TYPE U "DE-ION" AIR CIRCUIT BREAKERS

600 to 2000 AMPERES, 2500 to 15000 VOLTS, 60 CYCLES

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Instruction Book 5709-3

Westinghouse Electric & Manufacturing Company

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APPLICATION

The "De-ion" air circuit-breakers described herein are designed for operating service at from 600 to 2000 amperes at from 2500 to 15000 volts a-c. They may be used in general applications where conventional breakers might be applied. When specially equipped with hardened steel levers, pins, oversize bearings, etc., they are suitable for applications requiring long life and low maintenance under high repetitive duty. They operate entirely without oil and require only a normal atmosphere. They may be supplied for individual floor mounting or they may be included in complete metal-clad switching equipment.

DESCRIPTION

Fig. 1 shows a typical 3-pole, 7500-volt breaker suitable for truck mounting. The upper part, which is enclosed in tubular Micarta barriers, contains the pole units. The lower section, separated from the upper by a steel barrier, contains the solenoid operating mechanism, control panel and auxiliary switches. Fig. 2 shows a partially assembled 3-pole, 7500-volt breaker with two poles exposed to view. The de-ionizing chamber has been removed to show the contacts, operating linkage and mounting details. The de-ionizing chamber and other pole unit details are mounted on two Wood-Micarta supports which also insulate live parts of the breaker from the steel frame. The pole unit contact linkages are operated by Wood-Micarta lift rods from levers welded to a steel shaft located lengthwise of the frame, under the high tension compartment. This shaft, mounted on ball bearings, is connected to the solenoid-operated mechanism by a pair of short links from the center pole operating lever.

The contacts consist of copper blocks with arc-resisting tips at the top. In the closed position, contact is made only on the copper or main contact surfaces. In operation, the compression spring causes the stationary contact to rotate about its pivot causing the final break to occur at the arc-resisting tips. The movable contact, duplicate of the stationary contact, is mounted at the upper end of a steel operating arm which is pivoted at the bottom. This arm is in turn operated by a simple toggle, closing being effected by an upward push of the Wood-Micarta lift rod. In opening, the movable contact operating arm strikes a bumper consisting of a stack of felt washers enclosed in a metal cylinder and equipped with a steel striking head. Flexible shunts connect the stationary and movable contact members to their respective terminals.

De-Ionizing Chamber

Fig. 3 shows two de-ionizing chambers for 7500 volts. The one on the left is standing on end and has the static shields removed, showing the interior of the lower part of the arc box in which the contacts are located when on the breaker. The one on the right is in the normal position as when placed on the breaker.

The chamber or stack contains groups of copper and steel plates, see Items 10-14 in Fig. 6, stacked with layers of insulation, see Items 7-8-9-12-13 Fig. 6, between them so as to form a series of gaps, each gap having a circular pathway between the copper plates. The number of gaps in a given stack depends upon the voltage rating. They are arranged in groups of eleven gaps each separated by coils. Fig. 3 shows this construction, the thin lines indicating individual plates and the heavier spacers indicating the location of coils.

The static shields, mentioned above, are for the purpose of equalizing the voltage on the gaps of the stack after the breaker interrupts a circuit and while the breaker is in the open position. This is due to the fact that since, as explained below, the interrupting action of the breaker depends upon the action of a large number of arc cathodes in series, it is necessary that each gap get approximately its pro-rata share of voltage. These shields are usually of Micarta plate having sheets of metal foil embedded within, so proportioned as to correct the tendency of some of the gaps to become overstressed with voltage and of others to become understressed.

After the arc is drawn on the contacts, it is moved upward through the arc box and into the throat formed by the tapered slots, Fig. 6, Item 10, by a magnetic field produced by the passage of the main line current through the circuit consisting of the stud passing through the center of the stack of de-ionizing plates, the copper connectors at the front of the stack and the two studs extending externally on each side of and near the bottom of the stack. This circuit acts as a coil of one turn which energized the steel plates, sending flux across the arc box in the proper direction for moving the arc into the throat of the de-ionizing chamber.

As the arc enters the throat, the above mentioned coils are energized and they set up magnetic fields which are radial to the above mentioned circular pathways. The arc reaches the ends of the tapered slots and is transferred to the plates by the radial magnetic field, forming a multiplicity of short arcs in series. These short arcs continue to move at high speed until a zero point occurs in the current wave and it is then interrupted due to the action of the large number of arc cathodes in series. This entire series of events occurs very quickly and the high speed of the arc practically prevents deterioration of plates or insulation.

The arc box, mentioned above, consists of fibre plates as shown in Fig. 3 and Fig. 7, Item 15, with arc-resisting inserts, which are bolted through fibre spacers to the insides of the throat which is formed by the lower parts of the steel plates. The fibre has the property of burning clean under the action of the arc which leaves the insulation unimpaired.

GENERAL INSTRUCTIONS

Some models of these breakers are equipped with steel lifting straps for handling purposes only. This lifter should by all means be removed from the breaker before it is placed in service because it acts to decrease the insulation of live parts of the breaker to ground. No harm is caused by simply operating the breaker with the lifter in place.

The de-ionizing chambers or stacks are generally shipped packed separately from the breaker to guard against damage in shipment. For detailed instructions for installing the stacks, see special instructions applying to the particular breaker in question in the latter part of this book. Otherwise, all frame mounted and metal-clad breakers will be shipped from the factory completely assembled and adjusted. No change in adjustment should be required and none should be made unless it is obvious that they have been disturbed.

INSPECTION AND MAINTENANCE

Caution

Parts of the circuit-breaker itself in the high-voltage compartment of the housing are at line potential and the breaker should be isolated from the circuit by disconnecting switches, in line with standard practice for conventional circuit-breakers, before the cover is removed from the upper compartment.

"De-ion"circuit-breakers will operate for long periods of time with little maintenance but they should be given periodic inspections comparable to those of other switching apparatus of similar rating. The various points of maintenance described should be checked at intervals. The frequency of inspections should be determined by the severity of the duty to which the breaker is subjected.

General

Inspect the breaker structure in general and see that all bolts, nuts, etc. are tight and that all spring cotters, etc. are in place. Note evidence of excessive wear or other improper operation of the various parts.

In operating the breaker by hand there should be no binding or excessive friction. In opening the breaker slowly by hand the movable contact arms should come to rest securely against their bumpers and there should be no excessive friction or binding.

Heaters

Breakers are generally equipped with space heaters mounted on the frame for use under conditions of high atmospheric moisture. It is important that these heaters be used at all times when atmospheric conditions are favorable to the condensation of moisture or under conditions of excessive humidity. This applies particularly to conditions during shutdown periods although the heater may easily be required under normal running conditions.

Insulation

All insulating parts should be kept clean and free from accumulations of dirt or dust. Dry compressed air should be used to blow off loose dust. In doing this, the air should be directed into the arc box, upward toward the top of the stack and downward through the individual gap vents along the top of the stack. Other parts may be wiped off with a clean dry cloth.

Arc Box

If there are indications of severe burning or excessive deposits of soot, etc., in the arc box, it may be cleaned with sandpaper or a file. To do this conveniently, the de-ionizing chamber may be removed from the breaker. Unless the condition of

the arc box is unusually dirty, it should not be necessary to remove the fibre arc box from the stack.

De-ionizing Chamber

Insulation of Gaps. Each gap between pairs of copper and steel plates may be "lighted" or "rung" out with a light or bell ringer at not more than 250 volts per gap. Each gap should be open, but in case of extremely severe duty, some may become short-circuited by particles being blown from the arc box or contacts. Loose particles may be removed by blowing out the chamber thoroughly with dry compressed air directed in both top and bottom. If this does not remove the particles, pass 100 to 200 amperes at not more than 125 volts a-c. through the shorted gaps. This may be applied by thin copper straps inserted between the copper plates on each side of the shorted gaps. This should burn the gaps clean instantly but any short-circuits not removed by this treatment can be left until such time as the stack is disassembled. In an emergency a chamber may be used with as many as 15 per cent of the gaps short-circuited but it is recommended that any chambers having shorted gaps which do not clean up with the above treatment be disassembled and any damaged parts be replaced.

If the breaker is located in an exceptional atmosphere, there may be some shrinkage of the insulating spacers between the plates. For this reason, the insulating tie rod nuts should be checked at the regular inspections. If any looseness is found, the nuts should be tightened.

Contacts

See that the bolts holding the contacts in place are tight. Under normal conditions, the contacts should be good for a large number of operations at the rated rupturing capcity of the breaker. A moderate amount of burning on the main contact surfaces will not impair their current carrying ability due to the high pressure used. The contacts should not be kept in service if the arc tips touch in the closed position as this means that some pressure will be taken from the main contact surfaces. This will cause excessive heating due to current being diverted through the arc tips, which are of relatively high resistance.

Electric Closing Mechanism

The closing mechanism generally supplied is the type "SA-3" with a special main operating lever. See W. E. & M. Co., Instruction Book No. 5567.

Parts

Figs. 6, 7 and 8 show details of the breaker to assist in identification of parts in the complete assembly. Unless special instructions state otherwise, the parts shown may be taken

as common to all breakers described in this book. Some parts may differ in size and detail shape from those shown but similarity is sufficient for identification purposes. The following list gives names of the parts with respective numbers as given in the illustrations.

RENEWAL PARTS

Name	Fig. No.	Item No.
Radial Field Coil Assembly *	6	1
Radial Field Coil Spacer	6	2
Radial Field Coil and End Plates Only	6	3
Insulating Spacer	6	4
Insulating Spacer	6	5
Insulating Spacer	6	6
Insulating Spacer Assembly for 1 Gap	6	7-8-9 12-13
Copper De-ionizing Plate	6	10
Steel De-ionizing Chamber Plate	6	11
De-ionizing Chamber End Plate, Front	8	1
De-ionizing Chamber End Plate, Rear	8	2
De-ionizing Chamber Lower Tie Rod	8	10
De-ionizing Chamber Upper Tie Rod	8	11
De-ionizing Chamber Insulating Bushing, Lower	8	8
De-ionizing Chamber Insulating Bushing, Upper	8	9
Pole Unit Lift Rod	8	3
Upper Lift Rod End	8	4
Rear Toggle Link	8	5
Toggle Pin	8	6
Front Toggle Link	8	7
Rear Entering Field Connection	7	12
Rear Arc Horn	7	13
Front Arc Horn	7	14
Fibre Arc Box Side, L. H. Facing Breaker	7	15
Fibre Arc Box Side, R. H.	7	16
Insulating Arc Box Liner, L. H.	7	17
Insulating Arc Box Liner, R. H.	7	18
Arc Box Mounting Strip, Long	7	19
Arc Box Mounting Strip, Short	7	20
Lower Line Terminal Stud	7	21
Movable Contact Shunt	7	22
Movable Contact Conductor	7	23
Movable and stationary Contact	7	24
Movable Arc Horn	7	25
Movable Contact Arm	7	26
Upper Line Terminal Shunt	7	27
Stationary Contact Holder	7	28
Eye Bolt Nut	7	29
Stationary Contact Mounting Casting	7	30
Stationary Contact Spring and Washer	7	31
Stationary Contact Eye Bolt	7	32
Stationary Contact Spring Pin	7	33
Stationary Contact Pivot Pin	7	34
Stationary Contact Barrier	7	35

* Coil at either end of stack is designated by letter C. Adjacent coil is "B", next is "C", etc.

Name	Fig. No.	Item No.
Micarta Bushing.	7	36
Micarta Insulating Saddle	7	37
Arc Box Insert, Rear	7	39
Arc Box Insert, Center	7	40
Arc Box Insert, Front	7	41
Upper Spacer Tube	7	42

SPECIAL INSTRUCTIONS FOR STEEL MILL TYPE BREAKERS IN HIGH-ACTIVITY, 2500 TO 7500-VOLT SERVICE

Steel Mill Type Breakers for 2.5 to 7.5 KV.

Figs. 1 to 8 of this book apply to 7.5 kv. breakers under this classification, Fig. 9 shows outline dimensions of the floor mounting 3-pole rear-connected breaker.

Frequency of Inspection

The frequency of inspection, cleaning, etc., will depend upon the activity and duty of the breaker and upon the relative cleanliness of atmospheric conditions surrounding the breaker. For breakers in highly active or repetitive service such as steel mills it is recommended that inspections be made at intervals of 5000 to 6000 operations or at least every 2 months if conditions are not extremely dirty. When air conditions are clean and activity not particularly high, the periods between maintenance may be extended to from 6 months to a year.

Caution

See that the breaker is disconnected from the circuit before attempting any inspection or maintenance in the high tension compartment.

Installation of De-ionizing Chamber or Stack

To install a stack, lift it above the breaker by means of a chain block with hooks or rope passed through holes in the end plates provided for the purpose, as shown in Fig. 4, and lower it so that the rear end plate passes over the stationary contact casting as shown in Fig. 5, care being used to see that the insulation over the casting is not damaged. In this position, the bottom of the front end plate, at the right in Fig. 4, should rest on the bronze leaf springs with the slots in the chamber end plate ready to slide under the heads of the pins. The stack can now be pulled forward by the jack bolt until the mounting bolt hole in the rear end plate lines up with corresponding hole in the stationary contact casting as shown in Fig. 5. Insert the mounting bolt and tighten securely. Bolt the field connection securely and the stack is ready for service. To remove the stack go through the reverse procedure, care being used to see that the lifting hooks are in place and the weight partially taken up before loosening any bolts, etc.

Micarta Plate Barriers

Some designs of this size breaker are equipped with Micarta plate barriers between poles and on the four vertical outsides. A breaker of this design is illustrated in Figs. 1-A and 2-A. These Micarta barriers are held in place by large fibre bolts and nuts except where they are bolted to the grounded steel

frame. To gain access to a pole unit, remove the front barrier. Most inspection or other maintenance may be accomplished without removing the barriers between phases. In replacing the barriers do not tighten the fibre nuts sufficiently to damage the threads.

Tubular Barriers

On those breakers equipped with one-piece tubular Micarta barriers around each pole unit as shown in Fig. 1, remove the tie bolts at the top and lift the barrier straight upward from the pole unit. This exposes the pole unit to view for inspection or maintenance. In replacing the barriers be sure that each one is pressed fully down into position.

Contacts

In closing the breaker until the arc tips just touch, the clearance between the main contact surfaces should be approximately 1/8-inch. In the fully closed position the clearance between the arc tips should be approximately 1/8-inch. See "Contacts" under "Inspection and Maintenance".

Toggle Stops

The clearance at the toggle stops of the pole unit linkage should be approximately 1/16-inch.

Greasing

For breakers which are in service at high repetitive duty, greasing may be required at intervals of approximately one year. Pressure type fittings are provided at important points for use with an automobile type grease gun. Fittings are provided at the following points:

1. Movable contact lever pivot bearings, two fittings
2. Movable contact lever toggle pin bearings
3. Center toggle pin bearing located on Item 4, Fig. 8
4. Stationary toggle pin bearing, located on the sleeve of Item 7, Fig. 8

SPECIAL INSTRUCTIONS FOR STEEL MILL TYPE BREAKERS IN HIGH-ACTIVITY, 15,000-VOLT SERVICE

Steel Mill Type Breakers For 15 KV

Figs. 1, 10 and 11 are views of a 600 ampere, 15 kv. "De-ion" breaker for truck mounting. The construction of this breaker is very similar to the lower voltage breakers described in the "General" section of this book. Figs. 6, 7 and 8 may be used for identification of parts in studying the construction of the breaker.

Frequency of Inspection

The frequency of inspection, cleaning, etc., will depend upon the activity and duty of the breaker and upon the relative cleanliness of atmospheric conditions surrounding the breaker. For breakers in highly active or repetitive service such as steel mills, it is recommended that inspection be made at intervals of 5000 to 6000 operations or at least every two months if conditions are not extremely dirty. When air conditions are clean and activity not particularly high, the periods between maintenance may be extended to from six months to a year.

Caution

See that the breaker is disconnected from the circuit before attempting any inspection or maintenance in the high tension compartment.

Installation of De-ionizing Chamber or Stack

To install a stack, lift it above the breaker, using lifting hooks or a rope passed through holes in the end plate provided for the purpose, as shown in Fig. 11. (Lifting ropes not shown). Lower it into position with the front end plate (R.H. side of picture) resting on the two sheet bronze springs. As the stack is lowered into position, engage the large terminal clip on the flexible cable at the rear of the stack with the main terminal stud, between the two loose contact nuts. Push the stack forward until the notch in the front end plate foot engages center guide screw. Insert the rear jack bolt through the cross member of the rear end plate and force the stack forward until the pin holes in the rear end plate line up with the hole in the stationary contact casting. Install the pin and cotter pin and tighten the jack bolt medium tight. Too much tightening of the jack bolt may distort the cross member or pin.

Tighten the contact nuts against the large terminal clip. This completes the installation of the de-ionizing chamber.

Barriers

These breakers are equipped with tubular barriers as shown in Fig. 1. To remove a barrier, remove the tie bolts at

the top and lift the barrier straight upward from the pole unit. This exposes the pole unit to view for inspection or maintenance. In replacing the barriers, be sure that each one is pressed fully down into position.

Contacts

In closing the breaker until the arc tips just touch, the clearance between the main contact surfaces should be approximately 1/8-in. In the fully closed position the clearance between the arc tips should be approximately 1/8-inch. See "Contacts" under "Inspection and Maintenance".

Toggle Stops

The clearance at the toggle stops of the pole unit linkage should be approximately 1/16-inch.

Greasing

For breakers which are in service at high repetitive duty, greasing may be required at intervals of approximately one year. Pressure type fittings are provided at important points for use with an automobile type grease gun. Fittings are provided at the following points:

1. Movable contact lever pivot bearings, two fittings
2. Movable contact lever toggle pin bearings
3. Center toggle pin bearing located on Item 4, Fig. 8
4. Stationary toggle pin bearing, located on the sleeve of Item 7, Fig. 8

SPECIAL INSTRUCTIONS FOR "DE-ION" AIR CIRCUIT BREAKER
1200 AMP. - 7500 VOLTS - 3 - POLE
TOP CONNECTED - CUBICLE OR CELL MOUNTED

For general information regarding construction, inspection and maintenance see pages 3 to 10 and pages 11 and 12 except "Micarta Plate Barriers" and "Tubular Barriers".

Installation of De-ionizing Chamber or Stack

To install a stack, place the lifter in position over the pole unit as shown in Figure 12, first placing the lifter supporting rod in brackets on the sides of the cell toward the rear. Hook the upper end of the turn-buckle into position as shown in Figure 12. Hook the four hooks of the lifter carriage into the four holes in the stack end brackets. Raise the stack as far as possible by tightening the turn-buckle. Roll the carriage with the stack toward the rear of the cell into the position shown in Figure 13. Loosen the turn-buckle and push the stack to the rear to engage the finger contacts at the rear of the stack firmly with the contact surfaces on the stationary contact casting of the pole unit. Install four bolts at the bottom of the front line terminals and tighten firmly. This is a continuous current carrying joint and the contact surfaces should be clean. Tighten the four bolts firmly.

Unhook the carriage lifter hooks and remove the lifter. Install the jumper between the front stack terminal and the bus connection. This completes the installation of the stack. When all stacks are installed, remove the lifter supporting rod from the cell.

To remove the stack, go through the reverse procedure.

Pole Unit Barriers

Place the rear edge of the pole unit barrier on the horizontal steel plate beneath the breaker unit and push to the rear of the cell, guiding it along the sides of the pole unit. Press the barrier down as far as possible, engaging the front eye behind the front flange of the steel barrier. Insert the barrier retaining bolt through the hole at the bottom and tighten into the welded-on nut in the steel flange. Figure 14 shows the three pole unit barriers in position.

The breaker is now ready for service.

ALL TYPE U BREAKERS IN HIGHLY ACTIVE LOAD SWITCHING DUTY - SPECIAL INSTRUCTIONS

On all Type "U" breakers subject to a switching duty of the order of 1000 or more operations per month, with a majority of the operations on load or low current switching, the de-ionizing chamber should be checked at intervals of not less than 5000 to 6000 operations, as described on Page 7 under "De-ionizing Chamber -- Insulation of Gaps."

Fig. 1 - Typical Type "U" De-Ion Air Circuit-Breaker
2500 to 15000 Volts, for Steel Mill Type Service
Photo 228408

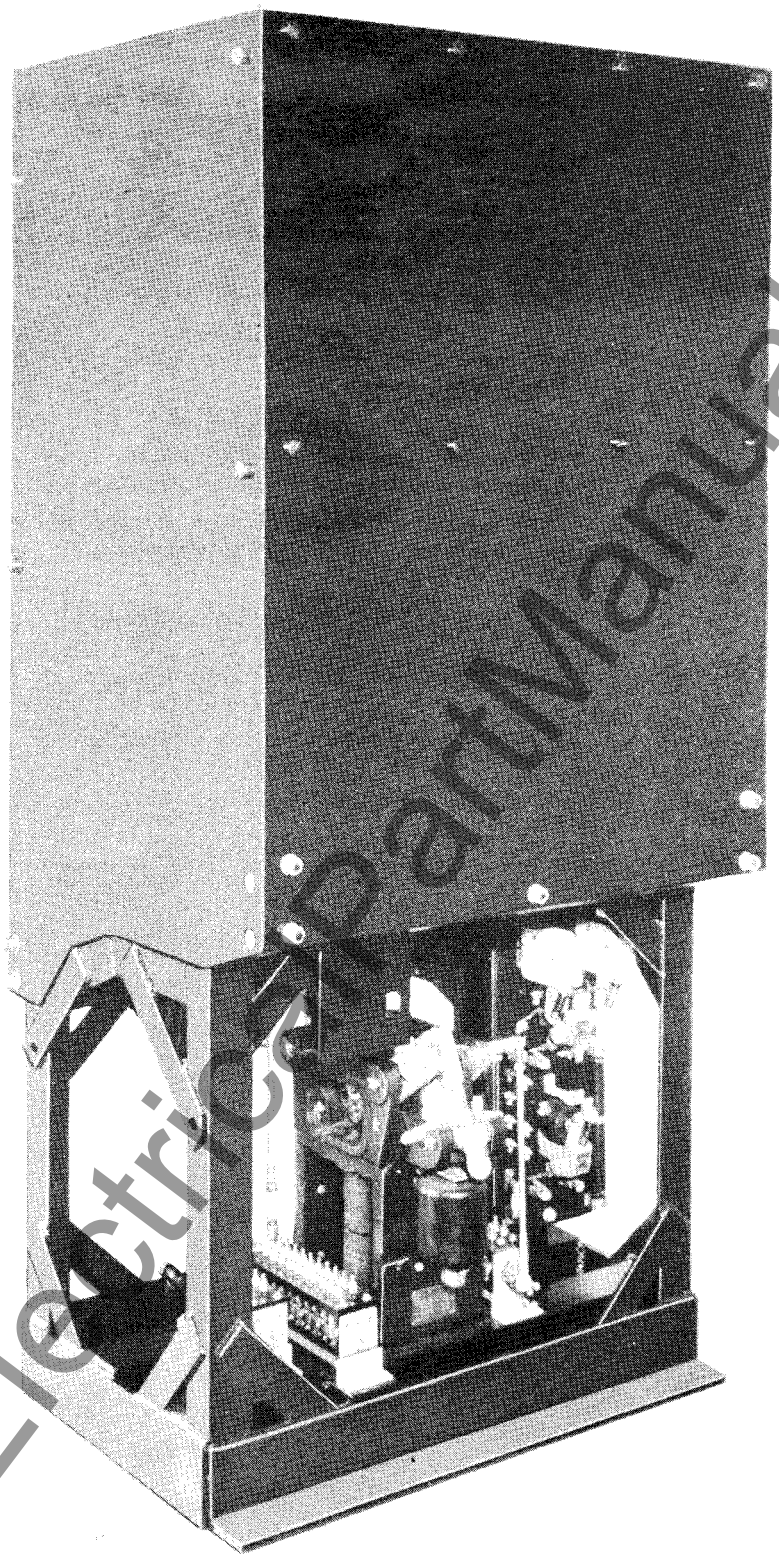

Fig. 1A - Typical Type "U" De-Ion Air Circuit-Breaker
Three Pole, 1200 Amperes, 7500 Volts
Photo 227227

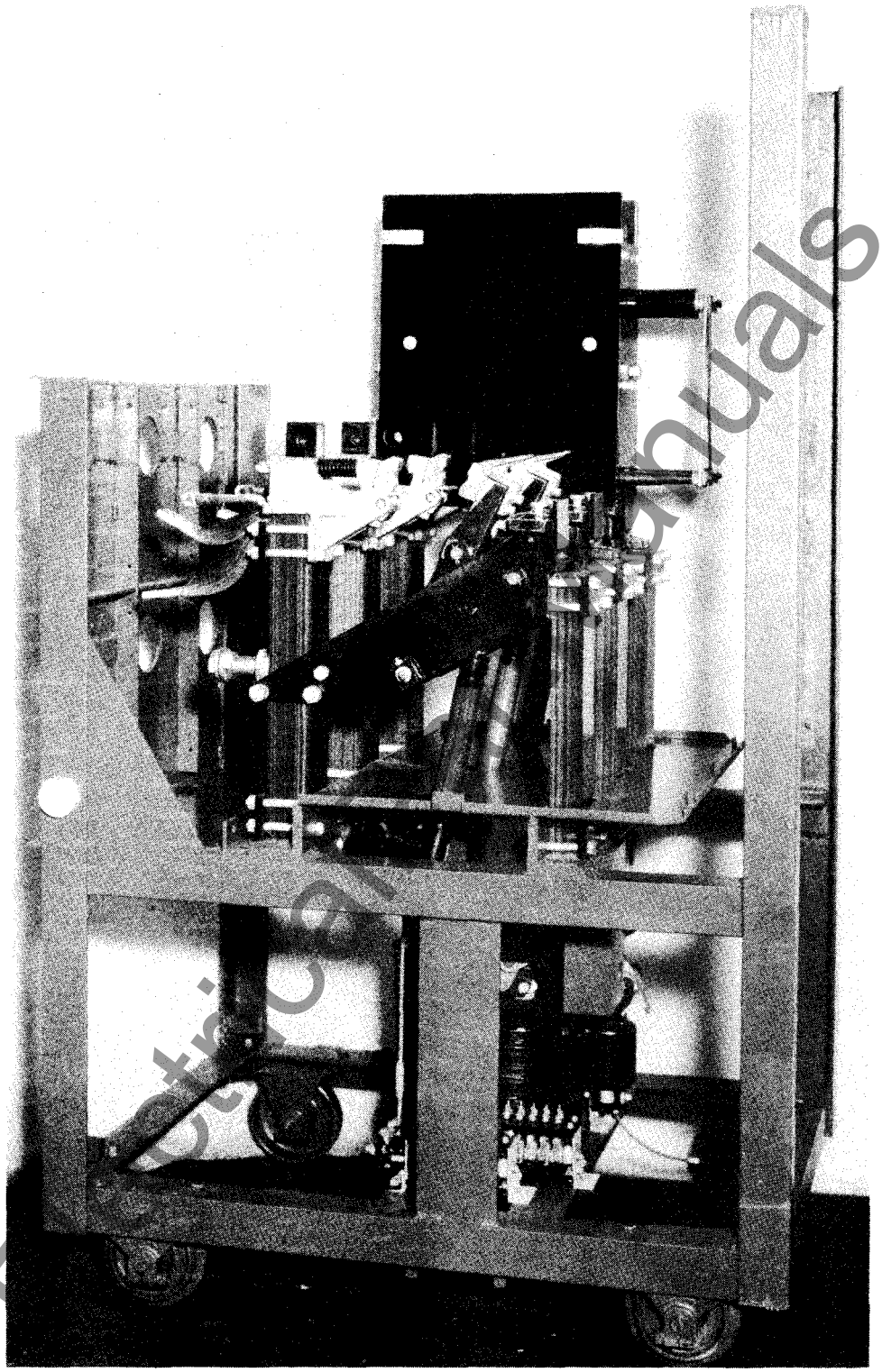

Fig. 2 - Typical Type "U" De-Ion Air Circuit-Breaker for 7500-Volt Service, with De-Ionizing Chambers Removed from Two Poles, showing Contacts, Insulating Supports, etc.
Photo 228409

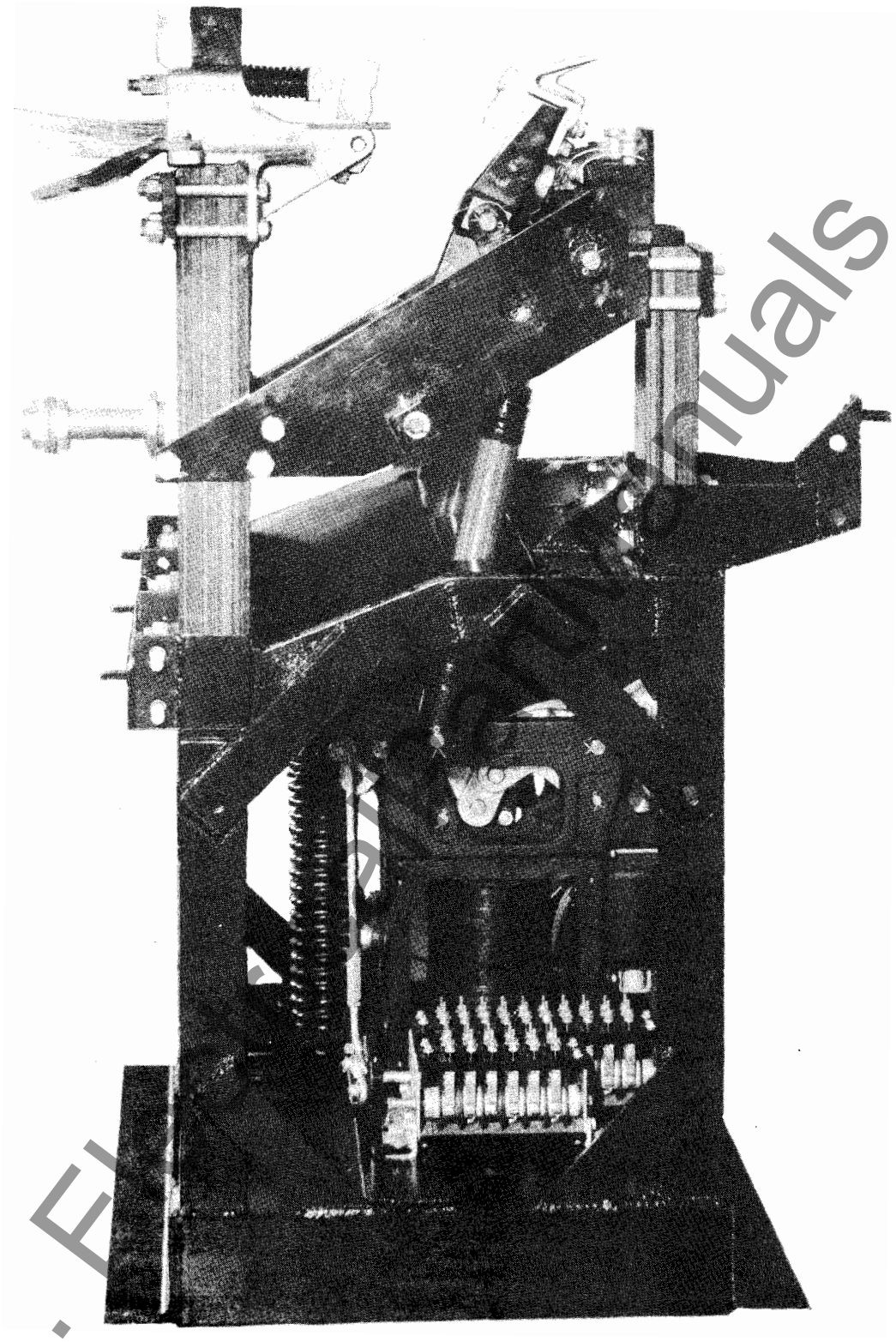

Fig. 2A - Typical Pole Unit without De-Ionizing Chamber,
for Type "U" De-Ion Circuit-Breaker
Photo 227226

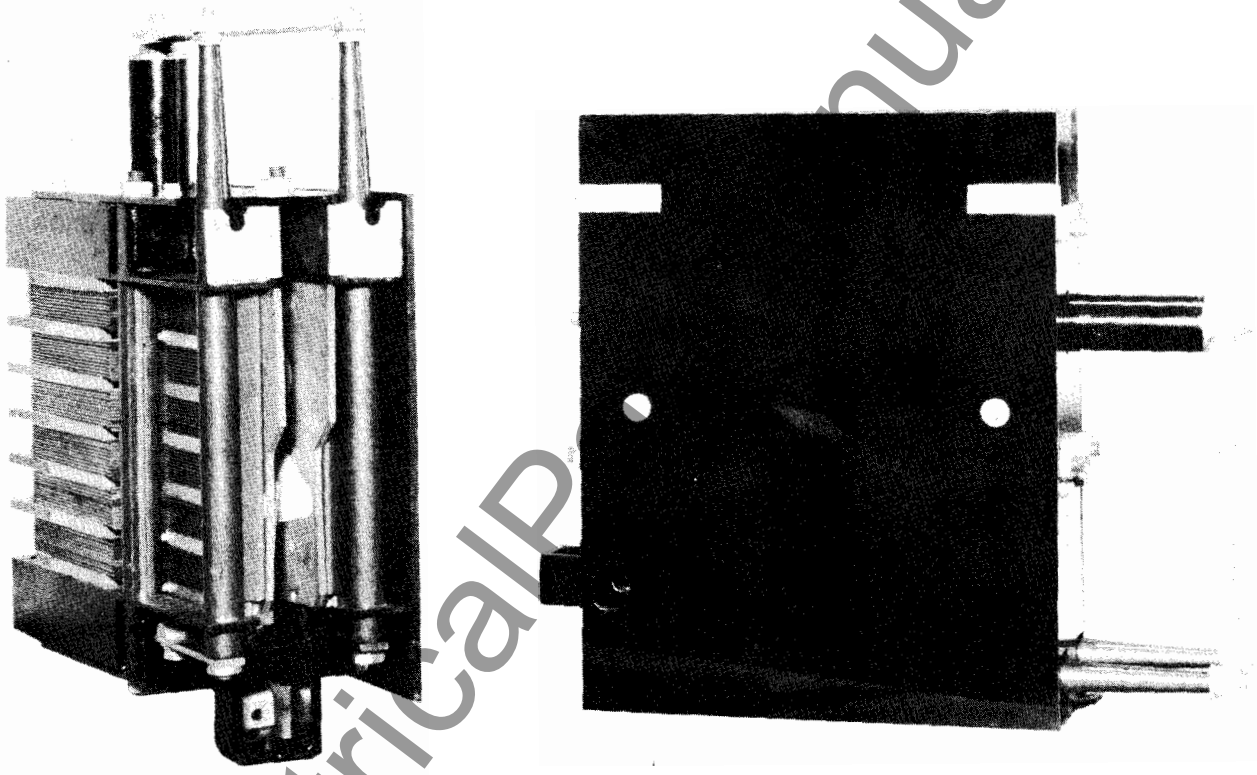

Fig. 3 - Typical De-Ionizing Chamber, for Type "U" De-Ion Circuit-Breaker, Bottom and Side Views
Photo 227228

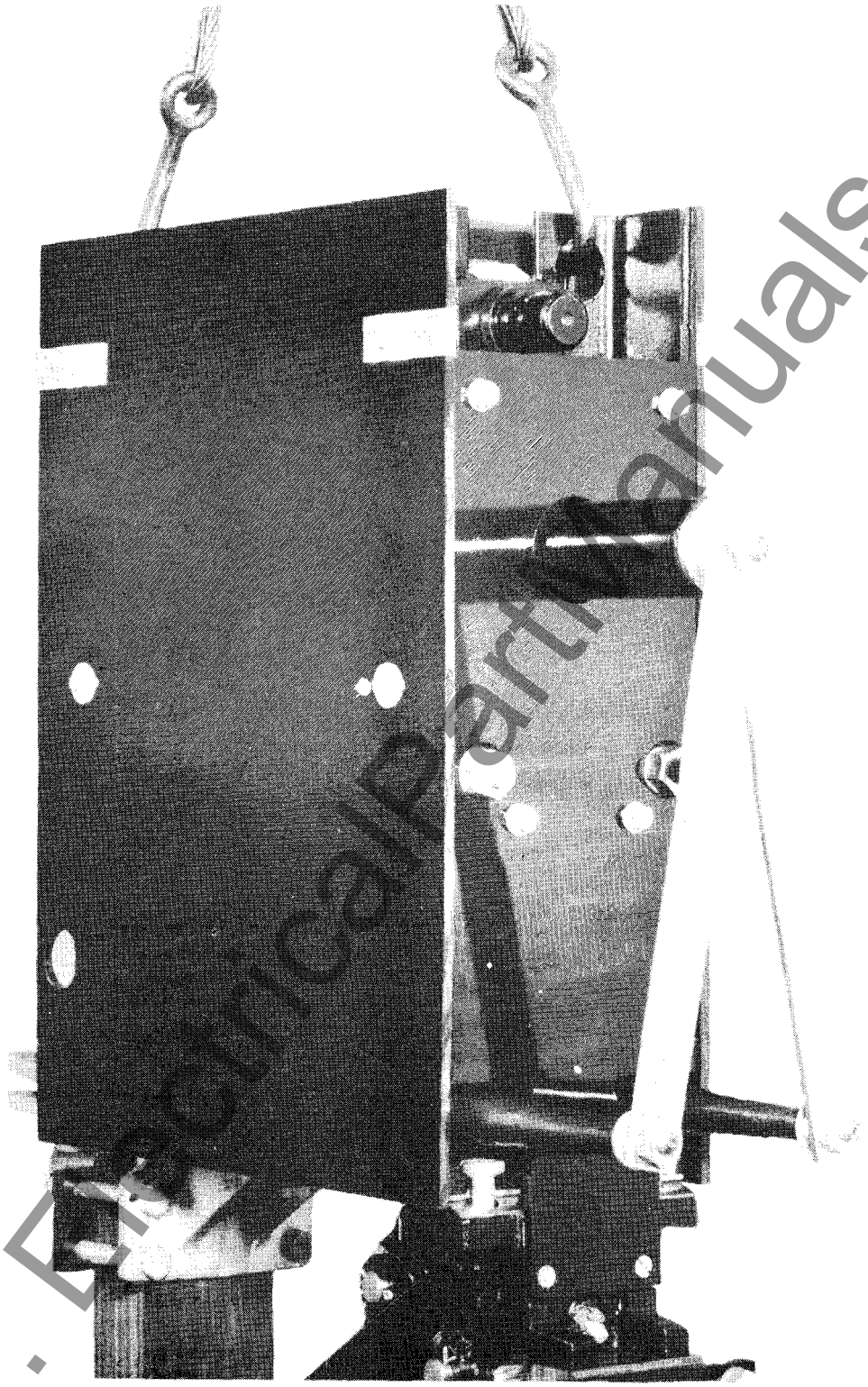

Fig. 4 - Installing De-Ionizing Chamber or Stack
Photo 227229

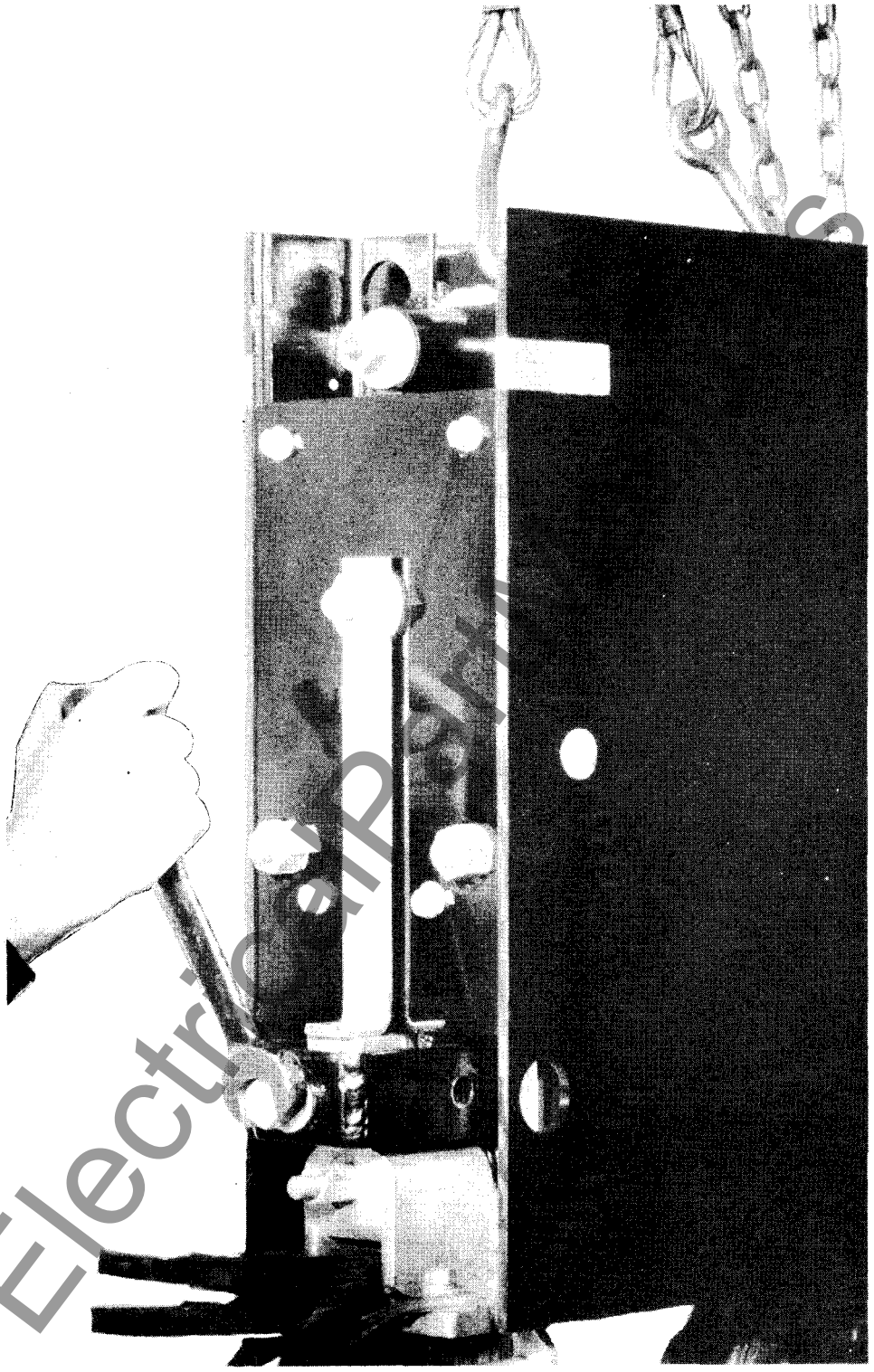

Fig. 5 - Moving De-Ionizing Chamber or Stack to Final Position with Jack Bolt
Photo 227230

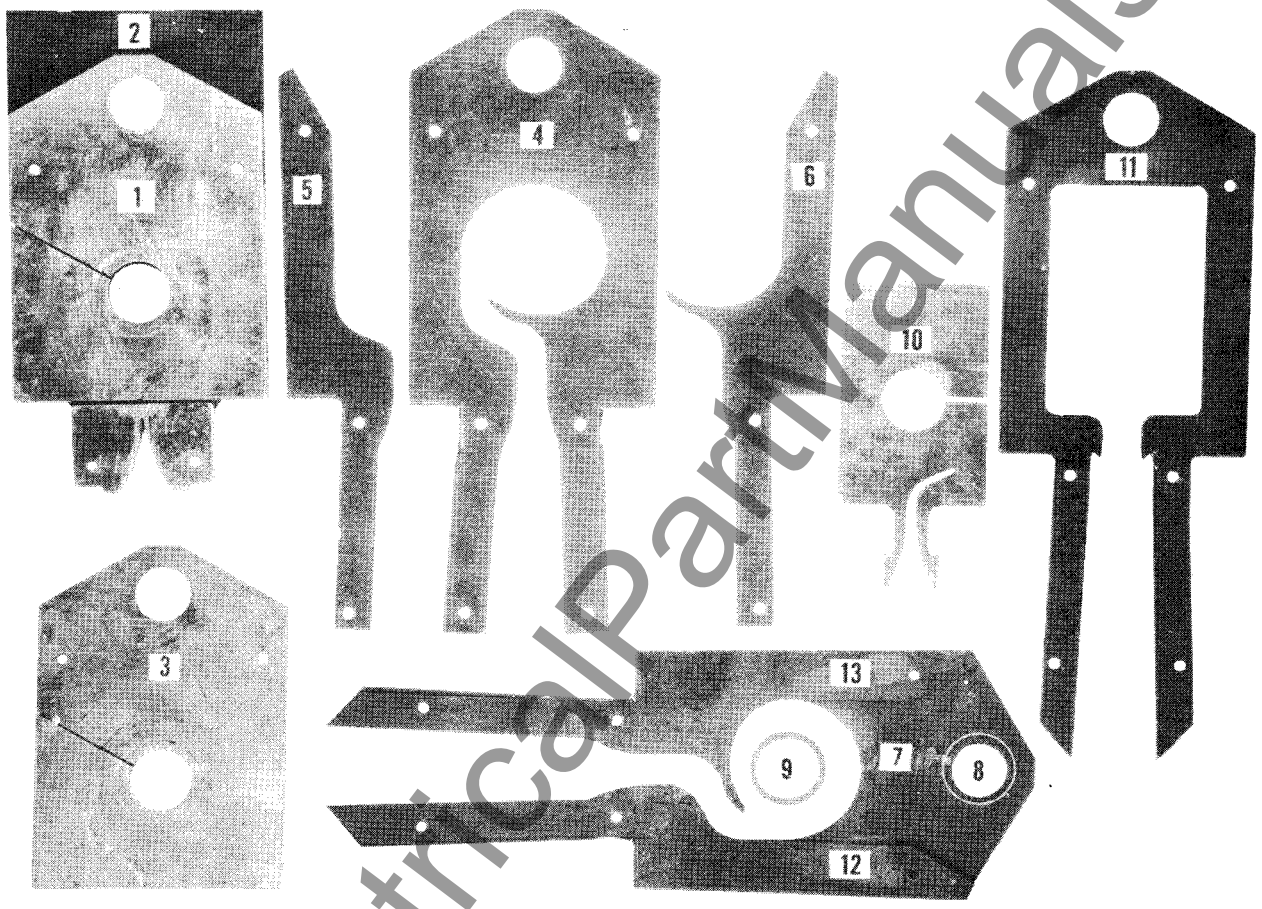

Fig. 6 - Details of Typical De-Ionizing Chamber
Photo 220435

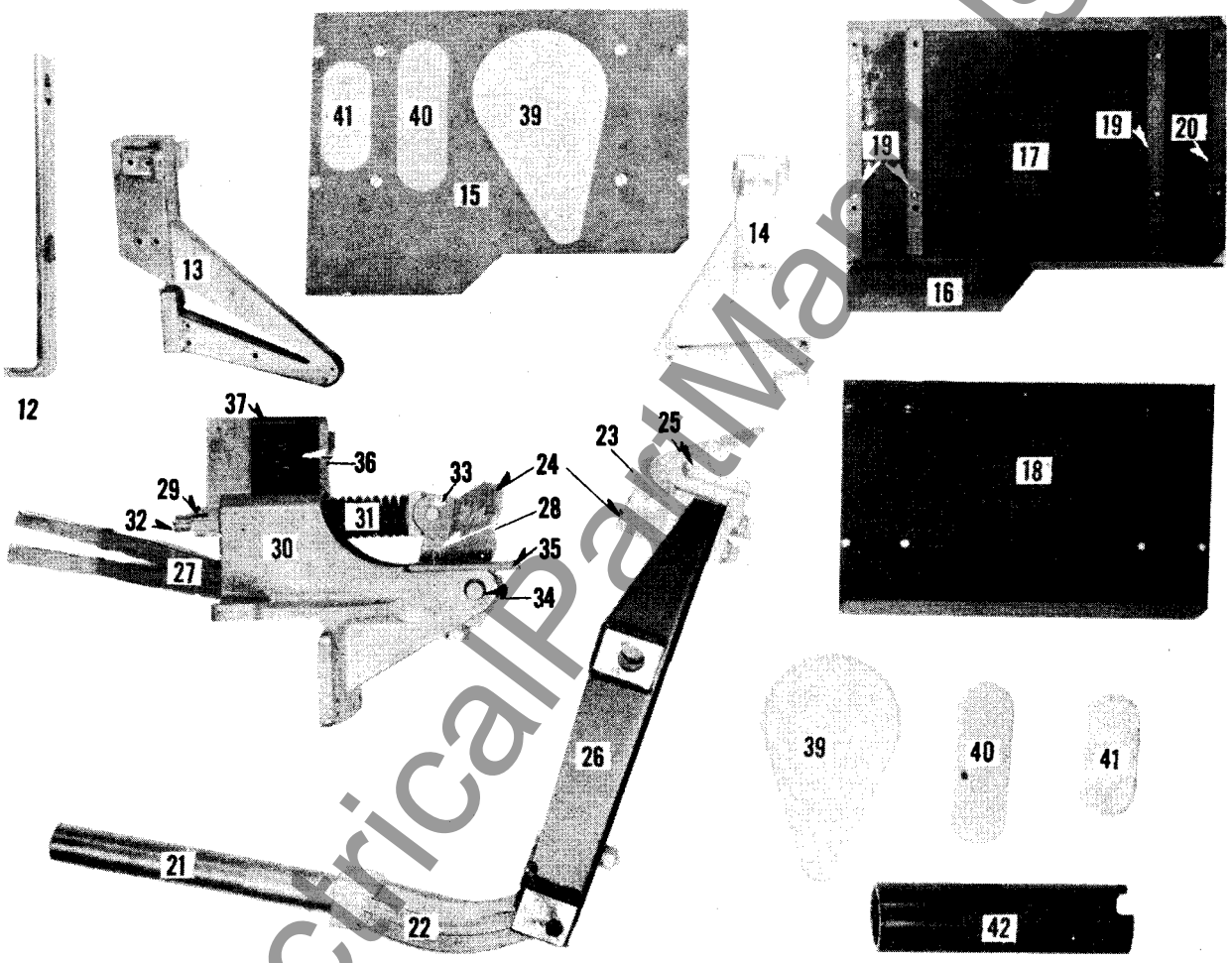

Fig. 7 - Typical Arc Box and Contact Details
Photo 227232

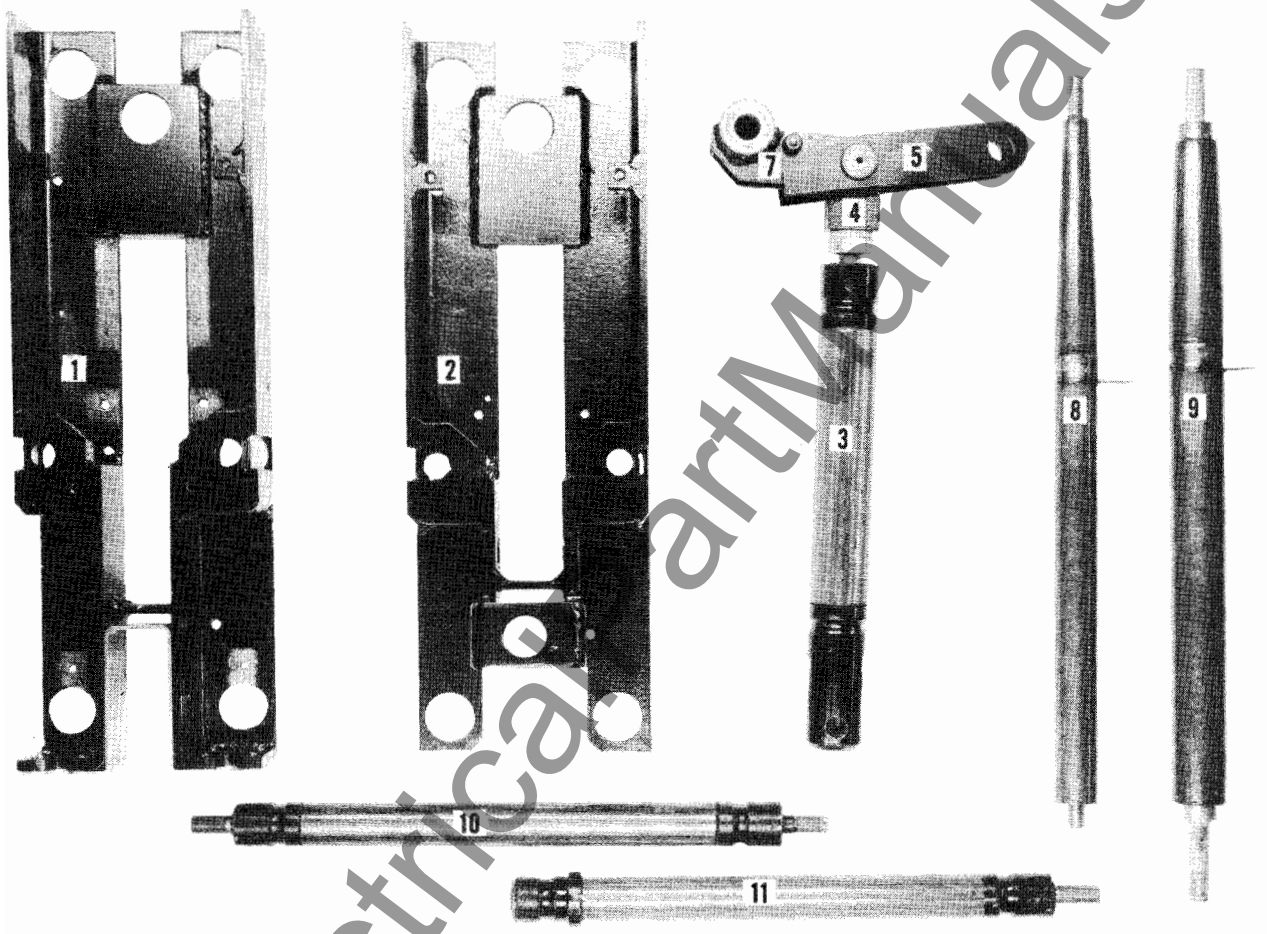

Fig. 8 - Typical De-Ionizing Chamber and Operating Details
Photo 227231

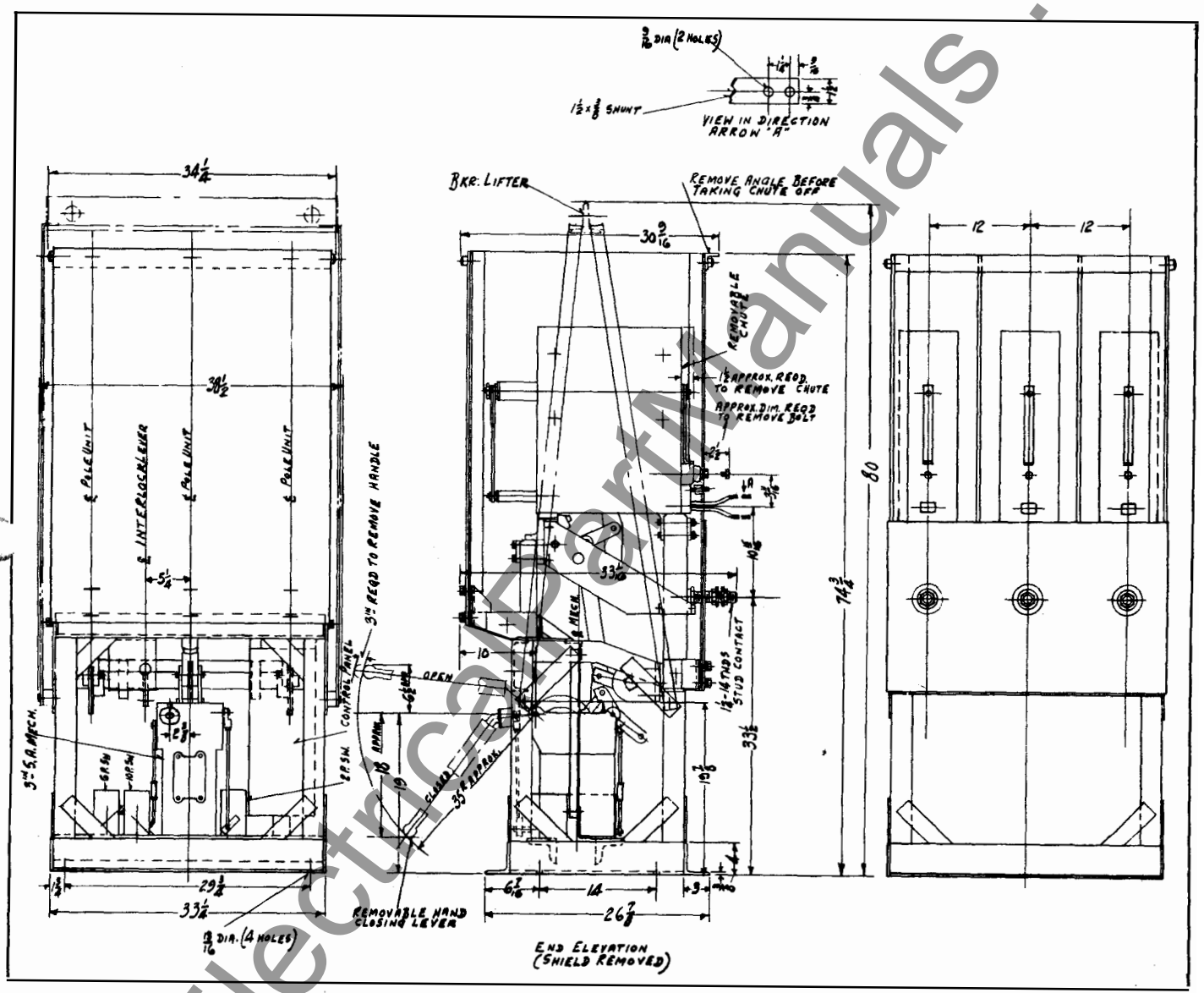

Fig. 9 - Outline Drawing for Typical Type "U" De-Ion Air Circuit-Breaker, Floor Mounting, Rear Connected
Dwg. 54-B-329-3

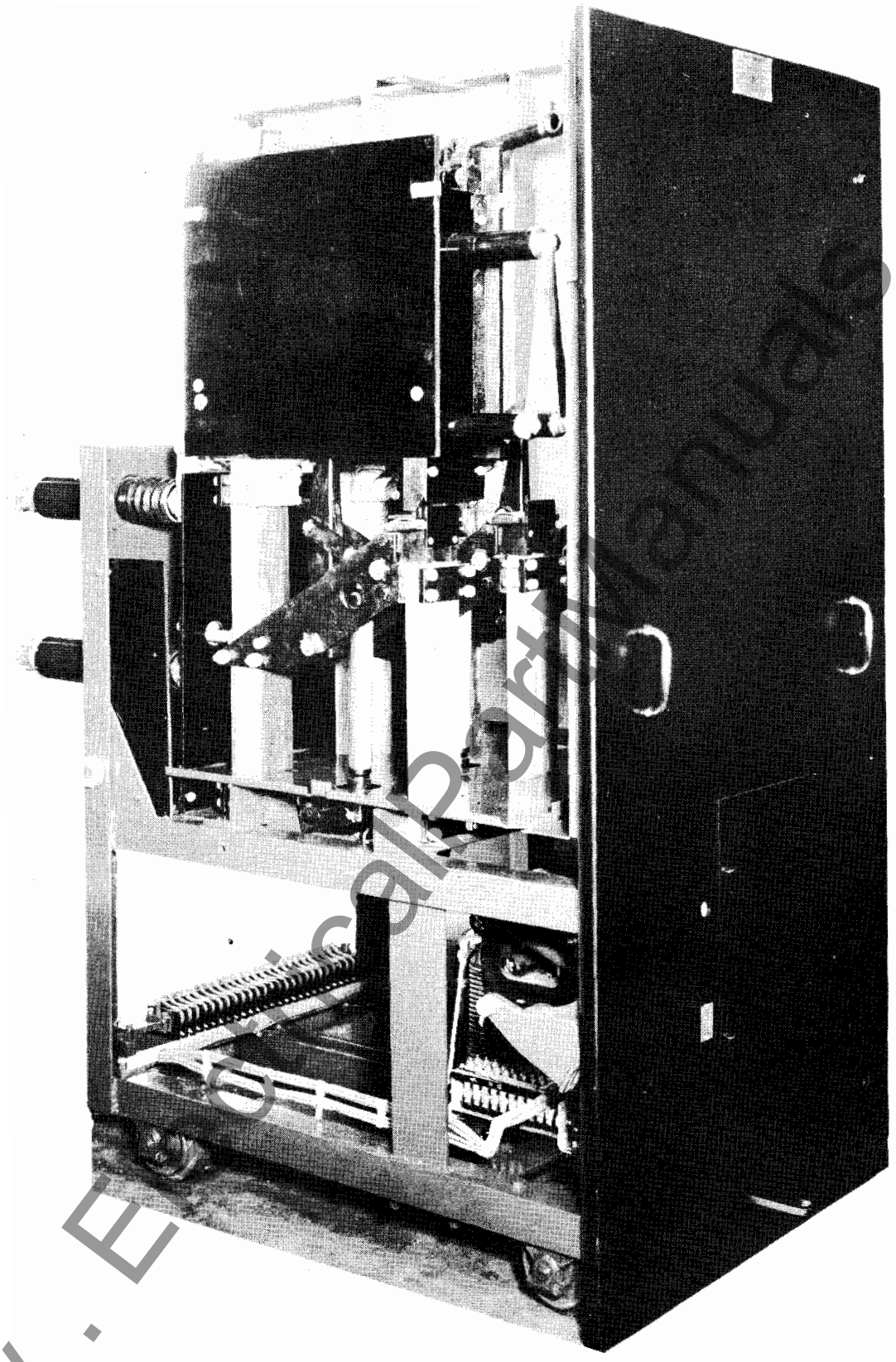

Fig. 10 - Typical Type "U" De-Ion Air Circuit-Breaker for 600-Ampere, 15000-Volt Service, Truck Mounting, with Pole Unit Barriers Removed
Photo 238139

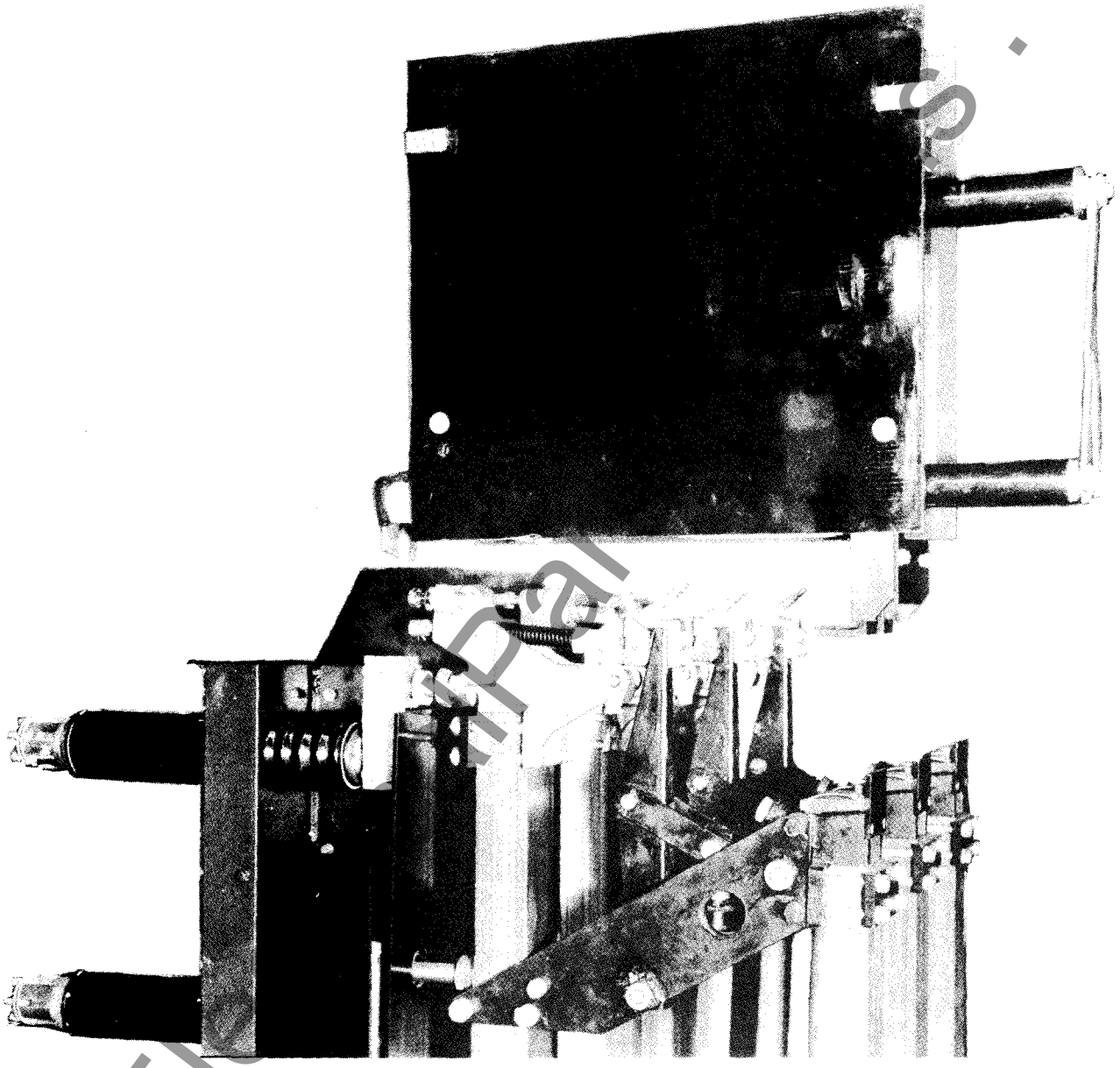

Fig. 11 - Typical Type "U" De-Ion Air Circuit-Breaker for 15,000-Volt Service, with De-Ionizing Chamber Suspended above Pole Unit Ready for Installation
Photo 238138

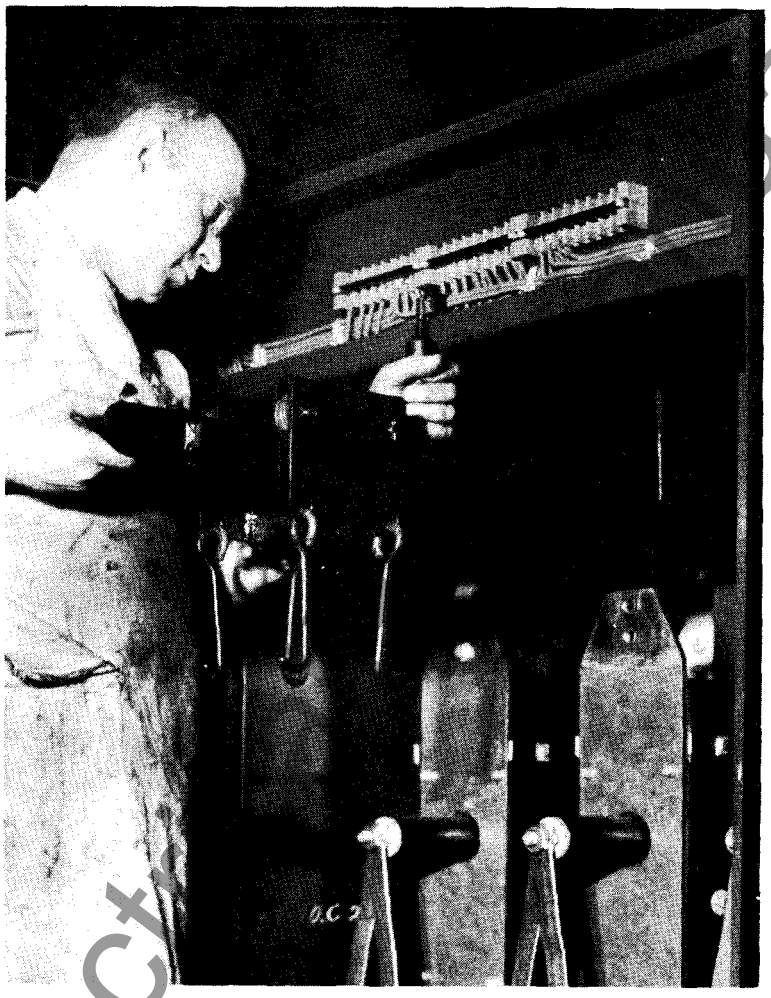

Fig. 12 - De-Ion Air Circuit-Breaker,
1200-Ampere; 7500-Volt,
Showing Installation of Stack Lifter
Photo 244694

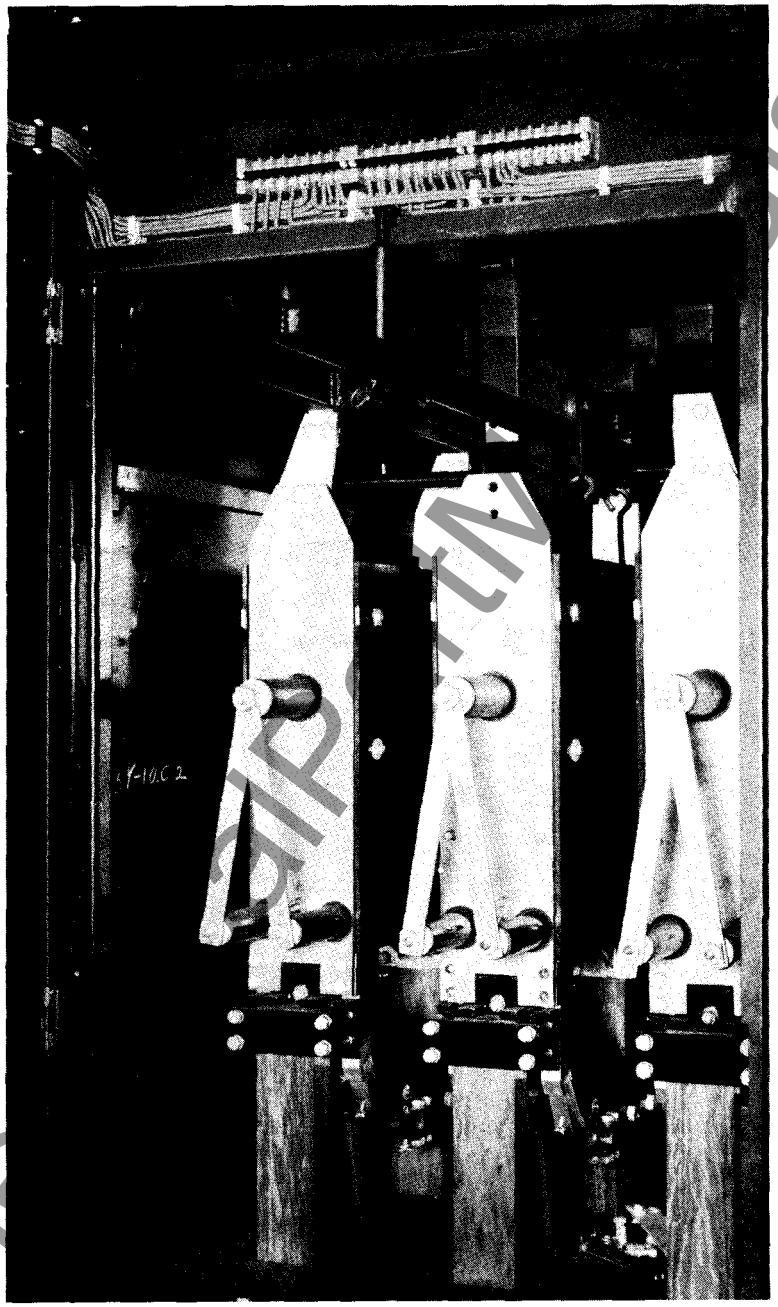

Fig. 13 - Breaker Illustrated in Fig. 12
(Lifter in Position)
Photo 244695

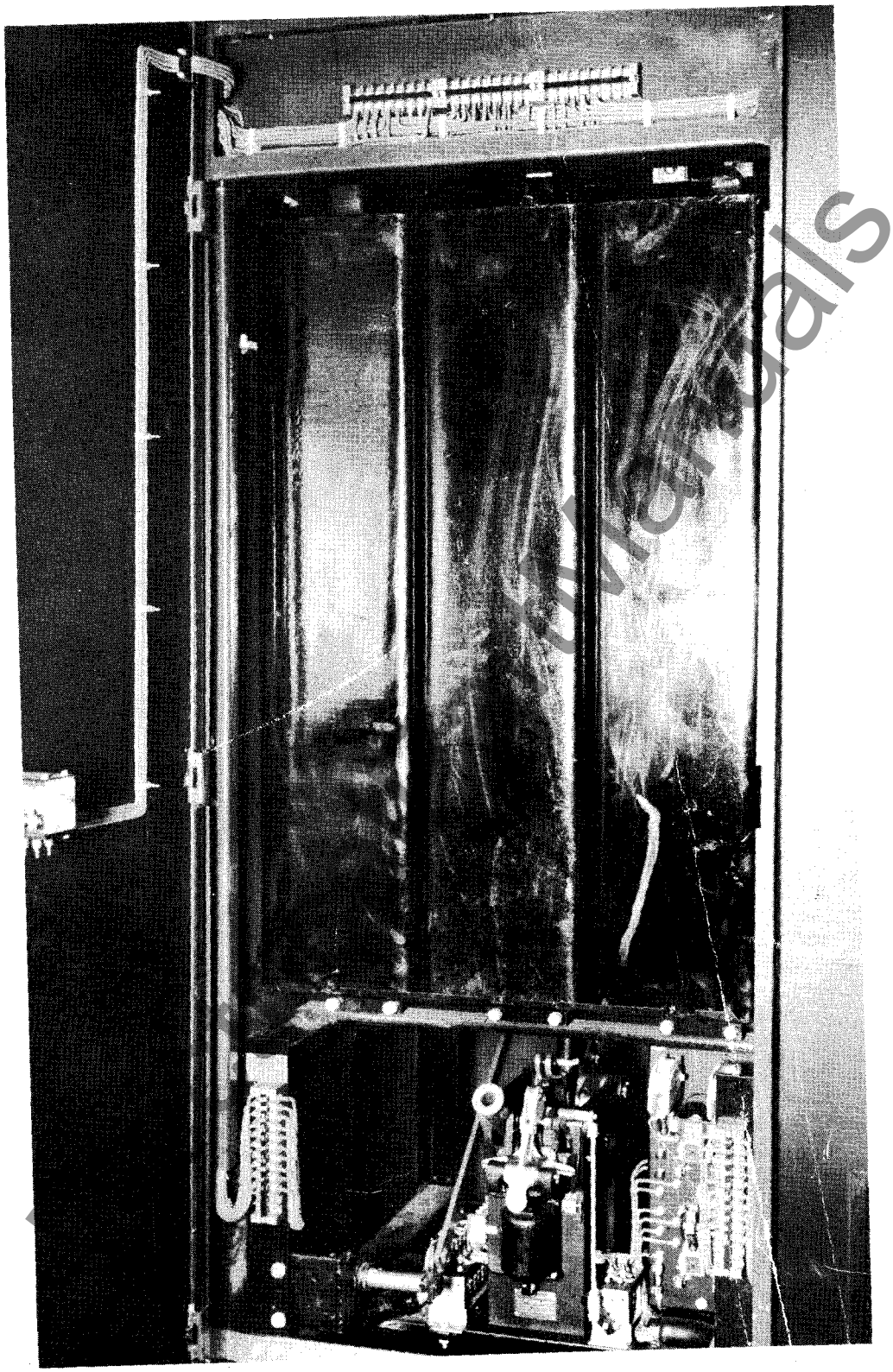

Fig. 14 - Breaker Illustrated in Fig. 12
(Pole Unit Barrier in Position)
Photo 244693