Sept. 10, 1940. L. T. BOURLAND 2,214,607

MAKE-ALIVE ELECTRODE

Filed May 6, 1938

Fig. 1.

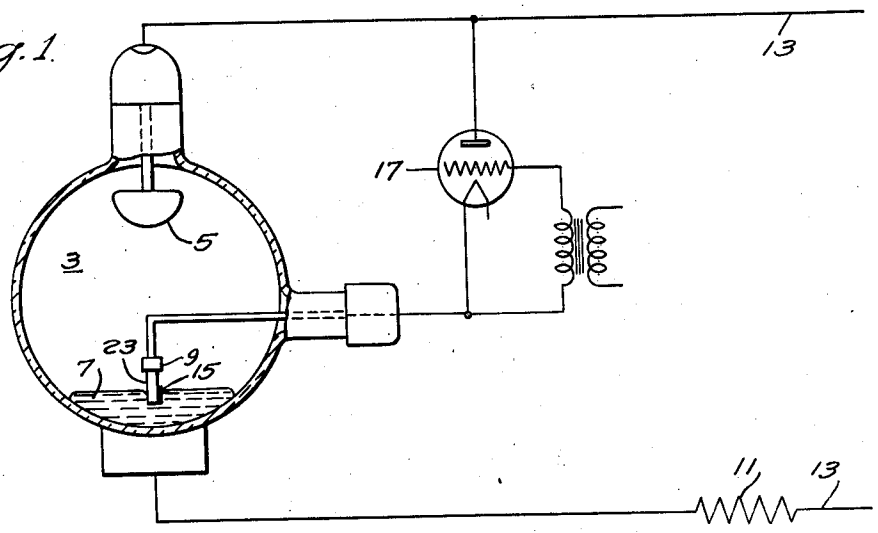


Fig. 2.

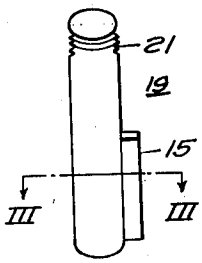


Fig. 4.

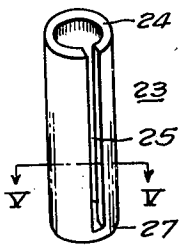


Fig. 6.

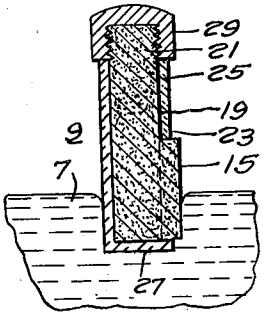
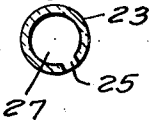


Fig. 3.

Fig. 5.



WITNESSES:

E. A. McCloskey.

J. Thomas Danko

INVENTOR

Langford T. Bourland.

BY

S. A. Strickland

ATTORNEY

Patented Sept. 10, 1940

2,214,607

UNITED STATES PATENT OFFICE

2,214,607

MAKE-ALIVE ELECTRODE

Langford T. Bourland, Forest Hills, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 6, 1938, Serial No. 206,317

4 Claims. (Cl. 250—27.5)

My invention relates to a vapor-electric device and more particularly to an electrode having a conductive portion extending from a non-conductive container and the method of constructing the same.

Heretofore in the art, it has been customary to initiate the cathode spot in vapor-electric discharge devices by passing a suitable current through an electrode of some resistance material which has been immersed in a pool of mercury. In general, the electrodes of this character have been a source of frequent difficulties in that the starting currents are high on heating the electrode to temperatures in the neighborhood of 1000° C. in the course of outgassing. The material which has proved most satisfactory for use as an electrode is boron carbide. The outstanding features are immunity to amalgamation with mercury and constant electrical characteristics. Numerous electrodes have been made in the laboratory by converting graphite to boron carbide upon exposing a graphite rod in vapors of boron oxide at temperatures in the neighborhood of 1800° C.

According to this invention, I construct a make-alive electrode which has a low starting current, as well as a low voltage drop, by permitting only a small part of the active portion of the electrode to make contact with the mercury. Briefly, I heat a substantially pure graphite rod having a portion protruding out from the surface in a resistance furnace in the presence of boron oxide for several hours. The portion of the electrode which I shall designate as the active portion or semi-conductive portion is placed in desired relation within a non-conductive member, which, in a specific case, is a quartz cylinder closed at one end. A slit or vertical groove is made in the quartz member extending from the open end to a point near the closed end of the container. The finished electrode has an active portion of boron carbide extending beyond the outer surface of the quartz container.

It is, therefore, an object of my invention to provide a make-alive electrode having a low voltage drop and a low starting current.

Another object of my invention is to provide an electrode structure and the method of constructing the same.

Another object of my invention is to provide an electrode having only a small portion of the active member in contact with the mercury.

Still further, it is an object of my invention to provide an electrode having a hard polycrystalline structure which is free of pores and which has little tendency to abrade.

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 is a diagrammatic illustration of a vapor-electric device with which my improved make-alive electrode may be utilized;

Fig. 2 is a view in perspective of the active member of the electrode according to my invention;

Fig. 3 is a sectional view of the active portion taken along the lines III—III.

Fig. 4 is a view in perspective of the non-conductive container supporting the active member of the electrode according to my invention;

Fig. 5 is a sectional view of the non-conductive container taken along the lines V—V; and

Fig. 6 is a sectional elevation of a complete electrode according to my invention.

For a more complete understanding of the operation of the apparatus employing my improved starting electrode with which my invention is concerned, I have illustrated in Fig. 1 a typical arrangement of a vapor-electric converter 3 having an anode 5, a pool type cathode 7 of vaporizable material such as mercury, gallium or tin and a make-alive electrode 9 permanently in contact with the cathode 7 during normal operation of the converter 3. The cathode 7 and the anode 5 are externally connected with a load 11 and some suitable current supply circuit 13. In order to initiate a discharge between the anode 5 and the metallic liquid cathode 7, it is essential that the anode 5 be maintained positive with respect to the cathode 7. Likewise, it is essential to provide an immersion-type starting electrode 9 having its tip portion 15 projecting into the pool type cathode 7. The starting electrode 9 is also connected externally to some suitable control device 17 for supplying exciting current, which is adapted to cause conduction of current from the starting electrode 9 into the mercury pool 7 at predetermined instants of time with respect to the main anode potential.

Referring to Figs. 2 and 3, I show a graphite rod 19 having a protuberance or tip portion 15 extending from the main surface substantially in the lower portion thereof. The rod 19 is placed in a suitable crucible in such a position that the top or head portion 21 is excluded from the effects of boron oxide during the heating of the rod 19. It is to be understood that I wish only to convert the tip portion which includes the

protruding portion 15 of the rod 19 into boron carbide, leaving the head portion 21 unconverted. After several hours of heating, the rod 19 has an unconverted portion or the head portion 21, which may be threaded, and a converted portion or the rib portion 15 both portions 15 and 21 physically constituting a single rod 19.

According to Figs. 4 and 5, I show a container 23 made of non-conductive material, such as quartz, which is opened at one end 24. A narrow groove 25 or slit is cut beginning with the opened end 24 and extending substantially near the closed end 27 of the container 23. The groove 25 is of sufficient width to permit passage of the protuberant portion 15 of the rod 19 when placed within the container 23.

Referring to Fig. 6, I show assembled a complete make-alive electrode 9 with the active or rod member 19 placed in desired relationship in the non-conductive container 23 with the protuberance 15 projecting beyond the outer surface of the quartz container 23 by way of the groove 25. The remaining portion of the groove 25 not having a protuberance 15 extending therefrom is covered with a strip of quartz and fusibly united with the quartz making up the container 23. A cap 29 of suitable metallic material having a threaded bore is secured to the unconverted member 21 of the rod 19.

The complete electrode 9 is preferably mounted in such a position as to maintain substantially a half portion of the protruding member 15 below the level of the mercury 7. In such case, the protruding or feather key member 15, which preferably is square-shaped, has only a small portion exposed to the mercury cathode 7. Lower starting voltages are required to start the rectifying process due to the short narrow path traversed by the current.

While for purposes of illustration I have shown a specific embodiment 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 or scope of the appended claims.

I claim as my invention:

1. An electrode comprising a body of carbonaceous semi-conducting material, said body having a main portion of a substantial cylindrical form, an upstanding rib on one side of said body adjacent one end thereof, a container of insulating material enclosing the major portion of said body, said container having a slit in one side thereof, said upstanding rib projecting through said slit.

2. A make-alive electrode comprising an elongated container of insulating material, said container having a hollow body portion, a slot in the side wall of the container adjacent one end thereof, there being an opening in the opposite end of said container, a body of carbonaceous material filling the hollow portion of the container, an upstanding rib on said body protruding through said slot, a portion of said body extending through the open end of said container, a portion of said body including said rib being essentially boron carbide while another portion of said body including the portion projecting from the end of the container being substantially pure carbon and a metallic connection secured to the portion of the body extending through the end of the container.

3. A make-alive electrode comprising a cylindrical quartz container closed at one end, a slot in the side wall of said container, said slot starting adjacent the closed end of the container and terminating in spaced relation to the other end of the container, a rod of carbon and boron carbide inserted in said container and substantially filling the same, an upstanding rib on the side of said rod, said upstanding rib projecting through said slot and a metallic connection to the rod.

4. An electrode comprising a substantially tubular container of non-conducting material, said container being closed at one end, the opposite end of said container being open, a slit in the side wall of the container adjacent the closed end thereof, a rod like body of semi-conducting material in said container and a portion thereof projecting beyond the open end of the container, an upstanding rib on said body, said rib extending through said slit and extending above the surface of said container.

LANGFORD T. BOURLAND.