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Federal Pacific Electric Company

Relay Instructions

Multi-Shot Reclosing Relay

Type VAR42

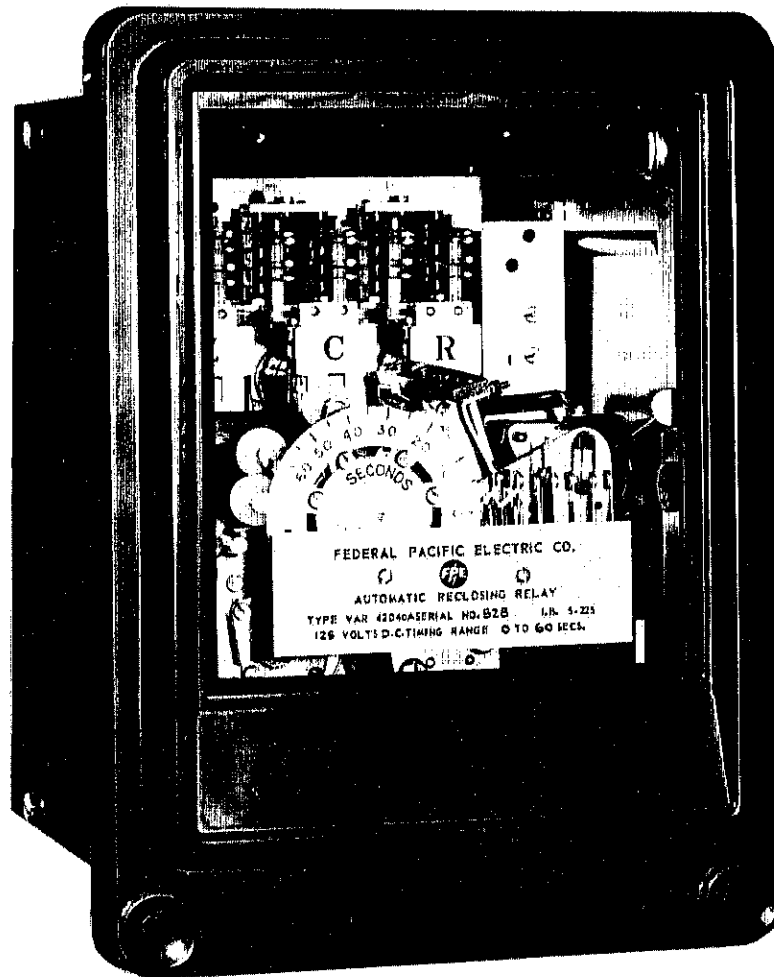


FIG. 1: TYPE VAR42 RELAY WITH CASE AND COVER - FRONT VIEW

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Relay Instructions do not necessarily include all details of applications 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 Co.

GENERAL INFORMATION

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 Co. Sales Office.

It is desirable to store relays in their cartons in a clean, dry area until required for use.

APPLICATION

The type VAR42 reclosing relay is a selective timing device which automatically controls the reclosing of a circuit breaker in the event it is tripped because of a fault on the protected line.

This multi-shot reclosing relay can be adjusted to give up to 4 automatic reclosures, the first of which can be immediate if desired.

If immediate first reclosure is used, it is advisable to provide a latch checking switch to insure that the mechanism is fully reset before the closing impulse is given. The other reclosures can be set at minimum intervals of 10 seconds totalling up to 60 seconds, each independently adjustable. When used in conjunction with time overcurrent relays having an instantaneous trip unit, the VAR42 can be arranged to cut out the instantaneous trip after the first reclosure until at least 10 seconds after a successful reclosure.

The relay can be arranged to reset after a successful reclosure without having to wait for the timing mechanism to complete its run. This feature can be cut out so that the relay makes a complete run before resetting, regardless of which reclosure is successful.

The VAR42 is a d.c. operated timer but relays are available for a.c. operation by use of selenium rectifiers internally mounted in the relay.

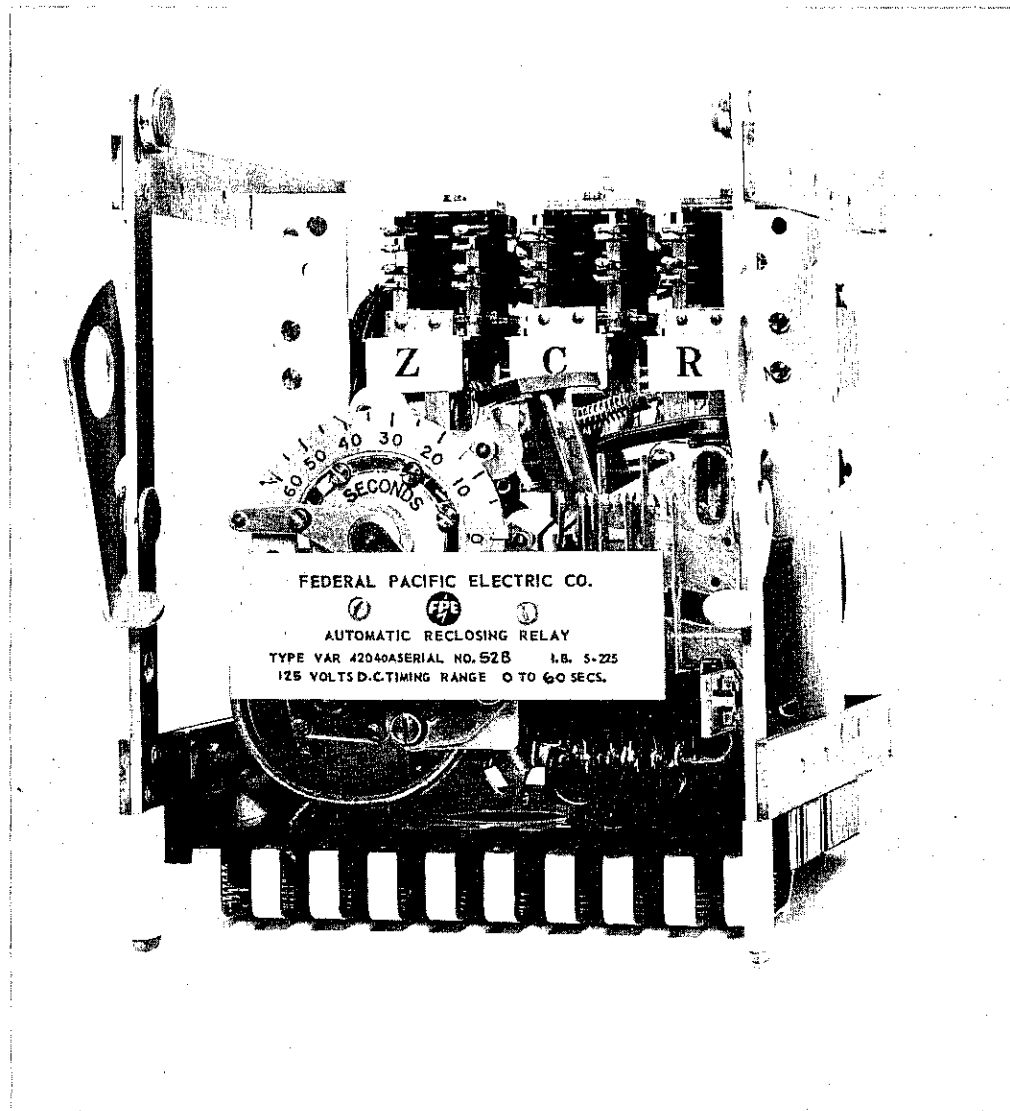


FIG. 2: TYPE VAR42 RELAY WITH CHASSIS WITHDRAWN FROM CASE – FRONT VIEW

DESCRIPTION

Figs. 1 to 4 illustrate the construction of a typical relay. Fig. 1 illustrates the complete relay, Figs. 2 to 4 show the relay chassis and parts assembly. An attracted armature electromagnet (unit T) whose coils are continuously rated, operates through a simple and reliable cam system to wind up a driving spring, through 180 degrees of rotation. The driving spring is mounted on the main shaft which carries a calibrated circular scale and 5 adjustable contact operating arms. As the charged spring rotates the main shaft, rollers on each of the arms close a pair of contacts. Four of the rollers A to D (see Fig. 7) operate one pair of contacts (T1) to provide a reclosing impulse with accumulated time up to a total of 60 seconds.

A minimum of 10 seconds can be set between reclosures. The first roller (A) can be set to close the timing contact (T1) initially providing immediate reclosing. Up to three rollers can be moved to an inoperative position so that the relay can be adjusted to give one, two, three or four reclosures.

The fifth roller (E) located close to the front of the relay, is used to initiate a lockout contact (T2) in the event all preset reclosing attempts were unsuccessful. All operating arms are adjustable on the front calibrated time dial by loosening the screws on the dial face which secure the individual roller lever arms.

In addition to the reclosing contact (T1) and lockout contact (T2), the timer (T) electromagnet operates three other pairs of contacts directly, T3, T4, T5; contact T3 is used to provide the instantaneous trip circuit cutout.

The time delay is regulated by a copper cup Fig. 3 which rotates in a permanent magnet field and is geared to the main shaft. The gearing is connected to the main shaft in the clockwise, or timing direction, but allows instantaneous resetting of the mechanism through a roller and ramp clutch assembly (Fig. 4) when the electromagnet is de-energized.

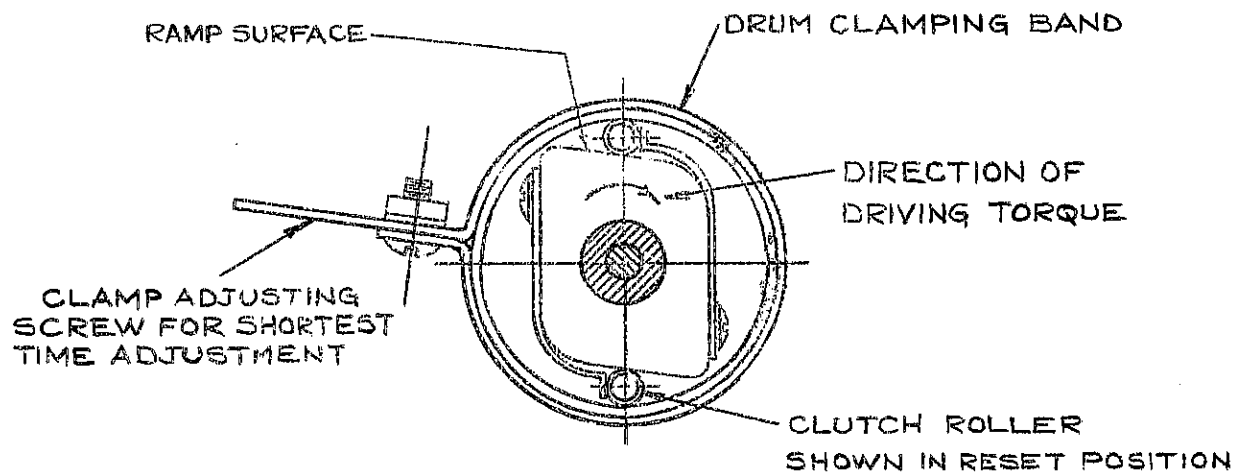


FIG-4 ROLLER AND RAMP CLUTCH

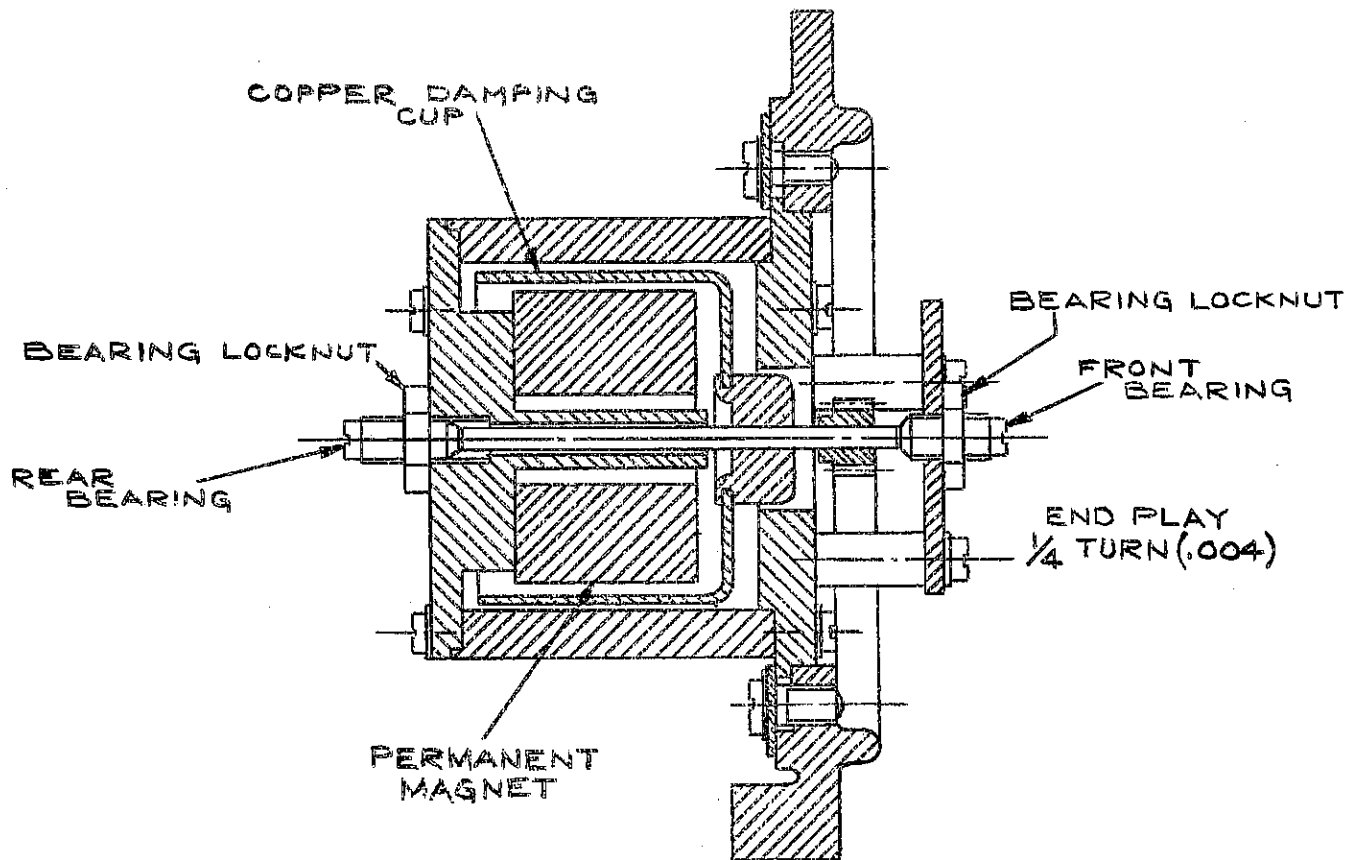


FIG-3 DAMPING MECHANISM

To facilitate selective anti pump, closing and resetting circuits in the complete scheme, 3 additional attracted armature units (Z, C, R) are provided. They are mounted at the top rear of the relay. Each unit has 4 contacts and the construction is similar to that of the target and seal in unit of the type CDG relay.

CASE AND COVER ASSEMBLY

The relay case and chassis assembly is designed to facilitate ease of testing and unit interchangeability. The case is of steel construction with top and bottom molded sections. The bottom mold assembly has 10 spring loaded contact fingers which are connected to the external studs provided for switchboard wiring. The relay units are mounted on a steel chassis which is removable from the case. Electrical connection from the relay units to the external relay terminal studs is made through spring loaded contact fingers on the bottom chassis mold. The internal relay wiring is connected to screw terminals on these contact fingers.

Since both contact fingers are substantially spring loaded, have a silver to silver connections and are self cleaning, a reliable connection between the case and chassis is provided.

To remove the relay chassis from the case, it is necessary to release the right and left hand latches by pulling them forward. Finger holes in the latches makes it convenient to pull out and retain the chassis in hand for inspection or transportation to a test bench.

The two rollers on top of the cradle assembly provided positive downward thrust insuring pressure wiping action between both sets of contact fingers.

The cover is of molded plastic material and contains a glass window and a neophrene gasket which gives a positive seal joint around the flange of the relay case. The cover cannot be replaced with the chassis in the case unless both latches are in the closed position. The cover is hinged at the top. A compression gasket fit and two cover knobs at the bottom provide a secure and tight cover seal.

PRINCIPLE OF OPERATION

The operation of the VAR42 is best explained by referring to a typical external connection diagram Fig. 5 and describing the contact operating sequence for some typical reclosing events. Refer to Fig. 7 for contact identification and location.

1. Assume breaker trips due to relay action

- 179 Z is energized through 101/1, 143A, 152b, 179C/1 and seals through 179Z/2 contact.
- 179 T is energized through 179Z/4 and 179R/3 and seals through 179T/4. The Instantaneous Trip Circuit is opened when 179T pick-ups and 179T/3 opens.
- 179 T/1 is set closed initially for immediate reclosure.
- 179 C is energized through 179T/1, 179Z/3, 179R/1 and seals around 179Z/3 through 179C/4.
- 152 X is energized through 101/1, 143A, 152b, 179C/2, 179Z/1, 152/LC, and 152Y/1 and seals through 152X/2 and 152Y/1.
- 152/CC is energized through 152X/1
- 152 Y is energized through 152aa when breaker operating mechanism is operated, seals in through 152Y/2 and cuts off 152X.
- 179 Z is deenergized when breaker closes and 152b opens.
- 179 C is deenergized when 179T/1 opens due to roller running off contacts.

2. Assume breaker remains closed after immediate reclosure

- 179 T remains energized through 101/1, 179T/4 and 179R/3.
- 179 T/1 closes a second time by roller B after an adjustable time delay, and if the 152/a contact shown partially dotted is connected to studs 5 and 6 then;
- 179 R is energized through 179T/1, 179T/5, 179C/3 and 152/a and seals through 179T/4 and 179R/2.
- 179 T is deenergized by opening of 179R/3 and 179R is de-energized by 179 T. If the dotted 152/a connection is not used, the succeeding
4
closures of 179T/1 by rollers B, C and D cannot pick-up 179C, since 179Z is deenergized and then;
- 179 R is energized through 179T/2, by roller E the final contact of the timer, and reset occurs as above.

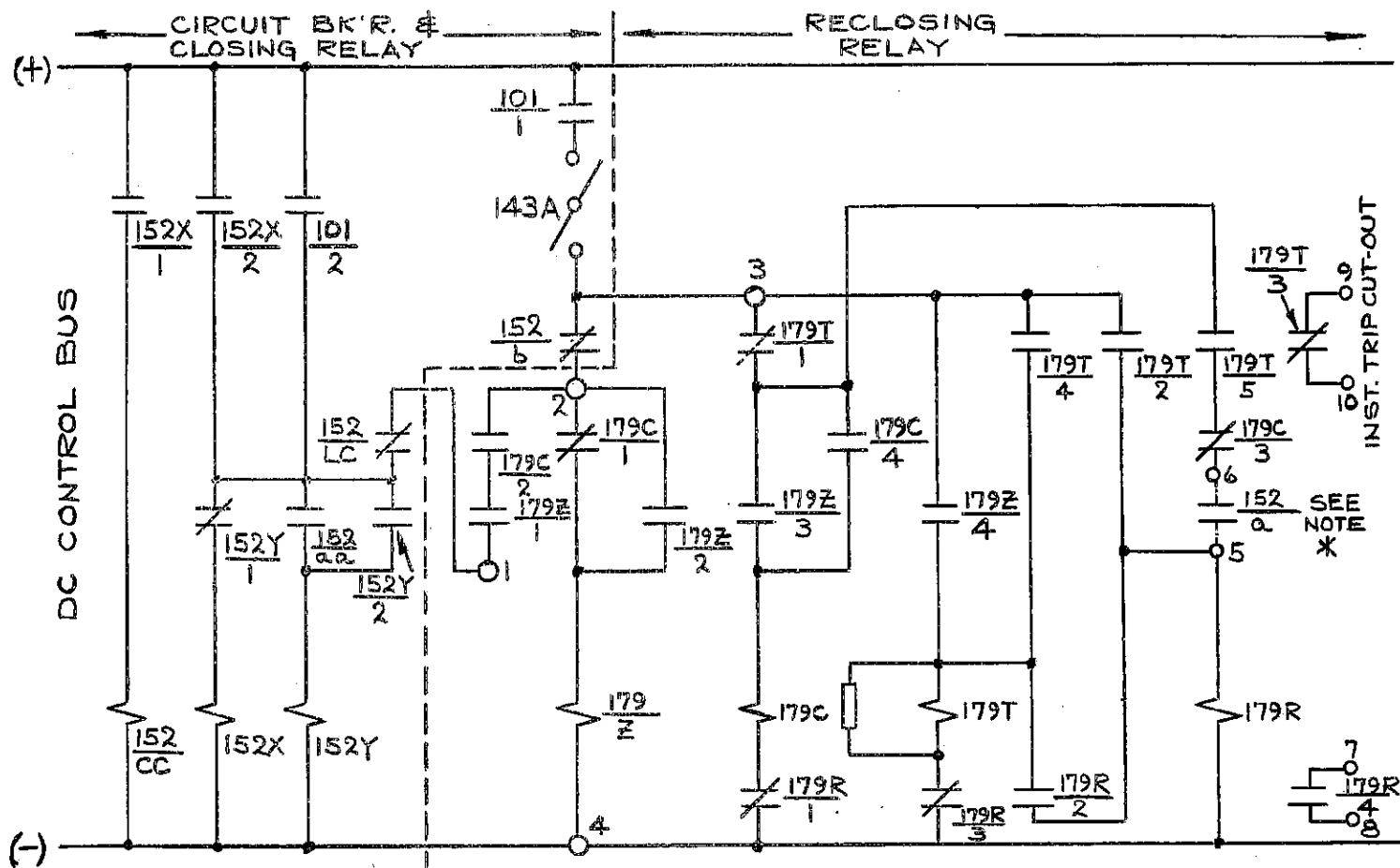


FIG-5
TYPICAL EXTERNAL CONNECTIONS OF TYPE VAR42-DC CONTROL

LEGEND

101 - CONTROL SWITCH
 101/1 - CLOSED AFTER "CLOSE"
 101/2 - OPEN AFTER "CLOSE"
 143A - RECLOSER CUT-OUT SWITCH
 152 - PWR. CIRCUIT BREAKER
 152/a { SWITCH CLOSED WHEN CIRCUIT
 BREAKER IS CLOSED
 152/a. { SWITCH CLOSED WHEN C.B. CLOSING
 MECHANISM IS IN OPER. POSITION.
 152/b { SWITCH CLOSED WHEN C.B. IS OPEN
 152/CC { CIRCUIT BK'R. CLOSING COIL
 152/LC { SWITCH CLOSED WHEN C.B. OPER.
 MECH. IS RESET & LATCHED
 152X - CLOSING RELAY
 152Y - CLOSING RELAY AUX.
 179 - AUTOMATIC RECLOSING RELAY
 179C - CLOSING UNIT

179R - RESETTING UNIT
 179T - TIMING UNIT
 179Z - ANTI-PUMP UNIT
 179T/3 179T/4 179T/5 - CONTACTS OPER. IMMEDIATELY
 179T/1 { CONTACT CLOSING AT PRESET INTER-
 VALS & CAN BE SET INITIALLY CLOSED
 FOR INSTANTANEOUS RECLOSE
 179T/2 { CONTACT CLOSING LAST & CAUSES
 LOCKOUT OR RESET
 179T/3 { CONTACT TO CUT-OUT INSTANTANEOUS
 TRIP CIRCUIT
 O - RELAY TERMINALS

* NOTE: RETAIN DOTTED CONNECTION IF RESETTING IS DESIRED BY NEXT CLOSURE OF 179T/1 FOLLOWING A SUCCESSFUL RECLOSURE. REMOVE IF 179T/2 ONLY SHOULD CAUSE RESET.

3. Assume breaker trips after immediate reclosure

If the breaker trips before 179T/1 contact opens, 179C remains energized through 179T/1, 179C/4 and 179R/1.

- 179 Z cannot be energized through 101/1 and 152b and 179C/1 since 179C/1 is open.
- 152 X cannot therefore be energized through 179Z/1 and only one reclosure can occur while 179T/1 is closed.
- 179 C is deenergized when 179T/1 opens due to the roller running off the contact.
- 179 Z is energized through 101/1, 152b, and 179C/1 and seals in.
- 179 C is energized when 179T/1 closes again.
- 152 X is energized when 179C/2 closes and the breaker is reclosed.

4. Assume the breaker remains closed after time delayed reclosure

Reset occurs as in 2, either through the 152/a contact when the next roller closes T1 or through 179T/2 when operated by roller E.

5. Assume breaker trips after time delayed reclosure

Reclosure occurs as in 3 until last closure of 179T/1 is unsuccessful.

- 179 C is deenergized when last closure of contact 179T/1 opens due to roller running off contact.
- 179 Z is energized through 152b and 179C/1 and seals through 179Z/2.
- 179 R is energized when 179T/2 closes and seals through 179Z/4 and 179R/2.
- 179 T is deenergized when 179R/3 opens.
- 179 C and 179T cannot be energized because 179R is sealed in.
- 179 Z and 179R will reset when 101/1 is opened to place control switch in agreement with breaker position.

INSTALLATION

INSPECTION

All relays should be examined as soon as possible for any damage sustained in transit. Any apparent damage should be reported to the transportation agency and the nearest F.P.E. Sales Office should be notified.

All packaging pieces if any should be removed. Each relay unit should be given mechanical inspection to see that moving parts operate freely.

The hinged armature unit should be operated mechanically charging the main spring. The roller assembly should rotate freely with each roller operating the contacts to the closed position. The roller assembly should reset completely upon sudden release of the armature.

MOUNTING

Protective relays should preferably be mounted where they are not subject to dirt, moisture, shock or excessive heat or vibrations. 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. 9 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 1/4" - 20 stud "B" and its lock washer 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 1/4" - 20 stud, special spacer and washer as shown in Fig. 9. Extension mounting studs are provided for panel thicknesses up to 1 1/2 inch.

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

CONNECTIONS

Internal Connections - Fig. 6

External Connections - Fig. 5

If resetting of the recloser is not desired when contact 179T/1 makes again after a successful reclosure, the 152/a contact connected between terminals 5 and 6 should be omitted. Then the outside roller which operates contact 179T/2, will initiate resetting of the recloser.

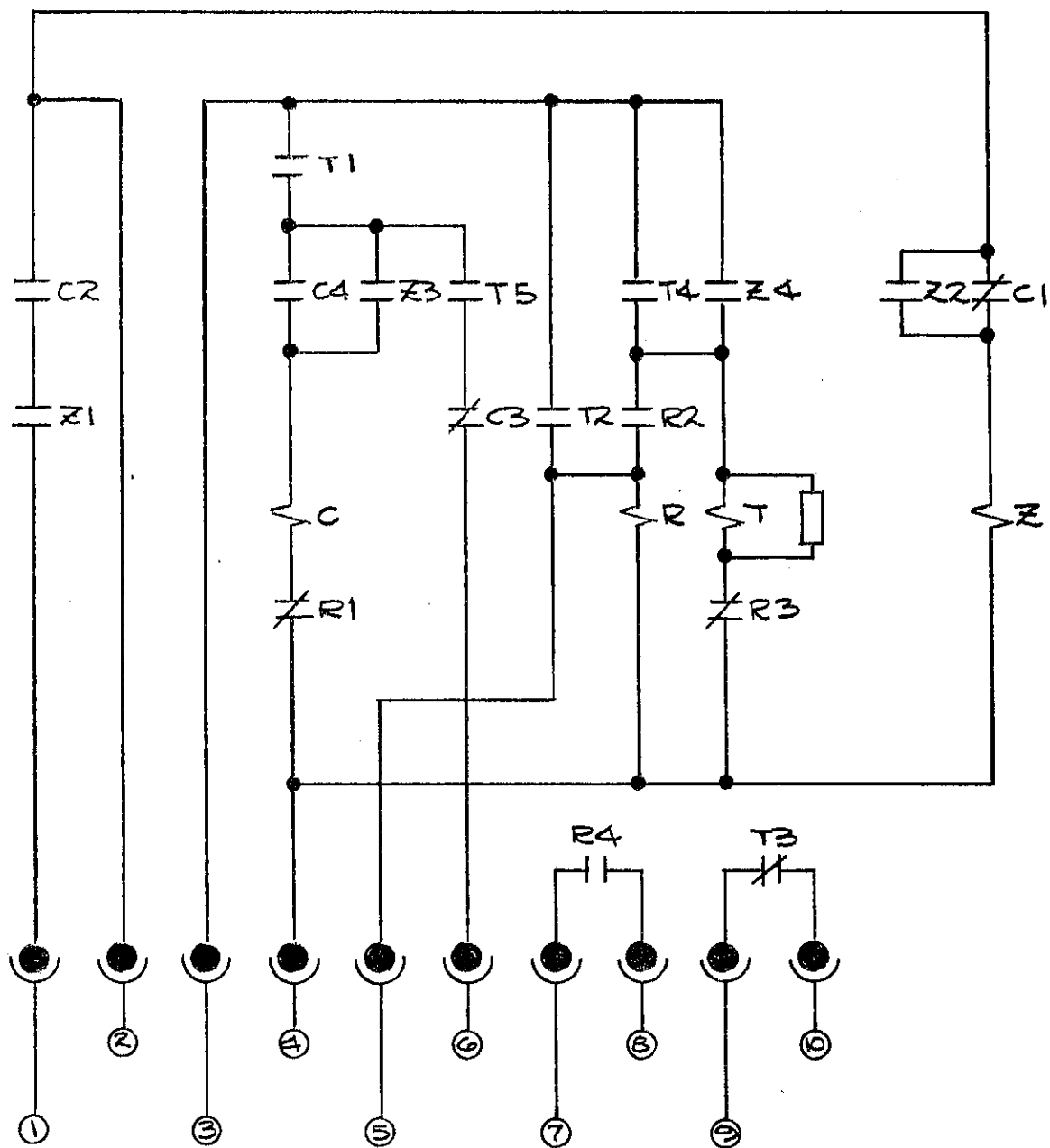
Instantaneous Tripping can be cutout before the reclosure by using contacts 179T/3 to open up the trip circuit.

NORMAL FIELD ADJUSTMENT

The only adjustments required when the relay is initially being put in service are the settings of the roller lever positions.

Timing: A good check on the timing intervals can be obtained with a minimum of equipment by using the solid line test connections Fig. 8 and a stop watch. Close S2, and then S1 and measure the closing interval to the instant unit C picks up. A d.c. indicating light can be used to show completion of the closing circuit through terminals 1 and 2.

If more accurate timing is required, a fast d.c. auxiliary relay can be connected in place of the indicating light, and its contacts used to operate a standard a.c. timer. The auxiliary relay time can be discounted since it is negligible.



FRONT VIEW

0 = RELAY CASE
 ● = RELAY UNIT
 C = CLOSING UNIT

R = RESET UNIT
 T = TIMING UNIT
 Z = ANTI-PUMP UNIT

FIG-6

INTERNAL CONNECTIONS OF TYPE VAR42 RELAY

Setting Reclosing Times: The timing contact T/1 is operated in succession by the 4 independently adjustable operating roller A B C and D and is used to initiate the reclosures. All the rollers are adjustable in relation to a time scale marked 0-60 seconds. The time indicated by the pointer on each roller is the time after the original opening of the breaker. For an immediate first reclosure the pointer is set on zero and contact T/1 will then be pre-closed by roller A, setting up the closing circuit.

Setting Recloser Reset and Lockout Times: The front timed contact T/2 is used to reset the relay if the last reclosure was successful, or to lock out if not.

The roller E can be secured to any of the rear contact-operating rollers and controls the number of attempted reclosures, e.g, if only two reclosures are desired, roller D is secured to the second reclosing roller. It is timed to operate 10 seconds after the last reclosure to allow time for the inverse time protection relay to operate if the fault is still persisting.

If 152/a contacts are connected between relay terminal studs 5 and 6, as shown in Fig. 5, resetting after a successful reclosure is accomplished by the next successive roller B, C or D. In this way resetting time can be reduced to 10 seconds after any successful reclosure.

For a complete check on operating sequence, refer to "Electrical Operations" check under Maintenance.

RELAY CHARACTERISTICS

RATINGS

Coils: The standard voltage ratings available are 48V, 125V and 250V D.C., 115V and 230V A.C.

Contacts: The timing contacts are rated to make, break or carry continuously 1250 VA A.C. with limits of 5 amps and 250 volts.

RELAY CHARACTERISTICS (Cont.)

On D.C. they are rated to make and carry continuously 1250 watts and break 100 watts non inductive or 50 watts inductive load with similar limits. They will also make and carry 30 amps A.C. or D.C. for 3 seconds.

BURDENS

D.C. - 19 watts on operation, 6 watts on lockout.

A.C. - 35 volt amps on operation, 7 VA on lockout.

TIMING

- (1) First reclosure can be set from 0 to a time depending on subsequent settings.
- (2) Subsequent reclosures cannot be set to less than 10 seconds after preceding one.
- (3) Total time available, to be divided between number of reclosures chosen (1, 2, 3, or 4) is 60 seconds.
- (4) With relays set to operate at specific times at 100% of rated voltage, the time deviation will be less than 10% at 70% and 120% of rated voltage.

MAINTENANCE

It is recommended that the relay be inspected and tested periodically. The relay as received from the factory has been tested, and no major adjustments should be necessary. However, if for some reason, the relay requires overhauling the following procedures will be helpful in restoring the relay to its proper operating condition. Identifying numbers refer to call outs in Fig. 7.

MECHANICAL INSPECTION OF MECHANISM

- (a) Check damping cup end play which should be approximately .004" (1/4 turn).
- (b) Examine gear teeth for particles of dirt that may cause clogging.
- (c) Check that clutch mechanism allows freedom for resetting and that clutch clamp (1) is secure.

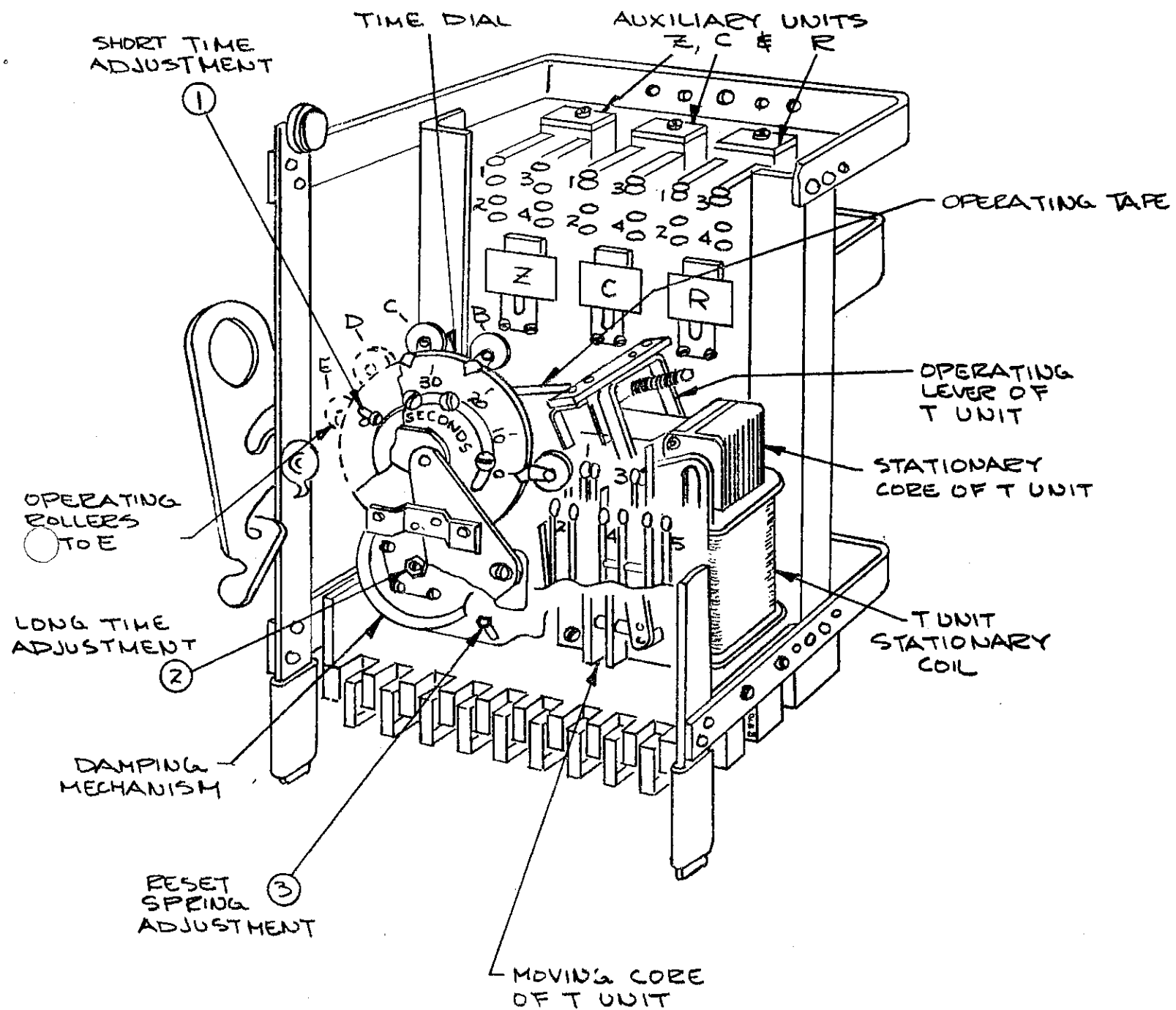


FIG-7

TYPE VAR42 - LOCATION OF ADJUSTMENTS, CONTACTS AND ASSEMBLYS

MAINTENANCE (Cont.)

- (d) Check for freedom of the moving core (4) of the electromagnet by manually operating the operating lever.
- (e) Examine operating tapes for wrinkles and kinks.

CONTACTS

Contact surfaces should be cleaned periodically. When required, a burnishing tool should be used. On no account should they be cleaned with knives, files or emery paper since these may leave scratches which cause arcing or particles of emery dust which may prevent the contact from closing.

The contact for all units should seldom require adjustment and it is advisable not to alter the factory adjustments unless they have for some reason been disturbed. The following can be used as a guide to restoring proper contact action. Refer to Fig. 7 for identification and contact location. The tensions, gaps and wipes are measured at the contact tips. The contact tension is the force required to just close or open the N.O. or N.C. contact pair.

<u>Unit Contact</u>	<u>Contact Gap</u>	<u>Contact Wipe</u>	<u>Moving Contact Initial Tension</u>
Z/1 to Z/4	.070" to .080"	.015" to .020"	10 - 15 grams.
C/1 to C/4	.070" to .080"	.015" to .020"	10 - 15 grams.
R/1 to R/4	.070" to .080"	.015" to .020"	10 - 15 grams.
T/1	.070" to .080"	.015" to .020"	5 - 8 grams.
T/2	.070" to .080"	.015" to .020"	5 - 8 grams.
T/3	.11" to .120"	.015" to .020"	15 - 20 grams.
T/4	.070" to .080"	.030" to .040"	20 - 25 grams.
T/5	.070" to .080"	.030" to .040"	20 - 25 grams.

ELECTRICAL OPERATION CHECK

Connect the relay as shown in Fig. 8 using the solid connection only and connect to rated voltage. The following sequence of operation assumes that the relay is set for immediate reclosing.

- (1) Close S2 and close S1 momentarily for about 2 seconds, simulating a 152b contact closure. Unit Z, C and T pickup. Z drops out when S1 is opened. C seals in through C/4 and drops out when T/1 opens because of the passing roller A. T stays picked up and the roller mechanism continues to time till roller E operates contact T/2. R picks up and resets T causing R to dropout.
- (2) To check the resetting circuit through terminals 5 and 6, close S2 (simulating a 152/A contact) after roller A passes contact T1. R should then pickup when roller B closes T1 and should reset T causing R to dropout..
- (3) To check the lockout circuit, close S1 after the last reclosing attempt, simulating the tripped breaker 152b contact position. When roller E closes T/2, R will pickup, Z will be picked up and T will reset. Resetting of Z and R will occur when S2 is opened.

All of the units should operate at 60% of rated D.C. voltage or less. The pickup of the T unit is fixed by the gap of the unit T (attracted armature design) and the adjustment of the resetting spring located at (3) in Fig. 9

TIMING ADJUSTMENTS

Make test connections as shown in Fig. 8.

The main calibration settings are obtained by two adjustments. Refer to Fig. 7 for the location of adjustment parts.

- (1) Position the operating roller A on the 10 second setting and check the timing. If necessary loosen the clamp (1) around the drum of the roller and ramp clutch and adjust the calibrated disk counter clockwise to increase the time or clockwise to decrease the time. Retighten the clamp and recheck the time.
- (2) Set the last operating roller on the 60 second setting and check timing.

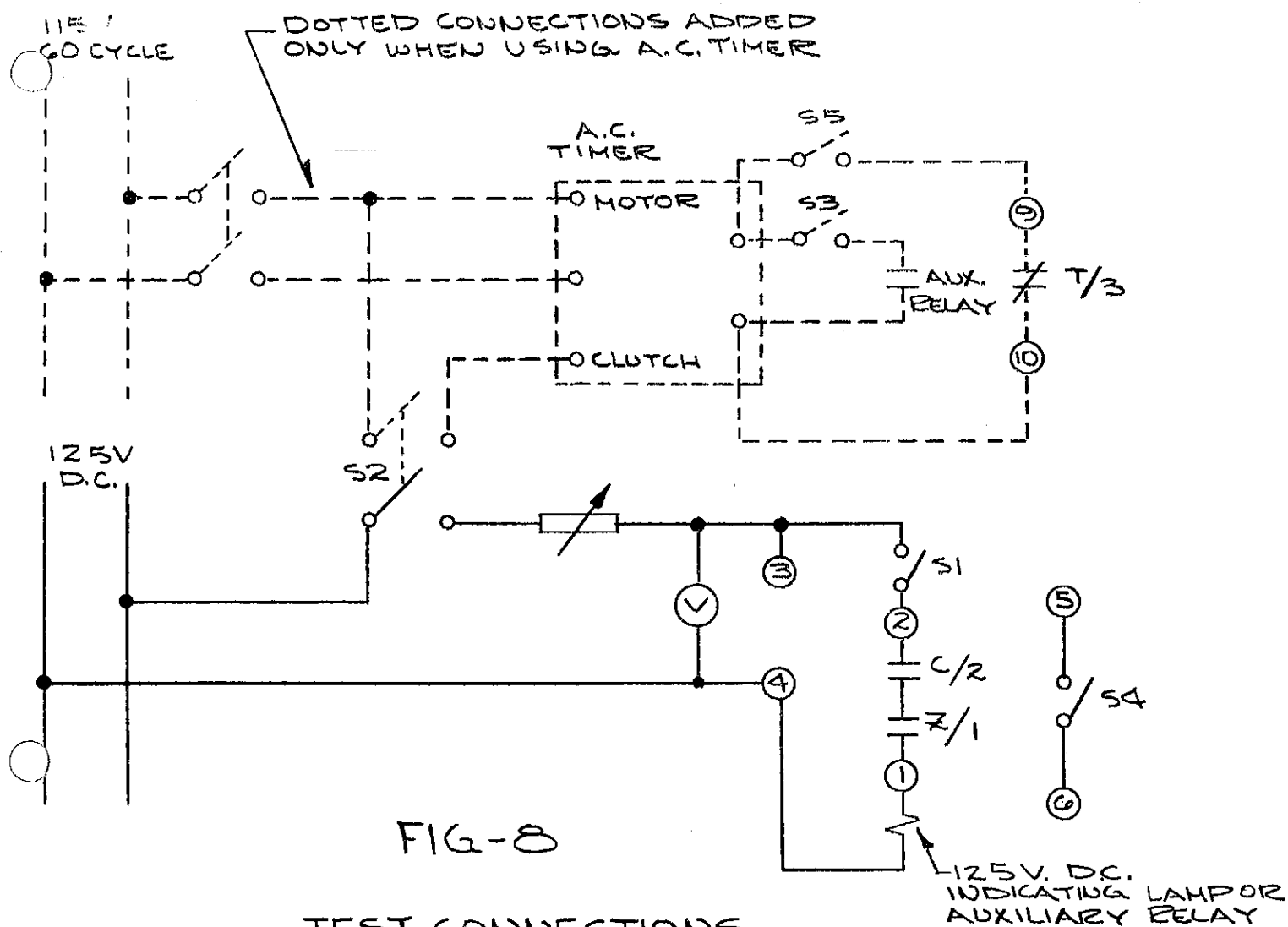


FIG-8

TEST CONNECTIONS D.C. BATED TYPE VAR42 RELAY

USING STOP WATCH:

CLOSE S2; CLOSE S1; TIME UNTIL UNIT C PICKS UP OR IND. LAMP LIGHTS UP AT DESIRED SETTING OR WHEN UNIT T DROPS OUT

USING A.C. TIMER:

CLOSE S1; CLOSE S2 TO START TIMER.

TIME-A, B, C, D - CLOSE S3 JUST BEFORE DESIRED TIME SETTING IS REACHED.

TIME-E - CLOSE S5 JUST BEFORE RESET IS REACHED

RELAY CAN BE RESET BETWEEN INTERVALS B, C OR D BY CLOSING S4

① ETC = TYPE VAR42 RELAY CASE CONNECTIONS

MAINTENANCE (Cont.)

If necessary this time can be set by the axial movement of the damping cup bearings (2). Screwing the front bearing in and rear bearing out increases the time. Before making adjustments the front and rear locknut should be loosened. The end play should be approximately .004" which is equivalent to 1/4 turn at the bearing screw from the zero play position. Refer to Fig. 3 for cross-sectional view of damping mechanism. Care must be taken to move the front and rear bearings sequentially in small amounts to avoid disengaging the bearing pins from the bearing. One turn of the screw is a safe amount.

RENEWAL PARTS

Parts recommended for stocking and considered necessary for the maintenance of the type VAR42 relays are listed in the Parts List 5-225. These have been selected on the basis of being the most subject to wear and damage under normal and abnormal conditions.