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VAPOR ELECTRIC DEVICE  
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Fig. 1.

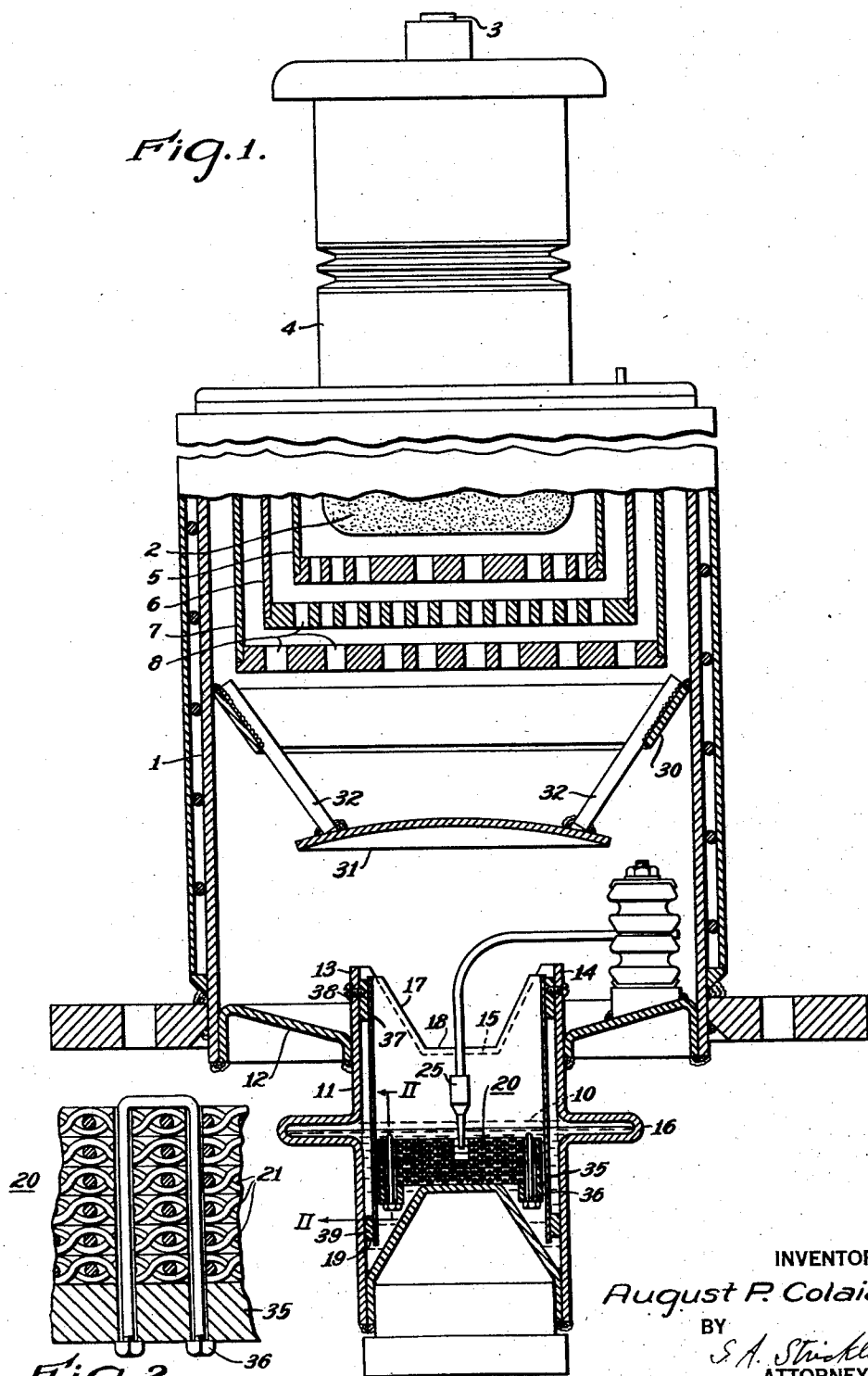


Fig. 2.

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## UNITED STATES PATENT OFFICE

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## VAPOR ELECTRIC DEVICE

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6 Claims. (Cl. 250—27.5)

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My invention relates to a vapor electric device, and particularly to a vapor electric device to be mounted on a moving platform which will be subject to shock, for example, such devices as locomotives and seagoing vessels.

In the operation of vapor electric devices on moving platforms, great difficulty has been experienced in maintaining the liquid cathode in proper operating position in the container. This is true particularly because the device is subject to motion of various kinds in various directions.

Primarily, the cathode device will be subject to inclination in various degrees in various directions. For instance, on shipboard, the roll of the ship will produce a lateral inclination which may sometimes amount to 45° from the vertical, and the pitch of the ship may produce a forward and reverse inclination of as much as 15°. At sea, storms produce extreme vibrations and, in the event of naval vessels, shock may be produced by explosions of guns on board or by the impact of shells or other missiles striking the vessels.

In a railway locomotive, inclination will be produced by track grades and by turning moments at corners and other places. In addition to these relatively minor angular inclinations, the tubes are frequently subject to shock. For example, in railway operations, the locomotive may be subject to severe braking operations or may contact relatively heavy objects at fair speed.

It has heretofore been proposed to build the cathode of a converter as a relatively deep cathode dish with the top edges elevated various amounts in various directions so that the expected inclination will not cause the cathode material to spill over the edge of the lip. It has also been found desirable to provide a relatively enlarged portion in the cathode dish at the normal operating level so that the evaporation of the operating vapor does not excessively reduce the level of the cathode material in the dish. I have found that these measures, alone, are inadequate, particularly when the converter may be subject to relatively severe shocks. Thus, the entire cathode material may be lost from the cup and deposited in some other portion of the container and require an appreciable time interval to return to its operating position.

I have found that a damping device may be placed in the cathode material which has very little, if any, effect on the normal movements of the cathode material but which substantially immobilizes the cathode material when it attempts movement at a high rate of speed.

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I have further found that, in shock, cathode material tends to flow along the vertical wall of the converter vessel, and I have found that migration of the cathode material may be effectively controlled by placing a baffle along the wall of the container in such a position that it impedes the flow of liquid upwardly along the container wall while allowing any condensed material to rapidly flow downwardly across the barrier. It is also desirable to provide a baffle between the cathode and the anode which is rigidly maintained and will prevent direct migration of cathode material through the space between the cathode dish and the anode.

I have further found that the unpredictable splashing about of portions of the cathode liquid tend to carry impurities into the cathode and that these impurities frequently result in the improper operation of the device. I have accordingly provided a barrier for segregating impurities from the mercury returning to the cathode dish.

It is, accordingly, an object of my invention to provide a vapor electric device the operation of which will be maintained regardless of shock applied to the device.

It is a further object of my invention to provide means for inhibiting the movement of cathode material from the cathode dish in response to shock.

It is a further object of my invention to provide a vapor electric valve in which the cathode material is maintained in a substantially operating position.

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 partially in section of a vapor electric device embodying my invention; and

Fig. 2 is a sectional detail taken in the direction of the arrows II—II of Fig. 1.

In the exemplary embodiment of my invention, the vapor electric valve comprises a metallic container 1 which may be substantially evacuated and in which there are a plurality of co-operating electrodes.

The anode 2 constructed of graphite, or other suitable material, is mounted in an upper portion of the container by a conducting stem 3 and mounted in insulated relation thereto by a vacuum-proof seal 4. The anode 2 is preferably surrounded by a plurality of anode shields which may, or may not, have potentials applied thereto

as may be desirable in the operation of the device. The shields 5, 6 and 7 are provided with openings 8 for the passage of the main current conducting arc in the device, insofar as possible, it is desirable to misalign the openings so that the anode 2 is not directly exposed through a series of openings 8. For simplicity of illustration, the working faces of the anode 2 and the shields 5, 6 and 7 are shown as planes, although frequently other shapes are desirable and particularly it is frequently desirable to make the working faces as segments of spheres to secure maximum mechanical strength and maximum area of arc openings 8.

In the bottom portion of the container 1, is a pool of cathode liquid 10 contained in a relatively narrow and deep cathode dish 11 set within the bottom 12 of the container 1.

In order to permit various angles of inclination in different directions without spilling the cathode liquid 10, the various portions of the upper edge of the cathode dish 11 are elevated different distances above the normal surface of the cathode material 10. For example, in the illustrated embodiment, the sides 13 and 14 of the cathode dish 11 are materially elevated so that the tube 1 may be inclined laterally through approximately 30° without spilling over the edge of the cup 11, while the forward portion 15 of the cup 11 is cut away so that only a relatively small inclination is permissible in that direction.

Preferably, the cup 11 is set into the bottom 12 of the container so that the forward or lowermost portion 15 of the rim is flush with the bottom 12 of the container 1.

Since a relatively narrow cathode dish 11 is used, it has been found that evaporating the cathode material 10 to supply the normal working vapor of the device frequently excessively reduces the level of the material remaining in the dish 11. For this reason, I have provided a large portion 16 adjacent the normal working level of the cathode material 10 and preferably so proportioned that when the tube is cold and inoperative, the cathode material 10 will be at the upper edge of the enlarged portion 16; and, during normal operating conditions, the cathode level will be somewhere intermediate the extremities of the enlarged portion.

Since the cathode material 10 condenses on all portions in the container 1 and flows back into the cathode dish 11, I have provided a strainer or dirt-barrier 17 in the form of a baffle substantially conforming to the cathode dish 11 and laterally spaced from the wall thereof, but having the portion 18 extend slightly above the lowermost edge 15 of the top of the cathode dish 11. Then, as the cathode material 10 flows into the cathode cup 11, it will flow downwardly between the barrier 17 and the inside of the cup 11 so that any dirt will be collected between the barrier 17 and the walls of the cup 11 while relatively clean mercury will flow downwardly and under the bottom end 19 of the barrier 17 and into the active portion of the cathode.

To prevent sudden migration of the cathode material 10 in response to shock, I have provided an impedance or baffle 20 in the form of a plurality of superposed layers of metallic mesh 21, firmly anchored below the normal operating surface of the cathode material 10. It is desirable to use a cathode impedance 20 through which the cathode material 10 will readily flow at normal speeds, but which offers a high impedance to the flow of cathode material 10 at high

velocity. For example, if the cathode material 10 is mercury, I have found that wire screen 21 having twelve mesh to the inch and composed of thirty-two mil molybdenum wire offers almost no impedance to the normal flow of the mercury, but maintains it substantially immobile in the event of sudden shock. A plurality of these screens 21 have been found necessary or desirable, the number used in the impedance 20 depending on the severity of the shock that may be encountered.

In order to initiate operation of the device, a plurality of make-alive electrodes 25, one of which is shown, are inserted, the tips extending into the cathode liquid and preferably some of the screens 21 are at least partially cut away or perforated to provide a portion to receive the tip of the make-alive electrodes 25. Preferably, these electrodes 25 are placed on the axis of the major motion or, in other words, in the portion of the cathode surface least subject to variation. For example, in the tube illustrated the maximum motion is sideways so that only the end of the row of electrodes 25 is visible.

In order to prevent the cathode liquid from running up the side walls of the container 1 in the event of shock, a baffle ring 30, preferably downwardly inclined, is welded to the sides of the container 1 between the region of the cathode and the region of the anode so that the cathode material 10 will not migrate far from the cathode dish 11 and will be rapidly returned so that, even in the event of severe shock, little if any of the cathode material 10 will migrate away from the cathode region. A cathode shield or baffle 31 is provided of such dimensions that it optically obscures the anode shield 7 from the active cathode surface. Preferably, this shield 31 is directly mounted on the baffle ring 30 by means of a plurality of metallic supports 32 directly welded to the baffle ring 30. While, of course, any firm and secure mounting may be utilized, I have found that directly mounting the baffle 31 on the baffle ring 30 has provided an extremely firm and secure mounting which effectively controls migration of loose cathode material into the anode region.

As the cathode material is of considerable weight, it is necessary to firmly secure the metallic mesh 21 to prevent its being torn loose by the inertia of the cathode material 10. For doing this, I have provided a mounting in the form of blocks 35 rigidly secured to the dirt-barrier 17 which, in turn, is rigidly supported in the cathode dish 11 by means of spacer blocks 37 and screws 38 while the bottom 19 of barrier 17 is supported by guide blocks 39. I have supplied U-bolts 36 extending through the mesh material 21 and firmly secured to the blocks 35. I have found that these U-bolts 36 firmly support the mesh material 21 and prevent distortion thereof.

While, for purposes of illustration, I have shown and described a specific embodiment 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. A vapor electric valve comprising a substantially evacuated container, an anode secured in insulated relation in the top portion of said container, a plurality of shields about said anode, a cathode dish of less diameter than the container, a pool of cathode liquid in said dish, the top of said dish being elevated various amounts in

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various directions so that it may be inclined in various directions without spilling the cathode liquid, a baffle of metallic mesh submerged in the cathode liquid, said mesh offering low impedance to normal flow of cathode material but offering high impedance to sudden flow thereof, a baffle rigidly supported between the cathode and the anode, and an annular baffle secured to the container between said first-mentioned baffle and the anode region.

2. A vapor electric valve comprising a substantially evacuated container, an anode secured in insulated relation in the top portion of said container, a plurality of shields about said anode, a cathode dish of less diameter than the container, a pool of cathode liquid in said dish, the top of said dish being elevated various amounts in various directions so that it may be inclined in various directions without spilling the cathode liquid, a baffle of metallic mesh submerged in the cathode liquid, said mesh offering low impedance to normal flow of cathode material but offering high impedance to sudden flow thereof, a baffle rigidly supported between the cathode and the anode, an annular baffle secured to the container between said first-mentioned baffle and the anode region, a plurality of make-alive electrodes cooperating with said cathode, said make-alive electrodes being on the axis of maximum movement of the cathode material.

3. A shockproof cathode construction for a vapor electric device having a container enclosing in spaced insulated relation an anode and a pool-type cathode, said cathode comprising a cathode pool, said cathode pool being retained in a relatively narrow and deep cathode dish, said dish having a contoured top to prevent spilling of the cathode material and means intermediate the ends thereof for maintaining the mercury level

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substantially constant during operation of the device, a dirt-collecting baffle secured adjacent the sides of the dish, said baffle conforming in shape to the shape of the dish, a screen readily passable by slowly flowing cathode material but offering high impedance to rapid motion of the cathode material, said screen being anchored below the normal surface of the cathode material.

4. In a vapor-electric valve a cathode comprising a deep cathode dish, a pool of cathode material in said dish, a substantially cylindrical barrier in said dish and spaced from the sides thereof, means for attaching said barrier rigidly to the sides of said cup, a plurality of layers of wire mesh rigidly supported in said pool of cathode material below the normal level thereof.

5. A vapor-electric valve comprising a container, a plurality of cooperating electrodes therein, one of said electrodes being a pool-type cathode, a deep relatively narrow cathode dish receiving said cathode, a barrier rigidly attached in spaced relation to the sides of the cathode dish, a plurality of layers of metallic screen rigidly supported in said cathode in proximity to the normal working surface thereof.

6. A vapor-electric valve comprising a container, a plurality of cooperating electrodes therein, one of said electrodes being a pool-type cathode, a deep relatively narrow cathode dish receiving said cathode, a barrier rigidly attached in spaced relation to the sides of the cathode dish, a plurality of layers of metallic screen rigidly supported in said cathode in proximity to the normal working surface thereof, a rigidly supported shield interposed between the surface of the cathode and the anode and an annular baffle connected to the wall of the container between the anode and cathode regions.

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