(Unclassified) NAVSHIPS 0962-073-7010

SWITCHBOARD TECHNICAL MANUAL

PART 2

CHAPTER 3B
CIRCUIT BREAKER

Navy Type ACB-1600HR
General Electric Type AK-2-100N

and

Navy Type ACB-1600HRC
General Electric Type AK-2-100N

(Applicable to Units Manufactured After 1972 and Starting with Serial # 0224A3561-6)

GENERAL ELECTRIC

PHILADELPHIA, PA.

(FSC 03497)

GEI-90900A

MAY, 1973

DEPARTMENT OF THE NAVY

NAVAL SHIP SYSTEMS COMMAND

11/4/74

APPROVAL AND PROCUREMENT RECORD

BASIC APPROVAL DATA FOR: NAVSHIPS 0962-073-7010

TITLE: Technical Manual GEI-90900A, Navy Circuit Breaker, Type ACB-1600HR and Type ACB-1600HRC.

APPROVED BY: Navsec ltr. 6158D, Serial 2123-6158D, dtd 21 June 1973

CONTRACT OR ORDER	VESSELS APPLICABLE	QUANTITY OF MANUALS	QUANTITY OF EQUIPMENT	BUILDING YARD
601H-4050-K25				Newport News Shipbuilding and Dry Dock Company

REMARKS

CERTIFICATION: **DATE** May 1973

It is hereby certified that the manual, NAVSHIPS 0962-073-7010, provided under this contract or order No. 601H-4050-K25, has been approved by authority of basic approval data shown above.

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Philadelphia, Pennsylvania

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CAUTION

PRIOR TO INSPECTION, MAINTENANCE OR REPAIR OF CIRCUIT BREAKER EXERCISE ELECTRICAL SAFETY PRECAUTIONS SPECIFIED IN NAVSHIPS TECHNICAL MANUAL 0901-000-0020, SECTION 9600.22. THE INPUT POWER MAY BE CONNECTED TO EITHER THE TOP TERMINALS OR BOTTOM TERMINALS OF THE BREAKER. IF INPUT POWER IS CONNECTED TO THE BOTTOM TERMINALS PRACTICALLY ALL OF THE BREAKER MECHANISM IS ENERGIZED EVEN THOUGH THE BREAKER MAIN CONTACTS ARE IN THE OPEN POSITION. EVEN THOUGH THE BREAKER IS IN THE OPEN POSITION THERE MAY BE SOME BREAKER DEVICES, SUCH AS UNDERVOLTAGE TRIP, WHICH MAY BE ENERGIZED FROM ANOTHER SOURCE.

SHIPBOARD INSULATION RESISTANCE TESTING OF CONNECTED POWER CABLES.

The shipboard periodic insulation resistance testing of the main power cables with a 500 volt dc tester will not damage the circuit breaker.

TECHNICAL MANUAL. This manual covers a circuit breaker with the maximum number of attachments available, various combinations of circuit protective settings and typical wiring diagrams.

(1) For full description data of a specific circuit breaker refer to the applicable Certification Data Sheet.

(2) For maintenance or troubleshooting of a specific circuit breaker installation you must refer to the complete switchboard wiring diagram shown in the applicable technical manual.

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CLASSIFICATION DATA

Manufacturer	General Electric Co., Philadelphia, Pa., U.S.A.
Type	Navy Type ACB-1600HR, Navy Type ACB-1600HRC General Electric Type AK-2-100N
Continuous Current Rating	1600 amperes
Voltage	500 volts AC 60 hertz
Poles	3
No. of Overcurrent Trips	2 or 3*
Rated Interrupting Current	100,000 amperes, asymmetrical
Short-time Rating	100,000 amperes, asymmetrical
Short-time Rating Duration	1/2 sec
Mounting	Removable assembly
Main Connections	Back
Normal Closing	Electric
Overcurrent Coils	800, 1000, 1200, 1400, and 1600 amperes
Characteristic Time Curve	Bands 1, 2, or 3
Temperature	50°C
Shock Classification	Class HI
Insulation Class	B
Protective Functions	Overcurrent trip
	Long-time delay and instantaneous
	Long-time delay, short-time delay, and instantaneous
	Short-time delay and instantaneous
	Instantaneous
	Shunt trip, when required
Accessories	Auxiliary switch (5a and 5b)
	Indicator light
	Instantaneous undervoltage device
	Undervoltage lockout device
	Overcurrent lockout device
Master Drawings ACB1600HR	0122F0966 (2 sheets)
Master Drawings ACB1600HRC	0122F0981 (2 sheets)
Certification of Approval	
Applicable Military Specification	MIL-C-17587
Weights	
Three-pole Electrical Circuit Breaker ACB1600HR Complete	580 lb
Three-pole Electrical Circuit Breaker ACB1600HRC Complete	590 lb
Stationary Component Only	160 lb

Note: Shunt trip device or undervoltage device when required add 2 lbs.

*The ACB-1600HR has two overcurrent trips, the ACB-1600HRC has three overcurrent trips.

SECTION B-1
General Instructions

PURPOSE

The fundamental purpose of a circuit breaker is to isolate a circuit from the source of power. This purpose can be served by normal off-on switching operations of normal continuous current or it can be served automatically under fault conditions. When the breaker is equipped with a shunt trip device, with the proper control wiring installed, the breaker may be opened from a location that is remote from the switchboard in which the breaker is installed.

WARNING

BEFORE INSPECTION, INSTALLATION, OR REMOVAL PROCEDURES, THE CIRCUIT BREAKER SHOULD BE IN THE OPEN POSITION AND THE BREAKER IN THE WITHDRAWN POSITION. IF THE STATIONARY COMPONENT IS TO BE REMOVED, THE SWITCHBOARD SHOULD BE DE-ENERGIZED. IF THE BUS CANNOT BE DE-ENERGIZED, USE INSULATED TOOLS, RUBBER GLOVES, AND A RUBBER FLOOR MAT.

CARE MUST BE TAKEN WHEN ANY MAINTENANCE WORK IS BEING DONE SO THAT THE BREAKER IS IN THE OPEN POSITION, THE MOTOR POWER IS OFF, AND THE CLOSING SPRINGS (1) (SEE FIGURE 1) ARE EXERTING THE LOAD ON THE SAFETY PIN (2). THE CLOSING SPRINGS SHOULD BE CHARGED WITH THE MAINTENANCE HANDLE, SO THAT THE SAFETY PIN CAN BE PLACED IN THE LOWER HOLE OF THE PUSH ROD (4). (THE UPPER HOLE IS USED IN THE INITIAL ASSEMBLY OF THE SPRINGS.) CONTINUE TO OPERATE THE MAINTENANCE HANDLE, THUS CLOSING THE BREAKER. THIS IS DONE SO THAT THE SAFETY PIN TAKES THE LOAD OFF THE SPRINGS.

FOLLOWING THE INSPECTION, THE CLOSING SPRING MUST BE RECHARGED, THE SAFETY PIN REMOVED FROM THE PUSH ROD, AND THE PIN PLACED IN THE SPRING CLIP (3).

HANDLING

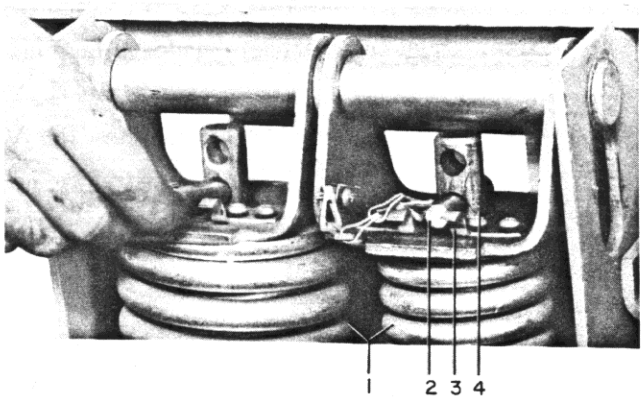
Care should be exercised in unpacking to avoid damage to breaker parts. Be sure that no loose parts are missing or left in packaging material. Blow out any dirt or loose particles of packaging material remaining on/or in the breaker unit.

If the breaker is not to be placed in service at once, it should be stored in a clean dry location in an upright position. It is also advisable not to cover the breaker with any material that 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.

INSTALLING STATIONARY COMPONENT

1. Place the stationary component in the switchboard compartment and push to the rear of the enclosure. Secure the stationary component to the switchboard vertical member with six bolts and to the switchboard front horizontal member with four bolts.

2. Bolt the switchboard bus and cables to the stationary component terminals. Provide the re-



1 Closing springs
2 Safety pin
3 Safety pin clip
4 Push rod

Figure 1. Installing safety pin in push rod

quired bracing to the buswork and cables to prevent the transfer of stresses, caused by possible short circuits, to the assembly terminals.

3. Connect control circuit wiring in accordance with the specific breaker wiring diagram.

4. To remove the stationary component, reverse the installation procedure.

INSERTING CIRCUIT BREAKER MOVING COMPONENT

NOTE

Before inspecting, installing or removing the circuit breaker, refer to the preceding safety precautions. Before installing the moving component, sparingly apply a coat of grease to the primary and secondary disconnects of the stationary component.

1. Make sure the breaker contacts are open.

2. Lift the breaker to a position approximately six inches above the height of the enclosure tray.

3. Move the drawout tray under the breaker as far as the tray will travel by moving the breaker stop pin release handle (6) (see figure 2) down and pulling the tray completely out.

4. Lower the breaker to a distance of about 1/2 inch 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 in back of the dowel pins.

5. 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 fit firmly on the tray.

6. Insert four 3/8-inch hexagonal head bolts through the holes in the front of the side angles of the breaker and thread them part way into the tapped holes in the tray. DO NOT TIGHTEN BOLTS FIRMLY. This permits self-alignment of the primary disconnects during the subsequent racking operation.

7. Push the breaker back into the compartment until the housing racking pins butt against the outer surface of the racking cam. In this position, the racking pin lifts 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 "connected" position.

NOTE

It is imperative that each stroke be performed with a positive motion and carried to its limiting position.

Interlocks hold the breaker trip-free until it is racked into the fully "connected" position. The fifth stroke of the handle is only a partial stroke and does not result in any further movement of the breaker. However, it does serve three useful purposes: (a) it positions the cam so that it cannot rotate and allow the breaker to back out under short-circuit stresses; (b) the partial stroke signals that the racking operation is complete; and (c) 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 should be completed because 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. This operation will reverse the pawl so that it is set for a racking-out operation.

NOTE

Any strokes beyond this point will cause the breaker to be trip-free.

Tighten the 3/8-inch hexagonal head bolts inserted in the front holes of the drawout tray. The breaker is now in the "connected" position.

WITHDRAWING CIRCUIT BREAKER MOVING COMPONENT

1. Trip the breaker to release the positive racking interlock and open the compartment door.

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 performed 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 five times to completely disengage the cams from their racking pins. After the fifth lifting stroke, let the handle drop to its normal position. This will reverse the racking pawl and set the mechanism for racking the breaker in again.

4. Move breaker stop pin release handle down and pull the breaker all the way from its compartment until the limit stop is reached.

5. Remove the four 3/8-inch hexagonal head bolts which hold the breaker on the tray.

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

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

8. The breaker can now be lowered to the desired position. When lowering the breaker, make sure it is held far enough away from the front of the switchgear so that its contacts do not interfere with devices or handles on the compartments beneath it as it is lowered.

MAINTENANCE

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. A complete inspection of the breaker, including contacts and arc quenchers, should be made after the breaker has interrupted a short circuit.

At regular inspection periods, the breaker should be operated manually to observe the contact alignment and to make sure all mechanism parts move freely without binding or excessive friction.

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

If overheating, not caused by overcurrent, is observed, a complete inspection of the breaker should be made, including connections and contacts. Inspect cable and bus connections for signs of overheating, and tighten all loose connections. Check to ascertain that all secondary connections are secure and all control wire is intact.

A complete contact inspection, including contact wipe and pressure, should be made at regular inspection periods and always after a known short-circuit current has been interrupted, to determine the condition of the contacts. It is necessary to remove the arc quenchers to properly inspect the contacts. Arcing contacts and arc quencher barriers should be replaced when they are eroded to half their original thickness.

At all times it is important that no pencil lines, paint, oil or other foreign materials remain on the insulating surfaces of the breaker since they may cause low resistance between points of different potential and result in eventual electrical breakdown.

Inspect all mounting bolts in the stationary component; tighten all bolts that appear loose.

Before replacing the breaker, check alignment and wipe clean the stationary primary and secondary contacts. Discoloration of the silvered surfaces is not ordinarily harmful unless atmospheric conditions cause deposits, such as sulphides, on the contacts. These deposits may be removed from the primary and secondary contacts by racking the breaker in and out several times. After cleaning the contacts, sparingly apply a fresh coat of grease to the stationary primary and secondary contacts.

REPLACING PARTS

Before replacing any part it is strongly recommended that the operator familiarize himself with all parts involved in making the replacement.

TROUBLE SHOOTING

Table 1 lists typical symptoms of breaker malfunctions, together with their causes and remedies. If at any time these symptoms are observed, their causes should be determined and the necessary corrective action taken.

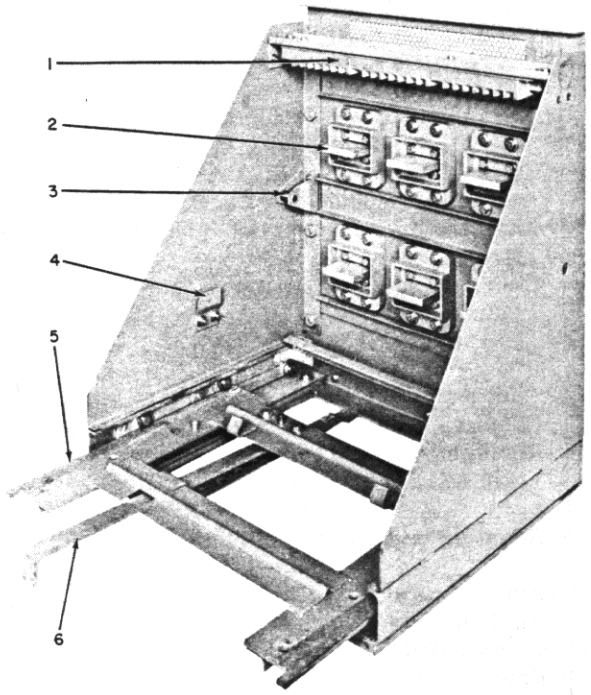
TABLE 1

TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Overheating	Contacts not aligned	Adjust contacts. See Section D-3.
	Contacts dirty, greasy or coated with dark film	Clean contacts.
	Contacts badly burned or pitted	Replace contacts. See Section E-1.
	Current-carrying surfaces dirty	Clean surfaces of current-carrying parts.
	Corrosive atmosphere	Check 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.
	Inductive heating	Correct bus or cable arrangement.
Failure to trip	Travel of tripping device does not provide positive release of tripping latch	Re-adjust. See Section D-12.
	Worn or damaged trip unit parts	Replace trip unit. See Section E-1.
	Binds in overcurrent trip device	Adjust overcurrent trip device. See Section D-12.
	Contacts binding in arc quencher	Remove high spots, or align arcing contacts. Replace arc quencher. See Sections E-1 and D-3.
False tripping	Overcurrent pickup too low	Check application of overcurrent trip device.
	Overcurrent time setting too short	Check application of overcurrent trip device.
	Bind in overcurrent trip device	Replace overcurrent trip device. See Section E-1.
Failure to close and latch	Binding in attachments preventing resetting of latch	Re-align and adjust attachments.
	Latch out of adjustment	Adjust latch. See Section D-4.
	Latch return spring too weak or broken	Replace spring. See Section D-4.
	Hardened or gummy lubricant	Clean bearing and latch surfaces.
	Safety pin left in push rod	Remove safety pin. See Section B-1.
	Motor burned out	Replace motor. See Section E-1.
	Faulty control circuit component	Replace or adjust faulty device. See Section E-1.
	Control voltage low	Increase control voltage.
Burned main contacts	Improper contact sequence (main contacts not sufficiently parted when arcing contacts part)	Increase arcing contact wipe. Adjust contact sequence by raising or lowering main movable contact pivot block. See Section D-3.
	Short-circuit current level above interrupting rating of breaker	Requires system study and possible replacement with breaker having adequate interrupting capacity.
	Loss of contact wipe or pressure	Replace stationary contact springs and dress up or replace contacts. See Section E-1.

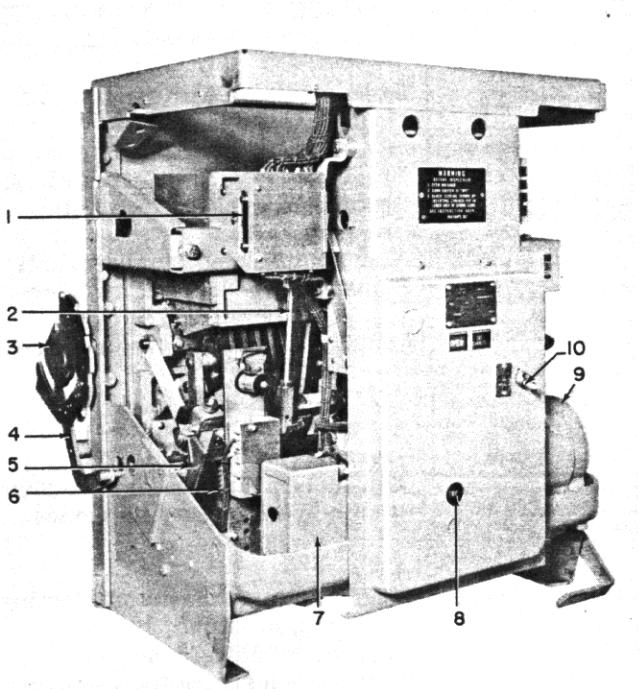
SECTION B-2
Description of Removable Assembly

The complete assembly of the ACB-1600HR and the ACB-1600HRC circuit breakers consists of a stationary component (see figure 2) that is mounted in the switchboard frame, plus a drawout-type moving component (see figure 3). The stationary component is an open box-type unit that is bolted to the front horizontal member in the switchboard frame. The stationary component contains the following parts: the six primary disconnects which serve as a separable connection between the switchboard stationary copper and the breaker moving component; the stationary portion of the secondary or control disconnects; a drawout tray which guides the circuit breaker element into the proper location; and two rollers which provide a support for the racking mechanism on the breaker.



1 Stationary secondary disconnects
2 Stationary primary disconnects
3 Racking pin
4 Drawout interlock cam
5 Drawout tray
6 Breaker stop pin release handle

Figure 2. Stationary component, with rollout tray shown in partial drawn-out position



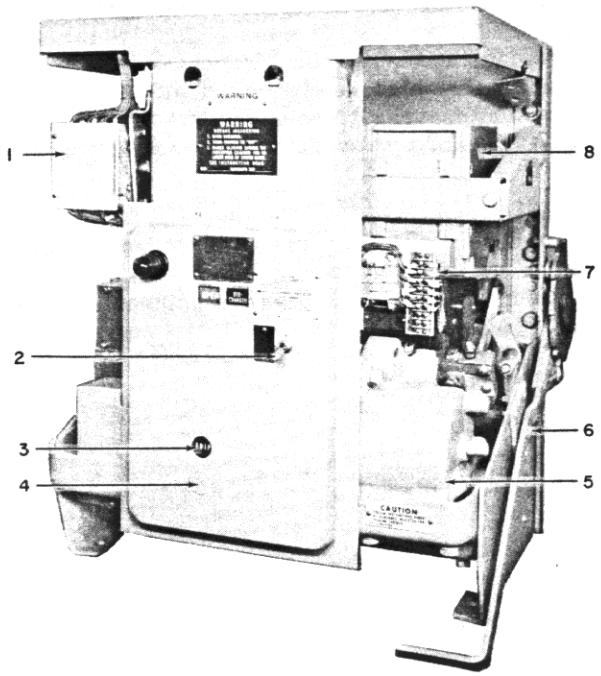
*1 Auxiliary switch**
2 Auxiliary switch operating linkage
3 Racking cam
4 Drawout interlock link
5 Anti-rebound hook
*6 Opening spring**
*7 Control relay**
8 Trip button
9 Gear reduction unit
10 Motor power switch

** Repair part*

Figure 3. Front oblique view of moving component

SECTION B-3
Description of Circuit Breaker

The Navy Type ACB-1600HR or the ACB-1600HRC circuit breakers are devices for interrupting in air a circuit between separable contacts under infrequent, normal and abnormal conditions. The interrupting rating is 100,000 amperes RMS at 500 volts, 60 cycles. The continuous current rating is 1600 amperes. Overcurrent trip coil ratings are 800, 1000, 1200, 1400, or 1600 amperes. The circuit breaker moving component (see figure 4) consists of two major parts: the back frame assembly and the front frame assembly. The back frame assembly (see figure 5) contains three pole unit assemblies, each mounted on an insulated molding. These moldings isolate the main current-carrying structure from the metal supporting base of the circuit breaker.

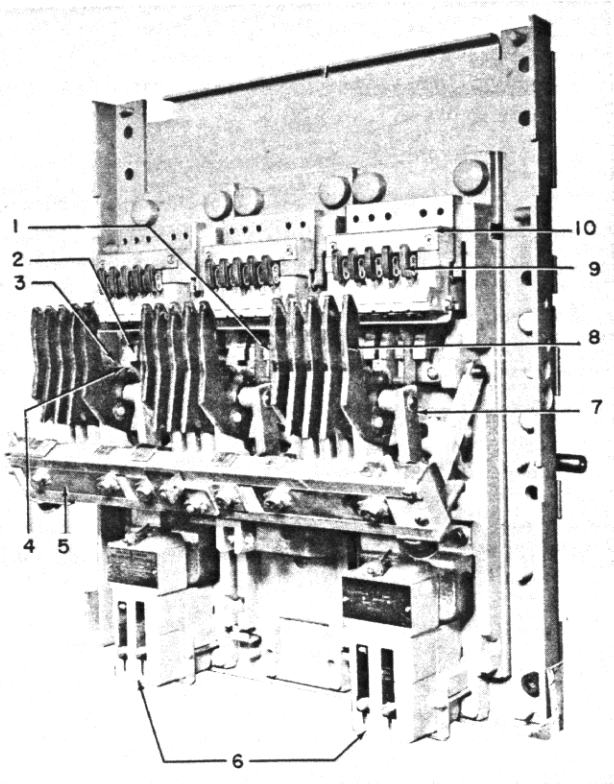


*1 Auxiliary switch**
2 Motor power switch
3 Trip button
4 Close button
5 Gear reduction unit
6 Drawout racking mechanism and handle
*7 Cut-off switches**
8 Arc quencher assembly

**Repair part*

Figure 4. Right side view of moving component

Each pole base serves as a mounting for the upper stud, the stationary and movable main contacts (2 and 4) (see figure 5), the stationary and movable intermediate contacts (1 and 3), the stationary and movable arcing contacts (8 and 9), the lower terminal (23) (see figure 7), series overcurrent coil, and the lower stud. These components are connected in series, in the order named, except the arcing con-



*1 Stationary intermediate contact**
*2 Stationary main contact**
*3 Movable intermediate contact**
*4 Movable main contact**
5 Crossbar
6 Overcurrent devices
7 Link
*8 Movable arcing contacts**
*9 Stationary arcing contacts**
10 Stop

**Repair part*

Figure 5. Front view of back frame assembly, moving component

tacts which are in parallel with the main contacts. The pole base linkage is arranged in such fashion that on opening, the main contacts open first, the intermediate contacts open second, and the arcing contacts open last to draw the arc into the arc quencher where it is promptly extinguished. The linkages of the three pole base units are connected together by an insulated crossbar (5) (see figure 5) that assures simultaneous operation of the three poles.

The coil of the series overcurrent trip device is mounted in series with the terminal and lower stud to detect the presence of an overcurrent. When an overcurrent condition exists, the movement of the armature to the closed air gap position engages the trip paddle, causing the trip shaft to rotate counter-clockwise. This releases the trip latch and trips the breaker open.

The front frame assembly (see figure 9) contains the operating mechanism which controls the opening and closing of the contacts on the back frame assembly. The front frame assembly also contains a motor and gear reduction unit and closing spring assembly. The motor and gear reduction unit operates through an output crank to pre-charge the closing spring assembly.

When a closing operation is desired, further charging of the closing springs results in the release of the energy stored in the closing springs. This energy is directed into the closing mechanism to close the contacts of the breaker. As the closing springs are discharged to close the breaker, the breaker is held closed by a prop in the mechanism assembly. Closing the breaker charges the opening springs which return the breaker to the open position on any subsequent tripping operation.

The shunt trip device, mounted on the mechanism frame, provides a means for tripping the breaker without regard to load conditions on the circuit. An auxiliary switch, which contains normally-open and normally-closed contacts and which is operated through linkage by the breaker crossbar, is incorporated for use in protective and control circuits. Manual tripping may be accomplished by manual operation of the trip button on the breaker escutcheon plate. The shock lock device, mounted on the right side of the operating mechanism, prevents the circuit breaker, when in the closed position, from tripping when subjected to a mechanical shock.

A racking mechanism, permanently mounted on the breaker, is used to insert and remove the breaker into and from the connected position. The drawout interlock is co-ordinated with the racking mechanism to prevent the insertion or removal of a closed breaker into or from the connected position.

The anti-rebound hook (5) (see figure 3) on the left side of the crossbar prevents accidental closing of the circuit breaker contacts, from the open position, when the circuit breaker is subjected to mechanical shock.

SECTION C-1
Operation of Circuit Breaker

CLOSING THE CIRCUIT BREAKER

Manual Operation (Maintenance Closing)

To observe the operation of the breaker without power, with the breaker open and springs discharged, proceed as follows:

1. Place the special ratchet-type maintenance handle, furnished with switchgear, on shaft (12) (see figure 11).

2. Charge the closing springs with the maintenance handle until the indicator (4) (see figure 10) reads "charged."

3. Continue to operate the maintenance handle until the breaker closes.

Electrical Operation (Normal Operation)

With the breaker opened and the closing springs discharged, the cycle for electrical operation is as follows:

1. The breaker will close only when the closing mechanism is in the charged position and the breaker is in the open position, as shown by their respective indicators. This is the reset position.

2. The motor and gear reducing mechanism charges the closing springs in the front frame through the linkage of the operating mechanism. This occurs automatically whenever the breaker is opened and the control power is still on.

3. When the closing control circuit is energized, the motor mechanism forces an over-center cam to travel past dead center. This releases the closing springs which close the breaker. The closing mechanism is now discharged and the breaker is closed.

TRIPPING THE CIRCUIT BREAKER

The breaker may be tripped by using the manual trip button, the shunt trip device, the undervoltage device, or by the overcurrent trip unit.

To trip the breaker manually, depress the trip button on the breaker escutcheon. This will trip the breaker manually through mechanical linkage. When the trip button is released, it will return to its normal position.

To trip the breaker electrically, turn the control switch, which is remotely located, to the TRIP position to energize the shunt trip coil. With this trip coil circuit closed, the shunt trip device will operate, causing the trip shaft to rotate in a counterclockwise manner, displacing the trip latch and tripping the breaker.

The undervoltage trip device will trip the circuit breaker, through the action of trip paddles, when voltage on the coil falls below the predetermined value.

The overcurrent trip unit will open the circuit breaker by rotating the trip shaft, through the action of the trip paddles, whenever the current exceeds the designated pickup values.

SECTION C-2
Typical Wiring Diagrams

Figures 24 and 26 show a typical elementary and connection diagram for the control of electrically-operated breakers. The diagram shows the breaker in the open position with the closing springs discharged. When the normal control voltage is applied to the control circuit, the motor will be energized through the normally-closed contacts F(3-4), R(Z1-Z2), X(8-4), E(3-4), L(2-2C), R(Z3-Z4), and J(1-2), until the precharging of the closing springs is completed. This occurs approximately 30 cycles before the spring-charging cam reaches the top dead-center position. The precharging operation is then concluded by the operation of the E and F switches. Cam-switch contact F(3-4) isolates the motor from the control power source and a dynamic brake is applied by reversing the motor field R(Z1-Z2) through the contacts E(2-1), X(4-8), R(Z2-Z1), X(7-3), F(1-2), L(2-2C), and R(Z3-Z4). The closing operation can then be obtained by using the remote close switch to complete the circuit. Operation of the closing switch causes relay X to pick up and close contact X(1-7), and thus completes the motor circuit through X(1-7), R(Z1-Z2), X(8-2), F(1-2), L(2-2C), and R(Z3-Z4). The motor carries through the spring-charging operation until the cam goes over top dead center. At this point the springs will discharge independently of the motor and close the breaker. The motor circuit is then interrupted by the contacts of switches E and F, which will revert to their original positions as shown in figures 24 and 26. The precharging operation, for the succeeding closing operation, is blocked by contact X(8-4) if contact is maintained on the remote switch and contact L(2-2C) remains open. If the remote switch contact has been released and the breaker is in the open position, the breaker will precharge the closing springs automatically as long as control power is available.

NOTE:

Figures 24 and 26 contain typical elementary and connection diagrams for explaination of operation of breaker. For checkout and maintenance purposes, use complete switchboard wiring diagram included in switchboard manual.

The operation of the remote trip switch, with the breaker closed, will cause the shunt trip coil to be energized and trip the breaker. The trip impulse is interrupted by the "a" contact of the auxiliary switch as the breaker opens.

SECTION D-1
General Assembly of Circuit Breaker

The various components and attachments of the moving component of the ACB-1600HR and the ACB-1600HRC circuit breakers are mounted on the front frame. Current-carrying parts are insulated from the breaker frame by the use of insulated bases. The main current-carrying contacts and arc chutes are located at the top of the breaker. The series overcurrent trip devices are mounted on the bottom of the insulated bases. The operating mechanism is centrally located in the front of the breaker. A mechanical position indicator is mounted on the front escutcheon just below the breaker nameplate. The shock lock for the trip shaft is mounted on the right side of the mechanism frame and the latch is mounted on the trip shaft. The manual trip button is located on the front escutcheon under the open and close indicator.

The gear reduction unit is mounted to the right of the front channel with the motor mounted behind it. The closing relay is located on the lower left side of the front channel below the auxiliary switch. The shunt tripping device is mounted to a bracket attached to the left side of the operating mechanism, and operates in series with an auxiliary switch contact. The undervoltage device is mounted to a bracket attached to the left side of the breaker side sheet, and trips the breaker when voltage falls below a predetermined setting.

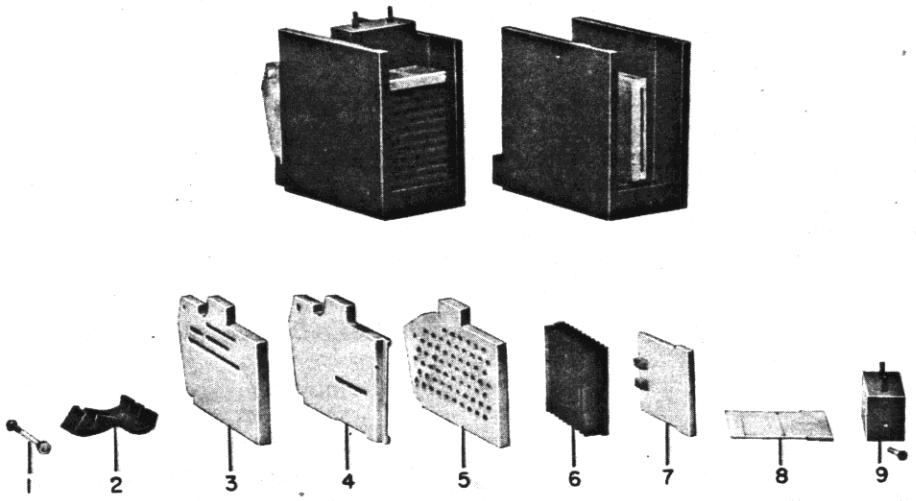
SECTION D-2
Arc Quencher

DESCRIPTION

The arc quencher extinguishes the arc when the circuit is interrupted. It also confines the arc products and isolates the pole units.

OPERATION

Each arc quencher (see figure 6) is made up of a number of inner barriers (5), two side barriers (3), and two pocket barriers (4). The inner barriers are held in place by the spacer block (9), steel back plate (8), compound support (7), and the muffler (6). The side and pocket barriers are held in place by the stud (1) and cap (2).



1 Stud
2 Cap
3 Side barrier
4 Pocket barrier
5 Inner barrier
6 Muffler
7 Compound support
8 Steel back plate
9 Spacer block

Figure 6. Disassembly of arc quenchers

SECTION D-3
Contact Assembly

DESCRIPTION

The function of the contact assembly is to open and close the circuit and to minimize the possibility of damage due to arcing.

OPERATION

Each pole unit assembly (see figure 7) consists of a set of arcing contacts, a set of main contacts, the actuating linkage, and the mounting base.

The stationary arcing contact consists of a set of parallel contact fingers (4), pin (8), and compression springs (5 and 6). These springs provide continuous contact pressure for the full travel of the contacts. Conducting leaf springs (9) shunt the pivot pin to prevent possible pitting at the pivot pin when interrupting high currents.

The movable arcing contact assembly consists of parallel contact arms (11) carried on two movable pivot pins (18 and 29). The contacts interleaf and pivot with respect to the main contacts about the pin (29). This relative motion is obtained by linkages from the upper pin (16) to the breaker mechanism.

The stationary main contact assembly includes current-carrying contacts and intermediate contacts at one end of the assembly.

The movable main contacts pivot around a stationary pin (27) which holds them to the terminal. These contacts are actuated by a second pin (16), connected by an insulated link (17) to the breaker mechanism. The conducting leaf springs (24) serve as shunts and also force the contacts against the pins to prevent pitting at the pivot point. The intermediate contacts are built up higher than the main contacts and subsequently will make before and break after the main contacts.

To function properly, a definite amount of contact pressure must be exerted between the movable and stationary contacts and a definite amount of contact wipe must exist on all contacts. Table 2 gives the figures for contact wipe and contact pressure which should be checked during regular inspections.

CONTACT ADJUSTMENTS

Measuring Contact Pressure

1. Remove arc quenchers (refer to Section D-2).

2. Close the breaker and measure dimension "B" (see figure 7).

3. Open the breaker. Place a push-type scale against the stationary arcing contacts at a point measured in line with the break between the contact stop and the contact pivot block. Push the contact backward until dimension "B" recorded in step 2 is reached. The scale should then be read.

4. If the pressure is not within the requirements listed in Table 2, refer to the paragraph below, "Adjusting Contact Wipe and Pressure."

Measuring Contact Wipe

1. Remove arc quenchers (refer to Section D-2).

2. With the breaker open, measure the horizontal distance from the edge of the stationary contact to the stationary block behind it ("B" dimension for arcing contacts; "C" dimension for main contacts). (See figure 7.)

3. Close the breaker and take the measurements discussed in step 2. The difference between the readings in steps 2 and 3 determines the wipe of the contacts.

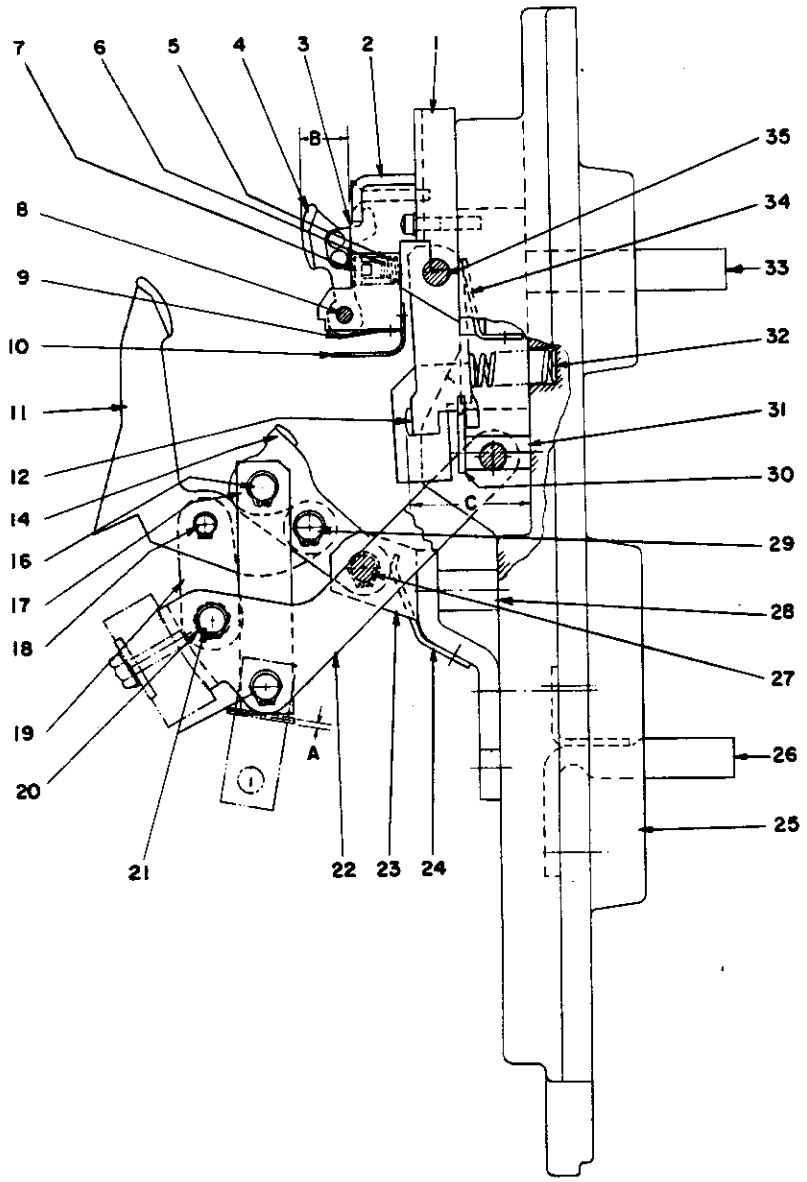
WARNING

BE EXTREMELY CAREFUL NOT TO TRIP THE BREAKER.

4. If the wipe is not within the requirements listed in Table 2, refer to paragraph below, "Adjusting Contact Wipe and Pressure."

Adjusting Contact Wipe and Pressure

1. To obtain proper contact wipe and pressure on the center pole, dimension "A" (see figure 7)



1 *Spacer*
2 *Stop*
3 *Block*
4 *Stationary arcing contact**
5 *Spring (outside) **
6 *Spring (inside) **
7 *Spring guide*
8 *Pivot pin*
9 *Leaf spring*
10 *Insulation*
11 *Movable arcing contact**
12 *Stationary main contact**
14 *Movable main contact**
16 *Pin*
17 *Link*
18 *Pin*
19 *Link*
20 *Insulating tube*
21 *Pin*
22 *Side link*
23 *Terminal*
24 *Leaf spring*
25 *Pole unit base*
26 *Lower stud*
27 *Pivot pin*
28 *Spacer*
29 *Pivot pin*
30 *Contact stop*
31 *Spacer*
32 *Contact spring**
33 *Upper Stud*
34 *Leaf spring*
35 *Pivot pin*

* *Repair part*

Figure 7. Pole unit assembly

should be increased to increase wipe and decreased to decrease wipe.

2. To change dimension "A," remove the clevis pin (12) (see figure 8) and rotate the clevis (13) as necessary.

3. To prevent overstressing the clevis threads, dimension "A" should not exceed 3/16 inch and space "A" should be filled with 0.005 shims until solid.

4. With the proper center pole wipe obtained, moving the crossbar adjusting plate on the center pole to the right will simultaneously increase the wipe on both outside poles; moving the adjusting plate to the left will have the reverse effect.

5. To increase the wipe on either outside pole individually, move the crossbar adjusting plate of that pole to the left; to decrease the wipe, move the adjusting plate to the right and at the same time move the serrated side link (22) (see figure 7) up or down in relation to the crossbar as required.

NOTE

If the proper contact pressure does not exist when the contact wipe is within its limits, the stationary contact springs should be replaced.

Contact Sequence (See Figure 7)

On the horizontal plane, the difference in the making of the arcing contacts on the same pole must be no greater than 1/32 inch; the difference between arcing contacts on separate poles must be no greater than 1/16 inch. If it is desired to advance or retard the closing of the main contacts of a pole, loosen the bolts holding the adjustment plate of that pole and slide the plate to the left to advance contact closing and to the right to retard contact closing. Make this adjustment on the outer poles, using the center pole as a reference. When retightening the adjustment plate bolts, make sure the locking tabs are turned up around the bolt heads to lock the bolts securely in place.

Contact sequence in the vertical plane should be such that when the arcing contacts are just touching, the intermediate contact gap should be at least 3/16 inch, and the main contact gap at least 1/4 inch.

NOTE

This check can best be made using the maintenance handle, with the safety pin restraining the closing springs.

If the gap is under the required minimum, it is usually possible to form the arcing contacts and obtain the required dimensions. To form the contacts, place a piece of conduit, approximately two feet long, over the contact and form the contact either forward or backward. If the proper dimensions are still not obtained, the movable arcing contacts should be replaced.

If it has been necessary to make any adjustments while obtaining proper contact sequences, the contact wipe and pressure must be checked and, if necessary, adjusted.

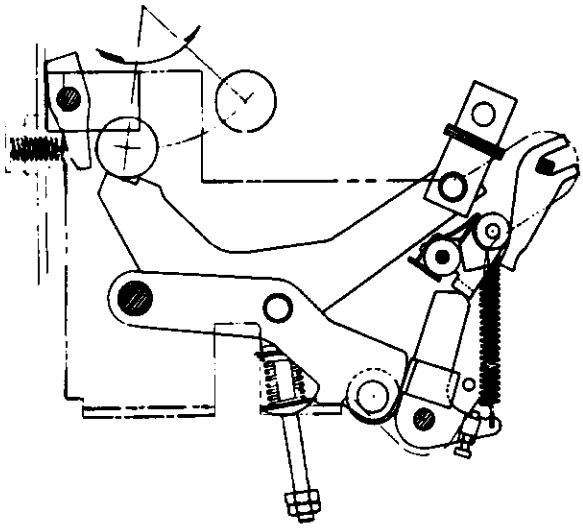
Contact Gap

When the breaker is open, the gap between the movable and stationary contacts should be between 2-5/8 inches and 2-3/4 inches. The gap may be adjusted, after contact wipes are maintained within tolerance, by adding or removing washers between the crossbar and the head of the buffer bolt.

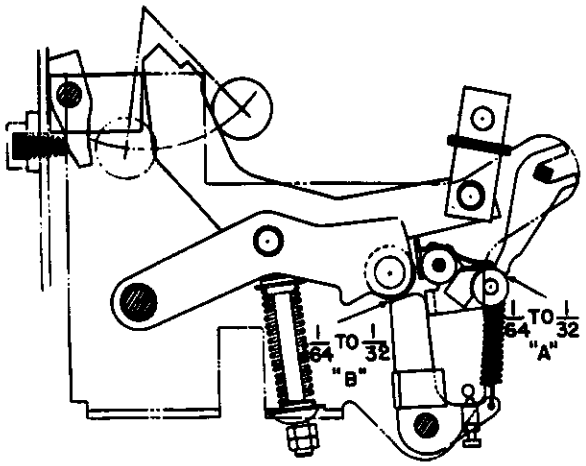
TABLE 2

CONTACT PRESSURES AND WIPES

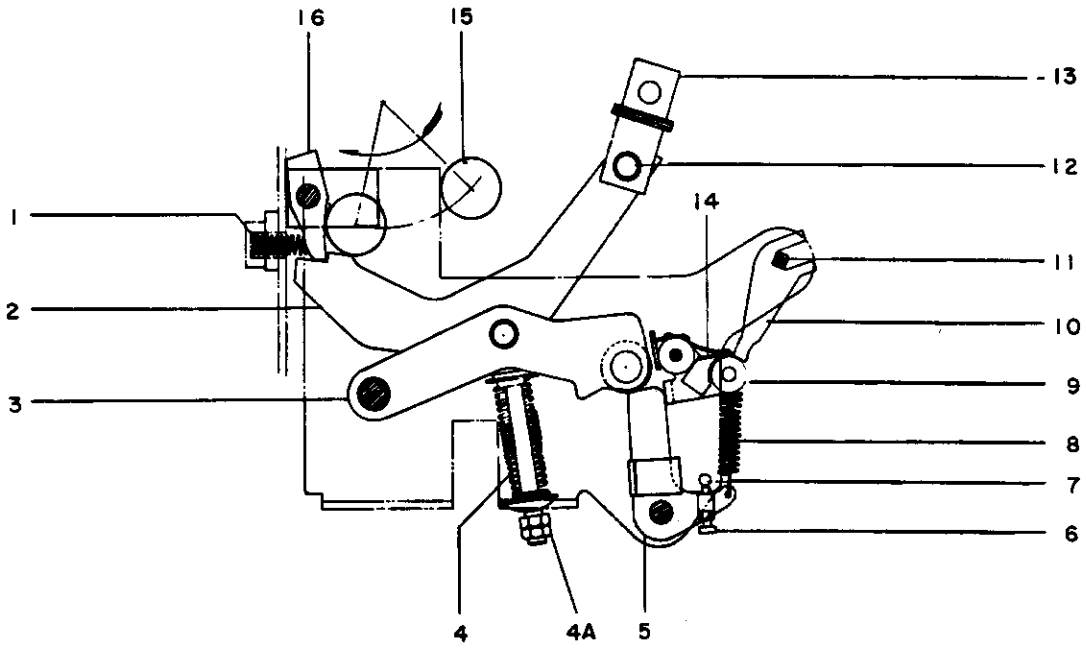
	No. of Contacts per Pole	Pressure (Lbs)	Wipe (Inches)
Main Contacts	3	58 to 68	1/16 to 3/32
Intermediate Contacts	1	58 to 68	(1/16 inch greater than main contact wipe)
Arcing Contacts	3	31 to 43	12/64 to 18/64



PART A
MECHANISM IN MOTION BEFORE RESETTING



PART B
MECHANISM IN RESET POSITION

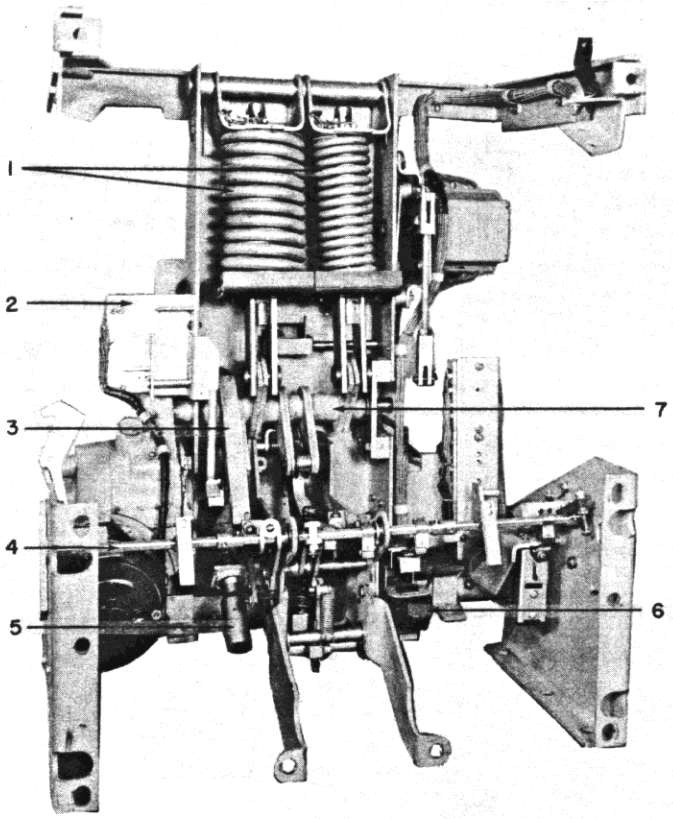


PART C
MECHANISM IN CLOSED POSITION
(CLOSING SPRING DISCHARGED)

1 *Spring**
2 *Cam*
3 *Link*
4 *Reset spring**
4A *Nut*
5 *Prop*
6 *Adjusting screw*
7 *Stop pin (adj. screw)*
8 *Prop return spring**
9 *Roller*
10 *Latch*
11 *Trip shaft*
12 *Clevis pin*
13 *Clevis*
14 *Mechanism latch*
15 *Roller*
16 *Prop*

* *Repair part*

Figure 8. Operating mechanism assembly



1 Closing springs
*2 Cut-off switches**
3 Paddle
4 Trip shaft
5 Shock lock device
6 Shunt trip device
7 Crankshaft and spring charging arms

** Repair part*

Figure 9. Rear view of front frame and mechanism assembly, moving component

SECTION D-4
Electrical Operating Mechanism

DESCRIPTION

The operating mechanism is used to open and close the breaker electrically.

OPERATION

The electrically-operated mechanism includes a motor and a gear reduction unit which charges the closing springs (16) (see figure 10) through a crankshaft (14). The crankshaft has an arm (13), with a roller (12), which rides on the closing cam (2) (see figure 8) of the operating mechanism. The position of this closing cam roller (12) is shown in figure 10. The closing cam is pinned to the center pole unit with a clevis and, through the crossbar, controls the opening and closing of the contacts.

With the breaker "open" and closing springs "discharged," the sequence of operation is as follows:

Charging the Closing Springs

1. The mechanism is in the position shown in figure 8A.

2. The motor (9) (see figure 10) turns the crank (10) which is mounted on the output shaft of the gear reduction unit. The charging roller (7), which is on the face of the crank, has paddle arm (11) bearing on it.

3. As the crank turns, the roller pushes the paddle arm upward, thereby charging the closing

springs, through the spring charging arm (15) of the crankshaft (14).

4. As the charging roller (7) approaches dead center, the cut-off switches reverse their contacts. This action applies the dynamic brake to the motor which prevents the charging mechanism from coasting to an over-center position allowing discharge of the closing springs.

5. The mechanism is now in the reset position (figure 8B), and the breaker is ready to close when a closing signal is given.

Closing the Breaker

1. With the mechanism in the position just described, and the closing springs charged, the application of a closing signal will cause the motor to continue to charge the closing springs. As the charging roller (7) (see figure 10) passes its top dead-center position (maximum spring charge position), the closing springs are free to discharge. Crank (10) can be overdriven independently of the motor so that roller (7) assumes its bottom dead-center position without restraint.

2. As the springs discharge, the rotation of the crankshaft (14) causes roller (15) (see figure 8) to rotate cam (2) and raise clevis (13). Prop (16) holds cam (2) in this position.

3. Raising clevis (13) closes the breaker contacts through the pole base linkage.

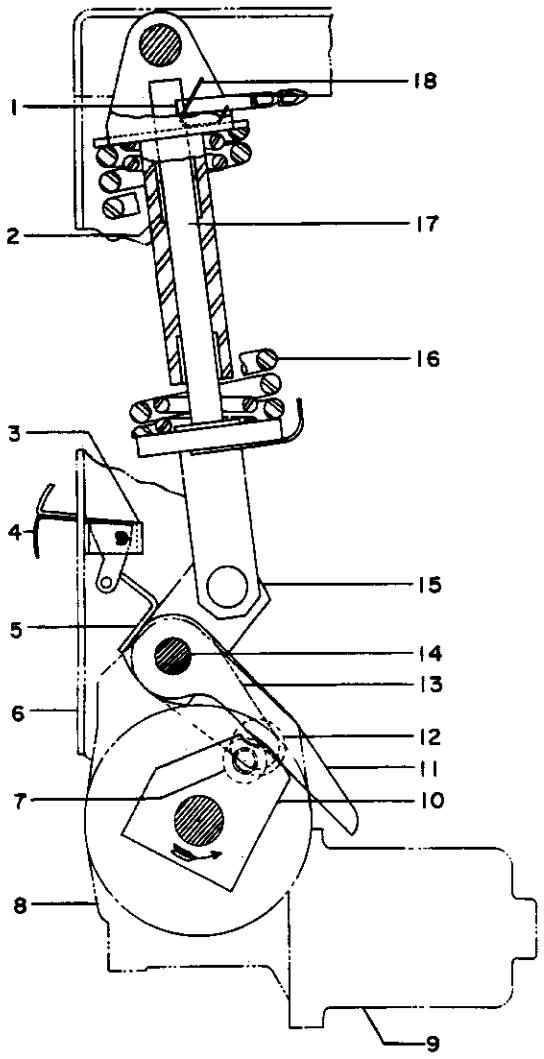
Opening the Breaker

Operation of any of the trip devices rotates the trip shaft (11) (see figure 8) which allows the trip latch (10) to release the latch prop (5). This allows the forces of the contact and opening springs to reposition the operating mechanism linkage to the position shown in figure 8B, if the closing springs are pre-charged. In this position the operating cycle may be repeated. If the closing springs are not pre-charged, the operating mechanism linkage will return to the position shown in figure 8A.

ADJUSTMENTS

All adjustments should be made with the operating mechanism in the reset position as shown in figure 8B. (The mechanism should be reset by manual operation with the safety pin in place.)

1. The gap between the trip latch (10) (see figure 8) and the roller (9) of the reset latch should



1 Pin	*10 Crank*
2 Bushing	*11 Paddle*
3 Bracket	*12 Closing cam roller*
4 Indicator	*13 Closing cam shaft*
5 Bracket	*14 Crankshaft*
6 Frame	*15 Spring charging arm*
7 Charging roller	*16 Closing spring**
8 Gear reduction unit	*17 Push rod*
*9 Motor**	*18 Clip*

** Repair part*

Figure 10. Closing spring and charging mechanism

be between 1/64 inch and 1/32 inch "A" dimension. This adjustment can be obtained by turning adjusting screw (6).

2. The center line of the trip latch (10) should pass through the center of the roller (9) to provide 5/32 inch + 1/32-0 inch latch wipe. To maintain this adjustment, the latch buffer stop is on the mechanism frame and can be adjusted by loosening the retaining screws to reposition the mechanism latch (14).

3. The distance between the roller on link (3) and prop (5) should be between 1/64 inch and 1/32 inch "B" dimension. To obtain this gap, advance or retard the nuts (4A) on the bottom of the rod, using the reset spring (4).

SECTION D-5

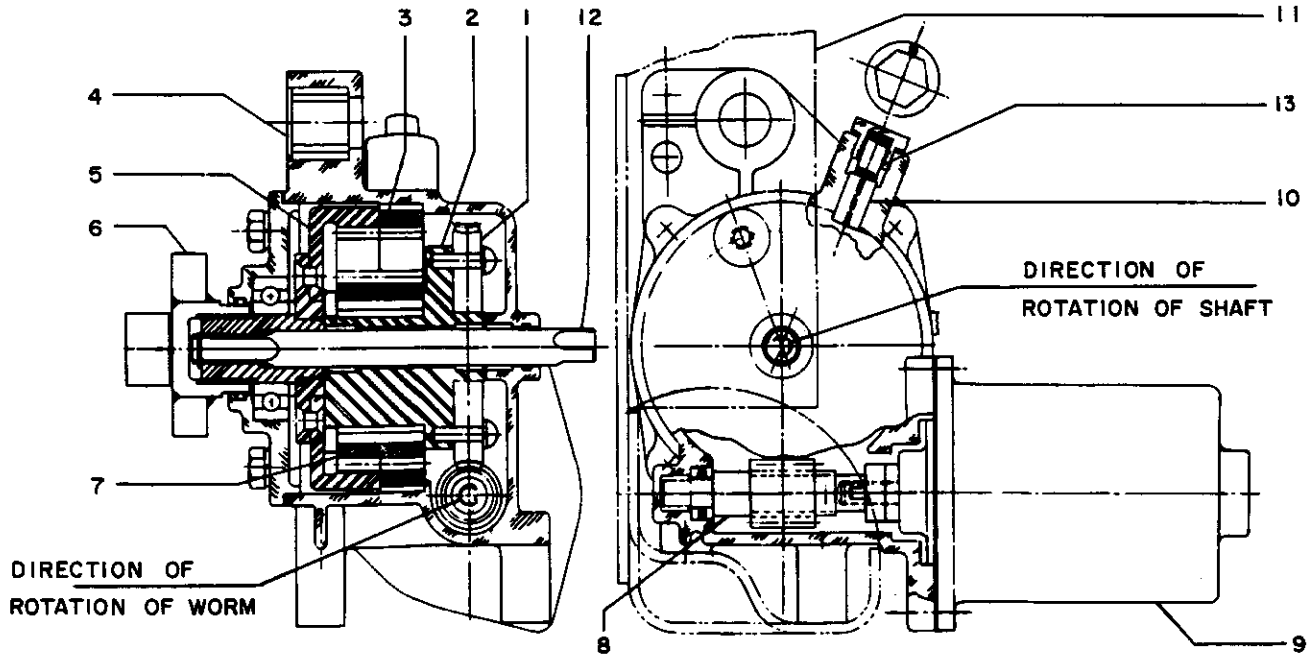
Motor and Gear Reduction Unit

DESCRIPTION

The motor and gear reduction unit provides the force to close the mechanism. The motor (9) (see figure 11) is mounted on the side of the gear reduction unit.

OPERATION

The motor, through a worm gear (1) (see figure 11) and a planetary gear train drives the crank with a reduction of 1000:1 to charge the closing springs.



1 Worm gear
2 Eccentric
3 Ring gear
4 Gear box
5 Internal gear assembly
6 Cam plate
7 Pinion gear
8 Worm shaft assembly
*9 Motor**
10 Ratchet pin
11 Front frame
12 Shaft for manual operating handle
*13 Spring for motor mechanism ratchet**

**Repair part*

Figure 11. Motor and gear reduction unit

SECTION D-6
Manual Trip

DESCRIPTION

The manual trip is used to trip the breaker manually through mechanical linkage.

OPERATION

The manual trip button device (8) (see figure 3) protrudes through the front escutcheon and extends through the operating mechanism frame. When the push button is pushed inward, it rotates the trip shaft counterclockwise, thus opening the breaker. The push button, when released, is brought back to its original position by a return spring.

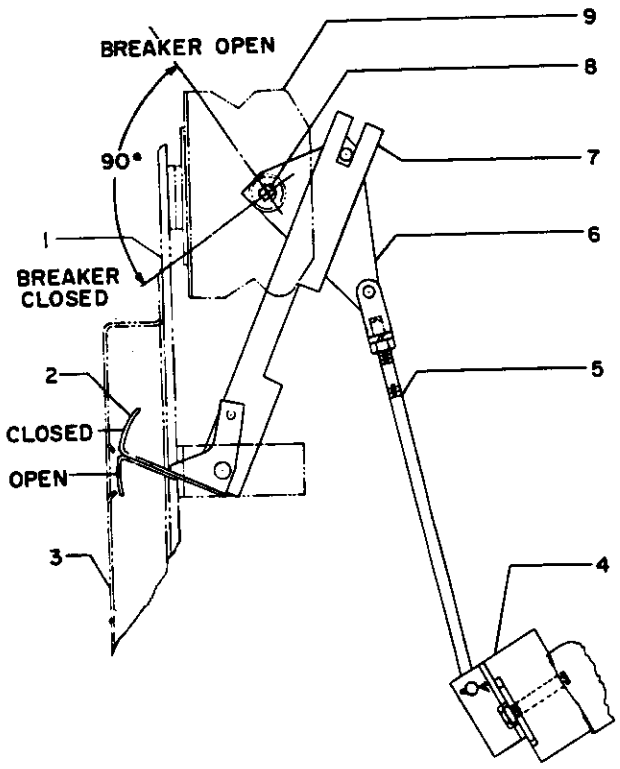
SECTION D-7
Position Indicator

DESCRIPTION

This position indicator shows whether the breaker is in the open or closed position.

OPERATION

When the breaker opens, the operating rod (5) (see figure 12), which is attached to the crossbar (4), turns the triangular link (6) clockwise, thus moving the link (7) to the rear. The indicator target (2) is rigidly fastened to link (7) and will be in the position shown in figure 12 when the breaker is completely opened.



1 Frame
2 Open and closed indicator
3 Front escutcheon
4 Crossbar
5 Operating rod
6 Triangular link
7 Link
8 Operating shaft
*9 Auxiliary switch**
**Repair part*

Figure 12. Open and closed indicator and auxiliary switch linkage

SECTION D-8

Springs Charged and Discharged Indicator

DESCRIPTION

The charged and discharged indicator shows the position of the closing springs.

OPERATION

When the springs are charged, the charging roller (7) (see figure 10) pushes up the paddle (11) which is tied to a link. The link is fastened to the indicator target (4) which will be in the position shown in figure 10. When the springs are discharged the indicator will move down, indicating that the springs are in the discharged position.

SECTION D-9

Auxiliary Switch

DESCRIPTION

The auxiliary switch is used in various control circuits to make and break circuits as the circuit breaker is opened and closed.

OPERATION

The auxiliary switch is mounted on the left side of the front frame (looking from the front). As the crossbar (4) (see figure 12) moves with the contacts to the open or closed position, it operates a triangular link (6), rotating the operating shaft (8) of the auxiliary switch. This shaft, through its cams, opens and closes the auxiliary switch contacts. Normally, the top terminals of the switch are "a" contacts (open when the breaker is open) and the bottom terminals are "b" contacts (open when the breaker is closed).

REVERSAL OF CONTACTS

In order to change "a" contacts into "b" contacts or vice versa, proceed as outlined in the following paragraphs.

Top Contacts (Normal "a" Contacts)

1. Remove top and bottom covers (4 and 6) (see figure 13).

2. Remove auxiliary switch from the breaker and place in position shown in figure 13A.

3. Unscrew four tie bolts (2) and remove end plate (5).

4. Remove pin (16).

NOTE

The pin is in parallel with the arrow on the auxiliary switch shaft (3).

5. Lift top cam (14) off the shaft (3), rotate 90 degrees, and turn it upside down.

6. Replace cam (14) on shaft (3). It should now be in the position shown in figure 13C.

7. Replace all parts in the reverse order of disassembly.

Bottom Contacts (Normal "b" Contacts)

1. Follow steps 1, 2 and 3 outlined for top contacts in the preceding paragraph.

2. Lift top cam (14) (see figure 13) off the shaft (3).

3. Lift top cam follower (11) off its pivot pin.

NOTE

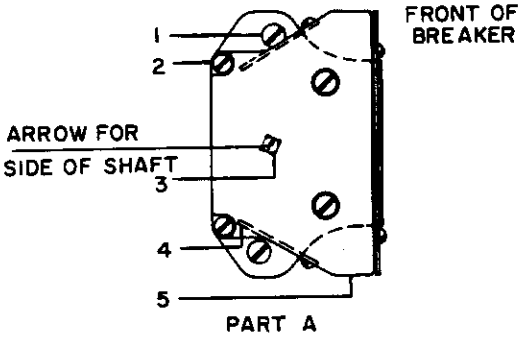
Do not allow contact pivot pin (13) to drop out.

4. Lift bottom cam (15) off the shaft (3), rotate it 90 degrees, and replace it on shaft. It should now be in the position shown in figure 13E.

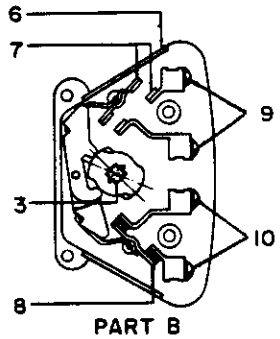
5. Replace all parts in the reverse order of disassembly.

NOTE

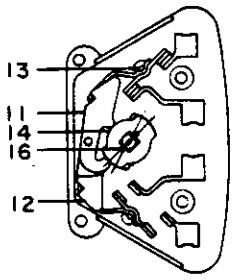
The adjustments described in the preceding two paragraphs can be made on any desired stage; each stage (one set of top and bottom contacts) can be individually lifted off the shaft. In replacing stages, be sure to check cam positions against the diagrammatic sketches shown in figures 13A, B, C, and D.



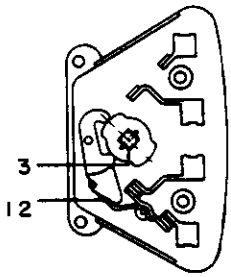
PART A



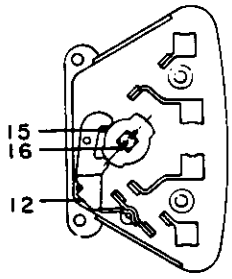
PART B
TOP CONTACTS
NORMAL CAM POSITION
"a" CONTACT (BREAKER OPEN)



PART C
TOP CONTACTS
REVERSE CAM POSITION
"b" CONTACT (BREAKER OPEN)



PART D
NORMAL CAM POSITION
"b" CONTACT (BREAKER OPEN)



PART E
REVERSE CAM POSITION
"a" CONTACT (BREAKER OPEN)

BOTTOM CONTACTS
WITH CAM & FOLLOWER OF TOP CONTACTS REMOVED

1 Mounting screw
2 Tie bolt
3 Auxiliary switch shaft
4 Bottom cover
5 End plate
6 Top cover
7 Top contacts
8 Bottom contacts
9 Top terminals
10 Bottom terminals
11 Top cam follower
12 Bottom cam follower
13 Contact pivot pin
14 Cam (top)
15 Cam (bottom)
16 Pin

**Repair part*

*Figure 13. Auxiliary switch**

SECTION D-10
Shock Lock

DESCRIPTION

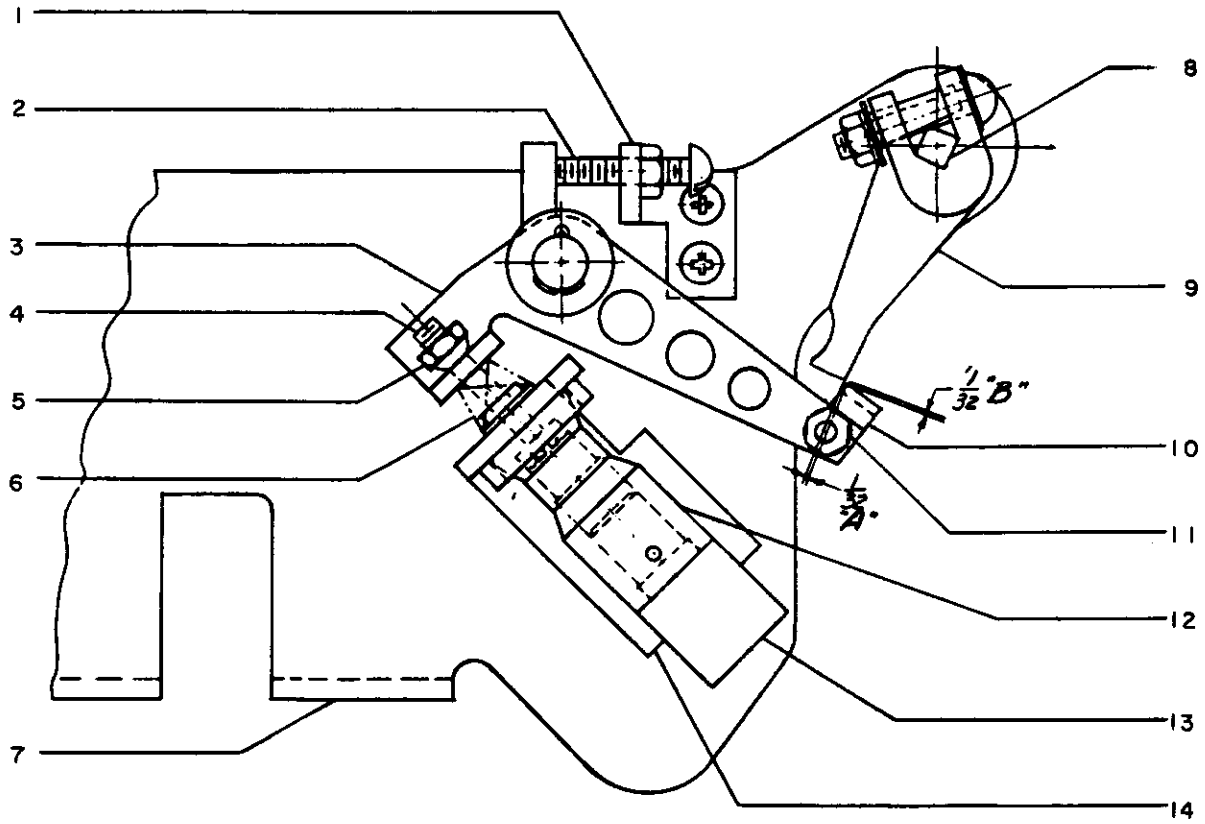
The purpose of the shock lock is to prevent the breaker from opening because of shock.

OPERATION

The shock lock consists of weights (12 and 13) (see figure 14), latch arm (3) and a latch (9). The weight and latch arm assemblies are mounted on the right side of the mechanism frame and the latch is mounted on the trip shaft (8). When a shock occurs, the weights (12 and 13) force latch arm (3) over latch (9), thereby preventing the trip shaft (8) from rotating and tripping the breaker. After the shock subsides, the lever return spring (6) will return the latch arm (3) to its original position.

ADJUSTMENTS

The adjusting nut (11) (see figure 14) and screw should be set on the serrated portion of the mating surface of the latch arm (3). Plate (10) should be firmly seated before tightening the adjusting nut (11).



1 Bracket
2 Adjusting screw
3 Latch arm
4 Adjusting screw
5 Stop nut
*6 Spring**
7 Mechanism frame
8 Trip shaft
9 Latch
10 Latch plate
11 Adjusting nut
12 Upper weight
13 Lower weight
14 Mounting bracket
**Repair part*

Figure 14. Shock lock device

The "B" adjusting screw (2) (see figure 14) should be set so that the "B" dimension is 1/32 inch maximum. The adjusting screw (4) is used to tighten the tension on spring (6) and to keep weights (12 and 13) taut. To check the operation of the shock lock to make sure that it will not interfere with the tripping of the breaker, proceed as follows:

WARNING

WHEN CHECKING THE OPERATION OF THE SHOCK LOCK, BE SURE THAT ALL MEMBERS OF THE OPERATOR'S BODY ARE CLEAR OF THE MOVING PARTS ON THE BREAKER.

1. Close breaker.

2. Hold the weight in the deflected position.

3. Push the trip button on the breaker front escutcheon.

4. Release the weight while maintaining pressure on the trip button.

5. The shock lock should reset and should not prevent the breaker from opening.

SECTION D-11

Electrical Closing Devices and Controls

OPERATION

The motor power switch, relay and motor mechanism are provided for closing the breaker electrically.

DESCRIPTION

Motor Power Switch

The motor power switch (10) (see figure 3) is located on the front escutcheon and is used to turn the motor power off and on.

Control Relay

The control relay (7) (see figure 3) is mounted on a plate to the left of the front escutcheon. It is used to open and close the motor circuit.

Cut-off Switches

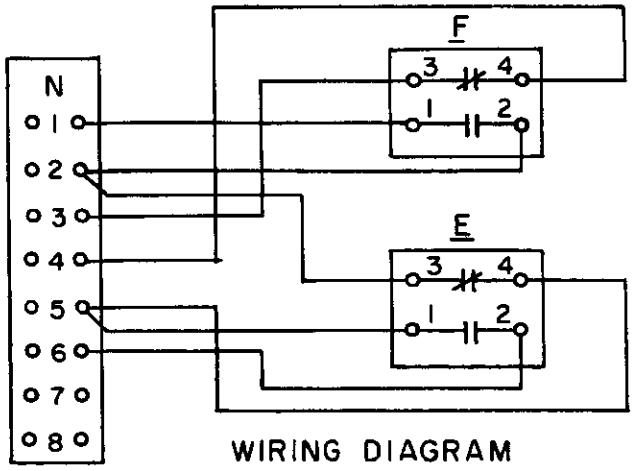
The motor cut-off switches are mounted as shown in figure 15. In this position, the closing springs are charged. When lever (5) reaches a predetermined position, the cut-off switches operate.

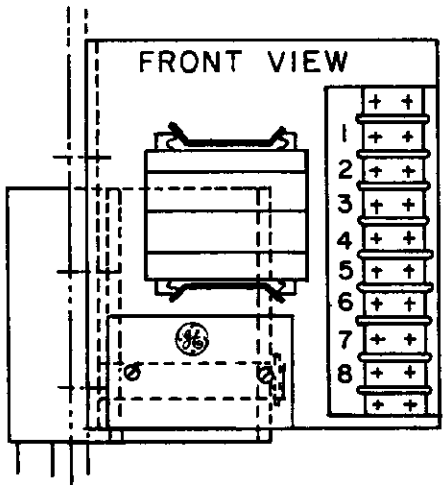
ADJUSTMENTS

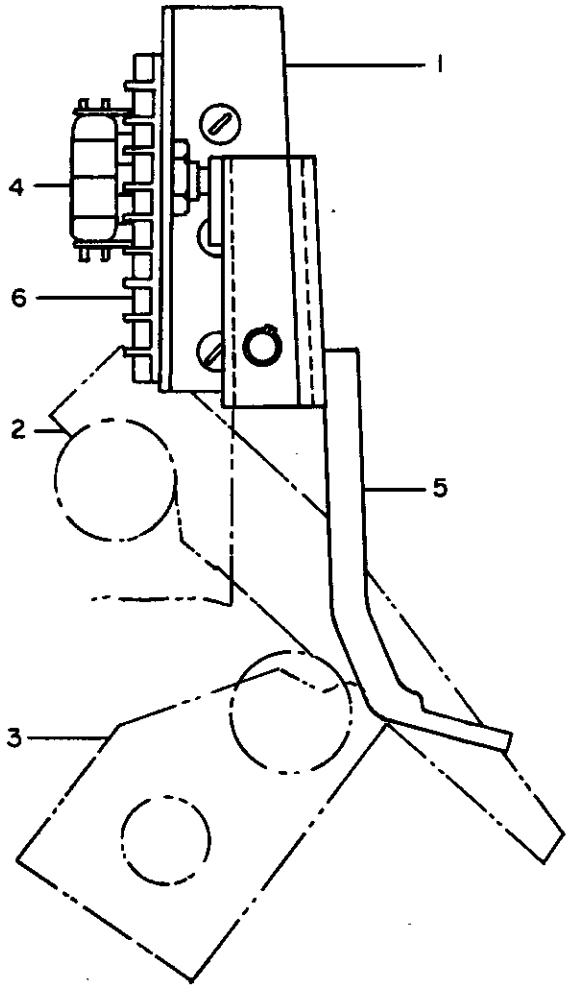
The switch assembly is pre-adjusted at the factory and no further readjustment should be required.

If considered necessary shipboard check of the adjustments should be made as follows:

Obtain positive toggling of the F and E switch by forming Part 5, figure 15. The switches must toggle as Part 5 climbs the step on Part 3.







1 Mounting bracket
2 Paddle
3 Crank
4 Motor cut-off switch
5 Lever
6 Terminal block

**Repair part*

*Figure 15. Cut-off switch**

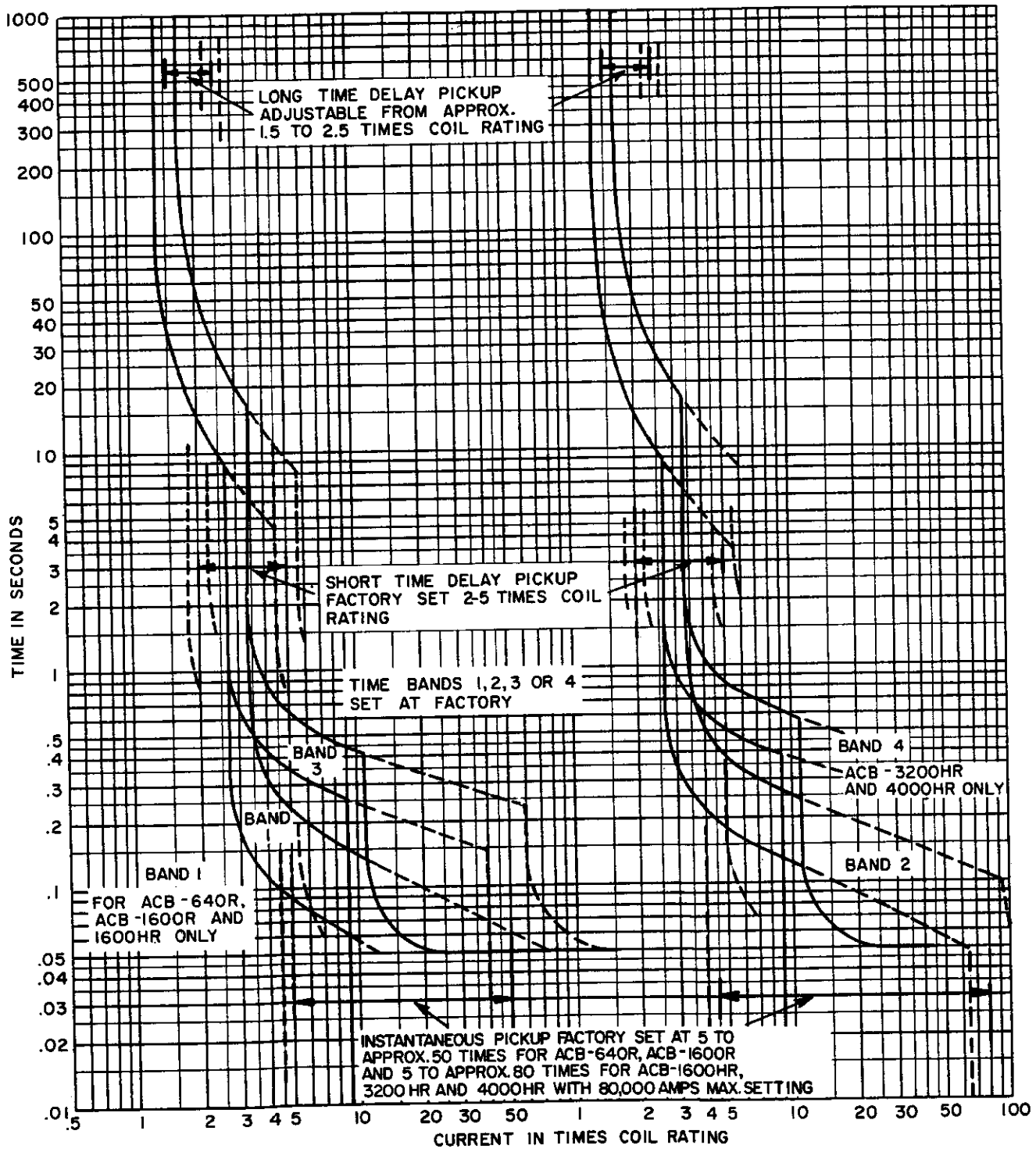


Figure 16. Line-current characteristic curves

SECTION D-12
Series Overcurrent Trip Device

DESCRIPTION

The series overcurrent trip device will cause the breaker to open within a predetermined time range depending on the magnitude of the fault current.

OPERATION

The series overcurrent trip device can be provided with the following tripping combinations:

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

Short-time-delay Tripping (Factory Adjustment Only)

The armature (7) (see figure 17) is restrained by a 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 figure 17A.

Long-time-delay Tripping (Three Settings Available)

The armature (11) (see figure 17) is restrained by a calibrating spring (12). After the magnetic force produced by an overcurrent condition overcomes this restraining force, the armature movement is further retarded by the flow of silicone oil in a cylinder (16). This mechanism produces an inverse time-delay characteristic. The mechanism is shown in figure 17B.

Instantaneous Tripping (Factory Adjustment Only)

Non-adjustable instantaneous tripping is accomplished when the magnetic force overcomes the force of a heavy restraining spring (19) (see figure 17) connected between the armature and the support fastened to the frame of the device.

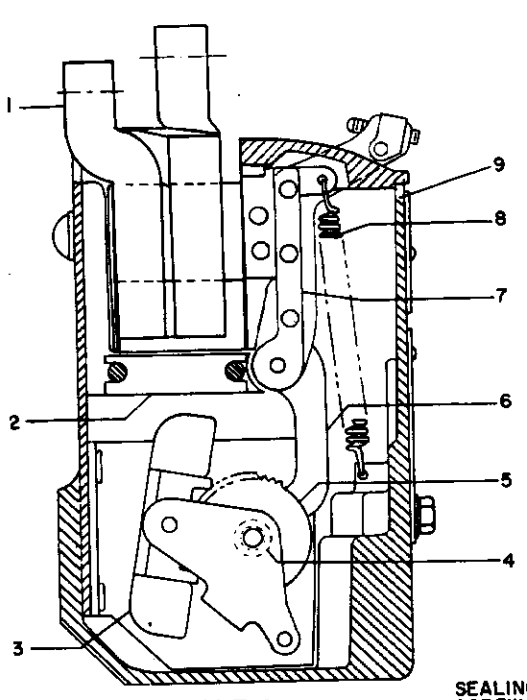
When instantaneous tripping is used in conjunction with long-time-delay tripping, the heavy instantaneous spring effectively connects the armature to the dashpot for overcurrents of low magnitude. For high levels of overcurrent, the force on the magnet is sufficient to stretch the instantaneous spring and allow the armature to move to the closed air gap position independently of the long-time-delay dashpot.

ADJUSTMENTS

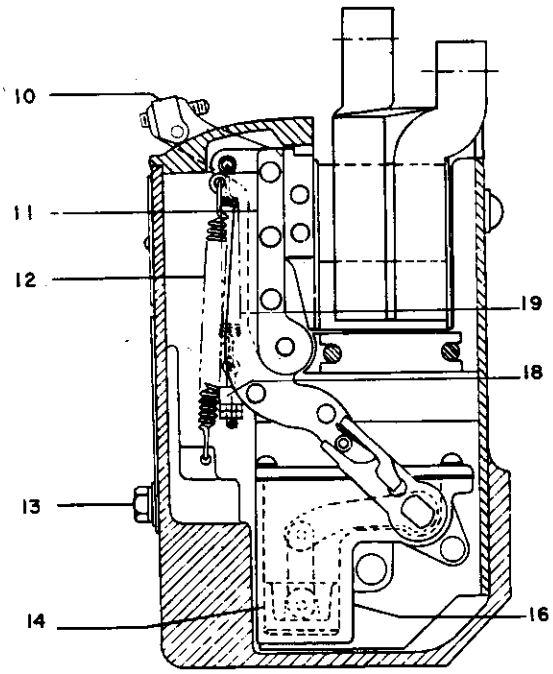
Calibration clamping nuts (13) (see figure 17) are used to set the desired pickup for the long-time-delay element.

To adjust for approximately 1/32-inch overtravel of trip arm (10) after tripping:

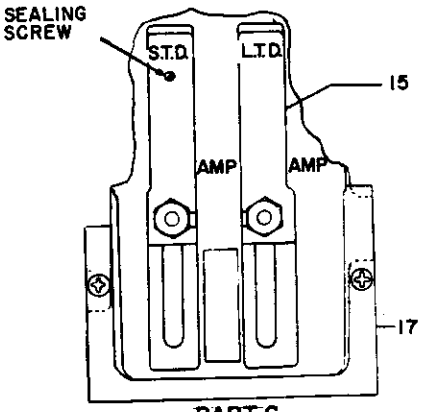
1. Check trip latch engagement. (See "Adjustments" in D-4 and figure 8.)
2. Loosen the lock nut and turn the adjusting screw on the trip arm (10) (figure 17). The screw should not touch the trip paddle when the breaker is "open" and the latch is reset, but should have a clearance not exceeding 1/32 inch.
3. Tighten the adjusting screw lock nut on the trip arm.



PART A
LEFT SIDE VIEW SHOWING SHORT TIME DELAY MECHANISM



PART B
RIGHT SIDE VIEW SHOWING LONG TIME DELAY MECHANISM



PART C
FRONT VIEW SHOWING MOUNTING BRACKET

1 *Series coil*
2 *Magnet*
3 *Pallet*
4 *Pinion*
5 *Escape wheel*
6 *Driving segment*
7 *Short-time-delay armature*
8 *Short-time-delay calibration spring*
9 *Plastic case*
10 *Trip arm*
11 *Long-time-delay armature*
12 *Long-time-delay calibration spring*
13 *Calibration clamp nut*
14 *Plunger*
15 *Calibration plate*
16 *Cylinder*
17 *Clamp*
18 *Spring holder*
19 *Instantaneous trip spring*

Figure 17. Series overcurrent trip device

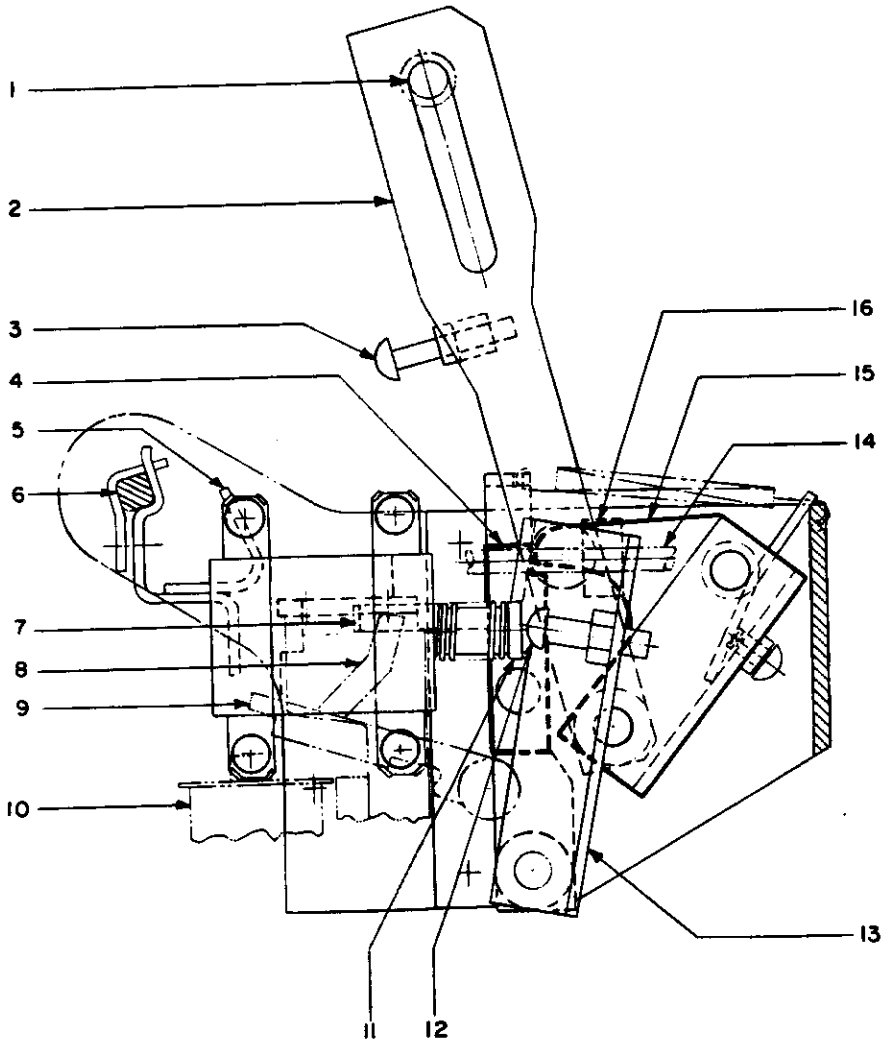
SECTION D-13
Overcurrent Lockout Device

DESCRIPTION

The overcurrent lockout device is mounted on the left side of the mechanism frame (looking from front). This device will cause a breaker to be trip-free after operation of one of the protective trip devices. The lockout device can be reset by operation of the manual trip button on the front escutcheon. This device also operates a switch with two sets of contacts, one normally open, the other normally closed. This switch may be used to open or close an external circuit, giving a bell or light indication of a protective trip device operation.

OPERATION

The lockout device is operated by the movement of the breaker's crossbar. The device operating link (2) (see figure 18) is engaged with the breaker crossbar side-link pin (1), thereby operating the



1 Crossbar side-link pin
2 Operating link
3 Lockout adjusting screw
4 Device latch
5 Lockout trip paddle
6 Trip shaft
7 Latch release strap
8 Shunt trip armature lever
9 Shunt trip armature
10 Shunt trip device
11 Bell alarm plunger
12 Device adjusting screw
13 Operating arm
14 Manual trip rod
15 Catch
16 Trip-rod release collar

Figure 18. Overcurrent lockout device

device whenever the breaker is tripped by the overcurrent trip devices, the undervoltage device and the drawout trip interlock. The shunt trip device and the manual trip button will defeat the device. The lockout device can be reset only by the manual trip button on the front escutcheon.

ADJUSTMENTS

1. Adjust the lockout device latch (4) (see figure 18) so that a clearance of 1/16 inch ± 1/64 inch is maintained with the catch (15) when the breaker is closed.

2. With the breaker fully open, adjust the device adjusting screw (12) on the operating arm (13) for an over-travel of 1/16 to 3/32 inch after the device contacts are just touching. This will assure that the device is operated when the breaker is tripped by an overcurrent or undervoltage condition, and by the drawout trip interlock.

3. The lockout adjusting screw (3) should be adjusted so that it engages the lockout trip paddle (5) and displaces the trip shaft (6) when the breaker is opened. This assures that the breaker is locked open until the device is reset as previously described.

4. With the manual trip button fully depressed, position the trip-rod release collar (16) on the trip rod (14) so that the latch (4) and catch (15) are disengaged before the breaker opens.

5. This device is equipped with latch release strap (7) which is engaged by the shunt trip armature lever (8) when the shunt trip device is operated. This defeats the device when the shunt trip device operates. The latch release strap (7), which is a part of the device latch (4), must be formed to hook around the shunt trip armature lever (8) in a manner that will assure that the device latch and catch are disengaged before the breaker opens.

SECTION D-14
Shunt Tripping Device

DESCRIPTION

The shunt tripping device provides a means for tripping the breaker by using a remote switch or relay contacts.

OPERATION

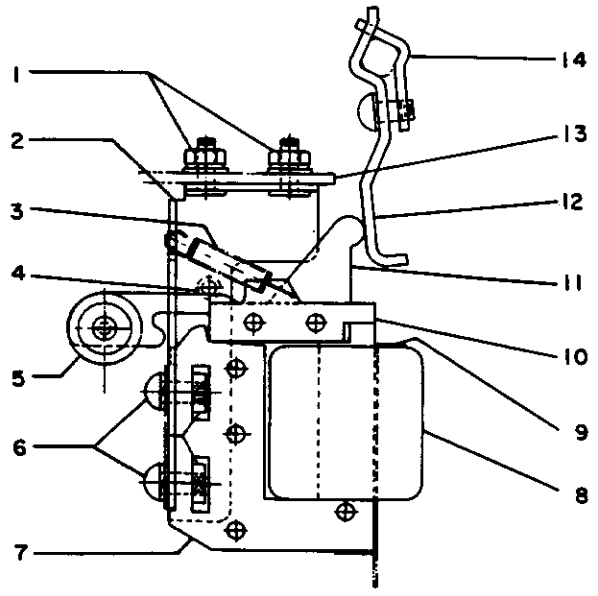
The shunt tripping device is mounted on a bracket attached to the left side of the operating mechanism (looking from the front).

A remote switch or relay contacts are used to close the circuit of the device. This causes the armature arm (11) (see figure 19) to engage the trip paddle (12), thereby tripping the breaker. The spring (3) is used to return the armature (10) to the neutral position after the breaker trips.

To prevent overheating, the momentary-rated coil (8) is cut off by contacts of the auxiliary switch which are open when the breaker is open.

ADJUSTMENTS

When the breaker is tripped, the armature should have 1/32-inch to 1/16-inch overtravel. If any adjustment is necessary to provide this amount of overtravel, the trip paddle (12) is formed in or out accordingly.



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 Clamp

** Repair part*

Figure 19. Shunt trip device

SECTION D-15
Undervoltage Trip Device

DESCRIPTION

The function of the undervoltage trip device is to trip the breaker when the undervoltage coil is de-energized by loss of voltage.

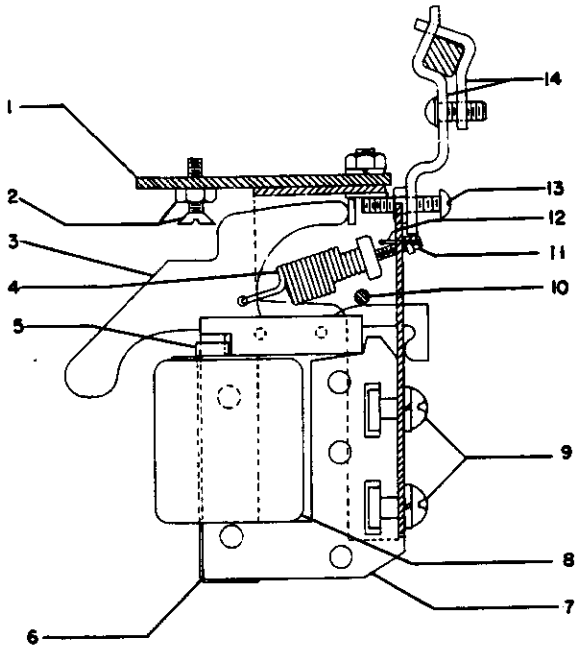
OPERATION

The undervoltage trip device is mounted on a bracket attached to the left side of breaker frame (looking from front). The undervoltage trip device consists of a coil (8) (see figure 20), magnet (7), armature (3), and spring (4). With rated voltage applied, the armature is attracted to the magnet. If the voltage falls below the predetermined value, the magnet releases the armature. The spring then pulls the armature upward, rotating the trip paddle (14), thereby tripping the breaker. This device will keep the breaker trip-free until the rated voltage is applied and the coil is energized.

ADJUSTMENTS

An adjusting screw (13) (see figure 20) in the trip paddle (14) is used to obtain from 1/32-inch to 1/16-inch overtravel after tripping the breaker.

Adjusting screw (2) and spring (4) are used respectively to adjust the armature so that it will pick up at 80 percent of rated voltage and drop out at between 30 and 60 percent of rated voltage.



1 Bracket
2 Adjusting screw and nut
3 Armature
*4 Spring**
5 Shading ring
6 Clamp
7 Magnet
*8 Coil**
9 Screws
10 Pin
11 Adjusting screw
12 Locking wire
13 Adjusting screw
14 Trip paddle and clamp
** Repair part*

Figure 20. Undervoltage trip device

SECTION D-16
Undervoltage Lockout Device

DESCRIPTION

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

OPERATION

The undervoltage lockout device is mounted on a bracket attached to the left side of the breaker frame (looking from front). This device is identical to the undervoltage trip device (Section D-15) with the addition of the lockout feature. The lockout feature consists of arm (2) (see figure 21), spring

1 Breaker crossbar
2 Arm
3 Lever
4 Bracket
5 Armature
*6 Coil**
7 Magnet
8 Trip paddle
9 Trip shaft
*10 Spring**

**Repair part*

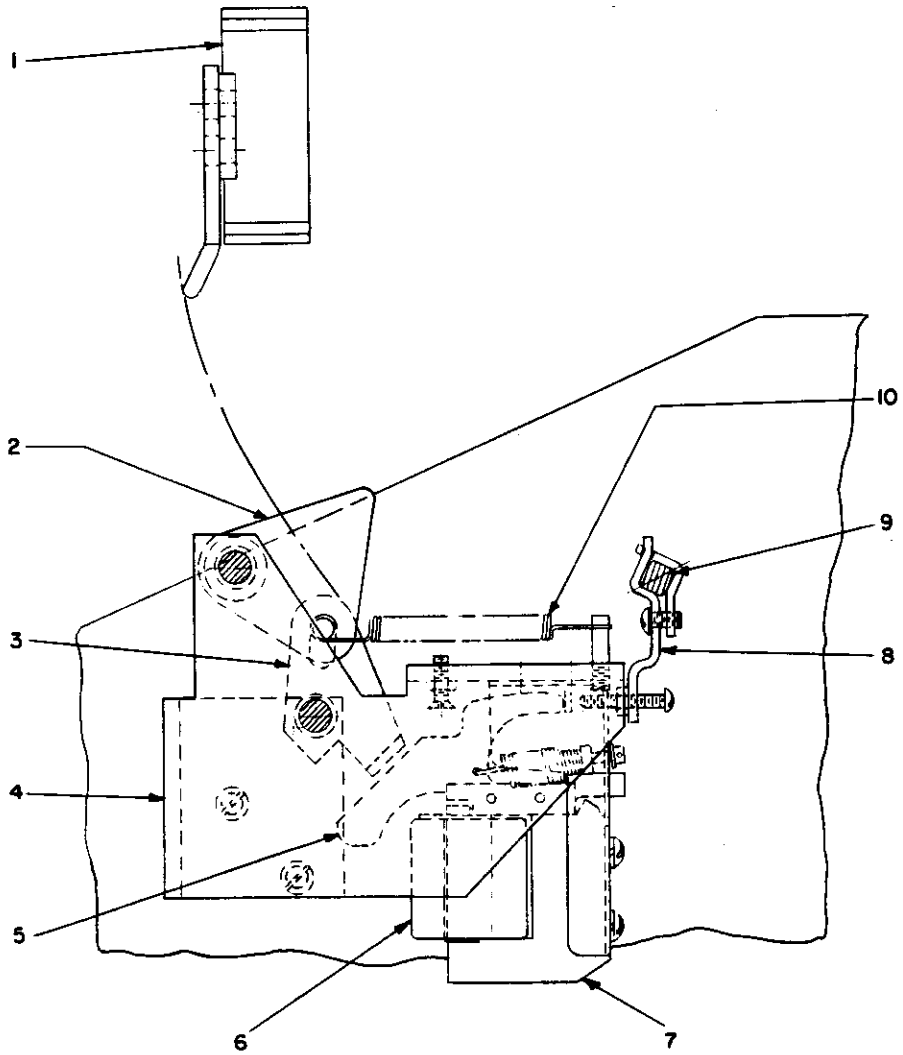


Figure 21. Undervoltage lockout device

(10), and lever (3). The lockout linkage is activated by the movement of the breaker crossbar (1). When the breaker is closed, the crossbar and lockout linkage is in the position shown and the undervoltage device is defeated by the lever holding the armature in the closed air gap position. When the breaker opens, the crossbar moves down, forcing the arm down and thus moving the lever up, releasing the armature (5) and allowing the undervoltage device to operate normally.

ADJUSTMENTS

The adjustments for the undervoltage lockout device are the same as for the undervoltage trip device (refer to Section D-15).

SECTION D-17
Drawout Interlock Device

DESCRIPTION

The drawout interlock prevents the breaker from being racked in or out of the "connected" position until after the breaker is tripped open.

OPERATION

The circuit breaker element is equipped with a positive mechanical interlock (4) (see figure 3) which engages the trip interlock cam (4) (see figure 2) in the skeleton enclosure and prevents the breaker from being racked in or out of the "connected" position until after the breaker is tripped open. This interlock also holds the breaker trip-free and prevents the breaker from being closed while it is being racked in or out of the "connected" position.

SECTION D-18
Movable and Stationary Secondary Disconnect Assemblies

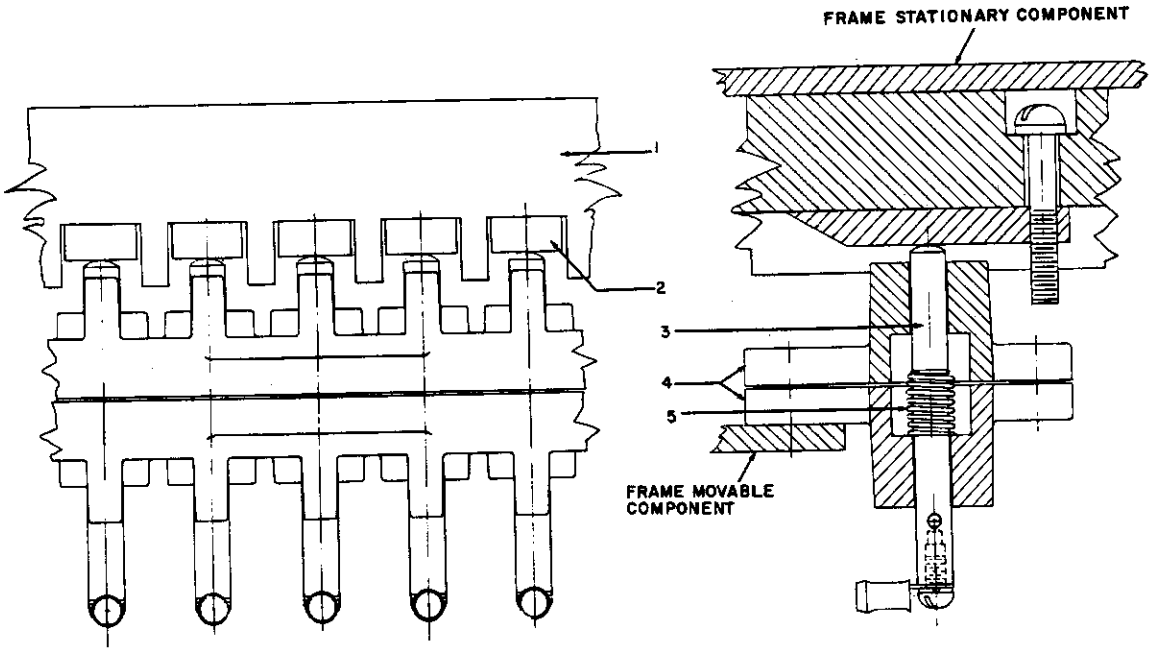
DESCRIPTION

Secondary disconnect assemblies permit the withdrawal of a drawout-type circuit breaker to the completely disconnected position without secondary wiring removal. The secondary disconnect assembly consists of two separate assemblies: the movable assembly mounted on the breaker, and the stationary assembly mounted in the stationary component.

The movable secondary disconnect assembly consists of two molded pieces bolted together which hold seven individual contacts and springs. The stationary secondary disconnect assembly consists of a compound base with seven contact strips. The contact strips are separated by a barrier wall which provides adequate creepage distance between contacts. Three assemblies to provide a total of 21 circuits may be mounted per breaker.

OPERATION

When the breaker is in its final "connected" position, the secondary disconnect assemblies are engaged. In this position the contact spring (5) (see figure 22) forces the contact (3) of the movable secondary disconnect assembly against the contact strip (2) of the stationary disconnect assembly, making a good electrical contact.



1 Base stationary disconnect
2 Contact strip
3 Contact
4 Base movable disconnect
*5 Contact spring**
**Repair part*

Figure 22. Movable and stationary secondary disconnect assemblies

SECTION D-19
Movable Primary Disconnect Assembly

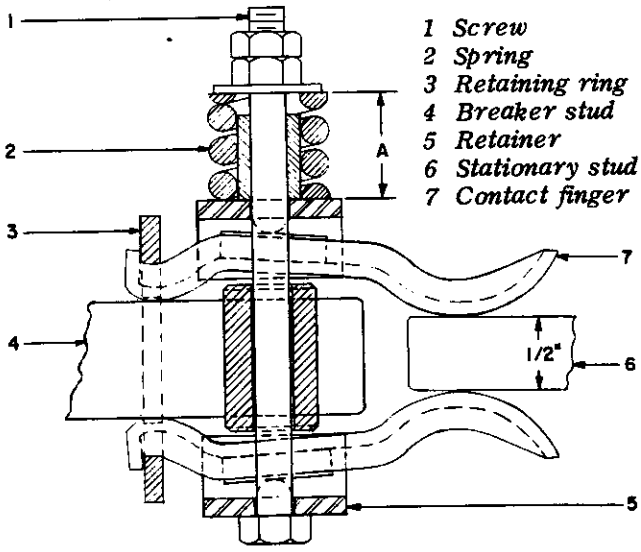
DESCRIPTION

The purpose of the disconnect is to serve as a connecting device for mounting the breaker to the stationary component.

OPERATION

The disconnects are attached to the circuit breaker studs on the rear side of the breaker.

Each disconnect consists of eight contact fingers (7) (see figure 23) secured to each breaker stud



1 Screw
2 Spring
3 Retaining ring
4 Breaker stud
5 Retainer
6 Stationary stud
7 Contact finger

Figure 23. Primary disconnect assembly

(4) by screw (1), retainers (5) and retaining rings (3). A spring (2) exerts pressure on the contact fingers when engaging the stationary studs (6). Retainers (5) and retaining rings (3) also serve to maintain the proper alignment of the fingers when engaging the stationary studs.

ADJUSTMENTS

The disconnect fingers should exert 80 to 100 pounds pressure on stationary stud (6) (see figure 23). Insert 1/2-inch thick bar in place of the stationary stud (6), and tighten nut and locknut on screw (1) until deflected length "A" of spring (2) is 25/32 inch.

SECTION E-1
Replacement of Repair Parts

NOTE

Before replacing any part it is strongly recommended that the operator familiarize himself with all parts involved in making the replacement.

1. Separation of Front and Back Frames of Moving Component

In order to replace the contacts, operating mechanism, or the overcurrent devices, the front frame must be separated from the back frame. To separate the two frames proceed as follows:

a. The breaker contacts must be open with the safety pin in place (see Section B-1).

b. Remove the two opening springs (6) (see figure 3) from the outside pole units.

c. Remove the clevis pin (12) (see figure 8) from the center pole unit.

d. Remove the six nuts from the back frame using a socket wrench with an extension. This includes the two nuts at the top of the frame.

e. Remove the auxiliary switch operating rod (5) (see figure 12).

f. Check along trip shaft for mechanical interference or connection between the overcurrent trip device and the trip paddles. Remove the mechanical connection if present; if interference exists, use extreme care when removing or reassembling the front and back frames to avoid mechanical breakage of trip devices. In reassembling the front and rear frames, the two frames should be positioned vertically so that the trip shaft is horizontally aligned.

NOTE

It is recommended that the breaker be fastened to a suitable mounting base with the front frame supported by a sling or hook as the bolts are being installed or removed.

CAUTION

CAREFULLY POSITION THE LOCATION OF CRANE HOOKS NEAR THE VERTICAL CHANNEL WHEN REMOVING OR REPLACING THE FRONT FRAME.

2. Replacement of Arc Quenchers (See Figure 6)

To replace arc quenchers, remove the channel-shaped retaining bar by removing two screws and two nuts. The arc quenchers can now be removed by lifting out and up, free of the movable arcing contacts. To disassemble these arc quenchers proceed as follows:

a. Remove screws holding spacer block (9).

b. Remove spacer block (9), steel plate (8), and compound support (7).

c. Rock muffler (6) slightly and remove. The inner barriers (5) can now be removed for inspection.

d. Remove nut and withdraw stud (1).

e. Remove cap (2). The side barriers (3) and pocket barriers (4) should be free.

f. Reassemble and replace the arc quencher in the reverse order. Tighten the fastenings after replacement.

3. Replacement of Stationary Arcing Contacts (See Figure 7)

a. Remove arc quenchers (see Section E-1-2).

b. Remove top contact block (3) and stop (2) by removing two screws. Remove insulation (10).

c. Remove pin (8) and free the stationary contacts (4) and springs (5 and 6).

d. Install new springs and stationary arcing contacts in the reverse order.

e. Adjust contact wipe and pressure (see Section D-3).

4. Replacement of Movable Arcing Contacts (See Figure 7)

The movable arcing contacts should be replaced when the stationary arcing contacts are replaced.

a. Separate the front frame from the back frame (see Section E-1-1).

b. Remove pins (18) (see figure 7) and (29) and withdraw the contacts.

c. Reassemble parts in the reverse order. The arcing contacts should be spaced by adding shims between the arcing contact and the insulating link (19) to assure proper alignment. The arc quencher may be used to restrict, to a minimum, sidewise motion of the movable contact.

5. Replacement of Stationary Intermediate and Main Contacts (See Figure 7)

a. Remove stationary arcing contacts (see Section E-1-3).

b. Loosen the four cap screws which hold the upper stud (33) to the pole unit base (25).

c. Remove the Truarc retaining rings from pin (35) and remove pin. The contacts can now be lifted out.

d. Reassemble contacts in the reverse order. Be careful to replace the intermediate contact in the proper position.

6. Replacement of Movable Intermediate and Main Contacts (See Figure 7)

a. Remove the movable arcing contacts (see Section E-1-4).

b. Loosen spring (24).

c. Slide link (17) to the side and off of pin (16).

d. Slide pins (16) and (27) far enough to the side to allow the movable intermediate and main contacts to be replaced.

e. Reassemble parts in the reverse order.

NOTE

Always check contact wipe and pressure following contact replacement (see Section D-3).

7. Replacement of Mechanism Assembly (See Figure 10)

a. Remove the front frame from the back frame (see Section E-1-1).

b. Remove pins holding spring charging arms (15) (see figure 10) to the closing spring assembly.

c. Remove two bolts underneath frame and two bolts from the front of the frame.

d. Remove any wiring which is attached to the mechanism frame.

e. Note the position of the trip paddles on the trip shaft. Remove the dowel pins from the trip shaft couplers which hold the sections of the trip shaft together. The mechanism is now free to be removed.

f. Reassemble the parts in the reverse order. Be sure to replace the trip shaft with the trip paddles in the correct position.

8. Replacement of Motor and Gear Reduction Unit (See Figure 10)

a. Remove the front frame from back frame (see Section E-1-1).

b. Remove pins from the closing spring charging arm (15).

c. Remove the plates from the right end of crankshaft (14).

d. Slide the crankshaft to the right until the left end of the shaft clears the gear unit housing.

e. Remove the buffer stop which is mounted to the side of the frame and directly over the motor (9).

f. Open the wire connections on the motor and remove the wire attached to the gear unit housing.

g. Remove four bolts on the bottom of the front frame and the bolt at the top of the gear reduction unit. The motor and gear reduction unit can now be removed.

NOTE:

If it is desired to replace only the motor unit, disconnect the motor leads and remove only the hardware fastening the motor to the gear reduction unit. When removing the motor only, the front frame should be placed front side down to prevent the oil from escaping from the gear unit. The new motor and gasket may now be replaced in the reverse order. A gasket may be cut out of gasket material by using the gear housing as a pattern.

9. Replacement of Auxiliary Switch (See Figure 13)

a. Disconnect all leads to the auxiliary switch.

b. Remove two mounting screws.

c. Disengage auxiliary switch shaft (3) from the crank.

d. Set arrow on new auxiliary switch as shown in figure 13A.

e. Push auxiliary switch shaft (3) into the square hole in the crank (breaker in open position).

f. Replace mounting hardware.

10. Replacement of Shock Lock (See Figure 14)

a. Remove stop nut (5).

b. Remove weights (12 and 13) and adjusting screw (4) from mounting bracket (14).

c. Remove spring (6) from between mounting bracket (14) and latch arm (3).

d. Remove latch arm (3) by removing cotter pin.

e. Replace in the reverse order and make adjustments as outlined in Section D-10.

11. Replacement of Latch

a. Remove the latch bolt and remove the wedge by pushing it upward.

b. Replace in the reverse order, making sure that the wedge lock is tight.

12. Replacement of Cut-off Switches (See Figure 15)

If the switches do not function properly they should be replaced as follows:

Remove three mounting screws and terminal board wiring and replace with new assembly.

13. Replacement of Control Relay

To replace the control relay (7) (see figure 3), remove cover, wiring and two holding screws located on the back of the plate. Replace relay and reconnect wiring.

14. Replacement of Series Overcurrent Trip

a. Remove front frame (see Section E-1-1).

b. Remove bolts holding the coil to the lower stud.

c. Remove bracket and mounting screws.

d. Before installing a new device, check travel of the trip arm: Insert a stiff rod or wire through the right hole in the overload device nameplate and push the armature solidly against the magnet. The trip arm should move at least 3/32 inch. If there appears to be insufficient movement of the trip arm, or if the armature appears to be binding, the device should not be used.

e. Replace new device in reverse order.

f. Adjust device as described in Section D-13 under "Adjustments."

15. Replacement of Shunt Trip Coil (See Figure 19)

a. Disconnect leads to coil.

b. Remove magnet (7) and coil (8) from frame (2).

c. Straighten lower end of clamp (9) and remove.

d. Remove coil (8) and install new coil in the reverse order of disassembly.

16. Replacement of Undervoltage Trip Coil (See Figure 20)

a. Disconnect leads to coil (8).

b. Remove mounting screws and remove magnet (7) and coil assembly.

c. Straighten laminations around shading ring (5).

d. Remove shading ring and straighten lower end of coil clamp (6).

e. Remove coil. Install new coil in reverse order.

17. Replacement of Primary Disconnect Spring (See Figure 23)

a. Remove nuts and washer from screw (1).

b. Lift spring (2) from screw.

c. Replace spring and assemble parts in reverse order of disassembly.

d. Adjust pressure as outlined in Section D-19.

18. Replacement of Primary Disconnect Contact Finger (See Figure 23)

a. Remove nuts and washer from screw (1).

b. Lift spring (2) and cylindrical spacer from screw.

c. Remove upper retainer (5) and lift upper contact fingers (7) with bowtie spacers from under retaining ring (3).

d. Withdraw screw and remove lower retainer (5). The two bowtie spacers will fall free.

e. Remove lower contact fingers (7) from retaining ring (3).

f. Assemble parts in reverse order.

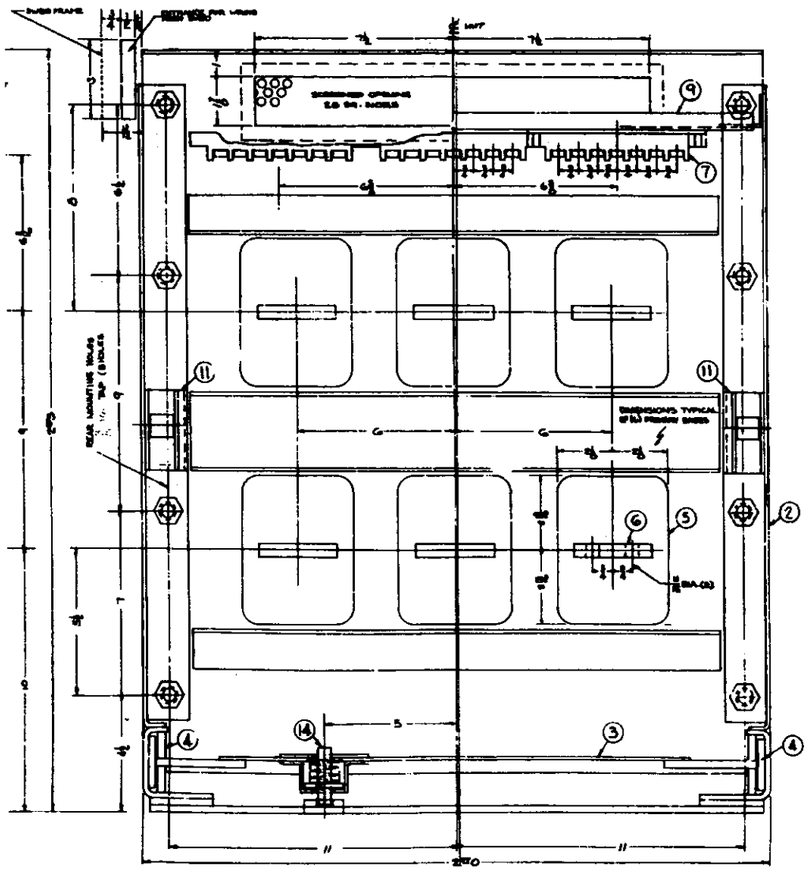
g. Adjust pressure as outlined in Section D-19.

SECTION E-2
Repair Parts List

Fig. No.	Index No.	Name of Part	No. Required per Breaker	Contractor's Service Part No.	Manufacturer's Service Part No.	Drawing Part No.
5	8	Arcing Contact, Movable	6		K-6404753P-1	53
5	8	Arcing Contact, Movable	9		127A6452P1	2
5	9	Arcing Contact, Stationary	15		295B408G3	1
19	8	Coil, Shunt Trip, 115 volts, 60 cycles			K-6275081G25	9
19	8	Coil, Shunt Trip, 450 volts, 60 cycles			K-6275081G27	10
19	8	Coil, Shunt Trip, 120 volts DC			K-6275081G29	11
20	8	Coil, Undervoltage, 450 volts, 60 cycles			K-6275081G31	50
24	54	Contact Bracket, Overcurrent Lockout	2		K-3845725G1	54
24	55	Contact Bracket, Overcurrent Lockout	2		K-3845725G2	55
24	56	Contact Strip, Overcurrent Lockout	2		K-3805658G1	56
5	3	Intermediate Contact, Movable	3		293B220G2	6
5	1	Intermediate Contact, Stationary	3		459A385G1	4
24	7	Light, 450 volts, 60 cycles			TS-130 Mazda	7
5	4	Main Contact, Movable	9		293B220G1	5
5	2	Main Contact, Stationary	9		293B221G1	3
10	9	Motor	1		5P66MA9	18
3	7	Relay, 115 volts, 60 cycles			12HGA11T70N	12
3	7	Relay, 125 volts DC			12HGA11T52N	13
7	5	Spring, Arcing Contact, Stationary	15		K-6509858	21
7	6	Spring, Arcing Contact, Stationary	15		K-6509859	22
9	1	Spring, Cam Prop Return	1		412A140	26
24	32	Spring, Drawout Plunger	1		412A124	32
24	42	Spring, Discharge Indicator	1		365A305	42
24	33	Spring, Drawout Trip Latch Return	1		412A292	33
7	32	Spring, Main Contact, Stationary	12		0412A0287	23
24	25	Spring, Manual Trip Button	1		412A139	25
9	4	Spring, Mechanism Reset	1		0148A2213	43
24	51	Spring, Mechanism Reset	1		0148A2214	51
11	13	Spring, Motor Mechanism Ratchet	1		K-6509871	44
3	6	Spring, Opening	2		K-6509813	24
24	37	Spring, Overcurrent Lockout	1		K-6509908	37
24	38	Spring, Overcurrent Lockout	1		K-6202671	38
24	39	Spring, Overcurrent Lockout	1		K-6172529	39
24	40	Spring, Overcurrent Lockout	1		412A171	40
24	31	Spring, Pawl on Drawout Handle	1		365A313	31
23	2	Spring, Primary Disconnect	12		412A222	34
9	8	Spring, Prop to Reset Latch	1		K-6403348	27
22	5	Spring, Secondary Disconnect	21		K-6403331	35
19	3	Spring, Shunt Trip	1		365A325	36
14	6	Spring, Shock Lock	1		K-6403315	29
24	28	Spring, Trip Shaft Return	1		412A269	28
20	4	Spring, Undervoltage Device	1		K-6172594	49
21	10	Spring, Undervoltage Lockout	1		K-6372957	41
3	1	Switch, Auxiliary (5 "a" and 5 "b")	1		DL-6353562NG-5	15
15		Switch, Cut-off	1		0227A7211G-1	16
3	10	Switch, Motor Power	1		127A6451P1	17
		Retaining Rings and Pliers	1		177L252G3	20

ZONE	REV	REVISIONS DESCRIPTION				
	A	RELEASED				
	B					
	C					

FOR FUTURE REVISIONS SEE SHEET *1



LIST OF MATERIAL						ITEM			
PC NO	NAME	QTY REQD	MATERIAL	MATL. SPEC.	SOURCE, SIZE, OR DRAWING AND SERVICE (NAVY) DESIG.	SHIPS DWG NO	UNIT WT LB	STD NAVY STOCK NO	REMARKS
1	ACB-1600 HR [illegible]	1		MIL-C-17501	0122F0966 SH1				
2	STATIONARY COMPONENT	1	STEEL	MIL-S-20166	8476760				
3	ROLL-OUT TRAY	1	STEEL	MIL-S-20166	8476764				
4	ROLL-OUT SIDE RUNNER	2	STEEL		8476764				
5	PRIMARY DISC DEVICE (BASE)	6	COMPOUND	MIL-P-14	P-4818800				
6	PRIMARY DISC DEVICE	6	COMPOUND	MIL-P-14	8476762				
7	SECONDARY DISC DEVICE (STATIONARY)	Δ	COMPOUND	MIL-P-14	8476746				
8	SECONDARY DISC DEVICE (MOVABLE)	Δ	COMPOUND	MIL-P-14					
9	SECONDARY DISC DEVICE SUPPORT BAR	1	STEEL	MIL-S-20166	8476746				
10	TRIP INTERLOCK	1	STEEL	MIL-S-20166	8476763				
11	CAM PIN SUPPORT	2	STEEL	STL-S-18786 MIL-S-843	8476763				
12	ROLL-OUT STOP BOLT 5/8-10 UNC-2B	1	STEEL						
13	5/8 FLAT WASHER	1	STEEL						
14	BREAKER STOP PIN	1	STEEL		8476765				
15	BREAKER STOP PIN LEVER	1	STEEL	MIL-S-20166	8476765				
16	SCREENED OPENING COVER PLATE	1	STEEL	MIL-S-20166					
17	BREAKER MTG BOLT 5/8-16 UNC-2B	4	STEEL						

Δ QUANTITY AS REQUIRED (3 MAX)

REFERENCES		
NO		DRAWING NO. (NAVY) (MFR'S)

NOTES:
1. FOR SWITCHBOARD MOUNTING DATA, REPAIR PARTS, WIRING DIAGRAMS AND OTHER DETAILS SEE SHEET 1.
2. CLEANING AND PAINTING OF ASSEMBLY TO BE IN COMPLIANCE WITH MILITARY SPECIFICATIONS MIL-E-917. PAINTED SWITCHBOARD GRAY.
3. THE MAIN SEPARATE DISCONNECTS MAY BE OBSERVED WHEN THE MOVING COMPONENT IS FULLY DRAWN OUT.

SCALE, WEIGHT:

WEIGHT OF REMOVABLE ASM WITH ELECTRIC MCH IS 565 LBS
WEIGHT OF REMOVABLE ASM WITHOUT MCH IS 165 LBS

DETAILS OF CIRCUIT BREAKER STATIONARY COMPONENT

MASTER DRAWINGS	GENERAL ELECTRIC
AIR CIRCUIT BREAKER NAVY TYPE ACB, 1600 HR/GE ANE-1000 800-1600 A, DC CONS - 250 V.A.C. 3 POLE - ELECTRIC INTER. CAPACITY 100,000 AMP REMOVABLE ASSEMBLY	LOW VOLTAGE SWGR. PHILA. 0122F0966
SCALE 3"=1" BY [illegible]	NAVY DWG NO. C

Figure 25

ACB-1600HR Master plan (sheet 2)

LIST OF MATERIAL					
PC NO	NAME	REQ QUANTITY	MATERIAL	MATL. SPEC.	MANUF. DWG. NO. AND SERVICE PART NO.
1	A.C.B-1600 HR.	1		MIL-C-17501	8111F8486 G01
2	STATIONARY COMPONENT	1	STEEL	MIL-S-20166	8477C760
3	ROLL-OUT TRAY	1	STEEL	MIL-S-20166	8477C764
4	ROLL-OUT SIDE RUNNER	2	STEEL		8477C764
5	PRIMARY DISC DEVICE (BASE)	6	COMPOUND	MIL-P-14	9-8518000
6	PRIMARY DISC DEVICE	6	COPPER ALLOY		8477C763
7	SECONDARY DISC DEVICE (STATIONARY)	6	COMPOUND	MIL-P-14	8477C746
8	SECONDARY DISC DEVICE (MOVABLE)	6	COMPOUND	MIL-P-14	
9	SECONDARY DISC DEVICE, SUPPORT BRK.	1	STEEL	MIL-S-20166	8477C746
10	TRIP INTERLOCK	1	STEEL	MIL-S-20166	8477C763
11	CAM PIN SUPPORT	2	STEEL	MIL-S-20166	8477C763
12	ROLL-OUT STOP BOLT	1	STEEL		
13	FLAT WASHER	1	STEEL		
14	BREAKER STOP PIN	1	STEEL		8477C765
15	BREAKER STOP PIN LEVER	1	STEEL	MIL-S-20166	8477C768
16	SCREENED OPENING COVER PLATE	1	STEEL	MIL-S-20166	
17	BREAKER MTG. BOLT	4	STEEL		

△ QUANTITY AS REQUIRED (3 MAX)

SECTION A-A
STATIONARY COMPONENT

SECTION B-B
STATIONARY COMPONENT

Figure 25. ACB-1600HR circuit breaker master plan (sheet 2)

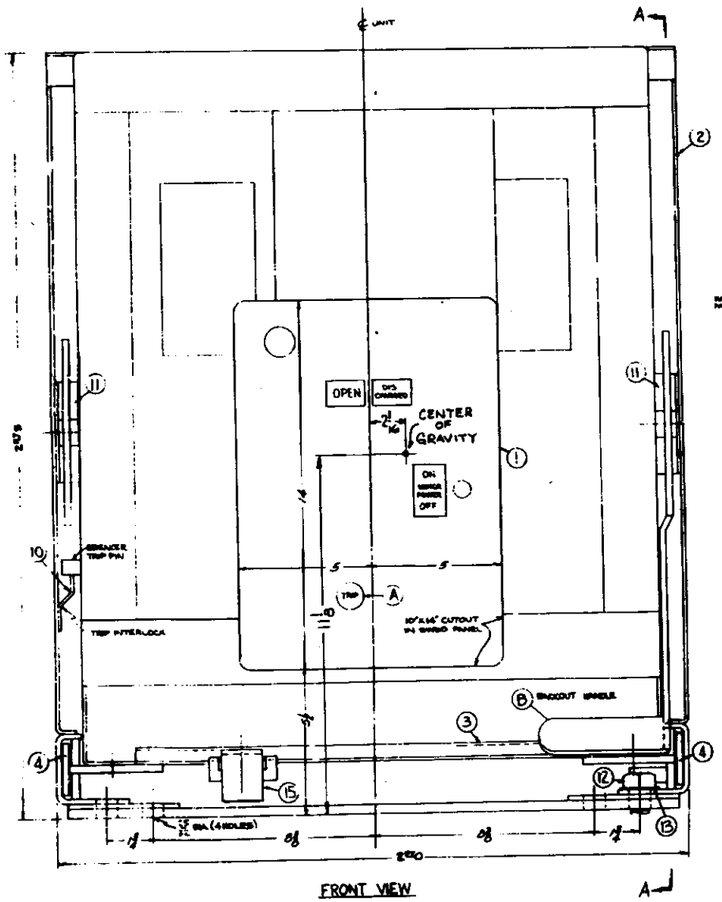
THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN REMOVING HINGED COMPONENT OF AIR CIRCUIT BREAKER FROM CONNECTED POSITION IN HOUSING.

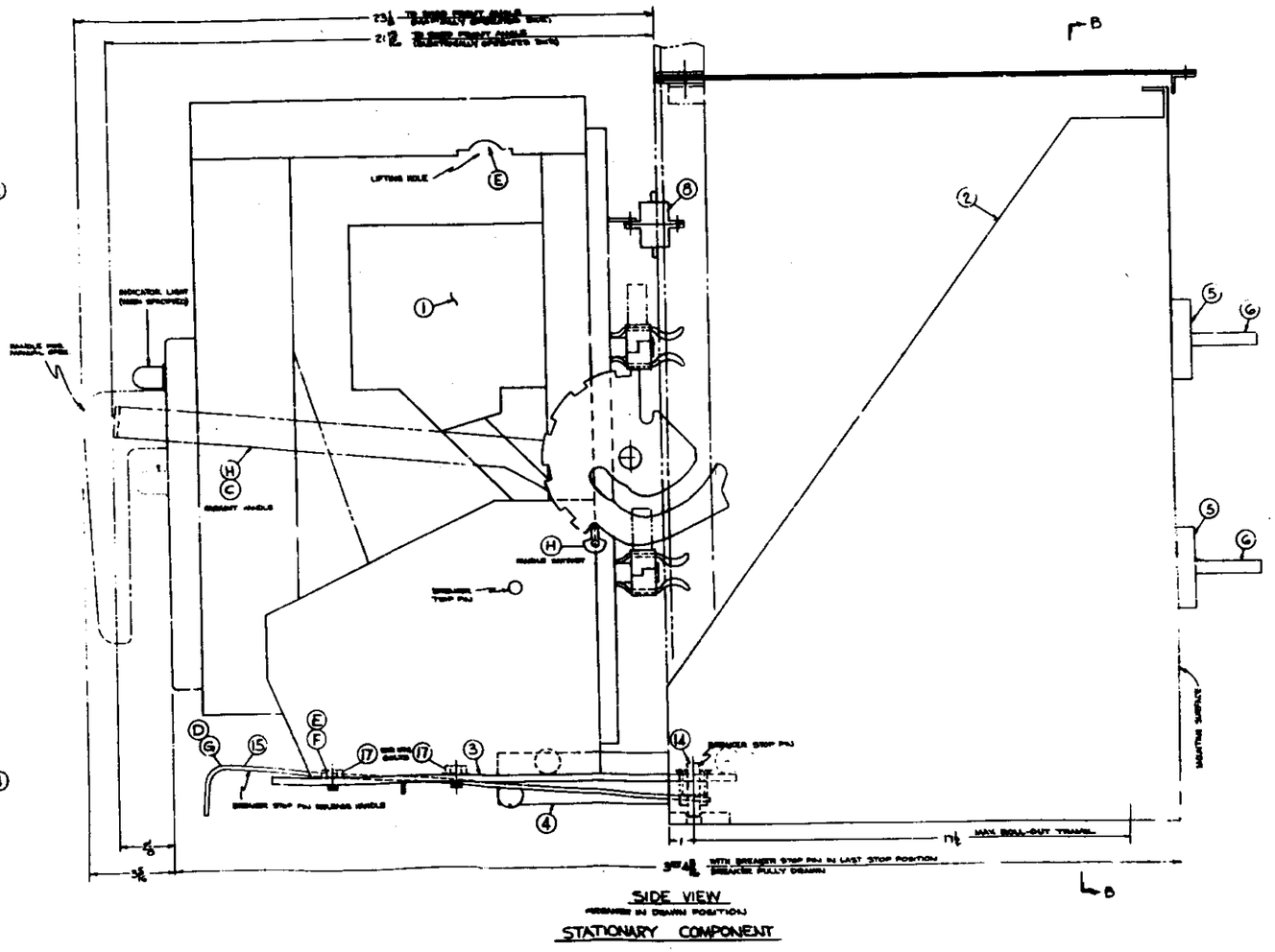
A. TRIP BREAKER BY DEPRESSING TRIP BUTTON. OPENING THE COMPARTMENT HINGED COVER.
B. LIFT BLACK OUT HANDLE, LOCATED ON LOWER RIGHT SIDE OF BREAKER, THIS WILL TRIP BREAKER IN EVENT SPRING A IS CHARGED.
C. PUSH THE BLACK OUT HANDLE FIVE (5) TIMES & THEN RELEASE HANDLE
D. PUSH BREAKER STOP PIN RELEASE HANDLE DOWN AND PULL BREAKER FORWARD TO LIMIT OF ITS TRAVEL. THE BREAKER MAY BE EASILY INSPECTED AND MAINTENANCE PERFORMED ON IT IN THIS POSITION.
E. IF BLACK DISTURBANCE IS NECESSARY IT MAY BE DESIRABLE TO REMOVE THE BREAKER FROM THE ROLL-OUT TRAY. THIS IS DONE BY REMOVING THE FOUR (4) MOUNTING BOLTS, ASCERTAINING THE BREAKER TO THE ROLL-OUT TRAY AND LIFT BREAKER FROM TRAY USING LIFTING HOLES SHOWN.

THE RECOMMENDED PROCEDURE SHOULD BE FOLLOWED WHEN PLACING HINGED COMPONENT OF AIR CIRCUIT BREAKER IN HOUSING.

F. HINGED CASE AND CIRCUIT BREAKER ON ROLL-OUT TRAY AND ROLL BREAKER INTO POSITION (5) APPROXIMATELY HALF.
G. PULL BREAKER STOP PIN RELEASE HANDLE DOWN AND PUSH THE BREAKER FULLY INTO HOUSING TO ENGAGE THE LOCKING POSITION AND RELEASE HANDLE FROM PIN RELEASE.
H. PUSH THE BLACK OUT HANDLE FIVE (5) TIMES AND THIS WILL MOVE THE BREAKER COMPLETELY INTO THE UNIT. REMOVING THE ROLL OUT TRAY FROM UNDER THE BREAKER CHASSIS.
I. RECHECK BY LIFTING HANDLE, THEN RELEASE HANDLE.
J. CLOSE THE COMPARTMENT FRONT HINGED COVER.

NOTE: THE HINGED COVER OF THE CIRCUIT BREAKER COMPARTMENT SHOULD ALWAYS BE CLOSED WHEN OPERATING THE CIRCUIT BREAKER IN ITS CONNECTED POSITION.





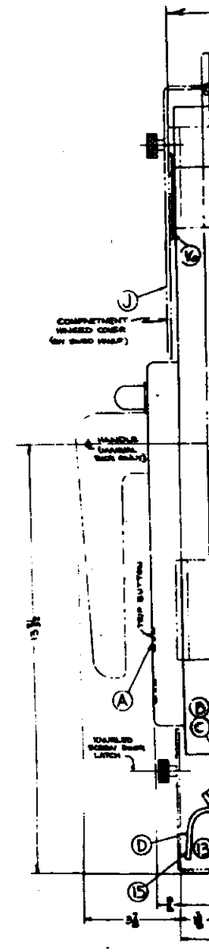


Figure 25. ACB-1600

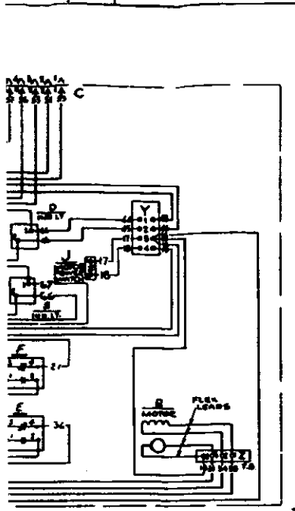
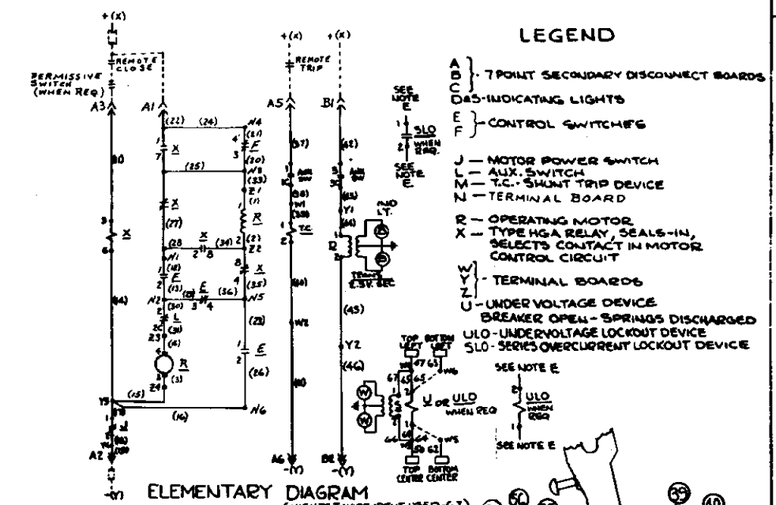


FIGURE 3



LEGEND

A, B, C } - 7 POINT SECONDARY DISCONNECT BOARDS
DAS-INDICATING LIGHTS
E, F } - CONTROL SWITCHES
J — MOTOR POWER SWITCH
L — AUX. SWITCH
M — T.C.-SHUNT TRIP DEVICE
N — TERMINAL BOARD
R — OPERATING MOTOR
X — TYPE HGA RELAY, SEALS-IN, SELECTS CONTACT IN MOTOR CONTROL CIRCUIT
W, Y, Z - TERMINAL BOARDS
U - UNDER VOLTAGE DEVICE
BREAKER OPEN - SPRINGS DISCHARGED
ULO - UNDERVOLTAGE LOCKOUT DEVICE
SLO - SERIES OVERCURRENT LOCKOUT DEVICE

NOTES

NOTE A —

NOMINAL VOLTAGE	SHUNT TRIP VOLTAGE RANGE
120 D.C.	70-140
115 A.C.	80-130
450 A.C.	360-500

NOTE B — CLOSING MOTOR

NOMINAL VOLTAGE	OPERATING VOLTAGE RANGE	FULL LOAD AMPS
120 V.D.C.	90-130	4.0
115 V.A.C.	90-130	4.0

NOTE C - USED ON SPECIFIC REQUISITIONS ONLY

NOTE D - UNDERVOLTAGE DEVICE

NOMINAL VOLTAGE	VOLTAGE RANGE	PICKUP @ MIN. VOLTAGE	DROP OUT VOLTAGE
450 A.C.	360-500	360 MIN	230-45

NOTE E - EXTERNAL WIRING FOR UNDERVOLTAGE LOCKOUT & OVERCURRENT LOCKOUT PER SPECIFIC APPLICATION

THIS BREAKER IS ANTI-PUMP WHEN ELECTRICALLY CLOSED UNDER AN UNDER-VOLTAGE CONDITION

FOR DETAILS OF STATIONARY COMPONENT OF CIRCUIT BREAKER SEE SHEET 2 OF THIS PRINT

COMPONENTS OF CIRCUIT BREAKER ARE FULLY COVERED BY TECHNICAL MANUAL NAVSHIPS-0967-2-GO10.

MOVING COMPONENT OF CIRCUIT BREAKER MAYBE REMOVED FROM SWITCHBOARD BY RACKING OUT BREAKER AND REMOVING BOLTS HOLDING BREAKER TO DRAWOUT TRAY

ATTEMPTS TO RACK OUT BREAKER WILL TRIP BREAKER

TYPICAL REPAIR PARTS LIST FOR ONE BKR.

ITEM	QTY	MFR.	MFR'S IDENTIFYING NO.
1	ARC CONTACT (STA)	15	
2	ARC CONTACT (MOV)	5	
3	MAIN CONTACT (STA)	5	
4	INTERMEDIATE CONT. (STA)	5	
5	MAIN CONTACT (MOV)	5	
6	INTERMEDIATE CONT (MOV)	5	
7	LIGHT 115V 60~; 450V 60~	4	
8			
9	COIL - SHUNT TRIP 115V 60~	1	SEE NOTE A
10	COIL - SHUNT TRIP 450V 60~	1	SEE NOTE A
11	COIL - SHUNT TRIP 120V D.C.	1	SEE NOTE A
12	RELAY 115V 60~	1	
13	RELAY 125V D.C.	1	
14			
15	CHAIR SWITCH (5 & 5A & 5B)	1	
16	SWITCH CUT-OFF	1	
17	SWITCH MOTOR POWER	1	
18	MOTOR	1	SEE NOTE D
19	RETAINING RINGS & PLIERS		
20	RETAINING RINGS & PLIERS	1	
21	SPRING (STA. ARC CONT.)	15	
22	(STA. ARC CONT.)	15	
23	(STA. MAIN CONT.)	12	
24	(OPERATING)	2	
25	(MAL. TRIP BUTTON)	1	
26	(CAM PROP RETURN)	1	
27	(TRIP TO RESET LEV.)	1	
28	(TRIP SHAFT RETURN)	1	
29	(SHOCK LOCK)	1	
30			
31	(RESET ON DO HANDLE)	1	
32	(D.O. PUSHER)	1	
33	(MOTOR CUT-OFF)	1	
34	(MOT. DISCONN.)	1	
35	(SEC. DISCONNECT)	21	
36	(SHUNT TRIP)	1	
37	(OVERCUR. LOCKOUT)	1	
38	(" ")	1	
39	(" ")	1	
40	(" ")	1	
41	(UNDERVOL. ")	1	
42	(DISCHARGE ROD)	1	
43	(MECH. RESET)	1	
44	SPRING (MOTOR MECH. DRIVER)	1	
45			
46			
47			
48			
C	SPRING (UNDERVOLTAGE DEV.)	1	
C	COIL - UNDERVOLTAGE DEVICE (SPARE)	1	SEE NOTE C
51	SPRING (MECH. RESET)	1	
52			
53	ARC CONTACT (MOV)	6	
54	CONTACT BKT. (OVERCUR. LO.)	2	
55	CONTACT BKT. (" ")	2	
56	CONTACT STRIP (" ")	2	

REVISIONS

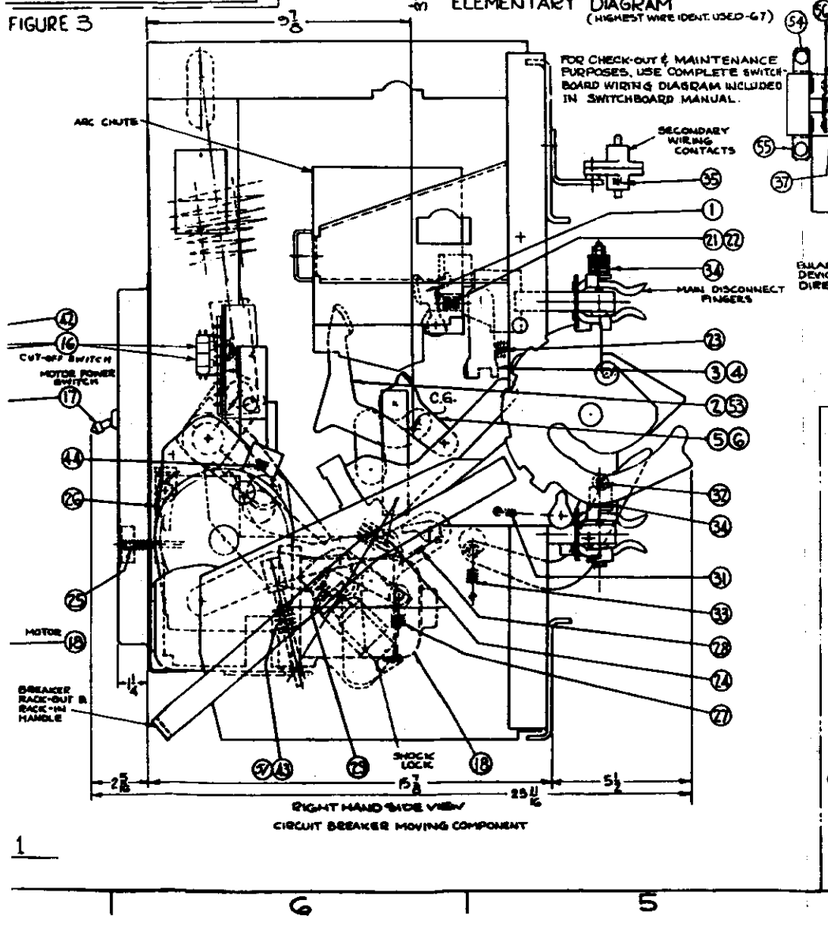
ZONE	REV	DESCRIPTION	DATE	BY	CHK'D
B	A	ISSUED	2 Jan 63		
	1				
	2				
	3				
	4				

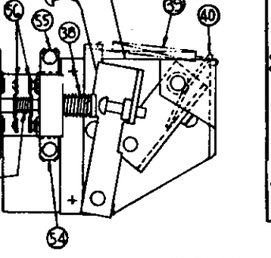
DESCRIPTIVE DATA

TYPE	NAVY TYPE ACB 1600 HRC
	GEN. ELEC. CO. TYPE AK-2-100N
CONTINUOUS CURRENT	1600A
VOLTAGE	600A.C.
POLES	3 POLES
RATED INTERRUPTING CURRENT	100,000 AMPS. A.C.
SHORT TIME RATING	100000 AMPS. RMS (30 CYCLES)
MOUNTING	REMOVABLE ASSEMBLY DRAWOUT
NORMAL CLOSING	ELECTRIC
OVERCURRENT COILS (AMPERES)	A00-1000-1200-1400-1600
AMBIENT TEMPERATURE	50°C
SHOCK CLASSIFICATION	CLASS H1
INSULATION CLASS	B
CONNECTIONS	BACK
PROTECTIVE FUNCTION	OVERCURRENT
	LONG TIME DELAY
	SHORT TIME DELAY
	(BAND 1, 2, 3)
	INSTANTANEOUS
	SHUNT TRIP
ACCESSORIES	INDICATOR LIGHT
	AUX. SWITCH 10 CIR. (5a & 5b)
	OVERCURRENT DEV. (INST.)
	UNDERVOLTAGE DEV.
	UNDERVOLTAGE LOCKOUT DEV.
	OVERCURRENT LOCKOUT DEV.
BUSHIPS APPROVAL LTR.	
TECHNICAL MANUAL - G.E. CO. GEI	NAVSHIPS 0967-2-GO10
SPECIFICATION	MIL-C-17587
SPECIFICATION EXCEPTIONS	NONE
TEST REPORT NO.	

DESCRIPTION	WEIGHT OF REMOVABLE ASSEMBLY COMPLETE	WEIGHT OF REMOVABLE COMPONENT ONLY
3 POLE ELECTRIC	550 LBS	450 LBS

1. REMOVABLE ASSEMBLY: EACH CIRCUIT BREAKER SUPPLIED IS A COMPLETE REMOVABLE SWITCHBOARD ASSEMBLY CONSISTING OF CIRCUIT BREAKER, REMOVABLE DISCONNECTS AND ASSOCIATED CONTROL WIRING, DRAWOUT MECHANISM AND ARRESTER, STRUCTURAL SUPPORT & AND BACK PLATE INCLUDING STANDOFF MAIN BUS CONNECTIONS AND STATIONARY TERMINALS FOR CONNECTION OF THE ACCESSARY EXTERNAL CONTROL WIRING.
2. UNLESS OTHERWISE SPECIFIED THE STANDARD CIRCUIT BREAKER IS FURNISHED WITH AN 10 CIRCUIT AUXILIARY SWITCH (5a AND 5b CONTACTS) AND A TERMINAL OF 21 SECONDARY WIRING DISCONNECT TERMINALS.
3. FOR FULL DESCRIPTION AND DETAILS APPLICABLE TO THIS BREAKER, OTHER THAN INSTALLATION DIMENSIONS REFERENCE MUST BE MADE TO THE APPLICABLE CERTIFICATION DATA SHEET AND TECHNICAL MANUAL GEI-100 NAVSHIPS 0967-2-GO10 0910.
4. THIS BREAKER ASSEMBLY IS DESIGNED FOR NAVY ENCLOSED UNIT EQUAL TO DES OF 21" WIDTH NAVSEA S 9310 - 5 SECTION.
5. BASIC MOUNTING REQUIREMENTS PER SPEC MIL-E-917





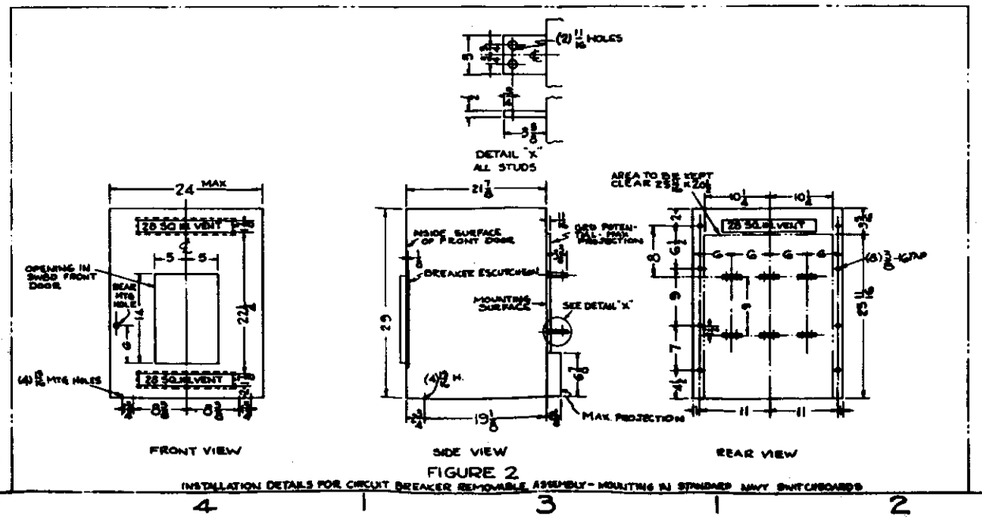


FIGURE 2
INSTALLATION DETAILS FOR CIRCUIT BREAKER REMOVABLE ASSEMBLY - MOUNTING IN STANDARD NAVY SWITCHBOARDS

Drawing By	MASTER DRAWINGS	GENERAL ELECTRIC
Appvd. By	AIR CIRCUIT BREAKER	LOW VOLTAGE SWGR. PHILA.
Appvd. Date	NAVY TYPE AC.B. 1600 HRC, W.T. 1000 TO 1600A., DC 0015-5000 MC	0122 F09981
	800 TO 1600A., DC 0015-5000 MC	
	3 POLE-ELECTRIC	
	INTER. CAPACITY 100,000 A.C.	B
	REMOVABLE ASSEMBLY	

Figure 26. ACB-1600HRC circuit breaker master plan (sheet 1)

Figure 26

ACB-1600HRC Master plan (sheet 1)

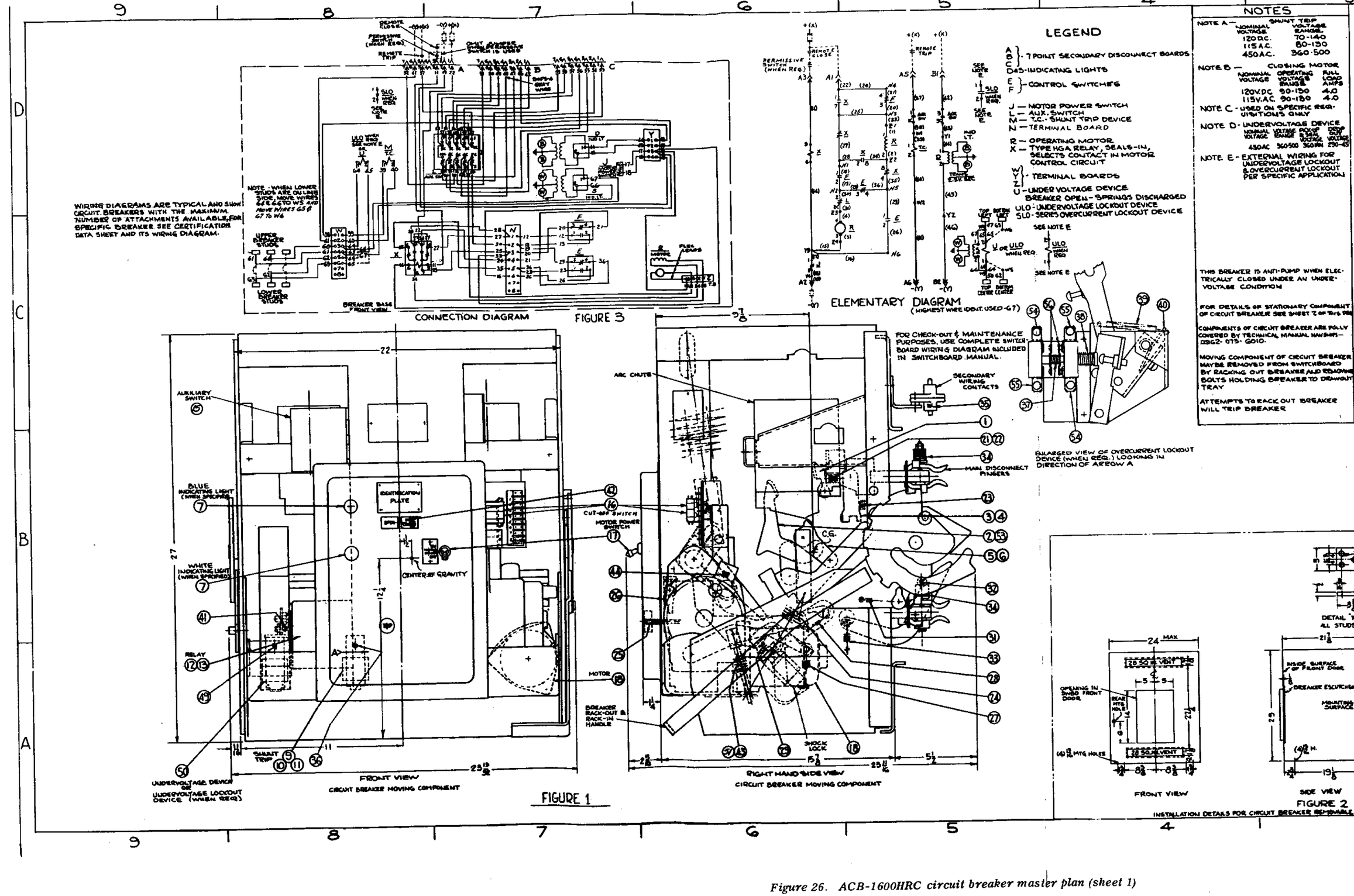


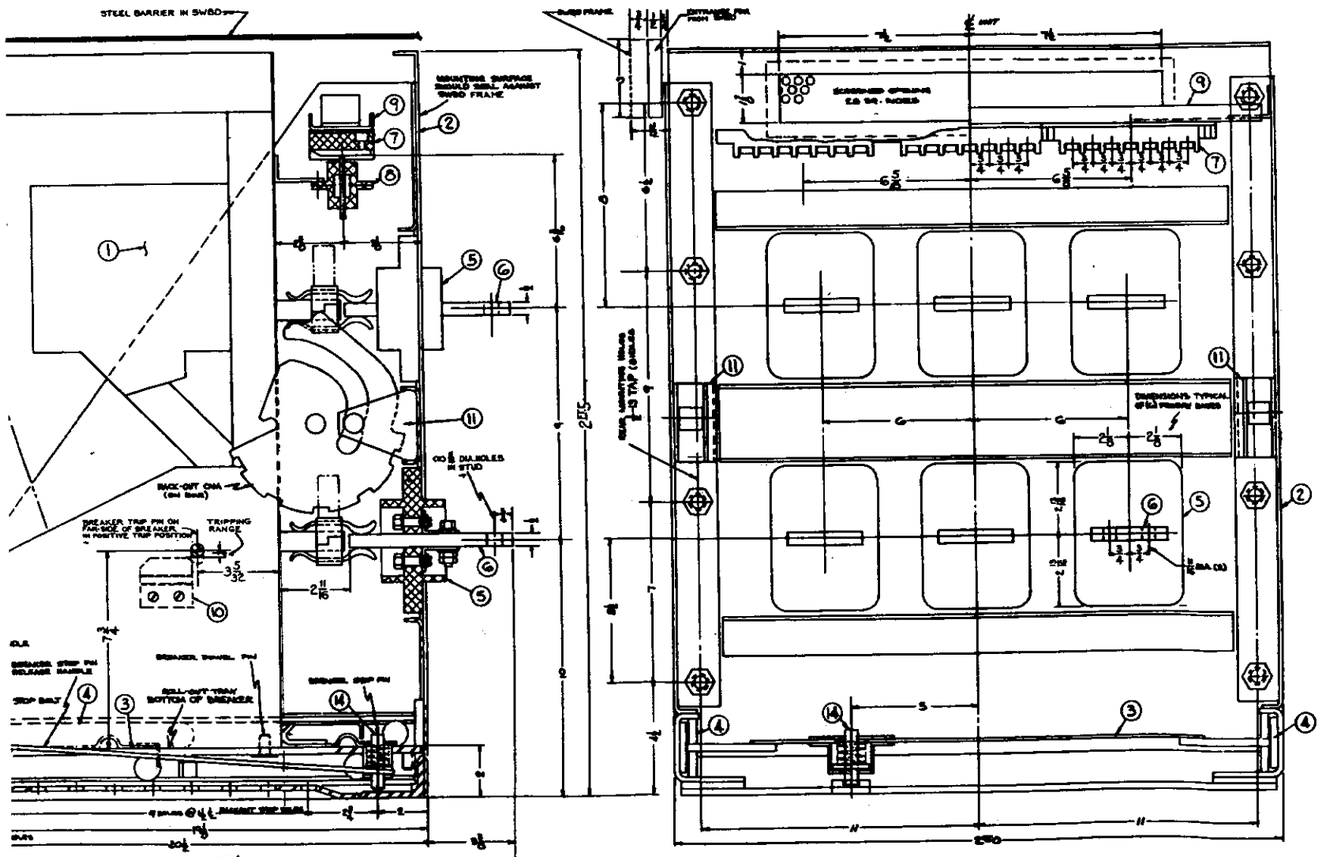
Figure 26. ACB-1600HRC circuit breaker master plan (sheet 1)

REVISIONS						
ZONE	REV	DESCRIPTION				
	A	ISSUED				
		11 APR. PER BUSHIP LTR 9520 SEA 6249 W-1262 DTD 16 MAR 1962				
	B	APPROVED PER NAVY SEA LETTER 0126 SEA 6249 W-1262 DTD 31 JUNE 1963				

FOR FUTURE REVISIONS SEE SHEET 1

LIST OF MATERIAL					ITEM			
FIG NO	NAME	NO ITEM	MATERIAL	MATL. SPEC.	NAVSHIPS DWG NO	UNIT WT LB	STD NAVY STOCK NO	REMARKS
1	ACB 1600 HRC GE TYPE AK-2-100	1		MIL-C-17357	0122F0981 sht 1			
2	STATIONARY COMPONENT	1	STEEL	MIL-S-20166	847C760			
3	ROLL OUT TRAY	1	STEEL	MIL-S-20166	847C764			
4	ROLL-OUT SIDE RUNNER	2	STEEL		847C766			
5	PRIMARY DISC DEVICE (SHOE)	6	COMPOUND	MIL-P-14	P-6618000			
6	PRIMARY DISC DEVICE	6	COMPOUND	MIL-P-20694	847C762			
7	SECONDARY DISC DEVICE (STATIONARY)	Δ	COMPOUND	MIL-P-14	847C746			
8	SECONDARY DISC DEVICE (MOVABLE)	Δ	COMPOUND	MIL-P-14				
9	SECONDARY DISC DEVICE SUPPORT DISC	1	STEEL	MIL-S-20166	847C746			
10	TRIP INTERLOCK	1	STEEL	MIL-S-20166	847C763			
11	CAM PIN SUPPORT	2	STEEL	MIL-P-16232	847C763			
12	ROLL-OUT STOP BOLT 5/8-10 SAE 1B	1	STEEL					
13	5/8 FLAT WASHER	1	STEEL					
14	BREAKER STOP PIN	1	STEEL		847C768			
15	BREAKER STOP PIN LEVER	1	STEEL	MIL-S-20166	847C765			
16	SCREENED OPENING COVER PLATE	1	STEEL	MIL-S-20166				
17	BREAKER MTG BOLT 5/8-10 SAE 1B	4	STEEL					

Δ QUANTITY AS REQUIRED (3 MAX)



REFERENCES		
NO	DRAWING NO	SPECIFICATION

NOTES: 1 FOR SWITCHBOARD MOUNTING DATA, REPAIR PARTS, WIRING DIAGRAMS AND OTHER DETAILS SEE SHEET 1.

2 CLEANING AND PAINTING OF ASSEMBLY TO BE IN COMPLIANCE WITH MILITARY SPECIFICATIONS MIL-E-917. PAINTED SWITCHBOARD GRAY.

3 THE MAIN DRAWOUT DISCONNECTS MAY BE OBSERVED WHEN THE MOVING COMPONENT IS FULLY DRAWN OUT.

SCALE WEIGHT

WEIGHT OF REMOVABLE ASM WITH ELECTRIC BKR IS 590 LBS.
WEIGHT OF REMOVABLE ASM WITHOUT BKR IS 160 LBS

DETAILS OF CIRCUIT BREAKER STATIONARY COMPONENT

DRAWN BY	MASTER DRAWINGS	GENERAL ELECTRIC
APPD BY	AIR CIRCUIT BREAKER	0122F0981
APPD	NAVY TYPE ACB-1600 HRC GE AK-2-100	
	600-1600A, AC 60HZ 3-POLE VAB	
	3 POLE-ELECTRIC	B
	REMOVABLE ASSEMBLY	

Figure 27

ACB-1600HRC Master plan (sheet 2)

THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN REMOVING MOVING COMPONENT OF AIR CIRCUIT BREAKER FROM CONNECTED POSITION IN HOUSING.

A. TRIP BREAKER BY DEPRESSING TRIP BUTTON, BEFORE OPENING THE COMPARTMENT HINGED COVER.
B. LIFT RACK OUT HANDLE; LOCATED ON LOWER RIGHT SIDE OF BREAKER, THIS WILL TRIP BREAKER IN EVENT STEP A IS OMITTED.
C. PUMP THE RACK OUT HANDLE (5) TIMES & THEN RELEASE HANDLE.
D. PUSH BREAKER STOP PIN RELEASE HANDLE DOWN AND PULL BREAKER FORWARD TO LIMIT ITS TRAVEL. THE BREAKER MAY BE SAFELY INSPECTED AND MAINTENANCE PERFORMED ON IT IN THIS POSITION.
E. IF MAJOR MAINTENANCE IS NECESSARY IT MAY BE DESIRABLE TO REMOVE THE BREAKER FROM THE ROLL-OUT TRAY. THIS IS DONE BY REMOVING THE FOUR (4) MOUNTING BOLTS, ANCHORING THE BREAKER TO THE ROLL-OUT TRAY AND LIFT BREAKER FROM TRAY USING LIFTING HOLES SHOWN.

THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN PLACING MOVING COMPONENT OF AIR CIRCUIT BREAKER IN HOUSING.

F. MOUNT THE AIR CIRCUIT BREAKER ON ROLL-OUT TRAY AND BOLT DOWN WITH FOUR (4) MOUNTING BOLTS.
G. PULL BREAKER STOP PIN RELEASE HANDLE DOWN AND PUSH THE BREAKER INTO UNIT UNTIL IT REACHES THE RACKING POSITION AND RELEASE BREAKER STOP PIN HANDLE.
H. PUMP THE RACK-OUT HANDLE FIVE (5) TIMES AND THIS WILL MOVE THE BREAKER COMPLETELY INTO THE UNIT. REVERSE THE RACHET BY LIFTING HANDLE, THEN RELEASE HANDLE.
J. CLOSE THE COMPARTMENT FRONT HINGED COVER.

NOTE: THE HINGED DOOR OF THE CIRCUIT BREAKER COMPARTMENT SHOULD ALWAYS BE CLOSED WHEN OPERATING THE CIRCUIT BREAKER IN ITS CONNECTED POSITION.

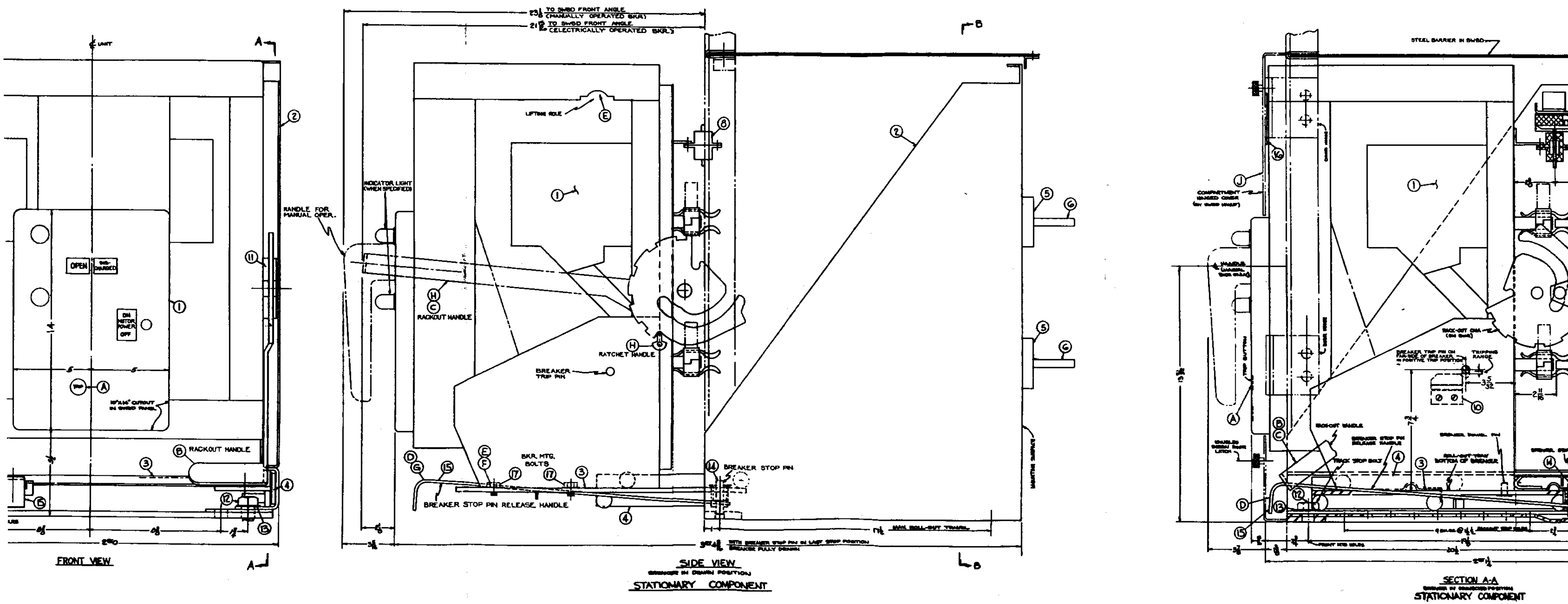


Figure 27. ACB-1600HRC circuit breaker master plan (sheet 2)

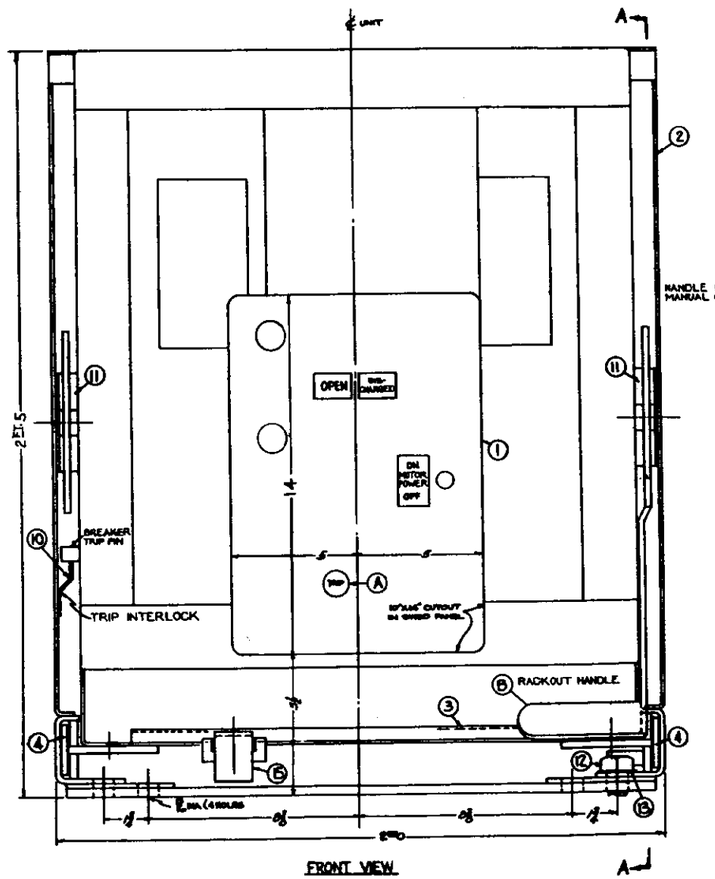
THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN REMOVING MOVING COMPONENT OF AIR CIRCUIT BREAKER FROM CONNECTED POSITION IN HOUSING.

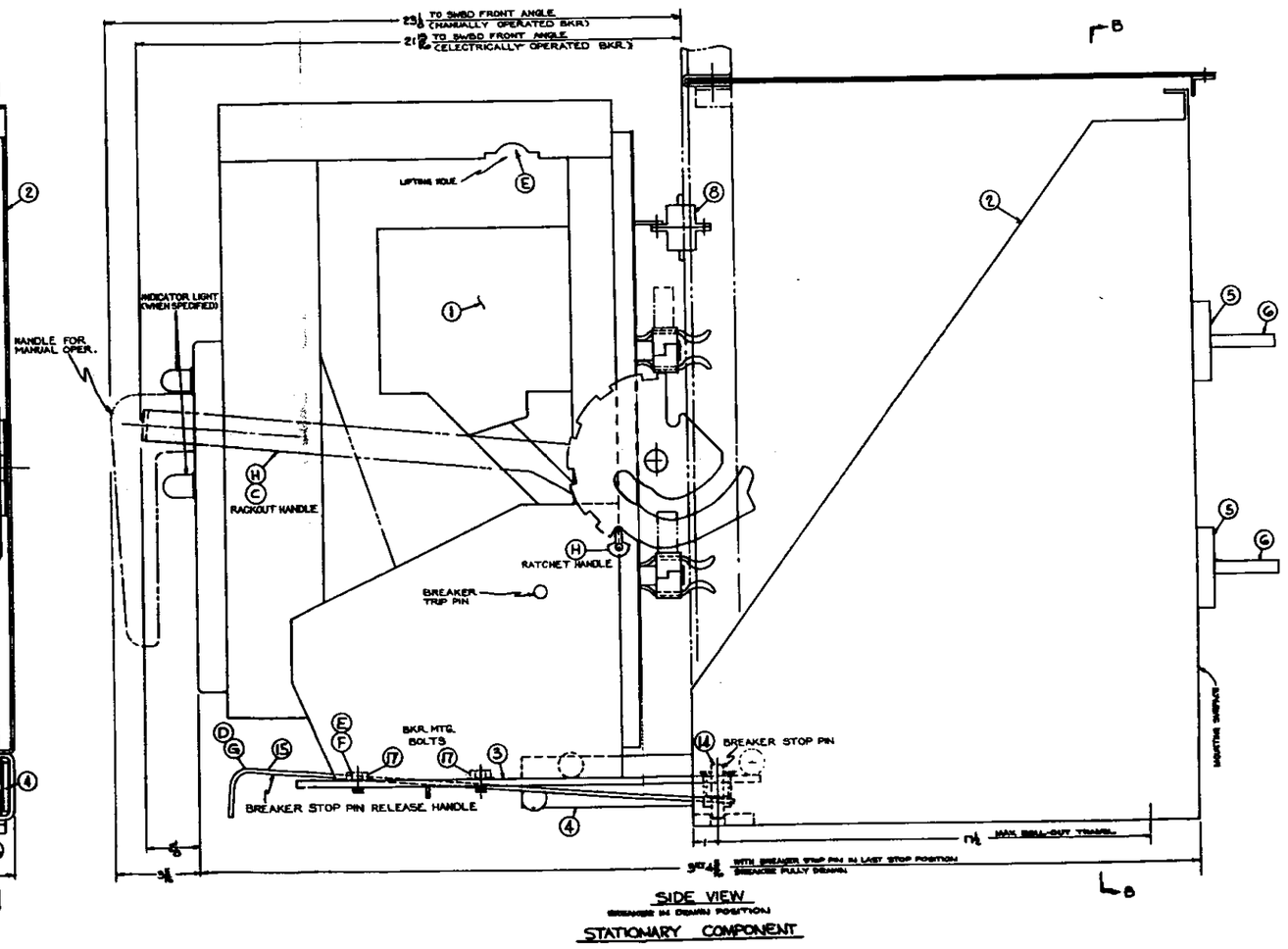
A. TRIP BREAKER BY DEPRESSING TRIP BUTTON, BEFORE OPENING THE COMPARTMENT HINGED COVER.
B. LIFT RACK OUT HANDLE, LOCATED ON LOWER RIGHT SIDE OF BREAKER, THIS WILL TRIP BREAKER IN EVENT STEP A IS OMITTED.
C. PUMP THE RACK OUT HANDLE (5) TIMES & THEN RELEASE HANDLE.
D. PUSH BREAKER STOP PIN RELEASE HANDLE DOWN AND PULL BREAKER FORWARD TO LIMIT ITS TRAVEL. THE BREAKER MAY BE SAFELY INSPECTED AND MAINTENANCE PERFORMED ON IT IN THIS POSITION.
E. IF MAJOR MAINTENANCE IS NECESSARY IT MAY BE DESIRABLE TO REMOVE THE BREAKER FROM THE ROLL-OUT TRAY. THIS IS DONE BY REMOVING THE FOUR (4) MOUNTING BOLTS, ANCHORING THE BREAKER TO THE ROLL-OUT TRAY AND LIFT BREAKER FROM TRAY USING LIFTING HOLES SHOWN.

THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN PLACING MOVING COMPONENT OF AIR CIRCUIT BREAKER IN HOUSING.

F. MOUNT THE AIR CIRCUIT BREAKER ON ROLL-OUT TRAY AND BOLT DOWN WITH FOUR (4) MOUNTING BOLTS.
G. PULL BREAKER STOP PIN RELEASE HANDLE DOWN AND PUSH THE BREAKER INTO UNIT UNTIL IT REACHES THE RACKING POSITION AND RELEASE BREAKER STOP PIN HANDLE.
H. PUMP THE RACK-OUT HANDLE FIVE (5) TIMES AND THIS WILL MOVE THE BREAKER COMPLETELY INTO THE UNIT. REVERSE THE RACHET BY LIFTING HANDLE, THEN RELEASE HANDLE.
J. CLOSE THE COMPARTMENT FRONT HINGED COVER.

NOTE: THE HINGED DOOR OF THE CIRCUIT BREAKER COMPARTMENT SHOULD ALWAYS BE CLOSED WHEN OPERATING THE CIRCUIT BREAKER IN ITS CONNECTED POSITION.





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