LOW VOLTAGE SWITCHGEAR

INSTRUCTIONS

TYPE KB
CIRCUIT BREAKERS

(INSULATED BASE)

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

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SUPERSEDES IB-1450

INSTRUCTIONS FOR INSTALLATION, OPERATION AND MAINTENANCE OF TYPE KB CIRCUIT BREAKERS

INTRODUCTION

This instruction book should be read and its contents followed for the installation operation and maintenance of the type KB circuit breakers. This book should be filed in a convenient place together with all information relative to switchgear. By following these instructions, the operator can prolong the life and usefulness of the equipment.

Type KB circuit breakers were designed in feeder circuits and also as main circuit breakers on medium capacity systems, particularly where frequent operation may be expected.

GENERAL MOUNTING CONSTRUCTION

Switchboard Mounting, generally consists of mounting the circuit breaker in a switchboard framework. A flat steel sheet or a formed door is then placed over the front of the breaker compartment.

U-Re-Lite, is a term applied to a circuit breaker enclosed within a steel box. The contacts may be closed or opened by a handle on the outside of the enclosure. The box may be easily removed for inspection of the apparatus.

Pull-Box U-Re-Lites, are supported on a back box so that they can be secured to a wall or column. The pull boxes are provided with knockouts for standard wiring conduits.

Panel Mounted U-Re-Lites, are when the circuit breaker base or mounting frame is secured to a panel with the studs extending through for back connection.

TRANSPORTATION

All types of KB switchgear prior to shipment, are carefully tested, inspected and crated at the factory. Every crate is plainly marked at convenient places with crate number and position. When size or other reasons make it necessary to divide the equipment for shipment, the unit number of the particular equipment enclosed is also marked on the crate, along with its weight.

Weights. Approximate net weights of Type KB dead front Circuit Breakers as follows:

3 Pole, 3 Coil Electrically operated	183 lbs.
3 Pole, 3 Coil Manually operated	156 lbs.
2 Pole, 2 Coil Electrically operated	154 lbs.
2 Pole, 2 Coil Manually operated	127 lbs.

Immediately upon receipt of the switchgear an examination should be made for any damage, or loss sustained during transportation. Check the contents against the packing list before discarding any packing material. If any shortage of material is discovered, notify the nearest I-T-E Circuit Breaker Company Representative at once.

If it is found that the shipment has been damaged through indications of rough handling, claim for damage should be filed at once with the carrier, and the I-T-E Circuit Breaker Company promptly notified. Information as to the damaged parts, part number, crate number, purchase order number, etc., should accompany the claim. The I-T-E Circuit Breaker Company is not responsible for damage after delivery of goods to the carrier. However, if the company is notified of such claims, there are forms available to lend assistance in securing any adjustment.

UNPACKING

Switchboard Type. Switchboard circuit breakers are assembled and shipped in stationary structures which should be moved into position by means of rollers under skids provided for this purpose. Remove all outer crating and bottom skids after units have been moved to the desired location.

U-Re-Lites (Pull box mounted) are shipped in separate crates and are blocked in by supporting members. Felt and heavy paper protect the surfaces of the box. The breaker rests in a wooden cradle at the bottom of the crate and is braced by cross pieces to the side of the crate. In removing the circuit breaker from the crate, a rope sling should be fastened to each block at each end of the cradle. When removing the circuit breaker from the cradle, the cover should be removed and the panel clamps removed. The cover is taken off by releasing the toggle latch at the bottom and unhooking the cover from the frame. The circuit breaker may then be lifted from the pull box frame and handled by the steel supporting frame carrying the contact arm shaft.

Warning: Do not lift the circuit breaker by the phenolic handle or by the molded cross support under the arc chutes.

Panel Mounted U-Re-Lites. Panel mounted U-Re-Lites are shipped in crates with their panels vertical. They are braced by padded blocking boards, and covered by heavy paper. To make unpacking more convenient the crate is stenciled so as to turn the panel horizontal before opening. Knock crate apart and remove breaker, by use of a rope sling. The studs on the rear of the panel should be used for lifting along with the steel support on the front of the panel.

ACCESSORIES

Some of the circuit breaker devices require supplies and accessories. If these are necessary, they will be found securely attached to the apparatus. Care should be taken to see that they are removed and held in stock for the installation of the circuit breaker.

STORAGE

If it is found necessary to store the equipment for any length of time, the following precautions should be taken.

(1) Uncrate the breaker, examine and make sure no loose parts are missing or left in the packing material.

(2) Cover any part of the circuit breaker susceptible to rust with heavy oil or grease.

(3) Store in a clean dry place with moderate temperature and cover with heavy wrapping paper to prevent deposits of dirt or foreign matter from settling on movable parts and electrical contact surfaces.

SAFETY PRECAUTIONS

Before making any adjustments or replacements, make certain that all control circuits have been DE-ENERGIZED. If circuit breaker is drawout pantograph mounted in a switchboard, withdraw breaker completely or to test position. If the circuit breaker is rigidly mounted, DE-ENERGIZE bus. Disconnect cables from leads, if there is a power source on the load side.

INSTALLATION

Switchboard Type. Before attempting any installation operations consult all drawings furnished by the I-T-E Circuit Breaker Company for the particular order. These drawings are in the form of floor plans, conduit locations, front and side views, primary and secondary wiring and a detailed summary of the equipment furnished.

Switchboards consisting of multiple units are usually shipped on two 4 inch channels. Unless otherwise specified, the channels are shipped for preliminary installation. The purpose of these channels when used, is to reinforce the switchgear for shipment and provide means of moving the section into position.

It is recommended that a minimum space of 28 inches be provided front of the frame to permit withdrawal and insertion of removable elements into the stationary structure as well as the manual and electrical operation of the type KB Circuit Breakers.

U-Re-Lites (Pull box mounted). In making the installation of the pull box mounting type, the circuit breaker should be removed from the pull box to facilitate mounting and pulling of cables. The circuit breaker is held in the welded pull box frame by four angle clips (found fastened near each corner of panel). Care should be taken, in removing the breaker to eliminate possible damage to the relay, the auxiliary switch or the overcurrent trip devices.

With the circuit breaker removed, the pull box should be mounted with the cover latch at the bottom using four ⅜ inch diameter bolts. Care should be taken to see that the supporting surface is even and approximately vertical. Protect the breaker from dirt or damage during installation of pull box and cables.

When the pull box is mounted properly and the cables are pulled into position the circuit breaker and panel may be lifted into its proper position. The bottom of the panel is equipped with skids for panel protection and location in the frame. The circuit breaker should then be placed in the frame and securely fastened with the previously mentioned angle clips. The pull box is equipped with side plates that may be removed for connection of cables.

U-Re-Lites (Panel mounted). Panel mounted U-Re-Lites are furnished either with the slate panel or for mounting on customer's panel (slate or steel). The method of installing a panel mounted U-Re-Lite is similar to (pull box mounted). The front cover should be removed to facilitate the mounting operation. The supporting framework either pipe or steel should be prepared in accordance with working drawings furnished with the circuit breaker device.

WIRING

Manually Operated Type. The wiring of the main circuits should be in exact accordance with the diagram accompanying the device. Care should be taken to see that the line cables are connected to the upper studs. Proper solder lugs are furnished with the pull box mounted type of U-Re-Lite. The pull box or mounting frame must be properly connected to a good ground. A lug is provided on the left hand side of the pull box for this purpose.

Electrically Operated Type. In addition to the main wiring mentioned above the control circuits must be installed in exact accordance with the diagram. Adequate size wires should be used in the control circuits to insure proper operation. Provision is made for grounding the solenoid frame of electrically operated breakers.

GENERAL CIRCUIT BREAKER CONSTRUCTION

The type KB circuit breaker shown in Fig. 1 is a standard 3 pole electrically operated dead front construction. These breakers may be of 2 to 4 pole construction depending on the application. On 4 pole breakers, an added pole is necessary. For 2 pole construction the center pole is omitted.

Each pole is an assembly of a movable main contact with its protective arcing contacts. The contacts close against the upper terminal block and are connected to the lower terminal by flexible conductors. The moving contact structures are mounted on a heavy square insulated connector bar which assures that all poles will open and close at the same time. The contacts operate in the following sequence; the arcing contacts separate after and close before the main contacts.

The arc chutes surround the main and arcing contacts and are supported by a molded cross bar and held in place by a retainer screw. The arc chutes are readily removed for inspection of the contacts. Interphase insulation is provided between arc chutes.

The closing and latching mechanism enclosed within a housing, is held to a steel supporting frame which is bolted to the panel. The closing force is transmitted through a short insulating link directly to the middle of the contact connector bar. A shelf of the supporting frame affords a mounting support for the shunt trip and undervoltage trip when used.

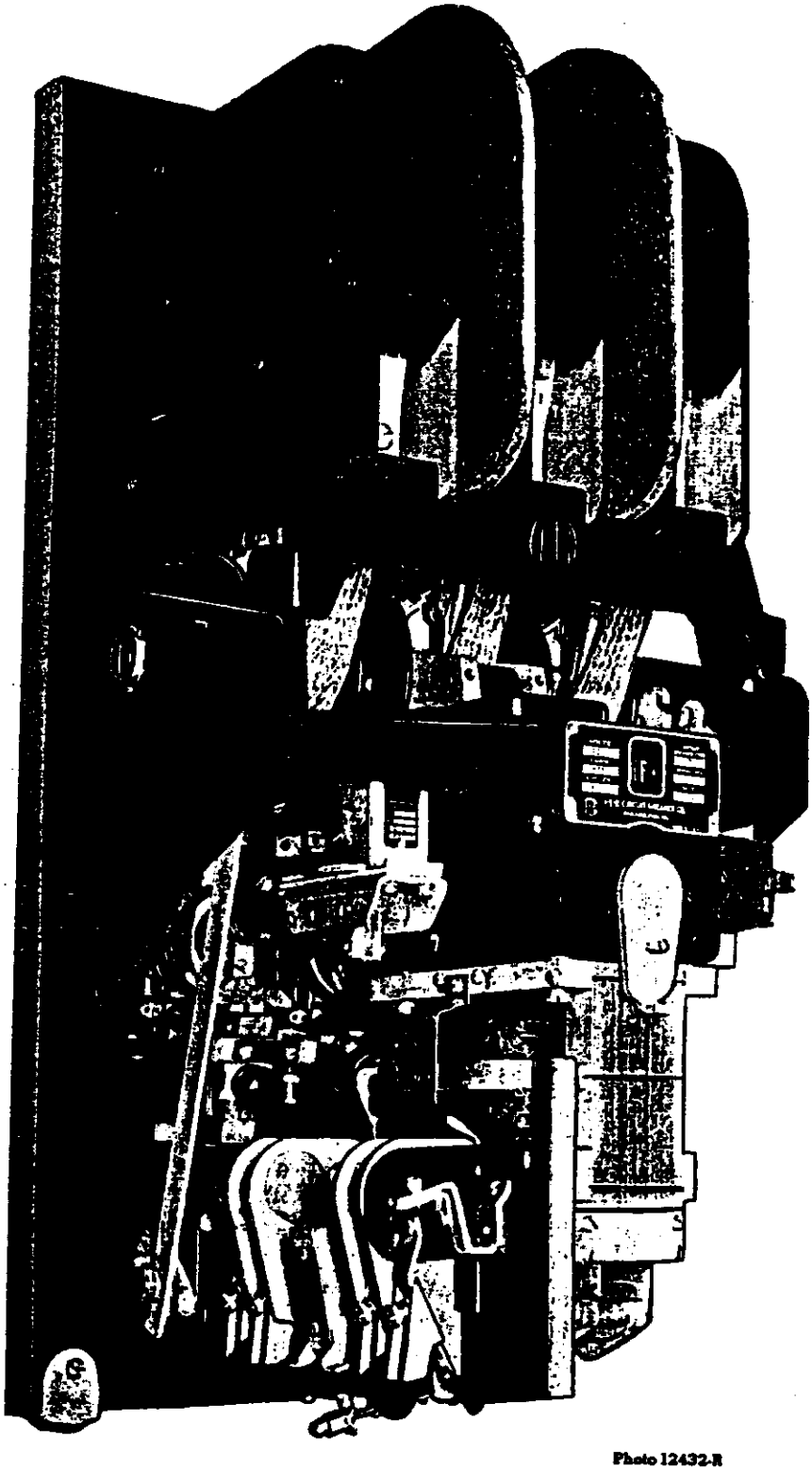

Photo 12432-R

Fig. 1—TYPE KB CIRCUIT BREAKER
3 POLE, 3 COIL, ELECTRICALLY OPERATED
Dead Front Mounting

Protective devices such as the dual magnetic overcurrent trip and the thermomagnetic overcurrent trip are mounted below the contact structure of each pole. When used, the reverse current trip is mounted in the center for 2 pole and outside the right hand pole for 3 pole circuit breakers. The above protective devices act directly on the breaker tripper bar to trip the breaker.

The solenoid operating mechanism for electrically operated breakers is attached directly below the closing and latching mechanism. Circuit breakers operated by a-c current are provided with a suitable rectifier mounted on the back of the panel or remote from the breaker.

The circuit breakers are mechanically trip free so that it is impossible to hold them closed on a fault. The interrupting rating for these breakers is 25,000 RMS amperes.

CONTACTS

Main.

The moving main contacts as shown in Fig. 2 are two in number and are mounted on individual contact arms. A silver alloy contact face is attached to the main contact lever to which a flexible conductor has been secured. The levers pivot about a bearing pin which is held in position by pressure against the contact arm through a spring link and a compression spring. While the breaker is open, the lower end of the contact levers bear against the stationary main contact. One spring and its spring link are associated with each pair of contact levers. The stationary main contact is a silver alloy block fastened to the upper current stud and is so positioned to engage the moving main contacts when the breaker is closed.

Arcing.

Two moving arcing conductor levers, pivot about a yoke pin passing through flanges of the contact arm. This pin is held in place by a "U" shaped spring as shown in Fig. 2. One compression spring bears against these contact levers, so that spring pressure is divided between both levers. The moving contacts are attached to their respective conductor levers by socket head screws. The center stationary arcing contact is connected to the upper stud through the blowout coil assembly.

The correct sequence requires that the contacts close in this order; first the arcing contacts, then the main contacts. They should open in the reverse sequence but the quick action prevents observation.

Maintenance. The main contacts as well as the arcing contacts (Fig. 2) should be inspected at least once every six months, and especially after each short circuit. The interphase barriers and arc chutes must be removed before making any examination and replacement of contacts.

The main contacts should not show any serious burning. If they do, the arcing contacts may be in bad condition, or the circuit breaker may be opening at currents beyond its interrupting capacity. A very slight burning or "pitting" does no harm. On the arcing contacts, a moderate amount of burning is to be expected, which does not interfere with proper performance. Occasionally it may be necessary to dress-up the arcing contacts. This should be done sparingly with light wipes of a fine file or fine sandpaper. Take precautions to prevent filings and abrasive particles from falling into the mechanism. Contacts which are badly burned should be replaced. The conductors should be inspected to see that they are not breaking or being pinched. There should be no kinks in them and bends should not be sharp.

Overheating. The standards for circuit breakers permit a temperature rise at the terminals of 30°C. above an ambient or room temperature of 40°C. An additional 15°C. is permitted in enclosed switchgear.

On the Fahrenheit scale, a temperature rise of 54°F. above an ambient or room temperature of 104°F. is permitted.

One way to detect a possible indication of overheating is to take a temperature reading. The thermometer bulb should only touch the metal while covered with putty. A reading is taken as soon as the temperature stops going up.

INDEX	DESCRIPTION
1	Panel (switchboard mounting)
2	Mounting screw (interphase barrier)
3	Stationary arcing contact (center)
4	Blowout coil
5	Moving arcing contact
6	Arcing contact pin
7	Stud (line)
8	Stationary main contact
9	Moving main contact, lever and conductor
10	Insulated connector bar
11	Mounting screw (operating mechanism)
12	Stud (load)
13	Series trip coil
14	Tripper bar
15	Screw (latch adjustment)
16	Thermomagnetic overcurrent trip
17	Terminal block
18	Auxiliary switch
19	Solenoid
20	Plunger stop pin
21	Solenoid switch (bb)
22	Solenoid coil retainer (R.H.)
23	Manual operating handle
24	Solenoid coil
25	Mounting screw (solenoid)
26	Operating mechanism
27	Shelf and support frame
28	Shim (if needed)
29	Insulating link
30	Buffer block
31	Contact arm cap
32	Contact adjusting eccentric cam
33	Set screw (adjusting cam)
34	Arc chute support (moulded)
35	Main contact spring
36	Contact arm
37	Screw (arc chute)
38	Moving arcing contact support and conductor
39	Main contact pivot pin
40	Spring retainer (arcing contact pin)
41	Arcing contact spring
42	Arc chute
43	Interphase barrier
44	Flat front sheet (shown)

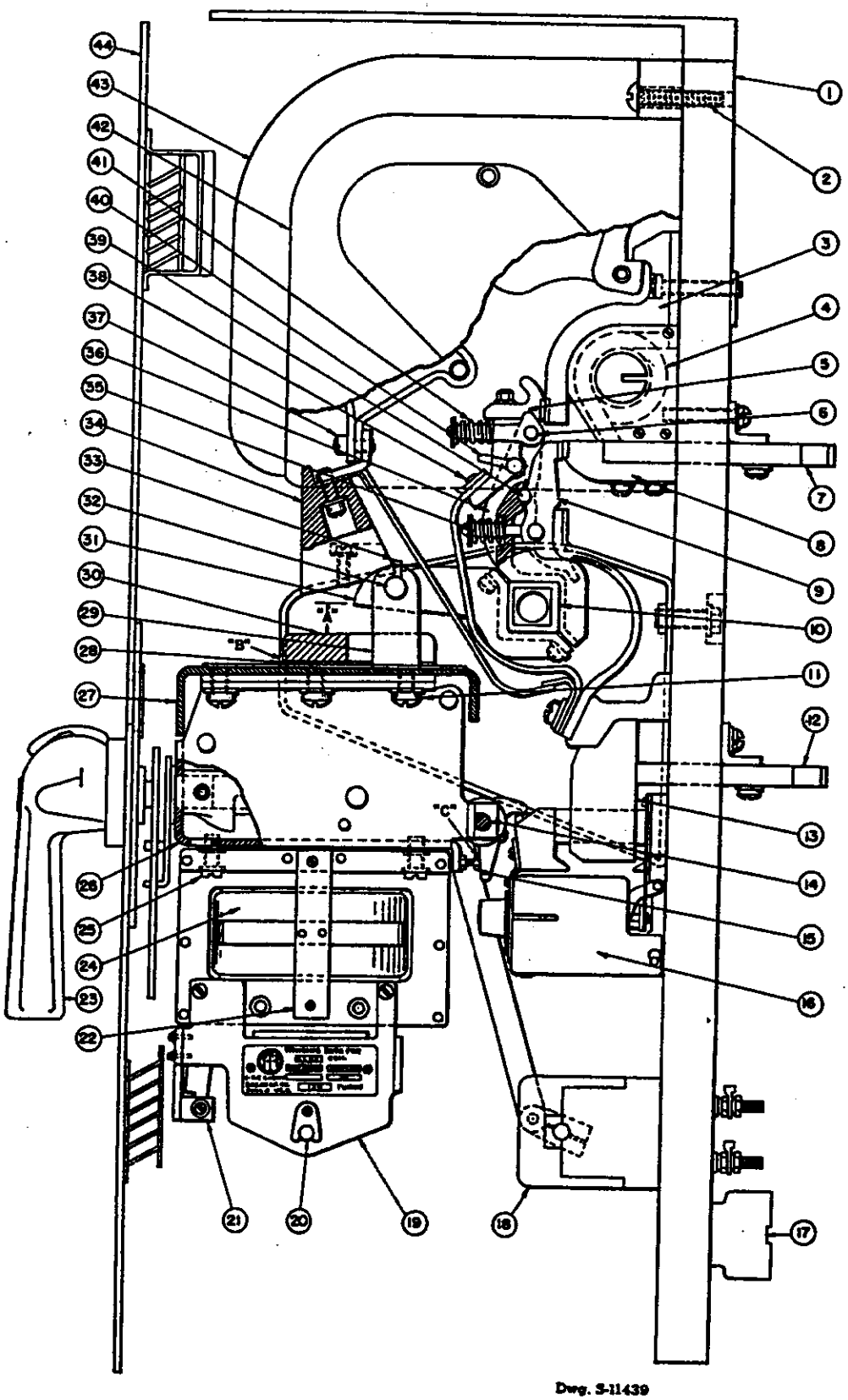

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Fig. 3—TYPE KB CIRCUIT BREAKER
Side Section View—Dead Front Mounting, Electrically Operated

Another method is to take a meter reading of the millivolt drop across the contacts. To obtain accurate millivolt drop readings use a suitable millivoltmeter, with pointed test prongs. A low d-c voltage source is recommended to supply current for the test current circuit. The maximum millivolt drop across the circuit breaker contacts should be 3 millivolts per every 100 amperes passed through these contacts.

A source of overheating is often caused by a loose connection between the circuit breaker and the bus or a loose bolted or soldered joint at the cable terminal. It is important not to let loose joints feed heat into the breaker.

When a circuit breaker is not operated for long periods of time, a high resistance oxide or sulphide may form on the contact surfaces which results in overheating. To burn off this high resistance film, the circuit breaker should be opened and closed several times under load at regular inspection periods.

Contact Adjustments. The contact adjusting eccentric cam (Fig. 2) must be properly adjusted after the mechanism is removed for any reason. Close the breaker manually until the main contacts just touch.

Measure the distance between the buffer block and the extreme outside end of the contact arm cap at "A". Complete the closing motion until operating mechanism is latched closed. Repeat measurement at "A ' which should show 1/16 inch minimum additional travel of contact arm cap. If adjustment is needed, trip breaker, loosen two set screws, turn eccentric cam and tighten its set screws. Close breaker and check distance as specified. Be sure set screws are tight after attaining adjustment.

Contact Lever Bar Replacement (Fig. 2). The entire moving contact assembly, with its associated flexible conductors and supporting insulated contact lever bar may be removed from the breaker as a unit. First disconnect the flexible conductors from the lower terminals. Remove the eccentric cam between the operating arm and insulating link. Disconnect the lower end of the opening springs from the stud inside the frame side plates, and remove the contact bar bearing screws. These bearing screws are secured by special washers and locking nuts. (Previously bearings were flanged plugs.) Before replacing the bar, be sure each contact arm is held securely by the socket head clamping screws. These bearings are properly lubricated at the factory and will not need attention for a long time. If lubrication should be necessary, use a small amount of oil or light graphite that will not run over the frame and collect dust.

Contact Opening Spring Replacement (Fig. 2). The contact opening spring has a link at one end which is hooked on a groove stud inside the frame side plate. The other end slips over a hook on the auxiliary arm.

Arcing Contact Replacements. The stationary and moving arc contacts as shown in Fig. 2 can be removed by withdrawing two screws each. The supporting levers carrying the moving arc contacts are also removable. Remove these supporting levers by withdrawing a cotter pin, spring link and pin retainer, that holds the pivot pin. The flexible conductors are brazed to the levers. The arcing contact spring is cadmium plated for identification. Do not substitute any other spring.

Main Contacts Replacements (Fig. 2). The stationary main contact is held in place by two screws to the upper terminal stud. The moving main contacts are removed by pulling the cotter pin from the spring link, and detaching the flexible conductors from the coil terminals. The main contact spring is plated black for identification. Do not substitute any other spring.

ARC CHUTE AND INTERPHASE BARRIER

The arc chute is supported by an insulated front support and locked in place by a screw at the front (Fig. 2). The arc chute confines the arc within a limited insulated space. Magnetic blowout irons placed on the outside of the insulating barriers are magnetized as the breaker opens.

The magnetic field thus set up, forces the arc into an extinguishing chamber. Insulating barriers within the chamber cool the arc, create a turbulent gas condition and provide a cooling draft across the arc core.

A stationary arcing horn in the arc chute is electrically connected to the lower terminal side of the contacts by a conductor with its attaching screw.

Before putting back the arc chutes after inspection or replacement of main or arcing contacts, inspect the arc chutes for any loose, broken or burned parts. Liners and side plates burned away in severe service particularly on d-c circuits, require replacement by a new arc chute. The arc chute should be so inserted to allow the insulating barriers to hook under the extrusion of the rear stationary arcing horn as shown in Fig. 2. Be sure front screw is tightened securely.

OPERATING MECHANISM

The operating mechanism shown in Fig. 2 includes the closing cams, trip free toggles, latches and tripper bar in a single removable unit. The engagement of contacts for all poles are actuated through this mechanism. Six screws hold the operating mechanism to the steel supporting frame.

Trip Free Operation. The circuit breaker is mechanically trip free.It is impossible to hold the breaker closed on a fault on which the overcurrent protective device is designed to operate.

As soon as the contacts touch under such conditions, the trip coil energizes the trip mechanism, the toggle is released and the partly stressed opening springs return the contacts to the fully open position.

Breakers equipped with undervoltage or reverse current trip are trip free under conditions against which these devices give protection.

Latch Reset Adjustment (Fig. 2). Should the breaker latch fail to reset after tripping, add a thin insulation shim (approx. .015 inch) under the buffer block for the contact bar operating arm at point "B"

Latch Bite Adjustment (Fig. 2). A stop screw for the tripper bar controls the latch bite. This cap screw is threaded into the back flange of the frame shelf. If the circuit breaker does not close properly due to slipping of latch, adjust the tripper bar stop screw so that breaker will trip with .045 inch feeler gauge at point "C" and will hold with .035 inch. Secure stop screw with its locknut.

MANUAL OPERATION

The circuit breaker may be either manually or electrically operated, or a combination of both.

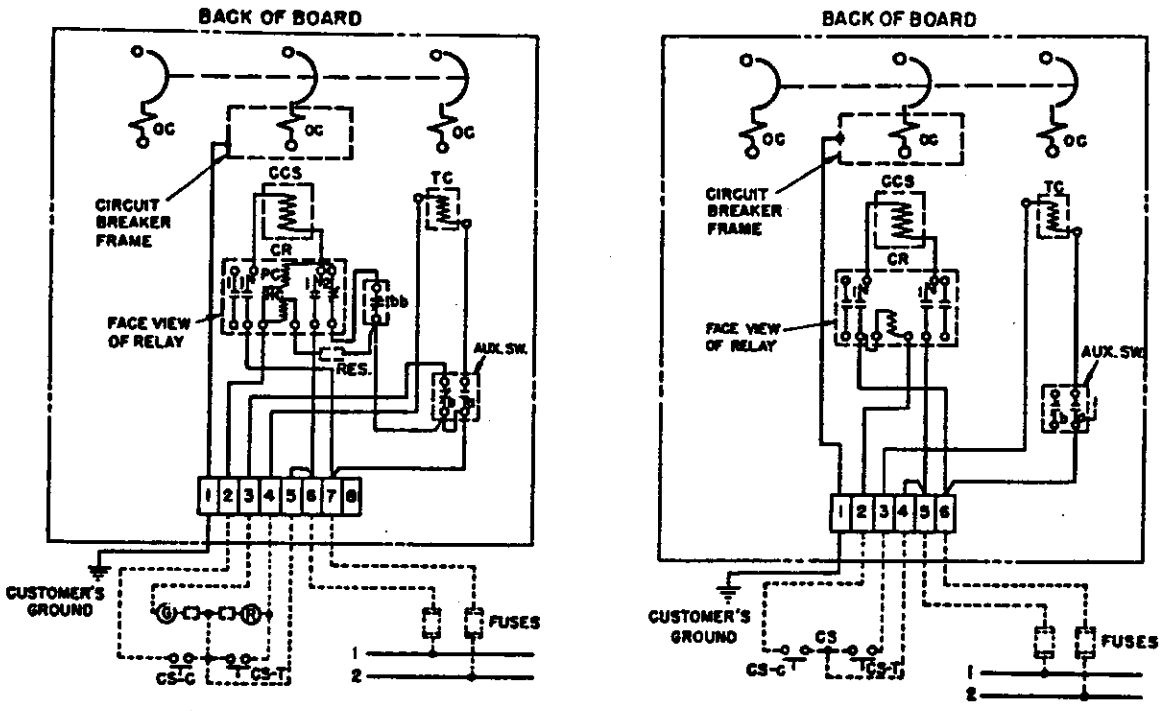
To close the breaker, the operating handle (Fig. 2) is turned clockwise about 90 degrees. This motion should be smooth and quick and requires little effort. When the breaker has closed, the handle when released returns automatically to a vertical position.

To trip the breaker, the handle is turned counter-clockwise about 45 degrees. A visual indicator is located above the operating handle, indicates the "ON" and "OFF" position of the contacts. The proper motions for operating the breaker are clearly indicated on a nameplate beneath the operating handle.

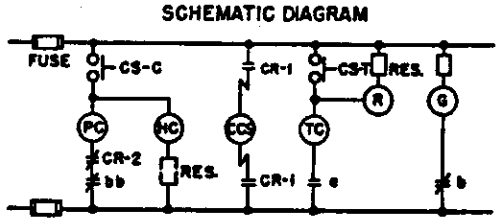
ELECTRICAL OPERATION

Solenoid A. C. The solenoid assembly as shown in Fig. 2 when circuit breaker is electrically operated, is attached to the underside of the mechanism housing by four mounting screws. Four springs have been placed between the solenoid magnet frame and the mechanism housing to absorb the shock of the plunger at the end of the closing stroke.

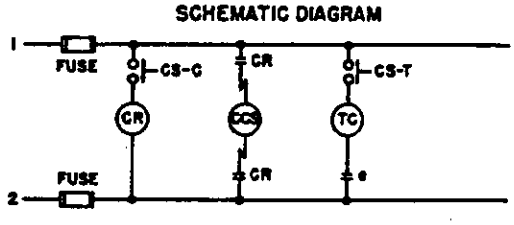
A control relay as shown in Fig. 4 mounted on the left side of the solenoid for electrically operated circuit breakers protects against pumping or repetition of the closing strokes. The use of a trip free relay protects the solenoid closing coil from damage, which is not designed for continuous service. For further information see section under Type R14 Control Relay. A "bb" switch (Fig. 2) usually mounted on the front of the solenoid, is operated by the solenoid plunger. The wiring of the main circuits should be in accordance with the diagram accompanying the circuit breaker. (Fig. 3) shows typical diagrams of connections for type KB electrically operated circuit breakers.



CUSTOMER'S CONNECTIONS SHOWN DOTTED



MAINTAINED CONTACT CONTROL SWITCH



MOMENTARY CONTACT CONTROL SWITCH

LEGEND

a—CONTACT CLOSED WHEN CIRCUIT BREAKER IS CLOSED
b—CONTACT CLOSED WHEN CIRCUIT BREAKER IS OPEN
bb—CONTACT CLOSED WHEN CLOSING SOLENOID IS IN NON-OPERATED POSITION
CCS—CLOSING COIL (PLUNGER RETURNS TO NON-OPERATED POSITION WHEN COIL IS DE-ENERGIZED)
CS—CONTROL SWITCH
CS-C—CONTROL SWITCH CLOSE CONTACT
CS-T—CONTROL SWITCH TRIP CONTACT
CR—CLOSING CONTROL RELAY (FRONT CONNECTED)
CR-1—CLOSING CONTROL RELAY CONTACT (CLOSED WHEN PICK-UP COIL IS ENERGIZED)
CR-2—CLOSING CONTROL RELAY CONTACT (OPEN ONLY WHEN PICK-UP COIL IS DE-ENERGIZED AND HOLDING COIL IS ENERGIZED)
G—INDICATING LAMP LIT WHEN CIRCUIT BREAKER IS OPEN
R—INDICATING LAMP LIT WHEN CIRCUIT BREAKER IS CLOSED
HC—CLOSING CONTROL RELAY HOLDING COIL
OC—OVERCURRENT TRIP COIL
PC—CLOSING CONTROL RELAY PICK-UP COIL
TC—TRIP COIL

POLE POSITIONS
FOR 2 POLE BREAKER USE OUTER POLES ONLY
FOR 3 POLE BREAKER USE ALL THREE POLES AS SHOWN

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Fig. 3—DIAGRAM OF CONNECTIONS FOR TYPE KB CIRCUIT BREAKER, ELECTRICALLY OPERATED 250 VOLTS DC, 600 VOLTS AC CONTROL

The solenoid construction consists of a magnet frame, plunger and closing coil. A rod from the plunger which extends up to the operating mechanism transmits the closing force to the toggle mechanism.

Coil Replacement. The closing coil is held in place by a spring clip on each side. This coil is removed by first removing the plunger stop pin and bushing and withdrawing the plunger. Disconnect the coil leads and remove the coil retaining spring clip from the right hand side. Then slip out the lower fibre spacing washer and withdraw coil.

Solenoid D. C. This solenoid is attached to the mechanism housing, is mounted and operates similar to the a-c solenoid. The construction differs somewhat for the d-c solenoid as to having a cylindrical center section, bottom plate assembly, plunger and closing coil. The control relay is mounted on the left and the "bb" switch on the right.

Adjustments. Clearance between the top plate of the solenoid and mechanism housing is maintained by mounting bushings to allow the two shock springs to absorb the shock of the solenoid during the closing stroke.

If the plunger should have too much overtravel, or not enough to close breaker, remove plunger stop pin and allow plunger to drop out. Gradually turn plunger rod in or out, replace plunger and proceed as follows. Turn operating handle to fully closed position. Push plunger up to stop limit and release handle from fully closed to normally closed position. Plunger should be pushed down .010 to .030 inch.

Shock Spring Replacement. Remove the four mounting screws and remove solenoid and two shock springs. Assemble by reverse operations.

Closing Coil Replacement. Remove plunger stop pin and plunger. Disconnect coil leads. Remove bottom plate assembly, by removing four mounting bolts, and allow coil to drop out. Replace coil with leads through insulators, and assemble by reverse operations. Check mechanical and electrical operation.

TYPE R14 CONTROL RELAY

For electrically operated circuit breakers, control relays as shown in Fig. 4 with heavy duty contacts are generally required to control the relatively large circuits 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.

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 has an armature on which the blowout, float and auxiliary contacts, are mounted. This armature is attracted by either the pick-up or holding coil, but is normally held in a neutral position by a spring. When both coils are energized at the same instant by the control switch, the stronger or pick-up coil attracts the armature 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 to attract the armature. The armature opens the relay contacts as it passes to the holding coil magnet. The armature remains attracted to the holding coil 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 to burn out.

For use with maintained contact control switch, an auxiliary contact is added to the non-repeat control relay, and is placed in series with the pick-up coil. This auxiliary contact is closed when the armature is in the neutral position (control switch contact open), closed when armature is attracted to pick-up coil (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 is protected against burn-out when the control button is maintained.

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.

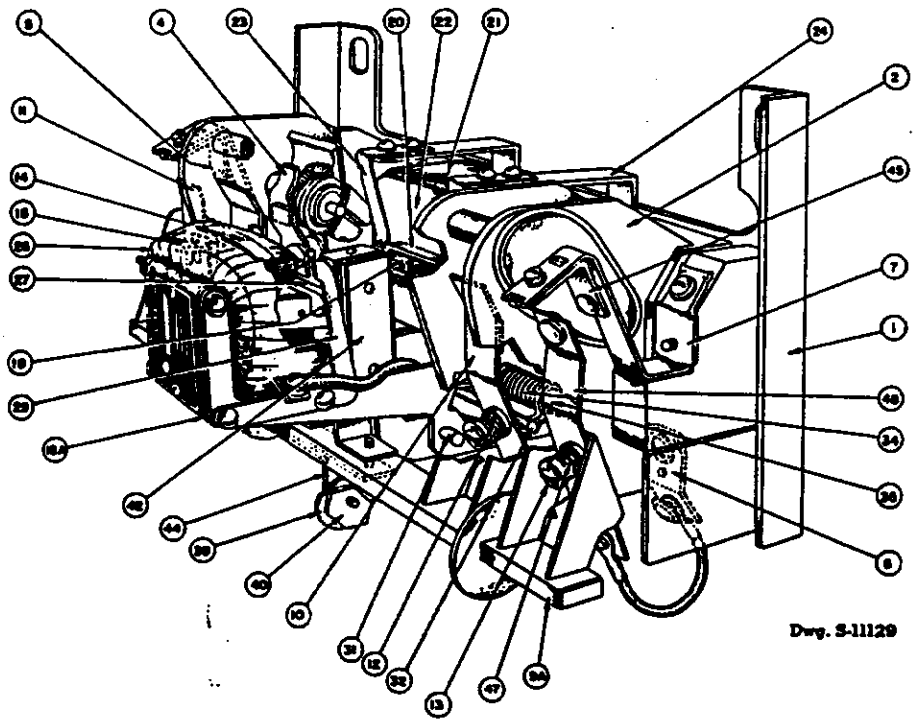
Adjustments. To adjust the position of the armature, loosen locking screw for the eccentric adjusting nut. Turn the nut until the position of the armature is such that the armature will move to the pick-up magnet when both coils are energized simultaneously. When the pick-up coil is de-energized the armature should move to the holding magnet.

The schematic diagrams shown in Figs. 5 to 8 give the various means of controlling electrically operated air circuit breakers.

Replacements:

To replace holding coil. Detach and identify coil leads. Remove screws to release the two coil holding brackets. Slide magnet up enough to pry off shading ring, then remove coil. Replace coil and assemble by reverse operations.

To replace pick-up coil. Detach and identify coil leads. Remove holding coil magnet, armature pin, and adjusting nut. Allow armature to drop down, then remove pick-up coil. Replace coil and assemble by reverse operations. Note, when replacing coil, position same as before, then complete assembling. Refer to Adjustments to position armature.



INDEX	DESCRIPTION
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. 4—TYPE R14 CONTROL RELAY

To replace moving blowout contact. Turn the contact spring cup through 90 degrees, then remove spring and remaining spring cup. Remove cotter pin through lower guide stud of bracket mounted on contact bar. Remove screw attaching flexible conductor to its lower terminal, then remove blowout contact. Replace blowout contact and assemble by reverse operations. Note: securely tighten screw attaching flexible conductor to its terminal.

To replace stationary blowout contact. Remove the moving blowout contact (refer to preceding paragraph). Insert a screw driver to reach and remove screw holding contact. Replace contact and assemble by reverse operations. Note: securely tighten attaching screw for contact before replacing moving contact.

WIRING DIAGRAMS

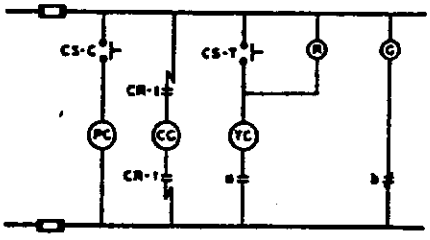


Fig. 5—Schematic diagram showing relay, and shunt trip. Control switch with momentary contacts.

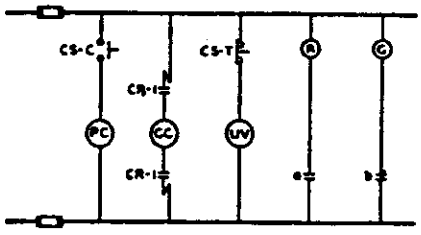


Fig. 6—Schematic diagram showing relay, and undervoltage trip. Control switch with momentary closing contact and maintained trip contact.

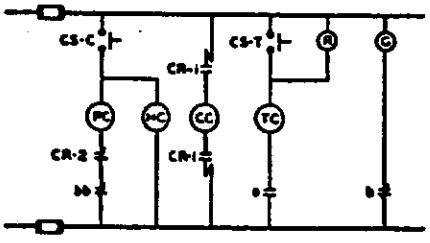


Fig. 7—Schematic diagram showing non-repeat relay and shunt trip. Control switch with contacts either maintained or momentary.

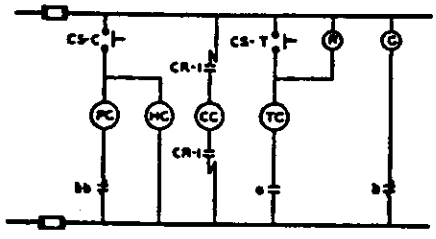


Fig. 8—Schematic diagram showing non-repeat relay and shunt trip. Control switch with momentary contacts.

LEGEND

F—Fuse
CS-C—Control switch—close
CS-T—Control switch—trip
CR—Control relay
CR 1—Control relay contacts, closed when pick-up coil is energized
CR 2—Control relay contacts, open only when pick-up coil is de-energized and holding coil is energized
HC—Control relay, holding coil
PC—Control relay, pick-up coil
a—Contact closed when circuit breaker is closed
b—Contact closed when circuit breaker is open
bb—Contact closed when closing solenoid is in non-operated position
CC—Circuit breaker closing coil
TC—Circuit breaker trip coil
UV—Circuit breaker undervoltage trip coil
G—Green indicating lamp
R—Red indicating lamp

DUAL MAGNETIC OVERCURRENT TRIP

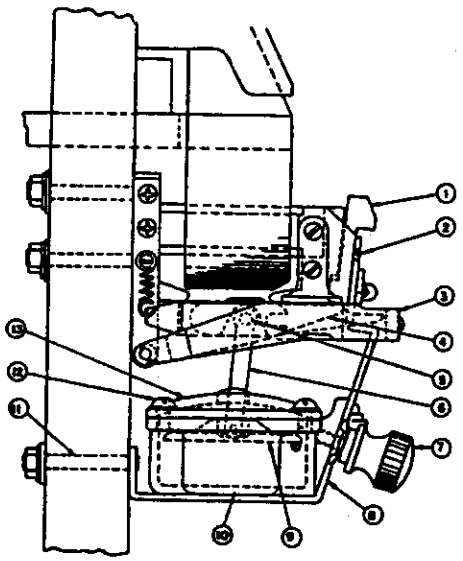
The dual overcurrent trip device shown in Fig. 9 combines moderate overcurrent protection with instantaneous short circuit protection. The unit is mounted on the circuit breaker directly beneath the pole with which it is associated. Since all poles are rigidly connected for opening and closing, response of the tripping device of one pole to an overcurrent or short circuit will cause the opening of all poles.

On continuous overloads, the armature is attracted to a magnet. After a pre-determined time delay, adhesive disc separates from the adhesive surface of oil cup. This allows the armature which is connected to disc by link, to move upward to strike a push pin and trip the circuit breaker. The instantaneous armature straddles the time delay armature. When a short circuit (set at 8 times continuous ampere current rating d-c and 12 times a-c) occurs, armature moves independently to trip circuit breaker.

Adjustments. The trip unit is set for a value of current slightly above the maximum steady load. If breaker trips under normal working conditions, lower the oil cup slightly, after loosening knob. Pointer on armature will indicate on support bracket the current value at which breaker will trip after a time delay.

Maintenance. Before putting circuit breaker into service, clean oil cup with carbon tetrachloride and dry thoroughly. Remove knob and support bracket after removing screws and stud. Allow armature to drop and remove pin. Remove screws to release cup from cover.

Caution: When handling, do not scratch adhesive surfaces of cup and disc. Insert ½ ounce of oil from container supplied. Replace cover, re-assemble unit, and set the knob at the predetermined calibration setting. Clean cup at least once a year to insure proper service. When fresh oil is needed send order with nameplate data to factory.



INDEX	DESCRIPTION
1	Push pin
2	Screw
3	Armature (instantaneous)
4	Armature (time delay)
5	Link pin
6	Link
7	Knob
8	Support bracket
9	Adhesive disc (moving)
10	Oil cup
11	Mounting stud
12	Cover screw
13	Cover (oil cup)

Dwg. S-11196

Fig. 9—DUAL MAGNETIC OVERCURRENT TRIP FOR TYPE KB CIRCUIT BREAKER

THERMOMAGNETIC OVERCURRENT TRIP

The thermomagnetic overcurrent trip in Fig. 10 is designed for standard a-c circuit breakers when used on individual motor circuits. The device provides direct acting inverse time operation. Dual magnetic overcurrent trip devices with oil film time delay are also available for a-c circuit breakers.

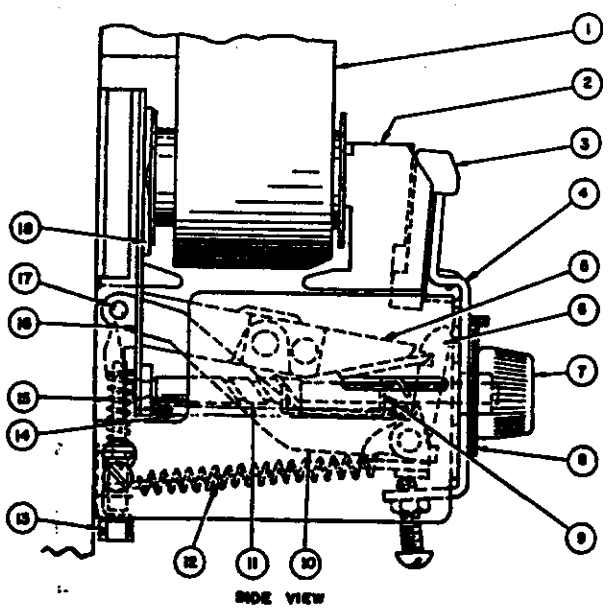
When thermomagnetic overcurrent trip devices are used, the adjustment varies the current tripping point and the time delay simultaneously so as to closely follow the heating curve of overloaded circuits. This combined adjustment makes it impossible to accurately rate the tripping range. The approximate tripping range is 100 to 150 percent of continuous ampere rating.

The unit is designed particularly for tripping a circuit breaker during overcurrent, single phase overcurrent and short circuit conditions. Its characteristics permit full voltage motor starting even when the accelerating period is abnormally long.

This device consists of a series coil, a magnet and an armature which provides power for direct tripping of the circuit breaker. Time delay is produced by an inductively heated bi-metal strip which permits the armature to trip the breaker on normal overloads, only after a selected time delay. This time is adjustable by moving a pointer around a scale with an insulated knob. The armature trips the breaker instantaneously on all currents above twelve times the breaker rated current.

Applied to the side of the thermomagnetic device will be found a diagram showing tripping curves for various setting of the adjustment knob. These curves are typical only and are to be used as guides in the adjustment of the device. All other adjustments are made at the factory and should not be changed without specific instructions.

Adjustments. When putting the circuit breaker in service, set the pointer about 1 setting for a lighting circuit or 2 to 2.5 setting for a motor circuit and close the breaker. If the breaker trips on normal inrush current, gradually increase the setting until it stays closed. Always check final adjustment after breaker has reached full load operating temperature. A change in load conditions or a large change in room temperature may require readjustment.



INDEX	DESCRIPTION
1	Series coil
2	Magnet
3	Push pin
4	Calibration plate assembly
5	Armature
6	Latch
7	Calibration knob
8	Calibration pointer
9	Adjusting rod nut
10	Latch support
11	Adjusting rod
12	Instantaneous spring
13	Adjusting stud
14	Latch spring
15	Anti-rattle spring
16	Thermal element
17	Armature pin
18	Heater

Dwg. S-11438

Fig. 10—THERMOMAGNETIC OVERCURRENT TRIP FOR TYPE KB CIRCUIT BREAKER

UNDERVOLTAGE TRIP

In certain instances it is desirable to interrupt a circuit in case the voltage falls below a predetermined value. For example, a direct current motor should be started only through a resistance in order to limit the current in the armature. If the power supply should fail, allowing the motor to slow down or completely stop, and then be restored with the starter in the running position, dangerous currents would flow in the armature. These excess currents may not only damage the motor, but may also cause injury to the driven machine.

Instantaneous. In the undervoltage device as shown in Fig. 11, a coil surrounds an electromagnet connected directly to the line and attracts a pivoted armature. (The time delay device is omitted for instantaneous.)

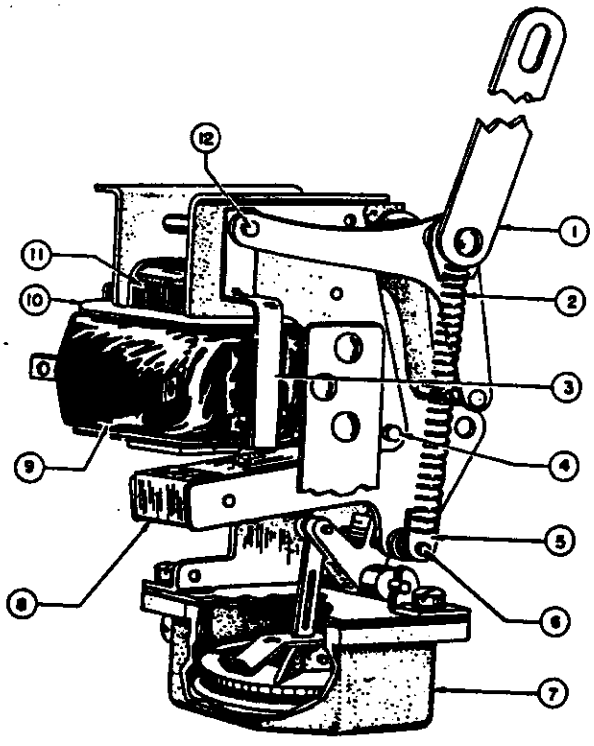
The armature is spring loaded by the breaker mechanism. When the voltage on the coil falls below a certain value, the magnetic pull on the armature is reduced and the armature is moved to the open air gap position by the spring. The force of the spring is at the same time transmitted to the tripper bar and the latch is released to trip the breaker. When the breaker opens, the armature is returned to the closed air gap position. The dropout voltage is approximately 30-60% of the normal circuit voltage.

Time Delay. When it is required that the breaker remain closed for a short interval following voltage failure, the addition of an oil film delay device as shown in Fig. 11 is available and added to the device previously described. Its addition delays the operation of the undervoltage trip for a definite predetermined time interval. If the normal circuit conditions do not restore during the interval, the circuit breaker will trip in its customary manner. The time delay is approximately 3 seconds at no voltage.

Maintenance-Time Delay. The time delay cups should be cleaned and oil renewed every six months.

Remove the four cup attaching screws. Remove cup and gasket. Do not mar the adhesive surfaces of either disc. Clean cup and adhesive discs with carbon tetrachloride and dry thoroughly. Refill cup with oil 1/8" from bottom of cup (1/2 ounce is specified) with oil supplied with breaker. Oil furnished by the manufacturer is recommended.

INDEX	DESCRIPTION
1	Operating Link
2	Reset Spring
3	Coil Retainer
4	Armature Hinge Pin
5	Lower Spring Link
6	Lower Link Pin
7	Oil Cup
8	Armature
9	Coil
10	Coil Insulating Washer
11	Magnet
12	Spring Arm Pivot Pin



Dwg. 8-11412

Fig. 11—UNDERVOLTAGE TRIP FOR TYPE KB CIRCUIT BREAKER

Coil Replacement. To remove the coil (Fig. 11) it is necessary to pull the armature pivot pin and the spring arm pivot pin. This permits the removal of the armature and spring arm. The coil may be withdrawn from the core of the magnet.

SHUNT TRIP

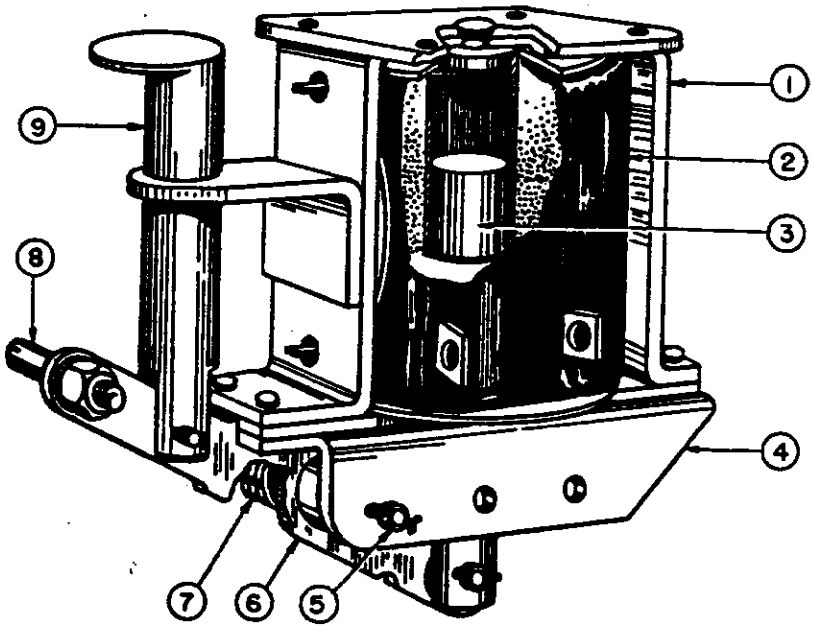
Numerous instances arise where it is desirable to be able to trip the circuit breakers electrically without regard to the load conditions in the circuit or from a remote point. Electrically operated circuit breakers are equipped with a shunt trip device. It may also be added to manually operated circuit breakers.

The shunt trip device as in Fig. 12 consists of a tripping magnet and armature. When the circuit is energized, the tripping magnet operates the armature which releases the latch and opens the breaker. In order to prevent the operating coil of the shunt trip device from burning out following the opening of the breaker, an auxiliary contact is provided to disconnect the coil from the circuit as the breaker opens. (Further information for this auxiliary switch is in Bulletin 46103.)

The shunt trip may be operated by any convenient source of potential such as a storage battery or control transformer.

Note: Since the shunt trip device is operated by completing a normally open circuit, grounds or faults in the control wiring would not be evident until the device failed to work when called upon to open the circuit breaker. Where these hazards to control wiring may occur an undervoltage device is recommended because it operates upon the opening of a normally closed circuit. An objection to this type of trip is that the breaker will open every time the main power source is disconnected if energized on the main source of power.

Coil Replacement. To remove the coil, withdraw four mounting screws which hold the magnet tie plate to magnet. The plunger, counterweight and coil retainer may then be withdrawn as a unit and the coil removed. Assemble by reverse operations.



INDEX	DESCRIPTION
1	Magnet Frame
2	Coil
3	Armature
4	Coil Retainer
5	Trip Lever Pivot Pin
6	Trip Lever
7	Trip Lever Spring
8	Trip Stud
9	Counterweight

Dwg. S-11140

Fig. 12—SHUNT TRIP FOR TYPE KB CIRCUIT BREAKER

REVERSE CURRENT TRIP

In order to protect direct current equipment, a device to trip the circuit breaker when the current reverses is desirable. Generators operated in parallel, or those used to charge batteries, should be protected with a reverse current device as shown in Fig. 13. If one generator were to lose its terminal voltage, the other generators or storage batteries would feed power into the disabled machine and tend to operate it as a motor.

The reverse current device consists of two magnetic systems, one energized by a series coil carrying the main current, the other by a shunt coil upon which the circuit potential is impressed. These two systems interact in much the same manner as that of the field and armature in a direct current motor. The polarity of the shunt coil system remains constant. The magnetic field of the series coil causes the armature to press against a stop screw when the current is flowing in the normal direction.

When reversed, the action of the series magnetic field is reversed, the armature rotates in the opposite direction and trips the breaker through its mechanical connection with the breaker trip mechanism. This device will trip on any reverse current in excess of the calibration setting. The calibration range of tripping adjustment is 5-25% of the ampere rating of the circuit breaker. The tripping action requires that 70% voltage be maintained.

INDEX	DESCRIPTION
1	Series Coil
2	Pole Piece (R.H.)
3	Shunt Coil Insulating Washer
4	Shunt Coil
5	Calibration Knob
6	Calibration Plate
7	Friction Spring
8	Calibration Spring
9	Pole Piece (L.H.)
10	Armature Stop Screw
11	Armature
12	Trip Lever

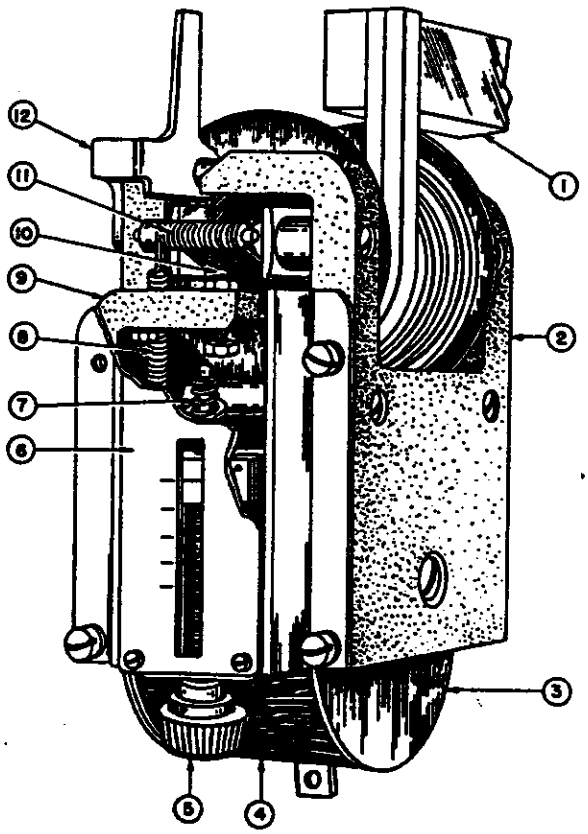


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Fig. 13—REVERSE CURRENT TRIP FOR TYPE KB CIRCUIT BREAKER

RECOMMENDED RENEWAL PARTS

In plants where many type KB circuit breakers are installed, where operations are frequent, interrupting duty is severe, and where length of outage is serious, certain renewal parts are recommended for stock. When ordering coils give voltage, d-c or a-c, and the frequency of the circuit in which the coil is to be connected. Give the number on the coil and nameplate data of the circuit breaker.

*Recommendations based on cases where outage would be serious. All recommended quantities are based on a 3 pole circuit breaker.

NAME OF PART	NUMBER OF CIRCUIT BREAKERS INSTALLED		
UNIVERSAL PARTS (FIG. 2)	1-5	6-10	11-25
Arcing contact (stationary)	3	6	9
Main contact (stationary)	0	0	3
Opening spring	2	4	6
Operating handle	0	0	1
Visual spring	0	0	1
OPERATING MECHANISM (FIG. 2)			
Operating mechanism (complete)	0	0	1*
Spring (centering arm)	1	2	3
Spring (reset)	0	1	3
Spring (toggle latch)	1	2	3
Spring (trip lever)	1	2	3
Spring (tripper bar)	1	2	3
MOVING CONTACT ARM & BAR (FIG. 2)			
Spring (arcing contact)	3	6	9
Spring (main contact)	1	3	6
Contact arm assembly	0	0	1*
Arcing contact	6	6	12
Main contact & conductor	0	0	3
Arcing contact support & conductor	0	3	3
SOLENOID A-C (FIG. 2)			
Solenoid (complete)	0	0	1*
Shock spring	0	4	8
Coil (closing)	1	1	1
SOLENOID D-C			
Solenoid (complete)	0	0	1*
Shock spring	0	2	4
Coil (closing)	1	1	1
CONTROL RELAY (TYPE R14) (FIG. 4)			
Stationary contact unit	2	4	6
Stationary contact (blowout)	2	4	6
Moving contact (blowout)	2	4	6
Coil (pick-up)	1	2	3
Coil (holding)	1	2	3
DUAL MAGNETIC OVERCURRENT TRIP (FIG. 9)			
Spring (anti-rattle)	1	2	3
THERMOMAGNETIC OVERCURRENT TRIP (FIG. 10)			
Spring (latch)	3	3	3
Spring (anti-rattle)	3	3	3
Spring (instantaneous)	3	3	3
UNDERVOLTAGE TRIP (FIG. 11)			
Spring assembly	0	1	3
Coil (operating)	1	1	1
SHUNT TRIP (FIG. 12)			
Spring (trip lever)	0	1	3
Coil (operating)	1	1	1
REVERSE CURRENT TRIP (FIG. 13)			
Spring (calibration)	0	1	3
Spring (friction-calibration screw)	0	1	3
Shunt coil	1	1	1