

Nov. 2, 1937.

C. H. PRESCOTT, JR

2,097,467

PHOTOELECTRIC TUBE

Filed Aug. 11, 1930

2 Sheets-Sheet 1

FIG. 1

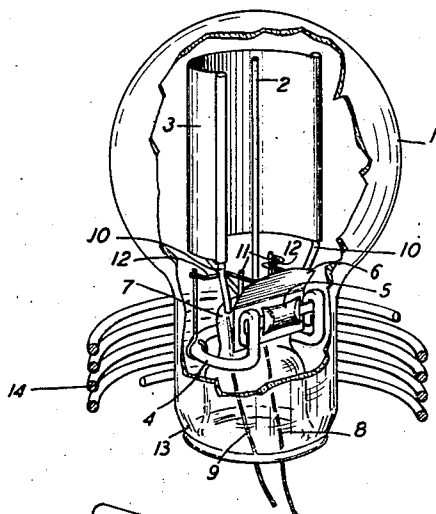
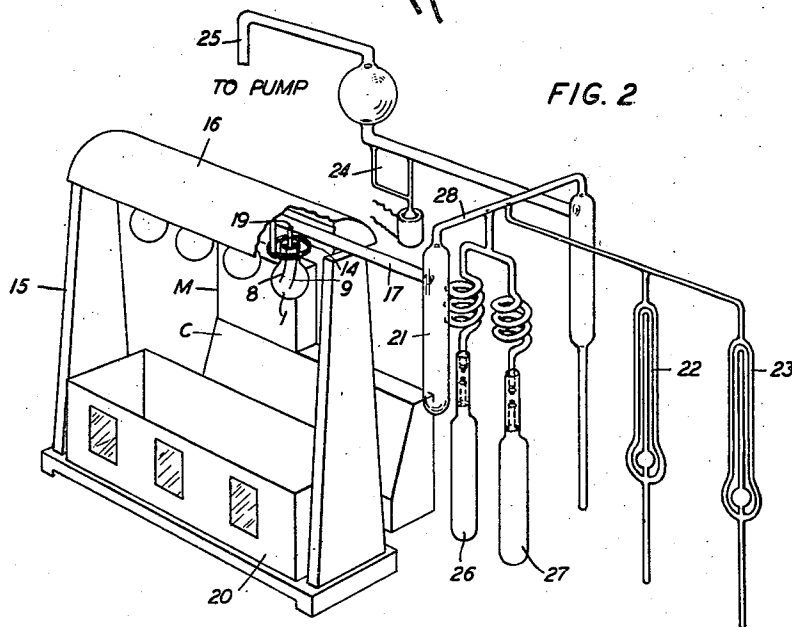


FIG. 2



INVENTOR
C. H. PRESCOTT, JR.
BY *J. P. Neville*

ATTORNEY

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C. H. PRESCOTT, JR

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2 Sheets-Sheet 2

FIG. 3

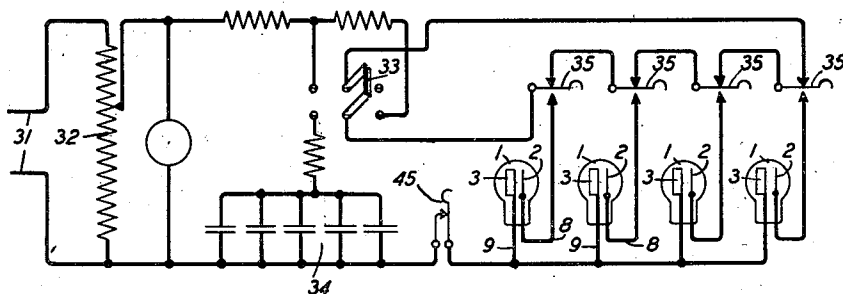


FIG. 4

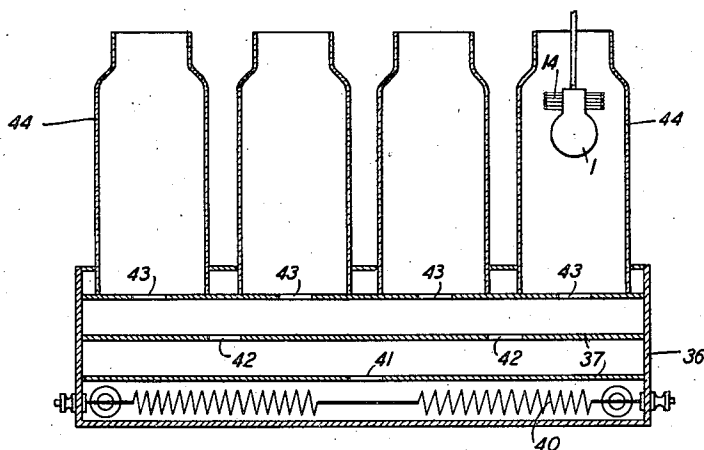
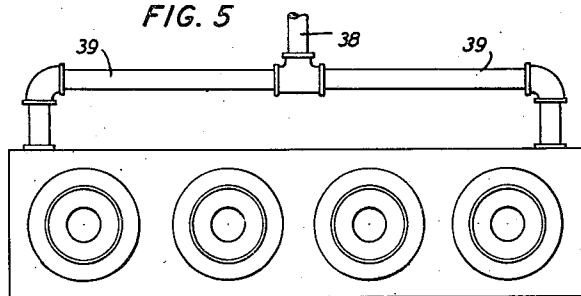


FIG. 5



INVENTOR
C. H. PRESCOTT, JR.
BY *J. T. Neville*

ATTORNEY

UNITED STATES PATENT OFFICE

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PHOTOELECTRIC TUBE

Charles H. Prescott, Jr., New York, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

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28 Claims. (Cl. 250—27.5)

The present invention relates to electro-optical apparatus and more particularly to photoelectric tubes and methods of making them.

The prior art discloses light sensitive tubes in which there is deposited on the inner walls of a glass bulb a layer of conductive material having its surface oxidized and having a film of light sensitive material deposited on the oxidized layer.

It has also been proposed to mount within a glass bulb, but out of contact with its walls, a self supporting member of conductive material which is heat treated to oxidize its surface and then to reduce the oxide to produce a roughened surface, after which the roughened surface is oxidized to a predetermined extent to render it receptive for light sensitive material, and then a film consisting of a fixed amount of light sensitive material is deposited upon the inner wall of the bulb, which is then heated to vaporize the light sensitive material and cause it to deposit on the oxide layer carried by the roughened surface. In accordance with the proposed process of manufacturing these tubes, the electrode members are mounted on supports respectively carried by a press and a lead-in wire which are sealed into a glass bulb, the assembly is heated to drive out occluded gases which are evacuated, and a mixture, adapted to chemically react at a temperature slightly above room temperature, is enclosed in a side tube which is heated to the desired temperature to cause the mixture to react and liberate a fixed amount of light sensitive material.

The present invention is directed to an improved light sensitive device of the character described in the preceding paragraph and to a more efficient method of manufacturing devices of that type.

An object of the invention is to reduce irregularities in the production of light sensitive devices.

A feature of the invention relates to the provision of means within the device for controlling the chemical reduction of a mixture to produce the light sensitive material.

Another object is to protect the elements assembled within the device when the mixture is caused to react.

Still another object is to prevent the vapor of the light sensitive material from coming into contact with the conditioned cathode surface when the mixture is reduced.

In accordance with one illustrative embodiment of the invention, the light sensitive device comprises a bulb enclosing a charge of argon at

a suitable low pressure, a wire anode of conductive material and a cathode in the form of a semi-cylindrical plate of silver, having its concave surface directed toward the anode. The silver plate, which constitutes the light sensitive film carrying element, after being thoroughly cleaned and annealed is mounted on supporting wires extending from a press sealed in the bulb. The bulb is baked for about thirty minutes in an oven at a temperature of about 320° to 400° C. to drive out occluded gases which are evacuated. Oxygen is admitted into the bulb and the concave surface of the plate is bombarded with positive ions to transform it into an oxide layer, and the plate is heated to a high temperature to reduce the oxide layer, whereby a roughened surface is provided.

The oxygen is then pumped out and a fresh supply of oxygen is introduced into the bulb, and the rough surface of the plate is ionically bombarded intermittently by causing a definite number of discharges of a fixed amount of electricity to occur between the anode and the plate. This bombardment effects a quantitative oxidation of the surface, whereby it is finally conditioned and rendered highly receptive of the light sensitive material. The number of electrical discharges is made proportional to the weight of the light sensitive material to be deposited on the conditioned surface of the silver plate.

The press is provided with supports which carry a protective shield and a conductor of low resistance in the form of an incomplete loop. The ends of the conductor are connected by a capsule of high resistance material. This capsule carries a cylinder enclosing a chemically reactive mixture including caesium chromate, aluminum and chromic oxide. The low resistance conductor and capsule connected in series therewith constitute a complete loop surrounding the press. A coil surrounding the bulb adjacent the press is supplied with high frequency current to induce current in the conductor and capsule, whereby they are heated to drive off occluded gases, which are evacuated. The current induced in the low resistance conductor which flows through the capsule is just sufficient to ultimately heat the capsule to the point at which an exothermic reaction is initiated. This heating is continued for a short time and is then discontinued. The chemical reduction initiated by heating the capsule is carried to completion to liberate the caesium by the heat generated when the aluminum reacts with the chromic oxide, included in the mixture.

The protective shield is supported adjacent the capsule and is provided with an upper portion, curved toward the inner wall of the bulb opposite the concave conditioned surface of the silver plate, whereby the highly heated caesium vapor is caused to be deposited upon the relatively cool wall of the bulb and is prevented from coming into contact with the oxidized surface of the plate which would be reduced and thereby destroyed by the hot caesium vapor. The shield also protects the anode, the supports for the electrodes and the press from the intense heat developed as a result of the chemical reaction and prevents caesium from being deposited on these elements.

A chamber, through which circulates hot air, maintained at a uniform temperature, is then raised into a position surrounding the bulb to vaporize the caesium deposited on its wall. Since the bulb is evenly heated, whereas the silver plate is relatively cool, the caesium will be deposited as a uniform film on the highly absorptive oxidized surface of the plate. During this stage of the process, care should be exercised to prevent heating the cathode to a temperature which would reduce the oxide layer. However, heating of the bulb is continued until the cathode is raised to a temperature such that some of the caesium combines with at least a part of the oxygen contained in the oxide layer.

The bulb is allowed to cool to room temperature, evacuated to a high vacuum and is then filled with argon at a pressure of hundredths of a millimeter of mercury.

A description of the embodiment, briefly described above, follows and is illustrated in the attached drawings.

Fig. 1 illustrates a photoelectric tube of the present invention;

Fig. 2 is a schematic layout of a portion of the apparatus used to produce the photoelectric tube shown in Fig. 1;

Fig. 3 is a schematic illustration of an electric circuit used in the process of producing the tube illustrated in Fig. 1;

Fig. 4 is a sectional view of another portion of the apparatus to be used in accordance with this invention; and

Fig. 5 is a plan view of the apparatus shown in Fig. 4.

Referring to Fig. 1, there is shown a photoelectric tube comprising a bulb 1, enclosing an anode 2, a cathode 3, a conductive loop consisting of a low resistance conductor 4 connected in series with a high resistance capsule 5 having associated therewith a deflecting or protecting shield 6. The capsule encloses a mixture comprising caesium chromate, chromic oxide, and aluminum. The caesium chromate is prepared from the raw materials, i. e., silver chromate and caesium chloride, by the well known precipitation, filtering, and drying processes. The caesium chromate thus obtained is ground to pass a 200 mesh sieve. Commercial chromic oxide is used without further treatment. The aluminum in very fine powder form is thoroughly cleaned by extraction with ether. The three constituents, now in pure form, are weighed out on an analytical balance in the following proportions: Cs_2O 0.5000 gr., Cr_2O_3 3.1800 gr. and Al 1.2900 gr. and are ground together and thoroughly mixed by passing through a 100 mesh sieve.

For each charge 0.0497 gr. of the mixture are weighed out to plus or minus 0.0010 gram. This mixture is transferred to a pill forming machine,

which is an arbor press of ordinary design, provided with dies adapted to produce a pellet of the desired form. The pellet, after being compressed to a very small compact mass, is reweighed to determine its exact final weight, which is used in calculating the degree of oxidation of the silver plate and also to insure that the amount of the mixture present is sufficient to produce the required amount of caesium.

The weighed pellet is placed within a protective molybdenum cylinder approximately $\frac{1}{8}$ inch in length, $\frac{1}{8}$ inch in diameter and 0.008 inch thick. This cylinder with the enclosed pellet is in turn placed inside a molybdenum sheath or envelope .001 inch thick and of capsule form, the ends of which are flattened, and the terminals of the heavy copper ring are crimped upon the flattened ends.

The bulb 1 is provided with a stem 7 through which pass a lead-in wire 8 for the anode 2 and a lead-in wire 9 for the cathode element 3, which comprises a semi-cylindrical plate of silver, the surface of which is highly polished. Element 3 is prepared by annealing it, cleaning its surface by washing in a chemical solution, washing in distilled water for about fifteen minutes, and then allowing it to dry in air.

The press carries a plurality of supports 10 for the cathode element 3 and two rods 11 to which is secured a saddle 12 for supporting the loop composing the conductor 4 and capsule 5 and the shield 6.

Associated with the extension 13 of the bulb, to which the press 7 is sealed, is a coil 14 adapted to be supplied with high frequency current to induce current in the conductor 4, for a purpose to be described later.

Fig. 2 shows an apparatus adapted to be used in the simultaneous production of four tubes. This apparatus comprises a frame 15, provided with a cap 16 of metal, a manifold 17 of glass with which is connected glass tubes 19, only one being shown, each adapted to be connected to a bulb 1.

The base of the frame carries an electric oven 20 adapted to be raised into a position surrounding the bulbs 1 and with its upper edge engaging the cap 16.

Associated with the frame is a manometer M and a control panel C for the current supply system shown in Fig. 3. The manifold 17 is connected to a pumping apparatus consisting of a liquid air trap 21, two McLeod gauges 22 and 23, a mercury vapor pump 24 adapted to be connected by a tube 25 to any suitable vacuum pump, not shown. Associated with the pumping system are apparatus 26 and 27, respectively, adapted to supply oxygen and an inert gas, for example, argon, to the bulbs 1. Apparatus 26 and 27 are connected to the conduit 28 by means of a connection having two branches, each including a mercury seal surrounding a pair of porous plugs of havite which are brought into contact to permit oxygen or argon, as the case may be, to be supplied to the bulb. These seals serve to cut off the apparatus 26 and 27 from the evacuating apparatus when it is operating.

Fig. 3 illustrates a current supply system for use in the process of manufacturing four bulbs. This system comprises a circuit 31, adapted to be connected to a direct current source, not shown, and a potentiometer 32 for controlling the potential applied through a switch 33 either to a condenser system 34 and through keys 35 to the electrodes 2 and 3 of the tubes 1, or directly

to these electrodes via the keys 35, depending upon whether the switch 33 occupies the left hand or right hand position. The keys 35 are connected to the lead-in wires 8 and 9 of the tubes 1 and are used to control the current supplied to the electrodes 2 and 3.

Figs. 4 and 5 show an apparatus for supplying a stream of hot air under pressure to four chimneys for heating the tubes. This apparatus comprises a hollow base member 36 divided into compartments by baffles 37. The lower compartment is connected to a compressed air pipe line 38 by branches 39 and encloses an electric heating unit 40. The lower baffle 37 is provided with a single opening 41 leading into the next higher compartment, which is connected to the upper compartment by a pair of openings 42. The upper compartment is provided with four openings 43, each leading into a chimney 44.

The hollow base 36 is designed to fit into and be firmly held by the electric oven 20, so that, when the latter is raised each chimney surrounds a bulb 1, as shown for one bulb at the extreme right in Fig. 4.

The method of producing photoelectric tubes, using the apparatus described above, will now be described.

The press 7 having been provided with the supports 10, 11, and the anode 2, the silver plate 3 is secured to supports 10 and the loop, consisting of the conductor 4 and capsule 5 and the shield 6, are mounted on the saddle 12 which is secured to the supports 11. The press is then sealed in the extension 13 of the bulb or tube 1, four of these bulbs are connected by means of tubes 19 to the manifold 17, the pumping apparatus is started, the oven 20 is energized and raised into position to surround the bulbs. The complete assembly is thereby heated to a high temperature to drive occluded gases out of the glass walls of the bulb, the press and the elements carried thereby, and these gases are evacuated by the pumping apparatus, the operation of which is discontinued when the desired degree of vacuum is produced in the bulb.

The assembly is now purged of impurities by admitting oxygen from the apparatus 26 and pumping it out. A fresh supply of oxygen is then supplied to the bulb and the keys 35 are intermittently actuated to cause a large current discharge to occur between the electrodes, whereby the concave surface of the plate 3 is bombarded with positive ions, and the oxygen is caused to enter into chemical combination with this surface to produce thereon a heavy layer of oxide. This layer is then decomposed or reduced by heat produced by continuous ionic bombardment, whereby the concave surface of the plate assumes a silvery color but is roughened.

Preferably the oxidation and reduction step is effected in each tube by supplying current at 675 volts in the presence of oxygen at 2.2 m. m. of mercury. The surface of the silver plate 3 is oxidized to a dark black color by closing the corresponding key 35 ten times for one and one half seconds each time, with intervals of one and one half seconds between closures, to permit the plate to cool. The key is then held down for from twenty to thirty seconds, whereby the surface of the plate is continuously bombarded to reduce the oxide and leave a bright silvery surface. Each bulb is treated in this manner, and the treatment may be repeated once or twice if necessary to produce a surface which is roughened to the desired degree.

The bulbs are now evacuated to a good vacuum, approximately 10^{-5} m. m. of mercury, and are refilled with oxygen to a pressure of about 2.16 m. m. of mercury. The switch is thrown into engagement with the left hand contacts to charge a five-microfarad condenser system to 650 volts, the key 35 corresponding to each tube is intermittently closed a number of times, determined by the weight in milligrams of the pellet within the capsule 5 multiplied by a constant. This constant is approximately 2 and the total number of closures used in the manufacture of a number of tubes varied between eighty and one hundred. During this operation the keys 35 are intermittently closed. In this manner a fixed amount of electricity is intermittently discharged between the elements 2 and 3 through the oxygen to produce an oxide layer which is adapted to absorb or combine with the predetermined amount of caesium to be introduced into the bulb.

The oxygen is then pumped out to a pressure of approximately 10^{-5} m. m. of mercury and the bulbs are ready for the production of caesium.

Caesium is produced by flashing the capsule by supplying high frequency current to the coil 14, the lower turn of which, as shown in Fig. 2, is in the same plane as the conductor 4. High frequency current of about 30 amperes is supplied to the coil 14 to induce in the conductor 4 a correspondingly large current which passes through the capsule 5 and heats it to a temperature just sufficient to initiate a chemical reaction. The caesium chromate and the chromic oxide are reduced by the aluminum, which causes a great amount of heat to be generated, aluminum oxide and metallic chromium are produced and metallic caesium is liberated in the form of vapor which escapes through the interstices of the capsule. During this stage the aluminum and chromic oxide react to generate heat of approximately 150,000 cal. per gram-molecule, whereby the chemical reaction with the caesium chromate is carried to completion and the caesium vapor is liberated at such temperature that, if allowed to deposit upon the oxidized surface of the plate 3 it would seriously damage and might completely destroy the oxide film because of the low decomposition temperature of the silver oxide, with the result that the finished cathode would be almost insensitive to light radiations. The residue in the capsule comprises aluminum oxide and metallic chromium.

To prevent the highly heated caesium vapor from coming into contact with the press and elements carried thereby, but especially with the oxidized electrode surface, there is provided a shield 6 which occupies a position between the capsule and the press and has its upper portion outwardly curved toward the wall of the bulb. The shield also serves to protect the press and the elements supported thereby, but especially the oxidized surface of the cathode member, from the intense radiant heat developed during the reduction of the mixture carried by the capsule. It also operates to deflect the caesium vapor away from the press and elements supported thereby and to direct it to the wall of the bulb which is immediately opposite the concave oxidized surface of the plate 3. In this manner the metal caesium is directed into contact with the relatively cool wall of the bulb and deposits thereon.

The shield is positioned and its curvature is such that it lies substantially in the direction of the lines of force produced by the high fre-

quency current flowing through the coil 14, i. e. it does not cut these lines of force, consequently, substantially no high frequency current is induced in the shield. As a result, it is not heated by high frequency current and hence does not radiate heat, which would detrimentally affect the oxidized surface.

The hot air apparatus shown in Figs. 4 and 5 is mounted upon the oven 20 and is raised into a position with the chimneys 44 surrounding the bulbs. Compressed air is supplied to this apparatus and the heating unit 40 is energized to heat the air passing across it to a desired temperature, such that the glass walls of the bulbs are uniformly heated to approximately 220° C. to vaporize the caesium. During this stage, the cathode member is at a relatively low temperature, compared with the rest of the assembly, and its oxidized surface has a pronounced affinity for the caesium vapor, consequently the caesium deposits upon the oxidized surface in the form of a uniform thin film and at least some of the oxygen of the layer combines with the caesium, as the heating is continued.

The time during which the stream of hot air is applied to the bulbs to promote the chemical combination of the oxygen and caesium depends upon the operating conditions in the case of each tube. The correct length of time for this treatment may be determined by testing the tubes from time to time by projecting light upon the cathode, supplying current from the oxidizing circuit, with the switch 33 in engagement with the right hand contacts and the voltage adjusted to 50 volts, and measuring the current flow between the electrodes by an ammeter connected to the jack 45 (Fig. 3).

With light projected upon the cathode, the hot air treatment is continued until the photoelectric current tends to decrease. When this occurs, the chimneys are lowered, and the bulbs are allowed to cool to room temperature with the pumping apparatus still in operation. When the desired degree of vacuum is attained, the pump is cut off.

Argon is now introduced into the tube from the apparatus 27 until its pressure assumes a steady state of approximately .05 m. m. of mercury and the tube is sealed off.

The method described above embodies a number of features which render it especially advantageous commercially.

The condenser discharge permits the oxidation process to be quantitatively controlled. The exothermic reaction enables the chemical reaction of the constituents of the mixture to be carried to completion and thereby insures that all of the caesium, present in the compound, is liberated. Hence the most advantageous conditions for the production of the light sensitive layer may be uniformly attained, and evolution of the caesium is effected with the application of the minimum amount of heat. Again use of the copper conductor for supporting the high resistance capsule permits a current of the proper amount to be induced in the conductive loop to initiate the exothermic reaction without causing the conductor to become highly heated, mounting the cathode member so that substantially no current is induced therein and using a shield for deflecting the hot caesium vapor to the wall of the bulb prevents heat radiated, when the elements of the mixture are caused to chemically react, from reaching the oxide layer and mounting the shield so that very little current is in-

duced in the shield, whereby it is not highly heated, all serve to protect the oxide layer against heat effects which would prematurely decompose the layer and thereby upset the conditions essential to the production of an efficient light sensitive tube. Moreover, heat treating the bulb with a stream of hot air permits the caesium condensed on its walls to be transferred to the oxidized layer of the member while the latter is cool, and, by continuing the heat treatment, the oxide layer is gradually heated to such temperature that all of the caesium within the bulb combines with the oxygen of the layer without decomposing the latter.

The cathode member may be a plate of any good conductive material, for example copper, nickel, and similar metals may be used, or members having surfaces of these metals. In certain cases the oxidation and reduction step, for producing the roughened surface, would have to be somewhat modified from that herein described.

Any of the alkali metals could be used in place of caesium. Rubidium, potassium, sodium and perhaps barium are typical examples of satisfactory substitutes for caesium.

While certain specific details are herein given in order to completely disclose one method of practicing the invention, it is to be understood that these details apply to a specific design of tube and that they may be modified without departing from the principles of the invention.

What is claimed is:

1. A method of preparing a cathode member of a photoelectric tube for the reception of electron emitting material which comprises surrounding the member with oxygen, and causing a series of periodic discharges of a fixed amount of electricity to said member to oxidize its surface.

2. A method of introducing a volatilizable metal into an evacuated container which comprises providing a mixture of a compound of the volatilizable metal, a reducing agent, and an oxide of a metal which is less volatile than the first mentioned metal to promote the generation of heat, and heating the mixture to a reaction temperature.

3. An electric discharge device containing electrodes, a mixture of an alkali metal chromate, a reducing agent and a heat generating metal oxide, and means for heating said mixture to a reaction temperature.

4. An electric discharge device containing a mixture of caesium chromate, a metallic reducing agent and a heat generating metal oxide, and means for heating said mixture to liberate the caesium.

5. An electric discharge device comprising an envelope provided with a stem and electrodes, a capsule within said envelope and enclosing a mixture including a compound of an alkali metal, a member having low resistance applied to said stem and supporting said capsule, and means for inducing in said member current which flows through said capsule for heating said mixture to a reaction temperature, and deflecting means adjacent said capsule.

6. An electric discharge device comprising an envelope provided with a stem and electrodes, a capsule within said envelope and enclosing a mixture including a compound of an alkali metal, a member having low resistance connected in series with said capsule, means carried by said stem and mounting said member, means for inducing in said member current which flows

through said capsule for heating the mixture to a reaction temperature, and deflecting means carried by said mounting.

7. A light sensitive device comprising an envelope provided with electrodes one of which is metal, supports for said metallic electrode, a capsule enclosing a mixture including a compound of an alkali metal, means for heating said capsule to cause said mixture to react and liberate said metal as a vapor, and means for preventing deposition of said metal on said metallic electrode.

8. A light sensitive device comprising an envelope provided with electrodes one of which is metal, supports for said metallic electrode, a capsule enclosing a mixture including a compound of an alkali metal, means for heating said capsule to cause said metal to be vaporized, and means for shielding said metallic electrode from radiated heat.

9. An electric discharge device having electrodes, a conductive ring consisting of a capsule enclosing a mixture including a compound of an alkali metal connected in series with a conductor of low resistance, means for inducing in said conductor high frequency current which heats said mixture to liberate the alkali metal, and adjacent said capsule a heat shield lying along the magnetic lines of forces produced by said last mentioned means.

10. An electric discharge device having electrodes, a conductive ring consisting of a capsule enclosing a mixture including an alkali metal connected in series with a conductor of low resistance, a coil to be supplied with high frequency current for inducing in said conductor current which heats said mixture to liberate the alkali metal, a heat shield adjacent said capsule and lying along the magnetic lines of force produced by said coil.

11. A light sensitive device comprising a bulb enclosing an anode, a capsule carrying a mixture including a compound of an alkali metal, a member having a surface sensitive to said alkali metal, means for heating said capsule to cause vaporization of said metal, and means for preventing deposition of the hot alkali metal on the sensitive surface of said member.

12. A light sensitive device comprising a bulb enclosing an anode, a capsule carrying a mixture including a compound of an alkali metal, a member having a surface sensitive to said alkali metal, means for heating said capsule to cause said mixture to react and liberate said metal as a vapor, and means for directing the hot alkali metal to the surface of the bulb.

13. A light sensitive device comprising a bulb enclosing an anode, a capsule carrying a mixture including a compound of an alkali metal, a member having a surface sensitive to said alkali metal, means for heating said capsule to cause vaporization of said metal, and means for directing the hot alkali metal to a portion of the surface of the bulb opposite the sensitive surface of said member.

14. Means for manufacturing a light sensitive device embodying a bulb enclosing an anode, a capsule carrying a mixture including a compound of an alkali metal and a member having a surface sensitive to said alkali metal, comprising means for heating said capsule to cause vaporization of said metal, means for directing hot alkali metal to the surface of the bulb, and means for transferring the alkali metal from the bulb surface to the sensitive surface of said member.

15. Means for manufacturing a light sensitive device embodying a bulb enclosing an anode, a capsule carrying a mixture including a compound of an alkali metal and a member having a surface sensitive to said alkali metal, comprising means for heating said capsule to cause vaporization of said metal, means for directing hot alkali metal to the surface of the bulb, and means for heating the bulb by a stream of hot air to vaporize the alkali metal deposited on the surface thereof.

16. A method of producing a light sensitive device comprising a bulb enclosing an anode and an electrode member which comprises oxidizing the surface of said member and reducing the oxide, forming an oxide layer on said surface, inserting in the bulb a mixture including a compound of an alkali metal, heating said mixture to a reaction temperature to liberate said alkali metal, directing the hot alkali metal to the surface of said bulb to the exclusion of the oxide layer on said member, and heating the bulb to transfer the alkali metal therefrom to the oxide layer on said member.

17. Means for manufacturing a light sensitive device embodying a bulb enclosing an anode, and an electrode member having a surface sensitive to alkali metal comprising means for depositing alkali metal upon the inner surface of said bulb, and means for heating said bulb by a stream of hot air to vaporize the alkali metal on said bulb to cause it to be deposited on said member.

18. The method of making a cathode member for a photoelectric tube which comprises introducing into the tube a definite amount of a compound adapted to liberate photoelectric material, introducing oxygen into the tube and oxidizing the surface of said cathode member by causing a number of periodic discharges of a fixed amount of electricity to said member, the number of said discharges bearing a predetermined ratio to the amount of said material and liberating said photoelectric material to deposit upon said oxidized surface.

19. A method of preparing a cathode member of a photoelectric tube for the reception of an electron emitting material which comprises surrounding the member with a gas, and intermittently causing a series of discharges each of a fixed amount of electricity to said member to cause the gas to combine with its surface.

20. A method for producing a cathode for a photoelectric tube which comprises forming a silver oxide coating upon a cathode plate, heating the plate to reduce the silver oxide, reoxidizing the plate, evolving caesium in the form of vapor directed away from said plate by heating a mixture including a caesium compound, and subsequently depositing a film of said caesium on said reoxidized plate.

21. An electric discharge device comprising an envelope containing electrodes, a capsule of high electrical resistance enclosing a mixture including a compound of an alkali metal, and an electrically conducting member in the form of a loop which supports said capsule to form therewith a closed electric circuit, said capsule forming a relatively small part of said circuit and said member being of high conductance throughout compared with said capsule, whereby if current is introduced in said member from without said device this current will generate a large amount of heat directly in said capsule for heating said mixture to a reaction temperature.

22. An electric discharge device containing

electrodes supported on a stem, a capsule of high electrical resistance enclosing a mixture including a compound of an alkali metal, an electrically conducting member in the form of a loop which is supported upon and substantially surrounds said stem and in turn supports said capsule to form therewith a closed electric circuit, said capsule forming a relatively small part of said circuit and said member being of high conductance throughout compared with said capsule, whereby if current is introduced in said member from without said device this current will generate a large amount of heat directly in said capsule for heating said mixture to a reaction temperature.

23. A light sensitive device comprising an envelope provided with electrodes one of which is metal, a support for said metallic electrode, a holder containing a mixture including a compound of an alkali metal, means insulated from said electrodes supporting said holder, means for heating said mixture to cause liberation of said metal as a vapor, and means for preventing deposition of metal from said vapor on said metallic electrode.

24. A light sensitive device comprising an envelope provided with electrodes one of which is metal, a support for said metallic electrode, a holder containing a mixture of an alkali metal chromate, a reducing agent and a heat-generating metal oxide, means insulated from said electrodes supporting said holder, means for heating said mixture to cause liberation of said metal as a vapor, and means for preventing deposition

of metal from said vapor on said metallic electrode.

25. A light sensitive device comprising an envelope provided with electrodes one of which is metal, a support for said metallic electrode, a holder containing a mixture including caesium chromate, chromic oxide and aluminum, means insulated from said electrodes supporting said holder, means for heating said mixture to cause liberation of said caesium as a vapor, and means for preventing deposition of caesium from said vapor on said metallic electrode.

26. A method of preparing a conductive member to receive an electronically active material which comprises roughening the surface of the member, and oxidizing the roughened surface to an extent proportional to the amount of the electronically active material to be applied thereto.

27. A method of preparing a conductive member to receive light sensitive material which comprises oxidizing the surface of the member, reducing the oxide, and oxidizing the resultant surface to an extent proportional to the amount of light sensitive material to be applied thereto.

28. A method of producing a cathode member of a light sensitive device for the reception of electron emitting material, which comprises oxidizing the surface of the member by electrical discharges in the presence of oxygen, and controlling the number of said electrical discharges in accordance with the amount of the electron emitting material used.

CHARLES H. PRESCOTT, JR.