

Feb. 8, 1949.

H. H. GATES
PROTECTED TRANSFORMER CIRCUIT
FOR HIGH-VOLTAGE TUBES
Filed Sept. 17, 1945

2,461,265

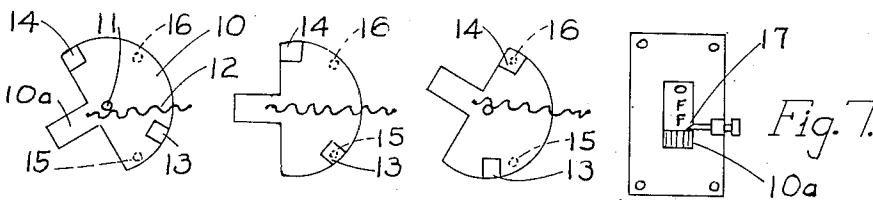
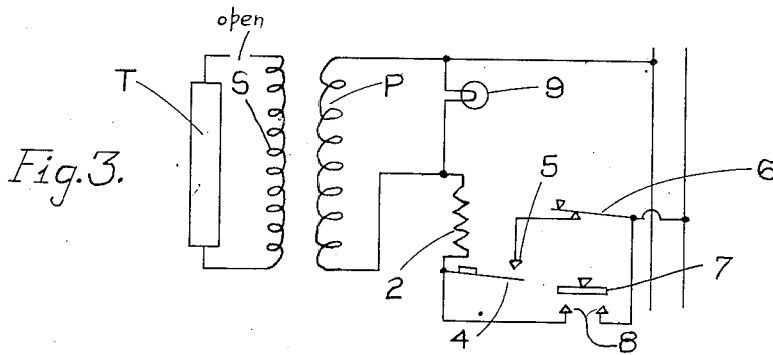
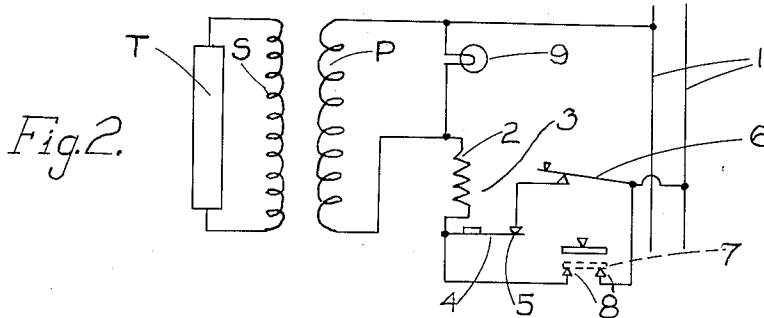
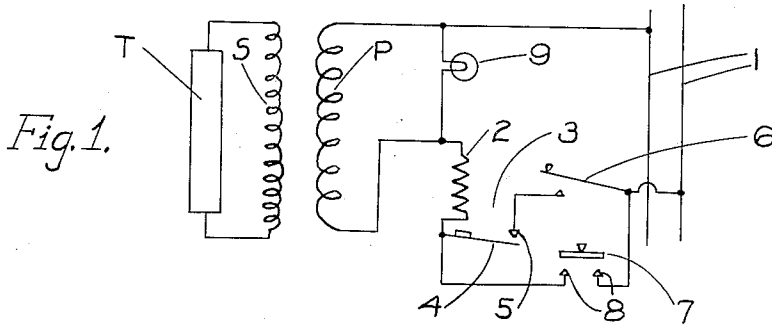


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

INVENTOR:
Herbert H. Gates
By *Owen W. Kennedy*
ATTORNEY

UNITED STATES PATENT OFFICE

2,461,265

PROTECTED TRANSFORMER CIRCUIT FOR
HIGH-VOLTAGE TUBES

Herbert H. Gates, Shrewsbury, Mass.

Application September 17, 1945, Serial No. 616,800

2 Claims. (Cl. 315-276)

1

The present invention relates to a protected transformer circuit designed particularly for use in connection with the operation at high voltages of luminous discharge tubes, such as those employed in neon signs, or for cold cathode lighting, or for other similar applications.

In the operation of such luminous discharge tubes, a high potential is required, which may range between 4000 and 15,000 volts, and such tubes are usually energized from transformers, the primary windings of which are connected to ordinary commercial lighting circuits at 110 or 220 volts. With a tube so energized, it is obvious that should the tube break, or should the secondary circuit be broken, the open circuit secondary voltage will rise far above its rating, and the transformer will constitute a menace to life, as well as a fire hazard. Such a condition cannot be corrected by the use of an ordinary fusible cut-out in the primary circuit of the transformer, for should the secondary of the transformer be open circuited, the current in the primary winding would be at its minimum value.

According to the present invention, there is provided an improved protected circuit for high voltage tube transformers, wherein provision is made for the automatic interruption of the primary circuit of the transformer should the tube break, or should the secondary circuit be broken or faulted, with a resulting falling off of the current traversing the primary winding. Furthermore, the circuit is so arranged that the primary winding of the transformer cannot be accidentally energized before the trouble in the secondary circuit has been cleared and the arrangement is safe to operate. The above and other advantageous features of the invention will hereinafter more fully appear from the following description considered in connection with the accompanying drawings, in which—

Fig. 1 is a diagrammatic view of a circuit embodying the present invention in non-operating condition.

Fig. 2 illustrates the circuit of Fig. 1 in condition for operating a luminous discharge tube.

Fig. 3 illustrates the functioning of the circuit to de-energize the primary winding upon the occurrence of an abnormal condition in the secondary circuit.

Figs. 4, 5 and 6 are fragmentary views illustrating the operation of a special switch for controlling the primary circuit.

Fig. 7 is a front view of the switch of Fig. 4.

Referring to the drawings, the circuit of the invention is shown in connection with a luminous

2

discharge tube T, which may be of any desired type such as is customarily employed in connection with advertising signs, or cold cathode lighting. The electrodes of the tube T are connected across the terminals of the secondary winding S of a transformer, the primary winding of which is indicated at P. The transformer is so designed as to provide a voltage across its secondary S, sufficiently high to start and operate the tube T.

One terminal of the primary winding P is connected to one of a pair of alternating current supply mains 1 energized from a commercial source, as indicated, while the other terminal of winding P is connected in series with the winding 2 of a protective relay device 3. The relay 3 further comprises a pivoted contact 4 movable with the relay armature, and one terminal of the winding 2 is connected to the contact 4. The free end of the contact 4 is spaced from a stationary contact 5 when the relay winding 2 is in a deenergized condition, as shown in Fig. 1. The relay contact 5 is adapted to be connected to the other supply main 1 by closure of a knife switch 6, which is shown open in Fig. 1.

In order to provide for initial pulling in of the relay 3 following closure of the knife switch 6, a push button switch 7 is provided, the normally open contacts 8 of which are connected in shunt around the knife switch 6 and the relay contacts 4 and 5. Therefore, a momentary closure of the push button switch 7, after closure of the knife switch 6, as indicated in dotted lines in Fig. 2, will cause sufficient current to traverse the relay winding 2 to pull in the armature and engage the movable contact 4 with the stationary contact 5.

Engagement of the relay contacts 4 and 5 as the armature pulls up establishes a holding circuit for the relay, even though the push button switch is released and returned to the full line position of Fig. 2. Therefore, the primary winding P of the transformer is energized, and the resulting high voltage of the secondary S starts the tube T and maintains its illumination. Generally speaking, the starting of the tube T is so quick that the momentary closure of the push button contacts 8 will be sufficient to start the tube and cause the relay winding 2 to draw sufficient current to hold the contacts 4 and 5 closed, and the fact that these contacts are closed is indicated by the illumination of a suitable pilot light 9 bridged across the terminals of the primary winding P.

As long as the discharge tube T remains in operative condition, with the circuit of the sec-

ondary winding S intact, as shown in Fig. 2, the tube will continue illuminated as long as the switch 6 remains closed. During the continued operation of the tube T, the relay winding 2 is traversed by the normal operating current of the primary circuit which is determined by the load on the transformer. The relay 3 is so designed that the normal operating current, when the tube T is running, is sufficient to hold up the relay armature and maintain the contacts 4 and 5 in engagement.

However, should the tube T break, or should the circuit of the secondary winding S be broken, as indicated in Fig. 3, the current in the primary winding P will drop sharply, although the open secondary voltage will rise to its rated value. When this occurs, the winding 2 will no longer hold up the relay armature, and the movable contact 4 will separate from the stationary contact 5, as shown in Fig. 3. The resulting opening of the primary circuit of the transformer will deenergize the secondary circuit so that dangerous high voltage conditions no longer exist. The opening of the primary circuit of the transformer will be indicated by extinguishment of the pilot light 9, so as to call attention to the fact that the circuit is no longer operative.

As previously pointed out, the relay 3 is so designed that normal operating current traversing the winding 2 when the tube is running is sufficient to hold up the relay armature to maintain the relay contacts 4 and 5 in engagement, whereas the greatly reduced current through the primary circuit, in the event of trouble, will not be sufficient to hold the relay closed. Obviously, the design of any particular winding 2 for the relay 3 will depend upon the rating of the transformer and the size of the tube T. As one illustrative embodiment of the invention, the relay winding 2 may be designed to hold the relay contacts closed, with a current range of between 1.5 to 2.5 amperes, with the relay dropping out to open the contacts 4 and 5 whenever the current falls appreciably below 1 ampere.

Assuming that the relay 3 has dropped out as a result of a fault in the tube circuit, as indicated in Fig. 3, the secondary circuit of the transformer will remain dead, while the relay 3 remains open, and there is no possibility of any one being injured by the high voltage of the secondary circuit, even though the knife switch 6 may be left closed, through inadvertence. When the extinguishment of the pilot light 9 calls attention to the fact that primary circuit has been opened, the normal procedure would be to open the knife switch until the tube has been replaced, or necessary repairs made to the secondary circuit. However, when once the relay has dropped out due to trouble in the secondary circuit, accidental closure of the knife switch 6 can do no harm, since the circuit of the relay winding 2 can be re-established only through operation of the push button 7 which is mounted apart from the knife switch 6.

Referring now to Figs. 4, 5 and 6, there is shown a modification of the circuit, wherein the functions of knife switch 6 and the push button 7 are incorporated in the movable element of a single switch of the snap action type, usually employed for wall switches. In Fig. 4, the movable element of such a switch is shown in the form of a rotatable disk 10 of insulating material turnable about a pivot 11, with the disk being maintained in the off position through the pull of a spring 12 below the pivot 11. The disk carries

angularly spaced bridging members 13 and 14 of conducting material that are adapted to cooperate with pairs of spaced stationary contacts 15 and 16, respectively. The contacts 15 are adapted to be connected in the circuit of Fig. 1 in the same manner as are the push button contacts 3, while the contacts 16 are connected between the relay contact 5 and one supply main 1. Therefore, engagement of the contacts 15 by the bridging member 13 will be equivalent to closing the push button switch, while engagement of contacts 16 by bridging member 14 will be the equivalent of closing the knife switch 6.

With the disk 10 of the snap switch in the off position of Fig. 4, the circuit is in the non-operating condition of Fig. 1. When it is desired to energize the tube T, the switch is moved to the on position of Fig. 6, which movement occurs with a snap action, due to the pull of the spring 12 above the pivot 11. When the snap switch is so moved from the off to the on position, it passes through the intermediate position of Fig. 5, so that the contacts 15 are bridged by the member 13 to energize the relay winding 2, momentarily, before the contacts 16 are bridged by the member 14. Therefore, moving the switch to the on position has the effect of momentarily establishing the circuit of the relay winding 2, so that bridging of the contacts 16 immediately thereafter holds up the relay. However, movement of the disk 10 from the position of Fig. 5 to the position of Fig. 6 has the effect of unbridging the contacts 15 as the member 13 moves past these contacts into the position of Fig. 6, where only the contacts are bridged by member 14.

As previously pointed out, when opening of the relay 3 breaks the primary circuit and extinguishes the pilot light 9, the normal procedure is to open the knife switch 6 before working on the secondary circuit. The same applies to the snap switch shown in Fig. 4, which is operated to the off position upon the occurrence of conditions causing the relay 3 to open.

In order to prevent premature operation of the switch to the closed condition of Fig. 6, before the secondary circuit has been cleared of trouble, a latch 17 is associated with the operating portion 19a of the movable disk 10 which serves to hold the switch in off position. As shown in Fig. 7, this latch 17 must be pulled out by hand before the portion 19a can be moved upwardly from the off position, thereby preventing closure of the primary circuit by accidental operation of the snap switch.

I claim:

1. In a circuit for high voltage illumination having, a transformer including a primary and a secondary winding, an illuminating device connected across said secondary winding, an alternating current source of electrical energy, one side of said primary winding being connected to one side of said energy source, and a normally open underload relay having its winding and one contact connected in series with the other side of said primary winding and having a second contact adapted to be connected with the second side of said energy source; the improvement which consists in the provision of a manually operable unitary switch movable from an open to a closed position with a snap action, said switch having contacts in circuit with said relay winding and the second side of said energy source so as to establish momentarily, upon an initial movement of said switch to an intermediate po-

5

sition between open and closed, a circuit around the open contacts of said relay and between said relay winding and the second side of said energy source to cause said relay to pull in and close its normally open contacts, and contacts in circuit with the second contact of said relay and said second side of said energy source so as to maintain, upon a final movement of said switch to a second position, said relay contacts closed as long as a current of predetermined value traverses the primary circuit.

2. In a circuit for high voltage illumination having, a transformer including a primary and a secondary winding, an illuminating device connected across said secondary winding, an alternating current source of electrical energy, one side of said primary winding being connected to one side of said energy source, and a normally open underload relay having its winding and one contact connected in series with the other side of said primary winding and having a second contact adapted to be connected with the second side of said energy source; the improvement which consists in the provision of a manually operable and spring-biased single-throw switch having contacts in circuit with said relay winding and the second side of said energy source so as to establish momentarily, upon an initial movement

6

of said switch to an intermediate position between open and closed, a circuit around the open contacts of said relay and between said relay winding and the second side of said energy source to cause said relay to pull in and close its normally open contacts, contacts in circuit with the second contact of said relay and said second side of said energy source so as to maintain, upon a final movement of said switch to a second position, said relay contacts closed as long as a current of predetermined value traverses the primary circuit, and manually operable means for locking said switch in its initial or open position thereby to prevent inadvertent use of said switch.

HERBERT H. GATES.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
472,084	Thum -----	Apr. 5, 1892
2,249,457	Catlett -----	July 15, 1941
2,305,096	McDermott -----	Dec. 15, 1942
2,308,987	Lotto -----	Jan. 19, 1943
2,309,711	Pearson -----	Feb. 2, 1943
2,310,149	McDermott -----	Feb. 2, 1943