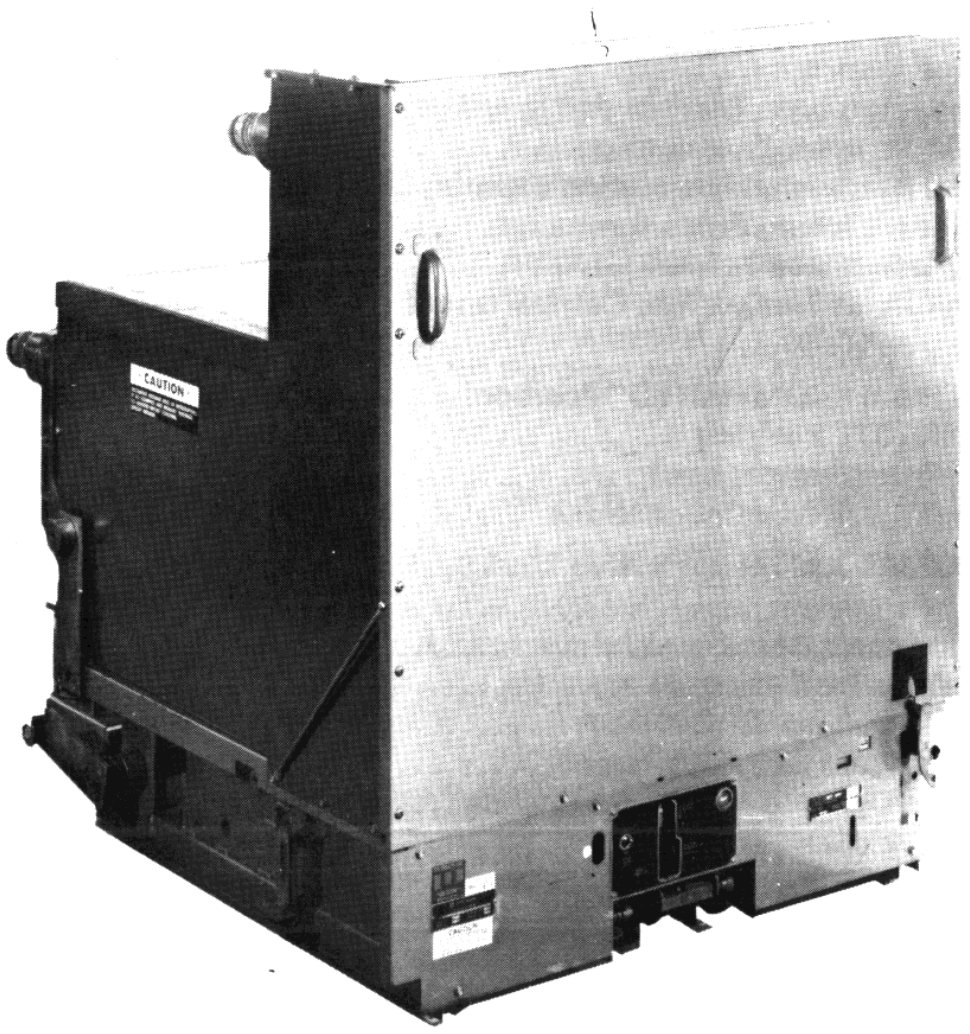
BBC
BROWN BOVERI

IB 6.2.6.7A

Installation/Maintenance Instructions

I-T-E Medium-Voltage Power Circuit Breakers

Type 38HKV1500
1200 and 2000 Amperes
38000 Volts



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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.

Section 1. INTRODUCTION

These instructions for installation, operation and maintenance of 38HKV 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.

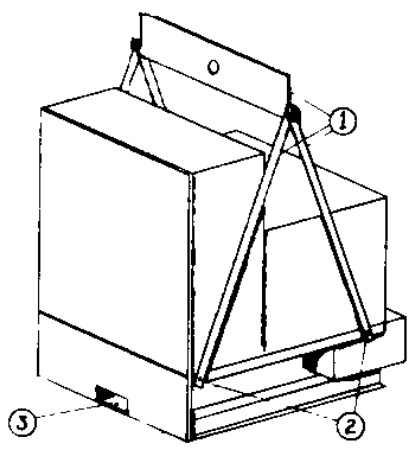
File these instructions in a readily accessible place together with drawings and descriptive data of the switchgear. These instructions are guides to proper maintenance of the equipment and prolong its life and usefulness.

Section 2. RECEIVING AND STORAGE

Immediately upon receipt of the circuit breakers, examine the cartons to determine if any damage or loss was sustained during transit. If injury or rough handling is evident, file a damage claim at once with the carrier and promptly notify the nearest District Office. Brown Boveri is not responsible for damage of goods after delivery to the carrier. However, we will lend assistance if notified of claims.

CAUTION CAUTION CAUTION CAUTION

THE DEVICE IS FACTORY SHIPPED IN A CLOSE POSITION TO PREVENT DAMAGE TO INTERRUPTERS. ANY RESHIPMENT OR HEAVY HANDLING BY USER REQUIRES THE DEVICE TO BE CLOSED TO PREVENT VOIDING WARRANTY. OPEN DEVICE BEFORE INSTALLATION PROCEDURES STARTED.



1. Breaker Lifting Yoke
2. Lifting Fastener Position
3. Fifth Wheel Pivot Hole

Fig. 1—Circuit Breaker & Lifting Yoke

Unpack circuit breakers as soon as possible after receipt. If unpacking is delayed, difficulty may be experienced in making a claim for damages not evident upon receipt. Use care in unpacking in order to avoid damaging any circuit breaker parts. Check the contents of each carton against the packing list before discarding any packing material. If any discrepancy is discovered, promptly notify the nearest District Office. Information specifying the purchase order number, carton number and part numbers of damaged or missing part 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 required that adequate means of protection be provided. This may be done by keeping the breaker in its original shipping carton and storing in a warm (approximately 15°C) dry (50% max humidity) and uncontaminated atmosphere. If the circuit breaker cannot be stored properly due to abnormal circumstances, it must be thoroughly checked before going into service to insure that it is without damage and it has not become generally contaminated.

Section 3. CIRCUIT BREAKER INSTALLATION

3.1 GENERAL

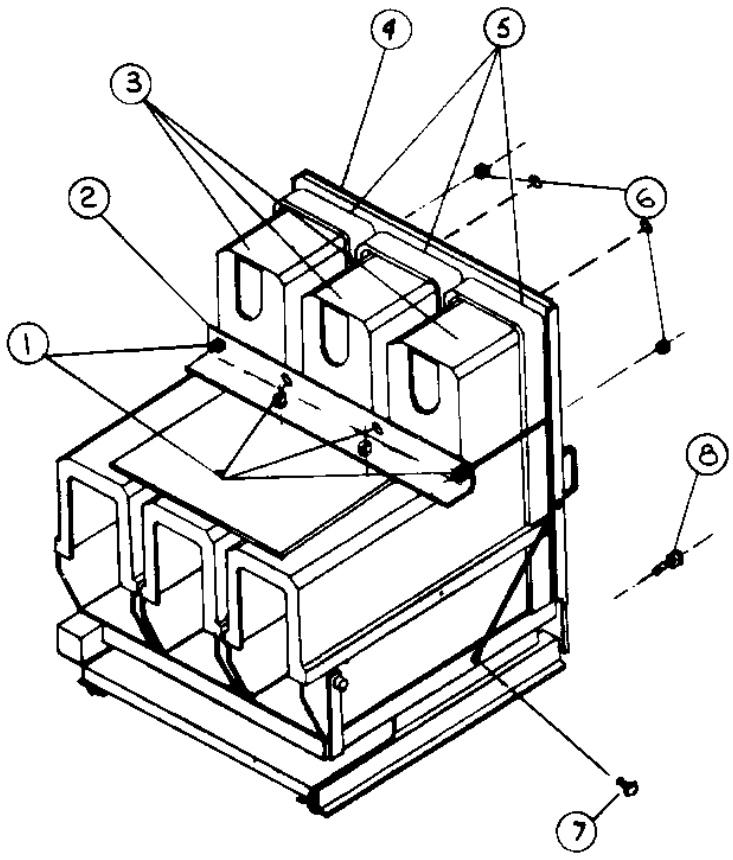
Prior to installation of the circuit breaker into a switchboard, certain preliminary inspections are made to insure proper operation.

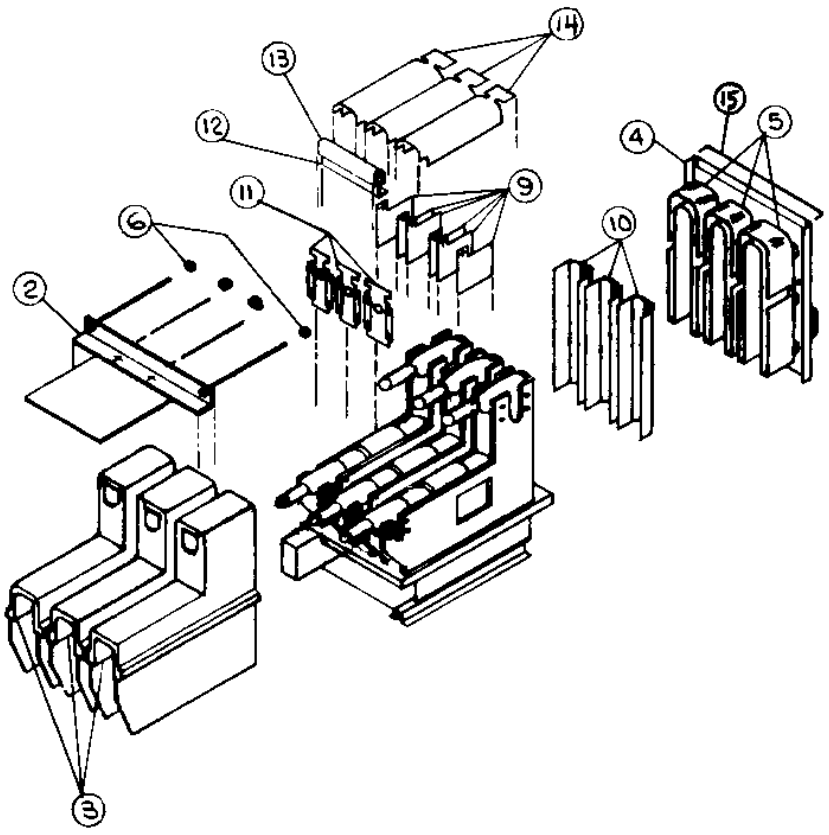
The circuit breaker is shipped with contacts closed, closing springs discharged and opening springs charged. If the circuit breaker is furnished with an undervoltage device, the device will be lock wired to allow closing of the breaker for shipment. A tag will identify the lock wire. To remove the wire,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

CAUTION CAUTION CAUTION CAUTION

PRIOR TO ANY DISASSEMBLY OR INSPECTION OF THE CIRCUIT BREAKER THE CLOSING SPRINGS SHOULD BE DISCHARGED, AND THE BREAKER SHOULD BE OPEN.

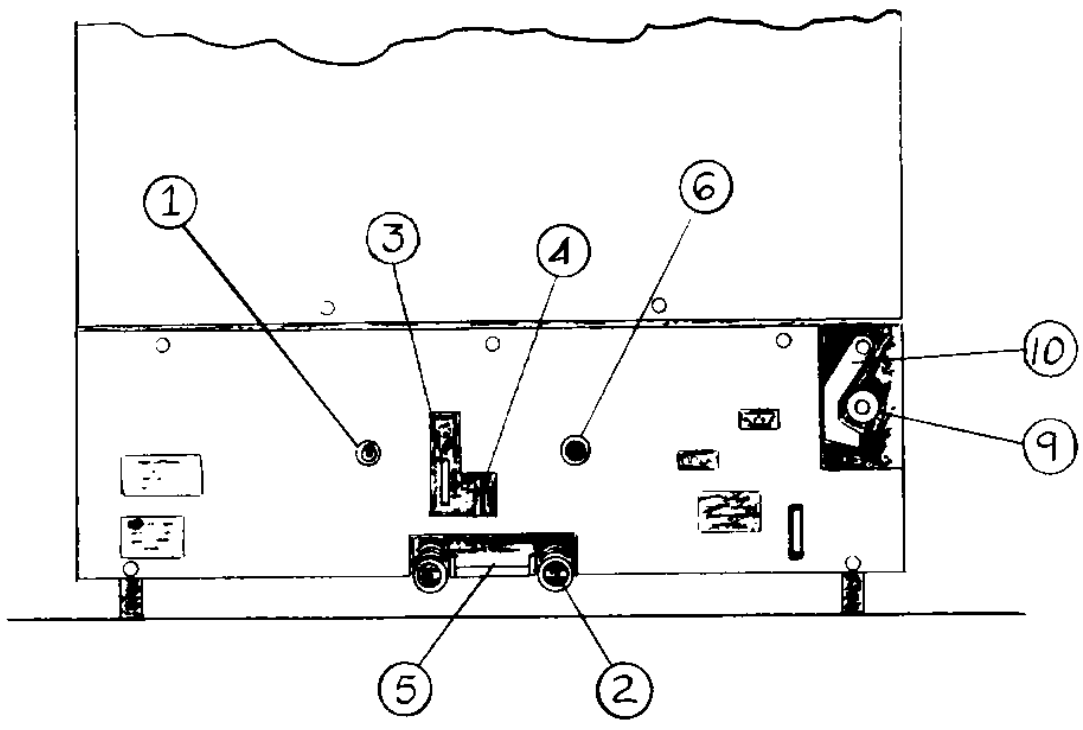
IF IT IS NECESSARY TO RAISE OR MOVE THE BREAKER, ATTACH THE LIFTING YOKE AT POINTS 2 (FIGURE1), OR A FIFTH WHEEL AT POINT 3 (FIGURE 1) TO TRANSPORT THE BREAKER AS REQUIRED.





1. Tie Bolts
2. Angle & Insulation Assy.
3. Interphase Barriers
4. Front Cover Assy. outer
5. Front Cover Assy. inner
6. Tie Bolt Nuts
7. Angle Bracket Assy. Screws
8. Front Cover Assy. Screws
9. Access Covers
10. Front Barrier
11. Intermediate Barriers
12. Insulation Angles
13. Insulation Strips
14. Top Covers
15. Insulation Strip

Fig. 2—Insulation Barrier Assembly



1. Motor Disconnect Switch
2. Closing Spring Guides
3. Charging Lever
4. Manual Close Lever
5. Fifth Wheel Pivot Hole
6. Manual Trip Button
7. Slow Close Bracket
8. Manual Charging Handle
9. Racking Screw
10. Unlocking Lever
11. Racking Crank
12. Fifth Wheel

Fig. 4—Front Circuit Breaker Panel and Accessories

3.2 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.

CAUTION CAUTION CAUTION CAUTION

THE DURESCA PRIMARY BUSHINGS OF THE CIRCUIT BREAKER ARE CAPACITIVELY GRADED AND CAN STORE A CHARGE AFTER BEING ENERGIZED AT RATED VOLTAGE OR AFTER DIELECTRIC TESTING. ALSO, THE MID-BAND RING ON THE VACUUM INTERRUPTERS, SO EQUIPPED, CAN ALSO ACQUIRE A CHARGE. ACCORDINGLY, IF A DIELECTRIC TEST IS CONDUCTED PRIOR TO INSTALLATION INSPECTION OR THE CIRCUIT BREAKER HAS JUST BEEN REMOVED FROM SERVICE, BE SURE TO DISCHARGE THE BUSHINGS WITH A GROUND STICK PRIOR TO HANDLING OF THE CIRCUIT BREAKER. THEN, AFTER THE INTERPHASE BARRIER IS REMOVED, DISCHARGE THE INTERRUPTER MID-BAND RING BEFORE PROCEEDING. PLEASE NOTE THAT THE CAPACITIVE CHARGE IS NOT HARMFUL BUT IT SHOULD BE REMOVED FOR COMPLETE SAFETY.

THE INTERPHASE BARRIERS AND INSULATION PARTS (FIGURE 2) MUST BE REMOVED FOR ACCESS TO AND INSPECTION OF THE VACUUM INTERRUPTERS AND THEIR ASSOCIATED ADJUSTMENTS.

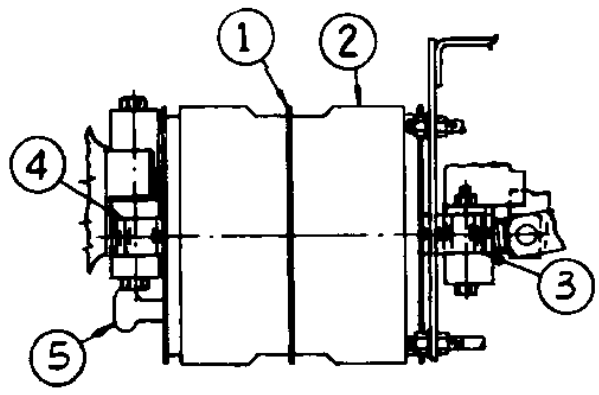
3.3 REMOVING INTERPHASE BARRIERS AND INSULATION (See Fig. 2)

For access to and visual inspection of the vacuum interrupters, it is necessary to first remove four nuts (6) at the front cover. Angle and insulation assembly (2) can now be removed. Slide the three interphase barriers (3) to the rear to remove. Now, remove the three top covers (14).

To make pushrod adjustments and/or contact speed measurements, the 1/4" nylon hardware holding the access cover (9) must be removed. Access cover (9) can now be slid to the rear of the breaker.

The front cover assembly (4) and (5) is removed by removing two screws (8) at the bottom of cover (4) and while supporting cover assembly (4) and (5) remove one screw (7) on each side of the breaker. The front cover assembly (4) and (5) can now be lifted off the breaker.

Front barriers (10) can be removed by removing four screws (lower hardware is nylon) from each of the three barriers. Barriers (11) are fastened together with nylon hardware.



1. Mid Band Metal Ring
2. Insulating Vacuum Envelope
3. Moving Contact Stud
4. Stationary Contact Stud
5. Pinch Off Tube and Seal

Fig. 3—Vacuum Interrupter

3.4 VACUUM INTERRUPTER EXAMINATION (See Fig. 3)

The insulating vacuum envelope (2) should be examined carefully for cracks in the area of the metal-to-insulation seals on both ends and around the mid-band ring (1). 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 (1), 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 (5) 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.

NOTE: Occasionally the inner shield, located inside the interrupter, will rattle slightly but this condition is normal.

3.5 INTERPHASE BARRIERS AND INSULATION EXAMINATION

All insulated parts should be checked for damage. There should be no through holes or apparent missing hardware. 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.

3.6 MANUAL SLOW CLOSE PROCEDURE (See Fig. 4)

NOTE: For personal and operational safety manual slow closing of the circuit breaker *must only* be performed when the circuit breaker is outside of its switchboard compartment.

1. With the breaker open, engage racking crank (11) with the racking screw (9). Turn racking screw (9) two or three turns clockwise until the unlocking lever (10) snaps into the first position. This corresponds to the "DISCONNECT" position.

2. 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).

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

FOR SAFETY AND PROPER OPERATION: Make sure tangs seat properly in the closing spring guides.

4. 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.

5. 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.

6. 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).

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).

8. 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.

NOTE: It is required 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.

3.7 INSTALLING INTERPHASE BARRIERS AND INSULATION (See Fig. 2)

The barriers and insulation are reinstalled by reversing the order of the removal operation. Check that the nylon hardware is reinstalled in the same location as removed and as specified in the removal operation. Also check that the six bushing ground clips are not distorted and are properly located for ground to the switchboard frame, see Figure 4A.

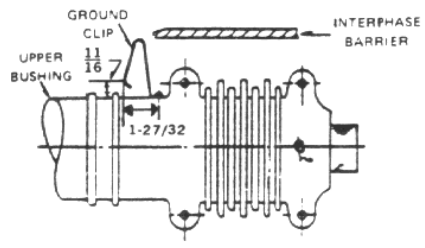


Figure 4A

NOTE:
UPPER BUSHING SHOWN
LOWER BUSHING HAS GROUND CLIP ON UNDERSIDE.

3.8 INSTALLING CIRCUIT BREAKER INTO COMPARTMENT (See Figures 4 and 5)

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

1. Turn motor disconnect switch (if supplied) (1, Figure 4) to "OFF" position.

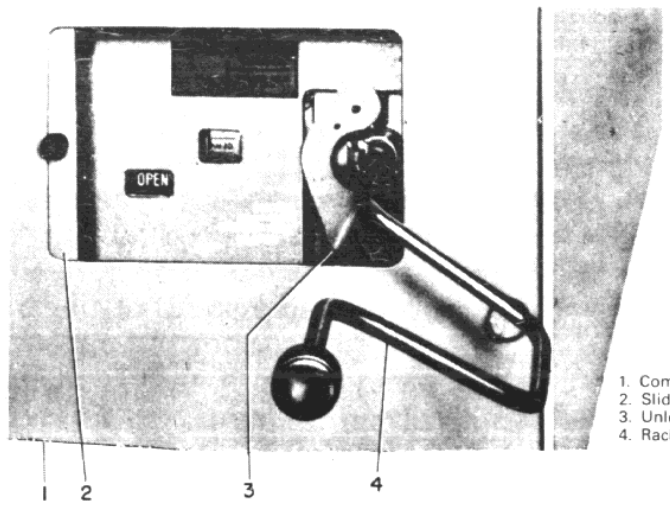
2. Engage racking crank (4, Figure 5) and push racking unlocking lever (3) to left, then rotate racking crank counterclockwise only until resistance to motion is felt. (DO NOT FORCE.)

3. Engage fifth wheel with hole guide (12, Figure 4) and push circuit breaker into compartment until stopped. (If closing springs were left in charged condition, they will automatically discharge.)

4. Engage racking crank and rotate clockwise until racking mechanism automatically stops at "DISCONNECT" position. (Breaker is now held captive in compartment.)

5. To rack circuit breaker to "TEST" position, push racking unlocking lever (3, Figure 5) to left, rotate racking crank approximately 1/4 turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stops at "TEST" position.

6. With the circuit breaker racked to "TEST" position, check for proper operation by operating all possible means of opening and closing. This includes control switches, relays, etc. Turn motor disconnect switch (1, Figure 4) to "ON" position to charge the closing springs, and operate the breaker as required. If motor disconnect switch (1, Figure 4) is not provided, springs will



1. Compartment Door
2. Sliding Panel
3. Unlocking Lever
4. Racking Crank

Fig. 5 — Method of Racking Circuit Breaker

automatically charge when approaching "TEST" position.

FOR SAFETY: When racking circuit breaker to "CONNECTED" position, close compartment door (1, Figure 5) and insert racking crank (4, Figure 5) through sliding panel (2, Figure 5).

7. Push unlocking lever (3) to left and turn racking crank (4) approximately 1/4 turn clockwise, then release unlocking lever. Continue cranking until racking mechanism automatically stays 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.

4. CIRCUIT BREAKER REMOVAL (See Figure 5)

4.1 REMOVAL FROM "CONNECTED" POSITION

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

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

4.2 "DISCONNECT" POSITION

Repeat same operation for "DISCONNECT" position.

4.3 REMOVAL FROM SWITCHBOARD

To position the racking mechanism for withdrawal of the circuit breaker from the switchboard, again push racking unlocking lever to the left and turn racking crank counterclockwise only until resistance to motion is felt (Approximately 2–3 turns—DO NOT FORCE)

NOTE: The closing springs, if charged, will automatically discharge when the racking mechanism is positioned for withdrawal from the switchboard. The circuit breaker can now be removed from the compartment by pulling on the two handles on front barrier.

4.4 SAFE OPERATION RECOMMENDATIONS

1. It is recommended that any circuit breaker be withdrawn and stored in the test position whenever it is to be maintained in the open position with no planned switching.
2. It is recommended that a ground test device be connected to the proper compartment when any work is to be done on any bus or feeder circuit.

Section 5. MAINTENANCE AND ADJUSTMENTS

5.1 GENERAL INFORMATION

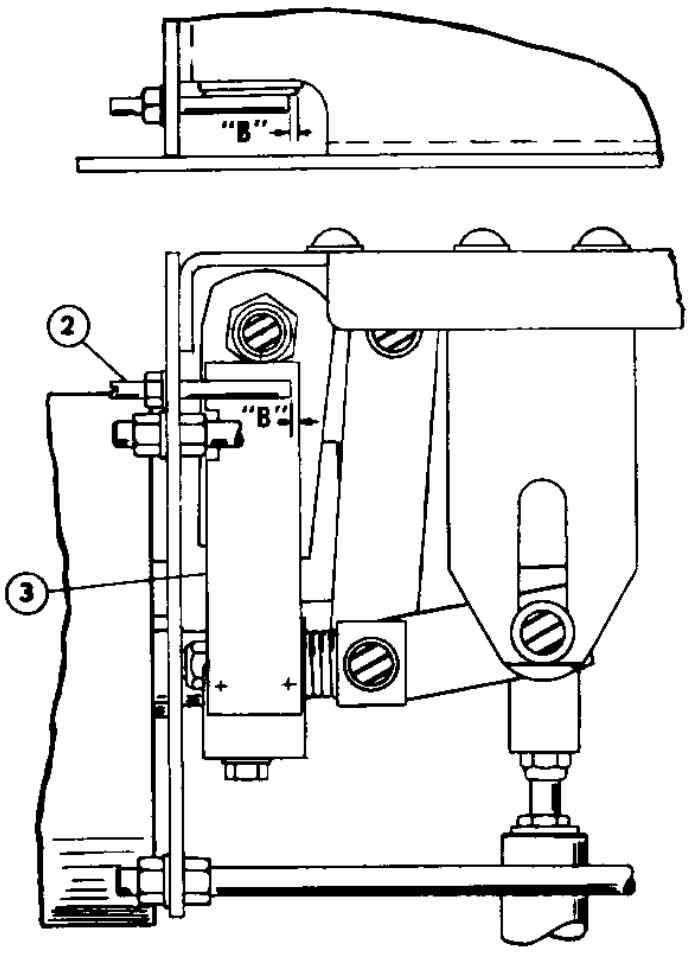
The 38HKV circuit breakers are designed for minimum maintenance and tested to insure that minimum maintenance will be required. There is only one basic adjustment normally required and that is contact pressure. This should be checked to the dimensional values required as described in paragraph 5.5. The 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 250 operations, regardless of the type of duty it is used for.

Vacuum interrupters, as used on the 38HKV 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 250 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.



2. Adjustable Pointer
3. Indicator Plate

Fig. 5A—Erosion Indicator

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

NOTES:

1. The following tabulated tests and adjustments are all that are normally necessary for proper maintenance and operation of the 38HKV 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.

See the previous sections for removal and installation of interphase barriers and insulation parts.

2. The vacuum interrupters as installed and adjusted in the breaker have been checked that they operate within their design limits. Caution must be used when working with the breaker that adjustments or changes are not made that would cause the interrupters to exceed these limits. The main concern here is contact travel (open air gap) and speeds. The breaker was originally adjusted so that the interrupter air gaps, including overtravel on opening does not exceed .850 inch. Any erosion of contacts would be in addition to this value. Any change that would increase the contact air gap, such as an adjustment at the pushrod, could over stress the internal metal bellows of the interrupter, resulting in cracks in the bellows and loss of vacuum.

5.2 EROSION INDICATOR CHECK (See Fig. 5A)

An erosion indicator is provided on each interrupter to show contact wear or erosion when closed. The erosion indicator consists of an adjustable pointer (2) and an indicator plate (3). This plate moves relative to contact wear. The tip of the adjustable pointer is set at the factory, with the breaker closed, to a "B" dimension of .125 inch from the edge of the indicator plate. The "B" dimension indicates the contact life of the interrupter. As the contacts erode the "B" dimension will decrease. When the adjustable pointer reaches the edge of the indicator plate, "B" dimension of zero, it is required that the interrupter be replaced.

CAUTION CAUTION CAUTION CAUTION

AFTER THE EROSION INDICATOR HAS BEEN INITIALLY SET, NO ADJUSTMENT TO THE POINTER OR THE "B" DIMENSION SHOULD BE MADE DURING THE LIFE OF THE INTERRUPTER.

5.3 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.

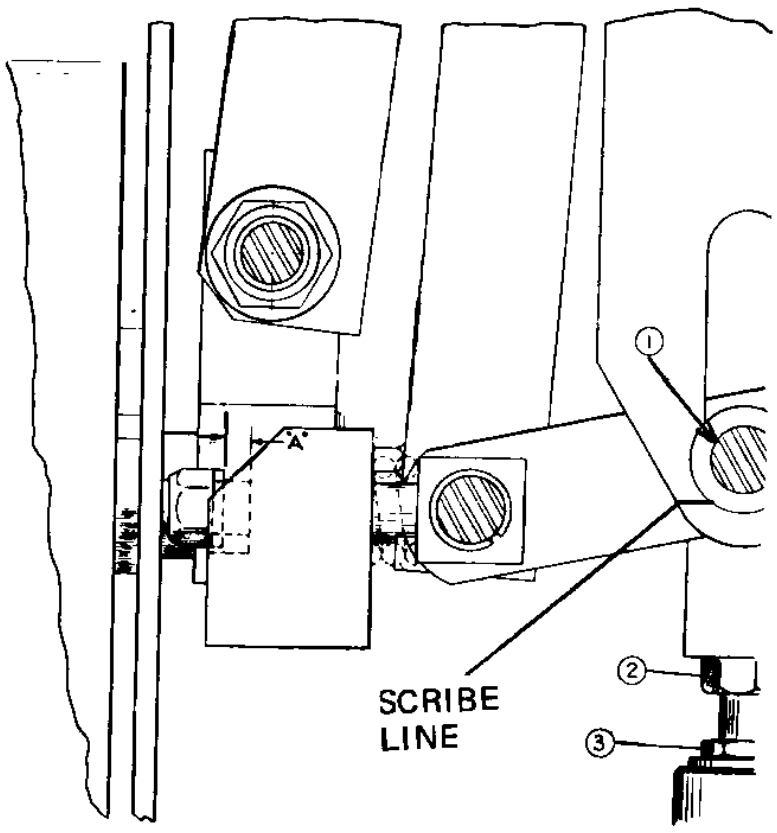
The following table lists the millivolt drop and resistance values for the circuit breakers, when manufactured, covered by this instruction book, from terminal to terminal, exclusive of the primary disconnects.

CIRCUIT BREAKER	MAXIMUM MV DROP*	MAXIMUM MICRO-OHMS
38HKV1500–1200 Ampere	19	95
38HKV1500–2000 Ampere	13	65
*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 vacuum interrupter. A millivolt drop across each vacuum interrupter above 4 (20 micro-ohms), measured between points 3 & 4 of Fig. 3, 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.

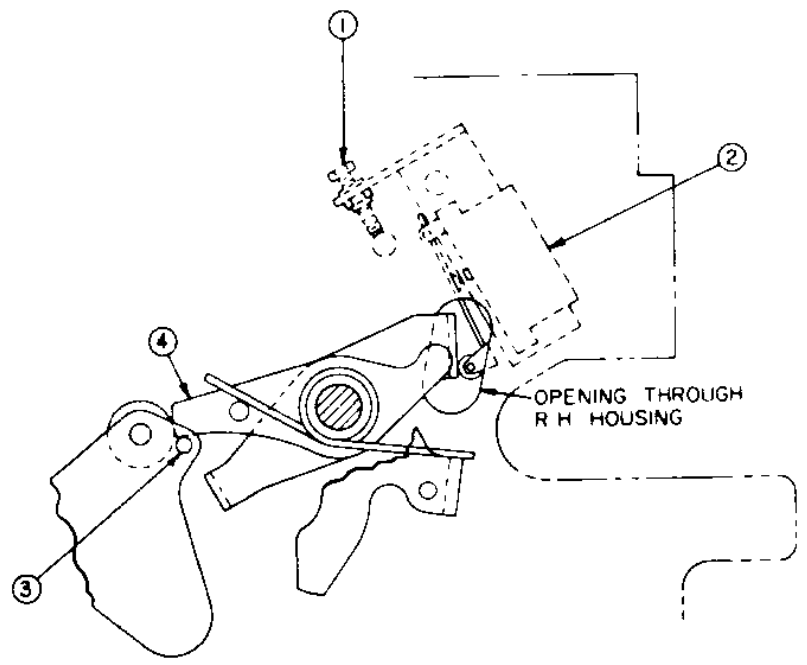
For optimum performance of the circuit breakers during periods of increased loading, it is recommended that the listed values not be exceeded.

If the millivolt drop is still too high, after it has



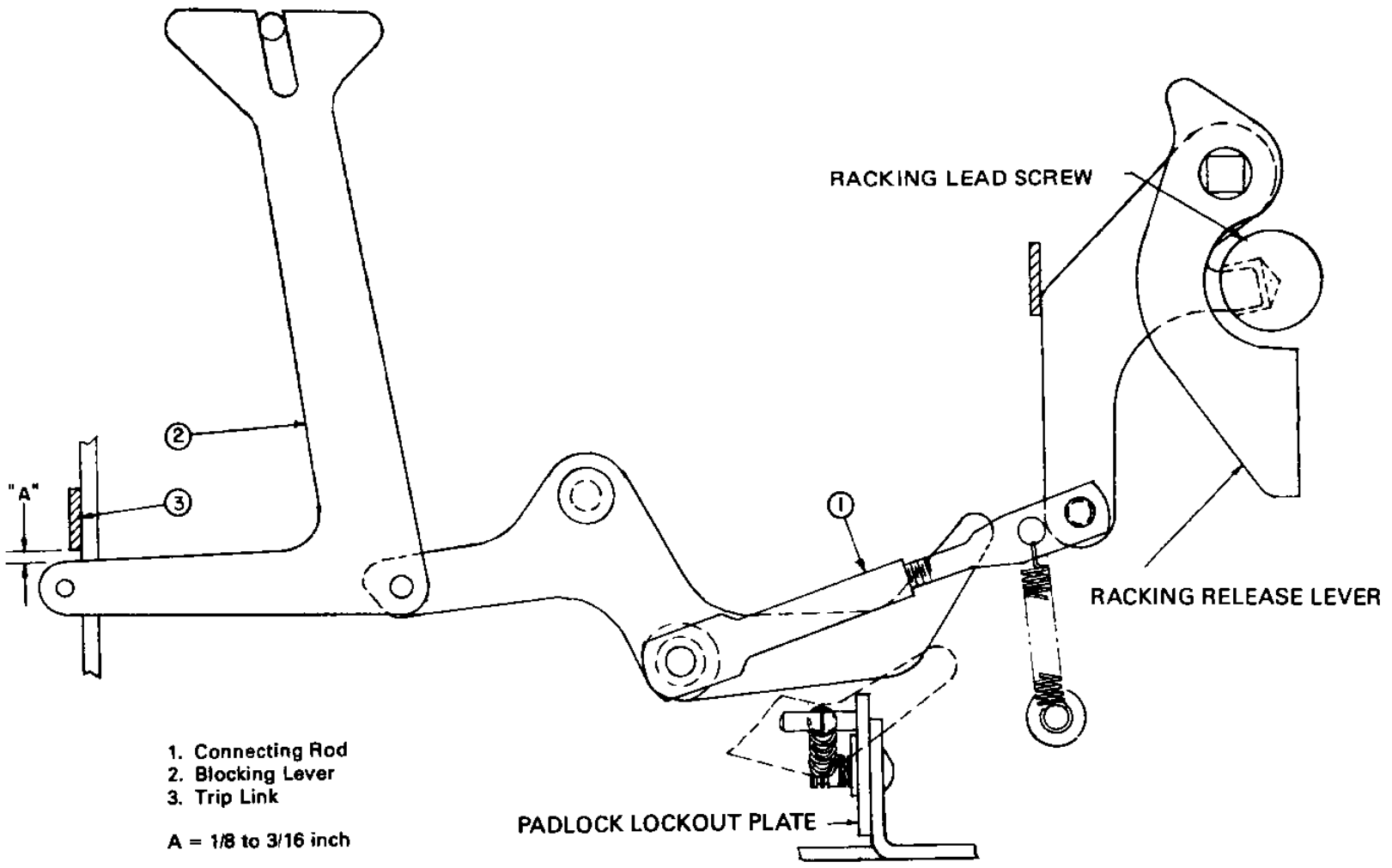
1. Pin
2. Push Rod Lock Nut
3. Push Rod Adjusting Stud

Fig. 6—Contact Pressure



1. Adjusting Screw
2. Latch Check Switch
3. Reset Stop Pin
4. Trip Latch

Fig. 7—Latch Check Switch Adjustment



1. Connecting Rod
2. Blocking Lever
3. Trip Link

A = 1/8 to 3/16 inch

Fig. 8—Racking Mechanism

been established that the contact pressure is correct and that erosion is not excessive, contact Brown Boveri for recommendations.

5.4 INSULATION CLEANING

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

*Remember to discharge bushings and midband ring on interrupters so equipped.

5.5 CONTACT PRESSURE AND CONTACT SEQUENCE

READ THIS SECTION 5.5 COMPLETELY BEFORE PROCEEDING WITH ANY CHECK OR ADJUSTMENT.

With the circuit breaker withdrawn from the switchboard, the following procedure should be followed for properly checking and/or adjusting the contact pressure and sequence on a 38HKV circuit breaker.

It should be noted that any change in "A" Dim. (Fig. 6) will affect both contact pressure and contact sequence; therefore, when checking and adjusting, both pressure and sequence should be considered.

The Notes 1 and 2 below should be referred to since it is necessary that the breaker closes fully for correct breaker operation and that the contact pressure, Dim. "A", should only be measured with the breaker fully closed. Also, if the adjusting stud (3, Fig. 6) is adjusted too far in the direction to add contact pressure, increase in Dim. "A", pin (1, Fig. 6) will bottom in the slot resulting in the breaker possibly not closing fully.

Prior to checking the breaker proceed as follows:

a. Remove interphase barriers and insulation parts as previously described.

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

1. Contact Pressure

a. Check that the breaker closes fully per Note 1.

b. See Fig. 6. With the breaker closed, the gap at "A" (4 places at each pole) is a measure of contact pressure. This gap will normally reduce as the contacts erode during service. If the contact pressure (Dim. "A") becomes less that 3/64 (.047) inch, (average of two places for each interrupter) readjustment to increase Dim. "A" is required and should be adjusted as follows:

b. 1 Open the breaker and loosen the pushrod locknut (2).

b. 2 Turn the pushrod adjusting stud (3) initially 1/2 turn to increase Dim. "A" (Turning the adjusting stud counterclockwise, as viewed from the top, will increase the contact pressure.) Refer to Notes 1 and 2 when adjusting.

b. 3 Close the breaker and recheck Dim. "A".

b. 4 Repeat steps b.2 and b.3 as required until Dim. "A" of 1/16 min. is obtained.

b. 5 Tighten locknut (2).

2. Contact Sequence

a. The three poles should make within 2 milliseconds of each other when closed at normal closing speed. An oscilloscope, oscillograph or similar timing method is the preferred method. If adjustment is required, then the contacts can be advanced or retarded as required. The procedure for this is the same as for "Contact Pressure" adjustment. An increase in "A" Dim., Fig. 6, will cause a contact to make earlier. Refer to Notes 1 and 2 when readjusting. After readjustment, recheck that the 3 poles make within 2 milliseconds.

b. If contact sequence cannot be checked during the normal closing as described in 2a above, then check as follows:

b.1 Connect an indicating light (or bell) across each pole of the circuit breaker.

b.2 Loosen the pushrod adjustment lock nut (2).

b.3 Partially slow close the circuit breaker as previously described.

b.4 With the manual spring charging handle, slowly pump until the first indicating light (or bell) comes on.

b.5 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 (3) counterclockwise, on the remaining two poles, as required, to bring the remaining two indicating lights (or bells) on.

b. 6 Complete the slow close operation and remove the slow close bracket.

b.7 Open the breaker.

b.8 Tighten the lock nuts (2) on each adjusting stud (3) to lock the pushrod adjustment stud in place.

b.9 Fast close the circuit breaker and recheck per Note 1. Trip the circuit breaker.

NOTES

1. Fully Closed Breaker (See Fig. 4)

Prior to "contact pressure and adjustment" procedure check, and following any required

contact readjustment, the breaker should be checked to see that it is closing fully as follows:

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 spring 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 then the factory should be consulted.

2. If the scribe line has been marked, check that the bottom of pin (1, Fig. 6) is not more than 3/32 below the scribe line when the breaker is closed.

5.6 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. At 125VDC—Times at other voltages may vary slightly.

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

3. Adjustments to correct times, if found to be outside limits, are critical and our District Office should be contacted.

5.7 OPERATING MECHANISM (See Figure 7)

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 (2) at right side of breaker (when used) is not actuated. Circuit breaker should not close before trip latch (4) has reset.

Latch-check switch adjustments—made with latch (4) against stop pin (3):

1. Turn in adjusting screw (1) until contacts of switch (2) "break" as indicated by an audible click or check with bell ringer.

2. Retract adjusting screw until switch contacts "make".

3. Retract adjusting screw one turn more. (Adjusting screw is self-locking.)

5.8 CONTROL RELAY ADJUSTMENT (See Fig. 8A)

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.

5.9 RACKING MECHANISM (See Figure 8)

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.

If it is possible to close breaker during a racking operation, it may be that interlocked blocking members are not positioned properly, which should be corrected as follows:

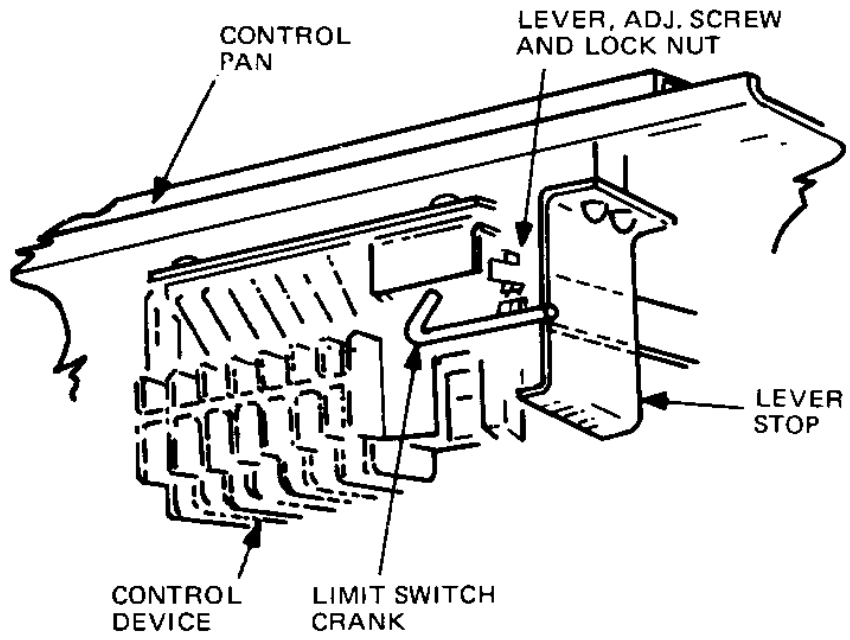


Fig. 8A—Control Relay

1. Remove the front mechanism coverplate.

2. With circuit breaker closed, make adjustments by regulating length of connecting rod (1) for 1/8" minimum to 3/16" maximum clearance at "A" between trip link (3) and blocking lever (2).

5.10 LUBRICATION

The 38HKV 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 Sanchen Company. (BBC No. 713222-A, 1 Pt. Can).

2. All other mechanism parts, bearings, pins, etc. have been lubricated with ANDEROL 757 manufactured by Tenneco Chemical, Inc., Intermediate Division. (BBC No. 712994-A, 4 oz. Tube)

In order to maintain reliable operations, it is important that all circuit breakers be lubricated at all times. All bearings and rolling surfaces that require lubrication have been properly lubricated at the factory during assembly and should not require any further lubrication during the life of the equipment. However, even the finest greases have a tendency to oxidize with age, as evidenced by hardening and darkening in color. In addition to lubricant oxidation, frequent operation of the breaker causes lubricant to be forced out from between the bearing surfaces. When these changes occur, regreasing is required to maintain reliable operation of the breaker. Elimination of the hardened lubricant is essential before regreasing is performed. A simple lubrication will often clear up minor misoperations which might be mistaken for more serious trouble.

If the grease should become contaminated or parts are replaced, lubrication should be done with NO-OX-ID or ANDEROL grease as applicable. Use of other greases have not been proven by test and are not recommended.

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.

5.11 DIELECTRIC TESTS

IT IS REQUIRED 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 each vacuum interrupter, the interrupter is faulty and must be replaced. Always insure that the contact adjustment is correct before conducting primary circuit dielectric tests.

When using two interrupters in series, considering the capacitive grading of the bushings and the configuration of the circuit breaker, it is recommended that each interrupter be dielectrically tested at (36 kV 60 Hz or 40 KV DC)Δ across the open gap. This is easily accomplished by removing the interphase barriers and connecting one test lead at the midpoint of the two interrupters and in turn applying the test voltage to the upper and lower bushings. The 60kV, 60 Hz or 80kV DC dielectric test of the complete circuit breaker should then be conducted with the contacts closed to properly field test the insulation structure. All bushing ground clips should be connected to test ground.

CAUTION CAUTION CAUTION CAUTION

WHILE THE PROCEDURE FOR DIELECTRIC TESTING A VACUUM BREAKER IS SIMILAR TO THAT FOR ANY OTHER TYPE BREAKER, THERE ARE THREE 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. The Duresca primary bushings on the circuit breaker are capacitively graded and can also store a charge after dielectric testing. A grounding stick should be used to discharge the bushings after test.
3. 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.

CIRCUIT	60Hz	DC
Δ Primary (Circuit Breaker Closed)	60kV	80kV
* Secondary (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. 4) 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.

ΔBefore conducting tests the pole insulation and interrupter envelope should be clean and dry. A capacitance current of up to 8 milliamps per pole for the AC test and up to 100 microamps per pole for the DC test is allowable.

If it is desired to make a dielectric test on the spring charging motor, turn the motor disconnect switch (1, Fig. 4) to the "ON" position. Apply test voltage (600V-60HZ or 848V-DC) for one minute to the motor circuit.

5.12 TROUBLESHOOTING

The following chart lists typical problems, their causes and corrective action required to remedy the malfunction.

TROUBLESHOOTING CHART

Problem	Probable Cause	Corrective Action
Breaker Fails to Close	Low or Incorrect Control Voltage	Adjust to Proper Level
	Closing Springs Not Charged	Adjust Per Section 5 8
	Control Relay Limit Switch Out of Adjustment	
	Breaker is not Racked into Test or Connected Position	Turn Operating Crank Clockwise until lever is locked into the desired position
	Latch Check Switch not Making (When Supplied)	Adjust Per Section 5.7
	Auxiliary Switch "b" Contact not Making	Determine Cause and Repair
	Racking Release Lever Linkage not properly adjusted	Adjust per Section 5.9
	Excessive Friction	Insufficient or Contaminated Lubrication (See Sec. 5 10)
	"Y" Contact not Making*	Defective "Y" Coil Circuit
	Undervoltage not operating (When) Supplied)	Low or Improper Voltage Applied
	Defective Close Coil Assembly	Replace Close Coil Assembly
Breaker fails to complete full closure	Excessive contact pressure	See Sect. 5.5, Note 2
	Mechanical interference of interrupter's operating linkage	Locate and remove interference
	Excessive Friction	Insufficient or Contaminated Lubrication (See Sec 510)
Breaker Fails to Trip	Low or Incorrect Control Voltage	Adjust to Proper Level
	Auxiliary Switch "a" Contact not Making	Determine Cause and Repair
	Defective Trip Coil Assembly	Replace Trip Coil Assembly
	Excessive Friction	Insufficient or Contaminated Lubrication (See Sec. 5.10)

Caution – Improper "Y" circuit operation could permit the breaker to pump to destruction.

5.13 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.

TABLE 1—OPERATING VOLTAGE RANGE

Nominal Control Voltage	Spring Charging Motor	Close Coil	Trip Coil	Undervoltage	
				Pick Up Maximum	Drop Out
24 V dc	—	—	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	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 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

****Alternating current is never recommended because the control power is affected by the power system that it is protecting. A sufficient reduction in control power during a heavy fault condition could prevent the HK circuit breaker from opening, leading to loss of total load and/or equipment damage.***

Section 6.0 ELECTRICAL OPERATING SEQUENCE, D-C CLOSING (See Fig. 9)

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

1—Immediately upon the availability of control power, the spring charging motor (Mot) is energized, which in turn charges the closing springs. When the closing springs are charged, limit switch contacts "LSb" are opened, and limit switch contact "LSa" is closed.

2—Operation of the Close Control switch energizes the latch release coil (X) through the circuit breaker auxiliary switch "b" contact, the normally closed lockout relay contact "Yb", and the limit switch contact "LSa". The latch release coil (X) releases the closing latch. The springs then discharge to close the circuit breaker.

3—When the springs discharge, limit switch contacts "LSb" close, and switch contact "LSa" opens.

4—When limit switch contact "LSb" in the motor circuit closes, the spring charging motor is energized, which in turn recharges the closing springs.

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

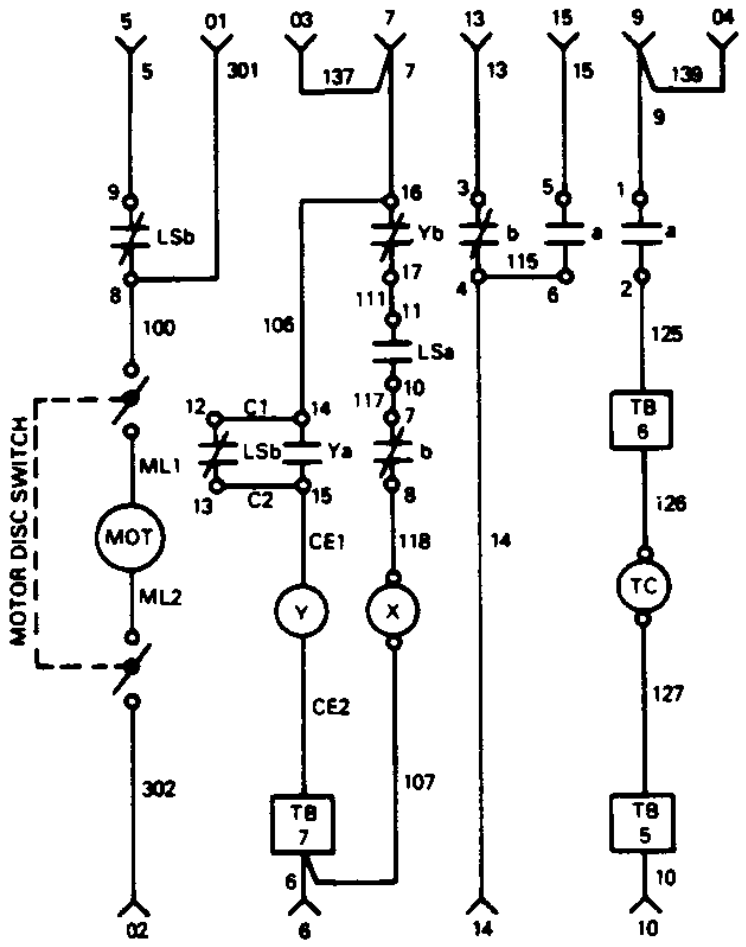


Fig. 9 — Typical Schematic Diagram of Control Circuit, DC Closing

For other optional electrical devices, refer to the specific contact diagrams.

REAR VIEW OF SECONDARY DISCONNECTS

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

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).

6—When the limit switch contacts "LSb" close, the lockout relay coil (Y) is energized and opens lockout relay contact "Yb", which deenergizes the latch release coil (X). Lockout relay contact "ya" closes, which seals-in the lockout relay coil (Y) as long as the "close" contact is maintained. The purpose of the lockout relay coil (Y) is to prevent pumping of the closing mechanism when closing against a faulted circuit.

7—After the breaker has closed and when the "close" switch is released by the operator, the lockout relay coil (Y) is deenergized. This allows the normally-closed lockout relay contact "Yb" to close, and the normally-open lockout relay contact "Ya" to open.

8—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.

9—The undervoltage device, if furnished, provides a direct acting lock-open and undervoltage tripping feature. This device must be energized to initially close the breaker, and also to maintain the breaker in a closed position.

10—The latch check switch, if furnished, insures that the tripping mechanism must be reset prior to energizing the closing latch release coil (X).

11—The stopping device switch, if applicable, prevents electrical reclosing of the circuit breaker after a manual trip until the stopping device has been manually reset.

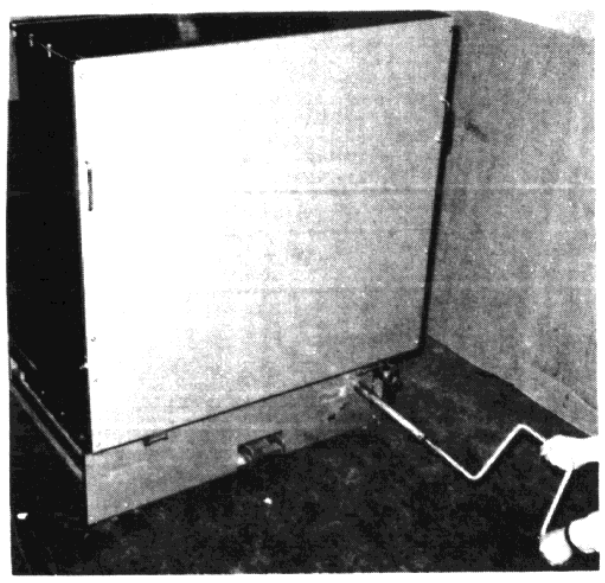


Fig. 10 — 38 kV Drawout Fused Switch Method of Closing and Opening

Section 7.0 AUXILIARY DEVICES (AS REQUIRED)

38KV-FS—This drawout fused switch is intended for control power or potential transformer switching. The device consists of an EJO-1 current limiting fuse in series with the interrupting switch. Two load break contacts are used in series, connected by a pushrod operated bridge, to comprise the interrupter switch. The pushrod is actuated by an over-center spring mechanism operated by a rotary mechanism extending from the front of the switch. Fig. 10 shows the method of closing and opening the switch contacts. After turning the hand crank

CLOSING AND OPENING OPERATION

Note the directional decal located on the lower front cover at the rotary mechanism.

With the earlier model, 02, after turning the hand crank approximately 6 turns clockwise, the switch can be heard to snap closed and after turning the hand crank approximately 6 turns counterclockwise the switch can be heard to open.

With the later model, 02B, the operation differs from the old model in that 11 turns are required to operate and the direction is counterclockwise to close and clockwise to open. The switch will open 5 amperes and the current limiting fuse protects the circuit for any short-circuit current up to the rating of the 38HKV1500 circuit breaker.

38KV-FPT—This drawout potential transformer uses the interrupter switch, mechanism and fuses of the drawout fused switch with Balteau potential transformers mounted on the rear of the truck in place of the lower bushings. The potential transformer secondary connections are wired out through the standard circuit breaker secondary disconnect.

These devices are basically maintenance free for their normal operating life. Racking procedure is the same as for the basic circuit breaker as outlined previously.

CAUTION CAUTION CAUTION CAUTION

CARE SHOULD BE EXERCISED WHEN REMOVING OR REPLACING THE GLASS ENCASED CURRENT LIMITING FUSES MOUNTED ON THE ABOVE DEVICES TO PREVENT ACCIDENTAL BREAKAGE.

38KV GROUND & TEST DEVICE—This device is generally the simple type, requiring manual connection of the grounding cables to the terminals selected. Safety barriers are provided with lock hasps so unused terminals can be safely isolated. Certain users utilize a special selector type G & T device and the detailed operational instructions are attached to the device itself and will not be restated here.

All auxiliary devices are basically maintenance free for their normal operating life. Racking procedure is the same as for the basic circuit breaker as outlined previously, except there are only two positions—CONNECTED and DISCONNECTED.

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Switchgear Products Group
W Columbia, SC 26169

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Section 8. RENEWAL PARTS

Only those recommended renewal parts be stocked that will be required to insure proper and timely maintenance for normal operation of 38HKV 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 test 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. Specific instructions regarding replacement of those part assemblies recommended are available if required.