



5, 7.5 AND 15HK CIRCUIT BREAKER OPERATION

The operations of the 5, 7.5 and 15HK breaker are as follows:

A—CLOSING

- 1—Charging of springs.
- 2—Energize close solenoid releasing close latch.
- 3—Closing cam operates on toggle closing mechanism.
- 4—Contacts close.
- 5—Recharge springs after closing for next closing operation.

B—OPENING

- 1—Energize shunt trip releasing trip latch.
- 2—Toggle mechanism collapses.
- 3—Breaker contacts open.

C—INTERRUPTING

- 1—Energize shunt trip.
- 2—Main contacts part.
- 3—Arcing contacts part establishing arc.
- 4—Blowout coils are inserted into interrupting circuit.
- 5—Arc is forced into arc chute by magnetic action of blowout coils.
- 6—Arc is stretched and cooled until extinction.

The above functions are performed by the following components:

- 1—Stored energy mechanism.
- 2—Breaker control devices.
- 3—Arc chutes.

STORED-ENERGY MECHANISM

The stored-energy mechanism uses a pre-determined amount of energy which is stored in the closing springs and is released by the closing latch to effect contact closure of the circuit breaker.

A—The mechanism operation sequence to close the breaker contacts consists of the following steps:

- 1—Spring charging.

a—Electrical (Figure 1) — The rotation of the motor drives the motor connecting rod which moves the end of the charge pawl carrier. The charge pawl picks up a tooth on the ratchet plate and turns the ratchet plate ahead of it. The holding pawl prevents the return of the ratchet plate. As the motor finishes a revolution, the pawl carrier returns to its original position and picks up the next tooth.

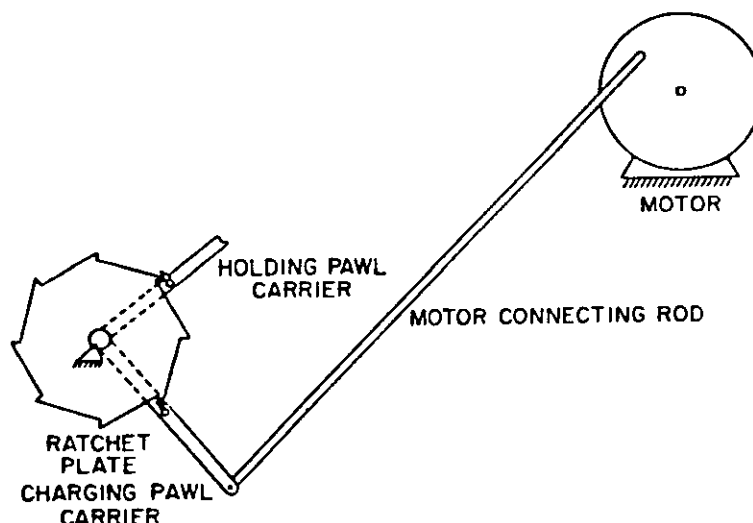


FIG. 1

STORED-ENERGY MECHANISM (Continued)

b—Manually (Figure 2) — For manual spring charging, the manual charging handle is inserted onto the manual charge lever and is moved up and down in a pumping motion. The charge level pivots about Point "A", in this case, and the pawl carrier reverses function in that the charging pawl carrier becomes the holding pawl carrier. The end of the

manual charge lever moves the holding pawl carrier up and down as it moves. On the handle down stroke, the holding pawl picks up a tooth on the ratchet plate and rotates it. On the up stroke of the handle, the holding pawl, free to rotate, slides down to pick up the next tooth. The charging pawl prevents the return of the ratchet plate.

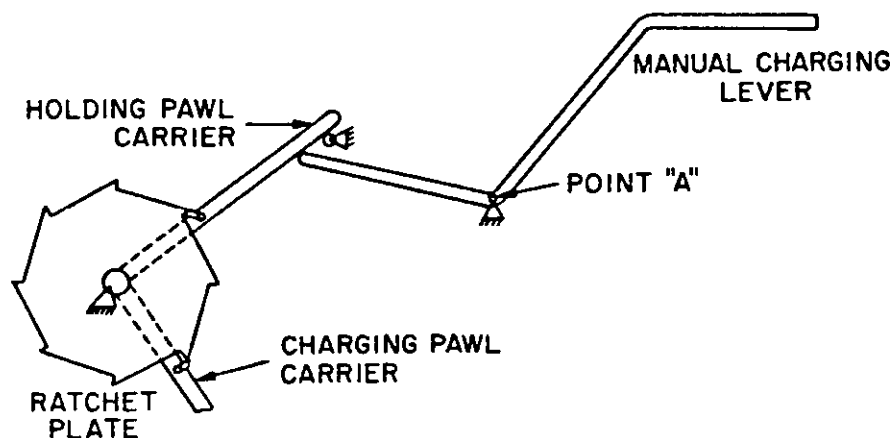


FIG. 2

The ratchet plate (Figure 3) rigidly fastened to the closing cam shaft is rotated. A crank on each end of the shaft compresses the springs.

When the springs are charged, they are held in position by the close latch.

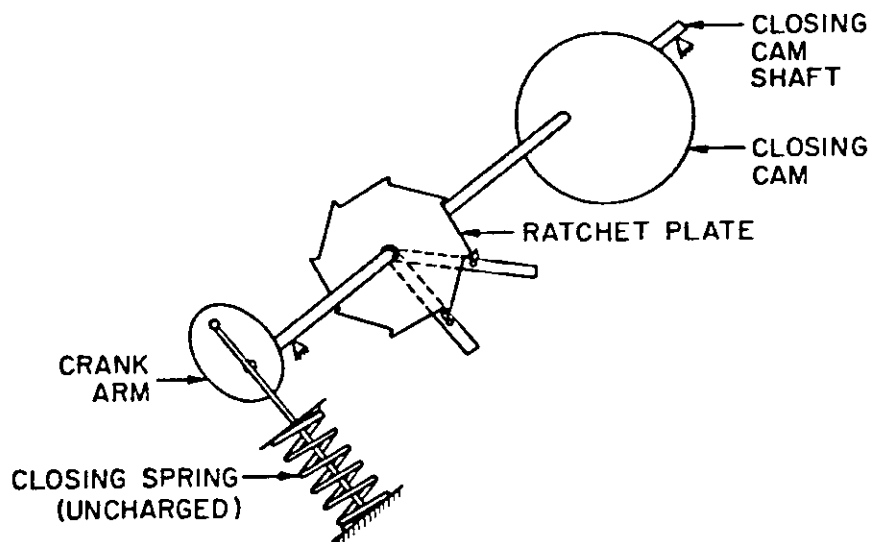


FIG. 3

STORED-ENERGY MECHANISM (Continued)

2—Releasing closing cam.

Fully charged, the spring energy is contained by the latch system (Figure 4) which prevents the closing cam from rotating. The energy of the closing springs are transmitted through the crank arm to rotate the closing cam.

To release the spring energy, either the closing coil or manual closing lever must be operated to release the secondary closing latch. When the secondary latch is released, the primary latch is forced downward by the closing spring allowing the close cam to rotate.

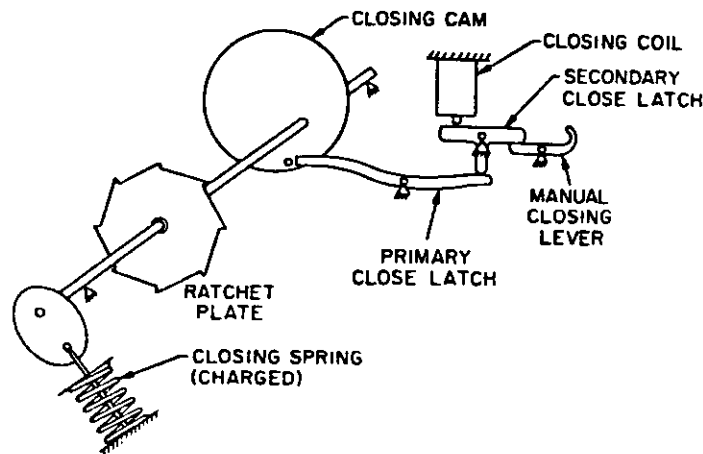


FIG. 4

3—Closing Operation

As the closing cam rotates (Figure 5), it straightens the second and third toggle links. The motion of the third toggle link rotates the jack shaft through its closing arc. The breaker contacts, connected to the jack shaft through push rods, close the breaker contacts as the jack shaft is rotated.

Straightening the toggle links loads the trip latch as they go over center to hold the breaker closed.

4—Charging

As soon as the closing contact sequence is completed, the springs are recharged as described in Part 1 above.

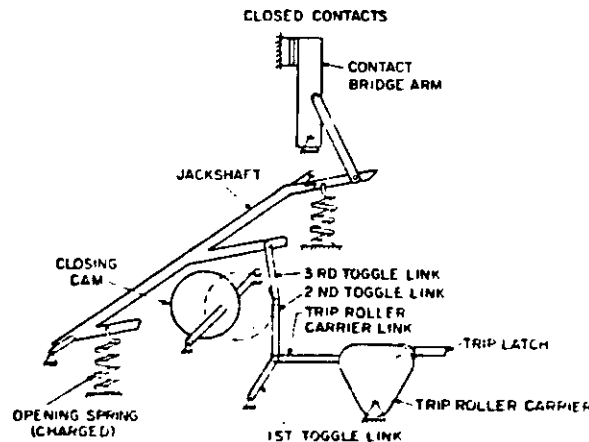


FIG. 5

STORED-ENERGY MECHANISM (Continued)

B—The mechanism operation sequence (Figure 6) to open the breaker contacts consists of the following steps.

Tripping action is initiated either by energizing the shunt trip or by pushing the manual trip button. The trip latch moves upward, releasing the trip roller carrier. The over center force of the toggle mechanism rotates

the trip roller carrier forward. As the first toggle begins to rotate about its pin, it releases the support provided to the second and third links. The second link collapses against the closing cam as shown. Opening springs charged during close provide the opening force.

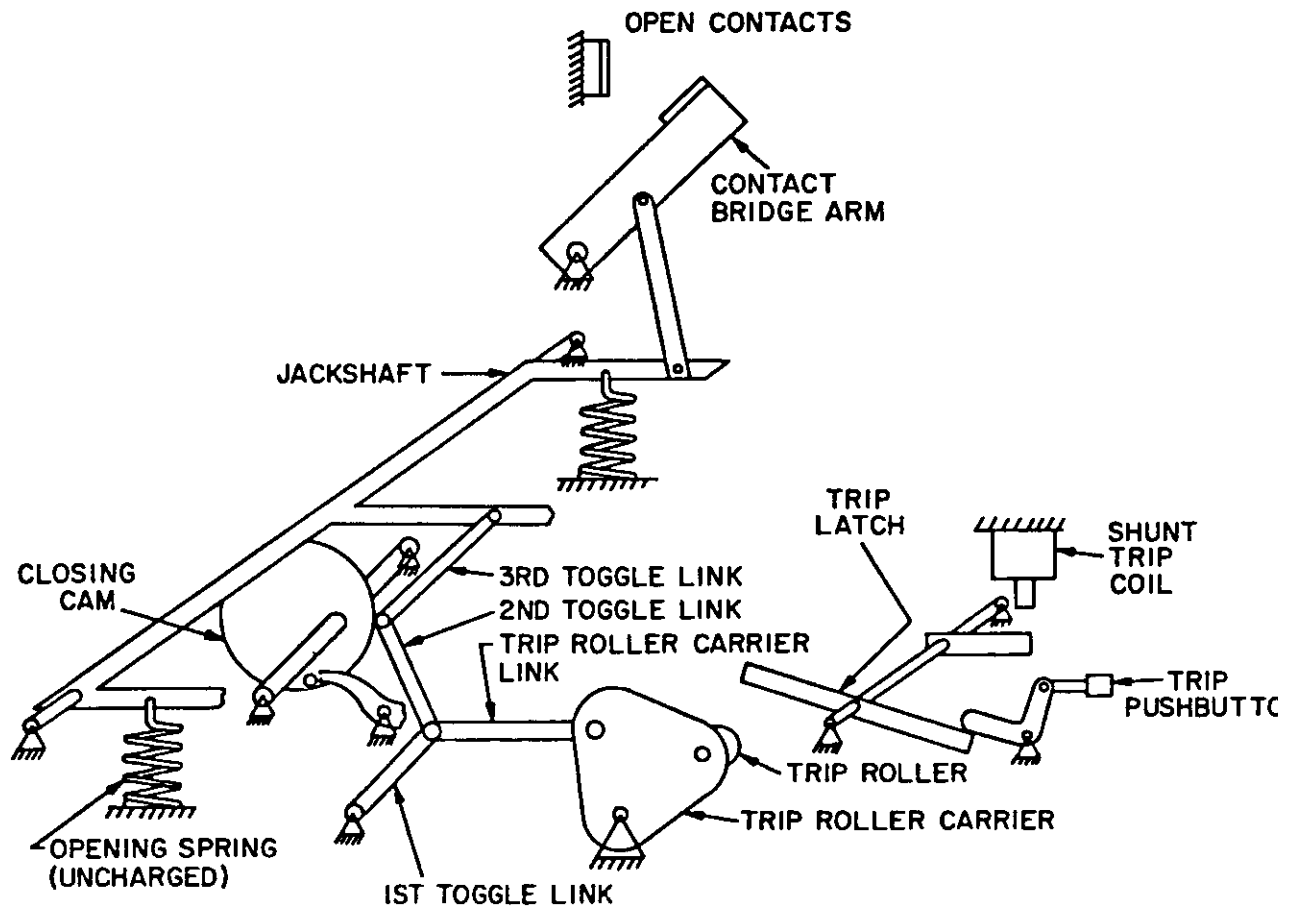


FIG. 6

BREAKER CONTROL DEVICES

The breaker control devices include all the relays, coils, auxiliary switches and motor, to electrically operate the breaker.

ARC CHUTES

The interruption function of the 5, 7.5 and 15HK breakers is performed by the arc chutes as follows:

Breaker contacts are fully closed (Figure 1).

Assume an overcurrent condition appears in the circuit.

1—The protective relay detects the overcurrent and energizes the shunt trip coil when its contacts close.

2—The shunt trip releases the trip latch closing the mechanism to start its mechanical tripping sequence to first open the main contacts (Figure 2) then opening the arcing contacts (Figure 3), thus establishing an arc which starts to expand. The arc then moves up the jump gap building up arc voltage to establish itself on the rear arc runner.

At the same time as the arc is being established on the rear runner, the arc transfers from the moving arcing contact to the front runner as shown.

3—As the arc rises and is transferred onto the arc runners, the contacts are removed from the arc circuit, the face wound blowout coils are inserted, creating a magnetic field across the arc chute. This field provides the driving force to drive the arc into the arc plates (Figure 4), where it is stretched and cooled to a point where at some early current zero it cannot re-establish itself.

4—On low current interruptions (below approximately 1000 amperes), the current is too low to establish a strong enough magnetic field across the arc chute to drive the arc into the arc plates. The puffer, mechanically connected to the moving bridge, provides a stream of air at the appropriate time to break the arc and cool the gases causing interruption of the circuit.

5—Figure 5 — The breaker contacts are fully opened and the arc is extinguished.

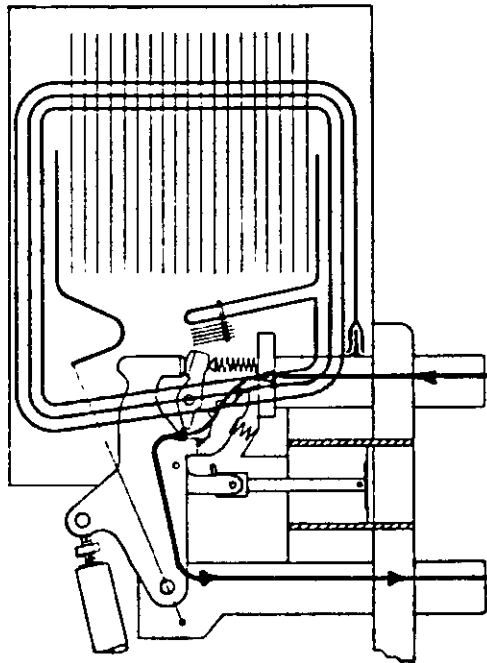


FIG. 1

ARC CHUTES (Cont.)

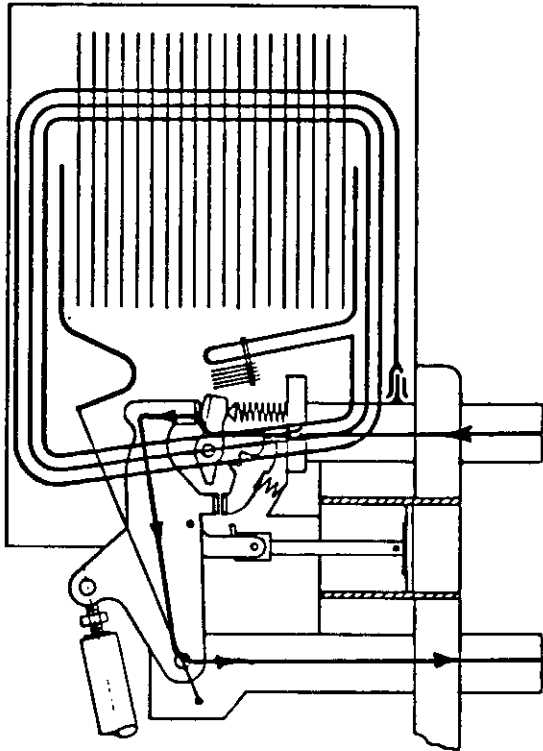


FIG. 2

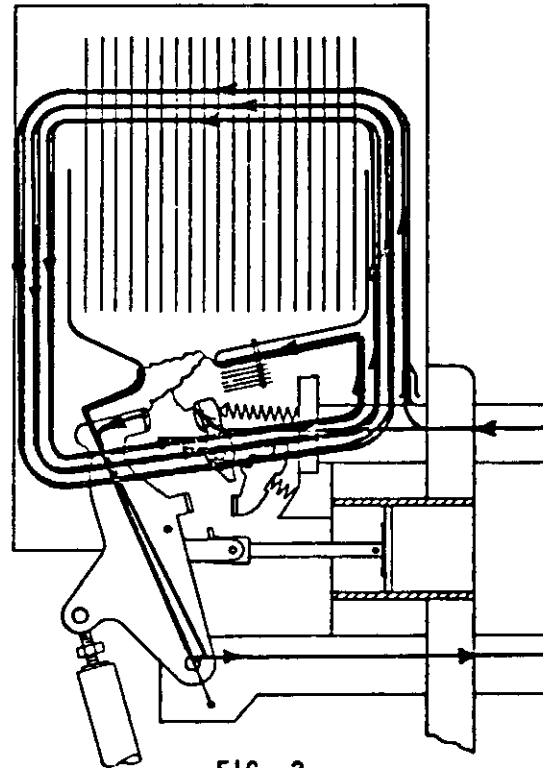


FIG. 3

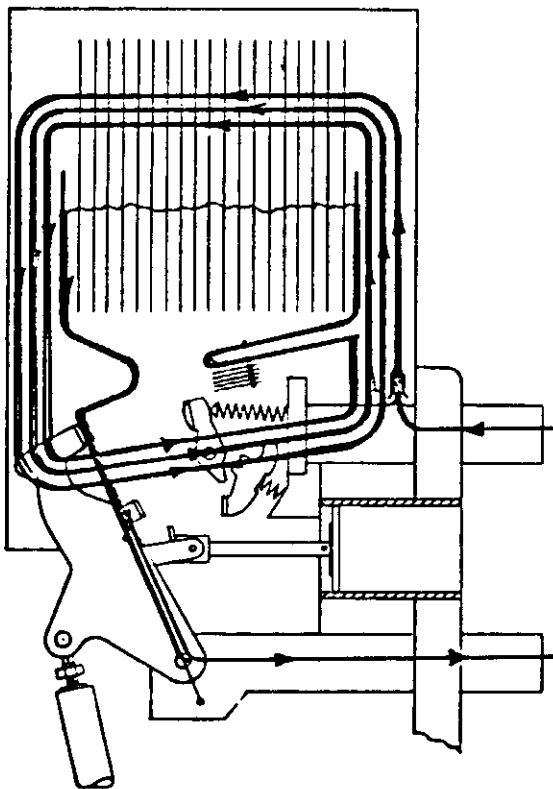


FIG. 4

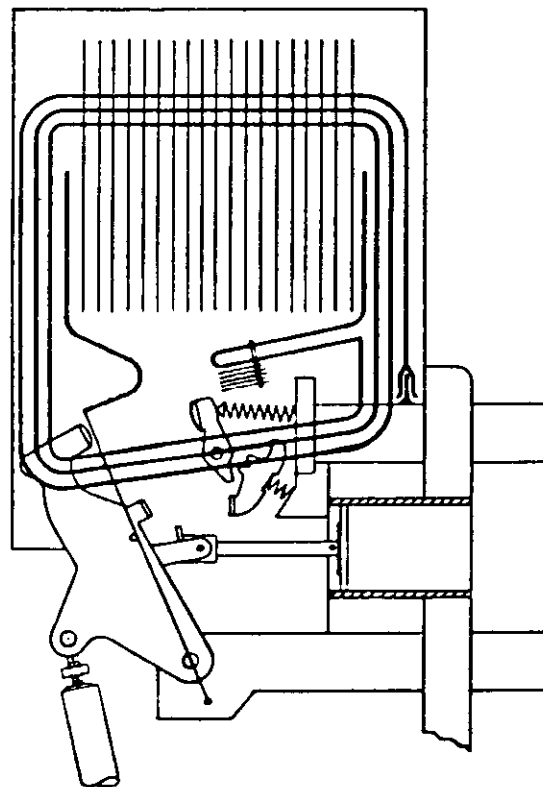


FIG. 5



SEQUENCE OF OPERATION

5HK ELECTRICALLY OPERATED GROUND & TEST DEVICE

OPERATING PROCEDURE

POTENTIAL TESTING

1. Keys should be in Locks A1 and B2 prior to installing device in compartment.
2. Insert in compartment and rack to connected position.
3. Withdraw hasp at Lock A1 and turn key in Lock A1. Device is now locked in connected position.
4. Transfer key from Lock A1 to Lock A2. Do not turn key.
5. Depress trip button and turn key in Lock B2. Grounding contacts are locked open. Transfer key from Lock B2 to B1.
6. Turn keys in Locks B1 and A2, open test port shutter and insert probes. Slide shutter right and turn key in Lock A2 to lock test probes. Transfer key from Lock A2 to Supervisory control. Proceed with potential testing.

TO GROUND TERMINALS

1. Test for potential by following above instructions.
2. Transfer key for Lock A2 from Supervisory control to Lock A2, turn key and open shutter. Remove test probes, close test port shutter and lock by turning key in Lock B1.
3. Transfer key from Lock B1 to Lock B2. Turn key in Lock B2 releasing trip button.
4. Turn key in Lock A2 and transfer to Supervisory control.
5. Unwind electrical closing cable provided for operator's safety and plug into a suitable outlet. Closing springs will charge automatically. Outlet to be furnished by customer. No provisions are provided for connecting the closing circuit to the switchboard control bus.
6. When closing springs are fully charged, depress "close" button. Ground contacts are now closed.
7. To lock ground contacts closed, push in contact locking lever lock and lock. The ground contacts are now physically blocked closed.
8. Transfer key from blocking device lock to Supervisory control.

TO REMOVE DEVICE FROM COMPARTMENT

1. Obtain key for contact locking lever and key for Lock A1 from Supervisory control.
2. Unlock contact locking lever and pull contact locking lever out. Open ground contacts by pushing trip button.
3. Turn key in Lock A1 to permit racking device from compartment.

NOTES:

Refer to DB-8.2.2.6 Page 4 for Outline Drawing

Refer to S-16763 for Locking Scheme. Consult Switchgear Division

SEQUENCE OF OPERATION**7.5 & 15HK ELECTRICALLY OPERATED GROUND & TEST DEVICE****OPERATING PROCEDURE****POTENTIAL TESTING**

1. Keys should be in Locks A1 and B2 prior to installing device in compartment.
2. Insert in compartment and rack to connected position.
3. Withdraw hasp at Lock A1 and turn key in Lock A1. Device is now locked in connected position.
4. Transfer key from Lock A1 to Lock A2. Do not turn key.
5. Depress trip button and turn key in Lock B2. Grounding contacts are locked open. Transfer key from Lock B2 to B1.
6. Turn keys in Locks B1 and A2, open test port shutter and insert probes. Slide shutter right and turn key in Lock A2 to lock test probes. Transfer key from Lock A2 to Supervisory control. Proceed with potential testing.

TO GROUND TERMINALS

1. Test for potential by following above instructions.
2. Transfer key for Lock A2 from Supervisory control to Lock A2, turn key and open shutter. Remove test probes, close test port shutter and lock by turning key in Lock B1.
3. Transfer key from Lock B1 to Lock B2. Turn key in Lock B2 releasing trip button.
4. Turn key in Lock A2 and transfer to Supervisory control.
5. Unwind electrical closing cable provided for operator's safety and plug into a suitable outlet. Closing springs will charge automatically. Outlet to be furnished by customer. No provisions are provided for connecting the closing circuit to the switchboard control bus.
6. When closing springs are fully charged, depress "close" button. Ground contacts are now closed.
7. To lock ground contacts closed, push in contact locking lever and lock. The ground contacts are now physically blocked closed.
8. Transfer key from blocking device lock to Supervisory control.

TO REMOVE DEVICE FROM COMPARTMENT

1. Obtain key for contact locking lever and key for Lock A1 from Supervisory control.
2. Unlock contact locking lever and pull contact locking lever out. Open ground contacts by pushing trip button.
3. Turn key in Lock A1 to permit racking device from compartment.

NOTES:

Refer to DB-8.2.2.6 Page 7 for Outline Drawing

Refer to S-16763 for Locking Scheme. Consult Switchgear Division vision.



SEQUENCE OF OPERATION

15HK-1000 ELECTRICALLY OPERATED GROUND & TEST DEVICE

OPERATING PROCEDURE

POTENTIAL TESTING

1. Keys should be in Locks A1, B1 and C1 prior to installing device in compartment.
2. Insert in compartment and rack to connected position.
3. Turn key in Lock A1. Device is now locked in connected position.
4. Transfer key from Lock A1 to Lock A2. Do not turn key.
5. Depress trip button and turn key in Lock B1. Grounding contacts are locked open. Transfer key from Lock B1 to B2.
6. Turn keys in Locks B2 and A2, open test port shutter and insert probes. Slide shutter right and turn key in Lock A2 to lock test probes. Transfer key from Lock A2 to lock test probes. Transfer key from Lock A2 to Supervisory control. Proceed with potential testing.

TO GROUND TERMINALS

1. Test for potential by following above instructions.
2. Transfer key for Lock A2 from Supervisory control to Lock A2, turn key and open shutter. Remove test probes, close test port shutter and lock by turning key in Lock B2.
3. Transfer key from Lock B2 to Lock B1. Turn key in Lock B1 releasing trip button.
4. Turn key in Lock A2 and transfer to Supervisory control.
5. Unwind electrical closing cable provided for operator's safety and plug into a suitable outlet. Closing springs will charge automatically. Outlet to be furnished by others. No provisions are provided for connecting the closing circuit to the switchboard control bus.
6. When closing springs are fully charged, depress "close" button. Ground contacts are now closed.
7. To lock ground contacts closed, pull out contact locking lever and turn key in Lock C1. The ground contacts are now physically blocked closed.
8. Transfer key from blocking device Lock C1 to Supervisory control.

TO REMOVE DEVICE FROM COMPARTMENT

1. Obtain keys for Lock A1 and C1 from Supervisory control.
2. Unlock contact locking lever and push contact locking lever in. Open ground contacts by pushing trip button.
3. Turn key in Lock A1 to permit racking device from compartment.

NOTES

Refer to DB-8 2.2 6 Page 8 for Outline Drawing

Refer to S-16940 for Locking Scheme Consult Switchgear Division

15HKV VACUUM CIRCUIT BREAKER OPERATION

The operation of the 15HKV breaker is similar to that shown on DB-8.2.3.8, Page 2 for circuit breaker operation, except Paragraph C, and any reference to arc chutes. Instead, any interruption of current takes place within the vacuum bottle, one bottle per phase. One (1) contact is stationary and one (1) is movable. Vacuum interruption has the inherent advantage of moving a light-weight contact a small distance in an almost perfect dielectric medium.

For general application and duty cycles, refer to:

Bulletin 8.3-1 (New)

RATINGS OF 15HKV VACUUM SWITCHGEAR*

Description	Type†	
	15 HKV 500	15 HKV 750
True MVA, Symmetrical	500	750
Continuous Current, A, RMS	1200	& 2000
Minimum Voltage, kV, RMS	11.5	12.5
Maximum Voltage, kV, RMS	15.0	15.0
Withstand Voltage, Low Frequency kV RMS	36	36
Withstand Impulse Level (BIL) kV RMS	95	95
Interrupting Capability, kA, RMS Minimum kV. Maximum kV.	25 19.3	35 29
Short-Time Capability kA, RMS 3-Second	25	35
Close & Latch Capability, kA, RMS	40	56
Interrupting Time Cycles (0-100%)	3	3
Asymmetrical Rating Factor	1.2	1.2
K-Factor	1.3	1.2

†15HKV500 Switchgear is also available with 400MVA interrupting capacity at 6.9kV. Refer to the nearest District Sales Office.

*Supersedes information currently in Bulletin 8.3-1 (New)