



DESCRIPTION • INSTALLATION • MAINTENANCE
INSTRUCTIONS

Low-Voltage
METAL-ENCLOSED
SWITCHGEAR

WESTINGHOUSE ELECTRIC CORPORATION
SWITCHGEAR DIVISION

EAST PITTSBURGH PLANT

EAST PITTSBURGH, PA.

SUPERSEDES I.B. 32-100-1

DECEMBER, 1952

(Rep. 11-66) Printed in U.S.A.

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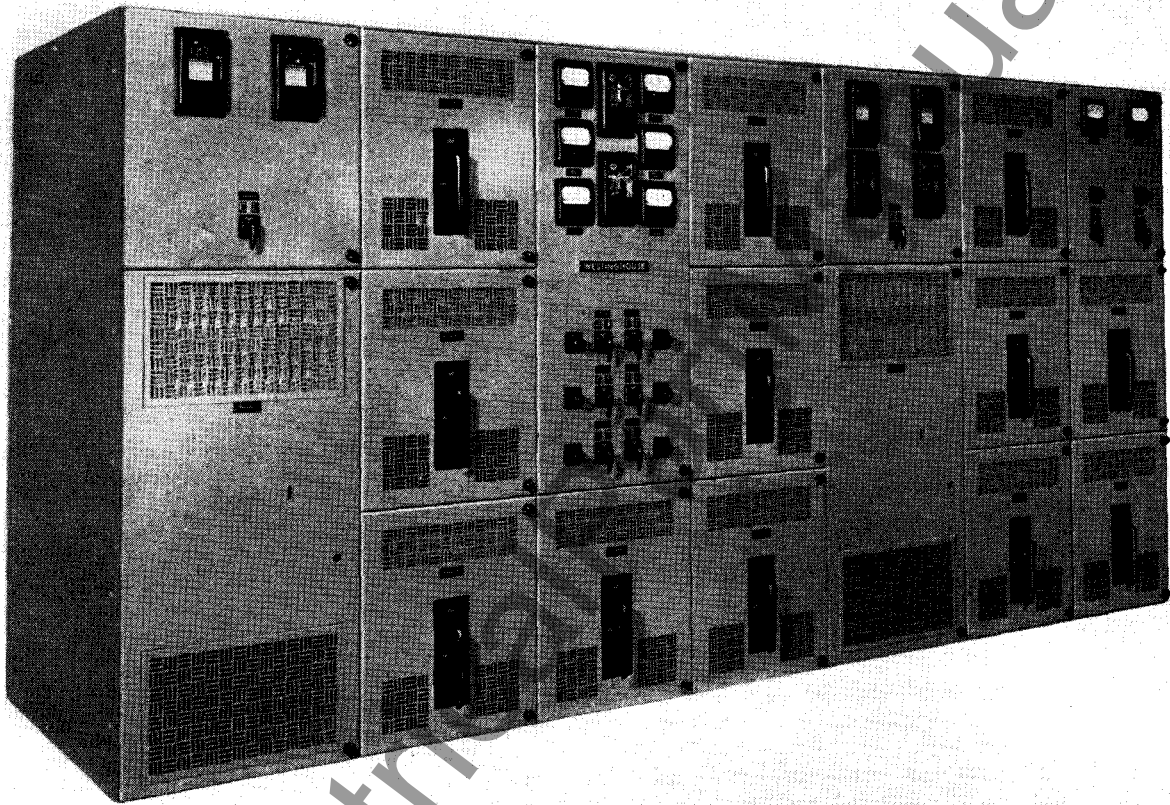
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Low-Voltage METAL-ENCLOSED SWITCHGEAR

This instruction book has been prepared to familiarize the purchaser's engineering and operating staff with the low-voltage (600 volts or lower) metal-enclosed switchgear supplied by Westinghouse. The information contained herein should be carefully studied before attempting to install or operate the equipment.

Proper installation, operation and maintenance are necessary to assure continued satisfactory service from the equipment. It should not be installed in places where it will be called upon to operate at voltages or currents greater than those for which it was designed.

For instructions pertaining to a particular piece of apparatus supplied as part of the switchgear equipment, refer to the instruction book or leaflet applying to that particular type of apparatus. Copies of the applicable publications are furnished along with this book for each switchgear installation.

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Caution: Only authorized and properly trained personnel should be permitted to operate or handle any portion of the switchgear.

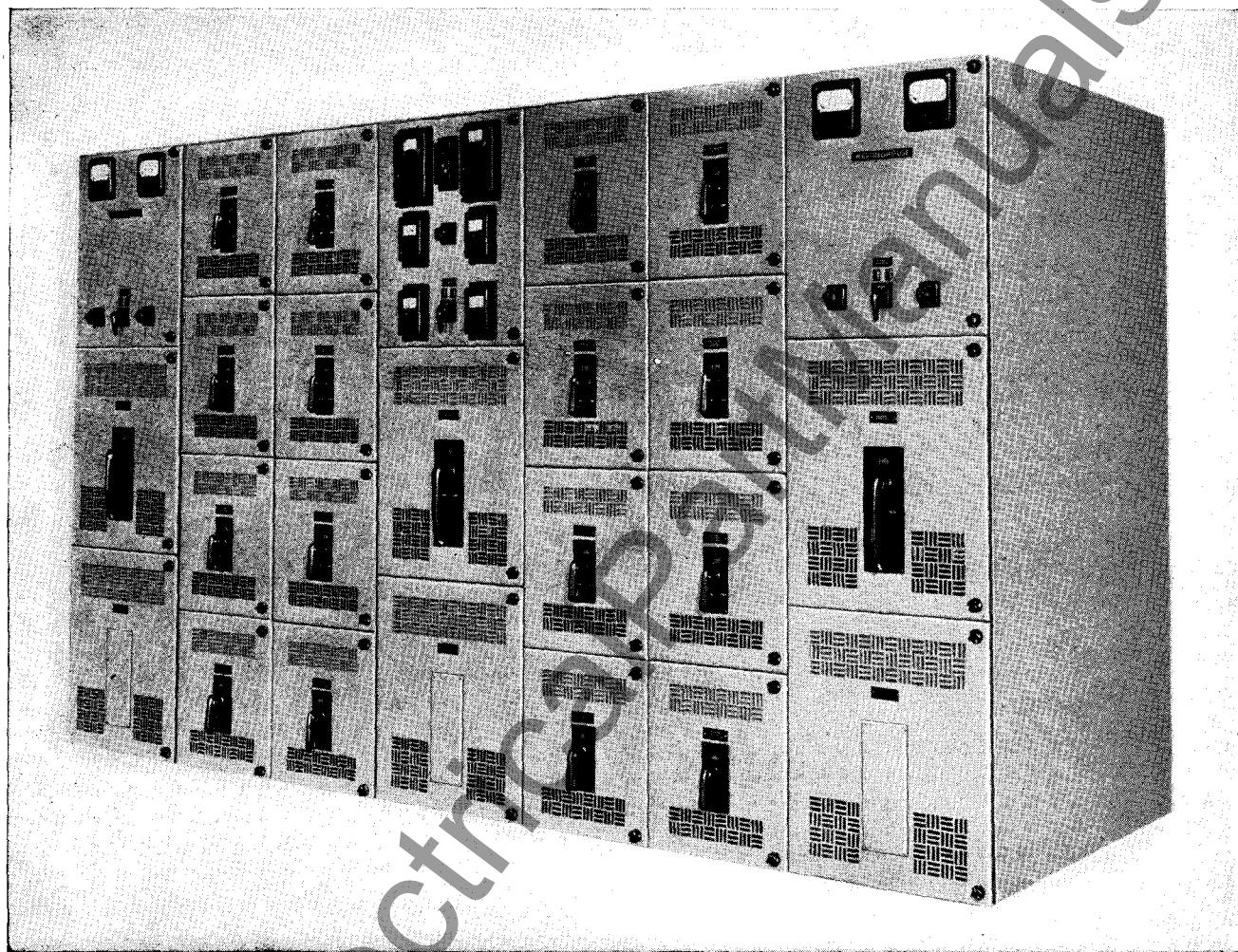


FIG. 1. Front View of Indoor Metal-Enclosed Switchgear Containing Types DB-25 and DB-50 Circuit Breakers as Removable Elements

DESCRIPTION

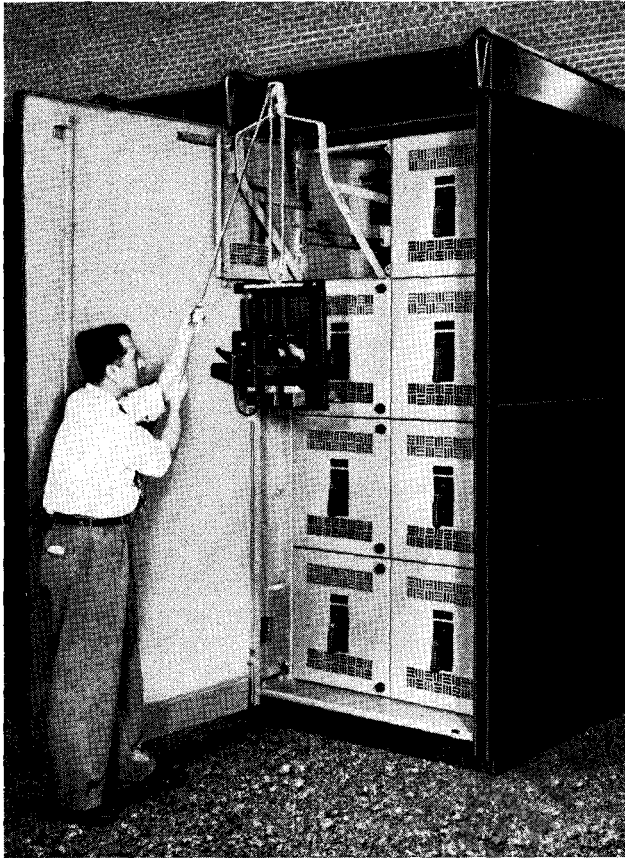


FIG. 2. Low-Voltage Switchgear Installed in an Outdoor Weatherproof Housing

Low-voltage (600 volts or below) indoor and outdoor metal-enclosed switchgear having drawout mounted type DB or DA air circuit breakers is completely factory assembled and tested. It is designed to require a minimum amount of labor for installation. See Figs. 1 and 2. Shipments are made completely assembled, or in sections of one or more housings, to suit the handling facilities at the point of installation.

The switchgear consists of a fixed part, called the stationary structure, and drawout-type circuit breakers, called the removable elements. The switchgear provides for three positions of the removable element, namely; "connected", "test", and "disconnected".

In the "connected" position, both the primary and secondary disconnecting devices are engaged, and the circuit breaker is ready for operation. In

the "test" position, only the secondary disconnecting devices are engaged, and the circuit breaker can be operated without energizing the power circuit. In the "disconnected" position, both the primary and secondary disconnecting devices are disengaged, and the entire circuit breaker is isolated.

SWITCHGEAR HAVING TYPES DB-15, DB-25 AND DB-50 CIRCUIT BREAKERS

Stationary Structure. The stationary structure is an assembly of one or more steel housings, each consisting of a formed and welded front enclosure containing the circuit breaker compartments and a rear enclosure for the bus copper, cables, instrument transformers and other detail equipment. See Fig. 3. The front compartments are completely enclosed, segregating each circuit breaker from the other breakers.

Each circuit breaker compartment is provided with the main stationary contacts and a rail along

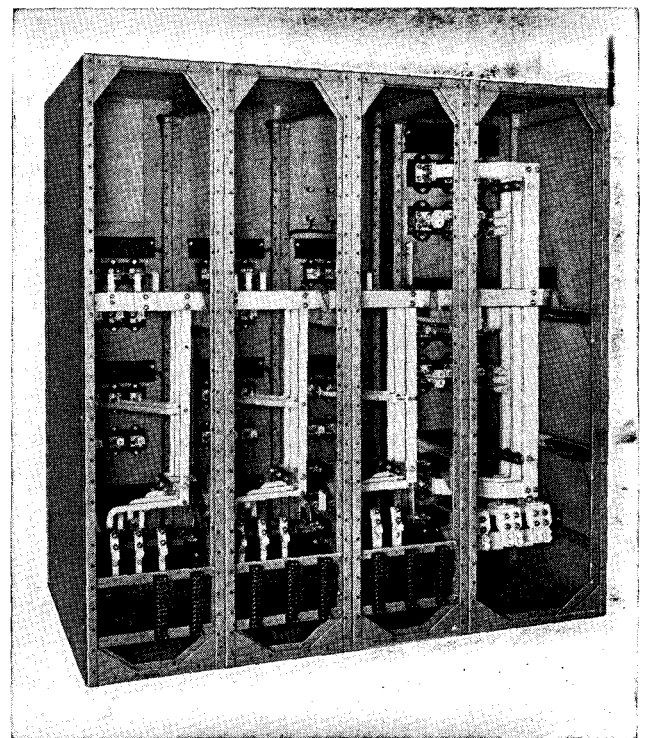


FIG. 3. View of Rear Bus Compartment

DESCRIPTION

each side for supporting the removable element. These rails permit the removable element to be moved between the "connected" and "disconnected" positions, with a positive stop for each position and by use of the rail extensions (for all except the type DB-15), completely out of the compartment.

The rear enclosure is made up of the rear frames, tie members, top sheets and rear covers, all bolted together and to the rear of the front compartment. The rows or square holes which are punched in the rear frame, tie members and the rear flanges of the front compartment permit changes and additions to be made without cutting, welding or drilling.

The universal type Micarta bus support blocks can be arranged to permit the use of one, two or three bars per phase. Thus, by a simple rearrangement of the insulating blocks, additional copper bars may be added to the bus in the field as future load requirements dictate. Figs. 4, 5 and 6 illustrate the arrangements of the Micarta blocks for one, two and three bars per phase, respectively.

Removable Element. The removable element consists of the air circuit breaker equipped with primary and secondary disconnecting devices, an operating mechanism, position indicator and interlocks. Wheels engage the side rails in the compartment to support and guide the removable element. For the DB-25 and DB-50 breakers the four wheels are mounted directly on the sides of the circuit breaker assembly, while for the DB-15 breaker the two rear wheels are on the breaker assembly, and the two front wheels are mounted on the sides of the compartment. For all type DB breakers the lifting bracket is permanently mounted at the top of the breaker assembly. See Figs. 8, 10 and 12.

Each removable element is provided with a positioning pin located as shown in Figs. 8, 10 and 12. The positioning pin engages slots on a bracket in the compartment to lock the removable element in each of the three positions. See Figs. 7, 9 and 11.

A separate levering device is used in moving the DB-25 and DB-50 elements while the primary disconnecting devices are in contact. The use of this device is illustrated in Fig. 16. The levering device is not required for the smaller type DB-15 breaker.

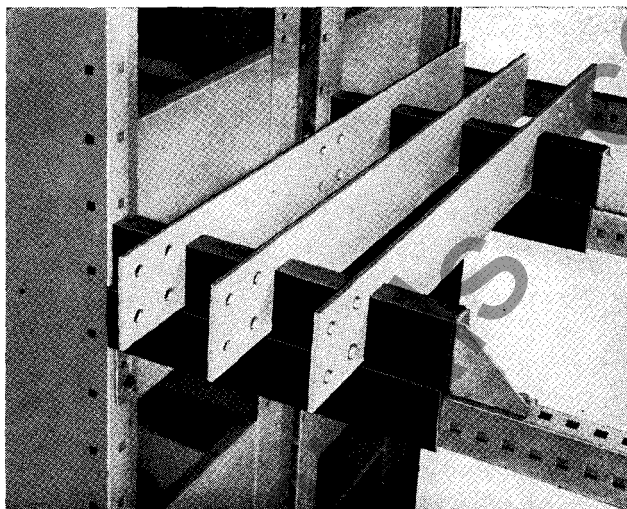


FIG. 4. Micarta Bus Supports Arranged for One Bus Bar Per Phase

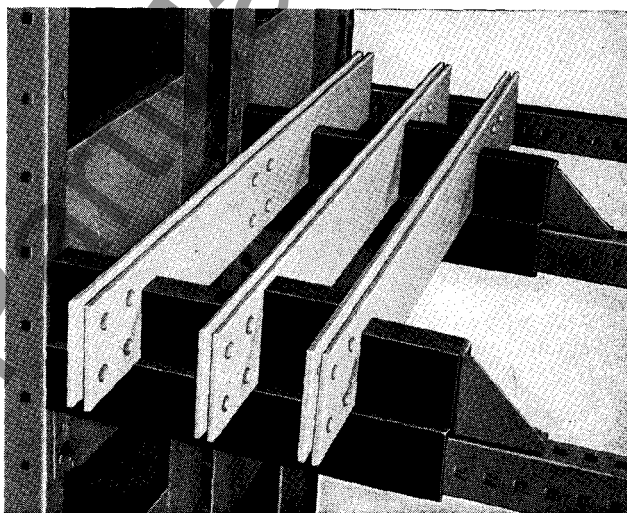


FIG. 5. Micarta Bus Supports Arranged for Two Bus Bars Per Phase

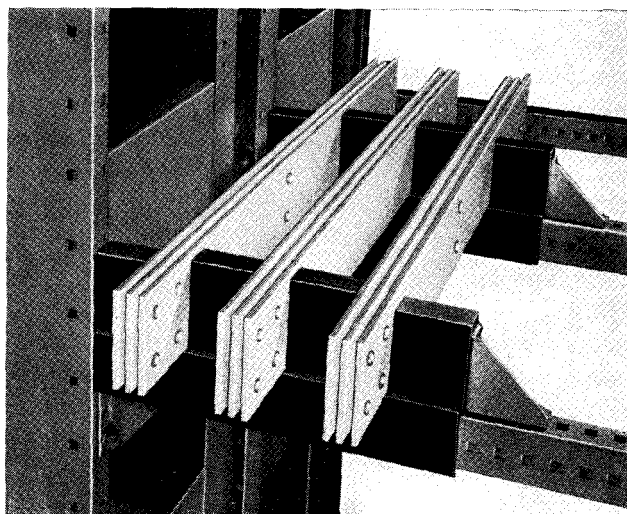


FIG. 6. Micarta Bus Supports Arranged for Three Bus Bars Per Phase

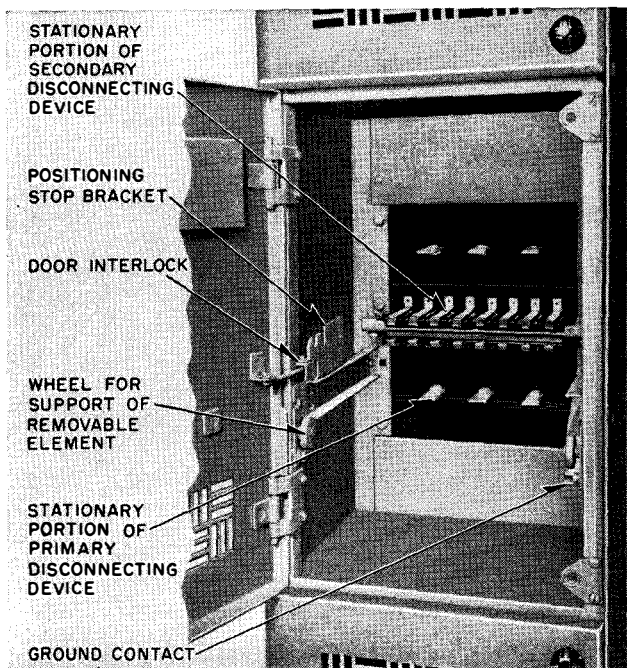
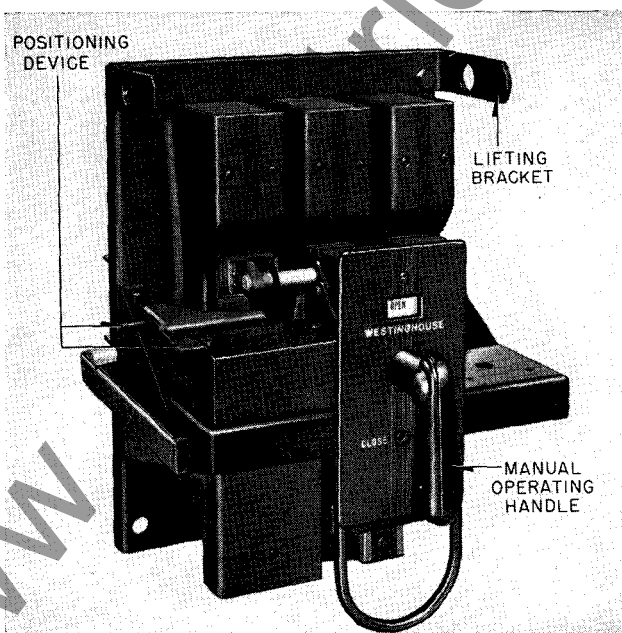


FIG. 7. Compartment for Type DB-15 Circuit Breaker

A ground clip is mounted on the rear of the removable element to contact the compartment ground shoe when the element is inserted into, or beyond, the "test" position.

A "code" nameplate is mounted on each removable element and on the rear of each compartment door to assure that the correct rating element is placed in the compartment. Always make certain the code letter is the same on the removable element and the stationary compartment.



A set of conjunction parts may be used to adapt a type DB-25 compartment for use with a type DB-15 removable element, or a DB-50 compartment for use with a DB-25 removable element. These parts are all bolted in the compartment, and of course, the correct stationary primary disconnecting devices must be used in such a modified compartment. Fig. 13 illustrates the use of these parts.

Interlocks. The front hinged door of the circuit breaker compartment is interlocked with the removable element so that the circuit breaker will automatically be tripped if an attempt is made to open the door when the circuit breaker is closed. This interlock also prevents closing the breaker while it is in the "connected" position with the door open. With the removable element withdrawn to the "test" position, however, the breaker can be closed with the compartment door open. This interlock can be modified to allow opening of the door, when the breaker is closed, to permit inspection of the breaker.

An interlock between the compartment and the removable element will automatically trip the circuit breaker if an attempt is made to move the element into the "connected" position while the circuit breaker is closed. This interlock also prevents closing the breaker when it is at any point between the "test" and "connected" positions.

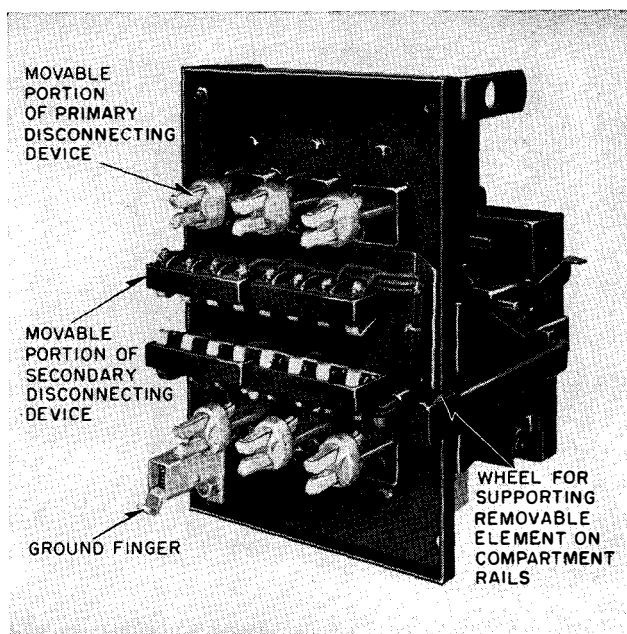


FIG. 8. Removable Element for Type DB-15 Circuit Breaker

DESCRIPTION

Before the removable element may be withdrawn from the "connected" position, the lever on the left side of the element must be depressed. This causes the positioning pin to move out of the positioning slot, and at the same time it causes the circuit breaker to trip if it is closed. Thus, the element cannot be withdrawn from the "connected" position while the breaker is closed.

Accessories. Standard accessories furnished for types DB-25 and DB-50 switchgear include a set of rail extensions and a levering device. Figs. 15 and 16 illustrate the manner in which the rail extensions are used in completely withdrawing the element from the compartment and show the method of moving the element into, or out of, the "connected" position by use of the levering device.

When type DB removable elements are furnished for outdoor service, a lifting device, as illustrated in Fig. 2, is furnished as a standard accessory in addition to the rail extensions and levering device.

There are no accessories required for indoor switchgear having type DB-15 removable elements. The element can be moved into, or out of, the "connected" position without the use of a levering device.

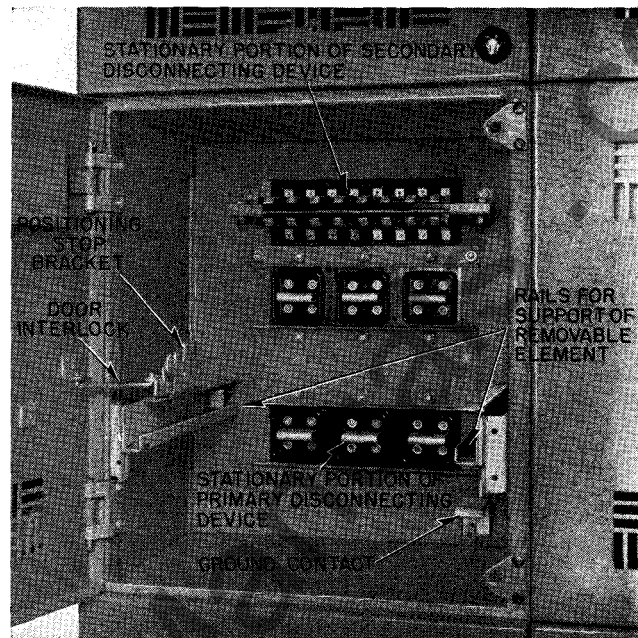


FIG. 9. Compartment for Type DB-25 Circuit Breaker

Inserting the Removable Element. For type DB-25 or DB-50 element, proceed as follows:

1. Open the compartment door and attach the rail extensions.

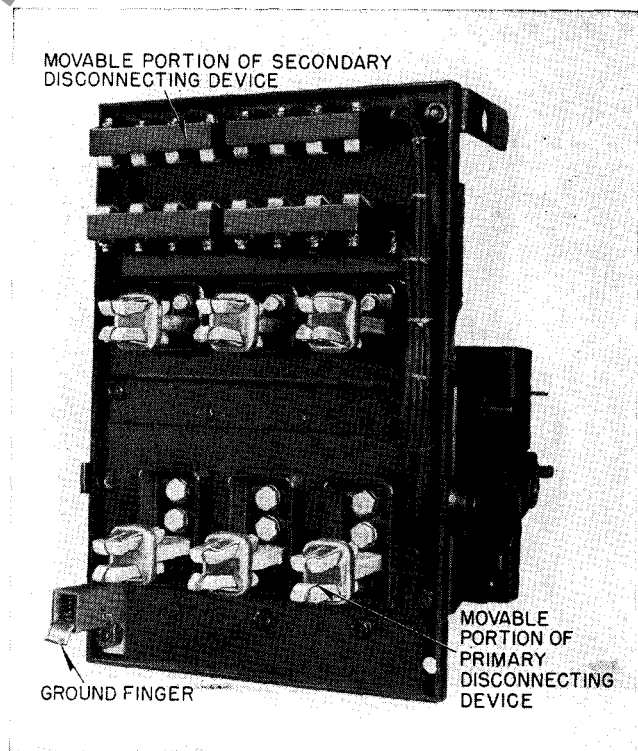
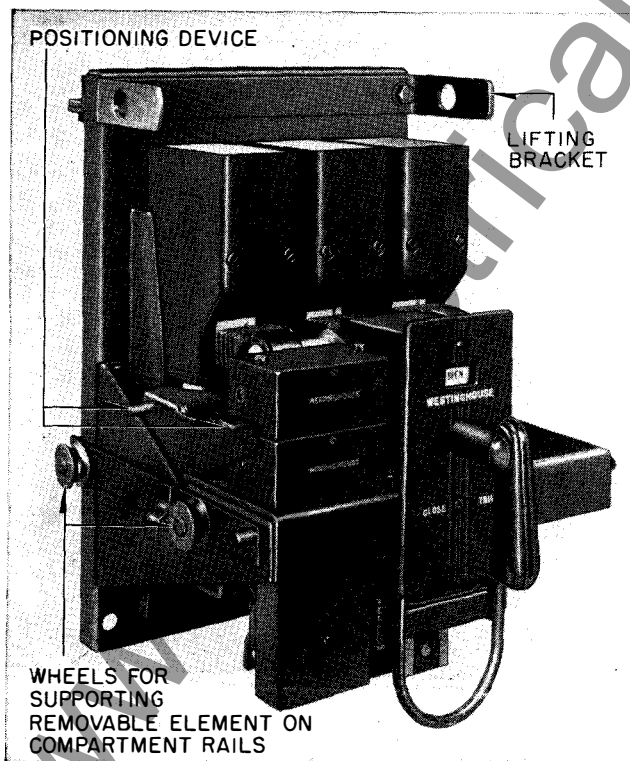


FIG. 10. Removable Element for Type DB-25 Circuit Breaker

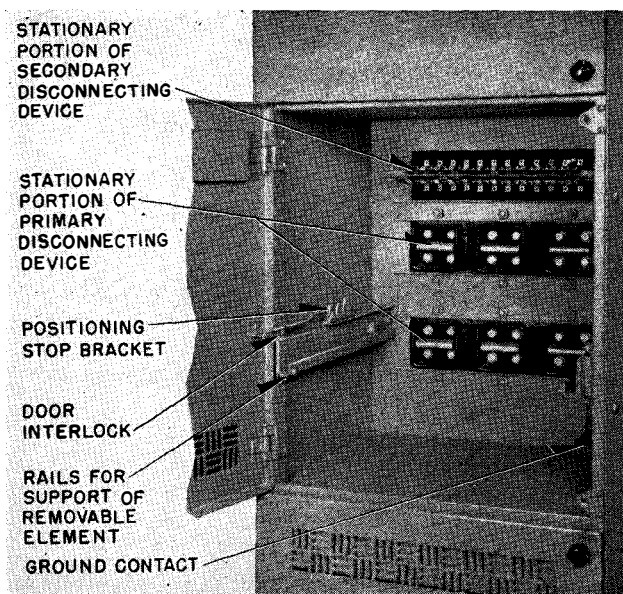


FIG. 11. Compartment for Type DB-50 Circuit Breaker

2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.

3. Lift the removable element and place it on the rail extensions.

4. Push the element into the compartment until the positioning pin drops into the first slot, thus holding the element in the "disconnected" position.

5. Remove the rail extensions.

6. Release the positioning stop pin by depressing the lever on the left side of the removable element,

and push the element further into the compartment until the pin engages the second slot, holding the element in the "test" position.

7. Close and trip the circuit breaker, and check its operation in general. The circuit breaker is closed by rotating the operating handle in a clockwise direction and tripped by turning the handle in the opposite direction.

8. Release the positioning stop pin, and push the element into the compartment until the movable and stationary portions of the primary disconnecting devices start to engage.

9. Insert the levering device, and lift up on the handle until the removable element reaches the "connected" position. This will be noted when the two rear wheels strike the stops located in the cell rails.

10. Remove the levering device. Close and latch the compartment door.

The method of inserting the type DB-15 removable element is similar, except that the element is lifted and placed directly on the compartment rails instead of on rail extensions, and a levering device is not required to move the element between the "test" and "connected" positions.

Removing the Element. For type DB-25 or DB-50 element, proceed as follows:

1. Trip the circuit breaker, and open the compartment door.

2. Insert the levering device handle.

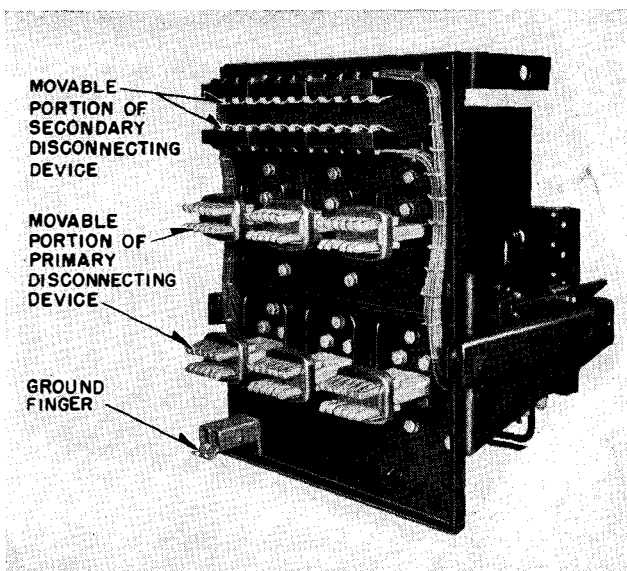
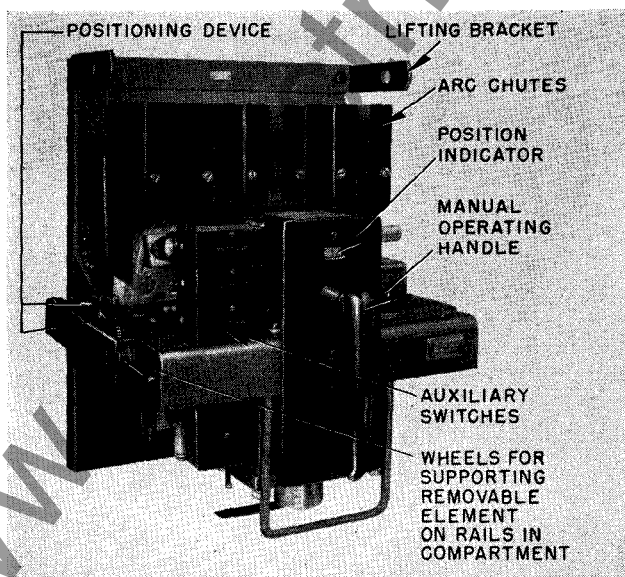


FIG. 12. Removable Element for Type DB-50 Circuit Breaker

DESCRIPTION

3. Pull down on the levering handle until it reaches the limit of its travel, and then remove the levering device. Pull out the element until the positioning pin engages the "test" position slot.

Note: Operation may be checked in this position without removing the element from the compartment.

4. Attach the rail extensions.

5. Release the positioning stop pin and pull the element out on the rail extensions.

6. Lift the removable element off the rails.

7. Remove the rail extensions. Close and fasten the compartment door.

Note: If it is desired to withdraw the element to the "disconnected" position only, release the positioning pin after step 3, and pull the element until the positioning pin engages the "disconnected" position slot.

The method of removing the type DB-15 removable element is similar, except that the rail extensions and the levering device are not required.

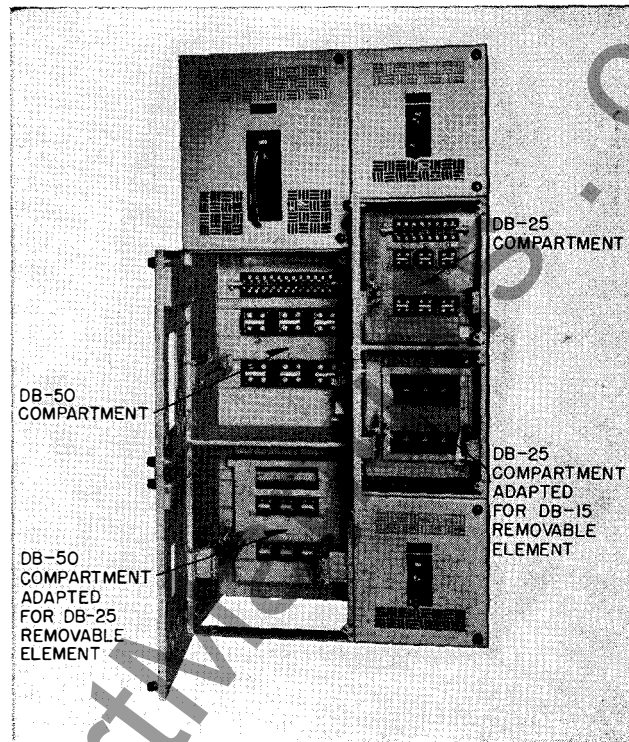


FIG. 13. Switchgear Having Conjunction Parts for Mounting Smaller Removable Elements

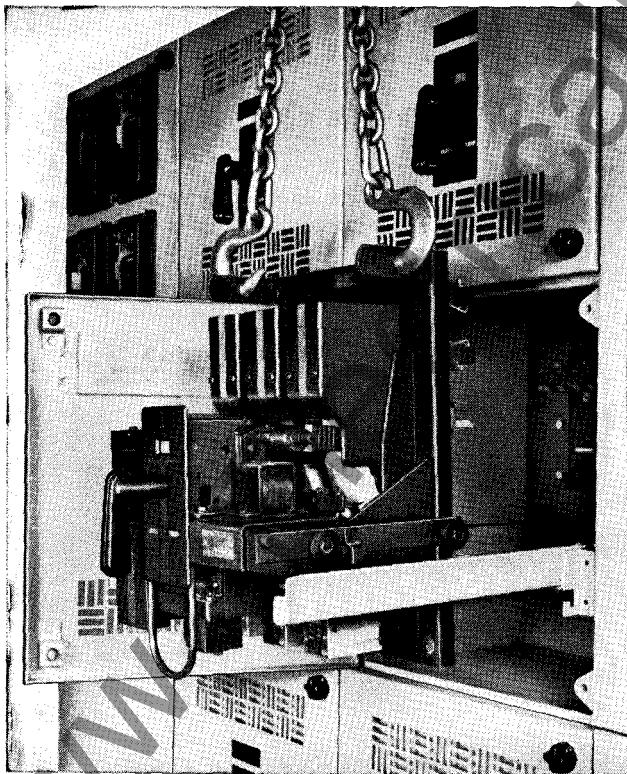


FIG. 14. Placing Type DB-25 Removable Element on the Rail Extensions Using a Hoist

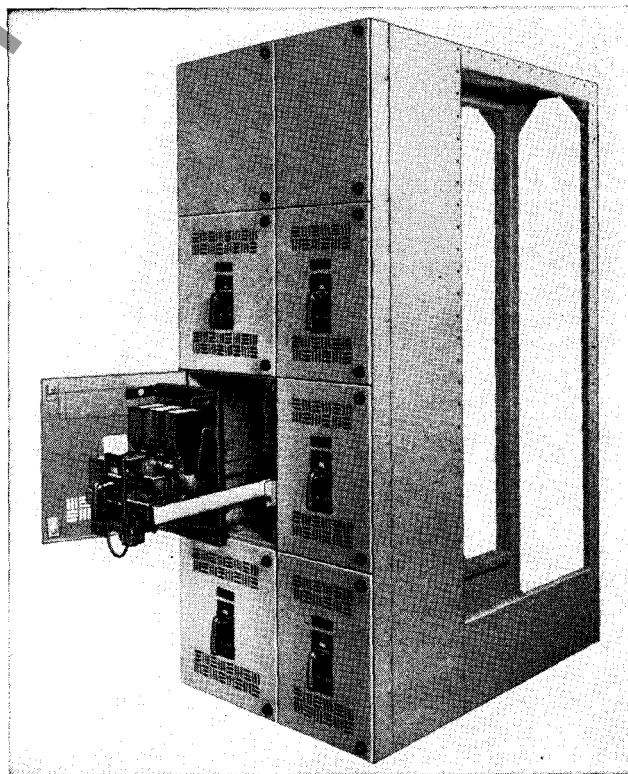


FIG. 15. Type DB-25 Element in Position on Rail Extensions Ready for Insertion in the Compartment

SWITCHGEAR HAVING TYPE DB-75, DB-100 & DBF-40 CIRCUIT BREAKERS

The type DB-75 and DB-100 breakers are equipped with wheels so that they may be rolled on the floor. DB-100 and DBF-40 breakers are supplied only in a "one-high" arrangement so that these breakers always roll into the housing at floor level. DB-75 breakers are arranged to be at floor level whenever possible, but can be mounted in "two-high" arrangements. A portable extension platform is provided with two-high DB-75 assemblies to facilitate inserting or removing the breaker.

The levering device for these breakers is a worm gear mechanism mounted in the housing having a lever arm on each side of the compartment to engage rollers on the breaker. The interlocking mechanism consists of a slider assembly at the right front of the compartment which is moved vertically by operating a "pull-pin" which extends thru the compartment door. The compartment is shown in Figure "A" (photo 350676).

INSERTING THE REMOVABLE ELEMENT

The interlocking and levering-in mechanism operates in the following fashion starting with the compartment door open and the levering mechanism set at "roll-out" position.

- (a) Align breaker flanged wheels with rails and push breaker into compartment.
- (b) If breaker is pushed slowly into the compartment one can feel the flanged wheels settle into the "disconnected" position notch with the breaker about 3/4 of the way in. (If the breaker is closed and the interlock "pull-pin" has been pulled the breaker will also be stopped at this position by interference of the trip interlock parts).
- (c) Push breaker into the compartment until the levering rollers engage the levering arms. The breaker should be "open" when this is done. Some rolling inertia is helpful to pass thru the disconnected position notch but the breaker should not be slammed into this position.
- (d) Pull out the interlock "pull-pin" -- the breaker must be "open" to permit this -- and insert the crank on the levering shaft.
- (e) Turning the crank approximately 1½ turns will set the indicator at "Test" position with the levering arms securely holding the breaker in the test position rail notch. If the crank is removed and the interlock "pull-pin" pushed in the breaker may be operated either electrically or with the maintenance closing handle for test purposes.
- (f) Turning the crank approximately 16 turns will move the breaker into the "connected" position. When the main contacts touch after about 8 turns of the crank, a noticeable additional effort is required for about two full turns to engage the contacts and then some reduction in effort should be noticed for several turns until the mechanism stop is reached.

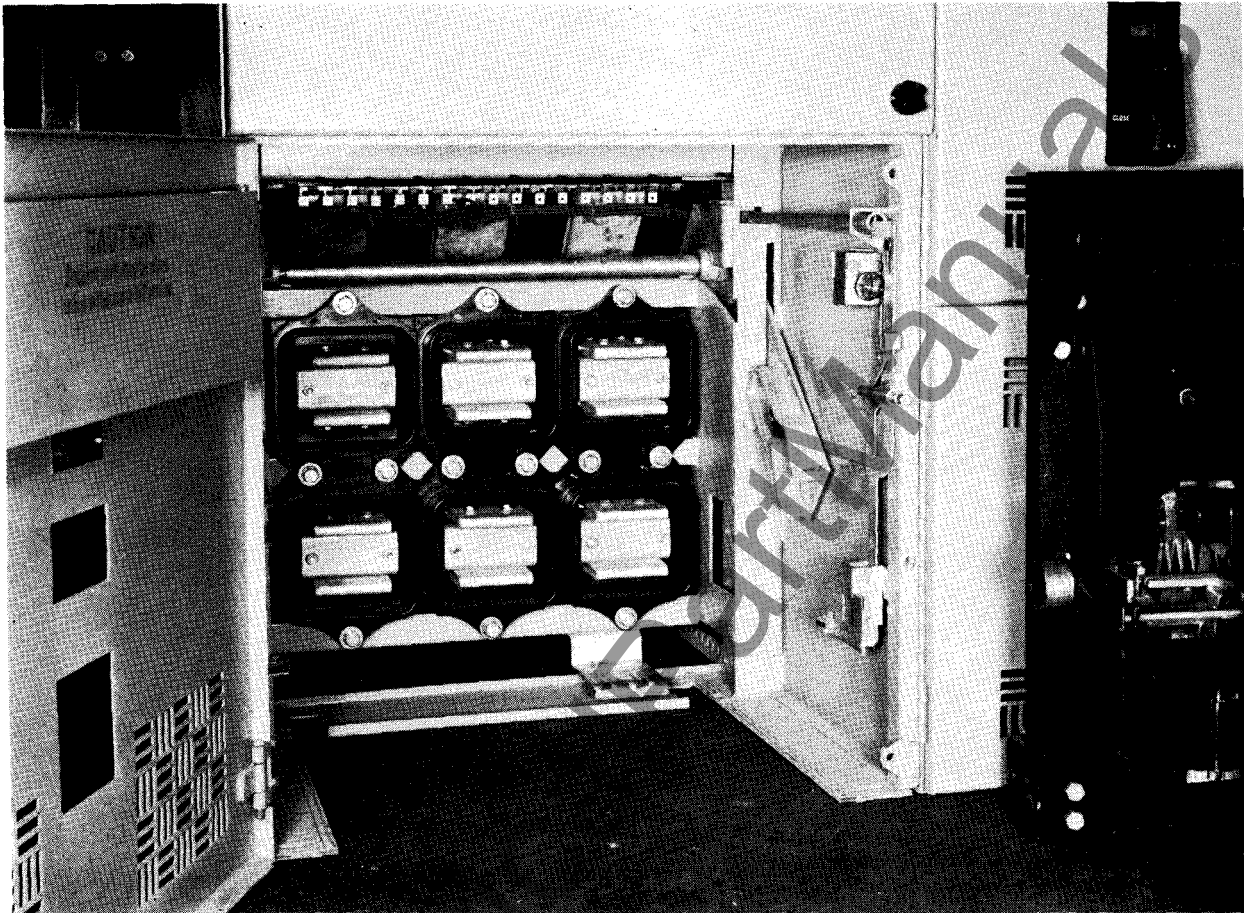


Figure "A". Photo 350676

(g) Remove the crank, close the door, secure the door latch knobs, and push in the interlock "pull-pin". A door interlock holds the breaker trip-free until the door is fully secured. Also releasing the interlock latches the door on the inside -- if the interlock is released first then the door cannot be fully closed.

(h) To *REMOVE* the breaker the simplified procedure is to:

- (1) Trip breaker.
- (2) Pull interlock "pull-pin".
- (3) Open door.
- (4) Insert crank.
- (5) Crank breaker out to "roll-out" position.
- (6) Pull breaker out of compartment.

The interlock parts of the DB-75 are so designed that the interlock cannot trip the breaker -- the breaker must be in the open position to permit movement of the interlock.

A levering device position indicator has been placed on the left side of the compartment as shown in Figure "B" photo 350675. The test position is established with the levering arms just securing the breaker without actually moving it horizontally -- this prevents the breaker "walking out" of the compartment when operated electrically. The roll-out and connected positions do not have indicating marks as they are established by the limits of travel of the levering device.

LUBRICATION

The levering device should have rollers and bearings lubricated with light machine oil and the worm gear lightly coated with a medium fibre grease.

The main disconnecting finger clusters and stationary contacts should be cleaned periodically but *KEPT DRY*. Vaseline or grease should *NOT* be applied to these contact surfaces as it will hold dirt and particles of plating which will cause an increase in the levering-in force required.

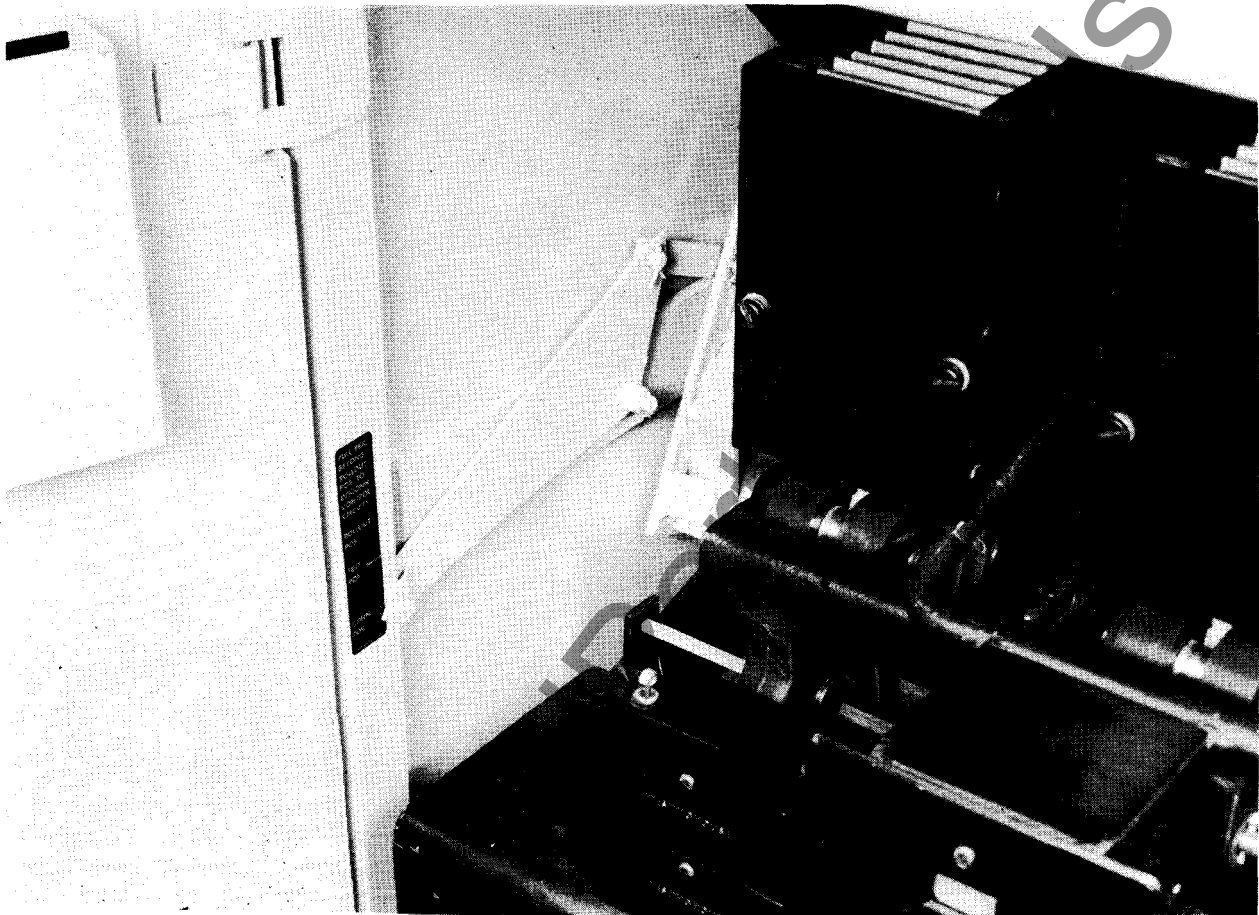


Figure "B". Photo 350675

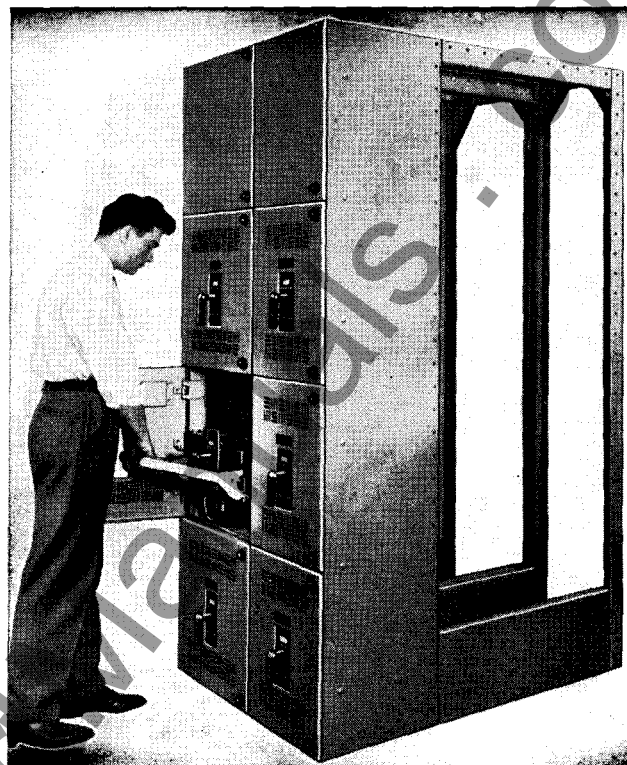
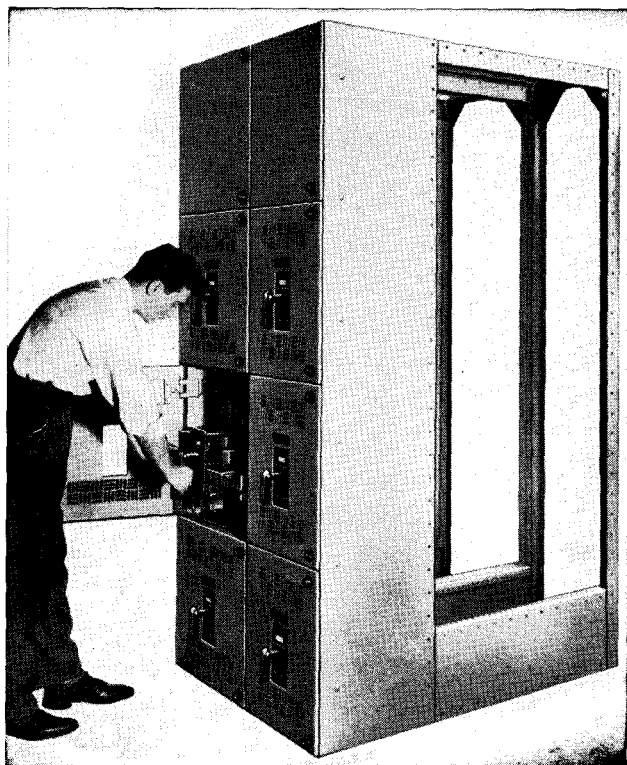


FIG. 16. Inserting a Type DB-25 Removable Element

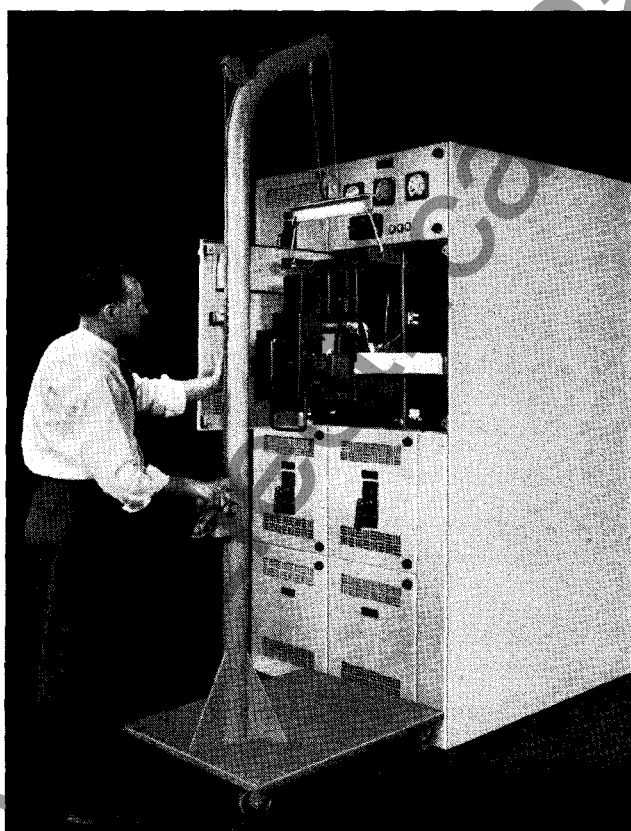


FIG. 17. Placing Type DB-50 Removable Element in Compartment Using the Handling Carriage, Supplied as an Additional Accessory When Ordered

SWITCHGEAR HAVING TYPE DA-75 CIRCUIT BREAKERS

The general features of type DA-75 drawout switchgear are similar to those explained previously for the type DB switchgear.

The circuit breaker is mounted on an insulating base, which is then mounted on a supporting frame or truck. The truck is mounted on wheels so that it may be rolled on the floor.

The positioning device is similar to that described for the DB line, except that there is a device on either side of the cell, both operated by a common handle on the truck.

The levering device is mounted on the truck and consists of a shaft having an eccentrically mounted pin at each end. The pins engage slots on each side of the compartment, and the levering action is obtained by rotating the shaft, using the maintenance hand closing lever supplied as an accessory. See Fig. 18.

When automatic shutters are supplied for type DA-75 circuit breaker compartments, they close and isolate the fixed portion of the primary disconnecting devices when the removable element is withdrawn. These shutters are arranged to close when the removable element is approximately half withdrawn from the cell.

DESCRIPTION

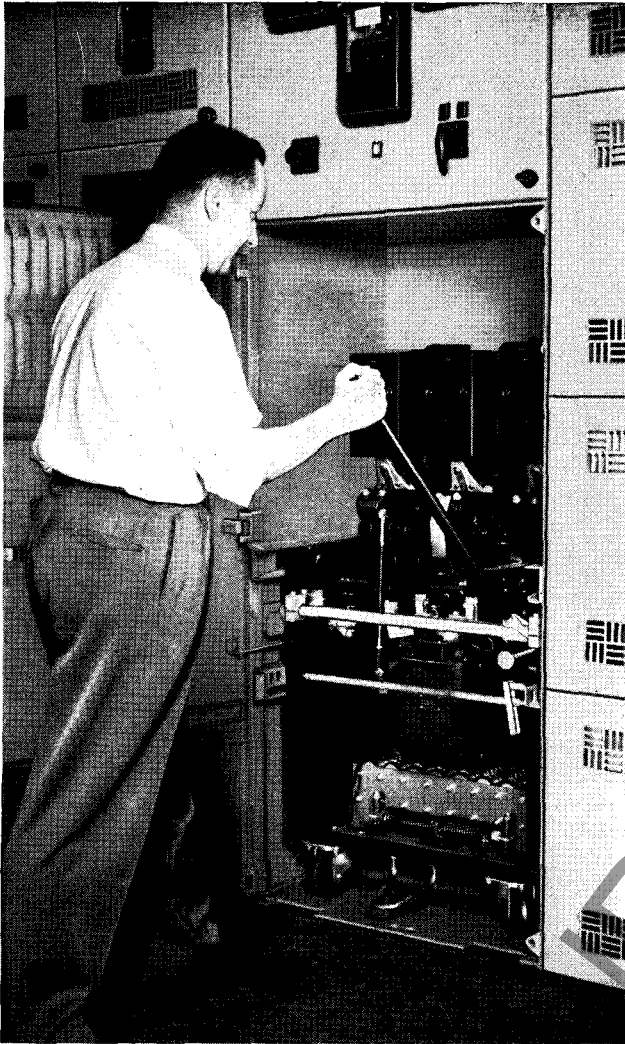


FIG. 18. Levering in a Type DA-75 Removable Element

Interlocks. The front hinged door of the circuit breaker compartment is interlocked with the removable element so that it cannot be opened while the circuit breaker is closed and so that the circuit breaker cannot be closed in the "connected" position while the door is open.

An interlock between the compartment and the removable element will automatically trip the circuit breaker if an attempt is made to move the element either into or out of the "connected" position while the circuit breaker is closed. This interlock also prevents closing the breaker when the removable element is at any point between the "test" and "connected" positions.

Accessories. A maintenance hand-closing lever and a pair of lifting brackets are furnished as standard accessories with each switchgear assembly. The hand-closing lever is inserted in the socket on the circuit breaker operating mechanism for closing

the breaker when the compartment door is open and the removable element is either in the "test" or "disconnected" position. The lever should be removed after the closing operation. This same lever is also used to lever the removable element into, or out of, the "connected" position, as shown in Fig. 18.

The lifting brackets attach to slots on the sides of the truck and are used to facilitate the lifting of the removable element with a hoist.

Inserting the Removable Element. The following procedure should be followed when placing a type DA-75 removable element in the compartment.

1. Open the compartment door.
2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.
3. Manually push the removable element into the compartment until the positioning stop engages and holds the element in the "disconnected" position.
4. Release the positioning stop by means of the lever on the right-hand side of the truck, and push the removable element further into the compartment until the positioning stop again engages and holds the element in the "test" position.
5. Close and trip the circuit breaker by means of the maintenance closing handle and trip button, and check its operation in general.
6. Release the positioning stop, and push the element into the compartment until the levering device engages the slots on the sides of the cell.
7. Insert the hand-closing lever in the socket of the levering device and raise it (see Fig. 18) until the positioning stop engages and holds the removable element in the "connected" position.
8. Close and fasten the compartment door.

Removing the Element. The following procedure should be followed in removing the type DA-75 removable element.

1. Trip the circuit breaker and open the compartment door.
2. Insert the levering handle.
3. Disengage the positioning stop and pull down on the levering handle until it reaches the limit of its travel. Remove the levering handle.
4. Disengage the positioning stop, and pull the element from the rails to the floor.

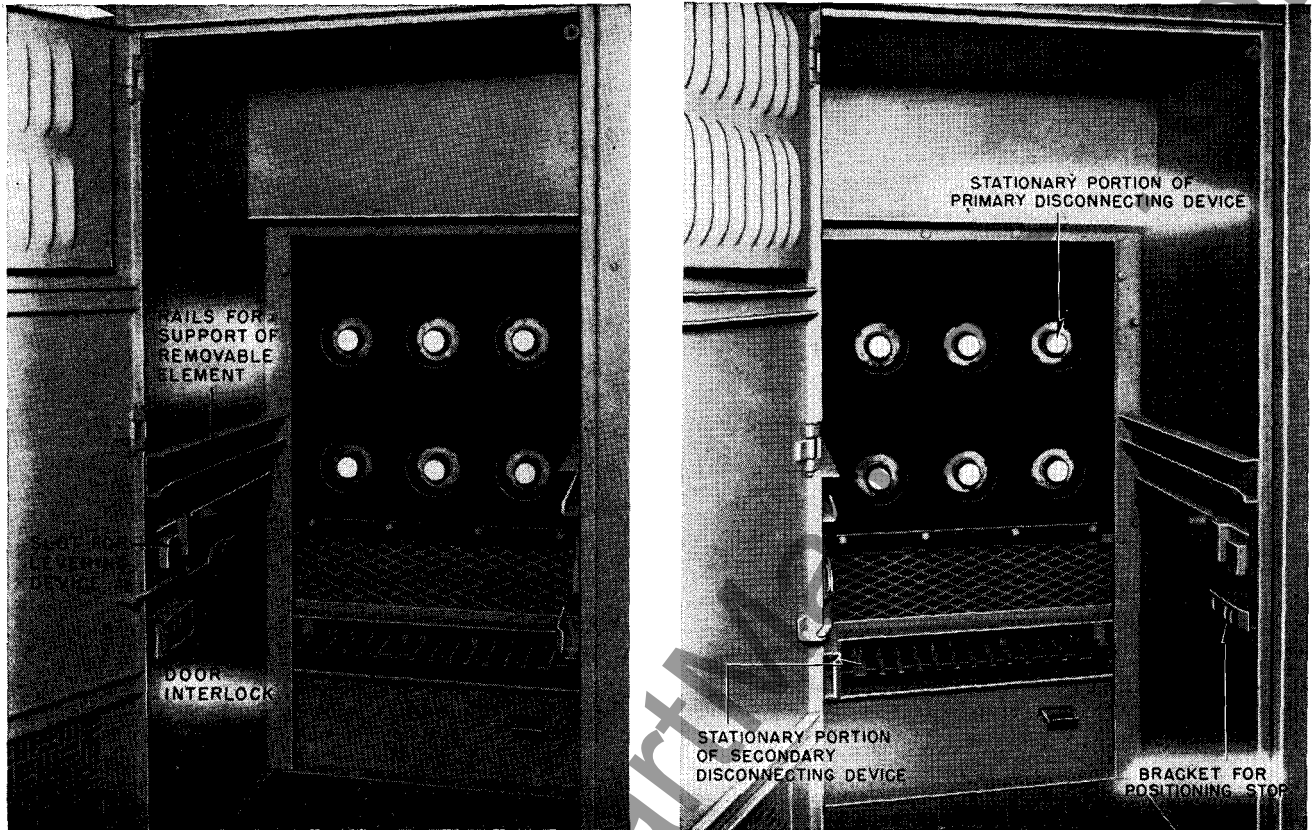


FIG. 19. Compartment for Type DA-75, 2000-Ampere Circuit Breaker

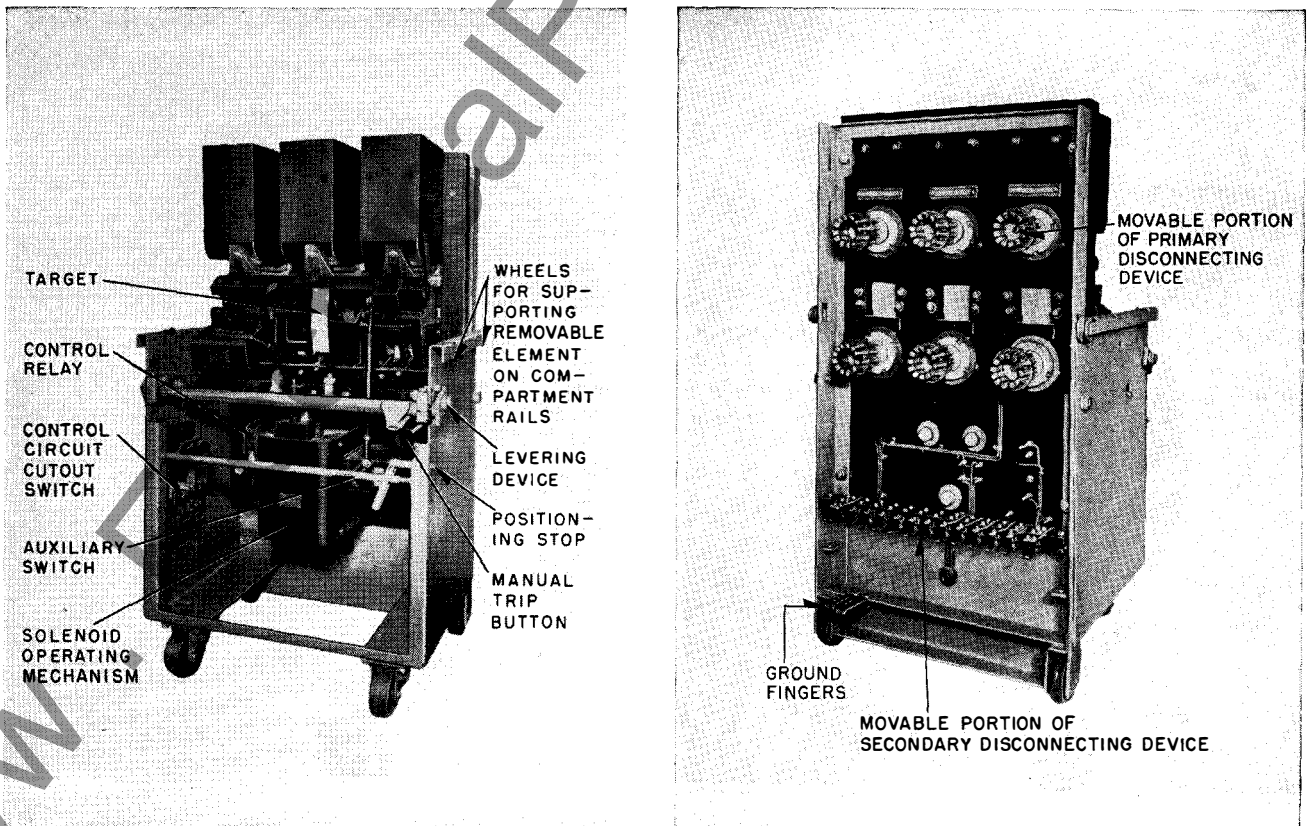


FIG. 20. Removable Element for Type DA-75, 2000-Ampere Circuit Breaker

DESCRIPTION

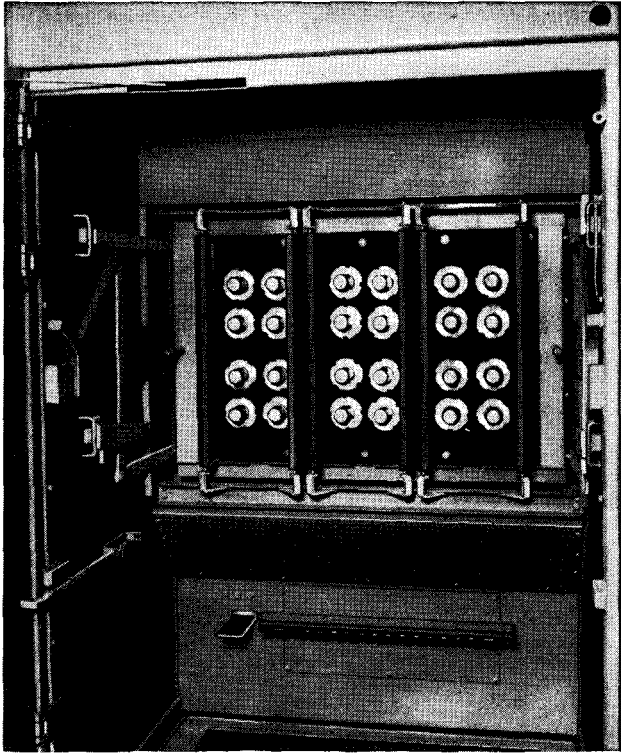


FIG. 21. Automatic Shutters in a Type DA-100, 4000-Ampere Compartment—Open Position

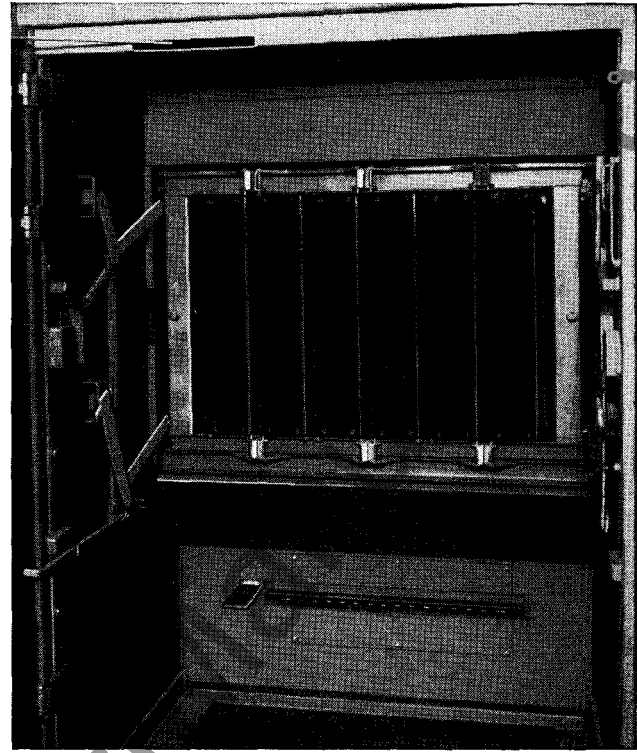


FIG. 22. Automatic Shutters in a Type DA-100 Compartment—Closed Position

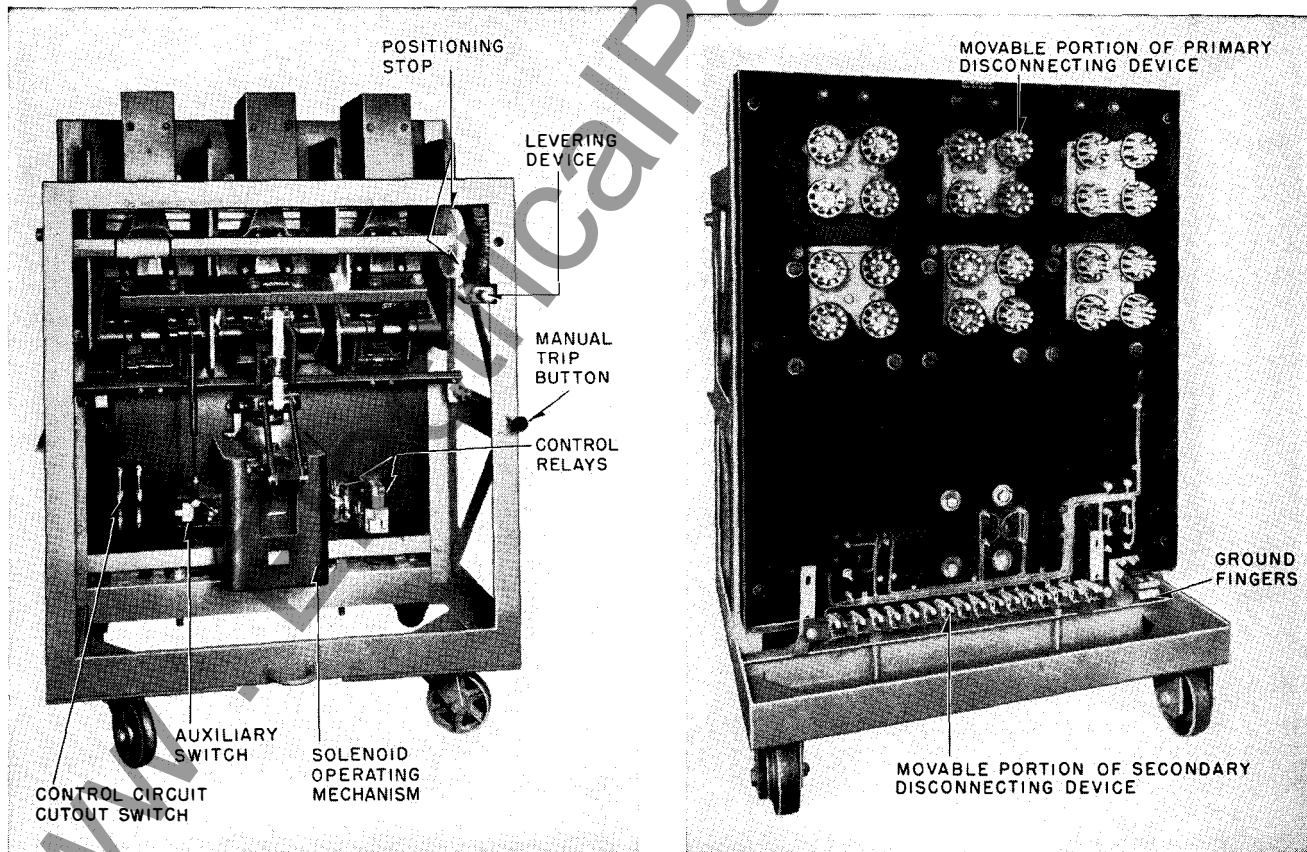


FIG. 23. Removable Element for Type DA-100, 4000-Ampere Circuit Breaker

SWITCHGEAR HAVING TYPE DA-100 CIRCUIT BREAKERS

The construction of the switchgear having type DA-100 removable elements is slightly different from that previously described for the type DA-75 switchgear.

Stationary Structure. The front circuit breaker compartment is similar to that supplied for DA-75 switchgear except that there are no side rails for rolling in the removable element. The removable element truck is equipped with wheels which rest on the bottom steel members of the compartment when the element is in place. The same safety interlocks are furnished as described for the DA-75 circuit breakers. See Figs. 21 and 22 for the automatic shutters supplied as optional equipment on DA-100 switchgear.

Removable Element. The removable element consists of the circuit breaker mounted in a rigid truck constructed of welded steel angles.

The levering device is arranged so that it moves the removable element between the "disconnected" and "connected" positions and is operated by a removable hand crank through a worm and gear (See Figs. 23 and 25). The positioning stop is built into the levering device and requires a manual release only when moving away from the "test" position.

No lifting brackets or extension rails are furnished or required for type DA-100 units.

Inserting the Removable Element

1. Open the compartment door.
2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.
3. Roll the element into the compartment until the roller on the movable portion of the levering device engages the compartment portion of the device.
4. Attach the hand crank to the truck levering device and turn in a clockwise direction until the element reaches the "test" position. At this point a pin will drop into a slot on the levering device, preventing further travel of the element.
5. Close and trip the circuit breaker by means of the maintenance closing handle and trip button, and check its operation in general.
6. Raise the pin to release it from the slot, and continue to rotate the crank in a clockwise direction until the element is in the "connected" position. On the 5000 and 6000-ampere removable elements, two gear ratios are provided on the levering device. After the main contacts on the element have started to engage the stationary main contacts in the compartment, the crank should be removed from the upper position and transferred to the lower position.

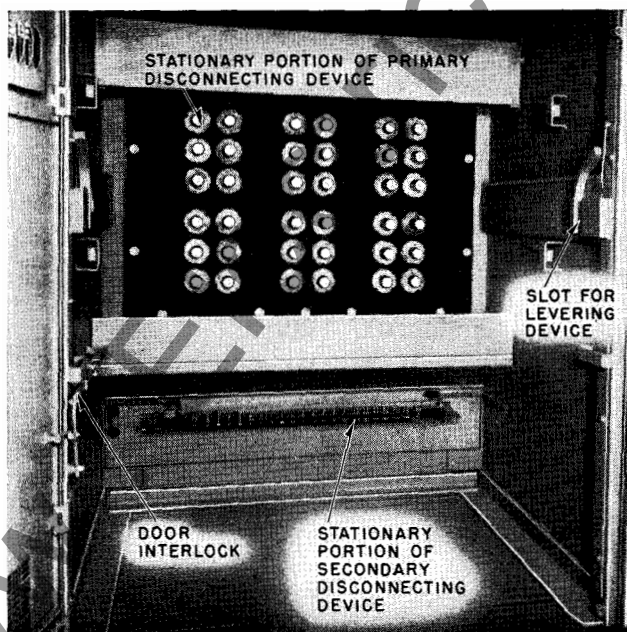


FIG. 24. Compartment for Type DA-100, 5000- or 6000-Ampere Circuit Breaker

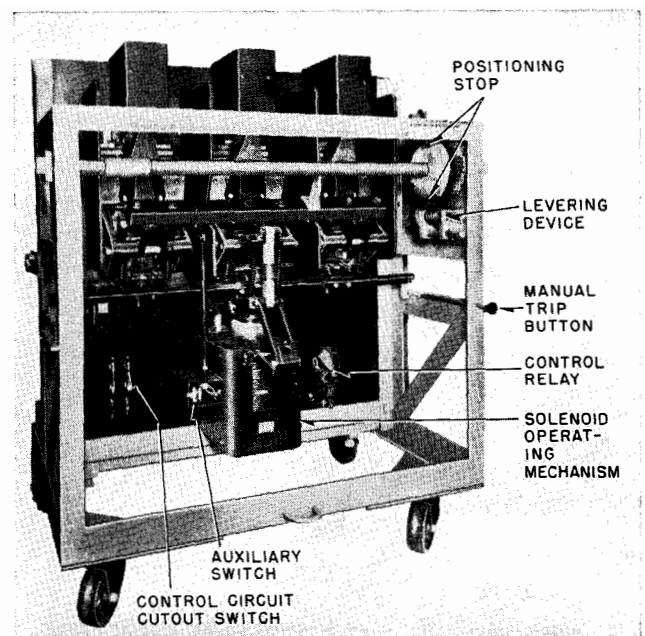


FIG. 25. Removable Element for Type DA-100, 5000- or 6000- Ampere Circuit Breaker

DESCRIPTION

tion. The crank is then rotated in a counter-clockwise direction until the element reaches the "connected" position. The higher gear ratio obtained with the crank in the lower position makes it easier to lever the element into the "connected" position.

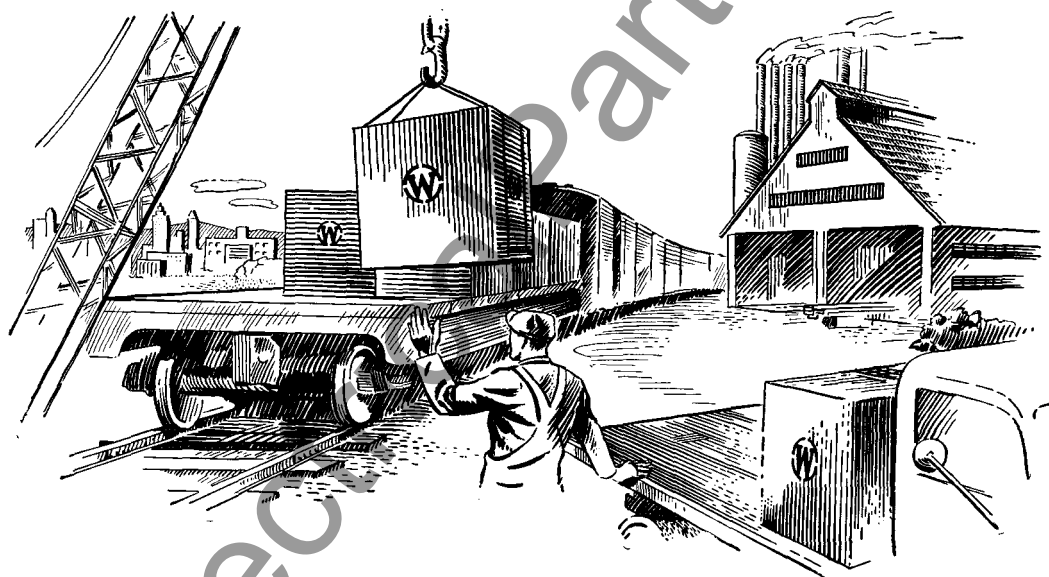
7. Remove the hand crank. Close and fasten the compartment door.

Removing the Element

1. Trip the circuit breaker and open the compartment door.

2. Attach the hand crank and rotate counter-clockwise until the levering device pin drops into the slot in the "test" position. (For the 5000 or 6000 ampere circuit breakers, the crank is first attached in the lower position and rotated in a clockwise direction until the main contacts are disengaged, after which the crank is transferred to the upper position and rotated in a counter-clockwise direction.)

3. Raise the stop pin and continue to rotate the crank in a counter-clockwise direction until the element is in the "disconnected" position.



RECEIVING, HANDLING AND STORING

RECEIVING

The switchgear is assembled, wired, adjusted and given complete commercial tests at the factory, after which it is carefully inspected and prepared for shipment. See Fig. 26. The types DB-15 and DB-25 removable air circuit breakers are shipped in their compartments while the larger breakers are packed in separate crates from the stationary switchgear housings. Each crate or box is plainly marked with an identification number, and a complete list of its contents is included in the shipping papers.

Immediately upon receipt of the shipment, identify all component parts and check them against the shipping list. Make a thorough examination to detect any damage which may have been incurred during transit. If any damage or evidence of rough handling is discovered, file a claim immediately with the transportation company, and notify the nearest Westinghouse Sales Office promptly.

HANDLING

Handle all crated or uncrated switchgear with extreme care since the panels contain delicate instruments and relays which may be damaged by rough handling.

Lifting irons are bolted to the top of the switchgear housings for use in handling the equipment where hoisting facilities are available. If hoisting facilities are not available, the skids on the bottom of the crates permit the use of pipe rollers.

When uncrating switchboards, care should be exercised to avoid breakage and scratching or marring of the panel finish.

Special care must be taken in unpacking the removable circuit breaker elements; the applicable circuit breaker Instruction Book, I.B. 35-255-1 for types DB-15 and DB-25 breakers, I.B. 35-230-C2 for type DB-50 breakers or I.B. 5943 for type DA breakers, should be carefully read before starting to unpack the circuit breakers.

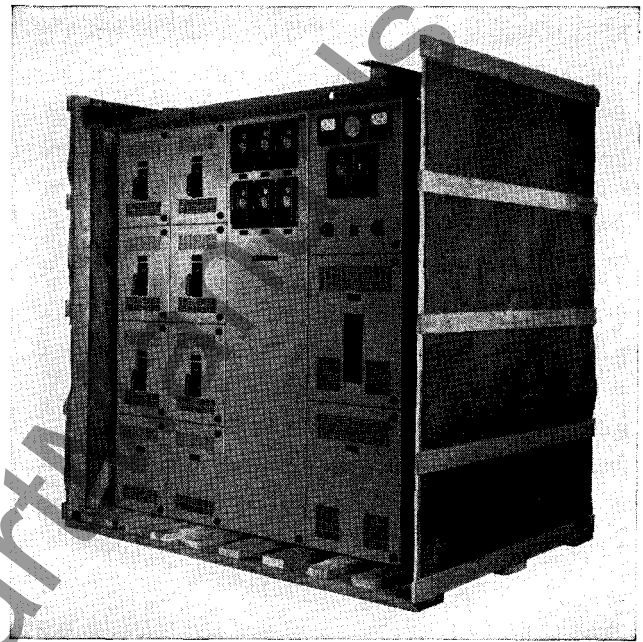


FIG. 26. Metal-Enclosed Switchgear Partially Prepared for Shipment. Shipping Angles on the Top May Be Used for Handling by a Crane, or Skids on Bottom Provide for Movement on Pipe Rollers.

After the crates have been removed, both the switchgear housings and the removable circuit breaker elements should be covered during the construction period for protection against dust and dirt.

STORING

Switchgear which is not to be installed immediately should be stored in a clean, dry place. Trouble and delay will be avoided by having good storage facilities arranged so that the apparatus will be accessible only to authorized persons and can be quickly located when required in the erection program. Crated apparatus will store much better if not unpacked. However, this must not prevent the inspection of the equipment as described previously. Conditions such as dampness, extreme temperature changes, dust and dirt should be carefully guarded against.

INSTALLATION

FOUNDATION

The switchgear is fabricated in welding jigs and assembled on level steel bedplates and is kept square and plumb at all times during erection and adjustment. Since the tolerances and adjustments are kept to a minimum, it must be installed on a smooth level base to retain the easy operation of the removable elements and the correct adjustments.

The preferred method of anchoring the indoor switchgear is by fastening it to steel channels which are embedded in the concrete floor. Floor plans for drilling and locating this steel are supplied with each contract. The top surfaces of the channels must be smooth, level and flush with the finished floor, and in the same plane.

Important: The surface of the floor between the channels must not project above the channels, and the floor in front of the channels should not vary more than $\frac{1}{8}$ inch in any square yard and must not project above the level of the floor steel.

Each housing is fastened to the floor channels by either bolting or welding as shown in Fig. 27. If bolting is to be used, the mounting bolts must be placed in the floor steel before the concrete is poured to assure that the tapped holes will not fill with concrete. Welding is a quick and easy method of securing the switchgear in place and eliminates the layout of the mounting holes in the channels.

PLACING OF STATIONARY STRUCTURE

After the foundation is completed, the complete switchgear assembly or section is set into place. The assembly drawings furnished with the switchgear should be referred to in making the installation. If the structure has been shipped in more than two sections, the center section should be placed in position first and fastened down. The remaining sections are then added progressively toward

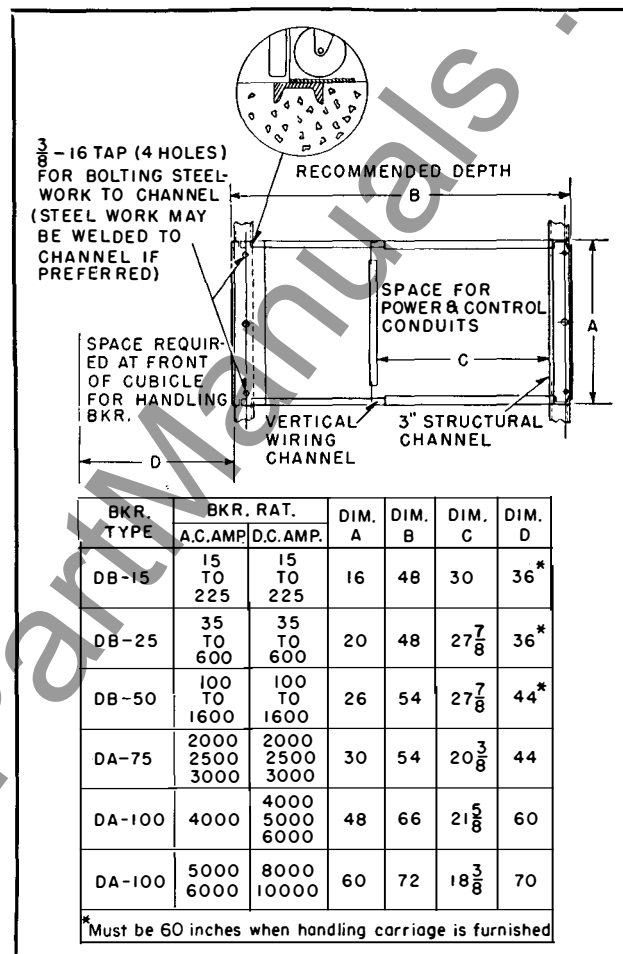


FIG. 27. Dimensions for Locating Stationary Structure

either end, bolting them together and fastening them to the floor steel. The lifting irons are removed from the top of each section after it is in place.

POWER CONNECTIONS

When the switchgear consists of two or more shipping sections, the main copper bus is necessarily disconnected between the shipping sections. These bus connections should be completed first, with particular attention to the pressure between the contact surfaces. It is essential that the connections be securely bolted, since the conductivity of the joint is proportional to the applied pressure rather than to the area.

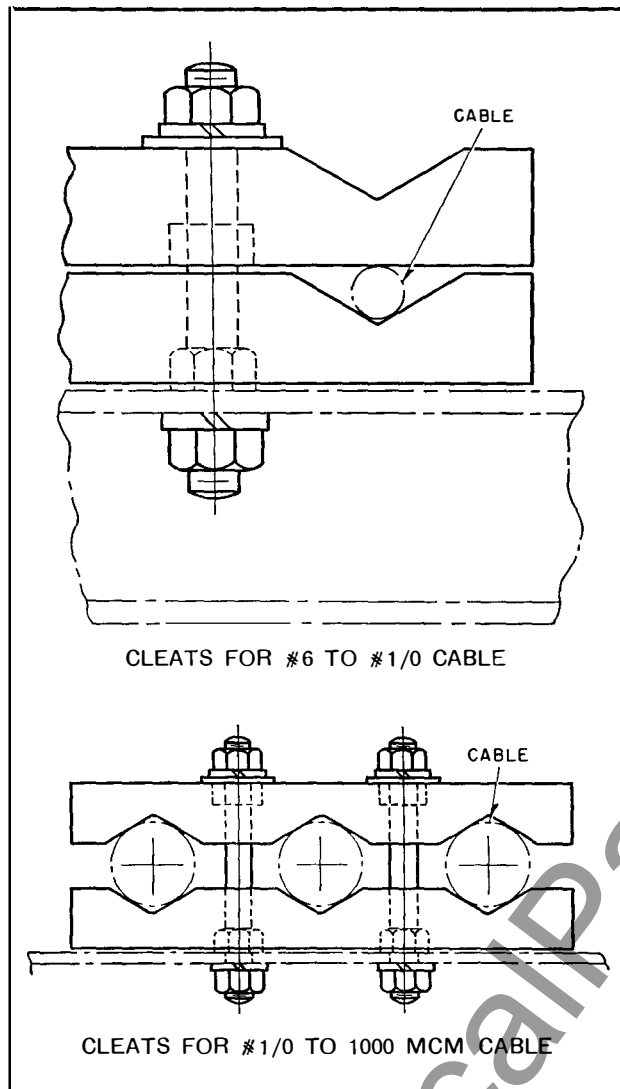


FIG. 28. Cable Clamping Block Arrangements

Clamping blocks are provided in the rear compartments to support the incoming cables to the terminals on the circuit breaker studs. Make sure that the connections to the switchgear are properly phased in accordance with the arrangement shown on the connection diagrams furnished with the switchgear.

Care must be exercised in the arrangement of cables when used in parallel. All three phases of an alternating-current circuit must be run in the same steel conduit. When there are two or more leads per phase and all cables cannot be run in a single conduit, one cable of each phase should be run in each conduit. When a number of cables are bunched, the inner ones will be unable to dissipate the required amount of heat, and excessive

temperature may result. Lead-covered or weather-proof cable must be used where moisture is present.

In making connections from the end of a conduit to the cable terminals, avoid sharp turns, corners and edges in order to prevent weakening of the cable insulation. The radius of a bend for rubber-covered, varnished-cambric or lead-covered cable should never be less than six times the outside diameter of the cable. With a small stranded conductor, the radius of a bend may be five times the outside diameter of the cable.

GROUND CONNECTION

A copper ground bus runs the full length of the switchgear. A copper riser in each unit connects this ground bus to each circuit breaker compartment ground shoe. A ground clip mounted on the rear of the removable element then contacts the stationary ground shoe when the element is inserted into or beyond, the "test" position.

A good ground should be connected to the cable terminal provided on the ground bus. The grounding conductor should be capable of carrying the maximum line-to-ground current for the duration of the fault.

Caution: A permanent low resistance ground is essential for adequate protection. A poor ground may be worse than none since it gives a false feeling of safety to those working around the equipment.

CONTROL CONNECTIONS

Any cross-panel control wires which have been disconnected for shipping purposes should first be reconnected. These wires have been properly tagged at the factory to facilitate the correct connections.

The terminal blocks for control circuit interconnections between the housings and the outgoing control cables are mounted across the rear of the switchgear, either at the bottom or the top, depending upon which direction the control cables leave the housing.

INSTALLATION

Relays designed to use movable armatures or rotating discs have these parts tied or blocked before shipment to protect them against possible damage in transit. Remove all ties and blocking from the relay armatures or discs after the switchgear is installed and before control energy is applied.

The connections between the control wiring in the switchgear and any remote equipment must be of adequate size. The size of conductor required will depend upon the distance and amount of current to be carried. When selecting wire or cable sizes for instrument transformer circuits, the losses in the conductor should be calculated and a check made to assure that the combination of instrument load and conductor losses does not exceed the capacity of the transformer.

For electrically-operated breakers, it is important that the voltage drop in the supply circuit be checked to assure proper operation. This is especially true where a low voltage trip source is used. See NEMA air circuit breaker standards for the range of control voltages at the terminals of the operating mechanism.

The outside covering of control circuit connections will depend on local conditions. If they are to be installed in a dry place, braid-covered cable will be satisfactory. If moisture is present, the cable will require either a lead sheath or a weatherproof covering.

Make sure that the polarity of the connections from d-c control sources is correct. The polarity is shown on the connection diagram.

When connecting external cables to the terminal blocks on the switchgear, exercise care to assure that the connections are properly made.

PRE-OPERATION CHECKS

After the switchgear equipment and apparatus to be controlled have been installed and all interconnections made, the equipment should be tested and given a final check before being placed in service. This is necessary to assure that the equipment has been correctly installed and that all connections are complete and have been properly made.

Caution: Extreme care must be exercised to prevent the equipment from being connected to the power system while the preliminary tests are being conducted. If disconnecting switches are not available, line leads should be disconnected to accomplish this.

The testing equipment required will depend entirely on the type of installation. Portable voltmeters, both a-c and d-c, with a wide range of scales, will usually be required. If the equipment to be put into service is quite extensive and complicated, both a-c and d-c ammeters should be available in case unexpected trouble develops.

Some simple portable device for ringing or lighting out circuits should be included in the testing equipment. A convenient method for the latter is to add a solid contact point to the lens end of a flashlight. At some other convenient place on the flashlight add a binding post. The battery and lamp should be connected in series between the contact point and the binding post. One end of a flexible wire, four or five feet in length, can be attached to the binding post and the other end provided with a spring clip for quick attachment to the point to be tested. Touching the contact point at the other end of the circuit whose continuity is being checked should complete the circuit through the lamp. Lighting of the lamp will indicate that the circuit is intact.

Although the inspection and tests given the switching equipment at the factory assure that all the connections on the switchboard are correct and in good order, they should be examined to make sure that they have not been loosened or damaged during shipment or installation. Tighten all bolted connections and joints to assure good contact.

Ring or light out the connections to the equipment apart from the switchboard, such as instrument transformers, circuit breaker operating mechanisms and auxiliary switches to make sure they are correct. The extent to which this will have to be done depends on the thoroughness of the installation work.

Important: There must be definite assurance that all connections are correct before an attempt is made to operate the equipment.

Before applying control energy, check all control circuits, except current and potential transformer secondary circuits, for grounds, and make sure that all circuits are clear.

In order to show up any errors in the installation, try out the different parts by putting current through them at reduced voltage. Continue this procedure progressively until all parts have been proved. Remedy any incorrect operations during the trial period.

Carefully store the covers for instruments, meters, relays and other devices which have to be removed during the course of installation and test. Since

these are made either partly or entirely of glass, they may be broken if not properly protected. If anything temporarily stops the test work, such as the end of the working day, replace all covers to keep dust and dirt from collecting on the vital parts of the equipment.

Any protective relays included with the equipment have been tested for correct connection and operation at the factory, but the settings of the relays for current, voltage or other quantities must be made by the purchaser in accordance with his standard practices to coordinate with the other portions of his system. Study carefully the applicable relay instruction leaflets, supplied with the switchgear equipment, before attempting to set the relays.



INSPECTION AND MAINTENANCE

In order to obtain satisfactory service from the switchgear, it must have proper inspection and maintenance regularly.

The intervals between the inspections will be determined by the operating and atmospheric conditions. Where dust is rapidly deposited within the switchgear, especially if it is abrasive or has a high conductivity, or where condensation occurs within the switchgear, the inspection and cleaning should be frequent.

The inspection must be done by experienced personnel and should cover all the devices and connections. Inspectors should be thoroughly instructed and experienced in both the function and adjustment of the various devices and should have a uniform method of making the inspection. Good results can very often be obtained by furnishing the inspectors with detailed lists covering points which need to be checked and reported at stated intervals. Prints of all drawings and copies of all instruction books, cards and leaflets should be readily available in case of trouble; the maintenance personnel can refer to them for such detailed information as may be required to correct the situation.

Extreme care must be exercised that no circuits are shorted or grounded and that the inspector experiences no personal harm. Correct any defect which is discovered, immediately.

Caution: Do not work around live parts except in extreme emergencies. If work must be performed on live equipment, take every possible precaution to guard against accidents. Tools should be insulated, and rubber gloves and insulating mats should be provided.

Consider all connections live until the men expecting to work on them assure themselves per-

sonally that the circuits are dead, and every possible precaution should be taken to see that there is no chance of a circuit being energized while the men are working on it. Lock or block open and place a suitable warning on switches which have been opened to de-energize equipment for maintenance purposes. In low-voltage metal-enclosed drawout switchgear, the removable elements can be readily withdrawn to the "test" or the "disconnected" position in which the primary circuits are dead.

Caution: Do not touch a circuit breaker under any circumstances when the removable element is in the "connected" position. Some of the exposed parts may be live even though the breaker is open.

Keep the premises, particularly the switchgear room, clean. Compressed air or a hand bellows may be used to remove dust from the interior of the switchgear and from the removable elements. Use an air hose equipped with an insulating nozzle to prevent contact with live circuits, and filter the air. Remove dirt which cannot be blown from the insulating surfaces with a cloth saturated with *Westinghouse Electric Corporation Solvent Material No. 1609-1, obtainable through any Westinghouse Engineering and Service Office. (When this solvent is not available, Stoddard Solvent or cleaner's naphtha can be used). Do not use abrasive material for cleaning silverplated surfaces since the plating will be removed, leaving the base material unprotected. The exterior of the switchgear may be cleaned by wiping with a chamois skin which has been immersed in luke warm water and wrung partially dry.

Before attempting inspection, maintenance or adjustment of any devices such as circuit breakers, relays, meters or instruments, read carefully the instruction book covering the particular device.



SUPPLEMENTARY INSTRUCTIONS

LOW VOLTAGE METAL ENCLOSED SWITCHGEAR THREE POSITION DRAWOUT TYPE

STATIONARY STRUCTURE

The stationary structure for three position drawout circuit breakers differs from the structure for single position drawout circuit breakers as described in I.B. 32-100-1 in the following respects:

1. The circuit breaker compartment doors may be closed and latched with the circuit breaker in either the connected, test, or disconnected position. (Page 7 of I.B. 32-100-1 gives a complete description of connected, test and disconnected positions). The distance the circuit breaker operating mechanism extends through the opening in the compartment door (Fig. 1) provides a visual indication of which position the breaker is occupying.
2. Type DB-50 and type DB-25 compartments have a latch on the right hand rail which secures the circuit breaker in the connected position. This latch is automatically released by inserting the levering device into the compartment preparatory to withdrawing the circuit breaker. (See page 11 of I.B. 32-100-1 for operation of levering device). Fig. 2 for type DB-50 and Fig. 3 for type DB-25 compartments show the levering device in position for moving the circuit breaker in or out of connected position and illustrate the manner in which the latch is released. (The circuit breaker element has been omitted in Fig. 2 and Fig. 3 to permit a better view of latch details).

CAUTION: The automatic rail latch is in addition to the positioning pin on the left side of the breaker element. The latter must still be operated manually as described on page 10 of I.B. 32-100-1.

REMOVABLE ELEMENTS

The type DB-15, DB-25, DB-50, DB-75 and DB-100 circuit breakers for three position drawout mounting differ from the single position drawout mounting circuit breakers described in I.B. 32-100-1, I.B. 33-850-1 & 2, I.B. 35-230-C3 and I.B. 33-850-4 & 5 in the following respects:

1. Operating Mechanism - Type DB-15, DB-25, Fig. 4 and Type DB-50 Fig. 5.

A rectangular extension is welded to the front of the operating mechanism, enclosing a longer handle shaft, close-open indicator assembly, and push button hand trip details. The removable operating handle is not used for manual tripping and is not supplied with electrically operated breakers.

NOVEMBER, 1958

WESTINGHOUSE ELECTRIC CORPORATION
ASSEMBLED SWITCHGEAR DEVICES

EAST PITTSBURGH PLANT

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EAST PITTSBURGH, PA.

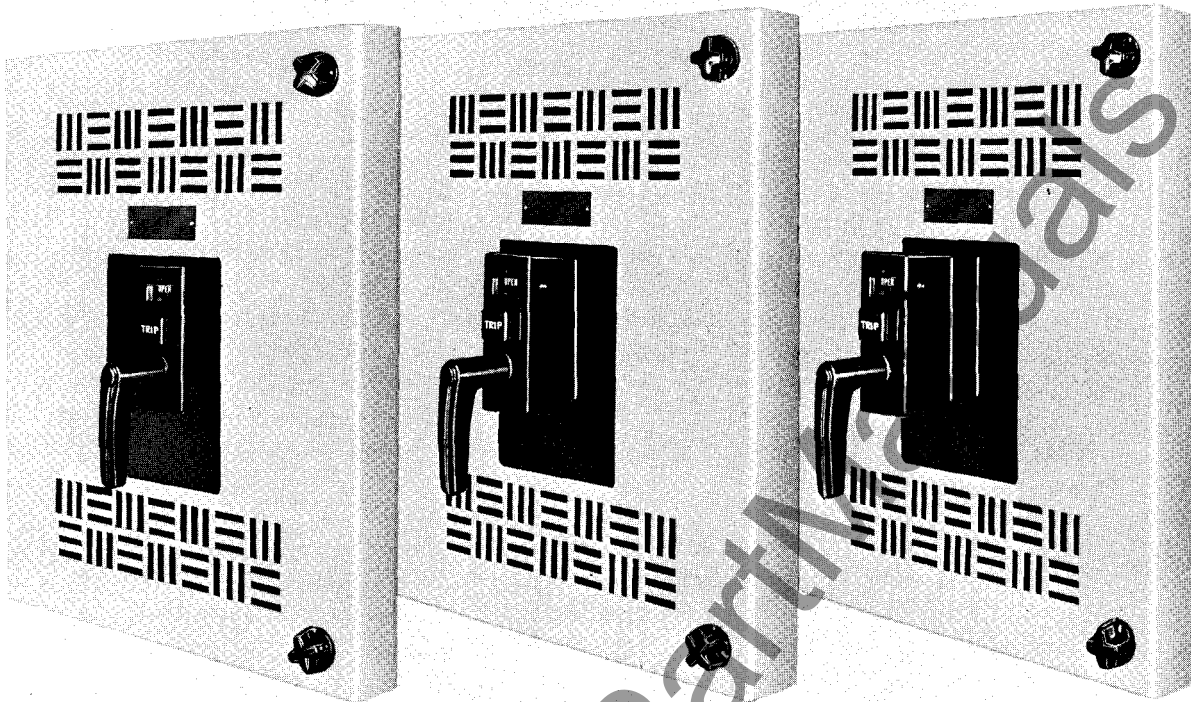


FIG. 1 - Type DB-25 Shown in all Three Positions. The Position of the Breaker in the Compartment is Indicated by the Light Colored Lines.

The space between the mechanism extension and the stationary compartment door is covered by a movable escutcheon plate. Straight line motion is secured by means of pantograph links.

MAINTENANCE: Oil the pantograph links if friction develops. Check for loose bolts.

2. Operating Mechanism - Type DB-75 or DB-100 Fig. 6

A rectangular extension is welded to front of the operating mechanism, enclosing the close-open indicator and the push button hand trip details. The removable maintenance handle is located below and behind this extension.

The space between the mechanism extension and the stationary compartment door is covered by a movable escutcheon plate. Straight line motion is secured by means of pantograph links.

MAINTENANCE: If friction develops oil the pantograph links. Check for loose bolts.

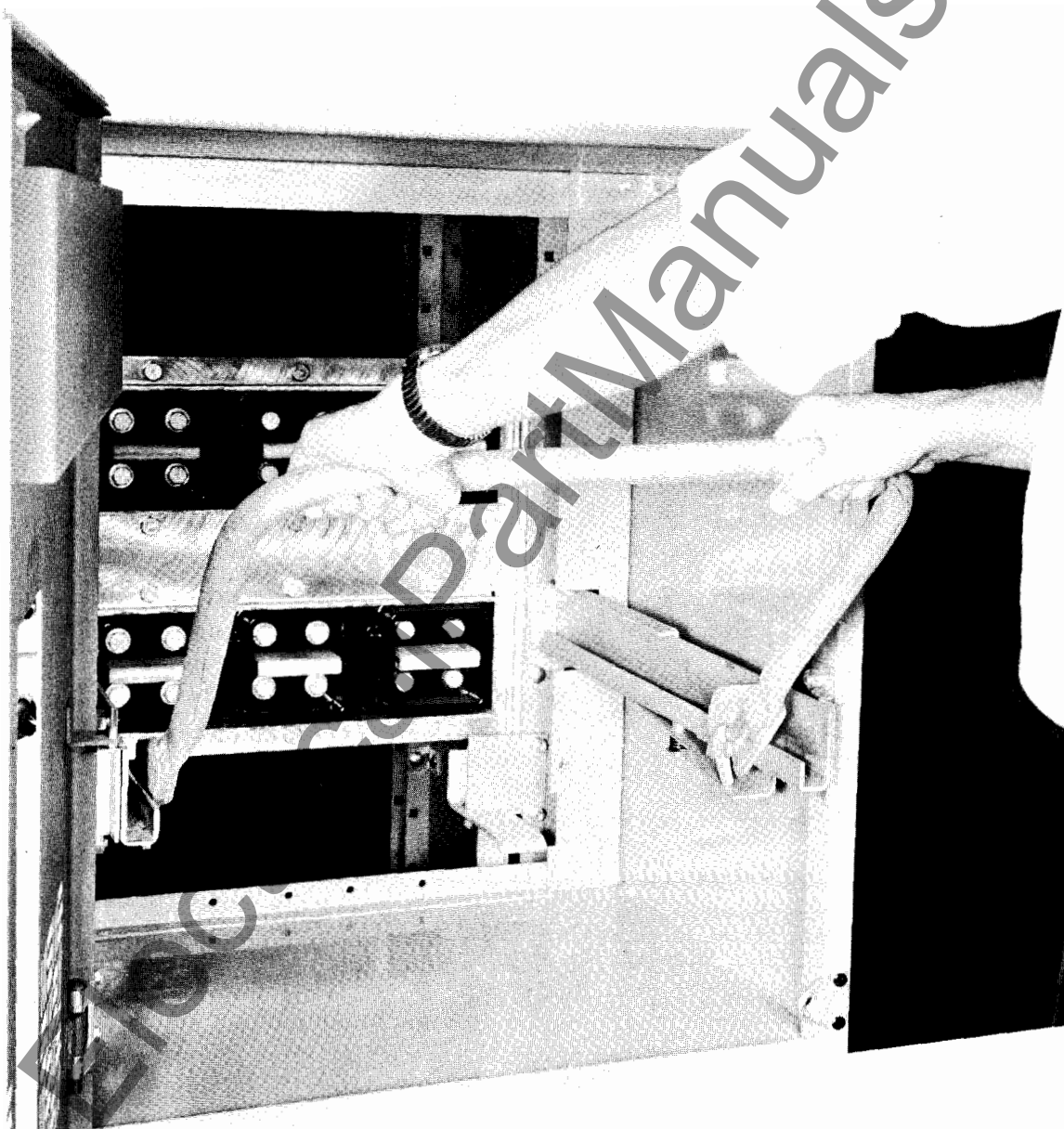


FIG. 2 - Type DB-50 Compartment Showing Automatic Rail Latch Released by Levering Device.

3. Alarm Switch - Fig. 7 Type DB-15 or DB-25 or Fig. 8 Type DB-50

The location and the operating principle are the same as the standard switch described on page 30 of I.B. 35-850-1 & 2 or page 26 of I.B. 35-230-C3. However the switch units are mounted vertically rather than horizontally and two switch units can be supplied.

MAINTENANCE: Clean the switch contacts when necessary. Check for loose bolts.

4. Type DB-50 Control Relay Fig. 9

The control relay mounts directly under the auxiliary switch. It is a single-coil, mechanical tripping device with the coil suitable for continuous duty. The operation sequence is outlined in Fig. 10. The contacts should normally last the life of the breaker, but are replaceable if necessary.

The relay trip pin and relay toggle release are designed so that the relay trips at approximately the same time as the breaker latches. The relay is not adjustable.

Inspection: Make certain all circuits are not energized. Manually lift the core of the operating solenoid to the fully closed position. While still holding core in closed position, raise the relay causing the close coil circuit to open. Release both core and trip pin. The relay linkage and trip pin should reset without any noticeable friction.

Maintenance: Remove screw in front cover plate. Remove cover by grasping it at the bottom and pull down and out. Check for loose screws, especially at contacts. Replace cover and check for loose mounting bolts.

5. Outline Dimensions

Fig. 11 Type DB-15 Three Position Circuit Breaker.

Fig. 12 Type DB-25 Three Position Circuit Breaker.

Fig. 13 Type DB-50 Three Position Circuit Breaker.

Fig. 14 Type DB-75 Three Position Circuit Breaker.

Fig. 15 Type DB-100 Three Position Circuit Breaker.

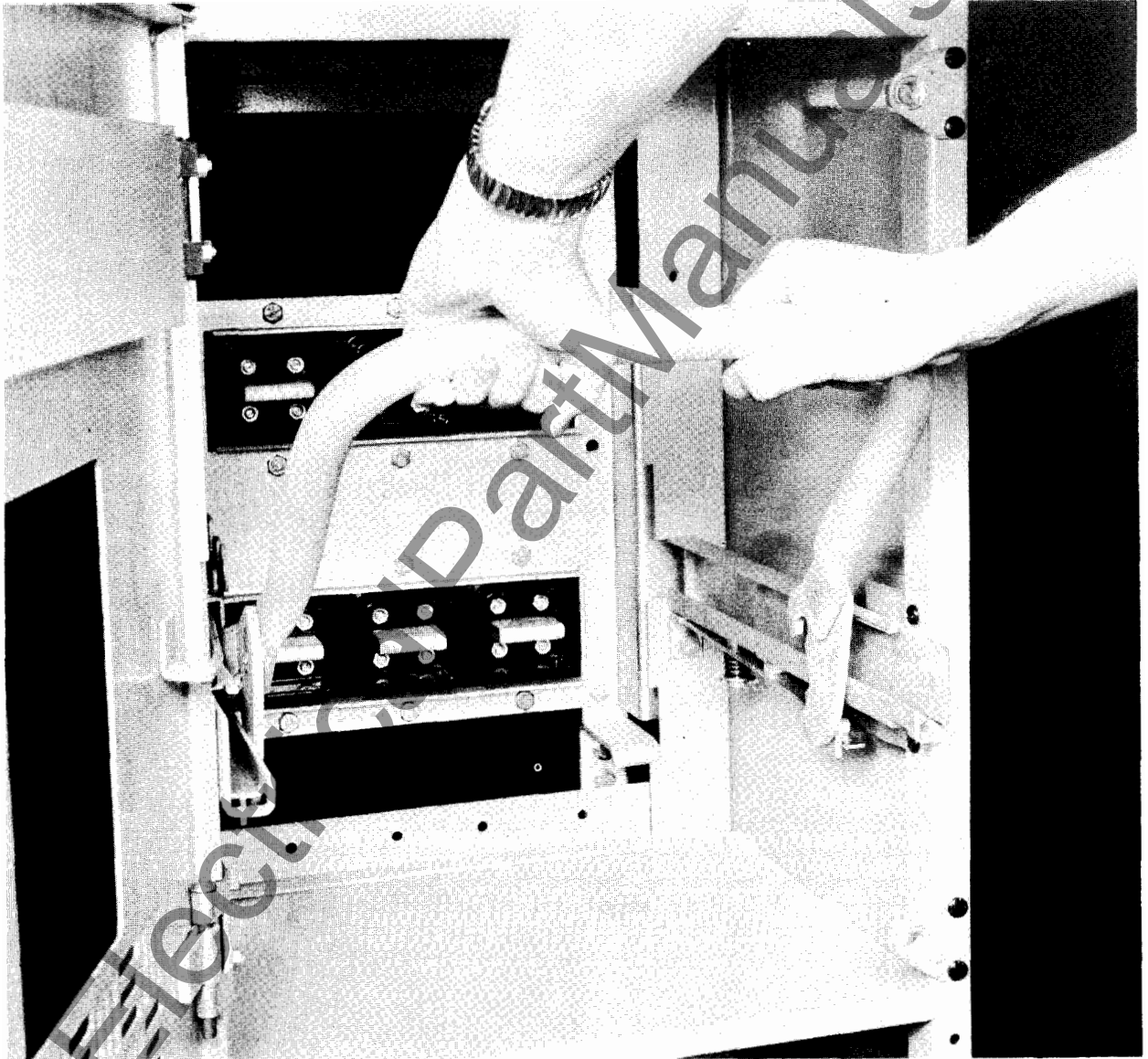


FIG. 3 - Type DB-25 Compartment Showing Automatic Rail Latch Released by Levering Device.

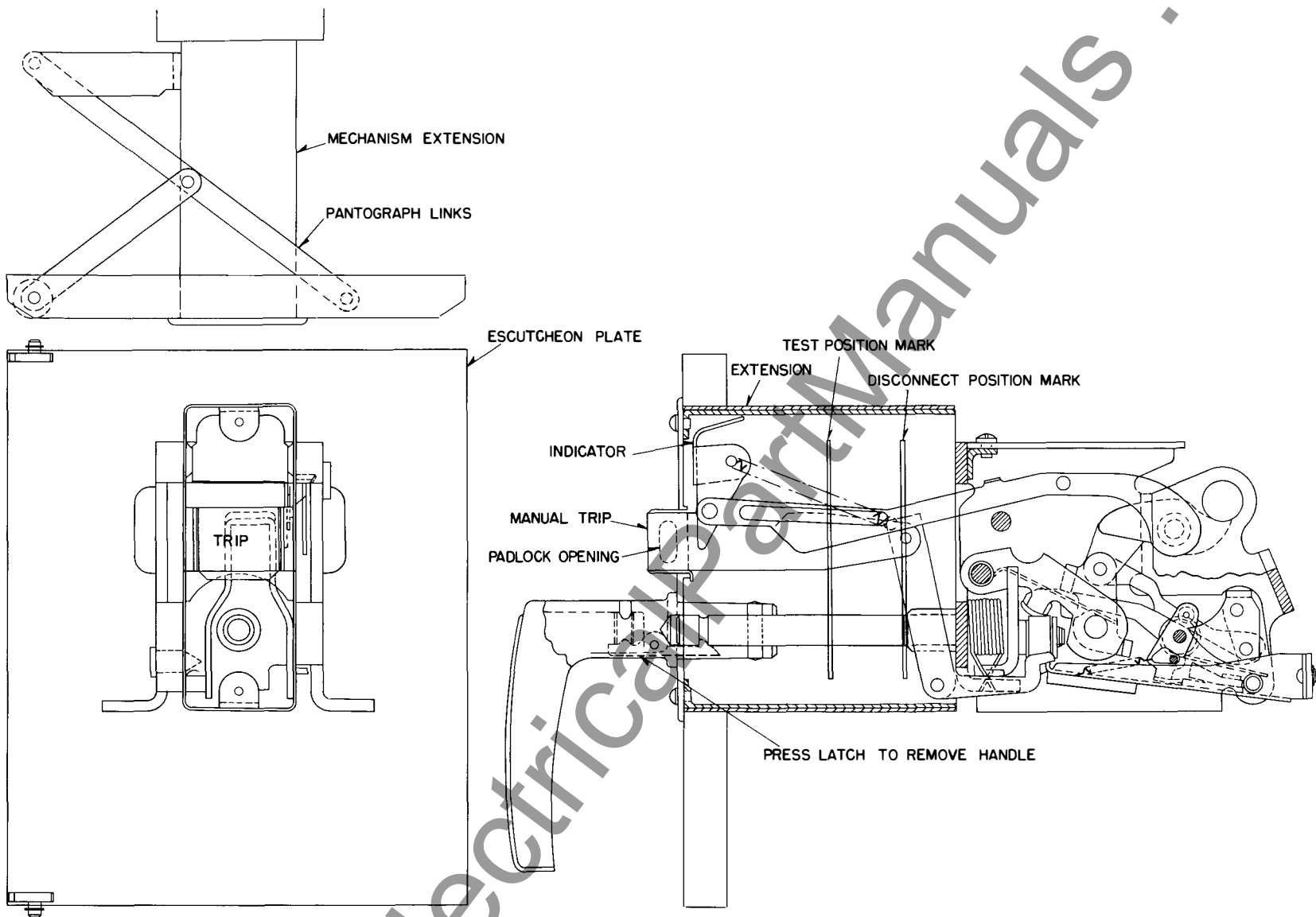
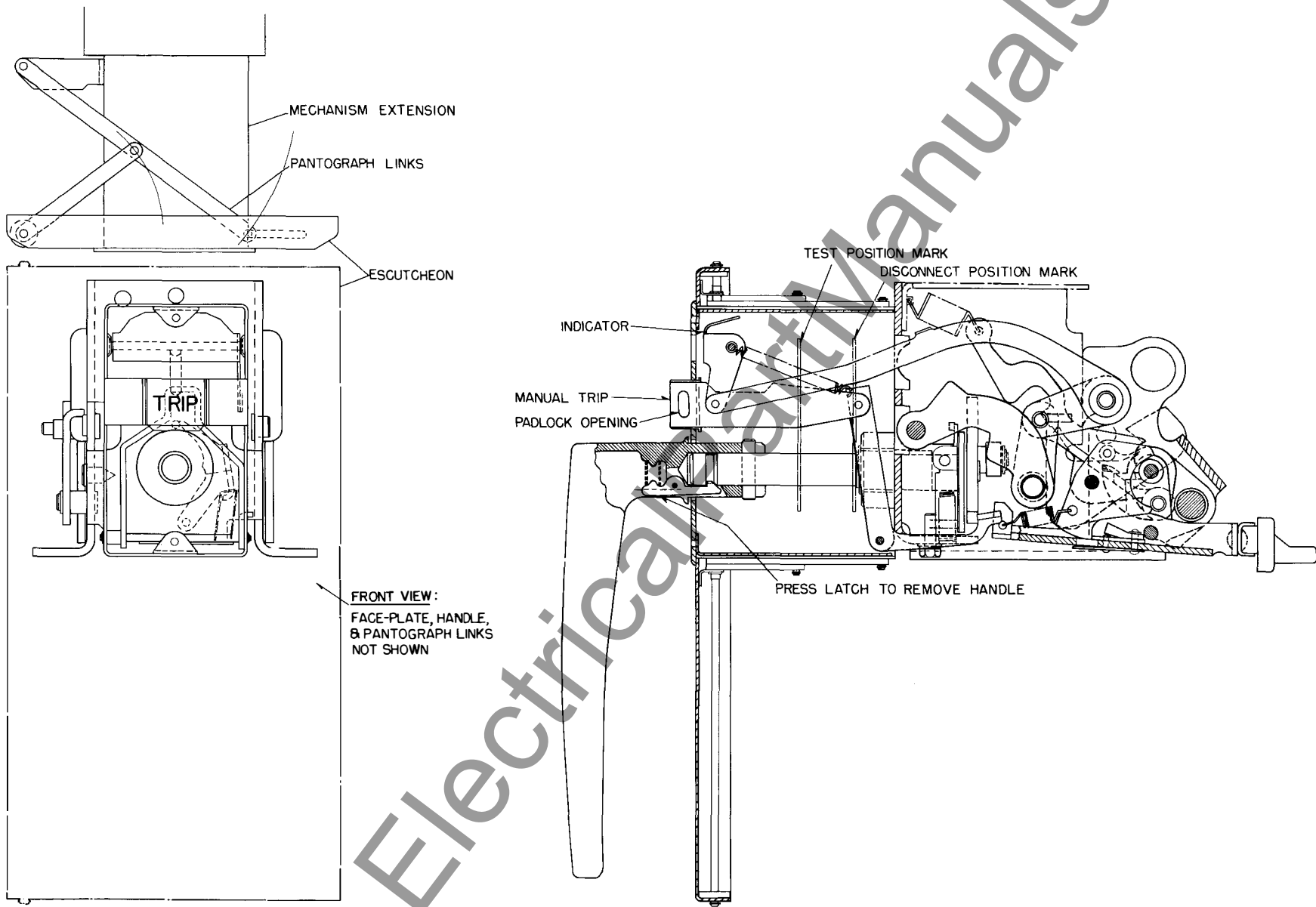


FIG. 4 - Type DB-15 and DB-25 Three Position Operating Mechanism.



◆ FIG. 5 - Type DB-50 Three Position Operating Mechanism.

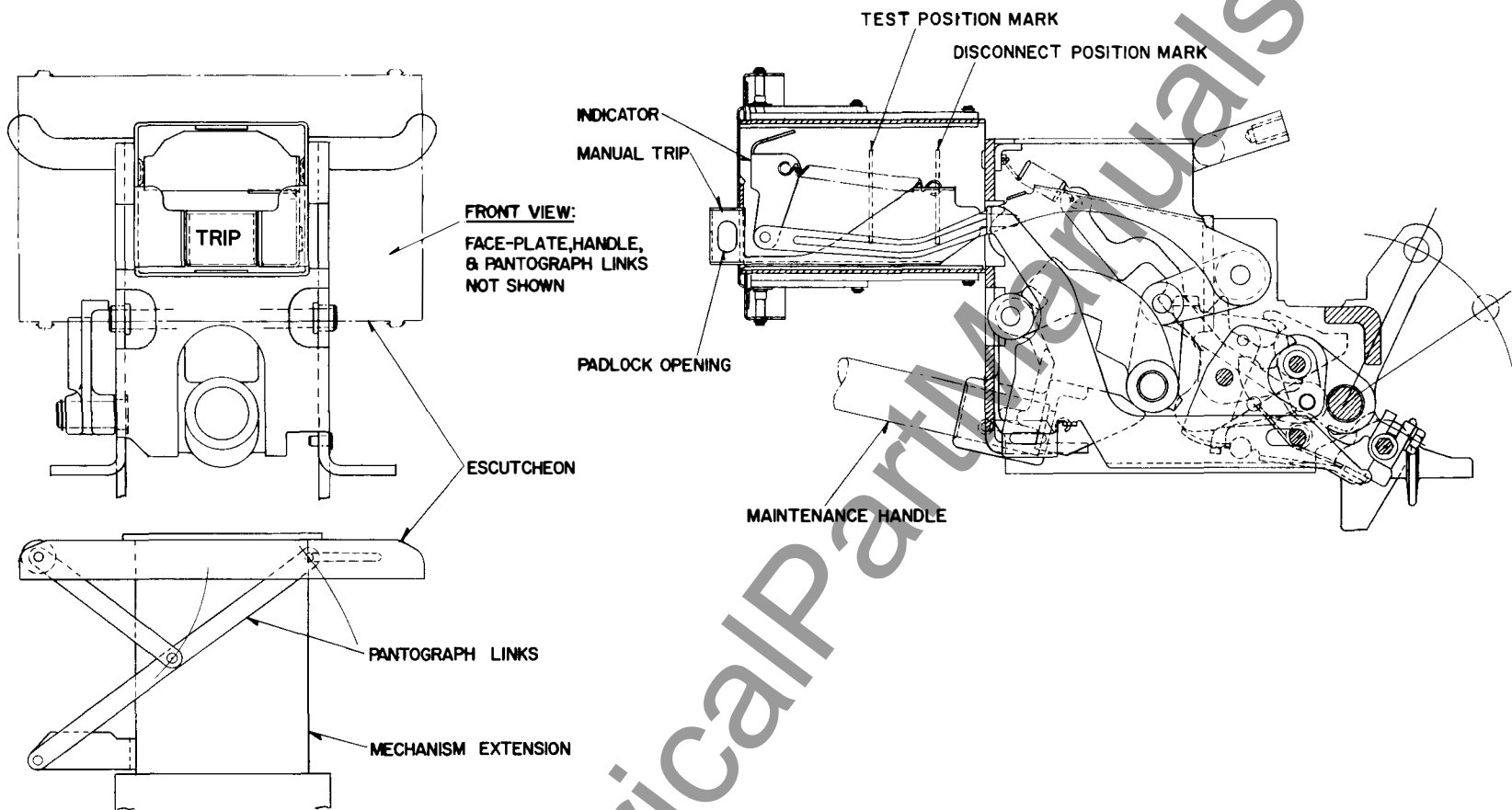


FIG. 6 - Type DB-75 and DB-100 Three Position Operating Mechanism.

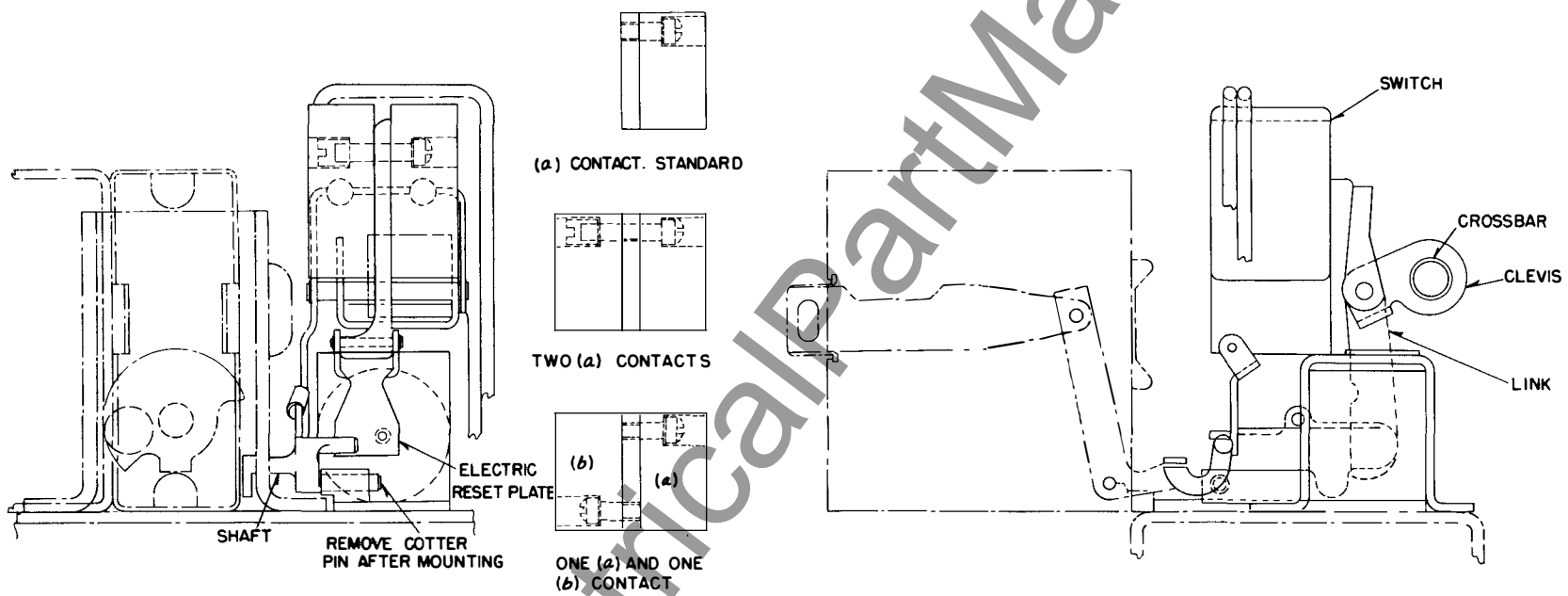


FIG. 7 - Type DB-15 and DB-25 Alarm Switch Attachment.

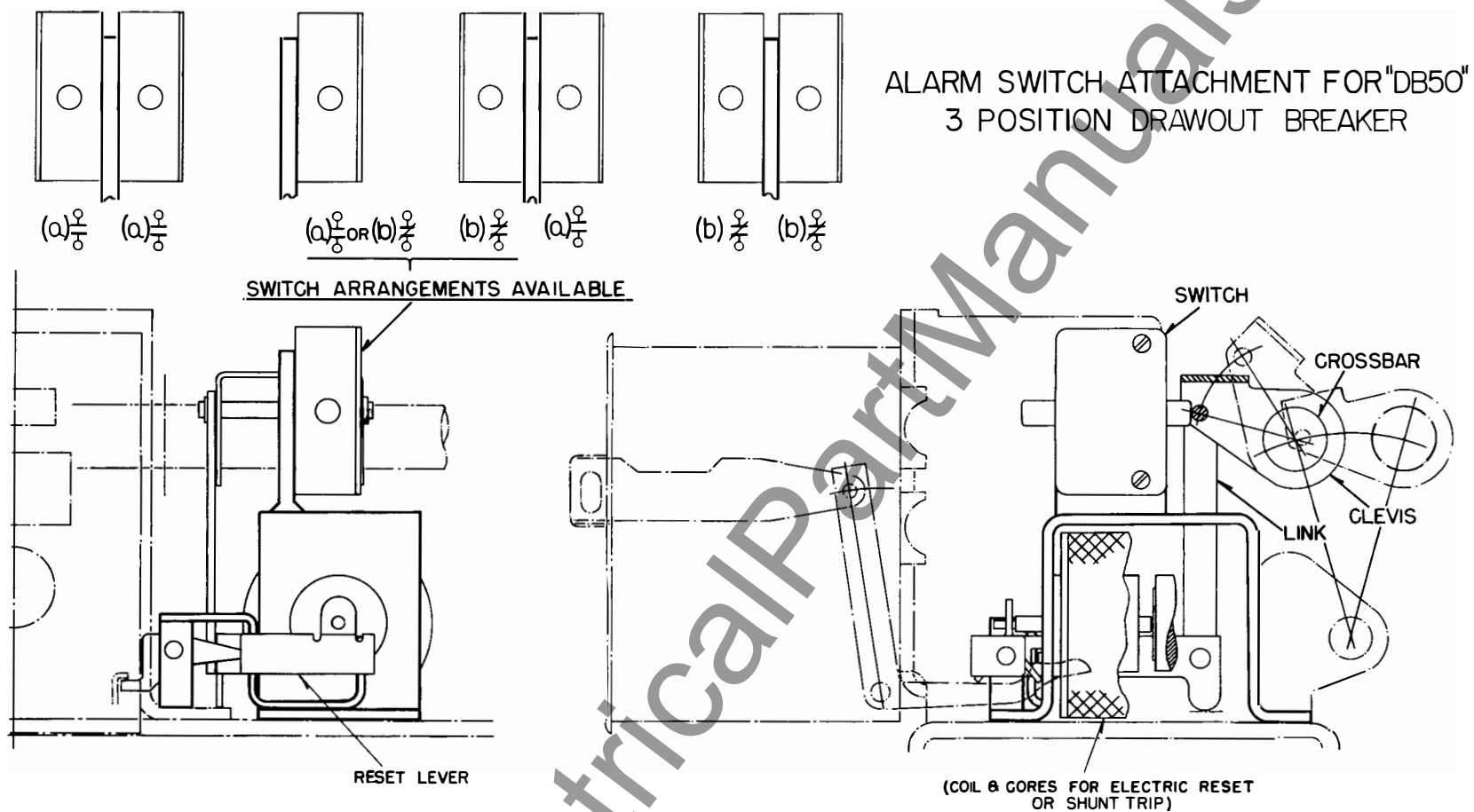


FIG. 8 - Type DB-50 Alarm Switch Attachment.

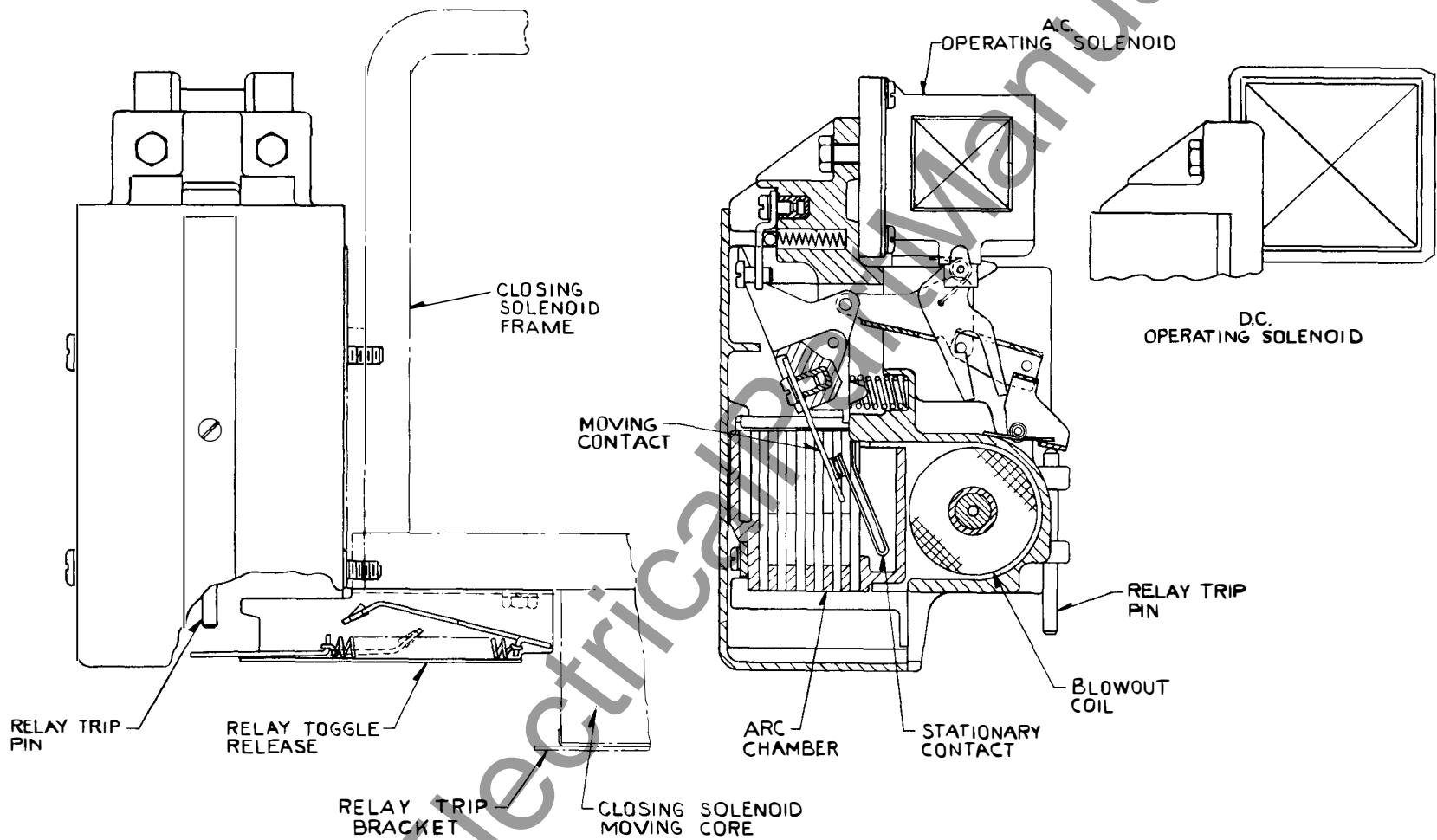
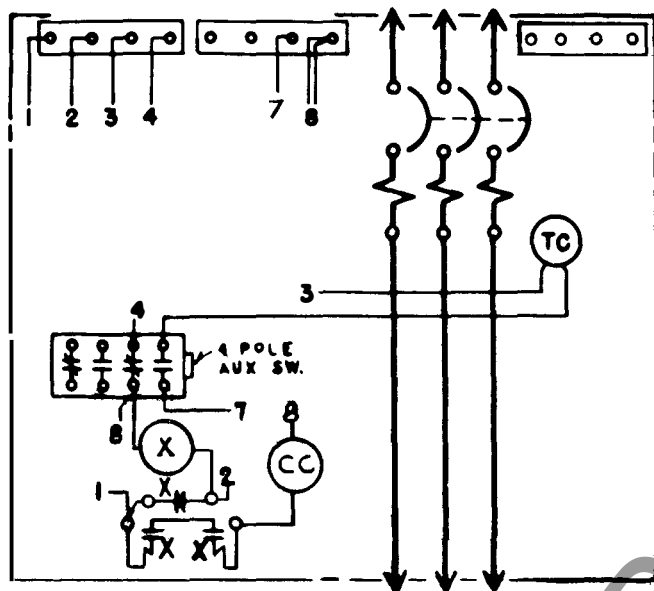


FIG. 9 - Type DB-50 Control Relay.



CONNECTION DIAGRAM (FV)

"DB" BREAKER OPERATION SEQUENCE

CONTROL SWITCH CS-C CLOSED

"X" RELAY PICKS UP & SEALS IN THRU AUX. CONTACT "X".

CLOSING COIL ENERGIZED THRU "X" CONTACT, CLOSING BREAKER.

IN CLOSING, BKR. CLOSING MECH. MECHANICALLY UNLATCHES "X" CONTACTS FREE OF "X" ARMATURE INTERRUPTING CLOSING CIRCUIT.

WITH BREAKER IN CLOSED POSITION, THE BREAKER MECH. IS LATCHED CLOSED BUT "X" CONTACTS REMAIN UNLATCHED FROM "X" ARMATURE.

WHEN BKR. IS TRIPPED, CLOSING MECH. DROPS, PERMITTING "X" LATCH TO RESET PROVIDED "X" COIL IS DE-ENERGIZED.

LEGEND

- CC-CLOSING COIL
- TC-TRIP COIL
- X-CONTROL RELAY
- CS-CONTROL SWITCH
- R-RED LAMP (CLOSED)
- G-GREEN LAMP (OPEN)
- a-AUXILIARY SWITCH CONTACT (MAKE)
- b-AUXILIARY SWITCH CONTACT (BREAK)

NOTE

* REMOVE DASHES FOR SEPARATE TRIP & LEAVE DASHES FOR COMMON TRIP.

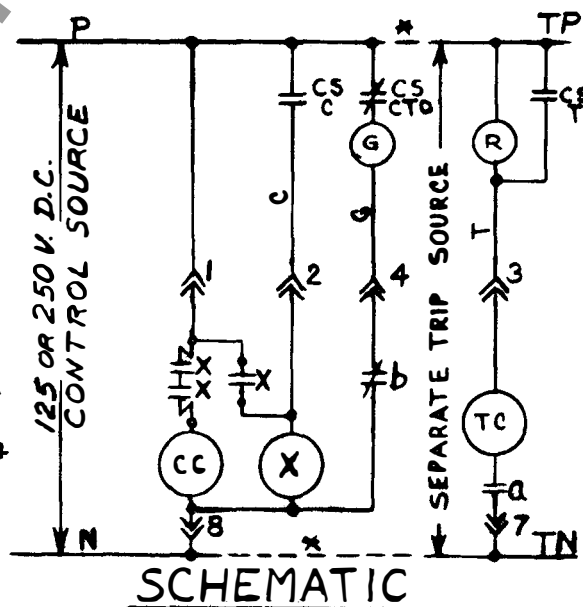


FIG. 10 - Type DB-50 Typical Diagram.

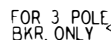


FIG. 1

FRONT VIEW OF STUD LOCATIONS
FOR MOUNTING 3 POLE BREAKER
WITH 2 OR 3 OVERCURRENT TRIPS,
OR 2 POLE BREAKER WITHOUT
REVERSE CURRENT TRIP.

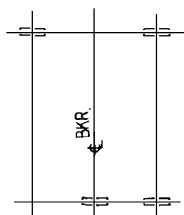


FIG. 2 - NEMA STD.

FRONT VIEW OF STUD LOCATION
FOR MOUNTING 2 POLE BREAKER
WITH 2 OVERCURRENT TRIPS AND
REVERSE CURRENT TRIP

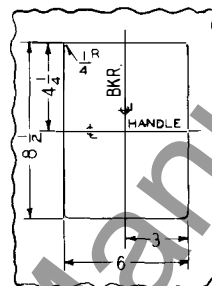


FIG. 3

CUTOUT IN DOOR

THE FOLLOWING ATTACHMENTS CAN
BE SUPPLIED WITHOUT INCREASING
OVERALL DIMENSIONS:

1. AUXILIARY SWITCHES (8 CIRCUIT MAX)
2. UNDERVOLTAGE TRIP
3. OPERATION COUNTER
4. ALARM SWITCH
5. ELECTRIC LOCKOUT
6. SHUNT TRIP

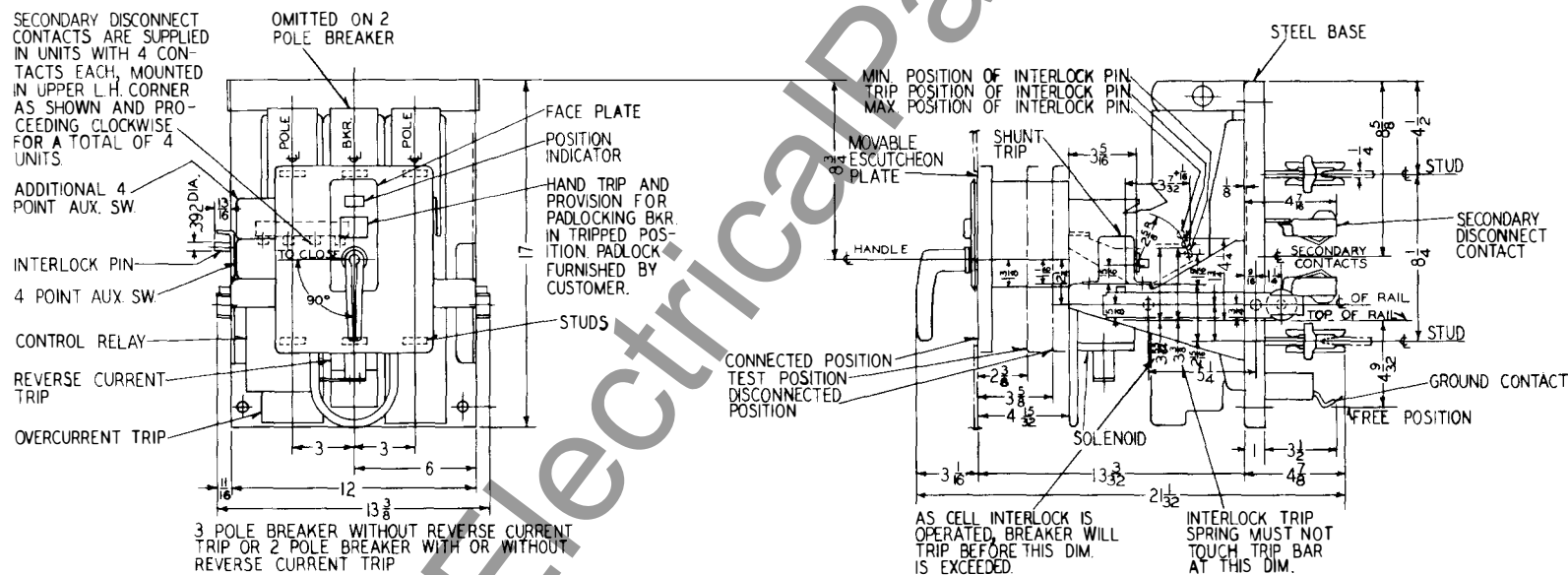
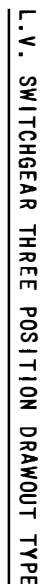


FIG. 11 - Type DB-15 Outline Dimensions.



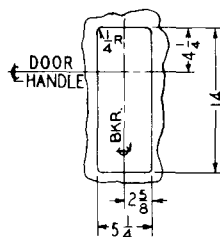


FIG.2 NEMA STD.

FRONT VIEW OF STUD LOCATIONS
FOR MOUNTING 2 POLE BREAKER
WITH 2 OVERCURRENT TRIPS
AND REVERSE CURRENT TRIP

FIG. 3

CUTOUT IN DOOR

1 AUXILIARY SWITCHES (12 CIRCUIT MAX.)
2 SHUNT TRIP
3 UNDERVOLTAGE TRIP (WITH OR WITHOUT
TIME DELAY)
4 ALARM SWITCH
5 ELECTRIC LOCKOUT
6 OPERATION COUNTER

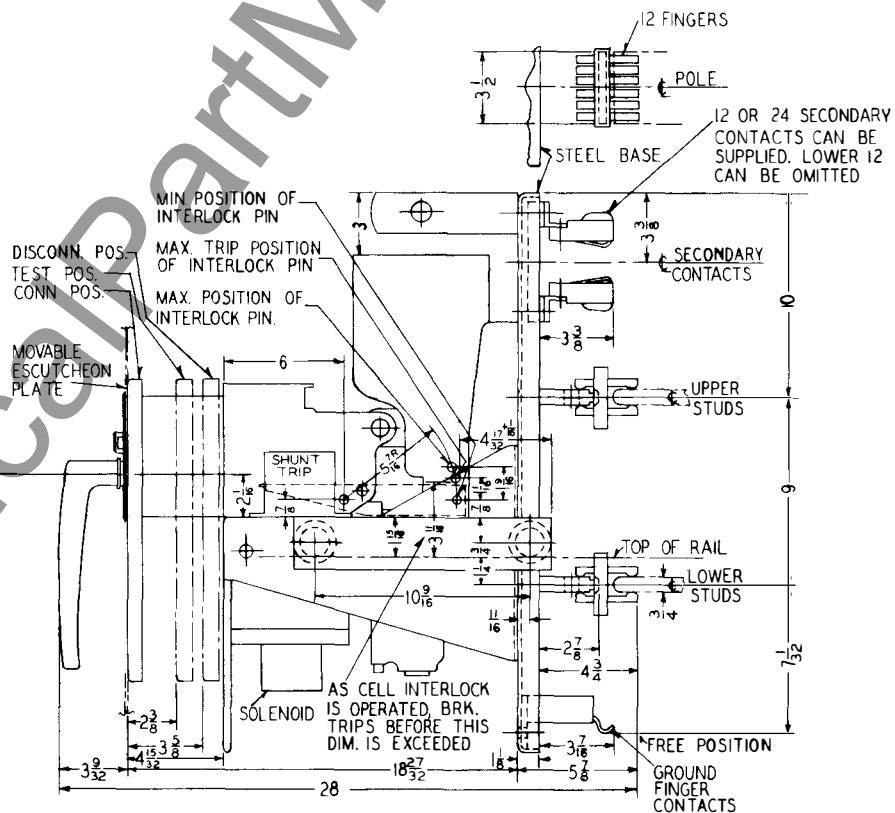


FIG. 13 - Type DB-50 Outline Dimensions.

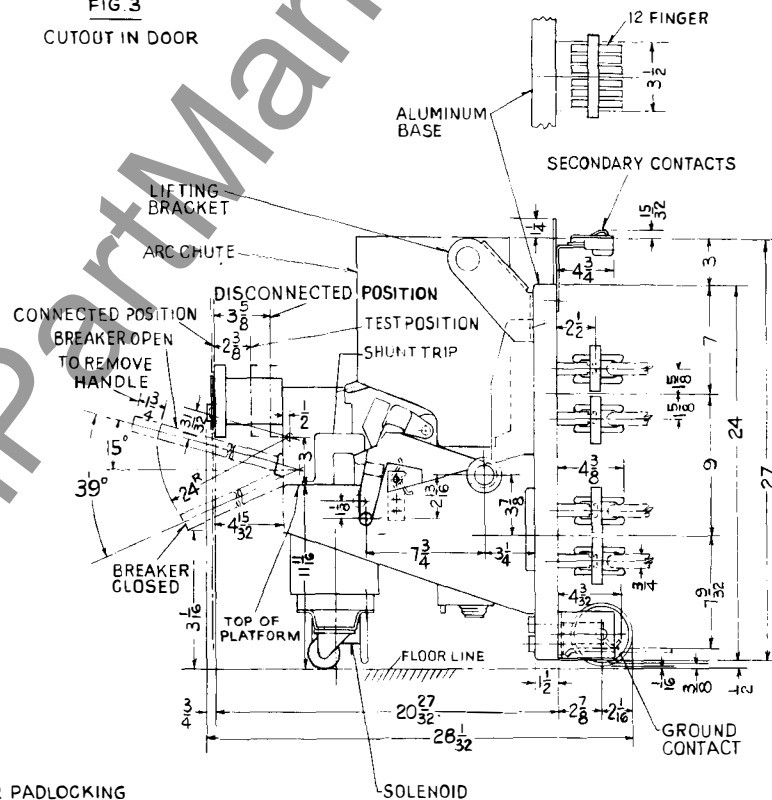
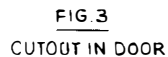
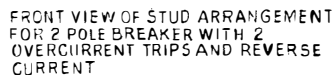
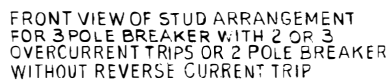
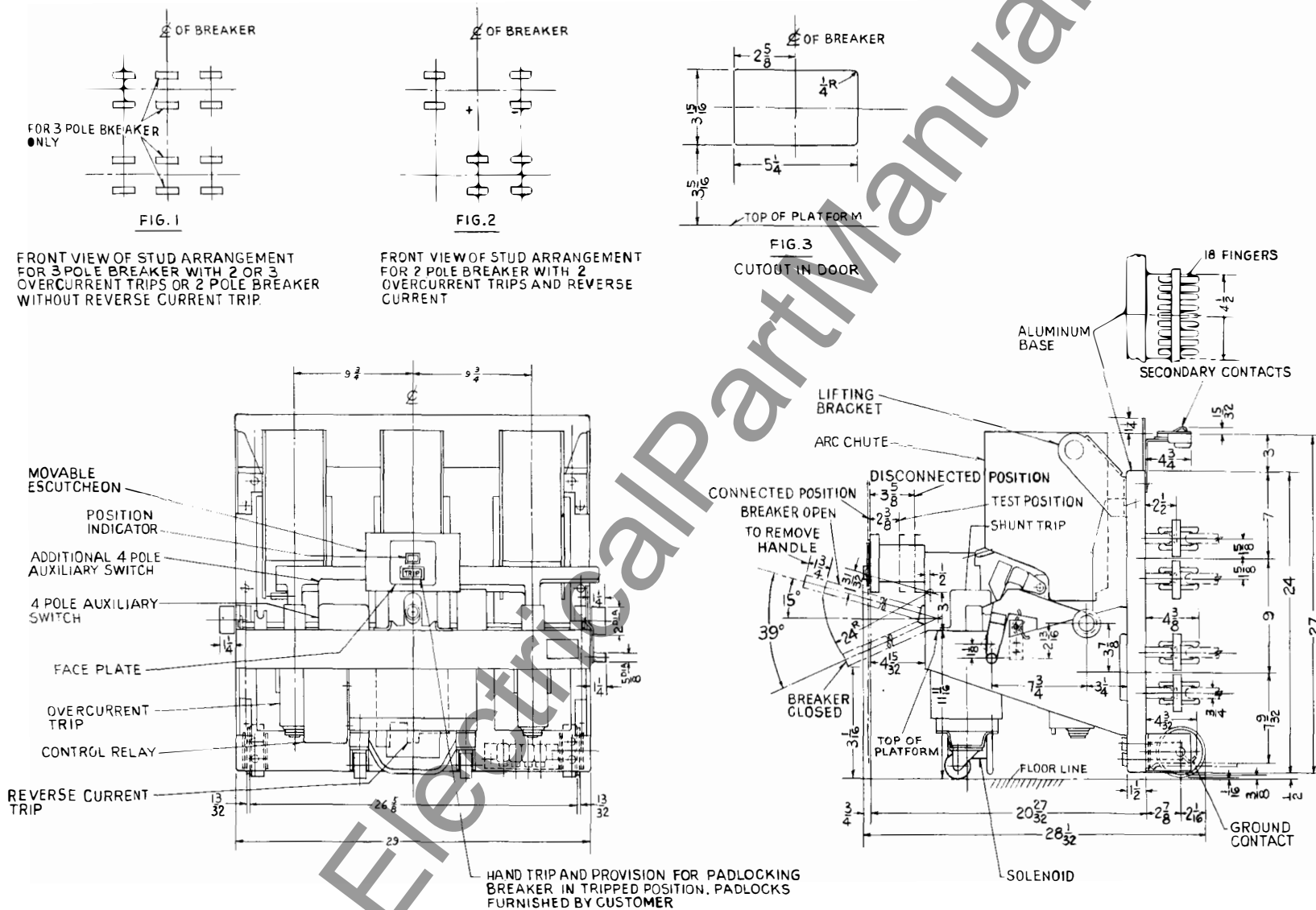


FIG. 14 - Type DB-75 Outline Dimensions.



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DESCRIPTION • INSTALLATION • MAINTENANCE

INSTRUCTIONS

Low-Voltage

METAL-ENCLOSED

SWITCHGEAR

WESTINGHOUSE ELECTRIC CORPORATION

SWITCHGEAR DIVISION

EAST PITTSBURGH PLANT

EAST PITTSBURGH, PA.

SUPERSEDES I.B. 32-100-1

DECEMBER, 1952

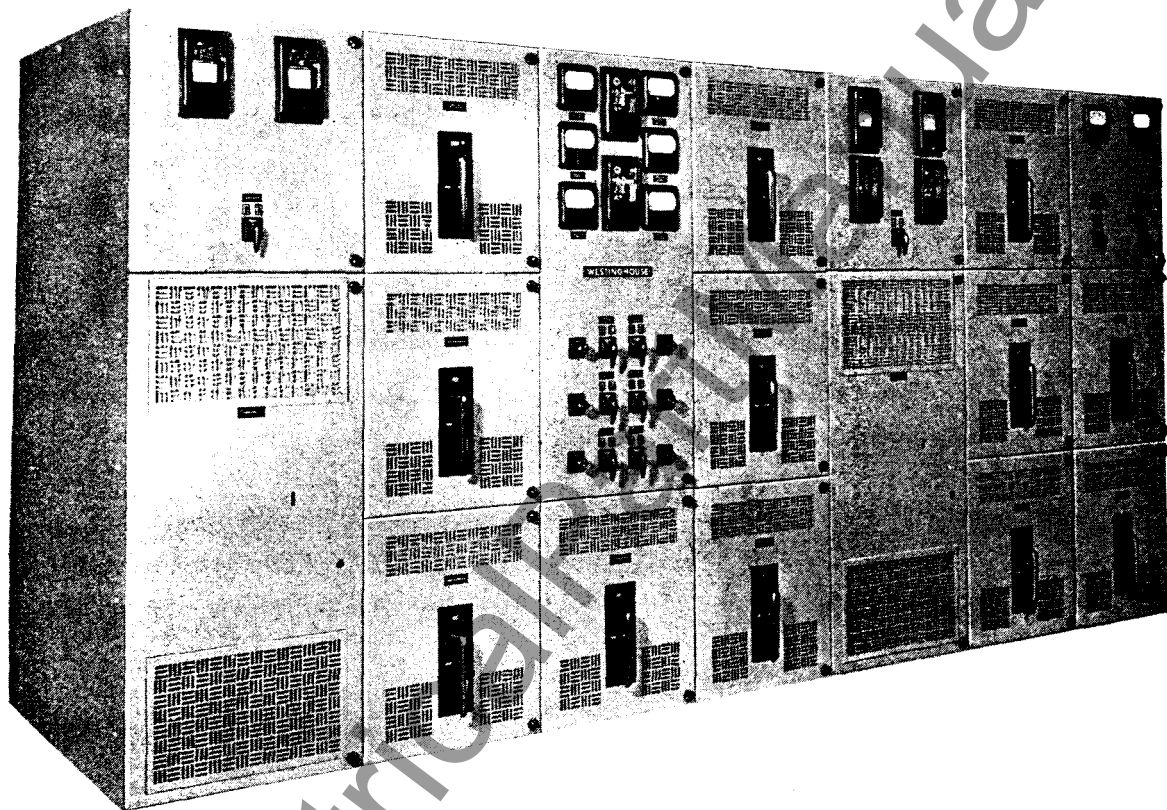
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Low-Voltage METAL-ENCLOSED SWITCHGEAR

This instruction book has been prepared to familiarize the purchaser's engineering and operating staff with the low-voltage (600 volts or lower) metal-enclosed switchgear supplied by Westinghouse. The information contained herein should be carefully studied before attempting to install or operate the equipment.

Proper installation, operation and maintenance are necessary to assure continued satisfactory service from the equipment. It should not be installed in places where it will be called upon to operate at voltages or currents greater than those for which it was designed.

For instructions pertaining to a particular piece of apparatus supplied as part of the switchgear equipment, refer to the instruction book or leaflet applying to that particular type of apparatus. Copies of the applicable publications are furnished along with this book for each switchgear installation.

•

Caution: Only authorized and properly trained personnel should be permitted to operate or handle any portion of the switchgear.

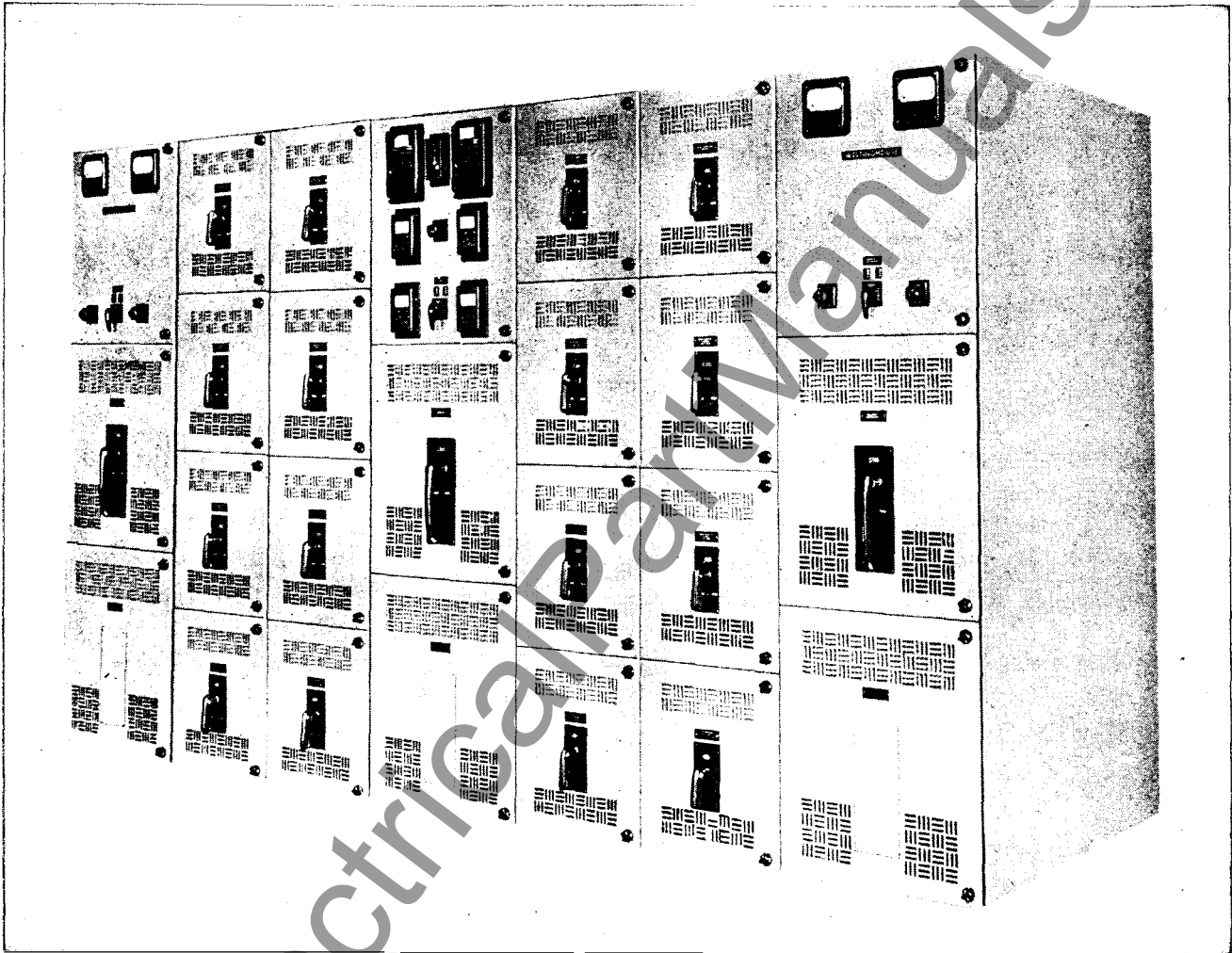


FIG. 1. Front View of Indoor Metal-Enclosed Switchgear Containing Types DB-25 and DB-50 Circuit Breakers as Removable Elements

DESCRIPTION

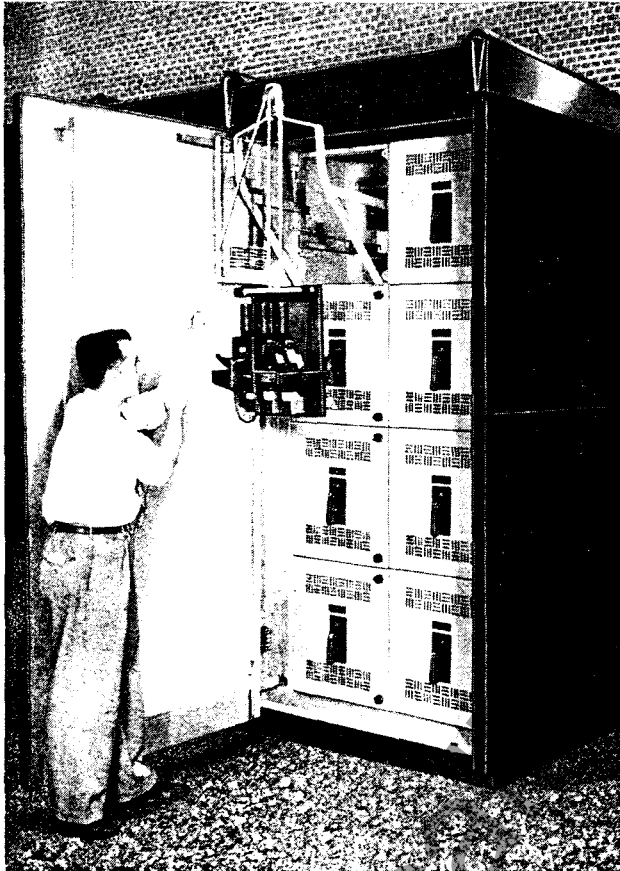


FIG. 2. Low-Voltage Switchgear Installed in an Outdoor Weatherproof Housing

Low-voltage (600 volts or below) indoor and outdoor metal-enclosed switchgear having drawout mounted type DB or DA air circuit breakers is completely factory assembled and tested. It is designed to require a minimum amount of labor for installation. See Figs. 1 and 2. Shipments are made completely assembled, or in sections of one or more housings, to suit the handling facilities at the point of installation.

The switchgear consists of a fixed part, called the stationary structure, and drawout-type circuit breakers, called the removable elements. The switchgear provides for three positions of the removable element, namely; "connected", "test", and "disconnected".

In the "connected" position, both the primary and secondary disconnecting devices are engaged, and the circuit breaker is ready for operation. In

the "test" position, only the secondary disconnecting devices are engaged, and the circuit breaker can be operated without energizing the power circuit. In the "disconnected" position, both the primary and secondary disconnecting devices are disengaged, and the entire circuit breaker is isolated.

SWITCHGEAR HAVING TYPES DB-15, DB-25 AND DB-50 CIRCUIT BREAKERS

Stationary Structure. The stationary structure is an assembly of one or more steel housings, each consisting of a formed and welded front enclosure containing the circuit breaker compartments and a rear enclosure for the bus copper, cables, instrument transformers and other detail equipment. See Fig. 3. The front compartments are completely enclosed, segregating each circuit breaker from the other breakers.

Each circuit breaker compartment is provided with the main stationary contacts and a rail along

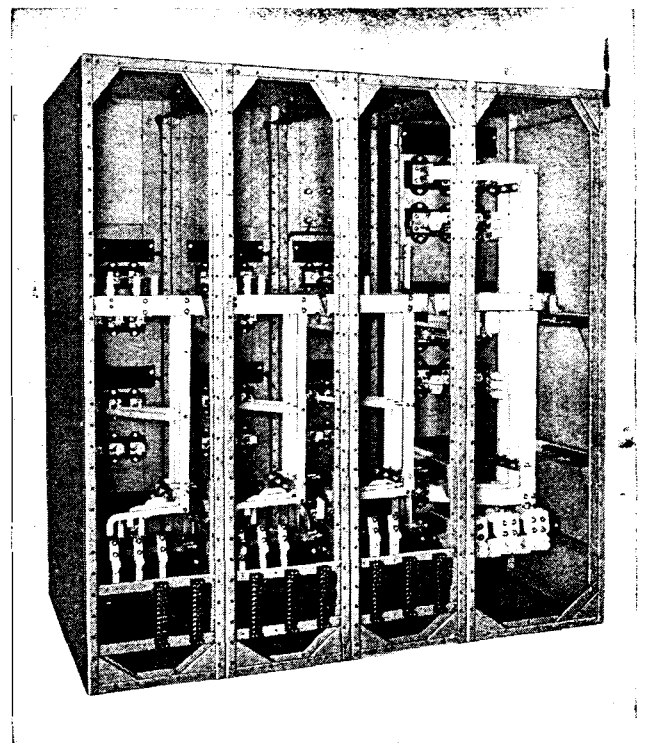


FIG. 3. View of Rear Bus Compartment

DESCRIPTION

each side for supporting the removable element. These rails permit the removable element to be moved between the "connected" and "disconnected" positions, with a positive stop for each position and by use of the rail extensions (for all except the type DB-15), completely out of the compartment.

The rear enclosure is made up of the rear frames, tie members, top sheets and rear covers, all bolted together and to the rear of the front compartment. The rows or square holes which are punched in the rear frame, tie members and the rear flanges of the front compartment permit changes and additions to be made without cutting, welding or drilling.

The universal type Micarta bus support blocks can be arranged to permit the use of one, two or three bars per phase. Thus, by a simple rearrangement of the insulating blocks, additional copper bars may be added to the bus in the field as future load requirements dictate. Figs. 4, 5 and 6 illustrate the arrangements of the Micarta blocks for one, two and three bars per phase, respectively.

Removable Element. The removable element consists of the air circuit breaker equipped with primary and secondary disconnecting devices, an operating mechanism, position indicator and interlocks. Wheels engage the side rails in the compartment to support and guide the removable element. For the DB-25 and DB-50 breakers the four wheels are mounted directly on the sides of the circuit breaker assembly, while for the DB-15 breaker the two rear wheels are on the breaker assembly, and the two front wheels are mounted on the sides of the compartment. For all type DB breakers the lifting bracket is permanently mounted at the top of the breaker assembly. See Figs. 8, 10 and 12.

Each removable element is provided with a positioning pin located as shown in Figs. 8, 10 and 12. The positioning pin engages slots on a bracket in the compartment to lock the removable element in each of the three positions. See Figs. 7, 9 and 11.

A separate levering device is used in moving the DB-25 and DB-50 elements while the primary disconnecting devices are in contact. The use of this device is illustrated in Fig. 16. The levering device is not required for the smaller type DB-15 breaker.

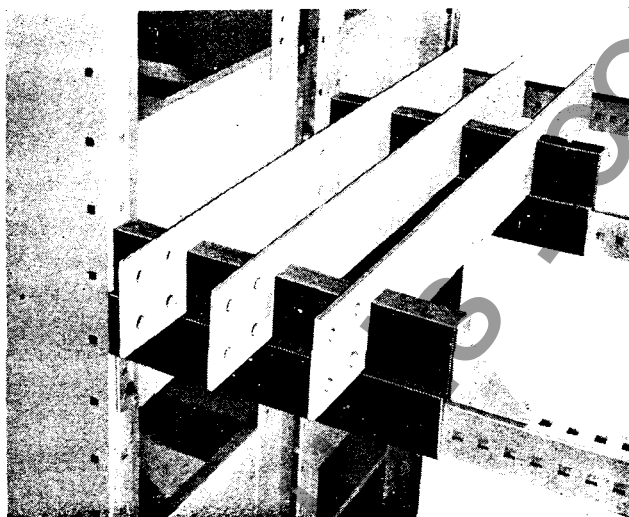


FIG. 4. Micarta Bus Supports Arranged for One Bus Bar Per Phase

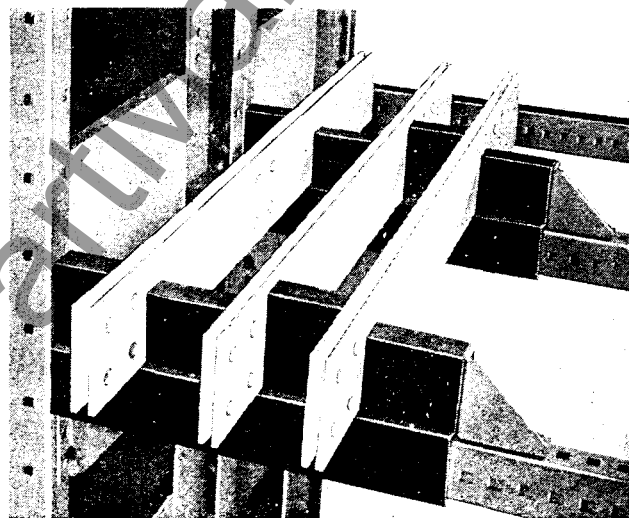


FIG. 5. Micarta Bus Supports Arranged for Two Bus Bars Per Phase

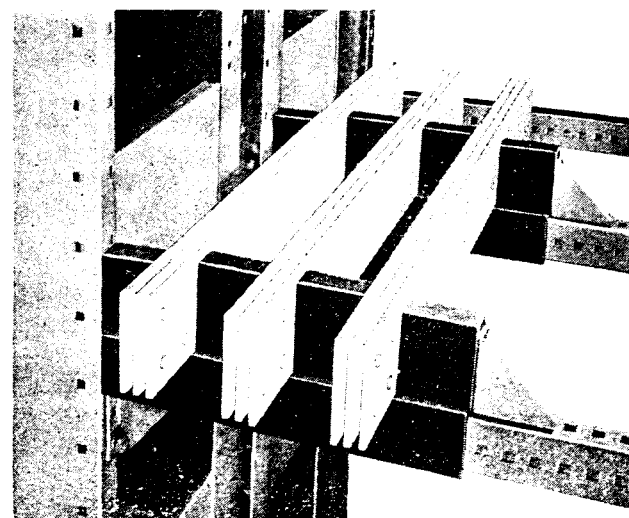


FIG. 6. Micarta Bus Supports Arranged for Three Bus Bars Per Phase

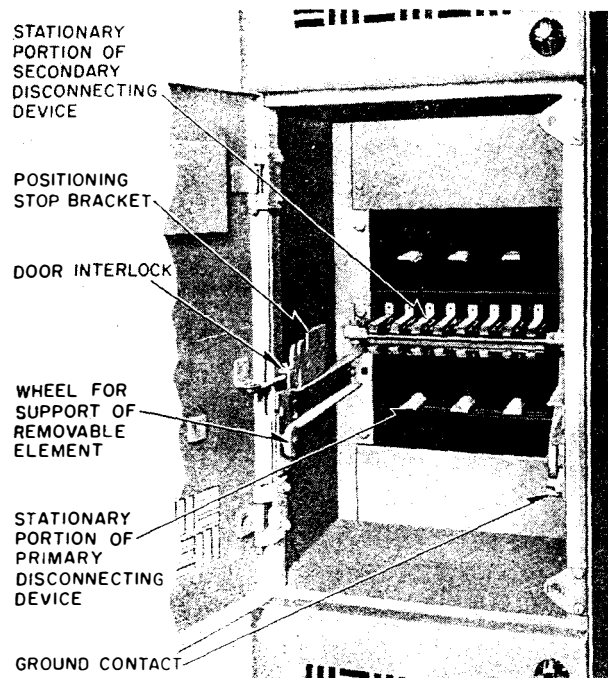


FIG. 7. Compartment for Type DB-15 Circuit Breaker

A ground clip is mounted on the rear of the removable element to contact the compartment ground shoe when the element is inserted into, or beyond, the "test" position.

A "code" nameplate is mounted on each removable element and on the rear of each compartment door to assure that the correct rating element is placed in the compartment. Always make certain the code letter is the same on the removable element and the stationary compartment.

A set of conjunction parts may be used to adapt a type DB-25 compartment for use with a type DB-15 removable element, or a DB-50 compartment for use with a DB-25 removable element. These parts are all bolted in the compartment, and of course, the correct stationary primary disconnecting devices must be used in such a modified compartment. Fig. 13 illustrates the use of these parts.

Interlocks. The front hinged door of the circuit breaker compartment is interlocked with the removable element so that the circuit breaker will automatically be tripped if an attempt is made to open the door when the circuit breaker is closed. This interlock also prevents closing the breaker while it is in the "connected" position with the door open. With the removable element withdrawn to the "test" position, however, the breaker can be closed with the compartment door open. This interlock can be modified to allow opening of the door, when the breaker is closed, to permit inspection of the breaker.

An interlock between the compartment and the removable element will automatically trip the circuit breaker if an attempt is made to move the element into the "connected" position while the circuit breaker is closed. This interlock also prevents closing the breaker when it is at any point between the "test" and "connected" positions.

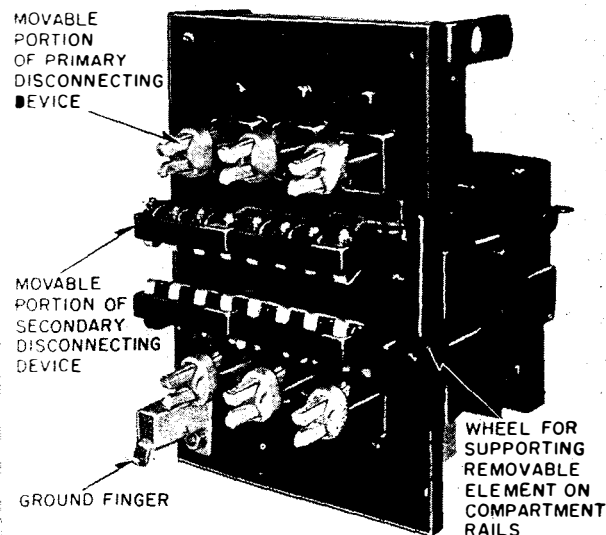
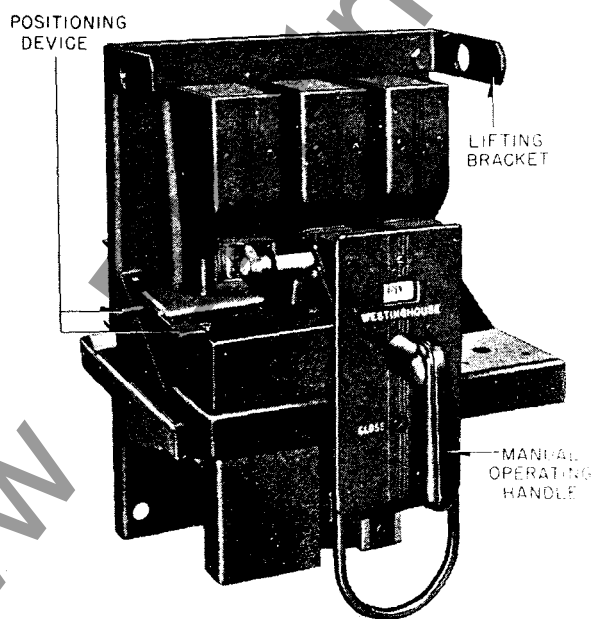


FIG. 8. Removable Element for Type DB-15 Circuit Breaker

DESCRIPTION

Before the removable element may be withdrawn from the "connected" position, the lever on the left side of the element must be depressed. This causes the positioning pin to move out of the positioning slot, and at the same time it causes the circuit breaker to trip if it is closed. Thus, the element cannot be withdrawn from the "connected" position while the breaker is closed.

Accessories. Standard accessories furnished for types DB-25 and DB-50 switchgear include a set of rail extensions and a levering device. Figs. 15 and 16 illustrate the manner in which the rail extensions are used in completely withdrawing the element from the compartment and show the method of moving the element into, or out of, the "connected" position by use of the levering device.

When type DB removable elements are furnished for outdoor service, a lifting device, as illustrated in Fig. 2, is furnished as a standard accessory in addition to the rail extensions and levering device.

There are no accessories required for indoor switchgear having type DB-15 removable elements. The element can be moved into, or out of, the "connected" position without the use of a levering device.

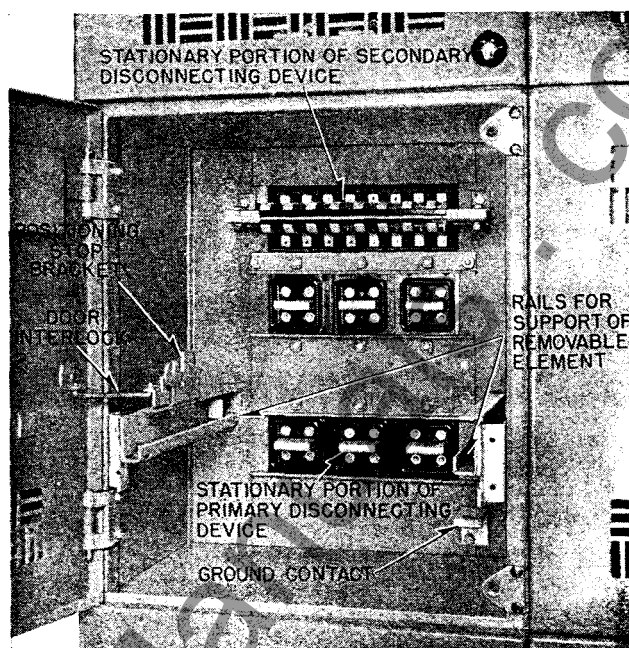


FIG. 9. Compartment for Type DB-25 Circuit Breaker

Inserting the Removable Element. For type DB-25 or DB-50 element, proceed as follows:

1. Open the compartment door and attach the rail extensions.

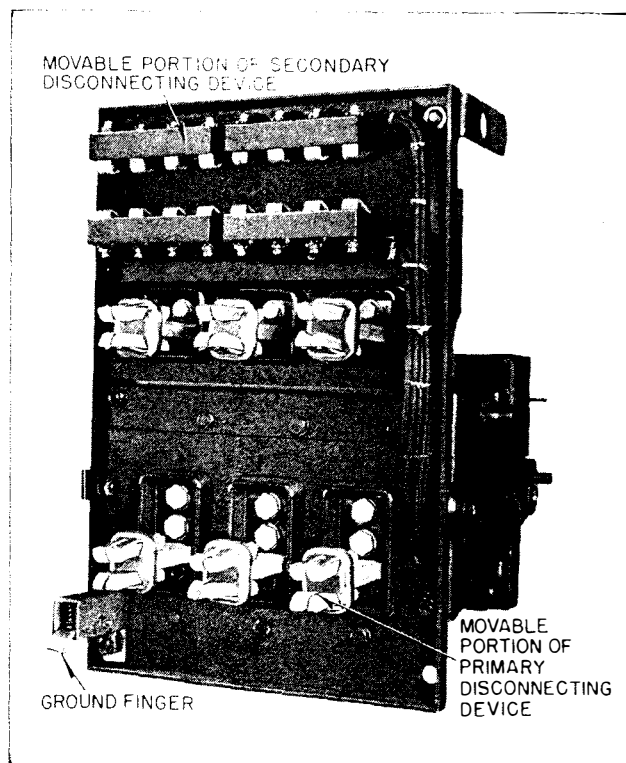
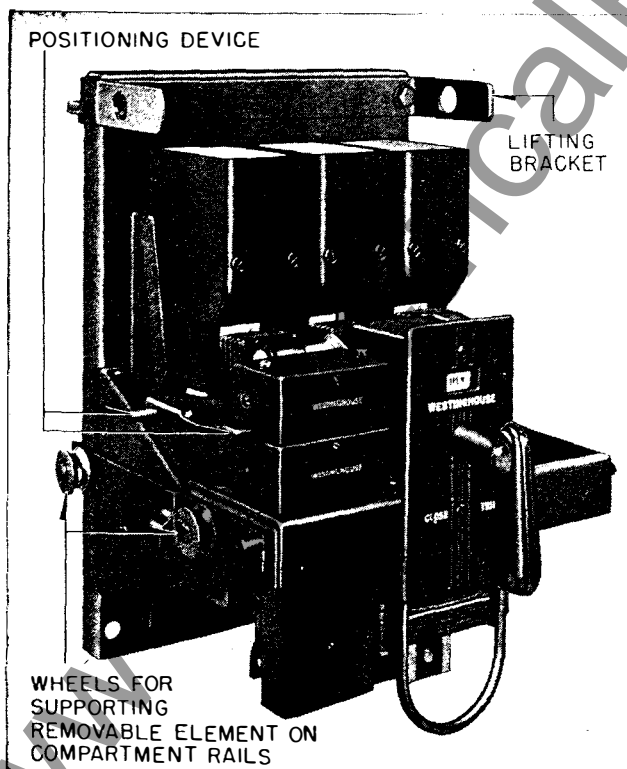


FIG. 10. Removable Element for Type DB-25 Circuit Breaker

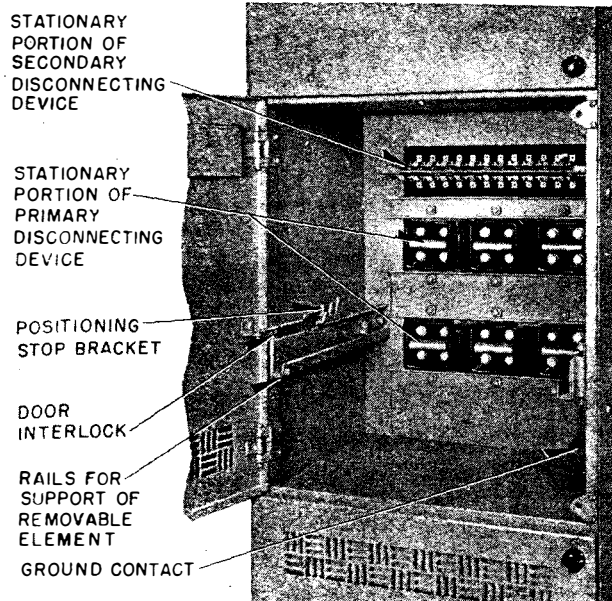


FIG. 11. Compartment for Type DB-50 Circuit Breaker

2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.

3. Lift the removable element and place it on the rail extensions.

4. Push the element into the compartment until the positioning pin drops into the first slot, thus holding the element in the "disconnected" position.

5. Remove the rail extensions.

6. Release the positioning stop pin by depressing the lever on the left side of the removable element,

and push the element further into the compartment until the pin engages the second slot, holding the element in the "test" position.

7. Close and trip the circuit breaker, and check its operation in general. The circuit breaker is closed by rotating the operating handle in a clockwise direction and tripped by turning the handle in the opposite direction.

8. Release the positioning stop pin, and push the element into the compartment until the movable and stationary portions of the primary disconnecting devices start to engage.

9. Insert the levering device, and lift up on the handle until the removable element reaches the "connected" position. This will be noted when the two rear wheels strike the stops located in the cell rails.

10. Remove the levering device. Close and latch the compartment door.

The method of inserting the type DB-15 removable element is similar, except that the element is lifted and placed directly on the compartment rails instead of on rail extensions, and a levering device is not required to move the element between the "test" and "connected" positions.

Removing the Element. For type DB-25 or DB-50 element, proceed as follows:

1. Trip the circuit breaker, and open the compartment door.

2. Insert the levering device handle.

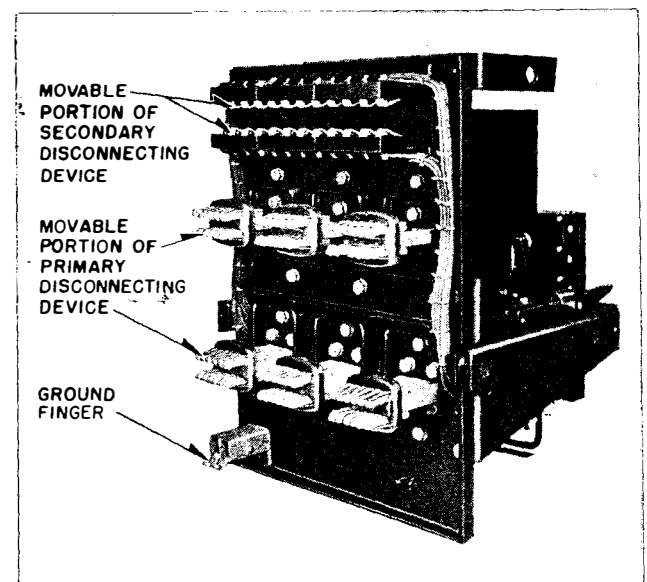
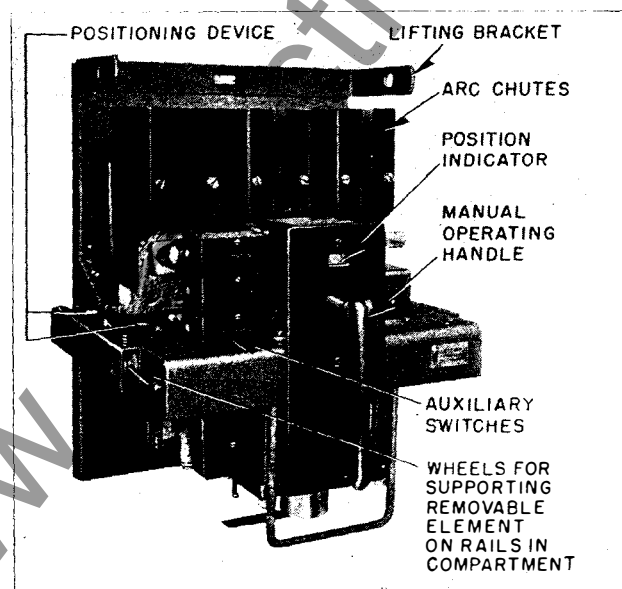


FIG. 12. Removable Element for Type DB-50 Circuit Breaker

DESCRIPTION

3. Pull down on the levering handle until it reaches the limit of its travel, and then remove the levering device. Pull out the element until the positioning pin engages the "test" position slot.

Note: Operation may be checked in this position without removing the element from the compartment.

4. Attach the rail extensions.
5. Release the positioning stop pin and pull the element out on the rail extensions.
6. Lift the removable element off the rails.
7. Remove the rail extensions. Close and fasten the compartment door.

Note: If it is desired to withdraw the element to the "disconnected" position only, release the positioning pin after step 3, and pull the element until the positioning pin engages the "disconnected" position slot.

The method of removing the type DB-15 removable element is similar, except that the rail extensions and the levering device are not required.

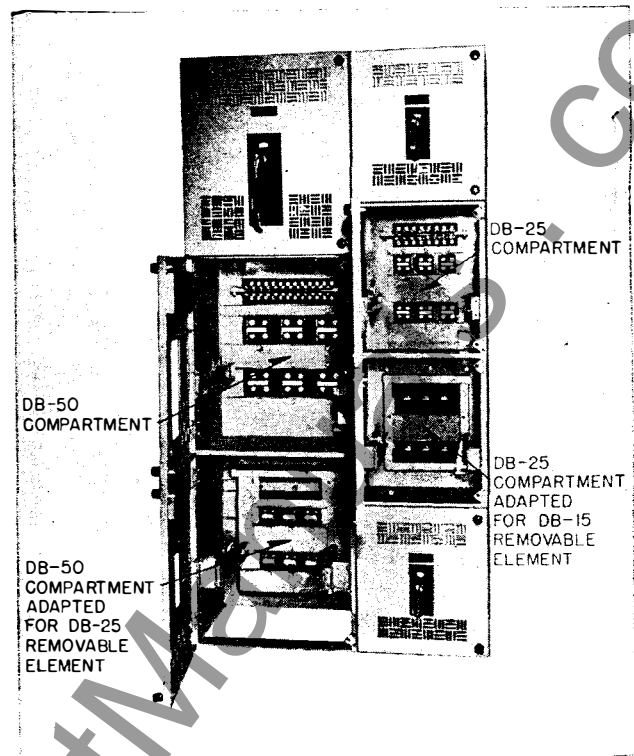


FIG. 13. Switchgear Having Conjunction Parts for Mounting Smaller Removable Elements

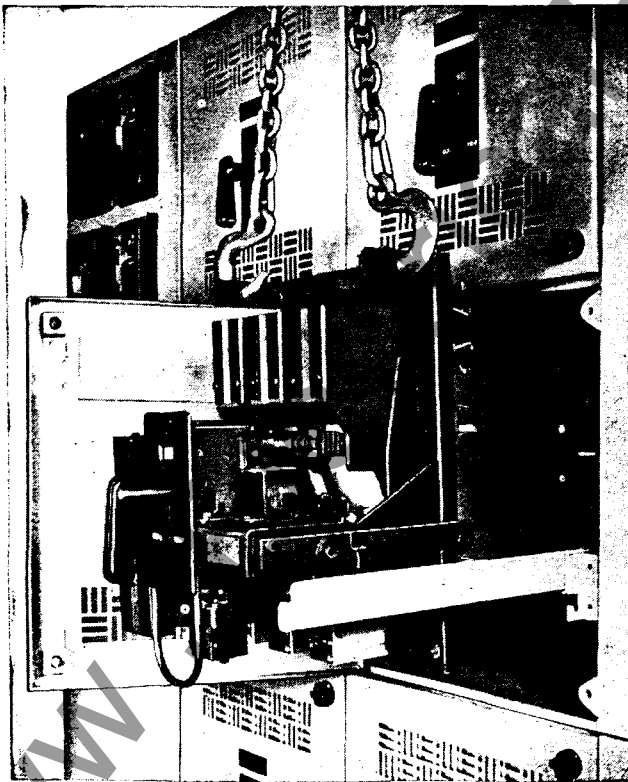


FIG. 14. Placing Type DB-25 Removable Element on the Rail Extensions Using a Hoist

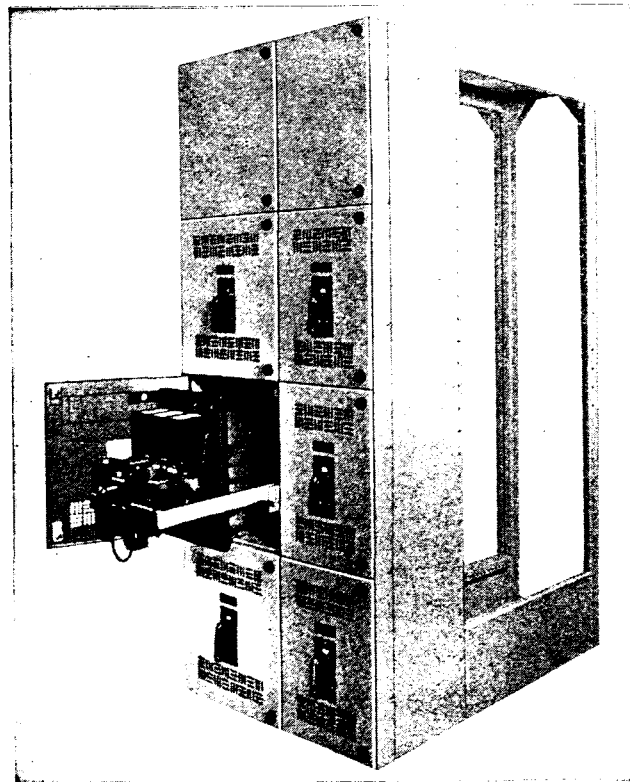


FIG. 15. Type DB-25 Element in Position on Rail Extensions Ready for Insertion in the Compartment

SWITCHGEAR HAVING TYPE DB-75, DB-100 & DBF-40 CIRCUIT BREAKERS

The type DB-75 and DB-100 breakers are equipped with wheels so that they may be rolled on the floor. DB-100 and DBF-40 breakers are supplied only in a "one-high" arrangement so that these breakers always roll into the housing at floor level. DB-75 breakers are arranged to be at floor level whenever possible, but can be mounted in "two-high" arrangements. A portable extension platform is provided with two-high DB-75 assemblies to facilitate inserting or removing the breaker.

The levering device for these breakers is a worm gear mechanism mounted in the housing having a lever arm on each side of the compartment to engage rollers on the breaker. The interlocking mechanism consists of a slider assembly at the right front of the compartment which is moved vertically by operating a "pull-pin" which extends thru the compartment door. The compartment is shown in Figure "A" (photo 350676).

INSERTING THE REMOVABLE ELEMENT

The interlocking and levering-in mechanism operates in the following fashion starting with the compartment door open and the levering mechanism set at "roll-out" position.

- (a) Align breaker flanged wheels with rails and push breaker into compartment.
- (b) If breaker is pushed slowly into the compartment one can feel the flanged wheels settle into the "disconnected" position notch with the breaker about 3/4 of the way in. (If the breaker is closed and the interlock "pull-pin" has been pulled the breaker will also be stopped at this position by interference of the trip interlock parts).
- (c) Push breaker into the compartment until the levering rollers engage the levering arms. The breaker should be "open" when this is done. Some rolling inertia is helpful to pass thru the disconnected position notch but the breaker should not be slammed into this position.
- (d) Pull out the interlock "pull-pin" -- the breaker must be "open" to permit this -- and insert the crank on the levering shaft.
- (e) Turning the crank approximately 1½ turns will set the indicator at "Test" position with the levering arms securely holding the breaker in the test position rail notch. If the crank is removed and the interlock "pull-pin" pushed in the breaker may be operated either electrically or with the maintenance closing handle for test purposes.
- (f) Turning the crank approximately 16 turns will move the breaker into the "connected" position. When the main contacts touch after about 8 turns of the crank, a noticeable additional effort is required for about two full turns to engage the contacts and then some reduction in effort should be noticed for several turns until the mechanism stop is reached.

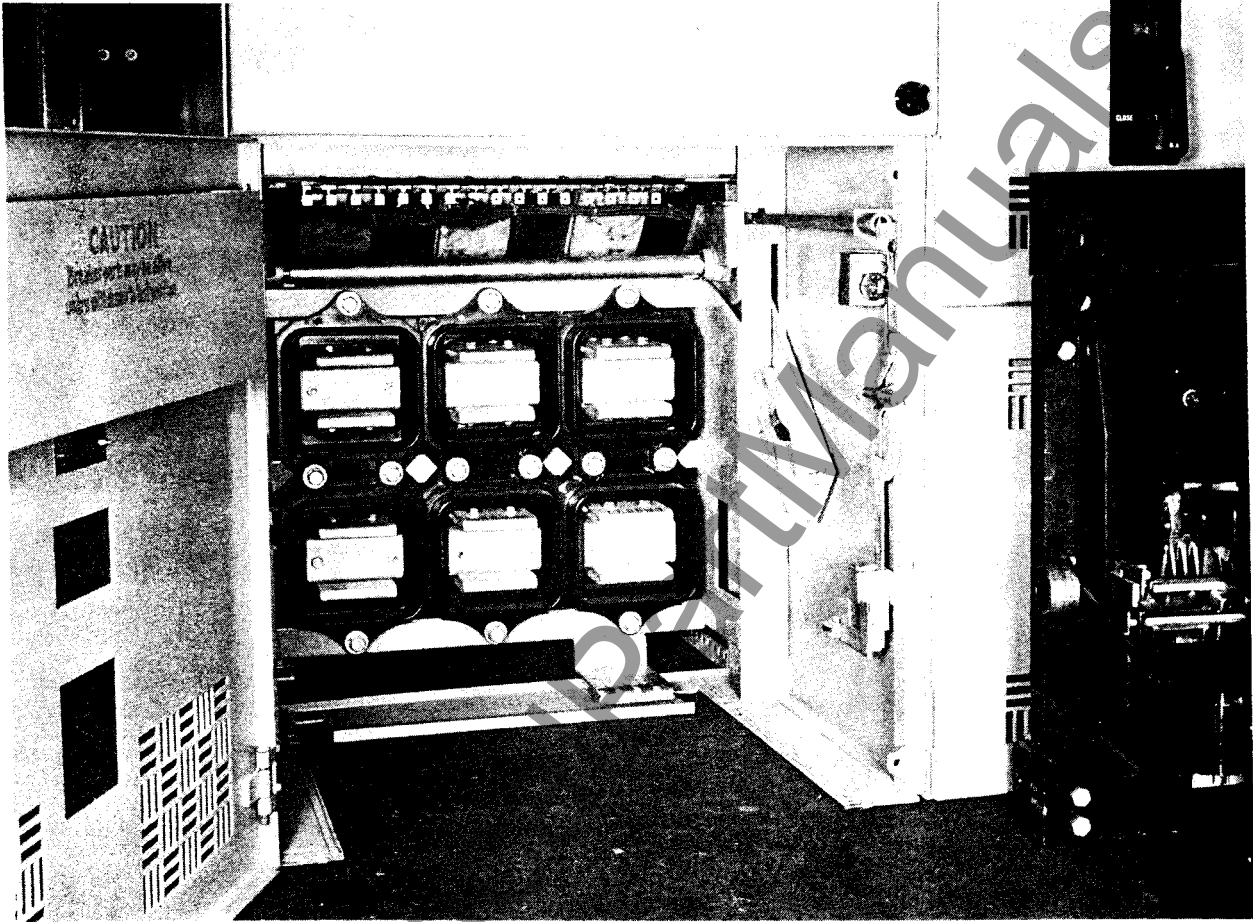


Figure "A". Photo 350676

- (g) Remove the crank, close the door, secure the door latch knobs, and push in the interlock "pull-pin". A door interlock holds the breaker trip-free until the door is fully secured. Also releasing the interlock latches the door on the inside -- if the interlock is released first then the door cannot be fully closed.
- (h) To *REMOVE* the breaker the simplified procedure is to:
- (1) Trip breaker.
 - (2) Pull interlock "pull-pin".
 - (3) Open door.
 - (4) Insert crank.
 - (5) Crank breaker out to "roll-out" position.
 - (6) Pull breaker out of compartment.

The interlock parts of the DB-75 are so designed that the interlock cannot trip the breaker -- the breaker must be in the open position to permit movement of the interlock.

A levering device position indicator has been placed on the left side of the compartment as shown in Figure "B" photo 350675. The test position is established with the levering arms just securing the breaker without actually moving it horizontally -- this prevents the breaker "walking out" of the compartment when operated electrically. The roll-out and connected positions do not have indicating marks as they are established by the limits of travel of the levering device.

LUBRICATION

The levering device should have rollers and bearings lubricated with light machine oil and the worm gear lightly coated with a medium fibre grease.

The main disconnecting finger clusters and stationary contacts should be cleaned periodically but *KEPT DRY*. Vaseline or grease should *NOT* be applied to these contact surfaces as it will hold dirt and particles of plating which will cause an increase in the levering-in force required.

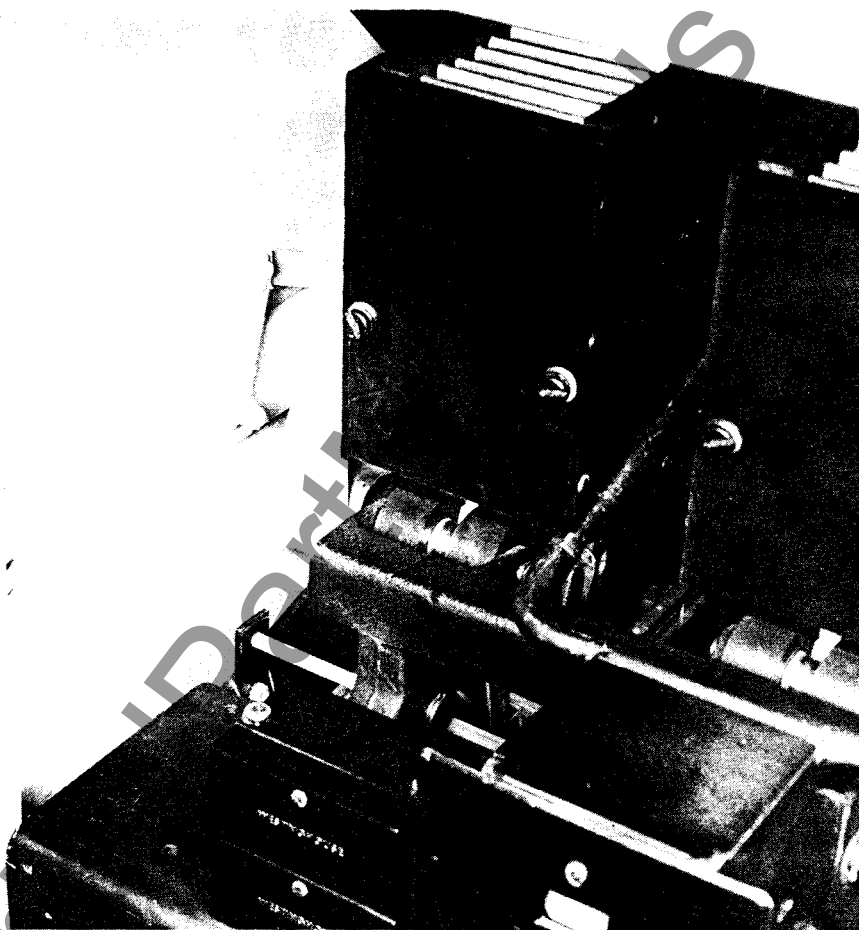


Figure "B". Photo 350675

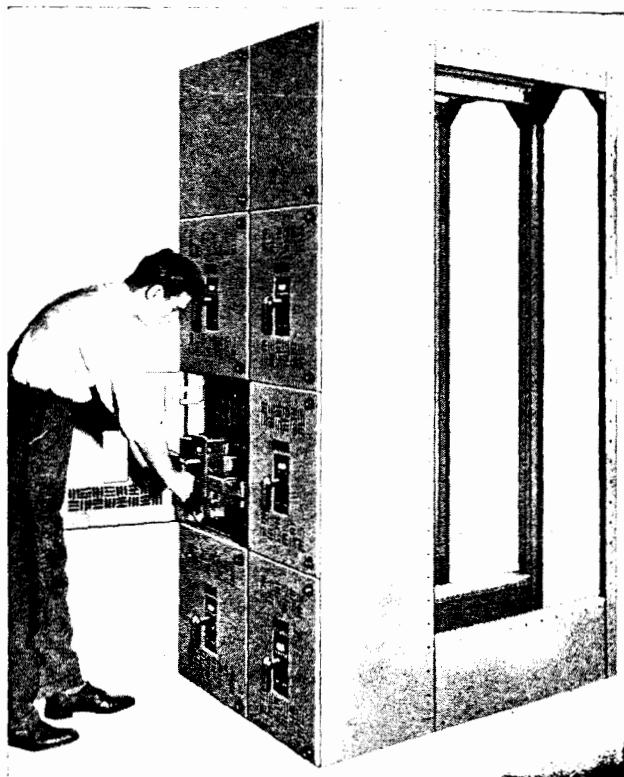


FIG. 16. Inserting a Type DB-25 Removable Element

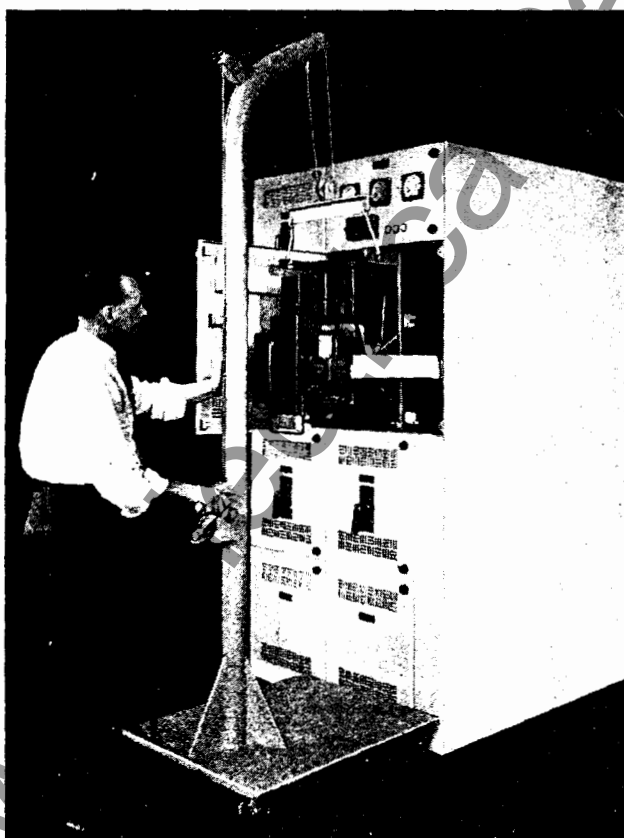


FIG. 17. Placing Type DB-50 Removable Element in Compartment Using the Handling Carriage, Supplied as an Additional Accessory When Ordered

SWITCHGEAR HAVING TYPE DA-75 CIRCUIT BREAKERS

The general features of type DA-75 drawout switchgear are similar to those explained previously for the type DB switchgear.

The circuit breaker is mounted on an insulating base, which is then mounted on a supporting frame or truck. The truck is mounted on wheels so that it may be rolled on the floor.

The positioning device is similar to that described for the DB line, except that there is a device on either side of the cell, both operated by a common handle on the truck.

The levering device is mounted on the truck and consists of a shaft having an eccentrically mounted pin at each end. The pins engage slots on each side of the compartment, and the levering action is obtained by rotating the shaft, using the maintenance hand closing lever supplied as an accessory. See Fig. 18.

When automatic shutters are supplied for type DA-75 circuit breaker compartments, they close and isolate the fixed portion of the primary disconnecting devices when the removable element is withdrawn. These shutters are arranged to close when the removable element is approximately half withdrawn from the cell.

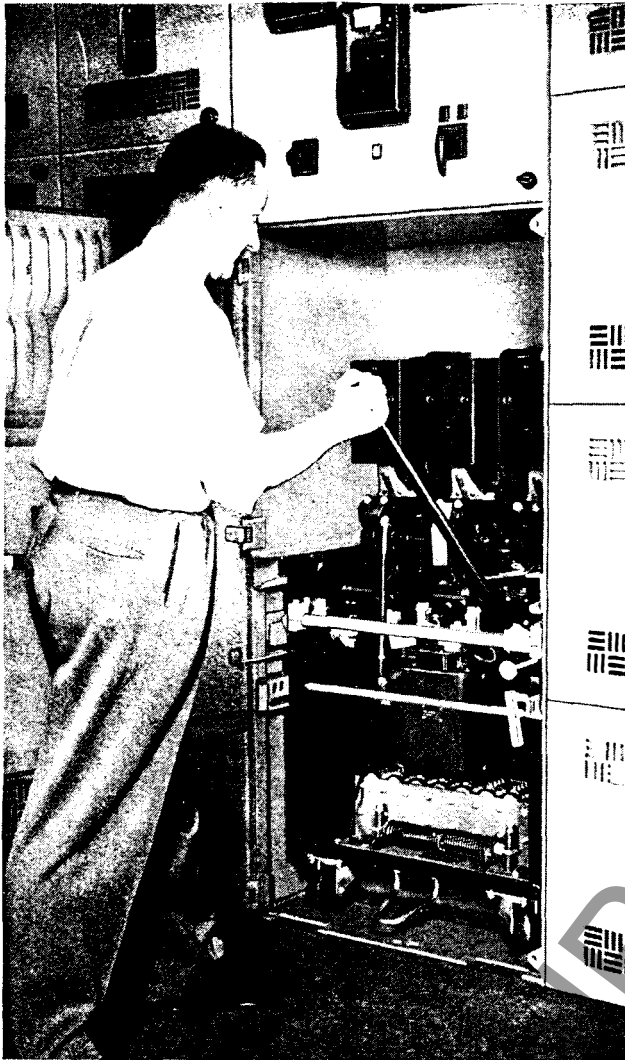


FIG. 18. Levering in a Type DA-75 Removable Element

Interlocks. The front hinged door of the circuit breaker compartment is interlocked with the removable element so that it cannot be opened while the circuit breaker is closed and so that the circuit breaker cannot be closed in the "connected" position while the door is open.

An interlock between the compartment and the removable element will automatically trip the circuit breaker if an attempt is made to move the element either into or out of the "connected" position while the circuit breaker is closed. This interlock also prevents closing the breaker when the removable element is at any point between the "test" and "connected" positions.

Accessories. A maintenance hand-closing lever and a pair of lifting brackets are furnished as standard accessories with each switchgear assembly. The hand-closing lever is inserted in the socket on the circuit breaker operating mechanism for closing

the breaker when the compartment door is open and the removable element is either in the "test" or "disconnected" position. The lever should be removed after the closing operation. This same lever is also used to lever the removable element into, or out of, the "connected" position, as shown in Fig. 18.

The lifting brackets attach to slots on the sides of the truck and are used to facilitate the lifting of the removable element with a hoist.

Inserting the Removable Element. The following procedure should be followed when placing a type DA-75 removable element in the compartment.

1. Open the compartment door.
2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.
3. Manually push the removable element into the compartment until the positioning stop engages and holds the element in the "disconnected" position.
4. Release the positioning stop by means of the lever on the right-hand side of the truck, and push the removable element further into the compartment until the positioning stop again engages and holds the element in the "test" position.
5. Close and trip the circuit breaker by means of the maintenance closing handle and trip button, and check its operation in general.
6. Release the positioning stop, and push the element into the compartment until the levering device engages the slots on the sides of the cell.
7. Insert the hand-closing lever in the socket of the levering device and raise it (see Fig. 18) until the positioning stop engages and holds the removable element in the "connected" position.
8. Close and fasten the compartment door.

Removing the Element. The following procedure should be followed in removing the type DA-75 removable element.

1. Trip the circuit breaker and open the compartment door.
2. Insert the levering handle.
3. Disengage the positioning stop and pull down on the levering handle until it reaches the limit of its travel. Remove the levering handle.
4. Disengage the positioning stop, and pull the element from the rails to the floor.

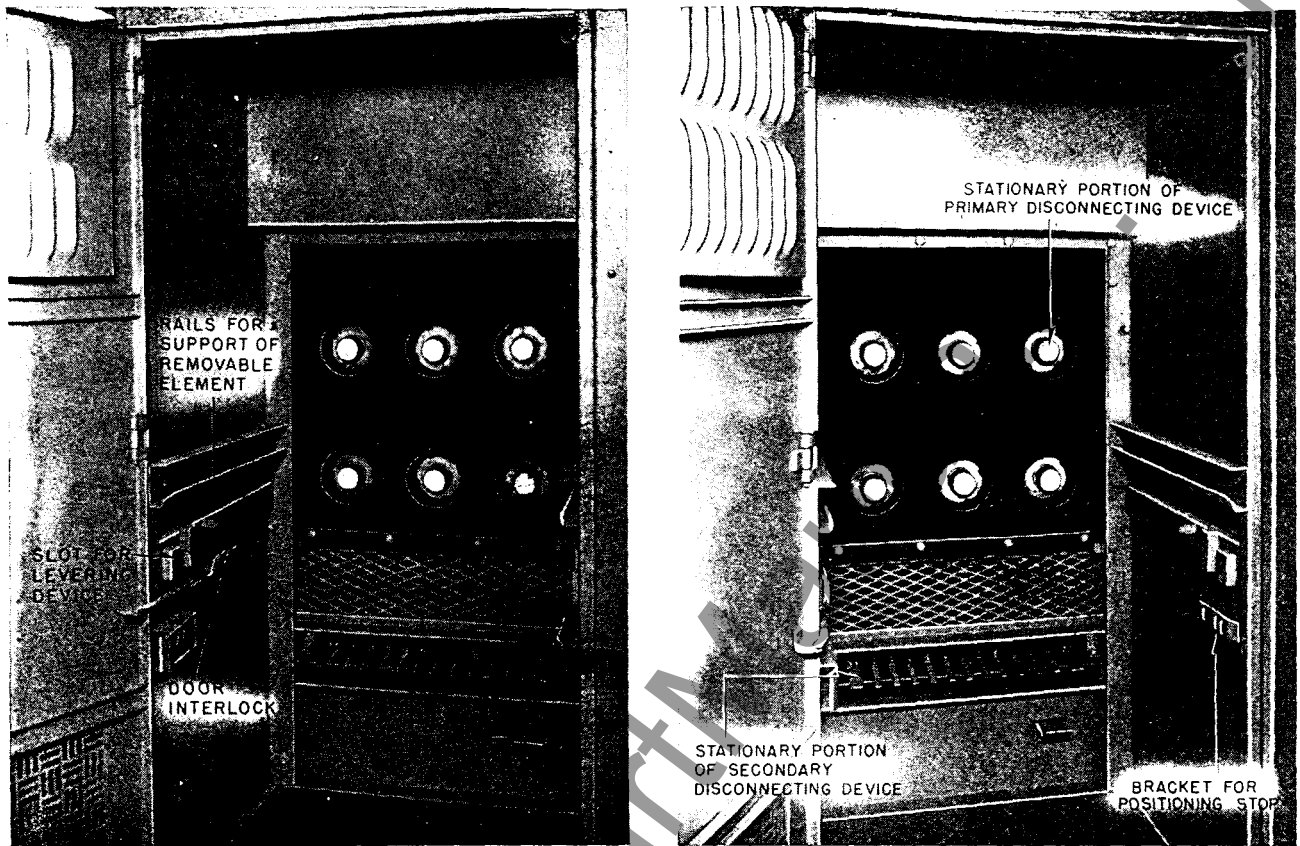


FIG. 19. Compartment for Type DA-75, 2000-Ampere Circuit Breaker

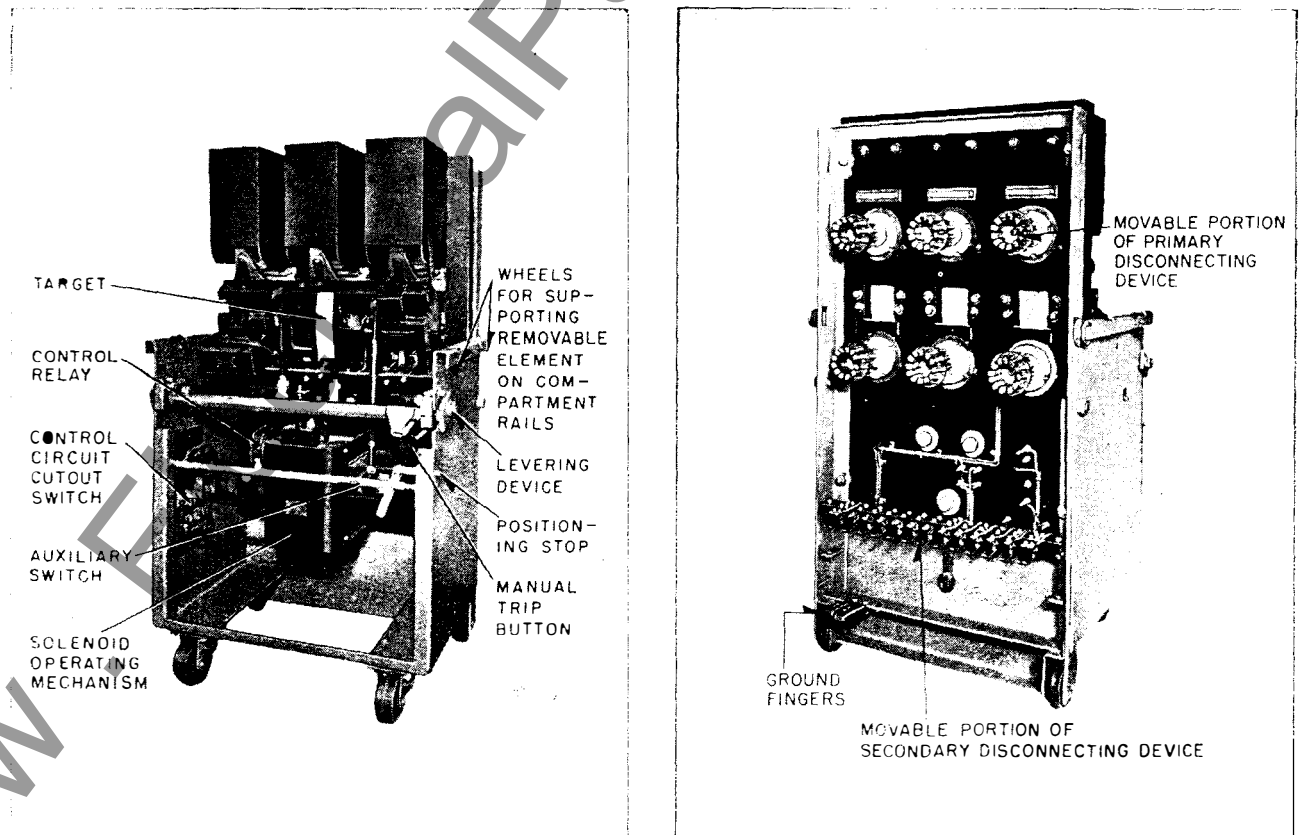


FIG. 20. Removable Element for Type DA-75, 2000-Ampere Circuit Breaker

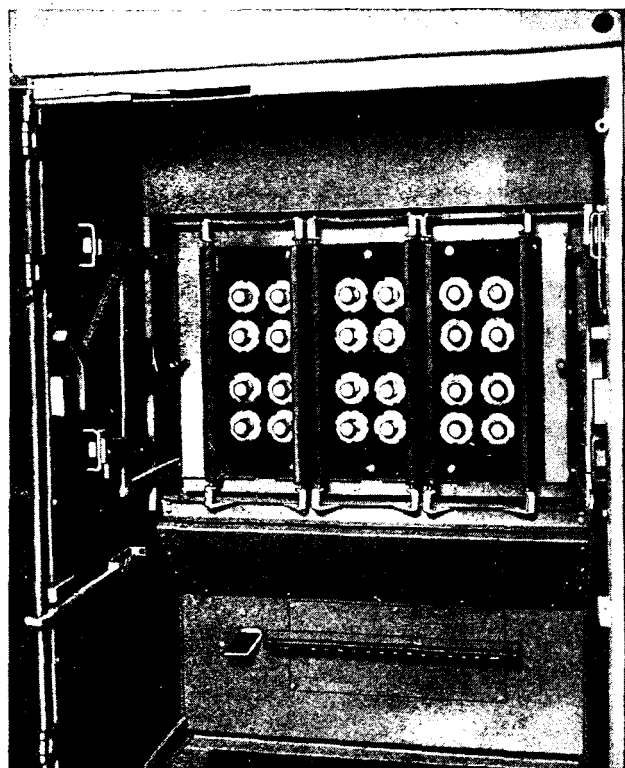


FIG. 21. Automatic Shutters in a Type DA-100, 4000-Ampere Compartment—Open Position

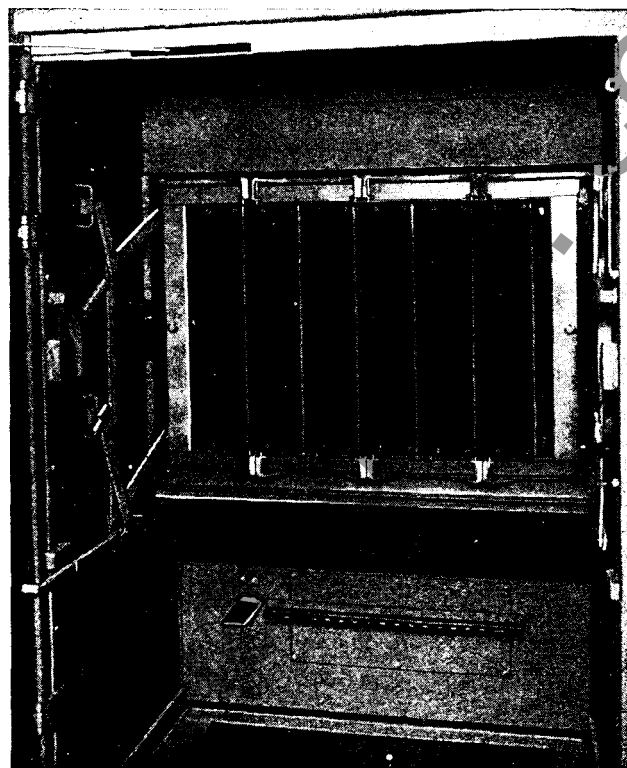


FIG. 22. Automatic Shutters in a Type DA-100 Compartment—Closed Position

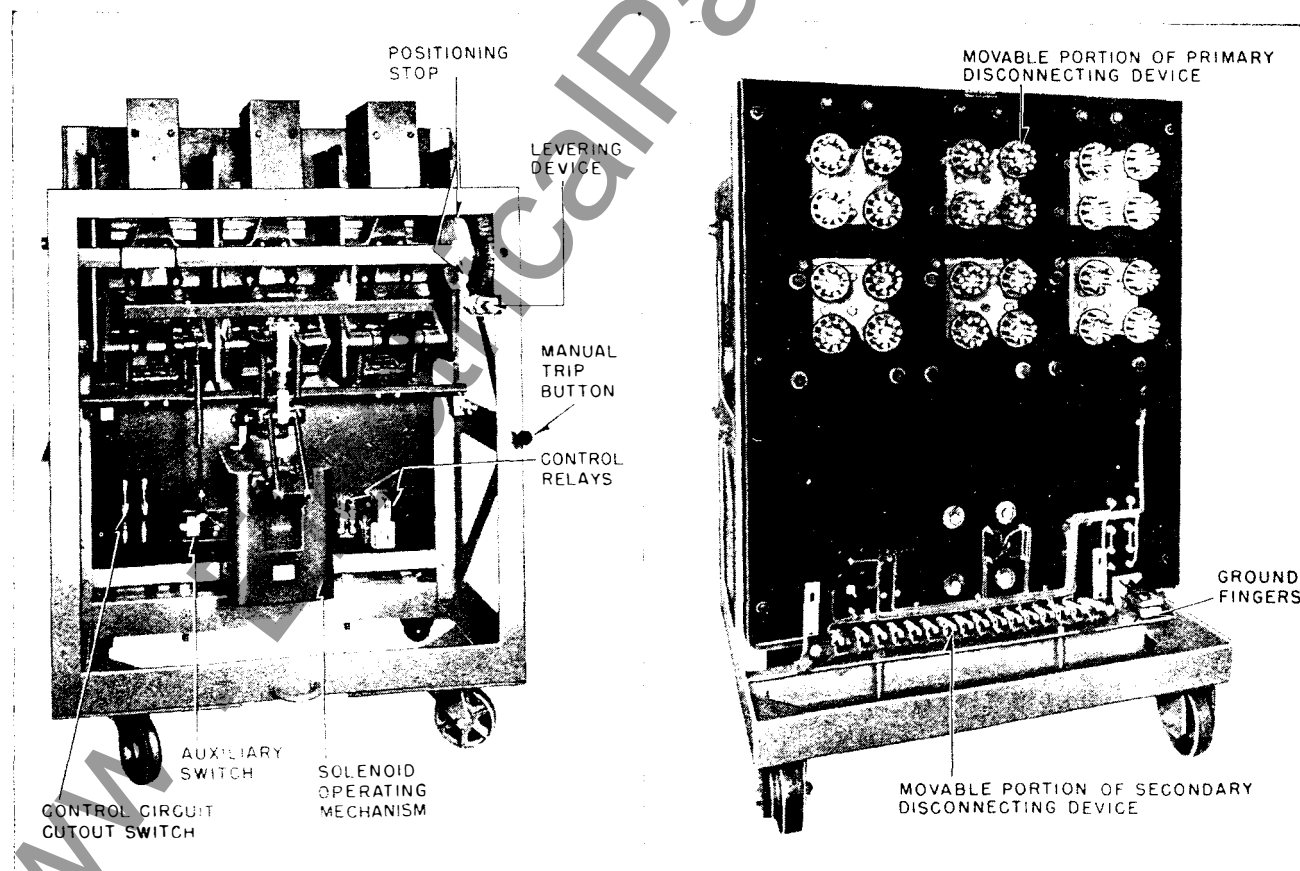


FIG. 23. Removable Element for Type DA-100, 4000-Ampere Circuit Breaker

**SWITCHGEAR HAVING TYPE DA-100
CIRCUIT BREAKERS**

The construction of the switchgear having type DA-100 removable elements is slightly different from that previously described for the type DA-75 switchgear.

Stationary Structure. The front circuit breaker compartment is similar to that supplied for DA-75 switchgear except that there are no side rails for rolling in the removable element. The removable element truck is equipped with wheels which rest on the bottom steel members of the compartment when the element is in place. The same safety interlocks are furnished as described for the DA-75 circuit breakers. See Figs. 21 and 22 for the automatic shutters supplied as optional equipment on DA-100 switchgear.

Removable Element. The removable element consists of the circuit breaker mounted in a rigid truck constructed of welded steel angles.

The levering device is arranged so that it moves the removable element between the "disconnected" and "connected" positions and is operated by a removable hand crank through a worm and gear (See Figs. 23 and 25). The positioning stop is built into the levering device and requires a manual release only when moving away from the "test" position.

No lifting brackets or extension rails are furnished or required for type DA-100 units.

Inserting the Removable Element

1. Open the compartment door.
2. Check the code nameplates on both the removable element and compartment door to see that they agree in code letter.
3. Roll the element into the compartment until the roller on the movable portion of the levering device engages the compartment portion of the device.
4. Attach the hand crank to the truck levering device and turn in a clockwise direction until the element reaches the "test" position. At this point a pin will drop into a slot on the levering device, preventing further travel of the element.
5. Close and trip the circuit breaker by means of the maintenance closing handle and trip button, and check its operation in general.
6. Raise the pin to release it from the slot, and continue to rotate the crank in a clockwise direction until the element is in the "connected" position. On the 5000 and 6000-ampere removable elements, two gear ratios are provided on the levering device. After the main contacts on the element have started to engage the stationary main contacts in the compartment, the crank should be removed from the upper position and transferred to the lower position.

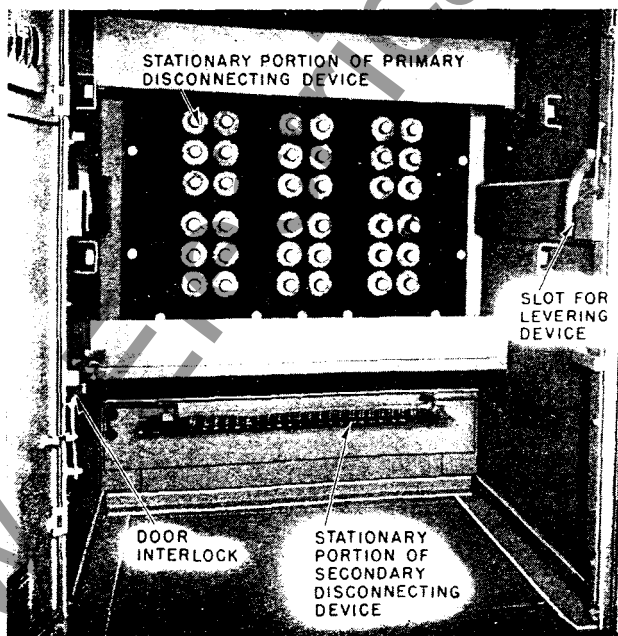


FIG. 24. Compartment for Type DA-100, 5000- or 6000-Ampere Circuit Breaker

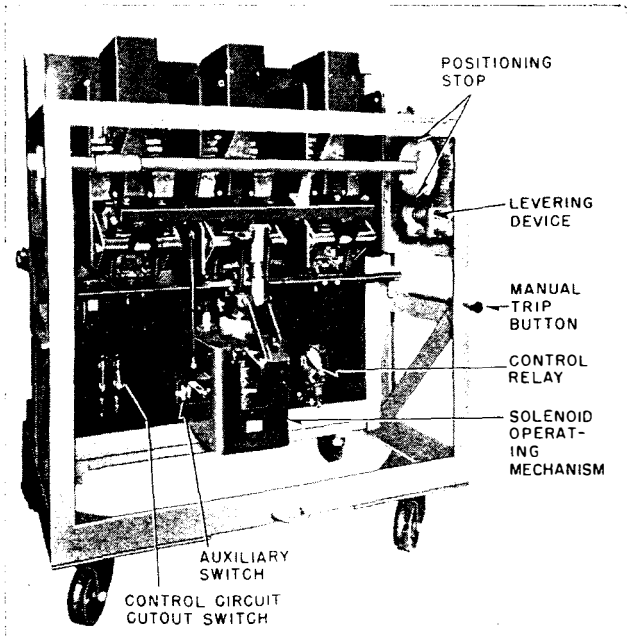


FIG. 25. Removable Element for Type DA-100, 5000- or 6000-Ampere Circuit Breaker

DESCRIPTION

tion. The crank is then rotated in a counter-clockwise direction until the element reaches the "connected" position. The higher gear ratio obtained with the crank in the lower position makes it easier to lever the element into the "connected" position.

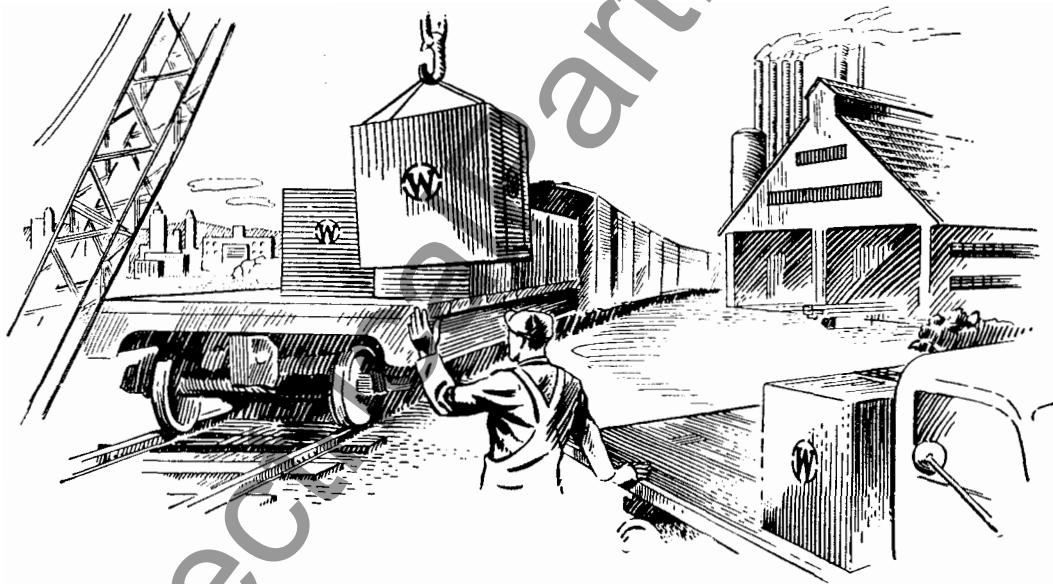
7. Remove the hand crank. Close and fasten the compartment door.

Removing the Element

1. Trip the circuit breaker and open the compartment door.

2. Attach the hand crank and rotate counter-clockwise until the levering device pin drops into the slot in the "test" position. (For the 5000 or 6000 ampere circuit breakers, the crank is first attached in the lower position and rotated in a clockwise direction until the main contacts are disengaged, after which the crank is transferred to the upper position and rotated in a counter-clockwise direction.)

3. Raise the stop pin and continue to rotate the crank in a counter-clockwise direction until the element is in the "disconnected" position.



RECEIVING, HANDLING AND STORING

RECEIVING

The switchgear is assembled, wired, adjusted and given complete commercial tests at the factory, after which it is carefully inspected and prepared for shipment. See Fig. 26. The types DB-15 and DB-25 removable air circuit breakers are shipped in their compartments while the larger breakers are packed in separate crates from the stationary switchgear housings. Each crate or box is plainly marked with an identification number, and a complete list of its contents is included in the shipping papers.

Immediately upon receipt of the shipment, identify all component parts and check them against the shipping list. Make a thorough examination to detect any damage which may have been incurred during transit. If any damage or evidence of rough handling is discovered, file a claim immediately with the transportation company, and notify the nearest Westinghouse Sales Office promptly.

HANDLING

Handle all crated or uncrated switchgear with extreme care since the panels contain delicate instruments and relays which may be damaged by rough handling.

Lifting irons are bolted to the top of the switchgear housings for use in handling the equipment where hoisting facilities are available. If hoisting facilities are not available, the skids on the bottom of the crates permit the use of pipe rollers.

When uncrating switchboards, care should be exercised to avoid breakage and scratching or marring of the panel finish.

Special care must be taken in unpacking the removable circuit breaker elements; the applicable circuit breaker Instruction Book, I.B. 35-255-1 for types DB-15 and DB-25 breakers, I.B. 35-230-C2 for type DB-50 breakers or I.B. 5943 for type DA breakers, should be carefully read before starting to unpack the circuit breakers.

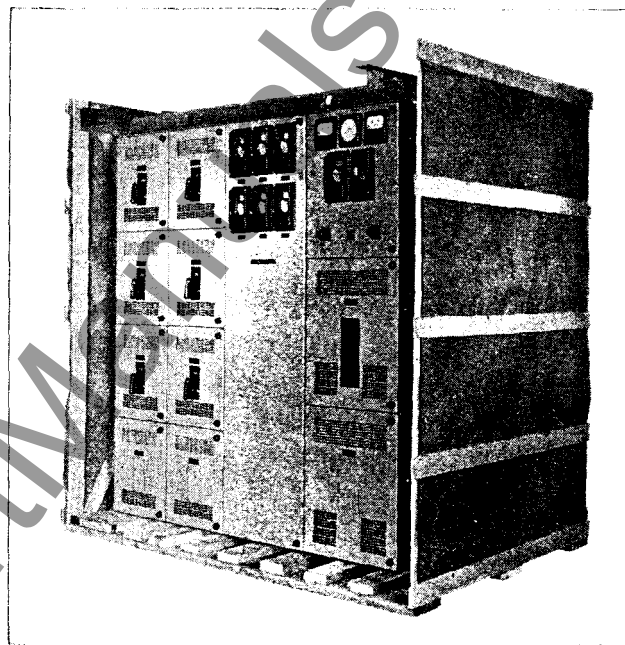


FIG. 26. Metal-Enclosed Switchgear Partially Prepared for Shipment. Shipping Angles on the Top May Be Used for Handling by a Crane, or Skids on Bottom Provide for Movement on Pipe Rollers.

After the crates have been removed, both the switchgear housings and the removable circuit breaker elements should be covered during the construction period for protection against dust and dirt.

STORING

Switchgear which is not to be installed immediately should be stored in a clean, dry place. Trouble and delay will be avoided by having good storage facilities arranged so that the apparatus will be accessible only to authorized persons and can be quickly located when required in the erection program. Crated apparatus will store much better if not unpacked. However, this must not prevent the inspection of the equipment as described previously. Conditions such as dampness, extreme temperature changes, dust and dirt should be carefully guarded against.

INSTALLATION

FOUNDATION

The switchgear is fabricated in welding jigs and assembled on level steel bedplates and is kept square and plumb at all times during erection and adjustment. Since the tolerances and adjustments are kept to a minimum, it must be installed on a smooth level base to retain the easy operation of the removable elements and the correct adjustments.

The preferred method of anchoring the indoor switchgear is by fastening it to steel channels which are embedded in the concrete floor. Floor plans for drilling and locating this steel are supplied with each contract. The top surfaces of the channels must be smooth, level and flush with the finished floor, and in the same plane.

Important: The surface of the floor between the channels must not project above the channels, and the floor in front of the channels should not vary more than $\frac{1}{8}$ inch in any square yard and must not project above the level of the floor steel.

Each housing is fastened to the floor channels by either bolting or welding as shown in Fig. 27. If bolting is to be used, the mounting bolts must be placed in the floor steel before the concrete is poured to assure that the tapped holes will not fill with concrete. Welding is a quick and easy method of securing the switchgear in place and eliminates the layout of the mounting holes in the channels.

PLACING OF STATIONARY STRUCTURE

After the foundation is completed, the complete switchgear assembly or section is set into place. The assembly drawings furnished with the switchgear should be referred to in making the installation. If the structure has been shipped in more than two sections, the center section should be placed in position first and fastened down. The remaining sections are then added progressively toward

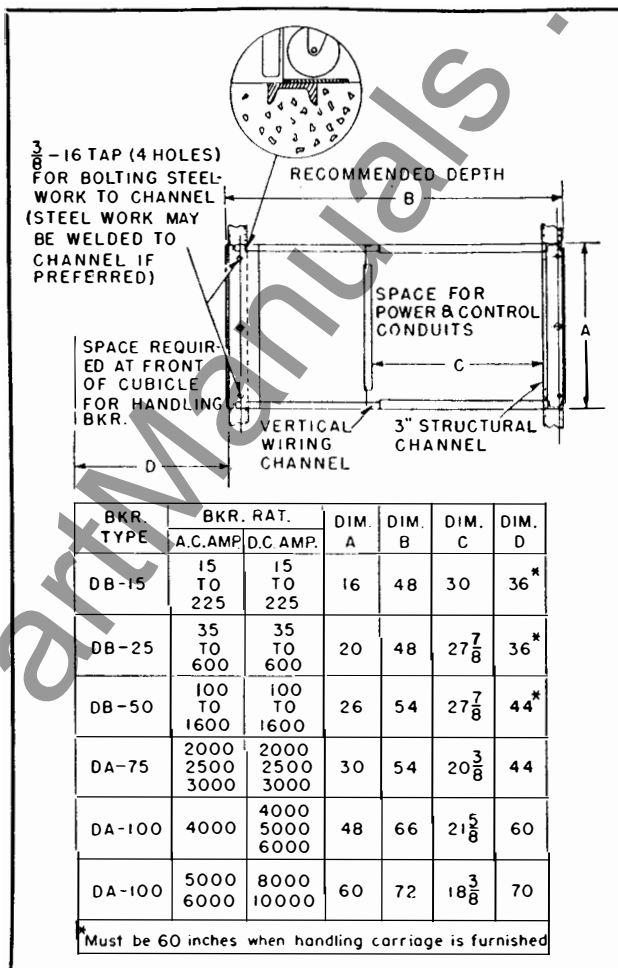


FIG. 27. Dimensions for Locating Stationary Structure

either end, bolting them together and fastening them to the floor steel. The lifting irons are removed from the top of each section after it is in place.

POWER CONNECTIONS

When the switchgear consists of two or more shipping sections, the main copper bus is necessarily disconnected between the shipping sections. These bus connections should be completed first, with particular attention to the pressure between the contact surfaces. It is essential that the connections be securely bolted, since the conductivity of the joint is proportional to the applied pressure rather than to the area.

L.V. METAL-ENCLOSED SWITCHGEAR

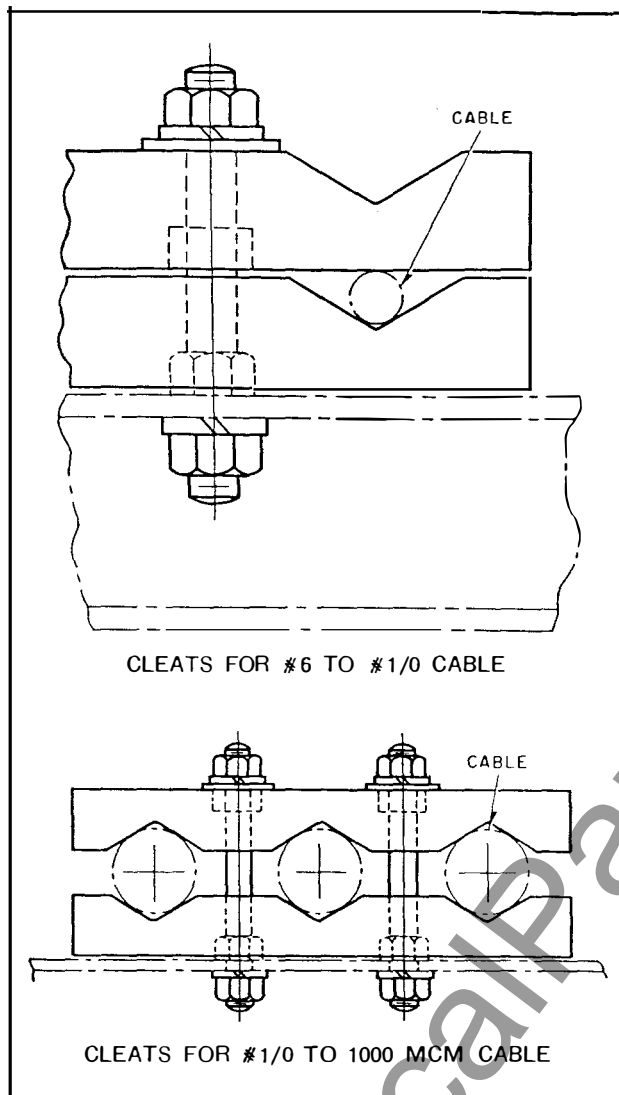


FIG. 28. Cable Clamping Block Arrangements

Clamping blocks are provided in the rear compartments to support the incoming cables to the terminals on the circuit breaker studs. Make sure that the connections to the switchgear are properly phased in accordance with the arrangement shown on the connection diagrams furnished with the switchgear.

Care must be exercised in the arrangement of cables when used in parallel. All three phases of an alternating-current circuit must be run in the same steel conduit. When there are two or more leads per phase and all cables cannot be run in a single conduit, one cable of each phase should be run in each conduit. When a number of cables are bunched, the inner ones will be unable to dissipate the required amount of heat, and excessive

temperature may result. Lead-covered or weather-proof cable must be used where moisture is present.

In making connections from the end of a conduit to the cable terminals, avoid sharp turns, corners and edges in order to prevent weakening of the cable insulation. The radius of a bend for rubber-covered, varnished-cambric or lead-covered cable should never be less than six times the outside diameter of the cable. With a small stranded conductor, the radius of a bend may be five times the outside diameter of the cable.

GROUND CONNECTION

A copper ground bus runs the full length of the switchgear. A copper riser in each unit connects this ground bus to each circuit breaker compartment ground shoe. A ground clip mounted on the rear of the removable element then contacts the stationary ground shoe when the element is inserted into or beyond, the "test" position.

A good ground should be connected to the cable terminal provided on the ground bus. The grounding conductor should be capable of carrying the maximum line-to-ground current for the duration of the fault.

Caution: A permanent low resistance ground is essential for adequate protection. A poor ground may be worse than none since it gives a false feeling of safety to those working around the equipment.

CONTROL CONNECTIONS

Any cross-panel control wires which have been disconnected for shipping purposes should first be reconnected. These wires have been properly tagged at the factory to facilitate the correct connections.

The terminal blocks for control circuit interconnections between the housings and the outgoing control cables are mounted across the rear of the switchgear, either at the bottom or the top, depending upon which direction the control cables leave the housing.

INSTALLATION

Relays designed to use movable armatures or rotating discs have these parts tied or blocked before shipment to protect them against possible damage in transit. Remove all ties and blocking from the relay armatures or discs after the switchgear is installed and before control energy is applied.

The connections between the control wiring in the switchgear and any remote equipment must be of adequate size. The size of conductor required will depend upon the distance and amount of current to be carried. When selecting wire or cable sizes for instrument transformer circuits, the losses in the conductor should be calculated and a check made to assure that the combination of instrument load and conductor losses does not exceed the capacity of the transformer.

For electrically-operated breakers, it is important that the voltage drop in the supply circuit be checked to assure proper operation. This is especially true where a low voltage trip source is used. See NEMA air circuit breaker standards for the range of control voltages at the terminals of the operating mechanism.

The outside covering of control circuit connections will depend on local conditions. If they are to be installed in a dry place, braid-covered cable will be satisfactory. If moisture is present, the cable will require either a lead sheath or a weatherproof covering.

Make sure that the polarity of the connections from d-c control sources is correct. The polarity is shown on the connection diagram.

When connecting external cables to the terminal blocks on the switchgear, exercise care to assure that the connections are properly made.

PRE-OPERATION CHECKS

After the switchgear equipment and apparatus to be controlled have been installed and all interconnections made, the equipment should be tested and given a final check before being placed in service. This is necessary to assure that the equipment has been correctly installed and that all connections are complete and have been properly made.

Caution: Extreme care must be exercised to prevent the equipment from being connected to the power system while the preliminary tests are being conducted. If disconnecting switches are not available, line leads should be disconnected to accomplish this.

The testing equipment required will depend entirely on the type of installation. Portable voltmeters, both a-c and d-c, with a wide range of scales, will usually be required. If the equipment to be put into service is quite extensive and complicated, both a-c and d-c ammeters should be available in case unexpected trouble develops.

Some simple portable device for ringing or lighting out circuits should be included in the testing equipment. A convenient method for the latter is to add a solid contact point to the lens end of a flashlight. At some other convenient place on the flashlight add a binding post. The battery and lamp should be connected in series between the contact point and the binding post. One end of a flexible wire, four or five feet in length, can be attached to the binding post and the other end provided with a spring clip for quick attachment to the point to be tested. Touching the contact point at the other end of the circuit whose continuity is being checked should complete the circuit through the lamp. Lighting of the lamp will indicate that the circuit is intact.

Although the inspection and tests given the switching equipment at the factory assure that all the connections on the switchboard are correct and in good order, they should be examined to make sure that they have not been loosened or damaged during shipment or installation. Tighten all bolted connections and joints to assure good contact.

Ring or light out the connections to the equipment apart from the switchboard, such as instrument transformers, circuit breaker operating mechanisms and auxiliary switches to make sure they are correct. The extent to which this will have to be done depends on the thoroughness of the installation work.

Important: There must be definite assurance that all connections are correct before an attempt is made to operate the equipment.

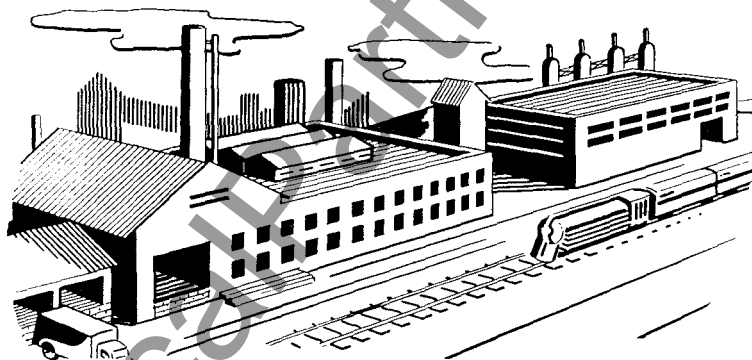
Before applying control energy, check all control circuits, except current and potential transformer secondary circuits, for grounds, and make sure that all circuits are clear.

In order to show up any errors in the installation, try out the different parts by putting current through them at reduced voltage. Continue this procedure progressively until all parts have been proved. Remedy any incorrect operations during the trial period.

Carefully store the covers for instruments, meters, relays and other devices which have to be removed during the course of installation and test. Since

these are made either partly or entirely of glass, they may be broken if not properly protected. If anything temporarily stops the test work, such as the end of the working day, replace all covers to keep dust and dirt from collecting on the vital parts of the equipment.

Any protective relays included with the equipment have been tested for correct connection and operation at the factory, but the settings of the relays for current, voltage or other quantities must be made by the purchaser in accordance with his standard practices to coordinate with the other portions of his system. Study carefully the applicable relay instruction leaflets, supplied with the switchgear equipment, before attempting to set the relays.



INSPECTION AND MAINTENANCE

In order to obtain satisfactory service from the switchgear, it must have proper inspection and maintenance regularly.

The intervals between the inspections will be determined by the operating and atmospheric conditions. Where dust is rapidly deposited within the switchgear, especially if it is abrasive or has a high conductivity, or where condensation occurs within the switchgear, the inspection and cleaning should be frequent.

The inspection must be done by experienced personnel and should cover all the devices and connections. Inspectors should be thoroughly instructed and experienced in both the function and adjustment of the various devices and should have a uniform method of making the inspection. Good results can very often be obtained by furnishing the inspectors with detailed lists covering points which need to be checked and reported at stated intervals. Prints of all drawings and copies of all instruction books, cards and leaflets should be readily available in case of trouble; the maintenance personnel can refer to them for such detailed information as may be required to correct the situation.

Extreme care must be exercised that no circuits are shorted or grounded and that the inspector experiences no personal harm. Correct any defect which is discovered, immediately.

Caution: Do not work around live parts except in extreme emergencies. If work must be performed on live equipment, take every possible precaution to guard against accidents. Tools should be insulated, and rubber gloves and insulating mats should be provided.

Consider all connections live until the men expecting to work on them assure themselves per-

sonally that the circuits are dead, and every possible precaution should be taken to see that there is no chance of a circuit being energized while the men are working on it. Lock or block open and place a suitable warning on switches which have been opened to de-energize equipment for maintenance purposes. In low-voltage metal-enclosed drawout switchgear, the removable elements can be readily withdrawn to the "test" or the "disconnected" position in which the primary circuits are dead.

Caution: Do not touch a circuit breaker under any circumstances when the removable element is in the "connected" position. Some of the exposed parts may be live even though the breaker is open.

Keep the premises, particularly the switchgear room, clean. Compressed air or a hand bellows may be used to remove dust from the interior of the switchgear and from the removable elements. Use an air hose equipped with an insulating nozzle to prevent contact with live circuits, and filter the air. Remove dirt which cannot be blown from the insulating surfaces with a cloth saturated with *Westinghouse Electric Corporation Solvent Material No. 1609-1, obtainable through any Westinghouse Engineering and Service Office. (When this solvent is not available, Stoddard Solvent or cleaner's naphtha can be used). Do not use abrasive material for cleaning silverplated surfaces since the plating will be removed, leaving the base material unprotected. The exterior of the switchgear may be cleaned by wiping with a chamois skin which has been immersed in luke warm water and wrung partially dry.

Before attempting inspection, maintenance or adjustment of any devices such as circuit breakers, relays, meters or instruments, read carefully the instruction book covering the particular device.