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POWER STORAGE DEVICE AND ELECTRICALLY POWERED VEHICLE

Abstract

A power storage device includes: a plurality of battery cells each having a positive electrode terminal and a negative electrode terminal, each of the plurality of battery cells being arranged side by side in a first direction; and a first cooler and a second cooler each being in contact with each of the battery cells directly or with a thermally conductive member interposed therebetween. The first cooler is located above the second cooler, and the second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals. The first cooler is lower in thermal conductivity than the second cooler.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS
[0001] This nonprovisional application is based on Japanese Patent Application No. 2024-019308 filed on Feb. 13, 2024 with the Japan Patent Office, the entire contents of which are hereby incorporated by reference.
BACKGROUND
Field
[0002] The present disclosure relates to a power storage device and an electrically powered vehicle.
Description of the Background Art
[0003] Conventionally, a power storage device has been mounted in an electrically powered vehicle. For example, Japanese Patent Laying-Open No. 2023-165300 discloses, as an example of a power storage device, a battery pack disposed below a floor panel of a vehicle. The battery pack disclosed in Japanese Patent Laying-Open No. 2023-165300 includes a plurality of battery modules and a battery case that accommodates the plurality of battery modules. The battery case has a lower plate constituting a bottom surface of the battery case. The lower plate is provided with a cooling path through which a coolant flows.
SUMMARY
[0004] When a battery cell is cooled from a plurality of surfaces, the area of the surface of a cooler that is exposed to the outside is larger than that in the case where the battery cell is cooled from one surface. This results in a larger amount of water droplets generated by dew condensation in the cooler. Thus, there is a demand to suppress a short circuit in the power storage device.
[0005] The present disclosure provides: a power storage device capable of, even in a case of using a plurality of coolers, suppressing a short circuit resulting from water droplets generated by dew condensation in each of the coolers; and an electrically powered vehicle including the power storage device.
[0006] According to an aspect of the present disclosure, a power storage device includes: a plurality of battery cells each having a positive electrode terminal and a negative electrode terminal, the plurality of battery cells being arranged side by side in a first direction; and a first cooler and a second cooler, each of the first cooler and the second cooler being in contact with each of the battery cells directly or with a thermally conductive member interposed therebetween. The first cooler is located above the second cooler, and the second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals. The first cooler is lower in thermal conductivity than the second cooler.
[0007] According to the above-described configuration, the first cooler located above the second cooler is lower in thermal conductivity than the second cooler. Dew condensation is less likely to occur in the case of lower thermal conductivity than in the case of higher thermal conductivity. Thus, dew condensation can be caused more preferentially in the second cooler than in the first cooler. Further, the second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals. Thus, water droplets resulting from dew condensation can be suppressed from adhering to the positive electrode terminals and the negative electrode terminals. Therefore, even when a plurality of coolers are used, a short circuit in the power storage device can be suppressed from occurring due to water droplets generated by dew condensation in the coolers.
[0008] Preferably, each of the battery cells has a first surface serving as a bottom surface. The second cooler is located below the first surface and is in contact with the first surface directly or

with the thermally conductive member interposed therebetween.
[0009] According to the above-described configuration, the second cooler is located below each battery cell. Thus, even when water droplets generated in the second cooler due to dew condensation fall down, the water droplets do not hit each battery cell. Therefore, a short circuit between the terminals can be prevented from occurring due to water droplets generated in the second cooler.
[0010] Preferably, the first cooler is in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween.
[0011] According to the above-described configuration, even when a high current is input into or output from each battery cell, each of the positive and negative electrode terminals that are more likely to generate heat in the battery cells can be cooled, and also, water droplets resulting from dew condensation can be suppressed from adhering to each of the positive and negative electrode terminals.
[0012] Preferably, each of the battery cells further has a second surface serving as a top surface. The positive electrode terminal and the negative electrode terminal protrude upward from the second surface.
[0013] According to the above-described configuration, the first cooler can be installed on the side of the top surface of each battery cell.
[0014] Preferably, the first direction is perpendicular to a vertical direction. Each of the battery cells has a first side surface and a second side surface, each of the first side surface and the second side surface having a normal direction along a second direction perpendicular to the first direction and the vertical direction. The positive electrode terminal protrudes from the first side surface in the second direction. The negative electrode terminal protrudes from the second side surface in the second direction.
[0015] According to the above-described configuration, the distance between the positive electrode terminal and the negative electrode terminal in each battery cell can be longer than that in the case where the positive electrode terminal and the negative electrode terminal protrude from the top surface of each battery cell. Therefore, a short circuit between each positive electrode terminal and each negative electrode terminal included in the same battery cell can be suppressed from occurring due to the water droplets resulting from dew condensation.
[0016] Preferably, each of the first cooler and the second cooler serves as a cooling pipe extending in the first direction and having a flow path for refrigerant. Each of the first cooler and the second cooler has: an inner surface in contact with the refrigerant; and an outer surface opposite to the inner surface. The outer surface of the first cooler has: a first contact region in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween; and a first non-contact region excluding the first contact region from the outer surface. The outer surface of the second cooler has: a second contact region in contact with each of the battery cells directly or with the thermally conductive member interposed therebetween; and a second non-contact region excluding the second contact region from the outer surface. The first non-contact region is smaller in area than the second non-contact region.
[0017] According to the above-described configuration, a portion of the first cooler's outer surface that is in contact with the gas inside the power storage device is smaller in area than a portion of the second cooler's outer surface that is in contact with the gas inside the power storage device. Therefore, as compared with the case where the above-mentioned relation regarding the areas is not established, dew condensation can be caused more preferentially on the outer surface of the second cooler while further suppressing dew condensation on the outer surface of the first cooler.
[0018] Preferably, the first cooler has a first portion and a second portion that are contiguous to each other in an outer peripheral direction of the first cooler, the first portion and the second

portion each extending in the first direction. The first portion and the second portion form the flow path. At least one of the first portion and the second portion is provided with a groove portion forming the flow path. At least a part of the first portion is in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween. The second portion is more distant from each of the positive electrode terminals and each of the negative electrode terminals than the first portion is. The first portion is higher in thermal conductivity than the second portion and lower in thermal conductivity than the second cooler.
[0019] According to the above-described configuration, the first portion in contact with each positive electrode terminal and each negative electrode terminal with the thermally conductive member interposed therebetween is higher in thermal conductivity than the second portion not in contact with the thermally conductive member. Therefore, as compared with the case where the thermal conductivity of the second portion is the same as or higher than the thermal conductivity of the first portion, each of the positive and negative electrode terminals can be efficiently cooled. Further, the second cooler makes it possible to suppress occurrence of dew condensation in the second portion of the first cooler.
[0020] Preferably, the first cooler is connected to a first pipe on an upstream side and connected to a second pipe on a downstream side. The first pipe is lower in thermal conductivity than the second pipe.
[0021] According to the above-described configuration, the amount of water droplets generated by dew condensation can be smaller in the first pipe on the upstream side of the first cooler than in the second pipe on the downstream side of the first cooler.
[0022] Preferably, the second cooler is connected to a third pipe on the upstream side and connected to a fourth pipe on the downstream side. The third pipe is connected to the first pipe. The fourth pipe is connected to the second pipe. The third pipe is lower in thermal conductivity than the fourth pipe.
[0023] According to the above-described configuration, the amount of water droplets generated by dew condensation can be smaller in the third pipe on the upstream side of the second cooler than in the fourth pipe on the downstream side of the second cooler. Further, refrigerant can be delivered from one path to two paths (the first pipe and the third pipe). Further, refrigerants can be merged from two paths (the second pipe and the fourth pipe) to flow into one path.
[0024] According to another aspect of the present disclosure, an electrically powered vehicle includes: a plurality of battery cells each having a positive electrode terminal and a negative electrode terminal, the plurality of battery cells being arranged side by side in a predetermined direction; and a first cooler and a second cooler, each of the first cooler and the second cooler being in contact with each of the battery cells directly or with a thermally conductive member interposed therebetween. The first cooler is located above the second cooler. The second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals. The first cooler is lower in thermal conductivity than the second cooler.
[0025] According to the above-described configuration, dew condensation can be caused more preferentially in the second cooler than in the first cooler. Therefore, even when a plurality of coolers are used, a short circuit in the power storage device can be suppressed from occurring due to water droplets generated by dew condensation in the coolers.
[0026] The foregoing and other objects, features, aspects, and advantages of the present disclosure will become apparent from the following detailed description of the present disclosure when taken in conjunction with the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIG. **1** is a side view of an electrically powered vehicle.

[0028] FIG. **2** is a partial cross-sectional view of a battery pack.

[0029] FIG. **3** is a top view of the battery pack.

[0030] FIG. **4** is a bottom view of the battery pack.

[0031] FIG. **5** is a diagram for illustrating a cooler.

[0032] FIG. **6** is a cross-sectional view taken along an arrow line VI-VI in FIG. **2**.

[0033] FIG. **7** is a diagram showing an upper cooler in FIG. **6** and the vicinity thereof.

[0034] FIG. **8** is a diagram showing a lower cooler in FIG. **6** and the vicinity thereof.

[0035] FIG. **9** is a diagram for illustrating a modification of the cooler attached above a battery module.

[0036] FIG. **10** is a diagram for illustrating another modification of the cooler attached above the battery module.

[0037] FIG. **11** is a diagram illustrating a battery pack according to another embodiment.

[0038] FIG. **12** is a diagram for illustrating a modification of the battery pack.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. In the embodiments described below, the same or corresponding portions are denoted by the same reference characters in the drawings, and the description thereof will not be repeated.

First Embodiment

[0040] FIG. **1** is a side view of an electrically powered vehicle. As shown in FIG. **1**, an electrically powered vehicle **1** includes a vehicle body **2**, a front wheel **3**, a rear wheel **4**, and a battery pack **10**. Battery pack **10** is attached to a bottom portion of vehicle body **2**. Electrically powered vehicle **1** is, for example, a hybrid electric vehicle that can travel with motive power from at least one of a motor and an engine, or an electrically powered vehicle that travels with drive force obtained from electric energy. Battery pack **10** and battery packs **10**A and **10**B (described later) each are one example of the “power storage device” of the present disclosure.

[0041] The following describes the configuration of battery pack **10** based on the state in which battery pack **10** is attached to electrically powered vehicle **1**. In other words, the direction and orientation of battery pack **10**, such as upper, lower, left, right, and up and down, are defined with respect to the state in which battery pack **10** is attached to electrically powered vehicle **1** (this state will be hereinafter also referred to as an “attached state”).

[0042] In the following description, the vertical direction is referred to as a “direction D**3**”. The vertically upward direction is defined as an “orientation of D**31**”. The vertically downward direction is referred to as an “orientation of D**32**”.

[0043] FIG. **2** is a partial cross-sectional view of battery pack **10**. FIG. **3** is a top view of battery pack **10**. FIG. **4** is a bottom view of battery pack **10**. In FIGS. **3** and **4**, an exterior case **11** described later is not shown for convenience of illustration.

[0044] As shown in FIGS. **2** to **4**, pipes **5**A, **5**B, **6**A, **6**B, **7**, and **8** are connected to battery pack **10**. Each of pipes **5**A, **5**B, **6**A, **6**B, **7**, and **8** is an external pipe connected to battery pack **10**. Aligned arrows shown in each of FIGS. **2** to **4** indicate the direction of the flow of refrigerant **900** (FIG. **6**), which will be described later.

[0045] Pipes **5**A, **5**B, and **7** are connected to each other on the upstream side of the flow of refrigerant **900**. Pipes **6**A, **6**B, and **8** are connected to each other on the downstream side of the flow of refrigerant **900**. Thus, refrigerant **900** having flowed from the upstream side is branched to flow through pipes **5**A, **5**B, and **7** on the upstream side of battery pack **10**, and then, flows into battery pack **10**. Then, refrigerants **900** flow through pipes **6**A, **6**B, and **8**. After that, branched refrigerants **900** flowing through the pipes merge with each other on the downstream side of battery pack **10**.

[0046] Pipes **5**A and **5**B are lower in thermal conductivity than pipes **6**A and **6**B. Pipe **7** is lower in thermal conductivity than pipe **8**. In the present example, pipes **5**A and **5**B are made of the same material. Pipes **6**A and **6**B are made of the same material.

[0047] Battery pack **10** includes exterior case **11**, a battery module **12**, coolers **13**A, **13**B, and **14**, and connection members **18** and **19**. Battery module **12** and coolers **13**A, **13**B, and **14** are accommodated in exterior case **11**. Battery pack **10** may include a plurality of battery modules **12**.

[0048] Battery module **12** includes a plurality of battery cells **100** and a plurality of bus bars **120**. The plurality of battery cells **100** are arranged side by side in a direction D**1**. Battery cells **100** are arranged in a row. Direction D**1** is orthogonal to direction D**3**. Direction D**1** corresponds, for example, to a front-rear direction of electrically powered vehicle **1**. Alternatively, direction D**1** corresponds to a vehicle width direction of electrically powered vehicle **1**. Direction D**1** is not particularly limited as long as it is orthogonal to direction D**3**.

[0049] As shown in FIG. **3**, each battery cell **100** has a positive electrode terminal **101** and a negative electrode terminal **102**. Positive electrode terminal **101** and negative electrode terminal **102** of battery cell **100** are distant from each other in a direction D**2** orthogonal to directions D**1** and D**3**. Battery cells **100** are arranged such that positive electrode terminals **101** alternate with negative electrode terminals **102** in direction D**1**.

[0050] In this way, battery pack **10** has two electrode terminal rows each extending in direction D**1** and spaced apart from each other in direction D**2**. Each electrode terminal row includes a plurality of positive electrode terminals **101** and a plurality of negative electrode terminals **102**. In each of the electrode terminal rows, positive electrode terminals **101** alternate with negative electrode terminals **102**. Coolers **13**A and **13**B are in contact with different electrode terminal rows with bus bars **120** and an adhesive layer **16** interposed therebetween.

[0051] Positive electrode terminal **101** of battery cell **100** is connected by bus bar **120** to negative electrode terminal **102** of adjacent battery cell **100** in an orientation of D**11** along direction D**1**. Negative electrode terminal **102** of battery cell **100** is connected by bus bar **120** to positive electrode terminal **101** of adjacent battery cell **100** in an orientation of D**12** along direction D**1**. Bus bar **120** is fixed to positive electrode terminal **101** and negative electrode terminal **102**.

[0052] Note that the “orientation of D**11**” is directed in the same direction as that indicated by the arrows described above. In other words, the orientation of D**11** corresponds to the direction in which refrigerant **900** (FIG. **6**), which will be described later, flows through battery pack **10**. The “orientation of D**12**” is opposite to the orientation of D**11**.

[0053] As shown in FIG. **2**, cooler **13**A is located above cooler **14**. Cooler **13**A is attached at a position higher than the position of cooler **14**. As shown in FIGS. **2** and **3**, cooler **13**A extends in direction D**1**. Cooler **13**A is connected to pipe **5**A via connection member **18** on the upstream side of the flow of refrigerant **900**. Cooler **13**A is connected to pipe **6**A via connection member **18** on the downstream side of the flow of refrigerant **900**.

[0054] Similarly to cooler **13**A, cooler **13**B is located above cooler **14**. Cooler **13**B is attached at a position higher than the position of cooler **14**. As shown in FIG. **3**, similarly to cooler **13**A, cooler **13**B extends in direction D**1**. Cooler **13**B is disposed in parallel to cooler **13**A at a position away from cooler **13**A in direction D**2**. Cooler **13**B is connected to pipe **5**B via connection member **18** on the upstream side of the flow of refrigerant **900**. Cooler **13**B is connected to pipe **6**B via connection member **18** on the downstream side of the flow of refrigerant **900**.

[0055] As shown in FIGS. **2** and **4**, similarly to coolers **13**A and **13**B, cooler **14** extends in direction D**1**. Cooler **14** is disposed in parallel to coolers **13**A and **13**B at a position away from coolers **13**A and **13**B in direction D**3**. Cooler **14** is connected to pipe **7** via connection member **19** on the upstream side of the flow of refrigerant **900**. Cooler **14** is connected to pipe **8** via connection member **19** on the downstream side of the flow of refrigerant **900**.

[0056] As shown in FIGS. **2** and **3**, coolers **13**A and **13**B are attached to battery module **12** with an adhesive. Cooler **13**A is attached on the top of battery module **12** with an adhesive. Specifically, as shown in FIG. **3**, coolers **13**A and **13**B are attached with an adhesive to the plurality of bus bars **120** arranged in a line in direction D**1**. More specifically, as shown in FIG. **2**, coolers **13**A and **13**B are fixed to bus bars **120** with an adhesive layer **16** made of an adhesive. Adhesive layer **16** has insulation properties and thermal conductivity. In the present example, coolers **13**A and **13**B are fixed to a top surface of each bus bar **120**.

[0057] When each bus bar **120** is attached to each positive electrode terminal **101** and each negative electrode terminal **102** such that the tip ends of each positive electrode terminal **101** and each negative electrode terminal **102** are exposed, coolers **13**A and **13**B can be brought into contact with these positive electrode terminals **101** and negative electrode terminals **102** alternately arranged in direction D**1** without bus bars **120** interposed therebetween. In other words, each of coolers **13**A and **13**B can be brought into contact with positive electrode terminals **101** and negative electrode terminals **102** with only the adhesive layer made of an adhesive interposed therebetween. Further, each of coolers **13**A and **13**B may be in direct contact with positive electrode terminals **101** and negative electrode terminals **102** alternately arranged in direction D**1** without bus bars **120** and adhesive layer **16** interposed therebetween.

[0058] As shown in FIGS. **2** and **3**, cooler **14** is attached to battery module **12** with an adhesive. Cooler **14** is attached on the bottom of battery module **12** with an adhesive. Specifically, as shown in FIG. **4**, cooler **14** is attached with an adhesive to the plurality of battery cells **100** arranged in a row in direction D**1**. More specifically, as shown in FIG. **2**, cooler **14** is fixed to each battery cell **100** by an adhesive layer **17** made of an adhesive. Adhesive layer **17** has thermal conductivity. In the present example, the adhesive forming adhesive layer **17** is the same as the adhesive forming adhesive layer **16**. However, the present disclosure is not limited thereto.

[0059] FIG. **5** is a diagram for illustrating coolers **13**A, **13**B, and **14**. As shown in FIG. **5**, coolers **13**A, **13**B, and **14** are tubular in shape. In other words, coolers **13**A, **13**B, and **14** each are a cooling pipe through which refrigerant **900** flows. In the present example, coolers **13**A, **13**B, and **14** each are a polygonal pipe. Specifically, coolers **13**A, **13**B, and **14** each are a rectangular pipe having a rectangular cross section. Note that coolers **13**A and **13**B each may be a square pipe having a square cross section.

[0060] According to such a configuration, a flow path **390**A through which refrigerant **900** flows is formed inside cooler **13**A. A flow path **390**B through which refrigerant **900** flows is formed inside cooler **13**B. A flow path **490** through which refrigerant **900** flows is formed inside cooler **14**. In the present example, coolers **13**A and **13**B have the same configuration. Coolers **13**A and **13**B are formed in the same shape and made of the same material. However, coolers **13**A and **13**B do not necessarily have to have the same shape but may have different shapes.

[0061] Each of coolers **13**A and **13**B has an outer surface **310** and an inner surface **320**. Inner surface **320** forms each of flow paths **390**A and **390**B. Refrigerant **900** comes into contact with inner surface **320**.

[0062] Outer surface **310** includes a top surface **311**, a side surface **312**, a bottom surface **313**, and a side surface **314**. Top surface **311**, side surface **312**, bottom surface **313**, and side surface **314** are connected in this order. The direction of the normal to top surface **311** and the direction of the normal to bottom surface **313** correspond to direction D**3**. The direction of the normal to side surface **312** and the direction of the normal to side surface **314** correspond to direction D**2**.

[0063] Adhesive layer **16** (see FIG. **2**) exists between bottom surface **313** and the plurality of bus bars **120**. Bottom surface **313** is bonded to the upper surfaces of the plurality of bus bars **120** with the above-mentioned adhesive.

[0064] Cooler **14** has an inner surface **420** and an outer surface **410**. Inner surface **420** forms flow path **490**. Refrigerant **900** comes into contact with inner surface **420**. Outer surface **410** includes a top surface **411**, a side surface **412**, a bottom surface **413**, and a side surface **414**. Top surface **411**, side surface **412**, bottom surface **413**, and side surface **414** are connected in this order. The direction of the normal to top surface **411** and the direction of the normal to bottom surface **413** correspond to direction D**3**. The direction of the normal to side surface **412** and the direction of the normal to side surface **414** correspond to direction D**2**.

[0065] Adhesive layer **17** (see FIG. **2**) exists between bottom surface **413** and a bottom portion of each battery cell **100**. Bottom surface **413** is bonded to a bottom surface of each battery cell **100** with the above-mentioned adhesive.

[0066] FIG. **6** is a cross-sectional view taken along an arrow line VI-VI in FIG. **2**. Specifically, FIG. **6** is a cross-sectional view including: a central axis of positive electrode terminal **101** that extends in direction D**3**; and a central axis of negative electrode terminal **102** that extends in direction D**3**. As shown in FIG. **6**, battery cell **100** includes an exterior case **103**, an electrode assembly **104**, a positive electrode tab **105**, and a negative electrode tab **106**, in addition to positive electrode terminal **101** and negative electrode terminal **102** as described above.

[0067] Exterior case **103** accommodates electrode assembly **104**, positive electrode tab **105**, and negative electrode tab **106**. In the present example, an electrolyte solution is sealed inside exterior case **103**. Electrode assembly **104** is, for example, a stacked electrode assembly in which positive electrodes and negative electrodes are alternately stacked with separators interposed therebetween.

[0068] Positive electrode tab **105** is connected to a positive electrode of electrode assembly **104** and positive electrode terminal **101**. Negative electrode tab **106** is connected to a negative electrode of electrode assembly **104** and negative electrode terminal **102**. When electrode assembly **104** is a stacked electrode assembly, each of positive electrode tab **105** and negative electrode tab **106** is constituted of a plurality of current collector foils.

[0069] Exterior case **103** includes a top surface **1031**, a side surface **1032**, a bottom surface **1033**, and a side surface **1034**. Top surface **1031**, side surface **1032**, bottom surface **1033**, and side surface **1034** are connected in this order. The direction of the normal to top surface **1031** and the direction of the normal to bottom surface **1033** correspond to direction D**3**. The direction of the normal to side surface **1032** and the direction of the normal to side surface **1034** correspond to direction D**2**.

[0070] Side surfaces **1032** and **1034** each are a part of the outer peripheral surface of exterior case **103**. The outer peripheral surface is also a part of the outer peripheral surface of battery cell **100**. The outer peripheral surface is contiguous to top surface **1031** and bottom surface **1033**. The outer peripheral surface includes four side surfaces. Among these four side surfaces, two side surfaces (not shown) excluding side surfaces **1032** and **1034** has a normal direction along direction D**1** and face each other with electrode assembly **104** interposed therebetween.

[0071] Positive electrode terminal **101** and negative electrode terminal **102** protrude from exterior case **103** in the orientation of D**31**. Positive electrode terminal **101** and negative electrode terminal **102** protrude upward from top surface **1031**.

[0072] In the present example, coolers **13**A and **13**B are located above positive electrode terminal **101** and negative electrode terminal **102**. Cooler **14** is located below positive electrode terminal **101** and negative electrode terminal **102**. In this way, positive electrode terminal **101** and negative electrode terminal **102** are located below coolers **13**A and **13**B, and cooler **14** is located below positive electrode terminal **101** and negative electrode terminal **102**.

[0073] Bus bar **120** is located above positive electrode terminal **101** and negative electrode terminal **102**. Coolers **13**A and **13**B are fixed to an upper surface of bus bar **120** with an adhesive. Thus, adhesive layer **16** exists between bus bar **120** and each of coolers **13**A and **13**B. Cooler **14** is fixed to bottom surface **1033** of exterior case **103** with an adhesive. Thus, adhesive layer **17** exists between cooler **14** and bottom surface **1033**. As described above, refrigerant **900** flows through coolers **13**A, **13**B, and **14**.

[0074] As described above, in the state in which at least battery pack **10** is attached to electrically powered vehicle **1**, coolers **13**A and **13**B are located above cooler **14**. Coolers **13**A and **13**B are made of a material different from the material of cooler **14**. Coolers **13**A and **13**B are lower in thermal conductivity than cooler **14**. The thermal conductivity of each of coolers **13**A, **13**B, and **14** more specifically means the thermal conductivity of a non-contact region (specifically, non-contact regions Q**1** and Q**2** described later) in each of coolers **13**A, **13**B, and **14**.

[0075] In the present example, coolers **13**A and **13**B are made of resin. The thermal conductivity of polyamide (6 nylon) (PA) as one type of resin at 20° C. is 0.25 W/(m.Math.K). Cooler **14** is made of aluminum (Al). The thermal conductivity of aluminum at 27° C. is 237.0 W/(m.Math.K). The method of measuring the thermal conductivity is not particularly limited, and the thermal conductivity can be measured by known methods.

[0076] The material of coolers **13**A and **13**B is not limited to resin. For example, coolers **13**A and **13**B may be made of rubber. Similarly, the material of cooler **14** is not limited to aluminum. For example, cooler **14** may be made of other metals such as iron or steel use stainless (SUS).

[0077] The thermal conductivity of natural rubber (with a density of 0.991 g/cm.sup.3) as one type of rubber at 20° C. is 0.13 W/(m.Math.K). The thermal conductivity of iron at 27° C. is 80.3 W/(m.Math.K). The thermal conductivity of stainless steel (SUS304) at 27° C. is 16.0 W/(m.Math.K). Cooler **14** is preferably made of aluminum rather than iron and stainless steel in terms of thermal conductivity and weight.

[0078] Tin (Sn) and aluminum are different in thermal conductivity by a maximum of about four times. In the case where coolers **13**A and **13**B and cooler **14** each are made of metal, coolers **13**A and **13**B may be made of metal having relatively low thermal conductivity such as tin, and cooler **14** may be made of metal having relatively high thermal conductivity such as aluminum.

[0079] The difference in thermal conductivity between cooler **14** and each of coolers **13**A and **13**B is preferably 50.0 W/(m.Math.K) or more at a prescribed temperature. The difference in thermal conductivity is more preferably 200.0 W/(m.Math.K) or more at a prescribed temperature. The prescribed temperature is preferably an environmental temperature around the power storage device. The prescribed temperature is preferably, for example, within a range of 5° C. or higher and 80° C. or lower. The prescribed temperature may be within a range of 20° C. or higher and 80° C. or lower, and is further preferably within a range of 20° C. or higher and 60° C. or lower.

[0080] Outer surface **310** of cooler **13**A has: a contact region (hereinafter also referred to as a “contact region P**1**”) in contact with positive electrode terminal **101** and negative electrode terminal **102** with adhesive layer **16** and bus bar **120** interposed therebetween; and a non-contact region (hereinafter also referred to as a “non-contact region Q**1**”) excluding contact region P**1** from outer surface **310**. Outer surface **310** of cooler **13**B also has contact region P**1** and non-contact region Q**1**.

[0081] Outer surface **410** of cooler **14** has: a contact region (hereinafter also referred to as a “contact region P**2**”) in contact with each battery cell **100** with adhesive layer **17** interposed therebetween; and a non-contact region (hereinafter also referred to as a “non-contact region Q**2**”) excluding contact region P**2** from outer surface **410**.

[0082] The total sum of the area of non-contact region Q**1** on outer surface **310** of cooler **13**A and the area of non-contact region Q**1** on outer surface **310** of cooler **13**B is smaller than the area of non-contact region Q**2** on outer surface **310** of cooler **14**. In other words, the following equation (1) is satisfied.

$$2\times Q1<Q2 \qquad (1)$$

[0083] FIG. **7** is a diagram showing cooler **13**A in FIG. **6** and the vicinity thereof. FIG. **8** is a diagram showing cooler **14** in FIG. **6** and the vicinity thereof.

[0084] As shown in FIG. **7**, the length of top surface **311** in direction D**2** is defined as L**11**. The length of side surface **312** in direction D**3** is defined as L**12**. Of the length of bottom surface **313** in direction D**2**, the length of a portion exposed to the outside is equal to the total value of L**13***a* and L**13***b*. Of the length of bottom surface **313** in direction D**2**, the length of a portion not exposed to the outside is defined as L**13***c*. L**13***c* corresponds to the diameter of positive electrode terminal **101** or negative electrode terminal **102**. The length of side surface **314** in direction D**3** is defined as

L**14**. Note that L**12** and L**14** are the same value. The total sum of L**13***a*, L**13***b*, and L**13***c* is equal to L**11**. Cooler **13**B also has the same dimensions as those of cooler **13**A.

[0085] Of the length of top surface **411** in direction D**2**, the length of a portion exposed to the outside is equal to the total value of L**21***a* and L**21***b*. Of the length of top surface **411** in direction D**2**, the length of a portion not exposed to the outside is defined as L**21***c*. The length of side surface **412** in direction D**3** is defined as L**22**. The length of bottom surface **413** in direction D**2** is defined as L**23**. The length of side surface **414** in direction D**3** is defined as L**24**. L**22** and L**24** are the same value. The total sum of L**21***a*, L**21***b*, and L**21***c* is equal to L**23**.

[0086] Similarly to the manner in which the above-mentioned equation (1) is satisfied, the following equation (2) is satisfied for each of the above-mentioned dimensions in the present example.

$$2\times(L11+L12+L13a+L13b+L14)<L21a+L21b+L22+L23+L24 \qquad (2)$$

[0087] The following describes the above-mentioned equation (2) with reference to the peripheral length (the outer peripheral length) of outer surface **310** and the peripheral length of outer surface **410**. The peripheral length of outer surface **310** of each of coolers **13**A and **13**B is defined as L**10**. The peripheral length of outer surface **310** of cooler **14** is defined as L**20**. Note that L**10** is represented by the following equation (3). L**20** is represented by the following equation (4).

$$L10=L11+L12+L13a+L13b+L13c+L14 \qquad (3)$$

$$L20=L21a+L21b+L21c+L22+L23+L24 \qquad (4)$$

[0088] Of peripheral length L**10** of cooler **13**A, the length of a portion exposed to the outside is represented by L**10**-L**13***c*. Of peripheral length L**10** of cooler **13**B, the length of a portion exposed to the outside is also represented by L**10**-L**13***c*. Of peripheral length L**20** of cooler **14**, the length of a portion exposed to the outside is represented by L**20**-L**21***c*. In this case, the following equation (5) is satisfied for L**10** and L**20**.

$$2\times(L10-L13c)<L20-L21c \qquad (5)$$

SUMMARY

[0089] The following is a summary of battery pack **10**. Note that battery pack **10** is summarized based on the state in which battery pack **10** is attached to electrically powered vehicle **1** as described above. Further, for convenience of description, coolers **13**A and **13**B are hereinafter also collectively referred to as a “cooler **13**”. Pipes **5**A and **5**B are also collectively referred to as a “pipe **5**”. Similarly, pipes **6**A and **6**B are also collectively referred to as a “pipe **6**”. Flow paths **390**A and **390**B are also collectively referred to as a “flow path **390**”.

[0090] (1) As shown in FIG. **2**, battery pack **10** includes: a plurality of battery cells **100** each having positive electrode terminal **101** and negative electrode terminal **102**, the plurality of battery cells **100** being arranged side by side in direction D**1**; cooler **13** in contact with each battery cell **100** with the thermally conductive member (bus bar **120** and adhesive layer **16** in the present example) interposed therebetween; and cooler **14** in contact with each battery cell **100** with the thermally conductive member (adhesive layer **17** in the present example) interposed therebetween. As shown in FIGS. **2**, **5**, and **6**, cooler **13** is located above cooler **14**. As shown in FIGS. **2** and **6**, cooler **14** is located below each of positive electrode terminals **101** and each of negative electrode terminals **102**. Cooler **13** is lower in thermal conductivity than cooler **14**.

[0091] According to such a configuration, cooler **13** located above cooler **14** is lower in thermal conductivity than cooler **14**. Dew condensation is less likely to occur in the case of lower thermal conductivity than in the case of higher thermal conductivity. Thus, dew condensation can be caused more preferentially in cooler **14** than in cooler **13**. Further, cooler **14** is located below each of positive electrode terminals **101** and each of negative electrode terminals **102**. Therefore, according

to battery pack **10**, water droplets resulting from dew condensation can be suppressed from adhering to positive electrode terminal **101** and negative electrode terminal **102**. Thus, even when a plurality of coolers such as coolers **13** and **14** are used, a short circuit in battery pack **10** can be suppressed from occurring due to water droplets generated by dew condensation in the coolers. Specifically, a short circuit can be suppressed from occurring between positive electrode terminal **101** and negative electrode terminal **102** of battery cell **100**. Note that the above-mentioned short circuit includes both: a short circuit between positive electrode terminal **101** and negative electrode terminal **102** between adjacent battery cells **100** (a short circuit between terminals that are not connected by bus bar **120**); and a short circuit between positive electrode terminal **101** and negative electrode terminal **102** in the same battery cell **100**.
[0092] (2) As shown in FIG. **6**, each battery cell **100** has bottom surface **1033**. Cooler **14** is located below bottom surface **1033** and is in contact with bottom surface **1033** with adhesive layer **17** interposed therebetween.
[0093] According to such a configuration, cooler **14** is located below each battery cell **100**. Thus, even when water droplets generated due to dew condensation in cooler **14** (specifically, water droplets adhering to the surface of cooler **14**) fall down, the water droplets do not hit each battery cell **100**. Therefore, a short circuit between positive electrode terminal **101** and negative electrode terminal **102** can be prevented from occurring due to the water droplets generated in cooler **14**.
[0094] (3) As shown in FIG. **2**, cooler **13** is in contact with each positive electrode terminal **101** and each negative electrode terminal **102** with bus bar **120** and adhesive layer **16** interposed therebetween.
[0095] According to such a configuration, even when a high current is input into or output from each battery cell **100**, positive electrode terminal **101** and negative electrode terminal **102** that are more likely to generate heat in each battery cell **100** can be cooled, and also, water droplets resulting from dew condensation can be suppressed from adhering to positive electrode terminal **101** and negative electrode terminal **102**.
[0096] (4) As shown in FIG. **6**, each battery cell **100** has top surface **1031**. As shown in FIG. **6**, positive electrode terminal **101** and negative electrode terminal **102** protrude upward from top surface **1031**.
[0097] According to such a configuration, cooler **13** can be installed on the top surface **1031** side of each battery cell **100**.
[0098] (5) As shown in FIG. **5**, cooler **13** serves as a cooling pipe extending in direction D**1** and having flow path **390** for refrigerant **900**. Cooler **14** serves as a cooling pipe extending in direction D**1** and having flow path **490** for refrigerant **900**. Cooler **13** has inner surface **320** in contact with refrigerant **900** and outer surface **310** opposite to inner surface **320**. Cooler **14** has inner surface **420** in contact with refrigerant **900** and outer surface **410** opposite to inner surface **420**.
[0099] Outer surface **310** of cooler **13** has: contact region P**1** in contact with positive electrode terminal **101** and negative electrode terminal **102** with bus bar **120** and adhesive layer **16** interposed therebetween; and non-contact region Q**1** excluding contact region P**1** from outer surface **310**. Outer surface **410** of cooler **14** has: contact region P**2** in contact with each battery cell **100** with adhesive layer **17** interposed therebetween; and non-contact region Q**2** excluding contact region P**2** from outer surface **410**. Non-contact region Q**1** is smaller in area than non-contact region Q**2**.
[0100] According to such a configuration, a portion of outer surface **310** of cooler **13** that is in contact with the gas inside battery pack **10** is smaller in area than a portion of outer surface **410** of cooler **14** that is in contact with the gas inside battery pack **10**. Therefore, as compared with the case where the above-mentioned relation regarding the areas is not established, dew condensation can be caused more preferentially on the outer surface of cooler **14** while further suppressing dew condensation on the outer surface of cooler **13**.
[0101] (6) As shown in FIGS. **2** and **3**, cooler **13** is connected to pipe **5** on the upstream side, and

connected to pipe **6** on the downstream side. Pipe **5** is lower in thermal conductivity than pipe **6**.
[0102] According to such a configuration, the amount of water droplets generated by dew condensation can be smaller in pipe **5** on the upstream side of cooler **13** than in pipe **6** on the downstream side of cooler **13**.
[0103] (7) As shown in FIGS. **2** to **4**, cooler **14** is connected to pipe **7** on the upstream side and connected to pipe **8** on the downstream side. Pipe **7** is connected to pipe **5**. Pipe **8** is connected to pipe **6**. Pipe **7** is lower in thermal conductivity than pipe **8**.
[0104] According to such a configuration, the amount of water droplets generated by dew condensation can be smaller in pipe **7** on the upstream side of cooler **14** than in pipe **8** on the downstream side of cooler **14**. Further, refrigerant **900** can be delivered from one path to two paths (pipes **5** and **7**). Further, refrigerants **900** can be merged from two paths (pipes **6** and **8**) to flow into one path.
<Modifications>
(First Modification)
[0105] FIG. **9** is a diagram for illustrating a modification of coolers **13**A and **13**B attached above battery module **12**. As shown in FIG. **9**, a cooler **13**C as a modification of coolers **13**A and **13**B includes first portion **351** and second portion **352**. In the present modification, two coolers **13**C are used in place of coolers **13**A and **13**B.
[0106] Cooler **13**C is equal in size and shape to coolers **13**A and **13**B. First portion **351** and second portion **352** are connected to each other in the outer peripheral direction of cooler **13**C, and each extend in direction D**1**. Every portion in each of coolers **13**A and **13**B mentioned above is made of the same material. In contrast, in cooler **13**C, first portion **351** and second portion **352** are made of different materials.
[0107] First portion **351** is provided with a groove portion **361**. Second portion **352** is provided with a groove portion **362**. First portion **351** and second portion **352** are superimposed on one another in direction D**3** such that first portion **351** is located below second portion **352**. First portion **351** and second portion **352** are superimposed on one another in direction D**3** such that groove portions **361** and **362** are contiguous to each other in direction D**3**. Typically, first portion **351** and second portion **352** are fixed to each other with an adhesive. Without being limited thereto, cooler **13**C may be integrally formed.
[0108] First portion **351** and second portion **352** form a flow path **390**C. Groove portions **361** and **362** form flow path **390**C.
[0109] At least a part of first portion **351** is in contact with positive electrode terminal **101** and negative electrode terminal **102** with the thermally conductive member (bus bar **120** and adhesive layer **16**) interposed therebetween. Second portion **352** is more distant from positive electrode terminal **101** and negative electrode terminal **102** than first portion **351** is. First portion **351** is higher in thermal conductivity than second portion **352** and lower in thermal conductivity than cooler **14**.
[0110] According to such a configuration, first portion **351** in contact with positive electrode terminal **101** and negative electrode terminal **102** with bus bar **120** and adhesive layer **16** interposed therebetween is higher in thermal conductivity than second portion **352** not in contact with bus bar **120** and adhesive layer **16**. Thus, as compared with the case where the thermal conductivity of second portion **352** is the same as or higher than the thermal conductivity of first portion **351**, positive electrode terminal **101** and negative electrode terminal **102** can be efficiently cooled. Further, cooler **14** makes it possible to suppress occurrence of dew condensation in second portion **352** of cooler **13**C.
[0111] In the example of the configuration described above, first portion **351** and second portion **352** have groove portion **361** and groove portion **362**, respectively, but the present disclosure is not limited thereto. At least one of first portion **351** and second portion **352** may be provided with a groove portion forming flow path **390**C. First portion **351** may be in direct contact with positive

electrode terminal **101** and negative electrode terminal **102** without bus bar **120** and adhesive layer **16** interposed therebetween. Alternatively, first portion **351** may be in contact with positive electrode terminal **101** and negative electrode terminal **102** with only an adhesive layer **16** interposed therebetween.

(Second Modification)

[0112] FIG. **10** is a diagram for illustrating another modification of coolers **13**A and **13**B attached above battery module **12**. As shown in FIG. **10**, a cooler **13**D is provided with a flow path **390**D.

[0113] In cooler **13**D, the position of flow path **390**D is different from those of flow paths **390**A and **390**B in coolers **13**A and **13**B. The position of flow path **390**D in cooler **13**D in direction D**3** is lower than the positions of flow paths **390**A and **390**B in coolers **13**A and **13**B in direction D**3**. Thus, in cooler **13**D, the thickness (L**16**) on the bottom surface **313** side is smaller than the thickness (L**15**) on the top surface **311** side. Except for this point, cooler **13**D has the same configuration as those of coolers **13**A and **13**B.

[0114] Even such a configuration makes it possible to achieve the same effect as that achieved in the case of using cooler **13**C described with reference to FIG. **9**.

Second Embodiment

[0115] The following describes a battery pack that is different in configuration from battery pack **10** in the first embodiment. FIG. **11** is a diagram illustrating a battery pack according to the present embodiment. FIG. **11** is a cross-sectional view taken along the arrow line at the same position as that in FIG. **6**.

[0116] As shown in FIG. **11**, battery pack **10**A includes a battery module **12**A, a cooler **13**E, and cooler **14**. Battery module **12**A includes a plurality of battery cells **100**A. Battery pack **10**A is different from battery pack **10** in the first embodiment in that it has battery module **12**A in place of battery module **12**, and has cooler **13**E in place of coolers **13**A and **13**B.

[0117] Battery cell **100**A includes positive electrode terminal **101**, negative electrode terminal **102**, an exterior case **103**A, electrode assembly **104**, positive electrode tab **105**, and negative electrode tab **106**. Exterior case **103**A accommodates electrode assembly **104**, positive electrode tab **105**, and negative electrode tab **106**. In the present example, an electrolyte solution is sealed inside exterior case **103**A. Positive electrode tab **105** is connected to a positive electrode of electrode assembly **104** and positive electrode terminal **101**. Negative electrode tab **106** is connected to a negative electrode of electrode assembly **104** and negative electrode terminal **102**.

[0118] Exterior case **103**A includes a top surface **1031**A, a side surface **1032**A, a bottom surface **1033**, and a side surface **1034**A. Top surface **1031**A, side surface **1032**A, bottom surface **1033**, and side surface **1034**A are connected in this order.

[0119] Side surfaces **1032**A and **1034**A each are a part of the outer peripheral surface of exterior case **103**A. The outer peripheral surface is also a part of the outer peripheral surface of battery cell **100**. The outer peripheral surface is contiguous to top surface **1031**A and bottom surface **1033**. As in the first embodiment, the outer peripheral surface includes four side surfaces.

[0120] Positive electrode terminal **101** and negative electrode terminal **102** protrude from exterior case **103**A in direction D**2**. Specifically, in battery cell **100**A shown in FIG. **11**, positive electrode terminal **101** protrudes from exterior case **103**A in an orientation of D**21**. Positive electrode terminal **101** protrudes from side surface **1034**A in direction D**2**. Negative electrode terminal **102** protrudes from exterior case **103**A in an orientation of D**22**. Negative electrode terminal **102** protrudes from side surface **1032**A in direction D**2**. Bus bar **120** is located on the lateral side of each of positive electrode terminal **101** and negative electrode terminal **102**. In the present example, no adhesive layer exists between cooler **13**E and bus bar **120**.

[0121] Cooler **13**E is located above cooler **14**. Cooler **14** is located below positive electrode terminal **101** and negative electrode terminal **102**. In the present example, cooler **13**E is equal in size and shape to cooler **14**. However, the present disclosure is not limited thereto. For example, cooler **13**E may be shorter in length (width) in direction D**2** than cooler **14**.

[0122] Coolers **13**E and **14** are made of different materials. In the present example, cooler **13**E is made of the same material as that of coolers **13**A and **13**B. Thus, cooler **13**E is lower in thermal conductivity than cooler **14**.

[0123] Cooler **13**E is attached on the top of battery module **12**A. Cooler **13**E is located above each battery cell **100**A. Cooler **13**E is fixed to top surface **1031**A of exterior case **103** with an adhesive. Thus, adhesive layer **16**A exists between cooler **13**E and top surface **1031**A. Refrigerant **900** flows through cooler **13**E.

[0124] As described above, in the state in which at least battery pack **10**A is attached to electrically powered vehicle **1**, cooler **13**E is located above cooler **14**. Cooler **14** is located below positive electrode terminal **101** and negative electrode terminal **102**. Cooler **13**E is lower in thermal conductivity than cooler **14**. Thus, similarly to battery pack **10** in the first embodiment, battery pack **10**A makes it possible to suppress water droplets generated by dew condensation from adhering to positive electrode terminal **101** and negative electrode terminal **102**. Therefore, even when a plurality of coolers such as coolers **13**E and **14** are used, a short circuit between positive electrode terminal **101** and negative electrode terminal **102** of battery cell **100**A can be suppressed from occurring due to water droplets generated by dew condensation in the coolers.

[0125] Each battery cell **100**A has two side surfaces **1032**A and **1034**A, each of side surfaces **1032**A and **1034**A having a normal direction along direction D**2** perpendicular to directions D**1** and D**3** in the state in which battery pack **10**A is attached to electrically powered vehicle **1**. Positive electrode terminal **101** protrudes from side surface **1034**A in direction D**2**. Negative electrode terminal **102** protrudes from side surface **1032**A in direction D**2**.

[0126] According to such a configuration, the distance between positive electrode terminal **101** and negative electrode terminal **102** in each battery cell **100** can be longer than that in the case where positive electrode terminal **101** and negative electrode terminal **102** protrude from top surface **1031** of battery cell **100** as in FIG. **6**. Therefore, a short circuit resulting from water droplets generated by dew condensation can be suppressed from occurring between positive electrode terminal **101** and negative electrode terminal **102** included in the same battery cell **100**.

<Modifications>

[0127] FIG. **12** is a diagram for illustrating a modification of battery pack **10**A. As shown in FIG. **12**, battery pack **10**B includes battery module **12**A and coolers **13**A, **13**B, and **14**. Battery pack **10**B is different from battery pack **10**A in that it includes coolers **13**A and **13**B in place of cooler **13**E.

[0128] As compared with battery pack **10** in the first embodiment that includes coolers **13**A and **13**B, in battery pack **10**B, the positions of positive electrode terminal **101** and negative electrode terminal **102** of battery cell **100**A are different from the positions of positive electrode terminal **101** and negative electrode terminal **102** of battery cell **100** shown in FIG. **6**. Thus, the positions of coolers **13**A and **13**B in battery pack **10**B are also different from those of coolers **13**A and **13**B in battery pack **10**.

[0129] Specifically, in battery pack **10**B, coolers **13**A and **13**B are located above cooler **14**, as in battery pack **10** in the first embodiment. Cooler **14** is located below positive electrode terminal **101** and negative electrode terminal **102**. Coolers **13**A and **13**B each are attached to battery module **12**A with an adhesive. Cooler **13**A is attached to a side portion of battery module **12**A with an adhesive. Specifically, coolers **13**A and **13**B are attached with an adhesive to a plurality of bus bars **120** arranged in a row in direction D**1**. More specifically, coolers **13**A and **13**B are fixed to bus bar **120** with adhesive layer **16** made of an adhesive.

[0130] Such a configuration also allows a longer distance between positive electrode terminal **101** and negative electrode terminal **102** in each battery cell **100**. Therefore, a short circuit caused by dew condensation between positive electrode terminal **101** and negative electrode terminal **102** can be further suppressed. Further, positive electrode terminal **101** and negative electrode terminal **102** that are more likely to generate heat can be efficiently cooled.

[0131] In the above-described example, battery pack **10**, **10**A, or **10**B is attached to an electrically

powered vehicle (specifically, electrically powered vehicle **1**), but the target to which battery pack **10**, **10**A, or **10**B is attached is not limited to the electrically powered vehicle.
[0132] Although the embodiments of the present disclosure have been described, it should be understood that the embodiments disclosed herein are illustrative and not restrictive in every respect. The scope of the present disclosure is defined by the terms of the claims, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

Claims

1. A power storage device comprising: a plurality of battery cells each having a positive electrode terminal and a negative electrode terminal, the plurality of battery cells being arranged side by side in a first direction; and a first cooler and a second cooler, each of the first cooler and the second cooler being in contact with each of the battery cells directly or with a thermally conductive member interposed therebetween, wherein the first cooler is located above the second cooler, and the second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals, and the first cooler is lower in thermal conductivity than the second cooler.
2. The power storage device according to claim 1, wherein each of the battery cells has a first surface serving as a bottom surface, and the second cooler is located below the first surface and is in contact with the first surface directly or with the thermally conductive member interposed therebetween.
3. The power storage device according to claim 2, wherein the first cooler is in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween.
4. The power storage device according to claim 3, wherein each of the battery cells further has a second surface serving as a top surface, and the positive electrode terminal and the negative electrode terminal protrude upward from the second surface.
5. The power storage device according to claim 3, wherein the first direction is perpendicular to a vertical direction, each of the battery cells has a first side surface and a second side surface, each of the first side surface and the second side surface having a normal direction along a second direction perpendicular to the first direction and the vertical direction, the positive electrode terminal protrudes from the first side surface in the second direction, and the negative electrode terminal protrudes from the second side surface in the second direction.
6. The power storage device according to claim 3, wherein each of the first cooler and the second cooler serves as a cooling pipe extending in the first direction and having a flow path for refrigerant, and has an inner surface in contact with the refrigerant and an outer surface opposite to the inner surface, the outer surface of the first cooler has a first contact region in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween, and a first non-contact region excluding the first contact region from the outer surface, the outer surface of the second cooler has a second contact region in contact with each of the battery cells directly or with the thermally conductive member interposed therebetween, and a second non-contact region excluding the second contact region from the outer surface, and the first non-contact region is smaller in area than the second non-contact region.
7. The power storage device according to claim 6, wherein the first cooler has a first portion and a second portion that are contiguous to each other in an outer peripheral direction of the first cooler, the first portion and the second portion each extending in the first direction, the first portion and the second portion form the flow path, at least one of the first portion and the second portion is provided with a groove portion forming the flow path, at least a part of the first portion is in contact with each of the positive electrode terminals and each of the negative electrode terminals directly or with the thermally conductive member interposed therebetween, the second portion is more

distant from each of the positive electrode terminals and each of the negative electrode terminals than the first portion is, and the first portion is higher in thermal conductivity than the second portion and lower in thermal conductivity than the second cooler.

8. The power storage device according to claim 1, wherein the first cooler is connected to a first pipe on an upstream side and connected to a second pipe on a downstream side, and the first pipe is lower in thermal conductivity than the second pipe.

9. The power storage device according to claim 8, wherein the second cooler is connected to a third pipe on the upstream side and connected to a fourth pipe on the downstream side, the third pipe is connected to the first pipe, the fourth pipe is connected to the second pipe, and the third pipe is lower in thermal conductivity than the fourth pipe.

10. An electrically powered vehicle comprising: a plurality of battery cells each having a positive electrode terminal and a negative electrode terminal, the plurality of battery cells being arranged side by side in a predetermined direction; and a first cooler and a second cooler, each of the first cooler and the second cooler being in contact with each of the battery cells directly or with a thermally conductive member interposed therebetween, wherein the first cooler is located above the second cooler, the second cooler is located below each of the positive electrode terminals and each of the negative electrode terminals, and the first cooler is lower in thermal conductivity than the second cooler.