March 27, 1945. J. H. RUBENSTEIN ET AL 2,372,295

STARTING DEVICE FOR FLUORESCENT TUBES

Filed March 24, 1942

Fig-1-

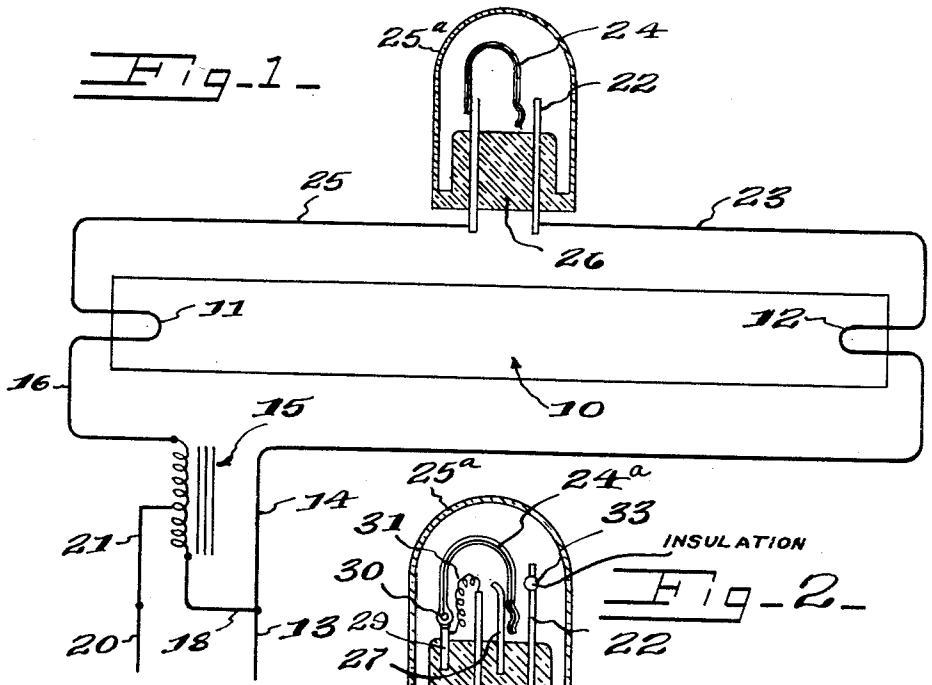


Fig-2-

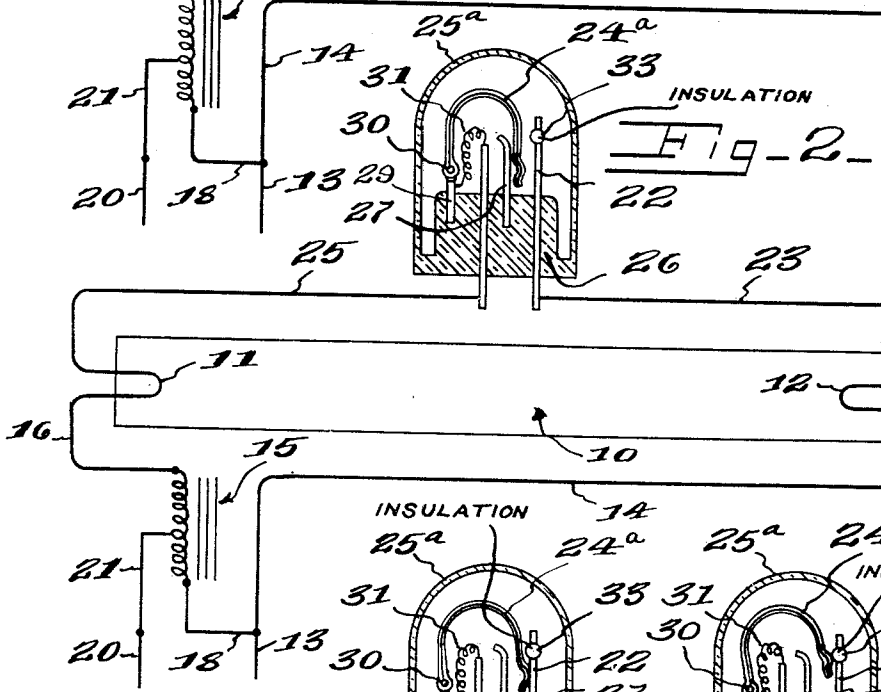


Fig-3-

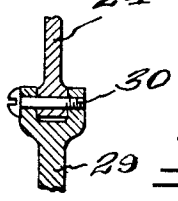


Fig-4-

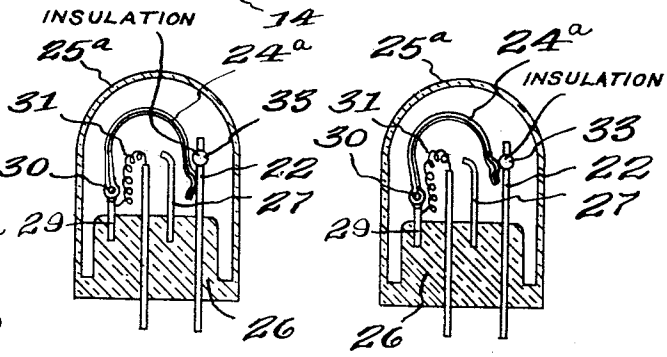


Fig-5-

INVENTORS.
Jacob H. Rubenstein & Lawrence J. De Martino
BY
Bodell & Thompson
ATTORNEYS.

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STARTING DEVICE FOR FLUORESCENT TUBES

Jacob H. Rubenstein and Lawrence J. De Martino, Syracuse, N. Y.

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7 Claims. (Cl. 200—113.5)

This invention relates to a starter device for fluorescent lighting tubes. The invention has as an object a fluorescent tube starter device which will function efficiently under all temperature ranges and will prevent flashing of the tube.

The invention consists in the novel features and in the combinations and constructions hereinafter set forth and claimed.

In describing this invention, reference is had to the accompanying drawing in which like characters designate corresponding parts in all the views.

Figure 1 is a schematic wiring diagram of the circuit connections for a fluorescent tube including the conventional type of starter now in use.

Figure 2 is a view, similar to Figure 1, showing a starter device embodying our invention connected in the circuit.

Figure 3 is a view of the starter shown in Figure 2 with the contacts in normal engagement.

Figure 4 is a view, similar to Figure 3, illustrating the position assumed by the thermo-responsive contact when the fluorescent tube is defective.

Figure 5 is a fragmentary sectional view of the pivoted connection between the thermo-responsive contact and the support.

Referring to Figure 1, 10 designates a conventional fluorescent lighting tube having filaments 11, 12 arranged in the ends thereof. One side of the filament 12 is connected to one side 13 of the source by a wire 14, and one side of the filament 11 is connected to the usual auto transformer 15 by wire 16. The transformer is connected to the side 13 of the source by wire 18, and the center tap of the transformer is connected to the opposite side 20 of the source by wire 21.

In this figure, the opposite sides of the filaments 11 and 12 are connected to the conventional starter device which includes a stationary or fixed contact and a thermo-responsive contact in the nature of a bimetallic arm. The fixed contact 22 is connected to the opposite side of the filament 12 by wire 23, and the bimetallic or thermo-responsive contact 24 is connected to the filament 11 by wire 25. With this arrangement, the filaments 11, 12 are connected in series through the starter device. The contacts 22, 24 are inclosed in a suitable envelope 25a which is exhausted, hermetically sealed, and then filled with a current conducting gas, such as neon. The movable U-shaped contact 24 is rigidly fixed at one end to a suitable support or base 26 of the enevlope and is arranged so that the free end is normally out of engagement with the fixed contact 22 also carried by the support 26.

At room temperatures, the gas in tube 10 will not pass sufficient current for ordinary lighting purposes. It is first necessary to ionize the gas by heating up the filaments 11, 12. This is done by passing sufficient current through the filaments to cause them to heat for a short period of time. The circuit for accomplishing this is as follows: Source 13, wire 14, filament 12, wire 23, contact 22, through the gas envelope 25a, thermal contact 24, wire 25, filament 11, wire 16, auto transformer 15, wire 21, to the opposite side 20 of the source. This circuit causes a glow discharge to form between the contacts 22, 24, the glow discharge determining the amount of current flowing in the circuit which is relatively small. The auto transformer 15 functions to impress a relatively high voltage across the contacts 22, 24, sufficiently to break down the resistance of the gas in the starter tube 25a and cause a glow discharge to form between these contacts. The source 13, 20 is the 110 volt conventional house system, while the voltage output of the transformer 15 is in the neighborhood of 175 volts for a 60 watt lamp when a current of small value is flowing. However, if the current flow is materially increased, the voltage on the output wire 14—16 is automatically reduced to approximately 110 volts.

The glow discharge formed between the contacts 22, 24, effectively heats the thermal contact 24 causing it to flex until the free end thereof moves into engagement with the contact 22. Thereupon, the resistance of the circuit is materially decreased with the result current now flowing in the circuit is relatively great and is effective to heat up the filaments 11, 12, causing the gas in the tube 10 to become ionized. This relatively heavy current flows through the filaments 11, 12 until such time as the circuit is opened by the disengagement of the contact 24 from contact 22. This period of time is not long due to the fact that immediately upon the engagement of contact 24 with contact 22 the glow discharge is extinguished and therefore contact 24 cools and moves out of engagement with contact 22. However, if the tube 10 is in good condition this period of time is sufficient to properly ionize the gas in each end of the tube and when the circuit is thus opened, the transformer 15 effects an inductive surge whereupon the voltage again

rises to its highest peak and because the gas in the tube 10 is ionized the current will flash from one filament to the other and once this is accomplished with the tube in good condition, it will continue to function. Immediately upon the current striking from one filament to the other, the tube consumes its rated current which is also relatively high and therefore the voltage is immediately reduced by the transformer 15 so that the glow discharge between the starter contacts 22, 24 will not be reestablished and the tube accordingly continues to function until the circuit is opened to extinguish the tube.

The disadvantage of the starter above described is that the thermostatic arm 24 is affected by the temperature of the surrounding atmosphere and if the device is positioned out of doors in the winter months, the tube will fail to start because the contact 24 will not heat sufficiently to engage the contact 22. Again, if the tube 10 is arranged in a low temperature the resistance of the tube materially increases with the result that even though the starter may function in the normal manner, the heating period of the filaments 11, 12 will not sufficiently ionize the gas to get the tube started. Also, when the tube 10 has been in use over a period of time, the filaments 11, 12 fail to properly ionize the gas in the tube, with the result that the tube will flash and then go out as the gas will not be ionized sufficiently to maintain operation of the tube at the lower voltage. When the tube fails to continue to function, the glow discharge is again produced in the starter and the starter proceeds through its cycle of operation. All this results in the defective tube continually flashing on and off.

Starting devices of the type referred to, made in accordance with our invention, will operate efficiently regardless of any changes in outside temperature, and further the starter will extinguish the flashing of a defective tube requiring its immediate replacement with a good tube.

We include certain structures in addition to these contacts. For instance, we provide a fixed stop 27 carried by the support 26 and which serves to limit the movement of the free end of the contact 24ª away from the contact 22. Also, a stem 29 is mounted on the support 26, and the contact 24ª is pivotally mounted on the stem 29, as by screw 30, the screw 30 serving as a means to tighten the pivotal joint between the contact 24ª and stem 29, whereby movement of the contact about its pivot is frictionally resisted. This arrangement is such that the contact 24ª is bodily movable toward and from the contact 22. The contact 24ª is constructed the same as contact 24 except instead of being rigidly secured at one end, it is pivotally mounted to the stem 29 and is therefore bodily movable, such movement being frictionally resisted. We also include a heating element, here shown in the form of the resistance coil 31 and being connected in series with the thermo-responsive contact 24ª and arranged in heat transfer relation thereto.

This starter, under normal conditions, functions in the same manner as the conventional starter previously described. The glow discharge is formed between the contacts 22, 24ª, causing the contact 24ª to become heated and the free end flexes until it engages the contact 22, Figure 3, whereupon the filament in tube 10 is started and thereupon, the glow discharge being extinguished, the thermal arm 24ª cools down and returns into engagement with the stop 27. The resistance 31 functions upon engagement of the contact 24ª with contact 22 to additionally heat the contact 24ª. This additional momentary heating however has no effect upon the operation of the starter under normal conditions.

The fact that the starter is located in a low temperature atmosphere, has no bearing whatever upon the operation of the device for the following reason. If the temperature surrounding the starter is low enough to cause further contraction of the contact 24ª after the free end thereof has engaged the stop 27, the pressure or bias on the contact 24ª will not be increased because the contact is permitted to move about the pivot 30 and under these circumstances, should the circuit be connected to the source, the heat from the glow discharge between the contacts 22, 24ª will cause the free end of the contact 24ª to freely move toward the contact 22. In other words, excessive heat will not be required to overcome any additional pressure or bias on the contact 24ª because there is none on account of the pivotal mounting at 30. Accordingly, regardless of how low the encountered temperature of the starter may be, the contact 24ª will flex into engagement with the contact 22 by application of the glow discharge.

The rigid contact 22 is provided with an insulating bead 33 which serves the following purposes. Referring to the conventional starter shown in Figure 1 and assuming the tube 10 has become defective so that the filaments 11, 12 when heated will not properly ionize the gas in the tube, this results in the flashing on and off of the tube as previously described. Under these conditions, when the circuit is connected to the source, the glow discharge forms between the contacts 22, 24. The contact 24 becomes heated by the glow discharge and moves into engagement with the contact 22 in the usual manner, thereupon the filaments 11, 12 become heated and, upon disengagement of contacts 24, 22, the tube will flash but will not function because the gas therein is not ionized. The glow discharge will therefore be again established between the contacts 22, 24, causing the contact 24 to reengage with contact 22 and again the tube 10 will flash. With the conventional starter, this process is repeated indefinitely or until one of the filaments 11, 12 burn out, or the starter fails, either of which events may not happen for a substantial length of time.

Under these conditions with our starting device, the repeated application of the relatively heavy current when the filaments 11, 12 are connected in series across the line results in the resistance 31 materially adding to the temperature of the thermo-responsive contact 21 whereupon, after a few of such applications, the contact is heated sufficiently so that it will not withdraw out of engagement with the contact 22. As soon as this happens, there is a continual application of relatively heavy current through the heater 31 which not only holds the free end of the contact 24ª into engagement, but causes the contact 24ª to continue to expand. This further expansion, upon the continued application of heat, causes the contact 24ª to move about its pivot 30 until it eventually assumes the position illustrated in Figure 4, whereupon the free end of the contact moves into engagement with the insulating bead 33. This opens the circuit and the tube 10 will thereupon stop flashing. The contact 24ª however will not move out of engagement with the bead 33 due to the fact that the glow discharge is now reestablished because of the spac-

ing between the contacts and due to the frictional resistance of the pivoted joint **30**, the contact will be held in this position and the glow discharge will be sufficient to maintain it in its expanded condition and in engagement with the bead **33**.

What we claim is:

1. A fluorescent tube starting device comprising a hermetically sealed envelope, a fixed contact rigidly mounted in said envelope, a thermo-responsive contact arranged in the envelope and being movable bodily toward and from said fixed contact, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts, said thermoresponsive contact being normally arranged in spaced relation to said fixed contact and being operable when heated by said glow discharge to expand into engagement with said fixed contact, the expansion of the thermo-responsive contact being independent of the bodily movement thereof, and means frictionally resisting bodily movement of said thermo-responsive contact.

2. A fluorescent tube starting device comprising a hermetically sealed envelope, a fixed contact rigidly mounted in the envelope and a thermo-responsive contact arranged in the envelope and bing movable bodily toward and from said fixed contact, a heating element connected in series with said thermo-responsive contact and arranged in heat transfer relation thereto, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts, said thermo-responsive contact being normally arranged in spaced relation to said fixed contact and being operable when heated by said glow discharge to expand into engagement with said fixed contact, the expansion of the thermo-responsive contact being independent of the bodily movement thereof, and means frictionally resisting bodily movement of said thermo-responsive contact.

3. A fluorescent tube starting device comprising a hermetically sealed envelope and a fixed contact arranged in said envelope, a thermo-responsive contact arranged in the envelope and being movable bodily toward and from the fixed contact, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts, and said thermo-responsive contact being normally arranged in spaced relation to the fixed contact and being operable when heated by said glow discharge to expand into engagement with said fixed contact, said fixed contact being provided with an insulator spaced from the point of normal engagement by the thermo-responsive contact, a heating element connected in series with said thermo-responsive contact and arranged in heat transfer relation thereto, said thermo-responsive contact being operable upon the continued application of heat from said heating element to move into engagement with said insulator, and means frictionally resisting the bodily movement of said thermo-responsive contact.

4. A fluorescent tube starting device comprising a hermetically sealed envelope, a fixed contact rigidly mounted in the envelope, a U-shaped thermo-responsive contact arranged in said envelope and being pivotally mounted at one end and being movable about said pivot toward and from the fixed contact, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts, the free end of said thermo-responsive contact being normally arranged in spaced relation to the fixed contact and said thermo-responsive contact being operable when heated by said glow discharge to expand and move the free end thereof into engagement with said fixed contact, the expansion of the thermo-responsive contact being independent of the bodily movement thereof, and means frictionally resisting movement of said thermo-responsive contact about said pivot.

5. A fluorescent tube starting device comprising a hermetically sealed envelope, a rigid contact mounted in the envelope, a thermo-responsive contact arranged in the envelope, said thermo-responsive contact being normally arranged in spaced relation to said rigid contact and being operable when heated to move into engagement with said rigid contact, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts to heat the same, an auxiliary heating element connected in series with said thermo-responsive contact and arranged in heat transfer relation thereto, and means carried by the rigid contact and cooperable with the movable contact to effect expiration of said contacts after prolonged engagement of the movable contact with the rigid contact.

6. A fluorescent tube starting device comprising a hermetically sealed envelope, a rigid contact mounted in the envelope, a thermo-responsive contact arranged in the envelope, said thermo-responsive contact being normally arranged in spaced relation to said rigid contact and being operable when heated to move into engagement with said rigid contact, said envelope containing a current conducting gas operable to cause a glow discharge between said contacts to heat the same, and an auxiliary heating element connected in series with said thermo-responsive contact and arranged in heat transfer relation thereto, said rigid contact being provided with an insulator spaced from the point of engagement by the thermo-responsive contact, said thermo-responsive contact being operable upon the continued application of heat from said heating element to move into engagement with said insulator.

7. A fluorescent tube starting device comprising a fixed contact rigidly mounted upon a support, a thermo-responsive contact mounted on said support and being movable bodily toward and from said fixed contact, heating means operable to heat said thermo-responsive contact, and said contact being normally arranged in spaced relation to said fixed contact and being movable when heated by said means to expand into engagement with said fixed contact, the expansion of the thermo-responsive contact being independent of the bodily movement thereof, and means frictionally resisting bodily movement of said thermo-responsive contact.

JACOB H. RUBENSTEIN.
LAWRENCE J. DE MARTINO.