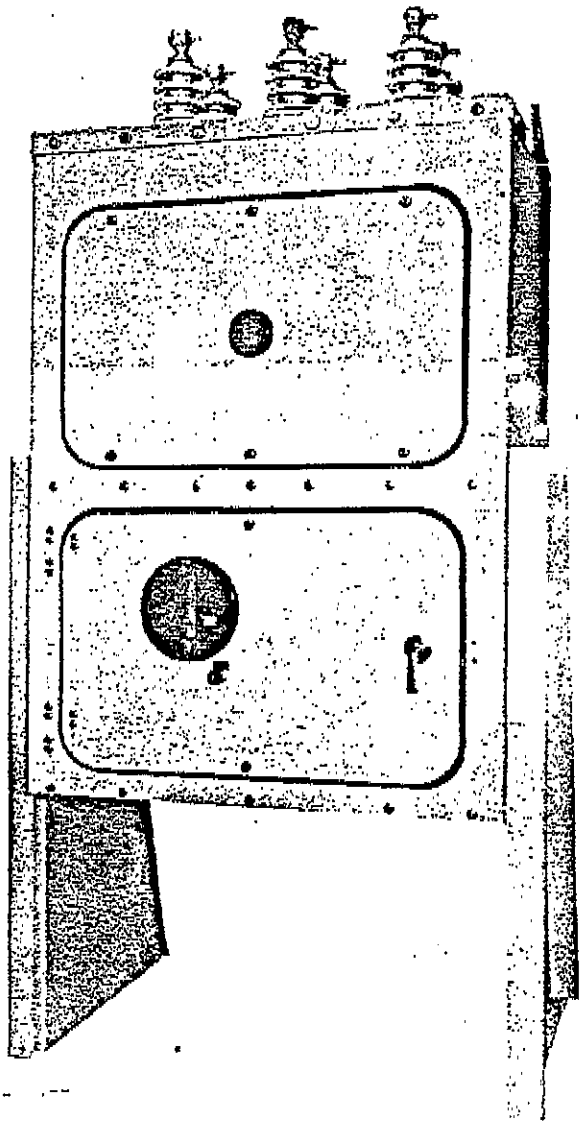
VACUUM POWER CIRCUIT BREAKERS

INSTRUCTIONS

TYPE VBK-15-12 AND VBK-15-20 VACUUM POWER CIRCUIT BREAKERS



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ITE Imperial CORPORATION

CONTENTS

INSTRUCTIONS FOR VACUUM POWER CIRCUIT BREAKERS TYPE VBK

INTRODUCTION

The VBK is a three-phase vacuum circuit breaker which is designed to accommodate various automatic tripping and closing schemes.

Stored energy is used for both closing and tripping of the I-T-E vacuum circuit breaker, a unique feature that assures positive closing or tripping regardless of the auxiliary power supply during these operations. Partial or hesitant closing of the contacts due to the loss of auxiliary power during the action is impossible.

A counter provides a convenient record for service and maintenance crews. Visual indicators easily show the operational status of the circuit breaker.

The three main assemblies of the vacuum circuit breaker are:

1. Vacuum Interrupters
2. Stored Energy Operating Mechanism
3. Overcurrent and Reclosing Relays (When Supplied)

These instructions for installation, operation and maintenance of I-T-E 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 circuit breaker. These instructions will be a guide to proper maintenance of the equipment and prolong its life and usefulness. The schematic and detailed wiring diagrams for the particular circuit breaker order covering relaying and control will be the guide for the electrical operation, trouble shooting and whatever maintenance would be necessary.

It is recommended that this manual and the equipment drawings be reviewed before actual work is started in installing, operating and/or maintaining this equipment.

RECEIVING AND STORAGE

Immediately upon receipt of the circuit breaker, examine it 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 breaker 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. If any shortage of material is discovered, promptly notify the nearest representative of the I-T-E Imperial Corporation. Information specifying the purchase order number, and part numbers of the damaged or missing parts should accompany the claim.

The circuit breaker should be installed in its permanent location as soon as practical. If the circuit breaker is not to be placed in service for some time, it is recommended that the heaters be energized to prevent condensation damage.

CIRCUIT BREAKER INSTALLATION

GENERAL

Prior to the initial installation of the circuit breaker, 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 circuit breaker should be opened, using the manual trip button, discharging the opening springs. If it is necessary to move or raise the circuit breaker, lifting plates (Fig. 1) are provided at the top of the circuit breaker housing for a crane lift.

WARNING: Do not allow the sling to bear against the porcelain bushings.

INSTALLATION INSPECTION

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

The height of the circuit breaker may be adjusted by inserting the leg fastening bolts in the holes corresponding to desired height. See typical outline drawing on page 4.

VACUUM INTERRUPTER EXAMINATION (Fig. 2)

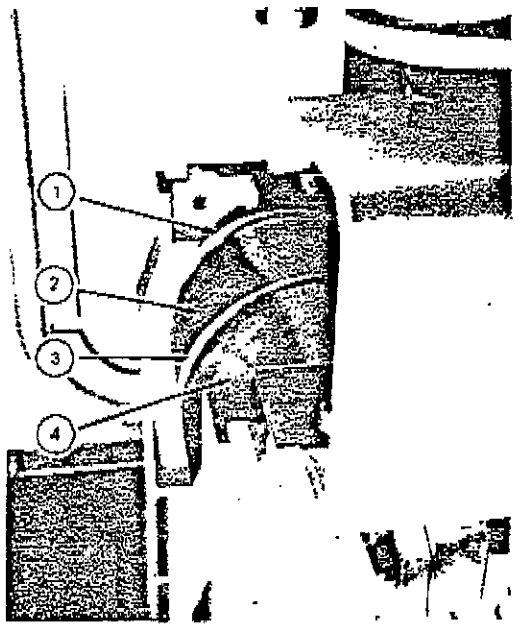
CAUTION: A grounding stick should be used to discharge the mid-band ring (3) on the vacuum interrupters (4), so equipped, before any work is done on the interrupters.

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 (3). 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 (3), when so equipped, has been bent by an accidental impact, that area should be scrutinized for glass seal damage. Small external chips, however, will not impair the useful life of the interrupters.

The pinch-off tube seal (1) 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. Vacuum integrity may be assured by means of a dielectric test. See section on dielectric tests.

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.



1. PINCH-OFF TUBE SEAL (FOR EXACT LOCATION SEE FIG. 6, ITEM 12)
2. INSULATING VACUUM ENVELOPE
3. MID-BAND RING
4. VACUUM INTERRUPTER

Fig. 2 — Vacuum Interrupter

This is important because dirt and dust can accumulate and, with moisture, can place the circuit breaker in jeopardy, dielectrically.

MOUNTING (Fig. 1)

Since the operation of the vacuum circuit breaker is relatively shock free, the foundation may be as simple as two parallel beams. If a concrete foundation is used, it should be level, but need not be of conventional-depth construction. The general configuration, dimensions, location of foundation bolts, power line connections, access panels or door and provisions for conduit connections needed to mount the circuit breaker are shown in Fig. 1. Refer also to the equipment drawings for specific installations.

The circuit breaker should be positioned on the foundation to permit adequate accessibility for manual operation and inspection. All lifting should be done with a sling that is hooked into the lifting plates that are provided. CARE SHOULD BE TAKEN THAT THE SLING DOES NOT COME IN CONTACT WITH THE BUSHINGS.

CAUTION: Prior to making any connections, all springs must be discharged and all wiring must be deenergized. Precautions must be taken to insure that all circuits connected, or to be connected, to the circuit breaker remain deenergized until all work is complete.

The overall height of the circuit breaker may be adjusted by inserting the leg fastening bolts in the holes corresponding to desired height.

CONTROL WIRING

After the circuit breaker is in position on its foundation, it is recommended that the control wiring be installed next. The supply wires should be large enough so that, with full control current flowing to the circuit breaker for one second, the voltage across the control terminals of the circuit breaker will be within the specified limits for the appropriate control voltage. (See Table 2.)

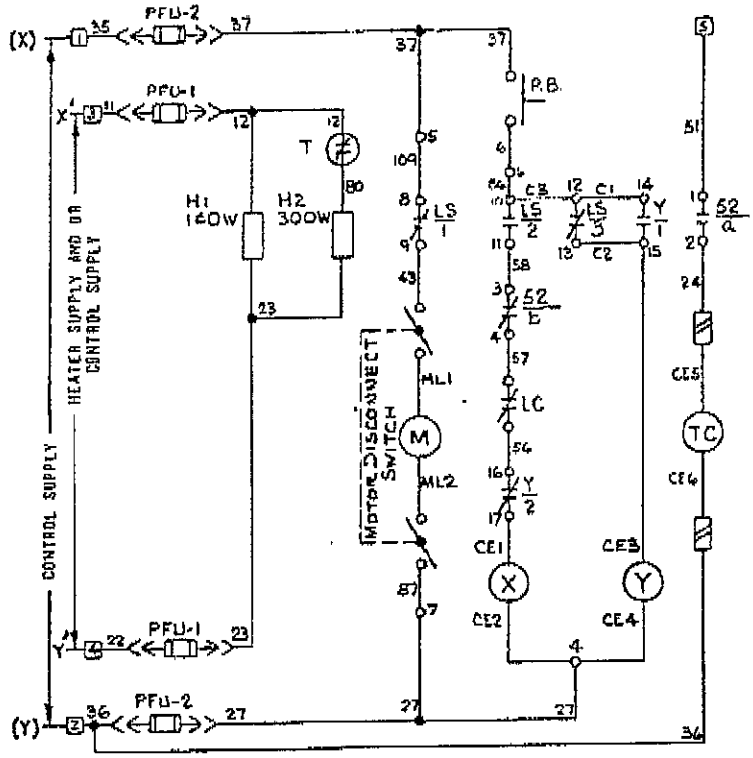
NOTE: The control conduit shall be brought into the low voltage compartment through the removable conduit plate.

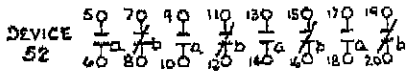
CONTROL CONNECTIONS

All controls and current transformer connections are made inside the low voltage compartment on the terminal boards provided. Fig. 3 shows a typical schematic diagram. Refer to the connection diagrams that are supplied with each circuit breaker for the proper wiring connections.

GROUND CONNECTIONS (Fig. 1)

The normal grounding practice is to connect a cable to the framework of the circuit breaker and to the ground. Grounding pads with ½" x 13 taps are provided on the circuit breaker for this purpose. They are located on each side of the mechanism compartment. The cable should be capable of carrying at least 25% of the continuous current rating of the circuit breaker, but should be no smaller than 4/0.





SPARE AUXILIARY SWITCH CONTACTS

LEGEND

a ---------- AUXILIARY SWITCH CONTACT (OPEN WHEN BREAKER IS OPEN)
b ---------- AUXILIARY SWITCH CONTACT (CLOSED WHEN BREAKER IS OPEN)
AS ---------- AUXILIARY SWITCH (52)
BCT ---------- BUSHING CURRENT TRANSFORMER
CE ---------- COIL END
H1, H2 ------ HEATER
LC ---------- LATCH CHECK SWITCH (CLOSED WHEN PRIMARY TRIP LATCH IS RESET)
LS 1 & LS 3 - LIMIT SWITCH CONTACT (CLOSED WHEN SPRINGS ARE DISCHARGED. OPEN WHEN SPRINGS ARE CHARGED)
LS 2 -------- LIMIT SWITCH CONTACT (OPEN WHEN SPRINGS ARE DISCHARGED. CLOSED WHEN SPRINGS ARE CHARGED)
M ---------- SPRING CHARGING MOTOR
MDS --------- MOTOR DISCONNECT SWITCH
ML ---------- MOTOR LEAD
PB ---------- PUSH BUTTON CONTROL SWITCH
PFU-1 ------- HEATER PULLOUT FUSE UNIT
PFU-2 ------- CONTROL PULLOUT FUSE UNIT
STB --------- SHORTING TERMINAL BLOCK
T ----------- THERMOSTAT
TB ---------- TERMINAL BLOCK
TC ---------- SHUNT TRIP COIL
X ----------- CLOSING LATCH RELEASE COIL
Y ----------- CONTROL RELAY LOCKOUT COIL
Y 1 --------- NORMALLY OPEN CONTROL RELAY CONTACT
Y 2 --------- NORMALLY CLOSED CONTROL RELAY CONTACT

NOTE: SCHEMATIC IS SHOWN WITH ALL DEVICES DEENERGIZED, BREAKER OPEN AND STORED ENERGY SPRINGS UNCHARGED.

Fig. 3 — Schematic Diagram of a Basic Breaker

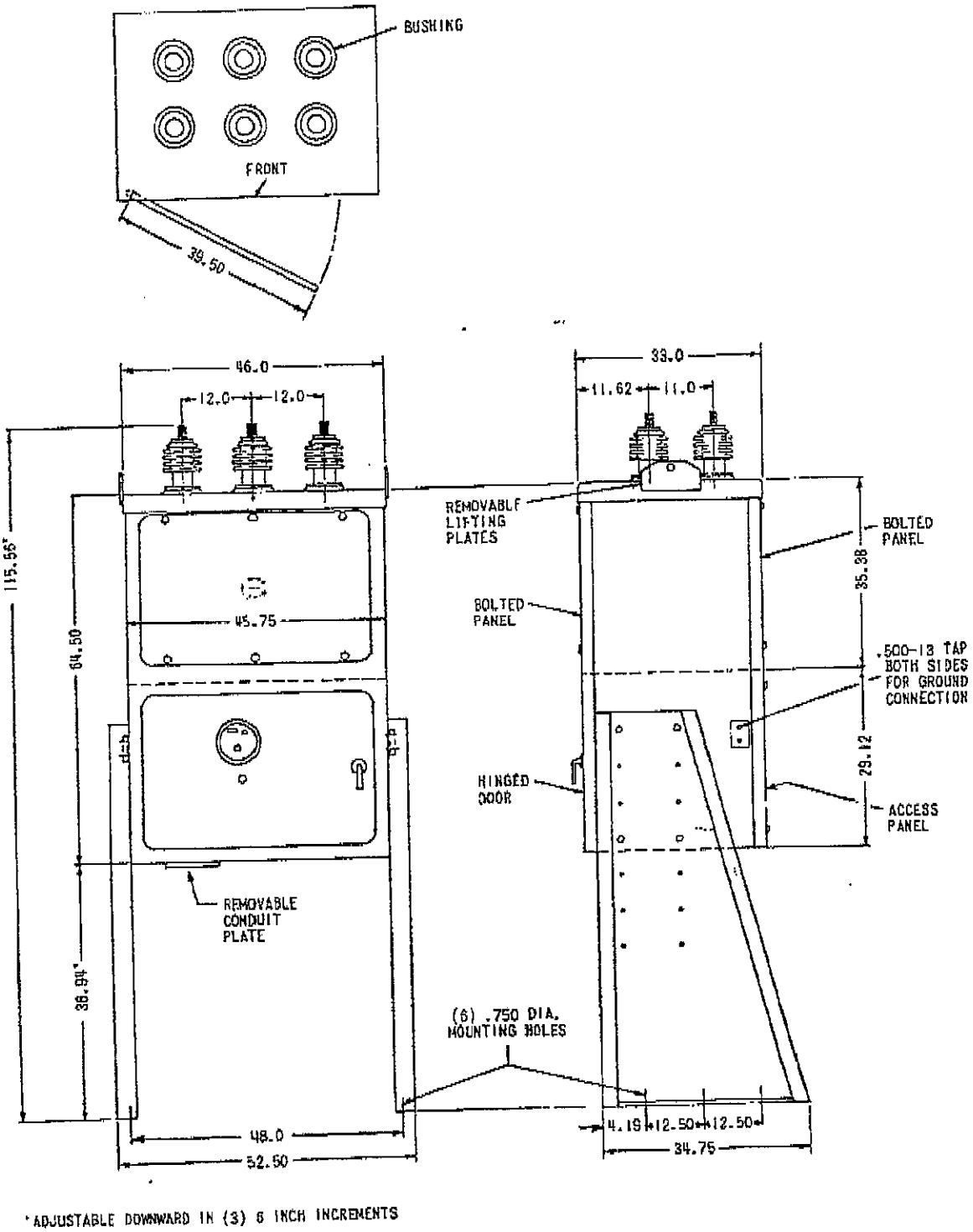


Fig. 1 — Typical Outline Drawing

PRIMARY CONNECTIONS

The bushings are not designed to withstand unnecessary strains from cable or bus bar. Therefore, the primary leads should be supported in a manner to avoid such strains on the bushings. Leads should be brought down from above, if possible. Standard practices concerning electrical clearance between primary leads and parts of the circuit breaker should be followed.

When the circuit breaker is to be operated for extended periods at or near full continuous current rating and/or when located in an area of high ambient temperature and solar radiation, the primary conductors should be equivalent to no less than the following.

600A – (1) 500MCM OR (1) ¼" x 2" – COPPER
800A – (1) 750MCM OR (1) ¼" x 3" – COPPER
1200A – (2) 500MCM OR (1) ¼" x 4" – COPPER
2000A – (4) 500MCM OR (2) ¼" x 4" – COPPER

PRE-OPERATION CHECKING

GENERAL

The breaker is not sensitive to deviations from true level, but, for sake of appearance, the level should be checked and corrected with shims, if necessary. Make the following checks to be sure everything is in good order:

1. Examine the internal insulated wiring to be sure it has not been damaged during handling and installation.

2. Check to see that there are no loose nuts, washers, bolts, snap rings, cotter keys, terminal connections, etc.

3. Check that the conduit connections are properly installed and tightened.

Before energizing, the breaker should be given a 37.5kV withstand test across open contacts to verify the integrity of the vacuum interrupters.

MANUAL OPERATION (Figs. 4 & 5)

The following procedure should be followed to check out the manual operation of the breaker:

A. Manual-Mechanical Operation

1. Open the motor power switch.

2A. VBK-15-12
Manually charge the closing springs using the removable Maintenance Handle. Insert the handle in the two slots in the PAWL CARRIER. Then raise and lower the handle in a pumping motion until the PAWL CARRIER no longer rotates the RATCHET WHEEL. The closing springs are now fully charged. (Upon occasion, the MOTOR CRANK ARM may stop in such a position as to prevent a full racking stroke, requiring it to be rotated manually. If this happens, pry the motor crank arm off center with a large screwdriver. You can move it either clockwise or counterclockwise. The closing springs may then be charged as described above.)

2B. VBK-15-20
Manually charge the closing springs by means of the manual charge handle inserted in the charging lever on the mechanism indicator panel.

3A. VBK-15-12
Close the main contacts by pushing up on the CLOSE LATCH RELEASE ROD.

3B. VBK-15-20
Close the main contacts by removing the cover from the manual close lever on the mechanism indicator panel and pulling the lever.

4. Open the main contacts by pressing the MANUAL TRIP BUTTON. NOTE: The VBK is so designed that the manual trip button will stay in when pressed. This keeps the breaker in a trip free condition until the padlock latch is pressed in restoring the manual trip button to its fully extended position.

B. Manual-Electrical Operation

If the foregoing checks are satisfactory, the breaker is then ready for electrical operation.

1. Turn the MOTOR SWITCH to ON. This will charge the closing springs. The opening springs are charged by the discharge of the closing springs.

2. Close and open the breaker with control switch, if used.

3. Close and open the breaker from the remote control switch (if used) and check the operation of any device connected to the auxiliary switches.

MECHANICAL SAFETY LOCKOUT (Figs. 4 & 5)

To place breaker in Mechanical Lockout (Safety Lockout), push mechanical trip button. This button is located in the control compartment on the escutcheon. This makes it impossible to close the breaker until reset.

EMERGENCY OPERATING PROCEDURE (Figs. 4 & 5)

Should control power be lost, the breaker can be operated by mechanical means as follows:

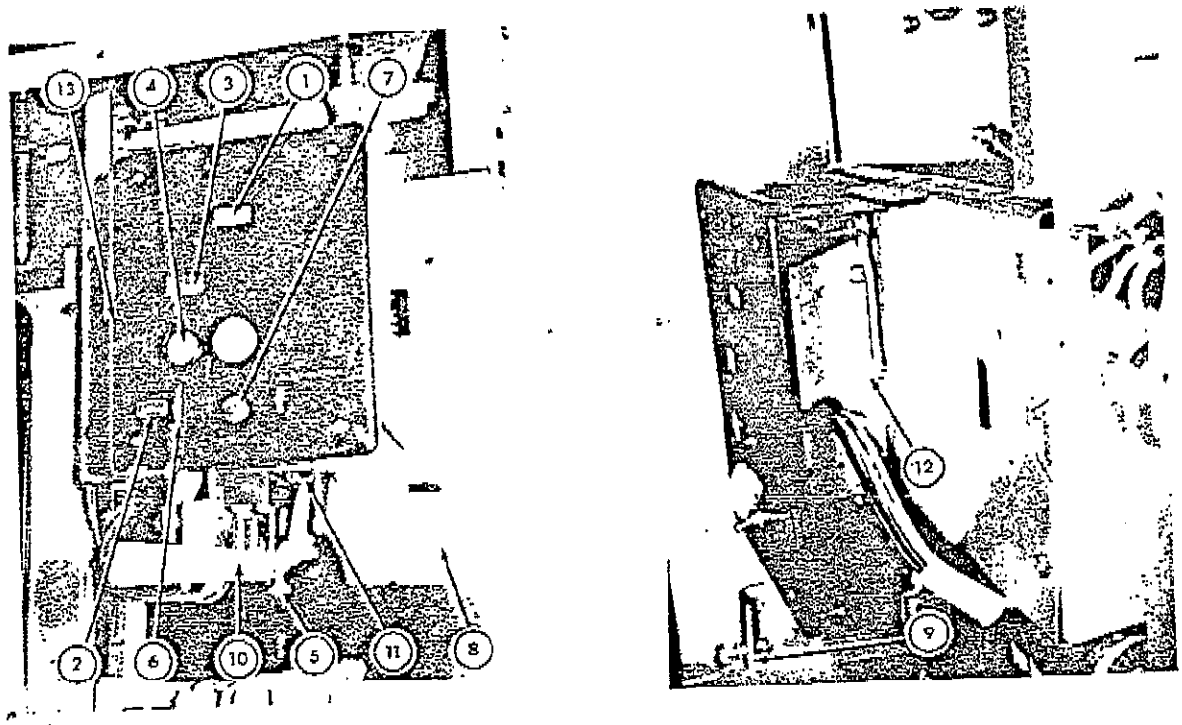
1. To trip the breaker open: (Door Closed)
Depress the RED TRIP BUTTON. This button is on the control compartment door.

2. To close the breaker: (Door Open)
Push the manual trip reset lever to reset and push the close latch release rod on the control relay on VBK-15-12 and pull the manual close lever on VBK-15-20. (Mechanical trip defeats mechanical closing until reset.)

NOTE: If the closing springs are discharged, manually charge them by following the procedure described under "Manual Operation".

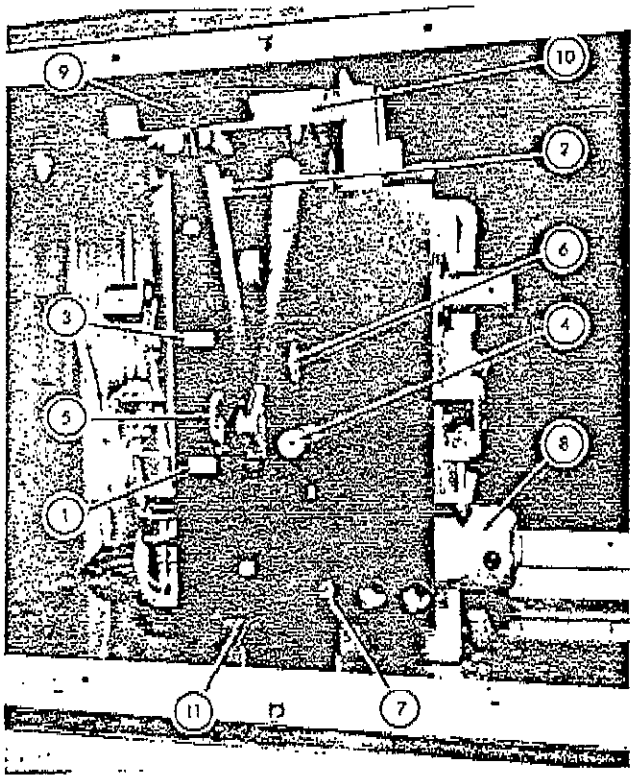
PERMISSIVE SWITCH (Figs. 4 & 5)

If specified, the emergency trip button will be combined with a permissive switch. This combination defeats all electrical and mechanical operations until manually reset.



1. CLOSING SPRING CHARGE INDICATOR
2. OPERATION COUNTER
3. CONTACT POSITION INDICATOR
4. MANUAL TRIP BUTTON
5. MANUAL CLOSE LATCH RELEASE ROD
6. MANUAL TRIP RESET LEVER AND PADLOCK HASP
7. SPRING CHARGING MOTOR DISCONNECT SWITCH
8. SPRING CHARGING MOTOR
9. TRIP LEVER EXTENSION FOR EXTERNAL EMERGENCY MANUAL TRIP
10. MANUAL SPRING CHARGING HANDLE (NORMALLY STORED IN MECHANISM COMPARTMENT)
11. PAWL CARRIER
12. SLOW CLOSE PIN
13. PERMISSIVE SWITCH (OPTIONAL) (BEHIND ESCUTCHEON)

Fig. 4 — Operating Mechanism and Indicator Panel VBK-15-12



1. CLOSING SPRING CHARGE INDICATOR_
2. OPERATION COUNTER
3. CONTACT POSITION INDICATOR
4. MANUAL TRIP BUTTON
5. MANUAL CLOSE LEVER (NORMALLY COVERED)
6. MANUAL TRIP RESET LEVER AND PADLOCK HASP
7. SPRING CHARGING MOTOR DISCONNECT SWITCH
8. SPRING CHARGING MOTOR
9. MANUAL SPRING CHARGING HANDLE (NORMALLY STORED IN MECHANISM COMPARTMENT)
10. SLOW CLOSE BRACKET (NORMALLY STORED IN MECHANISM COMPARTMENT)
11. PERMISSIVE SWITCH (OPTIONAL) (BEHIND ESCUTCHEON)

Fig. 5 — Operating Mechanism and Indicator Panel VBK-15-20

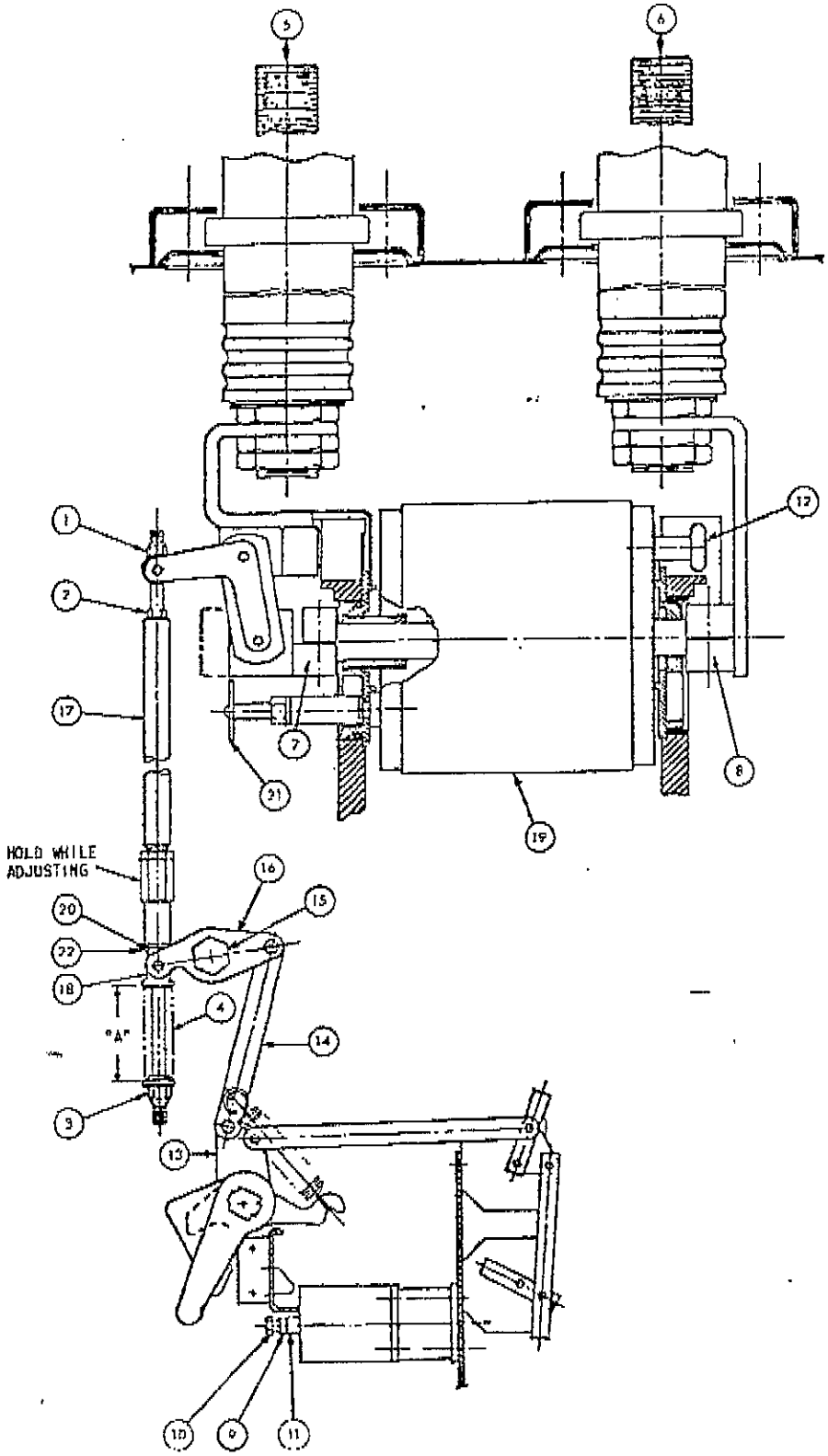


Fig. 6 — Vacuum Interrupter Linkage

MAINTENANCE AND ADJUSTMENTS

GENERAL

I-T-E circuit breakers are designed for minimum maintenance and tested to insure that minimum maintenance will be required. The only basic adjustment normally required 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 500 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.

Vacuum interrupters, as used on the circuit breaker, 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 measurement will be a guide for interrupter life. If the circuit breaker is subjected to many higher short-circuit current interruptions, the erosion indicator should be checked relative to the total interruptions in a given time period, rather than the 500 operation criteria. As a guideline, the wear measurement should be checked after the equivalent of 6 interruptions (600% SI) at rated maximum short circuit current.

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 assumed that these conditions were considered at the time of order; that the equipment supplied was designed for the special application; and that an appropriate supplemental maintenance program has been developed. These maintenance instructions only cover circuit breakers used under the standard service conditions.

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

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

WARNING: Prior to performing any tests or maintenance of the high or low voltage compartment, be sure that the breaker is disconnected from all electric power. After the power lines have been disconnected, attach grounding leads before touching any of the breaker parts. Be positive the framework is well grounded. Do not go near any of the operating parts until the operating springs have been discharged.

EROSION INDICATOR (Fig. 6)

An erosion indicator (21) is located in the high voltage compartment to measure contact erosion. When the circuit breaker is closed and the vacuum interrupters are new, the front of erosion indicator (21) is in line with the front of the vacuum interrupter moving contact clamp (7), (or marker attached). When the front of this moving contact clamp (7), (or marker attached) is in line with the rear of the contact erosion indicator (21), the vacuum interrupter contacts have eroded .125" and the vacuum interrupter should be replaced.

CAUTION: After the erosion indicator (21) in the high voltage compartment has been initially set, it should never be changed during the life of the interrupter. Never check contact erosion in the high voltage compartment until the breaker is deenergized and all parts discharged.

For convenience, a wear measurement can be established in the low voltage compartment by measuring the gap illustrated at point 22 in Fig. 6. This gap with the circuit breaker closed and a new vacuum interrupter installed is 3/16 inch minimum. When the gap decreases 1/8 inch from initial measurement with the circuit breaker closed, the erosion indicator in the high voltage compartment must be checked to establish precisely how much the vacuum interrupter contacts have eroded.

MILLIVOLT DROP TEST (Fig. 6)

During maintenance periods, the condition of the circuit 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 the instruction book.

CIRCUIT BREAKER	CONTINUOUS CURRENT	MAXIMUM MV DROP*	MAXIMUM MICRO-OHMS	MEASURED BETWEEN POINTS
VBK-15-12	600 & 800	35	175	5 & 6
VBK-15-20	600 & 800	30	150	5 & 6
VBK-15-20	1200	25	125	5 & 6
VBK-15-20	2000	20	100	5 & 6
VBK-15-12	---	11	55	7 & 8
VBK-15-20	---	4	20	7 & 8

*D.C. MILLIVOLT DROP WITH 200A FLOWING

On circuit breakers with normal or less than normal loadings, the listed values (between 5 & 6) may be exceeded. If this millivolt drop exceeds 150% of the listed values, check the millivolt drop across the vacuum interrupter (between 7 & 8). If this millivolt drop exceeds the values listed in the above table (between 7 & 8), this indicates that an adjustment in contact

-essure is required or that heavy contact erosion has curred. 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 -faces of the entire current carrying structure, vacuum errupter*, base insulation, 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.

MANUAL SLOW CLOSE PROCEDURE (VBK-15-12) (Fig. 4)

Manual slow closing of the vacuum circuit breaker can be accomplished when the circuit breaker is in the open position. Turn the motor charging switch to off. Engage the manual charge handle (10) in the pawl carrier (11). Pump the charging lever until the springs charged. Remove the charge handle. Hold the w close pin (12) down and push the manual close rod (5). This will cause the operating mechanism to partially close, but the vacuum interrupter contacts are still apart. Re-engage the manual charge handle (10) with the pawl carrier of the charging lever. Slowly pump the charging lever to slowly close the vacuum interrupter contacts. Remove the charge handle. To open the circuit breaker, push the manual trip button (4). Discharge the closing springs by pushing the manual close rod (5). This operation fast closes the circuit breaker. Open again by pushing the manual trip button.

CAUTION: The circuit breaker must never be slow closed with the primary circuit connected.

NUAL SLOW CLOSE PROCEDURE (VBK-15-20) (Fig. 5)

Manual slow closing of the VBK-15-20 can be accomplished when the circuit breaker is in the open position and the closing springs are discharged, as indicated by the closing spring charge indicator (1).

Engage the manual charge handle (10) in the charging lever (11). Pump the charging lever until the circuit breaker closing springs snap into the charged position.

Insert the slow close bracket into the slot in the closing spring tube. Remove the charging handle. Hold the flat of the charging handle against the slow close ket pushing toward the rear of the circuit breaker, keeping the slow close bracket in place, while pulling the manual close lever (5). This will cause the operating mechanism to partially close while the vacuum interrupter contacts are still apart. Insert the manual charge handle into the charging lever socket and slowly pump the charging lever to slowly close the vacuum interrupter contacts the required amount.

Continue to pump the charging lever until the slow close bracket becomes loose so that it can be removed. Remove the charging handle. Remove the slow close bracket. Push the manual trip button (4) to open the circuit breaker. Discharge the closing springs by pulling the manual close lever (5). This operation fast closes the circuit breaker. Open again by pushing the manual trip button.

NOTE: The slow close bracket can be removed or inserted only after the springs are completely charged.

CAUTION: THE CIRCUIT BREAKER MUST NEVER BE SLOW CLOSED WITH THE PRIMARY CIRCUIT CONNECTED.

CONTACT PRESSURE AND ADJUSTMENT (Fig. 6)

The following procedure should be followed for properly checking and/or adjusting the contact pressure and alignment on VBK circuit breakers.

A. 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 a vacuum circuit breaker. Therefore, during routine maintenance periods, if it is necessary to readjust the "simultaneous" (see Note 1) make of the contacts, this should be done as follows:

1. Close the circuit breaker and check that the contact pressure is between 2⅜ and 2⅝ inches for VBK-15-12 and 2⅜ and 2 13/16 inches for VBK-15-20, as measured at "A" of Fig. 6 on each pole.

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

a. Turn the pressure spring retaining nut (3) with the circuit breaker in the closed position, until the proper clearance is obtained. It is recommended that the contact pressure be set at a nominal 2½ inches for VBK-15-12 and 2 13/16 inches for VBK-15-20 when adjusting. Open and close the circuit breaker and recheck this dimension.

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

3. Loosen the pushrod adjustment locking nut (1).

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

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

6. 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.

7. Complete the slow close operation.

8. Open the circuit breaker, recharge the closing springs, fast-close the breaker and check that contact pressure is between 2⅜ inches minimum and 2⅝ inches maximum for VBK-15-12 and 2 3/16 inches and 2 13/16 inches

for VBK-15-20 as measured at "A" (Fig. 6) at each pole. Trip the circuit breaker.

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

NOTE 1: All three poles should touch within 2 milliseconds 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 6. An oscilloscope, oscillograph, or other timing method may be used, if available, to establish the 2 millisecond timing. [Contact bounce may be noted during low voltage timing tests but is not indicative of normal operation at rated voltages.]

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.

CIRCUIT BREAKER	CLOSING TIME RANGE - MS	OPENING TIME RANGE - MS
VBK-15-12	50 - 67	23 - 30
VBK-15-20	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.

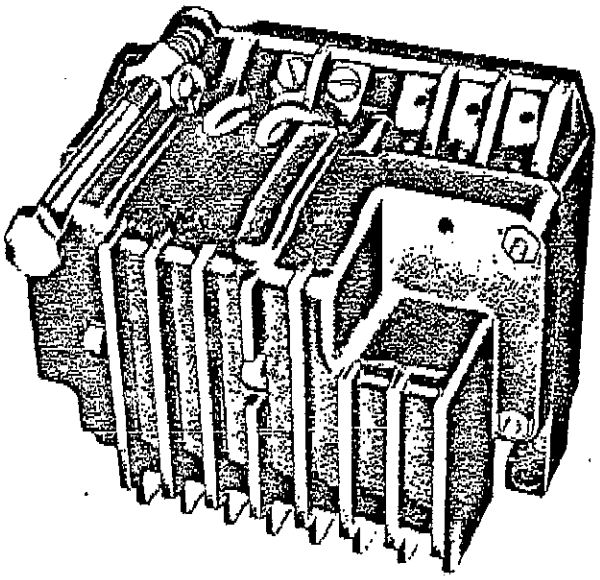


Fig. 7 — Closing Control Device

2. Adjustments to correct speeds, if found to be outside limits, are critical and I-T-E should be contacted for recommendations.

OPERATING MECHANISM

The operating mechanism is adjusted at the factory for proper operation and should not be disturbed under normal circumstances. If the circuit breaker should fail to close or trip electrically, the following adjustments involving latch check switch, closing control device, and shunt trip release should be checked. Always record original setting before readjusting.

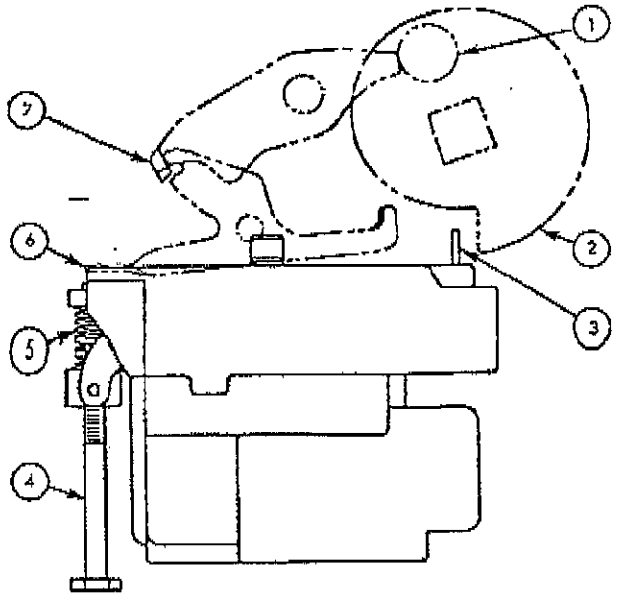
Close Latch Release Overtravel Adjustment (VBK-15-12) (Fig. 8)

The CLOSING CONTROL DEVICE of the OPERATING MECHANISM does not normally require any adjustment in the field. However, if necessary, the overtravel of the CLOSE LATCH RELEASE ROD (4) should be adjusted as described below. Do not attempt to adjust the internal relays or contacts of this device.

1. Back off the CLOSE LATCH RELEASE ROD (4) until it will not strike the SECONDARY CLOSE LATCH (6) when lifted as far as its travel will allow.

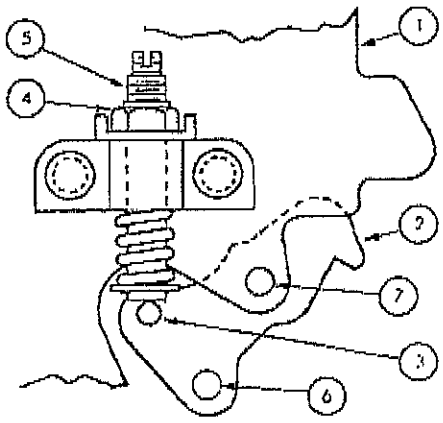
2. With the closing springs charged and the CLOSE LATCH RELEASE ROD (4) held up as far as possible, turn clockwise until the closing springs are released, closing the breaker.

3. Turn the CLOSE LATCH RELEASE ROD (4) one additional turn in the same direction.



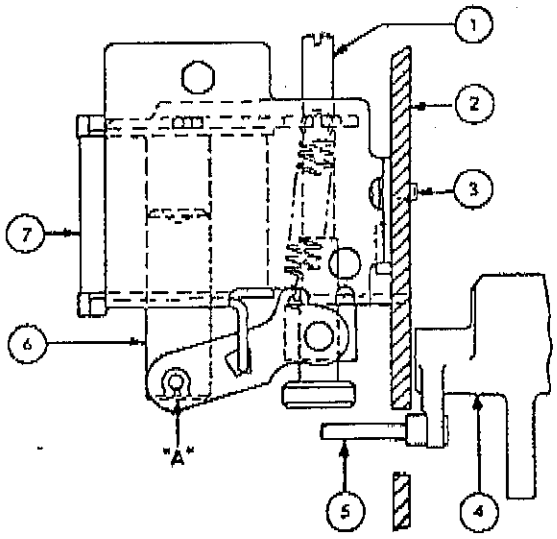
1. ROLLER, CLOSE LATCH
2. CHARGING CAM
3. ACTUATOR, LIMIT SWITCH
4. CLOSE LATCH RELEASE ROD
5. SPRING, TRIP ROD
6. SECONDARY CLOSE LATCH
7. PRIMARY CLOSE LATCH

Fig. 8 — Close Latch Overtravel Adjustment VBK-15-12



1. MECHANISM HOUSING
2. TRIP LATCH
3. TRIP LATCH EXTENSION PIN
4. NUT (SELF-LOCKING)
5. ADJUSTING SCREW
6. PIN
7. PIVOT PIN

Fig. 9 — Trip Latch Adjustment
VBK-15-12



1. TRIP ROD
2. MECHANISM HOUSING (LEFT-HAND SIDE)
3. MOUNTING SCREW
4. LATCH BAR
5. TRIP EXTENSION
6. ARMATURE
7. COIL

Fig. 10 — Shunt Trip Adjustment
VBK-15-12

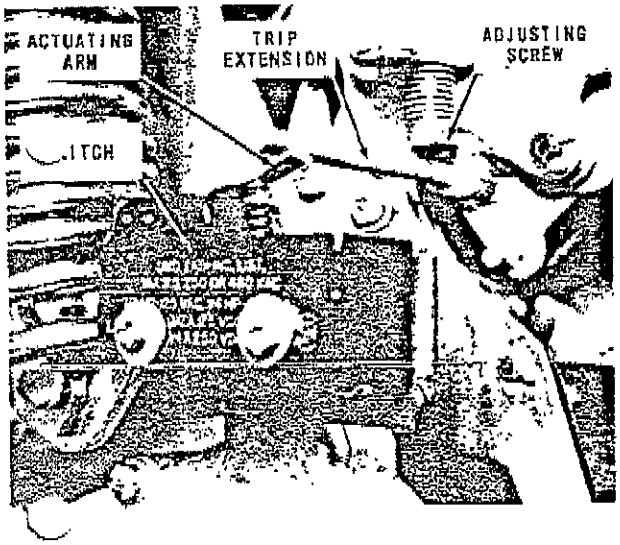


Fig. 11 — Latch Check Switch
VBK-15-12

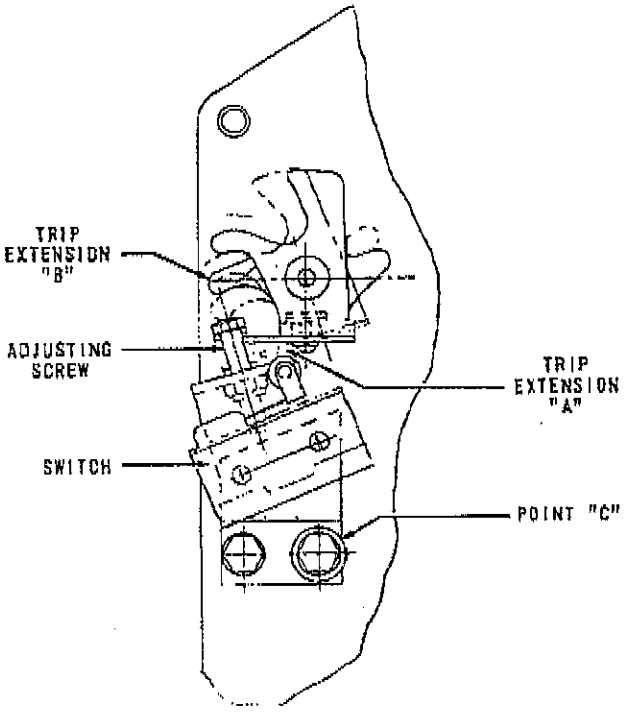


Fig. 12 — Latch Check Switch
VBK-15-20

Trip Latch Adjustment (VBK-15-12). (Fig. 9)

The trip latch adjustment screw is located on the right hand side of the operating mechanism housing. To adjust the engagement of the trip latch proceed as follows:

1. Back off the adjusting screw (5) to allow excessive latch engagement.
2. Be sure there is trip spring clearance.
3. Close the circuit breaker.
4. Turn the adjusting screw down slowly until the trip latch (2) just releases tripping the circuit breaker.
5. Back off adjusting screw 2.0 turns.
6. Be sure self-locking nut is seated properly.

Shunt Trip Adjustment (VBK-15-12) (Fig. 10)

1. Back off trip rod (1) until it will not trip the circuit breaker with the armature (6) pushed up as far as the travel will allow.
2. Close the circuit breaker.
3. Push up on the armature (6) at "A" as far as the armature travel will allow.
4. Hold the armature in step 3 and turn trip rod (1) down until the circuit breaker just trips.
5. Turn trip rod (1) down an additional 3 turns.

Latch Check Switch Adjustment (VBK-15-12) (Fig. 11)

The latch check switch mounts on the motor side of the mechanism. The actuating arm projecting from the micro switch is positioned under the trip extension. When adjusted properly, the micro switch will operate (close) .015" to .025" before the trip extension strikes the adjusting screw. The actuating arm is flexible and is bent to make adjustment.

Latch Check Switch Adjustment (VBK-15-20) (Fig. 12)

The latch check switch mounts on the motor side of the mechanism. The roller which is attached to the actuating arm of the micro switch is positioned under trip extension "A". When adjusted properly, the micro switch will operate (close) .015" to .025" before trip extension "B" strikes the adjusting screw. The micro switch bracket is slotted at point "C" to allow for adjustment.

Primary Close Latch Adjustment (VBK-15-20) (Fig. 13)

With the circuit breaker closing springs charged and circuit breaker contacts opened, the closing plunger (3) in de-energized position, there should be a 1/16" air gap between the rod (1) and the secondary latch (2) at point "A". Turn rod for 1/16" dimension.

Primary Trip Latch Adjustment (VBK-15-20) (Fig. 14)

Fig. 14 shows the arrangement necessary for the circuit breaker to be in the closed position. The springs hold the secondary latch down against screw (1). The secondary trip latch holds the secondary latch roller up, which in turn holds the opposite end of the primary trip latch down. This prevents the primary latch roller from moving to the left and opening the circuit breaker. If none of the various trip devices are acting on the tripper bar or the auxiliary latch tripper to open the circuit breaker or to prevent the circuit breaker from closing and the circuit breaker still will not close, then the following adjustment should be made.

1. Turn screw (1) down to insure that secondary trip latch will hold the secondary latch roller up.
2. With the circuit breaker closed, turn up on screw (1) until the breaker trips.
3. Turn screw (1) down two turns.

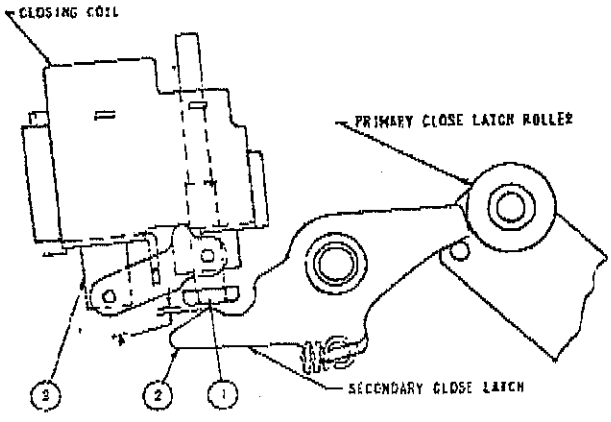


Fig. 13 — Primary Close Latch Adjustment VBK-15-20

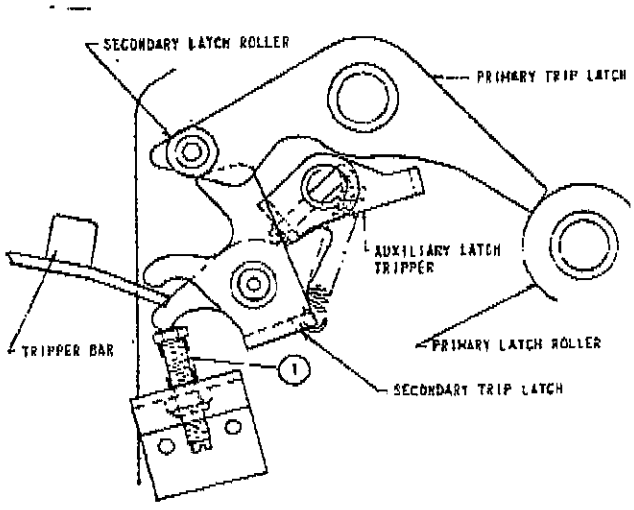


Fig. 14 — Primary Trip Latch Adjustment VBK-15-20

MAINTENANCE AND ADJUSTMENTS

GENERAL

I-T-E circuit breakers are designed for minimum maintenance and tested to insure that minimum maintenance will be required. The only basic adjustment normally required 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 500 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.

Vacuum interrupters, as used on the circuit breaker, 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 measurement will be a guide for interrupter life. If the circuit breaker is subjected to many higher short-circuit current interruptions, the erosion indicator should be checked relative to the total interruptions in a given time period, rather than the 500 operation criteria. As a guideline, the wear measurement should be checked after the equivalent of 6 interruptions (600% SI) at rated maximum short circuit current.

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 assumed that these conditions were considered at the time of order; that the equipment supplied was designed for the special application; and that an appropriate supplemental maintenance program has been developed. These maintenance instructions only cover circuit breakers used under the standard service conditions.

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

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

WARNING: Prior to performing any tests or maintenance of the high or low voltage compartment, be sure that the breaker is disconnected from all electric power. After the power lines have been disconnected, attach grounding leads before touching any of the breaker parts. Be positive the framework is well grounded. Do not go near any of the operating parts until the operating springs have been discharged.

EROSION INDICATOR (Fig. 6)

An erosion indicator (21) is located in the high voltage compartment to measure contact erosion. When the circuit breaker is closed and the vacuum interrupters are new, the front of erosion indicator (21) is in line with the front of the vacuum interrupter moving contact clamp (7), (or marker attached). When the front of this moving contact clamp (7), (or marker attached) is in line with the rear of the contact erosion indicator (21), the vacuum interrupter contacts have eroded .125" and the vacuum interrupter should be replaced.

CAUTION: After the erosion indicator (21) in the high voltage compartment has been initially set, it should never be changed during the life of the interrupter. Never check contact erosion in the high voltage compartment until the breaker is deenergized and all parts discharged.

For convenience, a wear measurement can be established in the low voltage compartment by measuring the gap illustrated at point 22 in Fig. 6. This gap with the circuit breaker closed and a new vacuum interrupter installed is 3/8 inch minimum. When the gap decreases 1/8 inch from initial measurement with the circuit breaker closed, the erosion indicator in the high voltage compartment must be checked to establish precisely how much the vacuum interrupter contacts have eroded.

MILLIVOLT DROP TEST (Fig. 6)

During maintenance periods, the condition of the circuit 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 the instruction book.

CIRCUIT BREAKER	CONTINUOUS CURRENT	MAXIMUM MV DROP*	MAXIMUM MICRO-OHMS	MEASURED BETWEEN POINTS
VBK-15-12	600 & 800	35	175	5 & 6
VBK-15-20	600 & 800	30	150	5 & 6
VBK-15-20	1200	25	125	5 & 6
VBK-15-20	2000	20	100	5 & 6
VBK-15-12	---	11	55	7 & 8
VBK-15-20	---	4	20	7 & 8

*D.C. MILLIVOLT DROP WITH 200A FLOWING

On circuit breakers with normal or less than normal loadings, the listed values (between 5 & 6) may be exceeded. If this millivolt drop exceeds 150% of the listed values, check the millivolt drop across the vacuum interrupter (between 7 & 8). If this millivolt drop exceeds the values listed in the above table (between 7 & 8), this indicates that an adjustment in contact

Tripper Bar Adjustment (VBK-15-20) (Fig. 15)

With the circuit breaker in the closed position, turn screw (1) up until the circuit breaker trips, then turn down 2¾ turns.

Shunt Trip Adjustment (VBK-15-20) (Fig. 16)

1. Back off trip rod (2) until it will not trip the circuit breaker when plunger (3) is pushed down.
2. Close the circuit breaker.
3. Hold plunger (3) down and turn up on the trip rod (2) until the circuit breaker just trips.
4. Turn trip rod (2) up an additional 2½ to 3 turns.

LUBRICATION

The vacuum circuit breakers are lubricated during factory assembly as follows:

1. All mating surfaces of moving current-carrying oints have been lubricated with NO-OX-ID special grade "A" grease manufactured by Dearborn Chemical Company.

2. All other mechanism parts, bearings, pins, etc., ave been lubricated with ANDEROL L757 manufac-ured by the Intermediate Division, Tenneco Chemical Company.

The circuit breakers normally require no lubrication during their usual service life. However, if the grease sho become contaminated or unduly oxidized (hard-en and darkened), or if parts are replaced, any re-lubrication should be done with NO-OX-ID or Anderol grease as applicable.

NOTES:

1. Do not use light oil to lubricate any mechanism parts.
2. 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 listed 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 circuit 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 cause 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 circuit 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, the circuit breaker enclosure steel provides sufficient shielding to protect personnel from X-radiation

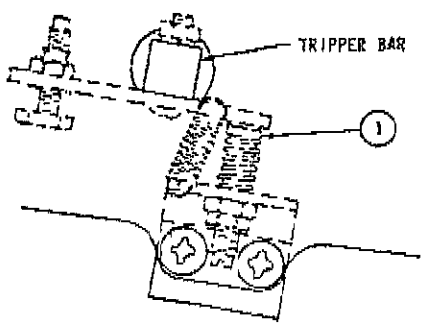


Fig. 15 — Tripper Bar Tripper Adjustment
VBK-15-20

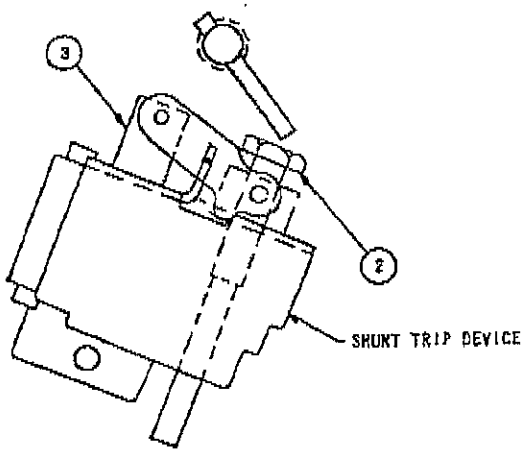


Fig. 16 — Shunt Trip Device Adjustment
VBK-15-20

at the test voltages recommended below at the normal distances maintained for electrical safety. Therefore, the high voltage compartment must have all covers installed before dielectric testing of the primary circuit.

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
PRIMARY	37.5kV	40kV
SECONDARY (CURRENT TRANSFORMER)	1850V	2650V
*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 (7, Figs. 4 & 5) to the "OFF" position. Apply test voltage (1100V-AC or 1500V-DC) for one minute to each of the secondary control wiring terminal points.

If it is desired to make a dielectric test on the spring charging motor, turn the motor disconnect switch 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 2A & 2B. 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
48 V dc	38-56	36-56	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	72-144

TABLE 2A - AVERAGE CURRENT VALUES - VBK-15-12

NOMINAL CONTROL VOLTAGE	SPRING CHARGING MOTOR	CLOSE COIL	TRIP COIL	LOCKOUT COIL	UNDER VOLTAGE
48 V dc	25.0	1.33	3.14	0.11	0.32
125 V dc	10.0	0.7	1.3	0.06	0.20
250 V dc	5.0	0.3	0.65	0.03	0.10
120 V ac	10.0	1.5	6.6	0.15	0.50
240 V ac	5.0	0.75	1.15	0.075	0.20

TABLE 2B - AVERAGE CURRENT VALUES - VBK-15-20

NOMINAL CONTROL VOLTAGE	SPRING CHARGING MOTOR	CLOSE COIL	TRIP COIL	LOCKOUT COIL	UNDER VOLTAGE
48 V dc	25.0	5.0	5.0	0.11	0.32
125 V dc	10.0	2.0	2.0	0.06	0.20
250 V dc	5.0	1.0	1.0	0.03	0.10
120 V ac	10.0	4.0	10.0	0.15	0.50
240 V ac	5.0	1.84	1.84	0.075	0.20

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 VBK 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 used 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.

IB-9.9.7-3 ISSUE C ADDENDUM

VBK-15-20

The following steps constitute an addendum to the subject instruction book and will supplement what is written in the instruction book.

CAUTION: If the 11/16 inch dimension referenced in Section 3 of this addendum is exceeded, the vacuum interrupter bellows may be damaged, resulting in loss of vacuum.

NOTE: Generally, before making or continuing any adjustments, insure that the mechanism is fully open - jackshaft arms resting on the stop pin - visible with escutcheon removed.

1. Latch Check Switch

   The latch check switch adjustment on page 15 of the instruction book should be made as the last adjustment or at least after the primary trip latch adjustment.

2. Closing

   The contact pressure springs (4) on page 10 of the instruction book should be checked or adjusted so that the "A" dimension will be 2 7/8 inches with the breaker closed. Do not adjust for a dimension less than 2 3/4 inches or greater than three inches. One thread minimum must be showing below the contact pressure adjusting nut.

3. Contact Travel Measurement and Simultaneous Make - Figure 1

   a. With the circuit breaker closed, the maximum dimension between the rubber bumper (30) and the L-shaped stop bracket (32) is 11/16 inches with the rubber bumper tight against the erosion indicator disc (21). When adjustment is required, loosen the disc (21) position the bumper (30) and secure the disc against the bumper securely.

   b. With the circuit breaker open, the clearance between the rubber bumper and the L-shaped stop is 0.005 to .020 inches. When adjustment is required, turn the pushrod (Figure 6, Item 2 of the instruction book) to obtain the necessary clearance.

NOTE: Because an instantaneous recording travel recorder was used to record total travel, this clearance may be factory set between 0.005 to 0.060 inches.

c. When adjustments are completed, simultaneous make should be rechecked per contact pressure and adjustment procedure page 12 of the instruction book. This may require readjusting the bumper on the poles having the air gap decreased.

4. LV Compartment Erosion Indicator Reference

It is noted that Issue C of the subject instruction book lists the low voltage erosion indicator reference (Figure 6, Item 22) and should be 3/16 inches with no maximum required. This also applies to "Issue B". This is not an adjustment, but a reference for erosion.

5. Dielectric Tests

To verify the dielectric integrity of the breaker after readjusting, all interrupters should be dielectrically tested for one minute. When testing with 40kV dc an allowable current flow up to 100 microamperes leakage, provided the bushings and the interrupter envelopes are clean. The test set to perform 60Hz dielectric tests must be capable of carrying more than 25 milliampere capacitive current, per pole tested, at 37.5kV.

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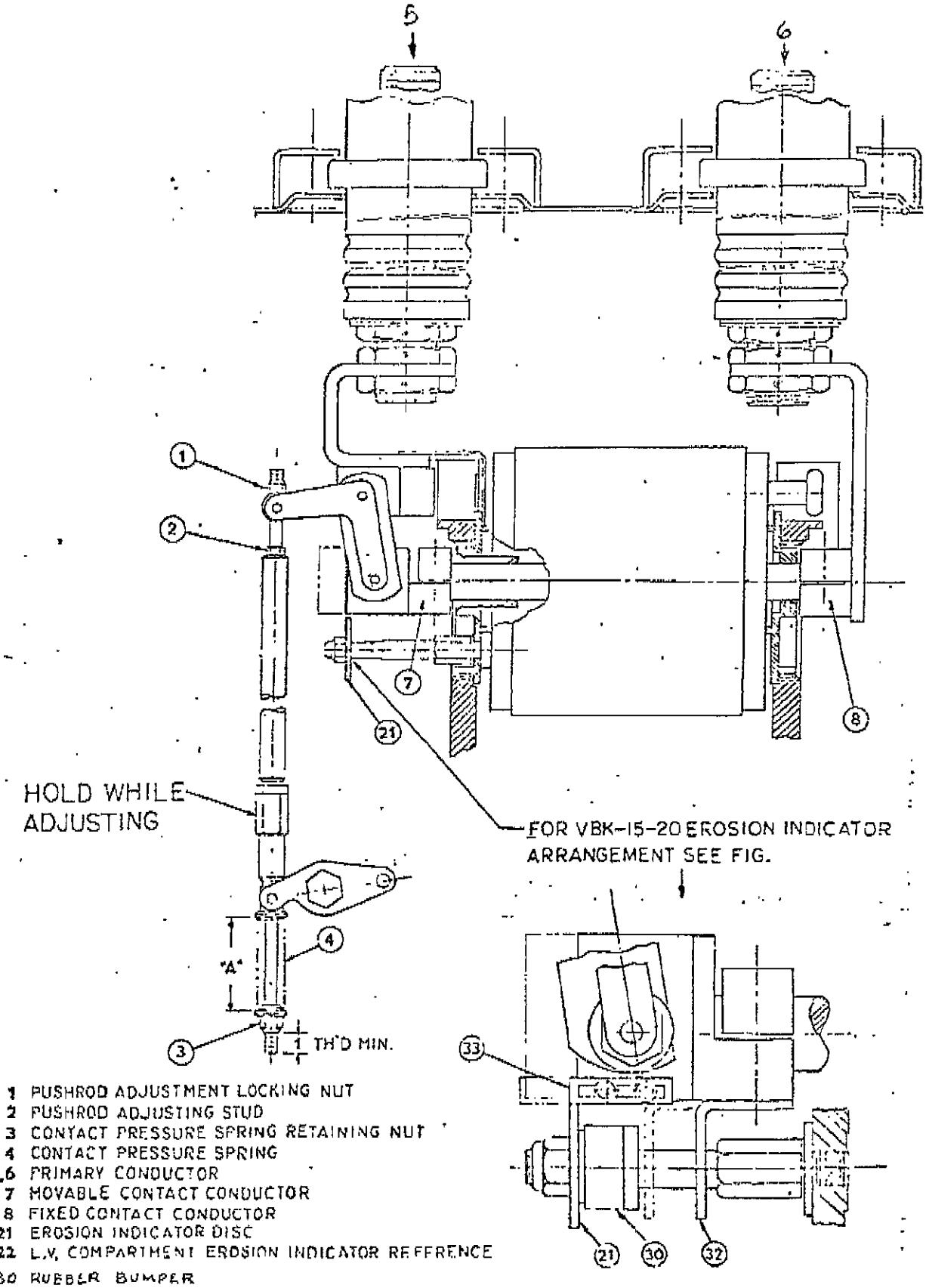

1 PUSHROD ADJUSTMENT LOCKING NUT
2 PUSHROD ADJUSTING STUD
3 CONTACT PRESSURE SPRING RETAINING NUT
4 CONTACT PRESSURE SPRING
5,6 PRIMARY CONDUCTOR
7 MOVABLE CONTACT CONDUCTOR
8 FIXED CONTACT CONDUCTOR
21 EROSION INDICATOR DISC
22 L.V. COMPARTMENT EROSION INDICATOR REFERENCE
30 RUBBER BUMPER
32 "L" SHAPED STOP BRACKET
33. EROSION INDICATOR MARKER.

FIG. 1
VACUUM INTERRUPTER LINKAGE