TEST TECHNICIAN
TRAINING SCHOOL

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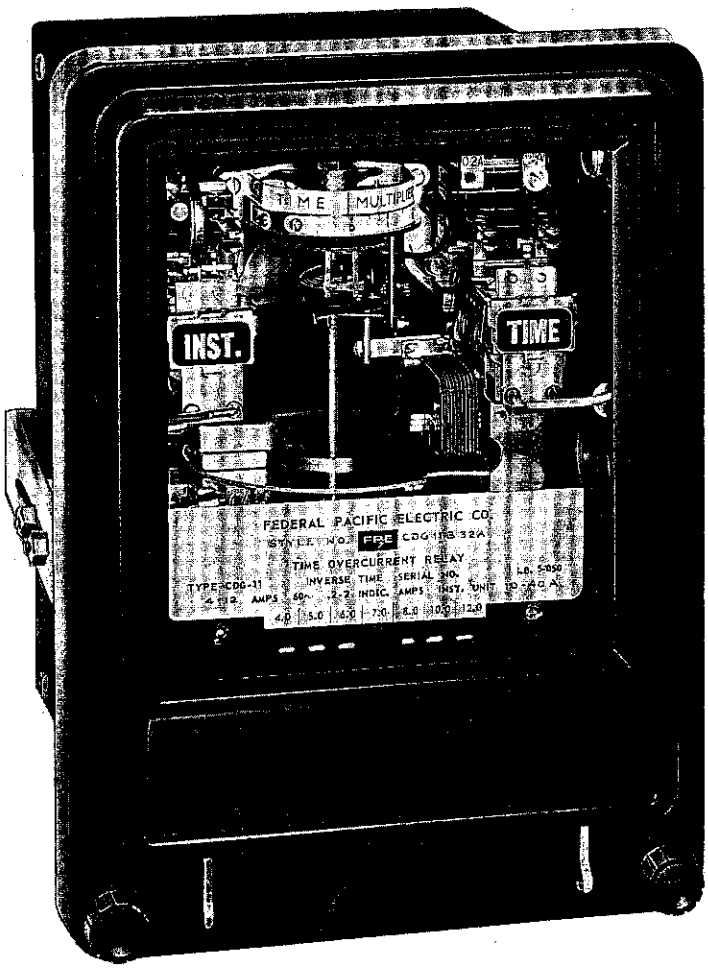
INSTRUCTIONS FOR
INSTALLATION AND OPERATION

IB 5-050
January 1959

TYPE CDG
Time Overcurrent Relays
Models CDG 11A, CDG 11B, CDG 13A, CDG 13B, CDG 14A, CDG 14B



Relay Instructions necessarily do not include all details of application nor do they cover all contingencies in installation, operation and maintenance. Matters not covered to the customer's complete satisfaction should be referred to the Federal Pacific Electric Company.

FPE
FEDERAL PACIFIC ELECTRIC COMPANY
GENERAL OFFICES: NEWARK 1, NEW JERSEY

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GENERAL INFORMATION

CONSTRUCTION FEATURES

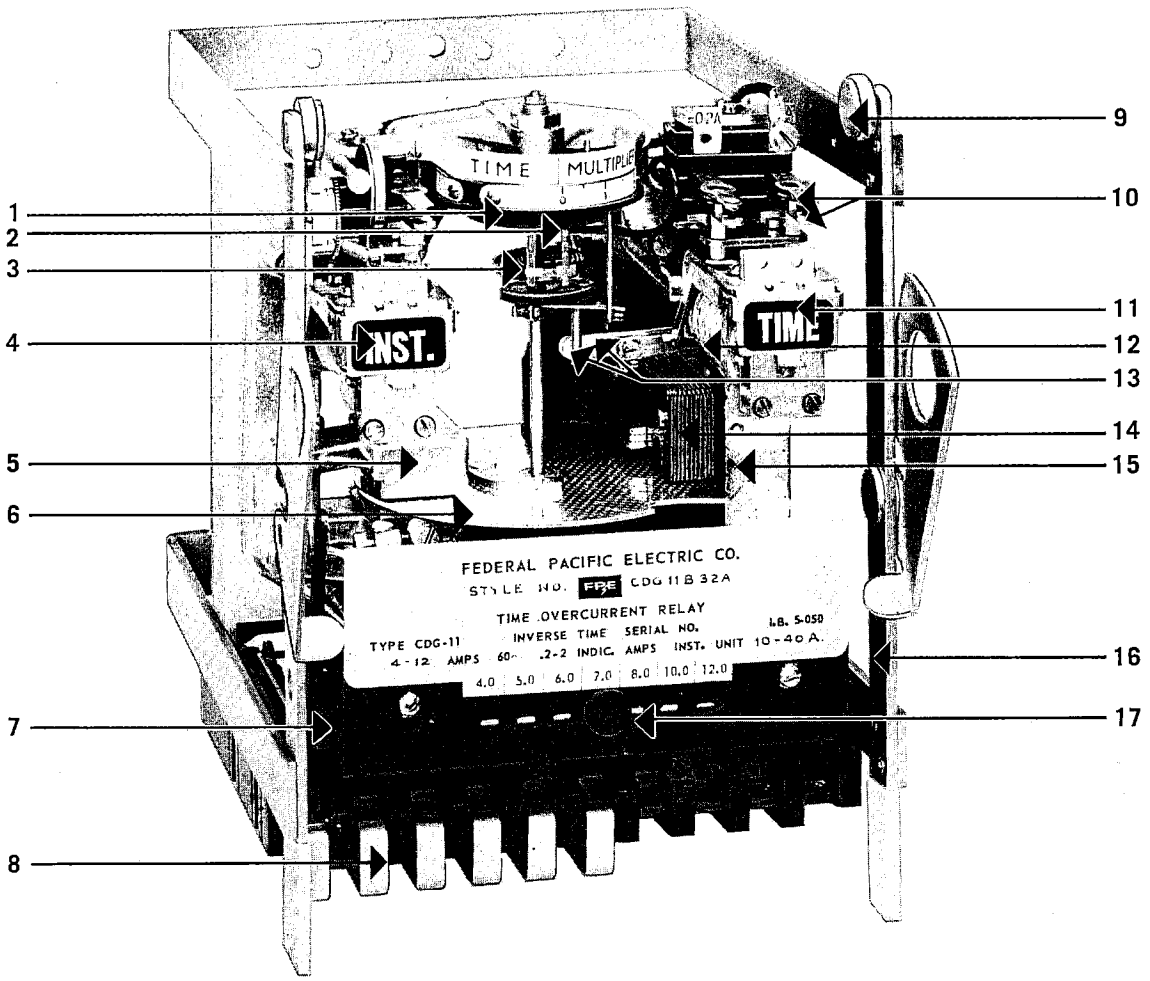


FIG. 1 CDG RELAY-FRONT VIEW WITHOUT CASE

1. **TIME DIAL** facilitates time setting by the rotation of a hand calibrated dial with a deeply knurled edge. A calibrated scale is provided in steps from 0 to 10.
2. **ADJUSTING SPRING COLLAR** slotted around the edge provides the means of controlling the spiral spring windup.
3. **SPIRAL CONTROL SPRING** acts as a lead-in conductor for the moving contact to complete the tripping circuit and determines the shape of the time-current curve near pickup current values.
4. **INSTANTANEOUS UNIT** having a hand calibrated dial and pickup settings which are manually adjustable through a spring-loaded worm and gear provides instantaneous overcurrent protection.
5. **ALCOMAX DAMPING MAGNET** retards the movement of the non-magnetic disk and controls the shape of the time-current curve at the higher current levels. A magnetic shunt screw is provided for manual adjustment of magnet strength.
6. **OPERATING DISK** provides accurate pickup current at all time-dial settings. The low inertia aluminum disk is accurately counter-weighted to give true balance.
7. **TRIP CIRCUIT** is automatically opened when the left-hand latch is rotated to withdraw the relay.
8. **CONTACT FINGERS** on the relay unit make connection with similar fingers on the case forming a single pair of contacts in each circuit. High contact force (2 lbs. per contact) is maintained by two springs in each of the drawout fingers.
9. **ROLLERS** insure that positive pressure is applied to the contact fingers.
10. **HEAVY-DUTY SEAL-IN CONTACTS** by-pass the spiral lead-in spring and the main relay contacts and remain closed until the trip circuit is opened by the circuit breaker auxiliary switch.
11. **OPERATION INDICATOR TARGET** consists of an orange background which is clearly visible when uncovered by the operation of the armature. The target is restored to its normal position by operating the external reset rod.
12. **SEAL-IN COIL.** A single tapped coil operates both the seal-in contacts and the operation indicator. Terminals on the front of the unit facilitate connection to either the 0.2 or 2.0 amp minimum operating current tap.
13. **CONTACTS** have substantial pressure and wipe.
14. **OPERATING ELECTROMAGNET** has a "C" shaped core with copper shading rings in the pole face. The operating coil has seven taps, each of which is brazed to a socket on the plug setting bridge.
15. **RELAY FRAME** is an aluminum alloy die-casting.
16. **STEEL CHASSIS** comprises a light and sturdy structure which supports the relay unit and molded contact blocks.
17. **TAP SETTING PLUG BRIDGE** provides a quick, reliable means of selecting the operating current. Upon withdrawal of the tap plug the maximum current tap is automatically connected.

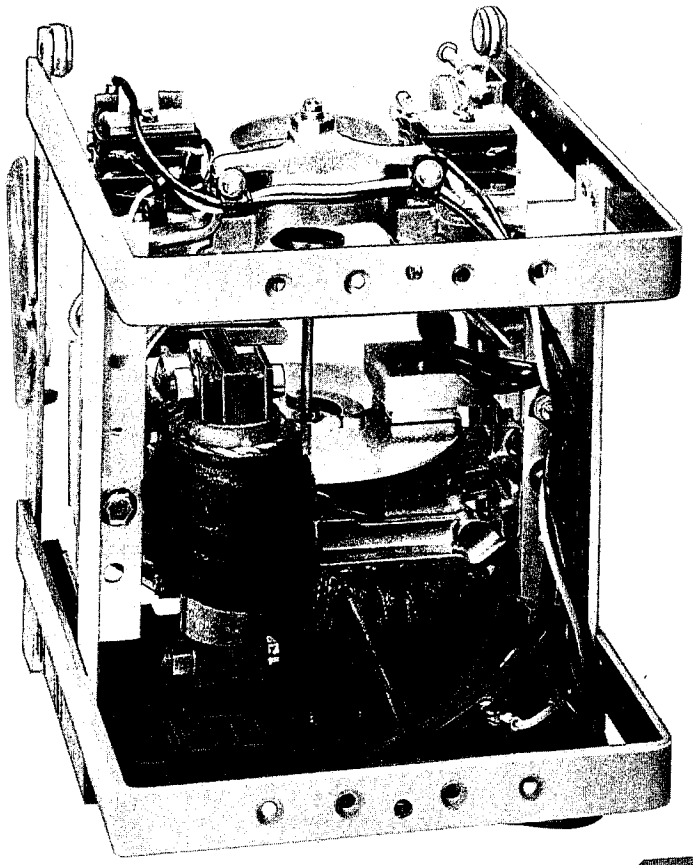


FIG. 2 CDG 11B-REAR VIEW WITHOUT CASE

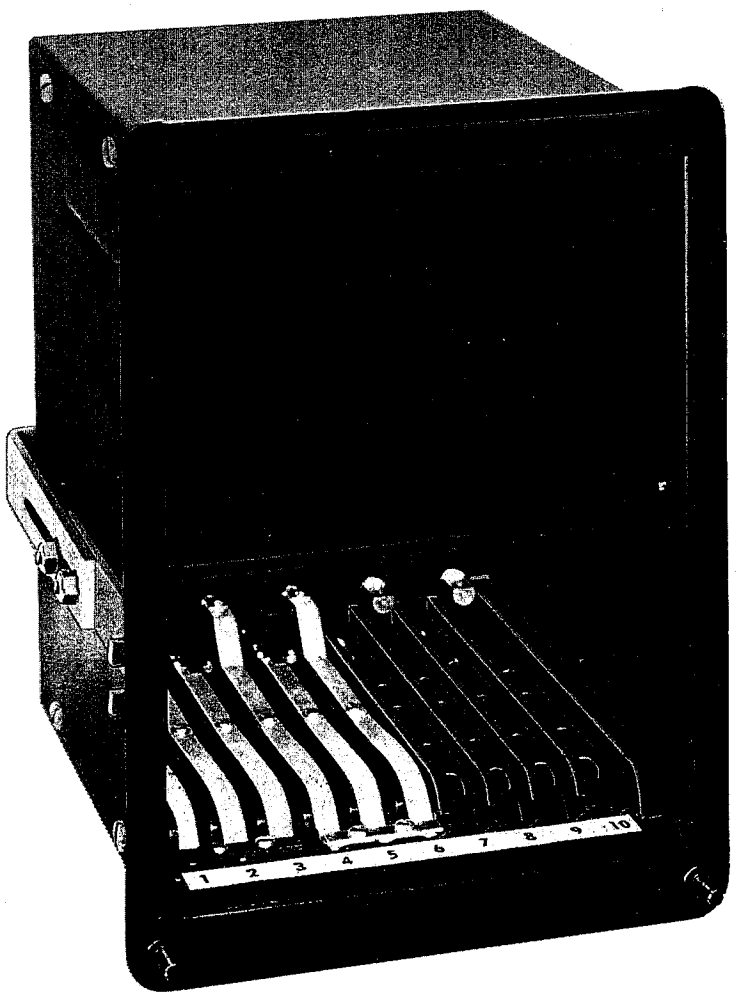


FIG. 3 CDG RELAY CASE - FRONT VIEW

Receiving and Storage

All relays are packed in cartons designed to prevent damage in shipment. However, it is recommended that the relays be inspected shortly after being received for any possible shipping damage so that necessary claims by the receiver can be made immediately to the transportation agency. A report should also be made to the nearest Federal Pacific Electric Sales Office.

It is desirable to store relays in their cartons in a clean, dry area until ready for use. Protective relays are of instrument calibre and should receive the careful handling accorded instruments.

Application

The relays covered in these instructions are time overcurrent, non-directional relays for use in the protection of a-c circuits and apparatus against phase and ground faults. The time-current characteristics are available in the inverse, very inverse and extremely inverse types as shown in Figs. 6 to 8. The curve shape selected depends on possible system conditions and coordination requirements with associated relays and devices. Each relay is equipped with a combination target and seal-in unit.

An instantaneous overcurrent unit can be furnished to supplement the inverse time unit to reduce tripping times under maximum fault conditions. This unit has a target, but does not require a seal-in unit for relief of contact duty.

Description

Time Delay Unit

The design is based on the induction disk principle using a shaded pole magnet to develop rotational torque. The disk is mounted on a shaft pivoted between two bearings. The lower bearing pin rides on a synthetic sapphire jewel which is spring mounted to minimize shocks. The moving contact is mounted on the disk shaft and its initial position relative to the stationary contact is determined by the position of the time lever whose calibrated scale is marked from 1 to 10. These time dial settings (TDS) give the family of curves shown in Figs. 6 to 8.

The tap plug bridge mounted in front of the relay, is connected to the electromagnet coil and allows selection of a tapped portion of the coil. A particular plug setting determines the closing current of the induction unit. The slotted collar, to which the spiral spring is attached, provides a finer means of closing current adjustment. The Alcomax damping magnet retards the movement of the disk to provide the necessary time delay. The screw adjustment in the bottom pole of the damping magnet acts as a magnetic shunt and provides an accurate means for the factory calibration of the magnet strength without shifting the magnet.

The 0.2 to 2 ampere target and seal-in unit is a hinged armature device having an operation indicator and contact for sealing around the induction unit contact, thus insuring positive operation and minimum wear of that contact. The relay coil is tapped and equipped with front terminals for connection to either the 0.2 or 2.0 ampere tap.

Relay Types Available

Table 1

Type	Time Curve	Instantaneous Unit	Internal Conn.	External Conn.	Outline and Panel Drilling
CDG 11A	Inverse	—	Fig. 9	Fig. 11-12	Fig. 16
CDG 11B	Inverse	X	Fig. 10	Fig. 11-13	Fig. 16
CDG 13A	Very Inverse	—	Fig. 9	Fig. 11-12	Fig. 16
CDG 13B	Very Inverse	X	Fig. 10	Fig. 11-13	Fig. 16
CDG 14A	Extremely Inverse	—	Fig. 9	Fig. 11-12	Fig. 16
CDG 14B	Extremely Inverse	X	Fig. 10	Fig. 11-13	Fig. 16

Instantaneous Trip Unit

This hinged armature unit is adjusted by a knurled calibrating knob, which varies the restraining spring tension on the hinged armature. The graduated scale is marked for a 4-1 ratio of maximum to minimum current pickup. A target is provided to indicate electrical operation of the unit. It is released by the attraction of the relay armature to the pole face.

Case and Chassis Assembly

The relay components are mounted on a withdrawable chassis to facilitate ease of testing and unit interchangeability. The relay elements are internally wired to screw terminals on the contact fingers of the bottom chassis mold. Switchboard wiring connects to the external terminal studs of the case which are electrically connected to contact fingers on the bottom relay case mold. These contact fingers are substantially spring loaded to give a reliable and visible electrical connection between the cradle and case.

To remove the relay chassis assembly from the case it is necessary to release the right and left hand latches. This is done by pulling the latch arms forward. The left hand latch arm, identified by red lacquer, is mechanically coupled to a switch assembled on the bottom chassis mold. This switch is the trip interlock and opens the trip circuit when the latch is pulled forward.

The two rollers on top of the cradle assembly assure positive downward thrust insuring pressure wiping action between both sets of contact fingers. The cover cannot be replaced until the two latches are in the closed position so that the chassis is locked in position and the trip circuit completed.

The current transformer circuits are shorted out automatically as the cradle is withdrawn from the case. The shorting contacts are visible at the front of the case as shown in Fig. 4 and the photograph of the interior of the case.

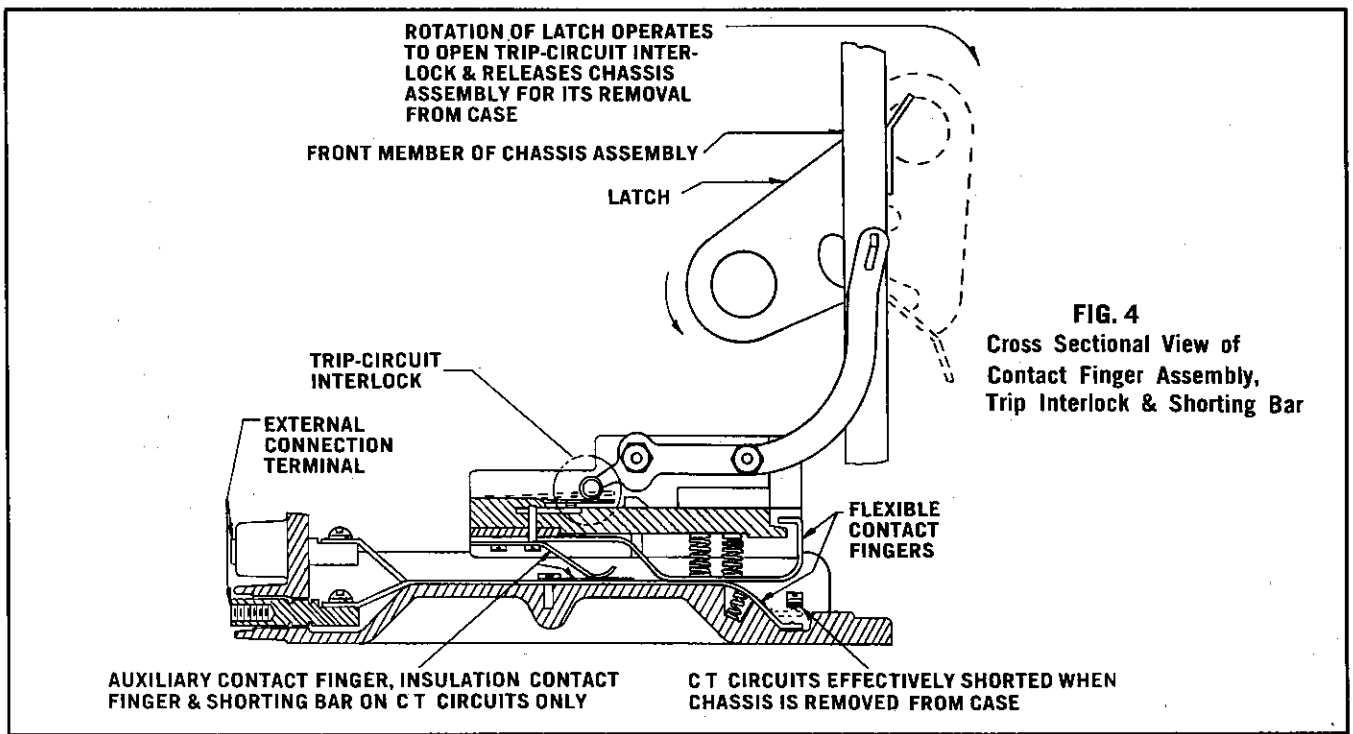


FIG. 4
Cross Sectional View of Contact Finger Assembly, Trip Interlock & Shorting Bar

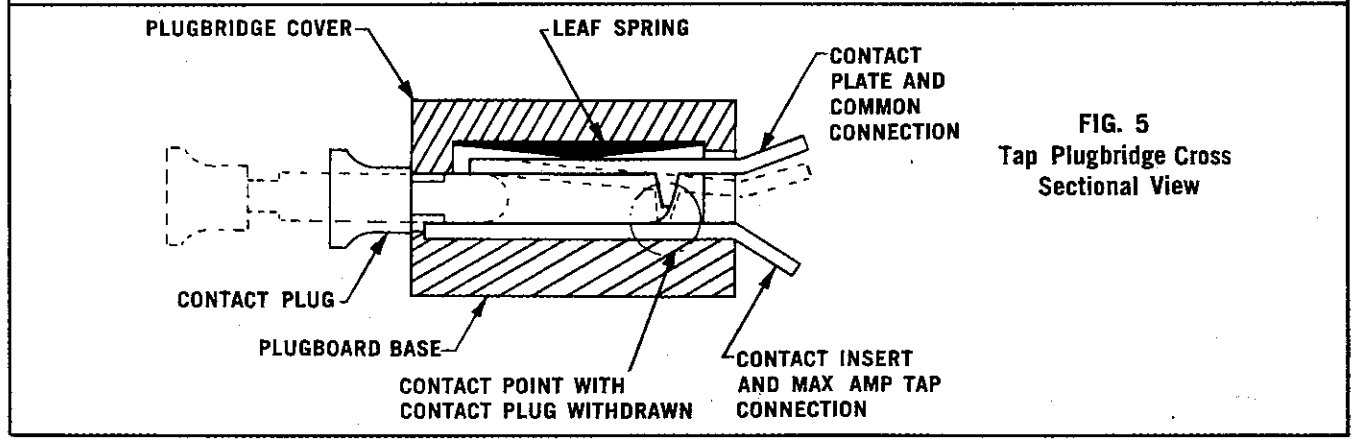


FIG. 5
Tap Plugbridge Cross Sectional View

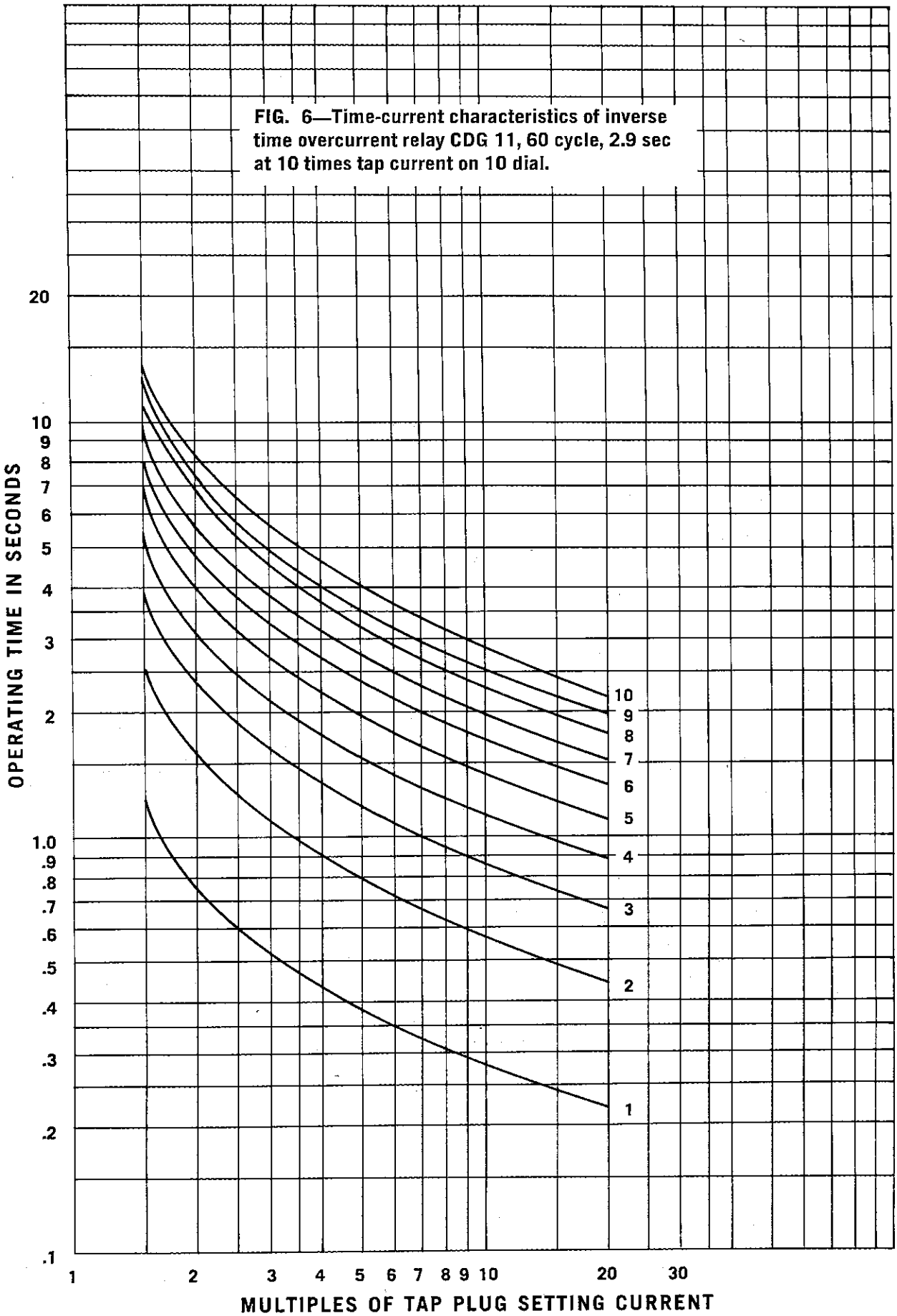


FIG. 6—Time-current characteristics of inverse time overcurrent relay CDG 11, 60 cycle, 2.9 sec at 10 times tap current on 10 dial.
OPERATING TIME IN SECONDS
20
10
9
8
7
6
5
4
3
2
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5 6 7 8 9 10 20 30
MULTIPLES OF TAP PLUG SETTING CURRENT

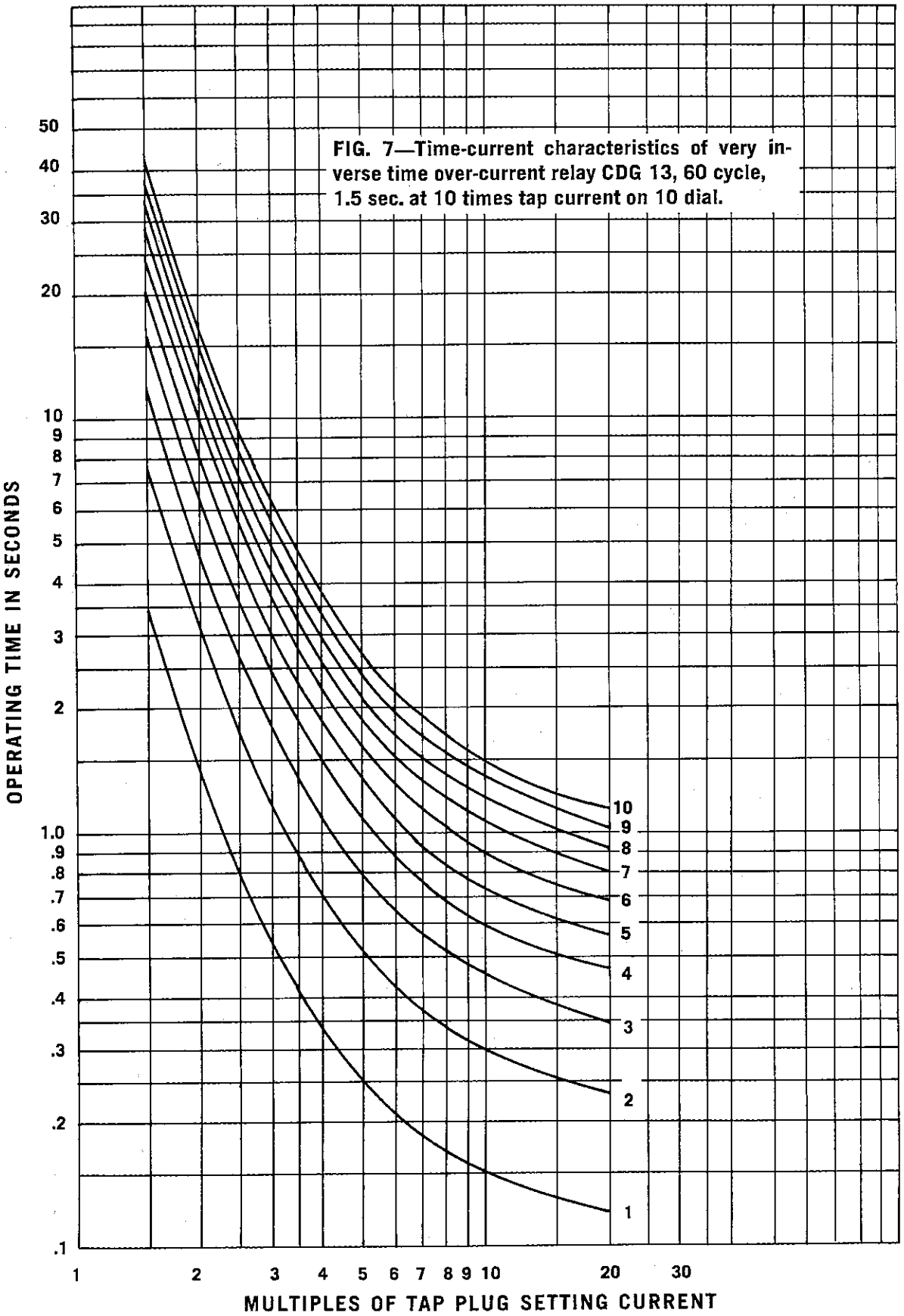


FIG. 7—Time-current characteristics of very inverse time over-current relay CDG 13, 60 cycle, 1.5 sec. at 10 times tap current on 10 dial.

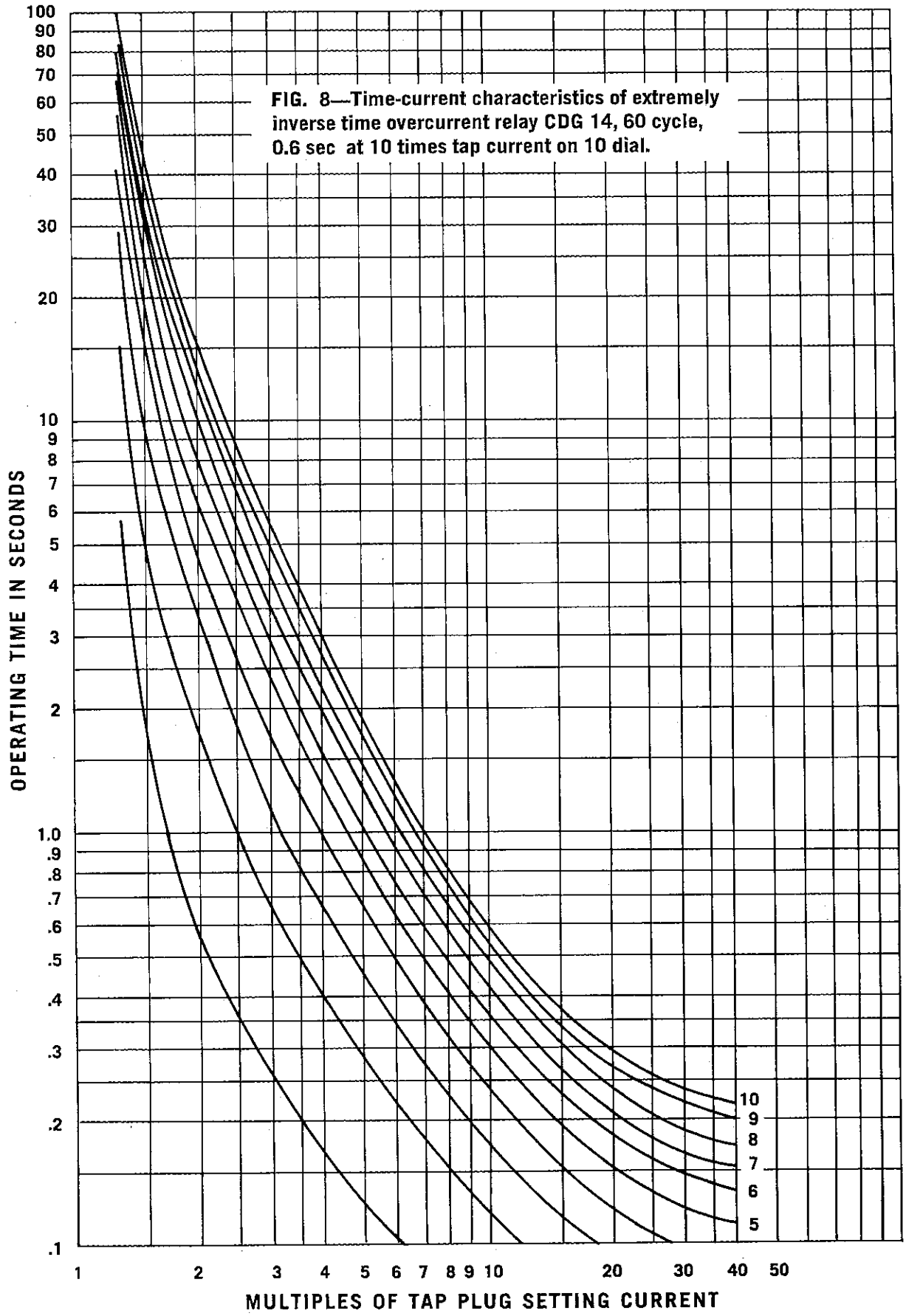


FIG. 8—Time-current characteristics of extremely inverse time overcurrent relay CDG 14, 60 cycle, 0.6 sec at 10 times tap current on 10 dial.

INSTALLATION

Inspection

Relays should first be examined for damage in transit and all packing pieces, if any, should be removed. Each relay unit should be given a mechanical inspection to see that the moving parts operate freely. The rotor end-shake should be approximately 1/64 inch. The disk should reset completely from the 10 TDS with the relay set on a level surface. The targets on both the seal-in and instantaneous units should drop when the armatures are mechanically closed.

Mounting

Protective relays should preferably be mounted where they are not subject to dust, moisture, shock or excessive heat or vibration. The relays after mounting should be freely accessible for the use of test equipment normally required in periodic field testing. Relay cases can be grounded by connection to the mounting studs of the case.

Semi-Flush Mounting: Brackets are provided which eliminate the necessity for drilling of any mounting holes. Fig. 16 illustrates the method of securing the case to the panel. The mounting brackets are initially pre-adjusted so that the two sliding parts are extended to fit the dimension X. The two nuts "A" are then tightened to maintain this dimension. The single tongue at the foot of the bracket is then inserted between the edge of the panel cutout and the side of the case. The final operation requires the assembly of the ¼" - 20 stud "B" and its lockwasher to the case mounting bushing. This results in a secure assembly of the case to the panel.

Projection Mounting: The case is mounted the conventional way using the ¼" - 20 stud, special spacer and washer as shown in Fig. 6. Extension mounting studs are provided for panel thickness up to 1½".

Other types of mounting such as rack mounting can be accommodated by using the flush mounting brackets.

Connections

Internal connections are shown in Figs. 9 and 10 for type CDG relays without or with instantaneous units respectively.

External connections are shown in Figs. 11 to 13.

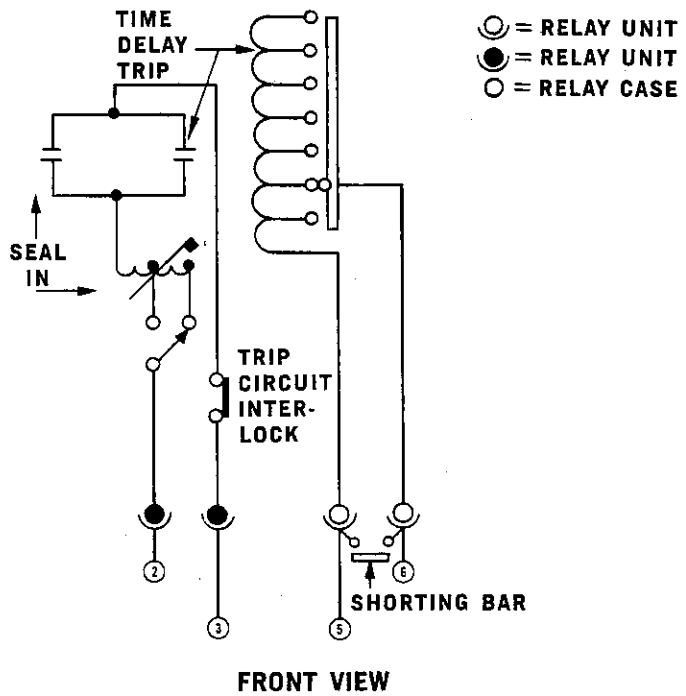


FIG. 9
Internal Connections
Types CDG 11A, 13A, 14A

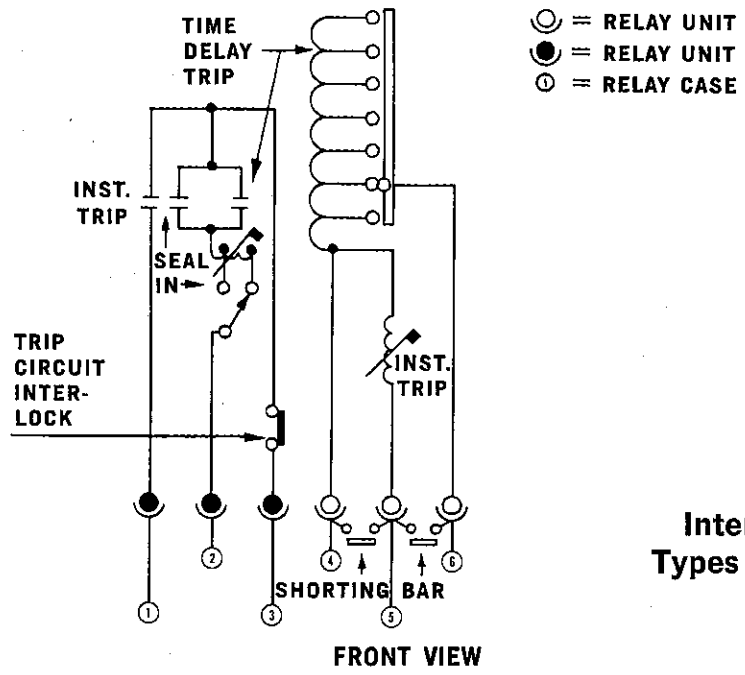
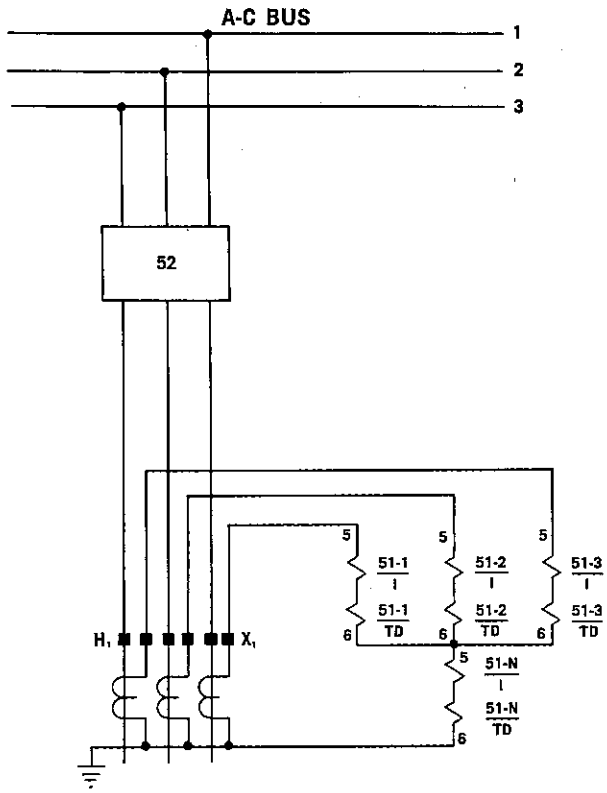


FIG. 10
Internal Connections
Types CDG 11B, 13B, 14B



LEGEND

51—time overcurrent relay
52—power circuit breaker
I—instantaneous unit
TD—time delay unit
5, 6—relay case terminals

FIG. 11
External Connections to
Current Transformers, Type CDG

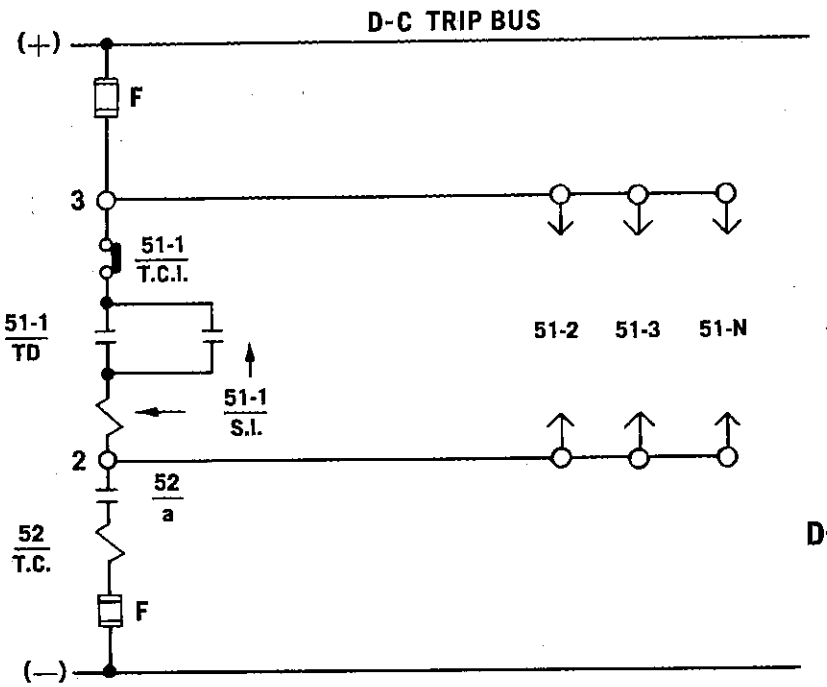
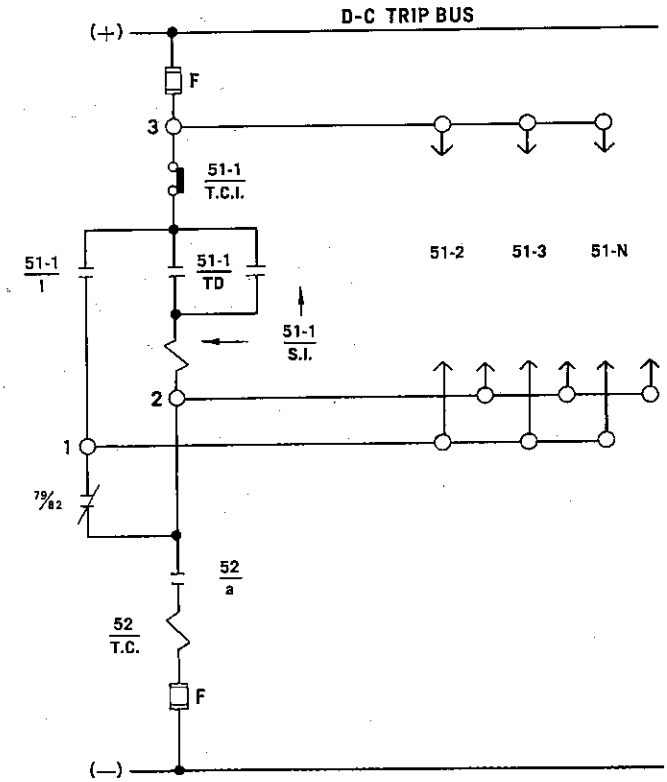


FIG. 12
External Connections to
D-C Trip Bus—Types CDG 11A
CDG 13A & CDG 14A



LEGEND FOR FIGS. 12 and 13
51—time overcurrent relay
52—power circuit breaker
a—aux. contact on breaker
79/82—a-c or d-c recloser (if used)
F—Fuse
I—instantaneous unit
S.I.—seal-in unit
T.C.—breaker trip coil
T.C.I.—trip circuit interlock
TD—time delay unit
1 ○—relay case terminal

FIG. 13
External Connections to D-C
Trip Bus—Types CDG 11B
CDG 13B & CDG 14B

Normal Field Adjustments

Refer to Fig. 14 for the location of adjustment parts referred to in the test.

Time Delay (Induction Disk Unit)

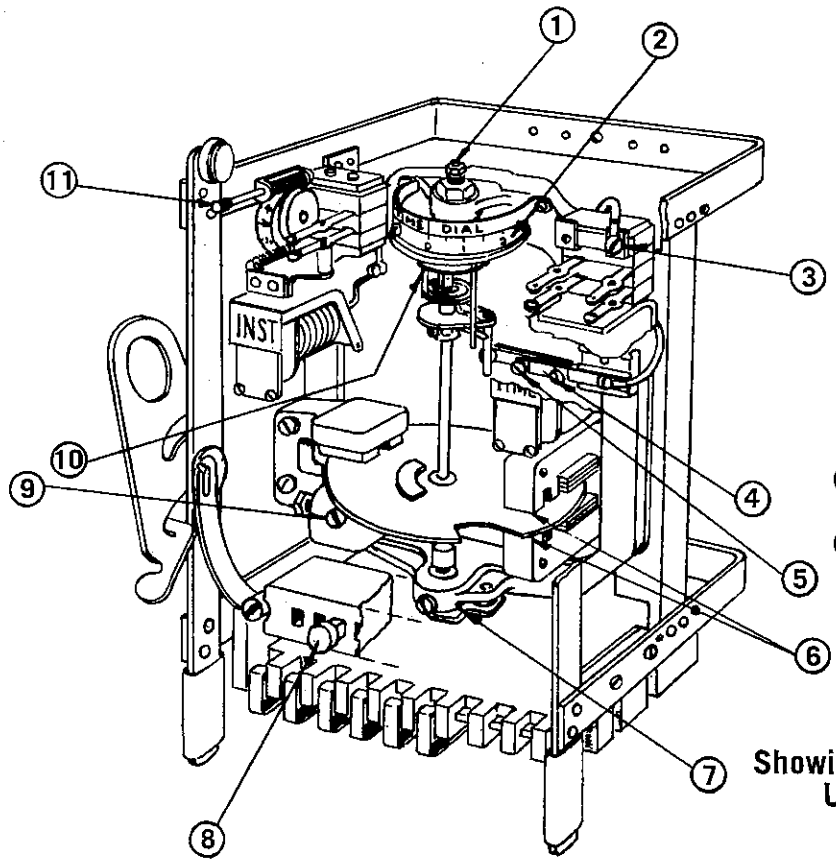
Tap Plug Setting (8) — Selection of the desired tap is made by inserting the removable plug in the proper location. The removal of the plug automatically connects the maximum tap across the current transformer secondary insuring that protection of the circuit is maintained and that the secondary is closed at all times. See Fig. 5. The unit is factory set to pickup at the values listed in Table 6 for the three relay types. The adjustment of the spiral spring not only determines the pickup value within these limits but also fixes the shape of the time curve at the lower multiples of tap plug settings. This is inherent in any induction disk relay design using a spiral spring.

The current at which the contacts will close can be varied by means of the spring adjusting collar. This collar (10) is slotted to facilitate fine current pick-up adjustment. However, it must be realized that any such adjustment will affect the relay operating times at the lower multiples of plug current settings. The greatest effect will occur at two times and lower.

Time Dial Settings (2) — The 10 TDS positions the moving contact at the maximum angle of rotation from the stationary contact and, therefore, will give the highest time current curve characteristic as shown in Figs. 6 to 8.

It should not be necessary to do any more than set the time dial to the position giving the desired operating time at a specific multiple of plug setting. If the control spring is adjusted from the factory setting, the operating times will be slightly different than shown on the published curves. The time accuracies are normally plus or minus 7% for all relays over most of the working range. The tolerance will be plus or minus 12% for the CDG 13 and CDG 14 from 2x to 4x the tap plug setting.

It is suggested that the times be set with a precision timer if better accuracies are required or if the spring setting is changed.



(1) Top Bearing Pin - Adjustable for rotor endshake.
(2) Time Dial - Adjustment of initial position of moving contact to select one of family of curves identified from 1 to 10.
(3) Seal-In Unit - Selection of 0.2 or 2 amp tap depending on trip current.
(4) Stationary Contact - Screw adjustment for initial tension.
(5) Stationary Contact - Screw adjustment for contact wipe.
(6) Disk Adjustment - Normally not required. Set screw in collar under disk.
(7) Lower Bearing - Sleeve and retainer clip for centering of disk in electromagnet gap.
(8) Tap Plug - For selection of operating tap of time delay induction disk unit.
(9) Brake Magnet - Screw adjustment for control of magnetic field strength of magnet and therefore the time curve.
(10) Spring Adjusting Collar - For setting of starting and closing currents of induction disk unit.
(11) Instantaneous Unit - Adjustment of pickup current by setting of the calibration dial.

FIG. 14
Type CDG Relay Chassis Showing Locations of Adjustment Parts Used in Calibrating the Relay

Adjusting the Contacts (5) — The contacts are normally adjusted to have approximately 1/16″ wipe. The first adjusting screw from the stationary contact tip controls the movement of this contact relative to the back stop. Normal contact opening time is less than six cycles and this can be reduced to less than three cycles by reducing the wipe.

Target and Seal-In Unit (3)

Selection of the 0.2 or 2.0 ampere tap is determined by the trip coil current. The 0.2 ampere tap is used for trip coils operating from 0.2 to 2 amperes at the minimum control voltage. The tap is changed simply by placing the screw in the marked terminal of the selected rating.

Instantaneous Unit (11)

The pickup current of this unit is adjustable over a 4 to 1 range by means of the knurled calibrating knob and will be within plus or minus 10% of the setting.

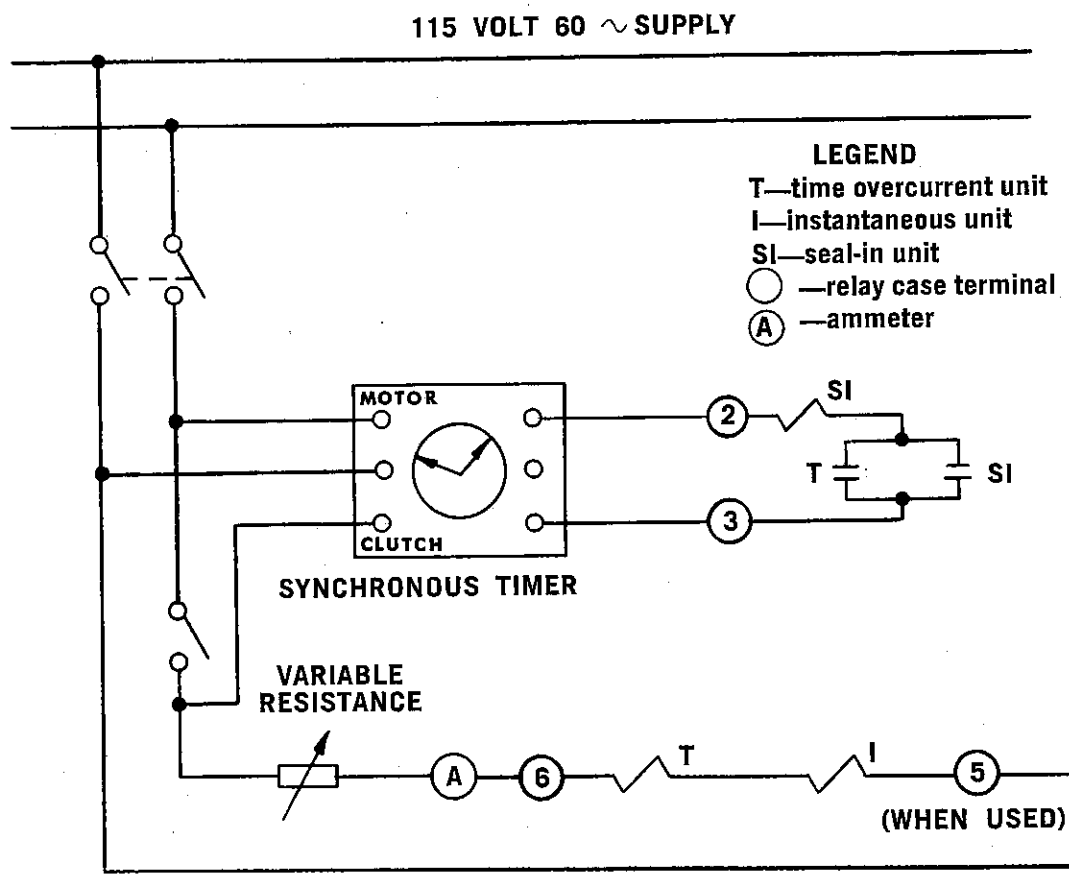


FIG. 15
Test Connections for Type CDG Relays

Relay Characteristics

Time Delay Unit Ratings - Amperes
Table 2

Coil Tap	Cont. Rating	Coil Tap	Cont. Rating	Coil Tap	Cont. Rating
4	17	1.5	6.8	0.5	2.4
5	19	2.0	8.2	0.6	2.6
6	20	2.5	9.3	0.8	3.0
7	22	3	11	1.0	3.3
8	23	4	12	1.2	3.8
10	24	5	13	1.5	4.0
12	26	6	14	2.0	4.8

Contact Ratings

The contacts are rated to make and carry for 0.5 seconds, but not interrupt, the current values given in the table at voltages not exceeding 250 volts.

Table 3

	CDG 11 CDG 13	CDG 14
Current - 0.5 sec	30 amp	15 amp

Target and Seal-in Unit

One contact, normally open and self reset, is provided. The current carrying rating is limited by the setting of the seal-in units as indicated in table 4. An auxiliary relay is required if the total tripping current exceeds the values given above. The seal-in contacts are not intended to interrupt the tripping current, therefore, the trip circuit must be opened by some other means such as an "a" auxiliary switch on the circuit breaker.

Table 4

Tap Rating	0.2 amp	2 amps
D-C Resistance	6.0 ohms	.13 ohms
Carry for Tripping Time	8.0 amps	30 amps
Minimum Operating Amps	0.2	2.0
Maximum Drop Out Amps	0.1	1.0

Instantaneous Unit

Instantaneous overcurrent protection is provided on type CDG relays by units in ranges of 4-16, 10-40 and 20-80 amperes. These units have self-operated targets and are mounted in the upper left hand corner of the relay. They operate in approximately 1 cycle or less above 2 times pickup current and in approximately ½ cycles above 5 times pickup.

Table 5

Calibration - Amps	* 1 Sec Rating Amps
4-8-12-16	340
10-20-30-40	700
20-40-60-80	1400
Continuous Rating-Amps	1.5 X Minimum Amp Setting

* The 1 sec rating of the time delay unit may be the limiting factor.

Relay Operating Characteristics
Table 6

	Relay Type Time Current Characteristics	CDG 11 Inverse	CDG 13 Very Inverse	CDG 14 Extremely Inverse
A	Percentage of tap plug setting required to close relay contacts from any multiplier setting.	100 to 105%	110 to 115%	120 to 125%
B	Percentage of tap plug setting required to initially start disk movement from 10 TDS.	95%	104 to 105%	104 to 105%
C	Percentage of tap plug setting at which disk will completely reset to #10 TDS.	90%	90%	90%
D	Maximum operating time deviation from published time curves. 2 to 4 x tap plug setting on all taps 4 to 20 x tap plug setting on all taps	 7% 7%	 12% * 7%	 12% * 7%
E	Resetting time to #10 TDS when relay is de-energized.	11 sec	50 sec	45 sec
F	Repeatable operating time accuracy.	1%	1%	1%
G	Contact break time with normal wipe Contact break time with no wipe	6 ∿ 2 ∿	6 ∿ 2 ∿	6 ∿ 2 ∿
H	Maximum overshoot at 20 x tap setting.	.04 sec	.05 sec	0.1 sec
I	Temperature effect on operation time 20° C to 60° C ambient 20° C to 0° C ambient	 −5% +5%	 −1.2% +1%	 −4.6% +3%

* Error is smaller above #1 time dial setting.

Time Delay Unit

The burdens given in table 7 are calculated at 5 amps based on the burden of the minimum tap which is the highest.

Table 7

Coil Amps	Tap	VA Burden at 5 Amps CDG 11	CDG 13	CDG 14
4-12	4	4.2	2.03	0.97
1.5-6	1.5	30.	12.2	4.9
0.5-2	0.5	280.	130.	45.

Instantaneous Unit

When an instantaneous unit is used (relay types CDG 11B, CDG 13B and CDG 14B), the additional burden must be added to those given in the table. In most cases, the burden is low and can be neglected. The va burden of the instantaneous units is 0.7 va at the minimum pickup point and 10 va at the maximum point. Table 8 gives va burdens at 5 amperes.

Table 8

Amp Range	VA Burden at 5 Amps
4-16	1.1
10-40	0.18
20-80	0.04

MAINTENANCE

MAINTENANCE

These relays are 100% checked for performance before being shipped and should not require any adjustments other than those normally required to place the unit in service. However, if the relay, for some reason, requires additional adjustment or maintenance, the following procedures and requirements can be used. Fig. 14 is provided for the convenience of locating the different adjustment parts on the relay.

Time Delay Unit

Disk and Shaft Assembly:

Rotor Endshake (1) - 1/64″ approximately

Control Spring — with the time dial set to its halfway position, the control spring should be approximately concentric. The outside turn should be shaped so that the radius gradually increases to correspond with the radius of the outer spring holders.

Bearings and Pivots:

The bottom bearing assembly (7) is secured by a spring clip which can be swung to the side to release the bottom jewel bearing for inspection. The jewel can be examined with a microscope for cracks or its overall surface can be felt with a fine needle. Both pivots can be removed if necessary, for examination.

Contact Adjustments:

The initial tension is factory adjusted for approximately 3 to 6 grams, measured at the contact tip. The adjusting screw (4) is the second one from the contact tip. The contact wipe to the backstop is set by the first adjusting screw (5) to the right of the contact tip and should be approximately 1/16″.

With the contacts just closing, the point of the largest radius (6) at the cutaway edge of the disc should be ⅝″ plus or minus 1/32″ at right angle to the front of the electromagnet for the CDG 11 and ⅜″ plus or minus 1/32″ for the CDG 13. The set screw on the moving contact assembly secures this adjustment.

Brake Magnet:

The locking screw (9) should be released and the adjusting screw set to the full in position and then backed out two turns. This is the nominal setting. The brake magnet should be set as close to the shaft as the screw will permit.

Calibration Tests:

(1) When the time dial is set on the zero position, the contacts should just be making. This position is factory calibrated and should not require correction if the stationary contact has been set correctly. Any other setting of the contacts requires recalibration of the time dial if the initial accuracy of the published time curves is to be retained.

(2) With the brake magnet removed, if necessary, the tap plug set on the lowest tap, and a time dial setting of 10, adjust the control spring (10) so that the minimum current required to move the disk away from the backstop is equal to the value given in Column B in Table 6. The closing current should then fall within the limits specified in Column A. This should be measured from approximately the 3 time dial position.

(3) Reassemble the brake magnet as close to the disk shaft as possible. Set the time dial at 10 and use the minimum tap. Using a current of 10 times the tap value set the operating time, from figures 6 to 8, correct by means of the adjusting screw (9) in the brake magnet. Time increases as the adjusting screw is backed out and vice versa. Lock the adjustment by the set screw provided.

The shape of the inverse time curves is determined by the combined settings of the spring and brake magnet. While the brake magnet affects the time curve from 2x to the maximum multiple of tap plug setting, the control spring setting has most effect from 3x down. Increasing the tension or windup will increase the operating time at the lower currents and tend to make the curves more inverse. Decreasing the tension will have the opposite effect. The closing current value should be rechecked to see if it is within the desired limits.

Target and Seal-in Unit

The armature gap, measured at the center of the core surface, should be approximately 0.060″.

The contact gap should be approximately 0.075″ and the force to just lift the contact arm clear of the 0.020″ thick support should be approximately 20 grams.

With d-c current applied the unit should operate between 90 and 100% of tap value.

The target should be free to drop when the contacts just touch.

Instantaneous Unit

The armature gap, measured at the center of the core surface should be approximately 0.060″ at the minimum relay setting.

The leaf spring initial tension should be set so the force required to just close the contacts is approximately 9 grams when applied at the moving contact tip.

The contact follow through (or wipe) should be about .020″.

The backstop spring should be set so that it rests against the backstop with little or no force.

All initial tension on the spring adjuster should be removed.

The target should be free to drop when the contacts just touch.

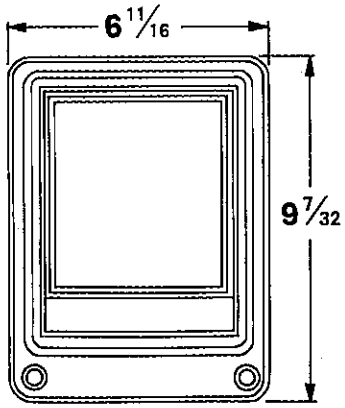
With 60 cycles a-c applied, the pickup should be within 10% of the calibrated scale.

Contact Cleaning

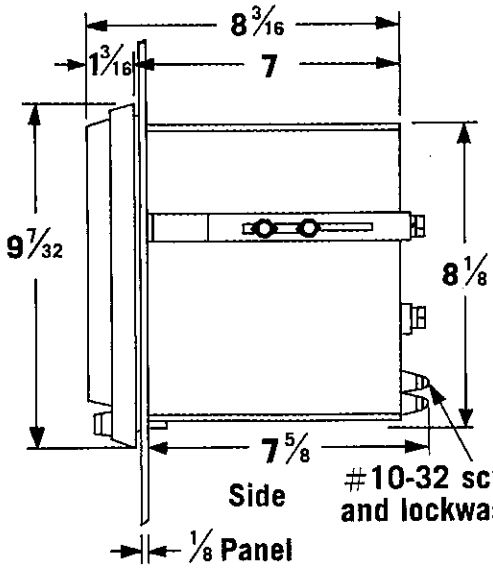
Silver contacts should be cleaned with a flexible contact burnishing tool. Any other means which may remove excess material or contaminate the contact surfaces should not be used. Such things as abrasive cloth or paper, files or knives should not be used. The knife edge or wedge shape of the contacts should not be altered.

RENEWAL PARTS

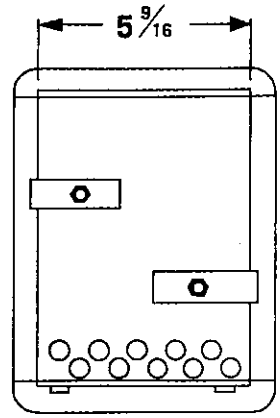
Parts recommended for stocking and considered necessary for maintenance of the type CDG relays are listed in the Parts List PL-5-050. These have been selected on the basis of being most subject to wear and damage under normal and abnormal conditions.



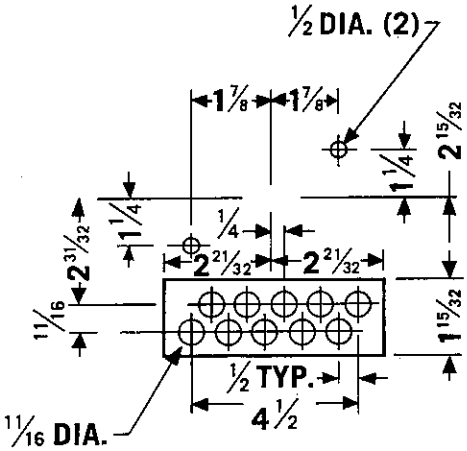
Front



Side

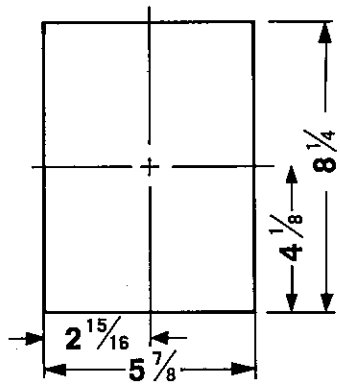


Rear

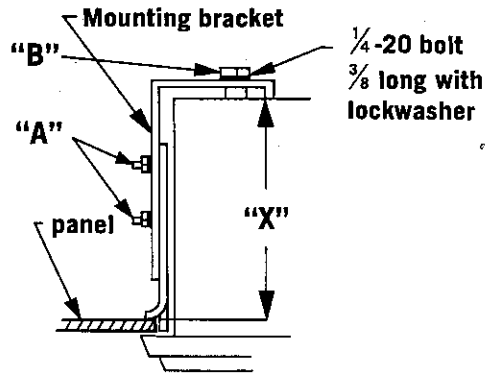


Projection Mounting

Drilling Plan
Front View

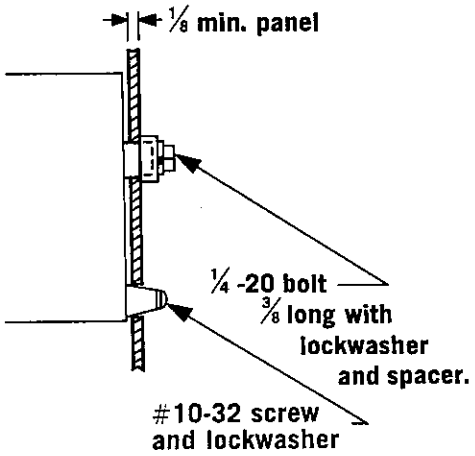


Flush Mounting cutout

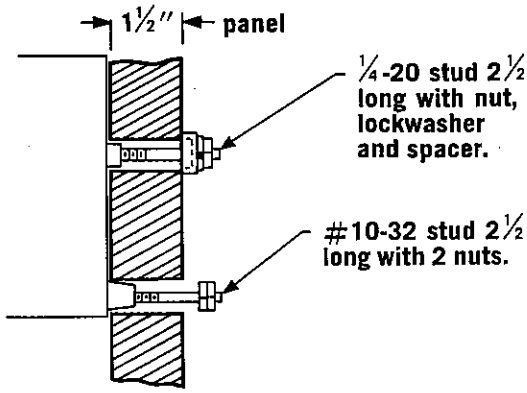


Adjust bracket length **X** to accommodate panel thickness. Secure nuts **A** and then tighten mounting bolts **B**.

Flush Mounting
Bracket position



1/8" Panel
Projection Mounting



1 1/2" Panel
Projection Mounting

FIG. 16
Outline, Panel Drilling & Mounting
Details of Size ID-10 Case

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JANUARY 1959

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