Westinghouse

Types LA and LB Light Relays

Installation and Operation

INSTRUCTION BOOK

Westinghouse Electric & Manufacturing Company

East Pittsburgh Works

East Pittsburgh, Pa.

I. B. 5524

Index

Westinghouse

Types LA and LB Light Relays

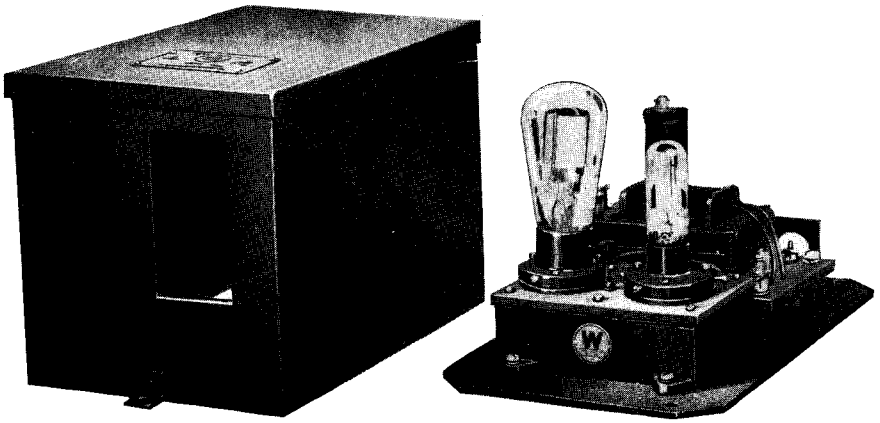


FIG. 1—TYPE LA LIGHT RELAY WITH COVER REMOVED

Introduction

The general scheme for the use of the types LA and LB light relays is to project a beam of light across an intervening space to the light relay where it passes through a window or lens and falls on a photo electric tube. Operation is effected by the making or breaking of this beam of light by any opaque object.

The types LA and LB light relays are designed for applications where a complete, or nearly complete cutoff of light can be had and are not well adapted to applications where the change in light is gradual. They are either "on" or "off" and have no intermediate points of operation. This operating characteristic makes them particularly well adapted to applications such as counting; as a limit switch; to start automatic operations such as shearing; as a safety device at doors, etc.; and as a paper break indicator in a paper mill.

This list will suggest many other applications in which the light relay can be used advantageously.

General Description

The Types LA and LB light relays consist of a photo electric tube, grid glow tube, transformer, telephone type relay, and the associated apparatus mounted on a metal base. The indoor units are enclosed by a sheet metal cover which screws to the base. The outdoor units are mounted in a weather proof cast iron case. The type LA light relay has a glass window in the cover through which light reaches the photo tube. In the type LB light relay this window is replaced by a 4 inch condensing lens.

The photo tube and grid glow tube are mounted in a photo tube amplifier unit which is screwed to the metal base of the light relay. This photo tube amplifier unit consists of a die-cast aluminum box with a molded panel upon which are mounted the tube sockets. This type of construction provides a dust and moisture proof housing for all connections to the photo tube and grid glow tube.

Detailed Description

The type LA light relay is designed for indoor service, a photograph with the cover removed is shown in Figure 1. The photo tube is placed directly behind the window. The transformer, telephone type relay, condenser and resistor are mounted on the base directly behind the photo tube amplifier unit. A molded terminal block has four terminals marked L_1, L_2, and M_1, M_2 to which the 110 volt power leads and the control circuit leads respectively are to be connected. A metal lug is welded to the base so that conduit may be brought to the light relay. The cover may be removed without disturbing the leads or the conduit.

A photograph of the **Type LB Light Relay** for indoor service with the cover removed is shown in Figure 2. The mechanical arrangement of the transformer, telephone type relay, condenser and resistor differs from that in the type LA light relay because space must be provided to take care of the focal length of the condensing lens. This equipment is mounted directly on the metal base of the light relay. Four terminals, also marked L_1, L_2, and M_1, M_2 are located on a molded terminal block. A metal lug is provided so that conduit may be brought to the light relay. The lens is supported by the front plate which is welded to the base, and is protected by a 4 inch metal tube. The cover can be removed without disturbing either the lens or the leads to the terminals.

The **Type LB Light Relay** is also available for outdoor service. The equipment is the same as that used for indoor service except that it is mounted in a weather proof cast iron case. The equipment is mounted on a metal base and may be removed bodily from the case without disturbing the connections by taking out the three screws that hold the metal base in position. The case has a hinged door that is provided with weather proof packing.

Light Sources

Any source of light may be used with the types LA and LB light relay that will illuminate the window or lens

Light Relay	Recommended Maximum Spacing Using as a Light Source: (Fig. 6 and 7)			Minimum Foot Candle Intensity at Window or Lens To Insure Operation.
	100 Watt Incandescent Lamp.	200 Watt Incandescent Lamp.	Type A Light Source Unit.	
Type LA	6″	10″	3′	180
Type LB	22″	32″	14′	12

sufficiently to insure operation. The above table will help in the choice of a suitable light source:

The type A light source unit is a projector that is designed especially for use with a light relay. A photograph is shown in Fig. 3. When a distance of more than 14 feet is to be spanned, a more powerful spot light must be used.

Installation and Connections

The types LA and LB light relays may be mounted in any position provided that the beam of light falls directly on the photo tube or lens. The mounting must be sufficiently rigid to prevent the beam from being deflected by vibration or shock. It should be arranged so that the object which is to cause operation will pass between the light relay and the light source, definitely interrupting the light beam. Care must be taken to see that the light relay is not placed where foreign objects, or dense clouds of steam or smoke will come into the beams of light as this will cause false operation. The light relays should not be subjected to temperatures exceeding 110°F. Vibration and shock will not affect operation as long as the apparatus is not damaged mechanically.

The types LA and LB light relays should be used in applications where an object definitely cuts off the light from the photo tube. The light beam must be completely restored after every operation. When the light relay is used for purposes such as counting objects in a production line there must always be sufficient space between them to permit the light beam to be re-established. The case of the type LA light relay and the indoor type LB light relay will protect the apparatus from dust and dirt such as is found in ordinary service but it is not weather proof. The outdoor type LB light relay should be used if it is to be exposed to the weather or extremely dirty conditions.

The source of light should be fed from the same voltage supply as the light relay whenever possible. When this is done the change in operating point of the light relay due to a change in line voltage is compensated for by the change in illumination of the lamp due to the voltage change.

When the light relay is in place, connect the terminals L_1, L_2 to the 110 volt 25-60 cycle supply. An internal wiring diagram is shown in Figure 4. The relay contacts are brought to terminals M_1, M_2. These contacts may be used to initiate any electrical operation.

To mount the photo tube and grid glow tube, remove the nickel plated screws which hold the ring on each socket. Loosen the three set screws whose heads extend at the side of each ring. Now place the base of the tube in the ring and tighten up the set screws when the bottom of the Micarta base on the tube extends about ⅛″ below the surface of the ring which is next to the cork gasket when assembled. The tube must also be in a position in the ring which will permit the replacement of the nickel plated clamping screws when the prongs have been inserted in the socket. When the ring has been properly fastened onto the base of the tubes insert them into their sockets. Place the photo tube in the socket that will be directly behind the window or lens of the light relay when the cover is in place. Now, replace the clamping screws and screw them down firmly but **do not force** the screws as this will result in breaking loose the hold which the set screws have on the base of the tube. When the photo tube has been put in place, the grid glow tube should now be placed in its socket and screwed down in a manner similar to that used in mounting the photo tube.

In the type LB light relay two sets of mounting holes are provided in the base for the four screws which hold the photo tube amplifier unit in place. The amplifier unit should be placed in the position nearer the lens when the

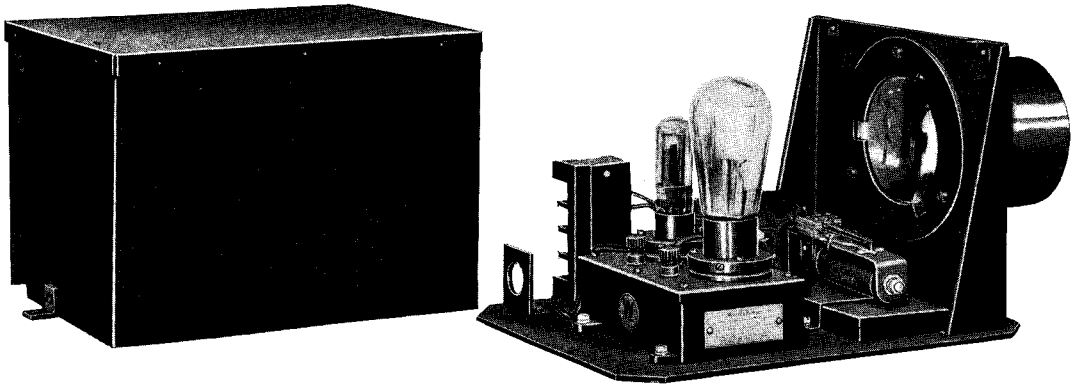


Fig. 2—Type LB Light Relay with Cover Removed

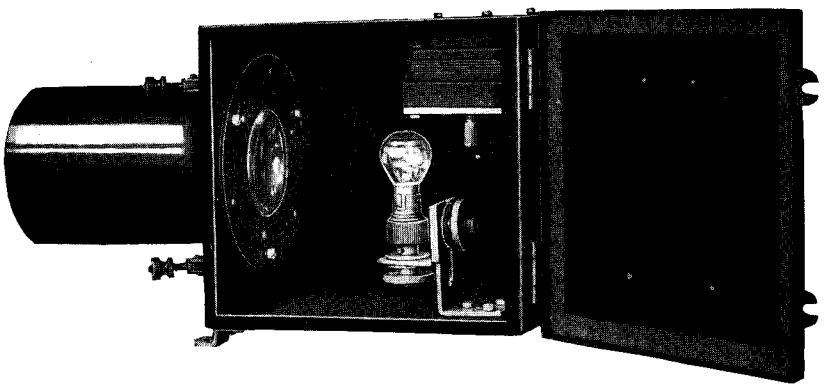


FIG. 3—TYPE LA LIGHT SOURCE

type A light source unit is used or when light enters the lens in parallel rays. The second set of mounting holes permits the amplifier unit to be placed 1 inch farther from the lens. This mounting should be used when the source of light is an incandescent lamp located 33 inches or less from the light relay.

Power Supply

The types LA and LB light relays can be made only for a-c. operation. They are available only for 110 volts at any frequency from 25 to 60 cycles. If it is desired to operate from other voltages specific inquiry should be made about the application. If the only power available is d-c. a small rotary converter may be used to supply the a-c.

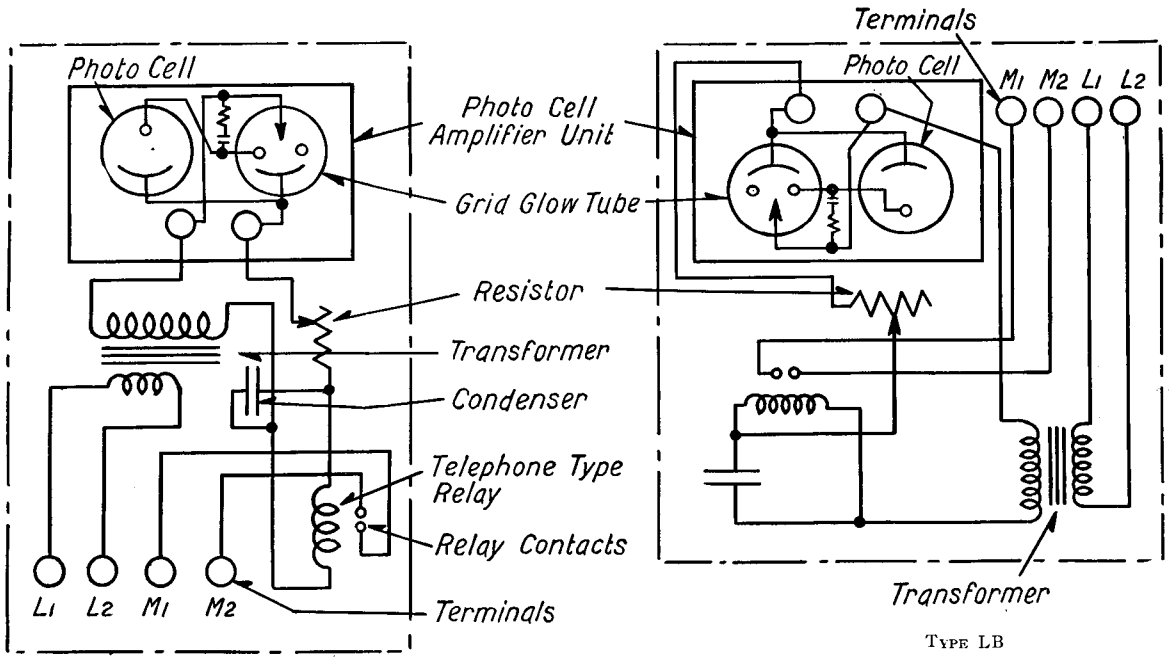
Relay Capacity

The relay contacts will open and close one ampere non-inductive load at 110 volts a-c. or ¼ ampere non-inductive load at 110 volts d-c. The contacts will handle ½ ampere at 110 volts a-c. with a load such as an ordinary relay coil. To control greater amounts of power an auxiliary relay must be used. A type M. C. relay or 12 K relay will be suitable for this purpose and will handle a 330 watt load and a 550 watt load respectively. In the relay circuit a-c. should be used whenever possible to avoid the burning of contacts caused by the use of d-c.

Operation

An example of operation of the type LA or LB light relay is as follows: The light relay and its light source are set up so that the beam of light falls upon the photo tube. The grid glow tube is dark, passing no current and the relay is de-energized. When an object interrupts the beam of light the photo tube is darkened, the grid glow tube passes current (glows) and the relay picks up. When the object passes out of the beam of light allowing the photo tube to be illuminated again the grid glow tube current is stopped and the relay drops out. The relay contacts close each time the light beam is interrupted and open when it is restored.

A schematic diagram of the circuit used in the types LA and LB light relay is shown in Figure 5. It may be seen that the photo tube, grid condenser and grid resistor act as a potentiometer on the a-c. supply, a tap on the potentiometer being connected to the grid of the grid glow tube. When the photo tube is dark, no current flows in the photo tube, or grid-cathode, branch of the potentiometer. The anode-grid



TYPE LA

TYPE LB

FIG. 4—WIRING DIAGRAMS OF TYPES LA AND LB LIGHT RELAYS

branch of the potentiometer passes a small current which brings the potential of the grid toward that of the anode and away from that of the cathode. When the grid potential is sufficiently near that of the anode, the grid glow tube breaks down and glows. When the photo tube is illuminated, the photo

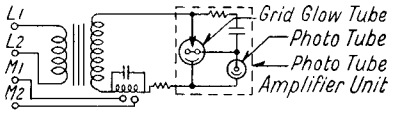


FIG. 5—SCHEMATIC WIRING DIAGRAM OF TYPES LA AND LB LIGHT RELAYS.

tube, or grid cathode, branch of the potentiometer passes current which brings the potential of the grid back toward that of the cathode. When the grid potential is sufficiently near that of the cathode the glow discharge stops and the current flow ceases.

It is seen from the above that the operation of the types LA and LB light relays is discontinuous; they are either **on** or **off** and have no intermediate points; the action of the photo tube is only to control whether or not the grid glow tube glows (passes current).

The figures given in this instruction book for the distance permissible between the light relay and its source of light are based on the use of photo tubes having a sensitivity of 6 microamperes per lumen and allowing an ample safety factor in the quantity of light. The figure of 6 microamperes per lumen is the minimum sensitivity of the type VB S# 664832 photo tubes as shipped. However, most of these tubes have an actual sensitivity much greater than and often more than double, this figure. With these more sensitive photo tubes a greater distance can be spanned but since the shipment of photo tubes having a sensitivity higher than the minimum cannot be promised, all maximum spacing data is based on this figure and the added photo tube sensitivity is added safety factor. Although a spacing greater than that recommended may be possible with a given photo tube it should not be used because of the possibility that a replacement photo tube may only meet the minimum sensitivity requirement.

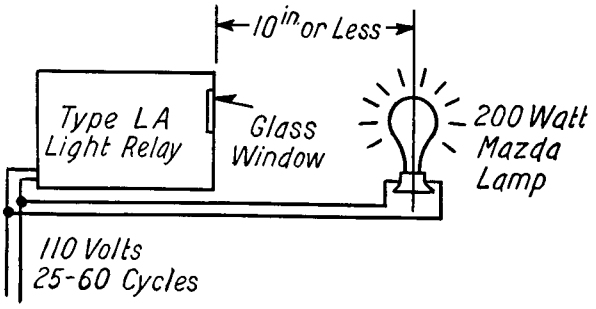


FIG. 6—SCHEMATIC SPACING DIAGRAM OF TYPE LA LIGHT RELAY

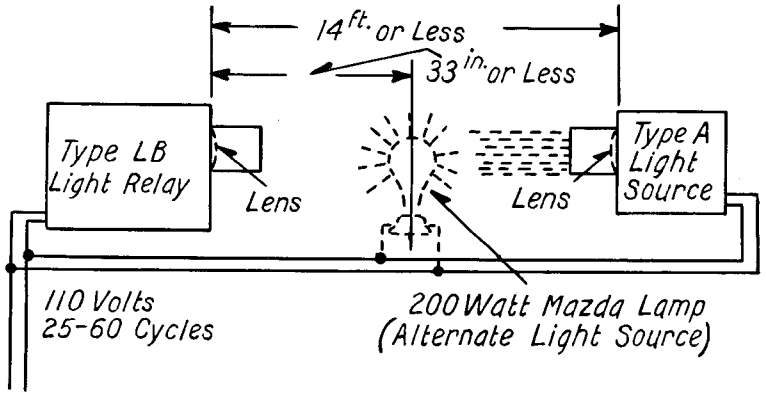


FIG. 7—SCHEMATIC SPACING DIAGRAM OF TYPE LB LIGHT RELAY

Speed of Operation

When operated alone, the light relay will make and break its contacts up to 600 times per minute.

Magnetic Counters may be obtained which in conjunction with the light relay will count up to 300 times per minute. A 4 microfarad condenser should be used in parallel with the counter coil to avoid contact sparking.

Maintenance

There are no adjustments to be made on the LA and LB light relays. Very little maintenance is required to keep them in operation. The glass window in front of the photo tube, and the incandescent lamp used as a source of light in the type LA must be kept clean. The frequency of cleaning will depend entirely on the cleanliness of the surrounding atmosphere, the average time between cleanings will probably be about 2 weeks. The lens of both the type LB and the type A light source must be kept clean.

The sensitivity of the photo electric tube will remain constant over a long period of time. It will have a life of 1 year or more of continuous operation.

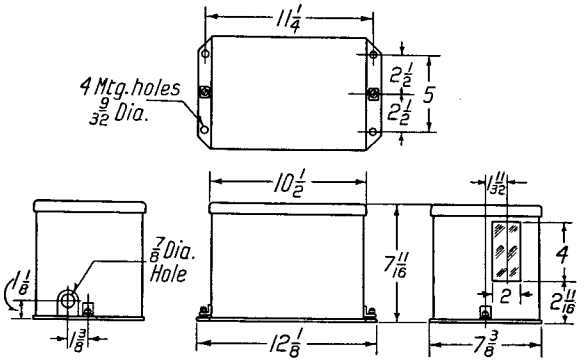


FIG. 8—DIMENSIONS OF LA LIGHT RELAY

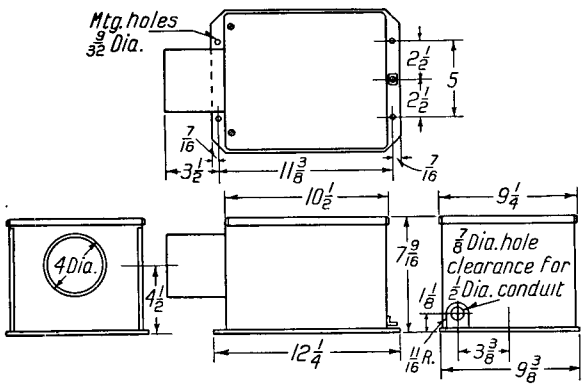


FIG. 9—DIMENSIONS IN INCHES OF TYPE LB LIGHT RELAY

The grid glow tube has no filament which is subject to burning out. It has an average life of 3000 hours of actual glowing when a current of approximately 10 milli-amperes is passing and requires no attention to keep it in operation. Since the glow tube is glowing only when the photo tube is darkened, it will have an average useful life of 5000 hours or more in most applications.

The lamp used for a light source unit should be replaced with sufficient frequency to minimize the danger of lamp failure. The automobile headlight bulb used in the type A light source unit is operated below its rated voltage in order to insure long life. It should be renewed every six months.

Tests

The types LA and LB light relays are subjected to a rigid inspection before leaving the factory and it is not expected that trouble will be encountered in service. There are no adjustments to be made in normal operation in the field. If, however, the light relay does not function properly when installed or after a period of service, the trouble may be found as follows:

(A) If, when the light relay is placed in service it does not function properly, it may be installed incorrectly. The circuit and the section on **Installation** should be checked carefully.

(B) If, when the photo tube is dark, the grid glow tube will not glow and pass current.

1. There may be no supply voltage.

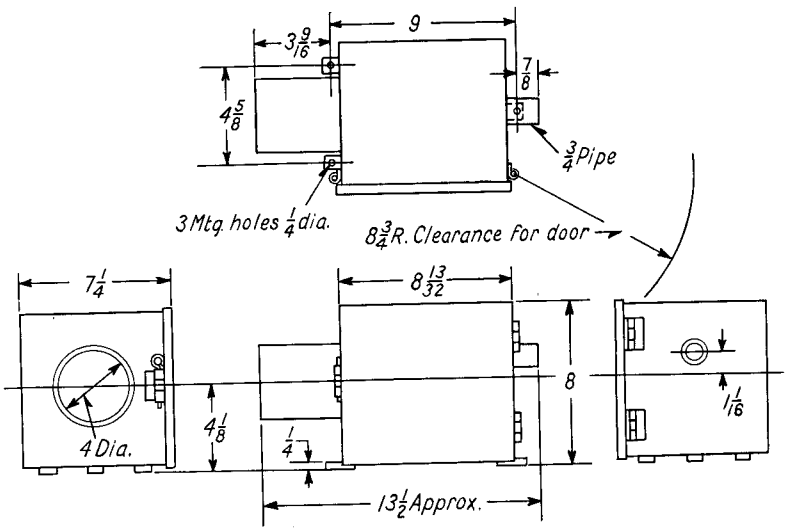


FIG. 10—DIMENSIONS IN INCHES OF TYPE LA LIGHT-SOURCE UNIT FOR INDOOR SERVICE.

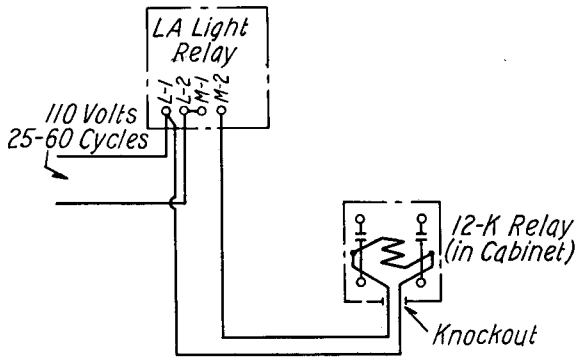


FIG. 11—DIAGRAM OF CONNECTIONS OF TYPE LA OR LB RELAY CONTROLLING AN AUXILIARY TYPE 12-K RELAY

2. The transformer, load resistor or relay may be damaged or open circuited.
3. The grid glow tube may have failed.

(C) If, when the photo tube is illuminated with the recommended amount of light the glow tube cannot be stopped from glowing and passing current.

1. The photo tube may have declined in sensitivity.
2. The grid glow tube may have failed. This kind of glow tube failure is unlikely.
3. The supply voltage may be excessively high.

(D) If, upon progressively illuminating the photo tube the grid glow tube glows and then stops glowing and then again glows, (shows transition points).
1. The grid glow tube is at fault.

(E) If the telephone type relay does not operate when the grid glow tube glows.
1. The supply voltage may be too low.
2. The relay coil or the condenser across the coil may be short circuited.
3. The load resistor may be out of adjustment.
4. The telephone type relay may be out of adjustment.

(F) If the telephone type relay chatters.
1. The condenser across the relay coil may be open circuited.
2. The relay may be out of adjustment.

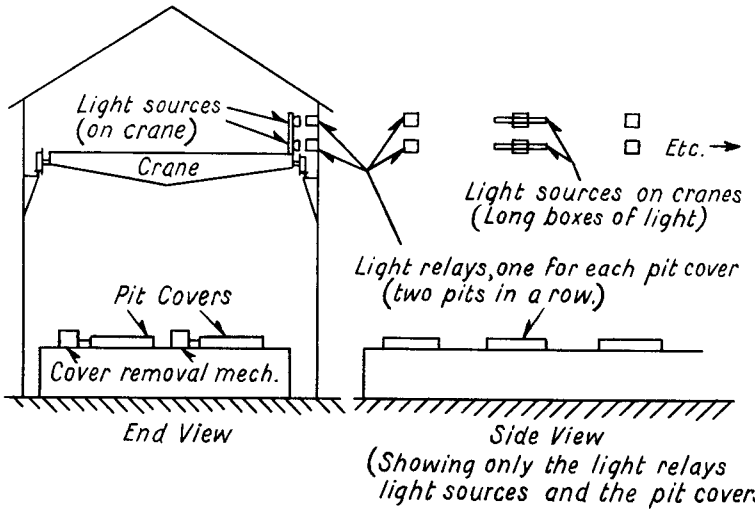


FIG. 12—TYPE LA LIGHT RELAYS MOUNTED IN SOAKING PIT SHED OF STEEL MILL. CRANE OPERATOR OPENS AND CLOSES PIT COVERS BY MEANS OF A LIGHT MOUNTED ON THE CRANE.

Discussion on Tests

The average life of the grid glow tube is discussed under **Maintenance.** Failure of the grid glow tube at the end of its useful life will be usually evidenced by failure to glow when the photo tube is darkened. (Sec. (B), 3).

The decline in photo tube sensitivity is very gradual and will not cause a sudden change in the operation of the light relay. Its life is discussed under "**Maintenance**".

If trouble described under (E) 3, 4, or (F) 2 is experienced one lead to the photo cell amplifier unit, terminal A or F, should be removed and a d-c. Milliammeter placed in the circuit. With 110 volts on the primary and the grid glow tube glowing there should be 10 milliamperes flowing in the circuit. If the current differs from this value adjust the load resistor until it is obtained.

The telephone type relay should pick up on approximately 6 milliamperes. If it does operate at this value of current it may be adjusted by changing its air gap. To do this loosen the lock nut and the screw on the end of the relay, then turn the hexagon headed screw to the right to make the relay pick up on less current and to the left to make it pick up on more current. The lock nut and screw should be carefully tightened again.

If it is found impossible to make the light relay work, it should be returned to the factory for repairs since in most cases our factory is better fitted to repair such apparatus than the customer.

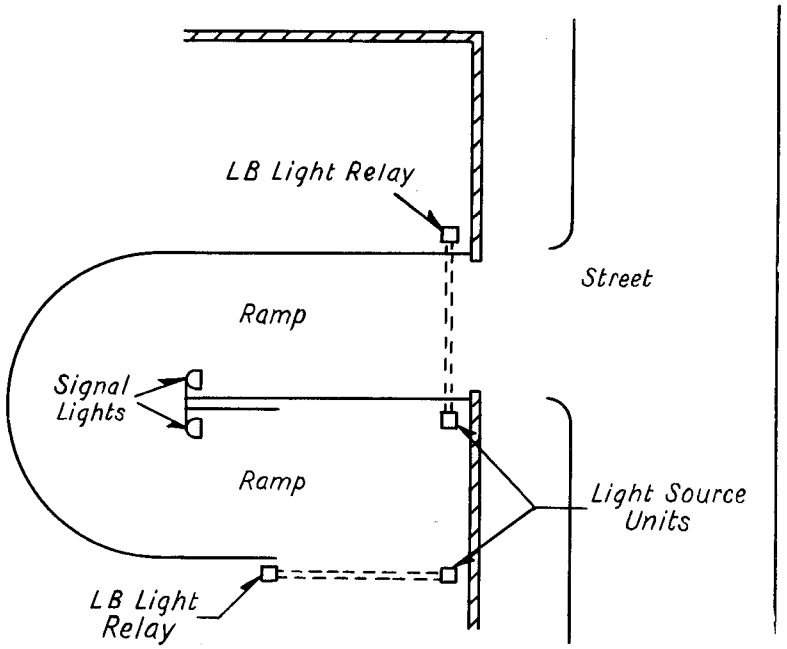


FIG. 13—TYPE LB LIGHT RELAYS OPERATING SIGNAL SYSTEM ON A ONE-WAY GARAGE RAMP. ARRANGEMENTS OF RELAYS MAY BE WORKED OUT FOR A WIDE VARIETY OF APPLICATIONS SUCH AS COUNTING TRAFFIC, PROTECTING DRIVE OR DOOR WAYS, SIGNALING OR RINGING ALARMS.

Storage when not in use

When not in use for a considerable period of time the light relay should be stored in a dry place and protected from dust, dirt and moisture. The photo tube and grid glow tube should be removed, wrapped in cloth or paper and placed in a carton by themselves.

Other Light Relays

The light relays described and listed in this booklet are carried in stock at the East Pittsburgh Works. Other light relays can be obtained that are suitable for applications where the light is gradually dimmed, and are not merely "**On**" and "**Off**" relays. In addition to use as a relay, they may be used to indicate or record degrees of light on an indicating or recording meter.

Inquiry should be made when operation different from that described for the types LA and LB light relays is desired.

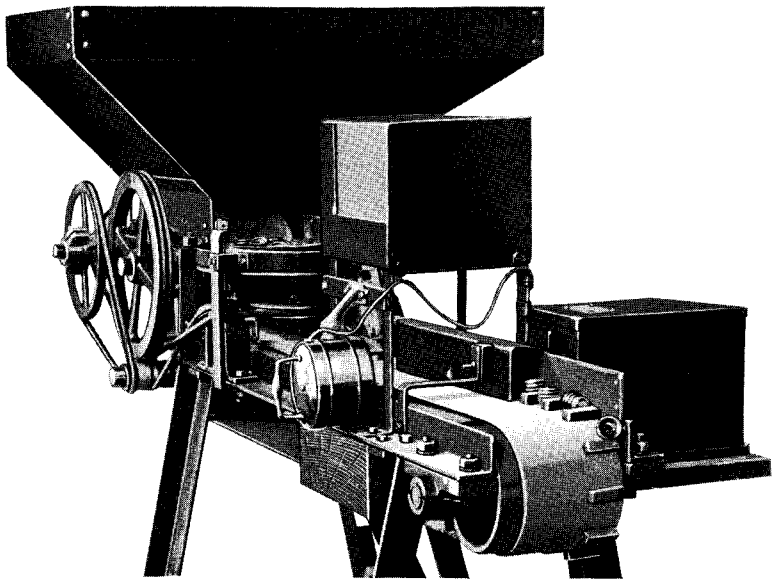


FIG. 14—TYPE LA LIGHT RELAY USED FOR COUNTING LAMP BASES

LIST OF LIGHT RELAYS AND ACCESSORIES

Description	Approx. Wt. Lb. Net	Approx. Wt. Lb. Shipping	Approx. Dim. In. Height	Approx. Dim. In. Width	Approx. Dim. In. Length	Style No
LA light relay, 110-volt a-c. 25 to 60 cycles, with Photo-electric Cell and Grid Glow Tube...	18	21	8	7½	12	708841
LB light relay for indoor service, 110-volt a-c. 25 to 60 cycles, with Photo-electric Cell and Grid Glow Tube	21	24	9	7½	12	708842
Type A light source unit for indoor service 110-volt, a-c., 25 to 60 cycles	12	15	8	8	8	708843
Spare Photo-electric Tube	4 oz.	1	...	...	....	664832
Spare Grid Glow Tube	6 oz.	2	...	...	....	687437
For MC Relays, see Westinghouse Catalog of Electrical Supplies	....	..	...	...	....	.....
Wall mounting for MC relay	....	..	...	...	....	674542
12-K Relay, 110-volt, 60 cycles, complete in cabinet	6¾	8	7½	9¼	5	676273
12-K Relay, 110-volt, 25 cycles, complete in cabinet	6¾	8	7½	9¼	5	676274
Magnetic Counter, 60 cycle, 110-volt	3	5	5¼	3	2¾	708844
4-Microfarad Condenser—Wall or Table Mounting	1	2	3	2¾	4¾	700637
Small Rotary Converter, 100 volt-amperes, 115 volts d-c. to 110 volts a-c., 60 cycles	30	..	6¾	4⅛	11	578136

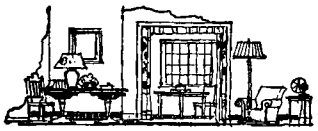
RECOMMENDED STOCK OF RENEWAL PARTS

The following is a list of the Renewal Parts and the minimum quantities of each that should be carried in stock. These are the parts most subject to wear in ordinary operation, and to damage or breakage due to possible abnormal conditions. The maintenance of such stock will minimize service interruptions caused by breakdowns.

NAME OF PART	NO. PER UNIT	RECOMMENDED FOR STOCK: Total number of units up to and including 2	RECOMMENDED FOR STOCK: 5	RECOMMENDED FOR STOCK: 15	STYLE NO.
Light Relay Complete	1	0	0	1	.....
Photo Electric Tube	1	1	1	2	661832
Grid Glow Tube	1	1	1	2	687437
Transformer	1	0	0	1	695796
Telephone Type Relay	1	0	1	1	695633
Glass Window for Type LA Relay	1	0	1	1	751699
Lens for Type LB Relay	1	0	1	1	751700
Load Resistor 8000 Ohms	1	1	1	2	716048
Condenser	2	0	1	1	552844
Amplifier Unit	1	0	1	1	674472
Grid Resistor	1	0	1	1	700667
Cork Gasket Between Panel and Case	1	0	1	2	707808
Binding Post	2	0	0	1	684386
Felt Washer for Binding Post	2	0	0	1	583626
Grid Condenser	1	0	0	1	684380

Parts indented are included in the part under which they are indented.

Westinghouse Products



Homes—Farms

Air Heaters
Auto Engine Heaters
Automatic Irons
Automatic Percolators
Automatic Ranges
Cozy Glow Heaters
Curling Irons
Fans
Hot Plates
Light and Power Plants
Lighting Equipment
Mazda Lamps
Motors for
Buffers and Grinders
Ice Cream Freezers
Ironers and Washers
Refrigerators
Sewing Machines
Vacuum Cleaners
Newel Posts
Panelboards
Rectigon Chargers for Automobile and Radio Batteries
Rectox Trickle Charger
Refrigerators, Electrical
Safety Switches
Sollaire Luminaires
Sol-Lux Luminaires
Solar Glow Heaters
Table Stoves
Tumbler Water Heaters
Turnover Toasters
Vacuum Cleaners
Wall-Type Heaters
Waffle Irons
Warming Pads
Water Heaters

Buildings

Arc Welding Equip.
Circuit-Breakers
Elevators and Control
Glue and Solder Pots
Instruments and Relays
Kitchen Equipment
Bake Ovens,
Hot Plates, Ranges
Lighting Equipment
Brackets, Newels and Lanterns
Reflectors & Lamps
Sol-Lux Luminaires
Lightning Arresters
Micarta Trays
Meters
Meter Service Switches
Motor Generators
Motors and Control for:
Coal and Ash-Handling Equipment
Compressors
Elevators
Fans and Blowers
Laundry Equipment
Refrigerating Equip.
Vacuum Cleaners
Water & Sump Pumps
Panelboards
SynchronousConverters
Safety Switches
Solar Glow Heaters
Stokers
Switchgear
Transformers

City Improvements

Airport Floodlights
Automatic Substations
Constant Current Regulators
Control Apparatus
Elec. Railway Equip.
Lighting Units
Mazda Lamps
Ornamental Standards
Parkway Cables
Street Brackets
Streethoods

Offices and Stores

Air Heaters
Bread-baking Oven
Elevators and Control
Fans, Desk and Exhaust
Fuses
Lighting Equipment
Mazda Lamps
Meters
Micarta Desk Tops
Motors for
Adding Machines
Addressing Machines
Motors for
Coffee and Meat Grinders, etc.
Dictaphones
Envelope Sealers
Fans and Blowers
Pumps
Refrigerating Machines
Panelboards
Safety Switches
Switches
Tumbler Water Heaters

Aviation

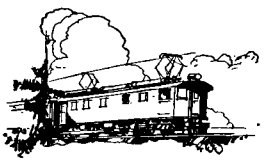
Approach, Boundary, Hangar, and Obstruction Lights
Arc Welding Equip.
Floodlight Projectors
Motor Generators
Reflectors
Transformers
Mazda Lamps
Micarta
Cabin-lining Plate
Fairleads
Hinge Bearings
Propellers
Pulleys
Tailwheels

Ships

Circuit-Breakers
Condensing Equipment
Deck Winch Motors
Elec.Heating Appar.
Eng. Room Auxiliaries
Fans and Blowers
Fuses
Generating Equipment
Instruments
Light and Power Plants
Lighting Equipment
Micarta Trays
Motors and Controllers
Ovens, Ranges and Galley Equipment
Panelboards
Propulsion Equipment
Diesel-Electric
Geared Turbine
Turbine Electric
Safety Switches
Switchgear

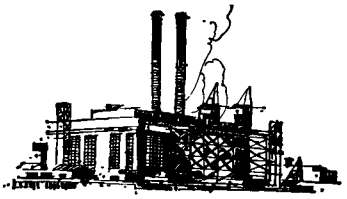
Electric Railways

Arc Welding Equip.
Automatic Substations
Babbitt, Solder & Pots
Baking Ovens
Circuit-Breakers
Elec. Trolley Coaches
Fans
Gas Electric Coaches
Gears and Pinions
Generators
Insulating Material
Insulators
Lighting Fixtures
Lightning Arresters
Line Material
Manual Substations
Mazda Lamps
Meters
Motors and Control
Panelboards
Portable Substations
Relays
Signal Equipment
Supervisory Control
Switchgear
Synchronous Convert's
Transformers
Trolley Poles



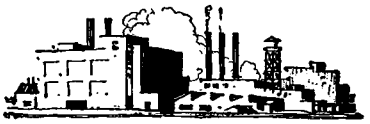
Railroads

ArcWelding Equipment
Automatic Substations
Babbitt, Solder & Pots
Baking Ovens
BatteryChargingEquip.
Cars—Multiple-Unit.
Gas-Elec., Oil-Elec.
Circuit-Breakers
Control Apparatus
Elec.HeatingApparatus
Fans
Gears and Pinions
Generators
Headlight Equipment
Instruments
Insulating Materials
Insulators
Lighting Equipment
Lightning Arresters
Line Material
Locomotives—Electric
Gas-Elec., Oil-Elec.
Manual Substations
Mazda Lamps
Micarta Gears
Motors and Control
Outdoor Substations
Panelboards
Power House Apparatus
Safety Switches
Signal Equipment
Stokers
Supervisory Control
Switchgear
Transformers
Yard Lighting Equip.



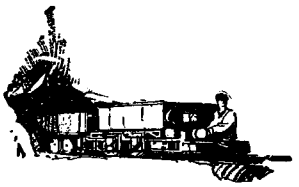
Electric Service Companies

Automatic Switching Equipment
Circuit-breakers
Condensers
Cutouts
Fans
Frequency-converters
Fuses
Generators
Instruments & Meters
Insulating Material
Insulators
Line Material
Lighting Equipment
Lightning Arresters
Micarta
Motors and Control
Motor Generators
Network Protectors
Network Transformers
Oil Testing and Purifying Equipment
Outdoor Substations
Panelboards
Porcelain Insulators
Relays
Safety Switches
Steam Turbines
Stokers
Supervisory Control
Switchgear
SynchronousConden'rs
SynchronousConv'ters
Transformers
Turbine Generators
Voltage Regulators



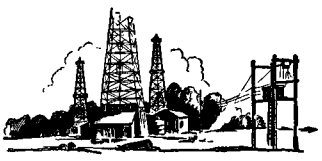
Mills and Factories

Arc Welding Equip.
Automatic Starters and Controllers
Babbitt & Babbitt Pots
Capacitors
Circuit-Breakers
Condensers
Fans, Desk and Exhaust
Furnaces and Ovens
Fuses
Generating Equipment
Insulating Materials
Knife Switches
Larry Car Equipment
Lighting Equipment
Lightning Arresters
Locomotives—Electric
Gas-Elec., Oil-Elec.
Mazda Lamps
Meters and Relays
Micarta Gears
Motors and Controllers
Panelboards
PipeFittings(Struct'al)
Power House Apparatus
Safety Switches
Solder & Glue Pots
Space Heaters
Stokers
Switchgear
Transformers
Turbines



Mines

Arc Welding Equip.
Auto. Feeder Equip.
Automatic Starters and Controllers
Automatic Substations
BatteryChargingEquip.
Circuit-Breakers
Clamps
Elec.HeatingApparatus
Fans
Gears and Pinions
Headlights
Insulating Materials
Insulators
Larry Car Equipment
Lightning Arresters
Line Material
Locomotives
Manual Substations
Mazda Lamps
Meters & Instruments
Micarta
Motor Generators
Motors for Hoists, Pumps, Tipples, and Breakers
Panelboards
Portable Substations
Relays
Safety Switches
Switchgear
Synchronous Conv'ters
Transformers
Ventilating Outfits



Oil Fields

Arc Welding Equip.
Change House Heaters
Floodlight Projectors
Gear Units
Insulators
Mazda Lamps
Motors and Control
Panelboards
Reflectors
Rig Lighters
Safety Switches
Small Light Plants
Transformers
Vapor Proof Fixtures

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

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ABILENE, KAN., 300 Cedar St. N.
ABILENE, TEX., 774 Butternut St.
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*BOSTON, MASS., 10 High St.
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DAVENPORT, IOWA, 206 E. Second St.
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*EL PASO, TEX., Oregon and Mills St.
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*GRAND RAPIDS, MICH., 507 Monroe Ave. N. W.
HAMMOND, IND., 135 Oakwood Ave.
*HOUSTON, TEX., 218 Main St.
*HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 20 N. Meridian St.
JACKSON, MICH., 212 W. Michigan Ave.
JACKSON, MISS., 519 Hemlock St.
JACKSONVILLE, FLA., 719 W. Forsyth St.
JOHNSTOWN, PA., 47 Messenger St.
JOPLIN, MO., 420 School St.
*KANSAS CITY, MO., 2124 Wyandotte St.
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*LOS ANGELES, CALIF., 420 San Pedro St. S.
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NEW YORK, N. Y., 150 Broadway
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OMAHA, NEB., 409 17th St. S.
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*PHILADELPHIA, PA., 3001 Walnut St.
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*PORTLAND, ORE., 83 Sixth St.
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SAN ANTONIO, TEX., Main and Commerce St.
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*SAN FRANCISCO, CALIF., 1 Montgomery St.
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*SEATTLE, WASH., 603 Stewart St.
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SPRINGFIELD, MASS., 395 Liberty St.
*ST. LOUIS, MO., 411 Seventh St. N.
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*TAMPA, FLA., 417 Ellamae Ave.
TERRE HAUTE, IND., 701 Wabash Ave.
TEXARKANA, ARK., 503 E. Sixth St.
TOLEDO, OHIO, 416-424 Madison Ave.
*TULSA, OKLA., 602 S. Main St.
*UTICA, N. Y., 258 Genesee St.
WASHINGTON, D.C., 1434 New York Ave. N.W.
WATERLOO, IOWA, 305 W. Fourth St.
WICHITA, KAN., 918 N. Lawrence St.
WILKES-BARRE, PA., 267 Pennsylvania Ave. N.
WILMINGTON, CALIF., 305½ Avalon Blvd.
WORCESTER, MASS., 54 Commercial St.
YOUNGSTOWN, OHIO, 16 Central Square
The HAWAIIAN ELECTRIC CO., Ltd., Honolulu, T. H.—Agent
*Warehouse located in this city.

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BINGHAMTON, N. Y., Westinghouse Electric Supply Co., Inc.
BIRMINGHAM, ALA., Moore-Handley Hdwe. Co.
BLUEFIELD, W. VA., Superior Supply Co.
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BROOKLYN, N. Y., Westinghouse Electric Supply Co., Inc.
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CANTON, OHIO, The Moock Elec. Supply Co.
CHARLOTTE, N.C., Westinghouse Elec. Sup. Co.
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CLEVELAND, O., Westinghouse Elec. Sup. Co.
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COLUMBUS, O., The Hughes-Peters Elec. Corp.
DALLAS, TEX., Westinghouse Elec. Sup. Co.
DENVER, COLO., The Mine & Smelter Sup. Co.
DES MOINES, IA., Westinghouse Elec. Sup. Co., Inc.
DETROIT, MICH., Westinghouse Elec. Sup. Co.
DULUTH, MINN., Westinghouse Electric Supply Co., Inc.
ELMIRA, N. Y., Westinghouse Elec. Sup. Co.
EL PASO, TEX., The Mine & Smelter Sup. Co.
ERIE, PA., Star Electrical Co.
EVANSVILLE, IND., Westinghouse Elec. Sup. Co.
FARGO, N.D., Westinghouse Elec. Sup. Co., Inc.
FLINT, MICH., Westinghouse Elec. Sup. Co.
GRAND RAPIDS, MICH., Westinghouse Electric Supply Co.
GREENSBORO, N.C., Westinghouse Elec. Sup. Co.
GREENVILLE, S. C., Mann Electric Supply Co.
HARLINGEN, TEX., Westinghouse Elec. Sup. Co.
HOUSTON, TEX., Westinghouse Elec. Sup. Co.
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WICHITA, KAN., United Electric Co.
WILMINGTON, DEL., Westinghouse Elec. Sup. Co. of Pa.
WORCESTER, MASS., Wetmore-Savage Electric Supply Co.
YORK, PA., Westinghouse Elec. Sup. Co. of Pa.
YOUNGSTOWN, O., The Moock Elec. Sup. Co.

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BUFFALO, N. Y., 141-157 Milton St.
CHARLOTTE, N. C., 210 E. Sixth St.
CHICAGO, ILL., 2201 W. Pershing Road
CINCINNATI, OHIO, 207 W. Third St.
CLEVELAND, OHIO, 2209 Ashland Rd. S. E.
DENVER, COLO., 2644 Walnut St.
DETROIT, MICH., 5757 Trumbull Ave.
FAIRMONT, W. VA., 602 Cleveland Ave.
HOUSTON, TEX., 2313 Commerce St.
HUNTINGTON, W. VA., 209 Ninth St.
INDIANAPOLIS, IND., 547 W. Merrill St.
JOHNSTOWN, PA., 47 Messenger St.
KANSAS CITY, MO., 2124 Wyandotte St.
LOS ANGELES, CALIF., 420 S. San Pedro St.
MILWAUKEE, WIS., 37 Erie St.
MINNEAPOLIS, MINN., 2303 Kennedy St. N.E.
NEWARK, N. J., Haynes Ave., Route 25
NEW YORK, N. Y., 460 West 34th St.
PHILADELPHIA, PA., 3001 Walnut St.
PITTSBURGH, PA., 6905 Susquehanna St.
PROVIDENCE, R. I., 393 Harris Ave.
SALT LAKE CITY, UTAH, 346-A Pierpont Ave.
SAN FRANCISCO, CALIF., 1466 Powell Street, Emeryville, Calif.
SEATTLE, WASH., 3451 East Marginal Way
SPRINGFIELD, MASS., 395 Liberty St.
ST. LOUIS, MO., 717 S. Twelfth St.
TOLEDO, OHIO, 203-205 First St.
UTICA, N. Y., 113 N. Genesee St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WORCESTER, MASS., 54 Commercial St.

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