ELECTRONIC TUBE REGENERATION

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1 Claim. (Cl. 313—94)

This invention relates to improvements in electronic tube regeneration, and more particularly to the increasing of the intensity of electron image pictures such as those produced in phototubes and in television receivers, and to the increasing of the intensity of light in an electron discharge lamp.

In television receivers the image produced is often faint or weak, which reduces appreciably the reception and clarity of the picture produced on the picture tube. Attempts have been made to increase the brilliance thereof, but these have required multiple tube amplifiers which are expensive and complex, and yet these have not been too satisfactory in building up a brilliant clear picture from a very feeble image.

I have discovered that regeneration can be accomplished in an electronic discharge tube having cathode and anode for space discharge therebetween by a coating of phosphors on the anode which will have the effect of increasing the intensity of light directed therefrom onto the cathode, causing the latter to release more electrons directly back to the anode, thus making more light and again repeating itself in a regeneration which continues to build up very quickly and to a very high value.

One object of this invention is therefore to provide regeneration in an electronic tube which will increase materially the light produced therein.

Another object of this invention is to combine the elements of a phototube with an electron discharge tube so as to obtain regeneration building up the effect of the electronic discharge to a high value.

A further object of the invention is to combine a photocathode with a television receiver tube so as to increase the intensity of the electron image picture produced therein without the necessity for using multiple tube amplifiers connected therewith.

Still another object of the invention is to combine an electronic lamp with a photocathode to produce regeneration of the light therein to a substantial brightness more effective than has been possible heretofore.

These objects may be accomplished by anode and cathode superimposed in cooperation in which the anode is provided with a phosphor coating of the character used in television receiving tubes which will produce an illumination thereon by the electrons from the cathode, which illumination will be directed back onto the cathode, releasing more electrons, and thereby building up the light effect in the tube or lamp. These elements may be combined in an electron discharge tube such as a television receiver tube or a fluorescent lamp, in such relation that the light therefrom strikes the cathode thus releasing electrons which in turn strike the anode, building up more light which is continued to increase thereby until a very high value is obtained. The anode and cathode can be placed very close together and may be used in a filament, if desired.

Certain embodiments of the invention are illustrated in the accompanying drawings in which:

Fig. 1 is a diagrammatic view of a phototube showing the invention applied thereto;

Fig. 2 is a side elevation of a television receiving tube having the invention applied thereto;

Fig. 3 is a similar view showing the television tube separated from the photo elements;

Fig. 4 is a similar view showing multiple cathodes and anodes;

Fig. 5 is a similar view in which the multiple cathodes and anodes are associated with a television tube; and

Fig. 6 is a diagrammatic view showing the invention applied to a fluorescent light.

The invention is shown in Fig. 1 in a simple embodiment in the nature of a phototube generally designated at 1 as representing the envelope thereof within which is provided with an anode 2 and a cathode 3, which are shown as separate elements in the conventional manner of providing these in a phototube. These elements may be provided on either transparent or opaque surfaces, as glass, mica, etc., which would be transparent, or on metal or other opaque surfaces. In most applications, however, it will be desirable to use transparent surfaces therefor.

The anode 2 is coated with a phosphor and preferably is arranged in relatively close relation to the cathode. The phosphor may be of conventional character used in television receiving tubes, which will fluoresce when bombarded with a cathode ray. Such phosphors include zinc orthosilicate, millemite, zinc sulfide, zinc cadmium sulfide, etc. Both of these preferably are flat surfaces. Thus the electrons from the cathode 3 to the anode 2 will travel in straight lines and will form a picture image or light on the phosphor of the anode. The light thus produced on the anode will in turn illuminate the cathode and thereby release more electrons from the latter which are directed back onto the anode, thus producing still more light on the latter and again repeating itself. This regeneration continues to build up to a very high value.

A source of electrical supply is indicated at 4 for the phototube elements and the latter may be controlled by a variable resistance 5, such as a potentiometer. The latter in the supply circuit may be used to control or limit the extent of brilliance or regeneration thus produced.

The invention is shown in Fig. 2 in association with a television tube 6 constructed in the usual manner as a cathode ray tube, adapted to form a picture image on the screen 7 thereof at the forward end of the tube.

Associated with the television receiver 6 are the phototube elements including the usual photo cathode 8 and anode 9. A source of electrical supply may be connected therewith through the television tube 6 or separately.

The elements of the phototube are shown in Fig. 2 enclosed in the television tube and spaced from the screen thereof, being combined in a single envelope. If desired, they may be separated therefrom, as shown in Fig. 3, and indicated at 8', 9', respectively. A lens 10 is interposed between the screen of the television receiver 6 and the photo cathode 8', being used either to amplify or reduce the image thereon.

The photo cathode may be formed on a transparent plate so as to receive a picture image from the back side thereof, directed onto the cathode by the lens 10 from the television receiver 6'. The parts may be so arranged, if desired, that the light can fall on the cathode from the front instead of the back. The anode 9 or 9' is mounted in close proximity to the cathode 8 or 8' and is coated with a phosphor of the character used in television receiving tubes, and when both the anode and cathode are formed on flat surfaces, the electrons travel in straight
lines from the cathode to the anode, thus forming a picture image on the phosphor of the anode, whereby the latter may be utilized as the screen (Fig. 3) in the case of a television receiver or to direct the light to the screen (Fig. 2) whereby the anode surface is very close to the cathode, this light in turn strikes the cathode and again releases electrons which are directed back to the anode, thus making more light, and again repeating itself in a regeneration which continues to build up to a very high value. A resistor in the supply circuit for the phototube may be used to control or limit the extent of brilliance or regeneration thus produced.

The anode as well as the cathode may be formed on transparent surfaces to obtain the proper effect according to the example illustrated as an embodiment of the invention. These elements should be assembled very close together, which spacing is greatly enlarged in the drawings for the purpose of showing the electron paths therebetween.

If desired, the anode and cathode can be formed on opposite sides of the same sheet of transparent glass or mica plate, as indicated at 11 in Fig. 5, either in single or multiple assembly. The plates may be made very thin and stacked close together.

It is also possible to use multiple cathodes and anodes separately formed or mounted as indicated at 2 and 3 in Fig. 4. The multiple assembly of anodes and cathodes, as Figs. 4 and 5, increase the build-up of the regeneration, and yet the means used therefor is very simple and inexpensive, and lends itself readily to the increasing of the brilliancy of a lamp to any desired value without special or complicated amplifier structure, as has been required heretofore. The anode surfaces being coated with a phosphor produce a visible image transmitted thereto from the cathode, which in turn may receive light from any available source or the image from the television receiver.

As noted above, a lens may be used to form the image either from the back of the cathode, as in Fig. 3, or from the front thereof. By using appropriate transparent materials, the desired results may be obtained in either event.

This principle of light regeneration may be applied also in the field of electric lighting. An example thereof is illustrated in Fig. 6, in which I have shown a fluorescent lamp 20, a gaseous atmosphere or a vacuum, with a suitable fluorescent material, if desired.

The lamp 20 does not require the usual electrodes but space discharge will be produced according to the principle of this invention set forth above.

Mounted within the envelope 20 which forms the body of the lamp is a second tube 21, which is preferably glass, mica, or other suitable transparent material and which may be mounted in any desired manner within the tube 20. The latter also may be formed of glass in the conventional manner. The tube 21 preferably is open at opposite ends thereof although these ends may be closed.

The envelope 20 carries on the inner surface thereof a thin transparent metallic coating which may be combined with a fluorescent coating, if one is used, or applied thereover. The metallic coating will function as an anode for the regeneration provided therein.

The second tube 21 carries on the periphery thereof a photo cathode which coats with the anode described in producing a space discharge.

A source of electrical supply is indicated at 22 and a resistor at 23 to limit the regeneration in the tube. These elements are connected in a supply circuit with the anode and cathode, respectively, and the resistance serves also as ballast.

While there will be enough residual electrons in the light of the average room to start the functioning of the tube which will build up very fast, a starting filament can be used if desired, as indicated at 24, connected with a suitable source of electrical supply, the filament being incandescent and mounted in any suitable part of the lamp such as the end portion illustrated in Fig. 6.

The anode is coated with a phosphor, as described above. The photo cathode is so mounted in the tube 20 as to receive light therefrom and to direct the electrons therefrom onto the phosphor of the anode, thus making more light and increasing brightness of the lamp as the cycle of regeneration continues, until this is restricted by the resistor 23.

While I have illustrated and described certain embodiments of the invention, it is recognized that other variations and changes may be made therein without departing from the invention as set forth in the claim.

I claim:

1. An electric lamp comprising an envelope, a tube of transparent material mounted in the envelope, a transparent metallic coating on the inner surface of the envelope forming an anode, a fluorescent coating on said metallic coating, and a photo-cathode on the periphery of the tube.

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