

Dec. 16, 1969

E. E. GRAY

3,484,301

ELECTRICAL CELL VENT VALVE

Original Filed Jan. 3, 1966

2 Sheets-Sheet 1

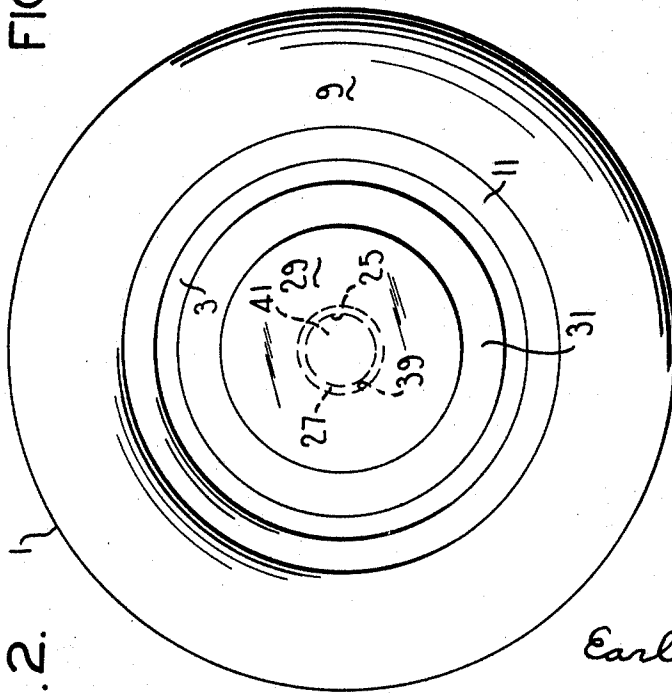
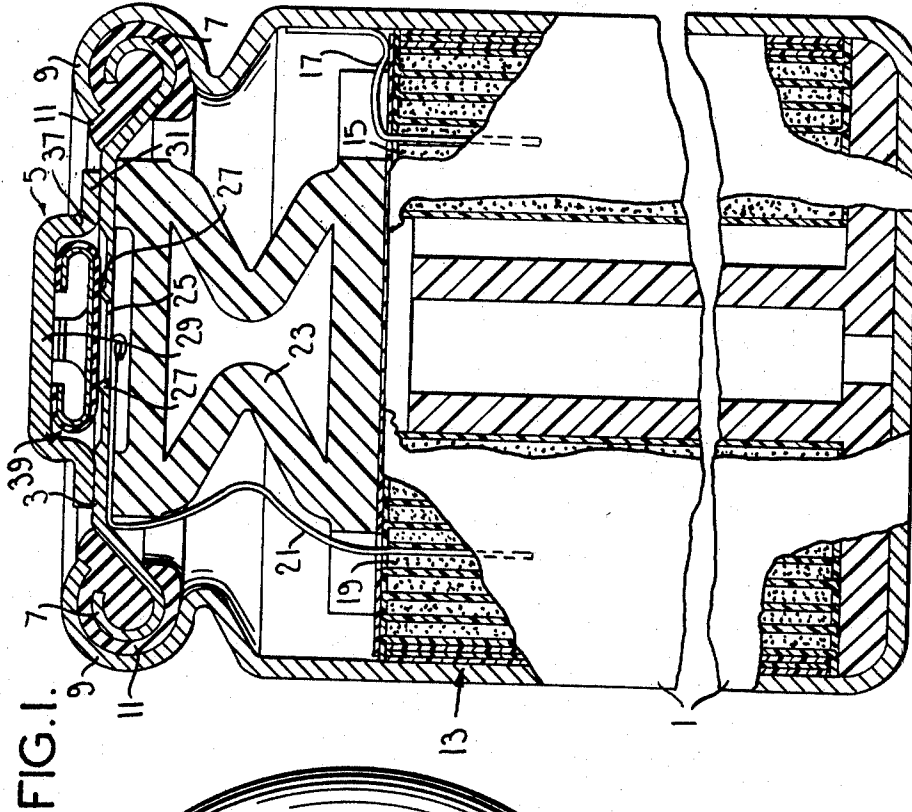
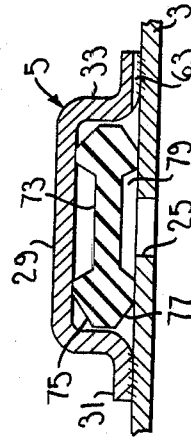


FIG. 9.



Earl E. Gray,
Inventor,
Koenig, Senniger, Powers and Leavitt,
Attorneys.

Dec. 16, 1969

E. E. GRAY

3,484,301

ELECTRICAL CELL VENT VALVE

Original Filed Jan. 3, 1966

2 Sheets-Sheet 2

FIG. 3.

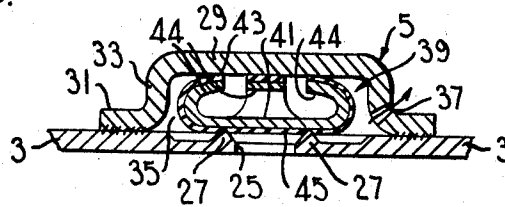


FIG. 4.

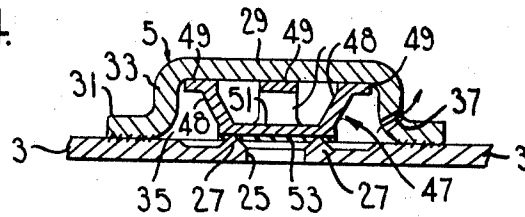


FIG. 5.

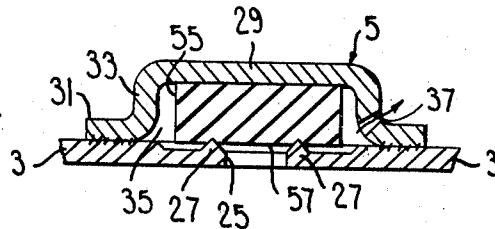


FIG. 6.

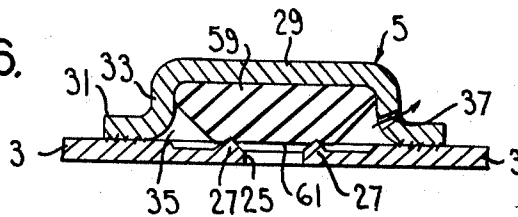


FIG. 7.

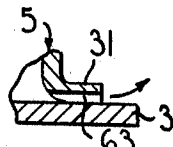
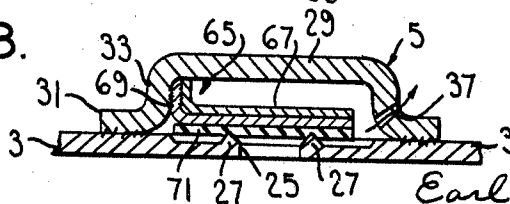


FIG. 8.



Earl E. Gray,
Inventor.
Koenig, Senniger, Powers and Leavitt,
Attorneys.

1

2

3,484,301

ELECTRICAL CELL VENT VALVE

Earl E. Gray, North Attleboro, Mass., assignor to Texas Instruments Incorporated, Dallas, Tex., a corporation of Delaware

Continuation of application Ser. No. 518,219, Jan. 3, 1966. This application Jan. 18, 1968, Ser. No. 698,989

Int. Cl. H01m 1/06

U.S. Cl. 136—178

1 Claim

ABSTRACT OF THE DISCLOSURE

A peripherally sealed cover of a cylindrical container for electrodes is provided with a hole which in some cases is surrounded by a raised integral portion of the cover. A one-piece flange cup-shaped contact button forming a cylindrical pocket has its flange welded to the cover. The button and the container form terminals for the electrodes. The button is provided for pressure release to atmosphere with port means by having its flange radially recessed across its welding surface. In several forms of the invention, a plate in the contact button is provided on its side facing the cover with an elastomeric layer. On its other side it carries spring fingers which react from the button to bias the elastomer material to close said hole. In another form, a cantilever-mounted bimetallic thermostatic member has an elastomeric facing to close the hole. In another form, instead of using a spring fingered plate, a unitary elastomeric disk-like member is inserted in the pocket of the contact button, and being of a maximum thickness to be squeezed between the button and the cover to form a seal around the opening. The elastomeric disk-like member has an outside diameter close to that of the inside diameters of the pocket in the contact button and provides substantially accurate coaxial alignment therewith. In one form of disk-like member, its inside face adjacent the cover is provided with a seating portion formed by an inward conical taper of the disk extending from its margin toward the hole in the cover so as to provide a narrow seat and an annular space between the seat and the ported weld between the button and the cover. In another form, an additional seat is formed by a similar taper on the other side of the elastomeric disk for providing a narrow seating engagement with the button.

Cross-references to related applications

This is a continuation of application Ser. No. 518,219, filed Jan. 3, 1966, which is now abandoned.

Among the several objects of the invention may be noted the provision of an electrical energy cell which vents to the atmosphere when internal pressure exceeds a predetermined level, without rendering the cell inoperative; the provision of a cell of this class which is automatically vented when internal pressures exceed a predetermined value and then is resealed when the pressure drops below said value; and the provision of a cell which vents excessive pressures to the atmosphere without adversely affecting operation of the cell. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claim.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

FIG. 1 is a cross section partially in elevation of a battery cell incorporating one form of the invention;

FIG. 2 is a plan view of the cell;

FIG. 3 is an enlarged fragmentary cross section of the pressure-relieving structure of the FIG. 1 cell; and

FIGS. 4-9 are fragmentary cross-sectional views illustrating modifications.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Sealed electrical energy cells, such as batteries, fuel cells and the like, produce oxygen at the cathode and consume oxygen at the anode. A nickel-cadmium battery is a specific example. The rates of production are such that under normal conditions the battery will operate under pressure at equilibrium, as for example under about 100 p.s.i. which is a safe limit. However, under certain charging and discharging conditions, and particularly at high charging rates (greater than a five-hour rate, for example), the pressure may increase beyond such a safe limit. Therefore, such batteries require a safety mechanism. Heretofore this has been accomplished by puncturing a safety diaphragm in response to excess pressure. This is not desirable because it renders the battery inoperative after puncture. Venting of gas from the battery to the atmosphere to reduce the internal pressure in the battery to the safe pressure limit and then reclosing the cell is more desirable. This is accomplished by means of the present invention.

Referring now particularly to FIG. 1, there is shown at 1 a container in the form of a metal cylinder or can having a sealed metal cover 3. At the center of the cover there is a contact cap or button 5. The rolled peripheral margin 7 of cover 3 is supported in a rolled portion 9 of the top of the container 1. An elastomeric sealing material 11 is interposed between the margin 7 of the cover 3 and the rolled portion 9.

Within the container 1 is located the usual electrically positive and negative plate or electrode assembly shown generally at 13. This may be of any type known to the art, as for example but without limitation, a so-called coiled or "jelly-roll" form wherein the positive plates, the negative plates and the separators therebetween are coiled in forming the plate assembly 13. One set of plates 15 (negative, for example) is electrically connected by conductor 17 to the metal container 1, making it of negative polarity. The other set of plates 19 (positive, for example) is connected by conductor 21 to cover 3, making it of positive polarity. The plates 15 and 19 form the assembly 13. Conductor 21 is held firmly in contact with cover 3 by a flexible spacer 23 positioned between plate assembly 13. Conductor 21 is held firmly in contact with electrode assembly 13. The spacer can be made from suitable caustic and/or acid-resistant elastomeric materials such as polypropylene or ethylene rubbers, Hycar, Thiokol, neoprene, etc. It should be somewhat resilient but have a substantially high yield point.

Referring now to FIG. 3 of the drawings, cover 3 has a hole 25 surrounded by a seat 27. Seat 27 can be formed by coining, machining or other suitable forming steps on cover 3.

Cap 5 as shown in FIG. 3 is generally concave or dish-shaped and comprises a circular center portion 29 joined to an annular rim portion 31 by a wall 33. Rim 31 around wall 33 is secured to cover 3. The circular center portion 29 on cap 5 is positioned immediately above the hole 25 and seat 27 and is spaced from them to provide a recess or cavity 35. There is a port or hole 37 in wall 33 which provides a passage between the recess or chamber 35 and the atmosphere through the cap 5.

A seal generally designated 39 is positioned within the chamber 35. In the FIG. 3 embodiment, the seal is constituted by a spider having a plurality of fingers or legs

43 (three of which are shown) which bear against cap 5 and bias the spider toward hole 25. Spider 39 comprises a cup-shaped metal spring member 41 having bonded to its outer face a suitable acid-resistant elastomeric sealing material 43. This may be natural or artificial rubber, Hy-car, Neoprene or the like. When the battery is being assembled, the seal 39 is positioned beneath cap 5 and the cap pressed downwardly toward cover 3 to compress the fingers 43 of spring member 41 at the time the rim 31 is secured to the cover 3 by bonding, welding, brazing, soldering or the like. The elastomer 43 has a surface 45 which extends across the seat 27 and engages the seat for closing off the hole 25. Surface 45 is normally biased into the sealing position shown in FIG. 3 by the resilient elastomer on the inwardly directed edge of member 41 reacting from cap 5. The curved fingers and sides of the seal also introduce springiness. The surface 45 can be moved away from seat 27 by pressure from inside container 1 acting against surface 45.

The strength of spring 41 can be selected for this use so that surface 45 remains sealed against seat 27 until a predetermined value of fluid pressure exists within container 1. When this pressure is exceeded, the seal will move upward as viewed in FIG. 3 to unseat surface 45 from seat 27, thereby releasing pressure in the container 1 through hole 25 into chamber 35 from which it is vented to the atmosphere through hole 37 in cap 5. After enough gas has been exhausted from container 1 to reduce pressure in it below the predetermined level required to unseat surface 45, then the spring 41 automatically recloses the hole 25 to the passage of fluids by forcing surface 45 against seat 27. Thus venting of the cell due to excessively high pressures does not result in total disabling of the cell as in the case of prior batteries which ruptured a diaphragm upon a certain pressure being reached within the cell. The elastic quality of sealing member 39 permits the battery or cell to be vented as many times as necessary and automatically reclosed each time without causing damage to the cell due to excessively high pressures and without leaving the cell open to the atmosphere after the pressure has been reduced to a satisfactory or safe value.

It will be understood that the configuration of the seal 39 can be varied considerably without departing from the spirit of the invention. For example, FIG. 4 illustrates a cup-shaped spring member 47 which has legs 48 and feet 49. Feet 49 engage center portion 29 of cap 5 for biasing spring 47 toward seat 27. There is a sheet or layer of a sealing material 51 (such as an acid- and caustic-resistant elastomer) bonded to the lower surface of spring 47. A sealing surface 53 on the elastomer 51 extends across hole 25 in cover 3 and is adapted to sealingly engage the seat 27 surrounding the hole. Here, as in FIG. 3, the elastomer sealing surface is biased into engagement with the seat, thereby providing for automatic opening of the seal on excessively high pressures in the cell and for automatically reclosing the cell when the pressure therein is lowered to a predetermined safe value.

FIG. 5 illustrates another embodiment of the seal for opening and closing hole 25. In this instance, the seal comprises a molded acid- and caustic-resistant closed-cell elastomer member 55 which can be loosely positioned within cap 5 or bonded to the inner surface of the center portion 29 of the cap. The elastomer member 55 is compressible and has a sealing surface 57 which engages seat 27 for closing communication between the interior of container 11 and chamber 35. Seal 55 is compressed between cap 5 and seat 27 so that surface 57 is biased against seat 27 by the natural elasticity of the member 55. The material used for sealing member 55 is selected and formed so that surface 57 will be forced off seat 27 when the pressure in container 1 reaches the predetermined safe value at which it is desired to vent the container to the atmosphere through hole 25 in cover 3 and hole 37 in cap 5.

In the FIG. 6 embodiment of the invention the seal is designated 59 and has a sealing surface 61 for engaging seat 27. The seal member 59 is the same as the seal 55 previously described except for its configuration or shape, the seal 59 being generally frusto-conical whereas seal 55 is cylindrical.

In the preceding description the chamber 35 was vented to atmosphere through a hole 37 in cap 5. This hole can be eliminated by attaching the rim 31 of the cap to cover 3 in such a manner that gas within chamber 35 can escape to the atmosphere through the inner face between the rim 31 and cover 3. This has been illustrated in an exaggerated manner in FIG. 7, which shows a passage 63 between the rim portion 31 of cap 5 and cover 3. Passage 63 can be formed by coining one or more notches or grooves on the underside of rim 31 of cap 5. Or this coiling may be applied to the cover 3 under the rim 31. Or escape passages can be formed by bonding or adhering the rim 31 to cover 3 at spaced intervals to leave unsealed areas through which fluids at high pressure can be vented to the atmosphere.

In the preceding embodiments employing springs 41 or 47 the spring should be capable of being calibrated to provide venting at a pressure compatible with safe operation of the energy cell. When the cell is subjected to considerable temperature variations or changes, then the sealing member can be constructed to compensate for these temperature changes. FIG. 8 illustrates a temperature-compensating sealing member which comprises a bimetallic strip 65 having a first strip of metal 67 bonded to a second strip or tab of metal 69. There is an elastomer 71 of the type previously described bonded to the lower surface of strip 69 and adapted to engage the seat 27. The bimetallic strip 65 is generally L-shaped and the elastomer 71 is on the bottom arm thereof which acts as a cantilever. The other arm or tab of the bimetallic strip is secured by welding, soldering, etc. to wall 33 of the cap 5.

If strip 67 is copper or other metal having a relatively high coefficient of expansion, and strip 69 is Invar or other metal having a low coefficient of expansion, then at high operating temperatures the sealing member of FIG. 8 will be opened to release pressure in the cell at correspondingly higher operating pressures. The relative coefficients of expansion for strips 67 and 69 can be reversed if the opposite result is desired, by suitable choice of metals.

The sealing member 39 of FIG. 3 and the sealing member 47 of FIG. 4 could be made of bimetallic material and function thermostatically like the bimetallic sealing member of FIG. 8.

FIG. 9 shows a further modification in which the portion of the cover 3 around hole 25 is left flat instead of being provided with a raised seat 27. In this instance, the seal for the hole 25 is constituted by a disk 73 of acid and caustic resistant elastomeric material, such as ethylene propylene rubber, formed with an enlarged annular peripheral bead or rim 75. This bead is squeezed between the portion 29 of cap 5 and the portion of cover 3 surrounding hole 25, the outer face of the bead engaging the cap 5 and the inner lip portion 77 of the bead engaging cover 3 around hole 25 and sealing against cover 3. The disk and the inner lip portion of the bead define a cavity 79 in communication with hole 25. The durometer of the seal 73, its compression, and the diameter of the inner lip portion 77 are selected so that, when the pressure on the cell exceeds a predetermined value, the seal will be forced away from the cover 3 for venting through a vent 63 the same as in FIG. 7.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the

above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electrical cell comprising a metallic container forming one cell terminal, a metallic cover marginally sealed to the container by insulating means, the cover having a hole therein, a one-piece, metallic, conductive cup-shaped contact button having a cylindrical wall and a substantially flat closed end, said wall being of smaller diameter than said cover and forming a second cell terminal, said button forming an inner cylindrical pocket and having an outer flange opposite said closed end, said flange having a groove extending across it from said pocket to the outer margin of the flange to provide a port across the flange, a weld fastening said flange to the cover, an imperforate, resilient elastomeric disk in the button having both central and marginal portions thinner than the inside depth of the cup-shaped button, said marginal portion of the disk being of a diameter near that of the inside diameter of said button thereby to register closely with said inside for substantially coaxially aligning the disk with the button, said disk having a circular bead located between its center and said marginal portion, said bead being formed by conical inwardly and outwardly converging tapers extending toward said center and toward said marginal portion respectively, to provide a circular seat on the inside of the closed end of the button end and to provide a circular seat on the outside of

the cover around said hole, said seats being smaller in diameter than the inside diameter of the button whereby spaces are formed, one space being located centrally and within said pocket between said disk and the inside end of the closed button within said bead, another space being located between one side of the outward conical taper and the cup wall adjacent the closed end of the button, and another space being located between the other side of the outward conical taper and the cup wall adjacent said flange for communication with said port, said disc by the holding action of said weld being compressed between the closed end of the button and the outside of the cover to place said seats under compression.

References Cited

UNITED STATES PATENTS

2,790,570 4/1957 Hodges et al.
3,293,081 12/1966 Daley ----- 136—178

FOREIGN PATENTS

1,119,351 12/1961 Germany.

WINSTON A. DOUGLAS, Primary Examiner

25 D. L. WALTON, Assistant Examiner

U.S. CI. X.R.

136—133; 220—44