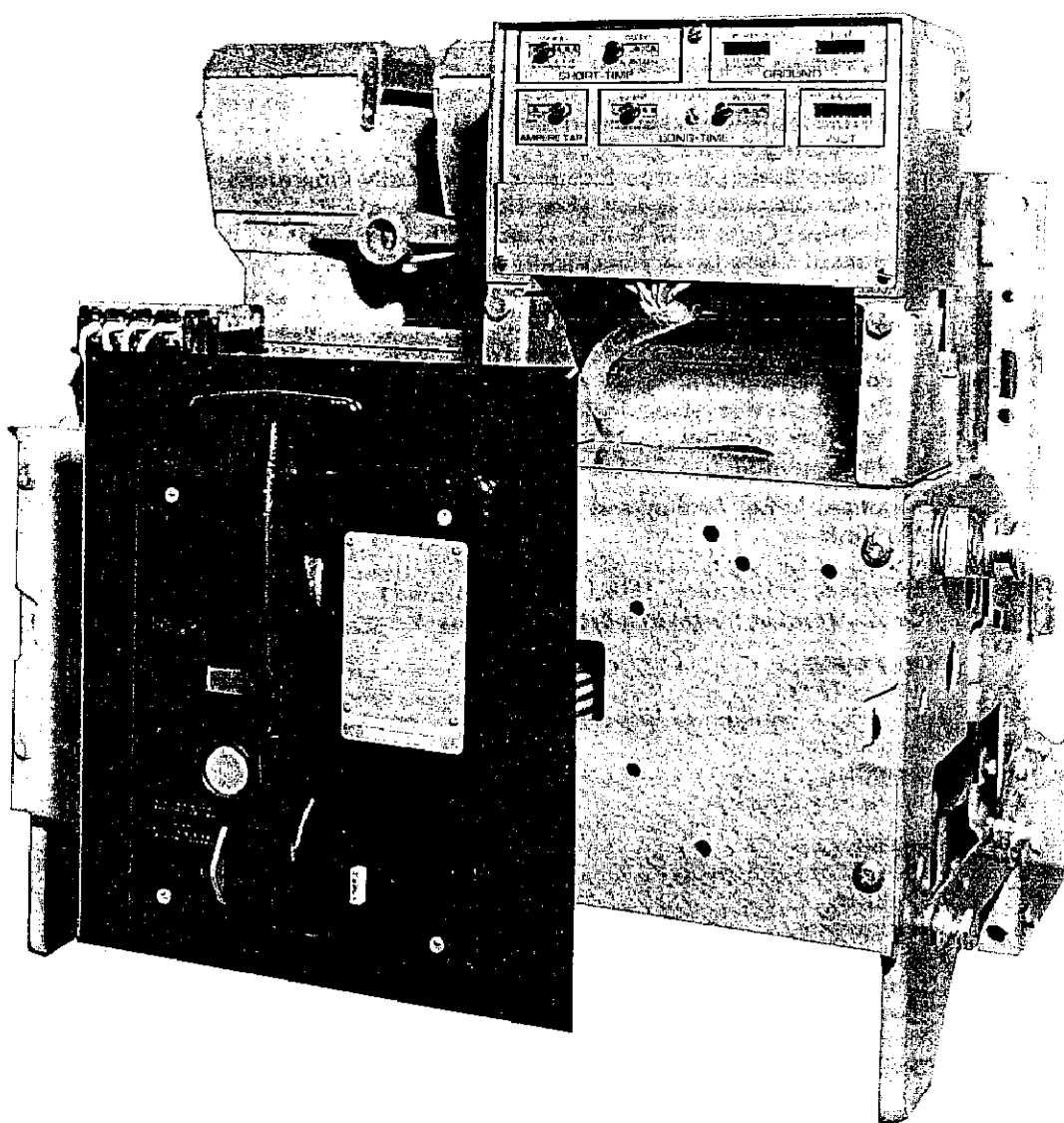


**I-T-E Low Voltage
Power Circuit Breaker**

Type K-225 thru 2000 and K-600S thru 2000S

Stationary Mounted and Drawout Mounted



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INTRODUCTION

These instructions apply to the type K-225 through K-2000 and K-600S through K-2000S circuit breakers; 225, 600, 800, 1600 and 2000 ampere ac continuous current rating respectively. The type K-225 through K-2000 are equipped with electro-mechanical overcurrent trip devices, whereas the type K-600S through K-2000S incorporate the solid state overcurrent trip devices. A K-1600S circuit breaker is shown on the front cover of this bulletin.

The K-225 through K-2000 circuit breakers can be furnished with two or three poles for dc or ac operation. K-600S through K-2000S circuit breakers are only furnished for three pole, ac operation.

All circuit breakers can be furnished as drawout or stationary mounted and are available as manually or electrically operated and with electrical control devices available in various ac and dc voltage combinations. The manually and electrically operated mechanisms are interchangeable on circuit breakers having the same current rating. Many optional features are also available.

An electrically operated, drawout type circuit breaker is shown in Figure 1, with a typical schematic diagram shown in Figure 2.

These instructions should be read thoroughly before handling, installing and/or operating the circuit breaker.

RECEIVING AND STORAGE

Immediately upon receipt of the circuit breakers, examine the cartons 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 nearest District Office. Brown Boveri is not responsible for damage of goods after delivery to the carrier. However, we will lend assistance if notified of claims.

Unpack circuit breakers 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 circuit breaker parts. Check the contents of each carton against the packing list before discarding any packing material. If any discrepancy is discovered, promptly notify the nearest District Office. Information specifying the purchase order number, carton number and part numbers of damaged or missing parts should accompany the claim.

Circuit breakers should be installed in their permanent location as soon as possible. (See Basic Handling below.) If possible, a drawout circuit breaker should be stored and

locked in the "DISCONNECTED" position in its compartment, with the door closed. Both the primary and control separable contacts are disconnected in this position. If the breaker cannot be installed in its compartment, it should be kept in its original carton and the carton should be sealed to prevent infiltration of dirt. Where conditions of high humidity prevail, the use of heaters is recommended, regardless of the method of storage selected.

BASIC HANDLING INSTRUCTIONS

Once the circuit breaker has been removed from its shipping carton, it should be turned to the upright position and placed on a flat surface to avoid damage to breaker parts. For safety, all handling in this position should utilize the lifting yoke (20, Fig. 1).

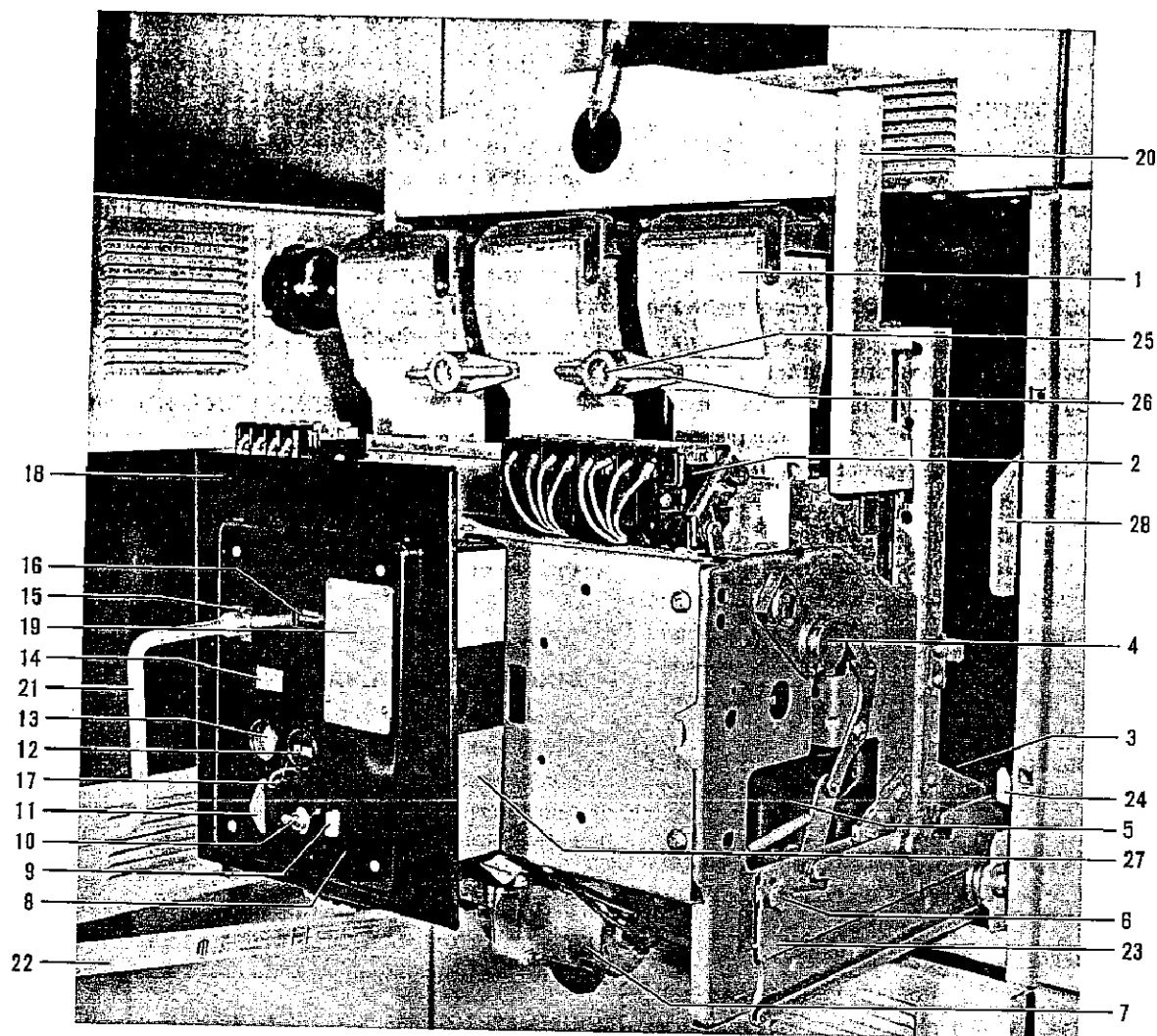
CIRCUIT BREAKER OPERATION

CIRCUIT BREAKER RATING

The continuous current rating is established by the frame size of the circuit breaker and is the number listed in the type designation; i.e., K-600 means the circuit breaker can carry 600 amperes continuously. Exceeding these ratings may raise the temperature of the circuit breakers beyond their design limit and thereby affect the life of the circuit breaker. Thus, any long-time pickup setting exceeding 100% of the frame size is to be used only for coordination, not for carrying increased continuous current.

CLOSING SPRING OPERATION (Electrically Operated)

The two closing springs supply the power that closes the circuit breaker and also charge the two opening springs during the closing operation. The closing springs are charged by a motor. The spring energy is available to close the circuit breaker, thus referred to as "stored energy." Closing springs are normally charged when the circuit breaker is opened. If charged after closing, the circuit breaker may be opened and then reclosed without recharging the springs. In earlier model drawout circuit breakers, the closing springs are automatically discharged when the circuit breaker is pulled to the fully withdrawn position (shown in Figure 1). This prevents accidental discharge. In later models, the springs are automatically discharged when racking the circuit breaker from the disconnected to the withdrawn position.



- | | | |
|----------------------------------|-------------------------------------|----------------------------------|
| 1. Arc Chute | 11. Locking Hasp | 21. Racking Crank |
| 2. Auxiliary Switch | 12. Electrical Close Push Button | 22. Removable Maintenance Handle |
| 3. Secondary Separable Contacts | 13. Manual Trip Button | 23. Track |
| 4. Racking Cam Assembly | 14. "OPEN" or "CLOSED" Indicator | 24. Latch |
| 5. Overcurrent Trip Device | 15. Racking Shutter | 25. Retaining Screw |
| 6. Positioning Pins | 16. Closing Spring Charge Indicator | 26. Retainer |
| 7. Closing Spring Charging Motor | 17. Manual Close Lever | 27. Position Indicator |
| 8. Escutcheon Assembly | 18. Self Aligning Dust Plate | 28. Cradle |
| 9. Automatic Trip Indicator | 19. Nameplate | |
| 10. Motor Disconnect Switch | 20. Lifting Yoke | |

**Fig. 1 — Typical Electrically Operated, Drawout Type
K-1600 Circuit Breaker**

CLOSING SPRING OPERATION (Manually Operated)

In one continuous downward pull of the handle the two closing springs are charged, and near the end of the stroke are discharged to fast close the circuit breaker. During closing, the two opening springs are charged.

ESCUTCHEON OPERATING FEATURES

Manually and electrically operated circuit breakers are provided with an extendible escutcheon face plate. This escutcheon provides a central area for the controls which are mounted directly on the circuit breaker.

The controls for the electrically operated circuit breaker (Figure 1) included in the escutcheon face plate are: (19) nameplate giving the various ratings assigned to the particular type of circuit breaker, (13) manual trip button, (17) manual close lever, (12) electrical close push button switch, (10) motor disconnect switch, (14) "OPEN" and "CLOSED" position indicator, (9) automatic trip indicator with optional facilities for alarm indication and for lockout, (11) means for padlocking the circuit breaker in the "CONNECTED", "TEST" or "DISCONNECTED" position and (16) closing spring charge indicator. Handle (22) is normally removed and is used for emergency closing spring charging or maintenance work.

The manually operated circuit breaker includes a manual closing handle but does not include the electrical close push button switch, motor disconnect switch, manual close lever, spring charge indicator or maintenance handle.

All drawout circuit breakers have the racking shutter (15) that must be raised to allow inserting of the racking crank (21).

A self-aligning dust plate (18) immediately behind the escutcheon face plate is used to exclude dust from the circuit breaker compartment. On drawout type circuit breakers, the escutcheon face will protrude through the front door of the compartment when the circuit breaker is in the "TEST" and "DISCONNECTED" positions. In these positions, the dust plate still functions to exclude dust.

Circuit Breaker Nameplate (Figure 1, Item 19)

The circuit breaker nameplate contains information regarding (1) the manufacturer's name and address, (2) type of circuit breaker design, (3) serial number of circuit breaker, (4) continuous current rating of frame size, (5) short circuit current rating at rated voltages, (6) frequency, (7) short time current.

Manual Charging Handle (Manually Operated)

The manual charging handle is a T-shaped lever used on manually operated circuit breakers to charge the closing springs and close the circuit breaker in one continuous downward stroke.

Manual Trip Button (Figure 1, Item 13)

The manual trip button, when pushed, trips the circuit breaker to "OPEN."

Circuit Breaker "OPEN" or "CLOSED" Indicator (Figure 1, Item 14)

This indicator shows the physical position of the circuit breaker contacts.

Automatic Trip Indicator (Figure 1, Item 9)

(Not including undervoltage, alarm switch or lockout)

The automatic trip indicator is provided as standard equipment on the K-line® circuit breakers and is used to indicate the operation of the overcurrent trip device. This device is an indicator only and does not prevent the circuit breaker reclosing.

Upon an overcurrent trip operation, the indicator protrudes from the front plate approximately 1/2 inch.

The automatic trip indicator should be reset after each trip indication by pushing back into its normal latch position. The operator should investigate the cause of tripping before resetting the automatic trip indicator and subsequent reclosing the circuit breaker after an outage which results in an operation of the indicator.

Automatic Trip Alarm Contacts (Hand Reset)

(Figure 1, Item 9)

An alarm switch for remote electrical indication, which is optional, shows when automatic tripping has occurred. This is accomplished by adding a precision snap switch to the automatic trip indicator assembly. The automatic trip indicator actuates the roller on the alarm switch which in turn causes a normally open contact to close and a normally closed contact to open an overcurrent trip. The alarm contact is manually reset by pushing the trip indicator (9) back into its normal position.

Automatic Trip Lockout (Hand Reset) (Figure 1, Item 9)

An additional device (which is also optional) may be added to the automatic trip indicator assembly device which serves to mechanically prevent reclosing the circuit breaker after an automatic trip operation. When the trip indicator is pushed in, the circuit breaker mechanism can then be operated to close the circuit breaker contacts.

Padlocking Device (Figure 1, Item 11)

All K-line circuit breakers are equipped with means of padlocking the circuit breaker mechanism in a trip-free position. This is accomplished by the use of a locking plate to maintain the manual trip button in a tripping direction when the locking plate is held forward by one or more padlocks. To obtain the condition for padlocking the circuit breaker in the open position, the manual trip button is pushed inward. Then the padlock plate is pulled out and the padlock inserted into the vertical slot. In this position, the mechanism is maintained trip free and the contact arm cannot be moved to the closed position.

On circuit breakers equipped with drawout mechanism, the padlocking device is associated with the drawout interlocking mechanism so that the circuit breaker cannot be moved from any of its three basic drawout positions of "CONNECTED", "TEST" or "DISCONNECTED" with the padlocking in effect.

Closing Spring Charge Indicator (Electrically Operated) (Figure 1, Item 16)

Under normal operating conditions, the closing springs are automatically charged after each tripping operation. However, there are occasions when the springs will be in a discharged state. Therefore, it is desirable that means be available to indicate the charged or uncharged condition of the closing springs. This is accomplished by a visual indicator seen through an aperture in the escutcheon plate. The indicator is marked "SPRINGS CHARGED" and "SPRINGS UNCHARGED."

Motor Disconnect Switch (Electrically Operated) (Figure 1, Item 10)

The motor disconnect switch is a double pole, single-throw toggle type switch connected in series with the charging motor circuit and is used to disconnect the motor from the voltage source. This cut-off switch is used (1), when it is desirable to prevent automatic recharging of the closing springs just prior to taking the circuit breaker out of service for maintenance and (2), for control wiring dielectric test. The motor must be disconnected for the control wiring dielectric test and subsequently tested at 540 V ac or 760 V dc.

Electrical Close Push Button (Electrically Operated) (Figure 1, Item 12)

The electrical close push button is used to electrically close the circuit from the escutcheon. This contact is connected in series with the latch release coil (52X). Energizing the latch release coil allows the charged springs to close the circuit breaker.

Manual Close Lever (Electrically Operated) (Figure 1, Item 17)

The manual close lever is provided on electrically operated circuit breakers to provide a means of closing the breaker without control power.

Racking Mechanism (Drawout Breaker)

The racking mechanism may be used to move the circuit breaker to any one of its three positions ("CONNECTED", "TEST" or "DISCONNECTED"). All of these positions are attainable with the cubicle door closed. The racking shutter (15, Fig. 1), which must be lifted to gain access to the racking mechanism, is interlocked with the circuit breaker so that the circuit breaker contacts must be open before the shutter may be lifted to rack the circuit breaker to another position. The circuit breaker can not be closed when the shutter is open. The circuit breaker may be padlocked open by means of the locking hasp. This automatically locks the racking mechanism. With the "TRIP" button (13, Fig. 1) depressed, the locking hasp (11, Fig. 1) may be pulled outward, accommodating from one to three padlocks, when the shutter is closed and the circuit breaker is tripped. The shutter can not be lifted and the breaker contacts can not be closed when the locking hasp is restrained by one or more padlocks.

There are two sets of arrows and indicating lines to show the circuit breaker position. One set is utilized with the compartment door closed and one set with the door open.

OPERATION OF DEVICES

Electro-Mechanical Overcurrent Trip Devices **Type K-225 thru K-2000 Circuit Breakers** (Figures 14 thru 18)

(A) Type OD-3 General Purpose Overcurrent Trip Device. The type OD-3 overcurrent trip device, for general purpose applications, provides long-time delay tripping on moderate overcurrents which are above the long-time pickup setting; and instantaneous tripping on fault currents above the instantaneous trip setting. This device must be properly set to provide adequate protection for an electrical system. Three adjustment screws on the bottom of the device provide independent control of the long-time pickup, instantaneous pickup and amount of time delay. The nameplate of this device shows the setting of these adjustments and the range of settings which are available. For information on the time-current characteristics of this device, request a copy of TD-6693.

(B) Type OD-4 Selective Overcurrent Trip Device. The type OD-4 overcurrent trip device, for selective tripping applications, provides long-time delay and short-time delay tripping. Independent adjustment of both pickup and time delay is provided for both types of tripping. The nameplate of this device shows the settings which are available. For information on the time-current characteristics of this device, request a copy of TD-6694.

(C) Type OD-5 Triple-Selective Overcurrent Trip Device. This overcurrent trip device is similar to the OD-4 except that an instantaneous trip characteristic is added to the long-time delay and the short-time delay functions provided on the OD-4. For information on the time-current characteristics of this device, request a copy of TD-6695.

(D) See Table 1 on facing page for complete list of Electro-Mechanical standard overcurrent trip devices available. See Maintenance Section for adjustments.

Power Shield™ Solid State Overcurrent Trip Devices **Type K-600S thru K-2000S Circuit Breakers** (See Figure 19)

This device includes the power supply sensors, overcurrent sensors, Power Shield solid state logic assembly, magnetic latch and the interconnecting wiring. Each phase of the circuit breaker has a power supply sensor and overcurrent sensor. The trip elements that are available are: long-time delay, instantaneous, short-time delay and ground fault. On a 3-phase 4-wire system, an additional remote sensor, mounted in the neutral bus, is required for complete ground fault protection.

The logic assembly is mounted near the front of the circuit breaker and with the cubicle door open the overcurrent control panel is readily accessible. This device must be properly set, as required by individual circuit conditions, to provide adequate protection for an electrical system. The movable plugs on the control panel provide independent control of the long-time, short-time, instantaneous and ground fault pickup and amount of time delay. The overcurrent device, with the exception of ground fault, will trip at the value of the AMPERE TAP setting times the plug setting of the various

pickup elements. The ground fault trip value will be the plug setting value times 100, as indicated on the nameplate.

(A) Type SS-3. This trip device is for general purpose application. It provides long-time delay tripping on moderate overcurrents, which are above the long-time pickup settings, and instantaneous tripping on fault currents above the instantaneous trip setting. For information on the time-current characteristics of this device, request a copy of TD-6966 (TD-9001*).

(B) Type SS-4 Selective Overcurrent Trip Device. This trip device, for selective tripping application, provides long-time delay and short-time delay tripping. For information on the time-current characteristics of this device, request a copy of TD-6967 (TD-9002*).

(C) Type SS-5 Triple-Selective Overcurrent Trip Device. This device includes the trip elements found in both the SS-3 and SS-4; i.e., long-time delay, short-time delay, and instantaneous tripping. For information on the time-current characteristics of this device, request a copy of TD-6967 (TD-9002*).

(D) The above three solid state overcurrent trip devices are available with ground fault protection and are designated by the types SS-3G, SS-4G and SS-5G. For information on the time current characteristics of this feature, request a copy of TD-6968 (TD-9005*).

(E) See Table 1A for a complete list of standard Solid State overcurrent trip devices.

TABLE 1
STANDARD ELECTRO-MECHANICAL OVERCURRENT TRIP DEVICES

Overcurrent Device Type	Trip Element			Time-Current Characteristic Curve
	Long- Time	Short- Time	Instan- taneous	
OD-3	X		X	TD-6693
OD-4	X	X		TD-6694
OD-5	X	X	X	TD-6695
OD-6	X		X	TD-6695
OD-7			X	None
OD-8			X	None
OD-9		X	X	TD-6699
OD-10		X		TD-6699

NOTE: OD-3 long-time delay element has one time delay band only. All other long-time & short-time delay elements have three time delay bands.

TABLE 1A
STANDARD SOLID STATE OVERCURRENT TRIP DEVICES

Overcurrent Device Type	Trip Element				Time-Current Characteristic Curve	
	Long- Time	Short- Time	Instan- taneous	Ground	Device in RED CASE	Device in GRAY CASE*
SS-3	X		X		TD-6966	TD-9001
SS-3G	X		X	X	TD-6966 TD-6968	TD-9001 TD-9005
SS-4	X	X			TD-6967	TD-9002
SS-4G	X	X		X	TD-6967 TD-6968	TD-9002 TD-9005
SS-5	X	X	X		TD-6967	TD-9002
SS-5G	X	X	X	X	TD-6967 TD-6968	TD-9002 TD-9005

NOTE: Time-current characteristic curves are not included in this book because separate coordination curves are normally provided with each order. When field calibration is performed, necessary instruction books (refer to page 18) will be provided and will include all pertinent timing information.

* Device in GRAY CASE (Current Manufacture)
TD-6966, TD-6967 & TD-6968 apply to Device in RED CASE

Control Device (Electrically Operated)

The control device (Fig. 12) is furnished on electrically operated circuit breakers. The device is mounted below and to the left of the mechanism. The control device contains three electrical components, the limit switch (LS), the lockout relay (52Y), and the latch release relay (52X). The schematic diagram of the control circuit (Fig. 2) illustrates the function of this device. In addition to its electrical functions, the base of the device provides a terminal block for the circuit breaker wiring.

The purpose of the lockout relay (52Y) is to require that, if the remote or local close contacts are closed, resulting in the charging springs discharging, the close contacts must first be released (opened) before the breaker can be reclosed. This prevents closing the circuit breaker more than one time unless the close contacts are first released.

Auxiliary Switches (Figure 1, Item 2)

The auxiliary switches contain the "a" and "b" contacts (Fig. 2) and are furnished in 4 or 8 contact ar-

rangements. They are mechanically interconnected with the main circuit breaker contacts such that, with the circuit breaker closed, the "a" contacts are closed. With the circuit breaker open, the "b" contacts are closed.

Undervoltage Trip Device

The electrically reset undervoltage trip device is a single-phase device which automatically trips the circuit breaker when the line voltage decreases to 30 to 60 percent of the rated voltage. This device may be furnished either for instantaneous trip operation or with adjustable time delay tripping of 1.5 to 15 seconds. The undervoltage trip device is an integral unit which may be added to the circuit breaker either at the factory or in the field.

The undervoltage device may be connected so that the automatic trip indicator (Figure 1, Item 9) will protrude from the front plate when the breaker is tripped by the undervoltage device.

See Table 4, page 20, for electrical characteristics.

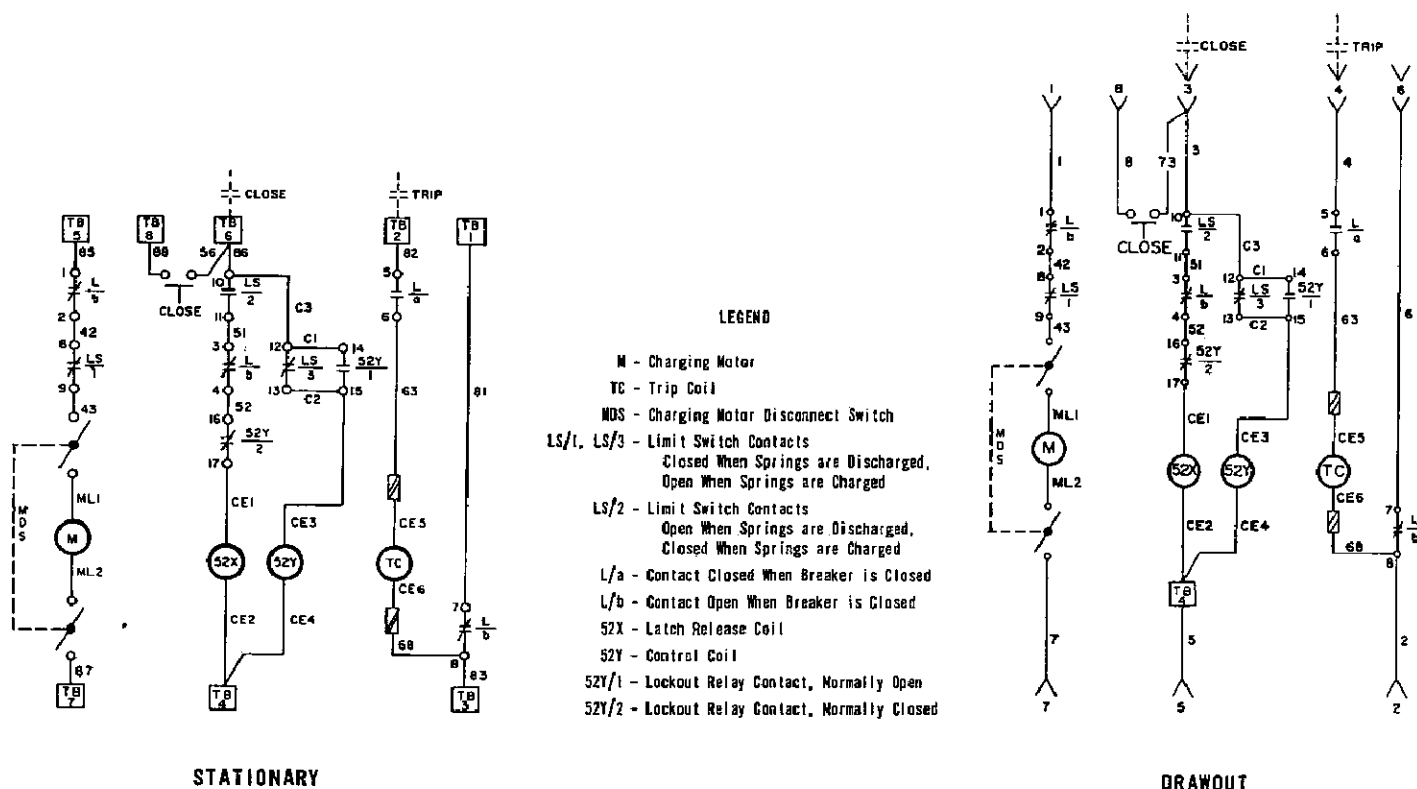


Fig. 2 — Typical Schematic Diagram of Control Circuit

INSTALLATION, INITIAL TESTING AND REMOVAL (Drawout & Stationary)

FOR SAFETY: When installing or removing stationary breakers, the supply for primary and control circuits must be de-energized at all times. Testing of stationary circuit breakers to be done with the primary supply circuit de-energized.

For initial installation of drawout breakers in the "CONNECTED" position, the supply for the primary circuit should be de-energized. Testing of the drawout breaker to be done in the test position.

NOTE: (K-225 thru K-2000 Circuit Breakers) Prior to inserting the circuit breaker into the switchboard and with the breaker in the upright position, exercise the three long time armatures ($\frac{5}{8}$ " wide armatures) several times until resistance to motion has increased, indicating that the oil dashpot is functioning properly. Improper operation can result because the circuit breaker is shipped or stored on its back. This causes the oil in the dashpot to be displaced and an air bubble can be trapped under the piston. The exercise removes the air to permit proper operation.

INSTALLATION (Stationary Type)

Lifting yoke (20, Fig. 1) should be used to move the breaker to the switchboard; however, other handling means will be required to move the breaker into position inside the switchboard.

INSTALLATION (Drawout Type)

To insert the circuit breaker into its compartment, proceed as described below:

(Refer to Fig. 1)

1. The circuit breaker must be in the "OPEN" position, the racking crank turned in the counterclockwise direction fully against its stop, and the motor disconnect switch (10) (electrically operated circuit breakers only) in the "OFF" position.

2. Open the compartment door and pull out the right-hand and left-hand tracks (23) to the fully extended and latched position.

3. Using a lifting yoke, lower the circuit breaker so that the positioning pins (6) (two each side of circuit breaker) rest in the cut-out sections of each track (23).

4. Remove the lifting yoke and push the circuit breaker toward the compartment. The circuit breaker will slide in the cut-out sections of the tracks until the positioning pins reach the end of the cutouts. An additional positive push will automatically release the two latches (24). This allows the circuit breaker to move toward the compartment until the racking cams (4) stop against their guides on the cradle (28).

5. Lift shutter (15) covering the racking opening, insert racking crank, and turn crank clockwise, pass through the "DISCONNECTED" position, until the position indicator on the cradle (left side) shows "TEST" position. Remove racking crank.

CHECKING CIRCUIT BREAKER OPERATION IN "TEST" POSITION (Electrically Operated, Drawout Type)

(Refer to Fig. 1)

1. Manually reset automatic trip indicator (9) if it protrudes approximately $\frac{1}{2}$ ". Push in to reset.

2. Turn motor disconnect switch (10) to "ON" position and closing springs will automatically charge.

3. Close circuit breaker by local close button and trip by local trip button.

NOTE: All breakers have a manual trip button. The local close button for electrical breakers is standard. The local trip button for electrical breakers is optional.

4. Close and trip circuit breaker by means of remote control switch.

5. Check each auxiliary device for proper operation.

6. Close the circuit breaker and check that the shutter (15) cannot be lifted to allow insertion of the racking crank. This demonstrates that the circuit breaker could not be racked out while closed in the connected position.

CHECKING CIRCUIT BREAKER OPERATION IN "TEST" POSITION (Manually Operated, Drawout Type)

(Refer to Fig. 1 and Cover Photo)

1. Manually reset automatic trip indicator (9) if it protrudes approximately $\frac{1}{2}$ ". Push in to reset.

2. Close the circuit breaker by pulling down on the "T" handle.

3. Trip by manual "TRIP" button (13).

4. Check each auxiliary device for proper operation.

5. Close the circuit breaker and check that the shutter (15) cannot be lifted to allow insertion of the racking crank. This demonstrates that the circuit breaker could not be racked out while closed in the connected position.

CHECKING CIRCUIT BREAKER OPERATION IN "CONNECTED" POSITION (Drawout Type)

(Refer to Fig. 1)

With the circuit breaker in the "OPEN" position and the motor disconnect switch (10) in the "OFF" position, insert the racking crank and turn clockwise until the position indicator on the cradle shows "CONNECTED" position.

CHECKING CIRCUIT BREAKER OPERATION (Stationary Type)

Follow the same procedure as for the drawout circuit breaker, except the circuit breaker will be in the "CONNECTED" position. Primary supply circuit must be de-energized.

EMERGENCY OPERATION (Electrically Operated)

Electrically operated circuit breakers may be charged manually by a removable maintenance handle (4, Fig. 3) for emergency operation.

The removable maintenance handle (4) is first positioned in two slots in the pawl carrier (2). The handle is then raised and lowered in a pumping motion until the pawl carrier (2) no longer rotates the ratchet wheel (1). The breaker closing springs now fully charged are ready for a closing operation which is done by raising the manual close lever (17, Fig. 1) on the escutcheon.

NOTE: The motor crank arm (3, Fig. 3) will stop occasionally in such a position as to prevent charging the springs with the handle. Should this happen, the motor crank arm must be rotated manually by using a screwdriver or similar tool to rotate the crank arm a sufficient amount so that the springs may be charged with the handle as described above.

CIRCUIT BREAKER REMOVAL (Drawout Type)

To move the circuit breaker to the "TEST" position or to remove it from the compartment, proceed as follows:

(Refer to Fig. 1)

1. With the compartment door closed, trip the circuit breaker by means of the remote mounted control switch or manual "TRIP" button (13) on the escutcheon.

2. Lift racking shutter (15), insert racking crank and turn counterclockwise until position indicator (27) on the right-hand side of the escutcheon shows "TEST" position. (NOTE: The circuit breaker may be tested in this position—primary contacts are disconnected and the control contacts are connected.)

3. Continue turning the racking crank counterclockwise until the position indicator (27) on the right-hand side of the escutcheon shows "DISCONNECTED" position.

4. Open compartment door and discharge closing springs (electrically operated breakers only) by lifting the manual close lever (17) on the escutcheon and then pushing the manual trip button on the escutcheon. Place motor disconnect switch (10) in the "OFF" position.

5. Insert racking handle and crank counterclockwise as far as the stops will allow.

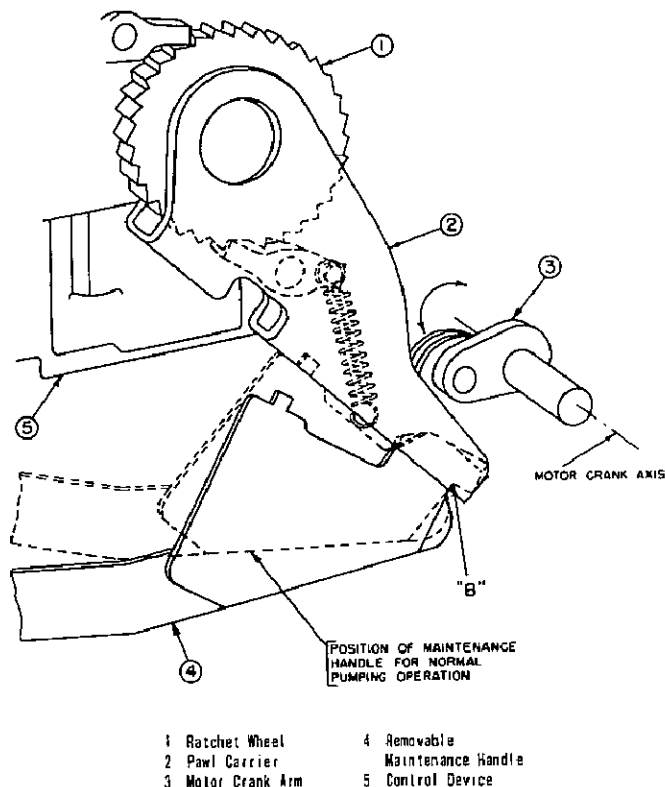


Fig. 3 — Method of Applying Maintenance Handle for Charging Closing Springs

6. Pull circuit breaker forward until tracks (23) are in the fully extended and latched position.

7. Using a lifting yoke, just pick up the circuit breaker weight.

8. With a positive pull, release positioning pins from cut-out sections of the tracks.

9. Remove circuit breaker from tracks by means of lifting yoke.

10. Release latch (24) on each track, push tracks into the compartment, and close compartment door.

NOTE: For safety, if the closing springs are charged, they will be automatically discharged when inserting or withdrawing the circuit breaker in the switchboard compartment.

MAINTENANCE

SAFETY NOTES

De-energize both primary and control circuits before making any inspections, adjustments or replacements of parts. Make certain breaker is open by observing indicator (14, Fig. 1), and closing springs are not charged by observing indicator (16, Fig. 1).

When it is necessary that the closing springs be charged, or the circuit breaker be closed, make sure to stay clear of operating parts.

Stationary breakers should be checked for operation with the control circuit energized and the primary power de-energized. Drawout breakers should be withdrawn to "TEST" position for checking the breaker operation. For further inspection, adjustments, cleaning or replacement of parts, the drawout circuit breaker should be withdrawn and moved to a suitable area.

Stationary breakers should likewise be removed, but, if removal is not possible, then the primary and control circuit sources **MUST BE DE-ENERGIZED**.

PERIODIC MAINTENANCE INSPECTION

The safety and successful functioning of the connected apparatus depends upon the proper operation of the circuit breaker. Therefore, it is recommended that a maintenance program be established that will provide for a periodic inspection of the circuit breaker as follows:

- K-225 — After 2,500 operations
- K-600, K-600S — After 1,750 operations
- K-800, K-800S — After 1,750 operations
- K-1600, K-1600S — After 500 operations
- K-2000, K-2000S — After 500 operations

The above inspection periods apply for no load or load current switching. If the listed number of operations are not completed in the first year of service, the circuit breakers should be inspected regardless. The circuit breaker should also be inspected after a short circuit or severe overload interruption, regardless of time period or number of operations.

Where unusual service conditions, as covered by ANSI Standard C37.13, exist, it must be assumed that these conditions were considered at the time of order; that the equipment supplied was designed for the special application; and that an appropriate supplemental maintenance program has been developed. These maintenance instructions only cover circuit breakers used under the standard usual service conditions.

The inspection should include opening and closing the circuit breaker electrically and manually. The unit should be visually inspected for loose or damaged parts. Arc chutes, contacts and insulation structure should be inspected as described below.

ARC CHUTE (Refer to Fig. 1)

Removal

1. If the circuit breaker has a solid state overcurrent trip device, it is necessary to remove two 1/4" diameter screws fastening the solid state control assembly. Move the assembly for access to the arc chute retaining screws.

2. Loosen the retaining screw (25) and remove the screw and retainer (26).

3. Pull the arc chute forward slightly then lift to remove.

Examination

1. Discoloration or slight eroding is not harmful.
2. Arc runners or cooling plates that are burned, or moldings that are cracked or broken require replacement of the arc chute.

Replacement

1. Properly position the arc chute in the upper molding.

2. Position retainer (26) and insert and tighten screw (25).

3. Replace the solid state control assembly.

CONTACTS

1. Remove dirt or grease on contacts with a clean lintless cloth.

2. Pitting or discoloration is not detrimental unless it interferes with proper contact adjustment.

3. Small burrs on the arcing contacts to be removed by filing along contour of the contact. Do not let filings fall into the mechanism.

4. Replace badly burned and pitted contacts that do not meet correct adjustment requirements.

5. If contacts are replaced or filed, then it is necessary to check the contact adjustment.

NOTE: Several operations at two week intervals will remove the effects of oxidation.

INSULATION STRUCTURE

Insulated parts should be checked for damage. Dust and dirt should be removed by air or wiped with a clean lintless cloth. Do not use any oil base solvents. Spray solvents vary as to type and are questionable. However, externally at rear terminals is the only critical area, which is easily wiped or blown out with air, so other methods are not necessary. If contamination is so great, means are probably necessary to isolate the entire equipment.

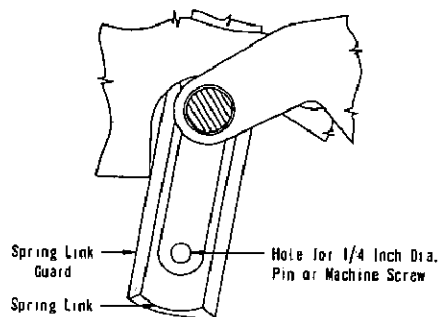


Fig. 4A

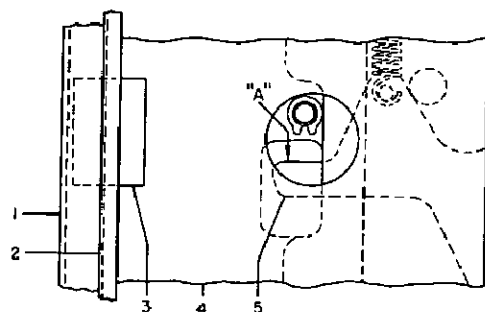


Fig. 4 — Partial View of Escutcheon Assembly (Right-Hand Side) Showing Slow Close Lever for Manually Operated Circuit Breakers

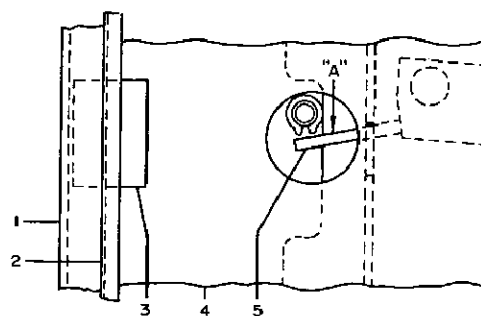


Fig. 5 — Partial View of Escutcheon Assembly (Right-Hand Side) Showing Slow Close Lever for Electrically Operated Circuit Breakers

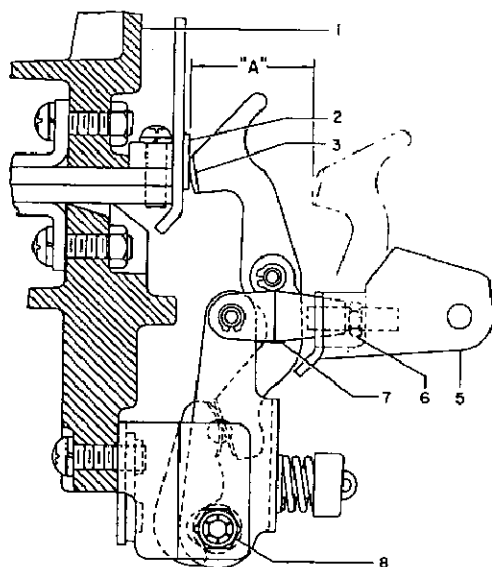


Fig. 6 — Contact Adjustment for Type K-225 Circuit Breakers

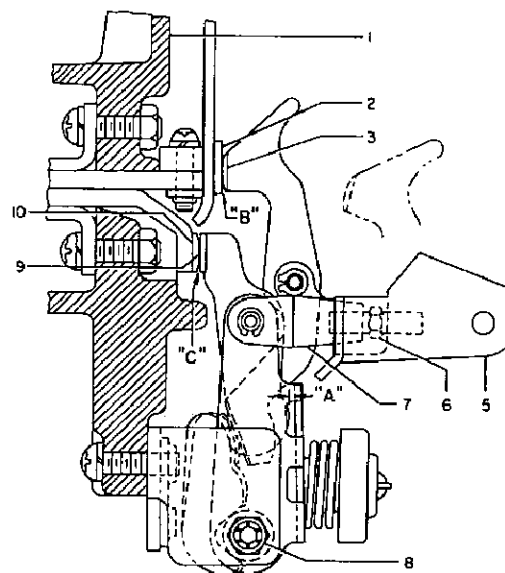


Fig. 7 — Contact Adjustment for Type K-600, K-600S, K-800, K-800S Circuit Breakers

ADJUSTMENTS

FOR SAFETY: See SAFETY NOTES in MAINTENANCE section.

NOTE: The operating mechanism must be operated slowly, as described in section SLOW CLOSE PROCEDURE, when performing any adjustment requiring contact movement.

In order to close the circuit breaker, the racking mechanism in drawout circuit breakers must be turned to a position such that the racking shutter (15, Fig. 1) is closed when the racking crank (21, Fig. 1) is removed.

SLOW CLOSE PROCEDURE

NOTE: The circuit breaker should be clamped down during the slow close procedure to keep it from tilting or moving.

Manually Operated Circuit Breakers

Refer to Fig. 4 unless otherwise noted.

1. On K-1600, K-1600S, K-2000 and K-2000S circuit breakers, at each of the two spring guards, loosely install $\frac{1}{4}$ inch diameter pins or machine screws. (See Fig. 4A)

2. Insert a screwdriver or rod through the hole in the escutcheon box (4) and mechanism housing assembly (right-hand side when facing the front of the circuit breaker).

3. Using the top of the hole as the fulcrum and the screwdriver or rod as the lever, depress the hold-up latch (5) at "A" and, at the same time, pull the operating handle downward to slowly close the circuit breaker contacts.

4. On K-1600, K-1600S, K-2000 and K-2000S circuit breakers, remove the two $\frac{1}{4}$ inch diameter pins or machine screws installed in step 1, after the slow close operation is complete.

Electrically Operated Circuit Breakers

NOTE: The charging cranks must be reset (see steps 8, 9, and 10 below) after the last slow close operation, or future electrical operation will be impossible.

Refer to Fig. 5 unless otherwise noted.

1. The closing springs must be charged; see spring charge indicator (16, Fig. 1).

2. Insert a screwdriver or rod through the hole in the escutcheon box (4) (right-hand side when facing the front of the circuit breaker) and depress the close block lever pin (5) at "A".

3. With the close block lever pin (5) held in the down position, lift the manual close lever (17, Fig. 1). The close block lever pin (5) will remain in the down position.

4. Insert the maintenance handle in the ratchet carrier and operate the handle to slowly close the contacts. (See Fig. 3 and "Emergency Operation".)

To repeat the slow close operation, continue with the following steps:

5. Insert the maintenance handle and continue the charging operation until the indicator (16, Fig. 1) shows "SPRINGS CHARGED"

6. Push manual "TRIP" button (13, Fig. 1) to open the contacts.

7. Repeat steps 2, 3, and 4 above for the slow close operation.

To reset the charging cranks for normal electrical operation, proceed as follows:

8. Repeat steps 5 and 6 above.

9. Lift manual close lever (17, Fig. 1) to close the contacts.

10. Push the manual "TRIP" button (13, Fig. 1) to open the contacts.

The circuit breaker is now ready for normal service operation with the charging cranks reset and the closing springs discharged.

CONTACTS

Type K-225 Circuit Breakers (Refer to Fig. 6)

1. The hex. portion of the adjusting stud (6) must be centered, within $1/16$ inch, between the yoke (7) and the insulator (5).

NOTE: On some circuit breakers, the hex. portion of the adjusting stud (6) must be centered between the locknut on the adjusting stud and the insulator.

NOTE: In the following steps 2 and 3, if adjustment is required, always turn the adjusting stud (6) in the direction to increase the contact pressure (counter-clockwise when viewed from the insulator).

2. Contact pressure is set by adjusting stud (6) for $1\frac{3}{4}$ inches, plus or minus $1/32$ inch open air gap measured at "A". Any adjustment of contact pressure must be followed by step 3.

3. Following the slow close procedure, slowly close the circuit breaker until the first contacts (2 and 3) just touch. The other two poles should be within .032 inch of touching. If not within .032 inch, then adjust stud (6) of these two poles in the direction to increase pressure until all three poles touch within .032 inch.

"If for any reason the breaker is disassembled and the contact structure Figures 6 and 7 is replaced or disassembled, the torque of the nut ((8) Figures 6 and 7)) should be checked. This should be adjusted to be between 15 and 25 foot pounds. This will provide sufficient side pressure on the hinge joint so the joint will be capable of adequately carrying its current rating."

Type K-600, K-600S, K-800, K-800S Circuit Breakers (Refer to Fig. 7)

1. The hex. portion of the adjusting stud (6) must be centered, within $1/16$ inch, between the yoke (7) and the insulator (5).

NOTE: On some circuit breakers, the hex. portion of the adjusting stud (6) must be centered between the locknut on the adjusting stud and the insulator.

2. Contact pressure is set by adjusting stud (6) so

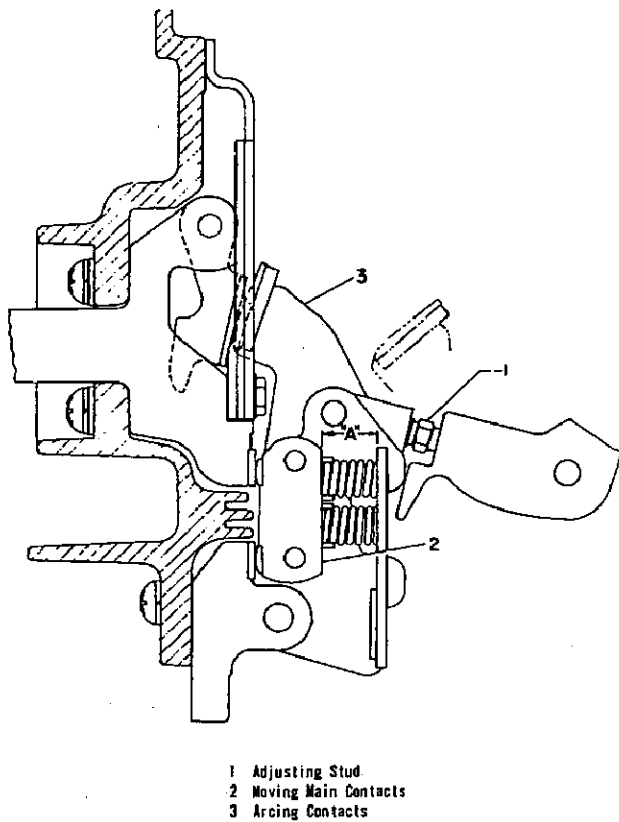


Fig. 8 — Contact Adjustment for Type K-1600, K-2000, K-1600S and K-2000S Circuit Breakers

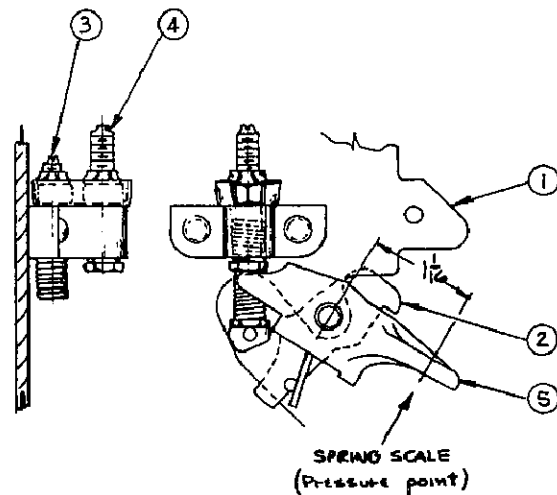


Fig. 9 — Latch Engagement and Tripper Bar Latch Engagement Adjustment

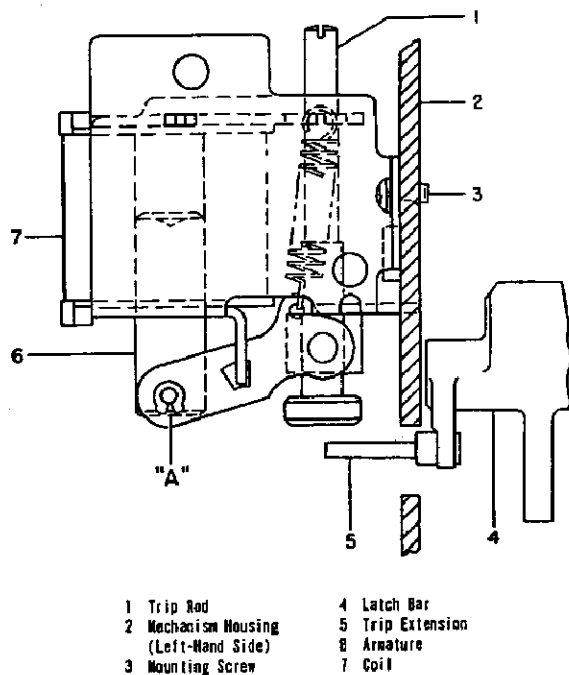


Fig. 10 — Shunt Trip Device Adjustment Type K-225 thru K-2000, K-1600S and K-2000S Circuit Breakers

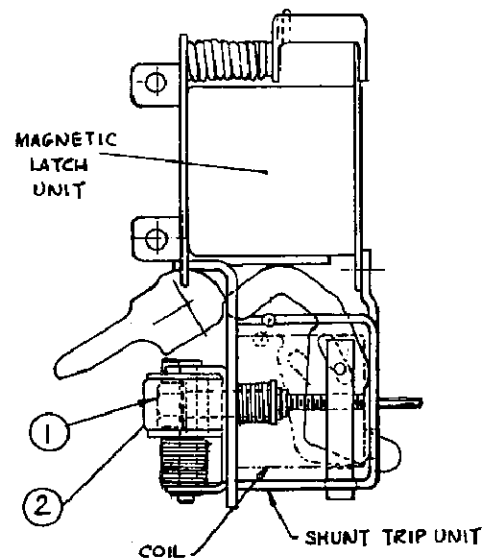


Fig. 11 — Shunt Trip Device Adjustment Type K-600S, K-800S Circuit Breakers

that there is a 5/64 to 3/32 inch gap, at "A", with the circuit breaker closed. This can be checked with 5/64 and 3/32 dia. wires (go and no-go) bent at 90 degrees. The 5/64 to 3/32 dimension is equivalent to .025 to .032 wiper, vertical movement of the main contacts during main contact engagement of the slow close operation. After adjusting, reclose the circuit breaker and recheck. Readjust if necessary. Any adjustment of contact pressure must be followed by step 3. Note that, after operation 3 is completed, contact pressure may exceed the 3/32 inch dimension on two poles. This is acceptable.

3. Following the slow close procedure, slowly close the circuit breaker until the first contacts (2 and 3) just touch. The other two poles should be within .032 inch of touching. If not within .032 inch, then adjust stud (6) of these two poles in the direction to increase pressure until all three poles touch within .032 inch.

"If for any reason the breaker is disassembled and the contact structure Figures 6 and 7 is replaced or disassembled, the torque of the nut ((8) Figures 6 and 7)) should be checked. This should be adjusted to be between 15 and 25 pounds. This will provide sufficient side pressure on the hinge joint so the joint will be capable of adequately carrying its current rating."

Type K-1600, K-1600S, K-2000, K-2000S Circuit Breakers (Refer to Fig. 8)

The main contact adjustment is to be made with the breaker in the latched closed position. The self-locking adjusting stud (1) is to be turned to provide contact pressure such that a 0.750 inch shim will just fit the space (A) at the rear of the moving main contacts (2).

After making this adjustment in contact pressure, open the circuit breaker, then reclose the circuit breaker normally and recheck the (A) gap. Readjust if necessary.

Open the circuit breaker and slow close the contacts until the arcing contact (3) of one pole just touches. The remaining poles should then be advanced by turning adjusting stud (1) so that these poles just touch or are within 0.032 inch of each other.

The contacts should now be in correct adjustment and the breaker may be put in service. Note that if an adjustment is necessary for "simultaneous" make, the contact pressure will increase on those adjusted poles. Thus, a dimension of less than 3/4 inch indicates more contact pressure, which is acceptable.

MECHANISM

The various mechanism adjustments described in the following sections apply to all circuit breakers covered by this Instruction Bulletin.

Latch Engagement (Bite) (Refer to Fig. 9)

The latch engagement adjusting screw (3) is located to the right of the right-hand mechanism housing (1). It can be reached easily from the top of the circuit breaker.

To adjust the latch (2) engagement, proceed as follows:

1. Back off adjusting screw (3) to assure excessive latch engagement.
2. Close the circuit breaker.
3. Turn adjusting screw (3) down slowly until the latch just releases, tripping the circuit breaker.
4. Back off the adjusting screw (3) 2 turns.

Tripper Bar Latch Engagement (Refer to Fig. 9)

The tripper bar latch engagement adjusting screw (4) is located adjacent to the latch engagement adjusting screw (3).

To adjust the tripper bar latch engagement, proceed as follows:

1. Back off adjusting screw (4) to assure excessive tripper bar travel.
2. Close the circuit breaker.
3. Turn adjusting screw (4) down slowly until the latch just releases, tripping the circuit breaker.
4. Back off the adjusting screw (4) 3 1/2 turns.

Tripper Bar Load (Refer to Fig. 9)

The tripper bar load is measured by use of a spring scale positioned as shown.

With the circuit breaker in the "CLOSED" position, the push required to trip the circuit breaker must be between 16 and 29 ounces.

SHUNT TRIP DEVICE

Trip Adjustment

Type K-225 thru K-2000, K-1600S, K-2000S

(Refer to Fig. 10)

1. Back off trip rod (1) until it will not trip the circuit breaker with the armature (6) pushed up as far as the travel will allow.
2. Close the circuit breaker.
3. Push up on the armature (6) at "A" as far as the armature travel will allow.
4. Hold the armature as positioned in step 3 and turn trip rod (1) down until the circuit breaker just trips.
5. Turn trip rod (1) down an additional 3 turns.

Trip Adjustment

Type K-600S, K-800S

(Refer to Fig. 11)

1. Turn hex. head adjustment screw (1) counter-clockwise (viewing from head end) until the circuit breaker will not trip when the armature (2) is pushed in as far as travel will allow.
2. Close the circuit breaker.
3. Push in on armature (2) as far as the armature travel will allow.
4. Hold the armature as positioned in step 3 and turn the hex. head adjustment screw (1) clockwise until the circuit breaker just trips.
5. Turn the hex. head adjustment screw (1) an additional 1 turn.

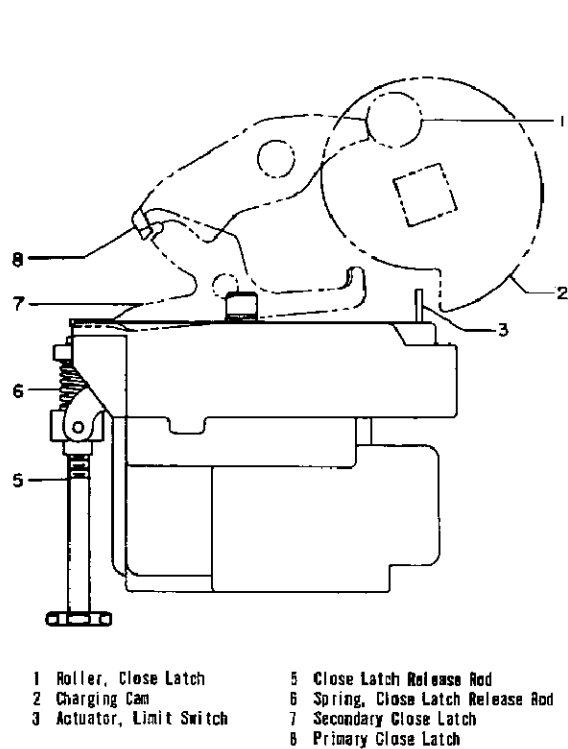
CONTROL DEVICE (Refer to Fig. 12)

The control device is adjusted before leaving the factory. It is recommended that no attempt be made to adjust the internal relays and contacts of this device in the field. If replacement of the control device is required, the close latch release rod (5) overtravel may be adjusted as described below.

Close Latch Release Rod Overtravel

1. Back off on close latch release rod (5) and check that the circuit breaker will not close by attempting to close it electrically or manually pushing up on close latch release rod (5) to the full extent of its travel.

2. Charge the closing springs. Push up on close latch release rod (5) to the full extent of its travel. While holding the close latch release rod in this position, turn up on close latch release rod (5) until the circuit breaker closes. Turn close latch release rod (5) up an additional $1\frac{1}{2}$ turns.

**Fig. 12 — Control Device Adjustment****MAGNETIC LATCH DEVICE (Type K-1600S, K-2000S)
Trip Adjustment (Refer to Fig. 13)**

1. Turn adjusting screw (1) out as far as possible so that the circuit breaker will not trip when the magnetic latch trips.

2. Remove the terminal block cover on the solid state assembly by removing two lower screws (Fig. 19). Disconnect two wires at terminals 15 and 16.

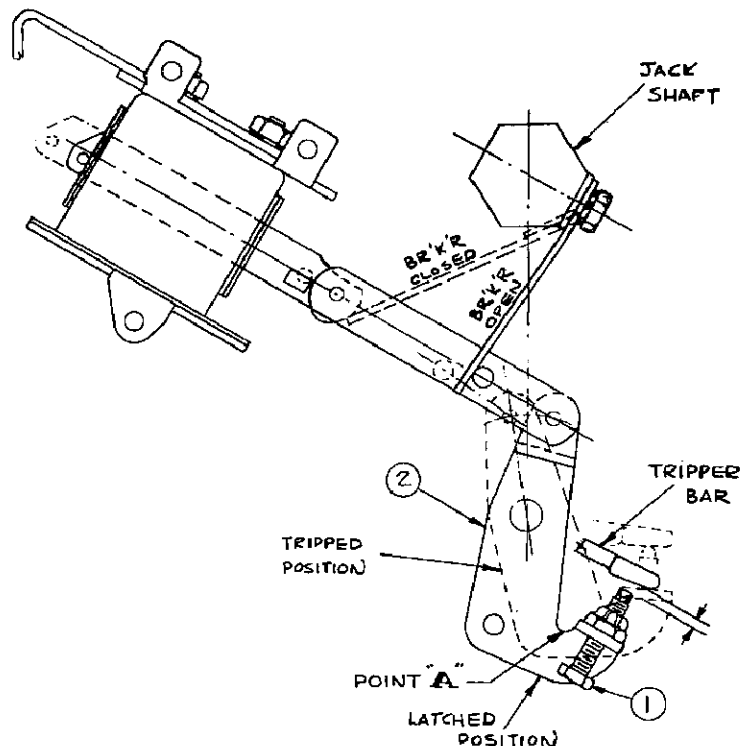
3. Close the circuit breaker.

4. While lightly holding down at point "A" so that the lever (2) does not move through its full stroke and trip the circuit breaker, momentarily apply the voltage (3V) from two dry cell batteries, size "D", to the two wires (+ to wire 16, - to wire 15) that were disconnected in operation 2. The magnetic latch should trip.

5. Gradually release the hold on lever (2).

6. While holding the lever (2) in the tripped position, turn in on screw (1) until the circuit breaker just trips, then turn in one additional turn.

7. Replace wires 15 and 16 and the terminal block cover.

**Fig. 13 — Magnetic Latch Trip Adjustment
Type K-1600S and K-2000S Circuit Breakers**

ELECTRO-MECHANICAL OVERCURRENT TRIP DEVICE ADJUSTMENTS

Long-Time Delay Band Adjustment

OD Types 4, 6, 20, 61 (See Fig. 15)

OD Type 5 (See Fig. 16)

Turn the adjustment until the top of the long-time delay indicator is in line with the desired delay line (Fig. 14). Push the armature toward the magnet, allowing time for the oil in the dashpot to be displaced. Release the armature, allowing the armature to reset. Check to see that the long-time indicator and line are in line. Readjust if required, and recheck by pushing the armature and allowing it to reset.

NOTE: OD-3 has only one long-time delay setting; which is factory set and therefore adjustment is not required.

Pick-Up Setting Adjustments (See Fig. 14)

Pick-up settings may be changed by turning the appropriate adjusting screw until the moving indicator lines up with the desired pick-up point line.

NOTE: The top line corresponds to the top pick-up point, the second line from the top corresponds to the second pick-up point from the top, etc.

Short-Time Delay Adjustment

OD Types 4, 5, 9, 10 (See Fig. 17)

Move the lever toward the left of the circuit breaker so that the short-time step pin can be moved to the desired short-time delay pin hole. Make certain the step pin drops into the pin hole.

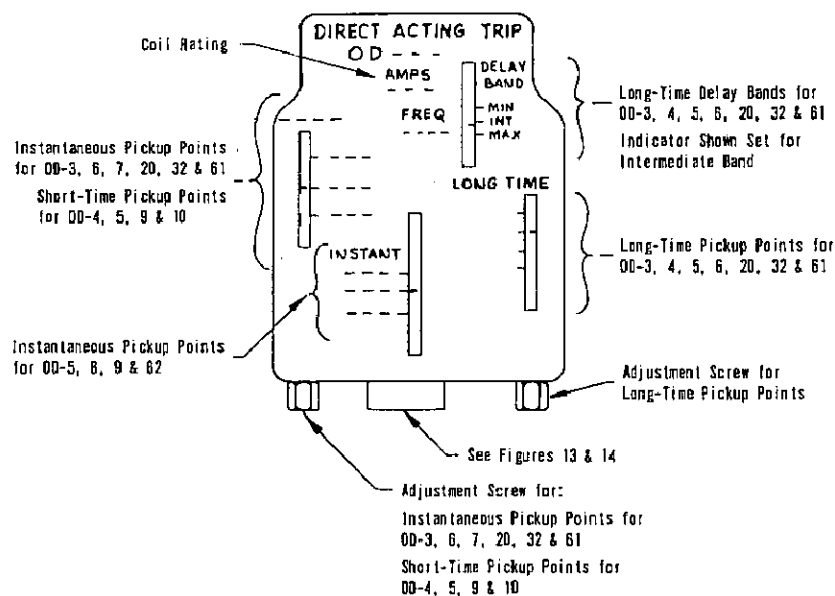


Fig. 14

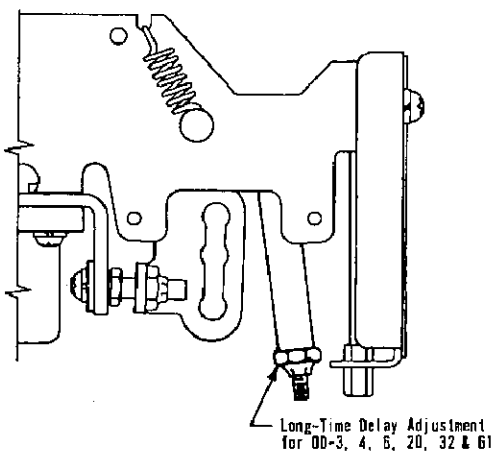


Fig. 15

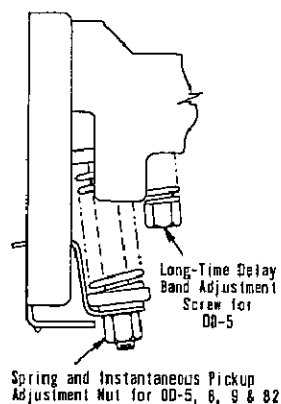


Fig. 16

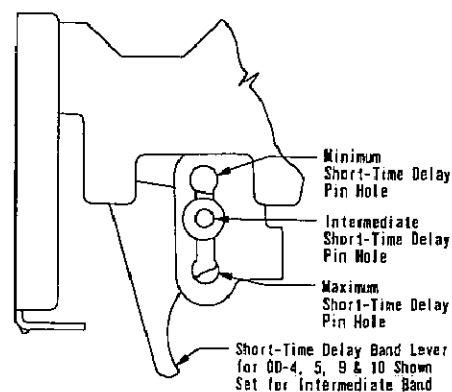


Fig. 17

Armature Trip Travel Adjustment

FOR SAFETY: Keep hands clear of all moving parts. The circuit breaker will trip to the "OPEN" position while checking or adjusting the armature trip travel.

The overcurrent trip device trip travel is set at the factory; however, if trip travel readjustment is required due to replacement of overcurrent trip devices or other parts, then readjust as follows:

1. (See Fig. 18). Back out on the two trip adjusting screws (1) until the screws are engaging the nut by approximately two turns.

2. Charge springs and close circuit breaker.

3. Using a one-foot long (approximate) stick, push up on the long-time armature, thick armature, at point "A", and hold it tight against the magnet. (When pushing, allow time for the oil dashpot to displace the oil.) While holding the armature in this position by pushing at point "B", turn up on screw (1) until the circuit breaker just trips. Continue to turn the screw an additional one turn. NOTE: During this adjustment operation, hold the armature firmly against the magnet, but do not exert excessive force that will result in incorrect adjustment due to distortion.

4. Charge springs and close circuit breaker. Push up on the thin armature and adjust screw (1) using the same procedure as in step 3 above.

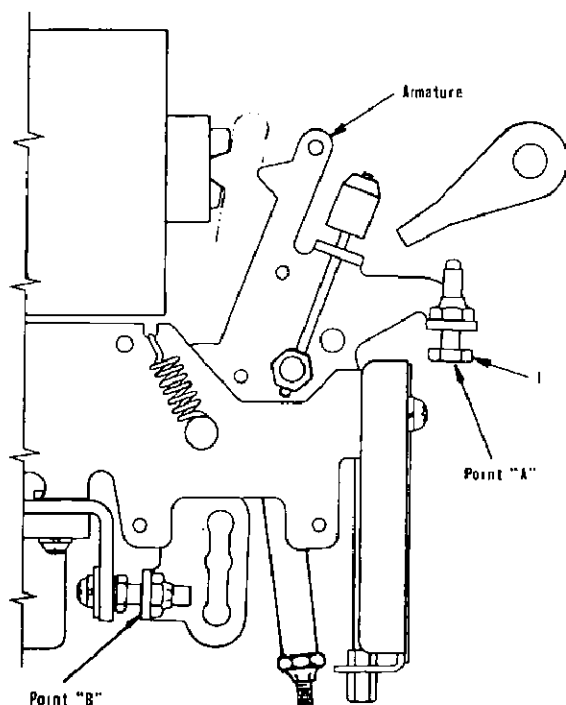


Fig. 18 — Armature Trip Travel Adjustment

5. Readjust the trip travel at the other two poles using the same procedure (steps 1 through 4).

Field Testing of Electro-Mechanical Overcurrent Trip Devices

Refer to IB-9.1.7-5 for complete testing of devices, using high current test sets.

SOLID STATE OVERCURRENT TRIP DEVICE SETTINGS (See Fig. 19)

No adjustments are necessary in selecting trip settings on this trip device. The selector plugs (solid circle) allow flexibility in settings and may be moved from one plug tap to another, consistent, however, with the pickup and time band settings necessary for proper circuit protection. Make certain that the selector plugs are pushed in completely for proper operation. If a plug is left out or not secure, the affected element will trip at the minimum setting shown, for safety, but coordination will be affected.

Field Testing of Solid State Overcurrent Trip Devices

For complete testing of these devices, refer to the following Instruction Bulletins:

IB-9.1.7-21 (Device in RED CASE)

IB 6.1.2.7 - 4 (Device in GRAY CASE)

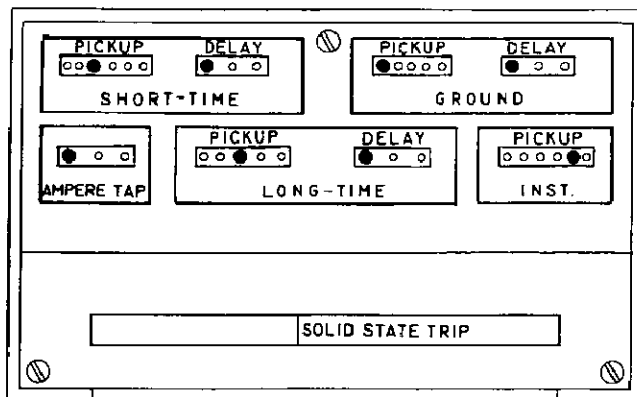


Fig. 19 — Solid State Overcurrent Trip Device
Type SS-5G Shown

LUBRICATION

The K-line circuit breakers are lubricated during factory assembly as follows:

1. All mating surfaces of moving current-carrying joints have been lubricated with NO-OX-ID special Grade "A" grease manufactured by Dearborn Chemical Company.

2. All other mechanism parts, bearings, pins, etc. have been lubricated with ANDEROL L757 manufactured by Tenneco Chemical, Inc., Intermediate Division.

The circuit breaker requires no lubrication during its normal service life. However, if the grease should become contaminated or if parts are replaced, any relubrication should be done with NO-OX-ID or ANDEROL grease as applicable.

NOTES:

1. Do not use NO-OX-ID grease on any main and arcing contact surfaces.

2. It is recommended that the primary disconnects be maintained by renewing the NO-OX-ID grease during maintenance periods.

3. Do not use light oil to lubricate any mechanism parts.

4. Do not allow grease to be deposited on any latch roller surface during relubrication.

5. The charging motor is sealed and no lubrication is required.

6. DO NOT LUBRICATE OVERCURRENT TRIP DEVICES OR OTHERWISE CLEAN OR SPRAY WITH ANY SUBSTANCE OTHER THAN AIR.

DIELECTRIC TEST

If the insulation has become contaminated, or routine tests are required, the test voltages to be applied for one minute to test the ability of the insulation to withstand overvoltages are as shown in Table 2, below.

It is not recommended that the motor be dielectric tested, but if desired, then test at 540 V ac or 760 V dc.

On K-600S through K-2000S circuit breakers, connect all sixteen terminals of the power shield solid state logic box together and to ground when conducting tests listed in Table 2. These terminals are located under the lower front cover of the logic box.

An additional dielectric test should be performed on K-600S through K-2000S circuit breakers as follows: Connect all sixteen terminals of the power shield solid state logic box together and apply 500 V ac between the sixteen terminals and metal parts normally grounded.

ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES

For closing and tripping currents, voltages and ranges, refer to Table 3, page 20.

For undervoltage trip devices, standard voltages and operating data, refer to Table 4, page 20.

Current values are average steady state values. Momentary inrush currents for all charging motors and ac coils are approximately 6-8 times these values.

RENEWAL PARTS

We recommend only those renewal parts be stocked that will be required to insure proper and timely maintenance for normal operation of the circuit breakers.

Refer to Renewal Parts Bulletin RP 6.1.2.8 - 1 for complete ordering information and Parts List. A copy of this bulletin will be furnished on request.

The minimum quantity of assemblies and items recommended in this bulletin is predicated on infrequent replacement of parts based on accumulated tests and operating experience. Total assemblies are recommended for fast replacement, when necessary, to return the breaker to service as quickly as possible. Then certain replaced assemblies, such as the stationary upper terminals, can be returned to the factory for nominal reconditioning. The bulletin contains specific part ordering instructions; and if desired, specific instructions regarding replacement of those part assemblies recommended, that are not obvious, are also available if ordered.

TABLE 2
TEST VOLTAGES TO BE APPLIED FOR ONE MINUTE
TO TEST THE ABILITY OF THE INSULATION TO WITHSTAND OVERVOLTAGES

	Breaker Open	Breaker Closed	Breaker Open or Closed
Breaker in Service or After Storage	1650 V ac -- 2300 V dc a. Between line and load terminals and metal parts normally grounded. b. Between line and load terminals	1650 V ac -- 2300 V dc a. Between terminals and metal parts normally grounded. b. Between phases.	1125 V ac -- 1600 V dc a. Between control circuit and metal parts normally grounded. NOTE: Motor must be disconnected from control circuit for this test.
After Short Circuit	1320 V ac -- 1860 V dc a and b as above	1320 V ac -- 1860 V dc a and b as above	900 V ac -- 1260 V dc a as above

TABLE 3
ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES
CLOSING AND TRIPPING CURRENTS, VOLTAGES AND RANGES

Type Breaker	Nominal Control Voltage	Average Closing Motor Current Amperes	Shunt Trip Current Amperes	Closing Relay Current Amperes		Closing Circuit Voltage Range	Shunt Trip Circuit Voltage Range	Recommended Control Fuse Size
				Anti-Pump	Release			
K-225 thru K-2000 and K-600S thru K-2000S	120 V ac 60 cycle	10.	6.5	.15	1.5	104-127	50-127	10 A
	240 V ac 60 cycle	5.	1.15	.075	.75	208-254	208-254	10 A
	48 V dc	25.	3.14	.15	1.33	38-56	28-56	15 A
	125 V dc	10.	1.3	.06	.7	100-140	70-140	10 A
	250 V dc	5.	.65	.03	.3	200-280	140-280	10 A

TABLE 4
UNDERVOLTAGE TRIP DEVICE
STANDARD VOLTAGES AND OPERATING DATA

Service Voltage	Current at Rated Volts	Maximum Pickup Voltage	Dropout Voltage Range
120 V ac 60 cycle	0.5	102	36-72
240 V ac 60 cycle	0.2	204	72-144
480 V ac 60 cycle	0.1	408	144-288
48 V dc	0.3	41	15-29
125 V dc	0.2	106	38-75
250 V dc	0.1	212	75-150