QT1257

TOUCH BUTTON TUBE

DESCRIPTION

The QT1257 is a cold cathode tube designed for use as a self-indicating electronic switch; it is actuated by touch.

RATINGS

Minimum anode-cathode d.c. breakdown voltage . . .	325	V
Anode-cathode d.c. maintaining voltage at 10mA	80	V
Maximum continuous cathode current	25	mA
Maximum peak cathode current	100	mA

OPERATION

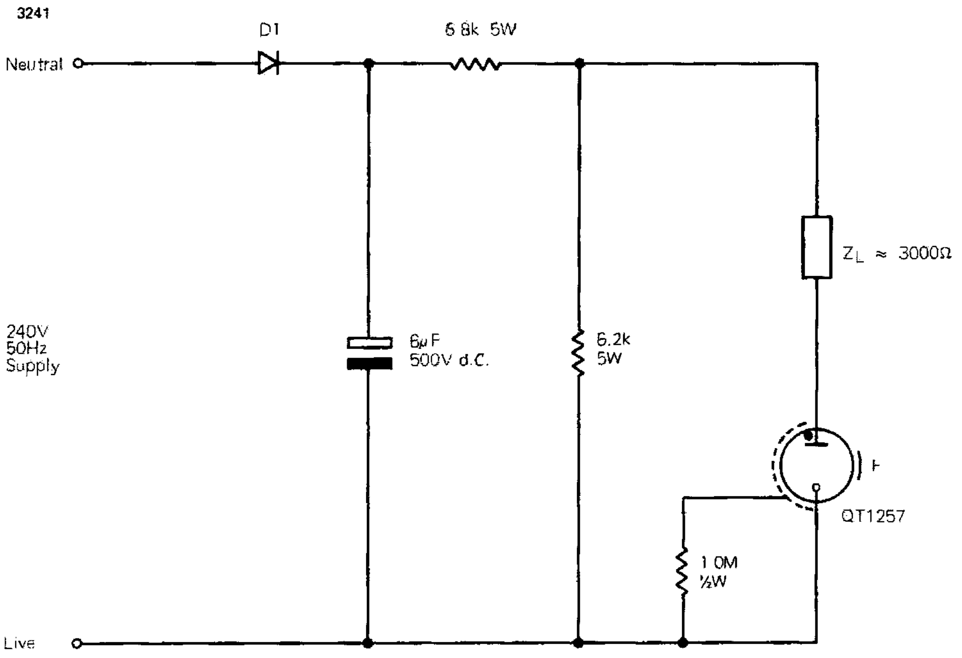
The Electronic Touch Button is a special type of trigger tube which is switched to the conducting state by the touch of a person's finger on an external control electrode which is placed at the end of the tube. After the electrode has been touched, the tube emits a visible glow until the h.t. supply is momentarily interrupted for a time exceeding the tube deionization time. The current flowing through the tube may be used to operate a relay.

A typical application of this tube is its use in the control panel of lifts for selecting the floor at which the passenger wishes to alight. When the tube corresponding to the selected floor is touched, it continues to glow until the lift reaches that floor.

A typical circuit is shown on page 2. The external screening* around the touch tube is connected to the live lead of the mains supply via a 1 megohm resistor. When the external control electrode F is touched by the hand, or is earthed, there is an alternating voltage of 240 volts between this electrode and the tube cathode. The current which flows produces enough ions to ignite the main gap. Even if the tube is touched by a hand covered with a glove, the capacitance between the external electrode and earth normally exceeds 5pF and this is adequate to fire the tube.

* The external screening may be coated with insulating material.

TYPICAL CIRCUIT

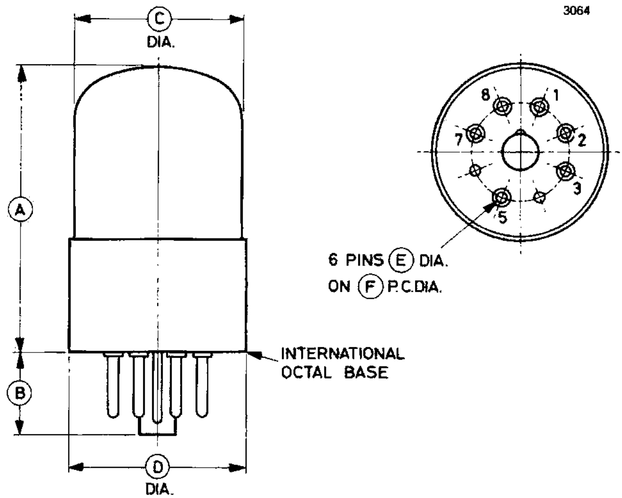


Nominal load current 12–15mA.

D1 Silicon rectifier, such as:–
AEI type SJ803–F

Z_L Relay; suggested types for use as load are:–
Radiospares type 46
STC types 25 or 25HD
Keyswitch types MH2 or MH2P (2500Ω coil)
Potter and Brumfield type KCP11 (10mA coil)

OUTLINE (All dimensions without limits are nominal)



Ref	Inches	Millimetres
A*	1.969 max	50.0 max
B	0.560 max	14.22 max
C*	1.181 max	30.0 max
D	1.253 max	31.83 max
E	0.093	2.36
F	0.687	17.45

Millimetre dimensions have been derived from inches except where marked *

Pin	Element
1	No connection
2	Cathode
3	No connection
4	Omitted
5	Anode
6	Omitted
7	No connection
8	No connection

TOUCH BUTTONS - DESCRIPTION OF OPERATION

Touch buttons utilise a three element gas filled tube as the active component.

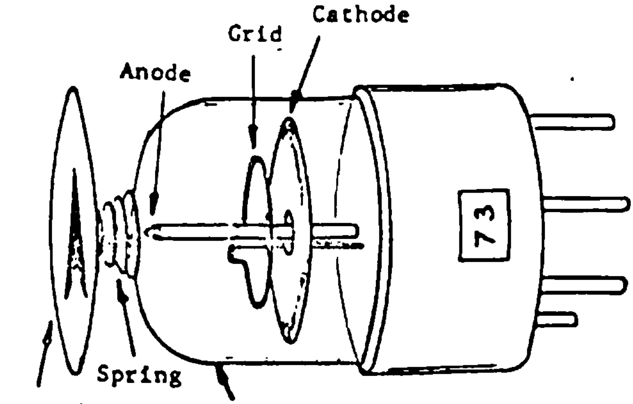


FIG. 1. OTIS TOUCH BUTTON TUBE

These tubes have only two states - conducting or not conducting. When conducting, the voltage drop across the tube is constant over a wide current range, and this voltage is printed on the side of the tube. (Normally 72V - 75V). If a D.C voltage is applied between anode and cathode such that the anode is positive, with respect to the cathode, and if this voltage is gradually increased, a point will be reached where the tube will 'fire' i.e. change from non-conducting to conducting state.
In thepractical touch button circuit, however, the anode voltage is held a little below the normal break-down voltage and the tube is fired by effectively lowering the break-down voltage of the tube to below the applied anode voltage. (see sketch 2).

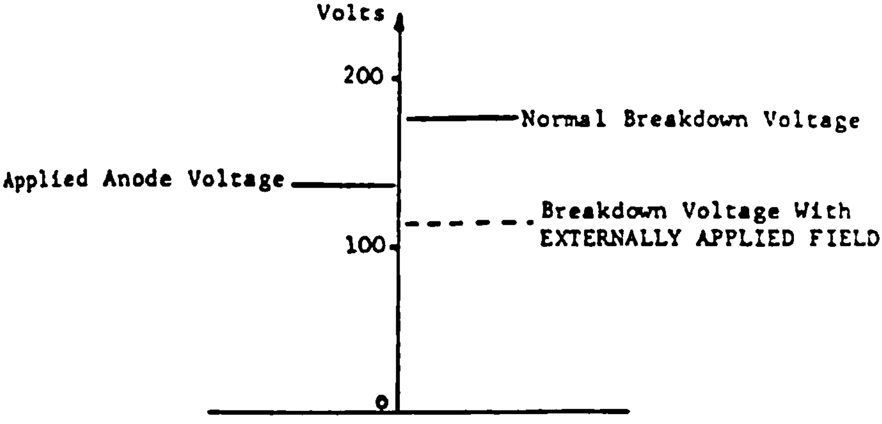


FIG. 2. TUBE FIRES WHEN BREAKDOWN VOLTAGE IS MADE LESS THAN THE ANODE VOLTAGE

The lowering of the break-down voltage is achieved by the application of an A.C. voltage between the cathode and the exterior of the glass envelope. This establishes an alternating field within the tube which excites the gas molecules and makes them more conductive.
The circuit used to apply the A.C. voltage across the tube is unusual in that 'the person touching the touch plate' and 'ground' are used as conductors. (see fig. 3).

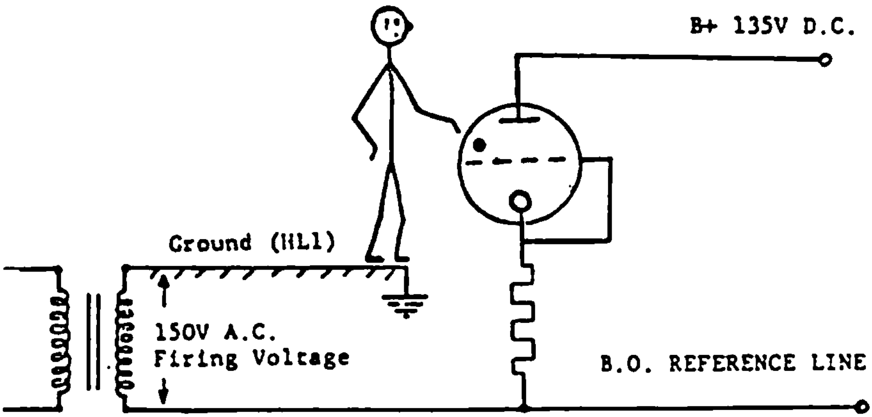


FIG. 3 FIRING OF TOUCH BUTTON

It is apparent that in this 'firing circuit' there are many insulators, e.g. the carpet on the floor, the soles of the persons shoes, the touch button plate and the glass envelope of the tube itself. However, it must be remembered that conductors separated by an insulator form a capacitor, and a capacitor is a conductor in an A.C. circuit. These capacitances in the firing circuit are, of course, very small and provide a very high impedance circuit in which the current is only about 0.01 μA.

Once fired, conduction continues after removal of the firing voltage, and the tube can only be extinguished by lowering the current through it, below a certain critical value.
In practise, this is done by injecting a positive D.C. voltage at the cathode of the tube. This decreases the voltage across the tube to below the normal tube volt drop causing the current in the tube to fall to below the critical value. We will return to this later.

THE SIGNAL VOLTAGE FROM THE TOUCH TUBE

The signal voltage is obtained at the cathode of the tube. Referring to fig. 4, it can be seen that when the tube is not conducting, there will be no volt drop across the cathode resistor and hence no output signal.

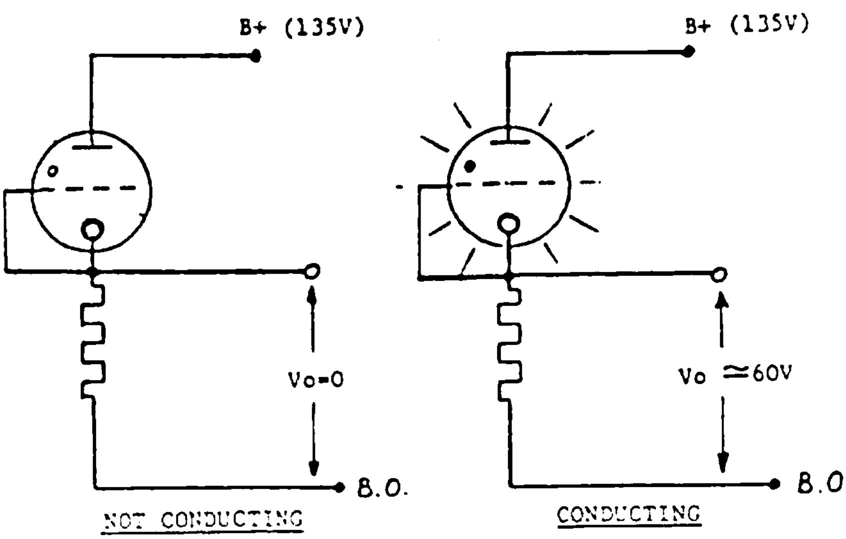


FIG. 4 VOLT DROP ACROSS CATHODE RESISTOR IS USED AS SIGNAL VOLTAGE

When the tube is conducting the current passing through the cathode resistance produces a volt drop across it, and this appears at the cathode as a positive D.C. voltage of about 60 volts. (relative to B.O. line)

CROSS-FIRING

Where two sets of hall or car buttons are used, the two touch tubes for each landing are, in effect, connected in parallel. The circuit is arranged so that when one tube is fired, the other one of the pair automatically fires thus ensuring that both touch plates are illuminated.
In this cross-firing process, the tube grids and anode resistors play an important role.

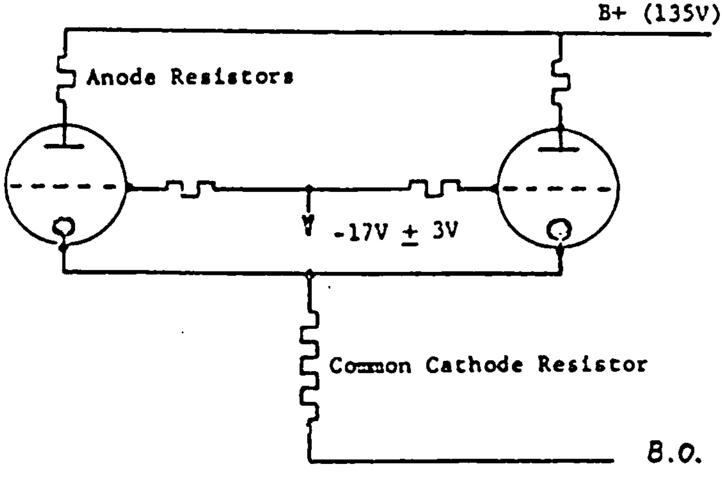


FIG 5 DOUBLE RISER CIRCUIT

When the first tube is fired, a current (double the normal value) flows, through the anode resistor, the tube and the 'shared' cathode resistor. This gives rise to a volt drop across the cathode resistor of about 60V.
Because the cathode of the unfired tube is connected to the top of this resistor, its voltage will rise from 0 to 60v. The voltage between the grid and cathode rises from 17V to 17+60 = 77. This is sufficient to cause 'breakdown' from cathode to grid, and a 'reverse' current is established flowing from cathode to grid. (see fig. 6).

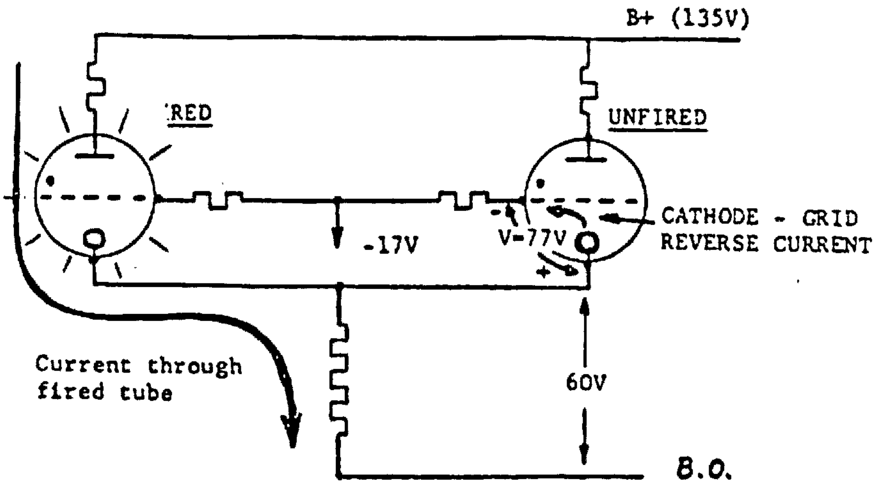


FIG. 6 CATHODE TO GRID BREAK-DOWN

The cathode-grid reverse current in the unfired tube excites the gas molecules, making them more conductive. This lowers the anode to cathode breakdown voltage. To just above the normal tube volt drop.

If the tubes wereconnected directly in parallel, the voltage across the unfired tube would be equal to the normal volt drop across the fired tube, and would not be 'just above' this voltage as required.

By including resistors in series with the anodes, the voltage to the unfired tube is equal to the normal volt drop of the fired tube PLUS the volt drop across the anode resistor of the fired tube. (see fig. 7). For this reason, it is essential that both tubes have the same volt drop as printed on the side of the tube.

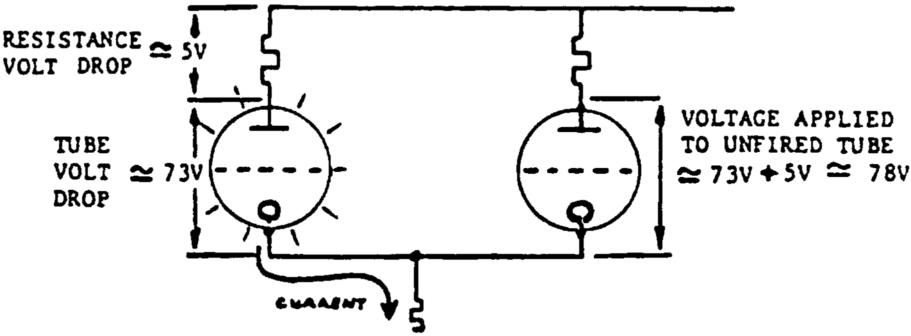


FIG.7 FUNCTION OF ANODE RESISTORS.

TOUCH BUTTONS

DETECTION OF SIGNAL VOLTAGE

The touch button circuit has a relatively high impedance and hence the signal voltage cannot be applied directly to a relay coil. Instead a silicon controlled rectifier (S.C.R.) is used to detect the signal and operate a relay.

A TYPICAL CIRCUIT IS SHOWN IN FIG. 8 BELOW.

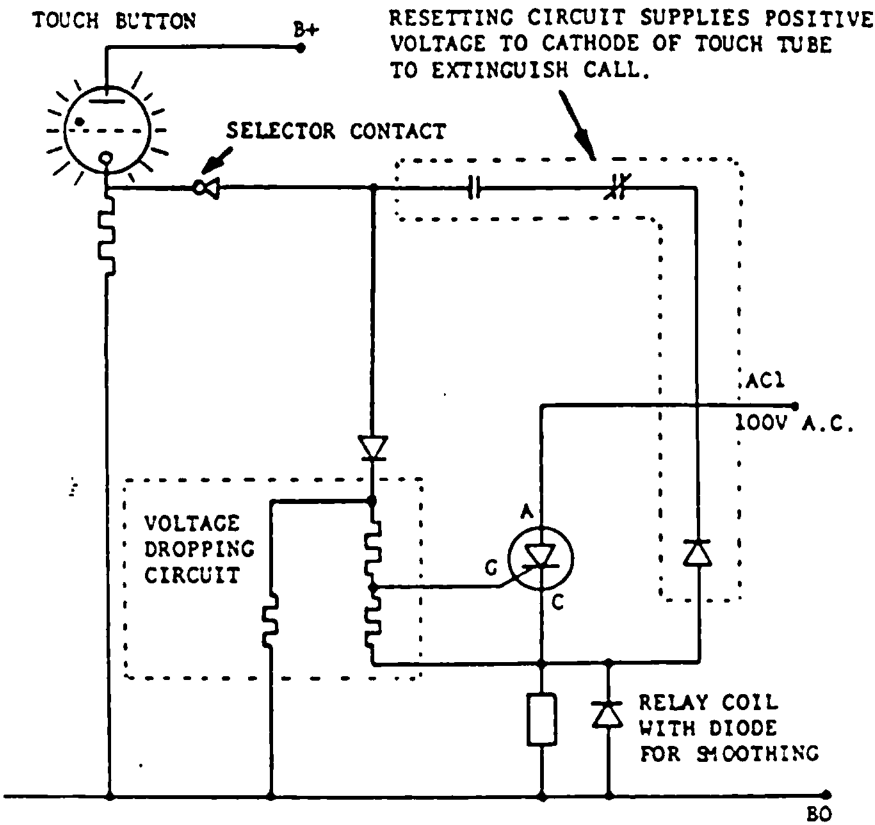


fig. 8 SCR circuit