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Inventor(s)	Tanaka; Hiroyuki et al.

Bus Bar Structure

Abstract

This bus bar structure which is disposed on a disposition object surface is provided with a first conductive plate part having a first thickness and second conductive plate parts having a second thickness. The first thickness is thinner than the second thickness, the first conductive plate part and the second conductive plate parts continuously extend in the front-back direction, and the first conductive plate part is configured such that at least a part of a component protruding from the disposition object surface can be housed in the space between the first conductive plate part and the disposition object surface.

Inventors: **Tanaka; Hiroyuki (Kakegawa-shi, JP), Kanamori; Takanori (Kakegawa-shi, JP)**

Applicant: **Yazaki Corporation** (Tokyo, JP)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This is a continuation of International Application No. PCT/JP2023/043001 filed on Nov. 30, 2023, and claims priority from Japanese Patent Application No. 2022-195794 filed on Dec. 7, 2022, the entire content of which is incorporated herein by reference.

TECHNICAL FIELD
[0002] The present invention relates to a busbar structure.
BACKGROUND ART
[0003] In a battery pack mounted on an electric automobile or a hybrid automobile that travels using an electric motor, a busbar is used for connecting electrodes of a plurality of cells. Further, even in an electric junction box for distributing power from a power source to various on-board devices in a vehicle, a busbar is also disposed inside to supply power to a predetermined load circuit (for example, refer to Patent Literature 1). When another component is present in a wiring path of a flat plate-shaped busbar and the busbar is wired across the other component, as shown in FIG. **3** of Patent Literature 1, the busbar is bent in part and routed so as to avoid the other component.
CITATION LIST
Patent Literature
[0004] Patent Literature 1: JP2000-151149A
SUMMARY OF INVENTION
[0005] However, when the flat plate-shaped busbar is bent to straddle the other component, an extra space is required in a plate thickness direction, that is, in a height direction that is a direction away from a disposition object surface.
[0006] The present invention has been made in view of the above-described circumstances, and an object thereof is to provide a busbar structure capable of saving space in a height direction.
[0007] In order to achieve the object described above, the busbar structure according to the present invention is characterized as follows.
[0008] A busbar structure to be disposed on a disposition object surface, the busbar structure including: [0009] a first conductive plate portion having a first thickness; and [0010] a second conductive plate portion having a second thickness, in which [0011] the first thickness is less than the second thickness, [0012] the first conductive plate portion and the second conductive plate portion extend continuously in a first direction, [0013] the first conductive plate portion is configured such that at least a part of a protrusion protruding from the disposition object surface is accommodated in a space between the first conductive plate portion and the disposition object surface, [0014] the first conductive plate portion has a first end face extending in a second direction intersecting the first direction, [0015] the second conductive plate portion has a second end face extending in the second direction, [0016] the first conductive plate portion and the second conductive plate portion are joined to each other at the first end face and the second end face, wherein the first conductive plate portion has a first side face extending in a third direction intersecting the first end face, [0017] the second conductive plate portion has a second side face extending in the third direction, and [0018] the first conductive plate portion and the second conductive plate portion are joined to each other at the first side face and the second side face.
[0019] According to the present invention, it is possible to provide a busbar structure capable of

saving space in a height direction.
[0020] The present invention has been briefly described above. Details of the present invention can be clarified by reading modes (hereinafter, referred to as “embodiments”) for carrying out the invention to be described below with reference to the accompanying drawings.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0021] FIG. **1** is a perspective view showing a busbar structure according to a first embodiment;
[0022] FIG. **2** is an exploded perspective view of the busbar structure shown in FIG. **1**;
[0023] FIG. **3** is a partially enlarged side view of the busbar structure shown in FIG. **1** in a wired state;
[0024] FIG. **4** is a perspective view showing a busbar structure according to a modification of the first embodiment;
[0025] FIG. **5** is a perspective view showing a busbar structure according to a second embodiment;
[0026] FIG. **6** is an exploded perspective view of the busbar structure shown in FIG. **5**; and
[0027] FIG. **7** is a perspective view showing a busbar structure according to a modification of the second embodiment.
DESCRIPTION OF EMBODIMENTS
[0028] Specific embodiments of the present invention will be described below with reference to the drawings.
First Embodiment
[0029] FIG. **1** is a perspective view showing a busbar structure **1** according to a first embodiment. FIG. **2** is an exploded perspective view of the busbar structure **1** shown in FIG. **1**. FIG. **3** is a partially enlarged side view of the busbar structure **1** shown in FIG. **1** in a wired state. Hereinafter, for convenience of description, as shown in FIG. **1**, a “front-rear direction”, a “left-right direction”, and an “upper-lower direction” are defined. The “front-rear direction”, the “left-right direction”, and the “upper-lower direction” are orthogonal to one another.
[0030] As shown in FIGS. **1** and **2**, the busbar structure **1** is to be assembled between components and/or devices of an automobile and used for electrical connections within a battery pack that is used as a power supply to drive a motor of a vehicle, for example.
[0031] The busbar structure **1** is disposed on an upper face (see FIG. **3**) of a component **53** as an example of a disposition object surface. The busbar structure **1** includes a busbar **11** having a first thickness and busbars **21** and **23** having a second thickness. The first thickness is less than the second thickness. The busbar **11** is an example of a first conductive plate portion, and the busbars **21** and **23** are an example of a second conductive plate portion. The busbar **11** and the busbars **21** and **23** extend in the front-rear direction. The front-rear direction is an example of a first direction. The busbar **11** is configured such that at least a part of a component **55** (see FIG. **3**) can be accommodated in a space between the busbar **11** and the disposition object surface. The component **55** is an example of a protrusion protruding from the disposition object surface. The busbar structure **1** is a busbar for supplying vehicle driving power, that is, a high-voltage busbar.
[0032] The busbar **11** is formed by punching a conductive metal plate having a first thickness. The busbar **11** has a rectangular shape with front and rear right corners cut out into square shapes when viewed in the upper-lower direction. The busbar **11** includes end faces **11***a* and **11***c* extending in the left-right direction and side faces **11***b* and **11***d* extending in the front-rear direction. The left-right direction is an example of a second direction intersecting the first direction, and the end faces **11***a* and **11***c* are examples of a first end face. The side faces **11***b* and **11***d* are examples of a first side face. A dimension of the busbar **11** in the left-right direction is larger than a dimension of the busbars **21** and **23** in the left-right direction.

[0033] The busbars **21** and **23** are conductive metal plates having a second thickness, extending in the front-rear direction, and formed into a long, flat rectangular parallelepiped shape. The second thickness is less than a thickness (first thickness) of the busbar **11**. The busbar **21** has an end face **21***a* extending in the left-right direction on a front side. The busbar **23** has an end face **23***a* extending in the left-right direction on a rear side. The end faces **21***a* and **23***a* are examples of a second end face.

[0034] Since the busbar **11** is thinner than the busbars **21** and **23**, the busbar structure **1** can be disposed at a position where a space in the upper-lower direction, that is, a plate thickness direction is limited. In the related art, in a case where there is another component on a wiring path in the vehicle and the busbar is disposed to detour in a height direction (plate thickness direction) to avoid the other component, an extra space is required in the height direction, which is a direction away from the disposition object surface. However, since the busbar **11** is thinner than the busbars **21** and **23**, a part of the other component can be accommodated in the space where the thickness is reduced. Accordingly, the busbar structure **1** can save the space in the height direction.

[0035] The busbar **11** and the busbar **21** are joined to each other by, for example, laser welding, with the end face **11***a* and the end face **21***a* abutting against each other. The end face **11***c* of the busbar **11** and the end face **23***a* and the busbar **23** are joined to each other by, for example, laser welding. By joining the busbar **11** and the busbars **21** and **23** having different thicknesses, the busbar structure **1** can be easily manufactured.

[0036] The busbar **11** and the busbar **21** are joined to each other at the side face **11***b* of the busbar **11** and a left side face of the busbar **21**. The busbar **11** and the busbar **23** are joined to each other at the side face **11***d* of the busbar **11** and a side face **23***b* of the busbar **23**. The busbar **11** and the busbars **21** and **23** are joined to each other in two directions, that is, the front-rear direction and the left-right direction, thereby enabling stable conduction.

[0037] The end face **11***a* and the side face **11***b* of the busbar **11** serve as joining faces with the busbar **21**. A sum of the area of the end face **11***a* and the area of the side face **11***b* in the busbar **11**, that is, the area of the joining faces with the busbar **21** is larger than the area of the end face **21***a* of the busbar **21**. The end face **11***c* and the side face **11***d* of the busbar **11** serve as joining faces with the busbar **23**. A sum of the area of the end face **11***c* and the area of the side face **11***d* in the busbar **11**, that is, the area of the joining faces with the busbar **23** is larger than the area of the end face **23***a* of the busbar **23**. In this way, since the area of the joining faces between the busbar **11** and the busbar **21**, **23** is larger than the area of the cross section of the busbar **21**, **23**, that is, the area of the end face **21***a*, **23***a*, a current can be stably passed between the busbar **21** and the busbar **23**.

[0038] In the busbar structure **1**, the busbar **11** and the busbars **21** and **23** are joined such that upper faces thereof are flush with each other. An arrangement example of the busbar structure **1** is shown in FIG. **3**. As shown in FIG. **3**, the busbar structure **1** is disposed between a component **51** and the component **53**. At this time, even when the component **55** is disposed to protrude upward from the upper face of the component **53**, an upper portion of the component **55** can be accommodated in below the busbar **11** since the busbar **11** is thinner than the busbars **21** and **23**. In other words, in the busbar structure **1**, in a busbar in which the busbars **21**, **11**, and **23** are integrated, a recessed portion **30** formed by reducing the thickness (second thickness, a predetermined thickness) of the busbars **21** and **23** is provided on a lower face of the busbar **11**, and the upper portion of the component **55** is accommodated in the recessed portion **30**. Therefore, the busbar **11**, which is thinner than other portions, is wired in a position where the space in the height direction is regulated, so that the busbar structure **1** can save space in the height direction. In addition, in the busbar structure **1**, the busbar **11**, which are thinner than the busbars **21** and **23**, is used to secure the joining faces equal to or larger than the cross section area of the busbars **21** and **23**, thereby enabling stable conduction. As described above, according to the busbar structure **1**, it is possible to achieve both space saving in the height direction and stable conduction.

[0039] FIG. **4** is a perspective view showing a busbar structure **1**A according to a modification of

the first embodiment. In the busbar structure **1** according to the first embodiment described above, the thin busbar **11** is joined to the busbars **21** and **23** at the abutting surfaces (end faces **21***a* and **23***a*) and the left side face (side face **23***b*). In this regard, the busbar structure **1**A shown **30** in FIG. **4** is different from the busbar **11** according to the first embodiment in the position of the notch provided in a busbar **13**. The thin busbar **13** is joined to the busbars **21** and **23** also at a right side face in addition to the abutting surfaces and the left side face. In this manner, the thin busbar **13** may be joined to the busbars **21** and **23** in three directions. By joining in three directions, the area of joining faces between the busbar **13** and the busbars **21** and **23** can be increased, so that the conduction can be further stabilized.

Second Embodiment

[0040] FIG. **5** is a perspective view showing a busbar structure **1**B according to a second embodiment. FIG. **6** is an exploded perspective view of the busbar structure **1**B shown in FIG. **5**. Hereinafter, for convenience of description, as shown in FIG. **5**, a "front-rear direction", a "left-right direction", and an "upper-lower direction" are defined. The "front-rear direction", the "left-right direction", and the "upper-lower direction" are orthogonal to one another. In the second embodiment, the same members and portions as those shown in FIGS. **1** to **4** are denoted by the same reference numerals, and redundant description thereof will be omitted.

[0041] As shown in FIGS. **5** and **6**, the busbar structure **1**B includes a busbar **15** having a first thickness, busbars **21** and **23** having a second thickness, and a busbar **17** having a third thickness less than the second thickness. The first thickness is less than the second thickness. The busbar **15** is an example of a first conductive plate portion, and the busbar **17** is an example of a third conductive plate portion. The busbar **15** and the busbar **17** extend in the front-rear direction. The front-rear direction is an example of a third direction.

[0042] The busbar **15** is a conductive metal plate having the first thickness, extending in the front-rear direction, and formed into a flat rectangular parallelepiped shape. The busbar **15** includes end faces **15***a* and **15***c* extending in the left-right direction and side faces **15***b* and **15***d* extending in the front-rear direction. The end faces **15***a* and **15***c* are examples of the first end face. The side face **15***b* is an example of the first side face.

[0043] The busbar **17** is a conductive metal plate having the third thickness, extending in the front-rear direction, and formed into a flat rectangular parallelepiped shape. The busbar **17** is formed longer than the busbar **15**. In the present embodiment, the third thickness and the first thickness are the same thickness. The busbar **17** has a side face **17***a* extending in the front-rear direction. The side face **17***a* is an example of a third side face.

[0044] Since the busbars **15** and **17** are thinner than the busbars **21** and **23**, the busbar structure **1**B can be disposed at a position where a space in the upper-lower direction, that is, a height direction is limited. In the related art, in a case where there is another component on a wiring path in the vehicle and the busbar is disposed to detour in the height direction to avoid the other component, an extra space is required in the height direction. However, since the busbars **15**, **17** are thinner than the busbars **21** and **23**, a part of the other component can be accommodated in the space where the thickness is reduced. Accordingly, the busbar structure **1**B can save the space in the height direction.

[0045] The busbar **15** and the busbar **21** are joined to each other by, for example, laser welding, with the end face **15***a* and the end face **21***a* abutting against each other. The end face **15***c* of the busbar **15** and the end face **23***a* and the busbar **23** are joined to each other by, for example, laser welding. By joining the busbars **15** and the busbars **21** and **23** having different thicknesses, the busbar structure **1**B can be easily manufactured.

[0046] The busbar **15**, the busbars **21** and **23**, and the busbar **17** are configured such that the side face **15***b* of the busbar **15** and a central portion of the side face **17***a* of the busbar **17** are joined to each other, a front end portion of the left side face of the busbar **21** and a rear end portion of the busbar **17** are joined to each other, and a rear end portion of the side face **23***b* of the busbar **23** and

a front end portion of the busbar **17** are joined to each other. In addition to the joining of the busbar **15** and the busbars **21** and **23** in the front-rear direction, the busbar **17** is also joined, so that more stable conduction is enabled by joining in two directions of the front-rear direction and the left-right direction.

[0047] The busbar **15** and the busbar **17** are joined to each other by the side faces **15***b* and **17***a*, so that functions the same as the busbar **11** shown in FIGS. **1** and **2** can be achieved as a single busbar.

[0048] The end face **15***a* of the busbar **15** and the rear end portion of the side face **17***a* of the busbar **17** serve as joining faces with the busbar **21**. A sum of the area of the end face **15***a* of the busbar **15** and the area of the rear end portion of the side face **17***a* of the busbar **17** which is the area of a portion joined to the busbar **21**, that is, the area of the joining faces with the busbar **21** is larger than the area of the end face **21***a* of the busbar **21**. The end face **15***c* of the busbar **15** and the front end portion of the side face **17***a* of the busbar **17** serve as joining faces with the busbar **23**. A sum of the area of the end face **11***c* of the busbar **15** and the area of the front end portion of the side face **17***a* of the busbar **17** which is the area of a portion joined to the busbar **23**, that is, the area of the joining faces with the busbar **23** is larger than the area of the end face **23***a* of the busbar **23**. In this way, since the area of the joining faces between the busbars **15** and **17** and the busbar **21**, **23** is larger than the area of the cross section of the busbar **21**, **23**, that is, the area of the end face **21***a*, **23***a*, a current can be stably passed between the busbar **21** and the busbar **23**.

[0049] In the busbar structure **1**B, the busbars **15** and **17** and the busbars **21** and **23** are joined such that upper faces thereof are flush with each other. According to the busbar structure **1**B, similarly to the busbar structure **1**, it is possible to achieve both space saving in the height direction and stable conduction.

[0050] FIG. **7** is a perspective view showing a busbar structure **1**C according to a modification of the second embodiment. In the busbar structure **1**B according to the second embodiment described above, the thin busbars **15** and **17** are joined to the busbars **21** and **23** at the abutting surfaces (end faces **21***a* and **23***a*) and the left side face (side face **23***b*). In this regard, the busbar structure **1**C shown in FIG. **7** differs from the busbar structure **1**B in that busbars **18** and **19** are joined to left and right side faces of the busbar **15** instead of the busbar **17** joined to the left side face of the busbar **15**. The busbars **18** and **19** have the same thickness as the busbars **15** and **17**. The dimensions of the busbars **18** and **19** in the left-right direction are half the dimension of the busbar **17** in the left-right direction. The busbars **18** and **19** are an example of the third conductive plate portion. In this manner, the busbars **18** and **19** are separately joined to both side faces of the busbar **15**, and the thin busbars **15**, **18**, and **19** integrally function similarly to the busbar **13** shown in FIG. **4**. The busbar structure **1**C is configured such that the thin busbars **15**, **18**, and **19** are joined to each of the busbars **21** and **23** in three directions, so that the area of joining faces between the thin busbars **15**, **18**, and **19** and the busbars **21** and **23** can be increased, and the conduction can be further stabilized.

[0051] The present invention is not limited to the above-described embodiments, and can be appropriately modified, improved, or the like. In addition, the material, shape, size, numerical value, form, number, arrangement position, and the like of components in the above-described embodiment are freely selected and are not limited as long as the present invention can be achieved. In the above-described embodiments, a busbar structure is manufactured by joining busbars having different thicknesses. Alternatively, the busbar structure may be manufactured by forming a part of a conductive plate having a uniform thickness into a thin shape by cutting or pressing.

[0052] Here, features of the busbar structure according to the embodiments of the present invention described above are briefly summarized and listed in the following [1] to [4].

[0053] [1] A busbar structure (**1**, **1**A, **1**B, and **1**C) to be disposed on a disposition object surface (the upper face of the component **53**), the busbar structure (**1**, **1**A, **1**B, and **1**C) including: [0054] a first conductive plate portion (busbars **11**, **13**, **15**, **17**, **18**, and **19**) having a first thickness; and

[0055] a second conductive plate portion (busbars **21** and **23**) having a second thickness, in which [0056] the first thickness is less than the second thickness, [0057] the first conductive plate portion and the second conductive plate portion extend continuously in a first direction (front-rear direction), [0058] the first conductive plate portion is configured such that at least a part of a protrusion (component **55**) protruding from the disposition object surface is accommodated in a space between the first conductive plate portion and the disposition object surface, [0059] the first conductive plate portion (**11**,**13**,**15**,**17**,**18**,**19**) has a first end face (**11***a*, **11***c*, **15***a*, **15***c*) extending in a second direction intersecting the first direction, [0060] the second conductive plate portion (**21**,**23**) has a second end face (**21***a*,**23***a*) extending in the second direction, [0061] the first conductive plate portion (**11**,**13**,**15**,**17**,**18**,**19**) and the second conductive plate portion (**21**,**23**) are joined to each other at the first end face (**11***a*, **11***c*, **15***a*, **15***c*) and the second end face (**21***a*,**23***a*), [0062] the first conductive plate portion (**11**,**13**,**15**,**17**,**18**,**19**) has a first side face (**11***b*,**11***d*) extending in a third direction (front-rear direction) intersecting the first end face (**11***a*, **11***c*, **15***a*, **15***c*), [0063] the second conductive plate portion (**21**,**23**) has a second side face (**23***b*) extending in the third direction, and [0064] the first conductive plate portion (**11**,**13**,**15**,**17**,**18**, **19**) and the second conductive plate portion (**21**,**23**) are joined to each other at the first side face (**11***d*) and the second side face (**23***b*).

[0065] According to the busbar structure having the configuration of the above [1], the thickness of the first conductive plate portion is less than that of the second conductive plate portion, and at least a part of the protrusion can be accommodated in the space between the disposition object surface and the first conductive plate portion. Therefore, the busbar structure can be disposed at a position where a space in the height direction, that is, a thickness direction is limited. In the related art, in a case where there is another component on a wiring path in the vehicle and the busbar is disposed to detour in the height direction to avoid the other component, an extra space is required in the height direction. However, according to the above configuration, since the thickness of the first conductive plate portion is reduced, a protrusion such as a part of the other component can be accommodated in the space where the thickness is reduced. This makes it possible to save space in the height direction. Further, since the first conductive plate portion and the second conductive plate portion are also joined to the third conductive plate portion, stable conduction can be achieved.

[0066] [2] In the busbar structure (**1**B, **1**C) according to [1], further including [0067] a third conductive plate portion (**17**,**18**,**19**) having a third thickness less than the second thickness, [0068] wherein the third conductive plate portion (**17**,**18**,**19**) has a third side face (**17***a*) extending in the third direction, and [0069] wherein the first conductive plate portion (**11**,**13**,**15**,**17**,**18**,**19**), the second conductive plate portion (**21**,**23**), and the third conductive plate portion (**17**,**18**,**19**) are joined to each other at the first side face (**11***b*,**11***d*), the second side face (**23***b*), and the third side face (**17***a*).

[0070] According to the busbar structure having the configuration of the above [2], the busbar structure can be easily manufactured by joining plates having different thicknesses. Further, since the first conductive plate portion and the second conductive plate portion are joined in two directions, the area of the joining face between the first conductive plate portion and the second conductive plate portion can be increased, so that stable conduction can be achieved.

[0071] [3] In the busbar structure (**1**, **1**A, **1**B, **1**C) according to [2], [0072] an area of a joining face between the first conductive plate portion and the second conductive plate portion is larger than an area of the second end face.

[0073] According to the busbar structure having the configuration of the above [3], the area of the joining face between the first conductive plate portion and the second conductive plate portion is larger than the area of the second end face of the second conductive plate portion. Therefore, an allowable current of the second conductive plate portion can be maintained in the first conductive plate portion.

[0074] [4] In the busbar structure (**1**, **1**A, **1**B, **1**C) according to any one of [1] to [3], [0075] the first

conductive plate portion and the second conductive plate portion are busbars for supplying vehicle driving power.

[0076] According to the busbar structure having the configuration of the above [4], for example, it can be used for electrical connections within a battery pack that is used as a power supply to drive a motor of a vehicle.

[0077] The present application is based on a Japanese patent application (Japanese Patent Application No. 2022-195794) filed on Dec. 7, 2022, and the contents thereof are incorporated herein by reference.

INDUSTRIAL APPLICABILITY

[0078] According to the present invention, it is possible to provide a busbar structure capable of saving space in a height direction. The present invention having this effect is useful in relation to a busbar structure.

Claims

1. A busbar structure to be disposed on a disposition object surface, the busbar structure comprising: a first conductive plate portion having a first thickness; and a second conductive plate portion having a second thickness, wherein the first thickness is less than the second thickness, wherein the first conductive plate portion and the second conductive plate portion extend continuously in a first direction, wherein the first conductive plate portion is configured such that at least a part of a protrusion protruding from the disposition object surface is accommodated in a space between the first conductive plate portion and the disposition object surface, wherein the first conductive plate portion has a first end face extending in a second direction intersecting the first direction, wherein the second conductive plate portion has a second end face extending in the second direction, wherein the first conductive plate portion and the second conductive plate portion are joined to each other at the first end face and the second end face, wherein the first conductive plate portion has a first side face extending in a third direction intersecting the first end face, wherein the second conductive plate portion has a second side face extending in the third direction, and wherein the first conductive plate portion and the second conductive plate portion are joined to each other at the first side face and the second side face.

2. The busbar structure according to claim 1, further comprising: a third conductive plate portion having a third thickness less than the second thickness, wherein the third conductive plate portion has a third side face extending in the third direction, and wherein the first conductive plate portion, the second conductive plate portion, and the third conductive plate portion are joined to each other at the first side face, the second side face, and the third side face.

3. The busbar structure according to claim 1, wherein an area of a joining face between the first conductive plate portion and the second conductive plate portion is larger than an area of the second end face.

4. The busbar structure according to claim 1, wherein the first conductive plate portion and the second conductive plate portion are busbars for supplying vehicle driving power.