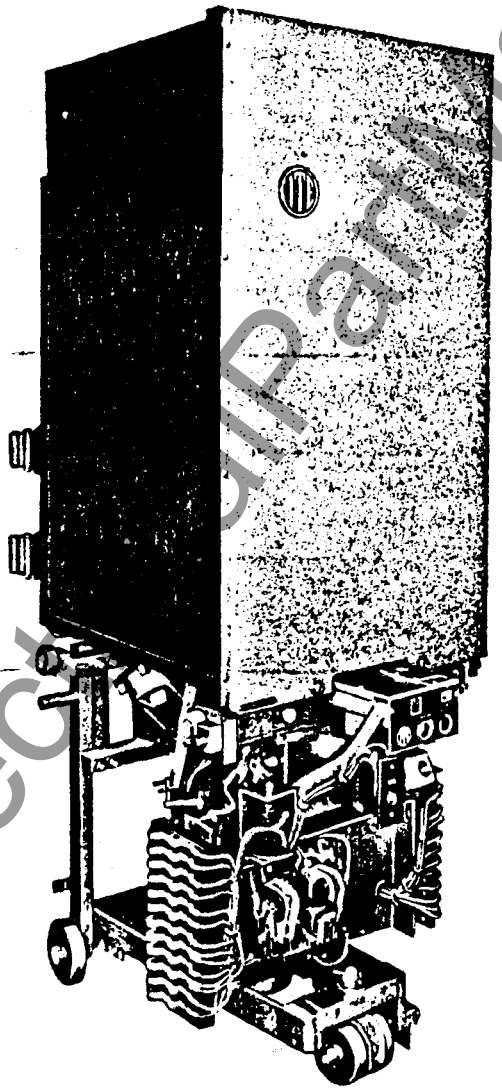
IB-5718 A

METAL-CLAD SWITCHGEAR

INSTRUCTIONS

HV CIRCUIT BREAKERS
TYPE 5HV-150, 1200 AMPERES
MODELS C4, C5, AND C6



I-T-E CIRCUIT BREAKER COMPANY • PHILADELPHIA 30, PENNSYLVANIA

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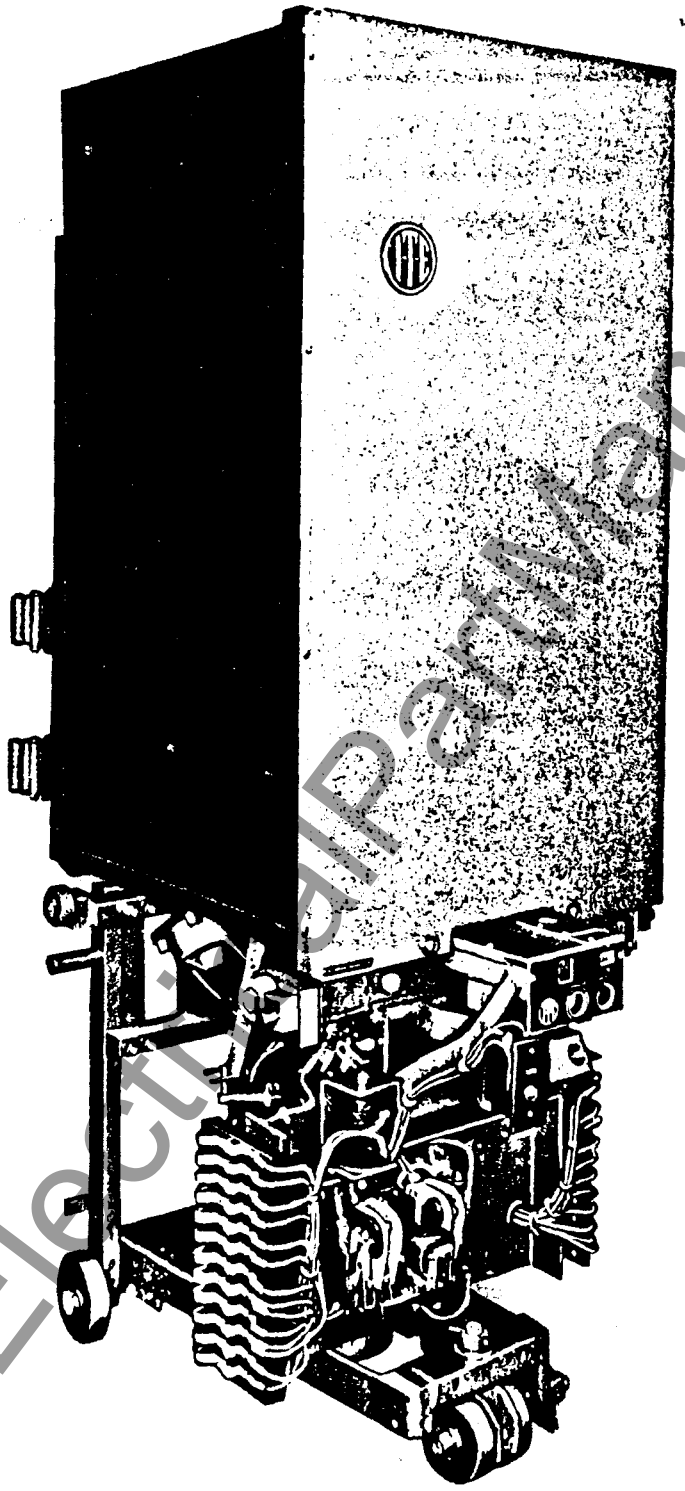


Cover Photo 27672-R

Photo 27672-R

Fig. 1—Type 5HV-150 Circuit Breaker

INSTRUCTIONS FOR
TYPE 5HV-150 CIRCUIT BREAKER, 1200 AMPERES
MODELS C4, C5, AND C6

INTRODUCTION

These instructions apply to the circuit breaker type and models listed in Table I. The circuit breaker model is designated by the serial number suffix as stamped on the nameplate.

TABLE I

Type	Model
5HV-150	C4
5HV-150	C5
5HV-150	C6

Read these instructions thoroughly and carefully before installing or attempting to operate the Type 5HV-150 power circuit breaker. The operator can prolong the life and usefulness of this equipment by following these instructions.

The circuit breaker, as shown in Fig. 1, is a three-pole, electrically operated circuit breaker designed for use in drawout switchboard installations. Each circuit breaker consists of a control panel, operating mechanism and solenoid assembly, upper and lower current carrying parts, blowout structure, arc chute, racking and visual assembly, and necessary supporting structure.

RATINGS

The Type 5HV-150 circuit breakers have a current rating of 1200 amperes, and are designed for application on a-c voltages from 3500 minimum to 4760 maximum. They have an interrupting rating of 100 MVA at 2300 volts and 150 MVA at 4160 volts. The rating of each circuit breaker is stamped on a nameplate which is attached to the top of the racking and indicator assembly.

RECEIVING, HANDLING, AND STORAGE

Each circuit breaker, before leaving the I-T-E Circuit Breaker Company, is carefully inspected and tested for proper operation and then crated by workmen who are experienced in the proper handling and packing of electrical equipment. Each crate is plainly marked at convenient places with the crate number, weight, and handling position.

TRANSPORTATION DAMAGE

Immediately upon receipt of the circuit breaker, examine the crates to determine if any damage or loss was sustained during transit. If injury or rough handling is evident, file a damage claim at once with the carrier and promptly notify the I-T-E Circuit Breaker Company. The I-T-E Circuit Breaker Company is not responsible for damage to goods after delivery to the carrier. However, the company will lend assistance in securing any adjustment, if notified of such claims.

HANDLING

Unpack the circuit breaker as soon as possible after receipt. If unpacking is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt.

Use care in unpacking in order to avoid damaging any of the circuit breaker parts. Check the contents of each package against the packing list before discarding any packing material. If any shortage of material is discovered, promptly notify the nearest representative of the I-T-E Circuit Breaker Company. Information specifying the purchase number, crate number, and part numbers of the damaged parts should accompany the claim.

STORAGE

When a circuit breaker can be installed immediately in its permanent location, it is advisable to do so even though it will not be placed in service for some time, unless conditions of high humidity prevail and it is not possible to energize space heaters or equivalent.

If the circuit breaker can not be installed in its permanent location, or the high humidity condition listed above prevails, the following precautions should be taken:

1. Uncrate the circuit breaker as described under HANDLING.
2. Cover with heavy wrapping paper to prevent dirt or foreign substances from settling on the movable parts and electrical contact surfaces.
3. Store in a clean, dry place with moderate temperatures.

DESCRIPTION

The circuit breakers are electrically operated against heavy springs located back of the contacts and in the operating mechanism and linkage. During inspection and maintenance periods, with the circuit breaker in the "TEST" position, the circuit breaker may be closed manually by a removable maintenance closing handle. The circuit breaker contacts are opened by the opening springs when the trip latch is released either by pushing the manual trip button or automatically by any trip device with which the circuit breaker is equipped.

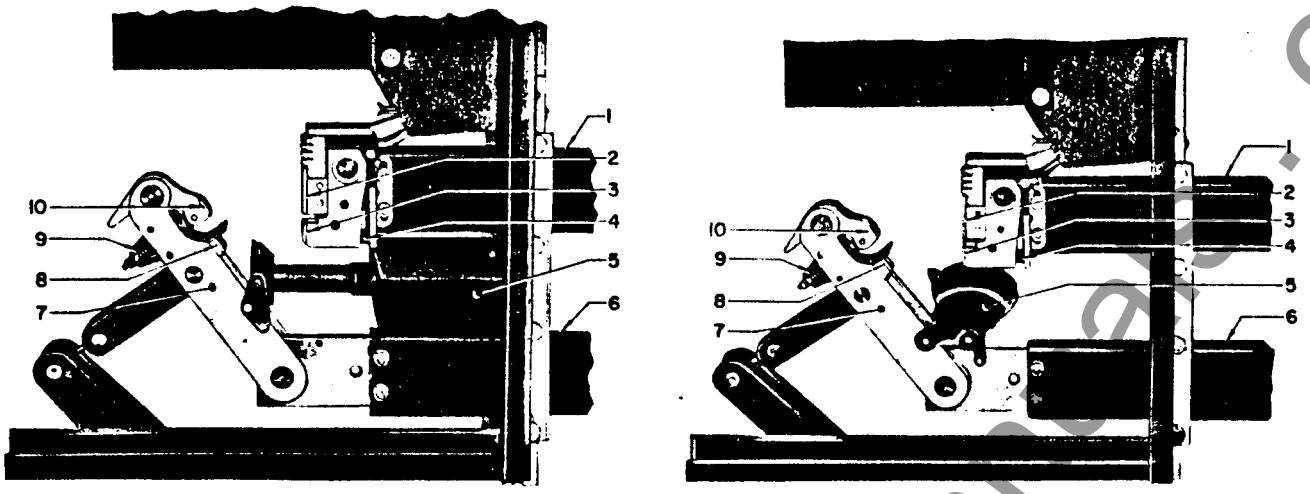


Photo 29618-RA
Photo 27683-RB

A—Model C6

B—Models C4 and C5

1 Upper Current Stud
2 Stationary Arcing Contact
3 Stationary Main Contact
4 Main Contact Spring
5 Puffer Assembly
6 Lower Current Stud
7 Movable Bridge Assembly
8 Movable Main Contact
9 Arcing Contact Spring
10 Movable Arcing Contact

Fig. 2—Partial View of Circuit Breaker Showing Current Carrying Parts and Puffer Assembly

The circuit breakers are "trip free" from the closing mechanism, which assures that the breaker contacts can not be closed as long as any trip device is functioning.

The current path of the circuit breaker is through the upper current studs, stationary contacts, movable contact bridge assemblies, and the lower current studs. When the circuit breaker opens, the main contacts open first, which shunts the current through the arcing contacts. When the arcing contacts open, a magnetic field is produced by the blowout coil which causes the arc to rise into the arc chutes where it is extinguished.

CURRENT STUDS

The upper and lower current studs (1 and 6, Fig. 2) are constructed of bar copper which is pressed into a rectangular, insulating, bakelite tube having a conductive inner surface liner.

CONTACTS

The correct contact closing sequence is as follows: (1) the arcing contacts close, and (2) the main contacts close. The contacts open in the reverse order, but the opening sequence can not be observed due to the speed with which the contacts operate.

All contact surfaces are silver-alloy blocks which are brazed to the stationary and movable contact parts. No flexible connectors are used to conduct the current between contact pivot points. These pivot points are silver to silver held under a fixed pressure by spring washers.

Main Contacts

The main movable contact bridge (7, Fig. 2) is a brazed assembly of two parallel copper bars and a silver-alloy contact block. The main contact bridge pivots on a tube which is supported by the lower terminal.

The stationary main contacts (3, Fig. 2), for each pole, pivot on a pivot tube supported by the upper terminals. Each pole has two stationary contacts which are "backed-up" by one compression spring (4, Fig. 2) per contact which furnishes the necessary contact pressure and wipe.

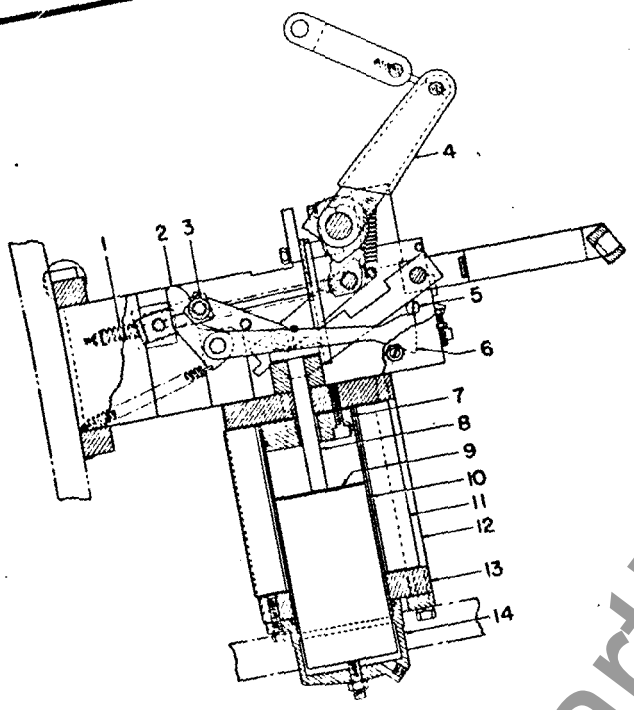
Arcing Contacts

The movable arcing contacts (10, Fig. 2) pivot on a pivot tube which is supported by the main contact bridge. Each pole of the circuit breaker has two movable arcing contacts, each of which is "backed-up" by a compression spring (9, Fig. 2) which furnishes the necessary contact pressure and wipe.

The stationary arcing contacts (2, Fig. 2), for each pole, consists of a right-hand and left-hand contact which are rigidly fastened to the upper terminals.

JUMP GAP

Directly above the stationary arcing contacts there is a piece of refractory material, with horizontal grooves, which facilitates the quick insertion of the blowout coil upon contact parting. The jump gap extinguishes the arc between the stationary



1 Opening Spring
2 Main Latch Hook
3 Main Latch Roller
4 Closing Arm Assembly
5 Tripper Bar
6 Main Latch
7 Guide Tube End
8 Push Rod
9 Plunger
10 Guide Tube
11 Closing Coil
12 Side Plate
13 Bottom Plate
14 Auxiliary Closing Pot

Fig. 3—Operating Mechanism and Solenoid Assembly Shown in the Open Position

arcing contact and the lower end of the rear arc runner to which the blowout coil is connected.

BLOWOUT STRUCTURE

The blowout support (1, Fig. 4) is supported by the back panel and is located directly above the stationary contacts. The blowout coil and its core are securely fastened between two blowout irons which in turn are supported by the blowout support.

ARC CHUTE

The arc chute (26, Fig. 4) is supported by the top edges of the blowout irons, and is securely held in place by a locking plate. A hole in the locking plate snaps over a pin on the blowout iron when the arc chute is properly positioned.

The arc chutes consist of a one piece front and side shell, and a series of arcing plates mounted in spaced relation transverse to the arc path.

When the circuit breaker opens, the main contacts separate first, followed by the arcing contacts which draw an arc. As the contact bridges move toward their open position, the arc, forced upward by its own magnetic field, impinges on the rear arc runner, thereby inserting the blowout coil in the circuit. The current in the blowout coil sets up a strong magnetic field which drives the arc up into the arc chute. As the contacts approach the open position, the arc transfers from the movable arcing contact to the front arc runner, which is connected to the lower terminal. The arc, as it rises along the front and rear arc runners, increases in length and at the same time is brought into contact with larger surfaces of the arcing plates. The arc is interrupted by the cooling, lengthening, and squeezing of the arc in many points along its path.

INTERPHASE BARRIER

The interphase barrier assembly (1, Fig. 5) provides the necessary isolation between phases of the circuit breaker. The barrier assembly has a metal front plate which is grounded to the circuit breaker frame. The barrier is removed as a complete unit and can be handled by one man.

OPERATING MECHANISM

The operating mechanism (Fig. 3) is located below the contact structure. The mechanism is conventional, having the usual toggle system and linkage for transmitting the force of the solenoid or manual closing handle to the contact bridge.

The mechanism is designed so that little force is required to trip the circuit breaker. This is necessary for fast tripping and for circuit breakers using transformer trip units which require the use of an auxiliary tripping device.

The circuit breakers are trip free over the range of the closing stroke. When the contacts make under "fault" conditions, the tripping device will operate the trip shaft, release the trip toggles, and allow the opening springs to open the contacts to the "OPEN" position.

SOLENOID

The solenoid (Fig. 3) is mounted directly below the operating mechanism. The solenoid consists of two side plates, a bottom plate, guide tube, plunger, push rod, and closing coil. The closing coil is centered by the guide tube which also guides the plunger.

When the closing coil is energized, the motion of the plunger and push rod is transmitted to the operating mechanism toggles. The toggle in turn transmits the force to close the breaker. A "bb" switch opens the pick-up coil circuit of the control relay near the end of the closing stroke. "Pumping", or repeated closing stroke is prevented by a lockout feature on the control relay.

CONTROL PANEL

The control panel (13, Fig. on which the various trip

1 Blowout Support
2 Blowout Iron
3 Movable Arcing Contact
4 Stationary Arcing Contact
5 Main Separable Contacts
6 Stationary Main Contact
7 Air Puffer Assembly
8 Movable Main Contact
9 Movable Bridge Assembly
10 Locking Bolt
11 Auxiliary Switch
12 Control Separable Contacts
13 Control Panel
14 Guide Bar
15 Control Relay
16 Locking Device Handle
17 Shunt Trip Device
18 Manual Closing Lever
19 Test Switch
20 Manual Trip Button
21 Nameplate
22 Closing Arm
23 Closing Link
24 Lower Lead Connection
25 Auxiliary Blowout Iron
26 Arc Chute

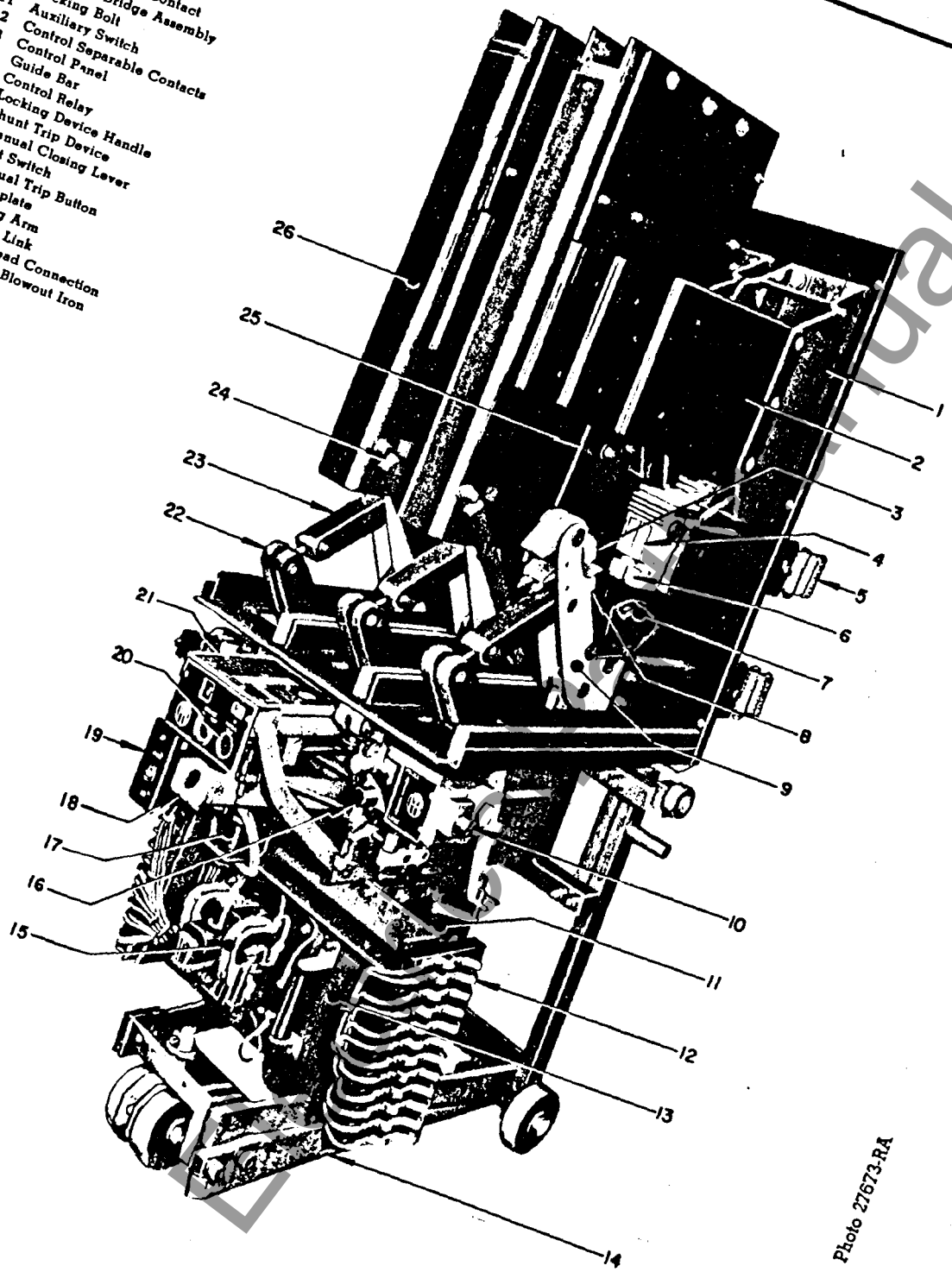
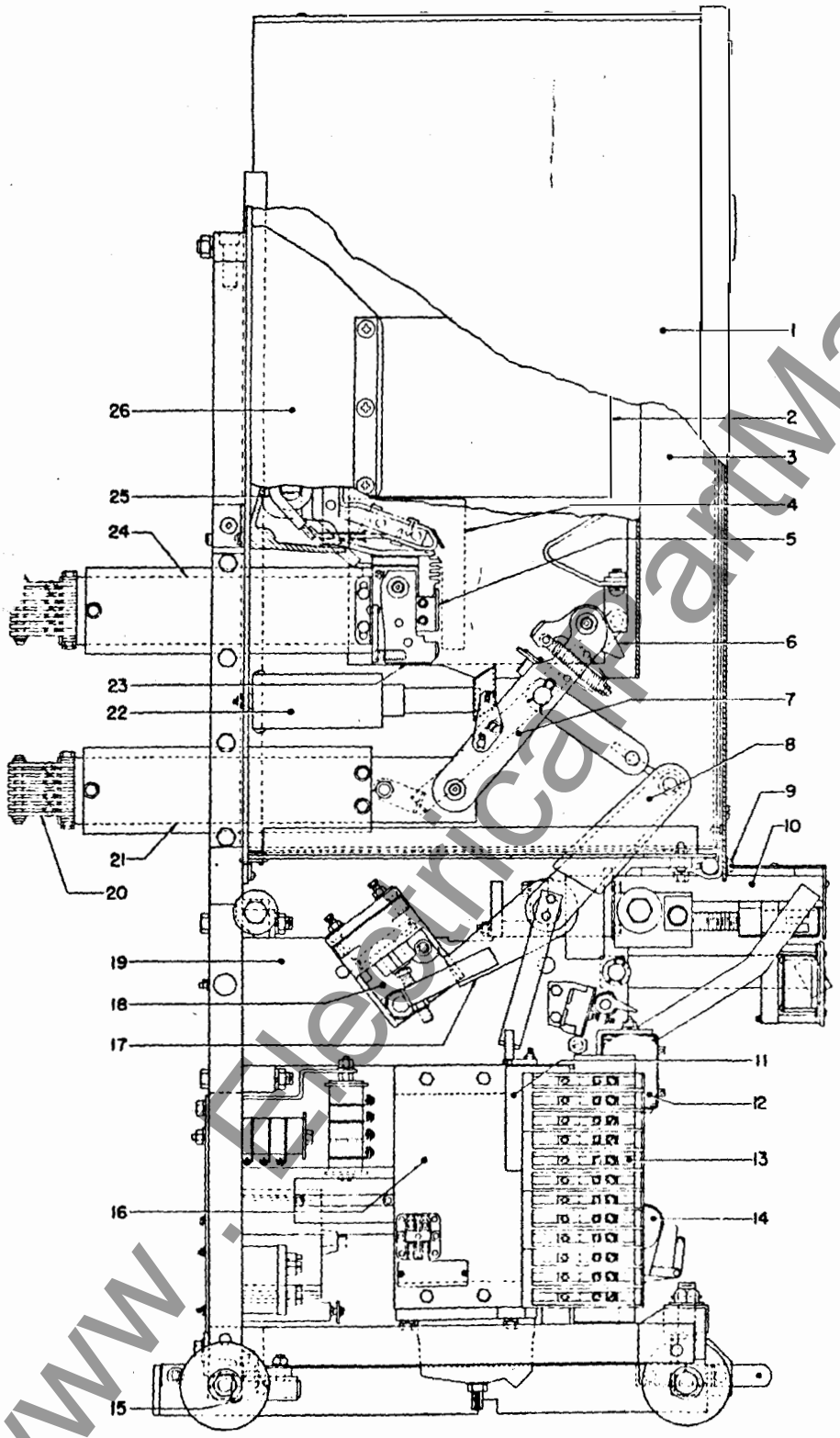


Photo 27673-RA

Breaker with Interphase Barrier and One Arc Chute Removed (Models C4 and C5)



1 Interphase Barrier Assembly
2 Blowout Iron
3 Arc Chute
4 Auxiliary Blowout Iron
5 Stationary Arcing Contact
6 Movable Arcing Contact
7 Movable Bridge Assembly
8 Closing Arm Assembly
9 Mounting Screw (Interphase Barrier)
10 Racking and Indicator Assembly
11 Auxiliary Switch
12 Shunt Trip Device
13 Control Separable Contacts
14 Control Relay
15 Ground Contact
16 Solenoid Assembly
17 Buffer Arm
18 Air Buffer Assembly
19 Operating Mechanism
20 Main Separable Contacts
21 Lower Current Stud
22 Air Puffer Assembly
23 Stationary Main Contact
24 Upper Current Stud
25 Blowout Coil
26 Blowout Support

Side View of Circuit Breaker (Model C6)

The shunt trip device is mounted on the upper left-hand corner of the control panel. A transformer trip assembly can also be supplied and mounted on this panel.

The Type R14 "trip-free" closing relay (15, Fig. 4) is mounted on the front of the control panel. The relay prevents "pumping" or repetition of the solenoid closing stroke and protects the closing coil which is not designed for continuous service. The instruction bulletin number for the Type R14 control relay is listed in the bibliography at the back of this bulletin. Copies of this bulletin will be furnished on request.

A Type L2 six contact auxiliary switch (11, Fig. 5) is mounted on the left-hand side of the circuit breaker. An additional auxiliary switch can be added on the right-hand side, if required. The instruction bulletin number for the Type L2 auxiliary switch is listed in the bibliography at the back of this bulletin. Copies of this bulletin will be furnished on request.

The control separable contacts (13, Fig. 5) are mounted at each side of the control panel. A total of 24 contacts can be furnished on each circuit breaker.

In addition to the above units, a latch-checking switch can be furnished for use with reclosing relays.

Ninety per cent of all wiring required is done on the panel. Any of the above mentioned devices can be added to the circuit breaker in the field without additional drilling since all holes necessary for mounting these devices are drilled at the factory.

RACKING AND INDICATOR ASSEMBLY

The racking and visual indicator assembly (10, Fig. 5) is located at the front of the circuit breaker directly above the control panel. A visual indicator plate fastens to the supporting bracket and contains the openings for the visual indicator, operation counter, racking handle, and manual trip button. Whenever the circuit breaker is in the "CLOSED" position, the racking opening is closed automatically by a shutter to prevent racking the circuit breaker from one position to another without first tripping it.

Another nameplate to the right of the indicator plate indicates the position of the locking bar.

The push button station (19, Fig. 4), located below the indicator plate, is used to operate the circuit breaker electrically in the "TEST" position. These push buttons will not operate the circuit breaker when it is in the "OPERATING" position.

The circuit breaker nameplate is attached to the top of the racking and indicator assembly; and is stamped with the necessary information concerning voltage, current, interrupting ratings, serial number, type, etc. The position indicator is a part of this nameplate and a pointer indicates either the "RACKED-OUT" or "OPERATING" position of the circuit breaker. Racking the circuit breaker from the "OPERATING" to the "RACKED-OUT" position moves it toward the front of the compartment. It is necessary to manually pull the circuit breaker toward the front of the compartment in order to place the circuit breaker in the "TEST" position.

BUFFER ASSEMBLY

The air buffer assembly (18, Fig. 5) is arranged so as to absorb the kinetic energy of the movable contact bridges and mechanism as they reach the open position. The buffer assembly, mounted at the left-hand side of the mechanism and consists of a cylinder containing a piston, piston rings, spring, and spring guide. As the circuit breaker approaches its open position, the impact of the buffer arm forces the piston rod and piston upward which compresses the air in the cylinder. The buffer is adjusted at the factory to hold the rebound of the contact bridges to approximately 15 per cent of their opening stroke. This adjustment is critical and must not be changed.

PUFFER ASSEMBLY

Two types of air puffers have been furnished on the circuit breaker models covered by this bulletin.

The air puffer assembly (22, Fig. 5), furnished on Model C6, consists of a chamber assembly, piston assembly, nozzle assembly, links, pivot pin, and the necessary hardware. The complete assembly is mounted as shown in Fig. 5. As the circuit breaker opens, the action of the movable bridge assembly pulls the nozzle and piston assemblies forward which compresses the air in the chamber. Exhaust ports in the nozzle assembly allow the air to escape as it is compressed. The tube and nozzle directs the air to the area directly below and in front of the stationary main contacts. This air, forced across the arc as the circuit breaker opens, shortens the total arcing time on interruptions of very low currents such as transformer or induction regulator magnetizing currents.

The air puffer (7, Fig. 4), furnished on Model C4 and C5 consists of a puffer chamber, flapper and gasket, and pivot pins. The puffer chamber pivots on a pin carried by the movable contact bridge, while the puffer flapper has two pivot points. One, a stationary pivot in the lower terminal; and two, a movable pivot in the puffer chamber. As the movable contact bridge opens, the puffer chamber is pulled forward causing the puffer flapper to move through its arc of travel in the chamber, producing a "puff" of air. A small opening in the puffer chamber directs the "puff" of air across the arc and thereby shortens the total arcing time on interruption of very low currents, such as transformer or induction regulator magnetizing currents.

INTERLOCKS

Interlocks are provided to prevent moving the circuit breaker to or from the "OPERATING" position while the contacts are closed.

These interlocks serve two functions. One prevents the insertion of the racking handle unless

the circuit breaker is in the "OPEN" position. The second holds the trip latch disengaged at all positions of the circuit breaker between the connected "OPERATING" and disconnected "RACKED-OUT" positions which prevents "making" or "breaking" current on the main separable contacts.

Key interlocks can be furnished for customer's special requirements.

MAIN SEPARABLE CONTACTS

The main separable contacts (20, Fig. 5) provide separable electrical connections between the circuit breaker terminals and the male contacts on the primary bus. The current carrying capacity and conductivity of the contact is maintained under severe current and temperature conditions.

GROUND CONNECTION

The ground bus contact (15, Fig. 5) is mounted on the bottom rear cross frame bracing. The contacts engage the ground bus before the circuit breaker reaches the "TEST" position and remains engaged from the "TEST" to the "OPERATING" position.

ACCESSORIES

A steering handle is furnished to facilitate moving truck type circuit breakers in and out of switchboards, as well as any other moving which may be required during the installation and maintenance of the circuit breaker.

A maintenance manual closing handle is furnished for manually operating the circuit breaker during test and maintenance periods.

A racking crank is furnished for racking the circuit breaker to either of its two positions within the switchboard.

A levering rod is furnished with Model C6 to assist in moving the circuit breaker between the "TEST" and "RACKED-OUT" positions.

INSTALLATION

The switchboard and all associated equipment should be completely installed, inspected, and tested before installing the circuit breakers.

Circuit breakers that have been in storage during the installation of the switchboard and associated equipment should be unwrapped and thoroughly cleaned.

Close and trip the circuit breaker manually before inserting it into the switchboard. If a test station is available, also check the electrical close and trip operations.

CAUTION: DE-ENERGIZE THE PRIMARY AND CONTROL CIRCUITS BEFORE INSERTING THE CIRCUIT BREAKER INTO THE SWITCHBOARD.

INSERTING CIRCUIT BREAKER

The procedure described below should be followed when inserting the circuit breaker into the switchboard:

1. The circuit breaker should be in the "OPEN" position, the position indicator at the "RACKED-OUT" position, and the locking device in the "UNLOCK" position.

2. By use of the steering handle, align the sides of the circuit breaker with the sides of the switchboard compartment.

3. Back the circuit breaker into the switchboard so that the guide bar at the bottom of the circuit breaker enters the guide slot on the switchboard compartment floor. Remove the steering handle.

4. Push the circuit breaker toward the rear of the compartment until the circuit breaker reaches the floor stop. The circuit breaker is now in the "TEST" position.

5. Energize the control circuit and electrically close and trip the circuit breaker from the push button station on its front panel.

6. With the circuit breaker in the "OPEN" position, place the levering rod so that the pin is in the slot at the front of the floor guide and the link is connected to the bracket on the circuit breaker. Move the "RELEASE" lever (on the compartment floor) toward the guide slot with the right foot; and at the same time jack the circuit breaker, by means of the levering rod, toward the rear of the compartment until a definite stop is reached.

7. Remove the levering rod and turn the locking device to the "LOCK" position. The circuit breaker is now in the "RACKED-OUT" position as indicated by the position indicator.

8. Insert the racking crank and turn it clockwise until the position indicator indicates the circuit breaker is in the "OPERATING" position.

9. Close all switchboard doors, energize the primary circuits and the switchgear is ready to be put into service.

REMOVING THE CIRCUIT BREAKER

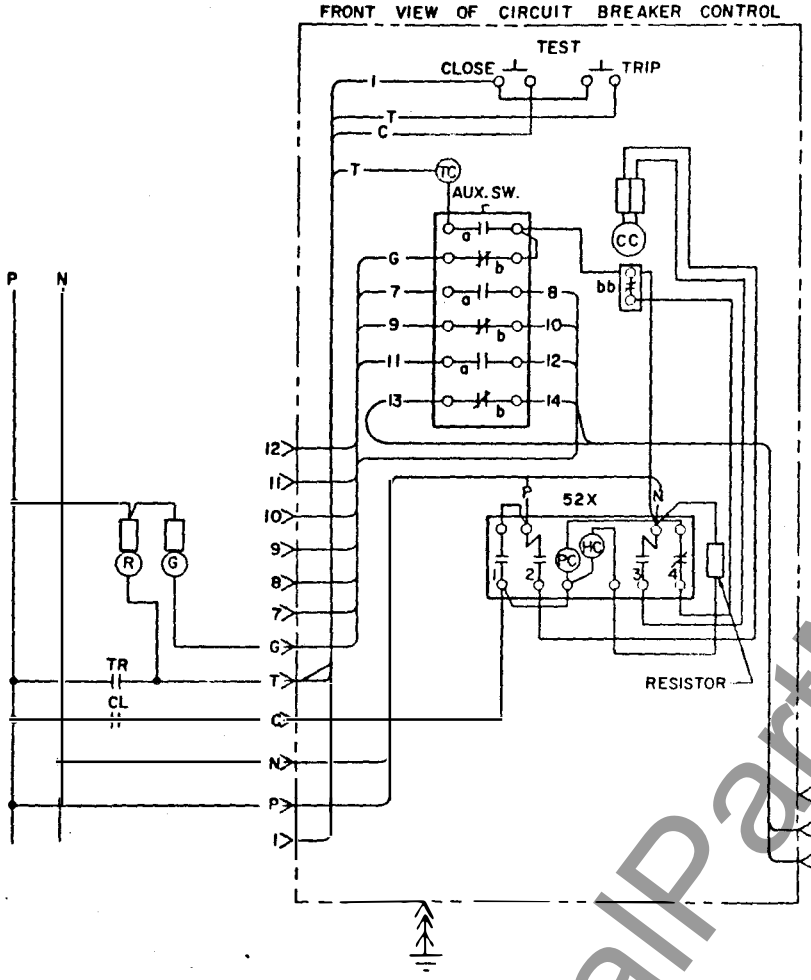
The procedure described below should be followed when removing the circuit breaker from the switchboard:

1. Trip the circuit breaker by means of the control switch on the front of the switchboard.

2. Open compartment door, insert the racking crank and turn it counter-clockwise until the position indicator indicates the circuit breaker is in the "RACKED-OUT" position.

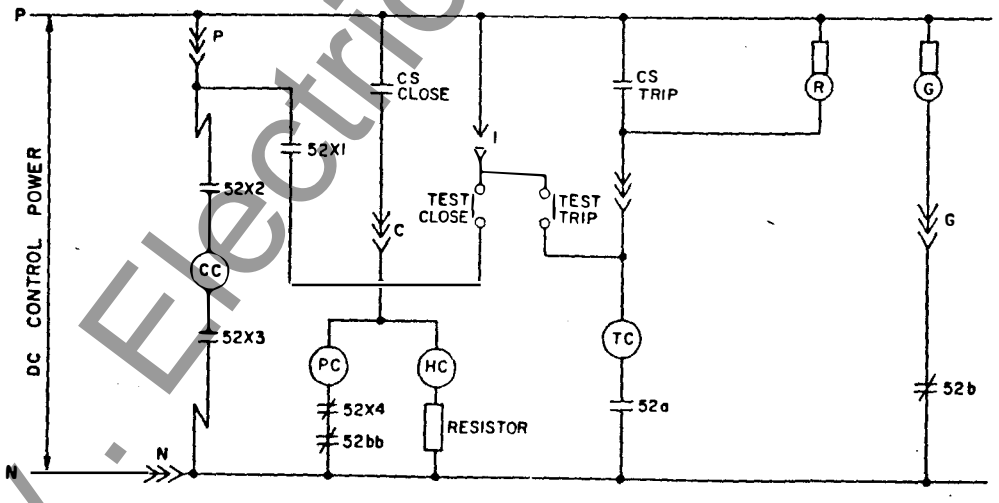
3. Turn the locking device to the "UNLOCK" position.

4. Insert the levering rod pin in the floor guide, attach the link to the bracket on the circuit breaker, and pull the circuit breaker forward until it reaches the floor stop. Remove the levering rod. The circuit breaker is now in the "TEST" position.



LEGEND

⩤	Disconnecting contact device closed when circuit breaker is in test position only.
⩤	Disconnecting contact device closed when circuit breaker is in test or operating position.
52	Air circuit breaker Type HV.
52a	Auxiliary switch contact closed when circuit breaker is closed, open when circuit breaker is open.
52b	Auxiliary switch contact closed when circuit breaker is open, open when circuit breaker is closed.
52bb	Contact closed when circuit breaker operating mechanism is in non-operated position. Opens at end of solenoid closing stroke.
52X	Circuit breaker closing relay Type R14—trip free.
52X-HC	Closing relay holding coil.
52X-PC	Closing relay pickup coil.
52X-1 52X-2 52X-3	Closing relay contacts closed when pickup coil is energized.
52X-4	Closing relay contact closed except when holding coil is energized and pickup coil is de-energized.
CC	Solenoid closing coil.
CS	Control switch.
TC	Shunt trip coil.
Note:	For 125 volt dc resistors are 1000 ohms. For 250 volt dc resistors are 2000 ohms.



SCHEMATIC DIAGRAM

Dwg. S-13825

Fig. 6—Typical Diagram of Connections

If it is desired to remove the circuit breaker from the switchboard, continue as follows:

5. Insert the steering handle. Move the "RELEASE" lever (on the compartment floor) toward the guide slot with the right foot and pull the circuit breaker forward until it is withdrawn from the switchboard.

OPERATION

The circuit breaker can be electrically operated when in the "TEST" or "OPERATING" position. With the circuit breaker in the "TEST" position, it can be operated only from the push button station mounted on the racking mechanism. However, when the circuit breaker is in the "OPERATING" position, it can be operated only from the remote mounted main control switch.

The circuit breaker can be manually operated in either the "TEST" position or when completely withdrawn from the switchboard as described under sections MANUAL CLOSING and MANUAL TRIPPING.

Refer to the schematic diagram (Fig. 6) when following the electrical closing and tripping procedures described below.

ELECTRICAL CLOSING

The circuit breaker is electrically closed by the operation of a control switch mounted on the front of the switchboard or at some remote point as follows:

Turn the control switch to the "CLOSE" position. This energizes simultaneously the pick-up coil (PC) and holding coil (HC) on the control relay. The stronger of the two coils, the pick-up coil, attracts the relay armature and closes contacts 52X-1, 52X-2, and 52X-3. (NOTE: Contact 52X-4 is closed when the relay is de-energized and remains closed when the relay armature is attracted to the pick-up coil magnet.) This energizes the solenoid closing coil (CC) and the solenoid plungers upward movement actuates the circuit breaker closing mechanism. At the end of its travel, the plunger rod causes the 52-bb switch contacts to open, thus de-energizing the pick-up coil (PC). The relay armature is then attracted by the magnet of the weaker or holding coil (HC) and opens all the 52X contacts. The opening of contacts 52X-2 and 52X-3 de-energizes the closing coil (CC).

If the control switch has a maintaining contact in the closing circuit, or if a momentary contact is held closed, the circuit breaker will not attempt to reclose if it trips on the first attempt due to some fault. The reason for this failure to reclose, even though the control switch is in the "CLOSE" position, is that the relay armature remains attracted to the magnet of the holding coil, thus preventing the 52X contacts from closing. Therefore, a second attempt to close the circuit breaker can not be made until the control switch is turned to the "OFF" position which de-energizes the holding coil and closes the 52X-4 contact.

The control relay is now in its normal de-energized position and will function to close the circuit breaker when the control switch is again turned to the "CLOSE" position. This non-repeat feature of the control relay prevents cyclic reclosing of the circuit breaker and assures that the momentarily rated pick-up coil receives only intermittent service.

ELECTRICAL TRIPPING

The circuit breaker can be electrically tripped by either pushing the "TRIP" push button on the circuit breaker or turning the control switch to the "TRIP" position. Either of the above means energizes the shunt trip coil (TC). The movement of the shunt trip armature rotates the trip lever and tripper bar enough to release the latch, resulting in consequent tripping of the circuit breaker.

The circuit breaker is tripped electrically in a similar manner by any other tripping device with which it may be equipped.

MANUAL CLOSING

CAUTION: NEVER CLOSE THE CIRCUIT BREAKER MANUALLY WHILE IT IS IN THE "OPERATING" POSITION IF THE BUS IS ENERGIZED.

The circuit breaker may be closed manually by inserting the manual closing handle into the socket of the manual closing lever (2, Fig. 7) and bearing down on it until the circuit breaker latches closed. The circuit breaker should be pulled to the "TEST" position or withdrawn from the switchboard before operating it manually for test or maintenance purposes.

MANUAL TRIPPING

The manual trip button (1, Fig. 7) is located on the visual indicator plate. To trip the circuit breaker, push the trip button which actuates a rod which in turn rotates the trip lever and tripper bar enough to release the main latch resulting in consequent tripping of the circuit breaker.

MAINTENANCE

The circuit breaker parts are designed and constructed so as to require a minimum of maintenance. However, it is recommended that a maintenance program be established that will provide for an inspection of the circuit breaker at least once every six months and immediately after operating to interrupt a fault.

An inspection should be made to determine the condition of the contacts, arc chutes, and electrical connections. This inspection can be made by measuring the voltage drop across the terminals of each pole. To obtain accurate readings, pointed terminals and a low, direct-current voltage should be used. The measured d-c drop between the ends of the terminals, at the rear of

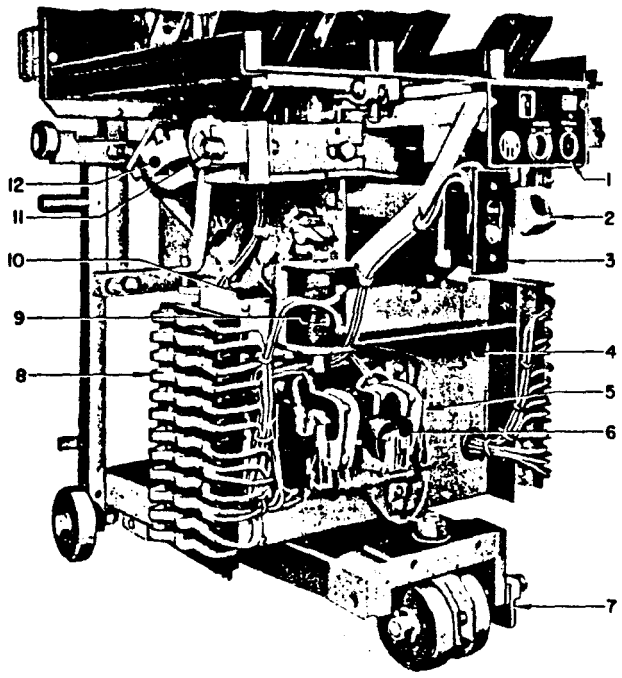


Photo 27670-RB

1	Manual Trip Button	7	Guide Bar
2	Manual Closing Lever	8	Control Separable Contacts
3	Test Switch	9	Shunt Trip Device
4	Control Panel	10	Auxiliary Switch
5	Resistor	11	Locking Bolt
6	Control Relay	12	Air Buffer Assembly

Fig. 7—Partial View Showing the Lower Section of the Circuit Breaker

the circuit breaker, should be less than 20 millivolts at rated current.

All mounting screws, fastening assemblies such as the operating mechanism and operating accessories, should be tight against their supporting members.

The main and arcing contacts can be exposed for inspection by removing the interphase barrier and arc chutes.

INTERPHASE BARRIER

To remove the interphase barrier, loosen two screws (9, Fig. 5) enough to allow them to be pushed down and out of engagement with the front of the interphase barrier. Then, lift the front and rear of the barrier slightly and slide it forward until the barrier is free of the circuit breaker.

ARC CHUTE

The arc chute (26, Fig. 4) can be removed by removing the screw fastening the lower lead connection (24, Fig. 4), lifting the spring clip, and pulling the arc chute forward along the blowout irons that support it.

CAUTION: THE ARC CHUTES ARE HEAVY. USE CARE IN HANDLING.

The arc chutes should be inspected whenever they are removed from the circuit breaker.

Discoloration or slight erosion of the interior does no harm. But, if the arc runners or arcing plates show signs of serious burning, or if the arcing plates, arc chute sides, or ends are cracked or broken, the arc chute should be replaced as a complete unit.

CONTACTS

Dirt or grease on the contacts should be removed by wiping them with a clean cloth saturated with carbon tetrachloride. Discoloration of the contact surface is not harmful.

The main contacts should not be filed or cleaned by using abrasives. Generally, the cleaning can be accomplished by closing and opening the contacts under no load conditions. The wiping action of the contacts dislodges any dirt or film. The above procedure also applies to the lower inner surfaces of the contact bridges where they bear against the lower terminals.

A moderate amount of pitting will not interfere with the operation of the arcing contacts. Occasionally, it may be necessary to remove small burrs with several light wipes of a fine file. Always follow the contour of the contacts and do not attempt to entirely eliminate the pitting. Prevent any filings from falling into the mechanism by covering it with a clean cloth. After filing the contacts, carefully remove the cloth and blow out any dust and particles that may have fallen into the mechanism with low pressure, dry air.

ADJUSTMENTS AND TESTS

The circuit breaker is adjusted, tested, and inspected before leaving the factory. Rough handling during transit or abnormal usage after installation may cause a change in some adjustments.

In making the adjustments and tests during maintenance periods, follow the sequence in which the adjustments and tests are listed in the following sections.

The adjusting and testing procedures described in the following sections apply only to the circuit breaker and its accessories. It is recommended that circuit breakers already installed in switchboards be removed and moved to a suitable test area.

REMOVING CIRCUIT BREAKER

The procedure for removing the circuit breaker from the switchboard is described under REMOVING CIRCUIT BREAKER in section INSTALLATION.

INTERPHASE BARRIER

The interphase barrier must be removed before making adjustments or tests. To remove the interphase barrier, proceed as described under INTERPHASE BARRIER in section MAINTENANCE.

ARC CHUTE

The arc chutes must be removed in order to inspect, maintain, or replace the contacts. The arc chutes should be removed from the circuit breaker and inspected as described under ARC CHUTE in section MAINTENANCE.

MECHANICAL ADJUSTMENTS AND TESTS

Contact Sequence (Refer to Fig. 8)

Slowly close the circuit breaker by using the manual closing handle and observe the position of the movable contacts relative to the stationary contacts.

The movable arcing contacts of the two outside poles should touch the stationary arcing contacts within 1/32 inch of the center pole. With the arcing contacts (1) just touching, the main contacts (3) should have a gap of 3/16 inch, plus 1/32 inch or minus 0, at "A".

The adjustment can be made by loosening the locknut on the spring stud (2) and then turning the adjusting nut in the required direction. Tighten the locknut after making any adjustment.

Main Contact Pressure (Refer to Fig. 8)

The stationary main contacts should be deflected 1/8 inch, plus or minus 1/32 inch, from the time the main contacts (3) just touch until the circuit breaker latches closed. This measurement is made at "B".

To adjust the main contact pressure, loosen set screw (7) for adjusting stud (8) and turn the stud in the required direction. Recheck the contact deflection at "B". Tighten set screw (7) when the adjustment is correct.

Contact Side Pressure (Refer to Fig. 8)

The side pressure at the pivot points of the movable bridges, movable arcing contacts, and stationary main contacts is a fixed pressure maintained by a compression spring assembly (13).

Should replacement of any of the above parts be required, adjustment to the correct pressure is made as follows:

1. Turn pivot screw (9) in until spring (10) is completely compressed.
2. Back off pivot screw (9) 1-1/2 turns.
3. Peen over end of pivot screw in slot of plug washer (12).

Tripper Bar

Inspect the tripper bar and associated parts for the following:

1. The tripper bar side play should not exceed 1/32 inch.
2. A clearance of from 1/4 to 3/8 inch must be maintained between the shunt trip tripper pin (3, Fig. 9) and tripper bar tripper (2, Fig. 9) at "A", Fig. 9.

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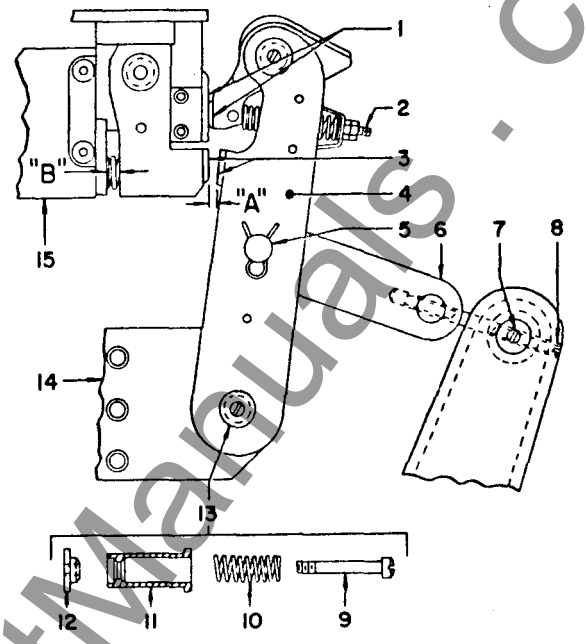

1	Arcing Contact	9	Screw
2	Spring Stud	10	Spring
3	Main Contacts	11	Spring Tube
4	Movable Bridge	12	Plug Washer
5	Pin, Bridge	13	Compression Spring Assembly
6	Closing Link	14	Lower Current Stud
7	Set Screw	15	Upper Current Stud
8	Adjusting Stud		

Fig. 8—Upper and Lower Current Studs and Bridge Adjustments

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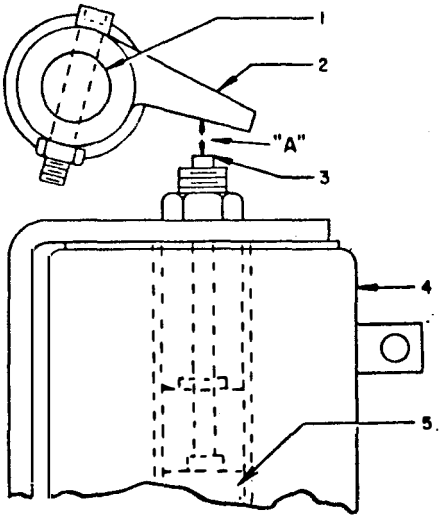
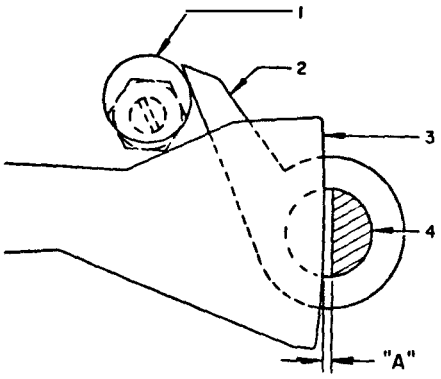


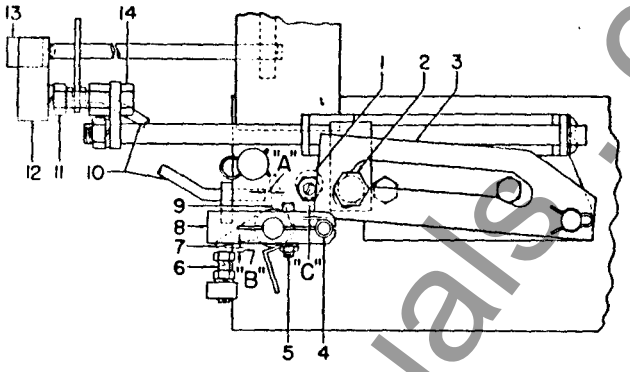
1 Tripper Bar
2 Tripper Bar Tripper
3 Trip Pin
4 Coil
5 Armature

Fig. 9—Shunt Trip and Tripper Bar Adjustments



1 Eccentric Stop (Right Hand)
2 Trip Rod Tripper
3 Main Latch
4 Tripper Bar

Fig. 10—Tripper Bar Overtravel Adjustment



1 Eccentric Stop (Right Hand)
2 Roller Stud
3 Trip Cam
4 Trip Pin
5 Locking Screw
6 Stop Screw
7 Tripper Bar Tripper
8 Trip Extension
9 Trip Rod Tripper
10 Manual Trip Rod
11 Locknut
12 Racking Bar
13 Manual Trip Button
14 Adjusting Screw

Fig. 11—Racking Trip Cam and Tripper Bar Adjustments

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Dwg. S-14756

3. Some clearance must be maintained between the manual trip rod (10, Fig. 11) and trip rod tripper (9, Fig. 11) at "A", Fig. 11. Check for this clearance by holding the tripper bar tripper (7, Fig. 11) against the stop screw (6, Fig. 11) and then pushing the manual trip button (13, Fig. 11). It should be possible to feel a slight inward movement of the trip button before the rod engages the trip rod tripper.

Tripper Bar Overtravel (Refer to Fig. 10)

The tripper bar should have a minimum overtravel of 0.002 inch after it reaches the tripping point. With the circuit breaker in the "OPEN" position, check for correct overtravel by holding the tripper bar in the fully tripped position (trip rod tripper must be against the right-hand eccentric stop) while the main latch is held as shown.

If adjustment is required, turn the right-hand eccentric (1) until the required clearance is obtained between the tripper bar face and the main latch (3) at "A". Tighten the locknut on the right-hand eccentric (1) after making any adjustment.

Tripper Bar Latch Bite (Refer to Fig. 11)

The tripper bar latch bite adjustment is accurately made at the factory. However, a check test can be made by placing a 0.145 inch feeler gauge between the stop screw (6) and tripper bar tripper (7) at "B". Hold the tripper bar tripper (7) against the feeler gauge and manually close the circuit breaker. The circuit breaker should remain closed when the tripper bar tripper is released. If the circuit breaker trips, adjust the stop screw (6) as described below. Following the above procedure, a 0.165 inch feeler gauge placed between the stop screw (6) and tripper bar tripper (7) should keep the circuit breaker tripped.

If adjustment is required, proceed as follows:

1. Turn stop screw (6) down to insure sufficient latch bite to close the circuit breaker.
2. Close the circuit breaker.
3. Turn stop screw (6) up slowly, with backward pressure on the tripper bar tripper (7) until the circuit breaker trips.
4. Turn stop screw (6) down 3 full turns and tighten the locknut.

Main Latch (Refer to Fig. 12)

The gap at "A", between the main latch hook (1) and main latch roller (2), should be 0.020 inch to 0.040 inch with the circuit breaker in the "OPEN" position. The plunger stop screw (8) at the bottom of the solenoid can be adjusted to produce the given dimension. Lowering the stop screw will increase the gap at "A" and vice ver . When the adjustment is correct, the stop screw (8) must be locked securely with its locknut.

Main Latch Reset Stop (Refer to Fig. 12)

The solenoid should be in its normal reset position. The reset stop point of the main latch (3) is adjusted by turning the eccentric stop (6) on the left-hand side of the mechanism. When the stop is adjusted correctly, there will be a clearance of 0.002 to 0.015 inch between the tripper bar (4) and main latch (3) at "B". Any clearance in excess of this measurement will cause unnecessary hammering of the latch against the latch surface of the tripper bar. Tighten the locknut on the eccentric (6) after making any adjustment.

"bb" Switch (Refer to Fig. 13)

The "bb" switch is a "precision snap switch" which is connected in series with the pick-up coil

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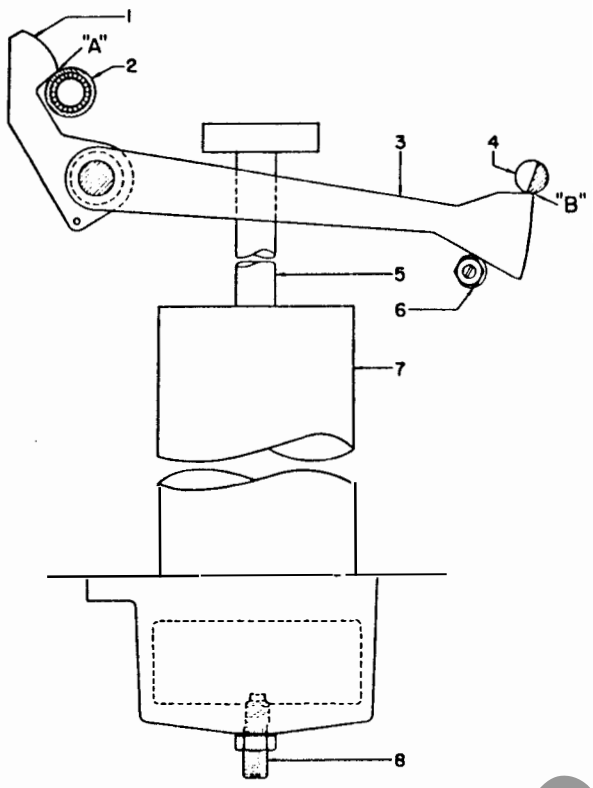


1 Main Latch Hook
2 Main Latch Roller
3 Main Latch
4 Tripper Bar
5 Solenoid Push Rod
6 Eccentric Stop (Left Hand)
7 Solenoid Plunger
8 Stop Screw

Fig. 12—Solenoid and Latch Adjustments

of the control relay. The "bb" switch contacts open and de-energize the relay pick-up coil the instant the solenoid reaches the end of its closing stroke.

To adjust the "bb" switch proceed as follows:

1. Loosen the locknut on adjusting screw (3).

2. Turn the adjusting screw (3) down, making sure the switch button (2) follows it, until the contacts open.

3. Turn the adjusting screw (3) up until the switch contacts close.

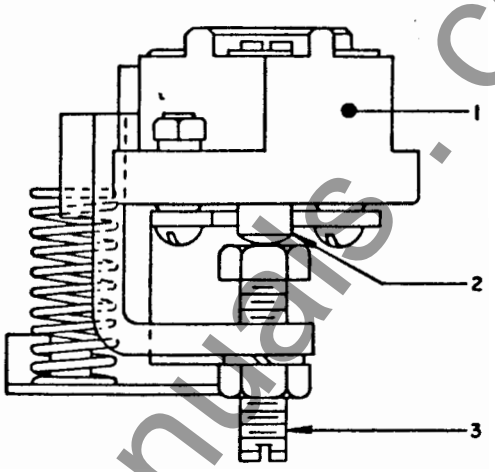
4. Add an additional 1/2 turn, in the direction to close the contacts, to insure sufficient switch contact pressure.

5. Tighten the locknut on the adjusting screw (3) when the adjustment is correct.

A circuit continuity means should be used to establish the adjustment at which the contacts open and close.

Auxiliary Switch Contacts

A circuit-continuity indicating means should be used to test the circuits of the auxiliary switch contacts at the point where they are wired to the control separable contacts. (Refer to the wiring diagram furnished with each installation.)



1 "bb" Switch
2 Button
3 Adjusting Screw

Fig. 13—"bb" Switch Adjustment

Manually close the circuit breaker and test for electrical continuity through the normally open "a" contacts.

Open the circuit breaker and test for electrical continuity through the normally closed "b" contacts.

Shunt Trip Tripper Travel

With the shunt trip armature (5, Fig. 9) held all the way up, there should be a clearance between the tripper bar stop screw (6, Fig. 11) and tripper bar tripper (7, Fig. 11) of not less than 0.222 inch and not more than 0.284 inch at "B", Fig. 11.

The tripper bar travel on circuit breakers having capacitor trip (shunt trip) is adjusted as described above.

Capacitor Trip

The capacitor should be tested for normal a-c trip. At normal voltage, the capacitor must have sufficient charge to trip the circuit breaker after the control voltage has been disconnected for 60 seconds.

Racking Trip Cam (Refer to Fig. 11)

CAUTION: DE-ENERGIZE THE PRIMARY CIRCUIT BEFORE CHECKING THE RACKING TRIP CAM ADJUSTMENT.

A check test for correct racking trip cam adjustment can be made with the circuit breaker in the switchboard compartment as follows:

With the circuit breaker in the "RACKED-OUT" position and the contacts closed, slowly rack the circuit breaker toward the "OPERATING" position. The circuit breaker should trip within 5 turns (maximum) of the racking crank. Rack the circuit breaker to the "OPERATING" position and count the number of turns necessary to trip the circuit

breaker while slowly racking it toward the "RACKED-OUT" position. The circuit breaker should trip between 2 and 5 turns of the racking crank.

If the circuit breaker does not trip within the recommended number of turns described above, remove the circuit breaker from the switchboard and adjust the racking trip cam as follows:

Check the gap at "C" with the racking bar (12) first racked against its stop in the "OUT" position and again when the bar is racked against its stop in the "IN" position. In both extreme positions of the racking bar, the gap at "C" should be 1/16 inch minimum. Adjustment to this dimension is made by loosening the locknut (11) on the adjusting screw (14) and turning it in the direction required to produce the given dimension. Tighten the locknut (11) after making any adjustment.

After making the above adjustment, rack the circuit breaker to a position that is half way between the "CONNECTED" and "RACKED-OUT" position. This half-way position is identified by the pointer of the position indicator being at the mid point between the "CONNECTED" and "RACKED-OUT" positions marked on the nameplate. Push the manual trip button (13) and observe that additional free motion of the tripper bar is present. Adjustment, to obtain free motion, is made by loosening the locking screw (5) and turning the trip extension (8). (NOTE: It may be necessary to remove the trip extension (8) from the tripper bar in order to turn it). Tighten the locking screw (5) after making any adjustment.

APPLYING CONTROL POWER

The circuit breaker is now ready for electrical tests. Provide an adequate source of supply for the test station, as a current load equivalent to 25 amperes at 125 volts a-c or d-c will be drawn by the circuit breaker closing coil during the closing cycle.

Move the circuit breaker so that it is within easy reach of the test station jack. Check to make sure that the control switch in the test station is in the "OFF" position. Remove the test jack from the test station compartment and install the test jack on the control separable contacts at the left-hand side of the circuit breaker. Make sure the marked contacts of the test jack meet the marked control separable contacts on the circuit breaker in direct relationship.

Energize the test station and proceed to close and trip the circuit breaker by means of either the test switch (3, Fig. 7) or the test station control switch.

Control Relay

The control relay operates to close the circuit breaker as described in section ELECTRICAL CLOSING. For test purposes, check the control relay for correct sequence of operation as follows:

Depress and hold the "CLOSE" button of the test switch (3, Fig. 7). The relay should pickup immediately and remain attracted to the magnet of the pick-up coil until the solenoid reaches the end of its closing stroke. At this point of the closing stroke, the pick-up coil is de-energized and the relay armature is attracted to the magnet of the holding coil. The armature will remain attracted to the magnet of the holding coil and all the 52X contacts will remain open until the "CLOSE" button is released. Upon release of the "CLOSE" button, the armature will return to its normal de-energized position and the 52X-4 contact will close.

If the control relay fails to interrupt the closing coil circuit upon completion of the closing stroke, or if the relay fails to operate when energized, recheck the "bb" switch adjustment.

REMOVING CONTROL POWER

This completes the electrical tests of the circuit breaker. De-energize the test station and place the control switch in the "OFF" position. Disconnect the test jack from the control separable contacts and replace the test jack in the test station compartment.

RE-INSTALLING CIRCUIT BREAKER

Before inserting the circuit breaker in the switchboard, replace the arc chutes, lower lead connections, and interphase barrier assembly. The arc chutes and interphase barrier are replaced by following the reverse of the procedure described under ARC CHUTE and INTERPHASE BARRIER in section MAINTENANCE.

Replace the circuit breaker in the switchboard as described under INSERTING CIRCUIT BREAKER in section INSTALLATION.

RENEWAL PARTS

It is recommended that sufficient renewal parts be stocked to facilitate proper maintenance and replacement of parts. The quantity of parts and items carried in stock should be based on the number of circuit breakers in service and previous operating experience.

When ordering renewal parts, address the nearest Sales Office of the I-T-E Circuit Breaker Company. Specify the type and serial number of the circuit breaker, description of part, and quantity required.

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

INSTRUCTIONS FOR R14 CONTROL RELAYS

GENERAL

For electrically operated circuit breakers, control relays with heavy duty contacts are generally required to control the relatively large currents drawn by the closing coils. Standard control switch contacts are not designed to handle the currents required for closing.

Inasmuch as all air circuit breakers are electrically trip free, the breaker contacts may be tripped to full open position at any point in the closing stroke of the solenoid. As long as the solenoid coil remains energized, the solenoid plunger will continue its motion to fully operated position regardless of whether circuit breaker contacts have been tripped open or not.

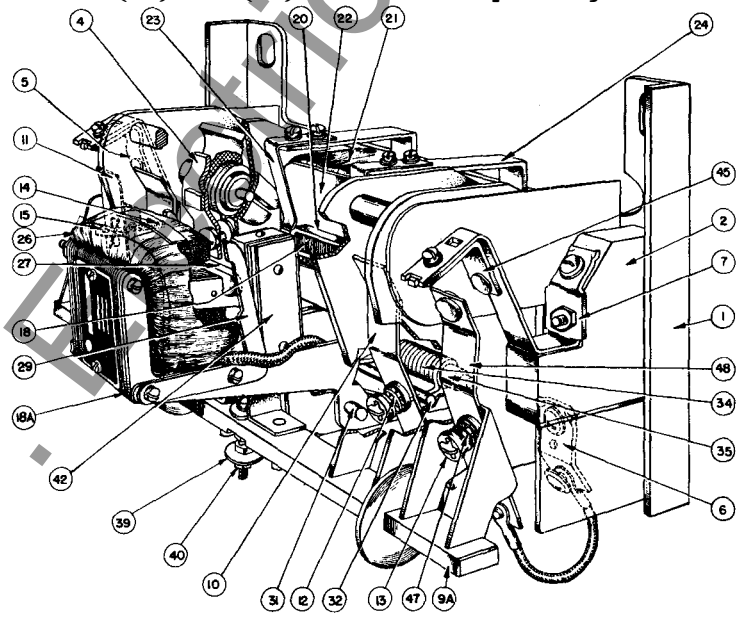
OPERATION

With the simplest form of control relay, having a single pick-up coil the relay contacts remain closed and the closing coil is energized as long as the control switch button is depressed. The solenoid cannot attempt to reclose until the control switch button is opened and reclosed so that there is no danger of reclosing against a short circuit. However, there is danger of burning out the closing coil and relay pick-up coil unless the control switch is of the momentary contact type and is depressed for a very short time only.

A non-repeat control relay as shown in Fig. 1 has an armature (42) on which the contacts, such as (10), (11) and (48) are mounted. This armature is attracted by either of two coils (21) and (26), but is normally held in a neutral position by a spring (34). When both coils are energized at the same instant by the control switch, the stronger or pick-up coil (21) attracts the armature (42) and energizes the circuit breaker closing coil through the relay contacts. At the end of the solenoid plunger stroke, a "bb" switch opens the pick-up coil circuit and allows the weaker or holding coil (26) to attract the armature (42). The armature opens the relay contacts as it passes to the holding coil magnet (18A). The armature remains attracted to the holding coil (26) as long as the control switch button is depressed. The relay cannot be made to attempt another closing operation until the control button is released.

It should be noted that the trip free relay described above must be used with a momentary contact control switch, because the solenoid plunger may return to the open position, thus closing the "bb" switch and causing the momentarily rated pick-up coil (21) to burn out.

For use with maintained contact control switch, an auxiliary contact (45) is added to the non-repeat control relay, and is placed in series with the pick-up coil (21). This auxiliary contact is closed when the armature (42) is in the neutral position (control switch contact open), closed when armature (42) is attracted to pick-up coil (21) (breaker closing) and open when armature is attracted to holding coil (closing operation complete, "bb" switch open or closed, control switch contact closed). In this way the pick-up coil (21) is protected against burn-out when the control button is maintained.



1	Relay base (front connected)
2	Stationary contact unit (a-c or d-c)
4	Stationary contact (blowout)
5	Stationary contact (float)
6	Lower terminal
7	Stationary contact bracket (aux. and float)
9A	Contact bar
10	Blowout contact (moving)
11	Float contact (moving)
12	Spring (blowout)
13	Spring cup
14	Spring (float contact)
15	Spring link (float contact)
16	Spring anchor (float contact)
18	Magnet (pick-up)
18A	Magnet (holding)
20	Shading ring (pick-up)
21	Coil (pick-up)
22	Coil washer (pick-up)
23	Coil clip (pick-up)
24	Coil clip support (pick-up)
26	Coil (holding)
27	Shading ring (holding)
29	Bracket (holding coil)
31	Armature pin
32	Spring pin
34	Spring (adjusting)
35	Spring bushing (adjusting)
39	Lever (adjusting)
40	Eccentric nut (adjusting)
42	Armature
44	Adjusting bracket (armature)
45	Stationary contact (auxiliary)
47	Spring (auxiliary contact)
48	Auxiliary contact (moving)

FIG. 1—R14 CONTROL RELAY—FRONT CONNECTED—TRIP FREE

An earlier type of non-repeat relay omitted the float contact and had holding coils designed only for momentary service. These relays were limited to momentary contact control to avoid burn-out of holding coil and failure of pick-up coil on reclosing of solenoid switch.

ADJUSTMENTS

To adjust the position of the armature (42), loosen two adjusting nuts (40). Turn the nuts until the position of the lever (39) is such that the armature (42) will move to the pick-up magnet (18) when both coils (21) and (26) are energized simultaneously. When the pick-up coil (21) is de-energized, the armature (42) should move to the holding magnet (18A).

RENEWAL PARTS

Holding coil (26). Detach and identify leads for coil (26). Remove screws holding two brackets (29) to coil magnet (18A). Shift magnet (18A) to remove shading ring (27) and holding coil (26). Replace coil and assemble by reverse operations.

Pick-up coil (21). Detach and identify leads for coil (21). Remove bottom nut for adjusting lever (39). Remove two screws holding side frames of armature (42) to contact bar (9A). If used, disconnect float switch spring link (15). Remove three screws for holding coil magnet (18A) and remove coil (26). Remove both coil clips (23). Pull armature (42) forward and remove pick-up coil (21). Replace coil and assemble by reverse operations. Refer to ADJUSTMENTS for positioning of armature (42).

Moving blowout contact (10). Turn contact spring cup (13) ninety degrees to remove spring (12). Remove inside spring cup. Remove screw attaching contact conductor to its lower terminal (6), then remove blowout contact (10). Replace contact and assemble by reverse operations. Note. Tighten screw securely which attaches conductor to terminal.

Stationary blowout contact (4). Remove two screws holding side frames of armature (42) to contact bar (9A) and pull entire bar assembly forward to remove stationary blowout contact (4). Replace contact and assemble by reverse operations. Note. Securely tighten attaching screw for contact (4). When replacing two screws holding side frames of armature (42) to contact for (9A) make certain plate washers (if used) are installed before tightening screws.

INSTRUCTIONS FOR AUXILIARY SWITCHES TWO AND SIX CONTACTS

DESCRIPTION

The six contact auxiliary switch as shown below is a front connected or back connected switch with double break rotary contacts. It is made in two or six contact units, and is entirely enclosed in a case of molded insulating material. The cover is easily removed to expose the switch contacts. These contacts are assembled on a shaft in any desired combination of contacts, closed when the breaker is closed "a," or closed when the breaker is open "b."

Any contact can be removed from the shaft and rotated to change an "a" contact to a "b" contact, or a "b" contact to an "a" contact. The 12 point star-wheel hole in the contact also permits some adjustment in timing, both by rotating contact on insulating sleeve for 30° adjustments, and by reversing on shaft for intermediate 15° adjustments. Punch marks show whether contact faces in standard or reversed direction.

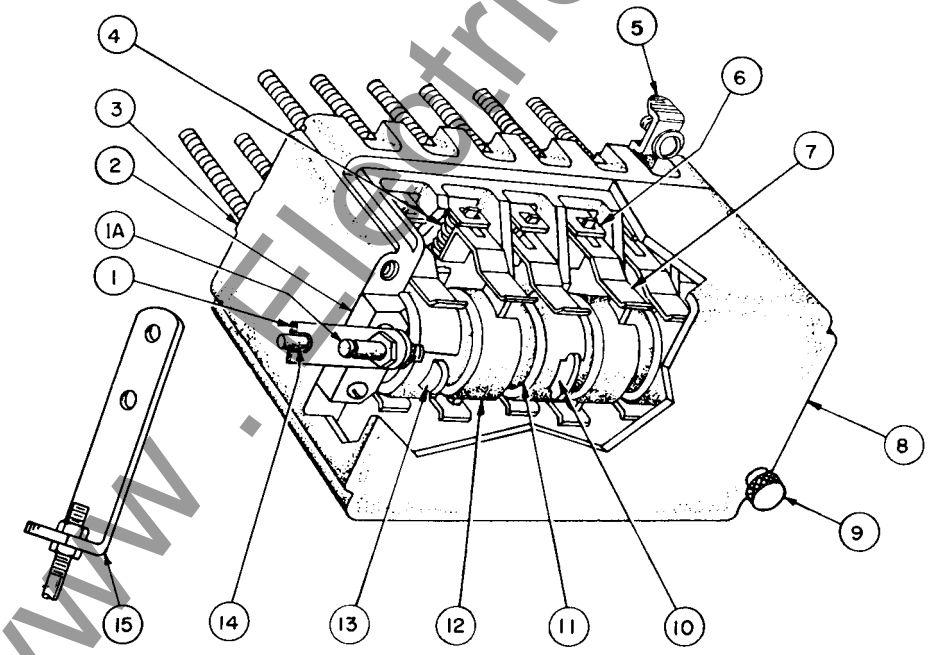
The switch contacts are rated for continuous current and interrupting:

125 volts dc—10 amperes
250 volts dc— 5 amperes
250 volts ac—10 amperes
440 volts ac— 5 amperes

For higher voltages and highly inductive circuits, two contacts are sometimes placed in series.

CONSTRUCTION AND OPERATION

A molded base (3), carries the stationary contact support (6), on which pivots the stationary contact (7). Contact pressure is maintained on the rotating contacts (10), and (13), by the contact spring (4). A molded bearing (2), is screwed to each end of the molded base (3). The shaft (14), rotates in these bearings. For the contact construction shown, an insulating sleeve covers the shaft (14), between the bearings (2). The rotating contacts (10), and (13), slide over this sleeve through a star type of opening. This allows the contacts to be positioned on the shaft in various relations with respect to each other. The rotating contact holder (12), and the bushing (11), provide insulation between the contacts. The short contact (13), has a short contact face and is used to interrupt the circuit during the first part of the crank movement. The long contact (10), has a long contact face and is used to delay the interruption of the circuit. A crank (1), is clamped to the end of the shaft (14). This crank has a pivot stud which is attached to the link (15), shown. This link is constructed for proper length between the operating device and the



1	Crank
1A	Crank stud
2	Molded bearing
3	Molded base (6 contacts) (shown)
3A	Molded base (2 contacts)
4	Stationary contact spring
5	Front connected terminal (when used)
6	Stationary contact support
7	Stationary contact
8	Molded cover (6 contacts) (shown)
8A	Molded cover (2 contacts)
9	Cover screw
10	Rotating contact (long)
11	Bushing
12	Rotating contact holder
13	Rotating contact (short)
14	Shaft with insulation (6 contacts) (shown)
14A	Shaft with insulation (2 contacts)
15	Link head

S-11558

switch so that the crank (1), rotates through ninety degrees, thereby changing the position of the contacts.

ADJUSTMENTS

To replace or change the position of the contacts, remove the two cover screws (9), and slide the molded cover (8) off the molded base (3). Remove the four screws holding the two molded bearings (2), to the molded base (3). It may be necessary to disconnect the link from the crank (1), by removing the cotter on the pivot stud of the crank. The shaft (14), can be removed from the molded base (3), and the contacts will slide off the shaft. For the construction shown, be sure to replace the rotating contact holder (12), and the bushing (11), in a uniform order. To replace the stationary contact (7) remove the entire switch from support. Remove the contact shaft assembly, and remove nuts and bushings on studs.