VENT CAPS FOR AIRPLANE BATTERIES

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This invention relates to vent plugs for airplane storage batteries of the general nature of that shown in United States Patent No. 2,717,610, issued to me on September 13, 1955. This invention, like the device of the patent, contemplates the provision of a casing containing a tiltable weight which actuates a high pressure relief valve and a low pressure relief valve, both of these valves being open when the battery and in up-right position, so that the gases generated in the normal operation of the battery may pass freely from the battery. When in operation of the airplane, the battery is tilted above a predetermined degree both of the valves are drawn to closed position, the high pressure (low area) valve seating upon a valve seat carried by the low pressure (large area) valve, to the end that escape of electrolyte from the battery, is prevented. The reason for providing a double valve structure such as above described is that it has been found that in some cases single valued structures have failed to operate satisfactorily due to the fact that during the tipping of the airplane and battery to close the valve to prevent escape of electrolyte, sufficient gas pressure has built up to hold the closed valve open even after the battery and weight returned to up-right position. Since a small area valve may be moved against such upbuilt gas pressure much more readily than a large area valve, the provision of the double valve arrangement provides means whereby, when the weight starts to move back to up-right position the small area valve is first moved from its seat on the large area valve to initially relieve the high pressure, after which the large area valve is moved from its seat on the casing to provide additional escape channels for the escape of the gases in the normal day by day operation of the battery.

The present invention provides several additional and highly advantageous features in an article of this sort. These features and advantages will be more readily understood by reference to the accompanying drawing, in which:

Fig. 1 is an enlarged perspective of a large area, low pressure valve, which carries a seat for the high pressure valve;

Fig. 2 is an enlarged side view of the valve of Fig. 1 shown in association with the high pressure valve and the actuating stem of the latter;

Fig. 3 is a vertical section of the whole assembly with the weight in up-right position;

Fig. 4 is a vertical sectional view showing the parts in tipped position; and

Fig. 5 is a fragmentary horizontal sectional view on line 5—5 of Fig. 3.

Like numerals designate corresponding parts throughout the figures of the drawing.

In the drawing, 5 designates the casing of the vent plug, said casing being formed of hard rubber or other suitable acid proof material and being threaded at its lower end 6, to adapt it to be screwed into the conventional filler opening of an airplane storage battery. The casing is hollow and is provided with an internal ledge 6a which constitutes a seat for a weight 7, of lead or other suitable heavy acid proof material. This weight is preferably, though not necessarily of free conical form and may have an underside cavity 8 formed in it for the purpose of raising its center of gravity and making it more sensitive to tipping influences.

A further feature of improvement resides in the provision of improved guide means between the low pressure valve and the casing by which the valve is prevented from cocking with respect to its seat and thus is kept in proper alignment with the valve stem of the high pressure valve, which stem passes through the low pressure valve.

A still further feature of improvement resides in providing a one piece, low pressure valve of rubber or rubber like material comprising a disc like valve proper, a plurality of guide ribs upstanding from the disc like valve which ribs are of such size and disposition as to, complementally, engage the internal wall of a relatively large opening in the bottom of casing 5, whereby to guide the valve, as hereinafter set forth.

In achieving the foregoing results I provide a one piece rubber valve and guide (Fig. 1) comprising a disc like portion 9, an upstanding tubular portion 10 and a plurality of radial ribs 11. The valve seat for the disc like valve is provided by that part of the bottom of casing 5 which the disc 9 overlaps and the ribs 11 constitute guides which engage in the opening 12, which extends through the bottom of casing 5. The bore of the tubular portion 10 is slightly larger than the diameter of the slender, acid proof, metallic stem 13 which carries the small area high pressure valve 14 upon its lower end, said high pressure valve seating upon seat 15 at the lower end of the bore of the tubular portion 10. While the disc 9 may be flat it preferably make it slightly concave-convex in cross section to better resist the upward pull of the weight and high pressure valve when the device is tipped or inverted. To further assure a tight seating of disc 9 upon its seat 9a shallow, annular ribs and grooves 9b may be formed upon the upper or concave face of the disc. The end of stem 13 of the high pressure valve preferably, though not necessarily, terminates in a head 13a which assists in anchoring the upper portion of the metallic stem 13 in a rubber or like flexible upper portion 16 of the stem by which the tipping movement of the weight is imparted, first to the high pressure valve and then to the low pressure valve. The metallic stem carries a collar 17 against which the lower end of the rubber portion of the stem abuts. The weight engages between integral enlargements 16a and 16b of portion 16. Thus the valve stem which, as a whole, comprises upper flexible portion 16 and lower, rigid metallic portion 13 may be given positive downward thrust as the weight returns to up-right position. This positive downward thrust first moves the high pressure valve from its seat upon the relatively soft rubber, low pressure valve assembly, at seat 15, and then positively thrusts the low pressure valve downwardly to open position by the contact of collar 17 with the upper end of the tubular portion 10.

To prevent the contact of collar 17 with the top of the tubular portion 10 from cutting off the escape of gas upwardly through the bore of the tubular portion, additional lateral ports 19a are provided which lead from said bore to outside of the tubular portion of this side of the valve assembly. To increase the flexibility of the disc 9 with respect to the tubular portion and ribs by which it is carried, said ribs are undercut as indicated at 10, leaving only the tubular portion as the point of attachment of the disc to the remainder of the structure.

With the device in tipped position both valves are closed and neither as nor electrolyte can pass from the battery. When the structure starts to tip back to up-right position the high pressure valve is first moved from
its seat on the low pressure valve, any excessive pressure in the battery being thus relieved, with the gases passing upwardly through the tubular portion 10, the bore of which is enough larger in diameter than stem 13 to permit such escape. When under continued movement of the casing, the collar 17 thrusts the low pressure valve from its seat additional passages of escape for the gases are provided, the gases being then free to pass upwardly through the relatively large opening 12 and through the channels constituted by the spaces 11e between the tubular portions of the casing. These gases find their way from the casing through a port 7a of weight 7 and a vent opening 5b at the top of casing 5.

The gases which pass through the tubular portion 10 when the high pressure valve is open and the low pressure valve is closed, pass laterally as described through ports 10a to the chamber C of the casing and thence through 7c and vent opening 5b.

The described arrangement enables me to use the relatively simple and inexpensive type of disc valve which contacts directly with the underface of the casing. It also permits the use of a large opening at 12, through the bottom of casing 5, for the free escape of the gases and the free return of electrolyte to the battery from the casing 5, while insuring proper guidance of the valves and prevention of cocking of the same. Further the use of a disc valve which is initially slightly concavo-convex in cross section results in said valve being drawn to completely flat form by the upward pull of the high pressure valve. Without this arrangement and with a structure wherein the escape channel through tubular portion 10 is enough larger in diameter than stem 13 to permit the escape of the gases around said stem there might be a tendency for the upward pull of the high pressure valve to push the disc of its central portion to draw the disc away from the desirable tight seating upon the bottom of the casing.

It is to be understood that this invention is not limited to the precise construction herein set forth and described but that it includes whatever changes fairly come within either the terms or the spirit of the appended claims.

What is claimed is:

1. A low pressure valve of the character described formed as a one piece structure of rubber and comprising a central vertical tubular portion and a transversely disposed concavo-convex disc-like portion of much greater diameter than the tubular portion and located at the lower end of said tubular portion, the bore of the tubular portion being continued through the disc-like portion and terminating in a small area tapering valve seat at the bottom of and centrally of the disc-like portion, and a plurality of spaced, integral ribs extending lengthwise of the tubular portion and radially with respect thereto.

2. A low pressure valve for vent caps, which vent caps are of the nature comprising a casing having a bottom presenting a flat lower face and a relatively large diameter vertical gas escape opening formed through said bottom, a tiltable weight in the casing, and a small area, high pressure valve which is drawn inwardly and axially of said opening by and upon tilting of the weight from the vertical; said low pressure valve being formed as a unit of a single piece of rubber-like, compressible material, said unit comprising a central upstanding tubular portion of materially smaller diameter than said opening to leave a substantial gas escape area therearound, spaced guide members extending from the tubular portion to the wall of said opening and serving to axially position said portion in said opening and a disc-like valve body portion integral with the tubular portion, the bore of the tubular portion extending through said disc-like portion having a small area seat for the high pressure valve at the mouth of said bore, said disc-like portion lying perpendicular with respect to the tubular portion and being of such materially greater diameter than the opening in the casing as to overlap and have the outer portion of its upper face seat upon the bottom of the casing at all points therearound, said disc-like portion being of slightly concavo-convex formation in cross-section, with its concave face disposed toward the tubular portion.

3. A low pressure valve for vent caps, which vent caps are of the nature comprising a casing having a bottom presenting a flat lower face and a relatively large diameter vertical gas escape opening formed through said bottom, a tiltable weight in the casing, and a small area, high pressure valve which is drawn inwardly and axially of said opening by and upon tilting of the weight from the vertical; said low pressure valve being formed as a unit of a single piece of rubber-like, compressible material, said unit comprising a central upstanding tubular portion of materially smaller diameter than said opening to leave a substantial gas escape area therearound, spaced guide members extending from the tubular portion to the wall of said opening and serving to axially position said portion in said opening and a disc-like valve body portion integral with the tubular portion, the bore of the tubular portion extending through said disc-like portion having a small area seat for the high pressure valve at the mouth of said bore, said disc-like portion lying perpendicular with respect to the tubular portion and being of such materially greater diameter than the opening in the casing as to overlap and have the outer portion of its upper face seat upon the bottom of the casing at all points therearound, said disc-like portion being of slightly concavo-convex formation in cross-section, with its concave face disposed toward the tubular portion.

4. A low pressure valve for vent caps, which vent caps are of the nature comprising a casing having a bottom presenting a flat lower face and a relatively large diameter vertical gas escape opening formed through said bottom, a tiltable weight in the casing, and a small area, high pressure valve which is drawn inwardly and axially of said opening by and upon tilting of the weight from the vertical; said low pressure valve being formed as a unit of a single piece of rubber-like, compressible material, said unit comprising a central upstanding tubular portion of materially smaller diameter than said opening to leave a substantial gas escape area therearound, spaced guide members extending from the tubular portion to the wall of said opening and serving to axially position said portion in said opening and a disc-like valve body portion integral with the tubular portion, the bore of the tubular portion extending through said disc-like portion having a small area seat for the high pressure valve at the mouth of said bore, said disc-like portion lying perpendicular with respect to the tubular portion and being of such materially greater diameter than the opening in the casing as to overlap and have the outer portion of its upper face seat upon the bottom of the casing at all points therearound, said disc-like portion being of slightly concavo-convex formation in cross-section, with its concave face disposed toward the tubular portion.
portion, leaving that portion of the tubular portion below said ribs as the sole connection between the tubular and the disc-like portions, there being a lateral port through the tubular portion.

6. A low pressure valve of the character described formed as a one piece structure of rubber and comprising a central vertical tubular portion and a transversely disposed concavo-complex disc-like portion of much greater diameter than the tubular portion and located at the lower end of said tubular portion, the bore of the tubular portion being continued through the disc-like portion and terminating in a small area tapering valve seat at the bottom of and centrally of the disc-like portion, and a plurality of spaced, integral ribs extending lengthwise of the tubular portion and radially with respect thereto, said ribs terminating short of the disc-like portion, leaving that portion of the tubular portion below said ribs as the sole connection between the tubular and the disc-like portion said disc-like portion being concavo-convex in cross-section with its concave face disposed toward the tubular portion.

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