PATENT SPECIFICATION (11) 1 534 037

(21) Application No. 5288/76 (22) Filed 11 Feb. 1976 (19)
(31) Convention Application No. 549304 (32) Filed 12 Feb. 1975 in
(33) United States of America (US)
(44) Complete Specification Published 29 Nov. 1978
(51) INT. CL.² H01M 2/12
(52) Index at Acceptance
H1B 212

(54) IMPROVEMENTS IN AND RELATING TO GAS VENTS FOR ELECTRIC STORAGE CELLS

(71) We, GOULD INC., a corporation organized and existing under the laws of the State of Delaware, U.S.A., of 10 Gould Center, Rolling Meadows, Illinois 60008, United States of America, to hereby declare the invention, for which we pray that a patent may be granted us, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to gas vents for electric storage cells and batteries, and in particular to so-called gang vents in which two or more gas vents are attached to a common frame for venting a plurality of battery cells.

If ignited by a spark, a jet of gas escpaing from the vent opening of a battery cell can cause an explosion which may damage or even destroy the battery. In an effort to prevent such explosions, it has been proposed to vent cells with a vent barrel which utilizes a porous, flame-arresting element to diffuse the escaping gas and to retard the entrance of a spark or flame into the cell. Where a plurality of barrels are ganged on a common frame, it has been proposed to collect and vent the gas from the ganged cells through a single porous element.

According to the present invention there is provided a gas vent for an electric storage cell, the vent comprising a body portion for insertion into a vent opening of the cell, the body portion having an aperture therein for the escape of gas therethrough from within the cell; a closure member releasably engaging the body portion; a porous body between an upper end portion of the body portion of the vent and the closure member; and means for maintaining a gap between the closure member and at least a portion of the porous body sufficient to allow gases within said cell to escape through the porous body while retarding the entry of a flame into the gap between the closure member and the porous body.

The invention further provides a vent barrel for closing a cell opening of a storage battery, the barrel comprising a tubular body portion molded from a plastics material, a downwardly-tapered funnel partition within the interior of the body portion dividing the interior of the body portion into upper and lower compartments, the tapered partition having a generally vertical hole in a lower end portion thereof for the escape of gas from the battery into the upper compartment, the lower compartment being defined by an elongate tubular portion for insertion into a cell opening, the upper end portion of the interior of the body portion being defined by a socket having an internal annular shoulder at its lower end; and a disc telescoped snugly into the socket and seated against the shoulder to cover the upper end of the upper compartment, the disc being of a porous material capable of allowing gas to escape upwardly out of the upper compartment while retarding the downward entrance of flame into the upper compartment.

Gas vents embodying the present invention will now be described, by way of example, with reference to the accompanying diagrammatic drawings in which:–

Figure 1 is a perspective view of a battery equipped with a gang vent embodying the present invention, with one of the vents shown in exploded relationship with the battery;

Figure 2 is a perspective view of one of the gang vents of Figure 1 with one of the vent barrels exploded from the vent frame;

Figure 3 is a vertical section, to an enlarged scale, on line 3–3 of Figure 2;

Figure 4 is a cut-away perspective view of the splash baffle of the vent of Figure 3;

Figure 5 is a perspective view of another gang vent embodying the present invention; and

Figure 6 is a vertical section on line 6–6 of

Figure 5.

Figure 1 shows an electrical storage battery 10 having a container 11 divided into cells and closed by a cover 12 formed with tubular bosses 13 which define vent openings 14 leading into the cells. Three side-by-side openings are arranged to be closed by a corresponding number of body portions, vent plugs or barrels 15 which form part of a gang vent 16.

The gang vent 16 includes a one-piece closure member or frame 17 (Figures 2 and 3) having a substantially flat and rectangular top plate 19 with a depending peripheral skirt 20. Spaced equally along the underside of the top plate 19, and projecting inwardly from the longer sides of the skirt, are three pairs of ribs 21 which serve to secure the vent barrels 15 to the frame 17. The ribs 21 or each pair oppose one another, and each includes an inwardly projecting lower lip 23 spaced downwardly from the top plate and having a concave inner surface, the inner surface of the ribs also being concave.

The gang vent may be made from any of a variety of plastics materials. Functionally, the material should be at least relatively acid-resistant and capable of serving the intended purpose under the temperature and other conditions to which the battery will be exposed. For example, polymers such as high heat polystyrenes, polypropylene and copolymers, polyvinyl chloride, ABS materials and other similar materials can be employed.

Each vent barrel 15 is a single-piece molding, and it has a porous body therein which serves as a flame arrestor 24 (Figure 3) which can be quickly and easily inserted into the molding. When attached to the frame 17, the three barrels 15 provide individual explosion-proof venting for the corresponding cells of the battery 10, and, in addition, the top plate 19 of the frame protects the flame arrestors from grease and dirt while retaining each arrestor in its associated molded part.

Each vent barrel 15 has a molded cylindrical tubular body 25 (Figure 3) sized to fit or telescope snugly but releasably in one of the vent openings 14. The lower end portion of body 25 is tapered downwardly and inwardly as indicated at 26 in Figure 3 to facilitate insertion of the body into an opening 14. In addition to the requirements for the material of the gang frame 17, the material utilized for the vent barrel should allow formation of a vent barrel with sufficient flexibility to facilitate its engagement with the frame, as described herein. The materials utilized for the frame are suitable for the vent barrels, for example various polyethylene materials can be used.

Around an upper end portion of the body 25 is a collar 27 with a lower end 28 adapted to seat against the upper side of a vent opening boss 13. A radially projecting flange 30 around the upper end of the collar cooperates with ribs 21 and lips 23 to secure the barrel 15 to the frame 17. As shown in Figures 2 and 3, the flange 30 is sandwiched between the underside of the top plate 19 and the upper sides of one opposing pair of lips 23, and is embraced by the concave surfaces of the ribs 21, while the concave surfaces of the lips 23 embrace the outer cylindrical surface of the collar 27. Barrels 15 are secured to the frame 17 by pushing each barrel lengthwise of the top plate 19 to snap the collar 27 between the lips 23. The ribs 21 and the lips 23 permit the barrels 15 to be moved through limited distances both lengthwise and cross-wise of the top plate 19 so that the bodies 25 of the barrels can be automatically centered with respect to the vent openings 14.

Each flame arrestor 24 is in the form of a cylindrical disc (see Figure 3) and can be made from various materials, for example polypropylene, ultra-high molecular weight polyethylene or fluorocarbon polymers (e.g. Pennwalt's "Kynar", Registered Trade Mark, a polyvinylidene fluorine polymer). The materials used should allow formation of a porous and gas permeable flame arrestor with a relatively uniform pore size distribution, and having adequate resilience and toughness to allow processing in conventional die-cutting and assembly equipment, without employing special procedures. The arrestors should in general have mean pore sizes of from 10 microns to 100 microns. It has been found that arrestors with mean pore sizes in the range of 10 microns to 20 microns or so, can restrict electrolyte flow and retard electrolyte spilling, in the event that the battery is inadvertently tipped on its side or inverted for short periods of time. Preferably, and for normal use, pore sizes ranging from 40 to 60 microns have been found to provide particularly good venting features and explosion protection. Arrestors with pore sizes ranging from 60 to 100 microns have been found to provide venting and explosion retardation.

The flame arrestor 24 is inserted in the body 25 simply by telescoping the arrestor into a socket portion 31 (Figure 3) in an upper end portion of the body, the lower end portion of the socket portion 31 having an annular shoulder 33 which defines a seat for the lower side of the arrestor. While the arrestor could be cemented within the socket portion, it preferably is sized to fit or telescope into the socket portion with a relatively tight press-fit so as to simplify assembly of the vent. To facilitate press-fitting of the arrestor into the socket portion, the collar 27 has an upwardly opening and circumferentially extending groove 34 therein.

The groove 34 allows the circumferential wall of the socket to flex radially outwardly to accommodate the arrestor 24 when the latter is pressed into the socket portion 31.

Once assembled barrels 15 have been attached to the frame 17 in the hereinbefore described manner, the top plate 19 closely overlies the arrestors 24, preventing the arrestors escaping from the socket portion 31 and protecting the porous material of the arrestors against becoming clogged by dirt and grease. Accordingly, arrestors have been found to stay clean throughout the service life of the battery 10 so as to effectively diffuse the gases developed in the associated cells and to retard the entrance of a flame into the cells if the battery should be exposed to an external flame or spark.

Vents in accordance with the present invention include means for maintaining a gap between an underside surface of the top plate and at least a portion of the top surface of the arrestor, so as to provide a positive vent for the gases which diffuse through the arrestors, while effectively retarding the entrance of a flame both into the battery cells and the space between the top plate and the arrestor. In the embodiment shown in Figures 1–4, the underside of the top plate 19 has a shallow longitudinally extending channel or groove 35 therein which extends across each of the longitudinally spaced arrestors. The depth of the channel 35 is preferably sufficiently small that in the event that escaping gases become ignited, a flame would not be sustained in the area of the arrestor. The depth of the groove should in general not exceed 0.381 mm and a depth of about 0.127 mm has been found to be a desirable gap both for purposes of positive venting of gases through the arrestor and for flame control.

In normal use or recharging of a battery fitted with this hereinbefore described vent, small quantities of hydrogen and oxygen gases liberated from the battery can accumulate under the top of the frame. If these gases are ignited, a small but harmless explosion may occur under the vent frame in the vicinity of the opening defined by the groove. This explosion, with its resultant shock waves, would tend momentarily to reverse the flow of gases through the groove and arrestor, but only long enough to prevent re-ignition of the gases. Such small explosions, therefore, serve to enhance the explosion-proof characteristics of the vent by further retarding the entrance of a flame into the groove area.

If the gassing rate of a battery fitted with this vent should reach an unusually high level, such as might be experienced if there were a defective voltage regulator or the battery were being exposed to a faster than normal charge, it is possible that the exiting gases could sustain continuous burning. In the case of such excessive gas discharge, the relatively small orifice defined by the groove 35 would act as a ribbon burner and direct the flame away from the arrestor and barrel so as to prevent entrance of the flame into the space between the arrestor and the frame, thereby tending to protect the arrestor from early damage.

The interior of the body 25 has a baffle 36 (Figures 3 and 4) for preventing liquid electrolyte from the cell from splashing upwardly against the lower side of the porous arrestor 24. Advantageously, the body 25 includes a partition or funnel 37 with a generally downwardly sloping surface which enables upwardly splashing electrolyte to drain back readily into the cell.

In Figure 3, the funnel 37 divides the interior of the body 25 into upper and lower compartments 39 and 40, and it includes a downwardly-tapered, frusto-conical wall 41 molded integrally with the body 25. Molded integrally with the lower margin of the wall 41 is a substantially upright wall 43 with a lower margin integral with a generally horizontal bottom wall 44. A vertical hole 45 in the bottom wall 44 is located at the upper end of a tubular protrusion 46 which depends from and is integral with the underside of the bottom wall 44. Gas from the cell is vented through the protrusion 46 and the hole 45, and into the upper compartment 39 for subsequent diffusion through the porous arrestor 24. The protrusion 46 acts as a deflector to reduce upward splashing of electrolyte through the hole 45.

The splash baffle 36 is spaced upwardly from and overlies hole 45, to deflect upwardly escaping electrolyte back downwardly into the cell while still venting gas from the cell and into the upper compartment 39. As shown in Figure 3 and 4, the illustrated baffle is a circular disc having a diameter approximately the same as that of the hole 45. Two narrow webs 47, molded integrally with the baffle and the upper side of the bottom wall 44, are spaced diametrically opposite each other across the hole. The webs 47 support the baffle 36 above the hole 45 but allow gas to flow through the hole 45 and into the upper compartment 39.

From the foregoing, it will be apparent that the splash baffle 36 helps protect the porous flame arrestor 24 from becoming plugged with electrolyte. In addition, materials from within the battery cell, such as oxide particles and other solid particles, are prevented from contacting and possibly plugging or obstructing the vent pores. Any electrolyte which does sputter upwardly past the baffle is readily drained back into the cell by the downwardly tapered wall 41 of the funnel 37.

Since the lower compartment 40 is

defined by the open ended tubular end portion of the body 25, the end of the body can be sufficiently long to provide secure mounting of the body 25 within the cell opening. By reason of its flexibility the body will reliably seal the opening so that all escaping gases will pass through the arrestor. Furthermore, the funnel partition 37 can also be located relatively high in the barrel so as to minimize the amount of electrolyte that enters the upper compartment 39.

Figures 5 and 6 show another gang vent embodying the present invention, parts similar to those described in relation to Figures 1 to 4 having been given similar reference numerals but with the suffix "*a*". The gang vent 16*a* has an elongate frame 17*a* with a top plate 19*a* to which a plurality of longitudinally spaced barrels 15*a* are removably secured in depending fashion by frame lips 23*a*, in the manner described above. The barrels 15*a* are of identical construction to those described above, each including a tubular body 25*a* having a tapered partition or funnel 37*a* which divides the barrel body into an upper compartment 39*a* and a lower, open-ended compartment 40*a*. A flat, cylindrical arrestor 24*a* is seated in an upper end portion of the compartment 39*a*, and the funnel 37*a* has a gas aperture 45*a* and a splash baffle 36*a*.

Each arrestor 24*a* and barrel 15*a* is maintained in closely spaced relation to the underside of the top frame plate 19*a*, for defining a positive escape area about substantially the entire outer periphery of the arrestor. In Figures 5 and 6 a pair of ribs 50 on the underside of, and extending longitudinally along the length of the top frame plate 19*a*, provide this spacing.

The barrel 15*a* and arrestor 24*a*, as shown in Figure 6, both abut the ribs 50 and are held in place by the frame lips 23*a*. Since the arrestor 24*a* is seated in the upper end of the barrel 15*a*, with its upper surface flush with the end of the barrel 15*a*, the arrestor 24*a* and barrel 15*a* are uniformly spaced with respect to the under surface of the top plate 19*a* so as to define an escape orifice about the entire periphery of the barrel 15*a*. While two longitudinal ribs 50 are utilized in the embodiment illustrated in Figures 5 and 6, it will be understood that additional ribs, or other equivalent means, could be used for maintaining the spacing of the arrestor and barrel with respect to the top frame plate.

The spacing between the top plate and the disc and barrel is again, preferably not in excess of 0.381 mm, and desirable results are obtained with a spacing of only 0.127 mm or less. As previously indicated, in normal use of the battery small quantities of escaping gases may accumulate under the top frame plate and cause harmless explosions so as to reverse momentarily the gas flow and prevent sustained ignition of the exiting gases.

In the event that the rate of gassing within the battery reaches such a high level that the vented gases will sustain continued burning if ignited, the small orifice defined by the spacing between the frame and the arrestor and barrel can act as a ribbon burner and direct the flame outwardly away from the arrestor and barrel. Such continuous burning would take place about substantially the entire periphery of the barrel, and, as a result, at least a portion of any flame would be directed outwardly to the sides of the vent frame and burn upwardly away from the battery surface, as indicated by the arrows in Figure 6. Not only does such sideward and upward direction of the flame away from the battery surface tend to minimize damage to the battery, but the black smoke that inherently results from such burning serves as an early warning of danger so as to permit prompt correction of the problem.

The vent barrels hereinbefore described are well suited for economical high volume production, because the body, the baffle and the funnel of each barrel are all molded as an integral unit and because the flame arrestor can be assembled into the socket in the body. Although the drawings illustrate three barrels ganged together on a common frame, the barrels are effective in preventing explosion of the battery, since the gas from each cell is vented through an individual flame arrestor. Furthermore, the relatively small spacing between each arrestor and the underside of the frame permits positive venting of the exiting gases and prevents the entrance of a flame into the space between the arrestor and the frame for further protection of the arrestor from damage in the event that the escaping gases should become ignited.

While ganging multiple vent barrels on a common frame, as herein specifically described, is particularly preferred, a frame could be utilized with a single vent barrel, if desired. Furthermore, while means are described herein for retaining the flame arrestor in position in the vent barrel, other means can be used, for example by assembling the arrestor in the barrel by spin welding, heat sealing, or ultrasonic welding. Similarly, while specific means have been shown for providing a positive vent for the gas which diffuses through the arrestors, other functionally equivalent means could be utilized.

Gas vents embodying the present invention include vent barrels which can be produced inexpensively by high-speed manufacturing processes and assembly techniques. At the same time, they include a porous flame-arresting element which is pro-

tected both from dirt and grease, and from splashing electrolyte. A plurality of barrels can be used to form a gang vent for venting each of a plurality of cells directly and individually through an associated flame arrestor. This can provide improved protection against the danger of explosion. Furthermore, a gang vent protects the flame arrestors against external dirt and grease and retains the flame arrestors from escape from the vent barrels. In addition, the use of a splash baffle enables the flame arrestor to be protected from sputtering electrolyte, the splash baffle co-operating with an integral funnel for draining the electrolyte back to the cell.

WHAT WE CLAIM IS:–

1. A gas vent for an electric storage cell, the vent comprising a body portion for insertion into a vent opening of the cell, the body portion having an aperture therein for the escape of gas therethrough from within the cell; a closure member releasably engaging the body portion; a porous body between an upper end portion of the body portion of the vent and the closure member; and means for maintaining a gap between the closure member and at least a portion of the porous body sufficient to allow gases within said cell to escape through the porous body while retarding the entry of a flame into the gap between the closure member and the porous body.

2. A vent as claimed in claim 1, in which the means for maintaining the gap includes at least one rib on the closure member which maintains substantially the entire upper surface of the porous member spaced from the underside of the closure member.

3. A vent as claimed in claim 2, including means for maintaining the body portion and the porous body spaced from the closure member by the same distance.

4. A vent as claimed in claim 1, in which the means for maintaining the gap comprises a channel in the underside of the closure member.

5. A vent as claimed in claim 1, in which the body portion includes an integrally molded, downwardly tapering funnel partition, the funnel partition has a splash baffle molded integral therewith and spaced upwardly from and overlying the aperture for returning liquid escaping upwardly from the cell downwardly towards the vent opening in the cell.

6. A vent as claimed in claim 1, having two ribs for maintaining the gap.

7. A vent as claimed in any of the preceding claims, wherein the gap is not more than 0.381 mm wide.

8. A vent as claimed in claim 7, wherein the gap is not more than 0.127 mm wide.

9. A vent as claimed in any of the preceding claims, having a plurality of body portions releasably engaging a single closure member for insertion into a plurality of cell openings in a storage battery.

10. A vent barrel for closing a cell opening of a storage battery, the barrel comprising a tubular body portion molded from a plastics material, a downwardly-tapered funnel partition within the interior of the body portion dividing the interior of the body portion into upper and lower compartments, the tapered partition having a generally vertical hole in a lower end portion thereof for the escape of gas from the battery into the upper compartment, the lower compartment being defined by an elongate tubular portion for insertion into a cell opening, the upper end portion of the interior of the body portion being defined by a socket having an internal annular shoulder at its lower end; and a disc telescoped snugly into the socket and seated against the shoulder to cover the upper end of the upper compartment, the disc being of a porous material capable of allowing gas to escape upwardly out of the upper compartment while retarding the downward entrance of flame into the upper compartment.

11. A gas vent for an electric storage cell or battery, the vent being substantially as herein described with reference to Figures 1–4 or Figures 5 and 6 of the accompanying drawings.

MATHISEN, MACARA & CO.,
Chartered Patent Agents,
Lyon House,
Lyon Road,
Harrow,
Middlesex HA1 2ET.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1978.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

tected both from dirt and grease, and from splashing electrolyte. A plurality of barrels can be used to form a gang vent for venting each of a plurality of cells directly and individually through an associated flame arrestor. This can provide improved protection against the danger of explosion. Furthermore, a gang vent protects the flame arrestors against external dirt and grease and retains the flame arrestors from escape from the vent barrels. In addition, the use of a splash baffle enables the flame arrestor to be protected from sputtering electrolyte, the splash baffle co-operating with an integral funnel for draining the electrolyte back to the cell.

WHAT WE CLAIM IS:–

1. A gas vent for an electric storage cell, the vent comprising a body portion for insertion into a vent opening of the cell, the body portion having an aperture therein for the escape of gas therethrough from within the cell; a closure member releasably engaging the body portion; a porous body between an upper end portion of the body portion of the vent and the closure member; and means for maintaining a gap between the closure member and at least a portion of the porous body sufficient to allow gases within said cell to escape through the porous body while retarding the entry of a flame into the gap between the closure member and the porous body.

2. A vent as claimed in claim 1, in which the means for maintaining the gap includes at least one rib on the closure member which maintains substantially the entire upper surface of the porous member spaced from the underside of the closure member.

3. A vent as claimed in claim 2, including means for maintaining the body portion and the porous body spaced from the closure member by the same distance.

4. A vent as claimed in claim 1, in which the means for maintaining the gap comprises a channel in the underside of the closure member.

5. A vent as claimed in claim 1, in which the body portion includes an integrally molded, downwardly tapering funnel partition, the funnel partition has a splash baffle molded integral therewith and spaced upwardly from and overlying the aperture for returning liquid escaping upwardly from the cell downwardly towards the vent opening in the cell.

6. A vent as claimed in claim 1, having two ribs for maintaining the gap.

7. A vent as claimed in any of the preceding claims, wherein the gap is not more than 0.381 mm wide.

8. A vent as claimed in claim 7, wherein the gap is not more than 0.127 mm wide.

9. A vent as claimed in any of the preceding claims, having a plurality of body portions releasably engaging a single closure member for insertion into a plurality of cell openings in a storage battery.

10. A vent barrel for closing a cell opening of a storage battery, the barrel comprising a tubular body portion molded from a plastics material, a downwardly-tapered funnel partition within the interior of the body portion dividing the interior of the body portion into upper and lower compartments, the tapered partition having a generally vertical hole in a lower end portion thereof for the escape of gas from the battery into the upper compartment, the lower compartment being defined by an elongate tubular portion for insertion into a cell opening, the upper end portion of the interior of the body portion being defined by a socket having an internal annular shoulder at its lower end; and a disc telescoped snugly into the socket and seated against the shoulder to cover the upper end of the upper compartment, the disc being of a porous material capable of allowing gas to escape upwardly out of the upper compartment while retarding the downward entrance of flame into the upper compartment.

11. A gas vent for an electric storage cell or battery, the vent being substantially as herein described with reference to Figures 1–4 or Figures 5 and 6 of the accompanying drawings.

MATHISEN, MACARA & CO.,
Chartered Patent Agents,
Lyon House,
Lyon Road,
Harrow,
Middlesex HA1 2ET.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1978.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.