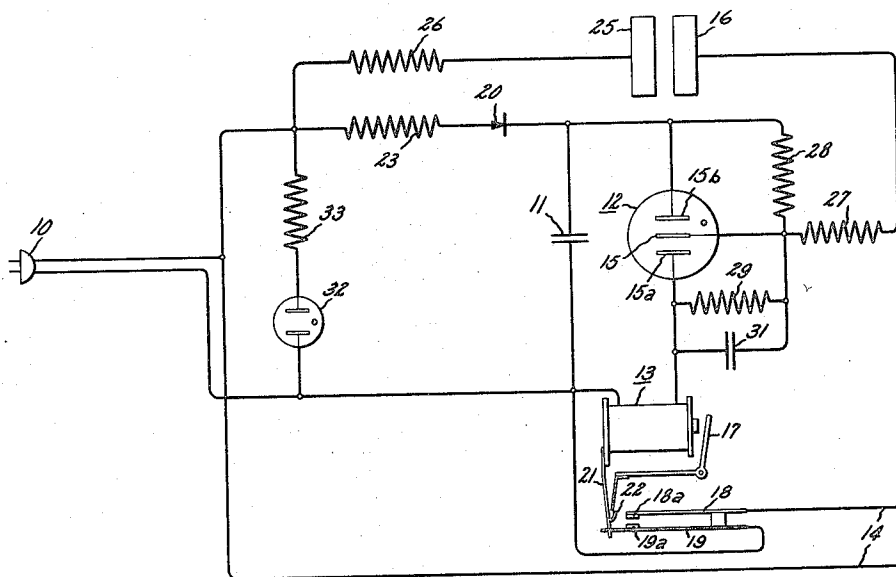


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ELECTRONIC CONTROL SWITCH
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ELECTRONIC CONTROL SWITCH

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This invention relates to an electric circuit control switch operable by touch contact; more particularly, it relates to an electric switch operable by touch contact with a pair of touch surfaces which provides reliable operation under a wide variety of external conditions.

In Harnden et al. application S. N. 497,242, filed March 28, 1955, which is assigned to the same assignee as the present application, there is described an electronically controlled switch in which a glow tube becomes conducting to energize a latching relay upon contact of a person with a touch surface. The present invention is directed to a switch of the same general type as that disclosed in the Harnden et al. application. This invention is directed particularly toward additional circuit elements which confer greater reliability of operation upon the switch.

It is an object of the present invention to provide an electronic type circuit switch operable by touch contact which will operate reliably under almost all operating conditions to which the switch is likely to be subjected.

It is another object of the invention to provide a switch operable by touch contact wherein there are two touch areas, one of which serves as a ground plane.

It is a further object of the invention to provide a switch operable by touch contact wherein the dark sensitivity of an electronic element is prevented.

A further object of the invention is to provide an electronic switch which avoids the buildup of a charge on circuit elements thereby preventing spurious operation.

Other objects of the invention will become apparent from the following specification considered in conjunction with the appended drawing which is a diagrammatic view of the circuit whereby the switch of the present invention operates.

Briefly stated, in accordance with one of its embodiments, the present invention comprises a switch operable by touch contact in which there is a glow tube having at least three electrodes, one of which is a control electrode, one a cathode, and one an anode; a latching relay having contacts which alternately open and close an external circuit upon energization of the relay; a capacitor in a circuit connecting the tube and relay in series and the capacitor in parallel therewith; a source of light in proximity to the glow tube; a first touch surface connected to the relay-tube-capacitor circuit at the potential of the anode side of the alternating current input; a second touch surface; and a high resistance circuit connecting the second touch surface to the control electrode of the glow tube, the circuit including high resistance branch connections to the other two electrodes of the glow tube.

The switch illustrated diagrammatically in the drawing is intended to operate on alternating current of the normal 110-120 volt range and, therefore, the circuit is shown connected to a conventional plug 10 although such a plug is not necessarily a part of the switch mechanism itself. Half-wave rectification of the line voltage is achieved by means of a rectifier 20 which may be of the conventional selenium type, but other types are also satis-

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factory. The line voltage is utilized to charge a capacitor 11, which is preferably of the electrolytic type, through a resistor 23. The capacitor 11 is connected across a circuit comprising a miniature glow tube 12 and a latching relay 13 which alternately opens and closes an external circuit 14 upon energization. The resistor 23 limits the rate of charging of the capacitor 11 to a safe value and, together with the capacitor, determines the refring time in addition to which it limits current flow from the supply through the relay 13 and tube 12 when the capacitor 11 discharges.

The miniature glow tube 12 preferably has at least three elements consisting of a control electrode 15, a cathode 15a, and an anode 15b. The tube 12 is desirably a miniature neon tube having in the envelope three electrodes of the same configuration with the control electrode 15 occupying an intermediate position which completely interrupts the line of sight between the cathode 15a and anode 15b. The three electrodes can be composed of metallic rod material about a quarter-inch in length by about one thirty-second-inch in width. Normally, the few milliamperes current-carrying capacity of the tube 12 is much too small to energize a relay. However, the tube may be overloaded sufficiently (i. e. 200 ma.) for a short interval to bring about momentary energization of a relay. Since the relay 13 is of the latching type, momentary energization thereof is sufficient to reverse the setting of its contacts.

The latching relay 13 has an armature 17 which is not a part of the external electrical circuit 14 but, nevertheless, effectuates the mechanical movement which controls the circuit. The actual circuit completing members are an immovable element 18 and a pair of spring biased elements 19 and 21, the elements 18 and 19 being equipped with contacting buttons 18a and 19a respectively.

The elements 19 and 21, which are biased in the direction of each other, have cooperating step-shaped ends whereby, in the open-contact position illustrated, the element 21 holds the element 19 out of contact with the element 18. The element 21 is equipped with a detent 22 which is engageable by the end of the attracted armature 17 when the contacts are in the open position illustrated. After engaging the detent 22, armature movement forces the element 21 out of engagement with the element 19 which brings into engagement the contacts 18a and 19a due to the spring bias of the element 19. At the same time, the tip of the element 19 engages the element 21 to hold the detent 22 out of the path of travel of the armature 17. On the next energization of the relay 13, the trip portion of the armature 17 misses the detent 22 and engages the element 19 to open the contacts 18a and 19a and enable the element 22 to spring into locking position and maintain the contacts in open position. Other types of latching relay are available and may be substituted for the particular type illustrated.

A control circuit for the tube 12 consists of a touch surface or plate 16 connected to the control electrode 15 through a trunk resistor 27. A branch circuit connects the touch plate 16 to the cathode 15a through the branch resistor 29 which preferably, though not necessarily, has a stabilizing capacitor 31 in circuit therewith. The anode 15b is connected to the touch surface 16 through a branch circuit including a resistor 28.

It is desirable that in addition to the touch surface 16 there be another touch surface 25—preferably in spaced relation thereto—to provide through a resistor 26 an electrical coupling to the anode of the tube 12 thereby avoiding the necessity of having the plug 10 always connected for the same polarity. In addition, by

coupling the touch surface 25 to the anode side of the source, the effect of the capacitance to ground of the person contacting the touch surface is no longer required and it is the conductivity (or impedance) of a person bridging the touch surfaces 16 and 25 which raises the potential of the control electrode 15 toward the anode 15b to render the tube 12 conducting. This, in effect, provides an artificial internal ground plane.

The tube 12 has a tendency to alter its characteristics in an erratic manner according to whether it is surrounded by light or darkness. Since this can result in spurious operation of the switch, a source of light 32 is connected across the line through a resistor 33. Since the source of light is always in operation, it is desirable that it be placed close to the tube 12 and operate on very low current. A miniature neon tube is satisfactory for this purpose both from the standpoint of initial cost, reliability, and low power consumption.

Spurious conduction of the tube 12 due to the gradual accumulation of a static charge on the surface 16 is avoided due to the fact that the branch circuits through the resistors 28 and 29 and capacitor 31 drain off such charge.

In operating the switch illustrated, the circuit is connected to a source of energy which charges the capacitor 11. The circuit characteristics are such that breakdown voltage of the tube 12 is not attained. When a person now touches the surfaces 16 and 25, anode potential is applied to the control electrode 15 to enable the tube 12 to become momentarily conducting, thereby energizing the relay 13 to change the setting of its contacts either to open or to close the circuit 14. While the external circuit 14 has not been shown in its entirety, it is obvious that any switch control function such as turning a lamp on and off or starting and stopping an electric motor or electronic apparatus could be brought about by the switch circuit illustrated. The touch surfaces 16 and 25 do not have to have any particular configuration, but in most applications it is desirable that they be placed close to each other, as by interleaving, so that it is difficult to touch one without also touching the other. There is thus provided a switch which is particularly useful for persons who have lost the use of their fingers since mere contact of the touch surfaces 16 and 25 with the arm or any part of the body will effect operation of the switch.

It is obvious that the circuit elements may be correlated for operation under widely varying voltage conditions. Such correlation of circuit components is within the realm of those skilled in the art and, therefore, the following listing of values for the resistors and capacitors of the circuit is intended to be illustrative without being limiting. The elements are identified by the numbers shown on the drawing.

Resistors

Number:	Resistance (megohms)
23-----	0.0082
26-----	0.68
27-----	0.1
28-----	10
29-----	6.8
33-----	0.47

Capacitors

Number:	Capacitance
11-----	mfd. 40
31-----	mmfd. 700

While the invention has been discussed primarily with reference to the specific embodiment illustrated, there are many obvious modifications which fall within the spirit of the invention. Therefore, the invention is limited in scope only as may be necessitated by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A switch operable by touch contact comprising: a first glow tube having an anode, cathode, and control electrode; a latching relay connected to the cathode of said tube, said relay having contacts adapted to control an external circuit; means for connecting the circuit formed by said tube and relay to a source of electrical energy; a capacitor connected across said tube and relay circuit; a second glow tube positioned to radiate light on said first glow tube; a first touch surface of conducting material connected through a high resistance to the anode of said first glow tube; and a second touch surface of conducting material in spaced relation with said first touch surface, said second touch surface being connected to all of the electrodes of said first glow tube through a branching circuit including a trunk resistor and additional resistors in the branch circuits leading to the cathode and anode, whereby touch contact with said touch surfaces effects conduction through said first glow tube when said switch is connected to a source of electrical potential.

2. A switch operable by touch contact comprising: a glow tube having an anode, cathode, and control electrode; a latching relay energizable by a circuit through said glow tube; a capacitor to control the output from said glow tube to said relay; a source of light to radiate light on said glow tube; a first touch surface of conducting material connected as a ground plane for said switch; a second touch surface of conducting material in spaced relation to said first touch surface; and a circuit including a trunk resistor connecting said second touch surface to the control electrode of said glow tube, said circuit also including high resistance branch connections to the other two electrodes of said glow tube.

3. A switch operable by touch contact comprising: a glow tube having at least three electrodes one of which is a control electrode, one a cathode and one an anode; a latching relay having contacts which alternately open and close an external circuit upon energization of said relay; a capacitor; a circuit connecting said tube and relay in series and said capacitor in shunt of said tube and relay, whereby the charge upon said capacitor controls the output from said glow tube to said relay; a source of light to radiate light on said glow tube; a first touch surface connected to the anode of said tube at ground potential; a second touch surface; and a high resistance circuit connecting said second touch surface to the control electrode of said glow tube, said circuit including high resistance branch connections to the other two electrodes of said glow tube, whereby said glow tube becomes conducting to energize said relay when said switch is connected to a source of electrical energy and said touch surfaces are bridged by touch contact.

4. A switch operable by touch contact as claimed in claim 3 wherein there is means for rectifying an alternating current input to the capacitor-glow tube-relay circuit.

5. A switch operable by touch contact as claimed in claim 3 wherein there is a capacitor connected in parallel in the branch circuit leading from the second touch surface to the cathode of the glow tube.

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