April 20, 1943. W. FOERSTE ET AL 2,317,265

FLUORESCENT LAMP

Filed July 26, 1940

Fig. 1.

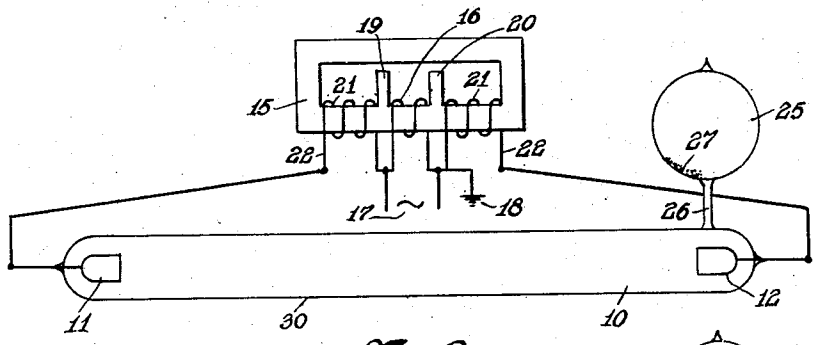


Fig. 2.

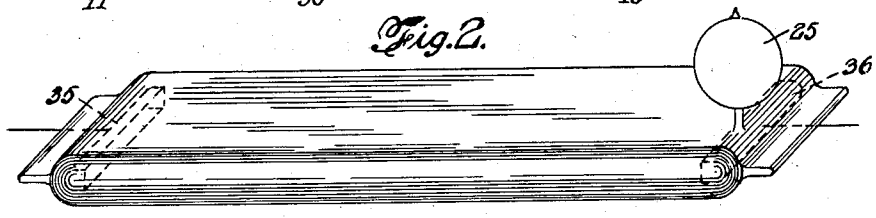


Fig. 3.

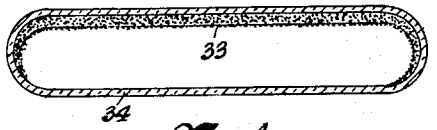


Fig. 4.

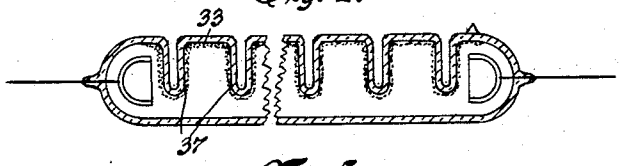


Fig. 5.

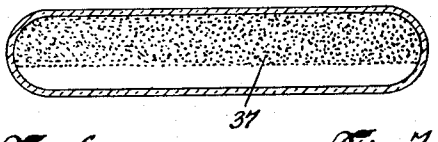


Fig. 6.

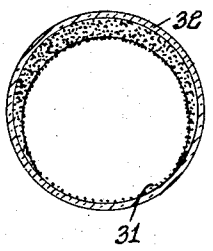
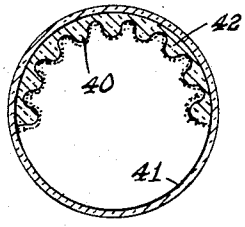


Fig. 7.



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FLUORESCENT LAMP

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Application July 26, 1940, Serial No. 347,590

4 Claims. (Cl. 176—122)

The invention relates to luminescent lamps, or rather the so-called fluorescent lamps, embodying a transparent gas-filled envelope coated internally with material fluorescing when a discharge is effected between electrodes in the envelope. Heretofore, this coating has extended entirely around the effective portion of the envelope, which is tubular in form, so that only so much of the light rays from the interior as penetrated the more or less opaque fluorescent material became externally visible.

It is an object of the present invention to increase the effectiveness of the fluorescent type of lamps by rendering available a greater proportion of the emitted light rays.

A further object of the invention is to increase the normal life of these lamps, and also to improve their operation.

In carrying out the invention, instead of coating over the entire effective inner surface of the envelope, as heretofore, a portion of this surface is left transparent and uncoated or the coating thereover materially reduced in density, thereby affording a window more or less transparent through which light rays emitted internally and which do not pass through the body of the coating may pass through in the opposite direction, and thus enhance the value of the lamp to a considerable extent. It affords, moreover, a lamp with directional effect. Provision is also made for increasing the effective surface area coated with fluorescent material to compensate to a large extent for the amount of fluorescing material lost in providing the said window.

In the case of short-length lamps whose life is considerably lessened due to the relatively reduced gas capacity, there is provided a means for supplementing the gas volume so that the life of the lamp is materially prolonged.

To steady the operation of the lamp, there is included in the electrical supply thereto a novel high-tension circuit which embodies an autotransformer with magnetic leakage cores.

The nature of the invention, however, will best be understood when described in connection with the accompanying drawing, in which:

Fig. 1 is a more or less diagrammatic view illustrating the novel fluorescent lamp and circuit for operating the same.

Fig. 2 is a perspective view of a modified form of the lamp.

Fig. 3 is a transverse section therethrough, on an enlarged scale.

Fig. 4 is a longitudinal view illustrating a modification in the coated surface area, and Fig. 5 is a transverse section therethrough.

Fig. 6 is a transverse section illustrating a modification in the coating arrangement.

Fig. 7 illustrates in transverse section a modification in the manner of increasing the coated surface area.

Referring to the drawing, more particularly Fig. 1 thereof, 10 designates an envelope of transparent material of the desired shape and length and designed to retain under a low pressure a rare gas such as argon, neon, etc., or combinations thereof, and associated with mercury, if its color and actinic effect is desired. Through this gas an electric discharge is arranged to take place as between the electrodes 11 and 12, of the self-heating emissive type, which are mounted in the opposite ends of said envelope. A suitable potential is applied to these electrodes to enable the discharge to take place, all of which is well understood and forms no particular part of the present invention. However, to steady the discharge and operation of the lamp, it is preferred to utilize the novel circuit arrangement indicated in the drawing, Fig. 1, wherein an auto-transformer 15 has its primary 16 connected with the source of alternating current supply indicated at 17, with one of the supply leads grounded as at 18. This primary is included between two magnetic leakage poles or cores 19 and 20, the secondary winding 21 being connected through the leads 22 to the respective electrodes. By this arrangement, the current flow in the secondary is limited due to the magnetic shunts provided by cores 19 and 20 and stabilization of the discharge secured, while the usual ballast resistance and consequent power loss are also eliminated thereby.

Where the lamps are of relatively short length, it will be understood that, due to the relatively lessened gas capacity, they will be short-lived and it is preferred, therefore, to provide a reserve supply of gas by increasing the volume of the tube outside of the discharge region. For example, a reservoir 25 for the gas may be arranged to communicate, through the connection 26 in the vicinity of one of the electrodes, with the interior of the tube to replenish the gas supply as its pressure becomes gradually reduced under the action of the discharge. In addition, there may be contained in the reservoir 25 a gas-evolving substance 27 such as magnesium and calcium carbonate, or organic matter such as certain hydrocarbons (anthracene, oils, gums, resins, etc.) to provide a common gas, in the

present instance carbon dioxide, which not only ennhances the quality of the light but appears to have a tendency to concentrate the discharge at the periphery or in close proximity to the fluorescent coating.

In accordance with the invention, the effective fluorescent or light-radiating surface of such tube is to be coated with suitable fluorescent material such as certain phosphors (zinc-beryllium silicate, cadmium and zinc silicates, etc.) as generally employed over its inner surface; but this material does not extend in the present instance over the entire surface, or may not be of the same density throughout. Thus, as indicated in Figs. 1 and 3, this material extends merely over the upper, or lower, portion and sides, leaving a window **30** entirely uncovered, in the embodiment shown in Figs. 1–5, through which light emanating from the fluorescent material will be clearly visible so that the inner fluorescence which, in the usual type of fully-coated interior, was lost to a large extent, is in the novel lamp fully effective in addition, of course, to the light otherwise radiated in the usual manner. Moreover, the extreme care required in applying the coating of the usual type of lamp is not necessary, as a more or less dense coating is not obectionable, in fact may improve the light-giving characteristic.

In Fig. 6 there is indicated a coating which extends entirely over the interior wall surface but has a portion **31** so reduced in density with respect to the normal thickness of the coated portion **32** that there will be interstices or a multiplicity of small windows, depending on the granular character of the material, which will transmit to a substantial extent the light rays from the fluorescent inner portion. As in the case of the hereinbefore described embodiment, the coating tapers from a portion of maximum thickness to a portion of minimum thickness which may terminate at a completely transparent window portion or be of such reduced dimensions or density, as indicated at **31**, Fig. 6, as to not interfere to a serious extent with the transmission of the light rays. If desired, this reduced density region may be extended entirely about the tube surface.

In view of the reduction of area in the fluorescent material resulting from the provision of the window, it is desirable to modify the structure of the envelope with a view to increasing the effective coated surface. For example, the tube may be of a flattened form as illustrated in Figs. 2 and 3 wherein a large coated surface **33** is indicated opposite the window **34**. This particular conformation, furthermore, brings the fluorescent material in closer proximity to the core of the discharge between the electrodes **35** and **36**. Or, the surface may be roughened by etching or sand-blasting the same, which not only increases the adhesion of the fluorescent material thereto, but makes for an increase in area.

A further modification is shown in Fig. 4 wherein the interior of the tube is provided with baffles or transverse projections **37** extending into the interior and over which the coating is applied. Tihs, moreover, locates a larger proportion of the fluorescent material in the region of the core of the discharge, making for a greater conversion and thus enhancing the efficiency of the lamp.

Or, as indicated in Fig. 7, the inner surface may be stippled or corrugated as indicated at **40**. To conveniently provide such irregular surfaces for receiving the fluorescent material, the material-bearing surface may be constituted as a separate element from the envelope itself. Thus, as indicated in Fig. 7, there is fitted into the envelope **41** a liner member **42** of transparent material which snugly fits therein and bears upon its inner face the desired irregularities **40** for increasing the surface area which receives the fluorescent material.

We claim:

1. A fluorescent lamp comprising a transparent envelope of relatively short length filled with a rare gas and provided with end electrodes for effecting an electronic discharge therebetween through said gas, and a reservoir for an additional supply of the rarefied gas located outside the discharge region and permanently in open communication therewith in proximity to one of the electrodes.

2. A fluorescent lamp comprising a transparent envelope of relatively short length filled with a rare gas and provided with end electrodes for effecting an electronic discharge therebetween through said gas, and a reservoir for an additional supply of the rarefied gas located outside the discharge region and permanently in open communication therewith in proximity to one of the electrodes, together with a common-gas-evolving substance retained in said reservoir.

3. A fluorescent lamp comprising an elongated flat, transparent envelope filled with a rarefied gas and with its inner, light-effective walls substantially parallel and faced with fluorescent material, and laterally extended electrodes directed substantially across the width of the envelope at its opposite ends for effecting a flattened electronic discharge therein between said electrodes.

4. A fluorescent lamp comprising a flat, transparent envelope filled with a rarefied gas and with its inner, light-effective wall faced with fluorescent material, laterally extended electrodes for effecting a flattened electronic discharge therein between said electrodes, and a reservoir for an additional supply of the rarefied gas located at one end of the envelope in open communication therewith in proximity to the corresponding electrode.

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