SWITCHBOARD TECHNICAL MANUAL

PART 2

CHAPTER 4
CIRCUIT BREAKER
Navy Type ACB-3200HR
General Electric Type AK-2-100N

CHAPTER 5
CIRCUIT BREAKER
Navy Type ACB-4000HR
General Electric Type AK-1-100N

(Applicable to Units Manufactured After 1972 and Starting with Serial # 0224A3561-1)

GENERAL ELECTRIC
PHILADELPHIA, PA.
(FSC 03497)

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REMARKS

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It is hereby certified that the manual, NAVSHIPS 0962-073-8010, 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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AIR CIRCUIT BREAKER, NAVY TYPES ACB-3200HR AND ACB-4000HR

CLASSIFICATION DATA

Manufacturer	General Electric Co., Philadelphia, Pa., U.S.A.
Types	Navy Type ACB-3200HR, General Electric Type AK-2-100N Navy Type ACB-4000HR, General Electric Type AK-1-100N
Continuous Current Rating	
Type ACB-3200HR	3200 amperes
Type ACB-4000HR	4000 amperes
Voltage	500 Volts, AC 60 Hertz
Poles	3
Rated Interrupting Current	100,000 amperes, asymmetrical
Short-time Rating	100,000 amperes, asymmetrical
Short-time Rating Duration	0.560 Sec.
Mounting	Removable assembly
Main Connections	Back
Normal Closing	Electric
Overcurrent Coils	
Type ACB-3200HR - 2000, 2400, 2800	3200 amperes
Type ACB-4000HR	4000 amperes
Characteristic Time Curve	Bands 2, 3, or 4
Temperature	50°C
Shock Classification	Class HI
Insulation Class	B
Accessories	Auxiliary Switch
Protective Functions	Overcurrent trip Long-time delay and instantaneous Long-time delay, short-time delay, and instantaneous Short-time delay and instantaneous Instantaneous Undervoltage trip, when required Shunt trip, when required
Master Drawings	
Type ACB-3200HR	G. E. No. 0122F0963 (2 sheets)
Type ACB-4000HR	G. E. No. 7078F30 (2 sheets)
Certification of Approval	
Applicable Military Specification	MIL-C-17587
Weights	
Complete Breaker	886 lb
Moving Component Only	538 lb

SECTION B-1

General Instructions

GENERAL

This manual describes both the Navy Type ACB-3200 HR and the Navy Type ACB-4000 HR air circuit breakers, since they are fully interchangeable in installation and operation except for overcurrent trip ratings.

PURPOSE

The fundamental purpose of a circuit breaker is to isolate a circuit from the source of power. This purpose may be served by normal off-on switching operations of normal continuous current, or it may 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, THE MOTOR POWER "OFF," AND THE BREAKER IN THE WITHDRAWN POSITION (SEE FIGURE 4). 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 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 (2) REMOVED FROM THE PUSH ROD, AND THE PIN PLACED IN THE SPRING CLIP (3).

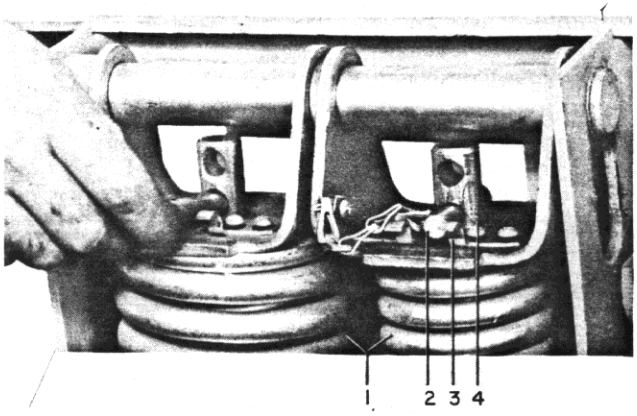
HANDLING

Care should be exercised in unpacking to avoid damage to breaker parts. Be sure that no loose parts are missing or left in the 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 thereby resulting in the 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



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

**Repair part*

Figure 1. Installing safety pin in push rod

the switchboard front horizontal member with four bolts.

2. Bolt the switchboard bus and cables to the stationary component terminals. Provide the required 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 as required per 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.

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 out under the breaker as far as the tray will travel by moving the breaker stop pin release handle to the right 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 all sit firmly on the tray.

6. Insert four 3/8-inch hexagonal head bolts through the holes in the front of the side angles on the breaker and thread them part way into the tapped holes in the tray. DO NOT TIGHTEN 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.

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 shown in figure 3.

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 dowr.

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 to the right 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

NOTE

De-energize the equipment completely by removing all sources of power, both primary and secondary. Also, be sure the breaker is in the open position before inspection or any maintenance work is done.

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, contacts, and flexible connectors. 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 as 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 of the primary disconnecting device contacts and stud. A thin coat of graphite lubricant (DAG 154) should be applied to the contact surface of the disconnects.

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 malfunction, together with their cause and remedy. If at any time these symptoms are observed, their cause should be determined and the necessary corrective action taken.

AIR CIRCUIT BREAKER, NAVY TYPES ACB-3200HR AND ACB-4000HR

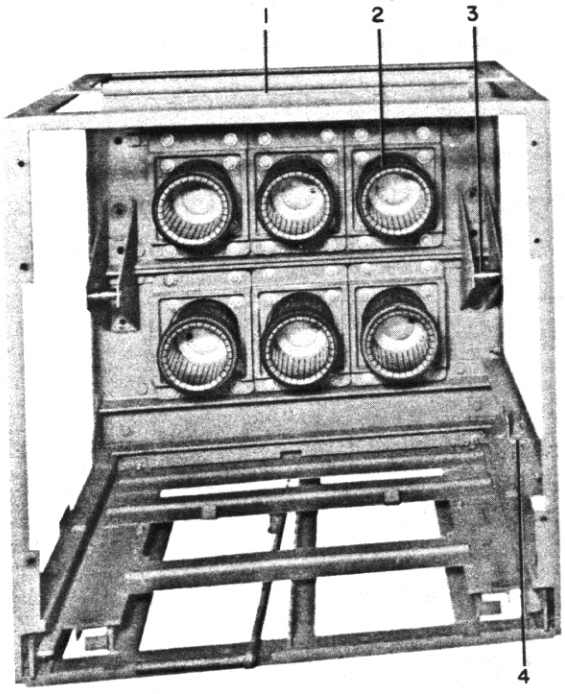
TABLE 1
TROUBLE SHOOTING

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 pick-up 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 attchments.
	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 or replace contacts. See Section E-1.
Difficult to Drawout	Primary disconnects both stationary & moving seize because of operating temperature.	Add thin coat of DAG 154 to primary disconnects. Obtainable from Acheson Colloids Co., Port Huron, Michigan.

SECTION B-2
Description of Removable Assembly

The complete assembly of the ACB-3200HR circuit breaker and ACB-4000HR circuit breaker consists of a stationary component (see figure 2) that is mounted in the switchboard frame plus a drawout-type moving component (see figures 3 and 4).

The stationary component is a box-type unit that is bolted to the vertical members in the back and 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 rollout 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 wiring disconnects
2 Primary disconnect (sta)
3 Racking pin
4 Drawout interlock device

Figure 2. Front view of stationary component

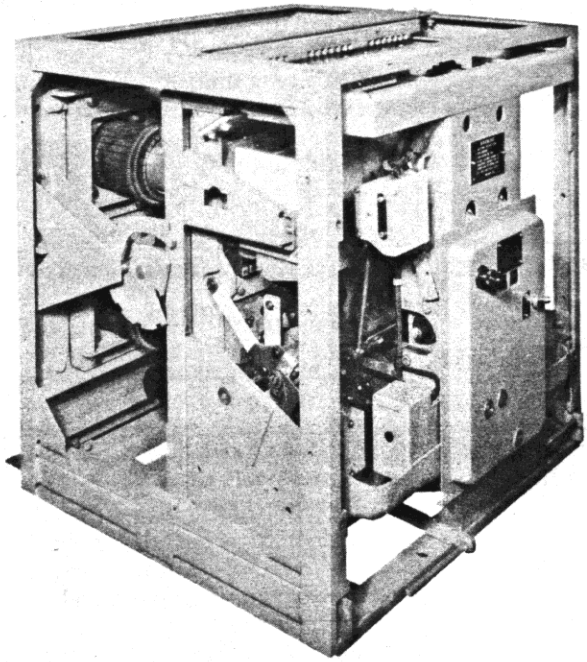


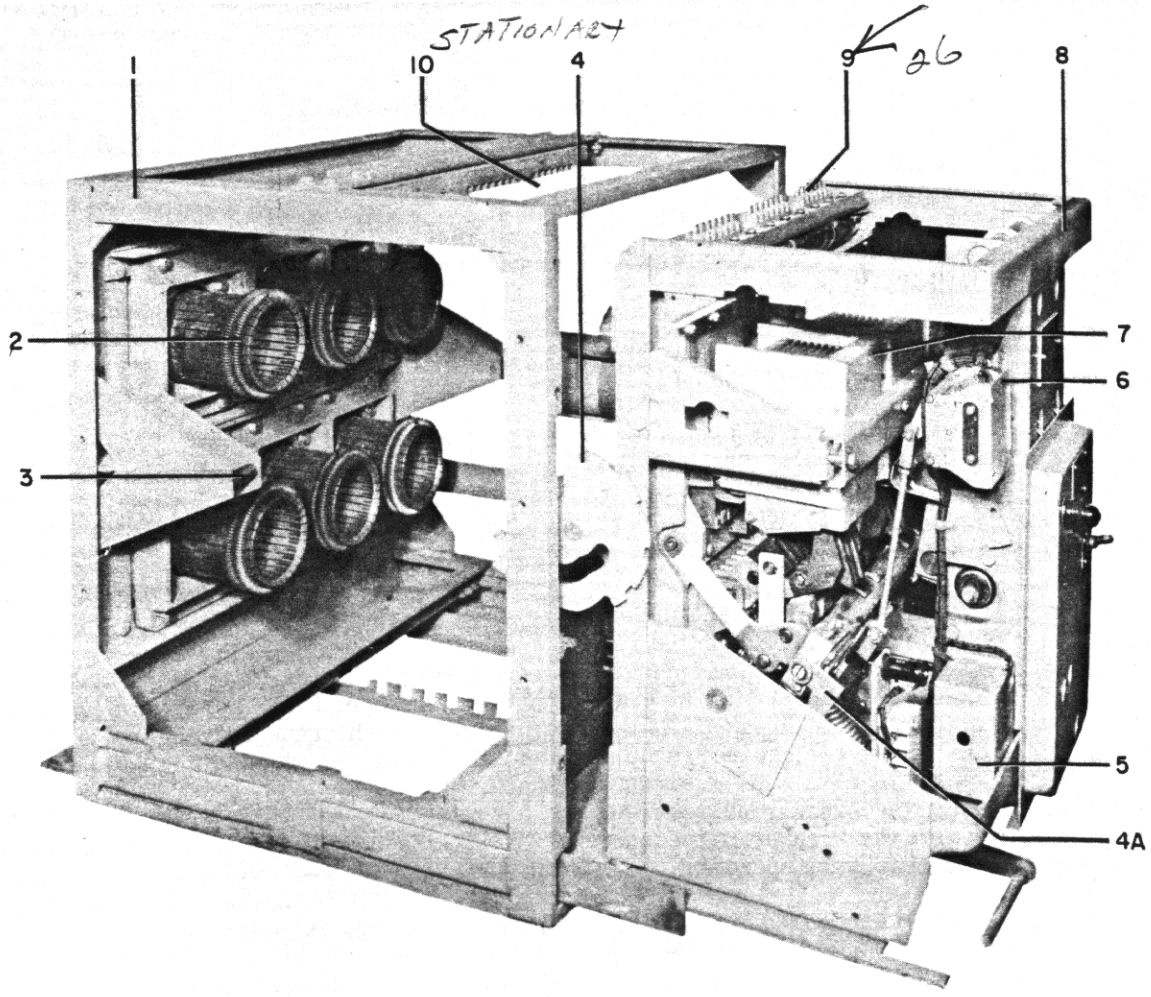
Figure 3. Removable assembly with breaker moving component shown in the connected position

SECTION B-3

Description of Circuit Breaker

The circuit breaker moving component (see figure 5) consists of two major parts: the back frame assembly and the front frame assembly. The back frame assembly (see figure 7) 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.

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



1 Stationary component
2. Primary disconnect (sta)
3 Racking pin
4 Racking cam
4A Anti-rebound hook
*5 Control relay**
*6 Auxiliary switch**
7 Arc quencher assembly
8 Circuit breaker moving component
9 Moving secondary disconnects
10 Stationary secondary disconnects

**Repair part*

Figure 4. Removable assembly with breaker moving component shown in the withdrawn position

named except for the arcing contacts, which are in parallel with the main contact.

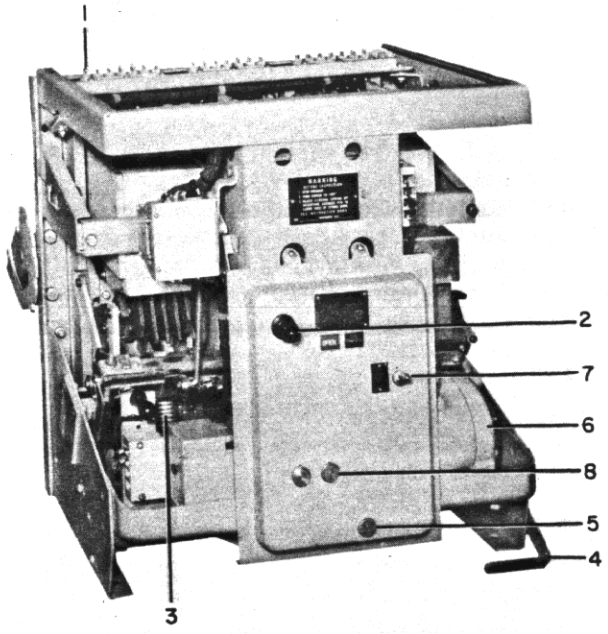
The pole base linkage is arranged in such fashion that on opening, the main contacts open first, the intermediate contacts open second, and the arcing contacts open last to draw the arc into the arc quencher where it is promptly extinguished. The linkages of the three pole base units are connected together by an insulated cross bar (6) (see figure 7) that assures simultaneous operation of the three poles.

The overcurrent trip device consists of an armature and magnet assembly mounted on the lower stud to the rear of the pole base and the calibration and timing unit mounted on the front of the pole base (see figure 7). The magnet and armature assemblies of the overcurrent trip device surround the lower stud to detect the presence of overcurrent. When an overcurrent condition exists, the movement of the armature to the closed air-gap position is transferred through the linkages to the calibration and timing unit, tripping the breaker per predetermined settings.

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 the 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 trip 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 cross bar, is incorporated for use in protective and control circuits. Manual tripping may be accomplished by manual operation of the trip button on the breaker



1 Secondary disconnects (movable)
*2 Indicating light**
*3 Opening springs**
4 Racking handle
5 Close button
6 Gear reduction unit
7 Motor power switch
8 Trip button

**Repair part*

Figure 5. Front view of moving component

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 (4A) (see figure 4) on the left side of the cross bar 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 12).

2. Charge the closing springs with the maintenance handle until the indicator (4) (see figure 11) reads charged.

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

Electrical Operation (Normal Closing)

With the breaker opened and the closing spring 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, or by the overcurrent trip unit.

To trip the breaker manually, depress the trip button on the breaker escutcheon. The breaker will trip 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 direction, displacing the trip latch and tripping the breaker.

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 23 and 25 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), M(Z1-Z2), X(8-4), E(3-4), and M(Z3-Z4), until the pre-charging of the closing springs is completed. This occurs approximately 30 cycles before the spring-charging cam reaches the top dead-center position. The pre-charging 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), and R(Z3-Z4). The closing operation can then be obtained by using a remote close switch.

NOTE:

Figures 23 and 25 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.

Operation of the closing switch causes relay X to pick up and close contact X(1-7), thus completing the motor circuit through X(1-7), R(Z1-Z2), X(8-2), F(1-2), 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&F, which will revert to their original positions as shown in figure 23.

The pre-charging 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 pre-charge the closing springs automatically as long as control power is available.

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-3200HR and the ACB-4000HR 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 breaker nameplate. The shock lock for 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.

SECTION D-2

Arc Quencher

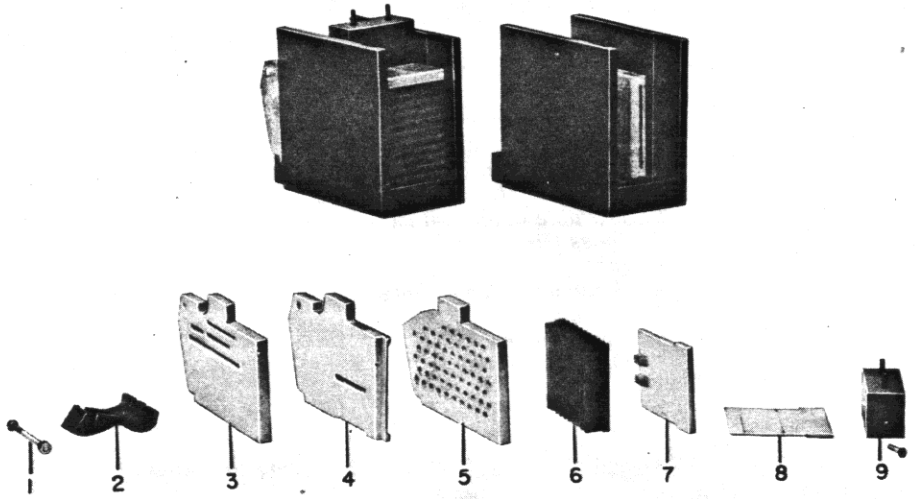
DESCRIPTION

(See Figure 6)

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

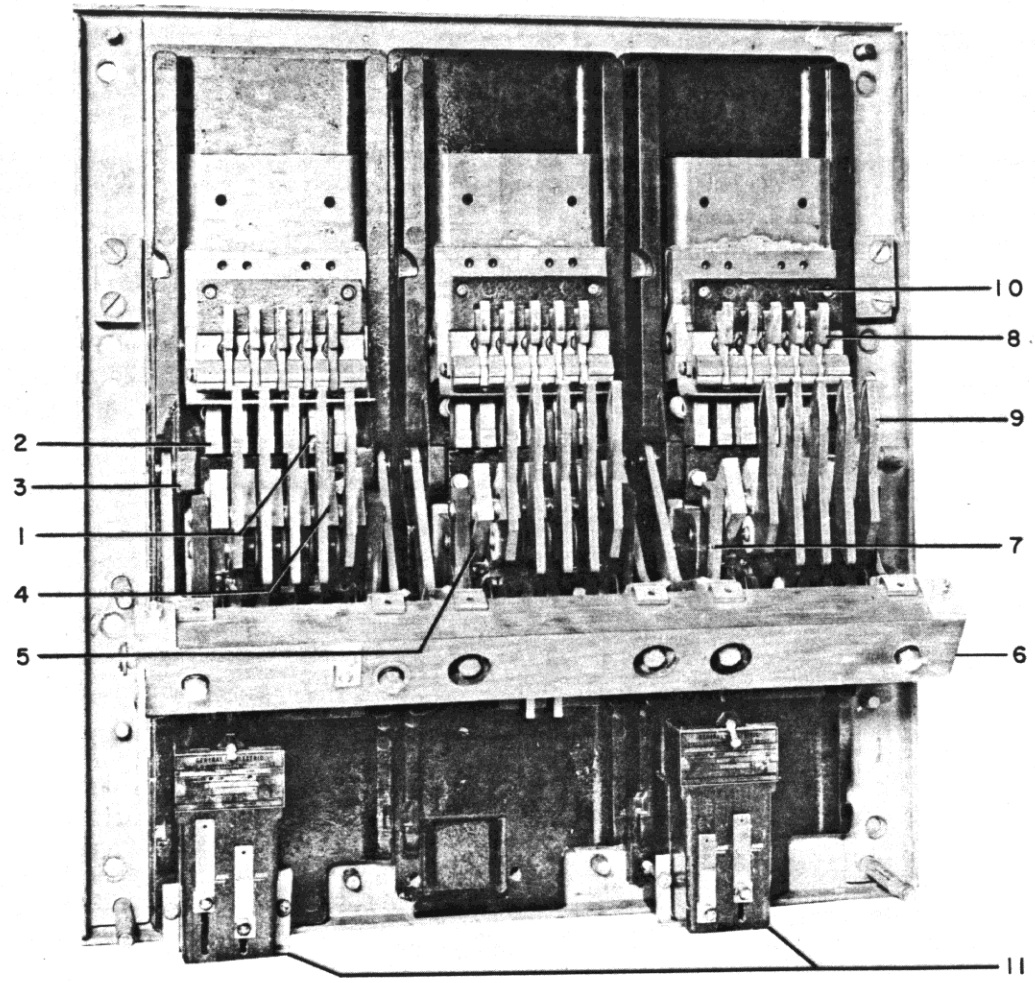
OPERATION

Each arc quencher 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



*1 Stationary intermediate contact**
*2 Stationary main contact**
3 Lower contact block
*4 Movable intermediate contact**
*5 Movable main contact**
6 Cross bar
7 Link
*8 Stationary arcing contact**
*9 Movable arcing contact**
10 Upper contact block
11 Overcurrent device

**Repair part*

Figure 7. Front view of back frame assembly, moving component

SECTION D-3
Contact Assembly

DESCRIPTION (SEE FIGURE 8)

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 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 (1), pin (2), and compression springs (21). These springs provide continuous contact pressure for the full travel of the contacts. Flexible braid leads 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 (4) carried on two movable pivot pins (8 and 18). The contacts interleaf and pivot with respect to the main contacts about the pin (18). This relative motion is obtained by linkages from the upper pin (6) 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 (17) which holds them to the lower block. These contacts are actuated by a second pin (6), connected by an insulated link (7) to the breaker mechanism. In addition to flexible braids, which shunt the current from the contact directly to the lower contact block, a steel spring (16) forces the contacts against the pins to prevent pitting at the pivot point. The intermediate contacts are built up higher than the main contacts and consequently 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 (see Section D-2).

2. Close the breaker and measure dimension "B" (see figure 8).

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 1 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 (see 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 8.)

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.

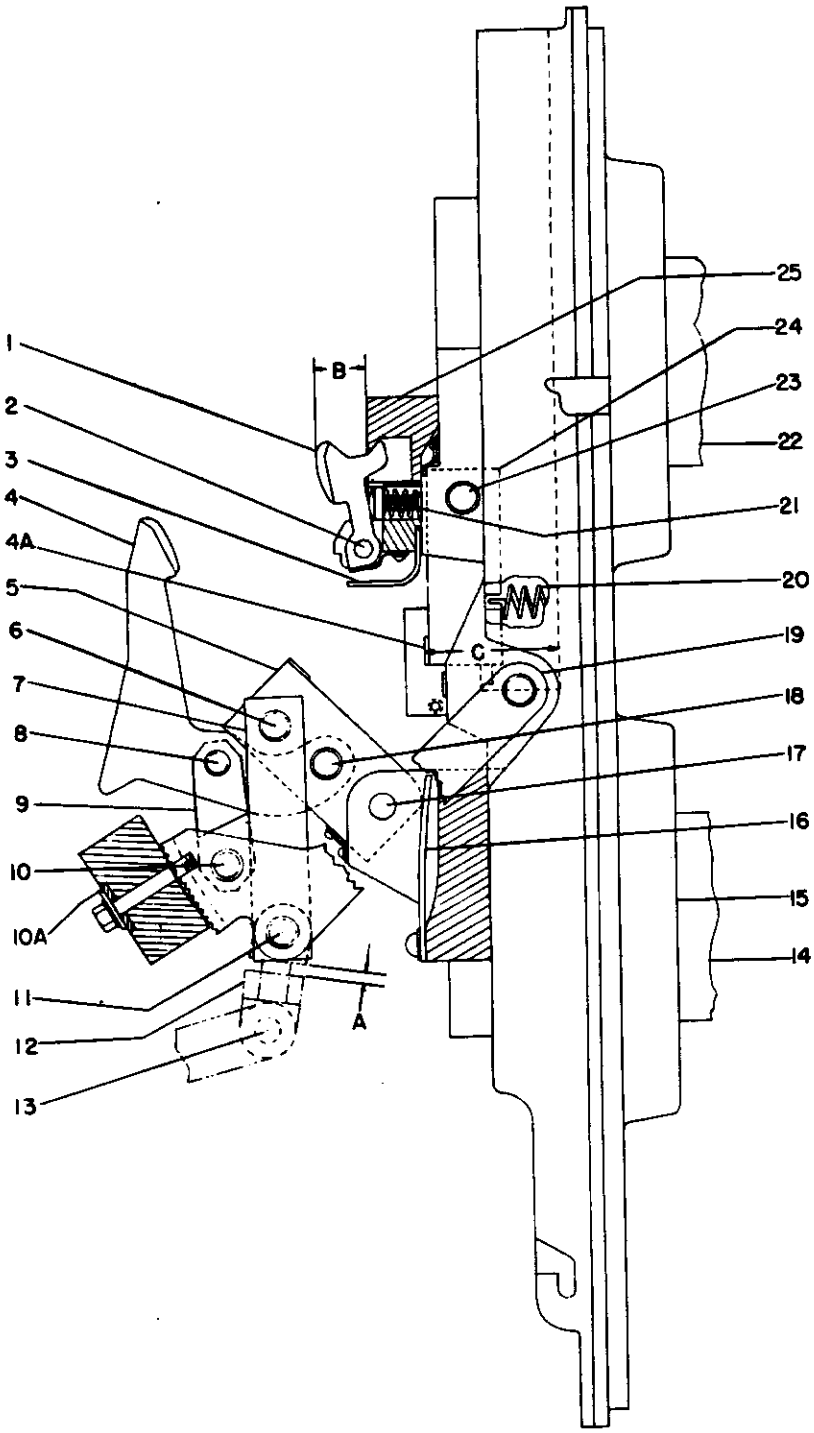
WARNING

BE EXTREMELY CAREFUL NOT TO TRIP THE BREAKER.

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

ADJUSTING CONTACT WIPE AND PRESSURE (SEE FIGURE 8)

1. To obtain proper contact wipe and pressure on the center pole, dimension "A" (see figure 8) should be increased to increase wipe and decreased to decrease wipe as necessary.



1 *Stationary arcing contact**
2 *Pin (stationary arcing contact)*
3 *Insulation*
4 *Movable arcing contact**
4A *Stationary intermediate contact**
5 *Movable main contact**
6 *Shouldered pin*
7 *Link*
8 *Pin (arcing contact link)*
9 *Insulating link*
10 *Pin (insulating link)*
10A *Adjusting plate*
11 *Pin (side link)*
12 *Clevis*
13 *Clevis pin*
14 *Lower stud*
15 *Pole unit base*
16 *Spring (main movable contact)*
17 *Pin (movable main contact)*
18 *Pin (movable arcing contact)*
19 *Side link*
20 *Spring (stationary main contact)**
21 *Spring (stationary arcing contact)**
22 *Upper stud*
23 *Pin (stationary main contact)*
24 *Stationary main contact*
25 *Top contact block*

**Repair part*

Figure 8. Pole unit assembly

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

3. To prevent overstressing the clevis threads (12), 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 (19) 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 8)

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 which hold 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, the main contacts 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 sequence, the contact wipe and pressure must be checked and, if necessary, adjusted.

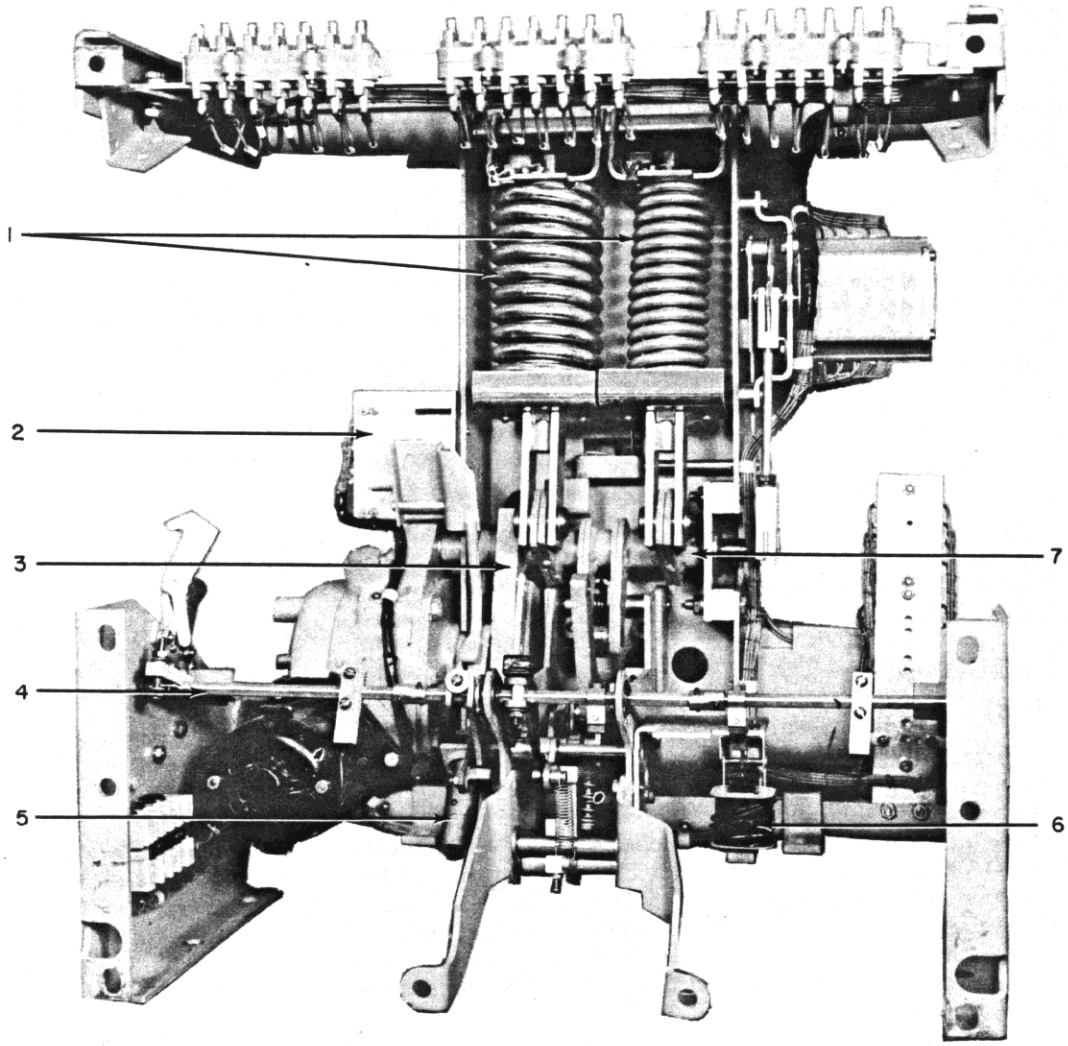
CONTACT GAP

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	5	35 to 45	1/16 to 3/32
Intermediate Contacts	1	35 to 45	(1/16 inch greater than main contact wipe)
Arcing Contacts	5	31 to 43	16/64 to 23/64



1 Closing springs
*2 Cut-off switch**
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 assembly, moving component

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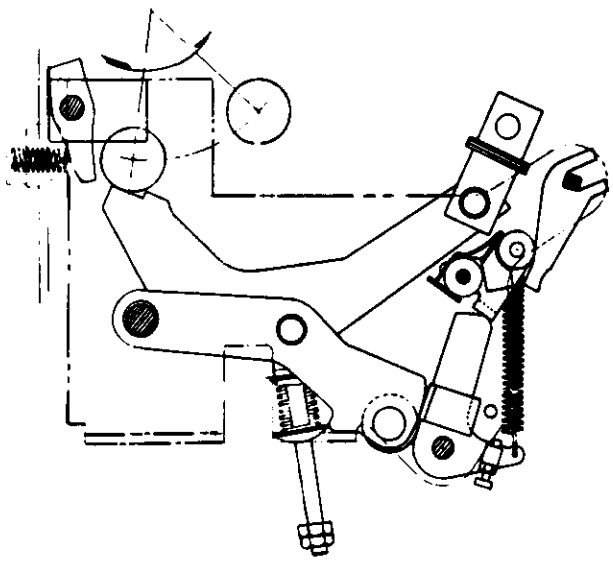
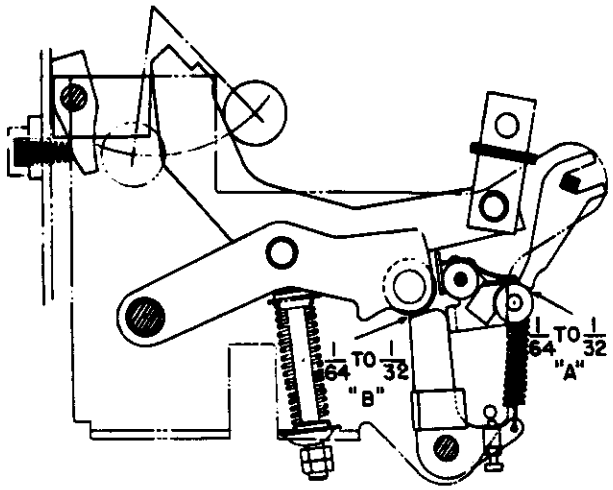
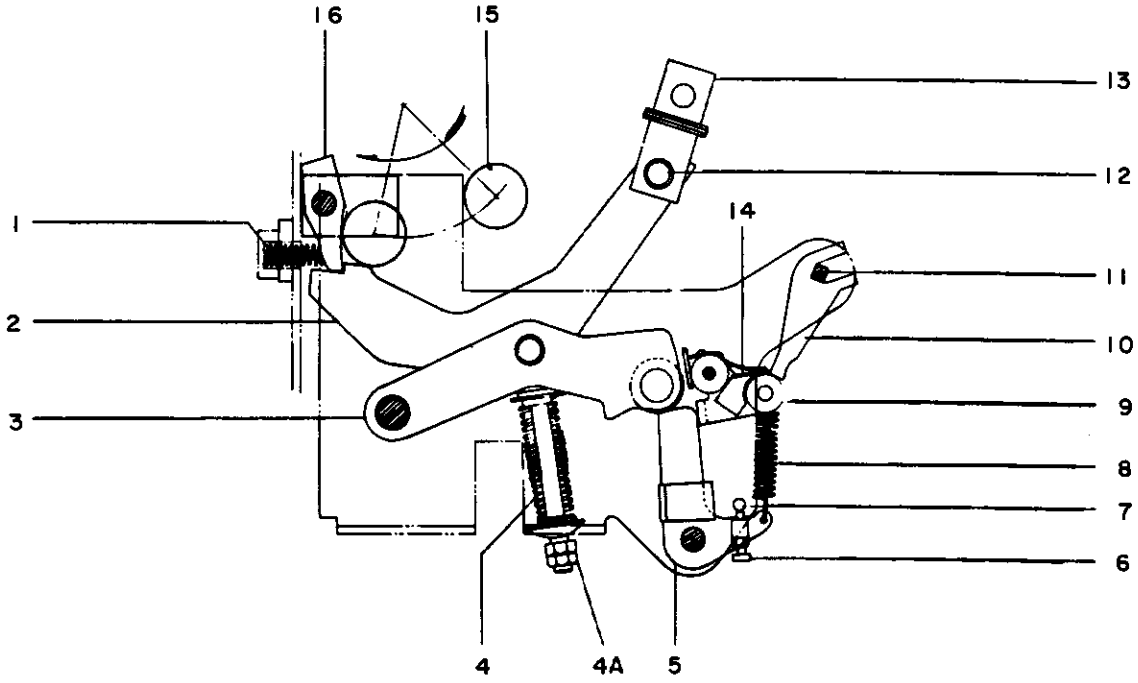


PART A
MECHANISM IN MOTION BEFORE RESETTING



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 10. Operating mechanism assembly

SECTION D-4

Electrical Operating Mechanism

DESCRIPTION (SEE FIGURES 10 AND 11)

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

OPERATION

The electrical-operated mechanism includes a motor and a gear reduction unit which charges the closing springs (16) (see figure 11) through a crankshaft (14). The crankshaft has an arm (13), with a roller (12), which rides on the closing cam (2) (see figure 10) of the operating mechanism. The position of this closing cam roller (12) is shown in figure 11. The closing cam is pinned to the center pole unit with a clevis and, through the cross bar, 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 (See Figures 10 and 11)

1. The mechanism is in the position shown in figure 10A.

2. The motor turns the crank (10) (see figure 11) 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 10B) and the breaker is ready to close when a closing signal is given.

Closing the Breaker (See Figures 10 and 11)

1. With the mechanism in the position described above 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 11) 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 spring discharges, the rotation of the crankshaft (14) (see figure 11) causes roller (15) (see figure 10) 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 (See Figure 10)

Operation of any of the trip devices rotates the trip shaft (11) (see figure 10) 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 10B, 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 10A.

ADJUSTMENTS

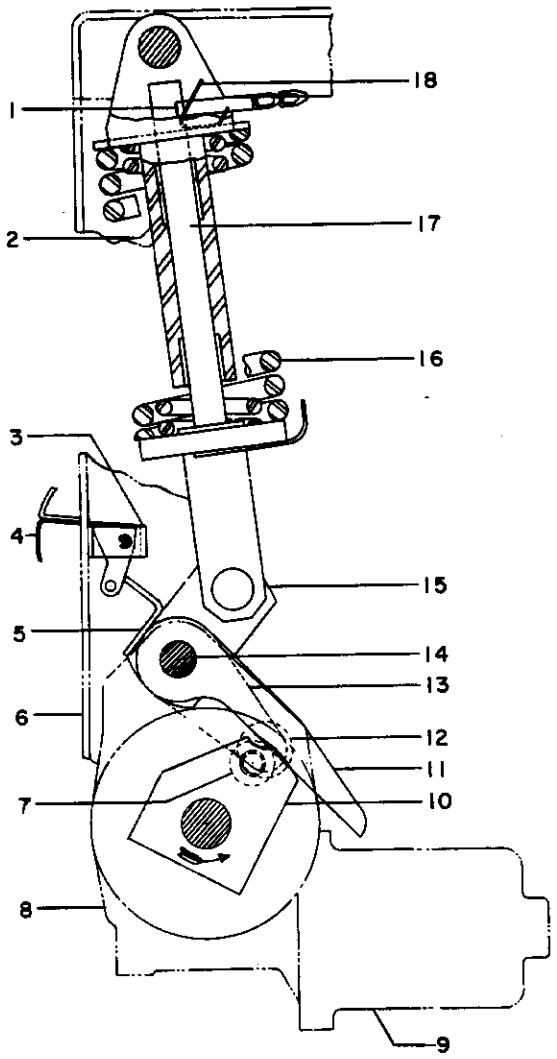
All adjustments should be made with the operating mechanism in the reset position as shown in figure 10B. (The mechanism should be reset by manual operation with the safety pin in place.)

1. The gap "A" between the trip latch (10) (see figure 10) and the roller (9) of the reset latch should be between 1/64 inch and 1/32 inch. 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 "B" between the roller on link (3) and prop (5) should be between 1/64 inch and 1/32 inch. To obtain this gap, advance or retard the nuts (4A) on the bottom of the rod using the reset spring (4).



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

**Repair part*

Figure 11. Closing spring and charging mechanism

SECTION D-5

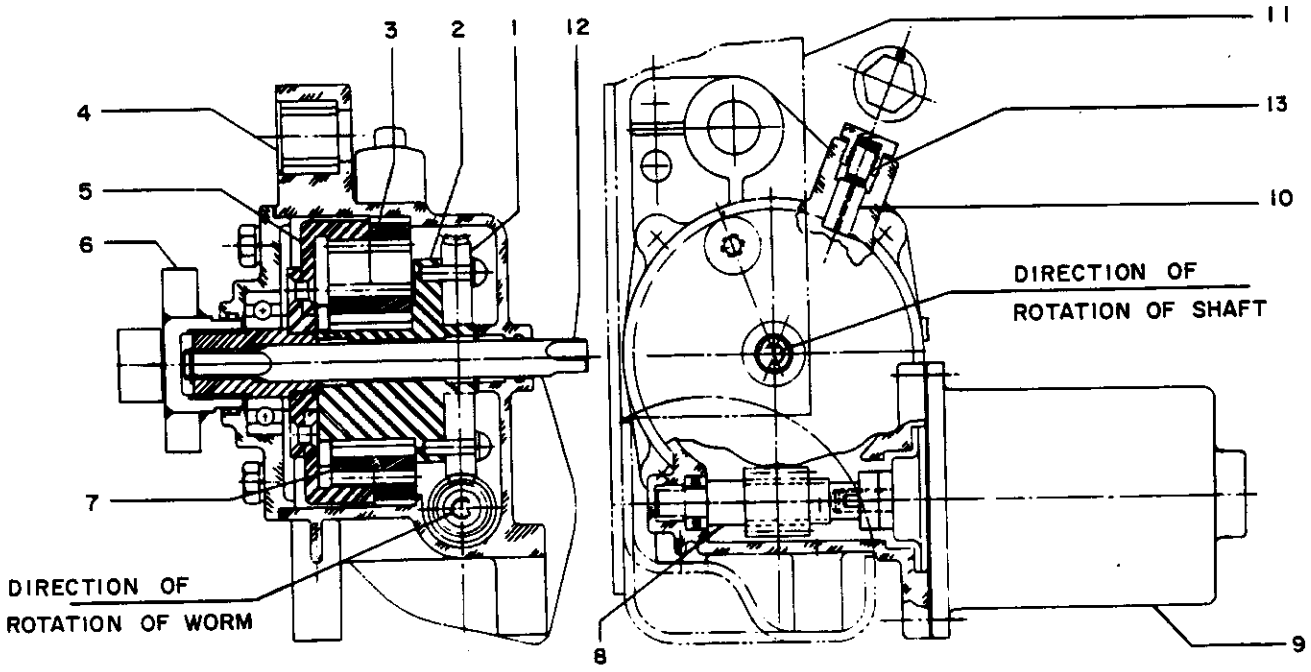
Motor and Gear Reduction Unit

DESCRIPTION (SEE FIGURE 12)

The motor and gear reduction unit provides the force to close the mechanism.

OPERATION

The motor (9) is mounted on the side of the gear reduction unit. Through a worm gear (1) and planetary gear train, the motor 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 12. Motor and gear reduction unit

SECTION D-6
Manual Trip

DESCRIPTION (SEE FIGURE 5)

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

OPERATION

The manual trip button device 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.

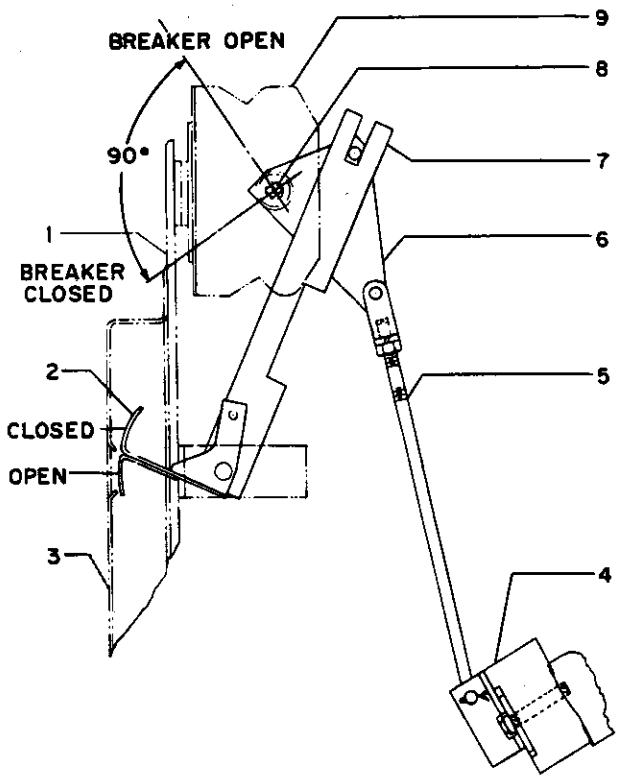
SECTION D-7
Position Indicator

DESCRIPTION (SEE FIGURE 13)

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

OPERATION

When the breaker opens, the operating rod (5), which is tied to the cross bar (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 on figure 13 when the breaker is completely opened.



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

**Repair part*

Figure 13. Open and closed indicator and auxiliary switch linkage

SECTION D-8
Springs Charged and Discharged Indicator

DESCRIPTION (SEE FIGURE 11)

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

OPERATION

When the springs are charged, the charging roller (7) 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 11. 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 (SEE FIGURES 13 AND 14)

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

OPERATION (SEE FIGURE 13)

The auxiliary switch is mounted on the left side of the front frame (looking from the front). As the cross bar (4) moves with the contacts to the open or closed position it operates, a triangular link (6) rotates 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 (See Figure 14)

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

Top Contacts (Normal "a" Contacts)

1. Remove top and bottom covers (4) and (6).

2. Remove auxiliary switch from the breaker and place in position shown in figure 14A.

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 14.

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) off the shaft (3).

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

NOTE

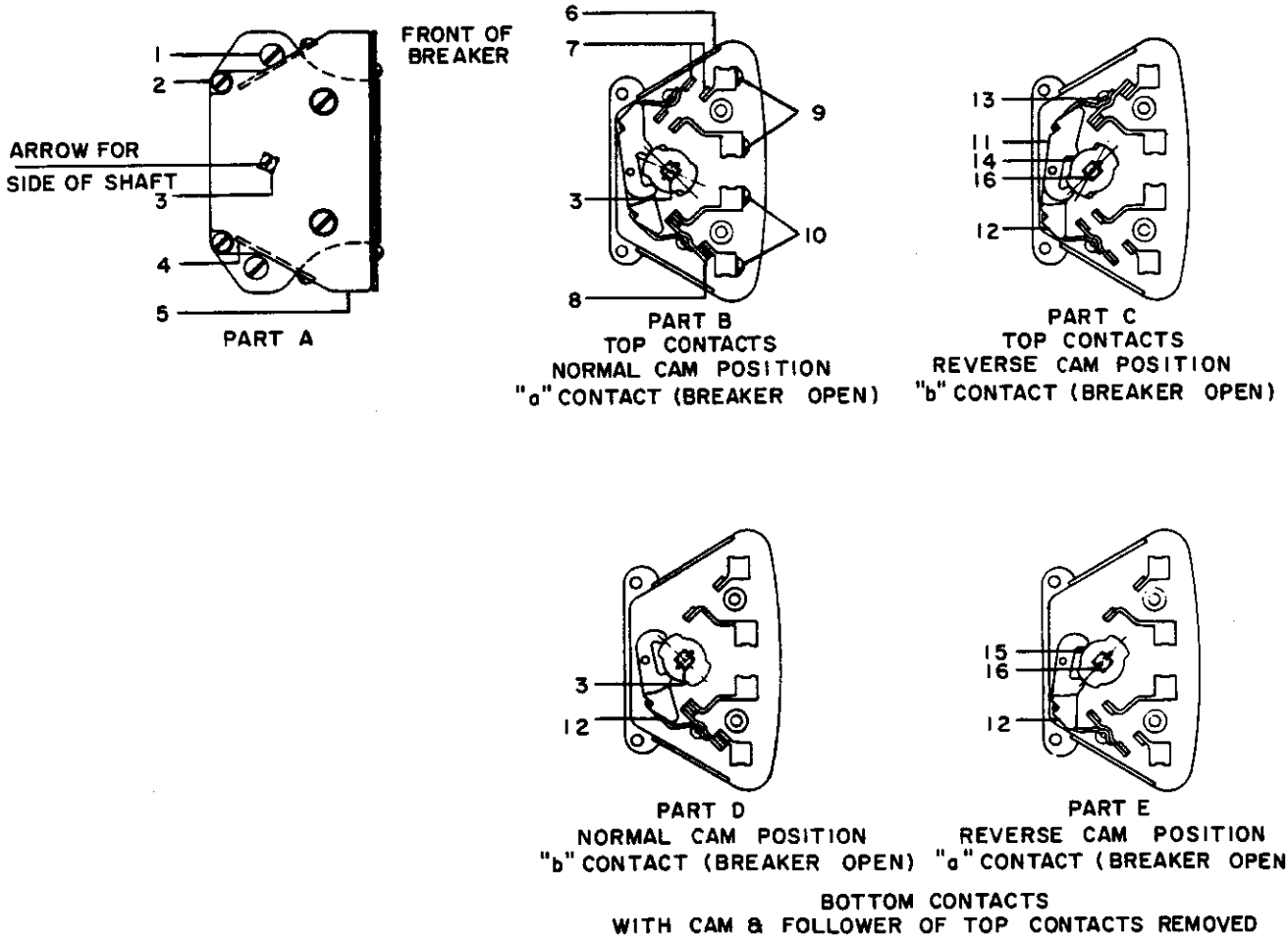
Do not allow contact pivot pin (13) to drop out.

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 14E.

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 figure 14A, B, C, and D.



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

**Repair part*

*Figure 14. Auxiliary switch**

SECTION D-10
Shock Lock

DESCRIPTION (SEE FIGURE 15)

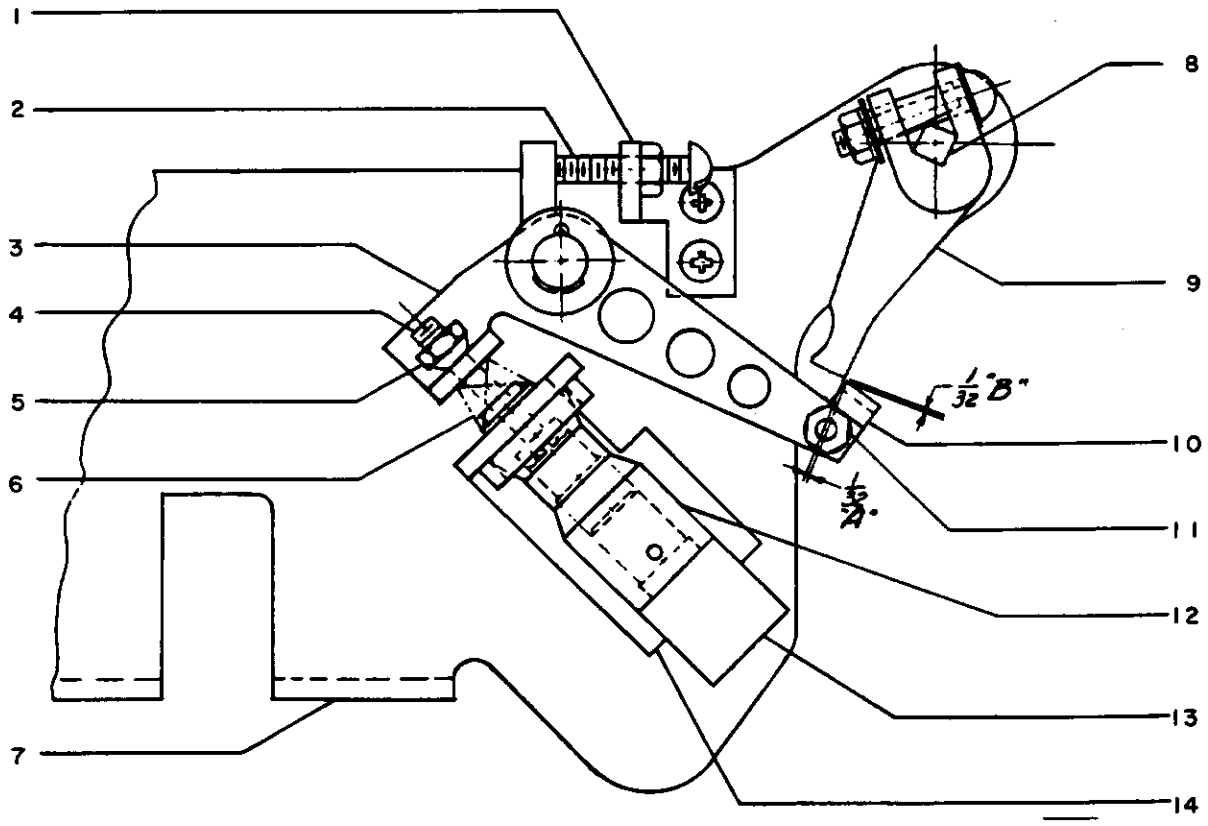
The purpose of the shock lock is to prevent the breaker from opening because of shock.

OPERATION

The shock lock consists of weights (12 and 13), latch arm (3) and a latch (9). The weight and latch arm assembly 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 15) 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 15. Shock lock device

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The "B" adjusting screw (2) 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 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 closing switch, relay, and motor mechanism are provided for closing the breaker electrically.

DESCRIPTIONS

Motor Power Switch

The motor power switch (7) (see figure 5) is located on the front escutcheon and is used to turn the motor power off and on.

Closing Switch

The closing switch is located on the bottom of the front escutcheon behind the closing button (5) (see figure 5) and mounted on the front frame.

Control Relay

The control relay (5) (see figure 4) 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 (See Figure 16)

The motor cut-off switches are mounted as shown in figure 16. In this position, the closing springs are charged. When lever (5) reaches a predetermined position, the cut-off switches operate.

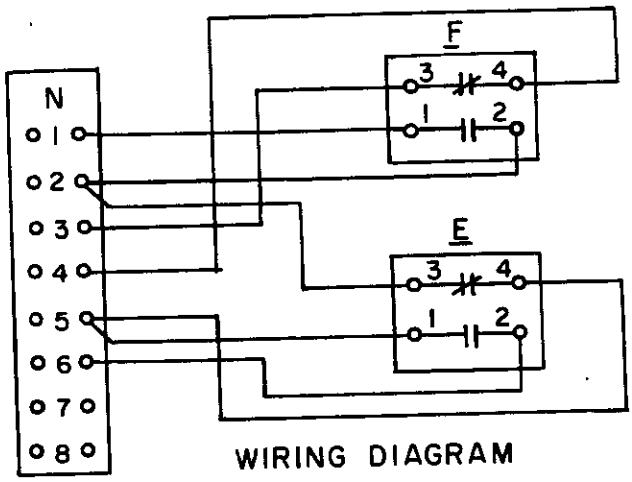
ADJUSTMENTS

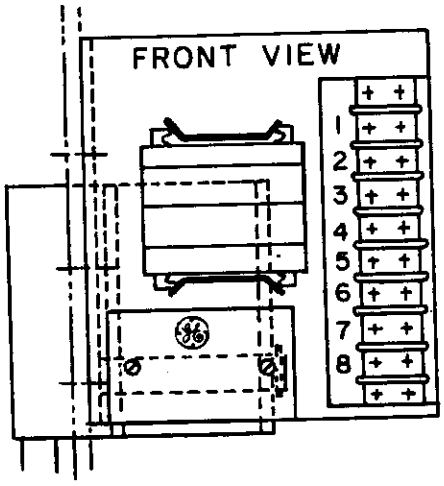
The switch assembly is pre-adjusted at the factory and no further readjustment should be required.

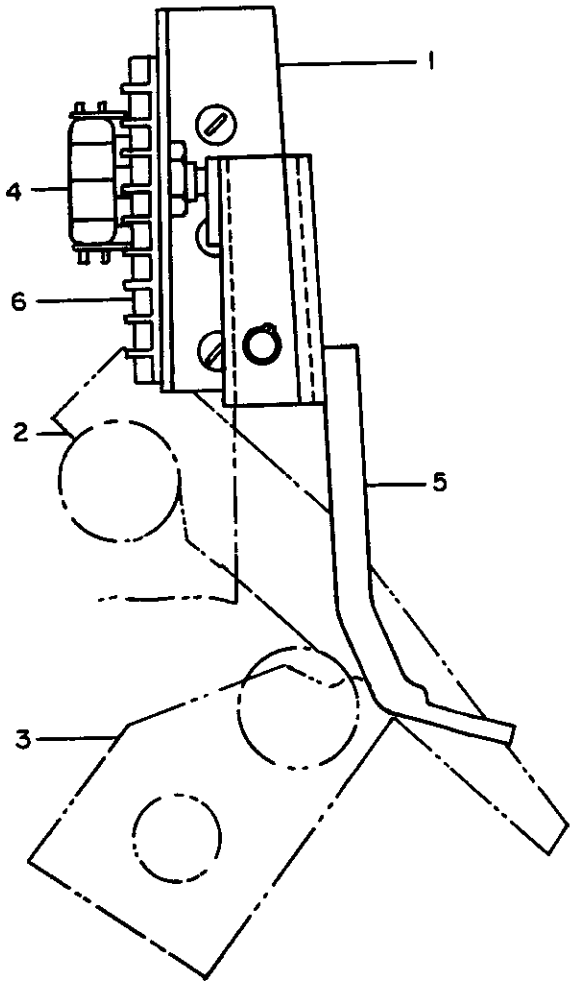
If considered necessary shipboard check of the adjustments should be made as follows:

Obtain positive toggling of the F and E switch by forming Part 5, figure 16. The switches must toggle as Part 5 climbs the step on Part 3.

AIR CIRCUIT BREAKER, NAVY TYPES ACB-3200HR AND ACB-4000HR







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

**Repair part*

*Figure 16. Cut-off switch**

SECTION D-12
Direct-acting Overcurrent Trip Device

DESCRIPTION

The direct-acting overcurrent trip device will cause the breaker to open within a pre-determined time range depending on the magnitude of the fault current.

OPERATION

The direct-acting overcurrent trip device can be provided with the following tripping combinations:

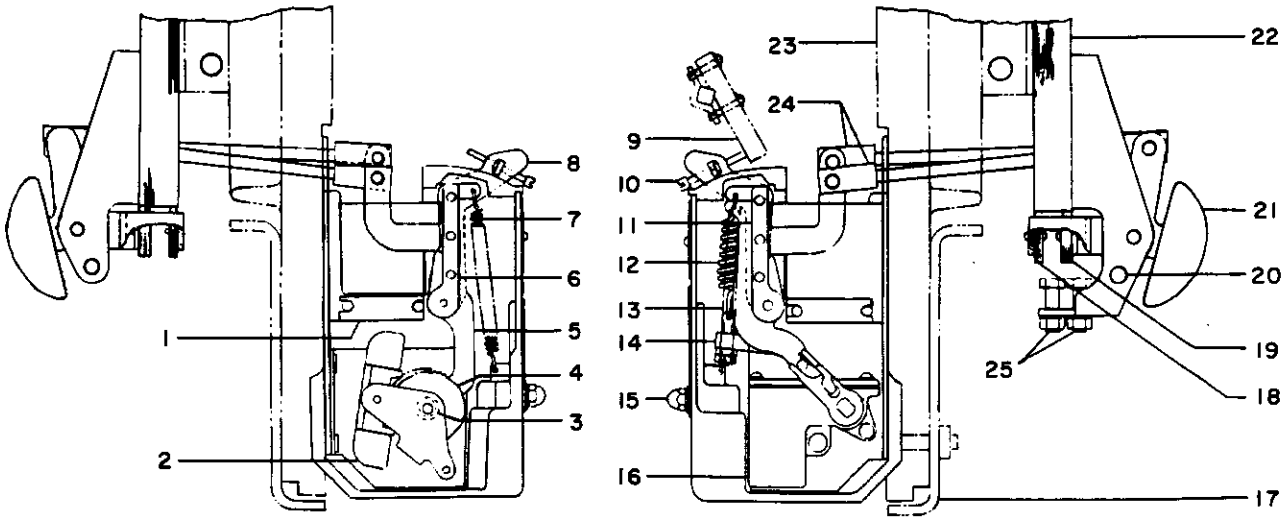
1. Long-time delay, short-time delay, and instantaneous tripping
2. Long-time and short-time delay tripping
3. Long-time delay and instantaneous tripping
4. Short-time delay and instantaneous tripping
5. Short-time delay tripping only
6. Instantaneous tripping

Short-time Delay Tripping (Factory Adjustment Only) (See Figure 17)

The armature (18) is restrained by a calibrating spring (7). 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.

Long-time Delay Tripping (3 Settings Available)

The armature (19) (see figure 17) is restrained by a calibrating spring (13). After the magnetic



1 Magnet
2 Pallet
3 Pinion
4 Escape wheel
5 Driving segment
6 S.T.D. lever
7 S.T.D. calibration spring
8 Trip arm
9 Trip paddle
10 Trip paddle adjusting screw
11 L.T.D. lever
12 Instantaneous trip spring
13 L.T.D. calibration spring
14 Spring holder
15 Calibration clamp nut
16 Cylinder
17 Frame
18 S.T.D. armature
19 L.T.D. armature
20 Stop pin
21 Counterweight
22 Magnet
23 Pole unit
24 Connecting rods
25 Armature adjusting screw

Figure 17. Direct-acting overcurrent trip device

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.

Instantaneous Tripping (Factory Adjustment Only)

Non-adjustable instantaneous tripping is accomplished when the magnetic force overcomes the force of a heavy restraining spring (12) (see figure 16) 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

1. The air gaps between magnet (22) and armatures (18 and 19) are set by adjusting screws (25). When replacing the device, refer to the drawing which accompanies each new device for specific gap dimensions. The gap dimension is measured from the magnet to the armature at the point where the gap is largest. Tighten the locking nuts on adjusting screws (25) after setting the proper air gaps.

2. With the air gap set as in Step 1, and the armatures (18 and 19) resting against the adjusting screws (25), move the crank, which attaches to the connecting rods (24), toward the front of the device. Adjust the connecting rods (24) to the proper length by turning them in the clevis which attaches them to the crank. Connecting rod pins should be in the left-hand direction (facing the back of the breaker) before attaching the tru-arc retainers.

3. Place a 1/32-inch gage between magnet (22) and armature (18).

4. Push the armature (18) solidly against the magnet (22) with the gage in place. The breaker should trip.

5. If the breaker does not trip, turn the adjusting screw (10), and repeat Steps 1 and 2.

6. This adjustment must be made for both armatures.

7. When the armatures are resting against the adjusting screws (25) and the breaker is reset, there should be 1/32-inch clearance between the adjusting screw (10) and trip paddle (9).

AIR CIRCUIT BREAKER, NAVY TYPES ACB-3200HR AND ACB-4000HR

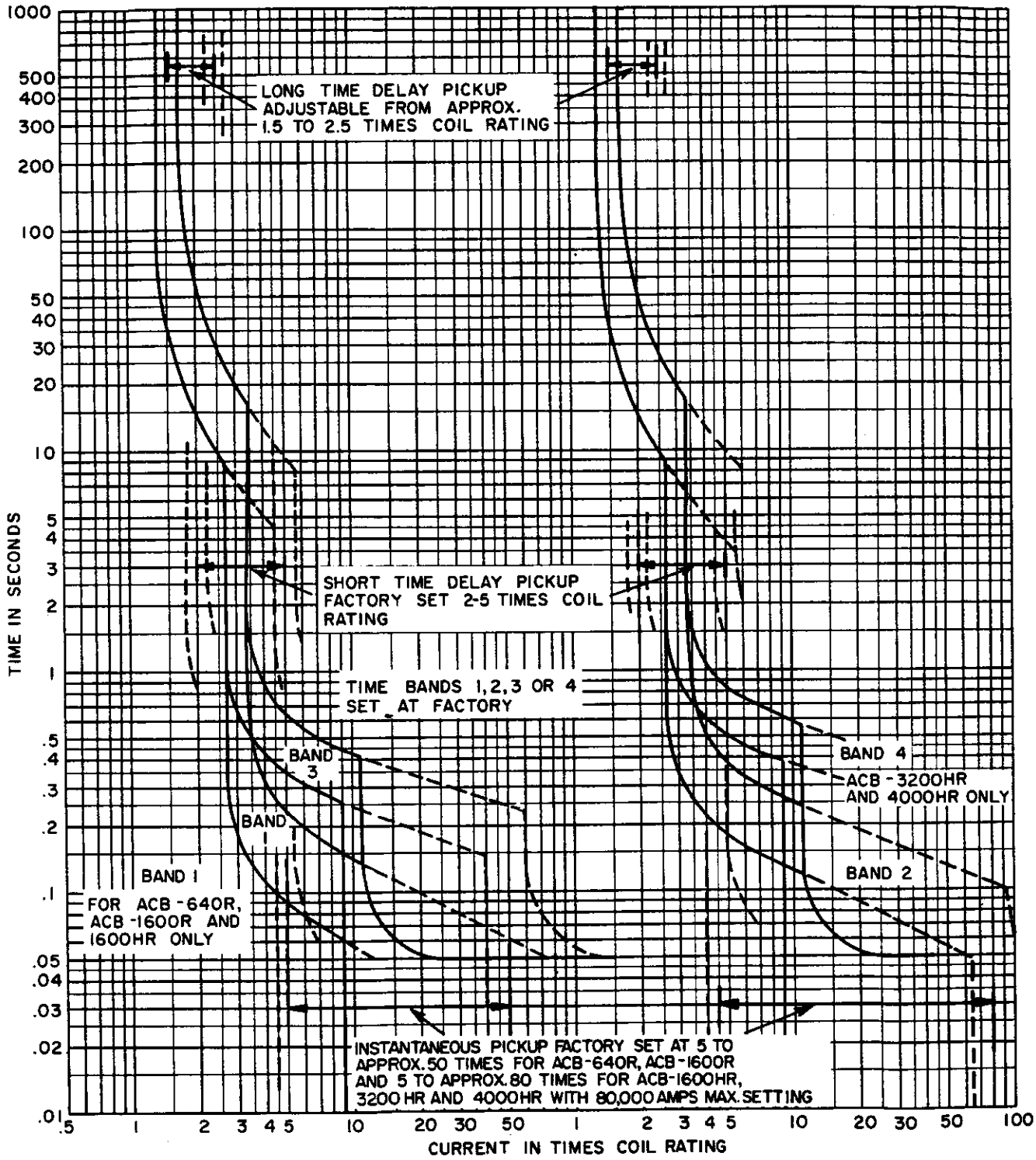


Figure 18. Line-current characteristic curve

SECTION D-13
Shunt Tripping Device

DESCRIPTION

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

OPERATION

(See Figure 19)

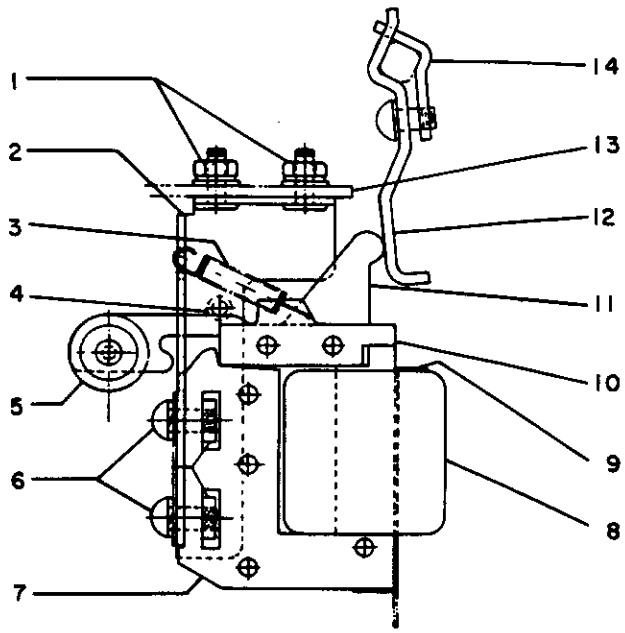
The shunt tripping device is mounted on a bracket attached to the left side of the operating mechanism (looking from the front).

A remote switch or relay contacts are used to close the circuit of the device. This causes the armature arm (11) 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*	*9*	*Clamp*
2	*Frame*	*10*	*Armature*
3	*Spring**	*11*	*Armature arm*
4	*Rivet*	*12*	*Trip paddle*
5	*Weight*	*13*	*Mechanism frame*
6	*Screws*	*14*	*Clamp*
7	*Magnet*		
8	*Coil**		

**Repair part*

Figure 19. Shunt trip device

SECTION D-14
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 (SEE FIGURE 20)

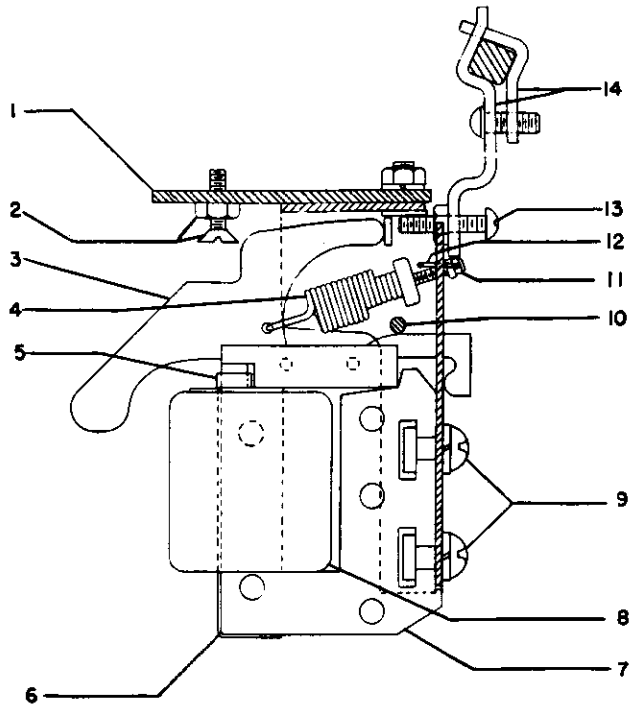
The undervoltage trip device is mounted on a bracket attached to the left side of breaker frame (looking from front).

The undervoltage trip device consists of a coil, magnet, armature, and spring. With rated voltage applied, the armature (3) is attracted to the magnet (7). If the voltage falls below the predetermined value, the magnet (7) releases the armature (3). The spring (4) then pulls the armature (3) 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) 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 between 30 and 60 percent of rated voltage.



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

Figure 20. Undervoltage trip device

SECTION D-15
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, which engages the trip interlock cam in the stationary component 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.

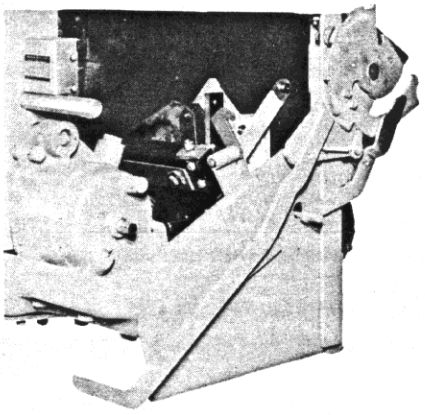


Figure 21. Drawout racking mechanism

SECTION D-16
Movable and Stationary Secondary Disconnect Assemblies

DESCRIPTION (SEE FIGURE 22)

Secondary disconnect assemblies permit the withdrawal of a drawout-type circuit breaker to the completely disconnected position without removing secondary wiring. 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 (4) bolted together which hold seven individual contacts and springs. Three assemblies to provide a total of 21 circuits may be mounted per breaker. The stationary secondary disconnect assembly consists of a compound base with twenty-one contact strips. The contact strips are separated by a barrier wall which provides adequate creepage distance between contacts.

OPERATION

When the breaker is in its final "connected" position, the secondary disconnect assemblies are engaged. In this position the contact spring (5) 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.

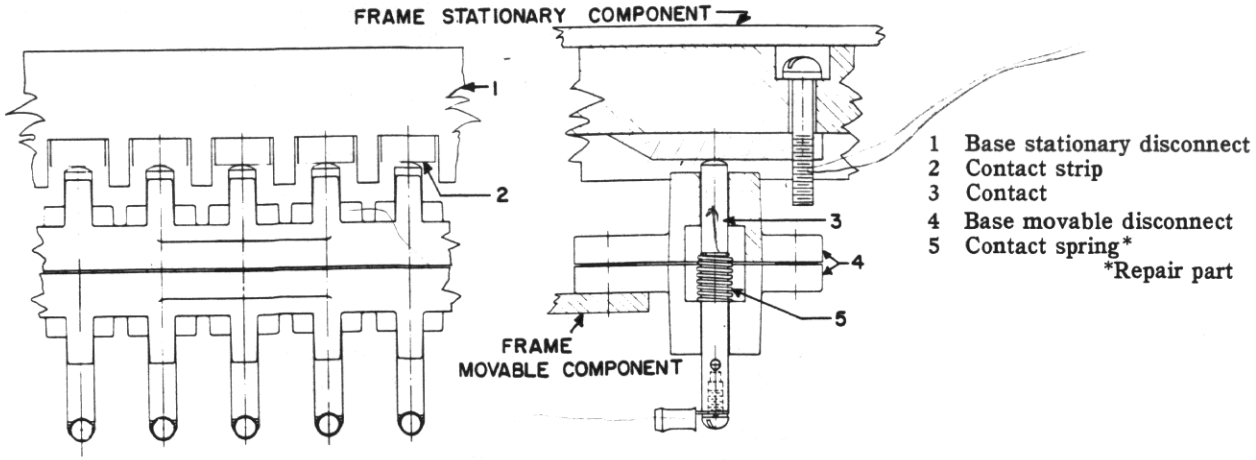


Figure 22. Movable and stationary secondary disconnect assemblies.

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 (3)(see figure 5) (on lower part of breaker) from the outside pole units.

c. Remove the clevis pin (13) (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 13).

f. Check along the 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 8)

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

b. Remove top contact block (25) by removing two screws. Remove insulation (3).

c. Remove the screws retaining the braids on the arcing contact.

d. Remove pin (2) and free the stationary contacts (1) and springs (21).

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

f. Adjust contact wipe and pressure. (See Section D-3.)

4. Replacement of Movable Arcing Contacts (See Figure 8)

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 (8) and (18) 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 (9) 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 8)

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

b. Remove lower contact block.

c. Loosen the four cap screws which hold the upper stud (22) to the pole unit base (15).

d. Remove the tru-arc retaining rings on pin (23) and remove pin. The contacts can now be lifted out.

e. 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 8)

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

b. Loosen spring (16).

c. Slide link (7) to the side and off of pin (6).

d. Slide pins (6) and (17) 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 11)

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

b. Remove pins holding spring charging arm (15) 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 11)

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

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

c. Remove the plate 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.

The gear reduction unit contains four ounces of oil similar to Atlantic Refining Company's Grade HFS No. 3. It should not be necessary to add or change oil except when the gear reduction unit and motor are disassembled.

9. Replacement of Auxiliary Switch (See Figure 14)

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 14A.

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

a. Remove stop nut (5) (see figure 15).

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 wedge lock screw is tight.

12. Replacement of Closing Switch

To replace the closing switch, remove the switch from the bracket, remove wiring, and replace with a new switch.

13. Replacement of Cut-off Switches

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

14. Replacement of Control Relay

To replace the control relay, remove wiring and two holding screws located on the back of the plate. Replace relay and reconnect wiring.

15. Replacement of Direct-acting Overcurrent Trip Device

a. Remove the front frame. (See Section E-1-1.)

b. Remove retainers and pins from the connecting rods (24) (see figure 17).

c. Remove the screws which secure the device to the breaker pole unit base. The device is now free.

d. Remove magnet (22) and armature assemblies (18 and 19) by removing screws which secure the assemblies to the lower stud.

e. To replace, follow the above procedure in the reverse order and adjust the device as described in Section D-12.

16. Replacement of Shunt Trip Coil

a. Disconnect leads to coil.

b. Remove magnet (7) (see figure 19) and coil (8) from frame (2).

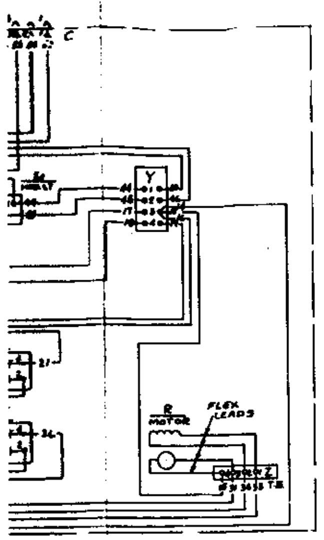
c. Form lower end of clamp (9) straight and remove.

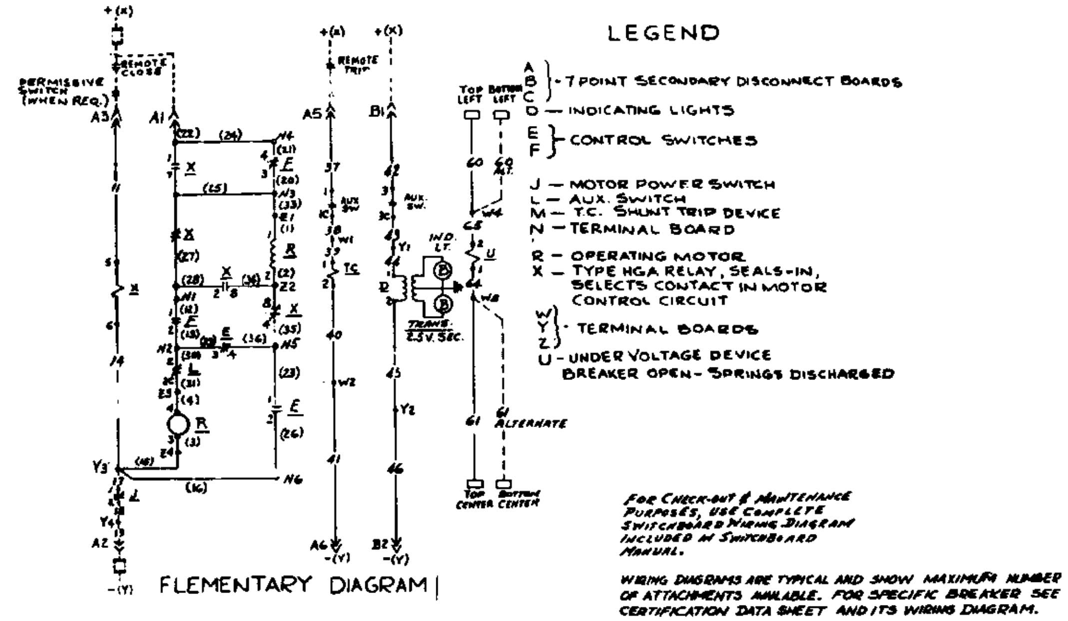
d. Remove coil (8) and install new coil in the reverse order of disassembly.

SECTION E-2
Repair Parts List

Fig. No.	Index No.	Name of Part	No. Required for Breaker	Contractor's Service Part No.	Manufacturer's Service Part No.	Drawing Part No.
8	1	Arcing contact (Stationary)	15		K-6203966 G-1	1
8	2	Arcing contact (Movable)	9		K-9921572 G-1	2
8	2A	Arcing contact (Movable)	6		K-6404753 P-1	2A
8	24	Main contact (Stationary)	15		K-6203979 G-1	3
8	4A	Intermediate contact (Stationary)	3		K-6203979 G-3	4
8	5	Main contact (Movable)	15		K-6203978 G-1	5
7	4	Intermediate contact (Movable)	3		K-6203978 G-3	6
8	21	Spring (Stationary Arcing Contact)	15		K-6509858	14
8	21	Spring (Stationary Arcing Contact)	15		K-6509859	30
8	20	Spring (Stationary Main Contact)	18		K-6509811	15
25	16	Spring (Pawl on Drawout Handle)	1		365A313	16
25	17	Spring (Drawout Trip Latch Return)	1		412A292	17
25	18	Spring (Trip Shaft Return)	1		412A269	18
5	3	Spring (Opening)	2		K-6509813	19
10	8	Spring (Prop to Reset Latch)	1		K-6403348 P-1	20
15	6	Spring (Shock Lock)	1		K-6403315	21
10	4	Spring (Mechanism Reset)	1		K-6403393 P-1	22
25	24	Spring (Manual Trip)	1		K-6509887	24
10	1	Spring (Cam Prop Return)	1		412A140	25
12	13	Spring (Motor Mechanism Ratchet)	1		K-6509871 P-1	26
19	3	Spring (Shunt Trip)	1		365A325	29
25	32	Spring (Discharge Indicator)	1		365A305	32
22	5	Spring (Secondary Disconnect)	21		K-6403331	31
25	33	Spring (Drawout Plunger)	1		412A124	33
25	38	Spring (Anti-rebound Hook)	1		K-6509872 P-1	38
25	7	Light 115V, 60 cycles	2		Mazda Type TS130	7
25	8	Relay 115V, 60 cycles	1		12HGA11T70N	8
19	8	Coil (Shunt Trip) 115V, 60 cycles	1*		K-6275081 G-25	9
-	-	Coil (Shunt Trip) 450V, 60 cycles			K-6275081 G-27	39
25	10	Auxiliary Switch (10 Contacts)	1*		DL-6353562N G-5	10
25	10	Auxiliary Switch (12 Contacts)			DL-6353562NG-6	10
16	5	Switch (Cut-off)	3		0227A7211 G-1	11
5	7	Switch (Motor Power)	1		127A6450 P-1	12
11	9	Motor	1		5P66MA9	13
-	-	Retaining Rings and Pliers	1		176L129 G-12	37

*One or the other coil and auxiliary switch used.





ELEMENTARY DIAGRAM

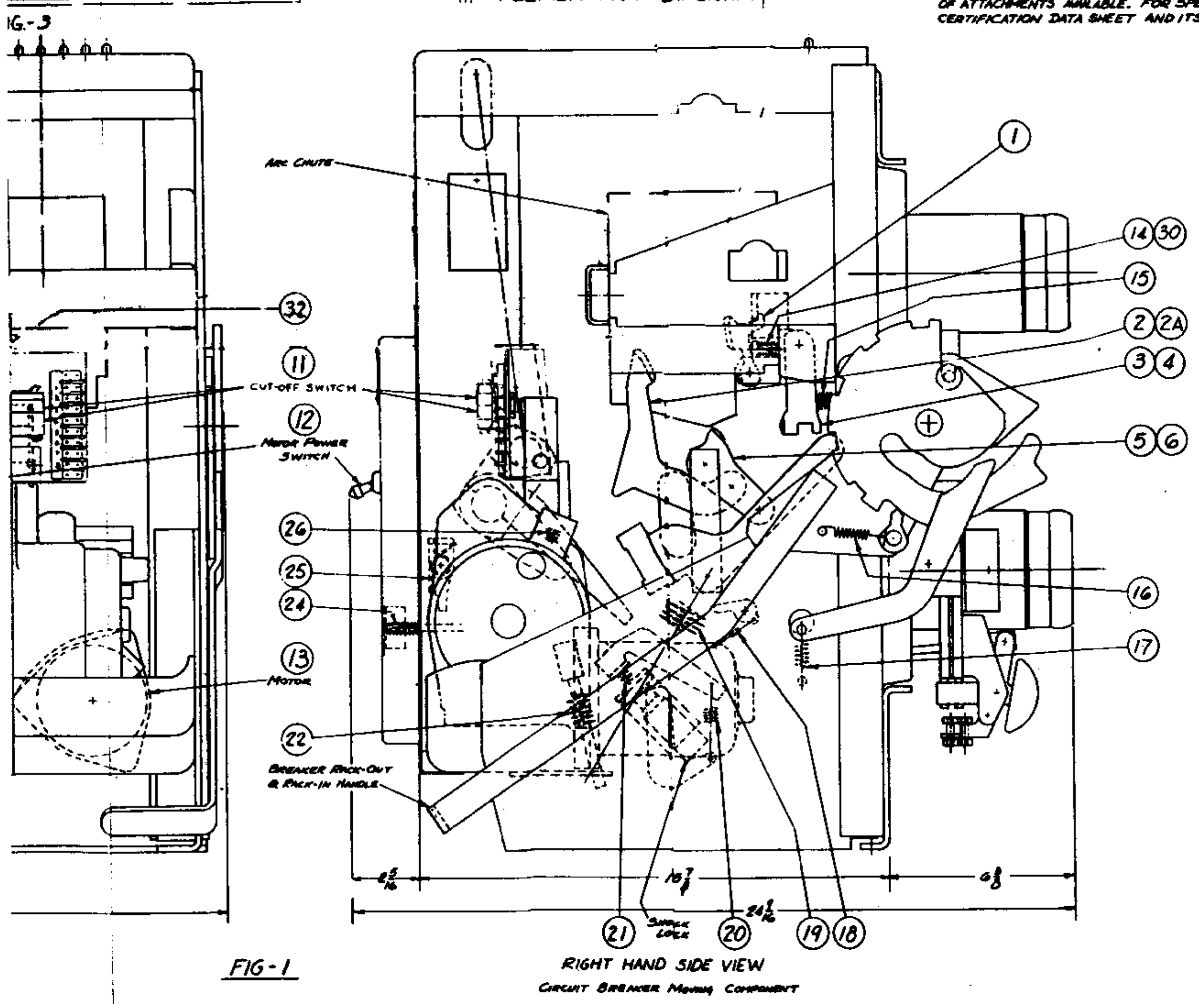


FIG-1

RIGHT HAND SIDE VIEW

CIRCUIT BREAKER MOVING COMPONENT

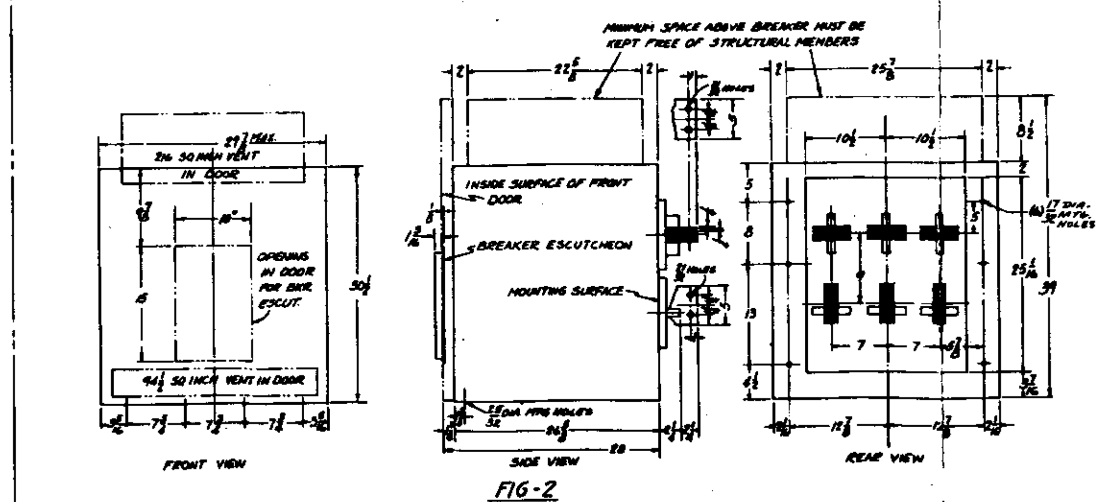


FIG-2

INSTALLATION DETAILS FOR CIRCUIT BREAKER REMOVABLE ASSEMBLY - MOUNTING IN STD NAVY SWITCHBOARDS

NOTES

NOTE A -

NOMINAL VOLTAGE	SHUNT TRIP VOLTAGE RANGE
115V - 60CY.	80 - 130
450V - 60CY	360 - 500

NOTE B -

NOM. VOLTAGE	CLOSING MOTOR VOLT RANGE	FULL LOAD CURR.
115V - 60CY	90 - 130	4.0 AMP.

NOTE C - USED ON SPECIFIC REQUISITIONS ONLY

NOTE D - UNDERVOLTAGE DEVICE

NOMINAL VOLTAGE	VOLTAGE RANGE	PICK-UP (SEAL VOLTAGE	DROP OUT VOLTAGE
450 A.C.	360-500	360 MIN.	290-45

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

FOR DETAILS OF STATIONARY COMPONENT OF SWITCHGEAR SEE SHEET 2 OF THIS DRAWING

COMPONENTS OF CIRCUIT BREAKER ARE FULLY COVERED BY TECHNICAL MANUAL NAVSHIPS — 0962-073-8010

MOVING COMPONENT OF SWITCHGEAR MAY BE REMOVED FROM SWITCHBOARD BY RACKING OUT BREAKER & REMOVING BOLTS HOLDING BREAKER TO DRAWOUT TRAY

ATTEMPTS TO RACK OUT BREAKER WILL CAUSE BREAKER TO TRIP

TYPICAL REPAIR PARTS LIST FOR ONE BREAKER

NOTE	ITEM		QTY.	MFG. INFO.	DRAWING	
	1	ARC CONTACT (STA.)	15		K-6203966-1	
	2	ARC CONTACT (MOV)	9		K-4921572G-1	
	2A	ARC CONTACT (MOV)	6		K-6404753P	
	3	MAIN CONTACT (STA.)	15		K-6205977G-1	
	4	INTERMEDIATE CONTACT (STA)	3		K-6205977G-5	
	5	MAIN CONTACT (MOV)	15		K-6205978G-1	
	6	INTERMEDIATE CONTACT (MOV)	3		K-6205978G-4	
	7	LIGHT BULB	2		MAZDA-#767	
	8	RELAY 115V 60CY	1		12HGA11TON	
	9	COIL - SHUNT TRIP 115V 60CY	1	SEE NOTE A	K-6275060[illegible]	
	10	AUXILIARY SWITCH (5a & 5b)	1		DL-6355062[illegible]	
	11	SWITCH CUT-OFF	1		227A7211G1	
	12	SWITCH MOTOR POWER	1		187A645[illegible]	
	13	MOTOR	1	SEE NOTE B	5P64MA9	
	14	SPRING - STA. ARC CONTACT	15		K-6509858	
	15	STA. MAIN CONTACT	18		K-6509811	
	16	PAWL ON D.O. HANDLE	1		365A318	
	17	D.O. TRIP LATCH RETURN	1		412A292	
	18	TRIP SHAFT RETURN	1		412A249	
	19	OPENING	2		K-6509818	
	20	PROP TO RESET LATCH	1		K-6403548P	
	21	SHOCK LOCK	1		K-6403315	
	22	MECH RESET	1		K-6403595P	
	23					
	24	MAN. TRIP	1		K-6509867	
	25	CAM PROP RETURN	1		412A140	
	26	MOTOR MECH. RATCHET	1		K-6509871P	
	27					
	28					
	29	SHUNT TRIP	1		365A985	
	30	STA. ARC CONTACT	15		K-6509859	
	31	SECONDARY DISCONNECT	21		K-6403381	
	32	DISCHARGE INDICATOR	1		365A306	
	33	SPRING D.O. PLUNGER	1		412A124	
	34					
	35					
	36					
	37	RETAINING RINGS & PLIERS	1		176L1276-12	
	38	SPRING - ANTI-REBOUND HOOK	1		K-6509872P	
	39	COIL - SHUNT TRIP 450V-60CY	1	SEE NOTE A	K-6275060[illegible]	
C	40	SPRING (UNDERVOLT. DEV.)	1		K-6172574	
C	41	COIL - UNDERVOLTAGE DEV. 450V[illegible]		SEE NOTE C	K-6275061G[illegible]	

REVISIONS

ZONE	REV	DESCRIPTION	DFT	APPD		
	A	ISSUED				
	B	[illegible]				

DESCRIPTIVE DATA

TYPE	NAVY TYPE ACB 3200 HR
	G.E. Co. TYPE AK2-100N-3200A
CONTINUOUS CURRENT	3200 AMPS. A.C.
VOLTAGE	500 - A.C. (60 HERTZ)
POLES	3 POLES
RATED INTERRUPTING CURRENT	100,000 AMPS. A.C.
SHORT TIME RATING	100,000 AMPS .560 SEC.
MOUNTING	REMOVABLE ASSEMBLY - DEAD FRONT -
	DRAWOUT - ELECTRICALLY OPERATED
NORMAL CLOSING	ELECTRICAL
OVERCURRENT COILS (AMPERES)	2000, 2400, 2800, 3200
AMBIENT TEMPERATURE	50°C
SHOCK CLASSIFICATION	CLASS HI
INSULATION CLASS	B
CONNECTIONS	BACK
PROTECTIVE FUNCTION	OVERCURRENT
	LONG TIME DELAY
	SHORT TIME DELAY (BAND 2,3,4)
	INSTANTANEOUS
	SHUNT TRIP
ACCESSORIES	INDICATOR LIGHT
	10 STAGE AUX SW (5a & 5b CONT.)
	21 SECONDARY WIRING CONTACTS
	UNDERVOLTAGE DEVICE (INST.)
BUSHIPS APPROVAL LETTER	
TECHNICAL MANUAL - G.E. Co. - GEI-83901A	NAVSHIPS 0962-073-8010
SPECIFICATION	MIL-C-17587
SPECIFICATION EXCEPTIONS	NONE
TEST REPORT NO. - NY 5419-17, EES 820024A, MEL RPT. 256/66	

DESCRIPTION	WGT-REM. ASM. COMPL.	WGT-D.O. COMP. ONLY
3 POLE ELECT	886 LBS.	534 LBS.

1. REMOVABLE ASSEMBLY - EACH CIRCUIT BREAKER SUPPLIED IS A COMPLETE REMOVABLE SWITCHBOARD ASSEMBLY CONSISTING OF CIRCUIT BREAKER, SEPARABLE DISCONNECTS & ASSOCIATED CONTROL WIRING, DRAWOUT MECHANISM & ASSEMBLY, STRUCTURAL SUPPORTS & BACK PLATE INCLUDING STATIONARY MAIN BUS CONNECTIONS, & STATIONARY TERMINALS FOR CONNECTION OF NECESSARY EXTERNAL CONTROL WIRING
2. UNLESS OTHERWISE SPECIFIED, THE STANDARD CIRCUIT BREAKER IS FURNISHED WITH A 10 STAGE AUXILIARY SWITCH (5a & 5b CONTACTS) & A MINIMUM OF 21 SECONDARY WIRING DISCONN. TERMS.
3. FOR FULL DESCRIPTION & DETAILS APPLICABLE TO THE BREAKER, OTHER THAN INSTALLATION DIMENSIONS, REFER TO THE APPLICABLE CERTIFICATION DATA SHEET & TECHNICAL MANUAL G.E.-GEI-83901A BUSHIPS # NAVSHIPS - 0962-073-8010
4. THIS BREAKER ASSEMBLY IS DESIGNED FOR NAVY SWITCHBOARD UNIT SIMILAR TO 6-7 OF 39 IN. WIDTH
5. BASIC MATERIAL REQUIREMENTS PER SPEC. MIL-E-917

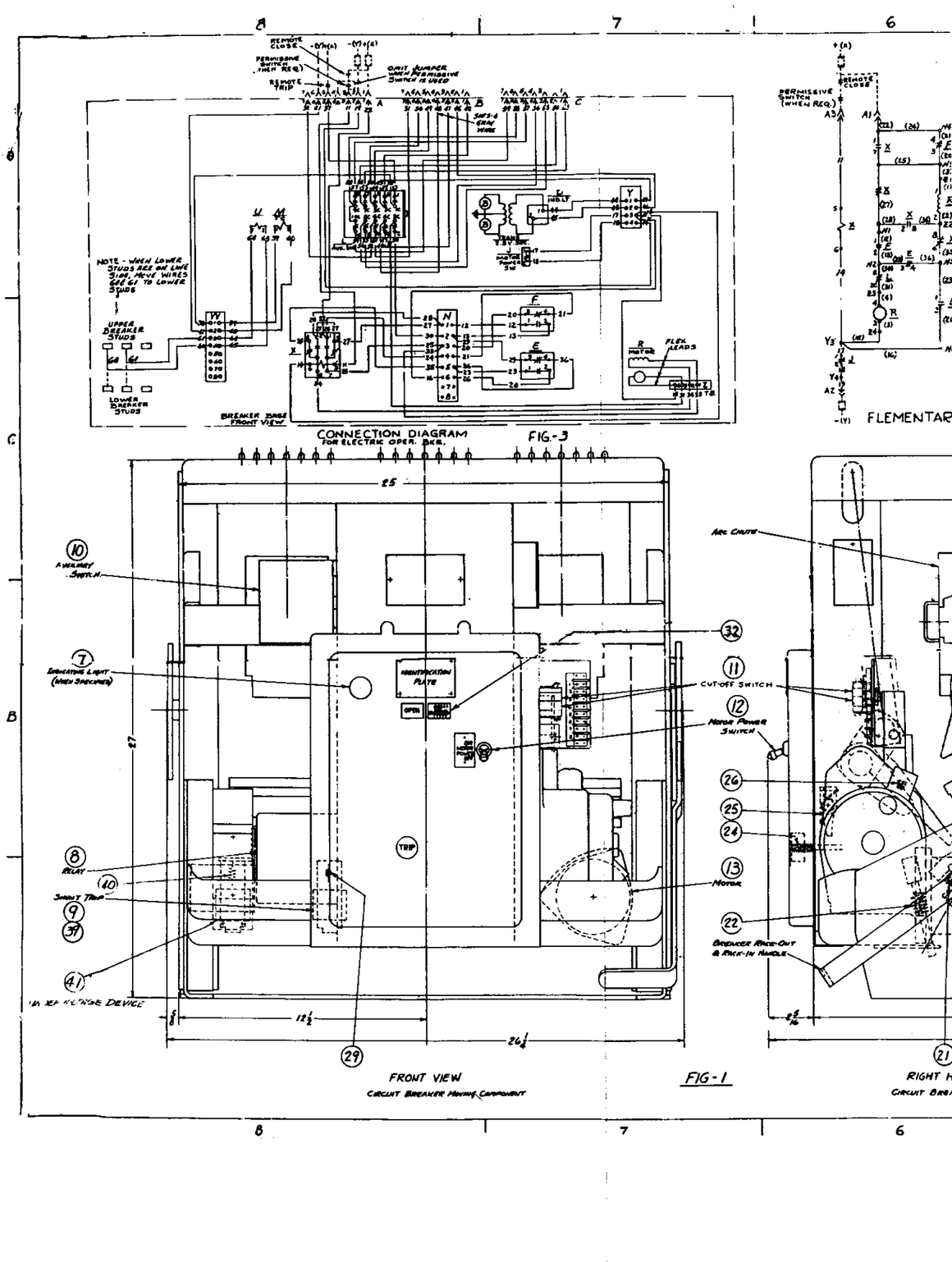
DRAWN BY / APPD BY / APPD DATE	MASTER DRAWING	GENERAL ELECTRIC
	AIR CIRCUIT BREAKER	LOW VOLTAGE SWGR. - PHILA.
	NAVY TYPE ACB 3200 HRGE-AK-2-100N 500 VOLTS AC. 60 CYCLE 3 POLE ELECTRICAL OPER. 100,000 A. AC.I.C. REMOVABLE ASSEMBLY	0122F0963
		NAVY DEPT BUSHIPS DWG NO. B
	SCALE - NONE / WEIGHT - SEE NOTE	CONT. ON SH-2 SH. NO. 1

Figure 23. AK-2-100N circuit breaker master plan (sheet 1)

Figure 23

AK-2-100N Master plan (sheet 1)

0962-073-8010



REVISIONS						
ZONE	REV	DESCRIPTION				
	A	ISSUED				
	B	1 APPROVED PER BUSHIPS LTR. [illegible] SER 660K-6126 DATED 8 DEC. 1964		PAG		
		2 CHG'D REAR MTG HOLES FROM [illegible] TO [illegible]				
		3 CHG. DIM. LOC. RACK-OUT HANDLE-2 [illegible] TO 3 [illegible]				
		4 APPROVED PER NAVSEC LTR. 6670 SER [illegible] DATED [illegible] JUNE 1973				

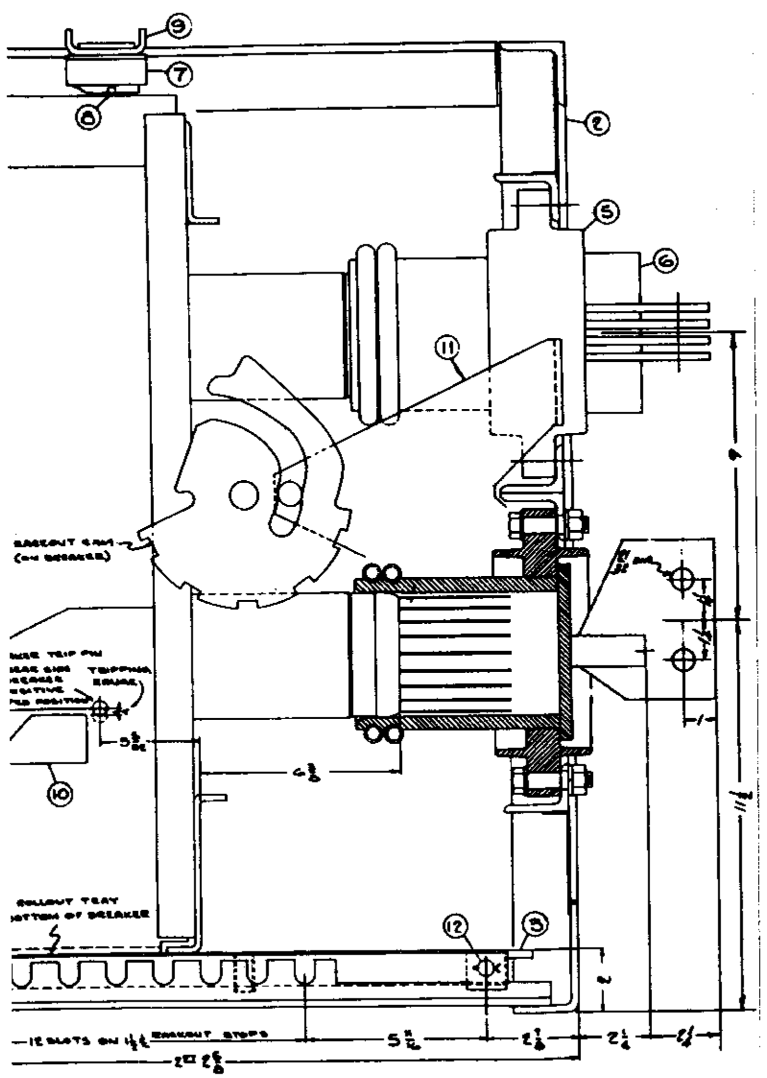
LIST OF MATERIAL									
PC NO	NAME	NO REQD	MATERIAL	MATL. SPEC.	CONTR. DWG. NO. AND SERVICE PART NO.	BUSHIPS DWG NO	UNIT WT LB	STD NAVY STOCK NO	REMARKS
1	ACB 3200 HR TYPE AK-2-100N	1		MIL-C-17587	0122F0963 GH				
2	STATIONARY COMPONENT	1	STEEL	MIL-S-20166	269C505				
3	ROLLOUT TRAY	1	STEEL	MIL-S-20166	266C635				
4	ROLLOUT SIDE RUNNER	2	STEEL	MIL-S-20166	238C903				
5	PRIMARY DISC. DEVICE (BASE)	6	COMPOUND	MIL-P-14	M-6512804				
6	PRIMARY DISC. DEVICE	6	COPPER STEEL	MIL-S-20166	858C660				
7	SECONDARY DISC. DEVICE (STATIONARY)	△	COMPOUND	MIL-P-14	266C514				
8	SECONDARY DISC. DEVICE (MOVABLE)	△	COMPOUND	MIL-P-14					
9	SECONDARY DISC. DEVICE SUPPORT	1	STEEL	MIL-S-20166	266C514				
10	TRIP INTERLOCK	1	STEEL	MIL-S-20166	269C505				
11	CAM PIN SUPPORT	2	STEEL	MIL-S-20166	269C508				
12	BREAKER STOP PIN	1	STEEL	MIL-S-20166	237C680				
13	BREAKER STOP PIN LEVER	1	STEEL	MIL-S-20166	239C646				
14	BREAKER MTG. BOLT 7/16-14 HEX. HD.	4	STEEL						

△ QUANTITY AS REQUIRED (3 MAX.)

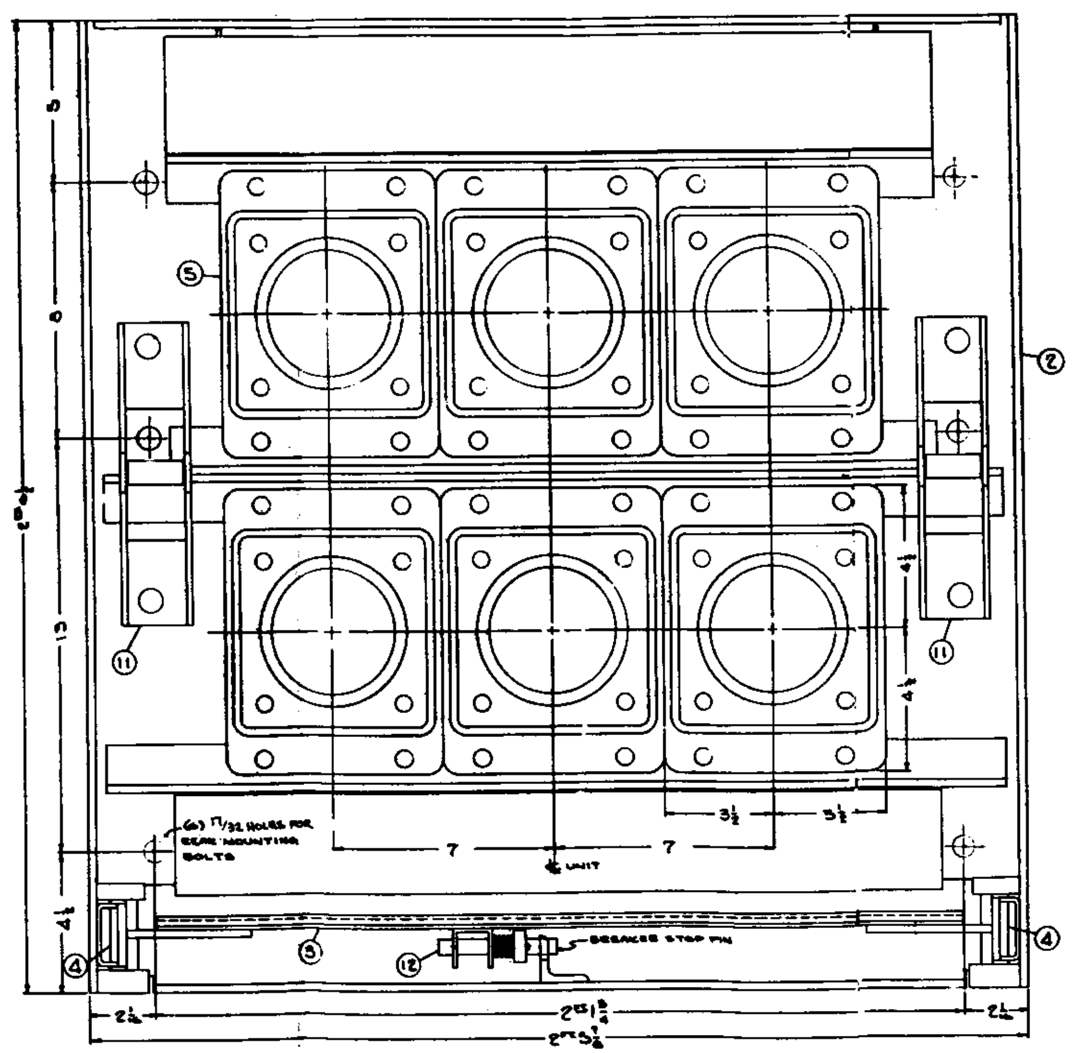
REFERENCES			
NO		DRAWING NO. CONTR. DWG.	BUSHIPS

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-[illegible] PAINTED SWITCHBOARD GRAY.
3. THE MAIN DRAWOUT DISCONNECTS MAY BE OBSERVED WHEN THE MOVING COMPONENT IS FULLY DRAWN OUT.

APPROX. WEIGHT:
CALCULATED WEIGHT OF REMOVABLE ASM. WITH BKR IS 886 LBS.
CALCULATED WEIGHT OF REMOVABLE ASM. WITHOUT BKR IS 346 LBS.



SECTION "A-A"
BREAKER IN CONNECTED POSITION
STATIONARY COMPONENT



SECTION "B-B"
BREAKER REMOVED
STATIONARY COMPONENT

DETAILS OF CIRCUIT BREAKER STATIONARY COMPONENT

DRAWN BY	MASTER DRAWING	GENERAL ELECTRIC
APP'D BY	AIR CIRCUIT BREAKER NAVY TYPE ACB 3200 HR. AK-2-100N 500 V. A.C. 60 CYCLE 3 POLE ELECTRICALLY OPERATED 100,000 A. AC.I.C. REMOVABLE ASSEMBLY	LOW VOLTAGE SWGR. PHILA. 0122F0963
APP'D DATE	SCALE 6" = 1' / WT. SEE ABOVE	REV B

Figure 24

AK-2-100N
Master plan
(sheet 2)

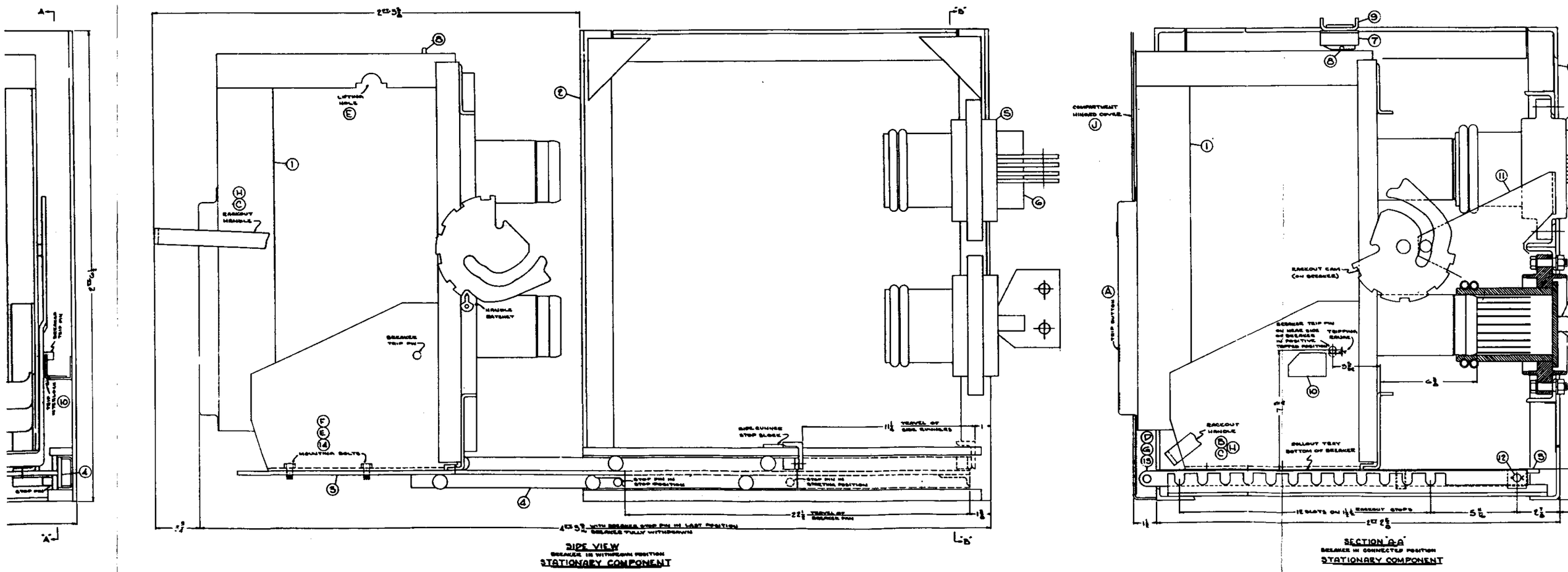


Figure 24. AK-2-100N circuit breaker master plan (sheet 2)

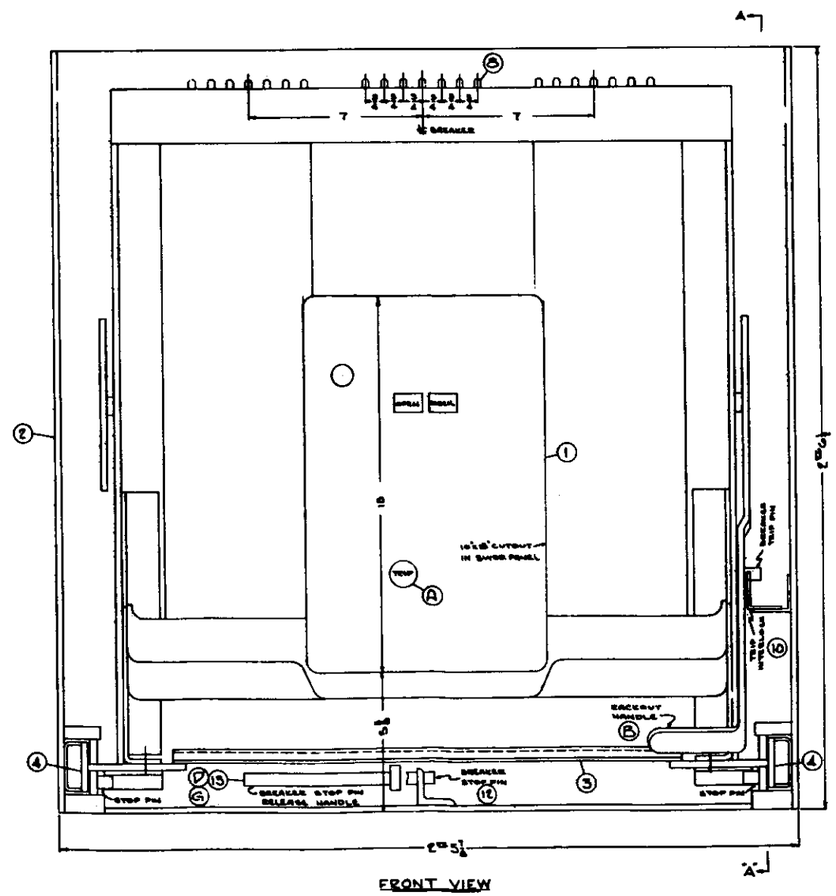
THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED UNDER REMOVING MOVING COMPONENT OF AIR CIRCUIT BREAKER FROM CONNECTED POSITION IN HOUSING.

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

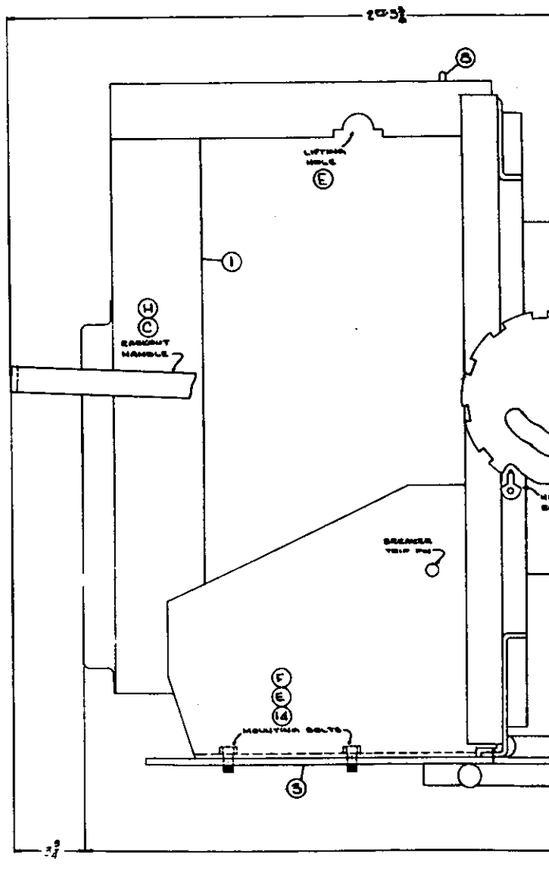
THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED WHEN PLACING MOVING COMPONENT OF AIR CIRCUIT BREAKER IN HOUSING.

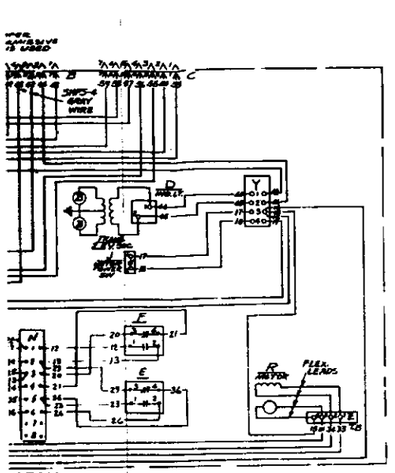
F. MOUNT THE AIR CIRCUIT BREAKER ON ROLLOUT TRAY AND SECURE WITH FOUR (4) MOUNTING BOLTS.
G. PULL BREAKER STOP PIN RELEASE HANDLE TO RIGHT AND PUSH THE BREAKER INTO THE UNIT UNTIL IT REACHES THE RACKING POSITION AND RELEASE BREAKER STOP PIN HANDLE.
H. PUMP THE RACKOUT HANDLE FIVE (5) TIMES AND THIS WILL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

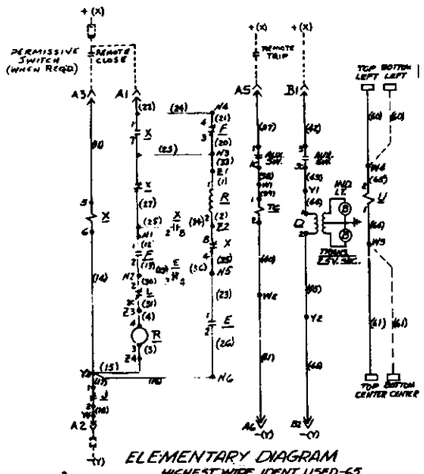
NOTE:
THE HINGED DOOR OF THE CIRCUIT BREAKER COMPARTMENT SHOULD ALWAYS BE CLOSED WHEN OPERATING THE CIRCUIT BREAKER IN ITS CONNECTED POSITION.



FRONT VIEW







LEGEND

A, B – 7 POINT SECONDARY DISCONNECT BOARDS
C – INDICATING LIGHTS
D – INDICATING LIGHTS
E, F – CONTROL SWITCHES
H – SHOCK SWITCH
J – MOTOR POWER SWITCH
L – ALC 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 – UNDERVOLTAGE DEVICE BREAKER OPEN – SPRINGS DISCHARGED

WIRING DIAGRAMS ARE TYPICAL AND SHOW CIRCUIT BREAKERS WITH THE MAXIMUM NUMBER OF ATTACHMENTS AVAILABLE. FOR SPECIFIC BREAKER SEE CERTIFICATION DATA SHEET AND ITS WIRING DIAGRAM.

ELEMENTARY DIAGRAM

HIGHEST WIRE IDENT. USED-65

FIG-3

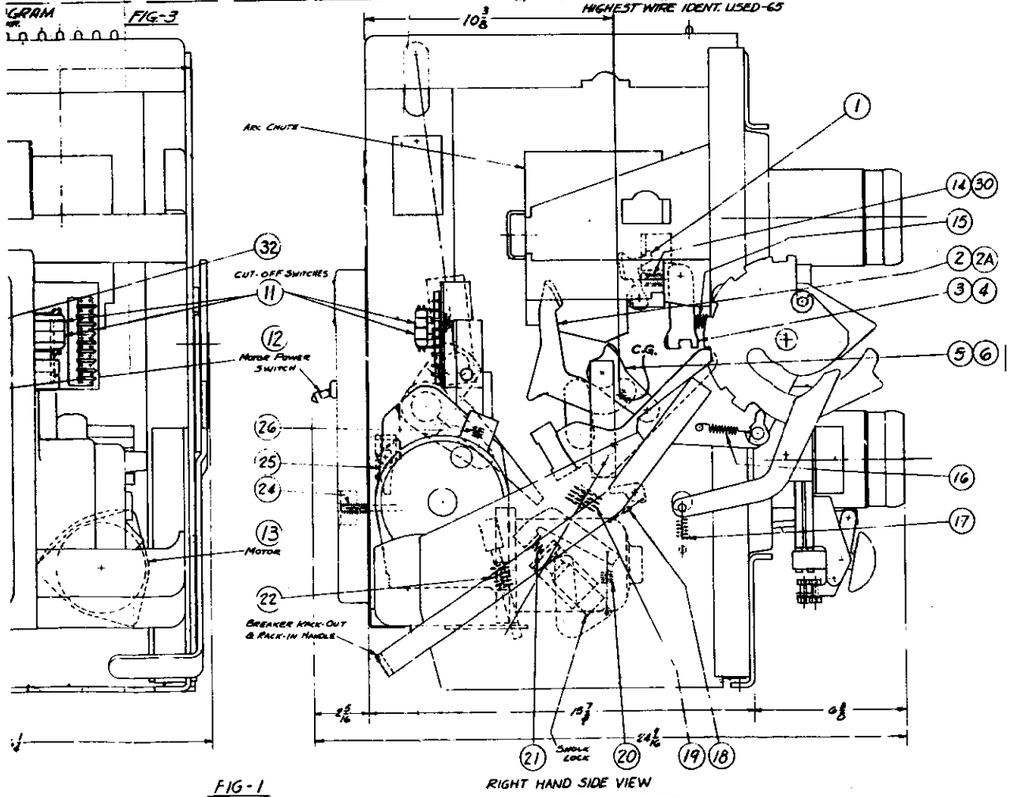


FIG-1

RIGHT HAND SIDE VIEW

CIRCUIT BREAKER MOVING COMPONENT

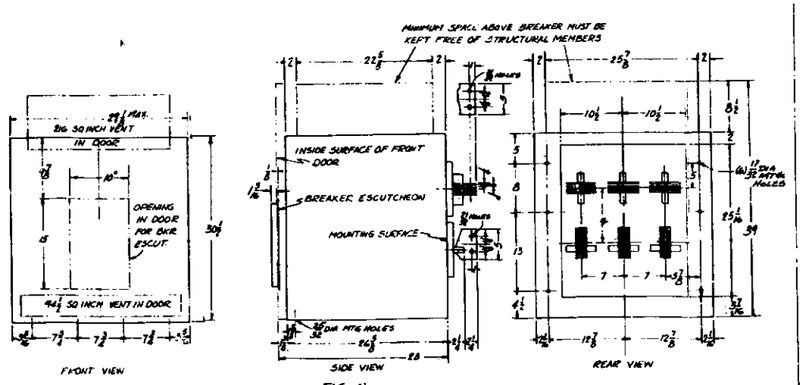


FIG-2

INSTALLATION DETAILS FOR CIRCUIT BREAKER REMOVABLE ASSEMBLY – MOUNTING IN STD NAVY SWITCHBOARDS

NOTES

NOTE A –

NOMINAL VOLTAGE	SHUNT TRIP VOLTAGE RANGE
115V – 60CY.	80 – 130
450V – 60CY	420 – 500

NOTE B –

NOM. VOLTAGE	CLOSING MOTOR VOLT RANGE	FULL LOAD CURR.
115V – 60CY	90–130	4.0 AMP.

NOTE C – USED ON SPECIFIC REQUISITIONS ONLY.

NOTE D – UNDERVOLTAGE DEVICE

NOMINAL VOLTAGE	PICK-UP VOLTAGE RANGE	DROP OUT VOLTAGE (SEAL-IN)	DROP OUT VOLTAGE
450 AC	360–500	360 MIN.	270–95

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

FOR DETAILS OF STATIONARY COMPONENT OF SWITCHGEAR SEE SHEET 2 OF THIS DRAWING

COMPONENTS OF CIRCUIT BREAKER ARE FULLY COVERED BY TECHNICAL MANUAL NAVSHIPS – 0962-073-6010

MOVING COMPONENT OF SWITCHGEAR MAY BE REMOVED FROM SWITCHBOARD BY RACKING-OUT BREAKER & REMOVING BOLTS HOLDING BREAKER TO DRAWOUT TRAY

ATTEMPTS TO RACK OUT BREAKER WILL CAUSE BREAKER TO TRIP

TYPICAL REPAIR PARTS LIST FOR ONE BREAKER

NOTE	ITEM NO.		QTY.	MFG. INFO.	DRAWING
	1	ARC CONTACT (STA)	18		K-8203966-1
	2	ARC CONTACT (MOV)	9		K-9915784-1
	2A	ARC CONTACT (MAV)	6		K-6467153-1
	3	MAIN CONTACT (STA)	45		K-6397796-1
	4	INTERMEDIATE CONTACT (STA)	3		K-8209796-5
	5	MAIN CONTACT (MOV)	18		K-6709784-1
	6	INTERMEDIATE CONTACT (MOV)	3		K-8209796-3
	7	LIGHT BULB	2		8MC24-1767
	8	RELAY 115V 60CY	1		(REVISION)
	9	CONT. – SHUNT TRIP 115V 60CY	1	SEE NOTE A	K-6772089-G1
	10	AUXILIARY SWITCH (5A & 5B)	1		DL-6397661-M1
	11	SWITCH CUT-OFF	2		8378721-1-G1
	12	SWITCH MOTOR POWER	1		8378683-1-P1
	13	MOTOR	1	SEE NOTE B	5P6674-A9
	14	SPRING – STA. ARC CONTACT	15		K-6391856
	15	STA. MAIN CONTACT	18		K-6309811
	16	PINS ON DD HANDLE	1		368434
	17	DD TRIP LATCH RETURN	1		412432
	18	TRIP SHAFT RETURN	1		412449
	19	OPENING	2		K-6509818
	20	PROP TO RESET LATCH	1		K-6403548-1
	21	SHOCK LOCK	1		K-6403395
	22	MECH. RESET	1		K-6403393-1
	23				
	24	MAIN TRIP	1		K-6309887
	25	CAM PROP RETURN	1		412440
	26	MOTOR MECH. RATCHET	1		K-6509811-1
	27				
	28				
	29	SHUNT TRIP	1		368395
	30	STA. ARC CONTACT	15		K-6309859
	31	SECONDARY DISCONNECT	21		K-6403551
	32	DISCHARGE INDICATOR	1		368430
	33	SPRING DD PLUNGER	1		412424
	34				
	35				
	36				
	37	RETAINING RINGS & PLIERS	1		19KL1275-13
	38	SPRING – ANTI-REBOUND HOOK	1		K-6309877-1
C	39	COIL – SHUNT TRIP 115V 60CY	1	SEE NOTE A	K-6772089-G1
C	40	SPRING – UNDERVOLTAGE DEV.	1		K-6412376
C	41	COIL – UNDERVOLTAGE DEV. 450V 60	1	SEE NOTE C	K-6433081-G1

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPD
	A	ISSUED		
B	1			
	2			
	3			
	4			
C	5			
	6			
	7			

DESCRIPTIVE DATA

TYPE	NAVY TYPE ACB 4000 MR G.E. Co. TYPE AK-1-100M 4000 A.
CONTINUOUS CURRENT	4000 AMPS AC.
VOLTAGE	500 A.C. (60 HERTZ)
POLES	3 POLES
RATED INTERRUPTING CURRENT	100,000 AMPS AC.
SHORT TIME RATING	100,000 AMPS .5 SEC.
MOUNTING	REMOVABLE ASSEMBLY-DEAD FRONT-DRAWOUT-ELECTRICALLY OPERATED
NORMAL CLOSING	ELECTRICAL
OVERCURRENT COILS (AMPERES)	4000
AMBIENT TEMPERATURE	50°C
SHOCK CLASSIFICATION	CLASS N1
INSULATION CLASS	B
CONNECTIONS	BACK
PROTECTIVE FUNCTION	OVERCURRENT LONG TIME DELAY SHORT TIME DELAY (BAND 4 & 5) INSTANTANEOUS SHUNT TRIP
ACCESSORIES	INDICATOR LIGHT 10 STAGE AUX. SW (5A & 5B (NOTE 2)) 21 SECONDARY WIRING CONTACTS UNDERVOLTAGE DEVICE – MAST.
BUSHIPS APPROVAL LETTER	
TECHNICAL MANUAL – GE Co – SET-85301A	NAVSHIPS-0962-073-6010
SPECIFICATION	MIL-C-17587
SPECIFICATION EXCEPTIONS	NONE
TEST REPORT NO. – NAVY 8419-17, SES 81C-7241, WSL DPPL 25462	

DESCRIPTION	WESTINGHOUSE COMP.	MST-GO CONFORMS
3 POLE ELECT.	986 LBS.	538 LBS.

1. REMOVABLE ASSEMBLY – EACH CIRCUIT BREAKER SUPPLIED IS A COMPLETE REMOVABLE SWITCHBOARD ASSEMBLY CONSISTING OF CIRCUIT BREAKER, SEPARABLE DISCONNECTS & ASSOCIATED CONTROL WIRING, DRAWOUT MECHANISM & ASSEMBLY, STRUCTURAL SUPPORTS & BACK PLATE INCLUDING STATIONARY MAIN BUS CONNECTIONS, & STATIONARY TERMINALS FOR CONNECTION OF NECESSARY EXTERNAL CONTROL WIRING
2. UNLESS OTHERWISE SPECIFIED, THE STANDARD CIRCUIT BREAKER IS FURNISHED WITH A 10 STAGE AUXILIARY SWITCH (5A & 5B CONTACTS) & A MINIMUM OF 21 SECONDARY WIRING DISCONN. TERMS.
3. FOR FULL DESCRIPTION & DETAILS APPLICABLE TO THE BREAKER, OTHER THAN INSTALLATION DIMENSIONS, REFER TO THE APPLICABLE CERTIFICATION DATA SHEET & TECHNICAL MANUAL 6E-GEE-939.1 A BUSHIPS "NAVSHIPS – 0962-073-6010
4. THIS BREAKER ASSEMBLY IS DESIGNED FOR NAVY SWITCHBOARD UNIT SIMILAR TO G-7 OF 39 IN. WIDTH
5. BASIC MATERIAL REQUIREMENTS PER SPEC. MIL-E-917

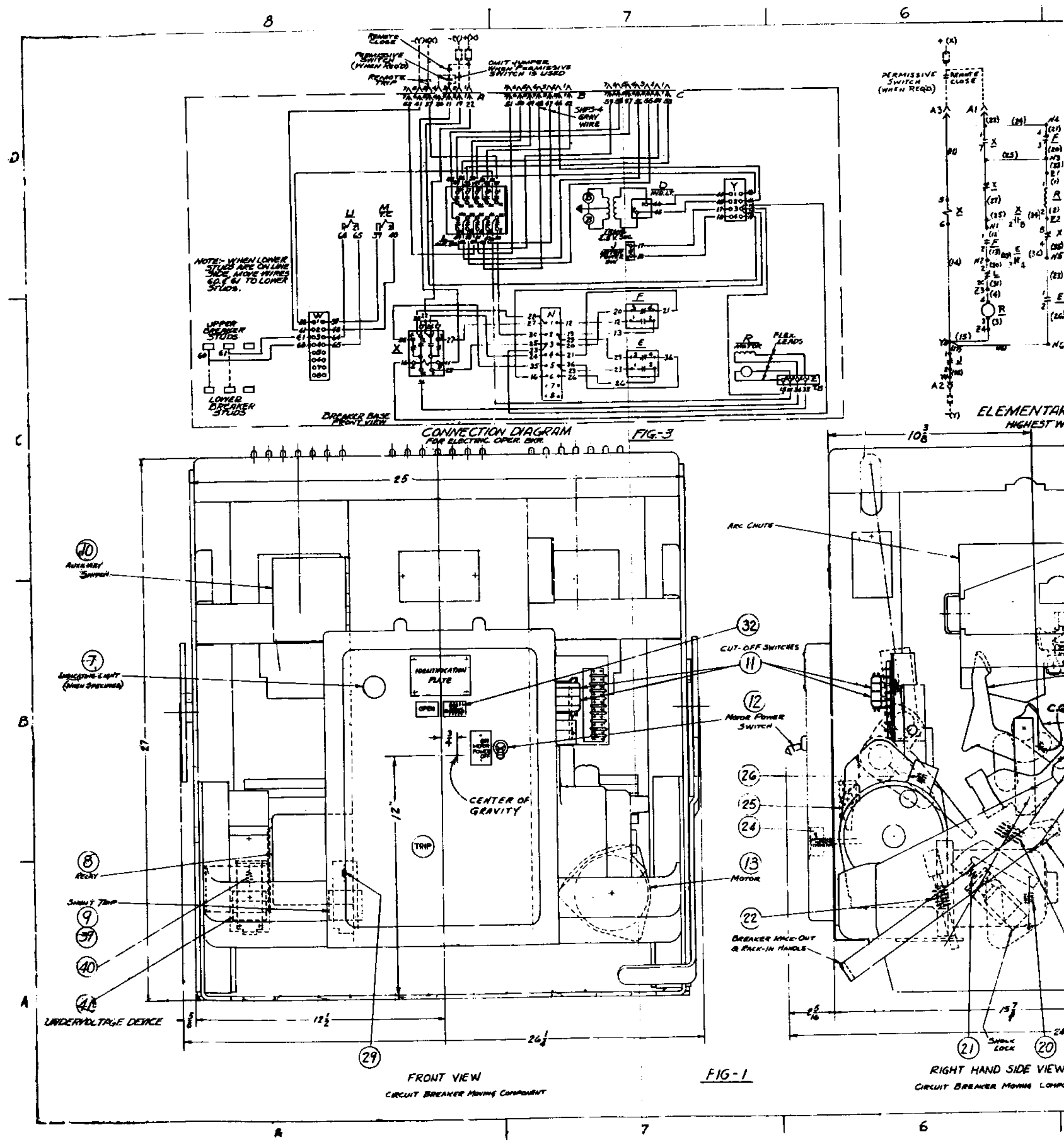
DRAWN BY	MASTER DRAWING	GENERAL ELECTRIC	
APPD BY	AIR CIRCUIT BREAKER	1 ONE VOLTAGE SWGR. PANELS	
INSP. PLAN 17, 1956	NAVY TYPE ACB 4000 AMP GR. AK-1-100M, 500 VOLTS A.C. 60 CYCLE 3 POLE ELECTRICAL OPER. 100,000 A.C.I.C. REMOVABLE ASSEMBLY	7078F30	
APPD DATE		NAVY DEPT BUSHIPS DWG NUMBER	
	SCALE – NONE WEIGHT – 986 MOTR	CONT ON SH-2	SHEET 1

LSP-E

Figure 25. AK-1-100N circuit breaker master plan (sheet 1)

Figure 25

AK-1-100N Master plan (sheet 1)



CONNECTION DIAGRAM
FOR ELECTRIC OPER. BKR.
FIG.-3
ELEMENTAR
FRONT VIEW
CIRCUIT BREAKER MOVING COMPONENT
FIG-1
RIGHT HAND SIDE VIEW
UNDERVOLTAGE DEVICE
CENTER OF GRAVITY
CUT-OFF SWITCHES
MOTOR POWER SWITCH
MOTOR
ARC CHUTE
BREAKER RACK-OUT & RACK-IN HANDLE
UPPER BREAKER STUDS
LOWER BREAKER STUDS
BREAKER BASE FRONT VIEW
IDENTIFICATION PLATE
TRIP