May 26, 1953 G. LEWIN ET AL 2,640,171

VAPOR ELECTRIC DEVICE CATHODE

Filed Oct. 25, 1951

Fig. 1.

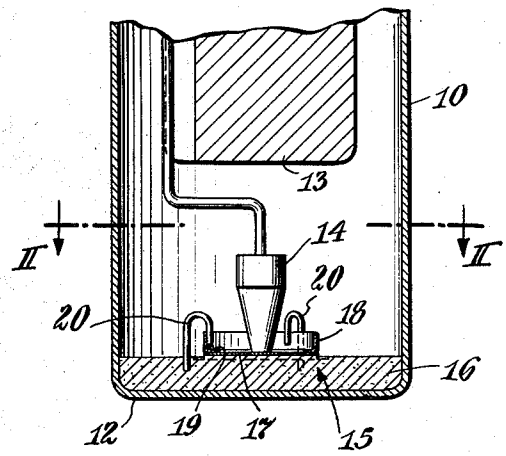


Fig. 2.

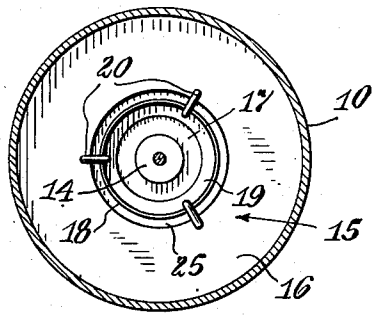


Fig. 3.

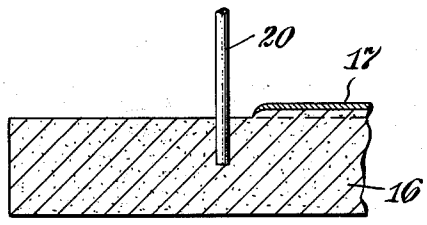


Fig. 4.

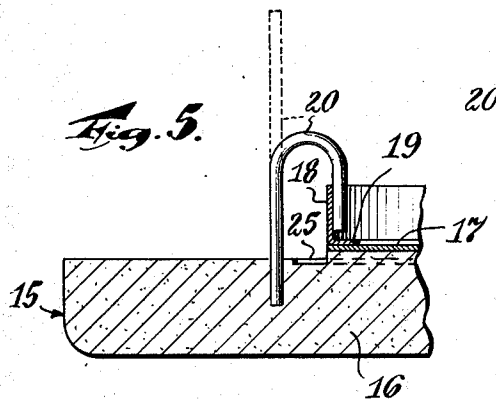
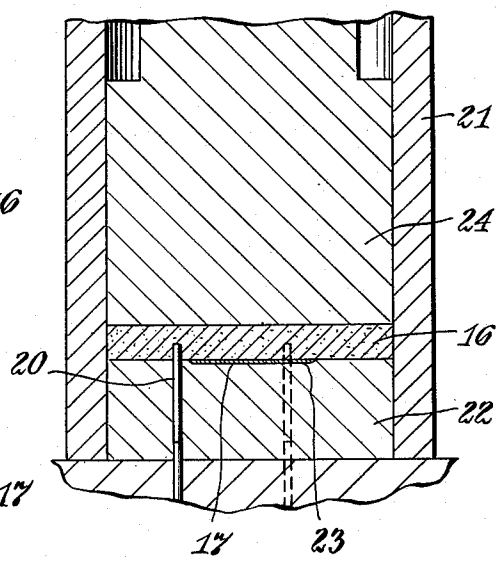


Fig. 5.



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Patented May 26, 1953 2,640,171

UNITED STATES PATENT OFFICE

2,640,171

VAPOR ELECTRIC DEVICE CATHODE

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Application October 25, 1951, Serial No. 253,122

7 Claims. (Cl. 313—178)

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This invention relates to cathode construction of a vapor electric device and, more particularly, is a cathode of sponge type under the general classification of solid cathodes, and also includes features of novelty in the method of fabrication thereof.

Sponge cathodes have been made of various materials and operate on the fact and theory that the porous nature of the sponge obtains a capillary action with respect to the mercury of an ignitron to keep a copious supply thereof at the arc bearing surface of the sponge during operation. We have found that the metals of the platinum group are excellent materials for constituting the sponge portion of the cathode, but the cost of such materials is prohibitive for use in commercial applications.

The present invention accordingly is directed to a sponge cathode construction enabling these desirable but costly metals to be effectively used in small quantities.

Specifically, the invention has objectives of constructional features limiting the arc-striking surface of any costly metal as to size and the total amount of this metal and yet obtain the benefits thereof to fullest extent necessary or desirable.

Other objects of the invention will appear to persons skilled in the art to which it appertains as the description thereof proceeds, both by direct recitation 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 vertical section of an essential portion of an ignitron wherein the present invention is included;

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

Fig. 3 is a longitudinal sectional view of a die arrangement for fabrication of the sponge cathode;

Fig. 4 is a detail section of a portion of the sponge cathode as formed by the dies; and

Fig. 5 is a detail section similar to Fig. 4, showing the completed construction of the same portion of the sponge cathode.

In the specific embodiment of the invention and associated ignitron construction illustrated in the drawing, but without limiting to details thereof, a sealed cylindrical casing 10 of steel or other sturdy material is shown having a bottom 12 integral therewith and having, at a distance above said bottom, an anode 13 appropriately supported and insulated from the casing as usual in the art. Between said anode 13 and bottom 12

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is an ignitor 14 here shown located axially of the container and directed toward and terminating at its bottom in engagement with a sponge cathode 15 located on said bottom wall 12. 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.

Said sponge cathode 15 preferably fits the container at its periphery and frictionally or otherwise is held permanently in fixed position. According to the present invention, the sponge portion of the sponge cathode 15 is constructed essentially of two different materials, of which one is used to take advantage of its relatively large interstices between granules for providing generous reservoir capacity, and also to take advantage of its characteristic of affinity, for and absorption of mercury coming in contact therewith. Selection of the other material to constitute the sponge portion of the cathode is for purpose of providing an arc-striking surface highly resistant to erosion due to the arc and yet of a character which will present a generous supply of mercury to the surface thereof by capillarity, and also of a nature not readily contaminated or poisoned during fabrication or during use. More specifically, the body portion 16 of the cathode is essentially of sintered iron or other material having high absorptive affinity for the reconstructing cathode fluid, such as the mercury above mentioned, and on said body is an arc-striking portion 17 of a character having the above-recited advantages and preferably a material of the platinum group of which both platinum and ruthenium are highly desirable examples. In view of the high cost of these platinum group materials, however, the previously developed technique for arc-striking inserts in sponge bodies is impracticable, and the construction by which approximately one to two grams of the precious metal for the size of ignitron disclosed below is required constitutes the essence of the present invention.

The arc-striking portion 17 comprises a disc less than half of the diameter of body portion 16 and of a thickness of substantially film proportion, so it is only a very small fraction of the thickness of the body portion. It may further be defined as so thin that it would not be alone self-supporting and requires the body portion for support to remain intact. For instance, an ignitron having a three and one-half inch diameter of cathode body and quarter inch thickness of body, the arc striking portion would be

approximately an inch in diameter and have a thickness of approximately two hundredths of an inch or less, and perhaps more vividly described as "paper thin." Its location is shown upon the upper surface of the body portion and coaxial thereto so as to be centrally contacted by the ignitor and lower end of which presses against the top central region of the said arc-striking portion.

The arc is limited to the top surface of the said arc-striking portion by a molybdenum or other refractory metal or insulating ring **18** superposed at the peripheral margin thereof. Said ring has an inturned flange **19** engaging flatwise on the said margin of the arc striking portion and has appropriate retainers **20** for holding the ring in place. The retainers may be variously constructed and in the present showing comprise wires of iron, molybdenum or other suitable material having one end embedded in and held securely by the sponge body and projecting from said body at the outside of said ring and bent over the edge of said ring where they may be welded or otherwise secured thereto.

Fabrication of the sponge cathode is performed primarily by utilization of pressure accomplished by provision of a hollow die **21** the inside diameter of which is made to correspond, with compensation for shrinkage, to the desired diameter of the cathode body to be formed. The bottom end of this hollow die is closed by a lower die **22** having holes therein for placement of the wires or other retainers **20**. Said lower die furthermore has a properly located socket **23** for reception and ultimate compression of the platinum group metal to form the arc-striking portion of the sponge cathode. An upper die **24** is depressible within the hollow die with a movement toward the lower die for compressing the material, placed on the lower die, into cake form to comprise the sponge cathode.

In practice, the platinum group metal, in powder or granular form, is first introduced into socket **23** of the lower die and leveled off to the plane of the top of that die. As the socket is shallow, a very limited amount of the multitudinous particles of the metal is required to fill it. Then the wires **20** are inserted into the lower die **22**. Next, a predetermined volume of granular or otherwise prepared material of multitudinous particles or units, such as iron powder, is introduced into the hollow die on top of the lower die and on top of the filled socket, and surrounding the upwardly projecting ends of the wires or retainers **20** previously placed in the lower die. A pressure of approximately 8 tons per square inch is then applied by the upper die upon the materials compressing the same into cake formation. Since the platinum group metal is compressed, the iron powder is forced into the socket **23** of the lower die and therefore in the finished cake the compressed iron will have a form juxtaposed to the arc-striking portion which is slightly higher than the surrounding top surface of the sponge cathode. After the compression is completed, the cake of materials, with the embedded wires **20** retained therein, is removed from the dies.

As the compression of the materials into the socket **23** of the die tends to feather-edge the layer of the platinum group metal arc-striking portion, it is advisable to machine-off the peripheral portion thereof while the cake is still "green" or not set by sintering, and obtain an arc-striking portion which is substantially flat throughout its entire area. This will avoid the tendency during subsequent sintering of cracks or crevices occurring at the edge and spreading to the exposed arc-striking surface. The machining operation may produce a shallow groove **25** in the surface of the iron body portion without detriment to the utility of the cathode. The location of wires **20** is sufficiently distant from the arc-striking area to admit the machine tool used in the machining operation.

Since the materials to be compressed are introduced in powder or granular condition, the compression thereof will cause some intermingling of the materials at their interfaces and consequently there will not be an absolute demarcation of materials at a definite plane, but at both sides of a general plane of attachment there will be an interlocking of the two materials. This interlocking of the materials, in conjunction with the paper-thin characteristic of the arc-striking portion and atomic diffusion during sintering will prevent separation which might otherwise result from different coefficients of expansion.

After the sintering of the compressed cake into an integral mass, at approximately 1800° F., final steps of fabrication include the placement of the arc-confining ring **18**, bending and attachment of the retainers **20** thereto, fitting and introduction of the assembly into the ignitron.

While the invention has been described as of particular advantage for costly materials comprising the arc-striking portion and iron as the body portion, the invention is not necessarily confined to those materials as many of the advantages derived by use of the inventive concept apply likewise with employment of other materials to constitute the sponge cathode or parts thereof.

We claim:

1. A sponge cathode comprising a body portion of porous material, and an arc-striking portion of a different porous material, said arc-striking portion being paper-thin and integral with and at the surface of said body portion.

2. A sponge cathode comprising a body portion of porous material, and an arc-striking portion of a different porous material, said arc-striking portion being of the order of 0.02 inch in thickness and integral with and at the surface of said body portion.

3. A sponge cathode comprising a body portion of porous material, and an arc-striking portion of different material integral with and at the surface of the body portion, said arc-striking portion comprising a thin layer of a sintered metal of the platinum group.

4. A sponge cathode comprising a body portion of porous material, an arc-striking portion of different material at the surface of and of less diameter than said body portion, and an arc-confining ring juxtaposed on the peripheral margin of said arc-striking portion.

5. A sponge cathode comprising a body portion of porous material, an arc-striking portion of different material at the surface of and of less diameter than said body portion, an arc-confining ring juxtaposed on the peripheral margin of said arc-striking portion, and retainers projecting from said body portion to said arc-confining ring positioning said ring substantially coaxially upon said arc-striking portion.

6. A method of fabrication of a sponge cathode comprising filling a socket in a die surface level full with multitudinous particles of one material,

covering the die surface and filled socket with a greater thickness of multitudinous particles of a different material, and compressing said materials simultaneously thereby integrally forming a layer of the compressed first mentioned material as part of the surface of the compressed second mentioned different material.

7. A method of fabrication of a sponge cathode comprising filling a socket in a die surface level full with multitudinous particles of one material, covering the die surface and filled socket with a greater thickness of multitudinous particles of a different material, and compressing said materials simultaneously thereby integrally forming a layer of the compressed first-mentioned material as part of the surface of the compressed second-mentioned different material, and trimming the edge of the compressed first-mentioned material in place on the compressed second-mentioned different material.

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