W E S T I N G H O U S E

TYPE RR-5 REGISTER REGULATOR

INSTALLATION, OPERATION AND MAINTENANCE

INSTRUCTION BOOK 5751-A
(12-37)

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY

EAST PITTSBURGH WORKS · EAST PITTSBURGH, PA.

INDEX

ILLUSTRATIONS

WESTINGHOUSE

TYPE RR-5 REGISTER REGULATOR

I - DESCRIPTION

(1) The RR-5 Register regulator, Fig. 1, is a photo-electrcc relay, which, as shown in Fig. 2 may be connected to give various operating characteristics as needed by differnnt control applications. The register regulator is equipped with a relay operated from a grid glow tube. As shown in Fig. 2 this relay may be made to operate if the illumination on the phototube is either increased or decreased. By connecting the equipment for either "impulse" or "static" control the register regulator will respond to either a transient change in illumination or to a permanent variation in illumination. The equipment may be connected so that the grid glow tube and relay are energized by a d-c. voltage or an a-c. voltage. When d-c. voltage is used the relay will remain in the operated position regardless of subsequent changes in phototube illumination.

As shown in Fig. 2 an external solenoid may be used instead of the relay.

II - OPERATION

(2) In Fig. 3 is shown the schematic diagram of connections. The phototube, shown in dotted lines, is connected so that when the illumination on the phototube is increased the grid - cathode voltage of the RJ-571 amplifier tube becomes more negative and the current through the tube decreases. This causes lead 30 to become more negative relative to lead 37. The voltage between 30 and 37 is applied to the grid circuit of the grid glow tube, provided terminals 5-6 are short-circuited. If switch 1 is in the "dark" position the grid glow tube will break down and carry current if the illumination on the phototube is decreased. With switch 1 in the "Light" position the grid glow tube will break down if the illumination on the phototube is increased. With terminals 5-6 open-circuited the grid glow tube cannot break down regardless of the amount of illumination on the phototube.

(3) The position of the plug connected to A determines whether "impulse" or "static" control is used. When "impulse" control is used the equipment responds only to a sudden transient coange in illumination, and does not respond to a gradual change in light intensity, caused for example by lamp voltage variations. When "static" control is used the operation is controlled by a definite value of illumination on the phototube.

II - OPERATION - Continued

(4) Depending upon the position of switch 2 either a-c, or d-c. voltage is applied to the grid glow tube. When a-c. is used the tube will carry current only so long as the grid voltage of the grid glow tube is more positive than required for breakdown of the tube. When d-c. is used the grid glow tube will continue to carry current regardless of the grid voltage until the switch between 3 and 4 in the anode circuit is opened, thus de-energizing the tube and relay.

III - GENERAL APPLICATION

(5) Mounting:

The RR-5 register regulator should be mounted in a vertical position, preferably in a location with no excessive mechanical vibrations. The phototube housing, the light source or the scanner may be mounted in any position, although the lamp base should not be higher than the lamp filament in order to prevent excessive heating of the lamp base.

(6) Temperature Limits:

The RR-5 register regulator will operate satisfactorily with ambient air temperatures between 50 degrees F. and 110 degrees F. when a KU-627 grid glow tube is used. When a KU-636 grid glow tube is used the ambient air temperature limits are 0 degrees F. to 150 degrees F. The phototube may be operated at ambient in temperatures between 0 degrees F. and 150 degrees F.

(7) A-C. Supply Voltage

The maximum variations in a-c. supply voltage should not exceed ± 10 per cent from rated voltage as given on the name plate. To obtain the best operating results the a-c. supply voltage should be kept as close to normal as possible. If the a-c. supply voltage is varying due to line drop it is recommended to run a separate line from the supply source to the register regulator in order to improve the voltage regulation.

(8) A-C. Supply Volt-Amperes:

The volt-ampere burden of the RR-5 register regulator is approximately 75 Va. when no solenoid is applied. When a solenoid is used the solenoid load must be added to give the total volt-ampere burden.

III - GENERAL APPLICATION - Continued

(9) Relay Contact Capacity:

The current interrupting capacity is as follows:

	Interrupting Capacity in Amperes				
Contacts	110 V. A-C.	220 V. A-C.	440 V. A-C.	125 V. D-C.	250 V. D-C.
One "Make"	20	12	7	2	0.7
One "Break"	10	6	3.5	1	0.4
* Two "Make" in series	30	20	10	3	1.0

* Reverse left hand stationary contact.

The continuous current carrying capacity of the relay contact is:

"Make" contacts : 12 amperes
"Break" contacts: 6 amperes

(10) Operations per Minute of Relay:

Maximum : 300
Recommended: 150

(11) Load Circuit Characteristic:

(A) A-C. Operation:

The voltage across terminals 1-3 with switch 2 connected for a-c. operation is half wave rectifier voltage having a crest value of 330 volts. The solenoid or external load must have sufficient reactance to limit the average current between 3 and 4 of Fig. 3 to 0.4 ampere if a KU-627 tube is used or 0.1 ampere if a KU-636 tube is used. These average currents should be read by a d-c. ampere meter. From Fig. 3 it may be seen that a Rectox rectifier is connected between 1 and 3. This Rectox will tend to smooth out the a-c. ripple caused by the rectified a-c. voltage in the load circuit if the reactance of the load is sufficiently high and the load current is low. As the load current is increased above 0.1 ampere the filtering effect of Rectox 1-3 rapidly decreases.

(B) D-C. Operation:

The load characteristic for d-c. operation is shown in Fig. I of Fig. 2. From these curves may be seen that the average d-c. voltage decreases with increasing load current. The load current as measured by a d-c. ampere meter must not exceed 0.3 ampere if a KU-627 tube is used or 0.1 ampere if a KU-636 tube is used.

III - GENERAL APPLICATION - Continued

(12) Grid Glow Tube:

It is recommended that a KU-627 grid glow tube be used except where the ambient air temperature exceeds the limits 50 degrees F. to 110 degrees F. In that case, use the KU-636 tube.

(13) Sensitivity:

(A) Static Operation:

The sensitivity of the type RR-5 register regulator when used with static control is 0.007 Lumen. This means that the equipment will operate satisfactorily if the quantity of light on the phototube is changed between zero and 0.007 Lumen. The definition of Lumen is:

$$L = FC \times A$$

where FC = illumination in foot candles
A = area in square feet of illuminated surface.

The area of the light sensitive cathode of the phototube is approximately 1 square inch and the amount of foot candles to operate the equipment or the sensitivity expressed in foot candles is therefore

$$\frac{FC}{\quad} = \frac{0.007}{\frac{1}{144}} \equiv \frac{1}{\quad} \text{ foot candle}$$

If an aperture A_1 square inches is used in front of the phototube the amount of foot candles will be

$$FC_1 = \frac{1}{A_1}$$

It should be noted that A_1 must be less than the area of the phototube cathode. The sensitivity values as given above are based on the assumption that the illumination on the phototube is changed between zero and 1 foot candle. If the illumination is changed from for example 10 to 11 foot candles at normal a-c. supply voltage, the illumination limits will decrease if the a-c. supply voltage is decreased. For this reason it becomes necessary to consider the minimum and maximum illumination at minimum and maximum a-c. supply voltage, and to make sure that the minimum illumination at maximum a-c. supply voltage is at least 1 foot candle lower than the maximum illumination at minimum a-c. supply voltage.

III - GENERAL APPLICATION - Continued

(B) Impulse Operation:

When impulse operation is used the RR-5 register regulator will operate on a variation in light of 0.015 Lumen corresponding to 2-foot-candle illumination on the phototube. The time during which this change in illumination occurs must not exceed 0.1 second.

(14) Speed of Response:

When the grid glow tube is connected for a-c. operation the illumination on the phototube must remain changed during two cycles of a-c. supply voltage in order to operate the relay. When d-c. operation is used the relay or solenoid will operate, if the illumination on the phototube remains changed during a time interval of 0.0002 seconds, provided the length of phototube leads does not exceed 6 feet. If longer leads are used the response will be slower due to the time lag caused by the capacity between the leads.

(15) Phototube Housing:

The SK-60 phototube should be mounted in a phototube housing, for example as shown in Fig. 1 (Price List 18-315). This phototube housing is of the general purpose type and does not have any aperture in front of the phototube. The phototube housing shown in Fig. 3 (Price List 18-315) is equipped with a 1/2" x 1/16" aperture and is particularly suited for register control applications as outlined in paragraph 18. The phototube should be connected to the RR-5 control panel by means of cable PDS-7129. For high speed response (0.01 second or faster) the length of the phototube leads must not exceed 6 feet. For other applications the phototube leads should not be longer than 25 feet. The phototube leads should be enclosed in a grounded metallic conduit, and there must be no other leads in this conduit.

(16) Light Sources:

A variety of light sources with different foot-candle characteristics are shown in Price List 18-316. By using the data given in paragraph 13 the maximum operating distances for static control with various light sources are found to be as follows:

	MAXIMUM OPERATING DISTANCES								
Light Source	Style 829396 829397 Type D	Style 849186 849187 Type E	Style 831706 Type F	Style 831704 Type G	Style 854118 Type H	Style 822109 Type K	40 Watt Lamp	60 Watt Lamp	100 Watt Lamp
Distance from light source to phototube.	25'	80'	25'	25'	40'	25'	6.3'	7.8'	10'

(16) Light Sources - Continued

The type J light source gives an illumination of approximately 15,000 foot candles at a distance 3/8 inch from the lower end of the snout of the housing. The diameter of the beam of light is approximately 3/8 inch.

(17) Scanners for Reflected Light:

Two scanners for reflected light are shown in Fig. 7 and Fig. 8 of Price List 18-315. The scanner in Fig. 8 which should preferably be used has a broad light beam approximately 3/16 in. x 5/16 in. The scanner in Fig. 7 has a concentrated beam approximately 3/32 in. x 1/4 in.

IV - REGISTER REGULATOR APPLICATIONS

(18) General:

When the RR-5 register regulator is used to control the register of paper or some other material, a spot should be printed on the material and should be used as the register mark. When the material is transparent, as for example cellophane or glassine paper, a dark spot should be printed on it and the type J light source and type D phototube housing should be arranged on opposite sides of the material so that the spot intercepts the beam of light projected on the phototube. When the material is non-transparent a spot with a color contrasting the color of the paper should be printed on the material and a type E or type F scanner for reflected light should be used.

(19) Color of Printed Spot:

The spot should preferably have a color which differs photoelectrically as much as possible from the color of the paper. If the color of the paper is white or light yellow the spot color should be black or dark blue. Red colors or colors with red components give approximately the same phototube response as white, light yellow or light blue. Red color should therefore not be used as a "dark" register mark. If the color of the paper is black, dark blue or brown, a yellow, white or red spot may be used. The color combinations which may be used in register control applications depend upon the maximum speed of the paper, the length of the phototube leads, and maximum variation in line voltage. Even though two colors may look similar to the human eye, they may give different response when viewed with a phototube. For this reason it is not practicable to give definite operating limits for various color combinations. It is therefore recommended that, before using color combinations which are not sufficiently contrasting, the color response be measured by scanning the two colors with the phototube and observing

(19) Color of Printed Spot - Continued

the deflection on the milliampere meter of the RR-5 register regulator when the equipment is connected for "static" control. If the difference in milliampere meter deflection for the two colors exceeds 0.3 milliampere, the colors may be used for register control applications.

(20) Size of Printed Spot:

The size of the printed spot should be 1/16" wide or more in the direction of travel of the paper. The length of the spot should be 1/2 inch plus the maximum sideways movement of the paper during normal operation.

(21) Impulse or Static Control:

Either "impulse" or "static" control may be used for register control applications. Because the calibration of the equipment is not affected by a-c. line voltage variations or by variations in paper color if impulse control is used, the "impulse" method of control is recommended.

(22) Maximum Paper Speed:

The maximum permissable paper speed depends upon (1) the difference between paper color and spot color, (2) the length of the phototube leads, and, (3) if "static" control is used the variations in a-c. supply voltage. If a black spot on white paper is used a maximum paper speed of 1500 feet per minute may be used, provided the length of the phototube leads does not exceed 6 feet. If the lead length is increased the maximum paper speed will decrease. If the "static" indication by the milliampere meter (between paper color and spot color) is 0.5 milliamperes, and the length of the phototube leads does not exceed 6 feet, a maximum paper speed of 600 feet per minute may by used.

(23) Selector or Limit Switches:

As shown in Fig. 2, selector or limit switches are used for the purpose of closing the grid glow tube, grid control circuit 5-6 or to interrupt the anode circuit 3-4. These switches may be in the form of cam-operated contacts designed to suit any particular application or may be commutator type switches as indicated in Fig. 2. In either case it is important that the switch be designed so that the insulating resistance between switch segments, or between segments and ground is at least 10-million ohms. A commutator type switch, designed for this application, is shown in Fig. 4

V - INSTALLATION

(24) Before installing the RR-5 register regulator read paragraphs 5 to 23 of this instruction book, then install equipment as shown in Fig. 2.

VI - ADJUSTMENTS

(25) (a) Insert RJ-571 amplifier tube and grid glow tube in their sockets and connect clips to top of tubes.

(b) Turn on a-c. power and allow unit to warm up for five minutes.

(c) "Static" Control:

If upper right hand switch is in "DARK" position, and the illumination on the phototube is maximum, turn potentiometer to zero position. Turn potentiometer slowly clockwise until tube breaks down. Observe reading of milliampere meter at tube breakdown. Turn potentiometer counter-clockwise until milliampere meter reading is decreased 0.2 milliampere.

The grid glow tube should now be de-energized. Decrease the illumination on the phototube. This should energize the grid glow tube.

If upper right hand switch is in "LIGHT" position and the illumination on the phototube is minimum, turn potentiometer all in clockwise. Turn potentiometer slowly counter-clockwise until tube breaks down. Observe reading of milliampere meter at tube breakdown. Turn potentiometer clockwise until the milliampere meter reading is increased 0.2 milliampere.

The grid glow tube should now be de-energized. Increase the illumination on the phototube. This should energize the grid glow tube.

(d) The potentiometer adjustments outlined in preceding paragraphs are suitable if maximum sensitivity is needed. If the variation in light intensity is considerable it may be preferable to adjust the potentiometer as follows:

With minimum illumination on the phototube adjust the potentioneter until the grid glow tube breaks down, and observe the potentiometer position. Repeat the test with maximum illumination on the phototube. Make final potentiometer position adjustment midway between the two observed potentiometer positions.

(e) "Impulse" Control:

When "impulse" control is used the adjustment should be made as follows:

(e) "Impulse" Control - Continued

If upper right hand switch is in "Dark" position turn potentiometer clockwise from zero until grid glow tube breaks down and observe the milliampere meter reading at breakdown. Turn the potentiometer counter-clockwise while the milliampere meter current is reduced 0.2 milliampere.

If upper right hand switch is in "LIGHT" position turn potentiometer from 100 until grid glow tube breaks down. Observe reading of milliampere meter at breakdown. Turn potentiometer clockwise until milliampere meter reading is increased 0.2 milliampere.

(f) IMPORTANT

KEEP MILLIAMPERE METER SHUNT SWITCH CLOSED EXCEPT WHEN TESTING EQUIPMENT.

VII - TESTING

(26) RJ-571 Tube:

(a) Observe that the tube filament is glowing when the tube is energized. If the filament is not glowing replace the tube.

(b) With phototube dark, or preferably removed from its socket, adjust the potentiometer to give 0.4 milliampere RJ-571 current. The potentiometer should now be approximately at the 55 position. By moving the potentiometer 3 divisions, the milliampere meter reading should change from 0.4 to at least 0.3. If this does not obtain replace the RJ-571 tube.

(27) Grid Glow Tube:

The grid glow tube should be replaced with a new tube if with switch 1 in the "DARK" position and terminals 5-6 closed it is necessary to change the RJ-571 current more then 0.1 milliampere in order to cause the grid glow tube to break down, and prevent it from breaking down.

(28) If any faulty or erratic operation is observed, first make sure that terminal 7 is properly grounded. Disconnect external leads to terminals 1 to 6 and a-c. and measure the resistance between each external lead and ground. This resistance must be 5-million ohms or higher.

VIII- RENEWAL PARTS

Name	Style
RJ-571 Amplifier Tube	RJ-571
KU-627 or KU-636 Grid Glow Tube	KU-627 or KU-636
SK-60 Phototube	SK-60
Milliampere Meter	818504
Potentiometer 20,000 ohms	1038329
Toggle Switch 2 P. D.T.	966576
Toggle Switch S.P. S.T.	1014539
Socket 4-prong	793202
Socket 5-prong	831726
Capacitor	948995
Rectox, small	971301
Rectox, large	966512
Transformer, 115/230 V., 60 cycle	966552
Transformer, 220/440 V., 60 cycle	966553
Resistor, 13000 ohms	943670
Reactor	850583
Resistor, 5 megohms	829465
Resistor, 1 megohm	860871
Resistor, 0.25 megohm	861041
Resistor, 0.1 megohm	860000
Resistor, 10,000 ohms	799952
Resistor, 500 ohms	943634
Capacitor 0.01 MF	1014540
Grid clip for KU tube	829334
Grid clip for RJ-571 tube	799907
Relay with coil for 60 cycle	1009784

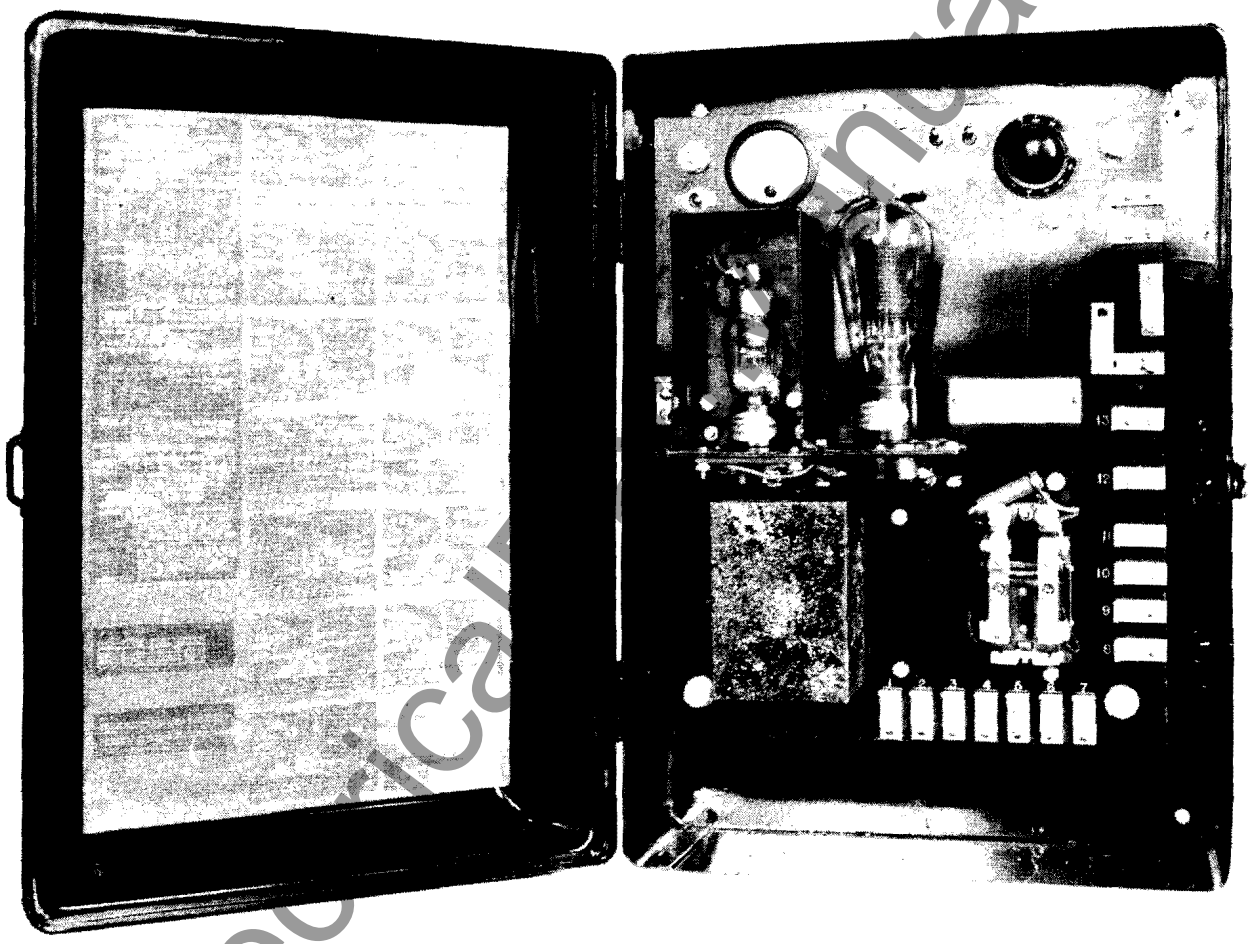


Fig. 1 - Type RR-5 Register Regulator
Photo 232257

INSTRUCTIONS FOR INSTALLATION
(For More Complete Information - See I.B. 5761)

MOUNTING: RR-5, Register Regulator vertical
Phototube Housing, any position.
Light Source, any position except that lamp base must not be higher than lamp filament.

TEMPERATURE: RR-5: (With KU-627 tube, maximum 110°F. Minimum 50°F.
(With KU-636 tube, maximum 150°F. Minimum 0°F.

Phototube: Maximum 160°F. Minimum 0°F.

A.C. VOLTAGE VARIATIONS: ± 10% of rated voltage, maximum, (See I.B. 5761)

CONNECTIONS: Use either of connections A to M.
Connect Links as shown in Fig. N.
Connect Lamp as shown in fig. O.
Operate "DARK" - "LIGHT" switch per fig. P.

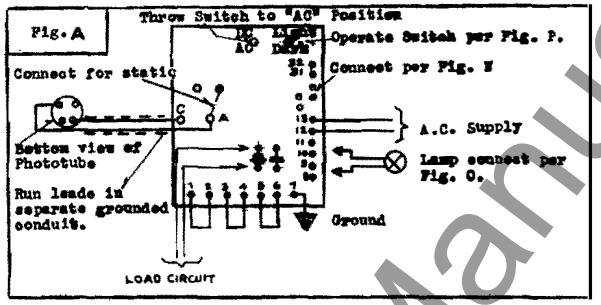
External Connection	Relay	Solenoid	A-C	D-C	Impulse	Static	Grid Selector	Anode Selector
A	X		X			X		
B	X			X	X	X		F.B.
C	X		X			X	X	
D	X			X	X	X		X
E	X			X	X	X	X	F.B.
								X

Style	Rated Volts	Rated Amperes	Connect to Terminals
842108	6-8	3.3	9-11
849088	6	5	9-10
856455	10	7.5	8-11
10-4463	8.5	4	8-10

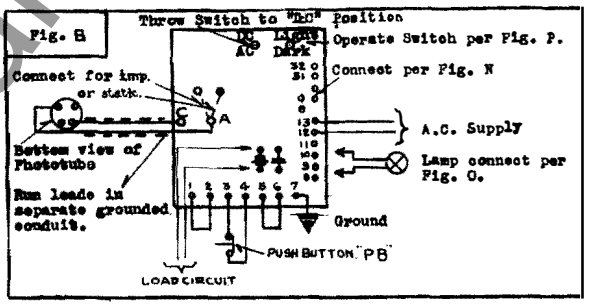
Fig. P.
Throw switch to "dark" position when relay or solenoid should be energized when the illumination on the phototube is decreased.

Throw switch to "light" position when relay or solenoid should be energized when the illumination on the phototube is increased.

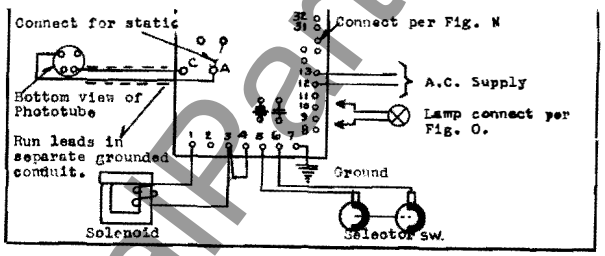
Fig. 2 - External Connections
For Type RR-5 Register Regulator
Dwg. 13-J-925



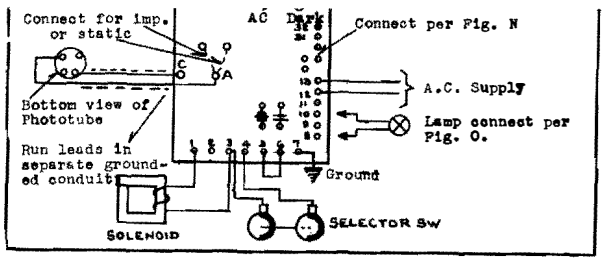
The relay will be energized when the illumination on the phototube is decreased for "dark" connection or increased for "light" connection. The relay will again be de-energized when the illumination returns to the original value.



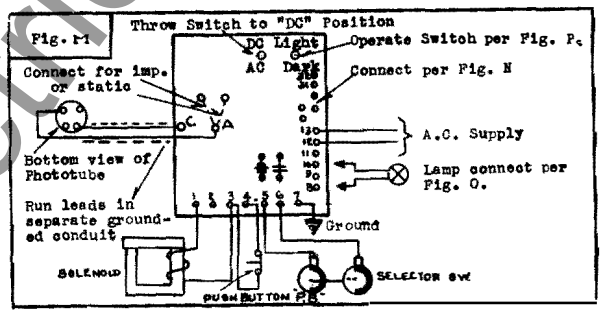
The relay will be energized if the illumination on the phototube is varied. The relay will then remain energized until reset by pushbutton PB.



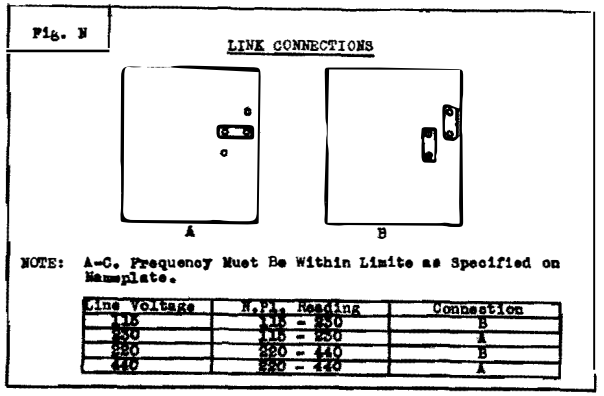
The solenoid will be energized if the illumination is varied provided the selector switch is closed. The solenoid is de-energized if the illumination returns to the original value or if the selector switch is opened.



The solenoid will be energized if the illumination on the phototube is momentarily changed provided the selector switch is closed. The solenoid remains energized until the selector switch is opened, regardless of further changes in phototube illumination.



The solenoid will be energized if the illumination on the phototube is momentarily changed provided the selector switch circuit is closed. The solenoid will remain energized, regardless of illumination and selector switch position until push button PB is opened.



NOTE: A-C. Frequency Must Be Within Limits as Specified on Nameplate.

Line Voltage	M.P.L. Reading	Connection
115	115 - 230	B
230	115 - 230	A
220	220 - 440	B
440	220 - 440	A

IMP - Sudden change
STATIC - Show moving spot.

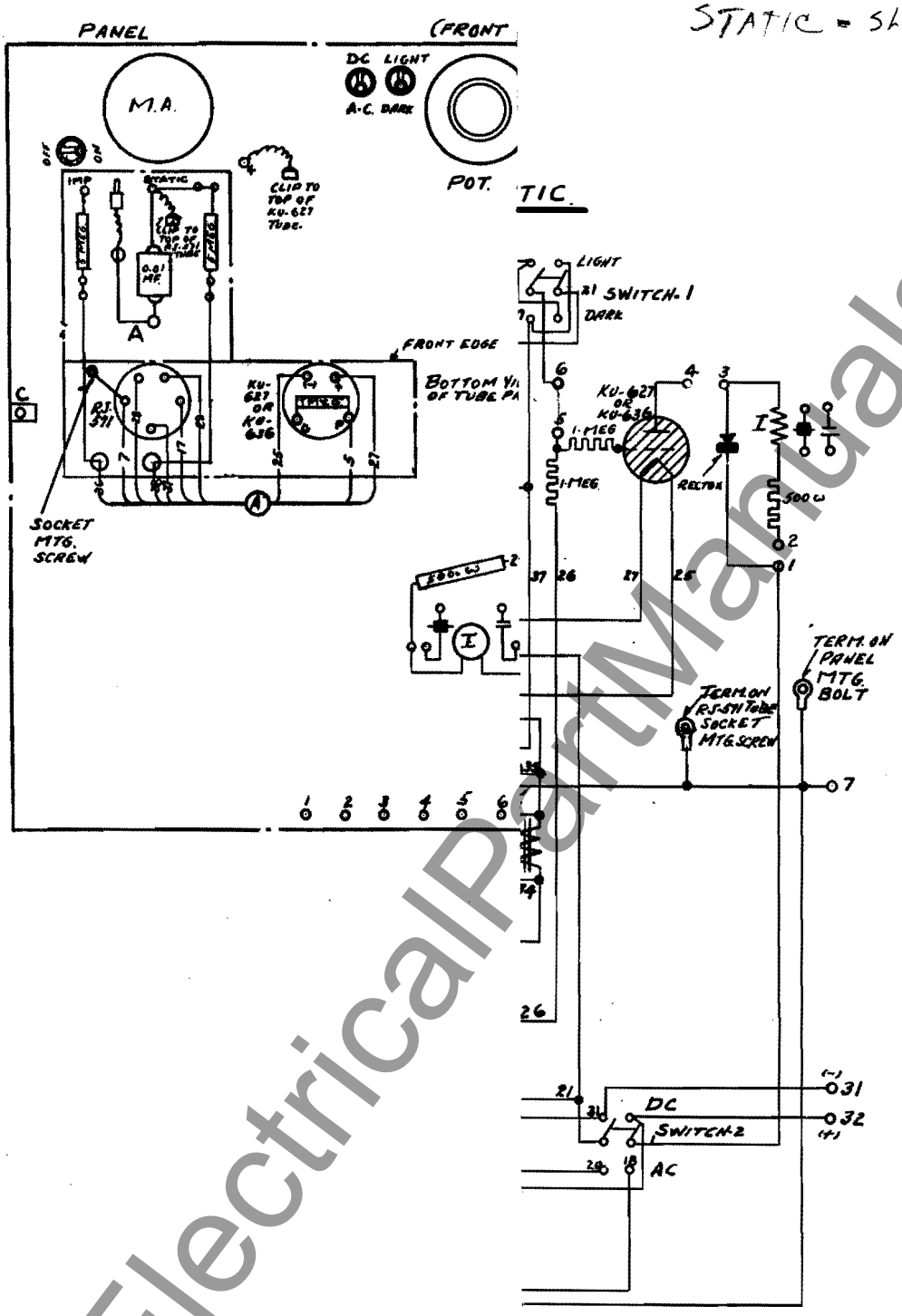


Fig. 3 - Schematic Diagram of Connec
Dwg. 70-B-724-2

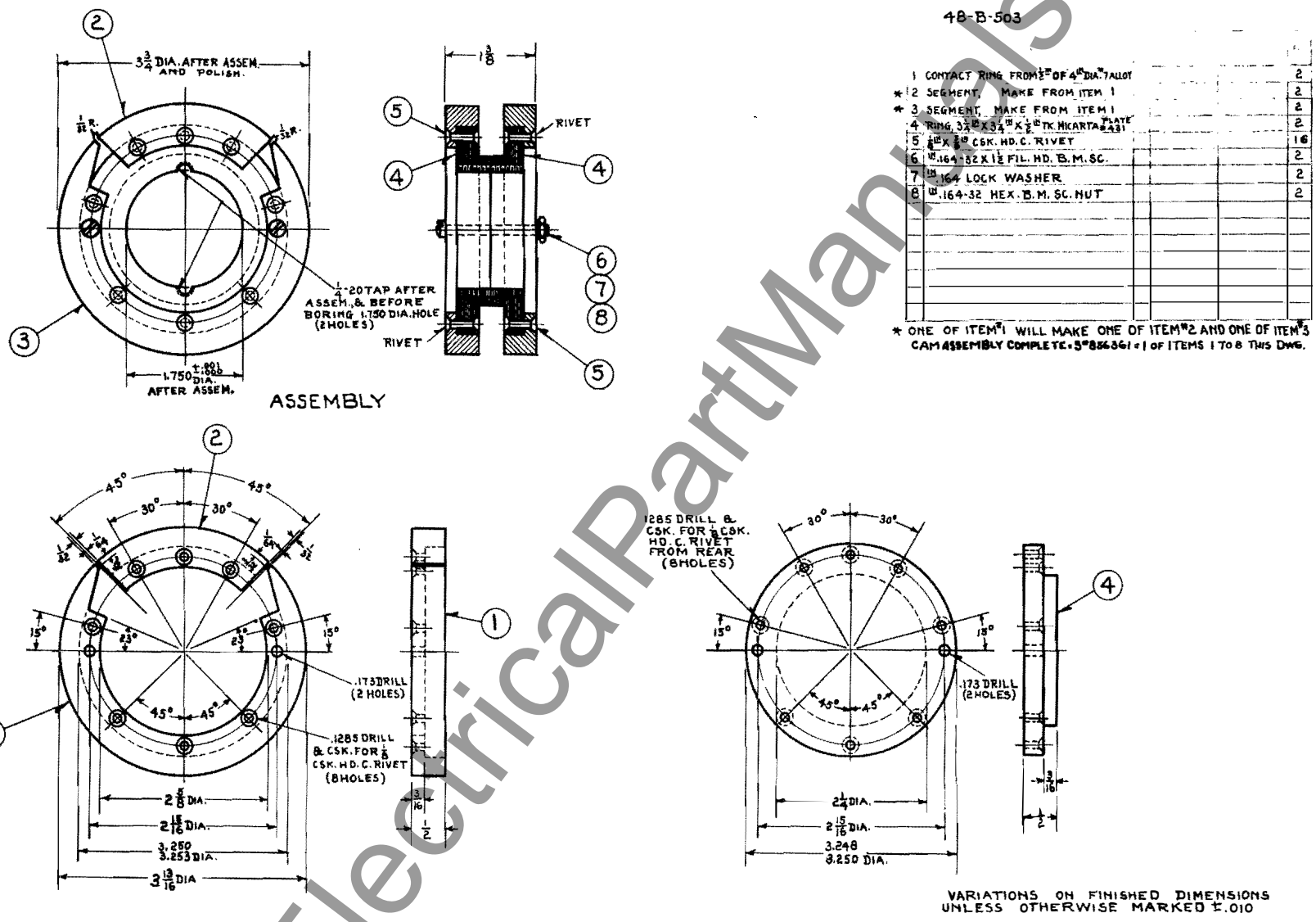


Fig. 4 - Selector Switch for Type RR-5 Register Regulator
Dwg. 48-B-503

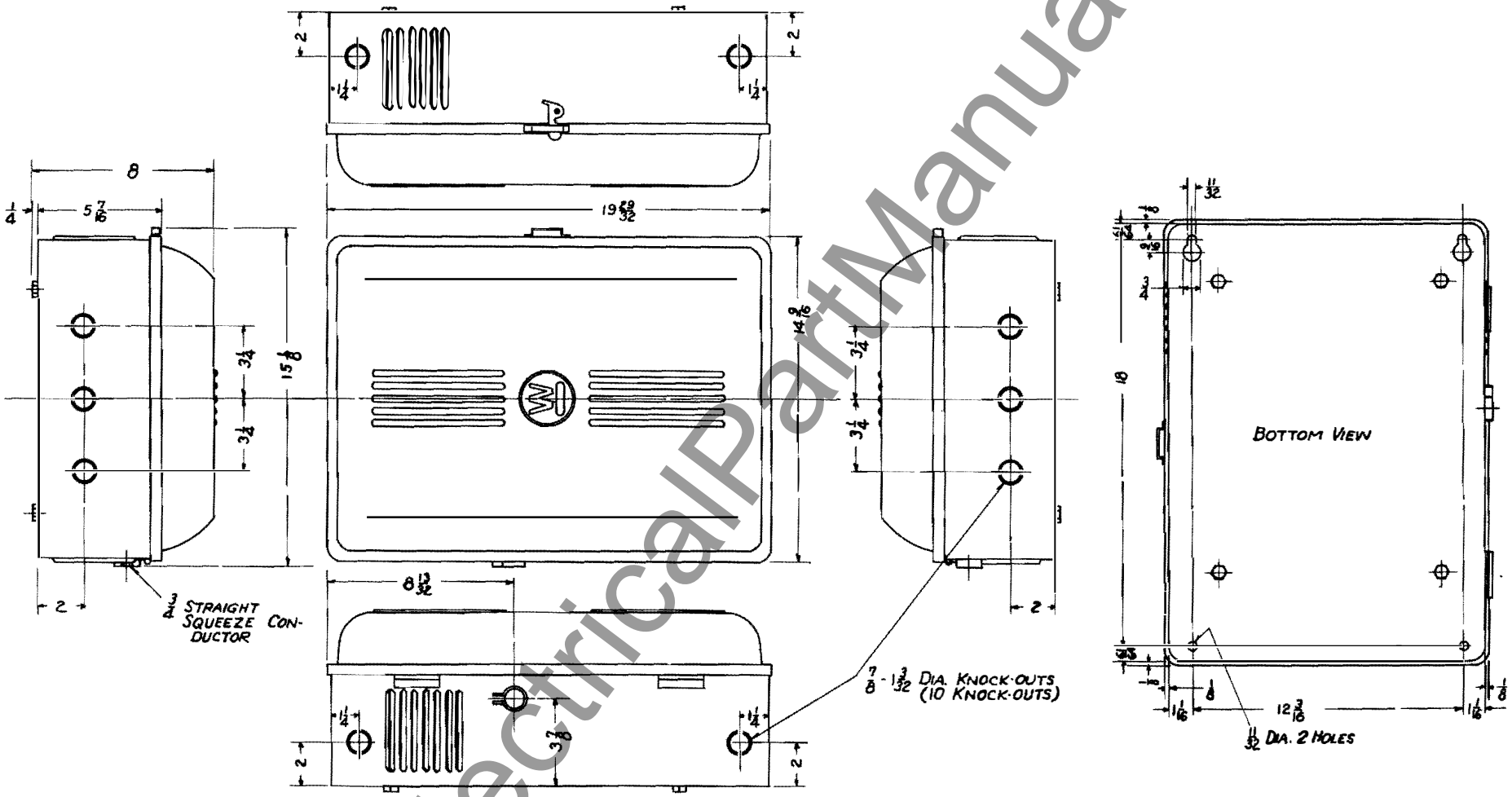


Fig. 5 - Type RR-5 Register Regulator - Outline Dimensions
Dwg. 39-C-545-3

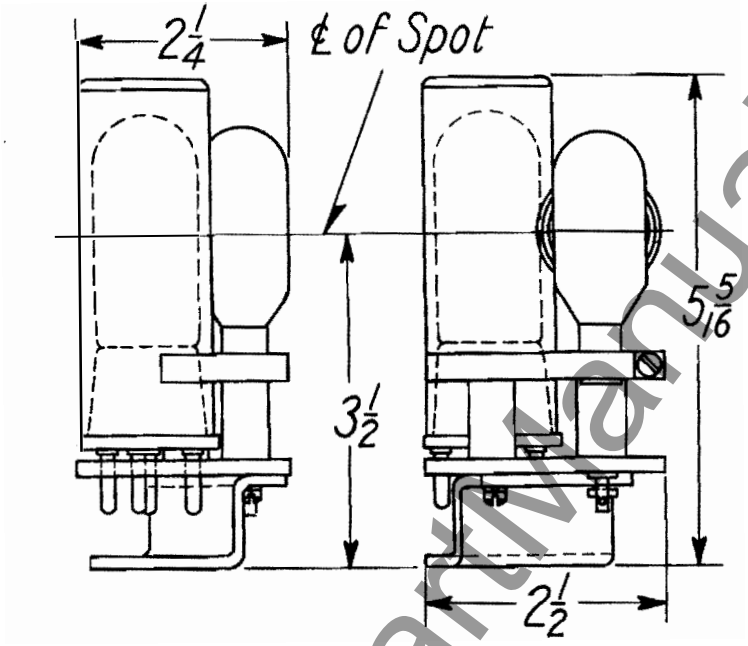


Fig. 6 - Type E Reflected Light Scanner
Dwg. T-67239

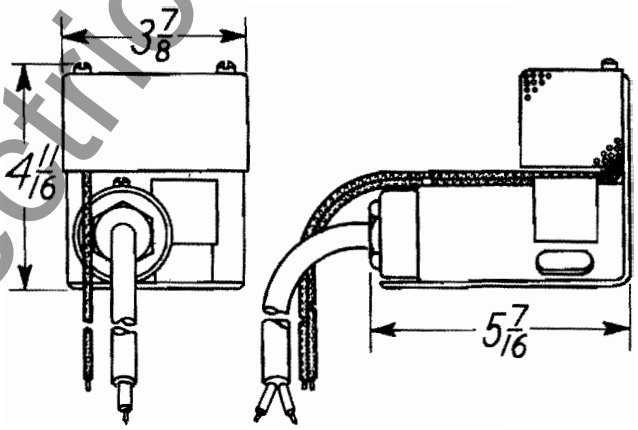


Fig. 7 - Type F Reflected Light Scanner
Dwg. T-67237

PHOTOTUBE HOUSINGS AND SCANNERS

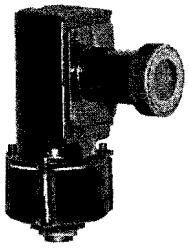


FIG. 1—TYPES A AND B GENERAL PURPOSE PHOTOTUBE HOUSINGS.

FIG. 2—TYPE C PHOTOTUBE HOUSING.

FIG. 3—TYPE D PHOTOTUBE HOUSING.

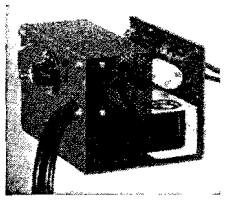


FIG. 4—TYPE H COMPENSATED SCANNER FOR REFLECTED LIGHT.

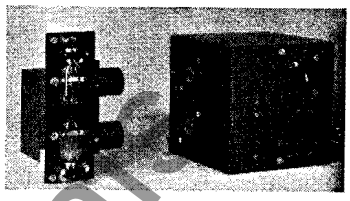


FIG. 5—TYPE G COMPENSATED SCANNER FOR TRANSMITTED LIGHT.

COMPLETE COMPENSATION FOR VARIATIONS IN BACKGROUND COLOR OR GLOSSINESS AND FOR LINE VOLTAGE IS OBTAINED BY UNIQUE CIRCUIT.

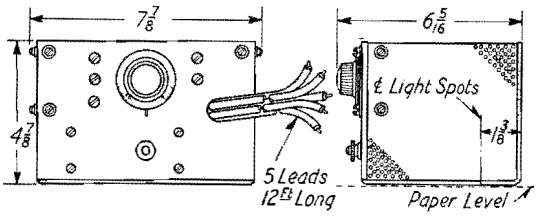


FIG. 6—TYPE H REFLECTED LIGHT SCANNER.

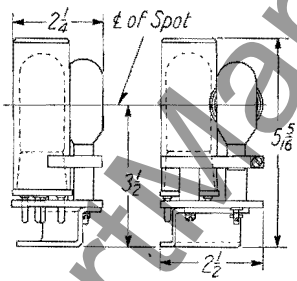


FIG. 7—TYPE B REFLECTED LIGHT SCANNER.

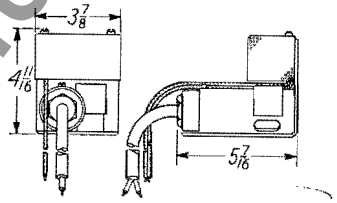


FIG. 8—TYPE F REFLECTED LIGHT SCANNER.

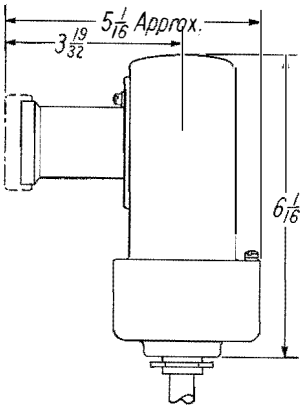


FIG. 9—TYPES A AND B PHOTOTUBE HOUSINGS The Type D Housing is similar except that the light admittance cylinder is replaced by a plate having a plain aperture. The horizontal dimensions are reduced approximately 2 1/16 inches. The general overall dimensions of the type C Housing are: Height O.A. 8½"; Width O.A. 2"; Depth O.A. 3¾".

TABLE 1—PHOTOTUBE HOUSINGS

Type	Description	Style Without Tubes ①	Approx. Ship. Wt.	Price Incl. Tubes ①
A ②	General Purpose, with 10 Ft. leads	②831 710	5	$19.00
B ②	Splash-Proof, with 10 Ft. leads	②831 708	5	21.00
C ②	Used Where Space is Limited, no leads	854 117	4	23.00
D	For Close-Up Work, 10 ft. leads	②849 083	4	23.00

① **Phototube 18-030, Type SR-50 or SK-60 Must be Ordered as Separate Items. Omission Price $7.00.**
② **Stocked** **W-2**
③ **When leads longer than 10 ft. are desired and may be used with the Photo-Troller, add a separate item specifying desired length of leads PDS-5344. This does not apply to Table 2. Cable $0.15 per foot W-2 for length over 10 feet.**

TABLE 2—SCANNERS

Type	Description	Style Without Tubes ①	Price Incl. Tubes ①	Tubes Required No.	Class	Type	Description	Ship. Wt.
E	Reflected Light Narrow Beam 12 ft. leads	856 471	$40.00	1 1	18–030 18–050	③ 856 455	Phototube Lamp	4
F	Reflected Light Broad Beam 12 ft. leads	850 679	40.00	1 1	18–030 18–050	③ 856 455	Phototube Lamp	4
G	Transmitted Light Compensated 12 ft. leads	④856 424	93.00	1 2 2	18–010 18–030 18–050	RJ-550 SR-50 856 455	Amplifier Phototube Lamp	7
H	Reflected Light Compensated 12 ft. leads	④850 640	93.00	1 2 2	18–010 18–030 18–050	RJ-550 SR-50 856 455	Amplifier Phototube Lamp	7

① **When ordering, enter a separate item for tubes as listed, since they are not included in Scanner Style. For omission prices on tubes see Price List 18-060.**
③ **Either SR-50 or SK-60 tubes may be used depending upon application.**
④ **Stocked.**
General changes since previous issue.

ORDERING INSTRUCTIONS

Phototube Housings consist of housing complete with an 18-030 Phototube. Style Numbers do not include Phototube, and a separate item for SR-50 or SK-60 must be entered on order. Prices include Phototube.

Scanners consist of light-source, lens system, phototube mounting and tubes as listed in Table 2. Tubes and lamps must be entered as separate items according to Table 2, since they are not included in scanner style number.

When Ordering—Specify: (1) Class 18-315, (2) Type, (3) Style, and (4) Application.

PHOTOTUBE HOUSINGS AND SCANNERS—Continued

PHOTOTUBE HOUSINGS

APPLICATION

18-315 Phototube Housings are general purpose industrial devices for use with 18-316 light sources, and are for the purpose of supplying a socket and housing for phototubes when mounted separately from the photo-electric controller or Photo-Troller, on an extended lead, or on the controller cabinet.

INDIVIDUAL CHARACTERISTICS

Type A—is a cast aluminum housing for general purpose applications. When mounted directly on the Photo-Trollers, it assumes the form of a turret and can be readily turned on its mounting to face any direction required, thereby making it possible to mount the Photo-Troller in any convenient position without regard to the direction faced by the phototube. When the phototube is to be mounted separately from the Photo-Troller cabinet, and not more than 10 feet away, the housing with the 10-foot leads should be ordered.

Type B—is identical with the type A with 10 foot leads except that it is arranged for mounting in applications where it must be splash-proof.

Type C—consists of a sheet metal housing developed for indoor applications where space limitations require a housing which is not in excess of two inches in width.

Type D—comprises a cast aluminum housing similar to that used with type A except that the light admittance cylinder through which the light enters is replaced simply by a flat plate in which a window is mounted so that the phototube may be placed closer to the material viewed. The glass window prevents any collection of dust or dirt in the housing and may be used for a surface over which such materials as paper, cellophane or cloth may pass in cutting applications.

INSTALLATION

Phototube Housings may be located in any convenient position and location where mechanical vibration is not so great as to mechanically cause damage and **must** be rigidly mounted to insure constant alignment with the light beam. While the housings may be mounted up to the maximum distances from the cabinets indicated in the Photo-Troller Price Lists, they should be mounted as near as possible to reduce the length of lead which must be composed of the cable recommended and run without other wires in grounded conduit. It is absolutely necessary that leads as specified be used with this equipment.

These Phototube Housings must not be operated in an ambient temperature above 160°F. If they are subject to radiant heat as from hot metals, special cooling or heat filters may be requested.

SCANNERS

APPLICATION

18-315 Scanners are a combination of light source, lens assembly, and phototube mounting for applications requiring scanning or viewing moving material for controlling its motion. These equipments are especially designed for controlling the cutting of paper, cellophane, and similar material in accordance with advertising matter or other printed designs.

INDIVIDUAL CHARACTERISTICS

Type G—is equipped with two phototubes, two lamps, and one amplifier tube so connected that the difference in response of the two phototubes feeds into the single amplifier tube enabling the equipment to automatically compensate for differences in glossiness or polish of the paper or material being scanned and at the same time providing great sensitivity. Furthermore, compensation is provided for changes in tube characteristics, variations in line voltage, and other factors which ordinarily seriously affect the operation of such equipment unless balanced out. The practice of mounting the amplifier tube in the scanner also increases the sensitivity and stability of the equipment. The leads to the scanner should be installed in separate grounded conduits. The cable supplied with the scanner must be used in order to reduce the capacity between leads and to make sure that the resistance to ground is high.

Type H—This equipment is identical in operation to Type E, but is to be used when the light is transmitted through the paper rather than reflected from it.

Type E—comprises a single lamp, lens system and phototube mounting and is to be used for reflected light applications where a simpler equipment than the compensated type is required.

Type F—also consists of a single lamp, lens system and phototube and is for reflected light applications where a slightly larger beam or spot of light is required.

INSTALLATION

Scanners should be mounted rigidly in a location as free from vibration as possible and near the Photo-Troller to reduce the length of leads. These scanners must not be used in an ambient temperature above 125°F.

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LIGHT SOURCES

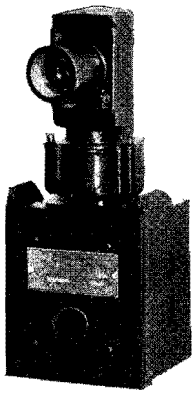


FIG. 1—TYPE D, LIGHT SOURCE

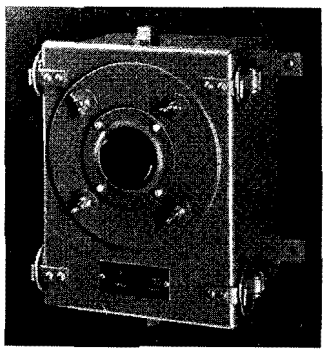
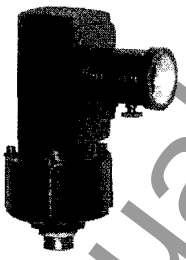


FIG. 2—TYPE E, LONG-RANGE LIGHT SOURCE.



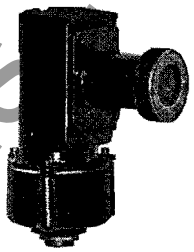


FIG. 3—TYPE F, GENERAL PURPOSE LIGHT SOURCE

FIG. 4—TYPE G, SPLASH-PROOF LIGHT SOURCE

FIG. 5—TYPE H, COMPACT LIGHT SOURCE

ORDERING INSTRUCTIONS

When Ordering

Specify: (1) 18-316, (2) type, (3) description, (4) style number, (5) volts, (6) cycles, and (7) give application.

Note—For special applications where listed light sources will not fill requirements, refer to Works, giving complete details including illumination requirements in foot candles, distance from light source to phototube, atmospheric conditions and application.

Lamps—Types D, F and G light sources are supplied with 6-8 volt, 32 candle-power lamp. Spare lamps should be ordered as 18-050, Style 842108 at **$.30 W-31.**

Types E, H, J and K light sources are supplied with a 6 volt, 5 ampere lamp especially designed for light source service. Spare lamps should be ordered as 18-050, Style 849085 at **$1.65 W-31.**

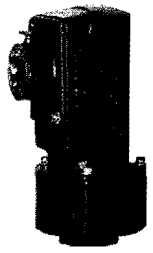


FIG. 6—TYPE J, CONCENTRATED BEAM LIGHT SOURCE

TABLE 1

Type	Description	Style No. Incl. Lamp	Power Supply			Min. Dist. From Lens At Which Beam Converges To a Point	Approx. Dia. of Beam		Shipping Weight Lbs.	Price Incl. Lamp
			Volts	Cycles	Watts		At Converging Point	At 10 Feet		
D	General Purpose, with Transformer. Indoor only.	①829 396	115/230	25–60	21	3″	¼″	10″	11	$24.00
D		①829 397	220/440	25–60	21	3″	¼″	10″	11	24.00
E	High Intensity, with Transformer. Indoor and Outdoor.	①849 186	115/230	25–60	35	Infinity	...	5″	18	27.00
E		①849 187	220/440	25–60	35	Infinity	...	5″	18	27.00
F	General Purpose. Indoor only.	① 831 706	②5.5	②a-c. or d-c.	18	3″	¼″	10″	4	15.00
G	Splash-Proof. Indoor only.	831 704	②5.5	②a-c. or d-c.	18	3″	¼″	10″	4	16.50
H	2″ Wide. Indoor only	854 118	③6	③a-c. or d-c.	30	Infinity	...	6″	4	19.00
J	Concentrated Beam. Indoor only.	①849 084	③6	③a-c. or d-c.	30	1″	⅛″	...	4	19.00
K	General Purpose. Indoor only.	882 109	③6	③a-c. or d-c.	30	3″	¼″	10″	4	18.00

① Stocked.
② Connect to any Class 18-310 Photo-Troller except Types LR & LT.
③ Connect to any Class 18-311 Photo-Troller. May also be used with 18-310 RH, RK, and RL Photo-Trollers if ordered similar to Style except to have 6-8 volt, 32 Candlepower lamp, Style 842108 with $0.30 W-31 price omission.

NOTE: All light sources except Type J can be supplied with an Infra-red Filter to obtain an almost invisible light beam. Price addition $10.00 W-2 for Type E; $2.00 W-2 for other types.

General changes since previous issue.

CHARACTERISTICS

Type D—consists of Type F Light Source mounted on cabinet which encloses transformer.

Type E—Extremely powerful beam for long range work.

Type F—Compactness and adaptability. May be mounted on Photo-Troller cabinet or on rigid or flexible conduit.

Type G—Similar to Type F except made splash-proof by use of suitable gaskets and glass window.

Type H—For use where mounting space is at a premium.

Type J—Produces a small, intense and highly concentrated spot of light for accurate close-up work.

DISTINCTIVE FEATURES

Installation costs reduced by eliminating transformer on many types.

High efficiency obtained by convenient and positive focusing adjustments.

Adaptability to application assured by wide selection of types.

Installation simplified by standard conduit fittings or knock outs.

Lamps are easily replaced without disturbing the adjustment of focus.

APPLICATION

18-316 Light sources are for the purpose of supplying a beam of light for actuating industrial type photo-electric controllers and light relays. They are especially adapted for Westinghouse 18-310 and 18-311 Photo-Trollers.

The proper light source for operating the photo-electric controller when located at a convenient distance from the phototube should be selected from Fig. 7. It is recommended that as great an excess of illumination as practicable be provided. The minimum illumination required for the operation of Westinghouse Photo-Trollers is listed in Price Lists 18-310 and 18-311.

When the light beam must pass through a dusty atmosphere or material that is light absorbing, such as water or glass, the illuminating values as shown in Fig. 7 should be decreased by a percentage which is a conservative estimate of the per cent absorption of the atmosphere or material.

When the light beam must be reflected from some surface before it reaches the phototube, the illumination values as shown in Fig. 7 must be multiplied by the reflection coefficient of the surface to obtain an estimate of the illumination that will be available at the phototube.

When an infra-red filter is used for supplying an invisible beam of light, the illumination values shown in Fig. 7 will be reduced to approximately 1/10 of the values shown.

LIGHT SOURCES—Continued

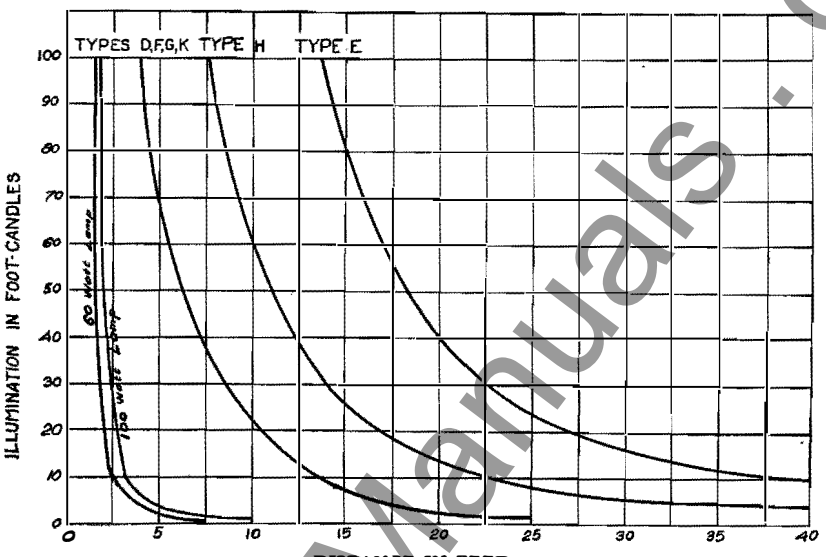


FIG. 7—ILLUMINATION INTENSITIES OF VARIOUS TYPES OF LIGHT SOURCES

INDIVIDUAL CHARACTERISTICS

All light sources except the Types D and E are designed to receive power from the Photo-Troller, or a separate transformer. These two types built for supplying their own power, have their own transformer, and may be used for Photo-Troller applications where it would not be practical to run leads from the Photo-Troller to the light source.

Type D—consisting of a cast aluminum lamp housing which may be mounted separately or on the sheet metal transformer box, is a general purpose indoor light source operated directly from an a-c. power supply rather than from transformer taps of the Photo-Troller. Provision is made for convenient focussing of the light beam.

Type E—is the most powerful light source and is particularly adapted to applications where the operating distance is necessarily large. Like the Type D, it also is operated directly from an a-c. power supply. As it has a 1/8 inch thick sheet metal cabinet adequately gasketed, it is suitable for indoor or outdoor application. A 3-inch diameter, 4 inch focal length lens is used for concentrating the light from the lamp.

Type F—is very compact consisting simply of a cast aluminum lamp housing. Unusual versatility of application is provided by its design which permits it to be mounted directly on the Photo-Troller cabinet or on 1/2 inch flexible or rigid conduit shaped to meet the individual application. A lens slide locked by a thumb screw provides convenient adjustment of the focus of the light beam.

Type G—is similar to Type F, but is splash-proof.

Type H—consists of a sheet metal lamp housing and was developed for indoor applications where space limitations require a light source which is not in excess of 2 inches in width.

Type J—comprises a cast aluminum housing and a special fixed focus lens system which gives a concentrated beam of high intensity for accurate close-up work where the distance between the phototube and light source does not exceed 2 inches.

Type K—is essentially the same in appearance and dimensions as the Type F, but has ventilating holes in the sides like the Type J to provide for the greater heat dissipation necessitated by the more powerful lamp. It is especially suited for general purpose use with the Class 18-311 Photo-Trollers.

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*†x‡CLEVELAND, OHIO, 1216 West Fifty-Eighth St.
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*DALLAS, TEXAS, 209 Browder St.
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‡HOUSTON, TEXAS, 2313 Commerce Ave.
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*JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 101 W. Eleventh St.
①‡†KANSAS CITY, MO., 2124 Wyandotte St.
*KNOXVILLE, TENN., Gay & Clinch St.
xLIMA, OHIO
*LITTLE ROCK, ARK., 1115 West 24th St.
§LITTLE ROCK, ARK., % Fones Bros. Hdwe., 2nd & Rock Sts.
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†PORTLAND, OREGON, 2138 N. Interstate Ave.
‡PORTLAND, OREGON, 720 N. Thompson St.
*†PROVIDENCE, R. I., 16 Elbow St.
*RALEIGH, N. C., 803 North Person St.
§RALEIGH, N. C., P. O. Box 443.
§READING, PA., 619 Spruce St.
*RICHMOND, VA., Fifth & Byrd
*§ROANOKE, VA., 726 First St., S. E.
*†ROCHESTER, N. Y., 410 Atlantic Ave.
*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO, CALIF., 1805 20th St.
*SALT LAKE CITY, UTAH, 10 West First South St.
†‡SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
§SALT LAKE CITY, UTAH, McCormick Bldg.
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xSOUTH PHILA. WKS., Essington, Pa.
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Westinghouse

Type F-122 Oil-Circuit-Breakers

400 Amperes, 5,000 Volts
600 Amperes, 7,500 Volts
800 Amperes, 5,000 Volts

INSTRUCTION BOOK

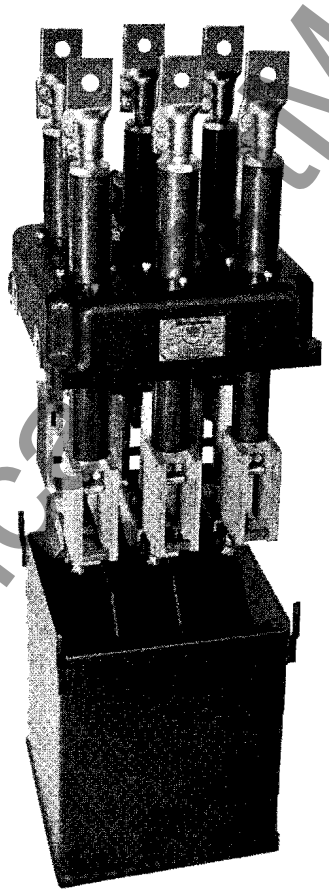

FIG. 1—TYPE F-122 OIL CIRCUIT-BREAKER UNIT. 600 AMPERES, 7500 VOLTS

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

Westinghouse Press
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INDEX

Westinghouse

Type F-122 Oil Circuit-Breakers

400-600 Amperes, 7500 Volts—800 Amperes, 5000 Volts
2- and 3-Pole

Manually or Electrically Operated

General Description

The type F-122 oil circuit-breaker is a low interrupting capacity breaker—embodying the desirable features of larger breakers, including internal mechanism, wound type micarta bushings, heavy butt type contacts, "De-ion Interruptors". Silver-to-silver main contacts are used on the 600 and 800 ampere breakers.

This breaker has a large factor of safety in interrupting capacity, being thoroughly tested in the testing laboratories at East Pittsburgh. The "De-ion Interruptor" assures speedy and positive operation with a minimum of disturbance.

The contacts are of large cross section, to withstand long service without renewal.

The breaker will give excellent service with a reasonable amount of care and the instructions which follow should be used as a guide in servicing this breaker.

Shipment

The breaker unit will be shipped separately, except when the mechanism is bolted directly to the breaker unit, boxed and fastened in the closed position. Operating mechanisms and details may be shipped in separate containers, all marked for easy identification.

Unpacking

Care should be used in unpacking the circuit-breakers and parts, so that small parts are not damaged. Extra precautions should be taken so that the bushings are not damaged.

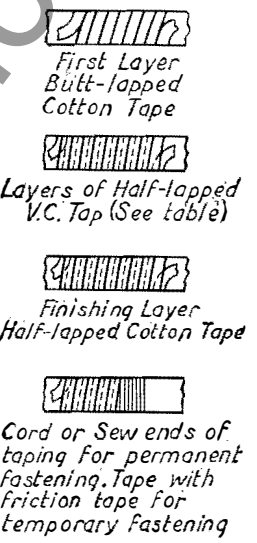
A careful inspection should be made, to insure that no parts were broken or damaged during shipment. In case of damage the proper claims should be made to the transportation company.

Installation

1. Attach the breaker to the supporting structure, first making sure that the structure is level
2. Remove the tank and examine the inside for evidence of moisture and foreign matter. Flush with insulating oil.
3. Connect the breaker to the operating mechanism. Remove the wire or blocking which holds the breaker in the closed position, and allow the breaker to open slowly.
4. Examine the contacts and note that they are clean and in alignment. For adjustment see section covering adjustment.
5. Operate the circuit-breaker by hand several times, watching each pole and the operating mechanism to be sure all parts move smoothly and freely.
6. When the mechanism is remote mounted, adjust the connections between the breaker and operating mechanism so that full contact is obtained and the breaker rests on the bumpers when in the open position.
7. Install connections to the breaker studs.
8. Insulate the connections with varnished cambric and non-elastic webbing in accordance with Westinghouse Standards for the various operating potentials. See Fig. 2.
9. With the tank removed, fill with Wemco "C" oil to the line marked on the tank or as directed on the breaker name plate.
10. Bolt the tank in place, being sure that it is drawn up evenly all around.
11. Connect the breaker frame, through one of the mounting bolts, to ground. The National Electric Code requires grounding cable to have one-fifth of the main circuit capacity except that it must never be smaller than No. 8 and need not be larger than No. 0, B & S gauge.

Adjustments

Breaker Mechanisms—The toggle mechanism is designed for reversible operation, so that the direction of oper-



Service Volts	Layers of Varnished Cambric Tape
2500	4
4000	5
4500	6
6600	7
7500	8

Wrap the conductor with butt-lapped layer of ".007 white cotton tape and cover with one coat of No. 9 insulating varnish (Westinghouse Catalog No. 311). Then wrap with half-lapped layers of ".010 varnished cambric tape (Westinghouse No. 1225 Tan Treated Cloth) applying as many layers as given in the above table. Apply a coat of No. 9 insulating varnish (Westinghouse No. 311) between layers. Tape over the cambric with one layer of ".007 cotton tape and wrap the ends with cord to keep them in place. Finish with two coats of M-1736 black insulating varnish (Westinghouse Catalog No. 414).

FIG. 2—INSTRUCTIONS FOR TAPING CONNECTIONS

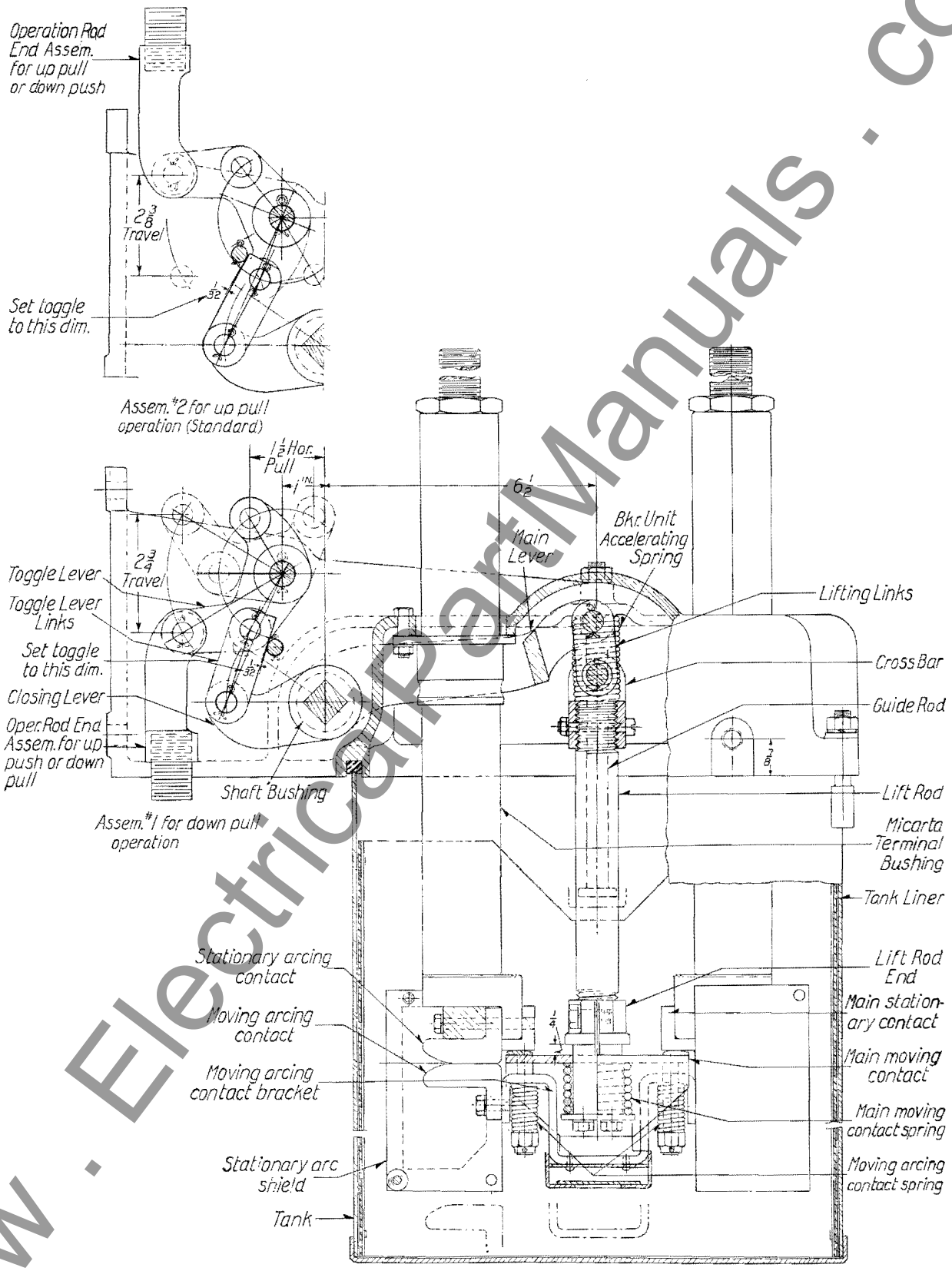


FIG. 3—BREAKER POLE UNIT—SIDE VIEW—CROSS SECTION

ation can be changed by a simple change in the position of the operating lever and connecting links. Both assemblies are shown in Figs. 3 and 9. To change from one direction of operation to the other the toggle lever and links are assembled as shown. The clearance between the operating links and the stop pin should be approximately $\frac{1}{32}$-inch in either case, when the contacts are in full contact.

Two guide rods, Figs. 3 and 4, are used to align the moving contacts and guide the contacts for straight line motion. The cross bar must move up and down freely on these rods. The lower end of the guide rods and the lower surface of the moving cross bar cooperate to form hydraulic bumpers. No adjustment is necessary, other than to be sure the moving contacts open to the full position. **Do not operate the breaker excessively without oil.**

Contacts—The contact arrangement is shown in Fig. 3. The main and arcing contacts are both of the butt type, the $\frac{1}{4}$-inch lead of the arcing contacts being maintained by the thickness of copper on the arcing tips while the contact pressure on the main contacts is obtained by a compression spring. With the breaker closed the main contact should be $\frac{1}{4}$-inch below the shoulder on the lift rod end. If necessary to adjust, the moving arcing contacts are removed, the lift rod end loosened and the contact assembly screwed up or down as necessary.

It is important that the $\frac{1}{4}$-inch dimension is maintained as this determines the contact pressure on the main contacts.

The 600 and 800 ampere main contacts make silver-to-silver contact and it is unnecessary to use an abrasive to keep them clean. The oxide of silver does not increase the contact drop, consequently the temperature of the contacts will not progressively increase as is the case with plain copper contacts carrying large currents. In fitting new contacts it is unnecessary that perfect line contact be obtained. With the comparatively soft material (silver) good contact is obtained after a few operations, as the silver flows slightly under pressure.

If the silver contacts on the moving contacts are replaced, use solder of at least 300°C. melting point. **Use only "pure silver", coin silver is unsatisfactory.**

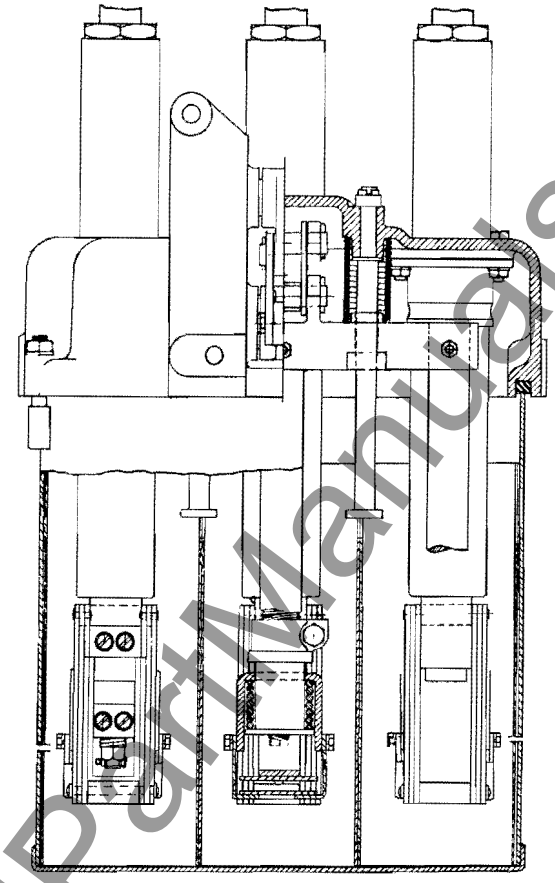


Fig. 4—Three-Pole Breaker Unit—Front View

The 400 ampere main contacts make copper to copper contact. However, the lower current density eliminates the necessity of cleaning the contacts regularly.

"De-ion Interruptors"—The "De-ion Interruptors" control the arc and quickly extinguish it by de-ionization. These devices need little attention other than an occasional inspection. They must be kept securely tightened and properly aligned so that the moving contacts move freely and do not rub causing excessive friction. The fibre insulation is affected very little by the arc action but should be inspected occasionally and replaced if excessive deterioration is found.

Terminal Bushings—The surface of the bushing insulation should be smooth and well varnished. If the varnished surface is damaged it should be smoothed off with fine sandpaper and re-varnished with three coats of good quality, clear, air-drying spar varnish. Each coat should be allowed to dry for 24 hours.

Operation

Points to be observed in operation—

1. Before making any adjustment to an oil circuit-breaker, make sure that all lines leading to it are electrically dead.
2. Be sure the breaker frame is grounded.
3. Do not operate the breaker excessively by the electrical operating mechanism when the oil tank is removed.
4. Examine all contacts frequently, especially after severe short-circuits. See that contacts are aligned properly. Replace those badly burned.
5. After making adjustments, operate the breaker carefully by hand to make sure that it operates smoothly and correctly.
6. Inspect the oil regularly and after severe short-circuits. If it shows

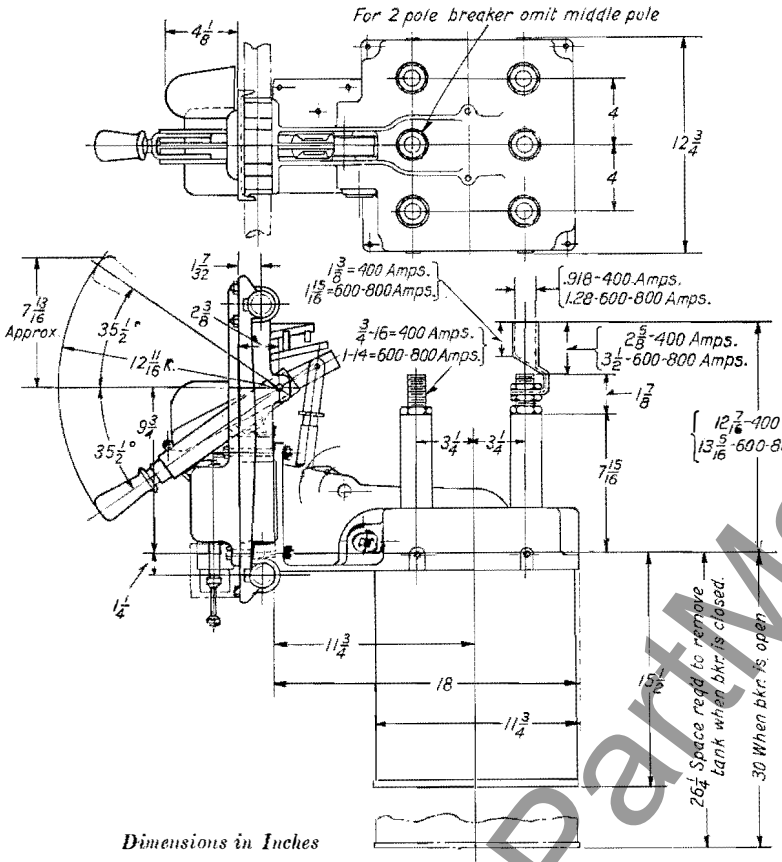


FIG. 5 —OUTLINE DRAWING FOR TYPE F-122 BREAKER WITH COMMON PIPE MOUNTING FOR UNIT AND COVERPLATE

signs of moisture, carbonization or dirt, filter and retest it before replacing it in service. See that the oil level in the tanks is maintained at the proper height.

7. Remove all oil and thoroughly clean the tanks, tank liners, lift rods, terminal bushings, etc., at least once a year.
8. Thoroughly inspect all bolts and nuts—and tighten if necessary. Inspect all pins, links and bearings especially for excessive wear. Check all cotter pins. Do not use thin lock washers on moving contact parts.
9. Arrange for regular inspection to see that the apparatus is in adjustment, the oil is of good quality and that the complete breaker functions as required. Regular inspection periods pay dividends.

Insulating Oil

Dielectric tests of the oil should be made every three months, to show if it is reasonably good for circuit-breaker work. Samples should not be taken until the oil has remained undisturbed for at least four hours. In testing for indication of water, take the sample from the bottom of the tank. If for indication of carbon, and after a heavy short-circuit, take the sample from the surface of the oil.

Care of Circuit-Breaker Oil—The care of the insulating oil in circuit-breakers is of the utmost importance in their successful operation. Contamination by dirt, moisture, metallic particles, lint, etc., all reduce the dielectric strength, upon which the operation and current interrupting ability largely depend. Consequently, the most careful attention should be given to keeping the oil clean, not only in filling the tanks originally but in later maintenance or other work on the breakers which might involve opening the tanks.

Only the highest grade, such as Wemco "C" or other approved oil should be used in the breakers. The oil should be new or at least thoroughly reconditioned by means of a filter press or centrifuge. In any case, before using, it should be given a dielectric test which should show a minimum of 22,000 volts (preferably 25,000 to 30,000) measured between 1-inch diameter discs spaced .1 inch apart.

Before filling, the tanks should be thoroughly cleaned and flushed out with insulating oil. The same treatment should be given the inside of the top of the breaker and the operating linkage and contact system. In doing this, rags which will leave lint should not be used as this absorbs and holds moisture

The same care should be used during inspection or maintenance work on the breaker, which should preferably be done only under favorable weather conditions. If the oil is to be reconditioned following operation of the breaker under short-circuit, the tank, and entire inside of the breaker should be cleaned before the oil is returned to the tank. If the work merely involves lowering or removal of the tank, care should be taken to keep the tank covered until it is replaced so that dirt, dust metallic particles, etc., cannot fall into the oil.

The above precautions may appear academic to those familiar with the maintenance and operation of oil circuit-breakers, but a little more than ordinary care in oil handling will be well repaid in reliable and dependable operation for which the breaker is designed and built.

For instructions as to the care and testing of insulating oil, see Instruction Book 5336.

Mounting of Switchboard Breaker (on Panel or on Panel Bracket)

Before mounting the coverplate and the breaker to the panel, first assemble the signal switch and bell alarm, if they are ordered, to the coverplate as shown on Fig. 6. Then place the 5-ampere tripping coils from the overload attachment, if supplied, in the coil box of the coverplate, and mount the coverplate

and the breaker to the panel. The breaker should be mounted as nearly level as possible. The nipple supplied with the breaker units should be screwed into the rod end on the rear of the operating handle and the mechanical set-up will be complete. By adjusting the amount by which the nipple is screwed into the rod end, it is possible to vary the contacts in the breaker. This adjustment should be made in such a way that full contact is obtained in the breaker when the handle is latched closed. In adjusting the breaker special care should be taken to see that the toggle lever is $\frac{1}{32}$ of an inch, or less, from the stop pin in the closed position. See Fig. 3 and instructions under "Adjustments." If this adjustment is not correct, the latch load on the coverplate will be excessive and the tripping attachments may not function properly. With this adjustment correct, the signal switch should make good contact in both the open and closed positions of the breaker. It should be observed that proper contact in the breaker is necessary in order to get proper contact on the signal switch.

When the adjustment of the breaker and signal switch is correct and operating properly, then the tripping cores can be put in place, and the nuts put on which hold them. If an under-voltage release is supplied, it may now be mounted on the coverplate and the leads thrust through the clearance between the coverplate and the panel, and then drawn back through the holes drilled in the panel for the leads.

For mounting other auxiliaries on the switchboard mounting breaker, see description under the heading of "Mounting of the Auxiliaries". (See page 8).

Mounting of Remote Control Breaker

The remote control breaker unit should be mounted in place upon the wall or pipe as nearly level as possible, and the operating rod end reversed so that the offset will be as shown in Figs. 3 and 9. The auxiliary switch and bell alarm contacts, if supplied, should be mounted in the coverplate before the coverplate is mounted on the panel or panel bracket. The two extra bolts supplied with the two-coil coverplate should be discarded. The coverplate can then be mounted as shown in Fig. 8, with the coils in place in the coil box. The tripping cores can then

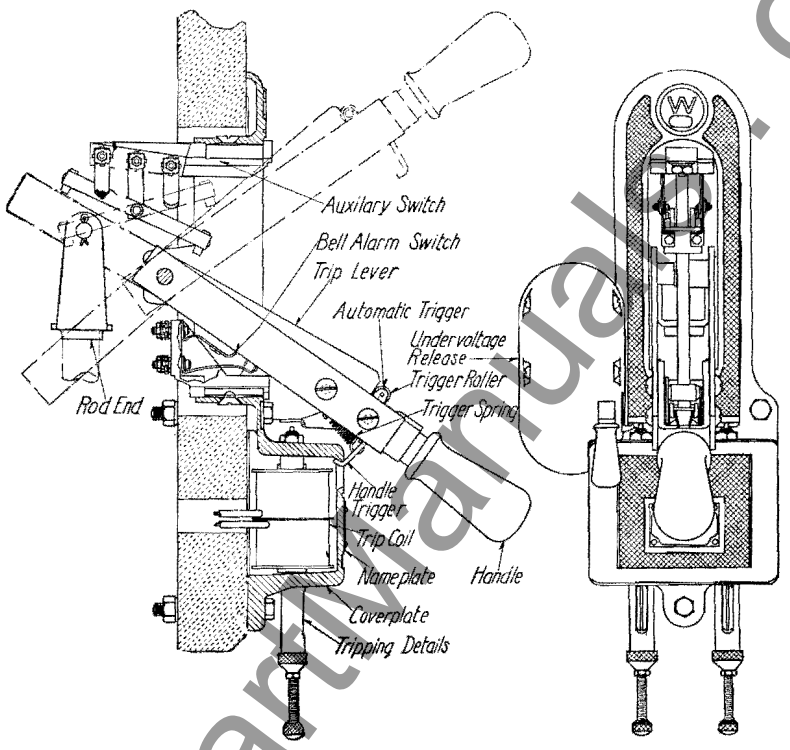
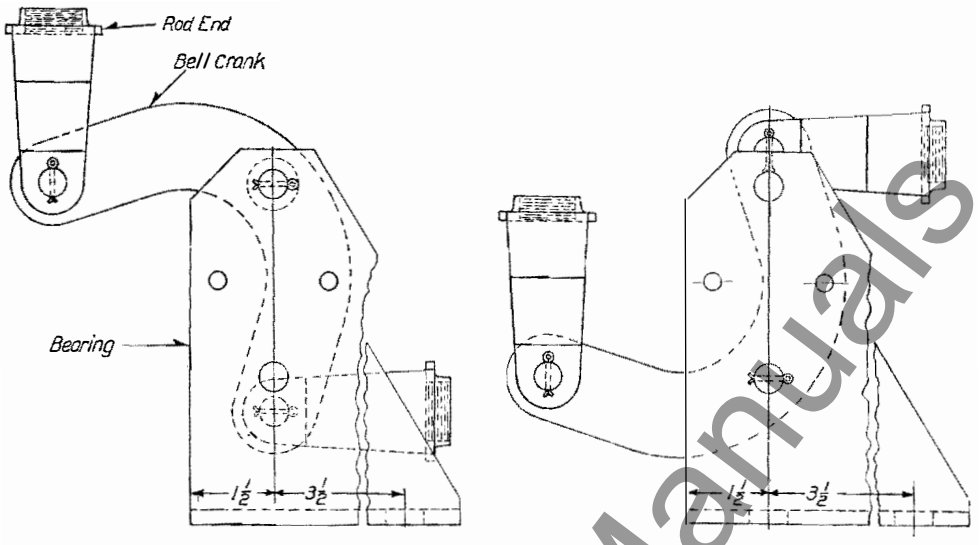


FIG. 6—SINGLE HANDLE 2-COIL COVERPLATE

be put in place on the coverplate and tightened. Here again, if an under-voltage release is used, it may be placed on the coverplate after it is assembled to the panel by pushing the leads through the clearance between the coverplate and the panel, and pulling them through the drilled holes in the panel. All connections should be made after the mechanical assembly is complete. The coverplate and breaker units should then be connected together with operating rods through the bell cranks as shown in Fig. 8.

The connecting pipes are $\frac{3}{4}$-inch x strong pipe, and should be cut 4 inches shorter than the distance between fulcrums of the levers to be connected. These pipes should be threaded $2\frac{3}{4}$ inches on each end with $\frac{3}{4}$-inch straight pipe thread. A $\frac{3}{4}$-inch pipe lock nut should be put at one end or the other of each pipe, with the exception of the breaker unit end. A pipe nut should never be used on the breaker unit end. The length of the pipe should be adjusted so that the travel of each crank lever is approximately equal on each side of the horizontal or vertical center line. The last length should be adjusted so that with the handle in the latched position, the contacts in the breaker are making full contact, as previously described. With proper adjustment on the breaker contacts, it will be observed that proper contact is secured on the signal switch if one is used. The bell cranks as supplied are for mounting above the floor. If it is desired to mount the bell cranks below the floor, it is necessary to reverse them. To reverse the bell cranks, remove the fulcrum pin and replace it in the lower hole. To reverse the accelerating device, it is necessary to remove the fulcrum pin and to replace it in the upper hole. It is also necessary to change the accelerating spring on the accelerating device. See Fig. 7.

Any length of pipe exceeding 12 feet should have an intermediate support. The operating rods should all be in tension except the one next to the breaker, and in applications where this vertical rod is long enough, to cause buckling under strain of closing the breaker, it will be necessary to reverse the accelerating device and also to reverse the toggle in



BELL CRANK SHOWING ASSEMBLIES FOR ABOVE AND BELOW FLOOR MOUNTING

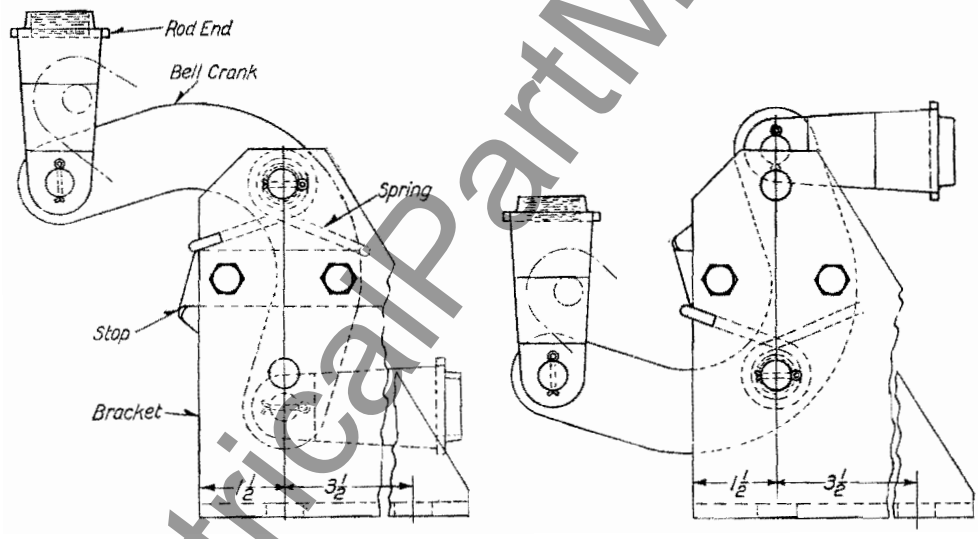


FIG. 7—ACCELERATING DEVICE SHOWING ASSEMBLY FOR ABOVE AND BELOW FLOOR MOUNTING

the breaker so that this rod will be in tension instead of compression. To reverse the toggle in the breaker the toggle lever should be reversed and the toggle links connected to the hole in the other end of the toggle lever. The contact pressure should always be checked after making this change, as it may be necessary to re-adjust the contacts. This will cause the toggle to close the breaker with a downward motion of the operating rod. See Figs. 3 and 9.

Mounting of the Auxiliaries

Electric Lock-out Device—The electric lock-out device mounts on the rear of the panel, and is attached to the coverplate as shown in Fig. 20. It is necessary to take out the fulcrum pin of the coverplate and remove the two washers which space the handle on either side from the lugs on the coverplate. The steel piece of the electric lock-out device occupies space left by the removal of the washer. The lock-out device can then be mounted as shown, and the set screws tightened so that it is held rigidly in place. It should be observed that the armature moves freely, and that with the armature closed, the handle has clearance to pass; while with the coil de-energized, and the armature open the lug is over the trip lever of the handle and successfully prevents it from closing.

Mechanical Interlock—When two single-handle coverplates, or the two handles of a double-handle coverplate, are to be interlocked so that only one can be closed at a time, the mechanical interlock is used. See Fig. 21. In order to mount this attachment, it is necessary to remove the fulcrum pin from the coverplate handle, and take off the spacing washer for the handles on the side next to the coverplate with which it is to be interlocked. Then the mounting brackets of the interlock may be placed on the

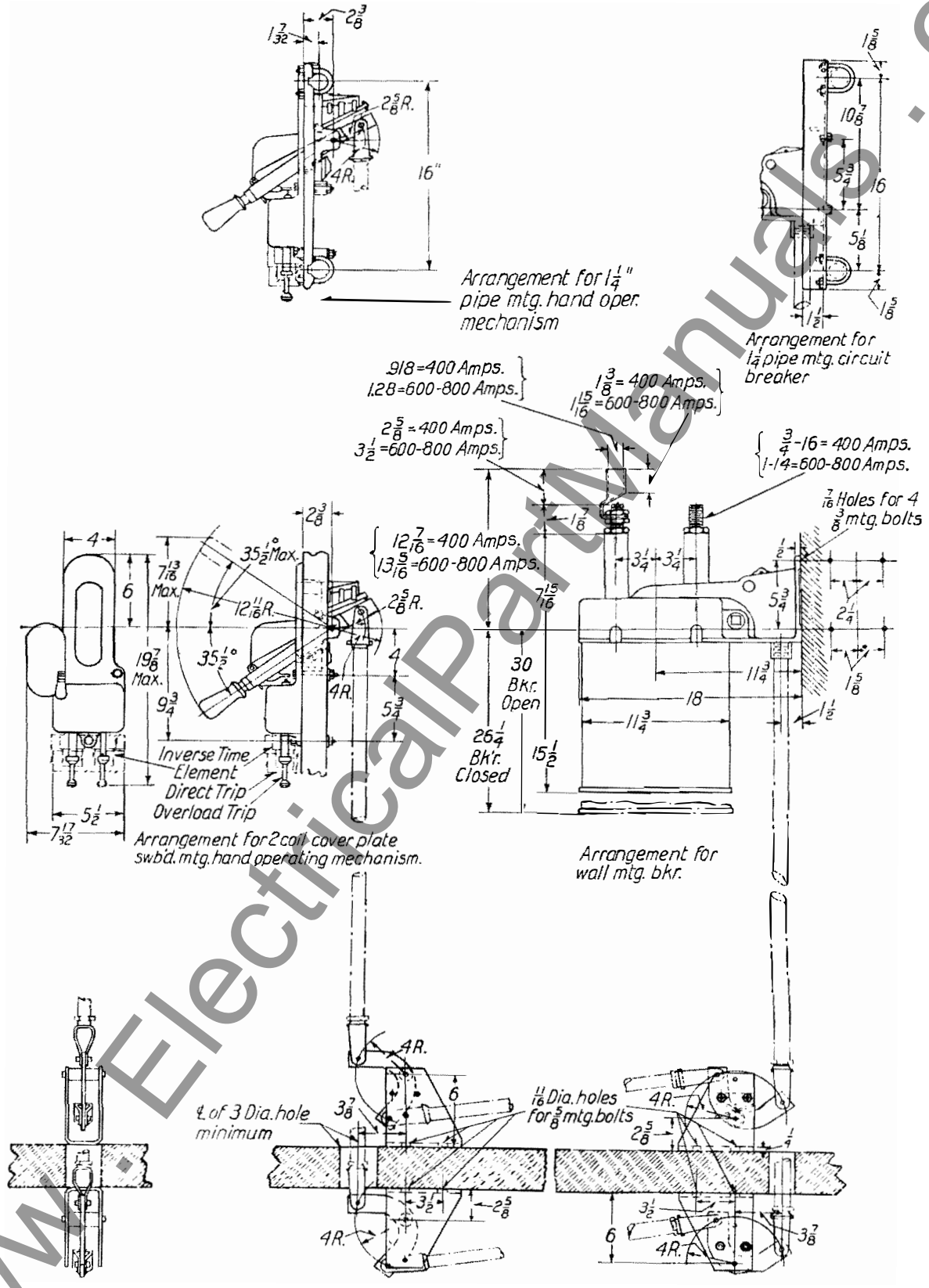


FIG. 8—REMOTE CONTROL MOUNTING DETAILS

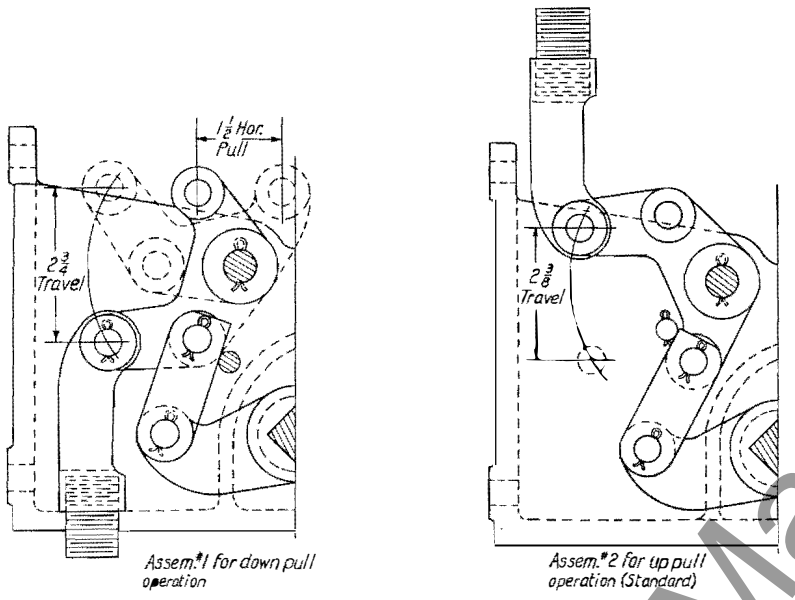


FIG. 9—TOGGLE ASSEMBLIES

coverplate as shown in the picture, and all screws tightened. It will be found that to put the brackets on first and to insert the interlock bar in place after the brackets are lined up will make the assembly easy. It should be observed that the interlock bar moves freely and is returned to the neutral position by the spring when the handle releases it.

The movement of one handle to the closed position should move the interlock bar over the other handle so that it locks on the straight part of the bar and not the beveled part. Adjustment is provided so that the length may be altered when assembling. When this interlock is used in addition to a lock-out device on one of the handles, a hole in the mounting bracket of the electric lock-out device takes the interlock bar and one of the interlock mounting brackets should be omitted. If for any reason the interlock bar does not move freely, it will be necessary to properly line up the holes in which it is supported. This can be done by loosening the coverplate mounting bolt and moving the coverplate bodily to alignment. In very extreme cases it may be found necessary to file the top lug of the mounting bracket to line up.

Mechanical Sequence Interlock—The mechanical sequence interlock can be mounted on a double-handle coverplate only. The brackets for the sequence interlock are held in place by a special pin which replaces the fulcrum pin of the handles, omit spacing washers for handle on one side of each handle only. The adjusting screws at top and bottom should be adjusted so that there will be no binding between the cam-shaped slot and the interlock pins on the coverplate lever. The interlock pins replace the standard pins for the rod ends. See Figs. 22 to 27.

Undervoltage Release Attachment—The hand retrieved undervoltage release attachment mounts on the left hand mounting bolt of the coverplates. It is necessary to remove this bolt and to put it in from the rear of the panel, screwing it into the undervoltage cover. Tightening the two undervoltage release mounting bolts clamps the undervoltage release tightly in the proper position. After it is completely mounted, operate it a few times by hand to see that the movement is free and that it operates properly. See Fig. 12.

The automatic retrieve undervoltage release mounts on the right hand side of the coverplate in a similar manner. It is necessary to bolt a reset pin to the trip lever of the coverplate to operate this device. See Fig. 13.

Other Tripping Devices—The **overload trip,** the **shunt trip,** and the **overload trip with dashpot,** as well as the **direct trip attachment,** mount on the coverplate by passing the core up through from the bottom into position in the coverplate and then securing it there by means of one nut. With the direct trip attachment, it is necessary that the leads from the lower coils be taken through the panel immediately below the coverplate. However, the tripping cores with the dashpot or direct trip below, should not be mounted on the coverplate until the mechanical installation is complete. This is necessary in order that all the bolt heads will be easily accessible.

Signal Switch and Bell Alarm—As indicated above, it is necessary to mount the signal switch and bell alarm in position on the coverplate as shown in Figs. 6 and 11, before the coverplate is put on the panel, otherwise it would be very difficult to tighten the screw which clamps it in position. This attachment is mounted in the coverplate by a flat-head machine screw.

Connections

After the breaker has been assembled, with its operating handle and auxiliaries as described above, the electrical connections should be made in accordance with the diagram furnished for the complete installation, if covered by a complete diagram, or in accordance with the diagram furnished in this instruction book. The main leads should be carefully soldered into the cable terminal furnished with the circuit-breaker. In case copper strap connections are to be used, they should be carefully grained before putting on and the contact nuts should be drawn down so as to bear evenly over their entire area. The lower contact nut should not touch the upper clamping nut of the bushing. The connection should have an area of not less than that given by the National Electric Code tables on allowable carrying capacity of wires and cables. After fastening in the main leads, the terminals should be insulated wth tape or insulating tube. See Fig. 2 for taping instructions. Good engineering practice demands that all terminals on circuit-breakers be insulated.

Maintenance of Accessories

Coverplate and Handle—The mechanical parts of the coverplate and handle should be kept in good condition in order

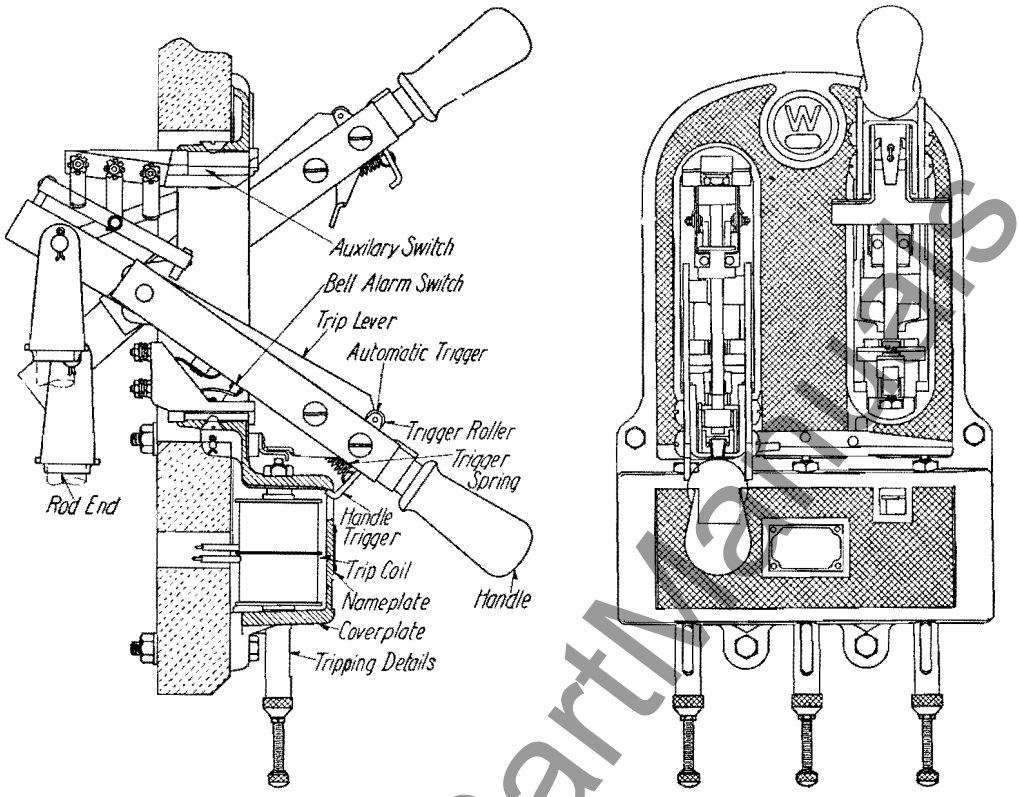


FIG. 10—DOUBLE HANDLE, 3-COIL COVERPLATE

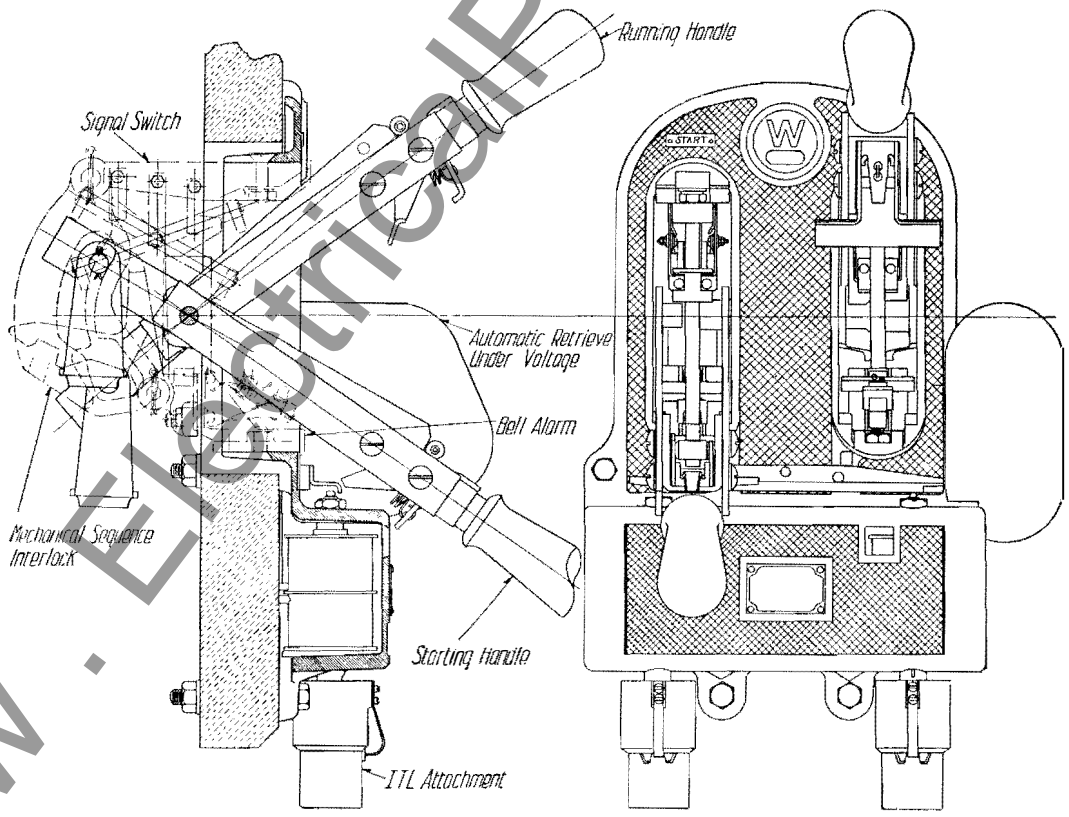


FIG. 11—DOUBLE HANDLE, 2-COIL COVERPLATE FOR MOTOR-STARTING EQUIPMENT

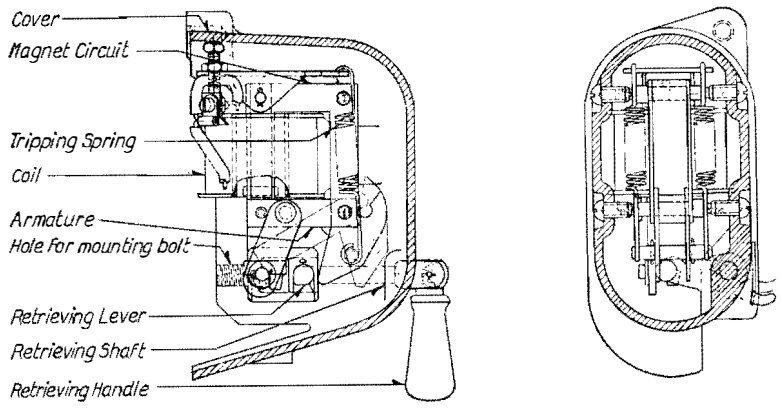


FIG. 12—HAND RETRIEVE UNDERVOLTAGE RELEASE

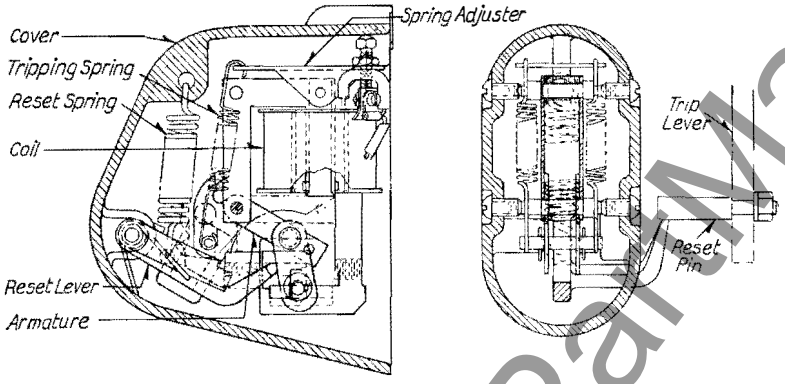


FIG. 13—AUTOMATIC RETRIEVE UNDERVOLTAGE RELEASE

that the tripping functions will be properly performed. A little oil on the bearings at intervals will keep the parts in good operating condition.

Other Devices—Though there is nothing about the construction of the other auxiliaries and tripping devices which would require the attention of the operator periodically, yet it is recommended that the tripping devices be given a casual inspection to see that cotter pins have not become lost and that screws and bolts are tight. Moving parts should be operated by hand to see that they are free on their bearings and do not bind.

Description and Adjustments of Auxiliaries

Coverplate—The coverplate contains the operating handle with space for overload coil, auxiliary switch, bell alarm, undervoltage and other auxiliaries. The operating handle is in two parts. The trip lever is attached to the breaker unit through a rod at the rear of the panel and engages the trigger in the handle lever on the front of the panel. The handle trigger holds the handle lever down after the circuit-breaker has been closed by pushing the handle. The auxiliaries will operate to disengage the trigger from the trip lever. Raising the handle disengages the handle trigger and permits the breaker unit to open.

The coverplate is made in three arrangements, the two-coil single-handle coverplate is used on non-automatic or automatic single-throw breakers unless special requirements demand the three-coil single-handle coverplate.

The double-handle coverplate is used with all automatic and non-automatic motor starting combination of breakers.

A special assembly of this double-handle coverplate can be used with motor starting combinations. It is provided with a pin to operate the automatic retrieve undervoltage release and latches are removed from starting side so that it is impossible to leave the motor running on starting voltage.

Undervoltage Release—The hand retrieve undervoltage release must be connected so as to leave the coil de-energized when the circuit-breaker is open. This may be done by energizing from the load side of breaker or wiring through the signal switch. Upon the reduction of the voltage across the coil

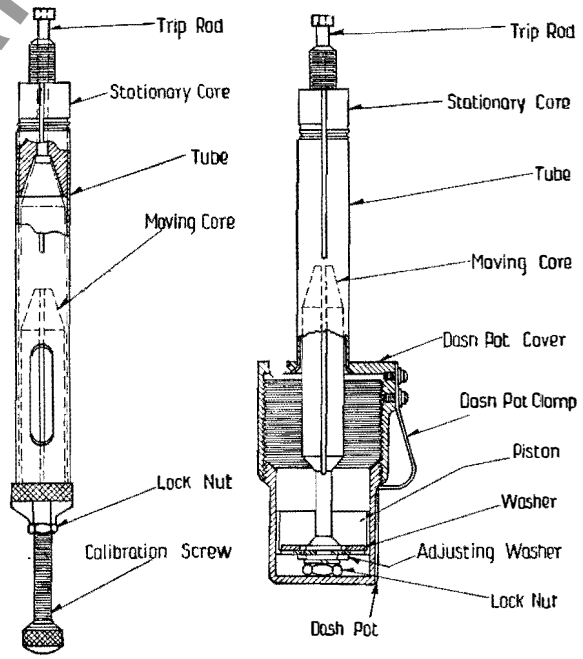


FIG. 14—OVERLOAD RELEASE CORES

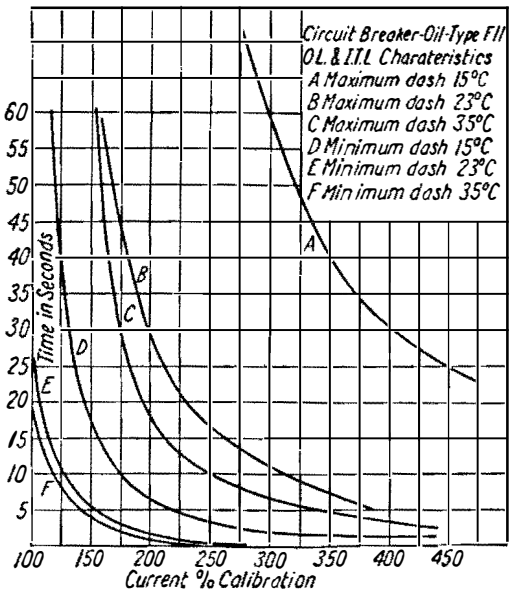


FIG. 15—CALIBRATION CURVE

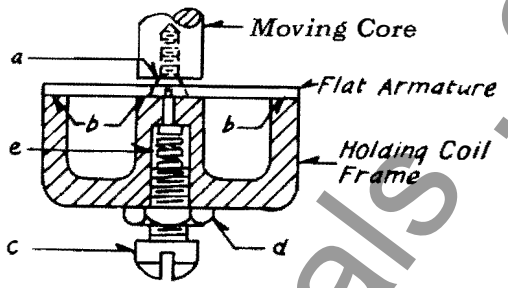


FIG. 17—DIRECT TRIP ARMATURE

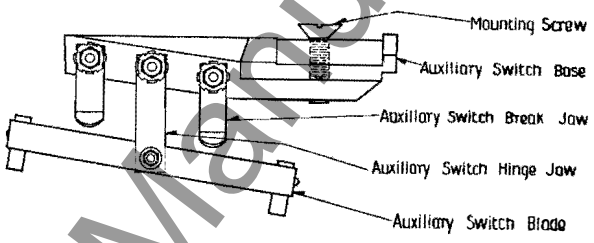


FIG. 18—AUXILIARY SWITCH

to approximately 50 per cent of the normal voltage, the armature will be drawn downward by the tripping springs. The armature will strike the tripping arm which will raise the trigger on the coverplate and allow the circuit-breaker to open. The armature is not reset by the circuit-breaker in opening and must be reset by rotating the retrieving handle to the left before the coil is re-energized. The coil will burn out if the current is flowing in the coil when the armature is not in the retrieved position. The retrieving handle must be released quickly to secure positive tripping action, in case the undervoltage coil is not energized.

If noise develops, the face of the armature and magnetic circuit should be inspected to see that a good clean seat is obtained when they are together. If necessary to clean this seat be careful to leave it bearing over its entire area. The coils are marked with their style number, the style number of the series resistor and the voltages and frequencies on which they may be used. Reference to these should be made in all correspondence regarding the device. The device is made for use with or without resistor, depending upon whether it is desired to trip the breaker by short-circuiting the undervoltage coil. When this is done it is necessary to have a resistor in the circuit in order that a short-circuit on the control wiring will not be obtained.

A screw adjustment is provided for the opening springs by which it is possible to alter the drop-out point over a considerable range.

The automatic retrieve undervoltage mounts on the right-hand side of the coverplate. Its operation is identical with that of the hand retrieve device except that an additional reset lever and spring are provided which will retrieve the armature to the closed gap position when the breaker opens. When the breaker closes, a pin on the coverplate trip lever engages this lever and holds it back so that the armature is free to trip the breaker. This undervoltage release should be energized from the line side of the breaker.

See Fig. 29 for connections when a rectox is supplied.

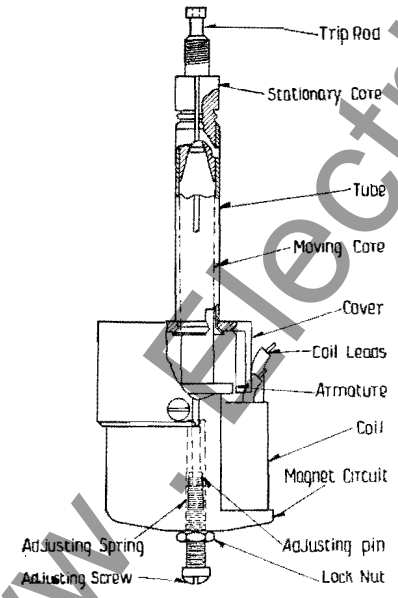


FIG. 16—DIRECT TRIP ATTACHMENT

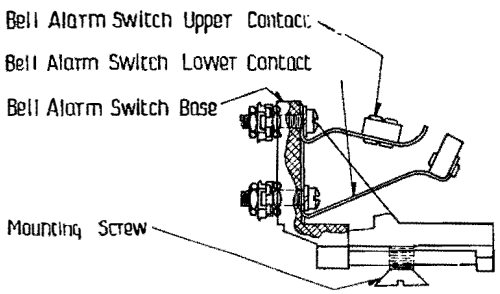


FIG. 19—BELL ALARM SWITCH

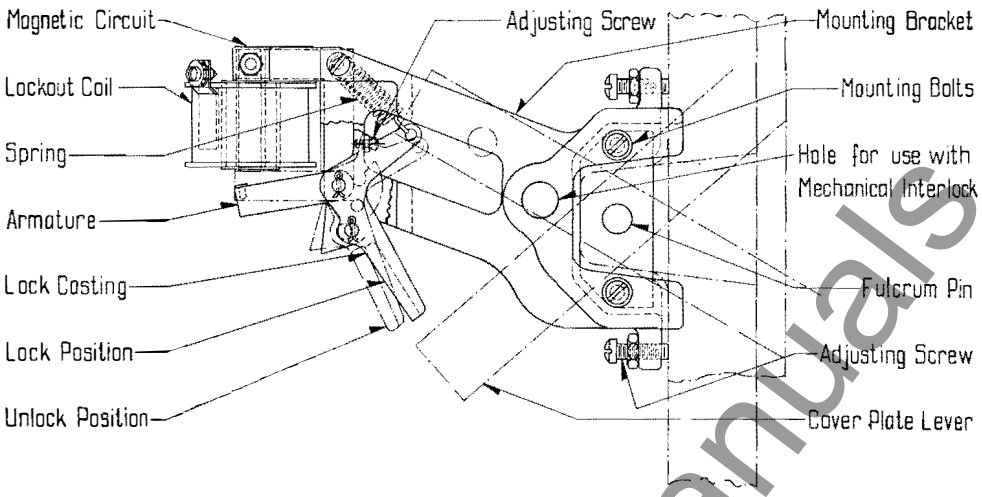


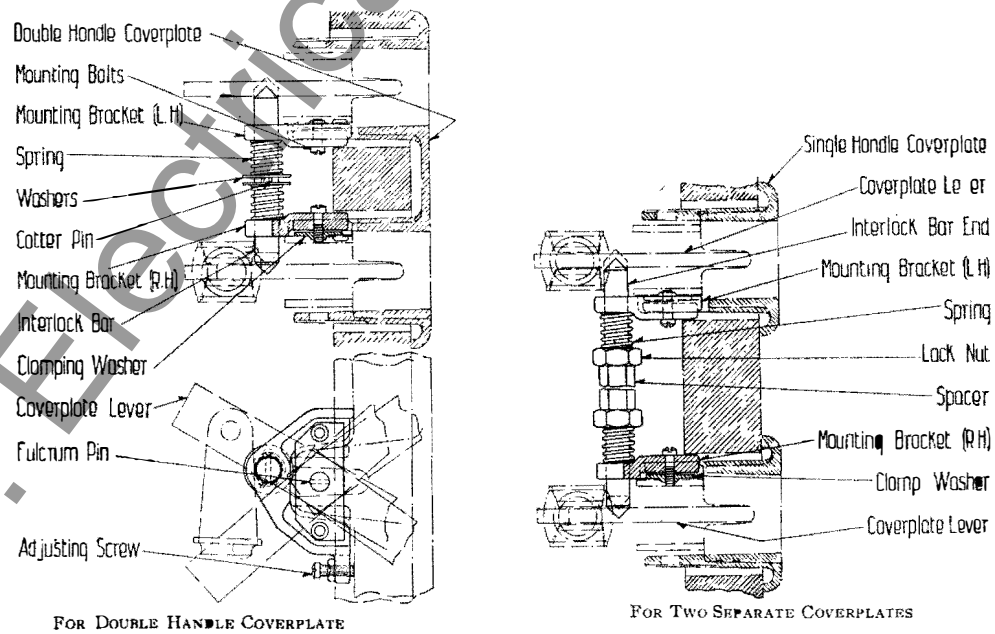
FIG. 20—ELECTRICAL LOCKOUT DEVICE

Overload Release (Fig. 14)—The overload release consists of the parts shown in the picture. The moving core is magnetically drawn against the trip rod which is pushed up against the trigger. The calibration is varied by changing the air gap between the moving and stationary cores, by raising and lowering the calibration screw. The lock nuts must be drawn tight after changing calibration. The calibration setting is indicated by figures on the tube opposite the line on the moving core and corresponds to amperes in the secondary of the current transformer.

If the opening of the circuit-breaker is not desired unless the overload continues, an oil dashpot is attached to the end of the moving core. The calibration is then inscribed on the dashpot and is varied by screwing the pot into the cover. The time is varied by changing the number of the holes in the bottom of the piston uncovered by the diaphragm. Instantaneous tripping is possible because the check valve action of the washer at the time of tripping varies inversely with the amount of overload and directly with the variation in the viscosity of the oil. Fig. 15 shows approximate variations of the time with the variations of the overload and the effect of changed temperature on the standard dashpot oil as supplied with the dashpot.

The values given in Fig. 15 are approximate and will vary somewhat with changes in temperature, and changes in viscosity of the oil. Where a definite time delay is required the delay should be obtained by the use of suitable relays. The oil in the dashpots should be renewed periodically to obtain the best service.

Fill with oil to ¾-inch above the inside bottom surface of the pot, with the plunger removed.



FOR DOUBLE HANDLE COVERPLATE

FOR TWO SEPARATE COVERPLATES

FIG. 21—MECRANICAL INTERLOCK

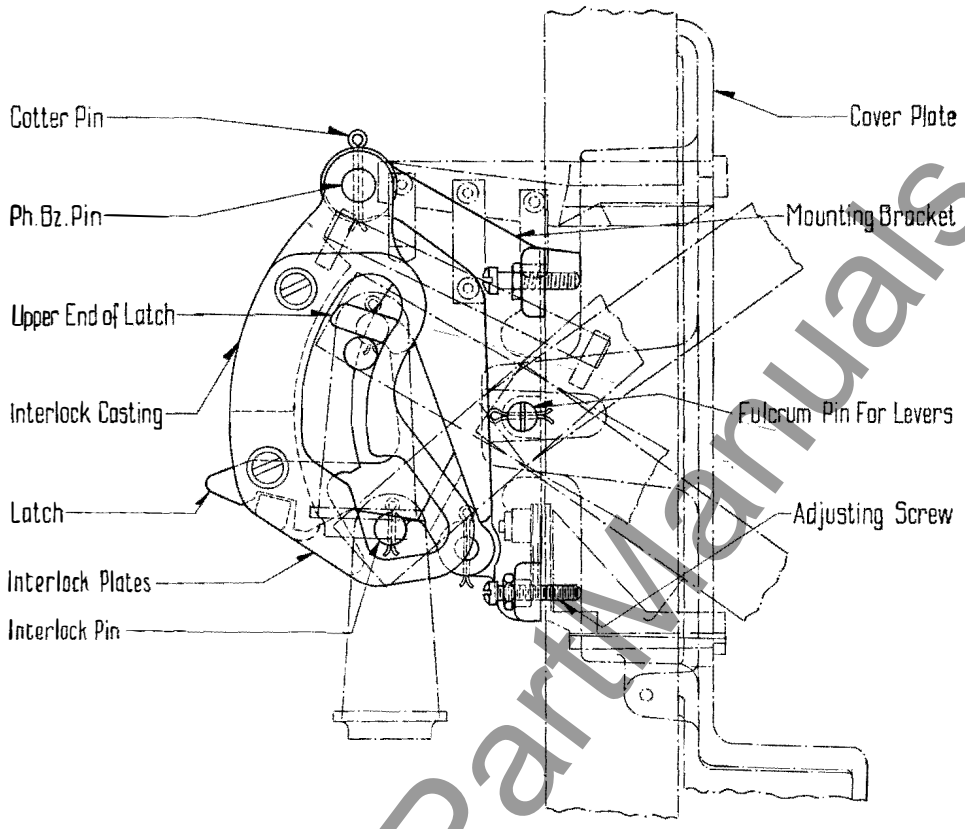


FIG. 22—MECHANICAL SEQUENCE INTERLOCK

Direct Trip Attachment (Figs. 16, 17, 28)—Two opposed trip coils are added below the overload trip coil when a definite time delay in tripping is desired. The holding coil, the terminals of which are marked 3 and 4, retains the armature which is fastened to the moving core until the terminals to the relay coil are short-circuited. The terminals are marked 1 and 2. The adjusting screw pushes on the balance spring which balances the weight of the moving core and armature and allows the armature to drop just far enough to touch the magnetic yoke when no current is flowing.

All dust and excelsior from packing must be removed from between the magnetic poles in order to permit the armature seating properly. Figure 17 shows the points that should be inspected to detect trouble.

Be sure that the flat armature is making good contact with the holding coil frame at point (b). If surfaces are dirty they should be cleaned off by rubbing lightly with a fine piece of emery cloth.

The flat armature must be able to move freely on the screw at point (a). Do not draw the screw tightly, as it is purposely left free to provide alignment of armature. If the setting of the adjusting screw (c) has been disturbed it should be readjusted until the proper pressure is put on the spring (e). This pressure is determined by the point at which the armature will remain seated when the breaker closes and it will trip when the secondary of the holding coil is short-circuited. After this setting is made and adjusted properly then the lock nut (d) should be tightly fastened.

Auxiliary Switch (Fig. 18)—The auxiliary switch is operated by the trip lever striking the fibre block in between the blades. The switch should be examined occasionally to be sure that the blades are making firm contact in the jaws, that the connections are tight and that the nuts are drawn tight on the clip washers at the hinge jaw.

Bell Alarm Switch (Fig. 19)—The bell alarm switch makes contact only when the handle is drawn down with the circuit-breaker open, as would be the case if tripped by any attachment. The upper block is depressed by the handle side bars and the lower block by the tripping lever. It should be examined occasionally to make sure that the contacts and all connections are secure.

Panel Bracket—The panel bracket is an iron casting with U-bolts to mount it to pipe structure and provided with holes so that the coverplate and breaker, or the coverplate alone, may be mounted on this bracket. It is especially adaptable to mounting the breaker on pipe structures where no panel is required, or where it is desirable to mount the breaker separately from the panel.

Pipe Bracket—The pipe mounting bracket for the breaker consists of pieces of angle iron provided with standard pipe fittings and holes so that the breaker unit is bolted to the angle iron and the angle iron is held to the pipe.

Pipe Structure—The pipe structure as supplied is a simple arrangement made of 1¼-inch pipe and standard

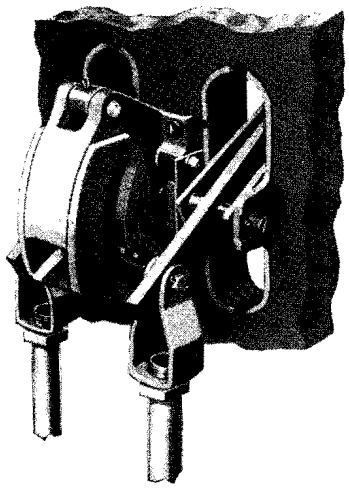


FIG. 23—VIEW OF STARTING SIDE WITH BOTH HANDLES OPEN

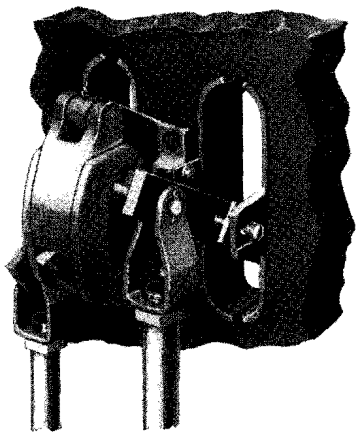


FIG. 24—VIEW OF STARTING SIDE WITH STARTING SIDE CLOSED

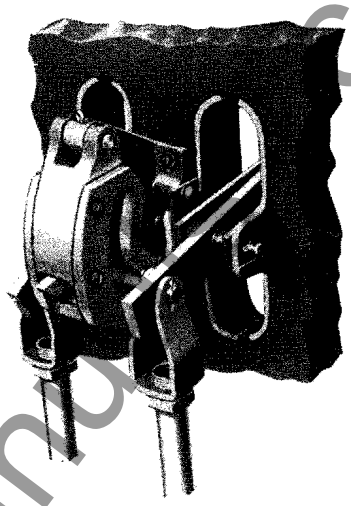


FIG. 25—VIEW OF STARTING SIDE JUST AS STARTING HANDLE IS REACHING ITS OPEN POSITION

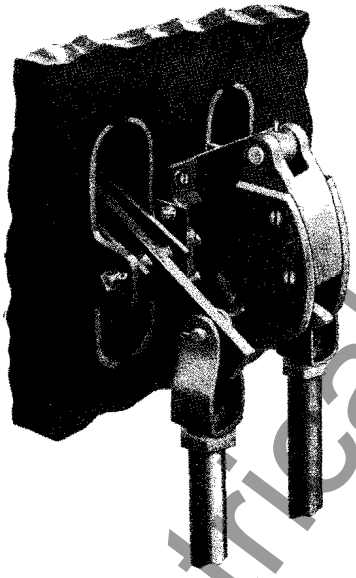


FIG. 26—VIEW OF RUNNING SIDE WITH BOTH HANDLES OPEN

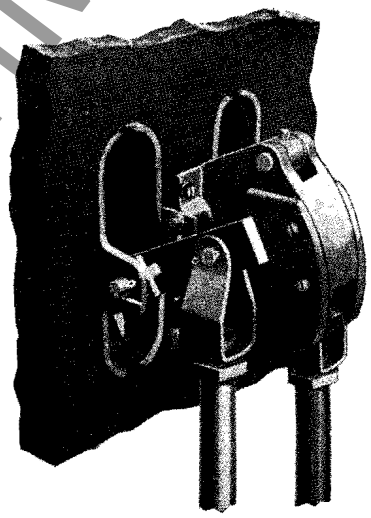


FIG. 27—VIEW OF RUNNING SIDE WITH RUNNING SIDE CLOSED

switchboard clamps, arranged to support the breaker by means of a panel bracket. It should be assembled with 12 inches of vertical pipe protruding above the horizontal pipe. This projection is for mounting transformers. When transformers are not used this pipe may be cut off.

Panel Frame Mounting Bracket—This bracket is designed for mounting the breaker 4½ inches back of the panel on a pipe structure, with the coverplate mounted on the front of the panel.

Mechanical Sequence Interlock (Fig. 22)—The sequence interlock provides first that both handles cannot be closed at the same time; second, the running handle cannot be closed until the starting handle has been completely opened; third, if the running handle is not thrown in within a very limited period of time after the starting handle is opened, it will be impossible to close the running side without first throwing in the starting side again.

With both sides of the circuit-breaker in the open position, the following operation should take place in putting the motor on the line with full voltage across the terminals. First, the starting handle is closed applying reduced voltage across the terminals on the motor. The upward motion of the starting handle at the upper end of its travel touches the upper projection of the unlocked lever and releases the interlocking casting. The interlocking casting then rotates on its axis to such a position that when the starting side of the circuit-breaker is open, the starting handle will then strike

the unlocking surface of the interlocking casting and withdraw it from in front of the running handle pin and allowing the running handle pin to raise, as would occur if the running side of the circuit-breaker had started to close. Thus it is easy to see that it is impossible to close the running side of the circuit-breaker until the starting side has been fully closed and has reached its full open position. At the opening of the circuit-breaker the interlock castings return to their original positions. The operation of the device can readily be seen by reference to the illustrations. Figs. 23 to 27.

RENEWAL PARTS DATA

Recommended Stock of Renewal Parts

TYPE F-122 OIL CIRCUIT-BREAKER

400-600 Amperes, 7500 Volts—800 Amperes, 5000 Volts, 2 or 3 Pole—Single Throw

FOR ILLUSTRATION OF PARTS SEE FIGURE 3

The following is a list of the Renewal Parts and the quantities of each that we recommend should be stocked by the user of this apparatus to minimize interrupted operation caused by breakdowns. The parts recommended are those most subject to wear in normal operation or those subject to damage or breakage due to possible abnormal conditions. This list of Renewal Parts is given only as a guide. When continuous operation is a primary consideration, additional insurance against shut-downs is desirable. Under such conditions more renewal parts should be carried, the amount depending upon the severity of the service and the time required to secure renewals.

	2-POLE			3-POLE			
Breakers in use up to and including		1	5		1	5	Style No. of Part
Description of Part	No. Req.	Recommended for Stock		No. Req.	Recommended for Stock		
Breaker Complete	1	0	0	1	0	0	.....
Breaker Unit Complete	1	0	0	1	0	0	.....
Accelerating Spring	2	0	1	2	0	1	969 732
*Moving Contact Complete	2	0	0	3	0	0	948 969
Lift Rod	2	0	1	3	0	1	947 447
Main Moving Contact	2	0	1	3	0	1	947 445
Main Moving Contact Spring	2	1	2	3	1	2	944 187
Moving Arcing Contact Bracket	2	0	0	3	0	0	1043 937
Moving Arcing Contact	4	4	8	6	6	12	947 450
Moving Arcing Contact Spring	4	2	4	6	2	4	1014 379
*Dashpot Cylinder	2	0	0	3	0	0	1041 484
*Dashpot Cylinder Mounting Screw	8	0	0	12	0	0	1016 729
*Dashpot Disc	2	0	0	3	0	0	1041 486
*Stationary Contact Complete	4	0	0	6	0	0	.....
Micarta Terminal Bushing (Standard)	4	0	2	6	0	2	969 733
Micarta Terminal Bushing (Lift-Up)	4	0	2	6	0	2	947 453
Main Stationary Contact	4	2	4	6	2	6	947 451
Stationary Arcing Contact	4	4	8	6	6	12	947 450
Stationary Arc Shield	4	0	0	6	0	0	947 454
Tank	1	0	0	1	0	0	947 455
Tank Liner	3	0	0	3	0	0	947 456
*Type SA-2 Operating Mechanism	1	0	0	1	0	0	See I.B. 5279
*†Closing Coil	1	0	0	1	0	0	†
*†Trip Coil	1	0	1	1	0	1	†

*Not listed on illustration.
†When ordering, specify identification number stamped on coil.
Parts indented are included in the part under which they are indented.

ORDERING INSTRUCTIONS

When ordering Renewal Parts, always specify the name of the part wanted as shown on the illustrations in this Instruction Book, giving Shop Order Number and the type of Circuit-Breaker as shown on the nameplate. For example:

One Moving or Stationary Contact Complete, 600 Amp. for Type F-122 Circuit-Breaker, S.O. 23-F-747 shown in Instruction Book 5746, Figure 3.

To avoid delays and misunderstandings, note carefully the following points:

1. Send all correspondence and orders to the nearest Sales Office of the Company.

2. State whether shipment is to be made by freight, express or parcel post. In the absence of instructions, goods will be shipped at our discretion. Parcel post shipments will be insured only on request. All shipments are at purchaser's risk.

3. Small orders should be combined so as to amount to a value of at least $1.00 net. Where the total of the sale is less than this, the material will be invoiced at $1.00.

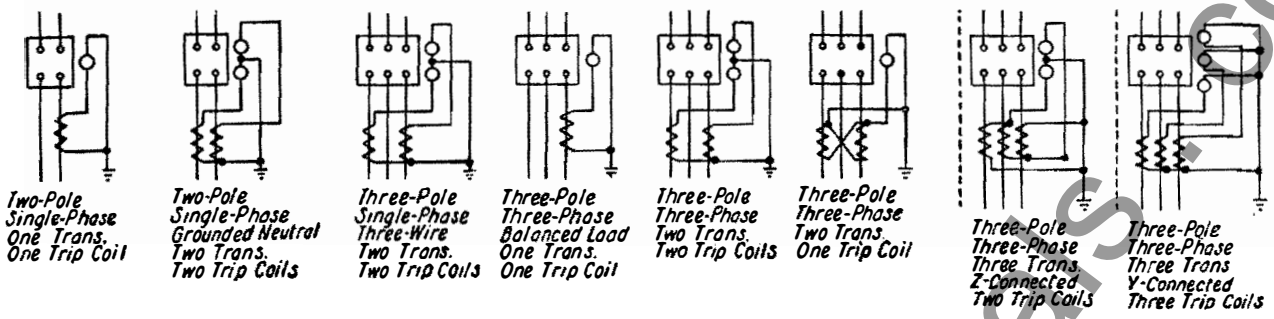


FIG. 28-A—TYPICAL TRANSFORMER TRIP COIL CONNECTIONS

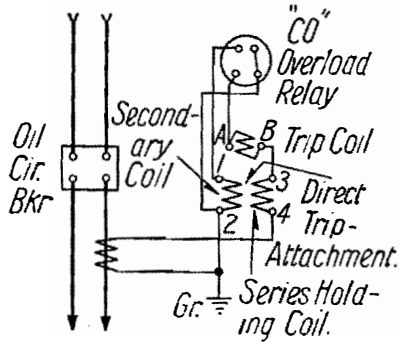


FIG. 28-B—SCHEMATIC DIAGRAM OF CONNECTIONS FOR DIRECT TRIP ATTACHMENT

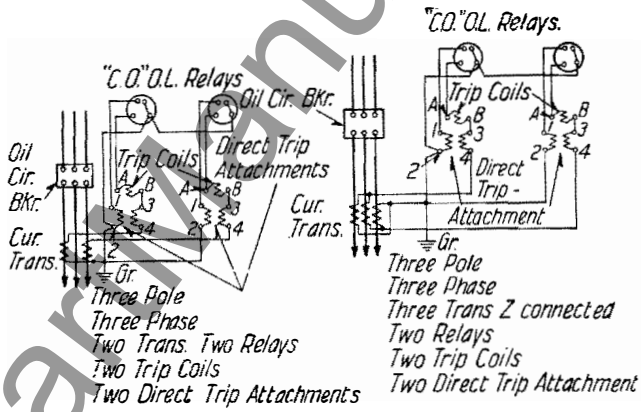
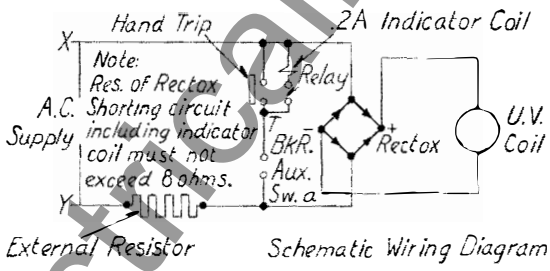


FIG. 28-C—DIAGRAMS OF CONNECTIONS FOR DIRECT TRIP ATTACHMENTS



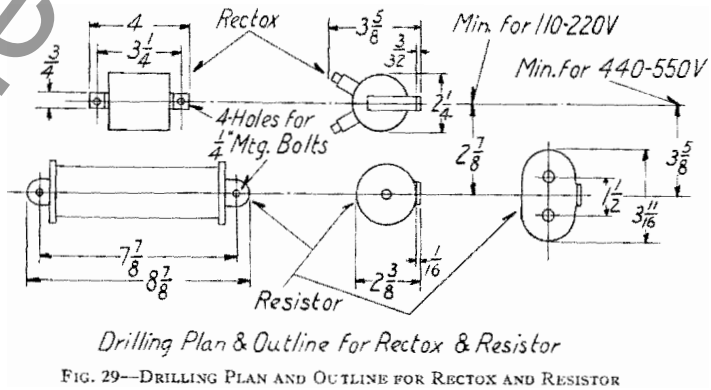


FIG. 29—DRILLING PLAN AND OUTLINE FOR RECTOX AND RESISTOR

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

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†APPLETON, WISC., 1029 So. Outagamie St.
#†*ATLANTA, GA., 426 Matietta St., N. W.
xATTICA, N. Y.
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*BAKERSFIELD, CALIF., 2224 San Emedio St.
*BALTIMORE, MD., 118 E. Lombard St.
†BALTIMORE, MD., 501 East Preston St.
xBALTIMORE, MD., 2519 Wilkens Ave.
①*†BATON ROUGE, LA., 128-134 So. Sixteenth St.
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*BIRMINGHAM, ALA., 1407 Comer Bldg.
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†#BOSTON, MASS., 235 Old Colony Ave., So. Boston, Mass.
①*†BRIDGEPORT, CONN., 540 Grant St.
① *BUFFALO, N. Y., 814 Ellicott Square
†#BUFFALO, N. Y., 1132 Seneca St.
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*BUTTE, MONTANA, 129 West Park St.
#BUTTE, MONTANA, Iron & Wyoming Srs.
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① *CHATTANOOGA, TENN., Volunteer State Life Bldg., Georgia Ave. & East Ninth St.
*CHICAGO, ILL., 20 N. Wacker Drive, P.O. Box B
†#CHICAGO, ILL., 2211 W. Pershing Road, P.O. Box 1103
*†#CINCINNATI, OHIO, 207 West Third St.
*†x#CLEVELAND, OHIO, 1216 W. Fifty-Eighth St.
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*DALLAS, TEXAS, 209 Browder St.
#DALLAS, TEXAS, 1712 Laws St.
*DAVENPORT, IOWA, 206 E. Second St., P.O. Box 55
*DAYTON, OHIO, 30 North Main St.
*DENVER, COLORADO, 910 Fifteenth St.
#DENVER, COLORADO, 1700 Sixteenth St.
†DENVER, COLORADO, 988 Cherokee St.
xDERRY, PA.
*DES MOINES, IOWA, 1400 Walnut St.
*†#DETROIT, MICH., 5757 Trumbull Ave., P.O. Box 828
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§EAST PEORIA, ILL., 900 W. Washington St.
x#EAST PITTSBURGH, PA.
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#EL PASO, TEXAS, 450 Canal St.
*EMERYVILLE, CALIF., 5915 Green St.
#†EMERYVILLE, CALIF., 1466 Powell St.
xEMERYVILLE, CALIF., 6121 Green St.
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① *FRESNO, CALIF., 872 Peralta Way, P.O. Box 1249
*GARY, IND., 846 Broadway
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① *GREENSBORO, N. C., 409 W. Bessemer St., P.O. Box 1828
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*HAMMOND, IND., 235 Locust St.
*HARTFORD, CONN., 36 Pearl St.
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*HOUSTON, TEXAS, 1314 Texas Ave.
#HOUSTON, TEXAS, 2313 Commerce Ave.
†HOUSTON, TEXAS, 2315 Commerce Ave.
†*#HUNTINGTON, W. VA., 1029 Seventh Ave.
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†INDIANAPOLIS, IND., 551 West Merrill St.
*ISHPEMING, MICH., 433 High St.
*JACKSON, MICH., 212 West Michigan Ave.
① *JACKSONVILLE, FLA., 37 Hogan St., South, P.O. Drawer K
*†JOHNSTOWN, PA., 107 Station St.
*KANSAS CITY, MO., 101 W. Eleventh St.
#†KANSAS CITY, MO., 2124 Wyandotte St.
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xLIMA, OHIO
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†MILWAUKEE, WISC., 4560 No. Port Washington Rd.
*†#MINNEAPOLIS, MINN., 2303 Kennedy St., N. E.
*MONROE, LA. 1503 Emerson St., P.O. Box 1851
*NASHVILLE, TENN., 219 Second Ave., N.
*NEWARK, N. J., 1180 Raymond Blvd.
†#NEWARK, N. J., Haynes Ave. & Lincoln Highway
xNEWARK, N. J., Plane & Orange St.
*NEW HAVEN, CONN., 42 Church St., P. O. Box 1817
*NEW ORLEANS, LA., 333 St. Charles St.
#NEW ORLEANS, LA., 527 Povdras St.
*NEW YORK, N. Y., 150 Broadway
†NEW YORK, N. Y., 150 Varick St.
*NIAGARA FALLS, N. Y., 253 Second St.
*NORFOLK, VA., 320 City Hall Ave.
*OKLAHOMA CITY, OKLA., 120 N. Robinson St.
#OKLAHOMA CITY, OKLA., Third & Alie Sts.
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*†#PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZONA, 11 West Jefferson St.
#PHOENIX, ARIZONA, 425 Jackson St.
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z*PITTSBURGH, PA., 306 4th Ave., Box 1017
#†PITTSBURGH, PA., 543 N. Lang Ave.
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†PORTLAND, OREGON, 2138 N. Interstate Ave.
#PORTLAND, OREGON, 720 N. Thompson St.
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*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO, CALIF., Twentieth & "R" Sts.
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†#ST. LOUIS, MO., 717 South Twelfth St.
§*SALT LAKE CITY, UTAH, 10 West First South St.
†#SALT LAKE CITY, UTAH, 346 A Pierpont Ave.
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*SAN DIEGO, CALIF., 861 6th Ave.
§SAN FRANCISCO, CALIF., 1355 Market St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
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†#SEATTLE, WASH., 3451 East Marginal Way
§SEATTLE, WASH., 1041 First Ave., South
xSHARON, PA., 469 Sharpsville Ave.
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*SOUTH BEND, IND., 216 East Wayne St.
xSOUTH PHILA. WKS., Essington, Pa.
°SOUTH PHILA. WKS., P.O. Box 7348, Philadelphia, Pa.
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*SPRINGFIELD, ILL., 601 E. Adams St., Box 37
*†SPRINGFIELD, MASS., 395 Liberty St.
xSPRINGFIELD, MASS., 653 Page Boulevard
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*TACOMA, WASH., 1023 "A" St.
*TAMPA, FLA., 417 Ellamae Ave., Box 230
*TOLEDO, OHIO, 245 Summit St.
xTRAFFORD CITY, PA.
*TULSA, OKLA., 303 East Brady St.
*†#UTICA, N. Y., 113 N. Genesee St.
*WASHINGTON, D. C., 1434 New York Ave., N. W.
*WATERLOO, IOWA, 328 Jefferson St., P.O. Box 147
*†WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
① *WORCESTER, MASS., 507 Main St.
*YORK, PA., 143 So. George St.
*YOUNGSTOWN, OHIO, 25 E. Boardman St.

Where address and P. O. box are both given, send mail to P. O. box, telegrams to address indicated.

WESTINGHOUSE AGENT JOBBERS

Westinghouse Electric Supply Company—Headquarters—150 Varick St., New York, N. Y.

Fully equipped sales offices and warehouses are maintained at all addresses.

ALBANY, N. Y., 454 No. Pearl St.
ALLENTOWN, PA., 522 Maple St.
ATLANTA, GA., 96 Poplar St., N. W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
BINGHAMTON, N. Y., 87 Chenango St.
BOSTON, MASS., 88 Pearl St.
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONTANA, 50 East Broadway
CHARLOTTE, N. C., 210 East Sixth St.
CHICAGO, ILL., 113 North May St.
CLEVELAND, OHIO, 6545 Carnegie Ave.
COLUMBIA, S. C., 915 Lady St.
DALLAS, TEXAS, 405 No. Griffin St.
DAVENPORT, IOWA, 402 E. Fourth St.
DES MOINES, IOWA, 1400 Walnut St.
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FORT WORTH, TEXAS, 210 Jones St.
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MEMPHIS, TENN., 366 Madison Ave.
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MILWAUKEE, WISC., 546 N. Broadway
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NEWARK, N. J., 49 Liberty St.
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zNEW YORK, N. Y., 150 Varick St.
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OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
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PITTSBURGH, PA., 575 Sixth Ave.
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RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
ROCHESTER, N. Y., 1048 University Ave.
ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
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SAN ANTONIO, TEXAS, 1211 E. Houston St.
SAN FRANCISCO, CALIF., 260 Fifth St.
①SEATTLE, WASH., 1051 First Ave., So.
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
①TACOMA, WASH., 1115 "A" St.
TAMPA, FLA., 417 Ellamae St.
TERRE HAUTE, IND., 234 So. 3rd St.
TOLEDO, OHIO, 1920 N. Thirteenth St.
TRENTON, N. J., 245 N. Broad St.
①TULSA, OKLA., 303 East Brady St.
UTICA, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N.W
WATERLOO, IOWA, 328 Jefferson St.
WHEELING, W. VA., 1117 Main St.
WICHITA, KANSAS, 233 So. St. Francis Ave.
WILLIAMSPORT, PA., 348 W. Fourth St.
WILMINGTON, DEL., 216 E. Second St.
①WORCESTER, MASS., 17 Mulberry St.
YORK, PA., 143 S. George St.

*Sales Office † Service Shop x Works # Warehouse ° First Class Mail Only § Merchandising Products Only z Headquarters ‡ Apparatus Products Only

①**Changed or added since previous issue.**

October, 1940

HP DOP. SEP BA Spl.

WESTINGHOUSE AGENT JOBBERS—Continued
Other Agent Jobbers

ABILENE, KAN., Union Electric Co.
AKRON, OHIO, The Moock Electric Supply Co.
BIRMINGHAM, ALA., Moore Handley Hdwe. Co.
BLUEFIELD, W. VA., Superior-Sterling Co.
① BUFFALO, N. Y., Buffalo Electric Co., Inc.
CANTON, OHIO, The Moock Electric Supply Co.
‡CHATTANOOGA, TENN., Mills & Lupton Supply Co.
CHICAGO, ILL., Hyland Electrical Supply Co.
CINCINNATI, OHIO, The Johnson Electric Supply Co.
COLUMBUS, OHIO, Pixley Electric Supply Co.
‡DENVER, COL., The Mine & Smelter Supply Co.
‡EL PASO, TEX., Mine & Smelter Supply Co.
ERIE, PA., Star Electrical Co.
HUNTINGTON, W. VA., Banks Miller Supply Co.
KANSAS CITY, MO., Columbian Elec'l Co.
KANSAS CITY, MO., Continental Elec. Co.
LEXINGTON, KY., Tafel Elec. & Supply Co.
LOUISVILLE, KY., Tafel Electric & Supply Co.
①§MONROE, LA., Monroe Hardware Co.
NASHVILLE, TENN., Tafel Electric & Supply Co.
NEW ORLEANS, LA., Electrical Supply Co.
NEW ORLEANS, LA., Monroe Hardware Co.
NEW YORK, N. Y., Times Appliance Co., Inc.
SAN DIEGO, CALIF., The Electric Supplies Distributing Co.
SCRANTON, PA., Penn Elect'l Engineering Co.
YOUNGSTOWN, OHIO, Moock Electric Supply Co.

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xBELLEVILLE, N. J., 720 Washington Ave.
zxBLOOMFIELD, N. J., Clearfield Ave.
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#BOSTON, MASS., 235 Old Colony Ave., S. Boston, Mass.
*BUFFALO, N. Y., 295 Main St.
*CHICAGO, ILL., 20 North Wacker Drive
#CHICAGO, ILL., 2211 W. Pershing Road
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*COLUMBUS, OHIO, 85 E. Gay St.
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*DAVENPORT, IOWA, 206 East Second St.
*DENVER, COLO., 910 Fifteenth St.
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① #PITTSBURGH, PA., 543 N. Lang Ave.
*RICHMOND, VA., 301 So. Fifth St.
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#ST. LOUIS, MO., 1219-21 Gratoit St.
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*SAN FRANCISCO, CALIF., 1 Montgomery St.
#SAN FRANCISCO, CALIF., 60 Federal St.
*SEATTLE, WASH., 603 Stewart St.
#SEATTLE, WASH., 3451 East Marginal Way
*SYRACUSE, N. Y., 961 W. Genesee St.
*TOLEDO, OHIO, 245 Summit St.
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BUFFALO, N. Y., 806 Ellicott Sq. Bldg.
CHICAGO, ILL., 222 No. Bank Drive
CINCINNATI, OHIO, Third & Elm Sts.
CLEVELAND, OHIO, 842 Rockefeller Bldg.
◆COLUMBUS, OHIO, 85 E. Gay St.
DALLAS, TEXAS, 209 Browder St.
◆DENVER, COLO., 1052 Gas & Electric Bldg.
◆DES MOINES, IOWA, 1408 Walnut St.
DETROIT, MICH., 5757 Trumbull Ave.
◆DUBUQUE, IOWA, c/o Roshek Store
◆HARTFORD, CONN., 410 Asylum St.
◆HOUSTON, TEXAS, 2315 Commerce St.
◆INDIANAPOLIS, IND., 551 W. Merrill St.
zxJERSEY CITY, N. J., 150 Pacific Ave.
◆KANSAS CITY, MO., 101 W. Eleventh St.
◆LANSING, MICH., 1406 Massachusetts Ave.
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◆LOUISVILLE, KY., 332 West Broadway
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NEW YORK, N. Y., 9 Rockefeller Plaza
NEW YORK, N. Y., 128 E. 149 St.
PHILADELPHIA, PA., 3001 Walnut St.
PITTSBURGH, PA., 435 Seventh Ave.
◆PORTLAND, ORE., 415 Terminal Sales Bldg.
◆SACRAMENTO, CALIF., 927 "O" St.
ST. LOUIS, MO., 1601 Ambassador Bldg.
SAN FRANCISCO, CALIF., 1 Montgomery St.
◆STEUBENVILLE, OHIO, 308 Narl. Exch. Bldg.
◆TULSA, OKLA., 303 Brady St.
WASHINGTON, D. C., 1112 21st St., N. W.

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY
Headquarters—150 Broadway, New York, N. Y., U. S. A.

*ARGENTINE, BUENOS AIRES, Cia. Westinghouse Electric Internacional, S. A., Rivadavia 819
*AUSTRALIA, SYDNEY, Box 2634-EE G.P.O.
*BRAZIL, RIO DE JANEIRO, Caixa Postal 1320
*BRAZIL, SAO PAULO, Caixa Postal 4191
① *COLOMBIA, MEDELLIN, Apartado Nacional 43
① *CHILE, SANTIAGO, c/o Wessel Duval y Cia. S.A.C., Casilla 86-D
*CUBA, HAVANA, Apartado 2289
*ENGLAND, LONDON, W.C. 2, 2 Norfolk St., Strand
① *INDIA, BOMBAY, Westinghouse Electric Co. of India Ltd., 294A Bazargate St.
*ITALY, MILANO, Piazza Crispi 3
*MEXICO, D. F. Mexico, Cia. Westinghouse Electric Internacional, Edificio la Nacional, Apartado 78 Bis.
*PANAMA, REPUBLIC, Panama, Apartado 742
*PERU, LIMA, Casilla 1685
*PHILIPPINE ISLANDS, Manila, P.O. Box 998
① *PUERTO RICO, San Juan, P.O. Box 1748
*SOUTH AFRICA, JOHANNESBURG, Westinghouse Electric Co. of South Africa Ltd., P.O. Box 6067

WESTINGHOUSE X-RAY COMPANY, INC.
Headquarters—21-16 43rd Ave., Long Island City, N. Y.

*ATLANTA, GA., 565 W. Peachtree St., N. E.
*BALTIMORE, MD., 118 East Lombard St.
*BOSTON, MASS., 270 Commonwealth Ave.
*CHICAGO, ILL., 14 No. Franklin St.
*CLEVELAND, OHIO, 7016 Euclid Ave.
*DALLAS, TEXAS, 207 Browder St.
① *DENVER, COLO., 910 Fifteenth St.
#*DETROIT, MICH., 5757 Trumbull Ave.
*KANSAS CITY, MO., 410 Professional Bldg.
zxLONG ISLAND CITY, N. Y., 21-16 43rd Ave.
*LOS ANGELES, CALIF., 420 S. San Pedro St.
*MILWAUKEE, WISC., 534 North Broadway
*NEW ORLEANS, LA., 427 Baronne St.
*NEW YORK, N. Y., 173 E. Eighty-Seventh St.
*OMAHA, NEB., 117 N. Thirteenth St.
*PHILADELPHIA, PA., 3001 Walnut St.
*PITTSBURGH, PA., 3702 Fifth Ave.
*PORTLAND, OREGON, 1220 S. W. Morrison St.
① *ROCHESTER, N. Y., 1048 University Ave.
*SAN FRANCISCO, CALIF., 870 Market St.
*SEATTLE, WASH., 3451 E. Marginal Way

BRYANT ELECTRIC COMPANY
Headquarters—1421 State St., Bridgeport, Conn.

*BOSTON, MASS.
zxBRIDGEPORT, CONN., Main Plant, 1421 State St.
xBRIDGEPORT, CONN., Plastics Division Plant, 1105 Railroad Ave.
*#CHICAGO, ILL., 844 West Adams St.
*#LOS ANGELES, CALIF., 420 S. San Pedro St.
*NEW YORK, N. Y., 101 Park Ave.
*#SAN FRANCISCO, CALIF., 325 Ninth St.

WESTINGHOUSE RADIO STATIONS
Headquarters—2519 Wilkins Ave., Baltimore, Md.

STATION KDKA, 310 Grant St., Pittsburgh, Pa.
STATION WBZ, 271 Tremont St., Boston, Mass.
STATION KYW, 1619 Walnut St., Philadelphia, Pa.
STATION WBZA, Hotel Kimball, Springfield, Mass.
STATION WOWO, 925 So. Harrison St., Fort Wayne, Ind.
STATION WGL, 925 So. Harrison St., Fort Wayne, Ind.

CANADIAN WESTINGHOUSE COMPANY, LIMITED
Headquarters—Hamilton, Ontario, Canada

*†#CALGARY, 320 Eighth Avenue West, Calgary, Alberta, Can.
#*EDMONTON, 10127,104th St.,Armstrong Block, Edmonton, Alberta, Can.
#*FORT WILLIAM, 112 McVicar St., Fort William, Ontario, Can.
#*HALIFAX, 158 Granville St., Halifax, Nova Scotia, Can., P.O. Box 204
xz*HAMILTON, Hamilton, Ontario, Can.
*LONDON, 504 Huron & Erie Bldg., London, Ontario, Can.
*MONTREAL, 1135 Beaver Hall Hill, Montreal, Quebec, Can.
§MONTREAL, 400 McGill St., Montreal, Quebec, Can.
#†MONTREAL, 1844 William St., Montreal, Quebec, Can.
*NELSON, B. C. Can., P. O. Box 70
#*OTTAWA, Ahearn & Soper Limited, P.O. Box 794, Ottawa, Ontario, Can.
*†#REGINA, 2408 Eleventh Ave., Regina, Saskatchewan, Can.
*SASKATOON, 238 First Ave. N., Saskatchewan, Can.
†#*SWASTIKA, Swastika, Ontario, Can.
*†#TORONTO, 355 King St., West, Toronto, Ontario, Can.
*VANCOUVER, 1418 Marine Bldg., Vancouver, B. C., Can.
†#VANCOUVER, 1090 Homer St., Vancouver, B. C., Can.
#*†WINNIPEG, 158 Portage Ave. East, Winnipeg, Manitoba, Can.

①**Changed or added since previous issue.**

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