

Oct. 6, 1936.

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2,056,392

PHOTOELECTRIC APPARATUS AND METHOD OF OPERATING THE SAME

Filed Nov. 19, 1932

Fig. 1

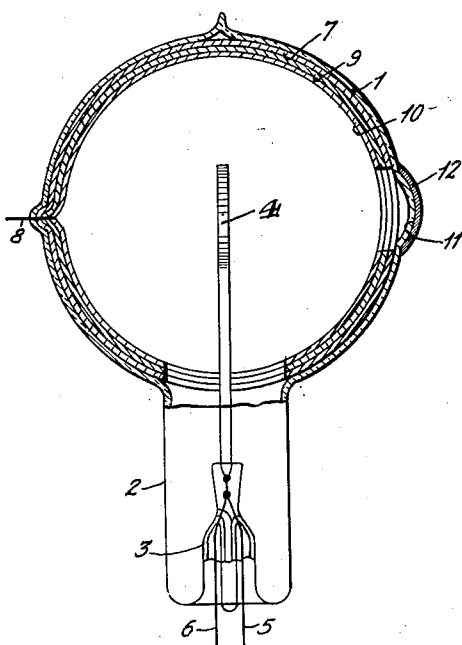
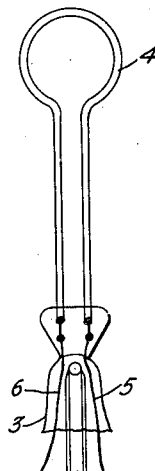


Fig. 2



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2,056,392

PHOTOELECTRIC APPARATUS AND METHOD OF OPERATING THE SAME

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Application November 19, 1932, Serial No. 643,320
In Great Britain June 14, 1931

1 Claim. (Cl. 250—27.5)

We have already devised a photo-electric tube comprising a photo-electric electrode in which are incorporated particles of a chemical compound mixed with particles of a photo-electric metal. Such a photo-electric tube is described and claimed in our copending application, Ser. No. 452,785 filed May 15, 1930. In fact, this tube comprises a cathode containing a layer consisting of a photo-electric material, for instance, caesium, which is carried by another layer containing particles of a chemical compound, for instance, calcium fluoride, mixed with particles of a photo-electric material, for instance, caesium. This layer may be applied in its turn to a metal substratum by which the supply of the electron current is facilitated.

In our copending application, Ser. No. 577,740, filed Nov. 28, 1931, is described and claimed a photo-electric tube having a cathode provided with a layer containing particles of a photo-electric metal, for instance caesium mixed with particles of an oxide of such a metal, for instance, caesium oxide, and particles of another metal, for instance, silver particles.

Experiments have proved that the sensitiveness of such extremely sensitive electrodes, i. e. the number of electrons emitted with definite exposure, is not constant, but decreases on irradiating the photo-electric electrode, provided a tension is applied to the electrodes. This decrease will be larger as the intensity of the exposure is greater. It has been found, for instance, that a tube which has been inoperative for some time and whose sensitiveness amounted to 30 micro-amperes per lumen, proved to have a smaller sensitiveness on irradiating the electrode with 0.5 lumen (2680° K.). After one hour, for instance, the sensitiveness amounted to 20 micro-amperes per lumen.

When being inoperative for some time the sensitiveness of such a tube increases again and after a sufficient rest it attains again its original value. This time interval may be considerably reduced by a short heating of the tube, for instance, for 1 minute to a temperature of 150° C.

This variation of the sensitiveness of the photo-electric tube is frequently a considerable nuisance. The present invention has for its purpose to obviate this drawback and relates to a photo-electric tube having a photo-electric electrode in which is incorporated a mixture of particles of a chemical compound and particles of a photo-electric material, and in addition to a method of operating such a tube.

According to the invention the photo-electric electrode of a tube of the type referred to above

is irradiated with light having such a composition that the ratio between the part of the light having a wave length of more than 5800 Å and the part having a wave length of less than 5800 Å is larger than this ratio for white light of a normal light source (electric vacuum or gasfilled incandescent lamp), in which light is emitted by an incandescent body. In fact, it has been found, that the light rays having a wave length of less than 5800 Å, i. e. essentially the green, blue and violet rays cause the decrease of the sensitiveness, whereas on the contrary rays having a wave length of more than 5800 Å, more particularly the red and the adjacent infrared rays further a constant sensitiveness. Consequently, if care be taken that the light with which the photo-electric electrode is irradiated, is relatively poorer in rays having a wave length of less than 5800 Å as compared with normal white light, then the decrease of sensitiveness is smaller during operation of the tube.

The invention is particularly advantageous when using a photo-electric tube having a photo-electric electrode containing a mixture of particles of a photo-electric metal, particles of an oxide of such a metal and in addition particles of another metal.

It has been found that, if the light used for the irradiation is relatively rich in rays having a wave length above 5800 Å the ratio between this part of the light and the part having a wave length under 5800 Å, is at least 10% larger than this ratio for white light emitted by an incandescent body, a considerable improvement with respect to a constant sensitiveness is yielded. Still better results are obtained if the difference between the said ratio amounts to 20% or even to 30%. It is also possible to proceed further and to irradiate the photo-electric tube with light substantially containing rays only having a wave length of more than 5800 Å.

The invention may be used in various ways. It is possible, for instance, to use a light source emitting substantially no or only a small quantity of rays having a wave length under 5800 Å. It is advantageous to use for this purpose an electric discharge tube filled with neon or sodium vapour.

In many cases it will be advisable, however, to provide a filter in front of the aperture of the photo-electric electrode through which enter the rays, said filter absorbing the light having a wave length of less than 5800 Å better than

light having a larger wave length. In this case ordinary white light sources may be used, for instance, electric incandescent lamps or the daylight. Preferably the filter is of such a nature that it is substantially transparent only for light having a wave length above 5800 Å. Excellent results have been obtained with filters showing a red colour when being traversed by light rays.

The filter may advantageously constitute part of the wall of the tube. It is possible, for instance, to make the whole wall of the tube or only the window for the passage of the rays of the material of which the filter consists. In general it will be simplest to apply the filter to the part of the tube wall transparent to the rays influencing the photo-electric electrode.

It is also possible to assemble the filter and the light source, for instance, by using an electric incandescent lamp having a red bulb as is usually employed in photography for instance.

The invention will be more clearly understood by reference to the accompanying drawing, representing, by way of example, a form of construction thereof.

Fig. 1 shows a photo-electric tube according to the invention, and

Fig. 2 shows a detail of this tube.

The photo-electric tube shown in Fig. 1 is highly evacuated and has a spherical wall 1 to which is sealed a tube 2. This tube is provided with a foot 3 carrying the electrode 4. As clearly appears from Fig. 2 this electrode is constituted by an almost entirely closed metal ring, whose ends are connected to the supply conductors 5 and 6.

On the wall 1 is provided a metal layer 7 consisting, for instance, of silver, said layer being electrically connected to the supply conductor 3 and coated with a layer 9 consisting of thoroughly mixed metal (silver) particles, particles of a photo-electric metal (caesium) and particles of an oxide of a photo-electric metal (caesium oxide). On this intermediate layer is provided a thin caesium layer 10.

This device is established in the following way. First of all a layer of a metal oxide, for instance, a silver oxide layer is produced which may be done by oxidizing a metal layer produced, for instance, by vaporization in a vacuum. However, the metal oxide layer may also be obtained in another manner, for instance, by vaporizing a metal oxide provided on an incandescible member mounted within the tube. After establishing the metal oxide layer an excess of a photo-electric metal, for instance, an alkali metal, is introduced into the tube, if desired, after a further exhaustion of the tube, whereupon the tube, which is not connected to a vacuum pump, is heated to such a temperature that the metal oxide is reduced and an oxide of the photo-electric metal is produced. The excess of photo-electric metal is made to penetrate into the produced mixture of metal particles and oxide

particles. It is advantageous to heat the tube gently for this purpose, for instance, to about 100° C. On the layer produced is also formed a thin alkali metal layer.

On reducing the metal oxide care must be taken that the tube is not heated to such an extent that the oxide of the photo-electric metal decomposes or volatilizes, or that the produced metal particles clog.

The method of establishing the photo-electric electrode is more amply set out in our United States patent application Serial No. 577,740.

It has been found that the passage of current produced in this tube when applying a tension to the anode by irradiating the photo-electric electrode with white light, gradually decreases with a constant intensity of irradiation. This drawback is avoided by irradiating the photo-electric electrode with light containing no or only a small quantity of rays having a wave length of less than 5800 Å. For this purpose the part 11 of the wall of the tube which part is not coated with the photo-electric material and serves for the passage of the light rays, is externally coated with a filter 12 (Fig. 1) showing a red colour on being traversed by light and consisting, for instance, of a lacquer layer containing a red colouring agent as is used, for example, in the manufacture of red lamps serving for photographic purposes.

It will be appreciated that the filter need not always be applied to the outer side of the window. It is also possible that the wall of the tube or the window is entirely constituted by the filter, for instance, by using a suitable red glass. Furthermore, it is also possible to arrange the filter so as to be loose from the wall of the tube and to locate it within the tube or in front of the window in the way of the light rays.

The rays having a wave length of less than 5800 Å are substantially entirely absorbed by the red filter, so that only rays having a greater wave length, viz. the red rays, may reach the photo-electric electrode. It has been found, that the sensitiveness of this electrode is practically constant on being irradiated with red rays. In a tube whose sensitiveness has decreased by irradiation with white light, the time required for re-establishing the original sensitiveness may be reduced by irradiating the photo-electric electrode with red light.

What we claim is:

The method of operating a photo-electric tube comprising the step of irradiating said tube with light, comprising a greater portion of light of wave length of more than 5800 Å units than of that less than 5800 Å units, the difference between the two portions of the light being at least ten percent of the sum of their amounts, whereby the sensitivity of the said tube remains constant irrespective of the time of irradiation.

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