Nov. 4, 1952 G. LEWIN 2,617,064

VAPOR-ELECTRIC DEVICE

Filed Oct. 12, 1950

Fig. 1.

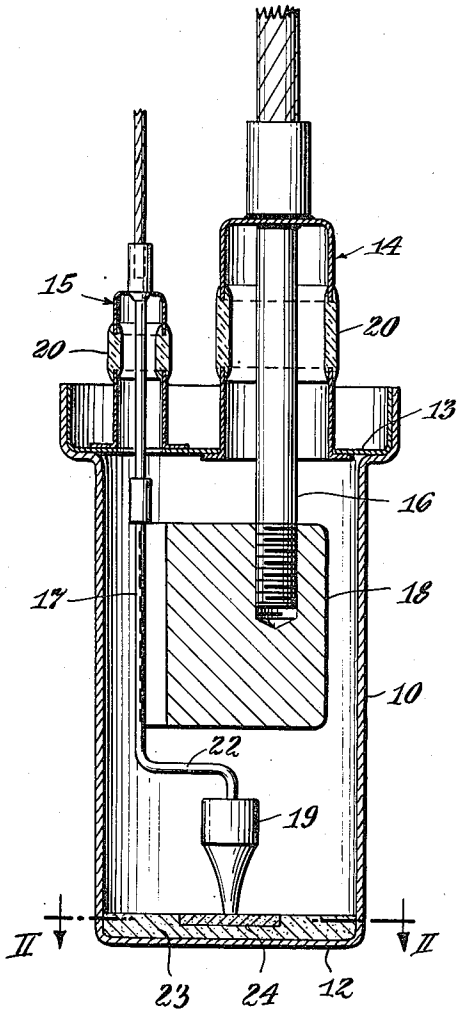


Fig. 3.

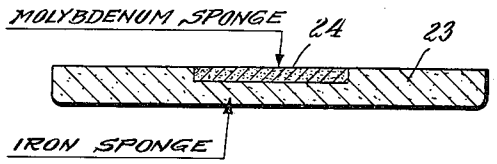


Fig. 4.

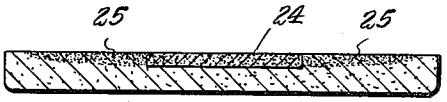


Fig. 5.

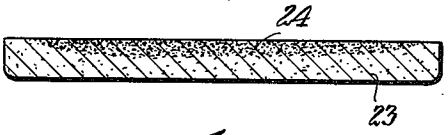
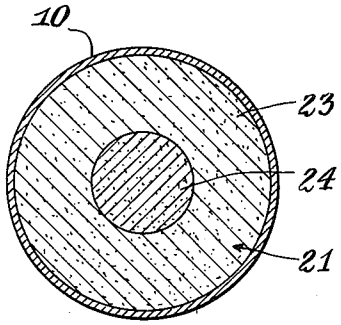


Fig. 6.

Fig. 2.



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VAPOR-ELECTRIC DEVICE

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Application October 12, 1950, Serial No. 189,784

11 Claims. (Cl. 313—170)

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This invention relates to vapor-electric devices such as are generally known as ignitrons.

Attempts have heretofore been made to provide a semi-solid or sponge cathode for electric discharge devices, and the present invention contemplates improvement thereover.

In the broad aspects of the invention, more stable and unfailing arc discharge is an objective and accomplishment thereof.

The invention also provides for the more effective cycle of vaporization at the point of arc instigation of the reconstructing liquid cathode material, condensation and return to the initial point of arc instigation.

The invention further provides for copious supply of the liquid cathode material at the point of arc instigation.

Another object of the invention is to provide a sponge cathode that will gulp in, as fast as available, all liquid cathode material condensing on or flowing to the sponge cathode, and yet make the liquid available at the surface where the arc strikes.

Other objects of the invention will appear to those skilled in the art to which the invention appertains as the description proceeds, both by direct reference thereto and by implication from the context.

Referring to the accompanying drawing, in which like numerals of reference indicate similar parts throughout the several views:

Fig. 1 is a central longitudinal sectional view of an ignitron of arbitrarily selected construction showing my invention embodied therein;

Fig. 2 is a cross-section on line II—II of Fig. 1;

Fig. 3 is a sectional view of the sponge cathode alone;

Figs. 4 and 5 are similar sectional views of modified constructions of sponge cathodes; and

Fig. 6 is a similar sectional view of a modified construction of disc for the firing area of the cathode.

In the specific embodiment of the invention and associated ignitron construction illustrated in the drawing, but without limiting to the details thereof, a cylindrical casing 10 of steel or other sturdy material is shown having a bottom 12 integral therewith and a top header 13 sealed at the upper rim of said casing to provide a closed envelope adapted to be evacuated.

The particular header shown, provides appropriate lead-in seals 14, 15 for electrode leads 16, 17 respectively for an anode 18 and ignitor 19 within the casing and supported from said header by said leads. The lead-in seals each include a glass or other insulating sleeve 20 by which the leads are kept electrically distinct from each other and from the casing. The anode 18 is located toward the top of the casing, well above the bottom wall 12, whereas the ignitor 19 is located below the anode, preferably centrally of the casing, and is directed toward and terminates at its bottom in the vicinity of said bottom wall. Said ignitor is shown as relatively slender and tapers downwardly, with its bottom end quite small. Said ignitor may be composed of materials as used for ignitors of the prior art, or may be of such other material or materials adapting it more especially to the present invention.

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A sponge cathode, designated generally by numeral 21, is provided in said container and is of pan-cake shape, and situated upon the bottom wall 12 of the ignitron, preferably fitting the container at its periphery and frictionally or otherwise held permanently in fixed position. The aforementioned lower small end of the ignitor 19 rests upon the upper surface of the sponge cathode 21 in constant contact therewith, and as one means for maintaining such contact without detriment to the lead-in seal 15, the lead-in 17 for the ignitor, between the seal and the ignitor, is shown with a transversely extending section 22 which, with the rest of said lead-in, possesses adequate resiliency, supplemented by the weight of the ignitor, to accomplish the purpose. The ignitor projects, from its contact on the sponge cathode, at right angles thereto and in a direction longitudinally of the casing. Mercury or other reconstructing liquid cathode material is applied to the sponge cathode 21 to the extent that said sponge will absorb the mercury or the like without any excess remaining on the surface. One manner of thus charging the sponge body with mercury is to cleanse the sponge material until sufficiently clean to be wetted by mercury and then apply an excessive amount of mercury in the casing, whereupon the sponge will immediately fill with mercury, after which the free mercury which is not absorbed into the sponge can be poured off. The sponge cathode 21, with the absorbed mercury, constitutes the cathode of the ignitron.

It has been suggested in copending application Serial No. 188,684, filed October 6, 1950, in the name of Donald E. Marshall, and assigned to the same assignee as the present application, that any one of various materials, sintered iron and sintered molybdenum being specifically recited, may be used for the sponge cathode. Each

of these specific materials has its distinctive advantages and disadvantages. For instance, a sintered iron sponge absorbs mercury more readily and remains wetted by mercury longer under adverse conditions than molybdenum. But iron has the disadvantage of more rapid erosion under action of the arc influenced by the necessarily high average current. Molybdenum dries up at its exposed surface far more rapidly than iron and is not as readily absorptive of mercury, and therefore may leave pools or drops of mercury on occasion on the surface of a molybdenum sponge cathode pending the delayed absorption of the mercury. Experience teaches that the surface of a molybdenum sponge may dry up during stand-by periods and also under conditions of temporary increase of gas pressure which may occur from overload. Excess mercury on the outside of the sponge is undesirable and detrimental since it may cause arc-backs or spontaneous ignition under shock. Furthermore, failure of mercury to reenter the sponge promptly, depletes the supply of mercury in the sponge where needed for arc-striking purposes. The lasting quality of molybdenum, however, is much superior to an iron sponge.

According to the present invention, I take advantage of the desirable characteristics of both iron and molybdenum in a sponge cathode. In the several exemplifications of the invention, each sponge cathode illustrated comprises a body portion **23** of sintered iron or other material having absorptive affinity for the reconstructing cathode fluid, such as the mercury above mentioned, and a sintered molybdenum, or equivalent material, arc-striking portion **24**. The interstices between granules of molybdenum are smaller than between iron granules which render capillarity in molybdenum more pronounced than capillarity of the iron body, and capacity for mercury superior to molybdenum.

In the embodiments of the invention illustrated in Figs. 1 to 5, inclusive, the body portion **23** of the sponge cathode is shown relatively flat or thin of pan-cake shape to fit within the bottom portion of the container flatwise on the bottom wall thereof and frictionally held in place as above described. In the showing of Figs. 1 to 4, inclusive, the arc-striking portion **24** comprises in whole or in part a smaller disc than said body portion, said smaller disc being embedded in said body portion **23** with the upper surfaces of said body portion and disc lying in a common plane whereby both are exposed within the container only at their upper faces. The disc is preferably located concentric to the said body, and is of less diameter and of less thickness than said body. Said disc is sintered compressed molybdenum or its equivalent having sponge characteristic and highly resistive to erosion. By use of granules of substantially equal size and applying evenly distributed pressure, the disc may be thereby made to be effectively homogeneous throughout. The capillarity of the disc is determined by the degree of compactness, but the material has ample sponge characteristic even when compressed under formulating force of several tons per square inch.

If so desired, the surface of the disc where the arc strikes, may be made closer grained than the part of the disc not subject to direct arc contact. Thus, in Fig. 6, the disc is indicated as having its upper surface of finer granules than are used to form the lower part of the disc. Thereby the lower part of the disc provides larger interstices between particles and constitutes a more ample reservoir for the mercury in proximity to the arc-striking surface of the closer-grained material, so there will be a copious supply of mercury to and for the arc-striking surface of the disc.

The body portion **23** of the sponge cathode may be made in whole or in part of compressed sintered iron granules an inherent characteristic of which is more active absorption of mercury coming in contact therewith than will occur with a similarly compressed sintered body of molybdenum granules. An ignitron in use will condense mercury vapor on the side walls of the container, and that condensation forms in drops which run down the wall and lodge upon the sponge cathode surface. By the provision of a sintered iron sponge in the vicinity of the side wall of the container said surface will be in appropriate location to receive and absorb the drops of mercury and thereby avoid presence or flow of mercury over the central arc-striking surface. The body portion furthermore extends under the molybdenum disc at the center, and accordingly will deliver the absorbed mercury to the under side of said disc during operation of the ignitron. By virtue of capillarity characteristic of the molybdenum, the supply of mercury from the iron body is fed to the arc-striking surface of the molybdenum disc.

If so desired, and by any of a precautionary measure, it is within the scope of the invention to form the body portion **23** with its upper surface comprising a graded thickness of molybdenum sponge **25** in the area radially outward from the central disc of molybdenum. This had the advantage that in event the arc spreads beyond the area of the disc, there still will be an erosive-resisting surface in contact with the arc. The structure of this modification, Fig. 4, preferably provides a deeper thickness of the molybdenum **25** toward the center of the body than toward the periphery thereof. The grading of the molybdenum thus affords maximum corrosion resistance in the area most likely to be affected by the arc, and affords maximum absorptive characteristic toward the periphery where the condensed mercury returns to the cathode.

If so desired, the graded molybdenum may be employed throughout the central portion of the body, and applied in appropriate depth and fineness of particles as shown in Fig. 5, to entirely replace the separately formed disc of molybdenum.

Another modification is shown in Fig. 6, the disc there shown being graded as to thickness of the fine and coarser particles, the top layer **26** of said disc having fine particles and the lower part of the disc having coarse particles, and the intermediate portion is graded from the fine particles at the top to the coarse particles at the bottom. This construction has the advantage of the arc-resisting surface at the top and of furnishing a more copious supply of mercury thereto by the capillarity derived from the larger interstices toward the bottom of the disc, which in turn are supplied by the reservoir of mercury in the interstices of the body **23**.

Other modifications of the invention may be made of similar nature to those above-described, so that further illustration is not deemed necessary for further indication thereof and as included within the terms of the appended claims.

I claim:

1. A vapor-electric device comprising a sealed

casing having an anode therein, a sponge cathode fixed in said casing, said cathode comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, an ignitor in said casing and in contact with one of said sponge materials, and reconstructive cathode material absorbed in said sponge cathode.

2. A vapor-electric device comprising a sealed casing having an anode therein, a sponge cathode fixed in said casing, said cathode comprising a body of one sponge material and an arc-striking portion of a different sponge material carried by said body, an ignitor in said casing and in contact with said arc-striking portion of the sponge cathode, and reconstructive cathode material absorbed in said sponge cathode.

3. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, one of said materials being characterized by affinity to absorption of a reconstructing cathode material and the other characterized by its resistance to erosion from the effects of an arc thereon.

4. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode, one of said sponge materials being carried by and of less surface area than the other and having greater resistance to erosion than the said one material from the effects of an arc thereon, said one material having greater affinity to absorption of a reconstructing cathode material than said other sponge material.

5. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, one of said materials being composed of sintered iron granules.

6. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, one of said materials being composed of sintered molybdenum granules.

7. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, one of said materials being composed of sintered iron granules and the other composed of sintered molybdenum granules.

8. A sponge cathode for a vapor-electric device, comprising different sponge materials at different portions of said cathode and with an extensive part of one making intimate contact with a corresponding part of the other, one of said materials comprising a larger body than the other, and said other being coaxially disposed with respect to the larger, and both having surfaces exposed in the same general direction.

9. A sponge cathode for a vapor-electric device, comprising a pan-cake shaped body portion of one material having an exposed upper surface, and a smaller disc of another material concentrically disposed to the body portion and having an upper face exposed in the same direction as said upper face of said body portion.

10. A sponge cathode for a vapor-electric device, comprising a pan-cake shaped body portion of sintered sponge iron having an exposed upper surface, and a smaller disc of molybdenum embedded in said body and with a face thereof exposed in the same direction as and lying substantially in the same plane as said exposed face of the body portion.

11. A sponge cathode for a vapor-electric device, comprising a cake of metallic sponge material having greater density at one portion thereof for constituting an arc-striking surface thereat resistive to erosion from the effects of the arc, and having another portion thereof of less density for promoting absorption of reconstructive cathode material condensation.

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The following references are of record in the file of this patent:

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