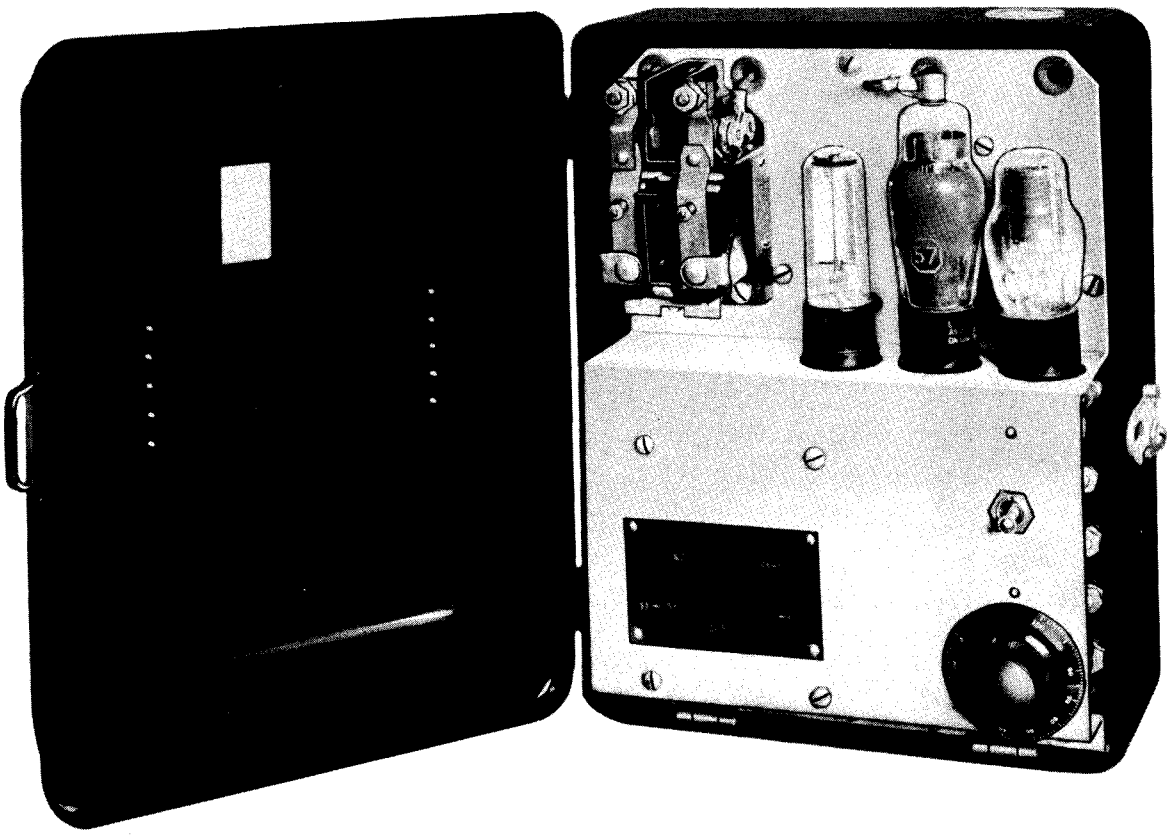
WESTINGHOUSE TYPE RX-1 PHOTO-TROLLER

Instructions for Installation



Westinghouse Electric and Manufacturing Company
East Pittsburgh, Pa.

Printed in U.S.A. (6-38

I.B. 5670-44

Westinghouse Type RX-1 Photo-Troller

INDEX

LIST OF ILLUSTRATIONS

Westinghouse Type RX-1 Photo-Troller

PREFACE

(1) The RX-1 Photo-Troller is one type of a line of general purpose photo-electric relays operated by an increase or decrease in the amount of light falling on a phototube. They are arranged to initiate an electrical sequency in response to changes of illumination caused by partially or completely interrupting a light beam. A few installations are shown which are representative of the great variety of applications.

In order that maximum flexibility of application may be obtained, various types of light sources and phototube housings may be used as shown in attached Price Lists 18-315 and 18-316. Several types of Photo-Trollers are available, each of which is best adapted for particular applications.

LIST OF APPLICATIONS

Limit of "flag" switch where a mechanical switch is undesirable such as for

Paper mills - break indicator
Automatic weighing
Sheet catcher in steel mill
Oscillating grinder belt
Paper and cellophane bag machines
Registering wrapper trademark on packaging machines
Stopping mechanical devices at accurate position
Liquid level control
Initiating flying shear.

Counting

Parts on production lines such as crankshafts, boxes, tin sheets.
People entering or leaving buildings
Automobile traffic

GENERAL DATA

Door Opening

The RX-1 photo-troller is arranged with a steel panel which is hinged at the bottom of the case and held in place by one screw at the top. The indoor units are provided with a rectangular knockout in the door which may be removed to serve as a light aperture if the phototube is mounted in the cabinet.

A type SG relay is operated directly from the tube circuit. Thus, no interposing sensitive relays, such as are usually needed if radio amplifiers are used, are required.

This relay has two pairs of contacts which can be arranged to give two normally closed contacts or one normally open and one normally closed contact.

The RX-1 Photo-troller provides the power supply for a light source with either a 6-8 volts, 32 candlepower lamp or a 6 volt, 5 ampere lamp, Style 849085.

A terminal board is provided at the rear of the panel for all connections except to the relay contacts which are on the relay itself in front of the panel. The terminal board is readily accessible for installation, since the removal of a single screw permits swinging the panel down on hinges to hang from the bottom of the cabinet.

The type RX-1 is equipped with a phototube, an amplifier tube and a thyratron tube. The output of the WL-735 phototube is amplified by a 57 tube. This output, in turn, operates a WL-629 thyratron which energizes the SG relay.

A switch is provided so that the unit may be used to energize the SG relay, when light on the phototube is either increased or decreased. For either arrangement, a minimum of 1.0 foot-candle light intensity is required to operate the relay. The light intensity must be reduced at least 50% to insure positive operation of the relay.

At least 0.2 second should be allowed between centers of light impulses, corresponding to 300 operations per minute. At the speed of operation, the 0.2 second must be divided equally between the "on" and "off" period. The maximum recommended rate of operation is 150 per minute. However, the approximate time of light change required to operate the relay is 0.05 second.

If the phototube is mounted in a separate housing, it may be located up to 25 cable feet distance, although standard housings are furnished with 10 feet of cable, which is usually sufficient. Distances beyond 10 feet slow down the speed of response 25%, and longer times than those given for operation must be allowed. The footcandle rating of the unit is then also increased to 1.5 footcandles.

(2) HOW TO SELECT AND APPLY PHOTO-TROLLERS

The first fundamental in application of photo-trollers is that is desirable to have as much excess illumination as possible beyond that required by the rating, in order that the safety factor will be increased.

Photo-trollers operate by variation of the quantity of light falling on the phototube. Ratings are given in terms of light intensity for greater convenience in application, and these ratings in terms of light intensity are based on the assumption that the full phototube or lens opening of the photo-troller will be used. Therefore, if the photo-troller is used in such a manner that only a portion of the phototube or lens opening is open, proportionately greater light intensity must be allowed.

If photo-electric equipment is to be operated in the vicinity of smoke, fog, dirt, steam or other similar conditions, it is necessary to add the best possible estimate of light loss factor so that adequate safety margin will be insured.

Since photo-trollers operate by variation of the quantity of light falling on the phototube, it follows that the method of obtaining this variation is important. Two methods of varying illumination are in general use - variation of transmission and variation of reflection.

Transmission is varied by arranging an opaque, or partially opaque, object to intercept the beam of light which normally passes from light source to phototube. This is the most common method of operation and may be used for automobiles, people, paper sheets, steel sheets, packages, etc. Clear cellophane is obviously not very opaque and, therefore, does not vary the light beam much when intercepted by it. When operating with material of this nature whose opacity is not high, it is very important to know what this opacity is. Such applications are usually more difficult and it is recommended that they be referred to the nearest District Office of the Westinghouse Company for recommendations.

Reflection is varied by arranging the optical system so that the light beam is reflected from the material to the phototube and the extent of this reflection is varied by the character of the surface of the material.

The actual procedure to be used in selecting the proper photo-trollers and light source is:

1 - Determine what portion of the light beam will be available under maximum illumination conditions.

2 - Determine what portion of the illumination will be intercepted by the controlling object.

3 - Select a photo-troller having the general characteristics desired, and then

4 - Select a combination of photo-troller and light source such that at the distances and operating conditions determined under paragraphs (1) and (2), adequate sensitivity will be obtained.

5 - Re-check all variable factors to make certain that adequate safety margin is proceded in the selection.

(3) Phototube Housings

T The RX-1 Photo-troller is arranged so that the phototube may be mounted inside the case. When this is done the knock-out in the case door should be pressed out to permit the light to reach the phototube. In many applications it is preferable to mount the phototube in a separate housing, and for this purpose, one of the housings shown in attached Price List 18-315 should be used.

(4) Various types of light sources are shown in attached Price List 18-316, all of which, except the type L, can be used with the type RX-1 Photo-troller. In selecting the light source care must be taken that the minimum illumination on the phototube must not exceed the values given in fig. 2.

In this figure are shown different scales for the maximum illumination for different percentage changes in a-c line voltage. Using, for example, the basic 2 per cent curve, it is seen that if the maximum illumination is 3 foot candles, the minimum illumination must not exceed 1.9 foot candles. If, however, the maximum line voltage variation is 20 per cent and the maximum illumination is 3 foot candles at maximum a-c voltage, then the minimum illumination 0.9 foot candles is found by following the circle from A to B, then to C and to D. By using the curves in fig. 2 in combination with the light source curves in fig. 7 of Price List 18-316, the required percentage reduction in illumination can be determined.

Example: - Light Source: Type F
Voltage Variations: 10%
Operating Distance: 30 feet

From fig. 7 Price List 18-316 is found, 2 footcandles.

From fig. 2 2 footcandles at 10 per cent voltage gives 0.8 footcandles. Minimum illumination.

Consequently: The illumination must be decreased from 2 footcandles to 0.8 footcandles, or 60 percent.

PRINCIPLE OF OPERATION

(5) The RX-1 Photo-troller as shown in fig. 3 consists essentially of two different control circuits, namely the phototube-amplifier circuit and the Thyratron control circuit.

The Phototube-Amplifier Circuit

The purpose of this circuit is merely to amplify the variations in voltage caused by changing illumination on the phototube. The circuit consists of a d-c source supplied by the rectox rectifier connected between 16 and 17. A voltage divider, consisting of a 5000 ohm potentiometer and two 25000 ohm resistors, is connected across this d-c source. The phototube circuit consists of the WL-735 phototube connected between A and C and the 10 MEGOHM resistor C-16. If the illumination on the phototube is increased, an increasing amount of current flows through the tube, thus making Lead C more positive relative to the potentiometer tap G. The voltage between C and G is the grid control voltage for the 57 amplifier tube. This tube, which is of the screen grid type, consists of a heater connected to 13-14, a cathode connected to G, a screen grid connected to A, a control grid connected to C and an anode connected to 15.

The characteristics of the 57 tube are such that the tube will pass no current if the voltage between C and G is more negative than approximately 2 volts. If the grid voltage is made less negative the current through the tube will increase and will reach its maximum value when the grid voltage is approximately zero.

When the current through the 57 tube is zero the potential of 15 is positive in relation to the potential of A. As the 57 current is increased the potential difference between 15 and A is decreased to zero and then again increased so that the potential of 15 becomes negative relative to the potential of A.

From the preceding discussion it may be seen that when the illumination on the phototube is low the potential of 15 is positive relative to A_1, whereas with the phototube highly illuminated the potential of 15 is negative relative to A.

The Thyratron Control Circuit

The WL-629 Thyratron tube consists of a heater connected to 8-10, a cathode connected to 8, an anode connected to 20, and a control grid connected to the 0.25 MEG resistor connecting to lead 19. The anode is connected in series with the SG relay coil to lead 7, and the cathode is connected to lead 8. When the tube becomes ionized the resistance of the tube between 20 and 8 changes from an infinite value to a low value, and rectified a-c current flows from 7 through the relay coil to 20, through the tube and to 8. The voltage between the grid and the cathode determines whether the tube conducts current or not.

If this voltage is more negative than approximately 6 volts, the tube does not become ionized, no current flows, and the SG relay is deenergized. If the grid voltage is made more positive, the tube conducts current and the relay is closed.

The control voltage for the WL-629 is a combination of a 135 degree phase shifted a-c voltage component obtained from capacitor 8-18, and a d-c component obtained from the amplifier tube output circuit 15-A, and which is applied to the grid circuit 18-19 by means of the double pole reversing switch.

The control voltage characteristics for the WL-629 tube are shown in fig. 4 in which E represents the critical grid voltage needed. It will be seen that when voltage 18-19 is made more positive the WL-629 tube breaks down at A at the beginning of the a-c voltage wave, and conducts current during the remainder of the half cycle.

The purpose of the reversing switch is to reverse the operation of the relay relative to the change of phototube illumination. With the switch in the "UP" position the relay is closed when the phototube is illuminated. With the switch in the "down" position the relay is energized when the phototube is dark.

INSTALLATION

(6) Mounting

Mount the Photo-troller with the panel in a vertical position. If the phototube is to be mounted inside the Photo-troller case, remove the knockout in the case door to permit light to reach the phototube. If the phototube is mounted in a separate housing, the housing may be mounted in any convenient position, up to 10 feet distant from the Photo-troller, or 25 feet if the Photo-troller is derated as outlined in paragraph 1.

The light source may be mounted in any position except that the lamp base must not be higher than the lamp filament.

(7) Temperature Limits

The Photo-troller should be mounted in a location where the ambient air temperature does not exceed 110° F. If the Photo-troller is mounted near furnaces or other equipment radiating an excessive amount of heat, the Photo-troller should be shielded by means of a suitable shield. The maximum air temperature at the location of the phototube housing should not exceed 150° F.

(8) A-C Voltage Variations

The a-c supply voltage should be within ± per cent of rated voltage. If the a-c voltage varies more than 2 per cent total, the conditions outlined in paragraph 4 should be considered.

(9) External Connections

Connect the Phototroller as shown in fig. 3, making sure that connections to terminals 1 to 4 are made as shown in the table in this figure. Connect the light source to terminals 5-6, using cable with 30 amperes capacity. When extended photo-tube is used, do not place the phototube in the socket inside the case, but connect the phototube housing to terminals A-C by means of cable PDS-7415-2 as supplied with the phototube housing. Make sure that terminal A on the Photo-troller terminal board is connected to terminal A in the phototube housing.

Run the cable in grounded metallic conduit, with no other leads in this conduit. The length of the phototube cable must not exceed 10 feet unless the Photo-troller is derated as outlined in paragraph 1, in which case cable up to 25 feet long may be used. Do not splice the phototube cable, and use no friction tape or other types of tape at the ends of the cable.

Ground terminal G inside the Photo-troller case to a waterpipe.

Run leads connecting to the relay contacts directly to the knockouts on the left hand side of the Photo-troller case. Do not run relay leads across the Photo-troller either in front or in rear.

(10) Relay Characteristics

Contact Interrupting Capacity

	110 Volts A-C	220 Volts A-C	440 Volts A-C	125 Volts D-C	250 Volts D-C
One "Make"	20	12	7	2	0.7
One "Break"	10	6	3	1	0.4
* Two "Make" in series.	30	20	10	3	1.

*Reverse left hand stationary contact.

Note: Two "Break" Contacts cannot be used.

Contact Carrying Capacity

One "make" contact: 12 amp. continuous.
One "break" contact: 6 amp. continuous.

Operations per Minute

Maximum 300. Recommended 150. (See paragraph 1).

(11) Operation

With the switch in "up" position the relay is closed when the phototube is illuminated. With the switch in the "down" position, the relay is closed when the phototube is dark.

(12) Sensitivity

With the phototube dark the relay will operate as shown in fig. 5, when the dial of the potentiometer is approximately at position 70. With one foot-candle illumination on the phototube the dial position is approximately 45 when the relay operates, and at dial position 0 approximately 4 foot candles are required to operate the relay. The sensitivity of the photo-troller conservatively rated, is, therefore, 1 foot candle. Due to this high sensitivity it is preferable to limit the maximum illumination on the phototube to 10 foot candles in order to obtain long phototube life. To obtain reliable operation the illumination on the phototube when the light intensity is minimum should not exceed the values as indicated in fig. 2.

The location of the curves vary considerably with varying phototube sensitivity as shown by the upper and lower limit curves in fig. 5.

(13) Adjustments:

1 - Turn on power and allow unit to warm up 5 minutes.
2 - Focus light source.
3 - With phototube entirely dark turn potentiometer until relay operates. The dial position should now be approximately 70.
4 - With maximum a-c supply voltage and minimum illumination on the phototube adjust the dial until the relay operates. Observe dial position D max. If necessary reduce the illumination by throwing the light beam out of focus so that D max. is not less than 40. With minimum a-c supply voltage and maximum illumination on the phototube cut off 1/2 of the light by means of an opaque object in front of the phototube, and adjust the dial until the relay operates. Read the dial position D min. To assure reliable operation, D minimum should be at least 15 divisions less than D maximum. If 15 divisions are not obtained the intensity of illumination must be increased by moving the light source nearer the phototube, or the difference between maximum and minimum illumination must be increased.

If, with one-half of maximum illumination, it is not possible to obtain relay operation, it is recommended that the illumination be decreased until the relay operates with the dial at the 0 position.

WHAT TO DO IF THE PHOTO-TROLLER DOES NOT OPERATE SATISFACTORILY

(14) General Tests

(a) Make sure that terminal G is grounded to a water pipe.

(b) Disconnect the ground wire from terminal G and measure by means of a Megger the resistance between terminal G and ground. This resistance should be 20 MEGOHMS or higher.

(c) Inspect the tubes to see that the filaments are heated.

(d) Make sure that the cable to the phototube housing is in a grounded metallic conduit with no other leads in the conduit.

(e) Make sure that terminal A on the terminal board is connected to terminal A in the phototube housing.

(f) Measure, by means of a d-c voltmeter with resistance 1000 ohms per volt, the voltage across 16-17. This voltage should be approximately 120 volts.

(15) Special Tests

I The WL-629 tube does not break down.

(a) Replace the WL-629 tube.

(b) Measure the a-c voltage between 8 and 20. This voltage should be approximately 190 volts.

(c) Connect a clip lead between 8 and 19. If the tube breakes down with this clip lead, but does not break down without the clip lead connected the trouble is either in the reversing switch or in the amplifier tube circuits.

(d) Check amplifier circuit as outlined in III.

II The WL-629 tube breakes down regardless of phototube illumination or potentiometer position.

(a) Replace the WL-629 tube.

(b) Check to see that the circuit from 18, through the switch to 19 to grid is not open.

(d) Check the amplifier circuit as outlined in D.

III Amplifier circuit does not operate properly.

(a) Remove the phototube from its socket and insert a milliampere meter in lead 15.

Adjust the potentiometer to position 100. The current through the milliampere meter should now be 0.3 MA or more. Turn the potentiometer towards zero. The current should not decrease and should be less than 0.05 MA with the potentiometer in position 40. If this condition is not obtained make the following tests:

(b) Replace the 57 amplifier tube.

(c) Measure the voltage across the potentiometer. This voltage should be approximately 12 volts. Use a d-c voltmeter with resistance 1000 ohms per volt for this test.

(d) Inspect circuit 16-C to see that the circuit is not open, and that C is not grounded.

(e) Make sure that resistor 15-17 is not open.

IV The SG relay does not open when deenergized.

(a) Inspect resistor 8-20 to see that this resistor is not open.

(b) Inspect to see that the relay leads do not rub against the armature.

V The sensitivity is lower than when the equipment was originally installed.

(a) Clean lens in light source.

(b) Replace the lamp in the light source.

(c) Replace the phototube and the amplifier tube.

(d) Inspect the phototube housing to see that there is no leakage between terminals A and C or between the terminals and ground.

(16) Spare Tubes

1 - Phototube WL-735
1 - RCA-57 Amplifier Tube.
1 - WL-629 Thyratron Tube

RENEWAL PARTS

(17)

Part	Style
4 Prong Socket	1039847
5 Prong Socket	1073482
6 Prong Socket	1039848
Shield	1073478
Capacitor 0.001 MF	1039933
Capacitor 0.01 MF	1039935
Capacitor 2 MF	1039932
Rectox Rectifier	1039843
Relay 60 cycle	1003884
Relay 25 cycle	1009786
Potentiometer 5000 ohms	860939
Potentiometer Dial	869654
Switch	966576
Resistor 1000 ohms	860880
25000 ohms	1038165
0.1 MEGOHMS	860002
0.25 MEGOHMS	846668
0.5 MEGOHMS	846667
10 MEGOHMS	1018950
Grid Clip	799907
Transformer 115/230 volts, 60 cycles	1039904
220/440 volts, 60 cycles	1039905
115/230 volts, 25 cycles	1039906
220/440 volts, 25 cycles	1039907

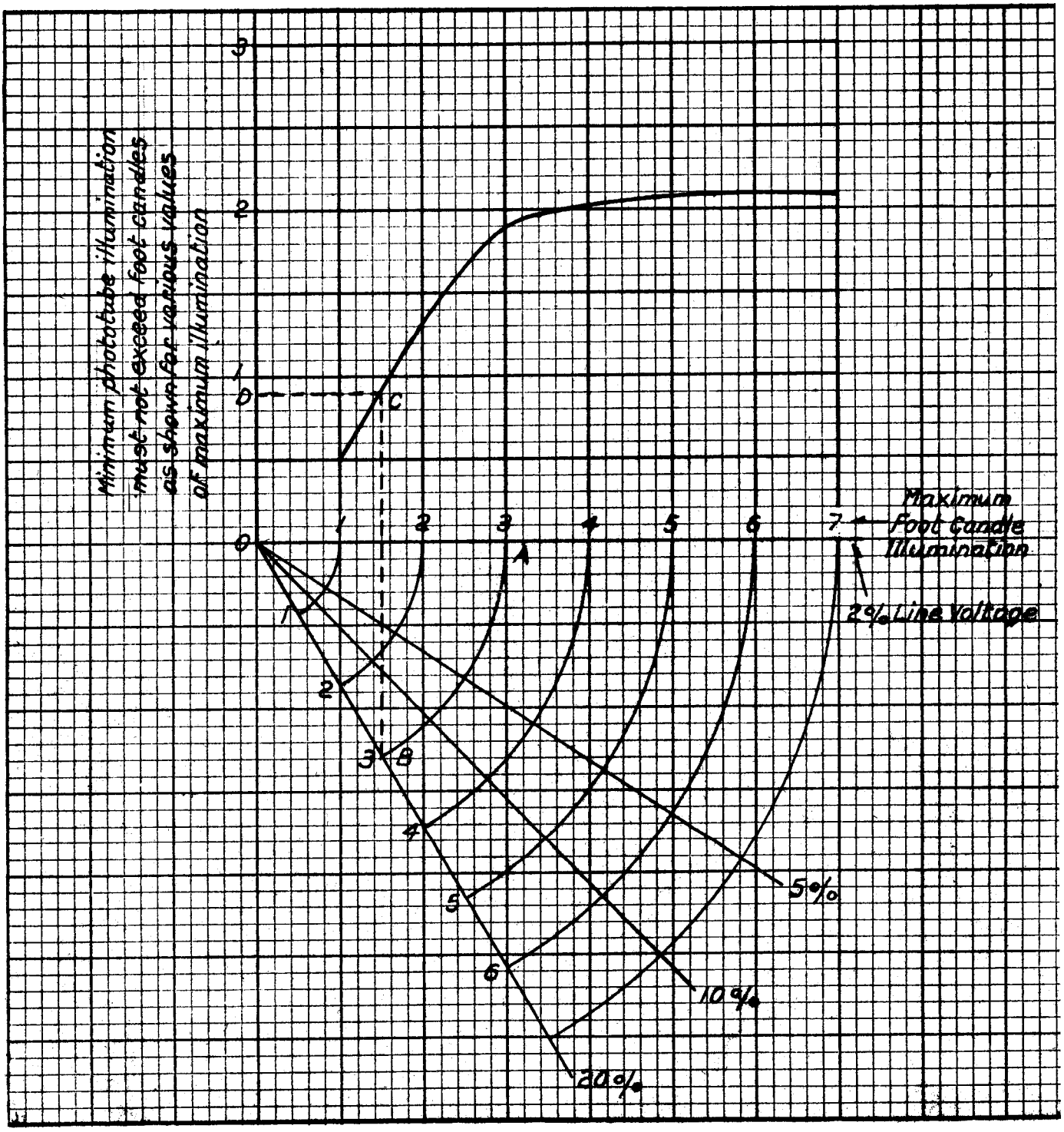
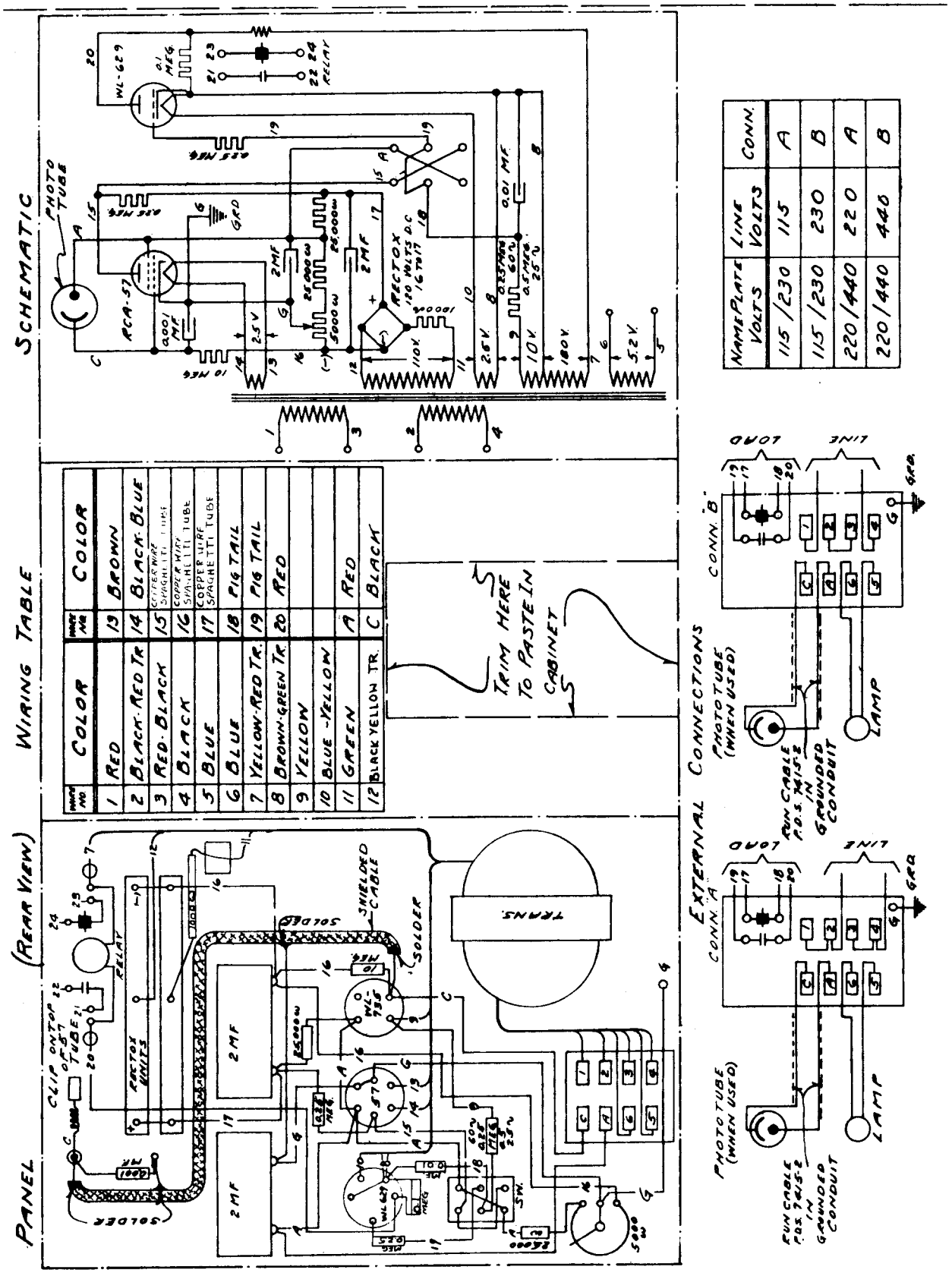


Figure 2 - Curve Showing How Much the Phototube Illumination Must be Decreased for Various Values of A-C. line Voltage Variation.



WIRE NO	COLOR
1	RED
2	BLACK-RED TR
3	RED-BLACK
4	BLACK
5	BLUE
6	BLUE
7	YELLOW-RED TR.
8	BROWN-GREEN TR
9	YELLOW
10	BLUE-YELLOW
11	GREEN
12	BLACK YELLOW TR.
13	BROWN
14	BLACK-BLUE
15	COPPER WIRE SPAGHETTI TUBE
16	COPPER WIRE SPAGHETTI TUBE
17	COPPER WIRE SPAGHETTI TUBE
18	PIG TAIL
19	PIG TAIL
20	RED
A	RED
C	BLACK

NAMEPLATE VOLTS	LINE VOLTS	CONN.
115/230	115	A
115/230	230	B
220/440	220	A
220/440	440	B

Figure 3 - Diagram of Connections

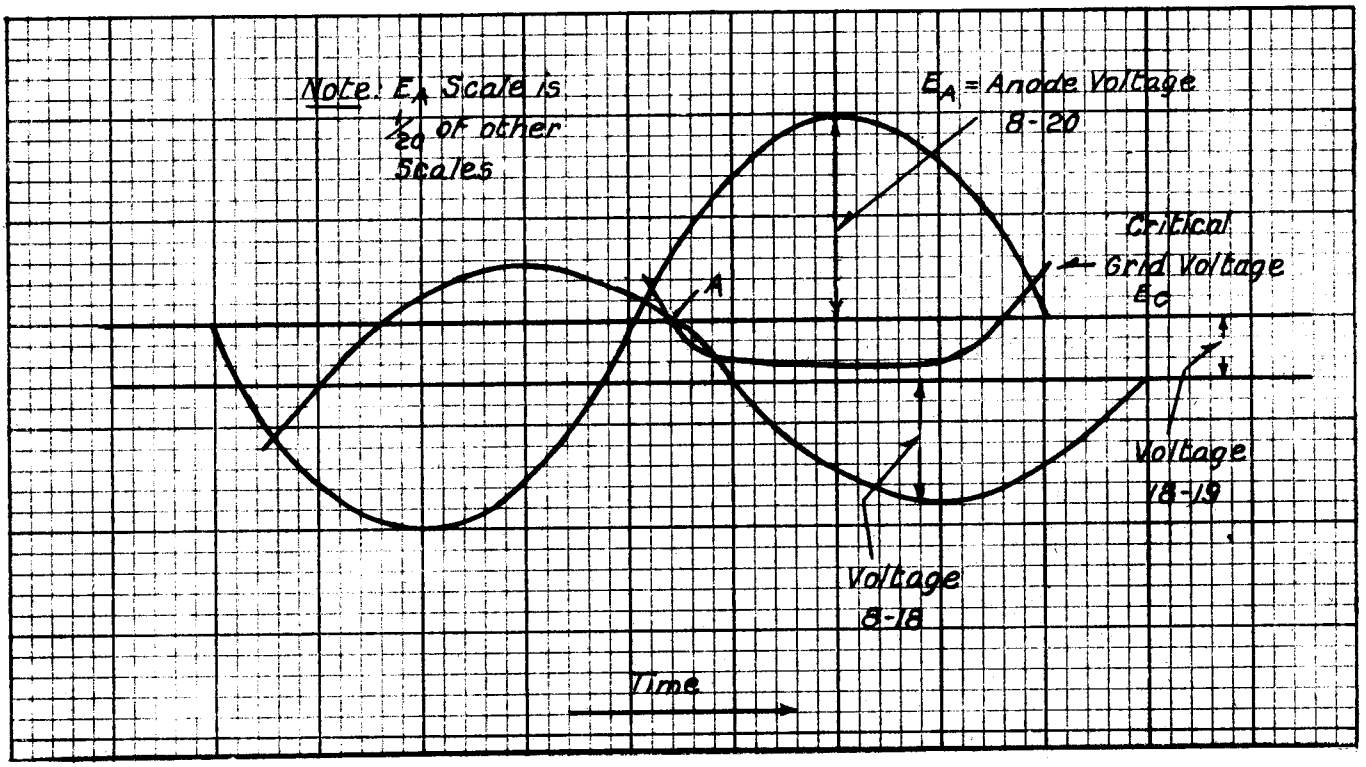


Figure 4 - Thyratron tube operating characteristics

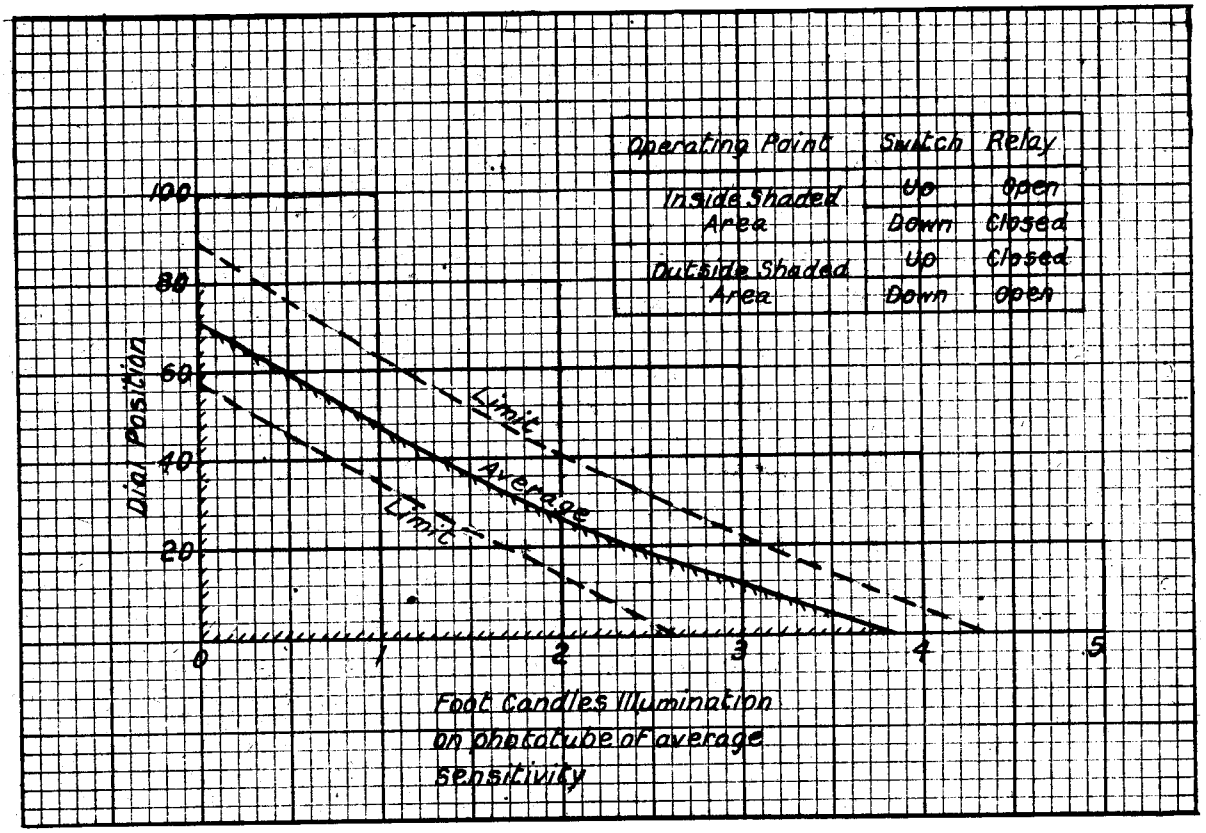


Figure 5 - Curves Showing Dial Position as a Function of Phototube Illumination.

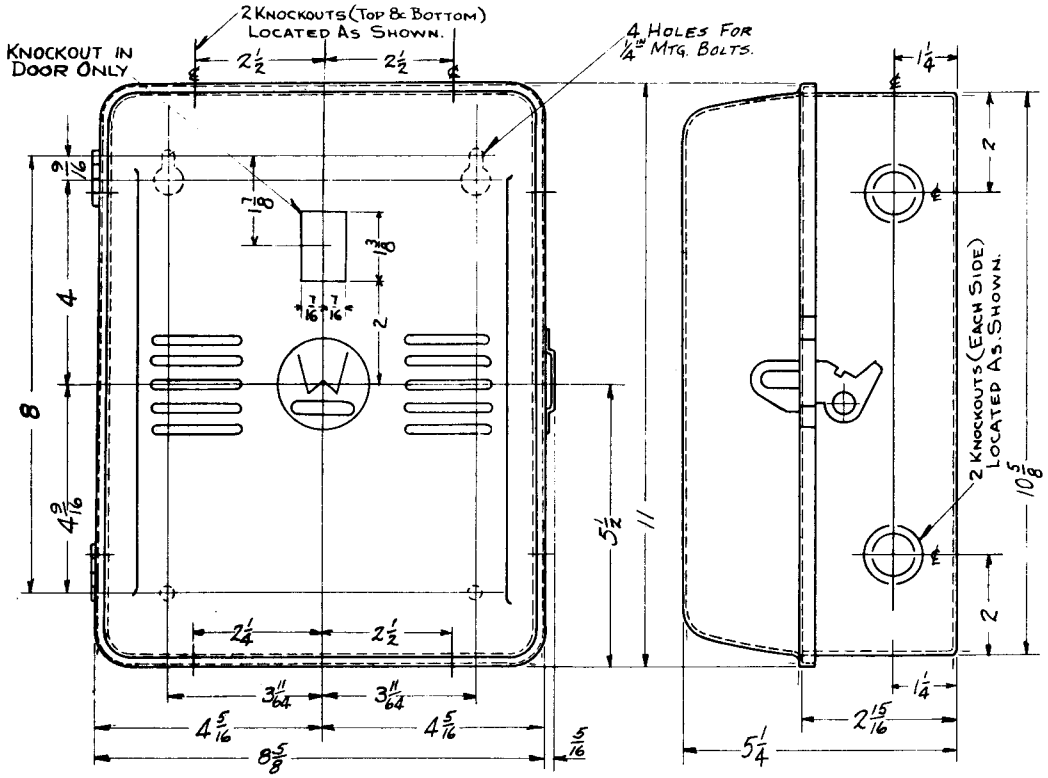


Figure 6 - Outline Drawing for 60 Cycle

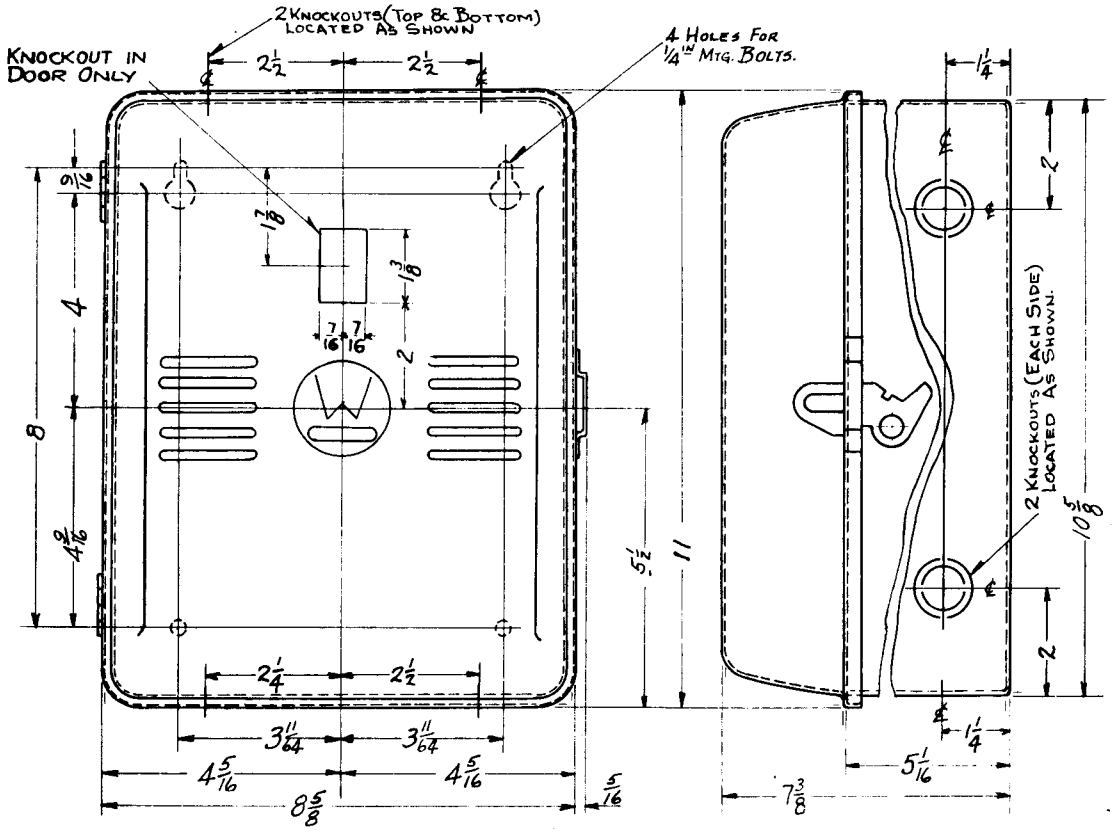


Figure 7 - Outline Drawing for 25 Cycle

PHOTOTUBE HOUSINGS AND SCANNERS

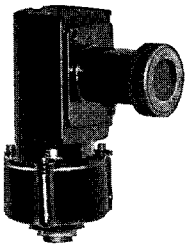


FIG. 1—TYPES A AND B GENERAL PURPOSE PHOTOTUBE HOUSINGS

FIG. 2—TYPE D PHOTOTUBE HOUSING

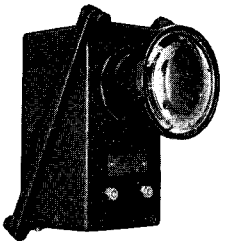


FIG. 3—TYPE S PHOTOTUBE HOUSING

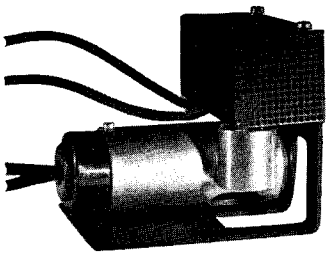


FIG. 4—TYPE F REFLECTED LIGHT SCANNER

TABLE 1

Type	Description	Style Without Tubes	Tubes Reqd.	Spare Tubes	Shipping Weight Lbs.	List Price Not Incl. Tubes
A	General Purpose, with 10 foot leads ③ Indoor only.	②1 073 380	See Table 2	See Price List 18-060	5	$12.00
B	Splash Proof with 10 foot leads ③. Indoor only.	②1 073 382			5	14.00
D	For close up work such as register control. Indoor only. 10 foot leads. ③	②1 073 383			4	16.00
S	To increase sensitivity of Photo-Troller by collecting light. Divide foot candle rating of Photo-Troller by 4 when using this housing. Use with LE relay. 10 foot leads. ③	② 839 552			5	18.50
F	Reflected light 12 foot leads.	② 850 679			7	35.00

② Stocked.

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 Type F. Cable **$0.15** per foot **W-2** for length over 10 feet.

CHOICE OF TUBES AND LAMPS

In order that these housings and scanners may be used with all Photo-Trollers, table 2 shows the Phototube to use. 18-310 Photo-Troller prices and 18-315 housing prices are unaltered by change of tubes per Table 2.

TABLE 2

Housing Photo-troller	A	B	D	S	F Scanner		No Housing Tube in Unit
					Phototube	Lamp	
RX	1-WL735	1-WL735	1-WL735	1-SK60	.....	.....	WL735
RX-1	1-WL735	1-WL735	1-WL735	1-SK60	1-SK60	1-849085 ④	WL735
RX-2 Indoor	.....	.....	.....	.....	.....	.....	WL735
RX-2 Outdoor	.....	.....	.....	.....	.....	.....	WL735
RK	.....	.....	.....	.....	.....	.....	SK60
RL	1-WL735	1-WL735	1-WL735	1-SR50	.....	.....	.....
LE	1-WL735	1-WL735	.....	1-SK60	.....	.....	SK60
RRO	1-WL735	1-WL735	1-WL735	1-SK60	.....	.....	.....
RR-5	1-WL735	1-WL735	1-WL735	1-SK60	1-SK60	1-856455	.....

④ When using F Scanner with RX-1, Style 849085 lamp must be used. Specify scanner as similar to Style 850679 but to be adapted for Style 849085 lamp. Order lamp as separate item.

ORDERING INSTRUCTIONS

Class 18-310 and 18-311 prices include all tubes required but the phototube is not included in the style although all other tubes are. Therefore, specify on the General Order:

(1) The Photo-Troller by style.
(2) The phototube from Table 2.
(3) The housing or scanner.
(4) The lamp for Type F scanner when it is on order.
(5) Enter spare tubes as separate items on order.

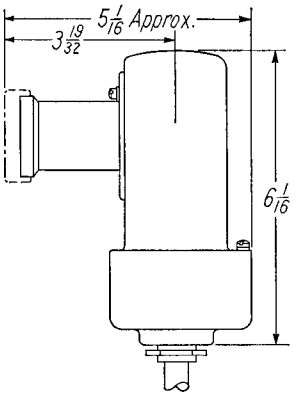


FIG. 5—TYPES A AND B PHOTOTUBE HOUSINGS

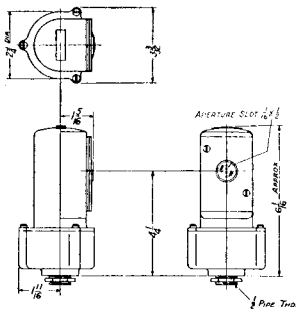


FIG. 6—OUTLINE OF TYPE D PHOTOTUBE HOUSING

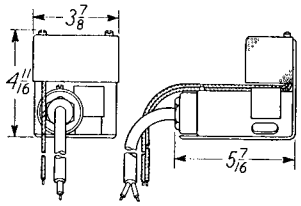


FIG. 7—TYPE F REFLECTED LIGHT SCANNER

General changes since previous issue.

Prices are subject to change without notice.

W-2

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.

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 housing 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.

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 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. Behind the window is an aperture $\frac{1}{16}$" by $\frac{1}{2}$". This aperture together with a light source such as the type D will operate on small spots on paper by change of transmission. For reflected light, use Type F scanner.

Type S—comprises a cast case suitable for mounting on conduit. Has 3" diameter lens which increases the sensitivity of a Photo-Troller four times compared with the other housings having no collecting lens. It can be furnished with gaskets to make it splash proof. It can also be furnished with an aperture to permit installation where daylight or other high light intensity would adversely affect operation of Photo-Trollers with other housings. This housing should not be used if a small diameter light beam is required.

TYPE F SCANNER

The Type F Scanner is a combination of light source, lens assembly, and phototube mounting for applications requiring scanning or viewing moving material for controlling its motion. This equipment is especially designed for controlling the cutting of paper, cellophane, and similar material in accordance with advertising matter or other printed designs where operation from reflected light is necessary.

Printed in U.S.A.

LIGHT SOURCES

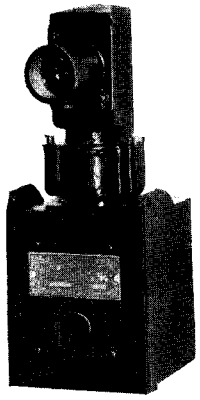


FIG. 1—TYPE D, LIGHT SOURCE

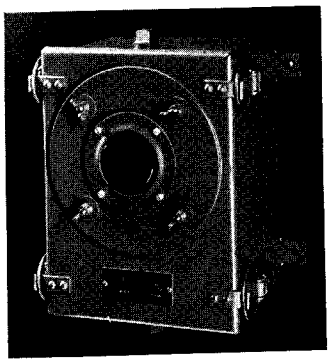


FIG. 2—TYPES E AND L, LONG-RANGE LIGHT SOURCES

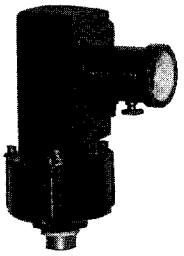


FIG. 3—TYPE F, GENERAL PURPOSE LIGHT SOURCE

FIG. 4—TYPE J, CONCENTRATED BEAM LIGHT SOURCE

TABLE 1

Type	Description	Style 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, visible light only	④829 396	115/230	25–60	21	3″	¼″	10″	11	$ 24.00
D		④829 397	220/440	25–60	21	3″	¼″	10″	11	24.00
E	High intensity, with transformer. Indoor, or outdoor, visible light	④849 186	115/230	25–60	35	Infinity	...	5″	18	27.00
E		④849 187	220/440	25–60	35	Infinity	...	5″	18	27.00
L	Long range with motor driven interrupter, indoor or outdoor	1 083 460	115/230	50–60	65	Infinity	...	5″	30	92.00
L		1 083 461	220/440	50–60	65	Infinity	...	5″	30	92.00
..	Infra red filter for types E or L only. 10% transmission.	④1 033 919	.....	....	..	.....	...	...	1	10.00
	Infra red filter for types E and L only. 20% transmission	1 083 482	.....	....	..	.....	...	...	1	10.00
S	High intensity without transformer, indoor only. To operate from photo-troller power	④839 588	⑤6–0	③ a-c. or d-c.	30	Infinity	...	5″	6	19.00
S	Same, but to operate from 115 V. line.	④839 555	115	a-c. or d-c.	40	Infinity	...	10″	6	25.00
..	Infra red filter for Type S only 10% transmission.	936 929	.....	....	..	.....	...	...	...	8.75
F	General purpose, indoor, visible light only.	④831 706	②5.5	② a-c. or d-c.	18	3″	¼″	10″	4	15.00
J	Concentrated beam, indoor, visible light only.	④849 084	⑤6.0	③ a-c. or d-c.	30	1″	3/16″	...	4	19.00
	Transformer { Primary 105- 115- 125 volts, 25-60 cycles; Secondary, No. 1— 6 volts, 5 amperes; Secondary, No. 2— 115 volts, 0.35 amperes }	④874 053	....	....	..	.....	...	...	..	7.00

② Connect to any Class 18-310 Photo-Troller except Types RX-2 and LE.
③ Connect to any Class 18-311 Photo-Troller. May also be used with 18-310 Photo-Trollers except RK, RL, RX-2 and LE. To use with LE, order also transformer Style 874053.
④ Stocked.

DISTINCTIVE FEATURES

Installation is convenient because transformer where required is mounted in the unit and where not required, the light source is many times supplied with power from a winding on the photo-troller itself.

High Efficiency obtained by convenient and positive focusing adjustment.

Adaptability to Application assured by wide selection of price.

Installation simplified by standard conduit fittings or knockouts.

Lamps are easily replaced without disturbing the adjustment of focus.

General changes since previous issue.

LIGHT SOURCES—Continued

APPROXIMATE DIMENSIONS IN INCHES

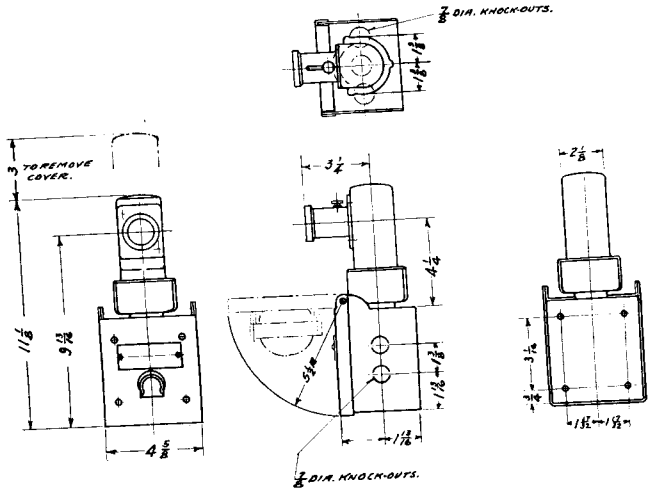


FIG. 9—TYPE D OUTLINE

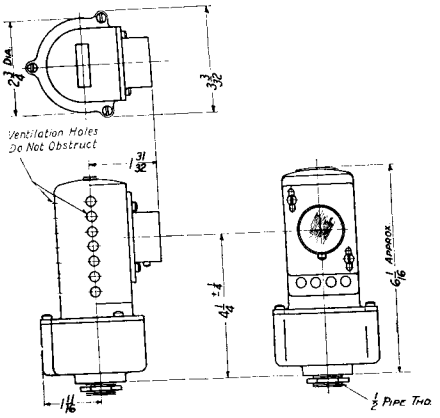


FIG. 10—TYPE J OUTLINE

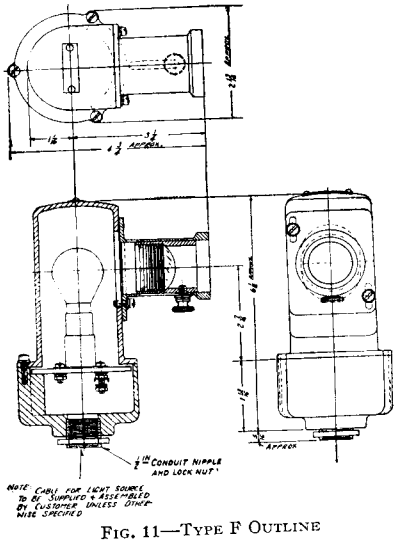


FIG. 11—TYPE F OUTLINE

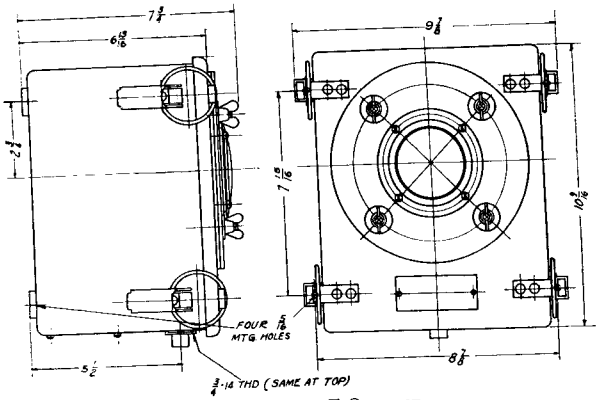


FIG. 12—TYPE E OUTLINE

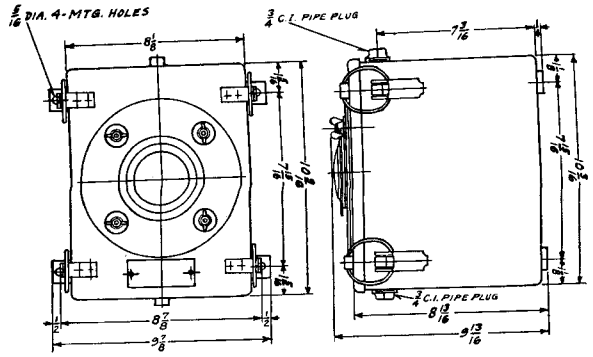


FIG. 13—TYPE L OUTLINE

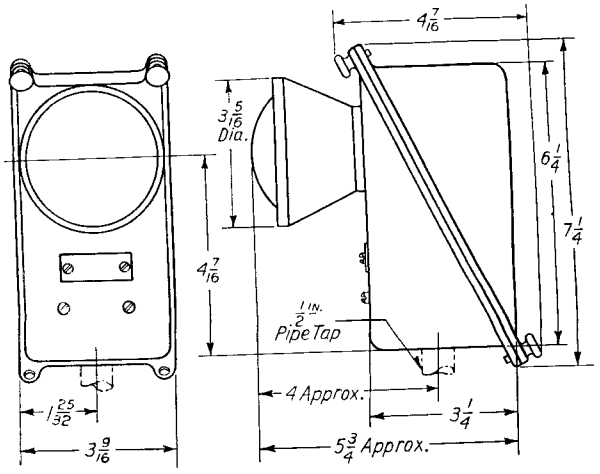


FIG. 14—TYPE S OUTLINE

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

Business Addresses

Headquarters, Pittsburgh, Pa.

*AKRON, OHIO, 106 South Main St.
*ALBANY, N. Y., 456 No. Pearl St.
§ALEXANDRIA, VA., 121 Frazier Ave.
*ALLENTOWN, PA., 522 Maple St.
*APPLETON, WISC., 1708 N. Drew St., P.O. Box 206
†APPLETON, WISC., 1029 So. Outagamie St.
#†*ATLANTA, GA., 426 Marietta St., N. W.
xATTICA, N. Y.
*BAKERSFIELD, CALIF., 2224 San Emedio St.
*BALTIMORE, MD., 118 E. Lombard St.
†BALTIMORE, MD., 501 East Preston Road
§BALTIMORE, MD., 40 S. Calvert St.
*BEAUMONT, TEXAS, 2293 Broadway Ave., P. O. Box 2367
*BINGHAMTON, N. Y., Suite 704, Marine Midland Bldg., 86 Court St.
*BIRMINGHAM, ALA., 2030 Second Ave.
*BLUEFIELD, W. VA., 208 Bluefield Avenue
§BOISE, IDAHO, P. O. Box 1597
*BOSTON, MASS., 10 High St.
†#BOSTON, MASS., 12 Farnsworth St.
*†BRIDGEPORT, CONN., Bruce Ave. & Seymour St.
*BUFFALO, N. Y., 814 Ellicott Square Bldg.
†#BUFFALO, N. Y., 1132 Seneca St.
*BURLINGTON, IOWA, 1708 River St.
*BURLINGTON, VER., 207 Park Ave.
*BUTTE, MONTANA, 129 West Park St.
#BUTTE, MONTANA, 742 Bryant Ave.
①*CANTON, OHIO, 120 W. Tuscarawas St.
*CEDAR RAPIDS, IOWA, 813 18th St., S.E., P. O. Box 148
*†#CHARLOTTE, N. C., 210 East Sixth St.
①*CHARLESTON, W. VA., 1415 Oakmont Rd. P. O. Box 865
*CHATTANOOGA, TENN., 536 Market St.
*CHICAGO, ILL., 20 N. Wacker Drive
†#CHICAGO, ILL., 2211 W. Pershing Road
xCHICOPEE FALLS, MASSACHUSETTS
*†#CINCINNATI, OHIO, 207 West Third St.
*†x#CLEVELAND, OHIO, 1216 West Fifty-Eighth St.
§COLUMBIA, S. C., 912 Lady St.
①*COLUMBUS, OHIO, 85 E. Gay St.
*DALLAS, TEXAS, 209 Browder St.
#DALLAS, TEXAS, 1712 Carter St.
*DAVENPORT, IOWA, 206 E. Second St.
*DAYTON, OHIO, 30 North Main St.
*DENVER, COLORADO, 910 Fifteenth St.
#DENVER, COLORADO, 1700 Sixteenth St.
†DENVER, COLORADO, 988 Cherokee St.
§DENVER, COLORADO, Gas & Elec. Bldg.
xDERRY, PA.
*DES MOINES, IOWA, 523 Sixth Ave.
*†#DETROIT, MICH., 5757 Trumbull Ave.
*DULUTH, MINN., 10 East Superior St.
①§EAST PEORIA, ILL., 900 W. Washington St.
x#EAST PITTSBURGH, PA.
*EL PASO, TEXAS, Oregon and Mills Sts.
#EL PASO, TEXAS, 450 Canal St.
§EL PASO, TEX., c/o Zork Hdwe. Co., 309 N, El Paso St.
*#†EMERYVILLE, CALIF., 1466 Powell St.
xEMERYVILLE, CALIF., 6161 Green St.
*ERIE, PA., 1003 State St.
*EVANSVILLE, IND., 201 N. W. First St.
*†FAIRMONT, W VA., 602 Cleveland Ave.
§FARGO, N. D., 520—3rd Ave. N.
*FORT WAYNE, IND., 1010 Packard Ave.
*FORT WORTH, TEXAS, 501 Jones St.
*FRESNO, CALIF., 872 Peralta Way, P. O. Box 632
*GARY, IND., 701 Washington St.
①*GRAND RAPIDS, MICH., 511 Monroe Ave. N. W.
*GREENSBORO, N. C., 108 S. Park Drive, P. O. Box 1828.
*GREENVILLE, S. C., West Earle St.
*HAMMOND, IND., 235 167th St.
*HARTFORD, CONN., Main & Pearl Sts., P. O. Box 745
*HONOLULU, T. H., Hawaiian Elec. Co. Agt.
*HOUSTON, TEXAS, 1314 Texas Ave.
#HOUSTON, TEXAS, 2313 Commerce Ave.
†HOUSTON, TEXAS, 2315 Commerce Ave.
§HOUSTON, TEXAS, 611-15 Petroleum Bldg.
①†*#HUNTINGTON, W. VA., 1029 Seventh Ave.
*INDIANAPOLIS, IND., 137 S. Penna. Ave.
†INDIANAPOLIS, IND., 551 West Merrill St.
*ISHPEMING, MICH., 433 High St.
*JACKSON, MICH., 212 West Michigan Ave.
①*†JOHNSTOWN, PA., 107 Station St.
*JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 101 W. Eleventh St.
#†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.
*†#LOS ANGELES, CALIF., 420 So. San Pedro St.
*LOUISVILLE, KY., 322 West Broadway
*MADISON, WISC., 508 Edgewood Ave.
xMANSFIELD, OHIO, 200 East Fifth St.
*MARSHALL, TEXAS, 504 Nathan St.
*MEMPHIS, TENN., 130 Madison Ave.
*MIAMI, FLA., 1036 N. Miami Ave.
*MILWAUKEE, WISC., 546 North Broadway
†MILWAUKEE, WISC., 1669 N. Water St.
*†#MINNEAPOLIS, MINN., 2303 Kennedy St., N. E.
*MONROE, LA., 1301 N. Fourth St.
*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.
①*NEW HAVEN, CONN., 42 Church St., P. O. Box 1817
①*NEW ORLEANS, LA., 333 St. Charles St.
#NEW ORLEANS, LA., 527 Poydras St.
*NEW YORK, N. Y., 150 Broadway
†NEW YORK, N. Y., 460 West Thirty-Fourth St.
*NIAGARA FALLS, N. Y., 205 Falls St.
①*NORFOLK, VA., City Hall Ave. & Bank St.
*OKLAHOMA CITY, OKLA., 120 N. Robinson St.
#OKLAHOMA CITY, OKLA., Third & Alie Sts.
*OMAHA, NEB., 409 South Seventeenth St.
§OMAHA, NEB., 117 N. 13th St.
*PEORIA, ILL., 104 E. State St.
*†#PHILADELPHIA, PA., 3001 Walnut St.
*PHOENIX, ARIZONA, 11 West Jefferson St.
xPITTSBURGH, PA., Nuttall Works, 200 McCandless Ave.
z*PITTSBURGH, PA., 306 4th Ave., Box 1017
#†PITTSBURGH, PA., 543 N. Lang Ave.
*PORTLAND, MAINE, 142 High St.
*PORTLAND, OREGON, 309 S. W. Sixth Ave.
†PORTLAND, OREGON, 2138 N. Interstate Ave.
#PORTLAND, OREGON, 720 N. Thompson St.
*†PROVIDENCE, R. I., 16 Elbow St.
①*RALEIGH, N. C., 803 North Person St., P. O. Box 1134
§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.
*SAN ANTONIO, TEXAS, 115 W. Travis St.
§SAN FRANCISCO, CALIF., 1355 Market St.
*SAN FRANCISCO, CALIF., 1 Montgomery St.
*SEATTLE, WASH., 603 Stewart St.
†#SEATTLE, WASH., 3451 East Marginal Way
xSHARON, PA., 469 Sharpsville Ave.
*SIOUX CITY, IOWA, 2311 George St.
*SOUTH BEND, IND., 216 East Wayne St.
§SOUTH BEND, IND., 107 E. Jefferson St.
xSOUTH PHILA. WKS., Essington, Pa.
°SOUTH PHILA. WKS., P. O. Box 7348, Philadelphia, Pa.
*SPOKANE, WASH., So. 158 Monroe St.
*SPRINGFIELD, ILL., 601 E. Adams St., Box 37
*†SPRINGFIELD, MASS., 395 Liberty St.
xSPRINGFIELD, MASS., 653 Page Boulevard
*ST. LOUIS, MO., 411 North Seventh St.
†#ST. LOUIS, MO., 717 South Twelfth St.
*SYRACUSE, N. Y., 420 N. Geddes St.
*TACOMA, WASH., 1023 "A" St.
*TAMPA, FLA., 417 Ellamae Ave., Box 230
*TOLEDO, OHIO, 245 Summit St.
*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 598.
*WICHITA, KAN., 233 So. St. Francis Ave.
*†WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
*†WORCESTER, MASS., 32 Southbridge 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 ELECTRIC SUPPLY COMPANY

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., 76 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, 3950 Prospect Ave
COLUMBIA, S. C., 915 Lady St.
DALLAS, TEXAS, 409 Browder St.
①DES MOINES, IOWA, 1400 Walnut St.
DETROIT, MICH., 547 Harper Ave.
DULUTH, MINN., 308 W. Michigan St.
EVANSVILLE, IND., 201 N. W. First St.
FLINT, MICH., 1314 N. Saginaw St.
FORT WORTH, TEXAS, 501 Jones St.
①GRAND RAPIDS, MICH., 511 Monroe Ave., N. W.
GREENVILLE, S. C., 200 River St.
HOUSTON, TEXAS, 1903 Ruiz St.
INDIANAPOLIS, IND., 137 S. Pennsylvania St.
JACKSONVILLE, FLA., 37 South Hogan St.
LOS ANGELES, CALIF., 905 East Second St.
MADISON, WISC., 1022 E. Washington Ave.
MIAMI, FLA., 1036 North Miami Ave.
MEMPHIS, TENN., 366 Madison Ave.
MILWAUKEE, WISC., 546 N. Broadway
MINNEAPOLIS, MINN., 215 South Fourth St.
NEWARK, N. J., 49 Liberty St.
NEW HAVEN, CONN. 240 Cedar St.
zNEW YORK, N. Y., 150 Varick St.
①NORFOLK, VA., 320 City Hall Ave.
OAKLAND, CALIF., Tenth & Alice Sts.
OKLAHOMA CITY, OKLA., 10 E. California St.
OMAHA, NEB., 117 North Thirteenth St.
PEORIA, ILL., 104 East State St.
PHILADELPHIA, PA., 1101 Race St.
PHOENIX, ARIZONA, 315 West Jackson St
PORTLAND, OREGON, 134 N.W. Eighth Ave.
PROVIDENCE, R. I., 66 Ship St.
RALEIGH, N. C., 322 S. Harrington St.
READING, PA., 619 Spruce St.
RICHMOND, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
①ROCHESTER, N. Y., 1048 University Ave.
ST. LOUIS, MO., 1011 Spruce St.
ST. PAUL, MINN., 145 East Fifth St.
SACRAMENTO, CALIF., 20th and R Sts.
SALT LAKE CITY, UTAH, 235 West South Temple St.
SAN ANTONIO, TEXAS, 1201 E. Houston St.
SAN FRANCISCO, CALIF., 260 Fifth St.
SEATTLE, WASH., 558 First Ave., South
SIOUX CITY, IOWA, 1005 Dace St.
SPOKANE, WASH., 152 So. Monroe St.
SPRINGFIELD, MASS., 46 Hampden St.
SYRACUSE, N. Y., 961 W. Genesee St.
TAMPA, FLA., 417 Ellamae St.
TOLEDO, OHIO, 812 Lafayette St.
TRENTON, N. J., 245 N. Broad St.
TULSA, 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.
WICHITA, KANSAS, 233 So. St. Francis Ave.
WILMINGTON, DEL., 216 E. Second St.
WORCESTER, MASS., 24 Southbridge 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
①Changed or added since previous issue.

January, 1938