. The relay itself is fastened to an intermediate bracket which is detachable from the main support. The junctures between the relay and the intermediate bracket and between the two brackets are rubber cushioned against vibration and shock.

REPLACEMENT

If replacement of the "Y" relay becomes necessary, it may be detached from its supporting brackets by removal of the fastening hardware. The leads to the relay should be cut off as closely as possible to the soldered connections so that enough wire will remain for connection to the new relay. Sufficient original wire is allowed for this purpose.

After the old relay has been removed, the wire leads to the relay should be stripped of insulation to about 1/4 of an inch from the ends. A good mechanical connection should be made before soldering.

After all connections are completed, the relay may should again be mounted to the breaker by means of its supporting brackets and hardware.

After replacement has been completed, the relay may be checked electrically in the following manner:

1. Apply closing voltage to terminal board or secondary disconnects.

2. Push button of closing switch and hold closed.

3. Continuing to hold push button in closed position, manually trip the breaker open.

4. If the breaker stays open, and makes no attempt to close, the "Y" relay is functioning properly.

5. While releasing the close button, observe the "Y" relay. It should open as the closing switch is released.

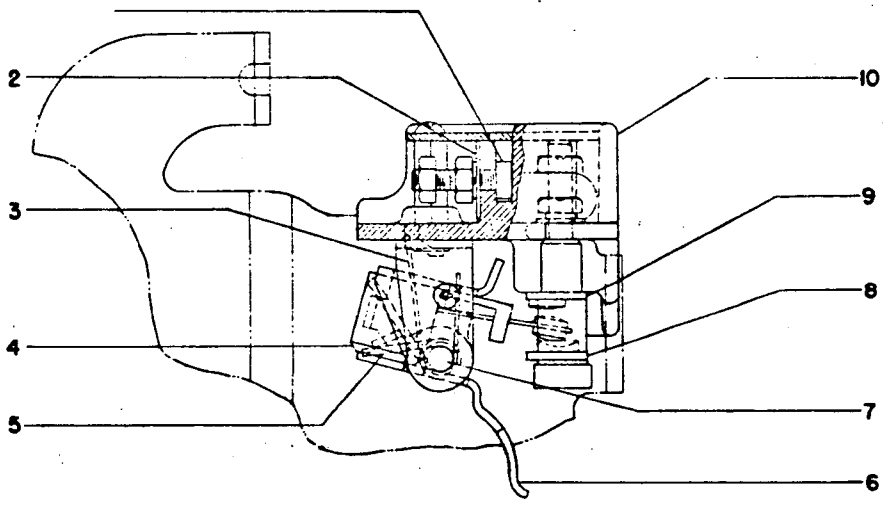


Figure 7. (695C162) Cut-Off Switch

1. Screw
2. Washer
3. Spring
4. Movable Contact Assembly
5. Spring
6. Actuator
7. Pivot Pin
8. Contact (BB)
9. Contact (AA)
10. Support

CLOSING SOLENOID

The closing solenoid consists of a magnet, armature and coil. This assembly is located directly beneath the breaker mechanism to which it is connected by a link which ties the upper end of the armature to the spring carrier of the mechanism. (See Figure 5.)

When voltage is applied to the coil, the magnetic force generated pulls the armature up into the coil and magnet assembly. This, in turn, rotates the spring carrier about its pivot, extending the mechanism spring and causing its line of action to move "over center", resulting in a closing operation.

REPLACEMENT

The only replacement operation that might conceivably be required on this assembly is that of the solenoid coil. To replace this, proceed as follows:

1. Remove escutcheon by unfastening four flat head screws in flange.
2. Remove closing switch. (See "Closing switch".)
3. Cut off or disconnect the coil leads.
4. Remove four screws which fasten lower section of magnet to upper section.
5. Allow lower section of magnet and coil to slide downward until clear of armature.
6. Reassemble with new coil by reversing order of procedure.

"X" CONTACTOR

The "X" contactor is a heavy-duty relay which performs the function of closing the circuit of the breaker solenoid during electrical operations. Three of the four sets of contact of the device are arranged in series to minimize the duty required of any one contact. As explained under "Operation", the fourth contact is used to "seal-in" the "X" coil.

The "X" contactor is located on the right beneath the horizontal front frame member. It is mounted on three studs which fasten it to a mounting bracket which is suspended from the frame. Rubber bushings on the mounting studs provide anti-vibration and anti-shock protection for the relay. The relay contacts and their terminals are covered by a molded piece of insulation which fits over spring clips that hold the cover in place.

REPLACEMENT

Removal of the complete device is accomplished by removing the cover, disconnecting the leads from the terminals, and removing the nuts from the three mounting studs. If the replacement unit includes the mounting bracket, the relay need not be removed from the old bracket. This can be taken off the breaker simply by removing the two screws which fasten it to the breaker frame. If the breaker is a drawout type, the supporting bracket of the "Y" relay may be temporarily displaced to provide access to the screws.

Since the expendable parts of the "X" contactor are the contacts and the coil, ease of replacement of these parts has been designed into the relay. Methods of procedure are as follows:

Contacts

1. Remove relay cover.
2. Remove terminal binding screw of stationary contact to be replaced.
3. Lightly pinch with pliers (pointed end) the split section of the contact which enters the hole in the compound body of the device and lift out the stationary contact.
4. With the fingers, pull forward on the spring guide of the movable contact, compressing the contact spring as far as possible.
5. With the spring thus held, grip the end of the contact strip with pointed pliers, turn it through 90 degrees on its long axis, and withdraw it.
6. Replace new contacts by reversing the procedure.

Coil

1. Remove relay cover.
2. Turn the two retaining spring clips on the ends of the device through 90 degrees about their pivots.
3. Pull out the two halves of the body of the device which carry the stationary contacts. When these are clear of the frame, the armature and movable contact assembly will move aside, exposing the coil.
4. Remove the terminal screws of the coil and pull it free of its retaining spring clips.
5. Place new coil on pole piece inside of the spring clips and fasten terminals to leads.
6. Just start the replacement of one of the compound blocks which hold the stationary contacts into its groove in the frame.
7. Position the armature and movable contact assembly to allow the entrance of the second stationary contact block.
8. When these parts are all properly aligned, with the stationary contacts under the movable contacts, push them into their guiding grooves in the frame until they bottom.

6. If the breaker is manually operated, and has no auxiliary switch, it is now free to be lifted clear of the breaker. If it has an auxiliary switch, this may be disconnected from the mechanism as described under "Auxiliary Switch - Replacement, elsewhere in these instructions.

7. If the breaker is electrically operated, it will be necessary to disconnect the mechanism from the solenoid armature. In order to do this, raise the mechanism as far as the travel of the armature will permit and remove the screw which binds together the two extensions of the armature. After this is removed, the armature extensions must be spread apart to release them from the link connecting with the mechanism. This can be done by threading a #10-32 screw at least 1-3/4 inches long into the top hole of the armature extension. This hole is just above the one from which the binding screw has been removed. As the end of the screw butts against the far extension, the two extensions will be spread open, releasing the mechanism link.

8. The replacement mechanism may be installed by reversing the order of procedure for disassembly. After reassembly, check the operation of the breaker and, if necessary, adjust the latch engagement.

REMOVAL OF FRONT ESCUTCHEON
MANUAL BREAKERS

1. Remove set screw fastening the plastic handle to steel operating shaft and remove the operating

2. Open and remove annealed (soft) retainer and two flat washers from shaft.

3. Remove four screws from flange of escutcheon If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon.

4. Push steel operating shaft through escutcheon bushing.

5. Remove handle reset spring (8) Figure 6, and escutcheon is free of breaker.

6. Handle and escutcheon assembly can be assembled most easily by exactly reversing the procedure for disassembly. In replacing the escutcheon it may be necessary to use pliers to pull the operating shaft fully into the escutcheon in order to have space enough to replace the flat washers and the soft retainer. The latter may be closed on its groove in the shaft by ordinary gas pliers. After replacement, check operation of breaker.

AUXILIARY SWITCH

The auxiliary switch is mounted on the left side of the operating mechanism frame. Its operating shaft is linked to the output crank of the breaker mechanism. Through a cam arrangement, the operating shaft of the switch controls the open and closed positions of the individual contact pairs. Each stage of the switch, which is usually two-stage or five-stage, contains one "a" and one "b" set of contacts. An "a" pair of contacts is always in the same position as the main breaker contacts. That is, open when the breaker contacts are open, and closed when the breaker contacts are closed. Just the oposite is true of the "b" contacts. The terminals of the switch are covered by a sheet of insulating material held in place by two screws fastened along its left edge. When this is removed, the terminals are exposed. The upper pairs of terminals are those which connect to "a" switches. The lower terminals connect to "b" switches.

REPLACEMENT

1. Remove auxiliary switch cover.

2. Disconnect leads to switch terminals.

3. Remove two screws which fasten switch to side of mechanism frame.

4. Remove switch by moving towards left.

5. Before mounting replacement switch, turn the crank end of the switch operating shaft in position to engage the hole in the link connecting with with the breaker mechanism. Be sure the bearing washer is in place between the mechanism link and the switch operating shaft.

6. Complete mounting by following disassembly steps in reverse order.

ELECTRICAL CONTROL COMPONENTS

These consist of the following:

1. Closing solenoid
2. "X" contactor (relay)
3. "Y" permissive relay
4. Cut-off switch
5. Closing switch
6. Shunt-trip device

The last two of these components may or may not be present in the control arrangement.

Should the mechanism continue to function improperly after the proper latch engagement has been set and the corrective measures listed in the "Trouble Shooting" chart carried out, it is generally recommended that no attempt be made to repair the mechanism interior but that a replacement mechanism assembly be obtained from the factory.

REPLACEMENT

1. If the breaker is electrically operated, remove the front escutcheon by taking four screws from flange. If the breaker is a drawout type, two small round head screws must also be removed from the bottom edge of the escutcheon. (For removal of front escutcheon from manually operated breakers, see procedure described below.)

2. Remove arc quenchers (See "Arc Quencher").

3. Disconnect the two insulated connecting links between the mechanism and the contacts as in step 2 of the procedure for "Separation of Front and Back Frames".

4. Remove the two elastic stop nuts, which fasten the upper extensions of mechanism frame to studs connecting with rear frame.

5. Remove four screws which fasten the bottom of the mechanism frame to the horizontal cross member of the front frame.

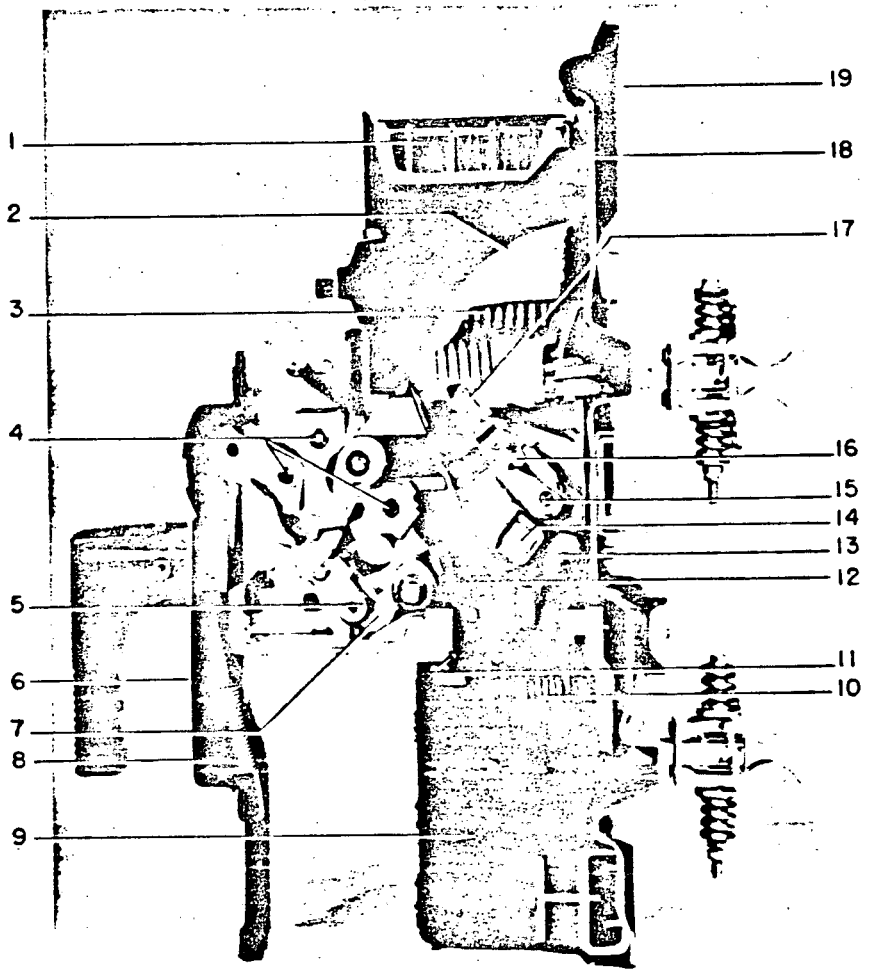


Figure 6. (8024516) Cut Away Model of Manually Operated AK-2 Breaker

1. Arc Quencher Muffler
2. Ceramic Side Plates
3. Steel Plates
4. Fixed Centers in Mechanism
5. Latch Roller
6. Escutcheon
7. Trip Latch
8. Handle Return Spring
9. Overload Device
10. Series Coil of Overload Device
11. Trip Arm of Overload Device
12. Trip Paddle
13. Movable Contact Pivot Support
14. Crossbar
15. Movable Contact Pivot
16. Contact Wipe Adjustment Pin
17. Movable Contact
18. Moulded Compound Bar
19. Steel Back Plate

the breaker will not close. Use the maintenance closing handle whenever closing or attempting to close the breaker during this entire operation.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move toward closing before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn to establish the position where the contacts move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

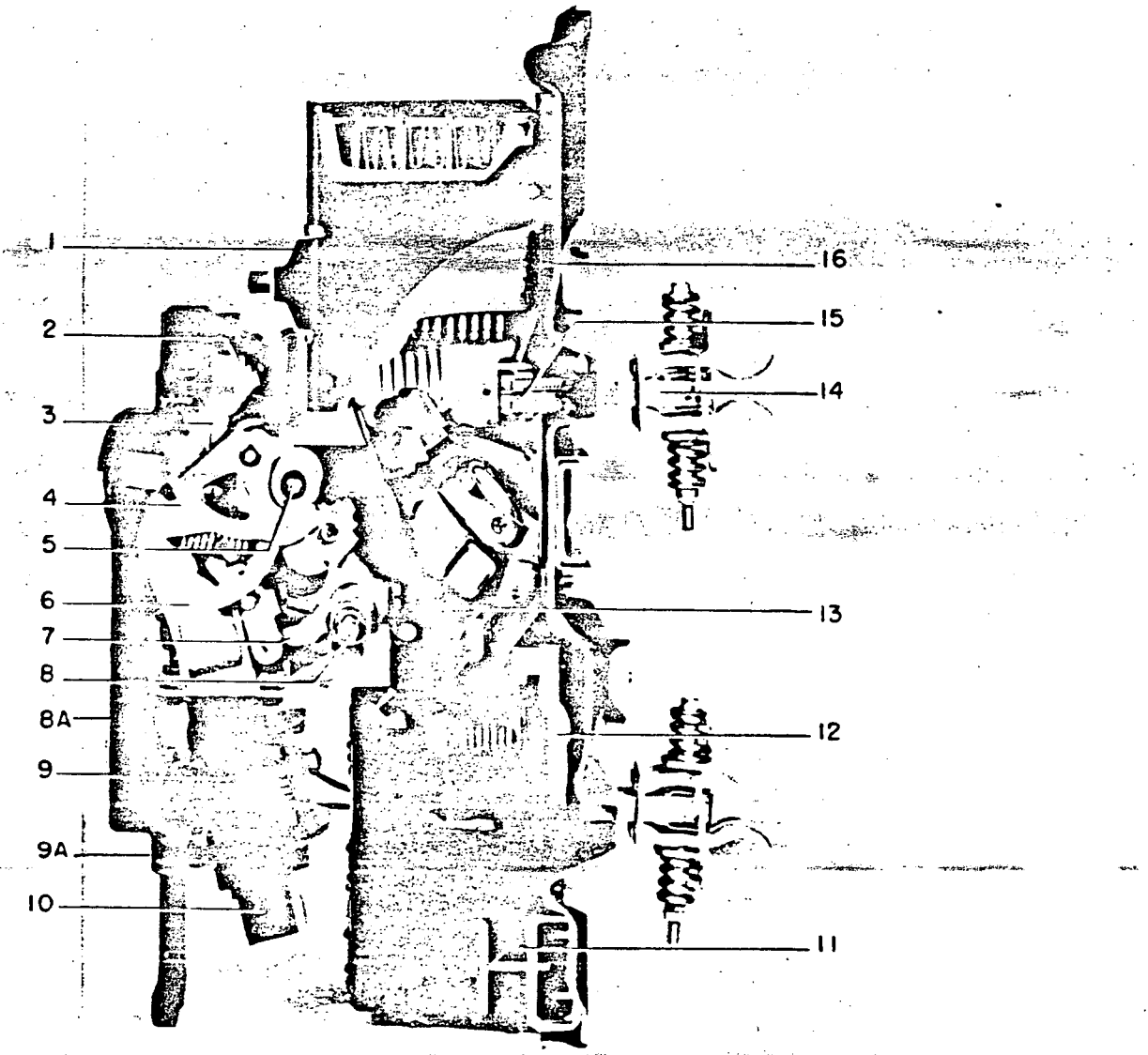


Figure 5. (8024457) Cut Away Model of Electrically Operated AK-2 Breaker

1. Arc Quencher Retainer
2. Cut off Switch
3. Cut off Switch Actuator
4. Spring Carrier
5. Shoulder Pin
6. Connecting Link
7. Trip Latch Roller
8. Trip Shaft
8A. Front Escutcheon
9. Closing Solenoid
9A. Location of Slots for Maintenance Handle
10. Closing Solenoid Armature
11. Cover Retainer of Overload Device
12. Lower Stud
13. Socket Head Screws
14. Upper Stud
15. Stationary Contacts and Springs
16. Arc Runner

CONTACT SPRINGS
(10) Figure 3

A minimum force of 5 lbs and a maximum of 9 lbs. should be required to begin movement of a single stationary contact from the open position towards the closed position. This may be checked by using a push scale applied at the point at which the movable contact touches the stationary contact. If these pressures are not obtained or if the spring is damaged, replacement is required.

In order to replace the contact spring the upper stud (17) must be removed. The hardware which fastens the stud to the breaker base consists of two screws (16), and nut (20). When These are removed, the stud may be withdrawn from the base in a forward direction. After the stud has been removed, it is a simple matter to disconnect the two ends of the spring (19) and replace it with a new one.

MECHANISM

The breaker mechanism is a spring actuated, over-center toggle type of mechanism. As the closing force is applied, either by movement of the operating handle or the closing solenoid armature, energy is stored in the operating springs. After the springs have gone over center, movement of the output crank of the mechanism is still blocked for a time by a cam arrangement. As the springs are further extended, the blocking cam moves from the output crank, and the springs are allowed to discharge part of their stored energy, closing the breaker contacts.

This assures a fast-snapping closing action regardless of the speed at which the closing handle is operated.

The breaker mechanism is tripped by the displacement of the trip latch (7), Figure 6. Looking at the breaker from the right hand side as in Figure 5, the tripping movement of the latch is counter-clockwise. Operation of any of the automatic trip devices or the trip push button causes the latch to move in the tripping direction. When the latch moves off the trip latch roller (7), the remaining force in the operating spring causes the mechanism toggle to collapse, resulting in the opening of the breaker contacts.

ADJUSTMENT

Since all the mechanism adjustments are carefully set by experienced factory personnel after assembly at the factory, it should normally not be necessary to make any adjustments in the field. At the time of installation, and also in the course of a maintenance inspection, if the breaker functions properly through several repeated operations, it is best to assume that adjustments are satisfactory.

If the breaker mechanism does not function properly, it is best to first perform the available remedial measures listed in the "Trouble Shooting" chart of these instructions. One of the remedies listed is that of proper mechanism latch engagement, the amount of engagement between the latch (7) and latch roller (5), Figure 6. This is the only adjustment that is required on the breaker mechanism, and proper latch engagement is obtained in the following manner:

(NOTE - Before making latch adjustments, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft (8), Figure 5, steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.)

Latch Adjustment - Manual Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right-hand mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. Rotate the closing handle 90 degrees counter-clockwise, setting the closing mechanism in the reset position. Turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position. NOTE: KEEP HANDS CLEAR OF THE CLOSING HANDLE WHEN MAKING THIS ADJUSTMENT.

3. Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn, and observing whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, you have established the position of the adjusting screw where the latch and latch roller begin to engage. In some cases, it may be necessary to turn the adjusting screw less than 1/4 turn in order to establish the position where the contacts begin to move before tripping occurs. When this position is established, note the position of the slot in the head of the adjusting screw.

4. Withdraw the adjusting screw three and one-half turns from the position noted in step 3. This sets the proper amount of latch engagement.

Latch Adjustment - Electrical Breaker

1. Locate the latch adjustment screw on the lower, outer side of the right mechanism side frame. This screw is threaded through a nylon insert locknut which, in turn, is welded to a projecting bracket on the side frame.

2. With the breaker in the open position turn the adjusting screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw, until

ment pin (15) on the center pole into position. Be sure the stationary insulation barriers are correctly located.

Align the cross bar with the left and right pole pivot supports and install the left and right pole movable contacts. Use the bullet nosed steel pin to aid in aligning the holes in the cross bar, the contacts and the pivot supports.

5. Install the left and right pole pivot pins while threading them through the spring clips and lock the spring clips (9). Be sure the pivot pins are fully inserted.

6. Adjust the contact wipe to 1/8" ± 1/32" by adjusting the eccentric contact wipe adjusting pin (15). The breaker must be open to adjust the wipe. In the event acceptable wipe cannot be obtained by moving the contact wipe adjusting pin (15), from the movable contact forward or backward as necessary to bring the wipe within the range of the contact wipe adjusting pin (15). Do not exceed the recommended settings for wipe; otherwise the breaker may not close completely. When viewed from the top with the breaker closed, the movable contact should be centrally located with respect to the stationary contacts. If the movable contacts are not centrally located as shown in section CC, form the movable contacts until they are nominally centered.

If the moving contacts are not centered with 1/8" separation when closed against the fixed contacts, they should be bent laterally (after opening the breaker contacts). To do this without squeezing the two movable contact arms together, a 1/8" spacer plate should be inserted between them; then the pair can be grasped with pliers and bent in the desired direction for centering.

New contacts should be adjustable using eccentric numbers 1, 2, or 3. These numbers are the ones visible when viewing the breaker from the front, not from above. (The higher numbers should be reserved for tightening at future maintenance readjustments after wear.) Also, if higher numbers are used, where adequate wipe is obtainable at settings 1, 2, or 3, it is possible that the stationary contacts will bottom, producing excessive back force on the breaker closing mechanism so that the toggle link will not pass center. As a result.the breaker will not complete its stroke, and inadequate pressure and wipe will result; burn-up of contacts from just load current will follow.

If the required wipe of new contacts cannot be obtained with eccentric number of 3 or lower, bending of the contact arms toward the closed position is required. This should be done individually, using an 8" Crescent or 1/2 - 5/8" tapered open end wrench to grasp the contact and a 10" Crescent or the 1" - 1-1/8" tapered open-end wrench to grasp the pivot portion of the arm. The soft copper arm will bend with little difficulty. Both arms should be bent identically.

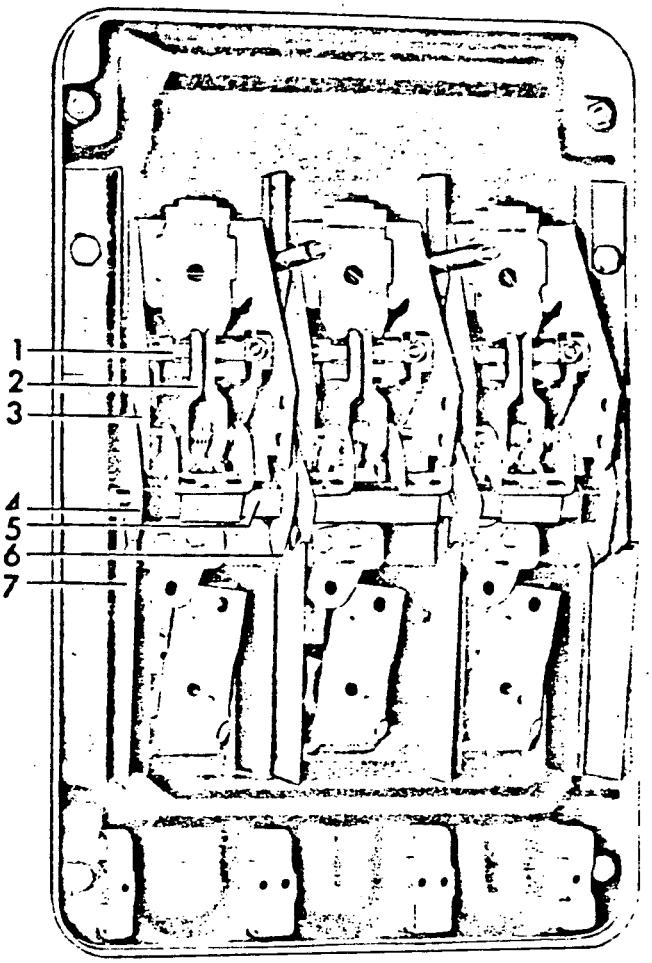


Figure 4. (8039851) AK-2-25 Back Frame - Location of Crossbar and Pole Shields

1. Stationary Contacts
2. Movable Contacts
3. Upper Stud Asbestos Shield
4. Crossbar Plastic End Shield
5. Crossbar Assembly
6. Crossbar Asbestos Inner Shield
7. Lower Stud Asbestos Shield

Operate breaker several times, and recheck wipe to make sure bending of movable arms did not occur in these operations.

7. Operate the breaker manually several times to assure proper functioning occurs, then replace the U shaped insulation (5) Figure 3 and arc quenchers. When replacing the arc quenchers be sure the quencher is seated downward completely and that the quencher clamp covers the knobs protruding through the arc quencher insulation.

stationary contacts and be sure to locate them in the breaker with the upper and lower contacts having their stop projecting surfaces as shown in the section AA, Figure 3. The upper left and lower right contacts are identical as are the lower left and upper right contacts.

3. By placing the hook on the end of the contact through the loop of the contact spring, the contact can be pushed toward the pivot surface and slipped behind the stop pin. Install all stationary contacts in all poles.

REPLACEMENT OF MOVABLE CONTACTS (18) Figure 3.

1. Coat the pivot area only of the new movable contacts with a thin coat of D50H47 grease.

2. Assemble the center pole movable contacts, align the pivot pin holes with the bullet nosed rod, and install the pivot pin and split pin.

3. Move the cross bar assembly into position and insert the eccentric contact wipe adjust-

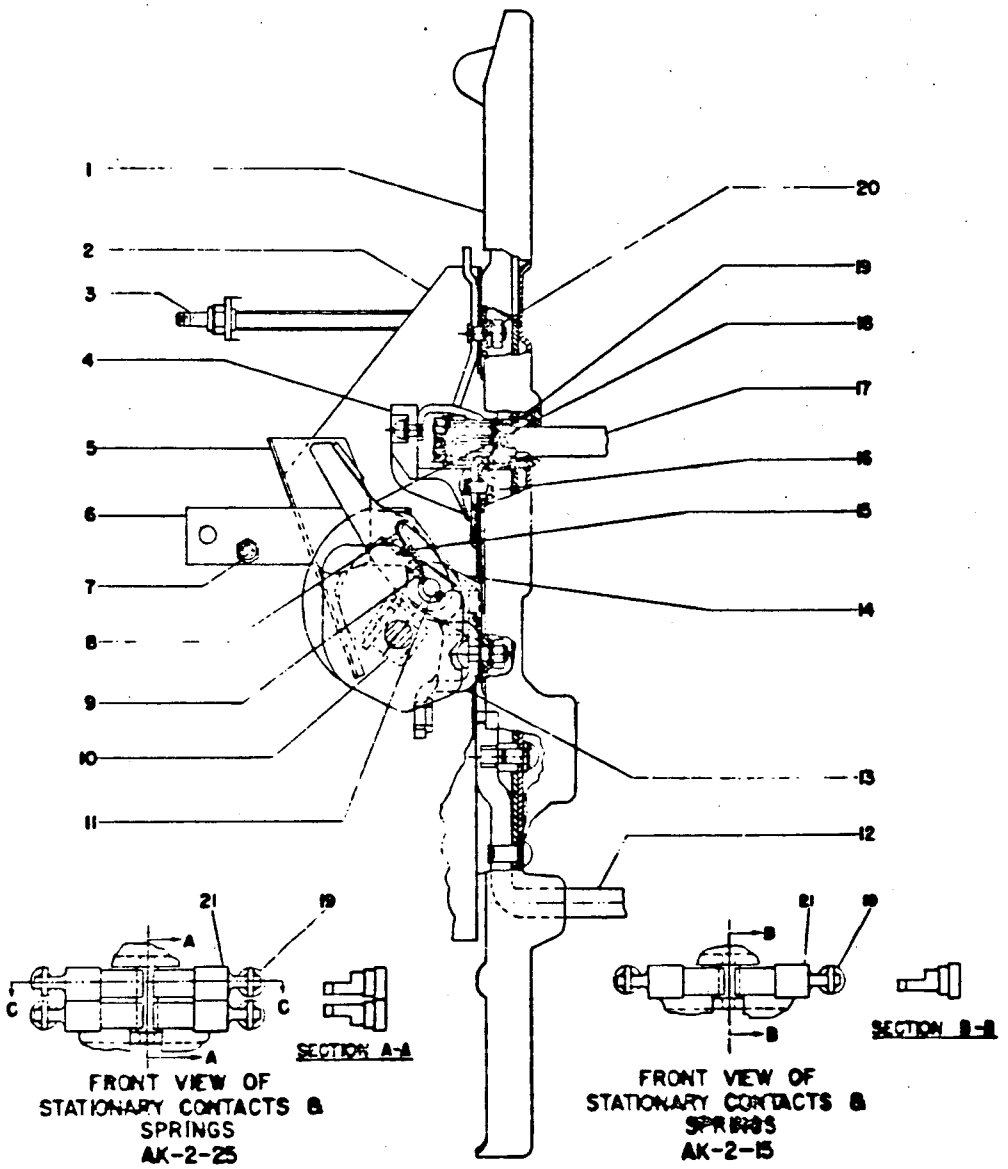


Figure 3. (549D409-2) Contact Assembly

1. Breaker Base
2. Insulation
3. Insulated Stud
4. Upper Stud Barrier
5. Insulation
6. Links (Insulated)
7. Tie Bolt
8. Spring
9. Spring Clip (Retainer)
10. Cross Bar
11. Pivot Pin
12. Lower Stud
13. Contact Pivot Support
14. Spring
15. Contact Wipe Adjustment Pin
16. Screw
17. Upper Stud & Arc Runner
18. Movable Contact
19. Spring
20. Nut
21. Stationary Contacts

shaped section which is easily accessible to a small, open end, 1/4 inch wrench. Two cantilever springs, which bear on each end against a portion of the hexagon section of the pin, lock the adjusting pin in place and provide index stops for the process of adjustment. The right hand hexagon shaped end of the pin is numbered from 1 to 6, which provides a reference for making wipe adjustments.

When contacts are to be adjusted, the recommended procedure is as follows:

1. With the breaker in the open position and using the numbers on the right end of each adjusting pin as a reference, set each pin in the same position. In many cases, the number 3 is a good beginning point. The proper view of the number on the adjusting pin is obtained by viewing the breaker from the front and the adjusting pin from approximately a 15 degree angle with respect to the movable contacts. Note that the numbers on the pin are not in numerical sequence as the pin is rotated.

2. By measurement, establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the contacts.

3. Close the breaker, and establish the amount of wipe by again measuring as in step two, and comparing the measurements with those taken with the breaker open.

4. If any set of contacts lead or lag the others, open the breaker and advance or retard the adjusting pin to the next higher or lower number. Moving the adjusting pin to a higher number will increase the contact wipe and moving to a lower number will decrease the contact wipe.

   NOTE: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex section of the pin.

5. When all the contacts have the recommended wipe of 3/32 to 5/32 of an inch, the contact adjustments are complete.

CONTACT REPLACEMENT

Figure 3

The normal situation that will exist in the matter of contact replacement will call for replacement of all the movable and stationary contacts at the same time. This will be the case where long use of the breaker in service has resulted in extensive wear or erosion of the silver alloy contact tips. A commonly used "rule of thumb" is that contact replacement is indicated if less than one-half of the original thickness (1/8 of an inch) of the contact tip material remains.

GENERAL PREPARATION

1. Remove arc quencher retainer (1), Figure 5 by loosening the two captured nuts with a 7/16" wrench.

2. Lift off the three arc quenchers.

3. Remove the U shaped insulation (5) Figure 3 from each pole by lifting it and disengaging the rivet heads thru the keyholed slots in the insulation.

4. As an aid to future reassembly of the movable contacts, note the position of all stationary insulation barriers with respect to barriers mounted on the cross bar.

REMOVAL OF MOVABLE CONTACTS (18) Figure 3.

1. Screw the threaded end of the steel rod lightly into pivot pin (11) on the right pole.

2. With a pair of long nosed pliers, unhook safety pin type spring clip (9) and extract pin (11) and remove spring clip (9).

3. Grasp movable contact assembly and remove it from its seat on the cross bar.

4. Repeat procedure 1, 2, and 3 above on the left pole.

5. Move the cross bar downward to disengage it from the contact wipe adjusting pin (15) on the center pole, then move the cross bar toward the front of the breaker.

6. Remove the split pin retaining the center pole pivot pin.

7. Remove the pivot pin and movable contact assembly.

REMOVAL OF STATIONARY CONTACTS (21) Figure 3.

1. Slip the blade of a heavy screw driver between the two upper contacts and force the contacts toward their pivot point sufficiently far to disengage the contact stop surface from the pin.

2. The contact can then be removed by disengaging the end of the contact from its spring.

3. The two lower contacts can be similarly removed.

REPLACEMENT OF STATIONARY CONTACTS (21) Figure 3.

1. Coat the contact pivot area only of each of the four contacts with a thin coat of D50H47 grease. Use only D50H47 grease.

2. Note the difference between the two types of

11. When all wires have been connected, refasten the body of the assembly to the breaker back frame.

ARC QUENCHER

The arc quencher is an integral riveted assembly composed of two ceramic side plates, a series of steel plates, and a muffler. The assembly is covered by a wrap around of insulating material which inhibits any sidewise emission of gases. The steel plates are held in position and supported by the ceramic sides which are grooved vertically to provide recesses for the vertical edges of the steel plates. The bottom edges of the latter form an inverted "V" along the path of the arc that may be drawn between the breaker contacts during interruption. The steel plates have the effect of breaking up the arc, and cooling it and the gases that result from interruption. The entire assembly provides a "chimney" effect which directs the hot, ionized gases upwards through the steel plates and mufflers and allows their safe and controlled escape at a cooler temperature.

The muffler at the top of the assembly is a serpentine shaped strip of perforated, copper plated steel. It is important that the perforations of the muffler be kept open, since their closure could tend to prevent the escape of the gases along the desired path. At the regular maintenance inspection it would be well to check their condition and open any of the perforations that appear to be clogged.

If any very extensive burning or corrosion is noted in the arc quencher, it should be replaced. Replacement is also indicated if any breaks or cracks are noted in the ceramic material.

REPLACEMENT

Removal of the arc quencher is simply a matter of lifting the assembly up and out, after the steel retainer across the front of the arc quenchers has been removed. The upper edge of the steel arc runner, fastened to the back plate of the breaker, fits into a recess in the back portion of the arc quencher which locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs after the arc quenchers have been replaced.

BREAKER CONTACT STRUCTURE

The copper current carrying parts of the breaker are all mounted on a common base of insulating material made of polyester glass mat. The copper of each pole consist of an upper stud and pivot, stationary contacts, two movable contact arms, a movable contact pivot, and the lower stud.

The upper stud branches into two pivot surfaces on its inner end on the forward or front side of the breaker base. Each of these convex pivot surfaces mates with the concave pivot surface on the rear side of the stationary contacts. Each of the stationary contacts pivot in a horizontal plane approximately at their mid-points. The end of the contact opposite to the contact tip end is formed into the shape of a small hook. A tension spring engages this hook and provides the necessary contact pressure at the pivot and also at the point of contact with the movable contact arm. When the breaker contacts open, a projection on the contact tip end of the stationary contact bears against a stop pin restricting the movement of the stationary contact. This arrangement results in a continual high force existing between the mating pivot surfaces.

The movable contact arms pivot in a vertical plane, each making contact with a pair of stationary contacts, and thus providing four low resistant parallel paths of current for each breaker pole. The movable contacts rotate about a burnished, silver plated, copper pin which, in turn, is held by a pivot support. Each side of the pivot support bears against the lower, outer surface of the contact arm and supplies a second low resistance path through the pivot. A "U" shaped spring clip made of silver plated conducting material provides an additional current path and protects the other contact surfaces of the pivot against pitting when in motion. It also contributes to the force tending to increase the contact pressure between the lower ends of the movable contacts and the pivot support.

The movable contact pivot support is mounted securely to the breaker base. If, as is normally the case, the pole is equipped with an overcurrent trip device, one of the terminals of the series coil of the trip unit is fastened to the lower end of the pivot support. The other terminal of the coil fastens to the lower stud.

CONTACT ADJUSTMENTS

The only adjustment to be made on the breaker contacts is that of contact wipe. This may be described as the distance the movable and stationary move while they are touching one another in the process of breaker closing. The amount of contact wipe can be measured by comparing the position of the front surface of the stationary contact when the breaker is open to its position when the breaker is closed, in reference to some absolutely stationary part of the breaker. The most convenient stationary part of the breaker to use as a reference point is the steel arc runner above and behind the stationary contacts.

The amount of wipe the contacts should have is nominally 1/8 of an inch. A plus or minus tolerance of 1/32 of an inch is allowed.

The means of adjusting contact wipe is provided by an eccentric pin which passes through the center of the movable contact assembly. Each end of this pin has a free, projecting, hexagon

BASIC BREAKER COMPONENTS

DISCONNECTS

PRIMARY DISCONNECTS

The primary disconnects are attached to the ends of the breaker studs on the rear side of the breaker base. Each disconnect assembly consists of two pair of opposed contact fingers. These are secured to the breaker stud by a bolt which passes through the assembly and the stud. When engaged with the stationary stud of the enclosure, the disconnect fingers exert a set amount of force against the stationary stud through the action of the compression springs. Retainers and spacers hold the contact fingers in correct alignment for engagement with the stud. The amount of force which the fingers exert against the stud is determined by degree to which the springs are compressed by the bolt and nut which hold the assembly together. This pressure is factory set between 60 and 70 pounds. If, for any reason, the disconnects must be taken apart, the position of the nut on the bolt should be carefully noted, so that in reassemblying, the original amount of compression can be restored by replacing the nut at its former position on the bolt.

SECONDARY DISCONNECT, FIGURE 2.

The secondary disconnects serve as connections between breaker control circuit elements and external control circuits. They are used only on drawout type breakers. A terminal board serves the same purpose on stationary mounted and general purpose enclosure mounted breakers. The secondary disconnects allow removal of the breaker without the necessity of having to detach external connections.

The movable part of the secondary disconnect consists of an insulating body which holds a conducting spring loaded plunger to which a flexible lead is attached. As the breaker moves into its enclosure, the plunger is depressed by sliding onto the stationary disconnects of the enclosure.

REPLACEMENT OF MOVABLE SECONDARY DISCONNECTS

1. Unfasten disconnect body from breaker back frame.
2. Open tabs which hold wires on inner side.
3. Pull contact tip loose from hollow tube.
4. Remove contact tip by cutting wire at its base.
5. Push wire through hollow tube of new disconnect assembly.
6. Strip insulation off end of wire to about 1/4 of an inch from end.
7. Place new contact tip on end of wire and crimp.
8. Pull wire through hollow tube until contact tip fits snugly against end of hollow tube.
9. Crimp tab on other side of assembly to hold wire in place.
10. Any hollow tubes which are not used should be pushed into the disconnect body and held in that position by placing fibre spacers over inner ends of tubes and spreading tabs.

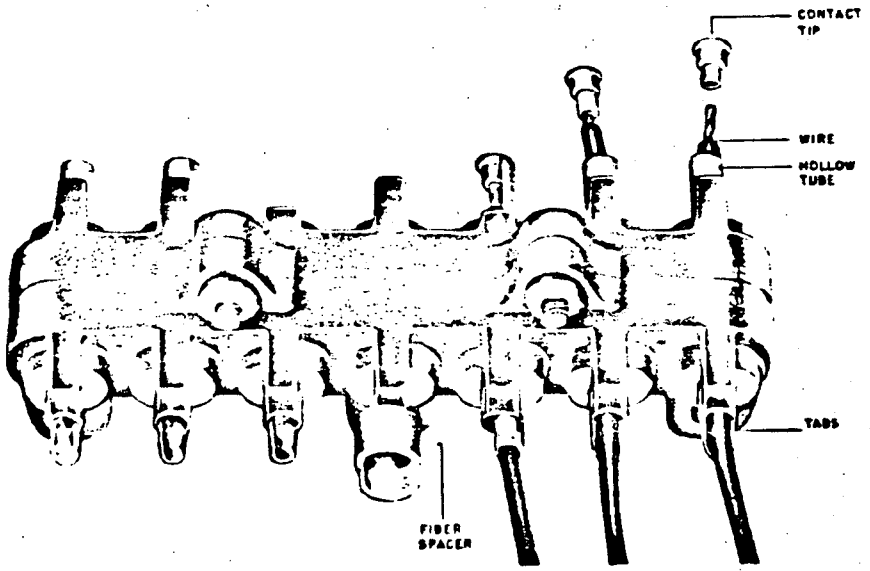


Figure 2. (8017973) Movable Secondary Disconnects

L EXCESS LUBRICANT SHOULD BE REMOVED H A CLEAN CLOTH IN ORDER TO AVOID Y ACCUMULATION OF DIRT OR DUST.

At each maintenance period, all silver to silver friction points, such as primary disconnects, should be cleaned and given a fresh coat of G.E. Spec. No. D50H47 lubricant.

TROUBLESHOOTING

The following table lists several typical symptoms of breaker malfunction, together with their causes and remedies. If, at any time, these symptoms are observed, their cause should be determined and the necessary corrective action should be taken.

TROUBLE	CAUSE	REMEDY
Overheating AK-2/3 Breakers	Contacts not aligned	Adjust contacts.
	Contacts dirty, greasy or coated with dark film	Clean contacts
	Contacts badly burned or pitted	Replace contacts
	Current carrying surfaces dirty	Clean surfaces of current carrying parts
	Corrosive atmosphere	Relocate or provide adequate enclosure
	Insufficient bus or cable capacity	Increase capacity of bus or cable
	Bolts and nuts at terminal connections not tight	Tighten, but do not exceed elastic limit of bolts or fittings.
	Current in excess of breaker rating	Check breaker application or modify circuit by decreasing load
	Excessive ambient temperature	Provide adequate ventilation
Failure to trip AK-2 Breakers	Travel of tripping device does not provide positive release of tripping latch	Re-adjust or replace tripping device and check mechanism latch adjustment
	Worn or damaged trip unit parts	Replace trip unit
	Bind in overcurrent trip device	Replace overcurrent trip device
False Tripping AK-2 Breakers	Overcurrent trip device pick up too low	Check application of overcurrent trip device
	Overcurrent trip device time setting too short	Check application of overcurrent trip device
	Bind in overcurrent trip device	Replace overcurrent trip device
Failure to Close and Latch AK-2/3 Breakers	Binding in attachments preventing resetting of latch	Re-align and adjust attachments
	Latch out of adjustment	Adjust latch
	Latch return spring too weak or broken	Replace spring
	Hardened or gummy lubricant	Clean bearing and latch surfaces
	Closing solenoid burned out	Replace solenoid coil
	Solenoid control device not functioning properly	Re-adjust or replace device
False Tripping AK-3 Breakers	Captive Thump screw on Power Sensor loose fail-safe circuitry reverts characteristic to minimum setting and maximum time delay	Tighten thumb screw on desired setting
	Tap setting dial on Power Supply incorrectly set	Set dial to correspond with Power Sensor coil tap
	External Ground Sensor Coil improperly connected	Refer to Figure 22, page 29 for polarity and connections. Check continuity of shield and conductors connecting the external Ground Sensor coil.
Failure to Trip AK-3 Breakers	Loose or disconnected power sensor disconnect plugs	Tighten or reconnect disconnect plugs
	Loose or broken power sensor coil tap connections	Tighten or reconnect tap connections

MAINTENANCE

INSPECTION

BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES, SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

If the breaker remains open or closed for a long period of time, it is recommended that arrangements be made to open and close it several times in succession, preferably under load.

At all times it is important not to permit pencil lines, paint, oil or other foreign materials to remain on the insulating surfaces of the breaker as they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of periodic inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times checking for obstructions or excessive friction.
2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.
3. Remove and inspect the arc quencher. Breakage of parts or extensive burning will indicate need for replacement.
4. Check contact condition and wipe
5. Check latch engagement.
6. Check operation of tripping devices, including overcurrent trip devices, making sure all have positive tripping action. (Discernible movement in tripping direction beyond point of tripping.)

(For detailed information on breaker features listed, refer to appropriate sections of these instructions.)

SEPARATION OF FRONT AND BACK FRAMES

Figure 3

Many maintenance operations will either require or be greatly facilitated by separating the front frame and mechanism of the breaker from the back frame or base, which consists of the current carrying parts of the breaker and their supporting structure. The procedure for this operation is as follows:

1. Remove the arc quenchers (see section on "Arc Quenchers").
2. Disconnect the two insulated connecting links (6), between the mechanism and the crossbar (10), by removing the tie bolt (7), and slipping the ends of the links off the ends of the shouldered pin, (5) Figure 5 in the mechanism.
3. If the breaker is a drawout type, with secondary disconnects, Figure 2, remove the secondary disconnect supporting bracket from the breaker back frame. Also remove any wiring bundle retainers that may be attached to the back frame.
4. Remove one elastic stop nut from each of two studs (3), which tie the upper ends of the mechanism frame to the back frame of the breaker.
5. Remove the two elastic stop nuts (9/16" Hex.) which fasten the wrap around portion of the front frame to the back frame. One of these is located on each side of the breaker, about 2/3 of the distance down from the top edge of the back frame.

   On drawout breakers for AKD Equipment, the bottom plate must be removed by first removing two #8-36 screws located at the front of the bottom plate and then freeing the plate from the slots located in the bottom of the back frame.
6. The two frames are now disconnected. However, care should be exercised in separating them to avoid damage to the trip shaft arms and paddles. While the back frame is held steady, lift the front frame and mechanism up and out so that the trip paddles on the trip shaft clear the trip arms of the overload trip devices.

   Reassembly of the two breaker halves is accomplished by following the procedure outlined in reverse order.

LUBRICATION

In general, the circuit breaker requires very little lubrication. Bearing points and sliding surfaces should be lubricated very lightly at the regular inspection periods with a thin film of extreme temperature, high pressure, light grease, similar to G.E. Spect. No. D50H15 or RPM No. 5. Hardened grease and dirt should be removed from latch and bearing surfaces by the use of a safe cleaning solvent such as kerosene. Latch surfaces should be left clean and dry and not be lubricated.

a rod against a trip paddle of the trip shaft, rotating it, and causing the mechanism trip latch to be displaced. This allows the mechanism linkage to collapse through the action of the mechanism operating springs.

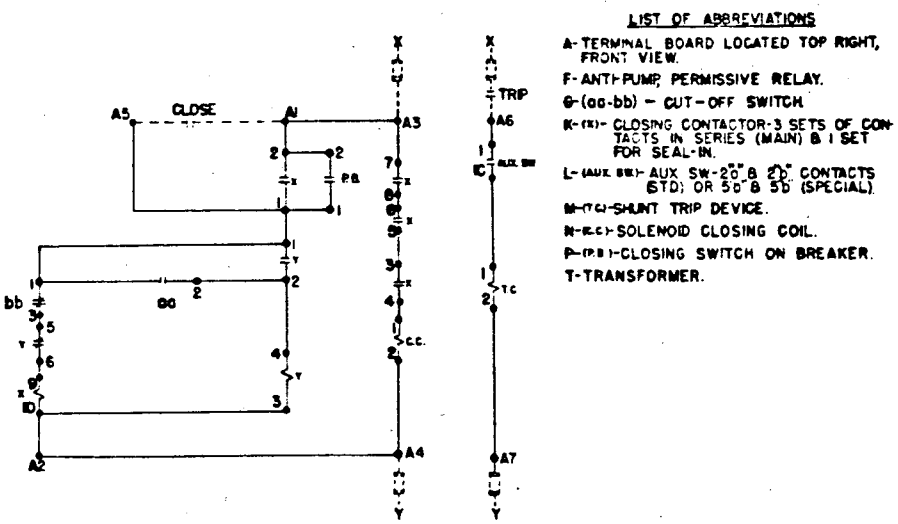
CAUTION: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

ELECTRICAL WITH MANUAL OPERATION

This operating mechanism provides both manual and electrical closing. The operating mechanism is similar to the mechanism of the standard electrical breaker with the addition of the manual handle, cam and mechanism connecting link. The solenoid connecting link and manual cam connecting link are both connected to the closing spring pin at the top of the mechanism, thus compressing the springs when force is provided by either means of breaker closing.

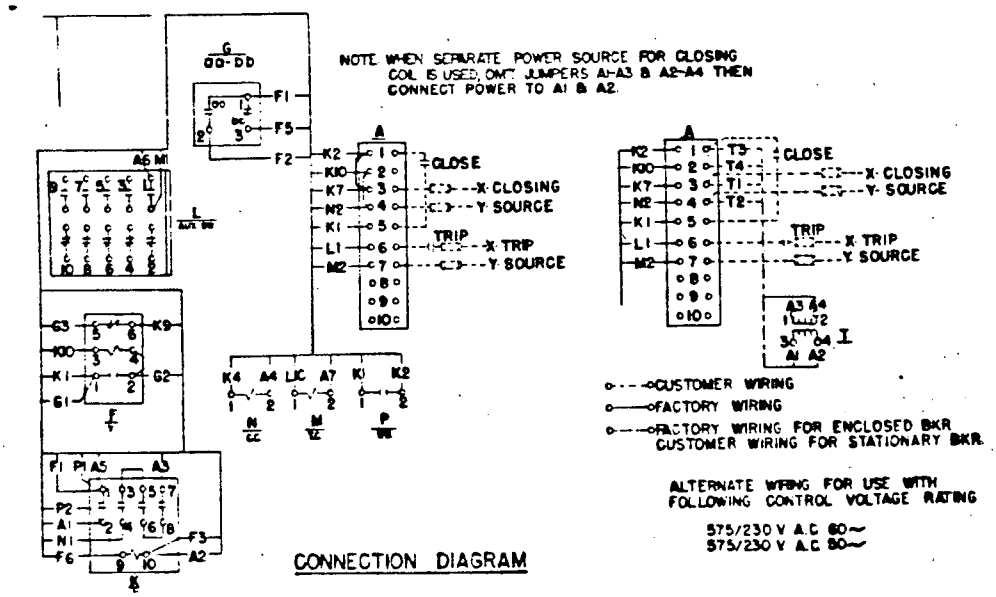
The breaker is manually closed by rotating the closing handle 90 degrees counterclockwise. No reset stroke is necessary as is the case with the standard manual breaker. Electrical closing may be performed either locally or remotely in the same manner as the standard electrical breaker.

Tripping is accomplished by the manual trip button on the escutcheon or by any of the electrical tripping devices available for use on the standard breakers.



ELEMENTARY DIAGRAM

FIG.



CONNECTION DIAGRAM

Figure 1. (695C160-1) & (695C159-1) Typical Wiring Diagram

POWER CIRCUIT BREAKERS

Types AK-2-15 and AK-2/3-25

INTRODUCTION

The instructions contained herein provide information for performing maintenance procedures and for replacing AK-2/3-15/25 breaker components and accessories. For information regarding the receiving, handling, storage and installation of these breakers, refer to GEK-7302 furnished with all AK breakers.

OPERATION

ELECTRICAL OPERATION
Figure 1

The electrically operated breaker closes whenever the closing solenoid coil is energized. This causes an upward movement of the solenoid armature, which initiates the mechanical closing action. The closing signal may be given either by a remote switch or relay, or by a closing button in the front escutcheon if the breaker is so equipped. Either action (refer to the elementary of the wiring diagram) energizes the coil of the X relay through the bb contacts of cutoff switch G and the normally closed contacts of the Y relay. When the X relay or contactor is energized, it closes its contacts. One of these (X1-2) seals in the X coil. The other three sets of contacts, which are arranged in series, activate the closing solenoid.

The breaker control scheme has an anti-pump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed. This prevents the repeated operations that would ensue if one of the automatic trip devices was activated at the time of closing. The Y relay, together with the cut-off switch, provides the anti-pump feature. The mechanical action of closing operates the cut-off switch, reversing the position of the contacts from that shown on the diagram. This energizes the Y relay, if contact is still maintained at the closing switch, with the result that the X relay circuit is opened by Y contacts 5-6. This prevents the X relay from again becoming energized. Y contact 1-2 seals in the Y coil as long as contact is maintained at the closing switch.

Electrically operated breakers may also be closed by means of the maintenance handle which is furnished with the breaker. This is a separate tool and is simply a lever which permits an operator to push upwards on the closing solenoid armature. Two small hooks on one end of maintenance handle are engaged in slots (9A) Figure 5, located in the lower portion of the front escutcheon (8A) Figure 5. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker.

The breaker may be tripped open by any one of a number of electrical tripping devices which will be described in detail later in these instructions. An individual breaker may have none or any combination of these devices. They are the overcurrent tripping device, shunt tripping device, undervoltage tripping device, reverse current tripping device, and open fuse lockout device. All of them effect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs through the breaker from left to right. Whenever the trip shaft is rotated in a counterclockwise direction looking from the right, the latch is displaced. The tripping devices are all equipped with strikers or trip arms which act against trip paddles rigidly fastened to the trip shaft, causing it to rotate on its bearings in a direction to trip the breaker.

The reverse current device and the shunt tripping device each have a set of auxiliary switch "a" contacts in their circuits. (An "a" contact is open when the breaker contacts are open.) This prevents their operation unless the breaker is closed.

The undervoltage device coil is normally continually energized. When the control voltage is low or non-existent, as when the breaker has been pulled out for inspection or maintenance, the breaker is rendered trip-free by the undervoltage device. If it is desired to close the breaker, the device armature must be tied down or blocked closed against the magnet. The open fuse lockout device is used on all AKU breakers and breaker fuse combinations. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses.

MANUAL OPERATION

The manually operated breaker is closed by first rotating the handle in a counterclockwise direction through 90 degrees, then rotating it clockwise back to its normal vertical position. The counterclockwise stroke resets the mechanism, readying it for the clockwise closing stroke.

The breaker may be tripped manually by pushing the manual trip button. This action pushes

CONTENTS

INSTRUCTIONS

GEI-50299B

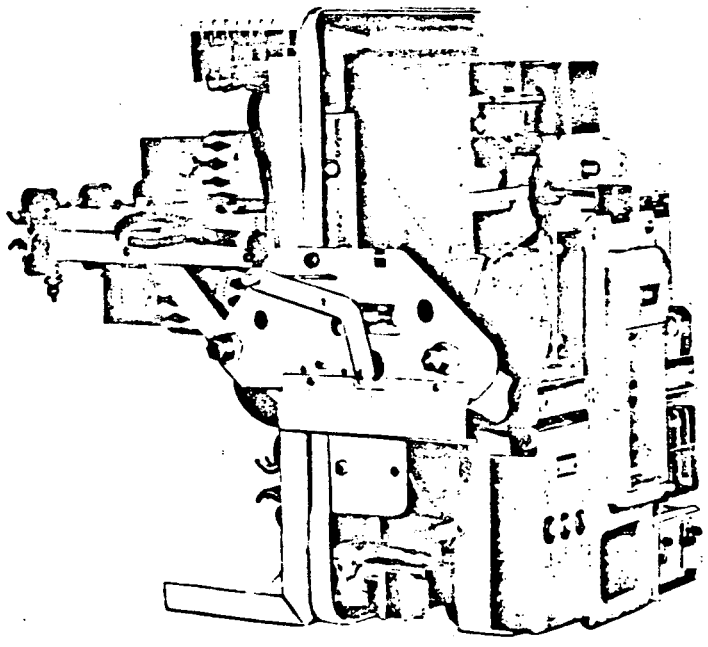
POWER CIRCUIT BREAKERS

TYPES:

AK-2/2A-15

AK-2/3/2A/3A-25

AKU-2/3/2A/3A-25



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MAINTENANCE INSTRUCTIONS

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BEFORE INSPECTION OR ANY MAINTENANCE WORK IS DONE, BE SURE THAT THE BREAKER IS IN THE OPEN POSITION. ALL ELECTRICAL POWER, BOTH PRIMARY AND CONTROL SOURCES SHOULD ALSO BE DISCONNECTED.

Periodic inspection of the circuit breaker is recommended at least once a year. More frequent inspections are recommended, if severe load conditions, dust, moisture, or other unfavorable conditions exist.

Always inspect the breaker after a short circuit current has been interrupted.

At the time of inspection, the following checks should be made after the breaker has been de-energized.

1. Manually operate the breaker several times, checking for obstructions or excessive friction.

2. Electrically operate the breaker several times (if breaker has electrical control) to ascertain whether the electrical attachments are functioning properly.

3. Remove the arc quenchers by removing the channel shaped retaining bar.

4. Inspect arc quenchers and contacts for breakage or excessive burning.

Should arc quencher barriers or contacts be eroded to half their original thickness they should be replaced.

LUBRICATION

In general, the circuit breaker requires moderate lumbrication. Bearing points and sliding surfaces should be lubricated at the regular inspection periods with a thin film of GE Lubricant D50H15. Before lubricating remove any hardened grease and dirt from latch and bearing surfaces with kerosene. ALL EXCESS LUBRICANT WHOULD BE REMOVED WITH A CLEAN CLOTH TO AVOID ANY ACCUMULATION OF DORT OR DUST.

On drawout breakers, the contact surface of the disconnect studs should be cleaned and greased with GE Grease Specification D50H47.

These instructions have as their purpose the imparting of information of a general nature concerning the installation and operation of Type AK power circuit breakers. If more complete and specific information is required, such as might be needed for overhauling the breaker, trouble shorting, or replacing parts of the breaker, refer to the complete instruction for the particular breaker type involved. These are:

Maintenance Manual	Breaker Type
GEI-50299	AK-2/2A/3/3A-15125, AK U-2/2A/3/3A-25
GEI-93863	AKF-2/2A-25
GEK-7303	AK-2/2A/3/3A-50/75/100, AKU-2/2A/3/3A-50 AK-2/2A/3/3A-50S/75S/ 100S, AKF-2C/2D/2E
GEK-7301	Power Sensor Solid State Test Instructions
GEK-7310	AK/AKU-4/5-50/50S
GEK-7309	Test Instructions for Installation or service of Power Sensor Equipped AK breakers

Renewal parts bulletins for the various types of breakers are:

Bulletin	Breaker Type
GEF-4149	AK-2-15/25
GEF-4150	AK-2-50
GEF-4395	AK-2/2A/3/3A-75
GEF-4396	AK-2/2A/3/3A-100
GEF-4527	AK-4/5-50

* Trade-Mark of General Electric Company

closing signal now given energizes ntrol relay X whose contacts close mplete the circuit through the closing coil. With the closing relay coil energized the breaker closes as described above. At the same time the closing relay contact closes to energize the anti-pump relay causing its contacts to reverse providing the anti-pump feature.

When the breaker closes, the mechanical operated G switches close to energize the motor again and the F switches open and de-energize the control relay. The auxiliary switch contact opens preventing the control relay from being energized until the breaker is tripped open. With the G switches closed, the motor charges the closing springs ready for the next closing operation.

MANUAL OR MAINTENANCE CLOSING OF ELECTRICAL BREAKERS

All electrical breakers may be closed manually by means of the maintenance handle furnished with the breaker or switchgear.

To close AK-15/25 breakers:

1. Place the two small hooks of the handle into the two slots located in the lower portion of the front escutcheon.
2. Rotation of the long end of the handle downwards forces the shorter end of the handle upwards against the bottom of the solenoid armature, and closes the breaker's contacts.

close AK-2/3-50/75/100 breakers:

ace the ratchet type maintenance andle on the shaft that protrudes from the gear reduction unit.

2. Operate handle until the spring charge indicator reads charged.
3. Continue to operate handle until the closing springs discharge and close the contacts.

To close AK-50S/75S/100S, AKF2C, 2D breakers and breakers equipped with the quick closing mechanism:

NOTE: All AKD, or AKD-5 drawout type breakers equipped with the quick closing mechanism cannot normally be closed manually when in the racked in (connected position), due to mechanical designed interference between the enclosure and the spring discharge lever on the breaker. If manual closing is desired with the breaker racked in, the interference feature must be removed, otherwise the breaker can be manually closed in the test position or fully racked out position only.

1. With the ratchet type maintenance handle applied to the gear box shaft, operate the handle until the springs are fully charged. The fully charged position is indicated by the spring charge indicator and by solid resistance to any further handle operation.
2. Push down on the push to close lever to release the energy stored in the closing springs which closes the breaker's contacts.

To close AK-4/5-50 breakers:

NOTE: AK-4A and AK-5A drawout breakers will be "trip-free" if the racking mechanism is in any position other than the "TEST" or "CONN" position. If the breaker is on a workbench or on the extended rails, and it is to be closed with the maintenance handle, operate the drawout mechanism as far as it will go in a clockwise direction. This will put the mechanism in the "connected" position, and the breaker may be closed. If this is done, the mechanism will have to be reset to the "disconnected" position before it can be reinserted into the breaker compartment in the enclosure.

1. Place the maintenance handle on the end of the camshaft below the motor.
2. Operate the handle until the closing spring goes over center and the breaker closes. If the breaker is a "quick-close" breaker, type AK-4/5-50S, the spring will not release upon going over center, but will be held off by a blocking link. This can be released by pulling forward on the closing solenoid armature located beneath the mechanism. This can be done safely, since no moving parts are located in this space.

TRIPPING

The breaker is tripped open by the displacement of a mechanism latch, which allows a toggle linkage supporting the movable contacts in the closed position to collapse. This trip latch is fastened rigidly to a trip shaft which runs horizontally from left to right through the breaker. All of the means provided for tripping the breaker operate through striker arms which displace the mechanism trip latch by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch. The manual trip button, overload devices, shunt trip, undervoltage tripping device, and reverse current trip all operate in this fashion to trip the breaker. The movement of the striker arms of all of these, when activated, should move from 1/32 to 1/16 inch beyond the point at which tripping occurs. This is what is meant by the expression, "positive tripping".

NOTE: BEFORE MAKING ANY ADJUSTMENTS TO TRIP DEVICE SETTINGS, THE BREAKER SHOULD BE IN THE OPEN POSITION AND CONTROL POWER REMOVED.

Most AK-2 and AK-4 air circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

All AK-3 and AK-5 type air circuit breakers will be equipped with Power Sensor* overcurrent trip devices. The time current band as well as the pickup settings of this device are adjustable. A single captive thumb screw adjusts all three phases for any particular characteristic or setting. Should a thumb screw be inadvertently left loose the Power Sensor* will revert to the "minimum" pickup settings or "maximum" time delay bands accordingly. If after installation, nuisance tripping occurs, check the Power Sensor* for proper settings as required for the specific application and tighten all the thumb screws on the Power Sensor*.

For a more detailed discussion of the construction, operation, and application of overcurrent trip devices refer to the following publications:

1. Maintenance manual for specific breaker involved (see "Maintenance").
2. "Selection and Application of Power Circuit Breakers" GET-1113.

TYPE AKU AND BREAKERS WITH FUSE-BREAKER COMBINATIONS

Open Fuse Lockout Device

This device may be furnished with any of the above type breakers. The open fuse lockout device consists of 3 separately operated devices (one per breaker pole) each wired in parallel to corresponding breaker fuses. These devices are mounted on the left hand side of the breaker (looking from front). The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses. This energizes the coil of the device causing the armature to engage the trip paddle, thereby tripping the breaker. Once operated, the armature is latched in the closed air gap position allowing the reset button to extend forward indicating which fuse has blown, and simultaneously holding the breaker in the trip-free position until the latch closed armature is released by the operating of the manual reset button.

OPERATION

MANUAL CLOSING

AK-15/25 manually operated breakers are closed by turning the handle 90 degrees counterclockwise and then clockwise 90 degrees back to the original position. The initial counterclockwise movement resets the closing mechanism. The clockwise movement closes the breaker.

The closing mechanism of the AK-2/3 50/75/100 manual breakers is a spring charged mechanism similar to the one used on AK-2/3-50/75/100 electrically operated breakers. AK-2/3-50/75/100 manual breakers are closed by rotating the closing handle counterclockwise through approximately 120 degrees, and then clockwise back through 120 degrees to the normal handle position. Four such complete movements of the handle are required to close the breaker. During the four counterclockwise movements and the first three clockwise movements of the handle, the springs are charged. After approximately 70 degrees travel of the fourth clockwise handle movement, the spring charged mechanism is driven over-center and the breaker closes. A charge-indicator, numbered 1 to 4, viewed through the breaker front escutcheon, moves with each complete handle movement and indicates the number of complete handle movements that have been performed.

AK-4/5-50 manual breakers are also closed by means of energy released through the discharge of a closing spring. The charging of the spring is done by a single stroke of the breaker handle. This involves raising the handle counterclockwise from the vertical position until a stop is encountered after about 140 degrees of rotation. The spring is then extended to its fully charged position as the handle is returned to its normal vertical position. Release of the spring, and resultant closing of the breaker, occurs when the "close" button in the escutcheon is pushed. (The breaker will close only if the racking mechanism is in the "CONN" or "TEST" position.)

ELECTRICAL CLOSING
(Figures 6 and 7)

STANDARD BREAKERS

AK-15 and AK-25 electrically operated breakers are closed by a solenoid coil. The armature of the solenoid is linked to the breaker mechanism and its movement, operating through the mechanism, closes the breaker. The closing solenoid circuit may be operated by a push button closing switch on the breaker or by a remote switch or relay, depending on the individual arrangements desired. When a closing signal is given, the X relay coil is energized and it in turn closes its contacts. One of these seals in the X coil circuit; the other three, which are arranged in series, energize the solenoid closing coil. As the breaker closes, a mechanically operated switch opens one pair of its contacts (bb) and closes another (aa). The contacts which open cut out the X relay coil. The contacts which close energize the Y relay coil, whose contacts now seal in the Y coil and hold open the X relay coil circuit. This prevents another closing operation if one of the protective devices operates to trip the breaker before contact at the closing switch is released.

Large AK breakers (AK-50/75/100) are closed by the discharge of a closing spring. This rotates a crankshaft which, by means of an attached roller, operates a closing cam, forcing the movable breaker contacts against the stationary contacts. The closing spring is charged through the operation of a motor and gear reduction unit.

The electrical control system is comprised of an X relay, two double contact mechanically operated switches (F and G), a push button closing switch and any means for remote closing which the user may incorporate into the system. When voltage is first applied to the breaker, (before any closing signal is given) the motor is energized through two of the X relay contacts and the two G switch contacts. The motor then compresses the closing springs to the "pre-charged" position at which point the mechanically operated F and G switches are operated. This opens the G contacts, stopping the motor, and closes the F contacts, which readies the system for the actual closing of the breaker. When the push button or remote switch signals for a closing operation, the X relay coil is energized, operating the X contacts. This seals in the X relay and energizes the motor once again and the closing operation takes place.

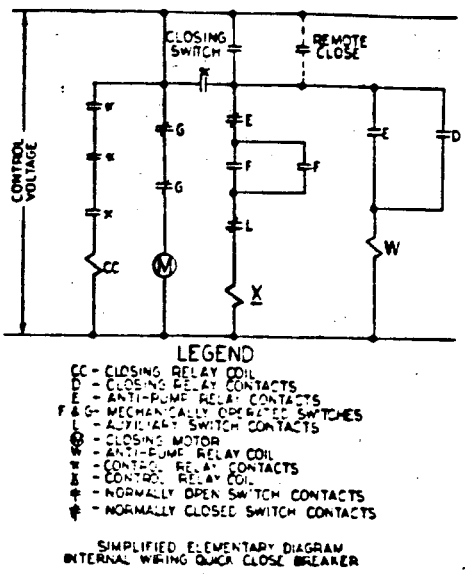


Fig. 8

QUICK CLOSE BREAKERS
(Figure 8)

Functionally, the quick close mechanism differs from the standard electrical mechanism in that the pre-charge operation is extended to completely charge the closing springs. At the end of the charging operation, which takes approximately 5 seconds, (2 seconds for AK-4/5-50 breakers) a latch plate engages the prop roller to prevent the closing springs from discharging.

With the closing springs fully charged the breaker is ready for a closing operation upon release of the prop roller. This may be accomplished either manually, by depressing the closing lever on the breaker, or electrically by closing the remote closing switch. Upon the release of the prop roller the closing springs discharge and close the breaker in the same manner as on the standard electrical breaker. AK-4/5-50 breakers are closed through a remote switch or the close button in the escutcheon, (if the breaker is equipped with a push button closing switch).

With control voltage applied, the motor is energized through the G switch contacts, and charges the closing springs. When the springs reach the fully charged position, the mechanically operated switches operate, reversing their contacts. Upon operation of these switches the motor is stopped by the opening of the G switch. The closing of the F switch prepares the breaker for a closing operation.

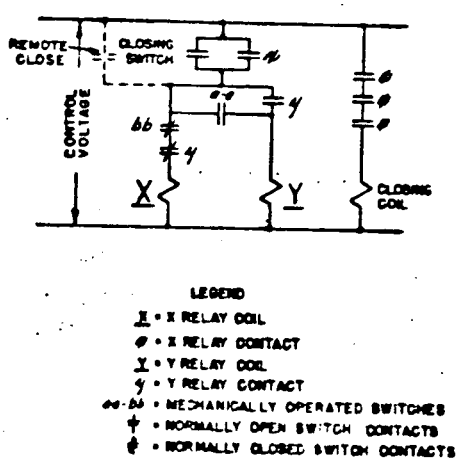


Fig. 6 Simplified Elementary Diagram Internal Wiring AK-15 and 25

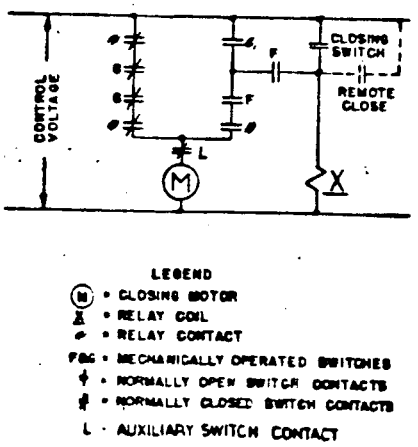


Fig. 7 Simplified Elementary Diagram Internal Wiring AK-50, 75 and 100

Fig. 6 (457A685)
Fig. 7 (457A684)
Fig. 8 (0156A2395)

...e the two track lock links, and ...e right track all the way forward.

4. Using a lifting device and the spreader provided for these breakers, raise the breaker and position it so that the mounting pins on the side of the breaker line up with the slots in the track and are about 2 inches above the track.

5. Pull the left track out and lower the breaker so that the mounting pins engage the slots in the tracks.

6. Engage the racking handle. This is done by pushing the trip button in the breaker escutcheon, sliding the cover below it to the right, and inserting the handle on the jackshaft.

7. Turn the handle counterclockwise as far as it will go, (if it will move in that direction) and remove the handle.

8. Push the breaker in against the track stops, and lock the track links.

9. Close the compartment door. Again engage the handle as in step 6, and rotate the handle clockwise as far as it will go. Towards the end, a high force requirement will be felt as the disconnect fingers on the breaker engage the stationary studs. A couple of turns later, and the stop will be encountered. The position indicator will now show "CONN."

Removal AK-2A/3A

1. ...ip the breaker.

2. Move the breaker and inner housing to the fully withdrawn position. (See Breaker Insertion, Steps 1, 2 and 3).

3. Rotate the two track lock links and pull the breaker out to the limit of the track travel. Attach lifting device and lift breaker up and away from compartment until primary disconnects clear the compartment.

4. Move the inner housing to the connected position by pushing the tracks back against the track stops and then follow Steps 7 and 8 under Breaker Insertion. The inner housing is now in the connected position and the breaker is free from its compartment.

Breaker Removal AK-4A/5A

1. Trip the breaker.

2. Engage the handle and rotate it counterclockwise. If the breaker closing spring is fully charged, it will be discharged automatically a couple of turns before the end of the action.

3. Open the door, unlock the track locks, and pull the breaker all the way forward. The breaker may now be lifted from the tracks.

NOTE: The installation of AK-2/3-50S/75S/100S/AKF2C/2D and breakers equipped with the quick-closing mechanism is the same as the other breakers described in this book. The only difference occurs with drawout breakers. The compartments that house the quick-close breakers will be equipped with an interlock that prevents the manual discharging of the closing springs while the breaker is in the racked in (connected position). This interlock, when requested, will be provided with both AKD and AKD5 equipment that require quick close breakers

CONNECTIONS

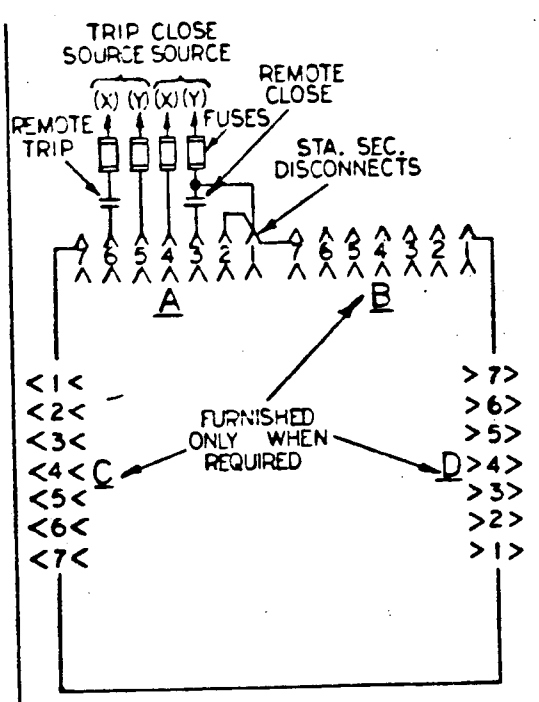
All electrical connections should be made to assure good conductivity. Mating surfaces should be parallel and firmly bolted or clamped together. Contact surfaces should be clean and have a smooth finish. The bus or cable connecting to the breaker should have adequate current-carrying capacity to prevent excessive heating. Control circuit connections should be made according to the wiring diagram which applies to each breaker specifically. Depending on the breaker type, those connections are made either to a terminal board on the breaker or to the stationary parts of the secondary disconnects.

INDIVIDUALLY ENCLOSED AND STATIONARY BREAKERS

The customers external connections for operation of breaker control components and accessories are shown in Fig. 1.

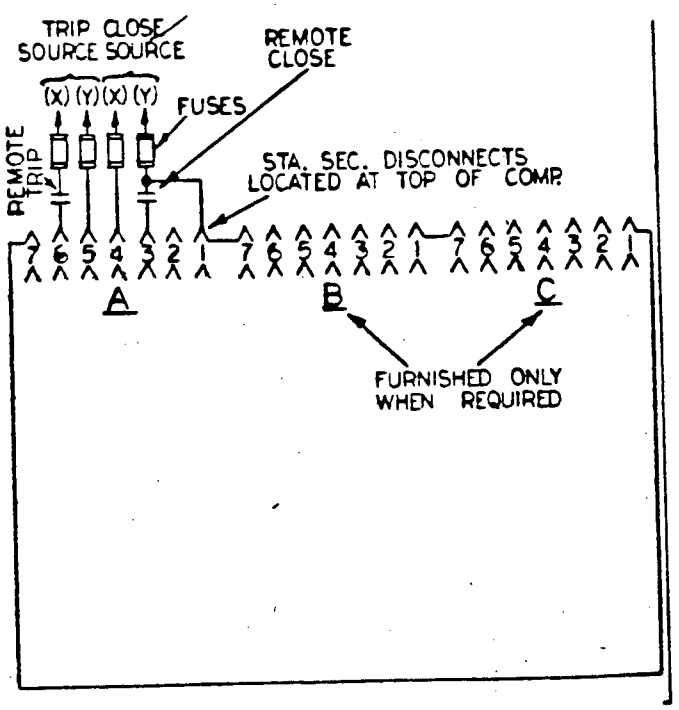
DRAWOUT BREAKERS

The customers external control connections to these breakers are made to the stationary secondary disconnected located in the breaker compartment as shown in Figs. 2 and 3, AKD Equipment and Figs. 4 and 5 AKD5 Equipment. (Note - If the breaker is used in a General Electric Company, Drawout Switchgear Equipment, all external connections must be made to terminal blocks located in the rear vertical wiring trough of the equipment.)



FRONT VIEW AK-1A-15, 25 & AK-2A-15, 25 BREAKER COMPARTMENT

Fig. 4



FRONT VIEW AK-2A-50, 75, 100 BREAKER COMPARTMENT

Fig. 5

Figs. 4 & 5 (0156A2377)

TYPICAL WIRING DIAGRAMS

1. The Connected Position - the breaker in the operating position, both primary and secondary contacts made and the door may be closed.

2. The Test Position - the primary (power) contacts not made but the secondary (control) contacts are made. Any breaker test not involving power may be made in this position. The door may be closed in this position.

3. Disconnect Position - neither the primary nor the secondary contacts made. The door may be closed.

4. Fully Withdrawn Position - the breaker completely out of its compartment ready for removal from the inner housing. The door must be open in this position.

Breaker Insertion AK-2A/3A - With the inner housing in the connected position proceed as follows:

1. Insert handle on jackscrew shaft located on left hand side of compartment right above indicator.
2. Rotate handle counter clockwise until jackscrew is stopped. (Indicator should read DISC).
3. Remove handle and open compartment door.
4. Rotate the two track lock links and pull the right track to the limit of its travel.
5. Using a lifting device, raise the breaker until the breakers mounting pins are approximately one inch above the tracks.
6. Pull the remaining track out to the limit of its travel and lower breaker so the breaker mounting pins drop into the slots in the track. Remove the lifting device.
7. Push the breaker in against the track stops. Rotate the two track lock links to lock the breaker in place. Close the compartment door.

   NOTE: When moving a breaker from one position to another, be sure breaker is tripped open.
8. Insert handle on jackscrew shaft and rotate clockwise to move breaker into the compartment. Breaker is in connected position when jackscrew can no longer be rotated. (Indicator should read CONN).

Breaker Insertion AK-4A/5A - With the inner housing in the connected position, proceed as follows:

1. Open door and remove wooden wedge in the lower guide slot of the inner housing.
2. Pull inner housing forward as far as possible.

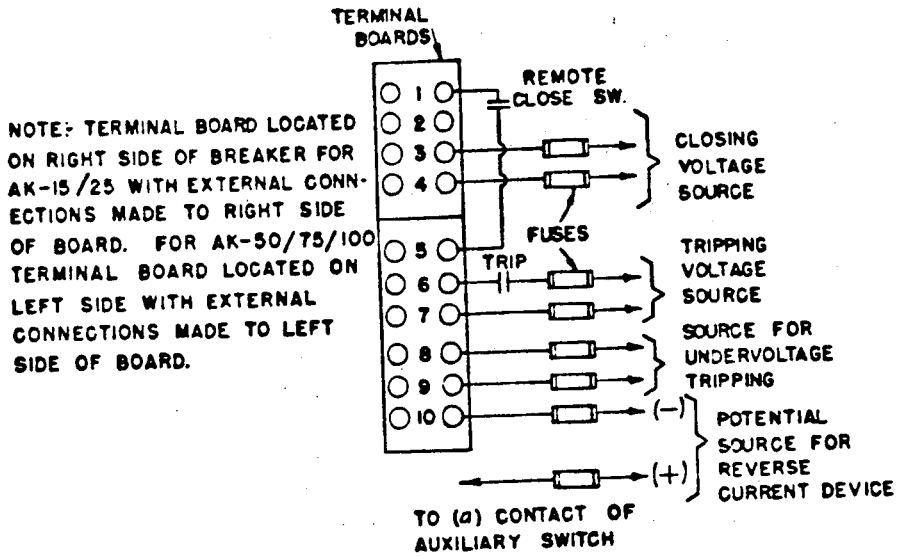


Fig. 1 (Front View)

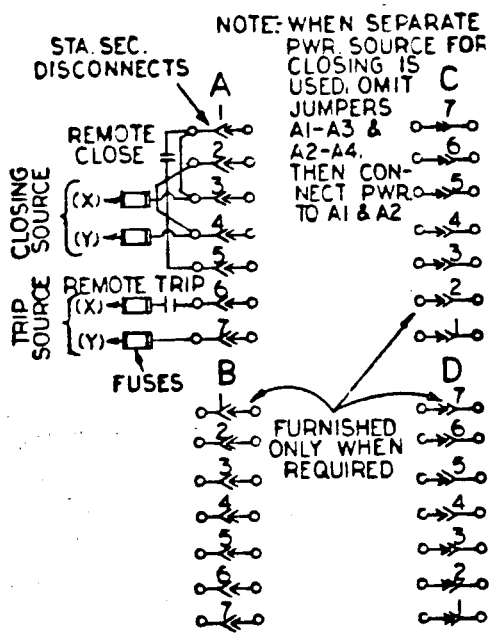


Fig. 2 Front View AK-15 and 25 Breaker Compartment

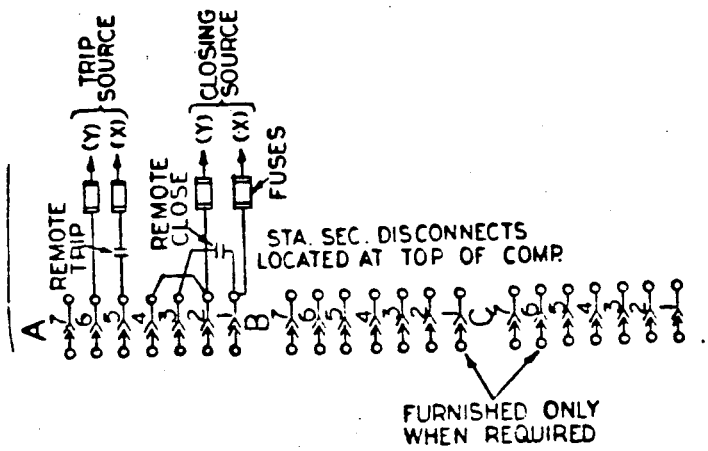


Fig. 3 Front View AK-50, 75, 100 Breaker Compartment

drawout breakers are fastened to a ing tray which extends out from the re to receive the breaker. Small breakers have guides on their side plates which slide in channels in the enclosures. Both large and small breakers have a test position in which the secondary disconnects are engaged, but the primary disconnects are not. In this position, the breaker may be operated electrically without energizing the load cable or bus.

Use D50H47 lubricant on the disconnect terminals to reduce the force required to insert the breaker.

Inserting Breaker AK-15 and 25

1. Trip the breaker.

2. Raise the breaker until the guides on the sides of the breaker are level with their mating supporting channels in the enclosure, and slide the breaker part way into its enclosure. (Note - The breaker will be obstructed by a position stop at the bottom of the enclosure after the breaker has traveled only a short distance into the cubicle. Lift the position stop handle, located at the bottom right of the enclosure, which will release the position stop and allow the breaker to travel further into the cubicle).

3. Raise the rackout handle forward and up as far as its travel will permit and push the breaker into the enclosure until the rackout pins on the handle assembly bear against the housing rackout cams on the side of the enclosing case.

Push downward on the rackout han- cing the pins on the handle up into ot in the stationary cam plate. This action forces the breaker through a final short portion of its movement into the enclosure and allows the operator to provide the force necessary to make the primary disconnects engage the stationary studs in the enclosure. In performing this operation, make sure that the handle is rotated downwards as far as its free travel will permit and then pull the racking handle down to be sure the trip interlock is released. (Note - When the racking handle is in any position other than completely down, the breaker cannot be operated and is held trip-free by the trip interlock. This applies to the "fully in" and "test" positions.)

Withdrawing Breaker AK-15 and 25

1. Trip the breaker open. If the breaker is not open, the interlock lever of the drawout mechanism will not permit operation of the rackout handle.

2. Pull the racking handle up and forward as far as it will travel, disengaging the primary disconnects.

3. Slide the breaker out until the position stop engages in the front slot in the bottom of the breaker carriage. The breaker is now in the "test" position, where its primary disconnects are safely disconnected from the line and load terminals of the enclosure. (Note - Refer to section describing "Test Position" in these instructions.)

To remove the breaker from its ure, lift the position stop handle and the breaker forward until the position stop engages the rear slot in the bottom of the breaker carriage. This is the safety position stop where both the primary and secondary contacts are disengaged. Again lift the position stop handle. Slide the breaker slightly forward to remove it from the enclosure.

Inserting Breaker AK-50, 75 and 100

1. Lift the breaker to a position approximately six inches above the height of the compartment tray.

2. Pull the drawout tray out under the breaker as far as the tray will travel. NOTE - When installing an individual skeleton housing for a drawout AK-50 or 75, locate a bolt head over the two front bottom mounting holes of the housing to provide a limit stop for the drawout tray.

3. Lower the breaker about 1/2" above the dowel pins on the tray and push the breaker back into its compartment so that the rear bottom angle of the breaker is against the guides on the tray directly back of the dowel pins.

4. Slowly lower the breaker onto the tray and at the same time guide it so that the holes in the rear angle of the breaker fit over the two dowel pins on the tray. If the breaker is correctly positioned on the dowels, its rear and side bottom frame angles will all sit firmly on the tray.

5. Insert two 3/8 inch hex. head screws through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. Do not tighten screws firmly. This provides better alignment of the primary stationary studs and the primary disconnects for the subsequent racking operation.

6. Push the breaker into the compartment until the "test" position stop engages to prevent further travel. (Note - Refer to section describing "Test Position" in these instructions.)

7. Release the test position stop by depressing its lever and push the breaker back into the compartment until the racking pins on the housing butt against the outer surface of the racking cam. In this position, the racking pin has lifted the locking arm on the cam which allows the racking handle to be lifted enough to allow the pawl to engage the first notch on the cam.

8. When the pawl engages the first notch on the cam, push the handle down again to its normal position. This causes the cam to rotate about the racking pin. Repeat this operation five times to rack the breaker into its final operating position. Interlocks hold the breaker trip free until it is racked into the fully contacted position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. It does serve three useful purposes: it positions the cam so that it cannot rotate and allow the breaker to back out under short circuit stresses; the partial stroke signals that the racking operation is complete, and it releases the trip interlock which was engaged by the racking pin during the previous four pumps of the racking arm. NOTE: Once a racking operation has been started, it must be completed, as the breaker cannot be reversed until the racking operation is completed.

9. After completing the fifth racking stroke, lift the handle as high as it will go and allow it to drop to its normal position. NOTE: Any strokes beyond this point will cause the breaker to be trip free. Tighten the 3/8 inch hex head screws inserted in the front holes of the drawout tray during step 5 of this operation. The breaker is now in the operating position.

Withdrawing Breaker AK-50, 75 and 100

1. Trip the breaker to release the positive racking interlock.

2. Lift the racking handle as far as it will go.

This operation will re-engage the trip interlock to hold the breaker trip-free for the remainder of the racking operation. Note that here the cam is rotated by lifting the handle, whereas in racking the breaker in, the operation is performer as a result of pushing the handle down.

3. Reset the handle to its lowered position and lift it again. This operation must be performed 5 times to completely disengage the cams from their racking pins. After the fifth lifting stroke let the handle drop to its normal position.

4. Pull the breaker out of its compartment until the test position stop engages to hold the breaker in the "test" position.

5. Depress the test position stop handle and pull the breaker out of its compartment as far as the drawout tray will travel.

6. Remove the two 3/8 hex. head screws which hold the breaker on the tray.

7. Attach a lifting device to the top frame of the breaker.

8. Lift the breaker approximately 1/2 inch off the dowel pins on the tray and then pull the breaker forward until its primary contacts clear the compartment.

9. Push the tray all the way back into its compartment. The breaker is now free from its compartment.

TEST POSITION

The "Test Position", as referred to in the previous instructions, is that breaker position where the primary power disconnect contacts are safely disengaged but the secondary control disconnects are engaged. In this position, the breaker may be tested or operated, manually or electrically without energizing the primary power circuit, provided the racking handle has been moved to the completely down position, thus releasing the trip interlock.

For a more complete description of drawout mechanisms and enclosures see AKD DRAWOUT EQUIPMENT INSTRUCTIONS, GEH-1830 and AKD5 Drawout Equipment Instructions GEI-90890.

DRAWOUT BREAKERS AKD5 EQUIPMENT

NOTE: AKD5 breakers are identified by letter "A" appearing after breaker number - example, "AK-2A-15".

Drawout Mechanism Operation - There are four positions of the drawout mechanism:

INSTALLATION AND OPERATION OF TYPE AK POWER CIRCUIT BREAKER

RECEIVING, HANDLING AND STORAGE

Before installing, or operating these circuit breakers, make a careful reading of the sections of these instructions which are pertinent to the anticipated work.

Upon receipt of a circuit breaker, immediately make an examination for any damage or loss sustained in shipment. If injury, loss or rough handling is evident, file a damage claim at once with the transportation company and notify the nearest General Electric Sales Office.

Unpack the circuit breaker as soon as possible after it has been received. Exercise care in the unpacking to avoid damage to the breaker parts. Be sure that no loose parts are missing or left in the packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker.

If the circuit breaker is not to be placed in service at once, store it in a clean, dry location in an upright position. Support it to prevent bending of the studs or damage to any of the breaker parts. Do not cover the breaker with any packing or other material which absorbs moisture, that may cause corrosion of breaker parts. A covering of kraft or other non-absorbent paper will prevent dust from settling on the breaker.

INSTALLATION

LOCATION

In choosing a location for the installation of an AK Circuit Breaker, there are two factors to be considered. The first of these is the effect of the location on the breaker itself. Much better performance and longer life may be expected if the area is clean, dry, dust-free, and well ventilated, than if the opposites to these conditions exist. The second consideration is convenience for operation and maintenance. The breaker should be easily accessible to the operator, and there should be sufficient space allowed for maintenance work to be done if this becomes necessary.

MOUNTING

AK Circuit Breakers are designed to be mounted in any one of three ways. These are dead front mounting, individual mounting with the enclosure being provided, and drawout mounting in which the breaker is designed for insertion into a cubicle in drawout equipment such as a substation or control board.

DEAD FRONT BREAKERS

These breakers are designed for mounting in a switchboard or enclosing case of the customer's design and construction. Mounting in this instance consists of bolting the breaker frame to a supporting structure within the switchboard or enclosure, connecting the power buses or cables, and making any necessary control connections. The front cover of the breaker enclosure may be a hinged door or a plate bolted to the panel. In either case, it should have a section cut out, through which the front escutcheon of the breaker may protrude. Outline drawing numbers giving the dimensions needed for preparing a suitable enclosure or cubicle for the various types of AK breakers are given below. These are for standard 2 or 3 pole breakers.

Breaker	Typical Outline Drawing No.
AK-2-15 and 25	695C116
AK-3-15 and 25	121C7570
AK-2-50 Man. Oper.	845C281
AK-2-50 Elec. Oper.	238C123
AK-3-50 Man. Oper.	121C7553
AK-3-50 Elec. Oper.	121C7555
AKT-2-50 Man. Oper.	102C3650
AKT-2-50 Elec. Oper.	102C3651
AKT-3-50 Man. Oper.	121C7589
AKT-3-50 Elec. Oper.	121C7590
AK-2-75 Man. Oper.	845C284
AK-2-75 Elec. Oper	269C225
AK-3-75 Man. Oper	121C7583
AK-3-75 Elec. Oper.	121C7557
AK-2-100 Man. Oper.	845C290
AK-2-100 Elec. Oper.	269C227
AK-3-100 Man. Oper.	121C7585
AK-3-100 Elec. Oper.	121C7559
AK-4-50 Man. Oper.	134C2600
AK-4-50 Elec. Oper.	134C2601
AK-5-50 Man. Oper.	134C2610
AK-5-50 Elec. Oper.	134C2611

The surface on which the breaker is mounted must be flat throughout in order not to impose any internal distortion on the breaker unit. The supporting structure must be rigid enough to avoid any possibility of the breaker studs supporting the weight of the breaker. Minimum cutout dimensions, as given by the appropriate outline drawing, must be maintained to provide adequate electrical clearance.

INDIVIDUALLY ENCLOSED BREAKERS

Individually enclosed breakers are supplied with several types of enclosures, most common is the general purpose type or the weather resistant type. The former is used for favorable indoor locations and the latter for outdoor locations or indoor locations that may be subject to unfavorable conditions. All of the enclosures are provided with suitable means for mounting on walls or supporting framework. Removable cover plates are supplied with the enclosures which may be drilled or machined to accommodate the entrance of bus ducts, conduits or cables. Steps in the procedure for installing enclosed breakers follow:

1. If the breaker is an AK-15, AK-25 or an AK-50, remove it from the enclosure. With AK-50 breakers, a handle and cam arrangement is used for that part of the breaker movement that involves the disengagement or engagement of the primary disconnect. AK-75 and AK-100 breakers are bolted solidly to the enclosure frame and need not be removed from the enclosure.

2. Remove cover plates of enclosure and prepare them to accommodate whatever power entrance means is used.

3. Mount enclosing case to supporting structure.

4. Replace cover plate and make power connections to stationary terminals in enclosure.

5. If the breaker is a type AK-15, AK-25 or AK-50 and has been removed from the enclosure, it may now be replaced. Control power connections to the terminal board should be made as required. (See CONNECTIONS).

6. Before energizing the power circuit, operate the breaker several times to be sure that it is functioning properly. (See OPERATION).

AK-4/5-50 breakers which are individually enclosed will have enclosures of the AKD5 drawout type. These breakers will be straight drawout breakers, types AK-4A-50 and AK-5A-50. (See instructions in this book under the heading, "Drawout Breakers AKD5 Equipment")

DRAWOUT BREAKERS AKD EQUIPMENT

Mounting drawout breakers consists of simply placing the breaker in the proper position with respect to its enclosure, sliding or rolling it to a stop position, and, by means of a racking handle and mechanism, racking it through the last part of its movement during which the stationary and movable halves of the disconnects engage.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

AUXILIARY DEVICES SPECIFICATIONS

TYPE LOAD OR P. F.	VOLTAGE		INTERRUPTING RATING (AMPS)		
	Nominal	Range	Auxiliary Switch	Bell Alarm Switch	EC-1 Switchette
Resistance	48 DC	41-56	25.00	-	-
	125 DC	106-140	11.00	2.5	0.30
	250 DC	210-280	2.00	0.9	0.15
	600 DC	508-672	0.45	0.3	-
Electro-Magnet	48 DC	41-56	15.00	-	-
	125 DC	106-140	6.25	2.5	0.30
	250 DC	210-280	1.75	0.9	0.15
	600 DC	508-672	0.35	0.3	-
75 - 85% Lagging	120 AC	104-127	75.0	30.0	-
	240 AC	208-254	50.0	15.0	10.0
	480 AC	416-508	25.0	7.0	10.0
	600 AC	520-635	12.0	5.0	-
30 - 35% Lagging	120 AC	104-127	50.0	30.0	-
	240 AC	208-254	25.0	15.0	10.0
	480 AC	416-508	12.0	7.0	10.0
	600 AC	520-635	8.0	5.0	-
Continuous Rating (Amps)			*20.0	*10.0	*10.0
Closing Rating (Amps) 30-35% PF or resistive			50.0	30.0	**

* Limited to 5.0A continuous rating of #16GA. wire on Drawout Breakers.

** Adequate for use with AK Breaker Shunt Trip Coils of the voltage ratings listed in above table. (Maximum current of 12.3A for the 120V. AC coil)

INSTRUCTIONS

GEK-7302B
Supersedes GEH-2021D

AK LOW VOLTAGE POWER CIRCUIT BREAKERS

Installation and Operation

Types

AK-2/3/2A/3A-15
AK-2/3/2A/3A-25
AK-2/3/4/5/2A/3A/4A/5A-50/50S
AK-2/3/2A/3A-75/75S
AK-2/3/2A/3A-100/100S

AKT-2/3/50/50S
AKU-2/3/2A/3A-25
AKU-2/3/4/5/2A/3A/4A/5A-50/50S
AKF-2/2A-25
AKF-2C/2D/2E

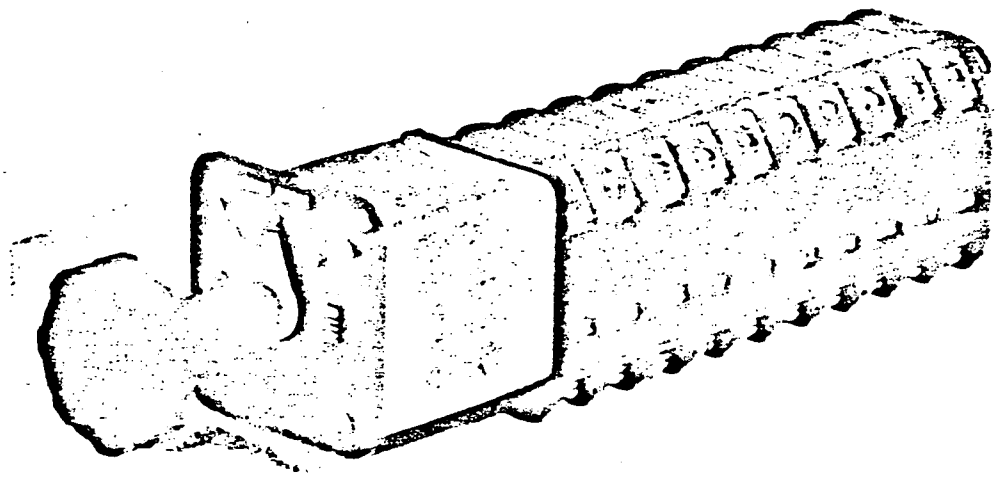
SWITCHGEAR PRODUCTS DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

INSTRUCTIONS

GEH-2038A
SUPERSEDES GEH-2038

CONTROL AND TRANSFER SWITCH

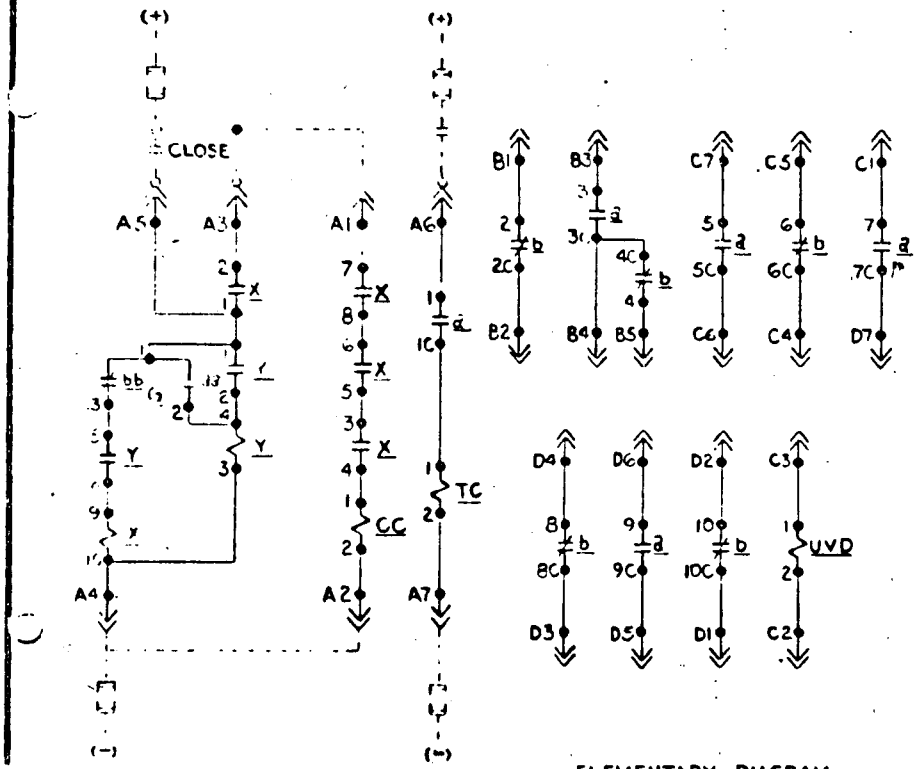
Type SBM



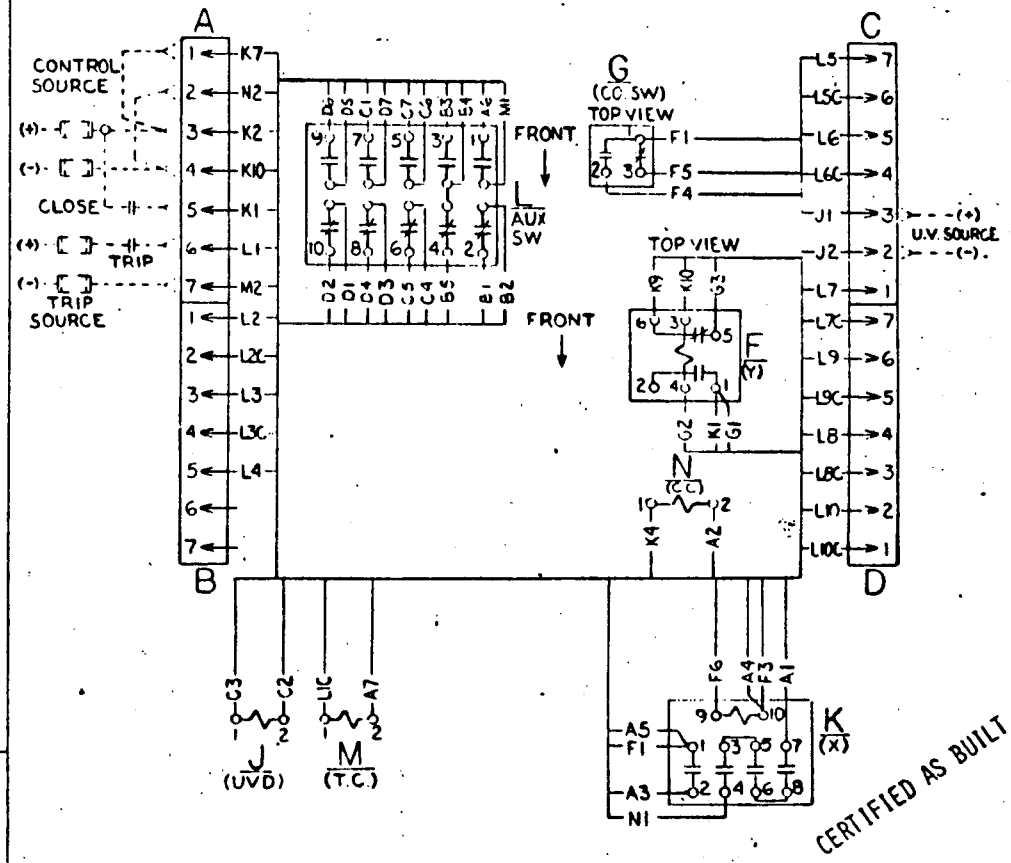
SWITCHGEAR DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.



ELEMENTARY DIAGRAM



CONNECTION DIAGRAM

CERTIFIED AS BUILT

SAN ONOFRE UNITS 2 & 3

LIST OF ABBREVIATIONS

A-SEC. DISC. LOCATED TOP LEFT FT. VIEW
B-SEC. DISC. LOCATED LOWER LEFT FT. VIEW
C-SEC. DISC. LOCATED TOP RIGHT FT. VIEW
D-SEC. DISC. LOCATED LOWER RIGHT FT. VIEW
F-(Y) ANTI-PUMP, PERMISSIVE RELAY
G-(aa-bb) CUTOFF SW
J-(U.V.) UNDERVOLTAGE TRIP DEVICE TIME DELAY OR INSTANTANEOUS
K-(X) CLOSING CONTACTOR - 3 SETS OF CONTACTS IN SERIES (MAIN) & 1 SET FOR SEAL-IN
L-(AUX. SW.) 5 "a" & 5 "b" CONTACTS (SPECIAL)
M-(TC) SHUNT TRIP DEV.
N-(CC) SOLENOID CLOSING COIL

REV. NO.	DATE	DESCRIPTION
2	12-3-75	REV PER CUST MKD DWG DTD 12-5-75
1	9-29-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

G.E. AK-2-25 CIRCUIT BREAKER
ELEMENTARY & CONNECTION DIAGRAM

DATE: 11-18-74
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO.
8052-B13.2

MEMORANDUM

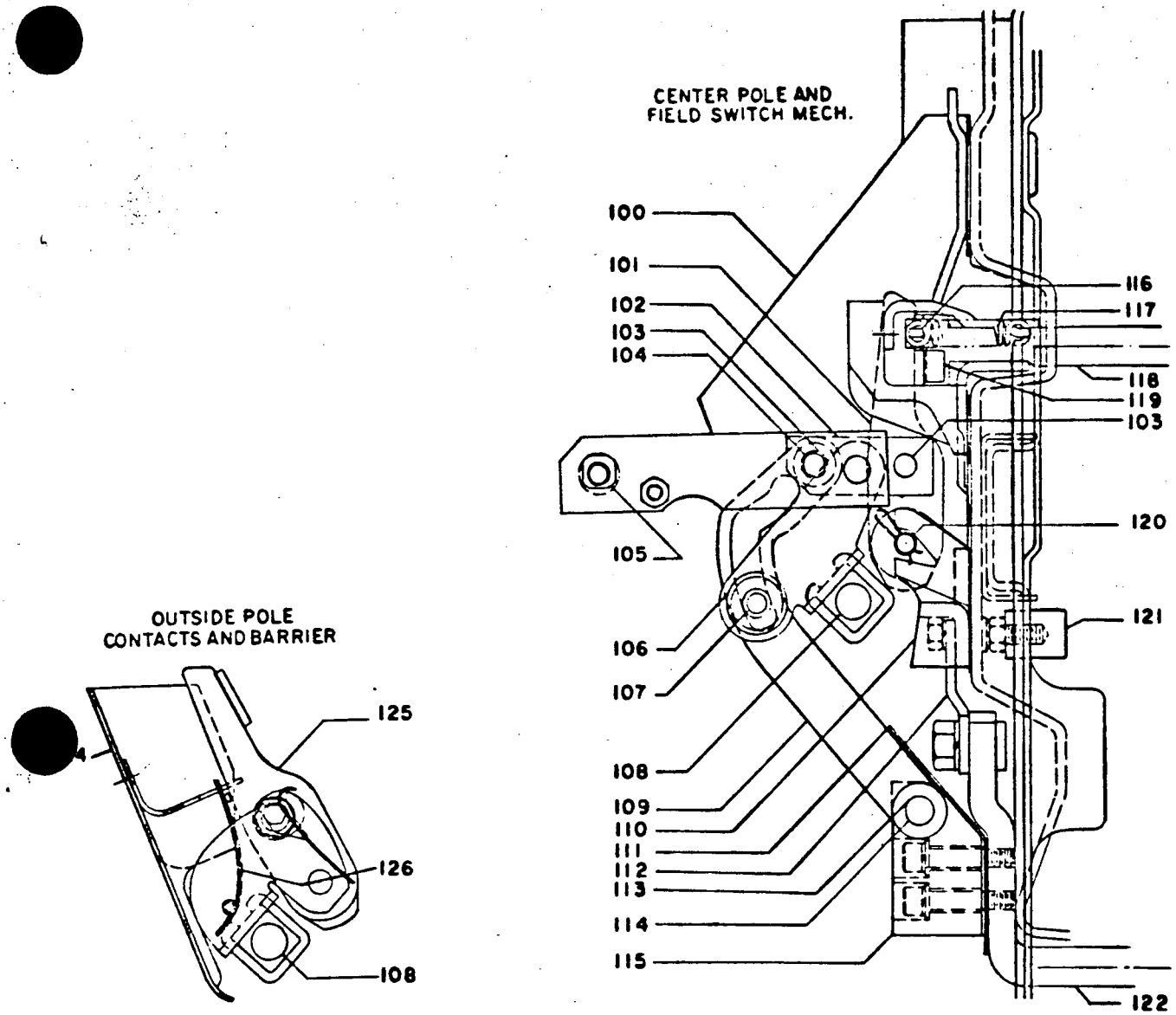


Fig. 23. Field switch mechanism and contact assemblies

NOTE: Parts listed below apply only to Types AKF-2-25 and AKF-2A-25. All other parts are identical to those used on Type AK-2-25.

Ref. No.	Qty. Per Center Pole	Catalog No.	Description	Ref. No.	Qty. Per Center Pole	Catalog No.	Description
100	1	073-108C9697P9	Insulation	114	1	073-412A404P136	Pin
*101	1	108C9696G1	Moving contact	115	1	108C9694P7	Lower pivot
102	2	108C9695P2	Link	*116	1	269C257G1	Stationary contact
103	4	394A133P8	Retaining ring	*116	1	269C257G2	Stationary contact
104	1	108C9695P9	Pin	117	2	412A286	Stationary contact spring
105	2	148A2279P1	Adjustable bushing	118	1	269C283G4	Upper stud
106	2	377A871P12	Bearing	119	1	108C9697P11	Contact spacer right side
107	1	108C9695P10	Cam follower	119	1	108C9697P12	Contact spacer left side
108	1	108C9696G1	Crossbar	120	1	269C280P1	Moving contact pivot pin
109	1	108C9695G3	Cam assembly, left	121	1	108C9698P14	Spacer
109	1	108C9695G4	Cam assembly, right	122	1	269C258G13	Lower stud
110	1	108C9695P6	Pivot	†123	1	293B288G1	Arc quencher
111	1	108C9694P8	Lower stud insulation	124	1	108C9697G3	Insulation
112	1	108C9695P3	Connector	*125	1	108C9698G2	Moving contact
113	2	394A133P9	Retaining ring	126	2	108C9694P5	Spring

*Recommended for stock for normal maintenance.
†Not shown.

Power Sensor Unit AK-25 (Fig. 19)

	With Long Time Delay 80 to 130% Range With Instantaneous Trip 4 to 12X Range	Without Long Time Delay With Instantaneous Trip 4 to 12X Range	With Long Time Delay 80 to 130% Range Without Instantaneous Trip	Without Long Time Delay Without Instantaneous Trip
With Ground Fault Protection 100 to 400 Amp Range				
Without Short Time Delay	073-184L373G57	073-184L373G78	----	----
With Short Time Delay 2 to 5X Range 4 to 10X Range	073-184L373G51 ↓ 184L373G54	073-184L373G66 ↓ 184L373G69	073-184L373G60 ↓ 184L373G63	073-184L373G72 ↓ 184L373G75
Without Ground Fault Protection				
Without Short Time Delay	073-184L373G43	073-184L373G50	----	----
With Short Time Delay 2 to 5X Range 4 to 10X Range	073-184L373G41 ↓ 184L373G42	073-184L373G46 ↓ 184L373G47	073-184L373G44 ↓ 184L373G45	073-184L373G48 ↓ 184L373G49

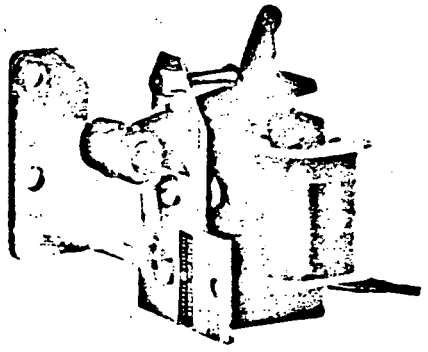


Fig. 20. Magnet trip device with mounting bracket

Magnet Trip Device with Mounting Bracket - Cat. No. 0846C0882 G4

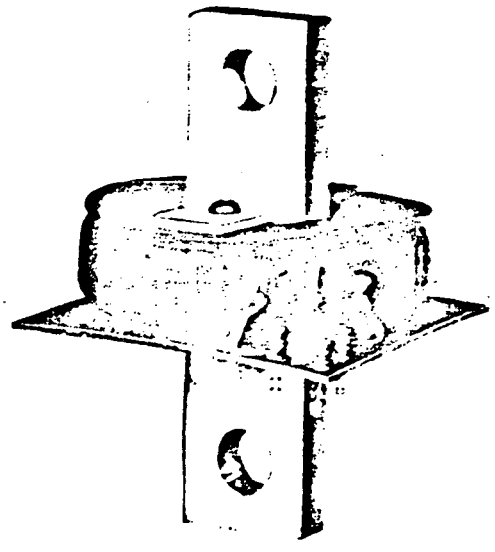


Fig. 21. Ground sensor coil with neutral mounting

Four ... Wire Grid Sensor Coils - Cat. No. 0132C2606 G1

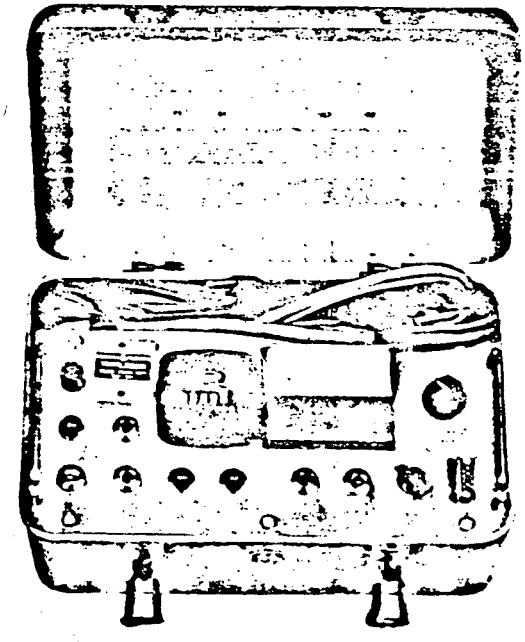


Fig. 22. Power sensor kit

Power Sensor Test Kit - Cat. No. 0102D2526 G10

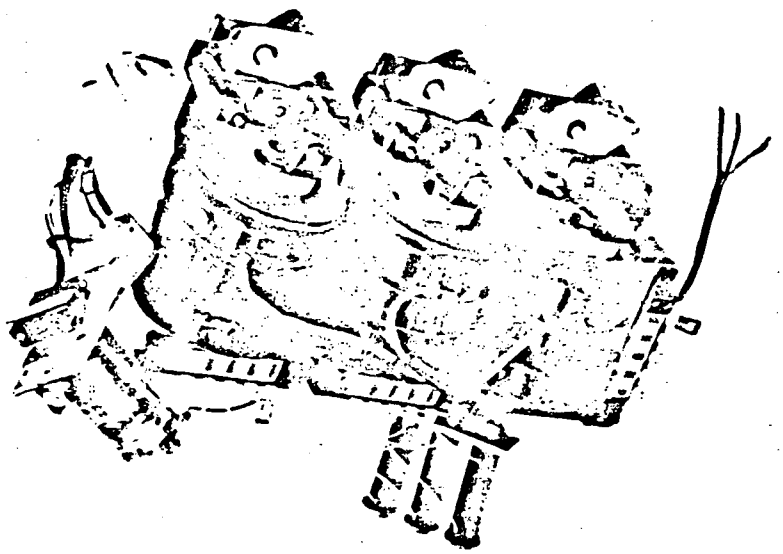


Fig. 17. Magnetic coil assembly

Magnetic Sensor Coils - Assembly (Fig. 17)

Without ground trip			With ground trip			
Poles	Rating	Cat. No.	Poles	Rating	Grd. Trip Range	Cat. No.
2	45/225	073-669D0858G2	2	45/225	100/400	073-669D0858G6
3	45/225	669D0858G3	3	45/225	100/400	669D0858G7
2	200/600	669D0858G4	2	200/600	100/400	669D0858G8
3	200/600	669D0858G5	3	200/600	100/400	669D0858G9
			2	200/600	300/1200	669D0858G10
			3	200/600	300/1200	669D0858G11

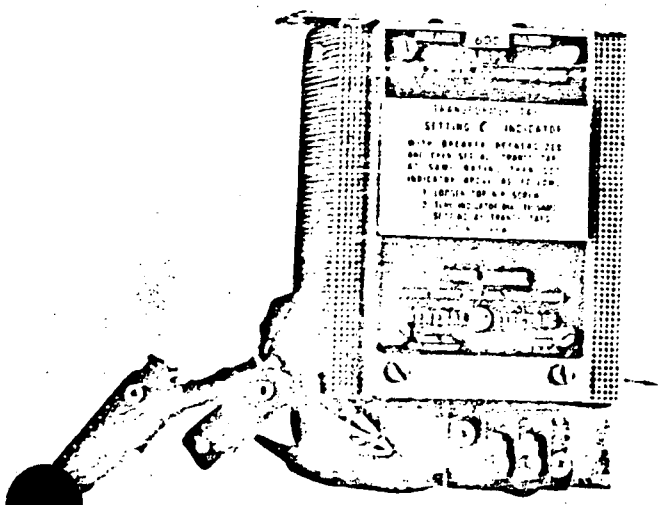


Fig. 18. Power supply unit

Power Supply Units - Cat. No. 0121C7519G1

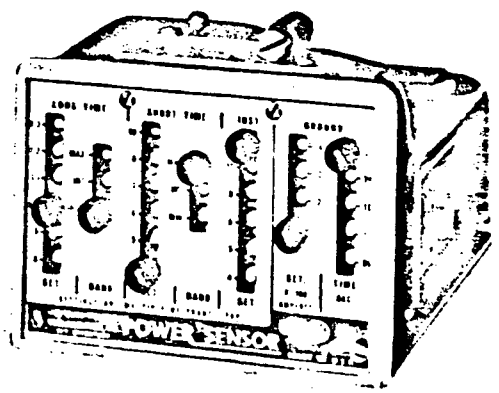


Fig. 19. Power sensor unit

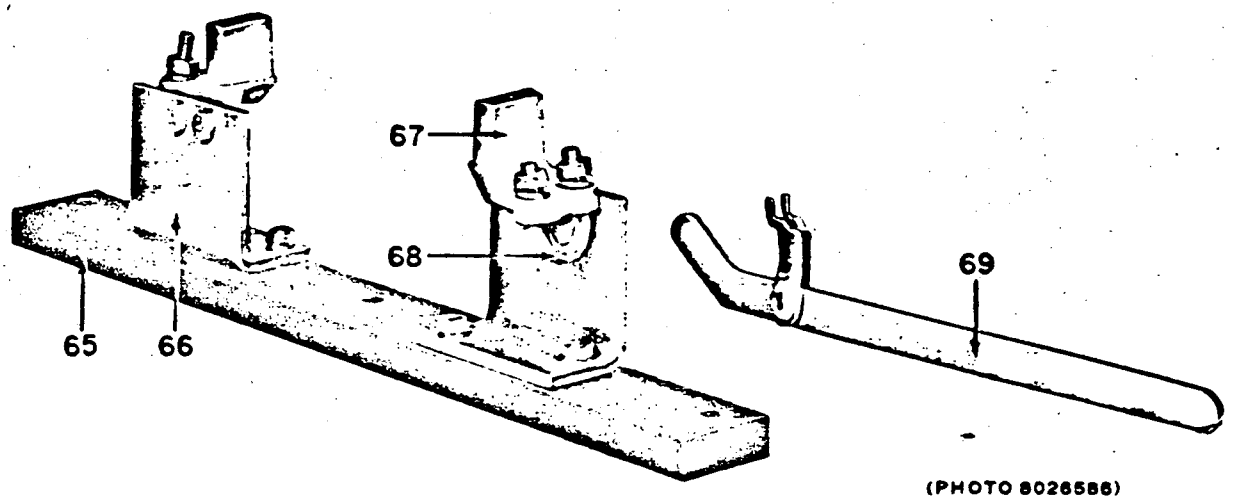


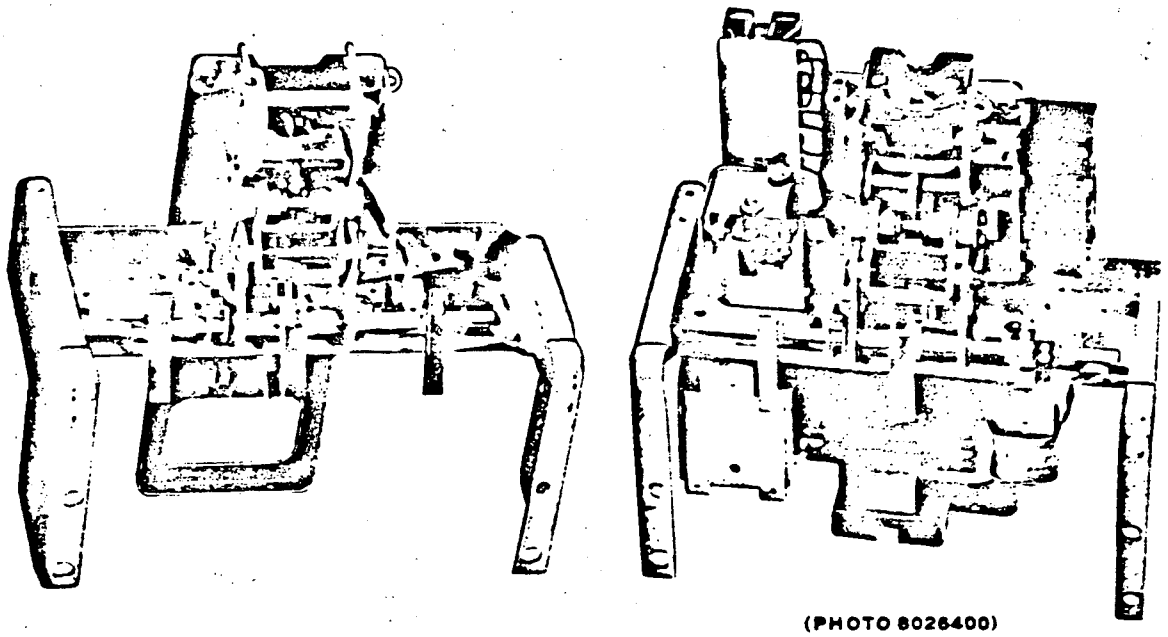
Fig 15. Accessories for wall mounting (ref. 65, 66, 67, 68)

Fig. 16. Maintenance handle for electrically operated breakers not equipped with manual handles (ref. 69)

TABLE B

Rating		Catalog Number			
				Undervoltage Device Coil (Ref. 58)	
Volts	Cycles	Closing Solenoid Coil (Ref. 26)	Shunt Trip Device Coil (Ref. 56)	Instantaneous or Old Design Oil Dashpot Type Time Delay	Static Time Delay Type
24	D-C	---	6275081G55	6275081G15	
48		366A773G17	6275081G28	6275081G9	
125		366A773G13	6275081G29	6275081G18	6275081G61¤
250		366A773G15	6275081G30	6275081G19	6275081G59¤
115	25	366A773G3	6275081G26	6275081G12	
208		366A773G6	6275081G29	6275081G10	
230		366A773G14	6275081G29	6275081G10	
460		366A773G11	6275081G7	6275081G17	
575		366A773G12	6275081G5	6275081G21	
115	50	366A773G2	6275081G56	6275081G4	
208		366A773G3	6275081G26	6275081G12	
230		366A773G5	6275081G26	6275081G12	
380		366A773G6	6275081G27	6275081G31	
460		366A773G8	6275081G4	6275081G3	
575		366A773G10	6275081G29	6275081G8	
115	60	366A773G1	6275081G25	6275081G26	
208		366A773G3	6275081G26	6275081G27	
230		366A773G4	6275081G26	6275081G7	6275081G59¤
460		366A773G7	6275081G27	6275081G31	
575		366A773G9	6275081G7	6275081G20	

¤Input voltage to static timing unit (Fig. 13A) indicated.



(PHOTO 8026400)

Fig. 14. Manual (left) and electrical (right) front frame assemblies for Type AK-2-15 and -25 power circuit breakers

NOTES FOR FIG. 14:

(1) Should it become necessary to replace the complete front frame of the breaker, it is necessary that the order include complete nameplate reading of existing breaker.

(2) If an existing manual breaker is to be converted to electrical operation, the order must include, in addition to complete nameplate reading, a description of desired change and complete voltage and frequency rating of both closing and tripping circuits.

TABLE A

Rating		Catalog Number				
		"X" Relay				"Y" Relay Complete (Ref. 48) §
Volts	Cycles	Relay Complete, Ref. 47 for Δ and Early -1 Breakers	Coil, only (Ref. 53) for Δ and Early -1 Breakers	Relay Complete, Ref. 47 for Late -1, and all -2 Breakers	Coil, only (Ref. 53) for Late -1, and all -2 Breakers	
24 48 125 250	D-C	295B445P1 295B445P2 295B445P3 295B445P4	295B445P201 295B445P202 295B445P203 295B445P204	116B7197P1 116B7197P2 116B7197P3 116B7197P4	116B7197P201 116B7197P202 116B7197P203 116B7197P204	295B444P1 295B444P2 295B444P3 295B444P4
115 208 230 460	25	295B445P7 295B445P10 295B445P13 ----------	295B445P207 295B445P210 295B445P213 ----------	116B7197P7 116B7197P10 116B7197P13 116B7197P16	116B7197P207 116B7197P210 116B7197P213 116B7197P216	295B444P7 295B444P10 295B444P13 ----------
230	40	295B445P12	295B445P212	----------	----------	295B444P11
115 208 230 380 460	50	295B445P6 295B445P9 295B445P12 295B445P17 295B445P15	295B445P206 295B445P209 295B445P212 295B445P214 295B445P216	116B7197P6 116B7197P9 116B7197P12 116B7197P17 116B7197P15	116B7197P206 116B7197P209 116B7197P212 116B7197P217 116B7197P215	295B444P5 295B444P8 295B444P11 295B444P17 295B444P14
115 208 230 460	60	295B445P5 295B445P8 295B445P11 295B445P14	295B445P205 295B445P208 295B445P211 295B445P215	116B7197P5 116B7197P8 116B7197P11 116B7197P14	116B7197P205 116B7197P208 116B7197P211 116B7197P214	295B444P5 295B444P8 295B444P11 295B444P14

al breaker had no suffix numeral or letter.

§ Only complete relay furnished.

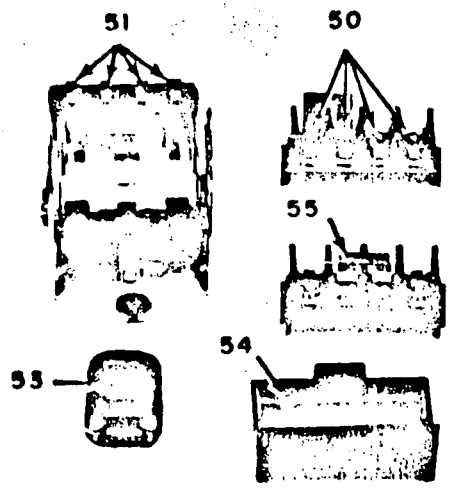


Fig. 6. "X" contactor (ref. 47)

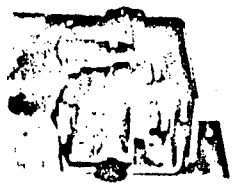


Fig. 7. "Y" relay (ref. 48)

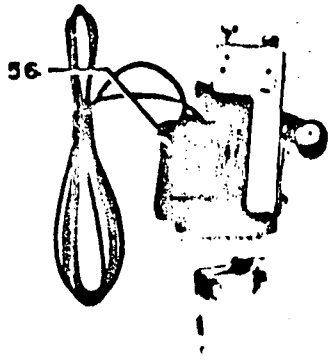


Fig. 8. Shunt trip device (ref. 41)

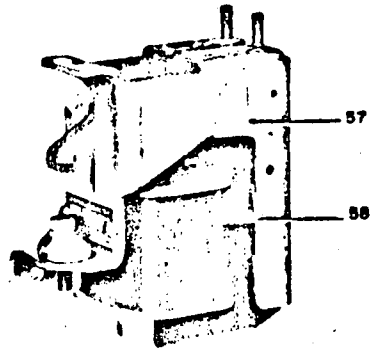


Fig. 9. Time delay undervoltage device (ref. 57)

Fig. 10. Cutoff switch (ref. 37)

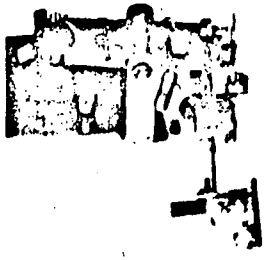


Fig. 11. Bell alarm device (ref. 61)

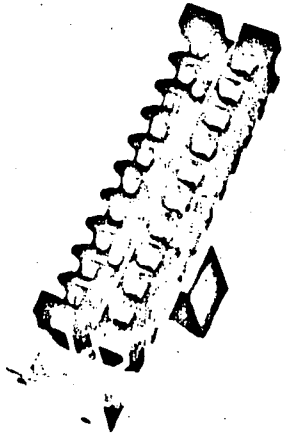


Fig. 12. Terminal board (ref. 62)

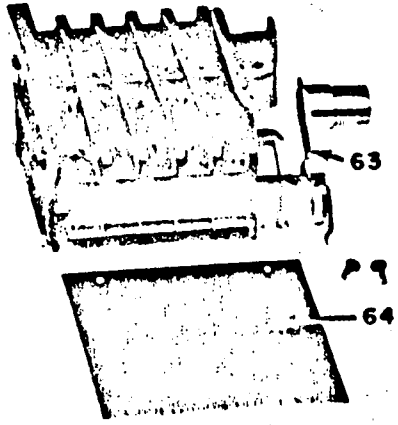


Fig. 13. Auxiliary switch (ref. 38)

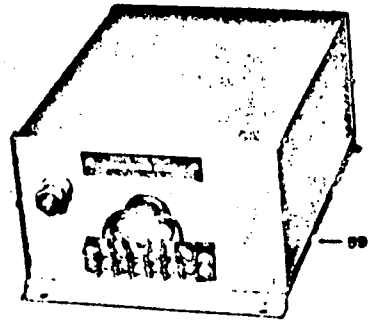


Fig. 13A. Static time delay

	Quantity Required for 3-pole Breaker Frame Size 225 Amp**	600 Amp**	Catalog Number	Description
36	4 maximum	4 maximum	073-386A110G2	Movable secondary disconnects (drawout breaker)
37	1	1	622C505G1	Cutoff switch (electrically operated breaker)
38	1	1	432A671G2	Auxiliary switch, 2 stages
38	1	1	432A671G5	Auxiliary switch, 5 stages
39	1	1	269C268P1	Manual trip button
†39A	1	1	269C268P12	Trip label
†40	1	1	412A133	Spring for manual trip button
41	1	1	622C502G1	Shunt trip device with coil
42	1	1	622C529G1	Closing switch
43	1	1	101C7891G1	Shaft assembly (Manual Breaker only) order Ref. 43 and 43A together
†43A	1	1	101C7891G2	Link assembly
44	1	1	259C607G1	Escutcheon, manual breaker (black)
44	1	1	259C607P10	Escutcheon, electrically operated breaker (black)
44	1	1	259C607G2	Escutcheon, electrically operated breaker (with handle) (black)
†44	1	1	259C607G3	Escutcheon, manual breaker (blue)
†44	1	1	259C607P11	Escutcheon, electrically operated breaker (blue)
†44	1	1	259C607G4	Escutcheon, electrically operated breaker (blue) with pistol grip handle
45	1	1	259C608G1	Indicator
46	1	1	276B191P1	Handle (black)
46	1	1	669D807P1	Handle (gray)
47	1	1	---------	"X" relay (see Table A, page 6)
*48	1	1	---------	"Y" relay (see Table A, page 6)
†49	1	1	148A2238	Return spring, rear of escutcheon
Δ*50	1	1	295B445P221	Stationary contacts, "X" relay — On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
Δ*51	1	1	295B445P222	Moving contacts, "X" relay — On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
†Δ52	1	1	295B445P223	Springs, moving contacts, "X" relay — On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
†Δ*52A	1	1	116B7197P221	Stationary contacts, "X" relay — all others
†Δ*52B	1	1	116B7197P223	Molded moving arm, "X" relay (with moving contacts) — all others
†Δ52C	1	1	116B7197P222	Armature return spring, "X" relay — all others
[illegible]	1	1	---------	Operating coil, "X" relay (see Table A, page 6)
[illegible]	1	1	622C501P1	Cover, "X" relay — On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
[illegible]	1	1	622C501P2	Jumper, "X" relay — On early AK-2-15, AK-2-25 and AKF-2-25 with no suffix number
*56	1	1	---------	Coil for shunt trip device (see Table B, page 7)
	1	1	269C282G2	‡Instantaneous undervoltage device, a-c (with coil)
	1	1	269C282G5	‡Instantaneous undervoltage device, d-c (with coil)
57	1	1	‡	Time-delay undervoltage device, a-c
57	1	1	‡	Time-delay undervoltage device, d-c
*58	1	1	--------	Coil for undervoltage device (see Table B, page 7)
59	1	1	▲	Static time delay, a-c or d-c (replaces complete time delay and volt device coil only)
*†60	1	1	6172594	Spring, for undervoltage device
61	1	1	269C299G2	‡Bell alarm device
62	1	1	6293908G275	Terminal board, 6 terminals
62	1	1	6293908G274	Terminal board, 10 terminals
63	1	1	846C865G1	Link and bushing for auxiliary switch
64	1	1	6314936P1	Cover for auxiliary switch, 1 stage
64	1	1	6314936P2	Cover for auxiliary switch, 2 stages
64	1	1	6314936P3	Cover for auxiliary switch, 5 stages
65	3	3	295B475P2	Base for wall mounted, general purpose breaker
66	3	-	394A144P1	Angle for wall mounted, general purpose breaker
67	6	-	275B995P1	Terminal for wall mounted, general purpose breaker
67	-	6	695C131P1	Terminal for wall mounted, general purpose breaker
68	6	-	394A106P1	Cable clamp for wall mounted, general purpose breaker
68	-	6	457A673G1	Cable clamp for wall mounted, general purpose breaker
69	1	1	269C276G2	Maintenance handle

* Recommended for stock for normal maintenance.

** See breaker nameplate for frame size.

† Not shown.

‡ If at any time a breaker is to have added to it either shunt trip, undervoltage device, or bell alarm device, the order for device must include the following information:

(1) Complete nameplate reading of breaker involved.
(2) Desired voltage rating of device, whether a-c or d-c, and if a-c, the frequency.
(3) In the case of undervoltage devices, specify whether instantaneous or time delay.

Δ On -1, specify Cat. No. of "X" relay when ordering these parts.

▲ Order by circuit breaker Serial No.

Ref. No.	Quantity Required for 3-pole Breaker Frame Size 225 Amp**	600 Amp**	Catalog Number	Description
1A	1	1	073-227D190P1	Back plate
1	3	3	269C260G1	Insulation for upper stud, rear
†1B	3	3	269C260G2	Insulation for upper stud, front
2	3	-	269C283G1	Upper stud assembly
2	-	3	269C283G2	Upper stud assembly
3	3	3	295B460P1	Barrier
*4	3	6	269C257G1	Stationary contact assembly
*5	3	6	269C257G2	Stationary contact assembly
*6	3	-	269C257G14	Moving contact
*6	-	3	269C257G15	Moving contact
*7	2	2	412A250	Spring (outside poles)
*7A	1	1	269C280P5	Spring clip (center pole)
8	2	2	269C277P9	Barrier
8A	1	1	269C277P10	Barrier, complete (includes Ref. Nos. 8 and 8A)
9	1	1	269C277G1	Cross bar assembly
10	3	3	269C258G3	Pivot
*11	3	3	269C280P8	Spring (back of pivot)
12	-	3	269C258G1	Lower stud assembly (not used on AK-3 or AK-3A)
12	3	-	269C258G2	Lower stud assembly
13	2	2	263C526P1	Insulation (under lower stud)
14	2	2	269C280P7	Support (outside)
15	2	2	269C280P6	Support (intermediate)
16	3	3	269B288G1	Arc quencher
17	-	1	121C7514G2	Arc quencher clamp AK-3 or 3A only
17	1	1	269C273G2	Arc quencher clamp (sand gray) AK-2 or 2A
18	2	2	269C280P4	Stud, arc quencher clamp
†19	2	2	177L215P219	Insulation for Ref. No. 18
†20	2	2	393A993P9	Stop nut for Ref. No. 18
*21	6	12	412A286	Stationary contact spring
21A	3	3	412A208	Movable contact spring
21B	6	6	269C277P11	Spring clip
†22	1	1	269C280P1	Moving contact pivot pin (center pole)
23	2	2	269C280P2	Moving contact pivot pin (outside poles)
*24	1	1	0412A0290	Spring
25	1	1	622C521G1	δMagnet and armature assembly
26	1	1	See table B	δClosing coil
27	3	3	See note below	Overcurrent trip device
28	6	6	386A163P1	Clamp for EC-2 trip device
28	3	3	6555445P1	Clamp for EC-1 trip device
29	-	6	269C281P5	Retaining ring
29	6	-	269C281P6	Retaining ring
30	3	-	845C276G2	Primary disconnect assembly
30	-	3	845C276G4	Primary disconnect assembly
30A	6	6	412A222	Spring
31	12	12	269C281P3	Retainer
*32	24	24	453A100P2	Contact finger
33	6	-	453A129P1	Retainer
33	-	6	453A129P2	Retainer
34	6	6	457A681P4	Spacer
35	6	6	---------	Screw, hex. hd, 1/4 in.-20 by 3 1/2 in.

* Recommended for stock for normal maintenance.

† Not shown.

** See breaker nameplate for frame size.

δ Electrically operated breakers

Note for overcurrent trip devices:

(1) No parts furnished for field installation on EC-1 trip devices.
(2) Only part furnished for field installation on EC-2 or EC-2A trip devices is plastic cover, Cat. No. 242C645P1.
(3) When replacement trip devices are ordered, it is imperative that order includes complete nameplate reading of the breaker or breakers involved and, if a contemplated ampere rating change is involved, the order should also include information as to ampere rating, time-current characteristic, and instantaneous trip setting desired.

Note for operating mechanisms:

(1) Individual parts cannot be furnished for operating mechanisms.
(2) When replacement is necessary give complete nameplate reading when ordering.

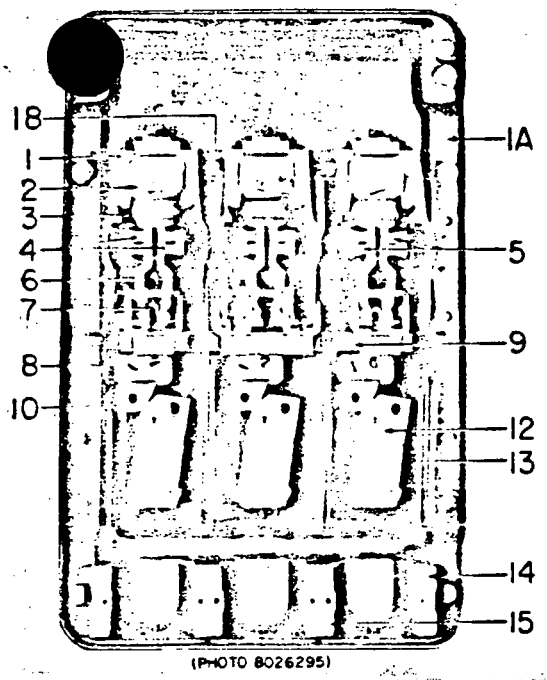


Fig. 2. Type AK-2-25 power circuit breaker back frame (operating mechanism removed)

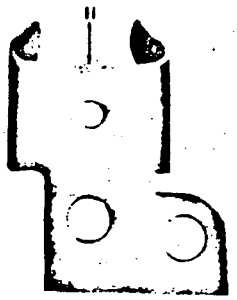


Fig. 2A. Spring (back of pivot)

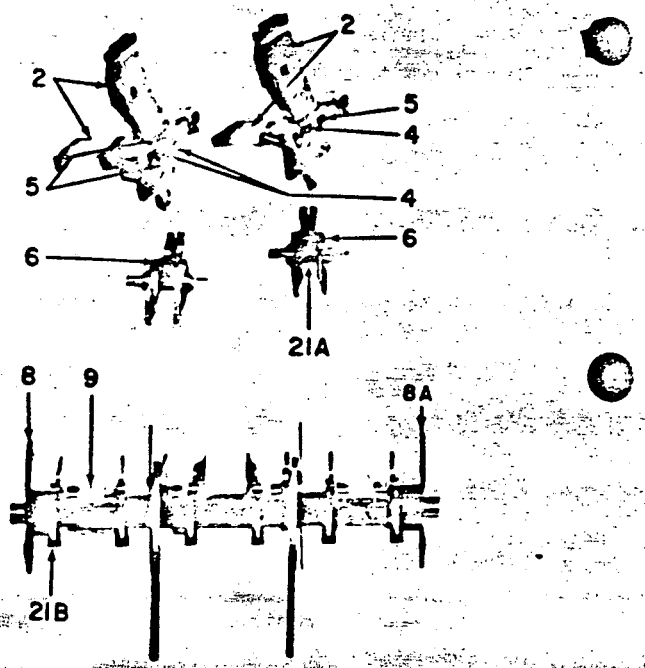
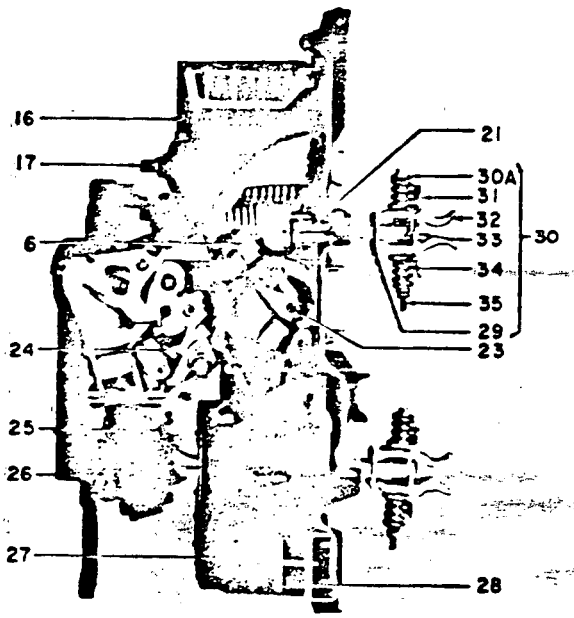


Fig. 3. Moving and stationary contacts and cross bar assembly



Cutaway view of type AK-2-25 electrically operated power circuit breaker

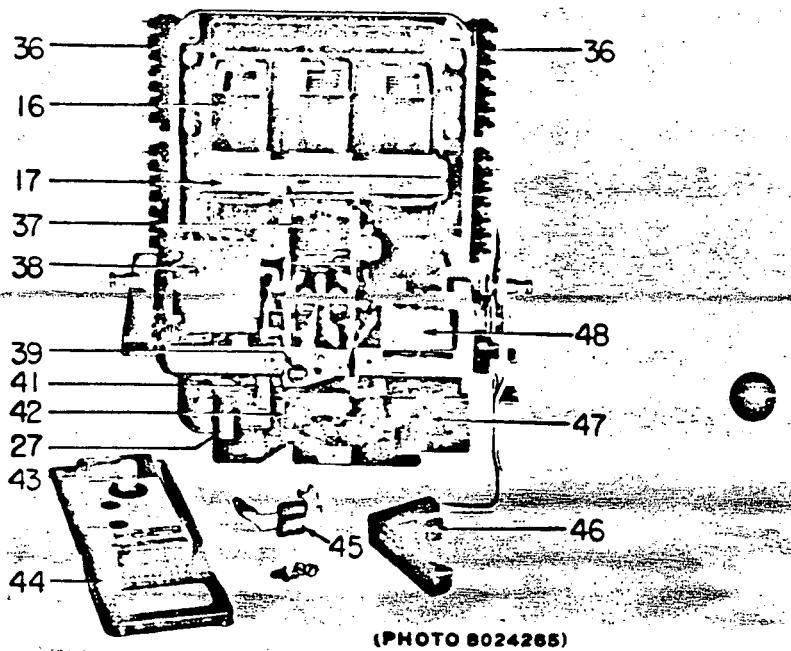


Fig. 5. Type AK-2-25 electrically operated power circuit breaker (escutcheon removed and dismantled)

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GEF-4149F
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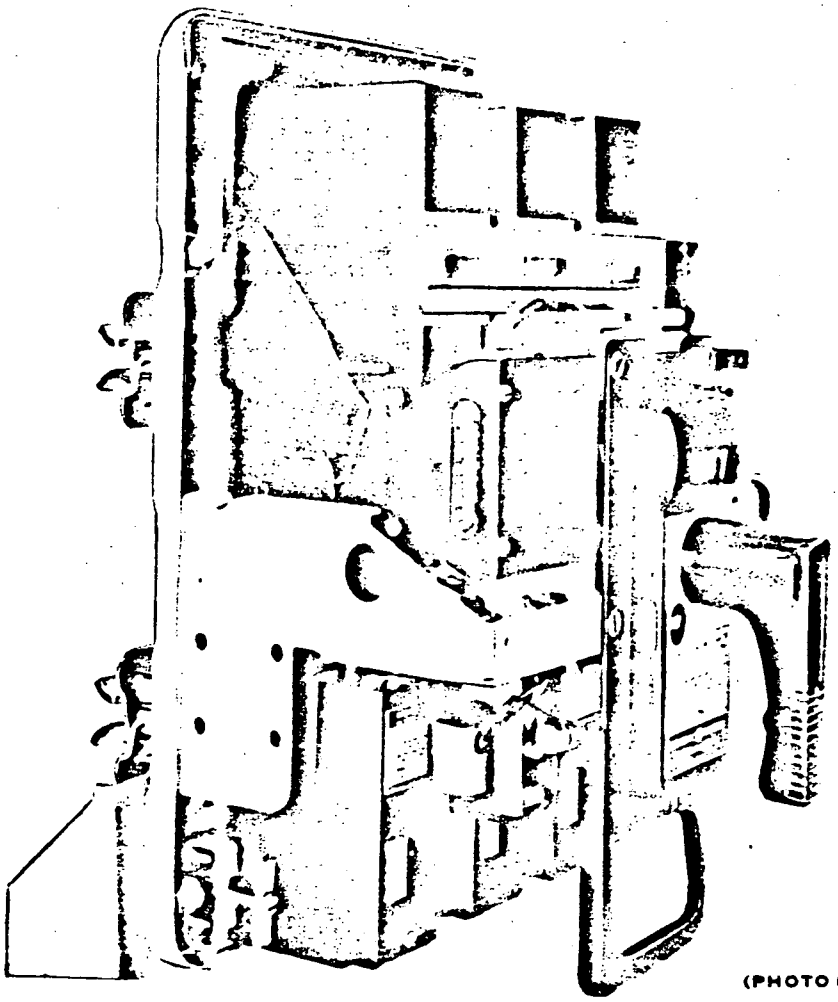
POWER CIRCUIT BREAKERS

TYPES

225 AMP FRAME SIZE	600 AMP FRAME SIZE		
AK-2-15	AK-2-25	AK-3-25	AKF-2-25
AK-2A-15	AK-2A-25	AK-3A-25	AKF-2A-25
	AKU-2-25	AKU-3-25	
	AKU-2A-25	AKU-3A-25	



(PHOTO 8024021)

Fig. 1. Type AK-2-25 manually operated power circuit breaker

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the breaker.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. CAUTION: When local facilities for breaker recalibration are not available, the breaker should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Avenue, Philadelphia 42, Pa.
4. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
5. For prices, refer to the nearest office of the General Electric Company.

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- • (Appleton) Menasha 54910 . . 1721 Racine St.
- • Milwaukee 53207 . . . 235 W. Oklahoma Ave.

• Electrical/Mechanical Service Shop • Instrumentation Shop Δ Special Manufacturing Shop

MISCELLANEOUS

Changes in breaker requirements may occasionally bring about the necessity of adding or changing breaker components or accessories in the field. The AK-2 breaker has been designed so that such additions or conversions are simple and easy to make, requiring only a minimum of time or skill on the part of the operator.

Special instructional drawings are available which will further simplfy the addition of such accessories to breakers which were originally shipped without them.

These drawings will accompany the necessary material when it is shipped from the factory. They will also be available upon request. The drawings and the accessory additions which they cover are listed below.

When an accessory is added to a breaker, it is recommended that the section of instructions contained herein covering that particular accessory be reviewed, in addition to referring to the following instructional drawing. Any adjustments described in these instructions should be carefully made after the device has been assembled on the breaker.

Conversion of breakers from manual to electrical operation is also covered on an instructional drawing. This operation consists simply of separation of the front and back frames of the breaker as described under "Maintenance" in these instructions and the reassembly of the existing back frame with the new front frame.

Addition of	Covered By
Shunt Trip Device	698C900
Auxiliary Switch	698C901
Undervoltage Device	698C902
Bell Alarm & Lockout Device	698C904
Drawout Mechanism	698C922
Conversion to Elec. Oper.	698C904

MAINTENANCE TOOLS

The following tools are recommended for proper maintenance of AK-2-15 and AK-2/3-25 breakers. (NOTE: Obtain from local hardware firm; do not order on General Electric Company.)

Screw Drivers

Long thin, slotted screw
Standard, slotted screw
Phillips, No. 2, (8" shaft)

Pliers

Waldes Truarc, No. 2 straight
Long Nose, side cutting, 6"

End Wrenches

Adjustable, 8"
1/4" open end

Allen Head Wrenches

5/16" for 3/8" screw
1/8" for 1/4" screw

Socket Wrenches (3/8" drive)

Ratchet Handle
12" extension bar
3/8" socket
9/16" socket
7/16" socket (long)

Miscellaneous Tools

1/4" Spintite (long shank)
7/16" Spintite
8/32 screw (at least 2" long)

RENEWAL PARTS

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required. Complete nameplate data of the breaker involved should be given as well as an accurate description of the parts required. If the parts needed are illustrated in this book, refer to the figure number and part number involved.

Renewal Parts which are furnished may not be identical to the original parts since from time to time design changes may be made. The parts supplied, however, will be interchangeable with the original parts.

Renewal Parts Bulletin

Bulletin	Breaker Type
GEF-4149F	AK-2-15/25 AK-3-25

OPEN FUSE LOCKOUT DEVICE
(Figure 31)

The Open Fuse Lockout Device consists of three separately operated devices (one per phase). Each wired in parallel to corresponding breaker fuses. This device is furnished on all AKU breakers. The purpose of this device is to trip the breaker upon the blowing of any one of the breaker fuses and render the breaker trip free until the blown fuse is replaced and the associated coil assembly reset.

OPERATION, Figure 31.

When any one of the breaker fuses blow, the coil (6) in that phase is energized and the armature (5) closes. With the armature closed, leaver (2) slips under the armature and latches it in the closed position. The latched closed armature holds the breaker in the trip free position until it is released by pushing the associated reset button (1). The coil is deenergized as soon as the breaker opens.

ADJUSTMENTS

1. Set top cylindrical collor (not shown) to engage the trip shaft paddle in the tripped position.
2. Check that each armature holds the breaker trip free when the armature position is limited in reset by the lower latch surface on the indicator.
3. With the breaker in the closed position, the top collor must clear the trip shaft paddle by more than 1/32 inch.

REPLACEMENT

1. Remove three mounting screws at top of device.
2. Remove coil leads from fuses and work wire harness back to the device. Remove device from breaker.
3. Replace new unit in reverse order and check procedure under ADJUSTMENTS.

AKD-5 INTERLOCK
(Figure 32)

The rackout mechanism is interlocked so that the circuit breaker must be open before the operating handle can be inserted. When the breaker is closed, the interlock link (1) operated by the breaker cross bar blocks the interlock linkage on the rackout mechanism.

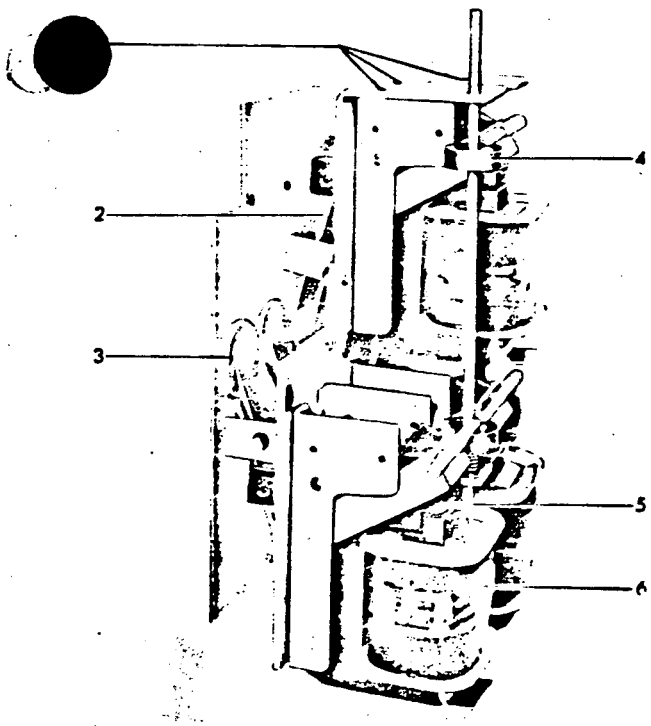


Figure 31. (8041865) Open Fuse Lockout Device

1. Mounting Holes
2. Lever
3. Reset Button
4. Collor
5. Armature
6. Coil

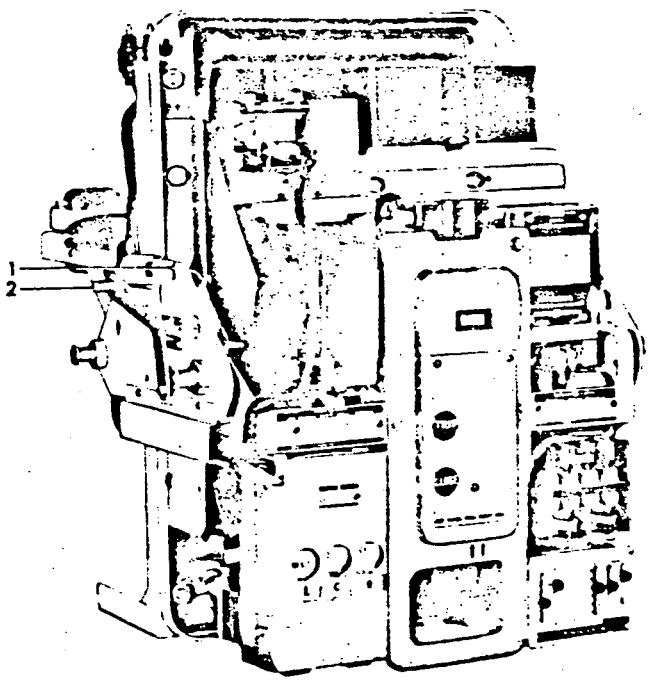


Figure 32. (8039852) AKD-5 Interlock

1. Rackout Mechanism Interlock
2. Trip Interlock

alternate breaker presents a convenient method of mechanically interlocking two or more breakers to assure that no two breakers may be closed at the same time.

BELL ALARM SWITCH AND/OR LOCKOUT ATTACHMENTS

(Figure 30)

The bell alarm device is mounted on top of the horizontal cross frame member just to the left of the mechanism frame when the breaker is viewed from the front. This device operates a switch with two sets of contacts, one normally open, the other normally closed. The switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

If the breaker is tripped open by any means other than the manual trip button or the shunt trip device, the bell alarm mechanism is activated. The alarm is shut off and the bell alarm and lockout mechanism is reset by operation of the manual trip button or shunt trip device. If the device is a bell alarm only, the bell alarm mechanism is also reset simply by closing the breaker.

OPERATION

Lever (2) is connected to the breaker mechanism so that when the breaker opens lever (2) rotates counterclockwise about pin (14). The motion is transmitted through links (1) and (13) to paddle (12) which operates bell alarm switch (11). If the device has the lockout feature, the movement of link (13) also causes lockout link (8) to slide in a direction that results in its striking trip paddle (5) which, by displacement of the breaker mechanism trip latch, makes it impossible to reset the breaker mechanism until the bell alarm mechanism is reset.

Link (6) serves as a latch in the bell alarm mechanism. If it is displaced, link (10) is free to rotate about its lower pin. This deprives the linkage of its normally fixed center of rotation about pin (15) and defeats both the bell alarm and the lockout operation. Operation of either the manual trip button or the shunt trip device will displace latch (6) and have this effect. Thus if the breaker is tripped by either of these means, the bell alarm and/or lockout will not operate. Also, operation of either of these devices will reset the switch and inactivate the lockout.

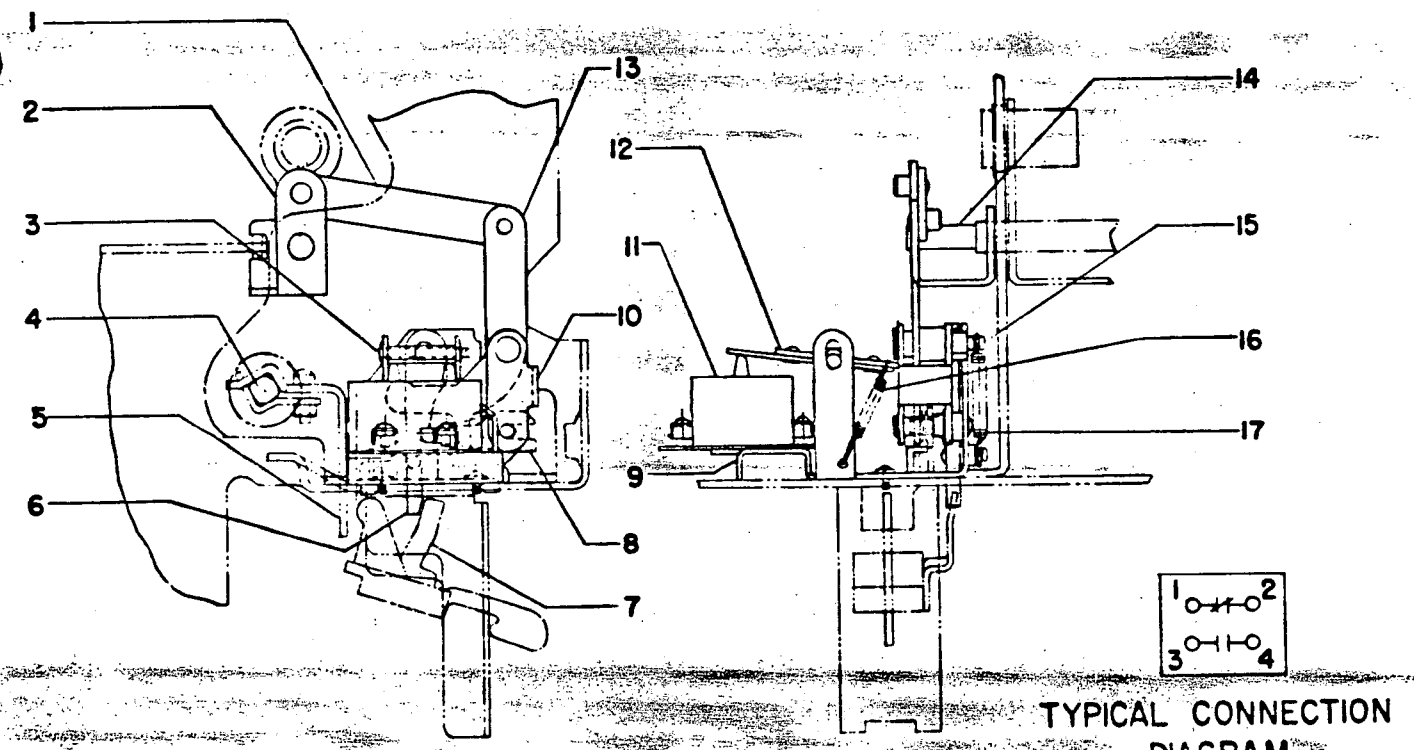
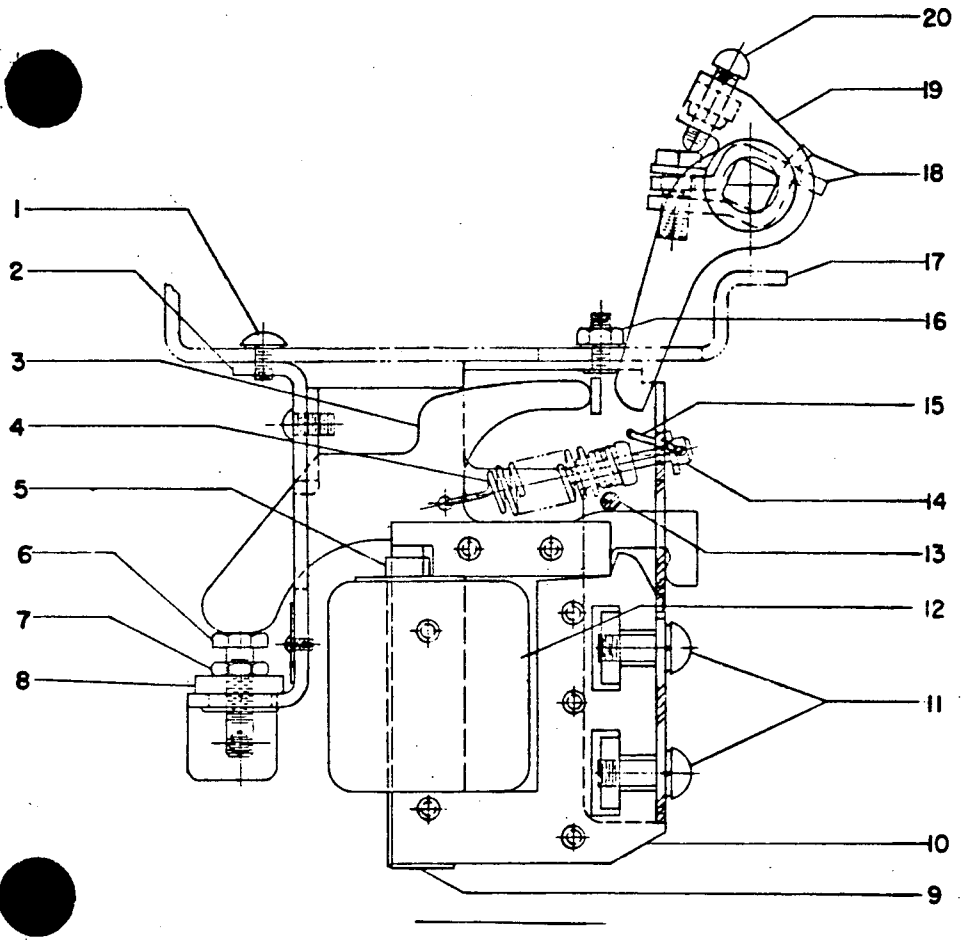


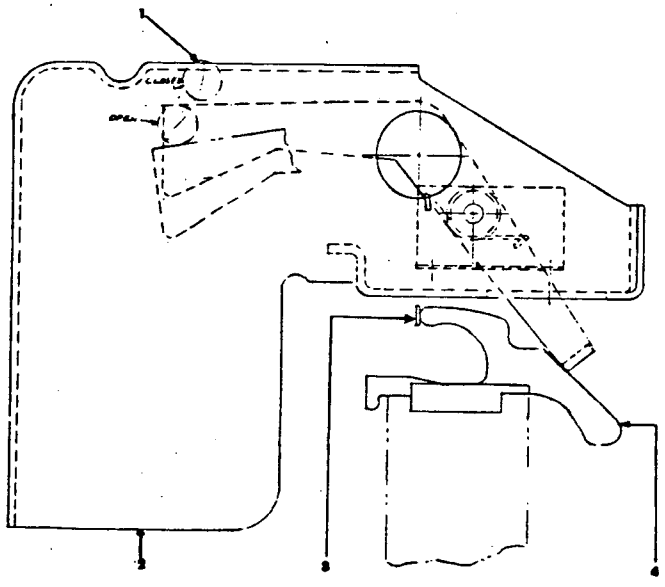
Figure 30. (695C158) Bell Alarm and Lockout Device

1. Link
2. Lever
3. Pin
4. Trip Shaft
5. Trip Paddle
6. Link
7. Trip Arm
8. Lockout Link
9. Frame
10. Link
11. Switch
12. Paddle
13. Link
14. Pin
15. Pin
16. Springs
17. Spring



1. Mounting Screw
2. Frame
3. Armature
4. Spring
5. Shading Ring
6. Adjusting Screw
7. Locking Nut
8. Bushing
9. Clamp
10. Magnet
11. Screws
12. Coil
13. Rivet
14. Adjusting Screw
15. Locking Wire
16. Mounting Nut
17. Mechanism Frame
18. Trip Paddle Clamps
19. Trip Paddle
20. Adjusting Screw

Figure 28. (0152C9206) Undervoltage Tripping Device



re 29. (0101C7842) Undervoltage Lockout Device

1. Cross Bar
2. Left Side Frame
3. Trip Paddle
4. Undervoltage Armature

ening of the bend in clamp (9) will separate the coil from the magnet. The coil leads, of course, must be disconnected.

INSTANTANEOUS UNDERVOLTAGE TRIPPING DEVICE

The instantaneous undervoltage device is mounted in the same location and manner as the static time-delay device and its construction is similar.

The adjustments and replacement of t is device are the same as those described above for the static time-delay undervoltage device.

UNDERVOLTAGE LOCKOUT DEVICE
(Figure 29)

The undervoltage lockout device holds an open breaker trip-free when the coil of the device is deenergized. When the breaker is in the closed position, linkage operated by the breaker mechanism cam positions itself to mechanically hold the undervoltage device armature in the closed air gap position to prevent tripping the breaker in the event the undervoltage device coil is deenergized. This feature when used in conjunction with normally-closed auxiliary contacts of an

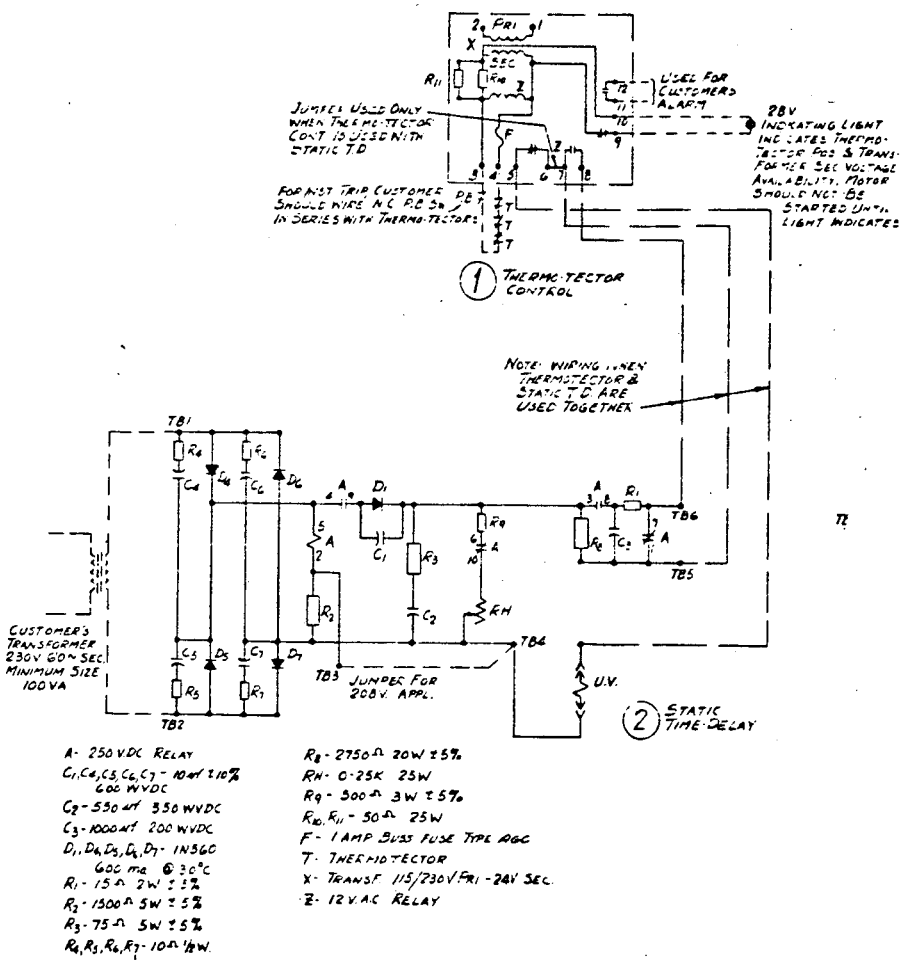


Figure 27. (0102C3699) Wiring Diagram

breaker through a normally closed "Z" contact in series with the undervoltage device mounted on the breaker.

WARNING - Do not use bell set to check continuity of bridge circuit in static time delay box, only a volt-ohm meter or vacuum tube volt meter should be used.

In the event the device fails to pick-up, the following checks are recommended to determine whether the magnetic device on the breaker or the static time delay unit is the faulty component.

A. Check input voltages across terminals 1 & 2 on static box. These voltages should be as follows:

1. Device 177L316G-12-208 or 230 volts A.C.
2. Device 177L316 G-14-125 volts D.C.
3. Device 177L316 G-15-250 volts D.C.

B. Check output voltages on terminals 4 & 5 with the under voltage device connected. The approximate voltages are as follows:

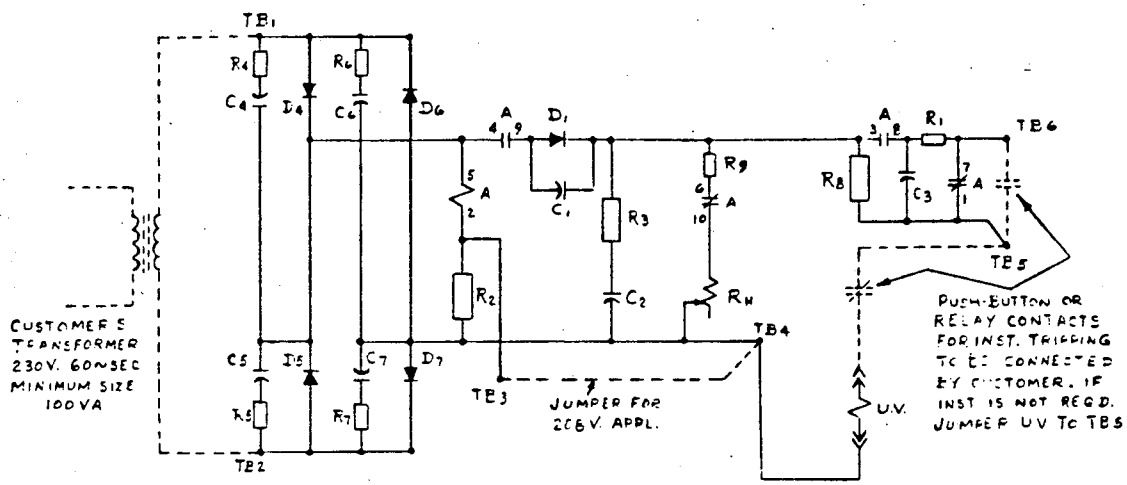
1. 208 Volt A.C. 177L316G-12-110 volts D.C.
   230 Volt A.C. 177L316G-12-120 volts D.C.
2. 125 Volt D.C. 177L316G-14 50 volts D.C.
3. 250 Volt D.C. 177L316G-15-100 volts D.C.

C. The resistance of the under-voltage coils are as follows:

1. 6275080 G-59 - 1830 Ohms.
2. 6275081 G-61 - 440 Ohms.

REPLACEMENT

The entire device may be dismounted by disconnecting the coil leads and removing screw (1) and nuts 16. Normally, only the coil (12) will ever need replacement. This may be removed from the device by taking out screws (11) which will free both the magnet (10) and the coil. Straight-



A - 250V DC RELAY
C_1, C_4, C_5, C_6, C_7 - .10 mf ±10% 600 WVDC.
C_2 - 550 mf 350 WVDC
C_3 - 1000 mf 200 WVDC
D_1, D_4, D_5, D_6, D_7 - IN560 - 600 ma @ 30°C
R_1 - 15 Ω 2W ±5%
R_2 - 1500 Ω 5W ±5%
R_3 - 75 Ω 5W ±5%
R_4, R_5, R_6, R_7 - 10 Ω ½W
R_8 - 2750 Ω 20W ±5%
R_H - 0-25,000 Ω 25 W
R_9 - 500 Ω 2W ±5%

Figure 26. (0102C3698) Wiring Diagram

breaker having the longer setting and higher pick-up, provided the fault is on the part of the line protected by the breaker having the lower setting.

For the exact characteristics and setting of each breaker in a selective system, reference should be made to a coordination chart for the particular system. (Figures 23, 24, and 25)

STATIC TIME DELAY UNDERVOLTAGE TRIPPING DEVICE

The Static Time Delay Undervoltage Tripping Device consists of an undervoltage device mounted on the breaker, a static time delay box mounted separately from the breaker and a control power transformer which is also mounted separately from the breaker when the reference voltage is other than DC., 208V AC or 230V AC. Refer to wiring diagram 0102C3698 (Figure 26).

The voltage 208V AC or 230V AC, to be monitored is connected to terminals #1 and #2 of the time delay box. The undervoltage device on the breaker is always connected through either its secondary disconnects or terminal board, to terminals #4 and #5 of the time delay box.

The undervoltage device is set to pickup at approximately 80% of bus voltage and drop out between 30% and 60%.

The undervoltage device coil circuit is continuously rated and will remain picked up as long as the voltage remains above the predetermined drop out voltage. The time delay is field adjustable between 1 and 5 seconds, it is factory set at the minimum setting, and once the time delay is established, it is consistent.

No more than one undervoltage device should be connected to a static time delay box.

The Static Time Delay Undervoltage can also be furnished in conjunction with the termotector control package, as shown on wiring diagram 0102C3699 (Figure 27). Overheating of the motor windings causes the termotector, imbedded in the motor windings, to open and allow the "Z" relay of the control box to instantaneously trip the

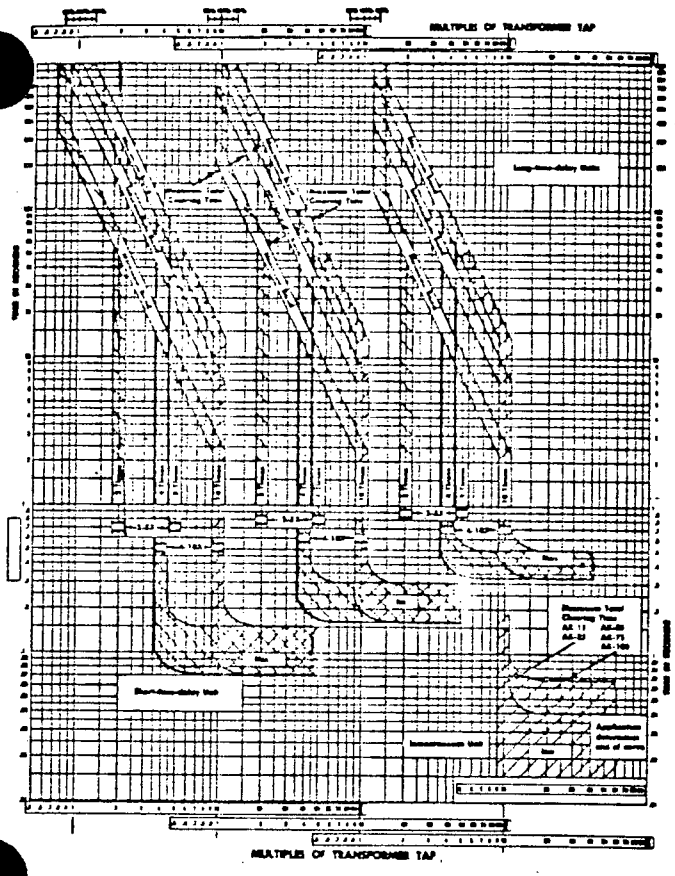


Figure 24. (109HL687) Time Curve

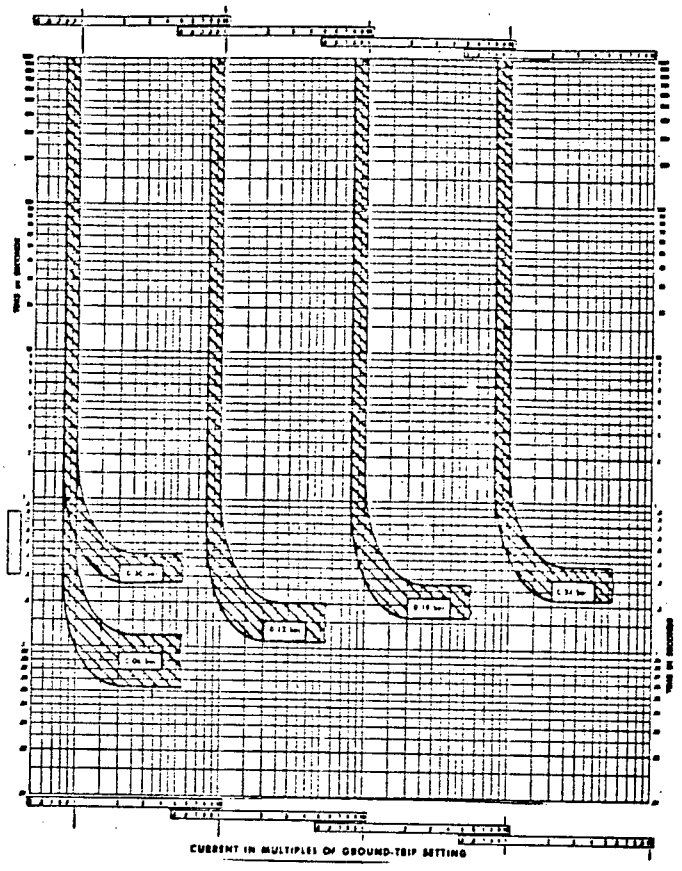


Figure 25. (109HL689) Time Curve

3. Remove four screws holding escutcheon to mechanism frame and remove escutcheon.
4. Disconnect control plug to power sensor coils and power sensor unit.
5. Remove cable clamps holding cabling in place.
6. Remove power supply unit with attached cabling.
7. Replace in reverse order.

SENSOR COILS (Figure 14).

1. Separate the breaker front and back frame as described in the section under "Maintenance".
2. Remove two screws holding sensor coil disconnect plug bracket to back frame.
3. Remove bolt holding resistor bracket to back frame.
4. Remove 2 screws holding capacitor bracket to back frame.
5. Unsolder three leads at ground disconnect and pull wire through hole in back frame. On stationary breakers with fourth wire ground disconnect, unsolder leads at external ground coil and pull wire through hole in back frame.
6. Remove primary disconnects per instructions under disconnects.
7. Remove three 3/8 hexagon headed bolt connecting coils to breaker copper.
8. With the back frame in the vertical position, and supported, grasp the outside coils and lift coil assembly from back frame. When carrying or moving sensor coil assembly, always support the outside coils.

SELECTIVE TRIPPING

Selective overcurrent tripping is the application of circuit breakers in series so that only the circuit breaker nearest the fault opens. Anyone or combination of two or more of the preceding over-current devices may be used in a selective system. The breaker having the shorter time setting and lower pickup will trip before the

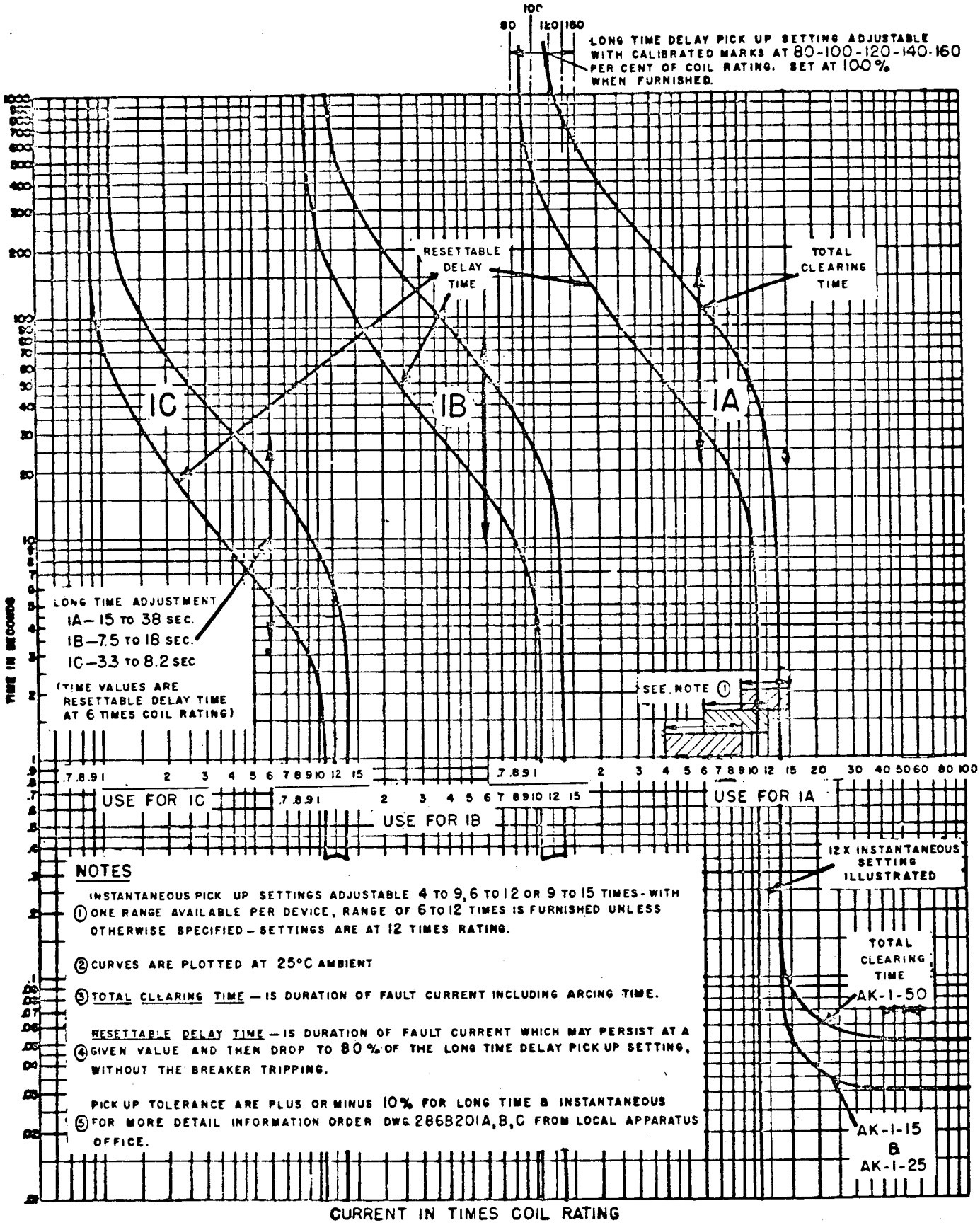


Figure 23. (286B209) Time-Current Characteristic - EC Devices

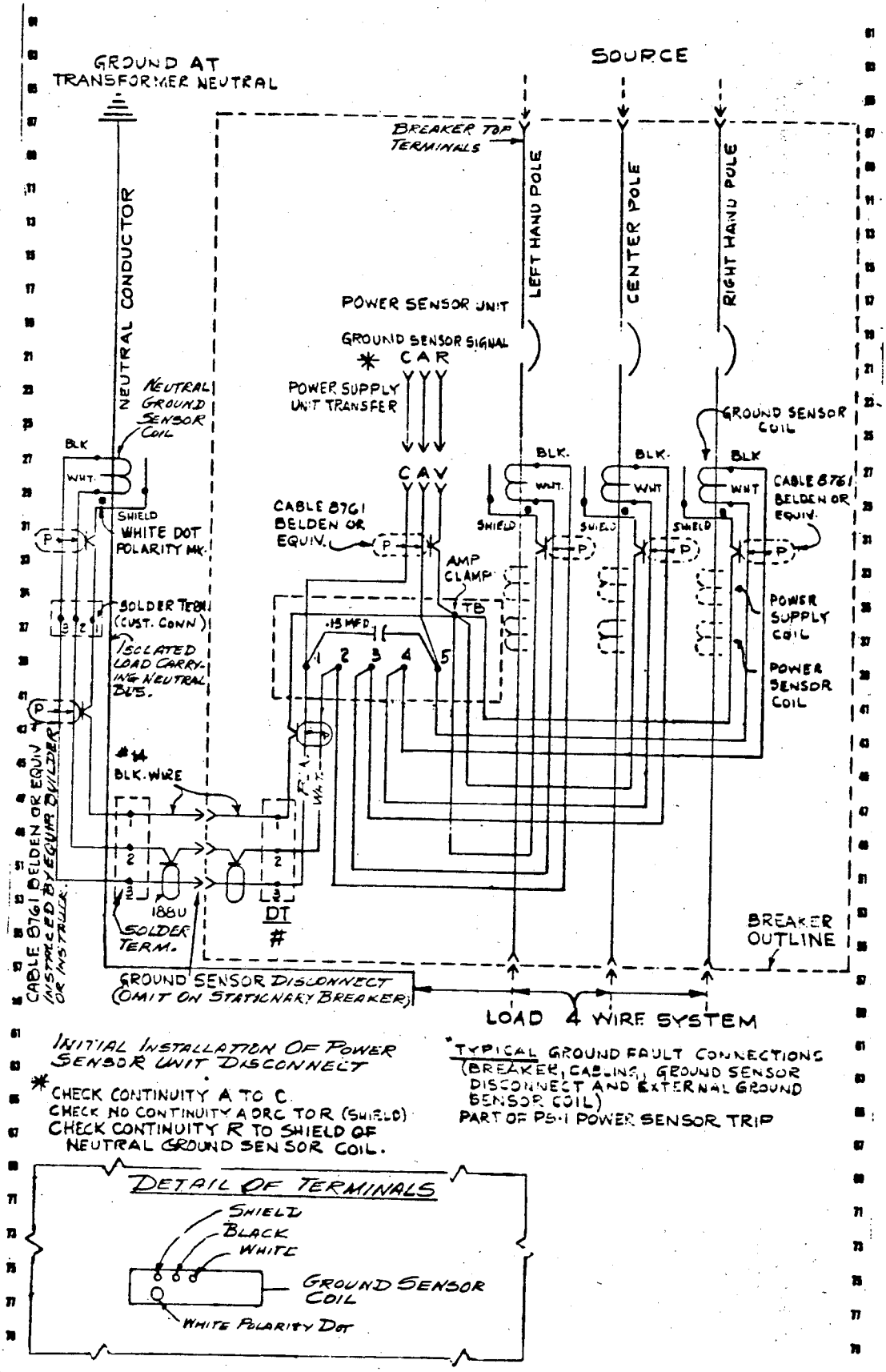


Figure 22. (138B2454) Ground Fault Wiring Diagram

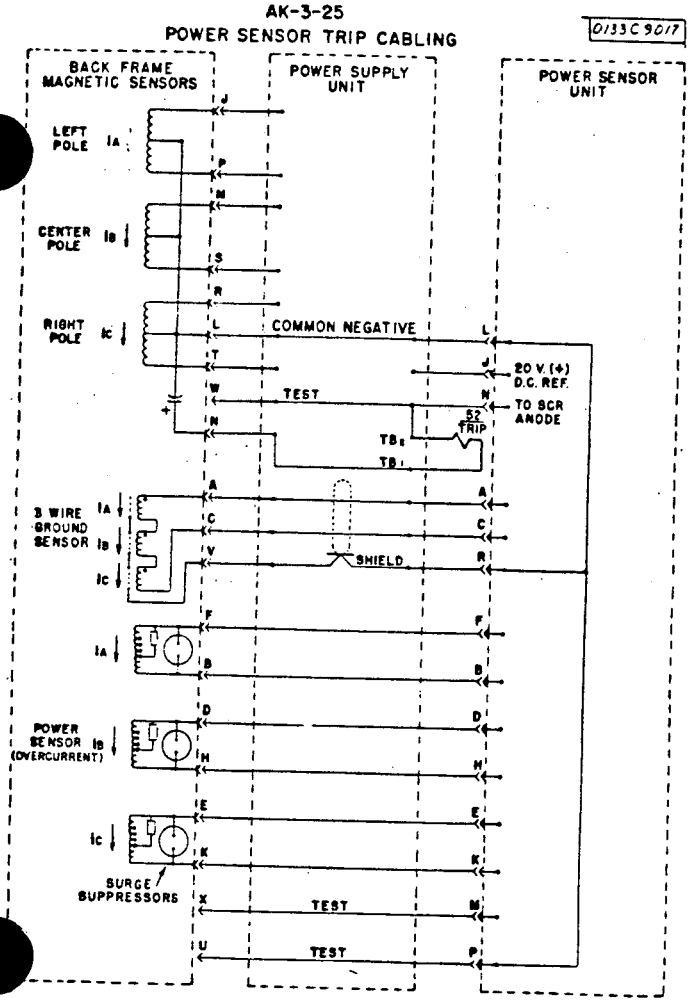


Figure 20. (0133C9017) Power Sensor Cabling Diagram

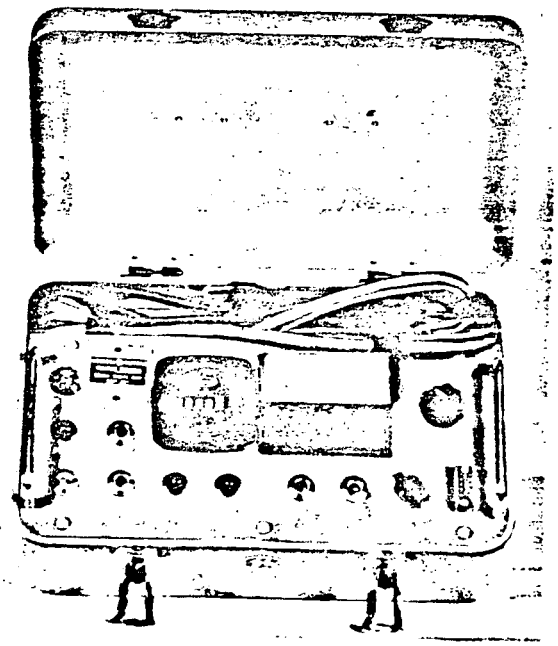


Figure 21. (8039962) Power Sensor Test Kit

TESTING MAGNETIC COILS

After the PST-1 Test Kit has been used to determine the adequacy of performance of the Power Sensor Unit, it may be advisable or required to test the magnetic coils by the use of a hi-current Low voltage type test set. In this event, only one test per phase need be made. This test should be made at some convenient multiple of pick-up setting such as 300% for comparison with published time-current curves.

In the event the breaker is equipped with ground sensor, the ground sensor will cause tripping on single phase testing unless the signal is shorted at the terminal board (Figure 22). Jumper points 1 and 5 during overcurrent test.

The above considerations should indicate which of the four major components is faulty and in need of replacement.

REPLACEMENT OF POWER SENSOR COMPONENTS

POWER SENSOR UNIT (Figure 16).

1. Loosen screw connecting the unit to the front frame.
2. Slide unit forward.
3. Remove control plug by alternately loosening the two retaining screws.
4. Replace in reverse order.

MAGNETIC TRIP DEVICE (Figure 17).

1. Remove trip solenoid wires from the terminal board on power supply.
2. Remove four screws holding power supply to breaker frame.
3. Pull power supply forward until restricted by wiring.
4. Remove two bolts holding trip device to breaker frame.
5. Lift out trip device.
6. Replace in reverse order.

POWER SUPPLY (Figure 15).

1. Remove magnetic trip wires from the terminal board on POWER SUPPLY
2. Remove four screws holding power supply to breaker frame.

between them. See drawing 138B2454 (Figure 22) with the breaker restored to service with the ground fault detector deactivated, establish whether there is false tripping due to overcurrent.

FALSE TRIPPING CAUSED BY FAULTY GROUND FAULT DETECTION

If the breaker is equipped for four wire service (fourth C.T. remotely mounted, Figure 18) it is important that the shielding be effective by having continuity from the disconnect plug at the Power Sensor Unit to the external C.T. and further, that this shield be isolated from the signal conductors. It is also important that continuity exists through the ground signal circuit. Check these conditions as follows; referring to Figure 22.

1. Remove connection plug at Power Sensor Unit and check continuity between A and C (Signal). Letters are located on end of plug.
2. Check to be sure no continuity exists between R and A, or between R and C.
3. Temporarily connect jumper from shield to either terminal at remote C.T. and check to assure the shield is continuous from Power Sensor Plug to remote C.T. by checking for continuity between R and A. If continuity does not now exist, shield is not continuous and point of discontinuity must be found. Check the control disconnect as the possible point of discontinuity. Remove jumper at remote C.T. after shield continuity is established.

Note the polarity marks on the ground sensors. Be sure the external ground C.T. senses the neutral current associated with the particular breaker load current and that polarity marks are in accordance with 138B2454 (Figure 22). If the breaker bottom studs connect to the source, the external C.T. must also have its polarity mark toward the source.

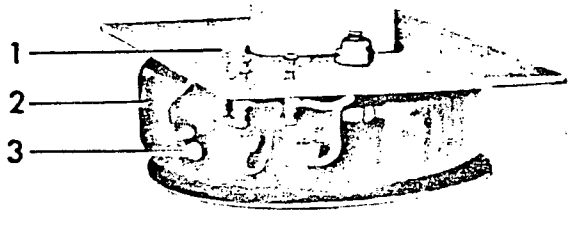


Figure 18. (8041867) Ground Sensor Coil (Remotely Located)

1. Terminal
2. External Ground Sensor Coil
3. White Polarity Dot

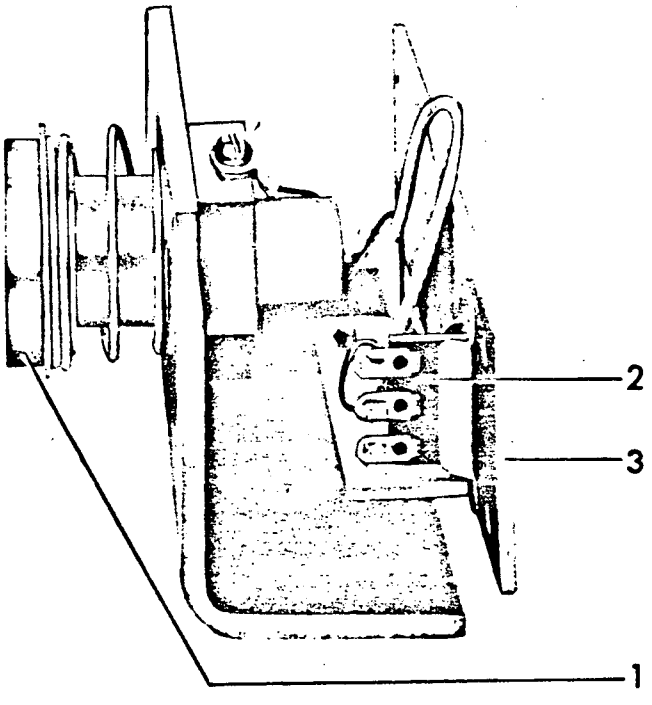


Figure 19. (8041971) Control Disconnect Plug.

1. Female Disconnect Plug
2. Terminal Board
3. Mounting Bracket

NOTE: No adjustment to the taps controlling pick-up or timing should be made with the breaker carrying current.

In the event the Power Sensor Device must be made non-operative to allow the breaker to continue carrying current without overcurrent protection, it is recommended that the leads to the tripping solenoid be removed to completely eliminate the possibility of the breaker tripping. Do not close breaker with power on the main contacts while the disconnect plug to the magnetic coils is disconnected

1. Check for the existence of overcurrent or ground fault conditions that may be causing the breaker to trip as a proper response to these abnormal circuit conditions.

2. The possibility of the breaker being trip free by mechanical interferences along the trip shaft or inadvertent shunt trip operations should be positively eliminated before investigating the Power Sensor. Successful operations in the test position should be obtained before proceeding with the Power Sensor trouble shooting.

3. A PST-1 Power Sensor Test Kit must be available. (Figure 21). Check the Power Sensor Unit for correct function for each pick-up setting and one point on each time delay characteristic. Then check for the correct operation of each phase of the Power Supply Unit. This procedure is described in the instruction manual (GEK-7301) for the PST-1 Test Kit, and GEK-7309 Power Sensor Instructions. If the test results for this test do not deviate more than 10% from the published curves, proceed to step 4. If the deviation is more than 10% contact the factory for possible replacement of the Power Sensor Unit.

4. If the breaker is equipped with ground fault protection, determine whether the false tripping is the result of falsely answering an overcurrent trip or a ground trip signal. This may be determined by temporarily eliminating the ground trip signal by shorting out the ground signal points 1 and 5 at the ground signal terminal board on the back frame bottom of the breaker. Terminals 1 and 5 can be identified by the 0.15UF capacitor connected

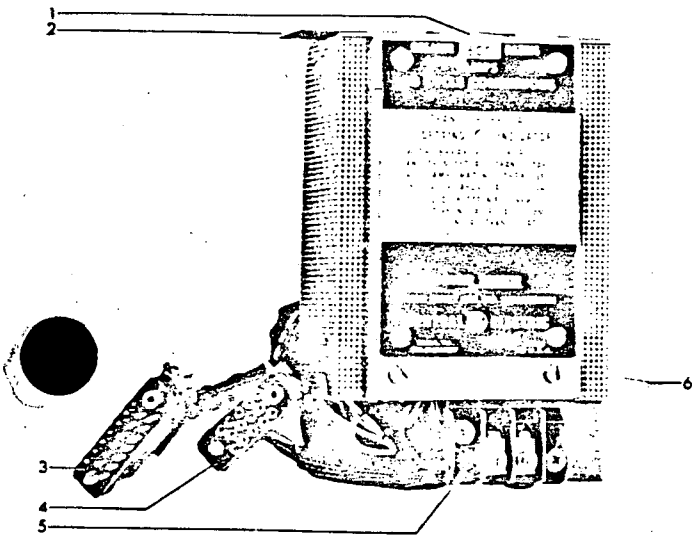


Figure 15. (8039810) Power Supply

1. Rating Disconnect
2. Mounting Bracket
3. Male Disconnect Plug
4. Female Disconnect Plug
5. Terminal Block
6. Mounting Bracket

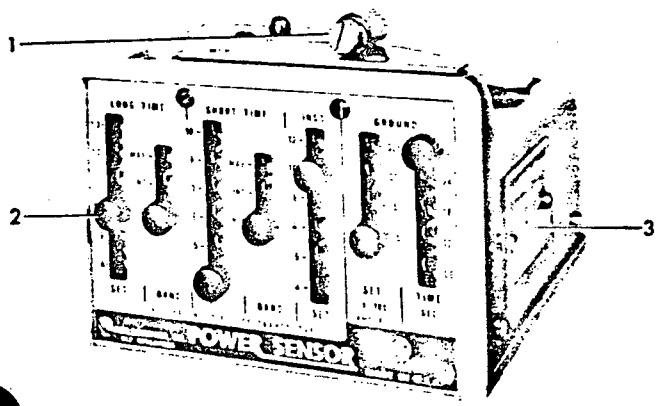


Figure 16. (8041864) Power Sensor Unit

1. Mounting Screw
2. Captive Thumb Screw
3. Name Plate

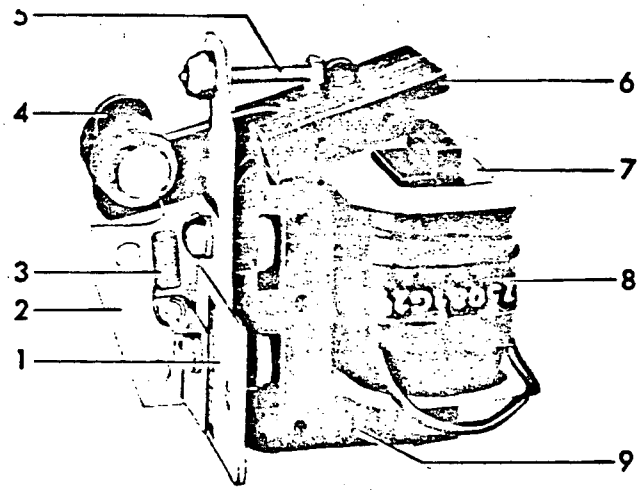


Figure 17. (8041863) Magnetic Trip Device

1. Name Plate
2. Mounting Bracket
3. Spring
4. Trip Arm
5. Adjusting Screw
6. Armature
7. Clamp
8. Coil
9. Magnet

POWER SENSOR TRIP

GENERAL DESCRIPTION

All AK-3 Type Air Circuit Breakers contain Power Sensor Overcurrent Trip Devices. The Power Sensor Trip functions with solid state components with the exception of the Magnetic Trip Device which is used to trip the breaker on signal from the Power Sensor Unit. The Power Sensor Overcurrent Trip Device consists of four major components.

1. The magnetic coils around the breaker conductors (Figure 14).
2. The Power Supply which provides both the tripping energy and the comparison basis for overcurrent detection (Figure 15).
3. The Power Sensor Unit with the various pick-up settings and time delay selection taps (Figure 16).
4. The Magnetic Trip Device which physically trips the breaker (Figure 17).

In addition to the phase overcurrent protection, a ground fault sensing feature may be provided. The Ground Sensing Device works on the principle that the instantaneous value of current flowing in the three conductors (or; in four conductors on four wire systems) must add to zero unless ground current is flowing. Therefore, if the electrical system is a four wire wye system with the neutral grounded at the transformer, the fourth sensing coil (Figure 18) must be included on the neutral conductor with its secondary combined with the secondaries of the three phase sensors which are mounted on the breaker. On Draw-out breakers, the output of the external neutral sensor must enter the breaker by a control disconnect (Figure 19) which is mounted low and on the centerline on the back of the breaker. Refer to Figure 20 for Power Sensor Cabling diagram.

MAINTENANCE

When mal-functioning of the Power Sensor Trip is indicated the trouble should be traced to one or more of these four components involved, and that component should be replaced as a unit. The following steps should be taken to detect a mal-functioning unit.

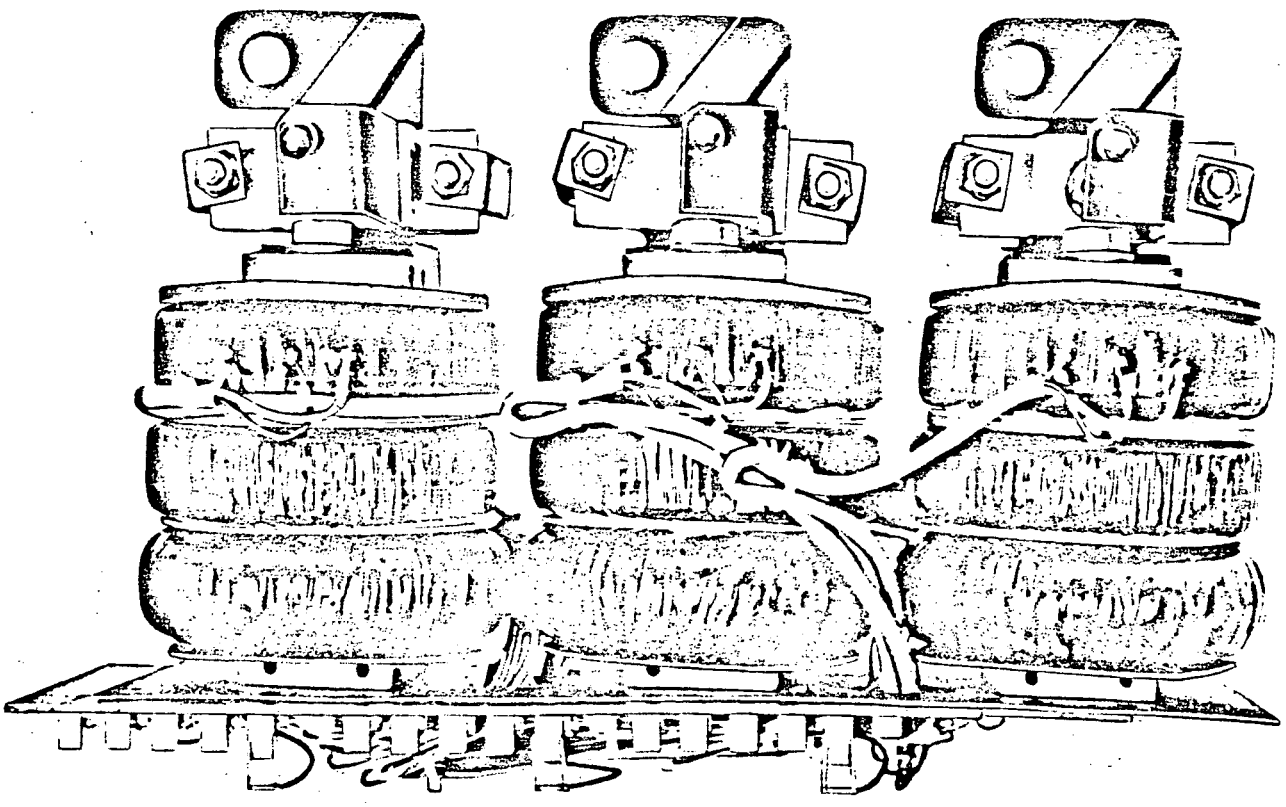


Figure 14. (8041866) Magnetic Coils

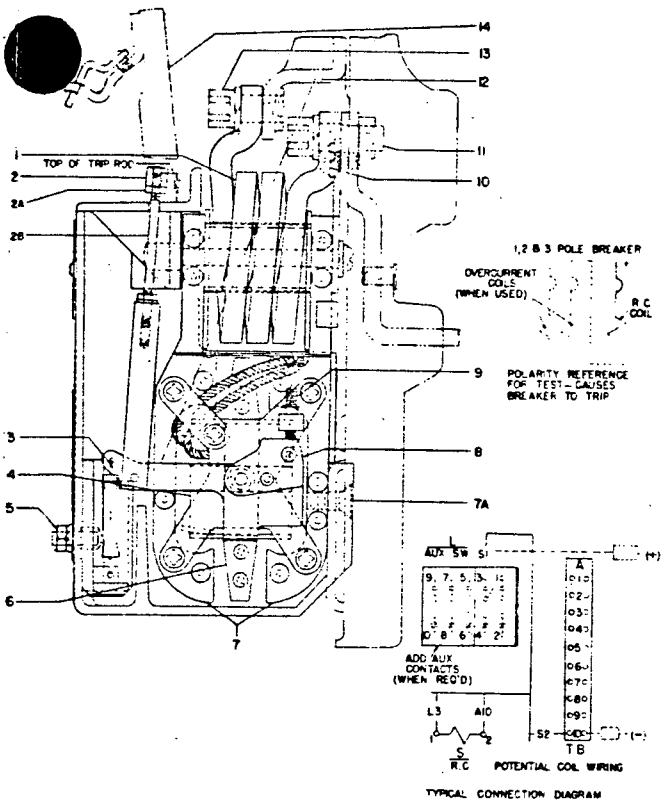


Figure 13. (286B209) Reverse Current Tripping Device

1.	Series Coil	7A.	Screws
2.	Adjusting Nut	8.	Counterweight
2A.	Locking Nut	9.	Stop Screw
2B.	Trip Rod	10.	Mounting Screw
3.	Spring	11.	Screw (Lower Stud)
4.	Potential Coil	12.	Trip Crank
5.	Calibration Nut	13.	Screw (Lower Stud)
6.	Armature	14.	Trip Paddle
7.	Pole Pieces		

The device consists of a series coil (1), with an iron core mounted between two pole pieces (7) and a potential coil connected across a constant source of voltage and mounted around a rotary type armature (6). Calibration spring (3) determines the armature pick-up value when a reversal of current occurs.

As long as the flow of current through the breaker is in the normal direction, the magnetic flux of the series coil and the magnetic flux of the potential coil produce a torque which tends to rotate the armature counterclockwise. The calibration spring (3) also tends to rotate the armature in the same direction. This torque causes the armature to rest against stop screw (9) attached to a bearing plate on the right side of the device.

If the current through the series coil (1) is reversed, armature (6) tends to move in a clockwise direction against the restraint of calibration spring (3). When the current reversal exceeds the calibration setting, the armature will move in a clockwise direction. This causes trip rod (2B) to move upwards against trip paddle (14), tripping the breaker open.

ADJUSTMENTS

The only adjustment to be made on the reverse current device is to make sure that the trip rod has a minimum overtravel of 1/32 of an inch beyond the point of tripping the breaker. The only occasion this adjustment should have to be made is when an old device is being replaced by a new one.

The new device will be factory adjusted so that the top end of the trip rod (2B) will extend 1/2 inch above the top of the device case, and no additional adjustments of the trip rod should be required. To obtain the proper 1/32 of an inch overtravel, close the breaker and proceed as follows:

1. Loosen the locking nut (2A).
2. Manually lift the trip rod and vary the position of the adjusting nut (2), thus establishing the position of the adjusting nut where the breaker is just tripped. (NOTE - Be sure that all parts of the person are kept clear of moving breaker parts when tripping the breaker.
3. With this position of the adjusting nut established, advance the adjusting nut upward one and one half turns.
4. Tighten the locking nut and the minimum 1/32 of an inch overtravel of the trip rod should be obtained.

REPLACEMENT

Replacement of the ED-1 Reverse Current Device is accomplished by means of the same procedure as that followed in the case of the EC Overcurrent Trip Devices. There is, however, one additional step to the taken. This consists of disconnecting the leads of the potential coil. These are connected to a small two point terminal board mounted between two of the phases on the breaker base. After the new device has been installed, adjust for overtravel of the trip rod as described above.

may be replaced without removing the device from the breaker by proceeding as follows:

1. Disconnect leads of coil (8).
2. Remove two screws (6) which fasten magnet (7) and coil to the frame (2).
3. Having removed the magnet from the device, straighten the end of clamp (9).
4. Remove the coil from the magnet.
5. Install new coil, again forming end of clamp (9) as shown.
6. Reassemble to frame.
7. Connect coil leads.

ADJUSTMENT

The only adjustment required on the shunt trip device is that which ensures positively that the breaker will trip when the device is activated. In order to be sure of this, armature arm (11) must travel from 1/32 to 1/16 of an inch beyond the point at which the breaker trips. A good method of checking this is to hold a 1/32nd shim between the magnet and armature at (10), and with the breaker closed, push upwards at (5), closing the armature against the magnet. If the breaker trips, there is sufficient overtravel. If adjustment is necessary, trip paddle (12) may be formed towards or away from armature arm (11).

PROTECTIVE DEVICES

An AK-2/3 breaker may be equipped with the following protective devices:

1. Overcurrent trip (Magnetic) AK-2
2. Power Sensor Trip (Static) AK-3
3. Reverse Current Trip AK-2
4. Under Voltage Trip & Lockout Device
5. Bell Alarm and/or Lockout device
6. Open Fuse lockout device.
7. AKD-5 Interlock AK-2A/AK-3A

OVERCURRENT TRIP DEVICE (Magnetic)

The typical overcurrent trip device consists of a magnetic structure, a series current coil, and a pivoted armature.

When current flow through the series coil generates a magnetic field strong enough, the armature overcomes the restraining force of a calibration spring attached to it, and closes against the magnet. This trips the breaker by means of an extension on the armature which strikes against a trip paddle on the trip shaft.

Depending on the type of individual device, the movement of the armature may be delayed for a time by a timing device. If a relatively long time-delay (seconds or minutes) is desired, the velocity of armature movement is governed by a piston moving through an oil dashpot. If only a short-time delay (cycles or milli-seconds) is required, movement is controlled by an escapement gear and pallets arrangement.

An AK-2-15/25 breaker may be equipped with either the EC-2 or EC-1 overcurrent trip device. The majority of applications will require the use of the EC-2 device. The EC-1 device is normally used when the short-time delay feature is required, or when the trip device is used to operate a special over-current alarm switch.

Most circuit breakers are equipped with series overcurrent trip devices either of the dual magnetic type (instantaneous and time delay tripping) or instantaneous alone. Breakers are designed to carry up to 100% of the continuous current rating of their trip devices. Any attempt to carry higher currents for a prolonged period will cause overheating and possible damage.

EC-2 OVERCURRENT TRIP DEVICE

The Type EC-2 overcurrent tripping device is available in three forms:

1. Dual overcurrent trip, with long-time delay and high-set instantaneous tripping.
2. Low-set instantaneous tripping.
3. High-set instantaneous tripping.

The dual trip has adjustable long-time and instantaneous pick-up settings and adjustable time settings. Both forms of instantaneous trips have adjustable pick-up settings.

DUAL OVERCURRENT TRIP, WITH LONG-TIME DELAY AND HIGH-SET INSTANTANEOUS TRIPPING.

By means of the adjustment knob (5), Figure 10, which can be manipulated by hand, the current pick-up point can be varied from 80 to 160 percent of the series coil rating. The indicator and a calibration plate (4), Figure 10, on the front of the case provide a means of indicating the pick-up point setting in terms of percentage of coil rating. The calibration plate is indexed at percentage settings of 80, 100, 120, 140 and 160.

EC-1 OVERCURRENT TRIP DEVICE

The EC-1 device can be provided with the following tripping combination

1. Long time delay, short time delay and instantaneous -tripping.
2. Long time and short time delay tripping only.
3. Long time delay and instantaneous tripping.
4. Short time delay and instantaneous tripping.
5. Short time delay tripping only.
6. Instantaneous tripping only.

   a. Adjustable (Low set)
   or
   Non-adjustable (High set)

SHORT TIME DELAY TRIPPING, Figure 12.

The armature (7) is retained by calibrating spring (8). After the magnetic force, produced by an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by an escapement mechanism which produces an inverse time delay characteristic. The mechanism is shown in the left side view of Figure -12.

The pickup for this device can be field set between limits having a ratio of 2-1/2 to 1 in the range of 200 to 1000% of the coil rating.

LONG TIME DELAY TRIPPING, Figure 12

The armature (12), is retained by the calibration spring (13). After the magnetic force, produced bs an overcurrent condition, overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a dashpot, which produces an inverse time delay characteristic. The mechanism is shown in the right side view of Figure 12.

INSTANTANEOUS TRIPPING, Figure 12.

a. Adjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition, overcomes the restraining force of the adjustable calibration spring (13).

b. Nonadjustable instantaneous tripping takes place after the magnetic force produced by an overcurrent condition overcomes the restraining force of a nonadjustable spring (14).

ADJUSTMENTS, EC-1 AND EC-2

In addition to the pick-up settings and time-delay adjustments already described, overcurrent trip devices must be adjusted for positive tripping. This adjustment is made at the factory on new breakers, but must be made in the field when the breaker mechanism or the overcurrent trip devices have been replaced.

Positive tripping is achieved when adjustment screw (2), Figure 10, is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism, when the armature closes against the magnet.

In order to make the adjustment, first unscrew trip screw (2), Figure 10, until it will not trip the breaker even though the armature is pushed against the magnet. . Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 of an inch and will make sure that activation of the device will always trip the breaker.

Adjustment screw (2), Figure 10, can best be manipulated by an extended 1/4 inch hex socket wrench.

In order to gain access to the adjustment screw on the center pole overload device, it will be necessary to remove the nameplate from the front escutcheon of the breaker. This will reveal a hole, centrally located in the escutcheon, by means of which the extended socket wrench can engage the adjustment screw.

REPLACEMENT, EC-1 and EC-2

Replacement of either the EC-1 or EC-2 overcurrent trip device is accomplished by the following procedure:

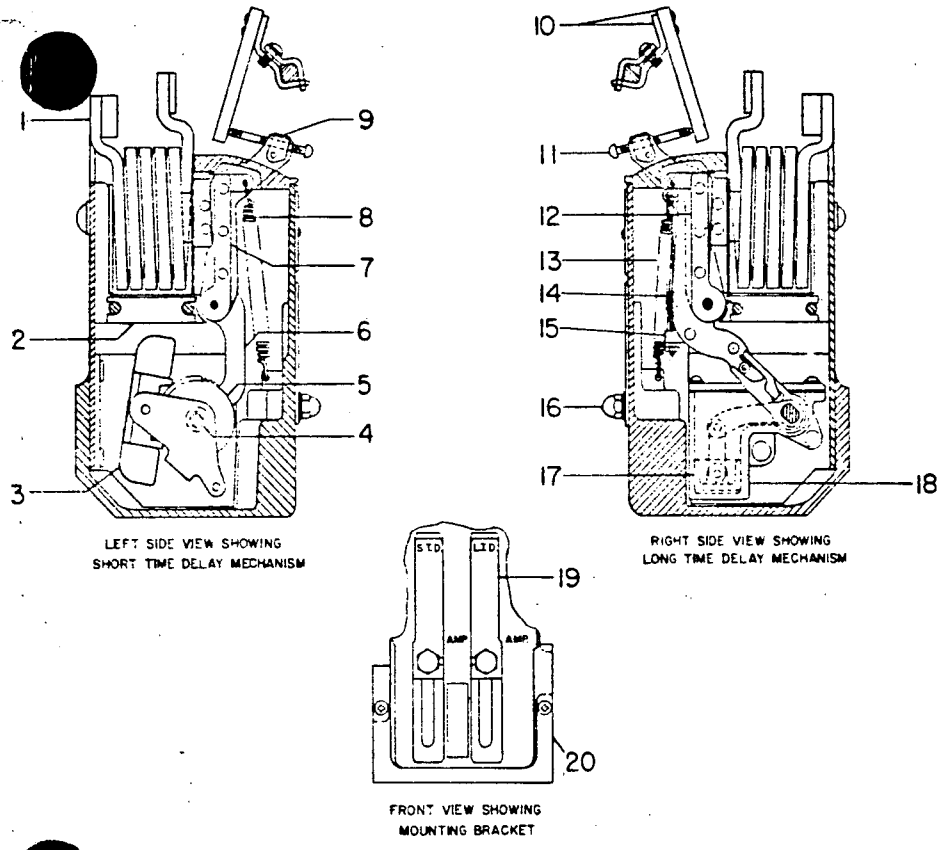
1. Separate the breaker's front and back frames as described in the section under "Maintenance".
2. Remove the steel clamps which fasten the cover of the device to the back of the breaker. NOTE: Pickup settings on the cover of each device are calibrated for the specific device. When replacing covers, replace on associated device.
3. Remove the 3/8 inch hexagon headed bolts which fasten the coil of the overload device to the breaker copper.
4. Remove the round head screw which fastens the frame of the overload to the breaker base.
5. After reassembling breaker with new overload device, adjust for "positive trip" as described under "Adjustments" of this section.

REVERSE CURRENT TRIP DEVICE

Figure 13.

The reverse current trip device sometimes used with d-c breakers will trip the breaker open if the direction of current flow is reversed.

This device is similar in appearance and is mounted in the same way as the overcurrent trip.



1. Series Coil
2. Magnet
3. Pallet
4. Pinion
5. Escape Wheel
6. Driving Segment
7. S.T.D. Armature
8. S.T.D. Calibration Spring
9. Trip Arm
10. Trip Paddle
11. Trip Paddle Adjusting Screw
12. L.T.D. Armature
13. L.T.D. Calibration Spring
14. Instantaneous Trip Spring (High Set)
15. Spring Holder
16. Calibration Clamp Nut
17. Plunger
18. Cylinder (Dashpot)
19. Calibration Plate
20. Clamping Bracket

Figure 12. (695C189) EC-1 Type Overcurrent Trip Device

NOTE: Forcing the adjusting screw to either extreme position may cause binding of the device and should be avoided.

INSTANTANEOUS LOW-SET TRIPPING

The low-set instantaneous pick-up point may be varied by the adjustment knob (5), Figure 10. The calibration in this case usually ranges from 80% to 250% of the series coil rating, the calibration plate being indexed at values of 80%, 100%, 200% and 250% of the rating.

INSTANTANEOUS HIGH-SET TRIPPING

The high set instantaneous pick-up value may have one of the following three ranges: 4 to 9 times coil rating; 6 to 12 times coil rating or 9 to 15 times coil rating. The pick-up setting may be varied by turning the instantaneous trip adjusting screw (4), Figure 11.

Three standard calibration marks will appear on the operating arm at (9), Figure 11, and the value of these calibration marks will be indicated by stampings on the arm as follows:

4X		6X		9X
6X	or	9X	or	12X
9X		12X		15X

At the factory, the pick-up point has been set at the nameplate value of the instantaneous trip current. (Usually expressed in times the ampere rating of the trip coil.) The variation in pick-up setting is accomplished by varying the tensile force on the instantaneous spring. Turning the adjustment screw changes the position of the movable nut (2), Figure 11, on the screw. The spring is anchored to this movable nut so that when the position of the nut is changed, there is a corresponding change in the spring load. As the spring is tightened, the pick-up point is increased. The top edge of the movable nut (2), Figure 11 serves as an index pointer and should be lined up with the center of the desired calibration mark, punched slots on operating arm, to obtain the proper instantaneous trip setting.

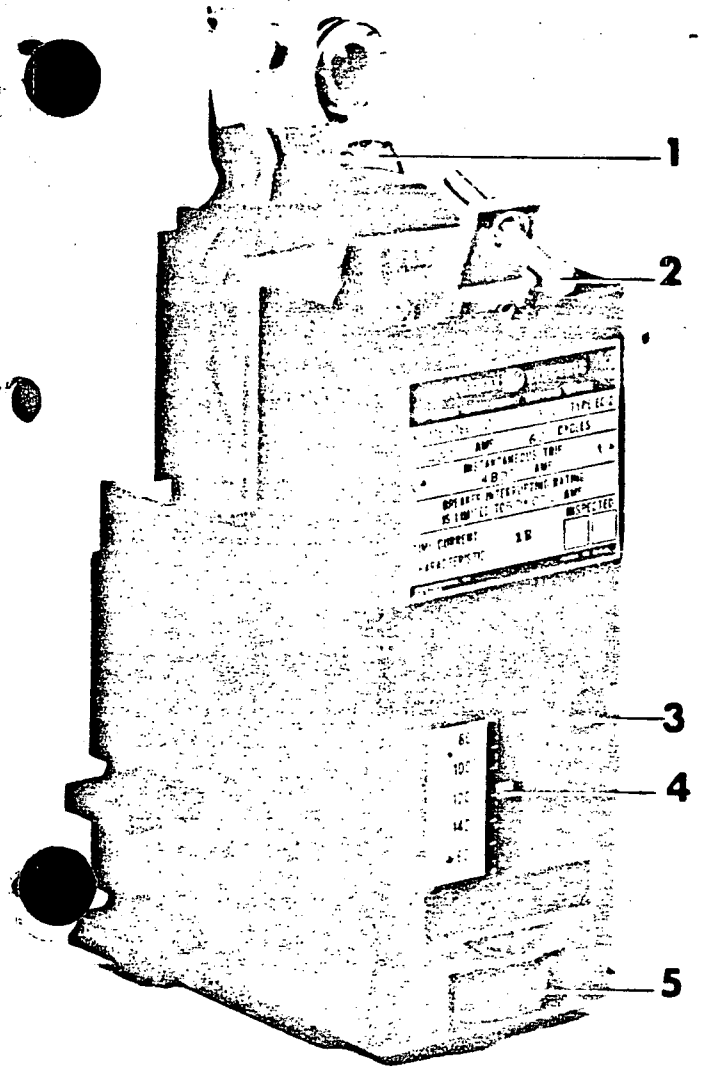


Figure 10. (8024842) EC-2 Overcurrent Trip

1. Series Coil
2. Trip Adjustment Screw
3. Opening for Time Adjustment
4. Pickup Indicator & Calib. Plate
5. Pickup Adjustment Knob

The long-time delay tripping feature can be supplied with any one of three time-current characteristics which correspond to the NEMA standards maximum, intermediate and minimum long-time delay operating bands. These are identified as 1A, 1B and 1C characteristics, respectively. Approximate tripping time for each of these, in the same order are 30, 15 and 5 seconds at 600% of the pick-up value of current. (See time-current characteristic curves 286B201A, B, and C).

The tripping time may be varied within the limits shown on the characteristic curves by turning the time adjustment screw (5), Figure 11. Turning in a clockwise direction increases the tripping time;

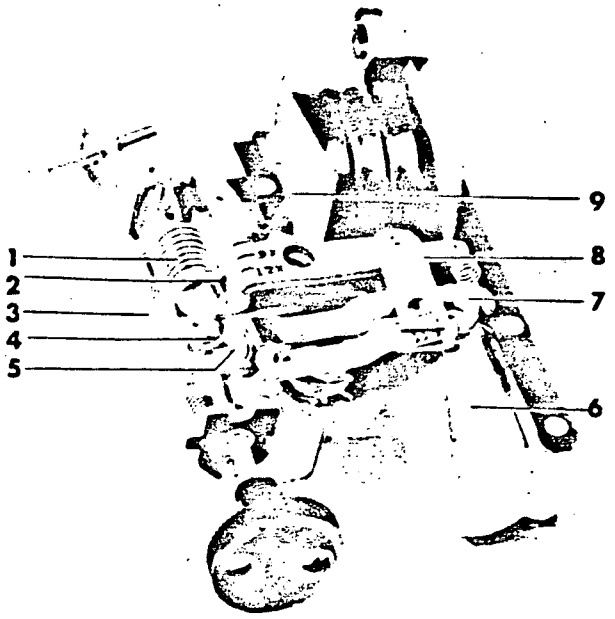


Figure 11. (8024843) EC-2 Overcurrent Trip With Cover Removed.

1. Instantaneous Calibration Spring
2. Movable Nut (Index Pointer)
3. Time-Delay Calibration Spring
4. Instantaneous Pickup Adjustment Screw
5. Time-Delay Adjustment Screw
6. Oil Dashpot
7. Dashpot Arm
8. Connecting Link
9. Instantaneous Pickup Calibration Marks

counter-clockwise motion decreases it. The dashpot arm (7), Figure 11 is indexed at four points, maximum - 2/3 - 1/3 - minimum from the left, as viewed in Figure 11. When the index mark on the connecting link (8), Figure 11, lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated. The 1A and 1B characteristic devices are shipped with this setting at the 2/3 mark and the 1C characteristic at the 1/3 mark. The standard characteristic curves are plotted at the same settings.

Time values are inversely proportional to the effective length of the dashpot arm. Therefore, the linkage setting that gives the shortest time value is the one at which dimension "A" Figure 11, is greatest. The time adjustment screw (5), Figure 11, may be turned by inserting a Phillips head screwdriver through the hole in the front of the case, but if it is desired to relate the linkage setting to the index marks on the linkage it will be necessary to remove the case. This may be done by removing the two mounting screws, one on each side of the case, which may be taken off without disturbing the trip unit itself.

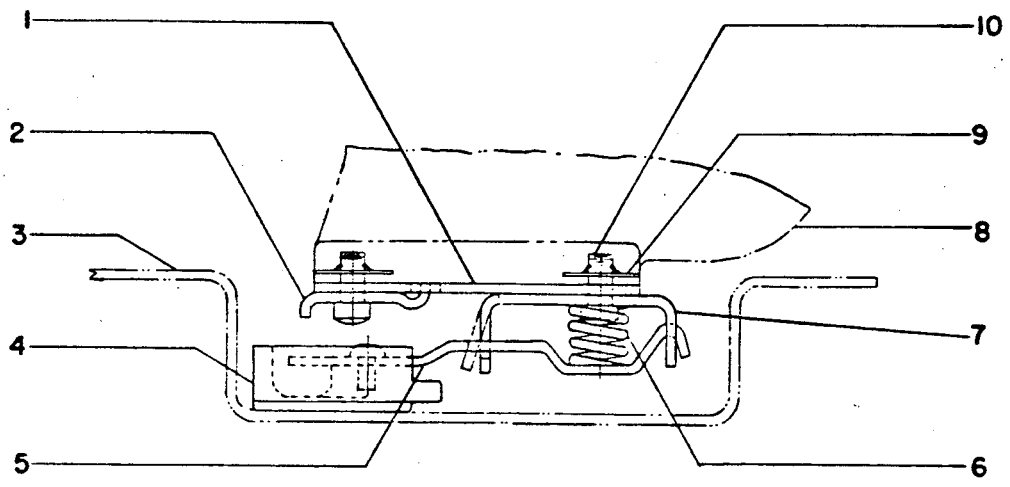


Figure 8. (805B905) Closing Switch (Top View)

1. Insulation
2. Stationary Contact
3. Front Escutcheon
4. Push Button
5. Movable Contact
6. Spring
7. Hinge
8. Closing Solenoid
9. Speed Nut
10. Screw

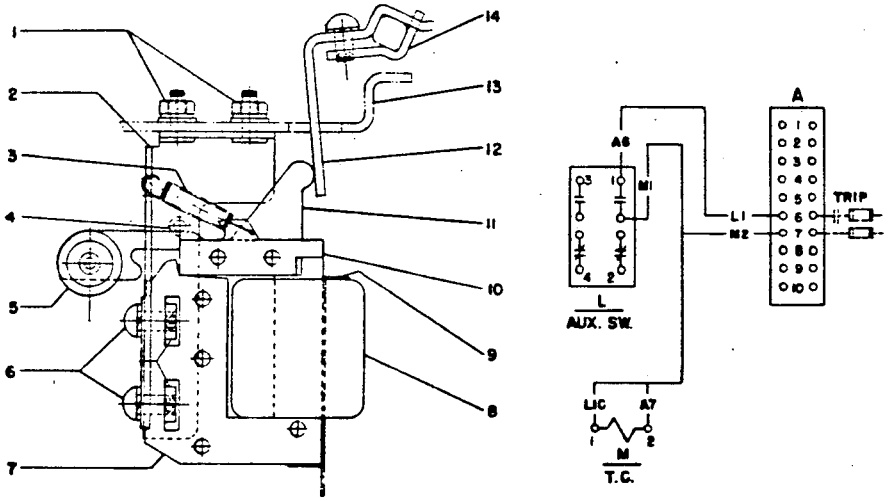


Figure 9. (695C161) Shunt Trip Device

1. Nut
2. Frame
3. Spring
4. Rivet
5. Weight
6. Screws
7. Magnet
8. Coil
9. Clamp
10. Armature
11. Armature Arm
12. Trip Paddle
13. Mechanism Frame
14. Trip Shaft Clamp

TABLE 5

ET-17 SPECIAL 128B1654

INDICATING LAMP COMPLETE

GROUP NO **	VOLTS	1 REQ'D. OF GR. OR PT. NO LISTED BELOW							
		RECEPTACLE	RESISTOR		OHMIC VALUE	BULB G.E. CAT. NO.	COLOR CAP	CARTON	OUTLINE
			DRG. NO.	PART NO.					
1	210-250 AC/DC	0116B6709GR-1	0165A7956	1	56K	NE51H**	SEE ORDERING TABLE	0165A9257	0165A7955
2	67-120 AC			8	80K	NE51 OR B1A			

** NE51H BULB
SUPPLIED BY CUSTOMER

TABLE 6

COLOR CAP

CAT. NO.	COLOR CAP	
	COLOR	CAT. NO.
0116B6708G	NONE	NONE
0116B6708G*C	CLEAR π	208A3768P1
0116B6708G*R	RED Ø	208A3768P2
0116B6708G*G	GREEN Ø	208A3768P3
0116B6708G*Y	YELLOW Ø	208A3768P4
0116B6708G*W	WHITE Ø	208A3768P5
0116B6708G*B	BLUE π	208A3768P6
0116B6708G*A	AMBER π	208A3768P7
0116B6708G*D	GREEN π	208A3768P8
0116B6708G*E	RED π	208A3768P9

TABLE 3

ET-17-INDICATING LAMP

VOLTAGE RANGE A-c/D-c	CAT. NO.* (INCLUDES LAMP, COLOR CAP, AND RESISTOR)	RESISTOR 0165A7956 PART NO.	RESISTOR 0165A7956 OHMIC VALUE	BULB GE CAT. NO.	RECEPTACLE	COLOR CAP †	CARTON	OUTLINE
110-139	0116B6734G1	1	200-K	B1A	0116B6709G1	SEE ORDERING TABLE 2	0165A9257P3	0165A7955
140-219	0116B6734G2	2	560 K					
220-299	0116B6734G3	3	750 K					
300-374	0116B6734G4	4	1 MEG					
375-449	0116B6734G5	5	1.2 MEG					
450-600	0116B6734G6	6	1.6 MEG					

† Specify color cap from Table 6 or 7.

TABLE 4

ET-16 SPECIAL 127B8177

INDICATING LAMP COMPLETE

GROUP NUMBER*	VOLTS	1 REQ'D. OF GR. OR PT.NO. LISTED BELOW					COLOR CAP	CARTON	OUTLINE
		RESISTOR				BULB G.E. CAT. NO.			
		RECEPTACLE	DRG. NO.	PART NO.	OHMIC VALUE				
1	70	0116B6709 G-1	0165A7844	7	750 Ω	1835	SEE ORDERING TABLE	0165A9257 P-1	0165A7859
2	17			8	50 Ω	756	**		
3	140			9	2500 Ω	NONE			
4	220			10	4300 Ω	1835			
5	32			2	200 Ω	1819			
6	125			11	3300 Ω	1835			
7	277			12	5900 Ω	1835			
8	140			9	2500 Ω	1835			
9	130			13	2300 Ω	1835			

**756 Bulb Supplied By Customer

RATINGS

Resistors ET-16 12.5 Watts
ET-17 1 Watt

BULB	DESIGN VOLTAGE	DESIGN AMPS	CANDLE POWER	AVERAGE LIFE (HOURS)
1819	28	.04A	Approx. .34	2500
1835	55	.05A	Approx. 1.1	5000
B1A	105-125	.3 MA	-	15,000

CONNECTIONS

See Figure 1A and 1B for typical tell-tale and dim-bright connections.

RECOMMENDED PANEL ASSEMBLY

Thread pal nut against shoulder of the receptacle. Insert remaining threads thru panel and thread escutcheon nut against panel. Assemble color cap fully, hand tighten, (do not force). Turn escutcheon nut back, up against color cap, then back off 1/2 to 3/4 turn (recommend 3/4 turn) to give at least 1/64 but not more than 1/32 clearance between color cap and escutcheon nut-(for up to 3/16 panel). For 1/4 panel, color cap will be flush with escutcheon nut. Tighten pal nut against panel to 10-12 inch pounds torque.

TABLE 1

ET-16 - INDICATING LAMP

CIRCUIT VOLTAGE RATED	CIRCUIT VOLTAGE MIN.	CIRCUIT VOLTAGE MAX.	CAT. NO. (INCLUDES LAMP, COLOR CAP, & RESISTOR	RESISTOR 0165A7844 PART NO.	RESISTOR 0165A7844 OHMIC VALUE	BULB GE CAT. NO	RECEPTACLE	COLOR CAP †	CARTON	OUTLINE
24 D-c	22	28	0116B6708G1	1	10	1819	0116B6709G1	SEE ORDERING TABLE 1	0165A9257P1	0165A7859
48 D-c	44	56	0116B6708G2	2	200	1819				
125 D-c	110	140	0116B6708G3	3	2000	1819				
250 D-c	220	280	0116B6708G4	4	5100	1835				
120 A-c	95	130	0116B6708G5	5	1900	1835				
240 A-c	195	260	0116B6708G6	6	4800	1835				

TABLE 2

ET-16 - FOR DIM-BRIGHT APPLICATION

CIRCUIT VOLTAGE RATED	CIRCUIT VOLTAGE MIN.	CIRCUIT VOLTAGE MAX.	CAT. NO* (INCLUDES LAMP, COLOR CAP, AND RESISTOR)	RESISTOR 0165A9217 PART NO.	RESISTANCE OHMS TOTAL	RESISTANCE OHMS TAP	BULB GE CAT. NO.	RECEPTACLE	COLOR CAP †	CARTON	OUTLINE
48 D-c	44	56	0127B8108G1	1	450	50	1835	0116B6709G3	SEE ORDERING TABLE 1	0165A9257P2	0165A9216
125 D-c	110	140	0127B8108G2	2	2550	1700	1835				
250 D-c	220	280	0127B8108G3	3	6000	4400	1835				
120 A-c	95	130	0127B8108G4	4	2450	1600	1835				
240 A-c	195	260	0127B8108G5	5	5700	4200	1835				

INTRODUCTION

The ET-16 (incandescent) and ET-17 (neon) indicating lamps consist of a common receptacle, plug in type resistors and lamps, escutcheon and color cap. Available for mounting on switchboard panels up to and including 1/4 inch thickness.

APPLICATION

These lamps can be used whenever a panel mounted signal or indicating lamp is desired.

The ET-16 is available for either one brilliance, or dim bright operation. The ET-17 can be used when extra long life is a factor and brilliance is not. It also can be used when low current is desired.

FEATURES

1. The simple "push-twist" type plug has been adopted for both the bulb and the resistor. This was accomplished by incorporating a bayonet base on both components.

2. A common receptacle for both the ET-16 and ET-17 coupled with the plug-in resistor and bulb makes it easy to change on the panel without disassembling.

3. The resistor is in series with the bulb, and the ohmic value for the different circuit voltages is designed at 80% of the rated bulb voltage to give it longer life. Changing voltages is easily accomplished by changing the series resistor. (See listed tables for the proper resistor).

4. A short circuit plug is available when a series resistor is not required or if an external resistor is to be used.

5. Standard GE extra-long-life bulbs are specified for all lamps. The ET-16 uses GE Cat. No. 1819 for the 24 d-c lamp and GE Cat. No. 1835 for the balance of the ratings. ET-17 uses GE Cat. No. B1A.

6. Terminals are readily available. They are designed for either AMP "FASTON" type connectors, solder, or screws.

7. Nine basic color caps designed for maximum visibility are available for ET-16: Translucent-red, green, yellow, white. Transparent-amber, red, green, blue, and clear.

   ET-17: Because of the special properties of neon, only amber, transparent red, and clear lenses are suitable.

   The color cpas have a knurled O.D. for easy removal.

8. The ET-16 is also available for dim bright applications.

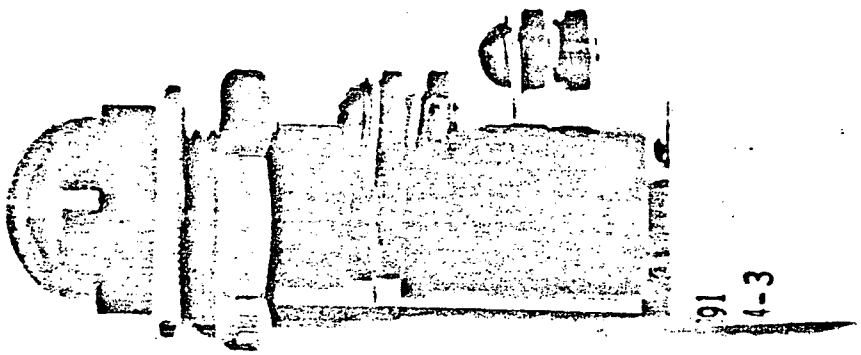
9. When special voltages or resistance is required other than those listed, a special lamp may be ordered with the proper design, or designated series resistor.

   If a bulb other than those listed above is required, the lamp will be furnished less the bulb.

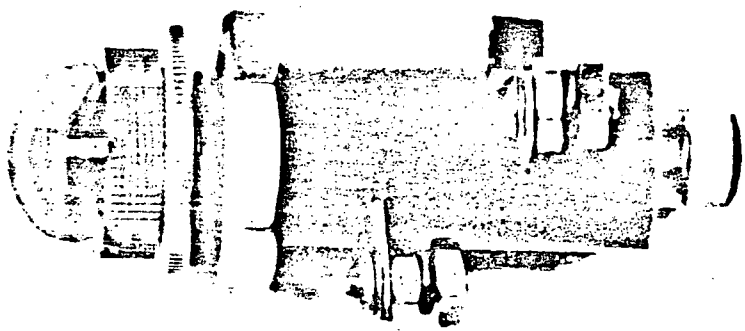
   Listed tables give some of the specials made available.

CONTENTS

INDICATING LAMPS
TYPE ET-16 and ET-17



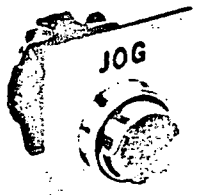
ET-16 INDICATING LAMP

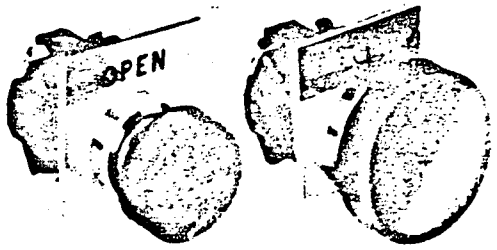


ET-17 INDICATING LAMP

POWER SYSTEMS MANAGEMENT DEPARTMENT
GENERAL ELECTRIC
PHILADELPHIA, PA.

PTP–PTM–UNLIGHTED PUSHBUTTONS





Button Color	EXTENDED HEAD	HALF GUARD	FULL GUARD	PTM–MUSHROOM HEADS	
			CATALOG LISTINGS		
Black	PTP22	PTP32	PTP42	PTM22	PTM32
Red	" P23	" P33	" P43	" M23	" M33
Orange	" P24	" P34	P44	" M24	" M34
Yellow	" P25	" P35	" P45	" M25	" M35
Green	" P26	" P36	" P46	" M26	" M36
Blue	" P27	" P37	P47	" M27	" M37
List Price[2]	$6.00	$6.00	$6.00	$12.00	$12.00
No Button List Price[2]	PTP21 $5.70	PTP31 $5.70	PTP41 $5.70	PTM11 $10.00	PTM11 $10.00

SEPARATE BUTTONS AND HEADS

Color	For PTP Operators	For PTM Operators 1⅝" Dia.	For PTM Operators 2¼" Dia.
Black	PTPZ02	PTMZ22	PTMZ32
Red	" PZ03	" MZ23	" MZ33
Orange	" PZ04	" MZ24	" MZ34
Yellow	" PZ05	" MZ25	" MZ35
Green	" PZ06	" MZ26	" MZ36
Blue	" PZ07	" MZ27	" MZ37
List Price	$ .30	$2.00	$2.00

ORDERING INSTRUCTIONS

[1] Contact blocks (any combination up to four) may be added to operator to make units. Add contact block suffix letter(s) to the operator catalog listing and increase the list price accordingly. See contact block alternatives on Page K4.
For example: PTP33C

OPERATOR CONTACT BLOCK (PTCC)

[2] Operator list price includes standard or blank legend plate. Choices and identification are shown on Page K16. Deduct $ .60 from list price if no legend plate is required. When legend plate is desired, add it to the catalog listing and separate with a hyphen.
For example: PTM33E-B04

OPERATOR BLOCK LEGEND PLATE 2¼" Square
"Emergency Stop on Red Field"

PTH–LIGHTED PUSHBUTTONS

Full voltage devices are not for use with 120 volt lamps.

EXTENDED LENS

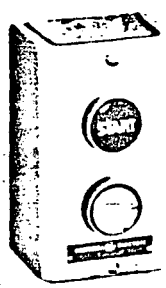
OPERATOR ONLY Contact block suffix letters may be added to operators for units.

Lens Color	Full Voltage Type[1] No Lamp	6-8 Volt	12 Volt	18 Volt	24 Volt	50/60 Hz Transformer with =51 Lamp 110/120 VAC	220/240 VAC	440/480 VAC	550/600 VAC	Resistor with =1450 Lamp 48 V AC/DC	120 V AC/DC
Red	PTH2103	PTH2123	PTH2133	PTH2143	PTH2153	PTH2213	PTH2223	PTH2243	PTH2263	PTH2303	PTH2313
Amber	" H2104	" H2124	" H2134	" H2144	" H2154	" H2214	" H2224	" H2244	" H2264	" H2304	" H2314
Yellow	" H2105	" H2125	" H2135	" H2145	" H2155	" H2215	" H2225	" H2245	" H2265	" H2305	" H2315
Green	" H2106	" H2126	" H2136	" H2146	" H2156	" H2216	" H2226	" H2246	" H2266	" H2306	" H2316
Blue	" H2107	" H2127	" H2137	" H2147	" H2157	" H2217	" H2227	" H2247	" H2267	" H2307	" H2317
White	" H2108	" H2128	" H2138	" H2148	" H2158	" H2218	" H2228	" H2248	" H2268	" H2308	" H2318
List Price[2,3]	$17.70	$18.00	$18.00	$18.00	$18.00	$22.00	$22.00	$22.00	$22.00	$18.00	$18.00
Operator Only without lens	PTH2101	PTH2121	PTH2131	PTH2141	PTH2151	Select separate lens and contact block(s) to complete unit. PTH2211	PTH2221	PTH2241	PTH2261	PTH2301	PTH2311
List Price[2,3]	$16.30	$16.60	$16.60	$16.60	$16.60	$20.60	$20.60	$20.60	$20.60	$16.60	$16.60

PTH continued on next page

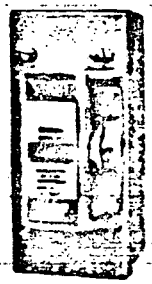
STANDARD-DUTY PUSH BUTTON STATIONS

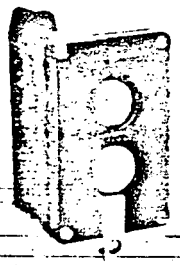
600 Volts Max. AC/DC 10 Amps Max. Continuous



CR2943 General-purpose surface-mounted station

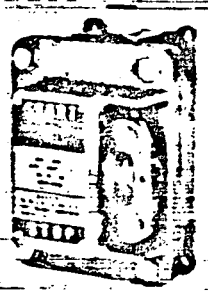
CR2943 Water and dust-tight station, NEMA Type 4





CR2943 Corrosion-resistant station, NEMA Type 4X

CR2941 Hazardous location station, NEMA Type 7



APPLICATION

Standard-duty pushbutton stations are designed for all normal START-STOP and REVERSE operations with a-c magnetic starters NEMA Sizes 00-4. Contact ratings are 10 amps carry, 600 volts max., 30 amps make and break at 110-125 volts a-c.

Stations are available in general-purpose, flush- or surface-mounted; dust- and water-tight; corrosion-resistant; and hazardous-location enclosures.

FEATURES

- **Easy-to-operate buttons** — Large concave buttons operate easily, even when gloves are worn.
- **Long-life contacts** — large silver contacts provide positive closure and assure a good connection.
- **Positive make and break** — strong springs behind buttons reduce the chances of contact freezing or accidental closure from machine vibration.
- **Extra safety** — an insulating strip between the terminals and back of the enclosure helps prevent electrical shorting.

PRICING INFORMATION — Surface-mounted Forms

ONE-UNIT STATIONS (Momentary Contact—except Selector Switches)

Black (A)	START	NA101E	$12.00	NJ201B	NJ301B	$38.00	NA101B	$46.00
Black (A)	(As Specified)	AA101B	12.00*	AJ201B	AJ301B	38.00*	AA101T	46.00*
Red (B)	STOP	NA101F	12.00	.....	NJ301A	.....	.....	.....
Red (B)	(As Specified)	AA101A	12.00*	.....	AJ301A	38.00	.....	.....
Red (B) (Locking Means)	STOP	NA101G	18.00	NJ201A§	NJ301C	38.00	NA101A§	46.00
Red (B) (Locking Means)	(As Specified)	AA101E	18.00*	AJ201A§	AJ301C	38.00*	.....	.....
2 Pos. Sel. Sw. (C) SPDT	(As Specified)	AA101S†	12.00†	.....	.....	.....	.....	.....
3 Pos. Sel. Sw. (C) SPDT	(As Specified)	AA101M‡	12.00‡	.....	.....	.....	.....	.....

TWO-UNIT STATIONS (Momentary Contact)

Black, Red (D)	START-STOP	NA102A¶	$12.00	.....	.....	.....	.....	.....
Black, Red (D) (Locking Bar)	START-STOP	NA102C	18.00	.....	.....	.....	.....	.....
Black (A), Red (B)	(As Specified)	AA102H	12.00*	.....	AJ302B	$38.00	.....	.....
Black (A), Red (B) (Locking Means)	START-STOP	.....	.....	NJ202A§	NJ302A	38.00	NA102B§	$46.00
Black (A), Red (B) (Locking Means)	(As Specified)	AA102AF	18.00*	AJ202A§	AJ302A	38.00*	.....	.....
Black (A), Black (A)	RAISE-LOWER	NA102B	15.00	NJ202F	NJ302F	38.00	NA102G	46.00
Black (A), Black (A)	FORWARD-REVERSE	NA102D	15.00	NJ202E	NJ302E	38.00	NA102F	46.00
Black (A), Black (A)	UP-DOWN	NA102E	15.00	NJ202G	NJ302G	38.00	NA102H	46.00
Black (A), Black (A)	OPEN-CLOSE	NA102G	15.00	NJ202H	NJ302H	38.00	NA102J	46.00
Black (A), Black (A)	(As Specified)	AA102A	15.00*	AJ202B	AJ302C	38.00*	AA102B§	46.00*

TWO-UNIT STATIONS (Maintained Contact)

Black, Red (H)	START-STOP	NA102W	$18.00
Black, Black (H)	ON-OFF	NA102X	18.00

THREE-UNIT STATIONS (Momentary Contact)

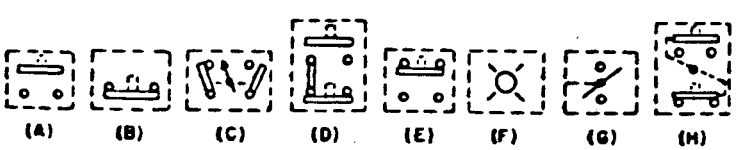
Black (E), Black (E), Red (B)	UP-DOWN-STOP	NA103F	$24.00
Black (E), Black (E), Red (B)	RAISE-LOWER-STOP	NA103G	24.00
Black (E), Black (E), Red (B)	FAST-SLOW-STOP	NA103H	24.00
Black (E), Black (E), Red (B)	FORWARD-REVERSE-STOP	NA103J	24.00
Black (E), Black (E), Red (B)	OPEN-CLOSE-STOP	NA103K	24.00
Black (E), Black (E), Red (B)	START-JOG-STOP	NA103L	24.00
Black (E), Black (E), Red (B)	(As Specified)	AA103AA	24.00*
Black (E), Black (E), Red (B) (Locking Bar)	(As Specified)	AA103C	30.00*
115/230 Volt Light (F), Black (A), Red (B)	START-STOP	NA103V	44.00

THREE-UNIT STATIONS (Maintained Contact)

115/230 Volt Light (F), Black, Black (H)	START-STOP	NA103Y	$50.00

* Add $3.00 GO-10G per station for any nameplate markings or arrangements not shown above.
† Five N.P.'s included: OFF-ON, FORWARD-REVERSE, HAND-AUTO, SLOW-FAST and OPEN-CLOSE.
‡ Three N.P.'s included: HAND-OFF-AUTO, FORWARD-OFF-REVERSE and OPEN-OFF-CLOSE.
§ Includes hole for padlock on STOP.
¶ Units are individually boxed and "Poly-Packed" 10 per carton as standard.

WIRING SYMBOLS (As noted under description in tables.)



(A) (B) (C) (D) (E) (F) (G) (H)

CONTACT RATINGS

110-125	10	30	3.0	1.1
220-250	10	15	1.5	0.55
440-480	10	7.5	.75	
550-600	10	6	.6	0.2

DIMENSIONS AND WEIGHTS

Surface-mounted Stations (General-purpose Enclosure)	1, 2 3	4⅝ 7⅛	2⅞ 2⅞	2⅞ 2⅛	½ - ¾ ¾ - 1	1 2½
Flush-mounted Stations (General-purpose Enclosure)	1, 2 3	5⅛ 8⅛	3⅛ 3⅛	3¼ 3¼	½ - ¾ ¾ - 1	1½ 3
Water & Dust-tight Enclosure	2	5¾	2⅞	3⅝	Pipe Tap Bottom ½	2
Water-tight & Corrosion Resistant	2	6⅛	3¼	3	Pipe Tap Bottom ¾	2
Hazardous Location	2	6⅝	4¼	4¼	Pipe Tap Top & Btm. ¾	6

Prices subject to change without notice.

GENERAL ELECTRIC

TYPE SBM
CONTROL SWITCHES

PRINCIPAL RENEWAL PARTS

Ref. No.	Catalog Number	Description
1A	888B208AAP1	Handle, fixed, pistol grip
†1B	888B208ABP1	Handle, fixed, oval
1C	888B208ACP1	Handle, fixed, knurled
†1D	6248034P2	Handle, fixed, lever
†2A	127A6780G1	‡Handle assembly, removable, standard
†2B	127A6780G3	‡Handle assembly, removable, engraved "R"
†2C	127A6780G4	‡Handle assembly, removable, engraved "T"
3	307V511P1	White pointer for handle
†4	307V516	Spring washer for pointer
5A	6049905P1	Mounting screw, 3/32 - 1/4 inch panel
5B	6049905P8	Mounting screw, 1 - 1 1/2 inch panel
6	NP-202491	Circuit designation plate (specify engraving)
7	127A6768P1	Escutcheon, fixed handle, no target (specify engraving)
8A	127A6757G1	Escutcheon, fixed handle, with target (specify engraving)
8B	127A6757G2	Escutcheon, fixed handle, with target ("TRIP" - "CLOSE")
8C	127A6757G3	Escutcheon, fixed handle, with target ("STOP" - "START")
8D	127A6757G4	§Escutcheon, fixed handle, with target (specify engraving)
8E	127A6757G5	§Escutcheon, fixed handle, with target ("TRIP" - "CLOSE")
8F	127A6757G6	§Escutcheon, fixed handle, with target ("STOP" - "START")
†9	888B207P1	‡Escutcheon, removable handle (specify engraving)
†10	127A6763P1	§Locking plate
†11	307V508P1	Shaft coupling (removable handle switches only)
12	127A6753P1	Front plate
13	127A6754P1	Stop wheel (standard)
†14A	127A6764G1	§Stop wheel and shaft assembly, 3/32 - 1/4 inch panel
†14B	127A6764G2	§Stop wheel and shaft assembly, 1-1 1/2 inch panel
15	127A6772G1	Roller arm assembly
16	6074939P91	Roller arm bearing sleeve
17A	127A6774P1	Index wheel, 8 points, 45 degree spacing
†17B	127A6774P2	Index wheel, 7 points, 45 degree spacing
†17C	127A6774P3	Index wheel, 4 points, 90 degree spacing
†17D	127A6774P4	Index wheel, 3 points, 90 degree spacing
*18	127A6781	Positioning spring
19	307V510P1	Torsion spring sleeve
*20A	127A6775P1	Torsion spring, standard (spring return CW and CCW)
*†20B	307V513P1	Torsion spring, special (spring return CCW to normal only)
*†20C	307V513P2	Torsion spring, special (spring return CW to normal only)
21	127A6760G1	Torsion spring actuator
22	127A6755P2	Front bearing
23	237C755P1	Front support
24	237C756P1	Barrier cover plate
*25	127A6770G1	Cam follower and moving contact assembly
26	237C759P(¶)	Cam
*27	127A6749G1	Stationary contact, upper
*28	127A6751G1	Stationary contact, lower
29	6047297P1	Connection screw
30	237C757P1	Intermediate barrier only (no contacts)
31	237C758P1	πRear support only (no contacts)
32	Δ	Rear bearing and shaft assembly
33	NP-202490	Rear bearing retainer and nameplate
34	127A6756G(◊)	Tie bolt

* Recommended for stock for normal maintenance.
† Not shown.
‡ Specify switch number, type of handle, and position in which removed.
§ Pull-to-lock switches only.
¶ Specify numeral molded in cam.
π Uses same contacts as intermediate barrier (References 27, 28, and 29).
Δ Specify model number of switch.
◊ Specify number of stages in switch.

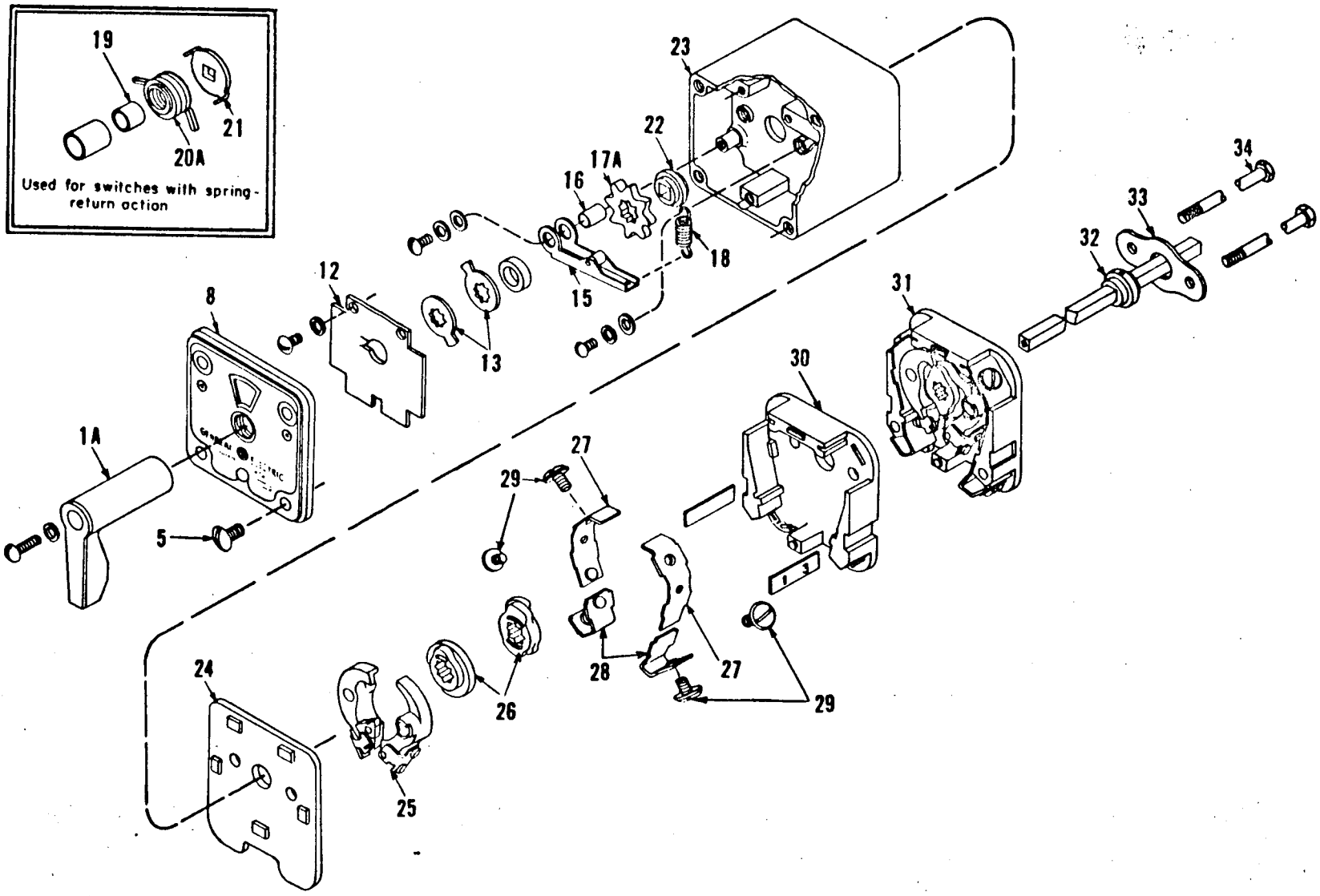


Fig. 2. Exploded view of typical two-stage type SBM switch. Maintained contact construction shown. For spring return action, references 19, 20, and 21 replace references 15, 16, 17, and 18.

RENEWAL PARTS

TYPE SBM
CONTROL SWITCHES

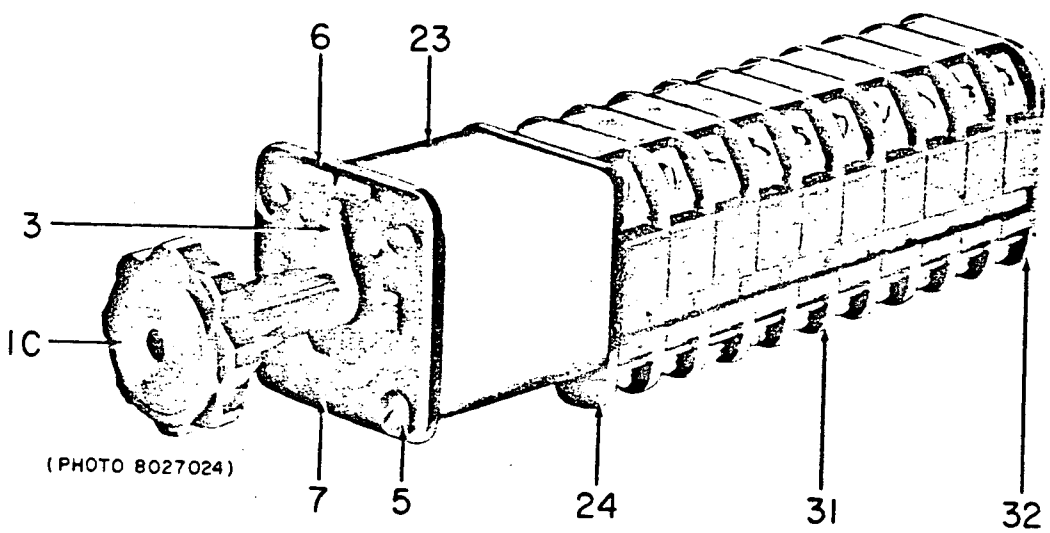


Fig. 1. Typical SBM control switch (fixed knurled handle, standard escutcheon, and ten stages of maintained contacts).

ORDERING INSTRUCTIONS

1. Always specify the complete nameplate data of the switch.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description, and this bulletin number.
3. Standard hardware, such as screws, bolts, nuts, washers, etc., is not listed in this bulletin. Such items should be purchased locally.
4. For prices, refer to the nearest office of the General Electric Company.

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CONNECTICUT
- • • (Southington) Plantsville 06479 . . . . . 370 Atwater St.

FLORIDA
- • • Jacksonville 32203 . . . . 2020 W. Beaver St.
- • (Miami) Hialeah 33010. . . 1062 East 28th St.
- • • Tampa 33601 . . . . . 19th & Grant Sts.

GEORGIA
- • (Atlanta) Chamblee 30341 . . . . . 5035 Peachtree Industrial Blvd.
- • Atlanta . . . . . 2379 John Glenn Dr.

ILLINOIS
- • • Chicago 60638 . . . . 6045 S. Nottingham Ave.

INDIANA
- • Evansville 47711 . . . 401 N. Congress Ave.
- • Ft. Wayne 46803. . . . . 1731 Edsall Ave.
- • Hammond 46320 . . . . . 1138 164th Place
- • • Indianapolis 46222 . . . 1740 W. Vermont St.

IOWA
- • (Davenport) Bettendorf 52722 . 1025 State St.

KENTUCKY
- • Louisville 40209. . . . 3900 Crittenden Drive

LOUISIANA
- • Baton Rouge 70814 . . . 10955 North Dual St.
- • • New Orleans 70114 . . . . 1115 DeArmas St.

MARYLAND
- • • Baltimore 21230. . . . . 920 E. Fort Ave.

MASSACHUSETTS
- • • △ (Boston) Medford 02155 . . . . . 3960 Mystic Valley Pkwy.

MICHIGAN
- • • △ (Detroit) Riverview . . . . 18075 Krause Ave.
- • Flint 48505 . . . . . 1506 E. Carpenter Rd.

MINNESOTA
- • Duluth 55807 . . . 50th Ave. W & St. Louis Bay
- • • Minneapolis 55430 . . . . 3025 49th Ave., N.

MISSOURI
- • • Kansas City 64120. . . . . 3525 Gardner Ave.
- • • St. Louis 63110 . . . . . 1115 East Rd.

NEW JERSEY
- • New Brunswick 08902 . . . . . 3 Lawrence St.

NEW MEXICO
- • Albuquerque 87109 . . . 4420 McLeod Rd. NE

NEW YORK
- • Albany 12205 . . . . . 1097 Central Ave.
- • • (Buffalo) Tonawanda 14150 . . 175 Milens Rd.
- • (Long Island) Old Bethpage 11804 . . . . . 183 Bethpage-Sweet Hollow Rd.
- • (New York City) North Bergen, N. J. 07012 . . . . . 6001 Tonnelle Ave.
- • (New York City) Clifton, N. J. 07012 . . . . . 9 Brighton Rd.
- • △ Schenectady 12305 . . . . . 1 River Rd.
- • Syracuse 13208. . . . 1015 E. Hiawatha Blvd.

NORTH CAROLINA
- • • Charlotte 28208 . . . . . 2328 Thrift Rd.

OHIO
- • Akron (Canton) 44720 . . . . . 7900 Whipple Ave. N.W.
- • • Cincinnati 45202. . . . . 444 West 3rd St.
- • • △ Cleveland 44125 . . . . . 6477 East 49th St.
- • Columbus 43229 . . . . . 6660 Huntley Rd.
- • • Toledo 43605 . . . . . 405 Dearborn Ave.
- • Youngstown 44507. . . . 272 E. Indianola Ave.

OKLAHOMA
- • Tulsa 74145. . . . . 5220 S. 100th East Ave.

OREGON
- • Eugene 97402 . . . . . 570 Wilson St.
- • • Portland 97210 . . . . . 2727 NW 29th Ave.

PENNSYLVANIA
- • Allentown 18103 . . . . . 668 E. Highland St.
- • (Delaware Valley) Cherry Hill, N.J. 08034 . . . . . 1790 E. Marlton Pike
- • Johnstown 15902 . . . . . 841 Oak St.
- • Philadelphia 19124 . . . 1040 East Erie Ave.
- • • (Pittsburgh) West Mifflin 15122 . . . . . 4930 Buttermilk Hollow Rd.
- • York 17403 . . . . . 54 N. Harrison St.

SOUTH CAROLINA
- • (Charleston) No. Charleston 29401 . . . . . 3490 Debonair St.

TENNESSEE
- • Knoxville 37914 . . . . . 2621 Governor John Sevier Hwy.
- • Memphis 38107. . . . . 708 North Main St.

TEXAS
- • Beaumont 77705 . . . . . 1490 W. Cardinal Dr.
- • Corpus Christi 78401 . . . . . 115 Waco St.
- • • Dallas 75235 . . . . . 3202 Manor Way
- • Houston 77036 . . . . 5534 Harvey Wilson Dr.
- • Houston 77036 . . . . . 6916 Harwin Dr.
- • Midland 79701 . . . . . 704 S. Johnston St.

UTAH
- • • Salt Lake City 84110 . . . 801 S. 7th West St.

VIRGINIA
- • • Richmond 23224 . . . . . 1403 Ingram Ave.
- • Roanoke 24013 . . . . . 1004 River Ave., SE

WASHINGTON
- • • Seattle 98134 . . . . . 3422 First Ave., South
- • Spokane 99211 . . . . . E. 4323 Mission St.

WEST VIRGINIA
- • • Charleston 25328 . . 306 MacCorkle Ave., SE

WISCONSIN
- • (Appleton) Menasha 54910 . . 1725 Racine St.
- • Milwaukee 53207 . . . 235 W. Oklahoma Ave.

• Electrical/Mechanical Service Shop • Instrumentation Shop △ Special Manufacturing Shop

GENERAL ELECTRIC COMPANY, PHILADELPHIA, PA.

Each cam has one number and seven letters around the shaft opening on one side of the cam and eight letters on the other side of the cam. When removing cams, mark the letter of the cam which corresponds to the shaft identification mark; thus cam and cam followers are removed in succession. This is done to each succeeding barrier.

When reassembling, it is only necessary to stack the cams back into the shaft in the same order as taken off, keeping the proper cam letter lined up with the shaft identification mark.

Before tightening the tie bolts into the front support, make sure that all the barriers are properly nested.

The parts which fit into the front support may now be assembled, placing the stops, if present, in their proper position with respect to the shaft identification mark.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of part wanted, and give complete nameplate data.

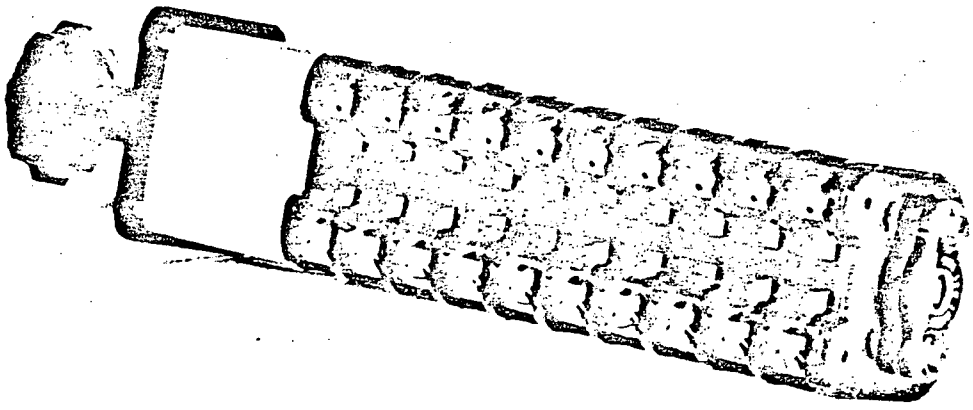


Fig. 3 (8027023)

Fig. 3 Bottom View of Type SBM Switch

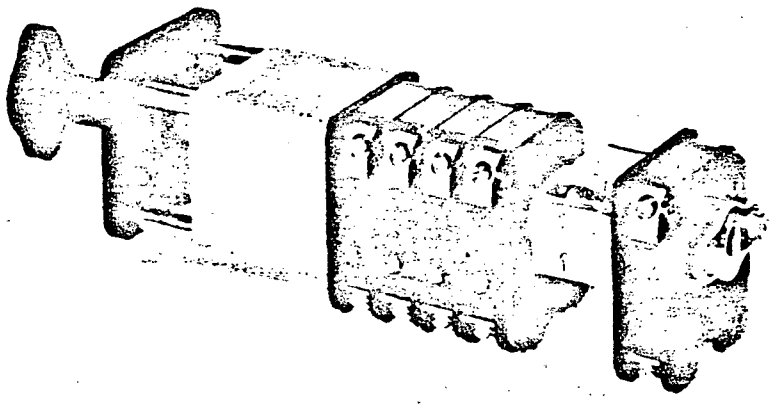


Fig. 4 (8027022)

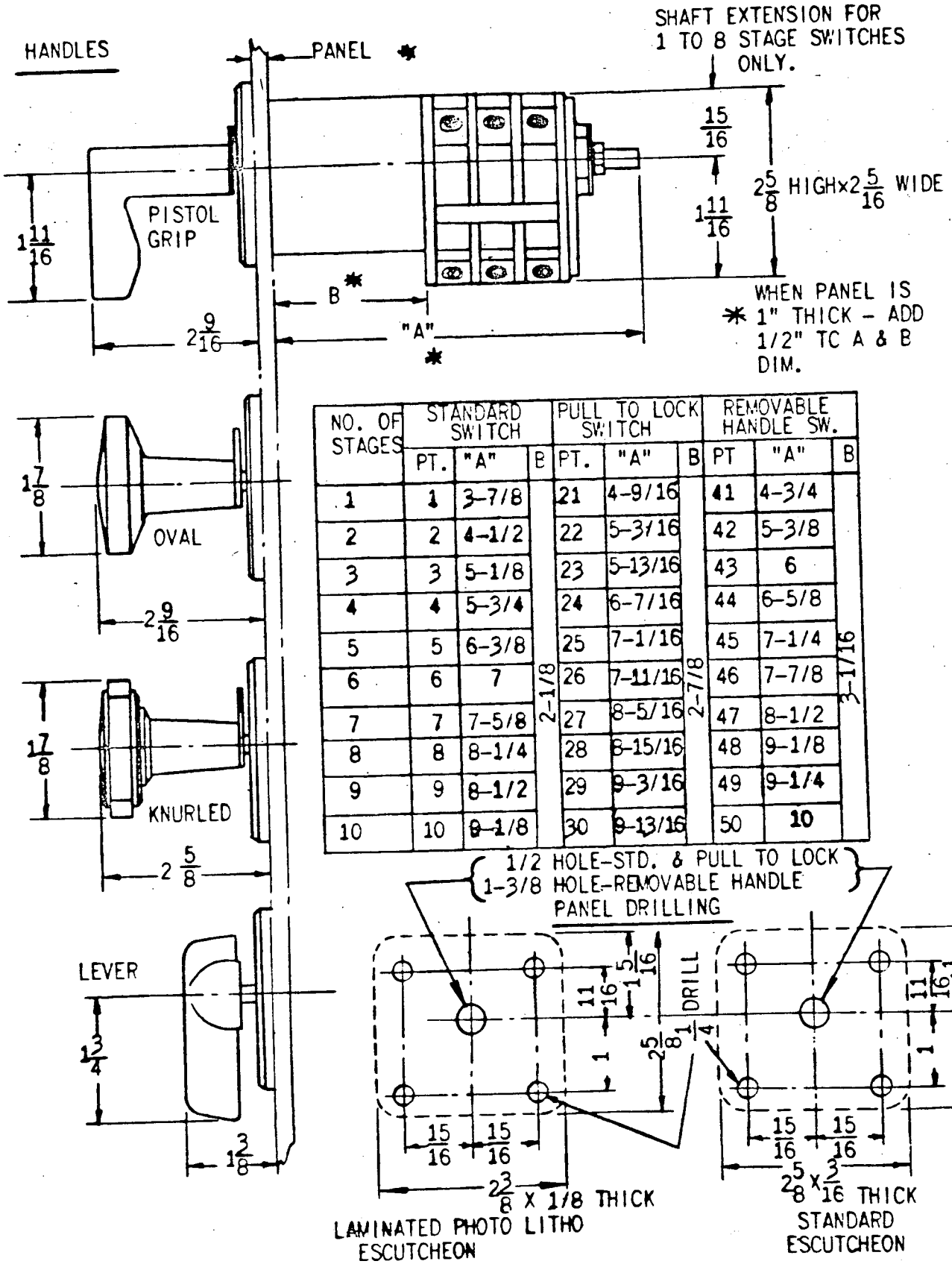
Fig. 4 View of Type SBM Switch with Additional Stage in Position

In such cases, it might be advantageous not to disturb the existing switch but to add directly to the present switch. In order to do this, the proper contact sequence should be ordered (no more than two stages) noting that this is for adding to an existing switch. These parts will be received assembled with a U-shaped bracked and a coupling with a square hole will also be received. Fig. 4 shows a Type SBM switch with an additional stage already in position.

To install these additional contacts, loosen the two tie bolts at the rear of the switch about 3/32 inch. Slide the loose bracket over the shaft and tie bolts so that the inner part of the bracket slot rests on the tie bolts between the tie bolts and nameplate. Tighten the tie bolts. Slide the coupling over the shaft extension on the present switch, then slide the shaft extension on the new barrier assembly into the coupling, keeping the shaft of the new contact barriers in the proper position to give the correct contact sequence corresponding to the handle position. This should cause the side holes in the two U-shaped brackets to line up. Fasten the brackets together with the hardware supplied.

If it is desired to disassemble the switch for any reason, the following procedure should be followed: Place an identifying mark on the handle end of shaft corresponding to a position on the escutcheon such as 12 O'clock. Remove the escutcheon. Remove the three screws fastening the front plate to the front support. If there are stops in the front support, the position relative to the shaft identification mark should be noted. Remove the stops, spacer and star wheel if they are present.

Unscrew the tie bolts and remove the front support. If any torsion springs are present, pull one tie bolt back far enough so that one arm of the torsion spring can be sprung away from the spring actuator. Remove the spring actuator, spring, and any spacers present. Remove the molded cover plate exposing the contacts of the first stage.



NO. OF STAGES	STANDARD SWITCH			PULL TO LOCK SWITCH			REMOVABLE HANDLE SW.		
	PT.	"A"	B	PT.	"A"	B	PT	"A"	B
1	1	3-7/8	2-1/8	21	4-9/16	2-7/8	41	4-3/4	3-1/16
2	2	4-1/2		22	5-3/16		42	5-3/8	
3	3	5-1/8		23	5-13/16		43	6	
4	4	5-3/4		24	6-7/16		44	6-5/8	
5	5	6-3/8		25	7-1/16		45	7-1/4	
6	6	7		26	7-11/16		46	7-7/8	
7	7	7-5/8		27	8-5/16		47	8-1/2	
8	8	8-1/4		28	8-15/16		48	9-1/8	
9	9	8-1/2		29	9-3/16		49	9-1/4	
10	10	8-1/8		30	9-13/16		50	10	

Fig. 2 (127A6779-6)

Fig. 2 Outline and Panel Drilling of Type SBM Switch

RATINGS

The switch is rated for a mechanical life of 00,000 operations. The electrical rating is 600 volts, 20 amperes continuous. The interrupting rating depends on several factors; namely, voltage, current and inductance of the circuit. It may be necessary to use two or more contacts in series to insure adequate interrupting ability on highly inductive circuits. The interrupting ratings are shown in Table I.

TABLE I

Circuit Voltage	Non-Inductive Cir.		Inductive Circuit	
	Number of Contacts			
	1	2(in ser)	1	2(in ser)
24 DC	10.0	30.0	8.0	25.0
48 DC	8.0	25.0	6.0	18.0
125 DC	5.0	15.0	4.0	10.0
250 DC	1.0	3.0	1.0	2.5
600 DC	0.4	0.8	0.3	0.7
115 AC	40.0	75.0	24.0	50.0
230 AC	25.0	50.0	12.0	25.0
460 AC	12.0	25.0	5.0	15.0
600 AC	10.0	20.0	8.0	12.0

CONSTRUCTION

The Type SBM switch is built up with a series of stages which are nested into each other, an operating shaft, a front support and a rear support.

The complete stack is tied together with two tie bolts threaded into the front support. These tie bolts also act as a bearing for the cam followers in each stage. Each stage consists of four stationary contacts and two moving contacts, (double break construction) two cams and two cam followers. The cams are mounted on the operating shaft. In case only one contact is required in a stage, a cam follower assembly is omitted.

CONTACT IDENTIFICATION

The contacts are marked for identification using a standard system. On each side of the switch midway on the barriers, is a confined marking strip. These strips are located between the two screws which define a contact. The marking strip on the right side, front view, looking toward the rear is numbered 1, 3, 5, etc. starting at the panel end. Those on the left side are marked 2, 4, 6, etc. If a contact is omitted the terminal screws are also omitted for that contact.

ENCLOSURES AND MOUNTING

The basic switch is totally enclosed except for an opening in the bottom to allow for a visual inspection of the contacts.

All switches are furnished for mounting in panels 3/32 to 1/4 inch thick. Variation in panel thickness is taken up by the use of two saddle washers mounted between the handle and escutcheon.

INSTALLATION

RECEIVING

Immediately upon receipt of a switch, examine it for any damage sustained in transit. If injury or rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office. The switches are completely assembled and packed in individual cartons before shipment.

If the switches are for stock purposes or not for immediate installation, they should be left in the shipping carton and stored in a clean dry location.

MOUNTING

For panel mounted switches, holes should be provided in the panel as shown in Fig. 2.

To mount a switch on a panel, first remove the handle and escutcheion, including where provided, the position-indicating pointer and the curved spring washers (saddle spring). Next, hold the switch in place on the back of the panel and insert the mounting screws through the escutcheon, panel, and spacers (if used) into the switch front support, but do not tighten the mounting screws. Attach the pointer, saddle springs and handle. Align the escutcheon on the panel.

When mounting removable-handle switches be certain that the shaft of the switch is properly positioned, so the handle is easily removed before the mounting screws are tightened.

MAINTENANCE

SERVICING

CONTACT CLEANING

At regular intervals, the switch contacts should be inspected for wear and burning. An opening at the bottom of the switch has been provided for this. (See Fig. 3) If the contacts are slightly pitted or coated with sulphide, they should be cleaned with a flexible burnishing tool similar to that included in the XRT relay tool kit.

REPAIR AND REPLACEMENT

In some cases, it is desirable to either replace a contact stage or to add an additional amount of contacts.

CONTROL AND TRANSFER SWITCH TYPE SBM

DESCRIPTION

INTRODUCTION

The Type SBM switches are cam operated devices having two mechanically and electrically separate contacts per stage. The switch is totally enclosed, having no cover. The contact terminals are brought out to the corners, allowing screw connections to be made over a large angle. The switch is so constructed so as to allow the addition of 1 or 2 extra stages to the switch with a minimum of effort.

APPLICATION

The Type SBM switches are intended primarily for the control of electrically operated devices such as circuit breakers, small motors and magnetic switches, and for the transfer of meters, instruments and relays.

OPERATION

The Type SBM switches are rotary cam operated switches. Rotation of the shaft causes contacts to open or close, depending upon the shape and setting of the cams. Each stage consists of two mechanically and electrically separate contacts. This is accomplished by means of two cams and two cam followers, assembled with moving contacts.

Each cam is constructed so as to have two operating surfaces. These surfaces operate on the cam follower. The cam follower has two tips which are located in offset horizontal planes lining up with the two cam operating surfaces. Thus, as the cam is rotated, one surface operates against the closing cam follower tip, while the opening cam follower tip is relieved. Both cam follower tips are always in contact with the cam surfaces. This allows for a positive closing and opening action not dependent upon springs.

Each cam follower has a spring loaded moving contact assembled to it. The compression spring acts to give adequate contact pressure when a contact is closed. The moving contact is held to the cam follower by a pin passing through a hole in the cam follower and angled slot in the moving contact. As the contacts close, the moving contact slides along this slot while compressing the spring thus causing relative motion or "wipe" between moving and stationary contacts.

Some applications, particularly of momentary contact switches, which have a torsion spring to return the switch to a central-neutral position, require a contact action which lags behind the switch motion (lost motion or slip contacts). Such contacts use cams with a special loose fit on the shaft. When the shaft has turned far enough tc close or open these contacts, it can be rotated 45 degrees in the reverse direction without moving the cams, but beyond this point, the cam moves with the shaft and the contacts either open or close as the case may be.

Momentary contact switches have a torsion spring that returns the switch to a central or neutral position when the handle is released after operation to a side position or positions. This torsion spring is designed for maximum of 90 degrees operation to each side of the central position. The torsion spring may have one end cut off or tied back in such a manner as to be effective on one side of the central position only. That is, the switch may have momentary contact to one side of the central position and maintaining contacts to the other side.

In some momentary contact (spring return) switches, a locking device is provided by which the shaft may be held against the action of the torsion spring by pulling out the handle when the switch is turned to one of the side positions.

POSITIONING

A detent wheel, mounted on the square shaft and acted upon by a spring loaded roller arm, gives positive positioning action to the switch.

REMOVABLE HANDLES

The removable handle option may be obtained with up to 3 keyways in the escutcheon. The keyway locations are at the discretion of the customer. The handle is removable in one position. Any style handle can be used for this operation.

ADD-A-STAGE

A shaft extension is provided to enable an additional stage to be coupled to the existing switch in the event that more contacts are required when the switch is in the hands of the customer.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

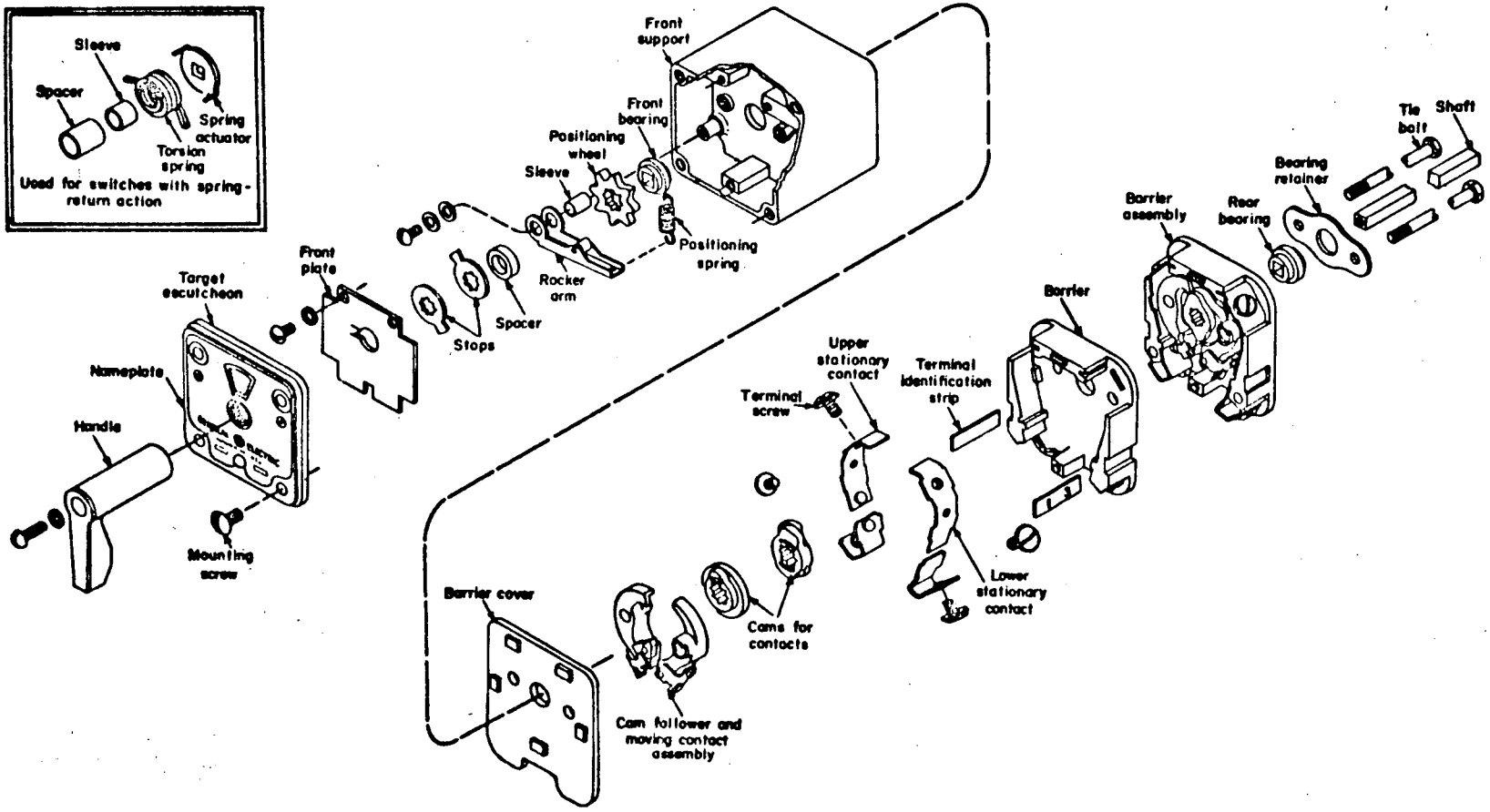
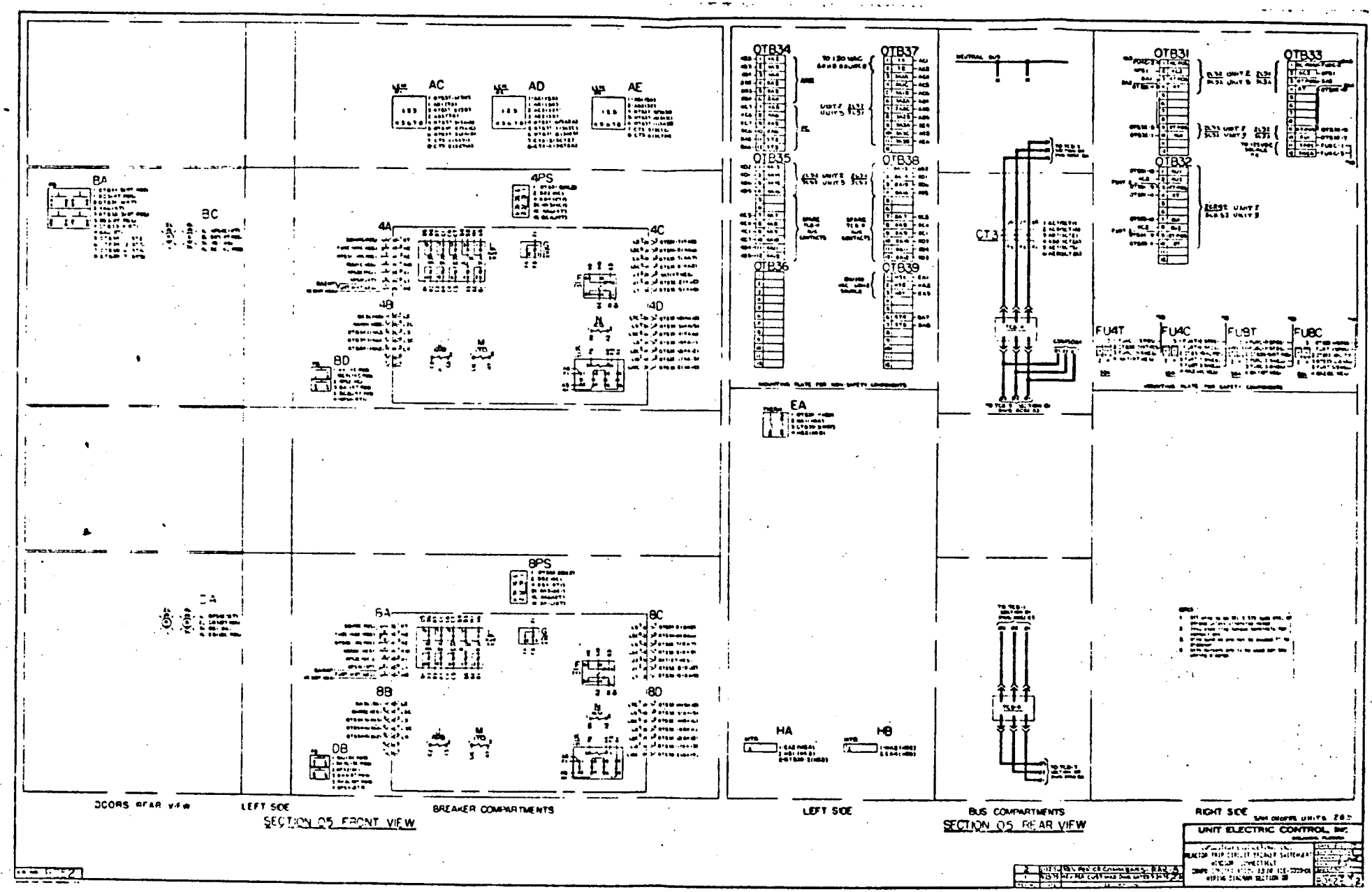


Fig. 1 Exploded View of Type SBM Switch

Fig. 1 (8913283)

Cover (8027024)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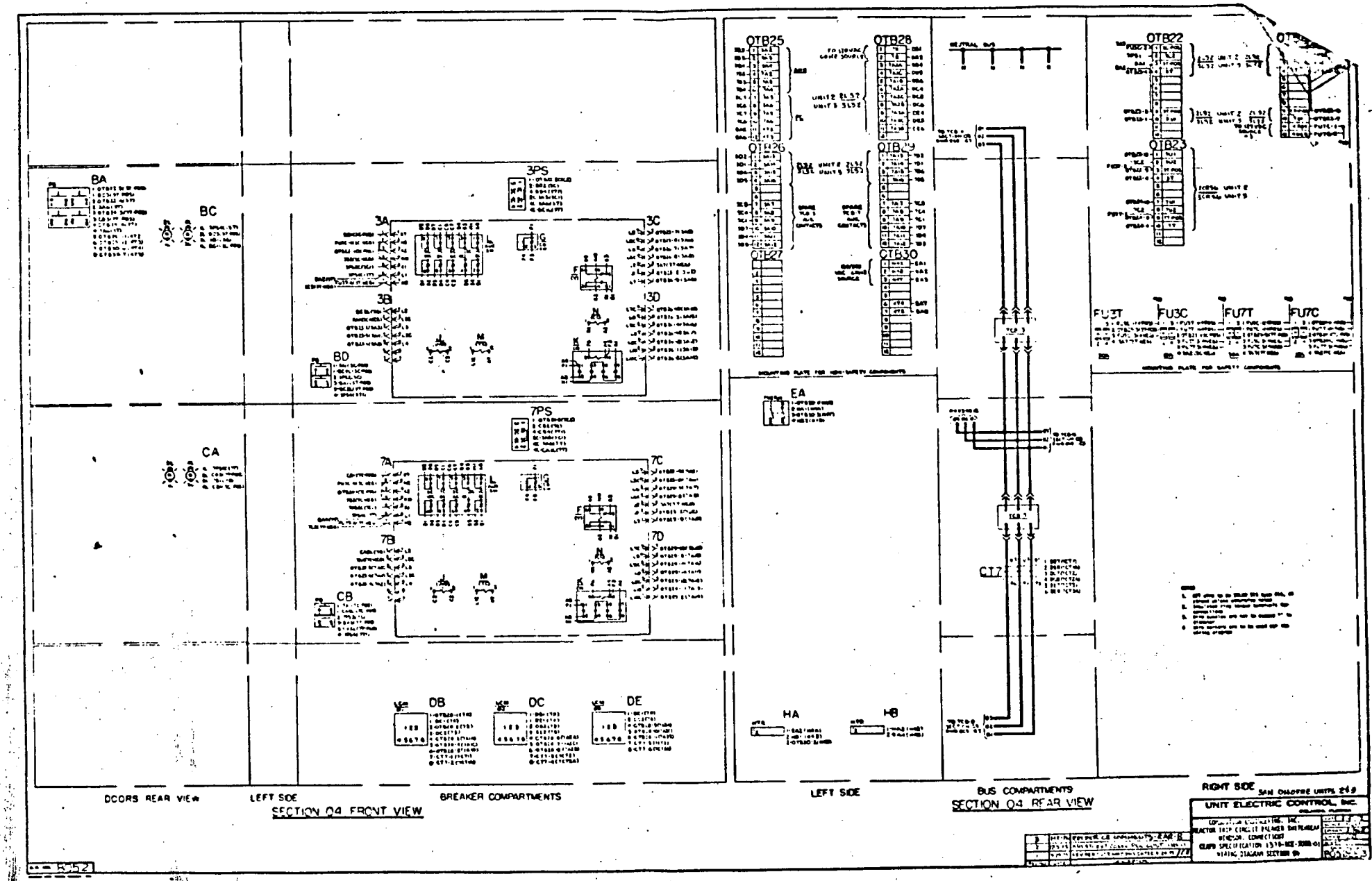
EA
HA
HB
OTB34
OTB37
OTB35
OTB38
OTB36
OTB39
OTB31
OTB33
OTB32
CT3
FU4T
FU4C
FU8T
FU8C
DOORS REAR VIEW
LEFT SIDE
BREAKER COMPARTMENTS
SECTION 05 FRONT VIEW
LEFT SIDE
BUS COMPARTMENTS
RIGHT SIDE
SECTION 05 REAR VIEW
UNIT ELECTRIC CONTROL INC.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OTB29
OTB27
OTB30
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DOORS REAR VIEW
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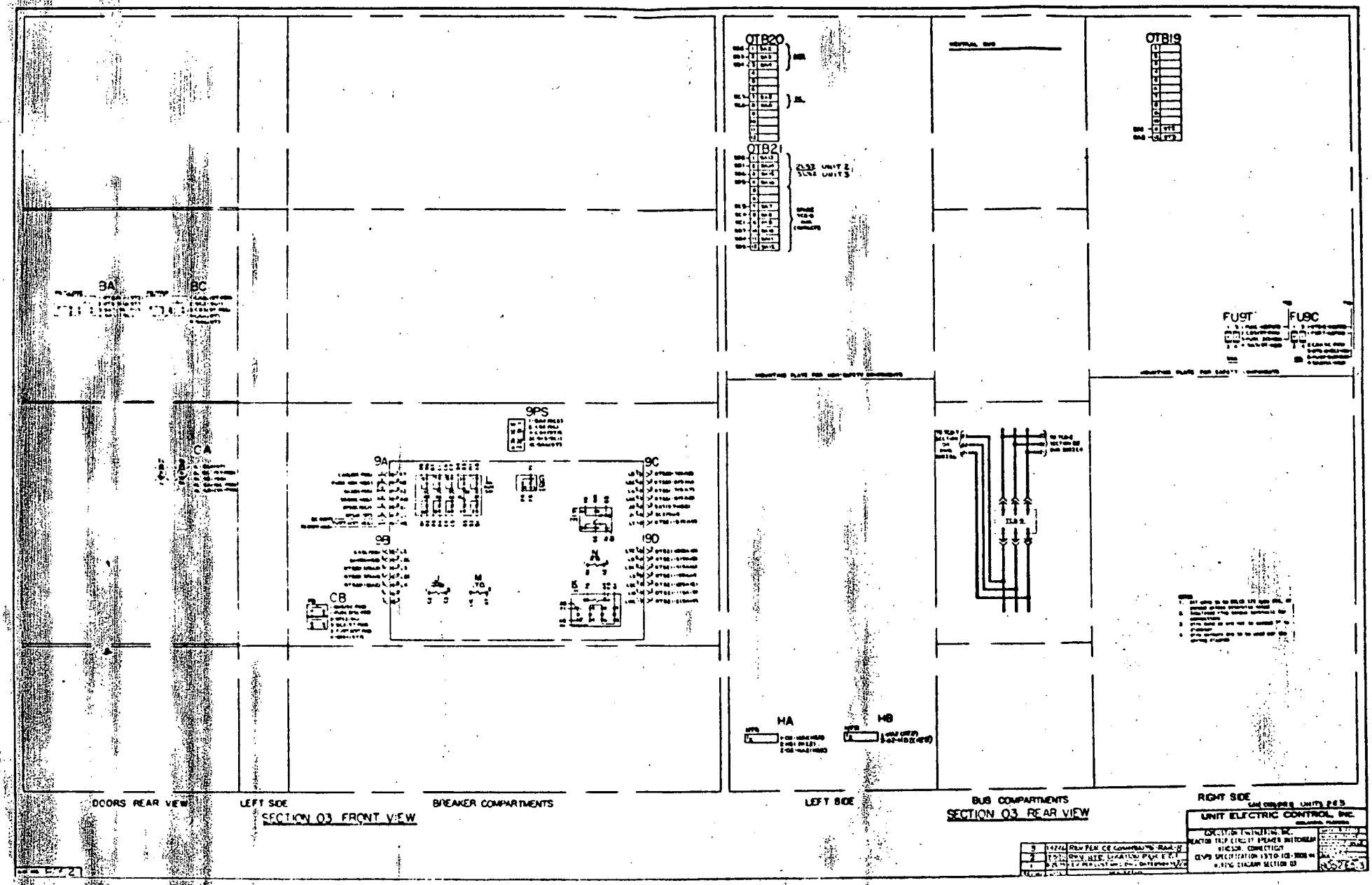
SECTION 04 REAR VIEW
UNIT ELECTRIC CONTROL, INC.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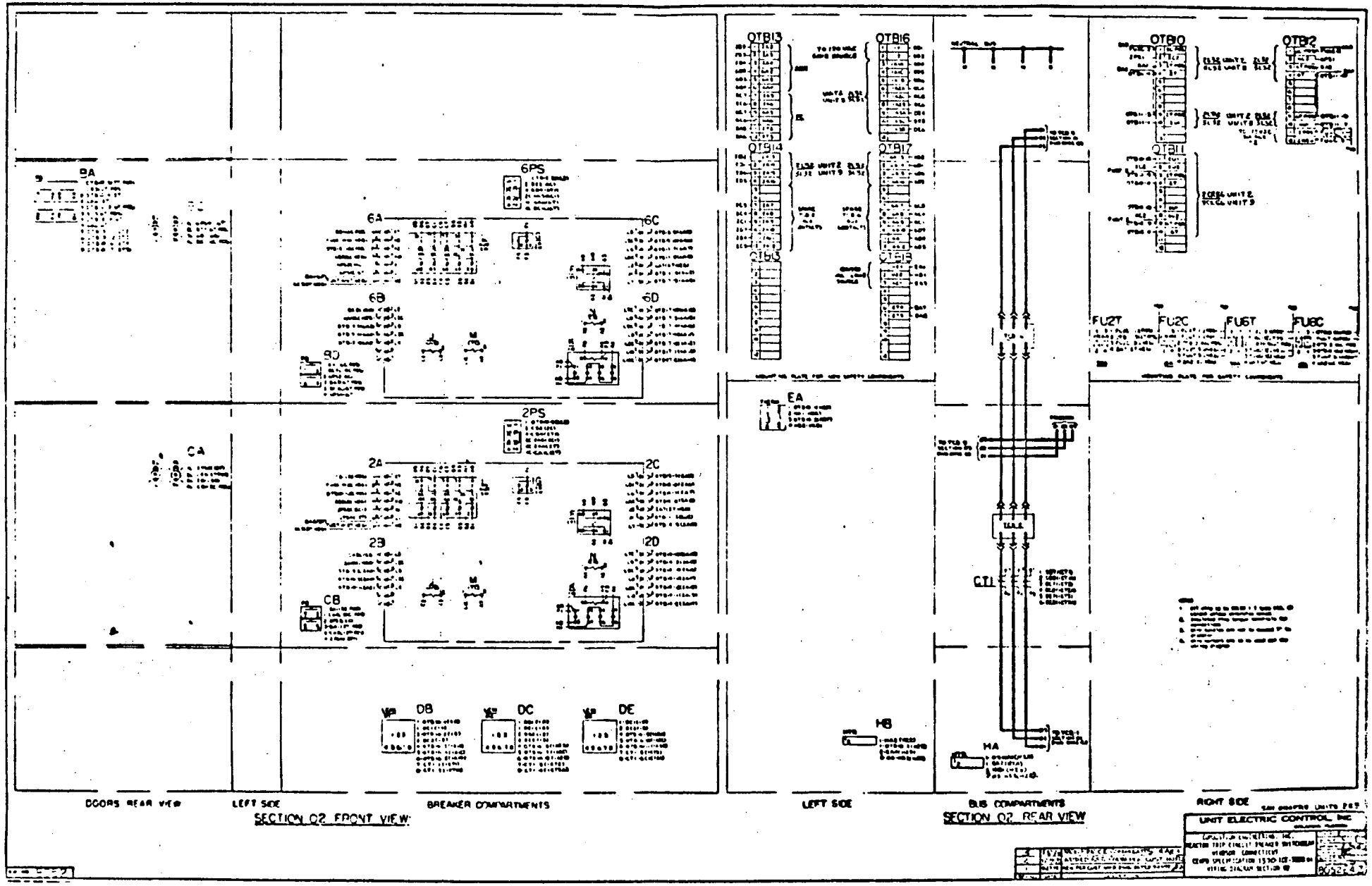
SECTION 03 REAR VIEW
UNIT ELECTRIC CONTROL, INC.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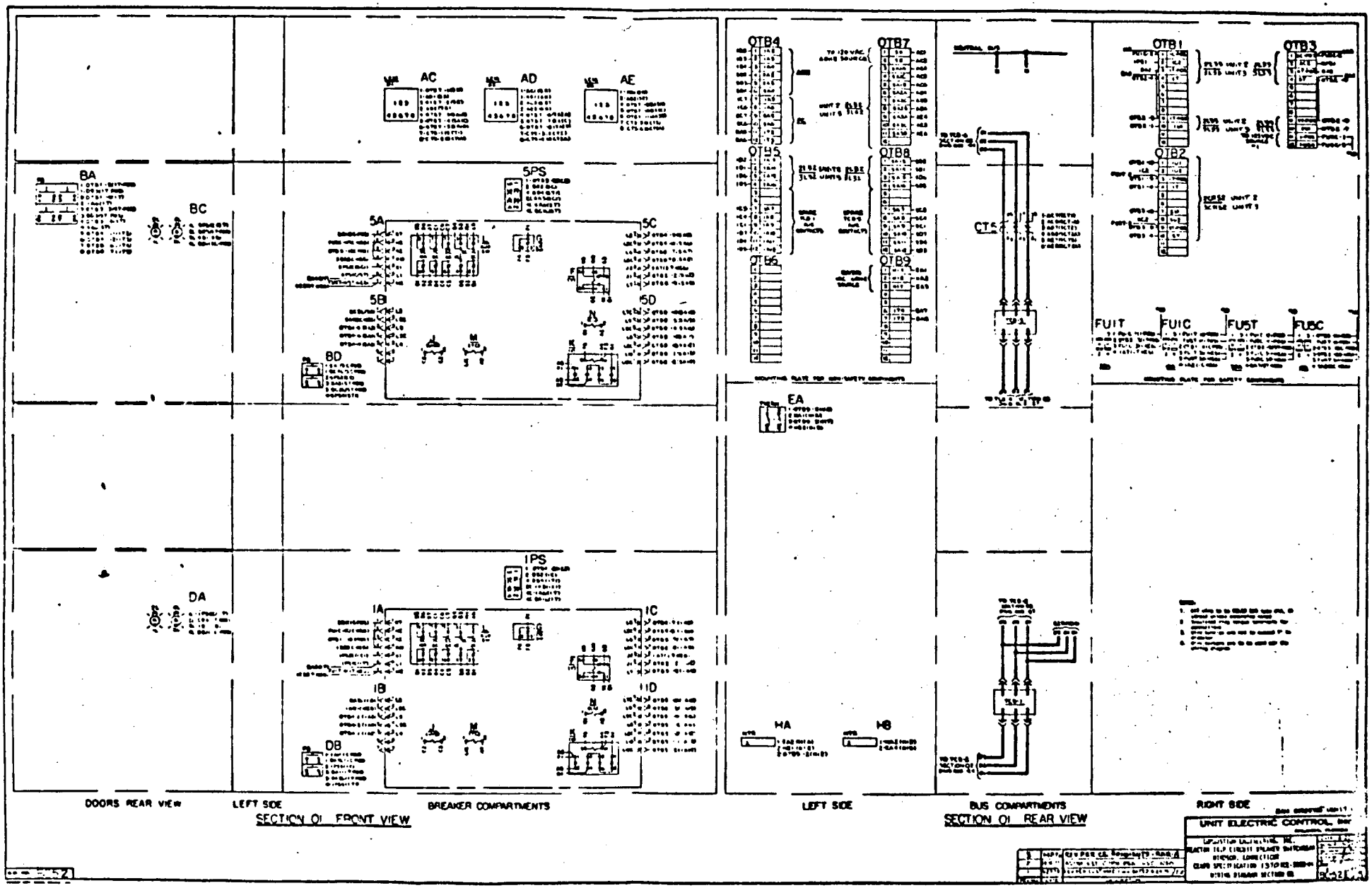
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FU5T
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DOORS REAR VIEW
LEFT SIDE
BREAKER COMPARTMENTS
SECTION 01 FRONT VIEW
LEFT SIDE
BUS COMPARTMENTS
RIGHT SIDE
SECTION 01 REAR VIEW
UNIT ELECTRIC CONTROL

MAINTENANCE INSTRUCTIONS

1. Low Current Monitors - no maintenance required. Check operation per System Operational Test when circuit breakers are tested.

2. Thermostats - no maintenance required. Check operation at regular intervals.

3. Circuit Breakers - maintenance should be performed per G.E. instructions GEK-7302B page 9 and GEI-50299B pages 5 and 6.

4. Position Switches - maintenance should be performed per G.E. instructions GEH-2038A page 4.

5. Test Switch - maintenance should consist of a visual check of the contacts at regular intervals for pitting or traces of sulfide. Cleaning with a burnishing tool is recommended.

6. Micro-Switch Pushbuttons - no maintenance required.

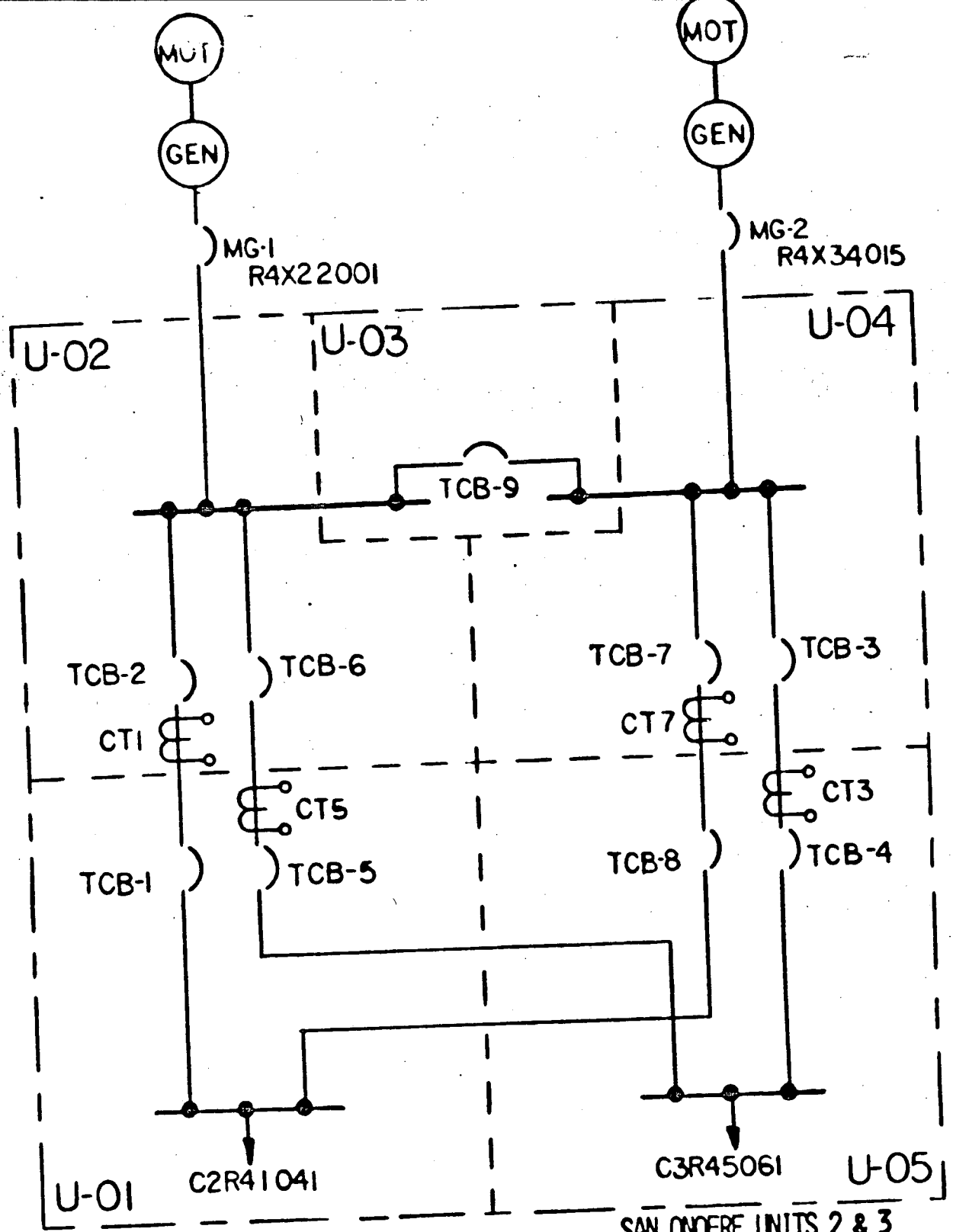
7. Indicating Lights - visual check for lamp or resistor failure at regular intervals.

8. Fuse Blocks - visual inspection for physical damage or corrosion at regular intervals.

9. Heaters - see thermostat listing.

RECOMMENDED SPARE PARTS

ITEM	RECOMMENDED STOCK
American Aerospace Controls Model S105-850 Current Level Controller. . .	1 complete assembly
Dayton Electric Manufacturing Company Model 2E174 Thermostat	1 complete assembly
General Electric Type AK-25.	See Renewal Parts Bulletin No. GEF-4149F
General Electric Type SBM Switch	See Renewal Parts Bulletin No. GEF-4167A
General Electric Type CR-2943 Switch.	1 complete assembly
Micro Switch Type PTP Switch	1 complete assembly
General Electric Type ET-16 Lamp.	2 complete assemblies (1 red & 1 green lamp) 10 #1835 bulbs 10 2000 OHM resistors
General Electric Type 8421-3 Fuse Block	2 fuse blocks 5 NON30 fuses 5 NON10 fuses
Chromalox Type OT-1025 Space Heater.	1 complete assembly
Buchanan 600V Terminal Block	1 complete assembly



SAN ONOFRE UNITS 2 & 3

REVISIONS	UNIT ELECTRIC CONTROL ORLANDO, FLORIDA
DATE	DATE 1-28-76
DATE	SCALE NH
DATE	DRAWN TH
DATE	APPROVED
8052-A1.0	

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION 1370-ICE-3008
ONE LINE DIAGRAM

CHART #2

TEST		SECTION 01			SECTION 02			SECTION 04			SECTION 05		
		PHASE 1	PHASE 2	PHASE 3	PHASE 1	PHASE 2	PHASE 3	PHASE 1	PHASE 2	PHASE 3	PHASE 1	PHASE 2	PHASE 3
a.1	X	OTB7-1	OTB7-1	OTB7-1	OTB16-1	OTB16-1	OTB16-1	OTB28-1	OTB28-1	OTB28-1	OTB37-1	OTB37-1	OTB37-1
	Z	OTB7-2	OTB7-2	OTB7-2	OTB16-2	OTB16-2	OTB16-2	OTB28-2	OTB28-2	OTB28-2	OTB37-2	OTB37-2	OTB37-2
a.2	a	OTB7-3	OTB7-6	OTB7-9	OTB16-3	OTB16-6	OTB16-9	OTB28-3	OTB28-6	OTB28-9	OTB37-3	OTB37-6	OTB37-9
	c	OTB7-4	OTB7-7	OTB7-10	OTB16-4	OTB16-7	OTB16-10	OTB28-4	OTB28-7	OTB28-10	OTB37-4	OTB37-7	OTB37-10
	b	OTB7-5	OTB7-8	OTB7-11	OTB16-5	OTB16-8	OTB16-11	OTB28-5	OTB28-8	OTB28-11	OTB37-5	OTB37-8	OTB37-11

CHART #3

TEST		SECTION 1	SECTION 2&3	SECTION 4	SECTION 5
b.1	X	OTB9-1	OTB18-1	OTB30-1	OTB39-1
	Z	OTB9-2	OTB18-2	OTB30-2	OTB39-2
	Y	OTB9-3	OTB18-3	OTB30-3	OTB39-3

CHART NO. 1

EST		TCB-1	TCB-2	TCB-3	TCB-4	TCB-5	TCB-6	TCB-7	TCB-8
a.1	T/P/	OTB1-9	OTB10-9	OTB22-9	OTB31-9	OTB3-9	OTB12-9	OTB24-9	OTB33-9
	U1	OTB1-10	OTB10-10	OTB22-10	OTB31-10	OTB3-10	OTB12-10	OTB24-10	OTB33-10
a.2	U1	OTB2-1	OTB11-1	OTB23-1	OTB32-1	OTB2-7	OTB11-7	OTB23-7	OTB32-7
	U2	OTB2-2	OTB11-2	OTB23-2	OTB32-2	OTB2-8	OTB11-8	OTB23-8	OTB32-8
b	C/P/	OTB1-1	OTB10-1	OTB22-1	OTB31-1	OTB3-1	OTB12-1	OTB24-1	OTB33-1
	C2	OTB1-2	OTB10-2	OTB22-2	OTB31-2	OTB3-2	OTB12-2	OTB24-2	OTB33-2
c	/P/	OTB3-11	OTB12-11	OTB24-11	OTB33-11	OTB3-11	OTB12-11	OTB24-11	OTB33-11
	/N/	OTB3-12	OTB12-12	OTB24-12	OTB33-12	OTB3-12	OTB12-12	OTB24-12	OTB33-12
g.3	T/P/	OTB2-3	OTB11-3	OTB23-3	OTB32-3	OTB2-9	OTB11-9	OTB23-9	OTB32-9
	T	OTB2-4	OTB11-4	OTB23-4	OTB32-4	OTB2-10	OTB11-10	OTB23-10	OTB32-10
g.4	T/P/	OTB1-3	OTB10-3	OTB22-3	OTB31-3	OTB3-3	OTB12-3	OTB24-3	OTB33-3
	T	OTB1-4	OTB10-4	OTB22-4	OTB31-4	OTB3-4	OTB12-4	OTB24-4	OTB33-4

C. MISCELLANEOUS TESTS

1. The following tests are provided to insure proper operation of the low current monitor and heater circuits. OTB points for each test are shown on chart #2. Wire numbers are prefixed with the circuit number. Heater circuit wire numbers are prefixed with an H then the section number. OTB points for heater circuits are shown on chart #3.

   a. Low current monitors

      a.1 Connect a variable A.C. current source 0-25 AMPS on the phase one bus across the current transformer. Connect 120V AC to OTB points as indicated.

      a.2 With 25 AMPS passing through the bus, use a bell or buzzer to check the mode of the contacts from the black box on the OTB points as indicated.

      a.3 Slowly lower the current with the bell or buzzer connected. The mode of the contacts will change within the 20 to 4 AMP range. Set the drop-out of the monitor for 10 AMPS.

      a.4 Repeat tests a.2 and a.3 for phase 2 and phase 3 current monitors.

      a.5 Repeat steps a.1 through a.4 on all twelve low current monitors.

   b. Heater Circuits

      b.1 Turn the thermostat down to 60°. Connect 208/120V AC single phase power with 0-5 AMP ammeters in the X and Y legs to the OTB's as indicated on chart #3.

      b.2 Turn the thermostat up slowly. At approximately 75°, the ammeters should indicate about .55 AMPS each for heater circuits in sections 1, 4 & 5. Sections 2 & 3 heater circuit ammeters should indicate about 1.1 AMPS.

g.4 Momentarily jumper OTB points as indicated. Breaker will trip on simulated closing of the remote K relay contact by energizing the trip coil. Remove jumper completely after test.

h. Trip the breaker using the "Emergency Trip" pushbutton.

i. With the breaker in the test position, trip and close the breaker using the "Test" trip and close pushbuttons.

j. With the breaker closed, attempt to rack it in. It should not rack in.

B. CIRCUIT BREAKER TCB-9

1. Breaker shall be in the operating position and in the tripped mode. OTB points for the tests are shown below. Wire numbers are prefixed with the breaker number, i.e. 9C/P/, 9C2, etc.

a. Connect 125V DC to OTB points /P/ & /N/, OTB12-11/P/ and OTB12-12/N/. The green light should come on. Push the close button. Breaker will close.

b. Perform test A.1.d from section A.

c. Perform test A.1.e from section A.

d. Perform test A.1.f from section A.

e. Tripping Operations. After each trip operation, close the breaker using test a.

e.1 Install a jumper between BC1 & BC2 in section 03. Trip the breaker by means of the trip button located on the door of compartment B, section 03. This test trips the breaker electrically through the trip coil. Remove the jumper.

e.2 Remove the two wires on BC4 and connect them together. Push the trip button on the door. Breaker will trip by means of the undervoltage device. Reconnect these wires.

f. Perform test A.1.i.

g. Perform test A.1.j.

SAN ONOFRE UNITS 2 & 3

SYSTEM OPERATIONAL TEST

A. CIRCUIT BREAKERS TCB-1 THRU TCB-8

1. Breakers shall be in the operating position and in the tripped mode. The breakers can be tested in the following sets; TCB-1 & TCB-5, TCB-2 & TCB-6, TCB-3 & TCB-7 and TCB-4 & TCB-8. OTB points for each breaker test are shown on chart #1. Wire numbers are prefixed with the breaker number, i.e. 1C/N/, 1C2, etc. for TCB-1.

   a. Install jumpers on OTB points T/P/ & U1 for a.1 & U1 & U2 for a.2

   b. Connect a normally open, momentary contact pushbutton or switch between OTB points C/P/ and C2.

   c. Connect 125V DC to OTB points /P/ and /N/. Green light should come on. When the pushbutton in part b is depressed, the breaker will close. When this operation is completed, do not disconnect the pushbutton. It will be used for test g.

   d. When the red light comes on indicating the breaker is closed for test c, verify this closing indication by using a bell or buzzer to ring through the primary contacts. With a bell or buzzer check auxiliary switch contacts 3-3c through 10-10c for mode; odd number contacts should be closed and even number ones open. Do not buzz 1-1c nor 2-2c, since these are hot contacts and proper operation is verified by the red and green lights coming on.

   e. Trip the breaker by means of the trip button located on the breaker. Re-check auxiliary switch contacts 3-3c through 10-10c for mode; odd number contacts should be open and even number ones closed. Do not buzz 1-1c nor 2-2c.

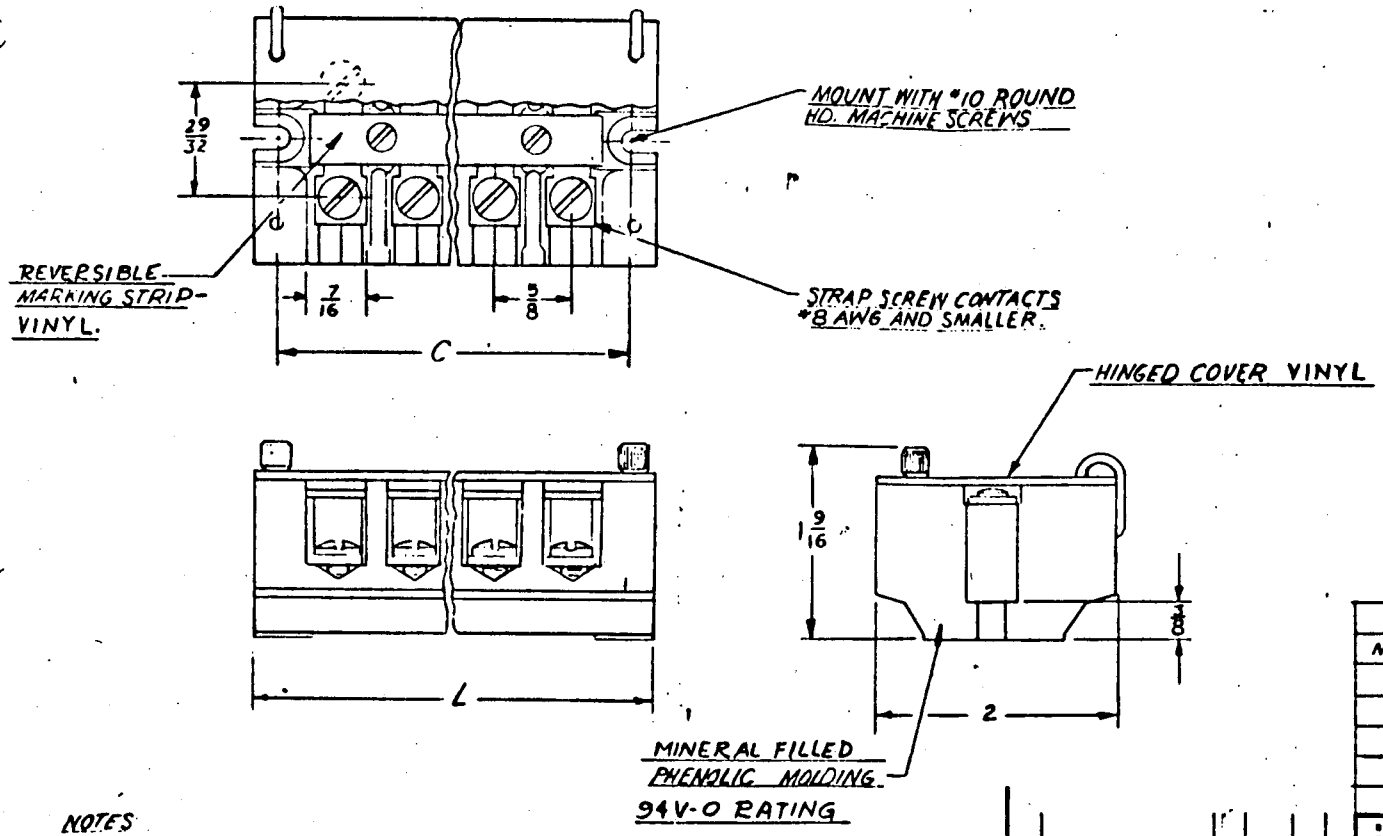
   f. Close the breaker using the maintenance operating device. Attempt to rack it out. It should not come out.

   g. Tripping Operations. After each trip operation, close the breaker using test c.

      g.1 Disconnect jumper installed in test a.1. Breaker will trip on this simulated opening of the remote K relay contact by dropping out the undervoltage device. Reinstall jumper after test.

      g.2 Disconnect jumper installed in test a.2. Breaker will trip on this simulated opening of the remote MT pushbutton by dropping out the undervoltage device. Reinstall jumper after test.

      g.3 Momentarily jumper OTB points as indicated. Breaker will trip on simulated closing of remote MT pushbutton by energizing the trip coil. Remove jumper completely after test.



NOTES

1. ALL DIMS FOR REFERENCE ONLY.

BLOCK DIMENSIONS		INCHES	
NO OF CIRCUITS	ASSY. NO.	C	L
2	616503-1	1-5/8	2
4	616508-2	2-7/8	3-1/4
6	616508-3	4-1/8	4-1/2
8	616509-4	5-3/8	5-3/4
12	616508-6	7-7/8	8-1/4

REV	DESCRIPTION	BY	DATE	ENG	APD
A	REVISED NOTE 2 ON PRINTS NOT ASSEMBLED. REMOVED WHITE DOTS.		5-6-71		

REVISIONS

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED DIM'S ARE IN INCHES. TOLERANCES: DEC. ± .005 FRACT ± 1/16 ANG. ± 1°
CASTING ± FORGING ±

SCALE FULL | ASSY NO | CAT. NO

MATERIAL:

HEAT TREAT: BUCHANAN SPEC. NO. TYPE

FINISH: BUCHANAN SPEC. NO. TYPE

DRG CHECK DATE 5-5-71
CH DATE
ENGR DATE
APPD DATE

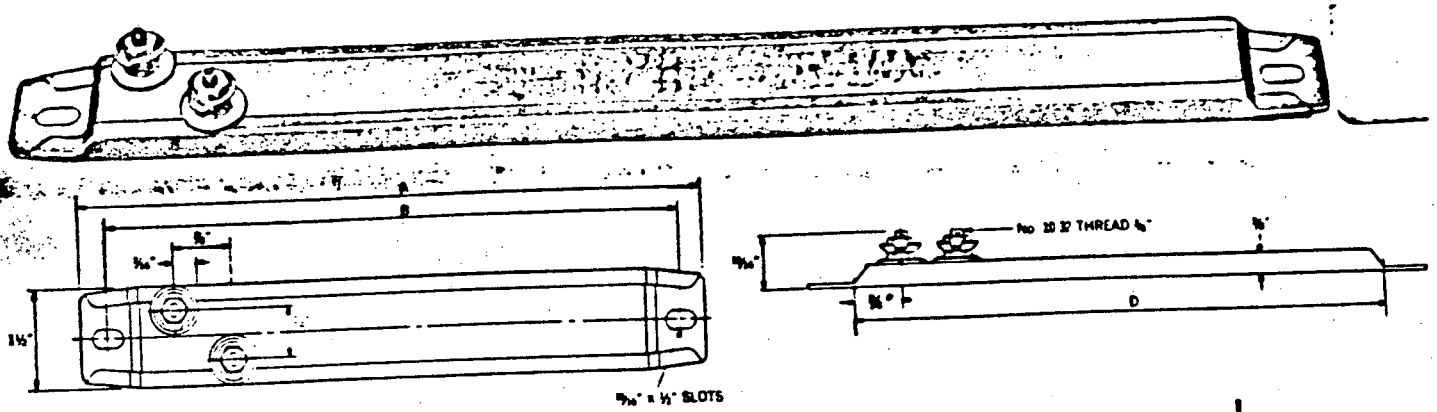
BUCHANAN ELECTRICAL PRODUCTS CORP.
UNION, N.J.

TITLE ONE PIECE TERMINAL BLOCK 94V-0 RATED

SIZE B | DWG. NO. C-616508 | REV A

3-22-76

TYPE OT 1½" wide



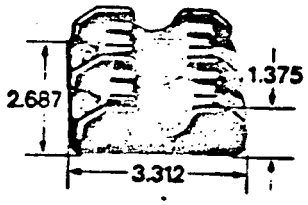
DIMENSIONS—Inches A Overall Length	B Mtg Hole Center	D Without Mtg Tabs	RUST-RESISTING IRON SHEATH See pg. 6 for max. sheath and work temp. Volts	Watts	Watts Per Sq In.	Catalog Number	Product Code No. (PCN)	CHROME STEEL SHEATH See pg. 6 for max. sheath and work temp. Volts	Watts	Watts Per Sq In.	Catalog Number	Product Code No. (PCN)	Approx. Net Wt Lbs
7½	6½	6	120	150	11	OT-715	129314	120	200	15	OT-702	129613	.50
			240	150	11	OT-715	129322	240	200	15	OT-702	129621	.50
8	7	6½	120	150	10	OT-815	129330	120	250	17	OT-802	129630	.56
			240	150	10	OT-815	129349	240	250	17	OT-802	129648	.56
			120	175	12	OT-817	129357	120	400	27	OT-804	129656	.56
			240	175	12	OT-817	129365	240	400	27	OT-804	129664	.56
10½	9½	9	120	250	10	OT-1025	129373	120	350	15	OT-1003	129672	.75
			240	250	10	OT-1025	129381	240	350	15	OT-1003	129680	.75
			...	...	..	.....	.....	120	400	17	OT-1004	129699	.88
			...	...	..	.....	.....	240	400	17	OT-1004	129701	.88
12	11	10½	120	250	8	OT-1225	129390	120	250	8	OT-1202	129710	.88
			240	250	8	OT-1225	129402	240	250	8	OT-1202	129728	.88
			...	...	..	.....	.....	120	350	14	OT-1203	129736	.88
			...	...	..	.....	.....	240	350	14	OT-1203	129744	.88
			...	...	..	.....	.....	120	500	17	OT-1205	129752	.88
			...	...	..	.....	.....	240	500	17	OT-1205	129760	.88
14	13	12½	120	300	8	OT-1430	129410	120	500	14	OT-1405	129779	1.0
			240	300	8	OT-1430	129429	240	500	14	OT-1405	129787	1.0
15¼	14¼	13¾	120	325	8	OT-1532	129437	120	500	12	OT-1505	129795	1.13
			240	325	8	OT-1532	129445	240	500	12	OT-1505	129808	1.13
17⅞	16⅞	16⅜	120	350	6.5	OT-1835	129453	120	500	10	OT-1805	129816	1.38
			240	350	6.5	OT-1835	129461	240	500	10	OT-1805	129824	1.38
			120	375	7	OT-1837	129470	120	750	15	OT-1807	129832	1.38
			240	375	7	OT-1837	129488	240	750	15	OT-1807	129840	1.38
			120	500	10	OT-1850	129496	120	1000	19	OT-1801	129859	1.38
			240	500	10	OT-1850	129509	240	1000	19	OT-1801	129867	1.38
19½	18½	18	120	350	6	OT-1935	129517	120	500	9	OT-1905	129875	1.5
			240	350	6	OT-1935	129525	240	500	9	OT-1905	129883	1.5
			120	500	8	OT-1950	129533	120	750	13.5	OT-1907	129891	1.5
			240	500	8	OT-1950	129541	240	750	13.5	OT-1907	129904	1.5
			...	...	..	.....	.....	120	1000	18	OT-1901	129912	1.5
			...	...	..	.....	.....	240	1000	18	OT-1901	129920	1.5
21	20	19½	120	500	8	OT-2150	129550	120	750	12	OT-2107	129939	1.63
			240	500	8	OT-2150	129568	240	750	12	OT-2107	129947	1.63
23¼	22¼	22¼	120	500	7	OT-2450	129576	120	500	7	OT-2405	129955	1.81
			240	500	7	OT-2450	129584	240	500	7	OT-2405	129963	1.81
			120	750	10	OT-2475	129592	120	750	10	OT-2407	129971	1.81
			240	750	10	OT-2475	129605	240	750	10	OT-2407	129980	1.81
			...	...	..	.....	.....	120	1000	14	OT-2401	129998	1.81
			...	...	..	.....	.....	240	1000	14	OT-2401	130008	1.81
			...	...	..	.....	.....	120	1500	19	OT-2415	129226	1.81
			...	...	..	.....	.....	240	1500	19	OT-2415	129234	1.81

Specify: Quantity, Catalog No., PCN, Volts, Watts, Strip Heaters. For additional features (page 6, available for Type OT, add: Without Mounting Tabs; Secondary Insulation Bushings—PCN 255716, Protective Terminal Cover—Catalog No. OT-AC-1, PCN 129242; Set of Two Ceramic Post Terminal Insulators—Part No. [illegible], PCN 259805.

CARTRIDGE FUSEHOLDERS 250 VOLTS

heavy-duty phenolic

Silver-plated fuse clips for better conductivity. Zinc-coated steel reinforcing springs for greater contact pressure on fuse. Terminal strip welded to fuse contacts. 7/16" brass terminal screws. Molded phenolic base. These heavy-duty fuseholders are larger and heavier and are not interchangeable with the standard-duty phenolic fuseholders. Use up to #10 round head machine screws for mounting. With barriers.

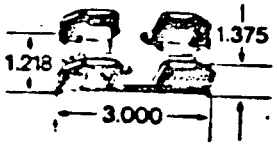


GE8452-J

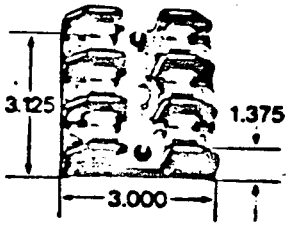
Cat. No.	pack std/ctn	description	amp rating
GE8451-J	50/5	single pole, black 3 5/16" long, 1 3/8" wide, 1 3/8" high	1 to 30
[illegible]2-J	50/5	double pole, black 3 5/16" long, 2 1/16" wide, 1 3/8" high	1 to 30
GE8453-J	50/5	triple pole, black 3 5/16" long, 3 1/16" wide, 1 3/8" high	1 to 30

standard-duty phenolic

Compact fuseholder line for tight quarters. Standard-duty one-piece fuse clips. For mounting use up to #10 round head machine screws. With barriers.



GE8411-J

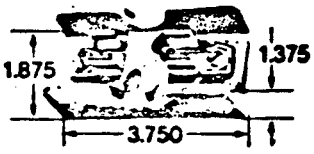


GE8431-J

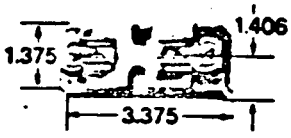
Cat. No.	pack std/ctn	description	amp rating
GE8411-J	50/5	single pole, black 3" long, 1 1/16" wide, 1 3/4" high	1 to 30
[illegible]-J	50/5	double pole, black 3" long, 2 1/2" wide, 1 3/8" high	1 to 30
GE8431-J	50/5	triple pole, black 3" long 3 1/8" wide, 1 3/8" high	1 to 30

standard-duty porcelain

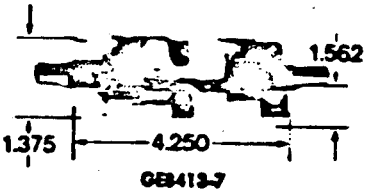
Heavy gray porcelain base fuseholders with and without barriers. Two piece standard-duty fuse clips. Use up to #10 round head machine screws.



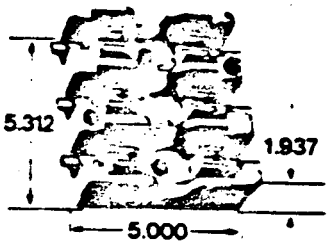
GE8412-J



GE8442-J



GE8413-J



GE8433-J

GE8423-J

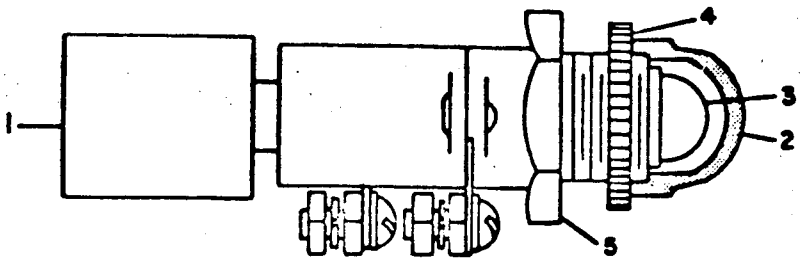
Cat. No.	pack std/ctn	description	amp rating
GE8412-J	50/5	single pole, with barriers, gray 3 1/4" long, 1 1/8" wide, 1 3/8" high	1 to 30
GE8442-J	50/5	single pole, without barriers, gray 3 1/8" long, 1 3/8" wide, 1 13/32" high	1 to 30
GE8413-J	50/5	single pole, gray porcelain 4 1/4" long, 1 3/8" wide, 1 5/16" high (add 1 1/2" to length for protruding lugs)	31 to 60
GE8423-J	25/1	double pole, gray porcelain 5" long, 3 1/8" wide, 1 13/16" high (add 13/16" to length for protruding lugs)	31 to 60
GE8433-J	10/1	triple pole, gray porcelain 5" long, 5 1/16" wide, 1 13/16" high (add 13/16" to length for protruding lugs)	31 to 60

FOR SCREW HOLE DIMENSIONAL DRAWINGS, SEE PAGE 114.

All devices on this page are listed by Underwriters' Laboratories, Inc.

Dimensional "lengths" given were measured parallel to orientation of the mounted fuse.

TYPE ET-16
INDICATING LAMPS



Indicating Lamp, Complete Assembly		* Resistor Reference No. 1		
Catalog No.	Rating, Volts	Catalog No.	Ohms, Total	Ohms, Tap
Lamps Operating At One Brilliancy				
721-0116B6708G1	24 D-C	721-0165A7844P1	10	--
G2	48 D-C	P2	200	--
G3	125 D-C	P3	2000	--
G4	250 D-C	P4	5100	--
G5	120 A-C	P5	1900	--
G6	240 A-C	P6	4800	--
Lamps With Tapped Resistor ("Dim-Bright" Operation)				
721-0127B8108G1	48 D-C	721-0165A9217P1	450	50
G2	125 D-C	P2	2550	1700
G3	250 D-C	P3	6000	4400
G4	120 A-C	P4	2450	1600
G5	240 A-C	P5	5700	4200

* Short circuit plug catalog 0165A7837G1 is substituted when resistor is omitted.

Color Cap, Reference No. 2		Lamp Bulb, Reference No. 3		Escutcheon, Reference No. 4
Catalog No.	Color	Catalog No.	Volts	Catalog No. 721-0165A7835
721-208A3768P1	†Clear	721-1819	§24	
P2	‡Red	721-1835	§all other	
P3	‡Green			
P4	‡Yellow			
P5	‡White			Locknut, Reference No. 5
P6	†Blue			
P7	†Amber			Catalog No. 721-0116B6709P11
P8	†Green			
P9	†Red			

†Transparent. ‡Translucent. §With proper resistor.

GENERAL ELECTRIC INSTALLATION AND SERVICE ENGINEERING OFFICES

FIELD SERVICE OFFICE CODE KEY
- * Mechanical & Nuclear Service
- † Electrical & Electronic Service
- ‡ Marine Service
- ‖ Transportation

FOR YOUR LASTING SATISFACTION . . . with the performance and availability of your General Electric equipment, GE provides this nationwide network of field service offices, serving utility, industrial, transportation and marine users. Qualified field engineers provide installation, start-up, employee training, engineering maintenance and other services, throughout the productive life of the equipment. For full information, call your nearest Installation & Service Engineering office.

ALABAMA
- † Birmingham 35205 . . . 2151 Highland Ave.
- *† ‡ Mobile 36609 . . . . . 1111 S. Beltline Highway

ALASKA
- † Anchorage 99501. . . . . 115 Whitney Rd.

ARIZONA
- *† Phoenix 85013 . . . . . 3550 N. Central Ave.
- † Tucson 85716. . . . . 151 S Tucson Blvd.

ARKANSAS
- † North Little Rock 72118. . . . . 120 Main St.

CALIFORNIA
- *† ‡ Los Angeles 90054 . . . . . 212 N. Vignes St.
- † Palo Alto 94303 . . . . . 960 San Antonio Rd.
- † Sacramento 95808. . . . . 3407 J St.
- † San Diego 92103 . . . . . 2560 First Ave.
- * ‡ San Francisco 94119 . . . 85 Hawthorne St.
- * Vernon 90058 . . . . . 3035 E. 46th St.

COLORADO
- *† Denver 80206. . . . . 901 University Blvd.

CONNECTICUT
- *† Meriden 06450 . . . . . 1 Prestige Dr.

FLORIDA
- † ‡ Jacksonville 32203 . . . . 4040 Woodcock Dr.
- † ‡ Miami 33134 . . . . . 4100 W. Flagler St.
- *† ‡ Tampa 33608 . . . . . 3104 S. Lois Ave.

GEORGIA
- *† ‡ Atlanta 30309 . . . . . 1860 Peachtree Rd., NW
- † ‡ Savannah 31405 . . . . . 5002 Paulsen St.

HAWAII
- *† ‡ Honolulu 96813. . . . . 440 Coral St.

ILLINOIS
- *† ‡ ‖ Chicago 60680 . . . . . 840 S. Canal St.

INDIANA
- † Evansville 47705 . . . 2709 Washington Ave.
- † Fort Wayne 46807 . . . . 3606 S. Calhoun St.
- *† Indianapolis 46207 . . . 3750 N. Meridian St.

IOWA
- † Davenport 52805 . . . P.O. Box 830, 1039 State St., Bettendorf

KENTUCKY
- † Louisville 40218 . . . . . 2300 Meadow Dr.

LOUISIANA
- † Baton Rouge 70806 . . . . . 8312 Florida Blvd.
- *† ‡ New Orleans 70125 . . . . 4747 Earhart Blvd.
- *† Shreveport 71104 . . . 3&0 Centenary Blvd.
- † Monroe 71201 . . . . . 1038 North 6th St.

MARYLAND
- *† ‡ Baltimore 21201. . . . . 1 N. Charles St.

MASSACHUSETTS
- *† ‡ Wellesley 02181 . . . . . 1 Washington St.

MICHIGAN
- *† ‡ Detroit 48202 . . . . . 700 Antoinette St.
- † Jackson 49201 . . . . . 210 W. Franklin St.
- † Saginaw 48607 . . . . . 1008 Second National Bank Bldg.

MINNESOTA
- † ‡ Duluth 55802 . . . . . 300 W. Superior St.
- *† ‡ Minneapolis 55416 . . . 1500 Lilac Drive So.

MISSOURI
- *† Kansas City 64106. . . . . 911 Main St.
- *† St. Louis 63101 . . . . . 1015 Locust St.

MONTANA
- † Butte 59701 . . . . . 103 N. Wyoming St.

NEBRASKA
- *† Omaha 68102 . . . . . 409 S. 19th St.

NEW JERSEY
- *† Millburn 07041. . . . . 25 E. Willow St.

NEW YORK
- † ‡ Albany 12205 . . . . 15 Computer Drive, West
- *† ‡ Buffalo 14205 . . . . . 625 Delaware Ave.
- *† ‡ ‖ New York 10022 . . . . . 841 Lexington Ave.
- * Rochester 14604 . . . . . 85 East Ave.
- *† ‡ Syracuse 13206 . . . . . 3532 James St.

NORTH CAROLINA
- *† ‡ Charlotte 28207 . . . . . 141 Providence Rd.
- * Wilmington Reigelwood 28456 . . . . . P.O. Box 186

OHIO
- *† Cincinnati 45206. . . . . 2621 Victory Pkwy.
- *† ‡ Cleveland 44104 . . . . . 1000 Lakeside Ave.
- † Columbus 43229 . . . . . 1110 Morse Rd.
- † ‡ Toledo 43606 . . . . . 3125 Douglas Rd.
- † Youngstown 44507. . . . . 872 Indianola Ave.

OKLAHOMA
- *† Oklahoma City 73106 . . . 2000 Classen Blvd.
- † Tulsa 74105 . . P.O. Box 7846, Southside Sta.

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- † Eugene 97401. . . . . 1170 Pearl St.
- *† ‡ Portland 97210. . . . . 2928 NW 29th Ave.

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- * Allentown 18102 . . . . . 1444 Hamilton St.
- *† ‡ Philadelphia 19102 . . . 3 Penn Center Plaza
- *† Pittsburgh 15222 . . . 300 6th Avenue Bldg.

SOUTH CAROLINA
- † ‡ Columbia 29204 . . . . . 2700 Middleburg Dr.
- † Greenville 29607. . 61 No. Pleasantburg Dr.

TENNESSEE
- *† Chattanooga 37411 . . . . . 5800 Bldg. Eastgate Center
- † Memphis 38130. . . . . 3385 Airways Blvd.

TEXAS
- *† Amarillo 79101 . . . . . 303 Polk St.
- *† ‡ Beaumont 77704 . . . . . 1385 Calder Ave.
- * ‡ Corpus Christi 78401. . 205 N. Chaparral St.
- *† Dallas 75222 . . . . 8101 Stemmons Freeway
- *† El Paso 79945 . . . . . 215 N. Stanton
- † Fort Worth 76102 . . . . . 409 W. Seventh St.
- *† ‡ Houston 77027 . . . . . 4219 Richmond Ave.
- † San Antonio 78204. . . . . 434 S. Main St.

UTAH
- † Salt Lake City 84111 . . 431 S. Third East St.

VIRGINIA
- * ‡ Newport News 23601 . . . . . 311 Main St.
- † ‡ Richmond 23230. . . . 1506 Willow Lawn Dr.
- † Roanoke 24015. . . . . 2018 Colonial Ave.

WASHINGTON
- *† ‡ Seattle 98188 . . . . . 112 Andover Park East, Tukwila
- † Spokane 99202 . . . . . E. 1805 Trent Ave.

WEST VIRGINIA
- *† Charleston 25328 . .906 MacCorkle Ave., SE

WISCONSIN
- * Appleton 54911. . . . 3003 West College Dr.
- † ‡ Milwaukee 53202 . . . . . 615 E. Michigan St.

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- • Mobile 36609 . . . . . 721 Lakeside Dr.

ARIZONA
- • (Phoenix) Glendale 85019 . 4911 W. Colter St.
- • Phoenix 85019 . . . . . 3840 W. Clarendon St.
- • Tucson 85713. . . . 2942 So. Palo Verde Ave.

CALIFORNIA
- • Los Angeles 90301 . . . . 6900 Stanford Ave.
- • (Los Angeles) Anaheim 92805 . . . . . 3601 E. LaPalma Ave.
- • (Los Angeles) Inglewood 90301 . . . . . 238 W. Florence Ave.
- • Sacramento 95814 . . . . . 98 North 17th St.
- *• (San Francisco) Oakland 94608 . . . . . 1650 34th St.

COLORADO
- *• Denver 80205. . . . . 9353 Larimer St.

CONNECTICUT
- *• (Southington) Plantsville 06479 . . . . . 370 Atwater St.

FLORIDA
- *• Jacksonville 32203 . . . . 3020 W. Beaver St.
- • (Miami) Hialeah 33010. . . 1062 East 28th St.
- *• Tampa 33601 . . . . . 19th & Grant Sts.

GEORGIA
- • (Atlanta) Chamblee 30341 . . . . . 5035 Peachtree Industrial-Blvd.
- • Albany . . . . . 2379 John Glenn Dr.

ILLINOIS
- *• Chicago 60638 . . . . 6045 S. Nottingham Ave.

INDIANA
- • Evansville 47711 . . . 601 N. Congress Ave.
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- • Hammond 46320 . . . . . 1132 164th Place
- *• Indianapolis 46222 . . . 3740 W. Vermont St.

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- • (Davenport) Bettendorf 52722 . 1025 State St.

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- • Louisville 40209. . . . 3900 Crittenden Drive

LOUISIANA
- • Baton Rouge 70814 . . . 10955 North Dual St.
- *• New Orleans 70114 . . . . . 1115 DeArmas St.

MARYLAND
- *• Baltimore 21230. . . . . 920 E. Fort Ave.

MASSACHUSETTS
- *• Δ (Boston) Medford 02155 . . . . . 3960 Mystic Valley Pkwy.

MICHIGAN
- *• Δ (Detroit) Riverview. . . . 18075 Krause Ave.
- • Flint 48505 . . . . . 1506 E. Carpenter Rd.

MINNESOTA
- • Duluth 55807 . . 50th Ave. W & St. Louis Bay
- *• Minneapolis 55430 . . . . 2025 48th Ave., N.

MISSOURI
- *• Kansas City 64120. . . . . 3525 Gardner Ave.
- *• St. Louis 63110 . . . . . 1115 East Rd.

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- • New Brunswick 08902 . . . . . 3 Lawrence St.

NEW MEXICO
- • Albuquerque 87109 . . . 6420 McLeod Rd. NE

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- *• Charlotte 28208 . . . . . 2338 Thrift Rd.

OHIO
- • Akron (Canton) 44720 . . . . . 7900 Whipple Ave. N.W.
- *• Cincinnati 45202. . . . . 644 West 3rd St.
- *• Δ Cleveland 44125 . . . . . 6477 East 49th St.
- • Columbus 43229 . . . . . 8660 Huntley Rd.
- *• Toledo 43605 . . . . . 405 Dearborn Ave.
- • Youngstown 44507. . . . 372 E. Indianola Ave.

OKLAHOMA
- • Tulsa 74145. . . . . 5220 S. 100th East Ave.

OREGON
- • Eugene 97402 . . . . . 370 Wilson St.
- *• Portland 97210 . . . . . 2727 NW 29th Ave.

PENNSYLVANIA
- • Allentown 18103 . . . . . 668 E. Highland St.
- • (Delaware Valley) Cherry Hill, N.J., 08034 . . . . . 1790 E. Marlton Pike
- • Johnstown 15902 . . . . . 841 Oak St.
- • Philadelphia 19124 . . . 1040 East Erie Ave.
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SOUTH CAROLINA
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TENNESSEE
- • Knoxville 37914 . . . . . 2621 Governor John Sevier Hwy.
- • Memphis 38107. . . . . 704 North Main St.

TEXAS
- • Beaumont 77705 . . . . . 3490 W. Cardinal Dr.
- • Corpus Christi 78401 . . . . . 115 Waco St.
- *• Dallas 75235 . . . . . 3207 Manor Way
- • Houston 77036 . . . . 8534 Harvey Wilson Dr.
- • Houston 77036 . . . . . 8916 Harwin Dr.
- • Midland 79701 . . . . . 704 S. Johnston St.

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- *• Salt Lake City 84119 . . . 901 S. 7th West St.

VIRGINIA
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- • Roanoke 24013 . . . . . 1004 River Ave., SE

WASHINGTON
- *• Seattle 98134 . . . . . 8422 First Ave., South
- • Spokane 99211 . . . . . E. 4323 Mission St.

WEST VIRGINIA
- *• Charleston 25328 . .906 MacCorkle Ave., SE

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- • (Appleton) Menasha 54910 . . 1725 Racine St.
- • Milwaukee 53207 . . . 835 W. Oklahoma Ave.

• Electrical/Mechanical Service Shop * Instrumentation Shop Δ Special Manufacturing Shop

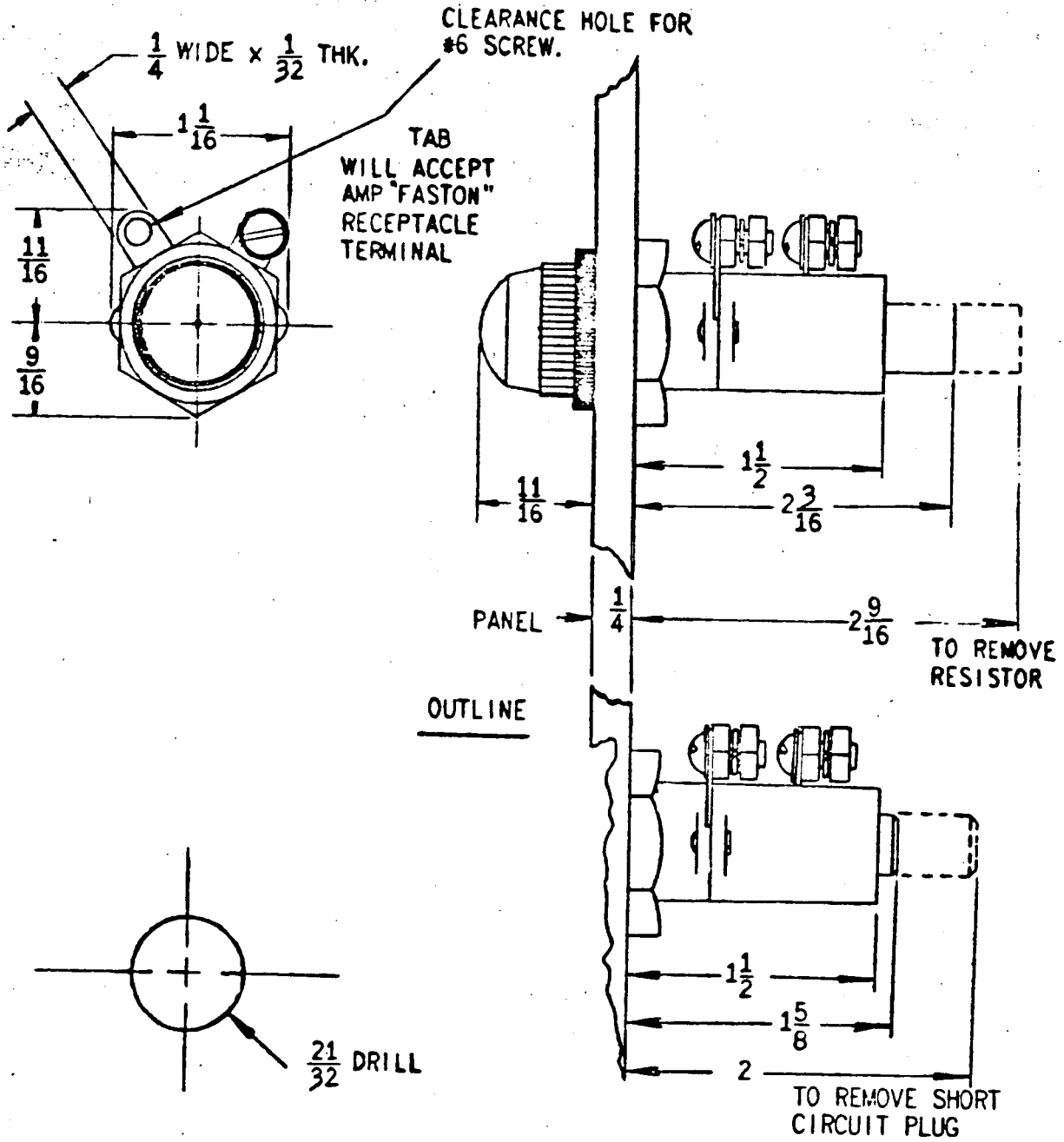


FIG. 4 (0165A7955-4) Outline And Panel Drilling For Neon Indicating Lamp Type ET-17

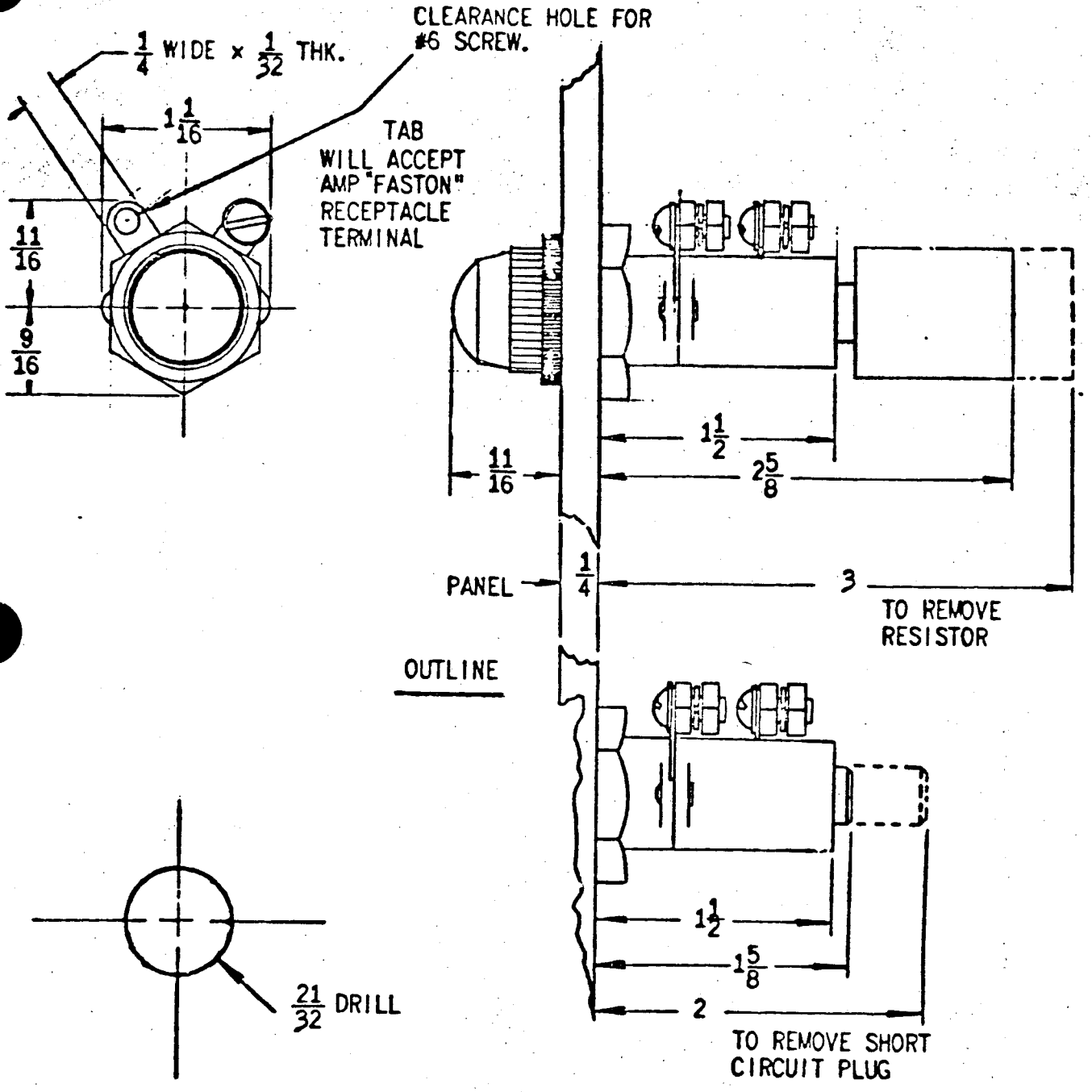
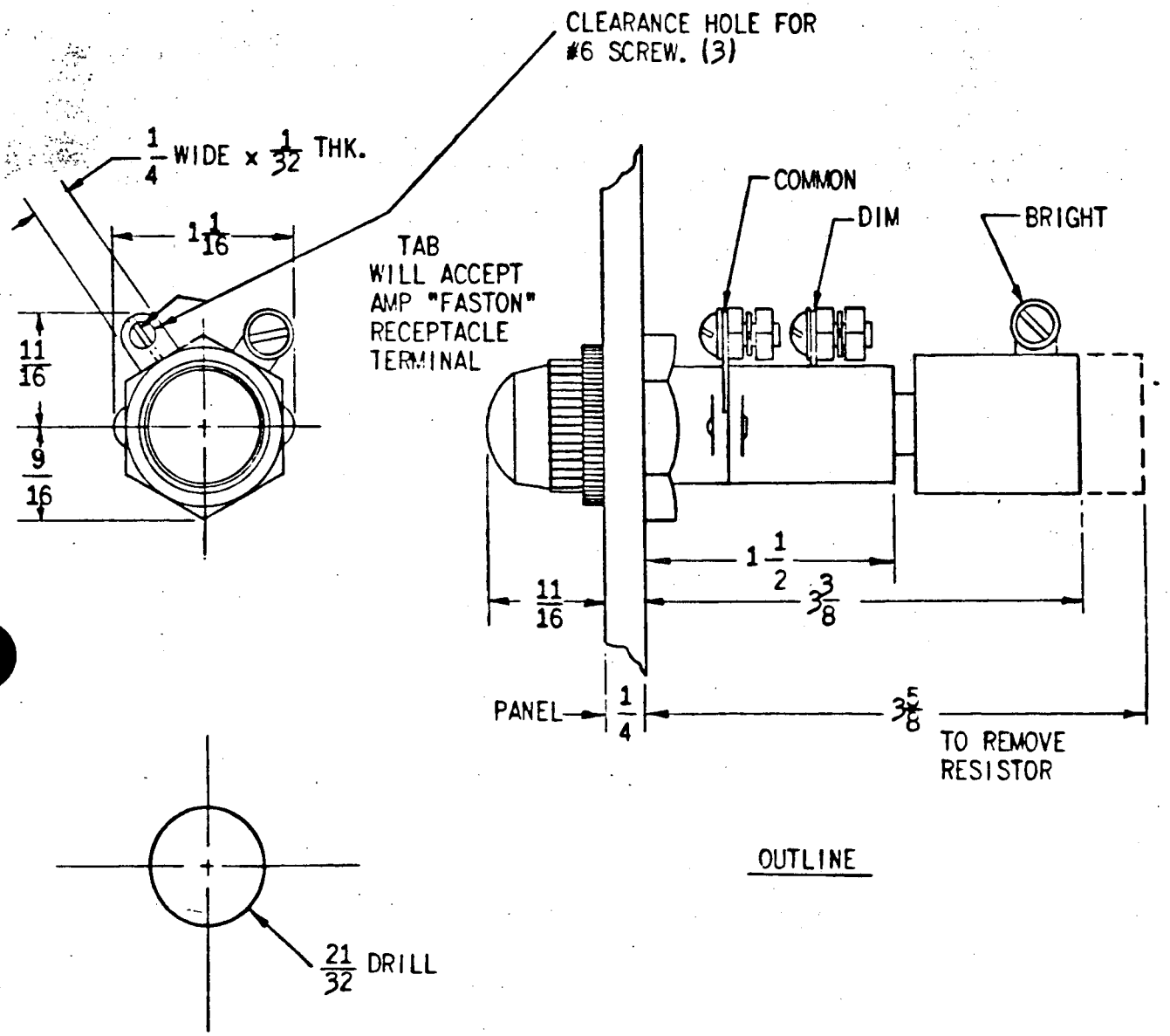


FIG. 3 (0165A7859-4) Outline And Panel Drilling For Type ET-16 Indicating Lamp



G. 2 (0165A9216-0) Outline And Panel Drilling For Type ET-16 Indicating Lamp With Tap Resistor For Dim Bright Operations

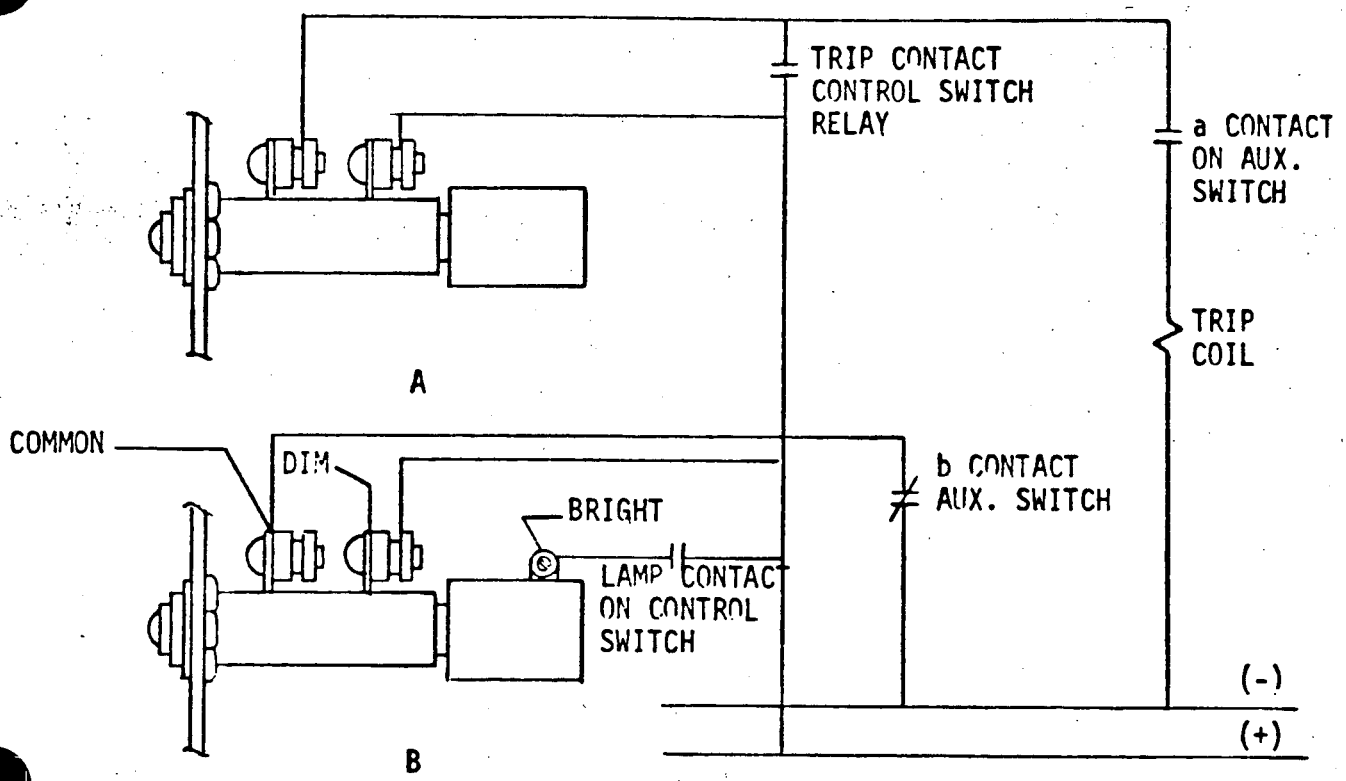


FIG A - SHOWS A TELL-TALE CIRCUIT FOR A CIRCUIT BREAKER CLOSE INDICATION. WHEN THE BREAKER IS CLOSED, THE LIGHTED (RED) LAMP SHOWS NOT ONLY THE BREAKER POSITION, BUT ALSO THAT THE TRIP CIRCUIT IS COMPLETE.

FIG B - FOR CIRCUIT BREAKER OPEN INDICATION, THE DIM-BRIGHT CONNECTION IS OFTEN DESIRABLE, ESPECIALLY WHEN A LARGE NUMBER OF LAMPS ARE LOCATED ON ONE PANEL. A LAMP UNIT WITH TAPPED RESISTOR IS REQUIRED, TOGETHER WITH A CONTROL SWITCH HAVING A LAMP CONTACT WHICH REMAINS CLOSED IN THE NORMAL POSITION, EXCEPT AFTER THE SWITCH HAS BEEN TURNED TO THE TRIP POSITION. A WHITE COLOR CAP ON THE LAMP IS CUSTOMARY. WHEN THE BREAKER IS TRIPPED WITH THE CONTROL SWITCH, THE SWITCH CONTACT IS OPENED, AND THE LAMP GLOWS WITH LOW BRILLIANCY. IF THE BREAKER IS TRIPPED AUTOMATICALLY, THE CONTROL SWITCH CONTACT SHORT-CIRCUITS PART OF THE LAMP RESISTOR SO THE LAMP GLOWS BRIGHTLY, AND THE NON-MANUAL OPERATION CAN BE EASILY LOCATED ON THE PANEL.

FIG. 1 (0246A3685-0) Typical Tell-Tale And Dim-bright Connections

ORDERING TABLE 7

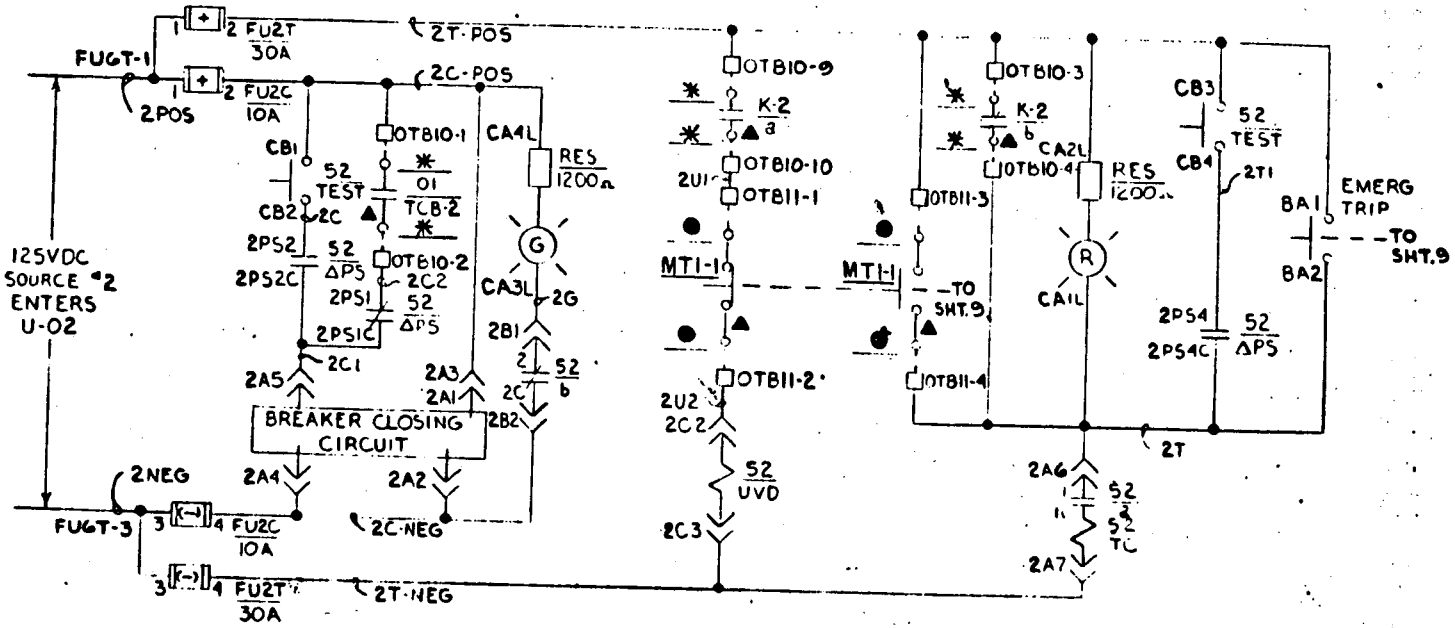
COLOR CAP

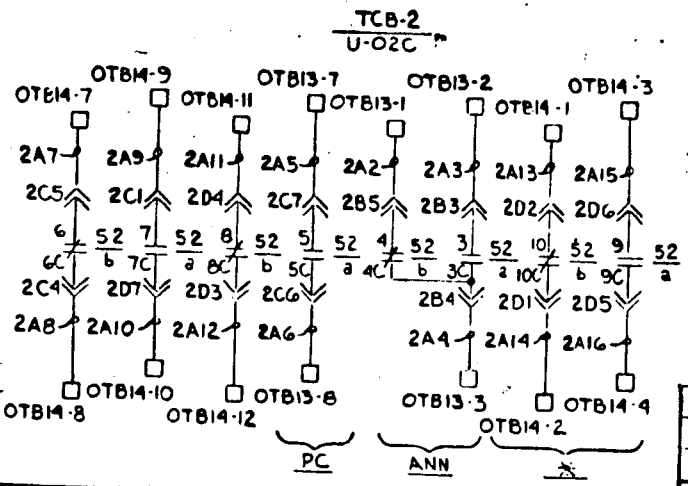
CAT. NO.	COLOR CAP	
	COLOR	CAT. NO.
0116B6734G*	NONE	NONE
0116B6734G*C	CLEAR	208A3768P1
0116B6734G*E	RED$_{\pi}$	208A3768P9
0116B6734G*A	AMBER	208A3768P7

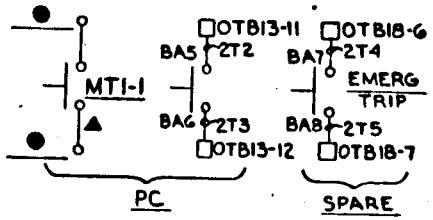
*=Group No. per Voltage Selected
For Other Voltages Refer to Company
Group No. with No. Suffix=Color Cap Omitted
$_{\pi}$Transparent
Ø Translucent

HOW TO ORDER

Order by complete Cat. No. and specify color cap.







▲-EXTERNAL CONTACTS TO RTSG
✱-UNIT 2-2L32
UNIT 3-3L32
●-UNIT 2-2CR56
UNIT 3-2CR56

CERTIFIED AS BUI

SAN ONOFRE UNITS 2 & 3

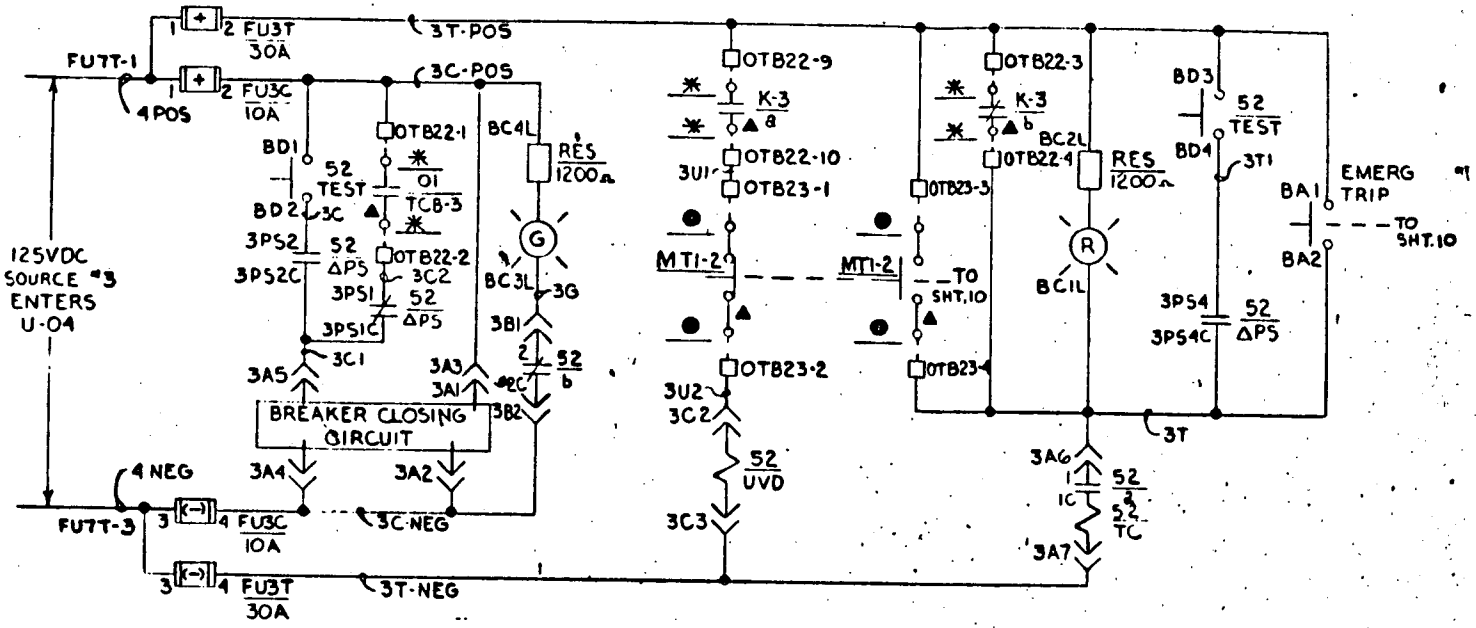
UNIT ELECTRIC CONTROL, INC.

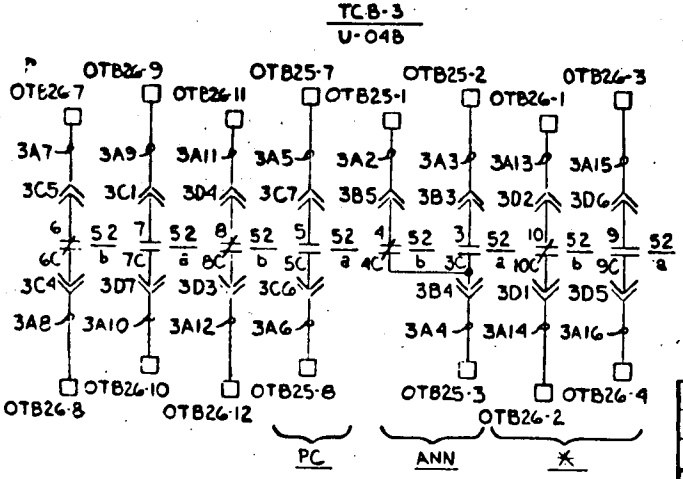
ORLANDO, FLORIDA

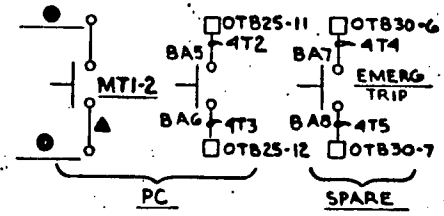
COMBUSTION ENGINEERING, INC.
ELECTRIC TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
POWER SPECIFICATION 3770-ICE-3008-01
DIAGRAM - ELEMENTARY - TCB-2

DATE: 8-18-7
SCALE: NONE
DRAWN
CH'K'D
SHEET NO.
DRAWING NO.
805 B5

REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV. PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO
1	9-27-75	REV PER CUST MKD DWG DATED 9-24-75







▲ - EXTERNAL CONTACTS TO RTSG
* - UNIT 2 - 2L32
UNIT 3 - 3L32
● - UNIT 2 - 2CR56
UNIT 3 - 3CR56

CERTIFIED AS BUILT

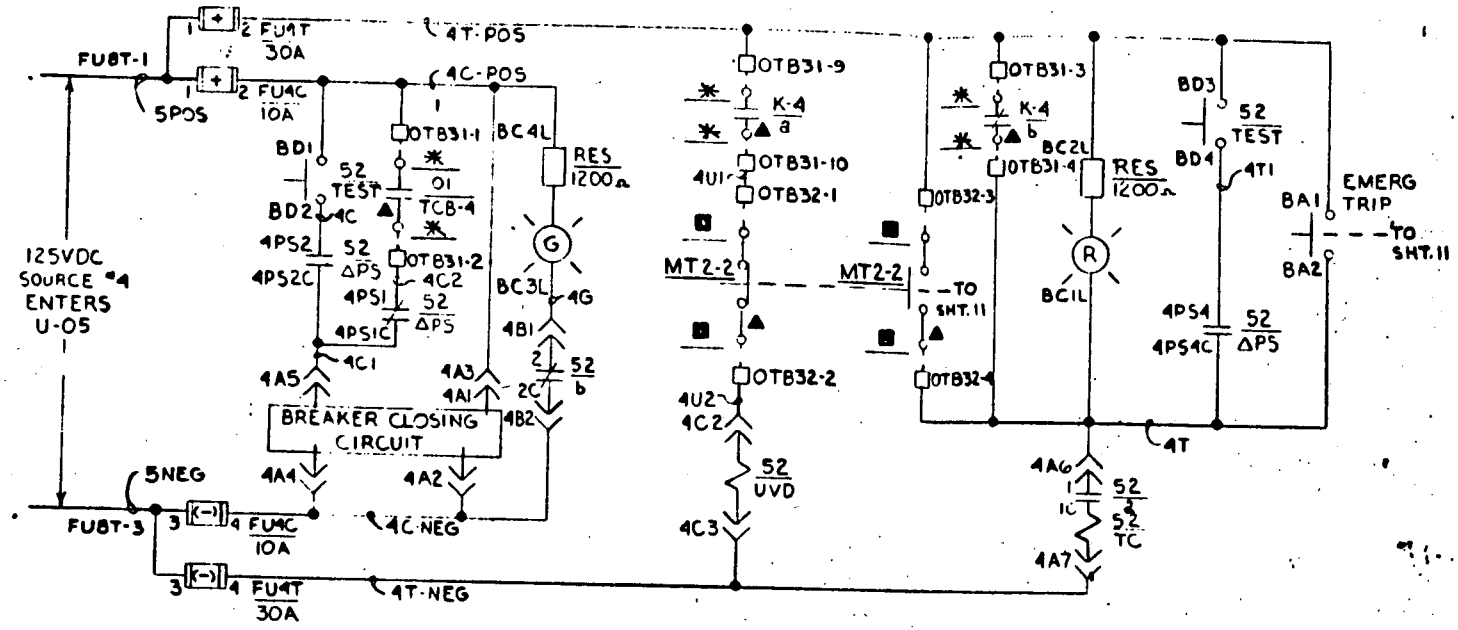
SAN ONOFRE UNITS 2 & 3

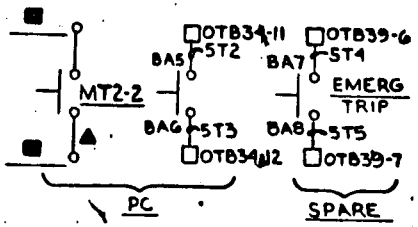
UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

CONSTRUCTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
[illegible], CONNECTICUT
[illegible] - ICE-3008-01
[illegible] - TCB-3

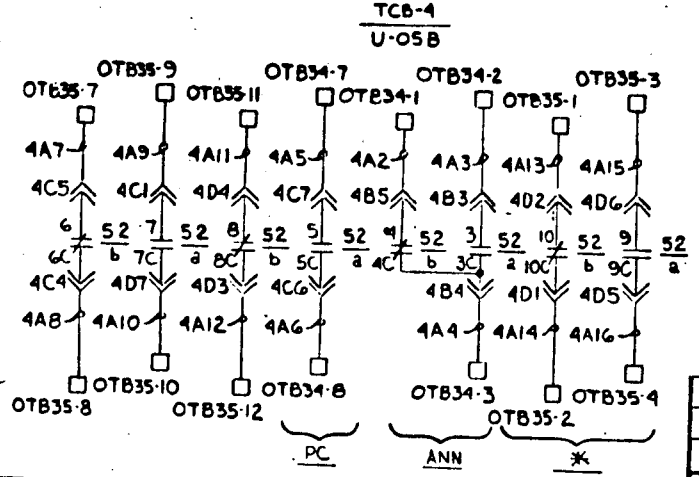
REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO.
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

DATE: 8-18-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B6.3





▲ - EXTERNAL CONTACTS TO RTSG
✱ - UNIT 2 - 2L32
UNIT 3 - 3L32
■ - UNIT 2 - 2CR52
UNIT 3 - 3CR52



CERTIFIED AS BUILT

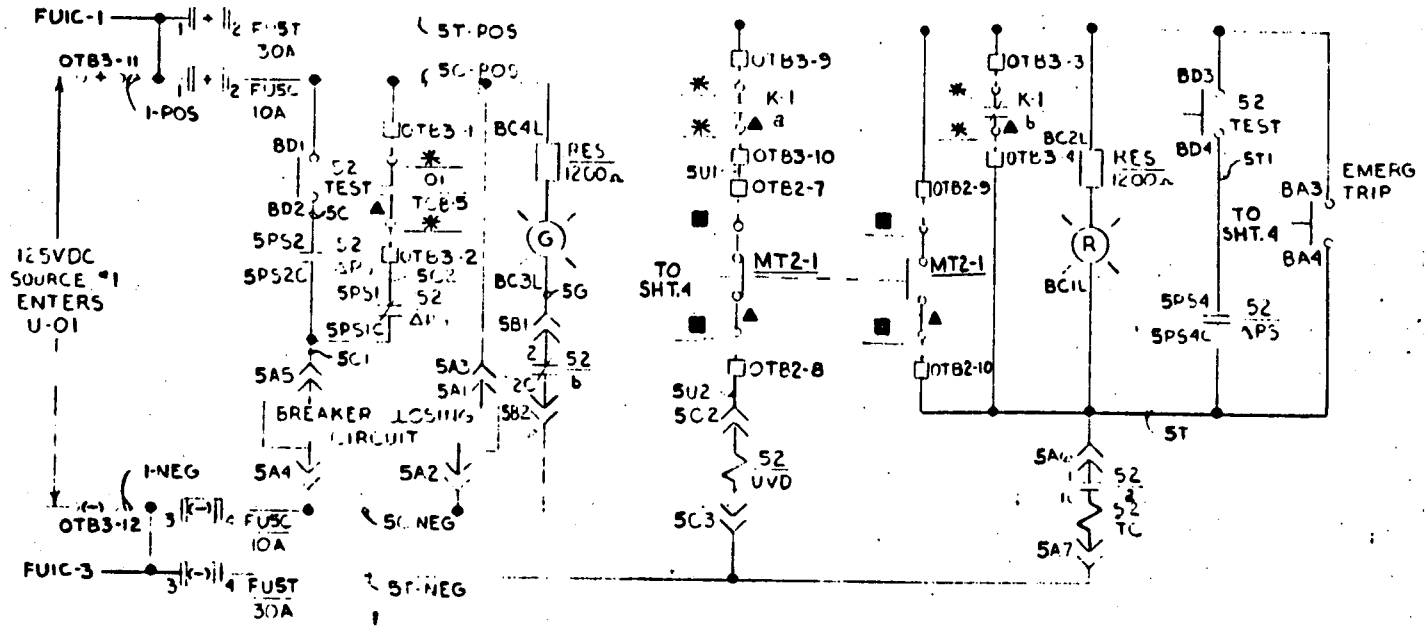
REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS-RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST INFO.
1	9-27-75	REV. PER CUST. MK'D. DWG. DATED 9-24-75

SAN ONOFRE UNITS 2 & 3

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION [illegible]-ICE-3008-01
DC ELEMENTARY - TCB-4

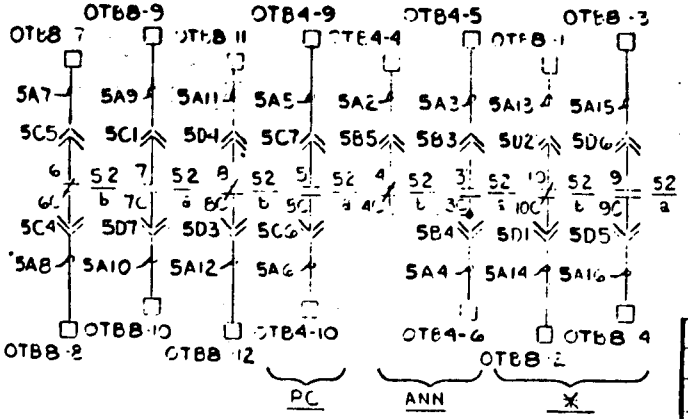
DATE: 8-18-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B7.



▲-EXTERNAL CONTACTS TO RTSG
✱-UNIT 2-2L32
UNIT 3-3L32
■-UNIT 2-2CR52
UNIT 3-3CR52

CERTIFIED AS BUILT

TCB-5
U-01B



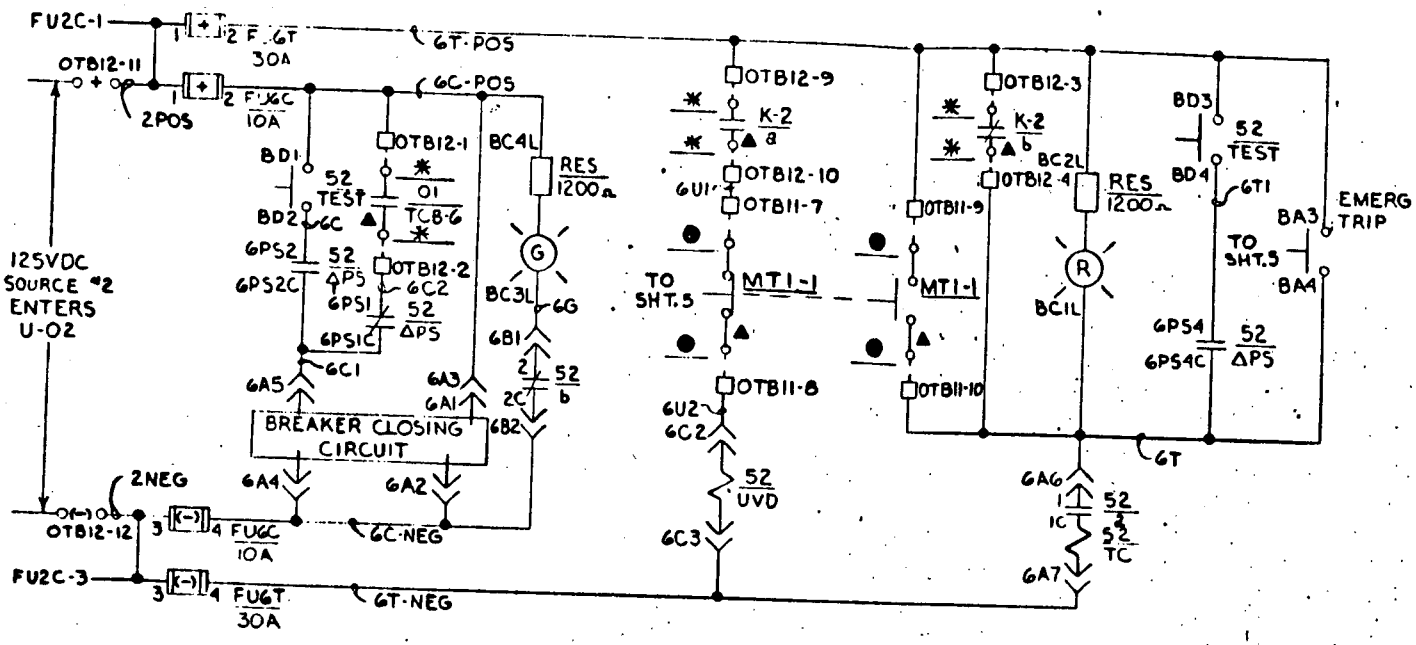
REV. NO	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

SAN ONOFRE UNITS 2 & 3

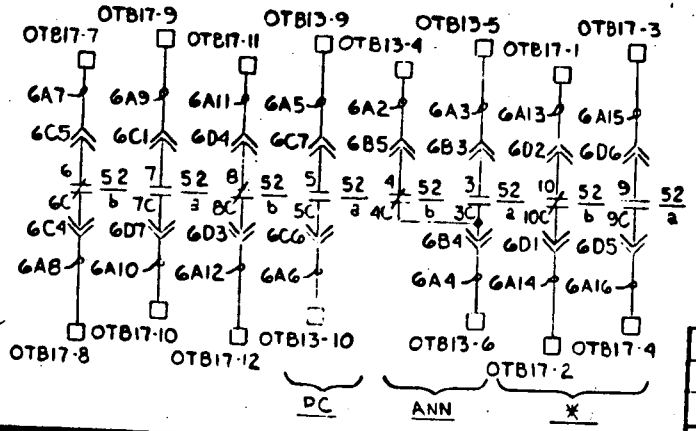
UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

[illegible] ENGINEERING, INC.
[illegible] CIRCUIT BREAKER SWITCHGEAR
[illegible] CIRCUIT
[illegible] 2575-ICE-3003-01
[illegible] TCB-5

DATE: 8-18-75
SCALE: NONE
DRAWN: [illegible]
CH'K'D: [illegible]
SHEET NO:
DRAWING NO. 8052-B8.



TCB-6
U-02B



▲-EXTERNAL CONTACTS TO RTSG
*-UNIT 2- 2L32
UNIT 3- 3L32
●-UNIT 2- 2CR56
UNIT 3- 3CR56

CERTIFIED AS BUILT

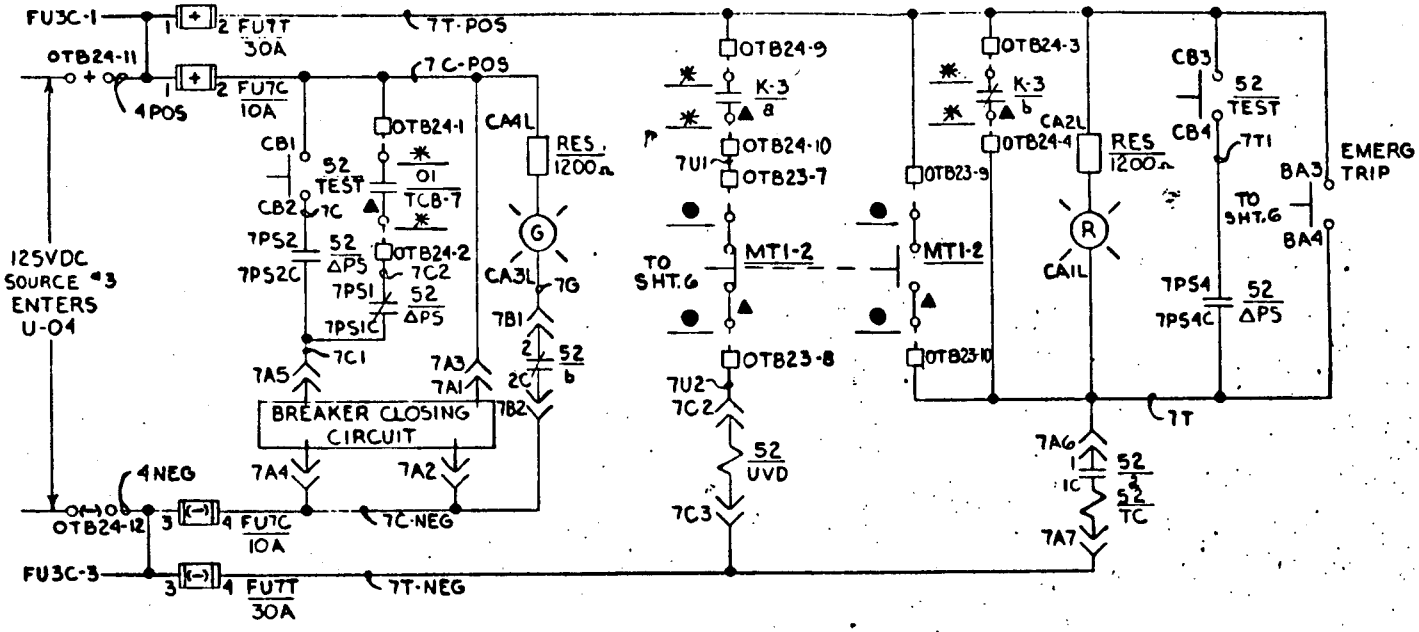
SAN ONOFRE UNITS 2 & 3

REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN PER CUST INFO
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

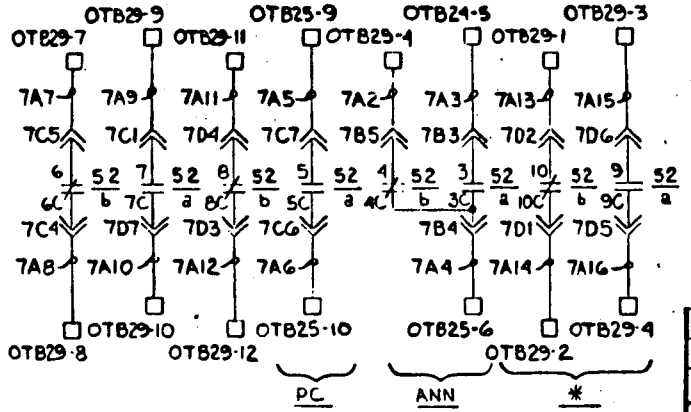
COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CE/UEC SPECIFICATION 8052-ICE-3003-01
DC ELEMENTARY - TCB-6

DATE: 8-18-75
SCALE: NONE
DRAWN: J Hall
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B9.3



▲-EXTERNAL CONTACTS TO RTSG.
✱-UNIT 2-2L32
UNIT 3-3L32
●-UNIT 2-2CR56
UNIT 3-3CR56

TCB-7
U-04C



REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO.
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

CERTIFIED AS BUILT

SAN ONOFRE UNITS 2 & 3

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION [illegible]-ICE-3008-01
DC ELEMENTARY - TCB-7

DATE: 8-18-75
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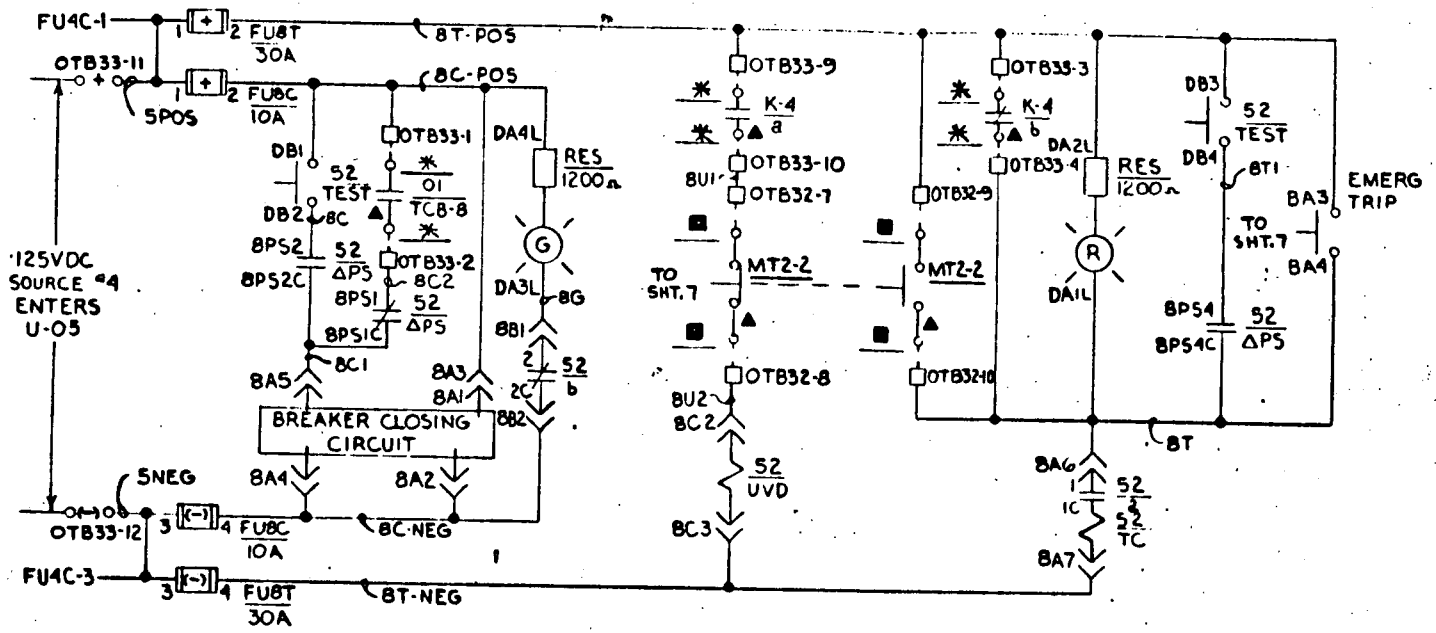
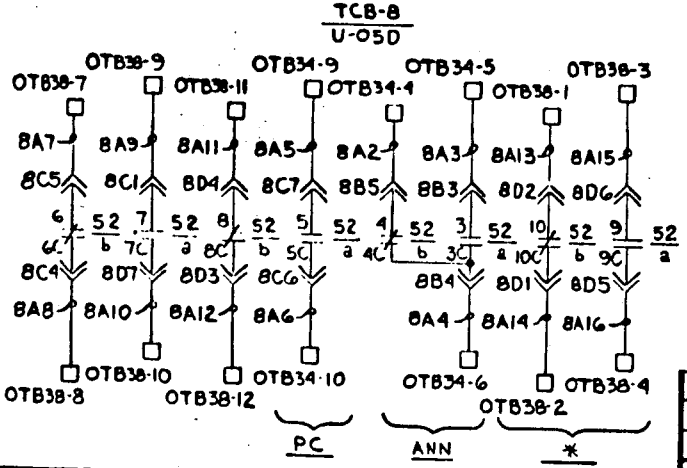
DRAWN:
CH'K'D:
SHEET NO.
DRAWING NO. 8052-B10.3



▲-EXTERNAL CONTACTS TO RTSG
✱-UNIT 2-2L32
UNIT 3-3L32
■-UNIT 2-2CR52
UNIT 3-3CR52



CERTIFIED AS BUILT

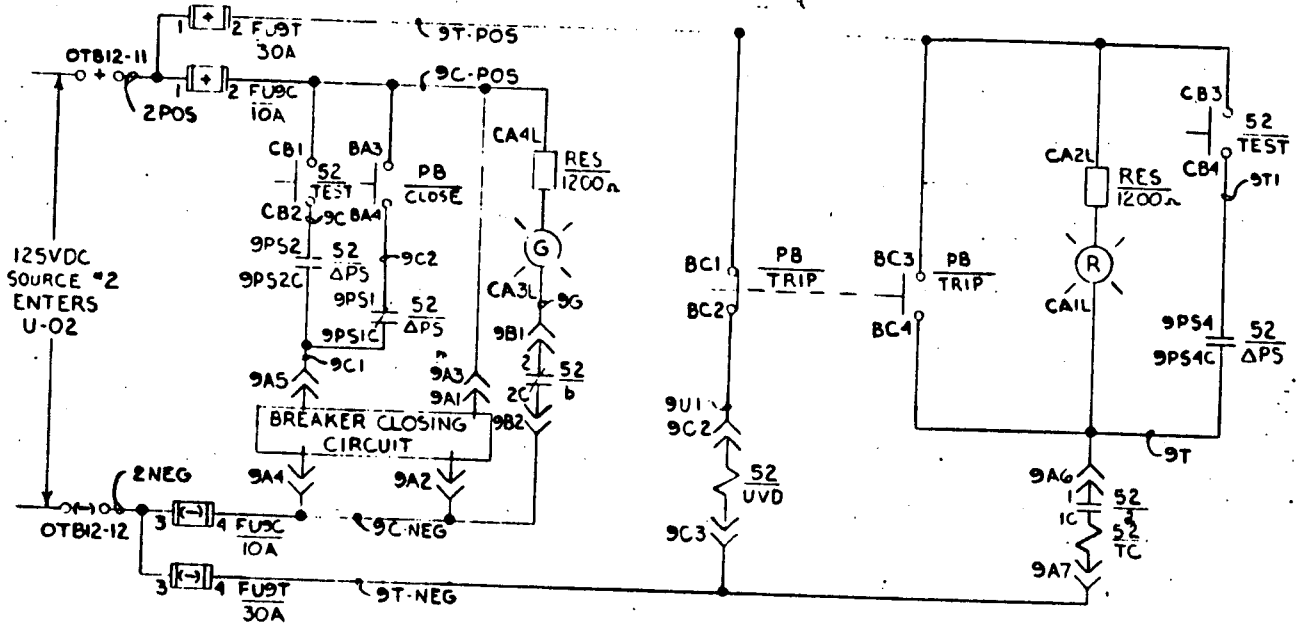
SAN ONOFRE UNITS 2 & 3

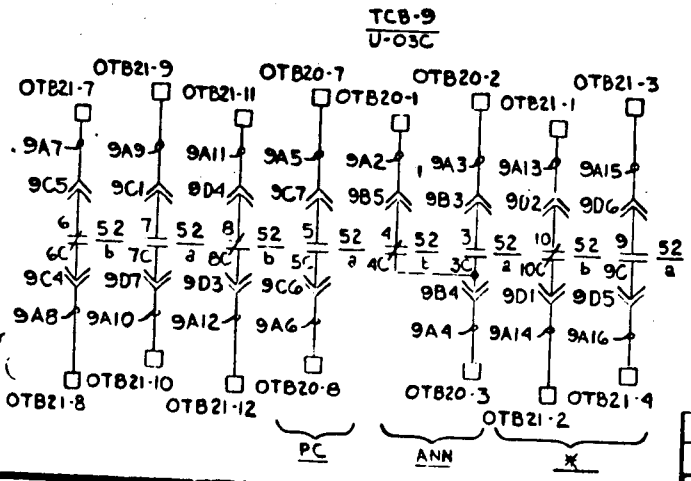
REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST INFO
1	9-27-75	REV. PER CUST. MKD. DWG, DATED 9-24-75

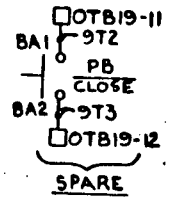
UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION -ICE-3008-01
DC ELEMENTARY - TCB-8

DATE: 8-18-75
SCALE: NONE
DRAWN: P. Hall
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B11.3







CERTIFIED AS BUILT

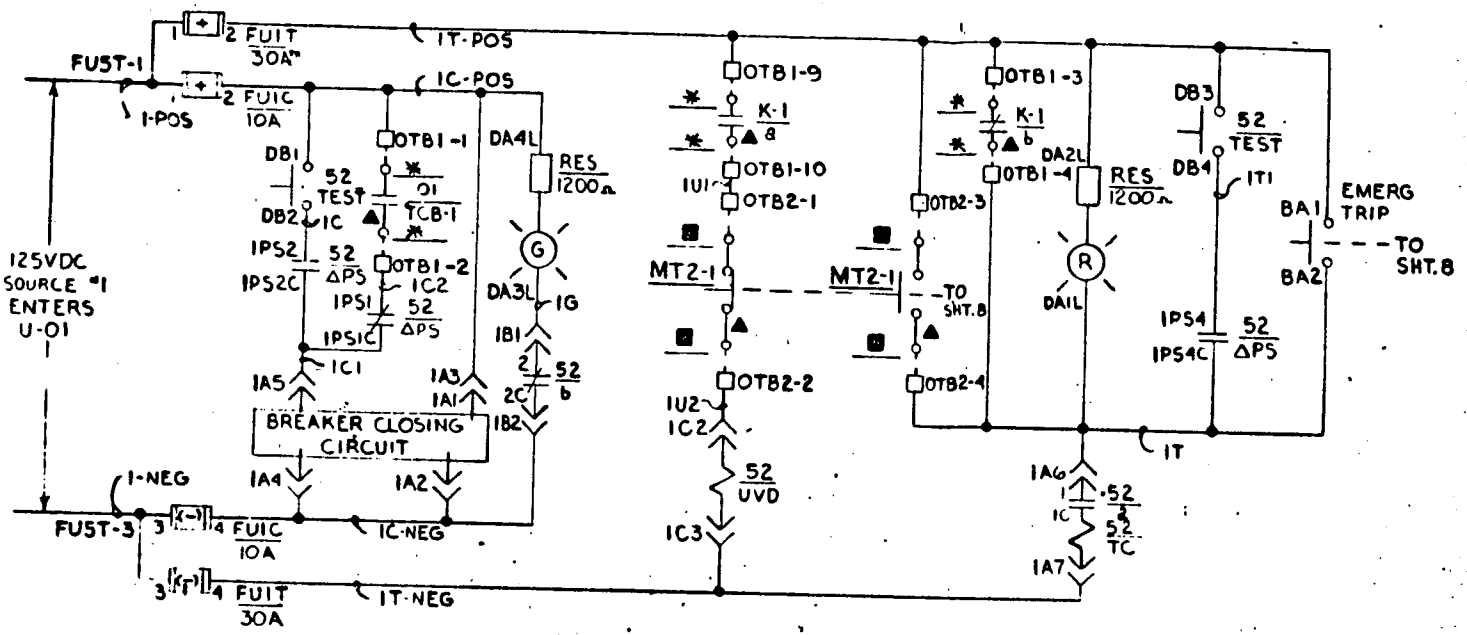
SAN ONOFRE UNITS 2 & 3

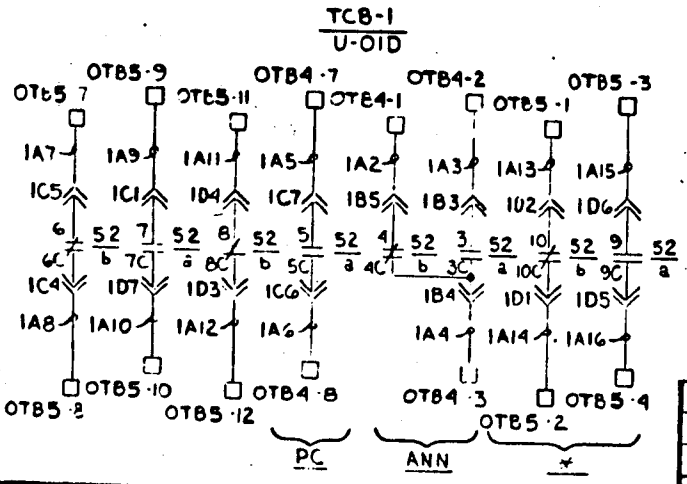
REV. NO.	DATE	DESCRIPTION
2	1-12-76	REV PER CE COMMENTS - RAR-8
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

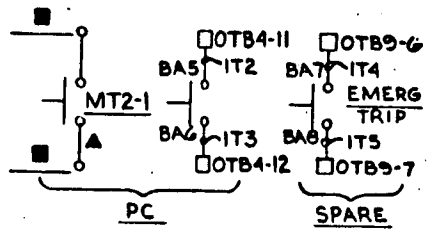
UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION [illegible]-ICE-3008-01
DC ELEMENTARY - TCB-9

DATE: 8-18-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B12.2







▲-EXTERNAL CONTACTS TO RTSG
*-UNIT 2-2L32
UNIT 3-3L32
■-UNIT 2-2CR52
UNIT 3-3CR52

CERTIFIED AS BUILT

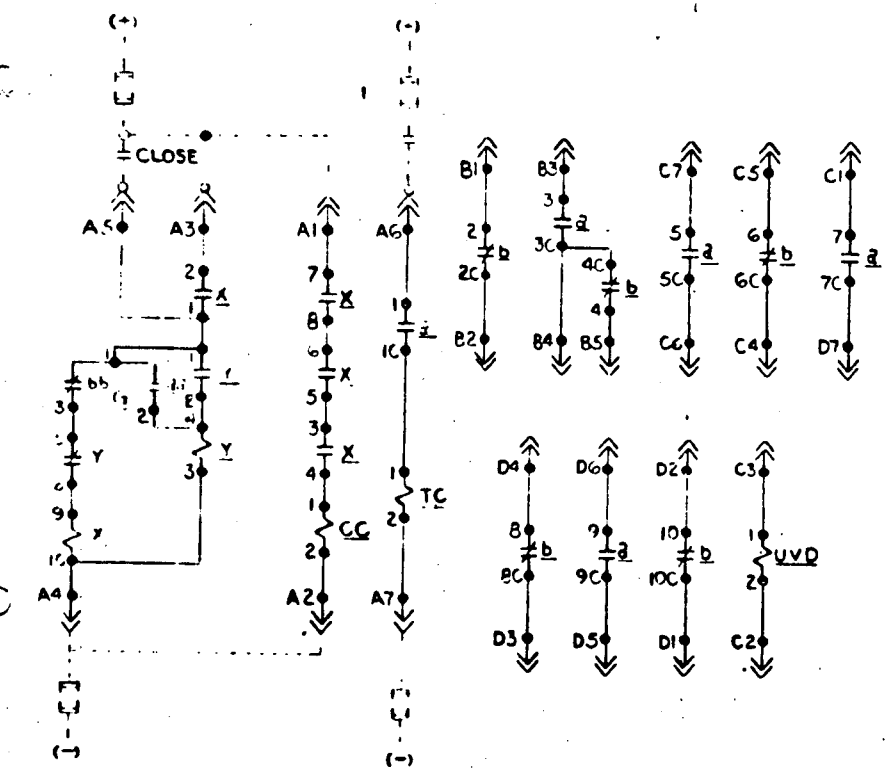
SAN ONOFRE UNITS 2 & 3

REV. NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS - RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO.
1	9-27-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

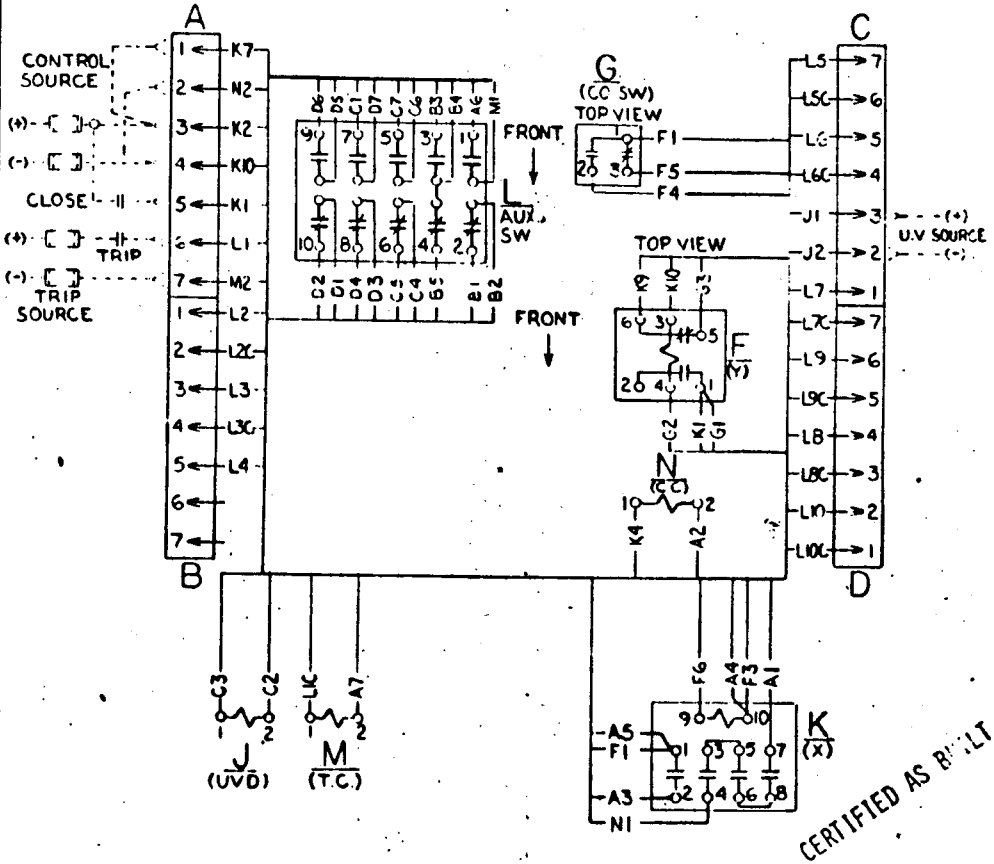
UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CE/UEC SPECIFICATION [illegible]-ICE-3008-01
DC ELEMENTARY - TCB-1

DATE: 8-18-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO
DRAWING NO 8052-B4.3



ELEMENTARY DIAGRAM



CONNECTION DIAGRAM

CERTIFIED AS BUILT

SAN ONOFRE UNITS 2 &

LIST OF ABBREVIATIONS

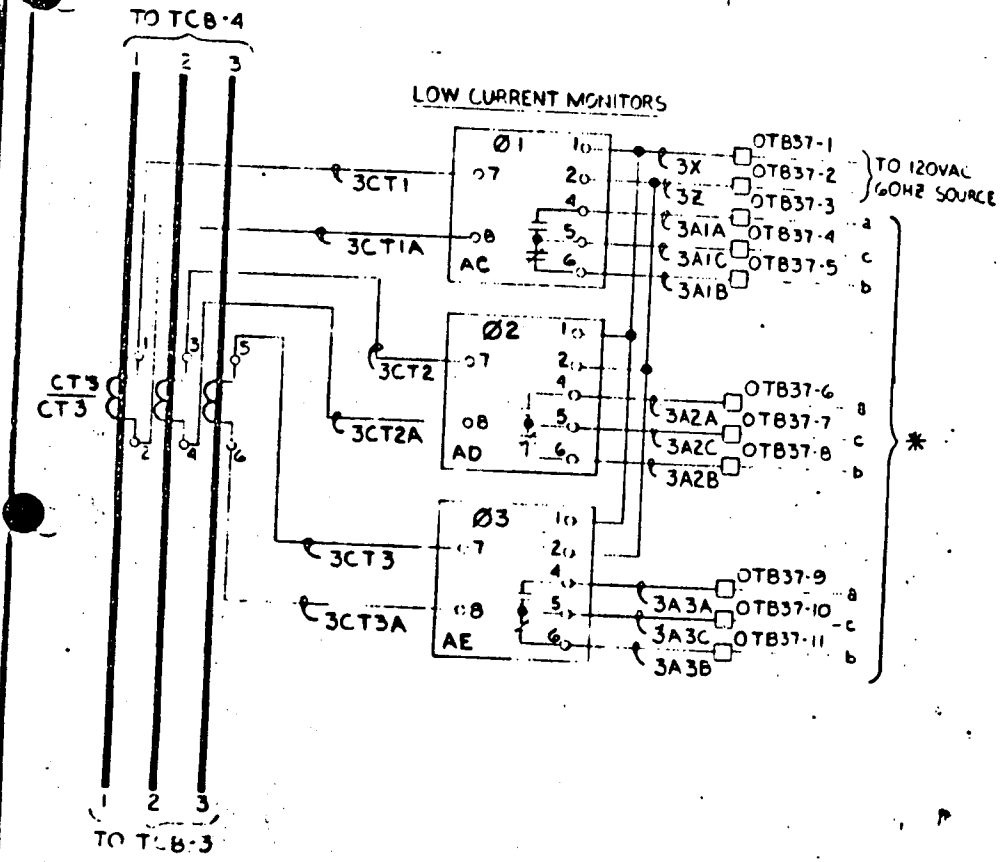
A-SEC. DISC. LOCATED TOP LEFT FT. VIEW
B-SEC. DISC. LOCATED LOWER LEFT FT. VIEW
C-SEC. DISC. LOCATED TOP RIGHT FT. VIEW
D-SEC. DISC. LOCATED LOWER RIGHT FT. VIEW
F-(Y) ANTI-PUMP, PERMISSIVE RELAY
G-(aa-bb) CUTOFF SW
J-(U.V.) UNDERVOLTAGE TRIP DEVICE TIME DELAY OR INSTANTANEOUS
K-(X) CLOSING CONTACTOR - 3 SETS OF CONTACTS IN SERIES (MAIN) & 1 SET FOR SEAL-IN
L-(AUX. SW.) 5 "a" & 5 "b" CONTACTS (SPECIAL)
M (T.C.) SHUNT TRIP DEV
N-(C.C.) SOLENOID CLOSING COIL

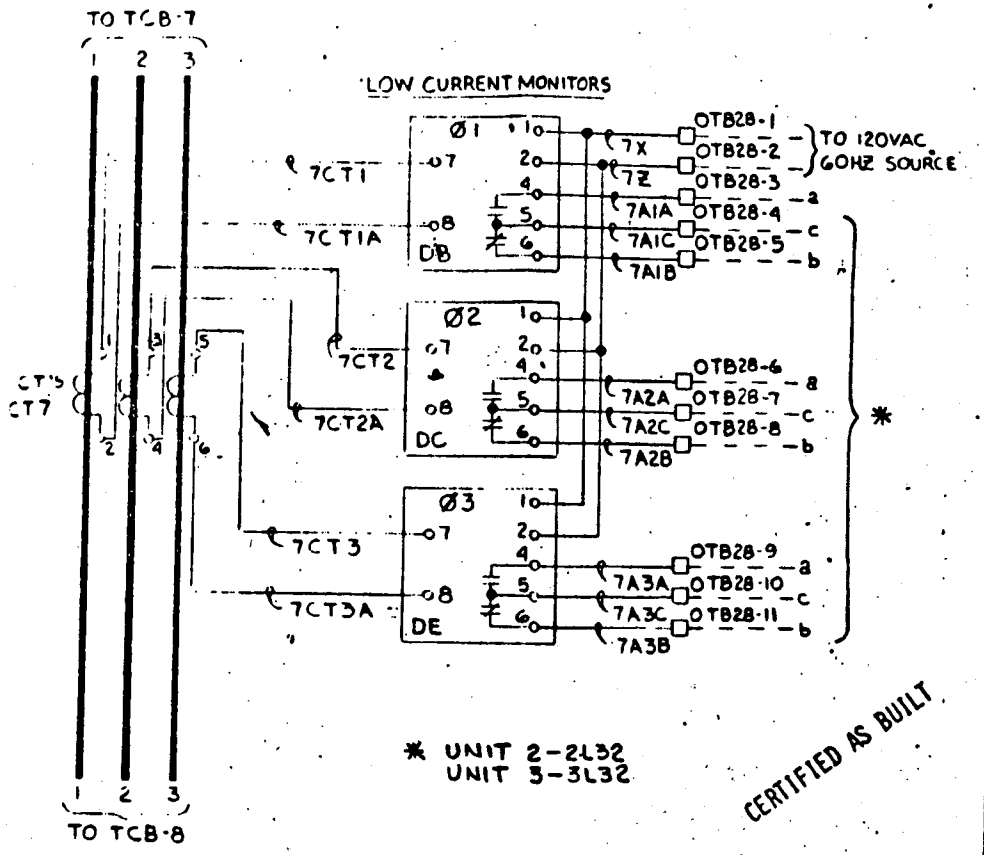
REV. NO.	DATE	DESCRIPTION
2	12-3-75	REV PER CUST MKD DWG DTD 12-5-75
1	9-29-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

G.E. AK-2-25 CIRCUIT BREAKER
ELEMENTARY & CONNECTION DIAGRAM

DATE: 11-18-74
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO
8052-B13





* UNIT 2-2L32
UNIT 3-3L32

CERTIFIED AS BUILT

SAN ONOFRE UNITS 2 & 3

REV. NO	DATE	DESCRIPTION
2	1-12-76	REV PER CE COMMENTS-RAR-8
1	12-5-75	ADDED EXT. CONN. PER CUST INFO

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION 137?-ICE-3008-01
CURRENT MONITOR ELEMENTARY

DATE: 8-19-75
SCALE: NONE
DRAWN:
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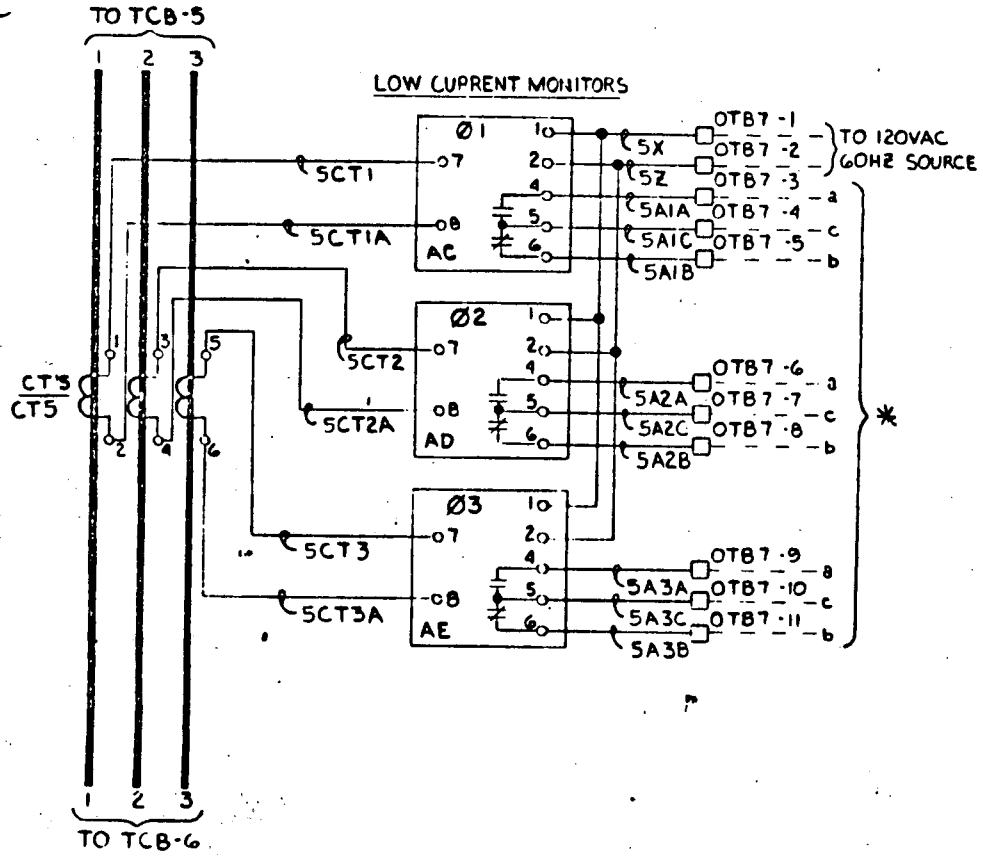
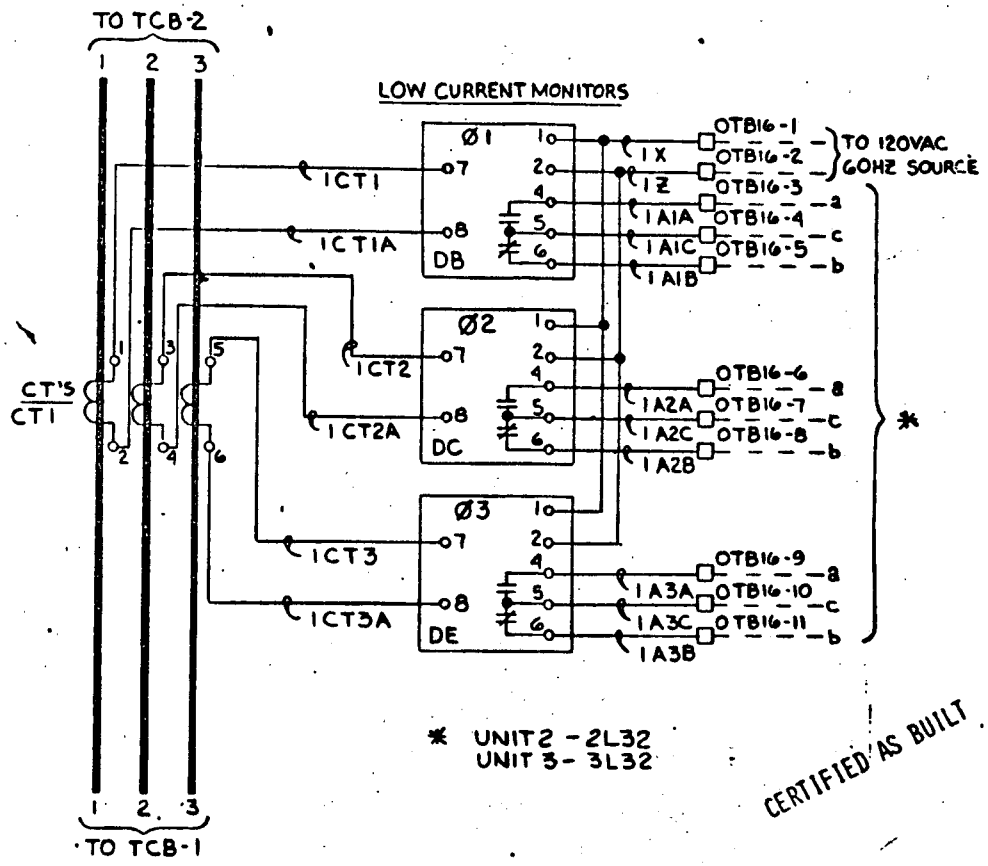
SHEET NO:
DRAWING NO
8052-B3.





* UNIT 2 - 2L32
UNIT 3 - 3L32

CERTIFIED AS BUILT

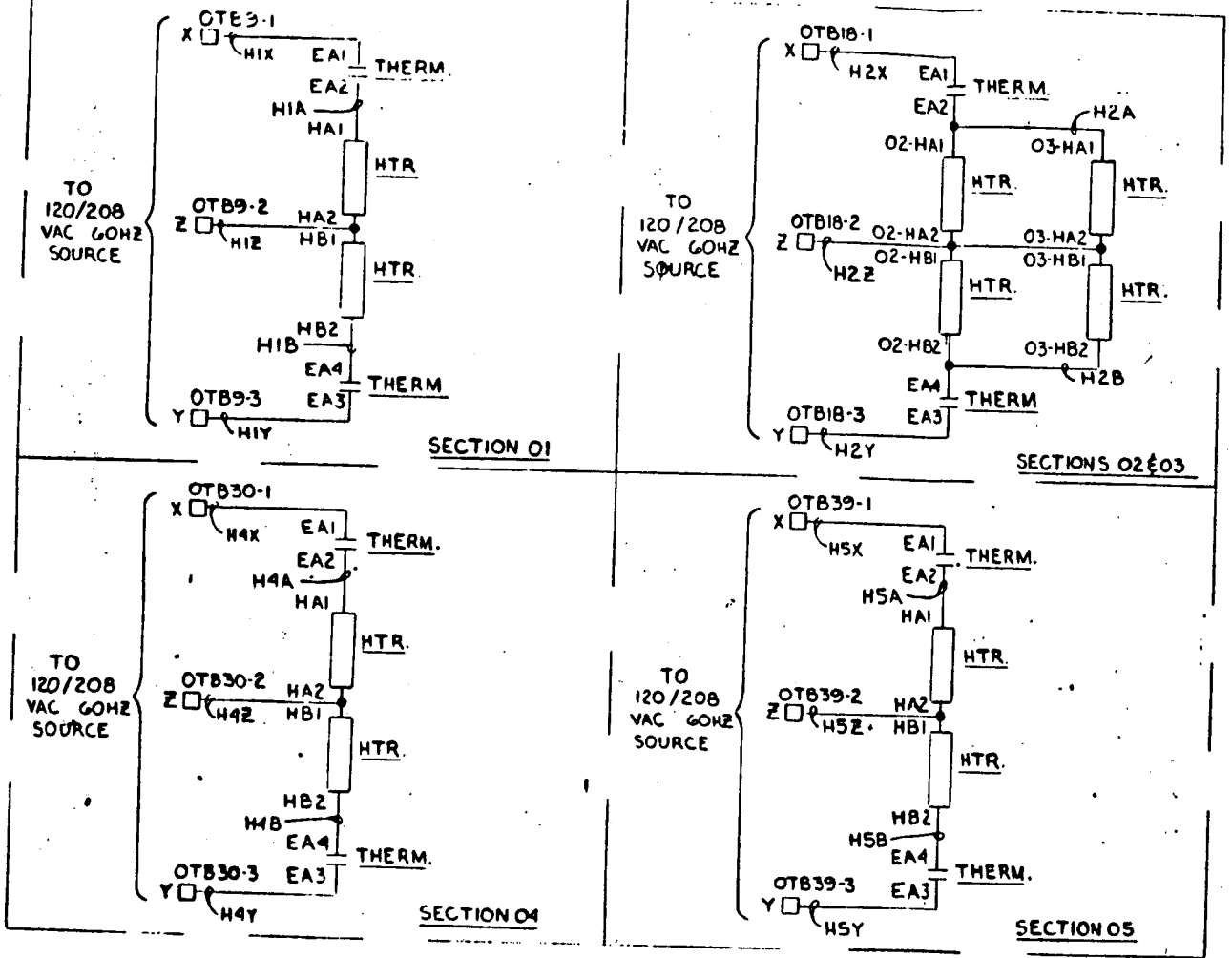
SAN ONOFRE UNITS 2 & 3

REV NO.	DATE	DESCRIPTION
3	1-12-76	REV PER CE COMMENTS-RAR-8
2	12-5-75	ADDED EXT. CONN. PER CUST. INFO
1	9-26-75	REV. PER CUST. MKD. DWG. DATED 9-24-75

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION -ICE-3003-01
CURRENT MONITOR ELEMENTARY

DATE: 8-19-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO. 8052-B2.3



CERTIFIED AS BUILT

SAN ONOFRE UNITS 2 & 3.

REV. NO.	DATE	DESCRIPTION
1	1-12-76	REV PER CE COMMENTS - RAR-8

UNIT ELECTRIC CONTROL, INC.
ORLANDO, FLORIDA

COMBUSTION ENGINEERING, INC.
REACTOR TRIP CIRCUIT BREAKER SWITCHGEAR
WINDSOR, CONNECTICUT
CENPD SPECIFICATION -ICE-3009-01
HEATER ELEMENTARY

DATE: 8-18-75
SCALE: NONE
DRAWN:
CH'K'D:
SHEET NO:
DRAWING NO
8052-B1.1