S.T.C. THERMAL DELAY SWITCHES

APPLICATIONS.

(see also notes on previous page)

6.1 CIRCUITS FOR HOLD-ON ARRANGEMENTS

As already stated, a satisfactory method of operation is to arrange for the delay switch to operate a relay fitted with "hold-on" contacts. Fig. 19 shows typical arrangements. Diagrams A and B differ only in that the relay is operated from different sources. Diagram C shows a typical circuit for switching on the input to a power supply, the relay being operated by the output of this supply.

Fig. 19A

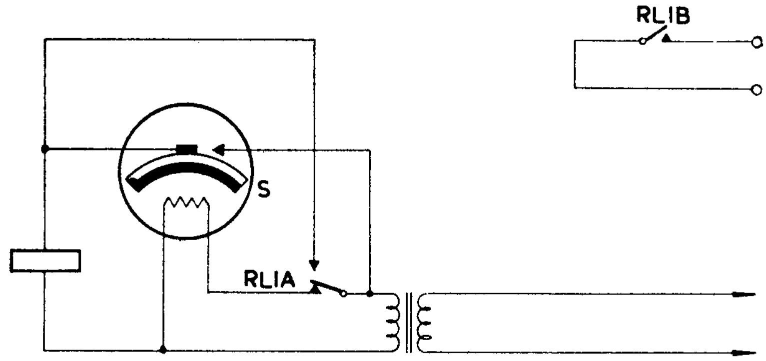
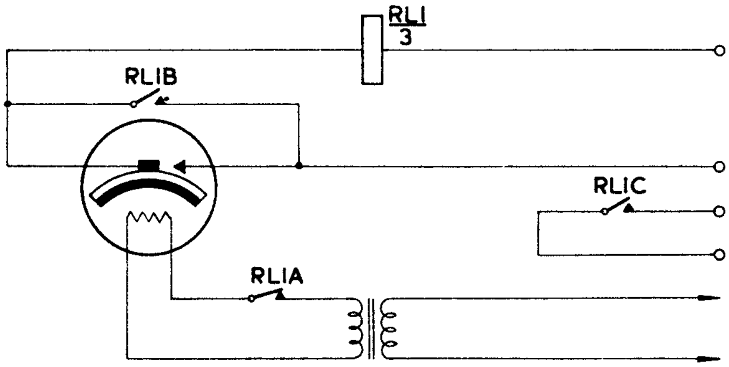


Fig. 19B



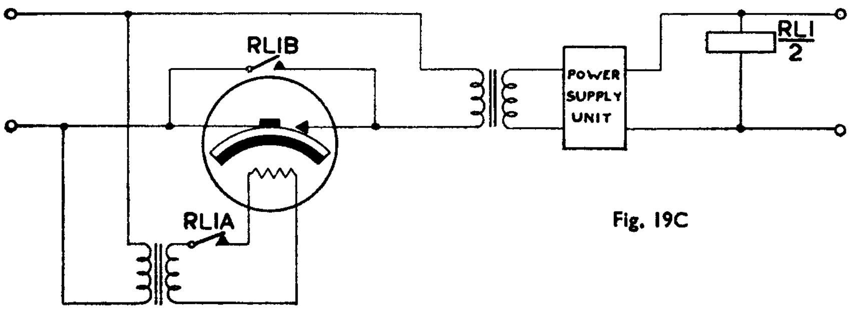


Fig. 19C

(continued)

6.2 CIRCUITS FOR LONG DELAYS

Delays longer than those provided by a single switch may be obtained by cascade connection of the appropriate combination of switches as in Fig. 20.

This circuit arrangement is sensitive to heater voltage and the total delay is the sum of the closing delay times of the switches used.

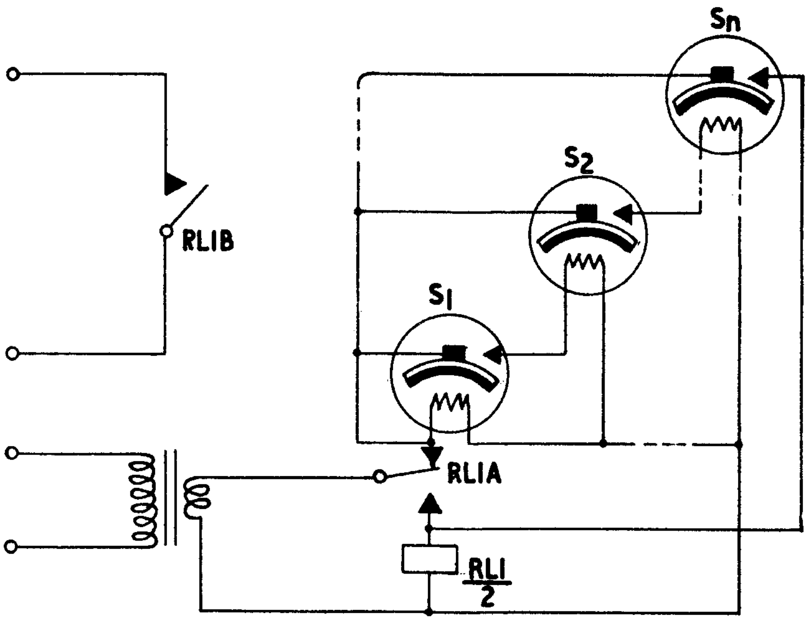


Fig. 20 Simple cascade circuit

A circuit which is largely independent of heater voltage and ambient temperature; which also yields less variation in total delay, considering the tube to tube spread with switches of a given type, is shown in Fig. 21. The total delay is the sum of the individual closing delay times plus the sum of the individual opening delay times. This circuit may be used with one or more switches but essentially two relays are required; the first to close at the end of the summed closing delays and to open again at the end of the summed opening delays, the second to close at the end of the summed closing delays and remain locked in. Contact RL1A must open before RL1B closes lest the circuit being controlled be momentarily completed before the end of the full delay. Only at the end of the total period is the circuit being controlled completed by the series connected contacts, RL1A and RL2B being simultaneously closed.

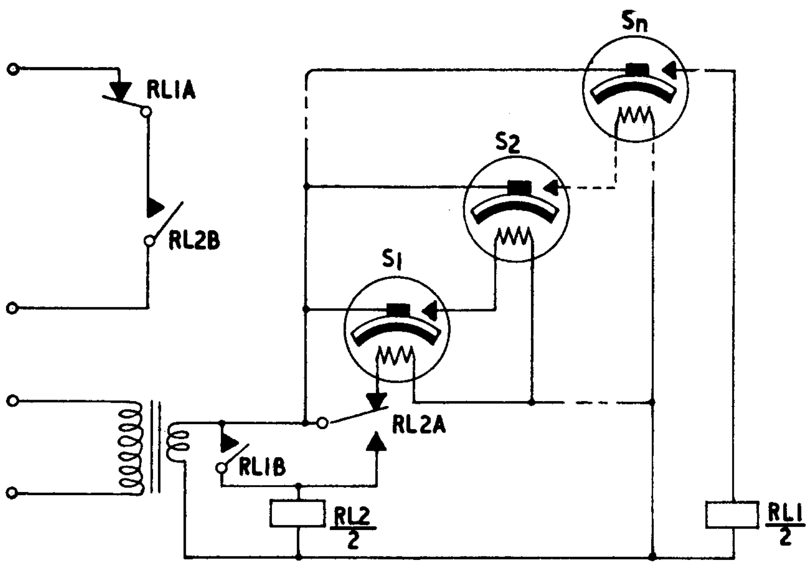


Fig. 21 Cascade circuit for summing closing and opening delay times

TYPICAL PERFORMANCE

Switch Type	Number	Delay (sec)	V_h for Constant Delay (V)
S102/1K	3	250	6 to 8
S107/1K	3	200	5 to 8

(continued)

6.3 REMOVAL OF SURGE LIMITING RESISTORS

Thermal delay switches may be utilised in circuits for the removal of surge limiting resistors in filament supply lines to tungsten filament valves. A similar arrangement may also be employed as a d.c. motor starter, replacing the manual type. A typical circuit is shown in Fig. 22. The surge limiting resistors R_1, R_2 and R_3 are short-circuited when the relays close. Each relay which has "hold-on" contacts, opens the heater circuit of the switch which operated it, and closes the heater circuit of the next switch. Relays will drop out when the supply voltage fails or is shut off and will ensure full protection when voltage is reapplied.

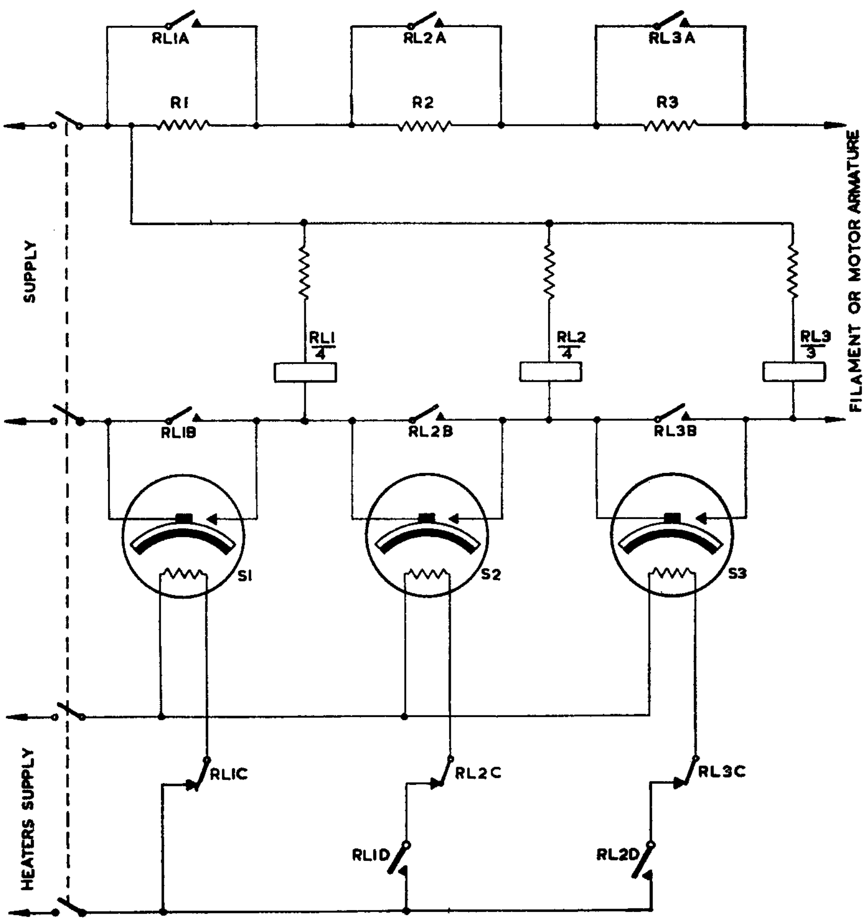


Fig. 22 Circuit for the successive short-circuiting of three surge limiting resistors

6.4 STAR-DELTA MOTOR STARTER

An arrangement for switching from star to delta connection of the stator windings of induction motors is shown in Fig. 23. The thermal delay switch allows for the motor to accelerate to maximum speed before operating the relay which locks itself in and opens the heater circuit of the switch. The relay change-over contacts should "break" before "make".

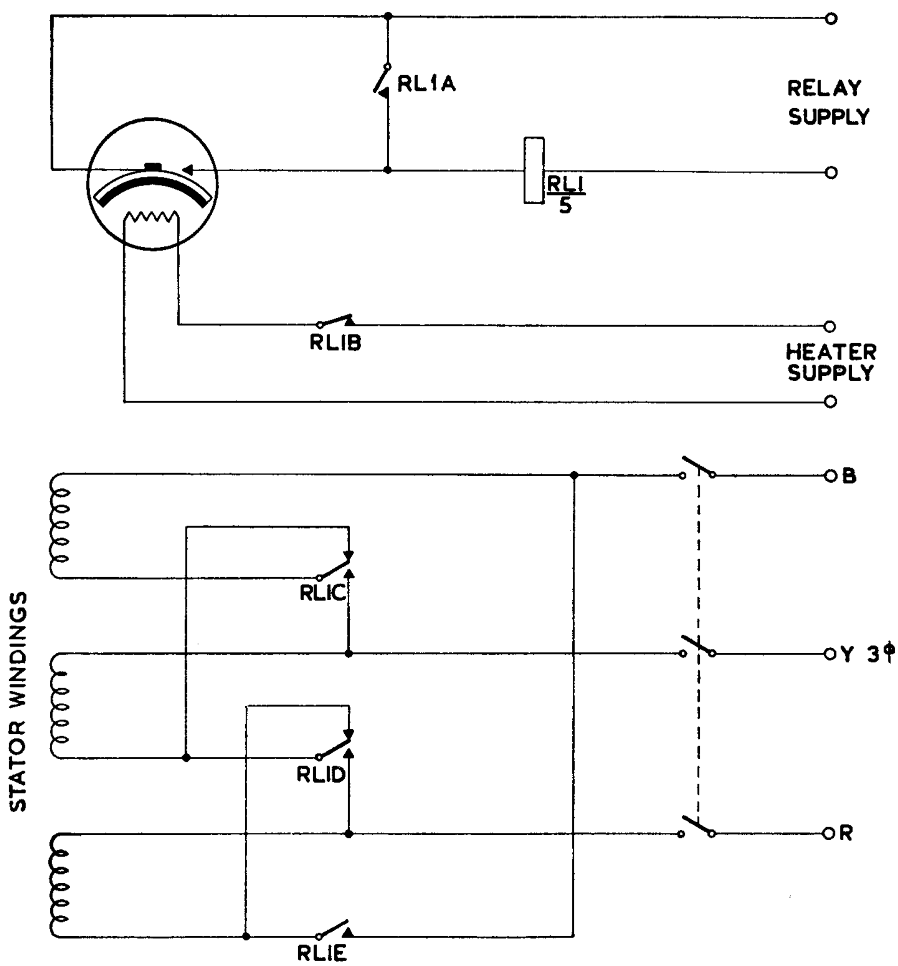


Fig. 23 Circuit for star-delta motor starting

(continued)

6.5 RELAXATION OSCILLATOR CIRCUITS

Two circuits using thermal delay switches in relaxation oscillators are shown in Fig. 24. The circuit employing one switch has a constant period of about 5 — 10 seconds irrespective of switch type. The mark-space ratio can be altered by adjustment of heater voltage since variation of this parameter has opposite effects upon opening and closing delay times.

The circuit employing two switches has a constant mark-space ratio of approximately unity and the period can be altered from about 10 seconds to 4 minutes by correct adjustment of heater voltage. A point is reached, however, when the opening time of the switches becomes greater than the delay time with a result that the circuit functions as a one-switch circuit.

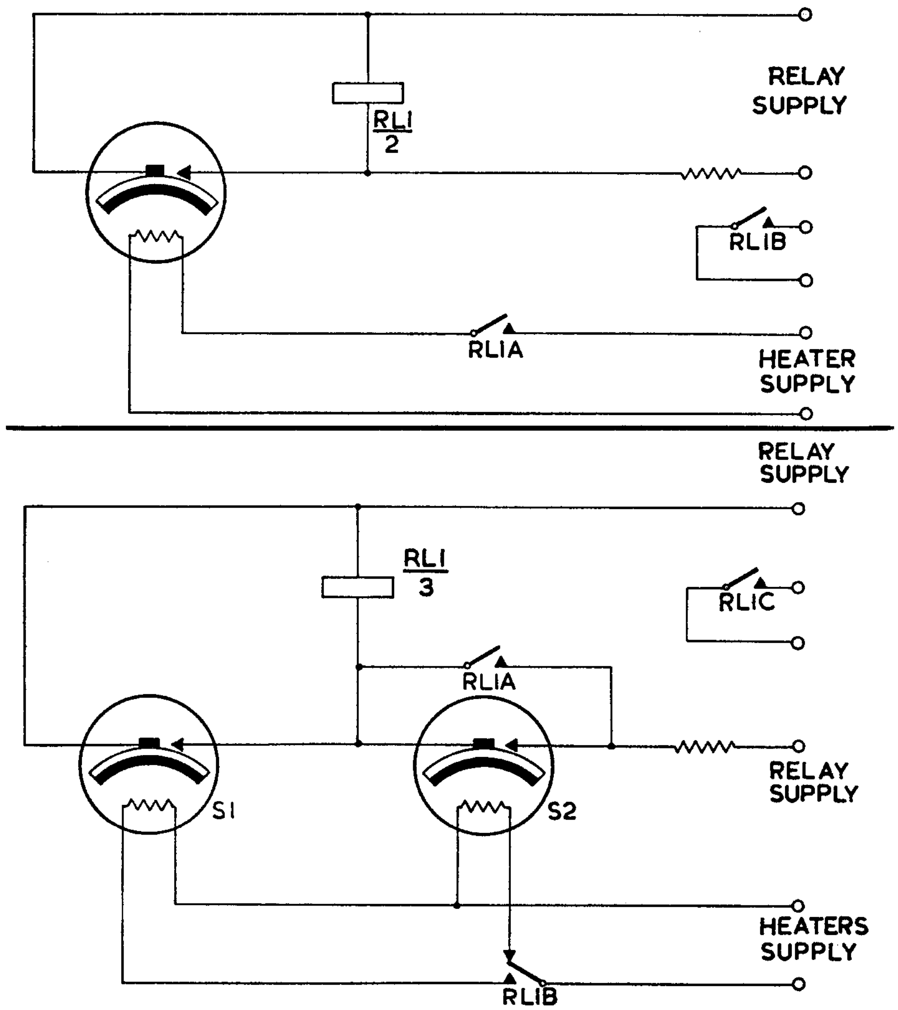


Fig. 24 Relaxation oscillator circuits

6.6 AUTO-RECLOSE CIRCUIT BREAKERS (SINGLE AND DOUBLE SHOT)

The circuits, Figs. 25 and 26, show the manner in which thermal delay switches may be utilised to re-close a circuit breaker after a fault on a power system. These circuit breakers open when a fault occurs and, after a delay, automatically close again. If the fault is still present, the breaker opens again. The single shot circuit breaker then remains open, while the double shot circuit breaker repeats the sequence before finally locking out if the fault remains.

A current transformer (CT) detects the overload or short circuit current in the line, operates a relay which, in turn, energises the trip coil of the circuit breaker. When the circuit breaker trips, heater voltage is applied to the delay switch, S_1, in both circuits. When the contacts of the switch S_1 close, the circuit breaker closing mechanism is energised by RL4 and the breaker closes. If the fault has cleared, the breaker will remain closed. If the fault still exists, the trip coil will again be energised and completes the circuit operating the lock-out relay, RL3 (the delay switch contacts still being closed). In the single shot circuit (Fig. 25) the lock-out relay, RL3, breaks both the delay switch heater and breaker closing coil circuits and the breaker then remains open.

In the double shot circuit (Fig. 26) the heater voltage is applied to the delay switch S_2 when the contacts of the delay switch S_1 close. When the contacts of the delay switch S_2 close, the closing relay operates once more. If the fault has cleared, the breaker will remain closed. If the fault still exists, the trip coil will again be excited and will operate the lock-out relay, RL4, causing a permanent open circuit for the closing relay RL5.

Note 1: It should be arranged that the trip coil contacts, which are normally "open", will "make" slightly before the circuit breaker opens. so as to ensure that the lock-out coil operates before the closing relay, when the short circuit still exists.

Note 2: Re-set coils for the lock-out relays have not been shown.

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S. T. C. THERMAL DELAY SWITCHES.
APPLICATIONS DATA CONTINUED.

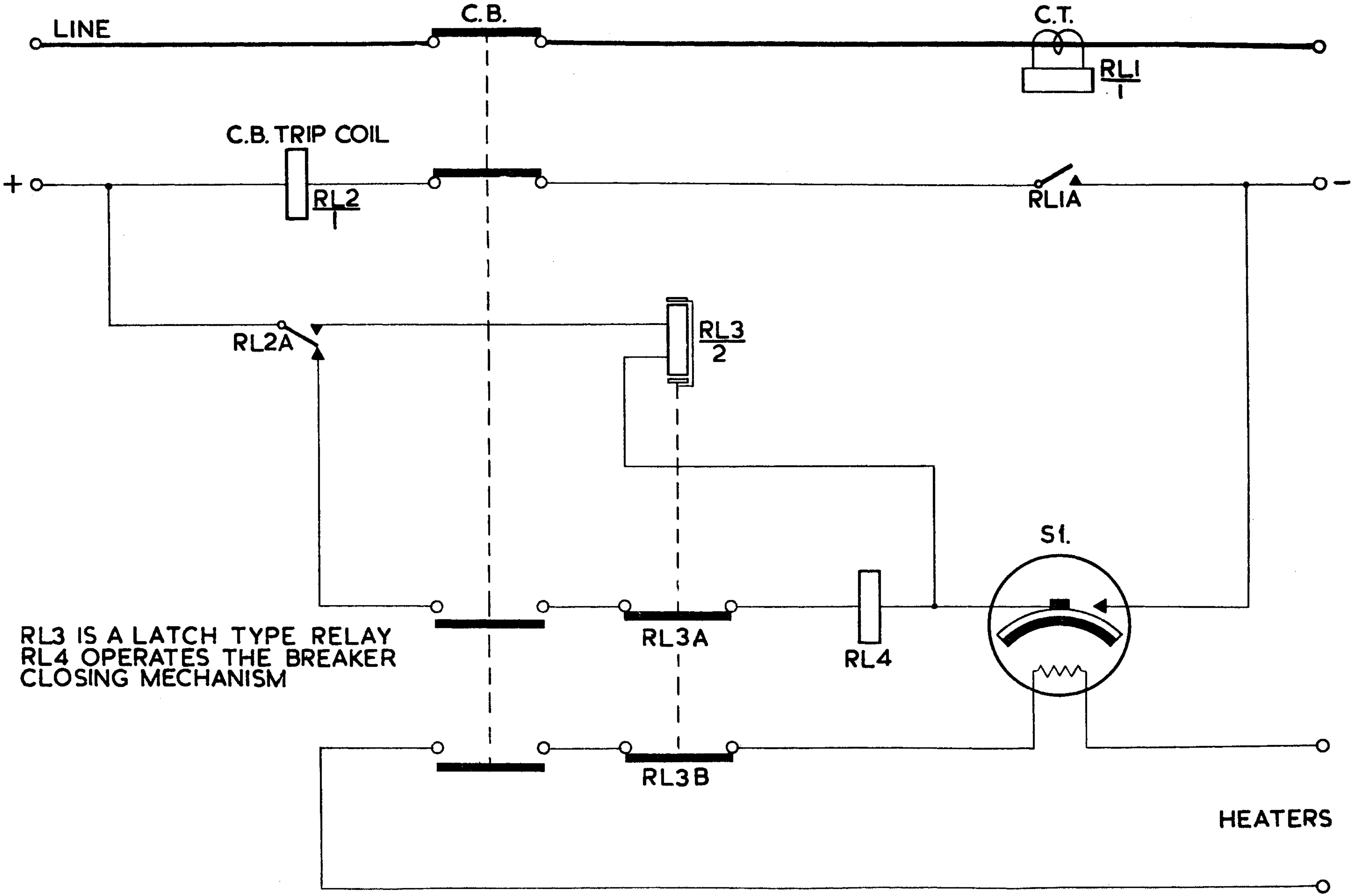


Fig. 25 Single shot auto-reclose circuit breaker

S.T.C. APPLICATIONS DATA (continued)

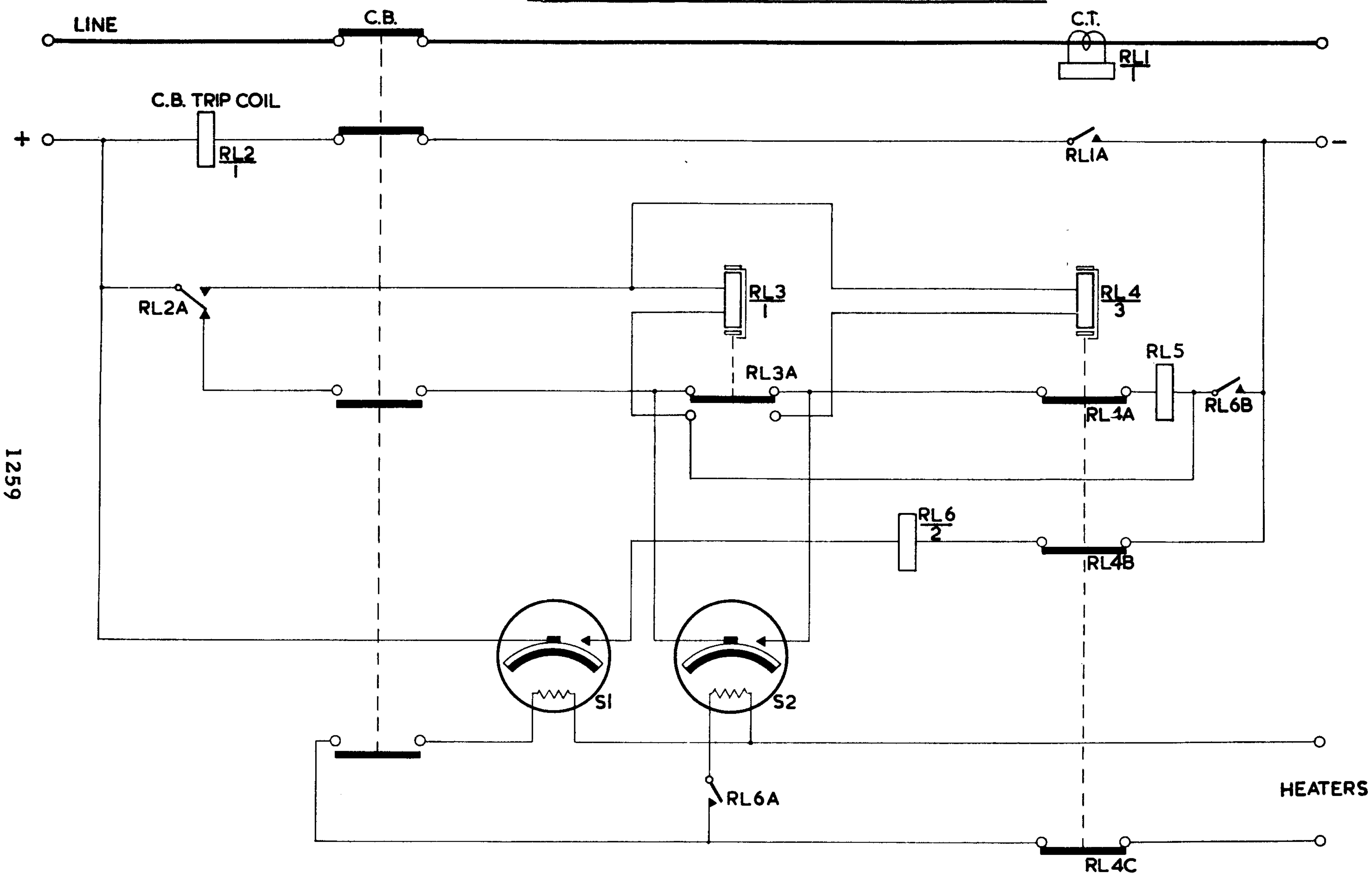


Fig. 26 Double shot auto-reclose circuit breaker

RL3 AND RL4 ARE LATCH TYPE RELAYS
RL5 OPERATES BREAKER CLOSING MECHANISM

PROVISIONAL DATA.

THERMAL DELAY SWITCH.

This miniature thermal delay switch has been designed to provide delay between the application of heater voltage and anode voltage in indirectly heated valves and mercury-vapour or gas-filled rectifiers.

HEATER

Heater voltage	19	V
Nominal current	0.165	A

DELAY TIME AT 20°C

Minimum delay	40	sec
Maximum delay	66	sec

MECHANICAL DATA

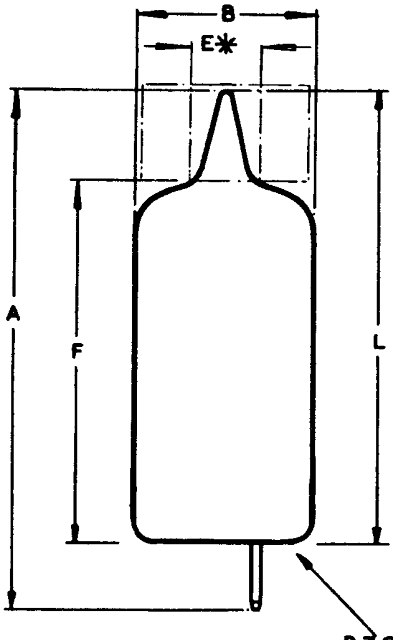
Maximum overall length	54,5	mm
Maximum seated height	47,5	mm
Maximum overall diameter	19,0	mm
Base	B7G	
Net weight	0.32	oz
	9	g
Mounting position	Vertical, base down	

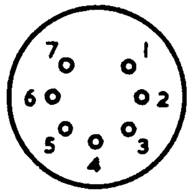
MAXIMUM RATINGS

Maximum open circuit D.C. voltage between contacts	220	V
Maximum open circuit A.C. voltage between contacts	100	V
Maximum contact current on make	1.0	A
Maximum surge current on make	5.0	A
Maximum current on break at 50 V D.C.	100	mA
Maximum heater-contact voltage	750	V

NOTE.—The intended method of operation is to arrange for the delay switch to operate an electro-magnetic relay fitted with a "hold-on" contact. By this means large powers can be handled and it can be so arranged that as the contacts close the heater supply of the switch is removed. This will ensure the full delay time in the event of a shut down.

Delay switches may be connected in series to obtain multiples of the quoted delay time.





BASING

1 HEATER
2 NO CONNEXION
3 ACTIVE STRIP
4 STATIONARY STRIP
5 NO CONNEXION
6 NO CONNEXION
7 HEATER

B7G BASE

✱ DENOTES MEASURED FROM BASE SEAT TO BULB TOP LINE AS DETERMINED BY RING GAUGE OF 'E' INTERNAL DIAMETER.

DIM.	MILLIMETRES	INCHES
A	54,5 MAX.	$2\frac{5}{32}$ MAX.
B	19,0 MAX.	$\frac{3}{4}$ MAX.
* F	38,0 ± 2,5	$1\frac{1}{2} \pm \frac{3}{32}$
* L	47,5 MAX.	$1\frac{7}{8}$ MAX.
E	11,1 DIA.	$\frac{7}{16}$ DIA.

NOTE: BASIC FIGURES ARE INCHES