

# INSTALLATION • OPERATION • MAINTENANCE I N S T R U C T I O N S

## TYPE RCD AUTOMATIC RECLOSING RELAY

**CAUTION:** Before putting protection relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Operate the relay to check the settings and electrical connections.

### APPLICATION

The type RCD relay initiates breaker reclosing following protective relay tripping. It is suitable for use in any a-c or d-c close circuit provided the breaker itself has adequate anti-pump protection.

### CONSTRUCTION

There are four components essential to the operation of the RCD reclosing relay as follows:

Reclosing timer, reset timer, an SX auxiliary relay, and an SG auxiliary relay.

In addition to these four there is also an operation indicator, two voltage dropping resistors, and several limit and transfer switches whose function will be explained in subsequent paragraphs.

#### 1. Reclosing timer

This timer is connected to run forward while the circuit breaker is open, to remain stationary while the breaker is closed and reset timer is running, and to reset to its starting position when the reset timer times out. The timing drum is driven by a synchronous motor, making a complete revolution in approximately four minutes. The motor is coupled to the drum, through a clutch assembly which is normally engaged. An electromagnetic clutch release unit permits spring return of the drum to its starting position. The reclosing timer controls four contacts. The first, the number 13 closing contact is a roller actuated snap action switch which is mounted directly below the reclosing drum on the front

of the relay. It is operated by cams spaced at desired intervals about the periphery of the reclosing drum. The other three contacts of the reclosing timer are operated by two cam screws located in the rear section of the disc assembly. At the start and timed-out positions of the drum's travel one or the other of two lever arms on the snap action switches is operated. Off normal contact No. 14 operates whenever the disc leaves its starting position; and lockout contacts 11 and 12 transfer whenever the drum completes the full revolution. However, the lockout cam can be adjusted for any time up to four minutes.

#### 2. Reset Timer

This timer is connected to run forward after the circuit breaker has closed, to reset to its starting position if the circuit breaker opens while it is running, to provide a signal for the resetting of the entire reclosing relay in preparation for a new cycle, when the breaker remains closed for the preset interval. The reset timer has the same arrangement of synchronous motor, clutch, release magnet, and reset spring, as described in the previous paragraph. However, the disc assembly is different in that there is one section. The time for complete revolution of the reset drum is one minute.

#### 3. SX Auxiliary Relay

The SX unit is a toggle action relay and controls contacts W1, W2, W3 and W4. The SX unit is referred to as the W unit on the internal schematic. The SX relay possesses memory action in that contacts W1 and W3 remain closed until the operating coil of the toggle unit is energized. Contacts W2 and W4 remain closed until the reset coil of the toggle unit is energized.

The function of the toggle unit when used in the a-c control scheme as shown in Fig. 3 is to provide by way of contacts W1 and W2, means to control the breaker 52X and 52Y coils. In

In addition to this, the W2 contacts also set up through the No. 16 contact a circuit by which the reset coil of the toggle unit will be energized. The W1 contact, through the transfer contacts 17 and 18, sets up the reset cycle by which the reclosing and reset motors are brought back to their initial position. The W3 contact of the toggle unit is used to lockout the instantaneous trip.

When used in the d-c control scheme shown in Fig. 3 the function of the toggle unit is essentially the same except that the W4 contact is now used in series with the 13 contact to control the 52X and 52Y functions.

#### 4. SG Auxiliary Relay

The SG auxiliary relay is controlled by the operation of the 52b switch, and is provided with a normally open and a normally closed contact designated as Z10 and Z9 respectively. Upon closing Z10 the reclosing motor is energized through the No. 11 reclosing motor contact. Upon opening the 52b switch, contact Z9 closes and Z10 opens, setting up through the preclosed W2 contact the circuit permitting the reset motor to initiate its cycle and thereby reset the reclosing motor and the reset motor.

#### Operation Indicator

The operation indicator is controlled by the number 12 contact which is a transfer contact located beneath and to the left of the reclosing motor. As the reclosing motor has timed out and approaches the lockout position, a preset cam screw in the rear disc assembly actuates the lever arm of the enclosed snap action switch. Upon closing of the No. 12 contact the operation indicator is energized and power to the reclosing motor is cut off. The target of the operation indicator drops and remains in that position until manually reset. The coil of the operation indicator is continuously rated.

#### Voltage Dropping Resistors

Two fixed tap resistors are provided at the back of the relay in order to give as much flexibility with regard to voltage ratings encountered on various types of systems. Their full resistance is 600 ohms and they are provided with a tap resistance of 175 ohms.

## OPERATION

Referring to Fig. 3, the a-c control circuit, a typical operating cycle would be as follows. When a line fault occurs, the instantaneous tripping relays close their contact 50 energizing the breaker trip coil 52 T.C. through a circuit from the positive bus through the preclosed W3 contacts, through the protective relay contacts 50, through the breaker contact 52a energizing the 52 T.C. trip coil of the breaker back to the negative side of the bus. The 52b breaker contact closes, energizing the W operate coil, and Z coil, through the 101 switch back to the other side of the a-c bus. Energizing the W operating coil causes contacts W1 and W2 to transfer as well as contacts W3 and W4. Opening W3 opens the trip circuit, closing W2 energizes the 52X and 52Y contactor coils through the #13 contact.

Should the breaker go in on instantaneous initial reclosure the 52b contact will open, the W (operate) and Z coils will be de-energized, therefore, the W2 contact will be closed and the Z9 contact will be closed completing the circuit for the reset motor. The reset motor will begin to time out and as it leaves its initial position contact 17 opens and contact 18 closes setting up the circuit for the reset clutch. As the reset motor times out, the reset cam, which is preset at the factory for a 10 second delay, trips the lever of the left hand switch causing contact #16 to close, thereby completing the circuit through W2 contact through the 16 contact through the reset coil of the SX unit. Energizing the reset coil of the SX unit causes its armature to toggle over, which closes W1 and W3 contacts and opens W2 and W4 contacts. In closing the W3 contact the instantaneous trip circuit is again set up. In closing the W1 and opening the W2 contact, the reset motor is de-energized and the reset clutch is energized, through the closed W1 contact through the closed #18 contact and through the reset clutch coil. Because of the speed with which the reset cycle takes place the reclosing motor never begins its cycle, even though there is a circuit through the W1 contact and the number 18 contact through the reclosing motor coil. Energizing the reset clutch causes the spring return of the reset drum to its starting position. As the drum resets itself contact #16 opens de-energizing the reset coil of the SX unit, and upon resetting, the lever of the right hand switch is closed by the first cam on the reset drum causing the #17 contact to close and the #18 contact to

open. Opening the #18 contact de-energizes the reset clutch and reclosing motor. The relay is once again in a position to perform the instantaneous initial reclosing function. Should the breaker fail to go in on instantaneous initial reclosure the following sequence of events takes place:

The breaker is open, therefore, the 52b switch is closed, the W operate coil and the Z coil are both energized, therefore, W2 is closed W1 is opened, W4 is closed and W3 is open. Z10 is closed, setting up the circuit through Z10 through the closed contact #11, through the reclosing motor and reset clutch coils, as the reclosing motor starts to rotate, the first cam in the rear section of the drum releases the right hand snap action switch lever, thereby, closing the #14 contact. However, the reclosing clutch does not get energized at this time since the W1 contact is open. As the instantaneous reclosing cam moves off the roller of the large snap action switch, the #13 contact is opened. Opening the #13 contact disconnects the 52X and 52Y coils from the circuit. The reclosing motor continues to rotate until the 10 second cam actuates the roller lever of the snap action switch and causes the #13 contact to close, thereby, energizing the 52X and the 52Y coils. Assuming that the breaker does not go in on the first or second reclosure the reclosing motor continues to rotate and as the third reclosing cam actuates the #13 contact let us assume that the breaker goes in at this point. Should the breaker successfully reclose, the 52b contact opens and the W operating coil of the toggle unit is de-energized as well as the Z coil. Contact Z10 opens thereby de-energizing the reclosing motor and contacts W1 and W2 remain in their former position because of the "memory action" of the SX unit, that is, W2 is closed and W1 is open. De-energizing the Z unit also causes Z9 to close, thereby, energizing the reset motor through a circuit from one side of the a-c bus through terminal #10 through contact W2 and Z9 through the reset motor coil to terminal 9 of the relay and back to the other side of the a-c bus. The reset motor begins to time out and as it does, contact #18 closes and #17 opens. Thereby, setting up the reset clutch circuit. As the 10 second cam of the reset motor actuates the left hand snap action switch the #16 contact closes energizing the reset coil of the SX unit toggles the armature over, thereby, opening the W2 contact and closing the W1 contact, the W3 contact is closed and the W4 contact is also open. Opening the W2 contact de-energizes the reset motor as well as the 52X and 52Y coils. Closing the W1 contact causes the

reset clutch to be energized through the closed contact #18, this results in resetting the reset drum causing the #16 contact to open which de-energizes the reset coil of the toggle unit, and causes the transfer contact #17 to close and #18 to open. Opening the #18 contact de-energizes the reset clutch, closing the #17 contact results in energizing the reclosing clutch through the pre-closed #14, #17 and W1 contacts and back to the source. Energizing the reclosing clutch results in resetting the reclosing drum, by means of the spring return mechanism, back to its initial position. As the reclosing drum resets itself, the screw cam in the rear section of the drum causes the right hand snap action switch lever to depress, which in turn opens the #14 contact and de-energizes the reclosing clutch. The relay is now totally reset and ready for another sequence of operation.

Had the breaker not gone in after the third reclosure the reclosing motor drum would have continued to rotate until the lockout cam, located in the rear section of the drum, tripped the lever of the left hand snap action switch directly beneath the drum. Tripping this switch results in transferring the #11 and #12 contacts so that, the #12 contact is closed energizing the operation indicator from one side of the a-c bus through terminal 10 through Z10 through the #12 contact and the operation indicator coil through the #9 coil of the relay back to the other side of the a-c bus. Energizing the operation indicator causes the target to drop and remain in this position until manually reset. The opening of the #11 contact interrupts the power to the reclosing motor causing it to stop at the lockout position.

After the breaker has been manually reset the 52b contact opens and the automatic resetting of the relay takes place as described in the previous paragraph. The target of the operation indicator is then reset manually and the relay is again ready for another sequence of operation.

It should be noted that manual reclosure after lockout does not reset the relay unless the breaker remains closed for the required reset interval as determined by the setting of the reset cam. Thus, if the breaker trips immediately on a trial reclosure, the relay remains locked out and does not set up a whole new sequence of reclosures. However, any travel that the reset timer may make under these circumstances is not reset when the breaker opens, because the open lockout contact #11 interrupts the circuit to the reset timer clutch release coil, as

well as to the reclosing timer motor. Consequently, a series of unsuccessful manual reclosures may eventually result in timing out the reset timer by steps, a little on each operation, causing the start of a new sequence.

## CHARACTERISTICS

The standard ratings of the type RCD reclosing relay are as follows:

Motor .....	120 volts 60 cycles
Z and W elements (SG	120 volts 60 cycles
and SX Auxiliary Relays).....	or 48/125 volts d-c

Provision has been made through the use of two fixed tap resistors to attempt to provide the user with as much flexibility as possible with regard to the various types of control voltage available. If it is desired to use the relay on the control voltage of 120 volts 60 cycles it is only necessary to move the left hand lead of each resistor over to the right so that there is a common connection between the leads going to each resistor. Looking at the rear view of the relay the three terminals of each resistor are referred to as terminal 1, 2 and 3 reading from right to left, therefore, for a control voltage of 120 volts 60 cycles, the movable or left hand lead on each resistor would be in position 1. When placed in position 2 the relay would be set for a control voltage of 48 volts d-c. When put in position 3, which is the way the relay is normally shipped from the factory, the control voltage of the relay is set for 125 volts d-c.

### Reset and Reclosing Timing Motors

The reduction gear units of each motor assembly are in the ratio of 4 to 1, that is, the motor shaft speed of 4 rpm results in a drum speed of 1 rpm. The reset drum rotates at 1 rpm, the reclosing drum rotates at 1/4 rpm.

## OPERATION INDICATOR

The coil of the operation indicator is continuously rated at 120 volts 60 cycles.

## INSTALLATION

The relay should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type

of FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench. Before placing in service, check to see that armature of toggle (W) unit is in right hand (rear view) position. See Fig. 4 for outline and drilling plan.

### Adjustments and Maintenance

The proper adjustments to insure correct operation of this relay have been made at the factory. Re-adjustment after receipt by the customer will be necessary only as required by the reclosing cycle requirements and the supply voltages of the particular application. In making such changes, or in checking the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be periodically cleaned with a fine file. Style #1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of imbedding small particles in the face of the soft silver and thus impairing the contacts.

The resistors in series with the Z and W elements should be connected in or out of the circuit as required by the voltage of the control supply to which the relay will be connected and as described in a paragraph under "CHARACTERISTICS".

Should it become necessary to replace the coil of the operation indicator, be sure that the core screw is in the "all in" position.

### Motor Lubrication

The synchronous timing motors have been supplied with an extra C.C. of silicone lubricating oil, and should not need further lubrication throughout their life.

The two posts provided on the upper portion of the relay (rear view) are provided to facilitate maintenance of the relay. The relay may be laid down on its back while performing routine maintenance without damage to the contacts of the SX relay.

## RELAY CAM SETTINGS

Looking at the front view of the relay, the knob posi-

tioned between the reclosing and reset drums provides for the manual rotation of either drum. When it is desired to manually turn the reclosing drum in order to facilitate cam positioning, the reset lever knob should be turned to the left. If it is desired to turn the reset drum manually the reset lever knob should be turned to the right.

### RESET CAM SCREW ADJUSTMENTS

It will be noted that there are two cam screws on the reset drum assembly; it should not be necessary to adjust the cam screw which holds the lever of the right hand snap action switch closed. However, should replacement of that switch become necessary, the cam screw should be moved in the direction to close the plunger of the switch and the gap between the lever of the switch and the switch body, as measured at the top of the switch should be  $1/16 \pm 1/64$  inch, when the switch is closed. This adjustment should be made with the reset drum in the fully reset position (with the roll pin against the stop). This cam is known as the reset off-normal cam.

### RESET CAM SETTING

With the reset drum in the fully reset position, apply 120 volts 60 cycles between terminals 8 and 9 for  $10 \pm 1$  second. Remove the voltage and bring the the second cam screw clockwise around the drum until the left hand microswitch contacts just close. Tighten the cam at that position and line up the 10 second mark of the dial plate with the center of the cam screw. Re-tighten the end nut to hold the scale plate at this position.

### RECLOSING "OFF-NORMAL" CAM

This adjustment is exactly the same as that performed on the reset off-normal cam setting.

### LOCKOUT CAM SETTING

The maximum time to lockout can be gotten by removing the lockout cam altogether and allowing the reclosing off-normal cam to perform the dual function of acting as the lockout cam as well. In that case, the maximum lockout time available is about 4 minutes. Should a shorter lockout time be required, it is necessary to use the second cam screw and to set it as desired in the rear section of the reclosing cam drum and to check this time by test.

### RECLOSING CAM SETTINGS

Four reclosing cams are supplied with the relay, the instantaneous initial reclosure, a 15 second

reclosure, a 60 second reclosure and a 120 second reclosure. Additional cams are available upon request. If the instantaneous initial reclosure cam is not desired, it can be easily removed. At this point it is important to note that the reclosing cams should not be spaced closer together than 20 seconds to permit the number 13 contact to open between cams.

The reclosing times available are from instantaneous reclosure, to a delay of approximately 3 minutes and 40 seconds.

The suggested minimum time for the first reclosing cam is 15 seconds. The minimum time between successive reclosing cam settings is 20 seconds. The suggested minimum off time (the time the #13 contact is open) is 5 seconds. The minimum on time per cam is approximately 12 seconds.

## REPAIRS AND RENEWAL PARTS

Repair can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

## ENERGY REQUIREMENTS

The burdens for the various elements of the RCD relay when energized from 120 volts 60 cycle supply are listed below:

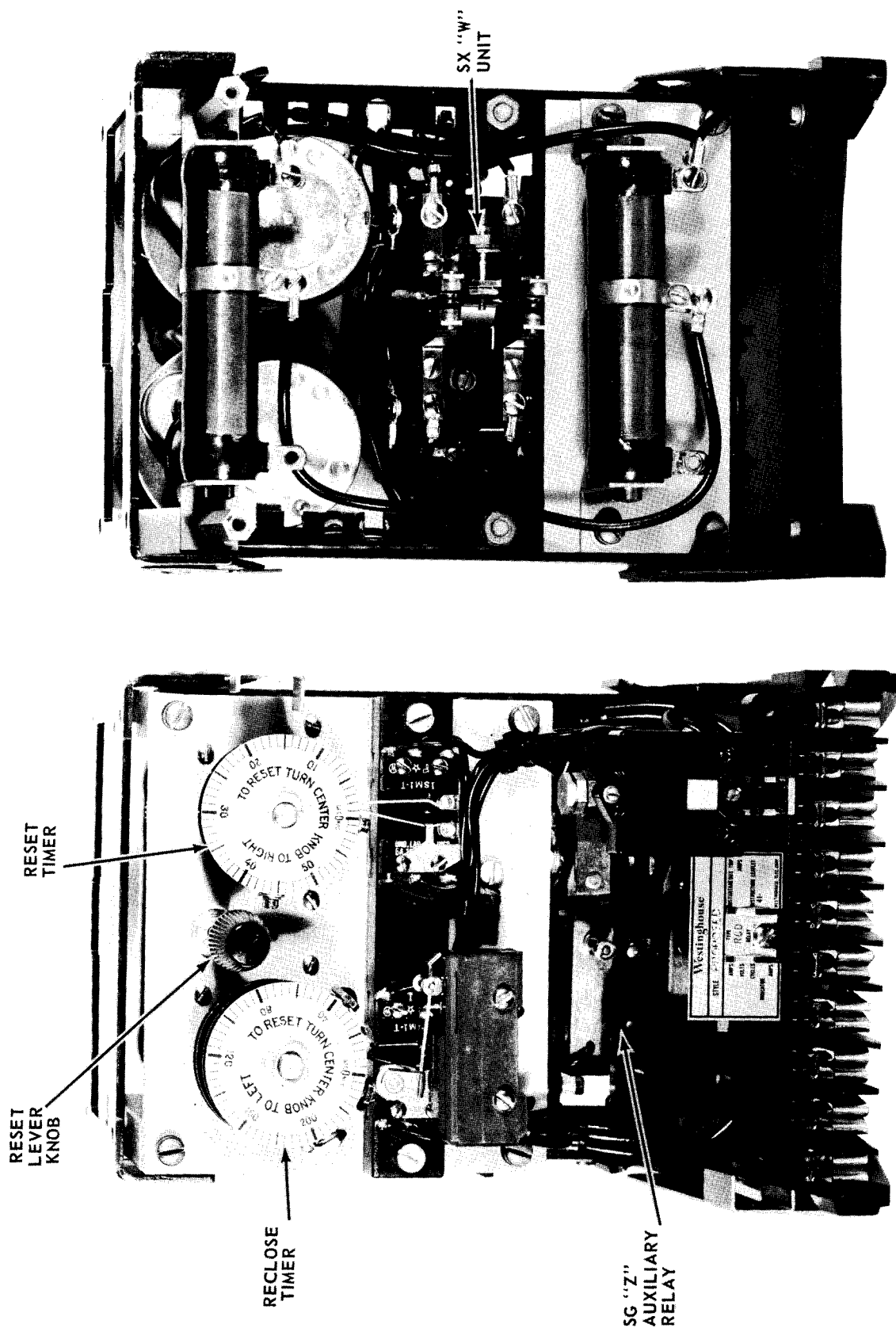
### Motor Circuits

Function	Volt/Amperes	Watts
Reclosing	9.40	6.40
Lockout	4.30	3.25
Reset	4.40	2.80
SG Aux. Relay (Z Unit)	12.5	6.70
SX Aux. Relay (W Unit)	10.2	6.5

When used on a d-c control voltage of 125 volts d-c, the SG burden is 20.2 watts.

The SX burden is 21.8 watts. The power dissipated in each resistor is 18.2 watts at 125 volts d-c

At 48 volts d-c control voltage the power dissipated in the SG unit is 6.7 watts, while the power dissipated in the SX unit is 7.5 watts. At 48 volts d-c the power dissipated in each of the resistors is 4.3 watts.



\* Fig. 1. Type RCD Relay

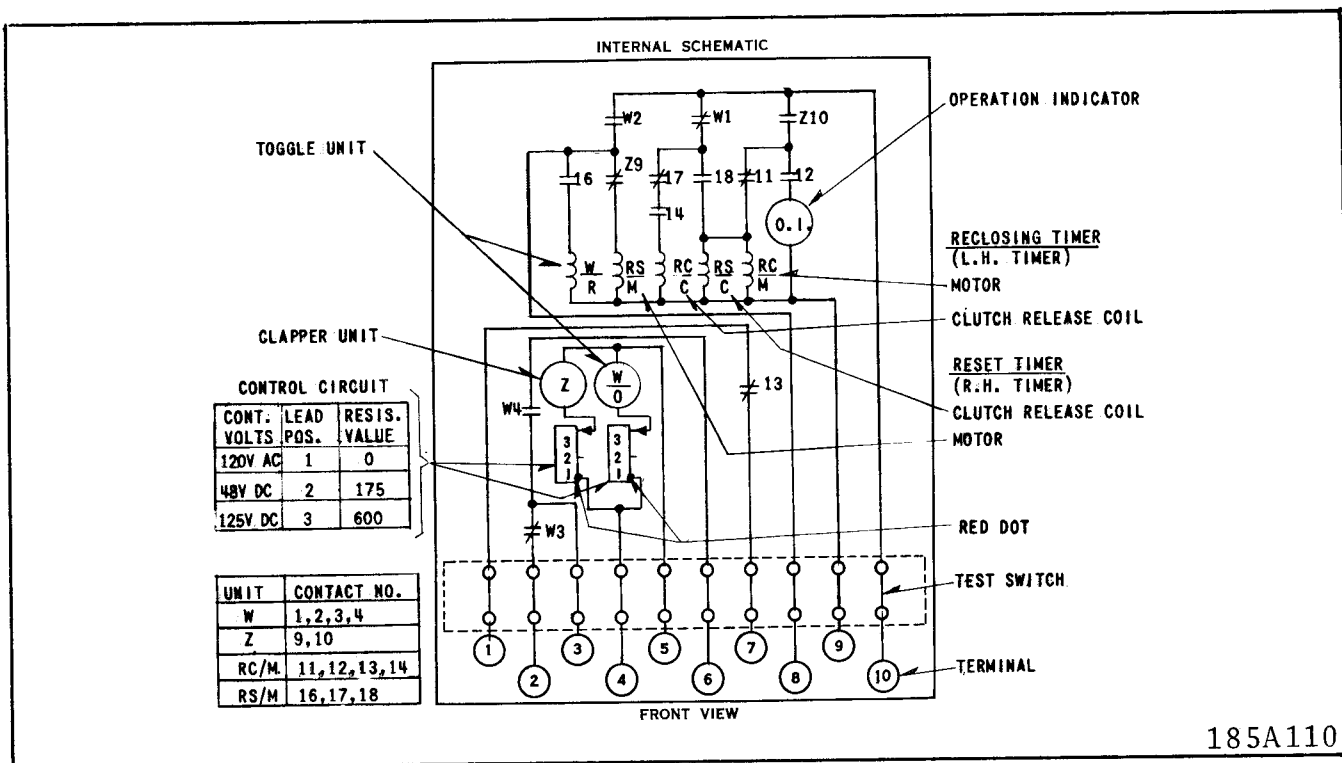


Fig. 2. Internal Schematic

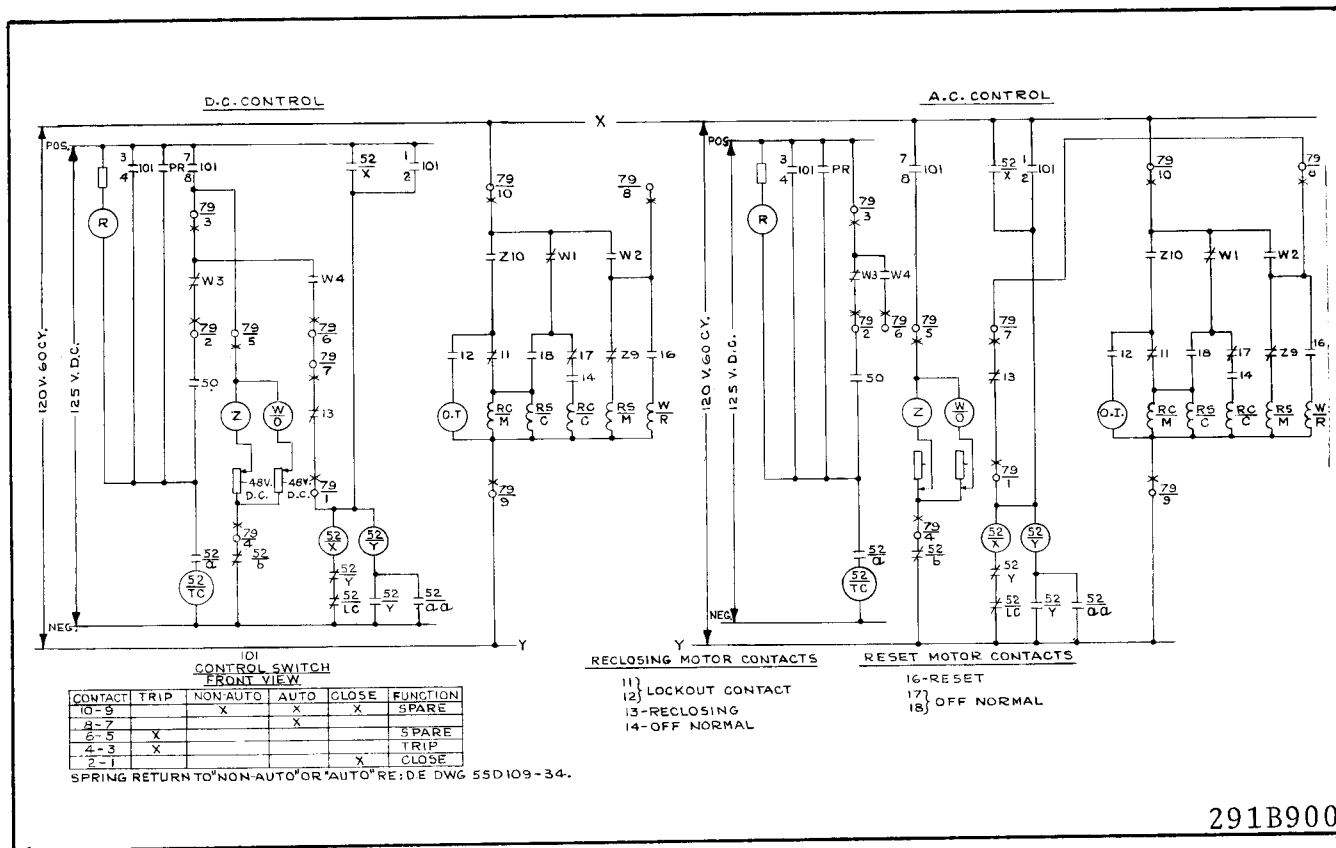
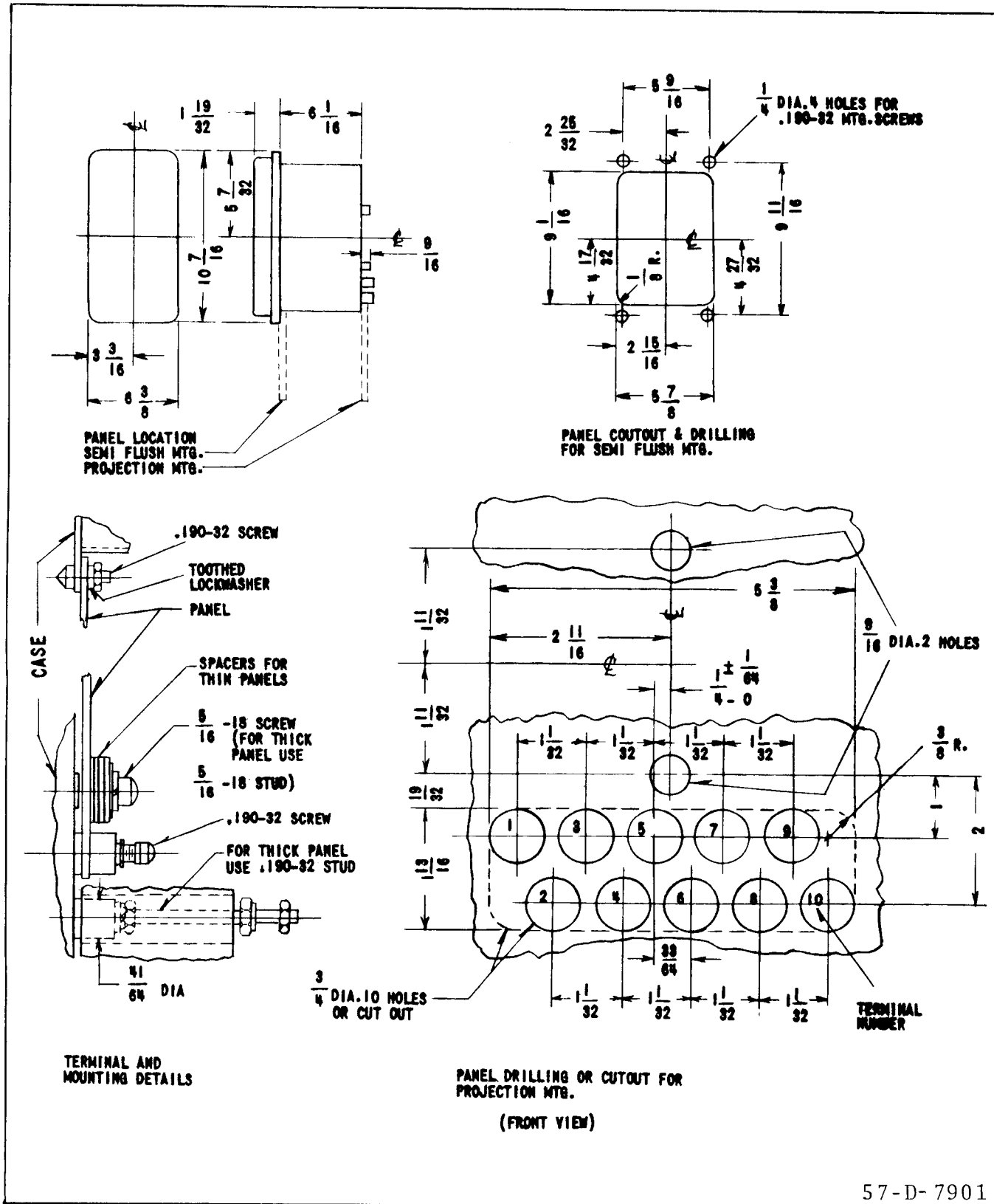


Fig. 3. External Schematic



57-D-7901

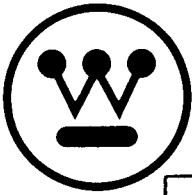
Fig. 4 Outline & Drilling Plan for the type RCD Relay in FT-21 case.

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# INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

## TYPE RCD AUTOMATIC RECLOSING RELAY

**CAUTION:** Before putting protection relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Operate the relay to check the settings and electrical connections.

### APPLICATION

The type RCD is a multi-shot electromechanical reclosing relay which, following breaker tripping due to a fault, can initiate from one to twelve closing attempts over a period of up to 4 minutes before locking out. It uses separate reclosing and reset timers to provide adjustable, constant reset time delay which is independent of the number of unsuccessful reclosing shots attempted.

The RCD relay requires only a 52b contact for circuit breaker status indication and can be used with any closing mechanism, whether ac or dc powered. However, the breaker close circuit must have standard anti-pump protection, i.e., it must be arranged so that for a single application of a closing signal the breaker must close only once, even if that closing signal is sustained beyond a subsequent trip.

The RCD can block tripping by instantaneous relays if desired, after the first reclosure (IT lock-out function). In distribution circuit applications, this permits isolation of permanent lateral circuit faults by fuse opening.

If all automatic reclosing shots are unsuccessful due to a permanent fault, a lockout contact energizes an Operation Indicator whose target drops and remains down until manually reset.

### CONSTRUCTION

There are four principal components in the RCD reclosing relay as follows:

Reclosing timer, reset timer, an SX auxiliary relay, and an SG auxiliary relay.

In addition to these four there is also an operation indicator, two voltage dropping resistors, and several limit and transfer switches whose function will be explained in subsequent paragraphs.

#### 1. Reclosing timer

This timer is connected to run forward while the circuit breaker is open, to remain stationary while the breaker is closed and reset timer is running, and to reset to its starting position when the reset timer times out. The timing drum is driven by a synchronous motor, making a complete revolution in approximately four minutes. The motor is coupled to the drum, through a clutch assembly which is normally engaged. An electromagnetic clutch release unit permits spring return of the drum to its starting position. The reclosing timer controls four contacts. The first, the number 13 closing contact is a roller actuated snap action switch which is mounted directly below the reclosing drum on the front of the relay. It is operated by cams spaced at desired intervals about the periphery of the reclosing drum. The other three contacts of the reclosing timer are operated by two cam screws located in the rear section of the disc assembly. At the start and timed-out positions of the drum's travel one or the other of two lever arms on the snap action switches is operated. Off normal contact No. 14 operates whenever the disc leaves its starting position; and lockout contacts 11 and 12 transfer whenever the drum completes the full revolution. However, the lockout cam can be adjusted for any time up to four minutes.

#### 2. Reset Timer

This timer is connected to run forward after the circuit breaker has closed, to reset to its starting position if the circuit breaker opens while it is running, to provide a signal for the resetting of the entire reclosing relay in preparation for

a new cycle, when the breaker remains closed for the preset interval. The reset timer has the same arrangement of synchronous motor, clutch, release magnet, and reset spring, as described in the previous paragraph. However, the disc assembly is different in that there is one section. The time for complete revolution of the reset drum is one minute.

### 3. SX Auxiliary Relay (W Unit)

The SX unit is a toggle action relay and controls contacts W1, W2, W3 and W4. The SX unit is referred to as the W unit on the internal schematic. The SX relay possesses memory action in that contacts W1 and W3 remain closed until the operating coil of the toggle unit is energized. Contacts W2 and W4 then close and remain closed until the reset coil of the toggle unit is energized. Contacts W1 and W2 actually comprise a single form "C" configuration with a common moving contact; similarly, W3 and W4 share a moving contact.

The function of the toggle unit when used in the a-c control scheme as shown in Fig. 3 (right side) is to provide by way of contacts W1 and W2, means to energize the breaker closing circuit in conjunction with the 13 contact on the reclosing timer. In addition to this, the W2 contacts also sets up through the No. 16 contact a circuit by which the reset coil of the toggle unit will be energized. The W1 contact, through the transfer contacts 17 and 18, sets up the reset cycle by which the reclosing and reset motors are brought back to their initial position. The W3 contact of the toggle unit is used to lockout the instantaneous trip after the first reclosure.

When used in the d-c control scheme shown on the left side of Fig. 3, the function of the toggle unit is essentially the same except that the W4 contact is now used in series with the 13 contact to control and energize the breaker closing circuit.

### 4. SG Auxiliary Relay (Z unit)

The SG auxiliary relay is controlled by the operation of the 52b switch, and is provided with a normally open and a normally closed contact designated as Z10 and Z9 respectively. Upon closing Z10 the reclosing motor is energized through the No. 11 reclosing motor contact. Upon opening the 52b switch, contact Z9 closes and Z10 opens, setting up through the pre-closed W2 contact the circuit permitting the

reset motor to initiate its cycle and thereby reset the reclosing motor and the reset motor.

### 5. Operation Indicator (O.I.)

The operation indicator is controlled by the number 12 contact which is a transfer contact located beneath and to the left of the reclosing motor. As the reclosing motor has timed out and approaches the lockout position, a preset cam screw in the rear disc assembly actuates the lever arm of the enclosed snap action switch. Upon closing of the No. 12 contact the operation indicator is energized and power to the reclosing motor is cut off. The target of the operation indicator drops and remains in that position until manually reset. The coil of the operation indicator is continuously rated.

### 6. Voltage Dropping Resistors

Two fixed tap resistors are provided at the back of the relay in order to give as much flexibility with regard to voltage ratings encountered on various types of systems. Their full resistance is 600 ohms and they are provided with a tap resistance of 175 ohms.

## OPERATION

Referring to Fig. 3, the a-c control circuit, a typical operating cycle would be as follows. When a line fault occurs, the instantaneous tripping relays close their contact 50 energizing the breaker trip coil 52 T.C. through a circuit from the positive bus through the preclosed W3 contacts, through the protective relay contacts 50, through the breaker contact 52a energizing the 52 T.C. trip coil of the breaker back to the negative side of the bus. The 52b breaker contact closes, energizing the W operate coil, and Z coil, through the 101 switch back to the other side of the a-c bus. Energizing the W operating coil causes contacts W1 and W2 to transfer as well as contacts W3 and W4. Opening W3 opens the trip circuit, closing W2 energizes the 52X and 52Y contactor coils through the #13 contact.

Should the breaker remain closed after instantaneous initial reclosure the 52b contact will open, the W (operate) and Z coils will be de-energized, therefore, the W2 contact will be closed and the Z9 contact will be closed completing the circuit for the reset motor. The reset motor will begin to time out and as it leaves its initial position contact 17 opens and contact 18 closes setting up the circuit for the reset clutch. As the reset motor times out, the reset

## TYPE RCD AUTOMATIC RECLOSING RELAY

cam, which is preset at the factory for a 10 second delay, trips the lever of the left hand switch causing contact #16 to close, thereby completing the circuit through W2 contact through the 16 contact through the reset coil of the SX unit. Energizing the reset coil of the SX unit causes its armature to toggle over, which closes W1 and W3 contacts and opens W2 and W4 contacts. In closing the W3 contact the instantaneous trip circuit is again set up. In closing the W1 and opening the W2 contact, the reset motor is de-energized and the reset clutch is energized, through the closed W1 contact through the closed #18 contact and through the reset clutch coil. Because of the speed with which the reset cycle takes place the reclosing motor never begins its cycle, even though there is a circuit through the W1 contact and the number 18 contact through the reclosing motor coil. Energizing the reset clutch causes the spring return of the reset drum to its starting position. As the drum resets itself contact #16 opens de-energizing the reset coil of the SX unit, and upon resetting, the lever of the right hand switch is closed by the first cam on the reset drum causing the #17 contact to close and the #18 contact to open. Opening the #18 contact de-energizes the reset clutch and reclosing motor. The relay is once again in a position to perform the instantaneous initial reclosing function. Should the breaker fail to remain closed after the instantaneous initial reclosure the following sequence of events takes place:

The breaker is open, therefore, the 52b switch is closed, the W operate coil and the Z coil are both energized, therefore, W2 is closed W1 is opened, W4 is closed and W3 is open. Z10 is closed, setting up the circuit through Z10 through the closed contact #11, through the reclosing motor and reset clutch coils, as the reclosing motor starts to rotate, the first cam in the rear section of the drum releases the right hand snap action switch lever, thereby, closing the #14 contact. However, the reclosing clutch does not get energized at this time since the W1 contact is open. As the instantaneous reclosing cam moves off the roller of the large snap action switch, the #13 contact is opened. Opening the #13 contact disconnects the 52X and 52Y coils from the circuit. The reclosing motor continues to rotate until the 10 second cam actuates the roller lever of the snap action switch and causes the #13 contact to close, thereby, energizing the 52X and the 52Y coils. Assuming that the breaker does not go in on the first or second reclosure the reclosing motor continues to rotate and as the third reclosing

\*cam actuates the #13 contact let us assume that the breaker goes in at this point. Should the breaker successfully reclose, the 52b contact opens and the W operating coil of the toggle unit is de-energized as well as the Z coil. Contact Z10 opens thereby de-energizing the reclosing motor and contacts W1 and W2 remain in their former position because of the "memory action" of the SX unit, that is, W2 is closed and W1 is open. De-energizing the Z unit also causes Z9 to close, thereby, energizing the the reset motor through a circuit from one side of the a-c bus through terminal #10 through contact W2 and Z9 through the reset motor coil to terminal 9 of the relay and back to the other side of the a-c bus. The reset motor begins to time out and as it does, contact #18 closes and #17 opens. Thereby, setting up the reset clutch circuit. As the 10 second cam of the reset motor actuates the left hand snap action switch the #16 contact closes energizing the the reset coil of the SX unit toggles the armature over, thereby, opening the W2 contact and closing the W1 contact, the W3 contact is closed and the W4 contact is also open. Opening the W2 contact de-energizes the reset motor as well as the 52X and 52Y coils. Closing the W1 contact causes the reset clutch to be energized through the closed contact #18, this results in resetting the reset drum causing the #16 contact to open which de-energizes the reset coil of the toggle unit, and causes the transfer contact #17 to close and #18 to open. Opening the #18 contact de-energizes the reset clutch, closing the #17 contact results in energizing the reclosing clutch through the pre-closed #14, #17 and W1 contacts and back to the source. Energizing the reclosing clutch results in resetting the reclosing drum, by means of the spring  
\* return mechanism, back to its initial position. As the reclosing drum resets itself, the screw cam in the rear section of the drum causes the right hand snap action switch lever to depress, which in turn opens the #14 contact and de-energizes the reclosing clutch. The relay is now totally reset and ready for another sequence of operation.

Had the breaker not gone in after the third reclosure the reclosing motor drum would have continued to rotate until the lockout cam, located in the rear section of the drum, tripped the lever of the left hand snap action switch directly beneath the drum. Tripping this switch results in transferring the #11 and #12 contacts so that, the #12 contact is closed energizing the operation indicator from one side of the a-c bus through terminal 10 through Z10 through the #12 contact and the operation indicator coil

through the #9 coil of the relay back to the other side of the a-c bus. Energizing the operation indicator causes the target to drop and remain in this position until manually reset. The opening of the #11 contact interrupts the power to the reclosing motor causing it to stop at the lockout position.

After the breaker has been manually reset the 52b contact opens and the automatic resetting of the relay takes place as described in the previous paragraph. The target of the operation indicator is then reset manually and the relay is again ready for another sequence of operation.

It should be noted that manual reclosure after lockout does not reset the relay unless the breaker remains closed for the required reset interval as determined by the setting of the reset cam. Thus, if the breaker trips immediately on a trial reclosure, the relay remains locked out and does not set up a whole new sequence of reclosures. However, any travel that the reset timer may make under these circumstances is not reset when the breaker opens, because the open lockout contact #11 interrupts the circuit to the reset timer clutch release coil, as well as to the reclosing timer motor. Consequently, a series of unsuccessful manual reclosures may eventually result in timing out the reset timer by steps, a little on each operation, causing the start of a new sequence.

## CHARACTERISTICS

The standard ratings of the type RCD reclosing relay are as follows:

Motor . . . . . 120 volts 60 hertz

- \* Z and W elements (SG and 120 volts 60 hertz SX Auxiliary Relays) . . . . . or 48/125 volts dc

Provision has been made through the use of two fixed tap resistors to provide the user with as much flexibility as possible with regard to the various types of control voltage available. If it is desired to use the relay on the control voltage of

- \* 120 volts 60 hertz it is only necessary to move the left hand lead of each resistor over to the right so that there is a common connection between the leads going to each resistor. Looking at the rear view of the relay the three terminals of each resistor are referred to as terminal 1, 2 and 3 reading from right to left, therefore, for a control voltage of 120 volts 60 cycles, the movable or left hand lead on each resistor would be in position 1. When placed

in position 2 the relay would be set for a control voltage of 48 volts d-c. When put in position 3, which is the way the relay is normally shipped from the factory, the control voltage of the relay is set for 125 volts d-c.

## Reset and Reclosing Timing Motors

The reduction gear units of each motor assembly are in the ratio of 4 to 1, that is, the motor shaft speed of 4 rpm results in a drum speed of 1 rpm. The reset drum rotates at 1 rpm, the reclosing drum rotates at  $\frac{1}{4}$  rpm.

## OPERATION INDICATOR

- \* The coil of the operation indicator is continuously rated at 120 volts 60 hertz.

## INSTALLATION

The relay should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type of FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench. Before placing in service, check to see that armature of toggle (W) unit is in right hand (rear view) position. See Fig. 4 for outline and drilling plan.

## Adjustments and Maintenance

The proper adjustments to insure correct operation of this relay have been made at the factory. Re-adjustment after receipt by the customer will be necessary only as required by the reclosing cycle requirements and the supply voltages of the particular application. In making such changes, or in checking the adjustments at regular maintenance periods, the instructions below should be followed.

All Z and W unit contacts should be periodically cleaned with a fine file. Style #1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of imbedding small particles in the face of the soft silver and thus impairing the

contacts. The resistors in series with the Z and W elements should be connected in or out of the circuit as required by the voltage of the control supply to which the relay will be connected and as described in a paragraph under "CHARACTERISTICS".

Should it become necessary to replace the coil of the operation indicator, be sure that the core screw is in the "all in" position.

#### **Motor Lubrication**

The synchronous timing motors have been supplied with an extra C.C. of silicone lubricating oil, and should not need further lubrication throughout their life.

The two posts provided on the upper portion of the relay (rear view) are provided to facilitate maintenance of the relay. The relay may be laid down on its back while performing routine maintenance without damage to the contacts of the SX relay.

#### **RELAY CAM SETTINGS**

Looking at the front view of the relay, the knob positioned between the reclosing and reset drums provides for the manual rotation of either drum. When it is desired to manually turn the reclosing drum in order to facilitate cam positioning, the reset lever knob should be turned to the left. If it is desired to turn the reset drum manually the reset lever knob should be turned to the right.

#### **RESET CAM SCREW ADJUSTMENTS**

It will be noted that there are two cam screws on the reset drum assembly; it should not be necessary to adjust the cam screw which holds the lever of the right hand snap action switch closed. However, should replacement of that switch become necessary, the cam screw should be moved in the direction to close the plunger of the switch and the gap between the lever of the switch and the switch body, as measured at the top of the switch should be  $1/16 \pm 1/64$  inch, when the switch is closed. This adjustment should be made with the reset drum in the fully reset position (with the roll pin against the stop). This cam is known as the reset off-normal cam.

#### **RESET CAM SETTING**

- With the reset drum in the fully reset position, apply
- \* 120 volts 60 hertz between terminals 8 and 9 for  $10 \pm 1$  second. Remove the voltage and bring the second cam screw clockwise around the drum until the left hand microswitch contacts just close.

Tighten the cam at that position and line up the 10 second mark of the dial plate with the center of the cam screw. Re-tighten the end nut to hold the scale plate at this position.

#### **RECLOSING "OFF-NORMAL" CAM**

This adjustment is exactly the same as that performed on the reset off-normal cam setting.

#### **LOCKOUT CAM SETTING**

The maximum time to lockout can be gotten by removing the lockout cam altogether and allowing the reclosing off-normal cam to perform the dual function of acting as the lockout cam as well. In that case, the maximum lockout time available is about 4 minutes. Should a shorter lockout time be required, it is necessary to use the second cam screw and to set it as desired in the rear section of the reclosing cam drum and to check this time by test.

#### **RECLOSING CAM SETTINGS**

Four reclosing cams are supplied with the relay, the instantaneous initial reclosure, a 15 second reclosure, a 60 second reclosure and a 120 second reclosure. Additional cams are available upon request. If the instantaneous initial reclosure cam is not desired, it can be easily removed. At this point it is important to note that the reclosing cams should not be spaced closer together than 20 seconds to permit the number 13 contact to open between cams.

The reclosing times available are from instantaneous reclosure, to a delay of approximately 3 minutes and 40 seconds.

- The suggested minimum time for the first timed
- \* reclosing cam is 15 seconds. The minimum time between successive reclosing cam settings is 20 seconds. The suggested minimum off time (the time the #13 contact is open) is 5 seconds. The minimum on time per cam is approximately 12 seconds.

#### **REPAIRS AND RENEWAL PARTS**

Repair can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

ENERGY REQUIREMENTS

When used on a d-c control voltage of 125 volts d-c, the SG burden is 20.2 watts.

The SX burden is 21.8 watts. The power dissipated in each resistor is 18.2 watts at 125 volts d-c

\* The burdens for the various elements of the RCD relay when energized from 120 volts 60 hertz supply are listed below:

Motor Circuits

Function	Volt/Amperes	Watts
Reclosing	9.40	6.40
Lockout	4.30	3.25
Reset	4.40	2.80
SG Aux. Relay (Z Unit)	12.5	6.70
SX Aux. Relay (W Unit)	10.2	6.5

At 48 volts d-c control voltage the power dissipated in the SG unit is 6.7 watts, while the power dissipated in the SX unit is 7.5 watts. At 48 volts d-c the power dissipated in each of the resistors is 4.3 watts.

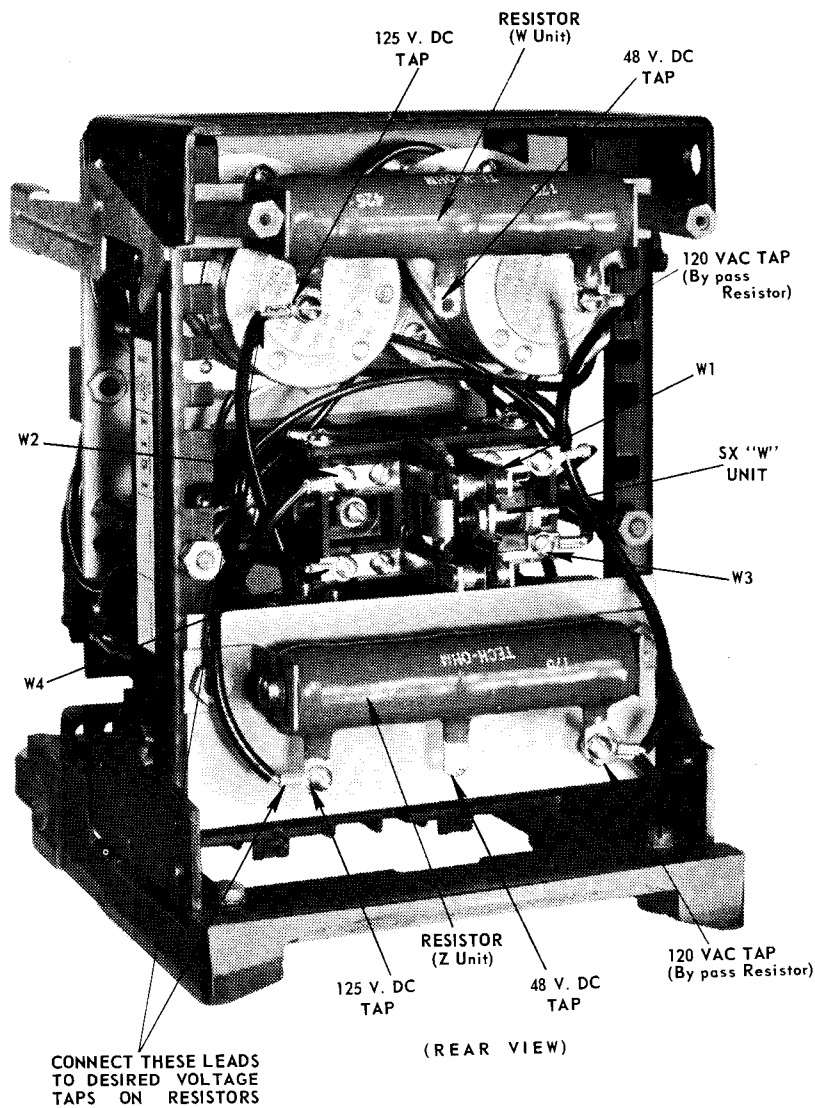
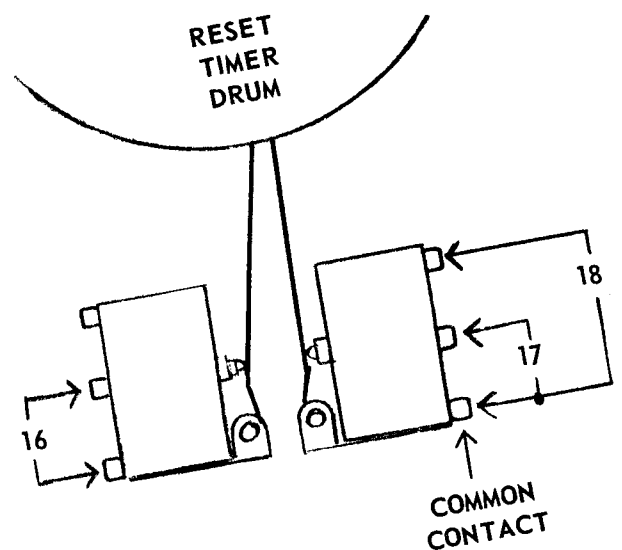
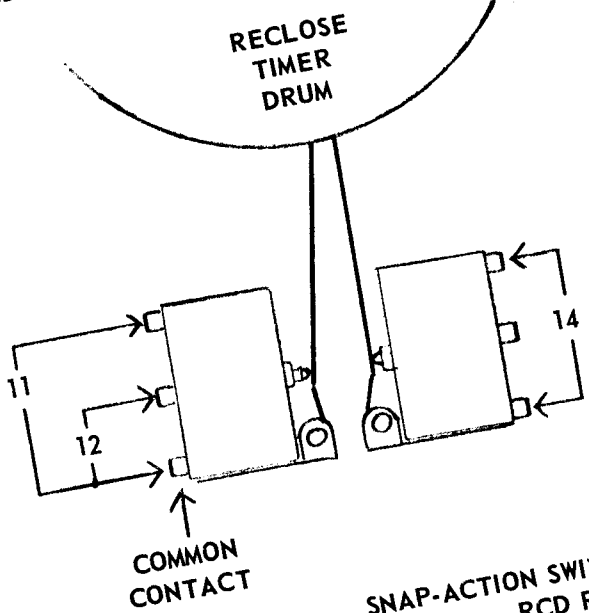
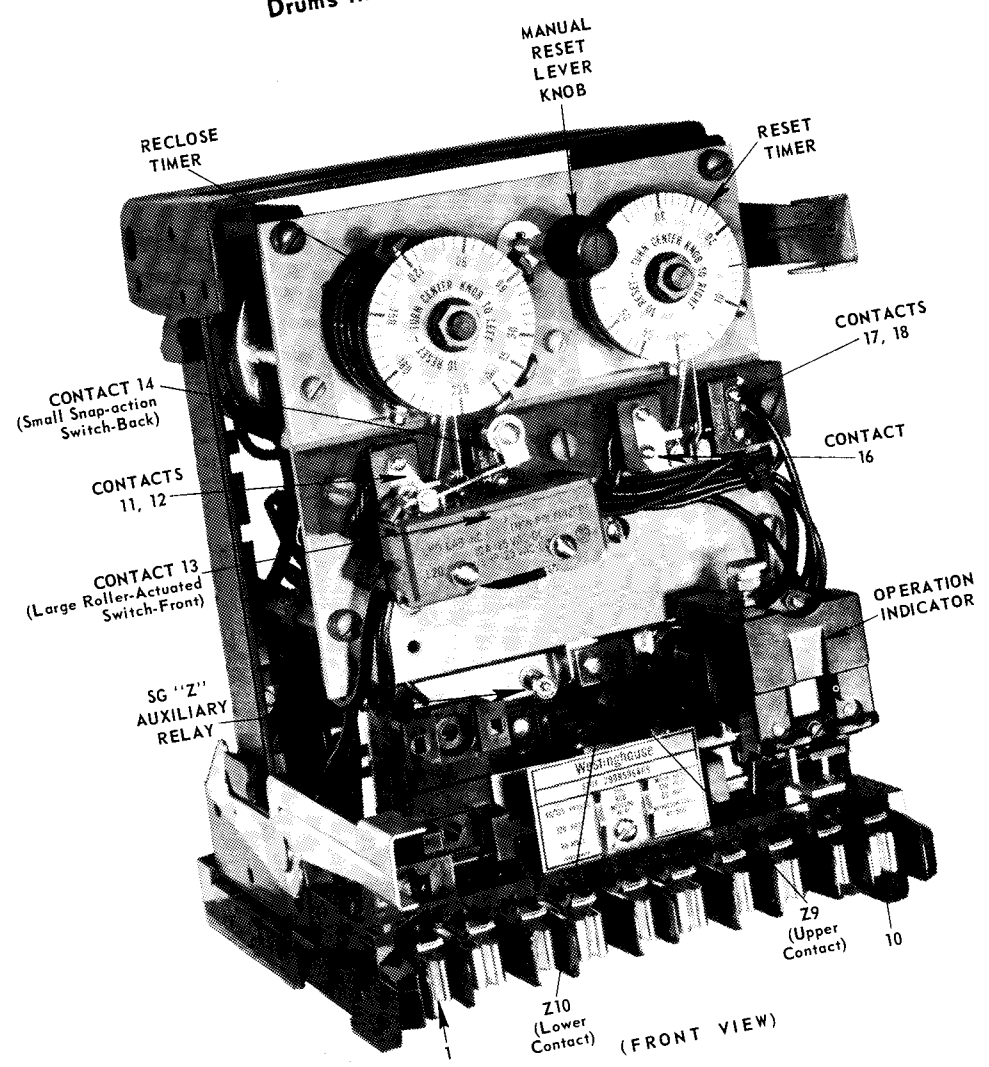


Fig. 1. Type RCD Relay

# TYPE RCD AUTOMATIC RECLOSING RELAY



## SNAP-ACTION SWITCH CONTACT IDENTIFICATION. RCD RELAY - FRONT VIEW Drums in Reset Position

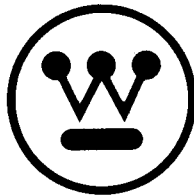


\* Type RCD Relay

AUTOMATIC RECLOSING DELAY







**WESTINGHOUSE ELECTRIC CORPORATION**  
**RELAY-INSTRUMENT DIVISION**

**NEWARK, N. J.**

Printed in U.S.A.



# INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

## TYPE RCD AUTOMATIC RECLOSING RELAY

**CAUTION:** Before putting protection relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Operate the relay to check the settings and electrical connections.

### APPLICATION

The type RCD is a multi-shot electromechanical reclosing relay which, following breaker tripping due to a fault, can initiate from one to twelve closing attempts over a period of up to 4 minutes before locking out. It uses separate reclosing and reset timers to provide adjustable, constant reset time delay which is independent of the number of unsuccessful reclosing shots attempted.

The RCD relay requires only a 52b contact for circuit breaker status indication and can be used with any closing mechanism, whether ac or dc powered. However, the breaker close circuit must have standard anti-pump protection, i.e., it must be arranged so that for a single application of a closing signal the breaker must close only once, even if that closing signal is sustained beyond a subsequent trip.

The RCD can block tripping by instantaneous relays if desired, after the first reclosure (IT lock-out function). In distribution circuit applications, this permits isolation of permanent lateral circuit faults by fuse opening.

If all automatic reclosing shots are unsuccessful due to a permanent fault, a lockout contact energizes an Operation Indicator whose target drops and remains down until manually reset.

### CONSTRUCTION

There are four principal components in the RCD reclosing relay as follows:

Reclosing timer, reset timer, an SX auxiliary relay, and an SG auxiliary relay.

In addition to these four there is also an operation indicator, two voltage dropping resistors, and several limit and transfer switches whose function will be explained in subsequent paragraphs.

#### 1. Reclosing timer

This timer is connected to run forward while the circuit breaker is open, to remain stationary while the breaker is closed and reset timer is running, and to reset to its starting position when the reset timer times out. The timing drum is driven by a synchronous motor, making a complete revolution in approximately four minutes. The motor is coupled to the drum, through a clutch assembly which is normally engaged. An electromagnetic clutch release unit permits spring return of the drum to its starting position. The reclosing timer controls four contacts. The first, the number 13 closing contact is a roller actuated snap action switch which is mounted directly below the reclosing drum on the front of the relay. It is operated by cams spaced at desired intervals about the periphery of the reclosing drum. The other three contacts of the reclosing timer are operated by two cam screws located in the rear section of the disc assembly. At the start and timed-out positions of the drum's travel one or the other of two lever arms on the snap action switches is operated. Off normal contact No. 14 operates whenever the disc leaves its starting position; and lockout contacts 11 and 12 transfer whenever the drum completes the full revolution. However, the lockout cam can be adjusted for any time up to four minutes.

#### 2. Reset Timer

This timer is connected to run forward after the circuit breaker has closed, to reset to its starting position if the circuit breaker opens while it is running, to provide a signal for the resetting of the entire reclosing relay in preparation for

a new cycle, when the breaker remains closed for the preset interval. The reset timer has the same arrangement of synchronous motor, clutch, release magnet, and reset spring, as described in the previous paragraph. However, the disc assembly is different in that there is one section. The time for complete revolution of the reset drum is one minute.

### 3. SX Auxiliary Relay (W Unit)

The SX unit is a toggle action relay and controls contacts W1, W2, W3 and W4. The SX unit is referred to as the W unit on the internal schematic. The SX relay possesses memory action in that contacts W1 and W3 remain closed until the operating coil of the toggle unit is energized. Contacts W2 and W4 then close and remain closed until the reset coil of the toggle unit is energized. Contacts W1 and W2 actually comprise a single form "C" configuration with a common moving contact; similarly, W3 and W4 share a moving contact.

The function of the toggle unit when used in the a-c control scheme as shown in Fig. 3 (right side) is to provide by way of contacts W1 and W2, means to energize the breaker closing circuit in conjunction with the 13 contact on the reclosing timer. In addition to this, the W2 contacts also sets up through the No. 16 contact a circuit by which the reset coil of the toggle unit will be energized. The W1 contact, through the transfer contacts 17 and 18, sets up the reset cycle by which the reclosing and reset motors are brought back to their initial position. The W3 contact of the toggle unit is used to lockout the instantaneous trip after the first reclosure.

When used in the d-c control scheme shown on the left side of Fig. 3, the function of the toggle unit is essentially the same except that the W4 contact is now used in series with the 13 contact to control and energize the breaker closing circuit.

### 4. SG Auxiliary Relay (Z Unit)

The SG auxiliary relay is controlled by the operation of the 52b switch, and is provided with a normally open and a normally closed contact designated as Z10 and Z9 respectively. Upon closing Z10 the reclosing motor is energized through the No. 11 reclosing motor contact. Upon opening the 52b switch, contact Z9 closes and Z10 opens, setting up through the pre-closed W2 contact the circuit permitting the

reset motor to initiate its cycle and thereby reset the reclosing motor and the reset motor.

### 5. Operation Indicator (O.I.)

The operation indicator is controlled by the number 12 contact which is a transfer contact located beneath and to the left of the reclosing motor. As the reclosing motor has timed out and approaches the lockout position, a preset cam screw in the rear disc assembly actuates the lever arm of the enclosed snap action switch. Upon closing of the No. 12 contact the operation indicator is energized and power to the reclosing motor is cut off. The target of the operation indicator drops and remains in that position until manually reset. The coil of the operation indicator is continuously rated.

### 6. Voltage Dropping Resistors

Two fixed tap resistors are provided at the back of the relay in order to give as much flexibility with regard to voltage ratings encountered on various types of systems. Their full resistance is 600 ohms and they are provided with a tap resistance of 175 ohms.

## OPERATION

Referring to Fig. 3, the a-c control circuit, a typical operating cycle would be as follows. When a line fault occurs, the instantaneous tripping relays close their contact 50 energizing the breaker trip coil 52 T.C. through a circuit from the positive bus through the preclosed W3 contacts, through the protective relay contacts 50, through the breaker contact 52a energizing the 52 T.C. trip coil of the breaker back to the negative side of the bus. The 52b breaker contact closes, energizing the W operate coil, and Z coil, through the 101 switch back to the other side of the a-c bus. Energizing the W operating coil causes contacts W1 and W2 to transfer as well as contacts W3 and W4. Opening W3 opens the trip circuit, closing W2 energizes the 52X and 52Y contactor coils through the #13 contact.

Should the breaker remain closed after instantaneous initial reclosure the 52b contact will open, the W (operate) and Z coils will be de-energized, therefore, the W2 contact will be closed and the Z9 contact will be closed completing the circuit for the reset motor. The reset motor will begin to time out and as it leaves its initial position contact 17 opens and contact 18 closes setting up the circuit for the reset clutch. As the reset motor times out, the reset

cam, which is preset at the factory for a 10 second delay, trips the lever of the left hand switch causing contact #16 to close, thereby completing the circuit through W2 contact through the 16 contact through the reset coil of the SX unit. Energizing the reset coil of the SX unit causes its armature to toggle over, which closes W1 and W3 contacts and opens W2 and W4 contacts. In closing the W3 contact the instantaneous trip circuit is again set up. In closing the W1 and opening the W2 contact, the reset motor is de-energized and the reset clutch is energized, through the closed W1 contact through the closed #18 contact and through the reset clutch coil. Because of the speed with which the reset cycle takes place the reclosing motor never begins its cycle, even though there is a circuit through the W1 contact and the number 18 contact through the reclosing motor coil. Energizing the reset clutch causes the spring return of the reset drum to its starting position. As the drum resets itself contact #16 opens de-energizing the reset coil of the SX unit, and upon resetting, the lever of the right hand switch is closed by the first cam on the reset drum causing the #17 contact to close and the #18 contact to open. Opening the #18 contact de-energizes the reset clutch and reclosing motor. The relay is once again in a position to perform the instantaneous initial reclosing function. Should the breaker fail to remain closed after the instantaneous initial reclosure the following sequence of events takes place:

The breaker is open, therefore, the 52b switch is closed, the W operate coil and the Z coil are both energized, therefore, W2 is closed W1 is opened, W4 is closed and W3 is open. Z10 is closed, setting up the circuit through Z10 through the closed contact #11, through the reclosing motor and reset clutch coils, as the reclosing motor starts to rotate, the first cam in the rear section of the drum releases the right hand snap action switch lever, thereby, closing the #14 contact. However, the reclosing clutch does not get energized at this time since the W1 contact is open. As the instantaneous reclosing cam moves off the roller of the large snap action switch, the #13 contact is opened. Opening the #13 contact disconnects the 52X and 52Y coils from the circuit. The reclosing motor continues to rotate until the 10 second cam actuates the roller lever of the snap action switch and causes the #13 contact to close, thereby, energizing the 52X and the 52Y coils. Assuming that the breaker does not go in on the first or second reclosure the reclosing motor continues to rotate and as the third reclosing

\*cam actuates the #13 contact let us assume that the breaker goes in at this point. Should the breaker successfully reclose, the 52b contact opens and the W operating coil of the toggle unit is de-energized as well as the Z coil. Contact Z10 opens thereby de-energizing the reclosing motor and contacts W1 and W2 remain in their former position because of the "memory action" of the SX unit, that is, W2 is closed and W1 is open. De-energizing the Z unit also causes Z9 to close, thereby, energizing the the reset motor through a circuit from one side of the a-c bus through terminal #10 through contact W2 and Z9 through the reset motor coil to terminal 9 of the relay and back to the other side of the a-c bus. The reset motor begins to time out and as it does, contact #18 closes and #17 opens. Thereby, setting up the reset clutch circuit. As the 10 second cam of the reset motor actuates the left hand snap action switch the #16 contact closes energizing the the reset coil of the SX unit toggles the armature over, thereby, opening the W2 contact and closing the W1 contact, the W3 contact is closed and the W4 contact is also open. Opening the W2 contact de-energizes the reset motor as well as the 52X and 52Y coils. Closing the W1 contact causes the reset clutch to be energized through the closed contact #18, this results in resetting the reset drum causing the #16 contact to open which de-energizes the reset coil of the toggle unit, and causes the transfer contact #17 to close and #18 to open. Opening the #18 contact de-energizes the reset clutch, closing the #17 contact results in energizing the reclosing clutch through the pre-closed #14; #17 and W1 contacts and back to the source. Energizing the reclosing clutch results in resetting the reclosing drum, by means of the spring  
\* return mechanism, back to its initial position. As the reclosing drum resets itself, the screw cam in the rear section of the drum causes the right hand snap action switch lever to depress, which in turn opens the #14 contact and de-energizes the reclosing clutch. The relay is now totally reset and ready for another sequence of operation.

Had the breaker not gone in after the third reclosure the reclosing motor drum would have continued to rotate until the lockout cam, located in the rear section of the drum, tripped the lever of the left hand snap action switch directly beneath the drum. Tripping this switch results in transferring the #11 and #12 contacts so that, the #12 contact is closed energizing the operation indicator from one side of the a-c bus through terminal 10 through Z10 through the #12 contact and the operation indicator coil

through the #9 coil of the relay back to the other side of the a-c bus. Energizing the operation indicator causes the target to drop and remain in this position until manually reset. The opening of the #11 contact interrupts the power to the reclosing motor causing it to stop at the lockout position.

After the breaker has been manually reset the 52b contact opens and the automatic resetting of the relay takes place as described in the previous paragraph. The target of the operation indicator is then reset manually and the relay is again ready for another sequence of operation.

It should be noted that manual reclosure after lockout does not reset the relay unless the breaker remains closed for the required reset interval as determined by the setting of the reset cam. Thus, if the breaker trips immediately on a trial reclosure, the relay remains locked out and does not set up a whole new sequence of reclosures. However, any travel that the reset timer may make under these circumstances is not reset when the breaker opens, because the open lockout contact #11 interrupts the circuit to the reset timer clutch release coil, as well as to the reclosing timer motor. Consequently, a series of unsuccessful manual reclosures may eventually result in timing out the reset timer by steps, a little on each operation, causing the start of a new sequence.

## CHARACTERISTICS

The standard ratings of the type RCD reclosing relay are as follows:

Motor . . . . .	120 volts 60 hertz
* Z and W elements (SG and SX Auxiliary Relays) . . . . .	120 volts 60 hertz or 48/125 volts dc

Provision has been made through the use of two fixed tap resistors to provide the user with as much flexibility as possible with regard to the various types of control voltage available. If it is desired to use the relay on the control voltage of

- \* 120 volts 60 hertz it is only necessary to move the left hand lead of each resistor over to the right so that there is a common connection between the leads going to each resistor. Looking at the rear view of the relay the three terminals of each resistor are referred to as terminal 1, 2 and 3 reading from right to left, therefore, for a control voltage of 120 volts 60 cycles, the movable or left hand lead on each resistor would be in position 1. When placed

in position 2 the relay would be set for a control voltage of 48 volts d-c. When put in position 3, which is the way the relay is normally shipped from the factory, the control voltage of the relay is set for 125 volts d-c.

## Reset and Reclosing Timing Motors

The reduction gear units of each motor assembly are in the ratio of 4 to 1, that is, the motor shaft speed of 4 rpm results in a drum speed of 1 rpm. The reset drum rotates at 1 rpm, the reclosing drum rotates at 1/4 rpm.

## OPERATION INDICATOR

The coil of the operation indicator is continuously  
\* rated at 120 volts 60 hertz.

## INSTALLATION

The relay should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type of FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench. Before placing in service, check to see that armature of toggle (W) unit is in right hand (rear view) position. See Fig. 4 for outline and drilling plan.

## Adjustments and Maintenance

The proper adjustments to insure correct operation of this relay have been made at the factory. Re-adjustment after receipt by the customer will be necessary only as required by the reclosing cycle requirements and the supply voltages of the particular application. In making such changes, or in checking the adjustments at regular maintenance periods, the instructions below should be followed.

All Z and W unit contacts should be periodically cleaned with a fine file. Style #1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of imbedding small particles in the face of the soft silver and thus impairing the

contacts. The resistors in series with the Z and W elements should be connected in or out of the circuit as required by the voltage of the control supply to which the relay will be connected and as described in a paragraph under "CHARACTERISTICS".

Should it become necessary to replace the coil of the operation indicator, be sure that the core screw is in the "all in" position.

#### **Motor Lubrication**

The synchronous timing motors have been supplied with an extra C.C. of silicone lubricating oil, and should not need further lubrication throughout their life.

The two posts provided on the upper portion of the relay (rear view) are provided to facilitate maintenance of the relay. The relay may be laid down on its back while performing routine maintenance without damage to the contacts of the SX relay.

#### **RELAY CAM SETTINGS**

Looking at the front view of the relay, the knob positioned between the reclosing and reset drums provides for the manual rotation of either drum. When it is desired to manually turn the reclosing drum in order to facilitate cam positioning, the reset lever knob should be turned to the left. If it is desired to turn the reset drum manually the reset lever knob should be turned to the right.

#### **RESET CAM SCREW ADJUSTMENTS**

It will be noted that there are two cam screws on the reset drum assembly; it should not be necessary to adjust the cam screw which holds the lever of the right hand snap action switch closed. However, should replacement of that switch become necessary, the cam screw should be moved in the direction to close the plunger of the switch and the gap between the lever of the switch and the switch body, as measured at the top of the switch should be  $1/16 \pm 1/64$  inch, when the switch is closed. This adjustment should be made with the reset drum in the fully reset position (with the roll pin against the stop). This cam is known as the reset off-normal cam.

#### **RESET CAM SETTING**

With the reset drum in the fully reset position, apply  
\* 120 volts 60 hertz between terminals 8 and 9 for  $10 \pm 1$  second. Remove the voltage and bring the second cam screw clockwise around the drum until the left hand microswitch contacts just close.

Tighten the cam at that position and line up the 10 second mark of the dial plate with the center of the cam screw. Re-tighten the end nut to hold the scale plate at this position.

#### **RECLOSING "OFF-NORMAL" CAM**

This adjustment is exactly the same as that performed on the reset off-normal cam setting.

#### **LOCKOUT CAM SETTING**

The maximum time to lockout can be gotten by removing the lockout cam altogether and allowing the reclosing off-normal cam to perform the dual function of acting as the lockout cam as well. In that case, the maximum lockout time available is about 4 minutes. Should a shorter lockout time be required, it is necessary to use the second cam screw and to set it as desired in the rear section of the reclosing cam drum and to check this time by test.

#### **RECLOSING CAM SETTINGS**

Four reclosing cams are supplied with the relay, the instantaneous initial reclosure, a 15 second reclosure, a 60 second reclosure and a 120 second reclosure. Additional cams are available upon request. If the instantaneous initial reclosure cam is not desired, it can be easily removed. At this point it is important to note that the reclosing cams should not be spaced closer together than 20 seconds to permit the number 13 contact to open between cams.

The reclosing times available are from instantaneous reclosure, to a delay of approximately 3 minutes and 40 seconds.

The suggested minimum time for the first timed  
\* reclosing cam is 15 seconds. The minimum time between successive reclosing cam settings is 20 seconds. The suggested minimum off time (the time the #13 contact is open) is 5 seconds. The minimum on time per cam is approximately 12 seconds.

#### **REPAIRS AND RENEWAL PARTS**

Repair can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

ENERGY REQUIREMENTS

\* The burdens for the various elements of the RCD relay when energized from 120 volts 60 hertz supply are listed below:

Motor Circuits

Function	Volt/Amperes	Watts
Reclosing	9.40	6.40
Lockout	4.30	3.25
Reset	4.40	2.80
SG Aux. Relay (Z Unit)	12.5	6.70
SX Aux. Relay (W Unit)	10.2	6.5

When used on a d-c control voltage of 125 volts d-c, the SG burden is 20.2 watts.

The SX burden is 21.8 watts. The power dissipated in each resistor is 18.2 watts at 125 volts d-c

At 48 volts d-c control voltage the power dissipated in the SG unit is 6.7 watts, while the power dissipated in the SX unit is 7.5 watts. At 48 volts d-c the power dissipated in each of the resistors is 4.3 watts.

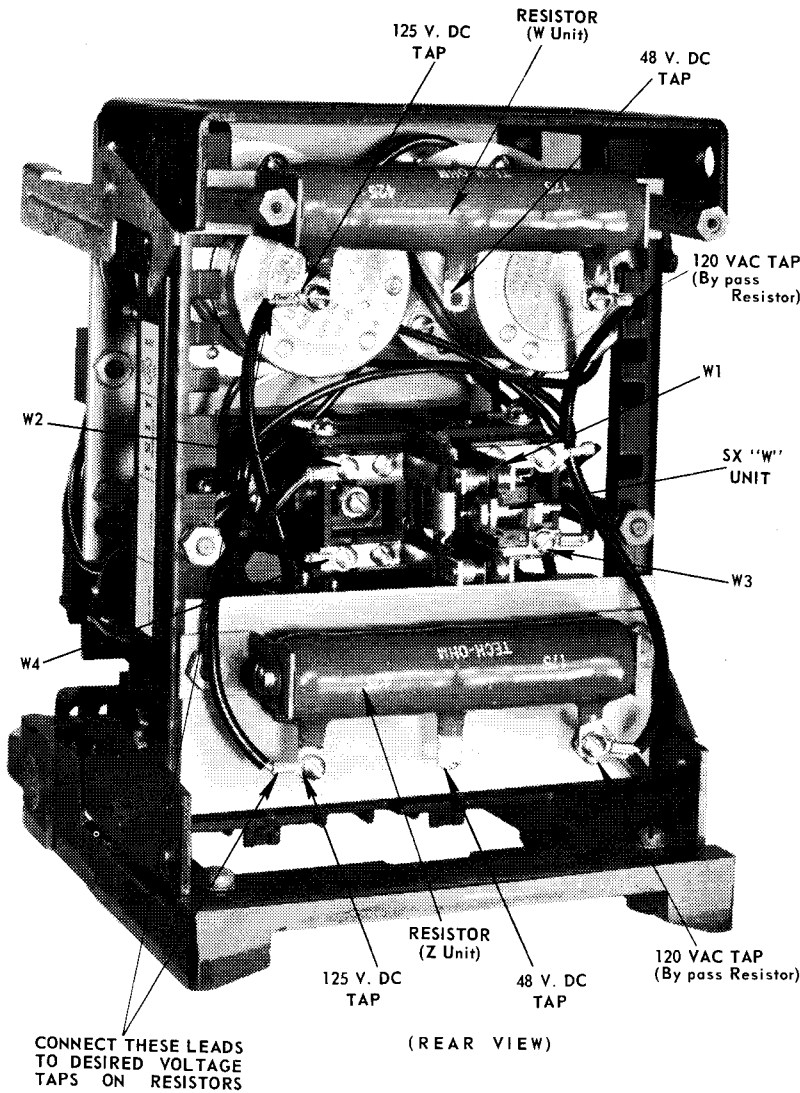
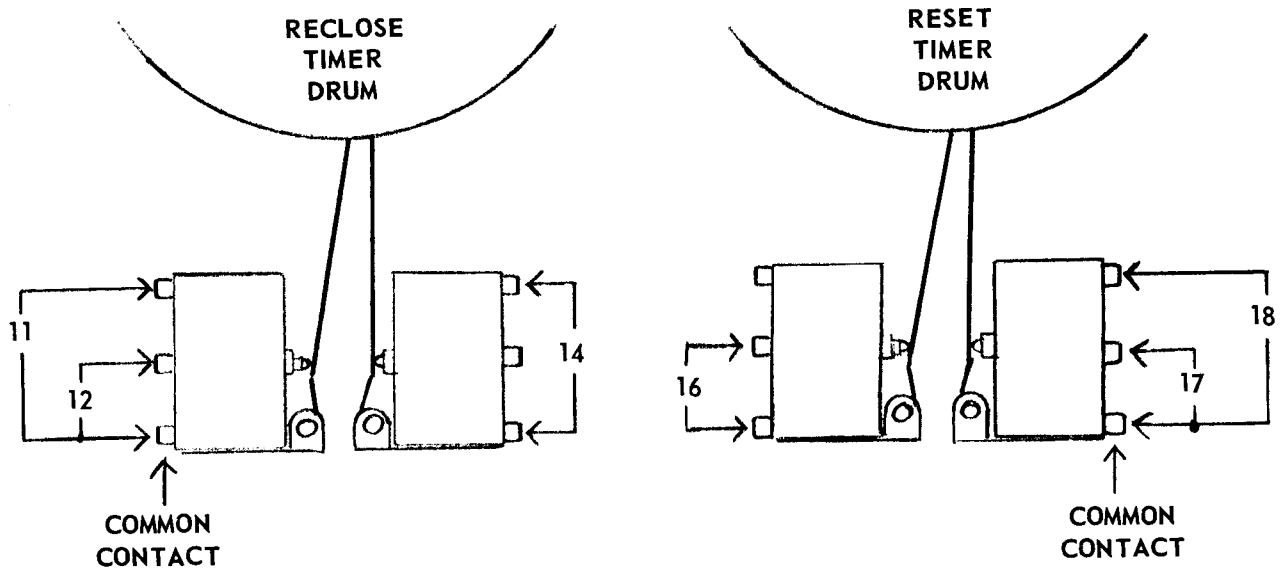
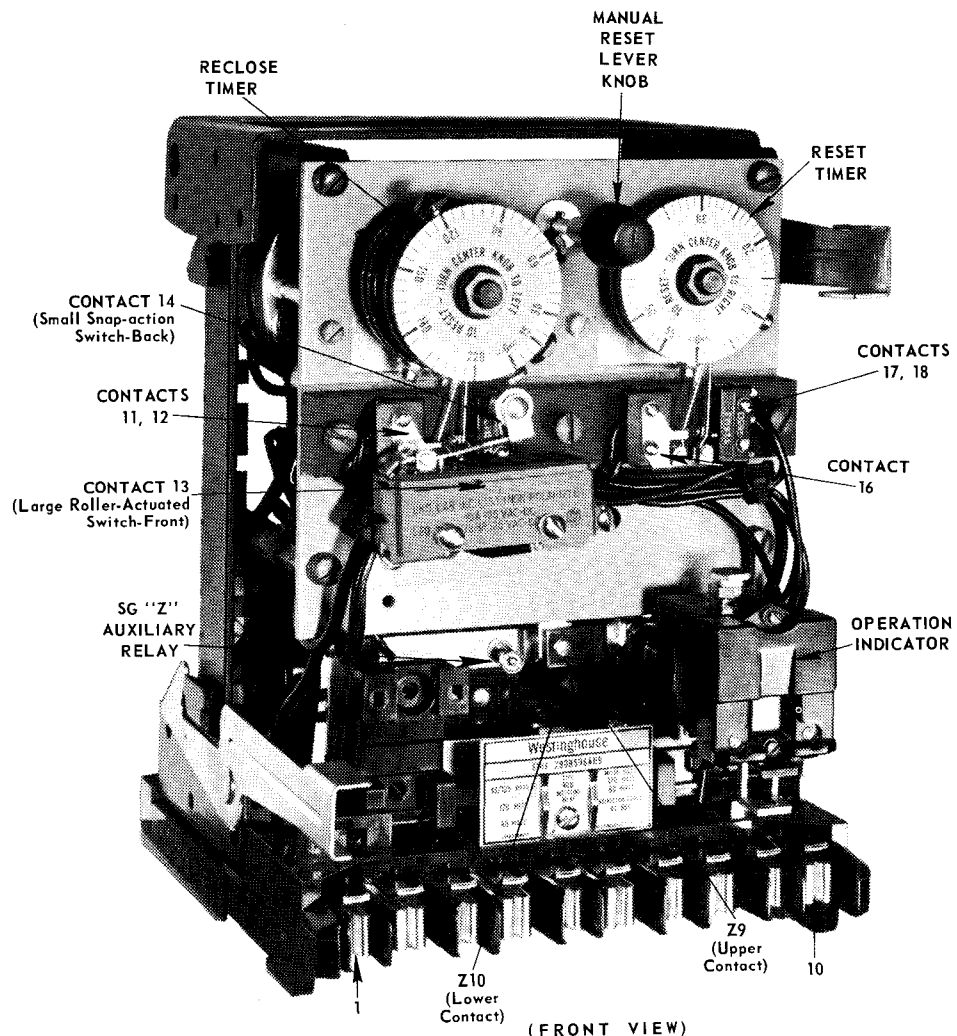


Fig. 1. Type RCD Relay





SNAP-ACTION SWITCH CONTACT IDENTIFICATION.  
RCD RELAY - FRONT VIEW  
Drums in Reset Position



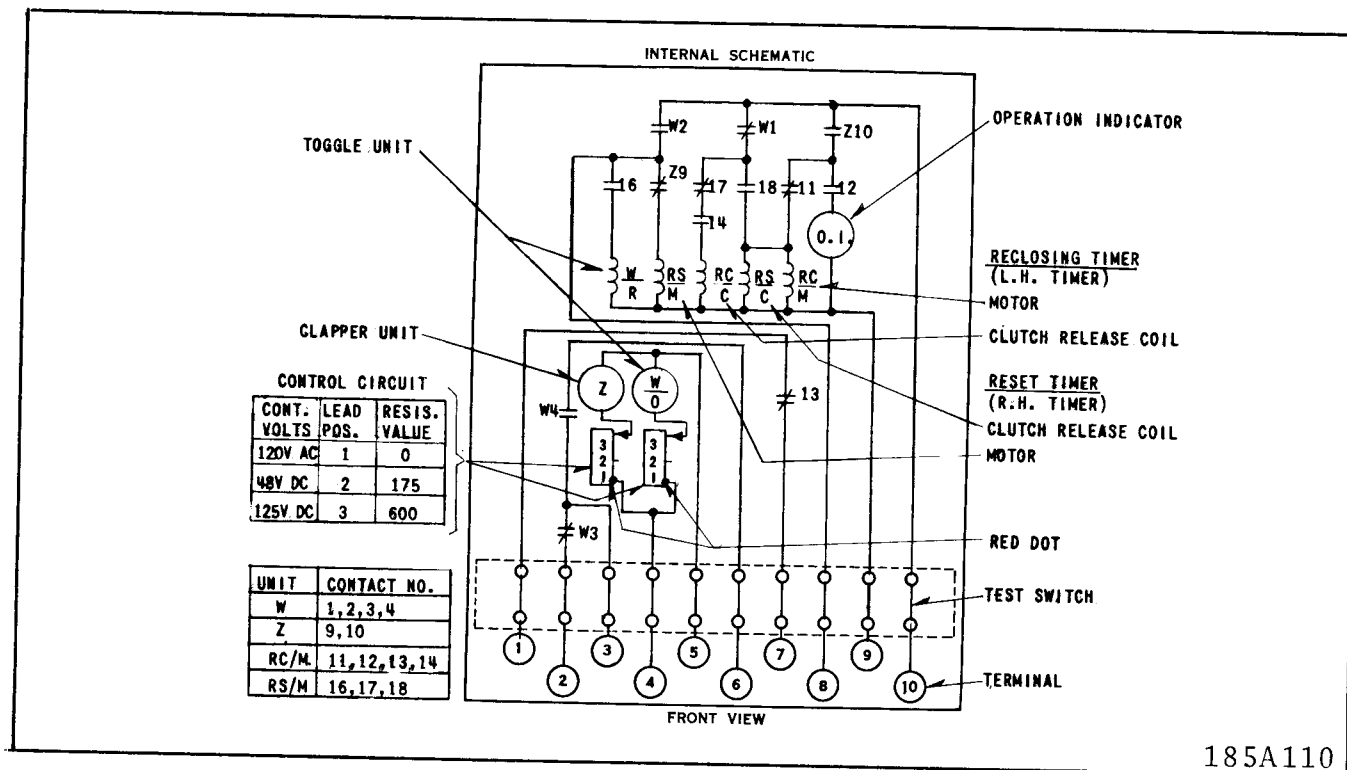
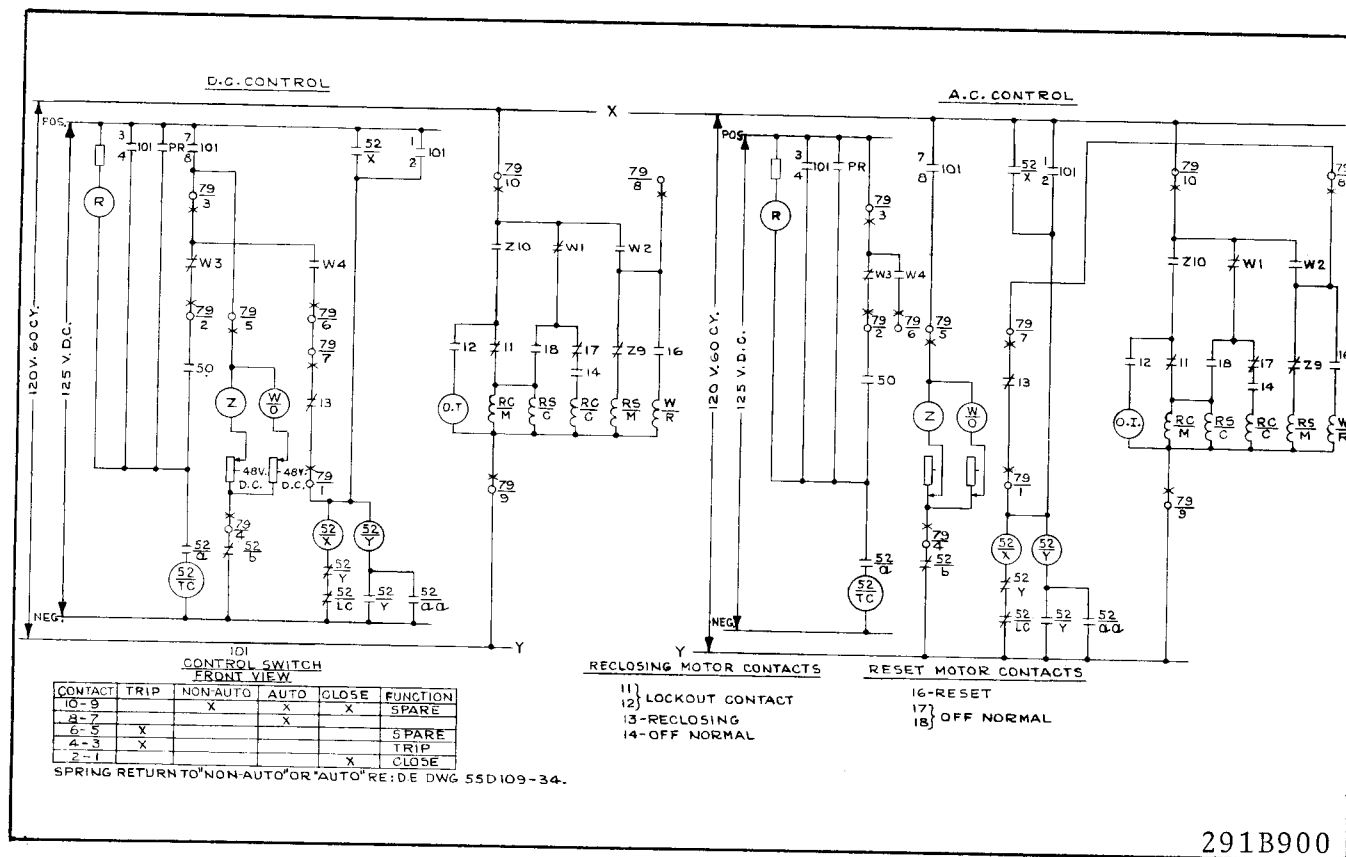


Fig. 2. Internal Schematic



\* Fig. 3. External Schematic

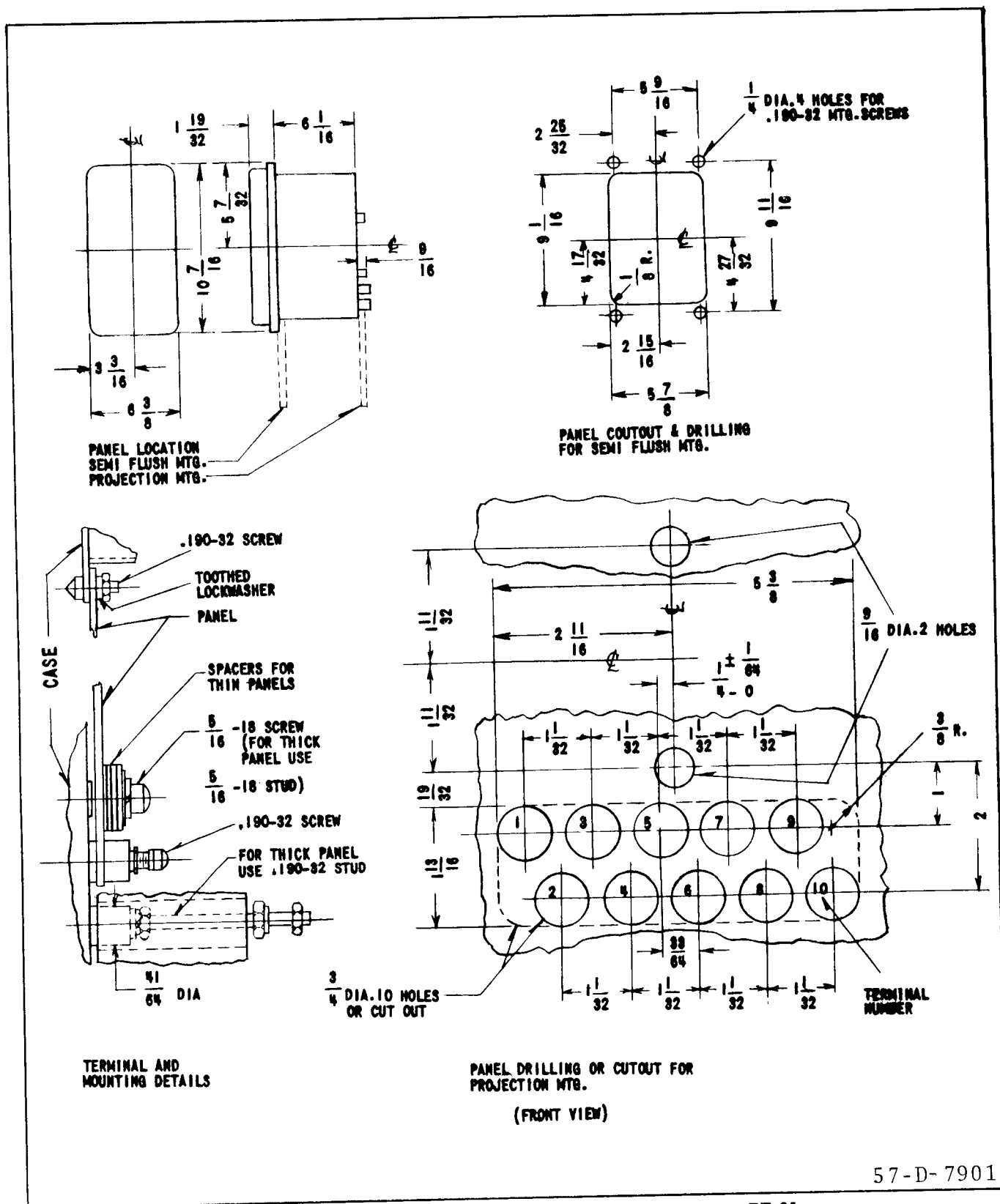
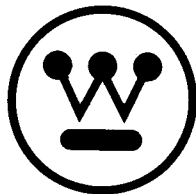


Fig. 4 Outline &amp; Drilling Plan for the type RCD Relay in FT-21 case.



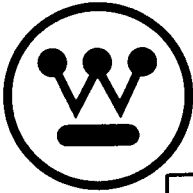




**WESTINGHOUSE ELECTRIC CORPORATION**  
**RELAY-INSTRUMENT DIVISION**

**NEWARK, N. J.**

Printed in U.S.A.



# INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

## TYPE RCD AUTOMATIC RECLOSING RELAY

**CAUTION:** Before putting protection relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment. Make sure that all moving parts operate freely. Inspect the contacts to see that they are clean and can close properly. Operate the relay to check the settings and electrical connections.

### APPLICATION

The type RCD relay initiates breaker reclosing following protective relay tripping. It is suitable for use in any a-c or d-c close circuit provided the breaker itself has adequate anti-pump protection.

### CONSTRUCTION

There are four components essential to the operation of the RCD reclosing relay as follows:

Reclosing timer, reset timer, an SX auxiliary relay, and an SG auxiliary relay.

In addition to these four there is also an operation indicator, two voltage dropping resistors, and several limit and transfer switches whose function will be explained in subsequent paragraphs.

#### 1. Reclosing timer

This timer is connected to run forward while the circuit breaker is open, to remain stationary while the breaker is closed and reset timer is running, and to reset to its starting position when the reset timer times out. The timing drum is driven by a synchronous motor, making a complete revolution in approximately four minutes. The motor is coupled to the drum, through a clutch assembly which is normally engaged. An electromagnetic clutch release unit permits spring return of the drum to its starting position. The reclosing timer controls four contacts. The first, the number 13 closing contact is a roller actuated snap action switch which is mounted directly below the reclosing drum on the front

of the relay. It is operated by cams spaced at desired intervals about the periphery of the reclosing drum. The other three contacts of the reclosing timer are operated by two cam screws located in the rear section of the disc assembly. At the start and timed-out positions of the drum's travel one or the other of two lever arms on the snap action switches is operated. Off normal contact No. 14 operates whenever the the disc leaves its starting position; and lockout contacts 11 and 12 transfer whenever the drum completes the full revolution. However, the lockout cam can be adjusted for any time up to four minutes.

#### 2. Reset Timer

This timer is connected to run forward after the circuit breaker has closed, to reset to its starting position if the circuit breaker opens while it is running, to provide a signal for the resetting of the entire reclosing relay in preparation for a new cycle, when the breaker remains closed for the preset interval. The reset timer has the same arrangement of synchronous motor, clutch, release magnet, and reset spring, as described in the previous paragraph. However, the disc assembly is different in that there is one section. The time for complete revolution of the reset drum is one minute.

#### 3. SX Auxiliary Relay

The SX unit is a toggle action relay and controls contacts W1, W2, W3 and W4. The SX unit is referred to as the W unit on the internal schematic. The SX relay possesses memory action in that contacts W1 and W3 remain closed until the operating coil of the toggle unit is energized. Contacts W2 and W4 remain closed until the reset coil of the toggle unit is energized.

The function of the toggle unit when used in the a-c control scheme as shown in Fig. 3 is to provide by way of contacts W1 and W2, means to control the breaker 52X and 52Y coils. In

In addition to this, the W2 contacts also set up through the No. 16 contact a circuit by which the reset coil of the toggle unit will be energized. The W1 contact, through the transfer contacts 17 and 18, sets up the reset cycle by which the reclosing and reset motors are brought back to their initial position. The W3 contact of the toggle unit is used to lockout the instantaneous trip.

When used in the d-c control scheme shown in Fig. 3 the function of the toggle unit is essentially the same except that the W4 contact is now used in series with the 13 contact to control the 52X and 52Y functions.

#### 4. SG Auxiliary Relay

The SG auxiliary relay is controlled by the operation of the 52b switch, and is provided with a normally open and a normally closed contact designated as Z10 and Z9 respectively. Upon closing Z10 the reclosing motor is energized through the No. 11 reclosing motor contact. Upon opening the 52b switch, contact Z9 closes and Z10 opens, setting up through the preclosed W2 contact the circuit permitting the reset motor to initiate its cycle and thereby reset the reclosing motor and the reset motor.

#### Operation Indicator

The operation indicator is controlled by the number 12 contact which is a transfer contact located beneath and to the left of the reclosing motor. As the reclosing motor has timed out and approaches the lockout position, a preset cam screw in the rear disc assembly actuates the lever arm of the enclosed snap action switch. Upon closing of the No. 12 contact the operation indicator is energized and power to the reclosing motor is cut off. The target of the operation indicator drops and remains in that position until manually reset. The coil of the operation indicator is continuously rated.

#### Voltage Dropping Resistors

Two fixed tap resistors are provided at the back of the relay in order to give as much flexibility with regard to voltage ratings encountered on various types of systems. Their full resistance is 600 ohms and they are provided with a tap resistance of 175 ohms.

## OPERATION

Referring to Fig. 3, the a-c control circuit, a typical operating cycle would be as follows. When a line fault occurs, the instantaneous tripping relays close their contact 50 energizing the breaker trip coil 52 T.C. through a circuit from the positive bus through the preclosed W3 contacts, through the protective relay contacts 50, through the breaker contact 52a energizing the 52 T.C. trip coil of the breaker back to the negative side of the bus. The 52b breaker contact closes, energizing the W operate coil, and Z coil, through the 101 switch back to the other side of the a-c bus. Energizing the W operating coil causes contacts W1 and W2 to transfer as well as contacts W3 and W4. Opening W3 opens the trip circuit, closing W2 energizes the 52X and 52Y contactor coils through the #13 contact.

Should the breaker go in on instantaneous initial reclosure the 52b contact will open, the W (operate) and Z coils will be de-energized, therefore, the W2 contact will be closed and the Z9 contact will be closed completing the circuit for the reset motor. The reset motor will begin to time out and as it leaves its initial position contact 17 opens and contact 18 closes setting up the circuit for the reset clutch. As the reset motor times out, the reset cam, which is preset at the factory for a 10 second delay, trips the lever of the left hand switch causing contact #16 to close, thereby completing the circuit through W2 contact through the 16 contact through the reset coil of the SX unit. Energizing the reset coil of the SX unit causes its armature to toggle over, which closes W1 and W3 contacts and opens W2 and W4 contacts. In closing the W3 contact the instantaneous trip circuit is again set up. In closing the W1 and opening the W2 contact, the reset motor is de-energized and the reset clutch is energized, through the closed W1 contact through the closed #18 contact and through the reset clutch coil. Because of the speed with which the reset cycle takes place the reclosing motor never begins its cycle, even though there is a circuit through the W1 contact and the number 18 contact through the reclosing motor coil. Energizing the reset clutch causes the spring return of the reset drum to its starting position. As the drum resets itself contact #16 opens de-energizing the reset coil of the SX unit, and upon resetting, the lever of the right hand switch is closed by the first cam on the reset drum causing the #17 contact to close and the #18 contact to



## TYPE RCD AUTOMATIC RECLOSING RELAY

open. Opening the #18 contact de-energizes the reset clutch and reclosing motor. The relay is once again in a position to perform the instantaneous initial reclosing function. Should the breaker fail to go in on instantaneous initial reclosure the following sequence of events takes place:

The breaker is open, therefore, the 52b switch is closed, the W operate coil and the Z coil are both energized, therefore, W2 is closed W1 is opened, W4 is closed and W3 is open. Z10 is closed, setting up the circuit through Z10 through the closed contact #11, through the reclosing motor and reset clutch coils, as the reclosing motor starts to rotate, the first cam in the rear section of the drum releases the right hand snap action switch lever, thereby, closing the #14 contact. However, the reclosing clutch does not get energized at this time since the W1 contact is open. As the instantaneous reclosing cam moves off the roller of the large snap action switch, the #13 contact is opened. Opening the #13 contact disconnects the 52X and 52Y coils from the circuit. The reclosing motor continues to rotate until the 10 second cam actuates the roller lever of the snap action switch and causes the #13 contact to close, thereby, energizing the 52X and the 52Y coils. Assuming that the breaker does not go in on the first or second reclosure the reclosing motor continues to rotate and as the third reclosing cam actuates the #13 contact let us assume that the breaker goes in at this point. Should the breaker successfully reclose, the 52b contact opens and the W operating coil of the toggle unit is de-energized as well as the Z coil. Contact Z10 opens thereby de-energizing the reclosing motor and contacts W1 and W2 remain in their former position because of the "memory action" of the SX unit, that is, W2 is closed and W1 is open. De-energizing the Z unit also causes Z9 to close, thereby, energizing the reset motor through a circuit from one side of the a-c bus through terminal #10 through contact W2 and Z9 through the reset motor coil to terminal 9 of the relay and back to the other side of the a-c bus. The reset motor begins to time out and as it does, contact #18 closes and #17 opens. Thereby, setting up the reset clutch circuit. As the 10 second cam of the reset motor actuates the left hand snap action switch the #16 contact closes energizing the reset coil of the SX unit toggles the armature over, thereby, opening the W2 contact and closing the W1 contact, the W3 contact is closed and the W4 contact is also open. Opening the W2 contact de-energizes the reset motor as well as the 52X and 52Y coils. Closing the W1 contact causes the

reset clutch to be energized through the closed contact #18, this results in resetting the reset drum causing the #16 contact to open which de-energizes the reset coil of the toggle unit, and causes the transfer contact #17 to close and #18 to open. Opening the #18 contact de-energizes the reset clutch, closing the #17 contact results in energizing the reclosing clutch through the pre-closed #14, #17 and W1 contacts and back to the source. Energizing the reclosing clutch results in resetting the reclosing drum, by means of the spring return mechanism, back to its initial position. As the reclosing drum resets itself, the screw cam in the rear section of the drum causes the right hand snap action switch lever to depress, which in turn opens the #14 contact and de-energizes the reclosing clutch. The relay is now totally reset and ready for another sequence of operation.

Had the breaker not gone in after the third reclosure the reclosing motor drum would have continued to rotate until the lockout cam, located in the rear section of the drum, tripped the lever of the left hand snap action switch directly beneath the drum. Tripping this switch results in transferring the #11 and #12 contacts so that, the #12 contact is closed energizing the operation indicator from one side of the a-c bus through terminal 10 through Z10 through the #12 contact and the operation indicator coil through the #9 coil of the relay back to the other side of the a-c bus. Energizing the operation indicator causes the target to drop and remain in this position until manually reset. The opening of the #11 contact interrupts the power to the reclosing motor causing it to stop at the lockout position.

After the breaker has been manually reset the 52b contact opens and the automatic resetting of the relay takes place as described in the previous paragraph. The target of the operation indicator is then reset manually and the relay is again ready for another sequence of operation.

It should be noted that manual reclosure after lock-out does not reset the relay unless the breaker remains closed for the required reset interval as determined by the setting of the reset cam. Thus, if the breaker trips immediately on a trial reclosure, the relay remains locked out and does not set up a whole new sequence of reclosures. However, any travel that the reset timer may make under these circumstances is not reset when the breaker opens, because the open lockout contact #11 interrupts the circuit to the reset timer clutch release coil, as

well as to the reclosing timer motor. Consequently, a series of unsuccessful manual reclosures may eventually result in timing out the reset timer by steps, a little on each operation, causing the start of a new sequence.

## CHARACTERISTICS

The standard ratings of the type RCD reclosing relay are as follows:

Motor .....120 volts 60 cycles  
Z and W elements (SG .....120 volts 60 cycles  
and SX Auxiliary Relays).....or 48/125 volts d-c

Provision has been made through the use of two fixed tap resistors to attempt to provide the user with as much flexibility as possible with regard to the various types of control voltage available. If it is desired to use the relay on the control voltage of 120 volts 60 cycles it is only necessary to move the left hand lead of each resistor over to the right so that there is a common connection between the leads going to each resistor. Looking at the rear view of the relay the three terminals of each resistor are referred to as terminal 1, 2 and 3 reading from right to left, therefore, for a control voltage of 120 volts 60 cycles, the movable or left hand lead on each resistor would be in position 1. When placed in position 2 the relay would be set for a control voltage of 48 volts d-c. When put in position 3, which is the way the relay is normally shipped from the factory, the control voltage of the relay is set for 125 volts d-c.

### Reset and Reclosing Timing Motors

The reduction gear units of each motor assembly are in the ratio of 4 to 1, that is, the motor shaft speed of 4 rpm results in a drum speed of 1 rpm. The reset drum rotates at 1 rpm, the reclosing drum rotates at 1/4 rpm.

### OPERATION INDICATOR

The coil of the operation indicator is continuously rated at 120 volts 60 cycles.

## INSTALLATION

The relay should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the type F'T projection case or by means of the four mounting holes on the flange for the semi-flush type

of F'T case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench. Before placing in service, check to see that armature of toggle (W) unit is in right hand (rear view) position. See Fig. 4 for outline and drill-plan.

### Adjustments and Maintenance

The proper adjustments to insure correct operation of this relay have been made at the factory. Re-adjustment after receipt by the customer will be necessary only as required by the reclosing cycle requirements and the supply voltages of the particular application. In making such changes, or in checking the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be periodically cleaned with a fine file. Style #1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of imbedding small particles in the face of the soft silver and thus impairing the contacts.

The resistors in series with the Z and W elements should be connected in or out of the circuit as required by the voltage of the control supply to which the relay will be connected and as described in a paragraph under "CHARACTERISTICS".

Should it become necessary to replace the coil of the operation indicator, be sure that the core screw is in the "all in" position.

### Motor Lubrication

The synchronous timing motors have been supplied with an extra C.C. of silicone lubricating oil, and should not need further lubrication throughout their life.

The two posts provided on the upper portion of the relay (rear view) are provided to facilitate maintenance of the relay. The relay may be laid down on its back while performing routine maintenance without damage to the contacts of the SX relay.

### RELAY CAM SETTINGS

Looking at the front view of the relay, the knob posi-

**TYPE RCD AUTOMATIC RECLOSING RELAY**

tioned between the reclosing and reset drums provides for the manual rotation of either drum. When it is desired to manually turn the reclosing drum in order to facilitate cam positioning, the reset lever knob should be turned to the left. If it is desired to turn the reset drum manually the reset lever knob should be turned to the right.

**RESET CAM SCREW ADJUSTMENTS**

It will be noted that there are two cam screws on the reset drum assembly; it should not be necessary to adjust the cam screw which holds the lever of the right hand snap action switch closed. However, should replacement of that switch become necessary, the cam screw should be moved in the direction to close the plunger of the switch and the gap between the lever of the switch and the switch body, as measured at the top of the switch should be  $1/16 \pm 1/64$  inch, when the switch is closed. This adjustment should be made with the reset drum in the fully reset position (with the roll pin against the stop). This cam is known as the reset off-normal cam.

**RESET CAM SETTING**

With the reset drum in the fully reset position, apply 120 volts 60 cycles between terminals 8 and 9 for  $10 \pm 1$  second. Remove the voltage and bring the the second cam screw clockwise around the drum until the left hand microswitch contacts just close. Tighten the cam at that position and line up the 10 second mark of the dial plate with the center of the cam screw. Re-tighten the end nut to hold the scale plate at this position.

**RECLOSING "OFF-NORMAL" CAM**

This adjustment is exactly the same as that performed on the reset off-normal cam setting.

**LOCKOUT CAM SETTING**

The maximum time to lockout can be gotten by removing the lockout cam altogether and allowing the reclosing off-normal cam to perform the dual function of acting as the lockout cam as well. In that case, the maximum lockout time available is about 4 minutes. Should a shorter lockout time be required, it is necessary to use the second cam screw and to set it as desired in the rear section of the reclosing cam drum and to check this time by test.

**RECLOSING CAM SETTINGS**

Four reclosing cams are supplied with the relay, the instantaneous initial reclosure, a 15 second

reclosure, a 60 second reclosure and a 120 second reclosure. Additional cams are available upon request. If the instantaneous initial reclosure cam is not desired, it can be easily removed. At this point it is important to note that the reclosing cams should not be spaced closer together than 20 seconds to permit the number 13 contact to open between cams.

The reclosing times available are from instantaneous reclosure, to a delay of approximately 3 minutes and 40 seconds.

The suggested minimum time for the first reclosing cam is 15 seconds. The minimum time between successive reclosing cam settings is 20 seconds. The suggested minimum off time (the time the #13 contact is open) is 5 seconds. The minimum on time per cam is approximately 12 seconds.

**REPAIRS AND RENEWAL PARTS**

Repair can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete name-plate data.

**ENERGY REQUIREMENTS**

The burdens for the various elements of the RCD relay when energized from 120 volts 60 cycle supply are listed below:

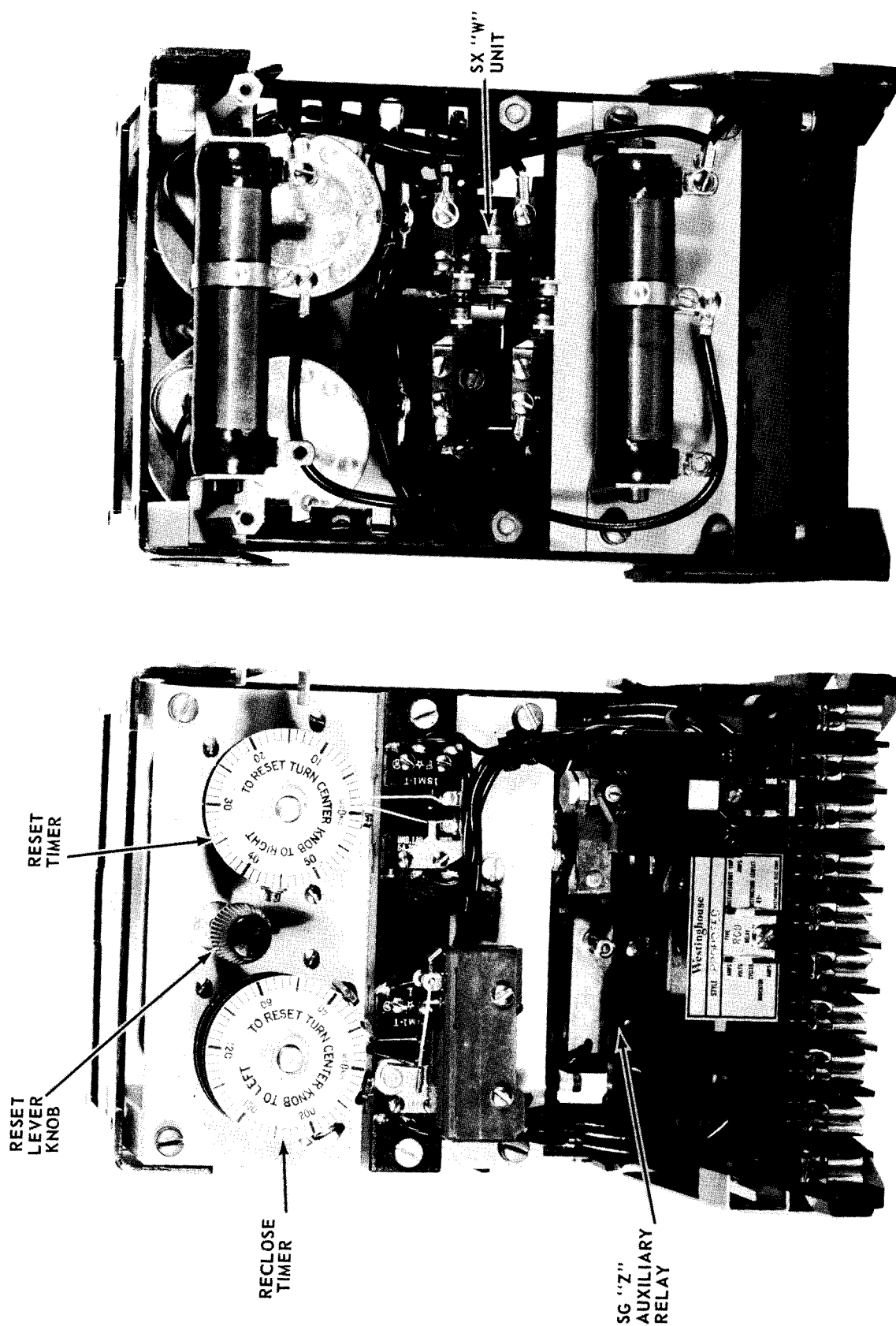
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<u>Function</u>	<u>Volt/Amperes</u>	<u>Watts</u>
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Reset	4.40	2.80
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SX Aux. Relay (W Unit)	10.2	6.5

When used on a d-c control voltage of 125 volts d-c, the SG burden is 20.2 watts.

The SX burden is 21.8 watts. The power dissipated in each resistor is 18.2 watts at 125 volts d-c

At 48 volts d-c control voltage the power dissipated in the SG unit is 6.7 watts, while the power dissipated in the SX unit is 7.5 watts. At 48 volts d-c the power dissipated in each of the resistors is 4.3 watts.



\* Fig. 1. Type RCD Relay

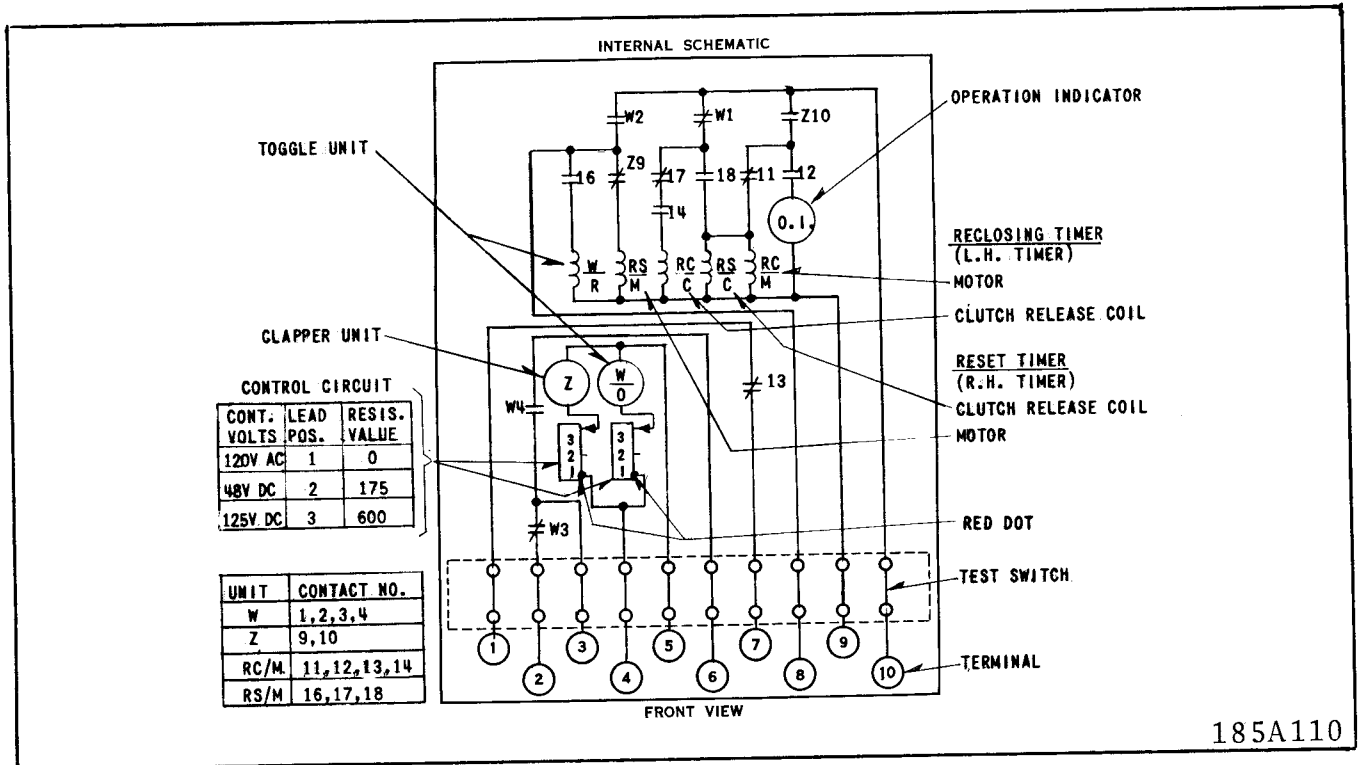


Fig. 2. Internal Schematic

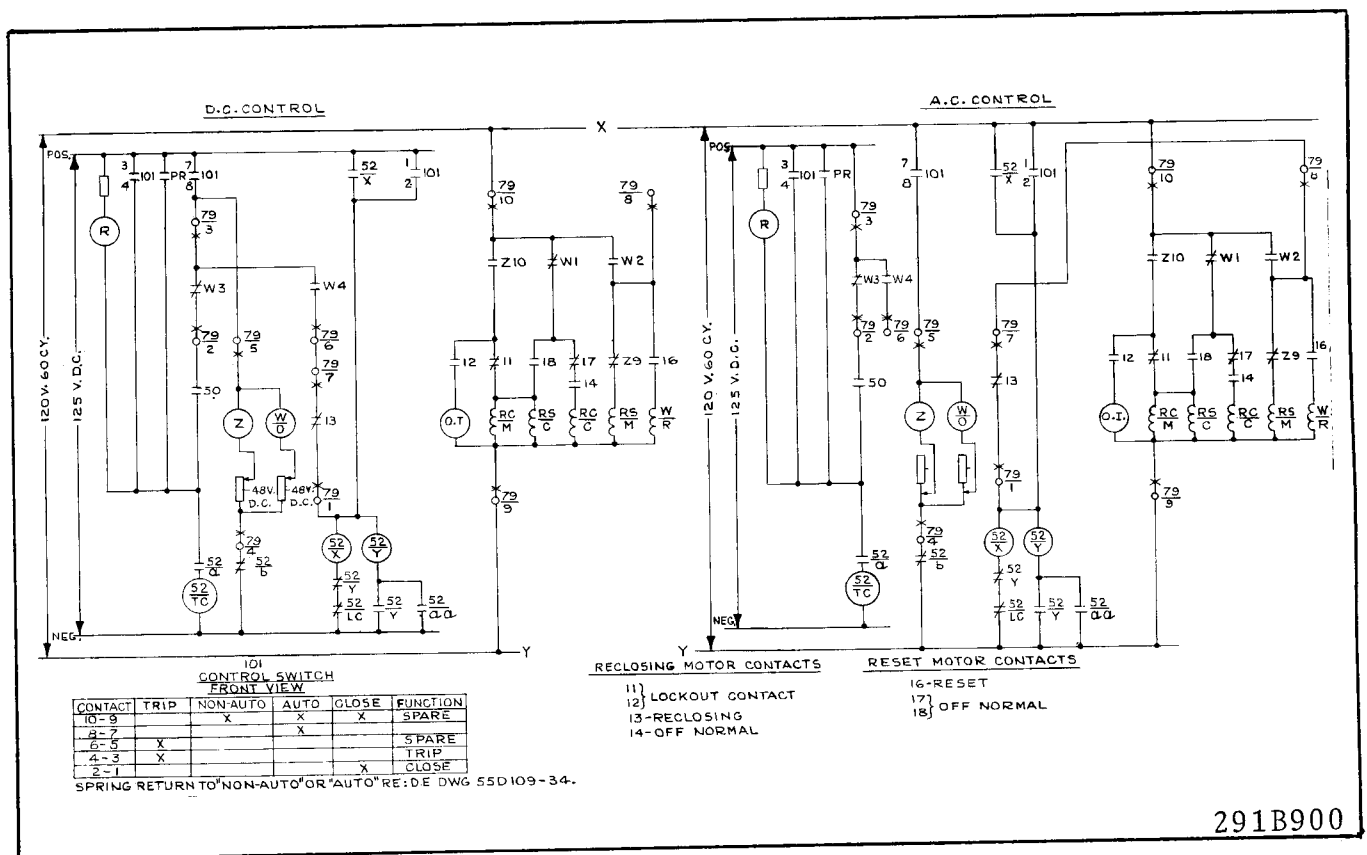
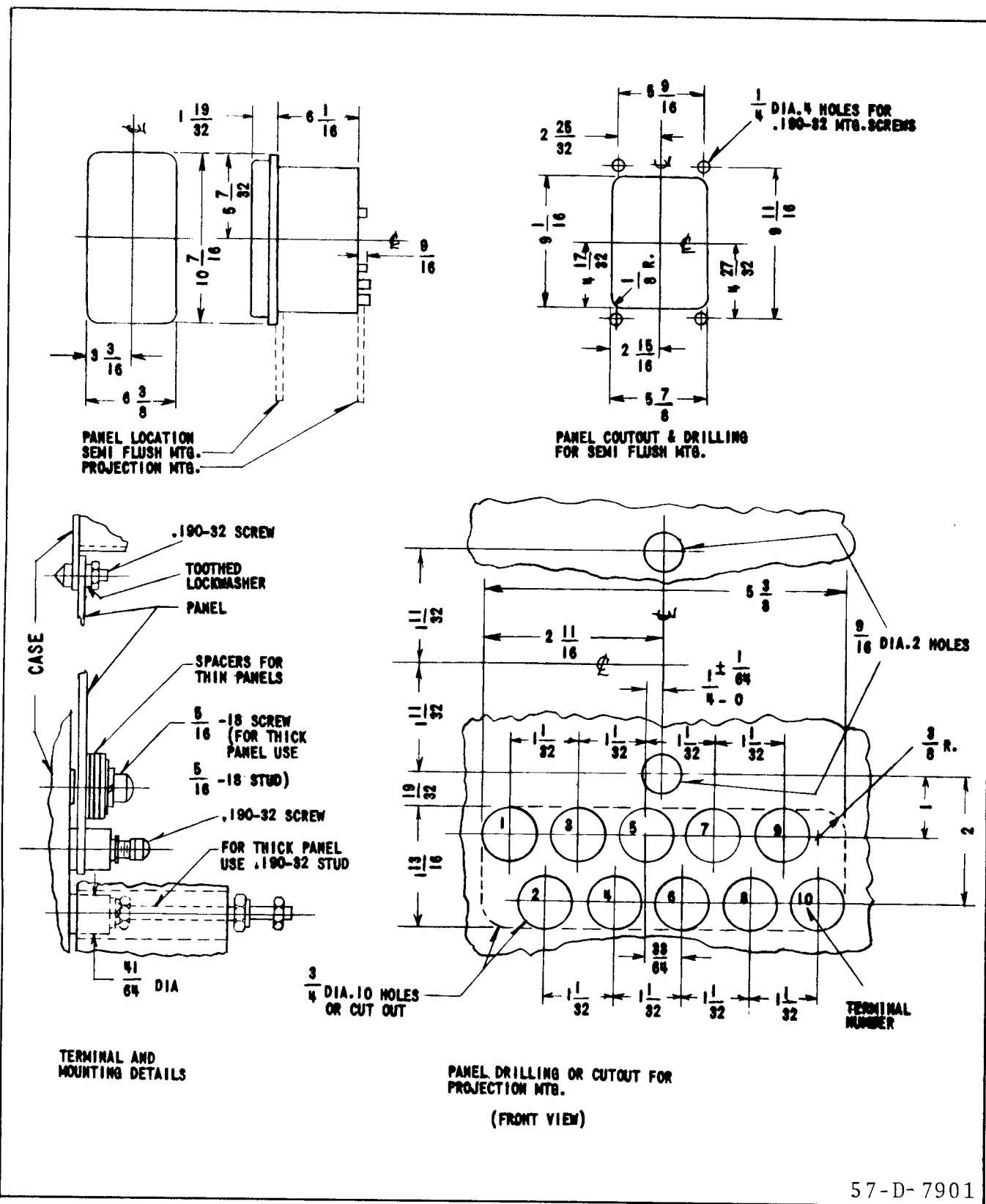


Fig. 3. External Schematic



**Fig. 4 Outline & Drilling Plan for the type RCD Relay in FT-21 case.**

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