Aug. 30, 1932. F. W. YOUNG 1,874,407

ELECTRICAL PROTECTIVE DEVICE

Filed Sept. 5, 1928

Fig. 1

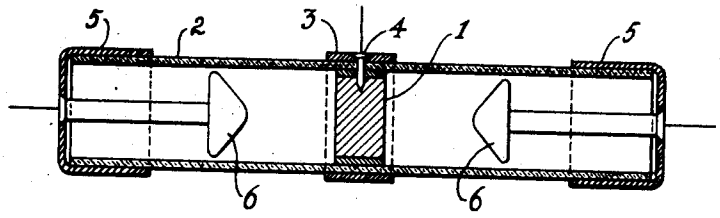
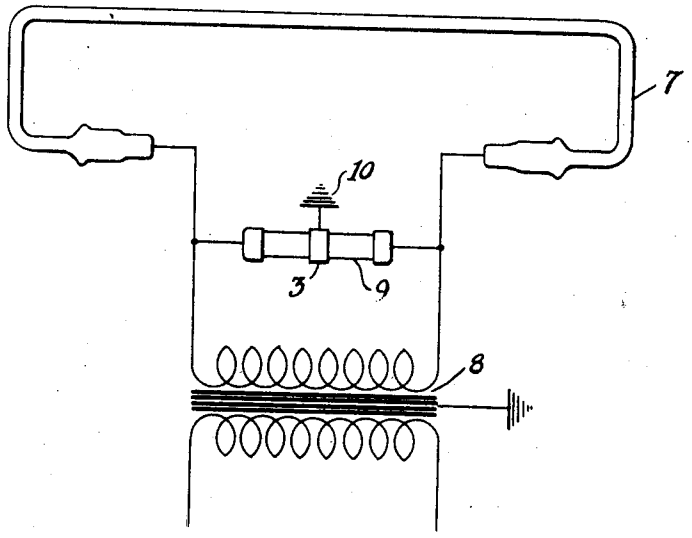


Fig. 2



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UNITED STATES PATENT OFFICE

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ELECTRICAL PROTECTIVE DEVICE

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The tubes for which this invention is particularly adapted, are those employing a rare gas such as neon or a mixture of such gases for illuminating purposes, such for example as display or advertising signs in which the letters of the sign are formed by the tube itself.

The electrical potentials necessary to ionize the gas in a discharge tube of the character described so that it becomes luminous are relatively high and increase with the length of the tube. In connection with commercial advertising signs, the most satisfactory starting potential is of the order of fifteen thousand volts. After the gas has become ionized, the potential required to keep it burning is relatively low.

Such tubes are ordinarily operated from the regular alternating current lighting circuit through a step-up transformer of the current limit type and they will withstand a short circuit for an indefinite period of time without damage. These transformers usually have the midpoint of the secondary grounded. In the case of tube breakage the entire open circuit voltage of the transformer is impressed upon the wiring and other parts of the circuit. If one side of the circuit becomes grounded one-half of the transformer will be short-circuited and the resultant current flowing through the other half of the transformer will be doubled. Either of these conditions if allowed to continue will result in breakdown of the wiring in the case of the tube breaking or in the breakdown of the transformer in case one side of the circuit becomes grounded. My invention is designed to protect these parts from the harmful effects resulting from the breakage of the tube or the grounding of any part of the secondary circuit.

The nature of my invention is illustrated in the accompanying drawing, in which—

Figure 1 is a cross section of the protective device through its longitudinal axis; and

Figure 2 is a plan view of a discharged tube and its electrical circuit including the protective device.

The protective device consists of a metal sleeve 1 which is filled with a fusible alloy, such as Wood's metal. This sleeve is positioned within a tube 2 of some insulating and non-combustible material. The insulating tube 2 is surrounded by a metal sleeve 3 which is in the same position with respect to the ends of the insulating tube as the internal sleeve 1. An electrical connection is established between outer sleeve 3 and the fusible metal within the inner sleeve 1 by means of a pin 4 or similar device which passes through both metal sleeves and the insulating sleeve into the fusible metal. The ends of the insulating tube 2 are closed by metal caps 5, in the center of the ends of which are openings through which pass rods 6 which form the two points of a spark gap. If desired, the rods 6 may be made adjustable to vary the extent of the spark gap in any suitable way. The outer ends of these rods terminate in suitable means for attachment to an electrical circuit.

The method in which this protective device is used is illustrated by Figure 2 in which the discharge tube 7 is shown connected to the secondary of step-up transformer 8 in the customary manner, the primary of the transformer being connected to a source of suitable electrical energy such as the ordinary lighting circuit, (not shown). Across the secondary of the transformer 8 is connected the protective device 9 of Figure 1. One end of each of the rods 6 is connected to one side of the secondary circuit and sleeve 3 is grounded as at 10. The rods 6 are so positioned that when the current is first turned on and before the gas in the tube is ionized, a spark will jump through the protective device to the fusible alloy. This spark, however, will persist only for an instant because the resistance of the tube will immediately decrease as the gas becomes ionized and the voltage in the secondary circuit will drop to approximately half its original voltage.

If the tube is broken or disconnected while the current is still flowing, the full open circuit voltage of the transformer is applied across the device and an arc will be formed from the spark gap points to the fusible alloy which will, in a few seconds, cause the alloy to melt, run out of its containing ring 1 and

short-circuit the gap, thus forming a complete metallic circuit across the secondary circuit.

Similarly if one side of the secondary circuit becomes grounded, the operating potential of the tube will be applied across one-half of the gap with similar results. By this means the circuit is fully protected against breakdown from high voltage surges incident upon the starting of the tube or the grounding of the secondary circuit without interference in any way with normal operation.

What I claim is:

1. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means normally maintaining said circuit open, and operating to close the connection and short-circuit the secondary circuit upon continued exposure to an abnormal voltage.

2. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means normally maintaining said circuit open and operating to close the connection and short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a spark gap.

3. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit and including means normally maintaining said circuit open, said means operating to close the connection and short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a spark gap, and a fusible element disposed between the points of said gap.

4. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means normally maintaining said circuit open and operating to close the connection to short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a spark gap, and a fusible plug interposed between the points of said gap, said fusible plug being grounded.

5. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means normally maintaining said circuit open and operating to close the connection to short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a tube of non-conducting material, spark gap terminals within said tubes at opposite ends thereof, and a fusible element disposed within said tube between said terminals.

6. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means normally maintaining said circuit open and operating to close the connection and short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a tube of non-conducting material, spark gap terminals within said tube, and fusible elements within said tube between said terminals, and a ground connection connected to said elements.

7. In an electrical circuit for electrical discharge tubes, the combination of a transformer having a primary winding for connection with a source of electrical energy, a secondary winding to which the tube is connected, and a connection across the secondary circuit including means clearly maintaining said circuit open and operating to close the connection and short-circuit the secondary circuit upon continued exposure to an abnormal voltage, said means comprising a tube of non-conducting material, spark gap terminals adjustably mounted in said tube, and an element between said terminals adapted upon heating to be melted and establish a metallic connection between said terminals.

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