PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in or relating to Photo-sensitive Cells.

We, ARCTURUS RADIO TUBE COMPANY, a corporation of the State of Delaware, United States of America, of 260, Sherman Avenue, Newark, New Jersey, United States of America, Assignees of SAMUEL RUBEN, a citizen of the United States of America, residing at 801, Riverside Drive, City and State of New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to a photo-sensitive cell and more particularly it relates to a cell utilizing the change of resistance of a cuprous oxide body to vary the internal resistance and thereby the output potential of a cell. The object of the invention is the provision of a photo-electric cell that is durable and has a high degree of sensitivity.

This invention constitutes an improvement upon the photo-sensitive cells described in our co-pending application for Patent bearing the Number 27,260/1929 (318,641) and in United States Letters Patents, 1,694,189 and 1,694,190 issued to us.

We have found that in photo-sensitive cells having an electrode composed of a copper base coated with an integrally formed layer of cuprous oxide in the low speed modulations of impressed light rays there is good response, as when a few cycles per second are applied, and that when the light is modulated at high speed, as for example above 1,000 cycles, the response is negligible, due to the lag in the electrode. We have also found that if such an electrode, that is one having a copper base with a surface coating of an integrally formed layer of cuprous oxide, is immersed for a few hours in a suitable solution, such as a concentrated solution of ammonium chloride, the reaction produces a very notable change in the surface of the electrode, which originally is glass-like and smooth. After such immersion the surface is etched and is composed of a layer of large uniform cuprous oxide crystals. There is a slight reaction between the solution and the cuprous oxide producing a compound cupric-ammonia. A similar reaction is obtained with the immersion of the electrode material in a solution of zinc chloride. It appears evident that these chlorides while dissolving the cuprous oxide also assist in forming the crystal condition.

A cuprous oxide electrode so treated has a minimum lag and is capable of giving efficient response to light modulations with a frequency greater than 1,000 cycles; also many electrodes so treated show uniform characteristics. From tests made with many cells few of those not so treated responded promptly to the light effect at high frequencies; also different cells showed variations in electrical characteristics. Treated as described, these same cells show a high degree of uniformity and become responsive to high speed modulation of impressed light, rendering them applicable for use in the various arts such as television, telephotography, voice recording, etc. employing a cell sensitized to a proper degree the voltage rises from .1 millivolt to 0.5 volts with a change from light to dark. Above a certain light-sensitivity a condition of saturation is reached, dependent to some degree upon the resistance of the external circuit, when no further rise in potential occurs. As this cell does not depend upon any photo-voltaic effects for the generation of a potential, as applied in the prior art, with oxides and reacting liquids, it is sensitive to light of low intensity and throughout the entire visible spectrum. As its response is an electro-physical one, rather than a photo-chemical effect it is capable of sustained operation over long periods, with small variations of its initial characteristics. In a preferred form for the tubes of my invention, the electrodes are mounted on insulating compound, such as bees wax and resin and the exposed parts are in an electrolyte, such as a solution of .1% of ammonium chloride.

For a better understanding of the invention reference is made to the accompanying illustrations showing one embodiment of the invention, in which Fig. 1

illustrates a copper electrode before its treatment by oxidation at a temperature of 1000° C., Fig. 2 represents an electrode having a cuprous oxide surface, of a bright ruby red appearance, and Fig. 3 illustrates an electrode having a properly etched cuprous oxide surface.

In the several Figs., 1 represents a copper electrode. A cuprous oxide surface is represented by 2, while 3 represents that surface when etched, the crystalline formation being so indicated.

Referring to Fig. 4, E represents the glass envelope, containing the cuprous oxide coated electrode I, having an etched cuprous oxide surface 3, and embedded in bees wax and resin 6, and exposed in electrolyte 5, the cadmium electrode 4, being likewise embedded and exposed. The cadmium electrode is so placed as to have a minimum effect upon the impressed light as applied to the cell. The leads to the two electrodes are at T1 and T2.

In operation a potential is generated in the cell between the cadmium and the ammonium chloride. As this potential is available externally by the discharge of current through the cuprous oxide layer and as the contact and internal resistance of this layer varies photo-electrically with exposure of the etched surface of the cuprous oxide electrode to light rays, due to a reduction in the contact and internal resistance, the output potential available is increased with such exposure.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An electrode for use with photo-electric cells and having an etched cuprous oxide surface.

2. An electrode for use in photo-electric cells having a non-porous and homogeneous etched surface of cuprous oxide integral with the body of the electrode and having a portion of the electrode encased in an insulating compound.

3. An electrode as claimed in claim 1 or 2, in which a portion of the electrode is surrounded by an electrolyte.

4. A method of making an electrode for use in photo-electric cells which comprises heating a copper body in an oxidizing atmosphere until a cuprous oxide layer is formed upon its surface, and thereafter impressing the electrode in a dissolving chloride solution, whereby the cuprous oxide surface of the electrode is etched.

5. A method of making an electrode for use in photo-electric cells, as claimed in claim 4, in which a concentrated solution ammonium chloride is used to etch the cuprous oxide surface of the electrode.

6. A method of making an electrode for use in photo-electric cells, which comprises heating a copper body in an oxide atmosphere to a temperature of about 1000° C., and thereafter impressing the copper body so treated in a solution of ammonium chloride.

Dated the 30th day of September, 1929.

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FIG.1.

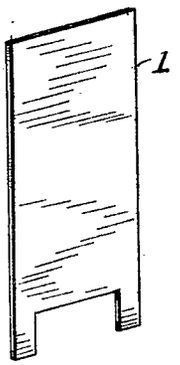


FIG.2.

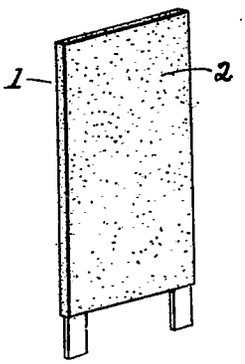


FIG.3.

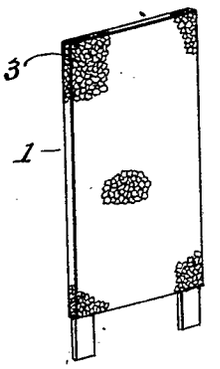
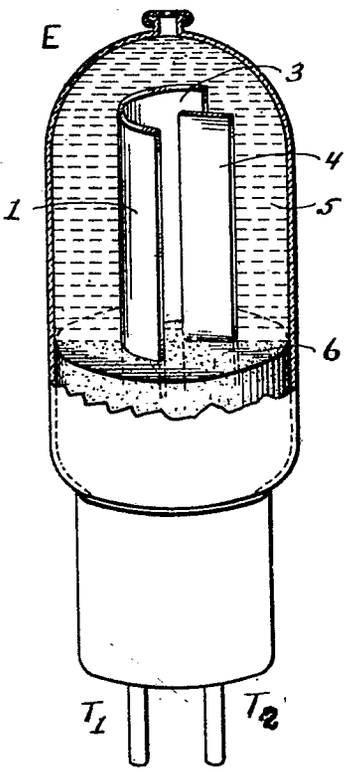


FIG.4.



[This Drawing is a reproduction of the Original on a reduced scale.]

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