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Westinghouse

Type 50-DH-50
Air Circuit Breaker

600-1200 Amperes
5000 Volts



INSTRUCTION BOOK

Westinghouse

Type 50-DH-50 Air Circuit Breaker

600-1200 Amperes, 5000 Volts

Installation

Operation Maintenance

INSTRUCTION BOOK

CAUTIONS

Safety for Personnel	Page 6
Storage	" 7
Handling, Unloading, Unpacking	" 7

Westinghouse Electric Corporation

East Pittsburgh, Pa.

I. B. 32-130-1

Westinghouse

Type 50-DH-50 Air Circuit Breaker

600-1200 Amperes, 5000 Volts

PURPOSE

The purpose of this instruction book is to acquaint the recipient with the characteristics of the 50-DH-50 Air Circuit Breaker. This book voids the Advance Instruction Book I. B. 33-670-2 printed 6-43. Instructions necessary for the complete installation, operation and maintenance will be found between the covers of this book. The type DH Air Circuit Breaker is rather new, how-

ever, its operation is, to a considerable degree, similar to that of an oil circuit breaker. It is built by a company that has been active in the manufacture of the higher voltage power air circuit breakers for the past fifteen years.

Fundamentally a power circuit breaker is a device for interrupting a circuit between separable contacts under normal or abnormal conditions. Ordinarily circuit breakers are required to operate only infrequently although some classes of breakers are suitable for frequent operations. The type "DH De-ion" Air Circuit Breaker is designed to operate in a normal atmosphere and is not dependent on the maintenance of any stored medium, such as air or liquid dielectric. Its performance is dependable, clean-cut and free from uncertainty.

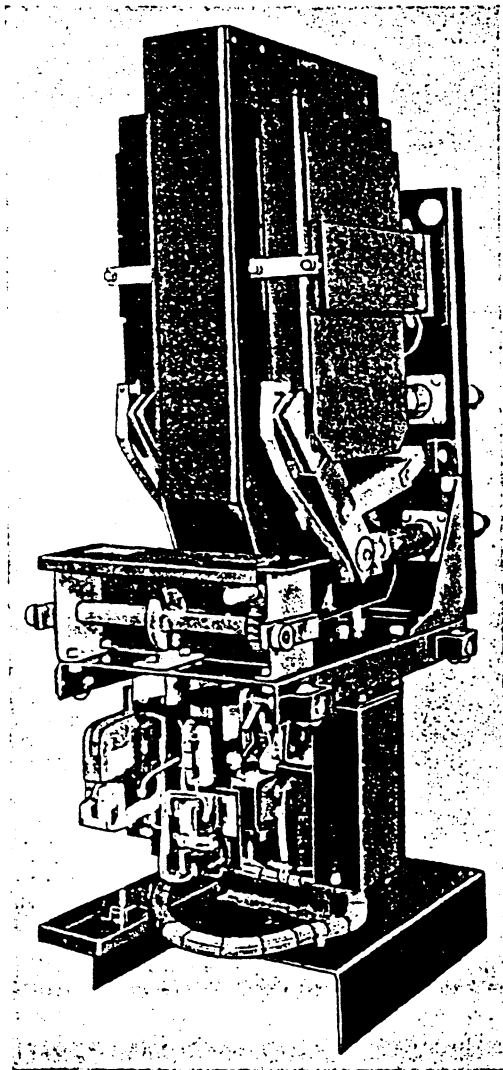


Fig. 1—Type 50-DH-50, 600 Ampere, 5000 Volt, 3-Pole, "De-ion" Air Circuit Breaker.

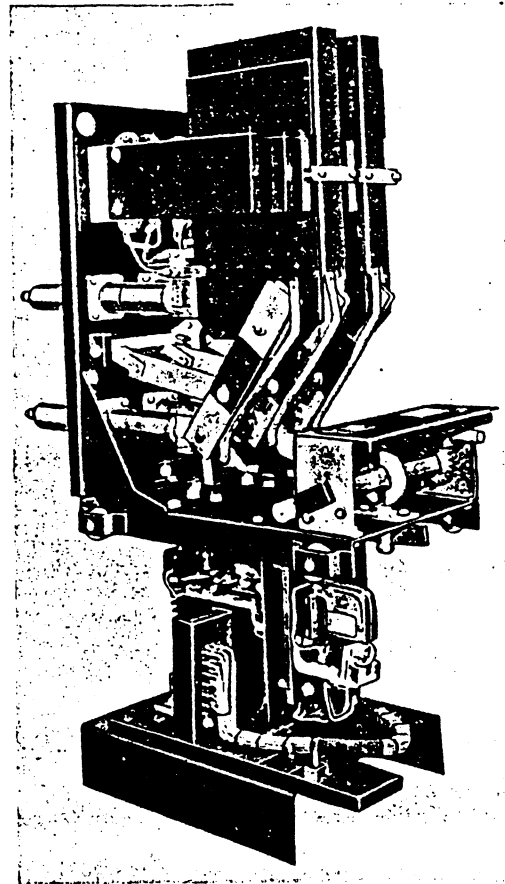


Fig. 2—Type 50-DH-50, 600 Ampere, 5000 Volt, 3-Pole, "De-ion" Air Circuit Breaker. Inter-phase Barrier and Arc Chamber Removed

all low voltage control accessories are located below the high voltage parts and isolated from them by a horizontal steel barrier to which a vertical plate is attached. This vertical plate supports the bushings, contacts, magnetic circuits, and arc chambers, all of these parts being at high potential.

Operating Mechanism

The electrical operating mechanism supplied with this breaker is the direct current solenoid type SAF-2 slightly modified to be adaptable to the application involved. This mechanism is mounted so that the moving core, operating in a vertical plane, acts through a toggle linkage, connecting rod, rotating shaft, and pull rods to close the breaker contacts. After a normal closure, upon de-energizing the closing coil, the moving core is returned to its normal open position by gravity; the breaker being held closed by the mechanism linkage until tripped by one of the tripping devices which form a part of the mechanism. If specified, a cut-off switch, to energize a control relay for interruption of the closing coil current, will be supplied. The latch-checking switch, when required, is mounted on the upper left side of the mechanism and is operated by the mechanism tripping latch. An auxiliary switch with a maximum of ten contacts is mounted vertically on the right side of the mechanism. This switch is operated simultaneously with the circuit breaker contacts.

Figure 3 shows a drawing of the breaker locating the various parts,—the primary disconnecting contacts are shown by Figure 4, page 5. The operating mechanism with auxiliary switches and



Fig. 3—Type 50-DH-50, "De-ion" Air Circuit Breaker, Front and Side View

Type 50-DH-50 Air Circuit Breaker

Contact Assembly

The breaker contact assembly, Figure 5, is located above the operating mechanism and operated by an operating rod, shaft and pull rods. This contact assembly must be capable of carrying normal load currents and drawing the arc during the interrupting periods in a manner that after circuit interruptions the contacts will be in such condition that the load current can be carried without undue temperature rise. The moving contacts are of the blade type with silvered hinged joints forming the lower contact. The upper moving main contacts consist of silvered serrations on the upper part of the blades. These serrations engage the silvered tongues of the upper studs when the breaker is in the closed position. The stationary arcing contacts are fastened to the top of and project over the stationary main tongues so that they engage the arcing contact surface on the blades as the breaker is opening or closing, however, these arcing contact surfaces do not engage each other when the breaker is in the fully closed position. The entire contact arrangement is so designed that the arcing contacts, which have arc resisting surfaces, part last on opening and engage first in closing to protect the main contact sur-

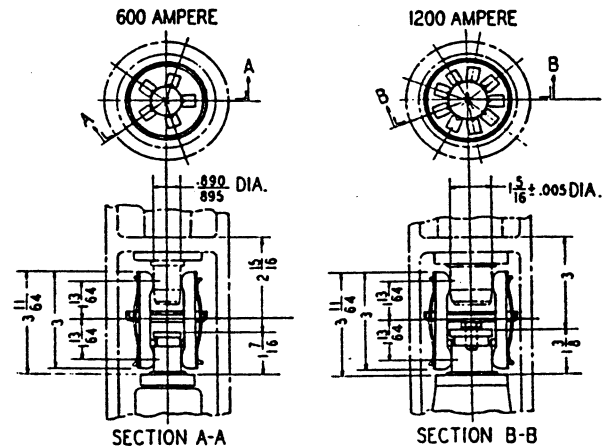


Fig. 4—Type 50-DH-50, "De-ion" Air Circuit Breaker, Primary Disconnecting Contacts

faces from any arcing that might be caused by either of these operations. Contact pressure is maintained on the earlier models by bronze spring cup washers; conical springs are used on the later designs.

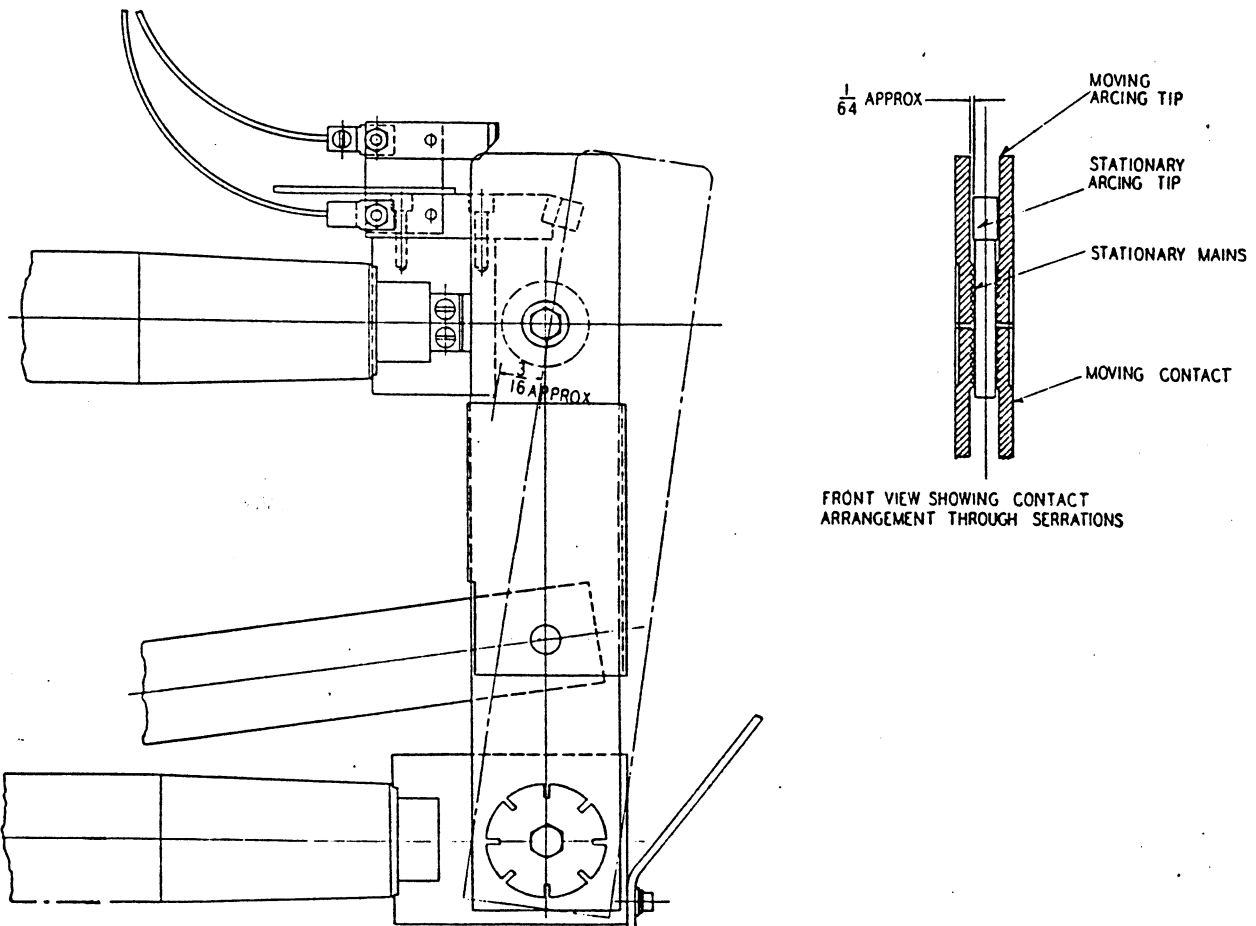


Fig. 5—Breaker Contact Assembly

Arcing Chambers and Magnetic Circuit

The arcing chambers are located immediately above the arcing contacts and consist of assemblies of laterally spaced ceramic plates, having V-shaped slots and held together with a moisture and heat resisting cement, encased in a protective covering of insulating material. An arcing horn is provided at each end of the ceramic plate assemblies and the insulating sides of the covering extend downward past the upper contacts. The arcing chambers are held in position by magnetic pole pieces. On interruption, the magnetic flux across the gap between the pole faces and through the arc chamber forces the arc upward into the interrupting slot.

Interphase Barriers

Interphase insulating barriers, built as a single unit are fastened to a support which is bolted to the horizontal steel plate base.

Operation of Breaker in Extinguishing Arc

Figure 6 shows a typical arrangement of the fundamental parts of the Type DH Air Circuit Breaker. The operation of the circuit breaker will be more clearly understood by referring to that figure while reading the remainder of this paragraph. The arcing contacts are so arranged that at the instant of parting they form a loop in the current path through the breaker, 1. The magnetic effect of this loop extends the arc rapidly upward as the contacts open, 2. Due to this looping effect, the arc almost instantly impinges against the fixed horn in the arc chamber immediately above the stationary arcing contact so that one arc terminal transfers to this horn; the other arc terminal remaining on the moving arcing contact momentarily, 3. The transfer of the arc to the horn alters the current path through the breaker to include the multi-turn coil as that coil is not carrying current when the breaker is in the closed position. Current flowing through that coil produces a magnetic flux which moves the arc upward into the arc chamber and the second arc terminal from the moving arcing contact to the arcing horn at the front end of the arc chamber, 4. A shunt path connects this horn

to the lower breaker terminal, thus relieving the contacts of the current carrying duty until the arc is extinguished in slot of the arc chamber, 5, 6.

SAFETY FOR PERSONNEL

The installation, operation, and maintenance of circuit breaker equipment requires that certain precautionary measures be taken to prevent accidents. The following list presents a few suggestions of that character.

(1) **Do not touch a live breaker:**

Parts of the circuit breaker above the horizontal isolating barrier are at line potential of the circuit to which the circuit breaker is connected. The breaker should be isolated from the circuit by disconnecting switches and the contacts solidly grounded, in conformance with conventional safety practice, before attempting any work on the breaker.

(2) Whenever possible the breaker should be in the open position when any work is being done on it. If that is impossible the trigger should be secured in the latched position by inserting a wooden block, approximately $2\frac{1}{8}'' \times \frac{3}{4}'' \times 3''$ long, between the trigger and the tripping lever in such a manner that it is impossible to move the trigger to the tripping position. Such a blocking arrangement is also useful when working with the under-voltage attachment.

(3) Before placing the circuit breaker in service make certain that the frame is effectively grounded and that minimum clearances for the rated voltages are maintained between live parts and ground. The same check as to clearances should be made between phases if barriers other than those supplied with the breaker are to be used.

(4) Never lay tools, such as wrenches and screw drivers, on any portion of the circuit breaker.

(5) When assembling the arcing chambers onto the breaker, check to see that the contact jaw on the stack has engaged the lead to the blow-in coil and that the chambers are centrally located so that there is no interference with the travel of the moving contacts.

(6) When lifting the breaker by cranes it is advisable to remove the arcing chambers and barriers before proceeding with such an operation.

(7) Do not replace any arc chamber after the ends of slots have become $\frac{3}{16}$ inches wide through erosion. (See "Arc Chambers" under "Operation and Maintenance.")

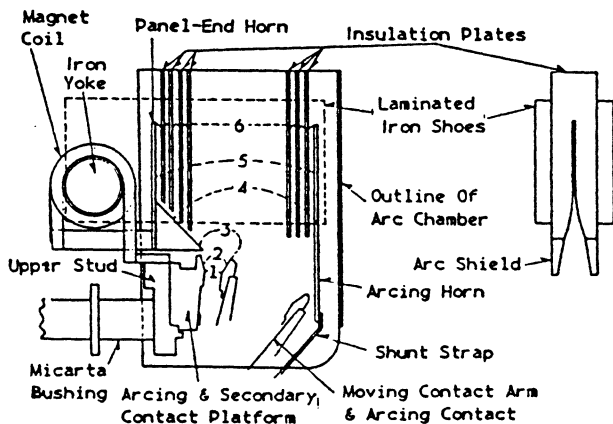


Fig. 6—Typical Arrangement of Component Parts

STORAGE

The arcing chambers and barriers are shipped separately from the breakers to guard against damage due to rough handling and for more secure protection against dust and moisture.

The breaker is designed for indoor service and should be put in a clean dry place immediately upon arrival.

HANDLING, UNLOADING and UNPACKING

The shipment of a Type DH Air Circuit Breaker requires careful handling and ample packing to protect the breaker from serious shocks while in transit. The breakers are completely assembled and tested at the factory and are then dismantled to permit the arcing chambers and barriers being shipped separately.

Immediately upon receipt of a circuit breaker, an examination should be made for any damage sustained while enroute. If injury is evident or indication of rough handling is visible, a claim should be filed at once with the Transportation Company and the nearest Westinghouse Sales Office notified promptly.

Unloading and uncrating the breaker requires very careful work. The base of the crate to which the breaker is fastened may be used as a skid in moving the breaker around. **Do Not Use Long Bars** to uncrate the breaker as they may slip through the crating and damage the equipment, a nail puller is recommended for that particular purpose. If a crane is available to use in removing the breakers from the crates considerable time can be saved in unpacking. Care should be exercised in attaching the lifting hooks to the lifting holes in the breaker frame to make certain that the chains are not lowered too far as to become untangled in some part of the breaker when the lift is made. Approximate net weights:— Breaker Complete 520 lb., Arcing Chambers 20 lb. each, Interphase Barrier 15 lb.

INSTALLATION AND ERECTION

With the exception of the arcing chambers and barriers, these breakers are shipped completely assembled and adjusted. No change in adjustments should be required and none should be made unless it is obvious that they have been disturbed. However, before attempting to operate the breaker electrically it should be closed carefully by hand to make certain that all parts are functioning properly.

At this time it is well to check the contacts to make certain that the settings have not been disturbed. The contact pressure adjustments are made with the contacts in the closed position. The lower, hinge contact, is adjusted by turning the nut two thirds of a turn past the point where it becomes snug. Pressure is secured on the upper contacts in the earlier models by cup washers held in compression by bolts and castle nuts, the castle nuts should be turned up five-sixths of a turn after they have

first been made snug. In later models the upper cup washer has been replaced with a conical spring and spacer arrangement in which case the nut should be turned up tight on the spacer and cottered in that position. When adjusted in this manner the moving contact blades will separate approximately $\frac{1}{8}$ inch when the arcing contacts engage. There should be a slight clearance between the arcing contacts when the blades are in the fully closed position, this separation is desirable to assure full pressure on the main contacts.

A light film of graphite grease is applied to both the arcing and main contacts before the breaker is operated on the test floor. This film is removed before shipment. Before the breaker is placed in service the arcing contacts should be inspected to see that they are free of oil. If the breaker is to be used in an application requiring highly repetitive operation a very light film of graphite grease applied to the main contacts will prevent galling, however, in such a case the film should always be sufficiently light so that none can work up onto the arcing contact surfaces.

As the breakers are more easily handled with the arc chambers removed it is advisable not to mount the arc chambers and barriers on the breaker until the breaker has been installed in its permanent location, and all connections made, or in the case of truck mounted breakers, until the metal clad cells are ready to receive the removable units. Before installing arc chambers inspect them to make certain that the vents and slots are open and free from foreign material. The arc chambers may then be assembled by resting their supporting surfaces on the pole faces of the magnetic circuit and sliding them into position, using the pole faces as a guide. After the arc chamber has been placed in position check to see that the contact blade of the rear arcing horn in the arc chamber has engaged the upper lead to the multi-turn coil. Connect the shunt strap to the front horn in the arc chamber. Check the tightness of the lower connection of those shunt straps as they may have loosened during transit. The stacks may then be secured in position by the non-magnetic retaining straps which are bolted to the ends of the magnetic poles. The breaker should then be closed slowly by hand to check that there is no interference in the movement of the moving contact blade.

The interphase barrier may then be bolted into position.

OPERATION AND MAINTENANCE

Starting Up

Before placing a breaker in service the power lines as well as the control wiring should be thoroughly tested for possible grounds and short circuits that might have developed during the installation period, also a final check should be made on the various control circuits to make certain that they were all operating correctly.

Maintenance

The frequency of inspection, cleaning, etc. will depend upon the activity and duty to which the breaker is subjected and upon the cleanliness of the atmosphere and surroundings of the breaker. For normal applications of the breakers described herein it is recommended that a preliminary or visual inspection be made every three months. A complete inspection, including removal of the stacks for cleaning, should be made every twelve months.

When breaker operating duty is high or where atmospheric conditions are dirty the inspections should be made more frequently. The following table is recommended as a guide for intervals between inspections until such time as accumulated experience from any particular application shall indicate that the periods may be lengthened, or should perhaps be shortened.

Inspection Detail	Frequency of Operating Duty		
	Normal 5 Oper. per day	Moderate 15 Oper. per day	Repetitive 30 Oper. per day
Clean Ex- ternal sur- faces	3 Mos.	3 Mos.	2 Mos.
Blow out Arcing Chambers	6 Mos.	3 Mos.	2 Mos.
Remove and Clean Arcing Chamber	12 Mos.	6 Mos.	4 Mos.
Inspect Contacts	6 Mos.	6 Mos.	4 Mos.
Inspect Mechanical Parts	12 Mos.	6 Mos.	4 Mos.

The frequency of repetitive operations should be limited to a maximum of 20 in 10 minutes. The maximum number of repetitive operations between maintenance periods should be 2500 whether the breaker is making inrush currents as encountered in motor starting service and interrupting up to a maximum of the breaker nameplate continuous current rating or operating on other repetitive operations which may be combined with fault duty. However, inspection and possible maintenance will be required after each fault operation.

Caution

Parts of the circuit breaker that are in the high voltage compartment of the unit are at line potential; consequently the breaker should be isolated from the line by disconnecting switches or contacts before attempting any work on the breaker. For additional safety measures see "SAFETY FOR PERSONNEL".

General

Inspect the breaker structure in general and see that all bolts, nuts, etc., are tight and that all

cotter pins, locking clips, etc. are in place. Note evidences of excessive wear or other improper operation of the various parts.

Clean off any accumulation of dust and dirt from the external surfaces. Dry compressed air is best suited for this purpose. Waste the air for a few seconds so that any residue of moisture that has accumulated in the air line will not be sprayed over insulating surfaces. Direct the air stream thoroughly into all joints and crevices. If compressed air is not available, this cleaning may be done with a clean dry cloth. Steam waste is not recommended for this purpose because of its tendency to leave a residue of lint on insulating surfaces.

Magnetic Circuit

The magnetic circuit assembly consists of the blow-in coils, the magnetic poles and yoke. This assembly is attached to and insulated from the back plate by a micarta block which is tapped to receive hexagon head bolts. Any tightening of these bolts should be done with a wrench having a lever arm of six-inches or less to avoid the possibility of stripping the threads in the micarta blocks.

Arcing Chambers

It should be borne in mind that the insulating parts of the arcing chamber remain in position across the contacts at all times. While the contacts are in the open position these insulating parts are subjected to the full potential across the breaker. Ability to withstand this potential will depend upon the care given to the insulation in the arcing chamber.

On general inspections the arcing chambers should be blown out with compressed air by directing the air stream upward from the contact area and out through the stack. Play the dry air stream thoroughly over the arc box sides (box like compartment in which the arc is drawn) and through each space between adjoining plates of the stack.

The arcing chamber should be removed periodically and thoroughly inspected. Any residue of dirt or arc combustion should be removed by a vigorous brushing. A stiff wire brush is not recommended for this purpose due to the possibility of scratching or roughening the insulating surfaces and inviting increased deposits of dirt in future service. Inspect the stack plates for metallic deposits, breakage or evidence of undue deterioration. The arc chambers derive considerable of the interrupting ability from the narrow upper end of the V-slots. That portion of the slot is nominally $\frac{1}{16}$ inch wide. When interrupting duty has caused the upper extremity of the slot to increase in width to $\frac{3}{16}$ inches the ceramic plates should be replaced.

After the arcing chamber has been replaced in position inspect to see that the contact tongue of the stack has engaged the jaw connecting to the blow-in coil and that the front arcing horn is securely connected to the lower terminal by means of the shunt straps. Also check the operation of the moving contact blades to insure that the arc chamber sides do not interfere with their travel.

Type 50-DH-50 Air Circuit Breaker

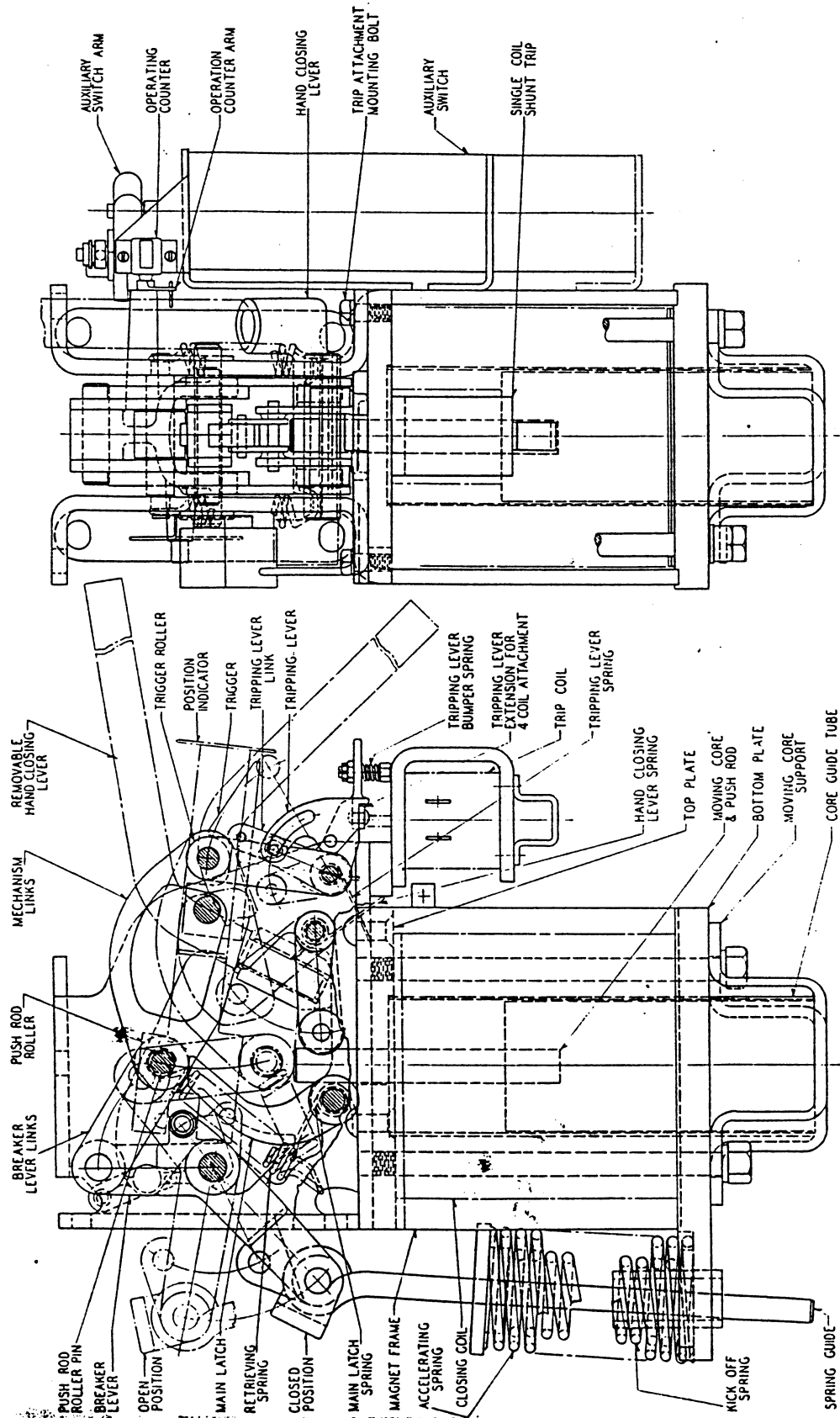


Fig. 7—Type 50-DH-50 Electrical Operating Mechanism

Contacts

The contacts should be inspected periodically for wear and for evidence of undue burning. Under normal conditions the contacts should be usable for a large number of operations within the rated rupturing capacity of the breaker. On the earlier models cup washers, held in compression by bolts and castle nuts, were used to obtain contact pressure on both the lower hinge contacts, and the upper contacts. On later models the cup washers were replaced by conical compression springs. The conical spring assembly is interchangeable with the cup washer assembly and should the customer at any time require those replacement parts it will be to his advantage if he ordered the later assembly. The contact pressure adjustments are made with the breaker in the closed position. Correct pressure for all models at the lower, hinge, contact is secured by turning the nut two-thirds of a turn past the point where it becomes snug. Correct pressure at the upper contacts for the earlier models is secured by turning the castle nuts five-sixths of a turn after they have been made snug. In the later models the compression of the conical spring is limited by a spacer; in this case the nut is turned up tight on the bolt and cottered in that position. When correctly adjusted the moving contact blades will separate approximately $\frac{1}{32}$ inch when the arcing contacts engage. There will also be a slight clearance between the arcing contacts when the blades are in the fully closed position, this separation is desirable to assure full pressure on the main contacts.

Any excessive roughness on the arcing contact surfaces may be removed with a fine file or sand paper, dust from emery cloth is conducting so should be removed before putting breaker in service. Check the tightness of the screws by which the stationary arcing contact is bolted to the upper stud.

The breaker should be opened slowly by hand to determine that the two contact surfaces part in proper sequence which should be as follows: (1) the main contacts part, (2) the arcing contacts part. When the contacts become worn to the point of changing this sequence of parting they should be replaced. This condition should not appear until the breaker has had a large number of operations.

In operating the contacts by hand there should be no binding or excessive friction. When opening the contacts slowly by hand, see that the contact arm passes to the full-open position so that the mechanism breaker lever engages the bumper.

Electrical Operating Mechanism

A type SAF-2 electrical mechanism, Figure 7, Page 9, slightly modified to best suit the particular operating conditions, is used to operate the Type 50-DH-50 Breaker. The mechanism is the direct-current solenoid type which operates on standard direct-current control voltages or, when equipped with a Rectox unit, on alternating-current. It is a mechanically full automatic mechanism and is trip free in all positions. An electrical closing operation

is secured by energizing the closing coil. A magnetic flux generated by the closing coil forces the moving core and attached push rod upwards against the push rod roller (located at the junction of the breaker lever links and the mechanism links.) By referring to Figure 7 it will be seen that this upward force straightens the toggle formed by the mechanism links and the breaker lever links causing the breaker lever to rotate counter-clockwise, as the trigger roller (which is fastened to the mechanism links) is held stationary by the trigger. Just before the moving core strikes the top plate, the main latch is forced under the push rod roller by the main latch spring, thus locking the mechanism in the closed position. The toggle formed by the breaker lever and the mechanism links is prevented from going over center by an adjustable stop on the breaker operating shaft. This stop is arranged to strike the back plate of the breaker.

Energizing the trip coil rotates the tripping lever counter-clockwise to break the tripping toggle, and pull the trigger out of engagement with the trigger roller. This permits the entire linkage, (mechanism links, breaker lever links and breaker lever) to move horizontally to the right and off the main latch, thus permitting the mechanism to move to the open position. As the push rod roller slides off the main latch, the retrieving springs pull the push rod roller downwards to reset the mechanism.

On truck mounted breakers an interlocking arrangement is connected to the SAF-2 mechanism in such a manner as to make it impossible to close the breaker if the arms of the racking-in device are in other than the "operating" or "test" position, also, this interlock prevents the rotation of the racking-in device arms when the breaker contacts are closed.

By adjusting the compressed length of the tripping lever bumper spring the toggle joint between the trigger and the tripping lever should be set either on toggle or slightly over toggle to prevent unlatching when closing the breaker on maximum voltage.

Single and Four Coil Tripping Attachments

The four coil attachment, Figure 8, Page 11, bolts to the mechanism frame in place of the single coil trip attachment. In bolting either attachment in position it is only necessary to observe that the coil plungers push the tripping lever upwards sufficiently to trip the mechanism. A tripping lever having suitable extensions must be used with the four coil attachment. The four coil attachment is designed to accommodate four tripping assemblies which may be equipped with either shunt or over-current coils and instantaneous or inverse time limit assemblies.

Overload Release

The overload release, Figure 9, Page 11, consists of the parts shown in the reference figure. The moving core is magnetically drawn against the trip

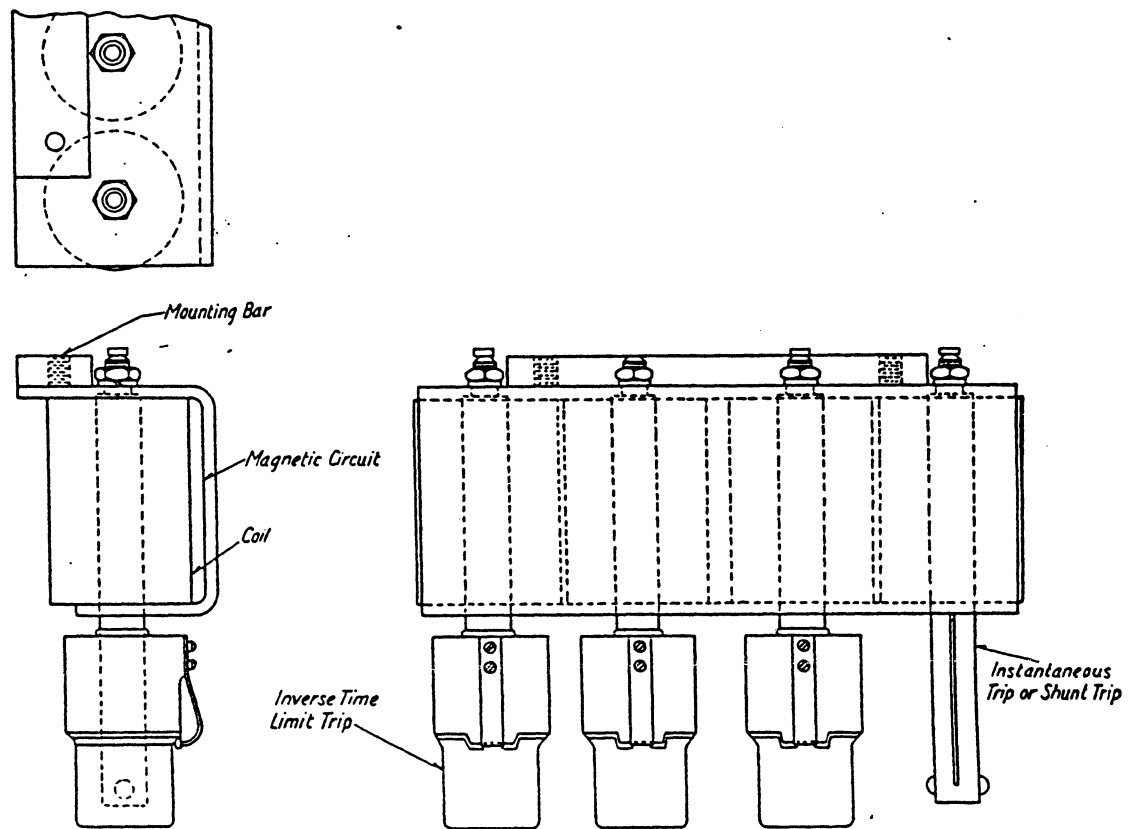


Fig. 8—Four Coil Attachment

rod which is pushed up against the tripping lever. The calibration is varied by changing the air gap between the moving and stationary cores by raising or lowering the calibration screw. The lock bolts must be drawn tight after changing the calibration. The calibration setting is indicated by figures on the tube and a line on the calibration plate. The setting thus indicated corresponds to the amperes in the secondary winding of the current transformer.

If the opening of the circuit breaker is not desired unless the overload continues, an oil dashpot delaying device is attached to the end of the moving core. The calibration is inscribed on the dashpot and is varied by screwing the pot into the cover. Time is varied by changing the number of holes in the bottom of the piston uncovered by the diaphragm. Instantaneous tripping is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the viscosity of the oil. Figure 10, page 12, shows approximate variations of the time with the variations of the overload and the effect of the two grades of oil. The values shown by these curves are approximate and will vary considerably with changes in temperature and changes in the viscosity of the oil. Where a definite time delay is required it is recommended that suitable relays be used.

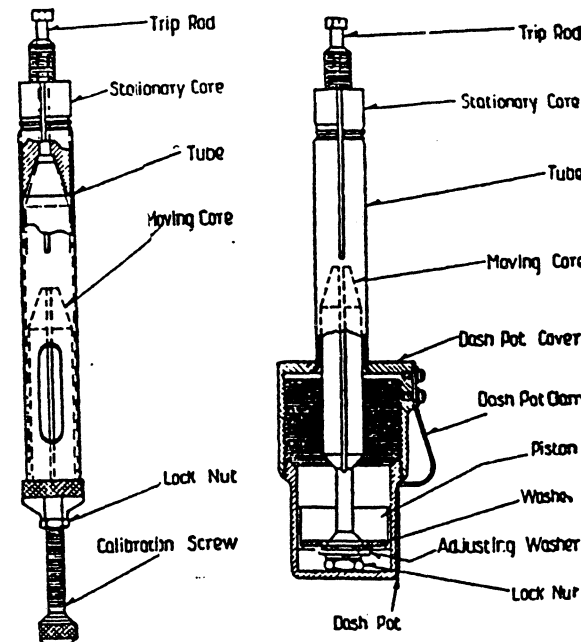


Fig. 9—Overload Release

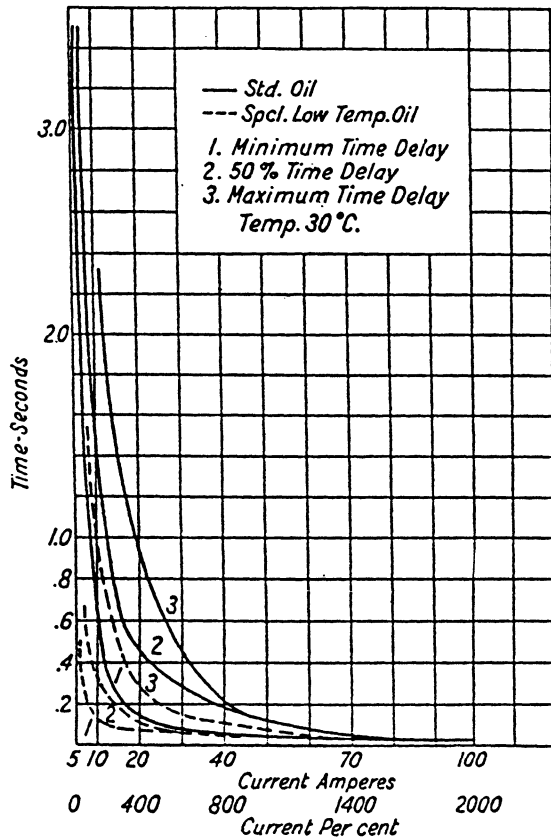


Fig. 10—Calibration Curve for Inverse-time-limit Attachment

The oil in the dashpots should be renewed periodically. Fill with oil to $\frac{3}{4}$ inch above the inside bottom surface of the cylinder, with the plunger removed.

Undervoltage Release

The undervoltage release, Figure 11, mounts on the left hand side of the mechanism frame with the two mounting screws as shown. The undervoltage reset extension of the breaker lever should operate between the undervoltage reset spring and the undervoltage hold in lever. As the mechanism closes, the reset extension of the breaker lever strikes the undervoltage hold in lever, which frees the undervoltage armature for operation in case of voltage failure. As the mechanism opens, the reset extension of the breaker lever strikes the undervoltage reset spring, retrieving the armature to its fully closed position. Failure to reset the undervoltage armature completely will result in improper operation as the holding coil is not capable of picking up the armature.

The turn buckle should clear the undervoltage armature during the tripping movement. The turn buckle should be set to secure $\frac{1}{8}$ " clearance between the end of the slot in the mechanism tripping lever and the outside adjusting bolt head, with the armature in the closed position.

The drop out voltage can be varied by regulating the extension of the two undervoltage tripping springs. A similar design, larger than shown by Fig. 11, is used on later applications.

Cut-Off Switch

The 50-DH-50 Air Circuit Breaker has been supplied with two types of cut-off switches.

The cut-off switch supplied on the earlier models is mounted on the left side of the mechanism just back of the undervoltage attachment, Figure 12, page 13. It is a normally closed switch that is held in the open position by means of an auxiliary compression spring which acts on the auxiliary switch lever. During the last portion of the closing stroke the moving core strikes the switch pin which

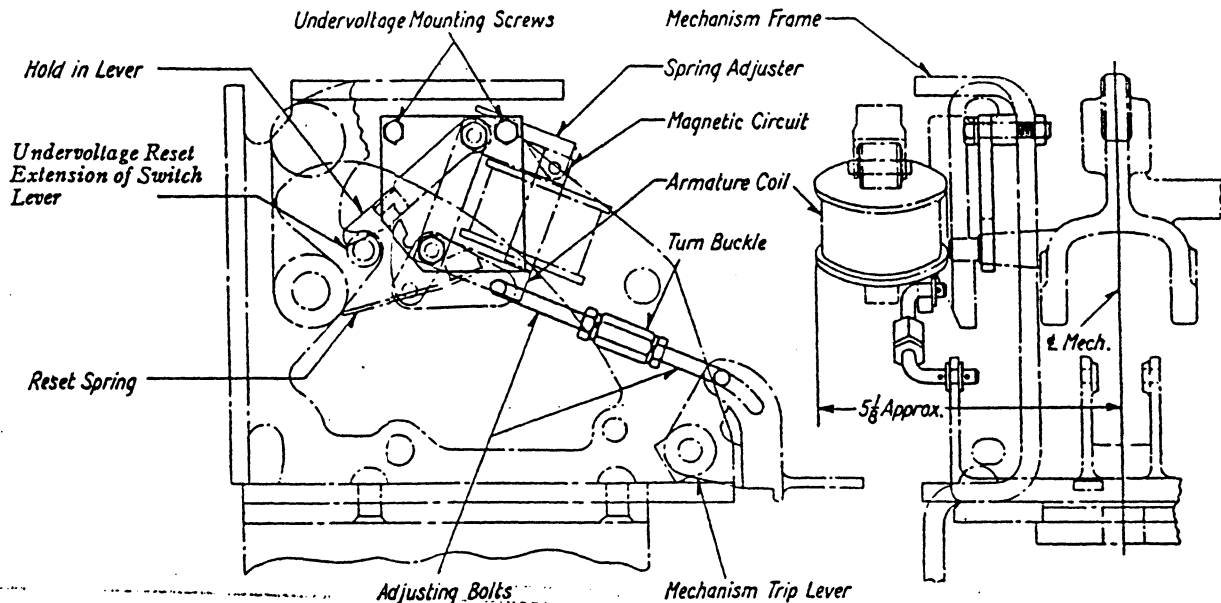


Fig. 11—Undervoltage Operating Assembly

of the closing stroke the mechanism push rod roller pin strikes that switch lever causing it to rotate and permit the switch to make contact—in this case contact is maintained when the circuit breaker is in the latched position. On a trip-free operation the push rod roller pin moves forward to engage the vertical leg of the switch lever thus causing a rotation of that lever to permit closure of the cut-off switch contacts.

Latch Checking Switch

The latch checking switch, Figure 14, mounts on the frame by two screws as shown in the reference figure. The switch operates directly from

the tripping lever and makes contact when the tripping lever is in the normal position and breaks contact when the tripping lever is raised.

Operation Counter

The operation counter mounts on the upper auxiliary switch bracket. After mounting in place and connecting to the auxiliary switch extension of the breaker lever, the operation counter arm should be loosened and set so that only one number is recorded for each operation of the mechanism. This setting should be checked for both manual and electrical operation of the mechanism.

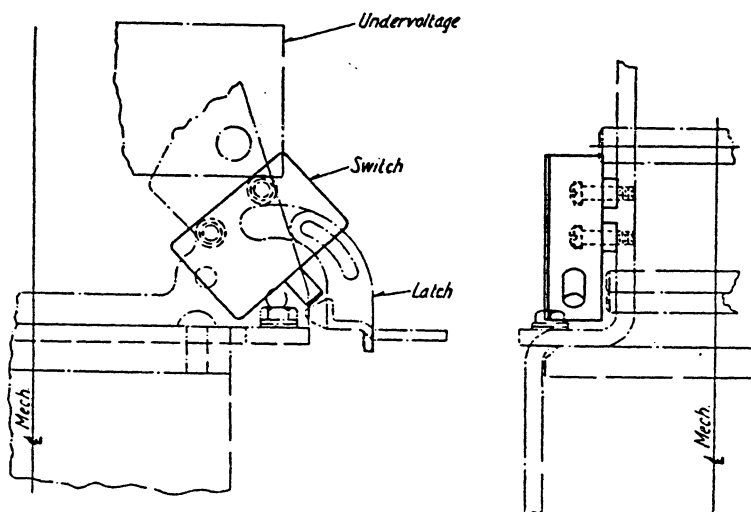
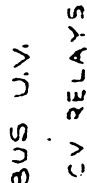
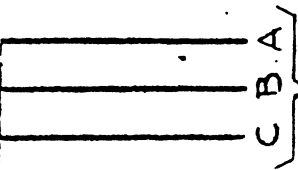


Fig. 14—Latch Checking Switch



WTH
50 DH 50
125 VDC
TYPE MECH
SAF-2