INSTRUCTIONS

# PLUNGER RELAYS

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

*Switchgear*

GENERAL ELECTRIC

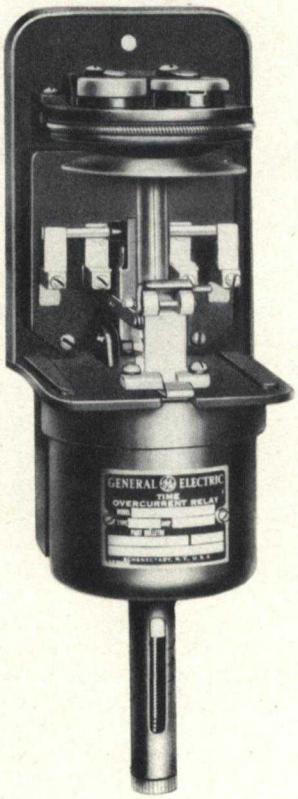


Fig. 1. Time Relay

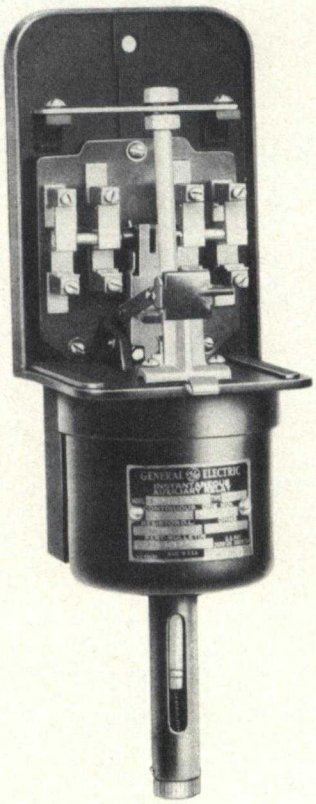


Fig. 2. Instantaneous Relay

# PLUNGER RELAYS

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

The Types PAA, PAC, PAV, PBA, PBC, and PCV plunger relays are designed to protect against overcurrent and undervoltage and also for use as auxiliary devices. The operation of these relays 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.

### INSTALLATION

Before installing, 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 before mounting the relay than afterward. See ADJUSTMENTS.

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. The contact spring should bear lightly against the front stop when the contact is open.

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, indicated by the fact that the contact bar holds the contact spring away from its front stop when the contact is closed.

#### 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 projection through the front of the cover. This rotation is accomplished by removing the clamping spring at the top of the rod 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.

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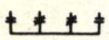
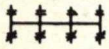
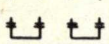
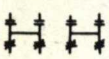
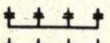
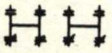
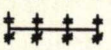
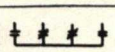
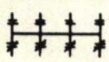
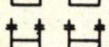
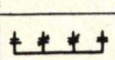
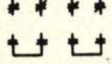
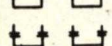
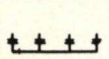
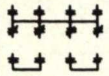
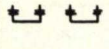
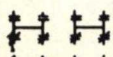
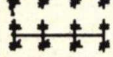
*These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.*

# APPLICATIONS AND CHARACTERISTICS

| Type of Relay | Application | Time | *Contacts | RATINGS Volts | RATINGS Amp | RATINGS Freq in Cycles | Reset | Indicating Target | Construction |
|---|---|---|---|---|---|---|---|---|---|
| PAC11A | Over-current | Inst |  | ... | 1 to 5 | 25 to 60 | Self or Hand | Yes | 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. 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. The standard time-delay relay is assembled at the factory to give the delay on pickup with instantaneous drop-out. |
| PAC12A | | Time | | ... | 1 to 5 | 40 to 60 | | Yes | |
| PAC13A | | Inst |  | ... | 1 to 5 | 25 to 60 | | Yes | |
| PAC14A | | Time | | ... | 1 to 5 | 40 to 60 | | Yes | |
| PAC11B | | Inst |  | ... | 1 to 5 | 25 to 60 | | Yes | |
| PAC12B | | Time | | ... | 1 to 5 | 40 to 60 | | Yes | |
| PAC13B | | Inst |  | ... | 1 to 5 | 40 to 60 | | Yes | |
| PAC14B | | Time | | ... | 1 to 5 | 40 to 60 | | Yes | |
| PBC11A | Sensitive Over-current | Inst |  | ... | 1 to 5 | 25 to 60 | Hand | Yes | The PBC relay is built in the instantaneous form with either hand- or hand-and-electrical reset only. It differs from the Type PAC in that the plunger is much lighter. The low point of calibration is approximately 50 per cent of the continuous capacity, while the high point of calibration is three times the lowest calibration value. |
| PBC12A | | Inst |  | ... | 1 to 5 | 25 to 60 | Hand | Yes | |
| PBC11B | | Inst |  | ... | 1 to 5 | 25 to 60 | Hand | Yes | |
| PBC12B | | Inst |  | ... | 1 to 5 | 25 to 60 | Hand | Yes | |
| PBC13A | | Inst |  | ... | 1 to 5 | 25 to 60 | Hand and Electric | Yes | |
| PBC13B | | Inst |  | ... | 1 to 5 | 25 to 60 | Hand and Electric | Yes | |
| PAV11A | Under-voltage Protection for D-c Circuits | Inst |  | 125 and 250 D-c | ..... | ..... | Self | No | 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. |
| PAV12A | | Time | | | ..... | ..... | Self | No | |
| PCV11A | Under-voltage Protection for A-c Circuits | Inst |  | 115 230, 460, and 575 A-c | ..... | 25 and 60 | Self | No | The PCV relay differs from the above constructions in that it is particularly adapted for operation on a-c voltage and is quiet at rated voltage with the plunger up. It may be obtained either in the instantaneous form or with the time-delay feature. The latter is assembled at the factory to give instantaneous pickup with time-delay drop-out. It has no provision for calibration but will pick up at approximately 80 per cent of rated voltage and drop-out at 30 per cent. |
| PCV12A | | Time | | | | | | | |
| PCV13A | | Inst |  | | ..... | 25 and 60 | Self | No | |
| PCV14A | | Time | | | | | | | |
| PCV11B | | Inst |  | | ..... | 25 and 60 | Self | No | |
| PCV12B | | Time | | | | | | | |
| PCV13B | | Inst |  | | ..... | 25 and 60 | Self | No | |
| PCV14B | | Time | | | | | | | |
| PAA11A | Auxiliary | Inst |  | 115, 230, 460, and 575 A-c | ..... | 25 and 60 | Self or Hand | Yes | 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. |
| PAA12A | | Time | | | | | | | |
| PAA13A | | Inst |  | | ..... | 25 and 60 | | Yes | |
| PAA14A | | Time | | | | | | | |
| PAA11B | | Inst |  | | ..... | 25 and 60 | | Yes | |
| PAA12B | | Time | | | | | | | |
| PAA13B | | Inst |  | 9 to 600 D-c | ..... | 25 and 60 | | Yes | |
| PAA14B | | Time | | | | | | | |
| PBA11A | Bell Alarm and Auxiliary | Inst |  | 115, 230, 460, and 575 A-c | † | 25 and 60 | Hand | Yes | The PBA relay is similar to the Type PBC except that it is equipped with an a-c or d-c potential coil. It is not suitable for continuous energization by alternating current. Current coils are also supplied when connected in series with other coils. |
| PBA12A | | Inst |  | | ..... | 25 and 60 | Hand | Yes | |
| PBA11B | | Inst |  | | ..... | 25 and 60 | Hand | Yes | |
| PBA12B | | Inst |  | 125, 250, and 650 D-c | ..... | 25 and 60 | Hand | Yes | |
| PBA13A | Auxiliary | Inst |  | | ..... | 25 and 60 | Hand and Electric | Yes | |
| PBA13B | | Inst |  | | ..... | 25 and 60 | | Yes | |

* Contacts may be changed from normally open to normally closed or vice versa by reversing position of the contact. Electrically separate contacts may be made common by replacing the movable contact bar. All contacts are shown in the de-energized position.

† One-minute rating of d-c coil in amperes: 1.5, 2.8, 6, 12, 25, 30, and 80.

## TIME DELAY

Time delay 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 not appreciably affected, 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 disk 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 disk rotates. This disk is arbitrarily marked from one to ten and the valve mechanism is so arranged that when the numeral one lies over the valve opening the time delay of the relay is at its minimum value; as the disk 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 ten. (See Fig. 3.)

The setting of the left-hand disk, 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 disk 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 disk 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.

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

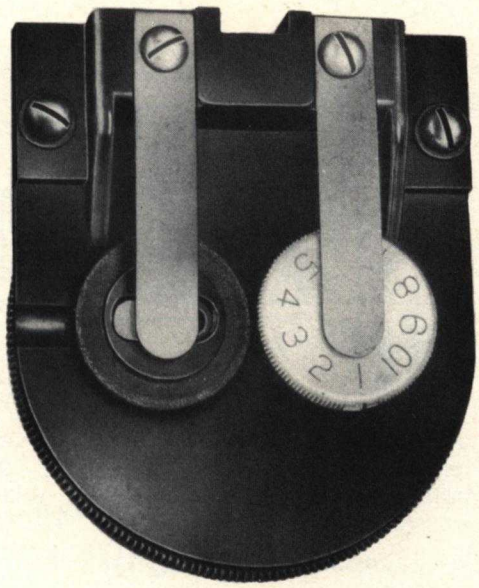



Fig. 3. Disks for Adjustment of Time Delay

## 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 value 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 various types 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.

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

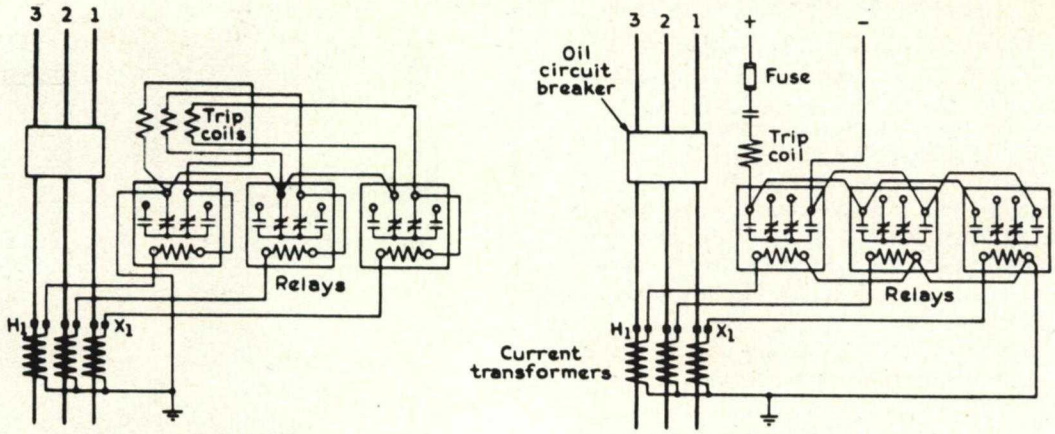



**Fig. 4. Connection Diagrams for Types PAC11A and PAC12A Relays**

means of a push-rod extending through the front of the cover.

## Contact Rating

By choosing the proper contacts the overcurrent 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 75 amperes for one-half second. 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 in noninductive circuits not in excess of those given in the following table:

| Volts | SNAP ACTION† | | NONSNAP ACTION†† | |
|---|---|---|---|---|
| | Amperes | | | |
| | A-c | D-c | A-c | D-c |
| 12 | .. | 6.0 | .. | 3.0 |
| 24 | .. | 4.0 | .. | 2.0 |
| 48 | .. | 2.5 | .. | 1.25 |
| 125 | 10 | 1.0 | 2.5 | 0.5 |
| 250 | 7 | 0.4 | 1.0 | 0.2 |
| 600 | 3 | 0.1 | 0.0 | 0.0 |

† All instantaneous and time contacts that open on the upstroke of the plunger.
†† Time contacts that open on the downstroke of the plunger.

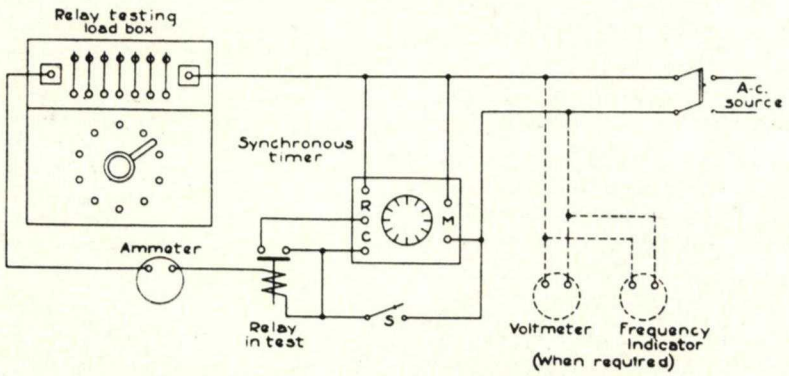



**Fig. 5. Connections for Testing a Circuit-closing Relay Operated from Same Supply as Type MF-2 Synchronous Timer**

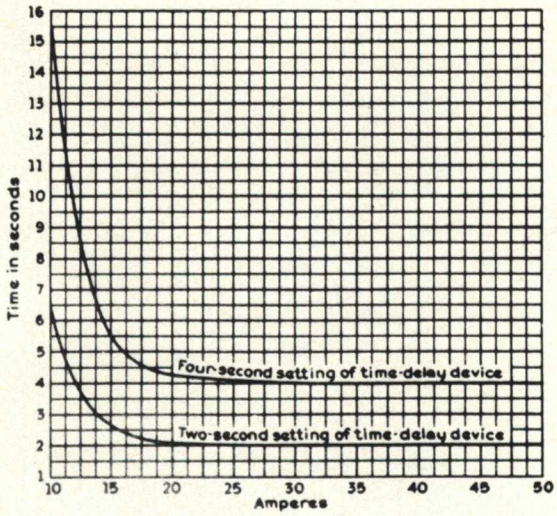



Fig. 6. Characteristic Time-current Curves of Type PAC Overcurrent Relays with 5-amp Coil; Plunger Setting at 8 Amperes with Two Different Settings of Time-delay Device

## 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 an overcurrent relay are shown in Fig. 5.

## Renewal Parts

When ordering renewal parts, write to the nearest Sales Office of the General Electric Company giving the quantity, catalog number if available, a complete description and nameplate rating of each item required.

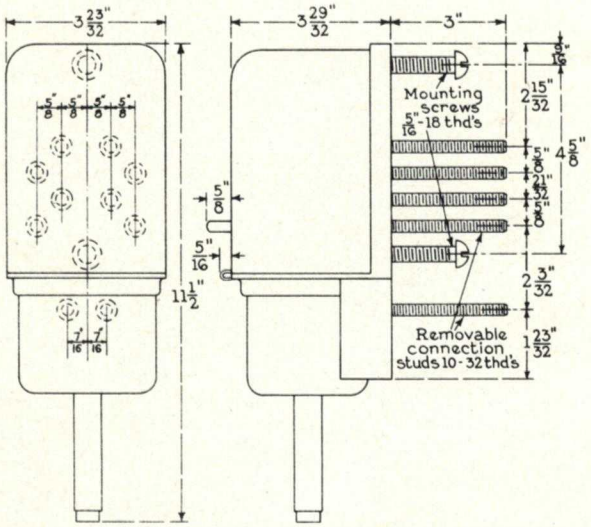



Fig. 7. Outline and Dimensions of Types PAA, PAC, PAV, PBA, and PBC Relays (Number of Studs Varies with Different Types)

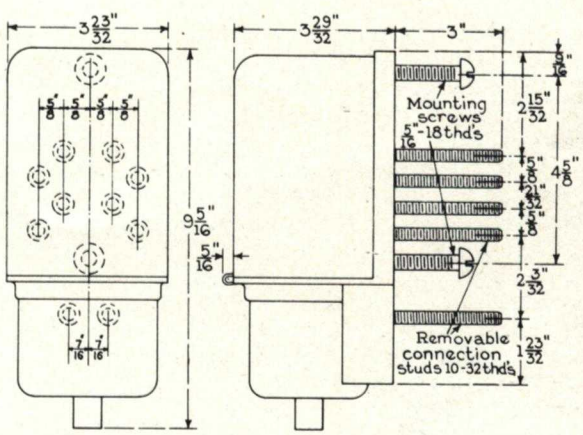



Fig. 8. Outline and Dimensions of Type PCV Relays (Number of Studs Varies with Different Types)