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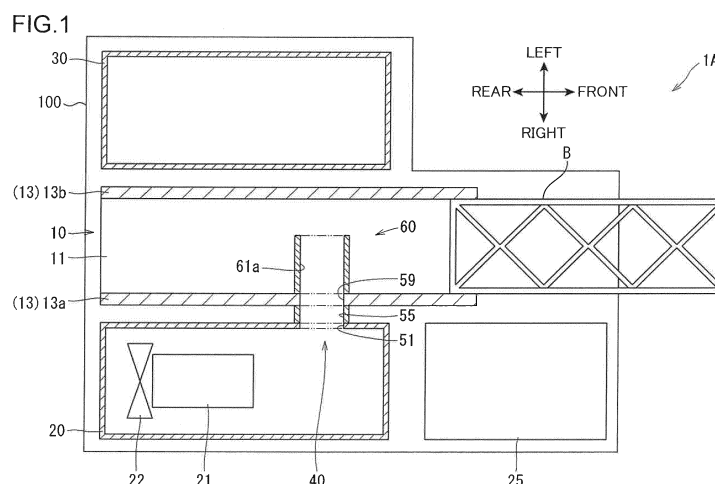
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(54) **UPPER ROTATING BODY FOR CONSTRUCTION MACHINE**

(57) An upper rotating body for a construction machine is configured so as to suppress noise within a cab. An upper rotating body (1A) is provided with a duct structure (40). The duct structure (40) is provided with a near-cab guard opening (51) and a right-side lateral plate opening (59). The near-cab guard opening (51) and the

right-side lateral plate opening (59) are openings respectively formed in a near-cab guard (20) and a right-side lateral plate (13a). The duct structure (40) guides an advance of sound from the near-cab guard (20) to a center section (60).



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Description

Technical Field

[0001] The present invention relates to an upper rotating body for a construction machine.

Background Art

[0002] For example, Patent Literatures 1 and 2 disclose conventional upper rotating bodies for construction machines. In the upper rotating body disclosed in Patent Literature 1, a sound-absorbing material is provided on an inner surface of an engine room located at the rear side of a cab. Further, in the upper rotating body disclosed in Patent Literature 2, a sound-absorbing material is provided at a portion at which a boom and a cab face one another. An attempt is made to suppress noise inside the cab by using such sound-absorbing materials.

Citation List

Patent Literature

[0003]

Patent Literature 1: JP 2007-217150 A
Patent Literature 2: JP 2011-251824 A

Summary of Invention

[0004] Porous materials are commonly used as sound-absorbing materials. Sound-absorbing materials made of porous materials do not have a sufficient sound absorptivity at a low frequency range of 200 Hz or lower. Further, resonance specific to the space inside the cab is likely to occur at the low frequency range. Thus, there is a possibility that noise inside the cab cannot be suppressed to a sufficient extent with the techniques disclosed in Patent Literatures 1 and 2. Accordingly, it is required to further reduce noise inside the cab.

[0005] In view of this, the present invention aims to provide an upper rotating body for a construction machine, in which noise inside a cab can be suppressed.

[0006] An upper rotating body for a construction machine according to the present invention includes: a center section; a noise source-housing guard; a cab; and a propagation part. The center section has a plurality of lateral plates that are disposed to face one another in a left-right direction and extend in a front-rear direction, and an internal space is formed between the plurality of lateral plates. The noise source-housing guard is disposed at a right side or a left side of the center section and houses a noise source. The cab is disposed at a front side or a rear side of the noise source-housing guard. The propagation part propagates sound generated by the noise source from an inside of the noise source-housing guard to the internal space of the center section.

The propagation part includes: a first emitting opening part; and a first receiving opening part. The first emitting opening part is a first emitting opening part opened in the noise source-housing guard. The first emitting opening part allows the sound to be emitted from the inside of the noise source-housing guard through the first emitting opening part. The first receiving opening part is a first receiving opening part opened in the center section. The first receiving opening part allows the sound emitted through the first emitting opening part to be received in the internal space through the first receiving opening part.

[0007] Noise inside the cab can be suppressed due to the above-described configuration.

Brief Description of Drawings

[0008]

FIG. 1 is a cross-sectional view from above of an upper rotating body 1A according to a first embodiment of the present invention.

FIG. 2 is a cross-sectional view from above showing a center section area A, and the like, of the upper rotating body 1A in FIG. 1.

FIG. 3 is a cross-sectional view of the upper rotating body 1A in FIG. 2 taken along arrow F3-F3.

FIG. 4 is a cross-sectional view from above of an upper rotating body 1B according to a first modified embodiment of the present invention.

FIG. 5 is a cross-sectional view from above of an upper rotating body 1C according to a second modified embodiment of the present invention.

FIG. 6 is a cross-sectional view from above of an upper rotating body 1D according to a third modified embodiment of the present invention.

FIG. 7 is a cross-sectional view of the upper rotating body 1D in FIG. 6 taken along arrow F7-F7.

FIG. 8 is a cross-sectional perspective view of the upper rotating body 1D in FIG. 6.

FIG. 9 is a cross-sectional view from a front side X1 of an upper rotating body 1E according to a fourth modified embodiment of the present invention.

FIG. 10 is a cross-sectional view from a front side X1 of an upper rotating body 1F according to a fifth modified embodiment of the present invention.

FIG. 11 is a cross-sectional view from above of an upper rotating body 201A according to a second embodiment of the present invention.

FIG. 12 is a cross-sectional perspective view of the upper rotating body 201A in FIG. 11.

FIG. 13 is a cross-sectional view from above of an upper rotating body 201B according to a sixth modified embodiment of the present invention.

FIG. 14 is a cross-sectional view from above of an upper rotating body 201C according to a seventh modified embodiment of the present invention.

FIG. 15 is a cross-sectional view from above of an upper rotating body 301A according to a third em-

bodiment of the present invention.

FIG. 16 is a cross-sectional perspective view of the upper rotating body 301A in FIG. 15.

FIG. 17 is a cross-sectional view from above of an upper rotating body 401A according to a fourth embodiment of the present invention.

FIG. 18 is a cross-sectional view from above of an upper rotating body 401B according to an eighth modified embodiment of the present invention.

FIG. 19 is a cross-sectional view from above of an upper rotating body 401C according to a ninth modified embodiment of the present invention.

FIG. 20 is a perspective view showing a left-side duct 380 of the upper rotating body 401C illustrated in FIG. 19.

FIG. 21 is a cross-sectional view from above of an upper rotating body 401D according to a tenth modified embodiment of the present invention.

FIG. 22 is a cross-sectional view from above of an upper rotating body 501A according to a fifth embodiment of the present invention.

FIG. 23 is a cross-sectional view from above of an upper rotating body 501B according to an eleventh modified embodiment of the present invention.

FIG. 24 is a cross-sectional view from above of an upper rotating body not including a duct structure 40 illustrated in FIG. 1.

Description of Embodiments

(First Embodiment)

[0009] With reference to FIG. 1, description is given of an upper rotating body 1A according to a first embodiment of the present invention.

[0010] The upper rotating body 1A is a constituent element of a construction machine. For example, the construction machine to which the upper rotating body 1A is provided is a crane, and specifically is a mobile crane. In another embodiment, the construction machine may be an excavator (for example a hydraulic excavator). The upper rotating body 1A is mounted on a lower travelling body (not illustrated) to be rotatable with respect to the lower travelling body. For example, the lower travelling body is that of the crawler type, and may be that of a wheeled-type. The upper rotating body 1A includes: a center section 10; a near-cab guard 20 (a noise source-housing guard); a cab 25; a cab-opposing-side guard 30; and a duct structure 40 (a propagation part).

[0011] The center section 10 (a rotating frame) is attached to the lower travelling body, and is provided at a center part of the upper rotating body 1A. The near-cab guard 20 and the cab-opposing-side guard 30 are attached (fixed) to the center section 10 in a state in which the near-cab guard 20 and the cab-opposing-side guard 30 sandwich the center section 10. The cab 25 is attached to the center section 10. As illustrated in FIG. 1, the upper rotating body 1A includes a base portion 100 having a

plate shape, and the center section 10, the near-cab guard 20, the cab-opposing-side guard 30, and the cab 25 may each be fixed to the base portion 100. In each of the drawings including FIG. 1, directions such as a "front-rear direction", a "left-right direction", and a "top-bottom direction" are illustrated in order to describe the upper rotating bodies according to the respective embodiments. However, these directions do not limit the operations and the forms of use of the upper rotating body according to the present invention. In FIG. 1, the center section 10 is disposed so that a longitudinal direction of the center section 10 is along the front-rear direction, and further, so that a width direction of the center section 10 is along the left-right direction. In the present embodiment, the near-cab guard 20 is disposed at a rear side of the cab 25 in FIG. 1, but the near-cab guard 20 may be disposed at a front side of the cab 25. The near-cab guard 20 is disposed at a right side of the center section 10, but the near-cab guard 20 may be disposed at a left side of the center section 10.

[0012] A boom B is attached to this center section 10. The boom B is a member for hoisting a hoisting load via a wire rope, and is derrickable with respect to the upper rotating body 1A. A base end part of the boom B is attached to a front-side end part of the center section 10. For example, the boom B is a lattice boom having a lattice structure. A gantry and a winch (both of which are not illustrated) are attached to the center section 10. The center section 10 includes: a bottom plate 11; a plurality of lateral plates 13; and connection members 15 (refer to FIG. 8).

[0013] The bottom plate 11 is a plate that forms a bottom part (a bottom-side portion) of the center section 10, and extends in the front-rear direction and the left-right direction.

[0014] Each of the lateral plates 13 is a plate that projects upward from the bottom plate 11, and extends in the front-rear direction and the top-bottom direction. In the present embodiment, the lateral plates 13 include two lateral plates 13. In another embodiment, the lateral plates 13 may include three or more lateral plates. The two lateral plates 13 are disposed to face one another in the left-right direction. The two lateral plates 13 include: a right-side lateral plate 13a (a cab-side lateral plate); and a left-side lateral plate 13b (a cab-opposing-side lateral plate). Of the two lateral plates 13, the right-side lateral plate 13a is disposed closer toward the near-cab guard 20 (the right side in FIG. 1). Of the two lateral plates 13, the left-side lateral plate 13b is disposed closer toward the cab-opposing-side guard 30 (the left side in FIG. 1). An internal area A1 (an internal space) of a center section area A, which will be described later, is formed between the two lateral plates 13.

[0015] The connection members 15 (refer to FIG. 8) are members connecting the two lateral plates 13 one another, and extend in the left-right direction. For example, the connection members 15 have a plate shape, and extend in the top-bottom direction.

[0016] The near-cab guard 20 (an engine guard) houses one or more noise sources therein. For example, the noise sources include: an engine 21; a fan 22; a hydraulic pump (not illustrated); a hydraulic motor (not illustrated); and a hydraulic valve (not illustrated). The engine 21 is a drive source of the construction machine. The fan 22 generates cooling air, and cools a radiator (not illustrated), for example. The near-cab guard 20 is disposed further toward the right side (at the outside in the left-right direction) than the center section 10 is, and is disposed at a position facing the center section 10 in the left-right direction. A predetermined clearance is provided between the near-cab guard 20 and the right-side lateral plate 13a in the left-right direction, in order to facilitate assembly. The near-cab guard 20 has an air intake port (not illustrated) formed therein. For example, the air intake port is provided at a rear-side portion (for example, the rear-side end part) of the near-cab guard 20.

[0017] The cab 25 (an operation room) is disposed at the front side of the near-cab guard 20. The cab 25 may be disposed at the rear side of the near-cab guard 20. The cab 25 is disposed to face the near-cab guard 20 in the front-rear direction. Note that a member such as an oil tank (not illustrated) may be sandwiched between the cab 25 and the near-cab guard 20. Further, the cab 25 is disposed further toward the right side than the center section 10 is. The cab 25 may be disposed further toward the left side than the center section 10 is.

[0018] The cab-opposing-side guard 30 houses devices (not illustrated) therein. The cab-opposing-side guard 30 faces the center section 10 in the left-right direction, and is disposed further toward the left side than the center section 10 is. In further detail, the cab-opposing-side guard 30 is disposed at an opposite side (the left side, or in other words, a cab-opposing-side) of a side (the right side) at which the near-cab guard 20 and the cab 25 are disposed, with respect to the center section 10. For example, the devices housed in the cab-opposing-side guard 30 are hydraulic devices. For example, these hydraulic devices include a hydraulic motor for driving the winch (not illustrated) attached to the center section 10. These hydraulic devices may include an engine, a fan, and a hydraulic pump.

[0019] The duct structure 40 propagates noise generated by the noise sources from the inside of the near-cab guard 20 to the center section area A of the center section 10. The duct structure 40 is a structure for reducing noise traveling from the inside of the near-cab guard 20 to the cab 25. The duct structure 40 causes sound (sound waves) inside the near-cab guard 20 to be emitted at a position distant from the cab 25. Air can flow inside the duct structure 40, and sound can travel inside the duct structure 40. In FIG. 1, end surfaces of cut sections are illustrated for portions of the duct structure 40 (the same applies to other drawings (with the exception of FIGS. 8, 12, 16, and 20)).

[0020] In the present embodiment, the duct structure 40 also has a function of an exhaust duct. The cooling

air generated by the fan 22 flows inside the duct structure 40. The duct structure 40 causes air (exhaust) inside the near-cab guard 20 to be emitted at a position distant from the near-cab guard 20.

[0021] An upstream side in a propagation direction of sound traveling inside the duct structure 40 is the same side as an upstream side of cooling air traveling inside the duct structure 40 (the same applies to a downstream side). In the following, an upstream and a downstream in the propagation direction of sound traveling inside the duct structure 40 are simply referred to as the "upstream" and the "downstream", respectively. The most upstream-side position of the duct structure 40 is defined as an "entrance of the duct structure 40", and the most downstream-side position of the duct structure 40 is defined as an "exit of the duct structure 40". The direction of flow inside the duct structure 40 is defined as a "flow direction".

[0022] This duct structure 40 allows the internal space of the near-cab guard 20 and an inside of a space further toward the left side than the right-side lateral plate 13a is to substantially communicate with one another. Specifically, the duct structure 40 allows the internal space of the near-cab guard 20 and the space inside the center section area A (refer to FIG. 4) to substantially communicate with one another. Herein, the phrase "substantially communicate" refers not only to a state in which spaces communicate with one another through a closed space, but also refers to a state in which spaces communicate with one another through a substantially-closed space, such as a "duct-like structure", which will be described later, (the same applies to the phrase "substantially communicate" in the following). Leakage parts (portions from which sound leaks, such as a small opening) may be present along a flow path inside the duct structure 40. The duct structure 40 may not have plate-shaped lateral walls and may have portions formed of rubber plates and rubber sheets. A part or an entirety of the duct structure 40 may be shaped in the form of a hose or a pipe. In the present embodiment, the duct structure 40 is constituted of openings and a duct (a tube-shaped member). The duct structure 40 includes: a near-cab guard opening 51 (a first emitting opening part); a right-side connection duct 55 (a guide part, a housing guard-side connection guide); a right-side lateral plate opening 59 (a first receiving opening part); and a center duct 60 (the guide part, a center section-internal guide) from the upstream side to the downstream side.

[0023] The near-cab guard opening 51 is an opening formed in the near-cab guard 20, and is a through hole that penetrates the left-side lateral wall of the near-cab guard 20 along the left-right direction. The near-cab guard opening 51 is disposed at a position facing the right-side lateral plate 13a in the left-right direction. The near-cab guard opening 51 is the entrance of the duct structure 40. The near-cab guard opening 51 allows sound to be emitted from the inside of the near-cab guard 20 through the near-cab guard opening 51. In the example illustrated in FIG. 1, the near-cab guard opening 51

is disposed further toward the front side than the fan 22 is, and is disposed further toward the front side than the engine 21 is. In FIG. 1, a boundary between the near-cab guard opening 51 and the space inside the near-cab guard 20 is illustrated as a two-dot chain line (the same applies to other boundaries).

[0024] The right-side connection duct 55 (the guide part, the housing guard-side connection guide) is a duct that communicates with the near-cab guard opening 51. The right-side connection duct 55 is disposed between the near-cab guard 20 and the right-side lateral plate 13a. The flow direction at the right-side connection duct 55 is the left direction. In other words, the right-side connection duct 55 is disposed to connect the near-cab guard opening 51 and the right-side lateral plate opening 59, and guides sound generated by the engine 21 to advance from the near-cab guard opening 51 toward the right-side lateral plate opening 59.

[0025] The right-side lateral plate opening 59 (the first receiving opening part) is an opening formed in the right-side lateral plate 13a, and is a through hole that penetrates the right-side lateral plate 13a along the left-right direction. The right-side lateral plate opening 59 is disposed at a position such that the right-side lateral plate opening 59 and the near-cab guard opening 51 face one another in the left-right direction. The right-side lateral plate opening 59 communicates with the right-side connection duct 55. Further, the right-side lateral plate opening 59 communicates with the near-cab guard opening 51 through the right-side connection duct 55. The right-side lateral plate opening 59 allows sound emitted through the near-cab guard opening 51 to be received in the center section area A (the internal space) of the center section 0 through the right-side lateral plate opening 59. The right-side lateral plate opening 59 is preferably disposed as follows. The position of the right-side lateral plate opening 59 is set so that the decrease in rigidity of the center section 10 when the right-side lateral plate opening 59 is formed therein is as small as possible compared to the case where the right-side lateral plate opening 59 is not formed in the center section 10. Specifically, the position of the right-side lateral plate opening 59, for example, is set at a position in the center section 10 at which the strain energy in a strain energy distribution is determined to be small and at which stress exerted is determined to be small. For example, such determination is performed by determining the strain energy distribution and a principal stress vector locus through structure analysis, and on the basis of lines of force estimated therefrom.

[0026] The center duct 60 (at least a part thereof) is a duct that is disposed to overlap with the center section 10 when viewed along the top-bottom direction. In further detail, as illustrated in FIG. 2, the center duct 60 is disposed inside the center section area A, which is defined by the two lateral plates 13. The center section area A is an area located further toward the left side than the right-side end part of the right-side lateral plate 13a is and also

located further toward the right side than the left-side end part of the left-side lateral plate 13b is. Further, the center section area A is an area located further toward the rear side than the front-side end parts of the lateral plates 13 are and also located further toward the front side than the rear-side end parts of the lateral plates 13 are. As illustrated in FIG 3, the center section area A includes: the internal area A1; an upper area A2; and a lower area A3, divided along the top-bottom direction. The internal area A1 is an area sandwiched between the right-side end part of the right-side lateral plate 13a and the left-side end part of the left-side lateral plate 13b. The upper area A2 is an upper area of the center section 10 (an area further toward the top-side than the top-side end parts of the right-side lateral plate 13a and the left-side lateral plate 13b are), and for example includes an area further toward the top-side than the winch (not illustrated) attached to the center section 10 is. The lower area A3 is a lower area of the center section 10, and includes an area further toward the bottom-side than the bottom plate 11 is. The center duct 60 is disposed in at least one of the internal area A1, the upper area A2, and the lower area A3. In the example illustrated in FIG. 3, the center duct 60 is disposed at the bottom-side portion of the internal area A1. Note that the center duct 60 may be disposed at the top-side portion of the internal area A1. As illustrated in FIG. 1, the center duct 60 communicates with the right-side lateral plate opening 59. The center duct 60 communicates with the near-cab guard opening 51 through the right-side lateral plate opening 59 and the right-side connection duct 55. The downstream-side end of the center duct 60 is the exit of the duct structure 40. The center duct 60 includes a straight-line part 61a. The straight-line part 61a is a portion at which the flow direction has a straight-line shape (including a substantially straight-line shape) (the same applies to the other straight-line parts in the following). The straight-line part 61a extends toward the left from the right-side lateral plate opening 59, and extends to a position that is further toward the right side than the left-side lateral plate 13b is. The center duct 60 may have a portion other than the straight-line part 61a. The center duct 60 is disposed to extend from the right-side lateral plate opening 59 to the internal space of the center section 10, and guides the advance of sound to the internal space.

[0027] For example, this center duct 60 is a duct provided with a tube shape by a plurality of plates being joined, or may be a hose. A part of the center duct 60 may be shared with (commonized with) a member constituting the center section 10. By the sharing of members, the center duct 60 can be provided with a simple configuration. Specifically, the bottom surface (bottom-side surface) of the center duct 60 can be shared with the bottom plate 11 (is formed by the bottom plate 11). By configuring portions (plates) of the center duct 60 that are not shared with the center section 10, among the members constituting the center duct 60, to have great plate thickness, the rigidity of the center section 10 can

be enhanced.

(Regarding the Path of Sound)

[0028] Sound inside the near-cab guard 20 travels as follows from the upstream side to the downstream side. Sound inside the near-cab guard 20 travels to the inside of the center duct 60 through the inside of the near-cab guard opening 51 (the entrance of the duct structure 40), the inside of the right-side connection duct 55, and the inside of the right-side lateral plate opening 59. This sound is emitted from the most downstream-side position of the center duct 60 (the exit of the duct structure 40) to the internal area A1 of the center section area A (that is, a position distant from the cab 25). Note that the sound inside the center duct 60 may be emitted to the upper area A2 or the lower area A3. Further, the exhaust path of cooling air generated by the fan 22 is the same as the path of sound described above. Here, the right-side connection duct 55 and the center duct 60 guide sound so that the sound advances from the near-cab guard 20 to the internal space of the center section 10 through the near-cab guard opening 51 and the right-side lateral plate opening 59.

(Regarding the Attenuation of Sound)

[0029] Sound passing through the inside of the duct structure 40 diminishes due to distance attenuation. Sound emitted from the exit of the duct structure 40 (the exit of the center duct 60) to the center section area A diminishes due to diffraction attenuation. As a result, sound reaching the cab 25 is reduced and noise inside the cab 25 is reduced, compared to the case where the duct structure 40 is not present. For example, quietness and comfort inside the cab 25 can be realized.

(Regarding the Sound-absorbing Material)

[0030] A sound-absorbing material may be provided at a part or an entirety of the inner surface of the duct structure 40. In this case, sound passing through the inside of the duct structure 40 is absorbed by the sound-absorbing material. As a result, sound reaching the cab 25 is further reduced. When rain may enter the inside of the center duct 60, it is preferable that any sound-absorbing material is not provided inside the center duct 60. On the other hand, when the center duct 60 is provided with a sound-absorbing material, a member covering the center duct 60 from above may be disposed in order to prevent the entry of rain.

[0031] The upper rotating body 1A illustrated in FIG. 1 has the following effects. The upper rotating body 1A includes: the center section 10; the near-cab guard 20; the cab 25; and the duct structure 40. The center section 10 has the plurality of lateral plates 13, which face one another along the left-right direction. The near-cab guard 20 is disposed further toward the right side or the left side

than the center section 10 is, and houses the engine 21. The cab 25 is disposed further toward the front side or the rear side than the near-cab guard 20 is. The duct structure 40 includes: the near-cab guard opening 51; and the center duct 60.

[0032] In the present embodiment, the near-cab guard opening 51 is an opening formed in the near-cab guard 20. Further, the center duct 60 substantially communicates with the near-cab guard opening 51. Due to this, sound inside the near-cab guard 20 travels to the inside of the center duct 60. Further, in the present embodiment, the center duct 60 is disposed to overlap with the center section 10 when viewed along the top-bottom direction. Due to this, sound inside the center duct 60 reaches the inside of the center section area A. Accordingly, compared to the case where the duct structure 40 according to the present embodiment is not provided, sound inside the near-cab guard 20 is less likely to reach the cab 25. Accordingly, noise inside the cab 25 can be suppressed.

[0033] FIG. 24 illustrates a conventional upper rotating body 601. In the upper rotating body 601, an opening part 651 is formed in the near-cab guard 20. For example, the opening part 651 is an exhaust port for releasing the exhaust of the fan 22, or an air intake port. From the opening part 651, sound generated by the noise sources (the engine 21 and the fan 22) inside the near-cab guard 20 is emitted. For example, sound emitted from the opening part 651 directly propagates to the cab 25. Further, when the opening part 651 is provided in the left-side surface of the near-cab guard 20, for example, multiple reflection of sound may occur as follows. Sound emitted from the opening part 651 undergoes multiple reflection between the right-side lateral plate 13a and the near-cab guard 20, which face one another in the left-right direction. Further, the sound emitted from the opening part 651 undergoes multiple reflection between the right-side lateral plate 13a and the cab 25. As a result, sound reaches the inside of the cab 25, and the comfort inside the cab 25 is reduced, for example. On the other hand, in the upper rotating body 1A of the present embodiment, sound inside the near-cab guard 20 travels to the inside of the center section area A through the duct structure 40 as illustrated in FIG. 1, and thus hardly reaches the cab 25. Accordingly, noise inside the cab 25 can be suppressed.

[0034] Further, in the present embodiment, the duct structure 40 includes the right-side connection duct 55, which allows the near-cab guard opening 51 and the center duct 60 to communicate with one another. Due to this, sound hardly leaks from the inside of the duct structure 40 to the outside of the duct structure 40 between the near-cab guard opening 51 and the center duct 60. Accordingly, noise inside the cab 25 can be further suppressed.

[0035] Further, in the present embodiment, the near-cab guard opening 51 is located further toward the cab 25 (the front side) than the engine 21 is (is located between the engine 21 and the cab 25). As illustrated in

FIG. 24, when the duct structure 40 is not provided, the closer (the further toward the front side) the position of the opening part 651 is to the cab 25, the more likely sound is to travel to the cab 25 from the near-cab guard opening 51. On the other hand, as illustrated in FIG. 1, the upper rotating body 1A of the present embodiment includes the duct structure 40. Accordingly, noise inside the cab 25 can be surely suppressed, even if the near-cab guard opening 51 is located close to the cab 25, or specifically, even if the near-cab guard opening 51 is located further toward the front side than the engine 21 is.

(First Modified Embodiment)

[0036] With reference to FIG. 4, the differences from the above-described first embodiment (refer to FIG. 1) are described for an upper rotating body 1B according to a first modified embodiment of the present invention. In the present modified embodiment, points of similarity with the first embodiment are provided with the same reference signs as in the first embodiment, and description thereof is omitted (the omission of description regarding points of similarity similarly applies to the description of other embodiments). The differences are as follows. The duct structure 40 includes: a right-side external opening 43 (a near-cab guard-side external opening); and a right-side duct 45 (the guide part, a housing guard-internal guide). The configuration of the center duct 60 differs from that in the first embodiment. The duct structure 40 further includes a right-side connection duct-like structure 155-2 (a housing guard-side connection duct-like structure).

[0037] The right-side external opening 43 is an opening formed in the near-cab guard 20. The right-side external opening 43 is provided separately from the near-cab guard opening 51, and is disposed at a different position from the near-cab guard opening 51. The right-side external opening 43 allows the inside of the near-cab guard 20 and the outside of the near-cab guard 20 to communicate with one another. The right-side external opening 43 allows the right-side duct 45 and the outside of the near-cab guard 20 to communicate with one another. The right-side external opening 43 is preferably provided at a position distant from the cab 25 in the near-cab guard 20, and, for example, is disposed in the rear-side portion of the near-cab guard 20 and in the rear-side lateral surface of the near-cab guard 20. The right-side external opening 43 may be disposed in the right-side lateral surface or the left-side lateral surface of the near-cab guard 20.

[0038] The right-side duct 45 is a duct that is disposed to extend from the near-cab guard opening 51 to the inside of the near-cab guard 20. In the first embodiment illustrated in FIG. 1, the near-cab guard opening 51 is the entrance of the duct structure 40. On the other hand, in the present modified embodiment illustrated in FIG. 4, the most upstream-side position of the right-side duct 45 is the entrance of the duct structure 40. The right-side

duct 45 communicates with the near-cab guard opening 51. The flow direction at the right-side duct 45 is the left direction and has a straight-line shape. Note that the flow direction may bend at the right-side duct 45 (similarly to a bend part 162a, which will be described later, and the like). The right-side duct 45 guides sound generated by the engine 21 to advance from the near-cab guard opening 51 toward the right-side lateral plate opening 59.

[0039] As illustrated in FIG. 4, the center duct 60 has a bend part 162a and a straight-line part 162b, in place of the straight-line part 61a in the first embodiment illustrated in FIG. 1. The bend part 162a is a portion at which the flow direction bends (changes) (the same applies to other bend parts described later). A sound reduction effect is achieved at a portion where the flow direction bends, such as the bend part 162a. The greater the quantity of portions where the flow direction bends, the greater the sound reduction effect is achieved by bending. The bend part 162a is disposed near the right-side lateral plate opening 59, and bends the flow direction from the left direction to the rear direction. The straight-line part 162b extends toward the rear from the bend part 162a. The most-downstream-side position of the straight-line part 162b is the exit of the duct structure 40. The right-side lateral surface of the straight-line part 162b is defined by the right-side lateral plate 13a.

[0040] The right-side connection duct-like structure 155-2 (the housing guard-side connection duct-like structure) is disposed near the position of the right-side connection duct 55 (refer to FIG. 1) in the first embodiment. The right-side connection duct-like structure 155-2 is a duct-like structure constituted of the near-cab guard opening 51 (the upstream part) and the right-side lateral plate opening 59 (the downstream part), which are disposed to spatially substantially communicate with one another. The right-side connection duct-like structure 155-2 allows the near-cab guard opening 51 and the center duct 60 to substantially communicate with one another. A duct-like structure is a structure the upstream part (the near-cab guard opening 51) and the downstream part (the right-side lateral plate opening 59) of which are spatially continuous to the extent that at least a part of acoustic energy is transmitted from the upstream part to the downstream part. For example, the expression "at least a part of" in the above-described phrase "at least a part of the acoustic energy" means 25% or more. For example, in a duct-like structure, at least a part of the upstream part (the near-cab guard opening 51) and at least a part of the downstream part (the right-side lateral plate opening 59) face one another in the propagation direction of sound (the left-right direction in FIG. 1).

[0041] In the present modified embodiment, the duct structure 40 includes the right-side connection duct-like structure 155-2, which allows the near-cab guard opening 51 and the center duct 60 to spatially substantially communicate with one another. Due to this, even when the right-side connection duct 55 (refer to FIG. 1) is not provided, sound can be transmitted from the upstream

part (the near-cab guard opening 51) of the right-side connection duct-like structure 155-2 to the downstream part of the right-side connection duct-like structure 155-2 (to the center duct 60 through the right-side lateral plate opening 59). Accordingly, noise inside the cab 25 can be suppressed.

[0042] Further, in the present modified embodiment, the duct structure 40 includes the right-side duct 45. The right-side duct 45 is disposed inside the near-cab guard 20 and communicates with the near-cab guard opening 51. Due to this, sound inside the near-cab guard 20 is reduced in the right-side duct 45, and is further reduced in the center duct 60. Accordingly, noise inside the cab 25 can be further suppressed compared to the case where the right-side duct 45 is not provided.

(Second Modified Embodiment)

[0043] With reference to FIG. 5, the difference from the above-described first modified embodiment (refer to FIG. 4) is described for an upper rotating body 1C according to a second modified embodiment of the present invention. The difference is the configuration of the center duct 60. The center duct 60 includes the bend part 162a and the straight-line part 162b, which are similar to those in the first modified embodiment. Further, the center duct 60 includes: a bend part 163a; and a straight-line part 163b. The bend part 163a is disposed near the rear-side end part of the straight-line part 162b, and bends the flow direction from the rear direction to the left direction. The right-side lateral surface of the bend part 163a is defined by the right-side lateral plate 13a. The straight-line part 163b extends toward the left from the bend part 163a. The most downstream-side position of the straight-line part 163b is the exit of the duct structure 40, and is disposed further toward the right side than the left-side lateral plate 13b is.

(Third Modified Embodiment)

[0044] With reference to FIGS. 6 to 8, the differences from the above-described first embodiment (refer to FIG. 1) are described for an upper rotating body 1D according to a third modified embodiment of the present invention. The differences are the configuration of the center duct 60 and a hydraulic hose 193 illustrated in FIG. 8.

[0045] As illustrated in FIG. 6, the center duct 60 includes the straight-line part 61a, which is similar to that in the first embodiment (refer to FIG. 1). Further, the center duct 60 includes: a bend part 164a; an expansion and shrinkage part 164b; and a straight-line part 164c. The bend part 164a is disposed near the left-side end part of the straight-line part 61a, and bends the flow direction from the left direction to the rear direction.

[0046] The expansion and shrinkage part 164b is a portion at which the cross-sectional area of the duct structure 40, viewed along the flow direction, changes, and is a portion at which the cross-sectional area expands and

shrinks. A sound reduction effect is achieved at the expansion and shrinkage part 164b due to the reflection of sound waves caused by the change in cross-sectional area. The expansion and shrinkage part 164b is disposed further toward the rear side than the bend part 164a is. The outer lateral surfaces of the expansion and shrinkage part 164b in the left-right direction are defined by the lateral plates 13. The front right-side lateral surface of the expansion and shrinkage part 164b is shared with the straight-line part 61a. As illustrated in FIG. 8, the expansion and shrinkage part 164b is shared with the connection members 15. For example, the connection members 15 shared with the expansion and shrinkage part 164b include a connection member 15 (refer to FIGS. 7 and 8) for reinforcing a support part of the gantry (not illustrated) and a connection member 15 near (at the rear side of) the connection member 15. The upstream-side end part (the entrance) and the downstream-side end part (the exit) of the expansion and shrinkage part 164b are constituted of through holes formed in the connection members 15.

[0047] As illustrated in FIG. 6, the straight-line part 164c extends from the downstream-side end part of the expansion and shrinkage part 164b toward the rear. The downstream-side end part of the straight-line part 164c is the exit of the duct structure 40. Note that the straight-line part 164c is omitted in FIG. 8. Further, in another embodiment, the straight-line part 164c need not be provided.

[0048] As illustrated in FIG. 8, the hydraulic hose 193 is disposed inside the duct structure 40. The hydraulic hose 193 is disposed over the entirety of the path from the entrance to the exit of the duct structure 40. Note that the hydraulic hose 193 may be disposed in only a part of the path from the entrance to the exit of the duct structure 40. A hydraulic device to which the hydraulic hose 193 is connected is housed inside the near-cab guard 20 (and the cab-opposing-side guard 30) (many hydraulic devices may be housed). Here, in order to draw the hydraulic hose 193 out to the outside from the inside of the near-cab guard 20, an opening in the near-cab guard 20 is necessary. Thus, the near-cab guard opening 51 (refer to FIG. 7) is used as the opening for inserting the hydraulic hose 193. Due to this, it becomes unnecessary to provide a new opening (an opening other than the near-cab guard opening 51) in the near-cab guard 20 for inserting the hydraulic hose 193. Openings that can be used for inserting the hydraulic hose 193 not only include the near-cab guard opening 51 but also include: the right-side lateral plate opening 59; a left-side lateral plate opening 271, which will be described later, (a second emitting opening part) (refer to FIG. 11); a cab-opposing-side guard opening 279, which will be described later, (refer to FIG. 11) (a second receiving opening part); and the like. The hydraulic hose 193 is disposed along the duct structure 40 stretching at least between the near-cab guard 20 and the center section 10.

[0049] In place of or in addition to the hydraulic hose

193, an electric cable may be disposed inside the duct structure 40. For example, this electric cable is a bundled electric cable (a wire harness) and is for electric control. For example, the electric cable may also be for power supply. An electric device to which this electric cable is connected is housed inside the near-cab guard 20 (and the cab-opposing-side guard 30) (many electric devices may be housed), similarly to the above-described hydraulic device.

[0050] The upper rotating body 1D according to the present modified embodiment, which is illustrated in FIG. 8, has the following effects. The upper rotating body 1D includes the hydraulic hose 193 or the electric cable, which are disposed inside the duct structure 40 (in the following, the phrase "the hydraulic hose 193 or the electric cable" is referred to as the "hydraulic hose 193"). In other words, the duct structure 40 has the function as a path for passing the hydraulic hose 193 or the electric cable between the inside and the outside of the near-cab guard 20. Due to this, at the portion at which the duct structure 40 is provided, it is not necessary to provide an opening (a new opening) for inserting the hydraulic hose 193 separately from the duct structure 40. Accordingly, a decrease in rigidity of a member (for example, the near-cab guard 20) occurring when a new opening is provided can be avoided. Further, the emission of sound from a new opening can be avoided. Further, the collision of wind, rain, and the like, against the hydraulic hose 193 can be suppressed by the duct structure 40, whereby the degradation of the hydraulic hose 193 can be suppressed.

(Fourth Modified Embodiment)

[0051] With reference to FIG. 9, the differences from the above-described first embodiment (refer to FIG. 1) are described for an upper rotating body 1E according to a fourth modified embodiment of the present invention. The differences are the position of a right-side connection duct 155-5 (a near-cab guard-side connection duct), the non-provision of the right-side lateral plate opening 59 (refer to FIG. 1), and the configuration of the center duct 60.

[0052] The right-side connection duct 155-5 (at least a part thereof) is disposed further toward the top side than the right-side lateral plate 13a is. For example, the position of the bottom-side end part of the right-side connection duct 155-5 in the top-bottom direction is the same as (or substantially the same as) the position of the top-side end part of the right-side lateral plate 13a in the top-bottom direction. The near-cab guard opening 51 is disposed to face the right-side connection duct 155-5 in the left-right direction. The right-side connection duct 155-5 includes: a straight-line part 155a; and a bend part 155b. The straight-line part 155a extends toward the left from the near-cab guard opening 51. The bend part 155b is disposed near the left-side end part of the straight-line part 155a, is disposed further toward the left side and

further toward the top side than the right-side lateral plate 13a is, and bends the flow direction from the left direction to the bottom direction.

[0053] Differing from in the above-described first embodiment (refer to FIG. 1), the center duct 60 has: a straight-line part 165a; a bend part 165b; and a straight-line part 165c. The straight-line part 165a extends toward the bottom from the bend part 165b. The right-side lateral surface of the straight-line part 165a is shared with the right-side lateral plate 13a. The bend part 165b is disposed near the bottom-side end part of the straight-line part 165a, and bends the flow direction from the bottom direction to the left direction. The bottom-side surface of the bend part 165b is shared with the bottom plate 11. The straight-line part 165c extends toward the left from the bend part 165b. The bottom-side surface of the straight-line part 165c is shared with the bottom plate 11. The position of the downstream-side end part of the straight-line part 165c is the exit of the duct structure 40.

[0054] In the present modified embodiment, the right-side lateral plate opening 59 (refer to FIG. 1) is not provided in the right-side lateral plate 13a. Accordingly, the rigidity of the right-side lateral plate 13a can be enhanced compared to the case where the right-side lateral plate opening 59 is provided in the right-side lateral plate 13a. On the other hand, in order to guide the flow inside the duct structure 40 to the internal area A1 of the center section area A without providing the right-side lateral plate opening 59, a portion for bending the flow direction, such as the bend part 155b, is necessary. Due to this, the pressure loss of air (exhaust) flowing inside the duct structure 40 increases compared to the case where it is unnecessary to provide the bend part 155b.

(Fifth Modified Embodiment)

[0055] With reference to FIG. 10, the differences from the above-described fourth modified embodiment (refer to FIG. 9) are described for an upper rotating body 1F according to a fifth modified embodiment of the present invention. The differences are the position of a near-cab guard opening 151, the position of a right-side connection duct 155-6 (a near-cab guard-side connection duct), the provision of a bottom plate opening 158 (the first receiving opening part), and the configuration of the center duct 60.

[0056] The near-cab guard opening 151 is disposed as follows. In the fourth modified embodiment illustrated in FIG. 9, the near-cab guard opening 51 is formed in the left-side lateral surface of the near-cab guard 20. On the other hand, in the present modified embodiment illustrated in FIG. 10, the near-cab guard opening 151 is formed, for example, in the bottom surface (the bottom-side surface) of the near-cab guard 20.

[0057] The right-side connection duct 155-6 (the near-cab guard-side connection duct) is disposed further toward the bottom side than the right-side lateral plate 13a is. The right-side connection duct 155-6 includes: a bend part 155s; a straight-line part 155t; and a bend part 155u.

The bend part 155s is disposed near the near-cab guard opening 151, is disposed further toward the bottom side than the near-cab guard opening 151 is, and bends the flow direction from the bottom direction to the left direction. The straight-line part 155t extends toward the left from the bend part 155s. The top-side surface of the straight-line part 155t is shared with the bottom plate 11. The bend part 155u is disposed near the left-side end part of the straight-line part 155t, and bends the flow direction from the left direction to the top direction.

[0058] The bottom plate opening 158 is an opening formed in the bottom plate 11, and is a through hole that penetrates the bottom plate 11 along the top-bottom direction. The bottom plate opening 158 allows the right-side connection duct 155-6 and the center duct 60 to communicate with one another. The center duct 60 includes a bend part 166a. The bend part 166a is disposed near the bottom plate opening 158, and bends the flow direction from the top direction to the left direction.

(Second Embodiment)

[0059] With reference to FIGS. 11 and 12, the differences from the above-described first embodiment (refer to FIG. 1) are described for an upper rotating body 201A according to a second embodiment of the present invention. The differences are the configuration of the center duct 60 and the position of the exit of the duct structure 40. As illustrated in FIG. 11, the upper rotating body 201A includes: a left-side lateral plate opening 271; a left-side connection duct 275 (a cab-opposing-side connection guide); and a cab-opposing-side guard opening 279 (the second receiving opening part). The left-side lateral plate opening 271, the left-side connection duct 275, and the cab-opposing-side guard opening 279 are not present in the first embodiment.

[0060] The center duct 60 includes a straight-line part 261a in place of the straight-line part 61a (refer to FIG. 1) in the first embodiment. The difference of the straight-line part 261a with respect to the straight-line part 61a in the first embodiment is as follows. As illustrated in FIG. 1, the downstream-side end part of the straight-line part 61a in the first embodiment is located further toward the right side than the left-side lateral plate 13b is (is located in the center section area A). On the other hand, as illustrated in FIG. 11, the downstream-side end part of the straight-line part 261a in the present embodiment is connected to the left-side lateral plate 13b (the left-side lateral plate opening 271).

[0061] The left-side lateral plate opening 271 (the second emitting opening part) is an opening formed in the left-side lateral plate 13b (at a different position from the right-side lateral plate opening 59), and is a through hole that penetrates the left-side lateral plate 13b along the left-right direction. The left-side lateral plate opening 271 communicates with the center duct 60. The left-side lateral plate opening 271 is preferably formed at a position at which the decrease in rigidity of the center section 10

is as small as possible (similarly to the right-side lateral plate opening 59). The left-side lateral plate opening 271 allows sound to be emitted from the internal space of the center section 10 through the left-side lateral plate opening 271.

[0062] The left-side connection duct 275 (the cab-opposing-side connection guide) is a duct that allows the cab-opposing-side guard opening 279 and the center duct 60 to communicate with one another (to be connected). The left-side connection duct 275 communicates with the left-side lateral plate opening 271. The left-side connection duct 275 is disposed between the left-side lateral plate 13b and the cab-opposing-side guard 30. The flow direction at the left-side connection duct 275 is the left direction. The left-side connection duct 275 guides sound to advance from the left-side lateral plate opening 271 toward the cab-opposing-side guard opening 279.

[0063] The cab-opposing-side guard opening 279 is an opening formed in the cab-opposing-side guard 30, and is a through hole that penetrates the right-side lateral wall of the cab-opposing-side guard 30 along the left-right direction. The cab-opposing-side guard opening 279 is disposed at a position such that the cab-opposing-side guard opening 279 and the left-side lateral plate 13b face one another in the left-right direction. The cab-opposing-side guard opening 279 communicates with the left-side connection duct 275. The cab-opposing-side guard opening 279 communicates with the center duct 60 through the left-side connection duct 275 and the left-side lateral plate opening 271. The cab-opposing-side guard opening 279 is the exit of the duct structure 40. Note that the left-side connection duct 275 and the cab-opposing-side guard opening 279 are omitted in FIG. 12. The cab-opposing-side guard opening 279 allows sound emitted through the left-side lateral plate opening 271 to be received in the inside of the cab-opposing-side guard 30 through the cab-opposing-side guard opening 279.

(Regarding the Path of Sound)

[0064] Sound (and also exhaust) inside the near-cab guard 20 illustrated in FIG. 11 travels as follows from the upstream side to the downstream side. Similarly to the first embodiment (refer to FIG. 1), sound inside the near-cab guard 20 travels to the inside of the center duct 60. This sound travels to the inside of the cab-opposing-side guard 30 through the inside of the left-side lateral plate opening 271, the inside of the left-side connection duct 275, and the inside of the cab-opposing-side guard opening 279. Here, the right-side connection duct 55, the center duct 60, and the left-side connection duct 275 guide sound so that the sound advances from the near-cab guard 20 to the internal space of the center section 10 and further to the inside of the cab-opposing-side guard 30 through the near-cab guard opening 51, the right-side lateral plate opening 59, the left-side lateral plate opening 271, and the cab-opposing-side guard opening 279.

(Regarding the Attenuation of Sound)

[0065] Similarly to the first embodiment (refer to FIG. 1), sound passing through the inside of the duct structure 40 diminishes due to distance attenuation. Here, the left-right direction distance from the entrance to the exit of the duct structure 40 can be made longer and thus the sound reduction effect achieved by distance attenuation can be increased in the second embodiment, compared to in the first embodiment. Sound emitted from the inside of the duct structure 40 to the inside of the cab-opposing-side guard 30 diminishes due to diffraction attenuation. Sound emitted from the inside of the cab-opposing-side guard 30 to the outside of the cab-opposing-side guard 30 through interstices of the cab-opposing-side guard 30, and the like, diminishes due to diffraction attenuation. Sound penetrating through the surfaces (the guard surfaces) forming the cab-opposing-side guard 30 from the inside of the cab-opposing-side guard 30 diminishes due to transmission loss. As a result, sound reaching the cab 25 is further reduced and noise inside the cab 25 is further reduced, compared to in the first embodiment.

(Regarding the Sound-absorbing Material)

[0066] A sound-absorbing material may be provided inside the cab-opposing-side guard 30 (for example, on an inner surface of the cab-opposing-side guard 30). In this case, sound inside the cab-opposing-side guard 30 is absorbed by the sound-absorbing material. As a result, sound reaching the cab 25 is further reduced.

[0067] The upper rotating body 201A illustrated in FIG. 11 has the following effects. The upper rotating body 201A includes the cab-opposing-side guard 30. The cab-opposing-side guard 30 is disposed at an opposite side (the left side) of a side (the right side) at which the near-cab guard 20 and the cab 25 are disposed, with respect to the center section 10. The duct structure 40 includes the cab-opposing-side guard opening 279. The cab-opposing-side guard opening 279 is an opening formed in the cab-opposing-side guard 30, and communicates with the center duct 60. Due to this, sound inside the near-cab guard 20 travels to the inside of the cab-opposing-side guard 30 through the duct structure 40. Accordingly, the duct structure 40 is capable of transmitting sound to a position located at a greater distance from the cab 25 in the left-right direction (for example, a position farther than the center section 10). Accordingly, noise inside the cab 25 can be further suppressed.

[0068] Further, in the present embodiment, the duct structure 40 includes the left-side connection duct 275, which allows the center duct 60 and the cab-opposing-side guard opening 279 to communicate with one another. Due to this, sound hardly leaks from the inside of the duct structure 40 to the outside of the duct structure 40 between the cab-opposing-side guard opening 279 and the center duct 60. Accordingly, noise inside the cab 25 can be further suppressed.

(Sixth Modified Embodiment)

[0069] With reference to FIG. 13, the difference from the above-described second embodiment (refer to FIG. 11) is described for an upper rotating body 201B according to a sixth modified embodiment of the present invention. The difference is the configuration of the center duct 60. The center duct 60 includes: the bend part 162a; the straight-line part 162b; and the bend part 163a, which are similar to those in the above-described second modified embodiment (refer to FIG. 5). Further, the center duct 60 includes a straight-line part 262a. The straight-line part 262a extends toward the left from the bend part 163a. The downstream-side end part of the straight-line part 262a is connected to the left-side lateral plate 13b (the left-side lateral plate opening 271).

(Seventh Modified Embodiment)

[0070] With reference to FIG. 14, the difference from the above-described second embodiment (refer to FIG. 11) is described for an upper rotating body 201C according to a seventh modified embodiment of the present invention. The difference is the configuration of the center duct 60. The center duct 60 includes: the straight-line part 61a; the bend part 164a; and the expansion and shrinkage part 164b, which are similar to those in the above-described third modified embodiment (refer to FIG. 6). Further, the center duct 60 includes: a bend part 263a; and a straight-line part 263b. The bend part 263a is disposed near the rear-side end part of the expansion and shrinkage part 164b, and bends the flow direction from the rear direction to the left direction. The straight-line part 263b extends toward the left from the bend part 263a. The downstream-side end part of the straight-line part 263b is connected to the left-side lateral plate 13b (the left-side lateral plate opening 271). The surface of the front left-side portion of the straight-line part 263b is shared with the expansion and shrinkage part 164b.

(Third Embodiment)

[0071] With reference to FIGS. 15 and 16, the differences from the above-described second embodiment (refer to FIG. 11) are described for an upper rotating body 301A according to a third embodiment of the present invention. In the second embodiment illustrated in FIG. 11, the exit of the duct structure 40 is disposed at the cab-opposing-side guard opening 279. On the other hand, in the present embodiment illustrated in FIG. 15, the exit of the duct structure 40 is disposed inside the cab-opposing-side guard 30. The duct structure 40 includes a left-side connection duct-like structure 375 (a cab-opposing-side connection duct-like structure). The upper rotating body 301A includes a left-side duct 380 (a cab-opposing-side guard-internal guide).

[0072] The left-side connection duct-like structure 375 is disposed near the position of the left-side connection

duct 275 (refer to FIG. 11) in the second embodiment. As illustrated in FIG. 15, the left-side connection duct-like structure 375 is a duct-like structure constituted of the left-side lateral plate opening 271 (the upstream part) and the cab-opposing-side guard opening 279 (the downstream part), which are disposed to spatially substantially communicate with one another. The left-side connection duct-like structure 375 allows the center duct 60 and the cab-opposing-side guard opening 279 to spatially substantially communicate with one another.

[0073] The left-side duct 380 is a duct that is disposed to extend from the cab-opposing-side guard opening 279 to the inside of the cab-opposing-side guard 30. The left-side duct 380 communicates with the cab-opposing-side guard opening 279. The left-side duct 380 guides the advance of sound to the inside of the cab-opposing-side guard 30. The left-side duct 380 includes: a bend part 381a; a straight-line part 381b; and a bend part 381c. The bend part 381a is disposed near the cab-opposing-side guard opening 279, and bends the flow direction from the left direction to the rear direction. The straight-line part 381b extends toward the rear from the bend part 381a. Parts of the left-side duct 380 are shared with the member constituting the cab-opposing-side guard 30. Specifically, the right-side surface of the straight-line part 381b is shared with the right-side surface (lateral surface) of the cab-opposing-side guard 30 (the same applies to the right-side surface of the bend part 381c). The bend part 381c is disposed near the rear-side end part of the straight-line part 381b, and bends the flow direction from the rear direction to the left direction. The downstream-side end part of the bend part 381c is the exit of the duct structure 40. Note that the left-side connection duct 275 and the cab-opposing-side guard opening 279, which are illustrated in FIG. 15, are omitted in FIG. 16.

(Regarding the Path of Sound)

[0074] In the second embodiment illustrated in FIG. 11, sound is emitted from the cab-opposing-side guard opening 279 to the inside of the cab-opposing-side guard 30. On the other hand, in the third embodiment illustrated in FIG. 15, sound is emitted from the downstream-side end part of the left-side duct 380 to the inside of the cab-opposing-side guard 30. Here, the right-side connection duct 55, the center duct 60, and the left-side connection duct 275 guide sound so that the sound advances from the near-cab guard 20 to the internal space of the center section 10 and further to the inside of the cab-opposing-side guard 30 through the near-cab guard opening 51, the right-side lateral plate opening 59, the left-side lateral plate opening 271, and the cab-opposing-side guard opening 279.

[0075] In the present embodiment, as illustrated in FIG. 15, the duct structure 40 includes the left-side connection duct-like structure 375, which allows the center duct 60 and the cab-opposing-side guard opening 279 to spatially substantially communicate with one another. Due to this,

even when the left-side connection duct 275 (refer to FIG. 11) is not provided, sound can be transmitted from the upstream part (the center duct 60 through the left-side lateral plate opening 271) of the left-side connection duct-like structure 375 to the downstream part (the cab-opposing-side guard opening 279) of the left-side connection duct-like structure 375. Accordingly, noise inside the cab 25 can be suppressed.

10 (Fourth Embodiment)

[0076] With reference to FIG. 17, the differences from the above-described third embodiment (refer to FIG. 15) are described for an upper rotating body 401A according to a fourth embodiment of the present invention. The differences are the configuration of the center duct 60, the configuration of the left-side duct 380, and the position of the exit of the duct structure 40. In the third embodiment illustrated in FIG. 15, the position of the exit of the duct structure 40 is inside the cab-opposing-side guard 30. On the other hand, in the fourth embodiment illustrated in FIG. 17, the position of the exit of the duct structure 40 is a position communicating with the outside of the cab-opposing-side guard 30. Specifically, the upper rotating body 401A includes a left-side external opening 490 (a third emitting opening part).

[0077] The center duct 60 includes: a straight-line part 461a; a bend part 461b; a straight-line part 461c; and a bend part 461d, in place of the straight-line part 261a (refer to FIG. 15) in the third embodiment. The straight-line part 461a is substantially similarly configured as the straight-line part 61a (refer to FIG. 1) in the above-described first embodiment. The difference of the straight-line part 461a with respect to the straight-line part 61a (refer to FIG. 1) is that the downstream-side end part of the straight-line part 461a is not the exit of the duct structure 40. The bend part 461b is disposed near the left-side end part of the straight-line part 461a, and bends the flow direction from the left direction to the rear direction. The left-side surface of the bend part 461b is shared with the left-side lateral plate 13b (the same applies to the left-side surface of the straight-line part 461c). The straight-line part 461c extends toward the rear from the bend part 461b. The bend part 461d is disposed near the rear-side end part of the straight-line part 461c, bends the flow direction from the rear direction to the left direction, and is connected to the left-side lateral plate 13b.

[0078] The left-side duct 380 includes a straight-line part 481a. The straight-line part 481a extends toward the left from the cab-opposing-side guard opening 279, and is connected to the left-side surface (lateral surface) of the cab-opposing-side guard 30.

[0079] The left-side external opening 490 (the third emitting opening part) is an opening formed in the cab-opposing-side guard 30. The left-side external opening 490 is disposed in the left-side surface (lateral surface) of the cab-opposing-side guard 30, and is, for example, disposed at the bottom-side portion (for example, near

the bottom-side end part) of the cab-opposing-side guard 30. The left-side external opening 490 allows the left-side duct 380 and the outside of the cab-opposing-side guard 30 (the outside of the upper rotating body 401A) to communicate with one another. The left-side external opening 490 is provided separately from (is disposed at a position different from) the cab-opposing-side guard opening 279. The left-side external opening 490 allows sound to be emitted from the left-side duct 380 to the outside of the cab-opposing-side guard 30 through the left-side external opening 490.

(Regarding the Path of Sound)

[0080] Sound (and also exhaust) inside the near-cab guard 20 travels as follows from the upstream side to the downstream side. Similarly to the above-described second embodiment (refer to FIG. 11), sound inside the near-cab guard 20 travels to the inside of the cab-opposing-side guard opening 279. This sound travels to (is emitted to) the outside of the cab-opposing-side guard 30 (the outside of the upper rotating body 401A) through the inside of the left-side duct 380 and the inside of the left-side external opening 490. Further, cooling air generated by the fan 22 is also discharged to the outside of the upper rotating body 401A, similarly to this sound. Here, the right-side connection duct 55, the center duct 60, the left-side connection duct 275, and the left-side duct 380 guide sound so that the sound advances from the near-cab guard 20 to the internal space of the center section 10 and the inside of the cab-opposing-side guard 30, and further to the outside of the cab-opposing-side guard 30 through the near-cab guard opening 51, the right-side lateral plate opening 59, the left-side lateral plate opening 271, the cab-opposing-side guard opening 279, and the left-side external opening 490.

(Regarding the Attenuation of Sound, etc.)

[0081] Similarly to the second embodiment (refer to FIG. 11), sound passing through the inside of the duct structure 40 diminishes due to distance attenuation. Here, the left-right direction distance from the entrance to the exit of the duct structure 40 can be made longer and thus the sound reduction effect achieved by distance attenuation can be increased in the fourth embodiment, compared to in the second embodiment (refer to FIG. 11). Further, sound emitted from the left-side external opening 490 to the outside of the cab-opposing-side guard 30 diminishes due to diffraction attenuation.

[0082] The upper rotating body 401A illustrated in FIG. 17 has the following effects. The duct structure 40 includes: the left-side duct 380; and the left-side external opening 490. The left-side duct 380 is disposed inside the cab-opposing-side guard 30 and communicates with the cab-opposing-side guard opening 279. Further, the left-side external opening 490 is an opening formed in the cab-opposing-side guard 30, is provided separately

from the cab-opposing-side guard opening 279, and allows the left-side duct 380 and the outside of the cab-opposing-side guard 30 to communicate with one another. Due to this, noise inside the near-cab guard 20 travels to the outside of the cab-opposing-side guard 30 through the inside of the left-side duct 380 and the left-side external opening 490. Accordingly, the duct structure 40 is capable of transmitting sound to a position located at a greater distance from the cab 25 in the left-right direction (for example, a position farther than the center section area A). Accordingly, noise inside the cab 25 can be further suppressed.

(Eighth Modified Embodiment)

[0083] With reference to FIG. 18, the differences from the above-described fourth embodiment (refer to FIG. 17) are described for an upper rotating body 401B according to an eighth modified embodiment of the present invention. The differences are the similarity of the configuration of the center duct 60 to that in the above-described third embodiment (refer to FIG. 15), and the configuration of the left-side duct 380. The left-side duct 380 includes: a bend part 482a; a straight-line part 482b; a bend part 482c; and a straight-line part 482d, in place of the straight-line part 481a (refer to FIG. 17) in the fourth embodiment. The bend part 482a is disposed near the cab-opposing-side guard opening 279, and bends the flow direction from the left direction to the rear direction. The straight-line part 482b extends toward the rear from the bend part 482a. Differing from the straight-line part 381b (refer to FIG. 15) in the third embodiment, the right-side surface of the straight-line part 482b is not shared with the left-side lateral plate 13b. The bend part 482c is disposed near the rear-side end part of the straight-line part 482b, and bends the flow direction from the rear direction to the left direction. The straight-line part 482d extends toward the left from the bend part 482c. The downstream-side end part of the straight-line part 482d is connected to the left-side surface of the cab-opposing-side guard 30, and communicates with the left-side external opening 490.

(Ninth Modified Embodiment)

[0084] With reference to FIGS. 19 and 20, the difference from the above-described fourth embodiment (refer to FIG. 17) is described for an upper rotating body 401C according to a ninth modified embodiment of the present invention. The difference is the configuration of the left-side duct 380. The left-side duct 380 includes: a straight-line part 483a; a bend part 483b; a straight-line part 483c; and a bend part 483d, in place of the straight-line part 481a in the fourth embodiment (refer to FIG. 17). The straight-line part 483c and the bend part 483d are illustrated in FIG. 20. The straight-line part 483a is substantially similarly configured as the straight-line part 481a (refer to FIG. 17) in the fourth embodiment. Differing from

the straight-line part 481a, the downstream-side end part of the straight-line part 483a is not directly connected to the left-side external opening 490. The bend part 483b is disposed near the left-side end part of the straight-line part 483a, and bends the flow direction from the left direction to the top direction. The left-side surface of the bend part 483b is shared with the left-side surface of the cab-opposing-side guard 30 (the same applies to the left-side surface of the straight-line part 483c). The straight-line part 483c extends toward the top from the bend part 483b. The bend part 483d is disposed near the top-side end part of the straight-line part 483c, bends the flow direction from the top direction to the left direction, and is connected to the left-side lateral surface of the cab-opposing-side guard 30. The top-side surface of the bend part 483d is shared with the top-side surface of the cab-opposing-side guard 30. For example, the left-side external opening 490 is disposed near the top-side end part of the cab-opposing-side guard 30, and communicates with the bend part 483d.

(Tenth Modified Embodiment)

[0085] With reference to FIG. 21, the differences from the above-described fourth embodiment (refer to FIG. 17) are described for an upper rotating body 401D according to a tenth modified embodiment of the present invention. The differences are the similarity of the center duct 60 to that in the seventh modified embodiment (refer to FIG. 14), and the configuration of the left-side duct 380. The left-side duct 380 includes: a bend part 484a; a straight-line part 484b; a bend part 484c; and a straight-line part 484d, in place of the straight-line part 481a (refer to FIG. 17) in the fourth embodiment. The bend part 484a is disposed near the cab-opposing-side guard opening 279, and bends the flow direction from the left direction to the front direction. The straight-line part 484b extends toward the front from the bend part 484a. The right-side lateral surface of the straight-line part 484b is shared with the right-side lateral surface of the cab-opposing-side guard 30 (the same applies to the right-side surface of the bend part 484c). The bend part 484c is disposed near the front-side end part of the straight-line part 484b, and bends the flow direction from the front direction to the left direction. The straight-line part 484d extends toward the left from the bend part 484c. The downstream-side end part of the straight-line part 484d is connected to the left-side surface of the cab-opposing-side guard 30, and communicates with the left-side external opening 490.

(Fifth Embodiment)

[0086] With reference to FIG. 22, the difference from the above-described ninth modified embodiment (refer to FIG. 19) is described for an upper rotating body 501A according to a fifth embodiment of the present invention. The difference is the provision of an auxiliary ventilation device 595. The auxiliary ventilation device 595 is an

auxiliary device promoting the flow of air inside the duct structure 40. Due to the auxiliary ventilation device 595, air (exhaust) inside the duct structure 40 can be caused to flow (to be discharged) smoothly even when the pressure loss inside the duct structure 40 is great. Specifically, the auxiliary ventilation device 595 is a fan (a fan separate from the fan 22). The auxiliary ventilation device 595 is a sound source, and may have an influence on the increase of noise inside the cab 25. Thus, the auxiliary ventilation device 595 is preferably disposed at a position distant from the cab 25. Specifically, the auxiliary ventilation device 595 is disposed inside the left-side duct 380, is for example disposed at the left-side portion (for example the left-side end part) of the left-side duct 380, and is for example disposed at the bend part 483b.

(Eleventh Modified Embodiment)

[0087] With reference to FIG. 23, the difference from the above-described tenth modified embodiment (refer to FIG. 21) is described for an upper rotating body 501B according to an eleventh modified embodiment of the present invention. The difference is the provision of an auxiliary ventilation device 595. The auxiliary ventilation device 595 is disposed inside the center duct 60, and is for example disposed inside the expansion and shrinkage part 164b.

[0088] The above-described embodiments may be modified in various ways. Constituent elements from mutually different embodiments may be combined with one another. For example, the right-side duct 45 in the first modified embodiment (refer to FIG. 4) may be added to the first embodiment (refer to FIG. 1). For example, the right-side connection duct 55 in the first embodiment (refer to FIG. 1) may be replaced with the right-side connection duct-like structure 155-2 (refer to FIG. 4). Further, the number and/or the arrangement of constituent elements in the above-described embodiments may be changed. For example, the number of the lateral plates 13, which are illustrated in FIG. 1, may be more than two. Further, some of the constituent elements in the above-described embodiments need not be provided (as described in the following).

[0089] The configuration of the duct structure 40 may be changed as follows. The positions of the entrance and the exit, the length, the shape, and the like, of the duct structure 40 may be changed. Whether or not the duct structure 40 is shared with other members may be changed. The duct structure 40 may either have one path or a plurality of paths from the entrance to the exit thereof, and the path(s) may branch and merge. The duct structure 40 may have one entrance or a plurality of entrances (the same applies to the exit). The duct structure 40 may have the same cross-sectional shape (for example, a rectangular shape) from the entrance to the exit, or the cross-sectional shape thereof may change along the path(s). The duct structure 40 is an exhaust duct in the above-described embodiments. However, the duct structure 40

may be an air intake duct (the entrance of the duct structure 40 may be an air intake port). In further detail, air (intake air) before suction by the fan 22 may flow inside the duct structure 40. Cooling air generated by the fan 22 need not flow inside the duct structure 40. The direction in which sound travels inside the duct structure 40 and the direction in which cooling air generated by the fan 22 flows may be the same direction or opposite directions.

[0090] Leakage parts may be present along the path(s) of the duct structure 40. Specifically, small openings and/or interstices may be present in ducts such as the center duct 60. Further, the right-side connection duct 55, for example, need not be provided. Further, the left-side connection duct 275 need not be provided when the cab-opposing-side guard opening 279 illustrated in FIG. 11 is provided, for example. Note that the right-side connection duct 55 is closer to the cab 25 than the left-side connection duct 275 is. Due to this, noise inside the cab 25 can be further suppressed in a case where the left-side connection duct 275 is not provided and the right-side connection duct 55 is provided, compared to the case where the right-side connection duct 55 is not provided and the left-side connection duct 275 is provided.

[0091] The position, the quantity, and the like, of the expansion and shrinkage part 164b (refer to FIG. 6) may be changed. For example, while the expansion and shrinkage part 164b is provided in the center section 10 in the above-described embodiments, the expansion and shrinkage part 164b may be provided inside the cab-opposing-side guard 30. The left-side connection duct 275 (refer to FIG. 11) may be disposed at the top side or the bottom side of the left-side lateral plate 13b, similarly to the right-side connection duct 155-5 (refer to FIG. 9) and the right-side connection duct 155-6 (refer to FIG. 10). The position, the quantity, and the like, of the auxiliary ventilation device 595 (refer to FIG. 22) may be changed. Further, the propagation part according to the present invention is not limited to that including a duct structure such as the duct structure 40. The propagation part may be formed so that sound advances between a pair of plate-shaped members that are disposed spaced away from one another. Further, the propagation part may have a form such that, in FIG. 1, only the near-cab guard opening 51 and the right-side lateral plate opening 59 are provided, without the right-side connection duct 55 and the center duct 60 being provided. In this case as well, sound generated by the engine 21 can be propagated from the near-cab guard 20 to the inside of the center section 10. Further, in FIG. 1, the right-side lateral plate opening 59 is not limited to being disposed at a position such that the right-side lateral plate opening 59 and the near-cab guard opening 51 face one another in the left-right direction, and other forms are possible as long as the arrangement is such that sound generated by the engine 21 passes between the right-side lateral plate opening 59 and the near-cab guard opening 51.

Claims

1. An upper rotating body for a construction machine, comprising:

a center section having a plurality of lateral plates that are disposed to face one another in a left-right direction and extend in a front-rear direction, wherein an internal space is formed between the plurality of lateral plates;
a noise source-housing guard disposed at a right side or a left side of the center section and housing a noise source;
a cab disposed at a front side or a rear side of the noise source-housing guard; and
a propagation part propagating sound generated by the noise source from an inside of the noise source-housing guard to the internal space of the center section, wherein the propagation part includes:

a first emitting opening part opened in the noise source-housing guard, wherein the first emitting opening part allows the sound to be emitted from the inside of the noise source-housing guard through the first emitting opening part; and

a first receiving opening part opened in the center section, wherein the first receiving opening part allows the sound emitted through the first emitting opening part to be received in the internal space through the first receiving opening part.

2. The upper rotating body for a construction machine, according to claim 1, wherein the propagation part includes a guide part guiding the sound to advance from the noise source-housing guard to the internal space of the center section through the first emitting opening part and the first receiving opening part.
3. The upper rotating body for a construction machine, according to claim 2, wherein the guide part includes a center section-internal guide disposed to extend from the first receiving opening part to the internal space of the center section and guiding an advance of the sound to the internal space.
4. The upper rotating body for a construction machine, according to claim 2 or 3, wherein the first emitting opening part and the first receiving opening part are disposed to face one another with a space in between in the left-right direction.
5. The upper rotating body for a construction machine, according to claim 4, wherein

the guide part further includes a housing guard-side connection guide disposed to connect the first emitting opening part and the first receiving opening part and guiding the sound to advance from the first emitting opening part toward the first receiving opening part.

6. The upper rotating body for a construction machine, according to any one of claims 2 to 5, wherein the guide part includes a housing guard-internal guide disposed to extend from the first emitting opening part to the inside of the noise source-housing guard and guiding the sound to advance from the first emitting opening part toward the first receiving opening part.

7. The upper rotating body for a construction machine, according to any one of claims 1 to 6, further comprising:

a cab-opposing-side guard disposed at an opposite side of a side at which the noise source-housing guard and the cab are disposed, with respect to the center section, wherein the propagation part includes:

a second emitting opening part opened in the center section at a position different from the first receiving opening part, wherein the second emitting opening part allows the sound to be emitted from the internal space of the center section through the second emitting opening part; and

a second receiving opening part opened in the cab-opposing-side guard, wherein the second receiving opening part allows the sound emitted through the second emitting opening part to be received in an inside of the cab-opposing-side guard through the second receiving opening part.

8. The upper rotating body for a construction machine, according to claim 7, wherein the second emitting opening part and the second receiving opening part are disposed to face one another with a space in between in the left-right direction.

9. The upper rotating body for a construction machine, according to claim 8, wherein the propagation part further includes a cab-opposing-side connection guide disposed to connect the second emitting opening part and the second receiving opening part and guiding the sound to advance from the second emitting opening part toward the second receiving opening part.

10. The upper rotating body for a construction machine,

according to any one of claims 7 to 9, wherein the propagation part includes a cab-opposing-side guard-internal guide disposed to extend from the second receiving opening part to the inside of the cab-opposing-side guard and guiding an advance of the sound to the inside of the cab-opposing-side guard.

11. The upper rotating body for a construction machine, according to claim 10, wherein the propagation part further includes a third emitting opening part opened in the cab-opposing-side guard at a position different from the second receiving opening part, wherein the third emitting opening part allows the sound to be emitted from the cab-opposing-side guard-internal guide to an outside of the cab-opposing-side guard through the third emitting opening part.

12. The upper rotating body for a construction machine, according to any one of claims 1 to 11, further comprising: a hydraulic hose or an electric wire disposed along the propagation part to stretch at least between the noise source-housing guard and the center section.

13. The upper rotating body for a construction machine, according to any one of claims 1 to 12, wherein the first emitting opening part is opened in the noise source-housing guard between the noise source and the cab.

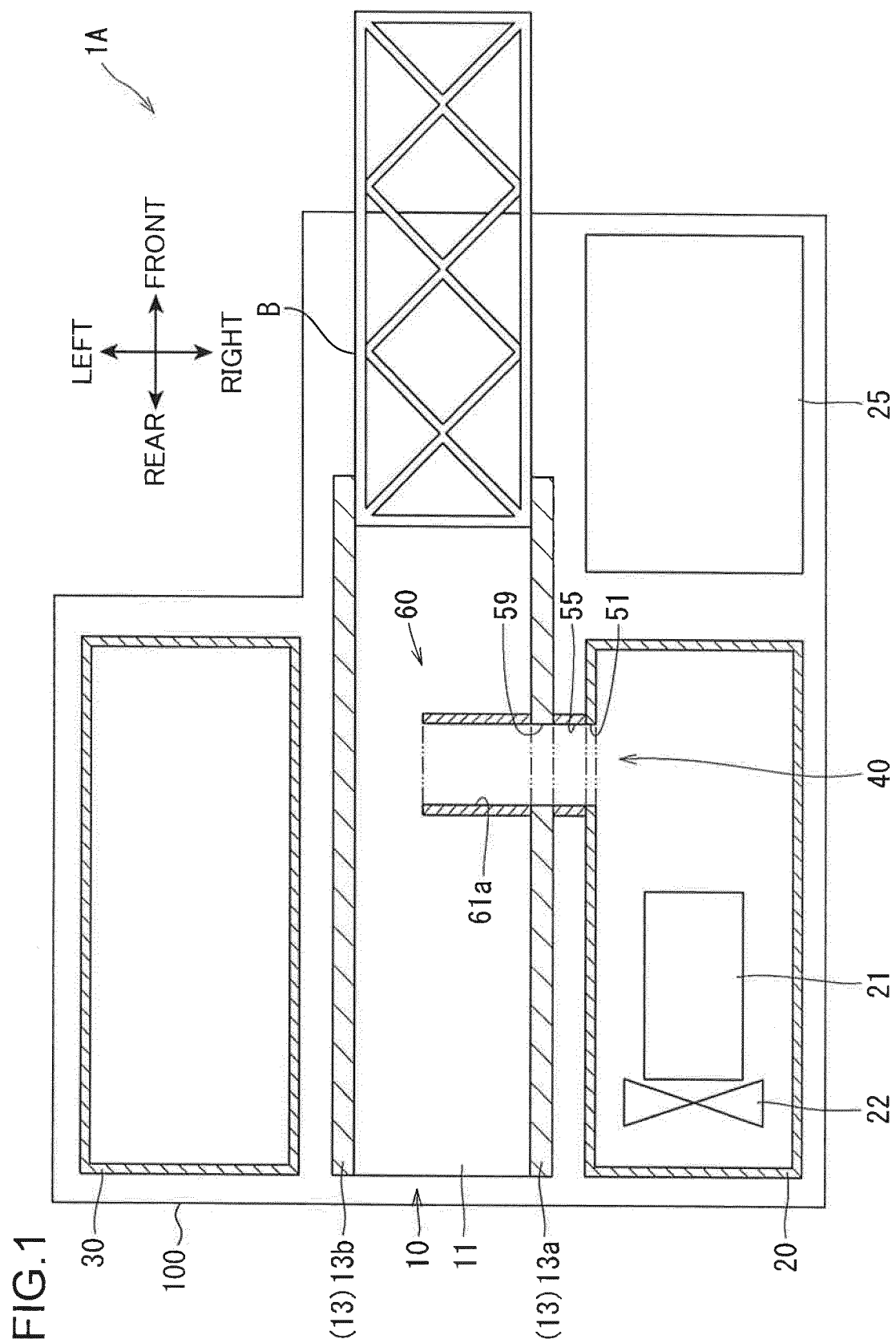
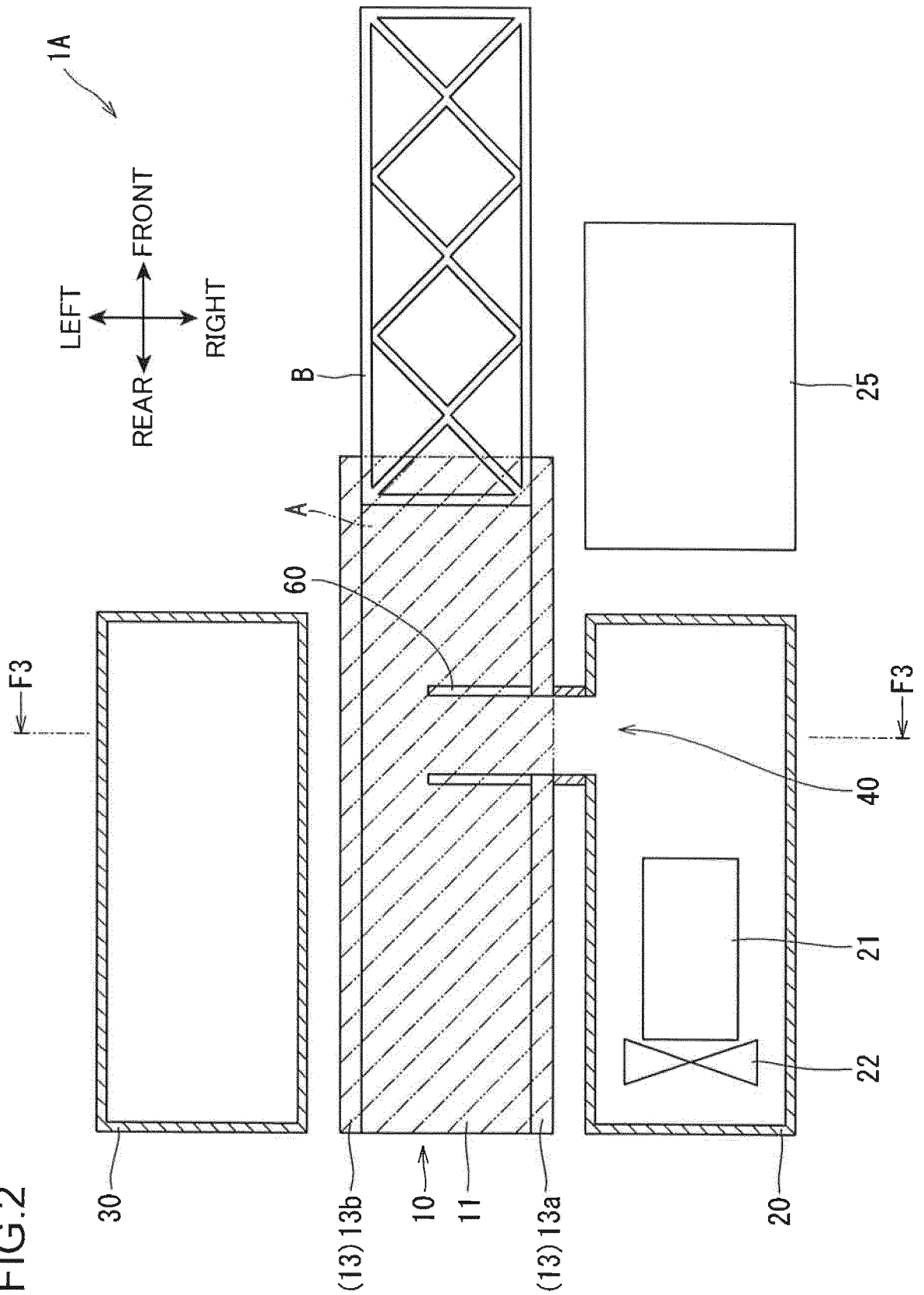


FIG.2



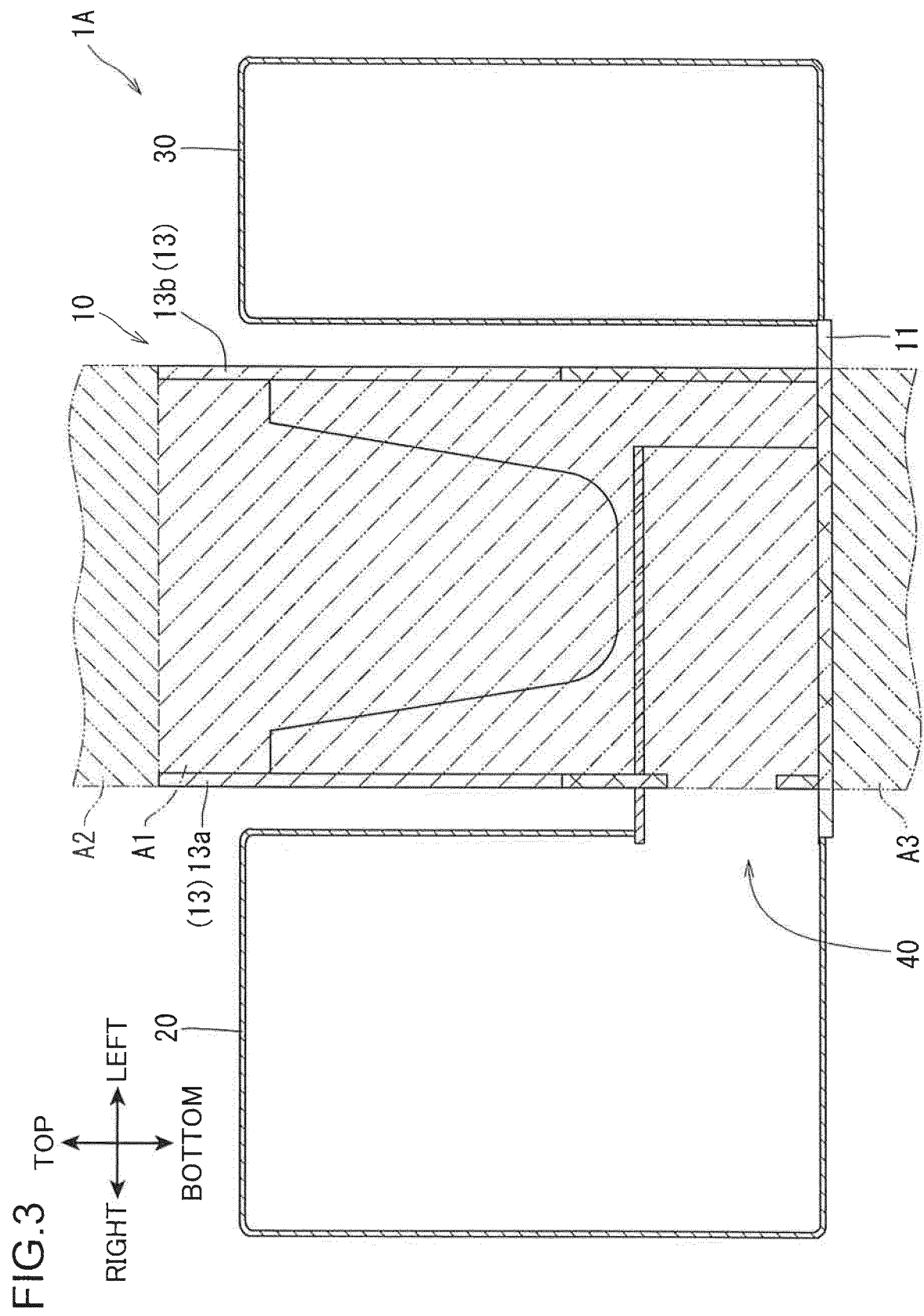


FIG. 4

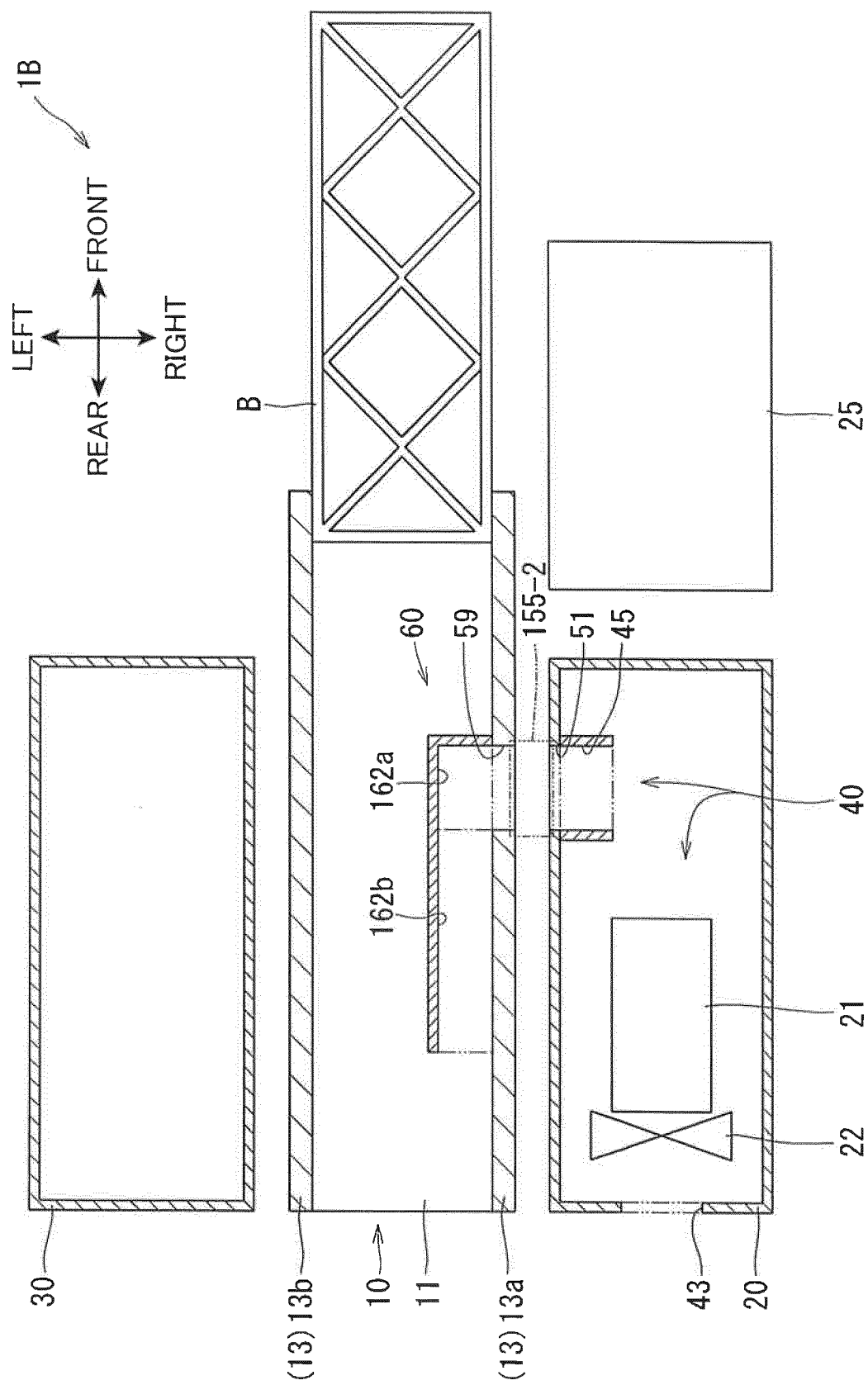
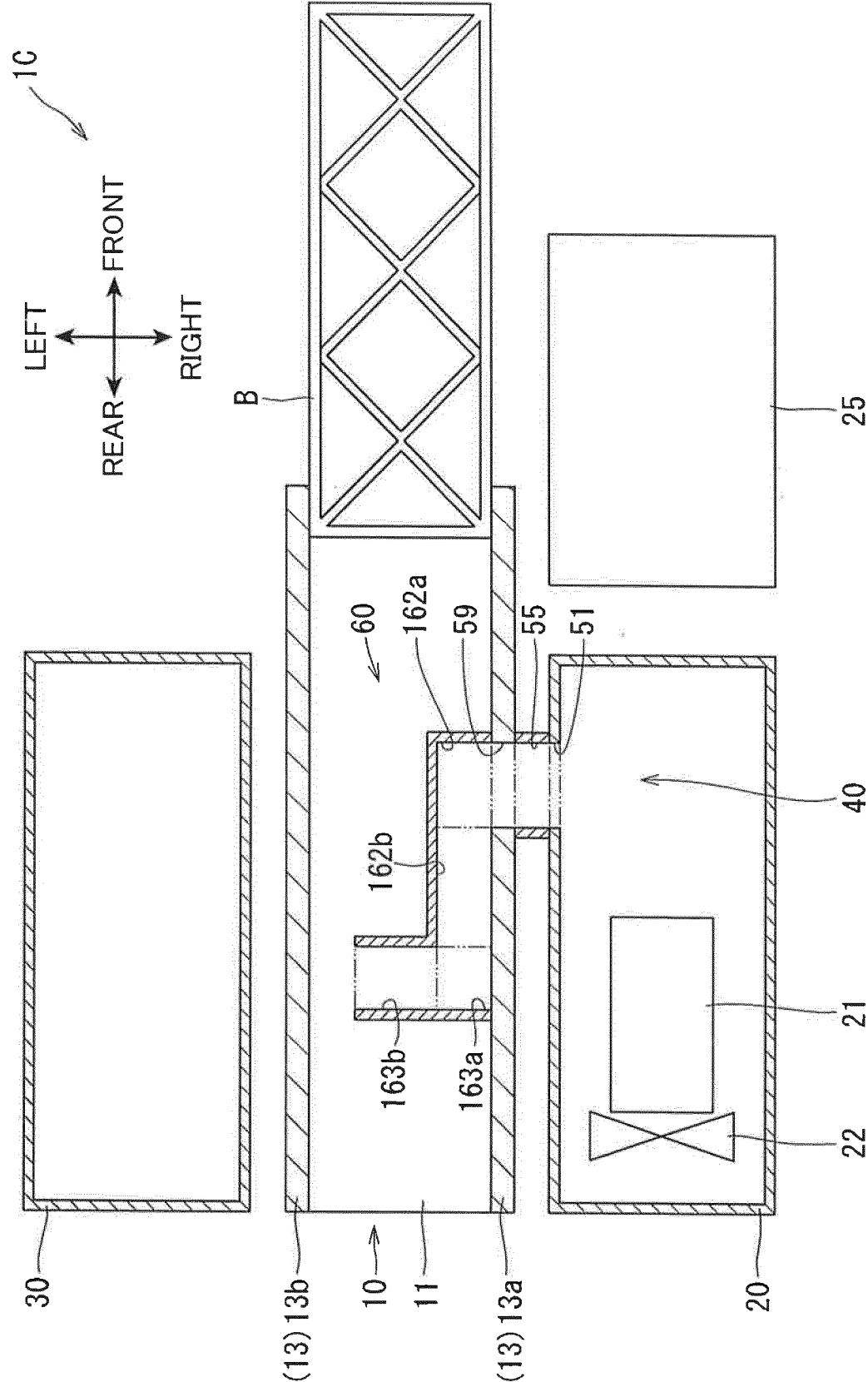


FIG.5



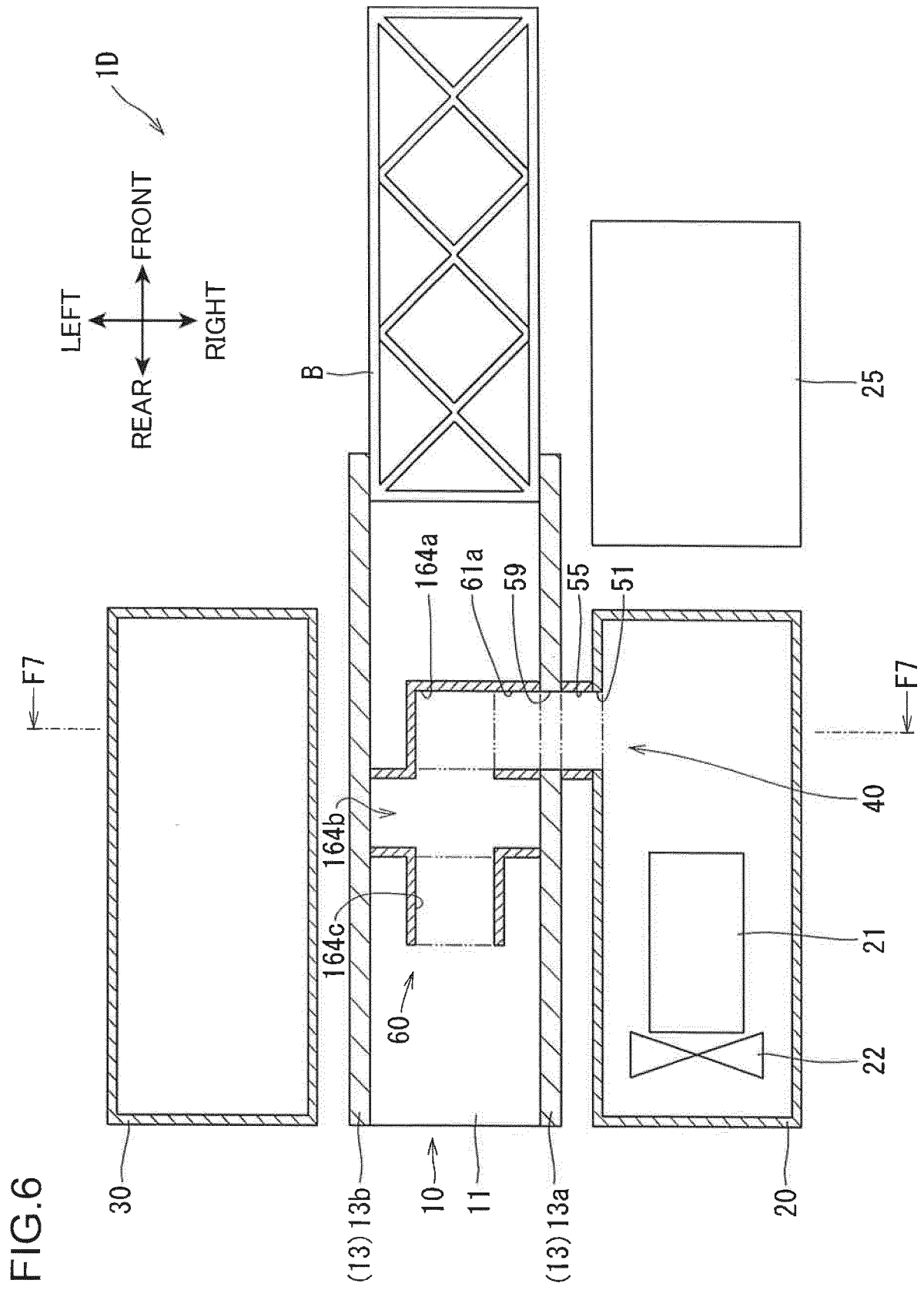


FIG. 7

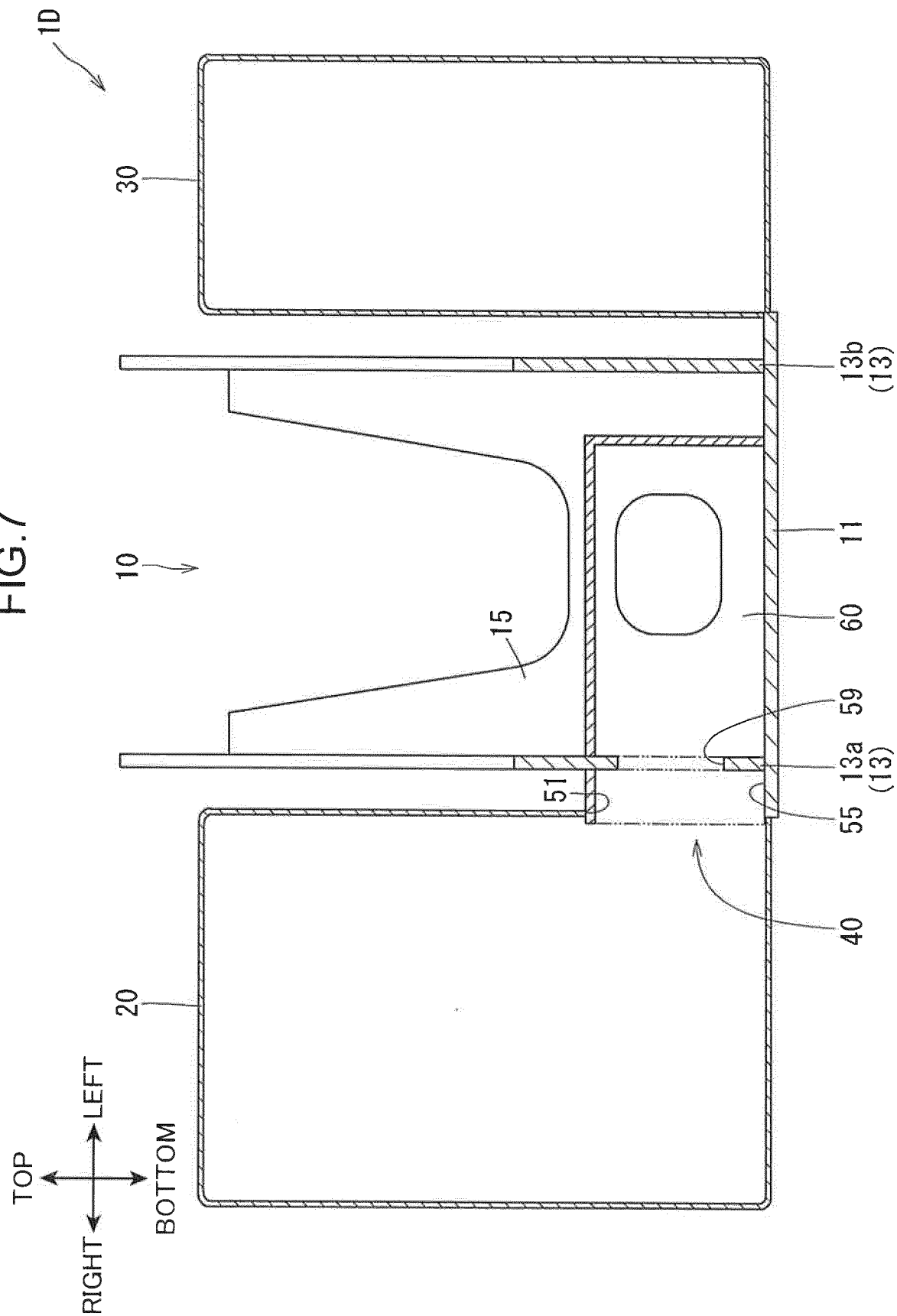
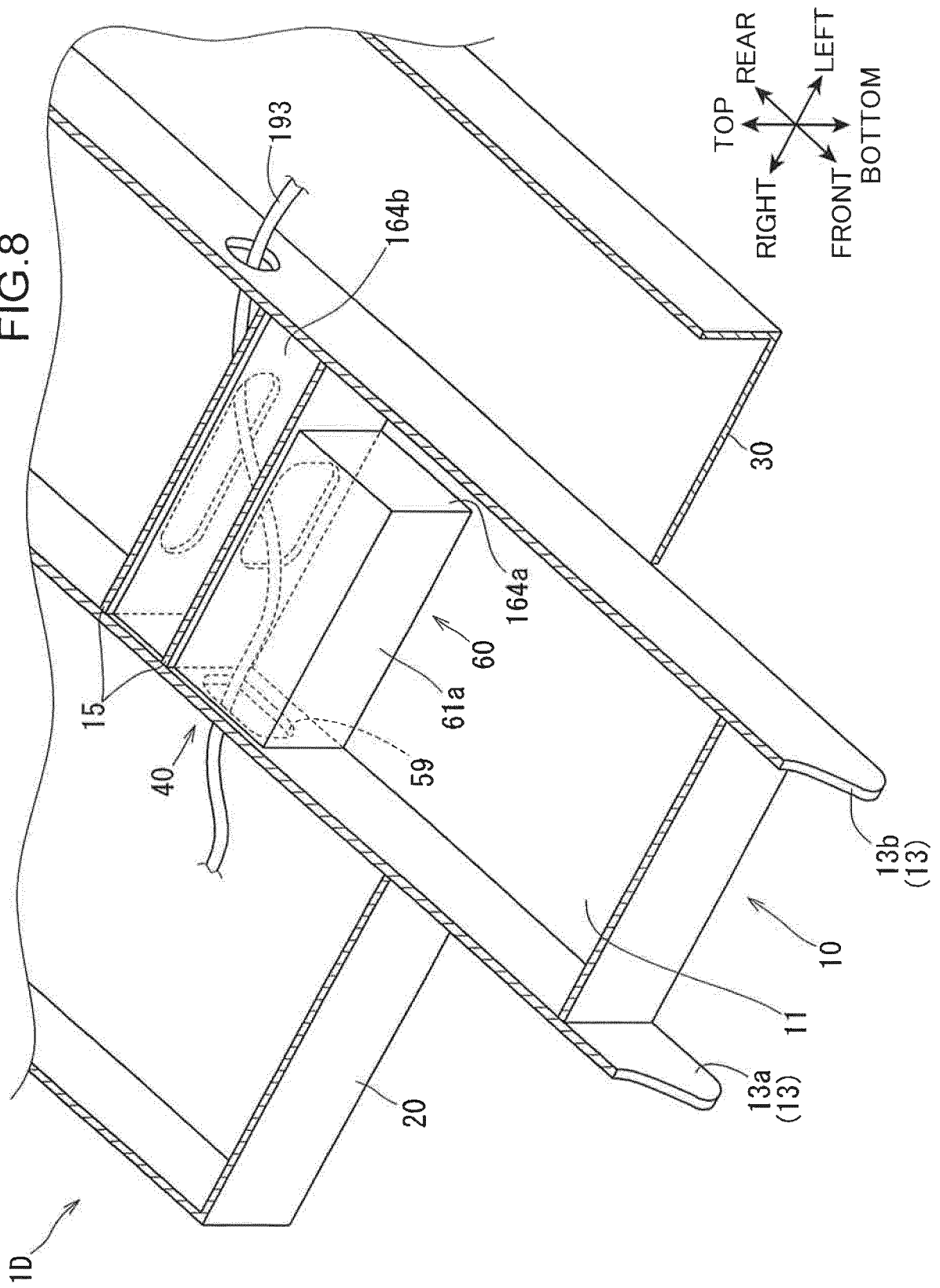
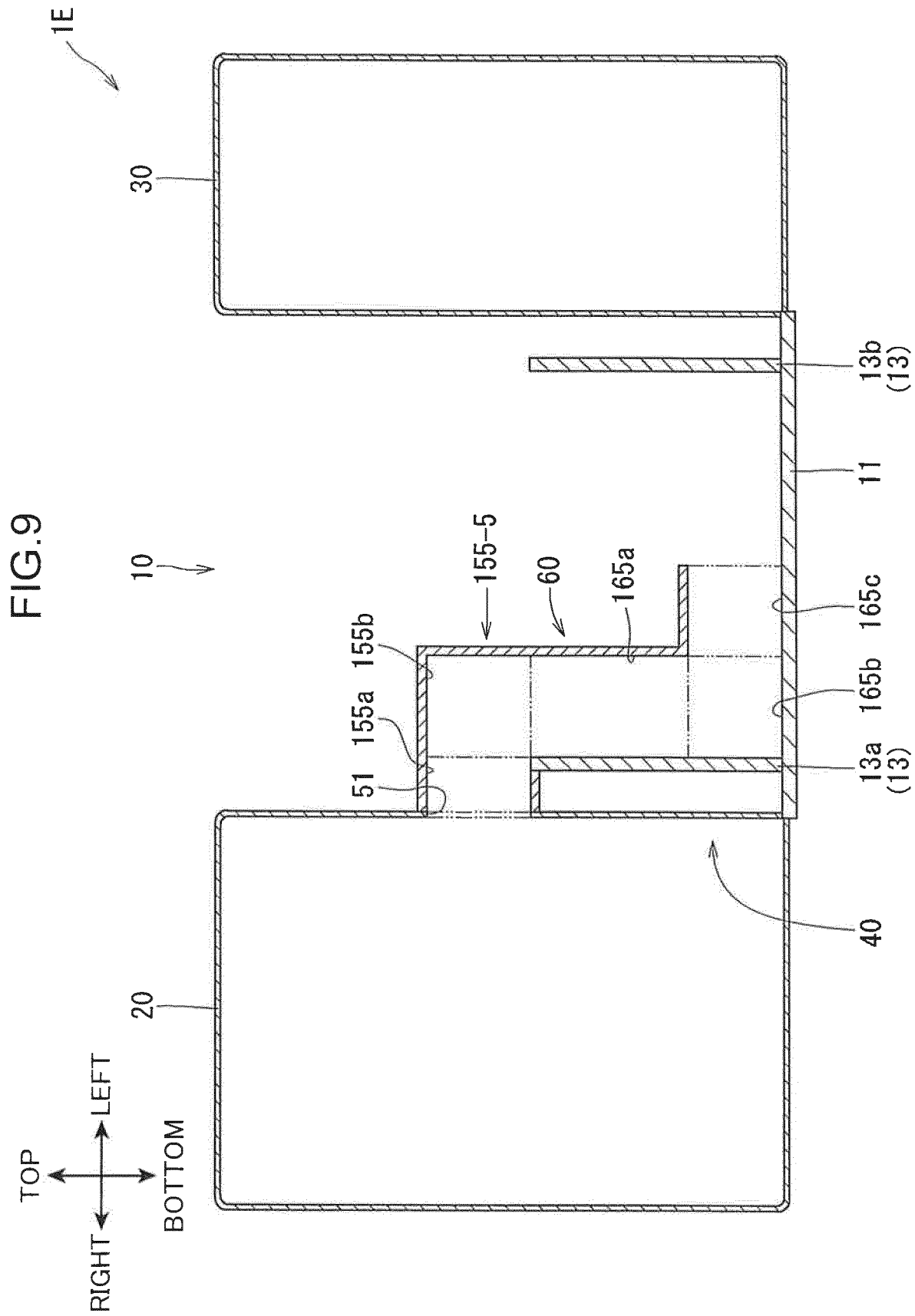


FIG.8





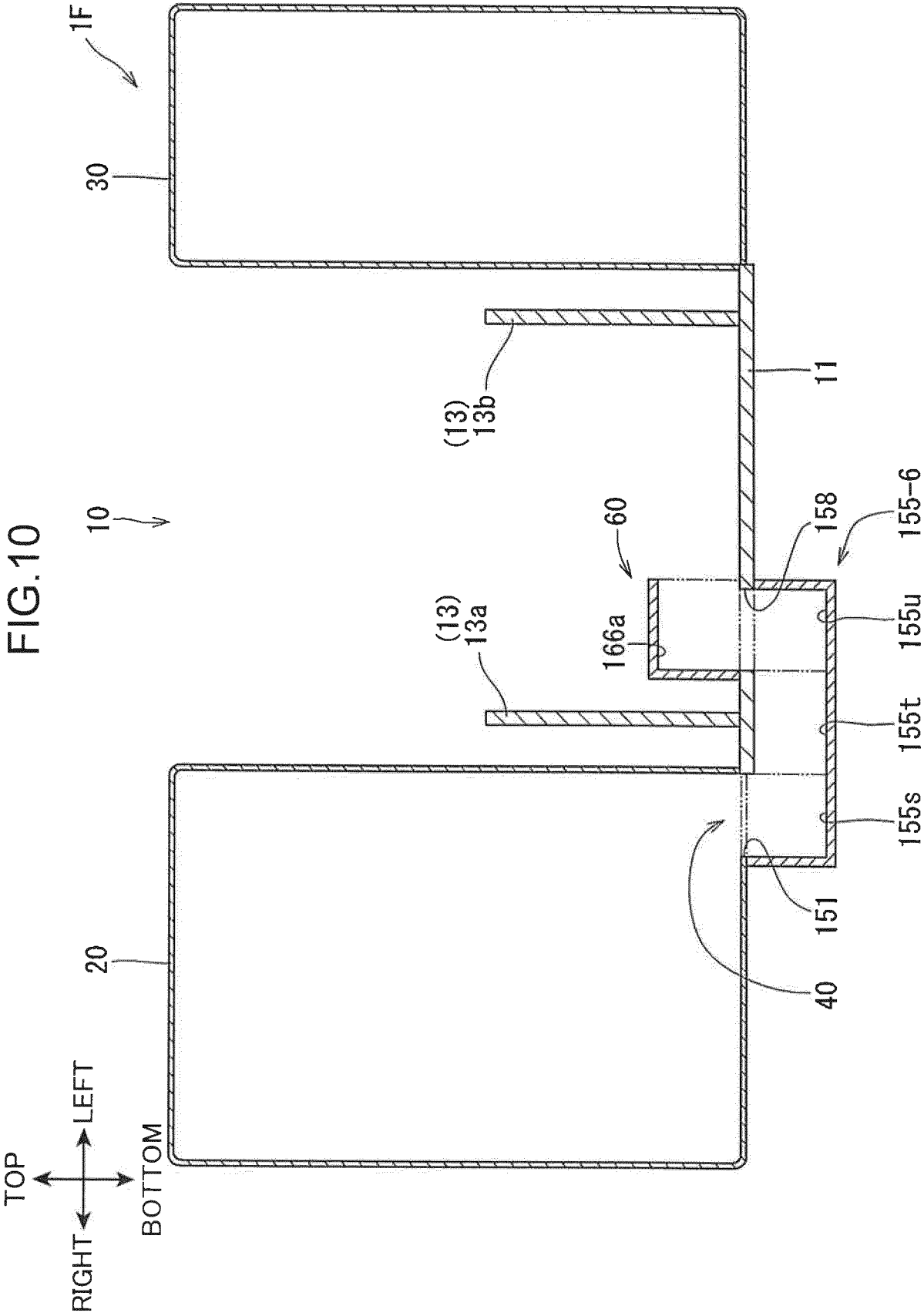


FIG. 11

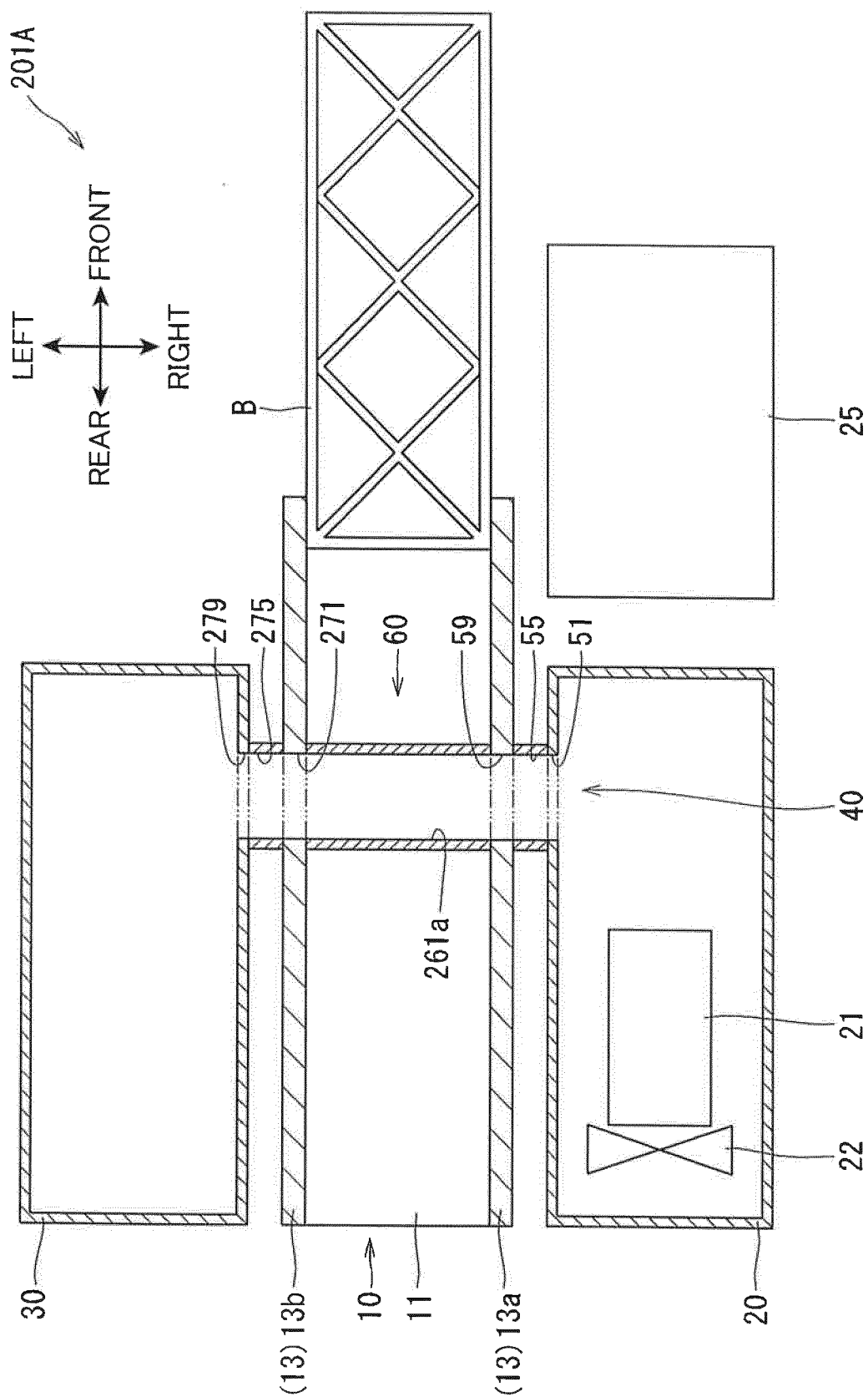


FIG.12

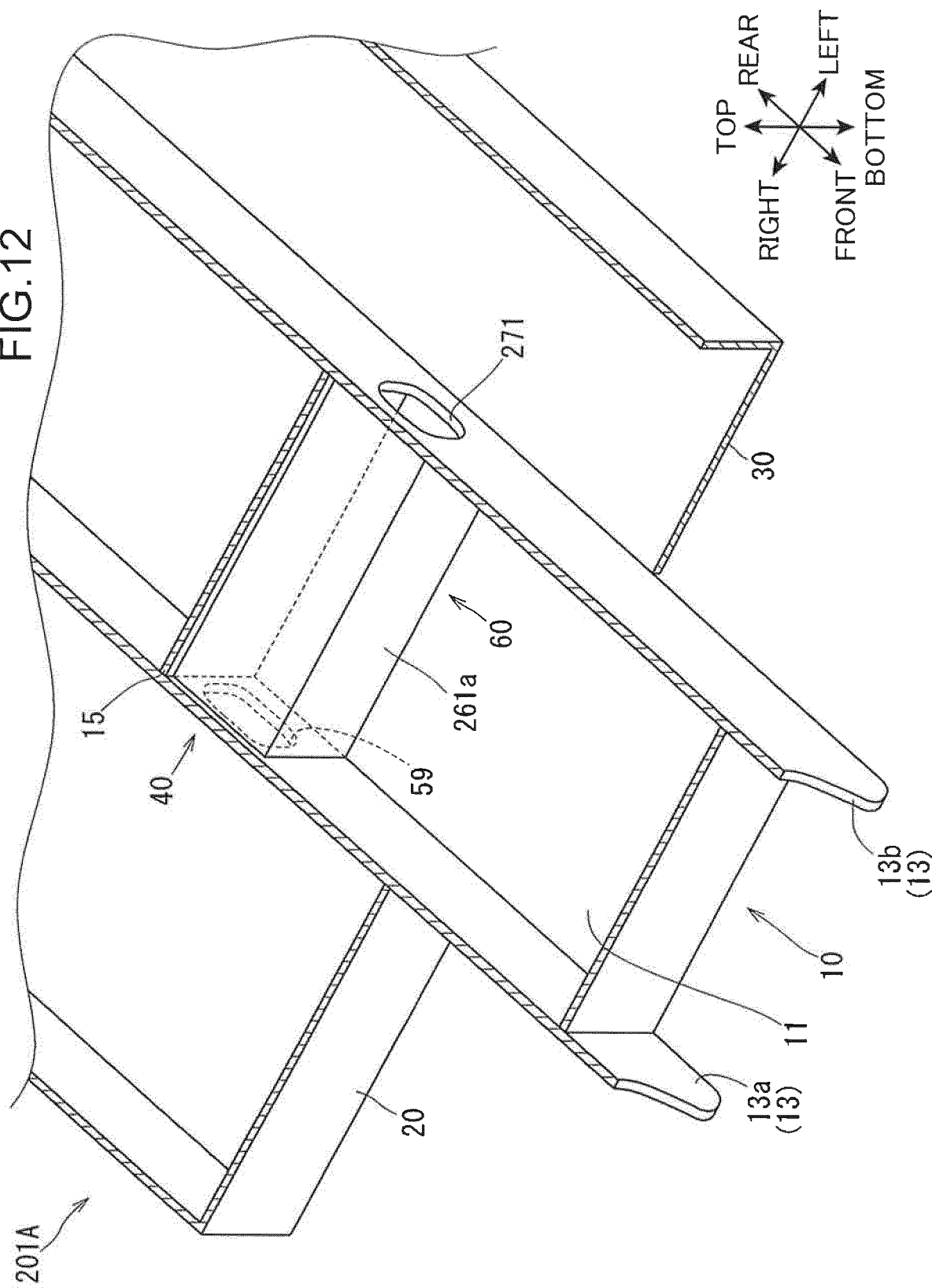


FIG.13

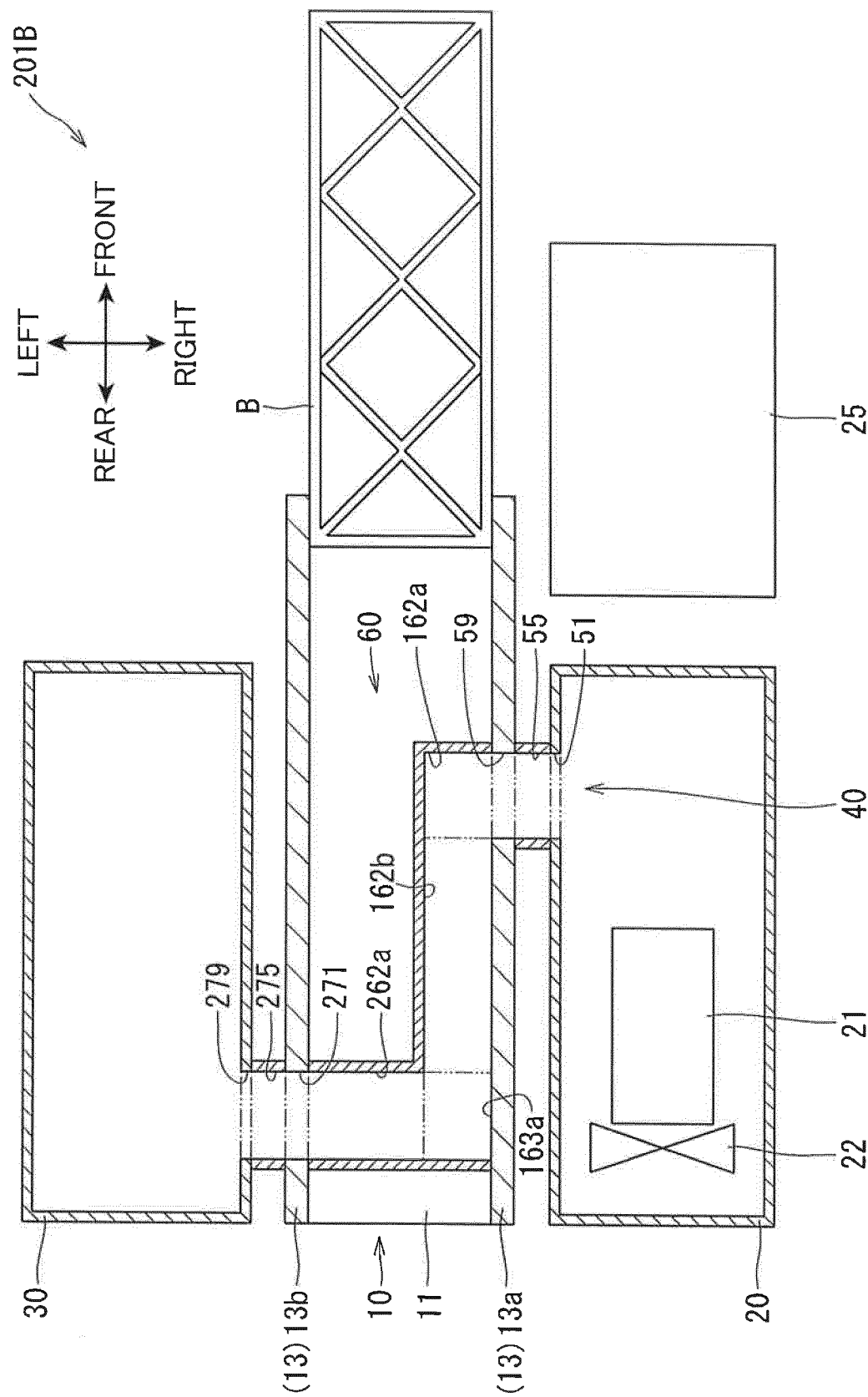


FIG. 14

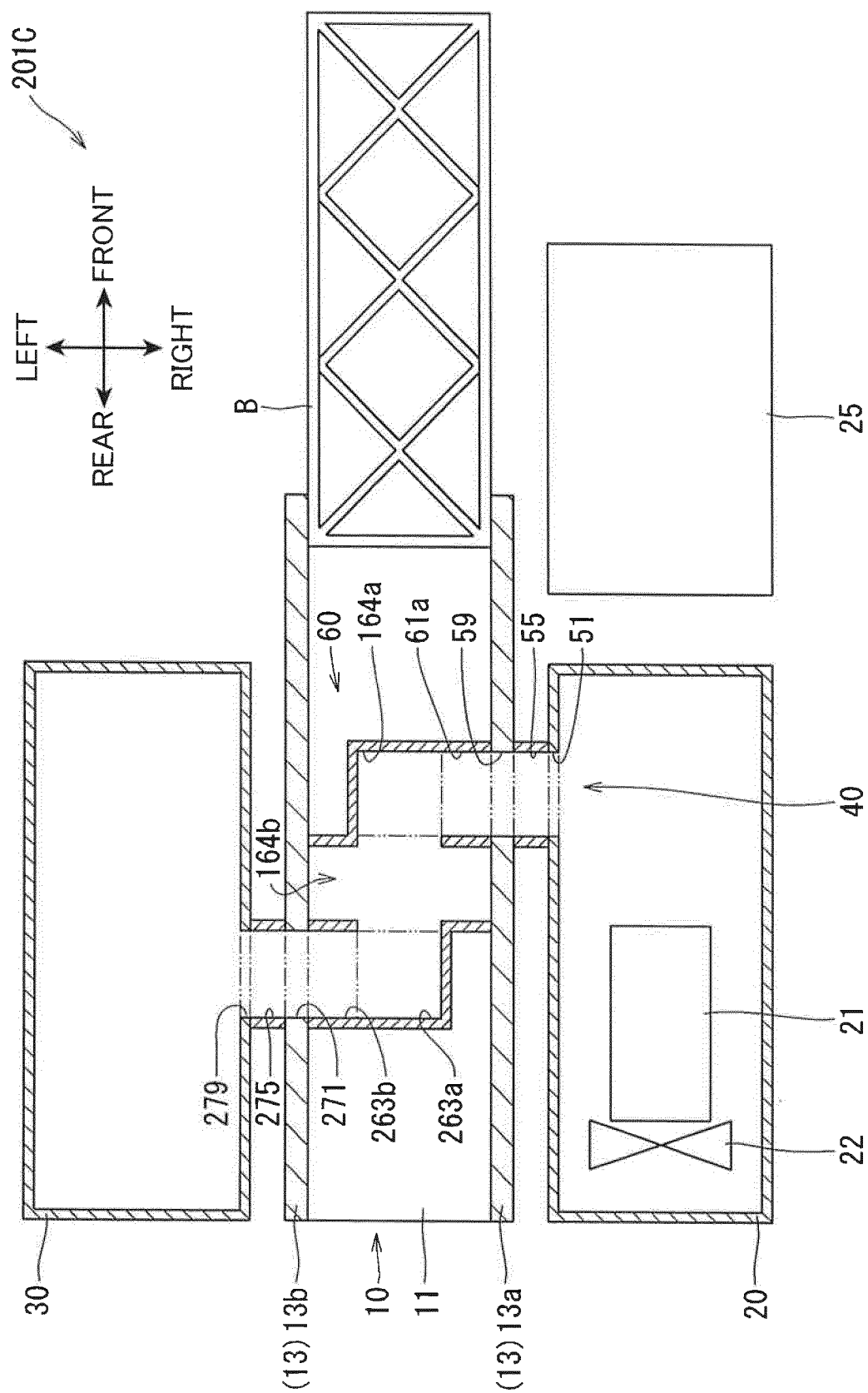
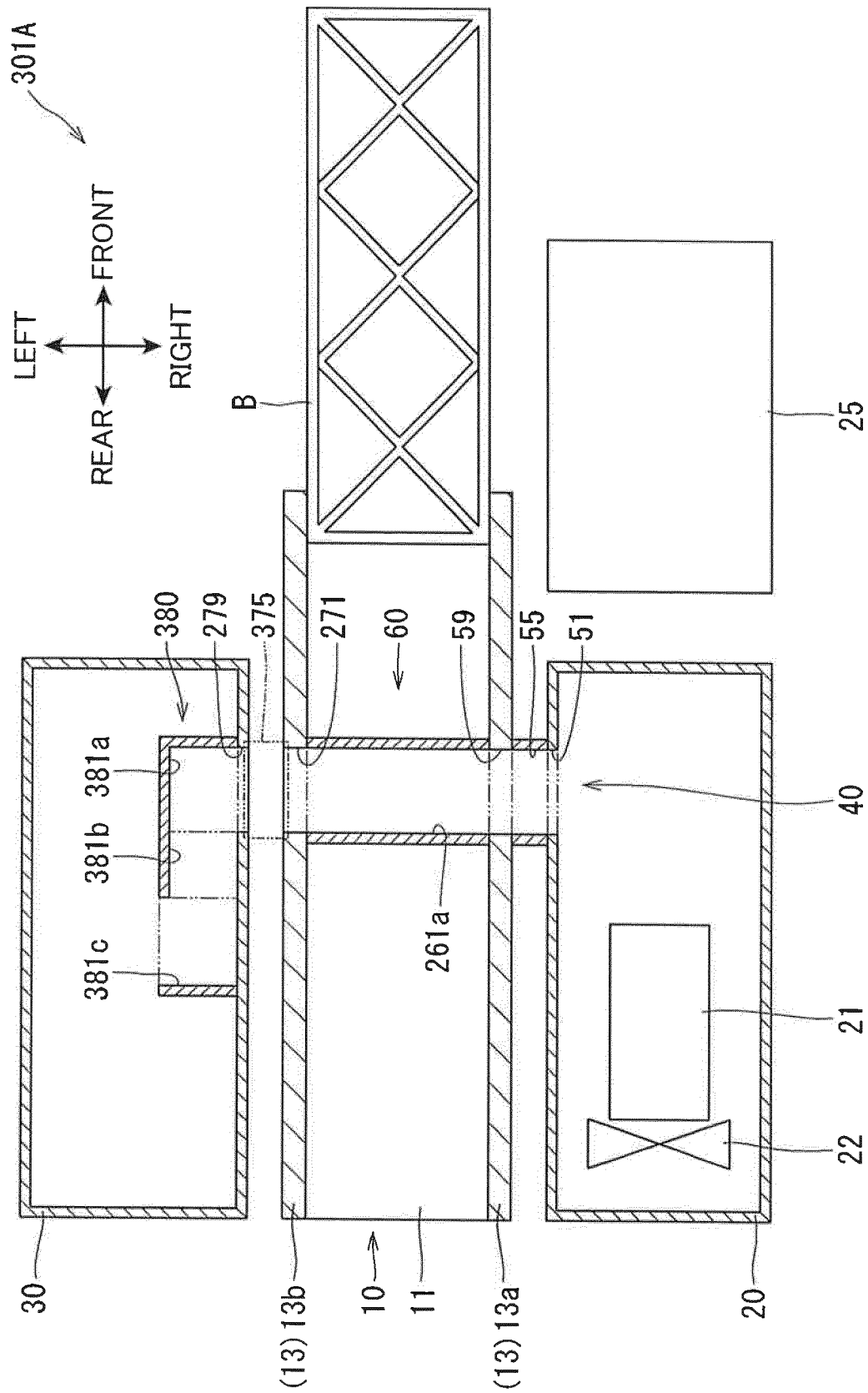


FIG.15



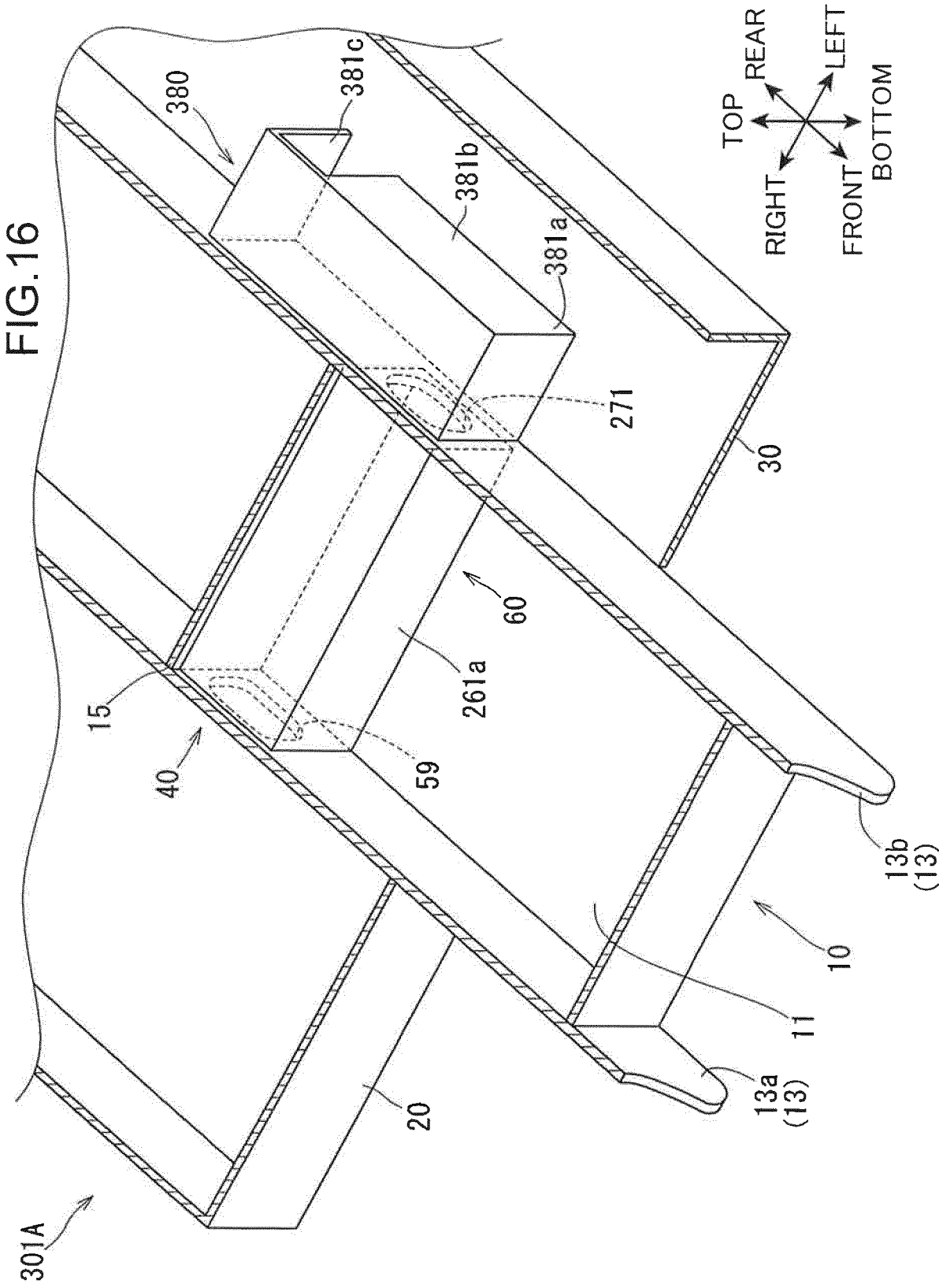


FIG. 17

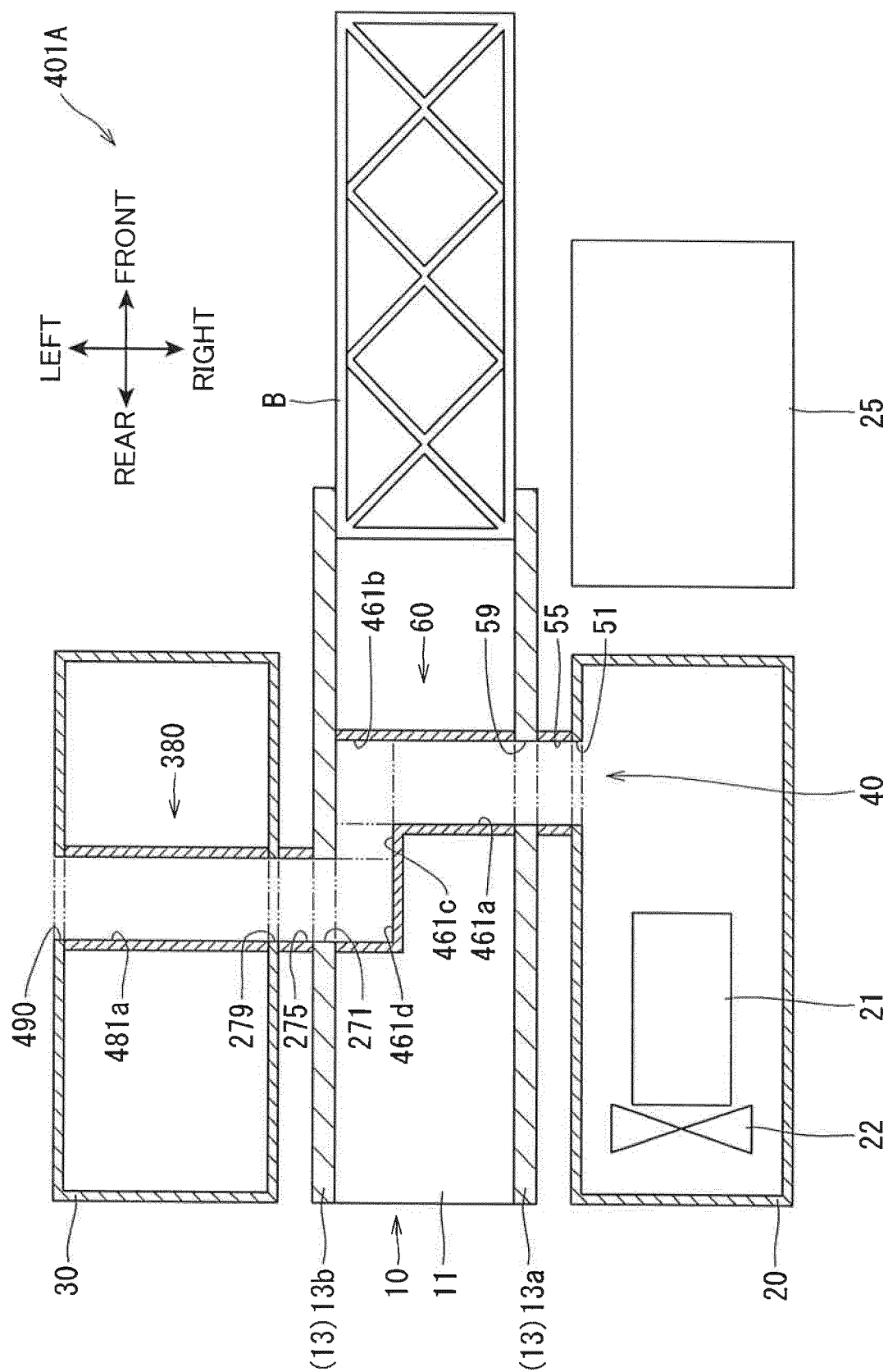


FIG. 18

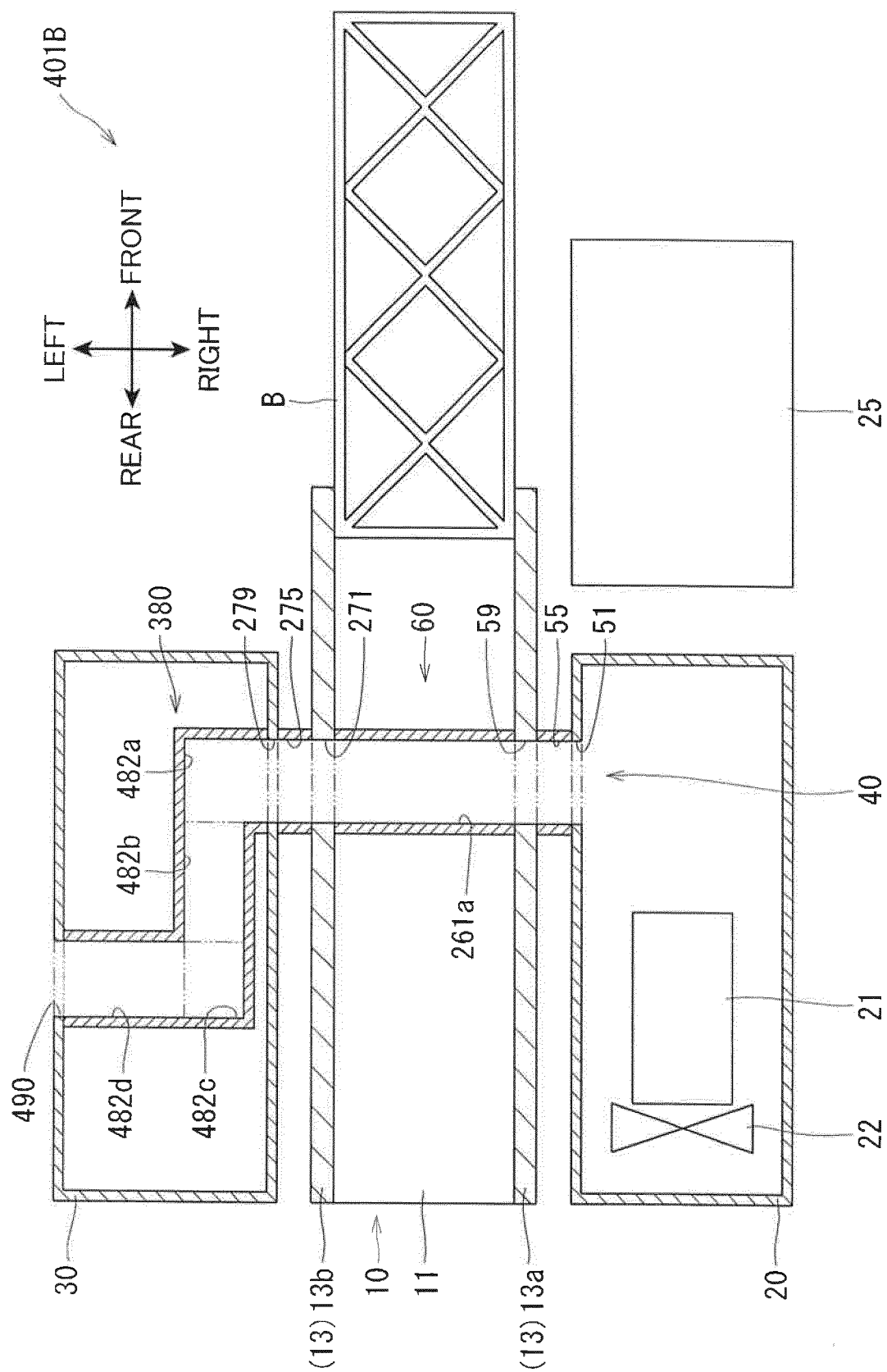


FIG.19

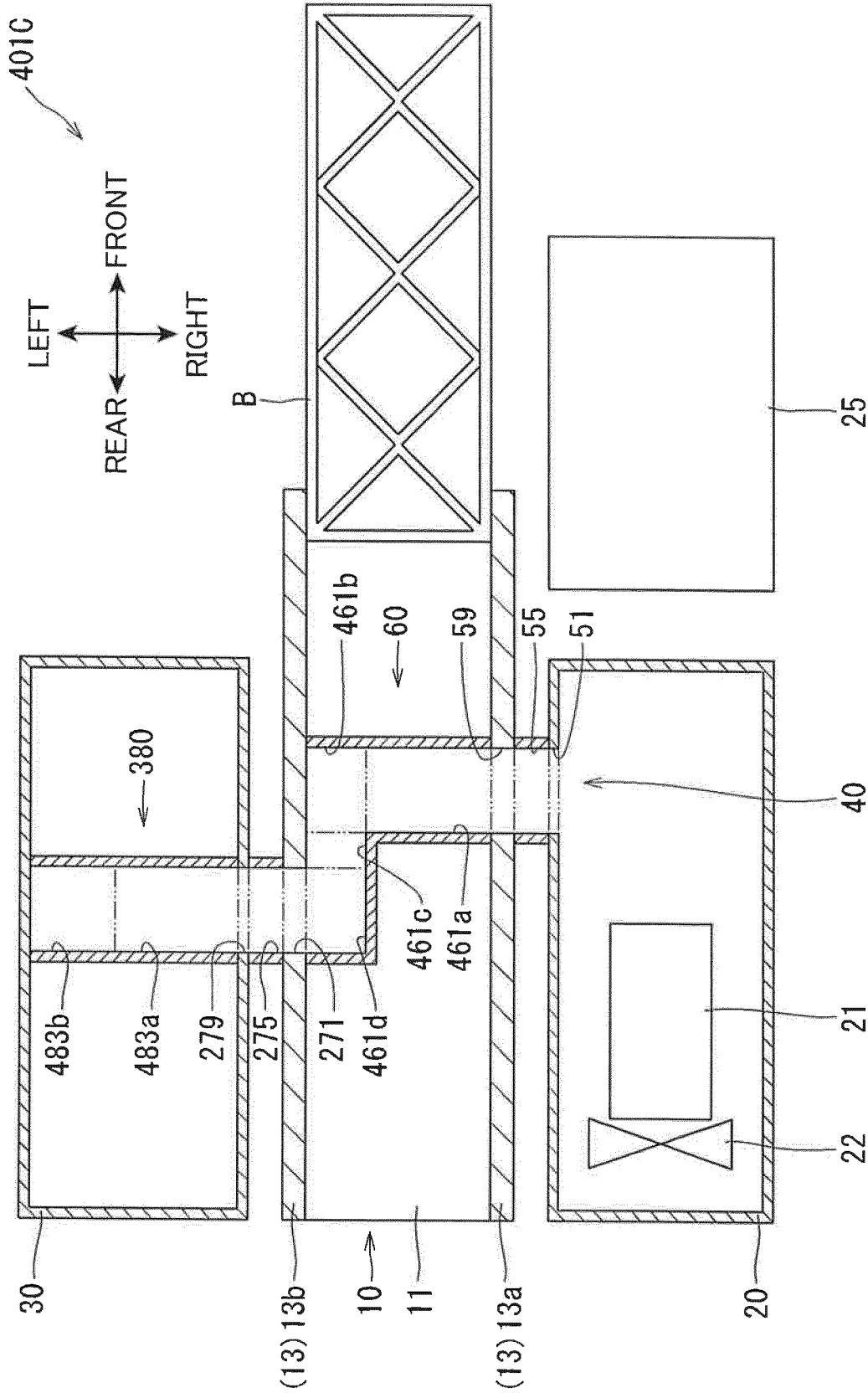


FIG.20

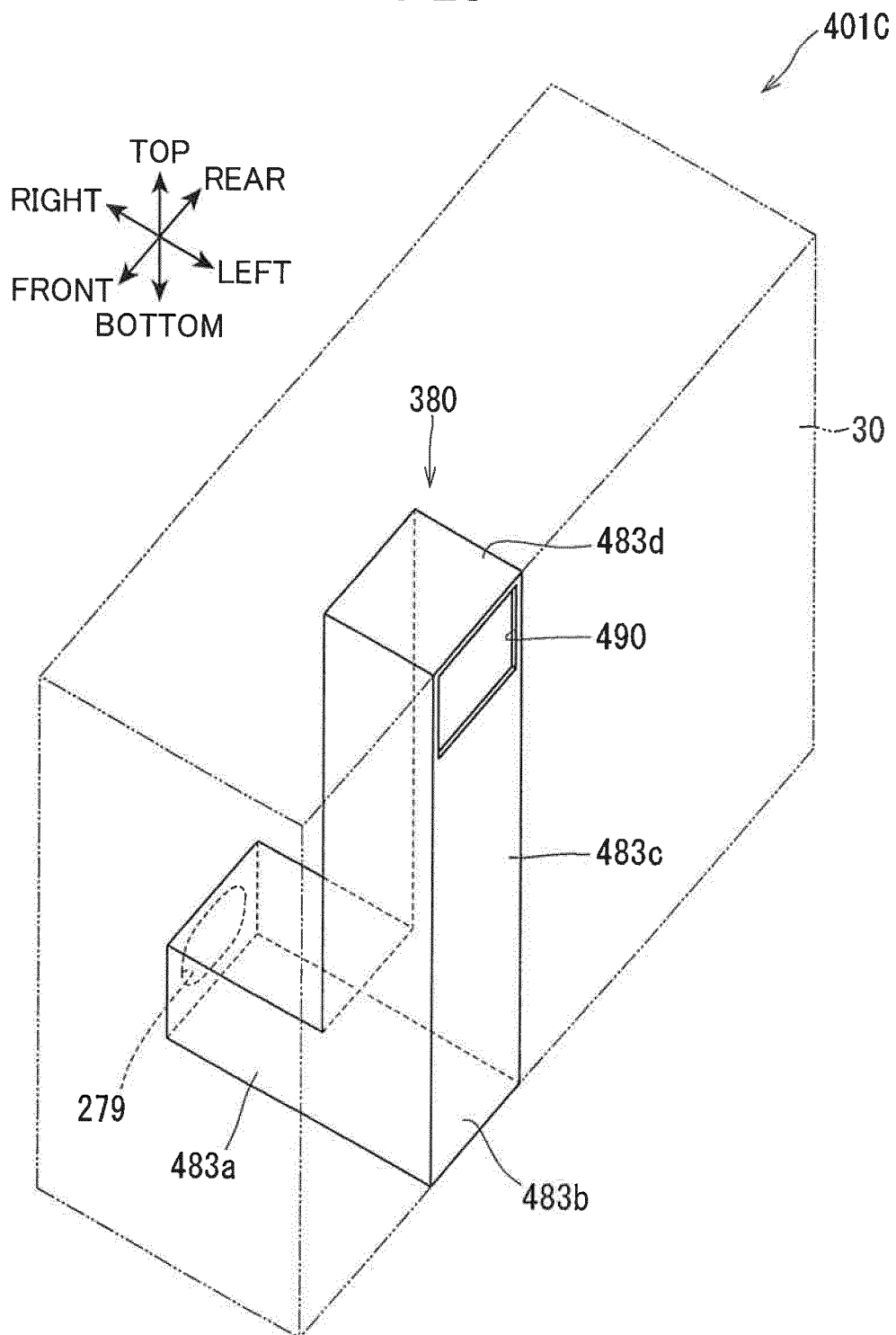


FIG. 21

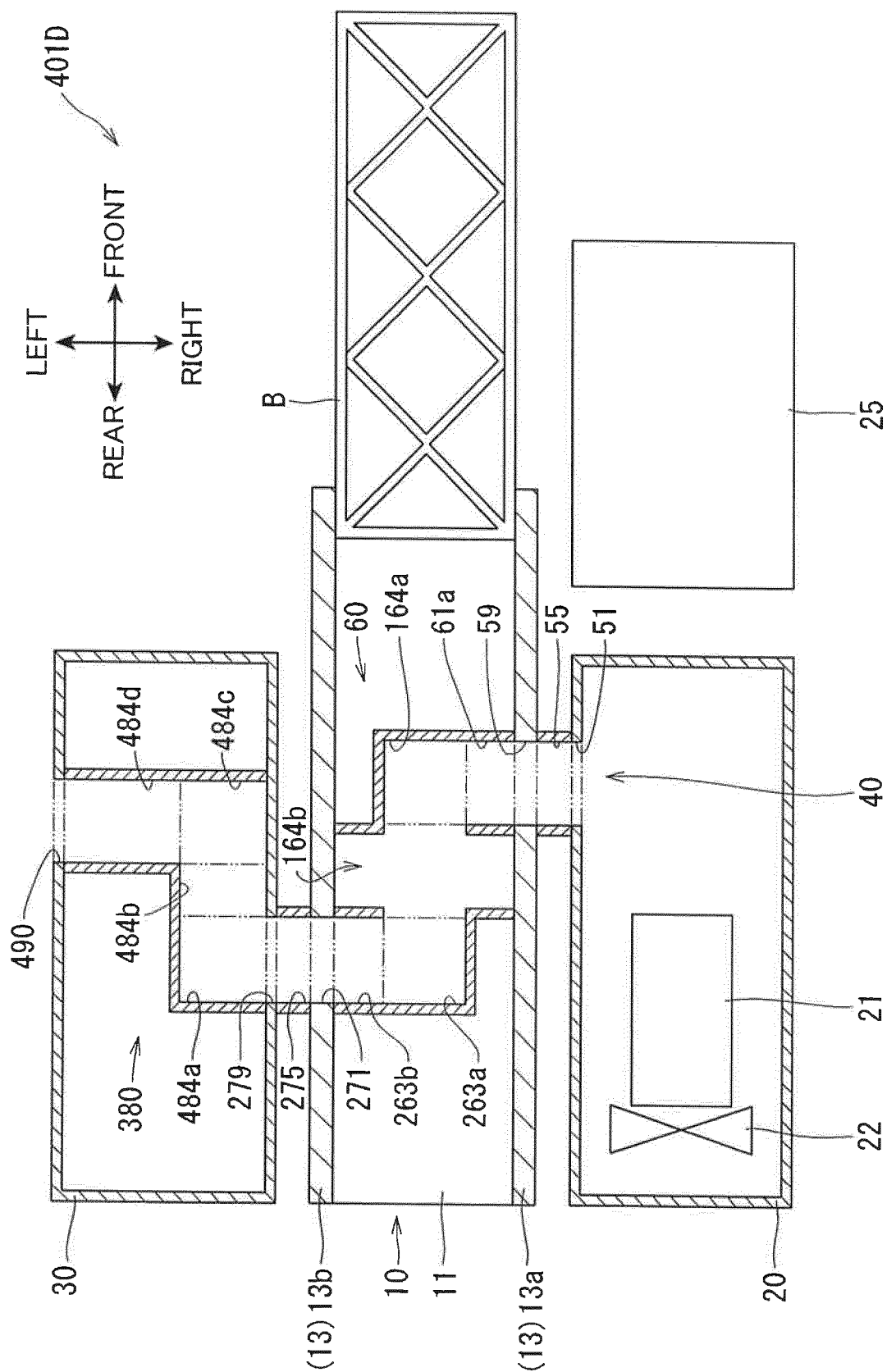


FIG.22

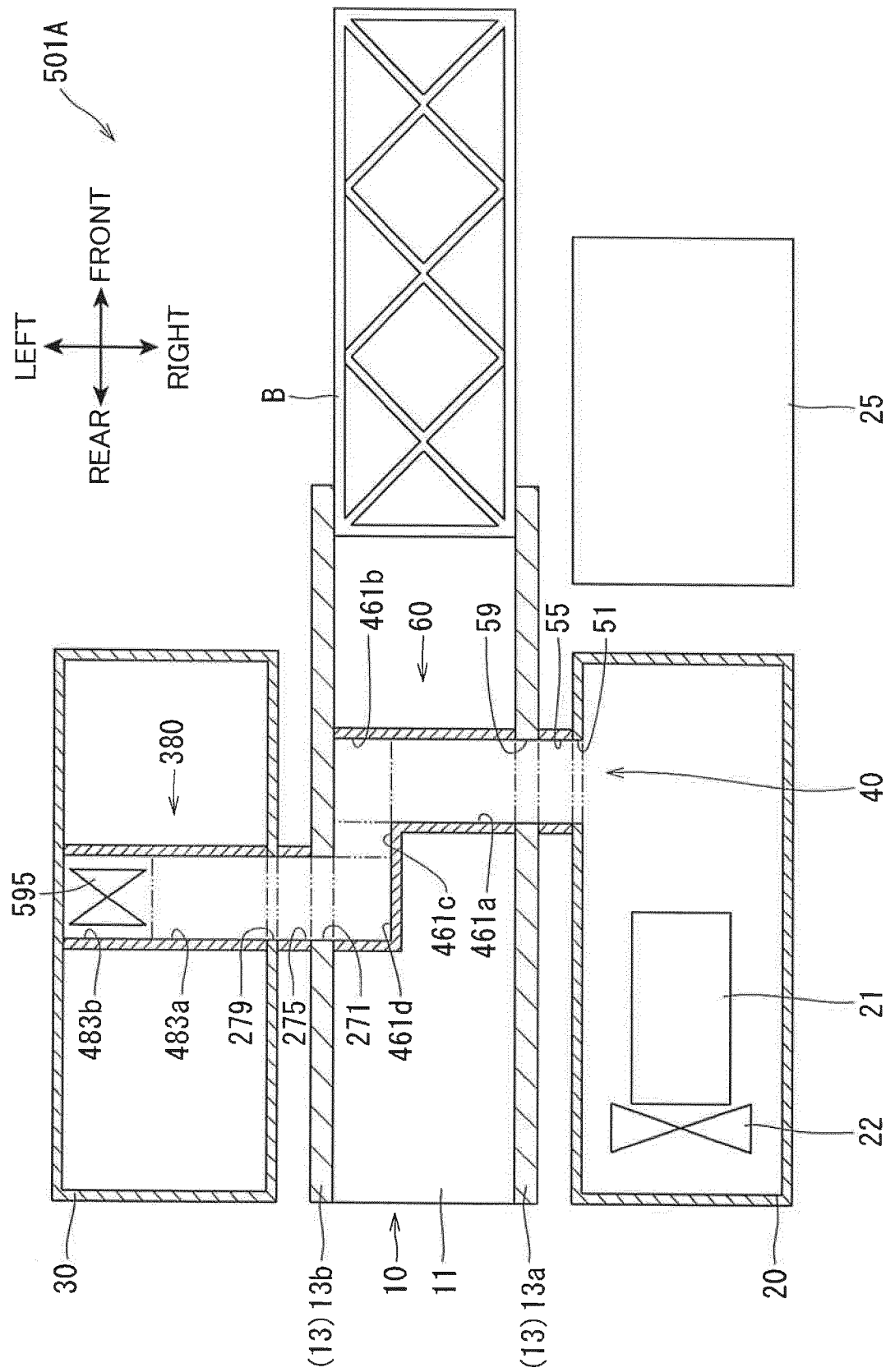


FIG.23

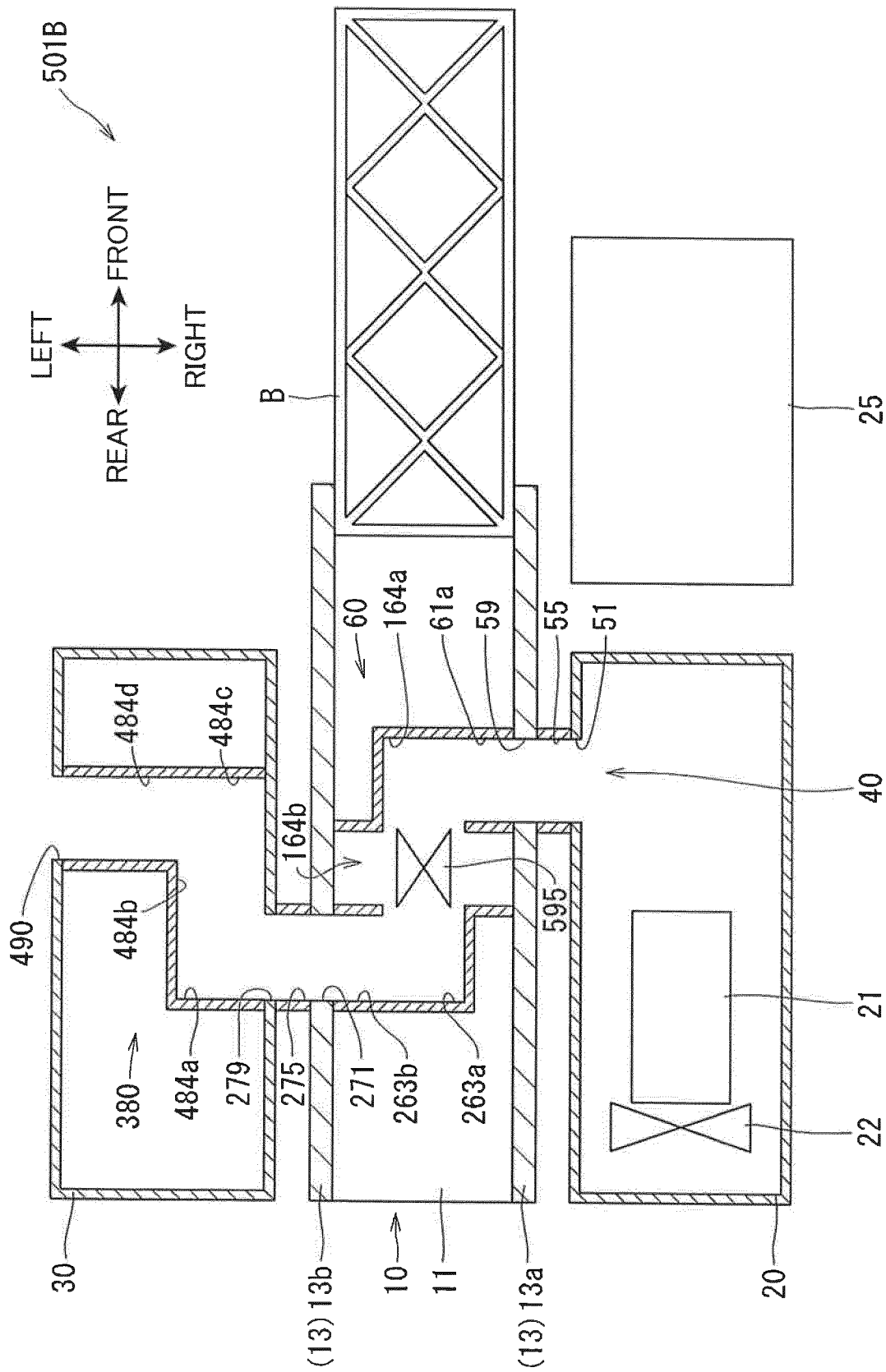
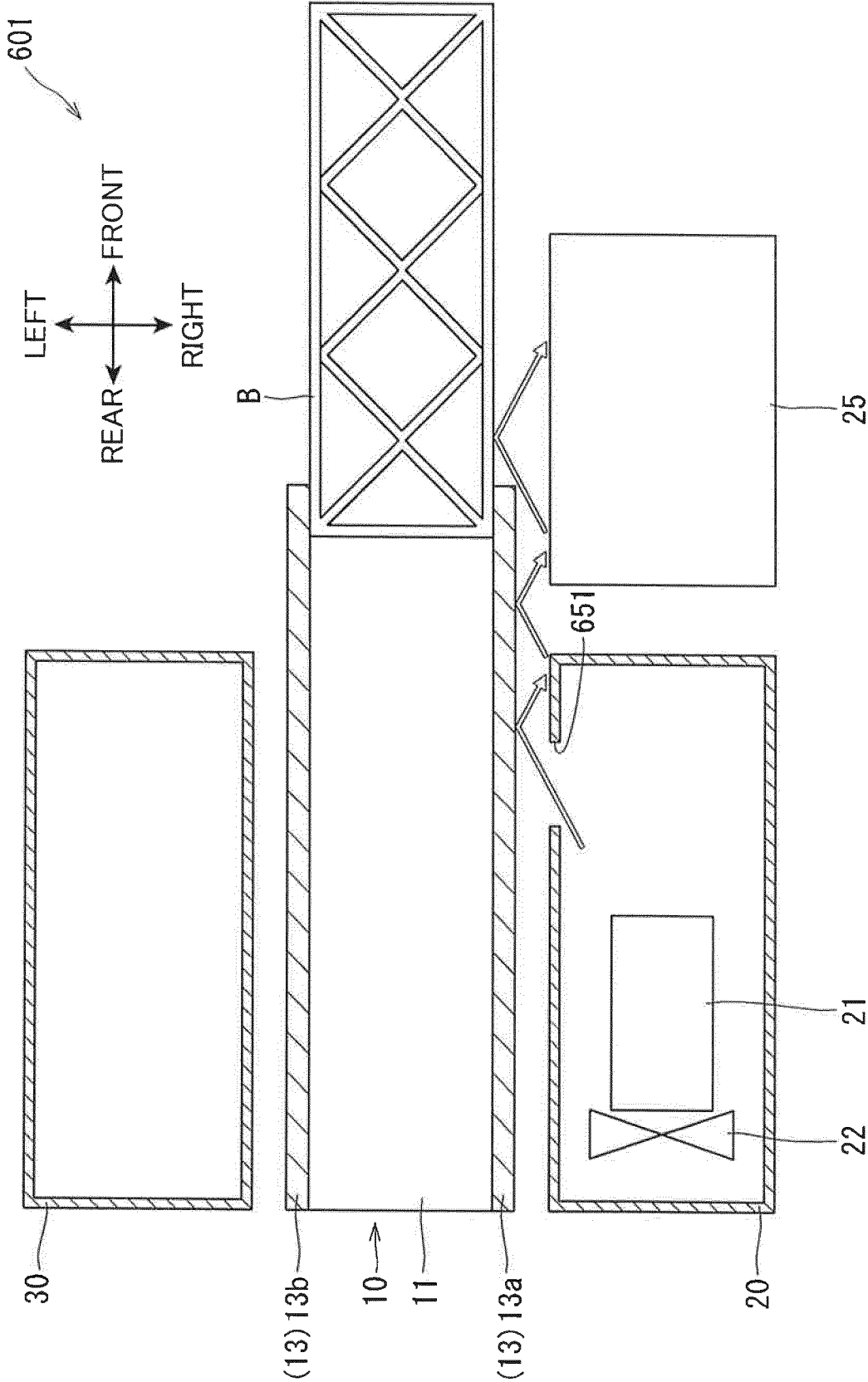


FIG.24



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/087334

A. CLASSIFICATION OF SUBJECT MATTER

B66C13/52(2006.01)i, E02F9/00(2006.01)i, E02F9/08(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B66C13/52, E02F9/00-9/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
 Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2013-230907 A (Kobe Steel, Ltd.), 14 November 2013 (14.11.2013), paragraphs [0010] to [0052]; fig. 1 to 12 (Family: none)	1-3, 6-7, 10-12 4-5, 8-9, 13
A	JP 2010-179707 A (Kobelco Cranes Co.), 19 August 2010 (19.08.2010), & EP 2213608 A2	1-13
A	JP 59-11782 Y2 (Kato Works Co., Ltd.), 10 April 1984 (10.04.1984), (Family: none)	1-13
A	JP 2003-82705 A (Hitachi Construction Machinery Co., Ltd.), 19 March 2003 (19.03.2003), (Family: none)	1-13

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
08 March 2017 (08.03.17)Date of mailing of the international search report
21 March 2017 (21.03.17)Name and mailing address of the ISA/
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3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

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