

## INSTALLING

### CONTROLLER SUPPORTS

Previous Sprague General Electric control systems have been made up with each contactor a self-contained unit and no particular care in lining up the car-body supports was necessary. With the PC controller, in which all contactors are operated from a cam shaft, it is essential that the supports attached to the car-body, from which the controller is suspended, be accurately installed, as, otherwise, the controller framework will be pulled out of shape and prevent the controller operating in a satisfactory manner. The points of support should not vary more than 1/8" from one plane. Poor alignment may be indicated by the cam shaft not rotating at 45 pounds air pressure, or controller may start slowly and pass beyond the point where it should stop.

### INSULATING FROM GROUND

The PC controller is arranged to be insulated from ground and clearance should be provided between all grounded pipes, hangers, brake rods, etc. and the metal box of the PC controller.

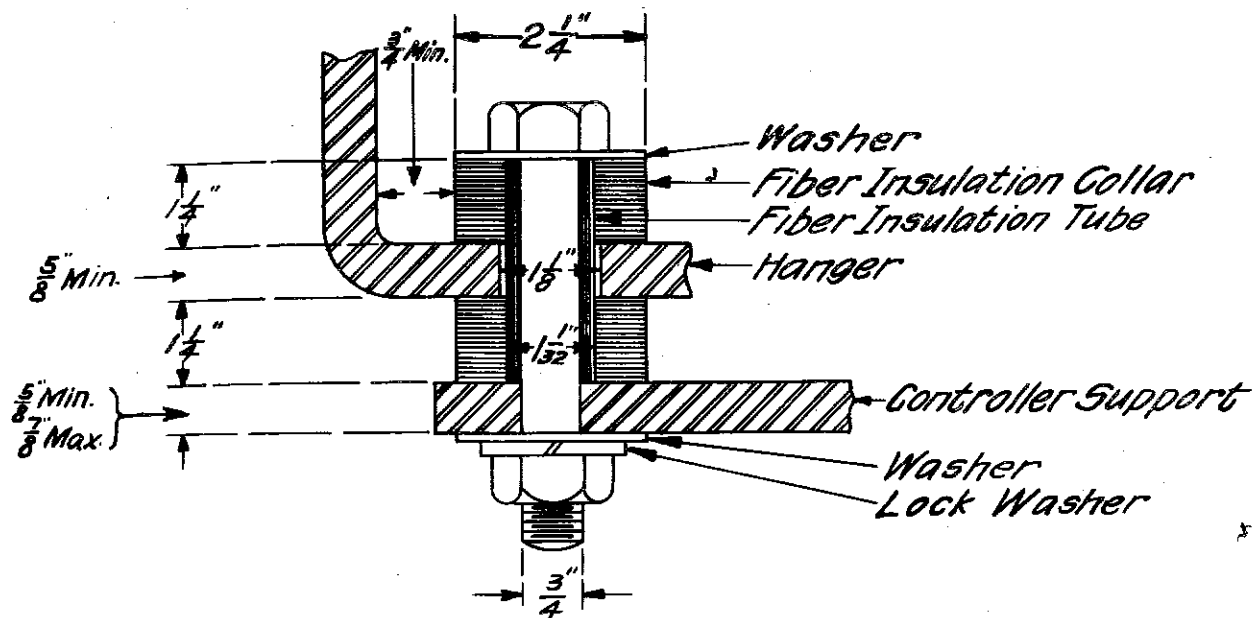
\* The insulation between the supports and the controller should be installed so that the bolts fastening the controller to its supports are not grounded. The method of insulation recommended is shown on Page 16.

The insulating joint used in the air pipe should be placed in a vertical pipe to prevent water collecting on the interior insulating surface.

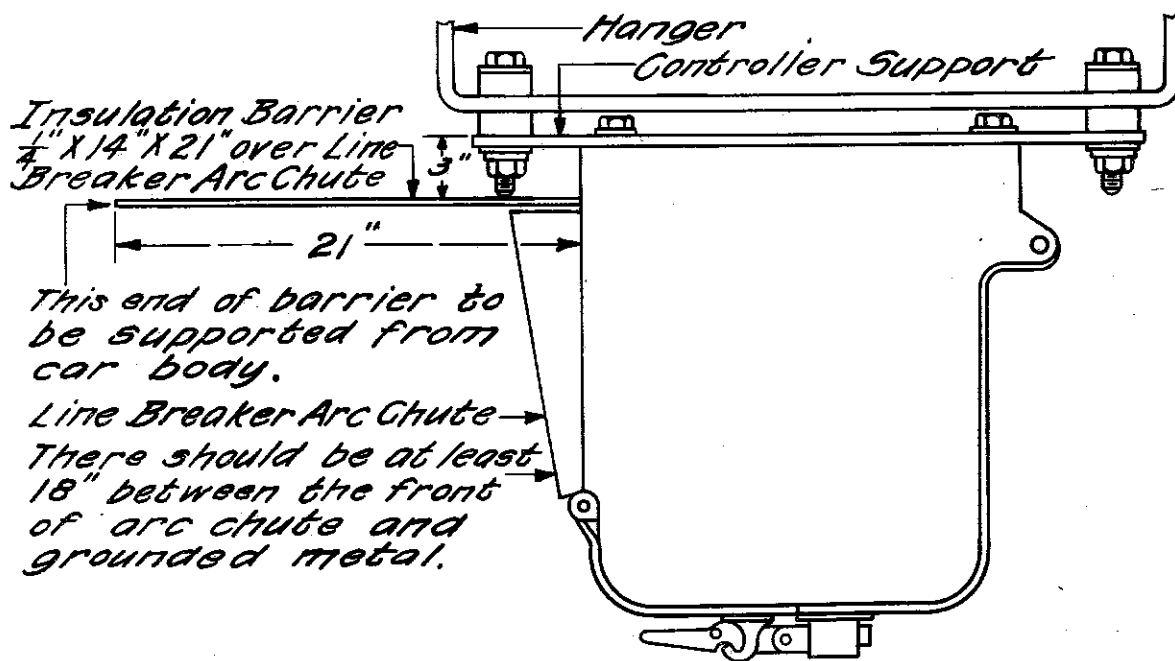
When a PC controller is installed without a cover over the line breaker arc chutes, there should be at least 18" to any grounded metal directly in front of the arc chute and at least 8" to any grounded metal adjacent to the top or sides of the arc chutes. If grounded pipes or rods are nearer than 18", they should be covered with sufficient insulation to give this distance. When such insulation is used, it should extend at least 3" beyond the outside vertical edges of the arc chutes. A suggested method of installing is shown on Page 18.

### AIR PIPING

For air brake operation, it is ordinarily recommended that the air piping from the compressor be arranged to condense moisture contained in the air. For compressors of 25 cu.ft. per Min, capacity, not less than 25 ft. of cooling pipe is used. With compressors of larger capacity, a greater amount of cooling pipe is required.

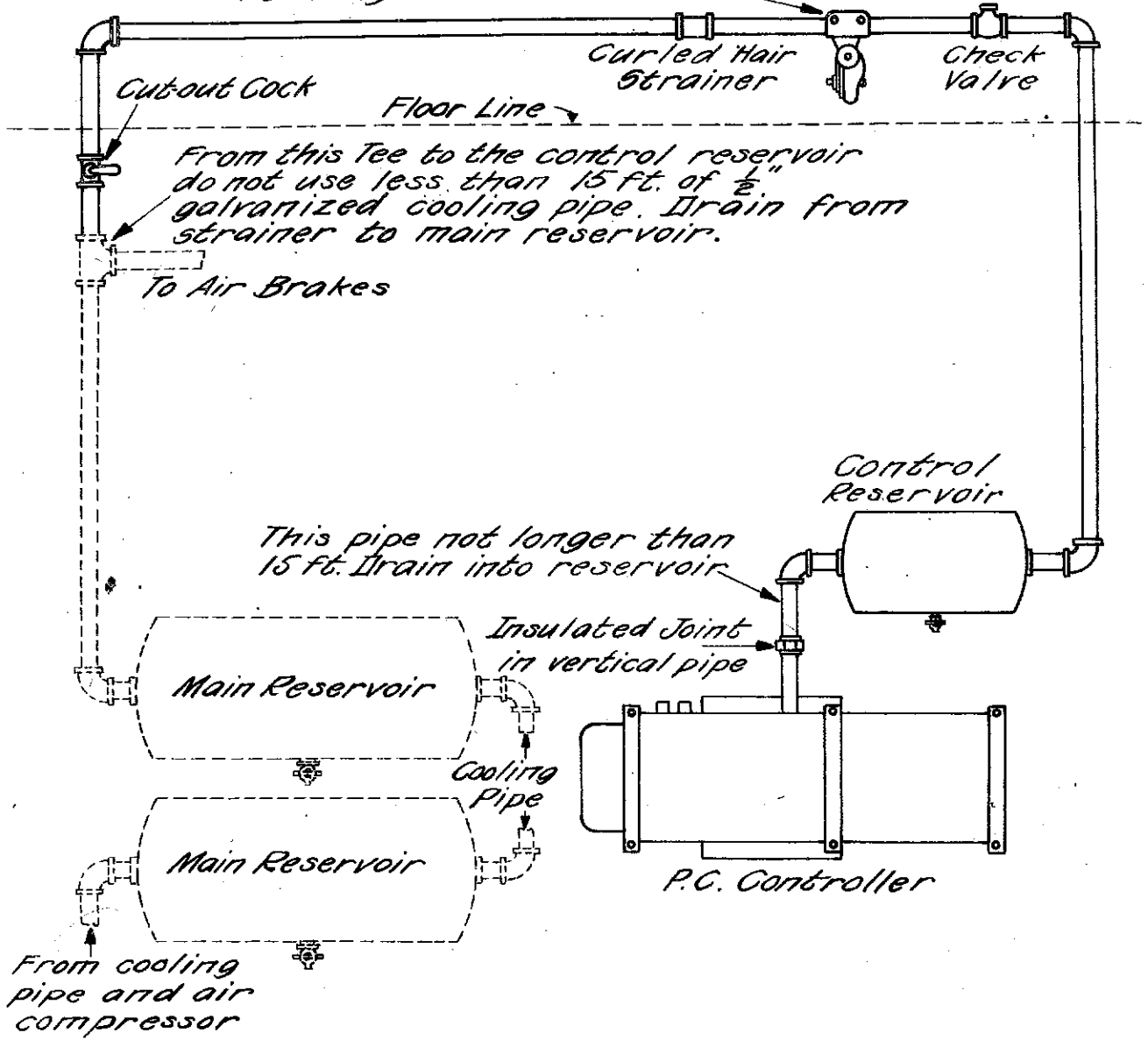


*Method of Insulating PG Controllers.*



*For Controllers without Covers over Arc Chute.*

Reducing Valve set for 70 lbs. on control side. When main reservoir pressure does not exceed 80 lbs. reducing valve is omitted



Piping Connections P.C. Control

For the PC controller, at least 15 ft. additional 1/2" galvanized cooling pipe is recommended. This cooling pipe should be installed between the air brake reservoir and the control reservoir for the PC controller.

The control reservoir should be located so that not over 15 ft. of pipe is needed to connect it to the PC controller. A shorter length is desirable. The piping Diagram, Page 19 shows the general arrangement and connections of the air details.

The piping should be arranged to drain the moisture into reservoirs.

When installing the air piping for the control, care should be taken to remove all rust and scale. After the piping is installed, it should be pounded with a hammer and blown out before connecting to the strainer or PC controller.

#### MAIN FUSE BOX.

Copper ribbon type fuse boxes, when used, are insulated from ground, where wood is used for insulation, there should be at least three inches (3") creepage distance between the fuse box supporting bracket and ground for 600 volt systems. When the voltage is 1200 or 1500, the distance should be six inches (6"). Where conduit is used, there should be at least three inches (3") along the surface of the cable from the end of the conduit to the fuse terminal on 600 volts, and on 1200 and 1500 volts six inches (6").

#### CONTROL COUPLER SOCKETS AND PLUGS.

When installing wires in the control couplers, the connection should be made as indicated on page 21. After the coupler sockets are assembled and installed on the car, the back of the coupler socket should be filled with compound. Page 22 shows the method of clamping the cable in the coupler plug, preventing strains being applied to the soldered connections when the plug is pulled out of the socket by the cable.

#### MOTOR RESISTORS.

Porcelain bolt insulators are furnished for the supplemental insulation between the individual resistor frames and their hangers, as shown on Page 23. When installing, the bolt insulators should be arranged to prevent the short circuiting of the porcelain position by mud or grounded metal.

Grounded conduit should not be supported from the resistor frames.

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# Method of making Cable Connections in Type M Control Couplers



Fig 1  
Insulation removed



Fig 2  
Wires formed into „J” and  
pinched flat



Fig 3  
Conductor inserted into  
Terminal. Wires projecting  
from Slots.

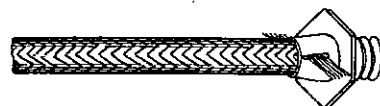


Fig 4  
Terminal pinched to-  
gether, by means of Gas  
Pliers to firmly grip the  
insulation.



Fig 5  
Wires bent close to Ter-  
minal (on one side) ready  
for soldering.



Fig 6  
Soldered (on one side  
only).

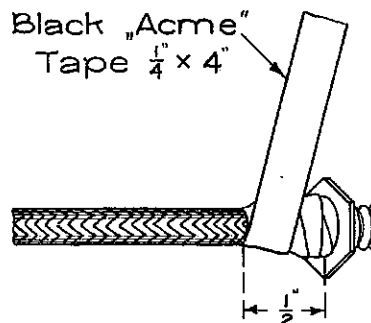


Fig 7  
Tape to Dimension

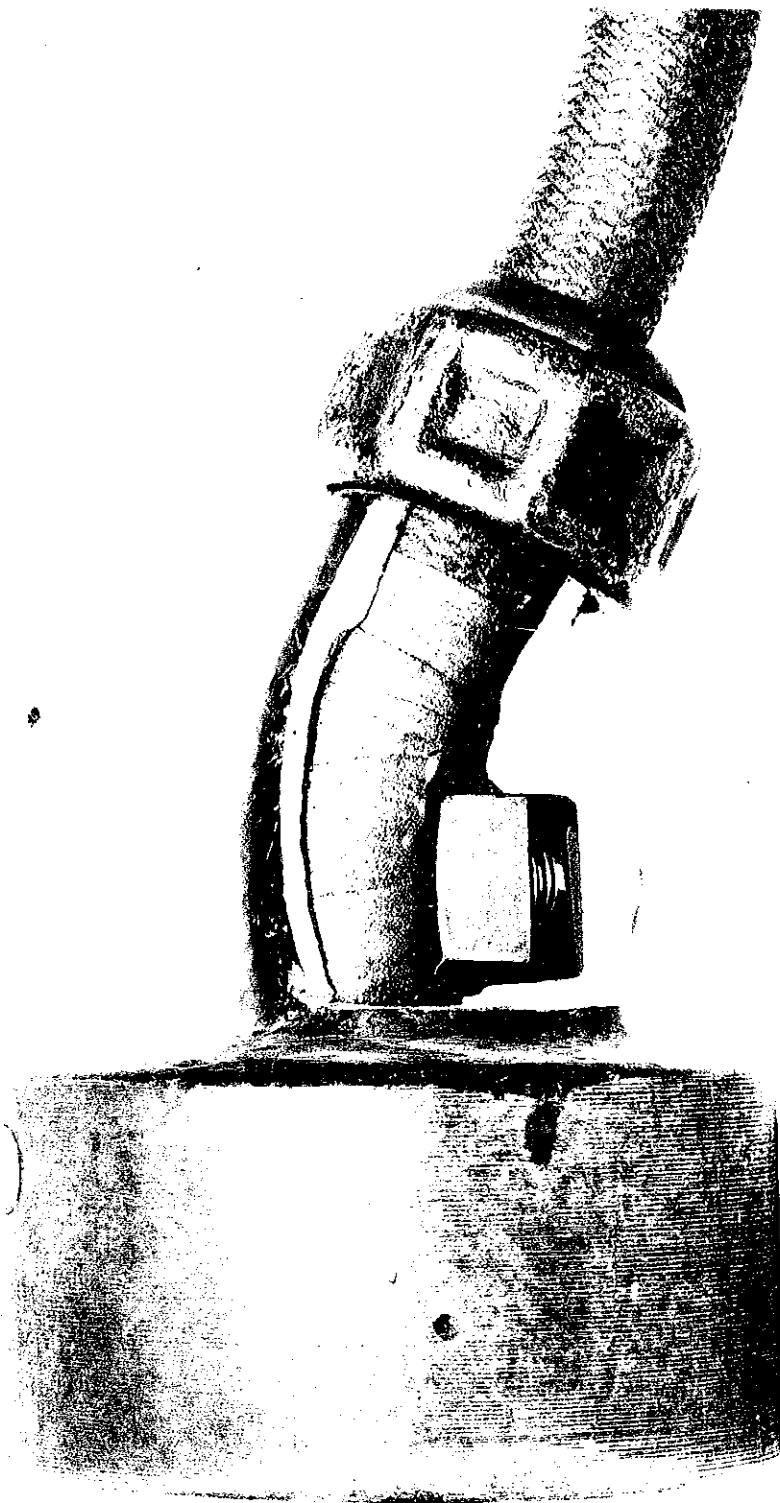
Checked *W. Torp*

Engineering Dept.

D.S. 1981

General Electric Company

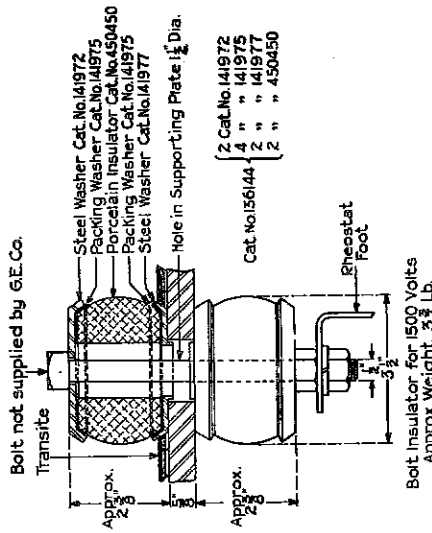
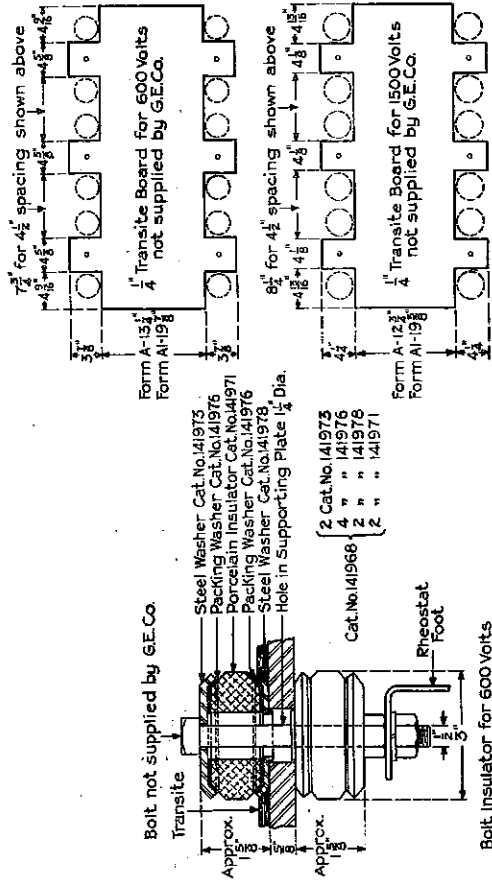
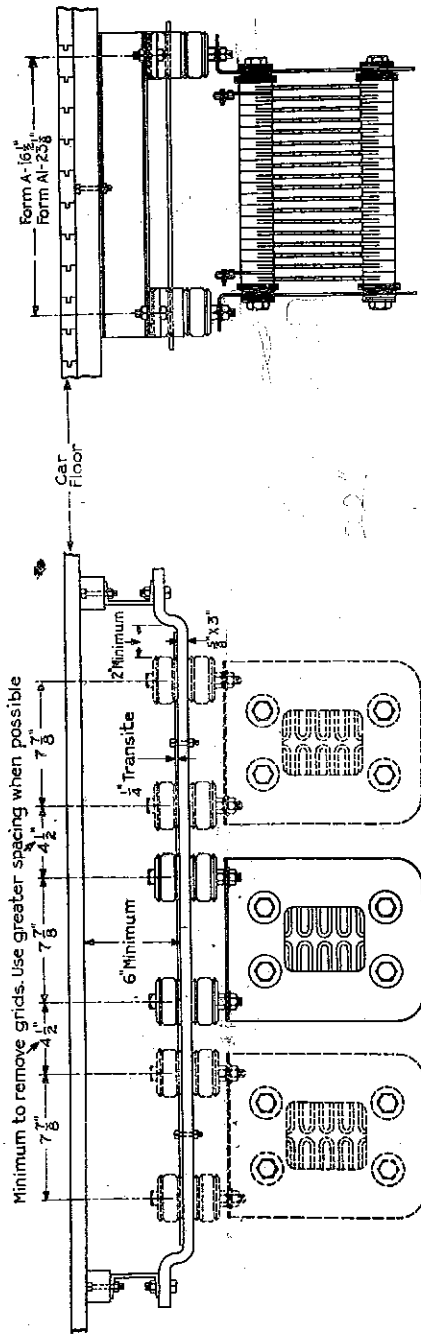
7 Aug 1901



314992 TYPE DC COUPLER PLUG SHOWING METHOD OF CLAMPING THE CABLE.  
ACTUAL SIZE INDEX E 341 4 5 7 17



# METHOD OF SUPPORTING TYPE RG RESISTORS USING PORCELAIN BOLT INSULATORS FOR 600- AND 1500-VOLT WORK



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1 JUNE, 1918

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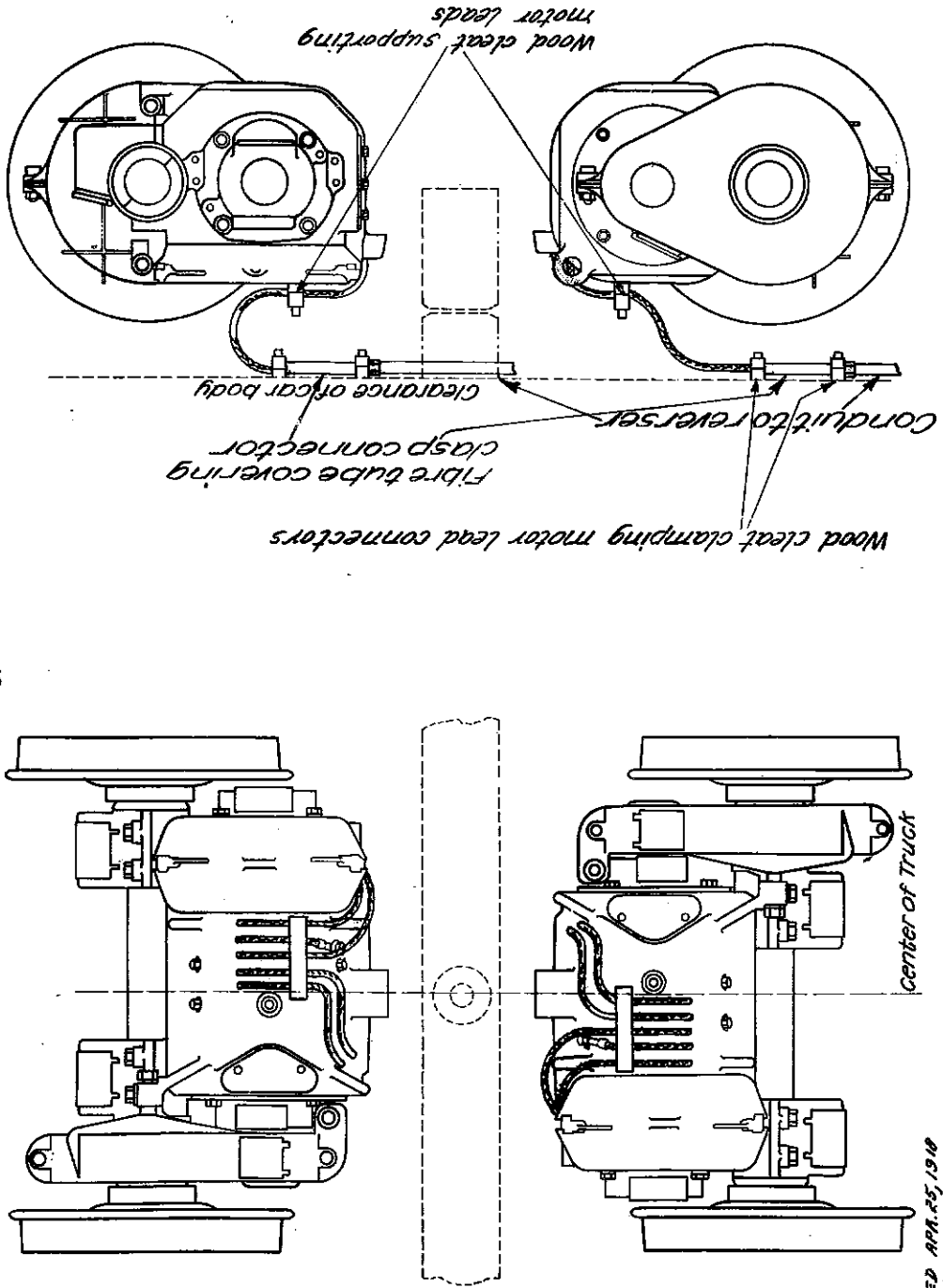
No. 15080  
Supersedes DS 28577  
DS 28578

2m 5-3-18

ENGINEERING DEPT.  
GENERAL ELECTRIC COMPANY



Diagram of Railway Motor Connections to Car Body  
For use with Type M Control



② REVISED APR. 25, 1910

Checked *CBC*  
Approved *[Signature]*

12 Apr. 1911  
1-2-5

Engineering Dept.  
General Electric Company

DS 22426

## SEQUENCE OF PC CONTROLLERS

To reduce the burning of contactor arc chutes to a minimum, it is essential that there be a definite relation between the closing and opening of some of the contactors, though adjustment to maintain this relation is not required for normal wear. This relation of contacts should be noted when a contactor is installed in the controller or the contactor pins and bearings are badly worn. To obtain the relation of contacts, turn the cam shaft with a wrench and see that the sequence, as noted below is obtained.

### SEQUENCE FOR PC-5 AND PC-6 CONTROLLERS.

When the cam shafts of the PC-5 and PC-6 controllers are turned on between points 2 and 3, the tips of the R-4 contactor should touch before the tips of the R1 and R3 open. Between points 5 and 6, the tips of P contactor should touch before the tips of R3, R4, R5 or S open and the tips of R5 contactor should be separated before the tips of R2 contactor touch. The tips of S contactor should be separated before the tips of G contactor touch.

### SEQUENCE FOR PC-9 CONTROLLER.

\* When the cam shaft of the PC-9 controller is turned on between points 5 and 6, the tips of P contactor should touch before the tips of contactors R1, R3 or S separate and the tips of R3 and S contactors should be open before the tips of the G contactor touches.

### SEQUENCE FOR PC-10 CONTROLLER.

When the cam shaft of the PC-10 controller is turned on, between points 5 and 6, the contact tips of the B contactor should touch before contact tips of the S, R12 and R22 contactors open. Between points 6 and 7, the tips of the P contactor should touch before the tips of B contactor open and the tips of the B contactor should be out of contact when the tips of the G contactor touch.

### SEQUENCE FOR PC-12 CONTROLLER.

When the cam shaft of the PC-12 controller is turned on between points 2 and 3, the tips of the R3 contactor should touch before the contact tips of contactors R4 and R5 separate. Between points 4 and 5, also 8 and 9, the tips of the R5 contactor should touch before the tips of R3 separate. Between points 5 and 6, the tips of P contactor should touch before tips of S or R5 separate and the tips of the S contactor should be open before the tips of the G contactor touch.

## SEQUENCE FOR PC-101 CONTROLLER.

When the cam shaft of the PC-101 controller is turned on between points 2 and 3, the tips of the R3 contactor should touch before the tips of either the R4 or R5 contactors separate. Between points 5 and 6, the tips of the P contactor should touch before the tips of R5, S1, and S2 contactors separate and the tips of contactors R5, S1 and S2 should be separated when the tips of contactors R3 and G touch. Between points 8 and 9, the tips of R5 contactor should touch before the tips of R3 contactor separate.

## PC-5, PC-6 and PC-9 CONTROLLERS.

### CONTACTOR UNITS, CONTROL DRUM AND CAM SHAFT.

The removal and replacement of these parts are exactly the same as for the PC-10 and PC-12 controllers. The description will be found on a following page.

### LINE BREAKER.

The ARC CHUTE is removed by taking out two cap screws. These cap screws are accessible from the bottom of the controller and are located in the arc chute pole pieces, on the outside of the arc chute, adjacent to the contact tips.

To remove the line breaker PISTON PACKING, it is necessary first to take off the arc chute, then take out one of the transite barriers. This allows the pins thru the operating and contact levers and the levers to be taken out. The cylinder head may now be taken off and the piston packing removed.

### REVERSER.

The reverse cylinder may be removed by disconnecting and removing the cutout switch and end bearing of the reverser. Then the reverse cylinder may be taken out thru the door that covers the cutout switch.

## PC-10 and PC-12 CONTROLLERS.

### CONTACTOR UNITS.

When a complete contactor is put in the PC-10 or PC-12 controller, its position may be located from its cam roller. Slotted holes in the contactor support provide means of adjustments. As all of the cam rollers are in line, a straight edge held against these in position will locate the one being put in.

The arc chute should be closed before the cap screws fastening the contactor in place are finally tightened, in order that the contactor may shift sideways until it takes its correct position.

## CONTROL DRUM

In order to remove the control drum, take out the cap screws holding the bearing at the line breaker end of the cylinder. Then slip the bearing off the shaft and the drum can be easily disengaged from the clutch and removed.

It is possible to put the control drum in place 180° from its correct position, and to prevent this, the two parts of the clutch, between the drum and the cam shaft, are marked.

## CAM SHAFT AND PINION

To remove the cam shaft, first take out the control drum, then take off the steel strap used as a stop for the covers. The cap bolts holding the cam shaft bearings can now be taken out and the cam shaft removed.

In order that the cam shaft and pinion may be correctly assembled in the rack, the best method is to mark the pinion and rack before taking these parts out. In case this is not done, the rack and pistons should be pushed toward the "on" magnet valve as far as they will go. The cam shaft and pinion are then put in place, so that none of the cams touch the cam rollers on the contactors.

## LINE BREAKER

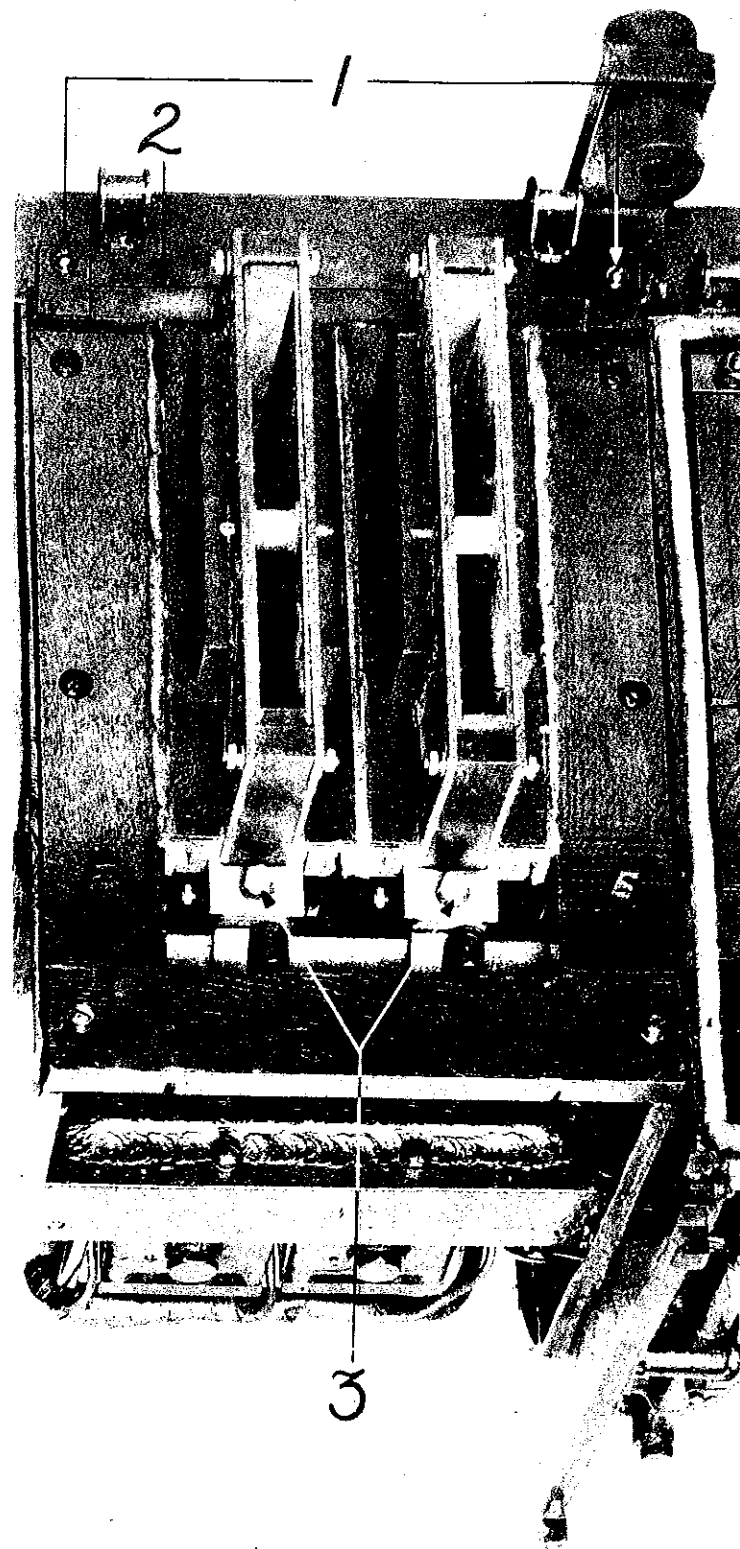
The PNEUMATIC PORTION of the line breaker is removed by disconnecting the control leads on the magnet valves, breaking the air connection at the pipe union and removing the four cap screws holding these parts to the controller frame. The air cylinders and magnet valves may then be removed toward the back of the controller until the yoke is disconnected from the pin thru the contact arm. Page 39 shows this yoke and pin.

The ARC CHUTE is removed by taking out two cap screws. These cap screws are accessible from the bottom of the controller and are located in the arc chute pole pieces, on the outside of the arc chute, adjacent to the contact tips.

## PC 101 CONTROLLER - 1500 VOLTS

The removal and replacement of the contactor units, reverser, control drum, cam shaft and main engine parts are practically the same for the PC-10 and 12 controllers.

The Arc Chute is removed by taking out screw and parts as indicated by numbers 1, 2, and 3, on page 28.



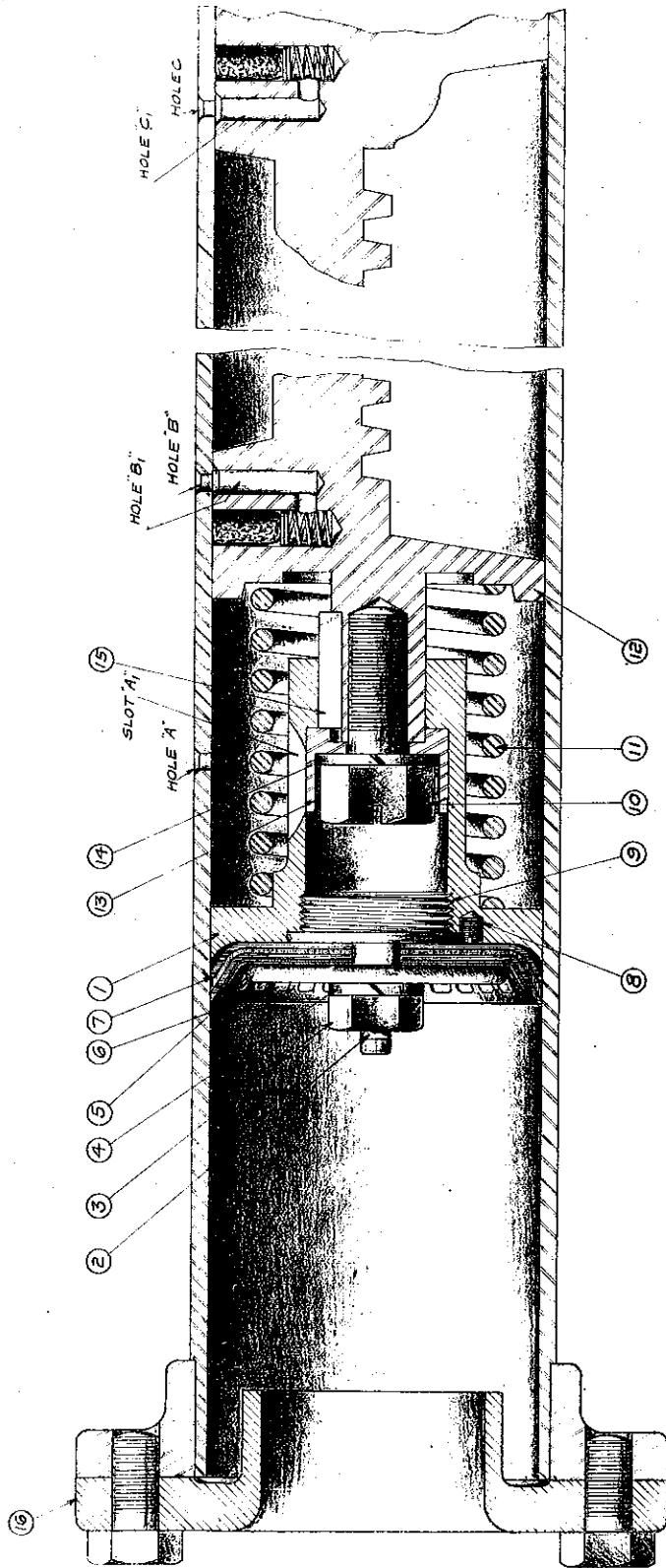
316958

TYPE PC-101 CONTROLLER. PARTS TO BE DETACHED TO REMOVE  
ARC CHUTES OF LINE BREAKER.

INDEX E-353.7

12 7 17

84700-28



Section Thru Main Engine Showing Piston for Types PC-10,  
 PC-12 and PC-101 Controllers.

## MAIN ENGINE

(PC-10, PC-12 and PC-101 Controllers)

### REMOVING PISTON SPRING

In order to take the mechanism apart, refer to Page 29.

First, remove cylinder head on "off" magnet end of main cylinder and revolve cam shaft by means of wrench - Cat.#176776 until piston head (#1) is near enough to the outer end of the cylinder to be accessible.

Second, remove cotter pin (#2), nut (#3), washers (#4), and follower (#5), expansion spring (#6) and leather packing cups (#7).

Third, remove lock screw (#8)

Fourth, remove stud cap (#9) by means of a pin wrench, Cat.#176775

Fifth, fasten ring (#16) - Cat.#176773 to cylinder flange, in place of cylinder head and revolve cam shaft until piston head (#1) is forced against it with considerable pressure.

Sixth, remove cap screw (#10) by means of a screw-driver, Cat. #189905, and, then turn cam shaft in the opposite direction until the pressure on ring (#16) is relieved.

Seventh, remove ring (#16). Piston head (#1) can now be slipped out, giving access to spring (#11).

### REPLACING PISTON SPRING

With the rack (#12) in place, turn the cam shaft until the end of the rack is accessible thru the opening in the end of the cylinder.

Insert spring (#11) and piston head (#1), taking care that the spring (#11) is properly placed over the shoulder on rack (#12) and that the key (#15) in rack lines up with the keyway in piston head (#1).

Fasten ring (#16) to the cylinder flange and turn the cam shaft until spring (#11) is compressed. While doing this, it will be necessary to see that rack (#12) is guided into the hole in piston head (#1).

Put piston guide (#13) and lock washer (#14) in place and screw cap-screw (#10) down firmly on the washer by means of screw-driver - Cat.#189905.

Remove wrench from cam shaft, thus allowing spring (#11) to drive rack (#12) out until piston guide (#13) bears against the shoulder in the bore of piston head (#1). See that the parts which slide are perfectly free and that the spring forces rack (#12) back without hesitation.

Remove ring (#16).

Oil the bore of the piston head (#1), in order that piston guide (#13) will slide easily.

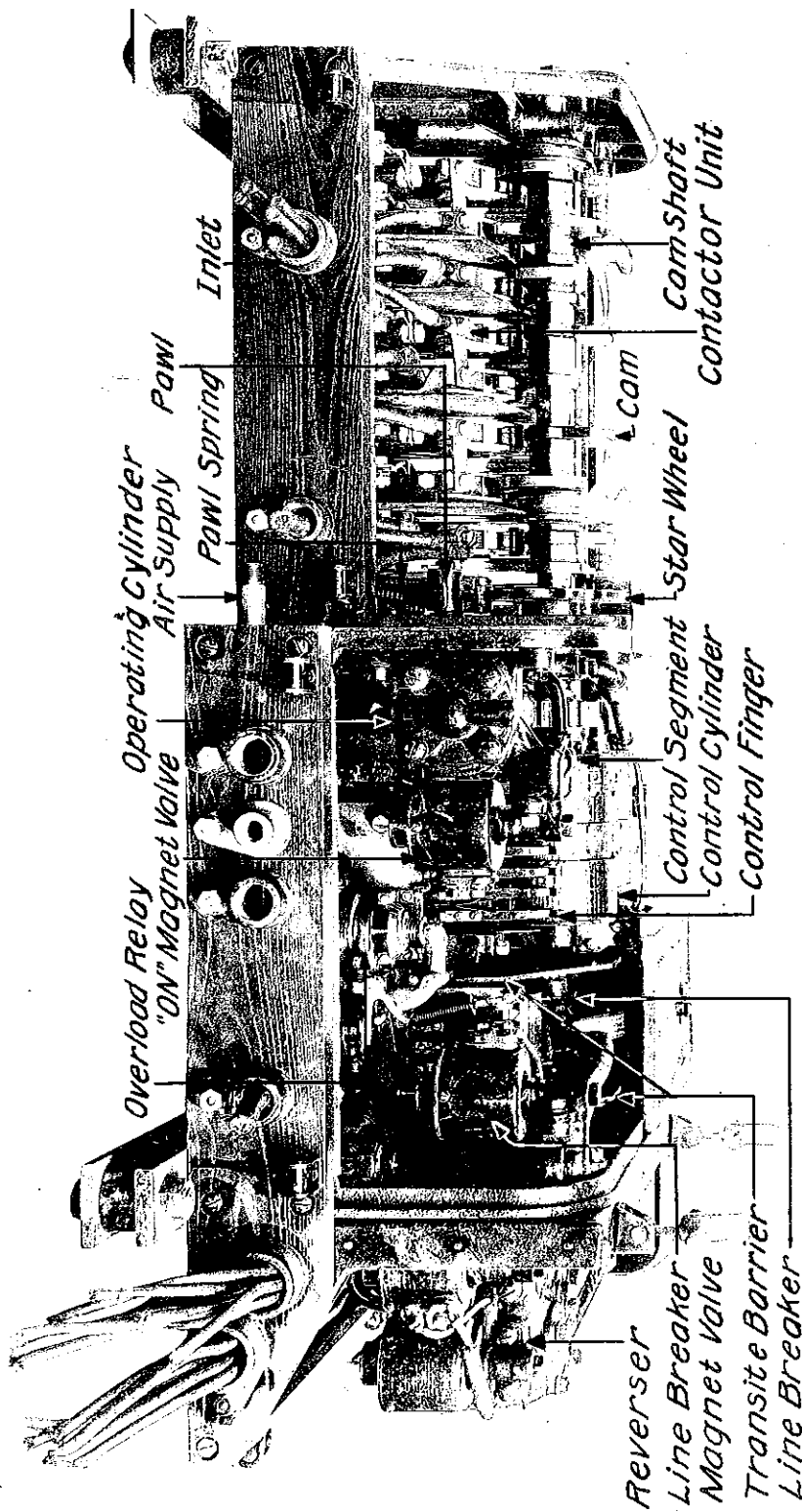
Put stud cap (#9) in place, by means of pin wrench Cat.#176775, and lock it in by means of lock screw (#8).

Replace leather cups (#7), expansion ring (#6), follower (#5) and washer (#4), nut (#3) and cotter pin (#2).

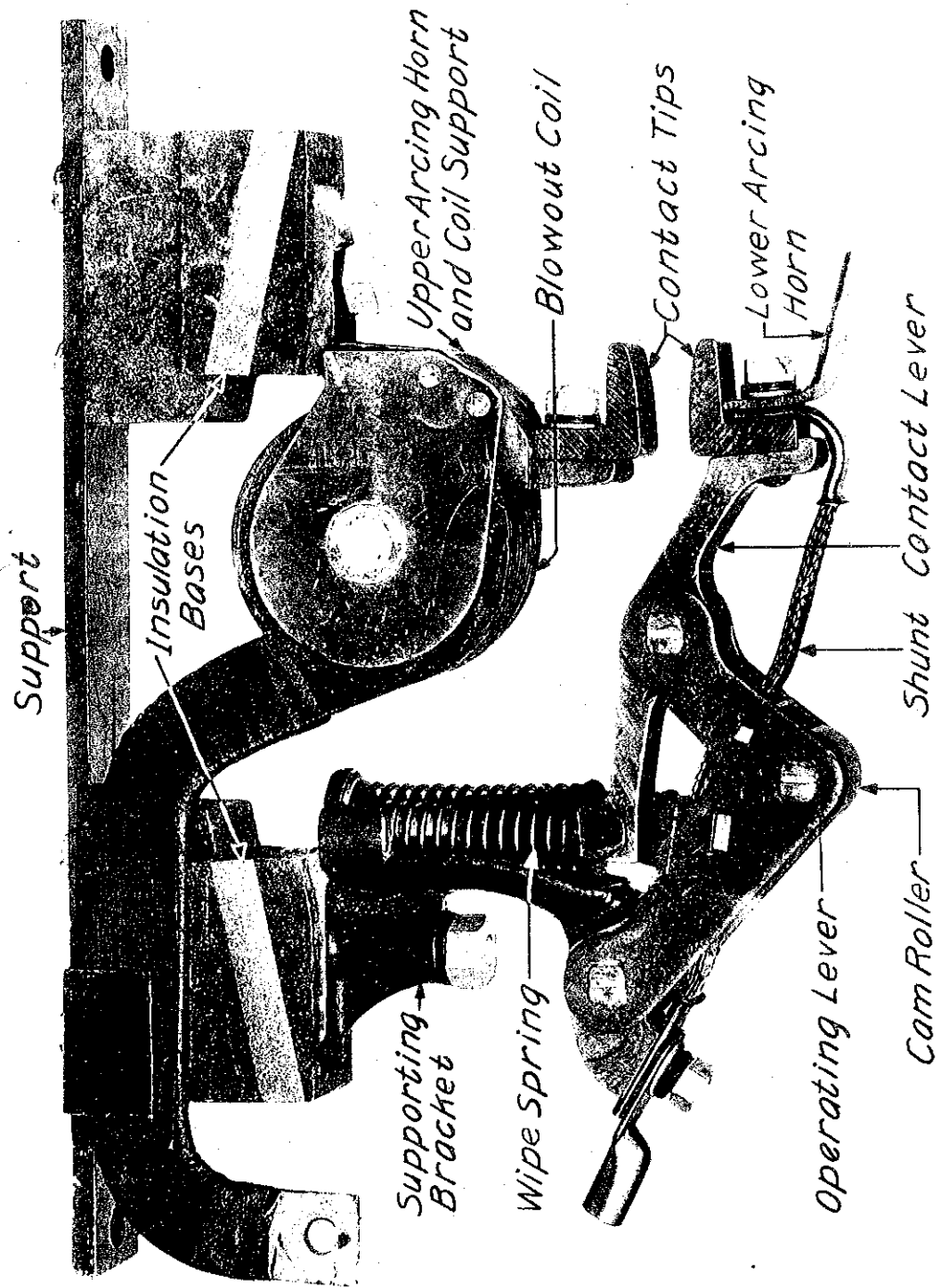
Replace cylinder head.

When the assembly is completed, turn the cam shaft to the "off" position, fill the air tanks, admit air to the "on" cylinder by pressing down the operating pin of the "on" magnet valve. The cam shaft should turn from the "off" to the first position, which may be noted by the contactors closed. When the air is released from the "on" cylinder, the cam shaft should turn to the "off" position. If this does not occur, or the operation is sluggish, there is some fault in the assembly of the piston spring.

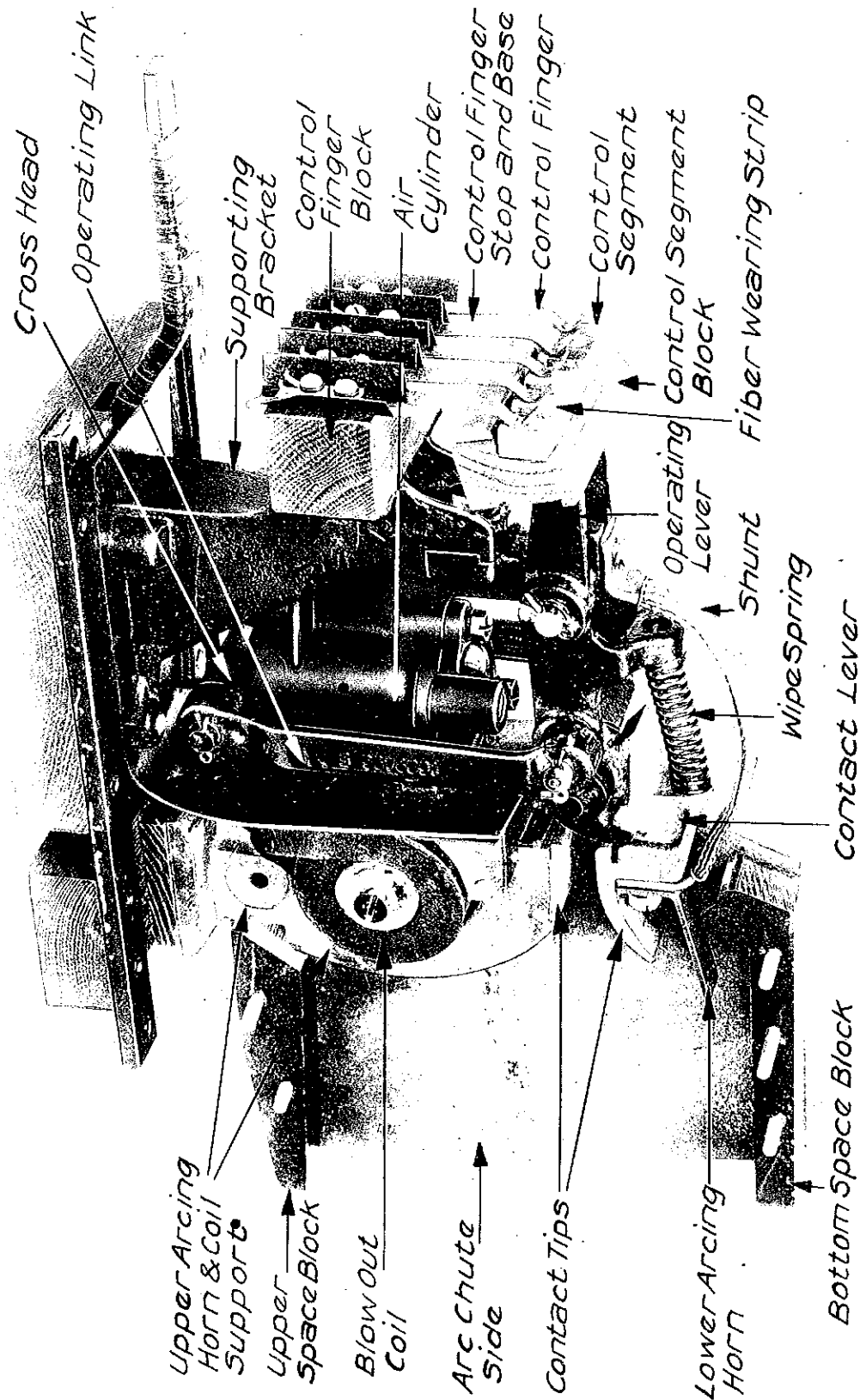




314746 PC-5 Controller

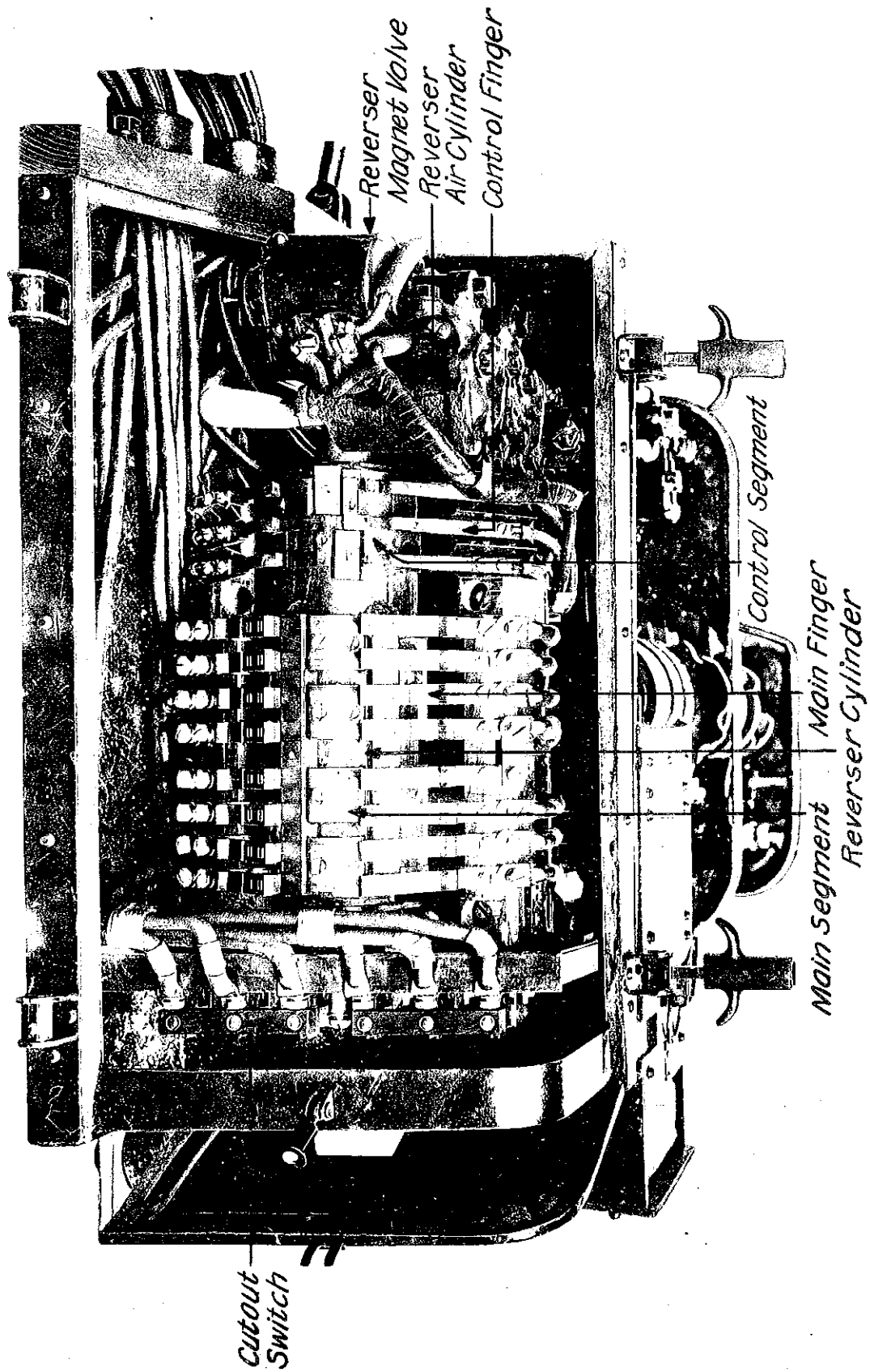


315355 Contactor Unit for Types PC5, PC6 and PC9 Controllers

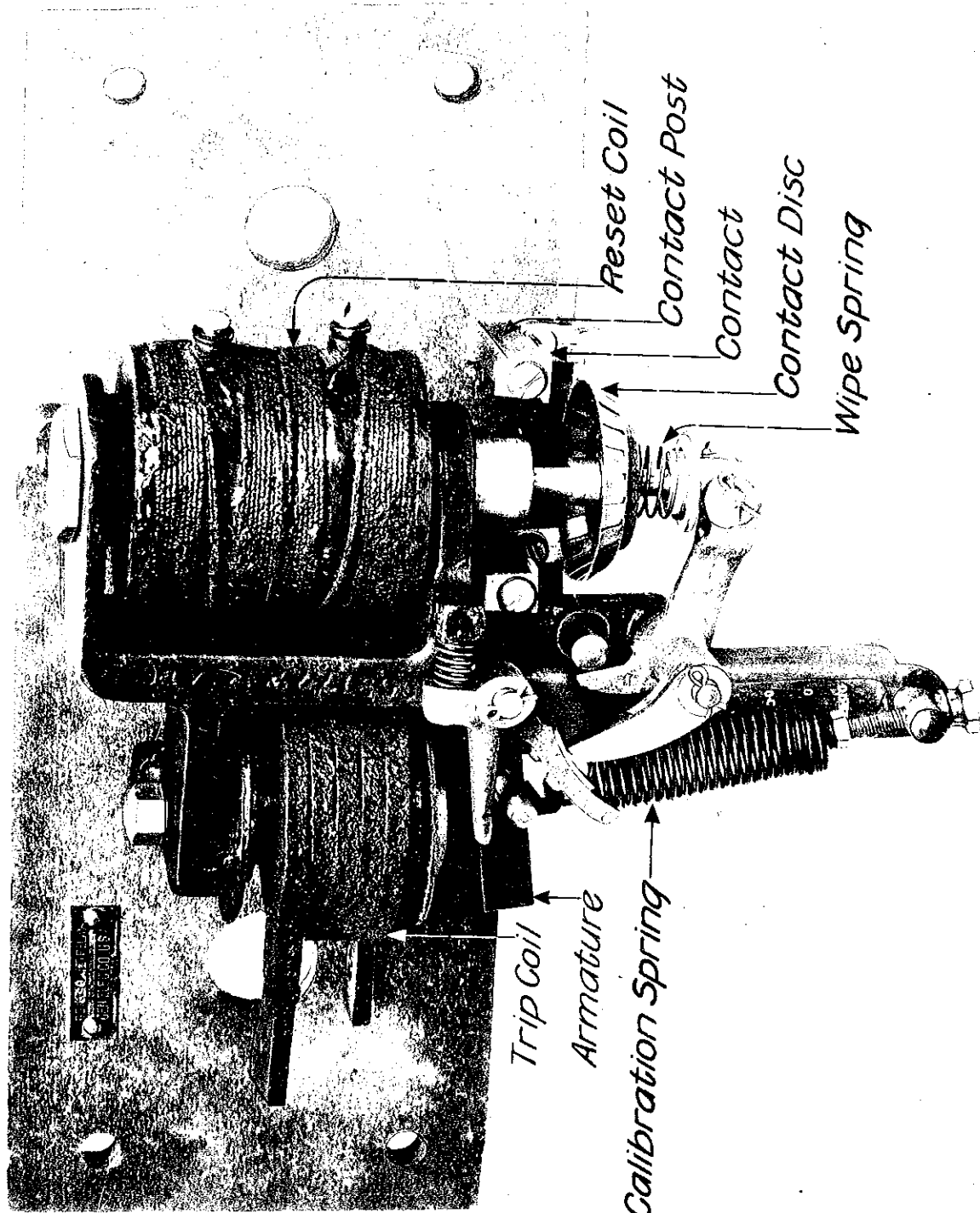


314174 LINE BREAKER UNIT FOR TYPES PC-5, PC-6 AND PC-9 CONTROLLERS.

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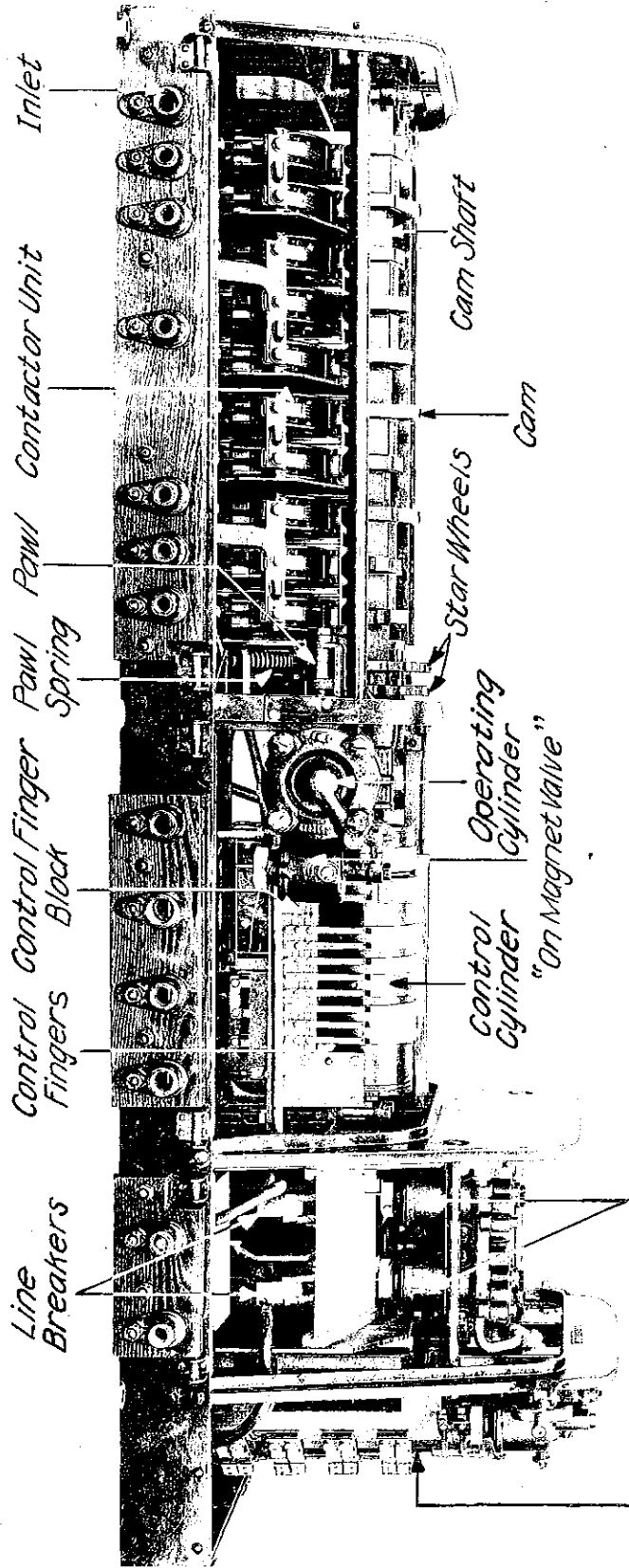
314745 PC-5 Controller (Reverser End.)



314632 OVERLOAD RELAY FOR TYPES PC-5, PC-6 AND PC-9 CONTROLLERS.

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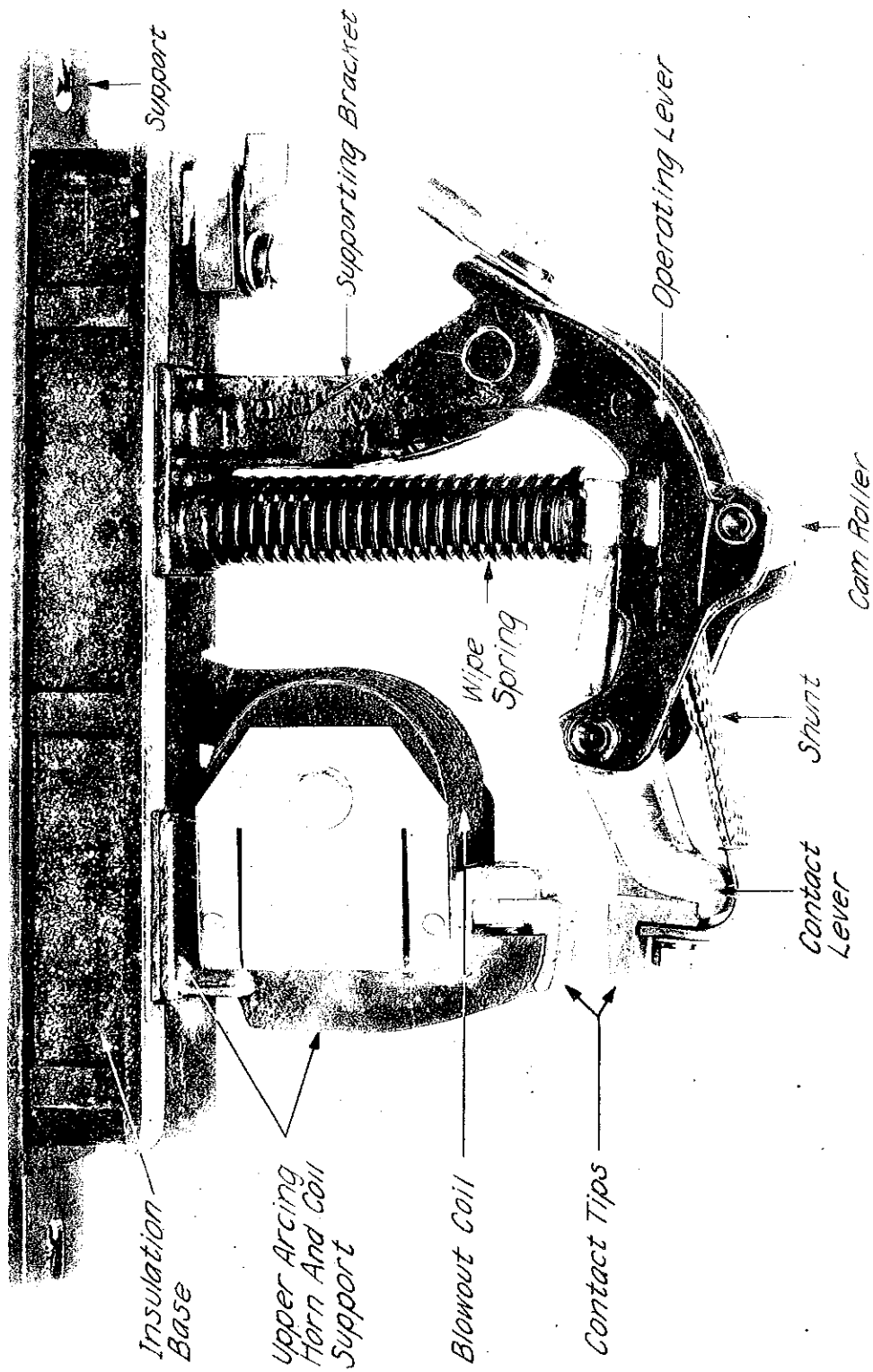


Reverser

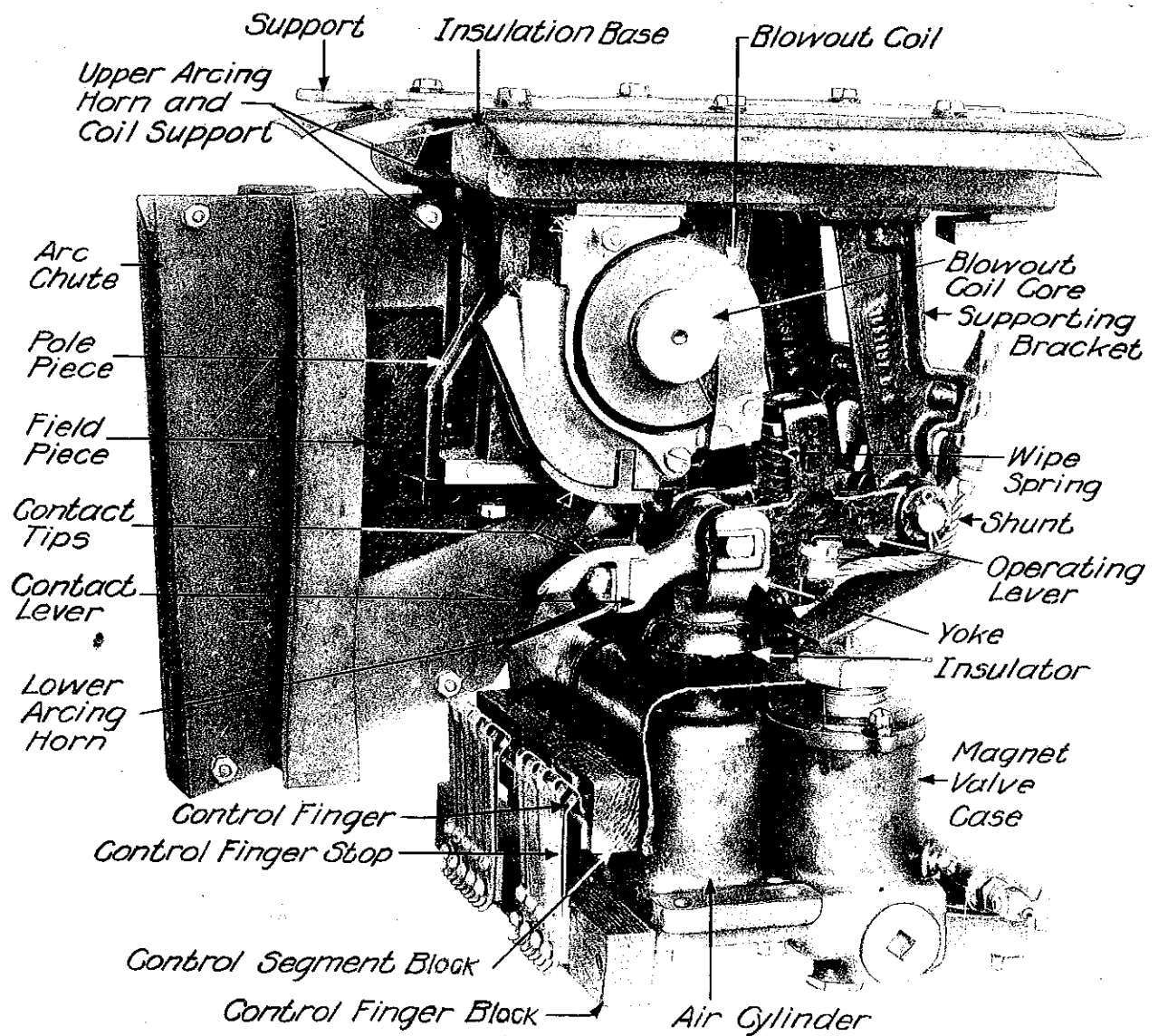
Line Breaker  
Magnet Valves

313600

PC-10-A Controller



313601 CONTACTOR UNIT FOR TYPES PC-10 AND PC-12 CONTROLLERS.  
INDEX E 3537

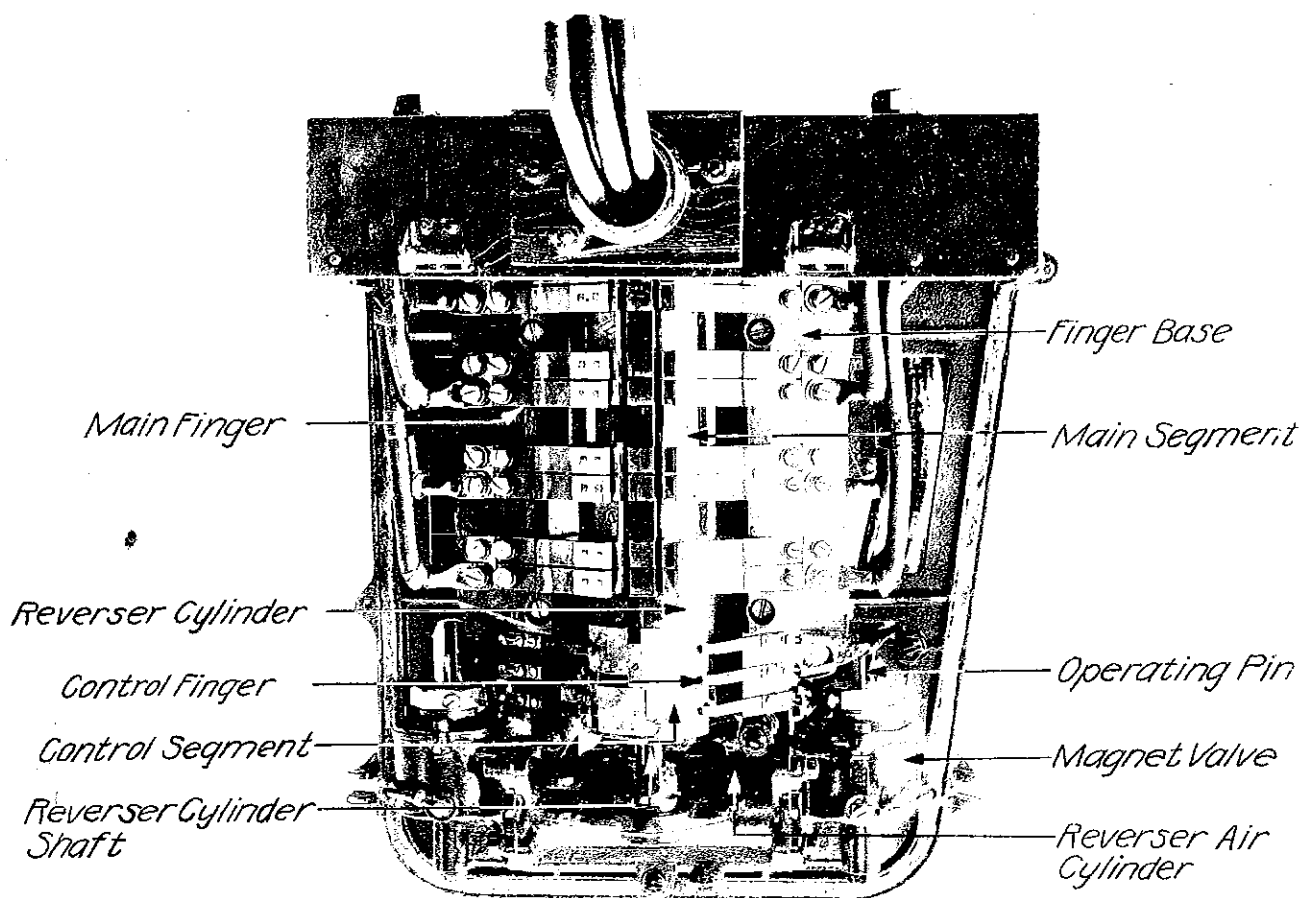


312493 LINE BREAKER UNITS FOR TYPES PC-10 AND PC-12 CONTROLLERS.

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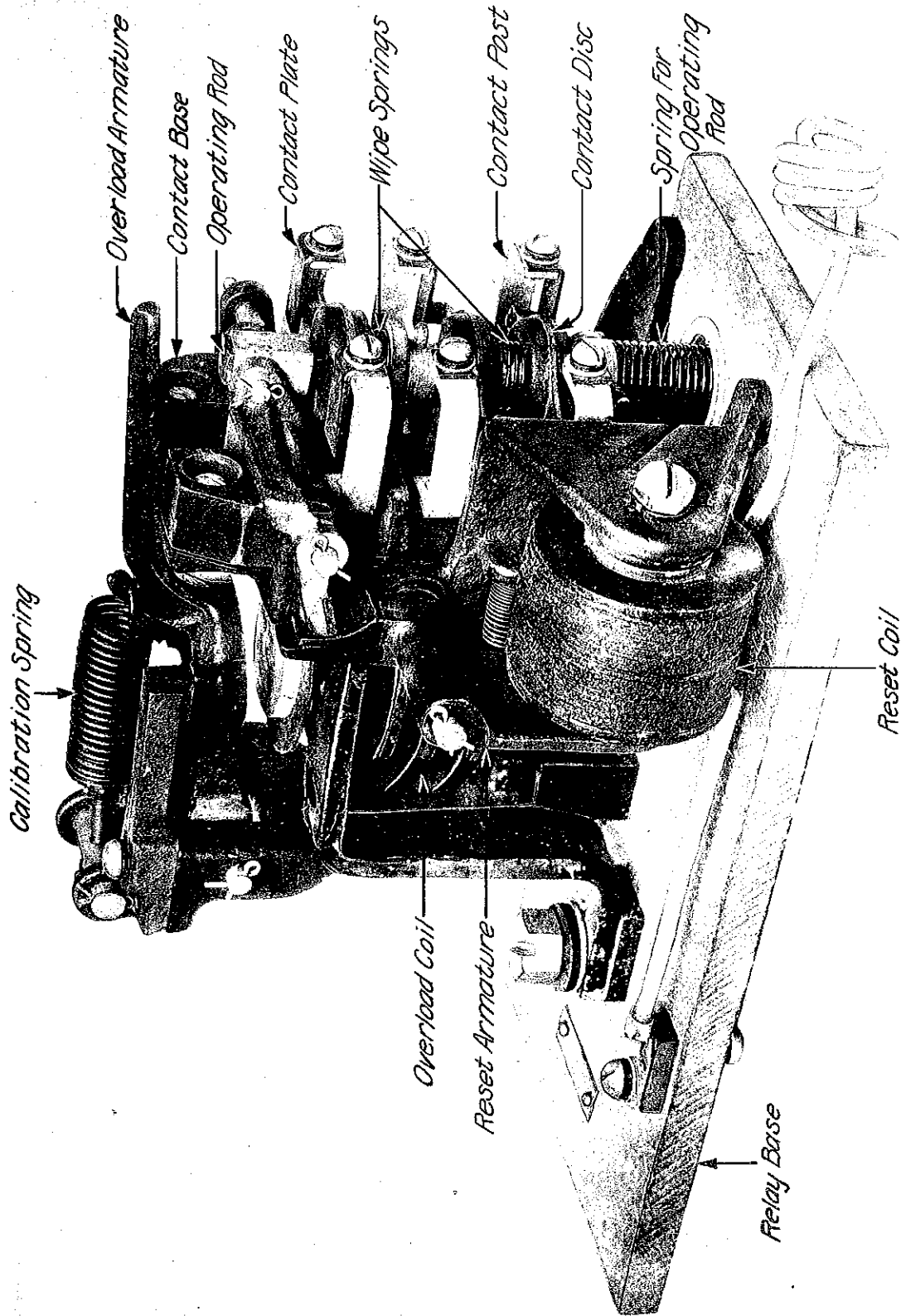
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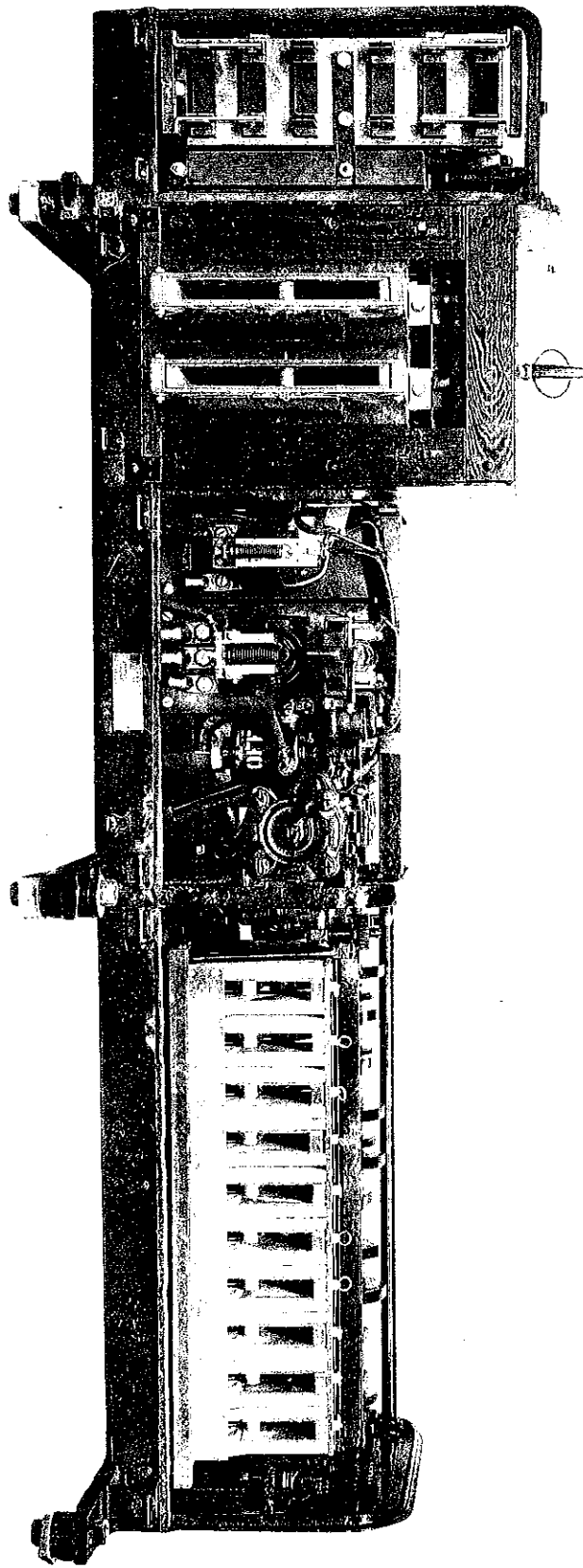
313684

Reverser For PC-10 Controller



313846 OVERLOAD RELAY FOR TYPES PC-10 AND PC-12 CONTROLLERS.  
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*Type PC-101, Form A, 1500 Volt Motor Controller.*