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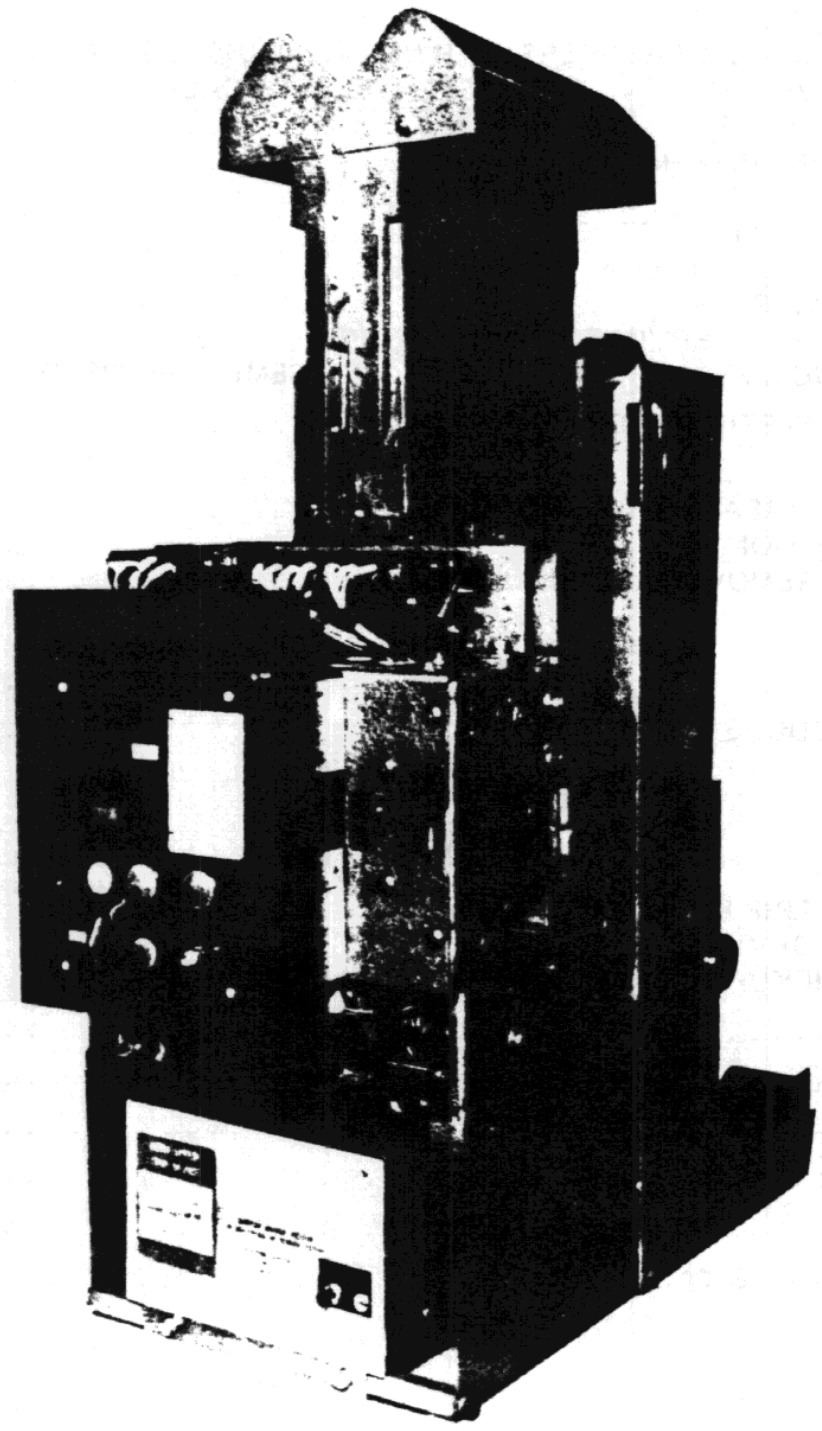
Installation/Maintenance Instructions

I-T-E D-C Low-Voltage Power Circuit Breakers

Type FBK-H High Speed

1600 thru 10,000 Amperes
800 Volts



Brown Boveri Electric

CONTENTS

PAGE

INTRODUCTION . . . 3
RECEIVING AND STORAGE . . . 3
BASIC HANDLING INSTRUCTIONS . . . 3
CIRCUIT BREAKER OPERATION . . . 3
- CIRCUIT BREAKER RATING . . . 3
- BASIC CIRCUIT BREAKER OPERATION . . . 3
- CLOSING SPRING OPERATION . . . 4
- ESCUTCHEON OPERATING FEATURES . . . 4
- OPERATION OF DEVICES . . . 5
  - CIRCUIT BREAKERS RATED OVER 6000 AMPERES CONTINUOUS . . . 5
  - TWO-POLE CIRCUIT BREAKERS . . . 5
  - SINGLE-POLE CIRCUIT BREAKERS WITH NEGATIVE DISCONNECT . . . 5
  - HIGH SPEED OVERCURRENT TRIP SYSTEM (ELECTRICAL) . . . 5
  - HIGH-SPEED TEST TRIP . . . 5
  - HIGH-SPEED TRIP (MECHANICAL) . . . 5
  - OTHER TRIP DEVICES . . . 5
  - RATE-OF-RISE FAULT DETECTOR 76HS-RR . . . 6
  - CONTROL DEVICE (LS) (X) (Y) . . . 6
  - AUXILIARY SWITCHES . . . 6
  - DIRECT ACTING UNDERVOLTAGE TRIP DEVICE . . . 6
  - DIRECT ACTING OVERCURRENT TRIP DEVICES (SEMI-HIGH SPEED) . . . 6

INSTALLATION, INITIAL TESTING AND REMOVAL . . . 6
- INSTALLATION . . . 6
- CHECKING CIRCUIT BREAKER OPERATION . . . 7
- EMERGENCY OPERATION . . . 7
- CIRCUIT BREAKER REMOVAL (DRAWOUT TYPE) . . . 7

MAINTENANCE . . . 8

ADJUSTMENTS . . . 9
- SLOW CLOSE PROCEDURE . . . 9
- CONTACTS . . . 9
- HIGH-SPEED TRIP . . . 9
- MECHANISM . . . 9
- SHUNT TRIP DEVICE . . . 10
- CONTROL DEVICE–TRIP ROD ADJUSTMENT . . . 10
- OD-OVERCURRENT DEVICE ADJUSTMENTS . . . 10
- HIGH-SPEED TRIP PICKUP SETTING . . . 10

LUBRICATION . . . 10

DIELECTRIC TEST . . . 10

ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES . . . 11

RENEWAL PARTS . . . 11

REFERENCES . . . 11

ILLUSTRATIONS, DRAWINGS & TABLES . . . 11 17

INSTRUCTIONS FOR FBK-H CIRCUIT BREAKER

Stationary and Drawout Mounted

INTRODUCTION

These instructions apply to the type FBK H 1600 through FBK-H 10,000 circuit breakers, 1600 through 10,000 ampere D.C. continuous current rating respectively at any voltage up to 800V. D.C. These high-speed circuit breakers will limit the magnitude and duration of fault currents to values significantly less than the circuit's available peak current. The circuit breakers are available as one or two pole breakers with high-speed trip in forward and/or reverse direction. Also available, is a negative disconnect withdrawal unit. The mechanisms are electrically operated and mechanically latched with provision for manual close, trip and maintenance slow closing.

A drawout type FBK-H 4000, single pole, 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 representative. Brown Boveri Electric 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 breakers parts. Check the contents of each carton against the packing list before discarding any packing material. If any discrepancy is discovered, promptly notify the company representative. 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 locations as soon as possible. (See Basic Handling section.) 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 a clean and dry location or covered and 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 crate, it should be kept in the upright position and placed on a flat surface to avoid damage to breaker parts. For safety, all handling in this position should utilize a lifting yoke (Figure 1, Item 20).

CIRCUIT BREAKER OPERATION

CIRCUIT BREAKER RATING

The continuous current rating is the maximum current that can be carried without exceeding rated temperature rise. There is no overload rating.

Exceeding the current rating may raise the temperature of the breaker beyond its design limit and thus affect the life of the circuit breaker.

BASIC CIRCUIT BREAKER OPERATION (See Fig 2)

(Refer to the specific schematic diagrams, electrical operating sequences and any other operational information furnished with the order.)

With the circuit breaker open, the closing springs discharged, the control power source energized, and the motor disconnect switch (MDS) closed, operation occurs as follows:

1. Immediately upon availability of control power, the spring charging motor is energized, which in turn charges the closing springs. When the closing springs are charged, limit switch contacts "LS/1" and "LS/3" are opened, and limit switch contact "LS/2" is closed.

2. Operation of the remote close control switch or local electrical close pushbutton (when supplied) energizes the close latch release coil (X) through the circuit breaker auxiliary switch "L/b" contact, the normally closed lockout relay contact "Y/2," the 76 HS1 contact and the limit switch contact "LS/2." The close latch release coil (X) releases the latch and the springs then discharge to close the circuit breaker.

3. When the springs discharge, limit switch contacts "LS/1" and "LS/3" close and limit switch contact "LS/2" opens.

4. When the circuit breaker closes, all auxiliary switch "b" contacts open and all auxiliary switch "a" contacts close.

5. When the limit switch contacts "LS/3" close, the lockout relay coil (Y) is energized and opens lockout contact "Y/2" which de-energizes the close latch release coil (X). Lockout contact "Y/1" closes which seals in the lockout relay coil (Y) as long as the "close" contact is maintained. The purpose of the lockout coil (Y) is to prevent pumping of the closing mechanism when closing against a faulted circuit.

6. The circuit breaker can be tripped by operation of the remote trip control switch which energizes the circuit breaker trip coil (TC) through the auxiliary switch "L/a" contact.

7. The closing springs recharge when the breaker is in the closed position.

CLOSING SPRING OPERATION

The two closing springs supply the power that closes the circuit breaker and also charge the 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". For safety, the closing springs are automatically discharged when drawout circuit breakers are racked from the disconnected to the withdrawn position.

ESCUTCHEON OPERATING FEATURES

FBK-H circuit breakers are provided with an extendible escutcheon face plate. This escutcheon provides a central area for the controls and indicators which are mounted directly on the circuit breaker.

The controls and indicators (Figure 1) included on the escutcheon face plate are: (19) nameplate giving the rating assigned to the particular circuit breaker, (13) manual trip button, (12) electrical close push button switch, (10) motor disconnect switch, (14) "OPEN" and "CLOSED" position indicator, (11) means for padlocking the circuit breaker in the "CONNECTED", "TEST", or "DISCONNECTED" position and (16) closing spring charge indicator. Maintenance handle (22) is inserted for manual spring charging and maintenance slow closing.

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 adjusts its position to still function as a dust shield.

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, (3) serial number, (4) continuous current rating, (5) short circuit current rating at rated voltages and (6) momentary current rating.

Circuit Breaker "Open" or "Closed" Indicator
(Figure 1, Item 14)

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

Manual Trip Button (Figure 1, Item 13)

This button, when pushed, mechanically trips the circuit breaker to "OPEN".

Padlocking Device (Figure 1, Item 11)

All FBK-H circuit breakers are equipped with means for 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 tripped position 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 (tripped position). 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 also 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" when padlocked.

Closing Spring Charge Indicator
(Figure 1, Item 16)

Under normal operating conditions, the closing springs are automatically charged after each closing 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 aperature in the escutcheon plate. The indicator is marked "SPRINGS CHARGED" and "SPRINGS DISCHARGED".

Auto-Trip Indicator (Optional)
(Figure 1, Item 17)

This button, engraved RESET, is located on the breaker escutcheon, when furnished Its normal position is depressed flush with the escutcheon. It can be arranged to pop out if the breaker trips automatically due to:

A. Operation of the Direct Acting Overcurrent Trip Device (Optional)

B. Operation of the Direct Acting Undervoltage Trip Device (Optional)

Depress the button before reclosing the circuit breaker.

Motor Disconnect Switch (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 volts.

Electrical Close Push Button (Figure 1, Item 12)

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

Racking Mechanism (Drawout Breaker)

The racking mechanism is 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 can be lifted to rack the circuit breaker to another

position. The circuit breaker cannot 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 "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 cannot be lifted and the breaker contacts cannot 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 within the compartment. One set, located on the dust cover, is utilized with the compartment door closed and one set, located on the cradle, is utilized with the door open.

OPERATION OF DEVICES

Circuit Breakers Rated over 6000 Amperes Continuous

Circuit breakers with these ratings consist of two (2) main contact assemblies with the upper terminals connected in parallel and the lower terminals connected in parallel. The electro-mechanical trip devices and high speed trip devices are calibrated for the current that passes through one main contact assembly and is equal to one-half the current passing through the circuit breaker.

Two-Pole Circuit Breakers

Two-pole circuit breakers with a continuous current rating less than 8000 amperes are assembled on one (1) circuit breaker frame. Two-pole circuit breakers with continuous current ratings of 8000 amperes and above consists of two (2) circuit breaker frames with the breakers being electrically interlocked.

The normal overcurrent trip device arrangement is to provide the high speed function(s) on the left hand pole and the direct acting overcurrent trip function (when ordered) also on the left hand pole.

Single-Pole Circuit Breakers with Negative Disconnect

Single-pole/negative disconnect circuit breakers rated up to and including 6000 amperes are on one (1) circuit breaker frame. Single-pole / negative disconnect circuit breakers rated in excess of 6000 amperes consists of two (2) frames, the circuit breaker on one (1) frame and the disconnect on the other.

High-Speed Overcurrent Trip System (Electrical Operation)

The high-speed overcurrent trip system is a multi-component system consisting of sensor(s), a high-speed trip control assembly (76HS), and the impulse trip coil. The system is represented by block diagram (see Figure 11).

The sensor(s), supplied in several ratings, provides a signal in direct response to the direction and level of the current (I) through the circuit breaker. This signal initiates the tripping operation. By proper selection of sensor ratings and connections, forward and/or reverse tripping functions are provided at selected settings.

The Hall device, integral in the sensor, produces an output voltage signal proportional to the current (I) through the circuit breaker and in the same polarity. When a fault occurs, this output voltage exceeds the level-detector threshold voltage value; (pickup) and the detector initiates a firing pulse to energize the impulse trip coil, which opens the circuit breaker. This high-speed tripping operation causes the circuit breaker contacts to part in approximately 3 milliseconds after the fault level reaches the selected pick-up value.

Pickup settings are provided that are 1.0, 2.0, 3.0 and 4.0 times the selected sensor rating and a tap block with plug is mounted on the front panel of the assembly for selecting the pickup setting required.

Monitoring: The high-speed control assembly is designed to monitor the trip system and to provide automatic interlocking in the event of low or unavailable control power. If control power is unavailable or the voltage is low, 76HS1 contact opens the close latch release coil circuit (Fig. 2). If the breaker is open, it cannot be closed electrically. 76HS3 contacts also opens. This contact is available to customer and is rated 15VA non inductive, 1 Amp maximum.

After a high-speed tripping operation, interlocking will not allow the breaker to close until the tripping capacitor is fully recharged. Refer to Table 4 for capacitor charging time.

High-Speed Test Trip

Another feature provided is a test push button which provides a means of simulating a sensor output signal above the pickup level. Pressing this button with the breaker closed will cause the breaker to trip open. This test should only be made with the circuit breaker in the **test** position when automatic reclosing equipment is provided, unless such equipment is disconnected for the test period.

High-Speed Trip (Mechanical Operation) (Refer to Figure 7)

As described in the electrical operation, above, the impulse trip coil (6) is energized when the current level through the circuit breaker reaches a predetermined value or when the high-speed test pushbutton (31, Fig. 1) is pushed. The impulse trip armature (2) acts on the high-speed trip latch (7) that releases the roller (8) connected to the main contact assembly. This sequence constitutes the high-speed trip operation.

When the latch (7) moves to release roller (8), it also causes the actuator (9) to strike the mechanism trip screw (4) that initiates the movement of the mechanism to the open position.

Other Trip Devices

Other trip devices such as shunt trip, undervoltage or electro-mechanical overcurrent trip devices act directly on the latch bar (10) causing roller (8), latch (7) and the jack-shaft to move as a unit in opening the circuit breaker. The operating trip times of these devices are not as fast as the high-speed overcurrent trip system.

Rate-of-Rise Fault Detector 76HS-RR
(Optional)

For transit application the rate-of-rise fault detector (R-R) functions to discriminate between normal train starting currents and actual track fault currents. The circuit is based on a true rate-of-rise principle. Upon detection of the track fault, the breaker will trip within a preset time limit. This device has adjustable time delay. This adjustment provides fault detection "reach" based on the parameters of the system. Inherent with this device is a push button operated test circuit for periodic maintenance checks. The test circuit simulates a track fault signal which checks the integrity of the R-R detector and trip system. NOTE: Where automatic reclosing circuitry is provided, the above test should only be made when the breaker is in the TEST position or if the reclosing circuit is disconnected during the test.

Control Device (Fig. 9)

This 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 (Y), and the latch release relay (X). 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. A close latch release plunger is available for manual close and spring discharge operation.

The purpose of the lockout relay (Y) 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 (anti-pump). The operating coil of lockout relay (Y) is designed for continuous duty. Consequently, the close signal can be a maintained contact.

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 arrangements. 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.

Direct Acting Undervoltage Trip Device
(Optional)

The electrically reset undervoltage trip device automatically trips the circuit breaker when the line voltage decreases to 30 to 60 percent of the rated voltage. This device may be furnished for either instantaneous or adjustable time delay (0.15 seconds) tripping.

See Table 3 for electrical characteristics.

NOTE: If no means are provided to trip the circuit breaker on loss of control power, a remote indication may be obtained by paralleling the 76HS3 contact with an auxiliary switch "b" contact. A closed circuit indicates a good power supply or an open breaker. An open circuit indicates a closed breaker with no high-speed trip capability.

Direct-Acting Overcurrent Trip Devices (Fig. 10)
(Optional) (Semi High Speed) (Bi-directional)

A. Type ODFBK-8 Overcurrent Trip Device. This device provides semi-high-speed instantaneous tripping normally adjustable from .8X to 2.5X the circuit breaker continuous current rating. A screw on the bottom of the device provides adjustment for the instantaneous pickup. The instantaneous setting is indicated on the device nameplate.

B. Type ODFBK-3 Dual Overcurrent Trip Device. This trip device, for general purpose applications, provides long-time delay tripping on moderate overcurrents which are above the long-time pickup settings; and instantaneous (semi-high-speed) tripping on fault currents above the instantaneous trip setting. Three adjustment screws on the bottom of the device provide independent control of the long-time delay.* The setting of these adjustments and the range of settings which are available are indicated on the device nameplate. The long time pickup is adjustable from 0.5X to 1.0X the circuit breaker continuous current rating. The instantaneous pickup is adjustable from 1.0X to 4.0X the circuit breaker continuous current rating. The time-current characteristics of this device are shown on Dwg. TD-6991 (copies available upon request).

*The long-time delay adjusting screw is factory set and is not to be disturbed.

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 should 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 should be done in the "TEST" position.

NOTE: If the circuit breaker has an overcurrent device with long-time delay (OD FBK-3), then, prior to inserting the circuit breaker into the switchboard and with the breaker in the upright position, exercise the longtime armature (1" wide armature) several times until resistance to motion has increased, indicating that the oil dashpot is functioning properly. Improper operation can result if 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) (Refer to Fig. 1)

Lifting yoke (20, Fig. 1) can be used to move the breaker to the installation location.

INSTALLATION (Drawout Type) (Refer to Fig. 1)

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

1. The circuit breaker must be in the "OPEN" position, the racking crank turned in the counter clockwise direction fully against its stop, and the motor disconnect switch (10) 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 (20), lower the circuit breaker so that the positioning wheels (6) (two on 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 wheels reach the end of the cut-outs. While holding the two latches (24, one on each side of the circuit breaker) down, push the circuit breaker toward the compartment until the racking cams (4) stop against their guides on the cradle (28). Release hold on latches

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. The shutter should close if the breaker is in the proper position

CHECKING CIRCUIT BREAKER OPERATION IN "TEST" POSITION (DRAWOUT TYPE) CONTROL POWER ON (Refer to Fig. 1)

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

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

NOTE: All breakers have a manual trip button. A local electrical trip button is optional.

3. Close and trip circuit breaker by means of remote control switch, (when used) if the control scheme allows this with the breaker in the "TEST" position.

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 while closed in the test position.

6. With the circuit breaker closed, push the high-speed test push button (31). The circuit breaker should trip, indicating that simulated sensor output signal will trip the circuit breaker. Note that a delay is required before the circuit breaker can be reclosed. The delay time is shown in Table 4.

7.* With the circuit breaker closed, de-energize the control circuit and note that the circuit breaker will open

CHECKING CIRCUIT BREAKER OPERATION IN "CONNECTED" POSITION (DRAWOUT TYPE) CONTROL POWER ON (Refer to Fig. 1)

Primary supply circuit must be de-energized 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. Proceed per "TEST" position operation above.

*Optional Feature

CHECK 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 (Refer to Fig. 3)

Circuit breakers may be charged manually by a removable maintenance handle (4) 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 are now fully charged and ready for a closing operation.

NOTE: The motor crank arm (3) may occasionally stop 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) (Refer to Fig. 1)

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

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

2. Lift racking shutter (15), insert racking crank and turn counter-clockwise 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. Remove the racking crank.

4. Open compartment door. Place motor disconnect switch (10) in the "OFF" position.

5. Insert racking crank and turn counterclockwise as far as the stops will allow. Check that the automatic spring discharge device will discharge the closing springs near the end of the racking operation.

6. Pull circuit breaker forward on tracks (23) to the fully extended and latched position.

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

8. Remove circuit breaker from tracks by means of lifting yoke and crane.

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

MAINTENANCE

SAFETY NOTES

De-energize both primary and control circuits before making any inspections, adjustments or replacements of parts. Make certain the circuit 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 charging 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 after a given number of operations as follows:

FBK-1600–6000-1 pole	500 Operations
FBK 8000 and 10000 and all 2 pole	250 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 exist, as covered by ANSI C37.14, 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. All accessible bolts, nuts and screws should be checked to insure that they are tight.

ARC CHUTE (Refer to Fig. 1)

Removal

1. Remove the hardware fastening the two return connections (9) to the arc chute.
2. Remove 2 bolts and washers (25).
3. Lift the arc chute straight up to remove.

Examination

Examine the arc chute for damage Discoloration or slight eroding is not harmful Arc runners or cooling plates that are badly burned or liner plates with large cracks require that the arc chute be replaced If a crust has formed on the liner plates, due to short circuit interruption or current switching, it should be removed by using a carborundum stone or scraper Remove all dirt by blowing out the arc chute with dry compressed air.

Installation

The arc chute is installed by reversing the removal sequence. Make sure to tighten the hardware at each end of the return connection.

On breakers equipped with *two (2)* arc chutes, there is a tie-rod located between the chutes. This rod ties the arc chute shelf (32, Fig. 1) to the rear breaker frame, if at any time this rod is disturbed or replaced, readjust as follows (The breaker must be open and the arc chutes installed.) Insert the rod through both holes in the shelf and the hole in the rear frame. Install a nut on both ends of the rod equalizing the thread on each end. Before tightening fully, insert a .010 shim under either nut, continue tightening the nuts until pressure is felt on the shim. Do not tighten further Remove the shim

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 can be removed by filing along contour of the contact. Do not let filings fall into the mechanism or puffer nozzle.
4. Replacement of contacts need only be considered when: after repeated dressing of any contacts, less than 50% of the original contact material thickness is left; the tips of the arcing contacts have been eroded away; any contact has been broken or cracked.
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

PUFFERS

The performance of the puffers can be readily checked during a maintenance interval. Each puffer, 1 for each contact assembly, should provide a moderate blast of air at the breaker contacts on opening of the circuit breaker. This can be detected by holding the hands or arm over the top of the contacts and opening the circuit breaker. If all puffers do not have puffing action, the circuit breaker must not be placed in service.

FOR SAFETY: Keep clear of all moving parts.

ADJUSTMENTS

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 charge the closing springs and to close and open the circuit breaker, the racking mechanism must be turned to a position such that the racking shutter (15, Fig 1) closes when the racking crank (21, Fig. 1) is removed

SLOW CLOSE PROCEDURE

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 Figure 4 unless otherwise noted.

1. The closing springs must be charged; check 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 [illegible] (5) at "A".

3. Push up on close latch release rod (5, Fig. 9) to manually close the circuit breaker. The close block lever pin (5, Fig. 4) will now remain in the down position. Remove screw driver or rod

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. Push up on close latch release rod (5, Fig. 9) to manually close the circuit breaker

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 (Refer to Figure 5)

1. The hex portion of the adjusting stud (1) must be centered within 1/16 inch between the yoke (2) and the insulator (3).

NOTE: In the following steps 2 and 3 turning the adjusting stud (1) counter-clockwise when viewed from the insulator (3) will increase the contact pressure and dimension "A".

2. The contact adjustment is to be made with the circuit breaker in the closed position. The self-locking adjusting stud (1) is to be turned to provide contact pressure such that the dimension at point "A" is 15/32". After making this adjustment in contact pressure, open and close the circuit breaker. Recheck the 15/32 dimension. Readjust if necessary

3. On two-pole circuit breakers or where two contact assemblies constitute one pole, open the circuit breaker and slow close the contacts until the leading arcing contacts (4) of one pole or contact assembly just touches. The remaining contact assembly should be advanced by turning adjusting stud (1) so that the arcing contact of the other contact assembly just touches.

HIGH-SPEED TRIP

Impulse Coil Trip Adjustment
(High-Speed Trip) (Refer to Figure 7)

1. With the circuit breaker closed, turn the adjusting screw (1) for dimension "A" of .025/.035 inch. When making this measurement make certain the striker pin (2) is [illegible] Figure 3

Mechanism Trip Adjustment
(Initiated by H.S. Trip) (Refer to Figure 7)

1. Back out on trip screw (4) so that when the high-speed trip test button (31, Fig. 1) is actuated to trip the breaker, the main contacts open but the breaker mechanism remains closed as shown by the indicator (14, Fig. 1).

2. Reset the jackshaft and mechanism by depressing the manual trip button. Close the breaker. Turn trip screw (4) in slowly until the mechanism and jackshaft just trip. Try closing twice; the breaker should not close. Back out trip screw (4) by half turns until the breaker will close. Trip the breaker. Turn trip screw (4) out two additional turns.

MECHANISM

Latch Engagement (Bite)
(Refer to Figure 6)

The latch engagement adjusting screw (2) is located to the right of the right-hand mechanism housing (1)

To adjust the latch engagement, proceed as follows:

1. Back off adjusting screw (2) to assure excessive latch engagement.

2. Close the circuit breaker.

3. Turn adjusting screw (2) down slowly until the latch just releases, tripping the circuit breaker

4. Back off the adjusting screw (2) two turns

Tripper Bar Latch Engagement
(Refer to Figure 6)

The tripper bar latch engagement adjusting screw (3) is located adjacent to the latch engagement adjusting screw (2).

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

1. Back off adjusting screw (3) to assure excessive tripper bar travel.

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) 3½ turns.

Tripper Bar Load (Refer to Figure 6)

The tripper bar load is measured by use of a spring scale (4) positioned as shown. With the circuit breaker in the "CLOSED" position, the push required to trip the circuit breaker must be between 40 and 60 ounces for a one pole unit and 48 to 80 ounces for a two pole unit.

SHUNT TRIP DEVICE (Refer to Figure 8)

After latch bite and tripper bar are set per "MECHANISM", proceed with the following:

1. Charge springs (electrically or manually).

2. Turn trip rod (1, Fig. 8) up until a .105 gauge fits between head of trip rod (1) and trip extension (5).

3. Remove gauge and close breaker.

4. Try .105" gauge, it should still fit. If it doesn't turn up trip rod until gauge can be inserted

5. Try .156" gauge—it should not fit

6. Push up slowly with screw driver or small rod at position "A" to make sure the breaker trips mechanically.

CONTROL DEVICE (Refer to Figure 9)

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.

Trip Rod Overtravel

1. Back off on the 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 the close latch release rod (5) to the full extent of its travel.

2. Charge the closing springs. Push up on the close latch release rod (5) to the full extent of its travel. While holding this rod up, turn it in until the closing springs are released, closing the breaker. Turn the close latch release rod (5) up an additional 1-1/2 turns.

OD-OVERCURRENT DEVICE ADJUSTMENTS
(Refer to Figure 10)

Pick-up Setting Adjustments

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

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

Armature Trip Travel Adjustment

CAUTION: 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 overload device trip travel is set at the factory, however, if trip travel readjustment is required due to replacement of overloads or other parts, then readjust as follows:

1. Back out on the two trip adjusting screws (2 & 3) until the screws are engaging the nut by approximately two turns.

2. Charge springs and close circuit breaker.

3. Using a 1-foot long (approx.) rod, push up on long time armature, thick armature at point "A", and hold it tight against the magnet. Turn in screw (3) until the breaker just trips. Continue to turn the screw in an additional 1-1/2 turns.

4. Charge springs and close the circuit breaker. Push up on the thin armature and adjust screw (2) using the same procedure as "3" above.

HIGH-SPEED TRIP PICKUP SETTING

The pickup current for high-speed trip operation is set to multiples of the sensor rating by locating the selector plug (26, Fig. 1A) in the desired tap block slot. If the selector plug is accidentally left out, the trip setting automatically reverts to the minimum setting.

LUBRICATION

The FBK 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 synthetic grease, manufactured by Tenneco Chemical Inc., Intermediate Division.

The circuit breaker requies 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 L757 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 does not require lubrication.

6. DO NOT LUBRICATE OVERCURRENT TRIP DEVICES.

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 1. **NOTE**: Disconnect

the charging motor by means of the motor disconnect switch (10, Fig. 1).

Before any dielectric tests are made on the control circuit, the plug connections at the rear of the circuit breaker connecting the circuit breaker and high speed trip assembly should be disconnected. No dielectric tests should be made on the high speed trip assembly parts.

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

ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES

For closing and tripping currents, voltages and ranges, refer to Table 2.

For undervoltage trip devices, standard voltages and operating data, refer to Table 3.

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

Brown Boveri Electric recommends only those renewal parts be stocked that will be required to insure proper and timely maintenance of the breaker.

Refer to renewal parts bulletin RP-16.4.1.8-1 for complete ordering information and parts list.

The minimum quantity of assemblies and items recommended in the bulletin are 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, high speed trip control, etc. can be returned to the factory for reconditioning or replacement.

REFERENCES

Additional reference material available.

IB-16.4.1.7-2 – Instructions for High-Speed Trip Control Assembly

IB-16.4.1.7-3 – Instruction Supplement for High-Speed Trip Control Assembly with Optional Monitoring Accessories

TD-6691 – OD-FBK-3 Time Current Characteristic Curves

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

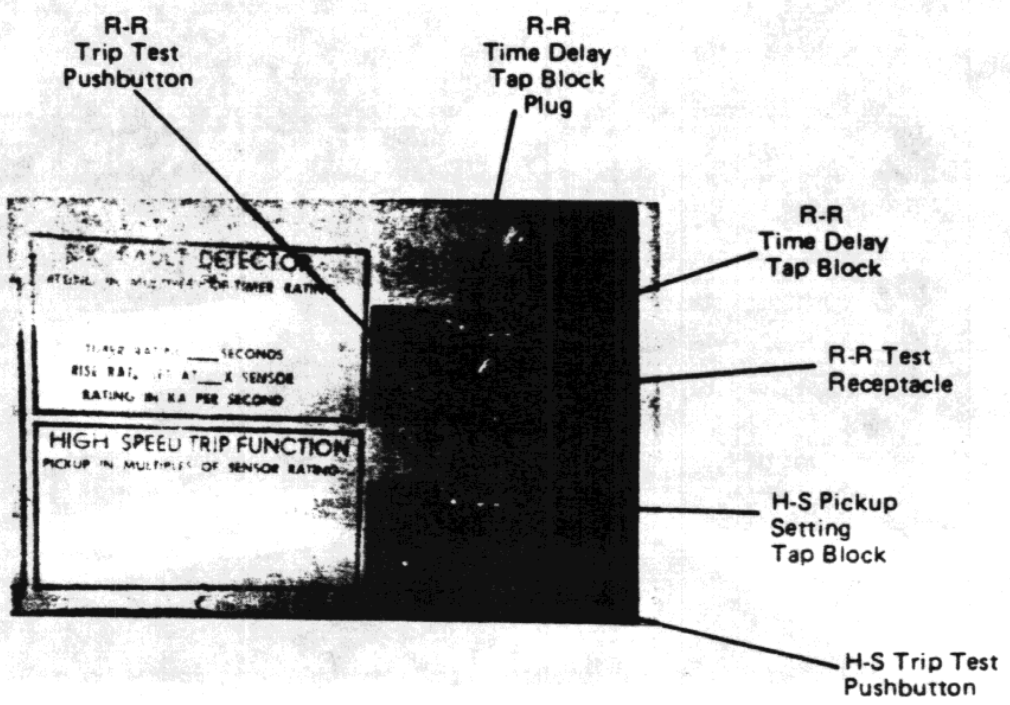


Fig. 1A—High-Speed Trip Control Assembly With R-R Fault Detector (Optional)

1. Arc Chute
2. Auxiliary Switch
3. Secondary Separable Contacts
4. Racking Cam Assembly
5. Overcurrent Trip Device (Semi-High Speed)
6. Positioning Wheels
7. Closing Spring Charging Motor
8. Escutcheon Assembly
9. Arc Chute Return Connections (Not Shown)
10. Motor Disconnect Switch
11. Locking Hasp
12. Electrical Close Push Button
13. Manual Trip Button
14. "OPEN" or "CLOSED" Indicator
15. Racking Shutter
16. Closing Spring Charge Indicator
17. Auto Trip Indicator
18. Self-Aligning Dust Plate
19. Nameplate
20. Lifting Yoke
21. Racking Crank
22. Removable Maintenance Handle
23. Track
24. Latch
25. Retaining Screws
26. High-Speed Trip Calibration Selector Plug
27. Position Indicator
28. Cradle
29. High-Speed Trip Control Assy. (76HS)
30. Operation Counter
31. High-Speed Trip Test Button
32. Arc Chute Shelf
33. Sensor Nameplate

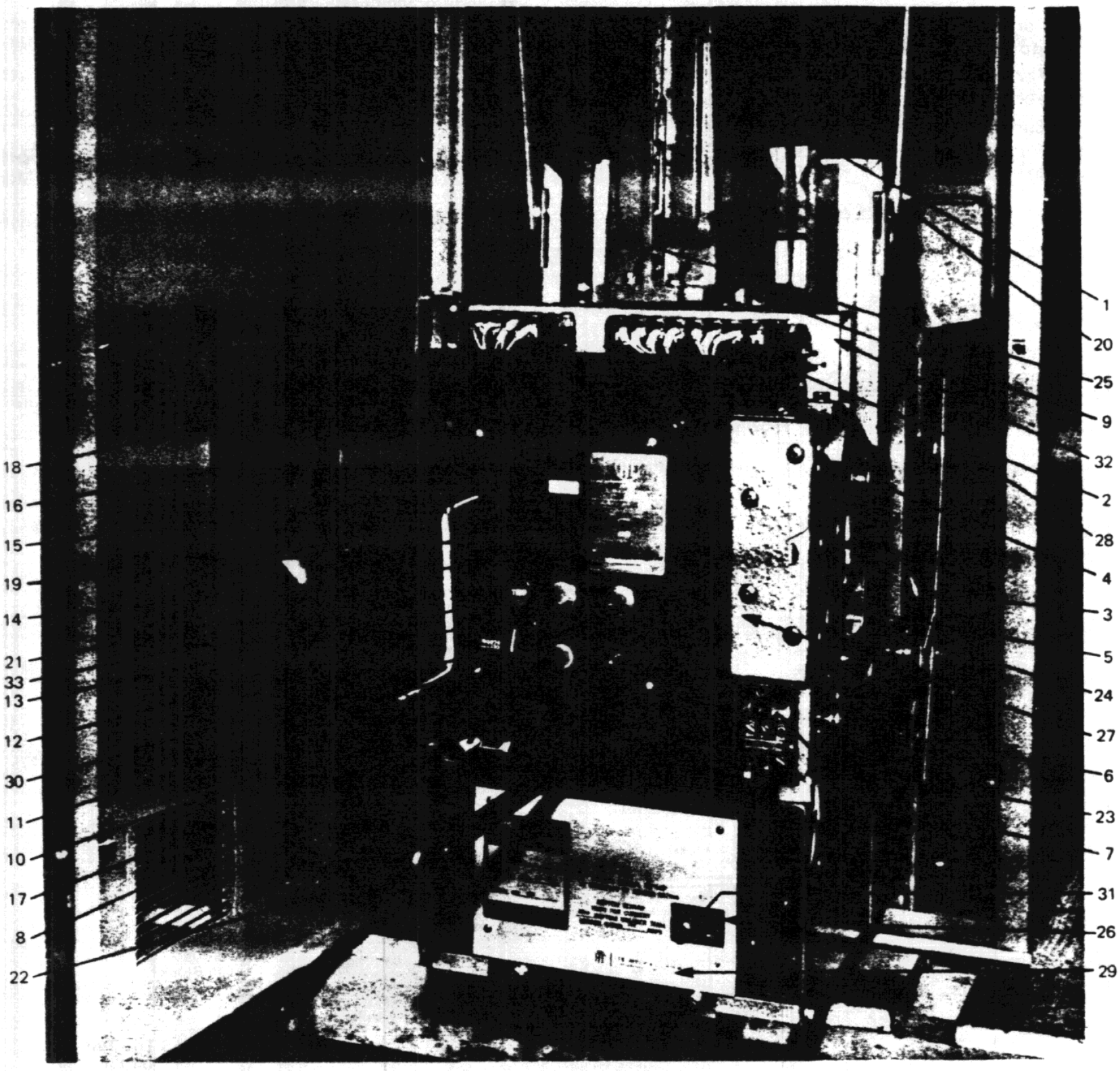
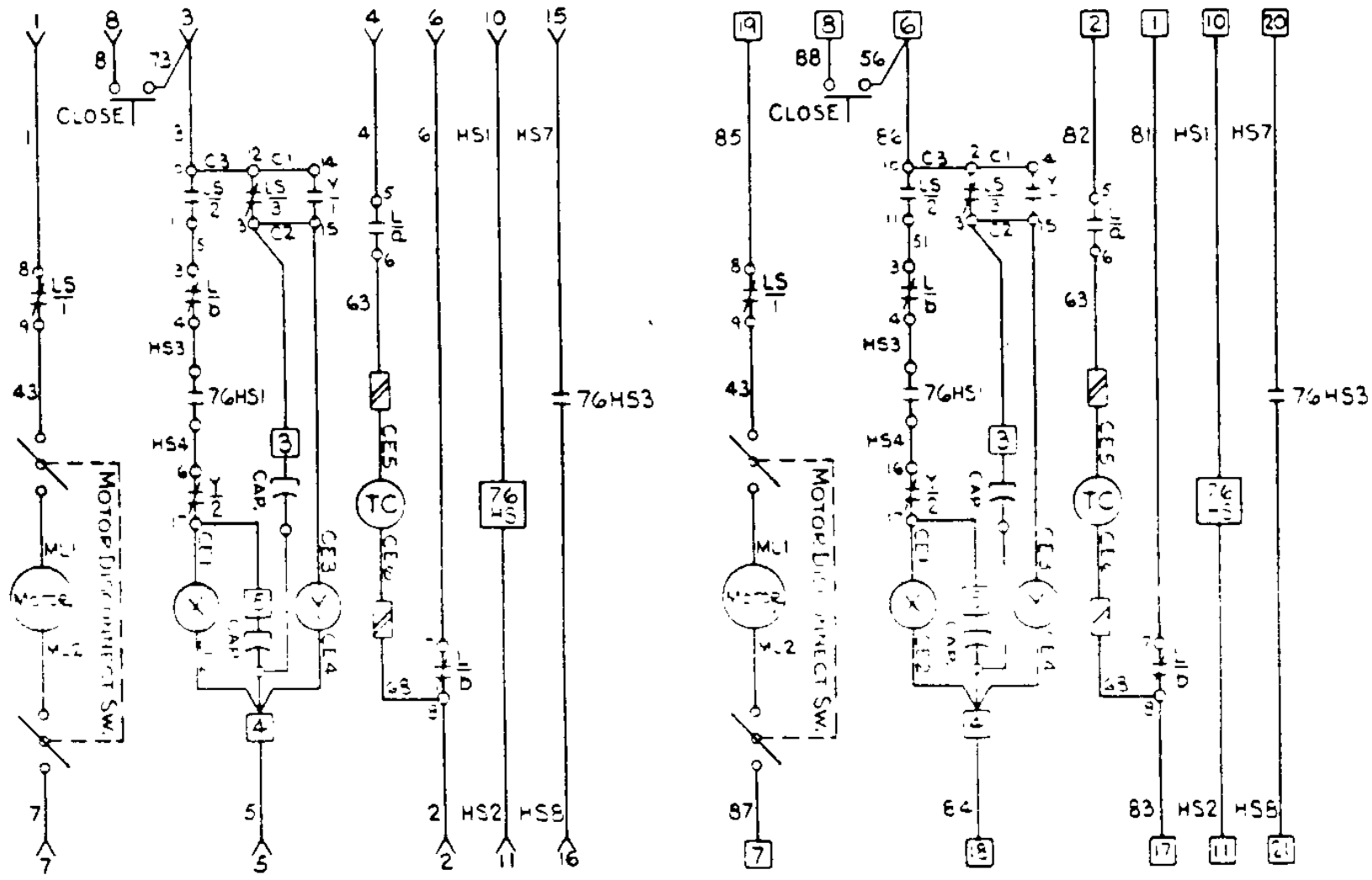


Fig. 1—FBK-H Drawout D-C Circuit Breaker—Major Components

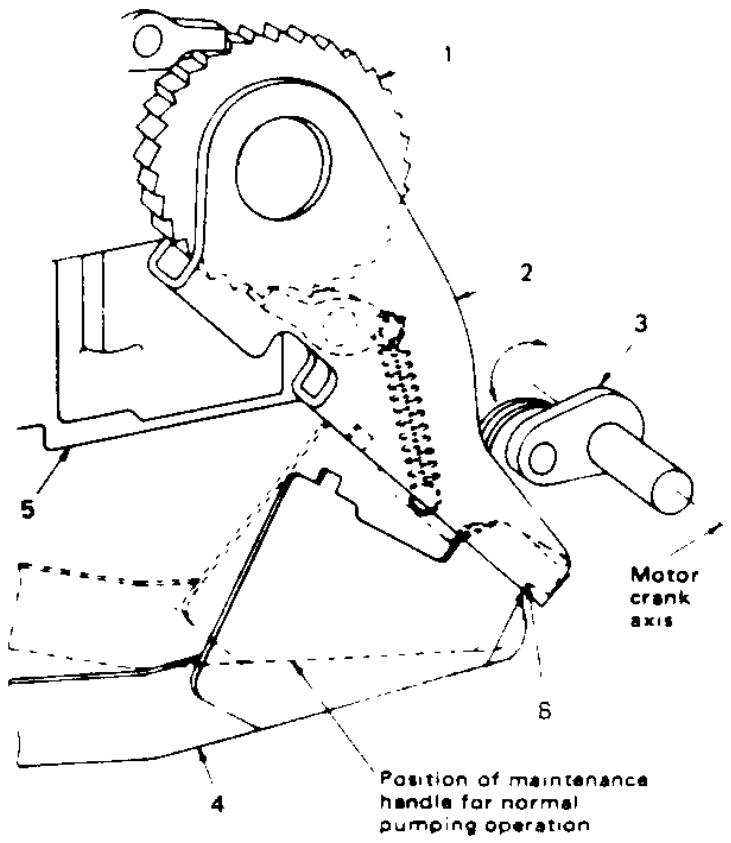


Drawout

Stationary

Symbol	Description
a	AUXILIARY SWITCH CONTACT OPEN WHEN BREAKER IS OPEN
b	AUXILIARY SWITCH CONTACT CLOSED WHEN BREAKER IS OPEN
bp	BYPASS SWITCH CONTACTS CLOSED WHEN DRAWOUT BREAKER IS WITHDRAWN
CE	COIL LEAD
L	AUXILIARY SWITCH MOUNTED ON LEFT HAND SIDE
LS 2	LIMIT SWITCH CONTACT OPEN WHEN SPRINGS ARE DISCHARGED CLOSED WHEN SPRINGS ARE CHARGED
LS 1 & LS 3	LIMIT SWITCH CONTACT CLOSED WHEN SPRINGS ARE DISCHARGED OPEN WHEN SPRINGS ARE CHARGED
ML	MOTOR LEAD
PB	LOCAL PUSH BUTTON RECOMMENDED OPERATION IN TEST POSITION ONLY
,	ALARM CONTACT CLOSES ON OVERCURRENT TRIP MANUALLY RESET
,	ALARM CONTACT OPENS ON OVERCURRENT TRIP MANUALLY RESET
R	AUXILIARY SWITCH MOUNTED ON RIGHT HAND SIDE
TB	TERMINAL BLOCK POINT
TC	SHUNT TRIP COIL
UV	UNDERVOLTAGE TRIP DEVICE
UV b	UNDERVOLTAGE CONTACT CLOSED WHEN UV COIL IS DE ENERGIZED OPEN WHEN UV COIL IS ENERGIZED
X	CLOSING LATCH RELEASE COIL
Y	CONTROL RELAY LOCKOUT COIL
Y +	NORMALLY OPEN CONTROL RELAY CONTACT
Y -	NORMALLY CLOSED CONTROL RELAY CONTACT
	MOVABLE SECONDARY DISCONNECT CONTACT
	KNIFE BLADE WIRE DISCONNECTS
LC	LATCH CHECK SWITCH CLOSED WHEN PRIMARY TRIP LATCH IS RESET
76HS 1 & 76HS 2	HIGH SPEED CONTROL MONITORING INTERLOCK CONTACTS OPEN IF
76HS 3	HIGH SPEED TRIP FUNCTION IS INOPERATIVE OR LOSS OF CONTROL VOLTAGE
76HS	HIGH SPEED CONTROL ASSEMBLY
	DISCONNECT PLUG PIN AND RECEPTACLE
MDS	MOTOR DISCONNECT SWITCH
CD	CONTROL DEVICE
K70	AUX. RELAY IN HIGH SPEED CONTROL ASSEMBLY
K	[illegible]
K	[illegible]
K	NORMALLY OPEN AUX. RELAY CONTACTS
LH	LATCH TYPE RELAY FURNISHED BY OTHERS
LH 52 & LH 52	NORMALLY CLOSED LATCH TYPE RELAY CONTACTS

Fig. 2—Typical Control Circuit Schematic Diagrams



1. Ratchet Wheel
2. Pawl Carrier
3. Motor Crank Arm
4. Removable Maintenance Handle
5. Control Device

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

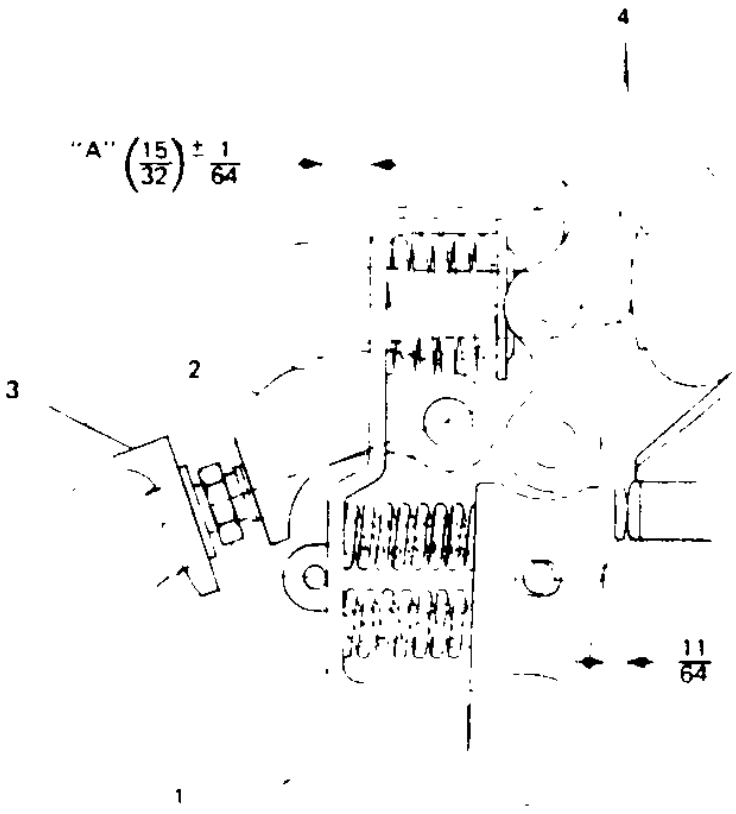
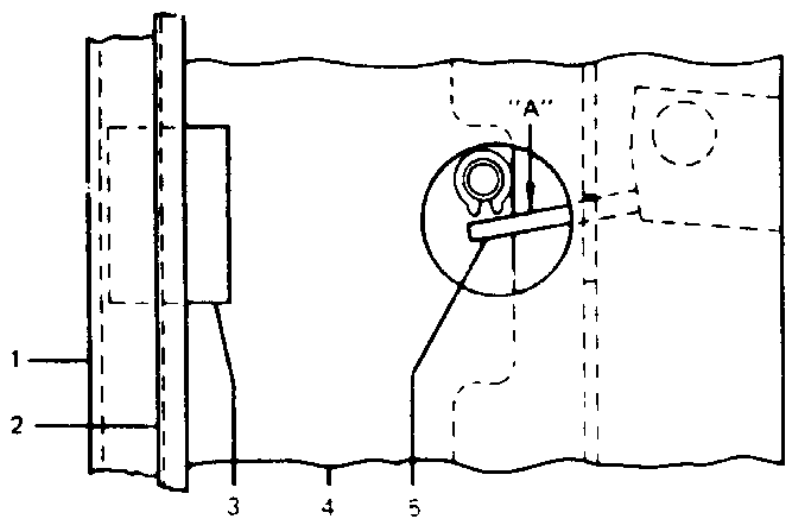
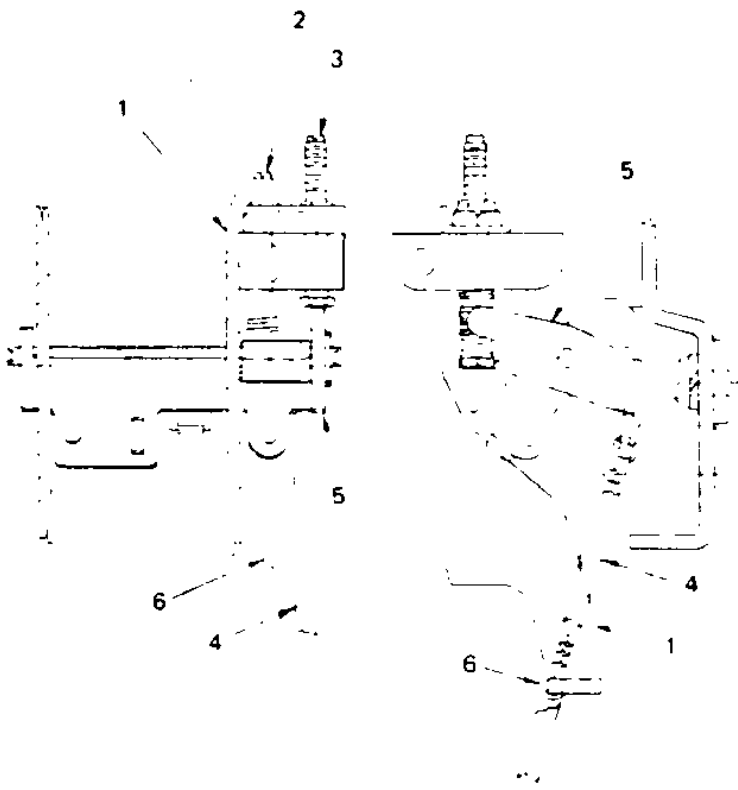


Fig. 5—Contacts



1. Escutcheon
2. Dust Plate
3. Spring, Dust Plate
4. Box, Escutcheon (Right-Hand Side)
5. Pin, Close Block Lever

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



1. Mechanism Housing
2. Latch Engagement Adjusting Screw
3. Tripper Bar Latch Engagement Adjusting Screw
4. Spring Scale (Push Type)
5. Tripper
6. Tripper Return Spring

Fig. 6—Trip Latch

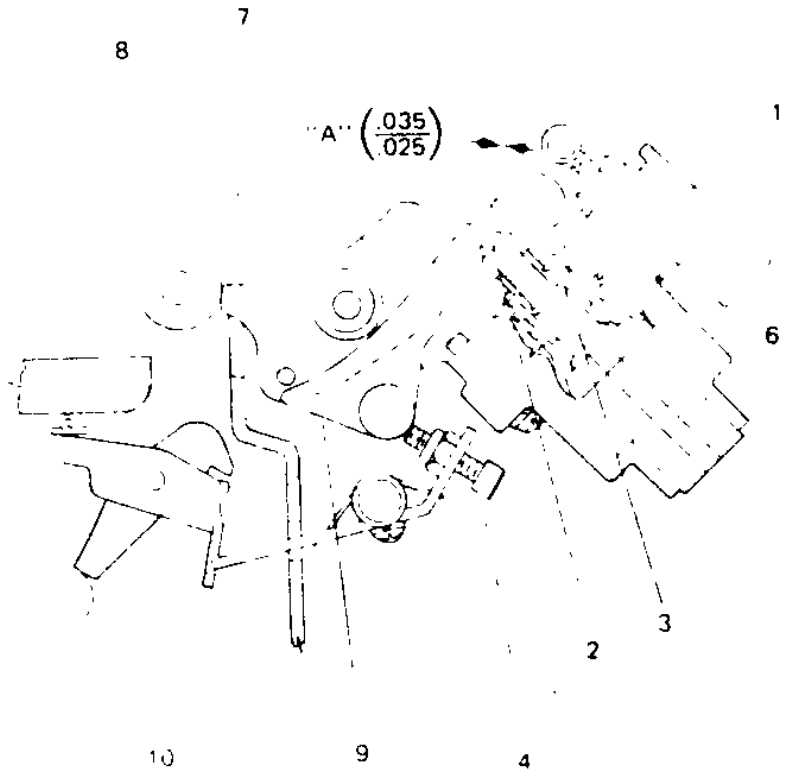
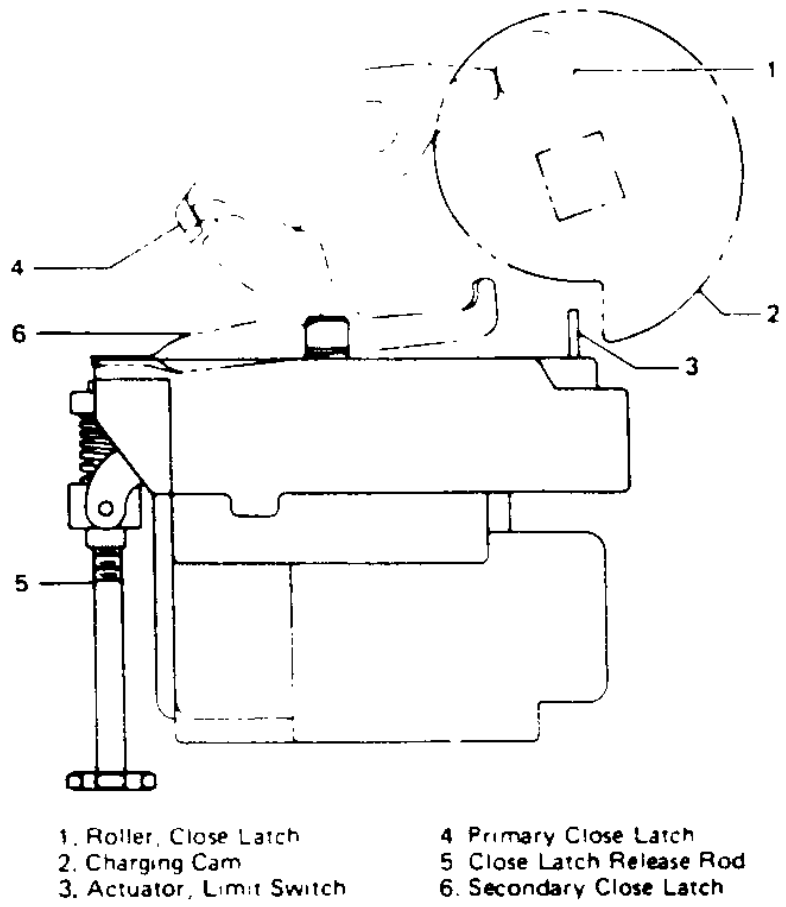
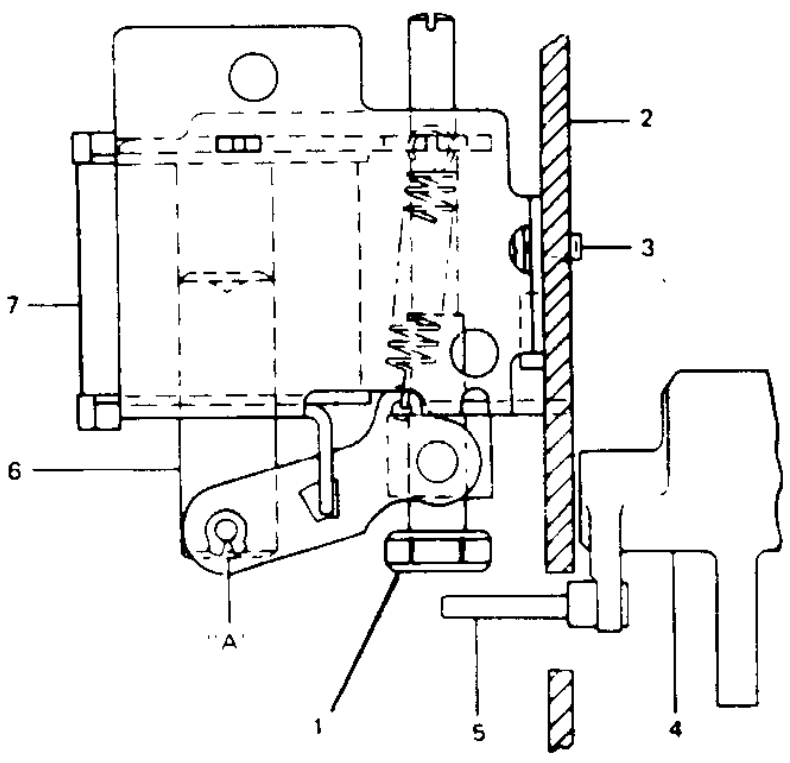


Fig. 7–High Speed Trip



1. Roller, Close Latch
2. Charging Cam
3. Actuator, Limit Switch
4. Primary Close Latch
5. Close Latch Release Rod
6. Secondary Close Latch

Fig. 9–Control Device Adjustment



1. Trip Rod
2. Mechanism Housing (Left-Hand Side)
3. Mounting Screw
4. Latch Bar
5. Trip Extension
6. Armature
7. Coil

Fig. 8–Shunt Trip Device Adjustment

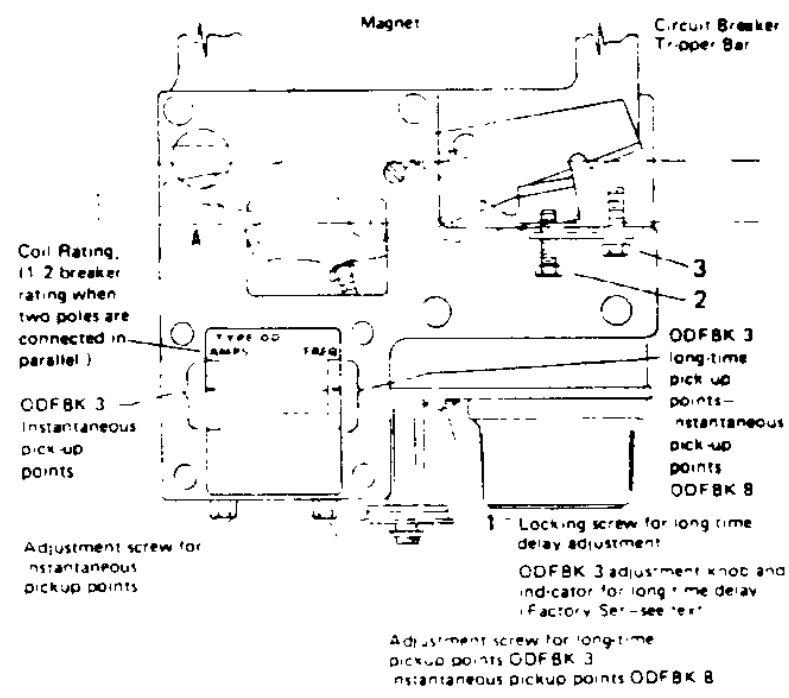


Fig. 10–Direct-Acting Overcurrent Trip Device

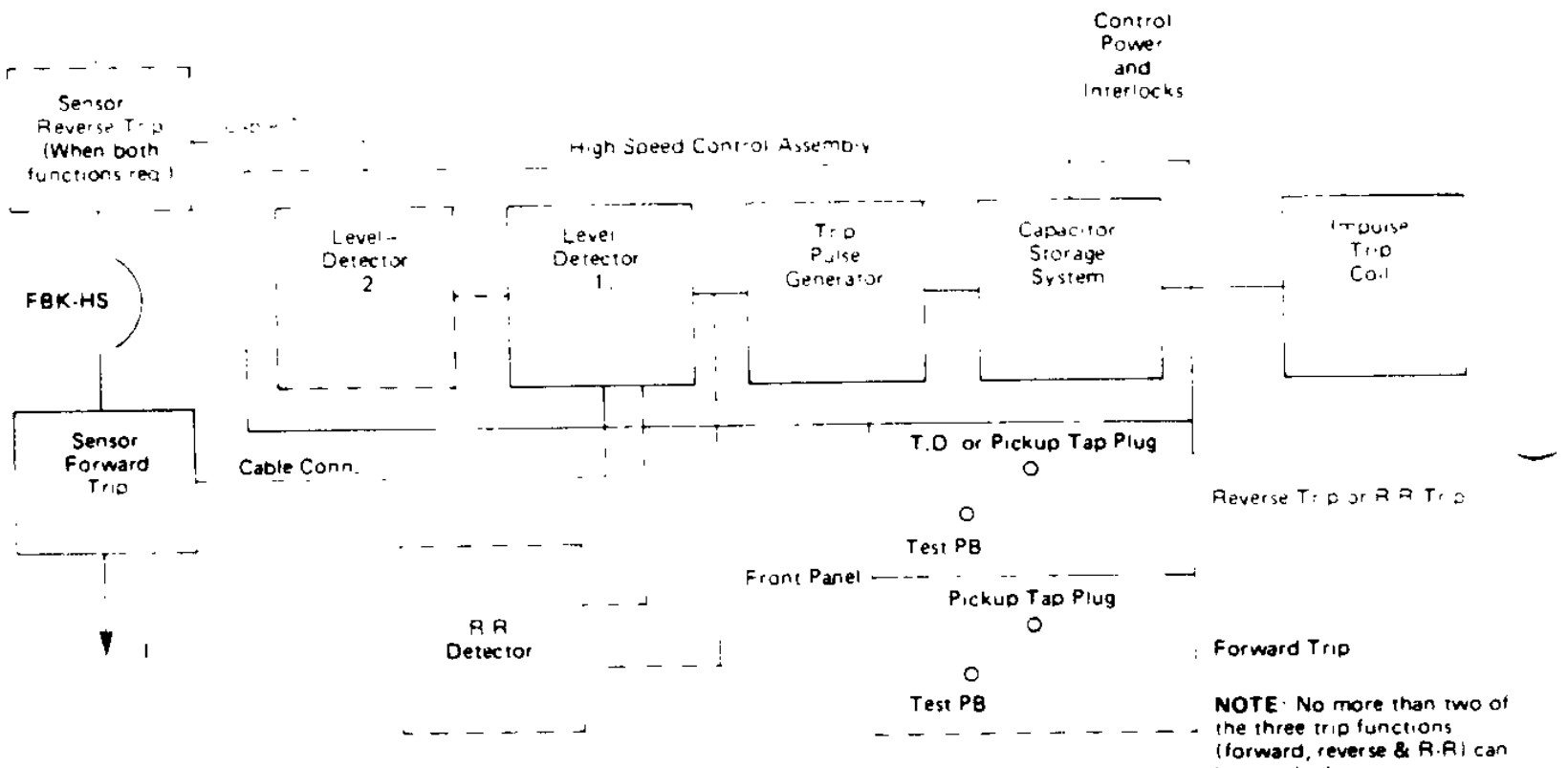


Fig. 11—High Speed Trip Control Assembly Block Diagram

TABLE 1

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	3150V. A C. a. Between line and load terminals and metal parts normally grounded b Between line and load terminals	3150V A C a Between terminals and metal parts normally grounded b Between phases	1125V A C a Between control circuit and metal parts normally grounded NOTE Motor & high speed trip assy must be disconnected from control circuit for this test
After Short Circuit	2520V A C a and b as above	2520V A C a and b as above	900V A C a as above and note

TABLE 2

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

Nominal Control Voltage	Average Closing Motor Current Amperes	Shunt Trip Current Amperes	CONTROL DEVICE Current Amperes (X) Anti-Pump	(Y) Release	Closing Circuit Voltage Range	Shunt Trip Circuit Voltage Range	FBK-H High Speed Trip Device Voltage Range	Recommended Control Fuse Size
120 ac 60 cycle	10	6 5	4	1 5	104-127	104 127	104-127	10 A
125V dc	10	1 3	06	7	106 140	70 140	70-140	10 A
250V dc	5	65	.03	.3	210 280	140-280	140-280	10 A

TABLE 3

UNDERVOLTAGE TRIP DEVICE STANDARD VOLTAGE AND OPERATING DATA

Service Voltage	Current at Rated Volts	Maximum Pickup Voltage	Dropout Voltage Range
120V ac 60 cycle	0 4	92	36-72
125V dc	0 2	100	38-75
250V dc	0 1	200	75-150

TABLE 4

MINIMUM RECLOSE TIME–SECONDS (TRIP CAPACITOR CHARGING TIME)

Service Voltage	Frame Size	
	1600-6000A	8000-10,000A
120V 60HZ (NOM)	4	8
104V 60HZ (MIN)	7	14
125V DC (NOM)	4	8
106V DC (MIN)	7	14
250V DC (NOM)	12	24
210V DC (MIN)	20	40

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