Jan. 5, 1943. A. H. TOEPFER 2,307,550

MAKE-ALIVE ELECTRODE AND METHOD OF MAKING

Filed May 7, 1942

Fig. 1.

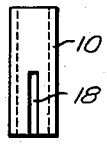


Fig. 2.

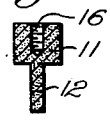


Fig. 3.

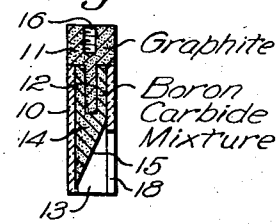


Fig. 4.

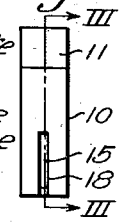


Fig. 5.

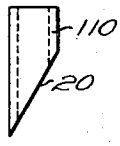


Fig. 6.



Fig. 7.

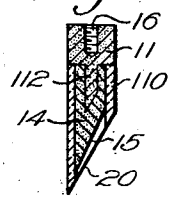


Fig. 8.

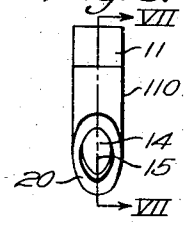


Fig. 9.

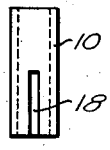


Fig. 10.

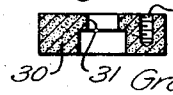


Fig. 11.

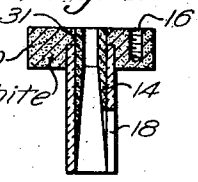


Fig. 12.

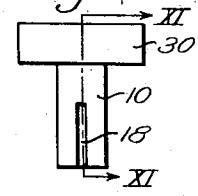


Fig. 13.

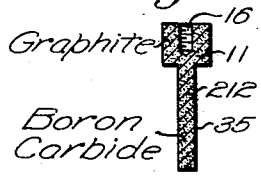


Fig. 14.

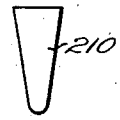


Fig. 15.

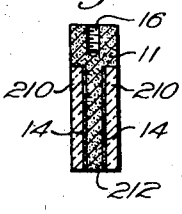


Fig. 16.

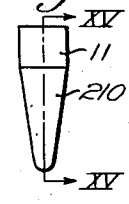
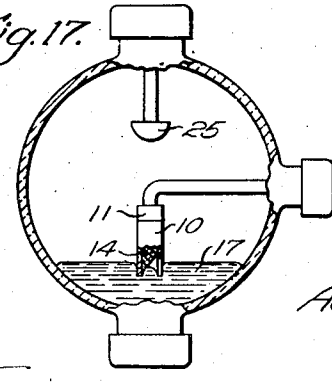


Fig. 17.



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Patented Jan. 5, 1943 2,307,550

UNITED STATES PATENT OFFICE

2,307,550

MAKE-ALIVE ELECTRODE AND METHOD OF MAKING

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Application May 7, 1942, Serial No. 442,066

13 Claims. (Cl. 250—27.5)

My invention relates to a make-alive electrode and method of making the same, and particularly to an improved low-current make-alike electrode for igniting the arc in a make-alike type valve.

In the operation of make-alike type valves, it is customary to use a make-alike electrode composed of a high resistance material and dipping into the cathode of the valve for periodically starting or creating a cathode spot to control the conductivity of the valve. Make-alive electrodes as heretofore constructed are usually composed of high resistance materials such as boron carbide or silicon carbide, and require material amounts of instantaneous power to successfully create the essential periodic cathode spots.

It has heretofore been determined that the amount of current required to successfully initiate a cathode spot may be materially decreased by properly shielding or enclosing a portion of the make-alive electrode. However, it has heretofore been impractical to construct a shielded make-alive electrode for use in commercial electric valves. I have discovered that faults heretofore present in shielded make-alive electrodes may be substantially eliminated by positively bonding the make-alive material to a suitable refractory insulating material. Also, I have found that by constructing the active make-alive material from a mixture of boron carbide and an organic binder, usually a carbon secured by decomposing or cracking a suitable hydrocarbon, a make-alive electrode is secured having substantially identical operating characteristics throughout a group of similarly constructed devices.

It is therefore an object of my invention to provide a make-alive electrode having low current characteristics.

It is a further object of my invention to provide the make-alive electrode which is uniformly reproduceable.

It is a further object of my invention to provide a make-alive electrode having the acting make-alive material firmly bonded to an insulating shield.

It is a further object of my invention to provide an improved method of constructing such make-alive electrodes.

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 an elevation of an insulating shield according to my invention;

Fig. 2 is a conducting head or connector for my improved make-alive;

Fig. 3 is a sectional elevation of an assembled make-alive electrode taken on line III—III of Fig. 4;

Fig. 4 is an elevation of a completed electrode;

Figs. 5 to 8 show similar views of a further modification according to my invention;

Figs. 9 to 12 show a further modification according to my invention;

Figs. 13 to 16 illustrate a further embodiment according to my invention; and

Fig. 17 is a sectional elevation of a vapor electric valve showing the application of my improved electrode.

In the illustrative embodiment of my invention according to Figs. 1 to 4, a shield 10 of insulating material, preferably of a refractory type such as alundum or quartz, is provided. For connection to this shield is a connector or head 11 of conducting material, preferably a substantially heat-resistant material such as graphite. This graphite connector or head is machined preferably with a projection 12 of reduced diameter to fit loosely within the bore 13 of the substantially tubular insulating shield 10.

In order to construct a surface of make-alive material, I have formed a paste 14 of boron carbide preferably of a fineness sufficient to pass through a 300-mesh screen and an organic binder preferably a readily crackable hydrocarbon material. While any suitable or readily crackable hydrocarbon may be utilized, I prefer to use materials such as starch or sugar which readily form a working paste and are easily cracked to produce substantially pure carbon. However, other forms of hydrocarbons such as oil or tar are completely practical. The paste 14 not only fills the interstices between the loosely fitted head 11 and the shield 10, but also fills a substantial part of the shield 10 to provide a working or active make-alive surface 15.

After assembling the head 11 and the shield 10 with the make-alive paste 14, the whole is subjected to temperature, preferably of about 1000° C. for some time to convert the hydrocarbon to substantially pure carbon, which is found to form a very strong bond with both the insulating shield 10 and the graphite connector 11. Preferably, the connector 11 is provided with a tapped opening 16 for connection with a suitable conducting lead.

In order to facilitate the movement of the cathode spot from the interior of the shield 10 to the surface of the cathode 17, an opening of suitable dimensions, such as a slot 18 is milled

in one side of the insulating shield 10. Obviously, this slot may be milled either before or after the construction of the make-alive surface 15 within the shield 10.

The embodiment of my invention according to Figs. 5 to 8 is substantially identical with that shown in Figs. 1 to 4, except that the shield 110 is cut away or broken away to provide a substantially diagonal point 20 on the shield which exposes a relatively larger proportion of the make-alive surface 15 to the cathode surface 17 exterior of the shield 110. The reduced portion 112 of the connector 11 may be provided with a sloping surface 19 substantially similar to the sloping surface 20 of the end of the shield 110, so that the reduced portion 112 will be substantially a constant distance from the surface 15 of the make-alive material 14, and thus eliminate any possible punctures of the make-alive material 14 at the end, or rather corners, of the conducting connector and the make-alive material.

In the embodiment of my invention according to Figs. 9 to 12, the conducting head 30 or connector is shaped to fit loosely outside of or telescope over the insulating shield 10, and is preferably provided with an opening 31 preferably substantially coaxial with the bore of the shield 10. This opening or vent 31 serves two purposes. In the construction of the electrode it facilitates the application of the paste 14 to the inner surface of the shield 10 as well as to the surface of the connector 30. After the completion of the electrode, the vent 31 serves as a means for readily introducing ionization from a cathode spot formed within the shield 10 to the space above the cathode 17 and thus facilitates pickup of the main arc between the anode 25 and the newly initiated cathode spot.

In the embodiment of the invention according to Figs. 13 to 16, the connector 11 is provided with an extension 212 of substantially the full length of the electrode and this extension 212 is preferably converted wholly or partially to boron carbide as disclosed in Smede Patent 2,095,769 or Bangratz Patent 2,186,189. The shield then is composed of two insulating plates 210 which are bonded to each side of the projection 212 by means of the boron carbide paste 14. I have found that the connection 11 and its extension 212 may be constructed as shown in the above-mentioned patents, and then ground down to provide substantially flat surfaces 35 for the attachment of the shielding plates 210.

In the operation of the make-alive electrode according to my invention, a cathode spot will be initiated adjacent to the shield by the passage of a relatively small current impulse through the make-alive material. The spot, once being initiated, will move out from the shield for the attachment of the make-alive arc, or if the arc attaches adjacent the surfaces 15 the restriction of the shield will force the cathode spot to move out from the make-alive surfaces 15, thus reducing the heating of the make-alive materials. The substantially enclosed construction of my make-alive electrode has a further advantage in that there is less tendency for dirt or impurities in or on the mercury to come into contact with the make-alive material.

The substantially tubular shield as disclosed in Figs. 1 to 4 and 9 to 12 has a further advantage in that it changes the mercury pressure against the make-alive surface 15. In the heretofore normally constructed make-alive electrode, the meniscus of the mercury pinches against the make-alive electrode so that it is pressed against the make-alive material with considerable force particularly at the junction of the mercury and the make-alive material. However, within the substantially tubular shield 10 the mercury rises within the tube and the surface tension on the mercury pulls it away from the make-alive surface, so that there is very little pressure at the juncture of the mercury and the make-alive material.

While for purposes of illustration I have shown and described specific embodiments of my invention, it will be apparent that 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. In a make-alive type valve, a make-alive electrode comprising a substantially tubular shield of refractory insulating material, a graphite head having a reduced portion extending loosely within the shield, a filling of boron carbide and carbon filling the space between the reduced portion of the head and the shield and securing the same together, said filling extending within the shield to provide an active electrode surface.

2. In a make-alive type valve, a make-alive electrode comprising a substantially tubular shield of refractory insulating material, a graphite head having a reduced portion extending loosely within the shield, a filling of boron carbide and carbon filling the space between the reduced portion of the head and the shield and securing the same together, said filling extending within the shield to provide an active electrode surface, a portion of said shield being cut away to facilitate movement of a cathode spot out from said active electrode surface.

3. A make-alive electrode for a vapor electric arc discharge device comprising a head of graphite, a protecting sleeve of quartz, a portion of said head being received in said protecting sleeve, a layer of high resistant material bonded to said head and said sleeve, said high resistant layer being composed of finely divided boron-carbide and a carbonized hydrocarbon.

4. A make-alive electrode for a vapor electric arc discharge device comprising a head of graphite, a protecting sleeve of quartz, a portion of said head being received in said protecting sleeve, a layer of high resistant material bonded to said head and said sleeve, said high resistant layer being composed of finely divided boron-carbide and a carbonized hydrocarbon, a portion of said sleeve being cut away to expose a portion of said high resistant layer.

5. The method of constructing a make-alive electrode which comprises providing a head of graphite, a tubular insulating body of a refractory insulating material, pasting the head and the insulating body together with a paste composed of finely divided boron carbide and a hydrocarbon material and heating the structure to carbonize the hydrocarbon and bond the head and the insulating body together.

6. A make-alive electrode comprising a graphite body, a shield member of a refractory insulating material, a mixture of finely divided boron carbide and carbon bonding said body and said insulating shield member together, said mixture providing an active make-alive surface.

7. A make-alive electrode for a vapor electric device comprising a shield of a refractory insulating material, a conducting head, a layer of

a high resistance material composed of boron carbide and carbon bonding said shield and said head together, said layer covering a portion of said head and a portion of said shield to provide an active make-alive surface.

8. A make-alive electrode for a vapor electric device comprising a shield of a refractory insulating material, a conducting head, a layer of a high resistance material composed of boron carbide and carbon bonding said shield and said head together, said layer covering a portion of said head and a portion of said shield to provide an active make-alive surface, said shield being shaped to expose a portion of said active surface.

9. A make-alive electrode for a make-alive type valve comprising a substantially tubular shield of refractory insulating material, a head of graphite shaped to loosely engage said shield, a filling of finely divided boron carbide and carbon interposed between the head and the shield and securing said head to said shield, said filling extending over a portion of the inner surface of the shield and forming the active face of the electrode, said shield having a slot therein giving access to the active face of the electrode.

10. A make-alive electrode for a make-alive type valve comprising a substantially tubular shield of refractory insulating material, a head of graphite shaped to loosely engage said shield, a filling of finely divided boron carbide and carbon interposed between the head and the shield and securing said head to said shield, said filling extending over a portion of the inner surface of the shield and forming the active face of the electrode, said shield having a slot therein giving access to the active face of the electrode, said head having an opening communicating with the bore of said shield.

11. A make-alive electrode for a make-alive type valve comprising a substantially tubular shield of refractory insulating material, a head of graphite shaped to loosely engage said shield, a filling of finely divided boron carbide and carbon interposed between the head and the shield and securing said head to said shield, said filling extending over a portion of the inner surface of the shield and forming the active face of the electrode, a portion of said shield being cut away to expose the active electrode face.

12. In a vapor electric valve, a make-alive electrode comprising a head of graphite, an active make-alive surface of boron carbide, a shield of refractory insulating material and a layer of boron carbide and carbon bonding said shield to said make-alive surface.

13. The method of constructing a make-alive electrode which comprises providing a head composed substantially of graphite, a shield of refractory insulating material, machining said head and shield to loosely interfit, pasting said head and shield in position with a paste of an easily cracked hydrocarbon and boron carbide and heating the assembly to crack the hydrocarbon and bond the head and shield into a substantially unitary structure.

ADOLPH H. TOEPFER.