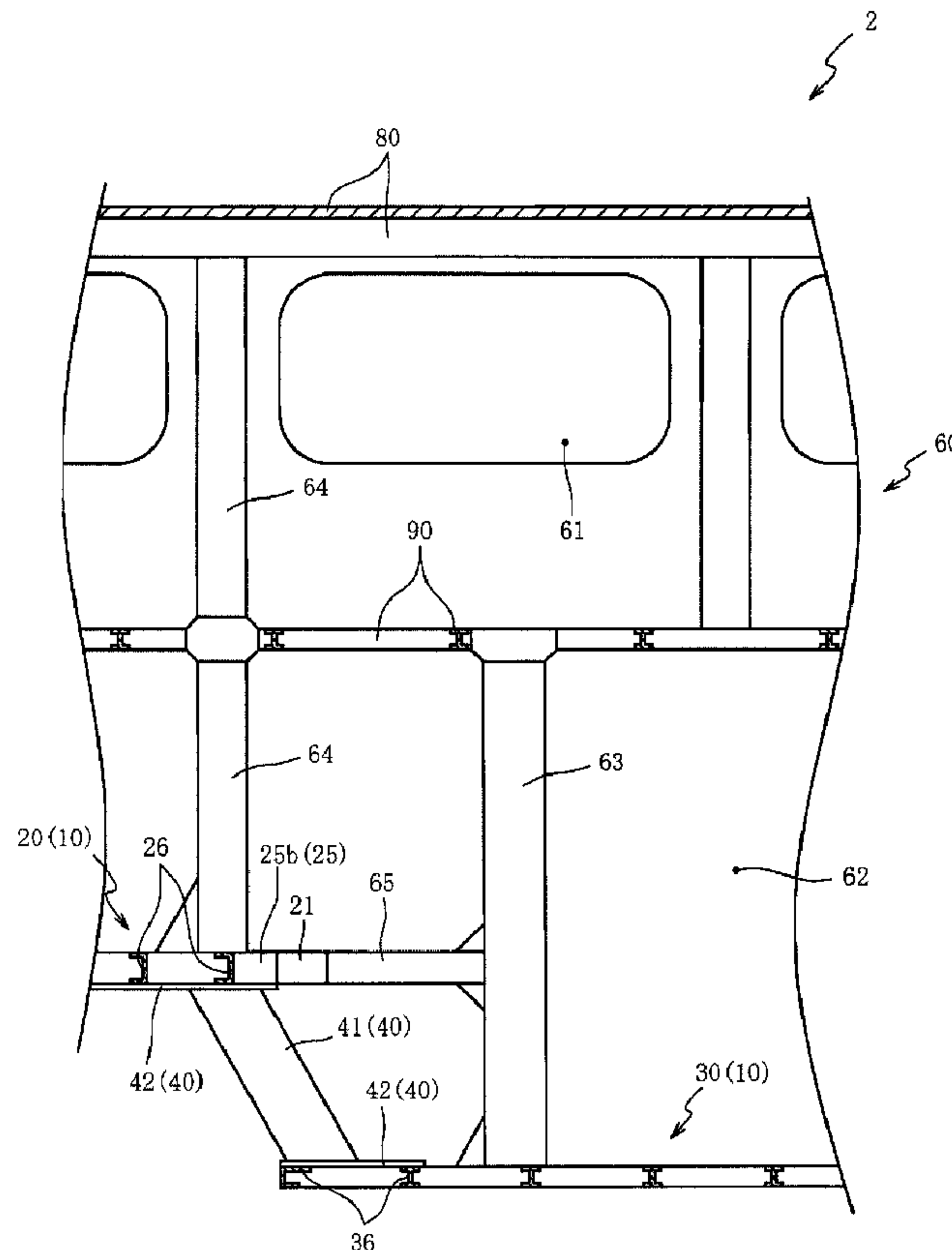




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(54) **Titre : VEHICULE FERROVIAIRE**
(54) **Title: RAILCAR**



(57) **Abrégé/Abstract:**

According to a railcar (1), a low-floor underframe (30) includes side beams (31) to which side bodysheils (60) are coupled, a high-floor underframe (20) includes a center sill (24) disposed to extend in a car longitudinal direction at a center in a car width direction

(57) Abrégé(suite)/Abstract(continued):

and a body bolster (25) coupled to this center sill (24) and to be an installation portion of a bogie (3), and the body bolster (25) is coupled to the side beam (31) by a coupling member (40). Thus, the car end compression load input to the high-floor underframe (20) can be directly transmitted from the center sill (24) and the body bolster (25) to the side beams (31) via the coupling member (40). This can disperse the car end compression load on the side bodyshells (60) to ensure the car strength against the car end compression load.

ABSTRACT

According to a railcar (1), a low-floor underframe (30) includes side beams (31) to which side bodysHELLs (60) are coupled, a high-floor underframe (20) includes a center sill (24) disposed to extend in a car longitudinal direction at a center in a car width direction and a body bolster (25) coupled to this center sill (24) and to be an installation portion of a bogie (3), and the body bolster (25) is coupled to the side beam (31) by a coupling member (40). Thus, the car end compression load input to the high-floor underframe (20) can be directly transmitted from the center sill (24) and the body bolster (25) to the side beams (31) via the coupling member (40). This can disperse the car end compression load on the side bodysHELLs (60) to ensure the car strength against the car end compression load.

Description

Title of Invention: RAILCAR

5 Technical Field

[0001]

The present invention relates to a railcar, and especially relates to a railcar that ensures car strength against a car end compression load.

10

Background Art

[0002]

A railcar that forms high floors only at bogie portions at car end sides and forms a low floor at a central portion in a car longitudinal direction has been known. For example, Patent Literature 1 discloses an underframe structure in such a partially-low-floor car. Specifically, a technique that constitutes an underframe from a first floor-surface underframe (a low-floor underframe), a second floor-surface underframe (a high-floor underframe) higher than this first floor-surface underframe by a predetermined height, and a center sill structure portion (a coupling member) that couples this first floor-surface underframe to this second floor-surface underframe is disclosed.

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20

25

Citation List

Patent Literature

[0003]

- 5 Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2012-210887 (for example, paragraphs 0021 to 0023 and FIG. 1).

Summary of Invention

10 Technical Problem

[0004]

 However, in the above-described conventional technique, the center sill structure portion (the coupling member) is disposed at a position that couples a center
15 sill of the first floor-surface underframe (the low-floor underframe) to a center sill of the second floor-surface underframe (the high-floor underframe). Thus, there has been a problem that a car end compression load input to the second floor-surface underframe is easily transmitted to
20 only the first floor-surface underframe to make it difficult to disperse on another structure; thus, it is difficult to ensure car strength against the car end compression load.

[0005]

- 25 The present invention has been made to solve the

above-described problem, and it is an object of the present invention to provide a railcar that ensures car strength against a car end compression load.

Solution to Problem

[0006]

A railcar according to a first aspect includes a low-floor underframe disposed at a center portion in a car longitudinal direction, high-floor underframes arranged at one side and another side in the car longitudinal direction across the low-floor underframe, and upper and lower positions of the high-floor underframes being set higher than upper and lower positions of the low-floor underframe, and coupling members that couple the low-floor underframe to the high-floor underframes in postures that incline downward from the high-floor underframes toward the low-floor underframe, and the low-floor underframe includes side beams to which side bodysells are coupled, the high-floor underframe includes a center sill disposed to extend in the car longitudinal direction at a center in a car width direction, and a body bolster to which the center sill is coupled to be an installation portion of a bogie, and the body bolster of the high-floor underframe is coupled to the side beams of the low-floor underframe by the coupling member.

[0007]

The railcar according to a second aspect is the railcar according to the first aspect, and the high-floor underframe includes side beams, and the side bodyshell includes a first side post coupled to the side beam of the low-floor underframe at a lower end to be disposed to extend in the car up and down direction, and a first frame member that couples the first side post to the side beam of the high-floor underframe and is disposed to extend in the car longitudinal direction.

[0008]

The railcar according to a third aspect, in the railcar according to the second aspect, includes a second-floor floor member disposed above the low-floor underframe of a car to support a floor surface of a second-floor, and an upper end of the first side post of the side bodyshell is coupled to the second-floor floor member.

[0009]

The railcar according to a fourth aspect is the railcar according to the third aspect, and the side bodyshell includes a second side post coupled to the side beam of the high-floor underframe at a lower end to be disposed to extend in the car up and down direction, and the second side post of the side bodyshell is disposed at a position approximately corresponding to a position where the coupling member is

coupled to the body bolster of the high-floor underframe, in the car longitudinal direction, and the second side post is coupled to the second-floor floor member.

[0010]

The railcar according to a fifth aspect is the railcar according to the fourth aspect, and an upper end of the second side post of the side bodyshell is coupled to a roof bodyshell.

[0011]

The railcar according to a sixth aspect is the railcar according to the fifth aspect, and the coupling member, the first side post, the first frame member, and the second side post are formed of members with closed cross-section structures.

Advantageous Effects of Invention

[0012]

According to the railcar according to the first aspect, the low-floor underframe includes the side beams to which the side bodysells are coupled, the high-floor underframe includes the center sill disposed to extend in the car longitudinal direction at the center in the car width direction and the body bolster coupled to this center sill and to be the installation portion of the bogie, and the body bolster of the high-floor underframe is coupled to the side beams of the low-floor underframe

by the coupling member. Thus, the car end compression load input to the high-floor underframe can be directly transmitted from the center sill and the body bolster of this high-floor underframe to the side beams of the low-floor underframe via the coupling member. This can disperse the car end compression load on the side bodysHELLs to ensure the car strength against the car end compression load.

[0013]

According to the railcar according to the second aspect, in addition to the effect that the railcar according to the first aspect provides, the side bodysHELL includes the first side post coupled to the side beam of the low-floor underframe at the lower end to be disposed to extend in the car up and down direction, and the first frame member that couples the first side post to the side beam of the high-floor underframe and is disposed to extend in the car longitudinal direction. Thus, the car end compression load input to the high-floor underframe can be transmitted from the side beam of this high-floor underframe to the first side post via the first frame member. That is, a route that transmits the car end compression load to the side bodysHELL is ensured. This facilitates to disperse the car end compression load on the side bodysHELL to ensure the car strength against the car end compression load.

[0014]

The railcar according to the third aspect, in addition to the effect that the railcar according to the second aspect provides, includes the second-floor floor member disposed above the low-floor underframe of the car to support the floor surface of the second-floor, and the upper end of the first side post of the side bodyshell is coupled to the second-floor floor member. Thus, the car end compression load input to the high-floor underframe can be transmitted to the second-floor floor member via the first side post. That is, the car end compression load can be dispersed on the second-floor floor member to ensure the car strength against the car end compression load.

[0015]

According to the railcar according to the fourth aspect, in addition to the effect that the railcar according to the third aspect provides, the side bodyshell includes the second side post coupled to the side beam of the high-floor underframe at the lower end to be disposed to extend in the car up and down direction, and this second side post is coupled to the second-floor floor member. Thus, the car end compression load input to the high-floor underframe can be transmitted from the side beam of this high-floor underframe to the side bodyshell and the second-floor floor member via the second side post. This can disperse the car end compression load on the side bodyshell

and the second-floor floor member to ensure the car strength against the car end compression load.

[0016]

The second side post is disposed at the position approximately corresponding to the position where the coupling member is coupled to the body bolster of the high-floor underframe, in the car longitudinal direction. Thus, the car end compression load input to the high-floor underframe to be transmitted from the center sill and the body bolster of this high-floor underframe can be efficiently transmitted to the second side post via the body bolster and the side beam. This facilitates to disperse the car end compression load on the side bodysHELL to ensure the car strength against the car end compression load.

[0017]

According to the railcar according to the fifth aspect, in addition to the effect that the railcar according to the fourth aspect provides, the upper end of the second side post of the side bodysHELL is coupled to the roof bodysHELL. Thus, the car end compression load input to the high-floor underframe can be transmitted to the roof bodysHELL via the second side post. That is, the car end compression load can be dispersed on the roof bodysHELL to ensure the car strength against the car end compression load.

[0018]

According to the railcar according to the sixth aspect, in addition to the effect that the railcar according to the fifth aspect provides, the coupling member, the first side post, the first frame member, and the second side post are formed of the members with the closed cross-section structures. Thus, the buckling can be restrained when these respective members receive the car end compression load. Consequently, the car strength against the car end compression load is ensured.

Brief Description of Drawings

[0019]

[FIG. 1] FIG. 1 is a side view of a railcar according to one embodiment of the present invention.

[FIG. 2] FIG. 2 is a cross-sectional view of the railcar along the line II-II in FIG. 1.

[FIG. 3] FIG. 3 is a cross-sectional view of the railcar along the line III-III in FIG. 1.

[FIG. 4] FIG. 4 is a front view of a carbody.

[FIG. 5] FIG. 5 is a partially enlarged top view of an underframe.

[FIG. 6] FIG. 6 is a partially enlarged cross-sectional view of the underframe along the line VI-VI in FIG. 5.

[FIG. 7] FIG. 7 is a partially enlarged top view of the underframe.

[FIG. 8] FIG. 8 is a partially enlarged cross-sectional view of the underframe along the line VIII-VIII in FIG. 7.

[FIG. 9] FIG. 9 is a partially enlarged cross-sectional view of the underframe along the line IX-IX in FIG. 7.

5 [FIG. 10] FIG. 10 is a partially enlarged cross-sectional view of the underframe along the line X-X in FIG. 8.

[FIG. 11] FIG. 11 is a partially enlarged cross-sectional view of the underframe along the line XI-XI in FIG. 5.

10 [FIG. 12] FIG. 12 is a partially enlarged cross-sectional view of the underframe along the line XII-XII in FIG. 5.

[FIG. 13] FIG. 13 is a partially enlarged cross-sectional view of the carbody.

15 Description of Embodiments

[0020]

Hereinafter, a description will be given of a preferred embodiment of the present invention with reference to the accompanying drawings. First, an overall
20 configuration of a railcar 1 will be described with reference to FIG. 1 to FIG. 4.

[0021]

FIG. 1 is a side view of the railcar 1 according to one embodiment of the present invention. FIG. 2 is a
25 cross-sectional view of the railcar 1 along the line II-II

in FIG. 1. FIG. 3 is a cross-sectional view of the railcar 1 along the line III-III in FIG. 1.

[0022]

As illustrated in FIG. 1 to FIG. 3, the railcar 1
5 mainly includes a carbody 2 internally including a
passenger room and an equipment room, bogies 3 that
supports this carbody 2 via air suspensions (not
illustrated), and wheels 4 journaled to these bogies 3.
The railcar 1 is a double-decker having upper and lower
10 two-layer passenger room structures to be formed as a
partially-low-floor car where parts of the bogies 3 in a
front and a rear are high-floored and a part between the
bogies 3 (a central portion in the car longitudinal
direction) is low-floored.

15 [0023]

The carbody 2 includes an underframe 10 that supports
a floor surface of a first floor, side bodyshells 60 whose
lower ends are coupled to side portions in a car width
direction (a right-left direction in FIG. 2 and FIG. 3) of
20 this underframe 10, end bodyshells 70 whose lower ends are
coupled to end portions in a car longitudinal direction (a
right-left direction in FIG. 1) of the underframe 10, a
roof bodyshell 80 coupled to upper ends of the side
bodyshells 60 and the end bodyshells 70, and a second-floor
25 floor member 90 positioned between the underframe 10 and

the roof bodyshell 80 to support a floor surface of a second floor.

[0024]

Connectors 5 are arranged at the end portions in the car longitudinal direction of the underframe 10. The connector 5 projects outside the end bodyshell 70 in the car longitudinal direction. A plurality of seats 6 are disposed side by side at floor surfaces supported by the underframe 10 and the second-floor floor member 90. Baggage racks 7 are disposed to protrude from inner surfaces of the side bodysells 60 above these plurality of seats 6. A plurality of window openings 61 are each openingly formed at the first floor and the second floor, and a plurality of door openings 62 are each openingly formed at the low-floor parts at the first floor, at the side bodysells 60.

[0025]

FIG. 4 is a front view of the carbody 2 and illustrates a state that an outer panel is removed to be a frame. As illustrated in FIG. 4, the end bodyshell 70 includes a pair of corner posts 71 disposed to extend in a vertical direction (an up and down direction in FIG. 4) at both end portions in the car width direction, a pair of end posts 72 that have predetermined distances in the car width direction between these pair of corner posts 71 to be

disposed to extend in the vertical direction, and reinforced beams 73 that couple the corner post 71 to the end post 72 or the end posts 72 together in the car width direction (a right-left direction in FIG. 4). Lower ends
5 of the corner posts 71 and the end posts 72 are coupled to a first end beam 22 (the underframe 10, see FIG. 5), and upper ends of the corner posts 71 and the end posts 72 are coupled to the roof bodysHELL 80, respectively.

[0026]

10 Next, a detailed configuration of the underframe 10 will be described with reference to FIG. 5 and FIG. 6. FIG. 5 is a partially enlarged top view of the underframe 10. FIG. 6 is a partially enlarged cross-sectional view of the underframe 10 along the line VI-VI in FIG. 5. FIG. 5 and
15 FIG. 6 schematically illustrate the connector 5 and an energy absorbing member 27 using two-dot chain lines.

[0027]

As illustrated in FIG. 5 and FIG. 6, the underframe 10 includes a low-floor underframe 30 disposed at a center
20 portion in the car longitudinal direction (a right-left direction in FIG. 5), high-floor underframes 20 arranged at one side and another side in the car longitudinal direction across this low-floor underframe 30 and upper and lower positions are set higher than that of the low-floor
25 underframe 30, and a coupling member 40 that couples this

high-floor underframe 20 to this low-floor underframe 30 in a posture that inclines downward from the high-floor underframe 20 toward the low-floor underframe 30 (see FIG. 11), to be symmetrically formed in the car width direction.

5 [0028]

The high-floor underframe 20 includes a pair of side beams 21 positioned at both sides in the car width direction (an up and down direction in FIG. 5) to be disposed to extend in the car longitudinal direction, a first end beam 22 positioned at the end portion in the car longitudinal direction to be disposed to extend in the car width direction, a second end beam 23 disposed separated from this first end beam 22 to an inner side (a right side in FIG. 5) in the car longitudinal direction and disposed to extend along the car width direction, a center sill 24 coupled to a center in the car width direction of this second end beam 23, at one end to disposed to extend in the car longitudinal direction, a body bolster 25 coupled to another end of this center sill 24 and installed across the pair of side beams 21 to be supported to the bogie 3 (see FIG. 1), a plurality of floor-receiving beams 26 disposed to extend in the car width direction, the energy absorbing member 27 arranged between the first end beam 22 and the second end beam 23, protruding members 28, and fuse members

25 F.

[0029]

The first end beam 22 is disposed separating outward in the car longitudinal direction from end portions in the longitudinal direction of the pair of side beams 21. As
5 described above, the lower ends of the pair of corner posts 71 are coupled to both ends in the longitudinal direction of the first end beam 22, and the lower ends of the pair of end posts 72 are coupled between these pair of corner posts 71. The second end beam 23 couples both end portions in
10 the longitudinal direction of the pair of side beams 21 in the car width direction, and is positioned outward the wheels 4 (see FIG. 1) in the car longitudinal direction.

[0030]

The lower end of the end post 72 is internally
15 inserted from an opening formed at a top surface of the first end beam 22 to be coupled to inner surfaces (two opposing surfaces in the car longitudinal direction and a surface opposed to the opening) of the first end beam 22. A plate-shaped reinforcing plate 29 is arranged inside the
20 second end beam 23 in a state where an outer edge of the reinforcing plate 29 is coupled to inner surfaces (two opposing surfaces in the car longitudinal direction and an lower surface (a lower side in FIG. 6)) of the second end beam 23.

25 [0031]

The center sill 24 is formed with curving downward such that the end portion at a side of the second end beam 23 (a left side in FIG. 6) expands a dimension in an up and down direction toward the outside in the car longitudinal direction. An outward end surface in the car longitudinal direction of this end portion is an installation surface 24a on which the connector 5 is installed. In this embodiment, the installation surface 24a of the center sill 24 is formed approximately flush with a surface at an outer side in the car longitudinal direction of the second end beam 23.

[0032]

The body bolster 25 includes a body bolster center portion 25a to which the other end at an inner side in the car longitudinal direction of the center sill 24 is coupled and disposed to extend in the car width direction, and body bolster extended portions 25b coupled to the pair of side beams 21 and disposed to extend in the car longitudinal direction to be positioned at both sides in the car width direction of the body bolster center portion 25a. The body bolster 25 is formed to be approximately H-shaped from a top view by these body bolster center portion 25a and body bolster extended portions 25b.

[0033]

The energy absorbing member 27 is a member for

absorbing an energy transmitted from the first end beam 22 to the second end beam 23 such that, when the first end beam 22 moves toward the second end beam 23 in consequence of the collision, the energy absorbing member 27 is
5 compressed to be deformed between these first end beam 22 and second end beam 23. A base end of the energy absorbing member 27 is coupled to the center in the car width direction of the second end beam 23 in a state having a predetermined distance from the first end beam 22. As the
10 energy absorbing member 27, a known configuration is employable, thus omitting its detailed description.

[0034]

Here, the center sill 24 is coupled to a surface at the inner side (the right side in FIG. 5) in the car
15 longitudinal direction at approximately a center in the car width direction of the second end beam 23. The energy absorbing member 27 is coupled to a surface at an opposite side of this surface (the surface at the outer side in the car longitudinal direction at the center in the car width
20 direction of the second end beam 23). Accordingly, the first end beam 22 is moved toward the second end beam 23 in collision. When the energy absorbing member 27 is compressed, the center sill 24 supports the second end beam 23 from behind to ensure surely deforming (compressing) the
25 energy absorbing member 27, and the second end beam 23

deforms inward in the car longitudinal direction to ensure reducing influence to the passenger room.

[0035]

The energy absorbing member 27 has the predetermined
5 distance from the first end beam 22. Thus, by this distance, at an early stage in the collision, this facilitates to transmit the load input to the first end beam 22 only to the fuse members F. Accordingly, this can restrain the energy absorbing member 27 from being a
10 resistance against buckling of the fuse member F. That is, when inputting the intended load, the fuse member F can be surely buckled.

[0036]

The protruding member 28 is a member for guiding a
15 moving direction of the first end beam 22 to be disposed to protrude from a surface at an inner side in the car longitudinal direction of the first end beam 22 toward the second end beam 23 along the car longitudinal direction. The second end beam 23 includes a slide holding portion 23a
20 that is an opening penetrated along the car longitudinal direction. This slide holding portion 23a receives a protruding distal end of the protruding member 28 (a distal end of the protruding member 28 is inserted into the slide holding portion 23a). Thus, the protruding member 28 is
25 held to the slide holding portion 23a slidably along the

car longitudinal direction. That is, this can regulate the moving direction toward the second end beam 23, of the first end beam 22, to the car longitudinal direction, in the collision.

5 [0037]

Here, the protruding member 28 is formed of a steel pipe with a rectangular cross-section (steel material with a closed cross-sectional structure). The slide holding portion 23a is formed as the opening having an inner shape
10 identical to or slightly larger than an outer shape of the protruding member 28. Forming the protruding member 28 with the steel pipe can endure bend and torsion, compared with a case formed of an open cross-sectional or solid member having an identical weight. Accordingly, this
15 ensures coupling strength between the first end beam 22 and the second end beam 23 to ensure improvement of rigidity at a car end portion (an end portion in the car longitudinal direction).

[0038]

20 As described above, the slide holding portion 23a is formed as the opening penetrated along the car longitudinal direction at the second end beam 23. Thus, when the first end beam 22 is moved toward the second end beam 23, the slide holding portion 23a can receive the protruding member
25 28 using a space at a back side (the inner side in the car

longitudinal direction) of the second end beam 23. That is, effect that guides the first end beam 22 along the car longitudinal direction (slide displacement of the protruding member 28 with respect to the slide holding
5 portion 23a) can be maintained until just before the first end beam 22 abuts on the second end beam 23.

[0039]

Forming the slide holding portion 23a as the opening of the second end beam 23 improves space efficiency to not
10 only ensure a passenger room space, but also ensure rigidity of the slide holding portion 23a, compared with a case where a different member arranged at a top surface or a lower surface of the second end beam 23 slidably holds the protruding member 28. Accordingly, the slide holding
15 portion 23a can strongly hold the protruding member 28, and to that extent, the coupling strength between the first end beam 22 and the second end beam 23 is ensured to ensure the improvement of the rigidity of the car end portion (the end portion in the car longitudinal direction).

20 [0040]

The fuse member F functions as a strength member that ensures the rigidity of the car end portion (the coupling part between the first end beam 22 and the second end beam 23) in normal operation. On the other hand, the fuse
25 member F is a member for allowing the first end beam 22 to

move toward the second end beam 23, by buckling when the load received in the collision exceeds a predetermined value. The fuse member F couples the first end beam 22 to the second end beam 23 along the car longitudinal direction.

5 [0041]

When the first end beam 22 collides with an oncoming car, the underframe 10 compresses the fuse members F in the longitudinal direction between the first end beam 22 and the second end beam 23. When the load exceeds the
10 predetermined value, the underframe 10 buckles this fuse member F to allow the first end beam 22 to move toward the second end beam 23.

[0042]

That is, in a structure of a conventional product
15 that breaks a plurality of coupling members such as rivets and bolts to allow the first end beam 22 to move toward the second end beam 23, influence of a dimensional tolerance and a position tolerance of each of holes and the coupling members gathers to facilitate to generate variation at
20 breaking strength. Thus, when the intended load is input, it has been difficult to allow the first end beam 22 to move toward the second end beam 23. However, as this embodiment, the structure that uses the buckling of the fuse member F ensures reducing variation of the load that
25 allows the first end beam 22 to move toward the second end

beam 23. Consequently, when the intended load is input, the first end beam 22 is allowed to move toward the second end beam 23.

[0043]

5 A pair of sets (slide mechanisms) including the protruding members 28 and the slide holding portions 23a are arranged. These pair of slide mechanisms are symmetrically disposed in the car width direction (in the up and down direction in FIG. 5) across the energy
10 absorbing member 27. This can straightly guide (move along the car longitudinal direction) the first end beam 22 toward the second end beam 23, for example, even when the oncoming car collides being biased in the car width direction to input an unbalanced load to the first end beam
15 22. Consequently, the fuse member F can be buckled by the intended load, and the energy absorbing member 27 can be stably compressed along the car longitudinal direction.

[0044]

 Similarly, a pair of fuse members F are arranged.
20 These pair of fuse members F are symmetrically disposed in the car width direction (the up and down direction in FIG. 5) across the energy absorbing member 27. This can uniform the load required for the deformation in the buckling and after the buckling of the fuse member F, in the car width
25 direction. That is, a posture with respect to the second

end beam 23, of the first end beam 22 inclines to ensure
restraining the protruding member 28 from getting
complicated inside the slide holding portion 23a.

Consequently, the slide displacement of the protruding
5 member 28 with respect to the slide holding portion 23a can
be smoothly performed.

[0045]

In this case, in this embodiment, the slide mechanism
(the set of the protruding member 28 and the slide holding
10 portion 23a) is disposed outside the fuse member F in the
car width direction (the upper side or the lower side in
FIG. 5). This facilitates to straightly guide (move along
the car longitudinal direction) the first end beam 22
toward the second end beam 23, for example, even when the
15 oncoming car collides being biased in the car width
direction to input the unbalanced load to the first end
beam 22. Consequently, this facilitates to buckle the fuse
member F by the intended load, and facilitates to stably
compress the energy absorbing member 27 along the car
20 longitudinal direction.

[0046]

Next, a detailed configuration of the fuse member F
will be described with reference to FIG. 7 to FIG. 10. FIG.
7 is a partially enlarged top view of the underframe 10.
25 FIG. 8 is a partially enlarged cross-sectional view of the

underframe 10 along the line VIII-VIII in FIG. 7. FIG. 9 is a partially enlarged cross-sectional view of the underframe 10 along the line IX-IX in FIG. 7. FIG. 10 is a partially enlarged cross-sectional view of the underframe 10 along the line X-X in FIG. 8.

[0047]

As illustrated in FIG. 7 to FIG. 10, the fuse member F includes a channel material 50 that couples the first end beam 22 to the second end beam 23, three plate-shaped bodies (a first plate member 51, a second plate member 52, and a third plate member 53) fixedly secured to this channel material 50 at regular intervals along the longitudinal direction, a first gusset plate 54 installed across the first end beam 22 and the channel material 50, and a second gusset plate 55 installed across the second end beam 23 and the channel material 50.

[0048]

The channel material 50, which is a member forming a frame of the fuse member F, is formed into an approximately U-shaped cross-section, including a web 50a disposed to extend along the car longitudinal direction (a right-left direction in FIG. 7) and a pair of flanges 50b disposed upright from both end portions (edge portions) of this web 50a. End surfaces in the longitudinal direction of the web 50a and end surfaces in the longitudinal direction of the

flange 50b are coupled to each of the first end beam 22 and the second end beam 23, in a posture that the web 50a is parallel to the vertical direction (the flange 50b is parallel to a horizontal direction).

5 [0049]

In this way, the fuse member F is formed of the channel material 50 with the approximately U-shaped cross-section. Thus, the fuse member F ensures the coupling strength between the first end beam 22 and the second end beam 23 to ensure the improvement of the rigidity of the car end portion in normal operation. On the other hand, when receiving the load that exceeds the predetermined value in consequence of the collision, the fuse member F promptly buckles to allow the first end beam 22 to move toward the second end beam 23.

15 [0050]

In this embodiment, the fuse member F is arranged in a posture that an opening side (a side at which the flange 50b is disposed upright) of the channel material 50 is opposed to an outside in the car width direction (a side of the protruding member 28) (see FIG. 5). As described later, the fuse member F can buckle in a mode that a back side (a lower side in FIG. 7) of the web 50a is folded outside (an uprightly-disposed side (an upper side in FIG. 7) of the flange 50b is an inside), with a reference position Ps as a

base point. That is, the channel material 50 can be folded to be doglegged to a direction separated from the protruding member 28.

[0051]

5 Accordingly, as described above, turning the opening side to the protruding member 28 can reduce interference of the folded channel material 50 to the protruding member 28 to ensure disposing the fuse member F close to the protruding member 28. This facilitates to obtain a guide
10 effect in a sliding direction by the slide mechanism (the protruding member 28 and the slide holding portion 23a) to ensure stably forming the buckling of the fuse member F.

[0052]

A thickness dimension of the channel material 50 (a
15 dimension between outer surfaces of the pair of flanges 50b, and dimensions in up and down directions in FIG. 8 and FIG. 9) is configured approximately identical to thickness dimensions of the first end beam 22 and the second end beam 23.

20 [0053]

The first gusset plate 54 and the second gusset plate 55 are each including upper and lower two plates. The top surface and a lower surface of the first end beam 22 are bonded on the outer surfaces of the respective flanges 50b
25 of the channel material 50 by the first gusset plate 54,

and the top surface and the lower surface of the second end beam 23 are bonded on the outer surfaces of the respective flanges 50b of the channel material 50 by the second gusset plate 55, respectively.

5 [0054]

This can restrain a base end side (a coupling part to the first end beam 22 or the second end beam 23) of the channel material 50 from buckling on ahead, when the load in consequence of the collision acts. That is, the
10 buckling in a mode that the channel material 50 is folded at an approximately central part in the longitudinal direction (a region between the first gusset plate 54 and the second gusset plate 55) can be surely formed. Consequently, the fuse member F (the channel material 50)
15 is facilitated to buckle into an intended shape.

[0055]

Here, at the fuse member F, a low-rigidity portion whose rigidity is partially low is formed at the reference position Ps between the first gusset plate 54 and the
20 second gusset plate 55. With this reference position Ps (the low-rigidity portion) as the base point, the fuse member F is configured to buckle in the intended shape. The low-rigidity portion is formed by lowering an uprightly-disposed height of the flange 50b and thinning a
25 plate thickness of the web 50a. This low-rigidity portion

will be described in the following.

[0056]

At the fuse member F, the low-rigidity portion is formed at the reference position Ps such that the height
5 disposed upright from the web 50a (a dimension in an up and down direction in FIG. 7) of the flange 50b is partially lowered. This can generate the buckling in the mode that the web 50a can be folded, with the reference position Ps (the low-rigidity portion) as the base point, when the load
10 in consequence of the collision acts, to facilitate to buckle the fuse member F into the intended shape.

[0057]

In particular, in this embodiment, at the channel material 50, the height disposed upright from the web 50a
15 of the flange 50b is continuously lowered toward the reference position Ps, in the region between the first gusset plate 54 and the second gusset plate 55 (see FIG. 7). That is, an outer edge of the flange 50b is formed to be approximately V-shaped. This can cause the load acted in
20 consequence of the collision to stably focus on the reference position Ps to ensure surely generating the buckling in the mode that the back side (the lower side in FIG. 7) of the web 50a is folded outside (the uprightly-disposed side (the upper side in FIG. 7) of the flange 50b
25 is the inside) at the reference position Ps (the low-

rigidity portion).

[0058]

At the fuse member F, the low-rigidity portion is also formed at the reference position Ps by thinning the plate thickness of the web 50a. This can cause the load
5 acted in consequence of the collision to further focus on the reference position Ps to ensure more surely generating the buckling in the mode that the back side (the lower side in FIG. 7) of the web 50a is folded outside (the uprightly-
10 disposed side (the upper side in FIG. 7) of the flange 50b is the inside) at the reference position Ps (the low-rigidity portion).

[0059]

In this case, in this embodiment, fixedly securing
15 the plate-shaped bodies (the first plate member 51, the second plate member 52, and the third plate member 53) to the back surface (a surface at a side opposed to an uprightly-disposed direction of the flange 50b) of the web 50a varies the plate thickness of the web 50a.
20 Specifically, fixedly securing the first plate member 51 and the second plate member 52 having a predetermined distance partially thins the plate thickness such that the plate-shaped body is not secured at the reference position Ps. This can reduce man-hours to ensure reduction of a
25 product cost to that extent, for example, compared with a

case of performing a cutting work to partially thin the plate thickness of the web 50a.

[0060]

The first plate member 51, the second plate member 52,
5 and the third plate member 53 are formed into horizontally long rectangular shapes in front view. Accordingly, fixedly securing these respective plate members 51 to 53 in postures that these longitudinal directions are set along the longitudinal direction of the channel material 50 (the
10 web 50a) can easily form thin parts (parts at which the plate thickness is thinned) disposed to extend with an equal width in a direction (the up and down direction in FIG. 8) perpendicular to the longitudinal direction of the web 50a.

15 [0061]

Here, it is also considered that an opening is disposed at the web 50a to form the low-rigidity portion at the reference position Ps. However, when the opening forms the low-rigidity portion at the reference position Ps, it
20 cannot be regulated that the web 50a is folded to which direction at the reference position Ps (the low-rigidity portion) to make this folded direction instable. In contrast, the structure that fixedly secures the plate-shaped bodies to the back surface of the web 50a to form
25 the low-rigidity portion at the reference position Ps can

stably regulate the direction that the web 50a is folded.
That is, this ensures surely generating the buckling in the
mode that the back side (the lower side in FIG. 7) of the
web 50a is folded outside (the uprightly-disposed side (the
5 upper side in FIG. 7) of the flange 50b is the inside) at
the reference position Ps (the low-rigidity portion).

[0062]

The first plate member 51, the second plate member 52,
and the third plate member 53, as described above, are
10 disposed at regular intervals one another along the
longitudinal direction of the web 50a (a distance between
the first plate member 51 and the second plate member 52,
and a distance between the second plate member 52 and the
third plate member 53 are set to be identical).

15 [0063]

In contrast, a group including the respective plate
members 51 to 53 is disposed being biased to a side of the
second end beam 23 (a right side in FIG. 8), in the
longitudinal direction of the web 50a. Therefore, a
20 distance larger than the distances between the plate
members 51 to 53 is formed between the first end beam 22
and the first plate member 51. On the other hand, a
clearance is not formed between the third plate member 53
and the second end beam 23 (that is, an edge portion of the
25 third plate member 53 is fixedly secured (coupled) to the

second end beam 23).

[0064]

This enhances coupling strength at a coupling part between the fuse member F and the second end beam 23 to ensure restraining this coupling part from being folded. Accordingly, this facilitates to buckle the fuse member F into the intended shape.

[0065]

That is, the connector 5 is arranged at a bottom surface side of the second end beam 23, and this connector 5 is projected outside the first end beam 22 in the car longitudinal direction (see FIG. 6). Therefore, the oncoming car may collide with the connector 5 on ahead, and in this case, the carbody 2 is deformed in a form that turns the end bodyshe11 70 (the first end beam 22) downward (lowers a head) by the load input from the connector 5. Thus, large bending moment acts on the coupling part to the second end beam 23, at the fuse member F.

[0066]

Accordingly, the edge portion of the third plate member 53 is fixedly secured to the surface at the outer side (a left side in FIG. 8) in the car longitudinal direction of the second end beam 23 to enhance the coupling strength at the coupling part between the fuse member F and the second end beam 23, thus ensuring resistance against

the above-described bending moment to ensure restraining the fuse member F from being folded at the coupling part to the second end beam 23.

[0067]

5 The group including the respective plate members 51 to 53 is disposed being biased to the second end beam 23 side (the right side in FIG. 8) in the longitudinal direction of the web 50a to ensure forming change of the plate thickness of the web 50a at a first position P1 and a
10 second position P2, which are described later, and increasing a size of the second gusset plate 55. That is, this increasing of the size of the second gusset plate 55 will be also effective for resisting against the above-described bending moment to restrain the fuse member F from
15 being folded at the coupling part to the second end beam 23.

[0068]

At the web 50a of the channel material 50, fixedly securing the first plate member 51, the second plate member 52, and the third plate member 53 to the back surface thins
20 the plate thicknesses at three positions: the reference position Ps, the first position P1 at a first end beam 22 side of this reference position Ps, and the second position P2 at the second end beam 23 side of the reference position Ps.

25 [0069]

Accordingly, when the load in the collision acts, while folding the fuse member F in the form that the back side (the lower side in FIG. 7) of the web 50a is outside (the uprightly-disposed side (the upper side in FIG. 7) of the flange 50b is the inside), as described above, at the reference position Ps, in contrast, the buckling in the mode that the back side of the web 50a is folded inside (the uprightly-disposed side of the flange 50b is the outside) can be generated at the first position P1 and the second position P2. This ensures reduction of the load required for the deformation of the fuse member F after this fuse member F buckles.

[0070]

In particular, in this embodiment, an edge portion of the first gusset plate 54 is positioned at the first position P1, and an edge portion of the second gusset plate 55 is positioned at the second position P2. Thus, at one or both of the first position P1 and the second position P2, when the web 50a is folded in the above-described form, the flange 50b constrained by the first gusset plate 54 or the second gusset plate 55 can be cut along the edge portion of the first gusset plate 54 or the second gusset plate 55. Accordingly, after the fuse member F buckles, the load required for the deformation of this fuse member F can be further reduced.

[0071]

As described above, the lower end of the end post 72 is coupled to the inner surface of the first end beam 22, and the plate-shaped reinforcing plate 29 is arranged
5 inside the second end beam 23, in a state where the outer edge of the reinforcing plate 29 is coupled to the inner surface of the second end beam 23.

[0072]

In this case, the end post 72 and the reinforcing
10 plate 29 are disposed in a straight line along the car longitudinal direction (see FIG. 10). These end post 72 and reinforcing plate 29, and the fuse member F are disposed at positions that positions in the car width direction (an up and down direction in FIG. 10) at least
15 partially overlap. That is, as viewed in the car longitudinal direction (viewed in a right-left direction in FIG. 10), the end post 72 and the reinforcing plate 29, and the fuse member F at least partially overlap. In this embodiment, the end post 72 and the reinforcing plate 29,
20 and the web 50a of the channel material 50 are disposed in a straight line along the car longitudinal direction.

[0073]

When the oncoming car collides with the end bodyshell
70 (see FIG. 4), that is, even when the oncoming car
25 collides with a focus on a position higher than the first

end beam 22, this facilitates to transmit the load in the collision to the fuse member F (the web 50a of the channel material 50) via the end posts 72. Consequently, the fuse member F is buckled to ensure absorption of the energy by
5 the energy absorbing member 27.

[0074]

Regardless of whether the oncoming car collides at the position higher than the first end beam 22 or directly collides with the first end beam 22, the reinforcing plate
10 29 can support the fuse member F (the web 50a of the channel material 50) that has received the load from a rearward to ensure surely buckling the fuse member F (the channel material 50).

[0075]

15 The description will be given returning to FIG. 5 and FIG. 6. The low-floor underframe 30 includes a pair of side beams 31 positioned at both sides in the car width direction (the up and down direction in FIG. 5) to be disposed to extend in the car longitudinal direction, and a
20 plurality of floor-receiving beams 36 disposed to extend in the car width direction. As described above, the railcar 1 is formed as the partially-low-floor car, and the underframe 10 is formed as an underframe structure where the low-floor underframe 30 is coupled to the high-floor
25 underframe 20 whose upper and lower positions are set

higher than that of this low-floor underframe 30 by the coupling member 40. This underframe structure will be described with reference to FIG. 11 to FIG. 13.

[0076]

5 FIG. 11 is a partially enlarged cross-sectional view of the underframe 10 along the line XI-XI in FIG. 5. FIG. 12 is a partially enlarged cross-sectional view of the underframe 10 along the line XII-XII in FIG. 5. FIG. 13 is a partially enlarged cross-sectional view of the carbody 2, 10 and corresponds to a cross-section along the line XI-XI in FIG. 5. FIG. 13 illustrates only a main configuration by simplifying the drawing for easily understanding.

[0077]

As illustrated in FIG. 11 to FIG. 13, the coupling 15 member 40 includes a main body member 41 formed of a steel pipe with the rectangular cross-section (steel material with the closed cross-sectional structure), and upper and lower pair of flange members 42 formed by projecting out from outer surfaces at both end portions in the 20 longitudinal direction of this main body member 41, to couple a lower surface of the body bolster extended portion 25b at the body bolster 25 of the high-floor underframe 20 to a top surface of the side beam 31 of the low-floor underframe 30.

25 [0078]

The upper and lower pair of flange members 42 are formed as plate-shaped bodies with rectangular shapes in front view that are parallel one another. The upper side flange member 42 is formed having a size (a width
5 dimensions, and a right-left directional dimension in FIG. 12) coupled to the lower surface of the body bolster 25 (the body bolster extended portion 25b) and a lower surface of the side beam 21, at the high-floor underframe 20.

[0079]

10 As described above, the high-floor underframe 20 includes the center sill 24 coupled to the center in the car width direction of the second end beam 23 at the one end to disposed to extend in the car longitudinal direction, and the body bolster 25 coupled to the other end of this
15 center sill 24 (see FIG. 5), and the side bodysHELL 60 is coupled to the side beam 31 of the low-floor underframe 30. Accordingly, when a car end compression load is input to the high-floor underframe 20, this car end compression load can be directly transmitted from the center sill 24 and the
20 body bolster 25 of the high-floor underframe 20 to the side beam 31 of the low-floor underframe 30 via the coupling member 40. This can disperse the car end compression load on the side bodysHELL 60 to ensure car strength against the car end compression load.

25 [0080]

A first side post 63 coupled to the side beam 31 of the low-floor underframe 30 at a lower end and disposed to extend in the up and down direction (an up and down direction in FIG. 13), and a first frame member 65 that
5 couples this first side post 63 to the side beam 21 of the high-floor underframe 20 and is disposed to extend in the car longitudinal direction (a right-left direction in FIG. 13) are arranged at the side bodyshell 60.

[0081]

10 Accordingly, when the car end compression load is input to the high-floor underframe 20, this car end compression load can be transmitted from the side beam 21 of the high-floor underframe 20 to the first side post 63 via the first frame member 65. That is, a route that
15 transmits the car end compression load to the side bodyshell 60 can be further ensured separately from the route by the coupling member 40. This facilitates to disperse the car end compression load on the side bodyshell 60 to ensure the car strength against the car end
20 compression load.

[0082]

In this case, the first side post 63 of the side bodyshell 60 is coupled to the second-floor floor member 90, at an upper end. Accordingly, when the car end compression
25 load is input to the high-floor underframe 20, this car end

compression load also can be transmitted to the second-floor floor member 90 via the first side post 63. This can disperse the car end compression load on the second-floor floor member 90, in addition to the side bodyshell 60, to ensure the car strength against the car end compression load.

[0083]

A second side post 64 coupled to the side beam 21 of the high-floor underframe 20 at a lower end and disposed to extend in the up and down direction (the up and down direction in FIG. 13) is arranged at the side bodyshell 60. This second side post 64 is coupled to the second-floor floor member 90, in the middle of the longitudinal direction. Accordingly, when the car end compression load is input to the high-floor underframe 20, this car end compression load can be transmitted from the side beam 21 of this high-floor underframe 20 to the side bodyshell 60 and the second-floor floor member 90 via the second side post 64. This can disperse the car end compression load on the side bodyshell 60 and the second-floor floor member 90 to ensure the car strength against the car end compression load.

[0084]

In this case, the lower end of the second side post 64 of the side bodyshell 60 is coupled to the side beam 21

of the high-floor underframe 20 at a position approximately
corresponding to a position at which the coupling member 40
(the main body member 41 and the flange member 42) is
coupled to the body bolster 25 of the high-floor underframe
5 20 in the car longitudinal direction (the right-left
direction in FIG. 13). Thus, the car end compression load
input to the high-floor underframe 20 to be transmitted
from the center sill 24 and the body bolster 25 of this
high-floor underframe 20 can be efficiently transmitted to
10 the second side post 64 via the body bolster 25 and the
side beam 21. This facilitates to disperse the car end
compression load on the side bodysHELL 60 to ensure the car
strength against the car end compression load.

[0085]

15 Further, the second side post 64 is coupled to the
roof bodysHELL 80 at an upper end. Accordingly, when the
car end compression load is input to the high-floor
underframe 20, this car end compression load also can be
transmitted from the side beam 21 of this high-floor
20 underframe 20 to the roof bodysHELL 80 via the second side
post 64. This also can disperse the car end compression
load on the roof bodysHELL 80, in addition to the side
bodysHELL 60 and the second-floor floor member 90, to
ensure the car strength against the car end compression
25 load.

[0086]

Here, similar to the main body member 41 of the coupling member 40, the first side post 63, the second side post 64, and the first frame member 65 are formed of steel pipes with the rectangular cross-sections (steel material with the closed cross-sectional structure). Accordingly, when receiving the car end compression load, buckling of these respective members (the main body member 41, the first side post 63, the second side post 64, and the first frame member 65) can be restrained. Consequently, the car strength against the car end compression load is ensured.

[0087]

Between the first side post 63 and the second side post 64, an intermediate post and a plurality of reinforcing beams are arranged (any of them is not illustrated). The intermediate post is disposed to extend in the up and down direction (the up and down direction in FIG. 13) to couple the second-floor floor member 90 to the first frame member 65. The reinforcing beams are disposed to extend in the car longitudinal direction (the right-left direction in FIG. 13) to couple the first side post 63 to the intermediate post and the intermediate post to the second side post 64.

[0088]

On a surface at a car room side of the first side

post 63, the second side post 64, and the intermediate post
(a side opposed to the outer panel, and a near side in a
paper of FIG. 13), a shear plate is stretched (fixedly
secured). The shear plate, which is a plate-shaped body
5 with an approximately rectangular shape in front view, in
this embodiment, is arranged in a form installed across the
first side post 63 and the intermediate post, and across
the intermediate post and the second side post 64. This
ensures the car strength against the car end compression
10 load.

[0089]

As described above, the present invention has been
described based on the above-mentioned embodiment. It will
be appreciated that the present invention will not be
15 limited to the embodiment described above, but various
modifications are possible without departing from the
technical scope of the present invention.

[0090]

While in the above-described embodiment, a case where
20 the outer shape of the protruding member 28 is formed into
the rectangular cross-section has been described, this
should not necessarily be construed in a limiting sense.
The outer shape may be formed into a circular-shaped cross-
section. While a case where the protruding member 28 is
25 hollow has been described, this should not necessarily be

construed in a limiting sense. The protruding member 28 may be solid.

[0091]

While in the above-described embodiment, as a method
5 that varies the plate thickness of the web 50a (partially
forms portions whose plate thicknesses are thin), a case
where the plurality of plate-shaped bodies (the first plate
member 51, the second plate member 52, and the third plate
member 53) are fixedly secured to the web 50a has been
10 described, this should not necessarily be construed in a
limiting sense. For example, performing a cutting work to
the web 50a may partially thin the plate thickness of the
web 50a. The method that fixedly secures the plate-shaped
bodies and the method that performs the cutting work may be
15 combined.

Reference Signs List

[0092]

- | | | |
|----|----|-----------------------|
| 1 | 1 | railcar |
| 20 | 3 | bogie |
| | 20 | high-floor underframe |
| | 21 | side beam |
| | 24 | center sill |
| | 25 | body bolster |
| 25 | 30 | low-floor underframe |

	31	side beam
	40	coupling member
	60	side bodyshell
	63	first side post
5	64	second side post
	65	first frame member
	80	roof bodyshell
	90	second-floor floor member

Claims

[Claim 1]

A railcar comprising:

a low-floor underframe disposed at a center portion in a car longitudinal direction;

high-floor underframes arranged at one side and another side in the car longitudinal direction across the low-floor underframe, and upper and lower positions of the high-floor underframes being set higher than upper and lower positions of the low-floor underframe; and

coupling members that couple the low-floor underframe to the high-floor underframes in postures that incline downward from the high-floor underframes toward the low-floor underframe,

wherein the low-floor underframe includes side beams to which side bodysHELLs are coupled,

wherein the high-floor underframe includes a center sill disposed to extend in the car longitudinal direction at a center in a car width direction, a body bolster to which the center sill is coupled to be an installation portion of a bogie, and side beams, and

the body bolster of the high-floor underframe is coupled to the side beams of the low-floor underframe by the coupling member,

wherein the side bodysHELL includes:

a first side post coupled to the side beam of the low-floor underframe at a lower end to be disposed to extend in the car up and down direction; and

a first frame member that couples the first side post to the side beam of the high-floor underframe and is disposed to extend in the car longitudinal direction,

the upper end of the first side post is located higher than the high-floor underframe, and

the first frame member couples the side beams of the high-floor underframe and the first side post, at a height substantially corresponding to that of the high-floor underframe.

[Claim 2]

The railcar according to claim 1, comprising

a second-floor floor member disposed above the low-floor underframe of a car to support a floor surface of a second-floor,

wherein an upper end of the first side post of the side bodyshell is coupled to the second-floor floor member.

[Claim 3]

The railcar according to claim 2,

wherein the side bodyshell includes a second side post coupled to the side beam of the high-floor underframe at a lower end to be disposed to extend in the car up and down direction, and

the second side post of the side bodyshell is disposed at a position approximately corresponding to a position where the coupling member is coupled to the body bolster of the high-floor underframe, in the car longitudinal direction, the second side post being coupled to the second-floor floor member.

[Claim 4]

The railcar according to claim 3,

wherein an upper end of the second side post of the side bodyshell is coupled to a roof bodyshell.

[Claim 5]

The railcar according to claim 4,

wherein the coupling member, the first side post, the first frame member, and the second side post are formed of members with closed cross-section structures.

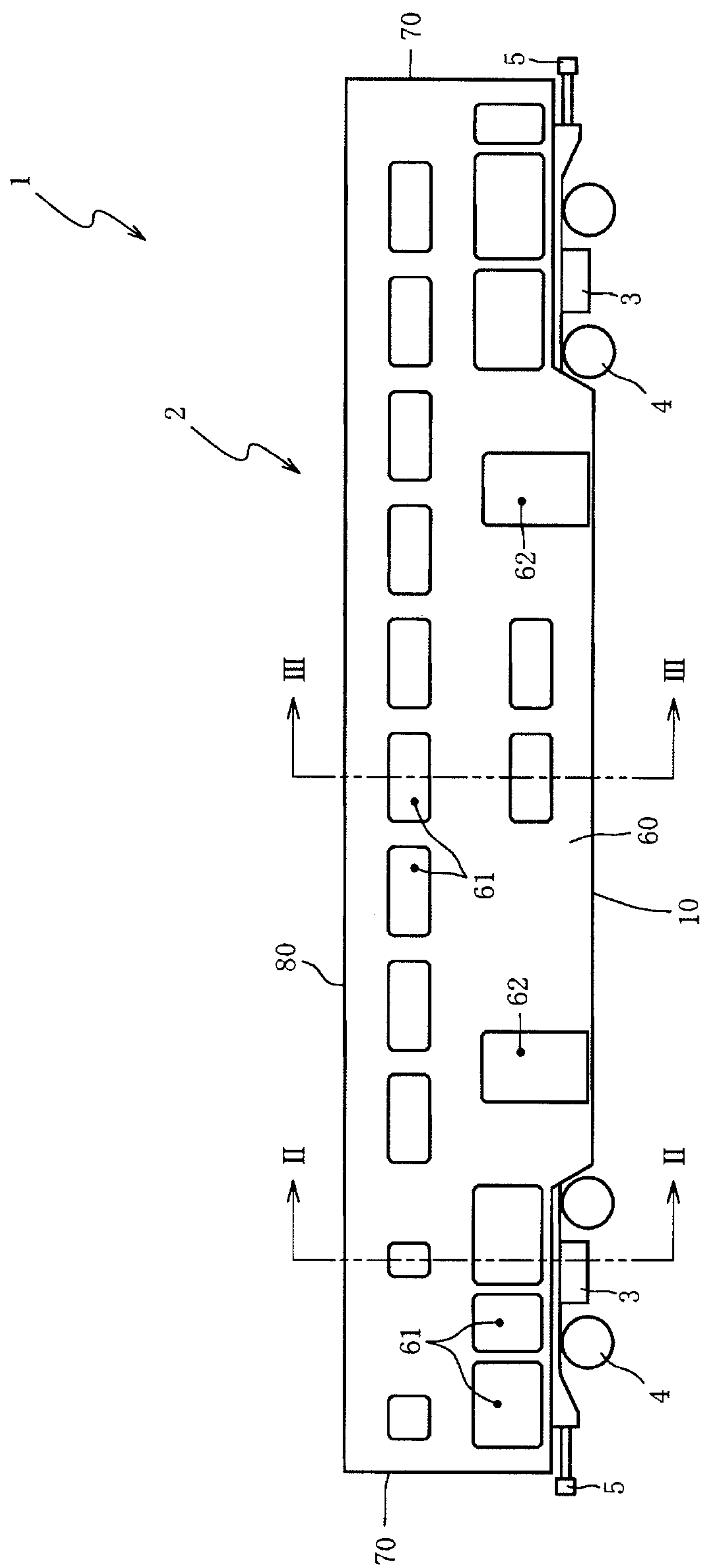


FIG. 1

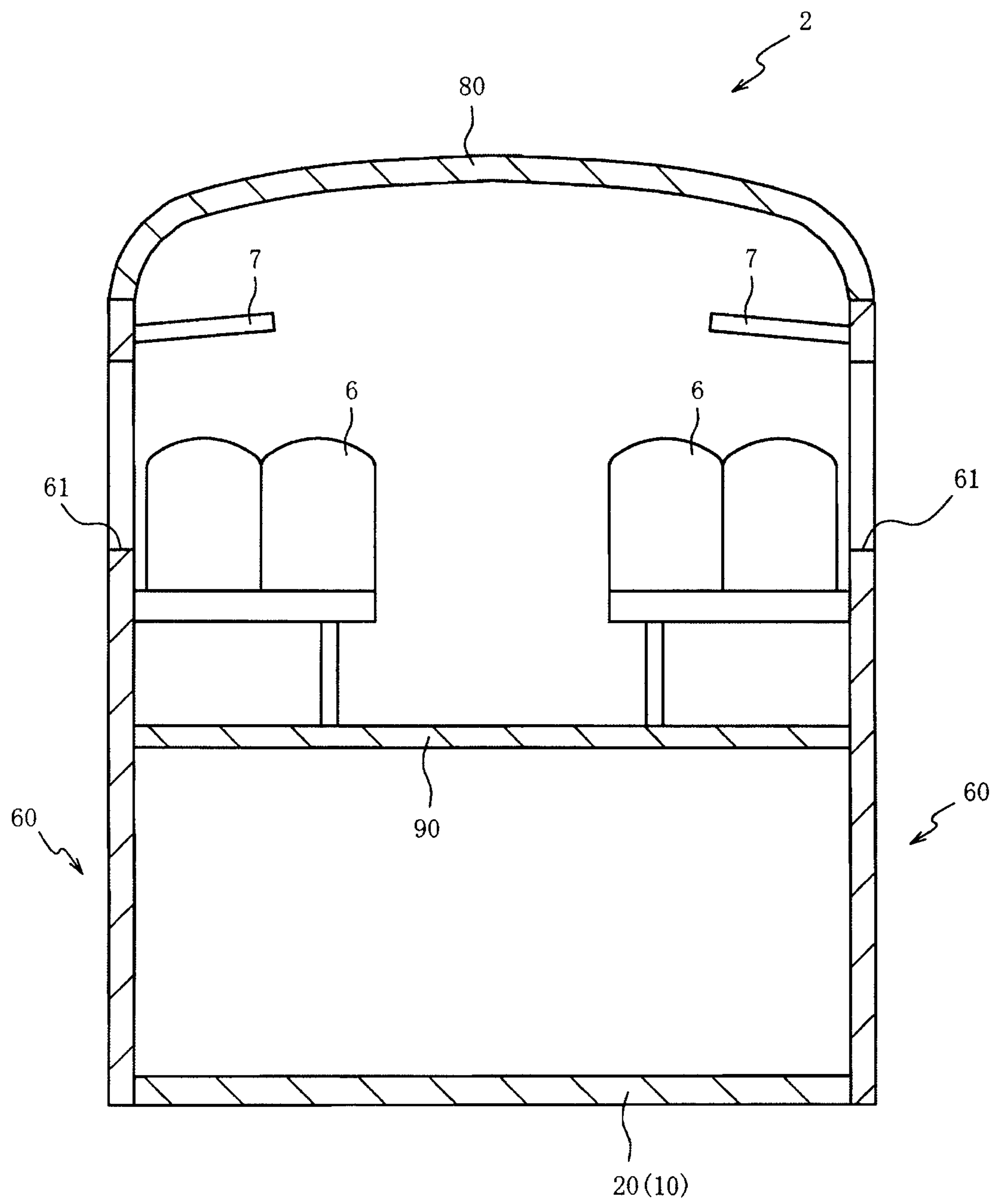


FIG. 2

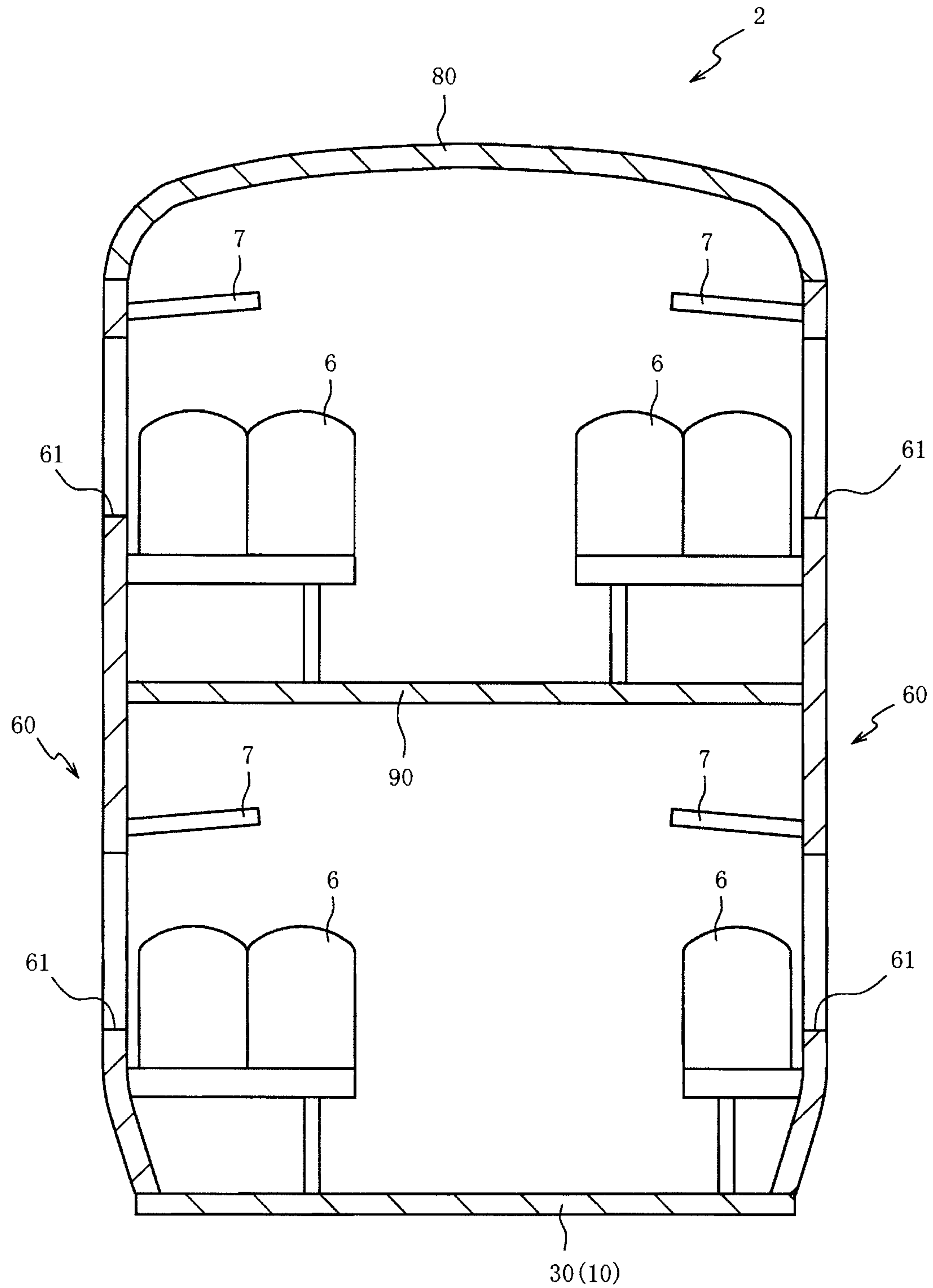


FIG. 3

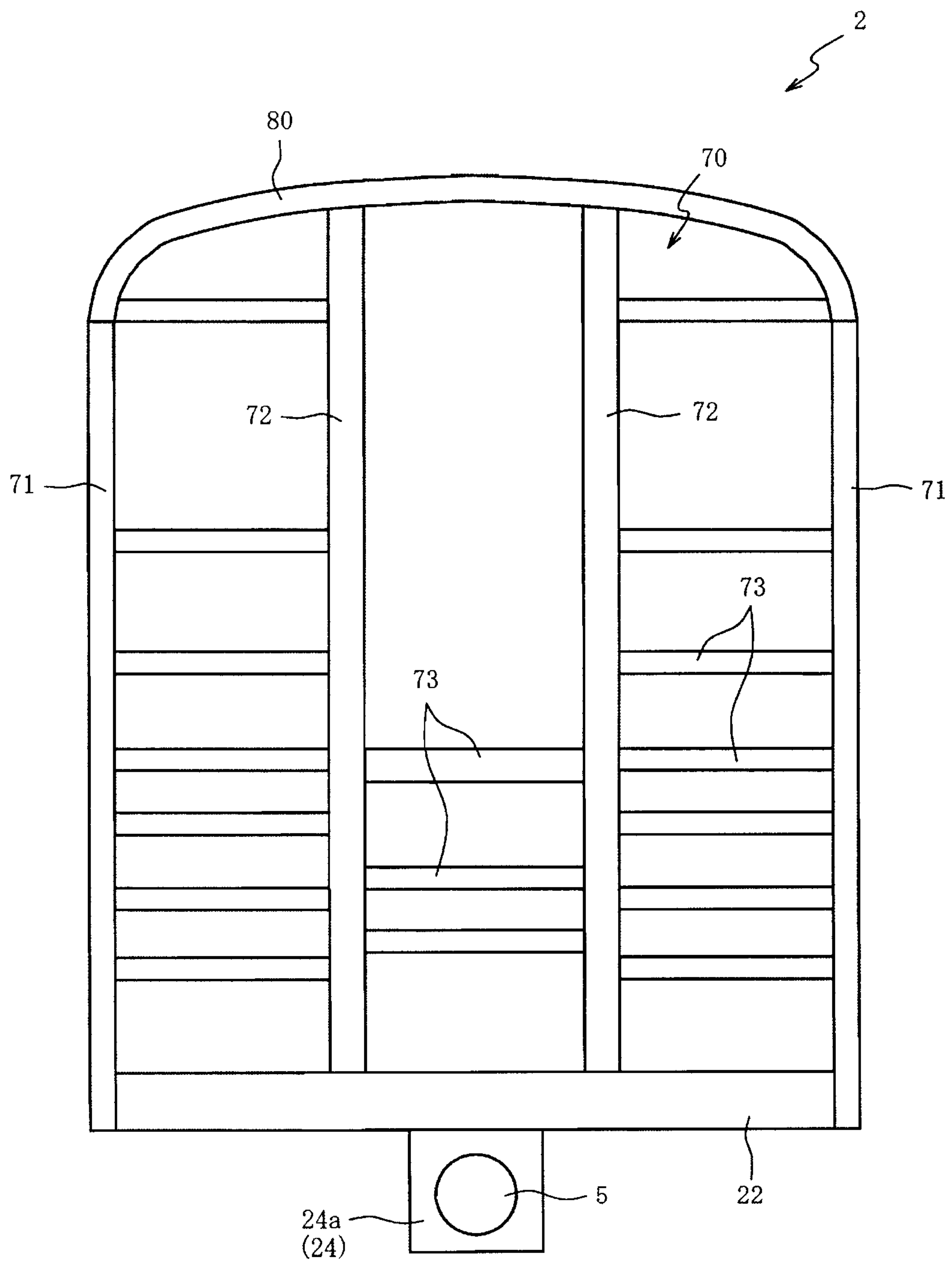


FIG. 4

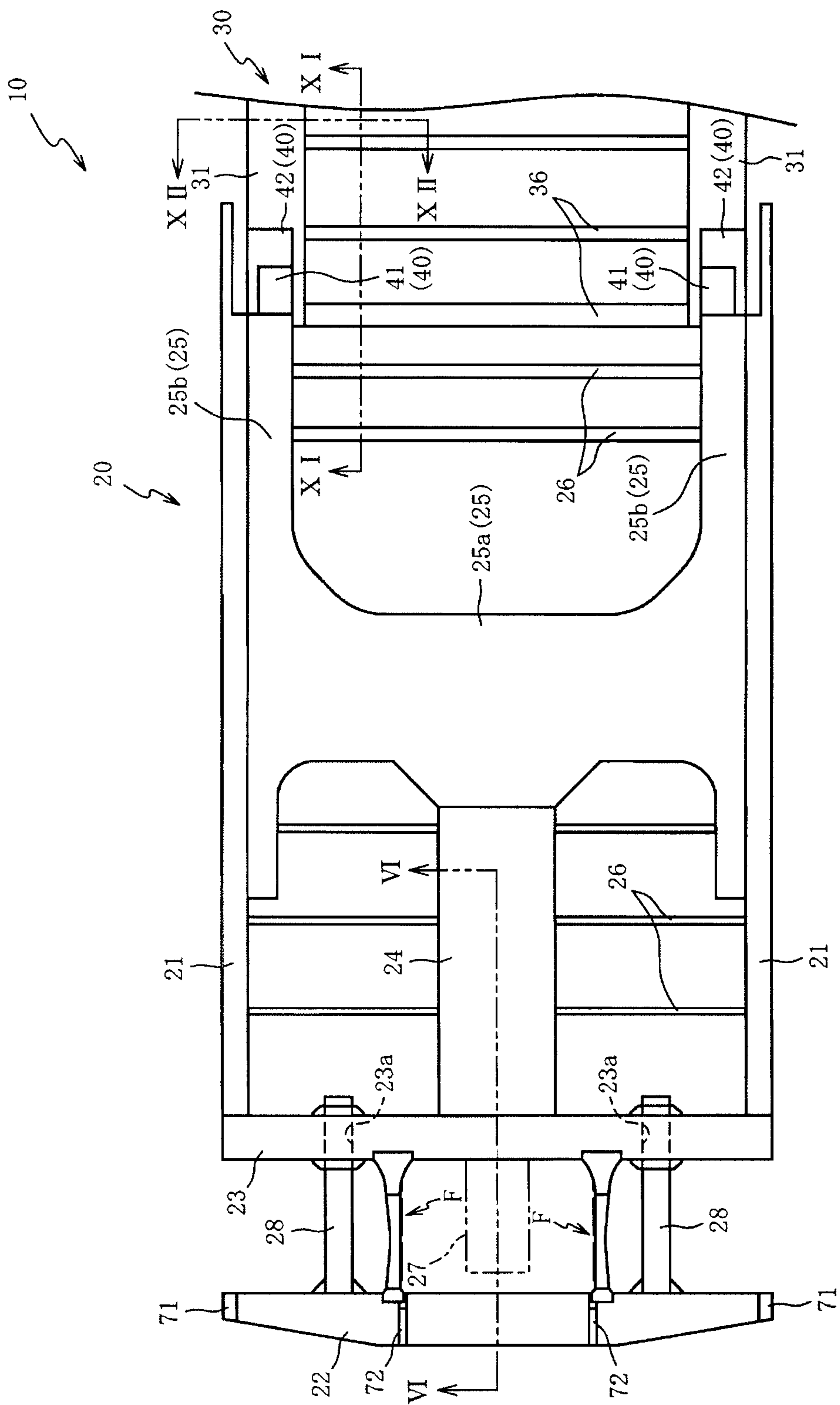


FIG. 5

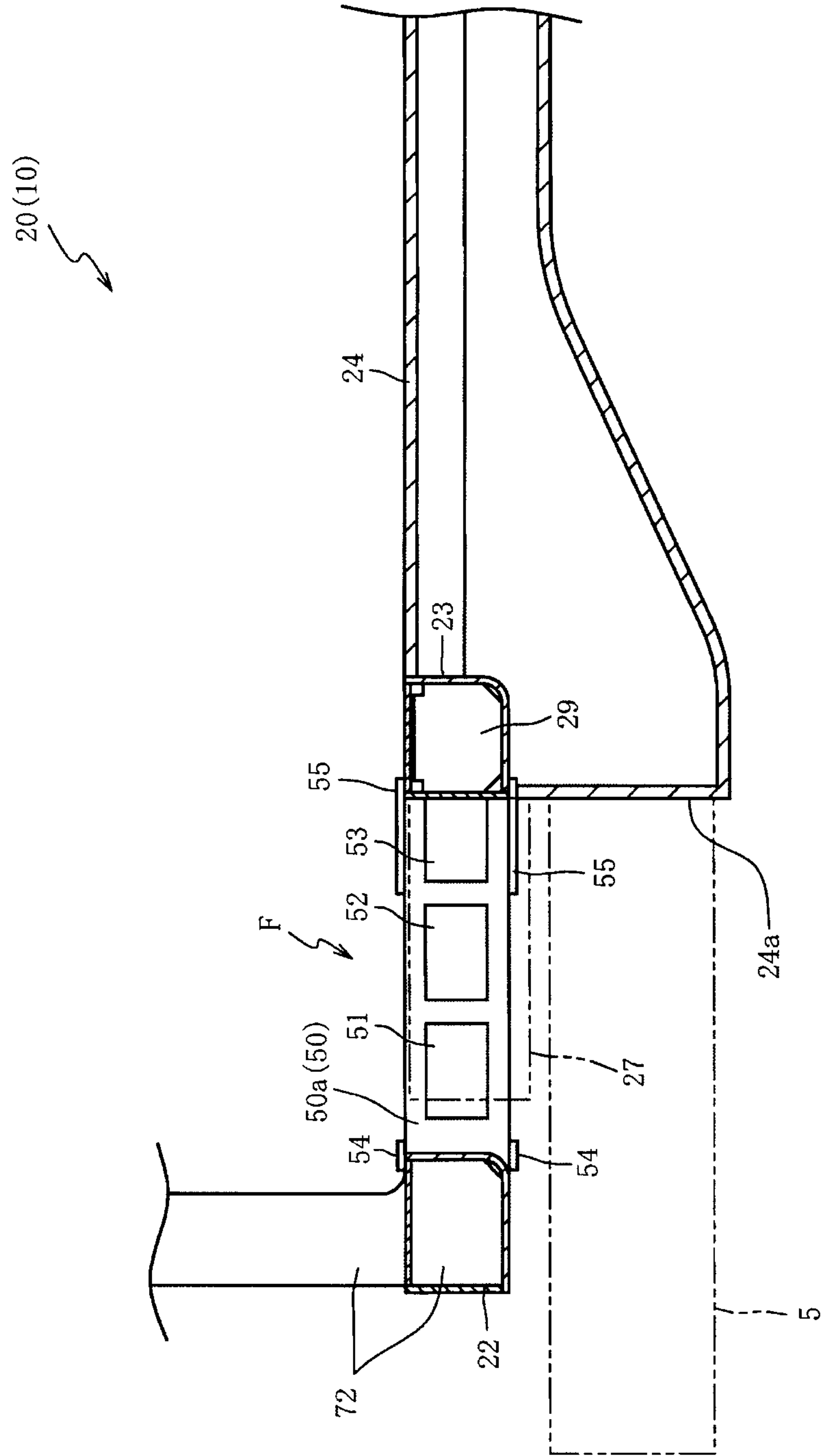


FIG. 6

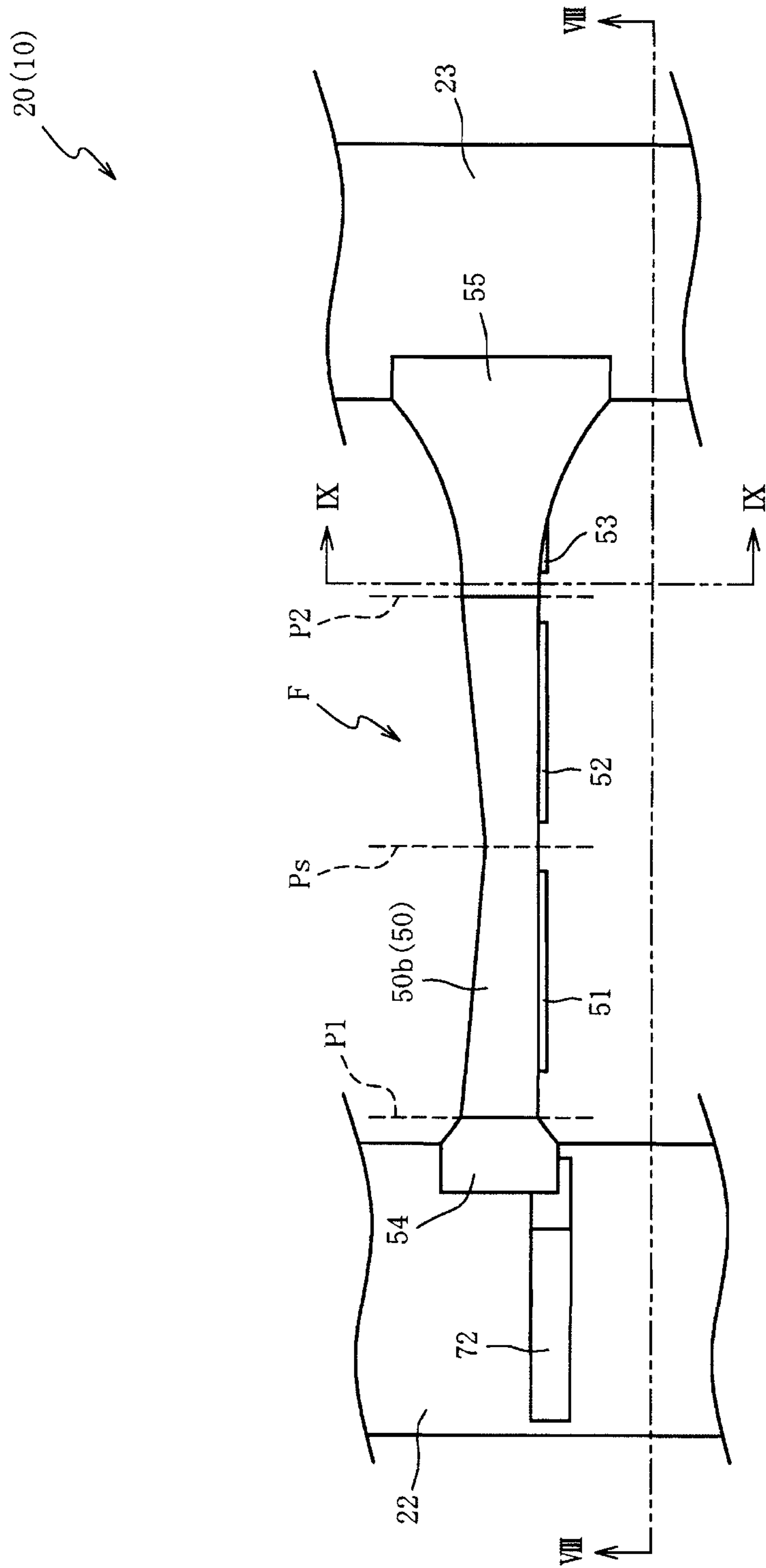


FIG. 7

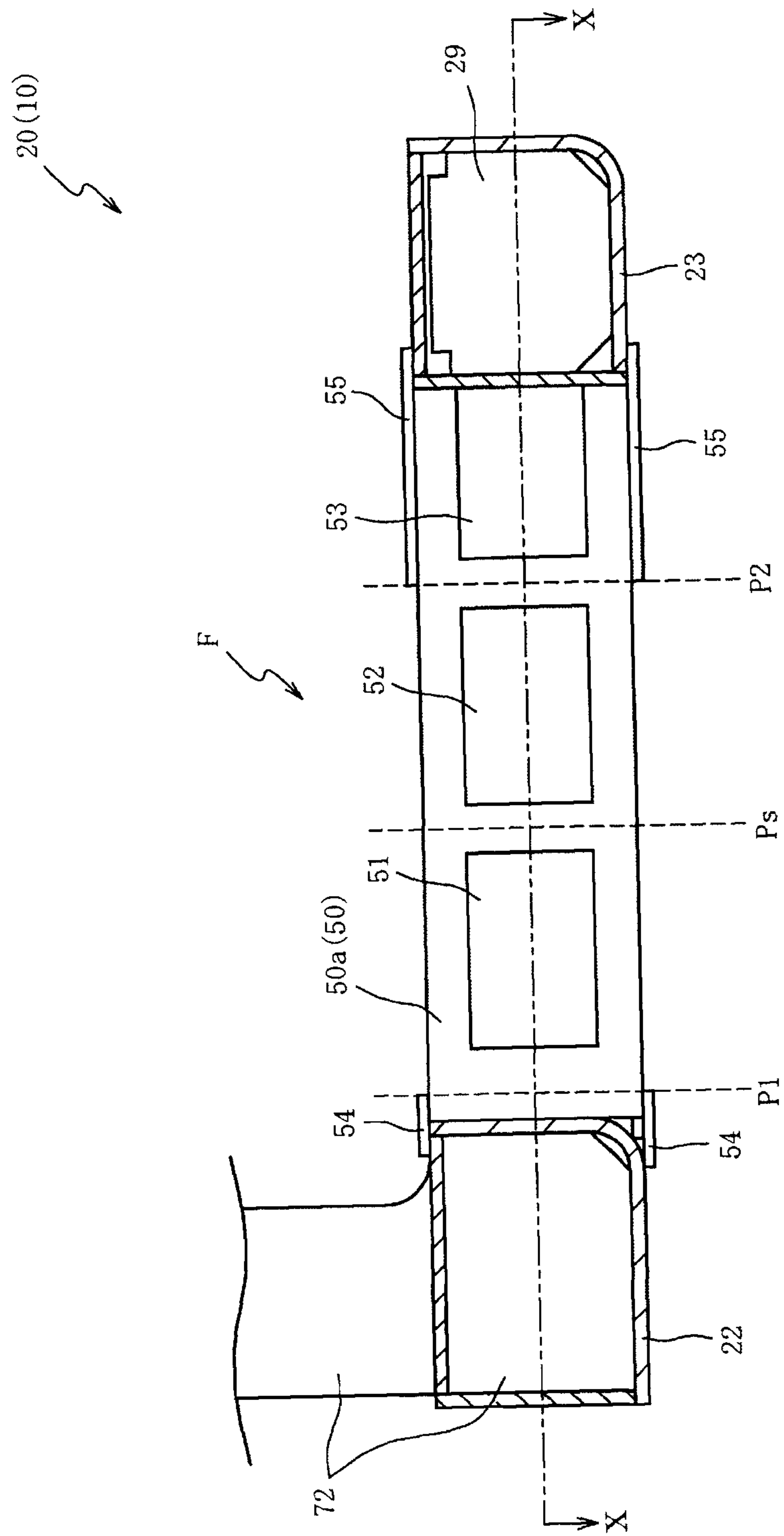


FIG. 8

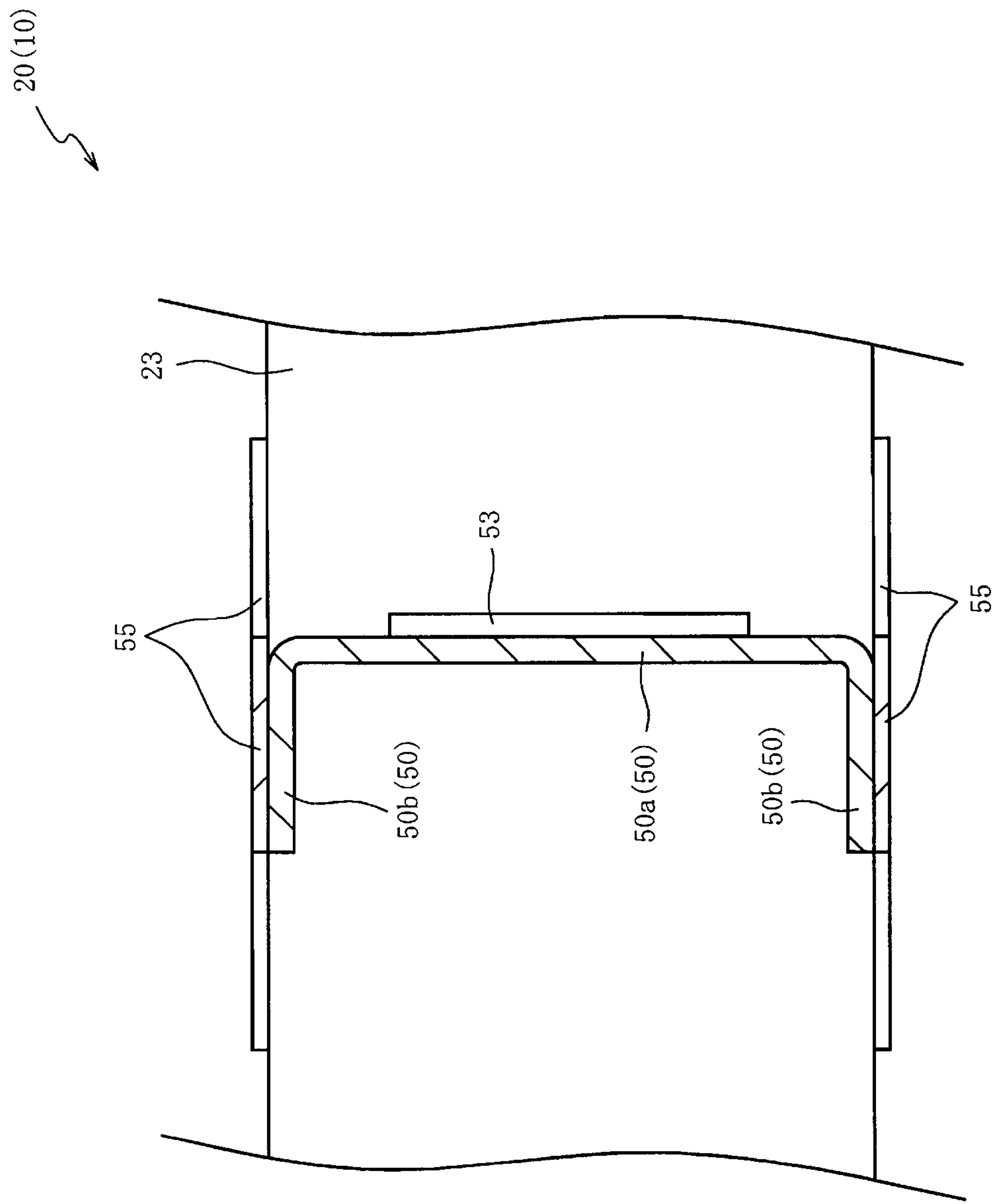


FIG. 9

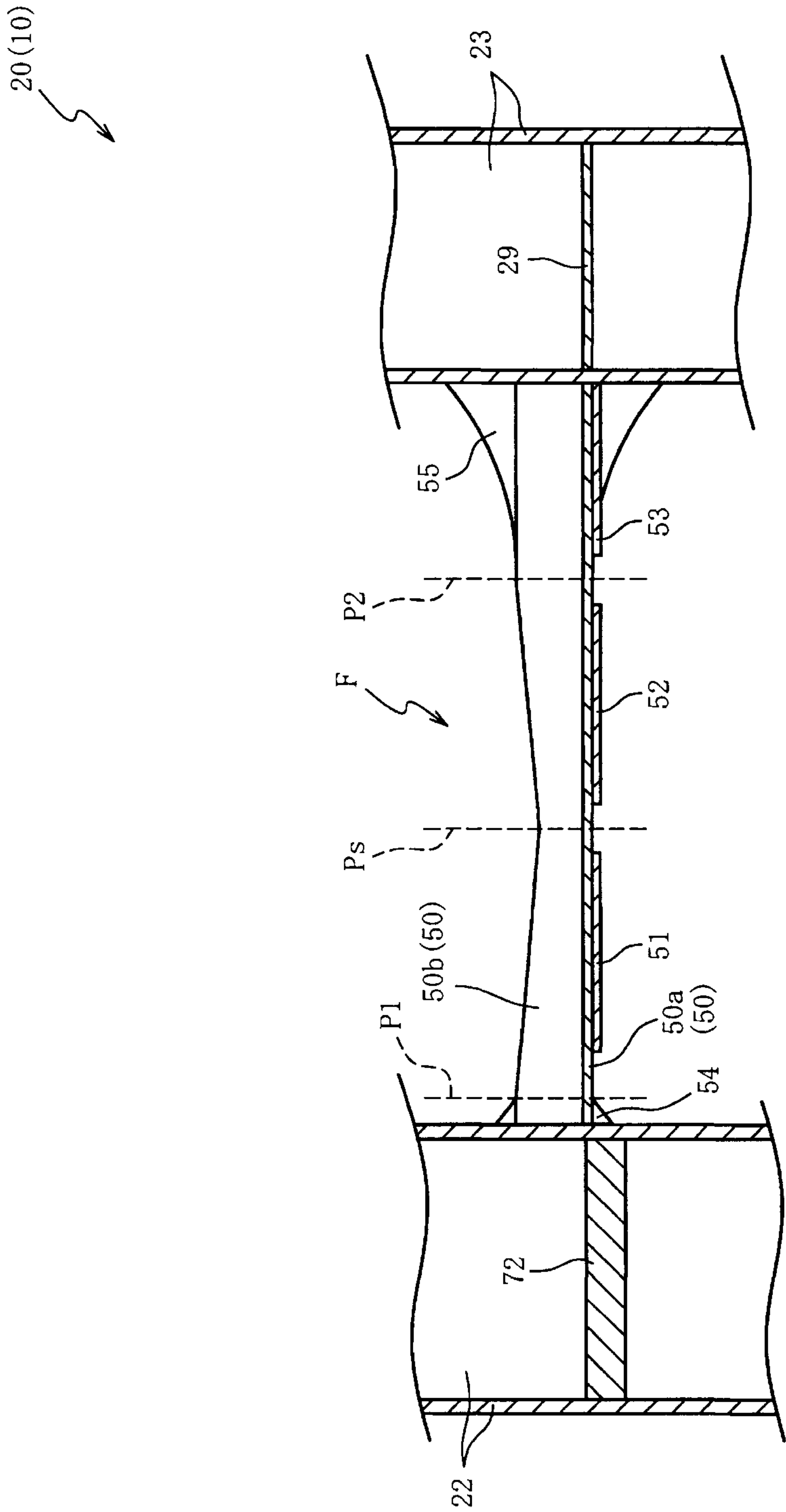


FIG. 10

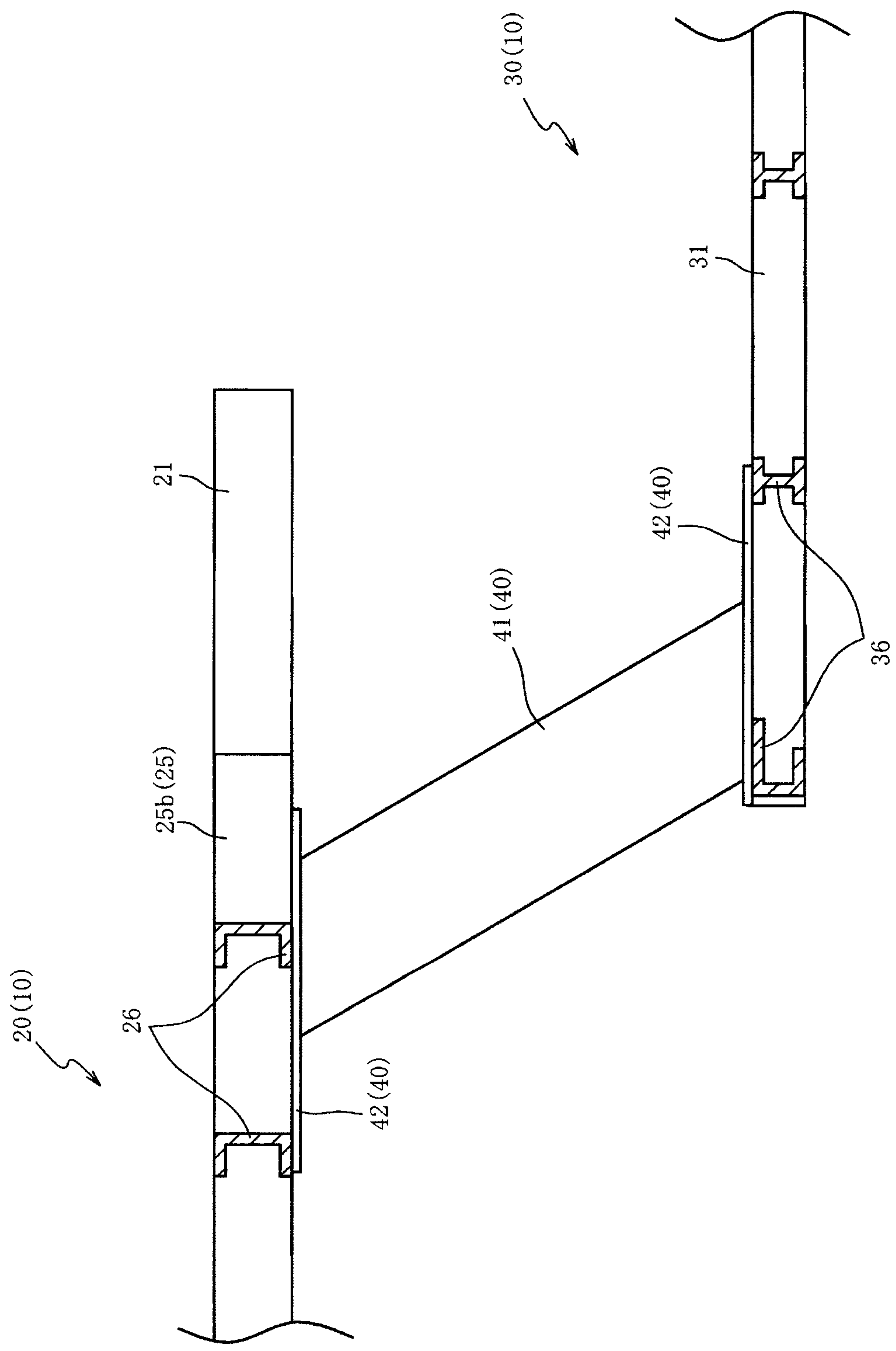


FIG. 11

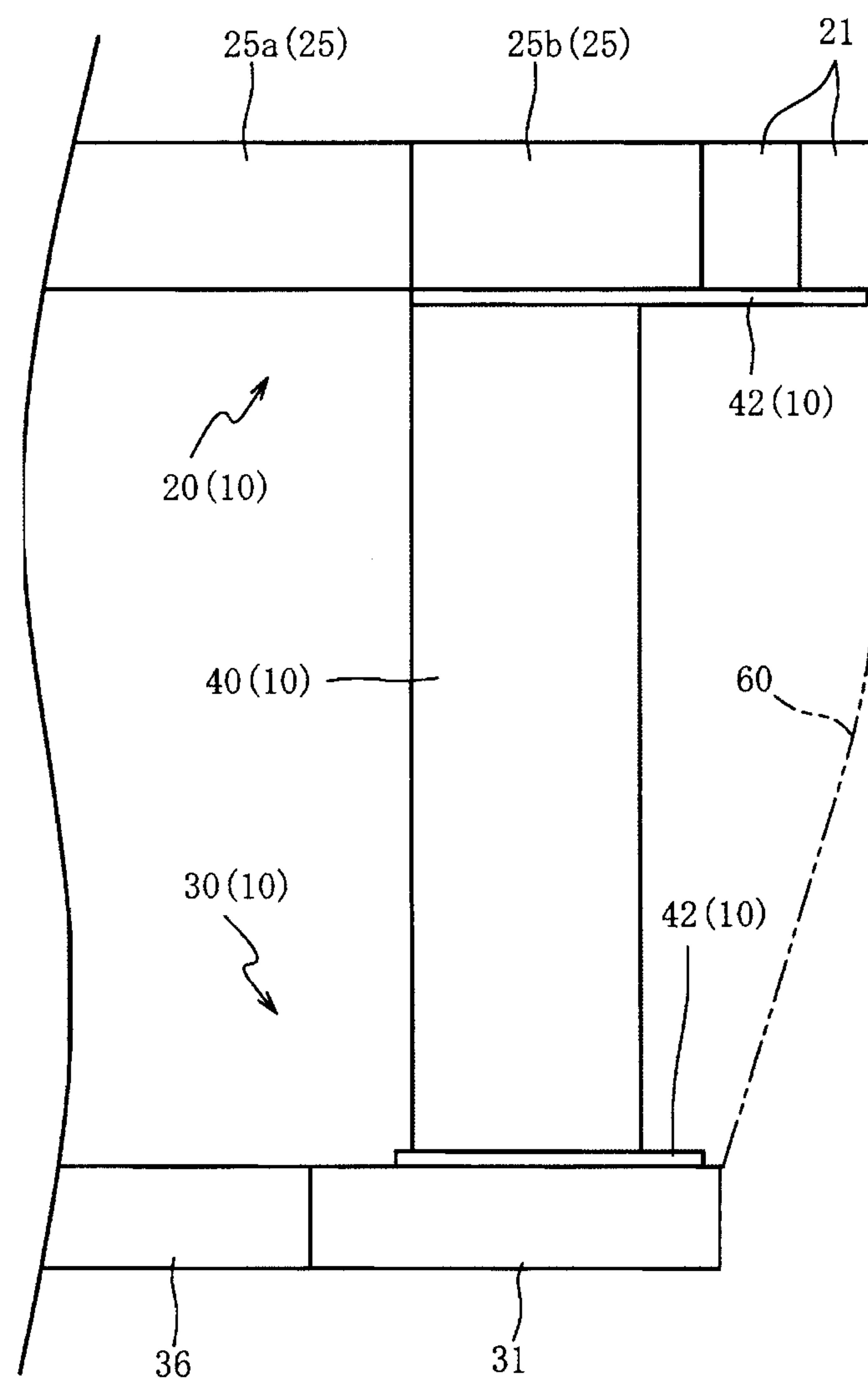


FIG. 12

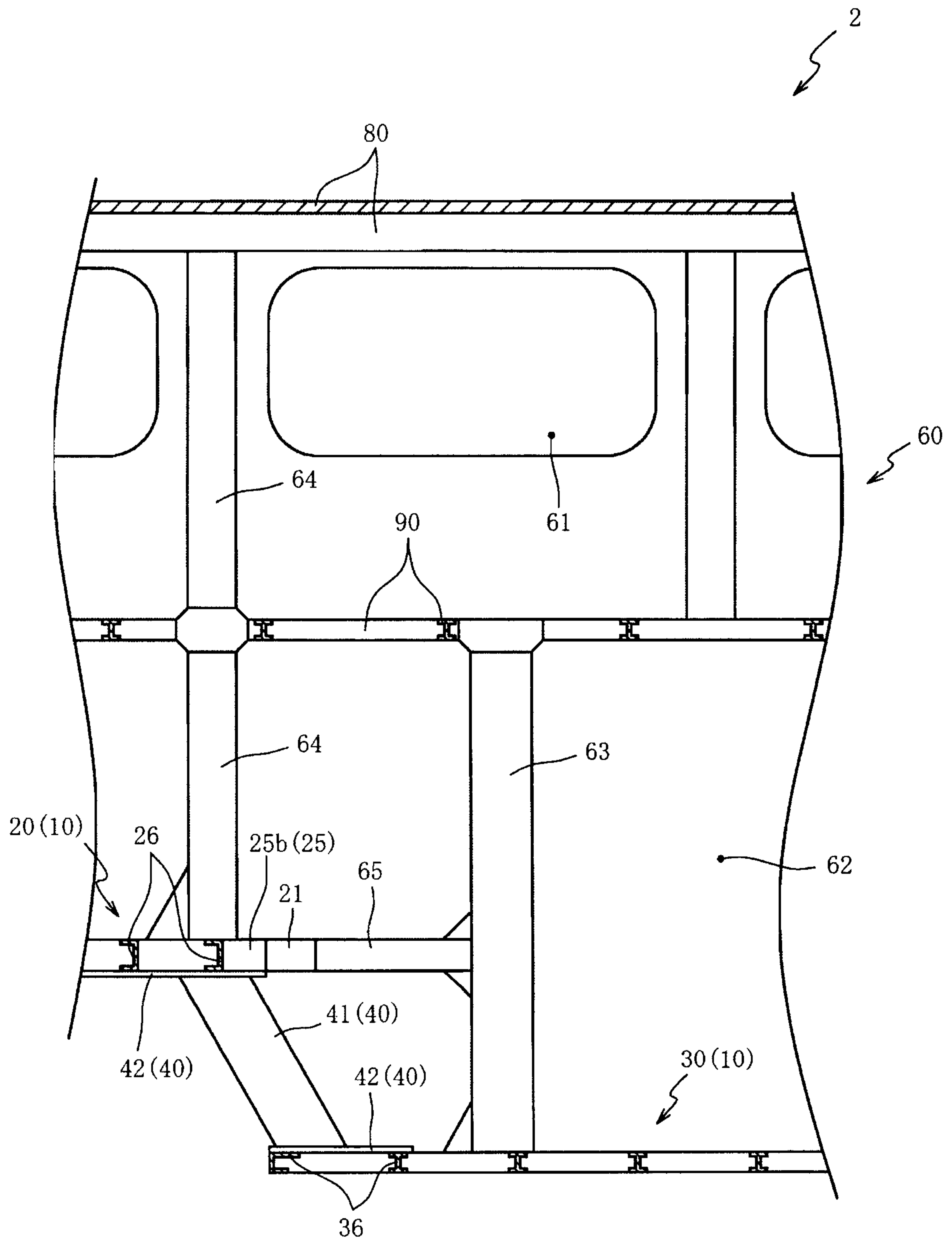


FIG. 13

