

SPECIFICATION

Battery

The present invention relates to a battery in which an electrode plate having one polarity is sandwiched by electrode plates having the other polarity with separator layers respectively disposed therebetween, the electrode plates being housed in a housing comprising a housing part having one polarity and another housing part having the other polarity.

In a conventional battery of the type above mentioned, the end of a conductive piece extended from the lateral side of the electrode plate having one polarity located at the centre of the battery, is inserted into a notch formed in an insulating plate located beneath the inner surface of the outer case having one polarity and is pressingly contacted with or welded to the outer case having one polarity, thereby to be connected thereto. Thus, according to such conventional flat battery, the collector mechanism of connecting the electrode plate having one polarity to the outer case having one polarity is complicated, and electrical short-circuit might generate in the battery if the insulating plate is positionally shifted.

According to the present invention there is provided a battery comprising an electrode plate having one polarity located at the centre portion of the battery;

an electrode plate having one polarity located at the centre portion of the battery,

a first electrode plate having the other polarity disposed on said electrode plate having one polarity with a first separator layer disposed therebetween,

a second electrode plate having the other polarity disposed beneath said electrode plate having one polarity with a second separator layer disposed therebetween,

an insulating plate disposed beneath the inner surface of an outer casing part having one polarity,

a collector rod passing through central bores formed in said insulating plate, said first electrode plate having the other polarity and said first separator layer,

an insulating cylinder disposed about the outer periphery of said collector rod, and

an outer casing part having the other polarity; and in which said collector rod is electrically connected at one end thereof to the inner surface of said outer casing part having one polarity and at the other end thereof to said electrode plate having one polarity,

said second electrode plate having the other polarity being electrically connected to said first electrode plate having the other polarity and to the inner surface of said outer casing part having the other polarity, and

said outer casing part having the other polarity being mounted to said outer casing part having one polarity through an insulating packing.

According to a battery of the present invention, the utilization coefficient of the electrode plate is

enhanced to improve the battery performance and the collector mechanism is improved to facilitate the battery assembling work.

Some embodiments of the invention will now be described, by way of examples, with reference to the accompanying drawings, in which:—

Fig. 1 is a sectional view of a first embodiment of a battery in accordance with the present invention,

Fig. 2 is a disassembled perspective view of portions of the battery shown in Fig. 1,

Fig. 3 is a sectional view of a second embodiment of a battery in accordance with the present invention,

Fig. 4 is a perspective view of portions of the battery shown in Fig. 3, taken from the underside thereof,

Fig. 5 is a sectional view of a third embodiment of a battery in accordance with the present invention,

Fig. 6 is a perspective view of portions of the battery shown in Fig. 5,

Fig. 7 is a sectional view of a fourth embodiment of a battery in accordance with the present invention,

Fig. 8 is a perspective view, with portions broken away, of a portion of the battery shown in Fig. 7 taken from the underside thereof, and

Fig. 9 is a sectional view of a fifth embodiment of a battery in accordance with the present invention.

It is here to be noted that like parts in Figs. 1 to 9 are designated by like numerals.

The description hereinafter will firstly discuss a first embodiment of a battery in accordance with the present invention, with reference to Fig. 1.

An electrode plate 1 having one polarity constituting a negative electrode of a battery is formed from a rolled lithium rolled plate which is used as the active material and is located at the centre of the battery.

An electrode plate 3 having the other polarity is disposed on the electrode plate 1 having one polarity with a first separator layer 2 disposed therebetween, and a second electrode plate 5 having the other polarity is disposed under the electrode plate 1 having one polarity with a second separator layer 4 disposed therebetween. The electrode plates 3 and 5 having the other polarity constitute the positive electrode plates of the battery and are formed with manganese dioxide being as active material.

An insulating plate 7 is disposed beneath the inner surface of an outer casing part 6 having one polarity, the part 6 forming a negative electrode terminal. Central bores are formed in the insulating plate 7, the electrode plate 3 having the other polarity, the first separator layer 2 and the electrode plate 1 having one polarity, and these central bores together form a bore portion 8.

As shown in Fig. 2, a plurality of bores 10 are formed in a collector plate 9 and a collector rod 12 having a flange 11 at the lower end thereof is inserted into a central bore 13 formed in the collector plate 9, and the collector rod 12 is

attached to the collector plate 9 in a unitary construction. An electrical insulating cylinder 14 for preventing electrical short-circuit is placed around the outer periphery of the collector rod 12.

- 5 The collector plate 9 is disposed beneath the electrode plate 1 having one polarity and comes into contact therewith, and the collector rod 12 is inserted into the bore portion 8. The upper end of the collector rod 12 is in contact with the inner surface of the outer casing part 6 having one polarity and is therefore electrically connected thereto. The lower end of the collector rod 12 is electrically connected to the electrode plate 1 having one polarity through the collector plate 9.
- 10 Thus, the collector plate 9 is located between the electrode plate 1 having one polarity and the second separator layer 4.

- A collector plate 17 having therein a plurality of bores 16 is disposed on the inner surface of an outer casing part 15 having the other polarity, the part 15 forming a positive electrode terminal. The upper surface of the collector plate 17 is in contact with the second electrode plate 5 having the other polarity. A collector piece 18 is extended from the lateral side of the first electrode plate 3 having the other polarity. The end of the collector piece 18 is held by and between the lower surface of the second electrode plate 5 having the other polarity and the inner surface of the outer casing part 15 having the other polarity. Thus, the first and second electrode plates 3 and 5 having the other polarity are electrically connected to the outer casing part 15 having the other polarity 15.

- The periphery of the outer casing part 6 having one polarity is attached to an insulating packing 19.

- A peripheral inturned edge 20 of the outer casing part 15 having the other polarity is caulked onto the upper surface of the insulating packing 19. Thus, the outer casing part 6 having one polarity is mounted to the outer casing part 15 having the other polarity through the insulating packing 19.

- As thus discussed hereinbefore according to the battery of the first embodiment, the electrode plates 3 and 5 having the other polarity are respectively disposed on and under the electrode plate 1 having one polarity. Therefore, as compared with a conventional battery in which one electrode plate having one polarity and one electrode plate having the other polarity are alternately superposed on each other, the reaction area of the electrode plate having one polarity is increased in the present invention, thereby to enhance the utilization coefficient of the electrode, whereby the battery performance may be improved.

- In a particular case of a manganese dioxide-lithium type battery in which negative electrode plate formed with lithium metallic plates being as active material is used for electrode plate having one polarity and positive electrode plate formed with manganese dioxide being as active material is used for electrode plate having the other polarity, lithium in the negative electrodes is

diffused in a crystal of manganese dioxide in the positive electrode plate in the discharge reaction. Therefore, as discharge is advanced, the thickness of each of the positive electrode plate is apt to be increased. When such thickness is increased, diffusion resistance is also increased, so that the utilization coefficient of the electrode plate is lowered.

- On the contrary, when two positive electrode plates are used as in the present invention and if the thicknesses of such positive electrode plates are reduced to half, inconvenience as above-mentioned may be restrained. Therefore, a battery discharge characteristic may be improved, so that the battery performance may be improved.

- A description will now be given of the collector mechanism for the electrode plate 1 having one polarity held between the first and second electrode plates 3 and 5 having the other polarity.

- The collector rod 12 projecting from the electrode plate 1 having one polarity passes through the respective central bores in the insulating plate 7 disposed beneath the inner surface of the outer casing part 6 having one polarity, the first electrode plate 3 having the other polarity and the first separator 2, and one end of the collector rod 12 is electrically connected to the inner surface of the outer casing part 6 having one polarity 6. Therefore, it is sufficient for assembling a battery to merely superpose the respective electrode plates and separator layers in succession, so that the battery assembling work may be very simplified.

- The description hereinafter will discuss a second embodiment of a battery in accordance with the present invention, with reference to Figures 3 and 4.

The second embodiment differs from the first embodiment in Fig. 1 in the following respects.

- As apparent from Fig. 3, the insulating plate 7 disposed beneath the inner surface of the outer casing part 6 having one polarity is formed integrally with an insulating cylinder 14 disposed about the outer periphery of the collector rod 12. Namely, the insulating cylinder 14 is integrally formed with the edge of the central bore in the insulating plate 7. The insulating plate 7 is secured to the inner surface of the outer casing part 6 having one polarity by an adhesive or thermal deposition.

The electrode plate 1 having one polarity has therein no central bore and the collector plate 9 is disposed on the electrode plate 1 having one polarity.

- According to the battery of the second embodiment, since the insulating plate 7 is securely attached to the inner surface of the outer casing part 6 having one polarity, there is no possibility of the insulating plate 7 being positionally shifted.

- Furthermore, since the insulating cylinder 14 is formed integrally with the insulating plate 7 and passes through the central bore in a first electrode plate 3 having the other polarity and the collector rod 12 projecting from the electrode plate 1

having one polarity is inserted into the insulating cylinder 14, it is possible to securely prevent the collector rod 12 from coming into contact with the first electrode plate 3 having the other polarity, thereby to prevent the occurrence of internal electrical short-circuit.

The description hereinafter will discuss a third embodiment of a battery in accordance with the present invention, with reference to Figures 5 and 6.

The third embodiment differs from the first embodiment illustrated in Fig. 1 in the following respects.

As shown in Figures 5 and 6, a resilient tab piece 21 is integrally formed with the collector plate 17 which is disposed between the inner surface of the outer casing part 15 having the other polarity and the second electrode plate 5 having the other polarity and has therein a plurality of bores 16. Namely, the resilient tab piece 21 is formed by having a portion of the collector plate 17 partially cut and raised up therefrom. The resilient tab piece 21 applies an upward resilient load to the second electrode plate 5 having the other polarity. The collector plate 17 is secured to the inner surface of the outer casing part 15 having the other polarity by spot-welding or other means.

According to the battery of the third embodiment, the collector rod 12 is upwardly resiliently loaded by the resilient force of the resilient tab piece 21 of the collector plate 17, through the second electrode plate 5 having the other polarity and the second separator layer 4, so that the upper end of the collector rod 12 is pressingly contacted with the inner surface of the outer casing part 6 having one polarity at all times. Thus, the collector rod 12 and the outer casing part 6 may be electrically connected readily and securely by merely superposing the electrode plates and separator layers in succession without the necessity of spot-welding.

The description hereinafter will discuss a fourth embodiment of a battery in accordance with the present invention, with reference to Figures 7 and 8.

The fourth embodiment differs from the first embodiment illustrated in Fig. 1, in the following respects.

No central bore is formed in the collector plate 9 and the collector rod 12 does not pass through the collector plate 9. After the insulating cylinder 14 has been placed around the collector rod 12, the collector rod 12 is secured at the upper end thereof to the inner surface of the outer casing part 6 having one polarity by spot-welding as shown in Fig. 8. The insulating plate 7, the first electrode plate 3 having the other polarity and the first separator 2 each having therein a central bore are inserted on the collector rod 12 in succession. The electrode plate 1 having one polarity provided at the lower surface thereof, with the collector plate 9 secured thereto, is then inserted over the collector rod 12. The collector plate 9 is pressed to the lower end of the collector rod 12. With

welding electrodes applied to the outer casing part 6 having one polarity and the collector plate 9, the lower end of the collector rod 12 is securely spot-welded to the collector plate 9.

According to the battery constituting the fourth embodiment shown in Fig. 7, since the collector rod 12 is, in advance, secured to the inner surface of the outer casing part 6 having one polarity, the collector rod 12 may be utilized as a jig means for inserting the insulating plate 7, the first electrode plate 3 having the other polarity and the first separator layer 2, respectively, whereby the battery assembling work may be performed very easily.

Moreover, since the collector rod 12 is secured at the lower end thereof to the collector plate 9 by spot-welding, the insulating plate 7, the first electrode plate 3 having the other polarity, the first separator layer 2, the electrode plate 1 having one polarity and the collector plate 9 are all formed into a unitary construction in the outer casing part 6 having one polarity, so that a unified structure may be provided, whereby the battery assembling work may further be facilitated.

Furthermore, the electrical connection between the collector plate 9 and the collector rod 12 may be more securely done, thereby to improve collector effect.

It is not necessary that the collector plate 9 and the collector rod 12 be secured to each other, they may merely be press-contacted with each other.

The description hereinafter will discuss a fifth embodiment of the present invention, with reference to Fig. 9.

The fifth embodiment differs from the fourth embodiment illustrated in Fig. 7 in the following respects.

The collector rod 12 is not inserted into the central bore in the electrode plate 1 having one polarity. The collector plate 9 is secured to the upper surface of the electrode plate 1 having one polarity and is contacted with the lower surface of a first separator layer 2. With one welding electrode applied to the outer casing part 6 having one polarity and the other welding electrode applied to the collector plate 9 through the central bore in the electrode plate 1 having one polarity, the collector rod 12 is securely spot-welded to the collector plate 9.

The operational effect of a battery of the fifth embodiment is substantially equal to that of the fourth embodiment of Fig. 7.

As thus discussed hereinbefore, according to the battery of the present invention, the utilization coefficient of the electrode plate may be enhanced thereby to improve the battery performance, and the collector mechanism may be improved thereby to facilitate the battery assembling work.

CLAIMS

1. A battery comprising:
 - an electrode plate having one polarity located at the centre portion of the battery,
 - a first electrode plate having the other polarity disposed on said electrode plate having one



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having one polarity is inserted into the insulating cylinder 14, it is possible to securely prevent the collector rod 12 from coming into contact with the first electrode plate 3 having the other polarity, thereby to prevent the occurrence of internal electrical short-circuit.

The description hereinafter will discuss a third embodiment of a battery in accordance with the present invention, with reference to Figures 5 and 6.

The third embodiment differs from the first embodiment illustrated in Fig. 1 in the following respects.

As shown in Figures 5 and 6, a resilient tab piece 21 is integrally formed with the collector plate 17 which is disposed between the inner surface of the outer casing part 15 having the other polarity and the second electrode plate 5 having the other polarity and has therein a plurality of bores 16. Namely, the resilient tab piece 21 is formed by having a portion of the collector plate 17 partially cut and raised up therefrom. The resilient tab piece 21 applies an upward resilient load to the second electrode plate 5 having the other polarity. The collector plate 17 is secured to the inner surface of the outer casing part 15 having the other polarity by spot-welding or other means.

According to the battery of the third embodiment, the collector rod 12 is upwardly resiliently loaded by the resilient force of the resilient tab piece 21 of the collector plate 17, through the second electrode plate 5 having the other polarity and the second separator layer 4, so that the upper end of the collector rod 12 is pressingly contacted with the inner surface of the outer casing part 6 having one polarity at all times. Thus, the collector rod 12 and the outer casing part 6 may be electrically connected readily and securely by merely superposing the electrode plates and separator layers in succession without the necessity of spot-welding.

The description hereinafter will discuss a fourth embodiment of a battery in accordance with the present invention, with reference to Figures 7 and 8.

The fourth embodiment differs from the first embodiment illustrated in Fig. 1, in the following respects.

No central bore is formed in the collector plate 9 and the collector rod 12 does not pass through the collector plate 9. After the insulating cylinder 14 has been placed around the collector rod 12, the collector rod 12 is secured at the upper end thereof to the inner surface of the outer casing part 6 having one polarity by spot-welding as shown in Fig. 8. The insulating plate 7, the first electrode plate 3 having the other polarity and the first separator 2 each having therein a central bore are inserted on the collector rod 12 in succession. The electrode plate 1 having one polarity provided at the lower surface thereof, with the collector plate 9 secured thereto, is then inserted over the collector rod 12. The collector plate 9 is pressed to the lower end of the collector rod 12. With

welding electrodes applied to the outer casing part 6 having one polarity and the collector plate 9, the lower end of the collector rod 12 is securely spot-welded to the collector plate 9.

According to the battery constituting the fourth embodiment shown in Fig. 7, since the collector rod 12 is, in advance, secured to the inner surface of the outer casing part 6 having one polarity, the collector rod 12 may be utilized as a jig means for inserting the insulating plate 7, the first electrode plate 3 having the other polarity and the first separator layer 2, respectively, whereby the battery assembling work may be performed very easily.

Moreover, since the collector rod 12 is secured at the lower end thereof to the collector plate 9 by spot-welding, the insulating plate 7, the first electrode plate 3 having the other polarity, the first separator layer 2, the electrode plate 1 having one polarity and the collector plate 9 are all formed into a unitary construction in the outer casing part 6 having one polarity, so that a unified structure may be provided, whereby the battery assembling work may further be facilitated.

Furthermore, the electrical connection between the collector plate 9 and the collector rod 12 may be more securely done, thereby to improve collector effect.

It is not necessary that the collector plate 9 and the collector rod 12 be secured to each other, they may merely be press-contacted with each other.

The description hereinafter will discuss a fifth embodiment of the present invention, with reference to Fig. 9.

The fifth embodiment differs from the fourth embodiment illustrated in Fig. 7 in the following respects.

The collector rod 12 is not inserted into the central bore in the electrode plate 1 having one polarity. The collector plate 9 is secured to the upper surface of the electrode plate 1 having one polarity and is contacted with the lower surface of a first separator layer 2. With one welding electrode applied to the outer casing part 6 having one polarity and the other welding electrode applied to the collector plate 9 through the central bore in the electrode plate 1 having one polarity, the collector rod 12 is securely spot-welded to the collector plate 9.

The operational effect of a battery of the fifth embodiment is substantially equal to that of the fourth embodiment of Fig. 7.

As thus discussed hereinbefore, according to the battery of the present invention, the utilization coefficient of the electrode plate may be enhanced thereby to improve the battery performance, and the collector mechanism may be improved thereby to facilitate the battery assembling work.

CLAIMS

1. A battery comprising:
an electrode plate having one polarity located at the centre portion of the battery,
a first electrode plate having the other polarity disposed on said electrode plate having one

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polarity with a first separator layer disposed therebetween,

a second electrode plate having the other polarity disposed beneath said electrode plate

5 having one polarity with a second separator layer disposed therebetween,

an insulating plate disposed beneath the inner surface of an outer casing part having one polarity,

10 a collector rod passing through central bores formed in said insulating plate, said first electrode plate having the other polarity and said first separator layer,

an insulating cylinder disposed about the outer periphery of said collector rod, and

15 an outer casing part having the other polarity; and in which said collector rod is electrically connected at one end thereof to the inner surface

of said outer casing part having one polarity and at the other end thereof to said electrode plate

20 having one polarity,

said second electrode plate having the other polarity being electrically connected to said first electrode plate having the other polarity and to the inner surface of said outer casing part having the

25 other polarity, and

said outer casing part having the other polarity being mounted to said outer casing part having one polarity through an insulating packing.

30 2. A battery as claimed in Claim 1, which the electrode plate having one polarity is an electrode plate formed of rolled lithium metallic plate serving as the active material, and the first and second electrode plates having the other polarity are electrode plates formed from manganese
35 dioxide serving as the active material.

40 3. A battery as claimed in Claim 1 or Claim 2, in which the collector rod is attached at one end thereof to a collector plate in which a plurality of bores are formed, and said collector plate is pressingly contacted with the electrode plate having one polarity.

4. A battery as claimed in Claim 3, in which a central bore is formed in the electrode plate

having one polarity, said collector rod being

45 inserted into said central bore and the collector plate being pressingly contacted with the lower surface of the electrode plate having one polarity.

50 5. A battery as claimed in Claim 3, in which the collector plate is pressingly contacted with the upper surface of the electrode plate having one polarity.

6. A battery as claimed in Claim 1, in which the insulating cylinder disposed about the outer periphery of the collector rod is formed integrally with the insulating plate which is disposed
55 beneath the inner surface of the outer casing part having one polarity.

7. A battery as claimed in Claim 1, in which a collector plate secured to the inner surface of the outer casing part having the other polarity by spot-welding is disposed between the lower surface of the second electrode plate having the other
60 polarity and the outer casing part having the other polarity, and said collector plate having a resilient tab piece to apply upward resilient loading to the second electrode plate having the other polarity.

8. A battery as claimed in Claim 7, in which the resilient tab piece is formed by a portion of the collector plate which is partially cut and raised up
70 therefrom.

9. A battery as claimed in Claim 1, in which the collector rod is secured at one end thereof to the inner surface of the outer casing part having one polarity.

75 10. A battery as claimed in Claim 9, in which the insulating plate, the first electrode plate having the other polarity and the first separator layer are inserted in succession on the collector rod.

80 11. A battery as claimed in Claim 10, in which the collector rod is secured at the other end thereof by spot-welding to the collector plate connected to the electrode plate having one polarity.

85 12. A battery substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.