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VEHICLE BODY FRONT STRUCTURE

Abstract

The vehicle includes a motor, a bulkhead portion constituting a part of a front part formed as a metal casting and partitioning the vehicle cabin and the power unit room on a vehicle rear side of the motor, a front mount portion which supports a vehicle front side portion of the motor with respect to the front part and is capable of releasing a support state of the motor when a load of a predetermined size or more is input from the vehicle front side, a rear mount portion which supports a vehicle rear side portion of the front mount portion and the vehicle upper side of the motor with respect to the front part, and an impact absorbing portion which is integrally provided with the bulkhead portion on the vehicle front side of the bulkhead portion and deforms when an impact load from the vehicle front side is input.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-024062 filed on Feb. 20, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to vehicle body front structures.

2. Description of Related Art

[0003] Japanese Unexamined Patent Application Publication No. 2021-75159 (JP 2021-75159 A) discloses an embodiment related to a vehicle rear structure. In this vehicle rear structure, a muffler located behind a motor is crushed by the motor in the event of a rear-end collision. The muffler can thus absorb impact energy of the motor.

SUMMARY

[0004] However, the above related art does not mention absorbing impact energy of a motor in the event of a frontal collision of a vehicle in which the motor is mounted on the front side of the vehicle, and there is room for improvement in this respect.

[0005] In view of the above circumstances, an object of the present disclosure is to provide a vehicle body front structure that can absorb impact energy of a motor in the event of a frontal collision of a vehicle in which the motor is mounted on the front side of the vehicle.

[0006] A vehicle body front structure of a first aspect includes: [0007] a motor disposed on a front side of a vehicle and configured to apply a driving force to a drive wheel; [0008] a bulkhead portion constituting part of a vehicle body that is a metal cast product, and separating a vehicle cabin and a power unit room from each other at a position behind the motor in a vehicle front-rear direction; [0009] a front mount portion configured to support a front part in the vehicle front-rear direction of the motor with respect to the vehicle body, and configured to release the motor from a supported state when a load of a predetermined magnitude or more is applied from the front side of the vehicle; [0010] a rear mount portion configured to support a rear part in the vehicle front-rear direction of the motor with respect to the vehicle body at a position behind the front mount portion in the vehicle front-rear direction and above the front mount portion in a vehicle up-down direction; and [0011] an impact absorbing portion that is provided integrally with the bulkhead portion on a front side in the vehicle front-rear direction of the bulkhead portion and that is configured to be deformed when an impact load is applied from the front side of the vehicle.

[0012] In the vehicle body front structure of the first aspect, the motor is disposed on the front side of the vehicle, and the motor applies the driving force to the drive wheel of the vehicle. The vehicle body that is a metal cast product is provided with the bulkhead portion constituting part of the vehicle body. The bulkhead portion separates the vehicle cabin and the power unit room from each other at a position behind the motor in the vehicle front-rear direction.

[0013] When an impact load is applied to the vehicle from the front side of the vehicle, the motor receives this impact load. As a result, the motor may enter the vehicle cabin. It is therefore preferable to absorb the impact energy of the motor before the motor enters the vehicle cabin.

[0014] In this aspect, the front part in the vehicle front-rear direction of the motor is supported with respect to the vehicle body by the front mount portion. The front mount portion is configured to release the motor from a supported state when a load of the predetermined magnitude or more is applied from the front side of the vehicle.

[0015] On the other hand, the rear part in the vehicle front-rear direction of the motor is supported

with respect to the vehicle body by the rear mount portion. The rear mount portion is supported at a position behind the front mount portion in the vehicle front-rear direction and above the front mount portion in the vehicle up-down direction.

[0016] Therefore, in this aspect, when an impact load of the predetermined magnitude or more is applied to the vehicle from the front side of the vehicle, the motor receives this impact load, so that the motor rotates about the rear mount portion as viewed in a vehicle width direction, and moves toward the bulkhead portion of the vehicle body.

[0017] The impact absorbing portion integral with the bulkhead portion is provided on the front side in the vehicle front-rear direction of the bulkhead portion. This impact absorbing portion is deformed when an impact load of the motor is applied from the front side of the vehicle. As a result, in this aspect, impact energy of the motor can be absorbed before the motor enters the vehicle cabin.

[0018] According to a vehicle body front structure of a second aspect, in the vehicle body front structure of the first aspect, the impact absorbing portion may include a front impact absorbing portion and a rear impact absorbing portion. The front impact absorbing portion includes a plurality of impact absorbing pieces whose thickness direction is a direction in which an impact load is applied. A plurality of reinforcing ribs is arranged in the rear impact absorbing portion so as to form a closed section as viewed in a vehicle up-down direction.

[0019] In the vehicle body front structure of the second aspect, the impact absorbing portion includes the front impact absorbing portion and the rear impact absorbing portion. The front impact absorbing portion includes the impact absorbing pieces whose thickness direction is the direction in which an impact load is applied. The impact absorbing pieces are flexibly deformed when an impact load of the motor is applied from the front side of the vehicle. The impact absorbing pieces thus contribute to absorption of the impact load.

[0020] On the other hand, the reinforcing ribs are arranged in the rear impact absorbing portion so as to form a closed section as viewed in the vehicle up-down direction. The rear impact absorbing portion thus has a higher rigidity against the impact load from the front side of the vehicle than the front impact absorbing portion.

[0021] Accordingly, in this aspect, the front part in the vehicle front-rear direction of the impact absorbing portion is more easily deformed by the impact load, and the rear part in the vehicle front-rear direction of the impact absorbing portion is less easily deformed by the impact load. As a result, it is possible to achieve both absorption of the impact load from the front side of the vehicle and reduction in entry of the motor into the vehicle cabin.

[0022] As described above, the vehicle body front structure according to the present disclosure is advantageous in that it can absorb the impact energy of the motor in the event of a frontal collision of the vehicle in which the motor is mounted on the front side of the vehicle.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Features, advantages, and technical and industrial significance of exemplary embodiments of the disclosure will be described below with reference to the accompanying drawings, in which like signs denote like elements, and wherein:

[0024] FIG. 1 is a cross-sectional view (a cross-sectional view taken along a I-I line in FIG. 2) showing a configuration of a front part of a vehicle to which a vehicle body front structure according to the present embodiment is applied;

[0025] FIG. 2 is a perspective view showing a configuration of a vehicle front portion of a vehicle body to which the vehicle body front structure according to the present embodiment is applied;

[0026] FIG. 3 is a plan view showing a configuration of a front mount portion of a motor mounted

on a vehicle to which the vehicle body front structure according to the present embodiment is applied; and

[0027] FIG. 4 is a plan view showing a configuration of an impact absorbing portion provided in a vehicle body of the vehicle to which the vehicle body front structure according to the present embodiment is applied (a four-way arrow view in FIG. 1).

DETAILED DESCRIPTION OF EMBODIMENTS

[0028] Hereinafter, an example of an embodiment of a vehicle body front structure according to the present disclosure will be described with reference to FIGS. 1 to 4. Furthermore, in the drawings, an arrow FR indicates a vehicle front side, an arrow UP indicates a vehicle upper side, and an arrow RH indicates a right side of the width direction of the vehicle.

[0029] First, a schematic configuration of the “vehicle 10” to which the vehicle body structure according to the present embodiment is applied will be described with reference to FIG. 2. In the present embodiment, since the vehicle 10 is basically symmetrical, the configuration of the vehicle 10 on the right side in the vehicle width direction will be mainly described below, and the configuration of the vehicle width direction on the left side will not be described as appropriate.

[0030] The vehicle 10 includes a “front part 12” as a vehicle body that constitutes a portion on the vehicle front side, a center part that constitutes a central portion in the vehicle front-rear direction and includes a battery frame that holds a battery and a battery, and a rear part that constitutes a portion on the vehicle rear side. The front part 12 is made of aluminum die cast. The center part is not shown. The rear part is made of aluminum die cast and is not shown.

[0031] As also shown in FIG. 1, the front part 12 includes a pair of side component portions 14, a “bulkhead portion 16”, and an “impact absorbing portion 18”.

[0032] The side component portion 14 includes a suspension tower portion 14A, a wheel house portion 14B, and a side member portion 14C. The suspension tower portion 14A has a box shape in which a lower side of the vehicle is opened and a circular penetrating portion 20 is formed on an upper surface thereof, and supports an impact absorber (not shown). 15

[0033] The wheel house portion 14B is provided integrally with the suspension tower portion 14A and has a spherical shape capable of accommodating a part of a tire (not shown).

[0034] The side member portion 14C is disposed on the vehicle lower side of the 20 suspension tower portion 14A and is integrally provided with the suspension tower portion 14A and the wheel house portion 14B. The side member portion 14C extends in the vehicle front-rear direction, and has a U-shaped cross-section when viewed from the vehicle front side.

[0035] A crash box 22 is attached to a part of the side member portion 14C on the 25 vehicle front side, and the front end portions of the crash box 22 are connected to each other by bumper reinforcement 24 extending in the vehicle widthwise direction.

[0036] On the other hand, the bulkhead portion 16 extends in the vehicle vertical direction and the vehicle width direction with the thickness direction being the vehicle front-rear direction, and is arranged along the front edge portion of the center part described above, 30 and partitions the “vehicle cabin 10A” and the “power unit room 10B”. In addition, the bulkhead portion 16 connects the side component portions 14 to each other in the vehicle width direction. The bulkhead portion 16 is provided with an impact absorbing portion 18.

[0037] As also shown in FIG. 4, the impact absorbing portion 18 includes an upper wall portion 18A constituting a portion on the vehicle upper side and a pair of side wall portions 18B constituting a portion on the vehicle width-direction outer side, and extends from the bulkhead portion 16 to the vehicle front lower side.

[0038] More specifically, in the impact absorbing portion 18, the portion on the front side of the vehicle than the border wall portion 18C connecting the side wall portions 18B to each other in the vehicle front-rear-direction central portion is defined as a “front impact absorbing portion 18D”.

More specifically, in the impact absorbing portion 18, a portion on the rear side of the vehicle than the border wall portion 18C is referred to as a “rear side impact absorbing portion 18E”.

[0039] The front impact absorbing portion **18D** has a plate shape in which a plate thickness direction is a vehicle front-rear direction, extends in the vehicle width direction, and a thickness is thinner than the border wall portion **18C**, and includes a plurality of “impact absorbing pieces **18D1**” arranged at predetermined intervals in the vehicle front-rear direction. The impact absorbing pieces **18D1** extends from the upper wall portion **18A** toward the lower side of the vehicle.

[0040] On the other hand, the rear impact absorbing portion **18E** includes a plurality of “reinforcing rib **18E1**”, a “reinforcing rib **18E2**”, and a plurality of “reinforcing rib **18E3**”. The plurality of “reinforcing ribbing **18E1**” extend in the vehicle front-rear direction when viewed from the vehicle up-down direction. “Reinforcing ribs **18E2**” extend in the vehicle-width direction. The plurality of “reinforcing rib **18E3**” extend across the reinforcing rib **18E1** and the reinforcing rib **18E2**. The reinforcing rib **18E1**, the reinforcing rib **18E2**, and the reinforcing rib **18E3** are arranged so as to constitute a triangular closed cross-section when viewed from the up-down direction of the vehicle. In the rear impact absorbing portion **18E** configured as described above, the rigidity with respect to the impact load from the front side of the vehicle is higher than that of the front impact absorbing portion **18D**.

[0041] Returning to FIG. **1**, the suspension member **26** is attached to the vehicle lower side portion of the front part **12** configured as described above, and the “motor **28**” is supported by the suspension member **26** from the vehicle lower side.

[0042] Specifically, the motor **28** is capable of applying a driving force to drive wheels (not shown) of the vehicle **10**, and includes a motor case **30** constituting an outer shell thereof. The motor case **30** includes a main body portion **30A** constituting a main part thereof, a pair of rear mounting piece portion **30B** extending from the main body portion **30A** to the vehicle rear upper side, and a front mounting piece portion **30C** extending from the main body portion **30A** to the vehicle front lower side.

[0043] More specifically, the support shaft portion **30B1** protrudes from the distal end-side portion of the rear mounting piece portion **30B** to the vehicle-width-direction outer side. The support shaft portion **30B1** is rotatably supported around the vehicle width-direction in the vehicle upper side of the wheel house portion **14B** and the vehicle front side of the bulkhead portion **16** in the side component portion **14** via the rear mount member **32**. Hereinafter, the assembly of the support shaft portion **30B** and the rear mount member **32** will be referred to as a “rear mount portion **34**”.

[0044] On the other hand, as shown in FIG. **3**, a penetrating portion **35** is formed at a distal end portion of the front mounting piece portion **30C**, and a connecting pin **36** is inserted through the penetrating portion **35** in the vehicle-width direction. Both end portions of the connecting pin **36** are attached to the front mount member **38** provided at the vehicle front side portion of the suspension member **26** via a bolt **40** and a nut (not shown). In the following description, the assembly of the connecting pin **36** and the front mount member **38** will be referred to as a “front mount portion **42**”. Further, the above-described rear mount portion **34** is located on the vehicle rear side and the vehicle upper side of the front mount portion **42** when viewed in the vehicle width direction.

[0045] Specifically, a penetrating portion **44** through which the shaft portion of the bolt **40** can be inserted in the vehicle vertical direction is formed in the upper wall portion constituting the vehicle upper side portion of the front mount member **38**, and a part of the vehicle rear side at the peripheral edge portion of the penetrating portion **44** is opened. On the vehicle rear side of the penetrating portion **44**, a slit portion **46** extending in the vehicle front-rear direction continuously with the penetrating portion **44** and having the vehicle rear side opened is formed. The length (width) of the slit portion **46** in the vehicle width direction is set to a length through which the shaft portion of the bolt **40** can be inserted.

[0046] Further, a pair of fuse portions **48** adjacent to each other in the vehicle width direction is provided at a boundary portion between the penetrating portion **44** and the slit portion **46**, that is, on the vehicle rear side of the shaft portion of the bolt **40**. The fuse portions **48** have a substantially

triangular plate shape that is reduced in width toward the center side in the vehicle width direction of the penetrating portion **44** and the slit portion **46** when viewed from the vehicle vertical direction.

[0047] The fuse portion **48** is plastically deformed when a load having a magnitude of a predetermined value or more is input from the bolt **40**. In a state in which the fuse portion **48** is plastically deformed, relative displacement of the bolt **40** toward the vehicle rear side with respect to the front mount member **38** is allowed.

[0048] In other words, the front mount portion **42** can release the motor **28** from the support state by receiving a load of a predetermined magnitude or more from the front side of the vehicle.

Actions and Effects of Embodiment

[0049] Next, actions and effects of the embodiment will be described.

[0050] In the present embodiment, as shown in FIG. **1**, a motor **28** is disposed on the front side of the vehicle, and a driving force is applied to the drive wheels of the vehicle **10** by the motor **28**. Further, the front part **12** made of a metallic cast product is provided with a bulkhead portion **16** constituting a part thereof, and the bulkhead portion **16** partitions the vehicle cabin **10A** and the power unit room **10B** on the vehicle rear side of the motor **28**.

[0051] Incidentally, when an impact load is inputted to the vehicle **10** from the vehicle front side, the motor **28** may enter the inside of the vehicle cabin **10A** by receiving the impact load from the motor **28**. Therefore, it is preferable to be able to absorb the impact-energy of the motor **28** before the motor **28** enters the inside of the vehicle cabin **10A**.

[0052] Here, in the present embodiment, as also shown in FIG. **3**, the front portion of the motor **28** on the vehicle front side is supported by the front mount portion **42** with respect to the front part **12**. The front mount portion **42** can release the motor **28** from the support state by inputting a load having a predetermined magnitude or more from the front side of the vehicle.

[0053] On the other hand, a portion of the motor **28** on the vehicle rear side is supported by the rear mount portion **34** with respect to the front part **12**, and the rear mount portion **34** is supported by the vehicle rear side and the vehicle upper side of the front mount portion **42**.

[0054] Therefore, in the present embodiment, when an impact load of a predetermined magnitude or more is input to the vehicle **10** from the front side of the vehicle, the motor **28** receives the impact load. As a result, the motor **28** rotates around the rear mount portion **34** as viewed in the vehicle width direction and moves toward the bulkhead portion **16** side of the front part **12**.

[0055] An impact absorbing portion **18** is provided integrally with the bulkhead portion **16** on the vehicle front side of the bulkhead portion **16**, and the impact absorbing portion **18** is deformed when an impact load of the motor **28** is input from the vehicle front side. As a consequence, in the present embodiment, the impact-energy of the motor **28** can be absorbed before the motor **28** enters the inside of the vehicle cabin **10A**.

[0056] Further, in the present embodiment, as shown in FIG. **4**, the impact absorbing portion **18** includes a front impact absorbing portion **18D** and a rear impact absorbing portion **18E**. The front impact absorbing portion **18D** includes a plurality of impact absorbing pieces **18D1** whose plate thickness direction is an input direction of an impact load (an input assumed direction). These impact absorbing pieces **18D1** are flexibly deformed by receiving an impact load of the motor **28** from the front side of the vehicle, and contribute to absorbing the impact load.

[0057] On the other hand, a plurality of reinforcing ribs **18E1**, reinforcing ribs **18E2**, and reinforcing ribs **18E3** are arranged in the rear impact absorbing portion **18E** so as to form a closed cross section when viewed from the up-down direction of the vehicle. The rear impact absorbing portion **18E** has higher stiffness with respect to the impact load from the front side of the vehicle than the front impact absorbing portion **18D**.

[0058] Therefore, in the present embodiment, the vehicle front portion of the impact absorbing portion **18** is easily deformed by the impact load from the vehicle front side, and the vehicle rear portion of the impact absorbing portion **18** is hardly deformed by the impact load from the vehicle

front side. Consequently, it is possible to both absorb the impact load from the front side of the vehicle and suppress the entry of the motor **28** into the inside of the vehicle cabin **10A**.

[0059] As described above, in the present embodiment, in the vehicle **10** in which the motor **28** is mounted on the vehicle front side, the collision energy of the motor **28** at the time of the front collision can be absorbed.

Claims

1. A vehicle body front structure comprising: a motor disposed on a front side of a vehicle and configured to apply a driving force to a drive wheel; a bulkhead portion constituting part of a vehicle body that is a metal cast product, and separating a vehicle cabin and a power unit room from each other at a position behind the motor in a vehicle front-rear direction; a front mount portion configured to support a front part in the vehicle front-rear direction of the motor with respect to the vehicle body, and configured to release the motor from a supported state when a load of a predetermined magnitude or more is applied from the front side of the vehicle; a rear mount portion configured to support a rear part in the vehicle front-rear direction of the motor with respect to the vehicle body at a position behind the front mount portion in the vehicle front-rear direction and above the front mount portion in a vehicle up-down direction; and an impact absorbing portion that is provided integrally with the bulkhead portion on a front side in the vehicle front-rear direction of the bulkhead portion and that is configured to be deformed when an impact load is applied from the front side of the vehicle.

2. The vehicle body front structure according to claim 1, wherein the impact absorbing portion includes a front impact absorbing portion and a rear impact absorbing portion, the front impact absorbing portion including a plurality of impact absorbing pieces whose thickness direction is a direction in which an impact load is applied, and a plurality of reinforcing ribs being arranged in the rear impact absorbing portion so as to form a closed section as viewed in a vehicle up-down direction.
