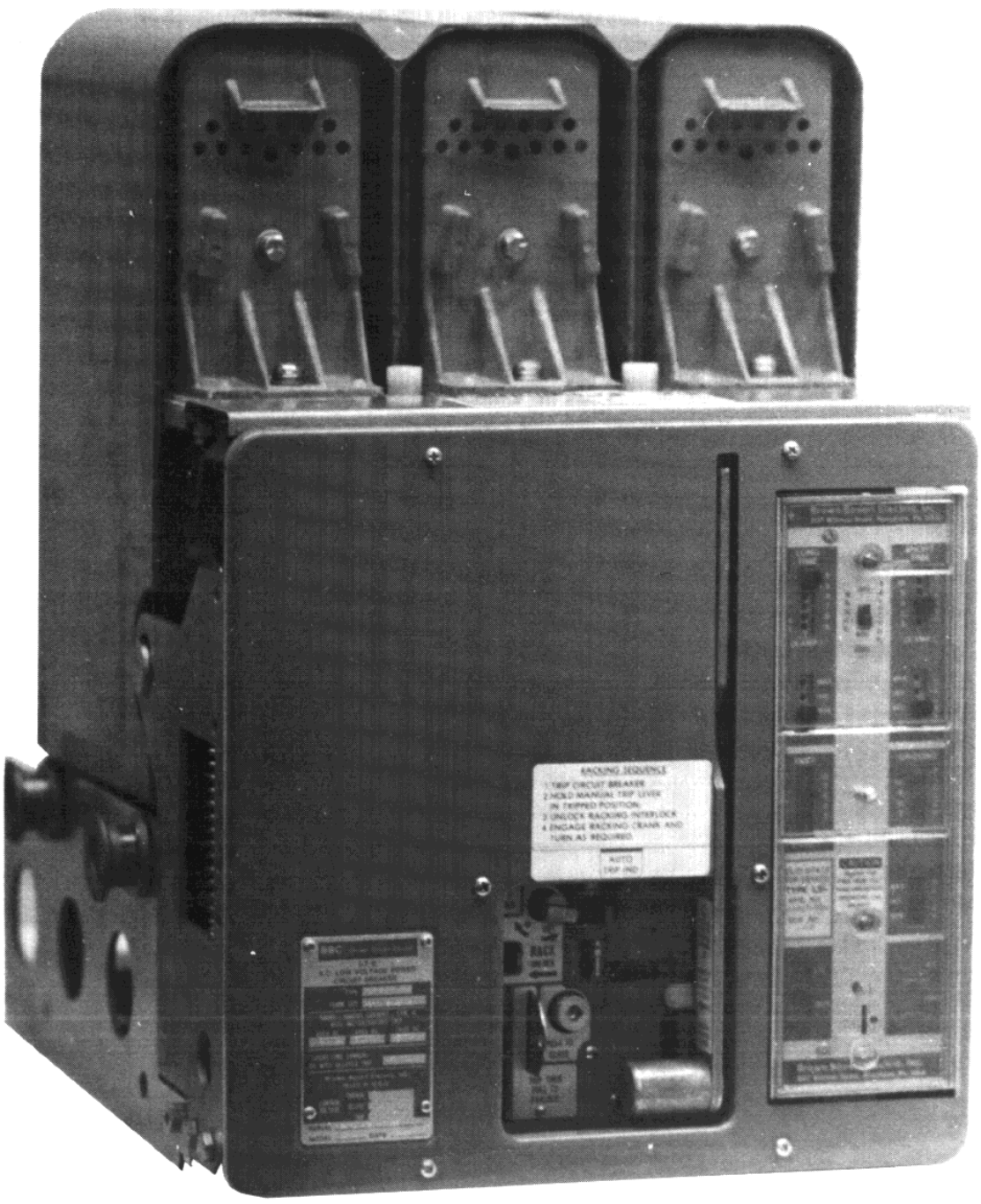
BBC
BROWN BOVERI

IB 6.1.1.7-1E

Installation/Maintenance Instructions

I-T-E Low-Voltage Power Circuit Breakers

Type LK and LKE 800 thru 4200 Amperes
Type LKD 800 and 1600 Amperes 600 Volts
Model-1A (Type LSS® Trip Device)



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For Renewal Parts refer to RP 6.1.1.8-1

1 GENERAL

1-1 INTRODUCTION

THIS MANUAL CONTAINS INSTRUCTIONS THAT SHOULD BE READ AND THOROUGHLY UNDERSTOOD BEFORE HANDLING, INSTALLING AND OPERATING THE CIRCUIT BREAKER. THE INSTRUCTIONS APPLY TO THE TYPES LK AND LKE CIRCUIT BREAKERS WITH AC CONTINUOUS RATINGS OF 800, 1600, 2000, 2500, 3200, 4000 AND 4200 AMPERES AND TYPE LKD WITH AC CONTINUOUS RATINGS OF 800, 1600 AMPERES.

The instructions are intended as a guide for receiving, inspecting, handling, storage, installation, check-out, operation, and maintenance of the type LK, LKE, and LKD circuit breakers. The information in this bulletin will facilitate proper use and maintenance thus prolonging the life and usefulness of this equipment.

All of the type LK circuit breakers are equipped with solid state trip devices.

File this Instruction Bulletin in an accessible place so that ready reference may be made when required.

1-2 RECEIVING, STORAGE AND HANDLING

Receiving

Immediately upon receipt of the circuit breakers, thoroughly examine cartons to determine if any evidence of damage was sustained during transit. If damage or rough handling is evident, note on Bill of Lading, file a damage claim at once with the carrier and promptly notify BBC Brown Boveri. The Company is not responsible for damage of goods after delivery to and acceptance by the carrier. However, we will, if requested, lend assistance when notified of claim.

Unpack the 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 of the circuit breaker parts. Check the contents of each carton against the packing list before discarding any packing material. If any shortage of material is discovered, promptly notify the carrier and the nearest District Office. Information specifying the purchase order number, sales order number, carton number and, if available, part numbers of the damaged or missing parts should accompany the claim. If part numbers are not available, a complete description of the affected part(s) must be stated.

Storage

Circuit breakers should be installed in their permanent location as soon as possible. If the circuit breakers are not to be placed in service for some time, it is necessary that adequate means of protection be provided. This may be done by keeping the circuit breaker in its original shipping carton in an upright position and storing indoors in a warm (approximately 15°C) dry, (50% max. humidity) and uncontaminated atmosphere. Standard domestic packaging is not suitable for outdoor storage. If the circuit breaker cannot be stored properly due to abnormal circumstances, it must be thoroughly inspected and repaired as necessary before placing in service to insure that it is without damage and uncontaminated. Failure to properly store the circuit breaker may void the warranty and lead to extensive refurbishing.

Handling

Once the circuit breaker has been removed from its shipping carton, it should be placed in an upright position on a smooth, flat surface to avoid damage to circuit breaker parts. For safety, all handling in this mode should utilize the lifting yoke (Figure 2-1), Item 14.

If the switchgear is equipped with an overhead lifting device, attach the yoke as illustrated in Figure 2-1, raise and install the circuit breaker into its compartment as detailed in Section IV. If the switchgear does not have the overhead lifting device, an external lifting device with capabilities for handling the circuit breaker weight, and compartment height requirements, is needed. In addition, this equipment must be compatible with the lifting yoke, and use a hoist type of lift. Do not attempt to raise the circuit breaker by any other means, as damage to the circuit breaker can occur rendering it unsatisfactory for service.

1-3 IMPORTANT NOTES AND WARNINGS

WARNING WARNING WARNING WARNING

ONLY QUALIFIED PERSONNEL WHO HAVE PREVIOUS EXPERIENCE AND TRAINING IN THE OPERATION AND MAINTENANCE OF ELECTRICAL POWER SYSTEMS SHOULD PERFORM TASKS ASSOCIATED WITH THE USE OF THESE CIRCUIT BREAKERS. IN ADDITION, THEY SHOULD FAMILIARIZE THEMSELVES WITH THIS INSTRUCTION BULLETIN BEFORE PERFORMING ANY OF THE FUNCTIONS INVOLVED

The successful and safe operation of a circuit breaker is dependent upon proper storage, handling, installation, operation, and maintenance. Neglecting certain fundamental installation and maintenance requirements may lead to personal injury, the failure and loss of the circuit breaker, as well as possible damage to other property.

WARNING WARNING WARNING WARNING

THERE IS THE HAZARD OF ELECTRICAL SHOCK OR BURN WHENEVER WORKING IN OR AROUND ENERGIZED ELECTRICAL EQUIPMENT. THE ELECTRICAL POWER MUST BE TURNED OFF BEFORE WORKING ON THE CIRCUIT BREAKER. EITHER DRAW OUT THE CIRCUIT BREAKER TO THE WITHDRAWN POSITION OR DISCONNECT ALL ELECTRICAL POWER SERVING STATIONARY EQUIPMENT BEFORE PERFORMING ANY MAINTENANCE ON THE CIRCUIT BREAKER. IN CASE OF DOUBT, SHUT OFF ALL ELECTRICAL POWER AT THE SOURCE BEFORE PROCEEDING WITH ANY WORK INSIDE THE CIRCUIT BREAKER CUBICLE WITHIN THE SWITCHGEAR ENCLOSURE, REFER TO THE SWITCHGEAR INSTRUCTION BOOK 3.1.1.7-1.

SHOULD ANY OF THE EQUIPMENT NOT FUNCTION AS DESCRIBED IN THE OPERATING PROCEDURE, CONTACT THE NEAREST DISTRICT OFFICE BEFORE ENERGIZING

2 DESCRIPTION

2-1 GENERAL DESCRIPTION

All type LK Circuit Breakers are furnished with three poles for use on 50/60 Hertz AC systems. These breakers are not applicable for use on DC systems.

Types LK, LKE, and LKD, integrally fused circuit breakers are available only in drawout construction. All types are available either as manually or electrically operated and with electrical control devices available in the most common AC and DC voltage combinations. A typical control schematic diagram is shown in Figure 4-1.

An electrically operated type LK or LKE drawout circuit breaker is shown in Figure 2-1.

Type LKD, integrally fused circuit breakers as shown in Figure 2-3, are assemblies of the basic type LK circuit breakers with integrally mounted current limiting fuses and an open fuse trip function to provide an overall coordinated protective device. Access to fuses is permitted when the LKD breaker is withdrawn (out) at which time the fuses are deenergized.

The maximum continuous current rating of each type circuit breaker is incorporated into the numerical designation; i.e., type LK-8 designates the circuit breaker can carry a maximum of 800 amperes continuously, type LK-16 designates the circuit breaker can carry a maximum of 1600 amperes, etc. For any selected long time setting, the solid state trip unit will coordinate in its overcurrent function up to 100% of setting. The standard solid state trip devices limit selection of long time setting, so as not to exceed the maximum continuous rating of the circuit breaker. Exceeding the maximum continuous current rating of a circuit breaker may cause the temperature to rise above design limits, thereby affecting life of the circuit breaker.

For additional information on electrical ratings and characteristics see Tables 2-1, 2-2, 5-1 and 5-3.

2-2 CIRCUIT BREAKER FRONT PLATE AND CONTROL CENTER (See Figure 2-1)

Manually and electrically operated circuit breakers utilize a front plate and control center providing central location for the controls and indicators. The controls and indicators for the electrically operated circuit breakers are designated in Figure 2-1.

Nameplate (Item 13)

The circuit breaker nameplate incorporates the manufacturer's name and address; and, in addition, lists the following circuit breaker information:

a. Type and frame size
b. Serial Number
c. Maximum Continuous Current Rating
d. Short Circuit Current Interrupting Ratings at Rated Voltage.
e. Frequency
f. Short Time Current
g. Control Voltage of Charging Motor, Close and Trip Coils
h. Maximum Continuous Current Rating of Fuses (Type LKD Circuit Breakers only)

Racking Shaft (Drawout Circuit Breaker Item 23)

WARNING WARNING WARNING WARNING

IT IS NECESSARY TO HOLD THE RACKING RELEASE LEVER TO THE LEFT. FOR AT LEAST ONE FULL TURN, OF THE RACKING CRANK WHEN RACKING IN OR OUT. NEGLECTING THIS STEP MAY RESULT IN DAMAGE TO THE RACK RELEASE LEVER.

The mechanical action of the racking procedure should always be smooth and free of binding. Additional force may be required only as the primary disconnect fingers are engaging the stationary terminals of the cradle. Should any binding or extra resistance be observed, stop, rack the breaker to the "out" position and investigate the cause of the racking problem. The cradle must be clear of all debris before installing the breaker since even small objects can be caught between the bottom of the breaker and the cradle.

The drawout circuit breaker is racked to any one of its four positions CONNECTED, TEST, DISCONNECTED, or WITHDRAWN (out) by rotating the racking shaft with the racking crank (Item 15). The racking lever (Item 10) must be released by moving it to the left in order to rotate the racking shaft. When the closing springs are charged, the trip lever (Item 8) must be raised each time to permit movement of the racking lever to the left-handed release position. The racking lever is mechanically interlocked with the circuit breaker to prevent release, unless the circuit breaker is in the OPEN position. To move the racking lever to the left, the trip lever (Item 8) must be raised simultaneously. When the racking lever is moved to the left, the circuit breaker becomes "Trip-Free" and it cannot be closed. A circuit breaker drawout position indicator (Item 19) denotes the drawout position on the left side of the rcessed control panel. As each position is reached except withdrawn, the racking lever will snap back to the normal right hand location, denoting a positive detent. The racking lever must be released before racking can proceed. See Section 3.2 for detailed racking instructions.

Manual Charging Handle (Item 16)

The Manual Charging Handle is used to manually charge the closing springs. To charge, depress charging handle latch (Item 18); lift the handle to disengage it from its support, rotate upward and slide it onto its engagement pin. Pump the handle approximatley eleven (11) strokes to charge the closing springs on manually operated circuit breakers.

When using the Manual Charging Handle to manually charge the closing springs on an electrically operated circuit breaker, it may take approximately eleven (11) pumping strokes of the handle to charge the closing springs. The amount of strokes is dependent upon the location of the charging link after the last charging cycle. The fully charged position is indicated by an audible click, after which the ratchet system is blocked. Return the charging handle to its stored position.

Closing Spring, Charged or Discharged Indicator (Item 11)

The condition of the Closing Springs, either CHARGED or DISCHARGED, is displayed by visual indication. The indicator is marked SPRINGS CHARGED, and the notation SPRINGS DISCHARGED is marked directly on the control center. When the springs are fully charged, the visual indicator SPRINGS CHARGED drops down and covers the SPRINGS DISCHARGED notation.

Charging Motor Disconnect Switch (Electrically Operated Circuit Breakers) (Item 5)

The Charging Motor Disconnect Switch is a two position 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. For normal operation, the Charging Motor Disconnect switch is left in the ON position. It may be placed in the OFF position to prevent automatic charging of the closing springs when desired. It must be placed in the OFF position before performing high potential testing of secondary wiring. The maximum voltage permitted during dielectric testing of the motor is 600VAC or 750VDC.

Manual Mechanical Close Push Button (Item 12)

The Manual Mechanical Close Push Button permits releasing, via mechanical linkages, the stored energy of the closing spring to accomplish circuit breaker closing. It is standard on both manually and electrically operated circuit breakers permitting local manual closing independent of control power.

Manual Mechanical Trip Lever (Item 8)

The Manual Mechanical Trip Lever, when raised, releases the stored energy of the opening springs to accomplish circuit breaker opening.

Electrical Close and Trip Push Button (Electrically Operated Circuit Breaker) (Item 7) (Optional)

Integrally mounted optional electrical close and trip push buttons are available for electrically operated circuit breakers. These push buttons may be wired to function in both CONNECTED and TEST positions or only in one of the two positions as specified for drawout construction. The CLOSE push button, when depressed, energizes the close coil releasing the stored energy in the closing springs to close the circuit breaker. The TRIP push button, when depressed, energizes the shunt trip coil releasing the stored energy in the opening springs to open the circuit breaker.

Circuit Breaker OPEN or CLOSED Indicator (Item 9)

This indicator denotes the physical position of the circuit breaker's main contacts by displaying OPEN or CLOSED.

Automatic Trip Indicator (Item 4)

The AUTOMATIC TRIP indicator is provided as standard equipment on all of the LK circuit breakers to denote the operation of the solid-state trip device and the open fuse trip device on type LKD circuit breakers. This device is an indicator only and does not prevent the circuit breaker reclosing. The indicator drops down from the top of the recess of the front cover plate to expose the word RESET. After any outage which results in an operation of the automatic trip indicator, the operator should investigate the cause of tripping prior to resetting the indicator and subsequent reclosing of the circuit breaker. The automatic trip indicator should be reset by pushing it upward into its normal latched position. See page 8 for optional automatic trip mechanical lockout.

Padlocking Hasp (Item 6)

LK, LKE and LKD circuit breakers are supplied with provisions for padlocking the circuit breaker mechanism in an open, trip-free position. The mechanical trip lever must be raised before pulling out the locking hasp to expose the slot through which the padlock(s) shank is inserted. With the padlocking hasp in this position, the mechanism is maintained open and trip-free preventing the circuit breaker from being closed. Also, racking is prevented thus locking the breaker in the position it occupies when the padlocking hasp is used.

Solid State Trip Device (Item 2)

The function of the Solid State Trip Device is to monitor the current flowing in the system and to initiate tripping of the circuit breaker when abnormal conditions occur. The available settings cover a broad range of current pickup in relation to time. See Detailed Description (para. 2-4) for more complete information.

Operation Counter (Item 22) (Optional)

The optional operation counter is used to count each opening of the circuit breaker contacts. The counter is nonresetable and gives only progressive adding indication. It is frequently used as a reference to schedule maintenance intervals.

2-3 CIRCUIT BREAKER INTERNAL COMPONENTS

The schematic diagram of the control circuit (Figure 4-1 or 4-2) and operating sequences in Section 4 illustrate the function of these devices. See Table 5-2 for electrical characteristics.

Closing Control Devices (Electrically Operated Circuit Breakers

The closing control devices furnished on electrically operated circuit breakers are the closing spring charging motor, the "X" close coil, and the "Y" relay. The "X" close coil when energized, releases the stored energy of the closing springs causing the circuit breaker to close. The "Y" relay coil prevents additional operation of the "X" closing coil while the close button is depressed should the breaker automatically trip upon closing. A second close operation can not occur until the close push button is released deenergizing the "Y" relay coil and the close push button is again depressed.

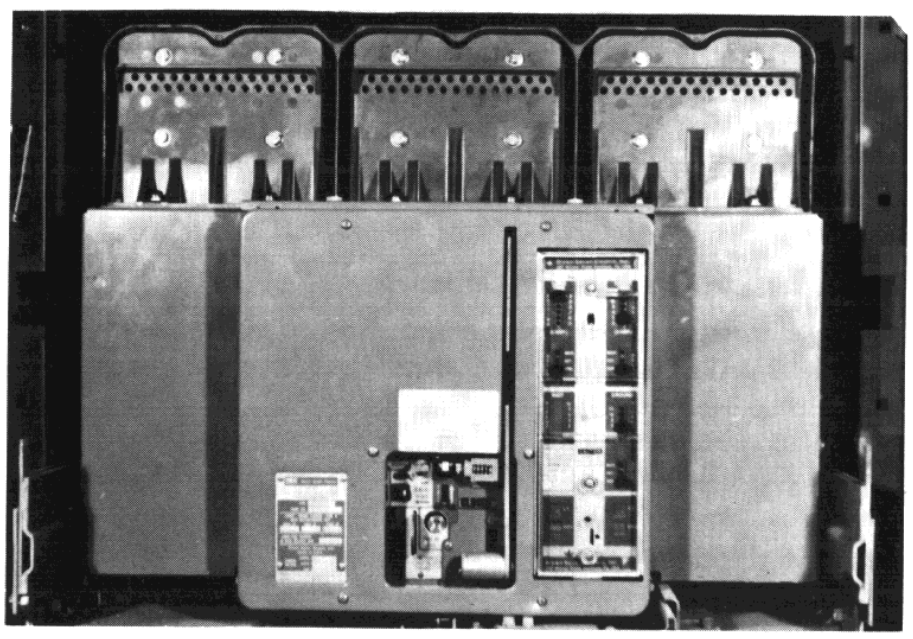


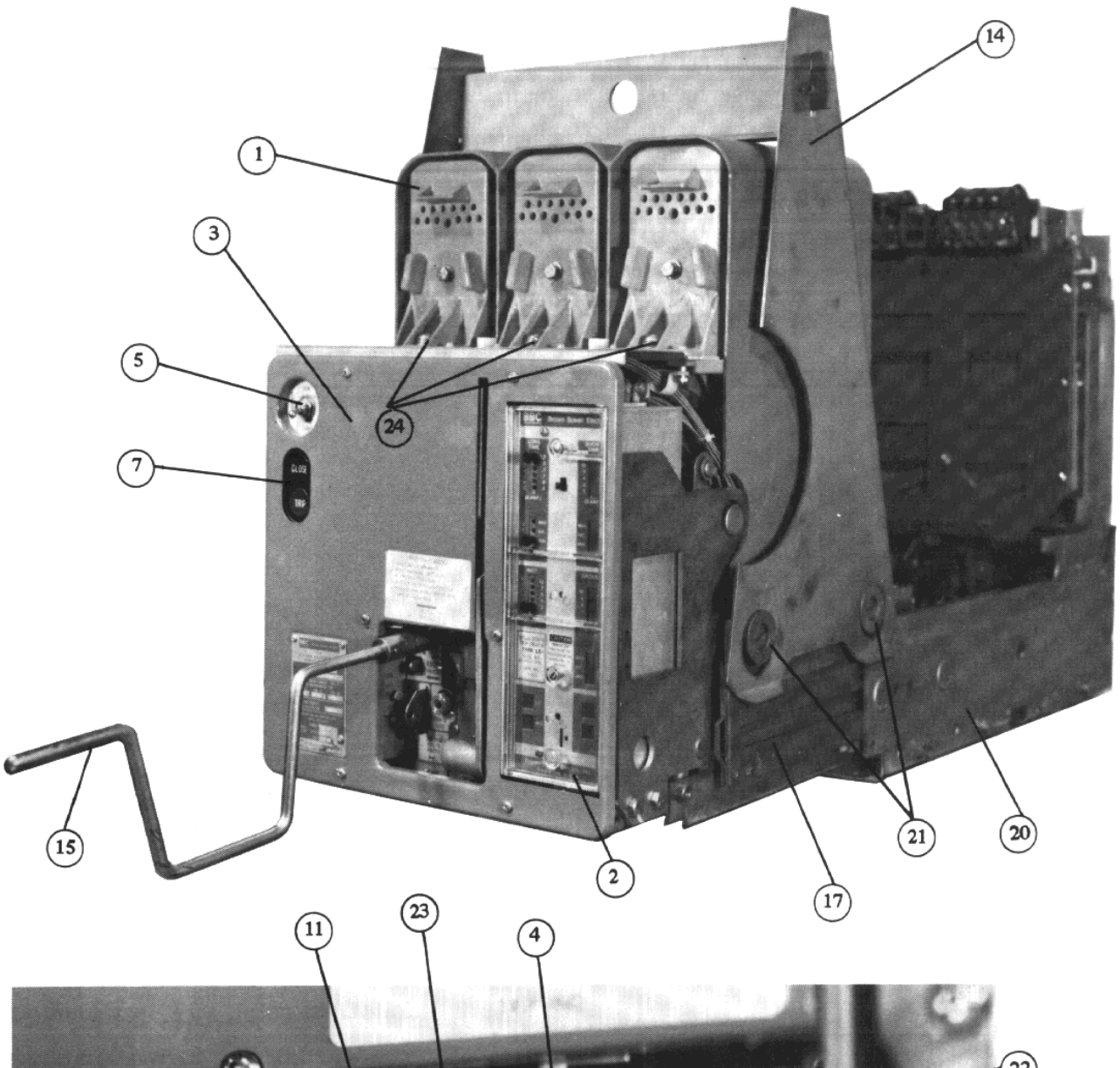
Figure 2-2 Typical Type LK-32 Circuit Breaker

Shunt Trip

The shunt trip when energized releases the stored energy of the opening springs causing the circuit breaker to open.

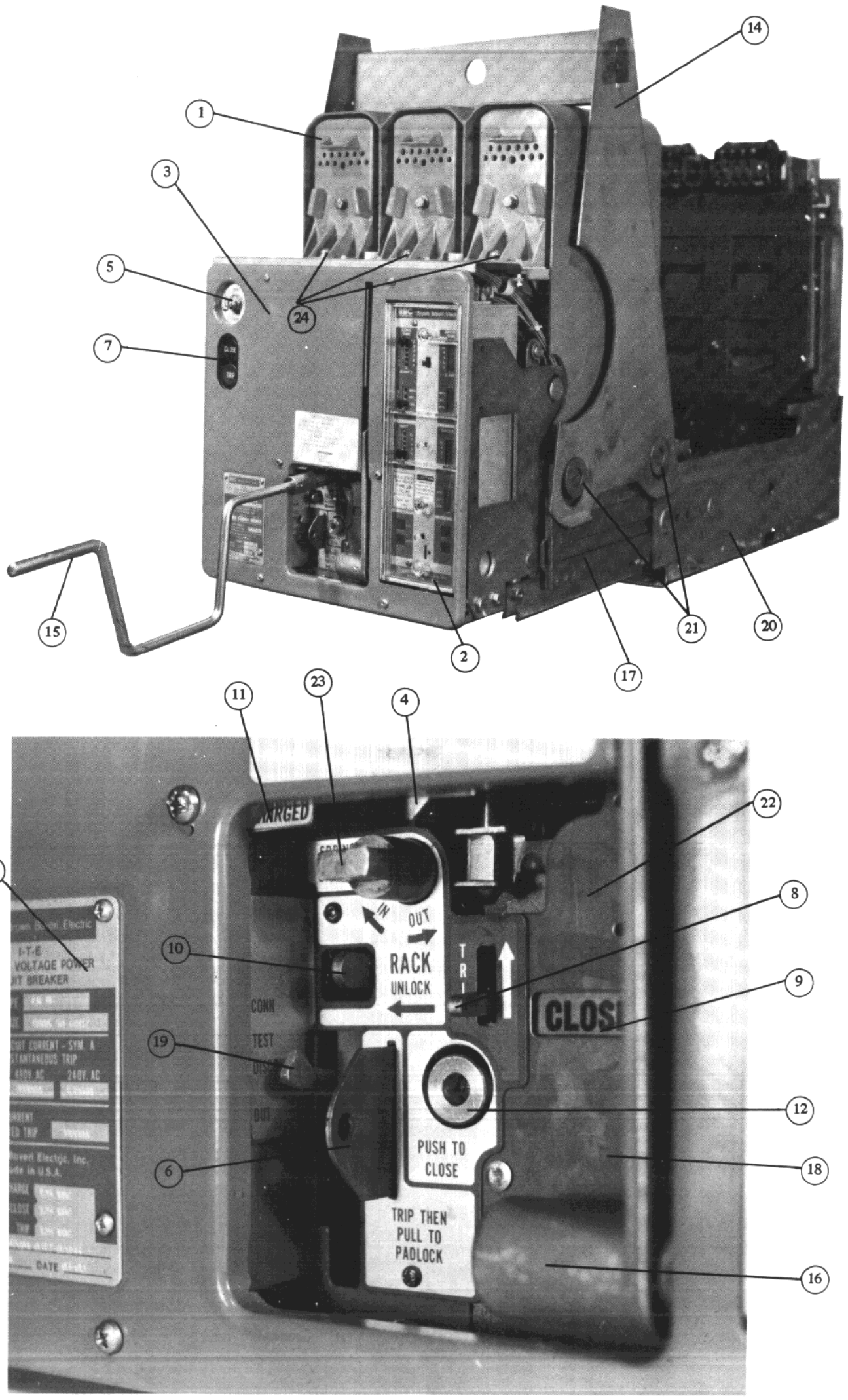
Integral Auxiliary Switch (Type L-3)

The integral circuit breaker mounted auxiliary switch contains the one "a" and three "b" contacts shown in Figure 4-2. It is mechanically interconnected with the circuit breaker mechanism such that, with the circuit breaker closed, the "a" contact is closed and the "b" contacts are open. With the circuit breaker open, the "a" and "b" contacts reverse positions. This integral auxiliary switch is for circuit breaker control and for operation of remote indicating lights only and it is not available for other use. See Table 5-3 for electrical ratings.



1. Arc Chute
2. Solid State Trip Device
3. Front Plate
4. Automatic Trip Indicator
5. Motor Disconnect Switch
6. Locking Hasp
7. Electrical close and Trip Pushbuttons*(Optional)*
8. Manual Trip Latch
9. "OPEN" or "CLOSED" Indicator
10. Racking Release Lever
11. Closing Spring Charge Indicator
12. Manual Close Button
13. Nameplate
14. Lifting Yoke (Lifting position)
15. Racking Crank (Engaged)
16. Charging Handle
17. Cradle Track
18. Charging Handle Latch (Not Shown This View.)
19. Position Indicator
20. Cradle
21. Wheels
22. Operation Counter*(Optional)* (Location)
23. Racking Shaft
24. Arc Chute Retaining Screw

Figure 2-1 Typical Electrically Operated Circuit Breaker



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15. Racking Crank (Engaged)
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23. Racking Shaft
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Figure 2-1 Typical Electrically Operated Circuit Breaker

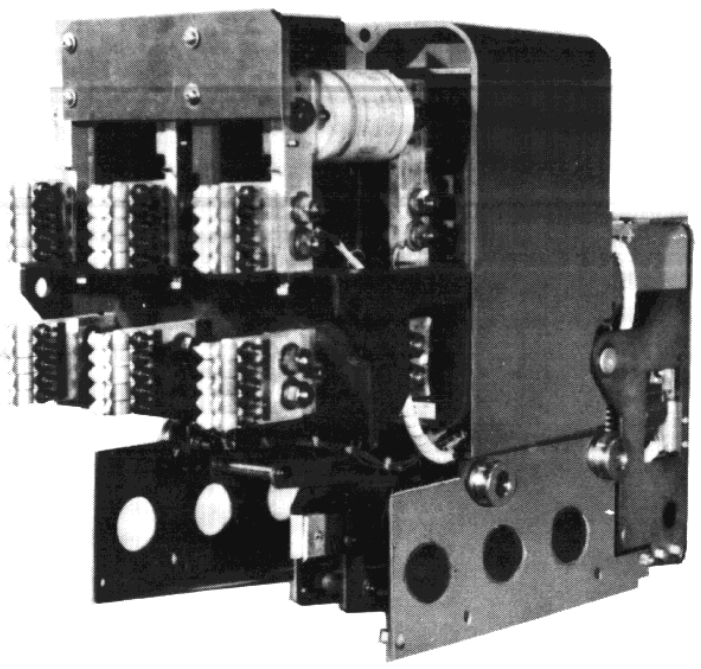


Figure 2-3 Typical Integrally Fused Type LKD-16 Circuit Breaker

Undervoltage Trip Device (Optional)

The undervoltage trip device via a single operating coil automatically trips the circuit breaker whenever the applied voltage decreases in the range of 30 to 60 percent (non-adjustable) of the operating coil voltage. This device may be furnished either for instantaneous trip operation or with factory adjustable time delay trip of 0-15 seconds. The undervoltage trip device is available for both factory and field installation. See Table 5-4 for electrical characteristics.

Undervoltage Trip Defeator (Optional)

WARNING WARNING WARNING WARNING

ACTIVATING THE DEFEATOR WILL ELIMINATE THE INTENDED PROTECTION PROVIDED BY THE UNDERVOLTAGE TRIP DEVICE.

Remove the circuit breaker from service before attempting this operation. Provision for defeating the optional undervoltage trip device are accessible through the front plate by inserting a flat blade screwdriver into the designated opening and rotating the screw counterclockwise one quarter turn. This feature is provided to facilitate operational checks when the circuit breaker is removed from service eliminating the need to energize this device during periods of maintenance. When returning the breaker to service, the defeator should be disengaged.

WARNING WARNING WARNING WARNING

THE CIRCUIT BREAKER SHOULD BE TAGGED WHEN THE UNDERVOLTAGE DEVICE HAS BEEN DEFEATED.

To restore the undervoltage trip device function, rotate the screw clockwise one quarter turn.

Undervoltage Lock Open Device (Optional)

The optional lock open device via a single operating coil mechanically prevents closing of the circuit breaker unless normal coil operating voltage is applied. This feature does not trip a closed circuit breaker under conditions of low or lost operating coil voltage.

Undervoltage Trip Alarm Switch (Optional)

An optional undervoltage trip alarm switch is available incorporating normally open and normally closed contacts. See Table 5-3 for electrical ratings.

Automatic Trip Mechanical Lockout (Manually Reset) (Optional)

An optional mechanical lockout device, when specified, is incorporated into the automatic trip indicator assembly to mechanically prevent reclosing the circuit breaker after an automatic trip operation. When the automatic trip indicator is reset, the lockout function is removed and the circuit breaker can then be reclosed.

Automatic Trip Alarm Switch (Manually Reset) (Optional)

An optional automatic trip alarm switch changes position whenever automatic tripping has occured. One normally open (r) and one normally closed (s) contact is provided. The automatic trip alarm switch is reset when the automatic trip indicator is reset. See Table 5-4 for electrical ratings of these contacts. A second alarm switch is also optionally available.

WARNING WARNING WARNING WARNING

OPEN FUSES MUST BE REPLACED BEFORE RESETTING THE INDICATORS. IF NOT, THE CIRCUIT BREAKER WILL TRIP UPON RECLOSING.

Current Limiting Fuses (Figure 2-4) (Type LKD only)

Current limiting fuses are mounted on the circuit breaker. Maximum continuous current rating of the fuses are noted on the nameplate. More complete information on the fuses is given in the Paragraph 2-6.

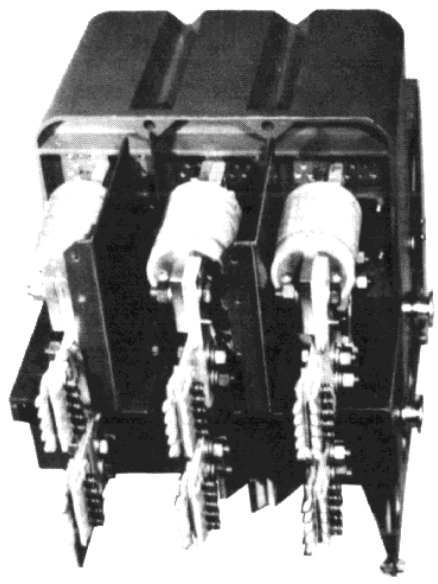


Figure 2-4 Current Limiting Fuses

Open Fuse Trip Indicator (Figure 2-5) (Type LKD only)

The type LKD integrally fused circuit breaker incorporates as a standard feature, three open fuse indicators (one per phase). The operation of any open fuse indicator also mechanically trips and locks out the circuit breaker. The circuit breaker Automatic Trip indicator is actuated in conjunction with the open fuse indicators. The mechanical lockout prevents closing the breaker until all indicators are reset. And optional open fuse trip alarm switch is available.

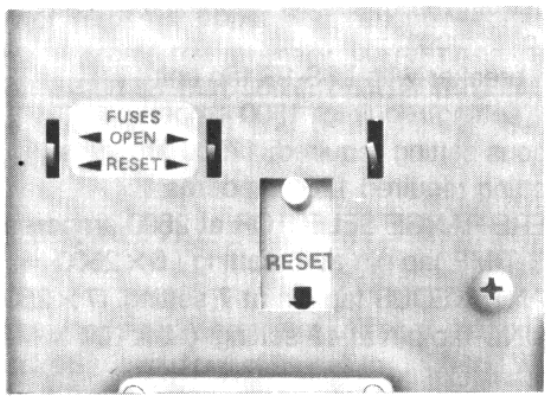


Figure 2-5 Open Fuse Trip Indicator (Part of Front Panel)

2-4 SOLID STATE TRIP SYSTEM

General Description

The solid-state trip system includes the sensors, the general purpose or total purpose Solid-State Trip Device (Power Shield Trip Unit), the magnetic latch and the interconnecting wiring. A current sensor is integrally mounted on each phase of the circuit breaker to supply a value of current to the Power Shield trip unit that is directly proportional to the current flowing in the primary circuit. When the value of current flowing in the primary exceeds the Power Shield trip unit settings for a given time, a signal is sent to the magnetic latch causing the circuit breaker to trip. On a three phase three wire system, ground faults are detected through a residual connection of all three sensors. On a three phase four wire system, provisions are made for input from a separately mounted sensor surrounding the neutral bus to obtain a residual connection of all four (4) sensors.

Power Shield Trip Unit (Solid State Trip Device)

The Power Shield Trip Unit (Figure 2-6) is visible on the front of the circuit breaker on the right hand side. It is completely self-powered, taking the tripping energy from the primary current flowing through the circuit breaker without the necessity of any additional power supply.

Protective Elements

Four basic trip elements within the Power Shield Trip Unit perform the protective functions. (1) long-time, (2) short-time, (3) instantaneous, and (4) ground fault. Power Shield types with various combinations of these protective elements are shown in Table 2-1. Selection of type is dependent upon the protection and coordination requirements for the specific power circuit.

The Power Shield Trip Unit is completely tested prior to shipment. Since there are no mechanical devices which may have lost adjustment during shipment, no readjustments, other than making the required settings, need be made prior to placing in service. The following trip characteristics are available: long time setting and delay; short time setting and delay; instantaneous setting, ground fault setting and delay.

The Power Shield Trip Unit must be properly set, as required by the individual circuit, in order to provide the necessary protection for the electrical circuit. With the transparent cover removed, the movable plugs on the unit faceplate enable independent selection of the long-time, short-time, instantaneous and ground fault characteristics as applicable. The Power Shield Trip Unit protective element(s), with the exception of ground fault, will cause the circuit breaker to trip at a value of ampere range selector position times the plug setting of the various pick-up elements. The ground fault trip value in primary amperes will be the plug setting times 100, as indicated on the faceplate.

Ampere Range Selector

The ampere range selector switch provides two settings — 50% and 100% of phase sensor rating. In the upper position, the setting is 100% of phase sensor rating. In the lower position, the setting is 50% of the phase sensor rating. This exclusive feature effectively expands all trip element settings except ground fault by 100%.

Tap Plugs

When tap plugs are removed from the Power Shield Trip Unit, the settings automatically revert to minimum. Changes in tap settings are not recommended while the breaker is closed and in service, as inadvertent or nuisance tripping may occur.

The Power Shield Trip Unit also provides test positions which are available only with the transparent cover removed.

WARNING WARNING WARNING WARNING

THESE TEST POSITIONS ARE ONLY TO BE USED DURING A SOLID-STATE TRIP SYSTEM TEST PERIOD. THE CIRCUIT BREAKER SHOULD NEVER BE PUT IN SERVICE WITH THE SELECTOR PLUGS IN THE TEST POSITION. AS A REMINDER, THE TRANSPARENT COVER INCORPORATES BARS TO INTERFERE WITH COVER INSTALLATION IF A SELECTOR PLUG IS LEFT IN A TEST POSITION.

Targets (Optional)

Operation indicators (targets) can be provided as an optional feature on total purpose types of Power Shield Trip Units. See listing in Table 2-1. When targets are specified, one indicator will be provided for each of the trip elements included; long-time, short-time, instantaneous, and ground. Therefore, up to a maximum of 4 targets will be supplied based on the number of trip elements on the particular trip unit. When a trip occurs, the target for the element which functioned will display orange. The target will retain its position despite shock or vibration until reset manually to black by means of an integral magnet on the faceplate of the Power Shield Trip Unit.

Available Settings

a. Ampere Range Selector Switch

The ampere range selector switch has 2 positions. The maximum setting (upper) corresponds with the phase sensor. The minimum setting (lower) corresponds with 50% of the phase sensor rating — Table 2-2.

b. Long-time
The long time current setting may be set at 0.6, 0.7, 0.8, 0.9, or 1.0 times the ampere range selector setting. Three long time delay bands are provided, except on the Type LSS-1 and LSS-2 units which have a non-adjustable time delay characteristic. The three bands are labeled MAX (maximum), INT (intermediate), and MIN (minimum).

c. Short-time
The short time current setting may be set at 2,3,4,6, or 10 times the ampere range selector setting. Three short time delay bands are provided: MAX (maximum), INT (intermediate), and MIN (minimum).

d. Instantaneous
The instantaneous current setting may be set at 3,4,5,7, or 12 times the ampere range selector setting.

e. Ground
The ground fault settings vary with the breaker frame size. They are listed in Table 2-2. These settings are marked on the front panel in hundreds of amperes (e.g.: 6 x 100 × 600 amperes pickup). Three ground fault delay bands are provided: MAX (maximum), INT (intermediate), MIN (minimum).

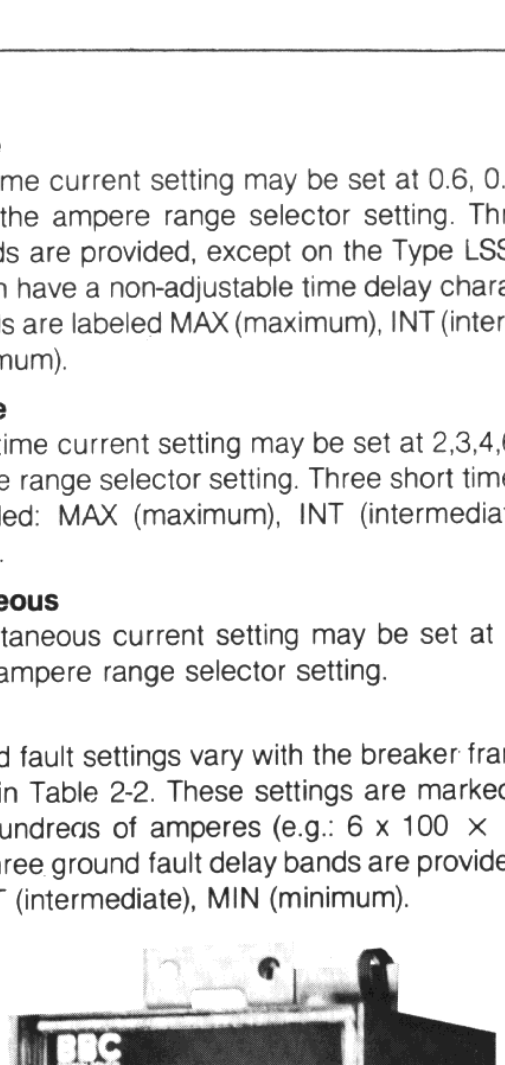


Figure 2-6 Solid State Trip Device

How To Make Settings

The values of current setting and delay times to be set must be determined by an analysis of the protection and coordination requirements of the power system. The ampere range selector is a 2-position switch on the Power Shield Trip Unit. All other settings are made by means of tap pins on the faceplate. The long-time, short-time, and instantaneous trip functions are calibrated in terms of multiples of the ampere range selector setting. The ground function is calibrated directly in hundreds of primary amperes.

An example of settings:

2500 Amp breaker with LSS-1G trip unit
Long Time setting required: 1500 amperes
Instantaneous setting required: 17500 amperes
Ground setting required 1200 amperes

1. Set AMPERE RANGE SELECTOR at 2500 amperes.
2. Set LONG TIME tap pin at .6 setting (.6 × 2500 = 1500)
3. Set INSTANTANEOUS tap pin at 7 setting. (7 × 2500 = 17500)
4. Set GROUND tap pin at 12 setting. (12 × 100 = 1200)

Alarm Features (Optional)

a. Load Alarm Relay

The load alarm relay provides contact closure when the primary current exceeds the relay set value. Contact closure is maintained for the duration of the high load condition. The load alarm setting is continuously adjustable from 60 to 100 percent of the Power Shield solid state trip device selector plug setting. Circuit breakers equipped with this feature are shipped set at the 100 percent setting. Refer to the nearest BBC District Office for instruction IB–8501 when other alarm settings are desired.

The load alarm relay requires control power. Control power is switch selectable for 125 and 250 volts DC; 120 and 240 volts AC.

b. Ground Alarm Relay

The ground alarm relay provides momentary contact closure for remote alarm circuits when a ground trip operation occurs.

The ground alarm relay required control power which is switch selectable for 125 and 250 volts DC; 120 and 240 volts AC.

The load alarm and ground alarm relays are located in the front lower left corner of the cicuit breaker.

Testing

See IB-6.1.1.7-2 for detailed instructions for testing the solid-state trip system.

WARNING WARNING WARNING WARNING

WHEN USING PRIMARY CURRENT TO TEST SOLID-STATE TRIP SYSTEMS EQUIPPED WITH THE GROUND TRIP FUNCTION, THIS FUNCTION MUST BE DEFEATED IN ORDER TO TEST THE OTHER TRIP ELEMENTS. THE GROUND TAP PIN MUST BE IN THE TEST POSITION AND A SPECIAL CABLE PART NUMBER 611786-T1 MUST BE USED. THIS CABLE IS INSERTED TEMPORARILY IN THE CIRCUIT CONNECTING THE TRIP UNIT AND THE CIRCUIT BREAKER. PLACING THE GROUND TAP PIN IN ITS TEST

POSITION ALONE IS NOT SUFFICIENT TO PROPERLY DEFEAT GROUND. FAILURE TO USE PART 611786-T1 CAN DAMAGE THE SOLID STATE TRIP SYSTEM WHEN PERFORMING PRIMARY CURRENT TESTING. CALL THE NEAREST BBC BROWN BOVERI DISTRICT OFFICE TO ORDER THE PART 611786-T1 GROUND CABLE.

(PRIMARY CURRENT NOTE)

Because each pole of LK25, 32, 40, and 42 circuit breakers uses two power stabs for upper and two power stabs for lower terminals, leads from the primary current injection test set should be connected so that current passes through both power stabs on the upper terminal and both on the lower terminal, with the breaker closed.

2-5 CRADLE (Figure 2-7)

General

All type LK drawout circuit breakers utilize a mating CRADLE in order to be racked into and out of its cell through the WITHDRAWN (out), DISCONNECTED, TEST, and CONNECTED positions.

The cradle incorporates the stationary primary and stationary secondary disconnects, emergency trip linkage, grounding connection and interference blocks. Optional equipment includes circuit breaker open/close position indicator, Truck Operated Cell (T.O.C.) and Mechanism Operated Cell (M.O.C.) auxiliary switches, current transformers, mechanical interlocks, Kirk Key interlock, door interlock, and safety shutters.

Stationary Primary Disconnects

The stationary primary disconnects interface with the moving primary disconnects mounted on the circuit breaker to provide the primary phase connections to and from the circuit breaker.

Stationary Secondary Disconnects

The stationary secondary disconnects interface with the moving secondary disconnects mounted on the circuit breaker to provide the control and indicating connections to and from the circuit breaker. Connecting points of each function are dedicated positions to provide for interchangeability of circuit breakers. See Figure 2-8.

The standard contacts function in both the CONNECTED and TEST positions. However, optional operating position only (O.P.) and test position only (T.P.) contacts are available. The "O.P." contacts function only in the CONNECTED position and the "T.P." contacts function only in the TEST position.

Safety Shutter (Optional)

An insulating safety shutter covers the upper and lower stationary primary terminals when the circuit breaker is withdrawn, to inhibit contact with the **live** terminals. As the circuit breaker is racked in, the safety shutter opens permitting the circuit breaker moving primary disconnects to engage the cradle stationary primary disconnects.

Emergency Trip Linkage

The emergency trip linkage mounted on the cradle floor is accessible through an opening in the switchgear compartment door. This standard feature enables emergency tripping of the connected circuit breaker with the compartment door closed. The emergency trip linkage only functions when the circuit breaker is in the CONNECTED position. An optional pushbutton mounted in the door opening to interface with the emergency trip linkage is available.

Open/Close Indicator (Optional)

The open/close indicator projects through an opening in the switchgear compartment door. Visual indication of whether the circuit breaker is open or closed is provided only when the breaker is in the connected position with the compartment door closed. The indicator utilizes standard color coding — red indicating the circuit breaker is closed and green indicating the circuit breaker is open.

Grounding Connection

A connection is incorporated for engaging the circuit breaker grounding contact to provide positive grounding to the switchgear frame.

Interference Blocks

Interference blocks are mounted on the cradle to interface with those mounted on the circuit breaker to reject the interchanging of different circuit breaker frame sizes, fused versus nonfused circuit breakers, and when specified, nuclear class "1E" versus non-class "1E" circuit breakers.

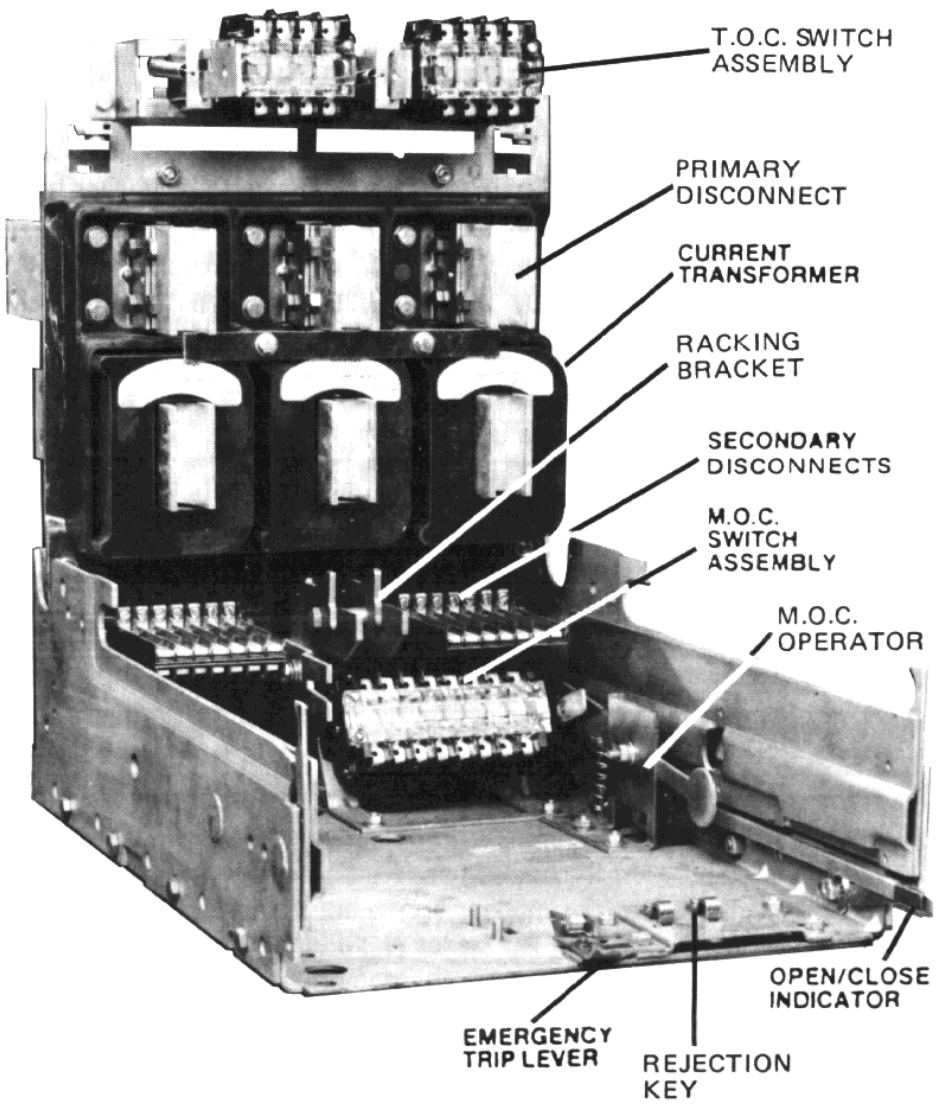


Figure 2-7 Cradle

TABLE 2-1 AVAILABLE POWER SHIELD TRIP UNIT TYPES

TYPE	Trip Protective Elements							Time-Current Characteristic Curve	GRD-Current Characteristic Curve
	Long-Time Setting	Long-Time Delay	Short-Time Setting	Short-Time Delay	Instantaneous Setting	Ground Setting	Ground Delay		
LSS-4	X	X	X	X	—	—	—	TD-9060	—
LSS-4G	X	X	X	X	—	X	X	TD-9060	TD-9062
LSS-5	X	X	X	X	X	—	—	TD-9060	—
LSS-5G	X	X	X	X	X	X	X	TD-9060	TD-9062
LSS-6	X	X	—	—	X	—	—	TD-9059	—
LSS-6G	X	X	—	—	X	X	X	TD-9059	TD-9062

TABLE 2-2 CURRENT SENSORS AND CIRCUIT BREAKER RATINGS

TRIP SYSTEM AMP RATING (Sensor)	AMPERE RANGE SELECTOR SETTING	GROUND PRIMARY AMPERES PICK UP SETTING	AVAILABLE ON CIRCUIT BREAKER TYPES
200	100, 200	100, 300, 600, 1200	LK, LKE, LKD 8 & 16
800	400, 800	100, 300, 600, 1200	LK, LKE, LKD 8 & 16
1600	800, 1600	300, 600, 900, 1200	LK, LKE, LKD 16
2000	1000, 2000	300, 600, 900, 1200	LK, 20
2500	1250, 2500	300, 600, 900, 1200	LK, LKE 25
3000	1500, 3000	500, 800, 1000, 1200	LK, LKE 32
3200	1600, 3200	500, 800, 1000, 1200	LK, LKE 32
4000	2000, 4000	500, 800, 1000, 1200	LK 40
4200	2100, 42000	500, 800, 1000, 1200	LK, LKE 42

Truck Operated Cell (T.O.C.) Switch (Optional)

The T.O.C. auxiliary switch mounts above the cradle primary disconnects and provides contacts for remote indication of the circuit breaker's drawout position. The switch is available in two separate arrangements. In the standard arrangement the auxiliary contacts operate between the CONNECTED and TEST positions. In the special arrangement the auxiliary contacts operate between the TEST and DISCONNECTED positions. The T.O.C. auxiliary switch is available in a 4 or 8 contact arrangement. See Table 5-3 for electrical ratings. Unless specified otherwise, half of the contacts are normally open while the other half are normally closed.

Mechanism Operated Cell (M.O.C.) Switch (Optional)

The M.O.C. auxiliary switch mounts on the cradle floor and provides contacts for remote indication of whether the circuit breaker primary contacts are in the Open or Closed position. Two assembly arrangements are available. In the standard arrangement the auxiliary contacts operate in the CONNECTED position only. In the special arrangement the auxiliary contacts operate in both the CONNECTED and TEST positions. The M.O.C. auxiliary contact assembly is available in a 4 or 8 contact arrangement. See Table 5-3 for electrical ratings. Unless specified otherwise, half of the contacts are "a" while the other half are "b".

Current Transformers (Optional)

Provisions for mounting one current transformer per phase are incorporated into all cradles. Current transformers are mounted on the lower primary cradle terminals for 800 and 1600 AMP circuit breakers. Current transformers are mounted on the upper primary cradle terminals for 2500, 3200 and 4200 AMP circuit breakers.

Mechanical Interlock (Optional)

Interconnected cradle-mounted linkage permits only one of two horizontally or vertically adjacent circuit breakers to be in the closed position at any time, when in the CONNECTED position.

Kirk Key Interlock (Optional)

Provisions for mounting a Kirk Key interlock are available with accessibility through the closed compartment door. The Kirk Key is released only when the linkage on the cradle locks the circuit breaker OPEN when in the CONNECTED position.

Door Interlock (Optional)

A door interlock is available to prevent the compartment door from being opened when the circuit breaker is closed, when in the CONNECTED position.

2-6 LKD (INTEGRAL FUSED) CIRCUIT BREAKERS

Current Limiting Fuses (See Figure 2-4)

The current-limiting fuses normally mounted on type LKD circuit breakers are a special type with the continuous current rating selected to provide coordination between the fuses, the solid state trip unit and other load side protective equipment. The maximum permissible continuous current rating of the fuses is noted on the circuit breaker nameplate.

When a fuse is opened on a high fault, the type LKD circuit breaker will be automatically tripped by the open fuse trip device. When a fuse has opened, it is recommended that all three fuses be replaced regardless of apparent condition, because the time-current characteristic of an unopened fuse could be altered changing the system coordination.

To replace the fuses, withdraw and remove the circuit breaker from its compartment and place it so that the fuses are readily accessible. Fuse replacement should be accomplished by changing only one fuse at a time and tighten the hardware associated with that fuse to 55-75 foot-pounds before loosening the hardware on either of the other two fuses. By changing only one fuse at a time, Primary Current Parts remain in proper alignment and all reference dimensions are maintained. Otherwise fuse replacement is a simple mechanical procedure.

CAUTION CAUTION CAUTION CAUTION

WHEN REPLACING THE FUSES, DO NOT REMOVE THE WIRES LEADING TO THE OPEN FUSE TRIP DEVICE. SHOULD IT BE NECESSARY TO CHECK INDIVIDUAL FUSE CONTINUITY, THE FUSES MUST BE REMOVED FROM THE CIRCUIT BREAKER TO ISOLATE THE FUSE FROM THE PARALLELED COIL OF THE OPEN FUSE TRIP DEVICE.

Replacement fuses MUST be the current-limiting type as originally installed or an approved equivalent. It is important for the fuses to be of the same continuous current rating as those originally installed so that established coordination is not affected. The installation of any other type fuse, even if modified for mounting, is prohibited.

Open Fuse Trip Device (Figure 2-5)

The open fuse trip device provides automatic opening of the circuit breaker to prevent single-phasing of protected equipment when one or more of the integral fuses open.

The device consists of three voltage coils with one coil wired in parallel with each fuse. The coils are energized by the voltage across the open fuse and causes the circuit breaker to trip.

When the open fuse trip device operates, a target indicator will appear in an opening in the circuit breaker front plate providing indication that the circuit breaker has opened due to fuse operation. At the same time, up to three indicators will extend through the front of the circuit breaker front plate indicating on which pole of the circuit breaker the fuse opened. This condition is visible only with the compartment door open. The automatic trip indicator on the control center will also have extended, providing visible external indication of automatic opening. If the automatic trip indicator is extended but the open fuse trip device indicators are not, then the circuit breaker opened from solid-state trip device operation.

When both the open fuse trip device indicators and the automatic trip indicator are extended, the circuit breaker will be held in the trip-free position so that it cannot be reclosed. If both indicators are inadvertently reset and the circuit breaker reclosed before the fuses are replaced, the circuit breaker will safely open again, when voltage is applied to the primary terminals, but this is not a recommended procedure.

After the fault is removed, and the fuses have been replaced the open fuse indicators and target indicator must be pushed down and the automatic trip indicator pushed up before operating the circuit

breaker mechanism. The fused circuit breaker may then be installed and service resumed.

The design of the open fuse trip device is such that no maintenance or adjustment is necessary on this device for its normal operating life. See Table 5-3 for electrical ratings of optional open fuse trip alarm contacts.

3 INSTALLATION AND REMOVAL

3-1 GENERAL

Drawout Positions

All of the type LK circuit breakers have four positive closed door drawout positions. By raising the access door, the circuit breaker may be racked to any of the four positions with the cubicle door closed. There is no protrusion of the circuit breaker beyond the cubicle door in any position. The circuit breaker is captive in all positions except WITHDAWN (out). In all captive positions, the circuit breaker may be padlocked open and in position with racking prevented.

A positive detent is provided at the disconnected, test, and connected positions.

a. Withdrawn (out)
In the WITHDRAWN (out) position, both primary and secondary contacts are disconnected. The circuit breaker may be inspected by rotating on the cradle tracks or it may be removed for more complete accessibility.

b. Disconnected
In the DISCONNECTED position, the primary and secondary disconnect terminals are disengaged and separated a safe distance from the corresponding stationary terminals.

c. Test
In the TEST position, the primary disconnecting terminals are disengaged; however, selected control contacts are connected to permit operation of the circuit breaker. The TEST position is used for testing circuit breaker operation and control system functions as provided. In this position, the circuit breaker is not suitable for internal inspection or any maintenance function.

d. Connected
In the CONNECTED position, both the primary and selected secondary disconnecting terminals are engaged, and the circuit breaker is ready for service.

3-2 INSTALLATION AND REMOVAL

WARNING WARNING WARNING WARNING

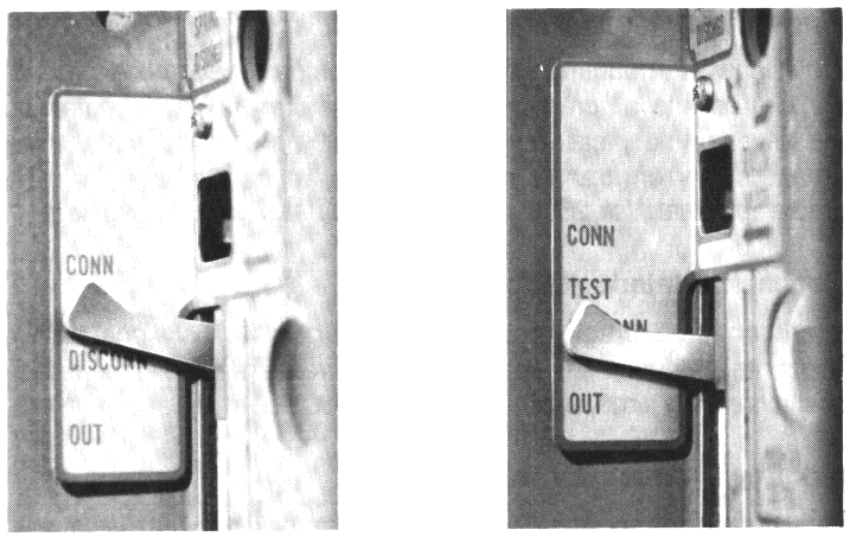
WHEN INSTALLING OR REMOVING CIRCUIT BREAKERS, THE SUPPLY FOR PRIMARY AND CONTROL CIRCUITS MUST BE DE-ENERGIZED AT ALL TIMES. TESTING CIRCUIT BREAKERS IS TO BE DONE WITH THE PRIMARY SUPPLY CIRCUIT DE-ENERGIZED AND THE CONTROL CIRCUIT ENERGIZED. TESTING IS TO BE DONE IN THE TEST POSITION.

IT IS NECESSARY TO HOLD THE RACKING RELEASE LEVER TO THE LEFT, FOR AT LEAST ONE FULL TURN, OF THE RACKING CRANK WHEN RACKING IN OR OUT. NEGLECTING THIS STEP MAY RESULT IN DAMAGE TO THE RACK RELEASE LEVER.

Installation

To insert the circuit breaker into its compartment, proceed as described below (Refer to Figure 2-1)

1. The circuit breaker must be in the OPEN position, the racking crank (15) turned in the counterclockwise direction to the fully withdrawn position and the motor disconnect switch (5) (electrically operated circuit breakers only) in the OFF position.
2. Open the compartment door and pull out the right-hand and left-hand tracks (17) to the fully extended position.
3. Using a lifting yoke (14) position the circuit breaker so that the wheels (21) (two each side of circuit breaker) rest on the tracks (17). Remove the lifting yoke.
4. Using two hands push the circuit breaker uniformly and firmly toward the compartment until it stops. Push the left-hand and right-hand cradle tracks (17) into the fully retracted position. The front plate (3) of the circuit breaker should be flush with ends of the cradle tracks (17). If flush, close the compartment door, open the access port and proceed to Step 5. If not, do not proceed to Step 5 and instead withdraw the cradle tracks (17) to the fully extended position and pull the circuit breaker out and inspect for foreign objects, normal breaker rejection features, racking hook in withdrawn position as referenced above in Step 1, etc.



Disconnected **Out**

Figure 3-1

5. (a) Engage racking crank (15), (b) push racking release lever (10) to the left and hold, (c) rotate the racking crank (15) clockwise one full turn, (d) release hold as racking lever (10) is now captive, (e) continue to rotate the racking crank (15) clockwise until the racking lever (10) snaps back to its right-hand position, (f) the circuit breaker position indicator should now point to DISCONNECTED as shown in Figure 3-1.
6. (a) repeat Steps 5(a) through 5(e). (b) the circuit breaker position indicator should now point to TEST as shown in Figure 3-1.
7. If circuit breaker is to be operated.
   (a) For electrically operated circuit breakers:
   Place the motor disconnect switch (5) in the ON position to charge the closing springs.
   (b) For manually operated circuit breakers:
   Manually charge closing springs as described in Section 2.2, Page 5 "Manual Charging Handle".
   (c) CLOSE and TRIP circuit breaker as applicable.

CAUTION CAUTION CAUTION CAUTION

If closing springs are charged, in order to release the racking latch (10), first the manual trip lever (8) must be raised and held to enable pushing the racking release latch to the left-hand position.

8. (a) Repeat Steps 5(a) through 5(e). (b) the circuit breaker position indicator should now point to CONNECTED as shown in Figure 3-1. Refer to Step 7 as applicable.

CAUTION CAUTION CAUTION CAUTION

To avoid circuit breaker racking mechanism damage, do not rack the breaker past the "CONNECTED" detent. Breaker to cradle penetration is not improved by doing so.

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

(Refer to Figure 2-1)

9. With the compartment door closed, trip the circuit breaker by means of the remote mounted control switch or the emergency manual TRIP button on the compartment door.
10. (a) Engage racking crank (15), (b) push racking release lever (10) to the left and hold. See caution above, (c) rotate the racking crank (15) counterclockwise one full turn, CAUTION — do not rotate racking crank clockwise (applicable only to the CONNECTED position). (d) release hold as racking lever (10) is now captive, (e) continue to rotate the racking crank (15) counterclockwise until the racking lever (10) snaps back to its right-hand position, (f) the circuit breaker position indicator should now point to TEST as shown in Figure 3-1. Refer to Step 9 as applicable.
11. (a) repeat Steps 10(a) through 10(e), (b) the circuit breaker position indicator should now point to DISCONNECTED.
12. (a) repeat Steps 10(a) through 10(d), (b) continue to rotate the racking crank (15) counterclockwise until it stops. During this operation the charging springs will be discharged automatically. The racking release lever will still be captive in the left-hand position. (c) the circuit breaker position indicator should now point to OUT (WITHDRAWN).
13. (a) Open compartment door, pull out left-hand and right-hand cradle tracks (17) into the fully extended position. (b) Pull the circuit breaker out onto the extended cradle tracks (17). (c) Attach the lifting yoke (14) to the circuit breaker wheels (21). The circuit breaker is now ready for removal through use of an approved lifting device.
14. After removal of the circuit breaker, push cradle tracks (17) into the withdraw position and close the compartment door.

WARNING WARNING WARNING WARNING

FOR SAFETY, IF THE CLOSING SPRINGS ARE CHARGED, THEY WILL AUTOMATICALLY BE DISCHARGED WHEN INSERTING OR WITHDRAWING THE CIRCUIT BREAKER IN THE SWITCHBOARD COMPARTMENT. HOWEVER, IT IS ALWAYS GOOD SAFETY PROCEDURE TO MANUALLY DISCHARGE THE CLOSING SPRINGS BEFORE INSERTING OR REMOVING THE CIRCUIT BREAKER.

4 OPERATION AND TEST

4-1 Closing Spring Operation

The closing springs supply the power that closes the circuit breaker and also charge the opening springs during the closing operation. The spring energy, available to close the circuit breaker, is referred to as "STORED ENERGY". For drawout type LK circuit breakers, the closing springs are automatically discharged when racking the circuit breaker from DISCONNECTED to WITHDRAWN (out) position. This action is intended to protect personnel who perform work on the circuit breaker after it has been withdrawn.

Electrically Operated Circuit Breakers

On standard electrically operated circuit breakers, the closing springs are automatically charged by a motor when the motor disconnect switch is ON and the circuit breaker is opened in the TEST or CONNECTED position. When the circuit breaker is being racked in, if the motor disconnect switch is ON, the motor will automatically charge the springs as the control contacts engage upon reaching the TEST position. An optional arrangement is available whereby the closing aprings are charged after closing. In this optional mode, the circuit breaker may be opened, reclosed and then reopened without the necessity of recharging the springs. This optional feature does not imply that the circuit breaker has instantaneous reclosing capabilities. Electrically operated circuit breakers incorporate the feature of manual charging of the closing springs as described under "Manually Operated Breakers".

WARNING WARNING WARNING WARNING

ON ELECTRICALLY OPERATED CIRCUIT BREAKERS, PLACE CHARGING MOTOR DISCONNECT SWITCH IN "OFF" POSITION BEFORE MANUALLY CHARGING THE CLOSING SPRINGS

Manually Operated Circuit Breakers

On manually operated circuit breakers, the closing springs are charged with an up and down pumping motion of the manual charging handle. To charge, depress handle retainer, lift the charging handle to disengage it from the stored position, rotate upward and slide it onto the engagement pin. Approximately eleven (11) pumping strokes are required to charge the closing springs. When the springs are fully charged (indicated by an audible click) after which the ratchet system is blocked, return the handle to its stored position. The SPRING CHARGED indicator will be visible and the circuit breaker can now be closed by depressing the manual mechanical push button. During the closing stroke, the opening springs are charged.

4-2 OPERATING SEQUENCE FOR TYPE LK CIRCUIT BREAKERS

Electrically Operated (Refer to Fig. 4 - 1 or 4 - 2)

With the circuit breaker open, the closing springs discharged and the control power source energized, when the motor disconnect switch (MDS) is placed in the "ON" position (closed), the following operations occur:

1. Immediately upon availability of control power, the spring charging motor (M) is energized, which in turn charges the closing springs. When the closing springs reach the fully charged condition (a) limit switch LS/1 opens to deenergize the charging motor (M), (b) limit switch LS/3 closes to set up the closing circuit, (c) the operating linkage of limit switch LS/2 is released to close contact LS/2 but if the "Y" relay (Y) is energized closing of the LS/2 contact will be blocked until the "Y" relay (Y) is deenergized.
2. Operation of the "close" switch simultaneously energizes the "Y" relay (Y) and the close coil (X) through the circuit breaker auxiliary switch "b" contact and the limit switch contacts LS/2 and LS/3. The close coil (X) releases the closing latch permitting the closing springs to discharge and close the circuit breaker.
3. When the "Y" relay (Y) is energized the limit switch LS/2 is latched open, as long as, a close signal is maintained immediately following a closing spring operation. Upon release of the closing signal the "Y" relay (Y) is deenergized and LS/2 contact closes. The purpose of the "Y" relay (Y) is to prevent pumping of the closing mechanism when closing against a faulted circuit. A second close operation can not occur until the "Y" relay (Y) is deenergized and a close signal is reapplied.
4. When the circuit breaker closes, all auxiliary switch "b" contacts open and all auxiliary switch "a" contacts close.
5. When the springs discharge, limit switch contact LS/1 closes, contact LS/3 opens, and the operating linkage of limit switch LS/2 opens contact LS/2.
6. On maintained control, the close signal must be interrupted to permit deenergizing of the "Y" relay (Y) in order to unlatch the limit switch LS/2 linkage to close limit switch LS/2 contact. On momentary control the "Y" relay (Y) is deenergized as soon as the close signal is removed allowing limit switch LS/2 to close.
7. The circuit breaker can be tripped by operation of the "trip" control switch which energizes the circuit breaker trip coil (TC) through the auxiliary switch "a" contact.
8. The closing springs automatically recharge when the circuit breaker is opened or tripped (except as otherwise noted) when the auxiliary switch "b" contact closes.

Manually Operated

With the circuit breaker open, the closing springs discharged, the manual spring charging handle is pumped to charge the springs.

1. The circuit breaker may be closed locally at the breaker by pushing the manual close button.
2. The circuit breaker may be tripped locally by the manual trip lever on the circuit breaker control center, the emergency trip on the cradle, or it may be tripped remotely when provided with an electrical shunt trip feature.
3. The closing springs may be charged manually when the circuit breaker is in the open or closed position.

Undervoltage Trip Device (Optional)

This device must be energized to initially close the breaker, and also to maintain the circuit breaker in a closed position.

4-3 OPERATIONAL CHECKOUT

WARNING WARNING WARNING WARNING

FOR SAFETY, THE CHECKOUT OF ALL CIRCUIT BREAKERS MUST BE PERFORMED WITH THE PRIMARY CIRCUIT DE-ENERGIZED, AND THE CONTROL CIRCUIT ENERGIZED. THE TEST POSITION SATISFIES THIS CONDITION.

Checking Circuit Breaker Operation in TEST Position (Electrically operated) (Refer to Figure 2-1)

1. Manually reset automatic trip indicator (4) if it is in the tripped position. Push up to reset.
2. Place motor disconnect switch (5) to "ON" position and closing springs will automatically charge.
3. Close and trip circuit breaker by local close and trip electrical push buttons (7) or local manual close button (12) and local manual trip lever (8).
4. Close and trip circuit breaker by means of remote control switch, as applicable.
5. Check each auxiliary device for proper operation.
6. With the circuit breaker closed verify that the racking release lever (10) cannot be moved to the left hand position without first tripping the circuit breaker. This demonstrates that the circuit breaker cannot be racked out when closed.

Checking Circuit Breaker Operation in TEST Position (Manually operated) (Refer to Figure 2-1)

1. Manually reset automatic trip indicator (4) if it is in the tripped position. Push up to reset.
2. Pump the charging handle (16) up and down to charge closing springs. When fully charged, push manual close button (12), to close.
4. With the circuit breaker closed verify that the racking release lever (10) cannot be moved to the left hand position without first tripping the circuit breaker. This demonstrates that the circuit breaker cannot be racked out when closed.
5. Trip by raising the manual "TRIP" lever (8).
6. Check each auxiliary device for proper operation.

Checking Circuit Breaker Operation in CONNECTED Position (Electrically Operated) (Refer to Figure 2-1)

With the circuit breaker open and in the TEST position and the motor disconnect switch (5) in the OFF ppsition, insert the racking crank, release racking release lever (10) and turn crank clockwise until the position indicator (19) shows CONNECTED position.

1. Manually reset automatic trip indicator (4) if it is in the tripped position. Push up to reset.

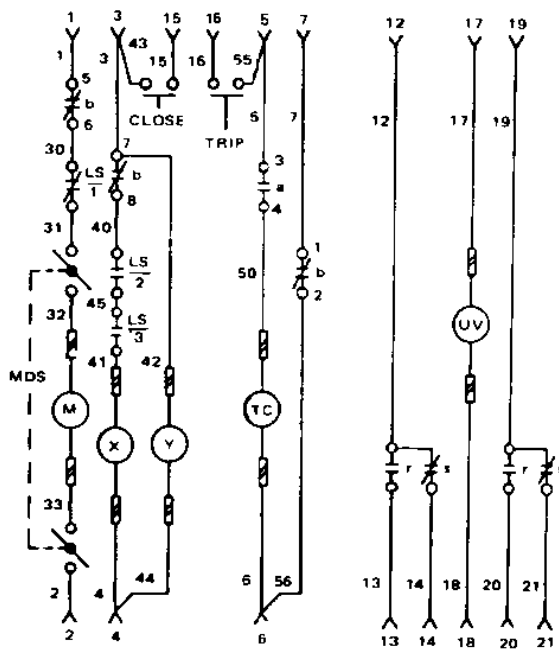


Figure 4-1 Typical Schematic Wiring Diagram of Control Circuit, 3-wire Scheme

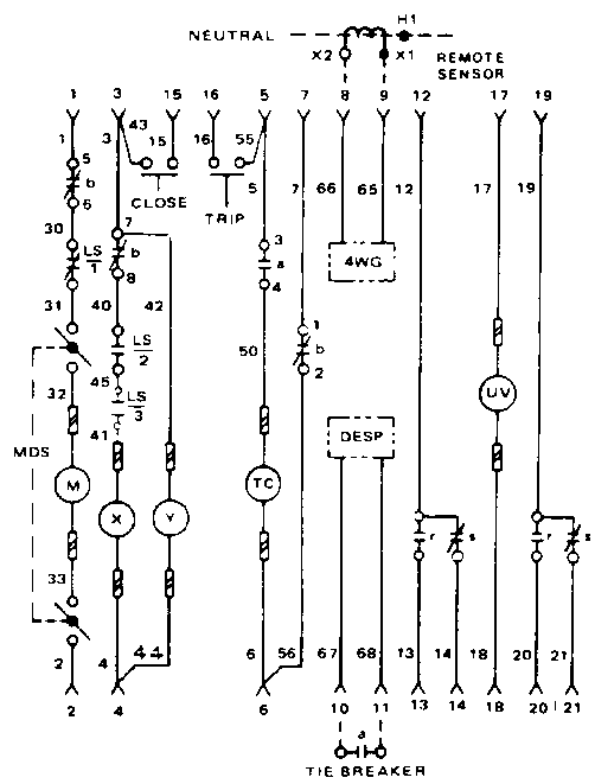


Figure 4-2 Typical Schematic Wiring Diagram of Control Circuit, 4-wire Scheme with Doubled Ended Substation Protection.

SYMBOL	DESCRIPTION
a	AUXILIARY SWITCH CONTACT, OPEN WHEN BREAKER IS OPEN.
b	AUXILIARY SWITCH CONTACT, CLOSED WHEN BREAKER IS OPEN.
LS/1	LIMIT SWITCH CONTACT. CONTACT OPEN WHEN CLOSING SPRINGS ARE DISCHARGED AND IS LATCHED OPEN WHEN "Y"-COIL IS ENERGIZED. CONTACT UNLATCHED CLOSED WHEN "Y"-COIL IS DE-ENERGIZED.
CLOSE	LOCAL ELECTRICAL CLOSE PUSHBUTTON.
TRIP	LOCAL ELECTRICAL TRIP PUSHBUTTON.
LS/1	LIMIT SWITCH CONTACT. CLOSED WHEN SPRINGS ARE DISCHARGED. OPEN WHEN SPRINGS ARE CHARGED.
LS/3	LIMIT SWITCH CONTACT. OPEN WHEN SPRINGS ARE DISCHARGED. CLOSED WHEN SPRINGS ARE CHARGED.
M	MOTOR, CLOSING SPRING CHARGING.
MDS	MOTOR DISCONNECT SWITCH.
r	ALARM CONTACT CLOSES ON OVERCURRENT (AND/OR GROUND) TRIP, MANUALLY RESET.
r(uv)	UNDERVOLTAGE ALARM SWITCH CONTACT. CLOSES ON UV TRIP. OPEN WHEN UV PICKS UP.
s	ALARM CONTACT OPENS ON OVERCURRENT (AND/OR GROUND) TRIP, MANUALLY RESET.
TC	SHUNT TRIP COIL.
UV	UNDERVOLTAGE DEVICE (TRIP OR LOCK OPEN).
SS ALARM	SOLID-STATE ALARM SWITCH (GROUND TRIP ALARM OR HIGH LOAD ALARM FUNCTION).
AR	ALARM RELAY COIL (GROUND TRIP ALARM OR HIGH LOAD ALARM FUNCTION).
X	CLOSE COIL, CLOSING LATCH RELEASE.
Y	"Y" RELAY COIL (PREVENTS PUMPING)

	TERMINAL BLOCK
	WIRE DISCONNECTS.
	MOVABLE SECONDARY DISCONNECT CONTACTS.
H1	PRIMARY SIDE OF NEUTRAL SENSORS.
X1 & X2	SECONDARY SIDE OF NEUTRAL SENSORS.
■	POLARITY MARK – ORIENT NEUTRAL SENSOR PRIMARY POLARITY (H1) TOWARD SOURCE IF BREAKER UPPER TERMINALS ARE SOURCE TERMINALS. REVERSE IF BREAKER UPPER TERMINALS ARE LOAD TERMINALS.
4WG	4 WIRE GROUND TRIP FUNCTION.
DESP	DOUBLE ENDED SUB-PROTECTION 4 WIRE GROUND FUNCTION.

NOTE: a AND b CONTACTS FOR CUSTOMER USE ARE MOUNTED ON CRADLE AND WIRED DIRECTLY.

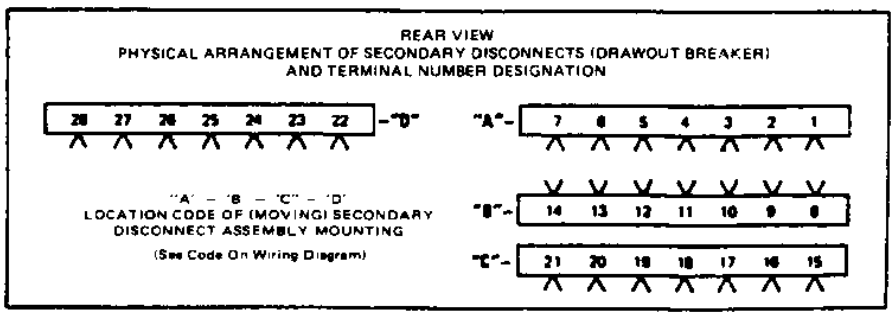


Figure 4-3 Wiring Diagram Legend

2. Place motor disconnect switch (5) to ON position and closing springs will automatically charge.
3. Close and bolt compartment door. Close and trip by local close and trip devices as allowed.
4. Close and trip circuit breaker by means of remote control switch, as applicable.
5. Check each auxiliary device for proper operation.
6. With the circuit breaker closed verify that the racking release lever (10) cannot be moved to the left hand position without first tripping the circuit breaker. This demonstrates that the circuit breaker cannot be racked out when closed.

Checking Circuit Breaker Operation in CONNECTED Position (Manually Operated) (Refer to Figure 2-1)

1. Manually reset automatic trip indicator (4) if it is in the tripped position. Push up to reset.
2. Pump the charging handle (16) up and down to charge closing springs. When fully charged push manual close button (12), to close.
3. Close and bolt compartment door. Open access port and push local close pushbutton (12).
4. With the circuit breaker closed verify that the racking release lever (10) cannot be moved to the left hand position without first tripping the circuit breaker. This demonstrates that the circuit breaker cannot be racked when closed.
5. Check each auxiliary device for proper operation.
6. Trip by raising the manual trip lever (8).
7. Repeat above and trip with emergency trip.

4-4 ABNORMAL OPERATION (Electrically Operated) (Refer to Fig. 2-1)

The circuit breaker must be racked to the TEST position to disconnect it from the primary power source. Motor disconnect switch (5) must be placed in the "OFF" position.

Manually charge the closing springs as described in Section 2.2, Page 5. Rack the circuit breaker into the CONNECTED position, as described in Section 3.2, Page 14. Close and secure the compartment door. Open the access port and push the manual close button (12).

5. MAINTENANCE (Refer to Fig. 2-1)

WARNING WARNING WARNING WARNING

DISCONNECT BOTH PRIMARY AND CONTROL POWER SOURCES BY RACKING THE CIRCUIT BREAKER TO THE DISCONNECTED OR WITHDRAWN (OUT) POSITION BEFORE MAKING ANY INSPECTIONS, ADJUSTMENTS OR PARTS REPLACEMENT. MAKE CERTAIN CIRCUIT BREAKER IS "OPEN" BY OBSERVING INDICATOR (9) AND CLOSING SPRINGS ARE "DISCHARGED" BY OBSERVING INDICATOR (11).

DO NOT ATTEMPT TO MANUALLY CHARGE THE CLOSING SPRINGS WITH THE CIRCUIT BREAKER EXTENDED ON ITS CRADLE TRACKS. IF THE CLOSING SPRINGS MUST BE CHARGED FOR MAINTENANCE PURPOSES, THE CIRCUIT BREAKER MUST BE REMOVED FROM THE CRADLE, THE RACKING CRANK (15) MUST BE ENGAGED AND ROTATED CLOCKWISE UNTIL THE POSITION INDICATOR (19) SHOWS "DISCONNECT"

WHEN IT IS NECESSARY THAT THE CLOSING SPRINGS BE CHARGED, OR THE CIRCUIT BREAKER BE CLOSED, BE SURE TO STAY CLEAR OF OPERATING PARTS

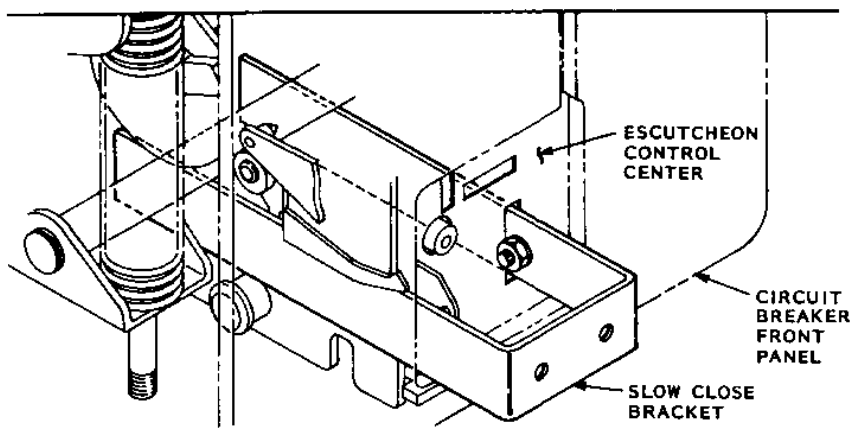


Figure 5-1 Slow Close Feature

5-1 SLOW CLOSE PROCEDURE (See Figure 5-1)

Refer to Warnings above.

1. The slow close procedure is the same for electrically operated or manually operated breakers, frame sizes 800 through 4200 amperes. The slow close procedure requires a slow close bracket available as an accessory. To order from BBC Brown Boveri use number 712229-T5.
2. Manually charge circuit breaker closing springs. Do not return handle to its stored position.
3. Insert slow close bracket straight into slots in circuit breaker control center as far as possible.
4. Push the manual close button to close the breaker. Note that the main contacts will move but not close when the slow close bracket is in place.
5. Pump the manual charge handle to slowly close the main contacts of the breaker.
6. The contact gap can now be measured (See Paragraph 5-3).
7. The slow close bracket can now be removed unless the slow close procedure is to be repeated.
8. To repeat the slow close procedure, first trip the breaker (with slow close bracket in place) then push the manual close pushbutton. Pump the manual charge handle to slowly close the main contacts.
9. The circuit breaker can be returned to service by removing slow close bracket, tripping breaker, reclosing (to discharge springs), then tripping again. The racking shaft must be racked to the "OUT" position prior to installation in cradle.

5-2 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:

LK, LKE & LKD 8	—After 1,750 operations
LK, LKE & LKD 16 & LK 20	—After 500 operations
LK & LKE 25, 32, 40 & 42	—After 250 operations

NOTE: AN OPERATION COUNTER IS AVAILABLE AS AN OPTION.

The above inspection periods apply for no load or load current switching. If the listed number of operations is not completed in the first year of service, the circuit breakers should be inspected regardless of count and an annual inspection thereafter is recommended. The circuit breaker should always be inspected after a short circuit or severe overload interruption, regardless of time prior or number of operations.

Where unusual service conditions 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. Maintenance records containing the date of last inspection and the condition of the circuit breaker, as well as any adjustments or replacements made, should be filed as a guide for any special attention. These maintenance instructions only cover circuit breakers used under the standard usual service conditions. Unusual conditions are covered in ANSI Standard C37.13. The inspection of all circuit breakers 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, "Y" relay and insulation structure should be inspected as described below.

Arc Chute (Refer to Figure 2-1)

a. Removal

1. Loosen and remove the retaining screws (24).
2. Pull the arc chute (1) forward then lift to remove.

b. Examination

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

c. Re-Installation

1. Properly position the arc chute in the upper molding.
2. Insert and tighten retaining screws (24).

Contacts (Accessible after removing Arc Chute) (See Fig. 5-2)

1. Remove dirt or grease on arcing contacts (1) and (2) with a clean, lint-free cloth.

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

3. Small burrs on the arcing contacts can be removed by filing along contour. Do not let fillings fall into mechanism.

4. Replace badly pitted contacts that do not meet correct adjustment requirements, "A".

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

"Y" Relay (Anti-Pump)

1. Rack the circuit breaker to the TEST position.

2. Operate the local or remote electrical close device as applicable to close the circuit breaker.

3. While maintaining the closing signal, trip the circuit breaker. The "Y" relay should prevent the reclosing of the circuit breaker until the close signal is removed and then re-applied.

4. If the "Y" relay does not perform as described, replace the "Y" relay assembly.

Insulation Structure

Insulated parts should be checked for damage. Dust and dirt should be removed by cleaning with a lint-free cloth. **Do not use any solvents.** To remove persistant contamination, apply a mild detergent and rinse with clear water and dry. If environmental conditions are too severe, action should be taken to prevent additional contamination.

5-3 ADJUSTMENTS (Refer to Fig. 2-1)

In order to close the circuit breaker, the racking lever(10) must be in its right-hand position. Otherwise the circuit breaker will be trip-free. When the racking mechanism is in DISCONNECTED, TEST, or CONNECTED positions the racking lever will be in the right hand position.

Contacts (Refer to Figure 5-2)

1. With the arc chutes removed, closing springs "discharged", the stationary arcing contacts (2) and stationary primary main contact fingers (6) should move freely for self-alignment by rocking them on the center support.

2. Charge springs and close the circuit breaker.

3. In the closed position check for 0.170±.010 inch gap measured "A", between the moving (1) and stationary (2) arcing contacts.

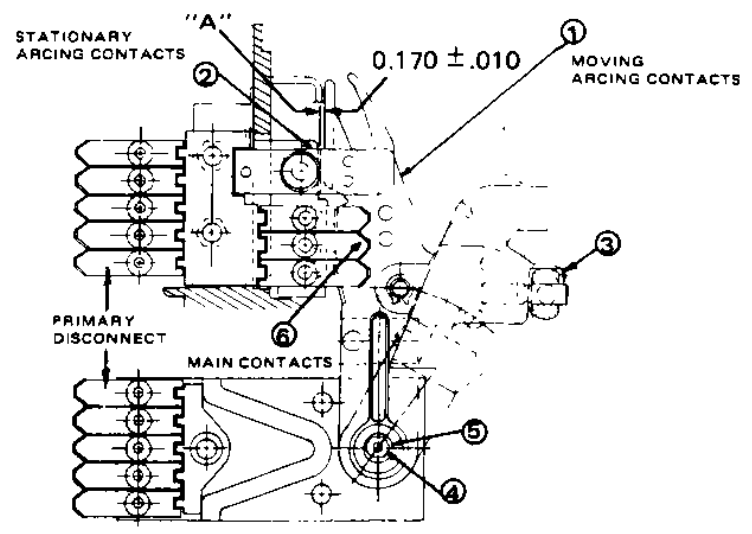


Figure 5-2 Contact Adjustment for Type LK Circuit Breakers

4. To adjust gap dimension turn adjusting screw (3) in the appropriate direction.

Mechanism

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

a. Closing Latch Pressure

The closing latch pressure measured at the close button using a spring scale shall be three (3) to eight (8) pounds for type LK-8, LK-16 and LK-20 circuit breakers, and five (5) to eight (8) pounds for type LK-25 and above. Pressure requirements are the same for equivalent type LKE and LKD circuit breakers. If these forces are exceeded, consult the nearest District Office.

b. Trip Latch Pressure

The trip latch pressure required to trip the circuit breaker is measured by using a spring scale at the end of the trip latch lever and shall be (1.5) to (4) pounds maximum. If these forces are exceeded, contact the nearest District Office.

c. Shunt Trip Device, Close Coil (X), "Y" Relay and Magnetic Latch Device

The shunt trip device, close coil (X), and "Y" relay are adjusted before leaving the factory. It is recommended that no attempt be made to adjust these devices in the field.

d. Magnetic Latch Device

The magnetic latch is calibrated prior to shipment. Adjustments are sealed and are not field adjustable.

On LK 2500 thru 4200 ampere circuit breakers, the horizontally mounted magnetic latch trip lever is adjustable to assure reliable circuit breaker tripping and proper magnetic latch reset.

Solid State Trip Device Settings (See Figure 2-6)

No adjustments are necessary in selecting trip settings on this trip device. The selector plugs allow flexibility in choosing settings and may be moved from one plug tap to another, consistent 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 is not secure, the affected element will trip at the minimum setting.

Field Testing of Solid State Trip Device

For complete testing of these devices, refer to Instruction Bulletin IB-6 1.1.7-2.

5-4 LUBRICATION

The LK 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 "A-Special" grease manufactured by Dearborn Chemical Company. To order from BBC Brown Boveri use Number 713222-A for one pint can.

2. All other mechanism parts, bearings, pins, etc. have been lubricated with ANDEROL 757 manufactured by Tenneco Chemical, Inc. Intermediate Division. To order from BBC Brown Boveri use Number 712994-A for a 4 oz. tube.

The circuit breaker should require no additional 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 "A-Special" or ANDEROL 757 grease as applicable. Refer to IB-8604 for lubrication instructions for LK circuit breakers applied in Nuclear or other severe service conditions as defined by ANSI C37.13, 1981.

CAUTION CAUTION CAUTION CAUTION

DO NOT LUBRICATE MAGNETIC LATCH DEVICE OR OTHERWISE CLEAN OR SPRAY WITH ANY SUBSTANCE.

1. Do not use NO-OX-ID "A-Special" grease on any arcing or main contact surfaces.

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

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

NOTES:

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

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

5-5 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 5-1.

It is not recommended that the motor be dielectric tested, but if desired, test at 600V ac or 750V dc. maximum.

WARNING WARNING WARNING WARNING

MOTOR MUST BE DISCONNECTED FROM THE CONTROL CIRCUIT FOR THIS DIELECTRIC TEST ON MOTOR.

5-6 ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES

For closing and tripping currents and voltage ranges, refer to Table 5-2.

For undervoltage trip devices, standard voltages and operating data, refer to Table 5-4.

Current values are average steady state values. Momentary inrush currents for all charging motors are approximately 6 to 8 times these values.

TABLE 5-1 TEST VOLTAGES TO BE APPLIED FOR ONE MINUTE TO VERIFY THE ABILITY OF THE INSULATION TO WITHSTAND OVERVOLTAGES

Breaker Position	Apply Voltage one minute - between	Test Voltage	
		AC (60 Hz.)	DC
Breaker Open	a) Primary (both Line and Load) and ground,	1650	2300
	b) Primary Line and Load,	1650	2300
Breaker Closed	a) Primary and ground,	1650	2300
	b) Phases,	1650	2300
	c) Secondary control wiring (other than e, f and g)	1125	1600
	d) Secondary control wiring (other than e, f and g) and ground,	1125	1600
	e) Motors (See 5-5)	—	—
	f) Secondary control devices 80Vac (110Vdc) or less and ground,	375	530
	g) Secondary control devices 80Vac(110Vdc) or less and primary circuit	375	530

Note: After Short Circuit, test in field to be run at 80% of values listed.

TABLE 5-2 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	Trip Circuit Voltage Range	Recommended Control Fuse Size
				Anti-Pump (Y-coil)	Close (X-coil)			
LK 8, LKE 8, LKD 8 LK 16, LKE 16, LKD 16 LK 20	120 VAC 60/50 Hz	10	9.0	.36	9.0	104-127	104-127	10A
	208-240 VAC 60/50 Hz	5	4.5	.18	4.5	208-254	208-254	10A
	48 VDC	15	4.5	.24	4.5	38-56	28-56	15A
	125 VDC	6	2.6	.12	2.6	100-140	70-140	10A
	250 VDC	3	1.3	.06	1.3	200-280	140-280	10A
LK 25, LKE 25 LK 32, LKE 32 LK 40, LK, & LKE 42	120 VAC 60/50 Hz	10	9.0	.36	9.0	104-127	104-127	10A
	208-240 VAC 60/50 Hz	5	4.5	.18	4.5	208-254	208-254	10A
	48 VDC	15	4.5	.24	4.5	38-56	28-56	15A
	125VDC	7	2.6	.12	2.6	100-140	70-140	10A
	250VDC	3.5	1.3	.06	1.3	200-280	140-280	10A

TABLE 5-3 ELECTRICAL RATINGS OF AUXILIARY SWITCHES

NOMINAL CONTROL VOLTAGE	SWITCH CURRENT AMPERES: AUTO TRIP ALARM (r&s)	UNDER VOLTAGE ALARM	OPEN FUSE TRIP ALARM	M.O.C. TYPE L-2	T.O.C TYPE L-2	INTEGRAL AUX. TYPE L-3
110-120 VAC 60/50 Hz	11	11	11	30	30	40
	4 (LAMP LOAD)					
208-240 VAC 60/50 Hz	11	11	11	20	20	25
480 VAC 60/50 Hz	N/A	N/A	N/A	10	10	15
600 VAC 60/50 Hz	N/A	N/A	N/A	7	7	8
24 VDC	6	6	6	20	20	10
	10 (LAMP LOAD)					
48 VDC	2.5	2.5	2.5	15	15	8
125 VDC	.5	.5	.5	10	10	5
250 VDC	.25	.25	.25	5	5	1

TABLE 5-4 UNDERVOLTAGE TRIP DEVICE STANDARD VOLTAGES AND OPERATING DATA

Control Voltage	Current At Rated Voltage	Minimum Pickup Pt., Volts	Dropout Voltage Range
110-120 VAC 60/50 Hz	.44	102	36-72
208 VAC 60/50 Hz	.19	166	62-125
220-240 VAC 60/50 Hz	.22	204	72-144
48 VDC	.33	41	14-29
125 VDC	.14	106	38-106
250 VDC	.07	212	75-150

Note;
Under voltage devices rated at 440/480 VAC and 550/600 VAC are not recommended Local codes may require segregated wiring, and current limiting fuses connected to the power source.

6 TROUBLESHOOTING GUIDE

The following chart lists typical problems, their causes and recommended corrective action to remedy the malfunction. Review breaker internal wiring diagram, safety notes, and breaker sequence of operation for specific breaker in question. For purposes of discussion below, refer to Figure 4-1.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
Breaker will not close (electrically)	(1) Incorrect low or absence of control voltage.	(1) Verify control voltage source, fuses and connections. Make corrections as necessary.
	(2) Closing springs are not charged.	(2) Ascertain that closing spring charge indicator is in spring charged position. If indicator indicates the closing springs are charged, go to (3); if not charged, ascertain that the motor disconnect switch is closed (see 4-1). If switch is closed and the closing spring indicator indicates the closing springs are not charged, charge springs manually (see 2-2). If breaker will now close electrically, there is a problem in the charging motor circuit. If the breaker will not close electrically, then close manually and trip manually.

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
		WARNING WARNING WARNING WARNING The (X) coil is located near linkages that could cause injury to personnel if accidental closing of the breaker should occur. Be certain that the closing springs are discharged when doing any testing or work in this area. If no visual damage can be found, remove front place and test continuity of (X) coil between Terminal 41 on limit switch and Terminal 4 of secondary disconnect. Replace closing coil assembly if defective.
	(4) Close coil circuit malfunction	(4) Completely remove breaker for bench testing. After breaker is removed and ready for testing, rotate racking shaft until position indicator indicates disconnected, test or connected position (closing springs can be pumped but will not latch charged and will be trip free in any other position). When performing the following tests stay clear of all linkages and pinch points. Charge springs manually, remove front plate and while depressing electrical close pushbutton test for low resistance continuity between Terminal 41 on limit switch and Terminal 15 on secondary disconnect. If high resistance is found, determine the cause (limit switch, close pushbutton, aux. switch, connections, etc.) and make adjustments, clean or replace if defective.
	(5) Contaminated or damaged secondary disconnects.	(5) Inspect secondary disconnects for contamination, proper alignment, spring pressure and condition of mating strap (provides pressure and alignment between moving and stationary parts). Make adjustments, clean or replace if defective.
	(6) Excessive Friction (insufficient or contaminated lubrication)	(6) Clean and lubricate as necessary (see 5-4).
Breaker is Trip Free	(1) Breaker is not racked into test or connected position.	(1) See 2-2 and ascertain that breaker is properly racked into test or connected position.
	(2) Magnetic latch malfunction (holding trip position).	(2) Determine if automatic trip indicator is showing and cannot be reset. Remove front plate and inspect magnetic latch for stuck or binding mechanism. Replace latch if defective.
	(3) Open fuse trip (LKD breakers)	(3) See 2-3 and replace if defective.
Breaker will not trip (electrically)	(1) Incorrect, low or absence of control voltage.	(1) See (1) of "Breaker will not close."
	(2) Trip-coil (TC) assembly malfunction.	(2) Close breaker and attempt to trip it manually. If the breaker will not trip manually, do not attempt to rack breaker from connected position, go to (5) below. If breaker will trip manually, rack breaker to out position, remove front plate, and inspect trip coil assembly for burned coil, obstructed mechanism, etc. If no visual damage can be found, test continuity of (TC) coil between Point 4 of Aux. switch and 6 of Secondary Disconnect. Replace trip coil assembly if defective.
	(3) Trip-coil circuit malfunction.	(3) Completely remove breaker for bench testing. After breaker is removed and ready for testing, rotate racking shaft until position indicator indicates disconnected, test or connected position (Breaker will be trip free in any other position). Staying clear of pinch points, charge springs and close breaker manually; while depressing electrical trip

PROBLEM	PROBABLE CAUSE	CORRECTIVE ACTION
		pushbutton, check for low resistance continuity between Terminal 16 of Secondary Disconnect and Terminal 4 of Aux. switch. If high resistance is found determine cause (trip pushbutton, Aux. switch, etc.) and replace as necessary.
	(4) Contaminated or damaged secondary Disconnects.	(4) See (5) of "Breaker will not close."
	(5) Excessive friction (insufficient or contaminated lubrication)	(5) Try to trip breaker manually. If breaker will not trip, drop all load, de-energize power and control circuits from breaker in question. Failure to do this can result in serious damage to equipment and personnel. After ascertaining that the breaker is fully de-energized, cautiously rack the breaker to the out position for inspection (see 5-1). Clean and lubricate as necessary (see 5-4).
Breaker is pumping.	(1) Y-Relay malfunction.	(1) Rack breaker to out position and inspect Y-Relay assembly (see5-1) for adjustments, burned coil, obstructed mechanism, etc. If no visual damage can be found, remove front plate, test continuity of (Y) coil between Terminal 7 of Aux. switch and Terminal 4 of Secondary Disconnect. Replace closing coil assembly if defective.
Closing Motor will not shut off automatically.	(1) LS/1 malfunction.	(1) Turn motor disconnect switch to off position. Rack breaker to out position, remove front plate, and inspect (LS1). Replace limit switch if defective.

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Supersedes Issue D
Printed in U.S.A. 3M 1286