W. R. WHITNEY.

ELECTRIC DISCHARGE DEVICE.

APPLICATION FILED NOV. 6, 1914.

1,267,827. Patented May 28, 1918.

Fig. 1.

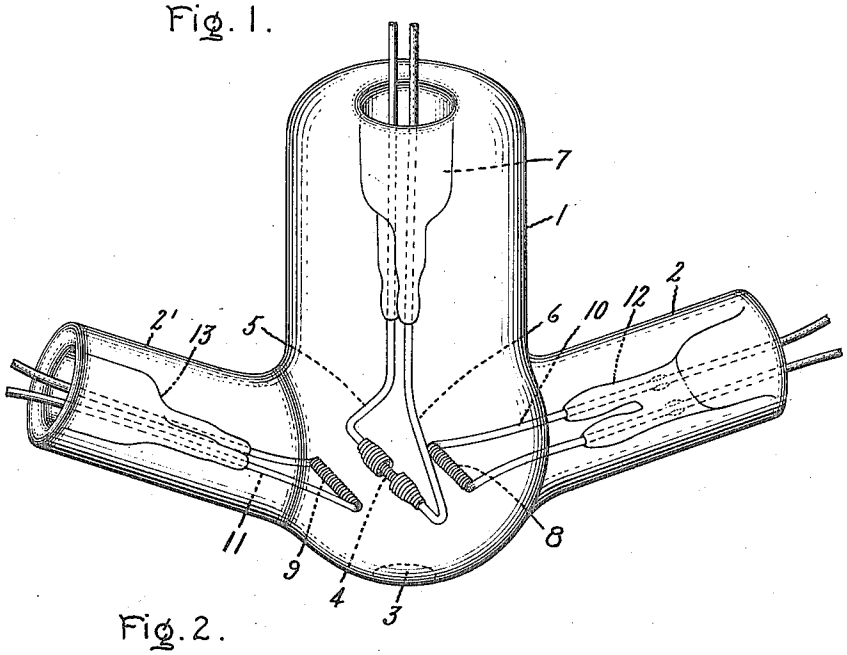


Fig. 2.

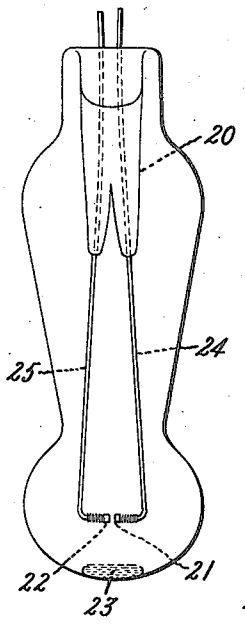


Fig. 5.

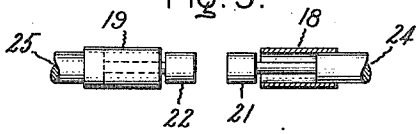


Fig. 3.

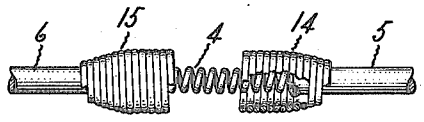
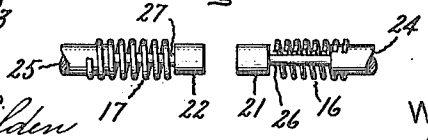


Fig. 4.



Witnesses:

George W. Tilden

J. Ellis Glen.

Inventor:

Willis R. Whitney,

by Albert G. Davis

His Attorney.

UNITED STATES PATENT OFFICE.

WILLIS R. WHITNEY, OF NISKAYUNA, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRIC DISCHARGE DEVICE.

1,267,827. Specification of Letters Patent. Patented May 28, 1918.

Application filed November 6, 1914. Serial No. 870,669.

To all whom it may concern:

Be it known that I, WILLIS R. WHITNEY, a citizen of the United States, residing at Niskayuna, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electric Discharge Devices, of which the following is a specification.

The present invention relates in general to electric discharge devices having a cathode operating at incandescence, and the object of my invention is to suppress local disintegration or erosion of the cathode near its supports and thus to lengthen the life of the apparatus.

In inclosed arc devices in which a cathode of refractory material operates at incandescence, the regions of the cathode near the supports, or in some cases a region of the support adjacent the cathode proper, is eaten away or disintegrated by some electrical action quite apart from the thermal evaporation, and which appears to be due to a bombardment by positive ions.

In accordance with my invention I provide a protecting means operating to prevent this local electrical disintegration of the cathode. This means probably operates by discharging the positive ions and may consist of a conductor extending into their path and maintained negatively charged. In one embodiment of my invention this discharging conductor is constituted by a conductive shielding means electrically connected to the cathode support and surrounding the region to be protected. This shield apparently operates to prevent the access of positive ions to the cathode. The electrical erosive action is transferred to the shield where it can do no harm. In examples of my invention hereinafter more fully described the shield means assumes the form of a sleeve spaced away from the cathode and interposed between the region of the cathode subject to disintegration and the anode.

My invention is applicable to various types of discharge devices containing an incandescent metal acting as a cathode, and the accompanying drawings illustrate two examples of devices embodying my invention. Figure 1 shows a rectifier; Fig. 2 shows an inclosed arc lamp; Figs. 3 to 5, inclusive, illustrate on an enlarged scale specific forms of my invention.

The particular form of rectifier shown in Fig. 1 as illustrating one application of my invention, comprises an envelop 1 consisting of glass and provided with side arms 2, 2′, for the convenience of the sealing-in of the anode terminals. The envelop is filled with an inert gas, such, for example, as nitrogen, argon, neon or mercury vapor or mixtures of these gases at a pressure ranging usually from about a centimeter of mercury to atmospheric pressure. When the arc is to operate in mercury vapor a globule of mercury 3 is provided and the envelop proportioned to run at a temperature at which the mercury vaporized will have the desired pressure. In the case of mercury vapor this pressure in some cases may be as low as about one millimeter.

The cathode 4, as more clearly shown in Fig. 3, consists of a conductor of some highly refractory material, such as tungsten, which in this case is helical although it may assume other forms. This cathode is connected to current conveying supports 5, 6, also preferably consisting of tungsten and sealed directly into the stem 7 of low expansion glass. In case the envelop itself does not consist of low expansion glass but consists of a glass having a different coefficient of expansion, for example lead glass or consists of quartz, a stem of low expansion glass may be joined thereto by a graded seal. The anodes 8, 9 may have any convenient form, in the present instance consisting of spirals of tungsten or other refractory metal. They are connected respectively to the supports 10, 11 sealed into stems 12, 13. It is not necessary that two supports should be provided for each anode, but it is obviously convenient to support a spiral in this manner.

At the respective ends of the cathode 4 are provided shields 14, 15, also preferably consisting of tungsten, although other metals such a molybdenum or iron may also be used. These shields in the device illustrated are attached to and electrically connected with the supporting wires 5, 6, and extend over the end turns of the cathode, as shown in Fig. 3. It is not necessary that the shields should have the particular form shown in Fig. 3 in which they are constituted of closely wound wire, but as shown in Fig. 4, in connection with the electrodes of an arc lamp, the shields 16, 17, consist of

spirals, the turns of which are spaced apart, and in Fig. 5 the shields 18, 19 consist of imperforate tubes.

The bombardment of the cathode by the positive ions with an accompanying abrasion appears to be greatest near the ends of the cathode. This may be connected with the fact that at this region the cathode is cooled by the conduction of heat away from the cathode through the lead but more probably is largely due to the fact that the positive ions bombard the most negative parts of the cathode, namely the terminals. As the shields extend into the path of the positive ions and being electrically connected to the supports, are maintained at the potential of the supports, the bombardment is received by the shields. Some disintegration of the shields occurs but as they may be made relatively heavy and are unheated, the erosion does little or no harm.

As already indicated my invention is applicable to various types of discharge devices, and in Fig. 2 has been shown applied to a miniature arc lamp.

The electrodes 21, 22 of refractory metal operate at incandescence in an atmosphere of inert gas, for example, nitrogen, argon, or mercury vapor furnished by a globule of mercury 23, when an arc is struck between the electrodes in any convenient manner, for example, by a high potential discharge. The envelop preferably is proportioned and the initial gas pressure so chosen that the pressure when the lamp is operating is of about the order of atmospheric pressure. The electrodes 21, 22 are carried by supports 24, 25 of tungsten or other refractory metal sealed into a stem 20. In order to reduce the heat losses from the electrodes 21, 22 to enable them to operate at highest incandescence, they preferably are connected to the main supports 24, 25 by stems 26, 27 of reduced diameter, and it is particularly these stems that are subject to disintegration. Each is heated to a temperature intermediate the working electrode and the support chiefly by conduction from the heated electrodes. The shields 16, 17, as already explained, may consist of spirals, Fig. 4, or of tubes 18, 19, Fig. 5. These shields extend the potential of the supporting wires around the stems and they protect the same from the disintegrating effect of positive ions. In the lamp illustrated the electrodes 21, 22 have substantially the same size and are intended particularly for operation with alternating current and hence each operates alternately as cathode. Each electrode, therefore, has been provided with protecting shields. In a lamp designed for direct current operation it is not necessary to provide a shield for the anode.

It should be understood that the particular forms of the cathode and of the shields here shown as well as the particular type of devices in connection with which my invention is described are illustrated only and my invention is not limited to such particular forms.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In an electrical device having an envelop, an incandescing electrode mounted therein, a current-conveying conductor therefor and a conductive shield mounted upon said conductor and extending around the negative end of said electrode but spaced apart therefrom.

2. In an electrical arc device comprising a container, a gaseous atmosphere at a pressure of at least about one millimeter of mercury, a cathode operating at incandescence, a support for said cathode and a conductive shield spaced away from said cathode and electrically connected directly to the support, and extending about an end of the cathode only to the exclusion of the remainder of the cathode.

3. An electrical device operating by gas ionization comprising an envelop, a gaseous filling therein, a cathode operating at incandescence one region of which operates relatively cooler than the remaining portion, a coöperating anode, and a shield electrically connected to said cathode and interposed between said cool region of the cathode and said anode.

4. In a vapor electric device comprising a container, a gaseous filling therein, at a pressure high enough to permit of ionization, an electrode operating at incandescence, a support therefor, a shield surrounding the junction only of said support and said electrode, and receiving the disintegrating effect of positive ionization, thereby protecting the cathode.

5. A vapor electric device comprising an envelop, a cathode operating at incandescence, supports therefor connected to said cathode, an anode, a gaseous atmosphere surrounding said electrode and a shield located between the region of the cathode adjacent the support and the anode.

6. A device comprising a container, a gas therein, at a pressure high enough to permit of ionization, a cathode of refractory material operable at incandescence, terminal conductors therefor and conductive shields surrounding the parts of the cathode adjacent the terminal conductors, said shields being maintained at the potential of the terminal conductors.

7. A device comprising a container, a gas therein, at a pressure high enough to permit ionization, a cathode of refractory material operating at incandescence, one region of which is subject to local destructive electrical disintegration, and a discharge-receiving shield located adjacent said region of the

cathode but leaving other parts of the cathode exposed.

8. The method of protecting an incandescent cathode operating in a gas from electrical erosion which consists in maintaining in the vicinity of said cathode a conductor negative with respect to said cathode.

In witness whereof, I have hereunto set my hand this 5th day of November, 1914.

WILLIS R. WHITNEY.

Witnesses:

MARY E. CHRISTIE,

BENJAMIN B. HULL.