Jan. 23, 1945. H. C. ATKINS 2,367,655

STARTING CONTROL FOR ELECTRIC DISCHARGE DEVICES

Filed May 8, 1942

Fig. 1.

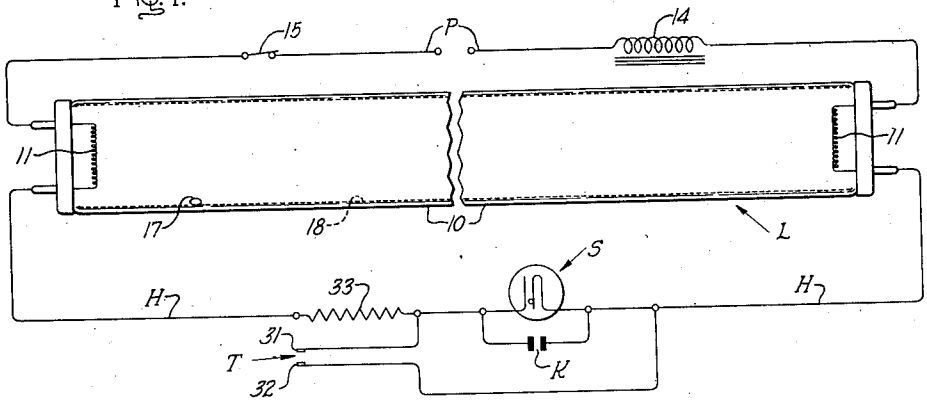
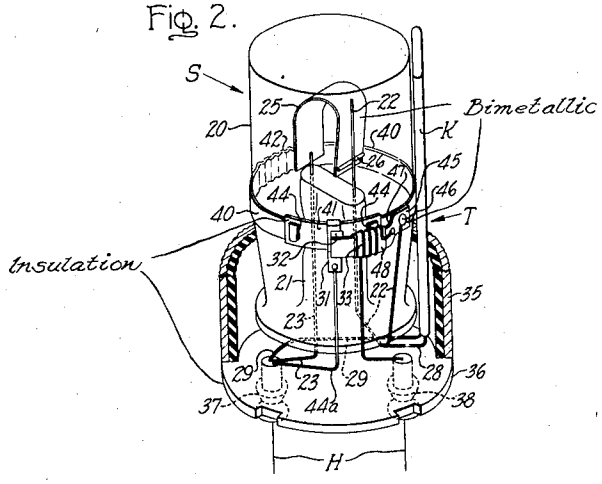


Fig. 2.



Inventor:
Harry C. Atkins,
by John K. Anderson
His Attorney

Patented Jan. 23, 1945 2,367,655

UNITED STATES PATENT OFFICE

2,367,655

STARTING CONTROL FOR ELECTRIC DISCHARGE DEVICES

Harry C. Atkins, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York

Application May 8, 1942, Serial No. 442,263

2 Claims. (Cl. 200—113.5)

This invention relates to the control of electric discharge devices, and is especially concerned with the starting of such devices. The invention is very useful in connection with fluorescent tubes or lamps of the positive column discharge type, and is hereinafter explained with particular reference to lamps of this character and their usual starting arrangements—as exemplified in U. S. Patent 1,951,112, March 13, 1934, to Wels, or U. S. Patent 2,212,427, August 20, 1940, to Peters, for instance.

Ordinary tubular fluorescent lamps have electrical starting circuits which are energized and broken to start the discharge. Sometimes this has to be done several times before the discharge actually starts. For this purpose, automatic means are commonly provided which will make and break the starting circuit indefinitely until starting is accomplished. One such starter that has been much used is commonly known as a "glow switch," comprising switch contacts and thermostatic means in a hermetically sealed cylindrical glass envelope containing a suitable operating atmosphere for a discharge that heats the thermostatic means. Glow switch and other types of starters may finally be enclosed in cylindrical metal casings or "cans" as they are generally called.

Through deterioration in service or as a result of accident, fluorescent lamps and other discharge devices eventually become incapable of starting and normal running, so that the only effect of the automatic efforts to start such a lamp is a continual flashing in it that is very annoying to those in the area that receives the light of the flashing lamp, besides uselessly wearing out the starter device. Usually, the incapacity for starting is due to loss of electron emission from one or both electrodes of the lamp, which may result from dissipation or other loss of activating material on which the emission depends. The objectionable flashing of such a lamp goes on indefinitely, until the power supply is shut off, or the lamp is removed from the circuit, or the starter wears out or fails.

In order to obviate the undesirable flashing of defective lamps without interfering with repetition of the attempts to start as long as there is any reasonable promise of success, it has been proposed to render the starter either ineffective to close the starting circuit or ineffective to open it after a fair number of attempts have failed to start the lamp successfully. One means for doing this is described in the application of Richard N. Thayer, Serial No. 422,306, filed December 10, 1941, assigned to the assignee of this application. The device there illustrated is of a "lock-in" type: i. e., the starter is rendered ineffective to open the starting circuit after reasonable efforts to start the lamp.

One purpose of my invention is to improve the arrangements for rendering starters ineffective, and especially as regards the combination of such means with the starters proper. I have chosen for illustration a combination of starter and anti-flash or no-blink device of lock-in type which corresponds broadly to the circuit arrangement for this purpose that is disclosed in the above-mentioned Thayer application, though quite different structurally. However, it is to be understood that in its broader aspects my invention is not limited to the Thayer circuits, nor to devices of lock-in type, nor to the form of construction here illustrated, but can be otherwise carried out and applied.

Various other features and advantages of the invention will become apparent from the description of one species and form of embodiment, and from the drawing.

In the drawing, Fig. 1 is a diagrammatic view of a fluorescent tube or lamp with circuit connections including my invention, a mid-portion of the lamp envelope being broken out and omitted; and Fig. 2 is a tilted or perspective view of starting switch apparatus suitable for the purposes of my invention, an enclosing casing for the apparatus being shown broken away.

I will first describe the portion of the circuits and apparatus shown which have heretofore been in use, and which permit the objectionable flashing of a defective lamp as described above.

Fig. 1 shows an ordinary fluorescent tube lamp L of the positive column electric discharge type with a tubular envelope 10 having spaced-apart activated thermionic cathodes 11, 11 in its ends, which may be specially heated cathodes of usual coiled filament type, and are shown connected across a power-supply circuit P including the usual ballast 14, which also serves as a starting inductance, and the manual make-and-break control switch 15. The envelope 10 may contain a low-pressure atmosphere of starting gas, such as argon at a pressure of 2 to 5 mm. of mercury, and also a vaporizable and ionizable working substance such as mercury. A supply of mercury, which may exceed the amount that will vaporize during operation of the lamp L, is indicated by a drop 17 inside the envelope 10, and an internal coating of fluorescent material or phosphor 18 on the envelope walls is also indicated. A start-

ing and electrode-heating circuit H is shown connected across the circuit P through the filamentary cathodes 11, 11, with a starting switch S included therein, which may be of a thermal type.

The general mode of operation in starting the lamp L with this circuit arrangement is that when the switch 15 is closed to turn on the lamp L, the automatic switch device S permits flow of current through the circuit H and the cathode filaments 11, 11 in series therein for a sufficient length of time to preheat the cathodes to an adequate emissive temperature, and then suddenly opens the circuit H; and the resulting voltage kick across the cathodes 11, 11 suffices to initiate discharge between them—or, in other words, starts the lamp.

As shown in Figs. 1 and 2, the starting switch S is of glow-switch type, comprising a glass bulb envelope or inner switch casing 20 containing a low pressure atmosphere of rare gas, such as argon at an absolute pressure of 25 mm. of mercury. The envelope 20 may include a stem 21 through which are sealed current leads 22, 23 that are connected to opposite sides of the circuit H, and are provided with terminals or electrodes inside the envelope between which a glow discharge takes place when the switch 15 is first closed. The lead 22 may have an extension (of nickel, for example) inward or upward from the stem 21 to serve as one terminal, while the other terminal may be formed by the end of a U-bent thermostatic bimetal strip member 25 attached to the other lead 23, as by welding, and constituting the temperature-responsive element of the switch S. The free end of the member 25 lies adjacent the lead 22 to coact therewith both as an electrode for the glow discharge and as a switch contact. For the latter purpose, a contact piece 26 (as of molybdenum) is shown welded to the free end of member 25. A capacitor or condenser K is shown connected across the circuit H by its leads 28, 29 in shunt with the switch S, to minimize radio interference as well as arcing between the contacts 22, 26.

The general operation of such a switch S is that when the circuit H is energized as a result of closing the hand switch 15, a glow discharge takes place across the gap between the parts 22, 25. This discharge heats the member 25 until it unbends sufficiently to touch the part 22, thus closing the circuit H and shorting out the glow discharge. The thus augmented flow of current in the circuit H continues long enough to heat the filamentary cathodes 11, 11 to an adequate electron-emissive temperature; and by the time this has been accomplished, the thermostatic member 25 cools sufficiently to open the circuit H and start the main discharge between the electrodes 11, 11, as already described. After the main discharge has started, the voltage on the device S is no longer high enough to maintain any discharge across the gap between the parts 22, 25.

If, however, the main discharge does not start on the voltage kick due to the opening of the circuit H by the switch S as just described, a glow discharge again takes place between the parts 22, 25, and the switch S again closes and opens, just as before; and if this effort is not successful in starting the main discharge, it is repeated—and so on. If the main discharge cannot be started at all, the lamp L would (with the circuit arrangement and parts so far described) go on to flash indefinitely in the objectionable manner explained above.

In accordance with my invention, means of control are provided for determining the condition of the circuit H as to continuity in such a way that after reasonable efforts of the starter S to start the main discharge, a condition of circuit H that prevents flashing of the lamp L is established and maintained, independent and regardless of any further action of starter S—indeed, the operation of starter S may be suspended. For my purpose, automatic control means may be employed whose period of operation (as fixed by design and adjustment) is long enough to include whatever number of attempts by starter S may be considered reasonably worth-while: e. g., a period of some seven to ten seconds under favorable voltage conditions, embracing some three to five attempts, say. The action of this automatic control need not be an arbitrary matter of fixed adjustment, however, but can be made responsive to the actual attempts of starter S to start the main discharge.

A simple control for this purpose is shown in Figs. 1 and 2 as comprising a thermal switch T whose contacts 31, 32 are connected across the starting circuit H in parallel with the starter S, to shunt the starter, but whose heating resistance 33 is connected into the circuit H in series with the starter S. As shown in Fig. 2, this switch T is mounted directly on the starter S and is very compactly arranged, so that it need not be at the outside of the body of the usual starter casing or can 35, or on the starter base disc 36 that forms the casing bottom and carries its external connectors 37, 38 for connection to opposite sides of the starting circuit H, but can lie alongside the starter envelope 20 inside the casing 35. For this purpose, a contact-carrying band 40 is shown around the starter envelope 20, being tautly stretched and clamped on the cylindrical body of the starter S. This band 40 is shown as consisting of a sheet metal strap section or strip with a short insulative section or strip 41 (as of insulative fiber) connected between its ends. To give the band 40 sufficient elasticity for tightly gripping the starter envelope 20 without danger of crushing it, the metal strap may have a transversely crimped part 42. The ends of the metal strap 40 may be secured to the fiber section 41 by hooking them through transverse end slots 44 in the fiber and doubling them flat. The contact 31 may be a sheet metal strap clamped around a narrowed portion of the insulative strip 41, and connected by a lead 44a to the external connector 37. The contact 32 is shown as the doubled free end of a thermostatic bimetal strip 45 forming the temperature-responsive element of the switch T, and having its other end anchored and attached to the metal portion of the band 40, as by welding (or even riveting) at 46, where the glow switch lead 22 is connected to it. Diverging outward from the band 40 at 47 directly adjacent its anchorage 46, the thermostat member 45 extends, as shown, in an arc concentric with the band 40 to its free end contact 32 directly opposite and outside of the contact 31. The heating resistance 33 is shown as a wire coil around the thermostatic strip 45 over a covering or wrapping of thermal and electrical insulation 48—such as asbestos paper—which increases the thermal inertia of the thermostat and its time of operation. One end of the heating coil 33 is connected to the member 45, and thus to the glow switch lead 22, while its other end is connected to the external connector 38. The condenser leads 28, 29 are shown as connected to the glow switch lead 22 and to the ex-

ternal connector 37 to which the glow switch lead 23 connects.

In starting a good lamp L, the starter S functions in the usual way, just as if the control T were absent: i. e., its contacts 26, 22 closed for only some 2 to 4 seconds, and the resultant heating of thermostatic member 45 is insufficient to close the control contacts 31, 32. Of course some current flows through the heater 33 during the glow discharge while the starter switch S is open, but this current is of low value, and the heating effect from it is insignificant. Even if several operating cycles of the starter S occur before the lamp L actually starts, the control contacts 31, 32 do not close, if the operating time of the control T is long enough. In the case of a defective lamp, on the other hand, the cumulation of heat in the member 45 from full energization of the heater 33 while the starter switch S is closed during repeated cycles of the starter eventually closes the control contacts 31, 32 and establishes circuit H independently of starter S. Current then flows continuously in circuit H, without any possibility of interruption or diminution by any action of starter S, and the lamp L ceases to flash.

However, if the circuit H is de-energized (by opening the hand switch 15, or by removing the defective lamp L and replacing it with a good one), and is allowed to remain de-energized long enough for the control thermostat 45 to cool off fully, the shunt at T will be opened, and the starter S will again be ready to start the lamp in the usual manner.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a starter of the character described, the combination with a main thermal starting switch having a casing, and connectors for connection to opposite sides of the starting circuit of a discharge device, of a band clamped around said casing, a thermostatic strip anchored at one end on said band and extending along adjacent the same, with a contact on the other end of said thermostatic strip and a cooacting contact on said band insulated from the thermostatic strip, and a heater wound around one of the aforesaid parts for heating the thermostatic strip, with means connecting said main starting switch and heater in series between the connectors aforesaid, and also connecting said contacts between said connectors in shunt with said main switch.

2. In a starter of the character described, the combination with a main thermal starting switch having a casing, and connectors for connection to opposite sides of the starting circuit of a discharge device, of a band clamped around said casing comprising a metal strip with an insulative strip interconnecting the ends of said metal strip, a thermostatic strip anchored at one end on said metal strip and extending along adjacent the same and along said insulative strip, a contact on said insulative strip adjacent the other end of said thermostatic strip for engaging the latter, and a heater on one of the aforesaid strips for heating the thermostatic strip, with means connecting said main starting switch, heater, and thermostatic strip and contact to the connectors aforesaid.

HARRY C. ATKINS.