

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO STORAGE BATTERIES

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

The present invention relates to storage batteries, and particularly, but not exclusively, to storage batteries which are maintenance free and/or resistant to vibration.

The term "maintenance free" as applied to storage batteries refers to a battery which does not require the addition of any water or other liquid during the life of the battery, due to the use of a special alloy in the battery plates. These maintenance free batteries are normally constructed with the plates resting directly on the bottom of the battery container so that there is space for an extra reservoir of electrolyte above the plates, and with the plates contained in open-top envelopes to prevent active material which drops to the bottom of the container from "treeing" between positive and negative plates and causing shorting. In heavy duty storage batteries, it is normally preferred to have the bottoms of the plates bonded to the battery container to provide vibration resistance. This type of bonding is not practical in maintenance free batteries, however, because it is the envelopes around the lower portions of the plates that become bonded to the container, and the plates are still free to vibrate within their envelopes.

According to the present invention there is provided a storage battery comprising (a) a plurality of alternately positive and negative plates disposed within an elec-

trolyte in a battery container, said plates resting on the bottom of said container, (b) a battery separator material in the form of envelopes around at least alternate plates with each envelope being sealed along at least the lower portions of the vertical edges of the plate and at least partially open along the lower edge of the plate to form bottom openings to permit access of a bonding material to the lower edge of the plate, and (c) a bonding material adhered to both the bottom wall of the battery container and the lower edges of the plates and extending through the bottom openings formed by said envelopes, said bonding material also sealing said bottom openings to prevent the treeing of active material between positive and negative plates at the bottom of the container.

The present invention also provides a method of forming a storage battery comprising the steps of (a) forming a layer of liquid bonding material on the bottom of a battery container, (b) placing a plurality of alternately positive and negative plates within the said container with the plates resting on the container bottom and with a battery separator material in the form of envelopes around at least alternate plates with each envelope being sealed along at least the lower portions of the vertical edges of the plate and at least partially open along the lower edge of the plate to form bottom openings to permit access of the bonding material to the lower edge of the plate so that the bonding material adheres to both the container bottom and the lower edges of the plates, the bonding material having sufficient depth to seal said openings to prevent the treeing of active material between positive and negative plates on the container bottom, and (c) solidifying the liquid bonding material.

These and other features of the invention

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will be apparent from the following detailed description of a storage battery and different components thereof in accordance with the invention which is given, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a fragmentary perspective view, partially in section, of a storage battery;

Figure 2 is a plan view of a blank used to form one plate envelope for use in the battery of Figure 1;

Figure 3 is an enlarged exploded perspective view of one of the plates and one of the envelopes used in the battery of Figure 1;

Figure 4 is a section taken along line 4-4 in Figure 3;

Figure 5 is an enlarged perspective view, exploded at one end, of a plate sleeve suitable for use in the battery of Figure 1;

Figure 6 is a section taken along line 6-6 in Figure 5;

Figure 7 is the same section shown in Figure 6 showing the sleeve after a plate has been inserted therein;

Figure 8 is an enlarged perspective view of an alternative plate sleeve suitable for use in the battery of Figure 1.

In Figure 1, there is shown a storage battery 10 having a plurality of partitioned cells 11 each of which contains four positive plates 12 and five negative plates 13. Of course, any desired number of plates may be used. The positive plates 12 are all interconnected via lugs 12a and a connector 12b with an external positive terminal 14. The negative plates 13 are also interconnected by similar means (not shown) as is well known in the art. The battery 10 is a maintenance free battery, with the plates 12 and 13 all resting on short ribs 15a on the bottom wall 15 of the battery container 16 so as to provide space for an extra reservoir of electrolyte between the top edges of the plates 12 and 13 and the top wall 17 of the container. Furthermore, adjacent pairs of positive and negative plates are separated by envelopes 18 which surround the positive plates 12 to prevent active material which drops to the bottom of the container 16 from "treeing" between the positive and negative plates and causing shorting. The envelopes 18 are made of conventional battery separator material having ribs 19 on the inside surfaces thereof and bearing against the positive plates 12 contained therein. While the invention will be described with particular reference to maintenance free batteries, the invention is also applicable to other types of storage batteries.

The bottoms of the plate envelopes contain openings to permit a bonding material on the bottom of the battery container to

anchor the plates to the container, with the bonding material also sealing the bottom openings of the envelope to prevent the treeing of active material between positive and negative plates at the bottom of the container. Thus, in the embodiment of Figures 1-4, the envelope 18 around each positive plate 12 is sealed along the vertical edges of the plate but forms a pair of holes or slots 20 along the lower edge of the plate. When the enveloped plate 12 is placed in the battery container 16, the bottom of the envelope 18 is submerged in a layer of liquid bonding material 21, suitably an epoxy compound, which flows through the holes 20 and into contact with the lower edge of the plate 12. The number, size, shape and location of the holes 20 are not critical, as long as they permit the liquid bonding material to flow into contact with the enveloped plates 12.

After the bonding material solidifies, it adheres to both the bottom wall 15 of the battery container and the plate 12, thereby firmly anchoring the plate 12 to the container to provide the desired vibration resistance. Furthermore, the liquid level of the bonding material 21 is above the uppermost edges of the holes 20 so that the bonding material also seals the holes 20 to prevent any active material that drops down to the bottom of the envelope 18 from escaping from the envelope and forming a conductive path between the enveloped positive plate 12 and one of the adjacent negative plates 13.

The particular envelope 18 illustrated in Figures 1-4 is suitably formed from a blank 18a of separator material as illustrated in Figure 2. The holes 20 are illustrated as being pre-formed in this blank 18a along a central fold line 22, but if desired the holes may be formed in the finished envelope either before or after the insertion of the battery plate therein. To form the envelope 18, the blank 18a is folded along line 22, and the resulting overlapped vertical edges 23a, 23b and 24a, 24b are sealed to each other. The sealing of the vertical edges may be effected by heat sealing a thermoplastic separator material; by ultrasonic sealing, by the use of suitable adhesives, or by any other suitable means. It is generally preferred to keep the width of the seal as narrow as possible subject to forming a reliable liquid-tight seal. The envelopes may be pre-formed before the plates are inserted therein, or the blanks 18a may be folded around the plates so that the plates are enveloped during the forming of the envelopes.

The envelopes can be open at the upper and lower ends but closed along substantially the whole of their vertical extent

and thus form sleeves with the vertical edges of the sleeves being formed by strips of heat shrinkable plastic film so that the sleeves can be shrunk snugly around the plates therein. Thus, as illustrated in Figures 5-7, a sleeve may be formed from two sheets 30a and 30b of separator material having their vertical edges joined to a pair of strips 31 and 32 of heat shrinkable plastic film. More specifically, the two heat shrinkable strips 31 and 32 are folded and sealed to the two pairs of vertical edges 33a, 33b and 34a, 34b of the two side sheets 30a and 30b. In their original form, these two folded heat shrinkable strips 31 and 32 form lateral extensions of the sleeve 30, thereby facilitating the insertion of a battery plate 12 therein. However, after the plate is inserted in the sleeve 30, the vertical edges are heated to shrink the two strips 31 and 32 so that they contract transversely against the vertical edges of the plate 12, as illustrated in Figure 7. The sleeve 30 thus fits snugly over the plate 12 to minimize the possibility of the sleeve riding up over the plate. This construction also minimizes the space occupied by the sleeve 30 along the vertical edges of the plate 12, thereby permitting the width of the plate to be maximized for any given size of battery container. The open bottom end of the sleeve 30 permits access of the bonding material to the plate 12 disposed within the sleeve, with the bottom of the sleeve being sealed when the bonding material solidifies. If desired, the heat shrinkable ends can also be used in the envelope type separators illustrated in Figures 1-4.

40 An alternative form of sleeve is illustrated in Figure 8. In this embodiment, an open-bottomed sleeve 40 is formed by heat sealing two sheets 41 and 42 of separator material along their adjacent vertical edges 41a, 42a and 41b, 42b. As in the case of the envelopes 18 shown in Figures 1-4, the sleeve 40 may be pre-formed or it may be formed around the plate to be contained therein.

50 If desired, the plate edge or edges may be sealed only at the lower portions of the plates where the active material collects. For example, the envelopes 18 of Figures 1-4 or the sleeves 30 and 40 of Figures 5-8 may be sealed only along the lower 30% of the plates to form a pocket for containing the active material and preventing it from treeing across to the adjacent plates.

60 As can be seen from the foregoing detailed description, this invention enables the production of a storage battery that has the battery plates firmly secured to the battery container by means of the bonding material, so that the plates are resistant to

vibration even in heavy duty applications. Because the bonding material itself seals the separator openings through which the bonding material gains access to the plate, the final battery assembly prevents treeing of active material between positive and negative plates at the bottom of the container so that there can be no shorting between the positive and negative plates. Because of the facility with which the separators can be formed, with the plates being pre-inserted in the separators if desired, this battery can be efficiently and economically manufactured at high production rates.

WHAT WE CLAIM IS:—

1. A storage battery comprising
 - (a) a plurality of alternately positive and negative plates disposed within an electrolyte in a battery container, said plates resting on the bottom of said container,
 - (b) a battery separator material in the form of envelopes around at least alternate plates with each envelope being sealed along at least the lower portions of the vertical edges of the plate and at least partially open along the lower edge of the plate to form bottom openings to permit access of a bonding material to the lower edge of the plate, and
 - (c) a bonding material adhered to both the bottom wall of the battery container and the lower edges of the plates and extending through the bottom openings formed by said envelopes, said bonding material also sealing said bottom openings to prevent the treeing of active material between positive and negative plates at the bottom of the container.
2. A storage battery as claimed in claim 1 wherein said envelopes are formed as sleeves.
3. A storage battery as claimed in claim 2 wherein the vertical edges of each sleeve are formed by strips of heat shrinkable plastic film so that the sleeve can be shrunk snugly against the plate contained therein.
4. A storage battery as claimed in claim 1 wherein each envelope is formed by a folded flexible sheet of separator material having the side edges of the separator material sealed to each other, said separator material having openings formed in the region of the fold to form said bottom openings for the bonding material.
5. A method of forming a storage battery comprising the steps of
 - (a) forming a layer of liquid bonding material on the bottom of a battery container,
 - (b) placing a plurality of alternately positive and negative plates within said container with the plates resting on the

and thus form sleeves with the vertical edges of the sleeves being formed by strips of heat shrinkable plastic film so that the sleeves can be shrunk snugly around the plates therein. Thus, as illustrated in Figures 5-7, a sleeve may be formed from two sheets, 30a and 30b of separator material having their vertical edges joined to a pair of strips 31 and 32 of heat shrinkable plastic film. More specifically, the two heat shrinkable strips 31 and 32 are folded and sealed to the two pairs of vertical edges 33a, 33b and 34a, 34b of the two side sheets 30a and 30b. In their original form, these two folded heat shrinkable strips 31 and 32 form lateral extensions of the sleeve 30, thereby facilitating the insertion of a battery plate 12 therein. However, after the plate is inserted in the sleeve 30, the vertical edges are heated to shrink the two strips 31 and 32 so that they contract transversely against the vertical edges of the plate 12, as illustrated in Figure 7. The sleeve 30 thus fits snugly over the plate 12 to minimize the possibility of the sleeve riding up over the plate. This construction also minimizes the space occupied by the sleeve 30 along the vertical edges of the plate 12, thereby permitting the width of the plate to be maximized for any given size of battery container. The open bottom end of the sleeve 30 permits access of the bonding material to the plate 12 disposed within the sleeve, with the bottom of the sleeve being sealed when the bonding material solidifies. If desired, the heat shrinkable ends can also be used in the envelope type separators illustrated in Figures 1-4.

40 An alternative form of sleeve is illustrated in Figure 8. In this embodiment, an open-bottomed sleeve 40 is formed by heat sealing two sheets 41 and 42 of separator material along their adjacent vertical edges 41a, 42a and 41b, 42b. As in the case of the envelopes 18 shown in Figures 1-4, the sleeve 40 may be pre-formed or it may be formed around the plate to be contained therein.

50 If desired, the plate edge or edges may be sealed only at the lower portions of the plates where the active material collects. For example, the envelopes 18 of Figures 1-4 or the sleeves 30 and 40 of Figures 5-8 may be sealed only along the lower 30% of the plates to form a pocket for containing the active material and preventing it from treeing across to the adjacent plates.

60 As can be seen from the foregoing detailed description, this invention enables the production of a storage battery that has the battery plates firmly secured to the battery container by means of the bonding material, so that the plates are resistant to

vibration even in heavy duty applications. Because the bonding material itself seals the separator openings through which the bonding material gains access to the plate, the final battery assembly prevents treeing of active material between positive and negative plates at the bottom of the container so that there can be no shorting between the positive and negative plates. Because of the facility with which the separators can be formed, with the plates being pre-inserted in the separators if desired, this battery can be efficiently and economically manufactured at high production rates.

WHAT WE CLAIM IS:—

1. A storage battery comprising
 - (a) a plurality of alternately positive and negative plates disposed within an electrolyte in a battery container, said plates resting on the bottom of said container,
 - (b) a battery separator material in the form of envelopes around at least alternate plates with each envelope being sealed along at least the lower portions of the vertical edges of the plate and at least partially open along the lower edge of the plate to form bottom openings to permit access of a bonding material to the lower edge of the plate, and
 - (c) a bonding material adhered to both the bottom wall of the battery container and the lower edges of the plates and extending through the bottom openings formed by said envelopes, said bonding material also sealing said bottom openings to prevent the treeing of active material between positive and negative plates at the bottom of the container.
2. A storage battery as claimed in claim 1 wherein said envelopes are formed as sleeves.
3. A storage battery as claimed in claim 2 wherein the vertical edges of each sleeve are formed by strips of heat shrinkable plastic film so that the sleeve can be shrunk snugly against the plate contained therein.
4. A storage battery as claimed in claim 1 wherein each envelope is formed by a folded flexible sheet of separator material having the side edges of the separator material sealed to each other, said separator material having openings formed in the region of the fold to form said bottom openings for the bonding material.
5. A method of forming a storage battery comprising the steps of
 - (a) forming a layer of liquid bonding material on the bottom of a battery container,
 - (b) placing a plurality of alternately positive and negative plates within said container with the plates resting on the



container bottom and with a battery separator material in the form of envelopes around at least alternate plates with each envelope being sealed along at least the lower portions of the vertical edges of the plate and at least partially open along the lower edge of the plate to form bottom openings to permit access of the bonding material to the lower edge of the plate so that the bonding material adheres to both the container bottom and the lower edges of the plates, the bonding material having sufficient depth to seal said openings to prevent the freeing of active material between positive and negative plates on the container bottom, and

(c) solidifying the liquid bonding material.

6. A method as claimed in claim 5 wherein each envelope is formed as a sleeve.

7. A method as claimed in claim 6 wherein the vertical edges of each sleeve are formed by strips of heat shrinkable plastic film so that the sleeve can be shrunk snugly against the plate contained

therein.

8. A method as claimed in claim 5 wherein each envelope is formed by a folded sheet of separator material having the side edges of the separator material sealed to each other, said separator material having openings formed in the region of the fold to form said bottom openings for the bonding material.

9. A storage battery substantially as herein described with reference to any one of the embodiments illustrated in the accompanying drawings.

10. A method of forming a storage battery according to claim 5 and substantially as herein described with reference to any one of the embodiments illustrated in the accompanying drawings.

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