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START CONTROL DEVICE FOR FLUORESCENT LAMPS

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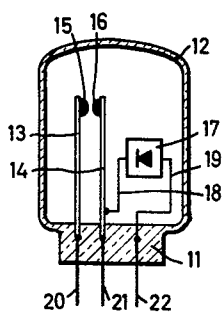
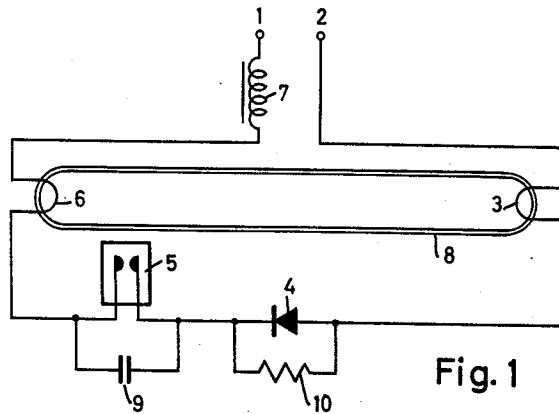


Fig. 2

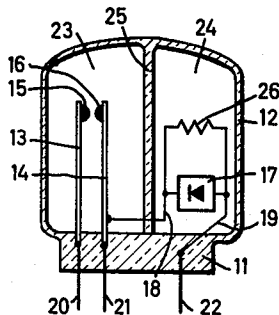


Fig. 3

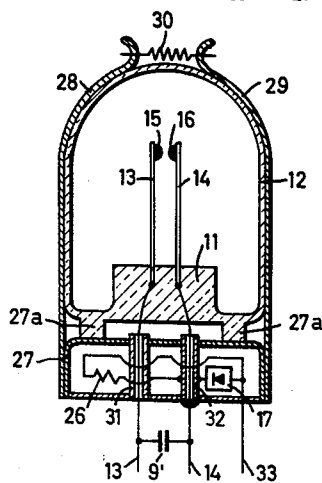


Fig. 4

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14 Claims. (Cl. 315—100)

My invention relates to a start control device for fluorescent lamps, particularly those of the hot-cathode type, and will be described hereinafter with reference to the drawings, in which

Fig. 1 is an explanatory circuit diagram for operating a fluorescent-lamp, including a starter circuit; and

Figs. 2, 3 and 4 are sectional and partly schematic views of three respective starter devices embodying the invention proper.

It has been proposed to operate fluorescent lamps with a starter circuit in which a rectifier diode is connected in series with a conventionally employed glow-type starter for more rapidly starting the lamp. The circuit diagram of Fig. 1 is of this type. Denoted by 1 and 2 are the two terminals of a lighting fixture to be connected to an alternating-current line. When the line voltage is switched on, the current passes from terminal 2 through the heater-filament electrode 3 of the fluorescent lamp 8, then serially through a rectifier diode 4 in the forward direction and through the glow discharge gap of a starter switch 5, then through the heater-filament electrode 6 and an inductive ballast 7 to the terminal 1. Due to the diode rectifier 4 in series with the starter switch 5, the inductive ballast 7 is not traversed by alternating current but conducts half-wave current which reduces the voltage drop across the ballast 7 in comparison with the voltage drop occurring if an alternating voltage were impressed upon the ballast. This is because the half-wave current flowing through diode 4 and the inductive ballast 7 have an essential direct-current component, so that the iron core of the ballast coil is constantly pre-magnetized a given amount, and the ballast, therefore, cannot carry as large a voltage as with alternating current.

The operation of the fixture is otherwise conventional. That is, when voltage is applied to terminals 1, 2 so that current passes through the heated electrodes 3, 6 and the glow discharge gap of starter switch 5, the bi-metal members of switch 5 becomes heated and the normally separated contacts enter into contact with each other. This causes a correspondingly stronger current to flow through the heater helices 3 and 6 whereby the discharge gap in the tubular lamp is pre-ionized to a great extent. The closing of the contact in starter switch 5 eliminates the glow discharge. Hence the heating of the bi-metal members ceases so that they cool gradually and have the increasing tendency to again open the closed contacts. The resulting separation of the contacts instantaneously interrupts the flow of current in the starter circuit. This produces at the inductive ballast coil 7 a corresponding voltage peak

$$L \frac{di}{dt}$$

which ignites the discharge between the two electrodes 3 and 6 of the fluorescent lamp, whereafter the lamp continues burning.

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The illustrated circuit also contains a capacitor 9 in parallel to the contacts of the starter switch 5, serving essentially for elimination of radio interference. In addition, an ohmic resistor 10 is connected parallel to the diode 4. This resistor has a thermo-negative resistance characteristic (thermistor) for current-limiting purposes. If trouble occurs in the starter circuit, for example if the contacts of the starter switch 5 when initiating the ignition of the fluorescent lamp remain closed beyond the normal interval of time, such prolonged closure may cause damage to the installation because then the inductive ballast 7 can carry an only small proportion of the voltage as long as the rectifier diode is effective and hence, in this condition, cannot sufficiently limit the current in the starter circuit. The ballast, therefore, may be traversed continuously by an excessive amount of current which causes a detrimentally great amount of heating. However, the large continuous current also causes heating of the protective resistor 10 which then, by virtue of its temperature-dependent resistance and negative temperature coefficient, increasingly forms a shunt for the diode 4 acting in the inverse direction of the diode. As a result, a practically pure alternating current will eventually flow through the ballast 7, thus increasing its inductive impedance which reduces the current to a harmless value.

It is an object of my invention to considerably simplify the design of a fluorescent lamp installation of the above-mentioned type, and to also simplify the assembling of such installation or fixture or the replacing of faulty components.

To this end, and in accordance with my invention, the starter switch and the rectifier diode are disposed in the circuit, not as spacially independent components, but in combined form, constituting a single unit or starter plug which occupies only slight total space and can be accommodated as a single wiring component on or in the lighting fixture or in the socket assembly for such fixture, if desired together with the thermistor in parallel to the rectifier and together with the capacitor in parallel to the starter switch proper. As a result, the expenditure and time involved in mounting and installing a fluorescent lighting fixture are reduced, and a number of further advantages are afforded toward simplification in the design of the auxiliary components and/or the facility with which the circuit can be completed or repaired.

According to a more specific feature of my invention, the rectifier diode, if desired together with the parallel thermistor, constitutes an individually independent component or subassembly and has its own housing adapted to be mechanically joined with the starter switch to form therewith a single composite unit that can be inserted as a whole into the circuit or lighting fixture. In such a device, the rectifier subassembly is preferably provided with channels for passing therethrough the connecting wires leading to the starter switch subassembly or to special contacts or terminals thereof. For example, a connecting wire of the starter switch may be stuck through such a channel of the rectifier subassembly to be connected in that channel to an electric terminal contact of the diode enclosed in the rectifier housing and to the parallel resistor, if the latter is enclosed in the same housing. Such a channel may be formed by a metal sleeve to which the parts enclosed within the rectifier housing are electrically connected. One or more connecting wires may extend from these enclosed components directly to the outside, or they may be connected to particular terminal contacts of the rectifier housing.

The parallel capacitor for the starter switch may likewise form a structural unit or subassembly which can be put together with the starter switch to form a single

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composite unit. However, according to an alternative feature of the invention, the parallel capacitor for the starter switch is combined with the rectifier and its parallel resistor to form a single structural subassembly together therewith. It is then only necessary to simply connect the starter subassembly and the composite rectifier subassembly, and to permanently join these two by soldering or clamping, in order to obtain a single component ready to be built into the lighting fixture.

According to still another feature of my invention, the rectifier element is disposed in the same housing that accommodates the starter switch. In this case, the rectifier element may be built into the same gas space as the starter switch, provided the type of rectifier is so chosen that no glow discharge can take place between its electrodes or at its p-n junction. For this purpose, the p-n junction, where it emerges at the surface of the semiconductor body of the diode, for example a silicon rectifier, may be provided with a suitable protective coating of varnish or other insulating material to prevent glow discharge.

According to still another feature of my invention, the housing of the starter switch contains an additional enclosed chamber for accommodating the rectifier element. If desired, the additional chamber may be filled with a protective gas, for example nitrogen, for increasing the service life of the rectifier element. The same additional chamber may enclose the parallel thermistor for the rectifier diode.

Embodiments of start control devices according to the invention will be described with reference to Figs. 2, 3 and 4 of the drawings, representing three such devices by way of example.

According to Fig. 2, the same gas space that contains the starter switch also encloses the diode rectifier according to the circuit diagram of Fig. 1. Denoted by 11 is an insulating mounting base of the device, and by 12 a cup-shaped housing, for example of glass, which forms an envelope for the gas space together with the base 11. The starter switch comprises two bi-metal legs 13, 14 which carry respective contacts 15 and 16. Mounted in the gas space is a rectifier element 17, shown only schematically, which is connected into the circuit by means of two connecting wires 18 and 19. Three connecting wires 20, 21 and 22 lead from the enclosed components to the outside of the housing, although these leads may also be connected to terminal contacts, for example, plug rings fastened to the mounting base 11. The unit thus formed comprises a series connection of the starter switch 5 and the rectifier diode 4 in accordance with the circuit diagram shown in Fig. 1.

In the embodiment illustrated in Fig. 3, the mounting base 11 of the starter device is fused or otherwise joined with the enclosing envelope 12. The space sealed within the envelope is subdivided by a gas-tight partition 25 into two chambers 23 and 24. Chamber 23 accommodates the above-described parts 13 to 16 of the starter switch, the reference numerals being in accordance with those used in Fig. 2 for respectively similar elements. Mounted in chamber 24 are the diode element 17 and a thermistor 26 in parallel to the diode. The diode and thermistor are connected to wires 18 and 19. The chamber 23 may be given a gaseous atmosphere particularly desired for the gas discharge between the contacts of the starter switch, whereas the chamber 24 is preferably provided with a different atmosphere, such as nitrogen, acting as a protective gas for the rectifier element 17. Three connecting wires 20, 21 and 22 pass from the enclosed components through the mounting base 11 to the outside for connection of the unit into the fluorescent-lamp starter circuit.

In the starter device shown in Fig. 4, the rectifier 4 together with the parallel connected thermistor forms an independent subassembly which is put together with the starter subassembly to form a single unit therewith.

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The housing of the rectifier subassembly is denoted by 27. Two spring bodies 28, 29 are firmly attached to the housing 27 at the outer periphery. The upper ends of the two spring bodies 28, 29 are U-shaped so that they can readily be shoved over the housing 12 of the starter switch subassembly. The over-all shape of the two spring bodies is adapted to the contour of the housing 12 when the subassembly housing 27 and the housing 12 are ultimately joined with each other. If desired, a mechanical connection can be provided between the free ends of the spring bodies for improved reliability of the connection. This is done in the illustrated embodiment by providing a pull spring 30 between the respective ends of springs 28 and 29.

The top wall of housing 27 abuts against projections 27a of the starter housing 12. Located in the interior of housing 27 are the rectifier element and the thermistor 26, both shown schematically. The rectifier housing 27 is provided with two through-channels formed of respective sleeves 31 and 32 that are traversed by the respective connecting wires 13 and 14 of the starter switch. The sleeve 31 consists of insulating material. The sleeve 32 consists of metal. The rectifier element 17 enclosed in housing 27 and the likewise enclosed thermistor 26 have one of their respective terminals electrically connected with the metal sleeve 32. The sleeve 32 is electrically connected with the connecting wire 14 of the starter switch by means of a soldered joint located at the lower end of sleeve 32. Another connecting wire 33 extends out of housing 27 and is connected to the second terminal of the rectifier element 17 and to the second terminal of the thermistor 26 within the housing 27.

In analogy to the circuit diagram of Fig. 1, a capacitor 9' is connected across the gap of the starter switch. If desired, the capacitor 9' can be designed as an individual subassembly to be joined with the composite device mechanically and electrically to form a single unit therewith.

It will be obvious to those skilled in the art that with respect to details of design and arrangement, a starter device according to my invention can be modified in various respects and hence may be embodied in devices other than particularly illustrated and described herein, without departing from the essential features of my invention and within the scope of the claims annexed hereto.

I claim:

1. A control device for fluorescent-lamp starting circuits, comprising a glow-discharge switch thermo-responsive for closing its contacts due to heating by glow discharge, a rectifier diode connected in series with said switch, said switch and said rectifier being joined together to form a single structural unit, and said unit having external electric connection means electrically interconnecting said switch and said rectifier and adapted for connecting said unit as a whole into the lamp starting circuit.

2. A control device for fluorescent-lamp starting circuits, comprising a glow-discharge switch thermo-responsive for closing its contacts due to heating by glow discharge, a rectifier diode connected in series with said switch, an envelope structure in which both said switch and said diode are mounted to form a single structural wiring component, and electric circuit connections interconnecting said switch and said diode within said envelope structure and extending to the outside for connecting said component as a single unit into the lamp starting circuit.

3. In a fluorescent-lamp starting device according to claim 2, said envelope structure having a single sealed space in which both said switch and said diode are mounted.

4. In a fluorescent-lamp starting device according to claim 2, said envelope structure having two gas-tight chambers sealed from each other in which said switch and said diode are mounted respectively.

5. In a fluorescent-lamp starting device according to

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claim 2, said envelope structure having two gas-tight chambers sealed from each other, a glow discharge atmosphere in one of said chambers, an inert atmosphere in said other chamber, said switch being mounted in said one chamber and said diode in the other chamber.

6. In a fluorescent-lamp starting device according to claim 2, said envelope structure having a sealed space in which both said switch and said diode are mounted, said diode having a semiconductor member and having a p-n junction emerging at the surface of said member, and an insulating coating on said member covering said p-n junction on said surface to prevent glow discharge at said member.

7. A control device for fluorescent-lamp starting circuits, comprising a glow-discharge switch thermo-responsive for closing its contacts due to heating by glow discharge, a rectifier diode connected in series with said switch, said switch and said diode having respective sealed housings and being fixedly mounted therein to form respective subassemblies together therewith, said two subassemblies being mutually engageable and having fastening means for joining them mechanically and electrically to form a single unit, said unit having outwardly extending electric conductors for connecting said unit as a single component in the lamp starting circuit.

8. A fluorescent-lamp starting device according to claim 7, comprising a thermistor electrically connected in parallel to said diode and mounted in said diode housing to form part of said diode subassembly.

9. In a control device according to claim 7, said fastening means comprising elastic latch members secured

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to said housing of said diode subassembly and engageable with the other housing for latching said two subassemblies together when said subassemblies are being joined.

10. In a control device according to claim 7, said housing of said switch subassembly having electric connecting leads attached to said switch and extending at one side of said latter housing to the outside and away from said latter housing, and said diode subassembly having channels traversed by said respective conductors when said two subassemblies are joined together.

11. In a control device according to claim 10, said diode subassembly having electric connecting leads attached to said diode and extending to the outside of said diode housing.

12. In a fluorescent-lamp starting device according to claim 2, said envelope structure having two gas-tight chambers sealed from each other in which said switch and said diode are mounted respectively, and a thermistor connected in parallel to said diode and mounted in the same chamber as said diode.

13. A fluorescent-lamp starting device according to claim 2, comprising a capacitor connected in parallel to said switch and joined with said envelope structure to form part of said single unit.

14. A fluorescent-lamp starting device according to claim 7, comprising a capacitor connected electrically in parallel with said switch and built together with said diode subassembly to form part thereof.

No references cited.