P. C. HEWITT.

METHOD OF AND APPARATUS FOR STARTING AND OPERATING MERCURY VAPOR APPARATUS.

APPLICATION FILED SEPT. 15, 1908.

998,175.

Patented July 18, 1911.

2 SHEETS—SHEET 1.

Fig. 1

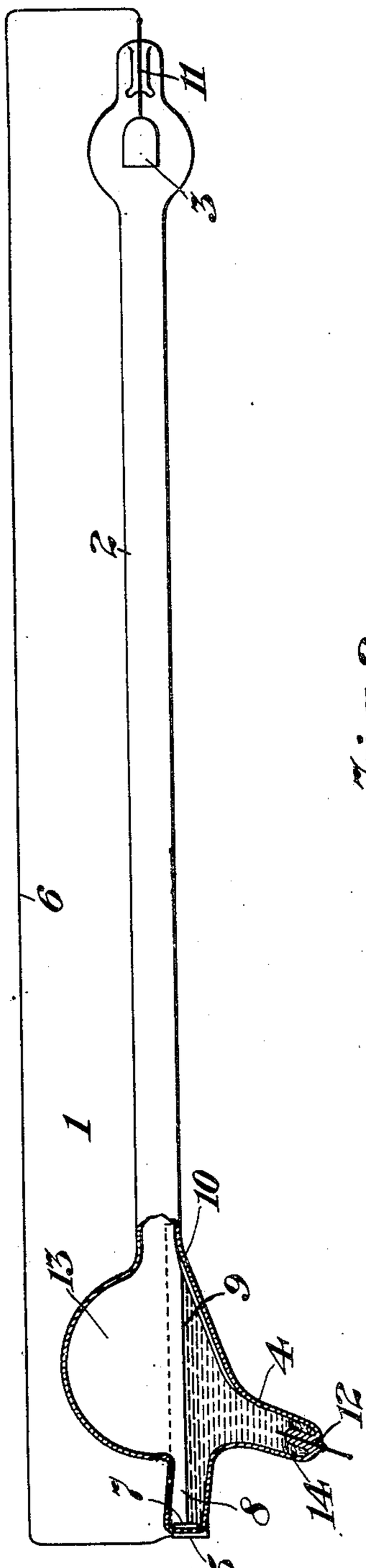
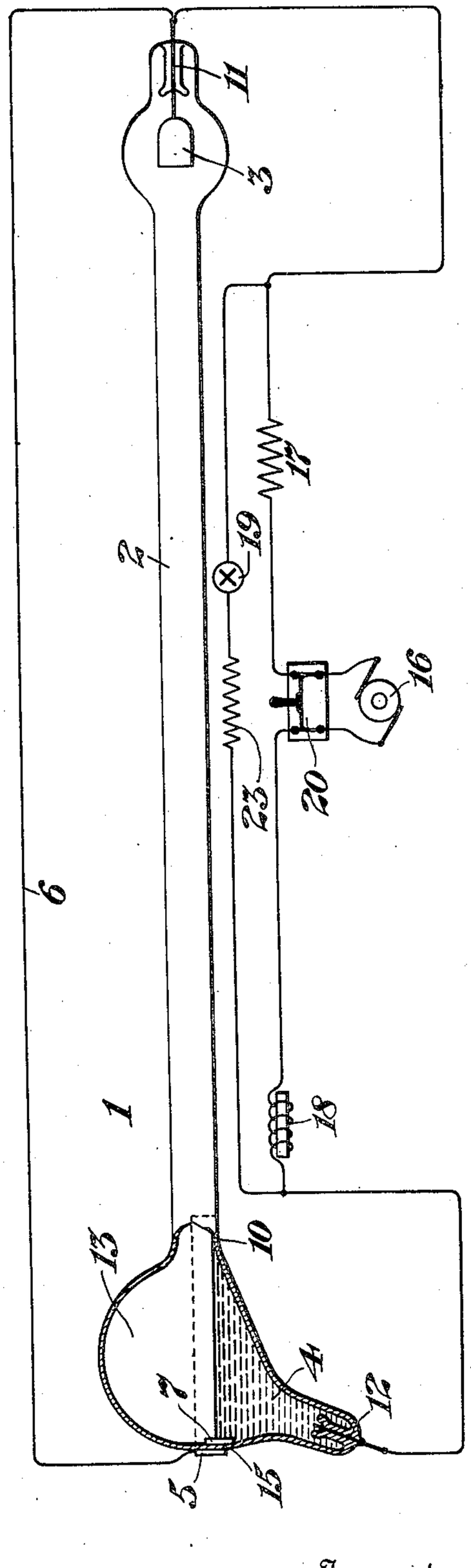


Fig. 2



Witnesses:
Chas. F. Clagett
Thos. H. Brown

Inventor
Peter Cooper Hewitt
By his Attorney
Charles A. Terry

P. C. HEWITT.

METHOD OF AND APPARATUS FOR STARTING AND OPERATING MERCURY VAPOR APPARATUS.

APPLICATION FILED SEPT. 15, 1908.

998,175. **Patented July 18, 1911.**

2 SHEETS—SHEET 2.

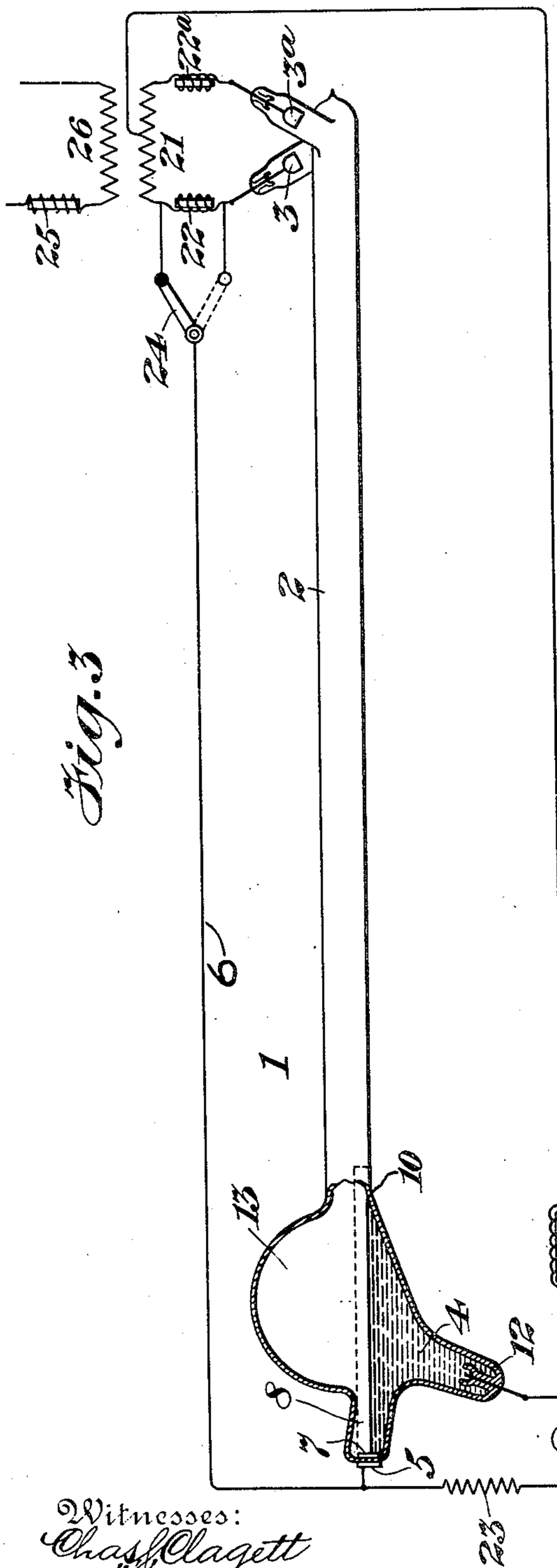


Fig. 3

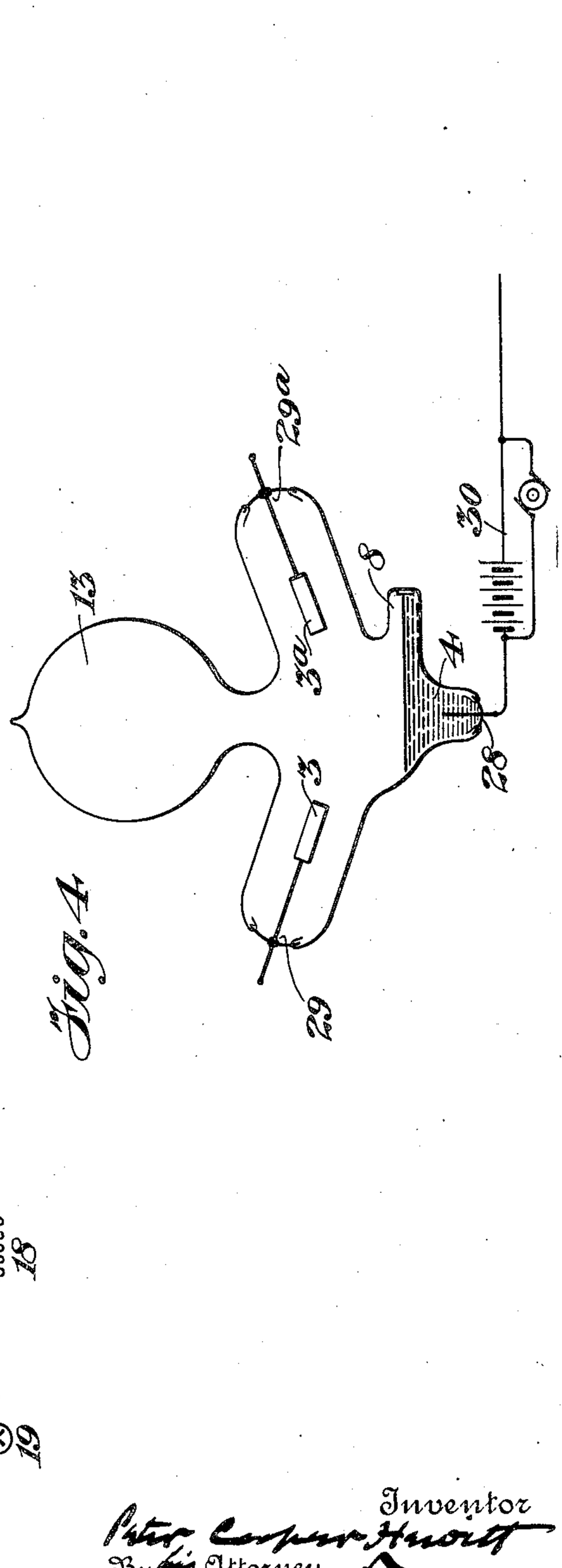


Fig. 4

Witnesses:
Chas. F. Clagett
Thos. H. Brown

Inventor
Peter Cooper Hewitt
By his Attorney
Charles A. Terry

UNITED STATES PATENT OFFICE.

PETER COOPER HEWITT, OF RINGWOOD MANOR, NEW JERSEY, ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

METHOD OF AND APPARATUS FOR STARTING AND OPERATING MERCURY-VAPOR APPARATUS.

998,175. Specification of Letters Patent. **Patented July 18, 1911.**

Application filed September 15, 1908. Serial No. 453,186.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and resident of Ringwood Manor, county of Passaic, State of New Jersey, have invented certain new and useful Improvements in Methods of and Apparatus for Starting and Operating Mercury-Vapor Apparatus, of which the following is a specification.

This invention relates to starting vapor electric devices and has for its object diminishing the voltage required to initially pass current through the device by modifying the initial phenomena manifest at the negative electrode, now known as the reluctance to starting residing at the negative electrode, and more particularly with refernce to a liquid negative electrode such as mercury, where the glass is repellent to the liquid or is not wetted by the liquid. Where the walls of the container and the liquid of the electrode are of this nature, the meniscus of the liquid is convex and presents a rounded edge surface toward the glass as in the case of pure mercury and clean glass which condition is most advantageous in certain forms of apparatus, but where the liquid wets the glass, as in the case of mercury with certain metals mixed with or dissolved in it, the meniscus turns up and presents a sharp edge where it comes in contact with the glass. Where it is desired to start such devices by means of an initial high potential and particularly when using a starting band as described the voltage required for starting has been found lower when the meniscus is turned up than when turned down; the turned up state of the meniscus being therefore advantageous in cases where it is desired to start with the lower voltage. I have found that where the meniscus, although turned down, is caused to turn up at a particular spot or point, the features of the turned up meniscus may be availed of by reason of the turning up at this spot or point and in many cases it has practical advantages over other forms of devices besides those of diminished voltage. I have found that this effect may be accomplished by causing the glass to have its surface so altered that it is no longer repellent to the mercury but attracts it, and that this can be accomplished at a particular spot. One way of accomplishing this is to seal on to the surface of the glass a conductor such as platinum, which extends above and below the surface of the mercury, in which case this conductor acts substantially as if it was the turned up meniscus. And further, in many cases, as in the case of platinum being the conductor referred to, even though the platinum is eaten or worn away, the desirable effect remains, even after it has disappeared, by reason of its having been there. To state the case in another way, the glass is caused to have the effect of being non-repellent to the mercury in whole or at a spot, in contradistinction to the mercury being amalgamated so as to adhere to the glass, and one way of doing this is to seal on to the glass a conductor as stated and further this small piece of conductor, from its nature, and by the action of the current on it, may cause the glass where is was originally placed, as well as at other points, to become non-repellent to the mercury, and thus facilitate starting by lower voltage.

In the drawing Figure 1 represents a mercury vapor lamp adapted to be started by the present invention. Fig. 2 represents a modification thereof, while Fig. 3 represents the application of another type of mercury vapor lamps and Fig. 4 shows a form which may be utilized as a rectifier.

In Fig. 1, 1 represents the container having a tubular portion 2, a positive electrode, 3, and a negative electrode, 4. A starting band, 5, is located outside, of the container in the neighborhood of the negative electrode 4 and extends above the surface of the electrode. This starting band 5 is connected by conductor, 6, with the lead of the positive electrode 3. A platinum wire, 7, is sealed or melted into the glass which constitutes the material of the container 1, at the rear end of the small chamber 8, communicating with the negative electrode chamber and normally partially filled with mercury therefrom. This platinum wire 7 is attached to the glass wall in the mercury chamber 8 and the meniscus of the mercury at this point is effected as described above so as to reduce its negative starting reluctance. A small quantity of the platinum may be caused to dissolve in the mercury of the electrode 4, either by the normal operation or at times of starting, or in the manufacture of the lamp, so that there will be a certain

amalgam in the mercury which may effect the meniscus in other places, as for example at 9, and facilitate starting at this point. In a device of the form shown in this figure, a very favorable point for the starting, with the condition of there being present an amount of amalgam in the mercury, is the end of the taper at 10, where the mercury will be in a condition to readily yield to the starting impulse. It will be noted that the meniscus will naturally take a very sharp edge at this point.

The general structure of this apparatus is indicated in the drawing. The container is of glass, through the walls of which is sealed the platinum lead wires 11 and 12. The bulb 13 serves as a condensing chamber and in general to regulate and control the operation of the lamp. The glass wool 14 serves to take up the mechanical shock of the mercury. The apparatus is exhausted in any suitable manner but ordinarily to the highest degree of purity, the exhaustion of all gaseous material except the mercury being complete. This degree of exhaustion is ordinarily necessary to secure suitable effectiveness of the negative starting reluctance and the best general operation of the device.

In the starting operation voltage is applied to the electrodes from the mains in the normal manner. A high voltage impulse is then impressed between the positive and negative electrodes and therefore between the starting band and the mercury of the negative electrode within. As a result the negative electrode starting reluctance of the mercury is overcome, under some conditions at the platinum wire 5, under others, perhaps at the point 9 and still others at the point 10. At the same time the starting impulse or a portion thereof is impressed between the main electrodes, through the vapor tubular portion 2, which is sufficient to overcome any residual opposition of this space or the gases therein. This second action is often very helpful. Then normal operation is established and the negative electrode spot will flit or wander around on the surface of the negative as is well known in such apparatus. In view of the form of the chamber 8 and the remoteness of the platinum wire 7, this negative electrode spot will rarely, if ever, run at this point and excessive amalgam will thus be avoided. It should be noticed that one of the advantages of this form is that when the negative electrode spot does attack the platinum wire, any throwing off of platinum or other solid constituent which may tend to adhere to the glass, will be found in the smaller chamber 8 and thus not interfere with the meniscus of the mercury or the starting of the lamp at other points. It should be noted that the effectiveness of the chamber 8, involves both the additional remoteness and the restricted dimensions thereof. The supply circuits and auxiliary apparatus shown in Fig. 2 may be used with the device of this figure in the same manner as there described.

In Fig. 2 the numbered parts such as the container 1, the tube 2, the positive and negative electrodes 3 and 4, respectively, the condensing chamber 13, the lead wires 11 and 12, etc., are equivalents of those shown in Fig. 1. In this figure, however, there is no supplementary chamber corresponding to 8 in Fig. 1, but a platinum wire 7 is melted into the glass at a point 15 and a starting band 5, connected with the positive electrode 3, lies just outside the container at and above the level of the mercury in the electrode 4. In this case a reliance is placed on the remoteness of the platinum wire 7 to protect it from the negative electrode operation and a permanent supply of amalgamated material is obtained from this wire. Starting occurs either at the wire 7 or at some other point where the effect of the amalgam may be suitable. The generator 16 supplies direct current through the resistance 17 and the inductance 18 to the lamp. The quick break switch 19 is in shunt between the main electrodes and in series with the controlling resistance 23.

The operation of Fig. 2 is very similar to the operation of Fig. 1, and the description of the latter applies in nearly all instances to the former. In Fig. 2 on the closing of the switch 20, the generator 16 applies normal potential upon the terminals of the lamp and also supplies current to the quick break switch 19 as soon as this is closed. In view of the negative electrode reluctance of the cathode 4, however, no current flows within the lamp. By the opening of the quick break switch a high potential impulse is produced between the positive electrode 3, and all parts connected thereto, including the starting band 3 and the negative electrode 4, which as explained in Fig. 1, initiates the operation of the apparatus. The inductance 18 serves to control and render continuous the current to the lamp. It also serves to give the starting impulse on the opening of the switch 19. The resistance 17 serves as a ballast and also to regulate the current flow. The switch 20 serves to control the application of current to the lamp.

Fig. 3 shows the application of the invention to an alternating current lamp. In this figure, 1 represents the container, 2 the tubular light giving portion, 3 and 3^a represent positive electrodes, 4 the negative electrode, 8 a supplementary chamber, 7 the platinum wire, 5 the starting band, and 13 the condensing chamber, all these parts having the same function as the corresponding parts in Figs. 1 and 2. In Fig. 3, the lamp is supplied from an alternating source, the second-

ary 21 of a transformer whose primary is 26. The terminals of the secondary 21 are connected through inductances 22 and 22ª, which inductances may have also ohmic resistance, to the lead wires of the positive electrode 3 and 3ª respectively. An intermediate point of the secondary winding 21 is connected through the inductance 18 to the negative electrode 4. A shunt containing the quick break switch 19 and a resistance 23 is connected between the lead of the electrode 3 and the lead of the electrode 4. The starting band 5 is connected with the conductor 6 and the positive electrode 3. The primary winding 26 is supplied in any suitable manner, the supply being regulated when desired by an impedance 25. By means of the switch 24, the starting band 5 may be connected either to the lead of the electrode 3 or to the terminal of the winding 21.

The operation of the apparatus is similar in most respects to that of Figs. 1 and 2. During normal operation, current flow is alternately through the leads of the secondary winding 21 to the negative electrode 4 in the manner now well understood in the art, the current being steadied and rendered continuous by the inductance coils 18, 22 and 22ª. The starting operation is accomplished from the electrodes 3 and 4 as in Figs. 1 and 2. There is this difference, however, that, since at certain points of the supply the electrode 3 is not impressed with a positive potential and can therefore, not operate or start the lamp, when the switch 19 is operated during such periods, starting does not result and the operation must be repeated until a favorable instant of time is found.

In Fig. 4 is shown the same starting arrangement adapted to a rectifier. Here the operation of the apparatus is the same as before except for the fact that the exhausted container is made broader and shorter, since no light is to be obtained therefrom and a low operating and starting resistance is desired. The same circuits and auxiliary apparatus may be used in Fig. 4 as in the other figures where appropriate. With the rectifier a work circuit 30 is usually provided for and the seals of the electrodes are often made to carry heavier currents, as for example, the platinum cups shown at 29, 29ª and 28. No starting band is provided in this figure.

Although certain specific embodiments of the apparatus are herein described, it is to be understood that the invention is not limited to the features shown.

Although for many reasons and to produce a number of the most important effects which may be utilized from applicant's apparatus, a very high degree of exhaustion and the vaporizable reconstructing property of the electrode 4, are essential, there may be other conditions when his apparatus may be utilized to advantage with these characteristics materially modified or even largely absent.

I claim as my invention:—

1. In a vacuum vapor electric apparatus, the combination with an hermetically sealed and completely exhausted container, and a plurality of electrodes therein, including an anode and a vaporizable reconstructing cathode, of a platinum wire sealed to the wall of the container and lying both above and below the surface of the vaporizable electrode located relatively remote from the anode and a starting band lying outside the container adjacent to the surface of said vaporizable electrode and said platinum wire, connected to the anode, together with means for supplying the apparatus with electric current, and means for applying a momentary high voltage impulse to the electrodes whereby starting is accomplished.

2. In a vacuum vapor electric apparatus, the combination with an hermetically sealed and completely exhausted container and a plurality of electrodes therein, including an anode and a vaporizable reconstructing cathode, of a quantity of solid material adapted to dissolve in or amalgamate with the material of the vaporizable electrode and lying both above and below the surface of the vaporizable electrode, said solid material being located in a separate chamber communicating with the cathode chamber and relatively remote from the anode together with means for applying a high voltage to said cathode.

3. In a vacuum vapor electric apparatus, the combination with an hermetically sealed and completely exhausted container and a plurality of electrodes therein, including an anode and a vaporizable reconstructing cathode, of a quantity of solid material adapted to dissolve in or amalgamate with the material of the vaporizable electrode and lying both above and below the surface of the vaporizable electrode, said solid material being located in a separate chamber of restricted dimensions communicating with the cathode chamber and relatively remote from the anode together with means for applying high voltage to said cathode.

4. In a vacuum vapor electric apparatus, the combination with an hermetically sealed and completely exhausted container and a plurality of electrodes therein, including an anode and a vaporizable reconstructing cathode, of a quantity of solid material adapted to dissolve in or amalgamate with the material of the vaporizable electrode and lying both above and below the surface of the vaporizable electrode, said solid material being located at a point from which the resistance of the vapor path to the anode is greater than the resistance of the normal

operating vapor path between the anode and the cathode together with means for applying high voltage to said cathode.

5. In a vacuum vapor electric apparatus, the combination with an hermetically sealed and completely exhausted container and a plurality of electrodes therein, including an anode and a vaporizable reconstructing cathode, of a quantity of solid material adapted to dissolve in or amalgamate with the material of the vaporizable electrode and lying both above and below the surface of the vaporizable electrode, said solid material being located in a separate chamber communicating with the cathode chamber and relatively remote from the anode, together with a starting band adjacent to the cathode and connected to the anode.

Signed at New York in the county of New York and State of New York this 14th day of September A. D. 1908.

PETER COOPER HEWITT.

Witnesses:
WM. H. CAPEL,
GEORGE H. STOCKBRIDGE.