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LEAD-IN BUSHING FOR VAPOR ELECTRIC DEVICES

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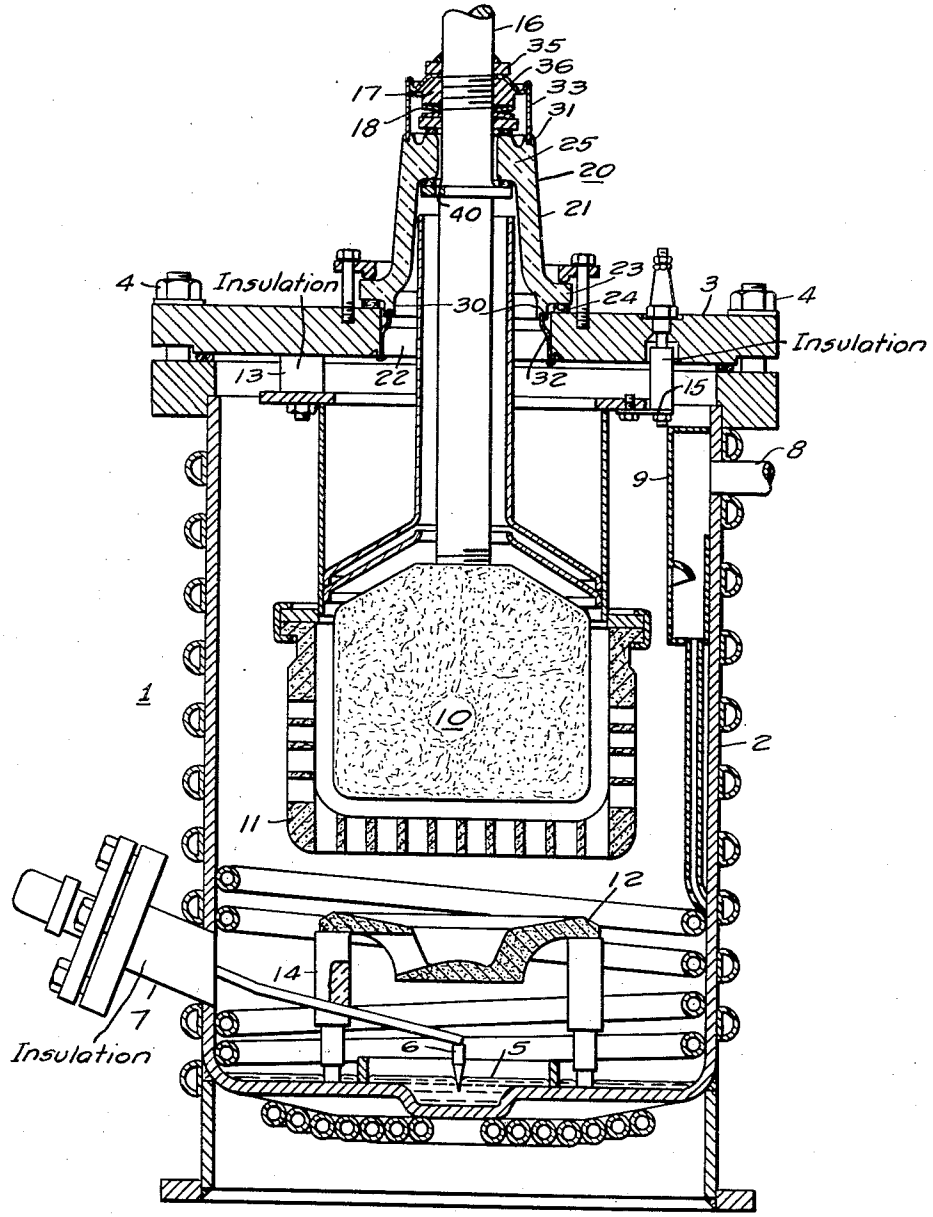

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LEAD-IN BUSHING FOR VAPOR ELECTRIC DEVICES

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1

Our invention relates to an insulating bushing and particularly to a lead-in bushing for a vapor-electric device.

In the construction and maintenance of vapor-electric devices, such as mercury-arc rectifiers, great difficulty has always been experienced in providing lead-in bushings for the various electrodes and particularly for the anodes because in operation it is necessary to maintain the bushings at almost perfect vacuum-tightness and at the same time to support the weight of the lead-in conductors as well as the electrodes connected thereto. Not only must the bushing be capable of maintaining the static pressures generated by the weight of the electrodes plus atmospheric pressure but they also must maintain the kinetic energy generated either by movement of the devices or by magnetic reactions during operation. A great many attempts have been made to build bushings which will not only support the anode but retain their vacuum-tightness over long periods of time.

Heretofore, the most nearly vacuum-proof constructions have been provided by relatively thin glass cylinders into the ends of which are sealed metallic inserts usually relatively cylindrical in shape. Because these inserts, by their very nature, must be very thin in order to secure a good bond with the vitreous material, they have been mechanically weak so that they not only yield under mechanical or static stresses applied to the electrodes but frequently yield sufficiently to crack loose the bond between the metal and the vitreous material.

Other types of bushings, such as the solder to porcelain bushings, have proven quite satisfactory in regard to mechanical stress, but are vulnerable to relatively low temperatures.

According to our invention, we have provided a glass-metal bushing having high temperature and vacuum characteristics and substantially immune to mechanical stresses. To accomplish this, we have provided a relatively cylindrical vitreous bushing of the so-called compressed glass type in which the body is of considerable thickness so that it may be mechanically clamped both to the wall of the container and to the leading-in conductor and of sufficient rigidity to readily withstand the mechanical stresses imposed thereon not only by the normal weight of the electrodes, such as an anode, with its lead-in stem but also the stresses created by movement of the converter either in use or during transportation thereof.

This relatively thick mechanically strong bushing is provided at each end thereof with a relatively thin upstanding portion to which a metallic element may be bonded and which, in turn, may be welded or otherwise integrally connected to the tank and lead-in stem respectively.

2

It is an object of our invention to provide a lead-in bushing in which the mechanical stresses and sealing functions are separate and distinct.

It is a further object of our invention to provide a lead-in bushing substantially non-affected by high temperatures.

It is a further object of our invention to provide a lead-in bushing in which the vacuum-tight seal is free from mechanical stresses.

Other objects and advantages of our invention will be apparent from the following detailed description taken in conjunction with the accompanying drawing, in which the figure is a sectional elevation of a vapor-electric valve embodying our invention.

In an exemplary embodiment of our invention, the valve comprises a container 1 having a substantially cylindrical wall 2, one end of which is closed by a suitable header 3, preferably mechanically detachable from the remainder of the container 1 as by bolts 4 although it may be permanently secured as by welding. A cathode pool 5 of vaporizable reconstructable material, usually mercury, is provided in the bottom of the container 1 and an ignition control device, such as a make-alive electrode 6, is arranged in permanent contact with the pool 5 of cathode material and is provided with a suitable lead-in bushing 7 for the application of control potential.

Usually, a pumping connection 8 is provided in some portion of the container 1, preferably a portion remote from the cathode pool 5, to permit ready evacuation of the container 1 and if desired the maintenance of such evacuation during the life of the container. If the valve is to be of the pumped type, that is, having evacuation maintained by the application of pumps, it is desirable to provide a mercury shield 9 to prevent droplets of mercury from impinging on the various electrodes in the valve.

In spaced insulated relation to the cathode 5 is a cooperating anode 10, usually constructed of graphite and preferably provided with shields such as the anode shield 11 and the cathode shield 12, both of which are also preferably constructed of graphite and supported from the container walls, preferably by insulated supports such as 13 and 14. If desired, the anode shield 11 may be provided with a lead-in connection 15 for the application of control potential to the anode shield 11.

The lead-in conductor 16 for the anode 10 is sealed to the header 3 by means of our improved vitreous seal 20. This seal 20 compises a substantially cylindrical body portion 21 of relatively great thickness and preferably of the so-called pressed glass construction.

The end of the body portion 21 adjacent to the opening 22 in the header 3 is provided with a flange-like portion 23 adapted to be secured in

firm mechanical contact, preferably through a suitable cushioning gasket 24 so that the body portion 21 is mechanically supported directly against and firmly in position with the header 3 so that any motion of the header 3 is necessarily imparted to the vitreous body 21.

The opposite end of the body portion 21 is provided with an inwardly extending flange 25 to which the anode stem 16 may be rigidly mechanically mounted preferably by means of a nut 17 and a spring 18. These mechanical connections provide a completely rigid and dependable mechanical connection for supporting the entire weight of the anode conductor 16 and the anode 10 from the lead-in bushing 20 and is of sufficient sturdiness to rigidly maintain the anode 10 in position regardless of stresses imparted to the same either by the movement of the anode 10 or by stresses set up by electrical operation of the device.

Since it is difficult to provide a pressure mechanical contact which is vacuum-tight, we have provided vacuum seals between the bushing 20 and the header 33 and between the bushing 20 and the lead-in conductor 16 which are substantially independent of the mechanical support and entirely free of the mechanical stresses set up by movement or by the weight of the electrode. As shown we prefer to place the vacuum seals at opposite ends of the bushing 20. Each of the vacuum seals comprises an upstanding collar or lip 30 or 31 which is of relatively small thickness compared to the thickness of the bushing proper and into each of these upstanding collars 30 or 31 is inserted a substantially cylindrical member 32 or 33, of a metal having a coefficient of expansion closely matching that of glass, which will provide ready sealing with the vitreous material and which is chemically inert to either hot or cold mercury. We prefer to use a nickel, cobalt steel such as presently sold under the trade-mark "Kovar" for the thin metallic inserts 32—33.

The lowermost of these inserts 32 is then integrally united with a portion 3 of the container 1, preferably by welding. The collar 30 and its insert 32 then provides a complete vacuum-tight seal whose only duty is to prevent the entrance of gas to the container 1 while the mechanical stresses are supported and distributed substantially independently of the vacuum seal.

In order to provide a similar seal between the topmost collar 31 and the leading-in conductor 16, a washer-like member 35 has welded thereto a disk-like element 36 which can be welded or otherwise integrally united to the topmost insert 33 in the vitreous collar 31. After the diaphragm or header 36 is welded to the insert 31, the washer 35 itself is integrally united, preferably by welding to the leading-in conductor 16 so that at both ends the bushing is provided with both mechanical and vacuum-tight seals, the mechanical and vacuum seals being substantially independent of each other.

While the inserts 32 and 33 may be secured by a variety of methods, we have found that best results have been obtained by heating the bushings in a furnace to a temperature of the order of annealing temperature after which a gas flame is applied to the collar and the insert fused into the vitreous material.

In order to evacuate the portion of the bushing 20 between the mechanical and the vacuum seal, it is desirable to provide an opening 40 through

the mechanical seal so that vapors or gases of any kind may readily pass from the small chamber enclosed between the mechanical seal and the vacuum-tight seal. Otherwise, after evacuation of the container, gases tend to leak out of this space into the container and possibly would impair the operation thereof.

While for purposes of illustration, we have shown and described a specific embodiment of our invention, it is apparent to those skilled in the art that changes and modifications can be made therein without departing from the true spirit of our invention or the scope of the appended claims.

We claim as our invention:

1. A vacuum electric device comprising a metallic container having an opening therein, an electrode in said container, a heavy glass bushing mechanically secured to said container and embracing said opening, an electrode stem extending through said bushing and mechanically attached thereto whereby said electrode and said stem are supported on said container by said bushing, a substantially annular insert embedded in said bushing adjacent the opening in said container, said insert composed of a metal readily wetted by glass and having a coefficient of expansion closely matching the glass, one edge of said insert being integrally united to the container to provide a vacuum-tight seal between said container and said bushing, a second substantially annular insert in said bushing, the edge of said second insert being integrally connected to said stem to provide a vacuum-tight connection between said stem and said bushing.

2. An insulating bushing for a vacuum device comprising a relatively thick substantially cylindrical body of pressed vitreous material, mechanical supports at each end of said body, a collar at each end of said body, said collars being relatively thin with respect to the thickness of said body and an annular metallic insert fused into each of said collars.

3. A lead-in bushing for a vapor-electric device comprising a metallic supporting member for said bushing, said member having an opening therein, a vitreous insulating body, a flange on said insulating body, means securing said flange in firm mechanical contact with said supporting member adjacent said opening, a conductor extending through said insulating body, means securing said body in firm mechanical contact with said conductor, a thin annular member of a metal wetted by glass and inert to mercury fused into the end of the insulating body adjacent the opening in said supporting member, the free end of said annular member being integrally united to said supporting member around said opening, a second annular member fused into said insulating body said second annular member being integrally united to said conductor.

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