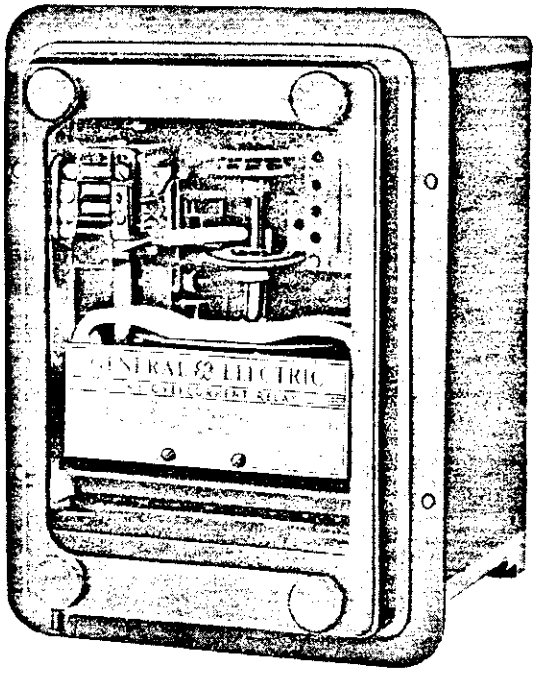
INSTRUCTIONS

TIME OVERCURRENT RELAYS



TYPES

IAC51A IAC51B IAC51C
IAC51D IAC51E IAC52A
IAC52B

IN DRAWOUT CASE

Switchgear

GENERAL ELECTRIC

TABLE OF CONTENTS

TIME OVERCURRENT RELAYS

TYPE IAC

GENERAL INFORMATION

TYPE	Contact Circuits	Instantaneous Unit	A-c Trip Unit	Induction Unit	Outline and Panel Drilling	Internal Connection
IAC51A(-)R or S	One	No	No	One	Fig. 1	Fig. 4
IAC51B(-)R or S	One	Yes	No	One	Fig. 1	Fig. 5
IAC51C(-)R or S	One	No	Yes	One	Fig. 1	Fig. 6
IAC51D(-)R or S	One	No	No	Three	Fig. 2	Fig. 7
IAC51E(-)R or S	One	Yes	Yes	One	Fig. 1	Fig. 8
IAC52A(-)R or S	Two	No	No	One	Fig. 1	Fig. 9
IAC52B(-)R or S	Two	Yes	No	One	Fig. 3	Fig. 10

The Type IAC relays comprise a group of relays that are employed to protect against overcurrent on single-phase and polyphase circuits. The various relays in this IAC group are identified by model numbers, and the relays differ in the number of circuits they close, the length of time delay and features that are determined by the characteristics of the protected circuit.

These relays consist of an induction unit or an induction unit with an instantaneous element which permits instantaneous tripping for extremely high currents, or an induction unit with an a-c tripping element for use where d-c power is unavailable or a-c tripping is preferred. Since practically all IAC relays are composed of various combinations of the above—that is, the induction unit, the instantaneous element and the a-c tripping element—they are, for convenience, described separately in the following text. The above table indicates the units comprising each type and also lists the internal connections and outline and panel drilling diagrams. These relays are all mounted in drawout cases.

There are three principal sizes of drawout cases, each of which has studs for external connections at both ends or only at the bottom. These are respectively referred to as "double-end" and "single-end" cases. In either construction, the electric connections between the relay units and the case are made through stationary molded inner and outer blocks; between the blocks nests a removable connecting plug which completes the circuits. The outer block, attached to the case, has the studs for external connections, and the inner block has terminals for the internal connections.

The relays may be surface or semiflush mounted. Surface mounted relays have studs extending from the back of the case and are mounted on the panel surface. Semiflush mounted relays have a flange around the front of the case and are mounted in panel openings, the flange being attached to the panel surface.

The relay mechanism is mounted in the steel framework, called the cradle, and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case by a latch at both top and bottom and by a guide pin at the back of the case. The connecting plug, besides making the electric connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is drawn to the cradle by thumbscrews, holds the connecting plug in place.

To draw out the cradle, the cover must first be removed. Then the plug can be drawn out. In so doing, the trip circuit is first opened, then the current-transformer circuits are short circuited and finally the voltage circuits are opened. After the plug has been removed, the latch can be released and the cradle easily drawn out. To replace the cradle, the reverse order is followed.

The relay may be tested while mounted on the panel, either from its own or another source of power, by replacing the connecting plug with a separate testing plug, or the cradle can be drawn out and replaced by another, which has been laboratory tested.

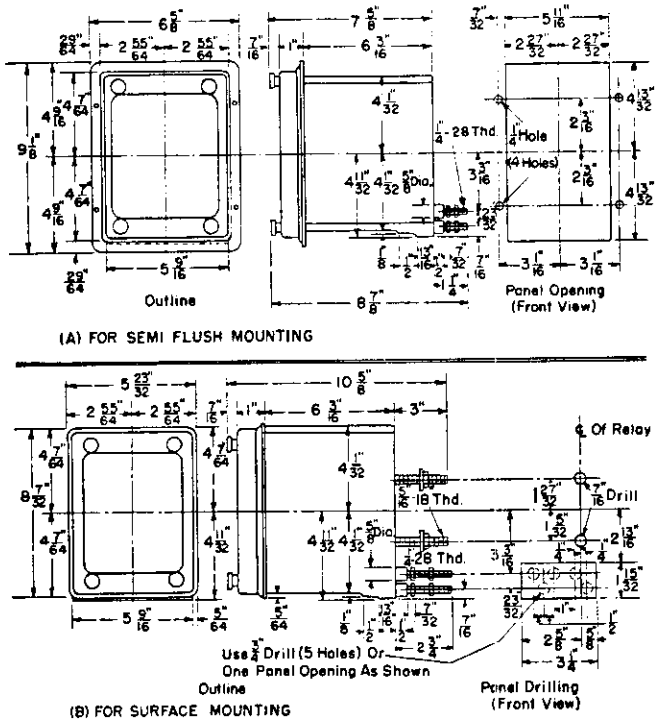


Fig. 1
Outline and panel drilling for one unit, single end, drawout case with 5 terminals

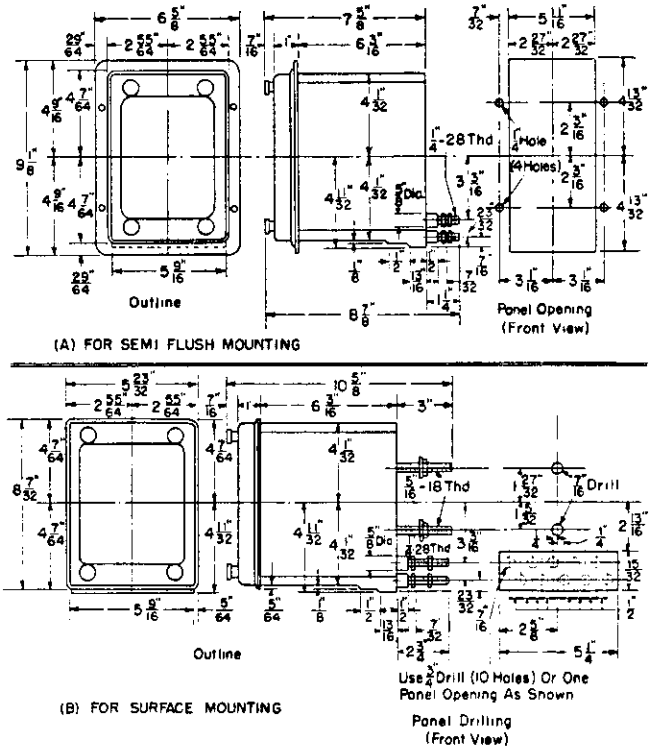


Fig. 3
Outline and panel drilling for one unit, single end, drawout case with 10 terminals

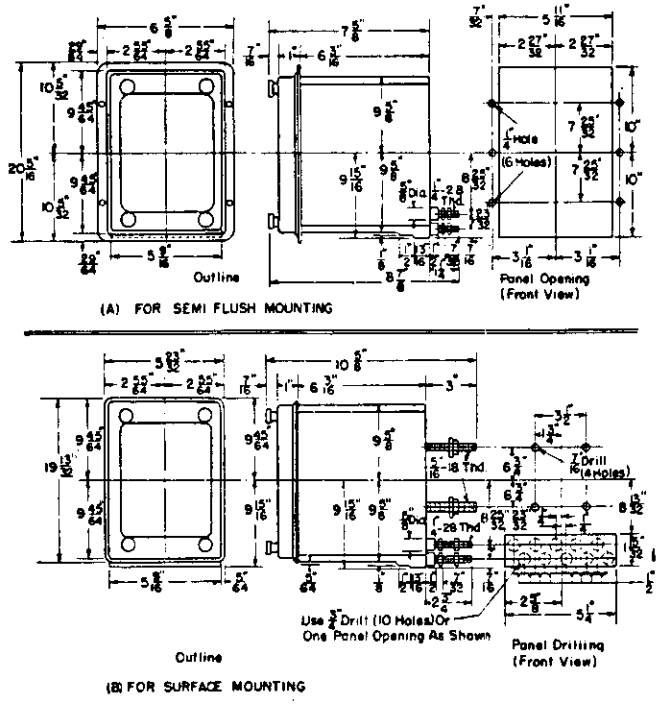


Fig. 2
Outline and panel drilling for three unit, single end drawout case

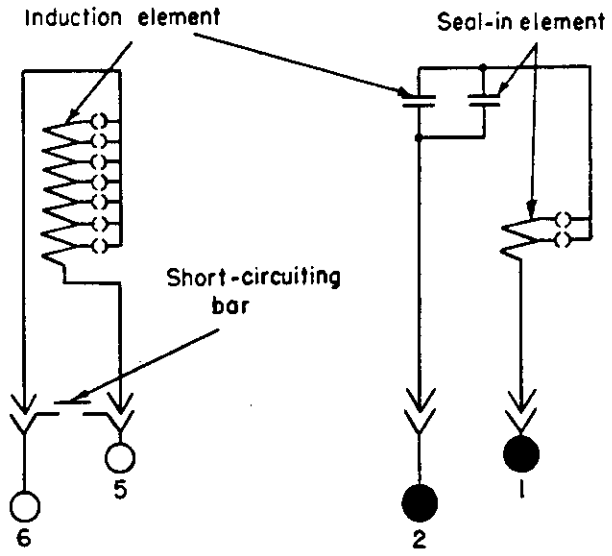


Fig. 4
Type IAC51A relay, internal connections (back view)

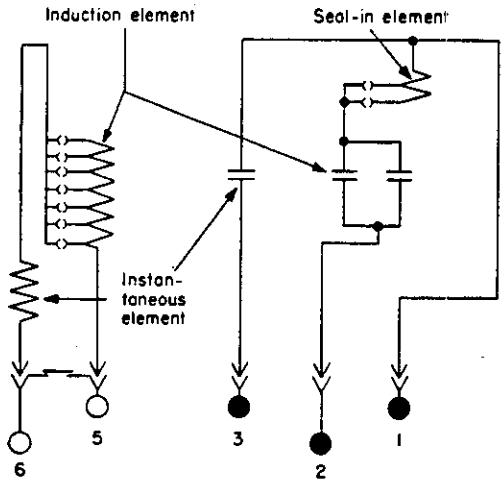


Fig. 5 Type IAC51B relay, internal connections (back view)

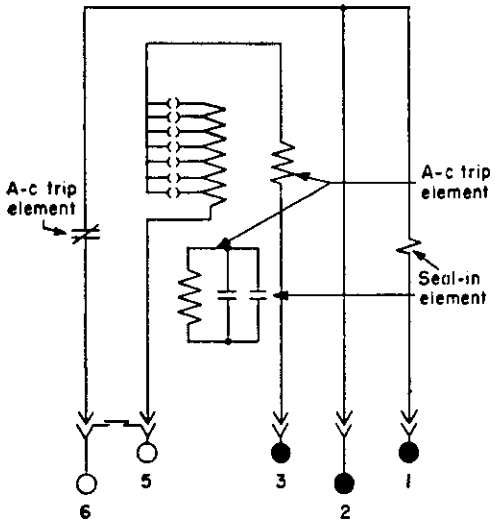


Fig. 6 Type IAC51C relay, internal connections (back view)

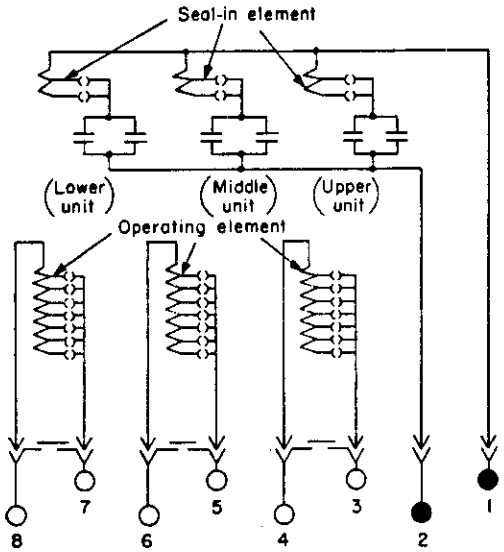


Fig. 7 Type IAC51D relay, internal connections (back view)

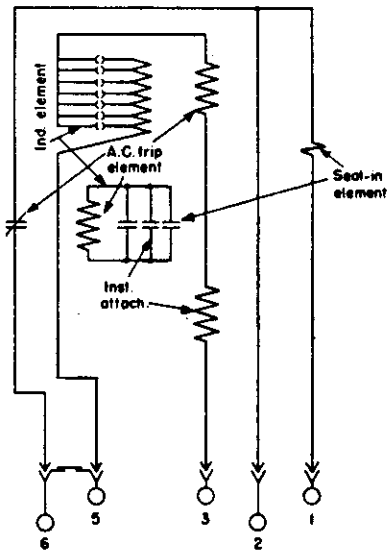


Fig. 8 Type IAC51E relay, internal connections (back view)

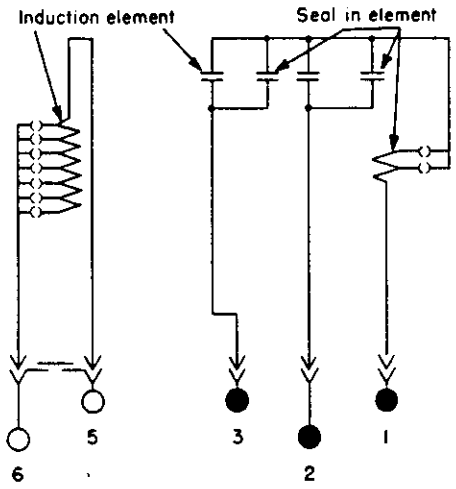


Fig. 9 Type IAC52A relay, internal connections (back view)

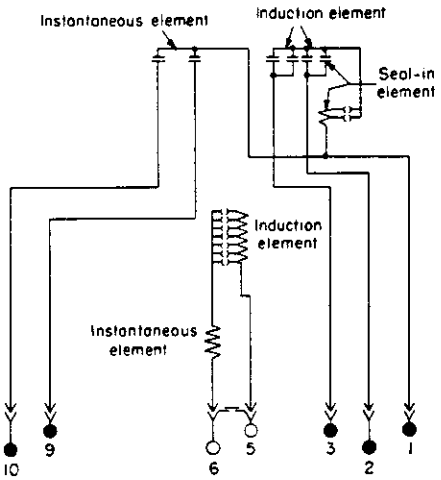
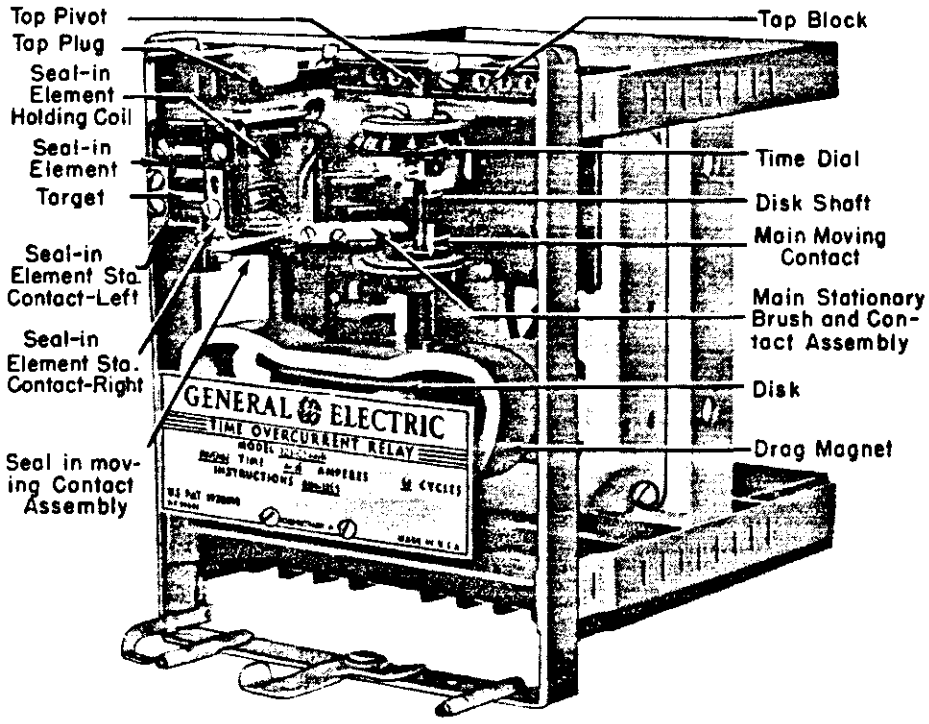
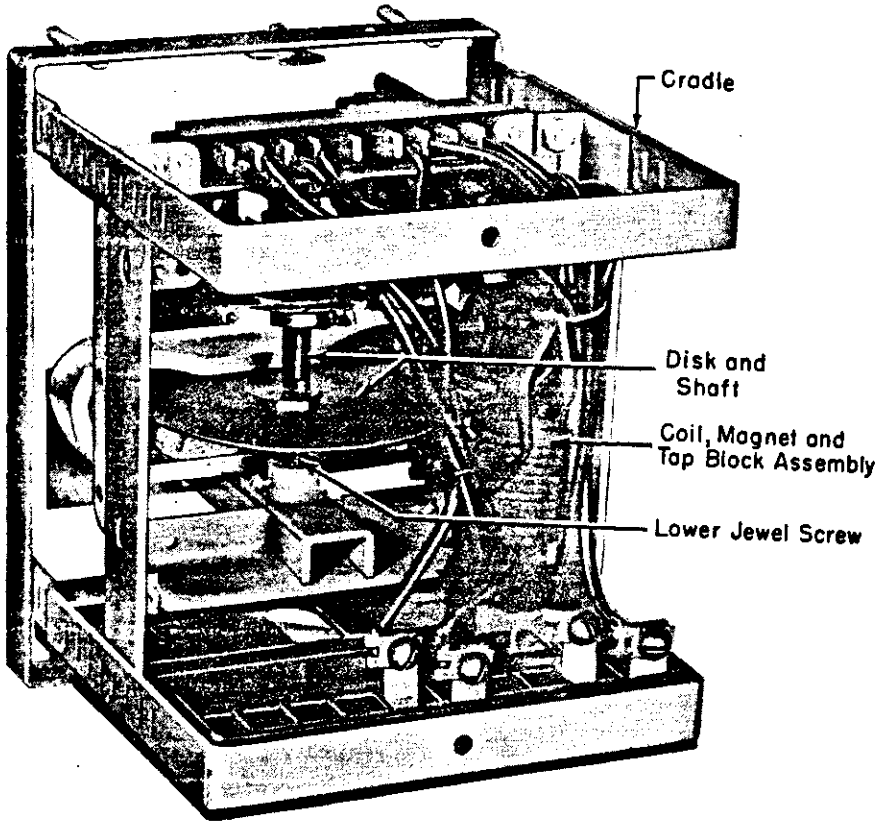


Fig. 10 Type IAC52B relay, internal connections (back view)



(front view)



(rear view)

Fig. 11
Induction unit for Type IAC relays

INDUCTION UNIT

GENERAL INFORMATION

The induction unit is the basic unit in all IAC relays. Fig. 11 shows the induction unit mounted in the cradle of a drawout case. These units are of the induction-disk construction type. The disk is actuated by a current-operating coil on a laminated U-magnet. The disk shaft carries the moving contact which completes the alarm or trip circuit when it touches the stationary contact or contacts. The disk shaft is restrained by a spiral spring to give the proper contact-closing current and its motion is retarded by permanent magnets acting on the disk to give the correct time delay.

There is a seal-in element mounted on the front to the left of the shaft. This element has its coil in series and its contacts in parallel with the main contacts such that when the main contacts close the seal-in element picks up and seals in. When the seal-in element picks up, it raises a target into view which latches up and remains exposed until released by pressing a button beneath the lower left corner of the cover.

APPLICATION

The induction unit is the main unit in all IAC relays, supplying the inverse time delay characteristics of the relay and sounding an alarm or tripping the breakers for overload currents which cause it to close its contacts.

OPERATING CHARACTERISTICS

The induction unit may have one or two circuit-closing contacts which close as the current increases to the pick-up value as set on the tap block. The time delay in closing the contacts is determined by the setting of the time dial (Fig. 11). The time-current characteristics are shown in Fig. 12.

RATINGS

The induction element is designed to use any one of three operating coils, each having a different combination of taps as follows: 4, 5, 6, 8, 10, 12 and 16 amperes; 1.5, 2.0, 2.5, 3.0, 4.0, 5.0 and 6.0 amperes; 0.5, 0.6, 0.8, 1.0, 1.2, 1.5 and 2.0 amperes.

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying ratings are affected by the selection of the tap on the target and seal-in coil as indicated in the following table:

Function	Amperes, 2-amp tap (0.13 ohm) target and seal-in coil	A-c or d-c 0.2-amp tap (7 ohm) target and seal-in coil
Tripping Duty	30	5
Carry Continuously	4	0.8

The tap setting used on the seal-in elements is determined by the current drawn by the trip coil. The 0.2-ampere tap is for use with trip coils that operate on currents ranging from 0.2 up to 2.0 amperes at the minimum control voltage. If this tap is used with trip coils requiring more than two amperes, there is a possibility that the 7-ohm resistance will reduce the current to so low a value that the breaker will not be tripped.

The two-ampere tap should be used with trip coils that take two amperes or more at the minimum control voltage, provided the tripping current does not exceed 30 amperes at the maximum control voltage. If the tripping current exceeds 30 amperes, an auxiliary relay should be used, the connections being such that the tripping current does not pass through the contacts or the target and seal-in coil of the protective relay.

BURDENS

Burdens for the standard coils are given in the following table. These are calculated burdens at five amperes based on burden of minimum tap.

Coil Amperes	Freq.	Tap	Volt Amp	Imp. Ohms	PF
4–16	60	4.0	8.8	0.35	0.29
	50	4.0	8.0	0.32	0.31
	25	4.0	7.5	0.30	0.36
15–6.0	60	1.5	59.0	2.36	0.26
	50	1.5	52.0	2.08	0.28
	25	1.5	48.0	1.92	0.34
0.5–2.0	60	0.5	530.0	21.2	0.26
	50	0.5	470.0	18.8	0.28
	25	0.5	430.0	17.2	0.34

Volt-ampere burdens for the lowest tap on any of the three coils can be determined for any value of current, up to 10 times tap setting, from Fig. 13.

SHIPPING, UNPACKING, AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of the relay, an examination should be made for any damage sustained during shipment. If injury or rough handling is evident, a damage claim should be filed at once with the transportation company and the nearest General Electric Sales Office notified promptly.

Reasonable care should be exercised in unpacking the relay, in order that none of the parts be injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original carton in a place that is free from moisture, dust, and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

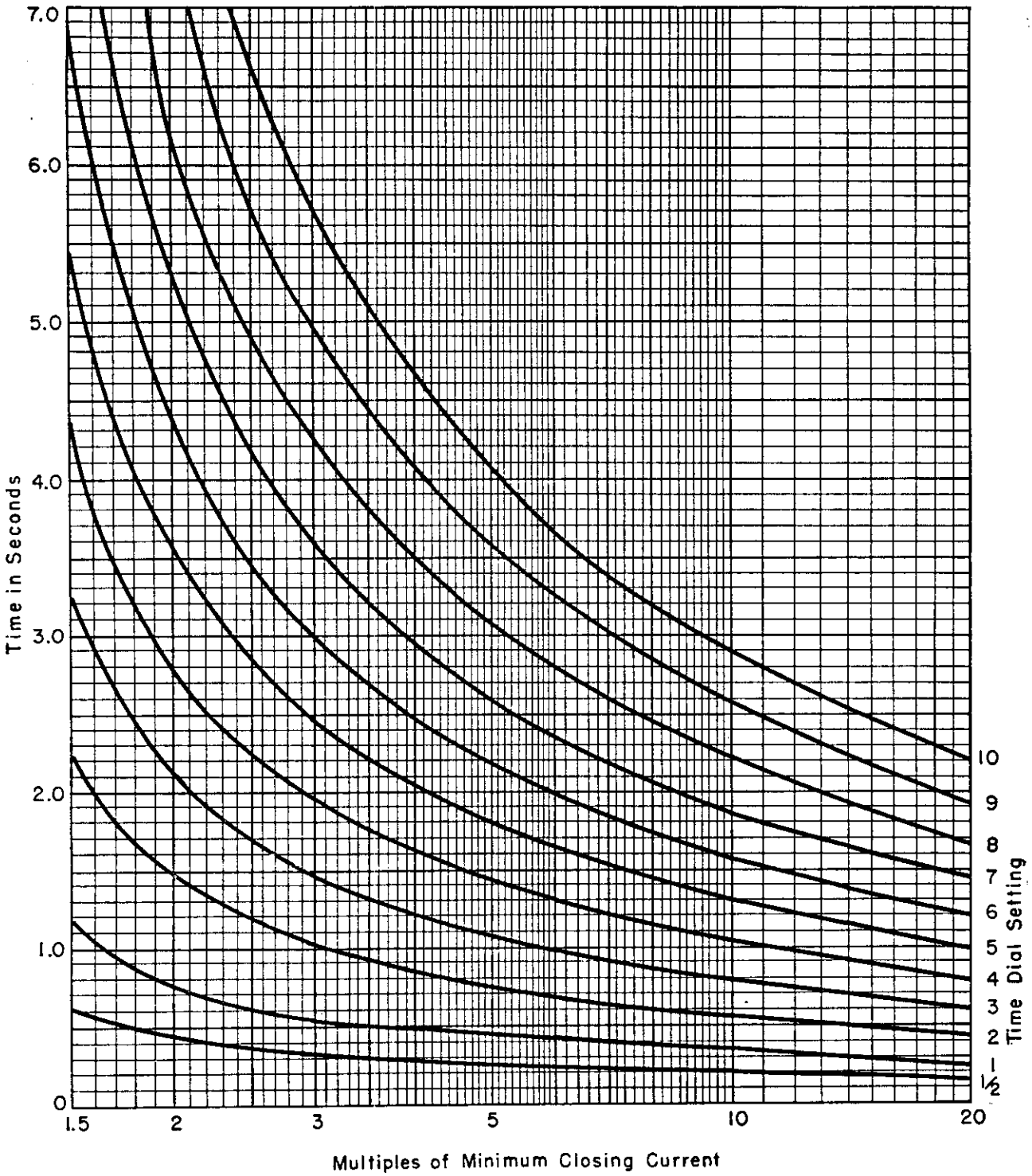


Fig. 12 Time-current characteristics of the Type IAC induction unit

INSTALLATION

LOCATION

The location should be clean and dry, free from dust and excessive vibration, and well lighted to facilitate inspection and testing.

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling diagrams for the various relay types are listed in the table at the front of this book.

CONNECTIONS

Internal connection diagrams for the various relay types are listed in the table at the front of this book.

Typical wiring diagrams, using relays with d-c control power, are given in Fig. 14.

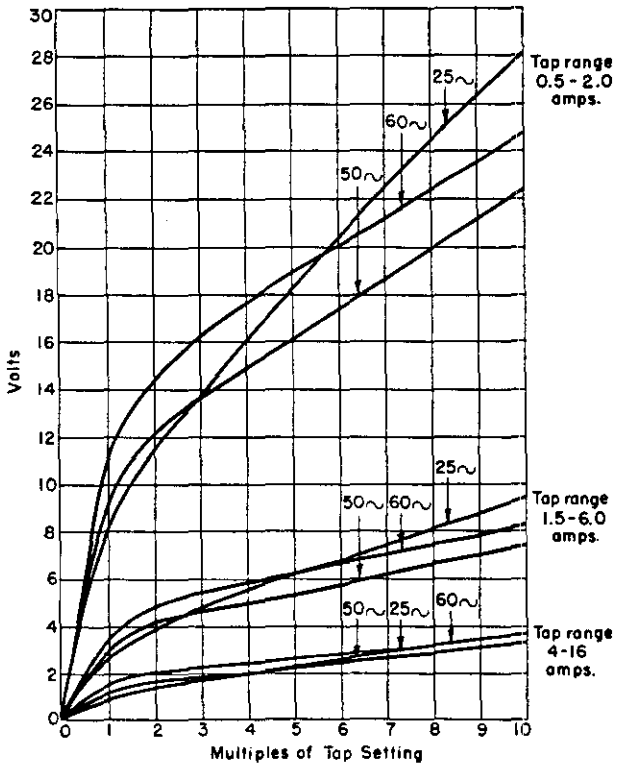


Fig. 13. Saturation curves for IAC relays

Typical wiring diagrams, using relays with tripping reactors, are given in Fig. 15.

A typical wiring diagram for Type IAC51E is shown in Fig. 16.

GROUND CONNECTIONS

One of the mounting studs or screws should be permanently grounded by a conductor not less than No. 12 B & S gage copper wire or its equivalent.

TARGET AND SEAL-IN ELEMENT ADJUSTMENTS

For trip coils operating on currents ranging from 0.2 up to 2.0 amperes at the minimum control voltage, set the target and seal-in tap plug in the 0.2-ampere tap.

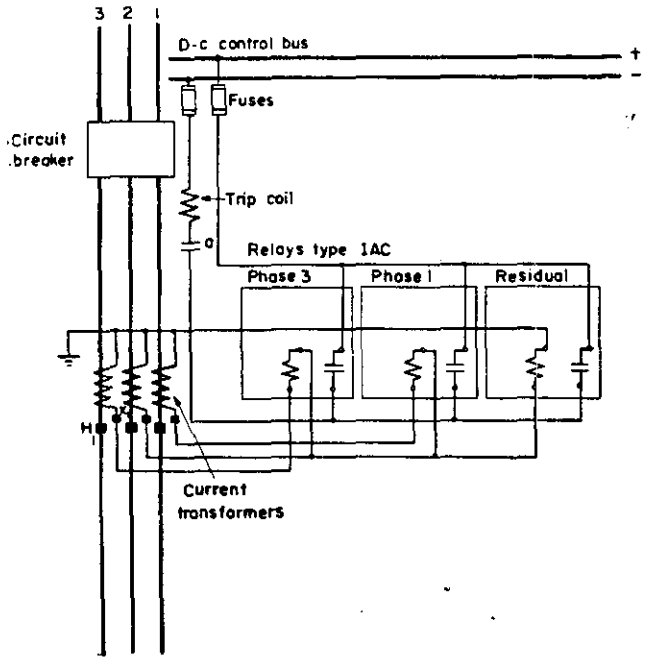
For trip coils operating on currents ranging from 2 to 30 amperes at the minimum control voltage place the tap plug in the 2.0-ampere tap.

The tap plug is the screw holding the right-hand stationary contact of the seal-in unit. To change the tap setting, first remove the connecting plug. Then, take a screw from the left-hand stationary contact, and place it in the desired tap. Next, remove the screw from the other tap, and place it back in the left-hand contact. This procedure is necessary to prevent the right-hand stationary contact from getting out of adjustment. If the tap plugs are left in both taps, the pickup will be less than 2.0 amperes on d-c but the seal-in element will take longer to close its contacts. On a-c the element will not pick up with screws on both taps.

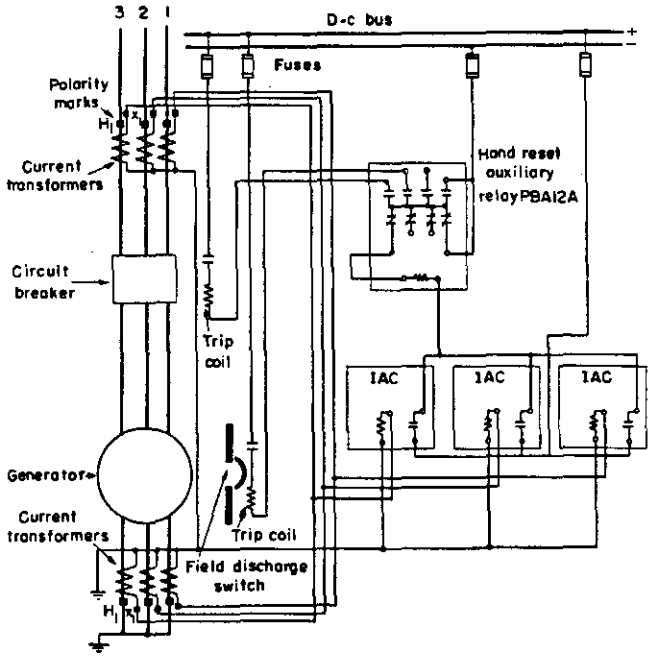
CURRENT SETTING

The current at which the contacts operate may be changed by changing the position of the tap plug in the tap block at the top of the relay. Screw the tap plug firmly into the tap marked for the desired current (below which the unit is not to operate).

When changing the current setting of the unit,



(a) Three-phase, three-wire, also four-wire, three-phase circuit, neutral grounded



(b) For tripping circuits with auxiliary relay

Fig. 14

Typical wiring diagrams using relays with d-c control power (back view of relays)

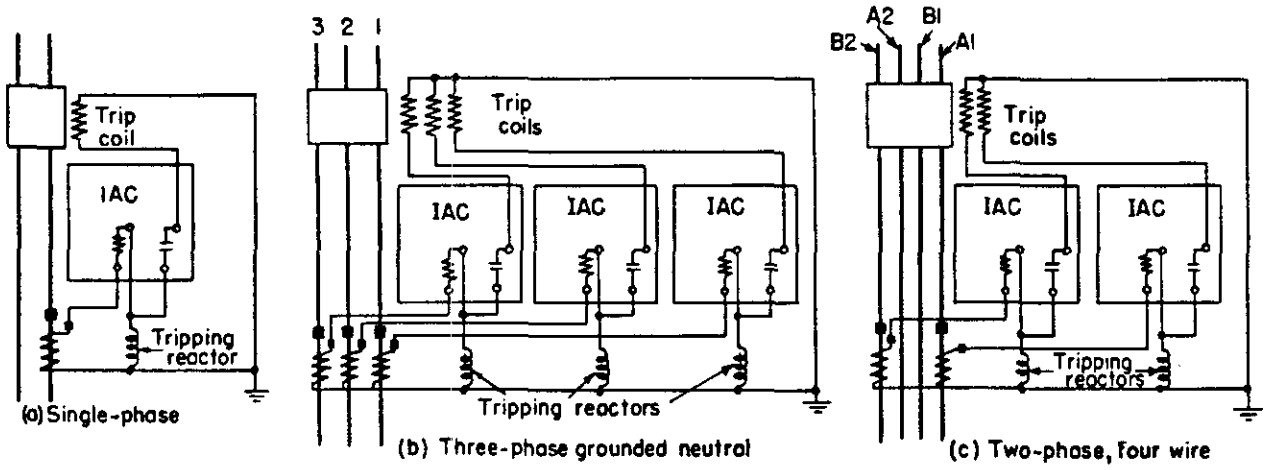


Fig. 15

Typical wiring diagrams, using relays with tripping reactors (back view of relays)

remove the connecting plug to short circuit the current-transformer secondary circuit. Next, screw the tap plug into tap marked for the desired current and then replace the connecting plug.

The pickup of the unit for any current tap is adjusted by means of a spring-adjusting ring. The ring may be turned by inserting a tool in the notches around the edge. By turning the ring, the operating current of the unit may be brought into agreement with the tap setting employed if, for some reason, this adjustment has been disturbed. This adjustment also permits any desired setting intermediate between the various tap settings to be obtained. The unit is adjusted at the factory to close its contacts from any time-dial position at a minimum current within five per cent of the tap-plug setting. The unit resets at 90 per cent of the minimum closing value.

TIME SETTING

The setting of the time dial (see Fig. 11) determines the length of time the unit requires to close its contacts when the current reaches the predetermined value. The contacts are just closed when the dial is set on 0. When the dial is set on 10, the disk must travel the maximum amount to close the contacts and therefore this setting gives the maximum time setting.

The primary adjustment for the time of operation of the unit is made by means of the time dial. However, further adjustment is obtained by moving the permanent magnet along its supporting shelf; moving the magnet in toward the back of the unit decreases the time, while moving it out increases the time.

If selective action of two or more relays is required, determine the maximum possible short-circuit current of the line and then choose a time value for each relay that differs sufficiently to insure the proper sequence in the operation of the several circuit breakers. Allowance must be made for the time involved in opening each breaker after the relay contacts close. For this reason, unless the circuit time of operation is known with accuracy, there should be a difference of about 0.5 second (at the maximum current) between relays whose operation is to be selective.

EXAMPLE OF SETTING

The time and current settings of the induction unit can be made easily and quickly. Each time value shown in Fig. 12 indicates the time required for the contacts to close with a particular time-dial setting when the current is a prescribed number of times the current-tap setting. In order to secure any of the particular time-current settings shown in Fig. 12, insert the removable plug in the proper tap receptacle and adjust the time dial to the proper position. The following example illustrates the procedure in making a relay setting.

Assume an IAC relay in a circuit where the circuit breaker should trip on a sustained current of approximately 450 amperes; also, the breaker should

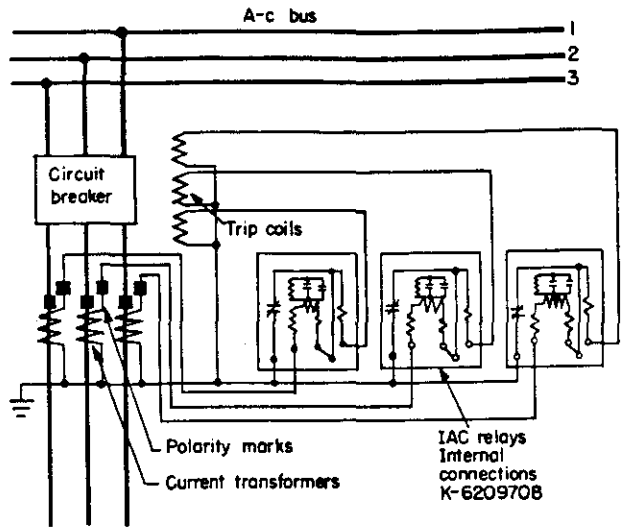


Fig. 16

Typical external connections for Type IAC51E relay

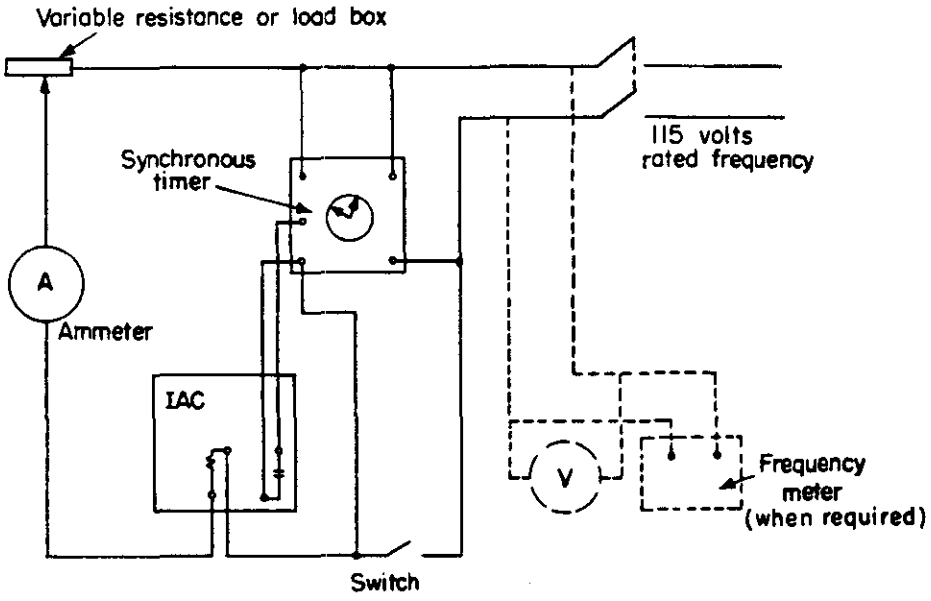


Fig. 17
Connections for testing single-phase IAC relay (back view of relay)

trip in 1.9 seconds on a short-circuit current of 3750 amperes. Assume further that current transformers of 60/1 ratio are used.

The current-tap setting is found by dividing the minimum primary tripping current by the current transformer ratio. In this case, 450 divided by 60 equals 7.5 amp. Since there is no 7.5-ampere tap, the 8-ampere tap is used. To find the proper time-dial setting to give 1.9 seconds time delay at 3750 amperes, divide 3750 by the transformer ratio. This gives 62.5 amperes secondary current which is 7.8 times the 8-ampere setting. By referring to the time-current curves (Fig. 12), it will be seen that 7.8 times the minimum operating current gives 1.9 seconds time delay when the relay is set slightly below the No. 6 time-dial setting.

The above results should be checked by means of an accurate timing device, such as the MF timer. Slight readjustment of the dial can be made until the desired time is obtained.

Aid in making the proper selection of relay settings may be obtained on application to the nearest sales office of the General Electric Company.

INSPECTION

At the time of installation, the relay should be inspected for tarnished contacts, loose screws, or other imperfections. If any trouble is found, it should be corrected in the manner described under maintenance.

OPERATION

Before the relay is put into service it should be given a partial check to determine that factory adjustments have not been disturbed. The time dial will be set at zero before the relay leaves the factory. It is necessary to change this setting in order to open the relay contacts.

The pickup current should be checked on one or more of the taps and the time should be checked for one or more dial settings.

Recommended test connections for the above test are shown in Fig. 17.

MAINTENANCE

These relays are adjusted at the factory and it is advisable not to disturb the adjustments. If, for any reason, they have been disturbed, the following points should be observed in restoring them:

DISK AND BEARINGS

The lower jewel may be tested for cracks by exploring its surface with the point of a fine needle. If it is necessary to replace the jewel, a very small drop of G-E Meter Jewel Oil, Cat. No. 66X728, should be placed on the new jewel before it is inserted. The jewel should be turned up until the disk is centered in the air gaps, after which it should be locked in position by the set screw provided for the purpose.

CONTACTS (CLEANING)

If the contacts become dirty or slightly pitted, they should be cleaned by scraping the surface lightly with a sharp knife or by using a fine clean file. Under no circumstances should emery or crocus cloth be used on fine-silver relay contacts. Finish by wiping the contacts with a clean, soft cloth and avoid touching them with the fingers. Silver contacts cleaned in this manner will remain in good operating condition for many months.

PERIODIC TESTING

An operation test and inspection of the relay at least once every six months are recommended. Test connections are shown in Fig. 17.

INSTANTANEOUS ELEMENT

GENERAL INFORMATION

The instantaneous element is a small instantaneous hinge-type element which may be mounted on the right front side of the induction unit (see Fig. 18). Its contacts are normally connected in parallel with the contacts of the main unit. Its coil is connected in series with the operating coil of the main unit.

When the current reaches a predetermined value, the instantaneous element operates, closing the contact circuit and raising its target into view. The target latches in the exposed position until released by pressing the button beneath the lower left-hand corner of the relay cover.

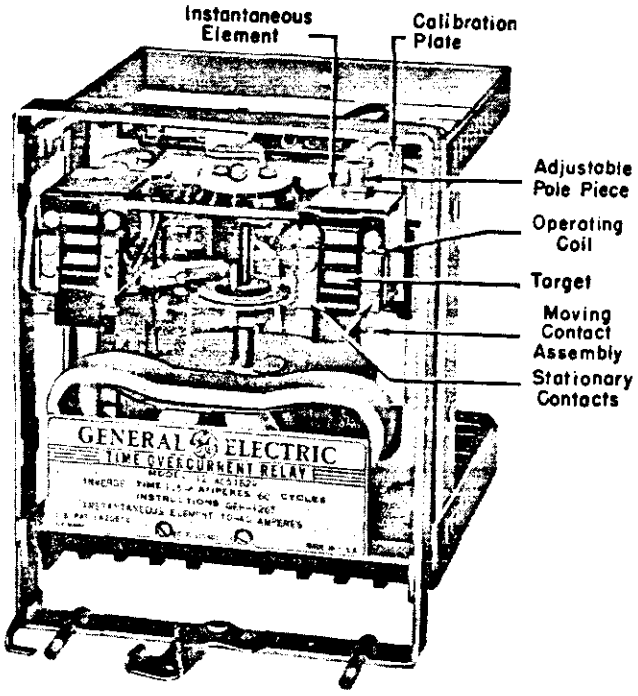


Fig. 18 Type IAC relay with an instantaneous element

APPLICATION

The instantaneous element is used on certain IAC relay models to provide instantaneous tripping for current exceeding a predetermined value.

OPERATING CHARACTERISTICS

The instantaneous element operates over a 4 to 1 range and has its calibration stamped on a scale mounted beside the adjustable pole piece. Time-current characteristics are shown in Fig. 19.

RATINGS

The instantaneous element is designed to use either of two coils having pickup ranges of 10 to 40, and 20 to 80 amperes respectively.

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts.

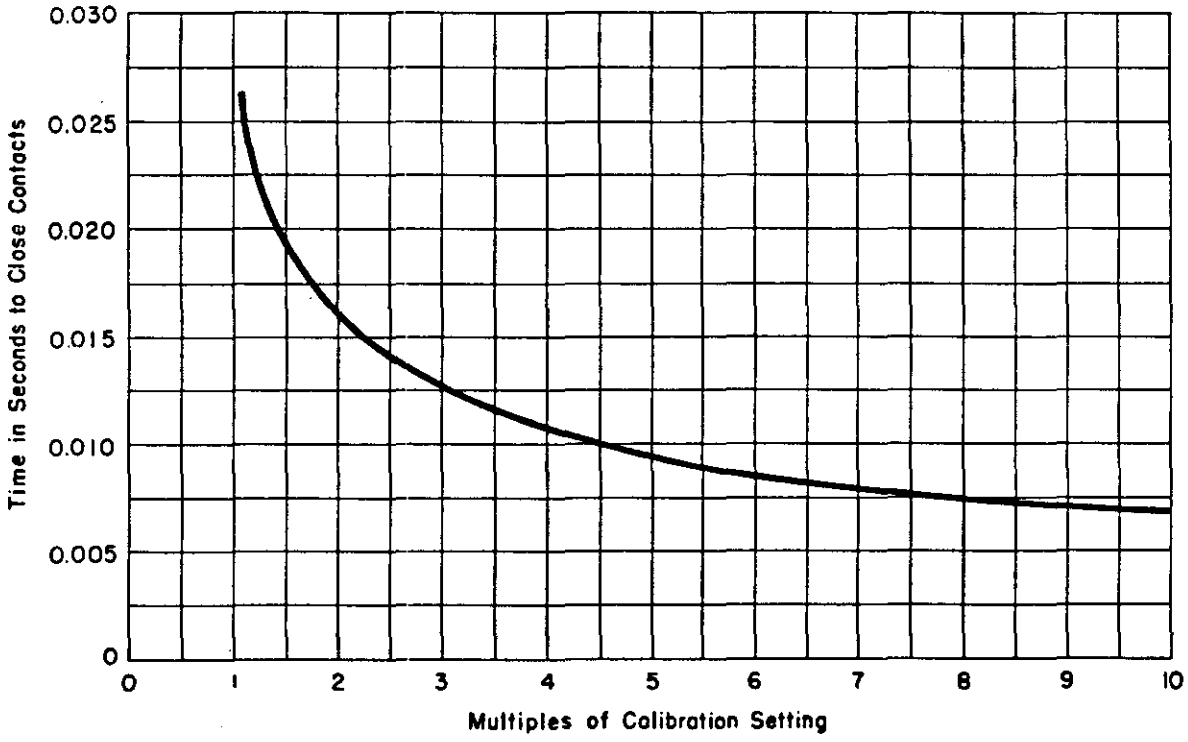


Fig. 19 Time-current characteristics of instantaneous element

BURDENS

Burden data on the instantaneous element coils are given in the following table:

Coil	Freq.	Amp	Volt Amp	Imp. Ohms	PF
10–40	60	5	0.83	0.033	0.95
	50	5	0.80	0.032	0.95
	25	5	0.65	0.027	0.98
20–80	60	5	0.21	0.008	0.95
	50	5	0.20	0.008	0.95
	25	5	0.15	0.007	0.98

ADJUSTMENTS

Select the current above which it is desired to have the instantaneous element operate and set the adjustable pole piece so that its hexagon head is even with the desired calibration on the scale. To raise or lower the pole piece loosen the locknut and turn it up or down and then tighten in position.

The contacts should be adjusted to make at about the same time and to have approximately $\frac{1}{8}$ in. wipe. This adjustment can be made by loosening the screws holding the stationary contacts and moving the contacts up or down as required.

A-C TRIPPING ELEMENT

GENERAL INFORMATION

The a-c tripping element is a Type REA relay element designed to energize a circuit-breaker trip coil from its associated current transformer upon the operation of the main unit of the IAC relay. It transfers the trip coil into the secondary of the current transformer when the main unit contacts close and removes the trip coil from the secondary circuit when the breaker trips.

The tripping element is mounted on the rear of the frame opposite the tapped operating coil of the induction unit (see Fig. 20). The operation of this element is illustrated in Fig. 21. The secondary current circulates through the induction unit current coil and the main coil of the REA auxiliary tripping element, returning through the REA contacts to the current transformer. Normally, most of the flux generated by the main REA coil passes through the upper limb of the magnetic structure and holds the armature firmly against this limb. When the contacts of the induction unit close, the shorting coil of the REA is short circuited and current flows in this coil by transformer action, causing a redistribution of flux which actuates the armature and the REA contacts. The opening of the REA contacts causes the secondary current to flow through the trip coil which trips the breaker.

APPLICATION

The a-c tripping element is used in Type IAC relays where a reliable direct-current tripping source is not available and it is necessary to trip the breaker from the current-transformer secondary.

RATING

The a-c tripping element has a continuous rating of five amperes but will operate on a minimum cur-

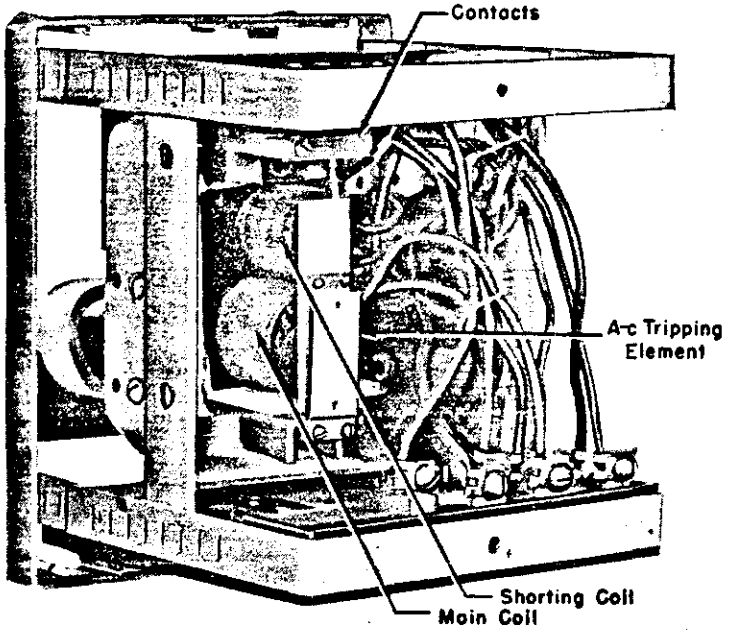


Fig. 20
Type IAC relay with a-c tripping element

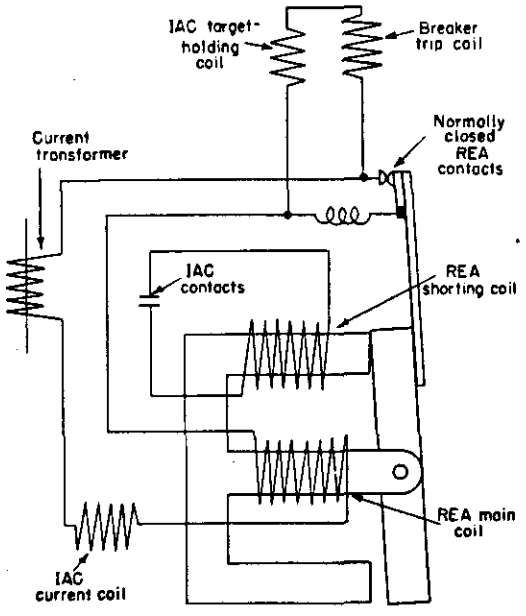


Fig. 21 Diagram illustrating operation of Type IAC relays having a tripping element

rent of 3.5 amperes. They should be used with three-ampere trip coils. The contacts of these elements will transfer current transformer secondary current up to 100 amperes. For applications where the secondary current exceeds 100 amperes, the REA11B relay, which has contacts rated 200 amperes, can be used in conjunction with IAC overcurrent relays. The REA11B is not mounted inside the IAC case.

BURDENS

Burdens for the REA element are given in the following table:

Frequency	Amp	Impedance in Ohms	PF	Volt Amperes
60	5	0.49	0.80	12.2
50	5	0.33	0.85	8.4
25	5	0.23	0.62	5.8

ADJUSTMENTS

The a-c tripping element should not require any attention other than occasional cleaning of the contacts.

However, if the adjustment should be lost, it may be restored as follows.

CONTACT ADJUSTMENT

With the element de-energized, the movable contact should lie against the stationary contact with enough tension to always insure a good closed circuit. The movable contact brush should be free of any kinks. Also this contact brush should not touch the compound bushing supported from the top of the armature. The brass backing strip should be adjusted to allow a $\frac{1}{16}$-inch contact gap with the contacts open. The compound bushing support should be adjusted to allow the back of the movable contact to just touch the brass backing strip when the armature operates to open the contacts. The outer edge of the compound bushing should be approximately $\frac{1}{32}$ inch from the inner edge of the stationary contact supporting post.

ARMATURE ADJUSTMENT

Loosen the two screws which hold the armature-assembly bracket to the bottom of the frame. Slide the bracket in or out, whichever is necessary, until the armature just touches the pole face of the upper core. In this position, the armature should be about $\frac{1}{32}$ inch from the pole face of the lower core. Next, slide the bracket in until the armature leaf spring assumes a vertical position and is spaced clear of both armature and the vertical tip of the bracket. With this setting, the armature should be flush against the pole face of both cores, and should put enough pressure on the armature to always return it flush against the pole face of the lower core after each operation of the unit. This alignment is important as a slight gap between armature and pole face of the lower core after the unit operates may cause contacts to open momentarily, dropping the relay target when the circuit breaker is reclosed. Under these conditions, the momentary opening of the contacts is due to the shock of the armature being pulled in against the pole face when the lower coil is energized. Excessive pressure on the armature, caused by the bracket being pushed in too far, will result in too high a pickup or chattering of the movable contact during operation of the element. Tighten the bracket screws securely after the proper adjustment has been obtained.

RECOMMENDED RENEWAL PARTS

When ordering renewal parts, address the nearest sales office of the General Electric Company. Specify quantity required, name of part wanted, and give complete nameplate data, including serial number. If possible, give the General Electric Company's requisition on which the relay was furnished.

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any worn, broken or damaged parts. Those most subject to wear in ordinary operation and to damage due to possible abnormal conditions are listed on next page. For illustration of parts, refer to Fig. 11, 18, and 20.

Name of Part	Stock Recommended for 1 Relay	Stock Recommended for 5 Relays
INDUCTION UNIT (Fig. 11)		
Coil Magnet and Tap Block Assembly	1	1
Main Moving Contact, Carrier and Control Spring	1	2
Main Stationary Brush and Contact Tip Assembly	1	2
Seal-in Element Holding Coil	1	1
Seal-in Element Stationary Contact, Right	1	2
Seal-in Element Stationary Contact, Left	1	2
Seal-in Element Moving Contact Assembly	1	2
Lower Jewel Screw	1	1
Top Pivot	1	1
Disk and Shaft	1	1
Control Spring	1	2
INSTANTANEOUS ELEMENT (Fig. 18)		
Instantaneous Element, Operating Coil	1	2
Moving Contact Assembly	1	2
Stationary Contact	2	4
A-C TRIPPING ELEMENT (Fig. 20)		
Stationary Contact	1	2
Moving Contact and Brush Assembly	1	2
Main Coil	1	1
Shorting Coil	1	1

IF YOU REQUIRE SERVICE

IF AT ANY TIME you find it necessary to repair, recondition, or rebuild your G-E apparatus, there are 25 G-E service shops whose facilities are available day and night for work in the shops or on your premises. Factory methods and genuine G-E renewal parts are used to maintain the original performance of your G-E apparatus. If you need parts only, immediate shipment of many items can be made from warehouse stock.

The services of our factories, engineering divisions, and sales offices are also available to assist you with engineering problems. For full information about these services, contact the nearest service shop or sales office listed below:

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Detroit 2, Mich.....5950 Third Ave.
Houston 1, Texas.....1312 Live Oak St.
Johnstown, Pa.....841 Oak St.
Kansas City 8, Mo.....819 E. 19th St.
Los Angeles 1, Calif.....6900 Stanford Ave.
Milwaukee 3, Wisc.....940 W. St. Paul Ave.
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New York 14, N. Y.....416 W. 13th St.
Philadelphia 23, Pa.....429 N. Seventh St.
Pittsburgh 6, Pa.....6519 Penn Ave.
St. Louis 1, Mo.....1110 Delmar Blvd.
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San Diego 1, Calif.....2045 Kettner Blvd.
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