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**MOLDED SADDLE FOR STORAGE BATTERY PLATES, STORAGE
BATTERY CONTAINER, AND STORAGE BATTERY**

This invention generally relates to a molded saddle for electrode plates. More particularly, this invention relates to a molded saddle for electrode plates of a stationary sealed type lead acid storage battery, a storage battery container, and a storage battery.

There has been known a molded saddle which is manufactured as a separate part of a battery container. The molded saddle is made into a sectionally mound-shaped support portion and is attached to the inner bottom surface of a battery container for supporting legs of positive or negative electrode plates of a storage battery.

The above-mentioned sectionally mound-shaped saddles which are carried by the battery container of a conventional storage battery are effective for supporting the negative and positive electrodes plates with the mound-shaped portions thereof. However, when the positive electrode plates extend or expand, they cannot absorb the extensions of the positive electrode plates at all or, if so, only insufficiently. Consequently, the positive plates become gradually warped with the lapse of time and active material falls from the positive plates, so that the capacity of the battery gradually decreases. In the worst cases, the positive electrode plate extensions push up against the strap interconnecting the tabs of the positive plates which, in turn, push up against the terminal-sealing portion resulting in the damage of that portion.

According to the present invention there is provided a molded saddle for supporting electrode

plates in a storage battery, the saddle comprising a base portion for attachment to a floor of the battery and a raised support portion extending from the base for supporting an electrode plate, the support portion
5 being flexible towards the plane of the base. A molded saddle in accordance with the present invention may be constructed so as to accommodate extension of the positive plates, thus overcoming the above-mentioned defects of the conventional saddle, and prolonging the
10 service life of a storage battery.

When the molded saddle for storage battery plates according to this invention is fixedly attached to the inner bottom surface of a battery container by adhering the horizontal base plate to the bottom surface of the
15 container, there is provided a storage battery container which results in a large vertical space remaining between the flexible raised support plate portion and the inner bottom surface of the battery container. Consequently, when the positive plates
20 which are supported on the flexible raised support plate portion extend, the flexible raised support plate portion subsequently moves downwards in order to absorb the extension of the positive plates completely. Thus, the increased extension of the positive plate, with the
25 lapse of time, can be absorbed well by the flexible raised support portion of the molded saddle of this invention; thereby, remarkably prolonging the battery life.

Furthermore, when the other end of the horizontal
30 base plate is extended in order to have a sectionally

mound-shaped negative plate support plate portion formed integrally with the molded saddle for supporting legs of positive plates, a molded saddle is disposed at a predetermined position on the bottom surface of the battery container for automatically supporting negative plates when the molded saddle for supporting the positive plates is attached at a predetermined position to the inner bottom surface of the battery container. Further, the battery container has a flexible, raised support plate portion of the positive plate-supporting molded saddle disposed in the battery container in such a manner that the legs of positive plates in a plate assembly placed in the battery container may be supported. Thus, when a storage battery is arranged so that the upper end portion of the flexible, raised support plate portion of the positive plate-supporting molded saddle is fitted into an engaging groove provided in the lower end surface of each positive plate's leg, the flexible, raised support plate portion can keep the positive plate supported in a more stable and secured fashion when the flexible raised support plate portion bends downwards and absorbs the positive plate extension.

For a better understanding of the present invention and to show how it may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a perspective view, partly omitted, of one embodiment of a molded saddle for storage battery plates according to this invention;

Figure 2 is a cross-sectional view, partly omitted, of one embodiment of a battery container and a battery according to the present invention;

Figure 3 is a cross-sectional view of a portion of a battery having a battery plate assembly and a molded saddle according to another embodiment of the present

invention;

Figure 4 is a partial cross-sectional view of a portion of a battery having a battery plate assembly and a molded saddle as in the embodiment show in Figure 3, after some use;

Figure 5 is a cross-sectional view of a portion of a battery having a battery plate assembly and a molded saddle made according to a further embodiment of the present invention;

Figure 6 is a partial cross-sectional view of a portion of a battery having a battery plate assembly and a molded saddle as in the embodiment shown in Figure 5, after some use;

Figure 7 is a graph showing the results of comparative life tests between the storage battery according to this invention and a conventional storage battery.

Referring to Figure 1, reference numeral 1 generally denotes a molded saddle for supporting positive plates of a storage battery according to one embodiment of the present invention. The molded saddle 1 is made up of an integrally formed structure having a horizontal base plate 1a which is to be securely attached to the inner bottom surface of a battery container, and a flexible, raised support plate portion 1b for supporting legs of positive electrode plates of a battery. The support plate portion is formed by extending one end of the horizontal base plate portion 1a so as to rise substantially upright and leave a large vertical space S between the upper end of the extension and the horizontal base plate which is to be attached to the inner bottom surface of a battery container. It is preferred that the molded saddle be formed longitudinally so that the legs of the positive plates which are lined up in the longitudinal direction of a plate assembly may be mounted thereon.

As shown in Figure 2, the molded saddles are disposed at the left and right-hand positions on the inner bottom surface 2a of a battery container 2 and securely attached thereto by bonding the horizontal base plate portions 1a to the bottom surface 2a with an adhesive or the like. When attached in the above-mentioned manner, a large vertical space S is formed between the upper end portion 1c of the flexible raised plate portion 1b for supporting the positive plate's leg and the inner bottom surface 2a of the battery container 2. The upper end portion 1c of the flexible, raised support plate portion 1b is angled downwards in a circular or square configuration so as to ensure sufficient strength and to provide a support surface for the portion 1b which can support a leg of each positive electrode plate in a stable manner. For molding thereof, soft synthetic resin, such as polypropylene, is used as a raw material and is formed so as to have the raised support plate portion 1b made relatively thinner; thereby, providing the portion 1b with flexibility. Although a saddle for supporting negative plates can be integrally made with the battery container when the container is molded, it can also be integrally formed with the molded saddle 1 as shown in Figure 1 instead of being integrally formed with the battery container. More specifically, the other end of the horizontal base plate portion 1a for supporting positive plates is extended to have a sectionally mound-shaped and longitudinally extended support plate portion saddle 5 integrally formed therewith for supporting lined-up legs of negative electrode plates; thereby, forming a positive/negative plate-supporting molded saddle M.

The molded saddles are disposed at the predetermined left and right positions on the flat bottom surface of the battery container and bonded

securely thereto to provide a battery container 2 carrying the positive/negative plate-supporting saddle of the present invention. The molded saddle for negative plates is made relatively thin and rigid and provided at its outer edge with a horizontally extended base plate 5a which is to be bonded to the inner bottom surface of the battery container to obtain a negative plate-supporting saddle 5 firmly fixed to the inner surface of the bottom of the battery container body 2. An engaging rib 6 may be provided on the inner bottom surface 2a of the container 2 while a corresponding engaging groove 7 may be provided on the lower surface of the negative plate-supporting saddle 5 so that the rib 6 is fitted into the groove 7 for providing additional mechanical strength. Thus, a plate assembly made up of a group of positive plates 3 and negative plates 4 which are interleaved with separators is mounted in the molded saddle M in such a manner that each positive plate's leg 3a and each negative plate's leg 4a may be respectively placed on the molded saddles 1 and 5.

As shown in Figure 2, each positive plate 3 is supported at the centre portion of the lower end surface of its square leg 3a by the cantilever type flexible, raised support plate portion 1b of the positive plate-supporting saddle 1 and the negative plate 4 is supported at the centre portion of the lower end surface of its square leg 4a by the sectionally mound-shaped negative plate-supporting saddle 5. However, as shown in Figure 3, it is preferable that the positive plate 3 be supported at a point biased toward one side on the lower end surface of its leg 3a by the curved upper end portion 1c of the flexible raised support plate portion 1b. In this manner, when the positive plate 3 becomes extended, the upper end portion 1c of the flexible, raised support plate

portion 1b bends downwards in response to the extension of the positive plate 3 so that it can keep the leg 3a supported on its back without slipping out of the lower end surface of the leg 3a, as shown in Figure 4.

5 As shown in Figure 5, the leg 3a of the positive plate 3 may be provided in its lower surface with an engaging groove 8 for receiving the upper end portion 1c of the flexible, raised support plate portion 1b which is fitted therein so that even when the raised
10 support plate portion 1b is bent downwards to be deformed in response to the extension of the positive plate 3 as shown in Figure 6, the leg 3a on the saddle 1 can be kept stable due to the engagement of the upper end portion 1c of the saddle 1 with the groove 8 in the
15 leg 3a. The leg 4a of the negative plate 4 may also be provided with a similar engaging groove 9 if necessary. In Figure 2, reference numerals 10 and 11 denote a positive tab and a negative tab, respectively, while reference numerals 12 and 13 designate a positive strap and a negative strap, respectively. Reference numeral
20 14 denotes a battery container lid, and numerals 15 and 16 represent a positive terminal and a negative terminal, respectively.

 Figure 7 shows service life characteristic curves
25 obtained from the results of accelerated life tests performed at 60°C on a battery equipment with the molded saddle of the present invention and on a conventional battery equipped with a conventional rigid saddle. More specifically, the accelerated life test
30 was carried out in such a manner that at 60°C, a charge at 0.2 C was provided, until the battery voltage became 2.25 V, then a constant-voltage charge of 2.25 V was continued for one month. Then, the battery was cooled to 25°C and a discharge at 0.16 C was provided at 25°C
35 until the end point voltage thereof became 1.75 V. The capacity thereof at that time was then measured, and

such a charge and discharge cycle was repeated. Thus, the resultant characteristic curves A and B between the battery of this invention and the conventional battery are as shown in Figure 7. As clearly seen in Figure 7, when compared to the conventional battery's curve B, curve A of the battery of this invention maintains a high battery capacity over a much longer period of time which proves that the life characteristic of the battery is improved by the saddle of this invention.

Thus, according to the present invention, the molded saddle for electrode plates of a storage battery has a horizontal base plate and a flexible, raised plate portion rising from one end of the horizontal base plate so that when the molded saddle is securely attached to the inner bottom surface of a storage battery container by bonding its horizontal base plate, there is a large, vertical space between the upper end portion of the flexible, raised plate portion and the inner bottom surface of the battery container.

Consequently, the leg of a positive plate is supported on the upper end portion of the flexible, raised plate portion, and when the positive plate becomes expanded or extended, the flexible, raised plate becomes expanded or extended, the flexible, raised plate portion is moved downwards in response to or in accordance with the extension of the positive plate in order to absorb the extension; thereby, preventing the positive plate from being warped. Accordingly, the capacity of the battery with the present invention's molded saddle can be kept at a high level over a longer period of time which results in the prolonging of the life of the battery. Furthermore, when the sectionally mound-shaped support portion for legs of negative plates is formed integrally with the positive plate-supporting molded saddle, the disposition of the positive plate-supporting molded saddle and the

negative plate-supporting molded saddle at the bottom surface of the battery container can be easily carried out which further contributes to bringing about a higher productivity of battery containers. In
5 addition, when a plate assembly is placed into the battery container according to this invention in such a way that each of the legs of the positive plates may be supported by the flexible, raised plate portion for supporting the positive plate at a point biased toward
10 one side, or when the upper end portion of the flexible, raised plate portion is fitted into the engaging groove provided in the lower end surface of each positive plate's leg, the engagement between the leg and the flexible, raised plate portion of the
15 molded saddle can be retained in a stable and secure manner even under the condition whereby the flexible, raised plate portion is bent downwards in response to or according with the extension of the positive plate. The above-described structural arrangement guarantees
20 effective and reliable performance of the saddle.



CLAIMS

1. A molded saddle for supporting electrode plates in a storage battery, the saddle comprising a base portion for attachment to a floor of the battery and a raised support portion extending from the base for supporting an electrode plate, the support portion being flexible towards the plane of the base.

2. A molded saddle as claimed in claim 1, in which a sectionally mound-shaped support portion, adapted to support a negative electrode plate, is formed integrally with the base portion.

3. A molded saddle as claimed in claim 2, in which the raised support portion is provided on the opposite end of the horizontal base portion from the sectionally mound-shaped support portion.

4. A storage battery, comprising a molded saddle as claimed in any one of the preceding claims.

5. A storage battery as claimed in claim 4, in which positive electrode plates are provided which have legs at their bottom edges, which legs engage the raised support portion of the molded saddle.

6. A storage battery as claimed in claim 5, in which the raised support portion engages the lower ends surface of each leg at a position offset from the centre of the leg, so that the raised support portion can slide across substantially the full width of the leg, if the raised support portion is compressed.

7. A storage battery as claimed in any one of claims 4 to 6, in which negative electrode plates are provided, which have legs at their bottom edges, which legs engage the sectionally mound-shaped support portion of the moulded saddle.

8. A storage battery as claimed in any one of claims 5 to 7, in which the lower end surface of the leg of each positive electrode plate is provided with an engaging groove which receives the upper end portion



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of the raised support portion.

9. A storage battery as claimed in claim 7 or 8 in which the lower end surface of the leg of each negative electrode plate is provided with an engaging groove which receives the upper end portion of the sectionally mound-shaped support portion.

10. A storage battery as claimed in any one of claims 4 to 9, in which the horizontal base portion of the saddle is securely attached to the bottom surface of a battery container body.

11. A moulded saddle for electrode plates of a storage battery substantially as described herein, with reference to, and as shown in Figures 1 to 6 of the accompanying drawings.

12. A storage battery substantially as described herein, with reference to, and as shown in Figures 1 to 6 of the accompanying drawings.