

# General Electric Company

Schenectady, N.Y.

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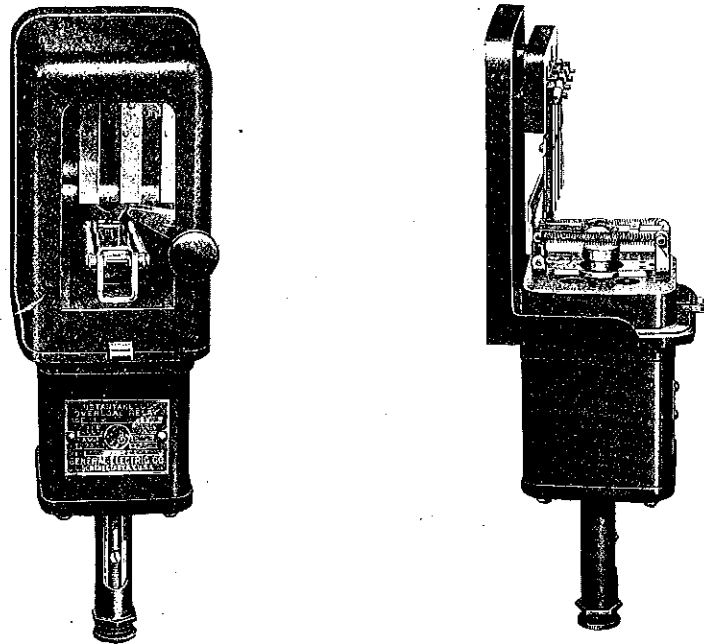
Bulletin No. IGE-47611

## TYPE PQ-6 INSTANTANEOUS, HAND RESET, OVERLOAD RELAY

The PQ-6 relay is extensively applied to alternating-current circuits for various purposes, the most important of these being its use for the differential protection of alternators, to which service it is especially suited.

With this differential protection, the possibility of excessive damage due to grounding or

and the PQ-6 relay is connected in parallel with each pair of current transformers. A simple wiring diagram of this connection is shown in Fig. 1, page 2. The neutral of the system should be grounded to obtain the greatest advantage of this protection.



TYPE PQ-6 OVERLOAD RELAY, SINGLE POLE, CIRCUIT CLOSING (3 CIRCUITS), HAND RESET

short circuiting of phases is reduced to a minimum.

This is accomplished by bringing out the leads of the machine to be protected and inserting current transformers at both ends of the windings. The secondaries of the transformers of each phase are connected in series

With the alternator running normally the same amount of current flows in both No. 1 and No. 2 current transformers and therefore no current in the coil of the PQ-6 relay. But, in case of an internal short circuit between phases or an internal ground (providing the neutral is grounded),

NOTE.—Data subject to change without notice.

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an unbalanced condition would be set up; that is, a greater amount of current would flow in one transformer than in the other. In such case the unbalanced secondary current would pass through the PQ-6 relay and the relay would operate instantaneously to trip the breaker, if this unbalanced current should exceed the minimum operating point for which the relay is set. Since the currents are balanced under normal conditions, a sensitive setting of the relay is possible.

was impossible for the attendant to act quickly enough to relieve the machine. This situation is guarded against where differential protection is provided.

## FEATURES

1. The PQ-6 relay contacts are arranged to close three control circuits. These contacts remain closed until reset by the operator.
2. The construction is such that the relay is kept free from dust and other foreign matter.

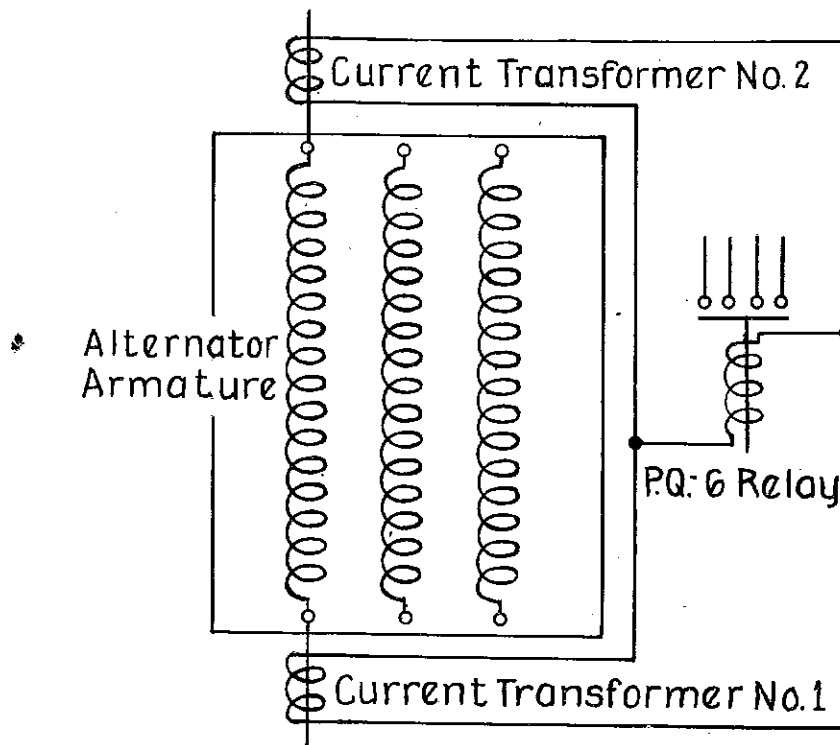


FIG. 1  
SIMPLIFIED DIAGRAM TO SHOW METHOD OF WIRING  
FOR DIFFERENTIAL PROTECTION OF ALTERNA-  
TORS (ONE PHASE)

In totally enclosed machines a ground or short circuit may easily result in considerable damage even though an attendant is looking on. Many times there is no outward indication to the attendant that trouble exists since the blower forces the smoke and hot air to the outside of the station. In such cases the damage is often extensive before the machine is relieved.

There are also cases on record where, although the fault was detected at the start, it

3. Manual resetting button is conveniently mounted on the face of the relay cover so that contacts may be reset without removing the cover.

4. The operating coil may be removed without disturbing the upper parts of the relay.

5. The cover of the relay is provided with a large glass window so that casual inspection may be made without its removal.

6. The relay operates on a low volt-ampere input: 1 ampere, 6 volts at 60 cycles, or on higher currents of proportionately lower voltages.

**APPLICATION**

The most common applications of the PQ-6 relay are as follows:

Differential protection of machines.

For use as auxiliary relays in combination with other relays or devices for closing tripping circuits and for closing signal circuits such as bell alarms.

\* For each application the diagrams as illustrated show the approved method of wiring for the individual service. Other methods are possible which are electrically equivalent and in particular installations may result in more economical and convenient wiring.

**Machine Protection**

Fig. 2 shows the approved method of wiring the device when used for the differential protection of "Y" connected alternators, while Fig. 3 shows the approved wiring for delta connected alternators.

**Automatic Opening of Generator Fields**

Provision for automatically opening the field circuit of each alternator should be supplied when differential or reverse power protection is used. The chief reason for opening the field circuit is that in case of short-circuited coils, a current would be induced in the coils as long as there is excitation on the machine, even though the oil circuit breaker was opened.

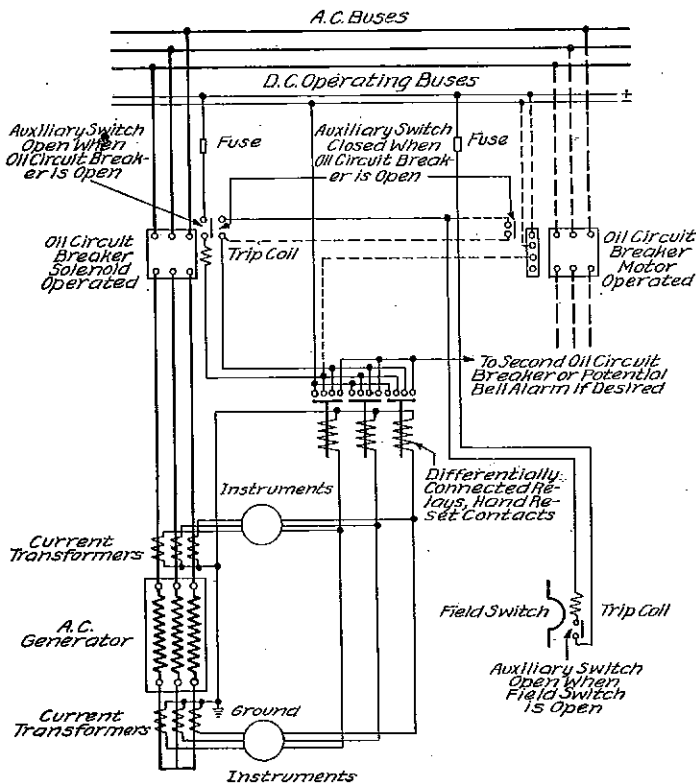
It is important to note that the oil circuit breaker connecting the alternator to the buses should open before the field circuit is interrupted, and to accomplish this it is necessary to have a circuit-closing auxiliary switch on the oil circuit breaker.

That it is preferable to open the oil circuit breaker before the field switch is evident from a consideration of the following:

1. When the field circuit is opened after the oil circuit breaker, there will be less liability of damage to the field circuit, due to the high voltage which would be induced in the field by the armature, if the field circuit were opened when heavy currents were passing through the armature.

2. Opening the field switch last also reduces the possibility of the alternator falling out of step with the remainder of the system and thereby preventing additional disturbance on the system.

It is, of course, evident that under none of the above mentioned conditions is the difficulty



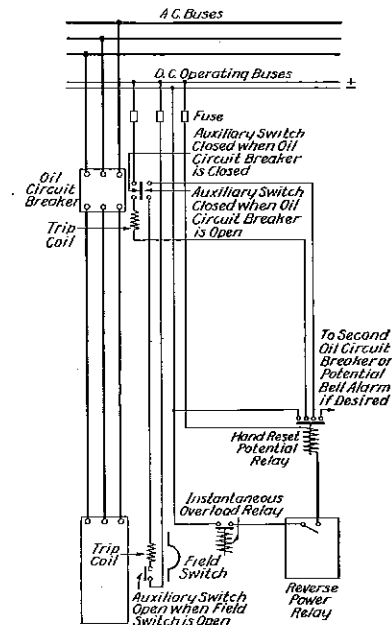
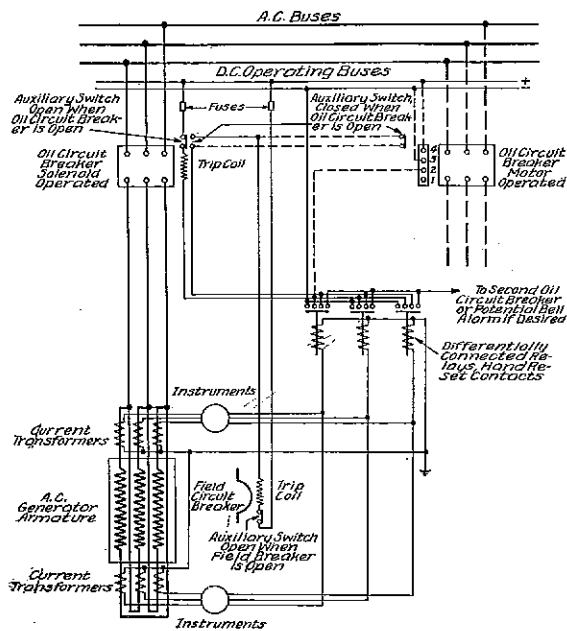
NOTE:—When a motor-operated oil circuit breaker is used a special auxiliary switch to close immediately after oil circuit breaker contacts part, is necessary to reduce time of tripping field switch to a minimum.

FIG. 2

**CONNECTIONS OF TYPE PQ-6, INSTANTANEOUS, HAND RESET, OVERLOAD RELAYS, CIRCUIT CLOSING (3 CIRCUITS) (FOR DIFFERENTIAL PROTECTION OF "Y" CONNECTED ALTERNATORS)**

\* See page 7, "Proper Loading of Current Transformers," for precautions to be observed when it is desired to connect instruments or meters to the same sets of current transformers with PQ-6 relays.

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NOTE:—When a motor-operated oil circuit breaker is used a special auxiliary switch to close immediately after oil circuit breaker contacts part is necessary, in order to reduce time of tripping field switch to a minimum.

FIG. 3  
CONNECTIONS OF TYPE PQ-6, INSTANTANEOUS, HAND RESET, OVERLOAD RELAYS, CIRCUIT CLOSING (3 CIRCUITS) (FOR DIFFERENTIAL PROTECTION OF "DELTA" CONNECTED ALTERNATORS)

FIG. 4  
CONNECTIONS OF TYPE PQ-6, INSTANTANEOUS, HAND RESET RELAYS, CIRCUIT CLOSING (3 CIRCUITS) IN CONJUNCTION WITH A REVERSE POWER RELAY (FOR REVERSE POWER PROTECTION OF ALTERNATORS)

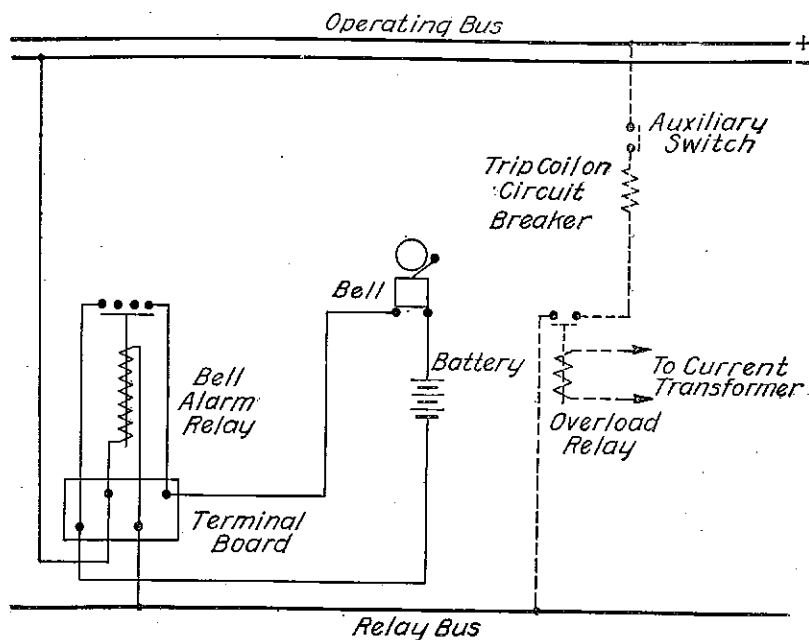


FIG. 5  
CONNECTIONS OF TYPE PQ-6 INSTANTANEOUS, HAND RESET RELAYS, CIRCUIT CLOSING (3 CIRCUITS) (FOR USE AS BELL ALARM RELAY)

entirely overcome by the opening of the oil circuit breaker first. The trouble is, however, sufficiently reduced to consider it the preferable method.

This arrangement requires either solenoid operation of the field switch or a manually operated field switch equipped with a shunt trip coil. Refer to Fig. 2 which shows the method of wiring.

When a manually operated field switch is used it will be necessary to provide a circuit-opening auxiliary switch on the field switch to open the shunt trip coil circuit. In the case of solenoid operated breakers this auxiliary switch is part of the standard equipment.

When the Type PQ-6 relay is applied as above, the hand reset contacts are used to advantage. By resetting the relay contacts the field switch may be reclosed while the main oil circuit breaker is still open.

#### For Use as an Auxiliary Relay

When the PQ-6 relay is used as an auxiliary relay its operation depends upon that of another relay or device. Two of the most common applications are diagrammatically shown in Figs. 4 and 5. Fig. 4 shows the PQ-6 relay used in combination with other relays for the closing of tripping circuits where reverse power protection is provided. Fig. 5 shows the wiring when the PQ-6 relay is used for closing bell alarm circuits.

#### OPERATION

The Type PQ-6 relay operates instantaneously and remains with contacts in the closed position until they are manually reset.

When the coil is sufficiently energized the plunger rises and strikes the contact toggle a blow at its center. In normal position the toggle is set with the contacts open and lies in a horizontal position with its joint slightly below center.

The toggle springs on either side tend to hold the toggle in this position, but when the joint is pushed slightly above center by the plunger the action of the springs is such that the toggle tends to fold upward. The movable contact being fastened to the free end of the toggle is at this time pulled forward and closes upon the stationary contacts.

To reset the relay contacts when the overload is removed, the resetting knob is turned to the left. The resetting finger presses upon the contact toggle and forces it to again assume the normal position with the joint below center and contacts open.

With this arrangement a slight pressure of the plunger against the toggle causes the relay to function.

#### CALIBRATION

When the PQ-6 relay is used as an overload relay for differential protection the calibrating tube is marked with values which indicate the minimum current which will lift the plunger and close the contacts. For this particular service the PQ-6 relay is usually adjustable between 1 and 2.5 amperes.

When it is used as an auxiliary relay the calibrating tube is marked for a plunger setting such that the relay will be operated by the minimum current which may be expected.

For the desired setting the index mark on the plunger should register with the current marking on the calibrating tube. Settings are effected by varying the plunger position with respect to the operating solenoid.

#### Relay Contacts

The contacts of the Type PQ-6 relay are so constructed that positive contact action is assured when the relay functions. The fixed contact members consist of flexible fingers fitted with silver tips which make contact upon the copper bar of the movable contact when that member is forced against the silver tips.

Any one contact finger will carry 20 amperes momentarily or 5 amperes continuously. The following tabulation shows the direct or alternating current which the contacts will interrupt at different voltages.

Voltage	Amperes Direct Current	Amperes Alternating Current
125	0.5	5.0
250	0.2	4.0
600	0.06	1.0

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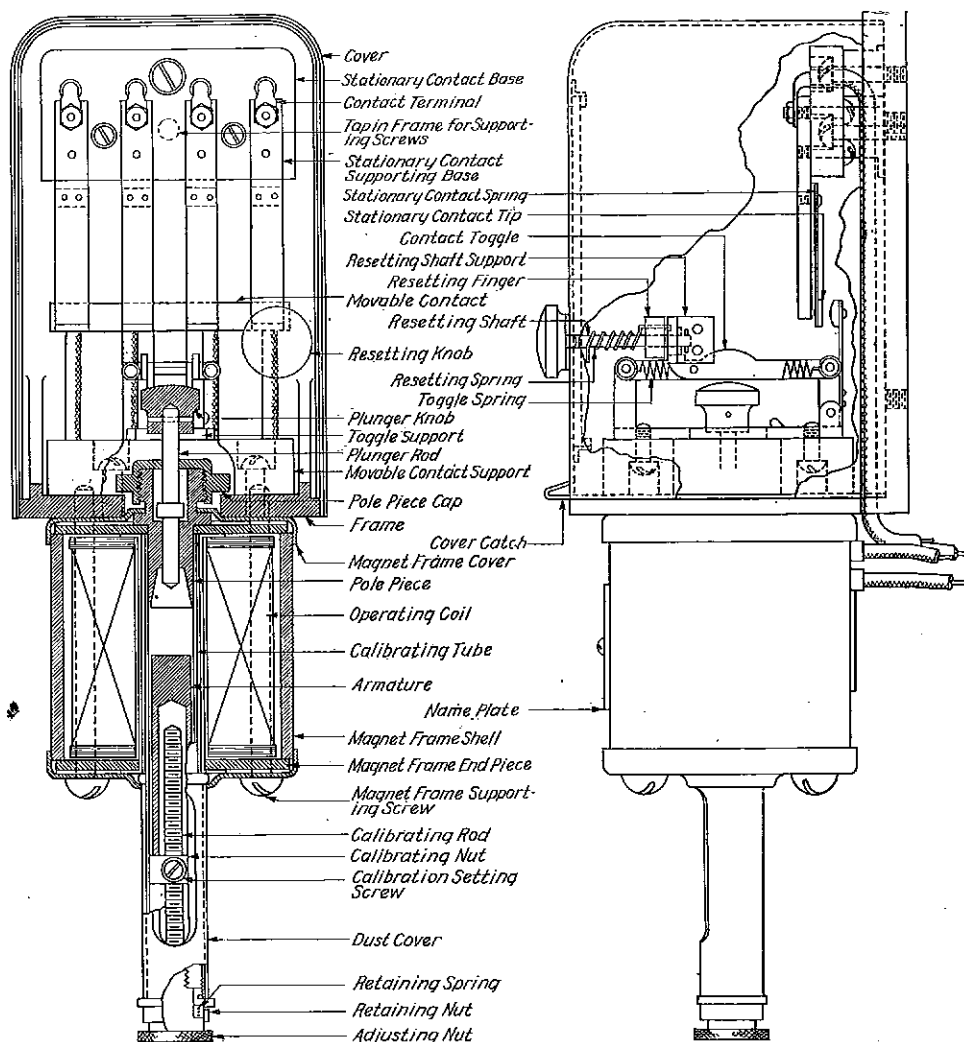


FIG. 6  
SECTIONAL VIEW OF TYPE PQ-6, INSTANTANEOUS,  
HAND RESET, OVERLOAD RELAY, STANDARD UNIT,  
SINGLE POLE, CIRCUIT-CLOSING (3 CIRCUITS)

It must be remembered that when the PQ-6 relay is used to trip a circuit-interrupting device, a circuit-opening auxiliary switch should be provided for opening the trip current.

**ORDERING DIRECTIONS**

When used for differential protection of alternators or in conjunction with reverse power relays for reverse power protection, specify continuous capacity of coils desired.

The PQ-6 relays for differential protection of alternators are regularly furnished with 2-ampere coils calibrated 1 to 2.5 amperes. Other capacities can be furnished with proportional calibrations. (See tabulation page 7.)

When used as auxiliary relays specify the voltage or current and whether they will be used on alternating-current circuits or on direct-current circuits. When used on alternating-current circuits, give the frequency.

Type PQ-6 Instantaneous, Hand Reset, Overload Relay IGE-47611-7

State whether the coils are to be energized continuously or intermittently. (These relays should not be energized continuously with alternating current after the plunger has been raised.) Relays for continuous service on direct current are calibrated at 40 per cent of the rated voltage.

When used as bell alarm relays to operate in series with trip coils, give the tripping voltage and the current taken by the trip coils at rated voltage; if for use with General Electric circuit breakers give the winding specifications of the trip coils.

Voltage bell alarm relays should be ordered the same as auxiliary relays.

The net weight of the PQ-6 relay is 14 pounds and shipping weight 15 pounds.

**Proper Loading of Current Transformers**

Any instruments or meters connected to the same current transformers should be connected in the secondaries of the two sets of current transformers in such a way as to give balanced secondary volt-ampere loading as closely as possible and always within 10 volt-amperes. The total volt-ampere burden in any case should be limited to a maximum of 30 on either current transformer. Only standard "K" type instrument transformers should be used for this class of service. If the maximum degree of sensitiveness and reliability is required, it is recommended that current transformers carrying no other secondary burden be used, and that the secondary loads from the two sets of current transformers be balanced.

**PQ-6 RELAYS**

**Rating, Calibration and Volt-ampere Loads of Operating Coils**

WHEN USED AS AN OVER-CURRENT RELAY			
Ampere Rating of Coils	Calibration of Coils (Amps.)	WSF of Coils	** Volt Amperes
1	5, .75, 1.0, 1.3,	324157	640.0
2	1.0, 1.5, 2.0, 2.5,	*324153	160.0
5	2.5, 3.5, 5.0, 6.0,	323230	25.0
10	5.0, 7.0, 10, 12	324520	6.4

\* Standard for differential protection of alternators.  
 \*\* Volt-amperes on the standard current transformer basis of 5 amperes, 60 cycles. (With reference to the carrying capacity of the coil or its operating value—the actual input necessary to operate the relay at its low point is approximately 6 volt-amperes at 60 cycles, i.e., 1 ampere at 6 volts, or 5 amperes at 1.2 volts, etc.)

WHEN USED AS AN AUXILIARY RELAY					
Service	Rating of Coils (Volts)	Resistor in Ohms	Calibration (Volts)	WSF of Coils	Amps. in Coil at Rated Voltage
One minute	125 d-c.	None	25	323921	0-33
One minute	250 d-c.	500	50	323921	0-29
Continuous	125 d-c.	500	50	323921	0-14
Continuous	250 d-c.	1400	100	323921	0-14
Continuous	600 d-c.	3900	250	323921	0-14

*WHEN USED AS A SIGNAL RELAY			
Oil Circuit Breaker Trip Coil	Voltage of Operating Circuit	Relay Coil WSF	Relay Setting (Amperes)
3040280	12	3040249	4.0
3040281	24	323874	2.0
3040282	125	324157	0.5
3040283	250	324455	0.2
90585	70/140	323874	2.0
90997	70/140	323874	2.0
90011	140/280	324153	1.0
90229	140/280	324153	1.0
94065	70/140	323874	2.0
324161	70/140	323874	2.0
94066	140/280	324153	1.0
324162	140/280	324153	1.0
324215	36/48	324520	5.0
3040403	36/48	324520	5.0

\* The coil of the bell alarm relay for signal indication is connected in series with the trip coil of the oil circuit breaker. Therefore proper coils must be chosen as given in the table to prevent excessive total resistance and insufficient current to operate both devices.

Since the WSF of the oil circuit breaker and the voltage of the operating coil are known, the proper relay can be readily selected from the table. For example, trip coil WSF 3040282 on 125-volt operating circuits requires coil WSF 324157 for the bell alarm relay.

DIMENSIONS AND DRILLING PLAN

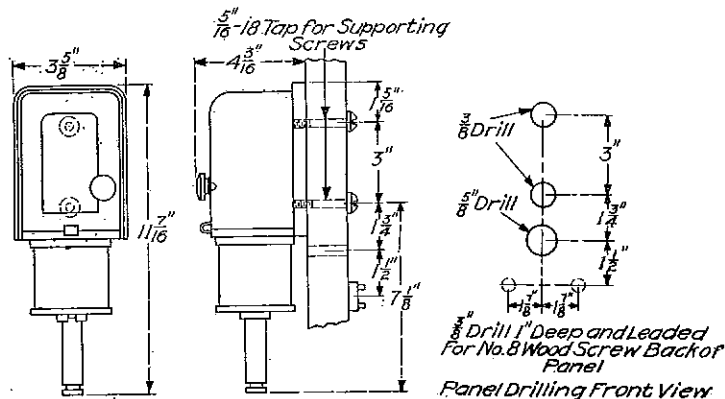


FIG. 7  
TYPE PQ-6 RELAY

120 Broadway  
New York, U. S. A.

International  
**General Electric**  
Company, Inc.

Schenectady, N. Y.  
U. S. A.

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