

Jan. 13, 1942.

W. E. CARPENTER ET AL

2,269,843

GLOW RELAY

Filed June 1, 1940

Fig. 1.

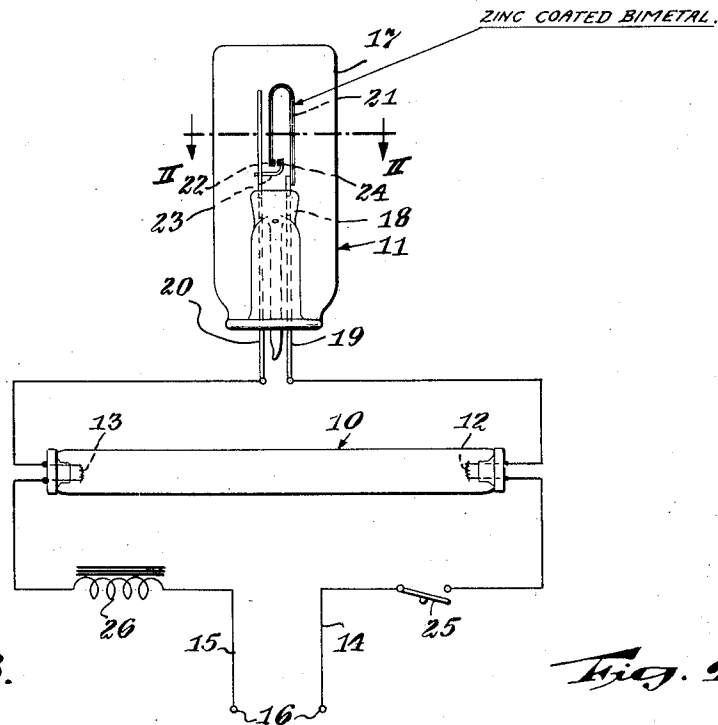


Fig. 3.

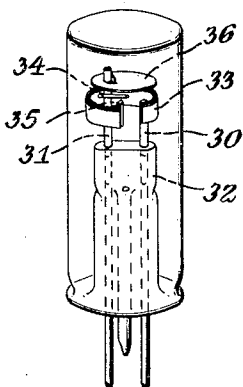


Fig. 2.

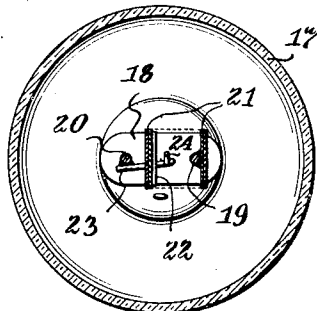
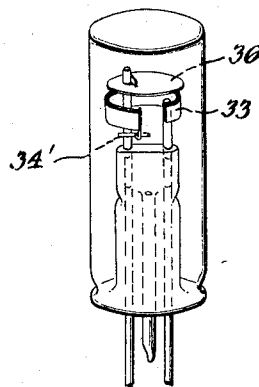


Fig. 4.



INVENTOR
D. S. GUSTIN
W. E. CARPENTER
R. F. HAYS, JR.
BY *John F. Newhouse*
ATTORNEY

UNITED STATES PATENT OFFICE

2,269,843

GLOW RELAY

Walter E. Carpenter, West Caldwell, and Daniel S. Gustin and Robert F. Hays, Jr., Bloomfield, N. J., assignors to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application June 1, 1940, Serial No. 338,358

9 Claims. (Cl. 250—27.5)

The present invention relates to a gaseous electric discharge device, and more particularly to what may be termed a no-power-loss relay for making and breaking an electric circuit. In particular, our invention is an improvement over the no-power-loss relay described in the co-pending application of Edward C. Dench, Serial No. 242,927, filed November 29, 1938. This type of device has many uses, but it is especially applicable to the starting of a gaseous discharge lamp. In lamps of the discharge type it is customary to employ electrodes of the thermionic type and to connect such electrodes in series with a suitable source of supply through the medium of suitable switching means. It is highly desirable in a circuit for such discharge lamps that the relay device which operates to open and close the circuit not only be positive in its operation, but at the same time consume no power from the circuit which is otherwise supplied to the lamp. A relay of this type is shown and described in the above noted application, and the present invention constitutes an improvement of such a device. This discharge relay has been especially utilized in connection with the starting of fluorescent lamps. It is important that switches for use with these lamps will always have a break-down voltage within certain desired limits. Fluorescent lamps of 36 inches length and 48 inches length operate on 220 commercial volt lines. The normal lamp voltage is 105 to 110. It is desirable that switches for use with such lamps have a break-down voltage between 130 and 180 volts.

It is an object of our invention to provide an improved relay discharge device that will have a break-down voltage within the desired limits.

Another object of our invention is to provide quicker and more dependable seasoning of the electrodes.

Another object of the invention is to eliminate undesirable photo-sensitivity.

Other objects and advantages of the invention will be apparent from the following description and drawing, in which:

Fig. 1 is a view partly in elevation and partly diagrammatic of our no-power-loss relay applied to a fluorescent lamp.

Fig. 2 is an enlarged cross-section on lines II—II of Fig. 1.

Figs. 3 and 4 are modifications of the relay in Fig. 1.

In Fig. 1, we have disclosed the gaseous discharge device 10, which, in this particular illustration, is a fluorescent lamp on a very small

scale and a starting relay or electronic switch 11 on a much enlarged scale. The discharge device has the two thermionic or filamentary electrodes 12 and 13 which are generally of tungsten coated with an oxide of barium and strontium to provide a copious supply of electrons when heated. These filamentary electrodes have connections 14 and 15 to any suitable source of electric energy 16, such as a 220 volt alternating current. It is desirable that the filamentary electrodes be heated up before the discharge starts through the lamp, and for this purpose the electronic switch or relay 11 connects two terminals of the electrodes in series to provide a path for the heating current through both of the electrodes. This relay in its preferred embodiment comprises a glass envelope 17 with a reentrant press 18 and two conductors 19 and 20 sealed through the press. To one of these conductors 19 a curved bimetallic element 21 preferably in the form of a U has a contact 22 on its free outer end. The bimetal has its layer of lower expansion metal on the inner or under side and the layer of higher expansion material on the outer or upper side so that additional heat will make the bimetal curve still more. While various combinations of metals may be used for the bimetal, such as nickel and molybdenum, we prefer to use nickel steel of approximately 36% nickel and the rest steel for the lower expansion metal and chromium nickel steel for the higher expansion metal. A contact bar 23 with a contact point 24 thereon is secured to the other electrode 20 with the contact point 24 in the path of movement of the free end of the bimetal when heat is applied to the bimetal. The bimetal in this embodiment tends to close the ends of the U when heat is applied thereto. The glass container is filled with a gaseous medium.

When the switch 25 is closed the heating current will pass through the electrode 12 and across the small discharge space from the bimetal 21 to the other electrode 23 of the gaseous relay 11 and then through the other electrode 13 of the fluorescent lamp 10. The discharge between the bimetal and contact bar 23 will heat up the bimetal and bend it into making contact with the contact bar 23. The discharge will then stop due to this short circuit of the electrodes and the bimetal will cool and then pull out of contact with the contact bar 23. This breaking of the contact will interrupt the series connection of the two electrodes. In one of the connections such as 15, to the lamp is a reactor 26. When the relay 11 breaks the circuit between the electrodes, an

inductive kick or voltage surge is applied to the electrodes from this reactor 26 and this voltage surge will break down the gaseous medium between the electrodes of the fluorescent lamp and start the lamp. With the initiation of the discharge in the lamp 10 there will be no passage of current through the relay 11, because the bimetal has assumed its unheated position as illustrated in Fig. 1, with a gap between the contact points 22 and 24. This is because the operating voltage of the fluorescent lamp is lower than the break down voltage of the switch.

We have found that relays constructed according to Fig. 1 have not always been positive in operation, and sometimes delay the starting of the lamp. We believe this is because the immediate starting of the relay in such cases would require more than the desired 180 volts normally applied to the electrodes of the relay. It is, accordingly, one of the objects of our invention to insure the positive action of the relay in starting the fluorescent lamp with a break-down voltage of anywhere from 130 to 180 volts applied to the relay. In particular, we have accomplished this result by applying a coating of a low work function material to the bimetal of the relay. The coating materials that we desire are those having a work function of between 3 and 4 and preferably approximately 3.5. These materials are zinc, thorium and hafnium. The utilization of these materials gives the proper work function so that the relay will operate between the desired limits of 130 and 180 volts especially when used in combination with helium or helium and argon. Of these three, however, thorium and hafnium are rather expensive and difficult to apply, and so we especially desire to utilize zinc as a coating for the bimetal. This coating can be applied by electro-plating a heavy coat on the bimetal. The bimetal could also be dipped or otherwise applied thereto. The other electrode, such as a bar 23, is also preferably coated with zinc.

We have found, however, that there was a variation in the operation of the relay when tested immediately after assembly and when enclosed in the container with the transformer and reactor. We discovered that this variation was due to a photo-electric effect that produced undesired electrons when the relay was tested in the light immediately after assembly. These relays generally had a medium of helium or neon-helium therein. We accordingly inserted a very small amount of argon in the helium or neon-helium. The percentage of argon ranges from a trace to .1% of the gaseous medium. During the seasoning process of the relay, the argon will bombard the zinc coating and clean up the surface of the zinc of particles that would normally tend to make the relay photo-sensitive. This particular amount of argon helps maintain the break-down voltage of the switches to a range between 130 and 180 volts on 60 cycle alternating current, as well as eliminating undesirable photo-sensitivity in the device.

In Fig. 3 and 4 we disclosed two modifications in which the electrodes of the switch are electrically balanced. It will be noted that in Fig. 1, the bimetal electrode 21 has a large area and the contact bar 23 a very small area. Undesirable rectification may sometimes occur due to the disproportionate size of these two electrodes. In Fig. 3 we have disclosed the relay switch 11 having two conductors 30 and 31 extending through the press 32. The curved bimetal 33 is connected to the conductor 30, but this bimetal is preferably

arranged in a horizontal plane. The other conductor 31 has a contact bar 34 attached thereto in the path of the contraction of the bimetal under the application of the discharge. The bimetal has a contact bar 35 attached to its free movable end. In order to electrically counter-balance the two electrodes, we preferably attach a disc 36 to the conductor 31 and this disc is of such an area as to substantially equalize the area of the bimetal exposed for a discharge area. By means of this construction, there will be no rectification of current because of the disproportionate size of the two electrodes.

In Fig. 4 we have disclosed the contact bar 34' extending in horizontal plane below the bimetal 33 and the disc 36 extending in a horizontal plane above the bimetal. The disc passes sufficient glow discharge current so that the transient is kept within reasonable limits.

The gaseous medium, as previously mentioned, is helium and this helium is from 40 to 150 millimeters of mercury pressure, and preferably 100 millimeters of pressure. This gaseous medium may have from 1% to 5% neon in the helium, and preferably 1%. The argon may be from .001% to .1% of the total, and is preferably .01% in either the helium or the helium-neon medium.

It is apparent that many modifications may be made in the form, number and arrangement and application of the various elements on the preferred embodiments illustrated herein, and accordingly we desire only such limitations to be imposed upon our invention as are necessitated by the spirit and scope of the following claims.

We claim:

1. A gaseous electric discharge device, comprising a container provided with an ionizable medium therein, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge, said electrode adapted to emit electrons being coated with a metal having a work function between 3 and 4.

2. A gaseous electric discharge device, comprising a container provided with an ionizable medium therein, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge, said electrode adapted to emit electrons being coated with zinc.

3. A gaseous electric discharge device comprising a container, provided with an ionizable medium therein, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge, said ionizable medium having a percentage of argon from a trace to .1% of said medium thereby maintaining break-down voltage over a greater range of

variation of the ionizable medium pressure and distance of electrode separation.

4. A gaseous electric discharge device comprising a container provided with an ionization medium therein, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge, said electrode adapted to emit electrons, being coated with zinc and said ionizable medium having a trace to .1% argon therein.

5. A gaseous electric discharge device comprising a container provided with helium at a pressure of 40 to 150 millimeters of mercury, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge.

6. A gaseous electric discharge device comprising a container provided with helium with 1% to 5% neon therein, said gases being at a pressure of 40 to 150 millimeters of mercury, electrodes disposed within said container, one of said electrodes being adapted to emit electrons and between which electrodes a discharge occurs upon the application of a potential thereto, one

of said electrodes being a bimetallic element adapted to be heated by the ensuing discharge and engageable with the remaining electrode to short-circuit the discharge path and extinguish the discharge.

7. A gaseous electric discharge device having electrodes of which one is a bimetallic electrode, a sealed container enclosing said electrodes, said container having a preponderance of helium gas filling the same, and having a fraction of one per cent of argon with the helium, said argon for serving to bombard and clean up one element of said bimetallic electrode of substance that would normally tend to make the device unduly photo-sensitive.

8. A gaseous electric discharge device having electrodes of which one is a bimetallic electrode, a sealed container enclosing said electrodes, said container having a preponderance of helium gas filling the same, and having substantially one-tenth of one per cent of argon with the helium for beneficially aiding in maintaining break-down voltage over a greater range of variation of gas pressure and electrode spacing.

9. A gaseous electric discharge device having mounted, spaced electrodes of which one is a bimetallic electrode, a sealed container enclosing said electrodes, said container having a rare-gas content under pressure, and another rare-gas in small amount of a fraction of one per cent in said container and having counteracting effect to photo-sensitivity of the bimetallic electrode.

WALTER E. CARPENTER.
DANIEL S. GUSTIN.
ROBERT F. HAYS, JR.