Revamping
Westinghouse Outdoor Oil Circuit-Breakers
With
"De-ion Grid" Contacts

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.
East Pittsburgh Works
I. B. 5584-A

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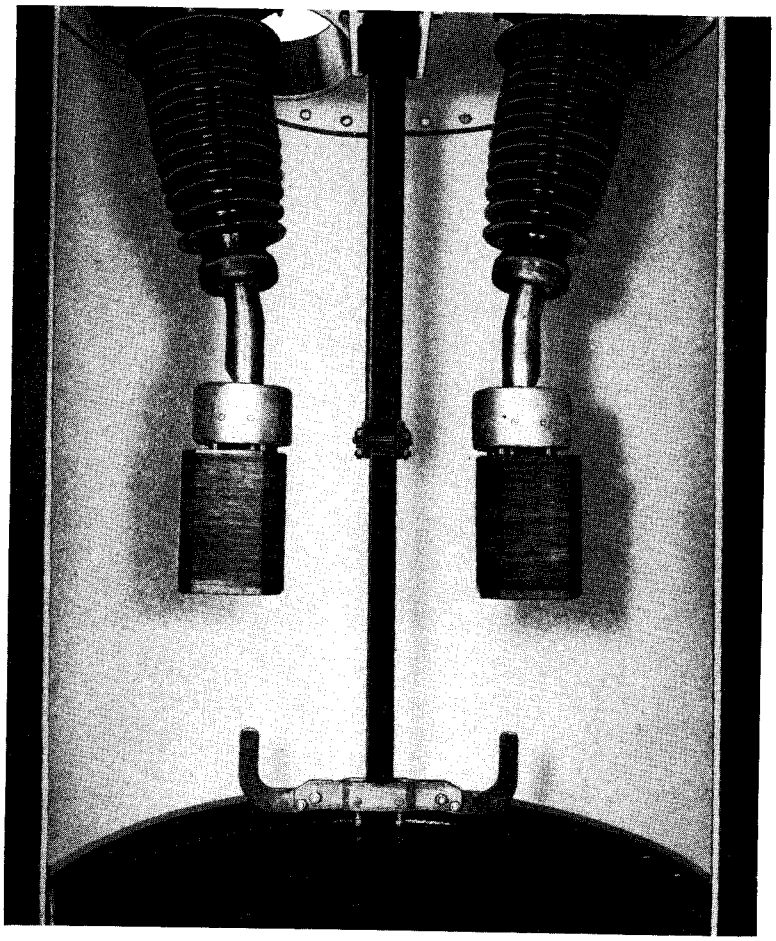

FIG. 1—TYPICAL POLE UNIT ASSEMBLY

Revamping
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DESCRIPTION

INTRODUCTION

In order to obtain improved breaker performance and quicker short circuit arc interruption as well as a substantial decrease in maintenance required, it is common practice to rebuild large outdoor oil circuit-breakers with De-ion Grid contacts. The change is usually such that no major change is required in the existing structure of the old breaker. By replacing merely the old moving and stationary contacts, lift rods and guides, and re-adjusting or slightly modifying spring adjustments, a substantial improvement is made. In case it is desired to obtain still quicker arc interruption, it may be necessary to go further into the original structure and replace or modify pole unit levers, pull rods, accelerating springs, solenoid operating mechanism as well. Because of changes made from time to time in the basis of assigning interrupting capacity ratings to oil circuit-breakers, it is not possible to tabulate the ratings for all types of breakers. This question of ratings will be covered in detail in the Order placed for revamping material.

In requesting information from the factory relative to the possibility of revamping a breaker, the identification should be as complete as possible. In all cases give the stock order number (S. O.) of the original breaker which will be found on the main name-plate. A new name plate will be supplied with the revamping material which will show the S. O. number of the new material as well as the S. O. number of the original breaker. **It should be understood that only through a S. O. number can any piece of apparatus be positively identified.**

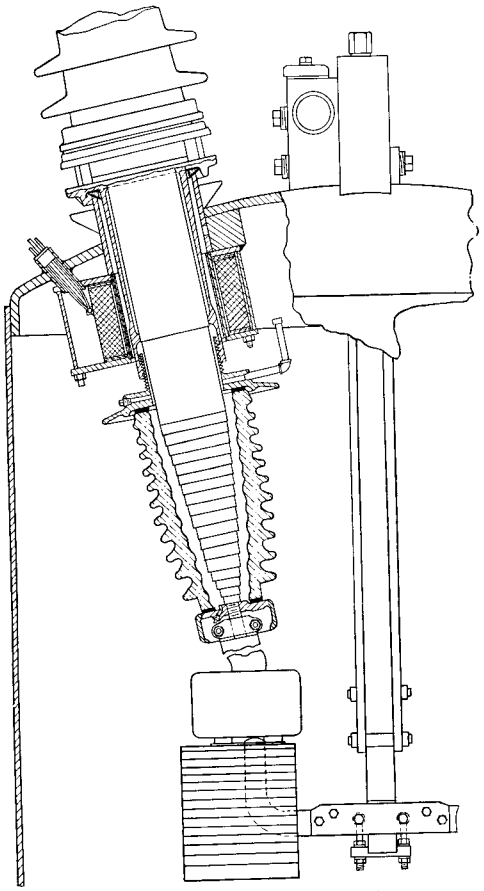

FIG. 2—ARC SHIELD AND TRANSFORMER ASSEMBLY

"DE-ION GRID" CONTACTS

The De-ion Grid Contact for 600-1200 ampere breakers consists of a simple light weight moving element, made of bar copper, which closes against a stationary element likewise of copper, giving a butt or finger type contact, depending on the requirements of the service. Where heavy continuous currents are to be carried by the breaker, an auxiliary brush type contact is provided, electrically paralleling the arcing element and protected from burning by it. Directly below the stationary arcing contact element, a stack of insulating and magnetic plates is suspended. It is within the slot of this stack that the arc is ruptured as the moving contact is pulled down through the stack and out the bottom. The stack is the active part of the contact assembly and therefore must be properly handled before and during the installation.

Beiefly the action of the De-ion Grid Contacts is as follows. The moving contact and also the arc stream above it, is surrounded by a magnetic field, set up by the current carried by the contact.

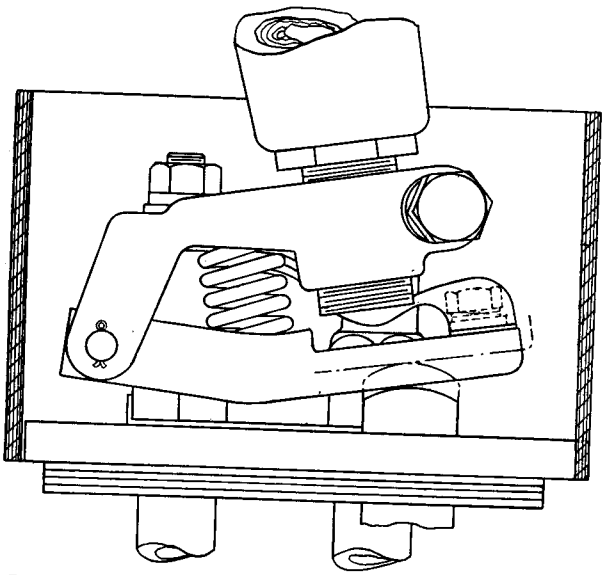

FIG. 3—"DE-ION GRID", SIZE C, STATIONARY CONTACT ASSEMBLY

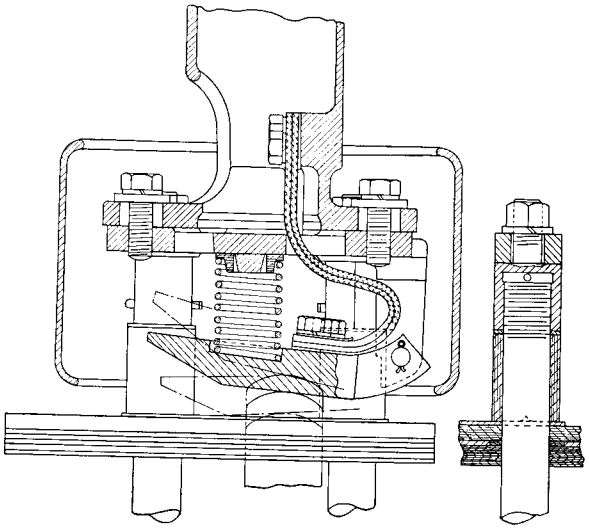

FIG. 4—"DE-ION GRID" SIZE B, STATIONARY CONTACT ASSEMBLY

Spaced at frequent intervals along the length of the stack, are iron plates surrounding the moving element or arc on three sides. These iron plates, under the influence of the magnetic field of the conductor, supply a force which pulls the arc back into the restricted portion of the slot of the stack. The iron plates are entirely insulated from the arc by fibre plates and the remainder of the stack is built up of other insulating plates, cut to such a shape as to provide a considerable reservoir of oil in the slot in which the arc is drawn. Part of this oil is vaporized by the arc, and from the nature of the slot the gases are prevented from leaving the slot in any direction except through the arc stream and vents. Thus the arc is continually being traversed through its entire length by relatively cool gases mixed with particles of liquid. This action is sufficient to de-ionize very rapidly the space in which the arc is

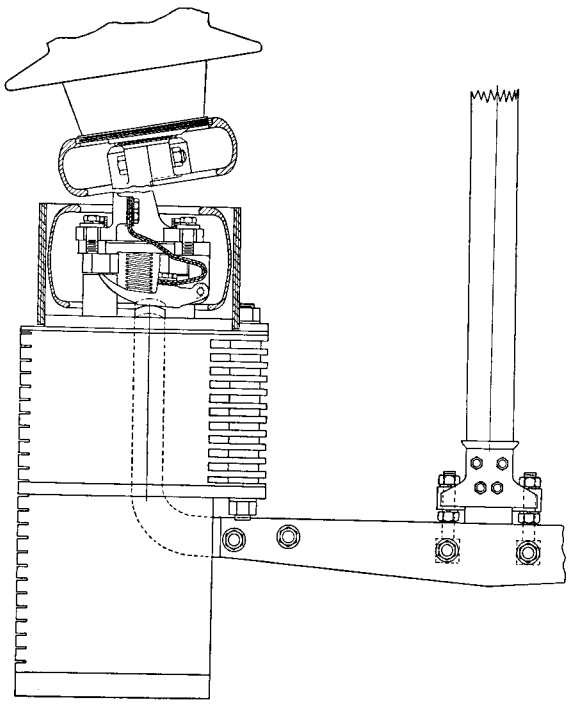

FIG. 5—"DE-ION GRID", SIZE A, STATIONARY CONTACT ASSEMBLY

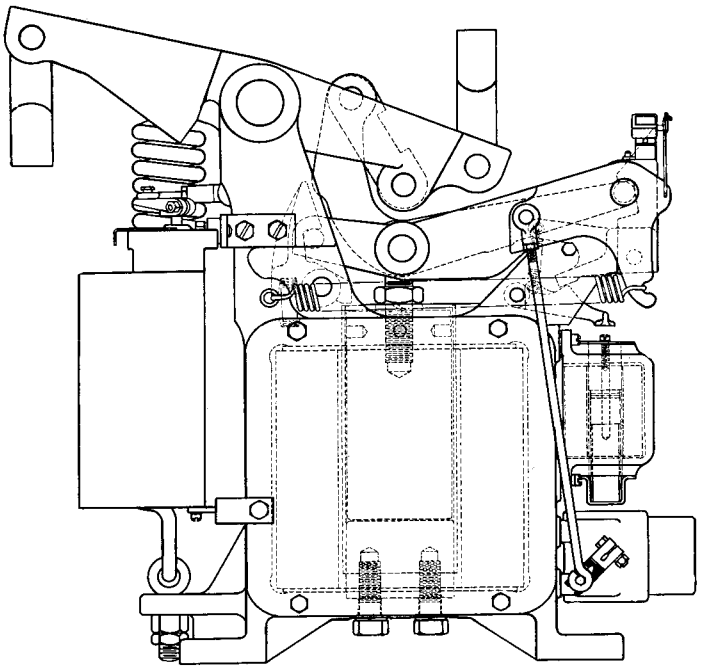

FIG. 6—SOLENOID MECHANISM, TYPE SA-4 (CLOSED POSITION)

drawn and a most efficient device for arc rupture is the result. Naturally as the length and duration of arcing is reduced, the amount of oil burned by the arc is diminished and the pressure within the tank kept to a very low value.

The stacks are pulled down firmly with insulating studs and it should not be necessary to loosen the stacks during the installation or during any later maintenance work on the breaker.

MATERIAL REQUIRED FOR CHANGE

The list of material supplied on a revamping order should always include moving and stationary contacts and insulating lifting rods. In breakers of recent construction this may be all that is required for the change. In older breakers it will generally be found necessary to supply a new lifting rod guide with supporting details. A new accelerating spring is frequently required to compensate for the lighter weight of the new contacts. It is sometimes found desirable to supply an oil dash

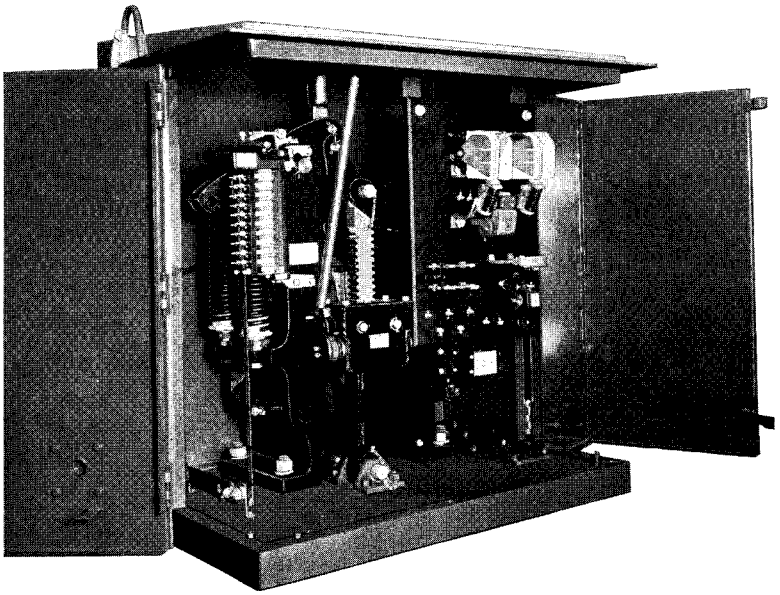

FIG. 7—SOLENOID MECHANISM, TYPE SA-6 (OPEN POSITION) WITH JACK TYPE HAND CLOSING

pot to serve as a stop for the pole unit levers in the open position of the breaker, and where these levers are not strong enough to stand up under the load of any increased acceleration, new levers may be supplied. Faster opening time can be obtained with a trip coil more powerful than normal and where breakers are equipped with a mechanically non-trip-free mechanism, a modern solenoid operating mechanism is frequently supplied. A different hand closing device may be required, and this should be ordered if none is already available in the same station.

The material actually received on a revamping order should be carefully checked against shortages before the work in a breaker is begun.

STORAGE OF MATERIAL

It should be understood that in every shipment there will be insulating material which will be damaged by moisture. The stationary contact stacks and all other insulation should be carefully stored up off the ground in a dry place. Insulating lifting rods must be kept dry and also great care must be exercised in supporting them mechanically so that they will not warp or bend, as difficulty in adjustment of the breaker will result from warped rods.

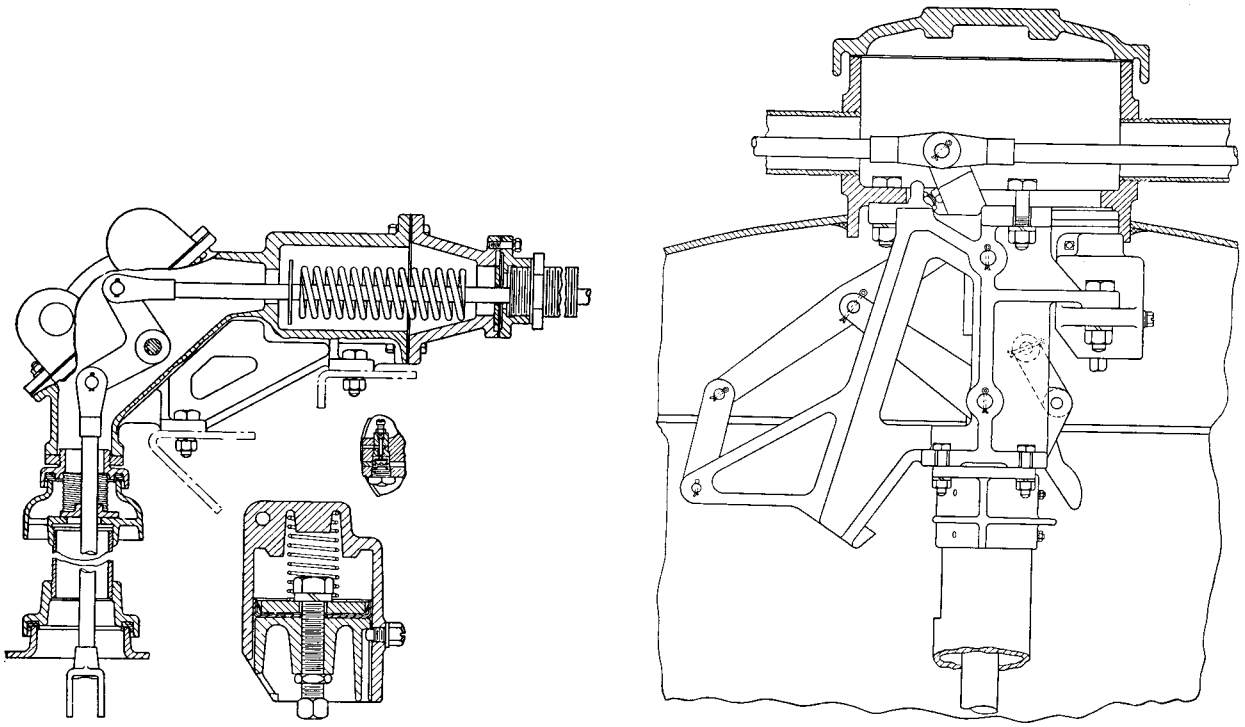

FIG. 8—MAIN ASSEMBLY DETAILS, TYPE G-2, 115,000 VOLT BREAKERS

INSTALLATION

The breaker tanks should be drained and lowered on frame mounted breakers and the old stationary contacts removed with the contact casting. The complete moving contact assembly should be removed by extracting the pin from the upper end of the lift rod, removing or loosening the lift rod guide if necessary or if it is to be replaced by a new one.

Pole unit mechanism adjustments should be carefully checked, as it sometimes happens that a breaker which has been in service for a number of years may not be in the best mechanical condition. If found to be correct, no changes should be made in the pole unit levers, stops or adjustments unless new levers are to be supplied, in which case this change should now be made. The new stationary contacts should be screwed on to the bushings, allowing a few threads clearance above the contact foot for adjustment. The moving contact and lift rod can now be assembled with the operating lever and guide, using the new pieces where they are supplied. In case a new oil dash pot is provided, it will probably be assembled as part of the guide mounting bracket, and should be carefully checked to make sure that it is free of any blocking or wiring used in shipment. The clearance between the plunger and the cylinder of this dash pot is not great, and the cylinder and vent holes must be kept clean in order that the levers and contacts will be brought to rest without excessive shock and rebound.

The breaker should then be closed slowly by hand, making certain that the moving contact enters the stack freely and does not drag along either side as the closing stroke is completed. It is desirable that all contacts make at approximately the same time, and that the lifting rod travel, after contract is first made, be equal in all poles. This can be accomplished in all breakers by running the stationary contact feet up or down the bushing and in most large breakers a further adjustment is

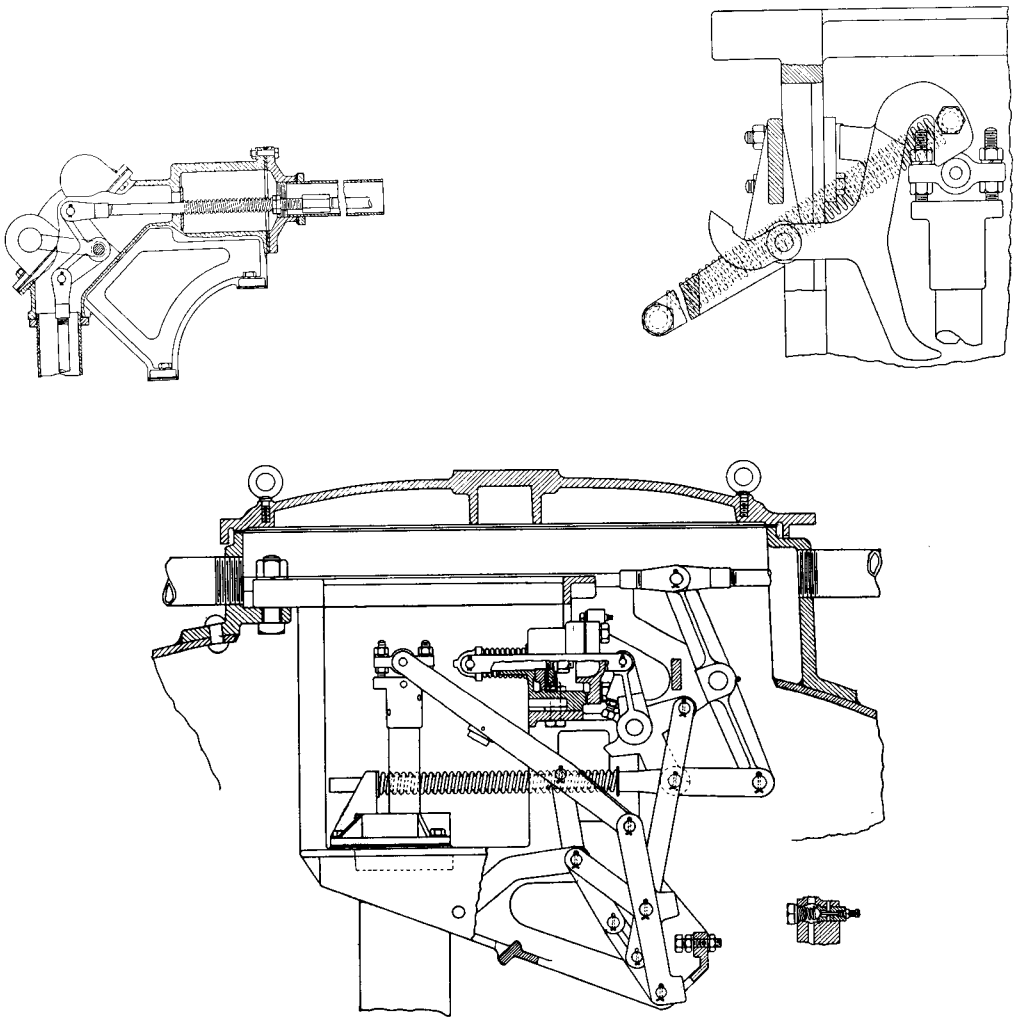

FIG. 9—MAIN ASSEMBLY DETAILS, TYPE G-2, 132,000 VOLT BREAKERS

provided at the moving contact. All three poles should strike the bumpers or oil dash pots simultaneously in opening, so as to prevent one pole taking the shock of stopping the entire breaker. Toggle lever stops should conform to drawing dimensions.

Since it is usually impossible to make factory tests of the proper spring adjustments, and since the speed of operation of one breaker may differ from that of another, it is hardly possible to set down a definite rule to cover every case. However, it has been found in most cases that all springs which were installed to balance the weight of the heavy cast contacts and to assist in the closing operation should be permanently removed. Also, it has been found that all accelerating springs either on the pole unit levers, the horizontal or vertical pull rods outside the tanks, or in the solenoid operating mechanism (except the SA-4 and SA-6 mechanism), should be removed and a single spring installed in the vertical pull rod housing above the operating mechanism. This is shown on drawings to be supplied with each order, and acts to hold the breaker in the open position as well as to accelerate its opening motion. Figures 8 to 18 illustrate the level systems which may be found in breakers to be revamped and which may need spring modification.

No change of balance or accelerating springs is required when revamping a breaker built since 1928 having light weight moving contacts, Wood Base Micarta lifting rods, and fabricated steel levers, as the change in contact weight and speed is not sufficient to require it.

Under some conditions it may be found found desirable to replace an old

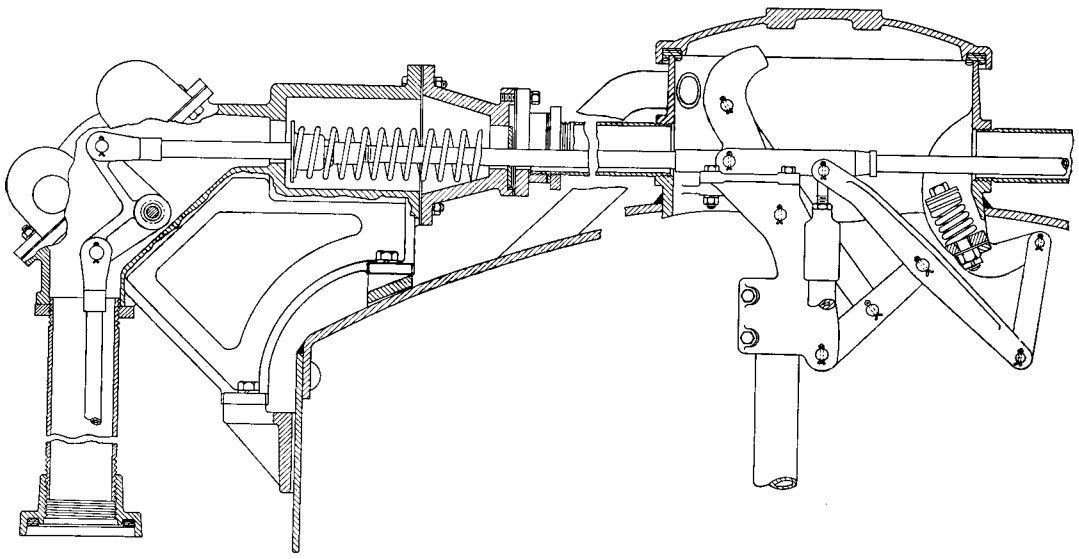

FIG. 10—MAIN ASSEMBLY DETAILS, TYPE G-2, 154,000 VOLT BREAKERS

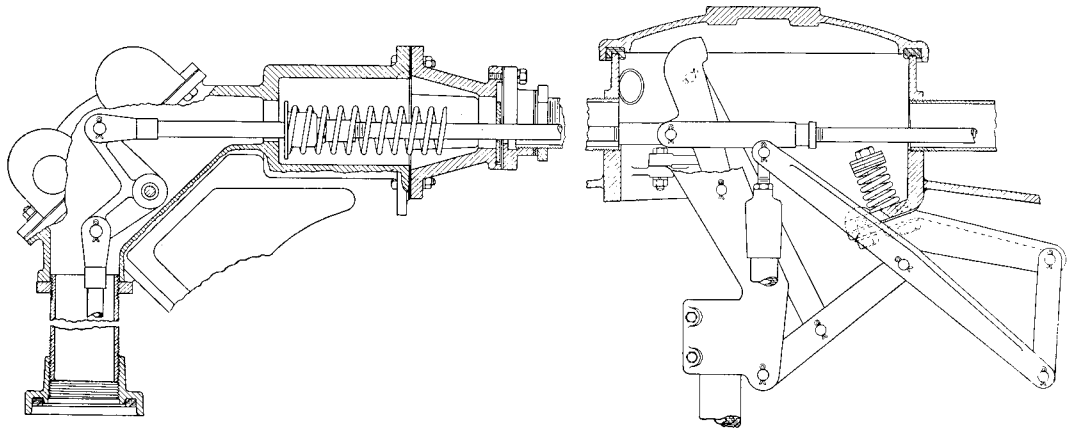

FIG. 11—MAIN ASSEMBLY DETAILS, TYPE G-2, 187,000 VOLT BREAKERS

operating mechanism of the mechanically non-automatic type by a new one, trip free in all positions. Faster opening speed on the lifting rod should be secured, since by tripping free of the solenoid core and mechanism levers, there is less inertia to the moving parts connected with the contacts. The old mechanism housing pull rod and the pipe up to the bell crank should be removed. In case the new mechanism is to be mounted on brackets welded to the tank shell, the steel should be cleaned of paint and the bracket fitted accurately into position and securely welded as shown on a drawing accompanying the order. It should be realized that this bracket must support the dead weight of the mechanism and housing (from 500 to 2200 pounds) and also the pull of the solenoid, which amounts to several thousand pounds. The mechanism mounting must be rigid so as to insure proper and permanent mechanical adjustments.

The new mechanism can now be set in position and connected up to the bell crank with either a new pull rod or the old rod cut down in length and rethreaded to suit. The mechanism has been tested at the factory and should require only minor adjustments at the time of installation. Under no condition should the latching surfaces be altered in any way. After checking the manual operation of the breaker the over travel of the magnet cores should be again checked. With the cores of the 4″ SA mechanism pulled together, there should be a gap of approximately $\frac{1}{16}$″ between the holding latch and the latch pin. With the 6″ SA mechanism this dimension should be approximately $\frac{1}{32}$″. In either case the adjustment is made by loosening the lock nut around the eye bolt at the

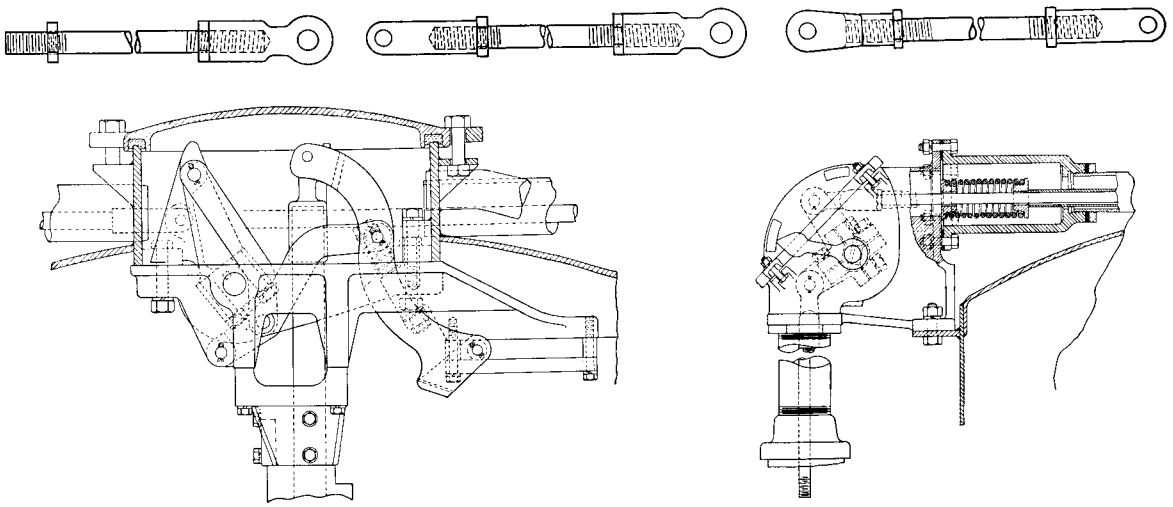

FIG. 12—MAIN ASSEMBLY DETAILS, TYPE G-22, 400-600 AMPERES, 110,000 VOLT OUTDOOR BREAKERS

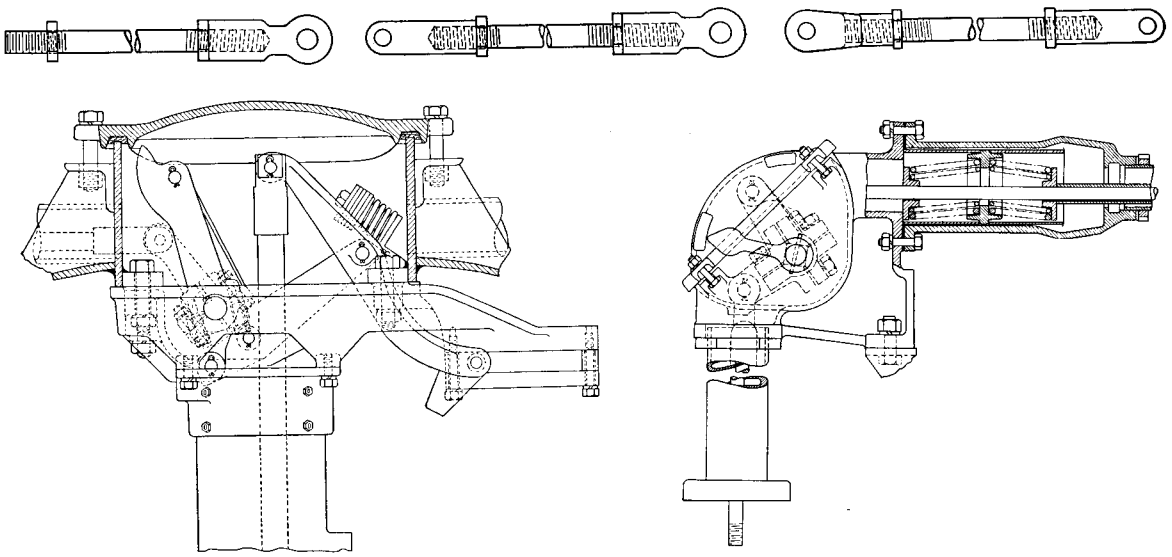

FIG. 13—MAIN ASSEMBLY DETAILS, TYPE G-22, 400-1000 AMPERES, 132,000; 154,000 VOLT BREAKERS

top of the moving core, running the core up or down as required, and carefully tightening the lock nut again.

The wiring diagram supplied with the new order should be carefully checked against the old and such changes as may be required, made in the connections between the breaker control panel, auxiliary switches, etc., and the station control. Changes should not be made in the permanent wiring of the new mechanism without notifying the factory so that all factory records may be kept up-to-date.

In case a new trip coil only is being supplied, it is not a difficult matter to remove the old coil and insert the new one, connecting it as shown on the new diagram.

In reassembling the breaker, care must be used that all weatherproof connections are tight. Pipe joints should be protected with cement and all gaskets should be replaced if damaged before being put back in place. Where any welding has been done, or other work which would injure the paint, these spots should be carefully cleaned and covered over, using first a good priming paint such as Westinghouse No. 8035, followed by at least two coats of oil proof, weather resisting paint such as Westinghouse No. 8036 and 8037 (dark gray in color).

Tanks should be thoroughly wiped out so as to be clean and dry. Where the breaker bushings are equipped with porcelain arc shields over the lower end of the condenser, it would be well to remove them, clean with Wemco C oil and, after replacing, fill with new Wemco C oil which shows a high dielectric test. In damp weather it may be necessary to

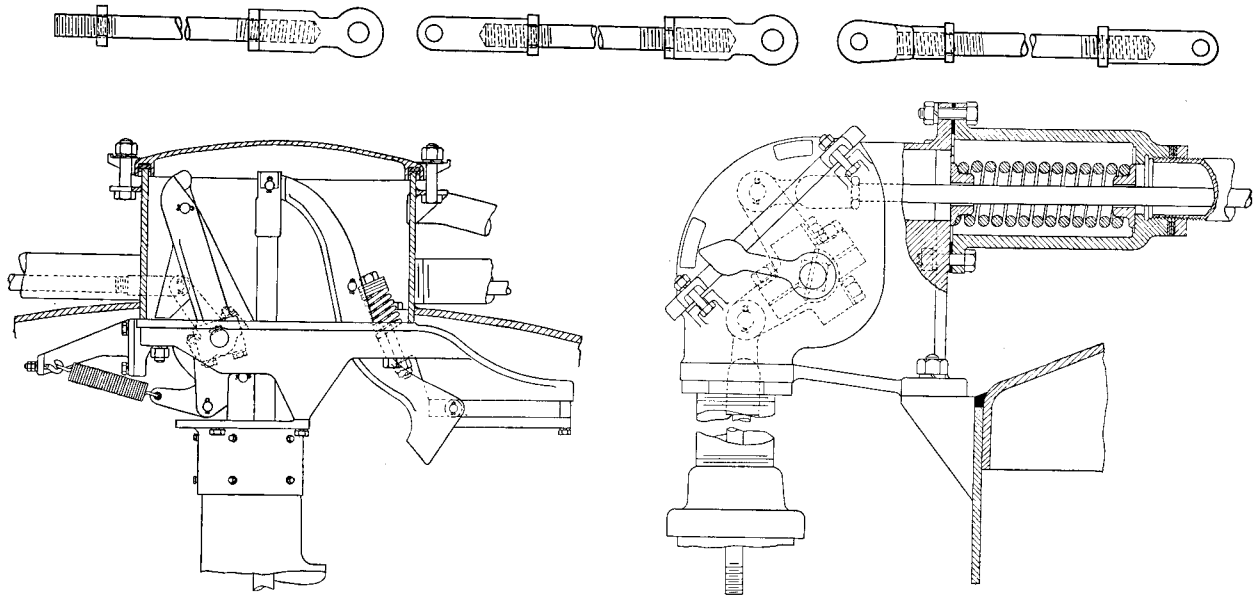

FIG. 14—MAIN ASSEMBLY DETAILS, TYPE G-22, 600 AMPERES, 187,000 VOLT BREAKERS

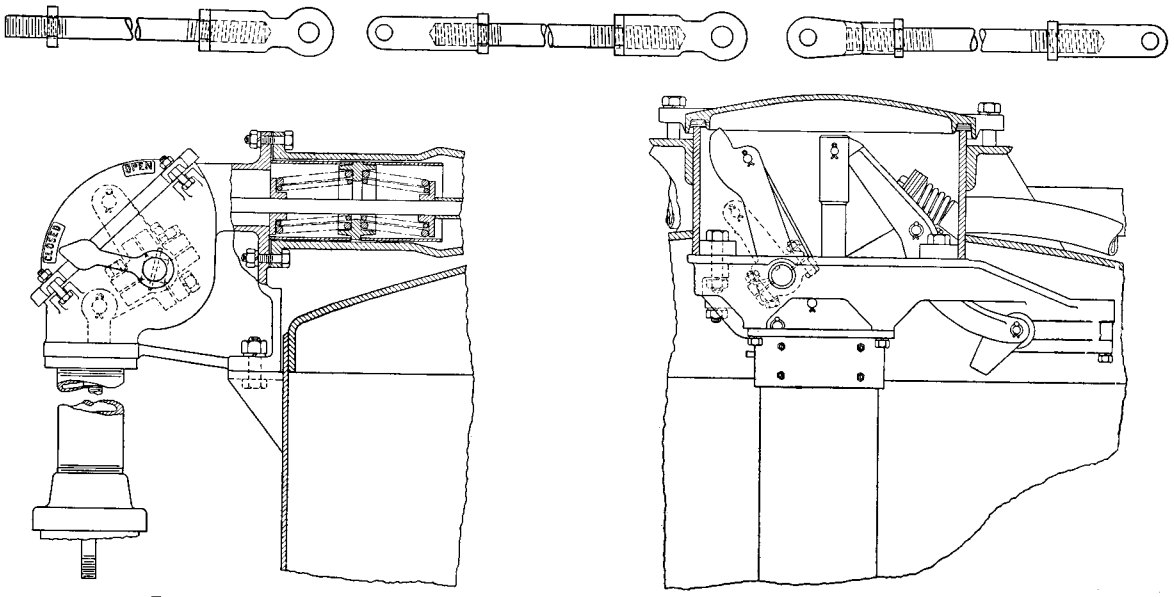

FIG. 15—MAIN ASSEMBLY DETAILS, TYPE G-22-A, 400-600 AMPERES, 132,000 VOLT OUTDOOR BREAKERS

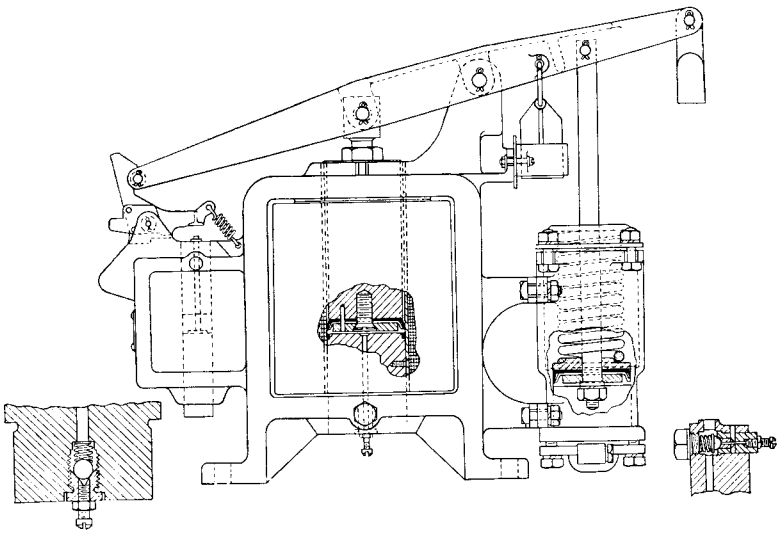

FIG. 16—ELECTRICAL MECHANISM DETAILS, TYPE G-2, 110,000 VOLT BREAKERS

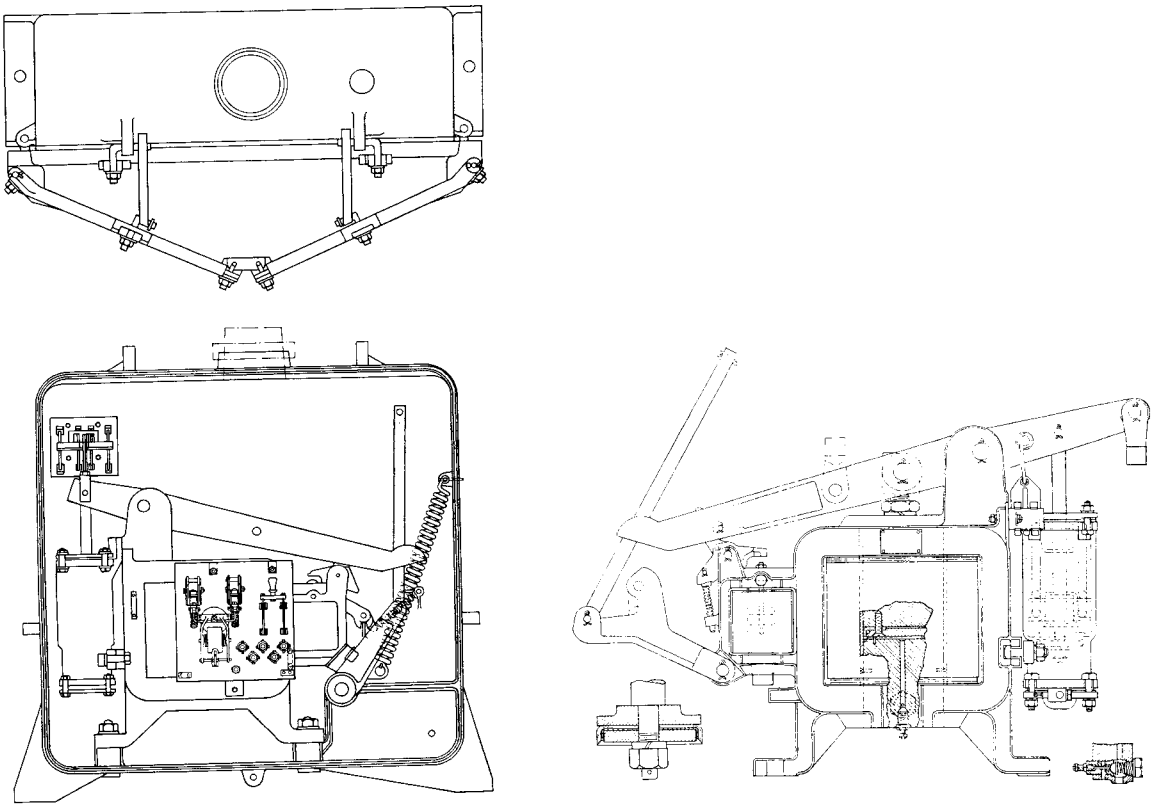

FIG. 17—ELECTRICAL MECHANISM DETAILS, TYPES G-2 AND G-22, 132,000; 154,000 OR 187,000 VOLTS AND TYPE G-22, 110,000 VOLT BREAKERS

warm the porcelain somewhat to prevent condensation of moisture. Do not permit the oil filling pipe on the arc shield assembly to touch the transformer case, as this would place a short circuit turn around the transformer and affect its ratio. The arc shields must be filled before the breaker tank is filled.

Before returning the breaker to service, it should be operated electrically a number of times to make sure that all adjustments of mechanism, pole unit levers, springs and contacts are correct. A final check should be made to determine that the toggle lever stops have not changed as a result of these operations. If possible, the breaker should be operated at minimum and maximum control voltage (90 and 130 volts d-c. for a 125 volt d-c. solenoid).

Unless exception has been taken during the negotiation and sale of the revamping material, the rebuilt breaker should be capable of withstanding the standard A.I.E.E. insulation test of 2¼ times rated voltage plus 2000 volts applied to the dry breaker (tanks filled with oil) from a 60 cycle source for one minute.

The operating speeds both closing and opening should be increased by reason of the lighter weight and more stream line shape of the moving contacts. A check made with a cycle counter or oscillograph will show the contacts parting on the opening stroke in much less time than was obtained with the old type of contacts, and it is quite possible that relay settings will need revision in order to hold the proper sequence of breaker operations when a fault occurs on the line. Accelerating springs should be adjusted so as to give rapid movement of the contacts, and yet not to cause excessive rebound as the contacts come to the open position. It should be possible to limit this rebound to never more than 15% of the breaker travel. Of course, it is far more desirable to keep within 5% of the travel, which can usually be accomplished when oil dash pots are supplied.

In case any definite commitment on opening or closing speed is made at the time of sale of any revamping material, information will be given by the factory which will enable a check test to be made by cycle counter or otherwise in the field.

The following references may be found valuable in connection with this Instruction Book:

De-ion Grid Oil Circuit-Breakers, I.B. 5502.

Type G—Oil Circuit-Breakers, I.B. 5235.

Insulating Oil for Electrical Apparatus, I.B. 5336.

Part Catalogue (Type G Bkrs.), P. C. 7201-1.

Type SA-3 Solenoid Mechanism, I.B. 5235.

Type SA-4 Solenoid Mechanism, I.B. 5467.

Type SAF-4—5664.

Type SAF-6—5805.

Type SAFR-6—5818.

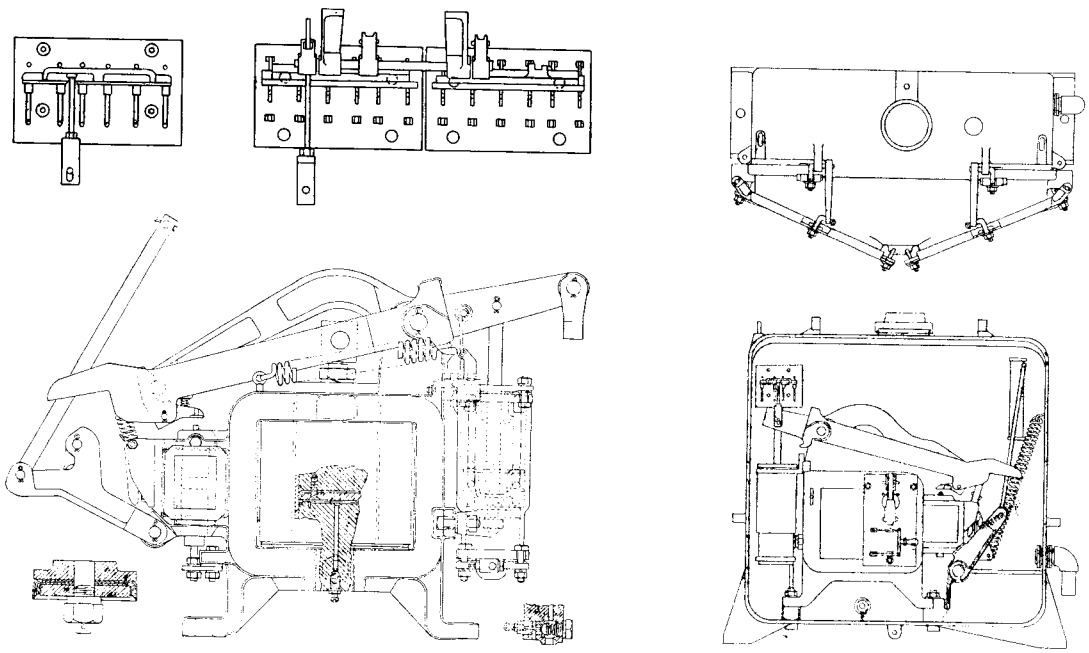

FIG. 18—ELECTRICAL MECHANISM DETAILS, TYPE G-22-A, 132,000 VOLT BREAKERS