



# INSTRUCTIONS

GEK-1269A  
SUPERSEDES GEK-1269

## RECLOSING RELAY



**TYPE NLR11A 6 & UP**  
**NLR11B 6 & UP**

**POWER SYSTEMS MANAGEMENT DEPARTMENT**

**GENERAL  ELECTRIC**

**PHILADELPHIA, PA.**

## NOTES

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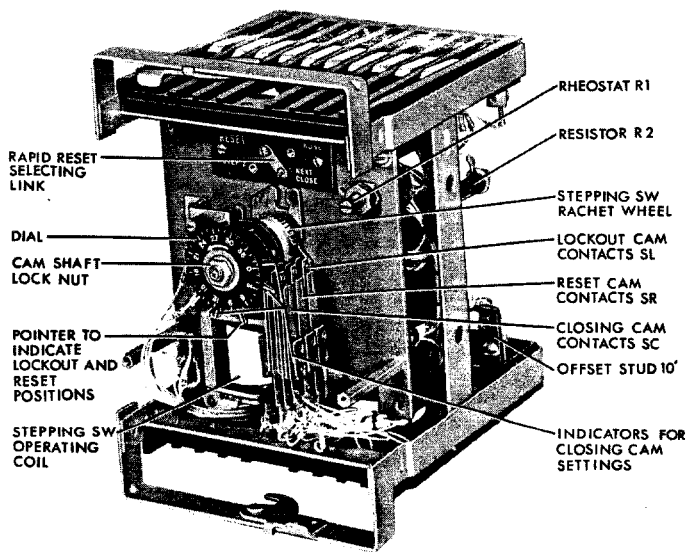


Fig. 1A (8035985) Front View

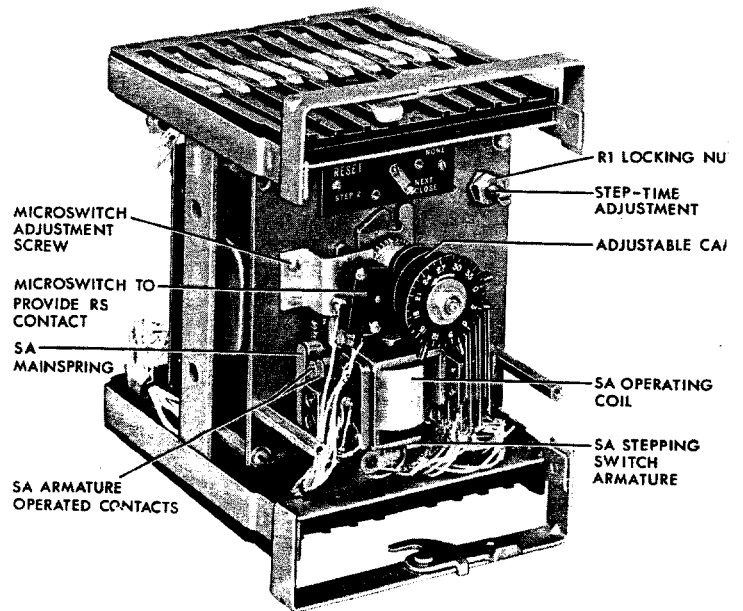


Fig. 1B (8035986) Front View

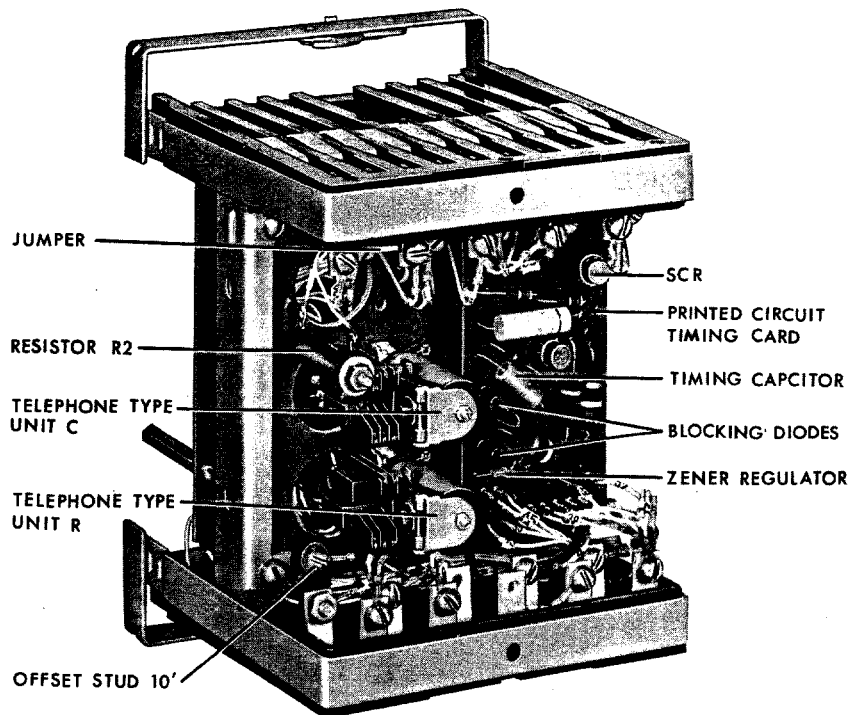


Fig. 1C (8035982) Rear View

Fig. 1 Type NLR11A Relay Removed From Case

# RECLOSING RELAY TYPE NLR11A, 11B

## INTRODUCTION

The Type NLR11A relay is a reclosing relay which automatically initiates the reclosing impulses to a circuit breaker which has been tripped by its protective relay. It is basically a timing device, and contains a DC operated timing circuit that employs solid state components to provide an extremely stable time delay function. The timing circuit is normally adjusted to provide a time interval of 5 seconds and to operate a stepping switch one step at the end of this interval. When the stepping switch operates, it resets the timer which starts timing for the next step. Adjustable cam-operated contacts provide reclosing signals on steps 0 to 34 incl. The 35 step is lockout and the 36 step is reset which completes the cycle and returns the relay to the starting point. The relay contains a small rheostat to provide step time adjustment from .5 to 5 seconds and a reset selecting link to provide rapid resetting of the relay after any successful reclosing either after 2 step time intervals, or on the next reclosing signal, or only at lockout as desired. Also, the relay contains two telephone-type relay units, one to maintain the closing signal and the other the reset signal to insure successful completion of each operation. A cam operated contact provides blocking of instantaneous trip signal if desired. An "RS" contact actuated by and adjustable cam is provided for blocking automatic tap changing during the reclosing cycle or for other functions.

The cams can be adjusted to provide for an immediate initial reclosure followed by two delayed reclosures, or for a delayed initial reclosure followed by two additional delayed reclosures. The reclosing relay resets automatically a preselected interval after any successful reclosure, or from its lockout position following a successful manual reclosure. Other reclosing cycles are also possible as described under ADJUSTMENTS.

Two blank rings (no lobes) are supplied with each relay for replacing two of the adjustable cams when a single reclosure is desired. Two reclosures may be obtained by replacing one of the adjustable cams with a blank ring.

## APPLICATION

The type NLR reclosing relay is suitable for application wherever it is desired to reclose a circuit breaker automatically one or more times after it has been tripped by its protective relay. When immediate initial reclosure is used, the circuit breaker mechanism should be provided with a position switch or latch-checking switch to insure

that the mechanism is ready to close the breaker before the closing coil is energized; and the protective relay contacts must open fast enough to prevent retripping of the circuit breaker following immediate reclosure.

A dc stepping relay Type NLA is available to provide an alarm after a specified number of subsequent reclosures.

Typical external connections are shown in Fig. 3A for dc control and in Fig. 3B for ac control.

More specific information relative to application is given in the section entitled APPLICATION CONSIDERATIONS.

## RATINGS

The NLR is basically a D.C. device but a bridge type rectifier is included when A.C. operation is required.

The relay has standard ratings of 48, 125 and 250 volts DC and 120 and 240 volts AC.

The relay contacts will interrupt the currents given in Table A.

TABLE "A"

Volts	Current Inductive*	Current Non-Inductive
48 V DC	1.0	3.0
125 V DC	0.5	1.5
250 V DC	0.25	0.75
115 V 60 cyc.	0.75	2.0
230 V 60 cyc.	0.5	1.0

### \*Induction of Average Trip Coil

The relay contacts will make and carry 30 amperes for tripping duty and carry 1.0 ampere continuously.

The NLR will operate in ambient temperatures of -20°C to 60°C with a max. time variation of 6%, and down to - 40°C with a max. variation of 10%.

## TOTAL TIME

The Type NLR relay is available with a total cycle of three minutes. This total time cycle is measured from the point where the relay starts timing to the point following lockout where the relay is reset. Shorter total times are available since total time = 36 x step time.

*These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.*

## BURDENS

The burden of the Type NLR is approximately as given in Table B. A.C. burden is at unity power factor.

TABLE "B"

VOLTS	FREQ.	RES.-OHMS MIN.
250	DC	1500
125	DC	400
48	DC	70
240	60	1500
120	60	400

The resistance values given are the relay resistance when the stepping switch coil is energized. The stepping switch coil is energized for about 8 milliseconds when the switch steps. At other times when the timer is running the relay resistance is approximately 10 times the values given in TABLE "B". When the relay is in reset, it has zero burden.

## RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

## DESCRIPTION

The NLR relay consists of a simple rugged stepping switch, a static timing circuit on a printed circuit card, a rheostat, a reset selecting link and 2 telephone-type relay units.

A photograph of the relay in its case with cover in place is shown on the cover of this Instruction Book. The series of photographs in Fig. 1 shows the principal parts in the relay and their relative positions in the assembly. All units and parts are identified by the nomenclature or device numbers used throughout the text.

## CASE

The case is suitable for either surface or semi-flush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism when one is required. Each cover screw has provision for a sealing wire.

The case has studs or screw connections at both ends for the external connections. The electrical connections between the relay units and the case studs are made through spring backed contact fingers mounted in stationary molded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case, have the studs for the external connections, and the inner blocks have the terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The cases and cradles are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the respective blocks of the cradle and case, also lock the latch in place. The cover, which is fastened to the case by thumbscrews, holds the connecting plugs in place.

To draw out the relay unit, the cover is first removed, and the plugs drawn out. The latches are then released, and the relay unit can be easily drawn out. To replace the relay unit, the reverse order is followed.

A separate testing plug can be inserted in place of the connecting plug to test the relay on the panel, either from its normal source of power or from other sources. Or, the relay unit can be withdrawn for testing and replaced by a spare relay unit.

## INSTALLATION

The relay should be mounted on a vertical surface in a location reasonably free from excessive heat, moisture, dust and vibration. The relay case may be grounded, if desired, using at least No. 12 B & S gage copper wire. The panel drilling for the NLR relays is shown in Fig. 10.

The internal connections for the Type NLR11 relay is shown in Figs. 2A & 2B.

Shorting bars are furnished between terminals 9 - 10 and 1 - 2 to complete the circuits between these terminals if the connection plug is withdrawn from the case.

Unless otherwise requested, all relays are adjusted at the factory for immediate initial reclosure. For delayed initial reclosure, loosen locking nut and move adjustable cam lobe in step

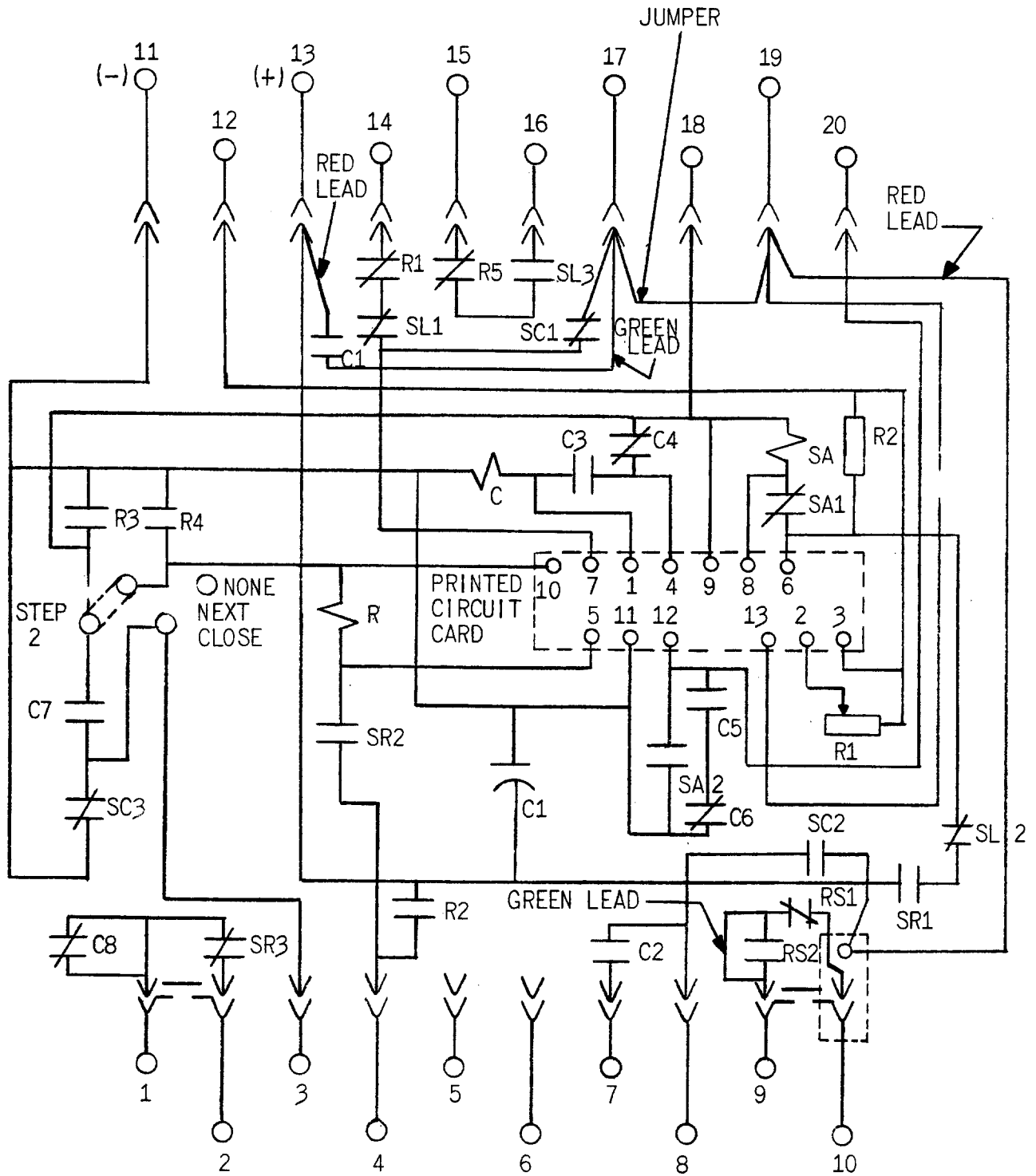
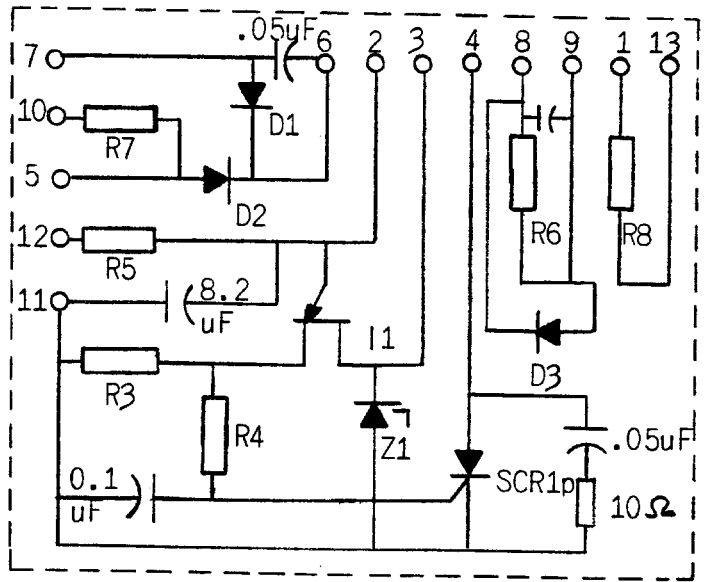


Figure 2A (0203A8614-2 Sh 1) Internal Connection Diagram For Relay Type NLR11A & -B, D-C Control. (Front View)

STEPPING SWITCH CONTACTS

CONTACTS	SWITCH CONTACTS		
	RESET	STEPS 1-34 INC	LOCKOUT
SL (⊕) (⊖)	CLOSED	CLOSED	OPEN
SL (⊖) (⊕)	OPEN	OPEN	CLOSED
SR (⊖) (⊕)	OPEN	CLOSED	CLOSED
SR (⊕) (⊖)	CLOSED	OPEN	OPEN
SC (⊕) (⊖)	CLOSED BY ADJUSTABLE CAMS IN ANY 3 NON-ADJACENT STEPS		
SC (⊖) (⊕)	CLOSED WHEN SC CONTACTS (⊕) ARE OPEN		
SA (⊖) (⊕)	CLOSED WHEN STEPPING SW. COIL IS ENERGIZED		
SA (⊕) (⊖)	OPEN WHEN STEPPING SW. COIL IS ENERGIZED		



PRINTED CIRCUIT CARD

MODEL	FORM		
12NLR11A(-)A	6	7	8
VOLTS D-C	250	125	48
RESISTANCE IN OHMS			
C COIL	14,000	3,600	500
R COIL	16,000	3,600	600
SA COIL	1,500	400	70
R1	1 MEG.	1 MEG.	1 MEG.
R2	18,000	8,000	2,000
R3	470	470	470
R4	47	47	47
R5	10	10	10
R6	8200	3900	1500
R7	8200	3900	1500
R8	2200	1000	390
CAPACITANCE VALUE			
C1	1uF	1uF	1uF

ACTUAL LOCATION OF CONNECTORS ON PRINTED CIRCUIT CARD

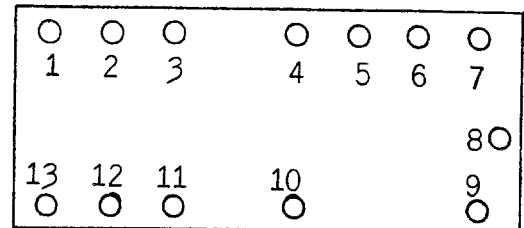


Fig. 2A (0203A8614-2 Sh.2) Continued



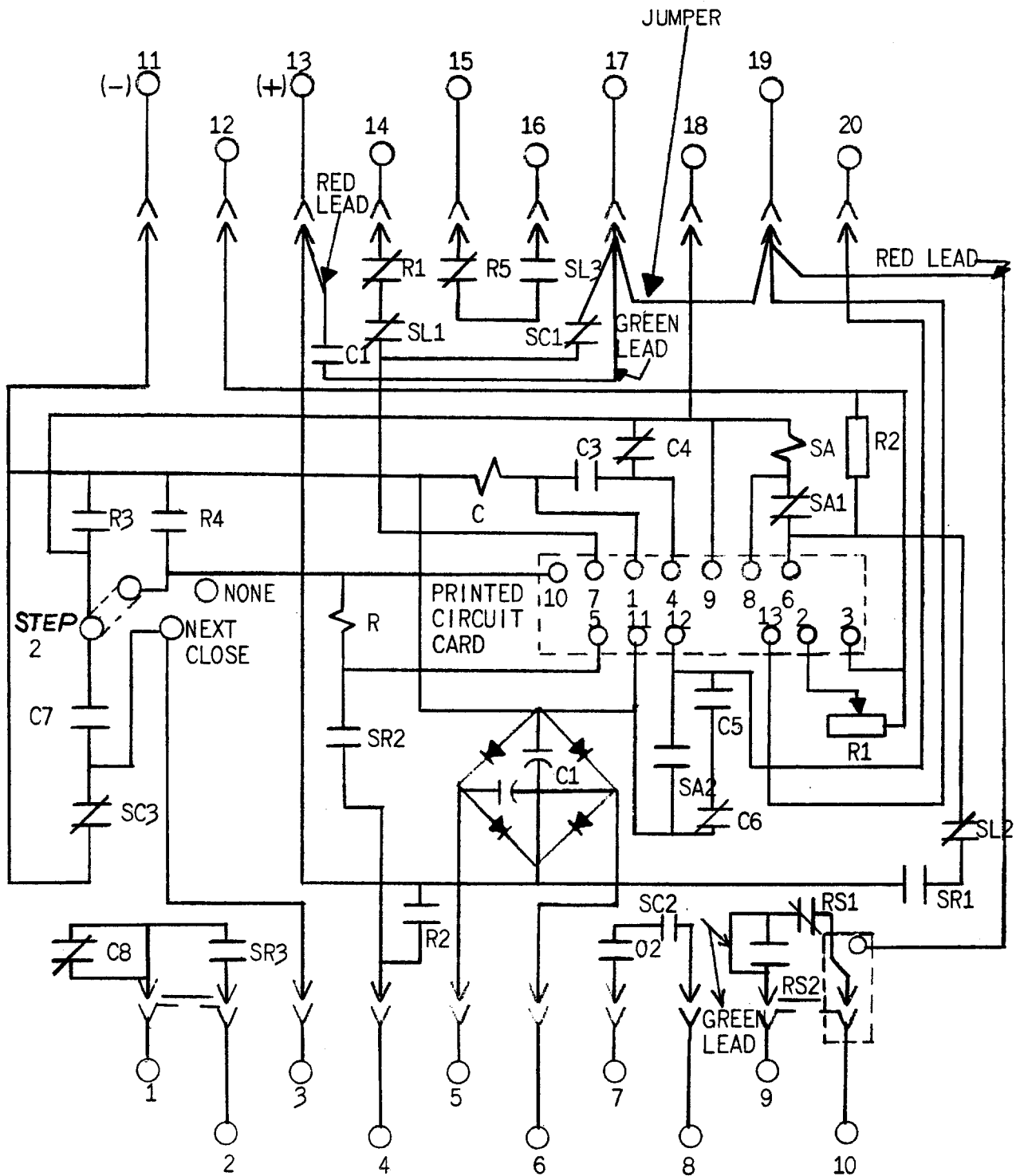
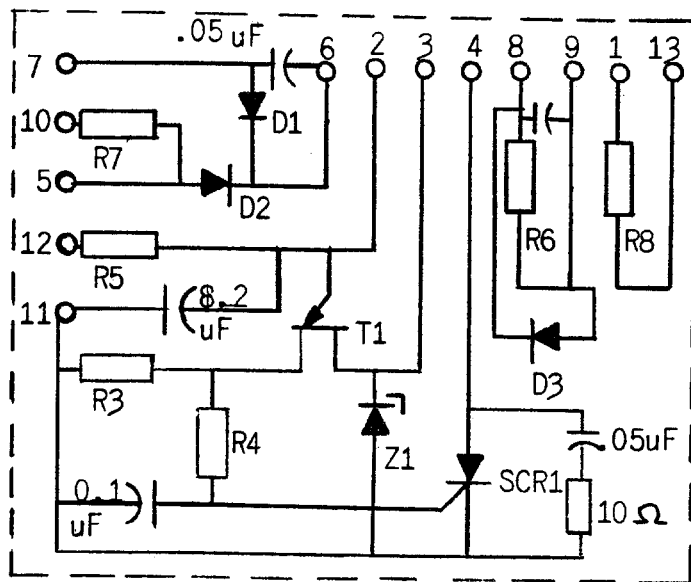


Fig. 2B (0203A8615-3 Sh. 1) Internal Connection Diagram For Relay Type NLR11A &-B, A-C Control 120 Volts. (Front View).

STEPPING SWITCH CONTACTS

CONTACTS	SWITCH POSITIONS		
	RESET	STEPS 1-34 INC	LOCKOUT
SL (⌘) CLOSED	CLOSED	CLOSED	OPEN
SL (⌘) OPEN	OPEN	OPEN	CLOSED
SR (⌘) OPEN	OPEN	CLOSED	CLOSED
SR (⌘) CLOSED	CLOSED	OPEN	OPEN
SC (⌘) CLOSED BY ADJUSTABLE CAMS IN ANY 3 NON-ADJACENT STEPS			
SC (⌘) CLOSED WHEN SC CONTACTS (⌘) ARE OPEN			
SA (⌘) CLOSED WHEN STEPPING SW. COIL IS ENERGIZED			
SA (⌘) OPEN WHEN STEPPING SWITCH COIL IS ENERGIZED			



PRINTED CIRCUIT CARD

MODEL	FORM		
12NLR11A(-)A	9		
VOLTS A-C	120		
RESISTANCE IN OHMS			
C COIL	5000		
R COIL	6500		
SA COIL	400		
R1	1MEG		
R2	10,000		
R3	470		
R4	47		
R5	10		
R6	3900		
R7	3900		
R8	1000		
CAPACITANCE VALUE			
C1	8 uF		

ACTUAL LOCATION OF CONNECTORS ON PRINTED CIRCUIT CARD

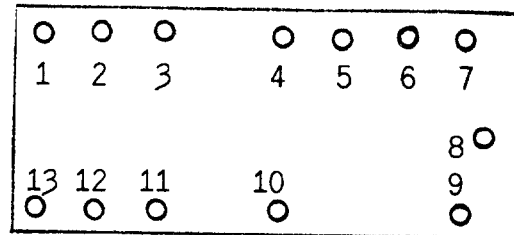


Fig. 2B (0203A81615-3 Sh. 2) Continued

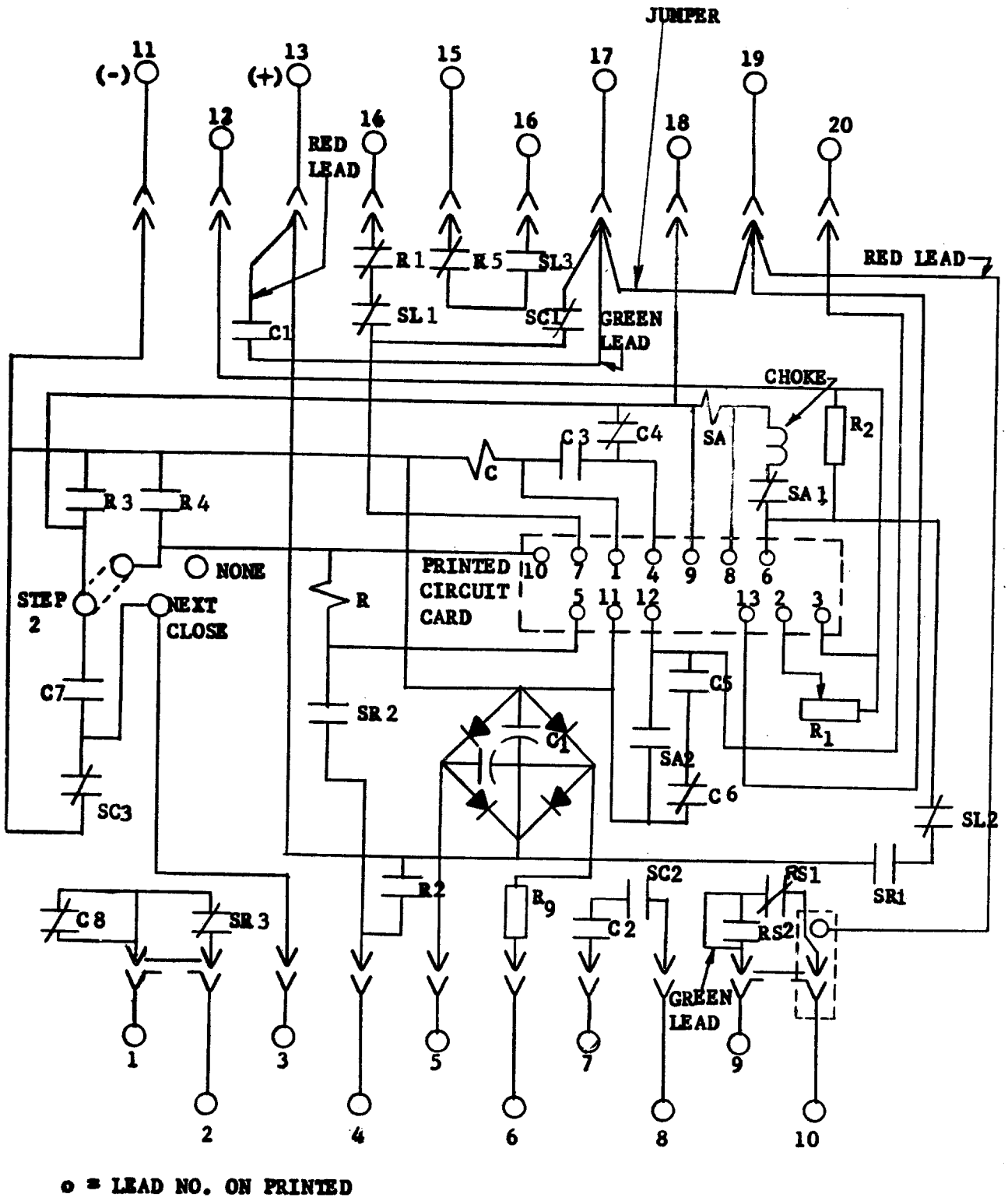
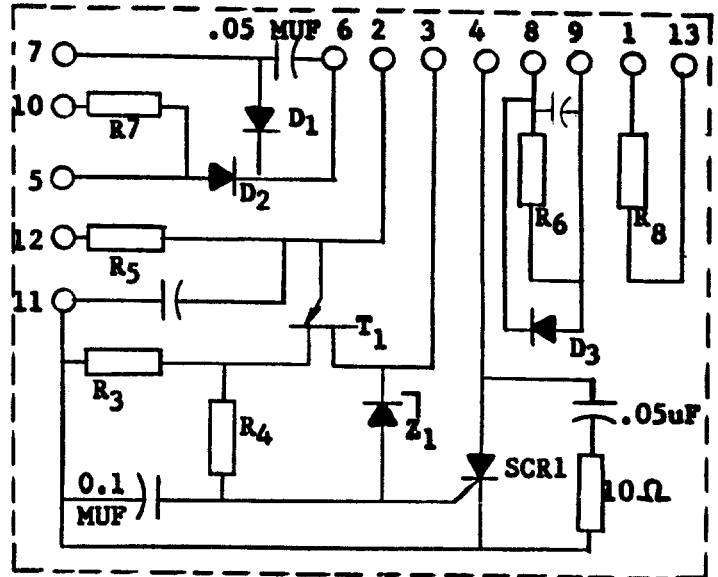


Fig. 2C (0207A7865 Sh 1) Internal Connection Diagram For Relay Type NLR11A &-B, A-C Control 240 Volts (Front View)

**STEPPING SWITCH CONTACTS**

CONTACTS	SWITCH POSITIONS		
	RESET	STEPS 1-34 INC	LOCKOUT
SL (≠)	CLOSED	CLOSED	OPEN
SL (⊕)	OPEN	OPEN	CLOSED
SR (⊕)	OPEN	CLOSED	CLOSED
SR (≠)	CLOSED	OPEN	OPEN
SC (⊕)	CLOSED BY ADJUSTABLE AMS IN ANY 3 NON-ADJACENT STEPS.		
SC (≠)	CLOSED WHEN SC CONTACTS ARE OPEN. (⊕)		
SA (⊕)	CLOSED WHEN STEPPING SWITCH COIL IS ENERGIZED.		
SA (≠)	OPEN WHEN STEPPING SWITCH COIL IS ENERGIZED.		



**PRINTED CIRCUIT CARD**

MODEL	FORM		
12 NLR11A(-)A	10	11	
VOLTS A-C	240	240	
RESISTANCE IN OHMS			
C COIL	21,000	21,000	
R COIL	28,500	28,500	
SA COIL	1,500	1,500	
CHOKE	3	3	
R1	1 MEG	1M	
R2	20 K	20K	
R3	470	470	
R4	47	47	
R5	10	10	
R6	8.2K	8.2K	
R7	8.2K	8.2K	
R8	2.2K	2.2K	
R9	500	500	
CAPACITANCE VALUE			
C1	2uF	2uF	

**ACTUAL LOCATION OF CONNECTORS ON PRINTED CIRCUIT CARD.**

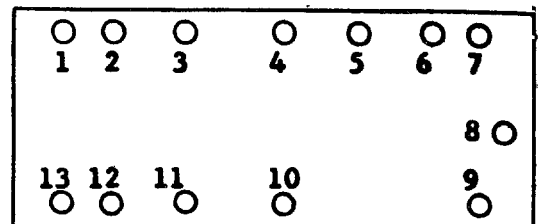
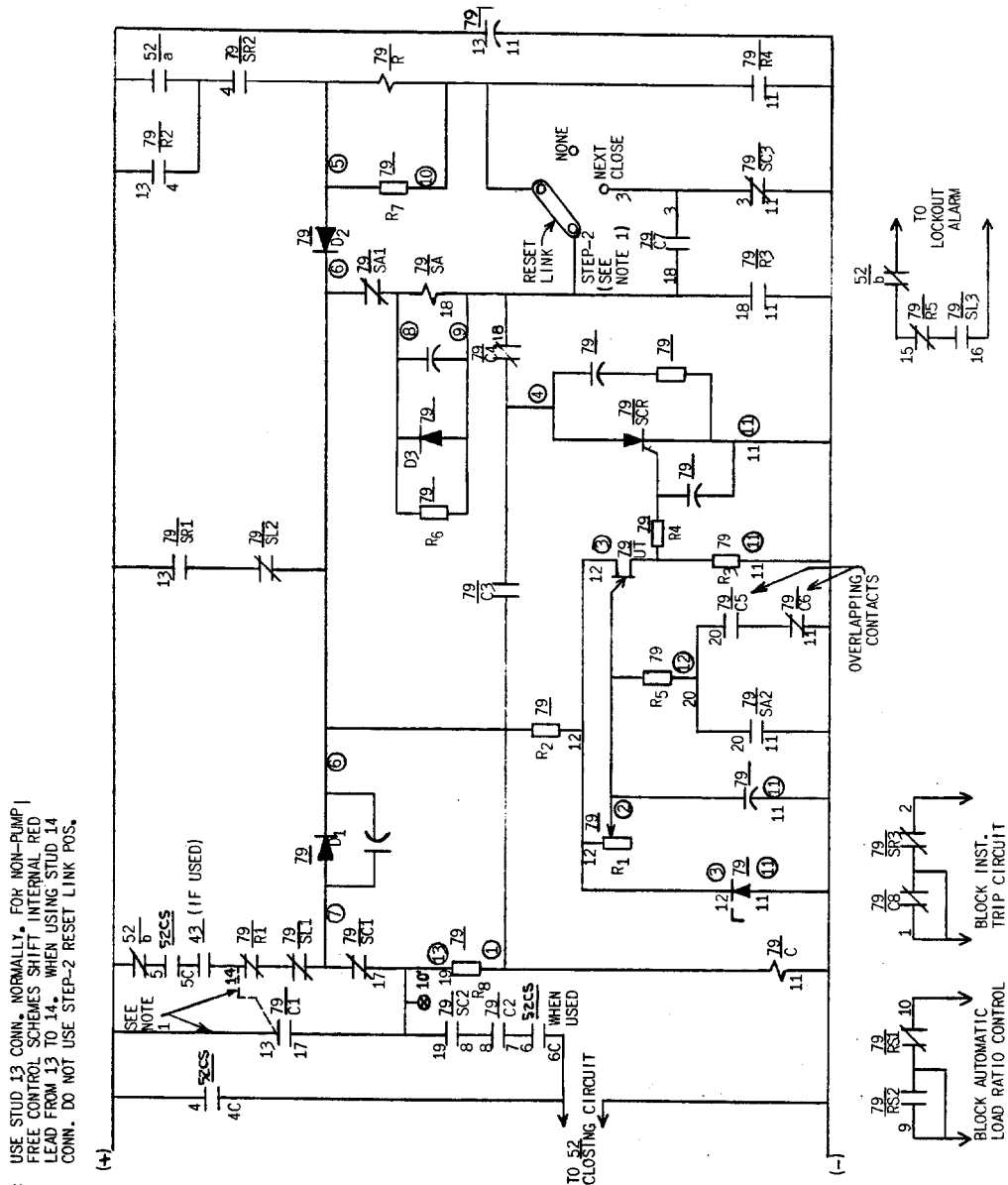


Fig. 2C (0207A7865 Sh 2) Continued



NOTE 1: USE STUD 13 CONN. NORMALLY, FOR NON-PUMP FREE CONTROL SCHEMES SHIFT INTERNAL RED LEAD FROM 13 TO 14. WHEN USING STUD 14 CONN. DO NOT USE STEP-2 RESET LINK POS.

CAM OPERATED CONTACTS	RESET STEP #0	STEPS 1-34	LOCKOUT STEP 35
SL -	X		X
SR -		X	
SR -		X	X
SL -		X	
SC -	X, ANY 3 NON-ADJACENT STEPS		
SC -	OPEN WHEN SC IS X		
RS -	X IN ANY 6 ADJACENT STEPS		
RS -	OPEN WHEN RS IS X		

LEGEND		DESCRIPTION
DEVICE NO.	INCL. ELEM.	
52CS	SB	CONTROL SWITCH
52		AC CIRCUIT BREAKER
79		AC RECLOSING RELAY
	C	CLOSING UNIT
	R	RESETTING UNIT
	RS	CAM OPER. AUX-FUNCTION SW.
	SA	ARMATURE OF STEPPING SW.
	SC	CLOSING CONTS. OF STEPPING SW.
	SL	LOCKOUT CONTS. OF STEPPING SW.
	SR	RESETTING CONTS. OF STEPPING SW.

BREAKER CONTROL SWITCH MODEL 16581B12			
CONTACT NUMBER	CLOSE	NORMAL AFTER CLOSE	TRIP
1			X
2			X
3	X		
4	X		
5	X		
6	X		

DESCR. OF DEVICE	INT. CONNS.	OUTLINE
NLR11A-1A or -1B (-A.C.)	020348614	K-6209272
NLR11A-1A or -1B (-A.C. (2))	020348615	K-6209272
NLR11A-1A or -1B (-A.C. (2))	020747865	K-6209272

⑥ - NUMBERS IN CIRCLES ARE TERMINAL POINTS ON PRINTED CIRCUIT CARD.

NUMBERS ON CONTACTS (79/R1, 79/SC1, ETC) ARE ARBITRARILY ASSIGNED FOR IDENTIFICATION PURPOSES.

Fig. 3A (0165B2204-0 Sh 1) Typical External Connections Diagram For the NLR11A & NLR11B Reclosing Relays D. C. Control Voltage.

NOTE 1: SHUNT RED LEAD FROM 13 TO 14 FOR NON-PUMP FREE A-C CONTROL SCHEMES. WHEN USING STUD 14 CONNECTION, DO NOT USE STEP-2 LINK POS.

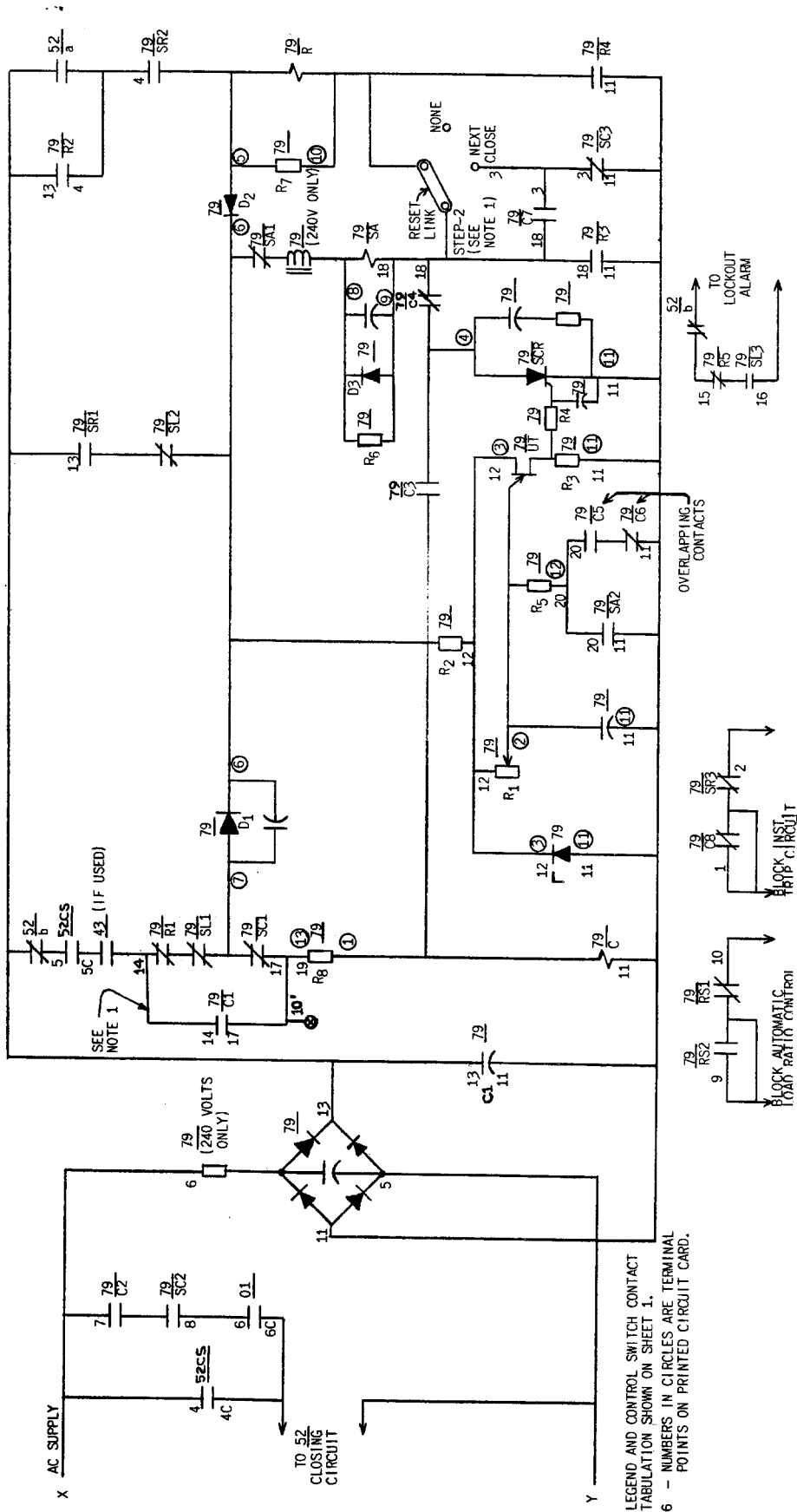


Fig. 3B (0165B2204-0 Sh 2) Typical External Connections Diagram For the NLR11A & NLR11B Reclosing Relays A-C Control Voltage

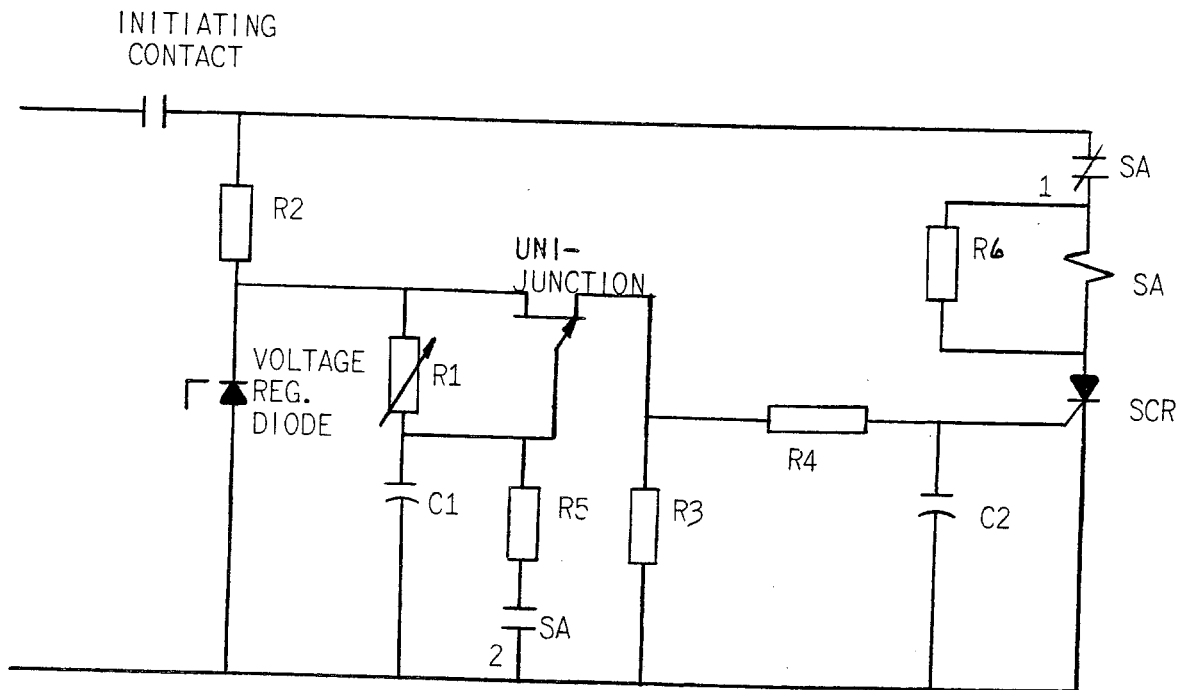
0 to the step number which will give the desired time delay and then tighten the locking nut. THE CAM SHAFT MUST BE FIRMLY HELD WHILE LOOSENING OR TIGHTENING LOCKING NUT TO PREVENT DAMAGE TO STEPPING SWITCH SPRINGS.

### PRINCIPLES OF OPERATION

The basic operating principles of the NLR reclosing relay will be explained with the aid of schematic diagrams Figs. 4 and 5.

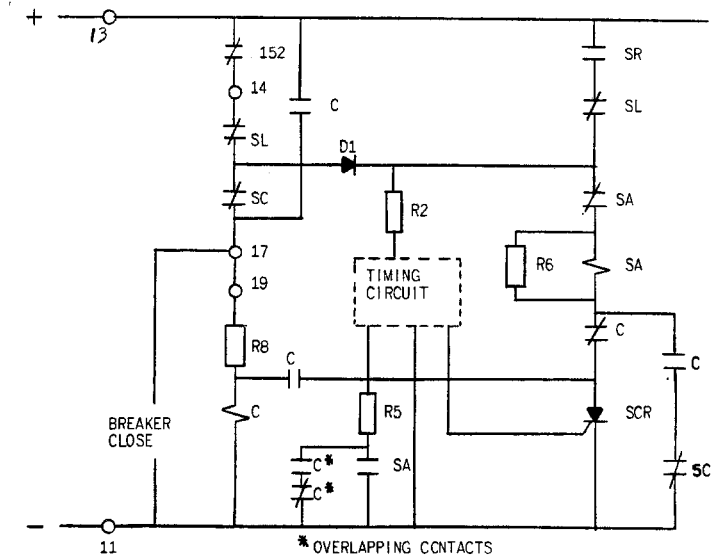
Fig. 4A is a schematic diagram of the timing circuit. When the initiating contact starts the timer, current flows thru the resistor R2 and adjustable resistor R1 to charge the capacitor C1. The zener regulator holds the voltage across R1

and C1 constant even when the supply voltage changes. This is accomplished by the breakdown characteristic of the zener regulator at a definite voltage to permit current to flow thru the zener without restraint above this breakdown voltage. This permits the voltage drop across R2 to vary with variations in the supply voltage while the voltage drop across R1 and C1 remains constant. Since the voltage across the R-C circuit is constant, the time to charge the capacitor up to a certain voltage will vary only when the value of the resistor R1 is changed. When the voltage across the capacitor C1 reaches a certain value (about 55 percent of the zener regulator breakdown voltage) it turns the unijunction permit a short pulse of current to flow thru Resistor R3. The voltage drop across R3 is impressed on the



**LEGEND**  
 SA-STEPPING SWITCH ARMATURE  
 SCR-SILICON CONTROLLED RECTIFIER

Figure 4A (0178A9145-1) Timing Circuit For Relay Type NLR11



CAM OPERATED CONTACTS	RESET	STEPS 1-34 INCL	LOCKOUT
SL	CLOSED	CLOSED	OPEN
SL	OPEN	OPEN	CLOSED
SR	OPEN	CLOSED	CLOSED
SR	CLOSED	OPEN	OPEN
SC	OPEN WHEN SC CONT. IS CLOSED		
SC	ADJUSTABLE TO CLOSE ON ANY 3 STEPS		

**LEGEND**  
 152-POWER CIRCUIT BREAKER  
 Ⓞ - RELAY STUDS

Fig. 4B (0178A9146-1) Breaker Reclosing Circuit With Contact Shown As They Are In Reset Position For Instantaneous First Reclosure.

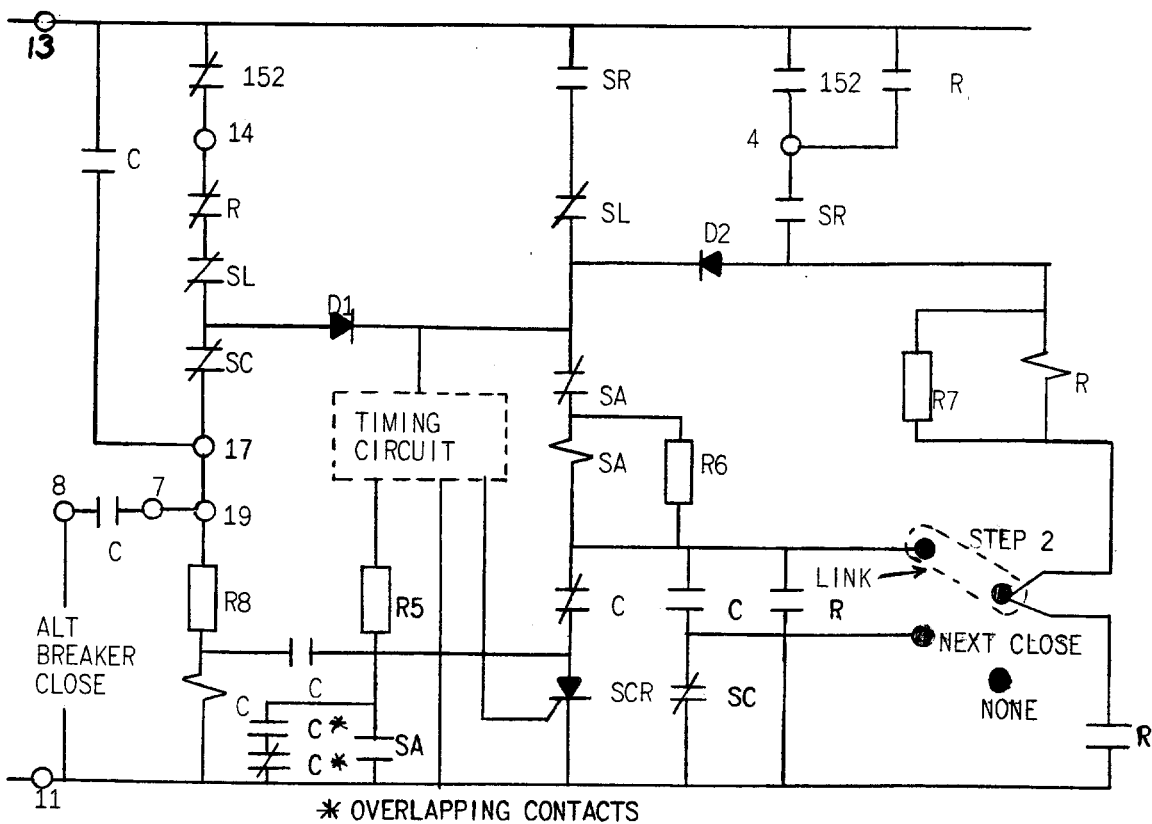


Fig. 4C (0178A9147-2) Breaker Reclosing Schematic Diagram And Reset Circuits



SCR (silicon controlled rectifier) gate long enough to turn on the SCR. When the unijunction is turned on it partially discharges the capacitor C1 and turns itself off. When the SCR is turned on it will stay on until its current is reduced below 20 milliamperes and once it is turned off it stays off until voltage is again applied to its gate. The resistor across the SA coil is to allow the current thru the SCR to build up quickly.

In the NLR relay when the timing circuit turns the SCR on, it operates the stepping switch armature. The armature movement opens one "SA" contact and closes another "SA" contact as shown schematically in Fig. 4 and Fig. 5. The opening of the SA contact turns the SCR off and the closing of SA contact completely discharges the capacitor C1 to reset the timing circuit. When the armature picks up it also raises the driving spring enough to clear the next tooth on the ratchet wheel and the driving spring snaps into the next notch. When the SCR is turned off by the SA contact the armature coil is de-energized and its main spring rotates the ratchet wheel 10 degrees. At this point the timing circuit starts timing again and it will rotate the stepping switch ratchet wheel another 10 degrees after another time interval has elapsed. All stepping switch operations will have the same time interval.

The ratchet wheel of the stepping switch is solidly connected to a cam shaft which contains three main cams. The two cams nearest to the ratchet wheel (schematically shown in Fig. 5) have

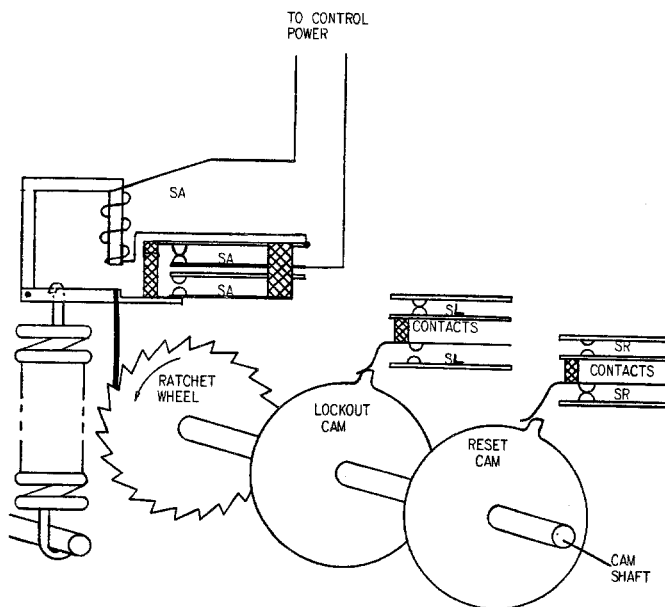


Fig. 5 (0178A9144-0) Stepping Switch For NLR Relays

only one lobe each and therefore raise their associated contact operating springs only during one step interval for each revolution of the ratchet wheel. A third cam (not shown in Fig. 5) has 3 adjustable lobes and these lobes may be set to raise their associated contact operating spring on any desired step. When the adjustable cam lobes raise their contact operating spring they close two "SC" contacts shown in Fig. 4B and one of these supplies the breaker closing signal. Since the adjustable cam lobes can be set to close the "SC" contact on any step of the ratchet wheel they can provide a breaker closing signal at reset (an instantaneous breaker reclosing signal) and - or on any subsequent step until the lockout position is reached which is 35 steps after reset. The schematic diagram Fig. 5 shows the ratchet wheel in the lockout position. In this position the (SL) lockout cam opens its SL contacts to open up the breaker closing circuit and the timing circuit (which prevents any further operation of the stepping switch until the breaker is manually closed as explained later) and closes an SL contact to ring an alarm. When the stepping switch armature coil is energized again, the switch steps from lockout to the reset position (as explained later).

The lockout cam has 3 contacts, one normally open and 2 normally closed.

The reset cam has 3 contacts, one normally open and 2 normally closed.

The adjustable cam (close) has 3 contacts, two normally open and 1 normally closed.

Fig. 4B shows the NLR breaker reclosing circuit with the NLR in the reset position and set for instantaneous first reclosure. In the reset position the SL contacts are closed, but the SR contacts are open so there is no circuit connecting the timer to power until the breaker (152) trips and closes its N.C. auxiliary switch. This energizes the breaker closing circuit and the "C" relay coil thru the preclosed SC contact and the timing circuit thru the blocking diode, "D1". The "C" relay steps the stepping switch once immediately and seals in to maintain the closing signal for one step interval. The instantaneous step is to prevent pumping the breaker if control power is lost and then returns and also to open the instantaneous trip blocking contact (1-2). The "C" relay maintains the closing signal to prevent a second closing impulse if the breaker trips during the step time interval. At the end of the first time interval the "C" relay is shorted out by the SCR and drops out. Its overlapping contacts discharge the capacitor C1 to reset the timing circuit. When the "C" Relay picks up the stepping switch closes its "SR" contacts at once and then the timer continues to run whether the breaker is open or closed since both the SR and SL contacts are closed and they provide a circuit to the timer. After the "C" relay drops out the stepping switch continues with equal elapsed time between steps until its ratchet reaches the step in which the lobe on the adjustable cam again closes the SC contact. At this point if the breaker is open the NLR will close it and if the breaker is closed no closing signal

will be given to the breaker closing circuit due to the blocking diode shown in Fig. 4B. In either case the stepping switch steps on with equal elapsed time steps to the next reclosing cam location and then closes the breaker if it is open as described above. The stepping switch steps on to the lockout position where the SL contacts open to deenergize the timer and stepping switch and a SL contact closes to sound the alarm if the breaker is open.

Figure 4C shows the reset circuit added to the breaker reclosing schematic. The link in the "Reset" selecting device is shown in the step two position. This means that the NLR relay will reset two step time intervals after any automatic breaker reclosure. After the NLR relay has reclosed the breaker as described above the breaker closes its normally open auxiliary switch shown in Fig. 4C. The "SCR" is always turned off by the time the breaker closes and at the start of the next step time interval is turned on by the timer. As the connections are shown in 4C when the SCR is turned on one step time after the breaker has been reclosed there is no circuit energizing the "R" relay coil because the "C" relay N.C. contact is still open. The next time the SCR is turned on the "R" relay coil is energized thru the N.O. breaker auxiliary switch, the SR contact, the step two reset link, the "C" relay N.C. contact and the SCR to the negative side of power. The R relay together with its parallel resistor, R7, draw enough current to keep the SCR turned on. The R relay seals in and the stepping switch armature picks up again as soon as it drops open. Thus the stepping switch runs without any delay and "homes" to the reset position where the NLR finds all connections to the plus bus open. The SR contacts open as "S" steps into the reset position and the R relay now drops out and closes its N.C. contact in the breaker closing circuit. The NLR relay is reset and waiting for the breaker to trip. The maximum reset time of the NLR relay after the "R" relay is energized is one to two seconds.

If the reset link is moved to the "NEXT CLOSE" position stud then "R" can be energized only when the NLR ratchet wheel has reached the step when the next reclosing signal is given. If the breaker is open the NLR relay recloses it as described above but if the breaker is closed then the "R" relay is energized, seals in to reset the NLR. The SC contact opens but the R relay seals in around it to maintain the circuit until the NLR is reset.

If the "NONE" position of the Reset Link is selected the NLR will not reset until the lockout position is reached. Then if the breaker is found closed or if the breaker is open and later is manually closed the timing circuit is energized thru the breaker N.O. auxiliary switch, the SR contact, and the blocking diode "D2". If the breaker remains closed for one step time interval then the timer turns the SCR on to step the stepping switch one step to the reset position which turns everything off. If the breaker trips during this step time interval then the NLR remains in the lockout position and sounds the alarm.

An additional adjustable cam is provided to operate the "RS" contact to provide blocking for the automatic tap changing circuit or other functions as desired. The auxiliary cam operates a micro switch to provide the "RS" contact. The auxiliary cam is held by friction and is released by loosening the locknut on the cam shaft. The cam shaft must be firmly held when loosening or tightening the lock nut. When the lock nut is loose the auxiliary cam can be easily moved to any position and the lock nut re-tightened. The "RS" contact can be made either a "N.O." or a "N.C." contact as desired by moving the green lead between studs 9 and 10. The "RS" contacts are connected to the relay studs 9 and 10. One "SR" contact is connected to studs 1 and 2 to be used to block instantaneous tripping during the reclosing cycle if desired.

When the NLR is operated on AC power a bridge type full wave rectifier is supplied to provide power for the NLR relay. On AC operation the "C" relay unit contact connected to studs 7 and 8 is used to energize the breaker closing circuit as shown in Fig. 3. When the NLR is operated from an AC source an instantaneous breaker reclosure is delayed by the pickup time (8 milliseconds maximum) of the "C" relay. Also the "C" relay contact can be used to close the breaker when the NLR is operated from a DC power source if desired.

The NLR relay can be connected to provide instantaneous reclose for instantaneous trip and time delay reclose for time delay trip. Elementary diagrams showing these connections will be supplied upon request.

An elementary diagram for connecting the NLR relay and a special auxiliary relay to provide two instantaneous initial reclosures plus two additional time delay reclosures will be supplied upon request.

Due to physical size the cam lobes on the adjustable cam cannot be set on adjacent steps. The reclosing times are multiples of the step time. If desired, the step time can be changed from the normal 5 seconds to any value from 1/2 to 5 seconds. It should be noted that the reset delay times and the time between the manual closing of the breaker when the NLR relay is in the lockout position and reset will change when the step time interval is changed.

## APPLICATION CONSIDERATIONS

### Interrupting Ratings Of Power Circuit Breakers

The derating factor for the interrupting rating of the power circuit breaker should be checked for the proposed reclosing cycle. This is given in ASA Standard C37.7 - 1952.

The Type NLR relay is versatile in adjustment and application. In addition to the wide choice of adjustments previously described, the relay has provisions for blocking the instantaneous trip circuit and / or the automatic load-ratio control during the reclosing cycle, and for selective reclosing. It can be used as a single-short reclosing relay if

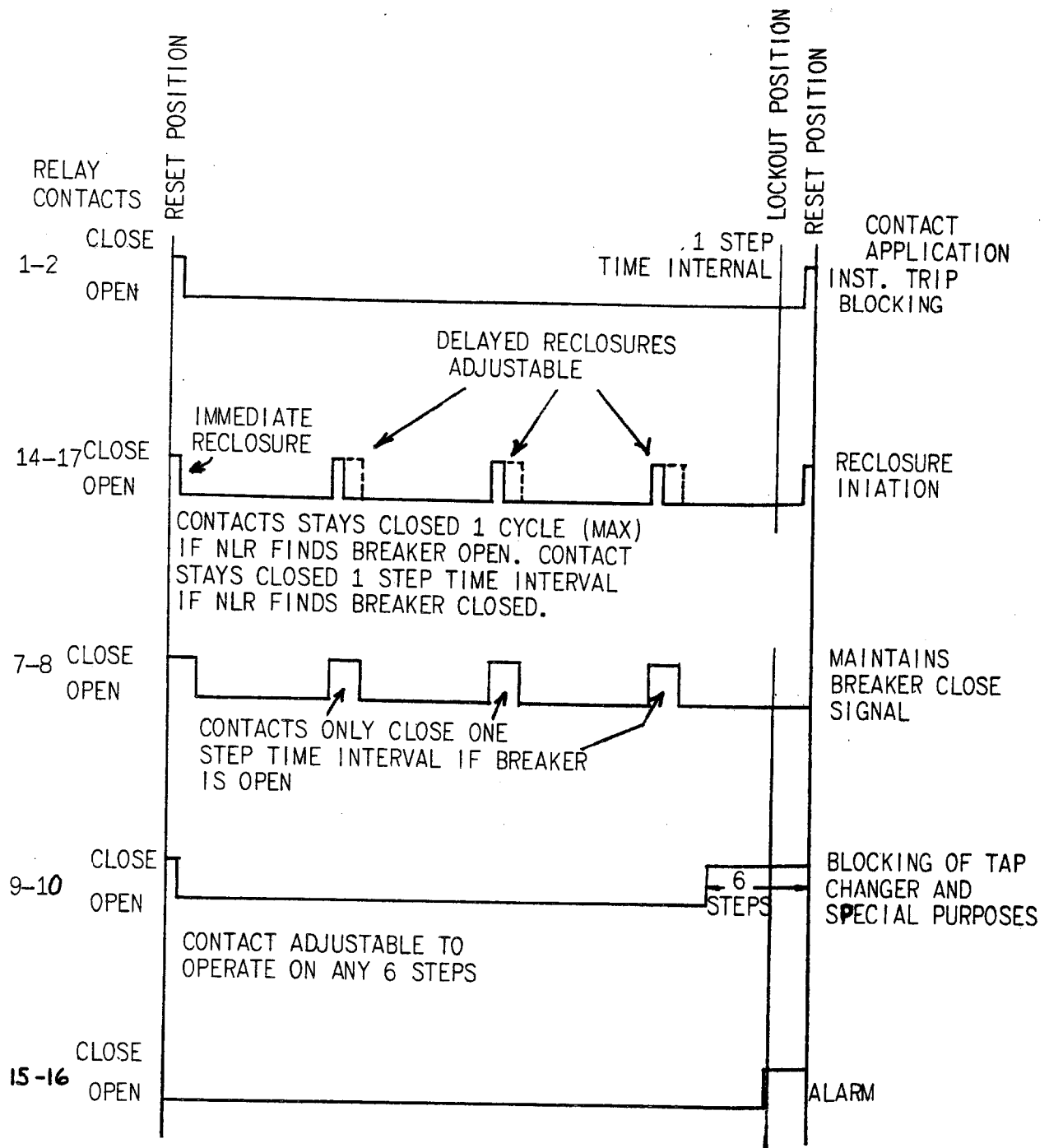


Fig. 6 (0178A9149-0) Sequence Diagram For NLR11 Relays

desired, but an NSR11 is more economical if the single reclosure is to be immediate. Some of these features are described in the following sections.

Control Switches

Referring to Fig. 3 it may be seen that a 3-stage control switch is used with these relays. This switch has an extra contact which prevents the NLR from reclosing the breaker after it has been tripped by the control switch. If tripped in this manner, the breaker must be reclosed by the control switch in order to restore the automatic reclosing feature.

Closing Control Circuits

It is essential that the circuit breaker mechanisms use closing circuits which assure complete closure of the breaker, even though the closing circuit is opened at some point before closure is complete.

Latch-Checking Switches

In order to assure successful operation of a breaker reclosed by an NLR relay adjusted for immediate initial reclosure, it is necessary to use a latch-checking switch on its solenoid mechanism, if it is trip-free. This switch completes the closing circuit only after the mechanism latch is properly reset for the reclosure.

AC Control Power

On a-c operation of the breaker control, it is necessary to insure pump-free operation in case the breaker closes onto a fault that causes the a-c control voltage to fall below the dropout level of the "Y" relay (or equivalent) which provides pump-free control under normal conditions. This can be done by special calibration, or by special connection, of the NLR.

To provide pump-free operation by special calibration, it is necessary to check that the "C" relay in the NLR drops out at a higher a-c voltage than the dropout of the "Y" relay or equivalent, and thus opens its 7-8 contact. The dropout of the "C" relay can be adjusted as indicated in the section on "Adjustments", or a resistor can be connected between studs 17 and 19 to raise the dropout, the jumper between these two studs having been removed.

When the NLR relay is used with a-c control power, and when the breaker closes onto a fault severe enough to drop out the "C" relay, the NLR will move forward one step without timing, before the control power fails on clearing the fault. This will shorten the delay between this reclosure and the next one, by one time step.

To provide pump-free operation by special connection, move the red wire from stud 13 to stud 14, thus making the NLR pump-free. With this connection the NLR takes an instantaneous step when the "C" relay picks up to close the breaker, and this step is lost in the reclosing cycle. Thus

to provide an instantaneous reclosure and then a 15-second reclosure the adjustable cam lobes would be set on positions "O" and "4" instead of "O" and "3". This setting eliminates the time error which may occur on low voltage with the standard connection. With this modified connection, the "STEP 2" position of the reset link must not be used.

Overcurrent Relays

The protective relays that trip the circuit breaker must open their contacts before the breaker recloses; otherwise the breaker may retrip immediately even though the fault has cleared.

Undervoltage Devices

In order to obtain the advantage of instantaneous reclosure on utilization devices, the undervoltage devices (or equivalent) in their control should not be instantaneous, but should have a dropout delay of 1 or 2 seconds.

CO-ORDINATION WITH BRANCH FUSES

On some systems involving "multi-shot" reclosing relays, the main feeder is protected by a circuit breaker, and the branch feeders by fuses. This economical means of sectionalizing a system requires that a fault on a branch be cleared initially by the main breaker tripped by a high-speed relay unit. If the fault persists following immediate reclosure, it must be cleared the second time by the branch feeder fuse. To accomplish

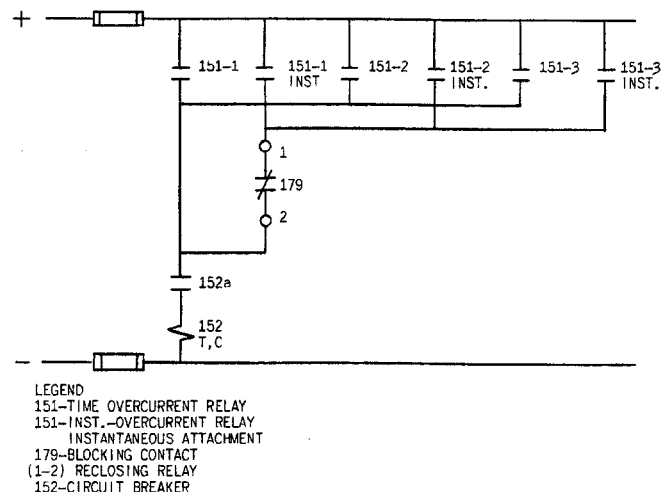


Fig. 7 (0178A9148-0) Diagram Showing Use of NLR Contact To Block Instantaneous Trip Circuit

this, the contacts of the high-speed unit must be blocked following the initial trip-out. This transfers tripping of the main breaker to a time delay unit and thus allows time for the branch fuse to clear. The "SR" contact connected to relay studs 1-2 can be used for this blocking function. This contact is closed in the reset position and opens before the breaker is reclosed and can be connected in series with the instantaneous trip circuit as shown in Fig. 7. This will block instantaneous tripping of the breaker on the first and subsequent reclosures, thus providing time for the branch fuse to clear the fault, rather than the main breaker.

Instantaneous tripping can be reinstated automatically when the relay locks out. This is accomplished by connecting the spare switch RS in parallel with 179 (1-2) contact and by setting the adjustable cam to operate the RS switch when the locked-out position is reached. With this connection, if the fault is still present when the circuit breaker is manually reclosed, the trip circuit will be energized instantaneously.

### SELECTIVE RECLOSING

In certain applications it is desirable to provide immediate initial reclosing if the circuit breakers are tripped by an instantaneous relay, but to eliminate the immediate reclosure and wait for the first delayed reclosure in the event that the breaker is tripped by a time delay relay. Such a situation can be handled with the Type NLR reclosing relay, and an elementary diagram showing recommended connections will be supplied upon request.

### 4 SHOT RECLOSING

Four reclosing impulses are available only if the initial one is instantaneous. Then an indicating dial is supplied with a fixed cam lobe in the zero position. The three adjustable cam lobes are then located as desired. The 4 shot relay is model 12NLR11B.

The NLR11A relay can be easily changed into a NLR11B relay by removing the dial and replacing it with a new dial which contains the fixed cam lobe.

### FUNCTIONS OF "RS" CONTACT

In making adjustments on the "RS" contact, it should be remembered that the cam is dimensioned to hold this switch operated for about 6 steps of the stepping switch. Normally, then, the "RS" contact shown closed on the diagram is open for 30 steps and closed for 6 steps. By moving the green jumper connected to the common point from stud 9 to stud 10 the contact shown open on the diagram becomes the effective one; and it is closed for 30 steps and open for 6 steps.

This spare contact "RS" can be applied in a variety of ways. Normally, the "RS" contact is closed in the reset position, and opens shortly after the start of the cycle, and recloses ahead of lockout.

With this normal adjustment, the "RS" contact can be connected in the control circuit to block automatic load-ratio control while the NLR is in its reclosing cycle, and reinstate it when the relay locks out or resets.

The "RS" contact, with the normal adjustment, can replace the "SR" (stud 1-2) contact in the instantaneous trip circuit mentioned under COORDINATION WITH BRANCH FUSES, to open this circuit only after the first reclosure, thus providing 2 high-speed tripouts of its breaker before shifting to time delay tripping to clear the branch fuse on the second reclosure or a later one.

The "RS" contact can also be used as a spare alarm contact, if the cam is reset so that the contact closes between the last reclosure and lockout, and opens between lockout and reset.

## **ACCEPTANCE TESTS**

### Mechanical Tests

1. Operate the telephone-type relay units and the stepping switch manually to check that all operate smoothly without binds.

### Electrical Tests

With the NLR relay in the lockout position connect rated voltage to the NLR relay as follows.

For DC operated relays connect plus to stud 13 and minus to stud 11.

For AC operated relays connect AC power to studs 5 and 6.

Check that there is no relay operation.

Note that indicating pointer points to lockout line on the nameplate.

Connect a jumper between studs 13 and 4 and note that the stepping switch steps once after a 5 second interval (or one step time interval if other than 5 seconds) and stays in the reset position. Note that indicator points to reset. With the stepping switch still in reset position, with jumper between studs 13 and 4, the reset link in the zero position, connect indicating lights to NLR as shown in Figure 8. Jumper stud 13 to stud 14 momentarily (1/2 second or less), or one step time if NLR is set for delayed reclose.

If NLR relay is set for instantaneous reclose the stepping switch steps instantaneously once. Then it delays two step time intervals before stepping again.

Note that relay runs in 5 second steps (or step time if it is other than 5 seconds) through all positions to reset.

## INSTALLATION PROCEDURE

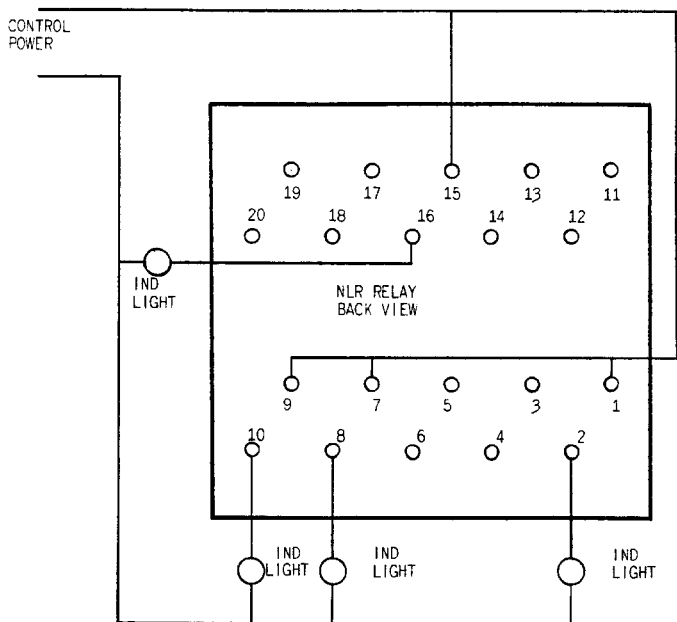


Fig. 8 (0178A9142-0) Test Connections For The NLR Type Relay

Note that indicating light 1-2 lights when SA is in reset position and goes out on the first step (instantaneous or otherwise) and stays out until reset is again reached.

Note that indicating light (studs 9-10) lights when auxiliary cam does not touch the microswitch operating button.

If the NLR relay is set for instantaneous 1st reclosure note that the indicating light (7-8) is energized for 5 seconds (or step time) starting as soon as jumper 13-14 was connected.

Note that the indicating light 15-16 is energized during the 5 second (or step time) lockout to reset interval.

Move the reset link to the "step 2" position. Then jumper studs 13 to 14 again removing the jumper as soon as light (7-8) comes on.

Note that 10 seconds (or 2 times step time) after the jumper was removed between studs 13 and 14 the NLR relay begins its rapid reset. Also note that indicating lights 7-8 and 15-16 are not energized during this rapid reset.

Next remove the 13-4 jumper and move the reset link to the "next close" position and again jumper studs 13 and 14 momentarily. Replace the 13-4 jumper after one step. Note that when the position is reached where the adjustable cam lobe operates its contacts to supply the next closing impulse that rapid reset begins and continues to reset.

### Mechanical Test

If after the ACCEPTANCE TESTS the relay is held in storage before shipment to the job site it is recommended that the visual and mechanical inspection described under the section on ACCEPTANCE TESTS be repeated before installation.

Check that adjustable cam lobes are set in proper positions to provide breaker reclosing impulses at the desired times. A lobe in the zero position will provide an immediate reclosing impulse when the NLR relay is in the reset position and the breaker trips. A second lobe in position 3 will provide a second reclosing impulse 3 times the step time interval (or 15 seconds) after the first breaker trip when the NLR is set for the standard step time. Likewise a third lobe in position 9 will provide a reclosing impulse 9 X 5 (or step time) or 45 seconds after the first breaker trip.

Set reset link in position to provide desired time delay before rapid reset.

### Electrical Tests

Make connections to NLR relay as shown in Fig. 9. With NLR relay in lockout position, close S2 and check that stepping switch step to reset after approximately 5 seconds (or one step time interval) and remains in the reset position. Note that indicating light 3 turns on at reset and indicating light 4 turns off.

Open S2 and close S1 and check that NLR relay initiates reclosing impulses (shown by indicating light 1 turning on) at desired intervals. Also check that stepping switch stops in lockout. Also check that the auxiliary cam (see Fig. 1) operates the micro switch to open (or close) the "RS" contact on the desired step as shown by indicating light 2. Adjust auxiliary cam if necessary as described in section on adjustments. Note that indicating light 3 turns off after first step.

Close S2 and after NLR has reset close S1 and note that the stepping switch starts its rapid reset after the desired time interval after the closing impulse.

If adjustments are necessary check the section on "ADJUSTMENTS" for instructions.

## ADJUSTMENTS

The telephone-type relays and stepping switch have been carefully adjusted at the factory to give correct adjustment. If these adjustments have been disturbed, readjust as follows:

With the telephone-type auxiliary relay de-energized each normally open contact should have a gap of .010"-.015". Observe the wipe on each normally closed contact by deflecting the stationary contact member towards the frame. Wipe should be approximately .005".

The wipe on each normally open contact should be approximately .005". This can be checked by inserting a .005" shim between the residual screw and the pole piece and operating the armature by hand. The normally open contacts should make before the residual screw strikes the shim.

The dropout of the telephone-type relays can be changed by changing the residual screw setting. This screw must be locked by means of its lock nut after resetting. The pickup of the telephone-type relays can be decreased by decreasing the spacing between the armature and the pole face by binding the contact arm.

After a pickup or dropout adjustment the relay contact gap and wipe adjustment must be rechecked as described above. The contact pressure should never be less than 10 grams measured at the contact tips.

The contact on the stepping switch unit should have minimum gap and wipe values which are the same as the telephone-type relay units. No other mechanical adjustment should be necessary except that all parts should move freely without binds or friction.

To change the time interval between reclosing impulses proceed as follows: -

Loosen the locknut and run it back to the end of the cam shaft. **HOLD THE CAMS FIRMLY WITH ONE HAND WHILE LOOSENING THE NUT TO LIMIT THE STRAIN ON THE CAM SHAFT.** Pull the indicating

dial forward far enough to permit moving adjustable cam rings. Then slide the rings which hold the contact operating lobes forward until the lobes are out of the locating sockets. Now the rings can be rotated to locate the three lobes in the desired location. After changing the setting of one lobe be sure all lobes are in the desired location.

If the desired total time intervals are not multiples of 5 seconds, then it will be necessary to change the step time intervals. To do this loosen the locknut on the rheostat (see Fig. 1) and turn the rheostat counter clockwise to decrease the step time interval. Connect the relay as shown in Fig. 9, connect the "reset" link to the none position, and close the S1 switch momentarily (1/2 second or less). The stepping switch will run with time delay steps to the lockout position and stop. Then by closing switch S2 it will move on to reset after one step time interval. By timing the 35 steps with a watch and adjusting the rheostat to produce the correct total time the step time interval can be set very accurately without special equipment. After setting the step time lock the rheostat and place the reset link on the position which will provide the desired reset time.

The "RS" contact connected to studs 9 and 10 is a micro switch contact operated by the auxiliary cam (see Fig. 1). The micro switch operating button is depressed in all but 6 steps of the 36 steps which make up one revolution of the cam shaft of the stepping switch. By loosening the locknut on the end of the cam shaft slightly, the auxiliary cam can be rotated to permit the micro switch button snap to its extended position on any desired step. The stepping switch armature can be depressed manually to step the switch to check that the "RS" contact operates on the desired step. By holding the stepping switch armature in the depressed position, the cam shaft can be rotated in counter-clockwise direction without any steps to speed up the check of the "RS" contact setting.

The contact connected to studs 9 and 10 closes when the micro switch operating button is released and opens 6 steps later. By moving the green lead connected to stud 9 to stud 10 the contact operation can be reversed (i.e. opens when microswitch button is released and closes 6 steps later.)

If, for any reason, the micro switch mounting or the stepping switch mounting has been disturbed the location of the micro switch with respect to its operating cam must be rechecked. Loosen the screws holding the micro switch bracket enough to permit the bracket to be moved slightly in either direction. By moving the bracket locate the micro switch so that the distance between the micro-switch case and the cam when the button is fully depressed is .025 to .045 inches.

If it ever becomes necessary to remove the diode board for any reason, the slip on terminals must be unsoldered before being pulled off the diode board stand-offs. When performing this operation care should be taken not to loosen the stand-offs.

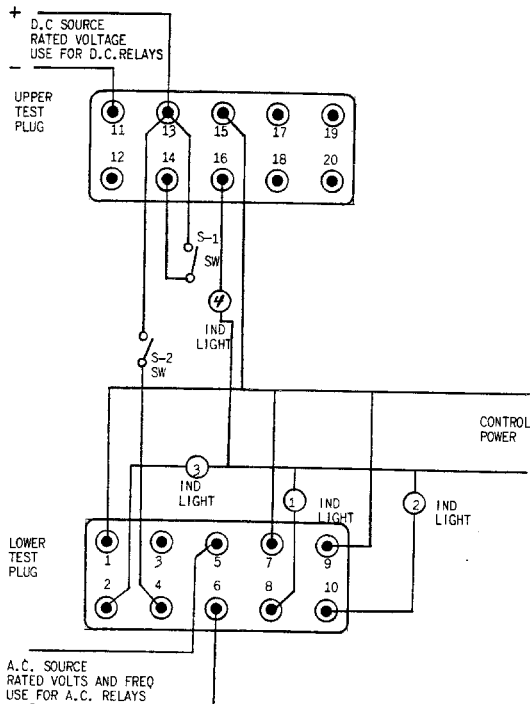


Fig. 9 (0178A9143-0) Field Test Connections For The NLR Type Relay

Due to physical interference the adjustable cam lobes cannot be set on adjacent positions. To obtain a setting such as 0-5-5-5 seconds we recommend making the step time interval 2 1/2 seconds and setting the cam adjustable cam lobes on positions 2, 4 and 6. A fixed cam lobe will be supplied attached to the indicating dial located in the zero position to initiate the breaker closing signal in the reset position. The relay is model 12NLR11B.

A contact of an auxiliary relay can be inserted between the N.O. breaker auxiliary switch and the NLR stud 4 (see Fig. 3) to block resetting under some system conditions. Thus an instantaneous overcurrent relay set at the same pickup point as the feeder time delay relays can be used to monitor the line after the initial reclosing impulse while instantaneous tripping is blocked. With the step time interval of the NLR set at one second, the rapid reset link set in the step two position and a N.C. contact of the monitoring instantaneous relay in the reset circuit the NLR will reset in 2 seconds after the first reclosing impulse if the fault has disappeared from the line but go on to the next close position if the fault persists.

## **PERIODIC CHECKS AND ROUTINE MAINTENANCE**

In view of the vital role of protective relays in the operation of a power system it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay, and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the following points be checked at an interval of from one to two years.

Operate the stepping switch and telephone-type relay units manually to be sure they operate freely. Check and clean contacts as described below.

Connect the relay as shown in Fig. 9 and run the NLR relay through its normal operation as described in section on INSTALLATION PROCEDURE.

For cleaning relay contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Relay contacts should not be cleaned with knives, files or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

The burnishing tool described is included in the standard relay tool kit obtainable from the factory.

## **RENEWAL PARTS**

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of part wanted, and give complete nameplate data. If possible, give the General Electric Company requisition number on which the relay was furnished.



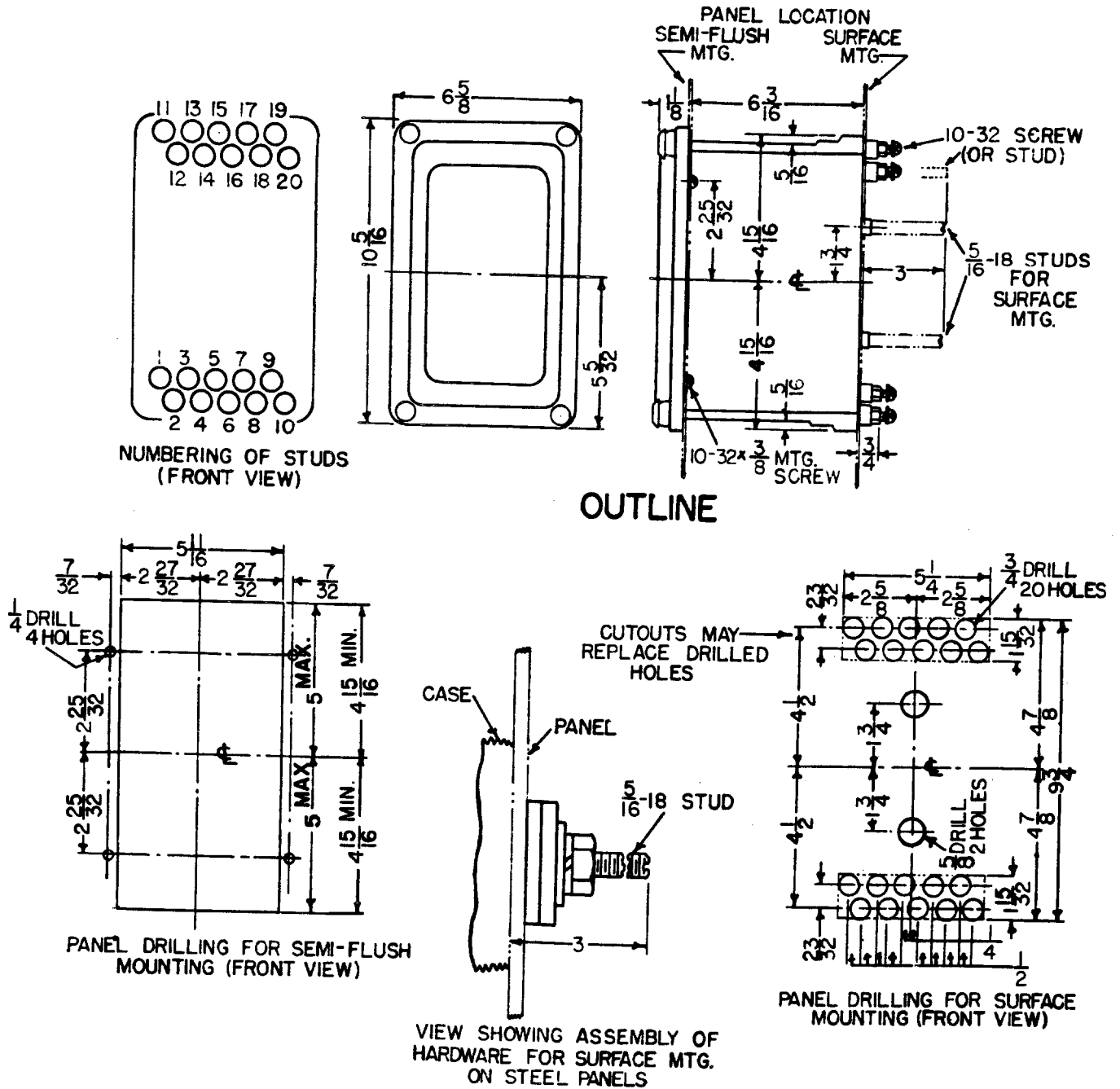


Fig. 10 (6209272-2) Outline And Panel Drilling Dimensions For The Type NLR11 Relay

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