Nov. 18, 1941. P. J. KAYATT 2,263,093

FLUORESCENT LAMP AND COATING THEREFOR

Filed July 13, 1939

Fig. 1.

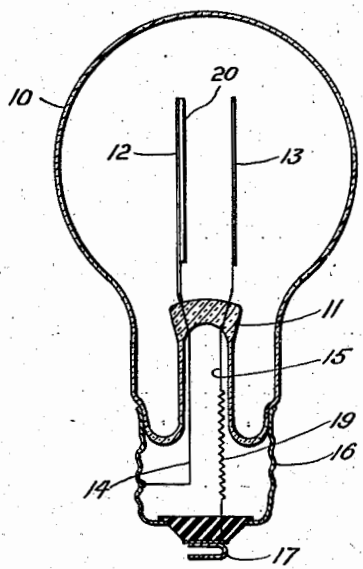


Fig. 2.

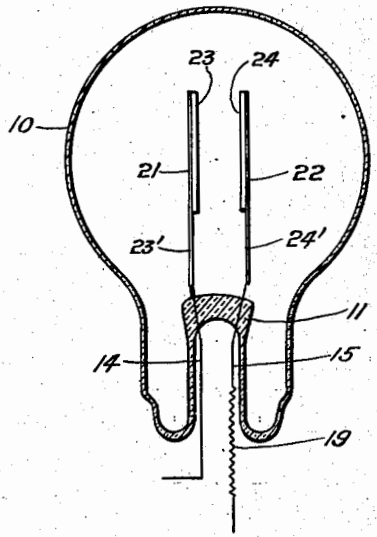


Fig. 3.

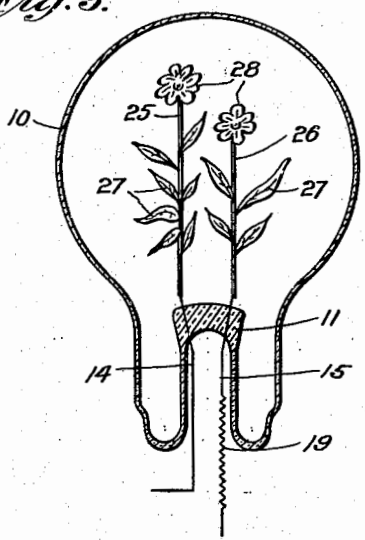
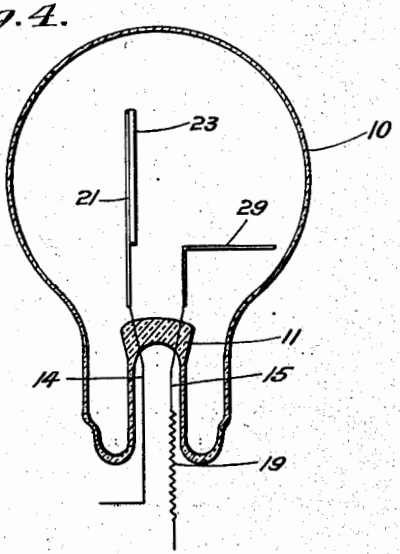


Fig. 4.



INVENTOR
Philip J. Kayatt
BY
ATTORNEY

Patented Nov. 18, 1941 2,263,093

UNITED STATES PATENT OFFICE

2,263,093

FLUORESCENT LAMP AND COATING THEREFOR

Philip J. Kayatt, New York, N. Y., assignor to Harry C. Zaun, Atlantic Beach, N. Y.

Application July 13, 1939, Serial No. 284,268

4 Claims. (Cl. 176—122)

This invention relates to electrical glow lamps and more particularly to such lamps of the cathode glow type wherein the visible light is at least partly produced by fluorescence.

In the art of electric illumination use has been made of lamps wherein at least a portion of the light came from the fluorescence of certain materials under the influence of an electric discharge produced in a gas such as mercury vapor or one of the noble or inert gases. However the prior art has found it necessary in such cases to use a discharge of the positive column type, needing for the production of such discharge either a voltage much higher than that available in the customary household distribution circuits, or else the provision of special electrodes which emit electrons to bring about the production of such a positive column discharge, and which require special means in order to heat them sufficiently to bring about such electron emission.

Fluorescent tubes of the prior art have accordingly suffered from the disadvantage of requiring ancillary apparatus such as transformers, reactors, electrode heaters, and the like, and could not be made with a single standard type base so that they could be directly substituted for a lamp of the usual incandescent type, in a household light socket. On the contrary, such tubes have required the use of one or more special type sockets, in order to bring to the tube the high potential and/or ancillary circuits needed in order to operate such tubes.

One object of the present invention is to combine in a single lamp a cathode glow discharge and a fluorescent light effect in such fashion that upon the connection of such lamp directly to circuits carrying voltages of the order of 110 volts, the lamp will immediately commence to operate and will continue in operation thereupon, without the existence in the lamp or in any ancillary apparatus connected thereto of voltages substantially higher than the voltage of the lines to which it is connected.

Another purpose of this invention s to utilize the anode surface of a glow lamp of the type described as an additional source of illumination. When a lamp of the cathode glow type is connected to direct current household mains of usual voltages, only the surface of the cathode will be covered with a glow discharge, and the anode will remain dark, while in the case of the lamp of my invention connected under such circumstances, the anode will likewise glow and emit additional light, without in any way detracting from the illumination of the cathode, and also without the consumption of any additional amount of electrical energy. In this fashion my lamp operates as a light producing device of increased efficiency.

A further object of my invention is to provide a lamp which shall be capable of being mounted in a two circuit base of the conventional type, so that it can be directly connected to lighting circuits of the order of 110 volts, by the simple insertion of such base in a conventional receptacle, and without the need of any additional circuit connections, so that the lamp of my invention may readily and easily be substituted for a lamp of the usual incandescent type by a household consumer of electric current, without the need for the services of one skilled in the electrical art in order to connect thereto special circuits or ancillary apparatus.

A further purpose of this invention is to provide for domestic and industrial use a low voltage glow lamp simultaneously emitting light of more than one color and thereby affording novel and attractive multi-color effects.

Another object of this invention is to afford a glow lamp exhibiting a design or pattern which will glow with different colors in different portions thereof.

Yet another purpose of my invention is to provide a glow lamp including a source of fluorescent light, which lamp shall not require any auxiliary starting or operating circuits demanding additional conductors entering the lamp base.

Yet a further purpose of this invention is to provide a glow lamp of the type described in which hazards of fire and/or shock are substantially eliminated by so constructing the lamp that no high voltages are needed for its starting or operation.

Referring now to the drawing hereunto appended, for the better understanding of my invention:

Fig. 1 is a side elevation partly in section of one form of the lamp of my invention, particularly suited for use upon D. C. supply circuits.

Fig. 2 shows also in side elevation and partly in section, the bulb of another form of my invention, suited particularly for use upon A. C. supply circuits.

Fig. 3 shows in elevation the bulb of another embodiment of my invention in the form of an ornamental lamp.

Fig. 4 shows a lamp having one of the electrodes fluorescing on one side only.

A glass bulb 10, of any suitable shape, is provided with a re-entrant supporting stem 11 of

conventional type, although it is to be understood that any other method of supporting the internal elements of the lamp may be employed, as known to those familiar in the art. In the form of Fig. 1, two electrodes 12 and 13 are mounted upon the stem and are connected by wires 14 and 15 respectively to the exterior shell 16 and central contact button 17, of a conventional screw base 18. Interposed in series between one of these leads 15 and the base, is a resistor 19, for limiting the current flow to the electrodes to a suitably safe value. This resistor may be of any type familiar to those skilled in the art, and may be made so small in size as to readily be enclosed within the base, without unduly heating the same, owing to the high efficiency of the lamp of my invention.

On the inner surface of electrode 12 I have illustrated a coating 20. For purposes of clarity this coating is here shown disproportionately thick, but it is to be understood that in the actual structure, this coating will ordinarily be only of a thickness a fractional part of that of the electrode upon which it is spread. This coating is formed of materials which are capable of fluorescence under the influence of ultra-violet rays or electrical discharges in rarified gases. Such materials are already known in the art and I shall hereinafter describe in detail a typical material of this type and the method of its application to the electrode. Electrode 13 may be of any suitable type which is suited to initiate and maintain electron emission under tensions of the order of 110 volts. The preparation of an electrode of this character is fully described in my United States Patent 2,084,911, but I do not limit myself to an electrode prepared according to this particular method, provided only that the electrode fulfills the requirements of satisfactory electron emission upon a low voltage and when cold.

When a lamp of the type just described is connected to D. C. mains so that electrode 12 becomes the anode and electrode 13 becomes the cathode, then the surface of electrode 13 will be covered with a cathode glow discharge, wherever such surface has been suitably treated so as to yield emission sufficient to initiate and maintain such a discharge. On the other hand, the surface of electrode 12, where such surface is coated with the fluorescent material 20, will become fluorescent or luminescent. The exact modus operandi by which such coating is excited into luminescence is not precisely known, but probably it is partly by the impingement thereupon of ultra-violet light, and possibly also partly by the direct action thereupon of the electrical discharge. That ultra-violet light is at least partly concerned in the production of the luminescence seems to be borne out by the fact that such light production is at its maximum when the gas within the bulb is chosen to promote the production of ultra-violet light, and also by the fact that the luminescence is relatively feebler on portions of the coating which may be shielded from the direct rays emitted by the other glowing electrode. However, I do not limit myself to any particular theories involved in the production of fluorescent illumination by this coating.

In lamps of this form I have found it desirable to provide upon some portion of the surface of the anode an electron emitting coating in addition to the fluorescent coating here shown. While the gas employed in this lamp may be any one or more of the usual gases used in glow tubes, such as mercury vapor, or the monatomic inert gases, yet I have found that the most efficient fluorescent action and the most striking colors are usually produced when at least a substantial fraction of a percent of the gas mixture within the bulb is constituted by argon or mercury vapor, or both. According to the exact shade of color which is desired, both in the case of the direct cathode glow, and in the case of the secondary fluorescent glow, the nature and percentage constitution of the gas mixture may be varied. The direct cathode glow produced by various gases and mixtures thereof is familiar to those skilled in the art and it is thought unnecessary to describe herein in detail such mixtures. Suitable gas mixtures and pressures are set forth in detail in my patent above referred to, but as above indicated, I have found that fluorescence is promoted by the presence of argon or mercury vapor, whatever other gases may make up the bulk of the filling. It is possible to make the entire filling of one gas such as argon, although better starting and more efficient operation especially upon low voltages, is found to occur when mixtures of more than one gas are employed.

Referring now to Figure 2, I have here shown a lamp whose two electrodes 21 and 22 are respectively coated over only a portion of the surface of each with layers 23 and 24 of fluorescent material, of a thickness exaggerated in the drawing for purposes of clarity. The portions of each electrode not covered by the fluorescent material indicated at 23' and 24' are treated so as to afford electron emission. When a lamp of this form of my invention is connected to a source of A. C., the electron emitting portions of the electrodes will glow with a cathode discharge of a color determined by the gas mixture present, while the coated portions of the electrodes, bearing the fluorescent material thereupon, will glow with the color which the particular fluorescent material may give rise to when excited in the particular gas mixture present. Accordingly the entire surface of both electrodes will glow with light which may be of more than a single color, i. e., the electrodes will appear differently colored on the coated and the uncoated portions, respectively. This type of lamp according to my invention may be used upon D. C. circuits, but when used so, the portion of the anode which does not have a coating of fluorescent material thereupon, will not glow, thus slightly reducing the efficiency of the lamp. However, it is to be noted that even when so operated, there will be present a lamp which displays a plurality of colors, partly produced by a direct cathode glow, and partly produced by secondary fluorescence.

In Fig. 3 I have illustrated a form of my invention which is similar in principle to that of Fig. 2, but wherein I have utilized the dual color glow to give certain novel ornamental effects. In this construction supporting wires 25 and 26 are made to simulate the stems of a plant, and each such stem bears thereupon leaves 27, 27 and blossoms 28, 28. The leaves are coated with fluorescent material according to my invention, while the blossoms are treated so as to give electron emission. Accordingly the leaves will glow by fluorescence, which may be made to present a green color, if so desired, while the blossoms will have the cathode glow color characteristic of the gas filling used in the bulb. Such a lamp will operate upon D. C. mains, but certain blossoms which happen to be located upon the anode supporting wire will of course fail to glow, although the leaves upon the anode stem will glow, so that such type lamps have been found to be sat-

isfactory even when used upon D. C. mains. It is also possible to make the entire simulacrum of a plant, including both the coated and the uncoated portions thereof, function as a cathode, and to supply in some other portion of the bulb an anode which shall not form a part of the glowing design, in case that it is desired that the entire plant shall glow when the lamp is operated upon D. C. current supplies.

The form shown in Fig. 4 is similar to Fig. 2, except that electrode 22 has been replaced by an electrode 29 extending horizontally so that both the fluorescent and non-fluorescent sides of electrode 21 will be visible.

While it is possible to construct a lamp according to the foregoing description by methods of manufacture known in the art, yet I have found particular advantages are to be gained when the following process of manufacture is followed.

The electrode material may be any metal or alloy which has been found suitable for glow electrode construction, but I prefer to use some form of iron, such as that known under the trade name of Svea metal. The surface of this metal is cleaned by the use thereupon of a suitable cleaning fluid such as chlorosol, ether, or the like. I then prefer autogenously to oxidize my electrodes by the well known process of heating them while in contact with an atmosphere containing oxygen to a degree sufficient to cause oxidation of the surfaces thereof, and especially in accordance with the detailed steps of the process set forth in my issued patent above referred to, so that there is produced upon the surface thereof a coherent coating consisting of a substantially black oxid or mixture of oxids of iron, autogenously produced from the actual body of the electrodes themselves.

There are two methods which I have found possible to use in the application of the fluorescent coating to the electrodes. I shall first describe the method employing an organic binder such as amyl acetate, butyl acetate, and similar substances, of which many varieties are familiar in the art. The fluorescent material may conveniently be chosen from a large group of compounds also familiar in the fluorescent art. Suitable materials include salts such as silicates of calcium, zinc, beryllium and cadmium, tungstates of calcium or samarium, or various complex salts including more than one metal in their composition.

The solid fluorescent material is ground to a degree of fineness suitable for suspension in a vehicle such as the organic acetates above mentioned, and mixed therewith, with or without the addition of a small amount of pyroxylin or nitrocellulose. As an illustrative mixture, I have found a suspension of 20 to 40 grams of Willemite in 200 to 400 cc. of butyl acetate, with the addition of 50 to 100 milligrams of nitro-cellulose to be suitable. This mixture is sprayed or brushed upon the dry electrodes at room temperature, or at a temperature very slightly higher, such as 120° F. to 130° F. The electrodes are thoroughly dried at this same temperature and then are heated to about 500° F., although this last mentioned temperature will vary according to the particular fluorescent materials which are used. During this heating the pyroxylin will decompose, becoming brown and then disappearing to leave a coating usually whitish under daylight.

After cooling in dry air, the electrodes are now ready to have applied thereto, or to such portions thereof as may be desired, the electron emitting coating. This portion of the process may be practiced according to the disclosures of my patent above mentioned, or by any other method familiar to the art.

I have found it possible to dispose with organic binders of the type above mentioned in the application of fluorescent material to my electrodes, using instead a binder which will evaporate at a comparatively low temperature and thus obviate the need for the high temperature heating above described, while yielding at the same time a more efficient product. I have found that if a suspension of the fluorescent material in acetone be sprayed upon the electrode which latter has upon its surface a slight degree of moisture, the acetone will rapidly evaporate and will leave the coating in an adherent condition upon the electrode. I prefer to heat the electrode to about 120–130° F. and either to deposit a slight film of moisture thereupon, as by condensation, or by spraying thereupon a slight amount of water at the same time that the acetone suspension of the fluorescent material is being sprayed thereupon. I have found the adherence of the powdered material to the surface of the electrode to be greatly promoted to a wholly unexpected degree by this presence thereupon of a trace of moisture, although the reason therefor is not at present fully understood. After application of material by this last described process, the electrode is ready to have the electron emitting coating applied thereto by any suitable process, such as that above referred to in connection with the method of coating using organic acetates.

While not confining myself to any particular theory, I have found that coatings produced by the acetone process are superior in performance to those produced by burning off an organic binder at a necessarily high temperature, possibly due to some undesirable reaction taking place between such binder and the fluorescent material at such elevated temperatures as are needed in order thoroughly to remove a binder of this organic nature.

The mounting, exhaust and gas-filling of the lamps of my invention may be practiced as known to those skilled in the art, as described, for example, in my issued patent above referred to.

While I have described my fluorescent material as applied to one or more of the electrodes of my lamps, yet it is possible to apply such material to other portions of the lamps, such as to a dead element therein, or to portions of the glass walls of the tubes, such as the stems, where it will likewise glow upon excitation by the cathode glow primarily produced upon one or more electrodes of such lamps.

I claim:

1. An ornamental electric glow lamp including a metallic electrode formed to simulate a natural object, substantially all the active surface of said electrode being covered with a first layer of an autogenous oxid of the metal base thereof, part of said electrode being coated with emissive material so as to exhibit a cathode glow thereover and another part of said electrode being coated with a fluorescent material so as to glow with a color differing from said cathode glow, whereby the natural colors of said object are simulated when said lamp is illuminated, and whereby said differently colored portions of the glowing electrode occupy discrete areas thereof.

2. A glow lamp comprising a transparent en-

velope, a connecting base fastened to said envelope and adapted to be inserted into an electric socket carrying an electric potential not exceeding 250 volts, an attenuated atmosphere including at least one easily ionizable gas chosen from the group comprised by the noble gases and mercury vapor, electrodes supported from said envelope within said atmosphere and connected to said base, said electrodes having upon substantially all the active surfaces thereof a first coating layer produced by autogenously oxidizing a portion of the actual electrode material in situ, an emissive coating covering a portion of said electrodes and a fluorescent coating covering another portion of said electrodes, whereby cathode glow and fluorescence are simultaneously displayed by different portions of said lamp when excited by current derived from said socket.

3. In a low voltage electric glow lamp, a metallic electrode being primarily coated with an autogenous oxid of the metal base thereof and being secondarily partly coated with emissive material so as to furnish a cathode glow thereupon when supplied with current in a suitable gaseous atmosphere, and partly coated with a fluorescent material so as to furnish secondary luminescence from said fluorescent material when said fluorescent material is excited by radiation from said cathode glow, said two secondary coatings being upon discrete portions of the electrode.

4. A multi-color glow lamp adapted to operate upon low voltage lighting circuits, comprising a transparent bulb, a mixture of gases therein, including at least one of the gases chosen from the group of inert gases, a plurality of metallic electrodes lying within said bulb and surrounded by said gaseous mixture, said electrodes being substantially entirely covered with a first layer of a metallic oxid produced by the autogenous oxidation of the metal base of said electrode, some portion thereof being coated with a second layer of an electron emissive material, and some other portion thereof being coated with a second layer of a fluorescent material, and means to support and conduct current to the electrodes within said bulb to separately produce fluorescence and a cathode glow.

PHILIP J. KAYATT.