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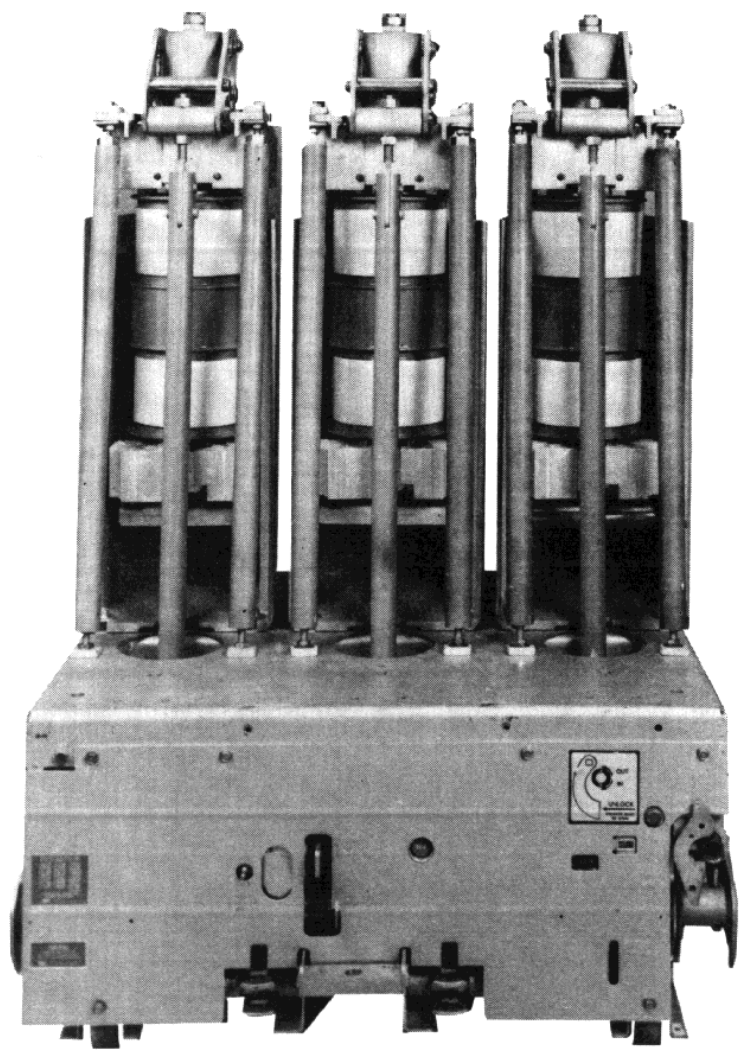
IB 6.2.4.7-1C

Installation/Maintenance Instructions

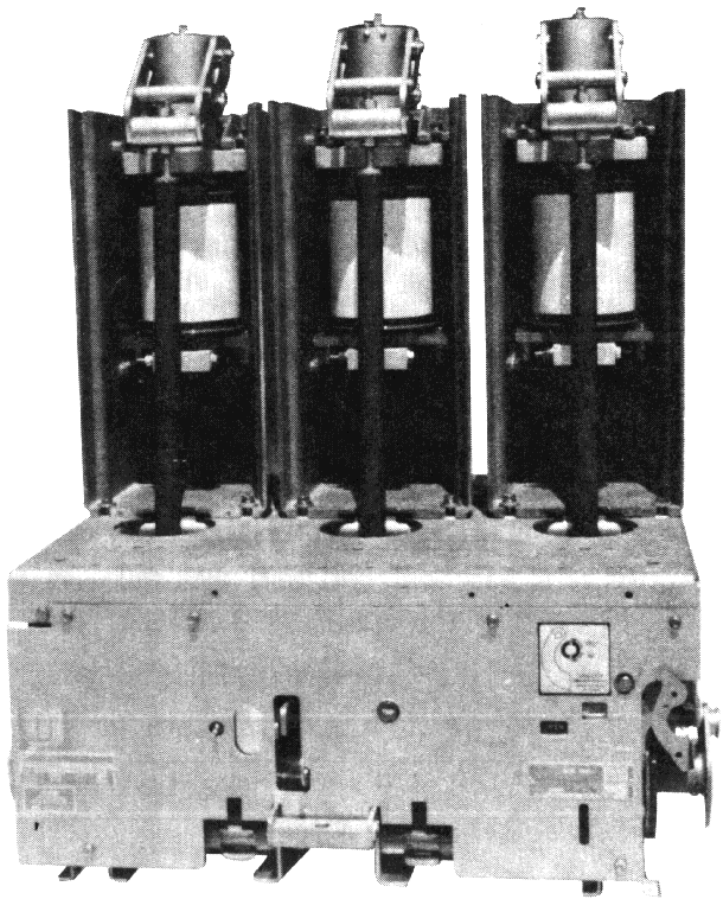
I-T-E Medium-Voltage Vacuum Power Circuit Breakers

Type 15HKV500, 750 and 1000 MVA
1200, 2000 and 3000 Amperes
15000 Volts

(Model 03C)



15 HKV 1000 MVA



15 HKV 500 & 750 MVA

CONTENTS

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.

INTRODUCTION

These instructions for installation, operation and maintenance of 15HKV vacuum circuit breakers should be read carefully and used as a guide during installation and initial operation.

The specific ratings of each model circuit breaker are listed on the individual nameplates.

File these instructions in a readily accessible place together with drawings and descriptive data of the switchgear. These instructions will be a guide to proper maintenance of the equipment and prolong its life and usefulness.

Switchgear designed to accept 15HK500 and 750MVA air-magnetic circuit breakers will accept 15HKV500 and 750MVA vacuum circuit breakers interchangeably, with very minimum modifications; however, the 15HK1000 air magnetic switchgear CANNOT accept the 15HKV1000 vacuum 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. The company is not responsible for damage of goods after delivery to the carrier, however, we will lend assistence if notified of claims.

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 nearest District Office. Information specifying the purchase order number and part numbers of the damaged or missing parts should accompany the claim.

Circuit breakers should be installed in their permanent location as soon as possible. If the breakers are not to be placed in service for some time, it is advisable to provide adequate means of protection. This may be done by keeping the breaker in its original shipping carton and storing in a warm, dry and uncontaminated atmosphere. If the circuit breaker cannot be stored properly due to circumstances, it must be thoroughly checked before going into service to insure it has not absorbed moisture, rusted or become generally contaminated in any way.

CIRCUIT BREAKER INSTALLATION

General

Prior to installation of the circuit breaker into a switchboard, certain preliminary inspections are made to insure proper operation. See subheading "Installation Inspection."

The circuit breaker is shipped with contacts closed, closing springs discharged and opening springs charged. If the circuit breaker is furnished with an undervoltage device, the device will be lockwired to allow closing of the breaker for shipment. A tag will identify the lock wire. To remove the wire, open the breaker and reach behind the control panel from the right side. Using wire cutters, cut and remove the tagged wire.

WARNING WARNING WARNING WARNING

Prior to any disassembly or inspection of the circuit breaker, the closing springs should be discharged, and the breaker should be open.

Referring to Fig. 1, if it is necessary to raise or move the breaker, attach a lifting yoke (5) at points 4 on both sides of the truck, or a fifth wheel at point 6 to transport the breaker as required.

Installation Inspection

Inspect condition of circuit breaker vacuum interrupters and electrical connections prior to installing the circuit breaker into the switchboard. Even though each circuit breaker is completely adjusted and tested at the factory, shipping and handling conditions could cause defects.

The interphase barrier assembly (2, Fig. 1) must be removed for access to and inspection of the vacuum interrupters, and their associated adjustments.

Removing Interphase Barrier (See Fig. 1)

500 & 750 MVA - Remove four lower front sheet screws (1) and two brace screws (7). Slide the barrier assembly straight towards the back of the breaker (approximately 6") until it is clear of its rear positioning guide. The barrier assembly may now be lifted up and away from the circuit breaker.

1000 MVA - Remove four lower front sheet screws and one flat head screw and nut on each lower side of the barrier assembly. The barrier assembly may now be lifted away from the circuit breaker.

Interphase Barrier Examination

All barrier hardware should be securely tightened. There should be no through holes or apparent missing hardware on the barrier assembly. Also, dust or dirt should be removed by wiping with a clean lintless cloth saturated with an oil-free solvent.

Vacuum Interrupter Examination (See Fig. 2)

CAUTION CAUTION CAUTION CAUTION

After the interphase barrier has been removed, a grounding stick should be used to discharge the mid-band ring, on the vacuum interrupters (1) so equipped, before any work is done on the interrupters.

The insulating vacuum envelope should be examined carefully for cracks in the area of the metal-to-insulation

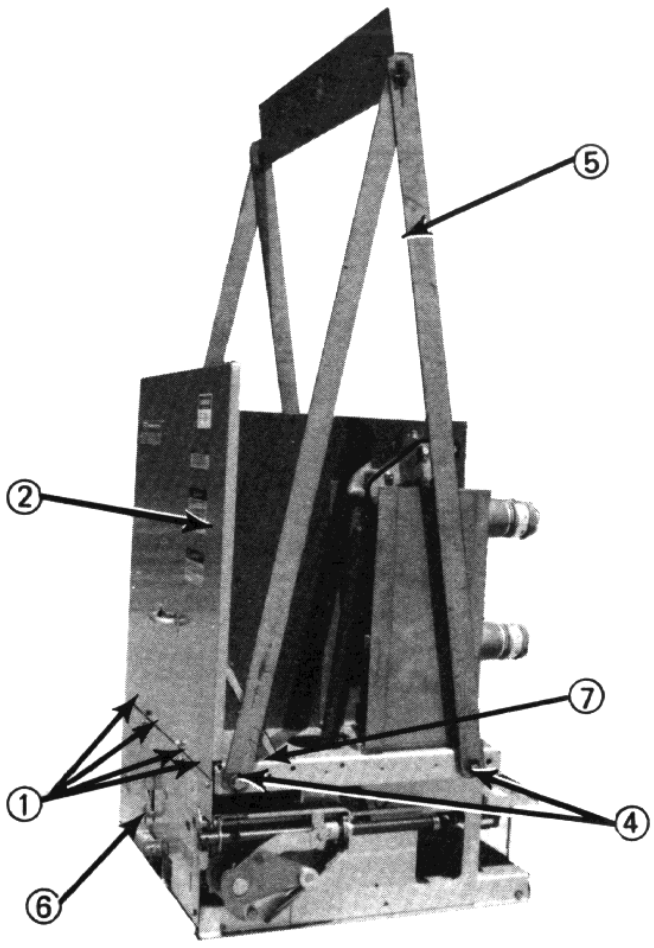


Fig. 1 — Circuit Breaker Assembly with Lifting Yoke Installed

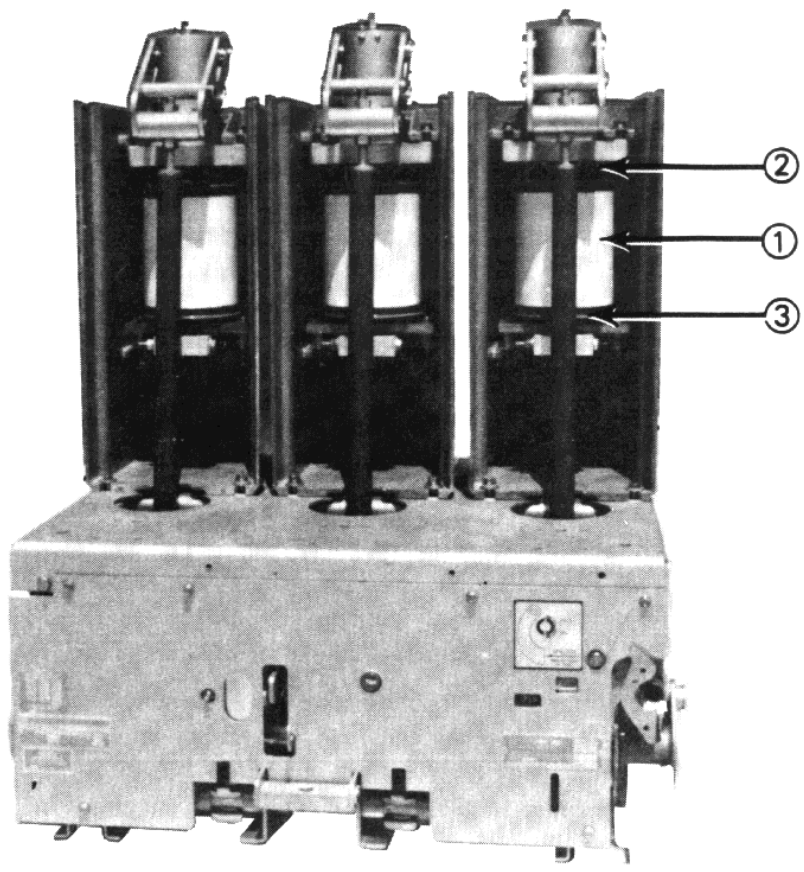


Fig. 2 — Circuit Breaker with Front Cover & Interphase Barrier Assembly Removed

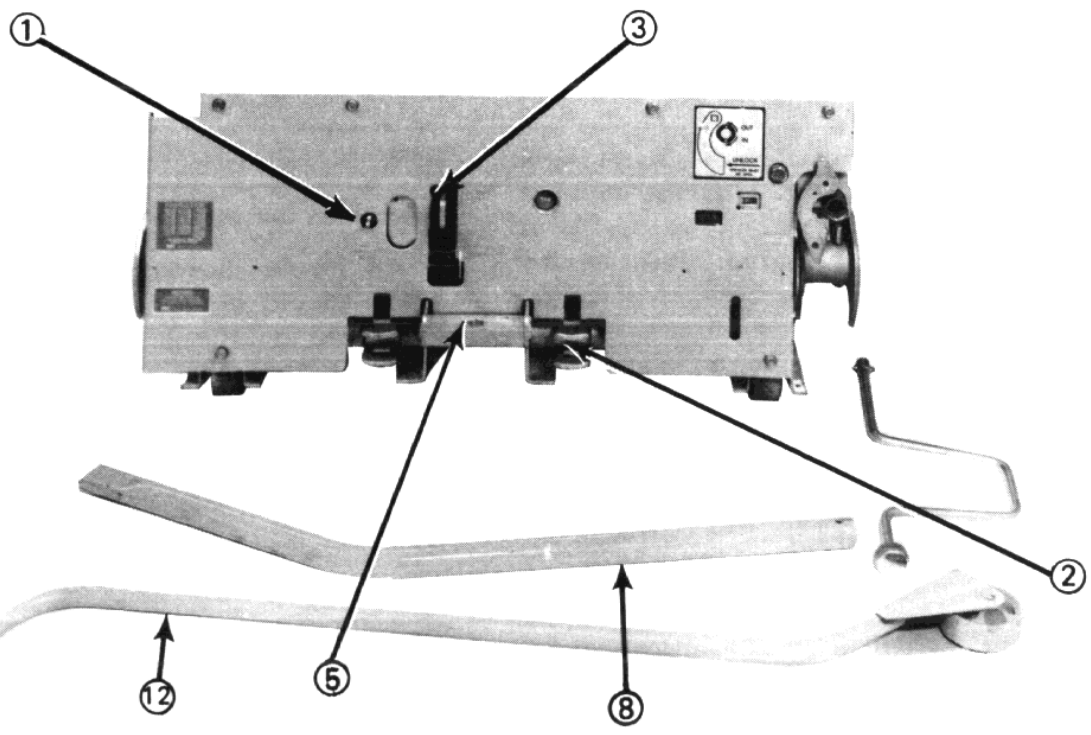


Fig. 3 — Front Circuit Breaker Panel & Accessories

seals on both ends and around the mid-band ring. Since a certain amount of transmitted light is usually required to detect cracks, the inspection should be done in a well lighted area. If the mid-band ring, when so equipped, has been bent by an accidental impact, that area should be specially scrutinized for seal damage. Small external chips, however, will not impair the useful life of the interrupter.

To prevent loss of vacuum care should be exercised so as not to damage the interrupter's plastic covered vacuum pinch-off tube (3).

Insulation Structure

All insulated parts should be checked for damage. Any dust or dirt should be removed by air or wiped with a clean lintless cloth saturated with an oil-free solvent. This is important because dirt and dust can accumulate and, with moisture, can place the circuit breaker in jeopardy, dielectrically. The lead support moldings are basically polyester glass and occasionally have some resin rich cracks or crazing develop but these do not indicate defective material and should not cause concern.

Installing Interphase Barrier (See Fig. 1)

Reverse the "Remove Interphase Barrier" procedure.

NOTE: It is recommended that a dielectric withstand test be made prior to initially putting this or any type vacuum circuit breaker into service. Refer to Dielectric Tests, in the Maintenance, Adjustments and Tests section of this bulletin, for the correct test procedure.

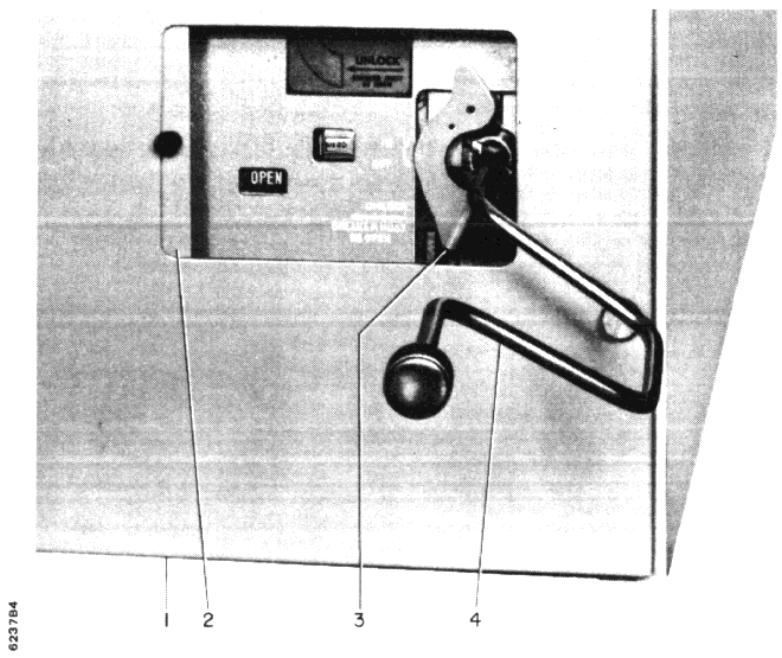


Fig. 4 — Method of Racking Circuit Breaker

Installing Circuit Breaker into Compartment (See Figs. 3 & 4)

NOTE: CLOCKWISE ROTATION of racking crank for inserting breaker. COUNTERCLOCKWISE rotation of racking crank for removal of breaker.

Turn motor disconnect switch (1, Fig. 3) to "OFF" position.

Engage racking crank (4, Fig. 4) and push racking unlocking lever (3) to left, then rotate racking crank counterclockwise only until resistance to motion is felt. (DO NOT FORCE.)

Engage the fifth wheel (12, Fig. 3) with hole (5, Fig. 3); guide and push circuit breaker into compartment until stopped. (If closing springs were left in charged condition, they will automatically discharge.) Again engage racking crank and rotate clockwise until racking mechanism automatically stops at "DISCONNECT" position. (Breaker is now held captive in compartment.)

To rack circuit breaker to "TEST" position, push racking unlocking lever (3, Fig. 4) to left, rotate racking crank approximately ¼ turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "TEST" position.

With the circuit breaker racked to "TEST" position, it should be checked for proper operation by operating all possible means of opening and closing, this includes control switches, relays, etc. Turn motor disconnect switch (1, Fig. 3) to "ON" position to charge the closing springs, and operate the breaker as required. (If motor disconnect switch (1, Fig. 3) is "ON", the springs will automatically charge when approaching "TEST" position.)

WARNING WARNING WARNING WARNING

When racking circuit breaker to "CONNECTED" position, close compartment door (1, Fig. 4) and insert racking crank (4, Fig. 4) through sliding panel (2, Fig. 4).

Push unlocking lever (3) to left and turn racking crank (4) approximately ¼ turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "CONNECTED" position.

CAUTION CAUTION CAUTION CAUTION

Do not attempt to rack any further.

The circuit breaker may now be put in service and be operated as required.

CIRCUIT BREAKER REMOVAL (See Fig. 4)

To remove circuit breaker from "CONNECTED" position, open the breaker as required.

Open sliding door (2) in front compartment door (1). Engage racking crank (4) and push racking unlocking lever (3) to left. Rotate racking crank (4) counterclockwise approximately ¼ turn, then release unlocking lever. Continue cranking counterclockwise until racking mechanism automatically stops at "TEST" position.

Repeat same operation for "DISCONNECT" position.

To position the racking mechanism for withdrawal of the circuit breaker from the switchboard, again push

the racking unlocking lever to the left and turn the racking crank counterclockwise only until resistance to motion is felt. (Approximately 2-3 turns—DO NOT FORCE.) The circuit breaker can now be removed from the compartment by pulling on the handle located on the front barrier.

NOTE: The closing springs, if charged, will automatically discharge when the circuit breaker is withdrawn from the switchboard.

MAINTENANCE, ADJUSTMENTS AND TESTS

General Information

The 15HKV circuit breakers are designed for minimum maintenance and tested to insure that minimum maintenance will be required. There is only one basic adjustment normally required and that is for the contacts. This should be checked to the dimensional values required as described elsewhere. A few other adjustments that are noted are required only when operational check indicates a problem. Of course, during the maintenance checks, all accessible bolts, nuts and screws should be routinely checked to insure that they are tight.

It is recommended that the circuit breaker be normally inspected after the first 2000 operations, (1000 for 15HKV 1000), regardless of the type of duty it is used for. These operations can be either no-load mechanical, load current switching, bulk capacitor or reactor switching operations, or for motor starting applications.

Vacuum interrupters, as used on the 15HKV circuit breakers, have an inherently long contact life and will provide trouble-free service under varied application conditions, as long as the circuit breaker is applied within its rating. The wear condition of the individual vacuum interrupters will vary, depending on circuit conditions and such variables as single phase versus three-phase interruption, X/R ratio (asymmetry) and relay delay times. Of course, interrupting high short-circuit current will cause contact erosion to occur faster than load current interruptions and the erosion indicator will be the guide for interrupter life. If the circuit breaker is subjected to many higher short-circuit current interruptions, such as a reclosing distribution circuit breaker, the erosion indicator should be checked relative to the total interruptions in a given time period rather than the 2000 or 1000 operation criteria. At the higher short-circuit currents, the total accumulated duty possible is in the order of 800% KSI, for guidance.

If, however, after the first inspection period there is no indication of any problems, actual operating experience with specific circuits will indicate the future amount of maintenance needed for the various circuit breakers and the procedure can be modified as required.

Of course, where unusual service conditions exist, as covered by ANSI Standard C37.04, it must be presumed 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 service conditions.

At the selected maintenance period, the following tests and adjustments should be made:

NOTE: The following tabulated tests and adjustments are all that are normally necessary for proper maintenance and operation of the 15HKV circuit breaker. The remaining portions of the breaker—close coil assembly, shunt trip device, control relay, auxiliary switch and motor—require no maintenance during the standard life of the circuit breaker regardless of the operating duty.

Erosion Indicator Check (See Fig. 5)

An erosion indicator (3, Fig. 5) is provided on each interrupter to show contact wear or erosion. The erosion indicator consists of a red line painted on the stem of the moving contact. As the contacts erode, the stem moves down further, and the distance between the top of the vacuum bottle and the red mark is decreased. When the bottom edge of the red marking reaches the top of the vacuum bottle it is recommended that the interrupter be replaced. It is noted that there is no "half-life" adjustment required because the contact springs provide sufficient pressure through the entire wear allowable.

D. C. Millivolt Drop Test

During maintenance periods, the condition of the breaker current circuit can easily be determined by performing a millivolt drop test. This test should be performed regardless of whether the circuit breaker had interrupted low or high currents or has minimum operations.

The following table lists the millivolt drop and resistance values for the circuit breakers covered by this instruction book, from terminal to terminal, exclusive of the primary disconnects.

CIRCUIT BREAKER	MAXIMUM MV DROP*	MAXIMUM MICRO-OHMS
15HKV500/750 1200 Ampere	7	35
15HKV500/750 2000 Ampere	6	30
15HKV1000 (ALL)	5	25
*Millivolt drop with 200 amperes D.C. flowing.		

On circuit breakers with normal or less than normal loadings, the listed values may be exceeded up to 150%. If the millivolt drop exceeds 150% of the listed values, check the millivolt drop across the vacuum interrupter. A millivolt drop across each vacuum interrupter above 4.0 (20 micro-ohms), measured between the interrupter's moving and stationary terminals, points 2 and 3 of Fig. 2, indicates that a heavy contact erosion has occurred.

For optimum performance of the circuit breakers dur-

ing periods of increased loading, it is recommended that the listed values not be exceeded.

If the millivolt crop is still too high, after it has been established that the contact erosion is not excessive, contact the nearest District Office for recommendations.

Insulation Cleaning

Any dirt, dust or grease should be removed from the surfaces of the entire current carrying structure, vacuum interrupter*, base insulation sheet and interphase barrier assembly. Wiping the surface with an oil-free solvent on a clean cloth or industrial wiper is normally sufficient for this purpose.

*Remember to discharge mid-band ring on interrupters so equipped.

Breaker Operation (See Fig. 5)

1. To check breaker operation, the breaker should be withdrawn from the switchboard, the barrier removed and the racking screw turned two to three turns clockwise until the racking unlocking lever snaps into the first position corresponding to the disconnect position.

2. Fully opened breaker - With the breaker open, check that the opening arm (5) has rotated clockwise so that roller (6) relative to the slot is positioned approximately as shown.

3. Fully closed breaker (see Fig. 3). Charge the closing springs and turn the motor switch (1) off. Close the breaker. Engage manual charge handle (8) with charging lever (3). During the initial portion of the downward stroke of the handle check to see which direction the closing springs guides (2) move. If the spring guides start to move out then the breaker did fully close. If the spring guide begins to move in and with additional pumping moves in until the mechanism can be heard to "snap in", then the breaker did not fully close originally. Excess contact pressure or friction can cause this condition and if it cannot be relieved than the factory should be consulted.

WARNING WARNING WARNING WARNING

Dimension "A" must be measured with the breaker closed; therefore use caution when making this measurement.

Adjustments should be made with the breaker open and the closing springs discharged.

Contact Adjustment (See Fig. 5)

1. Contact adjustment is set at the factory and readjustment should not be required for the life of the breaker, however, two dimensions are listed below in the event contact sequence requires a change or the original dimensions have been inadvertently changed. See adjustment procedure 3 below.

	"A"	"B"
15HKV500/750	.170 ± 020	1.020 ± 020
15HKV1000	.187 ± 020	1.230 ± 020

Note "A" dim. is average of the two sides.

2. Contact sequence - All three poles should touch within 2 millisecond at normal closing speeds. An oscilloscope, oscillograph or other timing method may be used, if available, to establish the 2 millisecond timing.

To bring contact sequence within 2 milliseconds, dim's "A" and "B" may be changed but are to be held within the tolerance shown. Increasing "A" dim. or "B" dim. will cause the contacts to make later. Decreasing the dim's will advance the contact make. See adjustment procedure 3 below.

3. Adjustment Procedure

a. Dim. "B" is changed by removing the cotter key, turn nut as required and install a new cotter key.

b. Dim. "A" must be measured with the breaker closed, but for safety, the breaker is to be opened when readjusted. Turning the two nuts (1) on the pushrod "UP" will decrease the "A" dim., and "DOWN" will increase "A" dim. Turning the nuts (1) 1/6 turn will change the "A" dim. by approximately .006 in. After adjusting "A" dim., make sure nuts (1) are tight. Close the breaker and recheck "A" dim.

The interphase barrier assembly can now be reinstalled. Return the racking screw to its original position by turning it counterclockwise approximately two to three turns until it stops.

Closing and Opening Times and Speeds

After the operation intervals noted previously, the closing and opening times are recommended to be checked by use of a cycle counter, travel recorder*, oscillograph, etc., to monitor the time from energizing to contacts touch or part.

*A potentiometer with mounting support, used in conjunction with an oscilloscope or oscillograph, and instructions are available on special order for specifically checking opening and closing speeds.

The circuit breaker closing and opening times should be within the following time ranges for normal operation.

CLOSING TIME RANGE - MS	OPENING TIME RANGE - MS
45 - 65	30 - 40

NOTES:

1. Below 0°C, the closing times will increase (but with no reduction in closing force); and opening times will be within the limits.

2. Adjustments to correct speeds, if found to be outside limits, are critical and the nearest District Office should be contacted for recommendations.

Operating Mechanism (See Fig. 6)

The operating mechanism is adjusted at the factory for proper operation and should not be disturbed unless the circuit breaker does not close electrically on reclosing duty.

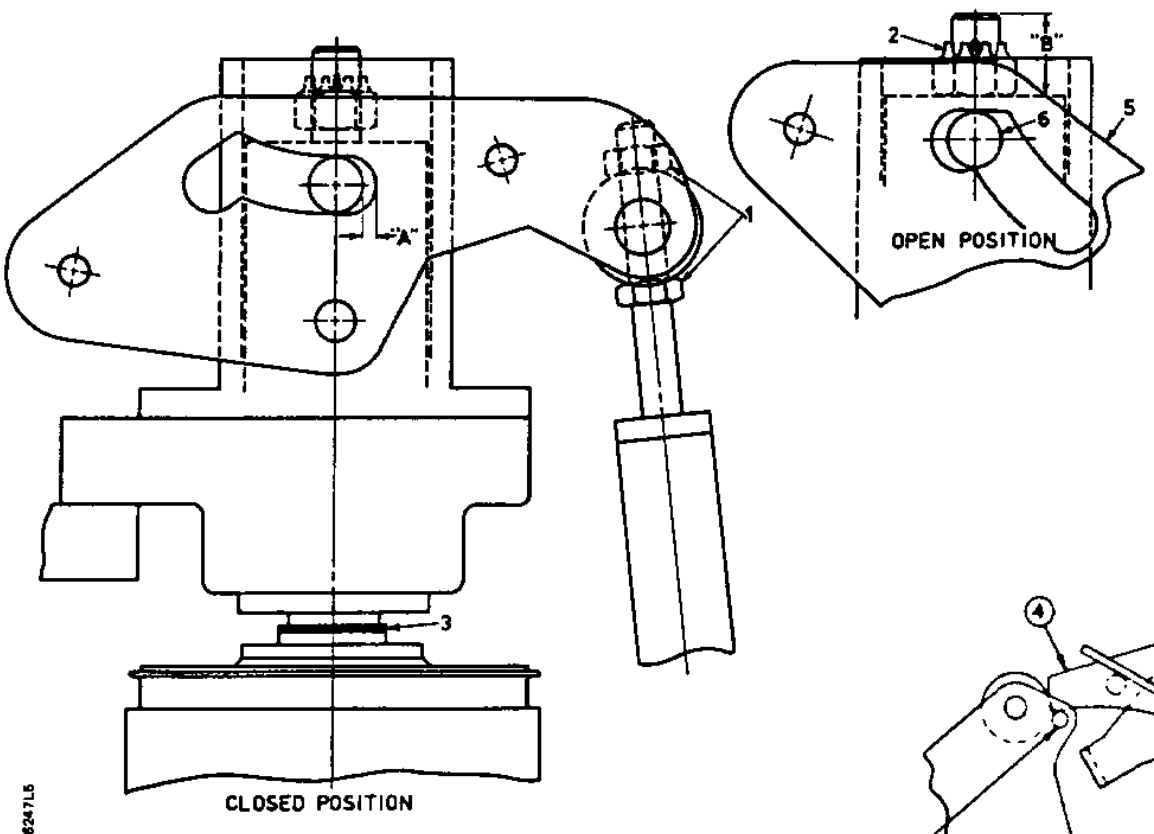


Fig. 5 — Contact Pressure

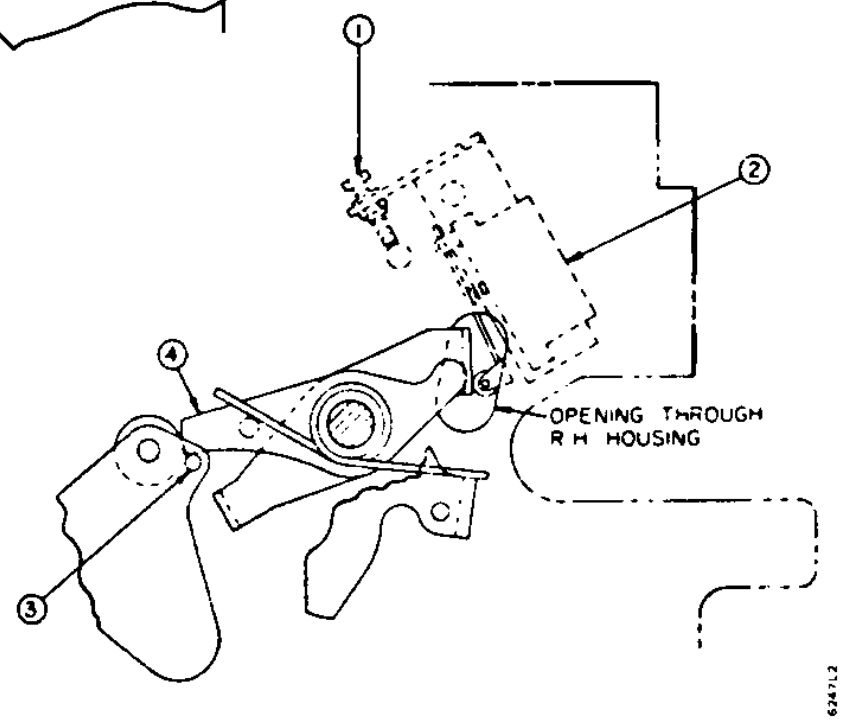


Fig. 6 — Latch Check Switch Adjustment

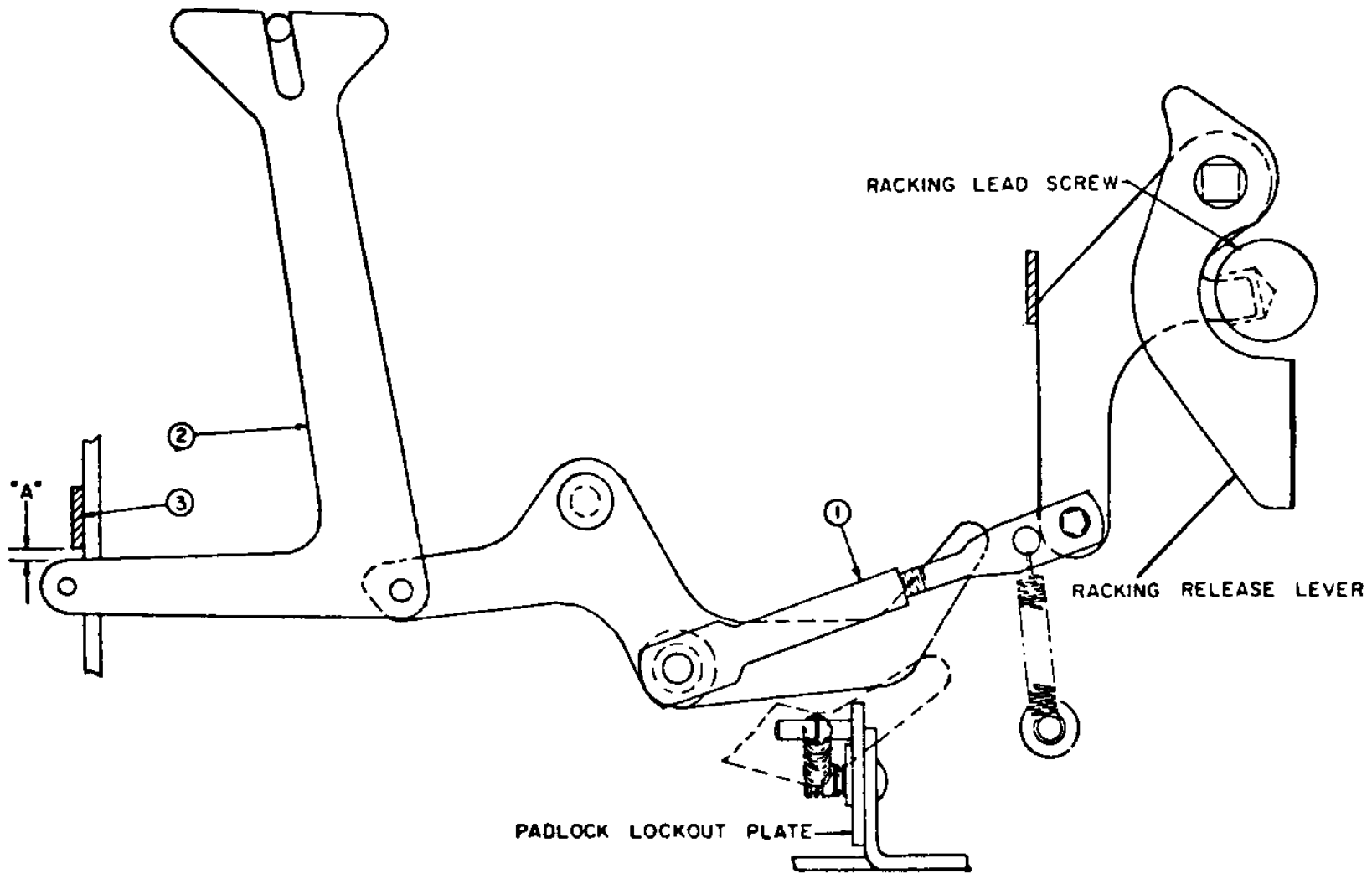


Fig. 7 — Racking Mechanism

This condition is caused when the latch check switch (when used) is not actuated. Circuit breaker should not close before trip latch (4) has reset.

Adjustments should be made with latch (4) against reset stop pin (3). Turn in adjusting screw (1) until contacts of switch (2) "break" (as indicated by an audible click or check with bell ringer). Retract adjusting screw until switch contacts "make", then rotate adjusting screw one turn more. (Adjusting screw is self-locking.)

Racking Mechanism (See Fig. 7)

The circuit breaker racking mechanism is adjusted for proper operation and should not be disturbed unless it becomes possible to close the breaker during a racking operation.

It may be possible that interlocked blocking members are not positioned properly, which should be corrected as follows:

Remove the lower front mechanism coverplate and with the circuit breaker closed, make adjustments by regulating the length of connecting rod (1) for 1/32 inch minimum to 3/32 inch maximum clearance at "A" between trip link (3) and blocking lever (2). The maximum adjustment at point "A" should not exceed 3/32 inch.

Control Relay Adjustment (See Fig. 8)

The control relay does not normally require any adjustment in the field. However, if necessary adjust the gap between the control device lever adjusting screw and the limit switch crank arm for a 1/64 – 1/32 gap with the closing springs charged. With the closing springs discharged, the gap between the lever stop and the lever should be 1/64" to 1/16".

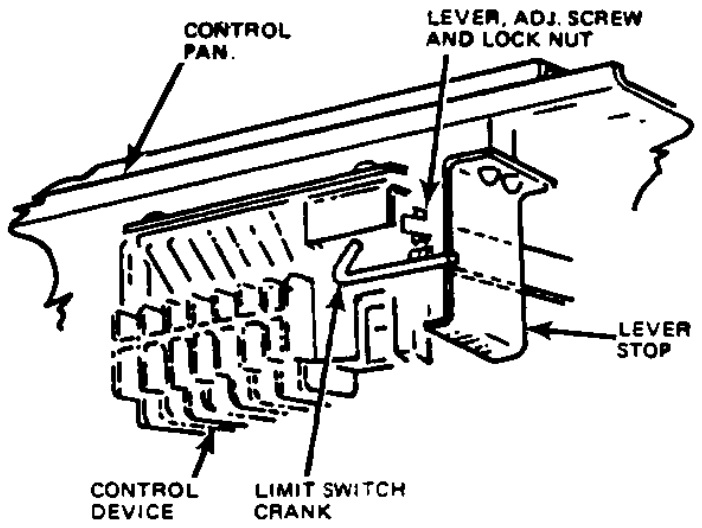


Fig. 8 Control Relay

LUBRICATION

The 15HKV circuit breakers are lubricated during factory assembly as follows:

1. All mating surfaces of moving current-carrying joints have been lubricated with Aerodag "G", a graphite based dry lubricant, manufactured by Acheson Colloids Company.

2. The primary disconnect contacts have been lubricated with NO-OX-ID special grade-A grease manufactured by Sanchem, Inc. (BBC No. 713222A, 1 Pt. can).

3. All mechanism parts, bearings, pins, etc., have been lubricated with Anderol 757 manufactured by the Intermediate Division, Tenneco Chemical, Inc. (BBC No. 712994A, 4 oz. tube).

The circuit breaker normally requires no lubrication during its usual service life. However, if the grease should become contaminated or unduly oxidized (hardened and darkened) or if parts are replaced, any relubrication should be done with the lubricants noted.

NOTES:

1. It is recommended that the primary disconnects be maintained by renewing the grease.

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

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

DIELECTRIC TESTS

It is recommended that dielectric withstand tests be made prior to initial use and then at routine maintenance periods to verify the integrity of vacuum interrupters. If, during the dielectric withstand test, the required test voltage cannot be sustained across the open contacts of the vacuum interrupter, the interrupter is faulty and must be replaced. Always insure that the contact adjustment is correct before conducting primary circuit dielectric tests.

CAUTION CAUTION CAUTION CAUTION

While the procedure for dielectric testing a vacuum breaker is similar to that for any other type breaker, there are two areas which require extra CAUTION in handling.

1. The internal shield of a vacuum interrupter can acquire an electrical charge which is usually retained even after the voltage is removed. On certain types of interrupters, this shield is attached to the exposed midband ring and a grounding stick should be used to discharge the ring before working on the device.

2. Dielectric test voltages higher than rated voltage, applied across open contacts, may cause a vacuum interrupter to emit some X-radiation which could be a health hazard on prolonged exposure at close range. Accordingly, even though the emission is low and on for such a short period of time, it is considered appropriate to exercise caution.

Therefore, do not run any primary circuit dielectric withstand tests on isolated interrupters with open contacts, above rated voltage unless test personnel are

adequately shielded or they are no less than six feet from the test unit.

Regarding complete breakers, it is noted that NO hazardous X-radiation is produced with closed contacts at any test voltage or with open contacts at rated voltage and there should be no cause for concern. Further, if the breaker is tested in its switchgear compartment, the enclosure steel provides sufficient shielding to protect personnel from X-radiation at the test voltages recommended below at the normal distances maintained for electrical safety.

The following test values should be used for dielectric testing the complete breaker and are to be applied for a one-minute period.

	60Hz	DC
Primary Circuit	36.0kV	40kV
*Secondary Circuit (Control)	1100V	1500V

*If it is desired to make a dielectric test on the secondary control wiring, turn the spring charging motor disconnect switch (1, Fig. 3) to the "OFF" position. Apply test voltage (1100V-AC or 1500V-DC) for one minute to each of the secondary disconnect contacts at the rear of the circuit breaker.

If it is desired to make a dielectric test on the spring charging motor, turn the motor disconnect switch (1, Fig. 3) to the "ON" position. Apply test voltage (540V-AC or 760V-DC) for one minute to the motor circuit.

ELECTRICAL CHARACTERISTICS OF CONTROL DEVICES

For operating voltage ranges for various nominal control voltages, refer to Table 1.

For average current values at various nominal control voltages, refer to Table 2. The current values given in this table are average, steady state values and momentary inrush currents for all charging motors and AC coils are approximately six to eight times these values.

ELECTRICAL OPERATING SEQUENCE

Please refer to the specific schematic diagrams and other operational information furnished with your order.

Fig. 9 is provided as a typical schematic for general information on electrical operation.

RENEWAL PARTS

We recommend only those renewal parts be stocked that will be required to insure proper and timely maintenance for normal operation of the 15HKV circuit breakers. Copies of the applicable Renewal Parts Bulletin for specific circuit breakers will be furnished on request to the nearest District Office.

The minimum quantity of assemblies and items recommended in these bulletins 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 can be returned to the factory for nominal reconditioning. The bulletins contain specific part ordering instructions; and if desired, specific instructions regarding replacement of those part assemblies recommended, that are not obvious, are also available if ordered.

TABLE 1 - OPERATING VOLTAGE RANGE

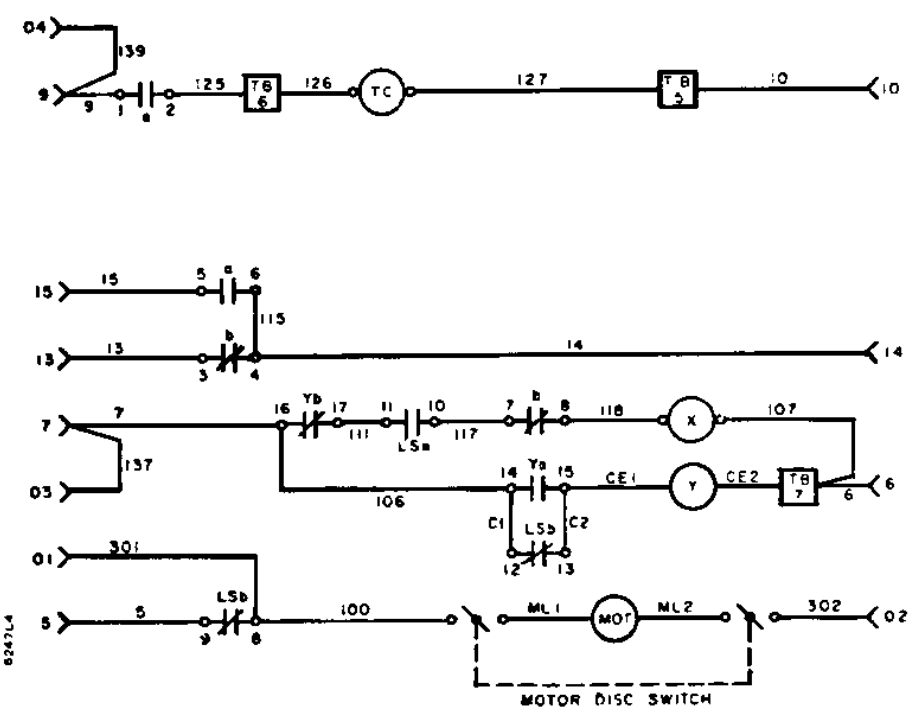
NOMINAL CONTROL VOLTAGE	SPRING CHARGING MOTOR	CLOSE COIL	TRIP COIL	UNDERVOLTAGE	
				PICK-UP MAXIMUM	DROP-OUT
24 V dc	-	19-28	14-28	21	7-14
48 V dc	38-56	38-56	28-56	41	15-29
125 V dc	100-140	100-140	70-140	105	38-75
250 V dc	200-280	200-280	140-280	212	75-150
120 V ac	104-127	104-127	104-127	102	36-72
240 V ac	208-254	208-254	208-254	204	74-144

TABLE 2 - AVERAGE CURRENT VALUES

NOMINAL CONTROL VOLTAGE	SPRING CHARGING MOTOR	CLOSE COIL	TRIP COIL	LOCKOUT COIL	UNDER VOLTAGE	N.E.C. FUSE
24 V dc	-	22.0	22.0	0.30	0.9	30
48 V dc	25.0	10.7	10.7	0.15	0.5	30
125 V dc	10.0	5.0	5.0	0.06	0.2	30
250 V dc	5.0	2.2	2.2	0.03	0.1	30
120 V ac	10.0	4.5	4.5	0.40	0.2	30
240 V ac	5.0	2.3	2.3	0.20	0.1	30

6 > < 5
9 > < 7
10 > < 13
15 > < 14
04 > < 03
02 > < 01

REAR VIEW OF SECONDARY DISCONNECTS



LEGEND

a - Auxiliary Switch Contact Closed When Breaker Is Closed.
b - Auxiliary Switch Contact Open when Breaker Is Closed.
LCb - Latch Check Switch Contact Closed When Breaker Operating Mechanism Is Reset.
LSa - Limit Switch Contact Open When Springs Are Discharged. Closed When Springs Are Charged.
LSb - Limit Switch Contact Closed When Springs Are Discharged. Open When Springs Are Charged.
TC - Shunt Trip Coil.
X - Closing Latch Release Coil.
Y - Control Relay Lockout Coil.
Ya - Normally Open Control Relay Contact.
Yb - Normally Closed Control Relay Contact.
TB - Terminal Block Point.
ML - Motor Lead.
CE - Coil Lead End.
C1, C2 - Terminal Jumper (Control Device).
> - Female Secondary Disconnect Contact.
UV - Undervoltage Trip Device.
UVb - Normally Closed Undervoltage Trip Device Contact.
69 - Permissive Control Switch.
BL - Blocking Lever Switch (Open When Ground Switch Is Locked In Ground Position).

Fig. 9——Typical DC Schematic Diagram of Control Circuit

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