Nov. 7, 1939. A. H. TOEPFER 2,179,310

VAPOR ELECTRIC DEVICE

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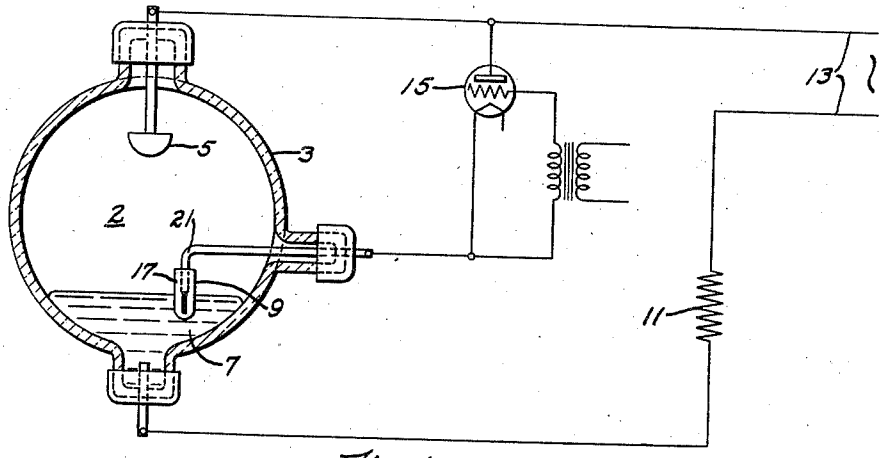


Fig. 1.

Fig. 2.

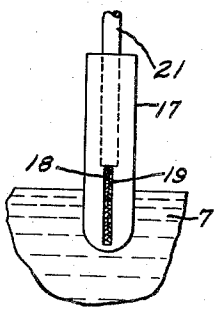


Fig. 5.

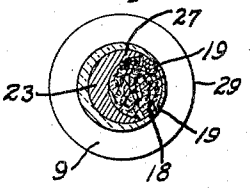
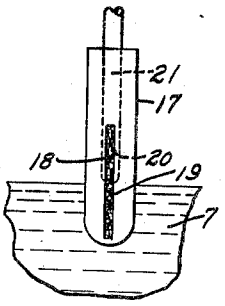


Fig. 3.



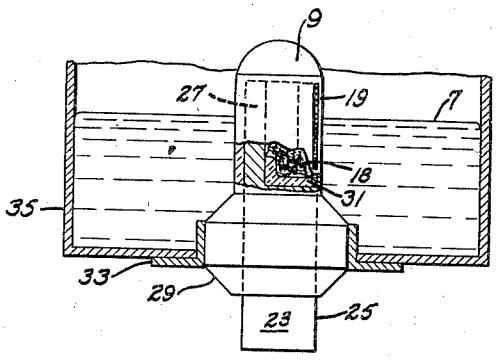


Fig. 4.

WITNESSES:

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VAPOR ELECTRIC DEVICE

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7 Claims. (Cl. 250—27.5)

My invention relates to a make-alive electrode for a vapor electric device and more particularly to electrodes of the high resistance type and the method of making the same.

In the operation of vapor electric discharge devices, it has been found advantageous to employ make-alive electrodes of some high resistance material such as boron carbide, carborundum, graphite, etc., to initiate an arc at the beginning of each conducting period in the rectifier. Recently, engineers have been designing and constructing electrodes to minimize the operating currents and voltages required to start an arc in such rectifiers. Tests have been made using irregularly shaped pieces of some high resistance material as make-alive electrodes, but considerable difficulty has been experienced with such electrodes which may heretofore have been unusable due to the fragile nature of the material and the difficulties of mounting the same.

In the make-alive electrode according to my invention, I utilize a quartz tube or some similar refractory material capable of withstanding high temperatures and heat shock. A narrow slit in the order of one-sixteenth of an inch is made in the side of the tube and then filled with irregular shaped pieces of boron carbide, carborundum or graphite. I select the pieces of the resistance material large enough not to pass through the slit, yet capable of projecting out through the slit. A suitable conductor for carrying current to the high resistance particles is extended down into the quartz tube so as to be in contact with the broken pieces of resistance material. Due to the buoyancy effect of mercury when such make-alive electrodes are immersed therein, a good contact between the conductor and the resistance material is maintained.

It is, therefore, an object of my invention to provide a make-alive electrode requiring a low operating current to initiate the arc discharge.

Another object of my invention is to provide an improved type of make-alive electrode for an arc discharge device.

Still further, it is an object of my invention to provide a method of constructing a make-alive electrode utilizing irregular shaped pieces of some high resistance material.

Other objects and advantages of my invention will be apparent from the following detailed description taken in conjunction with the accompanying drawing, in which:

Figure 1 represents diagrammatically a vapor discharge device of a type with which my improved make-alive electrode may be utilized;

Fig. 2 represents in detail a construction of a make-alive electrode according to my invention;

Fig. 3 represents another modification of a make-alive electrode;

Fig. 4 represents a modification of a make-alive electrode of the type mounted in the cathode of the discharge device; and

Fig. 5 is a plan view partly in section of a make-alive electrode shown in Fig. 4 according to my invention.

The arc discharge device 2 according to Fig. 1 of my invention comprises an evacuated container 3 of glass or other suitable material having an anode 5 sealed therein. Disposed with respect to the anode 5 and adapted to cooperate with it in conducting an arc discharge through the container 3, I show a cathode 7 of vaporizable material such as mercury. Suspended above the cathode 7 and having a portion permanently projecting below the surface of the cathode 7 is mounted a make-alive electrode 9 of the type which I shall fully explain. The anode 5 and the cathode 7 are externally connected with a load 11 and some suitable source of supply potential 13. Likewise, the make-alive electrode 9 is connected externally through a suitable unidirectional device 15, such as half-wave rectifier, with a grid control adapted to pass current to the make-alive electrode 9 at a predetermined time with respect to the anode potential.

In constructing a make-alive electrode 9 according to Fig. 2 of my invention, I employ a quartz tubing 17 opened at one end. Substantially near the closed portion of the tube 17, I bore a narrow slit 19 having a width in the neighborhood of one-sixteenth of an inch. The slit 19 need not be of any particular length, but I prefer one having such a length that a portion of the slit 19 remains below the cathode surface 7 as well as an approximately equal portion above the surface to compensate for variation in the mercury level. It is to be understood, however, that I do not wish to limit my construction to one slit 19 for it may be desirable to have several slits 19. Suitable size particles 18 of some high resistance material such as boron carbide are inserted into the tube 17 to such a depth as to cover the slit portion 19 of the quartz tube 17. It is a necessary property of a satisfactory make-alive material 18 that it shall not react chemically with the mercury in the presence of an arc discharge, nor should the make-alive material 18 become wet by the mercury.

In preparing the make-alive material 18 con-

templated by my invention, I take a rod of boron carbide and break it up into pices of a suitable size and screen the broken pieces to free the finely pulverized particles from those I intend using. The quartz tubing 17 is filled with many irregular shaped pieces of the starting material 18, so that the slit 19 is substantially covered. It may be desirable to shape the tubing 17 at this point so as to cause a portion of the boron carbide particles 18 to protrude out from the slit 19, thereby having an active portion exposed to the mercury cathode 7 when the make-alive electrode 9 is mounted in place. A suitable rod 21 of conducting material is extended into the open end of the tubing 17 and is brought into contact with the starting material 18. The rod 21 in Fig. 3 of my invention likewise may have a slit in line with the slit 19 of the quartz tubing 17.

According to Fig. 4 of my invention, I provide a make-alive electrode 9 of the type brought in through the mercury pool 7. A rod 23 of Kovar or molybdenum, having a stem portion 25 and a cup portion 27, is brought up through the mercury pool 7, so that the cup portion 27 protrudes slightly above the mercury surface 7. An insulating covering 29 of glass separates the rod 23 from the mercury in all but a slit portion 19 of the cup 27 which I maintain exposed to the cathode 7. The insulating covering 29 serves in addition as a vacuum seal for the make-alive electrode 9. Disposed in the base of the cup portion 27 of the make-alive electrode 9 is some insulating material 31, preferably glass. The glass insulator 31 may cover a side portion of the cup 27, but should be maintained below the mercury level. Particles of boron carbide 18 fill the cup portion 27, which I maintain closed at the projected end. A Kovar flange 33 sealed to the insulating covering 29 may be welded or copper soldered to the metal container 35 at the bottom thereof.

In the operation of the arc discharge device 2, an exciting potential is applied to the make-alive electrode 9 and an arc is struck between the mercury cathode 7 and an active portion of the boron carbide particles 18 which protrude out through the slit 19. Upon proper conditions of potential, the arc immediately expands into a greater arc which will transfer quickly to the anode 5 if the latter is sufficiently positive. Several of the make-alive electrodes 9 tested operated on 10 amperes peak current with a peak potential of 35 volts.

While I have shown and described specific embodiments of my invention, it will be apparent to those skilled in the art that many changes and modifications can be made therein without departing from the true spirit of my invention or the scope of the appended claims.

I claim as my invention:

1. A make-alive electrode comprising a container of insulating material, a slitted opening in a lower portion thereof and a plurality of independent loose particles of high resistance material in said container, the size of said particles being such that only a portion of several protrude out from said slitted opening and a conductor in contact with only a portion of said particles.

2. A make-alive electrode for an electric arc discharge device comprising a container of insulating material, a mass of loose particles of resistance material in said container, a slitted opening in said container adjacent said particles, the width of said slit being less than the size of said resistance particles and a conductor extending into said container and being in contact with some of said particles.

3. A make-alive electrode for an electric arc discharge device comprising a hollow cylindrical body of non-conducting material closed at one end, a slitted aperture near the closed portion of said body, a quantity of loose particles of high resistance material filling a substantial portion of said body and a conducting body extending into the open end of said non-conducting body and in contact with said resistance particles.

4. In combination with a mercury-pool discharge device, a make-alive electrode comprising a quartz container substantially filled with loose particles of boron carbide, a vertical slit in a lower portion of said container, said boron carbide particles capable of protruding from said slit and a conductor extending into said container, said conductor being in contact with at least some of said boron carbide particles but out of contact with said mercury-pool.

5. A vapor-electric device comprising an evacuated container, a pool-type cathode therein, an anode cooperating with said cathode, a make-alive electrode dipping into said cathode, said make-alive electrode comprising a container of non-conducting material, a plurality of loose particles of resistance material in a lower portion of said container, a slitted opening in that portion of said container dipping into said mercury-pool, an active portion of said resistance particles extending through said slit and a conductor in contact with part of said particles.

6. In an electric arc discharge device comprising an evacuated container, an anode and a mercury cathode therein, a make-alive electrode extending upwardly through said cathode, said make-alive electrode comprising a stem portion and a cup portion, said cup portion partially projecting above the surface of said cathode, an insulator disposed in the base of said cup portion of said make-alive electrode, a slit in said cup portion, an insulating covering separating said make-alive electrode from said cathode in all but said slit portion and providing a vacuum-tight seal for said make-alive electrode and a plurality of loose particles of high resistance material in said cup portion, an active portion of said resistance particles being exposed to said cathode by way of said slit.

7. A make-alive electrode for a vapor-electric device comprising a container of insulating material, a narrow longitudinal opening along one side of said container, a plurality of loose particles of resistance material in said container and partially extending through said opening, and a conductor extending into said container and making contact with at least one of said particles.

ADOLPH H. TOEPFER.