P. C. HEWITT.

VAPOR ELECTRIC APPARATUS.

APPLICATION FILED DEC. 19, 1912.

1,188,774. Patented June 27, 1916.

Fig. 1

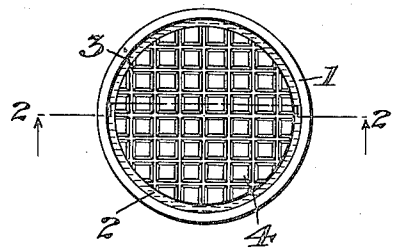


Fig. 2.

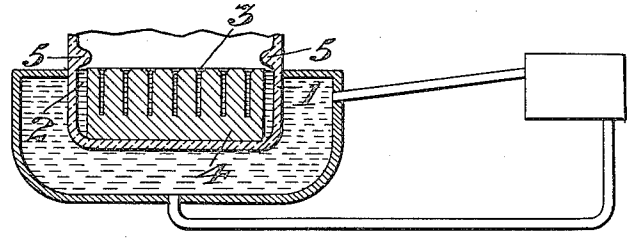


Fig. 3

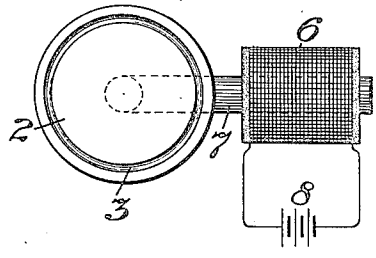
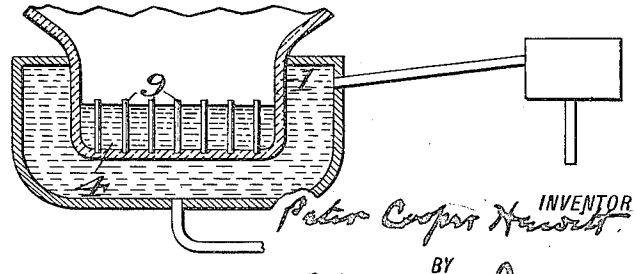


Fig. 4



WITNESSES

Chas. F. Clagett

Thos. H. Brown

INVENTOR

Peter Cooper Hewitt

BY

Charles A. Perry

ATTORNEY

UNITED STATES PATENT OFFICE.

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

VAPOR ELECTRIC APPARATUS.

1,188,774. Specification of Letters Patent. Patented June 27, 1916.

Application filed December 19, 1912. Serial No. 737,614.

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 Vapor Electric Apparatus, of which the following is a specification.

The vapor rectifier, in one of its typical forms, comprises an exhausted chamber, having two or more electrodes, one of which consists wholly or in part of a conducting or reconstructing volatile liquid, such as mercury or other elements that will be liquid during the operation of the device. The liquid electrode is held within a chamber of its own, which it is designed to fill. In some of the later types of rectifier, artificial external cooling means for the liquid or negative electrode are employed for the purpose of abstracting heat from it and maintaining a predetermined degree of vacuum in the container. The occasion for using special cooling means or devices for abstracting heat from the cathode and maintaining a certain degree of vacuum arises from the fact that there is danger of a too rapid volatilization of the cathode material, tending to liberate vapor too freely within the vacuum chamber unless provision is made for preventing it.

The present invention is directed toward providing, either as an addition to the artificial cooling already referred to or as a means independent of such cooling means for abstracting heat and maintaining the vacuum constant.

In the operation of a rectifier of this type, current from the positive electrode enters the negative electrode at one or more spots, usually called cathode spots, and these spots become centers, among others, for the generation of heat within the exhausted chamber on the surface of the negative electrode. The heat thus generated at these spots must either be absorbed from the surface by the material of the electrode or be dissipated by the vaporization of the electrode; and the latter is now chiefly the case in devices of this character using mercury for the negative electrode or cathode. As already explained such a liberation of vapor lowers the vacuum and impairs negative electrode reluctance or resistance and so the resisting power of the device.

Inasmuch as the heat generated at the surface of the cathode in the manner described is at a spot or at a very small area on the cathode (being about $\frac{1}{4}$ of a square inch when 100 amperes are delivered through the rectifier) and since the specific heat and the heat conductivity of mercury are small, vaporization results even though the material of the electrode be very cold. I have devised several ways of lessening the natural tendency to vaporization, one of which consists in increasing the normal surface area of the cathode spot in any given case; another consists in decreasing below normal the time that the spot is present on the same part of the cathode surface; and a third consists in giving to the cathode of whatever liquid it may be composed, a greater capacity for carrying off heat than it would have under normal physical conditions.

In carrying out the first of the above named inventions, I may cause mercury or other conducting liquid to be contained in narrow communicating spaces formed between walls of solid material, such spaces being narrower than a diameter drawn across the surface of the normal sized or unrestricted spot, and preferably much narrower. This will cause the spot to become elongated and, if extending in a linear direction, it will occupy a greater length than it normally would, since the current prefers to and will enter a liquid rather than a solid electrode. In this form of device the solid material constituting the walls is brought into close proximity to or into contact with the active surface of the liquid, and acts by reason of its position and its intimate relation to carry off heat from the surface as well as from the body of the liquid; and since the solid material may be selected as being a better heat conductor than the liquid functioning as the active part of the electrode, it may be made

to assist in carrying off heat from the body of the electrode itself, especially when the solid material is provided with means for abstracting heat from it internally or causing it to communicate with means external to the device. Such a structure might comprise a thick plate of iron or copper having communicating deep saw cuts across its surface (say $\frac{1}{8}$ of an inch in width and $\frac{1}{2}$ of an inch deep) at definite distances and at angles to each other being filled with mercury to within short distances of their tops, the mercury or other liquid forming the active part of the negative electrode so constituted of the device. The plate may be water or oil cooled at its bottom or from within by means of forced circulation of the water or oil.

The second embodiment of my invention depends upon the fact that the spot on the cathode surface follows the laws of the electric current when acted upon by a magnetic field, for which reason it may be caused to rotate and run over the surface of the cathode by placing a suitably disposed magnet in proper relation to the said surface. A convenient form is that of a strong straight magnet under the cathode in a vertical position, the rate of rotation of the spot being dependent upon the strength of the magnet and the current flowing to the cathode, whereby the normal movement of the spot over the surface of the cathode is increased and the amount of surface and material with which the spot comes in contact is also increased so that in a given time the amount of heat which must be absorbed by the cathode surface to restrict the vaporization is diminished below the normal. As the current flows in the liquid forming the cathode, by arranging an annular circulating path for the mercury and by causing magnetic lines to flow through this path in the right direction, the conducting liquid may be caused to flow by reason of the current flow in it, thus producing a forced circulation of the liquid.

Still another mode of creating the tendency to the maintenance of a constant vacuum in the exhausted chamber consists in increasing the heat conductive activity of the mercury or liquid acting as a cathode by mixing with it a material of higher heat conductivity. Mercury mixed with silver or copper will have such an increased conductivity for heat. The admixture of many of the elements with mercury does not materially interfere with its action as a cathode and such materials are, therefore, usable for this purpose when miscibly mixed with each other or forming an amalgamated mixture with the mercury or if only mechanically mixed in solid form. In the latter case, since most metals float on mercury, the metal used may be in the form of rods projecting from the bottom to which they are fastened when they will act somewhat in the same manner as the saw cut plate above referred to.

My invention is illustrated in the accompanying drawings in which—

Figure 1 is a plan of a portion of a mercury vapor apparatus constituting a chamber or pocket in which each negative electrode is held; Fig. 2 is a vertical section along the lines 2, 2, in Fig. 1; Figs. 3 and 4 illustrate modifications of the invention.

Referring to the first two figures of the drawing, 1 represents the outer wall of the negative electrode pocket or chamber. It should be understood that the chamber or pocket may be of any suitable shape or form. In these two figures, 2 represents a block or plate having grooves or slits, 3, made in the upper surface thereof or extending therethrough and being adapted to permit the exposure in said grooves or slits of surface of mercury, 4, or other electrode material to be acted upon by the current. Assuming that the block, 2, is provided with grooves, 3, in its upper surface, the said block will be so held, as by shoulders, 5, 5, in the interior of the wall, 1, as to permit the mercury to flow into said grooves and partially fill the same. Between the outer side of the block, 2, and the inside of the wall, 1, a ring of mercury or other liquid material will be held, as clearly shown in the first two figures of the drawing. On the other hand, if the block, 2, is deeply cut so as to form slits instead of grooves, the upper openings of these slits will be arranged to be of substantially the same dimensions and capacity as the grooves already referred to, and the number of shoulders will be increased sufficiently to keep the entire block structure down in substantially the position illustrated in Fig. 2. Or the block, as a separate piece of apparatus, may be dispensed with and the grooves or slits may be made in the wall of the container.

Referring to Fig. 3, the block, 2, is provided with an annular groove, 3, for containing the mercury. An electromagnet, 6, having a pole piece, 7, properly located with reference to the slot serves to influence the cathode spot formed upon the surface of the mercury and cause it to travel along the surface thereof by passing through the lines of magnetic force within the circle of the groove. Naturally the amount of cathode surface traversed by the spot is in this way increased, whereby the amount of heat absorbed by the cathode from its surface is increased above the normal. The magnet, 6, may be supplied from any suitable source, say the battery, 8, as shown in the drawing.

In Fig. 4 the mercury is shown at 4 and above the surface thereof are shown similar projecting points, 9, 9, the same constituting the terminal of rods of solid material suitably held at the bottom of the chamber so as to extend to or slightly above the surface of the mercury.

In all the instances recited, the effect is to absorb the heat from the surface of the negative electrode and to transmit it through the negative electrode to means external to the device for absorbing or dissipating the heat.

Claims addressed to certain features of the broad inventive idea disclosed herein are made in my application No. 719,362, filed September 9th, 1912.

I claim as my invention:

1. In a vapor apparatus, a negative electrode composed of a vaporizable reconstructing material, means for presenting its surface to the action of electric current in narrow confined bounds and means for causing a shifting of the cathode spot, such means consisting of an electro-magnet for producing a progressive movement of the cathode spot.

2. In a vapor apparatus, a liquid negative electrode disposed in a continuous groove returning upon itself and means for presenting the surface of the electrode to the action of electric currents, whereby the same may be expanded longitudinally.

3. In a vapor apparatus a liquid negative electrode disposed in communicating grooves giving to the said electrode a linear form, and means for presenting the surface of the electrode to the action of electric currents, whereby the same may be expanded longitudinally.

4. In a vapor apparatus a liquid negative electrode disposed in a continuous groove returning upon itself, and electromagnetic means for causing a progressive movement of the electrode material within the groove.

5. In a vapor electric apparatus, a negative electrode composed of vaporizable reconstructing material, and means for causing the cathode spot to act successively upon new portions of the electrode surface.

6. In a vapor electric apparatus, a negative electrode composed of vaporizable reconstructing material, the said apparatus being provided with a continuous channel narrower than the normal diameter of the cathode spot and exposing the surface of the electrode material to the action of electric currents, an electromagnetic means for causing the cathode spot to travel from one portion of the channel to the other.

7. In a vapor electric apparatus, a negative electrode, composed of vaporizable reconstructing material, a relatively good heat conducting body submerged in said material, the said body being provided with an opening within which the surface of the negative electrode material is exposed and an electromagnetic means for causing a progressive movement of the cathode spot.

8. In a vapor electric apparatus, a negative electrode, composed of vaporizable reconstructing material, a relatively good heat conducting body partially submerged in said material, the said body being provided with a circular opening within which the surface of the negative electrode material is exposed and electromagnetic means for causing a progressive movement of the cathode spot.

Signed at New York in the county of New York and State of New York this 14th day of December, A. D. 1912.

PETER COOPER HEWITT.

Witnesses:

WM. H. CAPEL,

THOS. H. BROWN.