D. E. CARPENTER.

VAPOR RECTIFIER.

APPLICATION FILED JUNE 9, 1914.

1,296,264. Patented Mar. 4, 1919.

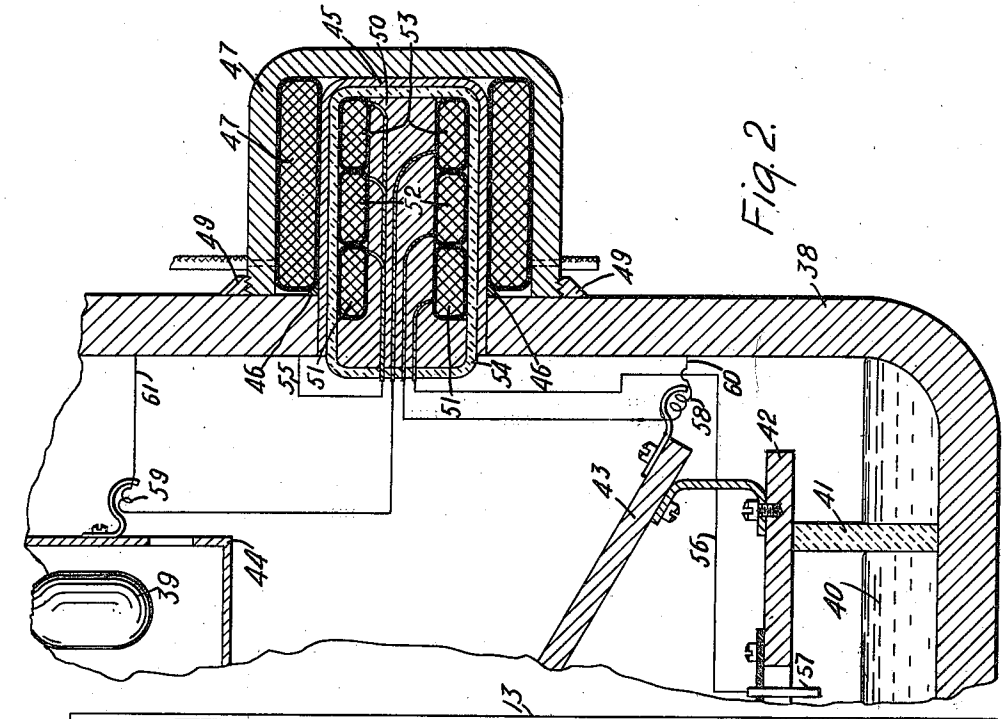

Fig. 2.

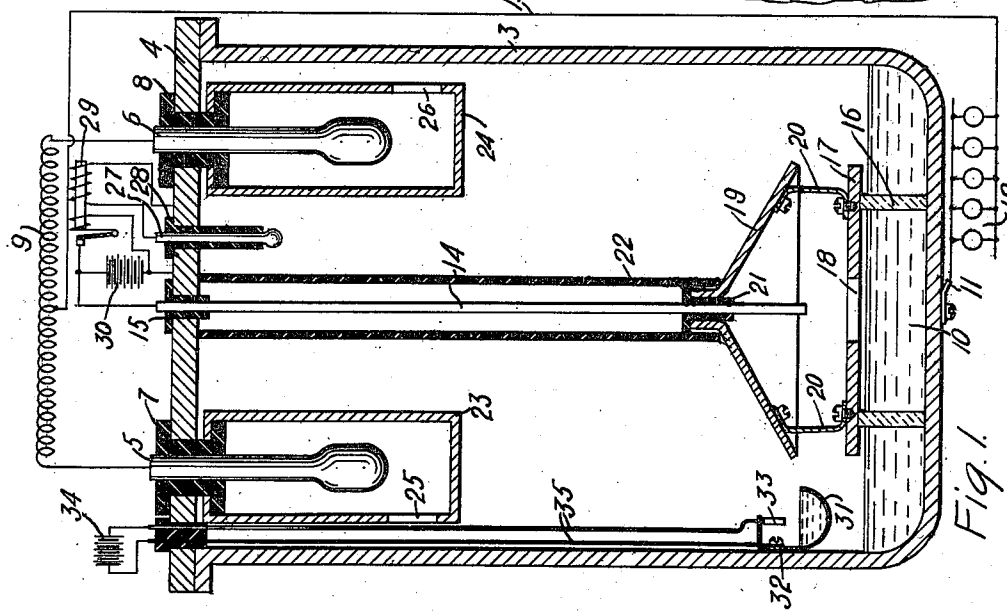

Fig. 1.

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VAPOR-RECTIFIER.

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To all whom it may concern:

Be it known that I, DAVID E. CARPENTER, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Vapor-Rectifiers, of which the following is a specification.

My invention relates to vapor electric apparatus, and it has for its object to provide means for readily starting an arc in apparatus of the character specified and for insuring the permanency and steadiness of the arc when started.

In the accompanying drawing, Figure 1 is a view, partially in section and partially in elevation, of a mercury vapor rectifier embodying my invention; and Fig. 2 is a view, in section, of a portion of a mercury vapor rectifier embodying a modified form of current supply.

As is well known in the art, the flow of an electric current through a gas or an evacuated space is possible only when said gas or said evacuated space contains ions or electrons. These ions or electrons are generally formed from the substance of one of the electrodes, generally the cathode. Accordingly, the flow of current through a mercury lamp or rectifier is possible because of the presence of ions or electrons from the body of mercury constituting the cathode, I have found that, with the extensive and complicated systems of shielding now in use to prevent the throwing off of masses of molecular mercury from the body of the cathode and hence to prevent short circuiting between the anodes, it is difficult to obtain a sufficient number of ions or electrons in the neighborhood of the anodes, their free passage upward from the cathode being greatly obstructed by the tortuous path provided for the arc. I have found that, by locating ion generating devices near the anodes and in proximity to points of inflection of the vapor arc, thus assuring a plentiful supply of ions at all portions on the vapor path, a vapor rectifier may be started much more readily and its operation, when started, may be rendered much more stable during wide fluctuations of load and of impressed voltage.

Referring to the form of device shown in Fig. 1, 3 is a container of substantially gas-tight material, such, for example, as drawn steel. The container 3 is provided with a cover 4 and the two are joined by any suitable gas-tight seal. A pair of anodes 5 and 6 project through the cover into the interior of the container 3 and are supported therefrom by insulating gas-tight seals 7 and 8. The anodes 5 and 6 are supplied with alternating current from a suitable source 9. A pool of mercury 10 in the bottom of the container serves as the cathode, and current is taken therefrom through the wall of the container to a connection 11 leading to a load 12. From the load 12, the rectified current is returned by a wire 13 to the mid point of the source 9, all as is well known in the art. A rod of conducting material 14 projects through the cover and is supported therefrom by an insulating gas-tight seal 15. The lower end of the rod 14 is adjacent the upper surface of the cathode pool so that, by the application of a moderately high voltage for starting or by the movement of the rod 14 into and out of the cathode pool, a keep-alive arc of the ordinary type may be maintained between the lower end of the rod and the surface of the cathode. A ring 16 of refractory insulating material, such, for example, as quartz, rests upon the bottom of the container 3 and serves to almost entirely separate the central portion of the cathode pool from the outer portions thereof and also serves to restrict the cathode activity to the central portion of the pool. A disk 17 of refractory material, such, for example, as iron, having an opening 18 in the central portion thereof, rests upon the upper edge of the ring 16 and serves to still further confine the region of cathode activity. A frusto-conical shielding member 19 is supported from the disk 17 by any suitable means, such, for example, as arms 20. The rod 14 is insulated from the member 19 by a bushing 21. A tube 22 of refractory insulating material, such, for example, as quartz surrounds the rod 14 and rests upon the member 19, shielding the rod 14 from the vapor arc. Shielding members 23 and 24, preferably constructed of conducting material, are supported from the sealing devices 7 and 8 in any suitable manner and render the direct arcing path between the anodes relatively long and tortuous, since the arcing

openings 25 and 26 face away from each other. The breaking down of the negative electrode reluctance of an anode is generally caused by the impact thereupon of a body of molecular mercury thrown off from the cathode by means of the cathode flame and, since the vapor arc must rise through the opening 18, pass out under the edge of the member 19 and pass through the openings 25 and 26, it is extremely difficult for any cathode particles to impinge directly upon the anodes.

An electrode 27 projects through the cover and is insulated, throughout the greater part of its length, by an extension of an insulating seal 28 or by any equivalent means. A Geissler-tube discharge is maintained between the lower end of the electrode 27 and the wall of the container by means of any suitable source of high-potential current, such, for example, as an induction coil 29, the primary winding of which is energized from a battery 30 which may also supply current to the keep-alive anode 14. A cup 31 is mounted on the wall of the container near the cathode and is insulated from the wall by insulating means 32. Condensation from the wall will keep the cup 31 filled with mercury at all times. An auxiliary anode 33 is mounted adjacent the mercury in the cup as, for example, by an extension of the insulating means 32. An ionizing arc is maintained between the anode 33 and the mercury in the cup 21 by any suitable source 34 through a full wire circuit 35.

Having thus described the structure and relative arrangement of the various elements of my device, the operation is as follows: By the application of high-potential, high-frequency, current or by any other suitable starting method, small direct current arcs are initiated between the lower end of the rod 14 and the cathode pool 10 and between the anode 33 and the pool in member 31. A Geissler-tube discharge is also initiated between the anode 27 and the wall of the container. By the operation of these discharges, the interior of the container is filled with ions or electrons so that, upon supplying alternating current from the source 9, alternate waves will flow from the anodes 5 and 6, and rectification will be initiated in the usual manner.

Cups, similar to the member 31, might be disposed throughout the container to serve as sources of ionization or means might be installed for maintaining Geissler discharges in various parts of the container for providing ions, as desired. Obviously, the number and arrangement of the ionic sources must be adapted to the specific system of shielding employed between the main anodes and the main cathode.

Referring to the form of my device shown in Fig. 2, 38 is the wall of a container, preferably of steel; 39 is one of the main anodes supported therein and 40 is the cathode pool, all as in the device of Fig. 1. Members 41, 42, 43 and 44 are similar in structure and in function to the corresponding members in Fig. 1. A cup shaped member 45 of non-magnetic material, such for example, as nickel alloy is welded to the edges of an opening in the wall of the container 38, as shown at 46. A winding 47 is slipped over the outer surface of the cup shaped member 45 and connected to any suitable alternating current source. A cup shaped member 48 of magnetic material, laminated if desired, is slipped over the winding 47 and attached to the container by any suitable means shown at 49. A laminated mushroom magnetic core member 50, carrying a plurality of windings 51, 52 and 53, is mounted within the cup shaped member 45 and is entirely sealed within a container 54 of gas-tight material, such, for example, as glass. One terminal of each of the windings 51, 52 and 53 is grounded on the wall of the container by a wire 55. The remaining terminal of the winding 51 is connected, by a wire 56, to an anode 57 supported adjacent the surface of the mercury of the cathode 40. The remaining terminals of the windings 52 and 53 are connected, respectively, to small filaments 58 and 59 supported adjacent the edge of the member 43 and the anode shield 44, respectively. The other terminals of the filaments 58 and 59 are grounded on the walls of the container by wires 60 and 61. The filaments 58 and 59 are composed of a substance which gives off ions profusely when highly heated, such, for example, as cerium oxid or thorium oxid.

Having thus described the structure of Fig. 2, the operation is as follows: Upon supplying alternating current to the winding 47, an alternating magnetic flux is set up through the core member 50, the cup shaped member 48 and that portion of the container wall constituting the edges of the opening in which is welded the member 45. Electromotive forces of any desired amount are generated within the windings 51, 52, 53, and the current flowing therefrom causes an arc between the anode 57 and the pool 40 and causes the filaments 58 and 59 to become incandescent. Ions or electrons are accordingly generated in great numbers within the container and, upon supplying an alternating electromotive force through the main anodes, current flow and rectification will ensue.

The specific transforming device 45—54 employed for setting up current flow in a plurality of separate circuits within a container without the necessity of sealing a great number of wires through the walls of the container, with liability to leakage, forms no part of my invention but is separately described and claimed in U. S. Pat-

ent No. 1,150,017, issued to the Westinghouse Electric & Manufacturing Company, Aug. 17, 1915, on an application filed by David C. Davis.

Obviously, any other old and well known means for generating ions by the current flow in the small auxiliary circuits of Fig. 2 may be employed.

While I have shown my invention in two specific embodiments, I do not wish it to be restricted to the specific forms shown, but desire that it be construed broadly to cover any and all means for generating ions or electrons at a plurality of points within the container of vacuum electric apparatus in order to promote the flow of current therethrough, and I desire that only such limitations shall be imposed upon my invention as are set forth in the accompanying claims.

I claim as my invention:

1. The combination with a vapor rectifier, comprising an evacuated container and suitable shielded working electrodes therein, of means for simultaneously generating ions at a plurality of points adjacent the arcing path between the working electrodes between which points there are means preventing free ionic travel.

2. The combination with a vapor rectifier, comprising an evacuated container and suitable working electrodes therein, of means independent of the main circuit for generating ions adjacent the main cathode, and means, also independent of the main circuit, for generating ions adjacent a main anode.

3. The combination with a vapor rectifier, comprising an evacuated container and suitable working electrodes therein, of means, including an auxiliary circuit, for generating ions adjacent one portion of the main arc path, means, including an auxiliary circuit, for generating ions adjacent another portion of the main arc path, and means for preventing the flow of pulsating current from one auxiliary circuit to the other.

In testimony whereof, I have hereunto subscribed my name this 28th day of May 1914.

DAVID E. CARPENTER.

Witnesses:
G. R. GWIN,
B. B. HINES.