Aug. 1, 1950

E. A. RICHARDS ET AL

2,516,916

PHOTOELECTRIC CELL

Filed Jan. 5, 1946

Fig. 1.

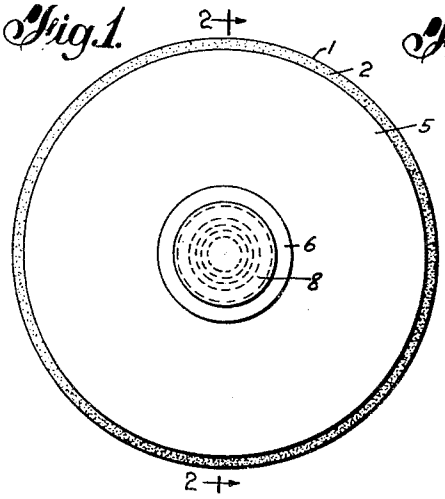


Fig. 2.

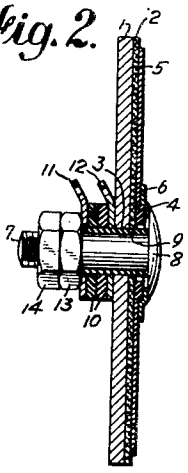


Fig. 6.

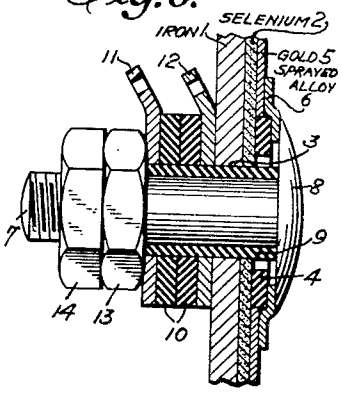


Fig. 3.

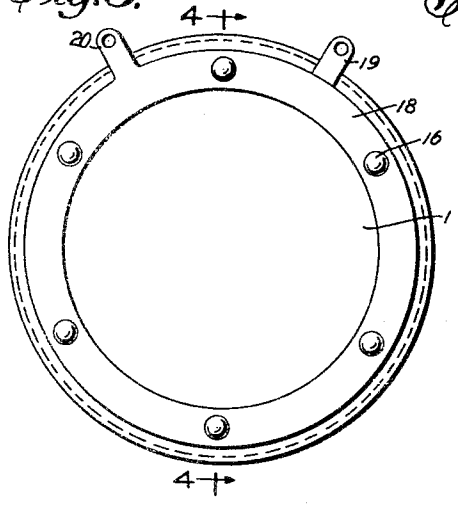


Fig. 4.

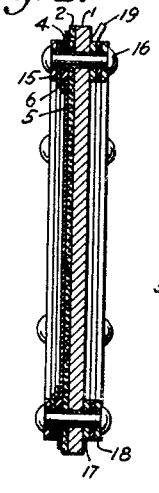


Fig. 5.

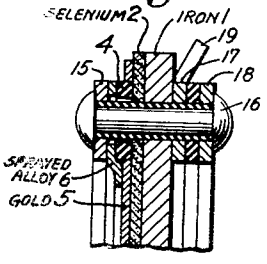


Fig. 7.

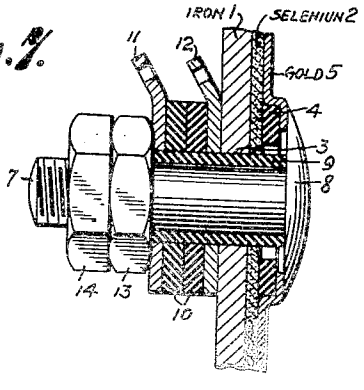
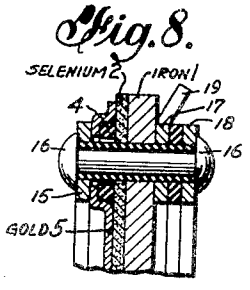


Fig. 8.



INVENTORS
EDWARD A. RICHARDS
WILLIAM E. PEASE
BY
Robert Harding Jr
ATTORNEY

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PHOTOELECTRIC CELL

Edward Arthur Richards and William Edward Pease, London, England, assignors, by mesne assignments, to International Standard Electric Corporation, New York, N. Y., a corporation of Delaware

Application January 5, 1946, Serial No. 639,469
In Great Britain February 6, 1945

8 Claims. (Cl. 136—89)

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The present invention relates to improvements in the construction of photoelectric cells.

Photoelectric cells of the self-generating type are commonly constructed by coating one side of a metal disc or plate with a light-sensitive material such as selenium, which is subjected to suitable heat treatment to convert it to the correct crystalline form. The active surface is then covered by a layer of conducting material such as gold which is so thin as to be translucent. This is usually accomplished by electrostatic deposition or by sputtering in a high vacuum. When the finished cell is put into use, it is necessary to make electrical connections to the plate supporting the selenium and to the conducting layer on the surface of the selenium. In order to make this latter connection, it is usual to mask the surface and then to apply a ring of alloy with a low melting point to the gold or other metal near the periphery of the disc. Connection is then made by light spring contacts which press on this ring of alloy and on the back of the plate. There are certain disadvantages in this arrangement, since the contact pressure must be very light in order to avoid damage to the electronic layer between the gold and the selenium. It is therefore difficult to make good electrical contact of a permanent nature and the contacts are liable to corrosion if a trace of moisture is present. The cell is frequently sealed against the ingress of moisture by the use of transparent varnish or other material, but this is liable to percolate between the alloy ring and the contact springs and to produce a bad contact.

Similar difficulties have been experienced with dry contact metal rectifiers and as described in our U. S. Patent No. 2,314,104 filed Feb. 23, 1940 and issued March 16, 1943 they have been overcome by insulating the semi-conducting layer of selenium or the like from the counter electrode over a limited area. It is then possible to apply sufficient contact pressure to the counter electrode over this limited area to prevent bad contacts without affecting the properties of the semi-conducting layer.

The principal object of this invention is to overcome the above-mentioned disadvantages by similar methods and to produce a robust assembly which can be rendered moisture-proof in any suitable manner without in any way interfering with the electrical connections to the cell.

This object is achieved according to the invention by providing a photoelectric cell comprising a metal base plate having a coating of light-sensitive material on the surface thereof, and a

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light-permeable electrically conducting counter-electrode covering the surface of the light-sensitive material, in which the light-sensitive material is electrically insulated from the counter-electrode over a limited portion of the area covered thereby.

The invention also provides a photoelectric cell comprising a metal base plate, a coating of light-sensitive material on the surface of the base plate, thin electrically insulating means covering a limited area of the surface of the said light-sensitive material, an electrically conducting layer of diaphanous material covering the remainder of the light-sensitive surface, a second layer of electrically conducting material secured to the surface of the said insulating means and extending also over a small portion of the surface of the diaphanous layer so as to make electrical contact therewith, and terminal means insulated from the base plate and clamped in contact with the said second layer over the whole or part of the said limited area. According to a modification, the second layer of conducting material is omitted and the diaphanous layer itself is made to extend over the insulating means so that the terminal means makes direct contact therewith.

In one form of photoelectric cell according to the invention a metal disc or plate is coated with selenium and subjected to the usual heat treatment, and the portion of the surface to which electrical connection is ultimately to be made is covered with a suitable electrically insulating enamel or varnish, or with a ring or washer of paper or other insulating material firmly cemented to the selenium surface. The remainder of the surface is then sputtered with gold or other translucent or transparent material and finally a layer or a low melting point alloy is applied over the insulated portion so as to overlap slightly the protected area. Any reasonable amount of pressure can then be applied over the insulated area without risk of damage to the sensitive surface.

Two methods of construction employing this arrangement will be described. In the first, the selenium-coated disc or plate has a central hole, and the insulating layer is applied to a central annular area surrounding this central hole. After the remaining surface has been sputtered with gold, a ring of alloy is sprayed on to at least part of this remaining surface so as to overlap slightly the outer circumference of the ring of insulation. Whilst this operation is being carried out, the edges of the hole are masked so as to leave a narrow uncoated ring at the center to

avoid the possibility of a short-circuit between the alloy and the supporting plate.

In the second arrangement the insulating ring is applied near the periphery of the disc before carrying out the sputtering process. A ring of alloy is then sprayed over the insulated area, the working surface of the disc being suitably masked in order to limit the width of the ring. Electrical connection is made by clamping a metal ring on to the disc over the insulated area.

Even when the electrical connection is made at the center, it may be convenient to apply an additional insulating ring at the periphery so that the disc may be mounted in a suitable housing and secured firmly around the outside edge without risk of damage to the sensitive surface.

Figs. 1 to 8 of the accompanying drawing illustrate several forms of the invention. Fig. 1 shows a front view of a photoelectric cell having a center contact arrangement, and Fig. 2 shows a sectional view at 2—2 of Fig. 1.

Fig. 3 shows a back view of a cell having a circumferential contact arrangement, and Fig. 4 shows a sectional view taken at 4—4 of Fig. 3; Fig. 5 shows an enlargement of a detail of Fig. 4; Figure 6 shows an enlarged view of a portion of Figure 2; and Figures 7 and 8 show alternative forms of the arrangements of Figures 2 and 4, respectively.

Referring to Figs. 1, 2 and 6, the photoelectric cell comprises a metal disc 1 of the iron group having a coating 2 of selenium applied in any suitable way and heat treated in the customary manner to develop the desired properties of the selenium. The disc 1 has a central hole 3 around which is co-axially fixed an annular insulating disc 4, which may be a varnish or the like applied in any convenient way, or it may be a washer of paper or other suitable insulator firmly cemented or otherwise secured to the selenium surface. The remainder of the surface of the selenium is then covered by sputtering with a thin translucent layer 5 of gold or the like, and an annulus 6 of silver or other suitable low melting point alloy is sprayed through a mask over the insulating disc 4. The mask should preferably be so designed that the annulus 6 extends slightly over the surface of the layer 5 so as to make contact therewith, and so as to allow a narrow uncovered margin round the periphery of the central hole to prevent short circuiting with the disc.

A bolt 7 with a broad head 8 is passed through the central hole and is insulated from the disc 1 by means of the insulating sleeve 9 and insulating washer 10. Terminal punchings 11 and 12 are provided for making external connections to the conducting layer 5 and to the disc 1 respectively, and the whole assembly is clamped tightly together by means of the nuts 13 and 14.

It will be seen that the pressure is exerted over the area covered by the annular insulating disc 4, so that the sensitive surface is not injured by the pressure. A good electrical contact is thus ensured, and the disc may be finished by a moisture proofing varnish without the risk of impairing the electrical contact.

It is to be noted that a broad headed rivet may be used instead of the bolt 7, in which case the nuts 13 and 14 are not required, and the parts are then secured by spreading out the end of the rivet.

An alternative form of the photoelectric cell is shown in Figs. 3, 4 and 5. In this case the disc 1 has no central hole, and the annular insulating disc or washer 4 is a narrow ring near the periphery of the disc. The alloy annulus 6 is also a narrow ring sprayed over the disc or washer 4 and overlapping the sputtered gold layer 5 slightly on the inside of the ring as shown in Fig. 5. A metal clamping ring 15 is clamped against the annulus 6 by means of six or other suitable number of rivets 16 (or screw bolts) insulated in the manner shown for the bolt 7 in Fig. 1. Two metal terminal rings 17 and 18 are clamped by the same rivets in electrical contact respectively with the disc 1 and with the ring 15. These terminal rings are provided with connecting tags 19 and 20.

It should be pointed out that if the gold that is used for the transparent or translucent or diaphanous layer 5 contains sufficient alloying material to provide the necessary degree of hardness, the alloy annulus 6 could be omitted and the diaphanous layer could be extended over the surface of the insulating ring 4, as shown in Figures 7 and 8 so that in that case direct contact is made between the bolt 7 (or the clamping ring 15) and the conducting layer 5.

As in the case of Figs. 1 and 2, the disc shown in Figs. 3, 4 and 5 could be moisture proofed without any risk of producing a bad electrical contact.

Reference is also made to copending application Serial No. 639,470, filed January 5, 1946, and which discloses improvements in the form of the insulating disc disclosed herein.

What is claimed is:

1. A photoelectric cell comprising a metal base plate, a coating of light-sensitive material on the surface of the base plate, thin electrically insulating means covering a limited area of the surface of the said light-sensitive material, an electrically conducting layer of transparent material covering the remainder of the light-sensitive surface, a second layer of electrically conducting material covering the surface of the said insulating means and extending also over a small portion of the surface of the transparent layer so as to make electrical contact therewith, and terminal means insulated from the base plate and clamped in contact with the said second layer over at least part of the said limited area.

2. A photoelectric cell comprising a metal base plate having a central hole, a selenium coating on the surface of the base plate, an annular layer of insulating varnish around the said hole on the surface of the selenium, a translucent metal layer covering the remainder of the selenium surface, an annular layer of a low melting point metallic alloy covering the said layer of insulating varnish and extending partially over the said metal layer, and electrical terminal means clamped in contact with the alloy layer, the contact pressure being exerted upon the base plate substantially only over the area covered by the insulating varnish.

3. A photoelectric cell according to claim 2 in which the base plate has a central hole surrounded by the said annular layer of insulating varnish, and in which the electrical terminal means comprises a bolt insulated from the plate and passing through the said hole and having a head clamped in contact with the alloy layer within the area of the layer of insulating varnish.

4. A photoelectric cell according to claim 2 in which the base plate is in the form of a circular disc, the annular layer of insulating varnish being substantially around the periphery of the disc and in which the electrical terminal means comprises a metal clamping ring clamped in contact

with the alloy layer within the area of the layer of insulating varnish by means of bolts or rivets insulated from the disc.

5. A photo-electric cell comprising a metal base plate having a central hole, a selenium coating on the surface of the base plate, an annular washer of insulating material around said hole and attached to the surface of the selenium, a translucent metal layer covering the remainder of the selenium surface, an annular layer of a low melting point metallic alloy covering the said washer and extending partially over said metal layer, and electrical terminal means clamped in contact with the alloy layer, the contact pressure being exerted upon the base plate substantially only over the area covered by the insulating washer.

6. A photoelectric cell according to claim 2 in which the translucent metal layer is a layer of gold.

7. A photo-electric cell comprising a metal base plate having a center hole, a selenium coating on the surface of said base plate, and annular washer of insulating material cemented to said selenium coating, a translucent metal layer covering the remainder of the selenium surface, an annular layer of a low melting point metallic alloy covering the said annular washer and extending partially over the said metal layer, and electrical terminal means clamped in contact with the alloy

layer, the contact pressure being exerted upon the base plate substantially only over the area covered by the insulating washer.

8. A photoelectric cell comprising a metal base plate having a center hole, a selenium coating on the surface of said base plate, and annular washer of insulating material cemented to said selenium coating, a translucent metal layer covering the remainder of the selenium surface, an annular layer of a low melting point metallic alloy covering the said annular washer and extending partially over the said metal layer, and electrical terminal means clamped in contact with the alloy layer against substantially only that portion of the alloy covering said annular washer.

EDWARD ARTHUR RICHARDS.
WILLIAM EDWARD PEASE.

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