
I·T·E Imperial
CORPORATION

CONTENTS

INSTRUCTIONS FOR 15 KV VACUUM POWER CIRCUIT BREAKERS TYPE 15HKV500 AND 15HKV750

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.

Switchboards will accept 15HKV Vacuum Circuit Breakers and 15HK Air Magnetic Circuit Breakers interchangeably without modification.

Refer to instruction bulletin IB-8.2.7-4 for instructions covering the 15HK Air Magnetic Circuit Breakers.

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 I-T-E Imperial Corporation. The I-T-E Imperial Corporation is not responsible for damage of goods after delivery to the carrier. However, the I-T-E Imperial Corporation will lend assistance 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 sales representative of the I-T-E Imperial Corporation. Information specifying the purchase order number, I-T-E sales order number, carton 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 initial installation of the circuit breaker into the switchboard, certain preliminary inspections should be made to insure proper operation. The inspection procedures for this are given in this section.

The circuit breaker is shipped with contacts closed, closing springs discharged and opening springs charged.

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

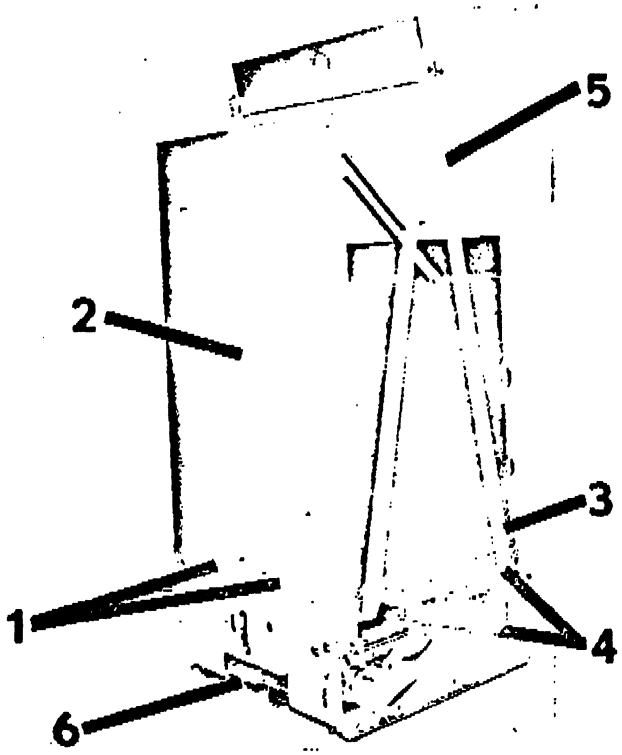


Fig. 1 — Circuit Breaker Assembly with Lifting Yoke Installed

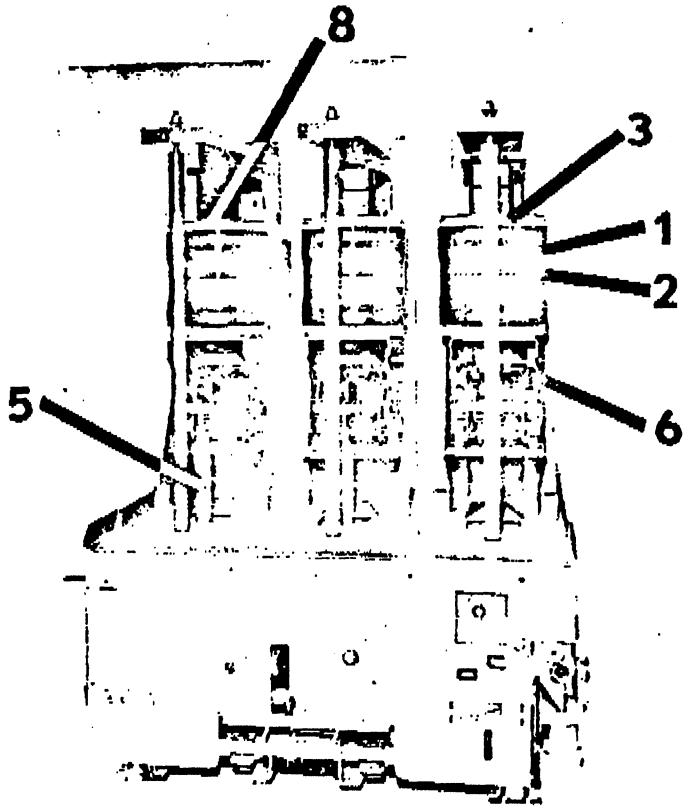


Fig. 2 — Circuit Breaker with Front Cover & Interphase Barrier Assembly Removed

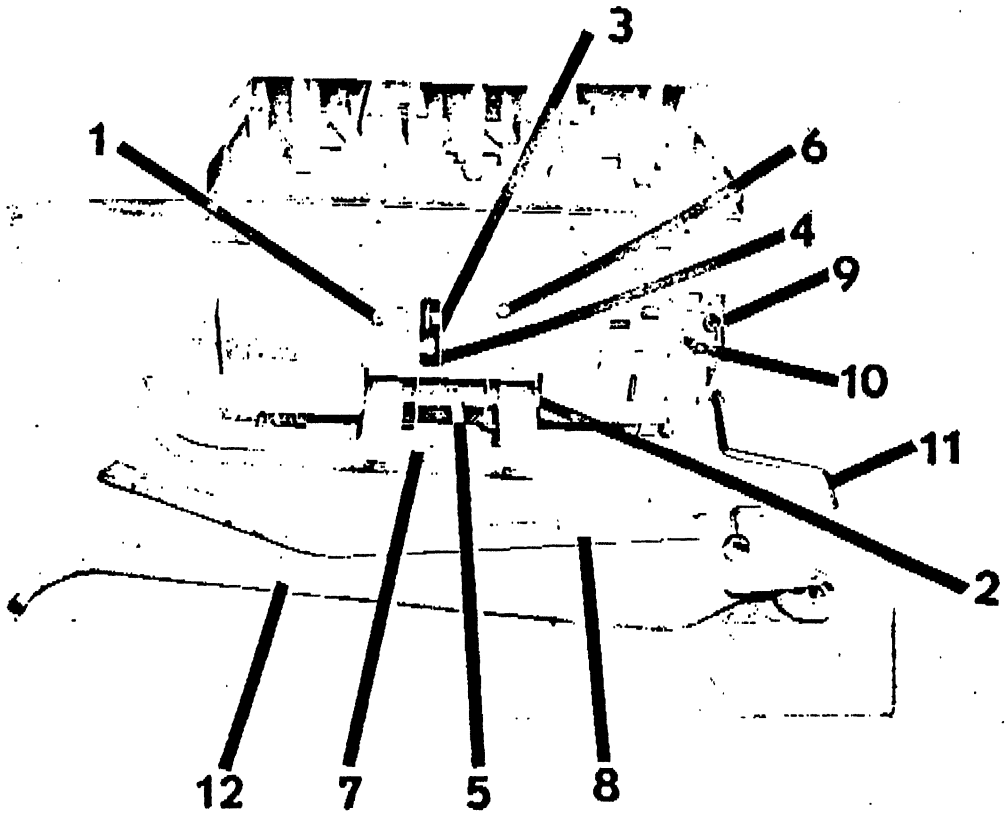


Fig. 3 — Front Circuit Breaker Panel & Accessories

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)

Remove two lower front sheet screws (1) and release two draw catches (3). Slide the barrier assembly straight forward (approximately 6") until it is clear of its rear positioning guides. The barrier assembly may now be lifted up and 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: After the interphase barrier has been removed, a grounding stick should be used to discharge the mid-band ring (2) on the vacuum interrupters (3) so equipped before any work is done on the interrupters.

The insulating vacuum envelope (1) should be examined carefully for cracks in the area of the metal-to-insulation seals on both ends and around the mid-band ring (2). 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 (2), when so equipped, has been bent by an accidental impact, that area should be specially scrutinized for glass seal damage. Small external chips, however, will not impair the useful life of the interrupter.

The pinch-off tube seal (8) is coated with soft solder and epoxy for protection. Care should be exercised to avoid cutting into the solder or bending or denting the pinch-off tube which could result in loss of vacuum.

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.

MANUAL SLOW CLOSING PROCEDURE (See Fig. 3)

Manual slow closing of the vacuum circuit breaker can be accomplished only when the circuit breaker is in the open position, outside of its switchboard compartment.

Engage racking crank (11) with the racking screw (9). Turn racking screw (9) two to three turns clockwise until the unlocking lever (10) snaps into the first position. This corresponds to the "DISCONNECT" position.

Engage manual charge handle (8) with the charging lever (3). Pump charging lever until the circuit breaker closing springs snap into the "CHARGED" position, then remove the handle (8).

Insert BOTH tangs of the slow close bracket (7) into the top holes of the closing spring guides (2).

Pull manual close lever (4) to discharge the closing springs onto the tangs of the slow close bracket (7). This will cause the circuit breaker operating mechanism to partially close, but the vacuum interrupter contacts will remain apart.

Re-engage the manual charge handle (8) with the charging lever (3), then slowly pump to slowly close the vacuum interrupter contacts, to check contact pressure, as listed in the Maintenance, Adjustments and Tests section.

To remove the slow close bracket (7) from the circuit breaker, continue pumping the handle (8) until the closing springs snap into the "CHARGED" position, then remove the handle (8), and the slow close bracket (7).

To open the circuit breaker, push the manual trip button (6). Discharge the closing springs by pulling the manual close lever (4), this operation FAST closes the circuit breaker. To open, again push the manual trip button (6).

Rotate the unlocking lever (10) and rotate the racking screw (9) counterclockwise two to three turns to return the racking mechanism to its "WITHDRAWN" position.

INSTALLING INTERPHASE BARRIER (See Fig. 1)

Lift barrier assembly (2) and slide to the rear of the circuit breaker. Position the vertical barrier sheets into their positioning guides at the rear of the circuit breaker, then push the barrier fully to the rear. Replace the two lower front sheet screws (1) and fasten the two draw catches (3) at the lower rear corners of the barrier assembly.

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.

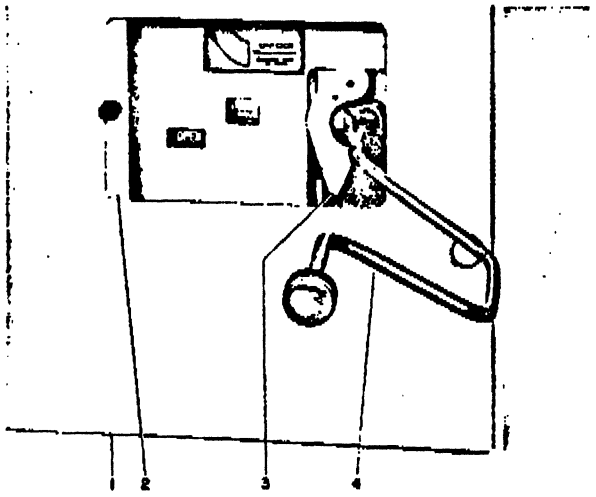


Fig. 4 — Method of Racking Circuit Breaker

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 (if supplied) (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 not provided, springs will automatically charge when approaching "TEST" position.)

FOR SAFETY: 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: 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 at the bottom of 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 contact pressure. This should be checked to the dimensional values required as described elsewhere. The few other adjustments that are noted are required only when an 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, 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 operation criteria. At the higher short-circuit currents, the total accumulated duty possible is in the order of 600% 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

An erosion indicator (6, Fig. 2) is provided on each interrupter to show contact wear or erosion. The erosion indicator consists of a pointer which is attached to the contact clamp on the stem of the moving contact, and a fixed target on the interrupter support frame. A band on the fixed target is equal in width to the maximum allowable contact erosion (0.125"). The pointer is factory set so that it is aligned with the bottom edge of the indicating band, when the contacts are new. As the contacts erode, the pointer moves upward across the band to indicate the amount of contact erosion. When the pointer approaches the top edge of the band 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 ⅛ inch wear allowable.

CAUTION: After the erosion indicator has been initially set, no adjustment to the pointer or the erosion band should be made during the life of the interrupter.

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 - 1200 Ampere	9	45
15HKV500 - 2000 Ampere	6	30
15HKV750 - 1200 Ampere	9	45
15HKV750 - 2000 Ampere	7	35
* Millivolt drop with 200 amperes 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 3.5 (17.5 micro-ohms), measured between points 4 & 5 of Fig. 5, indicates that an adjustment in contact pressure is required or that heavy contact erosion has occurred. The adjustment procedure for contact pressure is given later in this section.

For optimum performance of the circuit breakers during periods of increased loading, it is recommended that the listed values not be exceeded.

If the millivolt drop is still too high, after it has been established that the contact pressure is correct and that erosion is not excessive, contact I-T-E 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.

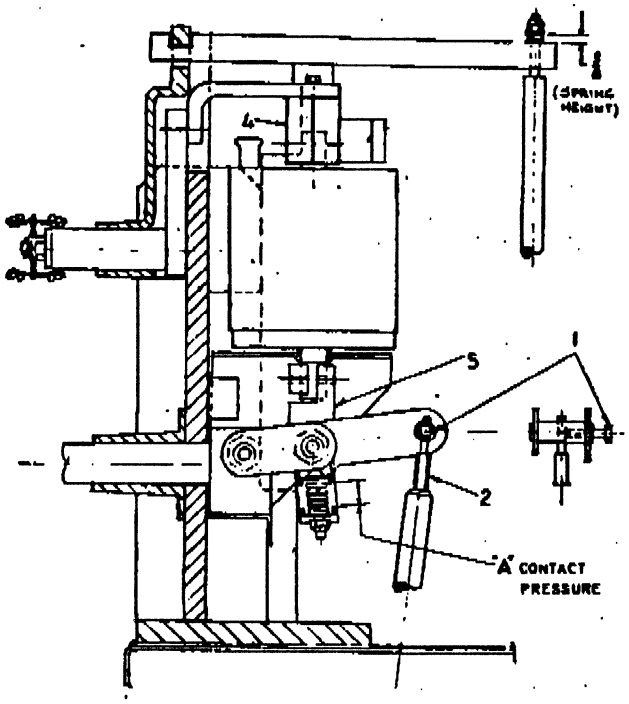


Fig. 5

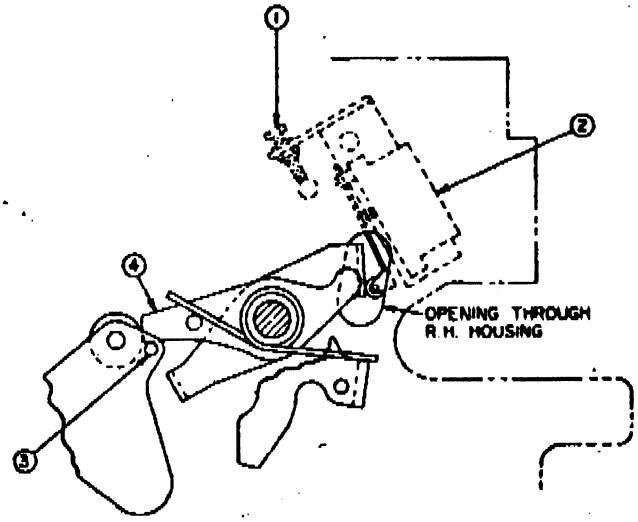


Fig. 6 — Latch Check Switch Adjustment

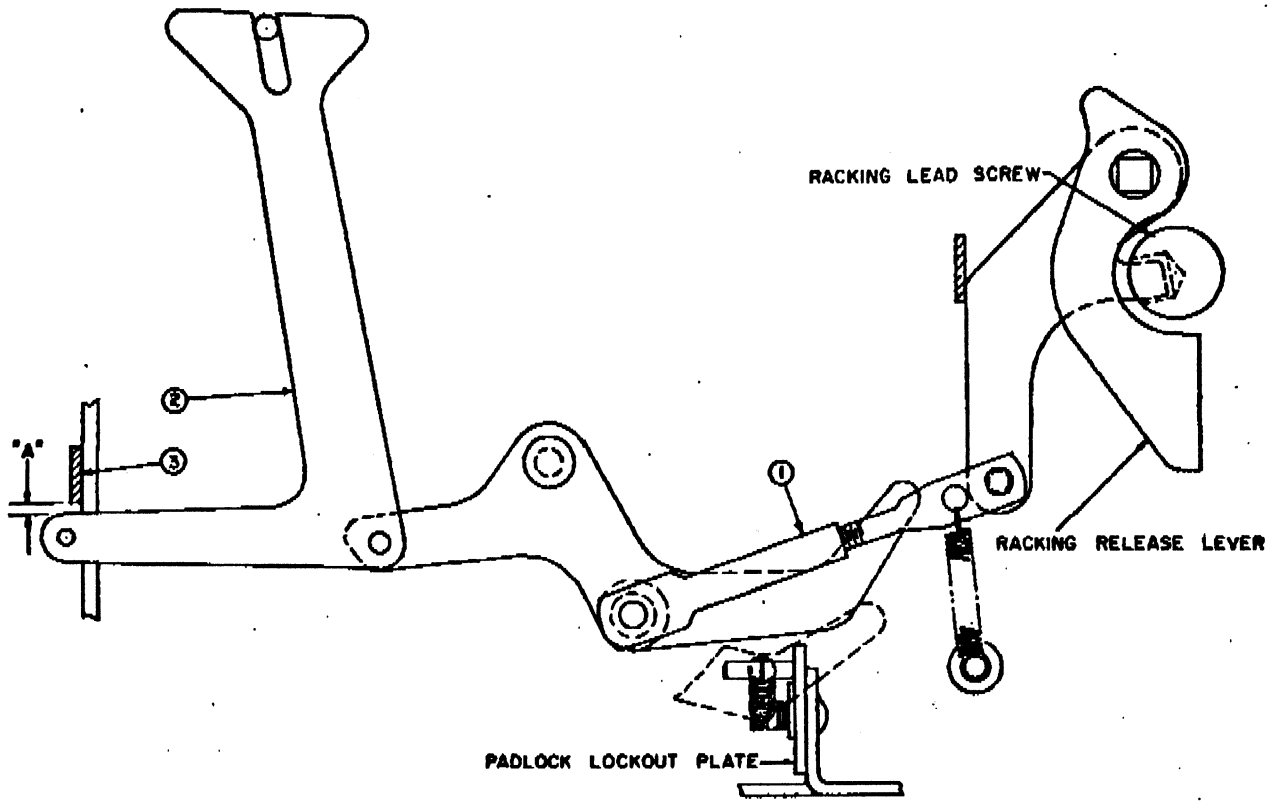


Fig. 7 — Racking Mechanism

CONTACT PRESSURE AND ADJUSTMENT (See Fig. 5)

With the circuit breaker withdrawn from the switchboard, the following procedure should be followed for properly checking and/or adjusting the contact pressure and alignment on a 15HKV type circuit breaker.

Since the contacts of a vacuum circuit breaker are enclosed in a sealed envelope, it is not possible to directly measure the sequence of contact making which is very important for vacuum circuit breakers. Therefore, during routine maintenance periods it is necessary to readjust the "simultaneous" (see Note 1) make of the contacts and this should be done as follows.

1. Remove interphase barrier assembly as previously described.

2. Turn racking screw clockwise approximately two to three turns until the racking-unlocking lever snaps into the first position corresponding to the "DISCONNECT" position.

3. See Fig. 5. Measure and record dim. "A" of the three poles with the breaker open. With the breaker closed, measure and record dim. "A". The DIFFERENCE between the two readings should be 7/64 to 3/16 inches.

If the contact pressure is not within the limits stated, the contact pressure must be adjusted to fall within these limits as follows:

a. Loosen the pushrod adjusting lock screws (1).

b. Turn the pushrod adjusting studs (2), with the circuit breaker in the closed position, until the DIFFERENCE in "A" dim., with the breaker closed and in the open position as measured previously, is 1/8 inch. (Turning adjusting stud (2) clockwise, viewed from the top, increases the difference in "A" dim. and increases contact pressure.)

4. Connect an indicating light (or bell) across each pole of the circuit breaker.

5. If not already done in step 3, loosen the pushrod adjustment lock screw (1).

6. Partially slow close the circuit breaker as previously described.

7. With the manual spring charging handle, slowly pump until the first indicating light (or bell) comes on.

8. FIRMLY hold the manual spring charging handle in the position where the first indicating light (or bell) came on, and rotate the pushrod adjusting studs (2) clockwise, on the remaining two poles, as required, to bring the remaining two indicating lights (or bells) on.

9. Complete the slow close operation and remove the slow close bracket.

10. Open the circuit breaker.

11. Recheck at dim. "A" with the breaker in the opened and closed position to see that the difference in "A" dim. of each pole, when opened and closed, is still within the 7/64 to 3/16 inches. Trip the circuit breaker.

12. Tighten the lock screws (1) on each adjusting stud (2) to lock the pushrod adjustment stud in place.

13. The interphase barrier assembly can now be reinstalled.

14. Return the racking screw to its original position by turning it counterclockwise approximately two to three turns until it stops.

15. The circuit breaker can now be replaced in its compartment and returned to service.

NOTE 1: All three poles should touch within 2 millisecond at normal closing speeds. The adjustment method outlined is factory proven to produce this timing as long as the first pole touch is held firmly per step 8. An oscilloscope, oscillograph, or other timing method may be used, if available, to establish the 2 millisecond timing.

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.

*Recorder with mounting support and instructions 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
40 - 50	25 - 35

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 I-T-E 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.

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 9/64 inch minimum to 3/16 inch maximum clearance at "A" between trip link (3) and blocking lever (2). The maximum adjustment at point "A" should not exceed 3/16 inch.

CONTACT SUPPORT BRACKET ADJUSTMENT (See Fig. 5) (High Momentary 15HKV500 and 15HKV750 Breakers)

The listed breakers have a momentary rating of 60kA and are provided with an upper contact support bracket which is spring loaded.

In the routine maintenance checks of the circuit breakers, the spring compression (3) should be checked to maintain it within 3/8 inch ± 1/32 inch.

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 NO-OX-ID special grade "A" grease manufactured by Dearborn Chemical Company.

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

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 NO-OX-ID or Anderol grease as applicable.

NOTES:

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

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: 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 mid-band 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. 8 is provided as a typical schematic for general information on electrical operation.

RENEWAL PARTS

I-T-E recommends 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 sales office of the I-T-E Imperial Corporation.

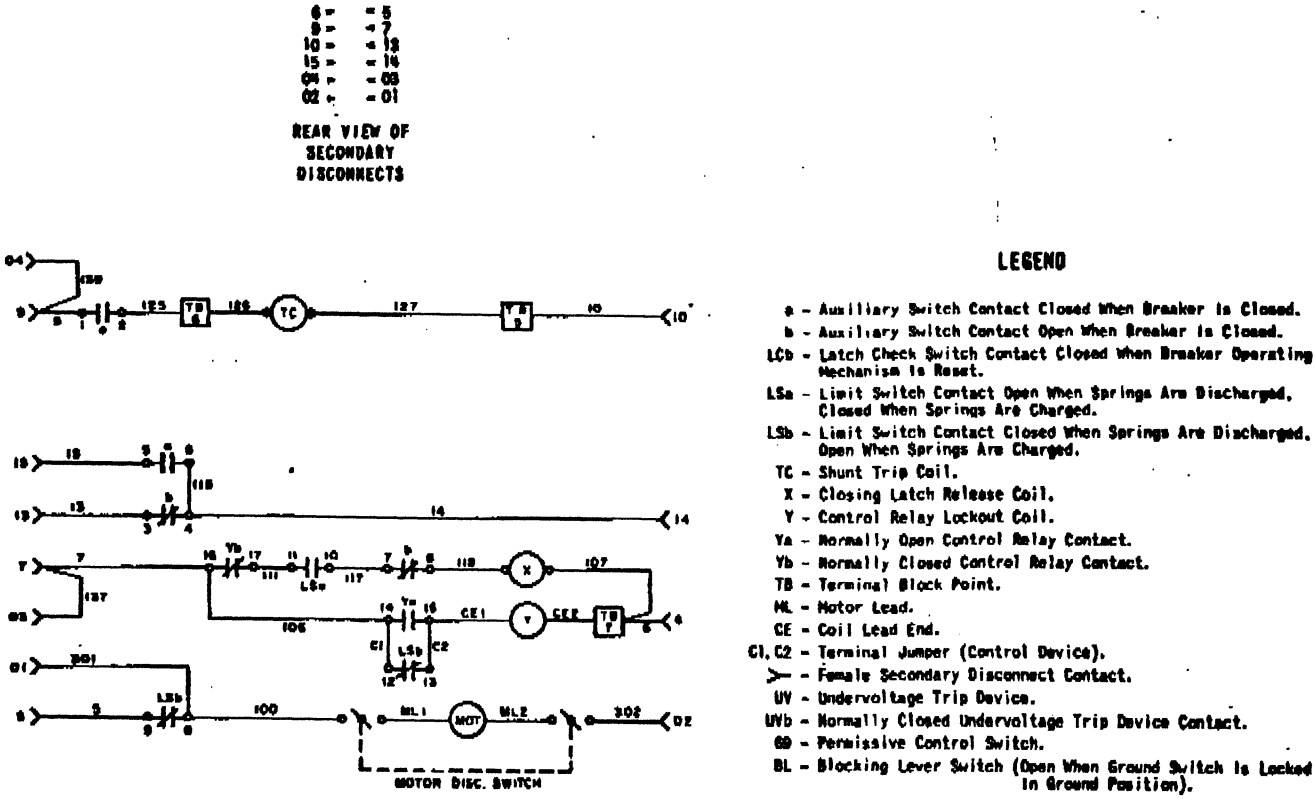
The minimum quantity of assemblies and items recommended in these bulletins are predicated on infrequent replacement of parts based on accumulated tests and operating experience. Total assemblies are recommended for fast replacement, when necessary, to return the breaker to service as quickly as possible. 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	15-28
125 V dc	100-140	100-140	70-140	106	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	0.8	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	4.6	4.6	0.40	0.2	30
240 V ac	5.0	2.9	2.3	0.20	0.1	30



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.
- GD - Permissive Control Switch.
- BL - Blocking Lever Switch (Open When Ground Switch Is Locked In Ground Position).

Fig. 8 — Typical DC Schematic Diagram of Control Circuit