INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

SGR-51 RECLOSING RELAY

APPLICATION

The SGR-51 Reclosing relay provides for instantaneous reclosure of an electrically operated circuit breaker, and automatically resets itself if the breaker remains closed for a predetermined adjustable time interval. If the breaker retrips before the end of this interval, the resetting operation of the relay is interrupted until the breaker is manually closed. Thus, the reclosing relay is applicable to either attended or non-attended stations.

CONSTRUCTION

The SGR-51 is a completely static relay consisting of (1) a timing circuit, (2) a flip-flop control circuit, (3) an output pulse circuit, and (4) a reclosing circuit. All components except the reclosing circuit Thyristor are mounted on a printed circuit board. The Thyristor is mounted on a heat sink located on a sub base. All components are identified on the internal schematic on Figure 1.

Timing Circuit

The timing circuit is a unijunction relaxation oscillator consisting of unijunction transistor Q1, resistors R1, R2, and R14 and potentiometer RH-1. After a preset time interval controlled by the front mounted time dial potentiometer RH-1, the relaxation oscillator fires and feeds an output pulse to the flip-flop control circuit.

Flip-Flop Control Circuit

The flip-flop control circuit consists of transistors Q_1 and Q_2, resistors R3, R4, R5, R6, R11, R_{12}, and R_{13}, and capacitor C_5. The flip-flop control circuit changes state when pulsed by the timing circuit. This turns transistor Q_4 off thereby removing the short circuit from capacitor C_3 and allowing the output pulse circuit to operate.

Output Pulse Circuit

The output pulse circuit consists of transistor Q4 and a unijunction relaxation oscillator made up of unijunction transistor Q_5, capacitor C_3, resistors R_8 and R_9, and pulse transformer T_1. When transistor Q4 turns off, the short circuit is removed from capacitor C_3 and C_3 charges through R_8 to the firing level of unijunction transistor Q_5. Q_5 fires and produces a pulse across winding 3-4 of pulse transformer T-1. Diode D_3 short circuits any back voltage generated in pulse transformer T1.

Reclosing Circuit

* The reclosing circuit consists of Thyristor, TCR holding circuit C_4 and R_{10}, and Zener diodes Z_2 and Z_3. The output pulse in winding 3-4 of pulse transformer T_1 is coupled through winding 1-2 to the gate of the TCR. This pulse turns the TCR on and allows current to flow from anode to cathode. Holding circuit C_4 and R_{10} allows the TCR to turn on when operated into an inductive load. Zener diodes Z_2 and Z_4 protect the Thyristor from transient voltages which might cause premature conduction or damage.

OPERATION

* The following description is made with reference to Figure 3.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions transistors Q_2, Q_4, and Q_6 are on and transistor Q_3 is off. When the breaker is closed, the 52B contact connected to terminal 4 opens and removes the base drive to transistor Q_6 turning it off. When Q_6 turns off, the short-circuit is removed from C_2 allowing it to charge through RH-1 and R_2. C_2 charges to the firing voltage of unijunction transistor Q_1. The time required for C_2 to charge and fire Q_1 is controlled by potentiometer RH-1 which is mounted on the front of the relay over a calibrated time dial. When Q_1 fires, C_2 discharges through Q1 and R_{14}. The resultant voltage drop across R_{14} causes the voltage on the emitter of Q_2 to rise above its base voltage. This causes flip-flop transistor

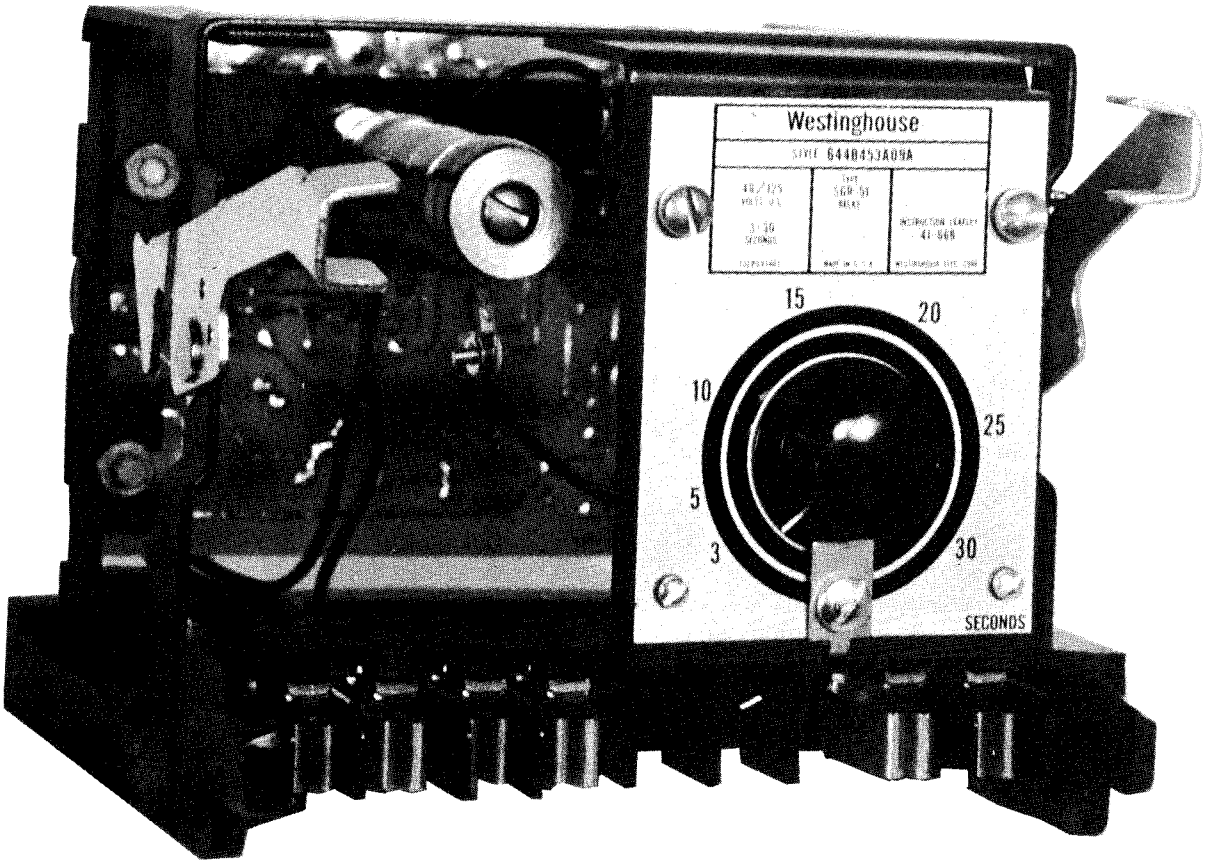


Fig. 1 Type SGR-51 Reclosing Relay (Front View).

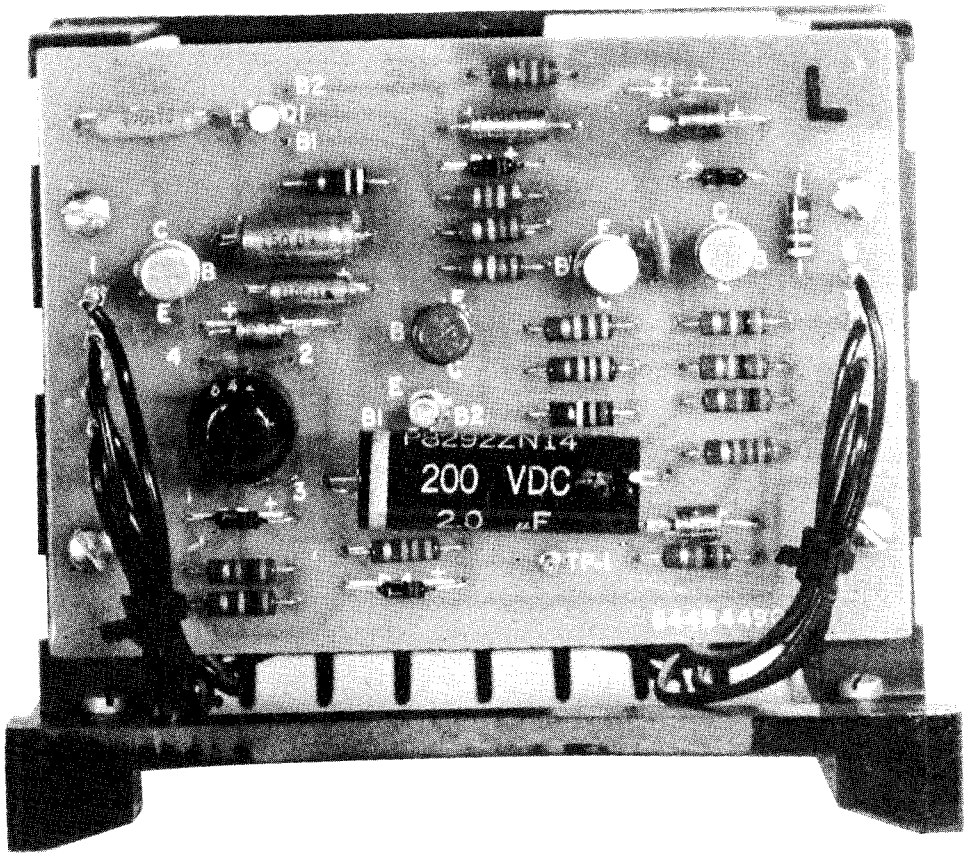


Fig. 2 Type SGR-51 Reclosing Relay (Rear View).

Q_2 to turn off which turns transistor Q_3 on. When Q3 turns on, its collector voltage drops to a low level and removes the base drive to transistor Q_4. The low voltage level on the collector of Q_3 also disables the timing circuit by forward biasing diode D_1 and providing a path for current to flow through RH-1, R_2, D_1 and Q_3 so that capacitor C_2 cannot charge up to a point where it will again fire unijunction transistor Q_1. If a fault appears on the protected line and a protective relay opens the breaker, the 52b contact connected to relay terminal 4 makes up and applies 24 volts to resistor R_8 in the output pulse circuit. Capacitor C_3 charges up to the firing level of unijunction transistor Q_5. The relaxation oscillator made up of capacitor C_3, unijunction transistor Q_5, resistors R_8 and R_9, and pulse transformer T_1 starts to oscillate. The positive pulses produced across pulse transformer T_1 by the oscillation of the relaxation oscillator are coupled to the gate of the TCR. The TCR turns on and allows current to flow from the positive battery supply through the TCR, out relay terminal 1, through the 52b contact and 52x coil to negative battery. The 52x coil is energized and the breaker immediately recloses. When the 52x coil is energized, the 52x contacts make and apply 24 volts to relay terminal 2. This positive voltage at terminal 2 is applied through resistor R_{16} and diode D_2 to the collector of flip-flop transistor Q3. This positive voltage on the collector of Q_3 causes Q_3 to turn off and Q_2 to turn on. When Q_3 turns off its collector goes positive providing base drive for transistor Q4. Q4 turns on and short-circuits capacitor C_3. With C_3 short-circuited, the output pulse circuit is disabled and positive pulses are removed from the gate of the TCR. The TCR turns off when the breaker recloses and the 52b contacts connected to terminal 1 open.

When the 52x contacts closed and applied a positive voltage to the collector of Q_3, the flip-flop was reset. In this state transistor Q_3 is off and Q_2 is on. With Q_2 off, its collector is highly positive. This reverse biases diode D_1 and turns Q_4 on. When Q_4 turns on it shorts C_3 and disables the output pulse circuit. When the breaker recloses, the 52b contacts connected to relay terminal 4 opens and remove the base drive to transistor Q_6. Q_6 turns off and capacitor C_2 is allowed to charge up again through RH-1 and R_2. Let us assume that a protective relay operates to trip the breaker before C_2 has charged to the firing level of Q_1. When the breaker opens, the 52b contact connected to relay terminal 4 closes and turns transistor Q6 on. Q6 short-circuits capacitor C_2 and removes the charge that had started to build up. Since the charge on C_2 had not reached a level to fire Q_1, the control flip-flop has not changed state and the output pulse circuit remains disabled. This means that there are no gate pulses being coupled to the gate of the TCR and it cannot turn on. Since the TCR does not turn on to energize the 52x coil and reclose the breaker, the breaker will stay locked out until manually closed.

CHARACTERISTICS

Voltage Rating

The SGR-51 is rated for 125 or 48 volts D.C. Unless otherwise specified, the relays are connected for 125 volt operation when shipped.

Thyristor

The Reclosing Thyristor is rated at 30 amps 125 volts D.C. for 20 cycles.

Temperature Range

The SGR-51 is designed to operate over a temperature range from -30°C to +60°C with a reset time of not more than ± 5%.

Energy Requirements

125 V.D.C.	45 Milliamperes
48 V.D.C.	45 Milliamperes

SETTINGS

Supply Voltage Setting

The correct tap on series resistor R_{17} (mounted on sub-base) should be selected for the supply voltage being used. For 125 V.D.C. operation, the two end terminals of R_{17} are used. For 48 V.D.C. operation the center terminal and the terminal nearest the sub-base are used.

Reset Time Setting

The reset time is controlled by front mounted potentiometer RH-1 which is mounted over a calibrated time dial. The reset time is variable from 3 to 30 seconds.

INSTALLATION

The relays 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 four mounting holes on the flange for semi-flush mounting or by

means of the rear mounting stud or studs for projection mounting. Either a mounting stud 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 the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nuts with a wrench.

For detailed FT case information refer to I.L. 41-076.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and no further adjustment should be required.

Acceptance Tests

The following check is recommended to insure that the relay is in proper working order. All checks can best be performed by connecting the SGR-51 as shown in Figure 3. The A relay is used to reset the SGR-51 flip-flop control circuit to the correct state and the B relay is used to simulate breaker action.

With the cal.-oper. switch in the oper. position, push PB-1 to close the B relay. If the B relay is tripped by pushing PB-2 before the reset time set on the time dial has elapsed, the B relay should trip and lock-out. If the B relay is tripped after the reset time has elapsed, the SGR-51 should reclose the B relay instantaneously on the first trip, and if the B relay trip circuit is still energized, the SGR-51 should not allow the B relay to reclose on the second trip.

Calibration Check

The following procedure may be used to accurately check the time dial calibration. Connect a lead from the printed circuit board test point TP-1 to SGR-51 relay terminal 3. With the cal.-oper. switch in the cal. position the B relay is connected to trip open when the SGR-51 times out and energizes its output at terminal 1. This enables the tester to accurately check the time dial calibration by using Ba and Bb contacts to control a timer. The tester pushes PB-1 to close the B relay and start the timer. When the SGR-51 reset timer times out an output appears at terminal 1 which trips the B relay and stops the timer.

Routine Maintenance

All relays should be checked at least once every year or at such other intervals as may be dictated by experience to be suitable to the particular application.

Trouble Shooting

Use the following procedure to locate the source of trouble in the event of improper relay operation.

1. Inspect all wires and connections.
2. Check resistances as listed on the internal schematic, Figure 1.
3. Check voltages or waveforms as listed under electrical checkpoints using a vacuum tube voltmeter and/or an oscilloscope.

Electrical Checkpoints

Apply rated voltage through a switch to terminals 8 and 9. Terminal 9 is positive.

Connect a lead from TP-1 (bottom center of printed circuit board) to relay terminal 3.

Connect a 1K 20 watt resistor from relay terminal 1 to relay terminal 8.

Set the time dial for 15 seconds.

Apply rated voltage to the relay before each test point check and interrupt it after each check. Take test point readings before and after the reset time shown on the time dial.

Use the following table to determine the correct voltages or waveforms at the indicated point. Refer to Figure 4 for printed circuit board component layout.

CIRCUIT	TEST POINT	NORMAL INDICATIONS		COMPONENTS CHECKED
		BEFORE RESET	AFTER RESET	
Circuit Board Supply Voltage	Relay Term. 3	24V ± 1.2V	24V ± 1.2V	R_{17}, Z_1
Timing Circuit	Junction of R_2 and C_2	Slow Voltage rise to approx. 18V	Approx. 1.8V	Q_1, Q_6, C_2, C_1 RH-1, D_1
Flip-flop Control Circuit	Junction of R_3 and R_4 Junction of R_6 and R_7	Approx. 1.3V Approx. 19V	Approx. 19V Approx. 1.3V	Q_2, Q_3, Q_5
Output pulse circuit	Junction of R_8 and C_3 Junction of Q_5 and T_1 Term. 3	.7 volts 0 volts	† Sawtooth waveform rising to 18V in 5 to 7 Msec. † 10 volt pulses every 5 to 7 Msec.	Q_4, Q_5, C_3, T_1, D_3
Reclosing Circuit	Across external 1K resistor connected to terminal 1	0 volts	Rated Voltage	TCR Z_2, Z_3, T_1, C_4

† Oscilloscope only

All measurements made between indicated points and terminal 8 (D.C. Negative)

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to customers who are equipped for doing repair work. When ordering parts, always give the complete data as shown in the electrical parts list.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	DESCRIPTION	WESTINGHOUSE STYLE NUMBER
	CAPACITORS	
C1	1.5MFD 35V 10%	187A508H09
C2	22 MFD 35V 10%	187A508H17
C3	1.5MFD 35V 10%	187A508H18
C4	2 MFD 200V 20%	187A624H05
C5	.01MFD 50V 20%	184A663H01
	CONTROLLED RECTIFIERS	
TCR	2N1846	184A614H06
	DIODE RECTIFIERS	
D1 thru D4	T155	183A790H09
	RESISTORS	
R1	680 ½W	184A763H23
R2	82000 ½W	836A503H70
R3	10000 ½W	184A763H51
R4	33000 ½W	184A763H63
R5	33000 ½W	184A763H63
R6	10000 ½W	184A763H51
R7	180,000 ½W	184A763H81
R8	2700 ½W	184A763H37
R9	1000 ½W	184A763H27
R10	1200 ½W	187A290H17
R11	27000 ½W	184A763H61
R12	27000 ½W	184A763H61
R13	330 ½W	184A763H15
R14	47 ½W	187A290H17
R15	10000 ½W	184A763H51
R16	470 ½W	184A763H19
R17	2250 tapped at 555 25W	187A321H03
R18	1000 ½W	184A763H27
R19	1,000,000 ½W	184A763H99
	TRANSFORMERS	
T1	Pulse Transformer	629A453H02
	TRANSISTORS	
Q2	2N697	184A638H18
Q3	2N697	184A638H18
Q4	2N2349	762A585H13
Q5	2N697	184A638H18
	UNIJUNCTION SWITCHES	
Q1	4JX5E695	629A435H02
Q5	2N2647	629A435H01
	ZENER DIODES	
Z1	HW24B	185A212H12
Z2	1N3051	187A936H01
Z3	1N3051	187A936H01
Z4	1N3026	187A936H03

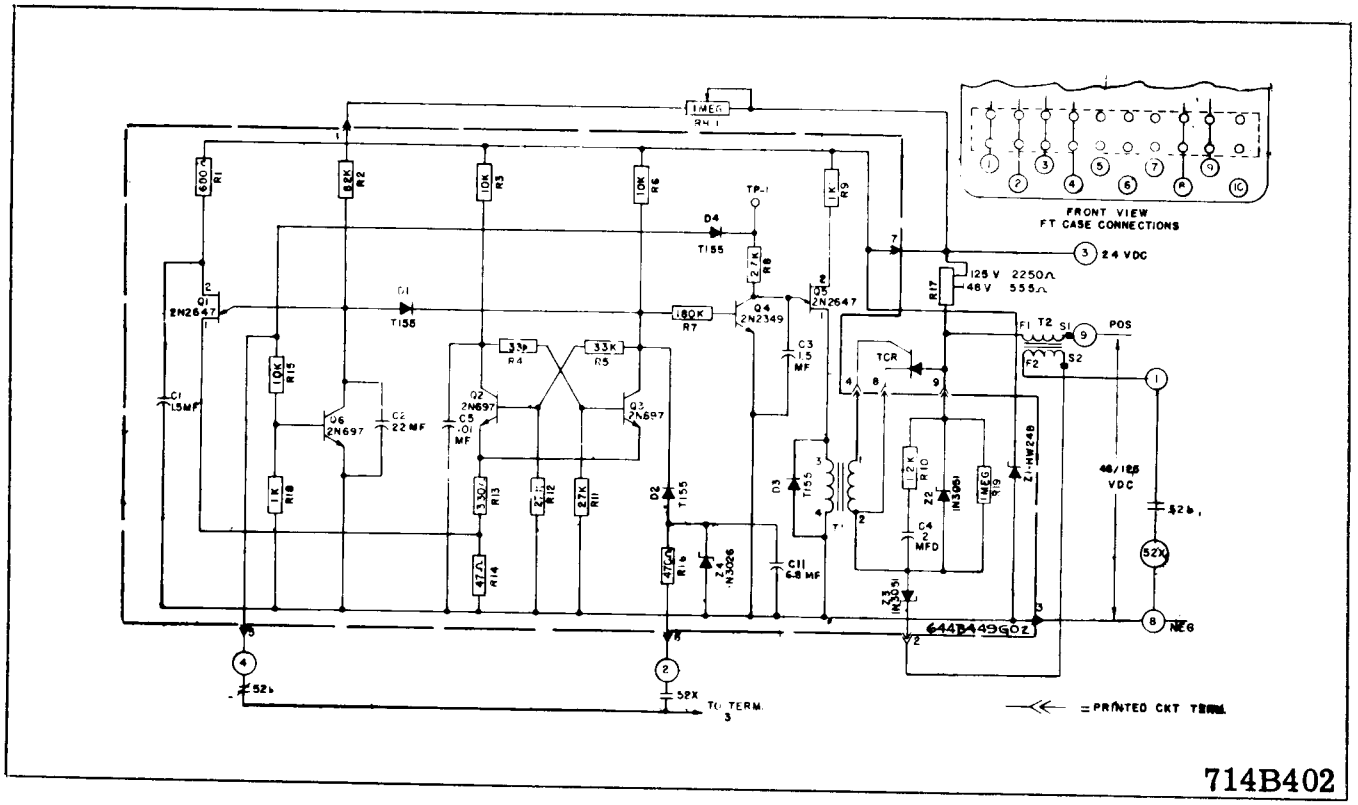


Fig. 3 Internal Schematic of Type SGR-51 Relay

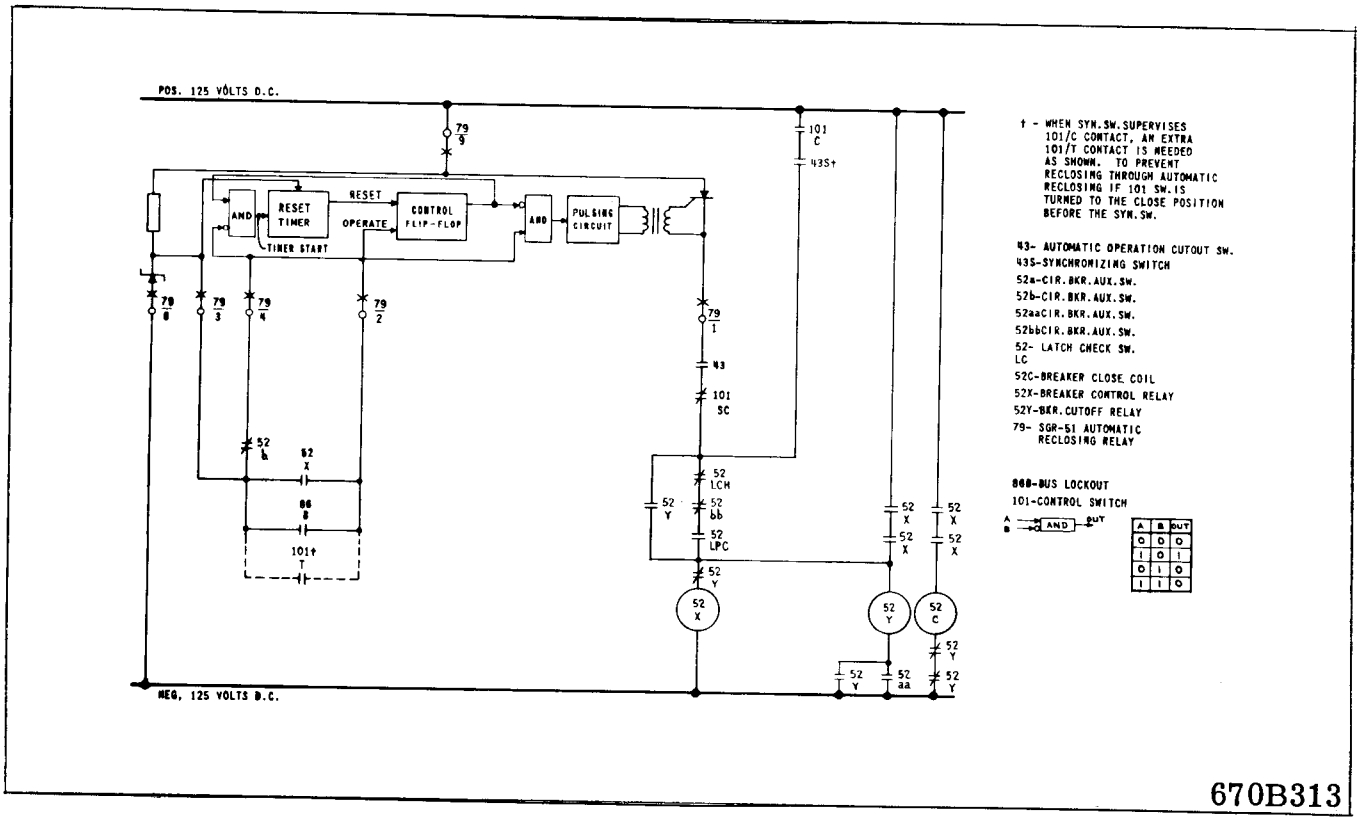


Fig. 4 External Schematic of Type SGR-51 Relay

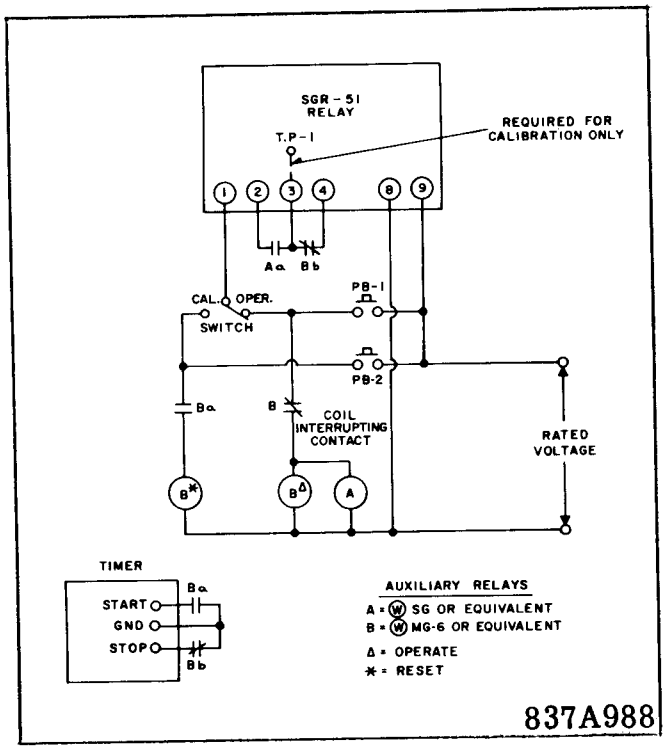
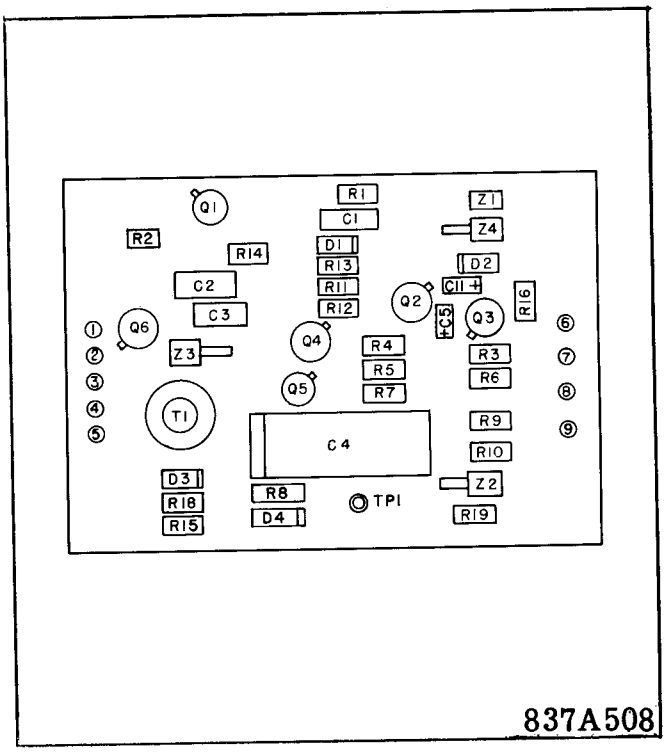


Fig. 5 Test Circuit for Type SGR-51 Relay



* *Fig. 6 Component Layout on SGR-51 Relay Printed Circuit Board*

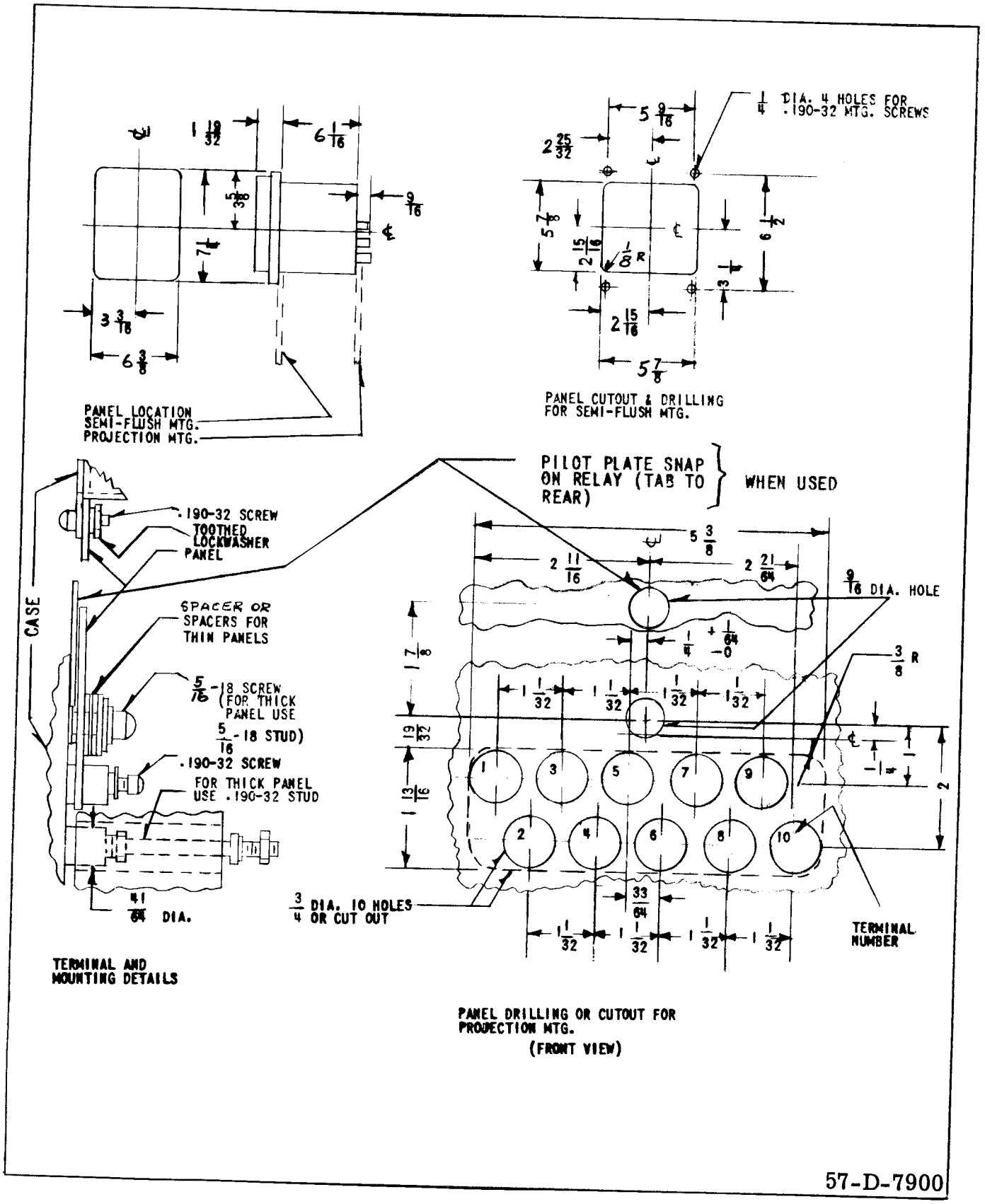
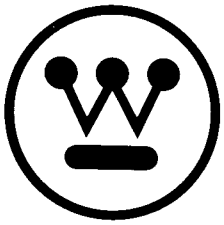


Fig. 7 Outline and Drilling in FT 11 Case



WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION
NEWARK, N. J.
Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

SGR-51 RECLOSING RELAY

APPLICATION

The SGR-51 Reclosing relay provides for instantaneous reclosure of an electrically operated circuit breaker, and automatically resets itself if the breaker remains closed for a predetermined adjustable time interval. If the breaker retrips before the end of this interval, the resetting operation of the relay is interrupted until the breaker is manually closed. Thus, the reclosing relay is applicable to either attended or non-attended stations.

CONSTRUCTION

The SGR-51 is a completely static relay consisting of (1) a timing circuit, (2) a flip-flop control circuit, (3) an output pulse circuit, and (4) a reclosing circuit. All components except the reclosing circuit Thyristor are mounted on a printed circuit board. The Thyristor is mounted on a heat sink located on a sub base. All components are identified on the internal schematic on Figure 1.

Timing Circuit

The timing circuit is a unijunction relaxation oscillator consisting of unijunction transistor Q1, resistors R1, R2, and R14 and potentiometer RH-1. After a preset time interval controlled by the front mounted time dial potentiometer RH-1, the relaxation oscillator fires and feeds an output pulse to the flip-flop control circuit.

Flip-Flop Control Circuit

The flip-flop control circuit consists of transistors Q_1 and Q_2, resistors R_3, R_4, R_5, R_6, R_{11}, R_{12}, and R_{13}, and capacitor C_5. The flip-flop control circuit changes state when pulsed by the timing circuit. This turns transistor Q_4 off thereby removing the short circuit from capacitor C_3 and allowing the output pulse circuit to operate.

Output Pulse Circuit

The output pulse circuit consists of transistor Q4 and a unijunction relaxation oscillator made up of unijunction transistor Q_5, capacitor C_3, resistors R_8 and R_9, and pulse transformer T_1. When transistor Q4 turns off, the short circuit is removed from capacitor C_3 and C_3 charges through R_8 to the firing level of unijunction transistor Q_5. Q_5 fires and produces a pulse across winding 3-4 of pulse transformer T-1. Diode D_3 short circuits any back voltage generated in pulse transformer T1.

Reclosing Circuit

The reclosing circuit consists of Thyristor TCR, holding circuits C_4 and R_{10}, and Zener diodes Z_2 and Z_3. The output pulse in winding 3-4 of pulse transformer T_1 is coupled through winding 1-2 to the gate of the TCR. This pulse turns the TCR on and allows current to flow from cathode to anode. Holding circuit C_4 and R_{20} allows the TCR to turn on when operated into an inductive load. Zener diodes Z_2 and Z_3 protect the Thyristor from transient voltages which might cause premature conduction or damage.

OPERATION

The following description is made with reference to Figure 1.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions transistors Q_2, Q_4, and Q_6 are on and transistor Q_3 is off. When the breaker is closed, the 52B contact connected to terminal 4 opens and removes the base drive to transistor Q_6 turning it off. When Q_6 turns off, the short-circuit is removed from C_2 allowing it to charge through RH-1 and R_2. C_2 charges to the firing voltage of unijunction transistor Q_1. The time required for C_2 to charge and fire Q_1 is controlled by potentiometer RH-1 which is mounted on the front of the relay over a calibrated time dial. When Q_1 fires, C_2 discharges through Q1 and R_{14}. The resultant voltage drop across R14 causes the voltage on the emitter of Q_2 to rise above its base voltage. This causes flip-flop transistor

SUPERSEDES I.L. 41-668A
*Denotes change from superseded issue.

EFFECTIVE MARCH 1968

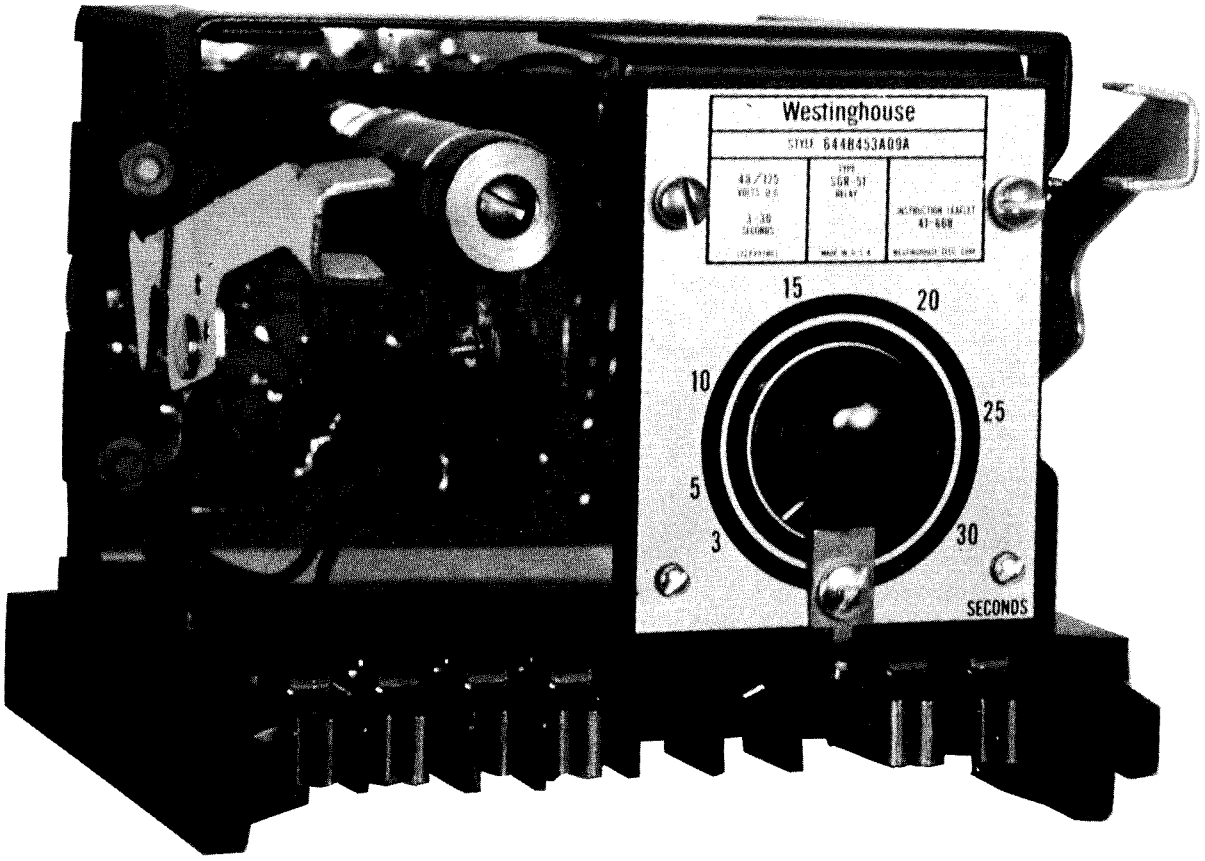


Fig. 1 Type SGR-51 Reclosing Relay (Front View).

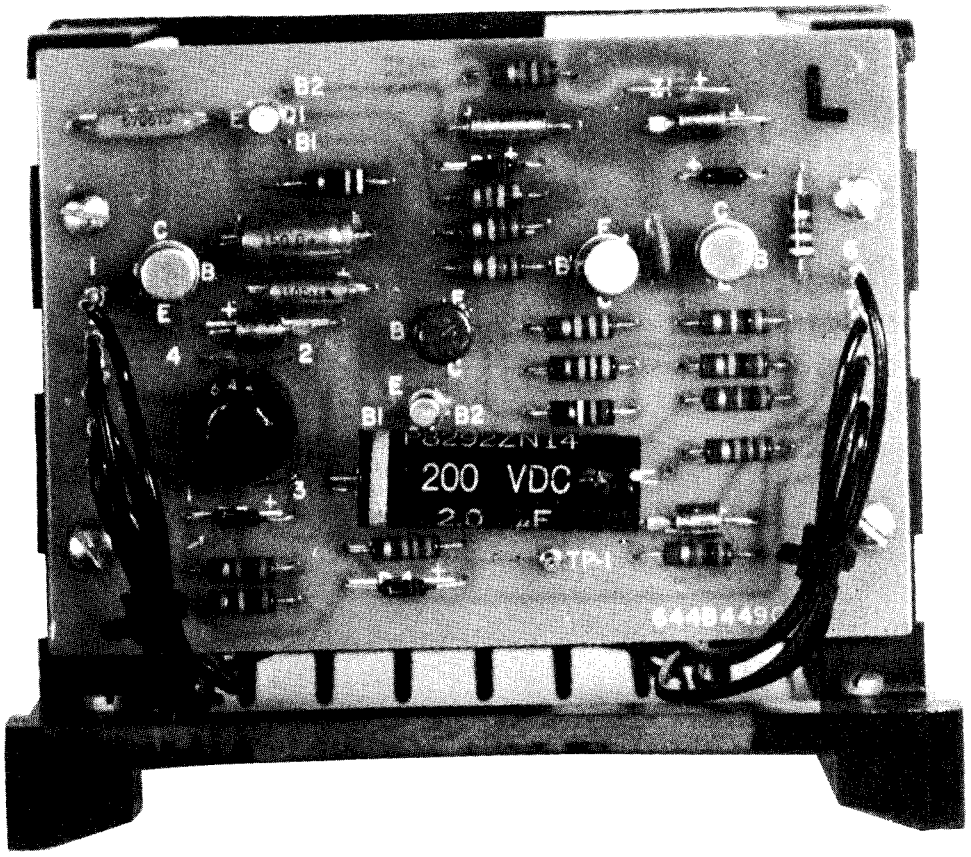


Fig. 2 Type SGR-51 Reclosing Relay (Rear View).

Q_2 to turn off which turns transistor Q_3 on. When Q3 turns on, its collector voltage drops to a low level and removes the base drive to transistor Q_4. The low voltage level on the collector of Q_3 also disables the timing circuit by forward biasing diode D_1 and providing a path for current to flow through RH-1, R_2, D_1 and Q_3 so that capacitor C_2 cannot charge up to a point where it will again fire unijunction transistor Q_1. If a fault appears on the protected line and a protective relay opens the breaker, the 52b contact connected to relay terminal 4 makes up and applies 24 volts to resistor R_8 in the output pulse circuit. Capacitor C_3 charges up to the firing level of unijunction transistor Q_5. The relaxation oscillator made up of capacitor C_3, unijunction transistor Q_5, resistors R_8 and R_9, and pulse transformer T_1 starts to oscillate. The positive pulses produced across pulse transformer T_1 by the oscillation of the relaxation oscillator are coupled to the gate of the TCR. The TCR turns on and allows current to flow from the positive battery supply through the TCR, out relay terminal 1, through the 52b contact and 52x coil to negative battery. The 52x coil is energized and the breaker immediately recloses. When the 52x coil is energized, the 52x contacts make and apply 24 volts to relay terminal 2. This positive voltage at terminal 2 is applied through resistor R_{16} and diode D_2 to the collector of flip-flop transistor Q3. This positive voltage on the collector of Q_3 causes Q_3 to turn off and Q_2 to turn on. When Q_3 turns off its collector goes positive providing base drive for transistor Q4. Q4 turns on and short-circuits capacitor C_3. With C_3 short-circuited, the output pulse circuit is disabled and positive pulses are removed from the gate of the TCR. The TCR turns off when the breaker recloses and the 52b contacts connected to terminal 1 open.

When the 52x contacts closed and applied a positive voltage to the collector of Q_3, the flip-flop was reset. In this state transistor Q_3 is off and Q_2 is on. With Q_2 off, its collector is highly positive. This reverse biases diode D_1 and turns Q_4 on. When Q_4 turns on it shorts C_3 and disables the output pulse circuit. When the breaker recloses, the 52b contacts connected to relay terminal 4 opens and remove the base drive to transistor Q_6. Q_6 turns off and capacitor C_2 is allowed to charge up again through RH-1 and R_2. Let us assume that a protective relay operates to trip the breaker before C_2 has charged to the firing level of Q_1. When the breaker opens, the 52b contact connected to relay terminal 4 closes and turns transistor Q6 on. Q6 short-circuits capacitor C_2 and removes the charge that had started to build up. Since the charge on C_2 had not reached a level to fire Q_1, the control flip-flop has not changed state and the output pulse circuit remains disabled. This means that there are no gate pulses being coupled to the gate of the TCR and it cannot turn on. Since the TCR does not turn on to energize the 52x coil and reclose the breaker, the breaker will stay locked out until manually closed.

CHARACTERISTICS

Voltage Rating

The SGR-51 is rated for 125 or 48 volts D.C. Unless otherwise specified, the relays are connected for 125 volt operation when shipped.

Thyristor

The Reclosing Thyristor is rated at 30 amps 125 volts D.C. for 20 cycles.

Temperature Range

The SGR-51 is designed to operate over a temperature range from -30°C to +60°C with a reset time of not more than ± 5%.

Energy Requirements

125 V.D.C.	45 Milliamperes
48 V.D.C.	45 Milliamperes

SETTINGS

Supply Voltage Setting

The correct tap on series resistor R_{17} (mounted on sub-base) should be selected for the supply voltage being used. For 125 V.D.C. operation, the two end terminals of R_{17} are used. For 48 V.D.C. operation the center terminal and the terminal nearest the sub-base are used.

Reset Time Setting

The reset time is controlled by front mounted potentiometer RH-1 which is mounted over a calibrated time dial. The reset time is variable from 3 to 30 seconds.

INSTALLATION

The relays 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 four mounting holes on the flange for semi-flush mounting or by

means of the rear mounting stud or studs for projection mounting. Either a mounting stud 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 the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nuts with a wrench.

For detailed FT case information refer to I.L. 41-076.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and no further adjustment should be required.

Acceptance Tests

The following check is recommended to insure that the relay is in proper working order. All checks can best be performed by connecting the SGR-51 as shown in Figure 3. The A relay is used to reset the SGR-51 flip-flop control circuit to the correct state and the B relay is used to simulate breaker action.

With the cal.-oper. switch in the oper. position, push PB-1 to close the B relay. If the B relay is tripped by pushing PB-2 before the reset time set on the time dial has elapsed, the B relay should trip and lock-out. If the B relay is tripped after the reset time has elapsed, the SGR-51 should reclose the B relay instantaneously on the first trip, and if the B relay trip circuit is still energized, the SGR-51 should not allow the B relay to reclose on the second trip.

Calibration Check

The following procedure may be used to accurately check the time dial calibration. Connect a lead from the printed circuit board test point TP-1 to SGR-51 relay terminal 3. With the cal.-oper. switch in the cal. position the B relay is connected to trip open when the SGR-51 times out and energizes its output at terminal 1. This enables the tester to accurately check the time dial calibration by using Ba and Bb contacts to control a timer. The tester pushes PB-1 to close the B relay and start the timer. When the SGR-51 reset timer times out an output appears at terminal 1 which trips the B relay and stops the timer.

Routine Maintenance

All relays should be checked at least once every year or at such other intervals as may be dictated by experience to be suitable to the particular application.

Trouble Shooting

Use the following procedure to locate the source of trouble in the event of improper relay operation.

1. Inspect all wires and connections.
2. Check resistances as listed on the internal schematic, Figure 1.
3. Check voltages or waveforms as listed under electrical checkpoints using a vacuum tube voltmeter and/or an oscilloscope.

Electrical Checkpoints

Apply rated voltage through a switch to terminals 8 and 9. Terminal 9 is positive.

Connect a lead from TP-1 (bottom center of printed circuit board) to relay terminal 3.

Connect a 1K 20 watt resistor from relay terminal 1 to relay terminal 8.

Set the time dial for 15 seconds.

Apply rated voltage to the relay before each test point check and interrupt it after each check. Take test point readings before and after the reset time shown on the time dial.

Use the following table to determine the correct voltages or waveforms at the indicated point. Refer to Figure 4 for printed circuit board component layout.

CIRCUIT	TEST POINT	NORMAL INDICATIONS		COMPONENTS CHECKED
		BEFORE RESET	AFTER RESET	
Circuit Board Supply Voltage	Relay Term. 3	24V ± 1.2V	24V ± 1.2V	R_{17}, Z_1
Timing Circuit	Junction of R_2 and C_2	Slow Voltage rise to approx. 18V	Approx. 1.8V	Q_1, Q_6, C_2, C_1 RH-1, D_1
Flip-flop Control Circuit	Junction of R_3 and R_4 Junction of R_6 and R_7	Approx. 1.3V Approx. 19V	Approx. 19V Approx. 1.3V	Q_2, Q_3, Q_5
Output pulse circuit	Junction of R_8 and C_3 Junction of Q_5 and T_1 Term. 3	.7 volts 0 volts	† Sawtooth waveform rising to 18V in 5 to 7 Msec. † 10 volt pulses every 5 to 7 Msec.	Q_4, Q_5, C_3, T_1, D_3
Reclosing Circuit	Across external 1K resistor connected to terminal 1	0 volts	Rated Voltage	TCR Z_2, Z_3, T_1, C_4

† Oscilloscope only

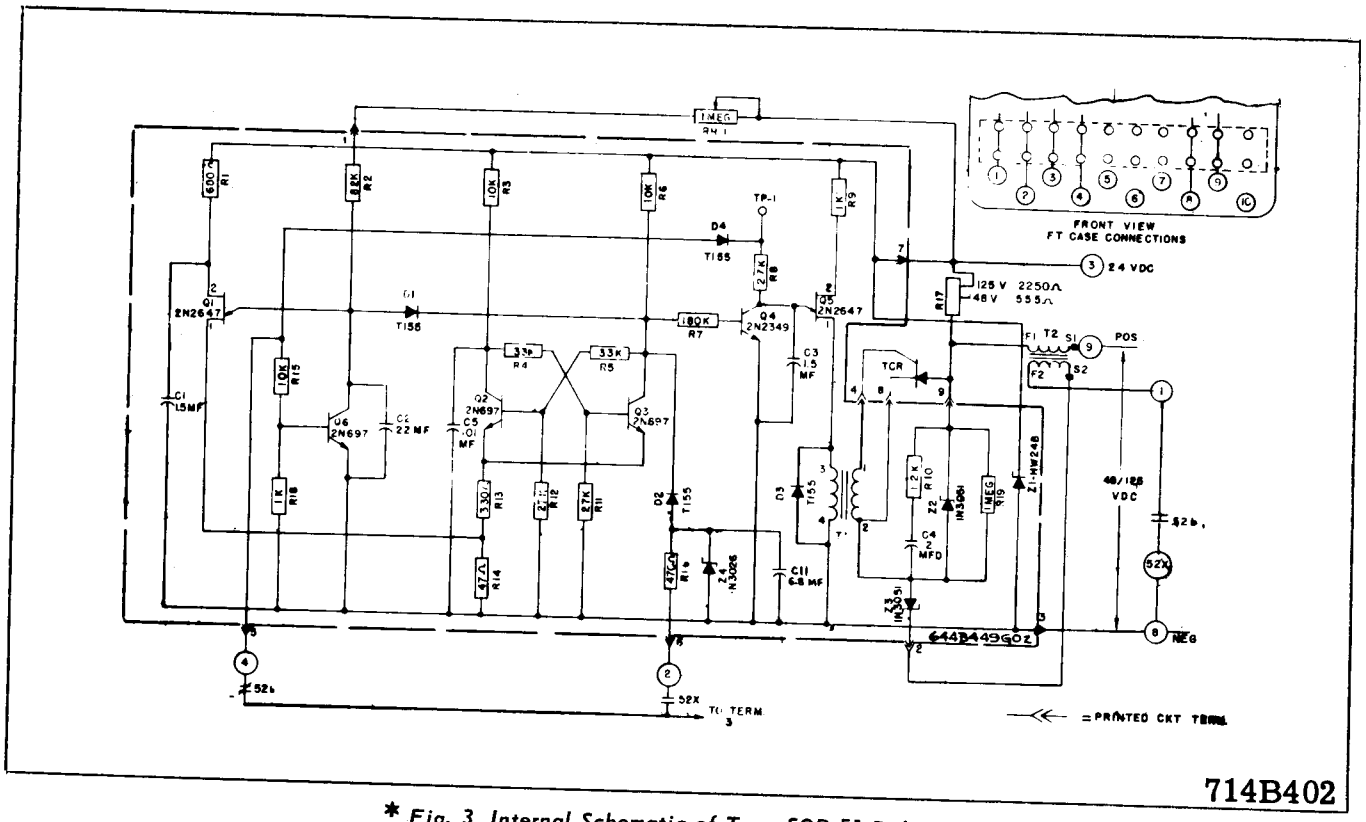
All measurements made between indicated points and terminal 8 (D.C. Negative)

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to customers who are equipped for doing repair work. When ordering parts, always give the complete data as shown in the electrical parts list.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	DESCRIPTION	WESTINGHOUSE STYLE NUMBER
	CAPACITORS	
C1	1.5MFD 35V 10%	187A508H09
C2	22 MFD 35V 10%	187A508H17
C3	1.5MFD 35V 10%	187A508H18
C4	2 MFD 200V 20%	187A624H05
C5	.01MFD 50V 20%	184A663H01
	CONTROLLED RECTIFIERS	
TCR	2N1846	184A614H06
	DIODE RECTIFIERS	
D1 thru D4	T155	183A790H09
	RESISTORS	
R1	680 ½W	184A763H23
R2	82000 ½W	836A503H70
R3	10000 ½W	184A763H51
R4	33000 ½W	184A763H63
R5	33000 ½W	184A763H63
R6	10000 ½W	184A763H51
R7	180,000 ½W	184A763H81
R8	2700 ½W	184A763H37
R9	1000 ½W	184A763H27
R10	1200 ½W	187A290H17
R11	27000 ½W	184A763H61
R12	27000 ½W	184A763H61
R13	330 ½W	184A763H15
R14	47 ½W	187A290H17
R15	10000 ½W	184A763H51
R16	470 ½W	184A763H19
R17	2250 tapped at 555 25W	187A321H03
R18	1000 ½W	184A763H27
R19	1,000,000 ½W	184A763H99
	TRANSFORMERS	
T1	Pulse Transformer	629A453H02
	TRANSISTORS	
Q2	2N697	184A638H18
Q3	2N697	184A638H18
Q4	2N2349	762A585H13
Q5	2N697	184A638H18
	UNIJUNCTION SWITCHES	
Q1	4JX5E695	629A435H02
Q5	2N2647	629A435H01
	ZENER DIODES	
Z1	HW24B	185A212H12
Z2	1N3051	187A936H01
Z3	1N3051	187A936H01
Z4	1N3026	187A936H03



* *Fig. 3 Internal Schematic of Type SGR-51 Relay*

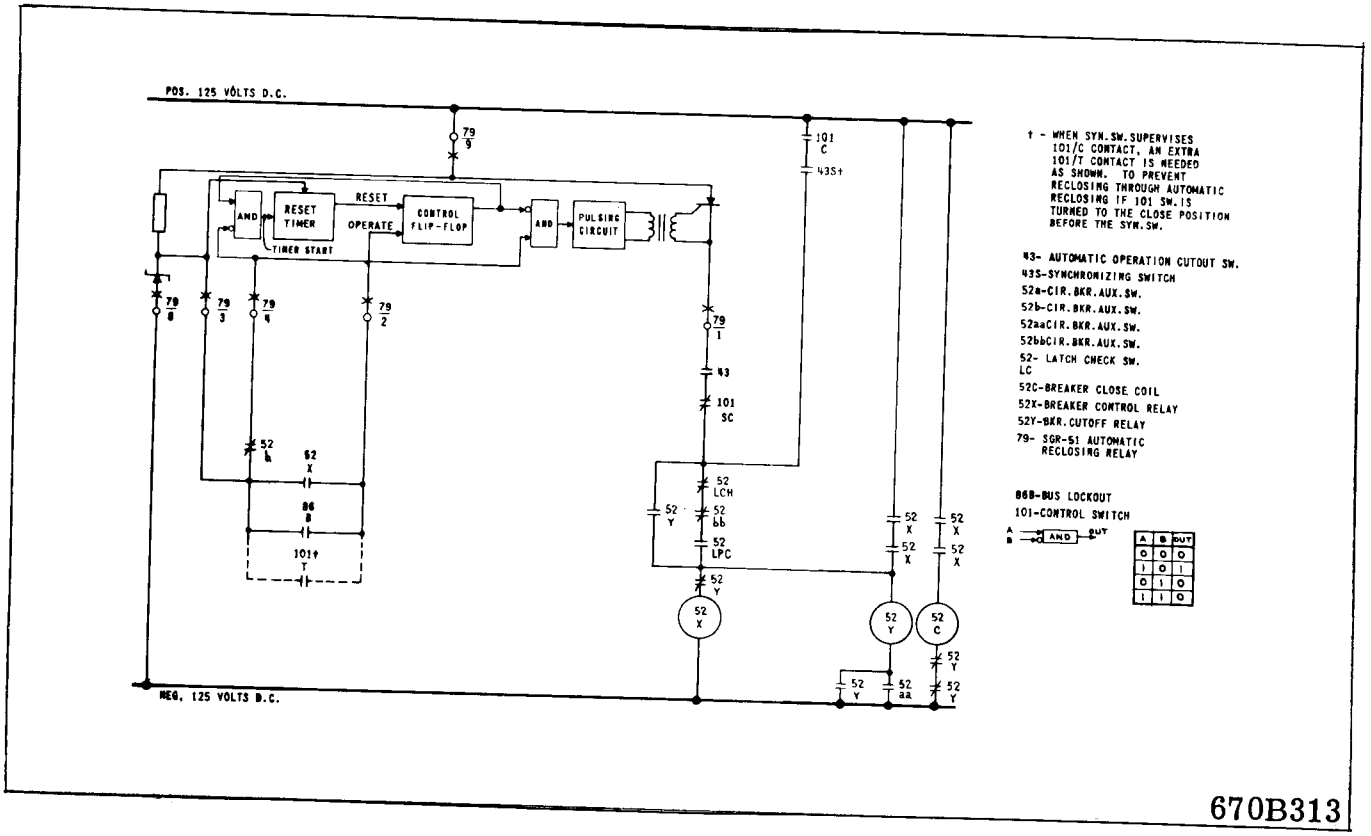


Fig. 4 External Schematic of Type SGR-51 Relay

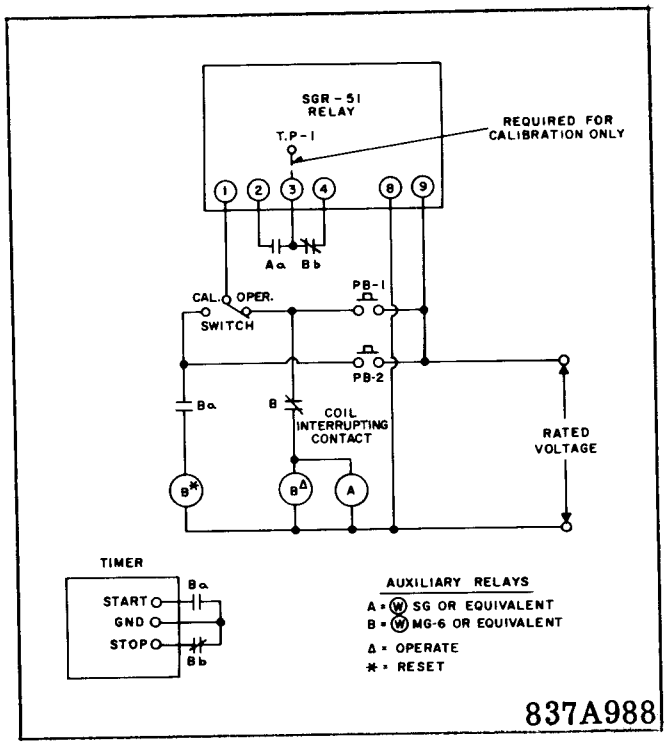


Fig. 5 Test Circuit for Type SGR-51 Relay

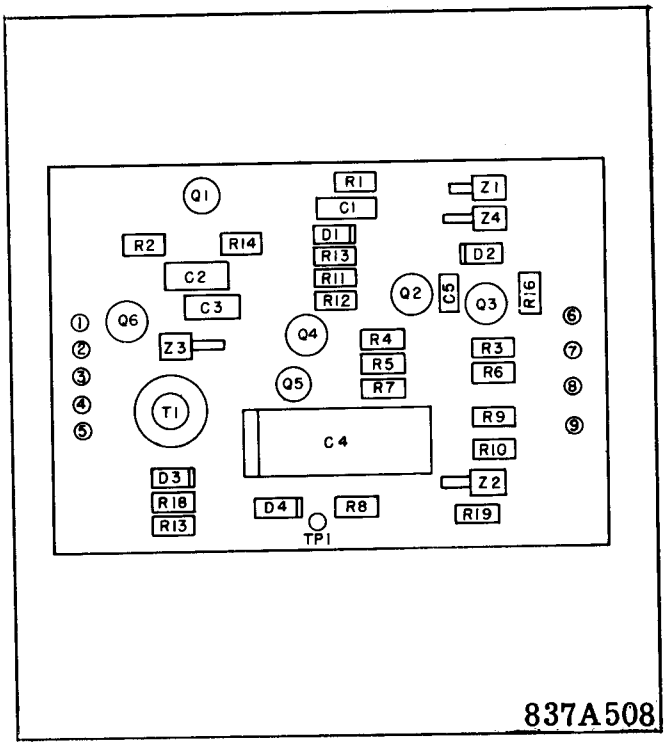
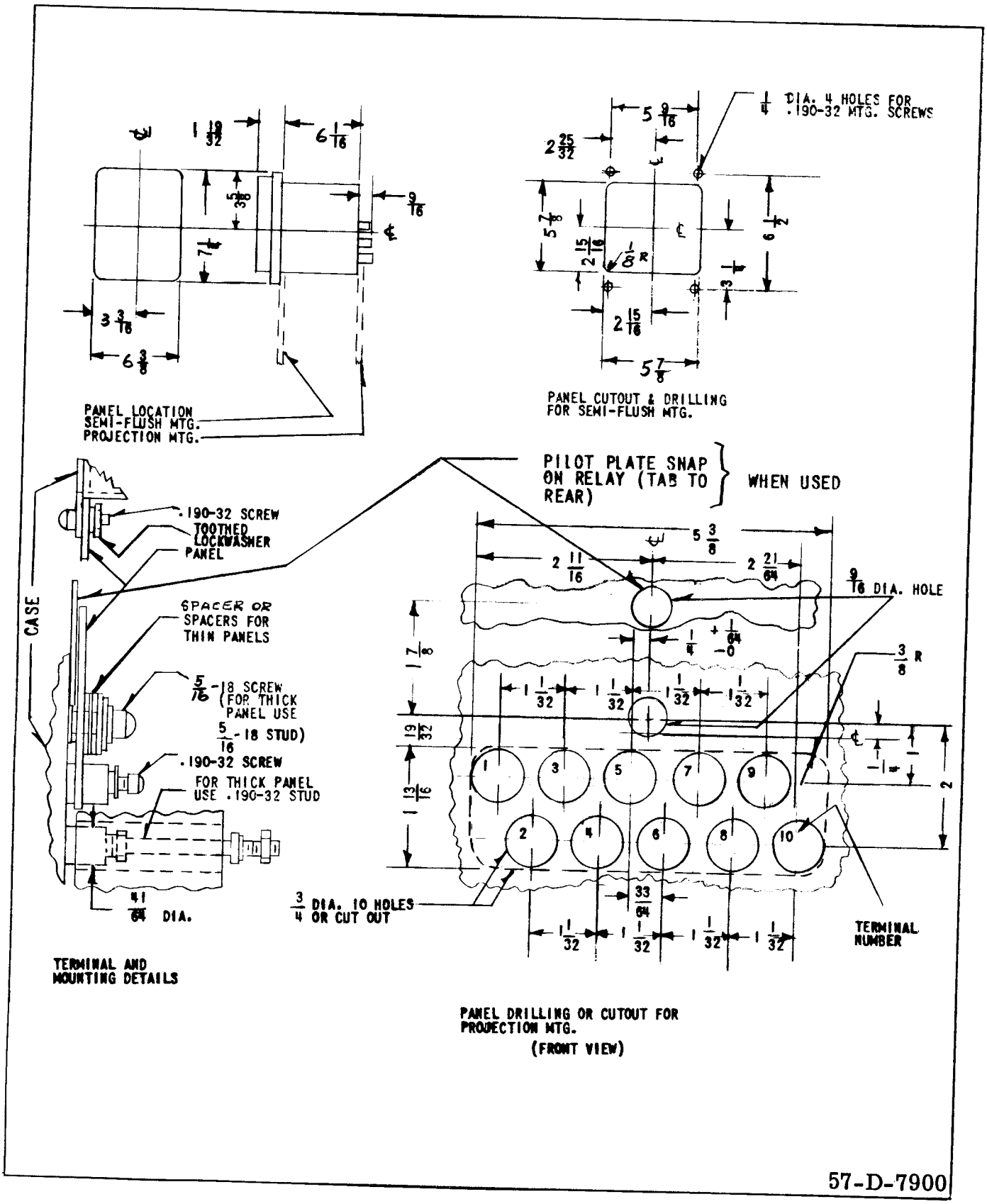
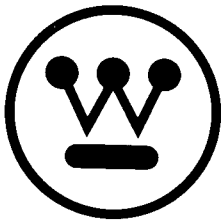


Fig. 6 Component Layout on SGR-51 Relay Printed Circuit Board



* *Fig. 7 Outline and Drilling in FT 11 Case*



WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION
NEWARK, N. J.
Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

SGR-51 RECLOSING RELAY

APPLICATION

The SGR-51 Reclosing relay provides for instantaneous reclosure of an electrically operated circuit breaker, and automatically resets itself if the breaker remains closed for a predetermined adjustable time interval. If the breaker retrips before the end of this interval, the resetting operation of the relay is interrupted until the breaker is manually closed. Thus, the reclosing relay is applicable to either attended or non-attended stations.

CONSTRUCTION

The SGR-51 is a completely static relay consisting of (1) a timing circuit, (2) a flip-flop control circuit, (3) an output pulse circuit, and (4) a reclosing circuit. All components except the reclosing circuit Thyristor are mounted on a printed circuit board. The Thyristor is mounted on a heat sink located on a sub base. All components are identified on the internal schematic on Figure 1.

Timing Circuit

The timing circuit is a unijunction relaxation oscillator consisting of unijunction transistor Q1, resistors R1, R2, and R14 and potentiometer RH-1. After a preset time interval controlled by the front mounted time dial potentiometer RH-1, the relaxation oscillator fires and feeds an output pulse to the flip-flop control circuit.

Flip-Flop Control Circuit

The flip-flop control circuit consists of transistors Q_1 and Q_2, resistors R_3, R_4, R_5, R_6, R_{11}, R_{12}, and R_{13}, and capacitor C_5. The flip-flop control circuit changes state when pulsed by the timing circuit. This turns transistor Q_4 off thereby removing the short circuit from capacitor C_3 and allowing the output pulse circuit to operate.

Output Pulse Circuit

The output pulse circuit consists of transistor Q4 and a unijunction relaxation oscillator made up of unijunction transistor Q_5, capacitor C_3, resistors R_8 and R_9, and pulse transformer T_1. When transistor Q4 turns off, the short circuit is removed from capacitor C_3 and C_3 charges through R_8 to the firing level of unijunction transistor Q_5. Q_5 fires and produces a pulse across winding 3-4 of pulse transformer T-1. Diode D_3 short circuits any back voltage generated in pulse transformer T1.

Reclosing Circuit

The reclosing circuit consists of Thyristor TCR, holding circuits C_4 and R_{10}, and Zener diodes Z_2 and Z_3. The output pulse in winding 3-4 of pulse transformer T_1 is coupled through winding 1-2 to the gate of the TCR. This pulse turns the TCR on and allows current to flow from cathode to anode. Holding circuit C_4 and R_{20} allows the TCR to turn on when operated into an inductive load. Zener diodes Z_2 and Z_3 protect the Thyristor from transient voltages which might cause premature conduction or damage.

OPERATION

The following description is made with reference to Figure 1.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions transistors Q_2, Q_4, and Q_6 are on and transistor Q_3 is off. When the breaker is closed, the 52B contact connected to terminal 4 opens and removes the base drive to transistor Q_6 turning it off. When Q_6 turns off, the short-circuit is removed from C_2 allowing it to charge through RH-1 and R_2. C_2 charges to the firing voltage of unijunction transistor Q_1. The time required for C_2 to charge and fire Q_1 is controlled by potentiometer RH-1 which is mounted on the front of the relay over a calibrated time dial. When Q_1 fires, C_2 discharges through Q1 and R_{14}. The resultant voltage drop across R14 causes the voltage on the emitter of Q_2 to rise above its base voltage. This causes flip-flop transistor

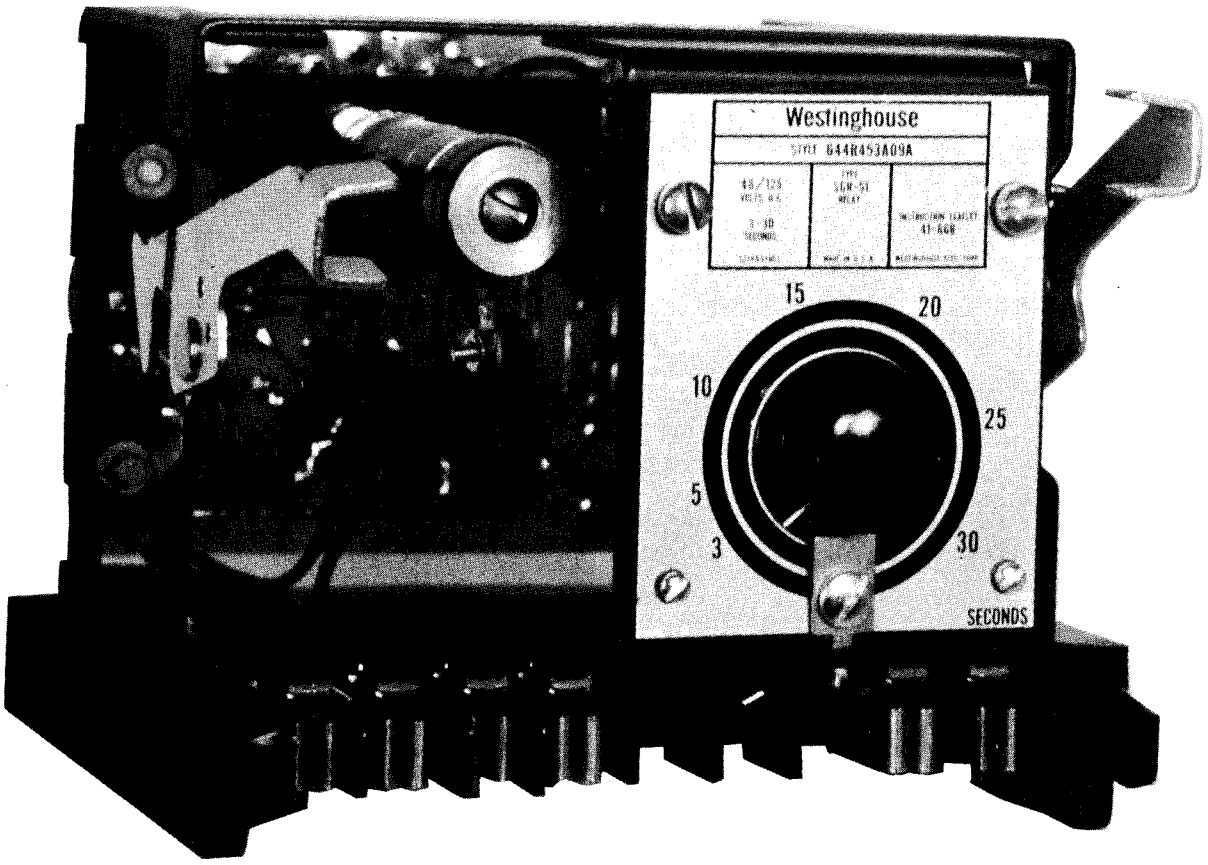


Fig. 1 Type SGR-51 Reclosing Relay (Front View).

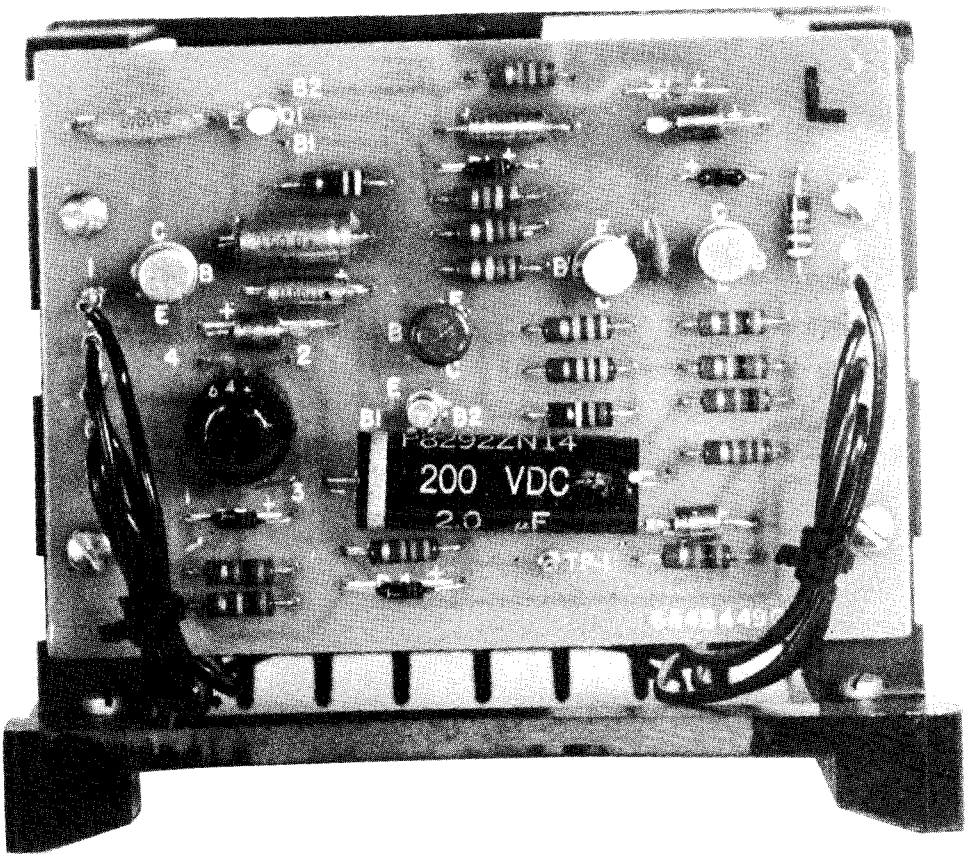


Fig. 2 Type SGR-51 Reclosing Relay (Rear View).

Q_2 to turn off which turns transistor Q_3 on. When Q3 turns on, its collector voltage drops to a low level and removes the base drive to transistor Q_4. The low voltage level on the collector of Q_3 also disables the timing circuit by forward biasing diode D_1 and providing a path for current to flow through RH-1, R_2, D_1 and Q_3 so that capacitor C_2 cannot charge up to a point where it will again fire unijunction transistor Q_1. If a fault appears on the protected line and a protective relay opens the breaker, the 52b contact connected to relay terminal 4 makes up and applies 24 volts to resistor R_8 in the output pulse circuit. Capacitor C_3 charges up to the firing level of unijunction transistor Q_5. The relaxation oscillator made up of capacitor C_3, unijunction transistor Q_5, resistors R_8 and R_9, and pulse transformer T_1 starts to oscillate. The positive pulses produced across pulse transformer T_1 by the oscillation of the relaxation oscillator are coupled to the gate of the TCR. The TCR turns on and allows current to flow from the positive battery supply through the TCR, out relay terminal 1, through the 52b contact and 52x coil to negative battery. The 52x coil is energized and the breaker immediately recloses. When the 52x coil is energized, the 52x contacts make and apply 24 volts to relay terminal 2. This positive voltage at terminal 2 is applied through resistor R_{16} and diode D_2 to the collector of flip-flop transistor Q3. This positive voltage on the collector of Q_3 causes Q_3 to turn off and Q_2 to turn on. When Q_3 turns off its collector goes positive providing base drive for transistor Q4. Q4 turns on and short-circuits capacitor C_3. With C_3 short-circuited, the output pulse circuit is disabled and positive pulses are removed from the gate of the TCR. The TCR turns off when the breaker recloses and the 52b contacts connected to terminal 1 open.

When the 52x contacts closed and applied a positive voltage to the collector of Q_3, the flip- flop was reset. In this state transistor Q_3 is off and Q_2 is on. With Q_2 off, its collector is highly positive. This reverse biases diode D_1 and turns Q_4 on. When Q_4 turns on it shorts C_3 and disables the output pulse circuit. When the breaker recloses, the 52b contacts connected to relay terminal 4 opens and remove the base drive to transistor Q_6. Q_6 turns off and capacitor C_2 is allowed to charge up again through RH-1 and R_2. Let us assume that a protective relay operates to trip the breaker before C_2 has charged to the firing level of Q_1. When the breaker opens, the 52b contact connected to relay terminal 4 closes and turns transistor Q6 on. Q6 short-circuits capacitor C_2 and removes the charge that had started to build up. Since the charge on C_2 had not reached a level to fire Q_1, the control flip-flop has not changed state and the output pulse circuit remains disabled. This means that there are no gate pulses being coupled to the gate of the TCR and it cannot turn on. Since the TCR does not turn on to energize the 52x coil and reclose the breaker, the breaker will stay locked out until manually closed.

CHARACTERISTICS

Voltage Rating

The SGR-51 is rated for 125 or 48 volts D.C. Unless otherwise specified, the relays are connected for 125 volt operation when shipped.

Thyristor

The Reclosing Thyristor is rated at 30 amps 125 volts D.C. for 20 cycles.

Temperature Range

The SGR-51 is designed to operate over a temperature range from -30°C to +60°C with a reset time of not more than ± 5%.

Energy Requirements

125 V.D.C.	45 Milliamperes
48 V.D.C.	45 Milliamperes

SETTINGS

Supply Voltage Setting

The correct tap on series resistor R_{17} (mounted on sub-base) should be selected for the supply voltage being used. For 125 V.D.C. operation, the two end terminals of R_{17} are used. For 48 V.D.C. operation the center terminal and the terminal nearest the sub-base are used.

Reset Time Setting

The reset time is controlled by front mounted potentiometer RH-1 which is mounted over a calibrated time dial. The reset time is variable from 3 to 30 seconds.

INSTALLATION

The relays 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 four mounting holes on the flange for semi-flush mounting or by

means of the rear mounting stud or studs for projection mounting. Either a mounting stud 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 the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nuts with a wrench.

For detailed FT case information refer to I.L. 41-076.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and no further adjustment should be required.

Acceptance Tests

The following check is recommended to insure that the relay is in proper working order. All checks can best be performed by connecting the SGR-51 as shown in Figure 3. The A relay is used to reset the SGR-51 flip-flop control circuit to the correct state and the B relay is used to simulate breaker action.

With the cal.-oper. switch in the oper. position, push PB-1 to close the B relay. If the B relay is tripped by pushing PB-2 before the reset time set on the time dial has elapsed, the B relay should trip and lock-out. If the B relay is tripped after the reset time has elapsed, the SGR-51 should reclose the B relay instantaneously on the first trip, and if the B relay trip circuit is still energized, the SGR-51 should not allow the B relay to reclose on the second trip.

Calibration Check

The following procedure may be used to accurately check the time dial calibration. Connect a lead from the printed circuit board test point TP-1 to SGR-51 relay terminal 3. With the cal.-oper. switch in the cal. position the B relay is connected to trip open when the SGR-51 times out and energizes its output at terminal 1. This enables the tester to accurately check the time dial calibration by using Ba and Bb contacts to control a timer. The tester pushes PB-1 to close the B relay and start the timer. When the SGR-51 reset timer times out an output appears at terminal 1 which trips the B relay and stops the timer.

Routine Maintenance

All relays should be checked at least once every year or at such other intervals as may be dictated by experience to be suitable to the particular application.

Trouble Shooting

Use the following procedure to locate the source of trouble in the event of improper relay operation.

1. Inspect all wires and connections.
2. Check resistances as listed on the internal schematic, Figure 1.
3. Check voltages or waveforms as listed under electrical checkpoints using a vacuum tube voltmeter and/or an oscilloscope.

Electrical Checkpoints

Apply rated voltage through a switch to terminals 8 and 9. Terminal 9 is positive.

Connect a lead from TP-1 (bottom center of printed circuit board) to relay terminal 3.

Connect a 1K 20 watt resistor from relay terminal 1 to relay terminal 8.

Set the time dial for 15 seconds.

Apply rated voltage to the relay before each test point check and interrupt it after each check. Take test point readings before and after the reset time shown on the time dial.

Use the following table to determine the correct voltages or waveforms at the indicated point. Refer to Figure 4 for printed circuit board component layout.

CIRCUIT	TEST POINT	NORMAL INDICATIONS		COMPONENTS CHECKED
		BEFORE RESET	AFTER RESET	
Circuit Board Supply Voltage	Relay Term. 3	24V ± 1.2V	24V ± 1.2V	R_{17}, Z_1
Timing Circuit	Junction of R_2 and C_2	Slow Voltage rise to approx. 18V	Approx. 1.8V	Q_1, Q_6, C_2, C_1 RH-1, D_1
Flip-flop Control Circuit	Junction of R_3 and R_4 Junction of R_6 and R_7	Approx. 1.3V Approx. 19V	Approx. 19V Approx. 1.3V	Q_2, Q_3, Q_5
Output pulse circuit	Junction of R_8 and C_3 Junction of Q_5 and T_1 Term. 3	.7 volts 0 volts	† Sawtooth waveform rising to 18V in 5 to 7 Msec. † 10 volt pulses every 5 to 7 Msec.	Q_4, Q_5, C_3, T_1, D_3
Reclosing Circuit	Across external 1K resistor connected to terminal 1	0 volts	Rated Voltage	TCR Z_2, Z_3, T_1, C_4

† Oscilloscope only

All measurements made between indicated points and terminal 8 (D.C. Negative)

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to customers who are equipped for doing repair work. When ordering parts, always give the complete data as shown in the electrical parts list.

ELECTRICAL PARTS LIST

CIRCUIT SYMBOL	DESCRIPTION	WESTINGHOUSE STYLE NUMBER
	CAPACITORS	
C1	1.5MFD 35V 10%	187A508H09
C2	22 MFD 35V 10%	187A508H17
C3	1.5MFD 35V 10%	187A508H18
C4	2 MFD 200V 20%	187A624H05
C5	.01MFD 50V 20%	184A663H01
	CONTROLLED RECTIFIERS	
TCR	2N1846	184A614H06
	DIODE RECTIFIERS	
D1 thru D4	T155	183A790H09
	RESISTORS	
R1	680 ½W	184A763H23
R2	82000 ½W	836A503H70
R3	10000 ½W	184A763H51
R4	33000 ½W	184A763H63
R5	33000 ½W	184A763H63
R6	10000 ½W	184A763H51
R7	180,000 ½W	184A763H81
R8	2700 ½W	184A763H37
R9	1000 ½W	184A763H27
R10	1200 ½W	187A290H17
R11	27000 ½W	184A763H61
R12	27000 ½W	184A763H61
R13	330 ½W	184A763H15
R14	47 ½W	187A290H17
R15	10000 ½W	184A763H51
R16	470 ½W	184A763H19
R17	2250 tapped at 555 25W	187A321H03
R18	1000 ½W	184A763H27
R19	1,000,000 ½W	184A763H99
	TRANSFORMERS	
T1	Pulse Transformer	629A453H02
	TRANSISTORS	
Q2	2N697	184A638H18
Q3	2N697	184A638H18
Q4	2N2349	762A585H13
Q5	2N697	184A638H18
	UNIJUNCTION SWITCHES	
Q1	4JX5E695	629A435H02
Q5	2N2647	629A435H01
	ZENER DIODES	
Z1	HW24B	185A212H12
Z2	1N3051	187A936H01
Z3	1N3051	187A936H01
Z4	1N3026	187A936H03

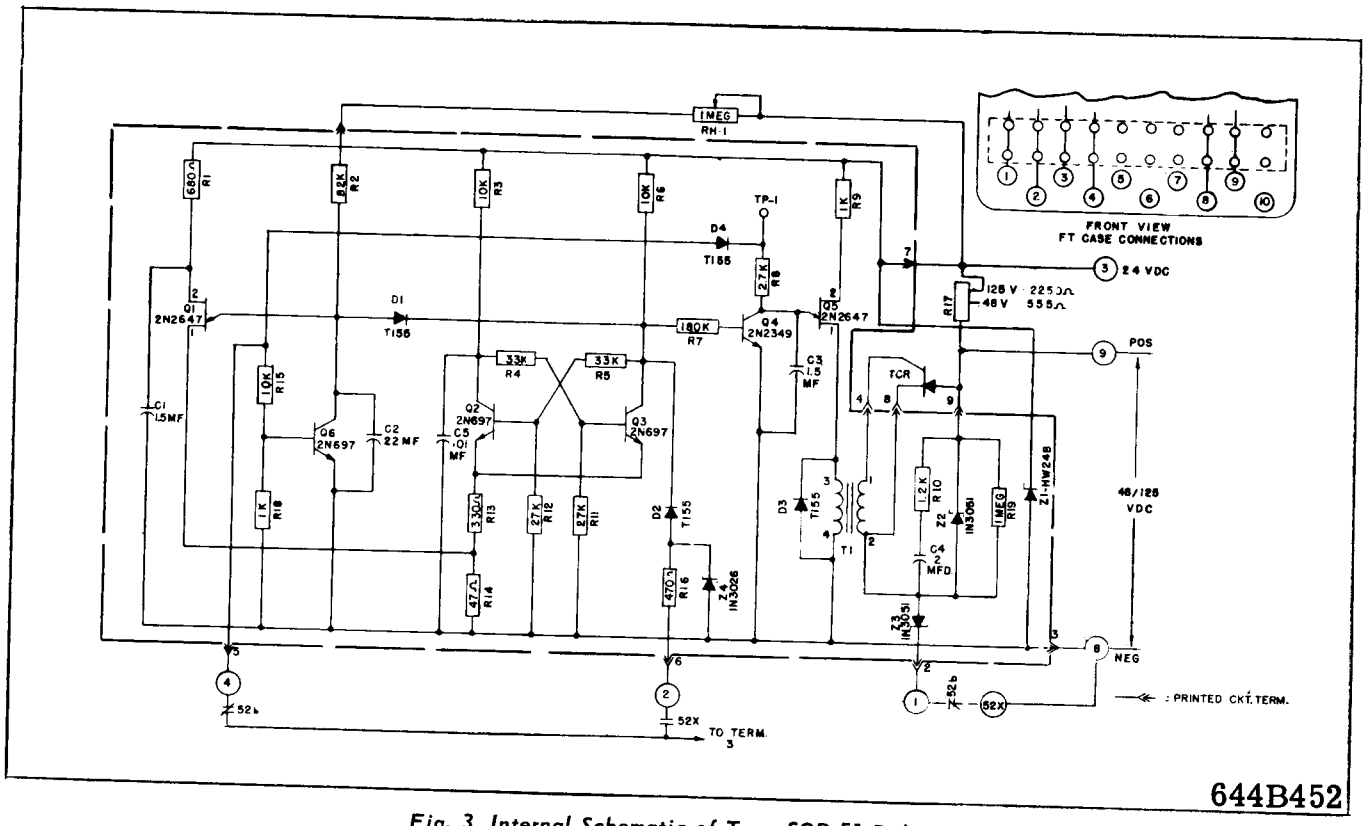


Fig. 3 Internal Schematic of Type SGR-51 Relay

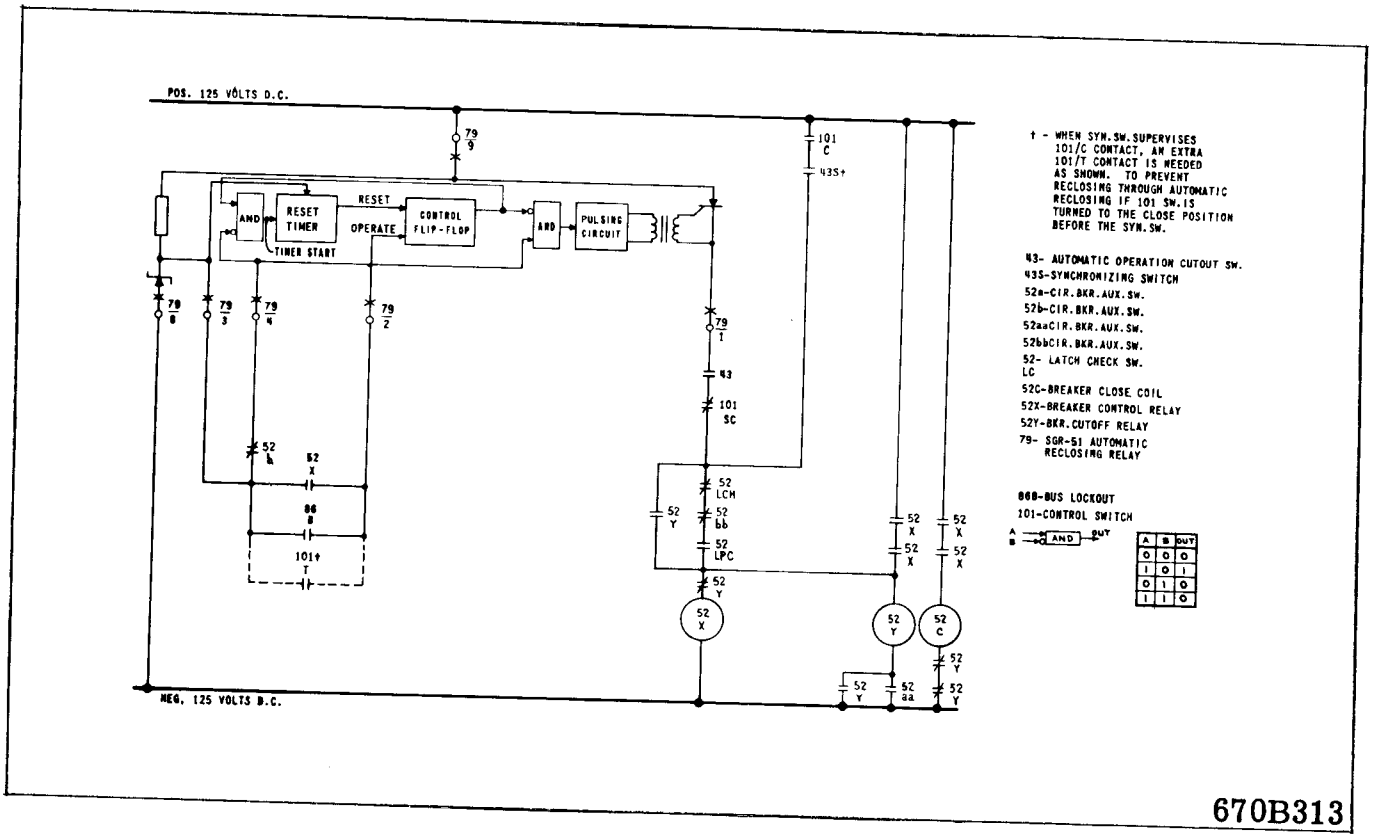


Fig. 4 External Schematic of Type SGR-51 Relay

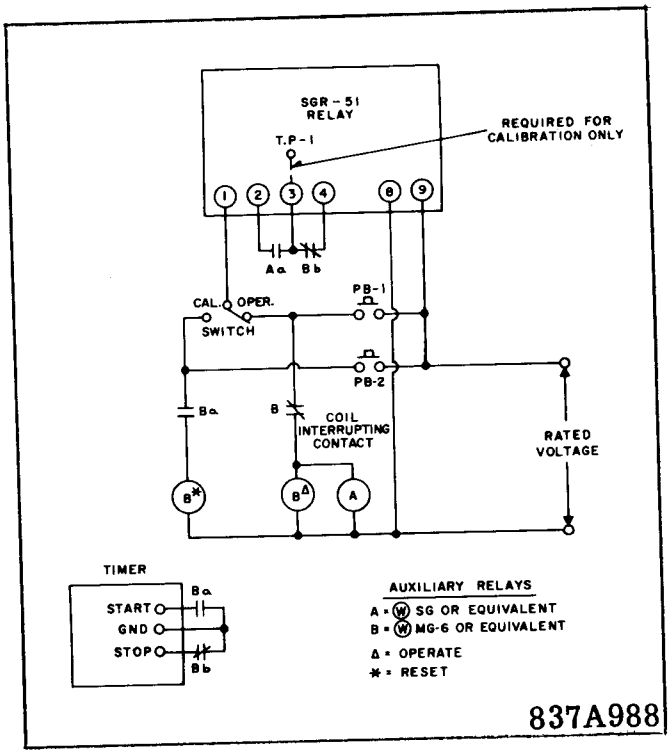


Fig. 5 Test Circuit for Type SGR-51 Relay

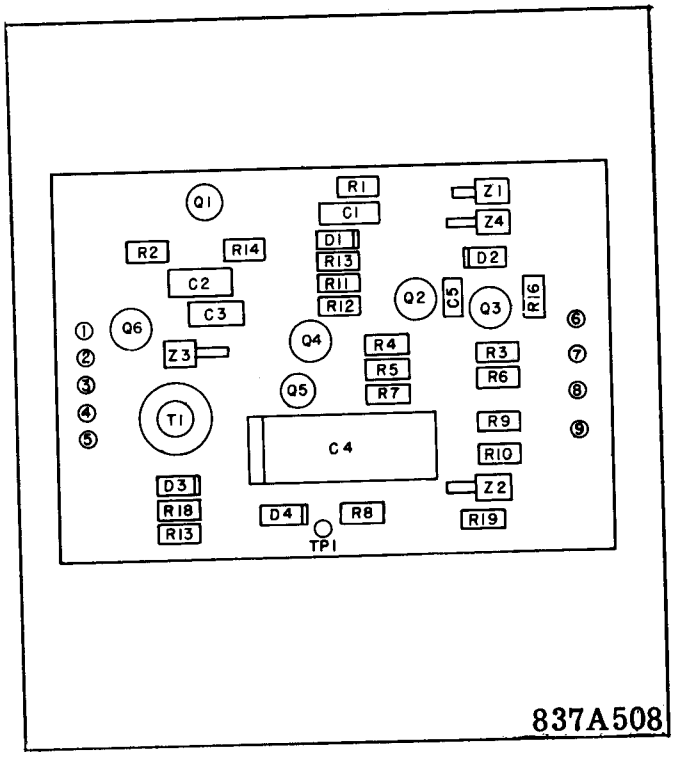
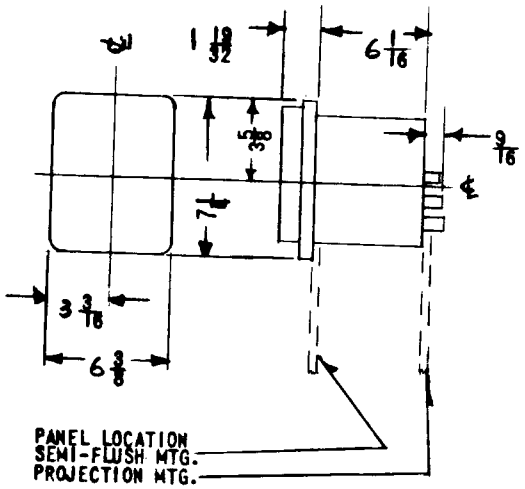
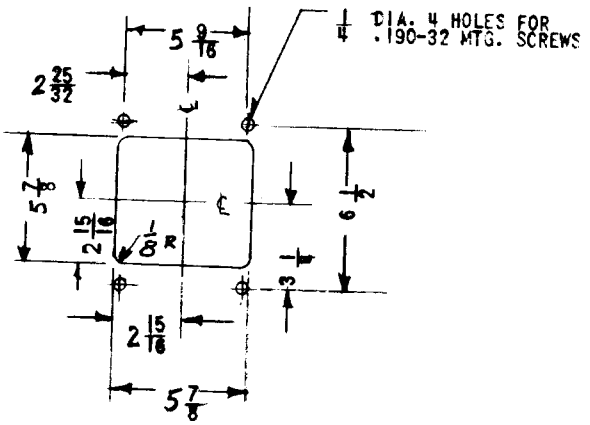
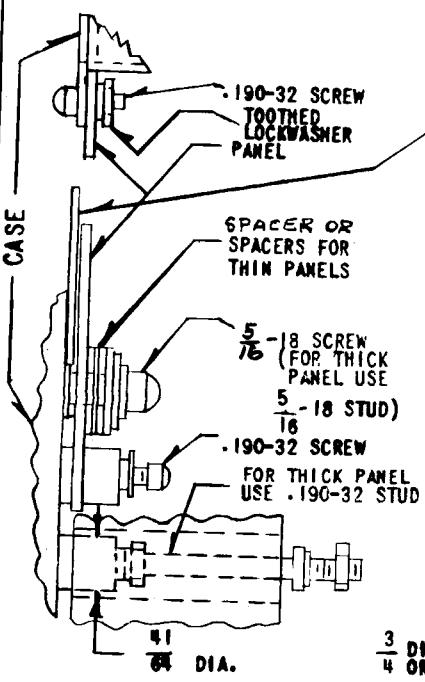


Fig. 6 Component Layout on SGR-51 Relay Printed Circuit Board

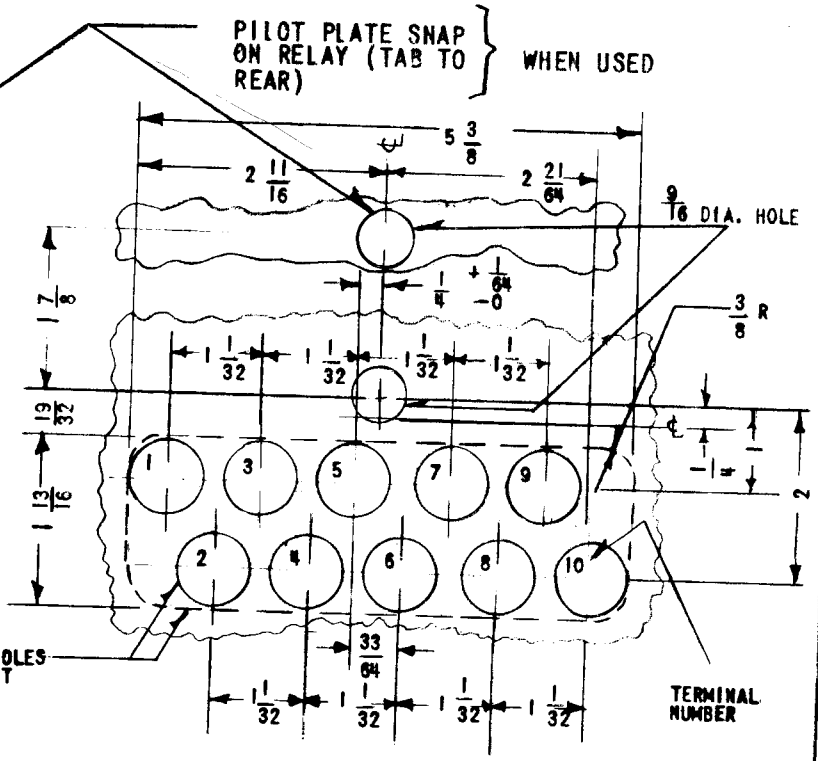




PANEL CUTOUT & DRILLING FOR SEMI-FLUSH MTG.

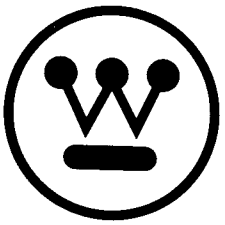


TERMINAL AND MOUNTING DETAILS



PANEL DRILLING OR CUTOUT FOR PROJECTION MTG.
(FRONT VIEW)

57-D-7900



WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION
NEWARK, N. J.

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

SGR-51 RECLOSING RELAY

APPLICATION

The SGR-51 Reclosing relay provides for instantaneous reclosure of an electrically operated circuit breaker, and automatically resets itself if the breaker remains closed for a predetermined adjustable time interval. If the breaker retrips before the end of this interval, the resetting operation of the relay is interrupted until the breaker is manually closed. Thus, the reclosing relay is applicable to either attended or non-attended stations.

CONSTRUCTION

The SGR-51 is a completely static relay consisting of (1) a timing circuit, (2) a flip-flop control circuit, (3) an output pulse circuit, and (4) a reclosing circuit. All components except the reclosing circuit Thyristor are mounted on a printed circuit board. The Thyristor is mounted on a heat sink located on a sub base. All components are identified on the internal schematic in Figure 1.

Timing Circuit

The timing circuit is a unijunction relaxation oscillator consisting of unijunction transistor Q1, resistors R_1, R_2, and R14 and potentiometer RH-1. After a preset time interval controlled by the front mounted time dial potentiometer RH-1, the relaxation oscillator fires and feeds an output pulse to the flip-flop control circuit.

Flip-Flop Control Circuit

The flip-flop control circuit consists of transistors Q_1 and Q_2, resistors R_3, R_4, R_5, R_6, R_{11}, R_{12}, and R_{13}, and capacitor C_5. The flip-flop control circuit changes state when pulsed by the timing circuit. This turns transistor Q4 off thereby removing the short circuit from capacitor C_3 and allowing the output pulse circuit to operate.

Output Pulse Circuit

The output pulse circuit consists of transistor Q4 and a

NEW INFORMATION

EFFECTIVE APRIL 1966

unijunction relaxation oscillator made up of unijunction transistor Q_5, capacitor C_3, resistors R8 and R_9, and pulse transformer T_1. When transistor Q4 turns off, the short circuit is removed from capacitor C_3 and C_3 charges through R8 to the firing level of unijunction transistor Q_5. Q_5 fires and produces a pulse across winding 3-4 of pulse transformer T-1. Diode D_3 short circuits any back voltage generated in pulse transformer T_1.

Reclosing Circuit

The reclosing circuit consists of Thyristor TCR, holding circuits C_4 and R_{10}, and Zener diodes Z_2 and Z_3. The output pulse in winding 3-4 of pulse transformer T_1 is coupled through winding 1-2 to the gate of the TCR. This pulse turns the TCR on and allows current to flow from cathode to anode. Holding circuit C_4 and R_{10} allows the TCR to turn on when operated into an inductive load. Zener diodes Z_2 and Z_3 protect the Thyristor from transient voltages which might cause premature conduction or damage.

OPERATION

The following description is made with reference to Figure 1.

Let us assume that the breaker is open and normal voltage is applied to the relay. Under these conditions transistors Q_2, Q_4, and Q_6 are on and transistor Q_3 is off. When the breaker is closed, the 52B contact connected to terminal 4 opens and removes the base drive to transistor Q_6 turning it off. When Q_6 turns off, the short-circuit is removed from C_2 allowing it to charge through RH-1 and R_2. C_2 charges to the firing voltage of unijunction transistor Q_1. The time required for C_2 to charge and fire Q_1 is controlled by potentiometer RH-1 which is mounted on the front of the relay over a calibrated time dial. When Q_1 fires, C_2 discharges through Q_1 and R_{14}. The resultant voltage drop across R_{14} causes the voltage on the emitter of Q_2 to rise above its base voltage. This causes flip-flop transistor Q_2 to turn off which turns transistor Q_3 on. When Q_3 turns on, its collector voltage drops to a low level and removes the base drive to transistor Q_4. The low voltage level on the collector of Q_3 also disables the timing circuit by forward biasing diode D_1 and providing a path for current to flow through RH-1, R_2, D_1 and Q_3 so that capacitor C_2 cannot charge up to a point where it will again fire unijunction transistor Q_1. If a fault appears on the protected line and a protective relay opens the breaker, the 52b contact connected to relay terminal 4 makes up and applies 24 volts to resistor R8 in the output pulse circuit. Capacitor C_3 charges up to the firing level of unijunction transistor Q_5. The relaxation oscillator made up of capacitor C_3, unijunction transistor Q_5, resistors R8 and R_9, and pulse transformer T_1 starts to oscillate. The positive pulses produced across pulse transformer T_1 by the oscillation of the relaxation oscillator are coupled to the gate of the TCR. The TCR turns on and allows current to flow from the positive battery supply through the TCR, out relay terminal 1, through the 52b contact

and 52x coil to negative battery. The 52x coil is energized and the breaker immediately recloses. When the 52x coil is energized, the 52x contacts make and apply 24 volts to relay terminal 2. This positive voltage at terminal 2 is applied through resistor R_{16} and diode D_2 to the collector of flip-flop transistor Q_3. This positive voltage on the collector of Q_3 causes Q_3 to turn off and Q_2 to turn on. When Q_3 turns off its collector goes positive providing base drive for transistor Q4. Q4 turns on and short-circuits capacitor C_3. With C_3 short-circuited, the output pulse circuit is disabled and positive pulses are removed from the gate of the TCR. The TCR turns off when the breaker recloses and the 52b contacts connected to terminal 1 open.

When the 52x contacts closed and applied a positive voltage to the collector of Q_3, the flip-flop was reset. In this state transistor Q_3 is off and Q_2 is on. With Q_3 off, its collector is highly positive. This reverse biases diode D_1 and turns Q4 on. When Q4 turns on it shorts C_3 and disables the output pulse circuit. When the breaker recloses, the 52b contacts connected to relay terminal 4 opens and remove the base drive to transistor Q6. Q6 turns off and capacitor C_2 is allowed to charge up again through RH-1 and R_2. Let us assume that a protective relay operates to trip the breaker before C_2 has charged to the firing level of Q_1. When the breaker opens, the 52b contact connected to relay terminal 4 closes and turns transistor Q6 on. Q6 short-circuits capacitor C_2 and removes the charge that had started to build up. Since the charge on C_2 had not reached a level to fire Q_1, the control flip-flop has not changed state and the output pulse circuit remains disabled. This means that there are no gate pulses being coupled to the gate of the TCR and it cannot turn on. Since the TCR does not turn on to energize the 52x coil and reclose the breaker, it will stay locked out until manually closed.

CHARACTERISTICS

Voltage Rating

The SGR-51 is rated for 125 or 48 volts D.C. Unless otherwise specified, the relays are connected for 125 volt operation when shipped.

Thyristor

The Reclosing Thyristor is rated 2t 30 amps 125 volts D.C. for 20 cycles.

Temperature Range

The SGR-51 is designed to operate over a temperature range from -30°C to +60°C with a reset time variation of not more than $\pm$ 5%.

Energy Requirements

125 V D.C.	45 Milliamperes
48 V D.C.	45 Milliamperes

CIRCUIT	TEST POINT	NORMAL INDICATIONS		COMPONENTS CHECKED
		BEFORE RESET	AFTER RESET	
Circuit Board Supply Voltage	Relay Term. 3	24V ± 1.2V	24V ± 1.2V	R_{17}, Z1
Timing Circuit	Junction of R_2 and C_2	Slow Voltage rise to approx. 18V.	Approx. 1.8V	Q_1, Q_6 C_2, C_1 RH-1, D_1
Flip-flop Control circuit	Junction of R_3 and R_4	Approx. 1.3V	Approx. 19V	Q_2, Q_3, C_5
	Junction of R_6 and R_7	Approx. 19V	Approx. 1.3V	
Output pulse circuit	Junction of R8 and C_3	.7 volts	⁄Sawtooth Waveform Rising to 18V in 5 to 7 Msec.	Q_4, Q_5, C_3, T_1, D_3
	Junction of Q_5 and T_1 Term. 3	0 Volts	⁄ 10 volt pulses every 5 to 7 Msec.	
Reclosing circuit	Across external 1K resistor connected to terminal 1	0 Volts	Rated Voltage	TCR Z_2, Z_3 T_1, C_4

⁄ Oscilloscope only

All measurements made between indicated points and terminal 8 (D.C. Negative)

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to customers who are equipped for doing repair work. When ordering parts, always give the complete data as shown in the electrical parts list.

Electrical Parts List

Circuit Symbol	Description	Westinghouse Style Number
	Capacitors	
C1	1.5MFD 35V 10%	187A508H09
C2	22 MFD 35V 10%	187A508H17
C3	1.5MFD 35V 10%	187A508H18
C4	2 MFD 200V 20%	187A624H05
C5	.01MFD 50V 20%	184A663H01
	Controlled Rectifiers	
TCR	2N1846	184A614H06
	Diode Rectifiers	
D1 thru D4	TI55	183A790H09
	Resistors	
R1	680 1/2w	184A763H23
R2	82000 1/2w	836A503H70
R3	10000 1/2w	184A763H51
R4	33000 1/2w	184A763H63
R5	33000 1/2w	184A763H63
R6	10000 1/2w	184A763H51
R7	180,000 1/2w	184A763H81
R8	2700 1/2w	184A763H37
R9	1000 1/2w	184A763H27
R10	1200 1/2w	187A290H17
R11	27000 1/2w	184A763H61
R12	27000 1/2w	184A763H61
R13	330 1/2w	184A763H15
R14	47 1/2w	187A290H17
R15	10000 1/2w	184A763H51
R16	470 1/2w	184A763H19
R17	2250 tapped at 555 25w	187A321H03
R18	1000 1/2w	184A763H27
R19	1,000,000 1/2w	184A763H99
	Transformers	
T1	Pulse Transformer	629A453H02

	Transistors	
Q2	2N697	184A638H18
Q3	2N697	184A638H18
Q4	2N2349	762A585H13
Q6	2N697	184A638H18
	Unijunction Switches	
Q1	4JX5E695	629A435H02
Q5	2N2647	629A435H01
	Zener Diodes	
Z1	HW24B	185A212H12
Z2	1N3051	187A936H01
Z3	1N3051	187A936H01
Z4	1N3026	187A936H03

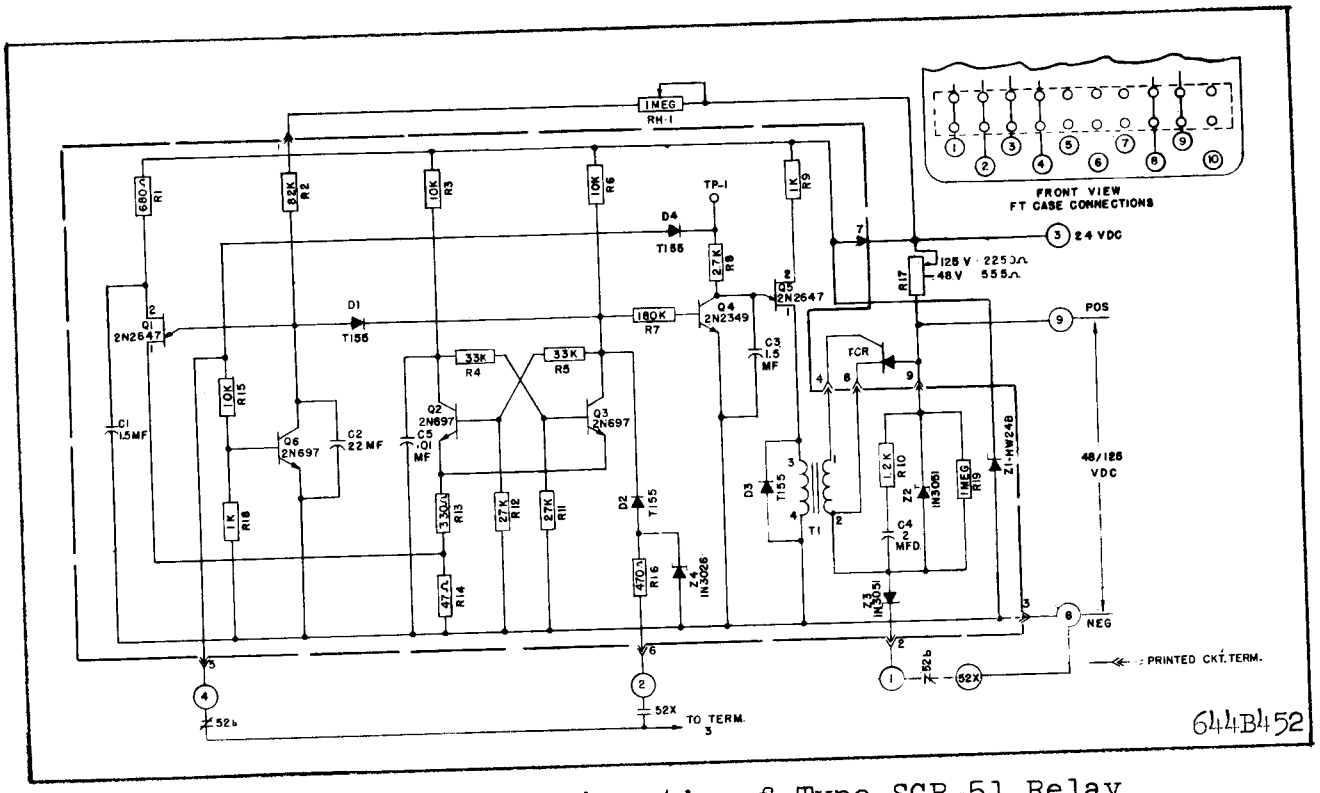


Fig. 1 Internal Schematic of Type SGR-51 Relay

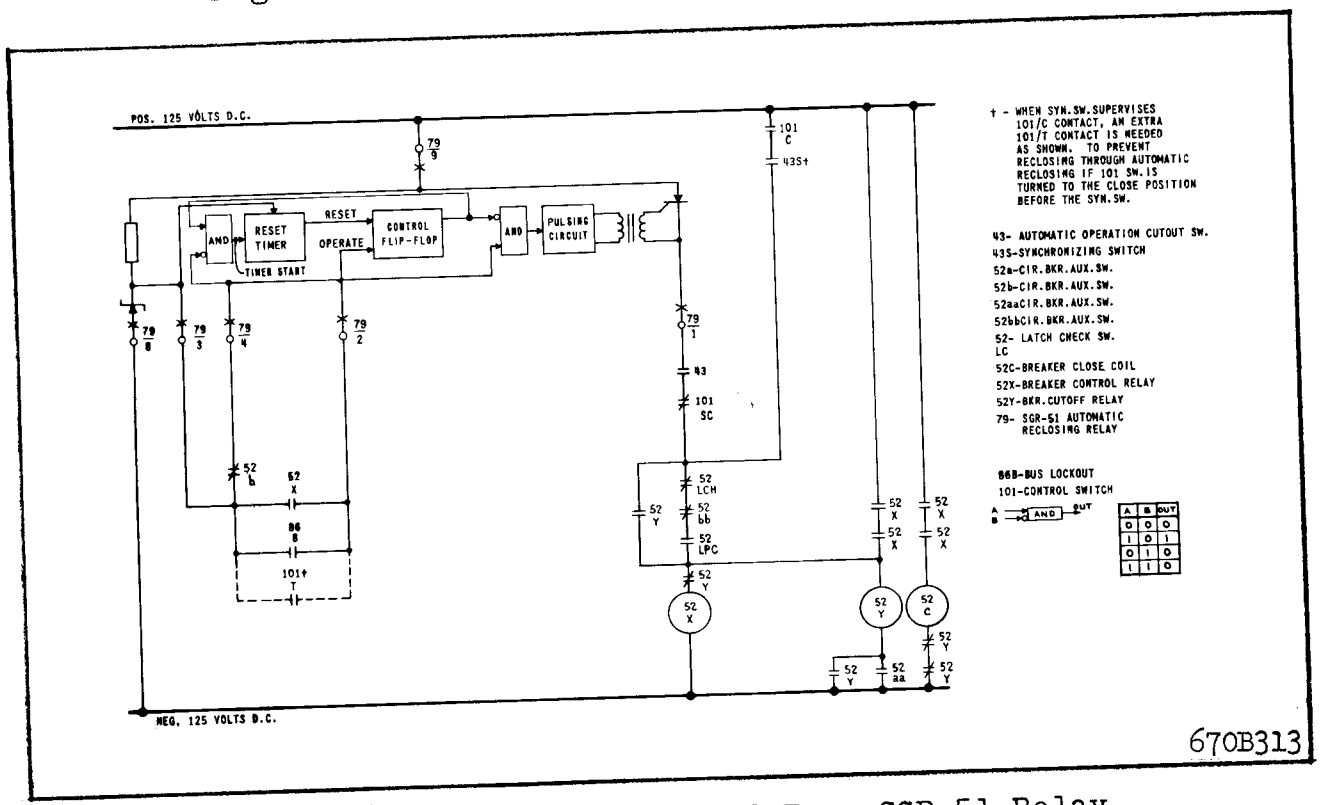


Fig. 2 External Schematic of Type SGR-51 Relay

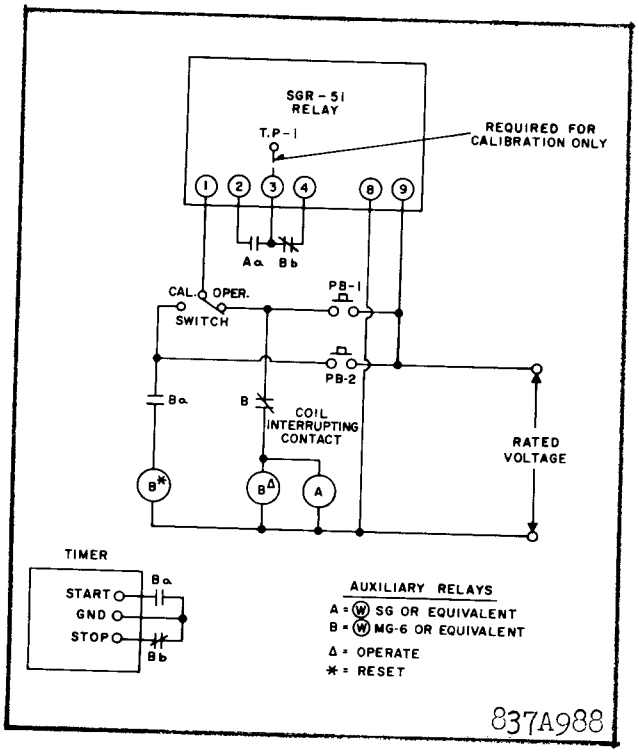


Fig. 3 Test Circuit for Type SGR-51 Relay

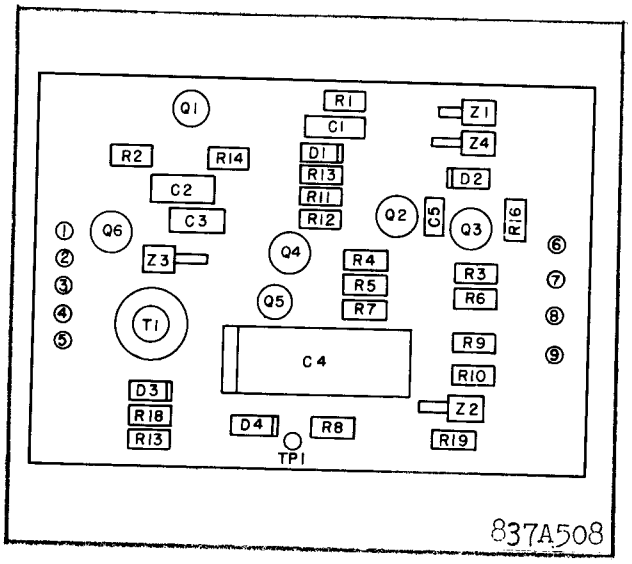
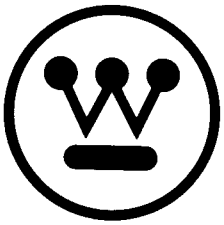


Fig. 4 Component Layout on SGR-51 Relay Printed Circuit Board



WESTINGHOUSE ELECTRIC CORPORATION
RELAY-INSTRUMENT DIVISION
NEWARK, N. J.
Printed in U.S.A.