Feb. 20, 1951 R. H. SEAMAN 2,542,367

PROTECTIVE DEVICE FOR TRANSFORMERS

Filed Nov. 13, 1945

Fig. 2

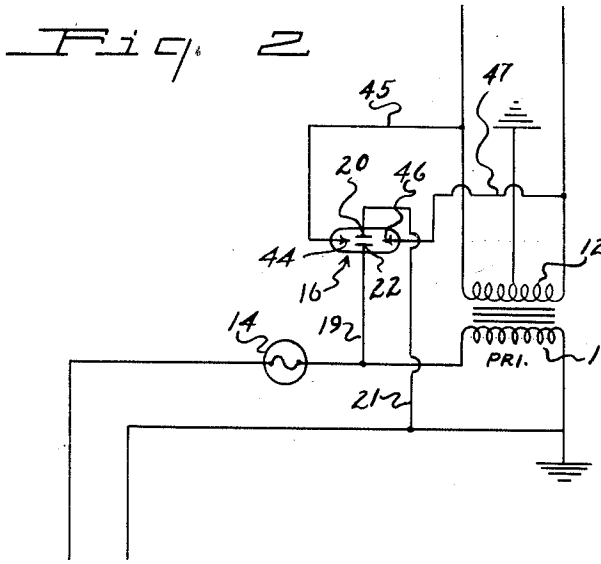
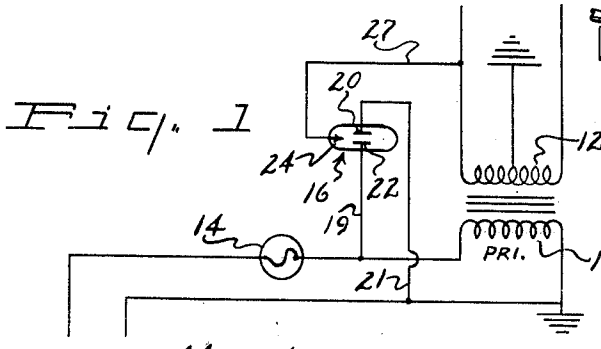


Fig. 1



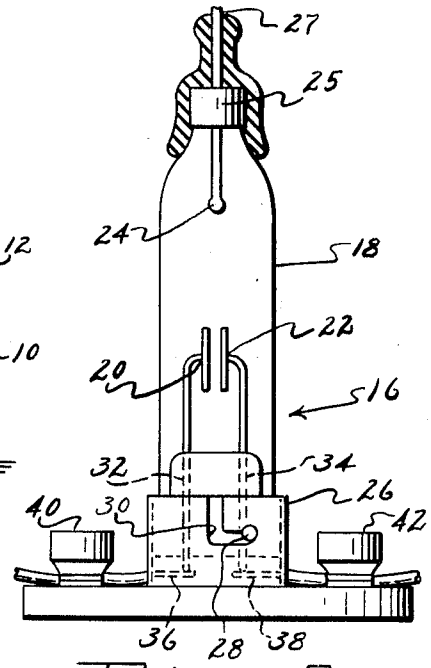


Fig. 3

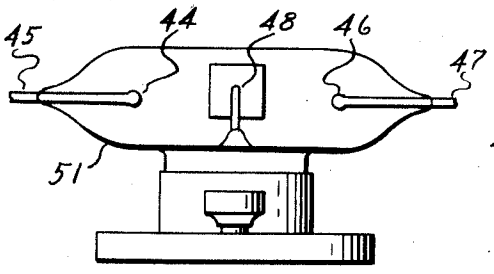


Fig. 4

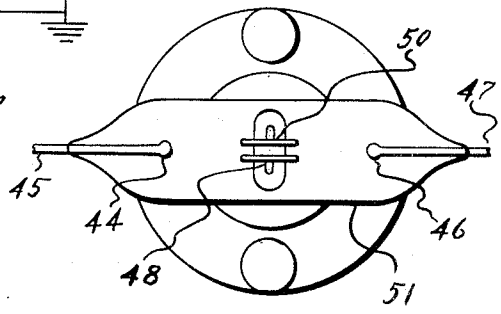


Fig. 5

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Patented Feb. 20, 1951

2,542,367

UNITED STATES PATENT OFFICE

2,542,367

PROTECTIVE DEVICE FOR TRANSFORMERS

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Application November 13, 1945, Serial No. 628,191

4 Claims. (Cl. 175—294)

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This invention relates to the provision of means primarily designed to protect electrical transformers of the step-up type from injury in the event that the secondary circuit of the transformer becomes accidentally opened.

The invention is hereinafter described as particularly applied to transformers used in neon sign work, although the scope of the invention is not necessarily so limited.

Transformers used in gaseous discharge tube circuits, and particularly in connection with neon tube signs, are of the high voltage type, the secondary voltage being usually of the order of 10,000 to 15,000 volts. Although it is general practice to provide transformers of the high leakage type for such use, the accidental breaking of the sign, which is a common occurrence, will nevertheless cause high voltages to build up in the secondary winding of the transformer with the result that if the circuit is not promptly disconnected the transformer is apt to become overheated and ruined or cause fires.

It is therefore advantageous to provide protective devices for such signs which will act practically instantaneously to interrupt the electrical power supply to the transformer. Such devices, for maximum safety, should operate if either side of the high tension circuit becomes open or accidentally grounded.

Also since it is frequently necessary to replace gaseous discharge tubes, and such replacement may be attempted by unskilled persons, particularly in indoor installations in which gaseous discharge tubes are likely to be of the hot cathode high current type, serious injury from electrical shock may be experienced by contacting the socket terminals with the fingers if the person attempts to fit a new tube in the sockets without first turning off the current. By the use of the device of this invention the current is cut off from the tube circuits as soon as the secondary or high voltage circuit is interrupted either by breaking of the tube or removal thereof from the socket without first turning off the current so that electric shocks cannot be experienced.

The peak voltages used in neon sign work are necessarily high in order to provide the striking voltage of the tube, which may be 25% or more in excess of the normal operating voltage. The brief application of such voltage in the transformer previous to lighting of the sign does not harm the transformer since the voltage drops immediately the sign is lighted, but the generation of this high voltage for any considerable

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period of time, should the sign be broken, will damage the transformer.

Neon signs are very commonly erected on the roadside or in relatively inaccessible places, such as on roof tops and the like, and a considerable period of time may elapse before the sign is visited for maintenance or the inoperativeness of the sign is noticed. Large numbers of transformers are used in connection with such gaseous discharge tube signs, both because of the great number of such signs and because large signs are commonly built up of separate sections, each provided with its own transformer, so that the cost of replacement of damaged transformers constitutes a relatively heavy item in the maintenance of such signs.

It is an object of the invention to protect transformers, particularly of the high voltage type used with gaseous discharge tubes, such as neon signs, by the provision of an inexpensive device which will act to interrupt the primary circuit of the transformer should the secondary circuit be accidentally opened.

It is a further object of the invention to provide a device of the kind described which is simple in construction and inexpensive to manufacture.

A further object of the invention is to provide a device of the kind described which may very readily be replaced if necessary.

Another object of the invention is to provide a protective device for the purpose described having no moving parts and therefore free from deterioration due to mechanical wear.

A further object of the invention is to provide a protective device for the purpose described which is actuated by the ionization of gas in a gaseous discharge tube to cause arcing across electrodes shaped and arranged to reduce to a minimum wear on the electrodes caused by the arc so that the device is practically free from deterioration due to the effect of the arc.

A further object of the invention is to provide a method of protecting transformers from damage due to building up of excessively high voltage in the secondary winding thereof.

Further features and objects of the invention will hereinafter appear in the following description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagram showing the connection of the protective device in a circuit including a transformer, in which one element is connected to one side of the secondary of the transformer;

Fig. 2 is a diagram showing the protective de-

vice having elements connected to both sides of the secondary of the transformer;

Fig. 3 is an elevation of the protective device shown diagrammatically in Fig. 1 and drawn to a larger scale;

Fig. 4 is a side elevation of the protective device diagrammatically shown in Fig. 2; and

Fig. 5 is a plan view of the device shown in Fig. 4.

Referring now to Fig. 1, the primary of the transformer is indicated by the numeral 10 and the secondary by the numeral 12. An overload fuse 14 of the usual type is provided in the transformer primary circuit as is customary.

The protective device of my invention is indicated by the numeral 16. The device comprises an envelope 18, which may be a length of glass tubing in which is sealed a suitable gas, such as argon or neon, at a suitable low pressure.

Two electrodes 20 and 22, preferably of plate-like form closely spaced, are sealed into the glass envelope to provide a spark gap, the distance between the electrodes being such that the normal maximum working potential of the secondary is insufficient to establish an arc between the electrodes. Electrode 22 is connected to one side of the primary winding by lead 19 and the other electrode 20 is connected to the other side of the primary winding by lead 21.

A third electrode 24, in the form of the device shown in Fig. 3, is sealed into the upper end of the glass envelope and may be connected through the metal cap 25 and lead 27 into one side of the secondary winding 12 of the transformer.

Should the secondary circuit of the transformer become opened, for instance, by the breaking of the neon sign, excessive voltages will be built up in the secondary, resulting in ionization taking place between electrode 24 and electrode 20 (or electrode 22) which reduces the resistance of the gas path between electrodes 20 and 22 thereby causing conduction from electrode 20 to 22 (or from 22 to 20) in parallel to the primary winding of the transformer. The current from this parallel circuit flowing through the fuse 14 will burn out the fuse. Once conduction takes place from electrode 20 to 22 (or from 22 to 20), conduction ceases from electrode 24 to electrode 20 (or 22).

When an arc is established the primary winding 10 of the transformer is of course directly shorted, causing the protective fuse 14 to "blow," thereby disconnecting the transformer from the power lines and preventing any damage thereto.

It will be noted that the protective device 16 can be formed to be readily inserted in a socket 26, the tube 18 being formed with a base furnished with a pin 28 engaging a slot 30 in the socket 26. Electrodes 20 and 22 may be furnished with pins 32, 34 projecting through the base and engaging with metal strips 36, 38, making contact with screw top terminals 40, 42 to which the leads 19 and 21 may be attached.

In the form of the device shown in Figs. 4 and 5, two electrodes 44, 46 are provided and are connected one to each side of the secondary winding by leads 45 and 47 respectively, as shown in the diagram of Fig. 2. Electrodes 48, 50 correspond in every way to electrodes 20, 22 of Figs. 1 and 2, and electrodes 44, 46 function, like electrode 24, to ionize gas in the sealed envelope 51.

It will be seen that the protective device of the invention provides a simple and inexpensive means for protecting transformers, particularly of the type used in neon sign work, from becoming damaged by breakage of the sign to which the transformer is connected.

The invention is hereinbefore described and illustrated in preferred forms, but it is to be understood that the scope of the invention is not in any way limited by this illustrative showing but only as indicated by the scope of the appended claims.

I claim:

1. A protective means for connection into a transformer circuit having an overload fuse in its primary circuit, comprising a container filled with ionizable gas, leads connected across said primary circuit and each terminating in an electrode within the container, said electrodes being spaced apart a distance sufficient to provide a spark gap across which an arc may not occur when said gas is not ionized, and means operable in response to excessive voltage in said secondary circuit to ionize said gas and thereby reduce the resistance to arcing across said gap.

2. The device of claim 1 wherein the last named means comprises a lead connected into one leg of said secondary circuit and terminating in a third electrode exposed to the gas within the container and operable in conjunction with one of said primary circuit connected electrodes in response to said excessive voltage to ionize said gas.

3. An electrical circuit having a transformer comprising a primary circuit and a secondary circuit, an overload fuse in the primary circuit, and means in the primary circuit to cause blowing of the fuse in response to excessive voltage in said secondary circuit, including: a sealed container filled with inonizable gas, a pair of leads connected into the primary circuit and each terminating in an electrode within the container, said electrodes being spaced apart to provide a gas filled spark gap therebetween of sufficient width to prevent arcing thereacross when the gas is not ionized, and electrode means exposed to said gas and operable in response to excessive voltage in the secondary circuit to ionize said gas, said last named electrode means being connected into the secondary circuit.

4. A protective means for connection into a transformer circuit having an overload fuse in its primary circuit, including a secondary triggered twin diode comprising a container filled with ionizable gas, a first pair of spaced electrodes and a second pair of spaced electrodes in said container, leads connecting said first pair of electrodes across the primary circuit of the transformer, leads connecting said second pair of electrodes across the secondary circuit of the transformer, said first and said second pair of electrodes being spaced apart a distance sufficient such that ionization of the gas does not occur under ordinary operating voltages of the transformer and said first pair of electrodes being spaced apart to provide a spark gap therebetween of sufficient width to prevent arcing thereacross when the gas is not ionized, said second pair of electrodes being operable in response to excessive voltage in said secondary circuit to ionize said gas and thereby reduce resistance to arcing across said gap.

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