March 17, 1936. T. H. LONG 2,034,586

PHOTOTUBE

Original Filed Jan. 17, 1931

Fig. 1.

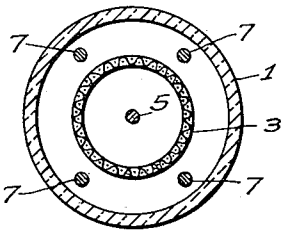


Fig. 2.

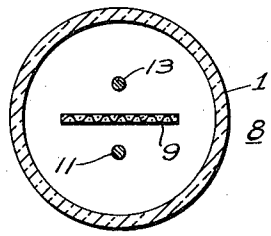


Fig. 3.

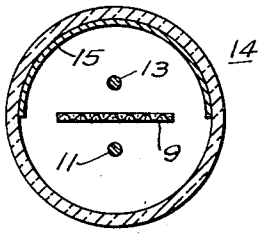


Fig. 4.

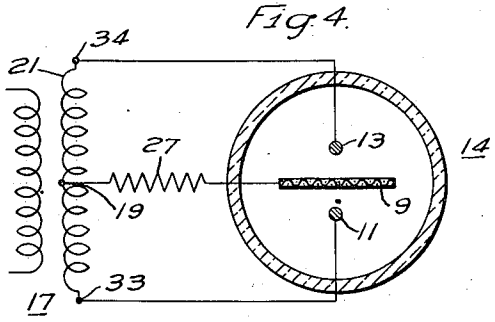


Fig. 6.

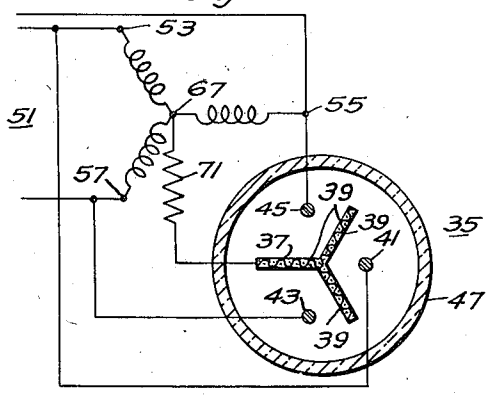
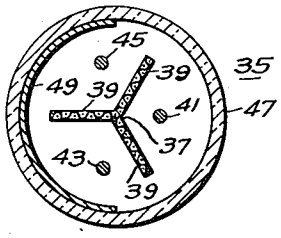


Fig. 5.



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UNITED STATES PATENT OFFICE

2,034,586

PHOTOTUBE

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Original application January 17, 1931, Serial No. 509,377. Divided and this application September 26, 1934, Serial No. 745,546

5 Claims. (Cl. 250—41.5)

My invention relates to photo-sensitive apparatus and has particular relation to apparatus in which a photo-sensitive device is energized from an alternating power source.

The present application is a division of my copending application Serial No. 509,377, filed January 17, 1931.

It is an object of my invention to provide a photo-sensitive system to be energized from an alternating-current power source, wherein the photo-sensitive device shall respond continuously regardless of the polarity of the potential applied thereto.

Moreover, by reason of the fact that the ordinary tube is conductive only during the time that half-cycles of an alternating-current power-supply source are impressed between its electrodes in proper polarity, its sensitivity, when it is utilized with the alternating-current power-supply source, is considerably smaller than its sensitivity when it is utilized with a direct-current power source.

It is, accordingly, an object of my invention to provide a photo-sensitive device that shall have a uniform response when subjected to the influence of an alternating-current power-supply source.

Another object of my invention is to provide a photo-tube adapted to deliver a continuous current when its photo-sensitive elements are subjected to the influence of light, and a potential from an alternating-current power supply source is impressed between its electrodes.

More concisely stated, it is an object of my invention to provide a photo-sensitive device of a type having a plurality of collecting electrodes so related to a photo-sensitive electrode that, when the device is subjected to the influence of a single-phase or a plural-phase potential, at least one collecting electrode is, at all times, adapted to collect the current from the photo-sensitive electrode.

According to my invention, I provide a photo-sensitive device of the type comprising a plurality of independent electrodes.

In the preferred embodiment of my invention, a single cathode is provided, and a plurality of anodes are associated with the cathode. The cathode is connected to the electrical center of the power-supply source, while the anodes are connected to the terminals of the source. As a result, the anodes are maintained at periodic potentials displaced in phase relative to each other of a predetermined angle.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and changes thereof, will best be understood from the following description of specific embodiments, when read in connection with the accompanying drawing, in which:

Figure 1 is a view, in transverse section, showing a photo-tube utilized in the practice of my invention;

Fig. 2 is a view, in transverse section, illustrating a modification of the tube shown in Fig. 1;

Fig. 3 is a view, in transverse section, showing a further modification of the tube illustrated in Fig. 1;

Fig. 4 is a diagrammatic view showing the essential elements of the circuit wherein a tube constructed according to Fig. 2 is utilized;

Fig. 5 is a view, in transverse section, showing a photo-tube utilized in a system constructed in accordance with my invention and energized from a three-phase source; and

Fig. 6 is a diagrammatic view illustrating the essential elements of the circuit wherein a tube constructed according to Fig. 5 is utilized.

The apparatus shown in Fig. 1 comprises a container 1 of transparent material wherein are disposed a cylindrical cathode 3 of perforated material and a plurality of anodes 5 and 7. The single anode 5 disposed within the cylindrical cathode 3 is adapted to be connected to one terminal of an alternating-current power-supply source, while the remaining anodes 7 are conductively connected and are adapted to be joined to another terminal of an alternating-current power-supply source.

The specific structure of the tube 1 will be apparent to one skilled in the art of manufacturing tubes and need not be specifically described herein.

In the tube 8 of the type illustrated in Fig. 2, the cylindrical cathode is replaced by a plane cathode 9 that is disposed between a plurality of independent anodes 11 and 13.

The tube 14, of the type illustrated in Fig. 3, has the additional feature of an internal reflecting surface 15 so disposed as to receive the light that is transmitted through the perforations of the cathode 9 and to reflect it back to the cathode. It is to be noted that the tube 14 can receive radiations only from the direction of the unsilvered surface of the container. It is, furthermore, understood that, in general, the tubes

are applied in situations wherein only a single source of light is available. A tube of the type illustrated in Fig. 3 has considerably higher sensitivity than tubes which are not provided with reflecting surfaces.

The apparatus illustrated in Fig. 4 comprises a transformer 17, the electrical center 19 of the secondary 21 of which is connected to the cathode 9 of a tube 14 through a load 27 of any type, (such as a mechanical relay or a thermionic amplifier, for example). The anodes 11 and 13 of the tube are connected to the terminals 33 and 34 of the secondary 21.

It is seen that the anodes 11 and 13 of the tube 14 are continually at potentials of opposite polarity; if one is positive relative to the cathode 9, the other is negative. As a result, a pulsating current flows through the load associated with the system. It will be noted that the system simulates a push-pull thermionic amplifier.

The tube 35 of the type illustrated in Fig. 5 is equipped with a cathode 37 comprising a plurality of plane surfaces 39 bounding a plurality of regions wherein the anodes 41, 43 and 45 are disposed. As illustrated in the view, the tube 35 is shown as equipped with a container 47 having a reflecting surface 49 similar to the container of the tube 14.

The apparatus shown in Fig. 6 comprises a three-phase line 51 to the terminals 53, 55 and 57 of which the anodes 41, 43 and 45 of a tube 35 of the type illustrated in Fig. 5, are connected, and to the electrical center 67 of which the cathode 37 of the tube is connected, through a load 71. It will be noted that, as the potentials impressed upon the anodes 41, 43 and 45 vary, each anode, in its turn, collects the current from the cathode 37.

Since the values of positive potential for the anodes 41, 43 and 45 overlap, the current supplied by the cathode 37 will, at times, be the sum of the current supplied to two anodes. By reason of this feature, the output of the system is rendered uniform, since, when one anode is decreasing in potential, the second anode is increasing and becomes positive before the former becomes negative. Hence, the increase in the potential of the latter anode tends to compensate for the decrease in the potential of the former anode.

It is understood that, although my invention has its most useful applications in the specific form described above and illustrated in the drawing in its most general application, it may be regarded as simply embodied in a plural electrode photo-tube.

As has been indicated above, my invention has been shown herein in certain specific embodiments. It has been applied to single-phase and to three-phase systems. It is understood that my invention equally as well applies to plural-phase systems of higher degree than three-phase.

While the principal features of my invention relate to its exercise in connection with tubes of the type having a single cathode and a plurality of anodes, or to tubes of the type having a single anode and a plurality of cathodes, it is equally well applicable to tubes of the type having a plurality of cathodes and a plurality of anodes, where such tubes prove useful.

Finally, it is well to point out that while, in the embodiments of my invention illustrated in Figs. 1 to 6, the cathodes are shown as perforated, there are certain connections wherein more than one source of light is usable and where, as a consequence, solid cathodes may be utilized.

Although I have shown and described certain specific embodiments of my invention, I am fully aware that many modifications thereof are possible. My invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. In combination a photo-sensitive device having at least two collecting electrodes capable of being maintained at independent potentials and a cathode having an electron-emissive surface of extended surface area, said electron-emissive surface being interposed between said electrodes whereby said electrodes are electrically shielded from one another, said electron-emissive surface having a photo-responsive surface on the side facing each electrode, a periodic power source having a plurality of terminal taps and an intermediate tap between which differences of potential are maintained, and means connecting the terminal taps of said source to said collecting electrodes and the intermediate tap to said electron-emissive surface.

2. Apparatus according to claim 1 characterized by that the periodic source is an alternating-current source, the terminal taps are maintained at potentials in substantially opposite phase to each other and the intermediate tap is maintained at a potential intermediate that of the terminal taps.

3. Apparatus according to claim 1 characterized by the electron-emissive surface being permeable to light and electrons, so that even light projected at any instant on said surface from a direction opposite one side will impinge also on the other side and electrons emitted from both sides of said surface will be collected by the collecting electrode that is positive relative to said surface.

4. In combination a plurality of anodes, an alternating current source having a plurality of terminals between which a difference of potential exists and a terminal the potential of which is intermediate that of said first-named terminals, means for connecting each of said anodes to one of said terminals, a cathode surface associated with each of said anodes, means for connecting all of said cathode surface to said last-named terminal and electrostatic shielding means interposed between said anodes.

5. In combination a plurality of anodes, an alternating current source having a plurality of terminals between which a difference of potential exists and a terminal the potential of which is intermediate that of said first-named terminals, means for connecting each of said anodes to one of said terminals, a photo-electric cathode surface associated with each of said anodes, means for connecting all of said cathode surface to said last-named terminal and electrostatic shielding means interposed between said anodes.

THOMAS H. LONG.