INSTRUCTIONS FOR
INSTALLATION

FPE

FEDERAL PACIFIC
Type DST 5 & 15 KV
Magnetic Air
Circuit Breakers
IN. DST

November 1959

Federal Pacific Type DST-5 and DST-15 Magnetic Air Circuit Breakers

INSTALLATION INSTRUCTION MANUAL

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DESCRIPTION

The DST magnetic air circuit breaker is electrically operated, horizontal drawout, three pole, for indoor and outdoor metal-clad switchgear.

The component parts are mounted on a welded steel frame equipped with wheels so that it can be easily moved into its cell. It has insulated interphase barriers, and a steel grounded front barrier to assure safety to operating personnel.

Primary disconnecting contacts carry the load current, and secondary disconnect contacts carry the control circuits for operating the circuit breaker.

The truck-mounted breaker is so interlocked with the racking-in mechanism that it is not possible to rack in the circuit breaker to its operating position when the circuit breaker is closed. It is also not possible to rack-out the circuit breaker from its operating position when the circuit breaker is closed. This protection is accomplished by a trip-lever that must be lifted before the racking-in crank can be inserted in the breaker frame.

These magnetic air circuit breakers are precision jig built devices and are factory adjusted and tested in compliance with NEMA standard factory operational tests. Each breaker is assigned a serial number and a careful record of each test is logged. This serial number should be referred to if it becomes necessary to contact the factory concerning a breaker.

As each breaker is carefully factory adjusted before it is shipped, no field adjustment should be necessary. The following information has been prepared for use only by Federal Pacific Electric field service personnel. Should it become necessary, consult the nearest sales office for field service assistance.

SHIPMENT

All circuit breakers are assembled in the factory before shipment, and tested for operational performance. Shipment is made in a total of five boxes and crates. The basic circuit breaker on its truck is in one crate. The three arc-chutes are packed in three separate boxes. The interphase barriers are packed in one crate. For 15KV circuit breakers, interphase barriers are inside the crate identified as right hand and left hand.

The serial number of each circuit breaker is on its nameplate and also marked on the circuit breaker crate. The two crates and the three boxes are marked with the factory FED number.

A copy of the packing list, enclosed in a water-proof envelope, is nailed on the outside of the circuit breaker crate. One envelope only is furnished with orders for more than one circuit breaker shipped to a single destination.

Each circuit breaker, in its crate, is enclosed in a *poly-vinyl dust and moisture-proof envelope*, which is zippered on three (3) sides. Within this envelope is a proper amount of *silica-gel* to absorb moisture.

It is recommended that this *envelope not be opened* prior to putting circuit breaker into service.

If breakers are to be stored for three (3) months or longer, silica-gel should be removed and placed in a dry oven to remove moisture, and then replaced in breaker envelope.

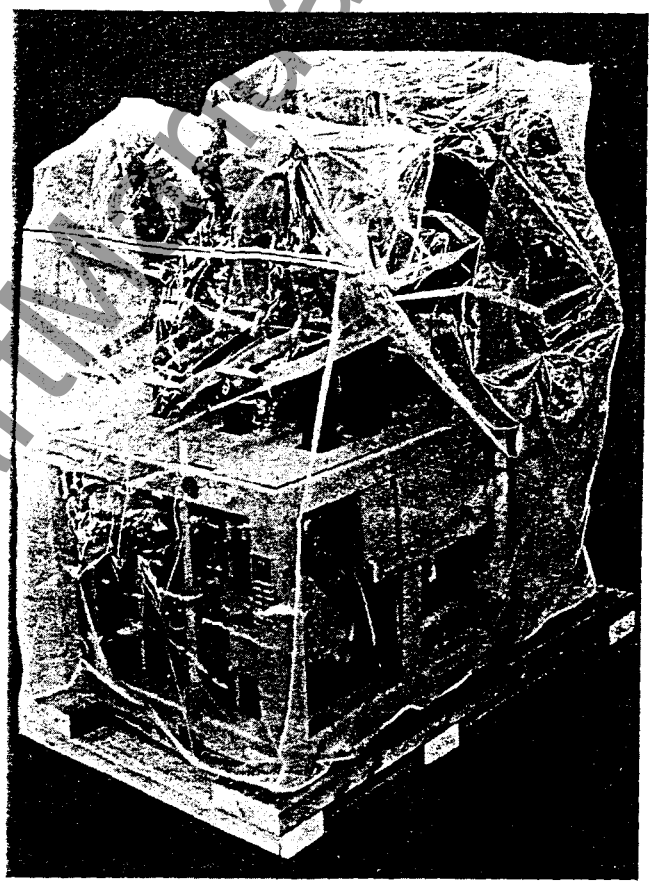

FIGURE 1

INSPECTION UPON RECEIPT OF SHIPMENT

When a shipment of circuit breakers is received, each circuit breaker should be examined before it is removed from the railroad car or truck. If any damage or indication of rough handling is evident, a description of the condition should be written on the freight bill, a claim should be filed against the carrier immediately, and notice of the extent of the damage sent immediately to the company at the address of the breaker from which shipment was made, giving serial number of the breaker, the carrier's name, and car number if shipped by rail. This information enables the company to supply needed information to assist the purchaser in support of the claim.

STORAGE BEFORE INSTALLATION

Circuit breakers arriving at the job in advance of installation should be stored indoors in a dry place. In cases where any time is to elapse before the circuit breaker is to be installed, the insulating parts should be tested for proper insulation level. If standard insulation level is not found, the insulating parts should be dried and retested. If stored near new construction work, care should be taken to protect from dust or other materials by covering with a tarpaulin.

BASIC ACCESSORIES

There is supplied with each metal-clad installation one of the following:

1. Racking-in crank
2. Manual or maintenance closing lever
3. Arc-chute lifting yoke
4. Test jumper (optional)
5. Breaker handling dolly (not illustrated)
6. Breaker transport truck (not illustrated) (outdoor installations only)

OTHER AVAILABLE BREAKER ACCESSORIES

CLOSING LOCKOUT SWITCH

5 KV toggle switch	1551-0534
5 KV momentary switch	1551-0533
15 KV toggle switch	1551-0529
15 KV momentary switch	1551-0528

CINCINNATI RECORDER ATTACHMENT

5 KV	1551-1858
15 KV	1551-0520

INTERLOCK ARRANGEMENT

5 KV (Standard Kirk Type F-3/8)	1501-0240
15 KV " " " "	1502-0240

LATCH CHECK SWITCH

5 & 15 KV	1551-1726

MECHANISM OPERATED CELL SWITCH (OPERATOR)

5 KV	1551-0636
15 KV	1551-0635

PADLOCK ARRANGEMENT

5 KV	1551-0523
15 KV	1551-0524

REACTOR TRIP RELAY ASSEMBLY

5 KV	1551-0791
15 KV	1551-0791

GROUND AND TEST DEVICES

5 KV

Current Rating	Symbol
1200 - Manual	1551-0314
2000 - Manual	1552-0314

15 KV

1200 - Manual	1551-0455
2000 - Manual	1552-0455

Also available electrical (solenoid operated) for Specific Applications.

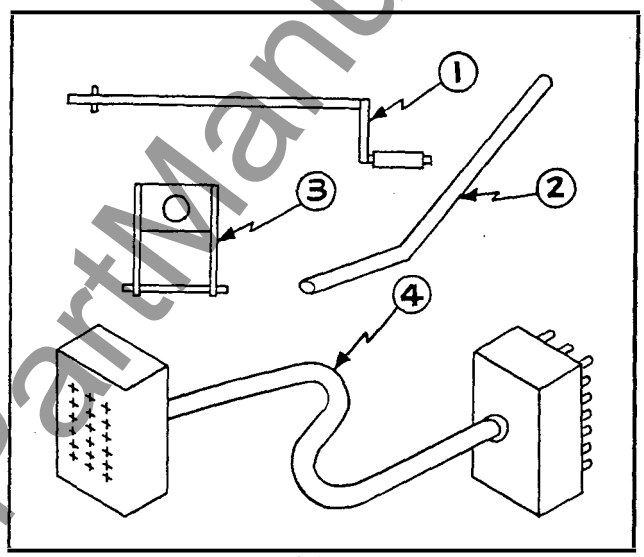

FIGURE 2

1. Racking-in crank

   Fits in socket at upper portion of mechanism to rack the breaker from "disconnect" to "test" to "operate" position in the cell. Shear pin located inside sleeve at handle protects racking mechanism from overstress.

2. Maintenance closing handle

   Fits in socket at lower frontportion of mechanism to close breaker for maintenance and inspection. *Must not be used to close breaker manually when breaker is in the cell.*

3. Arc chute lifting yoke

   Used to lift arc chutes into place on circuit breaker if hoist is available.

4. Test jumper

   Connects secondary circuits of breaker to test cabinet or to plug-in cell for testing when observation of mechanism or contacts is desired.

RATINGS OF DST BREAKERS

Type	Current Rating	Symbol
DST 5-75	1200	1553-1653
DST 5-150	1200	1555-1653
DST 5-150	2000	1554-1653
DST 5-250	1200	1551-1653
DST 5-250	2000	1552-1653
Dummy	1200	1551-0838
Dummy	2000	1552-0838
DST 15-150	1200	1552-1655
DST 15-250	1200	1551-1655
DST 15-250	2000	1551-0606
DST 15-500	1200	1551-1655
DST 15-500	2000	1551-0606
Dummy	1200	1551-1680
Dummy	2000	1552-1680

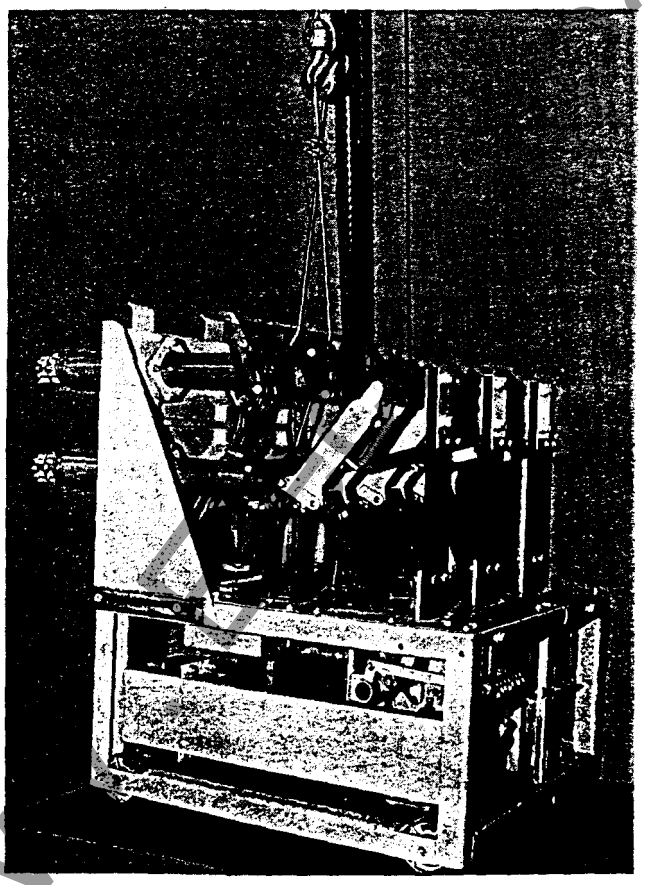

FIGURE 3

UNCRATING

If the breaker has to be moved to its proper location, lift the breaker in its crate if possible. If not, then lift the breaker without its arc-chutes and barrier. Always remove these components before lifting a breaker. Fig. 3 shows proper method of attaching lifting cable.

Uncrate the breaker. Use nail-puller for this purpose. Note that the breaker was shipped with contacts open, and blocked open with a shipping strut.

SETTING UP THE MAIN CIRCUIT BREAKER ASSEMBLY

1. After the breaker is uncrated, inspect for damage.
2. Clean off any accumulated dust with a dry cloth.
3. The contacts were not oiled or greased at the factory, nevertheless see that they are free from any oil or grease.
4. Check for any obvious loose hardware.
5. Do not install arc-chutes and barriers until ready to push the breaker into its cell.
6. First, operate the breaker by means of its maintenance operating handle. This is to be inserted into its socket at lower center of mechanism. See figure 8. Push the handle downward to close the breaker until an audible click is heard, indicating that the breaker has latched into the closed position. Check for any binding or friction.
7. Remove the manual closing handle.
8. Trip the breaker by raising the lift-to-trip lever.
9. Repeat 6 and 8 several times to insure proper operation.
10. Raise the lift-to-trip lever and insert the racking-in handle in socket that is uncovered by the projection on the trip bar. Note that in order to insert handle, the circuit breaker must be tripped open.
11. Turn handle to rotate racking-in lever against roller-lever against the step in the extended position (protruding outside the frame).
12. With handle still in the socket, place the manual closing lever in manual closing socket and attempt to close the breaker. It should trip-free. Note how trip-bar operates the cam to depress the trip armature.
13. If circuit breaker does not operate properly, check the contact adjustments as follows:

CHECKING FOR PROPER CONTACT ADJUSTMENTS

Main Contact Penetration

1. Close breaker to fully closed position (Figure 4A).
2. Scribe a line on copper contact bar immediately opposite edge of casting at (A) and (B).
3. Open breaker fully and again scribe lines at (A) and (B).

Lines at (A) and (B) should be 1/8" ± 1/32" apart.

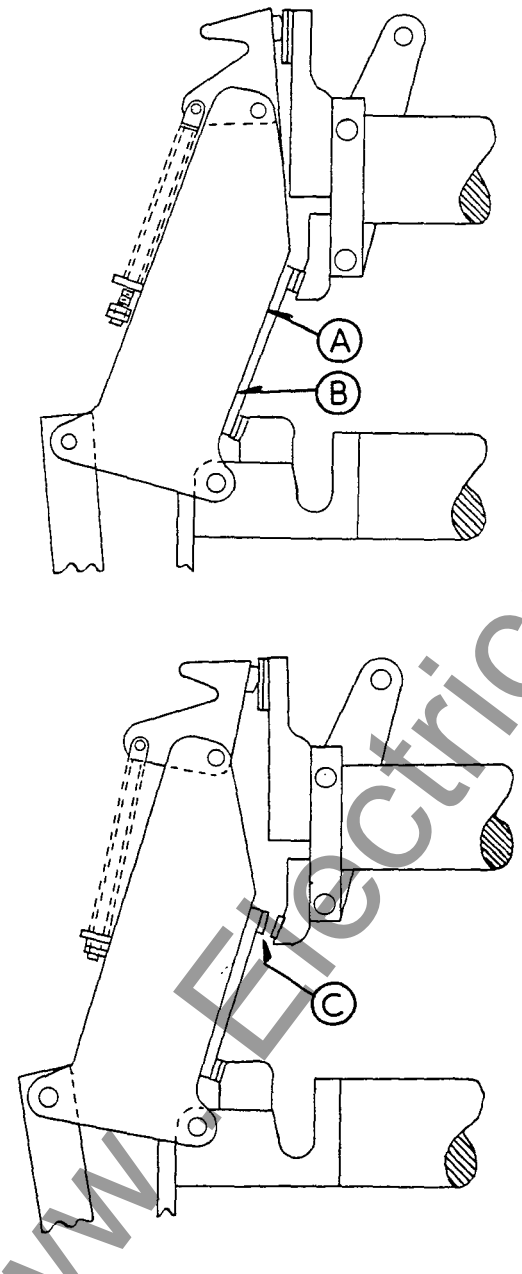

FIGURE 4

Arcing Contact Position

1. Close breaker manually until arcing contacts touch. (Figure 4B).
2. Gap at main contacts (C) should be approximately 3/8" ± 1/8-0. A 3/8" bolt is handy to check this adjustment.
3. Arcing contacts on 3 poles should touch simultaneously within 1/16".

1 - Arc chute installation (Figure 5).

1. Remove from crate.
2. Clean and blow out with dry air if necessary.
3. Inspect for damage
   a. Broken porcelain plates - small chips not objectionable
   b. Broken splitter plates - small chips not objectionable
4. Remove two loose screws (A) from side of contact and two cap screws (B) on back side of contact.
5. If hoist is available, remove through-bolt at (C) and install arc-chute lifting yoke.
6. Lift an angle shown and guide beveled end of pin (D) into hole in bracket (E).
7. Fasten bracket (F) to contact with screws (A).
8. Tilt arc chute back against rest on frame.
9. Remove lifting yoke and replace bolt at (C).

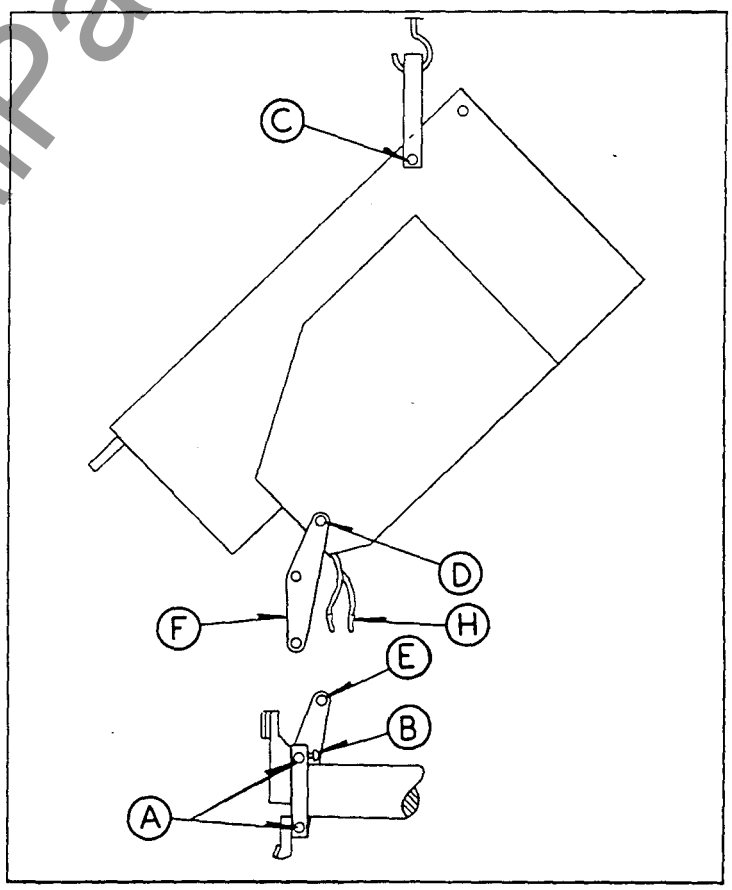

FIGURE 5

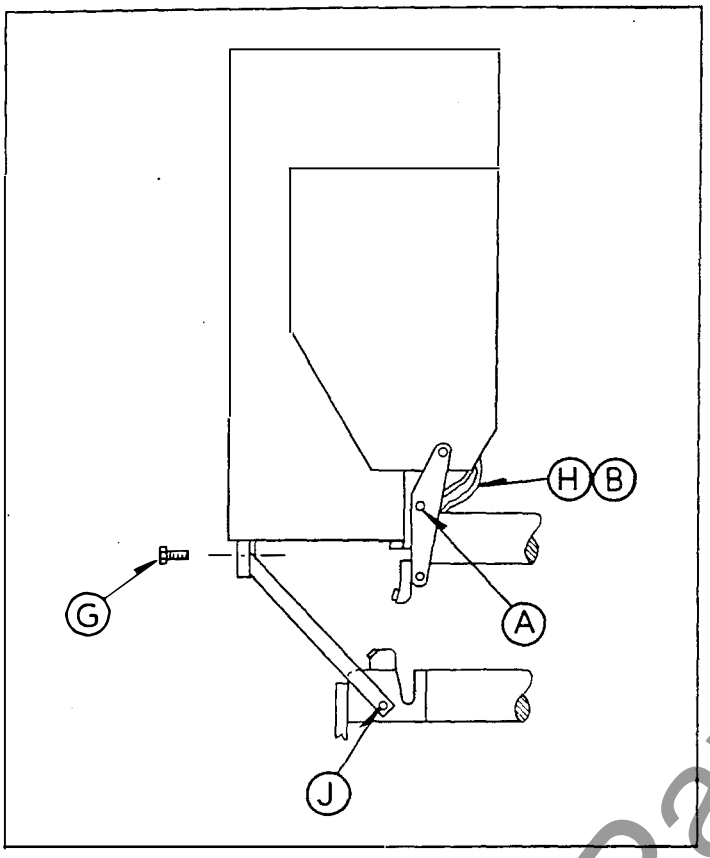

FIGURE 6

2 - Arc chute installation (Figure 6).

10. Remove bolt (G) from front upright.
11. Making sure that coil leads at (H) are free, gently lower arc chute until holes line up for bolt (G).
12. Install bolt (G) and tighten. This makes up mechanical and electrical connection at this point.
13. Tighten screws (J) on each side of bracket.
14. Fasten both coil leads at (H) with screws (B) removed in step 4. Note: These leads are in parallel. Other end of coil is connected internally to arc runner.
15. Check operation of breaker manually for any rubbing etc.

INSTALLATION OF INTERPHASE BARRIER

1. Remove from crate.
2. Wipe off dust with dry cloth.
3. Inspect for damage.
4. Remove two 1/2 inch bolts in front brace of breaker frame.
5. Slide the barrier assembly into place on the breaker. Make sure the outside sheets slip inside the frame gusset. See Figure 9.

Note: On 15KV breakers, slide right half of barrier assembly into place first, then left half. Install 1/4 inch bolt at top.

6. Tighten two lower bolts.
7. Check closing and tripping manually.

Electrical operation check
(May be done before installing arc chutes and barriers if power is available)

1. Check the closing and tripping voltages on the nameplate of the breaker. Breakers used with capacitor trip devices will indicate 125 volts d.c. for tripping. Breakers used with closing rectifiers will indicate 125 volts d. c. for closing.

2. Connect breaker to suitable supply.
   a. Connect test jumper (if available) to cell or test cabinet.
   b. If suitable supply not available, the breaker must be electrically operated several times after it has been installed in the cell in the test position. Before doing this, follow procedure in the following section entitled "Installing circuit breaker in cell". Be sure arc chutes and interphase barriers are installed before entering breaker in cell.

3. Close and trip the breaker electrically several times to insure proper operation.

SAFETY PRECAUTIONS

1. Before placing the circuit breaker in its cell, make sure that the circuit breaker frame will be adequately grounded to the ground-bus in the cell.

2. Be certain arc chutes and interphase barriers are installed before entering breaker in cell.

3. Check all main connections and contacts from bus to breaker and from breaker to line. Examine cell secondary contact connections. Make sure that phasing is correct, particularly if line feeds power into the breaker. This is extremely important if the breaker controls the output of a generator or synchronous motor.

4. It would be advisable to clean the circuit breaker with dry compressed air hose.

5. The upper part of the breaker, above the mechanism section, is normally enclosed by the interphase and front barriers, and the operator is protected from contact with live parts. Do not move the circuit breaker into the cell unless the barriers and arc chutes are in place. If, however, it is necessary to examine the action of the contacts, etc., with the breaker in the cell, the front barrier may be removed, but only in the "disconnect" or in the "test position". Never push the breaker in the "operating position" until all barriers are in place. In that position the breaker is live, whether closed or open.

6. Do not attempt to close the circuit breaker by hand against an energized circuit. The maintenance operating handle should only be used in testing the mechanical operation of the circuit breaker when not in the cell.

7. In order that sufficient closing force and acceleration are attained, the circuit breakers should be closed electrically from an adequate power source. See NEMA Standard SG-6-213.

8. Remove the circuit breaker from the cell when it is to be examined for maintenance or repair.

9. When testing the circuit breaker, make sure the circuit breaker control switch has a "do not operate" tag on it.

INSTALLING CIRCUIT BREAKER IN CELL

Before placing the circuit breaker in the cell, proceed as follows:

a. Before shipment, the circuit breaker closing relays in the top of the cells are "blocked". Remove these blocks, thus allowing the relays to operate.

b. See that the secondary sliding panel, with its plug-in block, is held at the front of the mechanism housing by its lock-pin.

c. Insert racking-in handle. Rotate handle counter-clockwise until lever-and-roller assembly is against its stop. This assembly is in the rear of the breaker on top of the mechanism housing. Racking-in lever should protrude outside the frame before placing breaker in frame.

Place breaker in its cell, and push until lever-and-roller assembly hits against horizontal racking-in hook which is mounting on rear of cell.

1. Rotate racking-in handle clockwise six (6) turns. Circuit breaker will at first back out a little and then go forward to Test position as shown by the indicators on the right-hand side-sheet.

2. Remove racking-in handle.

   To operate breaker in Test position, release secondary contact lock-pin and push sliding panel forward until its contacts engage similar contacts in the cell plug in block. The breaker can now be closed and tripped electrically several times to test the control circuits.

3. Insert the racking-in handle.

   The breaker is now open. Rotate racking-in handle eleven (11) more times clockwise. The shutter will be driven open as shown by its indicator. The secondary contact sliding panel will be automatically pushed toward the operator and locked in its operate position. The breaker is now in the operating position.

4. Remove the racking-in handle.

   The circuit breaker is ready for service, and should be closed and tripped electrically several times to assure that all control circuit connections and contacts are satisfactory. This should be done on a dead bus if possible. If the test must be made on a live bus, first read carefully the preceding section entitled "Safety Precautions".

   Close and fasten the cell door if breaker is to be tested on live bus.

5. When it is desired to rack the breaker into the Test position, first trip the breaker electrically by operating control switch, then insert racking-in handle.

   Rotate the racking-in handle counter clock-wise eleven (11) times. Shutter will close, and secondary contacts will be disconnected.

6. Remove the racking-in handle.

   To operate in Test position, release secondary contact lock-in pin and push sliding panel forward until its contacts engage contacts in the cell. The breaker can now be operated electrically in the Test position.

7. Insert the racking-in handle.

   The circuit breaker can be racked to the disconnect position by rotating the racking-in handle counter clock-wise six (6) times. The secondary contact sliding panel should be pulled forward to its operating position and locked there by its lockpin, otherwise there will be voltage on the control wiring of the circuit breaker.

Note:

As stated previously, under "Description", the circuit breaker has to be open before the operator can insert the racking-in handle into its socket. Therefore, it is impossible to rack a closed circuit breaker from Test to operating position, or from operating to test position.

GENERAL INFORMATION

5KV AND 15KV MAGNETIC AIR CIRCUIT BREAKERS

BREAKER - Dead Front - Figure 7

Note breaker has front steel plate that closes against angle irons in switchgear cell making a completely "dead front" arrangement!

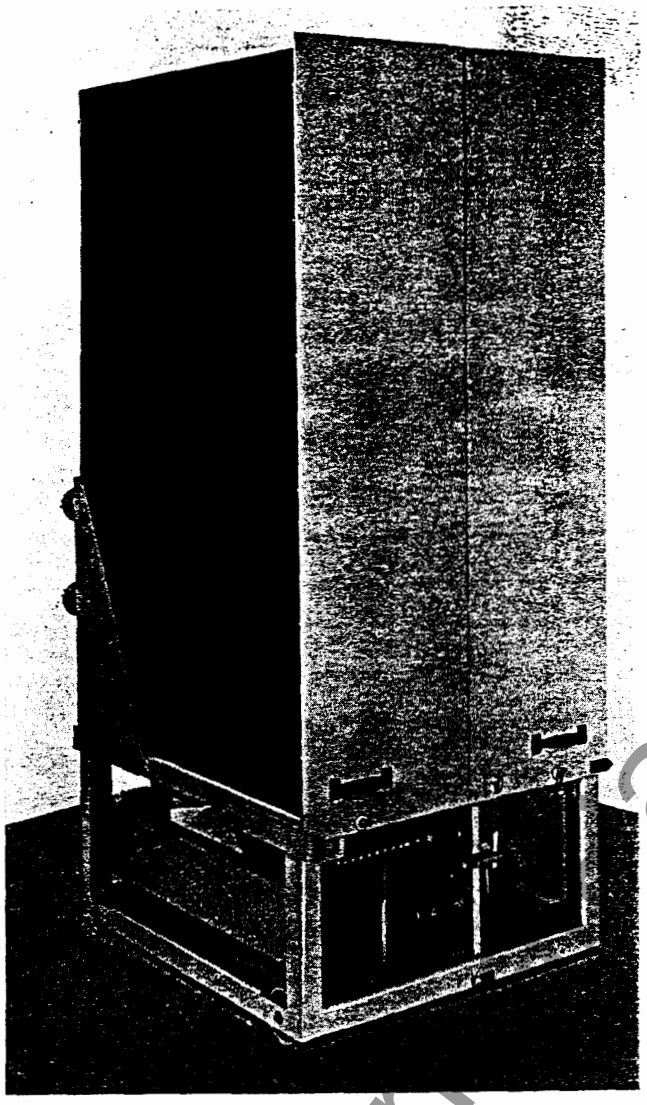

FIGURE 7

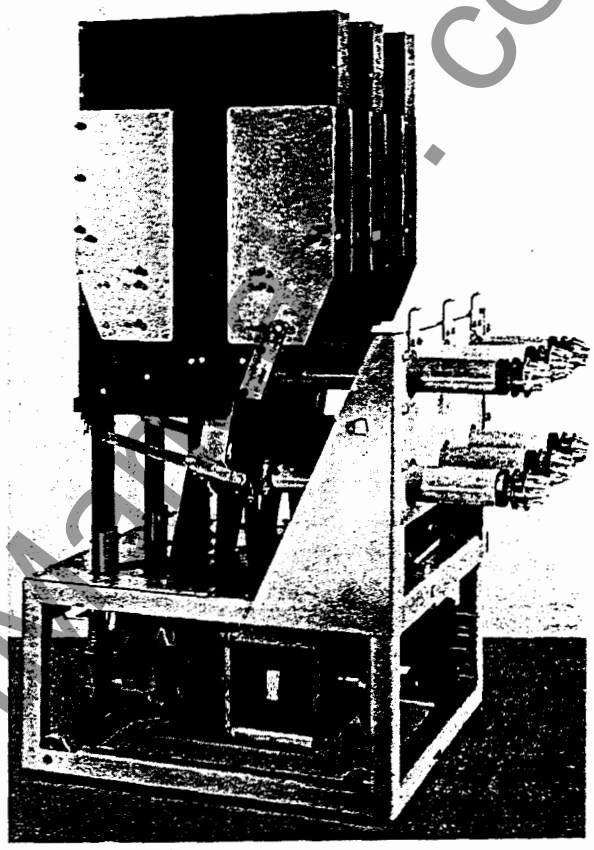

FIGURE 8

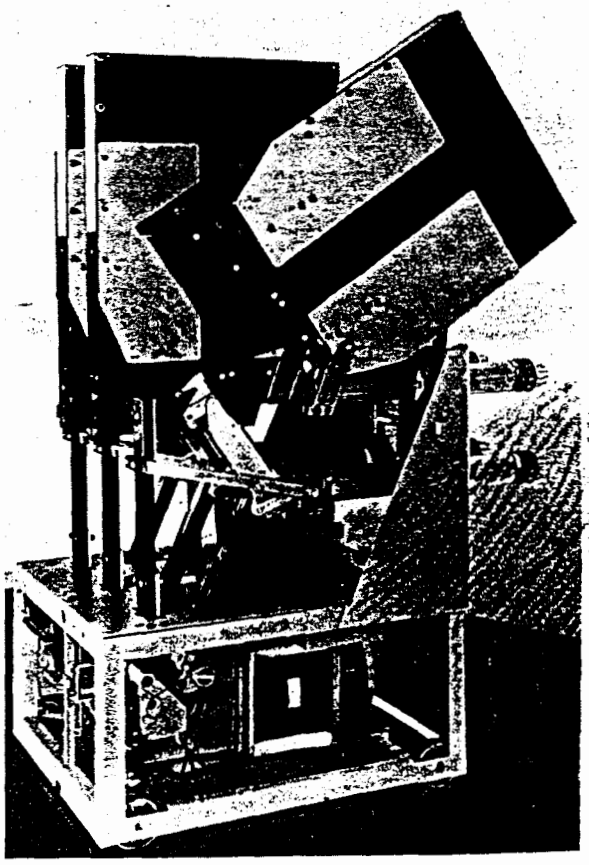

FIGURE 9

BREAKER FRAME - Figures 8 & 9

Breaker frame is a welded fabricated assembly of 1/8" and 1/4" thick steel very amply braced.

Four inch diameter wheels provide ease of withdrawal.

Breaker "position-indicator" mechanically locked with "breaker operating mechanism" provides positive visual indication of contact position.

Veeder counter is supplied to record number of operations.

GROUNDING - Figure 10 (I-11)

Breaker frame substantially grounded in both "operating" and "test" positions. 1/4" x 2" copper bar solidly bolted to breaker frame provides wiping action against stationary coil-spring loaded contact located in cell and formed of 1/8" x 2" copper.

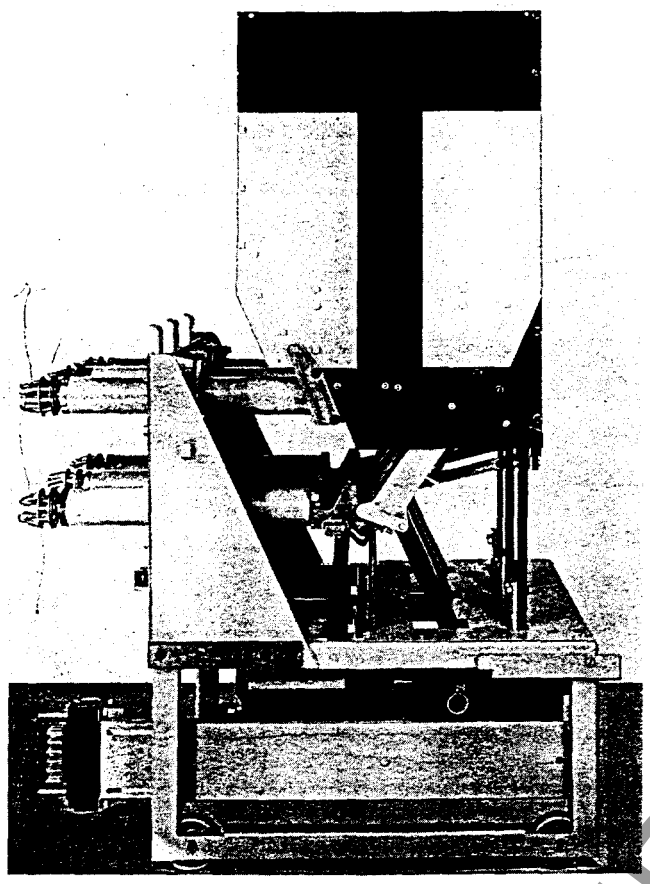

FIGURE 10

CLOSING SOLENOID - Figure 11

Note the closing solenoid plunger disc. At points near the close of the closing stroke (1) Breaker contacts are closing against considerable spring pressure and (2) The breaker may be required to close against fault currents within its full capability, which creates great mechanical forces tending to open the breaker. The plunger disc gives the solenoid additional pull and "zip" at the end of the stroke.

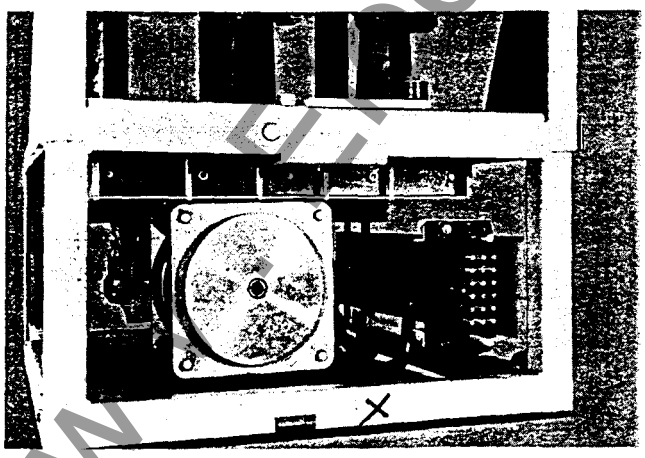

FIGURE 11

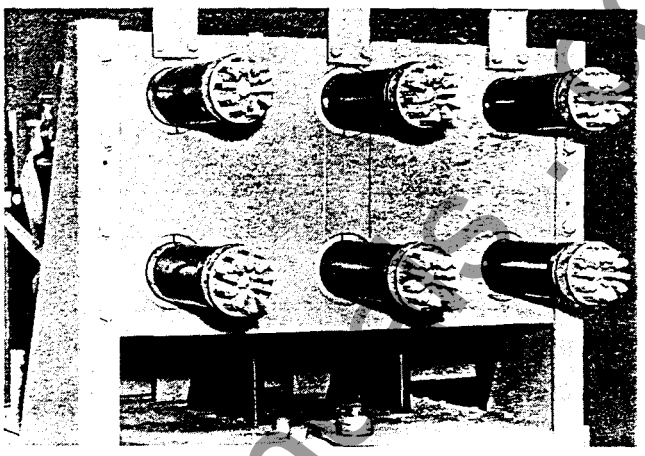

FIGURE 12

PRIMARY DISCONNECTS - Figure 12

Primary disconnects are self-aligning and consists of high pressure finger segments of extruded copper, heavily silver plated. Pressure is exerted on each finger by an individual leaf spring. A single brass retaining ring encircles the cluster of fingers. The disconnects are located on the breaker (not in the cell) for convenient inspection and maintenance when breaker is withdrawn from the housing.

SECONDARY DISCONNECTS - Figures 11 & 14

Secondary disconnect contact assembly may be (1) locked in place with pin to disconnect simultaneously with main contacts or (2) unlocked to remain connected with breaker in "test" position.

Secondary contacts may be readily engaged from front of breaker, before breaker is placed in "operating" position.

Horizontal travel of contacts considerably exceeds exact distance from "operating" to "test" position which eliminates any critical adjustment of contact movement.

"RACKING-IN" - Figures 11 & 12

The "racking-in" device is simple - positive - sturdy. Only two moving parts: (1) Horizontal shaft, manual crank on one end; worm gear on opposite end. (2) Horizontally rotating lever with cam roller and spur gear.

Requires only 17.5 turns for full travel of lever cam.

Breaker is in "test" position (clearly indicated in cell) before lever cam rotates to end of travel. This means breaker is firmly locked in cell in "test" position.

INTERLOCKING - Figures 13 & 14

Simple positive interlock bar that:

(1) Prevents insertion of "racking-in" crank, unless interlock bar is raised.
(2) Physically locks bottom of breaker to cell in "operating" position and prevents insertion from "test" position unless raised.
When interlock bar is raised it:
(a) trips breaker
(b) renders closing mechanism mechanically and electrically trip-free.

KIRK INTERLOCKS

Kirk interlock may be mounted in cell to prevent breaker insertion unless other equipment is in desired position.

Any electrical Kirk interlock scheme may, of course, be provided.

PUFFER - Figures 11 & 15

A single, large-sized puffer serves all three phases. This design gives the breaker the desirable characteristic of fast interruption on low currents. Air currents are conducted to each pole by three polyvinyl tubes.

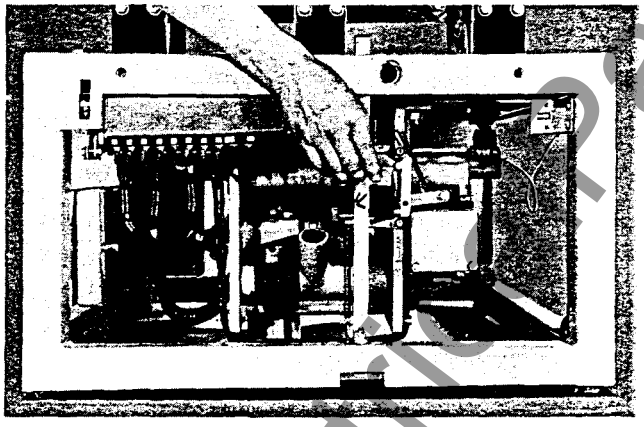

FIGURE 13

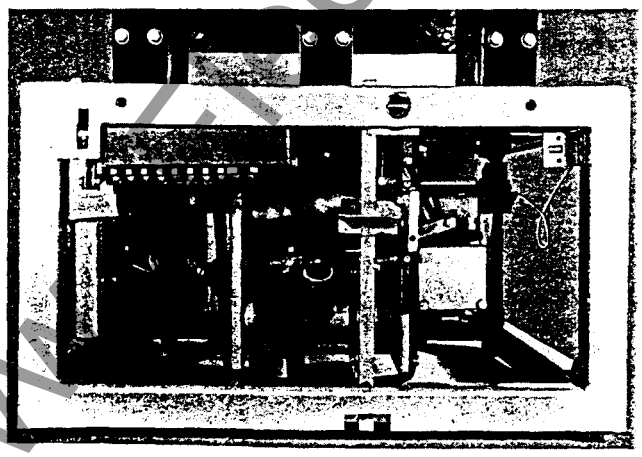

FIGURE 14

INTERRUPTION PRINCIPLE - Figures 16 & 17

Interruption is accomplished by the principle of elongation and cooling of the arc. The arc is magnetically forced into a series of closely spaced insulating barriers. The barriers both elongate the arc and at the same time absorb heat from the arc, thereby increasing the electrical resistance of the arc path. At an early current zero, the arc is interrupted. The arc path is so long and arc gases have been so cooled that re-ignition of the arc cannot take place and circuit interruption is accomplished.

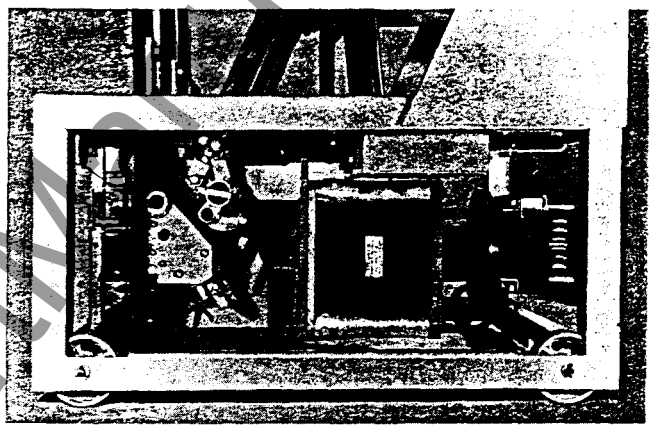

FIGURE 15

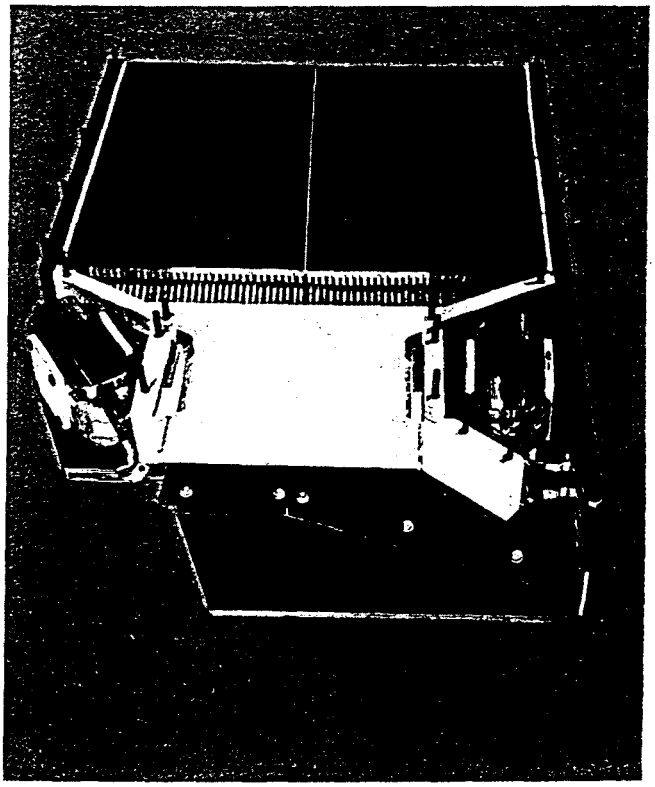

FIGURE 16

ARC CHUTE - Figure 9

By removing one bolt, the arc chute may be easily pushed back on a hinge, so contacts can be inspected. This is a very desirable maintenance feature.

CONTACTS - Figure 18

Main contacts of heavy copper and inlaid silver carry the normal operating current when breaker is in operation. Arcing takes place between contacts of special alloys which are extremely resistant to arc damage.

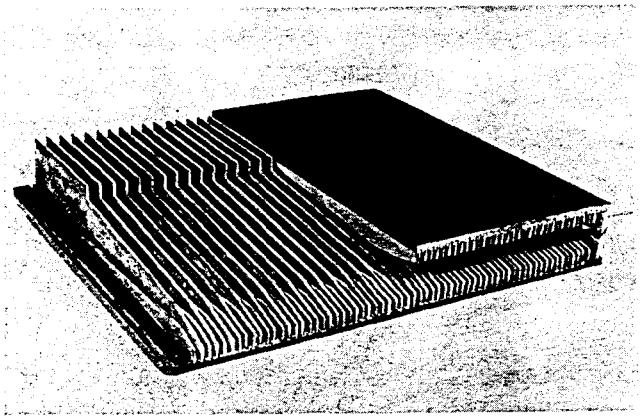

FIGURE 17

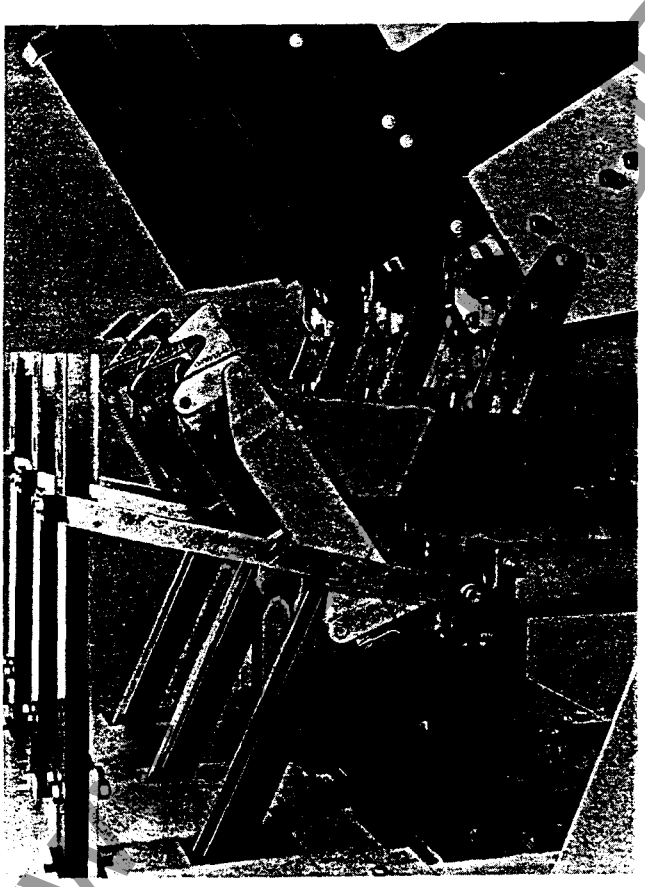

FIGURE 18

BAFFLE MATERIAL OF 15KV MAGNETIC CIRCUIT BREAKER - Figures 16 & 17

During fault interruptions, the arc which has a temperature of several thousand degrees F comes into intimate contact with the splitter plates or baffles. The material of the baffles must be able to withstand this drastic heat-shock without cracking or otherwise disintegrating.

The arc core is surrounded by hot gases which need to be cooled at a high rate. Fast propagation of the arc helps to expose large areas of the cool baffle plates to these hot gases. Porosity of the baffle material is of particular benefit for this action because it multiplies the surface area in contact with the gases.

The three principle attributes which we are looking for are:

1. High heat-shock properties.
2. Porosity without mechanical weakening.
3. Stability under high humidity.

These three qualities are not independent of each other and the problem for the engineer consists in combining them into the best possible compromise. Federal Pacific engineers have succeeded in producing a material which we believe has the best properties available today.

Heat shock resistance is generally a property of high zirconium-content materials and our baffle material is a *high zirconium-content refractory* for which we have developed special treatments to assure the highest heat-shock resistant properties.

Some materials when subjected to high local temperatures, expand and contract at different rates during a heating and cooling cycle. This results in permanent distortion with high "locked-in" stresses. At each short circuit the condition becomes worse and eventually leads to cracking of the plates. Our material is stable in that respect and no internal stresses develop.

Porosity has been increased progressively during the development of the DST breaker and our present material due to its porosity has large effective area.

Moisture absorption consists essentially of two types:

A. Mechanical absorption of moisture.
B. Chemical binding of moisture.

A. Mechanical absorption of moisture is determined by dipping the material in water and then measuring the amount of water absorbed. If the absorption is of mechanical nature only, then the water can be driven out quickly by heating to about 220°F. It is most desirable to be able to drive out *all* of the water in this manner and not have any chemical binding. Any porous material has the ability to

absorb varying quantities of water by this dipping process but so long as the water can readily evaporate there is no detrimental side reaction to this type of water absorption.

B. When water is chemically bound, it can usually not be driven off by a 220°F heating cycle but must undergo a much longer heating at higher temperature, say 400°F. This type of water absorption is very undesirable and usually leads to excessive warpage of the plates while in service.

The Federal Pacific baffle material has shown no tendency to warp because it does not chemically bind moisture.

BAFFLE ASSEMBLY - Figure 17

Baffles on alternate sides of the assembly are staggered in such a manner as to elongate the arc more and more as it ascends in the arc chute.

VEEDER COUNTER AND POSITION INDICATOR - Figure 14

Breaker "position-indicator" mechanically locked with "15KV operating mechanism" provides positive visual indication of contact position.

Veeder counter is supplied to record the number of operations.

HEPC Breakers ARE DST 5-350

INSTRUCTIONS AND ADJUSTMENTS TYPE DST-5-250 AND DST-15-500 MAGNETIC AIR CIRCUIT BREAKERS

NOTE

Basic Adjustments

1. Blade travel and contact engagement
2. Arc-chute installation and adjustment
3. Mechanism description
4. Mechanism adjustments (general)

Mechanism Adjustments

1. Adjustment roller to closing-lever
2. Adjustment prop to roller
3. Adjustment solenoid travel
4. Adjustment overtravel stop
5. Solenoid back-travel check

Latch Adjustment

Mechanism Check-points

Solenoid cut-off switch adjustment

Puffer

Shock absorber

Auxiliary switch contact

Contact adjustments

1. Main
2. Arcing
3. Cluster

Interlock and racking-in mechanism adjustment

1 - Blade Travel and Contact Engagement

The total travel of the breaker mechanism from the open to the closed position is set in the factory and may not be altered. Therefore, any adjustment of the contacts made in the closed position will alter, to a slight degree, the position of the blade when the breaker is open. With the breaker in the closed position as shown in the general assembly drawings, the deflection of the main bridging contacts should be 1/8 to 1/32. This is usually measured by scribing a mark on the copper bar when the breaker is closed. Then scribing another mark when the breaker is open. (These marks coincide with the edge of the blade castings on both positions). The distance between the two marks should measure 1/8 to 1/32. To alter this adjustment, it is necessary to alter the effective length of the operating rod by means of its threaded adjustment:

1. Remove the pin connecting the operating rod to the moving blade casting.
2. Loosen lock-nut at opposite end of rod (mechanism cover may be removed to do this).
3. Make one-half turn adjustment of rod as necessary to secure contact deflection desired.

   Note: One-half turn alters contact deflection approximately 1/32".

4. Reassemble and tighten.

2 - Arc-chute Installation and Adjustment

The arc-chute can be installed relatively easily if the hinge pin and one vertical support-plate are on the arc-chute assembly before it is lifted into position. Then either manually or by help of an overhead crane, the arc-chute, held in a generally tilted-back position, may be guided so that the pin will engage the hole in the support plate that

is left fixed to the upper bushing. With this condition achieved, it is relatively easy to engage the flathead screws to hold the other upper plate to the bushing.

Note for 5KV breaker: **Caution!** Install copper spacer when mounting arc-chute.

The arc-chute may now be tilted forward and the front support bolt or bolts tightened. It is then possible to make the terminal connections between the coil and the upper bushing. If the arc-chute is not vertical when mounted, it is usually possible to tip it the necessary amount after front support bolts are loosened ..... (15KV only).

3 - Mechanism Description

The closing mechanism is a solenoid operated mechanical trip-free mechanism which closes and latches the breaker against the operating forces exerted by the contacts, operating spring, and electro-magnetic forces due to short circuits. At any position during the closing operation the breaker may be tripped open, free of the closing energy. The solenoid pushes on the closing lever which is shaped somewhat like a crescent. This force is then transmitted to the main operating shaft of the breaker through a roller which is held in a fixed relation to these two parts. If the position of the roller is altered, it breaks the connection between these parts, and the main shaft is then free to move to the open position.

The roller is held in its fixed relationship to the moving parts by the latch assembly.

Depressing the magnet armature releases the latch, allowing the two internal toggles to collapse and thus release the roller from its relatively fixed position.

During a normal closing operation this latch linkage remains firm, allowing the solenoid and closing lever to rotate the main shaft all the way to its closed position. At this point a prop snaps into place engaging the latch roller and holding the main shaft in the closed position. Simultaneously, the solenoid cut-off switch operates to de-energize the solenoid, and, after the necessary decay of current, the solenoid and closing lever return to their initial position leaving the operating shaft in the closed position as held by the roller and the prop.

4 - Mechanism Adjustments

The most important adjustment of the mechanism is that of the roller. The tangent point between the roller and the flat surface it rests against should be approximately 1/8" from the lower corner of the flat surface. There are two such flat surfaces involved; one on the nose of the closing lever - the other on the end of the prop.

The first step in this procedure is to adjust the position of the roller with respect to the closing lever. This is done by altering the position of the main latch assembly by the insertion or removal of spacing washers that bolt this assembly to the mechanism frame. With the roller thus adjusted to the closing lever, the breaker may be closed, and the position of the prop may then be adjusted to the roller by means of the adjusting castle-nut on the prop return spring rod.

With this accomplished, the face of the prop and the face of the closing lever will coincide when the breaker is in the closed position or when the closing lever is brought up lightly against the roller (by means of the maintenance manual closing lever).

Mechanism Adjustments

1. Adjust roller to closing- lever face.

   (a) Tangent point of roller 1/8" from bottom corner.
   (b) Adjust by varying spacers in latch.

2. Adjust prop to roller.

   (a) Tangent point 1/8". Same as closing-lever.
   (b) Adjust by castle-nut on prop spring guide.

3. Adjust solenoid travel.

   (a) Close breaker manually.
   (b) Push solenoid plunger until it hits lightly against closing lever and trip-free roller.
   (c) Gap between brass washers and solenoid back plate 3/32"-1/8". (over-travel)
   (d) Adjust by changing shims inside plunger.

4. Over-travel stop adjustment. Adjust so that:

   (a) Mechanism cannot go over dead center.
   (b) Puffer piston does not hit rear spacer tubes.
   (c) Auxiliary switch linkage does not go over dead center.
   (d) Gap between stop and main shaft should be at least 1/8" minimum when breaker is closed. **Caution!** A check should be then made (manually) to insure that this adjustment does not allow the mechanism to lock on dead center.

5. Solenoid back-travel check.

   (a) Space between closing lever and roller, when circuit breaker is open, should be 1/16" to 1/8".
   (b) 5KV only - Projection of solenoid plunger beyond breaker frame 1-1/4" maximum,

Latch Adjustment

1. Latch armature engagement with segment.
   (a) 1/16" to 5/64".
2. Gap between armature and segment when latch is unloaded 1/16" to 3/32".
3. Adjust magnet frame to allow 1/32" to 1/16" over-travel of armature after latch trips.
   (a) Gap between armature rivets and magnet pole face approximately 3/8" when latch is set.
4. Force to trip breaker approximately 4 lbs.
5. Latch should break freely when armature is depressed when latch reset spring is overcome by hand.
6. Latch engaging surfaces on armature and segment should be free of paint or foreign matter.
7. Magnet pole face should be lined up with armature face.

Mechanism Check Points

1. Latch must reset under all conditions (mechanical and electrical).
2. With latch armature depressed, breaker should trip free before contacts have traveled half-way closed.
3. Latch must have at least 1/32" clearance.
4. At least 1/8" clearance between closing lever and trip free roller.
5. Cut-off switch operates simultaneously when prop engages roller.
6. Over-travel stop is not hit before the closing armature has touched the solenoid backplate and will not let breaker lock on dead center.

Solenoid Cut-Off Switch Adjustment

1. The solenoid cut-off switch is adjusted so that it closes its contact as prop snaps into position.
2. When the mechanism settles back onto the prop, the cut-off switch contacts must remain closed.

Puffer

1. Should be free of any binding.
2. Should be air-tight enough to restrict opening of breaker when nozzles are closed.
3. Should not be lubricated.
4. Piston should not hit tubular spaces in back.

Shock Absorber

1. Should be lubricated inside with Lubriplate or equivalent.
2. Orifice size selected will permit 10% bounce or normal opening. Trip-free opening will have more bounce (approximately 25%).
3. Piston-ring gaps should be 180° opposite from each other.

Auxiliary Switch

1. Linkage should not go over dead center on closing.
2. "A" switches make just before arc contacts touch.
3. Trip coil "A" switch makes 1" or sooner before arc trips make.
4. "B" contacts make after 60% of the breaker opening stroke.

Contacts

1. Main Contacts
   (a) 1/8" ± 1/32" deflection at top of bars on all 3 poles.
   (b) Make certain the two bolts at each end of the insulating support are tight.

   Note: The vertical insulating piece that supports the lower bushing from the breaker frame must be tight before these adjustments are made. Any loosening of the bolts holding this support will allow an upward movement of the lower bushing when the breaker is being closed, thus reducing contact deflection.

   (c) Clean and bright.
   (d) 50% of line to line when checked with carbon paper and thin tissue on manual closing.
   (e) 3/8" gap ± 1/16" when arcing contacts touch.
2. Adjustment of Arcing Contact
   (a) To adjust arcing contact, close breaker manually until the main upper contacts are separated by 3/8". At or near this point, the arcing contacts just touch. To adjust this, merely adjust the nut at the end of arcing contact spring rod.
   (b) With the individual phase thus adjusted, fine adjustment may then be made to effect simul-

taneously making of the three arcing contacts 1/16" of each other.

3. Cluster Contacts

   (a) Inside diameter of fingers. (Without tension).

   1200 amp. 1-1/8" - 1-1/4"
   2000 amp. 1-5/8" - 1-3/4"

   (b) Should be free to align to stud that is 3/16" off center in any direction without reducing contact pressure.

Interlocking must be adjusted to insure tripping of the breaker before the racking-in handle can be inserted. Fig. 19-A. This is done by adjustment of the eccentric cam on the interlock. Fig. 19-B.

1. Main contacts should be open 3/8" when arcing contacts touch. Fig. 20-A.
2. Arcing contact adjusting nut. Fig. 20-B.
3. Main contact bridging member. Fig. 20-C.
4. Pull pin to adjust push-rod. Fig. 20-D.
5. Shunt carries full current only during a portion of the interrupting time. Fig. 20-E.
6. Periodically test tightness of bolts. Fig. 20-F; Fig. 21-B.
7. Adjust main contact deflection by rotating push-rod on threaded clevis, 1/2 turn 1/32" on main upper contact. Fig. 21-A.
8. Main pivot axis. Fig. 21-C.
9. Interlock, Fig. 19-B, should trip the breaker before crank can be inserted into hole. Fig. 19-A.

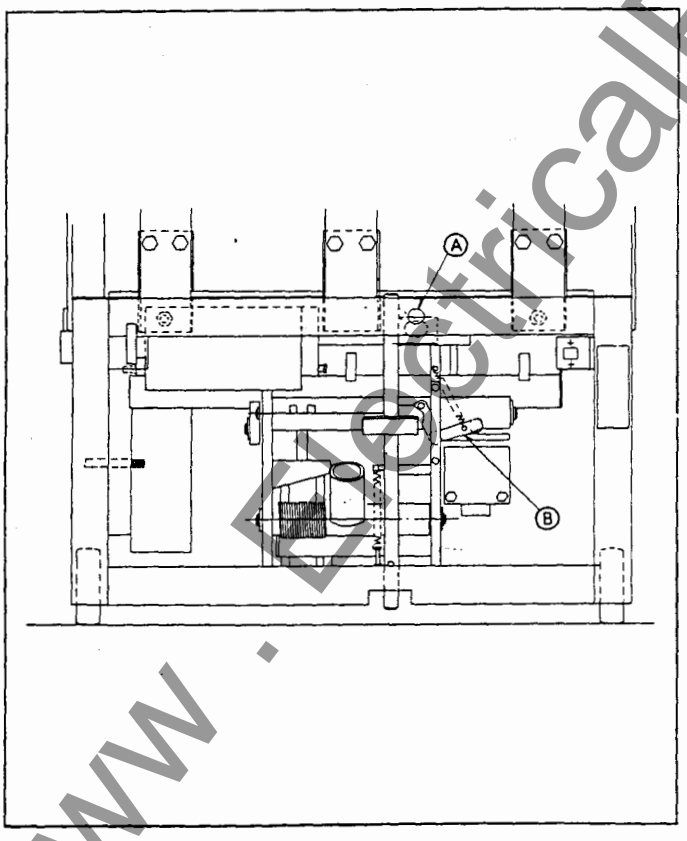

FIGURE 19

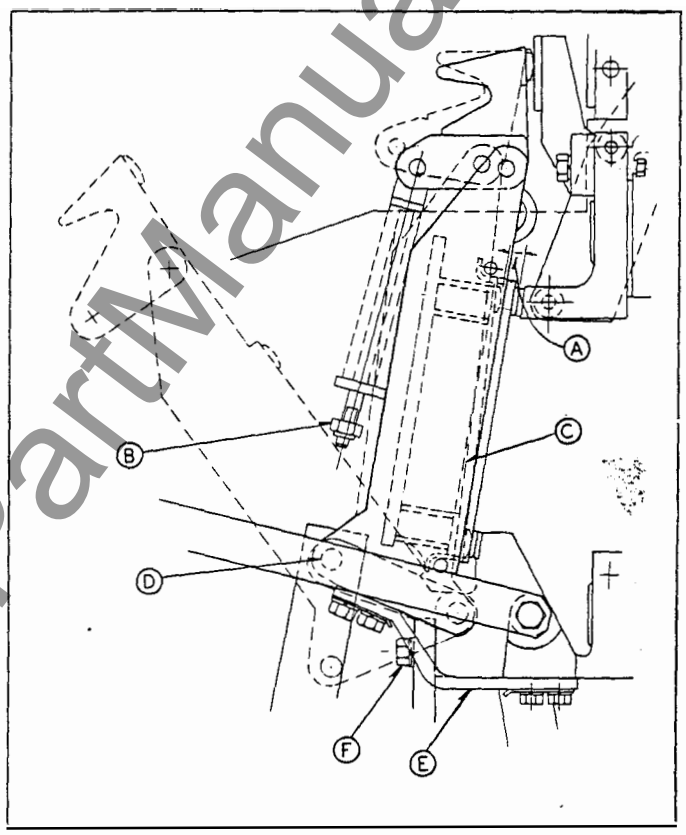

FIGURE 20

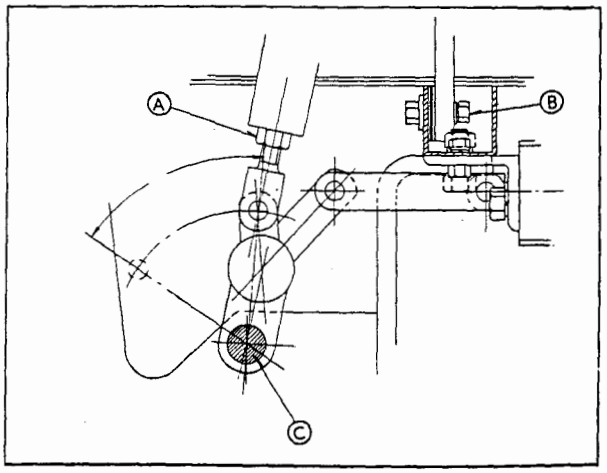

FIGURE 21

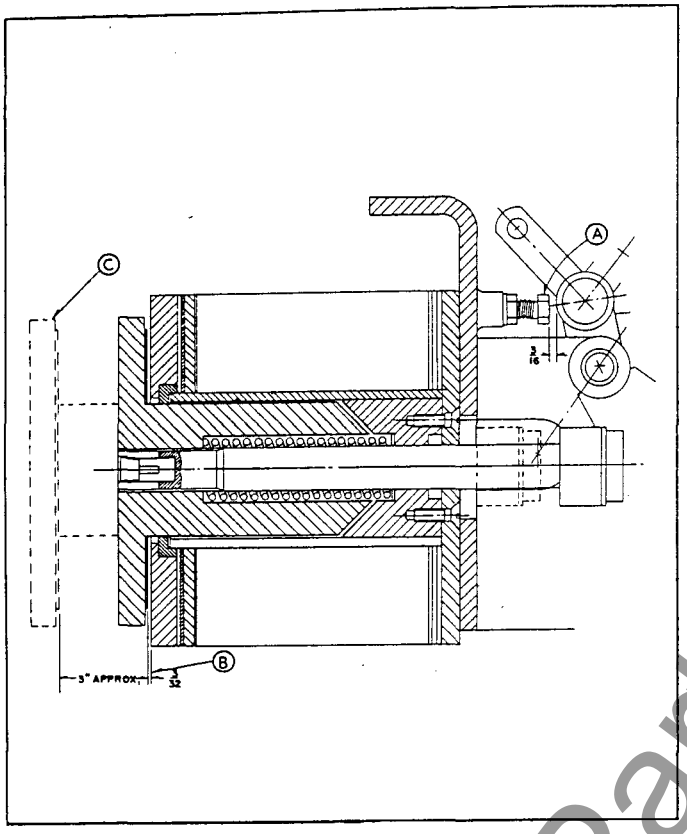

FIGURE 22

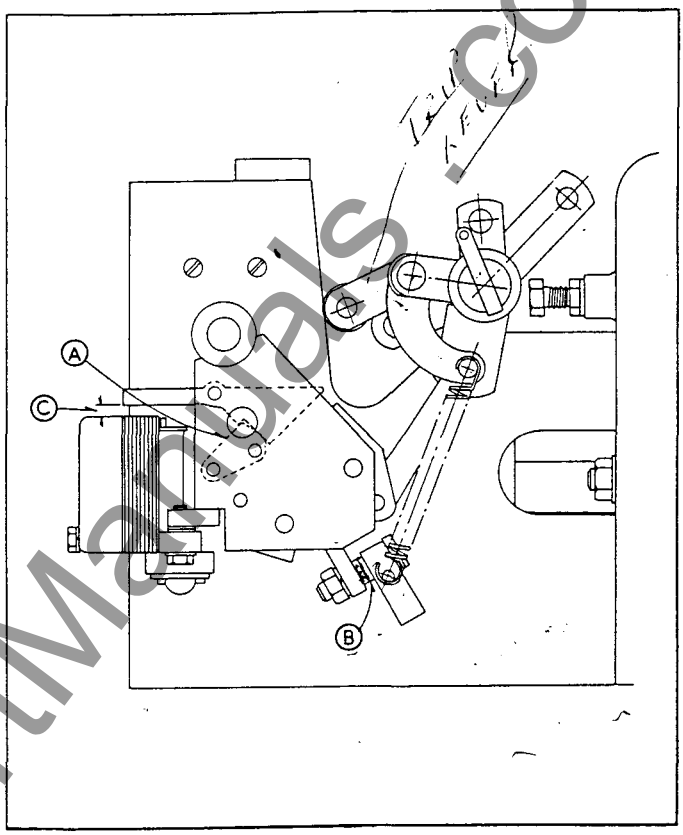

FIGURE 24

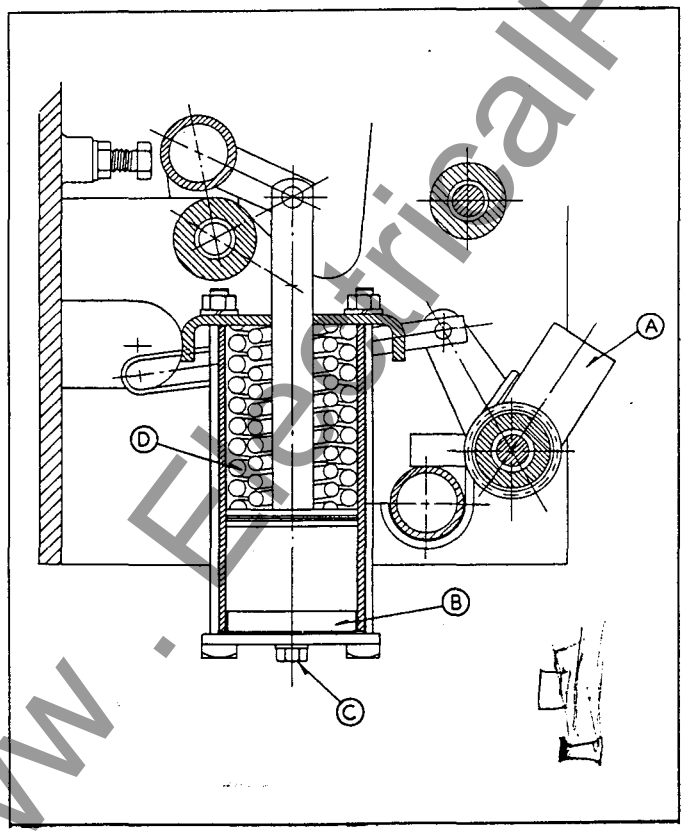

FIGURE 23

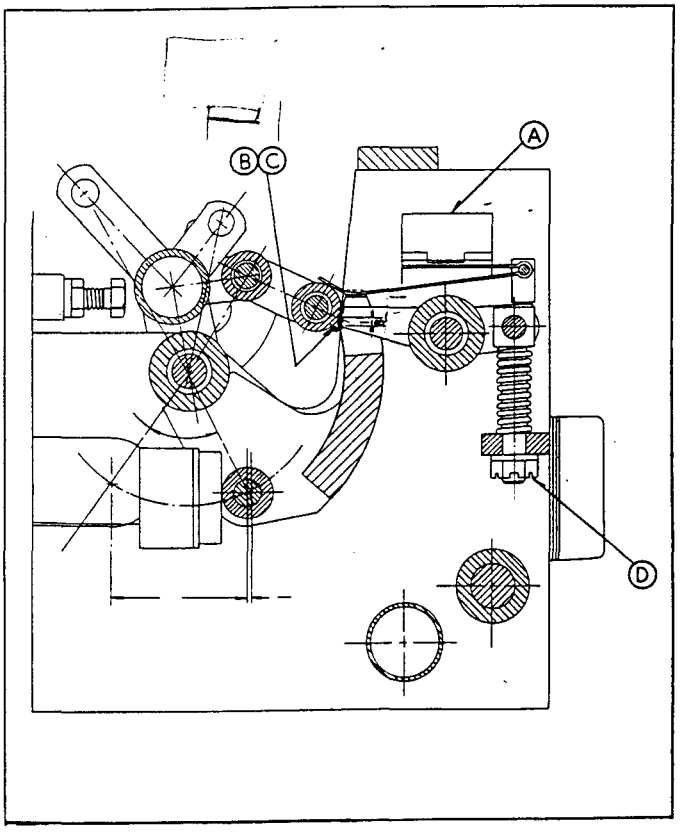

FIGURE 25

Fig. 22 15KV DST Mechanism Adjustments

1. Over-travel stop, Fig. 22-A, keeps main shaft from going dead center, but should not contact main shaft during electrical operation.

2. Adjustment, Fig. 22-B, should be 3/32" approximately. This gives enough travel to insure prop snapping into place.

3. Fig. 22-C is de-energized position of solenoid-plunger when breaker is in either open or closed position.

4. Manual closing lever. Fig. 23-A.

5. Neoprene pad to reduce shock. Fig. 23-B.

6. Exhaust orifice of shock absorber. Fig. 23-C.

7. Fig. 24-A - Latch rotates and permits toggle to collapse when armature is depressed.

8. Main opening springs. Fig. 23-D.

9. Varying number of spacers will adjust position of latch-roller to closing lever. Fig. 24-B.

10. Solenoid cut-off switch should operate only after prop snaps into position shown (breaker is closed). Fig. 25-A.

11. Tangent point of roller on surface to be 1/8" approximately from lower corner of surface. Fig. 25-B.

12. Adjust roller to closing-lever by moving latch-assembly. Fig. 25-C.

13. Nut to adjust prop to roller. Fig. 25-D.

14. 3/8" or enough gap to insure tripping. Fig. 24-C.

METHOD OF OPERATION

SEE SCHEMATIC DIAGRAM - Figure 26

Closing:

Assuming breaker is in the open position with voltage on the control bus, close control switch contact cs/c. Control relay 52/x is energized through a normally closed 52/y contact. Two (2) circuits are made simultaneously when control relay 52/x contacts close.

a. Seal-in circuit: Control relay 52/x is sealed in through its own contact which parallels cs/c contact.

b. Closing coil circuit: Control relay 52/x energizes the breaker closing coil 52/cc which closes the breaker.

Cut-off switch 52/aa closes just prior to the breaker main contacts, energizing the anti-pump relay, 52/y, through the 52/x seal-in contact. 52/y seals itself in and will remain energized until contact cs/c opens.

The normally closed 52/y contact in the control relay (52/x) circuit opens, thereby de-energizing 52/x which in turn breaks its seal-in contact and de-energizes the breaker closing coil.

Should the operator close the control switch when the breaker is already closed, the closing circuit will not again be energized - the 52/y coil will be energized through the cs/c and 52/aa contacts thus keeping the control relay (52/x) circuit open.

Anti-pump Feature:

If the operator closes the control switch, and holds the switch in that position when there is a short circuit on the load side of the circuit breaker, the overcurrent relays will function and energize the shunt trip coil, which will trip the breaker open.

Reclosure (pumping) of the circuit breaker is prevented because at that instant the 52/y coil is energized and its 52/y contact in the circuit of the 52/x coil is open. Therefore, the control relay 52/x cannot be energized and thus attempt to close the breaker again.

Suppressor Rectifier:

This rectifier is shown across the solenoid closing coil 52/cc. Its function is to limit the inductive kick when the circuit is opened and thus reduces the arc across the 52/x contacts in series with the 52/cc coil.

It is used only when the control circuit is direct current.

Opening:

Assuming breaker is in the closed position, energizing the trip coil from control switch or relays opens the circuit breaker by mechanical action of its operating mechanism.

Special Note:

This instruction covers the circuit breaker as manufactured in standard form. It is necessary to refer to the actual diagrams supplied with the circuit breaker, because the diagram shown is typical, and there are many variations for meeting job requirements.

SOURCES OF CONTROL

Federal Pacific Type DST Air Circuit Breakers are operated by d-c solenoids and shunt trip coils. The following methods of operating are available.

Station Battery Closing and Tripping. The recommended method of operation of the DST air circuit breaker is by means of 125 volt d-c station battery-the most reliable source of power because it is essentially

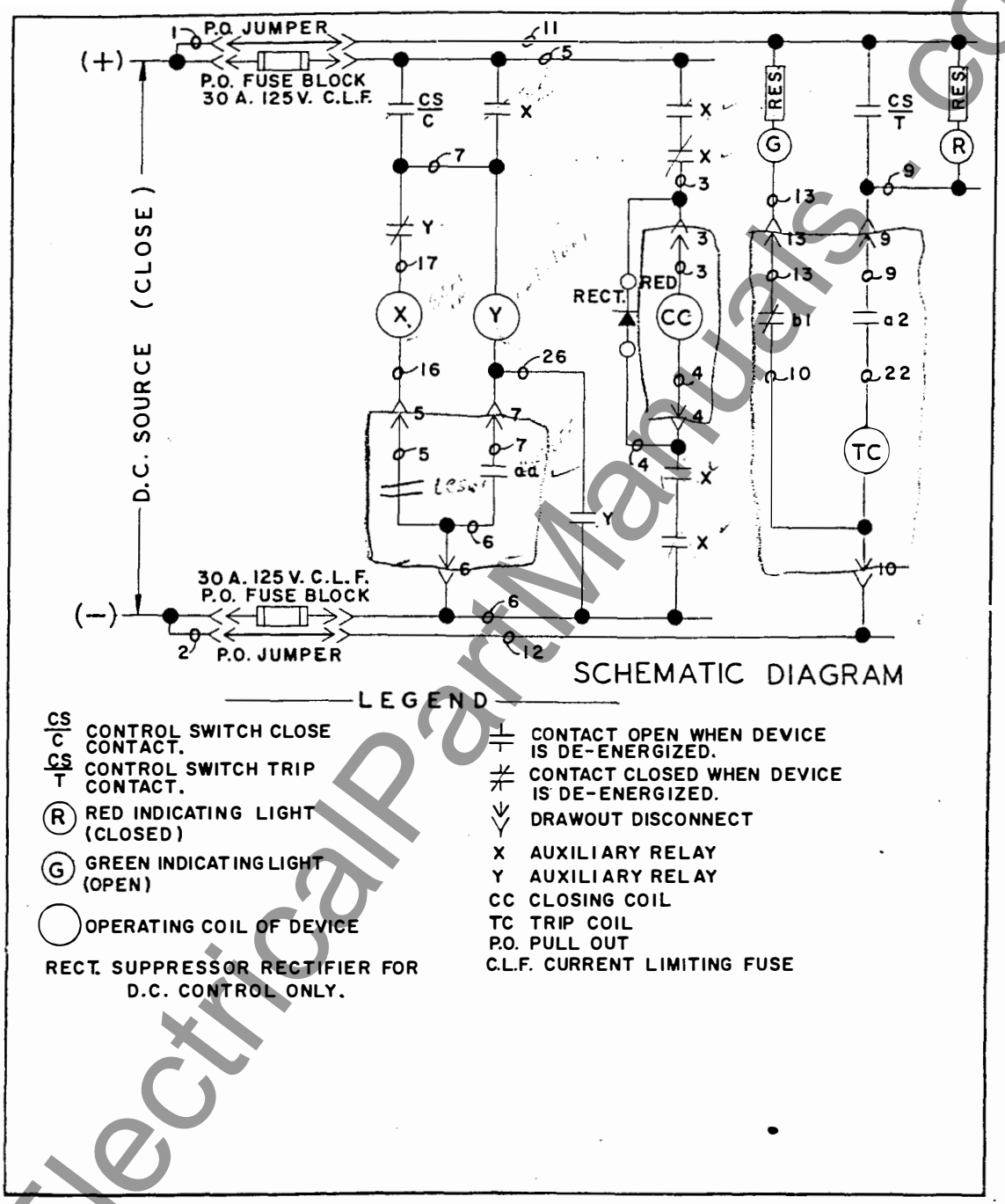

FIGURE 26

independent of the a-c system conditions, and is available at all times.

Rectified AC Closing. This type of operation finds its greatest application in outdoor installations or small isolated indoor installations where the housing and maintenance of a 125 volt station battery creates a major problem. A single phase operating transformer is used to supply 240 volt a-c to a rectifier, which furnishes 125 volt d-c to operate the breaker.

Tripping Battery. If a breaker is a-c closed, it is recommended that a d-c tripping battery be supplied. A constant, reliable source of tripping power is essential for a well-designed, dependable substation.

Capacitor Trip. In applications where it is impractical to supply a source of d-c control, a 240 volt a-c capacitor trip may be used. This requires that a potential transformer be connected to the incoming line ahead of the circuit breakers so that the capacitor trip device is energized before the breaker is closed. A 125 volt d-c shunt trip coil is used.

RATED CONTROL VOLTAGES AND THEIR RANGE

Rated control voltages and their ranges for control and power supply of operating mechanisms of breakers, when measured at the terminals of the mechanisms are;

CLOSING COILS

Source Voltage	Coil Voltage	Symbol	Amps.	Voltage Range
125 DC	125 DC	1551-1672	100	90-130
250 DC	250 DC	1552-1672	50	180-260
230 AC (Note #1)	125 DC	1551-1672	100	190-250
230 AC (Note #2)	125 DC	1553-1672	84	190-250

TRIP COILS

24 DC	24 DC	1551-0409	25.6	14-30
48 DC	48 DC	1554-0409	12.3	28-60
125 DC	125 DC	1551-1003	5	70-140
250 DC	250 DC		2.5	180-260
Capacitor Reactor	125 DC	1551-1003	--	190-250

WIRING DIAGRAMS

Scheme	Symbol	
	Without Latch Check	With Latch Check and Lockout
DC close and trip	1501-0395	1501-1955
AC close DC trip	1501-0394	1501-1956
AC close capacitor trip	1501-0396	1501-1957

Nameplate Marking

DST 5-75, 150, 250	DST 15-150, 250, 500
Rated KV 4.16	13.8
Max. Des. KV 4.76	15.0
BIL KV 60	95
Rated freq. 60	60

- Closing and trip volts are coil voltages **not** source voltages.

NOTE #1 - For use with DST 5-250, 15-500, 1200A and **all** 2000A breakers.

NOTE #2 - For use with DST 5-75, 5-150, 15-150 and 15-250, 1200A breakers only.

FIGURE 27

Coil Data

Closing coil
Closing time approximately 5 cycles after coil is energized.

Shunt trip coil
This coil is also used when capacitor trip device is specified.

Tripping time approximately 3.5 cycles from the time the coil is energized until the arc is broken.

Test Data

50 Micro-ohm resistance top to bottom of main contact.

Insulation test
10,000 megohms to ground

Dielectric test - DST-5 air circuit breaker 19 KV, 60 cycle, one minute dielectric withstand. (Test should be made with arc-chutes and interphase barriers in position, and from phase-to-phase and phase-to-ground).

Dielectric test - DST-15 air circuit breaker 36 KV, 60 cycle, one minute dielectric withstand. (Test should be made with arc-chutes and interphase barriers in position, and from phase-to-phase and phase-to-ground).

Secondary control wiring

1500 volt, 60 cycle one minute dielectric withstand.

Milli-Volt Drop Tests
Subject to Modification

Upper Flange to Lower Flange	Stud to Stud Without Clusters	Stud to Stud With Clusters
5KV		
1200	40	
2000	25	
15KV		
1200	50	
2000	35	

AIR CIRCUIT BREAKER MAINTENANCE

Federal Pacific Electric Company high voltage air circuit breakers are designed, tested and manufactured in accordance with NEMA Standards for power circuit breakers, Pub. No. SG4-1954 and as amended.

A periodic maintenance schedule should be established in accordance with NEMA Standards to insure years of trouble-free operation. The easily accessible arc-chutes, arc-contacts, many contacts etc. allow a complete inspection in a minimum of time.

Particular attention should be paid to NEMA SG4-5.07, paragraphs A & K, and a maintenance schedule put in effect based on the frequency of operation or six month intervals, whichever comes first.

Breakers installed under ideal operating conditions naturally should require less maintenance than those operating under more adverse conditions.

A convenient air circuit breaker log sheet is provided for each breaker.

NEMA - Standard for Power Circuit Breakers

SG4-5.07 repetitive duty and normal maintenance

Power operated breakers, when operating under usual service conditions, shall be capable of operating the required number of times given in the table on Page 34. The operating conditions and the permissible effect upon the breakers are given in the following paragraphs. For each column, all paragraphs listed must be given consideration.

Note: Conditions of switching of arc-furnaces or capacitors may require special consideration.

All parts of a breaker that function during a normal operation shall be included. Other parts such as overload coils, that function only during infrequent abnormal circuit conditions shall be excluded.

Servicing

Servicing shall consist of adjusting, cleaning, lubricating, tightening, etc., as recommended by the manufacturer. The operations listed are on the basis of servicing at intervals of six months or less.

Note: Federal Pacific Electric Air Circuit Breakers are designed as follows in accordance with NEMA SG4-2.13.

DST 5-75	1200 amp Line 1
DST 5-150	1200 amp Line 4
DST 5-150	2000 amp Line 5
DST 5-250	1200 amp Line 6
DST 5-250	2000 amp Line 7
DST 15-150	1200 amp Line 13
DST 15-250	1200 amp Line 14
DST 15-250	1200 amp Line 16
DST 15-500	2000 amp Line 17

Visual Inspection

Arc-Chutes: Tip the arc-chute back on the hinge pin and check the condition of the blow-out coils, interrupting chamber and arc-runners. (Small pieces or flakes of the ceramic arc plates may

chip off, if large pieces are broken a more thorough examination should be made to determine the extent of the damage.)

The interrupter chamber will become discolored with fault current interruption, (yellow, blue-green, or brown color but is operable unless mechanical damage is done to the arc-chamber or arc plates.

Arc-Contacts: The arc-contacts should be reasonably clean and free of pits, voids, and irregularities. A fine file may be used to dress the arc contacts. Minor pitting, etc., is to be expected under service conditions and will not necessitate replacement. Severe fault conditions will understandably cause more damage and may require replacement.

Arc-Contact Alignment: The arc-contacts should make before the main contacts and break after the main contacts. The stationary arcing contact is not adjustable, but the moving arc-contacts are individually adjustable, and should make within 1/16" of each other. (Close the breaker slowly with maintenance closing bar and observe three pole operation from the side of the breaker.)

Main Contacts: The main contacts should be reasonably clean and free of irregularities. Each contact is spring loaded, and in the open position the contact surfaces may not seat parallel. No current is interrupted by the main contacts and little or no pitting should be expected.

Main Contact Alignment: The lower set of main contacts should make before the upper set. Neither the upper or lower main contacts are adjustable, but are rather spring loaded. The lower and upper contacts should deflect 1/8". The upper main contacts should be 5/16" apart when the arcing contacts touch. (Close the breaker slowly with the maintenance closing bar and observe three pole operation from the side of the breaker.) A positive check on contact alignment is as follows: Insert a piece of white paper against the fixed main contacts with a piece of carbon paper between the white paper and moving contacts. Close the breaker slowly with the maintenance closing bar until it is latched closed. Trip the breaker manually and observe the contact line imprints on the white paper. A line contact of 50° per cent per contact is acceptable.

Auxiliary Switch: The "b" contacts should make in the open position and the "a" contacts in the closed position. The fingers of the auxiliary switches contacts can be dressed with crocus cloth if pitted. Severe pitting should be investigated circuit-wise and the auxiliary switch replaced.

Secondary Disconnects: The male prongs of the secondary disconnect should be clean and free of pitting. The molded housing should be reasonably clean and free of grease. (A small amount of petrolatum may be used on the two large guide pins and the small interlock pin.) Crocus cloth may be used to dress the male connectors.

Primary Disconnects: The primary disconnects should be clean and free of pitting. All the springs should be tight and the entire assembly should rotate freely on the stud. Loose springs will cause pitting of the contact areas and heating of the cell bushings as well as the breaker. Primary disconnects should be replaced as an assembly.

Lubrication

Trip Mechanism: A good grade of silicon grease or other lubricant that does not become stiff in cold weather should be used to lubricate the trip mechanism. The trip trigger should be kept free of corrosion at all times. All of the pins, bearing, etc., are a combination of non-ferrous metals and no corrosion or settling should result if lightly lubricated.

Closing Mechanism: A good grade of silicon grease or other lubricant that does not become stiff in. cold weather should be used to lubricate the closing mechanism. All of the pins, bearings, etc., are a combination of non-ferrous metals and no corrosion seizing should result if lightly lubricated.

Racking-in Mechanism: Any good grade of heavy grease may be used to lubricate the bearings, wormgear, etc.

Primary Disconnects: The leading edges should be lightly greased with petrolatum to provide less friction when racking-in. Caution: excessive petrolatum will melt off at high temperatures and establish a potential track path in the cell bushing.

Operational Inspection

Manual Close: Close the breaker slowly with the maintenance closing bar (arc chutes should be down and breaker completely operable except interphase barrier should be off). The breaker should close smoothly and easily.

A small amount of tremor should be experienced after the breaker latches in. **CAUTION:** Do not close breaker in operate position with maintenance closing bar or without interphase barrier.

Manual Trip: Trip the breaker by lifting the interlock trip bar. The breaker should trip easily with a minimum of lifting effort.

Electrical Close: Close the breaker by means of the test cabinet or in the test position in the cell.

Low Voltage Trip: Trip the breaker electrically with

the trip voltage adjusted to the minimum voltage indicated.

Rated	Minimum
24V DC	14V DC
48V DC	28V DC
125V DC	70V DC
250V DC	180V DC
230V AC (CAP.)	190V AC

Note: The trip voltage should be measured across the trip coil, *not* at the source. The armature may be blocked up to prevent tripping to get a steady voltage reading.

Puffer and Arc Chutes: Place a piece of thin paper over each arc chute and trip the breaker. The air blast from the puffer will raise the papers if the puffer is functioning properly and the arc-chute is free of obstructions.

When corresponding with the Factory, the following information should be given:

VOLTAGE CLASS _____

CONTINUOUS CURRENT _____

INTERRUPTING RATING _____

CLOSING VOLTAGE _____

CLOSING VOLTAGE RANGE _____

TRIP VOLTAGE _____

TRIP VOLTAGE RANGE _____

DATE INSTALLED _____

OPERATION COUNTER WHEN RECEIVED _____

OPERATION COUNTER WHEN INSTALLED _____

SERIAL NUMBER _____

REPLACEMENT OF COILS

Shunt-trip coil

Remove circuit breaker from cell.
Disconnect shunt-trip leads from terminal block.
Two hex head bolts support the shunt-trip device.

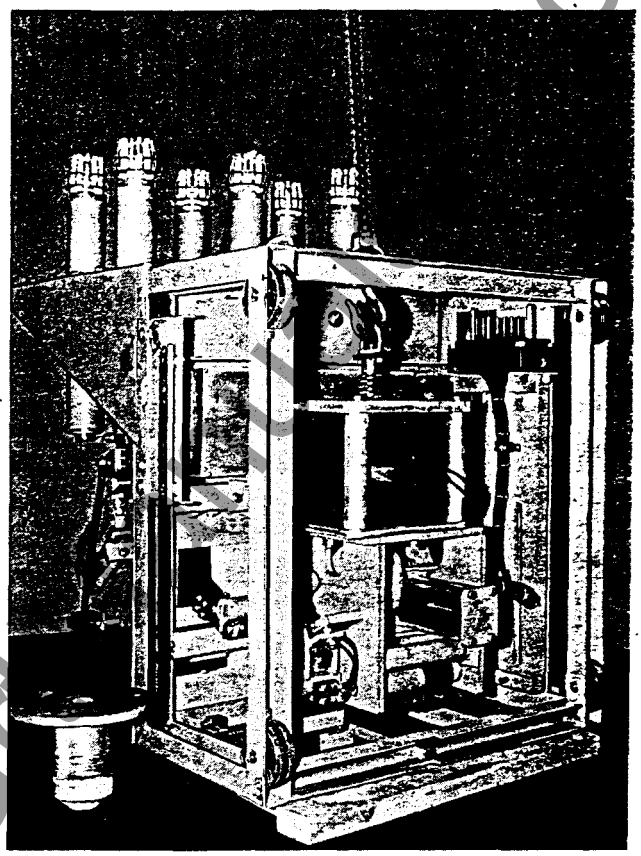

FIGURE 28

Remove these bolts and lift out the entire shunt trip device.
The shunt-trip coil can be replaced in a few minutes.

REPLACING SOLENOID COIL DST 15-500

Remove circuit breaker from cell and tip forward as shown in Figure 28. Disconnect the two coil-leads for the terminal block. Polarity is unimportant.

Remove circular plunger plate, etc., by removing the two 1-1/4" socket-head cap-screws that fasten it to the plunger shaft. Be careful to save the brass shims under the plunger-plate, also the two screws.

Remove end-plate, thus exposing coil.

Lift out coil (approximately 80 lbs.) noting that leads emerge from coil on right hand side of solenoid frame (as seen from rear of breaker).

Insert new coil, have leads emerge in proper direction.

Reassemble carefully in reverse order.

REPLACING SOLENOID MECHANISM AND COIL DST 5-250

Remove circuit breaker from cell and tip forward as shown in Figure 28. Disconnect the two coil-leads from the terminal block. Polarity is unimportant.

Remove circular plunger-plate, etc., by removing the two 1-1/4" socket-head cap-screws that fasten it to the plunger shaft. Be careful to save the brass shims under the plunger plate, also the two screws. Attach crane or hoist to the plunger shaft as shown in figure.

Loosen puffer device.

Remove the nuts from the three holding bolts on the bottom of the solenoid frame.

Lift complete solenoid out and set it down on floor or bench.

Remove end-plate, thus exposing coil.

Lift out coil (approximately 80 lbs.) noting that leads emerge from coil on right hand side of solenoid frame (as seen from rear of breaker).

Insert new coil, have leads emerge in proper direction.

Reassemble carefully in reverse order.

Lower complete solenoid into breaker frame. Adjust so that coil leads are on the right hand side. The 3 bolts on bottom plate will lineup with holes in breaker mechanism.

RECOMMENDED STOCK OF RENEWAL PARTS

One set of parts for every ten (10) circuit breakers.

1 Set of arcing contacts
1 Set main disconnecting contacts assembly
1 Shunt trip coil
1 Set lift or pull rods
1 Lot of fingers and segments for auxiliary switches
1 Secondary disconnecting block complete

Note: When ordering any of the items listed below the Serial Number of the breaker must be given.

FED-
Serial No._____

RECOMMENDED SPARE PARTS

*DST-5, 250-1200 Amp Air Circuit Breaker

General Assembly Drawing 1551-1653

Quantity - Total for one Circuit Breaker

3	Arcing contact, stationary	Dwg. 1551-1182
3	Arcing contact, movable	Dwg. 1551-1080
3	Main contact, upper stationary	Dwg. 1551-1073
3	Main contact, lower stationary	Dwg. 1551-1075
3	Main contact, movable	Dwg. 1551-1081
3	Arc chutes	Dwg. 1551-1590
6	Clusters (10 fingers each)	Dwg. 1551-0284
3	Pull-rod assembly	Dwg. 1551-1270
1	Solenoid coil, 250 volts DC	Dwg. 1552-1672
1	Solenoid coil, 125 volts DC (230 V AC source)	Dwg. 1553-1672
1	Solenoid coil, 125 volts DC	Dwg. 1551-1672
1	Shunt trip coil, 24 volts DC	Dwg. 1551-0409
1	Shunt trip coil, 48 volts DC	Dwg. 1551-1002
1	Shunt trip coil, 125 volts DC	Dwg. 1551-1003
1	Eight circuit auxiliary switch	Dwg. 1551-1665
4	One stage only of auxiliary switch	Dwg. 1551-1216

Control Panel for Outdoor-Indoor Metal-Clad Switchgear - Dwg. 2253-0387 or 3351-0454

Quantity - Total for One Circuit Breaker

1	Rectifier, 100 Amp	Dwg. 2701-0244
1	Suppressor Rectifier Reference Dwg. 3300-0006	Dwg. 087-004
1	Capacitor Trip Device	Dwg. 2753-0137
1	X Relay Contactor Bull. 501-U-151-CA-186-M, 115 V DC	Dwg. 039-017
1	X Relay Contactor Bull. 501-U-151-06-M, 230 V, 60 Cycle	Dwg. 039-016
1	X Relay Contactor Bull. 501-U-151-CA-187-M, 250 V DC	Dwg. 039-018
1	Y Relay, 2 N.O. & 2 N.C. Contacts, 115 V DC Continuous Duty, Coil Resistance 3650 Ohms	Dwg. 095-002
1	Y Relay, 2 N.O. & 2 N.C. Contacts, 230 V, 60 Cycle Coil Resistance 180 Ohms	Dwg. 095-004
1	Y Relay, 2 N.O. & 2 N.C. Contacts, 250 V DC Continuous Duty, Coil Resistance 13,000 Ohms	Dwg. 095-005
1	Fixed Resistor, 25 Watt, 1250 Ohms	Dwg. 099-013
1	18 Point Contact Secondary Block	Dwg. 2752-0107
1	18 Point Contact Secondary Block (Cell)	Dwg. 2751-0107

*See Renewal Parts Catalogs for other Rated Breakers

SUGGESTED AIR CIRCUIT BREAKER LOG SHEET

Inspection	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Date										
Inspector										
OPERATION COUNTER										
OPERATIONS SINCE SERVICING										
VISUAL INSPECTION										
ARC CHUTES										
ARCING CONTACTS										
ARCING CONTACT ALIGNMENT										
MAIN CONTACTS										
MAIN CONTACT ALIGNMENT										
AUXILIARY SWITCH										
SECONDARY DISCONNECTS										
PRIMARY DISCONNECTS										
LUBRICATION										
TRIP MECHANISM										
CLOSING MECHANISM										
RACKING IN MECHANISM										
PRIMARY DISCONNECTS										
OPERATIONAL INSPECTION										
MANUAL CLOSE										
MANUAL TRIP										
ELECTRICAL CLOSE										
ELECTRICAL TRIP										
LOW VOLTAGE TRIP										
PUFFER AND ARC CHUTES										

Code:

G-Good, F-Fair, X-should be replaced next inspection.

NOTES: _____

_____

_____

COMPLETE INSPECTION AND OPERATING TEST PROCEDURE FOR

4.16 KV-75/150/250 MVA, 1200 amp.
13.8 KV-150/250/500 MVA, 1200 amp.
4.16 KV-150/250/ 2000 amp.
13.8 KV-250/500/ 2000 amp.

Breaker Type DST 5-350, 4.16 KV
_____ MVA 1200 AMP. DATE 12-8-65

Serial No. 6210
Shop Ord. No. Fed. _____
Mfg. Ord. No. _____

Operating voltage range: Close 125 v. D.C.
V_____, TRIP 125 V_____

Operating time at normal voltage: Close____sec.
Trip_____sec. Reclose_____sec.
Breaker nameplate agrees with bill of material (v)_____

1. Check all hardware to be tight and in place (v) ✓

2. Control wiring continuity check ✓
Wiring Diagram No._____ Rev. No._____

3. Resistance of coils: Closing Coil .4 ohms,
Trip Coil 10 ohms. ✓

Resistance to be ±10% of the following values:

Closing Coils	Trip Coils
1551-1672 - 0.90 ohms	1551-0409 - 2.5 ohms
1552-1672 - 4.00 ohms	1551-1002 - 5.5 ohms
1553-1672 - 1.50 ohms	1551-1003 - 25 ohms

4. Mechanism adjustments before electrical operations:

(a) Close and open breaker slowly with manual closing lever holding prop away from roller. Check for smooth operation, binding, overtoggle, etc. (✓).

(b) Depress trip armature and manually close breaker.

allowable movement of main contacts 1" max. (✓). (FAST)

(c) Closing lever clearance to roller ~~(1/16-1/8)~~ MORE THAN 1/16"
_____Ga #2-4
Asm. to adjust shock absorber.

(d) Trip armature clearance to latch (.031 - .094)
O.K. Ga #3-5

(e) Trip armature engagement with latch (75% min.)
85% %
If less, check armature spring tension.

(f) Trip latch free of armature throughout latch stroke after tripping O.K.
If not free for complete stroke, call Inspection Leader.

(g) Trip armature clearance to pole face (3/8-7/16) 3/8 Ga #2-3
Adjust by the number of shims under coil frame.

(h) Closing lever wipe on roller (3/32-1/8)
O.K. in.
Adjust by adding or removing shims under latch frame asm.

(i) Prop wipe on roller (3/32-1/8)
3/32 in.
Adjust by turning adjusting nut on spring retaining screw.

(j) Stop clearance to main shaft (1/8-~~3/16~~)
_____Ga #1-2 NONE
CHECK OVER TOGGLE

(k) Closing armature overtravel clearance to plate (3/32-1/8)
3/32 Ga #2-3
Asm. to adjust by the number of shims between plunger and armature

5. *Contact* adjustments before electrical operations:

Main Contacts

(a) Contacting surface area should be 50% min. of bar with OK
Make impression using carbon and tissue. Dress contacts, if necessary

(b) Contact penetration (top and bottom all bars) 5KV, 15KV (1/8±1/32)

Adjust by turning clevis on bottom of push rods.
Ø A left - right, Ø B left - right, Ø C left - right
Top 3/16 - _____, _____ - _____, _____.

(c) Contact gap between stationary and moving

contacts _____ in.
5KV (2-7/8 ~~+ 1/4-0) Ga #3,4~~ — 3 1/2
15KV (5-1/8 + 3/8-0) Ga #1-2
ØA _____
ØB _____
ØC 3 1/16

Adjust shock absorber

(d) Primary gap at arcing contacts make 5KV, 15KV (3/8 + 1/8-0) Ga #1-3
ØA _____
ØB _____
ØC 3/8 + 3/16

Adjust using washers under spring guide nut.

Arcing Contacts

(a) Contacts on the same phase make simultaneously. OK

(b) Contacts make within 1/16 of each other on different phases. O.K.
Adjust using washers under spring guide nut.

6. **Auxiliary Switches**
Auxiliary Contacts

(a) Trip Coil - "A-A" contacts make (3/4-1) before arcing contacts touch (O.K.).

(b) Normally open "A" contacts make (0-1/4") before arcing contacts touch ( ).

(c) Normally closed "B" contacts make after arcing contacts are 60% open ( ).

Aux. contacts are adjusted by the spline shaft relation to cam or operating arm.

(d) Closing coil cut-off switch should make just after prop engages roller (O.K.).
Adjust by moving position of switch location on mech. frame.

(e) Latch check switch should make after trip armature has reset at least 50% (O.K.).
Adjust by turning operating screw in arm.

7. **Hard Trip and Lockout Switch**

Trip cam clearance to trip armature with breaker closed (1/32-Min.) 1/16" Ga #5
Trip armature overtravel with hand trip lifted (1/32-Min.) 1/32+ Ga #5
Lockout switch opens simultaneously or just before breaker trips (O.K.).
Lockout switch has overtravel with hand trip lifted (O.K.).

8. **Lubrication**

Check all latch, cams, rollers, bearings, etc. for lubrication.
Check all contacts for grease.

9. **Operating Control Voltage**

Breaker opens at 20% below minimum voltage _____ C.C.V., or _____ sec.
(At 10% below min. for 24V and 48V), (after 10 sec. delay on capacitor trip)

Breaker closes at 10% below minimum voltage _____ C.C.V.

10. **No Load Operations**

During operations observe veeder counter, semaphore, puffer operation and general performance of breakers.

Close and Trip 10 times at maximum voltage _____
Close and Trip 15 times at minimum voltage _____
Trip and Trip Free 10 times at normal voltage _____
Reclose 10 times at normal voltage _____
Reclose 15 times at minimum voltage _____
(Reclose breakers with latch check switch only)

11. **Electrical Timing**

Maximum trip time at normal voltage (0.05 sec.)
_____ sec. _____ cycles
Maximum closing time at normal voltage (0.25 sec.)
_____ sec. _____ cycles
Maximum trip free time at normal voltage (0.06 sec.)
_____ sec. _____ cycles
Maximum reclosing time at normal voltage (0.33 sec.)
_____ sec. _____ cycles
(Reclose breakers with latch check switch only)

12. **Analyzer Curves**

(a) Close and trip at minimum voltage

(b) Close and trip at normal voltage

(c) Reclose at minimum voltage

(d) Reclose at normal voltage

(e) Trip free at normal voltage
(Rebound on opening to be 10% maximum, check Orifice size.)

13. **Mechanical Check After Electrical Operations**

(a) Closing lever clearance to roller (1/16 - 1/8)
_____Ga #2-4

(b) Trip armature clearance to latch (.063 - .094)
_____Ga #3-4

(c) Trip armature engagement with latch (75% min.)
_____%

(d) Trip armature clearance to poleface (3/8 - 7/16)
_____Ga #2-3

(e) Closing lever wipe on roller (3/32 - 1/8)
_____In.

(f) Prop wipe on roller (3/32 - 1/8)
_____In.

(g) Stop clearance to main shaft (1/8 - 3/16)
_____Ga #1-2

(h) Closing armature overtravel clearance to plate (3/32 - 1/8)
_____Ga #2-3

If any changes in above, re-adjust and recheck minimum operating voltage

14. **Contact Check After Electric Operations**

Main Contacts

(a) Contact penetration
5KV, 15KV (1/8 ± 1/32)
ØA left - right, ØB left - right,
ØC left - right

Top _____ - _____, _____ - _____
_____ - _____.

(b) Contact gap (5KV 2 7/8 + 1/4-0) Ga #3-4, (15KV 5-1/8 + 3/8-0), Ga #1-2,
ØA _____
ØB _____
ØC _____

(c) Primary gap at arcing contacts make (3/8 + 1/8-0 5-15KV)
ØA _____
ØB _____
ØC _____

Arcing Contacts

(a) Contacts on same phase make simultaneously.

(b) Contacts make within 1/16 of each other on different phases.

If any changes in above, re-adjust and recheck after trip and close 5 times at normal voltage.

15. **Contact Resistance**

Resistance of new clean contacts

With baskets ( )
(1200A - 60 microhms or less)
(2000A - 40 microhms or less)

Without baskets ( )
(1200A - 30 microhms or less)
(2000A - 20 microhms or less)

ØA _____microhms
ØB _____microhms
ØC _____microhms

16. **High Potential Test**

Primary Hi Pot for one minute

36 KV for 15 KV breakers, 19 KV for 5 KV breakers

Secondary Hi Pot for one minute

1500 volt for all breakers _____

17. Test approval mark added to nameplate
_____

18. Analyzer curves and contact impression record is attached to this report _____

19. **Signatures:**

Test Inspector C. Pinkerton
Date Nov. 2-1-65

Factory Foreman _____
Date _____

Customer's Inspector _____
Date _____

Note: For making adjustments use gauges 1501-1742.

Revision No. _____ Date _____

Engineer _____