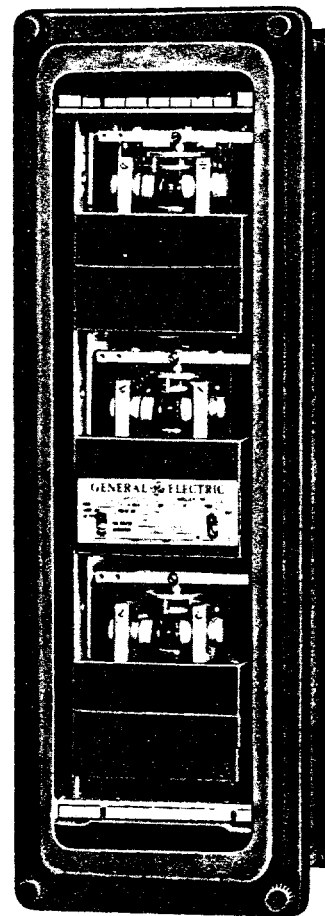




**INSTRUCTIONS**

**GEI-25369D**  
SUPERSEDES GEI-25369C

# **IMPEDANCE RELAYS**



**Types**  
**CFZ13A CFZ13B**

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**LOW VOLTAGE SWITCHGEAR DEPARTMENT**

**GENERAL  ELECTRIC**

**PHILADELPHIA, PA.**

# IMPEDANCE RELAYS

## TYPES CFZ13A AND CFZ13B

### INTRODUCTION

#### APPLICATION

Relay Types CFZ13A and CFZ13B are induction cylinder type impedance relays. The most common application of this type relay is its use as a fault detector in a Carrier-Current Pilot Relaying Scheme. This entire scheme, including the operation of the Type CFZ relay, is described in instruction book GEI-25363. However, it may be used in any application requiring a high-speed fault detector.

#### OPERATING CHARACTERISTICS

The pick-up current of the impedance units is virtually independent of the phase angle between the current and voltage. This characteristic is due to the induction cylinder construction which produces a constant torque throughout the current cycle.

The pick-up current of the three units can be adjusted by means of rheostats over a 2 to 1 range. With the minimum setting, the units pick-up at one ampere and zero volts, and 6 amperes at 100 volts. The corresponding maximum values are 2 amperes and 12 amperes respectively. The pick-up and reset characteristics of the impedance units, with the minimum setting, are shown in Fig. 1. The change of pick-up current at other voltages will be proportional to that for 100 volts. For example, with the maximum setting, the unit will operate at approximately 7.6 amperes at 60 volts.

The operating time of the circuit-opening contacts on the impedance units is often important because of its value in relation to the speed of operating of other relays in the protective system. Table I gives the maximum operating times for a 60 cycle unit set to pick up at 6 amperes and 100 volts. These times are valid so long as the relay current during the fault condition is not less than the appropriate value listed in Table I.

TABLE I

Impedance to Fault % Relay Setting	Maximum Operating Time Cycles	Minimum Relay Current Amperes
80	1	5
60	3/4	2
40	1/2	2
20	1/4	2

*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.*

The auxiliary telephone relay for power swing blocking is designated as OB. This element has a time-delay pickup of 4 cycles (60 cycle base) so that it cannot operate inadvertently on fault conditions. The drop-out time is not usually of importance in the control circuits, but is set at the factory for 15 \* cycles. Fig. 2 shows the pickup time characteristic of the OB unit.

#### RATINGS

The relays are available for either 60 or 50 cycle operation. Both models are rated for continuous operation at 115 volts and 5 amperes.

The auxiliary element, OB, can be furnished for operation at either 125 volts or 250 volts, d-c. The contacts of this element will make, break, or carry 110 watts at either control voltage with a non-inductive circuit or approximately 50 watts in an inductive circuit. The contacts of the impedance units will carry continuously and interrupt currents as follows:

TABLE II

Circuit Volts	Amperes	
	D-C	A-C
125	0.5	1.25
250	0.3	0.75

#### CONTACTS

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying rating is limited by the two forms of target and holding coils. Relays with 1.0 ampere target and holding coils, have a rating of 30 amperes for tripping duty, hence they will trip any circuit breaker with trip coil current within this rating.

#### BURDENS

The burden imposed on the potential transformer by each unit at 115 volts, 60 cycles, is 6-volt-amperes at unit power factor.

The burden imposed on the current transformer by each unit at 5 amperes, 60 cycles, is 16 volts-amperes at 0.6 power factor.

The 50 cycle burdens are slightly less in both cases.

\* Denotes change from superseded book.

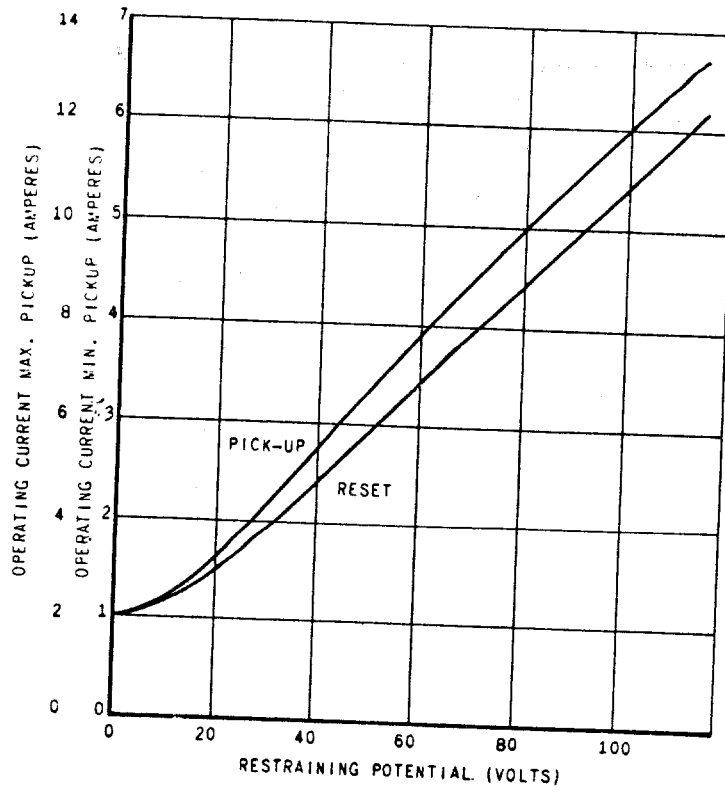
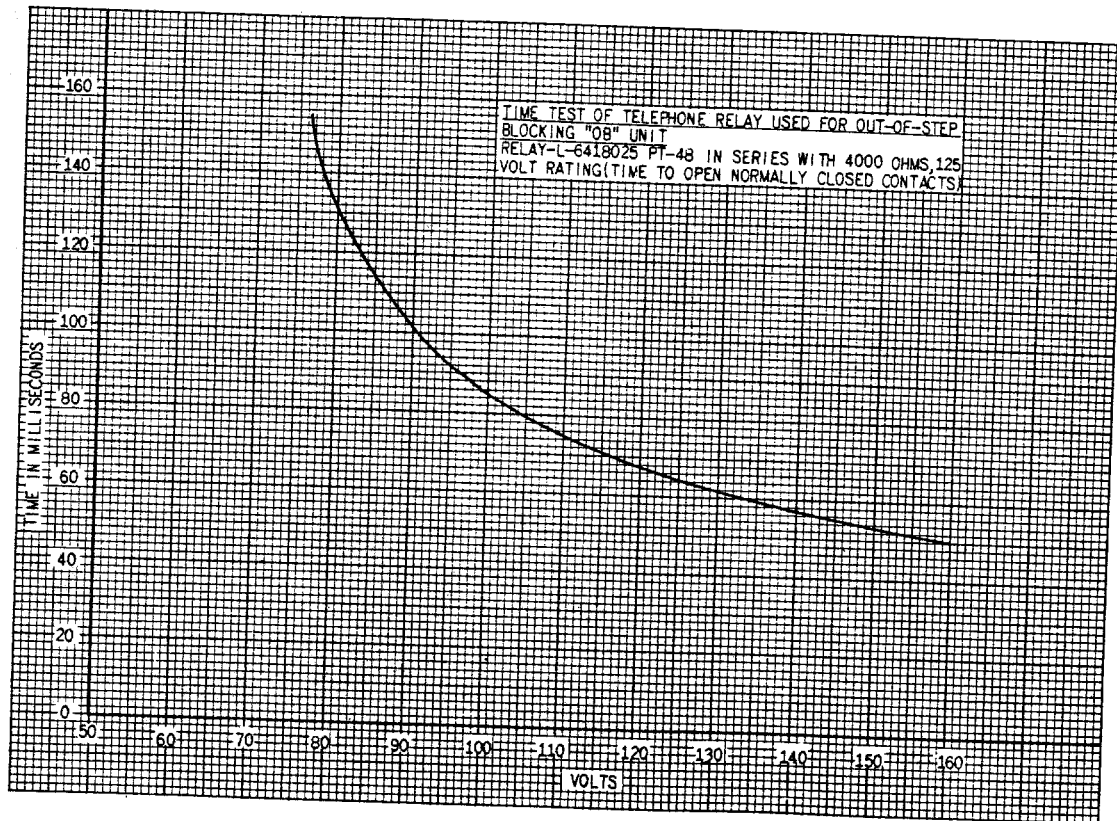


Fig. 1 Pickup and Reset Characteristics of Impedance Units with Minimum Setting



\* Fig. 2 Pickup Time Characteristics of the OB Unit

\* Denotes change since superseded issue.

## 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 unpack-

ing 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

### RELAY TYPES

The Type CFZ13A relay is a three unit high-speed fault detector or impedance relay. It contains an auxiliary time delay relay suitable for blocking the operation of the tripping function of a pilot system during power swing conditions.

Type CFZ13A7A to CFZ13A11A relays have a germanium blocking rectifier to prevent improper operation of the OB unit by formation of external sneak circuits.

The Type CFZ13B relay is similar to the Type CFZ13A relay except that the auxiliary telephone relay and its associated resistors are omitted. Also the internal connections have been changed.

### CASE

The case is suitable for either surface or semi-flush 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 nest 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 thumb-screws, 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.

### RELAY UNITS

The relay units are induction-cylinder devices for alternating current circuits. The principle by which torque is developed is the same as that employed in an induction-disk relay with a watt-hour meter element, though in arrangement of parts they are more like split-phase induction motors.

The stator has eight laminated magnetic poles projecting inward and arranged symmetrically around a central magnetic core. The poles are fitted with current coils. In the annular air gap between the poles and central core is the cylindrical part of cup-like aluminum rotor, which turns freely in the air gap. The central core is fixed to the stator frame; the rotor alone turns.

All eight poles on the induction cylinder unit have current coils which are all in series and which

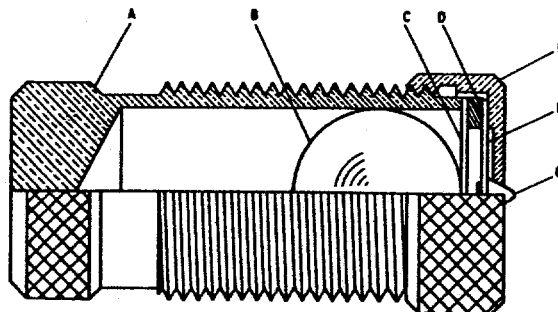


Fig. 3 Stationary Contact Assembly

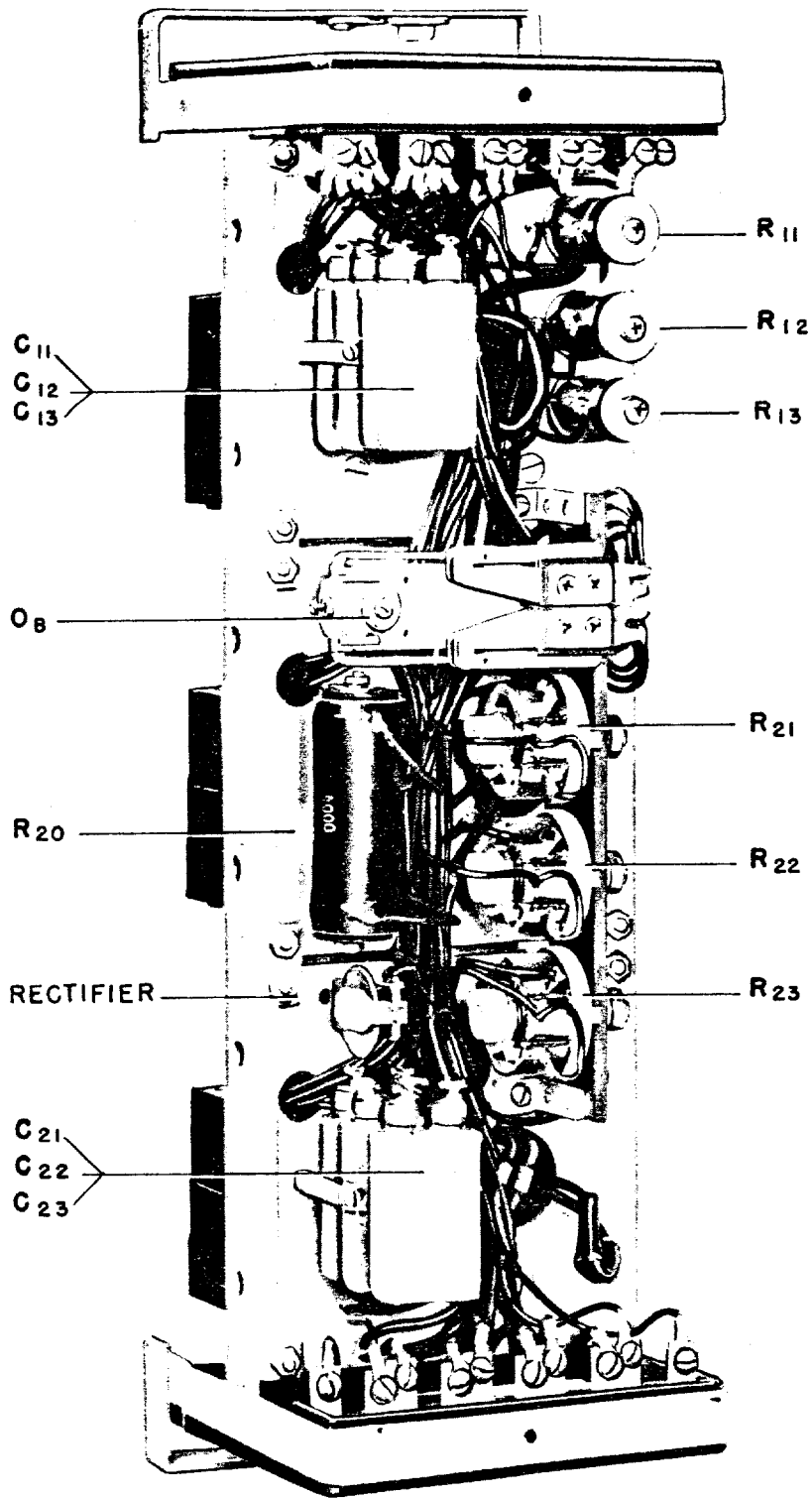


Fig. 4 (8016974)

Fig. 4 Location of Auxiliary Elements in the Type CFZ13A Relay

produce a closing torque proportional to the square of the current flowing through them.

The restraint element consists of two coils which are mounted on top of the unit in a place where holding coils are normally mounted. These two coils are connected in parallel and the power factor of the two coil circuit are such as to make the two coil fluxes 90 degrees apart. This produces a constant pull on the holding armature that is proportional to the square of the voltage applied to the coil circuits

### CONTACTS

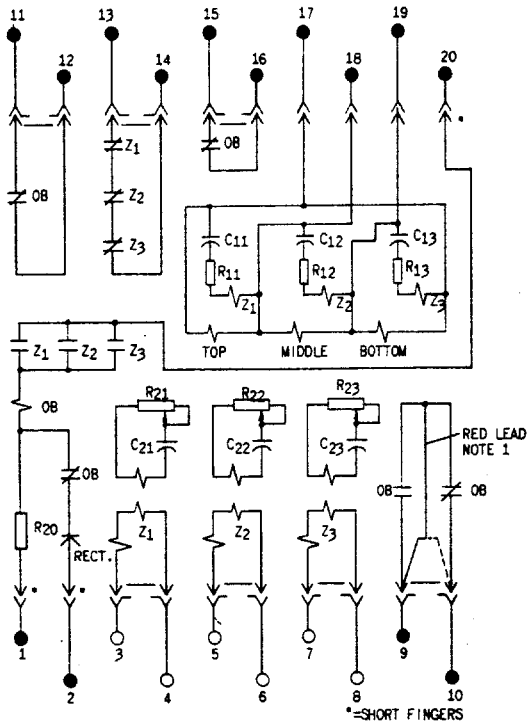
The contacts are especially constructed to suppress bouncing (Fig. 3). The stationary contact (G) is mounted on a flat spiral spring (F) backed up by a thin diaphragm (C). These are both mounted in a slightly inclined tube (A). A stainless steel ball (B) is placed in the tube before the diaphragm is assembled. When the moving contact hits the stationary contact, the energy of the former is imparted to the latter and thence to the ball, which is free to roll up the inclined tube. Thus, the moving contact comes to rest

with substantially no rebound or vibration. To change the stationary contact mounting spring, remove the contact barrel and sleeve as a complete unit after loosening the screw at the front of the contact block. Unscrew the cap (E). The contact and its flat spiral mounting spring may then be removed.

The contact gap may be adjusted by slightly loosening the screw at the front of the contact block. The screw should be loose enough only to allow the contact barrel to rotate in its sleeve.

The stop screw fastened with a locknut should hold the moving contact arm in a neutral position, i.e., with it pointing directly forward. Then bring the stationary contact up until it just touches the moving contact by rotating the contact barrel. Next, back it away 2/3 turn to obtain approximately 0.020 inch contact gap. Last, tighten the screw which secures the barrel.

The moving contact may be removed by loosening the screw which secures it to the contact arm and sliding it from under the screw head.



NOTE 1-COMMON CONNECTION OF "OB" AVAILABLE TO OBTAIN A N.O. OR N.C. CONTACT BY ITS CONNECTION TO STUD 9 OR 10. IF N.O. CONTACT IS USED, REMOVE SHORTING BAR.

Fig. 5 Internal Connections for the Type CFZ13A Relay (Front View)

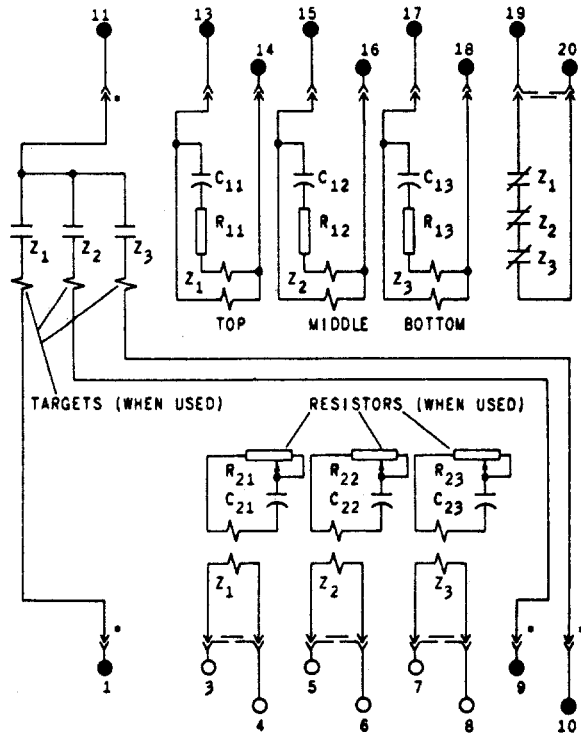


Fig. 6 Internal Connections for the Type CFZ13B Relay (Front View)

## INSTALLATION

### LOCATION

The location should be clean and dry, free from excessive heat and 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. 10.

Fig. 5 (376A995)

Fig. 6 (K-6400772)

## CONNECTIONS

Internal connections are shown in Fig. 5 and Fig. 6. The external connections are shown in Fig. 7.

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.

## ADJUSTMENTS

The impedance units have been set at the factory for the minimum pick-up current. The setting is satisfactory for many applications but may have to be increased to avoid operation on heavy load currents. The three rheostats, R21, R22, and R23 control the pickup. (See Fig. 4.) These rheostats are provided with locking nuts to prevent inadvertent changes in their settings.

## INSPECTION

At the time the relay is installed, the following points should be checked:

## MAINTENANCE

The lower jewel screw can be removed from the unit by means of an offset screw driver or an end wrench. The 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 new pivot should be screwed into the bottom of the shaft at the same time.

The lower jewel bearing should be screwed all the way in until its head engages the end of the threaded core. The upper bearing should be adjusted to allow about 1/64 inch end play of the shaft.

Press down on the contact arm near the shaft to check the clearance between the iron core and the inside of the rotor cup and thus depress the spring-mounted jewel until the cup strikes the iron; the shaft should move about 1/16 inch.

## CONTACTS

The left-hand (front view) stationary contacts on the impedance units have their silver tips mounted on a spiral spring which should be adjusted to allow the contacts to wipe in from 0.005 inch to 0.101 inch before being stopped by the diaphragm behind the spiral. This can be adjusted by removing the contact barrel from its support, after loosening the locking screw at the front of the support, sliding the barrel with its sleeve out of the support, and unscrewing the cap from the end of the barrel.

The contact wipe should be adjusted so that the contact gap is at least 0.010 inch and dropout is maintained at 90 per cent of pickup.

The right-hand stationary contact tip is mounted on a diaphragm and has negligible wipe. The position of this contact determines the pick-up setting of the unit.

If the right-hand moving contact brush and tip is replaced, it should be connected to the portion of the molded contact and armature support directly

1. There should be no noticeable friction in the operation of the assembly.
2. There should be 1/64 inch to 1/32 inch end play in the shaft.
3. The jewel screw and core locking nut at the bottom of each unit should be tight.

### \* CAUTION:

Every circuit in the drawout case has an auxiliary brush; this is the short one in the case (not on the cradle) which the connection plug or test plug should engage first. On every current circuit or other circuit with a shorting bar, make sure these auxiliary brushes are bent high enough to engage the connection plug or test plug before the main brushes in the case do, as otherwise the CT secondary circuit may be opened (where one brush touches the shorting bar) before the circuit is completed from the plug to the other main brush.

beneath the tip by a large drop of cement similar to No. 1286 †Glyptal cement.

## CONTROL SPRING

The upper control spring should be wound in the direction to close the right-hand (front view) contacts until its torque is such that one ampere in the operating circuit will just close the left-hand contacts after the restraining voltage has been slowly reduced to zero. This should be done by turning the adjusting ring, which is locked in front position by the hexagonal-headed screw at the rear.

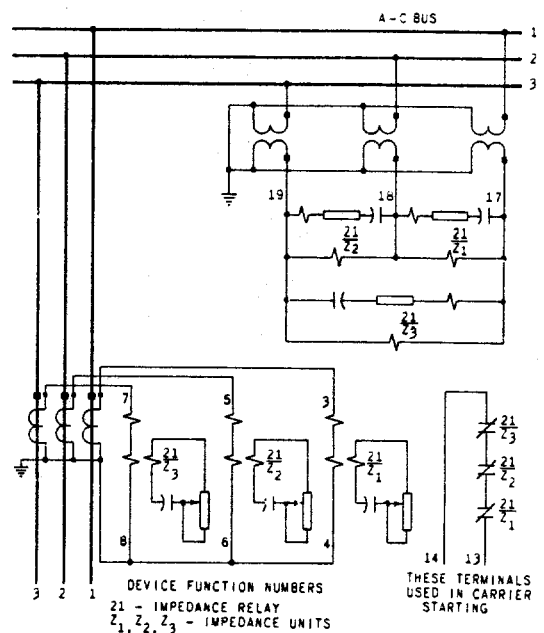


Fig. 7 Typical Elementary Connections for the Type CFZ13A Relay

Fig. 7 (K-6400749)

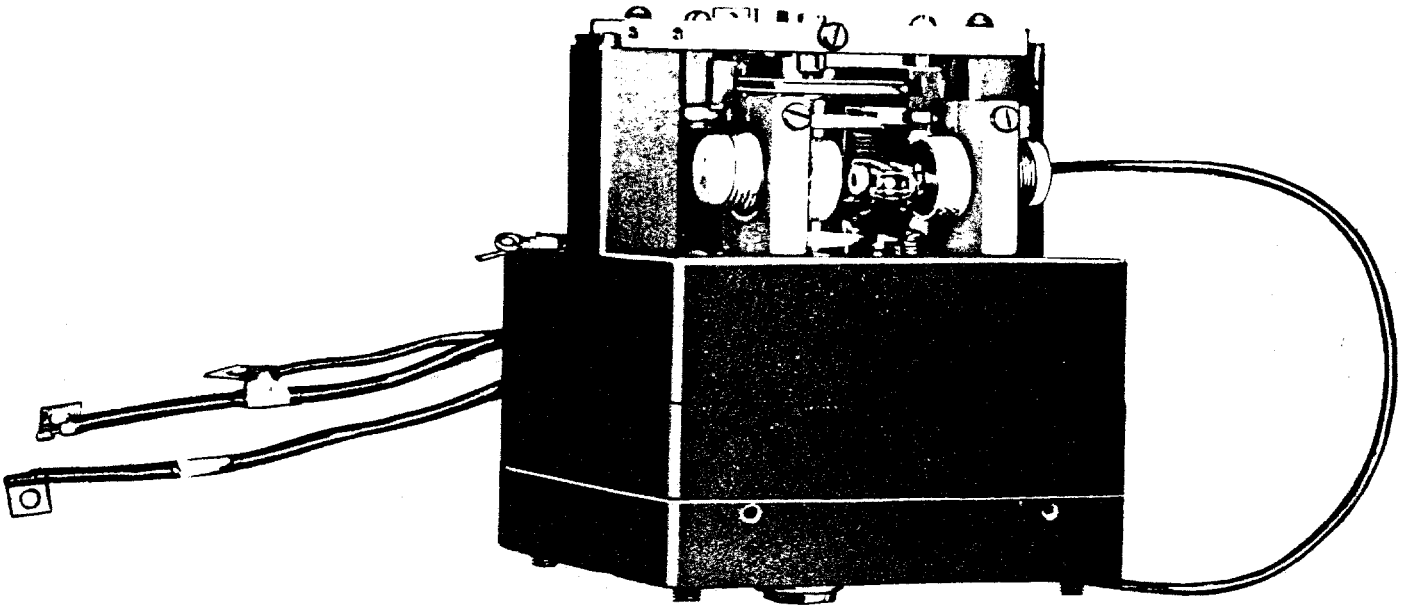


Fig. 8 Front View of an Impedance Unit Showing the Contacts and Control Spring

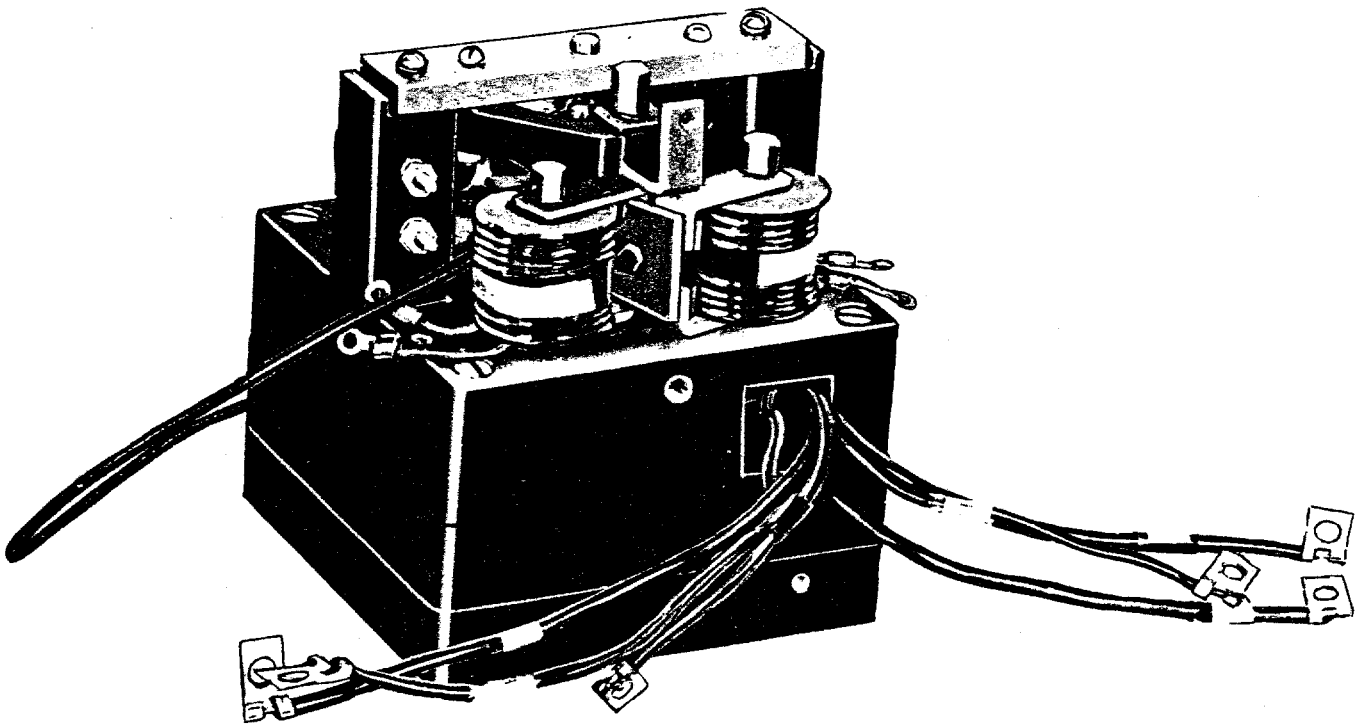


Fig. 9 Rear View of an Impedance Unit Showing the Potential Coils and Restraint Armature



## CLUTCH

This type unit is provided with a clutch which permits the rotor to slip with respect to the contact arm. The clutch is adjusted by means of the set screw on the right side of the molded contact supporting arm. This screw should be adjusted so that the clutch will slip with the limits of 12 to 15 amperes when the restraint voltage is zero.

## 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.

Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increases 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 is included in the standard relay tool kit obtainable from the factory.

## DISASSEMBLY

If access is desired to the rotor of a unit, or if a new pivot is to be installed in the shaft of either of the upper units, it is necessary to disassemble the unit as follows:

1. For the top and bottom units, unfasten the capacitors and resistors directly behind the unit but do not disconnect the leads to them. This permits observation of what leads must be removed in order to dismount the unit and gives access to the three flat-head screws which mount the unit on its base plate. Dismounting the string of resistors behind the middle unit by removing the screw at each end of their mounting strap will permit easier tracing of the leads.

2. For the middle unit, dismount the resistors on their mounting strap as described in (1), allowing the connections to remain, and unfasten the plate upon which the auxiliary relays are mounted from its bracket. Without unsoldering the connections, the resistors and auxiliary relays can be turned to permit inspection of what leads must be removed to dismount the unit, and access is given to the three flat-head screws mounting the unit to its base plate.

3. Remove all leads necessary to remove the unit from the relay, tagging them carefully.

4. Remove the three screws holding the unit to its base plate and remove the unit intact from the front of the relay.

5. By removing the four screws in the corners of the unit, the molded head with the contact and

restraint structures and the rotor can be lifted straight up. Care should be exercised that the aluminum cylinder is not scratched in coming out from its air gap. This gives access to the rotor and the pivot.

6. The restraint magnets can be removed by proceeding through (4) above and then removing the two screws holding the structure to the molded head and sliding it out. The nuts for these screws are held in two slots inside the head. It will aid in re-assembly if these nuts are moved to an end of each slot before attempting to mount the restraint magnets. Then the screw can be used to feel for the proper end of the slot before lowering the screw enough to engage the nut.

### 7. Caution note for Type CFZ13 relays:

When applying a soldering iron to the blocking rectifier terminals, the terminals should be held by pliers to conduct the heat away from the body of the rectifier during the soldering operation. By not following this procedure, the rectifier may be damaged.

## RECALIBRATING THE RELAY

If the calibration of the relay has been disturbed, it can be recalibrated as follows:

1. Turn the rheostat on the back of the relay to zero ohms.

2. Pass 1.0 ampere through the current coils, with no voltage on the potential circuit. Adjust the upper control spring so that the left contact will just close.

3. Apply 100 volts to the potential circuit and determine the current necessary to just close the left contact. The current should be 6 amperes. If less than 6 amperes, decrease the holding armature gap by backing off the right-hand contact barrel until the left contact will just close with 6 amperes. If the initial pick-up reading was more than 6 amperes, then the right-hand contact barrel should be screwed in until the left contact just closes at 6 amperes. When the proper setting is determined, lock the right-hand barrel by tightening the locking screw on the contact barrel support.

4. Apply 100 volts to the potential circuit and enough current to close the left contact, then slowly reduce the current until the left contact just opens. The current should be 5.4 amperes or higher. If the drop-out current is less than 5.4 amperes, the left contact should be screwed in until the dropout is 5.4 amperes. The contact gap should be approximately 0.015 inch when the two contacts are properly set.

5. If a pickup higher than 6 amperes at 100 volts is desired, proceed as follows: Set the current through the current coils at the desired pickup value and adjust the rheostat at the back of the relay until the left contact will just close. Lock the rheostat by tightening the locknut. Increasing the pickup by means of the rheostat raises the entire curve the same percentage. For example: If the pickup at 100

volts is increased from 6 amperes to 9 amperes, the pickup at zero volts will increase from 1 ampere to 1.5 amperes.

### PERIODIC TESTING

An operation test and inspection should be made once every six months.

To check the calibration of the units it is only necessary to apply a known voltage to the potential circuit and to determine the current through the current coils necessary to cause the left contact to close.

If the relay is calibrated for 6 amperes with pickup at 100 volts, the pick-up current required at any restraint voltage can be read directly from the curve shown in Fig. 1. If the pickup has been increased by adjustment of the rheostat, the pickup at any voltage will be the value read from the curve shown in Fig. 1, multiplied by the factor by which the pickup was increased by means of the rheostat. For example: If the pickup at 100 volts is 6 amperes, the pickup at 60 volts is 3.9 amperes. If the pickup at 100 volts is increased to 9 amperes, the pickup at 60 volts will be  $1.5 \times 3.9$  or 5.85 amperes.

### 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. If possible, give the General Electric Company requisition number on which the relay was furnished. Refer to publication GEF-3906 for a list of renewal parts.

\* Denotes change since superseded issue.

