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(54) **VEHICLE LOWER STRUCTURE AND METHOD OF ACCOMMODATING BATTERY IN A VEHICLE**

(57) [Task]

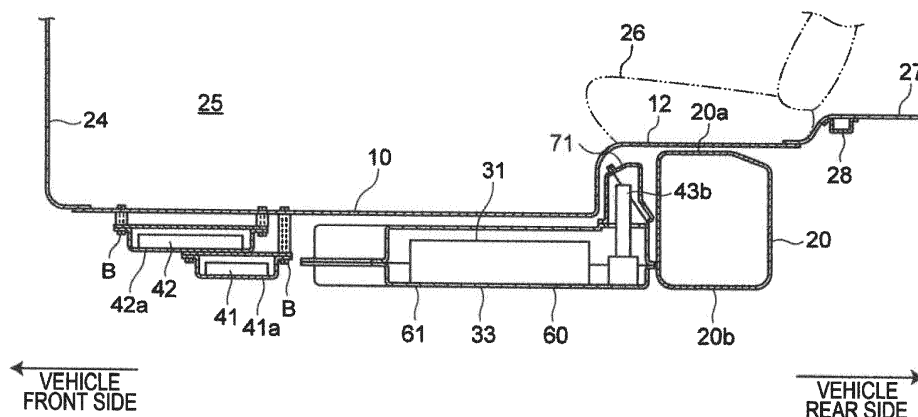
To protect a battery pack during a collision and suppress reductions in battery capacity and size of a cabin space.

[Solution]

A vehicle lower structure includes: a battery pack 33 having first and second battery units 31, 32 and a battery cover 60; and a fuel tank 20 that is arranged on a vehicle rear side to be higher than the first and second battery units 31, 32. At positions under a floor panel 10, the first and second battery units 31, 32 are arranged on both

sides in a vehicle width direction of a propeller shaft. The battery cover 60 has a coupling section 71 that couples first and second battery accommodation sections 61, 66. The coupling section 71 couples the first and second battery accommodation sections 61, 66 such that a vehicle rear side thereof is higher than the first and second battery accommodation sections 61, 66, extends in the vehicle width direction at a position above the propeller shaft 7, and is arranged next to a vehicle front side of the fuel tank 20.

FIG. 5



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Description

[Technical Field]

[0001] The present invention relates to a vehicle lower structure and to a method of accommodating a battery in a vehicle.

[Background Art]

[0002] A hybrid vehicle in which an internal combustion engine and an electric drive motor as drive sources are arranged in a vehicle front portion, in which a propeller shaft is arranged under a floor panel constituting a floor surface of a cabin, and in which power from at least one of the internal combustion engine and the electric drive motor is transmitted to drive wheels arranged in a vehicle rear portion by the propeller shaft has been known.

[0003] The hybrid vehicle in which plural battery modules for storing electricity to be supplied to the electric drive motor are connected and unitized as a battery unit and in which, at a position under the floor panel, the battery unit is arranged on each side in a vehicle width direction of the propeller shaft has also been known.

[0004] For example, in Patent document 1, a vehicle lower structure in which, at the position under the floor panel, the battery unit is arranged on each of the sides in the vehicle width direction of the propeller shaft is disclosed. In the vehicle lower structure disclosed in Patent document 1, a battery pack that includes the battery unit arranged on each of the sides in the vehicle width direction of the propeller shaft is attached to the floor panel in a manner to cover the propeller shaft from below.

[Prior Art Documents]

[Patent documents]

[0005] [Patent document 1] JP 5,483,293 B2

[Summary of the Invention]

[Problem to be solved by the invention]

[0006] In a hybrid vehicle in which, at the positions under the floor panel, first and second battery units are arranged on both sides in the vehicle width direction of the propeller shaft, there is a case where, on a lower side of a rear seat, a fuel tank that stores fuel to be supplied to the internal combustion engine arranged in the vehicle front portion is arranged under a kick-up section of the floor panel and where the first and second battery units are integrated as the battery pack and attached to a position under the floor panel.

[0007] In the case where, on a vehicle rear side of the first and second battery units, the fuel tank is arranged under the kick-up section of the floor panel, and the first and second battery units are integrated as the battery

pack and attached to the position under the floor panel, it is considered to use the battery pack having a coupling section that couples a first battery accommodation section for accommodating the first battery unit to a second battery accommodation section for accommodating the second battery unit and extends in the vehicle width direction. However, in the case where the coupling section of the battery pack is arranged under the propeller shaft, during a frontal collision, a rear portion of the propeller shaft possibly moves downward and is possibly deformed, which possibly damages the battery pack.

[0008] To handle the above problem, it is considered to arrange the coupling section of the battery pack at a position above the propeller shaft. However, when it is attempted to secure a cabin space, the first and second battery units are reduced in size due to the coupling section, which possibly reduces battery capacity. On the other hand, when it is attempted to secure the battery capacity, the floor panel is formed to be projected upward by the coupling section, which possibly reduces the cabin space in size.

[0009] In view of the above, the present invention has a purpose of providing a vehicle lower structure capable of protecting a battery pack during a collision and suppressing reductions in battery capacity and size of a cabin space in a vehicle in which, at positions under a floor panel, first and second battery units are arranged on both sides in a vehicle width direction of a propeller shaft.

[0010] This object is achieved by the features of the independent claims. Further developments are defined in the dependent claims.

[Means for solving the Problem]

[0011] In order to solve the above problem, the inventors of the present application have performed the earnest study on a configuration of a battery pack in consideration of protection of the battery pack, which has a coupling section coupling first and second battery accommodation sections, and an influence on battery capacity and a cabin space in the case where a fuel tank is arranged under a kick-up section of a floor panel on a vehicle rear side of the battery pack in a vehicle in which, at a position under the floor panel, first and second battery units are arranged on both sides in a vehicle width direction of a propeller shaft. As a result, the inventors of the present application found a configuration capable of protecting the battery pack during a collision and suppressing reductions in battery capacity and size of a cabin space, and completed the invention of the present application.

[0012] The present invention provides a vehicle lower structure including: a drive source having an internal combustion engine and an electric drive motor; a floor panel forming a floor surface of a cabin; and a propeller shaft extending in a vehicle longitudinal direction at a position under the floor panel to transmit power from the drive source to at least one drive wheel. The vehicle lower

structure includes: a battery pack having a first battery unit, a second battery unit, and a battery cover, at positions under the floor panel, the first battery unit and the second battery unit being arranged separately from each other on both sides in a vehicle width direction of the propeller shaft and storing electricity to be supplied to the electric drive motor; and a fuel tank arranged at a position under the floor panel and on a vehicle rear side of the first battery unit and the second battery unit in a manner to be higher than the first battery unit and the second battery unit. The battery cover has: a first battery accommodation section accommodating the first battery unit; a second battery accommodation section accommodating the second battery unit; and a coupling section that couples the first battery accommodation section and the second battery accommodation section. The coupling section couples the first battery accommodation section and the second battery accommodation section such that it extends in the vehicle width direction at a position above the propeller shaft, and it is arranged next to a vehicle front side of the fuel tank. Preferably, a vehicle rear side of the coupling section is higher than the first battery accommodation section and the second battery accommodation section.

[0013] According to the present invention, the battery pack has: the first and second battery units arranged under the floor panel and on both of the sides in the vehicle width direction of the propeller shaft; and the battery cover. The fuel tank is arranged on the vehicle rear side in a manner to be higher than the first and second battery units. The battery cover has the coupling section that couples the first and second battery accommodation sections. The coupling section couples the first and the second battery accommodation sections such that it extends in the vehicle width direction at the position above the propeller shaft, and is arranged next to the vehicle front side of the fuel tank. Preferably, the vehicle rear side of the coupling section is higher than the first and second battery accommodation sections,

[0014] In the vehicle in which the first and second battery units are arranged on both sides in the vehicle width direction of the propeller shaft, the coupling section of the battery cover is arranged above the propeller shaft. Thus, even in the case where the propeller shaft moves downward and is deformed during a frontal collision, it is possible to suppress the propeller shaft from coming into contact with the first and second battery units and the coupling section. Therefore, the battery pack can be protected.

[0015] The coupling section of the battery pack preferably couples the first and second battery accommodation sections such that the vehicle rear side thereof is higher than the first and second battery accommodation sections. Accordingly, it is possible to suppress a reduction in battery capacity of each of the first and second battery units and to suppress a reduction in size of a cabin space. The coupling section of the battery pack is arranged next to the vehicle front side of the fuel tank.

Accordingly, the coupling section and the fuel tank can be arranged under the kick-up section of the floor panel, which is arranged under the rear seat. In this way, it is possible to suppress occupant comfort from being degraded by the reduction in the size of the cabin space.

[0016] Therefore, in the vehicle in which, at the positions under the floor panel, the first and second battery units are arranged on both sides in the vehicle width direction of the propeller shaft, it is possible to protect the battery pack during the collision and to suppress the reductions in the battery capacity and the size of the cabin space.

[0017] The coupling section is preferably formed such that the length thereof in the vehicle longitudinal direction is less than a length of each of the first battery accommodation section and the second battery accommodation section.

[0018] With this configuration, vehicle rear sides of the first battery accommodation section and the second battery accommodation section are coupled by the coupling section, which is formed to have the less length in the vehicle longitudinal direction than each of the first and second battery accommodation sections. Thus, it is possible to effectively suppress the reduction in the size of the cabin space.

[0019] The floor panel may have a kick-up section in a rear portion of the floor panel at a position under a rear seat, the kick-up section being formed to be higher than a front portion of the floor panel, and the coupling section and the fuel tank may be arranged under the kick-up section.

[0020] With this configuration, the coupling section and the fuel tank are arranged under the kick-up section of the floor panel, which is arranged under the rear seat. Thus, it is possible to suppress the occupant comfort from being degraded by the reduction in the size of the cabin space.

[0021] The coupling section may include a concave section on an upper side of the coupling section, the concave section being dented substantially downward. The tank attachment member to which the fixing belt is fixed, may be arranged at least partly in the concave section. The fuel tank is fixed to or by the fixing belt.

[0022] In such a case, the concave section is provided on the upper side of the coupling section, and the tank attachment member is arranged in the concave section. Thus, compared to a case where the tank attachment member is arranged above the coupling section without providing the concave section to the coupling section, the tank attachment member can be arranged compactly above the coupling section.

[0023] The coupling section is preferably formed by joining a front cover member and a rear cover member, and mating surfaces of the front cover member and the rear cover member are preferably formed to be inclined downward in the vehicle toward the vehicle rear side.

[0024] With this configuration, the mating surfaces of the front cover member and the rear cover member con-

stituting the coupling section are formed to be inclined. Thus, compared to a case where the mating surfaces are not formed to be inclined, an opening of the mating surfaces can be increased, which facilitates attachment and detachment of components arranged in the coupling section. As a result, work efficiency can be improved.

[0025] According to a further aspect, there is provided a vehicle comprising a vehicle lower structure, as described above.

[0026] According to a still further aspect, there is provided a method of accommodating a battery in a vehicle comprising the steps of:

providing a battery cover,
forming the battery cover with a first battery accommodation section and a second battery accommodation section,
accommodating a first battery unit in the first battery accommodation section,
accommodating a second battery unit in the second battery accommodation section,
coupling the first battery accommodation section and the second battery accommodation section by means of a coupling section,
forming the coupling section at a rear end of the first battery accommodation section and the second battery accommodation section such that the coupling section is provided on a top side of the first battery accommodation section and the second battery accommodation section and extends substantially orthogonal to a longitudinal direction of the first battery accommodation section and the second battery accommodation section.

[0027] Preferably, the first battery accommodation section and the second battery accommodation section are mounted below a floor panel of the vehicle such that the coupling section extends in the vehicle width direction at a position above a propeller shaft of the vehicle and in front of a fuel tank of the vehicle.

[0028] Further preferred, the coupling section and the fuel tank are arranged under a kick-up section of the floor panel of the vehicle.

[0029] Preferably, the coupling section is formed by joining a front cover member arranged on a vehicle front side and a rear cover member arranged on a vehicle rear side, and

mating surfaces of the front cover member (72) and the rear cover member are formed to be inclined downward in the vehicle toward the vehicle rear side.

[Advantage of the invention]

[0030] With the vehicle lower structure according to the present invention, in the vehicle in which, at the positions under the floor panel, the first and second battery units are arranged on both of the sides in the vehicle width direction of the propeller shaft, it is possible to pro-

tect the battery pack during the collision and to suppress the reductions in the battery capacity and the size of the cabin space.

5 [Brief Description of the Drawings]

[0031]

Fig. 1 is a schematic view of a vehicle body to which a vehicle lower structure according to an embodiment of the present invention is applied.

Fig. 2 is a top view of the vehicle body to which the vehicle lower structure according to the embodiment of the present invention is applied.

Fig. 3 is a bottom view of the vehicle body to which the vehicle lower structure according to the embodiment of the present invention is applied.

Fig. 4 is a cross-sectional view of the vehicle body that is taken along line Y4-Y4 in Fig. 2.

Fig. 5 is a cross-sectional view of the vehicle body that is taken along line Y5-Y5 in Fig. 2.

Fig. 6 is a cross-sectional view of the vehicle body that is taken along line Y6-Y6 in Fig. 2.

Fig. 7 is a cross-sectional view of the vehicle body that is taken along line Y7-Y7 in Fig. 2.

Fig. 8 is a perspective view of a battery pack.

Fig. 9 is a cross-sectional view of the battery pack that is taken along line Y9-Y9 in Fig. 8.

Fig. 10 is an explanatory view for illustrating a modified example of a coupling section of the battery pack.

Fig. 11 is an explanatory view for illustrating a tank attachment member that is arranged above the coupling section illustrated in Fig. 10.

[Modes for Carrying Out the Invention]

[0032] A description will hereinafter be made on an embodiment of the invention with reference to the accompanying drawings.

[0033] Fig. 1 is a schematic view of a vehicle body to which a vehicle lower structure according to the embodiment of the present invention is applied. A vehicle according to the embodiment of the present invention is a hybrid vehicle in a front-engine, rear-wheel-drive layout that has, as drive sources, an internal combustion engine and an electric drive motor arranged in a vehicle front side and that transmits power from at least one of the internal combustion engine and the electric drive motor to rear wheels as drive wheels arranged in a vehicle rear side.

[0034] As illustrated in Fig. 1, a vehicle body 1 of the hybrid vehicle has: an internal combustion engine 3 as a drive source 2; an automatic transmission 4 as a transmission that is coupled to the internal combustion engine 3; an electric motor (a drive motor) 5 as the drive source 2 that is arranged between the internal combustion engine 3 and the automatic transmission 4; a propeller shaft

7 that is coupled to the automatic transmission 4 and transmits power from the drive source 2 to rear wheels 6; and a differential 8 that is coupled to the propeller shaft 7 and transmits the power from the drive source 2 to the right and left rear wheels 6.

[0035] At a position under a floor panel 10 that constitutes a floor surface of a cabin 25, the propeller shaft 7 extends in a vehicle longitudinal direction. A tunnel section 11 is provided in a center side in a vehicle width direction of the floor panel 10. The propeller shaft 7 is arranged inside the tunnel section 11. A front end portion of the propeller shaft 7 is coupled to the automatic transmission 4 via a universal joint 15, and a rear end portion of the propeller shaft 7 is coupled to the differential 8 via a universal joint 16.

[0036] In the vehicle body 1, when an impact load is applied from a vehicle front side to the drive source 2 during a frontal collision, the differential 8 receives the impact load through the propeller shaft 7. When the differential 8 receives the impact load, the differential 8 is no longer supported by the vehicle body 1, and a vehicle front side of the differential 8 rotates downward with an axle 9 being a fulcrum. When the vehicle front side of the differential 8 rotates downward, a vehicle rear side of the propeller shaft 7 moves downward and is deformed, and the drive source 2 moves rearward in the vehicle body. In this way, an impact absorption property is enhanced.

[0037] The vehicle body 1 includes an exhaust pipe 17 that extends substantially in the vehicle longitudinal direction from the engine 3. At a position under the tunnel section 11, the exhaust pipe 17 is disposed under the propeller shaft 7. A catalytic device 18 that includes, as an exhaust system component, a catalyst for purifying exhaust gas of the internal combustion engine 3 is disposed on an upstream side of the exhaust pipe 17. A silencer 19 that reduces noise generated at the time of releasing the exhaust gas of the internal combustion engine 3 to the atmosphere is disposed as the exhaust system component on a downstream side of the exhaust pipe 17.

[0038] The vehicle body 1 includes: a fuel tank 20 that stores fuel to be supplied to the internal combustion engine 3; and a battery 30 that stores electricity to be supplied to the electric motor 5. The electric motor 5 transmits the power to the rear wheels 6. In addition, during deceleration of the vehicle, the electric motor 5 is rotationally driven by the propeller shaft 7 and performs regenerative power generation to supply the generated electricity to the battery 30.

[0039] The battery 30 is formed as a battery pack 33 in which a first battery unit 31 and a second battery unit 32 are provided in an integrated manner. The first battery unit 31 and the second battery unit 32 are separately arranged from each other on both sides in a vehicle width direction of the propeller shaft 7. Each of the first and second battery units 31, 32 is formed such that plural battery modules for storing the electricity to be supplied to the electric motor 5 are connected and unitized. The

battery module includes plural battery cells, and the battery cell is a lithium-ion battery, for example.

[0040] The fuel tank 20 and the first and second battery units 31, 32 are arranged under the floor panel 10. The fuel tank 20 is arranged behind the first and second battery units 31, 32 and is arranged to be higher than the first and second battery units 31, 32.

[0041] At positions near the first and second battery units 31, 32, battery-related electrical components that are related to the battery 30 are arranged. As the battery-related electrical components, high-voltage components such as an inverter 41, a DC/DC converter 42, and a junction box 43 that are electrically connected to the first and second battery units 31, 32 are arranged. The high-voltage component and a high-voltage harness, which will be described below, respectively mean a component and a harness to which an AC voltage exceeding about 30 V or a DC voltage exceeding about 60V is applied.

[0042] The inverter 41 converts DC power stored in the battery 30 into AC power and supplies the AC power to the electric motor 5. In addition, during the deceleration of the vehicle, the inverter 41 converts the AC power generated by the electric motor 5 into the DC power and charges the battery 30 with the DC power. The DC/DC converter 42 converts high-voltage DC power, such as about 300 volts, stored in the battery 30 into low-voltage DC power, such as about 12 volts, and supplies the low-voltage DC power to an auxiliary machine and the like.

[0043] The junction box 43 includes: a front junction box 43a that is arranged in front of the first and second battery units 31, 32; and a rear junction box 43b that is arranged behind the first and second battery units 31, 32.

[0044] Each of the front and rear junction boxes 43a, 43b is a so-called connection box for protecting terminals used for connecting, branching, and relaying harnesses, and has a high-voltage relay, a fuse, and the like. The front and rear junction boxes 43a, 43b are electrically connected to the first and second battery units 31, 32.

[0045] The first and second battery units 31, 32 are electrically connected to each other by a battery harness as a high-voltage harness. The first and second battery units 31, 32 and the battery-related electrical components 41, 42, 43 are also electrically connected to each other by the battery harness as the high-voltage harness. The first and second battery units 31, 32 share the battery-related electrical components such as the junction box 43.

[0046] At a position near the first and second battery units 31, 32, a battery control unit 44 for controlling the first and second battery units 31, 32 is arranged. The battery control unit 44 is electrically connected to the first and second battery units 31, 32, the battery-related electrical components 41, 42, 43, and the like by harnesses.

[0047] Next, a specific description will be made on the vehicle lower structure according to the embodiment of the present invention with reference to Fig. 2 to Fig. 9.

[0048] Fig. 2 is a top view of the vehicle body to which the vehicle lower structure according to the embodiment

of the present invention is applied. Fig. 3 is a bottom view of the vehicle body to which the vehicle lower structure according to the embodiment of the present invention is applied. Fig. 4 is a cross-sectional view of the vehicle body that is taken along line Y4-Y4 in Fig. 2. Fig. 5 is a cross-sectional view of the vehicle body that is taken along line Y5-Y5 in Fig. 2. Fig. 6 is a cross-sectional view of the vehicle body that is taken along line Y6-Y6 in Fig. 2. Fig. 7 is a cross-sectional view of the vehicle body that is taken along line Y7-Y7 in Fig. 2.

[0049] As illustrated in Fig. 2, the vehicle body 1 includes the floor panel 10, right and left side sills 21, a first crossmember 22, and a second crossmember 23 in a lower portion of the vehicle body. The right and left side sills 21 are joined to both end portions in the vehicle width direction of the floor panel 10 and extend linearly substantially in the vehicle longitudinal direction. On an upper surface side of the floor panel 10, the first crossmember 22 and the second crossmember 23 are each hung between the right and left side sills 21 and extend in the vehicle width direction.

[0050] In the center side in the vehicle width direction, the floor panel 10 extends in the vehicle longitudinal direction and is formed with the tunnel section 11 that bulges substantially upward. As illustrated in Fig. 6, the tunnel section 11 includes an upper surface portion 11a and side surface portions 11b on both sides, and is opened downward. As illustrated in Fig. 5, a front end portion of the floor panel 10 is coupled to a dashboard 24. The dashboard 24 defines a vehicle front side of the cabin 25 and extends substantially in a vehicle body vertical direction.

[0051] The floor panel 10 has a kick-up section 12 in a rear portion of the floor panel 10. The kick-up section 12 is formed to be higher than a front portion of the floor panel 10. The kick-up section 12 is provided under a rear seat 26. The kick-up section 12 extends substantially upward from the front portion of the floor panel 10 and then extends substantially rearward in the vehicle in a substantially horizontal direction.

[0052] A rear floor panel 27 that is formed to be higher than a rear end portion of the kick-up section 12 is joined to a rear end portion of the floor panel 10, more specifically, the rear end portion of the kick-up section 12. The rear floor panel 27 extends substantially upward from the rear end portion of the kick-up section 12 and then extends substantially rearward in the vehicle in the substantially horizontal direction.

[0053] A third crossmember 28 is attached to a lower surface side of the rear floor panel 27. The third crossmember 28 is hung between front end portions of right and left rear frames 14 and extends in the vehicle width direction. The third crossmember 28 is formed to have a substantially hat-shaped cross section and is joined to the rear floor panel 27.

[0054] As illustrated in Fig. 6, in each of the right and left side sills 21, a side sill inner 21a constitutes a vehicle body inner side of the side sill 21, a side sill outer 21b

constitutes a vehicle body outer side of the side sill 21, and the side sill inner 21a and the side sill outer 21b are joined to each other. In this way, each of the right and left side sills 21 has a substantially closed cross-sectional shape.

[0055] The first and second crossmembers 22, 23 are separately arranged from each other in the vehicle longitudinal direction. The first crossmember 22 is arranged in front of the second crossmember 23. Each of the first and second crossmembers 22, 23 is formed to have a substantially hat-shaped cross section and is joined to the floor panel 10.

[0056] Each of the first and second crossmembers 22, 23 is divided in the vehicle width direction by the tunnel section 11. In each of the divided first and second crossmembers 22, 23, an outer end portion thereof in the vehicle width direction is joined to the side sill 21, and an inner end portion thereof in the vehicle width direction is joined to the tunnel section 11.

[0057] As illustrated in Fig. 3, right and left floor frames 50 are disposed on a lower surface side of the floor panel 10. The right and left floor frames 50 separate from each other in the vehicle width direction and extend substantially in the vehicle longitudinal direction. Each of the right and left floor frames 50 is arranged on an inner side in the vehicle width direction of respective one of the right and left side sills 21, and is arranged between the side sill 21 and the tunnel section 11 in the vehicle width direction.

[0058] As illustrated in Fig. 7, the floor frame 50 includes a lower surface portion 50a, side surface portions 50b on both sides, and flange portions 50c on both of the sides, and is formed to have a substantially hat-shaped cross section. The flange portions 50c on both of the sides are joined to the floor panel 10. In this way, the floor frame 50 cooperates with the floor panel 10 to have a substantially closed cross-sectional shape.

[0059] Front end portions of the right and left floor frames 50 are coupled to right and left front frames 13, respectively. The right and left front frames 13 are disposed in the vehicle front side in a manner to separate from each other in the vehicle width direction, and extend substantially linearly substantially in the vehicle longitudinal direction. Each of the right and left front frames 13 is formed to have a substantially closed cross-sectional shape and extends substantially forward in the vehicle from the dashboard 24.

[0060] Rear end portions of the right and left floor frames 50 are coupled to the right and left rear frames 14, respectively. The right and left rear frames 14 are disposed in the vehicle rear side in a manner to separate from each other in the vehicle width direction, and extend substantially linearly substantially in the vehicle longitudinal direction. Each of the right and left rear frames 14 is formed to have a substantially hat-shaped cross section, is attached to the lower surface side of the rear floor panel 27, and cooperates with the rear floor panel 27 to have a substantially closed cross-sectional shape.

[0061] Each of the right and left floor frames 50 has a front inclined section 51, a width increased section 52, and a rear inclined section 53. The front inclined section 51 is inclined to the outer side in the vehicle width direction from the vehicle front side toward the vehicle rear side. The width increased section 52 extends linearly and substantially rearward in the vehicle from the front inclined section 51, and a width thereof is increased to the outer side in the vehicle width direction. The rear inclined section 53 is inclined to the inner side in the vehicle width direction from the width increased section 52 toward the vehicle rear side. Each of the right and left floor frames 50 is formed such that a width in a center side in the vehicle longitudinal direction is increased to the outer side in the vehicle width direction in comparison with a vehicle front side and a vehicle rear side and that a distance between the right and left width increased sections 52 in the vehicle width direction is longer than that between the front inclined sections 51 and that between the rear inclined sections 53.

[0062] As illustrated in Fig. 6, right and left tunnel reinforcing members 54 are joined to the lower surface side of the floor panel 10. The right and left tunnel reinforcing members 54 are disposed on both sides in the vehicle width direction of the tunnel section 11 in a manner to separate from each other in the vehicle width direction and extend substantially in the vehicle longitudinal direction. The tunnel reinforcing member 54 is joined to the lower surface side of the floor panel 10 and cooperates with the floor panel 10 to have a substantially closed cross-sectional shape.

[0063] As illustrated in Fig. 2, right and left floor reinforcing members 56 are joined to the upper surface side of the floor panel 10. The right and left floor reinforcing members 56 each extend substantially in the vehicle longitudinal direction along the front inclined section 51 of the floor frame 50. The floor reinforcing member 56 cooperates with the floor panel 10 to have a substantially closed cross-sectional shape. A front end portion of the floor reinforcing member 56 is joined to the dashboard 24, and a rear end portion of the floor reinforcing member 56 is joined to the first crossmember 22. Vehicle body components such as the floor panel 10, the floor frame 50, and the tunnel reinforcing member 54 are each formed by pressing a steel sheet, for example.

[0064] At the positions under the floor panel 10, the automatic transmission 4 and the propeller shaft 7 are arranged in the center side in the vehicle width direction. As illustrated in Fig. 4, the automatic transmission 4 and the propeller shaft 7 are arranged in the tunnel section 11 and are supported by the vehicle body 1. As illustrated in Fig. 3, the automatic transmission 4 is arranged between the front inclined sections 51 of the right and left floor frames 50, and the propeller shaft 7 is arranged between the width increased sections 52 and/or the rear inclined sections 53 of the right and left floor frames 50.

[0065] At a position under the floor panel 10, the fuel tank 20 is disposed between the rear inclined sections

53 of the right and left floor frames 50. The fuel tank 20 is arranged under the kick-up section 12 of the floor panel 10 and is arranged to be higher than the front portion of the floor panel 10 (in particular a top wall of the fuel tank 20 is higher than the front portion of the floor panel 10).

[0066] As illustrated in Fig. 5, an upper surface portion 20a of the fuel tank 20 is arranged to be higher than the front portion of the floor panel 10, and a lower surface portion 20b of the fuel tank 20 is arranged to be lower than the front portion of the floor panel 10. The fuel tank 20 is formed to extend between both sides in the vehicle width direction and extend in the vehicle longitudinal direction. The fuel tank 20 is formed with a hollow space that stores the fuel therein.

[0067] As illustrated in Fig. 4, the fuel tank 20 has a concave section 20c at a center side in the vehicle width direction of the lower surface portion 20b. The concave section 20c is dented upward in a substantially semicircular cross-sectional shape so as to avoid interference with the propeller shaft 7. As illustrated in Fig. 3, the fuel tank 20 is supported from below by being fixed to the vehicle body 1 by right and left fixture belts 57 for fixing the fuel tank 20. A front end portion of the fixture belt 57 is fixed by a fastening bolt to a tank attachment member 58 that is attached to the width increased section 52 of the floor frame 50. A rear end portion of the fixture belt 57 is fixed by a fastening bolt to a tank attachment member 59 that is attached substantially to a center side in the vehicle width direction of the third crossmember 28.

[0068] The exhaust pipe 17, which extends from the internal combustion engine 3, and the catalytic device 18 are arranged under the floor panel 10. The exhaust pipe 17 and the catalytic device 18 are supported by the floor panel 10. The catalytic device 18 is disposed between the front inclined sections 51 of the right and left floor frames 50, and is arranged between the automatic transmission 4 and the front inclined section 51 of the floor frame 50 on the vehicle right side as one side in the vehicle width direction. However, the catalytic device 18 may also be arranged on the vehicle left side.

[0069] In the exhaust pipe 17 arranged under the floor panel 10, a portion on an upstream side of the catalytic device 18 extends substantially forward in the vehicle along the front inclined section 51 of the floor frame 50 and is coupled to the internal combustion engine 3, and a portion on a downstream side of the catalytic device 18 extends substantially inward in the vehicle width direction, then extends substantially linearly to the rear in the vehicle, and is coupled to the silencer 19.

[0070] At a position under the tunnel section 11 of the floor panel 10, the exhaust pipe 17 extends substantially in the vehicle longitudinal direction under the propeller shaft 7. As illustrated in Fig. 6, at the position under the tunnel section 11 of the floor panel 10, the exhaust pipe 17 is disposed at such a position that a center axis 7a of the propeller shaft 7 substantially matches a center axis 17a of the exhaust pipe 17 in the vehicle width direction.

[0071] At a position under the floor panel 10, the first

and second battery units 31, 32 are disposed in a manner to be separately arranged from each other on both of the sides in the vehicle width direction of the propeller shaft 7. Each of the first and second battery units 31, 32 is formed as a high-voltage battery that is unitized by connecting the plural battery modules.

[0072] At positions in front of the kick-up section 12 of the floor panel 10, the first and second battery units 31, 32 are arranged between the width increased sections 52 of the right and left floor frames 50. The first battery unit 31 is arranged between the propeller shaft 7 and the width increased section 52 of the floor frame 50 on the vehicle left side in the vehicle width direction, and the second battery unit 32 is arranged between the propeller shaft 7 and the width increased section 52 of the floor frame 50 on the vehicle right side in the vehicle width direction. The first and second battery units 31, 32 are integrally formed as the battery pack 33 and are supported by the vehicle body 1.

[0073] Fig. 8 is a perspective view of the battery pack, and Fig. 9 is a cross-sectional view of the battery pack that is taken along line Y9-Y9 in Fig. 8. As illustrated in Fig. 8 and Fig. 9, the battery pack 33 has: the first and second battery units 31, 32 that are arranged separately from each other on both sides in the vehicle width direction of the propeller shaft 7; and a battery cover 60 that accommodates the first and second battery units 31, 32.

[0074] Each of the first and second battery units 31, 32 is formed to have a substantially rectangular shape in a plan view, and is formed in a substantially rectangular parallelepiped shape. The first and second battery units 31, 32 are not limited thereto. The first and second battery units 31, 32 are formed to be substantially symmetrical on both sides in the vehicle width direction of the propeller shaft 7. As described above, the first and second battery units 31, 32 are arranged between the width increased sections 52 of the floor frames 50, and are each formed to have large battery capacity by increasing a width thereof in the vehicle width direction in comparison with a case where the width of the floor frame is not increased to the outer side in the vehicle width direction.

[0075] The battery cover 60 preferably has: a first battery accommodation section 61 that accommodates the first battery unit 31; a second battery accommodation section 66 that accommodates the second battery unit 32; and a coupling section 71 that couples the first battery accommodation section 61 and the second battery accommodation section 66 and extends in the vehicle width direction. The battery cover 60 is formed of an aluminum material, for example.

[0076] The first battery accommodation section 61 is formed in a substantially rectangular parallelepiped shape, and is configured to include: a first upper cover member 62 that constitutes an upper side of the first battery accommodation section 61; and a first lower side member 63 that constitutes a lower portion of the first battery accommodation section 61.

[0077] The first upper cover member 62 preferably in-

cludes: an upper surface section 62a that is formed in a substantially rectangular shape and extends in a substantially horizontal direction; a side surface section 62b that extends substantially downward from a peripheral edge portion of the upper surface section 62a; and a flange section 62c that extends outward from a lower end portion of the side surface section 62b in the substantially horizontal direction. The first upper cover member 62 is formed such that the upper surface section 62a bulges substantially upward.

[0078] The first lower cover member 63 preferably includes: a lower surface section 63a that is formed in a substantially rectangular shape and extends in the substantially horizontal direction; a side surface section 63b that extends substantially upward from a peripheral edge portion of the lower surface section 63a; and a flange section 63c that extends outward from an upper end portion of the side surface section 63b in the substantially horizontal direction. The first lower cover member 63 is formed such that the lower surface section 63a bulges substantially downward.

[0079] The first battery accommodation section 61 is formed such that the first upper cover member 62 and the first lower cover member 63 are joined to each other by joining the flange section 62c and the flange section 63c. The first battery unit 31 is attached to the lower surface section 63a of the first lower cover member 63 and is accommodated in a space defined by the first upper cover member 62 and the first lower cover member 63.

[0080] The first battery accommodation section 61 is formed with a front extending section 64 that extends substantially forward in a substantially rectangular parallelepiped shape from an outer side in the vehicle width direction of a vehicle front side of the first battery accommodation section 61. Each of the first upper cover member 62 and the first lower cover member 63 extends substantially forward in the vehicle from the outer side in the vehicle width direction of the vehicle front side in a manner to form the front extending section 64.

[0081] The front junction box 43a is formed in a substantially rectangular parallelepiped shape and is also formed in a flat shape. The front junction box 43a is transversely arranged such that a height thereof in the vertical direction is lower than a length thereof in the vehicle longitudinal direction. On the vehicle front side of the first battery unit 31, the front junction box 43a is attached to the lower surface section 63a of the first lower cover member 63 that constitutes the front extending section 64, and is accommodated in the space defined by the first upper cover member 62 and the first lower cover member 63.

[0082] As illustrated in Fig. 3, in the first battery accommodation section 61, the upper surface section 62a of the first upper cover member 62 is formed with a first opening 62d at a position on the vehicle rear side of the first battery unit 31. The first opening 62d is formed in a substantially rectangular shape, and is also formed in a long hole shape that is longer in the vehicle width direc-

tion than in the vehicle longitudinal direction. The rear junction box 43b, the battery harness, and the like are inserted into the first opening 62d.

[0083] The second battery accommodation section 66 is formed in a substantially rectangular parallelepiped shape, and is configured to include: a second upper cover member 67 that constitutes an upper side of the second battery accommodation section 66; and a second lower cover member 68 that constitutes a lower side of the second battery accommodation section 66.

[0084] The second upper cover member 67 includes: an upper surface section 67a that is formed in a substantially rectangular shape and extends in the substantially horizontal direction; a side surface section 67b that extends substantially downward from a peripheral edge portion of the upper surface section 67a; and a flange section 67c that extends outward from a lower end portion of the side surface section 67b in the substantially horizontal direction. The second upper cover member 67 is formed such that the upper surface section 67a bulges substantially upward.

[0085] The second lower cover member 68 includes: a lower surface section 68a that is formed in a substantially rectangular shape and extends in the substantially horizontal direction; a side surface section 68b that extends substantially upward from a peripheral edge portion of the lower surface section 68a; and a flange section 68c that extends outward from an upper end portion of the side surface section 68b in the substantially horizontal direction. The second lower cover member 68 is formed such that the lower surface section 68a bulges substantially downward.

[0086] The second battery accommodation section 66 is formed such that the second upper cover member 67 and the second lower cover member 68 are joined to each other by joining the flange section 67c and the flange section 68c. The second battery unit 32 is attached to the lower surface section 68a of the second lower cover member 68 and is accommodated in a space defined by the second upper cover member 67 and the second lower cover member 68.

[0087] As illustrated in Fig. 3, in the second battery accommodation section 66, the upper surface section 67a of the second upper cover member 67 is formed with a second opening 67d at a position on the vehicle rear side of the second battery unit 32. The second opening 67d is formed in a substantially rectangular shape, and is also formed in a long hole shape that is longer in the vehicle width direction than in the vehicle longitudinal direction. The battery control unit 44, the battery harness, and the like are inserted into the second opening 67d.

[0088] The coupling section 71 is formed in a substantially rectangular parallelepiped shape that extends longer in the vehicle width direction than in the vehicle longitudinal direction and the vertical direction. The coupling section 71 couples vehicle rear sides of the first battery accommodation section 61 and the second battery accommodation section 66. The coupling section 71 is

formed such that a length thereof in the vehicle longitudinal direction is less than that of each of the first and second battery accommodation sections 61, 66.

[0089] The coupling section 71 is higher than the first and second battery accommodation sections 61, 66, couples the first and second battery accommodation sections 61, 66, extends in the vehicle width direction, and is arranged next to a vehicle front side of the fuel tank 20. As illustrated in Fig. 9, the coupling section 71 is preferably configured to include: a front cover member 72 that constitutes a vehicle front side of the coupling section 71; and a rear cover member 73 that constitutes a vehicle rear side of the coupling section 71.

[0090] The front cover member 72 includes: a lower surface section 72a that is attached to the upper surface sections 62a, 67a of the first and second battery accommodation sections 61, 66; and a peripheral wall section 72b that extends substantially upward from the lower surface section 72a. As illustrated in Fig. 3, in the lower surface section 72a of the front cover member 72, a first opening 72c and a second opening 72d are formed on both sides in the vehicle width direction. The first opening 72c and the second opening 72d respectively correspond to the first opening 62d of the first battery accommodation section 61 and the second opening 67d of the second battery accommodation section 66.

[0091] The first and second openings 72c, 72d of the front cover member 72 are formed in the substantially same shapes as the first and second openings 62d, 67d of the first and second battery accommodation sections 61, 66. Each of the first and second openings 72c, 72d of the front cover member 72 is formed in a substantially rectangular shape, and is also formed in a long hole shape that is longer in the vehicle width direction than in the vehicle longitudinal direction. The rear junction box 43b, the battery harness, and the like are inserted into the first opening 72c. The battery control unit 44, the battery harness, and the like are inserted into the second opening 72d.

[0092] The peripheral wall section 72b of the front cover member 72 extends substantially upward from the lower surface section 72a and constitutes the vehicle front side and both sides in the vehicle width direction of the coupling section 71. A vehicle rear side of the peripheral wall section 72b is formed with a mating surface 72e with the rear cover member 73. The entire mating surface 72e in the vehicle width direction of the front cover member 72 is formed to be inclined substantially downward toward the vehicle rear side.

[0093] The rear cover member 73 includes: an upper surface section 73a; and a peripheral wall section 73b that extends substantially downward from the upper surface section 73a. The peripheral wall section 73b of the rear cover member 73 extends substantially downward from the upper surface section 73a and constitutes the vehicle rear side and both sides in the vehicle width direction of the coupling section 71. A vehicle front side of the peripheral wall section 73b is formed with a mating

surface 73c with the front cover member 72. The entire mating surface 73c in the vehicle width direction of the rear cover member 73 is formed to be inclined substantially downward toward the vehicle rear side.

[0094] The front cover member 72 is joined to the first and second battery accommodation sections 61, 66 using the plural fastening bolts B, each of which extends substantially in the vertical direction, by superposing the lower surface section 72a of the front cover member 72 on the upper surface sections 62a, 67a of the first and second battery accommodation sections 61, 66. The rear cover member 73 is joined to the front cover member 72 using the plural fastening bolts B, each of which is inclined and extends substantially forward and under the vehicle, by causing the mating surface 73c of the rear cover member 73 to mate with the mating surface 72e of the front cover member 72.

[0095] The coupling section 71 is formed with a hollow space therein by joining the front cover member 72 and the rear cover member 73 to each other. The coupling section 71 has a concave section 76a in a lower portion of a center section 76 in the vehicle width direction, and the concave section 76a is dented substantially upward. The concave section 76a of the coupling section 71 is formed between the first battery accommodation section 61 and the second battery accommodation section 66 in the vehicle width direction in a manner to correspond to the tunnel section 11 of the floor panel 10.

[0096] The center section 76 in the vehicle width direction of the coupling section 71 is formed such that a length thereof in the vertical direction is reduced by the concave section 76a to be less than that of an outer section 77 in the vehicle width direction on each side thereof. The center section 76 in the vehicle width direction of the coupling section 71 functions as a fragile section 76 that is fragile with respect to the impact load applied from the outer side in the vehicle width direction when the impact load is applied to the battery pack 33 from the outer side in the vehicle width direction.

[0097] The rear junction box 43b is arranged in the outer section 77 in the vehicle width direction on the vehicle left side of the coupling section 71. The rear junction box 43b is formed in a flat shape and is vertically arranged such that a length thereof in the vehicle longitudinal direction is less than a height thereof in the vertical direction.

[0098] As illustrated in Fig. 9, the rear junction box 43b is preferably attached onto a base 63d that is provided in the first battery accommodation section 61, and is accommodated in the coupling section 71 and the first battery accommodation section 61 through the first opening 62d of the first battery accommodation section 61 and the first opening 72c of the coupling section 71. The rear junction box 43b is arranged next to the vehicle front side of the fuel tank 20 such that a height thereof is greater than that of each of the first and second battery units 31, 32.

[0099] The battery control unit 44 is arranged in the

outer section 77 in the vehicle width direction on the vehicle right side of the coupling section 71. The battery control unit 44 is formed in a flat shape and is vertically arranged such that a length thereof in the vehicle longitudinal direction is less than a height thereof in the vertical direction.

[0100] Similar to the rear junction box 43b, the battery control unit 44 is preferably attached onto a base that is provided in the second battery accommodation section 66, and is accommodated in the coupling section 71 and the second battery accommodation section 66 through the second opening 67d of the second battery accommodation section 66 and the second opening 72d of the coupling section 71. The battery control unit 44 is arranged next to the vehicle front side of the fuel tank 20 such that a height thereof is greater than that of each of the first and second battery units 31, 32.

[0101] As illustrated in Fig. 8, in the coupling section 71, the battery harnesses such as a battery harness 78 and a battery harness 79 extend substantially in the vehicle width direction through the center section 76 in the vehicle width direction. The battery harness 78 electrically connects the first and second battery units 31, 32. The battery harness 79 electrically connects the rear junction box 43b and the battery control unit 44.

[0102] As illustrated in Fig. 6, in regard to the battery pack 33, plural attachment sections 61a, 66a on the outer sides in the vehicle width direction of the first and second battery accommodation sections 61, 66 are fixed to the floor frame 50 by using the plural fastening bolts B, plural attachment sections 61b, 66b on the inner sides in the vehicle width direction of the first and second battery accommodation sections 61, 66 are fixed to the tunnel reinforcing member 54 by using the plural fastening bolts B. In this way, at a position next to the vehicle front side of the fuel tank 20, the battery pack 33 is attached to a lower portion of the floor panel 10.

[0103] When the battery pack 33 is attached to the lower portion of the floor panel 10, the first and second battery units 31, 32 are separately arranged from each other on both sides in the vehicle width direction of the propeller shaft 7, the coupling section 71 is arranged under the kick-up section 12 of the floor panel 10 and above the propeller shaft 7, and the battery harness 78, which electrically connects the first and second battery units 31, 32, is disposed in a manner to run above the propeller shaft 7.

[0104] In addition, the coupling section 71 of the battery pack 33 is arranged to be higher than the first and second battery accommodation sections 61, 66, and is arranged in front of the fuel tank 20, at the position under the kick-up section 12 of the floor panel 10 arranged under the rear seat 26.

[0105] The rear junction box 43b and the battery control unit 44 are preferably arranged under the kick-up section 12 of the floor panel 10, and are separately arranged from each other on both sides in the vehicle width direction of the propeller shaft 7. The battery control unit 44 is arranged at such a position that the battery control

unit 44 overlaps at least a part of the rear junction box 43b in the vehicle longitudinal direction in a vehicle side view.

[0106] As illustrated in Fig. 5, the inverter 41 and the DC/DC converter 42 as the battery-related electrical components are arranged in the battery pack 33, more specifically, at positions near the vehicle front side of the first battery accommodation section 61. Each of the inverter 41 and the DC/DC converter 42 is formed in a flat shape, and is transversely arranged such that a height thereof in the vertical direction is less than a length thereof in the vehicle longitudinal direction. As illustrated in Fig. 3, each of the inverter 41 and the DC/DC converter 42 is formed in a substantially rectangular shape in the plan view.

[0107] Each of the inverter 41 and the DC/DC converter 42 is preferably formed to have a width in the vehicle width direction that is less than that of each of the first and second battery units 31, 32. The DC/DC converter 42 is preferably formed such that the width thereof in the vehicle width direction is less than that of the inverter 41 and the length thereof in the vehicle longitudinal direction is greater than that of the inverter 41.

[0108] The inverter 41 and the DC/DC converter 42 are preferably arranged between the front inclined sections 51 of the right and left floor frames 50, and are arranged between the transmission 4 and the front inclined section 51 of the floor frame 50 on the vehicle left side. The inverter 41 and the DC/DC converter 42 are arranged such that inner sides thereof in the vehicle width direction substantially match each other in the vehicle width direction.

[0109] The DC/DC converter 42 is arranged in front of the inverter 41, and is arranged on an upper side of the inverter 41 in a superposing manner in the vertical direction. As illustrated in Fig. 5 and Fig. 7, in a state of being accommodated in an inverter case 41a and a converter case 42a, the inverter 41 and the DC/DC converter 42 are directly or indirectly attached to the floor panel 10 by using the plural fastening bolts B.

[0110] The inverter 41 and the DC/DC converter 42 are preferably arranged between the transmission 4 and the floor frame 50 on the vehicle left side, and the catalytic device 18 is preferably arranged between the transmission 4 and the floor frame 50 on the vehicle right side. The catalytic device 18 and a combination of the inverter 41 and the DC/DC converter 42 are separately arranged from each other on one side and the other side in the vehicle width direction. In the vehicle side view, the inverter 41 and the DC/DC converter 42 are arranged at positions that overlap at least a part of the catalytic device 18 in the vehicle longitudinal direction.

[0111] The inverter 41 and the DC/DC converter 42 are electrically connected to the first battery unit 31 and the front junction box 43a by a battery harness 80 as the high-voltage harness. On the inner side in the vehicle width direction of the front extending section 64 of the first battery accommodation section 61, the battery har-

ness 80, which electrically connects the combination of the inverter 41 and the DC/DC converter 42 to a combination of the first battery unit 31 and the front junction box 43a, extends substantially in the vehicle longitudinal direction along the front extending section 64.

[0112] Although not illustrated, the vehicle body 1 also includes a battery-related electrical component such as a heater unit at a position between the transmission 4 and the front inclined section 51 of the floor frame 50 on the vehicle left side. The heater unit warms the cabin 25. The heater unit is formed in a flat shape, and is configured by a positive temperature coefficient (PTC) heater, for example.

[0113] In the vehicle body 1 that is configured as described above, in the case where the impact load is applied thereto from the front side of the vehicle body during the frontal collision, and the impact load is applied to the drive source 2 from the front side of the vehicle body, the vehicle front side of the differential 8 rotates downward, the vehicle rear side of the propeller shaft 7 moves downward and is deformed, and the drive source 2 moves rearward in the vehicle body.

[0114] At the positions under the floor panel 10, the first and second battery units 31, 32 are arranged on both sides in the vehicle width direction of the propeller shaft 7. Thus, even in the case where the vehicle rear side of the propeller shaft 7 moves downward and is deformed, it is possible to suppress the propeller shaft 7 from coming into contact with the first and second battery units 31, 32. The battery harness 78, which electrically connects the first and second battery units 31, 32, is arranged to run above the propeller shaft 7. Thus, it is also possible to suppress the propeller shaft 7 from coming into contact with the battery harness 78.

[0115] In addition, the vehicle body 1 includes the fragile section 76 in the coupling section 71 of the battery pack 33. Accordingly, in the case where the impact load is applied to the vehicle body 1 from the outer side in the vehicle width direction during a lateral collision, and the impact load is applied to the battery pack 33 from the outer side in the vehicle width direction, the fragile section 76 is crushed and deformed. Thus, it is possible to suppress the first and second battery accommodation sections 61, 66 from being crushed and deformed.

[0116] As described above, the vehicle lower structure according to this embodiment includes: the battery pack 33 having the first and second battery units 31, 32 and the battery cover 60 that are arranged under the floor panel 10 and on both sides in the vehicle width direction of the propeller shaft 7; and the fuel tank 20 that is arranged on the vehicle rear side of the first and second battery units 31, 32 and to be higher than the first and second battery units 31, 32. The battery cover 60 has the coupling section 71 that couples the first and second battery accommodation sections 61, 66. The coupling section 71 couples the first and second battery accommodation sections 61, 66 such that the vehicle rear side thereof is higher than the first and second battery accom-

modation sections 61, 66, extends in the vehicle width direction at the position above the propeller shaft 7, and is arranged next to the vehicle front side of the fuel tank 20.

[0117] In the vehicle in which the first and second battery units 31, 32 are arranged on both sides in the vehicle width direction of the propeller shaft 7, the coupling section 71 of the battery cover 60 is arranged above the propeller shaft 7. Thus, even in the case where the propeller shaft 7 moves downward and is deformed during the frontal collision, it is possible to suppress the propeller shaft 7 from coming into contact with the first and second battery units 31, 32 and the coupling section 71. Therefore, the battery pack 33 can be protected.

[0118] The coupling section 71 of the battery pack 33 couples the first and second battery accommodation sections 61, 66 such that the vehicle rear side thereof is higher than the first and second battery accommodation sections 61, 66. Accordingly, it is possible to suppress a reduction in the battery capacity of each of the first and second battery units 31, 32 and to suppress a reduction in size of a cabin space. The coupling section 71 of the battery pack 33 is arranged next to the vehicle front side of the fuel tank 20. Accordingly, the coupling section 71 and the fuel tank 20 can be arranged under the kick-up section 12 of the floor panel 10, which is arranged under the rear seat 26. In this way, it is possible to suppress occupant comfort from being degraded by the reduction in the size of the cabin space.

[0119] Therefore, in the vehicle in which, at the positions under the floor panel 10, the first and second battery units 31, 32 are arranged on both sides in the vehicle width direction of the propeller shaft 7, it is possible to protect the battery pack 33 during the collision and to suppress the reductions in the battery capacity and the size of the cabin space.

[0120] The coupling section 71 is formed such that the length thereof in the vehicle longitudinal direction is less than that of each of the first and second battery accommodation sections 61, 66. In this way, the vehicle rear sides of the first battery accommodation section 61 and the second battery accommodation section 66 are coupled by the coupling section 71, which is formed to have the less length in the vehicle longitudinal direction than each of the first and second battery accommodation sections 61, 66. Thus, it is possible to effectively suppress the reduction in the size of the cabin space.

[0121] At the position under the rear seat 26, the rear portion of the floor panel 10 has the kick-up section 12 that is formed to be higher than the front portion thereof. The coupling section 71 and the fuel tank 20 are arranged under the kick-up section 12. Accordingly, the coupling section 71 and the fuel tank 20 are arranged under the kick-up section 12 of the floor panel 10, which is arranged under the rear seat 26. Thus, it is possible to suppress the occupant comfort from being degraded by the reduction in the size of the cabin space.

[0122] The coupling section 71 is formed by joining the

front cover member 72 and the rear cover member 73. The mating surfaces 72e, 73c of the front cover member 72 and the rear cover member 73 are each formed to be inclined downward toward the vehicle rear side. In this way, the mating surfaces 72e, 73c of the front cover member 72 and the rear cover member 73 constituting the coupling section 71 are formed to be inclined. Thus, compared to a case where the mating surfaces are not formed to be inclined, an opening of the mating surfaces 72e, 73c can be increased, which facilitates attachment and detachment of the components 43b, 44 arranged in the coupling section 71. As a result, work efficiency can be improved.

[0123] Fig. 10 is an explanatory view for illustrating a modified example of the coupling section of the battery pack. As illustrated in Fig. 10, a concave section 76b that is dented substantially downward can also be formed on an upper side of the center section 76 in the vehicle width direction of the coupling section 71 provided to the battery pack 33 such that a tank attachment member 88, to which the fixture belt 57 for fixing the fuel tank 20 is attached, is arranged thereon.

[0124] Fig. 11 is an explanatory view for illustrating the tank attachment member that is arranged above the coupling section illustrated in Fig. 10. As illustrated in Fig. 11, the concave section 76b may be formed on the upper side of the coupling section 71 of the battery pack 33, and the tank attachment member 88 may be arranged in the concave section 76b. Instead of the tank attachment member 58 that is attached to the floor frame 50, the tank attachment member 88 that is arranged in the concave section 76b of the coupling section 71 may be attached to a lower surface side of the kick-up section 12 of the floor panel 10.

[0125] As the tank attachment member 88, the tank attachment member 88 that includes: a bottom surface section 88a extending in the substantially horizontal direction; and a vertical surface section 88b extending substantially upward from a vehicle rear side of the bottom surface section 88a, that is joined to the kick-up section 12 of the floor panel 10, and to which the front end portion of the fixture belt 57 is fixed by using the fastening bolt B can be used.

[0126] In this case, the two tank attachment members 88 are attached to the lower surface side of the kick-up section 12 of the floor panel 10, the front end portion of each of the fixture belts 57 is fixed to a respective one of the two tank attachment members 88, the rear end portion of each of the fixture belts 57 is fixed to the tank attachment member 59 that is attached to the center side in the vehicle width direction of the third crossmember 28, and the fuel tank 20 is supported from below by the fixture belts 57.

[0127] As described above, the coupling section 71 can include the concave section 76b, which is dented substantially downward, on the upper side of the coupling section 71, and the tank attachment member 88, to which the fixture belt 57 for fixing the fuel tank 20 is attached,

can be arranged in the concave section 76b. In such a case, the concave section 76b is provided on the upper side of the coupling section 71, and the tank attachment member 88 is arranged in the concave section 76b. Thus, compared to a case where the tank attachment member is arranged above the coupling section 71 without providing the concave section to the coupling section 71, the tank attachment member 88 can be arranged compactly above the coupling section 71.

[0128] In this embodiment, the drive motor 5 is arranged between the engine 3 and the transmission 4. However, the drive motor may be arranged separately from the engine 3 and the transmission 4, and the power from at least one of the engine 3 and the drive motor 5 may be transmitted to the drive wheels 6.

[0129] The vehicle according to this embodiment is the hybrid vehicle of an internal combustion engine vertically arranged type in which the internal combustion engine 3 is arranged in the vehicle front side and the power from the internal combustion engine 3 is transmitted to the drive wheels 6 arranged in the vehicle rear side. However, the present invention can also be applied to a four-wheel-drive hybrid vehicle of the internal combustion engine vertically arranged type and a four-wheel-drive hybrid vehicle of an internal combustion engine transversely arranged type that is based on the front-engine, front-wheel-drive vehicle.

[0130] The present invention is not limited to the exemplary embodiment, and various improvements and design changes can be made thereto within the scope that does not depart from the gist of the present invention.

[Industrial Applicability]

[0131] As it has been described so far, according to the present invention, in the vehicle in which, at the positions under the floor panel, the first and second battery units are arranged on both sides in the vehicle width direction of the propeller shaft, it is possible to protect the battery pack and to suppress the reductions in the battery capacity and the size of the cabin space. Thus, there is a possibility that the present invention is favorably used in this type of the vehicle.

[Description of Reference Signs and Numerals]

[0132]

2 Drive source
3 Internal Combustion Engine
5 Electric Motor
7 Propeller shaft
10 Floor panel
12 Kick-up section
20 Fuel tank
31 First battery unit
32 Second battery unit
33 Battery pack

60 Battery cover
61 First battery accommodation section
66 Second battery accommodation section
71 Coupling section
72 Front cover member
73 Rear cover member

Claims

1. A vehicle lower structure including: a drive source (2) having an internal combustion engine (3) and an electric drive motor (5); a floor panel (10) forming a floor surface of a cabin; and a propeller shaft (7) extending in a vehicle longitudinal direction at a position under the floor panel (10) to transmit power from the drive source (2) to at least one drive wheel (6), the vehicle lower structure comprising:

a battery pack (33) having a first battery unit (31), a second battery unit (32), and a battery cover (60), at positions under the floor panel (10), the first battery unit (31) and the second battery unit (32) being arranged separately from each other on both sides in a vehicle width direction of the propeller shaft (7) and storing electricity to be supplied to the electric drive motor (5); and a fuel tank (20) arranged at a position under the floor panel (10) and on a vehicle rear side of the first battery unit (31) and the second battery unit (32) in a manner to be higher than the first battery unit (31) and the second battery unit (32), wherein the battery cover (60) has:

a first battery accommodation section (61) accommodating the first battery unit (31);
a second battery accommodation section (66) accommodating the second battery unit (32); and
a coupling section (71) that couples the first battery accommodation section (61) and the second battery accommodation section (66), and

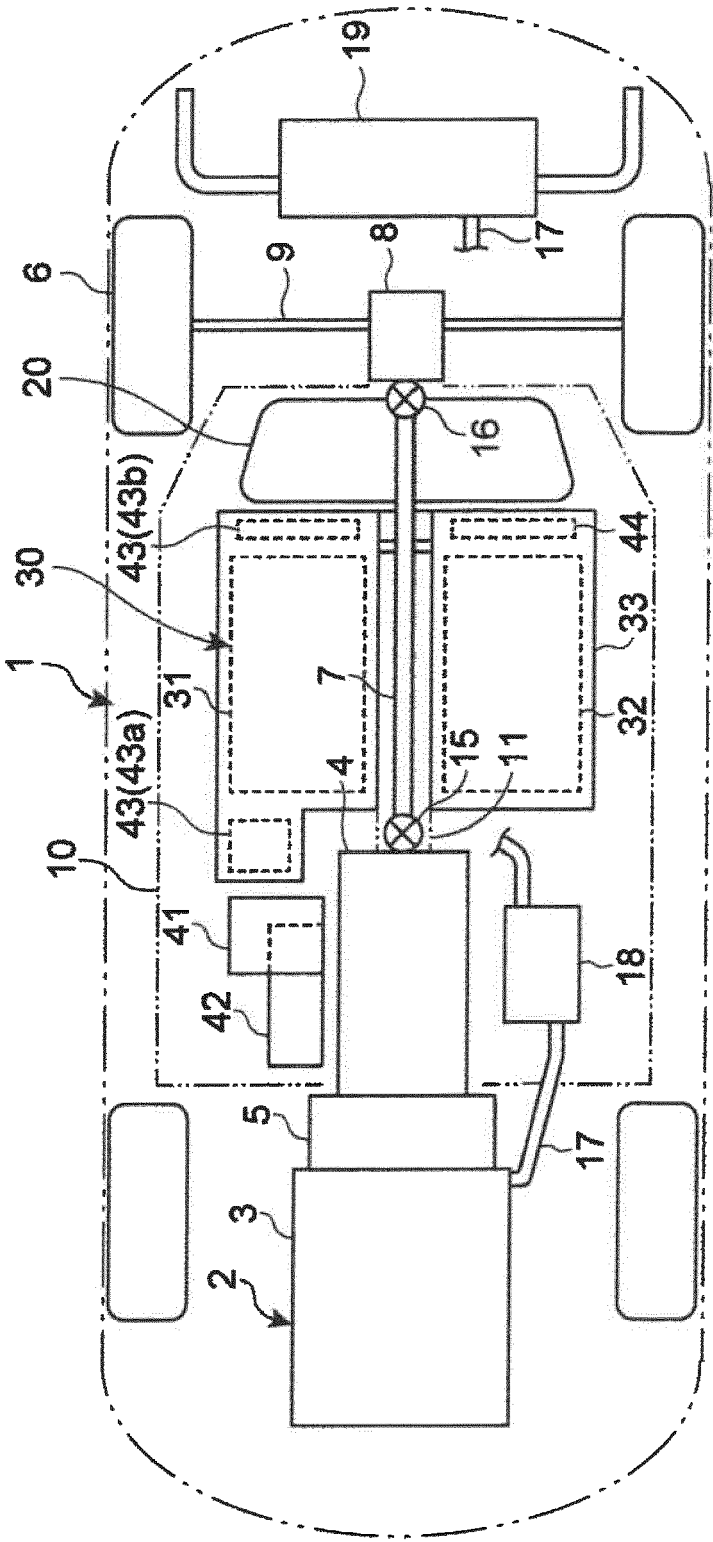
the coupling section (71) couples the first battery accommodation section (61) and the second battery accommodation section (66) such that it extends in the vehicle width direction at a position above the propeller shaft (7), and is arranged next to a vehicle front side of the fuel tank (20).

2. The vehicle lower structure according to claim 1, wherein a vehicle rear side of the coupling section (71) is higher than the first battery accommodation section (61) and the second battery accommodation section (66).

3. The vehicle lower structure according to claim 1 or 2, wherein
the coupling section (71) is formed such that the length thereof in the vehicle longitudinal direction is less than a length of each of the first battery accommodation section (61) and the second battery accommodation section (66). 5
4. The vehicle lower structure according to any one of the preceding claims, wherein
the floor panel (10) has a kick-up section (12) in a rear portion of the floor panel (10) at a position under a rear seat (26), the kick-up section (12) being formed to be higher than a front portion of the floor panel (10). 10 15
5. The vehicle lower structure according to claim 4, wherein
the coupling section (71) and the fuel tank (20) are arranged under the kick-up section (12). 20
6. The vehicle lower structure according to any one of the preceding claims, further comprising:
a tank attachment member (58, 59) to which a fixture belt (57) for fixing the fuel tank (20) is attached, wherein
the coupling section (71) includes a concave section (76b) on an upper side of the coupling section (71), the concave section (76b) being dented substantially downward, and
the tank attachment member (58, 59) is arranged at least partly in the concave section (76b). 25 30 35
7. The vehicle lower structure according to any one of the preceding claims, wherein
the coupling section (71) is formed by joining a front cover member (72) arranged on a vehicle front side and a rear cover member (73) arranged on a vehicle rear side, and
mating surfaces (72e) of the front cover member (72) and the rear cover member (73) are formed to be inclined downward in the vehicle toward the vehicle rear side. 40 45
8. A vehicle comprising a vehicle lower structure according to any one of the preceding claims.
9. A method of accommodating a battery in a vehicle comprising the steps of: 50
providing a battery cover (60),
forming the battery cover (60) with a first battery accommodation section (61) and a second battery accommodation section (66),
accommodating a first battery unit (31) in the first battery accommodation section (61), 55
- accommodating a second battery unit (32) in the second battery accommodation section (66),
coupling the first battery accommodation section (61) and the second battery accommodation section (66) by means of a coupling section (71), forming the coupling section (71) at a rear end of the first battery accommodation section (61) and the second battery accommodation section (66) such that the coupling section (71) is provided on a top side of the first battery accommodation section (61) and the second battery accommodation section (66) and extends substantially orthogonal to a longitudinal direction of the first battery accommodation section (61) and the second battery accommodation section (66).
10. The method of claim 9, wherein
the first battery accommodation section (61) and the second battery accommodation section (66) are mounted below a floor panel (10) of the vehicle such that the coupling section (71) extends in the vehicle width direction at a position above a propeller shaft (7) of the vehicle and in front of a fuel tank (20) of the vehicle.
11. The method of claim 9 or 10, wherein
the coupling section (71) and the fuel tank (20) are arranged under a kick-up section (12) of the floor panel (10) of the vehicle.
12. The method of any one of the preceding claims 9 to 11, wherein
the coupling section (71) is formed by joining a front cover member (72) arranged on a vehicle front side and a rear cover member (73) arranged on a vehicle rear side, and
mating surfaces (72e) of the front cover member (72) and the rear cover member (73) are formed to be inclined downward in the vehicle toward the vehicle rear side.

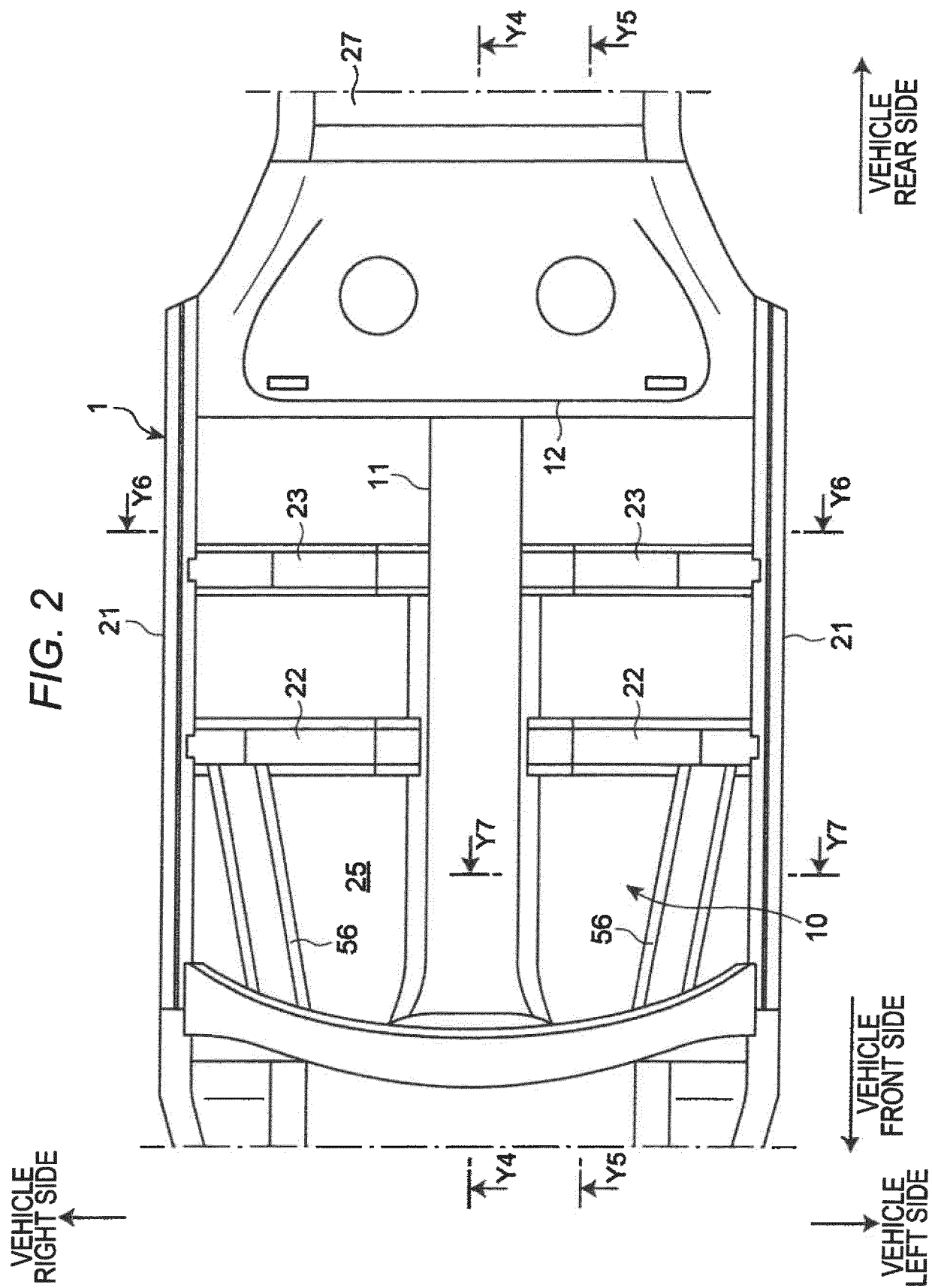
FIG. 1

VEHICLE
LEFT SIDE



VEHICLE
FRONT SIDE
VEHICLE
RIGHT SIDE

VEHICLE
REAR SIDE



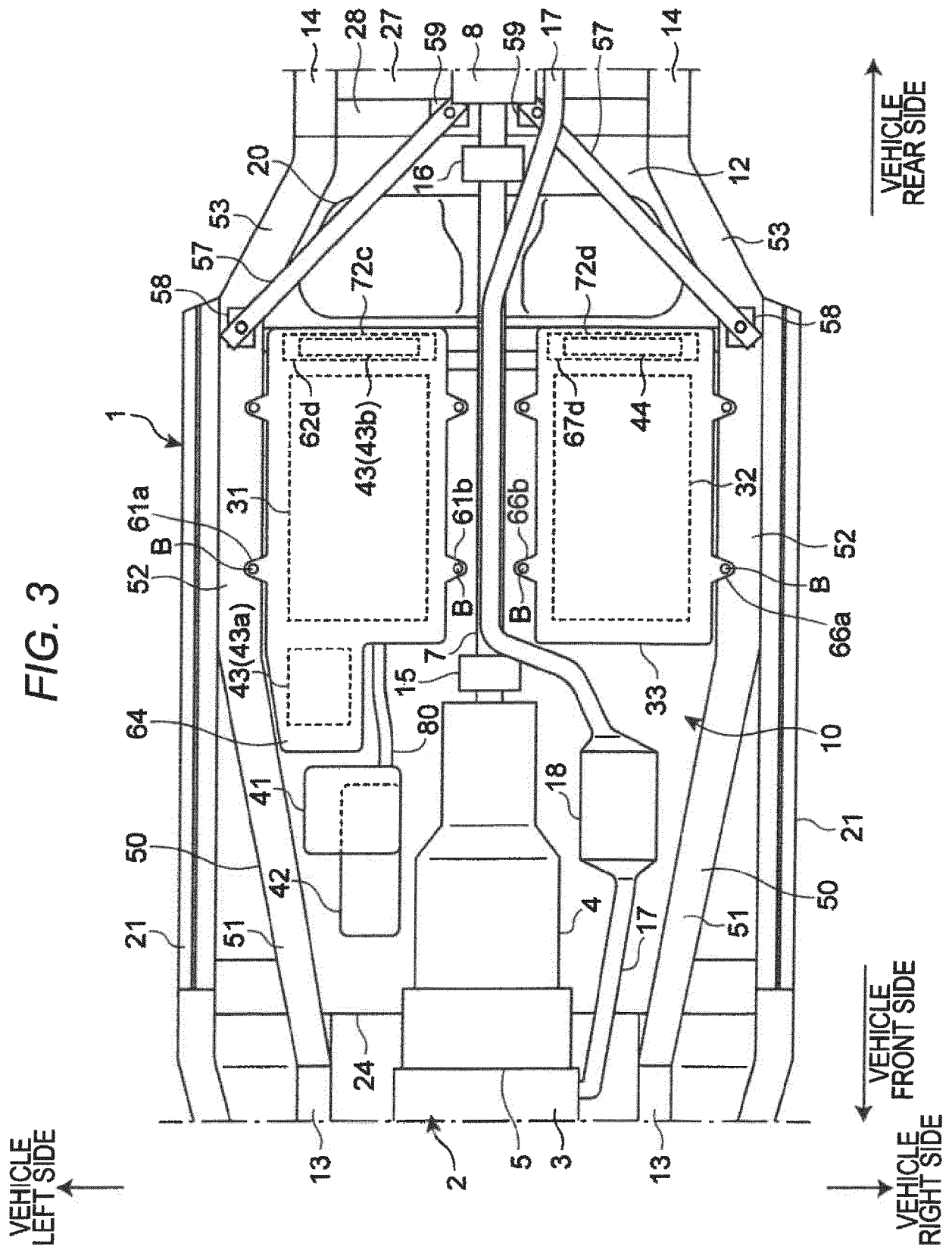


FIG. 4

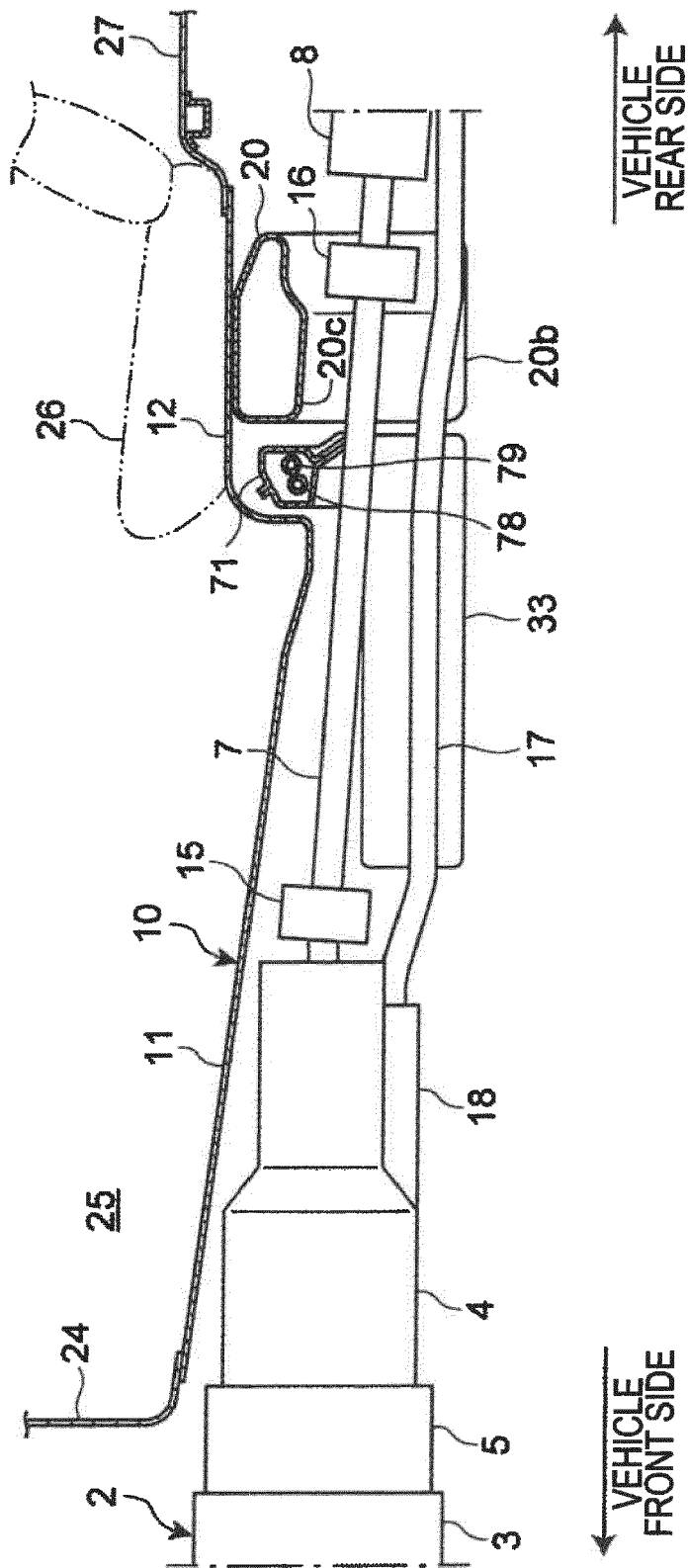


FIG. 5

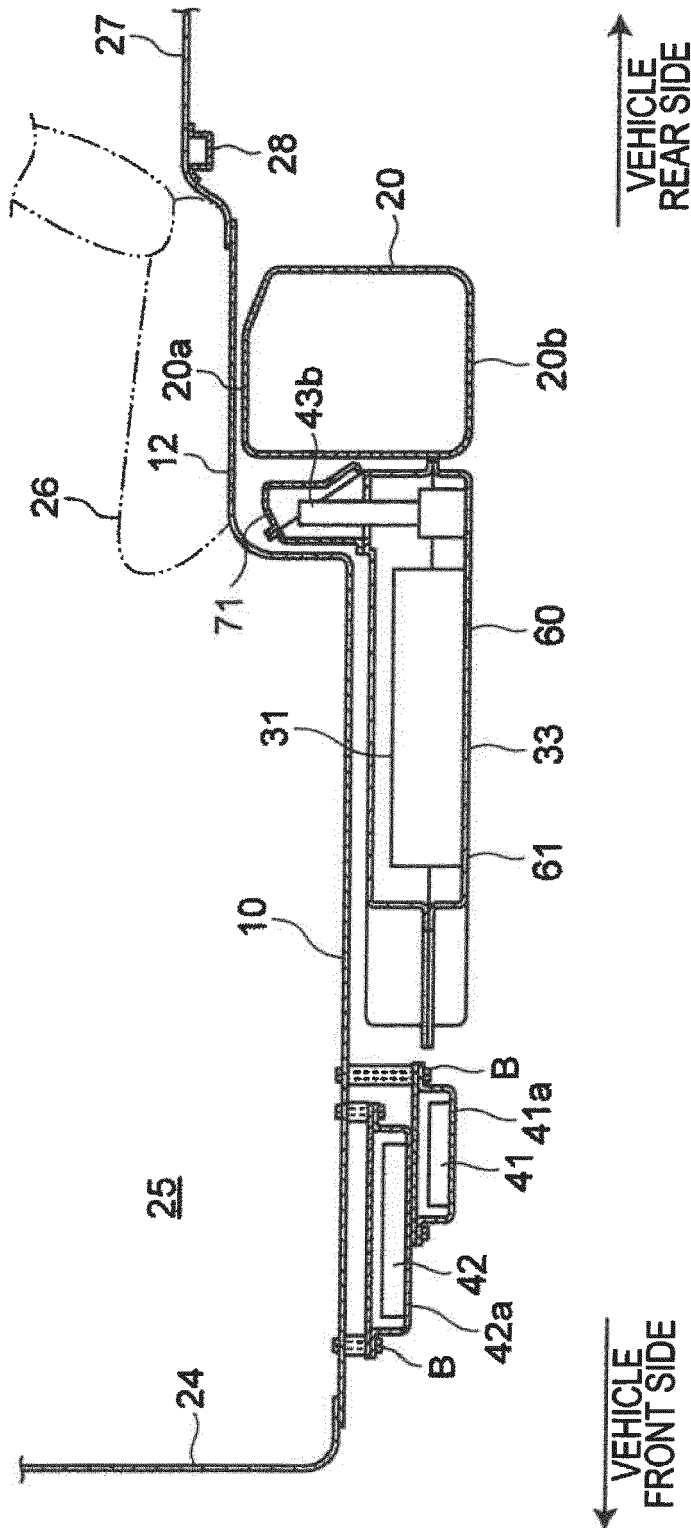


FIG. 6

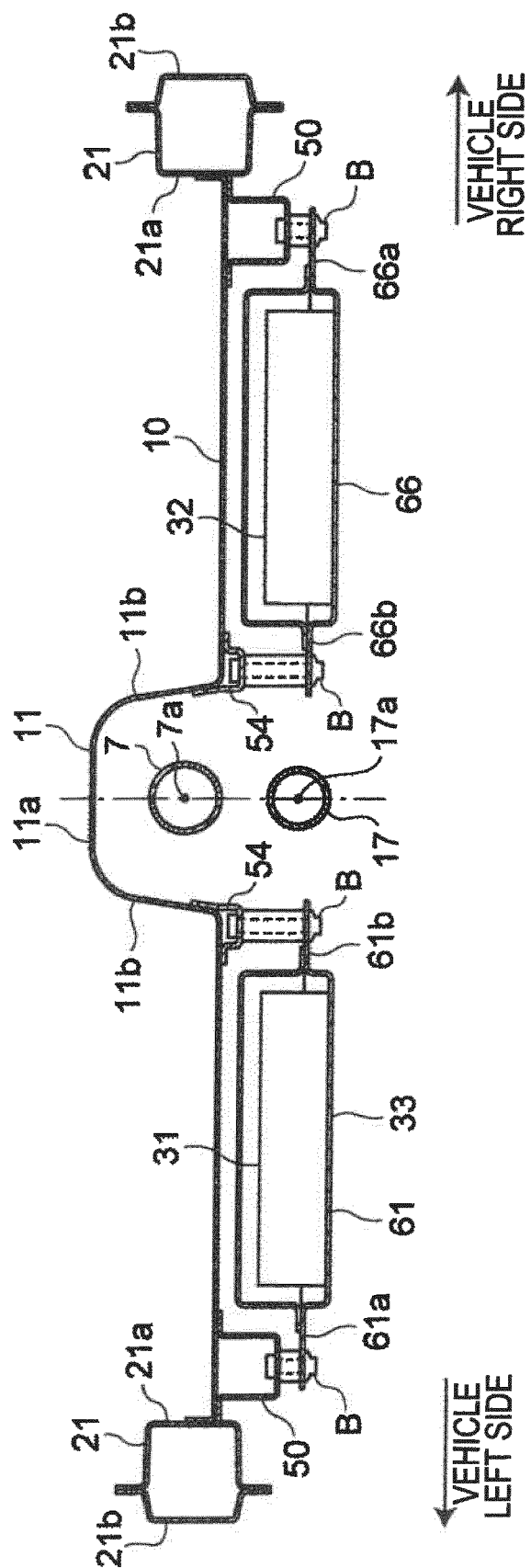


FIG. 7

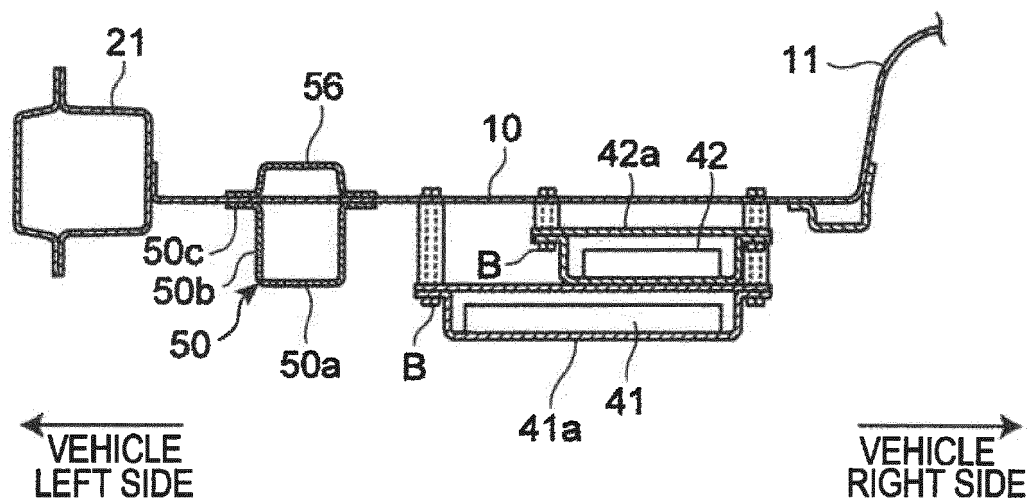


FIG. 8

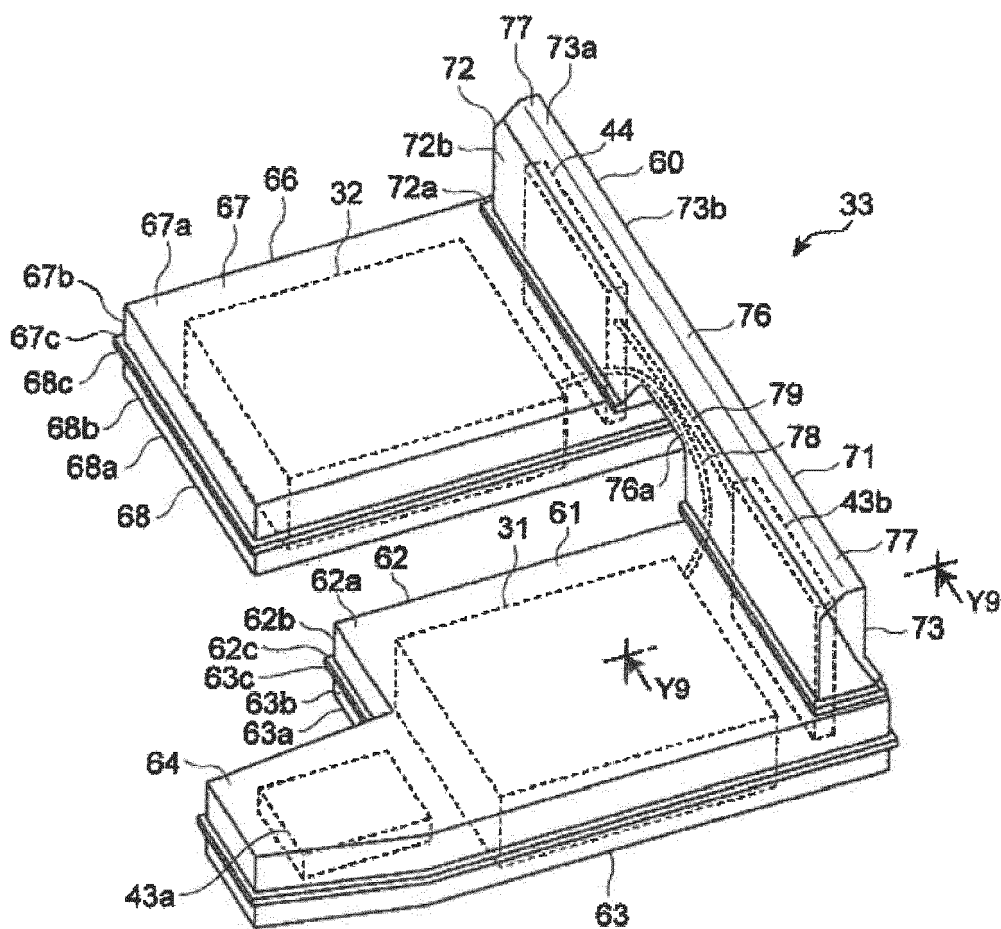


FIG. 9

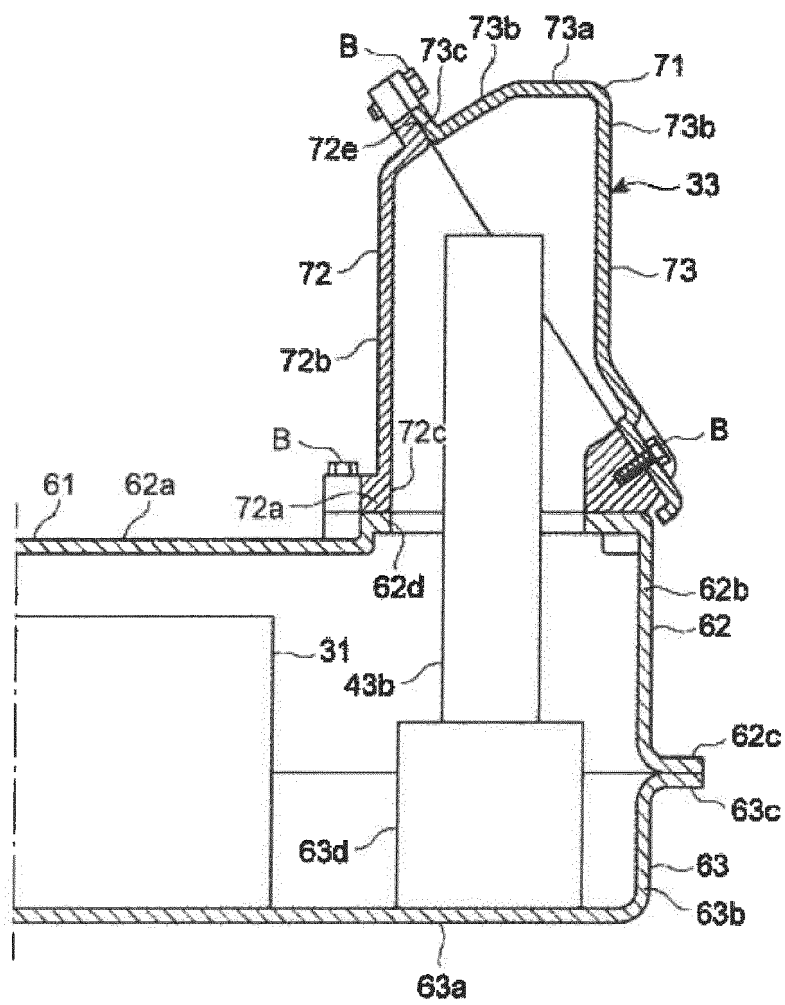


FIG. 10

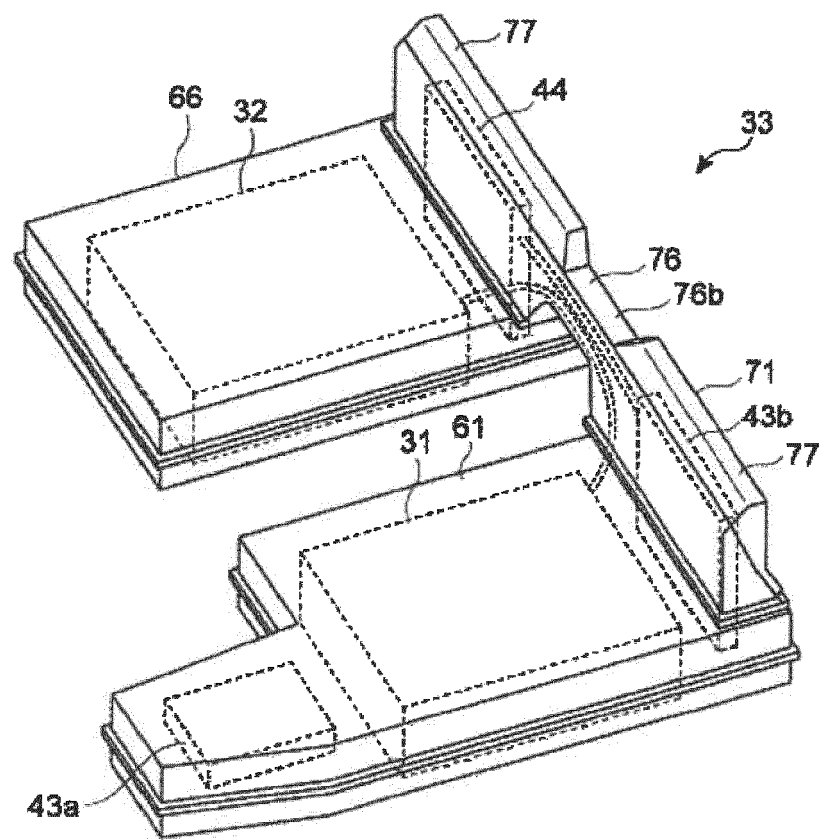
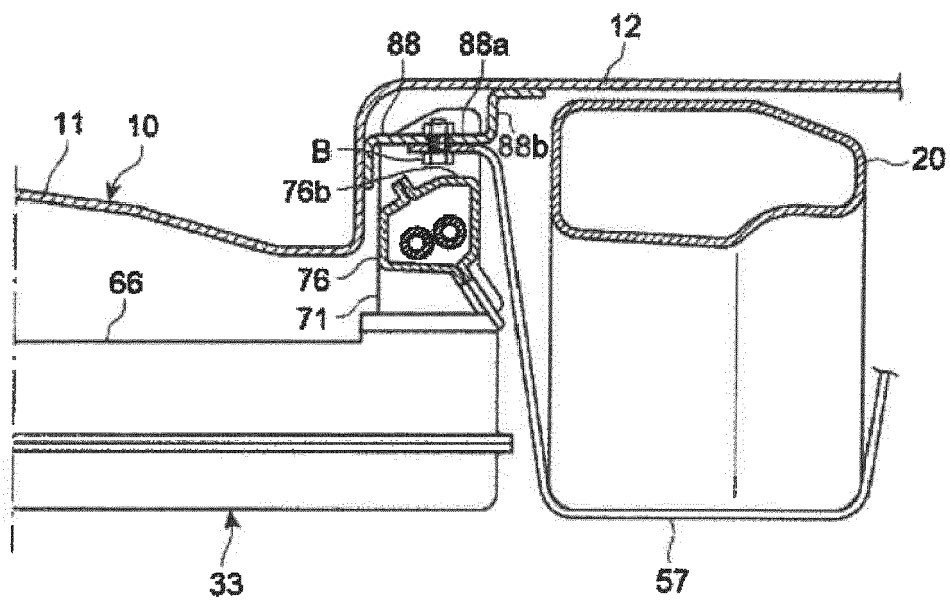


FIG. 11





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Place of search Munich		Date of completion of the search 20 April 2021	Examiner Eriksson, Jonas
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