

DESCRIPTION

TITLE

ASSEMBLED BATTERY

FIELD

5 Embodiments described herein relate generally to an assembled battery.

BACKGROUND

 In a case where a comparatively large current is required, an assembled battery configured by combining a plurality of battery packs may be used.

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CITATION LIST

PATENT LITERATURE 1: International Publication No. 2017/158763

SUMMARY

15 Cases which see a plurality of battery packs combined pose problems with respect to assembly and the search for effective cooling methods. Therefore, to solve such problems, the present invention provides an assembled battery that can be easily assembled and effectively cooled.

20 To solve such problems, an assembled battery of an embodiment comprises; a plurality of first chassis, each having an approximately rectangular solid shape, accommodating a battery cell, and including a main circuit terminal for taking out a charge-discharge current of the battery cell; a main circuit line connecting the main circuit terminals; a plurality of plates facing a predetermined surface of the first chassis, and each

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provided with a cooling passage having a cooling medium inlet and a cooling medium outlet; a cooling pipe connecting the cooling passages; and a second chassis accommodating the plurality of first chassis in a depth direction perpendicular to a surface of the plate, and including a total terminal for taking out a charge-discharge current of the battery cell outside, and a cooling pipe inlet and a cooling pipe outlet for taking a cooling medium outside, wherein the main circuit terminal, the main circuit line, and the total terminal are provided at an upper part of the second chassis in a height direction, and the cooling medium inlet, the cooling medium outlet, the cooling pipe, the cooling pipe inlet, and the cooling pipe outlet are provided at a lower part of the second chassis in a height direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an assembled battery according to an embodiment.

FIG. 2 is a perspective view of a frame of the assembled battery according to the embodiment.

FIG. 3 is a partially exploded perspective view of the assembled battery according to the embodiment.

FIG. 4 is an exploded perspective view of a battery pack, a first fixing member, a second fixing member, and a plate according to the embodiment.

FIG. 5 is a perspective view of a battery cell according to the embodiment.

FIG. 6 is an exploded perspective view of the battery pack, the first fixing member, the second fixing member, and the plate according to the embodiment.

5 FIG. 7 is a perspective view of the plate according to the embodiment.

FIG. 8 is a perspective view of the plate according to the embodiment.

FIG. 9 is a cross-sectional view of a cooling passage according to the embodiment.

10 FIG. 10 is a cross-sectional view of a groove according to the embodiment.

FIG. 11 is a perspective view of the plate and cooling pipes according to the embodiment.

15 FIG. 12 is a perspective view of a main circuit line and a communication line according to the embodiment.

FIG. 13 is a perspective view of a main circuit line and a communication line according to a modification.

DETAILED DESCRIPTION

20 Hereinafter, an assembled battery of an embodiment will be explained with reference to the drawings. In each of the following drawings, directions are defined for the sake of convenience. Direction X indicates a direction along a longitudinal direction of an assembled battery 1, direction Y indicates a direction along a short-length
25 direction of the assembled battery 1, and direction Z indicates a direction along a height direction of the assembled battery 1. Direction X, direction Y, and

direction Z are orthogonal to each other.

FIG. 1 is a perspective view of the assembled battery 1 according to the embodiment. As shown in FIG. 1, the assembled battery 1 has an approximately rectangular solid shape formed of a thin metal plate.

The assembled battery 1 has an approximately rectangular solid shape surrounded by an upper surface 1a, which is a surface on the upper side of a Z-axis direction; a lower surface 1b facing the upper surface, among the side surfaces interposed between the upper surface 1a and the lower surface 1b; side surfaces 1c and 1d perpendicular to a Y-axis direction and facing each other; and side surfaces 1e and 1f perpendicular to an X-axis direction and facing each other.

On an upper part of the side surface 1e in the Z-axis direction (height direction), total terminals 2a and 2b are provided to extract a charge-discharge current of a plurality of battery packs 10 (to be explained later). Furthermore, similarly, a lower part of the side surface 1e in the Z-axis direction (height direction) includes a cooling pipe inlet 3a and a cooling pipe outlet 3b to take out a cooling medium that flows in a cooling passage (not shown) formed on a plate (not shown; to be explained later) to the outside of the assembled battery 1.

FIG. 2 is a perspective view of a frame 20 configuring the assembled battery 1. In FIG. 2, the thin metal plate forming the upper surface 1a, the lower surface 1b, and the

side surfaces 1c, 1d, 1e, and 1f of the assembled battery 1 shown in FIG. 1 and parts accommodated inside the assembled battery 1 are not shown.

As shown in FIG. 2, the assembled battery 1 is formed of a frame 20 serving as its framework, to which the thin metal plates forming the upper surface 1a, the lower surface 1b, and the side surfaces 1c, 1d, 1e, and 1f are fixed. These thin metal plates are fixed by being welded to the frame 20, or by being fastened to the frame 20 by rivets 4. Furthermore, it is preferable that boundaries between the frame 20 and the thin metal plates are sealed without gaps by a resin material. The assembled battery 1 comprises a second chassis that is configured by the frame 20 and the upper surface 1a, the lower surface 1b, and the side surfaces 1c, 1d, 1e, and 1f formed of thin metal plates.

By fixing the thin metal plates to the frame 20 in this manner, moisture from outside can be prevented as much as possible from intruding into the assembled battery 1.

The battery packs 10, etc. to be accommodated inside the assembled battery 1 will be explained with reference to FIG. 3, etc. FIG. 3 depicts the frame 20, the battery packs 10 to be accommodated in the assembled battery 1, a first fixing member 60, a second fixing member 61, a plate 18, and a cooling passage 50 in the assembled battery 1. As shown in FIG. 3, a plurality of battery packs 10 are accommodated in the assembled battery 1 together with the

first fixing member 60, the second fixing member 61, and the plate 18.

The battery pack 10 comprises a first chassis including a rectangular bottom wall part 12, an upper part 13 facing the bottom wall part 12, and four side walls connecting the upper part 13 and the bottom wall part 12. Among the four side walls, a wall perpendicular to the Z-axis and formed on the upper side in the Z-axis direction will be referred to as a "first side wall 31", and a wall facing the first side wall 31 and formed on the lower side in the Z-axis direction will be referred to as a "second side wall 32". The battery pack 10 is, for example, divided into a plurality of partitions in a vertical direction between the upper part 13 side and the bottom wall part 12 side, in which a battery cell 5 (to be explained later) is accommodated in a manner that a surface including a positive electrode terminal 7a and a negative electrode terminal 7b thereof is accommodated on the upper part 13 side of the battery pack 10, and a surface facing the surface including the positive electrode terminal 7a and the negative electrode terminal 7b is accommodated on the bottom wall part 12 side of the battery pack 10. Furthermore, in each partition, a plurality of battery cells are accommodated in a width direction. For example, three stages of partitions exist in the vertical direction. If eight pieces of battery cell are accommodated in the width direction of each partition, a total of 24 pieces of

the battery cell are accommodated in a manner which sees the surfaces including the positive electrode terminal 7a and the negative electrode terminal 7b aligned in one direction. In other words, the surfaces facing the surfaces including the positive electrode terminal 7a and the negative electrode terminal 7b are accommodated in a manner that sees them aligned in one direction. In this manner, the surfaces facing the surfaces including the positive electrode terminal 7a and the negative electrode terminal 7b of the battery cell 5 can be aligned on the bottom wall part 12 side, and each of the battery cells 5 can be cooled evenly and efficiently by attaching the plate 18 (to be explained later) to face the bottom wall part 12.

On the first side wall 31 are formed, for example, four connecting parts 40, by which the first fixing member 60 is connected to the first side wall 31. On the second side wall 32 is formed, for example, four connecting parts 41, by which the second fixing member 61 is connected to the second side wall 32.

Furthermore, the first side wall 31 comprises a main circuit terminal 14 for taking out a charge-discharge current of the battery cell 5. Two main circuit terminals 14 are formed, one of which is a positive electrode and the other of which is a negative electrode.

The first side wall 31 also comprises a communication terminal 15 to be connected to a communication line 90 for communicating with the other battery packs 10. In the

present embodiment, the first side wall 31 comprises two communication terminals 15 to be connected to two communication lines 90.

5 The battery pack 10, the first fixing member 60, the second fixing member 61, and the plate 18 to be accommodated in the assembled battery 1 will be explained in detail with reference to FIG. 4. As shown in FIG. 4, the battery pack 10 is attached in a manner so that its bottom wall part 12 faces the plate 18, and the battery pack 10 and the plate 18 are connected by the first fixing member 60 and the second fixing member 61.

The battery pack 10 accommodates the battery cell 5 as shown in FIG. 5. As shown in FIG. 5, the battery cell 5 is configured into a flat rectangular solid shape that is thin in one direction. The battery cell 5 includes a chassis 6, 15 the positive electrode terminal 7a, and the negative electrode terminal 7b. An electrode body and an electrolytic solution (not shown) are accommodated inside the chassis 6. For example, the electrode body may be formed by a positive electrode sheet and a negative 20 electrode sheet (power generation elements) and, wound in spiral via a separator. Furthermore, for example, the electrode body may be formed by a positive electrode sheet and a negative electrode sheet being laminated via a separator. The positive electrode terminal 7a and the 25 negative electrode terminal 7b are connected respectively to the positive electrode sheet and the negative electrode

sheet of the electrode body.

The chassis 6 is configured by a metal material (for example, aluminum, an aluminum alloy, or stainless steel) or a synthetic resin material. The chassis 6 is configured by a combination of an accommodating body 6a and a lid body 6b. The accommodating body 6a is formed in an approximately rectangular solid box shape with its upper part opened, and accommodates the electrode body and the electrolytic solution therein. The lid body 6b closes the opened upper part of the accommodating body 6a. The chassis 6 may also be referred to as a "container".

The connecting parts 40 and 41 include, for example, a female screw part (not shown) therein, and are formed to be connectable to a bolt having a male screw part (not shown). The connecting parts 40 and 41 may also be configured integrally with the battery pack 10 by, for example, insert molding.

The first fixing member 60 comprises a first battery pack connection hole 60a through which, for example, a bolt penetrates at a portion facing the connecting part 40 formed on the first side wall 31 of the battery pack 10. By passing the bolt through the first battery pack connection hole 60a and fastening it to the connecting part 40, the first fixing member 60 can be fixed to the battery pack 10.

In the same manner as the first fixing member 60, the second fixing member 61 also comprises a second battery pack connection hole 61a through which, for example, a bolt

penetrates at a portion facing the connecting part 41 formed on the second side wall 32. By passing the bolt through the second battery pack connection hole 61a and fastening it to the connecting part 41, the second fixing member 61 can be fixed to the assembled battery 1.

The first fixing member 60 includes an XZ-planar surface and a YZ-planar surface, which are surfaces standing vertically with respect to a surface (an XY-planar surface) facing the battery pack 10. On the XZ-planar surface is formed a plate connection hole 60b to be connected to the plate 18 (explained later in detail), and on the YZ-planar surface is formed a frame connection hole 60c to be connected to the frame 20 of the assembled battery 1. In other words, the first fixing member 60 comprises a first fixing piece that stands vertically along the XZ-planar surface and on which the plate connection hole 60b is formed, and a second fixing piece that stands vertically along the YZ-planar surface and on which the plate connection hole 60c is formed.

Furthermore, a portion of the plate 18 to be connected to the first fixing member 60 includes a female screw part 18c and is formed to be connectable to a bolt. Therefore, by passing the bolt through the plate connection hole 60b formed on the first fixing member 60 and fastening it with the female screw part formed on the plate 18, the first fixing member can be fixed to the plate 18. The female screw part 18c may or may not be completely penetrated. As

will be explained latter, in a case where battery packs 10 are fixed on both sides of the plate 18, it is preferable that the female screw part 18c is penetrated.

5 In the same manner, a portion of the frame 20 to be connected to the first fixing member 60 includes, for example, a female screw part, and is formed to be connectable to a bolt. In this manner, by passing the bolt through the frame connection hole 60c formed on the first fixing member 60 and fastening it with the female screw
10 part (not shown) formed on the frame 20, the first fixing member 60 can be fixed to the frame 20.

As shown in FIG. 6, the second fixing member 61 includes an XZ-planar surface and a YZ-planar surface, which are surfaces standing vertically with respect to a
15 surface (an XY-planar surface) facing the battery pack 10. On the XZ-planar surface is formed a plate connection hole 61b to be connected to the plate 18 (explained later in detail), and on the YZ-planar surface is formed a frame connection hole 61c to be connected to the frame 20 of the
20 assembled battery 1. In other words, the second fixing member 61 comprises a first fixing piece that stands vertically along the XZ-planar surface and on which the plate connection hole 60b is formed, and a second fixing piece that stands vertically along the YZ-planar surface
25 and on which the plate connection hole 60c is formed.

Furthermore, a portion of the plate 18 to be connected to the second fixing member 61 includes a female screw part

18c and is formed to be connectable to a bolt. Therefore,
by passing the bolt through the plate connection hole 60b
formed on the second fixing member 61 and fastening it with
the female screw part 18c formed on the plate 18, the
5 second fixing member 61 can be fixed to the plate 18.

In the same manner, a portion of the frame 20 to be
connected to the second fixing member 61 includes, for
example, a female screw part, and is formed to be
connectable to a bolt. Therefore, by passing the bolt
10 through the frame connection hole 60c formed on the second
fixing member 61 and fastening it with the female screw
part (not shown) formed on the frame 20, the second fixing
member 61 can be fixed to the frame 20.

In this manner, each of the first fixing member 60 and
15 the second fixing member 61 are connected and fixed to the
plate 18 and the frame 20 via a bolt, etc.

In FIG. 4, one battery pack 10 is fixed to one plate
18, however, the configuration is not limited thereto.
Therefore, as shown in FIG. 6, two battery packs 10 may
20 also be fixed to one plate 18.

The plate 18 will be explained with reference to
FIG. 7 and FIG. 8. FIG. 7 is a perspective view of the
plate 18, and FIG. 8 is a perspective view of the plate 18
when observed from the backside of FIG. 7.

25 The plate 18 can fix the battery pack 10, and has a
function capable of cooling the battery pack 10. The
battery pack 10 is fixed in a manner so that the bottom

wall part 12 of the battery pack 10 faces the plate 18. In the present embodiment, due to the structures of the first fixing member 60 and the second fixing member 61, the bottom wall part 12 is fixed to the plate 18. As a means for fixing the battery pack 10 on the plate 18, as explained earlier, the first fixing member 60 and the second fixing member 61 are used. The plate 18 includes a plurality of female screw parts 18c for fixing the first fixing member 60 and the second fixing member 61.

In the plate 18, a groove 50a is formed on a first surface 18a, which faces the battery pack 10, or a second surface 18b, which is on the opposite side of the first surface 18a. A tubular cooling passage 50 is embedded in the groove 50a. The groove 50a and the cooling passage 50 are formed of a combination of straight portions and curved portions starting from one end and returning to another end portion of the plate 18 to cover a wide area of the plate 18. That is, a cooling medium inlet 50-1, which is a starting end and a cooling medium outlet 50-2, which is a finishing end of the groove 50a and the cooling passage 50, are formed at two locations on one end of the plate 18. In the present embodiment, the cooling medium inlet 50-1 and the cooling medium outlet 50-2 are positioned at a lower part of a plate height direction (Z-axis direction).

The cooling passage 50 is formed by pressing a hollow annular pipe 50b into the groove 50a. The pipe 50b is preferably made of metal, such as copper. The plate 18 can

be cooled by flowing a cooling medium in this hollow annular pipe 50b.

FIG. 9 is a partial cross-sectional view of the cooling passage 50 and the groove 50a according to the present embodiment. The cooling passage 50 is formed by pressing the hollow annular pipe 50b into the groove 50a. The pipe 50b is preferably made of metal, such as copper. FIG. 9 shows a state in which the pipe 50b is pressed into the groove 50a and deformed. The pipe 50b has a circular cross-section prior to deformation.

FIG. 10 is a cross-sectional view showing only the groove 50a according to the present embodiment. As shown in FIG. 10, in the groove 50a according to the present embodiment, when "A" indicates the width of the opening of the groove 50a, a width "B" that is larger than "A" is formed near the bottom of the groove 50a from the opening of the groove 50a. In other words, in the case where "C" indicates a distance from the opening of the groove 50a to the bottom of the groove 50a, the width "B" that is larger than the width "A" is formed at $1/2C$ to C from the opening.

Furthermore, before the hollow annular pipe 50b is pressed into it to configure the cooling passage, the groove 50a has a bottom curve whose curvature radius is larger than that of an outermost portion of the pipe 50b. The bottom curve of the groove 50a has a curvature radius that is larger than half the width of the opening of the groove 50a.

When the pipe 50b is pressed into such a groove 50a, the circular pipe 50b comes in contact with the bottom part of the groove 50a. By being pressed in further, a portion of the pipe 50b that has come in contact with the groove 50a becomes deformed along the shape of the groove 50a in the manner shown in FIG. 9.

In a plurality of plates 18 provided on the assembled battery 1, the cooling passages 50 provided on the plates 18 are connected to each other by a cooling pipe 70 (to be explained later). Therefore, at the cooling medium inlet 50-1 and the cooling medium outlet 50-2 of the plate 18, a cooling pipe connecting part 51 is formed to be connected to the cooling pipe 70. In some cases, this cooling pipe connecting part 51 may be formed to extend along both directions of the X-axis direction from the plate 18 in the manner shown in FIG. 4, or formed to extend on one side along the X-axis direction as in the plate 18 shown in FIG. 7 and FIG. 8.

The positional relation between the plate 18 and the cooling pipe 70 that configure the assembled battery 1 will now be explained with reference to FIG. 11. FIG. 11 is a perspective view of a state in which a plurality of plates 18 and a plurality of cooling pipes 70 are connected.

In FIG. 11, the plates will be referred to as a "first plate 18-1", a "second plate 18-2", a "third plate 18-3", and a "fourth plate 18-4" from the plate 18 positioned on the very left of the drawing.

On both surfaces of the first plate 18-1, two battery packs 10 (not shown) are fixed. Furthermore, in the drawing, one battery pack 10 (not shown) is fixed on the surface on the left side of the second plate 18-2. On both surfaces of the third plate 18-3, two battery packs 10 (not shown) are fixed. On both surfaces of the fourth plate 18-4, two battery packs 10 (not shown) are fixed. Therefore, a total of seven battery packs are fixed from the first plate 18-1 to the fourth plate 18-4.

The cooling pipe 70 is connected to the cooling pipe inlet 3a and the cooling pipe outlet 3b of the assembled battery 1, and further connected to the cooling passage 50 of each plate 18.

In the present embodiment, the cooling pipe inlet 3a included in the frame 20 of the assembled battery 1 is first connected to the cooling medium inlet 50-1 of the third plate 18-3 via the cooling pipe 70. Furthermore, the cooling medium outlet 50-2 of the third plate is connected to the cooling medium inlet 50-1 of the fourth plate 18-4 via the cooling pipe 70. Subsequently, the cooling medium outlet 50-2 of the fourth plate 18-4 is connected to the cooling medium inlet 50-1 of the first plate 18-1 via the cooling pipe 70. Furthermore, the cooling medium outlet 50-2 of the first plate 18-1 is connected to the cooling medium inlet 50-1 of the second plate 18-2 via the cooling pipe 70. The cooling medium outlet 50-2 of the second plate 18-2 is connected to the cooling pipe outlet 3b included in

the frame 20 via the cooling pipe 70.

By arranging the piping in the above manner, the cooling medium can flow from outside the assembled battery 1 into the cooling pipe inlet 3a, and can eventually be taken outside the assembled battery 1 from the cooling pipe outlet 3b via the cooling pipe 70 or the cooling passage 50 included in each plate 18. In this manner, each plate 18 is cooled by the cooling medium, which may cool the battery pack 10 fixed to each plate 18 or the battery cell 5 accommodated therein, thereby suppressing degradation in battery performance caused by heat generation.

Furthermore, in the present embodiment, the cooling pipe inlet 3a is connected directly to the third plate 18-3, which is a plate closest to the center portion of the assembled battery 1 in the X-axis direction. Therefore, the coolest cooling medium may flow to the cooling passage 50 of the third plate 18-3. Since the third plate 18-3 is a plate closest to the center portion of the assembled battery 1 in the X-axis direction, it is positioned at a point where heat is most difficult to be dissipated. By flowing the coolest cooling medium to such a plate, the battery pack 10 may be cooled efficiently.

The positional relation between a main circuit line 80 and the communication line 90 provided on the upper side of the assembled battery 1 in the Z-axis direction will now be explained with reference to FIG. 12. FIG. 12 shows a wiring of the main circuit line 80 and the communication line 90

in the case where seven battery packs 10 are accommodated in the assembled battery 1.

As shown in FIG. 12, the assembled battery 1 according to the present embodiment has the main circuit line 80 connected to the main circuit terminal 14 of a plurality of battery packs 10 accommodated therein, and the communication line 90 connected to the communication terminal 15 of the battery pack 10. The end part of the main circuit line 80 includes a main circuit connector 81, which is connected to each main circuit terminal 14. Furthermore, the main circuit line 80 electrically connects each of the battery packs 10; however, the end parts of such electrically connected circuits are connected to the total terminals 2a and 2b. Since this connecting method differs depending on whether the battery pack is connected in series or in parallel, etc., the connecting method shown in FIG. 12 is an example.

As described in the embodiment, the assembled battery 1 is capable of accommodating a plurality of battery packs and efficiently cooling them.

Furthermore, since the battery pack can be fixed to the plate and the frame via the first fixing member and the second fixing member, the assembling efficiency can be improved.

Furthermore, since the cooling pipe, the cooling pipe inlet, the cooling pipe outlet, the cooling medium inlet, and the cooling medium outlet, through which the cooling

medium flows, are provided at a lower part of the assembled battery in the height direction, and the main circuit line, the main circuit terminal, and the total terminal, through which electricity flows, are provided at an upper part of the assembled battery in the height direction, the sections may be provided separately. Therefore, the possibility of the cooling medium causing a short circuit, etc., due to, water leakage, the water being an example of the cooling medium, or coming into contact with the main circuit line, can be reduced.

<Modification>

A modification will now be explained with reference to FIG. 13. The configuration of the present modification is basically the same as that of the embodiment, with partial differences. Here, explanations that are the same as those made in the embodiment will be omitted as appropriate.

In the above-described embodiment, the assembled battery 1 is explained as including seven battery packs 10; however, in the present modification, an assembled battery including six battery packs 10 will be explained.

FIG. 13 is a perspective view of a state in which a plurality of plates 19 and a plurality of cooling pipes 100 configuring the assembled battery according to the present modification are connected.

In FIG. 13, the plates will be referred to as a "first plate 19-1", a "second plate 19-2", and a "third plate 19-3" from the plate 19 positioned on the extreme left of the

drawing.

On both surfaces of the first plate 19-1, two battery packs 10 (not shown) are fixed. Also, on both surfaces of the second plate 19-2, two battery packs 10 (not shown) are fixed. Also, on both surfaces of the third plate 19-3, two battery packs 10 (not shown) are fixed.

A cooling pipe 70 is connected to a cooling pipe inlet 3a and a cooling pipe outlet 3b of an assembled battery 1, and further connected to a cooling passage 50 of each plate 19.

In the present modification, the cooling pipe inlet 3a included in a frame 20 of the assembled battery 1 is first connected to a cooling medium inlet 50-1 of the second plate 19-2 via the cooling pipe 70. Furthermore, a cooling medium outlet 50-2 of the second plate is connected to a cooling medium inlet 50-1 of the first plate 19-1 via the cooling pipe 70. Subsequently, a cooling medium outlet 50-2 of the first plate 19-1 is connected to a cooling medium inlet 50-1 of the third plate 19-3 via the cooling pipe 70. A cooling medium outlet 50-2 of the third plate 19-3 is connected to the cooling pipe outlet 3b included in the frame 20 via the cooling pipe 70.

By arranging the piping in the above manner, the cooling medium can flow from outside the assembled battery 1 into the cooling pipe inlet 3a, and can finally be taken outside the assembled battery 1 from the cooling pipe outlet 3b via the cooling pipe 70 or the cooling passage 50

included in each plate 19. In this manner, each plate 19 is cooled by the cooling medium, which may cool the battery pack 10 fixed to each plate 19 or the battery cell 5 accommodated therein, thereby suppressing degradation of battery performance caused by heat generation.

Furthermore, in the present modification, the cooling pipe inlet 3a is connected directly to the second plate 19-2, which is a plate closest to the center portion of the assembled battery 1 in the X-axis direction. Therefore, the coolest cooling medium may flow to the cooling passage 50 of the second plate 19-2. Since the second plate 19-2 is a plate positioned closest to the center portion of the assembled battery 1 in the X-axis direction, it is positioned at the point where heat generation can most easily occur. By flowing the coolest cooling medium to such plate, the battery pack 10 may be cooled efficiently.

As described in the embodiment and the modification, the assembled battery 1 is capable of accommodating a plurality of battery packs and efficiently cooling them.

Furthermore, since the battery pack can be fixed to the plate and the frame via the first fixing member and the second fixing member, the efficiency of assembly can be improved.

Furthermore, since the cooling pipe, the cooling pipe inlet, the cooling pipe outlet, the cooling medium inlet, and the cooling medium outlet, through which the cooling medium flows, are provided at a lower part of the assembled

battery in the height direction, and the main circuit line, the main circuit terminal, and the total terminal, through which electricity flows, are provided at an upper part of the assembled battery in the height direction, the sections
5 may be provided separately. Therefore, the possibility of the cooling medium causing a short circuit, etc., due to, water leakage, the water being an example of the cooling medium, or coming into contact with the main circuit line, can be reduced.

10 While some embodiments of the invention have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. These novel embodiments can be implemented in various other forms, and various omissions, replacements,
15 and changes can be made without departing from the spirit of the invention. These embodiments and their modifications are included in the scope and gist of the invention as well as in the inventions described in the claims and their equivalents.

20 REFERENCE SIGNS LIST

1... Assembled battery, 2a... Total terminal, 2b... Total terminal, 3a... Cooling pipe inlet, 3b... cooling pipe outlet, 5... Battery cell, 6... Chassis, 7a... Positive electrode terminal, 7b... Negative electrode terminal, 10...
25 Battery pack, 18... Plate, 19... Plate, 20... Frame, 40... Connecting part, 41... Connecting part, 50... Cooling passage, 51... Cooling pipe connecting part, 60... First

fixing member, 61... Second fixing member, 70... Cooling
pipe, 80... Main circuit line, 81... Main circuit connector,
90... Communication line, 100... Cooling pipe

CLAIMS

1. An assembled battery comprising:

a plurality of first chassis, each having an approximately rectangular solid shape, accommodating a battery cell, and including a main circuit terminal for

taking out a charge-discharge current of the battery cell;
a main circuit line connecting the main circuit terminals;

a plurality of plates facing a predetermined surface of the first chassis, and each provided with a cooling passage having a cooling medium inlet and a cooling medium outlet;

a cooling pipe connecting the cooling passages; and

a second chassis accommodating the plurality of first chassis in a depth direction perpendicular to a surface of the plate, and including a total terminal for taking out a charge-discharge current of the battery cell outside, and a cooling pipe inlet and a cooling pipe outlet for taking a cooling medium outside, wherein

the main circuit terminal, the main circuit line, and the total terminal are provided at an upper part of the second chassis in a height direction, and the cooling medium inlet, the cooling medium outlet, the cooling pipe, the cooling pipe inlet, and the cooling pipe outlet are provided at a lower part of the second chassis in a height direction.

2. The assembled battery according to claim 1,

wherein the plate either faces a predetermined surface of the first chassis, or a predetermined surface and a surface facing the predetermined surface.

5 3. The assembled battery according to claim 1 or 2, wherein the cooling pipe inlet is connected directly to the cooling medium inlet provided on a plate close to a center portion among the plurality of plates in the depth direction.