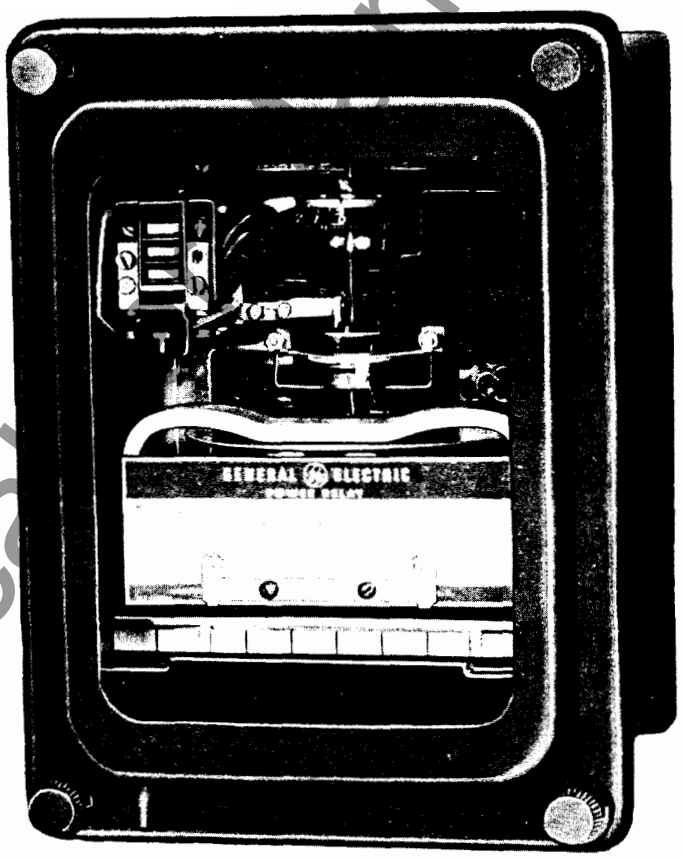
INSTRUCTIONS

GEH-1784A
SUPERSEDES GEH-1784

POWER DIRECTIONAL RELAYS



Types

ICW51A ICW52A
ICW51B ICW53A

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

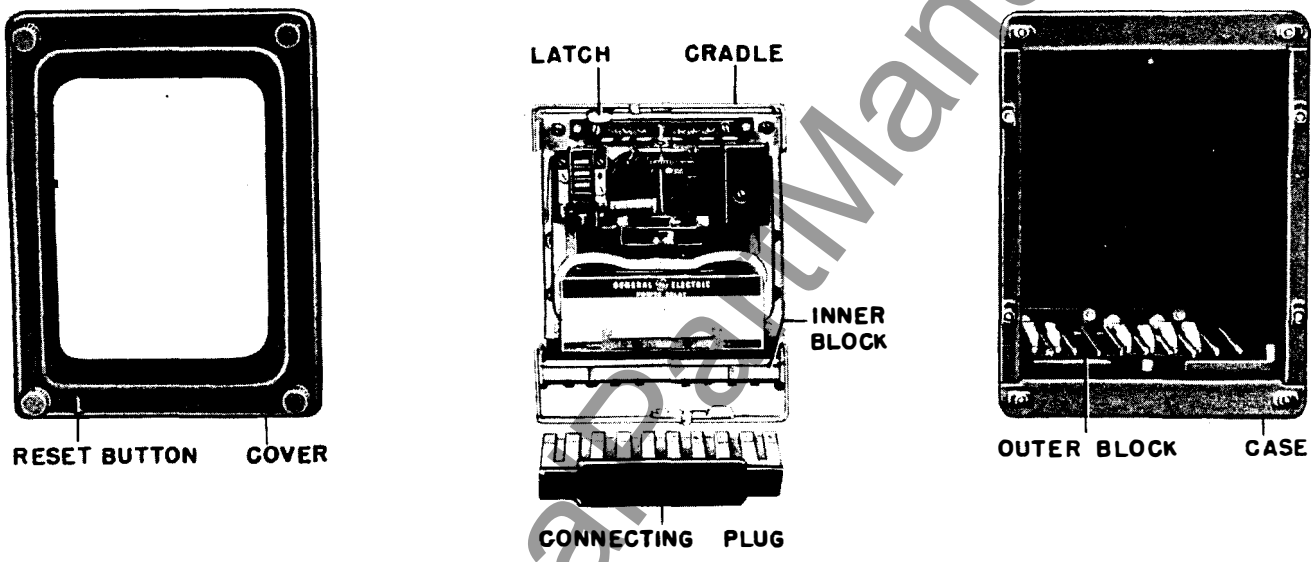


Fig. 1 Type ICW51B Relay-Disassembled (Front View)

POWER DIRECTIONAL RELAYS
TYPE ICW

INTRODUCTION

The Type ICW relays are designed for power-directional applications. The operation of these relays depends upon both phase angle and magnitude of the applied current and voltage. They will operate when power flow is of sufficient magnitude and in a specific direction. Some models are constructed to operate on an inverse-time-watt characteristic, while others operate practically instantaneously.

APPLICATION

The Type ICW51A and Type ICW51B relays are commonly used to protect against excess power flow in a given direction. For example: A small generating station has its own local load and a normally-closed emergency tie to a large power source. The station has enough capacity to supply its own load, but cannot supply an appreciable amount of power into the large system. In such a case, either a Type ICW51A or a Type ICW51B relay may be used. The relay will trip the tie breaker if power in excess of a predetermined amount is fed into the large system over a given period of time. The relay will maintain the tie if the local station fails and power is fed to its load from the large system. Fig. 3 illustrates this example using a Type ICW51A relay and assuming the a-c bus as the station bus.

The Type ICW51A relay is also designed to protect a-c generators from motoring if the losses under the above conditions should exceed a specific percentage of the generator rating. For this application, the time delay of the relay should be sufficient to prevent tripping of the generator breaker on temporary power surges due to synchronizing or other causes. External connection diagrams for these relays are shown in Figs. 3 to 6.

To determine the pickup of a relay in line amperes, apply the following formulae:

$$I = \frac{W}{\sqrt{3}E \cos \Theta} \quad \text{for the Type ICW51A relay}$$

$$I = \frac{W}{E \cos \Theta} \quad \text{for the Type ICW51B relay}$$

where Θ is the angle by which the current lags the voltage.

The Type ICW52A relay is used as a control relay for measuring phase watts.

The Type ICW53A relay is commonly used to measure reactive kilo-voltamperes and thereby controlling power-factor correcting equipment. By changing the tap settings, two of these relays can be used as controlling units in a capacitor installation as they function to switch capacitor steps in or out. If these relays are used for such applications, a sufficient margin between individual settings must be allowed in order to prevent pumping. Fig. 6 shows the external connections for one of these relays.

OPERATING CHARACTERISTICS

RELAY PICKUP

The pickup of the minimum and maximum taps for the various relay models when power flows in the proper direction is as follows:

Relay Type	Calibration	Pickup	
		Min. Tap	Max. Tap
ICW51A	Three-phase watts	15	60
		25	100
		50	200
		100	400
		200	800
ICW51B	Single-phase watts	10	40
		25	100
		50	200
		100	400
		200	800
ICW52A	Three-phase watts	100	1000
ICW53A	Single-phase vars	15	150

OPERATING TIME

Contact-closing time of the Type ICW51A and Type ICW51B relays for power in excess of tap setting can be controlled in order to prevent relay operation due to transient and momentary power surges. Relay pick-up time as a function of multiples of minimum pick-up power flow is given in Fig. 2. Time delay adjustments and time dial setting procedures are described under ADJUSTMENTS.

RATINGS

The current-carrying rating of the contact circuit is determined by whether the relay has a seal-in unit and by the tap used on the seal-in coil. The values for the three possible arrangements are given in the following table:

Seal-in Unit	No	Yes	Yes
Seal-in Unit Tap	--	0.2 amp	2.0 amp
Carry continuously	2.0 amps	0.8 amp	3.5 amp
Carry for trip duty (250 volt or less)	30 amps	5 amp	30 amp
D-C resistance of seal-in coil	--	7 ohms	0.13 ohms
60 Cycle impedance of seal-in coil	--	52 ohms	0.53 ohms

When the contacts of the induction unit are not by-passed by the seal-in unit contacts, they may try to interrupt the circuit. The interrupting rating of the contacts for non-inductive loads are as follows:

Make and Interrupt at:	A-C Amps	D-C Amps
125 volts	1.50	0.30
250 volts	0.75	0.15
600 volts	0.00	0.00

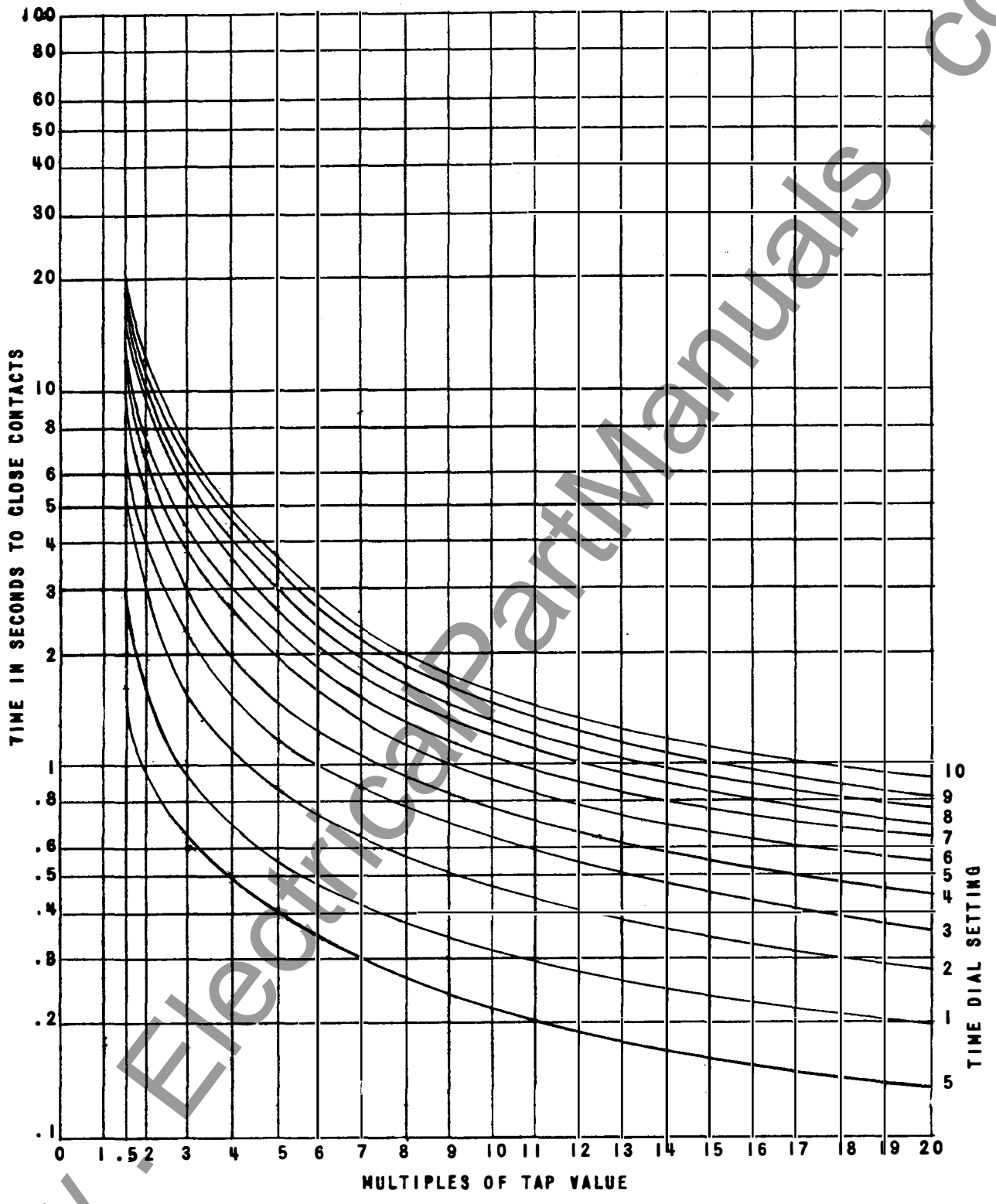


Fig. 2 Time-Watt Curves For Type ICW51 Relays

Fig. 3 376A958

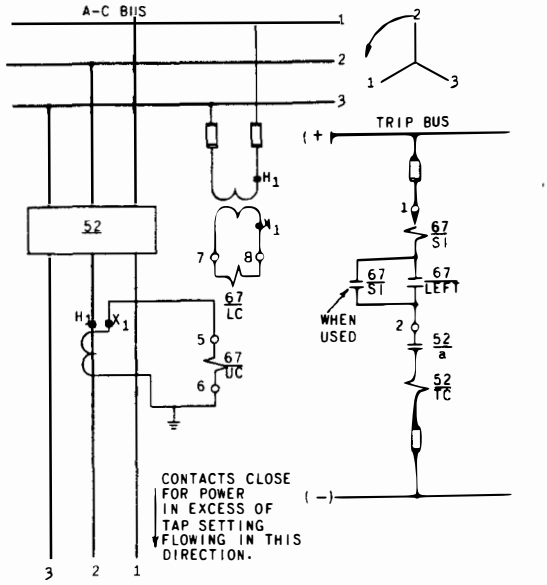


Fig. 3 External Connections For Relay Types ICW51A And ICW52A

Fig. 4 376A956

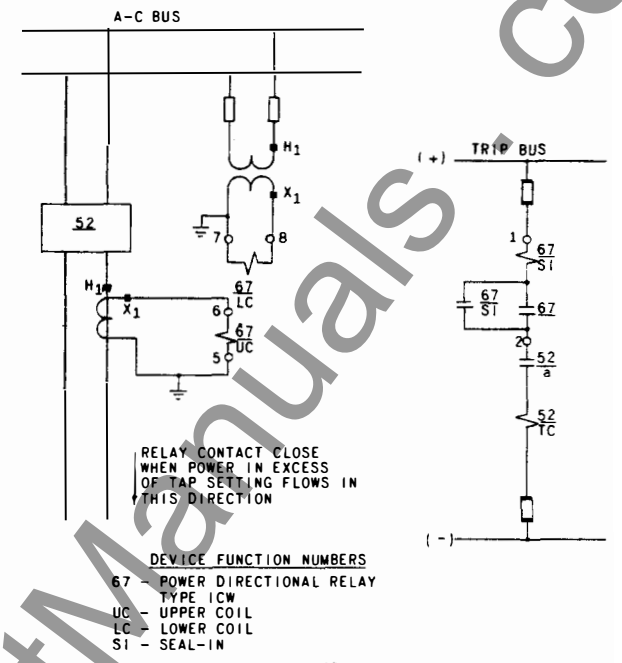


Fig. 4 External Connections Of A Type ICW51B Relay Used For Single-Phase Applications

Fig. 5 376A959

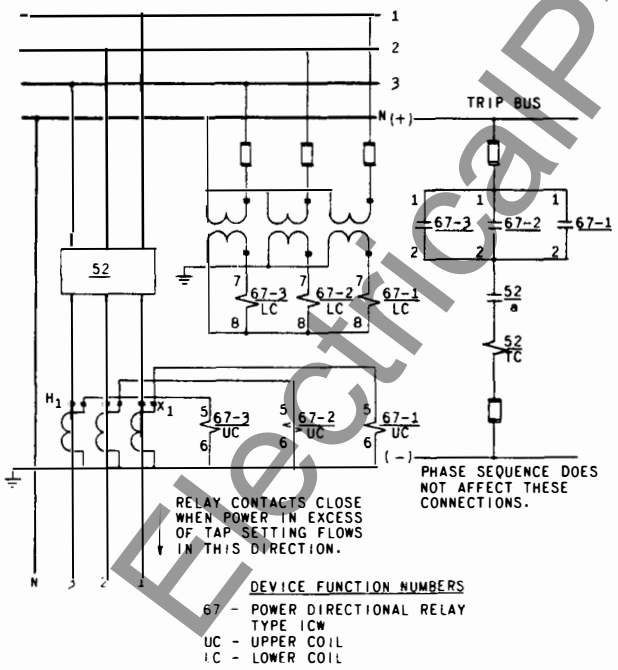


Fig. 5 External Connections Of Three Type ICW51B Relays Used For Protection Of 3-Phase, 4 Wire System Having Unbalanced Load

Fig. 6 376A957

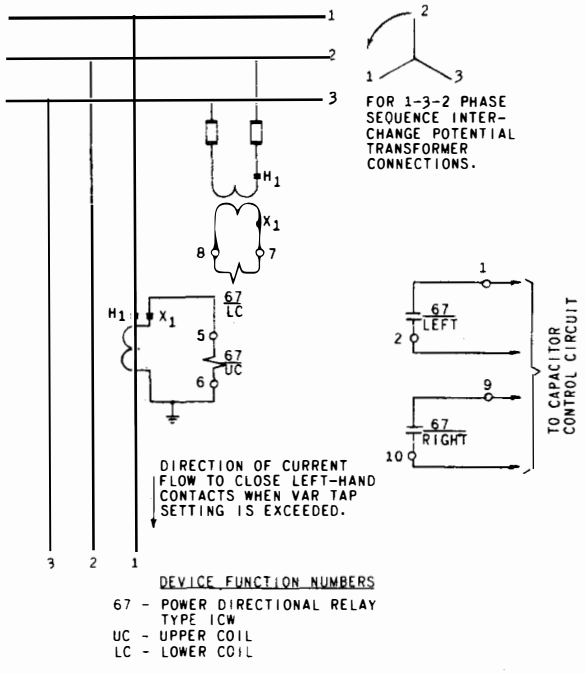


Fig. 6 External Connections For The Type ICW53A Relay

BURDENS

The burdens imposed on current and potential transformers by these relays are given in the following tables:

POTENTIAL BURDEN AT 60 CYCLES

Relay	Range	Rated Volts	Watts	V.A.
ICW51A	All ranges	120	3.28	3.32
ICW51B	10-40 watts	120	2.2	15.7
	all other ranges	120	0.66	4.69
ICW52A	100-1000 watts	120	3.28	3.32
ICW53A	15-150 vars	120	2.2	15.6

CURRENT BURDEN AT 60 CYCLES

Relay	Rating		Burden	
	Range	Rated Amps.	Watts	V.A.
ICW51A	15-60 watts	5	40.5	81.0
	25-100	5	14.62	29.25
	50-200	5	3.67	7.35
	100-400	5	0.912	1.825
	200-800	5	0.225	0.45
ICW51B	10-40 watts	5	18.5	37.0
	25-100	5	7.5	29.25
	50-200	5	3.67	7.35
	100-400	5	0.912	1.825
	200-800	5	0.225	0.45
ICW52A	100-1000 watts	5	10.15	20.3
ICW53A	15-150 vars	5	10.15	20.3

RECEIVING, HANDLING 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 a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

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

If the relays are not to be installed immediately, they should be stored in their original cartons 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.

DESCRIPTION

The relays covered by these instructions are identified by model numbers. The main construction differences of these models are given in the following table and are described under RELAY TYPES.

Model	Contacts	Time Dial	Seal-in Unit	Int. Conn.
12ICW51A(-)A	One N.O.	Yes	Yes	Fig. 9
12ICW52A(-)A	One N.O.	Yes	Yes	Fig. 10
12ICW52B(-)A	Double Throw	No	No	Fig. 11
12ICW53A(-)A	Double Throw	No	No	Fig. 12

RELAY TYPES

The Type ICW51A relay is an overpower or reverse-power relay having single circuit-closing contacts. These contacts are open when the relay is de-energized. This relay is of the inverse time characteristic and contains a time dial and seal-in unit. The taps located on the current coil are calibrated in three-phase watts. The Type ICW51A relay functions from line current and line-to-line voltage and exhibits maximum torque to close its contacts when the applied current leads the applied voltage by 90 degrees (three-phase unity power factor).

The seal-in unit is mounted to the left of the shaft as shown in Fig. 7. This unit has its coil in series and its contacts in parallel with the main contacts such that when the main contacts close, the seal-in unit picks up and seals in. When the seal-in unit 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.

The Type ICW51B relay is similar to the Type ICW51A relay except that the taps on the current coil are calibrated in single-phase relay watts (line to neutral voltage). To obtain their three phase values, the calibration watts must be multiplied by 3. Maximum closing torque is obtained when the applied current and voltage are in phase.

The Type ICW52A relay is similar to the Type ICW51A relay except that is has no seal-in unit, time dial or taps and has one normally-open and one normally-closed contact.

The Type ICW53A relay is a single-phase var relay without a seal-in unit or time dial. It has double throw, single-circuit contacts with the right contact (front view) closed when the relay is de-energized. The right contact closes at a value 10 per cent below the left contact-closing value. Operation is practically instantaneous for vars in excess of tap setting. The calibration is in vars based on line current and line-to-line voltage. Connections are so arranged that at three-phase unity power factor these quantities are at right angles, and no torque is produced. As the power factor decreases the torque increases until a maximum is reached at zero power factor (zero phase angle between phase one current and phase 2 to phase 3 voltages). Three-phase var pickup is $\sqrt{3}$ times the tap setting.

Fig. 7 8014256

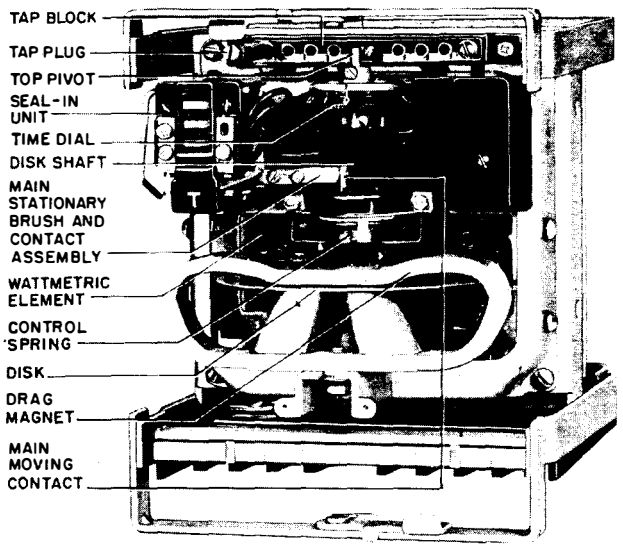


Fig. 7 Type ICW51B Relay, Unit In Cradle (Front View)

Fig. 8 8014257

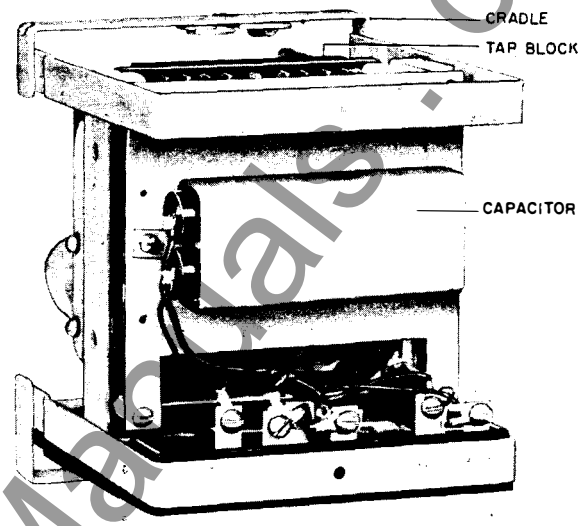


Fig. 8 Type ICW51B Relay, Unit In Cradle (Rear View)

INTERNAL CONSTRUCTION

The operating unit is similar to that used in a standard watthour meter as shown in Fig. 7. The lower and upper windings on the iron core are the potential and current coils, respectively. The induction disk is embossed to assure flatness and to give increased rigidity.

The damping magnet consists of a pair of alnico magnets enclosed in a steel circuit. It is mounted by clamp screws on a shelf along which it can be moved for time adjustments.

The relays have high pressure, silver-to-silver contacts. The fixed contacts are adjustable and the movable contact direct acting.

The upper bearing consists of a polished steel pin and a bronze guide bearing. It provides a definite alignment of the relay shaft. The lower bearing consists of a polished steel pivot that is carried by a jewel bearing. The jewel is seated on a spring which minimizes shock.

CASE

The case is suitable for either surface or semiflush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends or at the bottom only for the external connections. The electrical connections between the relay units and the case studs are made through spring backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminals for the internal connections.

The relay mechanism is mounted in a 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 with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also locks the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plug in place.

To draw out the relay unit the cover is first removed, and the plug drawn out. Shorting bars are provided in the case to short the current transformer circuits. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay in place on the panel either from its own source of current and voltage, or from other sources. Or, the relay unit can be drawn out and replaced by another which has been tested in the laboratory.

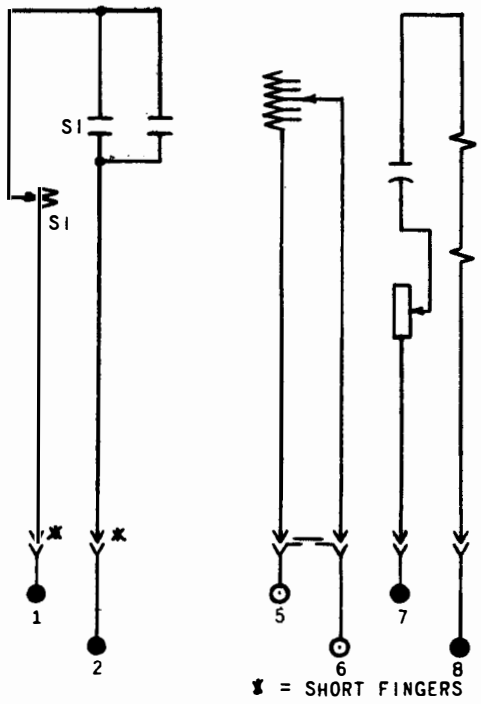


Fig. 9 362A630

Fig. 9 Internal Connections For Type ICW51A Relay (Front View)

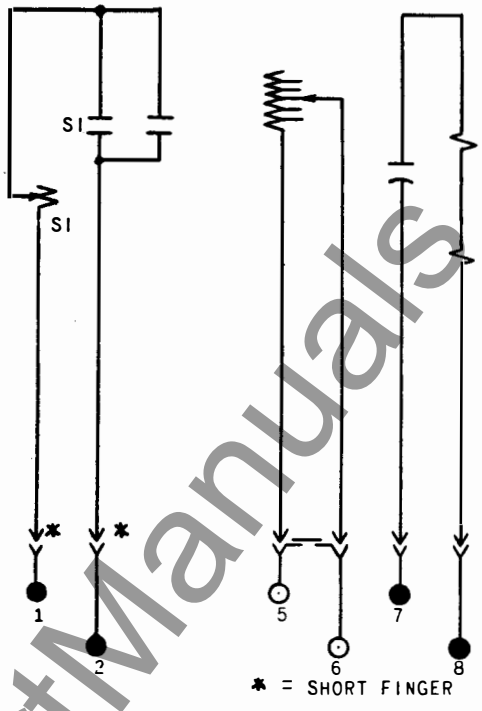


Fig. 10 362A631

Fig. 10 Internal Connections For Type ICW51B Relay (Front View)

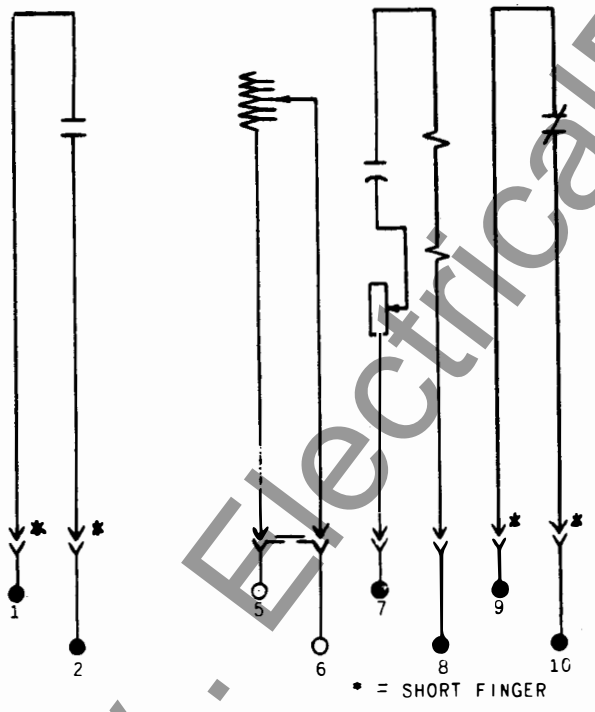


Fig. 11 362A628

Fig. 11 Internal Connections For Type ICW52A Relay (Front View)

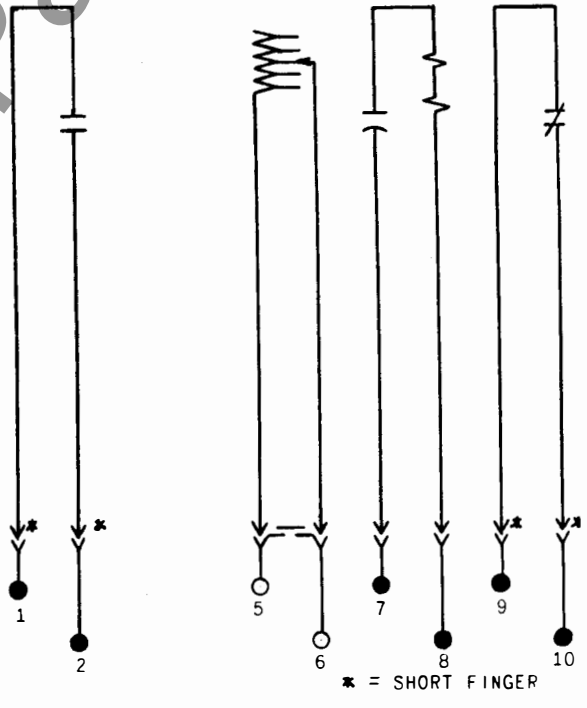


Fig. 12 362A632

Fig. 12 Internal Connections For Type ICW53A Relay (Front View)

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 relays should be mounted on a vertical surface. The outline and panel drilling dimensions are shown in Fig. 14.

CONNECTIONS

The internal connection diagrams are shown in Figs. 9 to 12. Typical wiring diagrams are shown in Figs. 3 to 6.

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.

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.

ADJUSTMENTS

PICKUP

The magnitude of power above which the normally-open contact will be closed is determined by the setting of the lower control spring. To calibrate the relay to operate at a desired value of watts, apply the desired pick-up value of watts to the relay (see Fig. 13) and adjust the lower control spring until the left contact just closes. The lower control spring is adjusted by inserting the blade of a screw driver in one of the notches in the periphery of the control-spring adjusting ring and turning the adjusting ring counterclockwise to raise the pickup or clockwise to lower the pickup.

DROPOUT

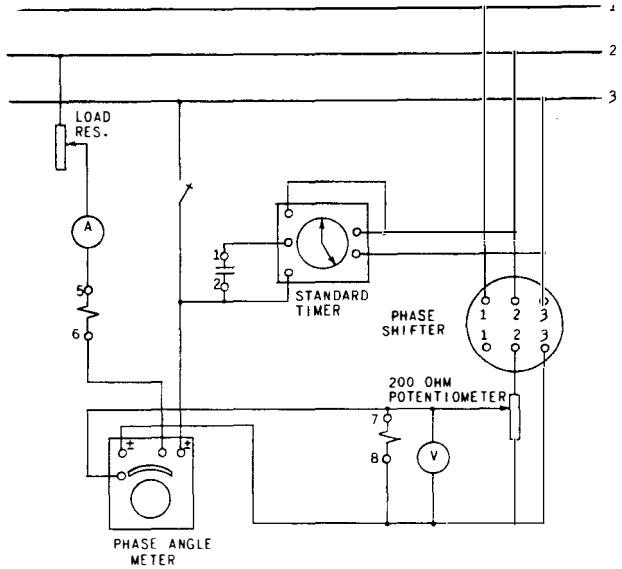
For relay types ICW52A and ICW53A, the magnitude of power below which the normally-closed contact will be closed is determined by the contact gaps and the pick-up setting. After the pick-up setting is made as described above, the contact gap is adjusted by loosening the two lock screws in the clamp bar at the top of the shaft. The moving contact of the normally-closed contact is connected to this clamp bar and can be turned relative to the moving contact of the normally-open contact. The lead-in spring for the upper moving contact is also connected to this clamp bar, therefore, changing the position of the upper clamp bar will change the pick-up setting slightly. This can be reset by changing the lower control spring as described above. When both the pickup and dropout are set to the desired value, the locking screws of the top clamp bar should again be tightened.

TIME SETTING

For relay types ICW51A and ICW51B, the time required for the normally-open contact to close when rated power is applied to the relay is determined by the time dial setting. The maximum time setting is obtained when the time dial is set on the number 10 time dial setting. The time on any other time dial setting is approximately proportional to the time dial setting.

For relay types ICW52A and ICW53A, the time required to close the contacts is a function of the pick-up and drop-out settings. It is possible to set any two of the three variables. For instance, if the pickup watts and the drop-out time are important, then the pick-up value can be set as given above. The drop-out time can be adjusted by adjusting the contact gap until the desired drop-out time is obtained. The value of drop-out watts will be determined by the gap setting that was made to get the drop-out time and cannot be set to another value without changing the drop-out time.

Typical test connections are shown in Fig. 13.



NOTE: FOR TESTING ICW51B & ICW53A RELAYS THE PHASE SHIFTER IS NOT NEEDED & ONLY A SINGLE PHASE SUPPLY IS NECESSARY. CARE MUST BE TAKEN THAT THE VOLTAGE "V" AND CURRENTS "A" ARE IN PHASE. FOR TYPE ICW52A & ICW53A AN ELECTRONIC TIMER SHOULD BE SUBSTITUTED FOR THE STANDARD TIMER.

Fig. 13 Test Connections For Type ICW Relays

Fig. 13 376A955

TARGET AND SEAL-IN UNIT

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-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 in the left-hand contact. This procedure is necessary to prevent the right-hand stationary contact from getting out of adjustment. Screws should not be in both taps at the same time as pickup for d-c will be the higher tap value and a-c pickup will be increased.

TESTING

The testing source should be at least 120 volts a-c of good wave form and constant frequency. Low voltage transformers (or phantom loads) should not be used for testing induction relays as the result may be a distorted wave form and incorrect operation.

With the equipment shown in Fig. 13, pick-up tests, time tests, and a complete directional characteristic can be taken. When taking time curves, be sure the timing device begins to record at exactly the moment the relay circuit is closed and will stop at exactly the moment the contacts close.

OPERATION

The operating unit of these relays is similar to the standard watthour-meter units. It is provided with a potential coil (lower) and a current coil (upper). By means of series capacitance and resistance in the potential circuit, the relays are adjusted for their angle of maximum torque.

MAINTENANCE

DISK AND BEARINGS

The lower jewel may be tested for cracks by exploring its surface with the point of a fine needle. The jewel should be turned up until the disk is centered in the air gaps, after which it should be locked in this position by the set screw provided for this purpose.

CONTACT CLEANING

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact. Sometimes an ordinary file cannot reach the actual points of contact because of some obstruction from some other part of the relay.

Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

The burnishing tool described above can be obtained from the factory.

PERIODIC TESTING

An operation test and inspection of the relay at least once every six months are recommended. Test connections are shown in Fig. 13.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

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 requisition number on which the relay was furnished.

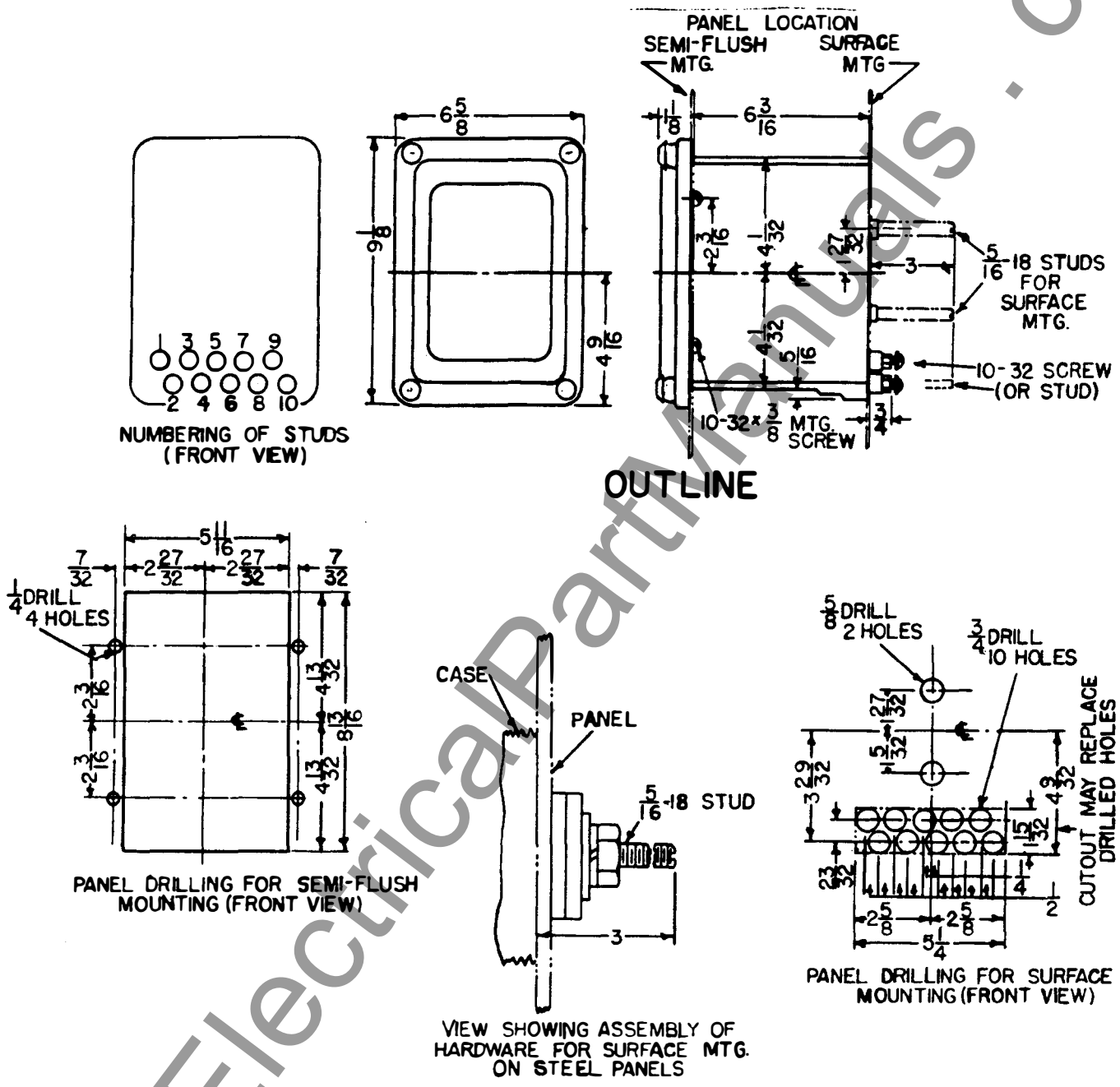


Fig. 14 K-6209271

Fig. 14 Outline And Panel Drilling Dimensions For Type ICW Relays