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PHOTOELECTRIC TUBE

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Fig. 1

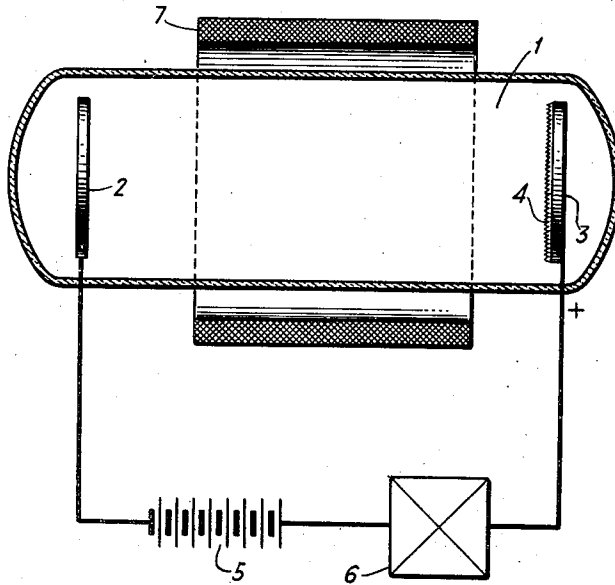
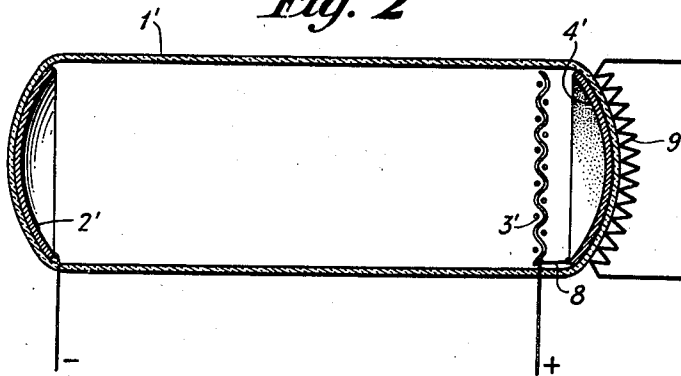


Fig. 2



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PHOTOELECTRIC TUBE

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2 Claims. (Cl. 250—27.5)

My invention relates to light sensitive devices and more particularly to a phototube capable of amplification within the tube.

In the conventional phototube the electric currents produced are too weak to be directly employed for the purposes intended. In view of this fact the photo-electric currents are amplified by means of special amplifier circuits; however this requires sensitive and expensive apparatus. It is the object of the present invention to provide a photo-electric tube of high power whereby amplification by means of additional amplifier circuits can be dispensed with.

According to the invention, this is accomplished by means of a fluorescent substance or material on the anode in the phototube, which substance is made to glow by the photo-electrons released from the photocathode by the impinging light, so that an increased release of electrons occurs.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which the Figure 1 is a schematic representation of a phototube in section embodying my invention and its associated circuit, and Figure 2 is a schematic representation of a modification of my invention.

In the figure, the envelope 1 of the phototube contains the photocathode 2 and oppositely disposed anode 3. The photocathode may be any of the conventional type cathodes and may have any of the usual structural shapes and may consist of a special plate, as shown, or it may be deposited on the wall of the vessel. Likewise, the anode may be of any shape other than that shown. According to the invention a layer 4 of fluorescent material is applied to the anode. The cathode and anode are connected in the conventional manner, to the positive and negative poles of a voltage supply battery 5 across the load 6. If light falls from the outside on the cathode, photo-electrons will be liberated therefrom which impinge on and bombard the anode after being accelerated by the anode potential. The kinetic energy of the photo-electrons will thereby be transformed into light by the fluorescent layer or coating 4, and this light will in turn add to the illuminations of the cathode thereby releasing more photo-electrons from the cathode. This action which may be designated as an optical feed back, may under suitable selection of the operating conditions be successively repeated resulting in an extremely high increase in the

photo-electric current. The photo-electric current can be increased by one hundred to one thousand times its initial value. It is desirable to have the cathode or the anode or both formed as concave surfaces whereby the concave sides face each other which can be accomplished in an especially simple manner when the electrodes are deposited on correspondingly curved parts of the wall of the vessel as shown in Figure 2. In this arrangement, dispersion of the photo-electrons as well as of the light in lateral direction will be avoided, so that all primary, secondary, and other photo-electrons will impinge on the anode, and the entire fluorescent light rays will be directed upon the cathode.

It is also possible to provide electron-optical reproducing elements such as electrical or magnetic fields or both, by means of which the photo-electrons will be directed into desired paths. In the figure there is shown for example for this purpose a coil 7 in cross section which surrounds the electron path. An especially large amplification will be obtained if the fluorescent substance is so chosen that its range of emission comes within the maximum spectral sensitivity of the photocathode.

Finally it may be advisable for example in view of the path of rays of the primary light, to arrange the fluorescent layer 4' separate from the accelerating anode 3' for instance in such manner that the anode is formed as a grid or net and placed between the cathode 2' and the fluorescent layer 4'. Also in this case the anode accelerates the photo-electrons to such velocity that its energy content causes the fluorescent layer 4' to glow. In this case the layer 4' will be electrically connected in a suitable manner for example by conductor 8 with the anode, so as to avoid disturbing space charges. With respect to the path of rays of the primary light it may eventually be advisable to provide a transparent cathode 2' so that the primary light can be radiated thereon from the rear.

If fluctuations of light which vary very rapidly are to be transformed into electric current, the inertia of the fluorescence, i. e. the slow dying-out of the luminescence may produce a disturbing effect. In this case it will be of advantage to provide means such as a heating resistor 9 which may be against the envelope 1' for heating the fluorescent layer so that the dying-out period will be much shortened.

Finally, in the application of the idea of the invention it is immaterial whether the phototube

is highly evacuated or whether a gas filling is provided.

The inventive idea can be correspondingly applied to any type of phototube other than described and shown. Thus it is possible to also correspondingly apply the feed back to blocking layer or resistance cells.

It is obvious that if desired, the high power photo-currents produced in this way within the tube may also be further amplified by additional amplifier arrangements.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is,—

1. A phototube having an elongated tubular envelope having closed ends providing concave surfaces facing each other, a photocathode on one of said concave surfaces and a fluorescent layer on the other concave surface of said envelope, and an anode, within said envelope, said anode and fluorescent layer being electrically connected.

2. A phototube having an elongated tubular envelope having closed ends forming concave surfaces facing each other, a photocathode on one of said concave surfaces and a fluorescent coating on the other concave surface of said envelope, and an anode within said envelope, said anode and fluorescent coating being electrically connected, and means for heating the fluorescent coating.

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