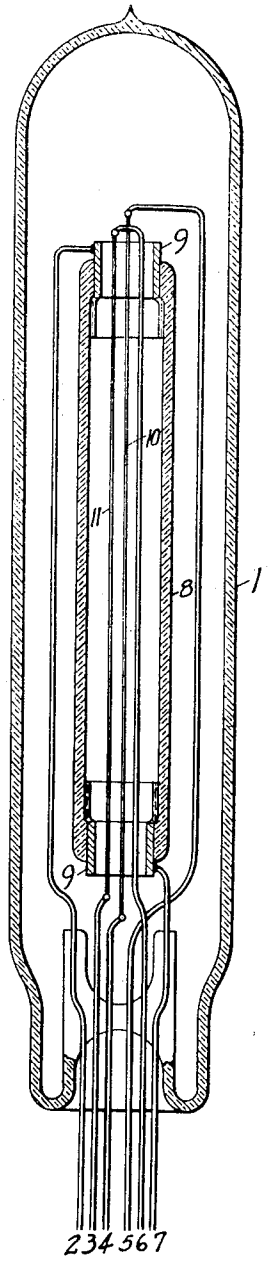
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PHOTO ELECTRIC TUBE

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PHOTO-ELECTRIC TUBE

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My invention relates to light-sensitive relays and particularly to such relays employing the photo-electric properties of the alkali metals.

An object of my invention is to produce a light-responsive relay of the photo-electron type which shall be stable in operation and unvarying in sensitivity.

A further object of my invention is to produce a photo-electric tube in which the light-sensitive coating may be deposited on a definite and predetermined portion of the tube and which will not vaporize and redeposit upon the parts of the tube intended to remain transparent.

Other objects of my invention will become apparent throughout the following specification taken in connection with the appended drawing, wherein

The single figure is a longitudinal section of a photo-electric tube embodying my invention.

A photo-electric tube comprising an evacuated glass container having a pair of electrodes, one of which comprises a surface of alkali-metal, is already known in the art. In one convenient form of such tube the alkali metal is deposited in the form of a thin film upon which light is projected through a transparent window in a portion of the tube wall. It is a defect of such tubes that the relatively volatile alkali-metal tends to vaporize in the course of time from the surface on which it is originally deposited and to deposit on the portion of the tube wall which is intended to remain transparent in order to permit the entry of light. This results in a decrease in the sensitivity of the tube both because the photo-sensitive material disappears from the electrode on which it was intended to be the active constituent and because its deposition on a portion suspended in position of the light window cuts off the activating beam.

In accordance with my invention, I avoid both of the above mentioned defects by depositing a thin film of an alkali-metal to constitute the photo-electric surface, superposed upon a film of a more stable metal, such as tungsten or molybdenum. This film, being so thin that it is relatively transparent to light, does not, to any substantial extent, cut down the emission of photo-electrons by the alkali-metal surface but does have the property of preventing the vaporization of the latter. The disappearance of the alkali metal from the portion of the tube in which it was originally deposited, and its deposition on other parts of the tube wall, with the consequent defects described above, is thereby avoided.

Referring to the drawing, my photo-electric tube consists of an evacuated glass tube 1, of an ordinary type, through one end of which are sealed in the wires 2, 3, 4, 5, 6 and 7. Wires 2 and 7 extend above the press and act as supports for an interior glass tube 8.

In the tube, as originally made up, the glass tube 8 is perfectly clear. Inside each end is inserted a copper collar 9 which fits tightly against and is fused to, the glass. The fused joint and a small length of the glass tube adjacent thereto is coated inside with silver by any of the well-known silver deposition processes. The copper collars 9 are welded, respectively, to the support wires 2 and 7 and thus hold the glass tube 8 firmly in position coaxial with the container 1.

The inleading wire 5 is extended high above the press outside of the tube 8, and a filament 10 of tungsten or molybdenum is positioned in the axis of the tube 8 between the ends of the support wire 5 and the in-leading wire 4. The inleading wire 6 is extended high above the press and a filament 11 of platinum or nickel coated with potassium nitride or sodium nitride, or some other salt of an alkali-metal, is connected in position inside the tube 8 between the ends of the support wire 6 and the inleading wire 3.

The tube so constructed is evacuated, by methods well-known in the art, to a high degree of vacuum and, while still on the pump, current is passed through the filament 10, by means of the leads 4 and 5, to heat it to such temperature that the interior of the tube 8 is covered uniformly by a thin film of metal. The proper thickness may be determined by resistance measurements. For example, a tube one inch long and ¼" inside diameter should have a resistance of one megohm. Current is then passed through the filament 11, by means of its inleading wires, and a thin film of the alkali-metal is deposited over the surface of the noble metal. The film of the noble metal, made in accordance with the foregoing directions, will be of such thickness as to prevent evaporation of the alkali-metal but still will be transparent to light. In fact, the two films together may be so thin as to be transparent.

When it is desired to use the photo-electric tube which I have described, one terminal of a source of electro-motive force may be connected, through one of the leads 2 and 7, to one of the copper rings 9, and the other terminal of said source may be connected to any one of the remaining inleading wires. Current is conducted from the rings 9, through the silver film, to the potassium and molybdenum films aforesaid and

flows from those surfaces to the filament 10 or the filament 11 to which the other terminal of the source has been connected. By varying the amount of light which strikes the surface of the molybdenum and potassium film, the amount of current which a given electro-motive force will cause to flow through the interior of tube 8 will vary correspondingly. Current from this source will, therefore, be modulated in accordance with the amount of light permitted to strike the interior surface of the tube 8. Otherwise, the mode of operation of my photo-sensitive tube is similar to that of tubes at present well-known in the art and needs no separate description.

While I have referred to the photo-electric film deposited on the tube 8 as being of potassium, it will be recognized that a film of any of the other photo-sensitive metal may be deposited thereon by the same process; rubidium or cæsium for example. Any of the known processes for deriving metallic films, such as distillation from the pure metal instead of a compound like the nitride above described, may be used.

Similarly, while the superposed layer has been described as being tungsten or molybdenum it will be recognized that any other suitable metal may be deposited by substantially the same process.

While I have described a particular embodiment of my invention as required by the patent statutes, it will be apparent to those skilled in the art that many modifications of the structure which I have chosen to describe may be made without departure from the principles of my invention. I desire, therefore, that the terms of the appended claims to be given their broadest reasonable interpretation and that they be limited only by their express language and by the requirements of the prior art.

I claim as my invention:

1. A photo-electric cathode comprising a transparent layer of substance having a tendency to vaporize, superimposed upon a transparent layer of a metal having a lower vapor-pressure.

2. An evacuated container enclosing a photo-electric element comprising a transparent film composed of a photo-electric metal and another metal and means cooperating therewith to make an operating device.

3. An evacuated container enclosing a photo-electric element comprising a transparent film consisting of an alkali metal and a metal having a lower vapor-pressure and means cooperating therewith to make an operating device.

4. A photo-electric tube comprising a vacuum tight container and a transparent layer thereon comprising a photo-electric metal and a metal having lower vapor-pressure and means cooperating therewith to make an operating device.

5. A photo-electric tube comprising a container, a cathode structure extending axially through a portion of said container and an anode structure extending axially through said portion of said container, said cathode structure and said anode structure being axially symmetrical, the outer electrode structure being transparent.

6. A photo-electric tube comprising a container, a cathode structure extending axially through a portion of said container and an anode structure extending axially through said portion of said container, said cathode structure and said anode structure being axially symmetrical, the outer electrode structure of said cathode and anode structures being spaced from the wall of said portion of the container and also being transparent.

VLADIMIR K. ZWORYKIN.