

INSTRUCTIONS GEH-954A

# PLUNGER RELAYS

TYPES PAA, PAC, PAV, PBA, PBC, AND PCV



**GENERAL**  **ELECTRIC**  
SCHENECTADY, N. Y.

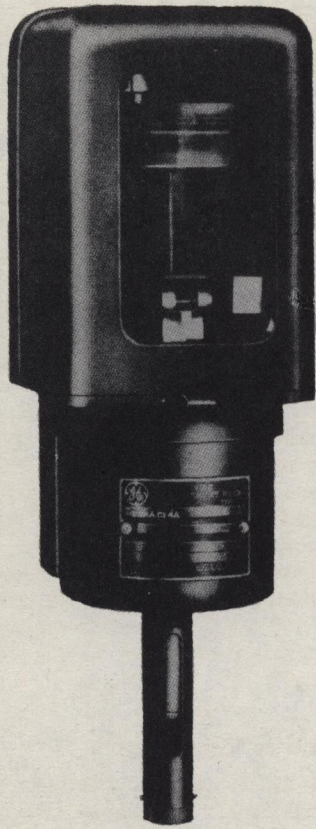


Fig. 1. Time Relay

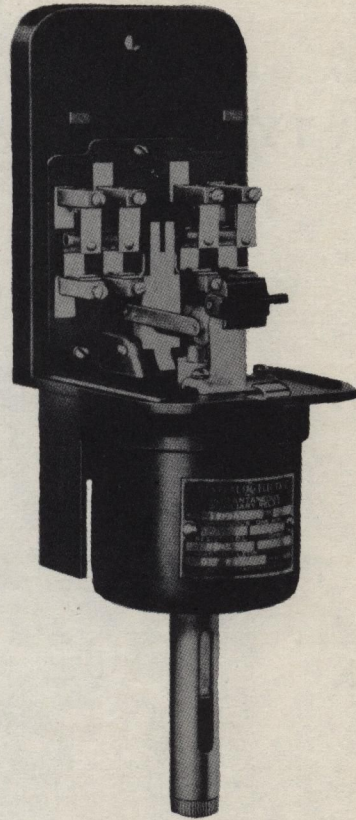


Fig. 2. Instantaneous Relay

# PLUNGER RELAYS

## TYPES PAA, PAC, PAV, PBA, PBC, and PCV

The above nomenclature embraces a line of relays designed to protect against overcurrent and undervoltage and also for use as auxiliary devices. The same principle of operation is common to all of them and depends upon the action of a magnet coil in attracting or releasing the plunger when predetermined values of voltage or current are present in the circuit to which the coil is connected. By means of a snap toggle mechanism the operation of the contacts is quick-acting on the upstroke of the plunger. These contacts can be arranged in several ways which, with the use of a coil suitable for the particular purpose in view, adapt these relays to a large number of applications.

Three distinct varieties of the general construction are available. These are differentiated by the second letter of the nomenclature; thus the letter "A" denotes the standard construction, "B" indicates the sensitive form (hand or electrical reset only), while "C" distinguishes a shaded-pole construction designed to insure quiet operation on alternating voltage. The three types are not interchangeable in service and the outstanding features of each are listed on page 4.

### INSTALLATION

When received, the cover should be removed and the relay inspected to make sure that the toggle snaps quickly when the plunger is raised slowly by hand, and that the plunger drops down freely to its normal position when released.

It may be more convenient to adjust the contacts (see below) before mounting the relay than afterward.

The relay should be mounted on a vertical surface, preferably in a location free from excessive vibration, dirt, moisture, or corrosive fumes.

### ADJUSTMENTS

See that the die-cast cam at the front of the relay bears evenly against the two rollers; the supporting holes in this cam are slotted for

adjustment. Make sure that the screws holding this cam are tight, because these partially determine the amount of wipe on the back contacts.

### Contacts

The stationary contacts can be placed in either of two positions, one of these being toward the back of the relay and the other toward the front. These positions may be readily obtained by loosening the screw on the front of the contact block, removing the stationary contact and replacing it in the desired position.

Lifting the plunger and operating the contact bar solely by hand, see that all the back contacts make simultaneously and all the front contacts make simultaneously. Adjust for this condition, if necessary, by loosening the set screws and moving the contact piece forward or backward as required.

After locking the adjustments, see that the contacts still make simultaneously, and then operate the contact mechanism slowly by means of the plunger and see that each contact has wipe.

### Automatic or Hand-reset

In the construction of types PAA and PAC relays the upper portion of the plunger rod is surrounded by two semi-cylindrical die-castings which carry four projecting parts at the bottom spaced 90 deg. apart, located under the toggle arms, and two similar parts spaced 180 deg. apart, located directly over the toggle arms. These projecting parts or knobs may be adjusted to two positions; when the two upper knobs lie across the toggle arms the contacts are automatically reset by the fall of the plunger, whereas when they are rotated through 90 deg. they pass downward between the toggle arms, and the contacts remain in the operated position until reset manually by means of the push rod projecting through the front of the cover. This rotation is accomplished by removing the clamping spring at the top of the rod

## APPLICATIONS AND CHARACTERISTICS

Type of Relay	Application	Time	*Contacts	RATINGS			Reset	Indicating Target	Construction			
				Volts	Amp.	Freq. in Cycles						
PAC11A PAC12A	Over-current	Inst. } Time }		{ ... 1 to 5	1 to 5 40 to 60	25 to 60 40 to 60	Self or Hand	Yes Yes	<p>The PAC relay can be obtained either instantaneous or with time delay, and with either self- or hand-reset. When arranged for self-reset, the plunger drops at approximately 70 per cent of the current at which it picks up, after the plunger has lifted, until it strikes the toggle.</p> <p>The time delay may be adjusted for any time up to 20 seconds at 125 per cent of its calibration. The low point of calibration is approximately the same as the continuous capacity, while the highest calibration is three times the lowest calibration value.</p> <p>The standard time-delay relay is assembled at the factory to give the delay on pickup with instantaneous dropout.</p>			
PAC13A PAC14A		Inst. } Time }		{ ... 1 to 5	1 to 5 40 to 60	25 to 60 40 to 60		Yes Yes				
PAC11B PAC12B		Inst. } Time }		{ ... 1 to 5	1 to 5 40 to 60	25 to 60 40 to 60		Yes Yes				
PAC13B PAC14B		Inst. } Time }		{ ... 1 to 5	1 to 5 40 to 60	25 to 60 40 to 60		Yes Yes				
PBC11A PBC12A		Sensitive Over-current	Inst. } Time }		{ ... 1 to 5	1 to 5 25 to 60		25 to 60		Hand and Electric	Yes Yes	
PBC11B PBC12B			Inst. } Time }		{ ... 1 to 5	1 to 5 25 to 60		25 to 60			Yes Yes	
PBC13A PBC13B	Inst. } Time }			{ ... 1 to 5	1 to 5 25 to 60	25 to 60	Yes Yes					
PAV11A PAV12A	Under-voltage Protection for D-c. Circuits		Inst. } Time }		125 and 250 D-c.	.....	.....	Self	No No		<p>The PAV relay is similar to the Type PAC relay except that it is equipped with a potential coil to fit the device for use as a d-c. undervoltage relay.</p>	
PCV11A PCV12A			Under-voltage Protection for A-c. Circuits	Inst. } Time }		115, 230, 460, and 575 A-c.	.....		25 and 60			Self
PCV13A PCV14A	Inst. } Time }				.....		25 and 60	No				
PCV11B PCV12B	Inst. } Time }			.....	25 and 60		No					
PCV13B PCV14B	Inst. } Time }			.....	25 and 60		No					
PAA11A PAA12A	Auxiliary	Inst. } Time }			115, 230, 460, and 575 A-c.		.....	25 and 60	Self or Hand	Yes	<p>The PAA relay is similar to the Type PAC except that it is equipped with an a-c. or d-c. potential coil. When used on a-c. this relay is suitable for momentary energization only.</p>	
PAA13A PAA14A		Inst. } Time }					.....	25 and 60		Yes		
PAA11B PAA12B		Inst. } Time }		.....		25 and 60	Yes					
PAA13B PAA14B		Inst. } Time }		9 to 600 D-c.		.....	25 and 60	Yes				
PBA11A PBA12A		Bell Alarm and Auxiliary	Inst. } Time }			115, 230, 460, and 575 A-c.	.....	25 and 60		Hand		Yes Yes
PBA11B PBA12B			Inst. } Time }				.....	25 and 60				Yes Yes
PBA13A PBA13B	Auxiliary		Inst. } Time }		125, 250, and 650 D-c.		.....	25 and 60	Hand and Electric		Yes Yes	
PBA11A PBA12A			Inst. } Time }				.....	25 and 60			Yes Yes	

\* ● Positions of contacts.  
 ○ Alternative positions of contacts.  
 † One-minute rating of d-c. coil in amperes: 1.5, 2.8, 6, 12, 25, 30, and 80.

and rotating the semi-cylindrical castings carrying the knobs until the latter reach the desired position. The spring must then be replaced in the recess provided for it.

### TIME DELAY

This feature is obtained by means of a bellows and air valve located at the top of the plunger rod. The bellows is composed of a rubber compound which must not be lubricated, and which is unaffected, either in its action or in its durability, by high or low temperature. The rate at which the air is expelled by the upward stroke of the plunger and is returned on the downward stroke is governed by a calibrated disc at the right-hand side of the bellows controlling the air valve, the latter being located directly in front of the Bakelite drum upon which the disc rotates. This disc is arbitrarily marked from 1 to 10 and the valve mechanism is so arranged that when the numeral 1 lies over the valve opening the time delay of the relay is at its minimum value: as the disc is rotated so that higher numerals lie vertically over the valve aperture the time delay increases and reaches the maximum time setting of the relay at the numeral 10. (See Fig. 3.)

The setting of the left-hand disc, which is not calibrated, determines whether the delay brought about by the bellows will occur on the upward stroke of the plunger, on its downward stroke, or on both. By raising the clip which holds this disc in place, and removing the latter, two valves are displayed one of which contains a removable poppet, while the other does not. The action of the poppet is as follows:

When the poppet is placed in the left-hand valve opening, with the dowel pin on the cover seated in the recess at the back of the molded part, the time delay takes place on the upward stroke of the plunger and there is no time delay on the downward stroke.

When the poppet is placed on the right-hand valve opening, with the dowel pin still seated in the recess at the back of the molded part, the action is reversed, the time delay now occurring on the downward stroke, while the upward stroke is practically instantaneous.

With the poppet still in the right-hand valve opening, but with the disc replaced so that the dowel now rests directly on top of the poppet, instead of in the recess previously described, the time-delay action of the relay occurs on both the upward and downward strokes.

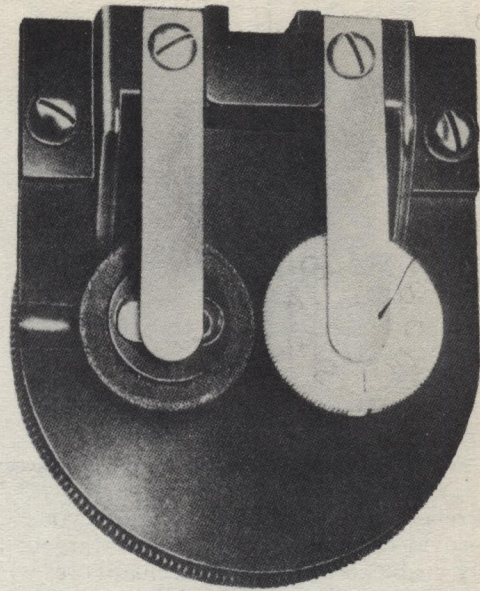


Fig. 3. Discs for Adjustment of Time Delay

In making the any of above adjustments care should be taken to see that the leather washer under the disc is properly seated when the latter is replaced.

### OVERCURRENT SETTING

The current at which the plunger operates is predetermined by the height at which it rests in the calibrating tube at the bottom of the relay. The groove in the lower end of the plunger should be set opposite to the valve in amperes at which it is desired that the relay shall operate. This setting is accomplished by turning the knurled nut until the plunger groove rests opposite the desired tripping current.

From the variety of adjustments enumerated above, and the number of coils and arrangements of contacts available, the almost universal field of application of these relays, where the plunger type is desired, will be readily apparent. For convenience, certain details of construction of the several varieties are given in the tabulation on page 4.

The overcurrent relays types PAC and PBC are equipped with current coils. The others are provided with potential coils, except certain forms of the type PBA relay which are intended for operation in series with a circuit breaker trip coil; these relays are provided with coils suitable for this purpose.

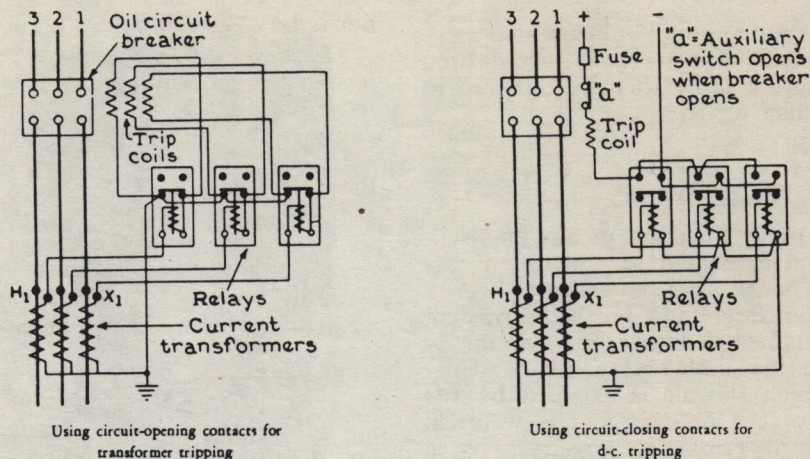


Fig. 4. Connection Diagrams for Types PAC11A and PAC12A Relays

All relays, except the undervoltage type PCV, are provided with targets. These targets are plainly visible, orange-colored semaphores which come into view when the plunger rises to operate the relay. They are reset manually by means of a push-rod extending through the front of the cover.

**Contact Rating**

By choosing the proper contacts the over-current relay can be used for direct tripping by the current transformer, or it can be used to trip the breaker indirectly from a separate d-c. power supply.

Each contact of the relay will carry 5 amperes continuously or 20 amperes for one minute. To avoid burning the contacts the trip circuit should be interrupted by an auxiliary switch on the circuit breaker, instead of by the relay contacts, when a tripping source other than the current transformer is used.

The contacts of the circuit-opening relay, used for direct tripping from the current transformer, will operate successfully on secondary currents up to 50 amperes. Beyond this value circuit-closing contacts, in conjunction with a battery or other suitable tripping means, should be used.

Any one contact will safely interrupt currents not in excess of those given in the following table:

Volts	UPSTROKE	Amperes		DOWN-STROKE
	D-c.	A-c.	D-c.	A-c.
12	5.0	10.0	2.5	5.0
30	3.0	10.0	1.5	5.0
125	1.0	10.0	0.5	2.5
250	0.4	7.0	0.2	1.0
600	0.1	3.0	0.0	0.0

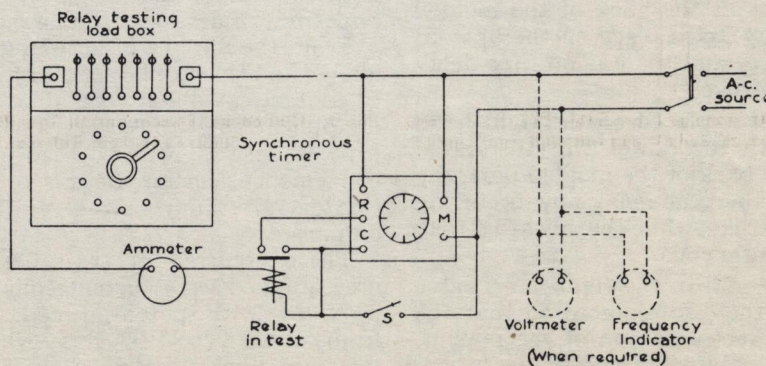


Fig. 5. Connections for Testing a Circuit-closing Relay Operated from Same Supply as Type MF-2 Synchronous Timer

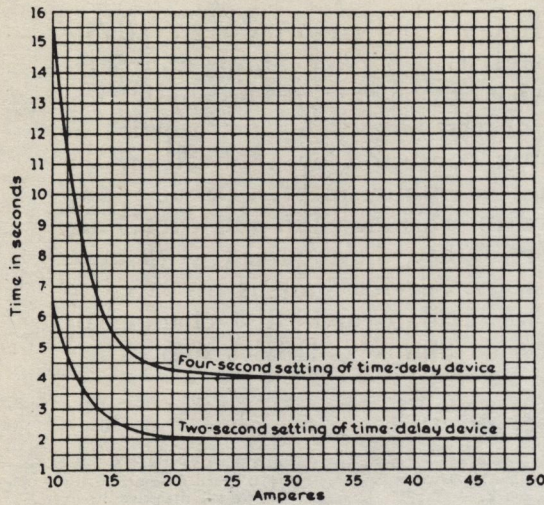


Fig. 6. Characteristic Time-current Curves of Type PAC Over-current Relays with 5-amp. Coil; Plunger Setting at 8 Amperes with Two Different Settings of Time-delay Device

### Secondary Burden

The burden imposed upon the current transformer by the 5-ampere coil, which is the most commonly used, is approximately 22.5 volt-amperes at 5 amperes, 60 cycles.

### Periodic Tests

It is advisable to test the relays periodically to insure their positive operation. Typical testing connections for overcurrent relay are given in this book, while the various methods of adjustment have already been described.

### Renewal Parts

Order renewal parts by Cat. No. from the nearest Office of the General Electric Company. If the Cat. No. is not available, give a complete description of the part required, together with the complete rating and all other information that may appear on the relay nameplate.

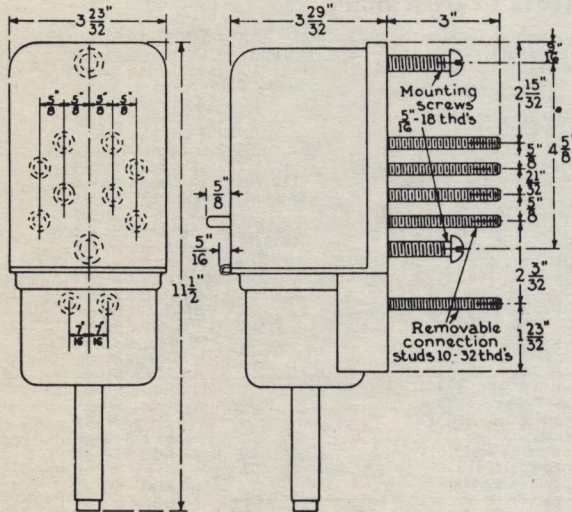


Fig. 7. Outline and Dimensions of Types PAA, PAC, PAV, PBA, and PBC Relays (Number of Studs Varies with Different Types)

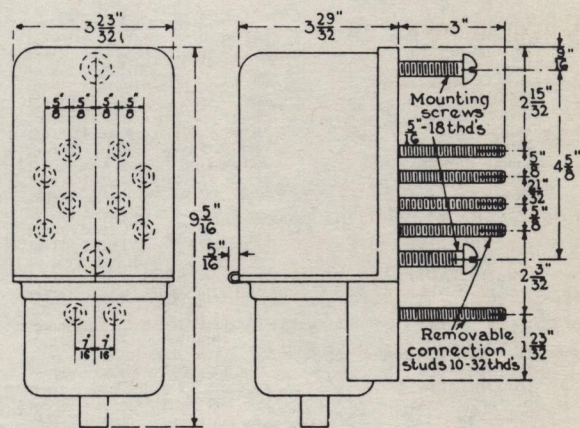


Fig. 8. Outline and Dimensions of Type PCV Relays (Number of Studs Varies with Different Types)

## WHEN SERVICE IS REQUIRED

**T**HE facilities of our engineering departments and factories are available to purchasers of G-E apparatus, through G-E Service Shops and Sales Offices. Any additional information or advice can be obtained on application to the nearest Sales Office. When it is necessary to renovate, repair, or change apparatus to meet a new operating condition or application, the facilities of the nearest Service Shop should be employed. Each Service Shop is equipped to maintain the same standard of workmanship and excellence of materials as that employed in the factory. When the required work must be performed on the purchaser's premises, the Service Shop is prepared to send capable and dependable men into the field to make the changes or repairs promptly and efficiently. G-E Service Shops and Sales Offices are located at the points listed below.

### SERVICE SHOPS

Atlanta, Ga.	496 Glenn Street, Southwest	Milwaukee, Wis.	940 West St. Paul Avenue
Buffalo, N. Y.	318 Urban Street	Minneapolis, Minn.	410 Third Avenue, North
Chicago, Ill.	509 East Illinois Street	New York, N. Y.	416 West Thirteenth Street
Cincinnati, Ohio	215 West Third Street	Philadelphia, Pa.	429 North Seventh Street
Cleveland, Ohio	4966 Woodland Avenue	Pittsburgh, Pa.	16 Terminal Way, South Side
Dallas, Texas	1801 North Lamar Street	St. Louis, Mo.	1110 Delmar Boulevard
Detroit, Mich.	5950 Third Avenue	Salt Lake City, Utah	360 West Second South Street
Houston, Texas	1312 Live Oak Street	San Francisco, Calif.	361 Bryant Street
Kansas City, Mo.	819 East Nineteenth Street	Seattle, Wash.	1508 Fourth Avenue, South
Los Angeles, Calif.	5203 Santa Fe Avenue		

Special service divisions are also maintained at the following Works of the Company: Erie, Pa.; Ft. Wayne, Ind.; Pittsfield, Mass.; Schenectady, N. Y.; and West Lynn, Mass. (River Works and West Lynn Works).

### SALES OFFICES (Address nearest office)

Akron, Ohio	335 South Main Street	Memphis, Tenn.	8 North Third Street
Atlanta, Ga.	187 Spring Street, Northwest	Milwaukee, Wis.	940 West St. Paul Avenue
Baltimore, Md.	39 West Lexington Street	Minneapolis, Minn.	107 South Fifth Street
Bangor, Me.	600 Main Street	Nashville, Tenn.	234 Third Avenue, North
Binghamton, N. Y.	19 Chenango Street	Newark, N. J.	744 Broad Street
Birmingham, Ala.	600 North Eighteenth Street	New Haven, Conn.	129 Church Street
Boston, Mass.	140 Federal Street	New Orleans, La.	837 Gravier Street
Buffalo, N. Y.	1 West Genesee Street	New York, N. Y.	570 Lexington Avenue
Butte, Mont.	20 West Granite Street	Niagara Falls, N. Y.	201 Falls Street
Cedar Rapids, Iowa	203 Second Street, Southeast	Oklahoma City, Okla.	119 North Robinson Street
Charleston, W. Va.	304 Capitol Street	Omaha, Nebr.	409 South Seventeenth Street
Charlotte, N. C.	200 South Tryon Street	Philadelphia, Pa.	1405 Locust Street
Chattanooga, Tenn.	536 Market Street	Phoenix, Ariz.	435 West Madison Street
Chicago, Ill.	230 South Clark Street	Pine Bluff, Ark.	501 Main Street
Cincinnati, Ohio	215 West Third Street	Pittsburgh, Pa.	436 Seventh Avenue
Cleveland, Ohio	4966 Woodland Avenue	Portland, Me.	25 Bedford Street
Columbus, Ohio	40 South Third Street	Portland, Ore.	621 Southwest Alder Street
Dallas, Texas	1801 North Lamar Street	Providence, R. I.	111 Westminster Street
Davenport, Iowa	511 Pershing Avenue	Richmond, Va.	700 East Franklin Street
Dayton, Ohio	25 North Main Street	Rochester, N. Y.	89 East Avenue
Dayton, Colo.	650 Seventeenth Street	St. Louis, Mo.	112 North Fourth Street
Des Moines, Iowa	418 West Sixth Avenue	Salt Lake City, Utah	200 South Main Street
Detroit, Mich.	700 Antoinette Street	San Antonio, Texas	201 Villita Street
Duluth, Minn.	14 West Superior Street	San Francisco, Calif.	235 Montgomery Street
El Paso, Texas	109 North Oregon Street	Schenectady, N. Y.	1 River Road
Erie, Pa.	10 East Twelfth Street	Seattle, Wash.	821 Second Avenue
Evansville, Ind.	123 Northwest Fourth Street	Spokane, Wash.	421 Riverside Avenue
Fort Wayne, Ind.	1635 Broadway	Springfield, Ill.	607 East Adams Street
Fort Worth, Texas	408 West Seventh Street	Springfield, Mass.	95 State Street
Grand Rapids, Mich.	148 Monroe Avenue, Northwest	Syracuse, N. Y.	113 South Salina Street
Hartford, Conn.	338 Ann Street	Tacoma, Wash.	1019 Pacific Avenue
Houston, Texas	1312 Live Oak Street	Toledo, Ohio	420 Madison Avenue
Indianapolis, Ind.	110 North Illinois Street	Tulsa, Okla.	409 South Boston Street
Jackson, Mich.	212 Michigan Avenue, West	Utica, N. Y.	258 Genesee Street
Jacksonville, Fla.	237 West Forsyth Street	Washington, D. C.	806 Fifteenth Street, Northwest
Kansas City, Mo.	106 West Fourteenth Street	Waterbury, Conn.	72 West Liberty Street
Knoxville, Tenn.	602 South Gay Street	Wichita, Kan.	116 South Main Street
Los Angeles, Calif.	212 North Vignes Street	Worcester, Mass.	165 Commercial Street
Louisville, Ky.	455 South Fourth Street	Youngstown, Ohio	25 East Boardman Street

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