

T. W. CASE.  
 PROCESS OF PRODUCING PHOTO-ELECTRIC CELLS.  
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1,376,604.

Patented May 3, 1921.

Fig 1.

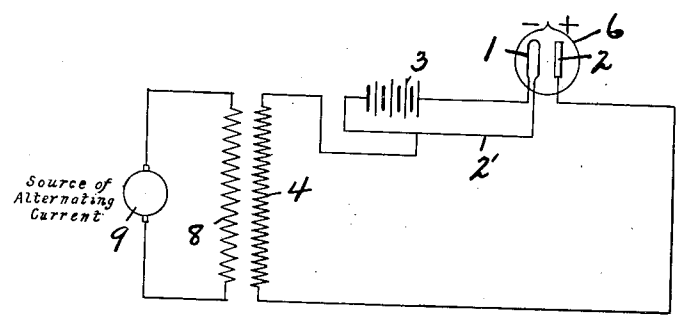
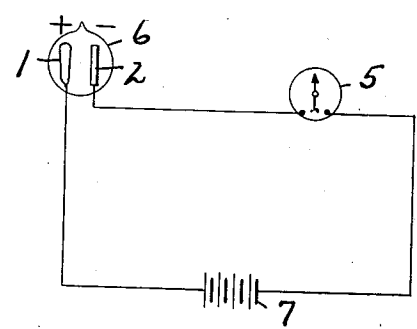


Fig 2.



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# UNITED STATES PATENT OFFICE.

THEODORE W. CASE, OF SCIPIO, NEW YORK.

PROCESS OF PRODUCING PHOTO-ELECTRIC CELLS.

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Specification of Letters Patent.

Patented May 3, 1921.

Application filed August 27, 1920. Serial No. 406,462.

*To all whom it may concern:*

Be it known that I, THEODORE W. CASE, of Scipio, in the county of Cayuga, in the State of New York, have invented new and useful  
5 Improvements in Processes of Producing Photo-Electric Cells, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

10 This invention relates to certain improvements in processes of manufacturing photo-electric cells.

The object of the invention is to produce a highly efficient cell of the character described, and which shall be of simple construction, unusually constant and uniform  
15 in re-action and relatively permanent in its activity.

Other objects and advantages relate to the details of the process involving certain preferred, but perhaps non-essential steps, all of which will more fully appear from the following description taken in connection with the accompanying drawings, in which:—

25 Figure 1 is a diagrammatic view illustrating a method of carrying out one step of the process.

Fig. 2 is a diagrammatic view illustrating a manner of use of the photo-electric cell as produced by this invention.

30 The process comprises primarily the coating of an electrode capable of being heated, such as a filament with a suitable material, as, for instance, metallic oxid such as strontium oxid, barium oxid or calcium oxid.  
35 This coating may be produced upon the filament in any suitable way as by dipping the same in strontium nitrate, barium nitrate or calcium nitrate, respectively, at a suitable temperature to cause the same to flow  
40 upon the filament, and thereby changing the nitrates of the elements to the oxids.

The coated filament is then placed in an ordinary glass tube or bulb opposite a metallic electrode as for instance a nickel plate.  
45 The bulb is then evacuated and the whole is baked at such a temperature as may be suitable for eliminating practically all traces of gases. Then the heated filament and metallic electrode are connected in circuit with  
50 a source of sufficiently high potential so as to heat the plate red hot, thus driving off from the metallic electrode any remaining traces of gases and oxygen.

55 The metallic electrode temperature is then

reduced by regulating the potential to that found by experiment most suitable under the circumstances for the particular operating conditions. A suitable circuit has been provided containing a source of potential  
60 for heating the filament. When the filament temperature is high enough, the coating thereon is thrown off in relatively small particles.

By connecting the filament and metallic electrode in a circuit containing a suitable source of potential, the thrown-off material of the coating applied to the filament is to a very large extent caused to be deposited upon the metallic electrode. In other words,  
70 the high potential existing between the electrodes acts as a directive agency and causes the thrown-off material to deposit upon the plate in a thin layer where it is continuously bombarded by the cathode rays or electrons  
75 emanating from the heated filament.

It is believed that when the filament, as described, is coated with a metallic oxid such as barium oxid, that the oxid is lost when the material is thrown off from the filament and that the deposit upon the  
80 metallic electrode is substantially pure metal, as for instance, barium, strontium, calcium, or a compound of sodium and potassium, dependent upon the character of the coating.  
85 Whether the reduction is due to the bombardment of electrons or not is not known.

Although a high potential direct current is suitable for the purpose described, the applicant in his work has usually incorporated a transformer in the circuit whereby  
90 the potential of the alternating current available was stepped up to an extent suitable for most effectively acting as a directive agency of the material thrown off from the  
95 heated filament. During this step of the operation the tube or bulb is connected to a suitable vacuum pump for maintaining a substantially complete vacuum within the  
100 bulb.

The deposition may be maintained for stated intervals, as, for instance, five minute periods, and after each such period the photo-electric qualities of the cell may be tested in comparison with a constant source  
105 of light, and when the maximum re-action is obtained, or the action desired, the vacuum pump may be shut off and the tube containing the filament and metallic electrode sealed.

During the process of manufacture, when 110

using a direct current, the potential in the circuit is so arranged as to maintain a positive potential upon the metallic electrode and a negative potential upon the filament.

5 In Fig. 1 I have diagrammatically illustrated a hookup suitable for carrying out the depositing step of this process in which the filament —1— is connected in an independent heating circuit —2— with a source  
10 of potential —3— and in which the circuit between the filament —1— and metallic electrode —2— includes the secondary —4— of a transformer, the primary —8— of which is connected in circuit with a suitable source  
15 —9— of alternating current. The secondary of the transformer embodies a considerably larger number of coils than the primary to produce desired voltage. When the process of producing the cell is completed, as  
20 described, the filament is thereafter used as an unheated electrode, and any other form of electrode may be substituted.

In Fig. 3 I have illustrated the cell in a hook-up suitable for measuring light intensity in which two electrodes are connected  
25 in circuit with a source of potential —7— and a galvanometer —5—. Variations in the light rays to which the cell (which includes the electrodes —1— and —2— and  
30 the vacuum tube or bulb —6—) is exposed will be accurately indicated in a known standard of measurement by the galvanometer —5—.

This process of manufacture permits the  
35 deposit of two or more metals at practically the same time upon the electrode —2— which is illustrated as in the form of a plate, but may be in any other form desired. Such a result may be obtained by coating the  
40 filament or heatable electrode with the two or more materials (such as barium oxid and strontium oxid) desired to form the sensitive element of the cell, and by carrying out the method as herein  
45 described, the two or more coatings will be thrown off from the filament and will deposit upon the metallic electrode and constitute a unitary coating thereon.

All traces of oxygen should preferably be  
50 removed from the bulb —6— but it may be desirable at times, and my invention permits of introducing into the bulb —6— a quantity of an inert gas such as Argon or Helium. Under such circumstances it may be sug-  
55 gested that the photo-electrons emitted by the action of light ionize the inert gas by compact resulting in maximum conductivity.

The physical structure of the metal so deposited is not at present known with absolute  
60 certainty, and the theory of the action that results in the unexpected sensitivity of the element so produced is more or less a matter for intelligent speculation, and the applicant hesitates to state positively any  
65 definite theory and desires to confine him-

self to the demonstrated fact that the element so produced is highly sensitive and relatively permanent in its activity, but with this reservation it may be suggested as indicative of applicant's present theory that 70 the metal deposited is in a peculiar structural condition resultant from the fact of its deposit in the manner described under constant bombardment by cathode rays or electrons. 75

The process above described permits of practically perfect control in the manufacture of cells of uniform action. Further, the method offers a substantially perfect control  
80 in obtaining the desired spectral sensitivity of the cell by combining the proper substances on the filament to be deposited on the metallic electrode, and by permitting control of the deposition by proper potential between the electrodes and proper tem- 85 perature.

Although I have described a particular process embodying specific details as illustrative of a method of producing the per-  
90 haps preferred product, yet many of the preferred details and some of the steps described as useful in producing such a preferred product may be omitted, or substitutions may be made therefor without departing from the invention as set forth in 95 the appended claims.

What I claim is:

1. The process of producing a photo-electric cell comprising coating a heatable electrode with suitable material, inclosing said  
100 electrode and a second electrode in a vessel under vacuum, heating said electrode to throw off said coating connecting said electrodes in an electrical circuit, whereby the said thrown-off material deposits on the  
105 second electrode under bombardment of electrons.

2. The process of producing a photo-electric cell comprising coating a filamentary electrode with suitable material, inclosing  
110 said electrode and a second electrode in a vessel under vacuum, heating said electrode to throw off said coating connecting said electrodes in an electrical circuit, whereby the said thrown-off material deposits on the  
115 second electrode under bombardment of electrons.

3. The process of producing a photo-electric cell comprising depositing a coating of light, re-active material upon one of the  
120 electrodes as it is thrown off from the other electrode.

4. The process of producing a photo-electric cell comprising depositing a coating of light, re-active material upon one of the  
125 electrodes as it is thrown off from the other electrode by the action of heat.

5. The process of producing a photo-electric cell comprising depositing a coating of light, re-active material upon one of the elec- 130

trodes as it is thrown off from the other electrode, and subjecting such material as deposited to bombardment by cathode rays.

6. The process of producing a photo-electric cell comprising depositing a coating of light, re-active material upon one of the electrodes as it is thrown off from the other electrode by the action of heat and subjecting such material as deposited to bombardment by cathode rays.

7. The process of producing a light reactive electrode, comprising coating an electrode with suitable material, inclosing said electrode and a second electrode in a vessel under vacuum, heating said electrode having the light reactive coating to throw off said coating, connecting said electrodes in an electrical circuit, whereby the said thrown-off material is directly deposited in a layer on the second electrode under electron bombardment.

8. The process of producing an electrode embodying a layer of light reactive material, consisting in inclosing two electrodes in a vacuum vessel, one of which electrodes comprises a material desired to form the layer upon the other electrode, connecting said electrodes in a circuit, including a source of potential, heating the said electrode which comprises the material desired to form the

layer to disintegrate the said material and cause it to be thrown off, and directly deposited in the form of fine particles upon the other electrode under electron bombardment.

9. The process of producing an electron-emitting cathode comprising depositing a layer of suitable material upon an element constituting a portion of said cathode, while the said element is operatively connected in circuit, as an anode, with another electrode, which comprises the material to be deposited.

10. The process of producing an electron-emitting cathode comprising coating a heatable electrode with suitable material, inclosing said electrode and a second electrode in a vessel under vacuum, heating the said heatable electrode to throw off the said coating, connecting said electrodes in an electrical circuit whereby the said thrown-off material deposits on the second electrode in the form of fine particles and under bombardment of electrons.

In witness whereof I have hereunto set my hand.

THEODORE W. CASE.

Witnesses:

CARL J. SPONABLE,  
JOHN TABER.