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(54) **VEHICLE FRONT STRUCTURE**

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(57) **ABSTRACT**

The vehicle front structure includes a dash portion disposed at the vehicle front portion and partitioning the vehicle cabin and the outside of the vehicle cabin, and a pair of right and left front pillar portions connected to both end portions of the dash portion in the vehicle width direction and extending in the vehicle vertical direction, and a die-cast main framework integrally formed therewith, an outer panel disposed outside the main framework in the vehicle width direction and configured to constitute an aesthetic surface and fastened to the main framework, an instrument panel reinforcement extending in the vehicle width direction between the pair of right and left front pillar portions in the vehicle cabin, and a linking bracket connecting the main framework and the instrument panel reinforcement.

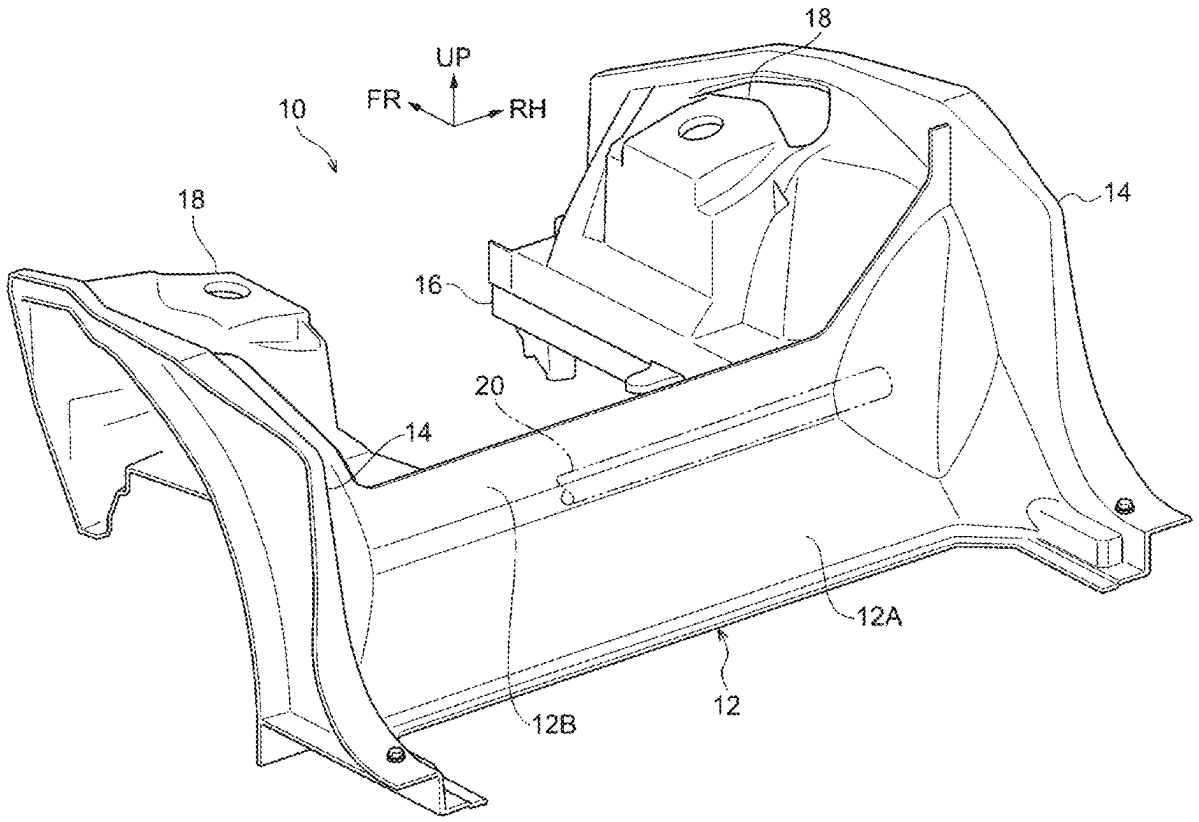

FIG. 1

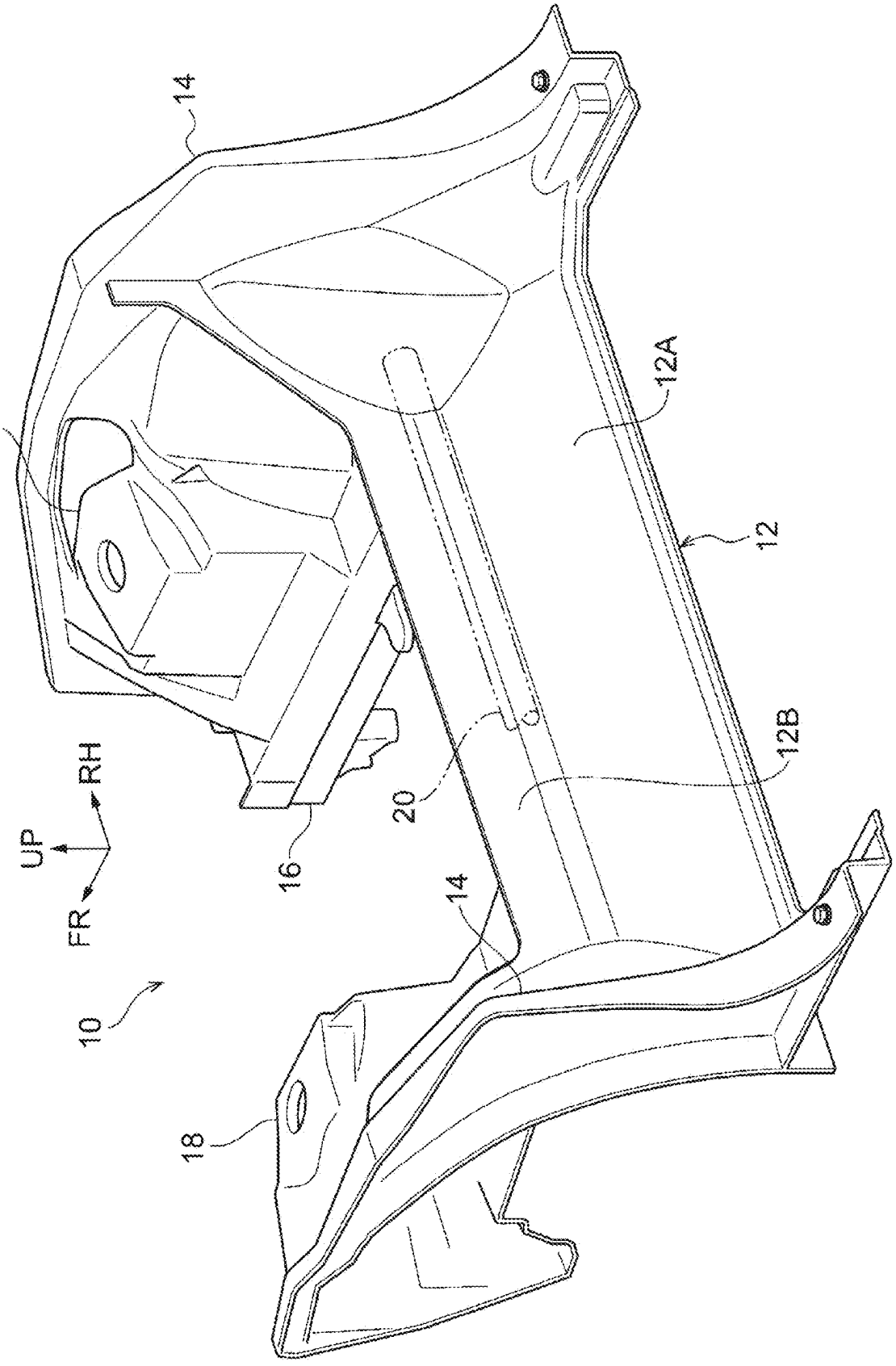

FIG. 2

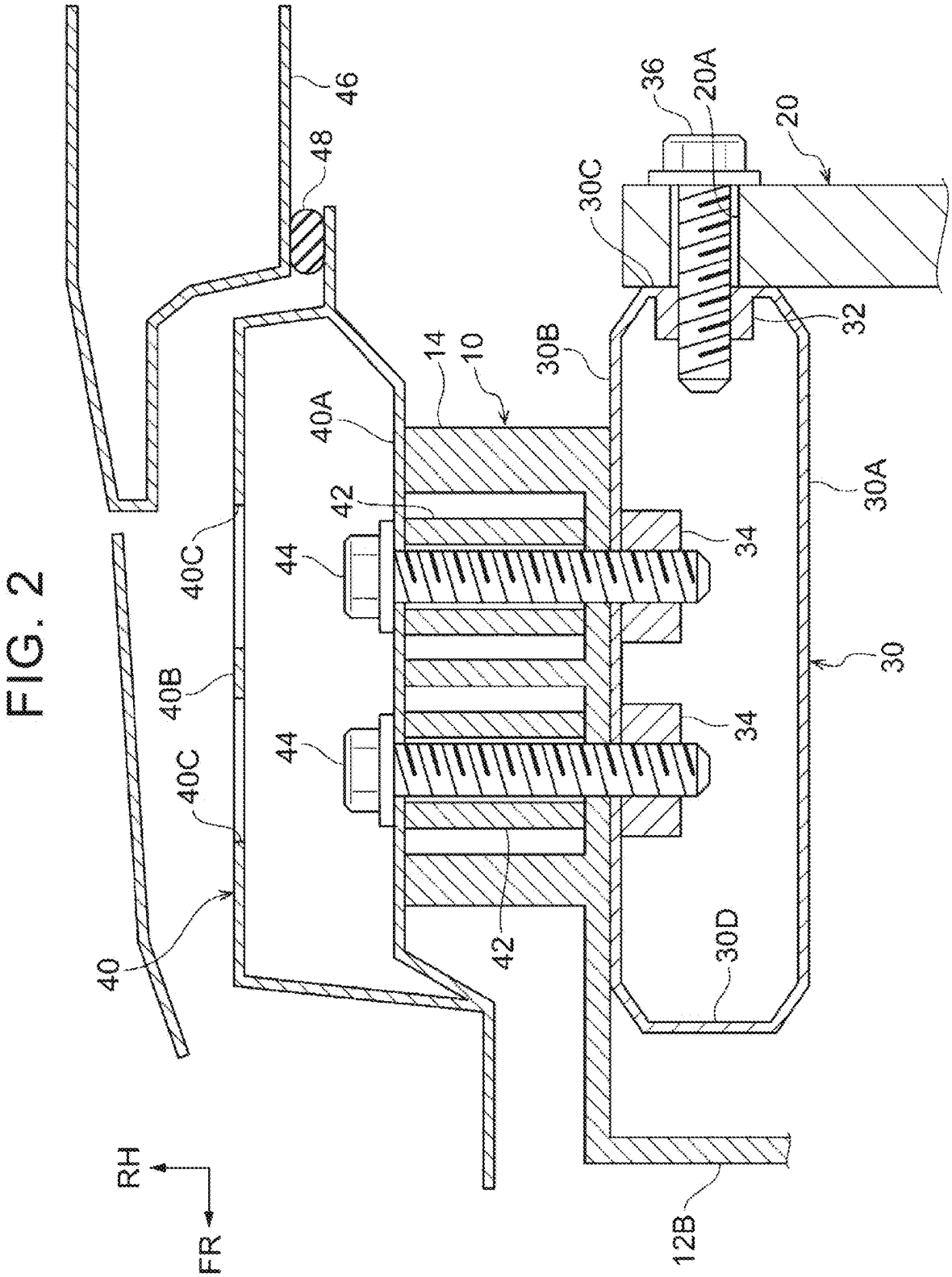
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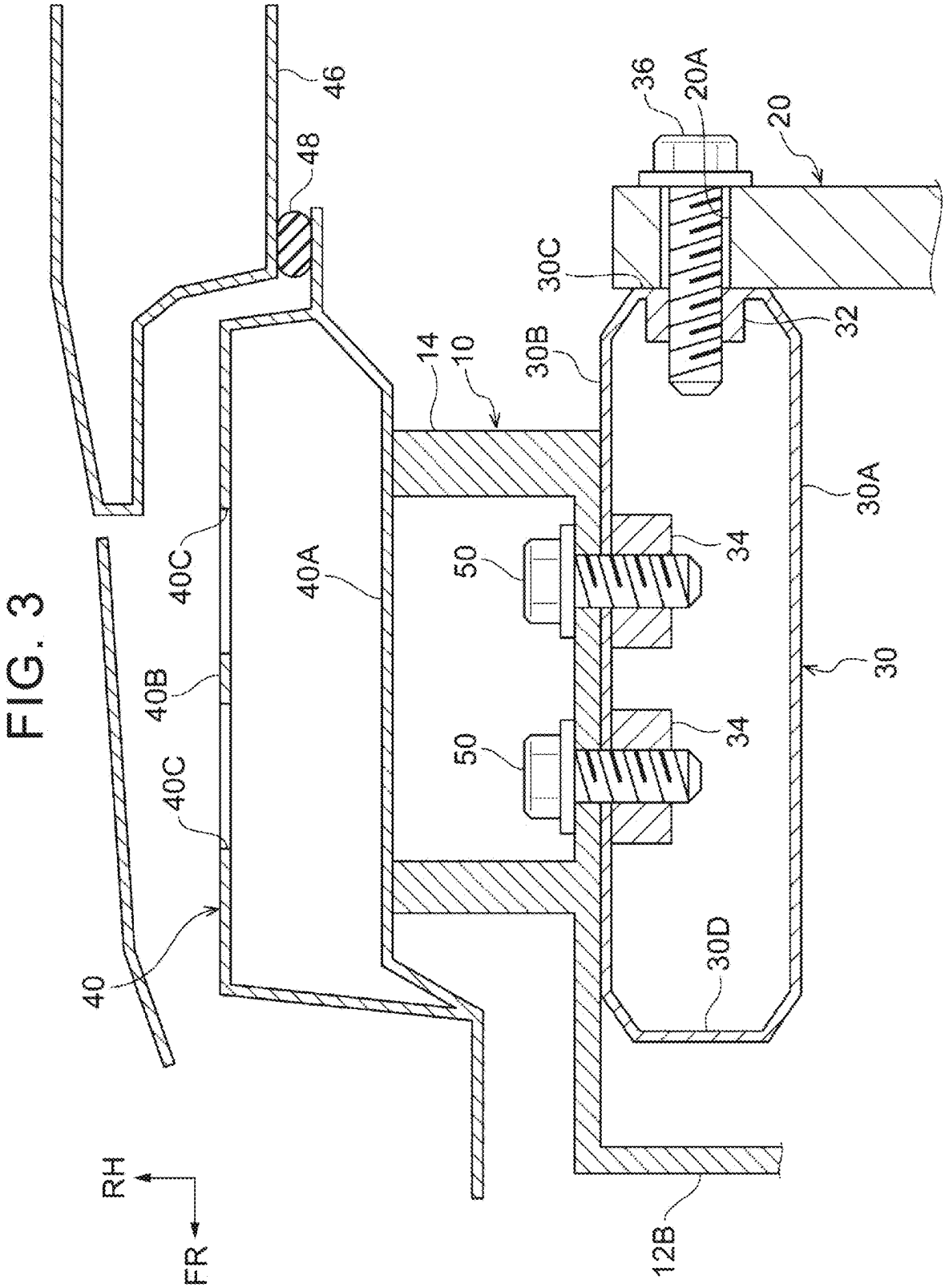
FIG. 3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VEHICLE FRONT STRUCTURE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Japanese Patent Application No. 2024-024061 filed on Feb. 20, 2024, incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

[0002] The disclosure relates to a vehicle front structure.

2. Description of Related Art

[0003] Japanese Unexamined Patent Application Publication No. 2008-94172 (JP 2008-94172 A) discloses a structure in which a cross car beam (instrument panel reinforcement) extending in a vehicle width direction is provided inside an instrument panel. Also, in the structure described in JP 2008-94172 A, side brackets are attached to both end portions of the cross car beam, and the cross car beam is connected to vehicle body panels via the side brackets.

SUMMARY

[0004] However, in the structure described in JP 2008-94172 A, the both end portions of the instrument panel reinforcement are attached to the vehicle body panels formed of a rigid plate or the like, and accordingly there is a possibility that rigidity of the attachment portion cannot be sufficiently secured.

[0005] An object of the disclosure is to provide a vehicle front structure in which rigidity of an attachment portion between an instrument panel reinforcement and a vehicle body can be secured.

[0006] A vehicle front structure according to Aspect 1 includes

a main framework that is die cast and that integrally includes a dash portion disposed at a vehicle front, partitioning between inside of a vehicle cabin and outside of the vehicle cabin, and a pair of right and left front pillar portions connected to both end portions of the dash portion in a vehicle width direction and extending in a vehicle up-down direction,

an outer panel that is disposed on an outer side of the main framework in the vehicle width direction and makes up an aesthetic surface, and that is also fastened to the main framework,

an instrument panel reinforcement extending in the vehicle width direction between the right and left front pillar portions in the vehicle cabin, and

a linking bracket that links the main framework and the instrument panel reinforcement.

[0007] In the vehicle front structure according to Aspect 1, the main framework is die cast and integrally includes the dash portion and the right and left front pillar portions. Also, the outer panel that makes up an aesthetic surface is disposed on the outer side of the main framework in the vehicle width direction, and the outer panel and the main framework are fastened. Further, the instrument panel reinforcement is provided extending in the vehicle width direction between the right and left front pillar portions in the vehicle cabin, and the main framework and the instrument panel reinforcement are linked by the linking bracket. Thus, by linking the instrument panel reinforcement to the main framework that is die cast, the rigidity of the attachment portion can be secured, in comparison with a structure connected to a steel plate or the like.

[0008] In the vehicle front structure according to Aspect 2, in Aspect 1,

the instrument panel reinforcement and the linking bracket are fastened in a vehicle front-rear direction, and

the main framework and the linking bracket are fastened in the vehicle width direction.

[0009] In the vehicle front structure according to Aspect 2, fastening directions of the instrument panel reinforcement and the linking bracket, and of the main framework and the linking bracket, are different from each other. Accordingly, attachment strength can be maintained satisfactorily with respect to both vibrations in the vehicle front-rear direction and vibrations in the vehicle width direction.

[0010] In the vehicle front structure according to Aspect 3, in Aspect 1,

the main framework, the outer panel, and the linking bracket are fastened together by fasteners.

[0011] In the vehicle front structure according to Aspect 3, the number of parts can be reduced due to reducing the number of fasteners by fastening the three parts together, in comparison with a case in which the respective parts are individually fastened to each other. Further, by fastening together, the main framework can be clamped between the outer panel and the linking bracket.

[0012] In the vehicle front structure according to Aspect 4, in Aspect 3,

a collar member is disposed between the outer panel and the linking bracket.

[0013] In the vehicle front structure according to Aspect 4, distance between the outer panel and the linking bracket can be maintained constant by the collar member.

[0014] In the vehicle front structure according to Aspect 5, in any one of Aspects 1 to 4,

the main framework includes a front side member portion extending to a forward side in a vehicle from the dash portion.

[0015] In the vehicle front structure according to Aspect 5, the main framework includes the front side member portion, and accordingly the number of parts can be reduced in comparison with a structure configured including a front side member separate from a main framework.

[0016] As described above, according to the vehicle front structure of the disclosure, rigidity of the attachment portion between the instrument panel reinforcement and a vehicle body can be secured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] 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:

[0018] FIG. **1** is a perspective view illustrating a part of a vehicle front structure according to an embodiment;

[0019] FIG. **2** is an enlarged cross-sectional view of a main part of the main framework, the instrument panel reinforcement, and the linking brackets according to the embodiment; and

[0020] FIG. **3** is an enlarged cross-sectional view of a main part illustrating a fastened state of a main framework, an instrument panel reinforcement, and a linking bracket in a modification example.

DETAILED DESCRIPTION OF EMBODIMENTS

[0021] A vehicle front structure according to an embodiment will be described with reference to the drawings.

[0022] FIG. **1** is a perspective view illustrating a part of a vehicle front structure according to an embodiment. Note that the arrow FR, the arrow UP, and the arrow RH in the drawing indicate the vehicle front direction, the vehicle upper direction, and the vehicle right direction in the vehicle, respectively. In the following description, when the front, rear, up, down, and right and left directions are used without special mention, the front and rear directions in the vehicle front-rear direction, the up and down directions in the vehicle up-down direction, and the right and left directions in the vehicle left-right direction (width direction) are respectively indicated.

[0023] As shown in FIG. **1**, the main framework **10** constituting the vehicle front structure includes a dash portion **12**, a front pillar portion **14**, a front side member portion **16**, and a suspension tower portion **18**. Further, the main framework **10** is made of die cast, and the dash portion **12**, the front pillar portion **14**, the front side member portion **16**, and the suspension tower portion **18** are integrally formed by casting.

[0024] The dash portion **12** is disposed in the vehicle front portion and partitions the vehicle cabin and the outside of the vehicle cabin, and a surface of the lower portion of the dash portion **12** on the vehicle rear side is an inclined surface **12**A in which the upper side is located on the vehicle front side from the lower side. The inclined surface **12**A is located below the instrument panel (not shown).

[0025] A surface of the upper portion of the dash portion **12** on the vehicle rear side extends substantially perpendicularly in the vehicle up-down direction and the vehicle width direction.

[0026] Front pillar portions **14** are connected to both end portions of the dash portion **12** in the vehicle width direction, and the pair of right and left front pillar portions **14** extend in the vehicle vertical direction. Specifically, a lower portion of the front pillar portion **14** extends in the vehicle front-rear direction, and a rocker of a skeleton member (not shown) is connected to a rear end portion of the front pillar portion **14**.

[0027] The front pillar portion **14** extends obliquely from the rear end portion toward the vehicle upper side and the vehicle front side, and is configured to transmit a load acting on the main framework **10** in the vehicle vertical direction.

[0028] A pair of right and left front side member portions **16** extend from both end portions in the vehicle width direction of the dash portion **12** toward the vehicle front side. The front side member portion **16** extends in the vehicle front-rear direction and is configured to transmit a load input from the vehicle front side to the vehicle rear side.

[0029] Suspension tower portions **18** are provided on the vehicle width direction outer sides of the pair of right and left front side member portions **16**, respectively. The suspension tower portion **18** is positioned on the vehicle upper side relative to the front side member portion **16**, and is configured to be capable of supporting a suspension (not shown).

[0030] Here, an instrument panel reinforcement **20** extending in the vehicle width direction is provided on the vehicle cabin side of the dash portion **12**. The instrument panel reinforcement **20** is a substantially cylindrical member installed between the right and left front pillar portions **14**, and the instrument panel reinforcement **20** is configured to support a steering shaft (not shown), an air conditioner, and the like.

[0031] FIG. **2** is an enlarged cross-sectional view illustrating a state in which the main framework **10**, the instrument panel reinforcement **20**, and the linking bracket **30** are fastened in the embodiment. As shown in FIG. **2**, an outer panel **40** is disposed on the vehicle width direction outer side of the main framework **10**.

[0032] The outer panel **40** constitutes a part of the aesthetic surface of the vehicle, and includes an inner wall portion **40**A located on the inner side in the vehicle width direction in a plan view, and an outer wall portion **40**B located on the outer side in the vehicle width direction, and is configured in a closed cross-section shape. The outer panel **40** may be integrally formed by extrusion or the like, or may be formed by superposing two rigid plates.

[0033] A flange extending toward the vehicle rear side is formed at a rear end portion of the outer panel **40**, and a side door **46** is disposed on the vehicle width direction outer side of the flange via a sealing material **48**.

[0034] The main framework **10** is fixed to the inner wall portion **40**A of the outer panel **40**. Specifically, a plurality of ribs extending outward in the vehicle width direction are formed on a surface of the front pillar portion **14** of the main framework **10** on the outside in the vehicle width direction, and the ribs are fixed to the outer panel **40** in a state of being abutted against the outer panel **40**.

[0035] The method of fixing the outer panel **40** and the main framework **10** is not particularly limited. For example, it may be mechanically fixed using bolts, rivets, or the like. Further, for example, it may be fixed using an adhesive or the like, or it may be fixed by a joining means such as welding. In the present embodiment, the front pillar portion **14** of the main framework **10** and the inner wall portion **40**A of the outer panel **40** are temporarily fixed by an adhesive material (not shown).

[0036] Here, the instrument panel reinforcement **20** and the main framework **10** are connected by a linking bracket **30**.

[0037] The linking bracket **30** is formed of metal in a closed cross-sectional shape. In the present embodiment, the linking bracket **30** includes a bracket inner wall portion **30**A located on the vehicle width direction inner side and a bracket outer wall portion **30**B located on the vehicle width direction outer side. The linking bracket **30** includes a bracket rear wall portion **30**C and a bracket front wall portion **30**D. The bracket rear wall portion **30**C connects the rear end of the bracket inner wall portion **30**A and the rear end of the bracket outer wall portion **30**B. The bracket front wall portion **30**D connects the front end of the bracket inner wall portion **30**A and the front end of the bracket outer wall portion **30**B.

[0038] A first weld nut **32** is provided inside the linking bracket **30**. The first weld nut **32** is provided on the inner surface of the bracket-rear-wall portion **30**C, and the first bolt **36** is screwed. Here, a bolt hole **20**A is formed at an outer end portion of the instrument panel reinforcement **20** in the vehicle width-direction, and the bolt **36** is inserted into

the bolt hole **20**A and screwed into the first weld nut **32**. As described above, the instrument panel reinforcement **20** and the linking bracket **30** are fastened in the vehicle front-rear direction by inserting the bolt **36** from the vehicle rear side and screwing into the first weld nut **32**.

[0039] A second weld nut **34** is provided inside the linking bracket **30**. Two second weld nuts **34** are provided on the inner surface of the bracket-outer-wall portion **30**B, and are spaced apart from each other in the vehicle-front-rear direction. A bolt **44** as a fastening portion is screwed to each of the two second weld nuts **34**.

[0040] A working hole **40**C into which the bolts **44** can be inserted is formed in the outer wall portion **40**B of the outer panel **40**. A bolt **44** is inserted from the working hole **40**C, and the bolt **44** is inserted into the inner wall portion **40**A of the outer panel **40** and the front pillar portion **14**, and is screwed into the second weld nut **34**. As described above, the main framework **10** and the linking bracket **30** are fastened to each other in the vehicle width direction by the bolts **44** and the second weld nuts **34**.

[0041] In particular, in the present embodiment, the main framework **10**, the outer panel **40**, and the linking bracket **30** are fastened together by the bolts **44**.

[0042] Here, a collar member **42** is provided between the outer panel **40** and the linking bracket **30**. The collar member **42** is disposed at the insertion position of the two bolts **44**, and is disposed between the ribs arranged in the vehicle front-rear direction in the front pillar portion **14** of the main framework **10**. The collar member **42** is in contact with the outer panel **40** and the linking bracket **30**, respectively.

Operations

[0043] Next, the operation of the vehicle front structure according to the present embodiment will be described.

[0044] In the vehicle front structure according to the present embodiment, as shown in FIG. **1**, the die-cast main framework **10** is integrally formed including a dash portion **12** and a pair of right and left front pillar portions **14**. Further, since the main framework **10** includes the front side member portion **16**, the number of parts can be reduced as compared with a structure including a front side member separate from the main framework **10**.

[0045] Further, in the vehicle front structure of the present embodiment, the instrument panel reinforcement **20** extending in the vehicle width direction between the pair of right and left front pillar portions **14** is provided in the vehicle cabin. Further, as shown in FIG. **2**, an outer panel **40** is provided on the vehicle width direction outer side of the main framework **10**, and the outer panel **40** and the main framework **10** are fastened.

[0046] Furthermore, the main framework **10** and the instrument panel reinforcement **20** are connected by a linking bracket **30**. In this manner, the instrument panel reinforcement **20** is connected to the die-cast main framework **10**. As a result, the rigidity of the attachment portion between the instrument panel reinforcement **20** and the vehicle body can be ensured as compared with a structure in which the instrument panel reinforcement is connected to a steel sheet or the like.

[0047] Further, in the vehicle front structure of the present embodiment, the fastening direction of the instrument panel reinforcement **20** and the linking bracket **30** is different from the fastening direction of the main framework **10** and the linking bracket **30**. Specifically, the instrument panel reinforcement **20** and the linking bracket **30** are fastened in the vehicle front-rear direction, and the main framework **10** and the linking bracket **30** are fastened in the vehicle width direction. Accordingly, attachment strength can be maintained satisfactorily with respect to both vibrations in the vehicle front-rear direction and vibrations in the vehicle width direction.

[0048] In particular, in the present embodiment, since the three members of the main framework **10**, the outer panel **40**, and the linking bracket **30** are fastened together, the number of parts can be reduced by reducing the number of bolts that are fasteners as compared with the case where the respective parts are fastened together. Further, by fastening together, the main framework **10** can be sandwiched between the outer panel **40** and the linking bracket **30**.

[0049] Further, in the present embodiment, since the collar member **42** is provided between the main framework **10** and the outer panel **40**, the distance between the outer panel **40** and the linking bracket **30** can be maintained constant by the collar member **42**.

[0050] In the present embodiment, the collar member **42** is provided between the main framework **10** and the outer panel **40**, but the present disclosure is not limited thereto. For example, as in the modification shown in FIG. **3**, a structure without the collar member **42** may be employed.

Modifications

[0051] FIG. **3** is an enlarged cross-sectional view illustrating a state in which the main framework **10**, the instrument panel reinforcement **20**, and the linking bracket **30** are fastened in a modification example.

[0052] As shown in FIG. **3**, in the vehicle front structure according to the present modification, the instrument panel reinforcement **20** and the linking bracket **30** are mechanically fastened by the bolt **36** and the first weld nut **32** as in the embodiment.

[0053] A bolt **50** different from the embodiment is screwed to the second weld nut **34** provided in the linking bracket **30**. The bolt **50** has an axial length shorter than that of the bolt **44** of the embodiment, and the head portion of the bolt **50** abuts on an outer surface of the front pillar portion **14** of the main framework **10** in the vehicle width direction. Therefore, in the present modification, the two members of the main framework **10** and the linking bracket **30** are fastened by the bolt **50** and the second weld nut **34**.

[0054] The main framework **10** and the outer panel **40** are fixed by other means. For example, it may be fastened mechanically by a bolt or rivet or the like separate from the bolt **50** may be fixed by an adhesive material or the like. Further, it may be joined by welding or the like.

[0055] Although the vehicle front structure according to the embodiment and the modification has been described above, it is needless to say that the vehicle front structure can be implemented in various forms without departing from the gist of the present disclosure. For example, in the above-described embodiment and modification, as shown in FIGS. **2** and **3**, the linking bracket **30** is a closed cross-sectional structure of a substantially rectangular shape in a closed cross-sectional view, but the present disclosure is not limited thereto, and other shapes may be used.

[0056] Further, in the above-described embodiment and modification examples, the fastening direction between the main framework **10** and the linking bracket **30** and the fastening direction between the instrument panel reinforce-

ment **20** and the linking bracket **30** are different from each other, but the present disclosure is not limited thereto. For example, the instrument panel reinforcement **20** and the linking bracket **30** may be fastened in the vehicle width direction.

[0057] Further, in the above-described embodiment, the instrument panel reinforcement **20** and the linking bracket **30** are fastened by one bolt **36**, but the present disclosure is not limited thereto, and the position and the number of bolts are not particularly limited. For example, the instrument panel reinforcement **20** and the linking bracket **30** may be fastened by two or more bolts and a weld nut.

[0058] Further, in the above embodiment, the main framework **10** and the linking bracket **30** are fastened by two bolts **44**, but the present disclosure is not limited thereto, and the position and the number of bolts are not particularly limited. For example, the main framework **10** and the linking bracket **30** may be fastened by three or more bolts and a weld nut, or a combination of a bolt and a rivet may be fixed.

[0059] With respect to the above embodiments, the following supplementary notes are disclosed.

Appendix 1

A vehicle front structure including a main framework that is die cast and that integrally includes a dash portion disposed at a vehicle front, partitioning between inside of a vehicle cabin and outside of the vehicle cabin, and a pair of right and left front pillar portions connected to both end portions of the dash portion in a vehicle width direction and extending in a vehicle up-down direction,

an outer panel that is disposed on an outer side of the main framework in the vehicle width direction and makes up an aesthetic surface, and that is also fastened to the main framework,

an instrument panel reinforcement extending in the vehicle width direction between the right and left front pillar portions in the vehicle cabin, and

a linking bracket connecting the main framework and the instrument panel reinforcement.

Appendix 2

The instrument panel reinforcement and the linking bracket are fastened in a vehicle front-rear direction, and

The vehicle front structure according to Appendix 1, wherein the main framework and the linking bracket are fastened in a vehicle width direction.

Appendix 3

The vehicle front structure according to Appendix 1 or 2, wherein the main framework, the outer panel, and the linking bracket are fastened together by fasteners.

Appendix 4

The vehicle front structure according to any one of claims 1 to 3, wherein a collar member is provided between the outer panel and the linking bracket.

Appendix 5

The vehicle front structure according to any one of claims 1 to 4, wherein the main framework includes a front side member portion extending from the dash portion toward a vehicle front side.

What is claimed is:

1. A vehicle front structure comprising:

a main framework that is die cast and that integrally includes a dash portion disposed at a vehicle front, partitioning between inside of a vehicle cabin and outside of the vehicle cabin, and a pair of right and left front pillar portions connected to both end portions of the dash portion in a vehicle width direction and extending in a vehicle up-down direction;

an outer panel that is disposed on an outer side of the main framework in the vehicle width direction and makes up an aesthetic surface, and that is also fastened to the main framework;

an instrument panel reinforcement extending in the vehicle width direction between the right and left front pillar portions in the vehicle cabin; and

a linking bracket that links the main framework and the instrument panel reinforcement.

2. The vehicle front structure according to claim **1**, wherein:

the instrument panel reinforcement and the linking bracket are fastened in a vehicle front-rear direction; and

the main framework and the linking bracket are fastened in the vehicle width direction.

3. The vehicle front structure according to claim **1**, wherein the main framework, the outer panel, and the linking bracket are fastened together by fasteners.

4. The vehicle front structure according to claim **3**, wherein a collar member is disposed between the outer panel and the linking bracket.

5. The vehicle front structure according to claim **1**, wherein the main framework includes a front side member portion extending to a forward side in a vehicle from the dash portion.

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