June 15, 1943. R. F. HAYS, JR 2,321,910

TIME DELAY GLOW SWITCH

Filed Oct. 23, 1941

Fig. 1.

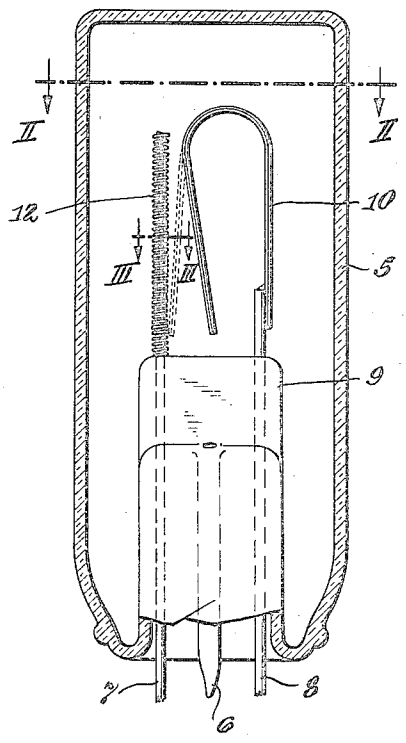


Fig. 2.

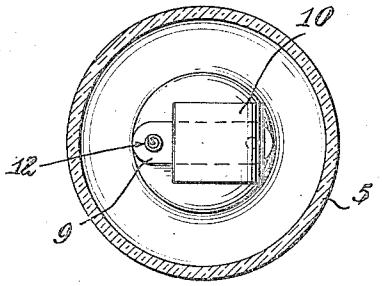


Fig. 3.

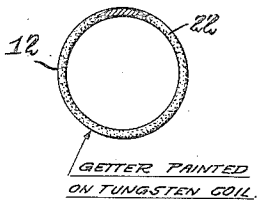


Fig. 4.

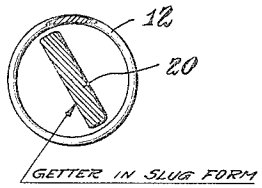


Fig. 5.

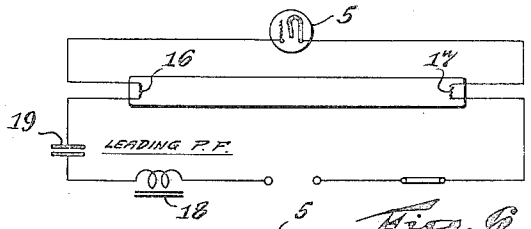
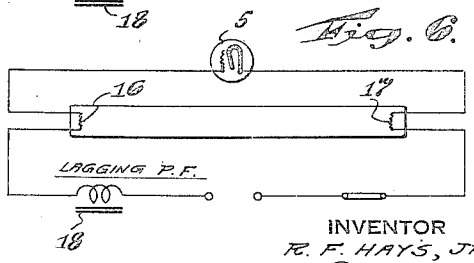


Fig. 6.



INVENTOR
R. F. HAYS, JR.
BY
ATTORNEY

Patented June 15, 1943 2,321,910

UNITED STATES PATENT OFFICE

2,321,910

TIME DELAY GLOW SWITCH

Robert F. Hays, Jr., East Orange, N. J., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 23, 1941, Serial No. 416,172

7 Claims. (Cl. 250—27.5)

The present invention relates to what is known to the art as a glow relay device now commercially employed for the starting of fluorescent lamps and constitutes an improvement over such a device as shown in my prior Patent 2,228,210, issued January 7, 1941, and assigned to the same assignee as the present invention.

Certain standards have now been established for devices of this character, and while prior structures under some conditions comply with these standards, it has not invariably followed that they are satisfactory under all operating conditions. There are several desiderata for devices of this type which must be fulfilled to insure satisfactory operation under all conditions. For example, the glow relay must operate very rapidly so as to complete a heating circuit to the thermionic electrodes of the fluorescent lamp, and this heating circuit must be maintained closed for a sufficient period of time to allow the electrodes to be heated to maximum electron-emitting temperature prior to further operation of the glow relay to cause a high voltage surge to be applied across the electrodes, otherwise such high voltage will result in a deterioration of the electrodes with a substantial shortening in the life of the lamp.

Consequently, during the first two phases of operation of the glow relay two diametrically opposite requirements are necessary; first, rapidity of operation and, secondly, a slight time delay of not less than approximately 1.35 seconds. Moreover, since both fluorescent lamps and glow relays are used on both leading and lagging power factor circuits, slightly different conditions exist which heretofore have resulted in the operation of the glow relay being somewhat slower when employed in a leading power factor circuit than in the case of a lagging power factor circuit.

In addition, it has not been feasible heretofore to employ getters in conjunction with glow relay devices to remove occluded gases which otherwise contaminate the gaseous filling because of the fact that they cause the breakdown voltage of the device to be too low for practical operation for the intended purpose of starting a fluorescent lamp.

It is acordingly an object of the present invention to provide a glow relay device which initially operates very rapidly and with a predetermined time delay during further stages of its operation.

Another object of the present invention is the provision of a glow relay device which operates with a predetermined time delay to enable the thermionic electrodes of a fluorescent lamp to be heated to a sufficiently high temperature with resulting copious flow of electrons before the application of a high starting voltage to the lamp electrodes, thus eliminating deleterious results to the latter which would otherwise ensue.

Another object of the present invention is the provision of a glow relay device which is efficiently operable either with a leading or lagging power factor circuit for the starting of a fluorescent lamp.

A further object of the present invention is the provision of a glow relay device for the starting of fluorescent lamps wherein a getter is employed for removing impurities in the gas without deleteriously affecting the breakdown voltage of the device.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawing wherein:

Fig. 1 is an elevational view partly in section and on an enlarged scale of a glow relay device constructed in accordance with the present invention.

Fig. 2 is a sectional view taken on the line II—II of Fig. 1.

Fig. 3 is a plan view partly in cross section of a portion of one of the electrodes and taken on the line III—III of Fig. 1.

Fig. 4 is a view similar to Fig. 3, but showing a slight modification which one of the electrodes may take.

Fig. 5 is a schematic diagram of a leading power factor circuit for energizing a fluorescent lamp in which the glow relay device of the present invention may be employed.

Fig. 6 is a schematic diagram similar to Fig. 5 but showing a lagging power factor circuit for energizing the lamp and employing the glow relay of the present invention.

Referring now to the drawing in detail, the device as shown in Fig. 1 comprises an envelope 5, which may be of a vitreous material such as glass or the like, and after evacuation through an exhaust tip 6 is filled with an ionizable medium such as argon, neon, helium, or a mixture thereof. A pair of leading-in and supporting conductors 7 and 8 are sealed into a press portion 9 of the envelope and extend a slight distance interiorly of the envelope 5. An electrode in the form of a U-shaped bimetallic element 10 has one of its ends welded or otherwise affixed to the leading-in conductor 8 with the free end thereof suspended in juxtaposition to the extending end of the remaining leading-in conductor 7.

The structure thus far described is identical to that shown and claimed in my above noted patent. In order to impart a predetermined time delay during actual closure of a circuit by engagement of the electrodes, the leading-in conductor 7 has an electrode which as shown is in the form of a refractory metal helix 12 welded or otherwise secured thereto. Such electrode may be of tungsten or molybdenum in the form of a wire, ribbon or braid, its primary requirement

being that it be of such material that it heats quickly and its surface area not be too great so as to sacrifice the high transient voltage resulting upon separation of the electrodes as disclosed in my above mentioned patent.

The advantage of such construction resides in the fact that upon the application of a voltage sufficient to break down the device, a glow discharge results between the electrodes 10 and 12, due to the bimetallic electrode 10 emitting electrons because it is a metal of low work function or it may be provided with an electron-emitting coating, if desired. The ensuing glow discharge heats the tungsten filament 12, which is of comparatively small surface area, to a temperature sufficiently high that it in turn begins to emit electrons by thermionic emission and the glow discharge is converted into an arc discharge, the latter then raising the temperature of the tungsten electrode 12 substantially to white heat. The bimetallic electrode 10 is likewise heated by both the glow discharge and the subsequent arc discharge and deflects so that a substantial portion of its surface area contacts a comparable portion of the contiguous surface area of the filamentary electrode 12, as shown by the dotted lines in Fig. 1, thus short-circuiting the electrodes and extinguishing the discharge.

However, since the filamentary electrode 12 is substantially at white heat and is disposed in close proximity to the bimetallic electrode 10, this heat is transmitted to the bimetallic electrode 10 by radiation and by conduction through the contacting surface areas, thus causing a predetermined time delay before the bimetallic electrode cools sufficiently to separate from the filamentary electrode and return to its normal position. This time delay is necessary so that when the glow relay device is employed in a circuit such as shown in Fig. 5 for starting a fluorescent lamp, the lamp electrodes 16 and 17 are heated to a sufficiently high electron-emitting temperature before the high voltage surge induced by the inductance 18 is impressed across the electrodes 16 and 17 at the instant of separation of the glow relay electrodes 10 and 12 upon cooling of the bimetallic electrode 10.

This resulting time delay is of further advantage particularly when a glow relay device of the present invention is employed for starting a fluorescent lamp when operated on a leading power factor circuit, such as shown in Fig. 5, which includes a series condenser 19. As hereinbefore mentioned, previous types of glow switches have operated fairly satisfactorily on lagging power factor circuits such as shown in Fig. 6 wherein the lamps are of the lower wattage type. However, when operated on leading power factor circuits, which necessarily include a condenser in series with the inductance, they have closed verly slowly. In order to produce a high transient voltage at the instant of separation of the electrodes, one electrode must be small, as described and claimed in my above noted patent, which results in the glow switch operating or functioning as a rectifier, thus charging the series condenser with D. C. voltage. This D. C. voltage subtracts from the A. C. supply voltage during the half cycle that the bimetallic electrode functions as cathode so that little heat is produced and the electrodes close very slowly. On the other half cycle when the small electrode is cathode, the D. C. voltage on the series condenser adds to the A. C. supply voltage and produces a great amount of heat at the small electrode.

Accordingly, the small electrode functions as cathode only 50% of the time, and the rapidity of operation of the glow relay is dependent upon the particular half cycle of the voltage impressed across the electrodes at the instant of starting. In the structure of the glow switch of the present invention wherein the electrode 12 comprises a small tungsten coil, the same action takes place for an instant. The abnormally great amount of heat applied to the filamentary electrode 12 causes it to become a good thermionic emitter, so that its emission exceeds that of the bimetal, and the condenser 19 charges up in the opposite direction.

Thus, even on the half cycle when the bimetallic electrode 10 is momentarily functioning as cathode, the voltage on the condenser 19 adds to the A. C. supply voltage so that the bimetallic electrode 10 heats very rapidly and the electrodes contact each other very quickly. The actual result is that the glow relay of the present invention, in contradistinction to previous types, operates more quickly on a leading power factor circuit than on a lagging power factor circuit, although its rapidity of operation even on a lagging power factor circuit is well within the standards now fixed by lamp manufacturers.

In addition to the glow relay of the present invention providing a predetermined time delay during one phase of its operation, the construction thereof also makes it possible to employ getters without affecting the break-down voltage of the device. Inasmuch as the filamentary tungsten electrode 12 is substantially at white heat due to the ensuing arc discharge, the hot tunsten reacts with some impurities in the filling gas and thereby serves as a getter. The tungsten coil also makes possible the use of more efficient getters, such as zirconium or tantalum, which require a high temperature to produce gettering. A small sliver or slug 20 of such materials may be inserted in the coil in the manner shown in Fig. 4, or the materials may be applied to the tungsten coil in the form of paint, as shown at 22 in Fig. 3, which eliminates the necessity of flashing the getter with high frequency while on the exhaust machine.

It should thus become obvious to those skilled in the art that a glow relay device is herein provided wherein the bimetallic electrode is heated very rapidly so that the relay very quickly performs its initial operating step. Also, due to the present construction, a predetermined time delay is provided which maintains the electrodes in contact with each other, thus enabling the filamentary electrodes of a discharge lamp to be heated to a sufficiently high temperature that a copious flow of electrons ensues prior to separation of the electrodes upon cooling of the bimetallic element. This accordingly eliminates the application of a high voltage surge to the lamp electrodes prior to their being heated to substantially maximum electron-emitting temperature, which would otherwise cause sputtering of the electrodes and thereby materially lessening the useful life of the lamp.

Although one specific embodiment of the present invention has been shown and described, it is to be understood that other modifications of the same may be made without departing from the spirit and scope of the appended claims.

I claim:

1. A gaseous electric device comprising an envelope provided with an ionizable medum therein and a pair of electrodes, one of which is a

thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode into contact with the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and means independent of said electrodes for heating said thermo-expansive electrode for a short period of time following engagement of said electrodes to impart a slight time delay in the separation thereof upon cooling of said thermo-expansive electrode.

2. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode into contact with the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and means associated with the other of said electrodes for transmitting heat to said thermo-expansive electrode for a short period of time following their engagement and after extinguishment of said discharge to impart a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode.

3. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode into contact with the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and said other electrode being of a metal which is heated by the discharge to a higher temperature than said thermo-expansive electrode and operable to transmit its heat to said thermo-expansive electrode after extinguishment of said discharge to cause a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode.

4. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode into contact with the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and said other electrode comprising a refractory metal winding and heated by the discharge to a higher temperature than said thermo-expansive electrode and operable to transmit its heat to said thermo-expansive electrode after extinguishment of said discharge to cause a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode.

5. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode and contact of an appreciable surface area thereof with a comparable surface area of the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and said other electrode having a surface area substantially less than said thermo-expansive electrode and heated by the discharge to a higher temperature than the latter and operable to transmit its heat through the contacting surfaces of appreciable area to said thermo-expansive electrode after extinguishment of said discharge to cause a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode.

6. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode into contact with an appreciable surface area of the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, and said other electrode comprising a refractory metal helix having a surface area substantially less than that of said thermo-expansive electrode and heated by the discharge to a higher temperature than said thermo-expansive electrode, and operable to transmit its heat through its contacting surface area to said thermo-expansive electrode after extinguishment of said discharge to cause a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode.

7. A gaseous electric device comprising an envelope provided with an ionizable medium therein and a pair of electrodes, one of which is a thermo-expansive electrode adapted to emit electrons to cause a glow discharge between said electrodes thereby heating the same with attendant movement of said thermo-expansive electrode and contact of an appreciable surface area thereof with a comparable surface area of the other of said electrodes to short-circuit the same and extinguish said discharge, and said thermo-expansive electrode being movable away from said other electrode upon cooling, said other electrode having a surface area substantially less than said thermo-expansive electrode and heated by the discharge to a higher temperature than the latter and operable to transmit its heat through the contacting surfaces of appreciable area to said thermo-expansive electrode after extinguishment of said discharge to cause a slight time delay in the separation of said electrodes upon cooling of said thermo-expansive electrode, and means associated with said electrodes within said envelope and operable as a getter for absorbing impurities in said filling gas.

ROBERT F. HAYS, JR.