March 21, 1944. C. H. HODGKINS 2,344,774

STARTING AND OPERATING CIRCUIT FOR DISCHARGE LAMPS

Filed June 24, 1942

Fig. 1.

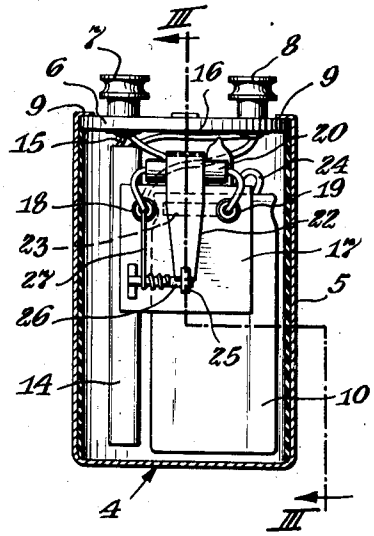


Fig. 2.

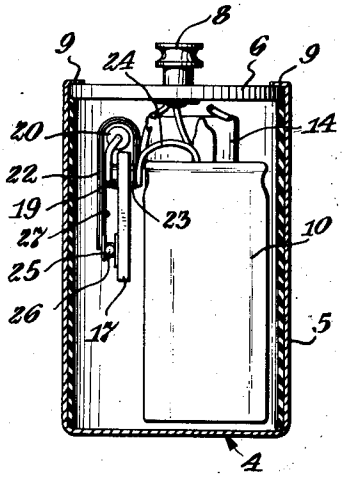


Fig. 3.

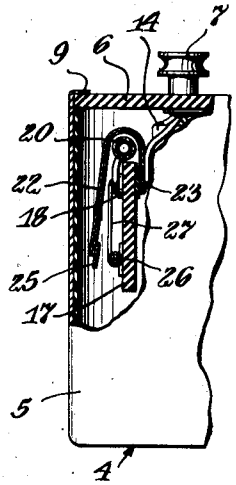


Fig. 4.

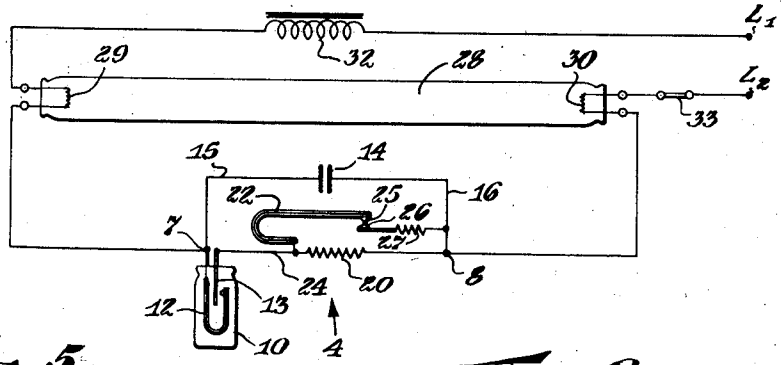


Fig. 5.

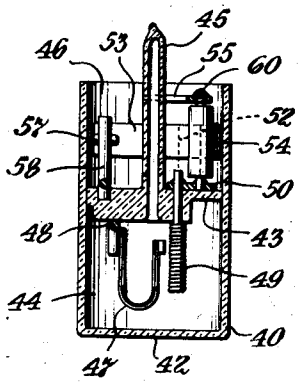
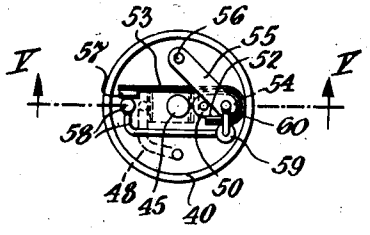


Fig. 6.



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STARTING AND OPERATING CIRCUIT FOR DISCHARGE LAMPS

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4 Claims. (Cl. 315—100)

The present invention relates to gaseous discharge lamps and particularly to the starting and operating of such lamps of the fluorescent type from the usual source of electrical energy of the customary domestic potential.

It is customary with lamps of this type to connect the filamentary electrodes in series with an inductance element across the domestic source of supply and a relay device, such as shown in Patent 2,200,443, issued May 14, 1940, to E. C. Dench, is employed to first connect the filamentary electrodes in a series heating circuit to raise the temperature thereof to electron emissivity, after which the relay operates to interrupt the series heating circuit and causes a high voltage surge from the series connected inductance, which thus initiates a discharge between the preheated electrodes.

The difficulty with such circuit arrangement resides in the fact that if the discharge lamp becomes defective and the discharge accordingly fails to start for any reason, the relay continues to operate indefinitely, thus not only shortening its useful life but since it repeatedly completes and interrupts the series heating circuit for the filamentary lamp electrodes, the latter will continuously glow and constitute a source of annoyance to the user because of the low efficiency of the radiation thus produced which is a waste of electrical energy.

It is accordingly an object of the present invention to provide a starting and operating arrangement for a gaseous discharge lamp wherein a relay unit is employed to initiate a discharge in the lamp while consuming no energy during operation of the latter, and which relay unit operates to prevent glowing of the lamp electrodes by "locking-out" the lamp in the event a discharge is not initiated therein after several operations of the relay.

Another object of the present invention is the provision of a relay unit for starting and operating a gaseous discharge lamp which can be readily inserted in the socket for the lamp and is operable to initiate a discharge in the latter while consuming no energy once such discharge is started, but in the event the lamp becomes defective, the relay operates to "lock-out" the lamp.

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 a sectional view in elevation of the relay unit of the present invention and showing the relative arrangement of the various parts;

Fig. 2 is a view similar to that of Fig. 1 but taken at 90° to the latter;

Fig. 3 is a sectional view taken on the line III—III of Fig. 1;

Fig. 4 is a diagrammatic illustration of the starting and operating circuit of the present invention and employing the relay unit as shown in the preceding figures;

Fig. 5 is a sectional view taken on the line V—V of Fig. 6 and showing a modification which the relay unit of the present invention may take, and

Fig. 6 is a top plan view of the modification as shown in Fig. 5.

Referring now to the drawing in detail, the relay unit 4 shown in Fig. 1 comprises a casing 5 of a plastic material or light metal permanently closed at one end and having its other end closed by an insulated cap 6 provided with a pair of socket terminals 7 and 8 and held in place as by bent lugs 9 protruding from the casing 5.

Disposed within this casing is a glow switch 10 of the type shown in Patent 2,228,210, issued January 7, 1941, to R. F. Hays, Jr., comprising a vitreous envelope provided with an ionizable medium at a suitable pressure and having a pair of electrodes 12 and 13, one of which 12 is a bimetallic element, as shown more clearly in Figs. 4 and 5. A radio frequency-suppressing condenser 14 is also housed within the casing 5 and is connected directly to the socket terminals 7 and 8 by conductors 15 and 16. In addition a thermal relay is supported within the casing 5 which comprises a base of insulating material 17. A pair of metallic eyelets or the like 18 and 19 pass through this base 17 and a high ohmic resistance heater 20 has its ends connected to these eyelets 18 and 19 which positions the heater 20 a little above the insulated base 17.

Partially surrounding this heater 20 is a heat-responsive element in the form of a substantially U-shaped bimetallic member 22 having its shorter rear leg secured to a conducting strip 23 disposed on the back of the base 17 and extending horizontally part way thereacross, and from which a conductor 24 extends to one of the electrodes 12' of the glow switch 10. The free depending end of the bimetallic element 22 is provided with a contact 25 normally engaging a metallic contact member 26. This latter contact 26 is arranged in heat transfer relationship

with a series resistance heater 27 to which one end of the latter is connected, while the remaining end of the heater 27 is connected to the eyelet 18 and hence to the socket terminal 8 as well as to one side of the condenser 14.

By reference now more particularly to Fig. 4, the circuit arrangement utilizing the relay unit above described is schematically illustrated. As therein shown a discharge lamp 28 which may be of the well known fluorescent type is provided with a pair of filamentary electrodes 29 and 30. One end of the electrode 29 is connected through an inductance or choke coil 32 to one side of a domestic source of supply L1 of the customary domestic potential of 115–230 volts. In a similar manner, one end of the electrode 30 is connected through a switch 33 to the other side of the supply source L2 with the remaining ends of the electrodes 29 and 30 being connected together to thus form a series heating circuit therefor, by the relay unit 4.

Upon closure of the switch 33, the full voltage of the supply source L1—L2 will be impressed across the electrodes 12 and 13 of the glow switch 10 by a circuit which extends from one side of the supply source L1 through electrode 29 to socket terminal 7, thence to bimetallic electrode 12, and from electrode 13 through bimetallic member 22, contacts 25 and 26, series resistance heater 27, to socket terminal 8 and thence through lamp electrode 30 and switch 33 back to the other side of the supply source L2. The condenser 14 is in electrical parallel with the glow switch 10 as well as the thermal relay, while the high ohmic resistance 20 is short-circuited by the normally closed contacts 25 and 26.

This supply voltage is sufficiently high to cause a glow discharge to take place in the glow switch 10 which rapidly heats the bimetallic electrode 12, causing it to deflect into engagement with the stationary electrode 13, thereby completing a series heating circuit for the lamp electrodes 29 and 30. By the time these electrodes have reached electron-emitting temperature, the bimetallic electrode 12 of the glow switch 10 will have cooled and will return to its normal position. At the instant of separation of the electrodes 12 and 13, a high voltage surge will be impressed across the preheated filamentary lamp electrodes 29 and 30, thus initiating a discharge in the lamp. If for any reason the discharge is not initiated upon the first completion of the cyclic operation of the glow relay 10, the latter will continue repetitious operation due to application of the supply voltage thereto until the lamp 28 is in operation. Moreover, during operation of the lamp the relay unit 4 consumes no energy since the voltage drop across the lamp is below that necessary to again reestablish a glow discharge in the glow switch 10.

The operation of the circuit as shown in Fig. 4 and thus far described differs in no way from that as shown and described in the above noted Patent 2,228,210 to R. F. Hays, Jr. However, as above noted, such an arrangement possesses the disadvantage that should the lamp fail to start due to deactivation of its filamentary electrodes or similar cause, the glow relay will continue to go through its cyclic operation, causing repeated glow of the lamp electrodes with material shortening of the useful life of the glow switch.

In the circuit arrangement of the present invention such disadvantage is eliminated by the provision of the relay unit as above described. For example, if the lamp 28 fails to start after a few cyclic operations of the glow switch 10, the series resistance heater 27 continues to build up heat with each operation of the glow switch 10 until sufficient heat is developed which is transferred to contact 26 and thence by conduction to the bimetallic member 22, to cause the free end thereof to deflect away from the base 17 and interrupt the normal engagement of the contacts 25 and 26. This deflection of the bimetallic member 22 thus disconnects the series heater 27 from the circuit and at the same time removes the former short-circuit from the high ohmic resistance heater 20, thus placing the latter in series with the glow switch 10.

Although the high omhic resistance heater 20 will thus be in the circuit, its characteristics are such that the current is limited to a value where a very low current glow discharge results in the glow switch 10 which is insufficient to heat the bimetallic electrode 12 enough to cause it to deflect into engagement with the stationary electrode 13. At the same time the high ohmic resistance heater 20 supplies sufficient heat to maintain the contacts 25 and 26 in an open circuit position which thus "locks-out" the defective lamp, preventing unnecessary and futile repetitious operation of the glow switch 10, thereby preserving its useful life and at the same time eliminating glowing of the lamp electrodes 29 and 30. Upon replacement of the defective lamp, the relay unit returns to its normal position ready to operate in the manner above described to start the new lamp.

In Figs. 5 and 6 a modification of the relay unit 4 is shown which differs from that previously described merely in positioning of the various parts (with the exception of the condenser 14) in a single vitreous envelope. By reference to these latter figures it will be noted that a vitreous envelope 40, closed at one end 42, is provided with a partition 43, also of the same vitreous material as the envelope 40, which is hermetically sealed to the interior of the envelope. As viewed from Fig. 5, two chambers are thus formed, the lower chamber 44 being evacuated and then filled with a suitable gas through an exhaust stem 45, while the upper chamber 46 may be open to the atmosphere.

A U-shaped bimetallic electrode 47 is supported upon a leading-in and supporting conductor 48 extending to the socket terminal 7 and corresponds to the bimetallic electrode 12. A stationary electrode 49 is likewise disposed in the hermetically sealed chamber 44 and extends through the partition 43 where it is secured to a short connecting strap 50 with an upstanding projection 52 which is connected to a U-shaped bimetallic member 53 corresponding to the member 22 previously described relative to the preceding modification. A high ohmic resistance heater 54 likewise has one of its ends connected to the strap 50, while its other end is connected to a similar strap 55 extending to a leading-in conductor 56 which connects to the socket terminal 8.

Again the free end of the bimetallic member 53 is provided with a contact 57 normally engaging a contact 58 embedded in the partition 43 and in electrical heat transfer relation to a series resistance heater 59 to which one end of the heater is electrically connected as in the previously described modification. Also, the remaining end of the series resistance heater is connected by a conductor 60 to the strap 55 which thus completely connects all of the various elements of the modification of Figs. 5 and 6 in the

identical relationship as shown in the circuit arrangement of Fig. 4, so that either the modification of Figs. 1–3 or that of Figs. 5–6 can be readily inserted in a socket, since the latter construction is likewise housed within the casing 5 together with the condenser 14.

It thus becomes obvious to those skilled in the art that a simple yet efficient circuit arrangement is provided by the present invention wherein a relay unit is employed for the starting and operating of a discharge lamp, particularly of the fluorescent type, which relay consumes no energy during operation of the lamp. Moreover, when the lamp becomes defective and will accordingly not start after a predetermined period of time following initial operation of the relay unit, the latter automatically operates to "lock-out" the defective lamp and effectively disconnect the same from the source, thereby preserving the useful life of the relay unit and at the same time eliminating the former annoyance of continued glowing of the electrodes of the defective lamp.

Although several embodiments of the present invention have been shown and described, it is to be understood that still further modifications of the present invention may be made without departing from the spirit and scope of the appended claims.

I claim:

1. In combination, a gaseous electric discharge lamp containing at least one thermionic cathode and a cooperating electrode, and a starting and operating circuit therefor comprising an inductance, means connecting one end of said thermionic cathode and said cooperating electrode across the terminals of a current source in series with said inductance, and a relay device connected across the opposite end of said thermionic cathode and said electrode for initiating a discharge in said lamp and for locking-out said lamp in the event the same becomes defective comprising a glow discharge device operable to initiate a discharge in said lamp, a relay including actuating means connected in series with said glow discharge device and a pair of normally closed contacts for completing a circuit to said actuating means and to said glow discharge device, and operable by said actuating means upon continued operation of said glow discharge device for a predetermined period of time to cause opening of said contacts; and current limiting means connected in electrical series with said glow discharge device by opening of said contacts and operable to maintain the same in an open position and to limit the current supplied to said glow discharge device to a value insufficient to cause the same to operate in a futile attempt to initiate a discharge in said lamp when the latter becomes defective.

2. In combination, a gaseous electric discharge lamp containing at least one thermionic cathode and a cooperating electrode, and a starting and operating circuit therefor comprising an inductance, means connecting one end of said thermionic cathode and said cooperating electrode across the terminals of a current source in series with said inductance, and a relay device connected across the opposite end of said thermionic cathode and said electrode for initiating a discharge in said lamp and for locking-out said lamp in the event the same becomes defective comprising a glow discharge device operable to initiate a discharge in said lamp, a relay including a bimetallic element and a resistance heater therefor together with a pair of normally closed contacts for completing a circuit to said resistance heater and to said glow discharge device, and operable by said resistance heater upon continued operation of said glow discharge device for a predetermined period of time to cause opening of said contacts; and current limiting means connected in electrical series with said glow discharge device by opening of said contacts and operable to maintain the same in an open position and to limit the current supplied to said glow discharge device to a value insufficient to cause the same to operate in a futile attempt to initiate a discharge in said lamp when the latter becomes defective.

3. In combination, a gaseous electric discharge lamp containing at least one thermionic cathode and a cooperating electrode, and a starting and operating circuit therefor comprising an inductance, means connecting one end of said thermionic cathode and said cooperating electrode across the terminals of a current source in series with said inductance, and a relay device connected across the opposite end of said thermionic cathode and said electrode for initiating a discharge in said lamp and for locking-out said lamp in the event the same becomes defective comprising a glow discharge device operable to initiate a discharge in said lamp, a thermal relay including a resistance heater element in series with said glow discharge device and a pair of normally closed contacts and operable upon continued operation of said glow discharge device for a predetermined period of time to heat said thermal relay and cause opening of said contacts with interruption of the circuit to said glow discharge device, and a high ohmic resistance heater connected in series with said glow discharge device by opening of said contacts and operable to maintain said contacts in an open position and to limit the current supplied to said glow discharge device to a value insufficient to cause the latter to affect said lamp in the event the same becomes defective.

4. In combination, a gaseous electric discharge lamp containing at least one thermionic cathode and a cooperating electrode, and a starting and operating circuit therefor comprising an inductance, means connecting one end of said thermionic cathode and said cooperating electrode across the terminals of a current source in series with said inductance, and a relay device connected across the opposite end of said thermionic cathode and said electrode for causing the initiation of a discharge in said lamp and for locking-out said lamp in the event the same becomes defective comprising a glow switch provided with electrodes one of which is a bimetallic element adapted to be heated by the ensuing glow discharge upon the application of the voltage of said current source therebetween, said bimetallic electrode being operable to deflect into engagement with the other electrode of said glow switch to complete a series heating circuit for said thermionic cathods and to extinguish said glow discharge and operable upon cooling thereof to interrupt said series heating circuit and cause a high voltage surge from said inductance across the electrodes of said lamp with attendant initiation of a discharge therebetween, and a thermal relay comprising a heat-responsive member normally closing a pair of contacts and a resistance heater element included in said series heating circuit and operable upon repetitious operation of said glow switch for a predetermined pe-

riod of time to heat said heat-responsive member and cause opening of said normally closed contacts and disconnection of said resistance heater element from said circuit, and a high ohmic resistance heater element connected in series heating circuit by opening of said normally closed contacts and operable to heat said heat-responsive element and maintain said contacts in an open position, and said high ohmic resistance heater element being operable to limit the current in said series heating circuit to a value below that normally required to cause the resulting glow discharge to heat the bimetallic electrode of said glow switch sufficiently to cause deflection thereof into contact with the remaining electrode, in the event said discharge lamp becomes defective.

CHARLES H. HODGKINS.