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(54) **AIR COMPRESSION DEVICE AND AIR SUCTION DEVICE**

LUFTKOMPRESSIONSVORRICHTUNG UND LUFTABSAUGVORRICHTUNG

DISPOSITIF DE COMPRESSION D'AIR ET DISPOSITIF D'ASPIRATION D'AIR

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Description

TECHNICAL FIELD

[0001] The present invention relates to an air compression device. The present application further discloses related air suction device.

BACKGROUND

[0002] In railway vehicles, compressed air is used as a driving source for door opening-closing devices, brakes, and other devices. Thus, railway vehicles are equipped with an air compression device to generate compressed air (see, for example, Patent Literature 1).

[0003] As one example of the air compression device used in railway vehicles, there is an compressor housed in a casing. The casing has an air inlet port for introducing air into the compressor. An air inlet filter is provided to the air inlet to remove dust and other contaminants from the outside air. An outlet of the compressor housed in the casing is connected to an external compressed-air tank through a pipe. Further related example of air compression devices are disclosed in US 3 369 736 A, CN 101 539 315 A, and JP 2008 214109 A, however these documents do not disclose an opening-closing mechanism configured to close an auxiliary air inlet when a pressure difference between inside and outside of the casing has not reached a predetermined value, and configured to open the auxiliary air inlet when the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value.

RELEVANT REFERENCES

LIST OF RELEVANT PATENT LITERATURE

[0004] Patent Literature 1: Japanese Patent Application Publication No. 2014-152744

SUMMARY

[0005] In conventional air compression devices, the amount of air intake is largely reduced compared to the amount that the compressor normally requires when the air inlet filter attached to the casing inlet is clogged with dust, when a large foreign object such as a plastic bag blocks the inlet filter, or when snow or freezing occurs on the inlet filter. This increases the load on the compressor and may result in inconveniences such as increased heat generation in the compressor due to the increased load on the compressor, and a longer required time to fill the compressed air tank with air due to the insufficient air intake.

[0006] The present invention provides an air compression device and air suction device that can introduce sufficient air to its suction side even when an airflow resistance of a main filter of its air suction side increases.

[0007] An air compression device according to the invention includes: a compressor compressing air suctioned therein and discharging compressed air; a casing housing the compressor there, the casing having a main air inlet and an auxiliary air inlet for introducing air for the compressor; a main air inlet filter filtering air introduced into the main air inlet; and an opening-closing mechanism configured to open the auxiliary air inlet when a pressure difference between the inside and the outside of the casing is equal to or greater than a predetermined value to allow air outside the casing to flow into the casing, wherein the opening/closing mechanism is further configured to close the auxiliary air inlet when a pressure difference between inside and outside of the casing has not reached to a predetermined value.

[0008] With the above configuration, when the pressure difference between the inside and the outside of the casing has not reached to the predetermined value, the opening-closing mechanism closes the auxiliary air inlet. At this time, the outside air is suctioned into a suction portion of the compressor through the main air inlet filter. Whereas when the airflow resistance of the main air inlet filter increases and the pressure difference between the inside and the outside of the casing reaches to or exceeds the predetermined value, the opening-closing mechanism opens the auxiliary air inlet. At this time, the outside air is suctioned into the suction portion of the compressor through the auxiliary air inlet. Thus, sufficient air can be introduced to the suction side of the compressor even when the airflow resistance of the main inlet filter increases.

[0009] The opening-closing mechanism may include a lid movable between an opened position in which the auxiliary air inlet is opened and a closed position in which the auxiliary air inlet is closed; and a restraining portion restraining the lid in the closed position and releasing the restraint on the lid when the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value.

[0010] The restraining portion may be a spring that biases the lid toward the closed position.

[0011] The air compression device may further include a stopper that prevents further opening of the lid when the pressure difference between the inside and the outside of the casing is larger than the predetermined value and the displacement of the lid in its opening direction becomes larger than a predetermined amount.

[0012] The opening-closing mechanism may include: a lid movable between an opened position in which the auxiliary air inlet is opened and a closed position in which the auxiliary air inlet is closed; and a detector detecting whether the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value based on at least one selected from the group consisting of a pressure inside the casing, a discharge flow rate of the compressor, and an amount of heat generated in the compressor; and an actuator causing the lid to move to the opened position when the

detector detected that the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value.

[0013] The detector may detect whether the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value based on at least one selected from the group consisting of a discharge flow rate of the compressor and an amount of heat generated in the compressor. The compressor may include an air introducing portion for introducing air that has flowed into the casing; and an introducing portion filter for filtering air that is introduced through the air introducing portion. The air compression device may further includes an introducing portion filter alarm that informs degradation of ventilation performance of the introducing portion filter when the pressure difference between the inside and the outside of the casing that is equal to or greater than the predetermined value is continuously detected after the actuator causes the lid to be opened.

[0014] A cover may be attached to the casing for covering the auxiliary air inlet from outside the casing, and the cover opens vertically downward.

[0015] An auxiliary filter having a lower collection performance than that of the main air inlet filter may be provided at the auxiliary air inlet.

[0016] An open alarm notifying that the auxiliary air inlet has been opened by the opening-closing mechanism may be further provided.

[0017] A cooling fan may be provided inside the casing. When the pressure difference between the inside and the outside of the casing is less than the predetermined value, the cooling fan sends outside air that has flowed into the casing through the main air inlet filter as cooling air to the compressor, and when the pressure difference between the inside and the outside of the casing is equal to or greater than the predetermined value, the cooling fan sends outside air that has flowed into the casing through the auxiliary air inlet as cooling air to the com pressor.

[0018] The casing may be disposed under a body of a railway vehicle

[0019] A suction side of the auxiliary air inlet may open in a direction orthogonal to a traveling direction of the railway vehicle.

[0020] An air compression device disclosed herein as a related example not covered by the claims includes: a compressor including a compressor body that compresses air suctioned therein and discharges compressed air, and an air introducing portion that has a main air introducing port and an auxiliary air introducing port and introduces air into the compressor body; a compressor including a compressor body that compresses air suctioned therein and discharges compressed air, and an air introducing portion that has a main air introducing port and an auxiliary air introducing port and introduces air into the compressor body; an opening-closing mechanism opening the auxiliary air introducing port when a pressure difference between inside and outside of the air introducing portion is equal to or greater than a predetermined value to allow air outside the air introducing portion to flow into the air introducing portion.

[0021] With the above configuration, when the pressure difference between the inside and the outside of the air introducing portion has not reached to the predetermined value, the opening-closing mechanism closes the auxiliary air introducing port. At this time, the outside air is suctioned into a suction portion of the compressor through the introducing portion filter. Whereas when the airflow resistance of the introducing portion filter increases and the pressure difference between the inside and the outside of the casing reaches to or exceeds the predetermined value, the opening-closing mechanism opens the auxiliary air introducing port. At this time, the outside air is suctioned into the suction portion of the compressor through the auxiliary air introducing port. Thus, sufficient air can be introduced to the suction side of the compressor even when the airflow resistance of the introducing portion filter increases.

[0022] An air suction device disclosed herein as a related example not covered by the claims includes: a suction unit suctioning air; casing housing the suction unit thereinside, the casing having a main suction port and an auxiliary suction port for introducing air for the suction unit; casing housing the suction unit thereinside, the casing having a main suction port and an auxiliary suction port for introducing air for the suction unit; an opening-closing mechanism opening the auxiliary suction port when a pressure difference between inside and outside of the casing is equal to or greater than a predetermined value to allow air outside the casing to flow into the casing.

[0023] With the above configuration, when the pressure difference between the inside and the outside of the casing has not reached to the predetermined value, the opening-closing mechanism closes the auxiliary suction port. At this time, the outside air is suctioned into a suction portion of the suction unit through the main suction port filter. Whereas when the airflow resistance of the main suction filter increases and the pressure difference between the inside and the outside of the casing reaches to or exceeds the predetermined value, the opening-closing mechanism opens the auxiliary suction port. At this time, the outside air is suctioned into a suction portion of the suction unit through the auxiliary suction port. Thus, sufficient air can be introduced to the suction side of the suction unit even when the airflow resistance of the main suction filter increases.

[0024] An air suction device disclosed herein as a related example not covered by the claims includes: a suction unit including a suction unit body that suctions air, and a suction introducing portion that has a main suction introducing port and an auxiliary suction introducing port and introduces air into the suction unit body; an introducing portion filter disposed at the main suction introducing port to filter air introduced into the main suction introducing port; and an opening-closing mechanism opening the

auxiliary suction introducing port when a pressure difference between inside and outside of the suction introducing portion is equal to or greater than a predetermined value to allow air outside the suction introducing portion to flow into the suction introducing portion.

[0025] With the above configuration, when the pressure difference between the inside and the outside of the suction introducing portion has not reached to the predetermined value, the opening-closing mechanism closes the auxiliary suction introducing port. At this time, the outside air is suctioned into a suction portion of the suction unit body through the introducing portion filter. Whereas when the airflow resistance of the introducing portion filter increases and the pressure difference between the inside and the outside of the suction introducing portion reaches to or exceeds the predetermined value, the opening-closing mechanism opens the auxiliary suction introducing port. At this time, the outside air is suctioned into the suction portion of the suction unit through the auxiliary suction introducing port. Thus, sufficient air can be introduced to the suction side of the suction unit even when the airflow resistance of the introducing portion filter increases.

ADVANTAGEOUS EFFECTS

[0026] In the air compression device described above, the auxiliary air inlet and the auxiliary air introducing port are opened by the opening-closing mechanism when the airflow resistance of the air inlet filter or the introducing portion filter increases significantly. Thus, sufficient air can be introduced to the suction side of the compressor. In the air suction device described above, the auxiliary suction port and the auxiliary suction introducing port are opened by the opening-closing mechanism when the airflow resistance of the main suction port filter or the introducing portion filter increases significantly. Thus, sufficient air can be introduced to the suction side of the suction unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic side view of a railway vehicle according to an embodiment of the present invention.

Fig. 2 is a schematic plan view of the railway vehicle according to the embodiment of the invention.

Fig. 3 is a side view of an air compression device according to a first embodiment of the invention.

Fig. 4 is a front view of the air compression device according to the first embodiment of the invention.

Fig. 5 is a schematic sectional view of the air compression device according to the first embodiment of the invention.

Fig. 6 is a schematic sectional view of the air compression device according to the first embodiment of the invention for illustrating its operation.

Fig. 7 is a schematic sectional view of the air compression device according to the first embodiment of the invention for illustrating its operation.

Fig. 8 is a schematic sectional view of an air compression device according to a second embodiment of the invention for illustrating its operation.

Fig. 9 is a schematic sectional view of the air compression device according to the second embodiment of the invention for illustrating its operation.

Fig. 10 is a schematic sectional view of an air compression device according to a third embodiment of the invention for illustrating its operation.

Fig. 11 is a schematic sectional view of the air compression device according to the third embodiment of the invention for illustrating its operation.

Fig. 12 is a partial side view of an air compression device according to a fourth embodiment not covered by the claims.

DESCRIPTION OF THE EMBODIMENTS

[0028] The embodiments of the present invention will be hereinafter described with reference to the drawings. In the following embodiments, like elements will be denoted by the same reference signs and redundant descriptions will be partly omitted.

<Railway Vehicle>

[0029] Fig. 1 is a schematic side view of a railroad vehicle 100 equipped with an air compression device 1 according to an embodiment. As shown in Fig. 1, two air compression device 1 are installed under a body 100a of the railroad vehicle 100, for example. In the following description, a direction in which the railway vehicle 100 is traveling is referred to as a "traveling direction," and a direction perpendicular to the traveling direction is referred to as a "vehicle width direction." Further, "upper" and "lower" refers to the upper and lower direction when the railway vehicle 100 is placed on a rail 103 (see Fig. 2).

[0030] The air compression 1 intakes the outside air to generate compressed air used in the railway vehicle 100. Specifically, the compressed air generated by the air compressor is used to operate pneumatic devices such as a brake device and a door opening-closing device installed in the railway vehicle.

[0031] Fig. 2 is a schematic plan view of the railway vehicle 100 to illustrate the arrangement of the air compression device 1. In Fig. 2, the air compression device 1, the rail 103 (track) on which the railway vehicle 100 runs, and a sleeper 102 are illustrated by two-dotted lines. As shown in Fig. 2, this embodiment is illustrated as the case where two air compression devices 1 are arranged side by side in front and rear in the traveling direction of the vehicle. However, the embodiment is not limited to this case. For example, the single air compression device 1 may be provided.

<Air Compression Device of First Embodiment>

[0032] Fig. 3 is a side view of the air compression device 1 according to the first embodiment viewed from the traveling direction. Fig. 4 is a front view of the air compression device 1 viewed from the outside in the width direction of the vehicle. Fig. 5 is a sectional view (cut along the width direction) of a portion of the air compression device 1 corresponding to the portion V shown in Fig. 3. The air compression device 1 includes a compressor 10 for compressing and discharging the intake air, a cooling fan 11 for sending cooling air to the compressor 10, and a casing 12 that houses the compressor 10 and the cooling fan 11. The casing 12 in this embodiment includes a rectangular-parallelepiped-shaped casing body 13 having an opening 9 (see Fig. 5) at one end in the vehicle width direction, and an end cover 14 detachably attached to one end of the casing body 13 on the side where the opening 9 is provided. The opening 9 of the casing body 13 is formed in an upper portion of a wall of the one end of the casing body 13. Between the wall of the casing body 13 on the one end and the end cover 14, formed is a main air inlet 15 that opens vertically downward. A main air inlet filter 16 is attached to the main air inlet 15 to filter the air (outside air) introduced into the casing 12 through the main air inlet 15.

[0033] The compressor 10 is driven by an electric motor (not shown). For example, a scroll-type (structure) of the compressor 10 may be used. The compressor 10 of this embodiment includes a compressor body 10A that compresses the intake air and then discharges it, and an air introducing portion 10B that is connected to the suction side of the compressor body 10A and suctions the air that flows into the inside of the casing 12. Inside the air introducing portion 10B, an introducing portion filter 17 is provided to filter the air introduced through an inlet 10Ba of the air introducing portion 10B. A discharge pipe 19 (see Figs. 6 and 7) connected to an external compressed air tank 18 (see Figs. 6 and 7) is connected to a discharge side of the compressor body 10A.

[0034] An auxiliary air inlet 20 that has a horizontally-long-rectangular shape is formed in an upper portion of an end surface of an end cover 14. The auxiliary air inlet 20 penetrates a wall of the end cover 14 in the portion facing the opening 9 of the casing body 13 in the vehicle width direction. The auxiliary air inlet 20 introduces the outside air into the casing 12. An opening-closing mechanism 21 that opens and closes the auxiliary air inlet 20 is attached to the end cover 14.

[0035] The opening-closing mechanism 21 includes a lid 22 that is movable between an opened position in which the auxiliary air inlet 20 is opened and a closed position in which the auxiliary air inlet 20 is closed, and a spring 23 that applies an biasing force to the lid 22 toward the closed position. The lid 22 includes a horizontally-long rectangular-shaped plate 22a, which is slightly larger than the auxiliary air inlet 20, and a sealing member 22b disposed around an peripheral edge of the plate 22a. An upper edge of the lid 22 is pivotably supported by a portion of the end cover 14 around an upper edge of the auxiliary air inlet 20 inside the casing 12. The lid 22 is pivotably attached to the end cover 14 by hinges 24. The lid 22 pivots about a support shaft 24a that extends along the upper edge of the auxiliary air inlet 20. The hinge 24 is equipped with the aforementioned spring 23 that applies the biasing force to the lid 22. In this embodiment, the spring 23 is a torsion spring.

[0036] The lid 22 receives the biasing force of the spring 23, and the sealing member 22b disposed in the periphery of the plate 22a tightly contacts the periphery of the auxiliary air inlet 20. In this manner, the lid 22 closes the auxiliary air inlet 20 from the inside of the casing 12. A surface of the lid 22 that faces the inside of the casing 12 is subjected to the pressure of the air inside the casing 12. A surface of the lid 22 that faces the auxiliary air inlet 20 is subjected to the pressure of the outside air (external air) outside the casing 12. The lid 22 opens and closes the auxiliary air inlet 20 depending on the balance between a pressure difference between the inside and the outside of the casing 12 and the biasing force of the spring 23.

[0037] When the pressure difference between the inside and the outside of the casing 12 has not increased to a predetermined value or more (normal state) in the opening-closing mechanism 21 that has the lid 22 and spring 23, the lid 22 closes the auxiliary air inlet 20 with the biasing force of the spring 23. From this close state, if the pressure difference between the inside and the outside of the casing 12 increases to the predetermined value or more due to an increase in an airflow resistance of the main air inlet filter 16 caused by clogging of the main air inlet filter 16, adhesion of large foreign substances, snow accretion, freezing, etc., the lid 22 of the opening-closing mechanism 21 opens the auxiliary air inlet 20. In this embodiment, the spring 23 of the hinge 24 serves as a restraining portion for retaining the lid 22 in the closed position. The spring 23 quits pressing the lid 22 to the closed position when the pressure difference between the inside and the outside of the casing 12 exceeds the predetermined value.

[0038] A stopper 25 is attached in a portion of the end cover near the lower edge of the auxiliary air inlet 20 to control excessive displacement of the lid 22 in the opening direction to keep the lid 22 inside the casing 12. The stopper 25 has a hook portion 25a that bends in an L-shape in the pivot direction of the lid 22 and is disposed at a predetermined distance from the wall of the end cover 14 where the auxiliary air inlet 20 is formed. A part of the hook is situated within the pivoting path of the lid 22. When the pressure difference between the inside and the outside of the casing 12 becomes larger than the predetermined value and the displacement of the lid 22 in the opening direction becomes larger than a predetermined amount, the stopper 25 prevents further opening displacement of the lid 22 with the hook portion 25a contacting the lower edge of the lid 22.

[0039] The end cover 14 (casing 12) has a cover 26 that covers the periphery of the auxiliary air inlet 20 from the outside of the end cover 14 and opens downward in the vertical direction. The cover 26 covers the auxiliary air inlet 20 from the outside in the vehicle width direction and also from above and from the left and right sides (sides in the traveling direction). The lower side of the cover 26 has an opening 26a that opens vertically downward. When the auxiliary air inlet 20 is opened by opening the lid 22, the outside air is introduced into the inside of the casing 12 through the opening 26a of the cover 26 and through the auxiliary air inlet 20.

[0040] The cooling fan 11 disposed inside the casing 12 sends the outside air that has flowed into the inside of the casing 12 through the main air inlet filter 16 to the compressor 10 as cooling air when the pressure difference between the inside and the outside of the casing 12 does not exceed the predetermined value. Furthermore, when the pressure difference between the inside and the outside of the casing 12 increases to the predetermined value or more due to clogging of the main air inlet filter 16, the cooling fan 11 sends, as cooling air, the outside air that flows in through the auxiliary air inlet 20 opened by the opening-closing mechanism 21 to the compressor 10.

[0041] In the air compression device 1 of this embodiment, the intake side of the main air inlet 15 and the auxiliary air inlet 20 through which the outside air is introduced into the casing 12, open such that they face in a direction orthogonal to the traveling direction of the railway vehicle 100. In other words, the intake side of the main air inlet 15 opens such that it faces downward in the vertical direction. The intake side of the auxiliary air inlet 20 opens vertically downward through the opening 26a in the cover 26.

<Operation of Air Compression Device>

[0042] Fig. 6 is a schematic sectional view of the air compression device 1 to illustrate its normally operating state (when the airflow resistance of the main air inlet filter 16 is less than the predetermined value). When the pressure difference between the inside and the outside of the casing 12 is not greater than the predetermined value, the opening-closing mechanism 21 closes the auxiliary air inlet 20 as shown in Fig. 6. When the compressor 10 and the cooling fan 11 operate in this state, the air (outside air) outside the casing 12 is introduced into the casing 12 through the main air inlet filter 16 under suction force by the compressor 10 and the cooling fan 11. The air introduced into the casing 12 is suctioned into the compressor body 10A through the air introducing portion 10B of the compressor 10, and is then pressurized in the compressor body 10A and discharged as compressed air. The compressed air discharged from the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

[0043] While the air compression device 1 is operating as described above, the outside air passes through the main air inlet filter 16 and is introduced into the casing 12, so relatively large dust particles in the outside air are removed by the main air inlet filter 16. Dusts that pass through pores of the main air inlet filter 16 and enter into the casing 12 are removed by the introducing portion filter 17 disposed in the air introducing portion 10B of the compressor 10. The introducing portion filter 17 has a finer mesh than that of the main air inlet filter 16.

[0044] Further, some of the air introduced into the casing 12 through the main air inlet filter 16 is sent to the compressor 10 as cooling air by the cooling fan 11. In this way, the compressor 10 is cooled by the outside air that has a relatively low temperature. Consequently, the temperature rise in the compressor 10 is suppressed, and a fine compression performance of the compressor 10 is maintained.

[0045] Fig. 7 is a schematic sectional view of the air compression device 1 to illustrate its operating state when the pressure difference between the inside and the outside of the casing 12 increases to the predetermined value or more. When the airflow resistance of the main air inlet filter 16 increases, it hinders the introduction of the outside air into the casing 12 through the main air inlet 15. This gradually increases the pressure difference between the inside and the outside of the casing 12. When the pressure difference between the inside and the outside of the casing 12 exceeds the predetermined value, a differential pressure between the inside and the outside of the casing 12 surpasses the biasing force of the spring 23 and pushes the lid 22 of the opening-closing mechanism 21 to open as shown in Fig. 7. As a result, the auxiliary air inlet 20 of the casing 12 is opened as the lid 22 opens, and the outside air is suctioned into the compressor body 10A from the air introducing portion 10B of the compressor 10 through the auxiliary air inlet 20. The compressed air generated in the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

[0046] When the auxiliary air inlet 20 is pushed and opened by the differential pressure between the inside and the outside of the casing 12 as described above, the outside air flows directly into the casing 12 through the auxiliary air inlet 20. At this time, the outside air flows into the auxiliary air inlet 20 through the opening 26a of the cover 26 (see Figs. 3 and 4), which opens vertically downward. Therefore, dust mixed in the outside air is less likely to enter the inside of the cover 26. Here, an auxiliary filter 35 may be installed at the auxiliary air inlet 20, as illustrated by the double-dashed chain lines in Figs. 6 and 7. The auxiliary filter 35 is preferably coarser than the main air inlet filter 16, for example. Furthermore, an open detection sensor 30 may be provided to detect that the lid 22 is opened as shown in Figs. 6 and 7. When the open detection sensor detects that the lid 22 has been opened, an open alarm 31 may be activated. The open alarm 31 may be any device that is capable of notifying a driver or vehicle manager of the opening of the lid 22, such as a

lamp, chime and buzzer.

[0047] Further, some of the air introduced into the casing 12 through the auxiliary air inlet 20 is sent to the compressor 10 as cooling air by the cooling fan 11. In this way, the compressor 10 is cooled by the outside air that has a relatively low temperature.

< Advantageous Effects of First Embodiment >

[0048] In the air compression device 1 of this embodiment, when the airflow resistance of the main air inlet filter 16 increases and the pressure difference between the inside and the outside of the casing 12 exceeds a predetermined value, the auxiliary air inlet 20 of the casing 12 is opened by the opening-closing mechanism 21. Thus, sufficient air can be introduced to the suction side of the compressor 10. Therefore, when the air compression device 1 of this embodiment is employed, even when the airflow resistance of the main air inlet filter 16 increases, it is possible to prevent the load increase of the compressor 10 caused by shortage of the intake air and the delay in filling the compressed air tank 18 with air.

[0049] Furthermore, in the air compression device 1 of this embodiment, the opening-closing mechanism 21 includes the lid 22 that can be moved between the opened position and the closed position, and the restraining portion (spring 23) for retaining the lid 22 in the closed position. The restraining portion (spring 23) is configured to release its pressing on the lid 22 to the closed position when the pressure difference between the inside and the outside of the casing 12 exceeds the predetermined value. When the air compression device 1 of this embodiment is employed, the auxiliary air inlet 20 can be opened when the airflow resistance of the main air inlet filter 16 increases, without using an actuator or any other large equipment. In this embodiment, the spring 23 is used as the restraining portion to keep the lid 22 in the closed position, however, the restraining portion is not limited to the spring 23. For example, the restraining portion for retaining the lid 22 in the closed position may be composed of a breakable member that is broken when a load exceeding the predetermined value is applied thereon. Furthermore, in this embodiment, the lid 22 is configured to open and close the auxiliary air inlet 20 by pivoting on the support shaft 24a of the hinge 24, however the configuration is not limited to this. For example, the lid 22 may slide along the wall of the casing 12 to open and close the auxiliary air inlet 20.

[0050] In the air compression device 1 of this embodiment, the restraining portion is the spring 23 that biases the lid 22 toward the closed position. Therefore, after the airflow of the main air inlet filter 16 is temporarily reduced due to snow adhesion or the like, the lid 22 can be spontaneously returned to the original closed position when the airflow of the main intake filter 16 is restored. Furthermore, when the spring 23 is used as the restraining portion, the initial pressure of the opening operation of the lid 22 can be easily adjusted by adjusting the initial load of the spring 23, etc.

[0051] Furthermore, the air compression device 1 of the embodiment is provided with the stopper 25 that prevents further opening of the lid 22 when the pressure difference between the inside and the outside of the casing 12 becomes larger than the predetermined value and the displacement of the lid 22 in the opening direction becomes larger than a predetermined amount. Thus, excessive opening displacement of the lid 22 can be prevented by the stopper 25. Therefore, in the air compression device 1 of the embodiment, interference of the lid 22 with other parts in the casing 12 can be avoided when the auxiliary air inlet 20 is opened, and thereby it is possible to prevent the lid 22 or other components from being damaged.

[0052] Furthermore, the air compression 1 of this embodiment has the cover 26 that is attached to the casing 12 for covering the auxiliary air inlet 20 from outside the casing 12, and the opening 26a of the cover 26 opens vertically downward. Thus, it is possible to prevent dust, snow, etc. mixed in the outside air from directly entering through the auxiliary air inlet 20 when the auxiliary air inlet 20 is opened by the lid 22.

[0053] In the air compression device 1 of the embodiment, when the pressure difference between the inside and the outside of the casing 12 is less than the predetermined value, the cooling fan 11 in the casing 12 sends the outside air that has flowed into the casing 12 through the main air inlet filter 16 as cooling air to the compressor 10. When the airflow resistance of the main inlet filter 16 increases and the pressure difference between the inside and the outside of the casing 12 is equal to or greater than the predetermined value, the cooling fan 11 inside the casing 12 sends the outside air that has flowed into the casing 12 through the auxiliary air inlet 20 as cooling air to the compressor 10. Therefore, even when the airflow resistance of the main air inlet filter 16 increases due to clogging or the like, it is possible to send a sufficient amount of the outside air flowing through the auxiliary air inlet 20 to the compressor 10 by the cooling fan 11. In this way, in the air compression device 1 of the embodiment, even when the airflow resistance of the main air inlet filter 16 increases, the compressor 10 can be reliably cooled with the outside air, and thereby it is possible to prevent performance degradation of the compressor 10 caused by heat of the compressor 10.

[0054] The air compression device 1 of the embodiment is disposed under the body 100a of the railway vehicle 100. Therefore, running wind can be used to efficiently cool the casing 12 and the air introduced into the casing 12 while the railway vehicle 100 is running.

[0055] Furthermore, in the air compression device 1 of this embodiment, the suction side of the auxiliary air inlet 20 opens in the direction orthogonal to the traveling direction of the railway vehicle 100. Therefore, when the auxiliary air inlet 20 is opened while the railway vehicle 100 is running, the running wind can efficiently prevent dust, snow, and the like from entering the auxiliary air

inlet 20.

[0056] As as illustrated by the double-dashed chain lines in Figs. 6 and 7, the auxiliary filter 35 with a lower collection performance than that of the main air inlet filter 16 may be provided at the auxiliary air inlet 20 of the casing 12. In this case, entry of external dust into the casing 12 through the auxiliary air inlet 20 can be more reliably reduced when the auxiliary air inlet 20 is opened.

[0057] Furthermore, as shown in Figs. 6 and 7, the open alarm 31 may be provided to inform that the auxiliary air inlet 20 has been opened by the opening-closing mechanism 21. In this case, the driver or railway manager can be promptly informed that the main air inlet filter 16 needs to be inspected, replaced, or cleaned.

<Air Compression Device of Second Embodiment>

[0058] Figs. 8 and 9 are schematic sectional views of an air compression device 101 of the second embodiment. Fig. 8 illustrates an operating state of the air compression device 101 when the pressure difference between the inside and the outside of the casing 12 is less than a predetermined value. Fig. 9 illustrates an operating state of the air compression device 101 when the pressure difference between the inside and the outside of the casing 12 is equal to or grater than the predetermined value. The air compression device 101 of this embodiment has the same configuration as the air compression device 1 of the first embodiment, except for the configuration of an opening-closing mechanism 121 that opens and closes the auxiliary air inlet 20 of the casing 12. Accordingly, the configuration of the air compression device 101 will be described below, focusing on the opening-closing mechanism 121.

[0059] The opening-closing mechanism 121 includes the lid 22 that is movable between the opened position in which the auxiliary air inlet 20 is opened and the closed position in which the auxiliary air inlet 20 is closed, a pressure sensor 41 that detects the pressure inside the casing 12, and an electric motor 40 that moves the lid 22 to the opened position when the pressure sensor 41 obtains a detection value indicating that the pressure difference between the inside and the outside of the casing 12 has reached the predetermined value or higher. The lid 22 is pivotally supported by the casing 12 and is pivoted with a driving force of the motor 40. The motor 40 is controlled by a controller 42.

[0060] The pressure sensor 41 is able to detect an increase in the airflow resistance of the main air inlet filter 16. In other words, if the airflow resistance of the main inlet filter 16 increases due to clogging, etc., the pressure in the casing 12 gradually decreases as the airflow resistance increases. Therefore, the increase in the airflow resistance of the main air inlet filter 16 can be determined by checking whether the pressure inside the casing 12 is below a predetermined value.

[0061] The motor 40 serves an actuator that moves the lid 22 between the closed position and the opened position. In this embodiment, the motor 40 serves as the actuator. However the actuator is not particularly limited. For example, the actuator is not limited to the motor system, but may be a hydraulic actuator or a pneumatic actuator.

[0062] The open alarm 31 is connected to the controller 42. When the pressure sensor 41 detects that the pressure difference between the inside and the outside of the casing 12 has reached or exceeded the predetermined value and a signal indicating this is supplied to the controller 42, the controller 42 controls the motor 40 to move the lid 22 to the opened direction and activates the open alarm 31. This allows the driver or vehicle manager to be notified that the auxiliary air inlet 20 is opened.

<Operation of Air Compression Device>

[0063] While the pressure sensor 41 does not sense the increase of the pressure difference between the inside and the outside of the casing 12 (the pressure difference has not reached or does not exceed the predetermined value), the opening-closing mechanism 121 keeps the auxiliary air inlet 20 closed as shown in Fig. 8. When the compressor 10 and the cooling fan 11 operate in this closed state, the air (outside air) outside the casing 12 is introduced into the casing 12 through the main air inlet filter 16 under suction force by the compressor 10 and the cooling fan 11. The air introduced into the casing 12 is suctioned into the compressor body 10A through the air introducing portion 10B of the compressor 10, and is then pressurized in the compressor body 10A and discharged as compressed air. The compressed air discharged from the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

[0064] While the air compression device 101 is operating as described above, relatively large dust particles in the outside air are removed by the main air inlet filter 16. Dusts that pass through pores of the main air inlet filter 16 and enter into the casing 12 are removed by the introducing portion filter 17 disposed in the air introducing portion 10B of the compressor 10.

[0065] Further, some of the air introduced into the casing 12 through the main air inlet filter 16 is sent to the compressor 10 as cooling air by the cooling fan 11. In this way, the compressor 10 is cooled by the outside air that has a relatively low temperature. Consequently, temperature raise in the compressor 10 is prevented. Thus, the compression performance of the compressor 10 is well maintained and the compressed air tank 18 can be quickly filled with the compressed air.

[0066] While the pressure sensor 41 detects the increase of the pressure difference between the inside and the outside of the casing 12 (the pressure difference has reached or exceeds the predetermined value), the controller 42 causes the motor 40 in the opening-closing mechanism 121 to move the lid 22 to the opened position as shown in Fig. 9. As a result, the auxiliary air inlet 20

of the casing 12 is opened as the lid 22 opens, and the outside air is suctioned into the compressor body 10A from the air introducing portion 10B of the compressor 10 through the auxiliary air inlet 20. The compressed air generated in the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

[0067] Further, some of the air introduced into the casing 12 through the auxiliary air inlet 20 is sent to the compressor 10 as cooling air by the cooling fan 11. In this way, the compressor 10 is cooled by the outside air that has a relatively low temperature.

< Advantageous Effects of Second Embodiment >

[0068] In the air compression device 101 of this embodiment, when the airflow resistance of the main air inlet filter 16 increases and the pressure difference between the inside and the outside of the casing 12 reaches to or exceeds the predetermined value, the auxiliary air inlet 20 of the casing 12 is opened by the opening-closing mechanism 121. Thus, sufficient air can be introduced to the suction side of the compressor 10. Therefore, in the air compression device 101 of the second embodiment, even when the airflow resistance of the main air inlet filter 16 increases, it is possible to prevent the load increase of the compressor 10 caused by shortage of the intake air and the delay in filling the compressed air tank 18 with air.

[0069] In particular, in the air compression device 101 of the second embodiment, the sensor (pressure sensor 41) detects the increase of the pressure difference between the inside and the outside of the casing 12 (that the pressure difference has reached the predetermined value or higher). The lid 22 is configured to be opened by the actuator (motor 40) based on the detection result of the sensor (pressure sensor 41). Thus, in the air compression 101 of this embodiment, when the airflow resistance of the main inlet filter 16 increases, the actuator (motor 40) can quickly and reliably open the auxiliary air inlet 20.

[0070] Furthermore, the air compression device 101 of the second embodiment is equipped with the open alarm 31 that notifies that the auxiliary air inlet 20 has been opened by the opening-closing mechanism 121. Thus, the driver or railway manager can be promptly informed that the main air inlet filter 16 needs to be inspected, replaced, or cleaned.

<Air Compression Device of Third Embodiment>

[0071] Figs. 10 and 11 are schematic sectional views of an air compression device 201 of the third embodiment. Fig. 10 illustrates an operating state of the air compression device 201 when the pressure difference between the inside and the outside of the casing 12 is less than a predetermined value. Fig. 11 illustrates an operating state of the air compression device 201 when the pressure difference between the inside and the outside of the casing 12 is equal to or grater than a predetermined value. The air compression device 201 of this embodiment has the same configuration as the air compression device 101 of the second embodiment, except for the configuration of the opening-closing mechanism 121 that opens and closes the auxiliary air inlet 20 of the casing 12. Accordingly, the configuration of the air compression device 201 will be described below, focusing on different features from the opening-closing mechanism 101 of the second embodiment.

[0072] The opening-closing mechanism 121 includes the lid 22 that is movable between the opened position in which the auxiliary air inlet 20 is opened and the closed position in which the auxiliary air inlet 20 is closed, a temperature sensor 44 that senses the temperature of the compressor body 10A of the compressor 10, and the electric motor 40 that moves the lid 22 to the opened position when the temperature sensor 44 obtains a detection value indicating that the pressure difference between the inside and the outside of the casing 12 has reached the predetermined value or higher. It is preferable that the temperature sensor 44 be indirectly fixed to the compressor body 10A and be disposed in the vicinity of the compressor body 10A inside the casing 12. The motor 40 is controlled by the controller 42. When the temperature sensor 44 obtains a detection value indicating that the pressure difference between the inside and the outside of the casing 12 is greater than the predetermined value, the controller 42 controls the motor 40 to move the lid 22 to the opened position (to open the auxiliary air inlet 20).

[0073] The opening-closing mechanism 121 of the third embodiment differs from that of the second embodiment in that a temperature sensor 44 is employed as the sensor to determine that the pressure difference between the inside and the outside of the casing 12 have reached to or exceeds the predetermined value. When the airflow resistance of the main air inlet filter 16 increases, the amount of the outside air introduced into the casing 12 decreases, which increases the intake load of the compressor 10 increases. As a result, heat is generated in the compressor body 10A. In this embodiment, focusing on this fact, it is determined whether the pressure difference between the inside and the outside of the casing 12 is equal to or greater than the predetermined value (whether the airflow resistance of the main air inlet filter 16 has reached to or exceeds a predetermined value) based on the temperature of the compressor body 10A (the temperature detected by the temperature sensor 44).

[0074] In addition to the increase in the airflow resistance of the main air inlet filter 16, for example, an increase in the airflow resistance of the introducing portion filter 17 at the air introducing portion 10B of the compressor 10 may also be considered causing the compressor body 10A of the compressor 10 to heat up. For this reason, in the air compressor 201 of the third embodiment, when

the lid 22 is moved to the opened position by the motor 40 (when the auxiliary air inlet 20 is opened), the controller 42 determines whether the detection value of the temperature sensor 44 is below a predetermined value (a value indicating the increase in the airflow resistance of the main air inlet filter 16). When the detection value of the temperature sensor 44 has not decreased below the predetermined value (when the increase in the airflow resistance of the main inlet filter 16 is continuously detected by the detector), the controller 42 activates the introducing portion filter alarm 46 which informs degradation in the ventilation performance of the introducing portion filter 17.

[0075] In this embodiment, the temperature sensor 44 is used as the detector to determine whether the pressure difference between the inside and the outside of the casing 12 is equal to or greater than the predetermined value (whether the airflow resistance of the main air inlet filter 16 has reached to or exceeds the predetermined value), but the configuration is not limited to this. For example, instead of the temperature sensor 44, a flow rate sensor 48 that detects a discharge flow rate of the compressor 10 (illustrated by the double-dashed chain lines in Figs. 10 and 11) may be used. In other words, when the airflow resistance of the air inlet filter 16 increases, the discharge flow rate of the compressor 10 decreases as the air-intake resistance increases. Therefore, by detecting a change in the discharge flow rate by the flow rate sensor 48, it is also possible to determine whether the pressure difference between the inside and the outside of the casing 12 is equal to or greater than the predetermined value (whether the airflow resistance of the main air inlet filter 16 has increased to the predetermined value).

< Advantageous Effects of Third Embodiment >

[0076] As described above, since the air compression device 201 of the third embodiment is basically configured in the same manner as the air compression device 101 of the second embodiment, the third embodiment can basically produce substantially the same effects as the second embodiment.

[0077] Furthermore, in the air compression device 201 of the third embodiment, when the detector (temperature sensor 44 or flow rate sensor 48) continues to detect a value indicating an increase in the air flow resistance even after the motor 40 (actuator) moved the lid 22 to the opened position, the controller 42 activates the introducing portion filter alarm 46. Therefore, according to the air compression device 201 of the third embodiment, it is possible to notify a driver or vehicle manager that the ventilation performance of the introducing portion filter 17 has decreased without providing a separate dedicated detector for detecting the decrease in the ventilation performance of the introducing portion filter 17.

<Air Compression Device of Fourth Embodiment not covered by the claims>

[0078] Fig. 12 is a schematic sectional view of an air compression device 301 of the fourth embodiment. The air compression device 301 of the fourth embodiment includes the compressor body 10A that compresses and discharges the intake air, and an intake air introducing portion 310B of the compressor 10 for introducing the air into the compressor body 10A. The compressed air tank 18 is connected to the discharge side of the compressor body 10A through the discharge pipe 19. The air introducing portion 310B has a main air introducing port 50 and an auxiliary air introducing port 51. The introducing portion filter 17, which filters the air introduced into the main air introducing port 50, is disposed downstream of the main air introducing port 50. An opening-closing mechanism 321 is provided at the auxiliary air introducing port 51.

[0079] The opening-closing mechanism 321 is equipped with a lid 52 that is movable between an opened position in which the auxiliary air introducing port 51 is opened and a closed position in which the auxiliary air introducing port 51 is closed. The opening-closing mechanism 321 closes the auxiliary air introducing port 51 by the lid 52 when the pressure difference between the inside and the outside of the air introducing portion 310B is less than than a predetermined value. The opening-closing mechanism 321 opens the auxiliary air introducing port 51 by opening the lid 52 when the pressure difference between the inside and the outside of the air introducing portion 310B has reached to or exceeds the predetermined value. The opening-closing mechanism 321 for moving the lid 52 to the opened position and the closed position can be the same as the opening-closing mechanism 21, 121 of the first to third embodiments, for example.

<Operation of Air Compression Device>

[0080] When the pressure difference between the inside and the outside of the air introducing portion 310B is less than the predetermined value (when the airflow resistance of the introducing portion filter 17 is less than a predetermined value), the lid 52 of the opening-closing mechanism 321 closes the auxiliary air introducing port 51. When the compressor body 10A operates in this closed state, external air receives a suction force from the compressor body 10A, and the external air is introduced through the introducing portion filter 17 in the air introducing portion 310B. The air introduced into the air introducing portion 310B is pressurized in the compressor body 10A and discharged as the compressed air. The compressed air discharged from the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

[0081] Whereas when the pressure difference between the inside and the outside of the air introducing

portion 310B is equal to or greater than the predetermined value (when the airflow resistance of the introducing portion filter 17 have reached to or exceeds the predetermined value), the lid 52 of the opening-closing mechanism 321 opens the auxiliary air introducing port 51. When the compressor body 10A continuously operates in this opened state, the outside air is suctioned into the compressor body 10A through the auxiliary air introducing port 51. The compressed air generated in the compressor body 10A is provided into the compressed air tank 18 through the discharge pipe 19.

< Advantageous Effects of Fourth Embodiment >

[0082] In the air compression device 301 of the fourth embodiment, when the airflow resistance of the introducing portion filter 17 increases and the pressure difference between the inside and the outside of the air introducing portion 310 reaches to or exceeds the predetermined value, the auxiliary air introducing port 51 is opened by the opening-closing mechanism 321. Thus, sufficient air can be introduced to the suction side of the compressor body 10A. Therefore, in the air compression device 301 of the fourth embodiment, even when the airflow resistance of the introducing portion filter 17 increases, it is possible to prevent the load increase of the compressor 10 caused by shortage of the intake air and the delay in filling the compressed air tank 18 with air.

< Embodiment of Air Suction Device not covered by the claims>

[0083] The embodiments of the air compression device have been described, but by changing the compressor 10 in each embodiment to a suction unit, it is possible to obtain a suction device that is not used for supply the compressed air to a target. An embodiment of the suction device can be obtained by replacing the terms in each of the above embodiments of the air compression device with the following. The suction device of each embodiment thus obtained can have the same effect as each of the above embodiments of the air compression device.

< Air Suction Device corresponding to First to Third Embodiments > Compressor 10 -> Suction unit 10

[0084]

Main air inlet 15 -> Main suction port 15
Auxiliary air inlet 20 -> Auxiliary suction port 20
Main air inlet filter 16 -> Main suction port filter 16

< Air Suction Device corresponding to Fourth Embodiment > Compressor 10 -> Suction unit 10

[0085]

Compressor body 10A -> Suction unit body 10A
Air introducing portion 310B -> Suction introducing portion 310B
Main air introducing port 50 -> Main suction introducing port 50
Auxiliary air introducing port 51 -> auxiliary suction introducing port (51) 51

LIST OF REFERENCE NUMBERS

[0086] 1, 101, 201, 301...air compression device, 10...compressor, 10A...compressor body, 10B...air introducing portion, 11...cooling fan, 12 ...casing, 15...main air inlet, 16...main air inlet filter, 17...introducing portion filter, 20...auxiliary air inlet, 21...opening-closing mechanism, 22...lid, 23...spring (restraining portion), 25...stopper, 26...cover, 31...open alarm, 35...auxiliary filter, 40...motor (actuator), 41...pressure sensor (detector), 44...temperature sensor (detector), 46...introducing portion filter alarm, 48...flow rate sensor (detector), 50...main air introducing port, 51...auxiliary air introducing port, 100...railway vehicle, 100a...vehicle body, 310B...air introducing portion, 321...opening-closing mechanism

Claims

1. An air compression device (1, 101, 201, 301), comprising:

   a compressor (10) compressing air suctioned therein and discharging compressed air;
   a casing (12) housing the compressor (10) therein, the casing (12) having a main air inlet (15) and an auxiliary air inlet (20) for introducing air for the compressor (10);
   a main air inlet filter (16) filtering air introduced into the main air inlet; and
   an opening-closing mechanism (21) configured to open the auxiliary air inlet (20) to allow air outside the casing (12) to flow into the casing (12),
   the opening-closing mechanism (21) configured to close the auxiliary air inlet (20) when a pressure difference between inside and outside of the casing (12) has not reached to a predetermined value, and configured to open the auxiliary air inlet (20) when the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value.

2. The air compression device (1, 101, 201, 301) of claim 1, wherein the opening-closing mechanism (21) may include:

   a lid (22) movable between an opened position in which the auxiliary air inlet (20) is opened and a closed position in which the auxiliary air inlet

(20) is closed; and
a restraining portion (23) restraining the lid (22) in the closed position and releasing the restraint on the lid (22) when the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value.

3. The air compression device (1, 101, 201, 301) of claim 2, wherein the restraining portion (23) is a spring that biases the lid (22) toward the closed position.

4. The air compression device (1, 101, 201, 301) of claim 2 or 3, further comprising a stopper (25) preventing further opening of the lid (22) when the pressure difference between the inside and the outside of the casing (12) is larger than the predetermined value and displacement of the lid (22) in its opening direction becomes larger than a predetermined amount.

5. The air compression device (1, 101, 201, 301) of claim 1, wherein
the opening-closing mechanism (21) includes:

a lid (22) movable between an opened position in which the auxiliary air inlet (20) is opened and a closed position in which the auxiliary air inlet (20) is closed;
a detector detecting whether the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value based on at least one selected from the group consisting of a pressure inside the casing (12), a discharge flow rate of the compressor (10), and an amount of heat generated in the compressor (10); and
an actuator causing the lid (22) to move to the opened position when the detector detected that the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value.

6. The air compression device (1, 101, 201, 301) of claim 5, wherein the detector detecting whether the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value based on at least one selected from the group consisting of a discharge flow rate of the compressor (10) and an amount of heat generated in the compressor (10),
wherein the compressor (10) includes:

an air introducing portion (10B) for introducing air that has flowed into the casing (12); and
an introducing portion filter (17) for filtering air that is introduced through the air introducing portion (10B),
wherein the air compression device (1, 101, 201, 301) further includes an introducing portion filter alarm (46) that informs degradation of ventilation performance of the introducing portion filter (17) when the pressure difference between the inside and the outside of the casing (12) that is equal to or greater than the predetermined value is continuously detected after the actuator causes the lid (22) to be opened.

7. The air compression device (1, 101, 201, 301) of any one of claims 1 to 6, wherein a cover (26) is attached to the casing (12) for covering the auxiliary air inlet (20) from outside the casing (12), and the cover (26) opens vertically downward.

8. The air compression device (1, 101, 201, 301) of any one of claims 1 to 7, wherein an auxiliary filter (35) having a lower collection performance than that of the main air inlet filter (16) is provided at the auxiliary air inlet (20).

9. The air compression device (1, 101, 201, 301) of any one of claims 1 to 7, further comprising an open alarm (31) notifying that the auxiliary air inlet (20) has been opened by the opening-closing mechanism (21).

10. The air compression device (1, 101, 201, 301) of any one of claims 1 to 9, further comprising a cooling fan (11) is provided inside the casing (12),
wherein when the pressure difference between the inside and the outside of the casing (12) is less than the predetermined value, the cooling fan (11) sends outside air that has flowed into the casing (12) through the main air inlet filter (16) as cooling air to the compressor (10), and when the pressure difference between the inside and the outside of the casing (12) is equal to or greater than the predetermined value, the cooling fan (11) sends outside air that has flowed into the casing (12) through the auxiliary air inlet (20) as cooling air to the compressor (10).

11. The air compression device (1, 101, 201, 301) of any one of claims 1 to 10, wherein the casing (12) is configured to be disposed under a body of a railway vehicle.

12. The air compression device (1, 101, 201, 301) of claim 11, wherein a suction side of the auxiliary air inlet (20) is configured to open in a direction orthogonal to a traveling direction of the railway vehicle.

Patentansprüche

1. Luftkompressionsvorrichtung (1, 101, 201, 301), die umfasst:

einen Kompressor (10), der in ihn angesaugte Luft komprimiert und komprimierte Luft abgibt;
ein Gehäuse (12), in dem Kompressor (10) aufgenommen ist, wobei das Gehäuse (12) einen Haupt-Lufteinlass (15) und einen Neben-Lufteinlass (20) zum Einleiten von Luft für den Kompressor (10) aufweist;
einen Haupt-Lufteinlassfilter (16), der in den Haupt-Lufteinlass eingeleitete Luft filtert; sowie
einen Öffnungs-Schließ-Mechanismus (21), der so ausgeführt ist, dass er den Neben-Lufteinlass (20) öffnet, um zuzulassen, dass Luft von außerhalb des Gehäuses (12) in das Gehäuse (12),
wobei der Öffnungs-Schließ-Mechanismus (21) so ausgeführt ist, dass er den Neben-Lufteinlass (20) schließt, wenn eine Druckdifferenz zwischen Innenseite und Außenseite des Gehäuses (12) einen vorgegebenen Wert nicht erreicht hat, und so ausgeführt ist, dass er den Neben-Lufteinlass (20) öffnet, wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser.

2. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 1, wobei der Öffnungs-Schließ-Mechanismus (21) enthalten kann:

einen Deckel (22), der zwischen einer geöffneten Position, in der der Neben-Lufteinlass (20) geöffnet ist, und einer geschlossenen Position bewegt werden kann, in der der Neben-Lufteinlass (20) geschlossen ist; sowie
einen Rückhalteabschnitt (23), der den Deckel (22) in der geschlossenen Position zurückhält und das Zurückhalten des Deckels (22) löst, wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser.

3. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 2, wobei der Rückhalteabschnitt (23) eine Feder ist, die den Deckel (22) in Richtung der geschlossenen Position vorspannt.

4. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 2 oder 3, die des Weiteren einen Anschlag (25) umfasst, der weiteres Öffnen des Deckels (22) verhindert, wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) größer ist als der vorgegebene Wert und Verschiebung des Deckels (22) in seiner Öffnungsrichtung ein vorgegebenes Maß überschreitet.

5. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 1, wobei der Öffnungs-Schließ-Mechanismus (21) enthält:

einen Deckel (22), der zwischen einer geöffneten Position, in der der Neben-Lufteinlass (20) geöffnet ist, und einer geschlossenen Position bewegt werden kann, in der der Neben-Lufteinlass (20) geschlossen ist;
einen Detektor, der auf Basis wenigstens einer Größe, die aus der Gruppe ausgewählt wird, die aus einem Druck im Inneren des Gehäuses (12), einer Abgabe-Strömungsgeschwindigkeit des Kompressors (10) und einer in dem Kompressor (10) erzeugten Wärmemenge besteht, erfasst, ob die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser, sowie
ein Betätigungselement, das bewirkt, dass sich der Deckel (22) an die geöffnete Position bewegt, wenn der Detektor erfasst hat, dass die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser.

6. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 5, wobei der Detektor auf Basis wenigstens einer Größe, die aus der Gruppe ausgewählt wird, die aus einer Abgabe-Strömungsgeschwindigkeit des Kompressors (10) und einer in dem Kompressor (10) erzeugten Wärmemenge besteht, erfasst, ob die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser,
wobei der Kompressor (10) einschließt:

einen Luft-Einleitabschnitt (10B) zum Einleiten von Luft, die in das Gehäuse (12) eingeströmt ist; und
einen Einleitabschnitt-Filter (17) zum Filtern von Luft, die über den Luft-Einleitabschnitt (10B) eingeleitet wird,
wobei die Luftkompressionsvorrichtung (1, 101, 201, 301) des Weiteren eine Einleitabschnitt-Filter-Warneinrichtung (46) einschließt, die über Verringerung von Lüftungsleistung des Einleitabschnitt-Filters (17) informiert, wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12), die dem vorgegebenen Wert gleich oder größer ist als dieser, kontinuierlich erfasst wird, nachdem das Betätigungselement Öffnen des Deckels (22) bewirkt hat.

7. Luftkompressionsvorrichtung (1, 101, 201, 301) nach einem der Ansprüche 1 bis 6, wobei eine Abdeckung (26) an dem Gehäuse (12) zum Abdecken des Neben-Lufteinlasses (20) gegenüber der Au-

ßenseite des Gehäuses (12) angebracht ist, und sich die Abdeckung (26) vertikal nach unten öffnet.

8. Luftkompressionsvorrichtung (1, 101, 201, 301) nach einem der Ansprüche 1 bis 7, wobei ein Neben-Filter (35), der eine geringere Abscheideleistung hat als die des Haupt-Lufteinlassfilters (16) an dem Neben-Lufteinlass (20) vorhanden ist.

9. Luftkompressionsvorrichtung (1, 101, 201, 301) nach einem der Ansprüche 1 bis 7, die des Weiteren eine Öffnungs-Wameinrichtung (31) umfasst, die meldet, dass der Neben-Lufteinlass (20) durch den Öffnungs-Schließ-Mechanismus (21) geöffnet worden ist.

10. Luftkompressionsvorrichtung (1, 101, 201, 301) nach einem der Ansprüche 1 bis 9, die des Weiteren ein Kühlgebläse (11) umfasst, das im Inneren des Gehäuses (12) vorhanden ist,
wobei, wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) kleiner ist als der vorgegebene Wert, das Kühlgebläse (11) Außenluft, die über den Haupt-Lufteinlassfilter (16) in das Gehäuse (12) eingeströmt ist, als Kühlluft zu dem Kompressor (10) leitet, und wenn die Druckdifferenz zwischen der Innenseite und der Außenseite des Gehäuses (12) dem vorgegebenen Wert gleich oder größer ist als dieser, das Kühlgebläse (11) Außenluft, die über den Neben-Lufteinlass (20) in das Gehäuse (12) eingeströmt ist, als Kühlluft zu dem Kompressor (10) leitet.

11. Luftkompressionsvorrichtung (1, 101, 201, 301) nach einem der Ansprüche 1 bis 10, wobei das Gehäuse (12) so ausgeführt ist, dass es unter einem Wagenkasten eines Schienenfahrzeugs angeordnet ist.

12. Luftkompressionsvorrichtung (1, 101, 201, 301) nach Anspruch 11, wobei eine Ansaugseite des Neben-Lufteinlasses (20) so ausgeführt ist, dass sie sich in einer Richtung orthogonal zu einer Fahrtrichtung des Schienenfahrzeugs öffnet.

Revendications

1. Dispositif de compression d'air (1, 101, 201, 301), comprenant :

un compresseur (10) comprimant l'air qu'il aspire et refoulant de l'air comprimé ;
un boîtier (12) logeant le compresseur (10), le boîtier (12) comportant une entrée d'air principale (15) et une entrée d'air auxiliaire (20) pour introduire de l'air pour le compresseur (10) ;
un filtre d'entrée d'air principale (16) filtrant l'air introduit dans l'entrée d'air principale ; et
un mécanisme d'ouverture-fermeture (21) configuré pour ouvrir l'entrée d'air auxiliaire (20) afin de permettre l'entrée d'air extérieur au boîtier (12) dans le boîtier (12),
le mécanisme d'ouverture-fermeture (21) étant configuré pour fermer l'entrée d'air auxiliaire (20) quand une différence de pression entre l'intérieur et l'extérieur du boîtier (12) n'a pas atteint une valeur prédéterminée, et pour ouvrir l'entrée d'air auxiliaire (20) quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est supérieure ou égale à la valeur prédéterminée.

2. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 1, dans lequel le mécanisme d'ouverture-fermeture (21) peut comprendre :

un couvercle (22) mobile entre une position ouverte dans laquelle l'entrée d'air auxiliaire (20) est ouverte et une position fermée dans laquelle l'entrée d'air auxiliaire (20) est fermée ; et
une portion de retenue (23) retenant le couvercle (22) en position fermée et libérant la retenue sur le couvercle (22) quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est supérieure ou égale à la valeur prédéterminée.

3. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 2, dans lequel la portion de retenue (23) est un ressort qui contraint le couvercle (22) vers la position fermée.

4. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 2 ou 3, comprenant en outre une butée (25) empêchant toute ouverture ultérieure du couvercle (22) quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est supérieure à la valeur prédéterminée et le déplacement du couvercle (22) dans sa direction d'ouverture devient supérieur à une valeur prédéterminée.

5. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 1, dans lequel le mécanisme d'ouverture-fermeture (21) comprend :

un couvercle (22) mobile entre une position ouverte dans laquelle l'entrée d'air auxiliaire (20) est ouverte et une position fermée dans laquelle l'entrée d'air auxiliaire (20) est fermée ;
un détecteur détectant si la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est ou non supérieure ou égale à la valeur prédéterminée sur la base d'au moins une valeur sélectionnée dans le groupe constitué par une pression à l'intérieur du boîtier (12), un débit de

refoulement du compresseur (10) et une quantité de chaleur générée dans le compresseur (10) ; et

un actionneur provoquant le déplacement du couvercle (22) vers la position ouverte quand le détecteur détecte que la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est supérieure ou égale à la valeur prédéterminée.

6. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 5, dans lequel le détecteur détecte si la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est ou non supérieure ou égale à la valeur prédéterminée sur la base d'au moins un paramètre sélectionné dans le groupe constitué par un débit de refoulement du compresseur (10) et une quantité de chaleur générée dans le compresseur (10),
dans lequel le compresseur (10) comprend :

une portion d'introduction d'air (10B) pour introduire de l'air qui est entré dans le boîtier (12) ; et un filtre de portion d'introduction (17) pour filtrer l'air introduit à travers la portion d'introduction d'air (10B),
dans lequel le dispositif de compression d'air (1, 101, 201, 301) comprend en outre une alarme de filtre de portion d'introduction (46) qui informe de la dégradation des performances de ventilation du filtre de portion d'introduction (17) quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) qui est supérieure ou égale à la valeur prédéterminée est détectée en continu après que l'actionneur a provoqué l'ouverture du couvercle (22).

7. Dispositif de compression d'air (1, 101, 201, 301) selon l'une quelconque des revendications 1 à 6, dans lequel un couvercle (26) est attaché au boîtier (12) pour recouvrir l'entrée d'air auxiliaire (20) depuis l'extérieur du boîtier (12), et le couvercle (26) s'ouvre verticalement vers le bas.

8. Dispositif de compression d'air (1, 101, 201, 301) selon l'une quelconque des revendications 1 à 7, dans lequel un filtre auxiliaire (35) ayant une performance de collecte inférieure à celle du filtre d'entrée d'air principale (16) est pourvu sur l'entrée d'air auxiliaire (20) .

9. Dispositif de compression d'air (1, 101, 201, 301) selon l'une quelconque des revendications 1 à 7, comprenant en outre une alarme d'ouverture (31) notifiant que l'entrée d'air auxiliaire (20) a été ouverte par le mécanisme d'ouverture-fermeture (21).

10. Dispositif de compression d'air (1, 101, 201, 301) selon l'une quelconque des revendications 1 à 9, comprenant en outre un ventilateur de refroidissement (11) pourvu à l'intérieur du boîtier (12),
dans lequel, quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est inférieure à la valeur prédéterminée, le ventilateur de refroidissement (11) envoie l'air extérieur qui est entré dans le boîtier (12) à travers le filtre d'entrée d'air principale (16) comme air de refroidissement au compresseur (10), et quand la différence de pression entre l'intérieur et l'extérieur du boîtier (12) est supérieure ou égale à la valeur prédéterminée, le ventilateur de refroidissement (11) envoie l'air extérieur qui est entré dans le boîtier (12) à travers l'entrée d'air auxiliaire (20) comme air de refroidissement vers le compresseur (10) .

11. Dispositif de compression d'air (1, 101, 201, 301) selon l'une quelconque des revendications 1 à 10, dans lequel le boîtier (12) est configuré pour être disposé sous une caisse d'un véhicule ferroviaire.

12. Dispositif de compression d'air (1, 101, 201, 301) selon la revendication 11, dans lequel un côté aspiration de l'entrée d'air auxiliaire (20) est configuré pour s'ouvrir dans une direction orthogonale à une direction de circulation du véhicule ferroviaire.

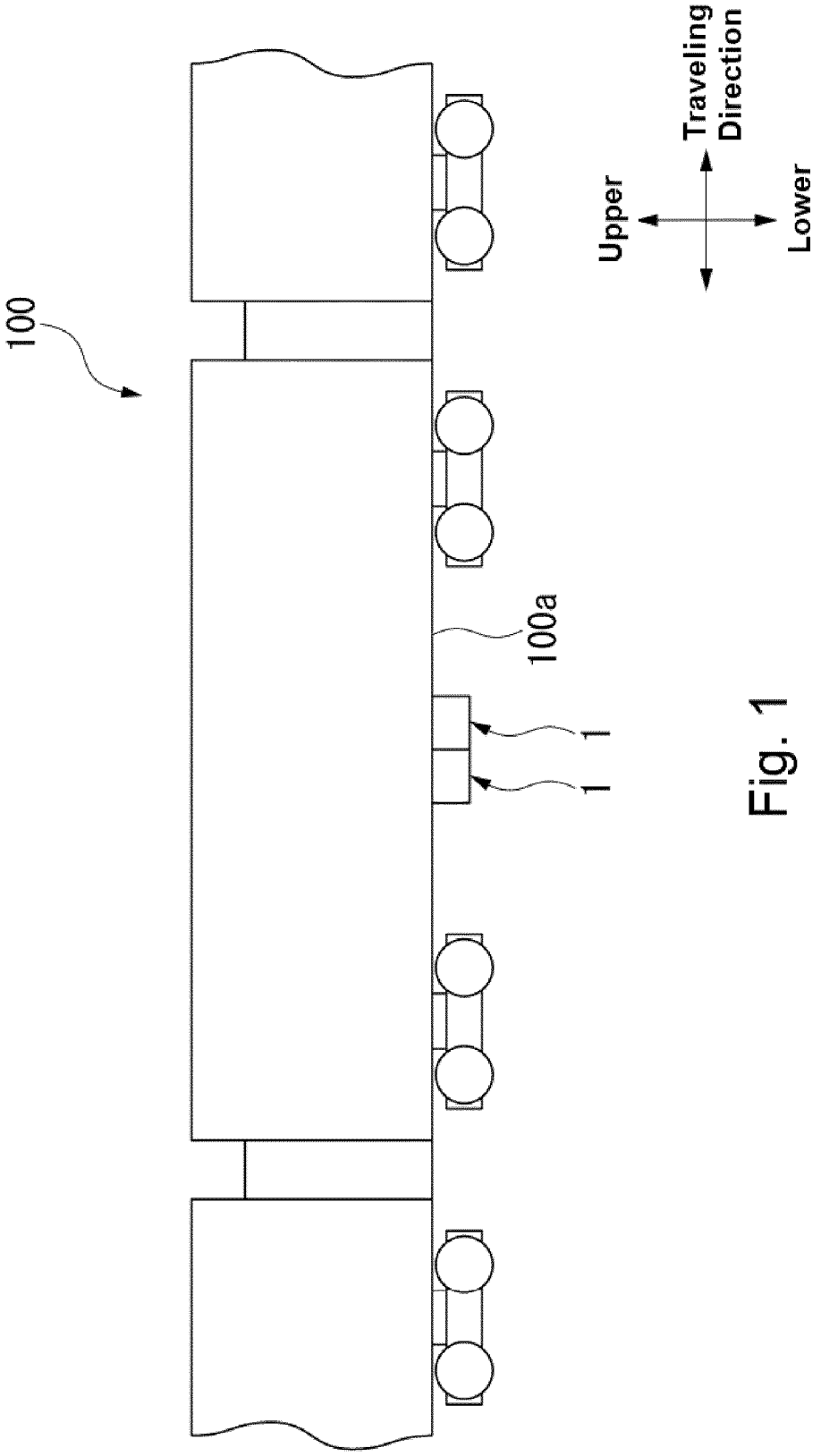

Fig. 1

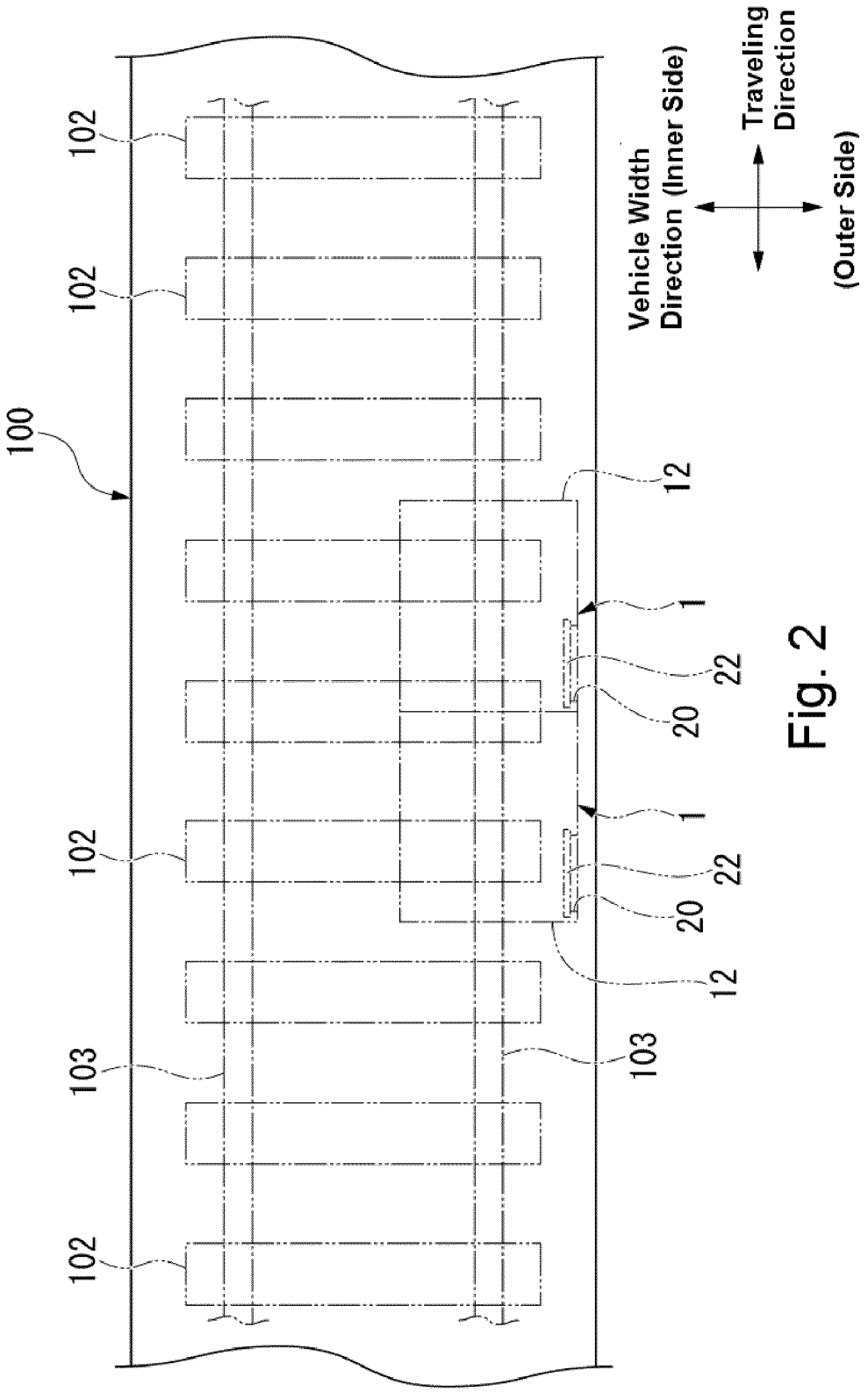
100
102
102
102
102
103
103
12
12
1
1
22
22
20
20
Vehicle Width Direction (Inner Side)
Traveling Direction
(Outer Side)

Fig. 2

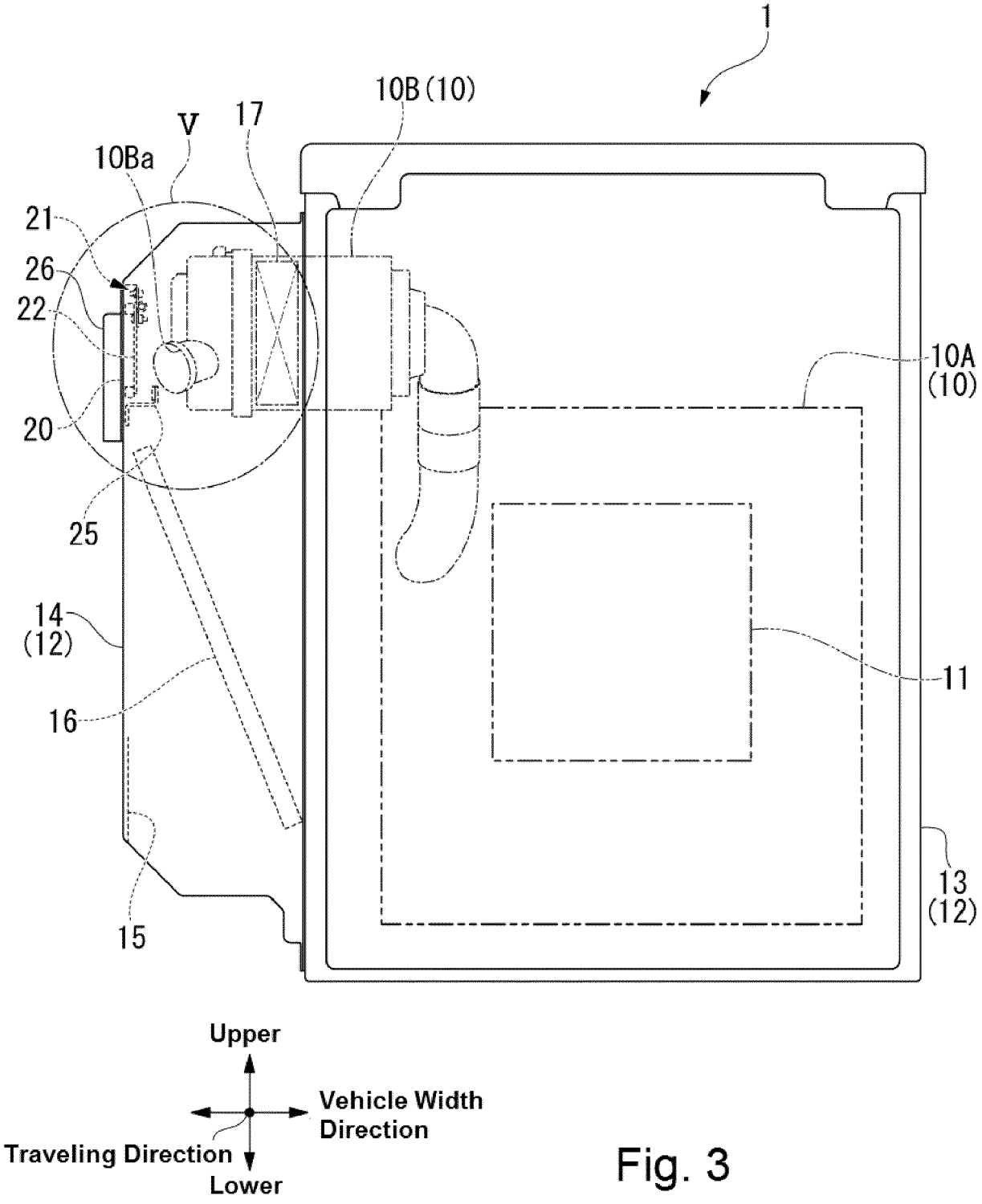
1
10B (10)
V
17
10Ba
21
26
22
20
25
10A
(10)
14
(12)
16
11
15
13
(12)
Upper
Vehicle Width
Direction
Traveling Direction
Lower

Fig. 3

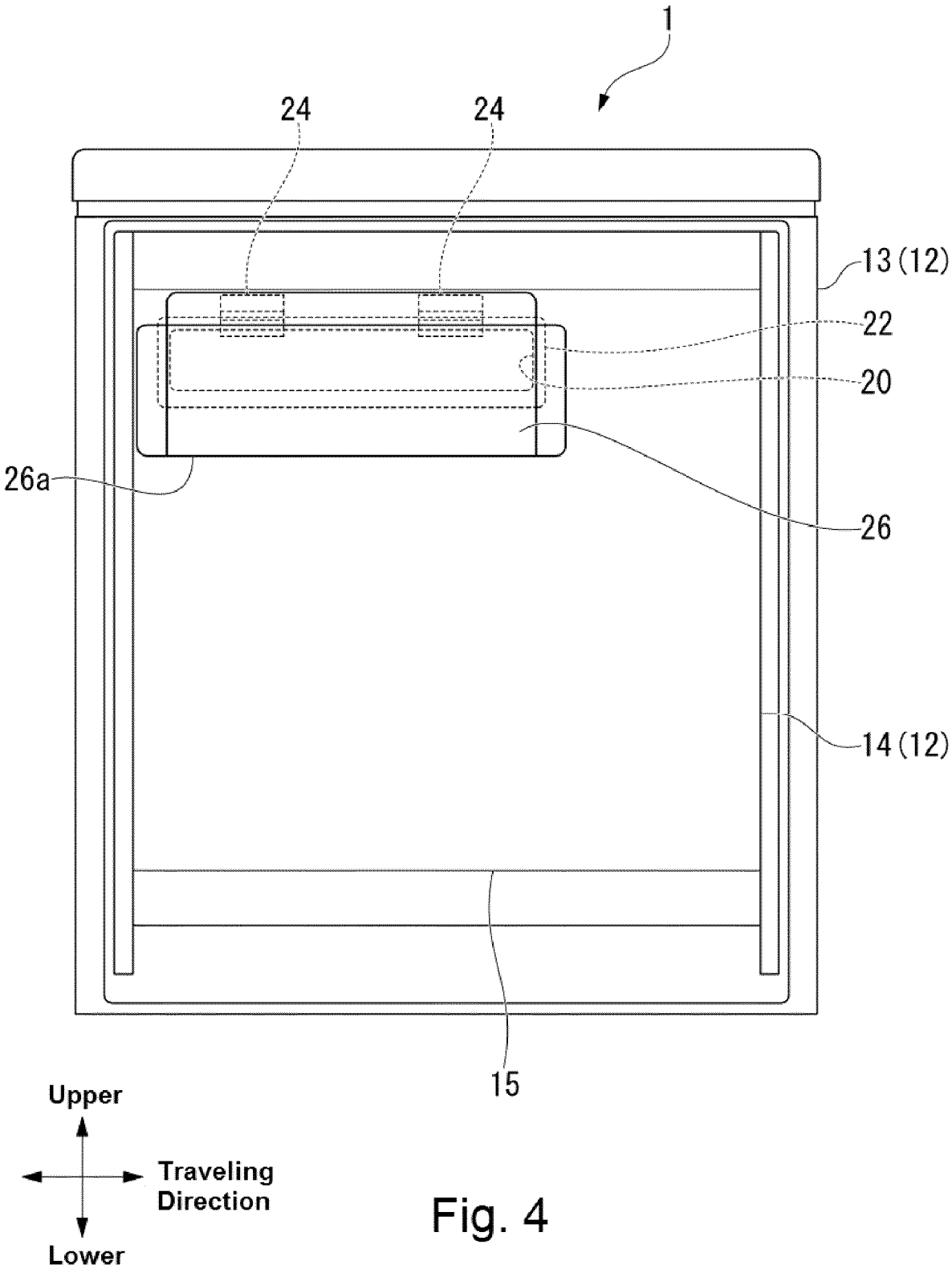
1
24
24
13 (12)
22
20
26a
26
14 (12)
15
Upper
Traveling Direction
Lower

Fig. 4

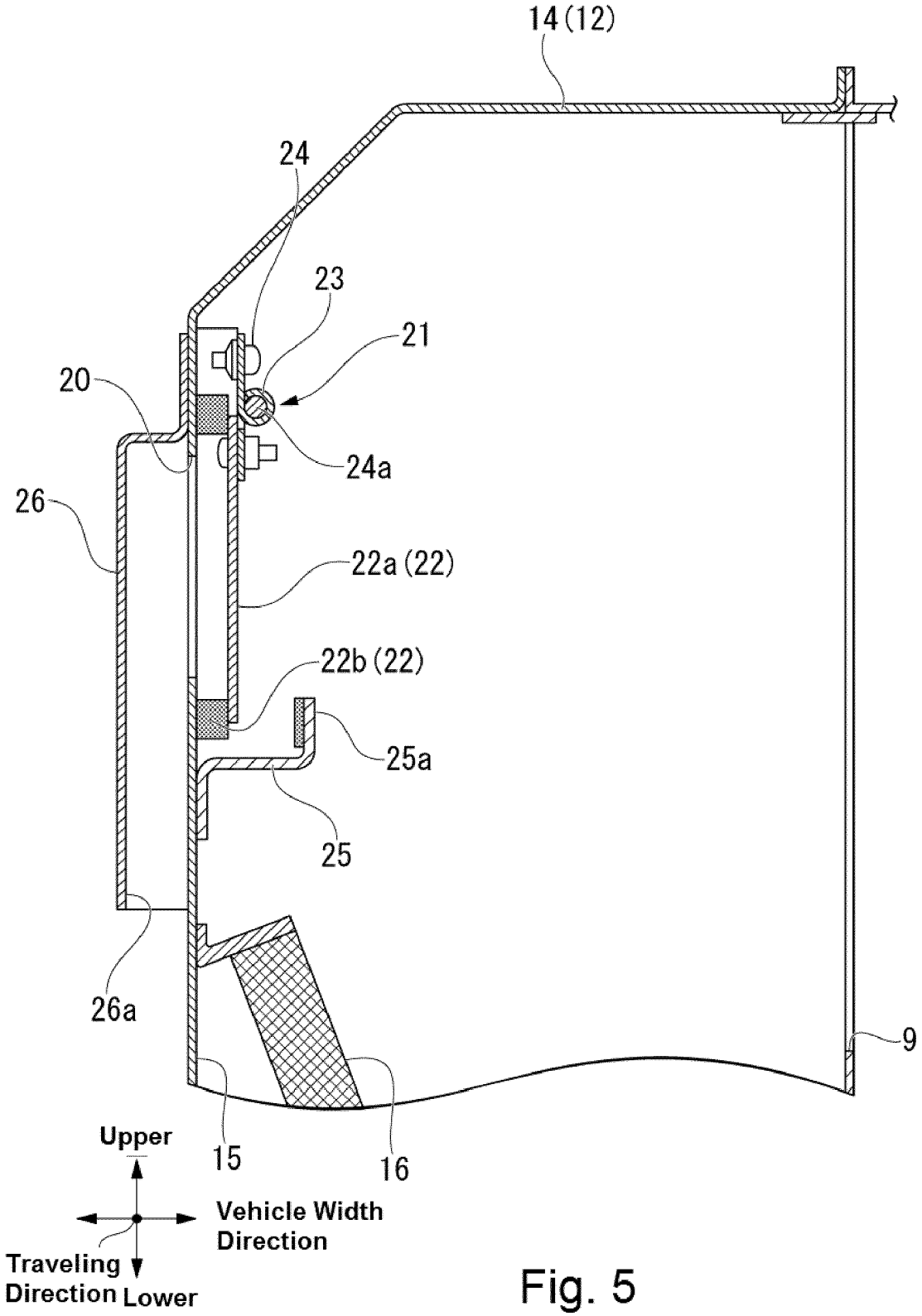
14 (12)
24
23
21
20
24a
26
22a (22)
22b (22)
25a
25
26a
9
15
16
Upper
Vehicle Width Direction
Traveling Direction
Lower

Fig. 5

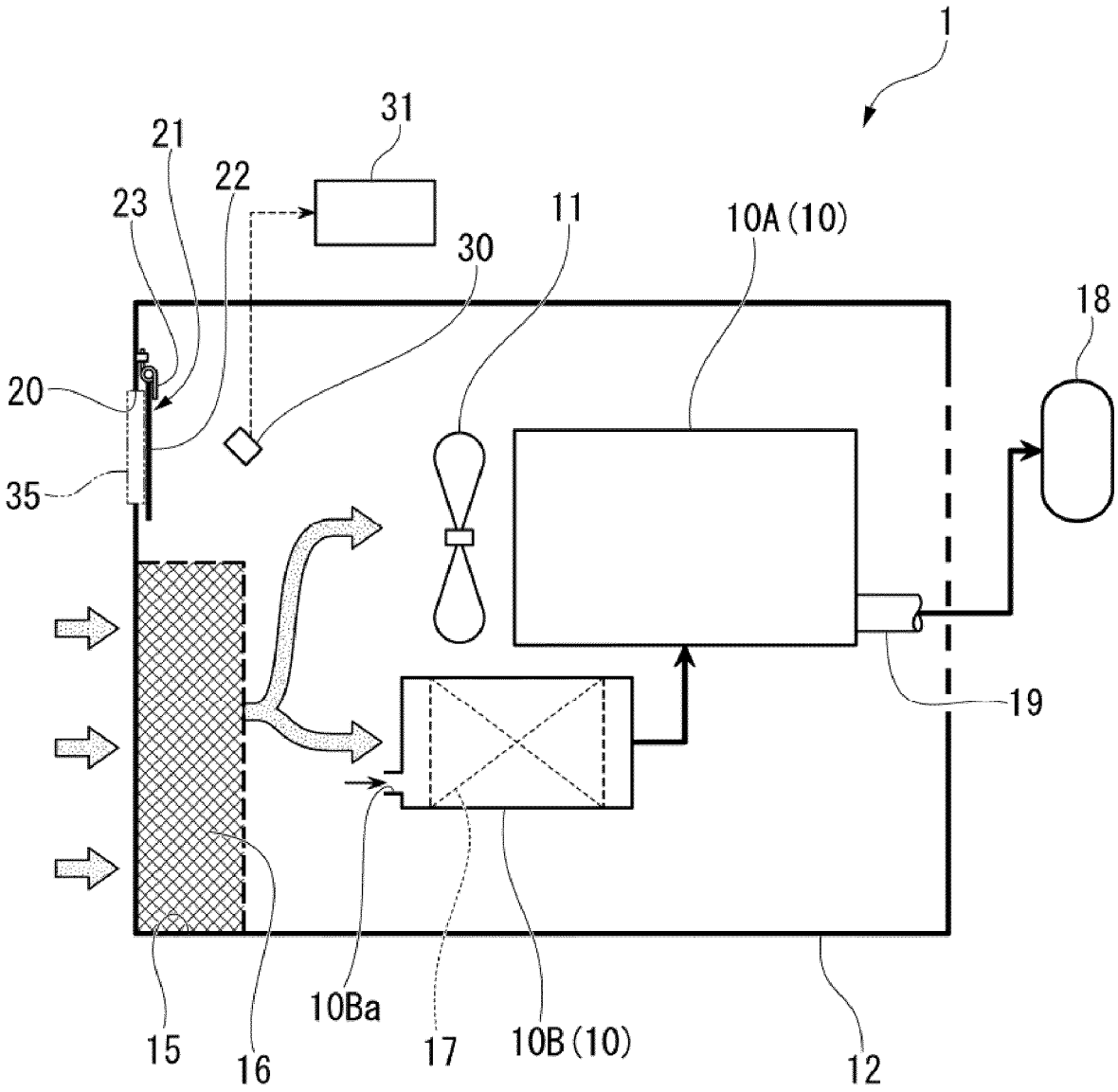

Fig. 6

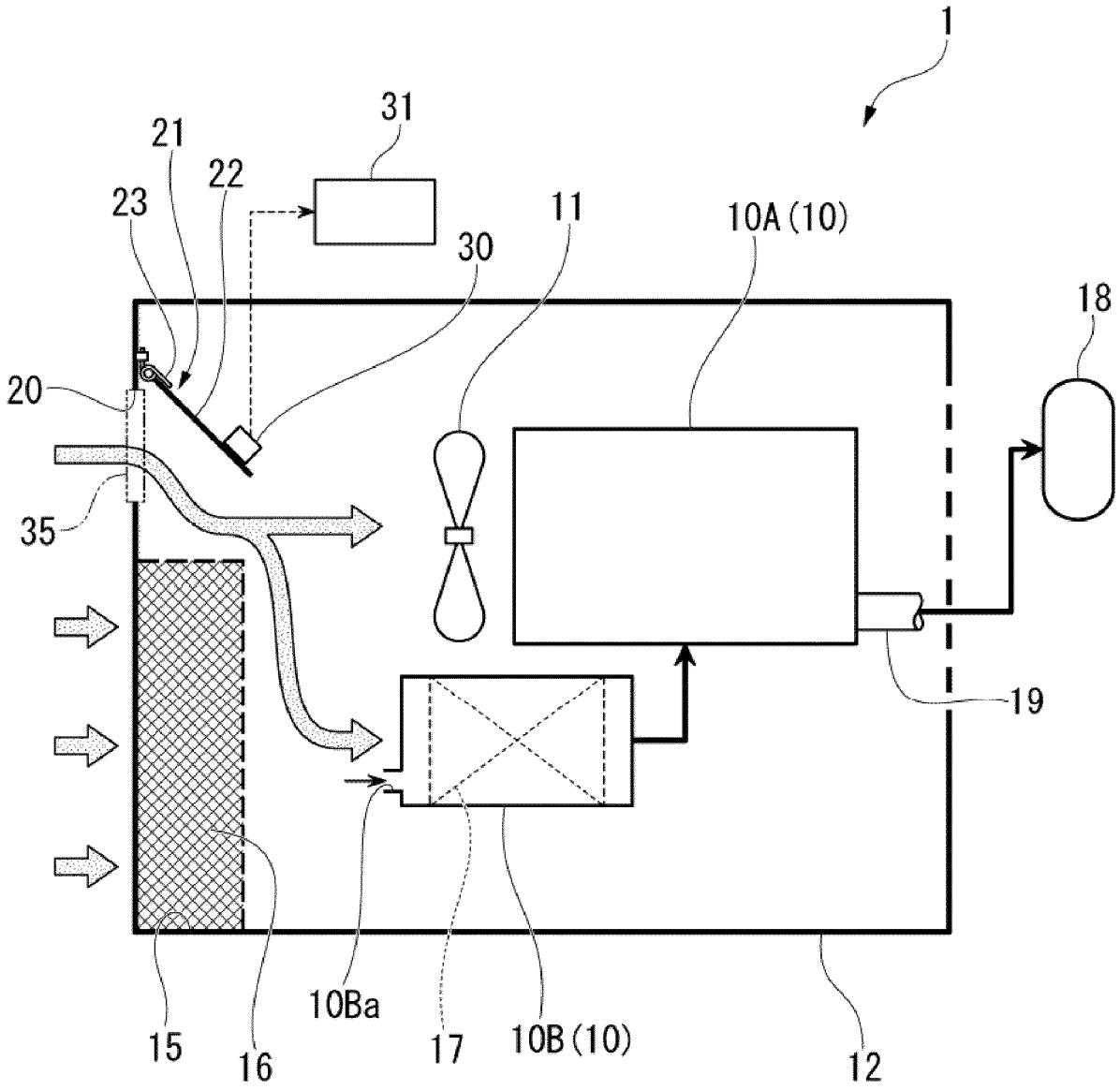

Fig. 7

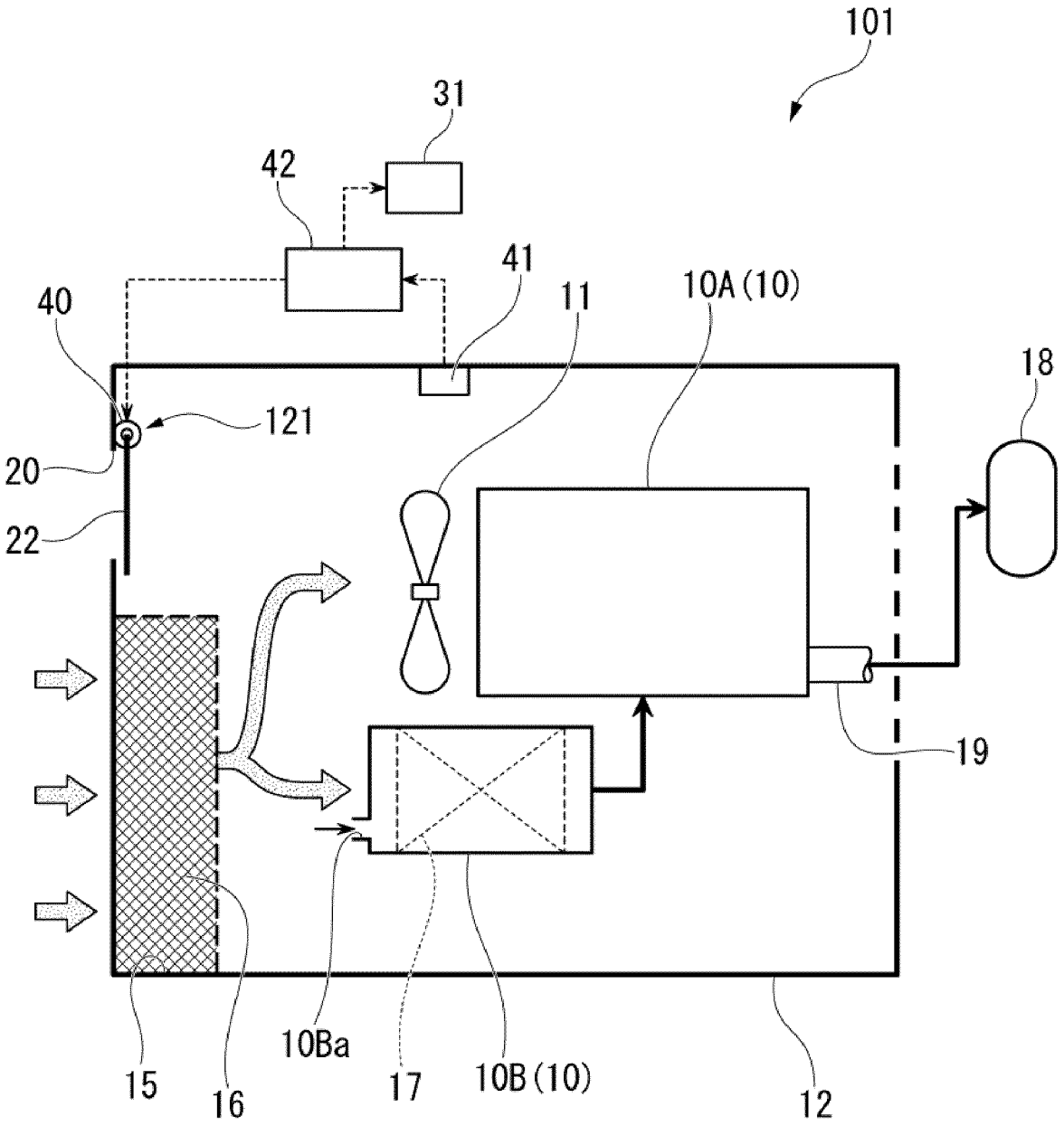

Fig. 8

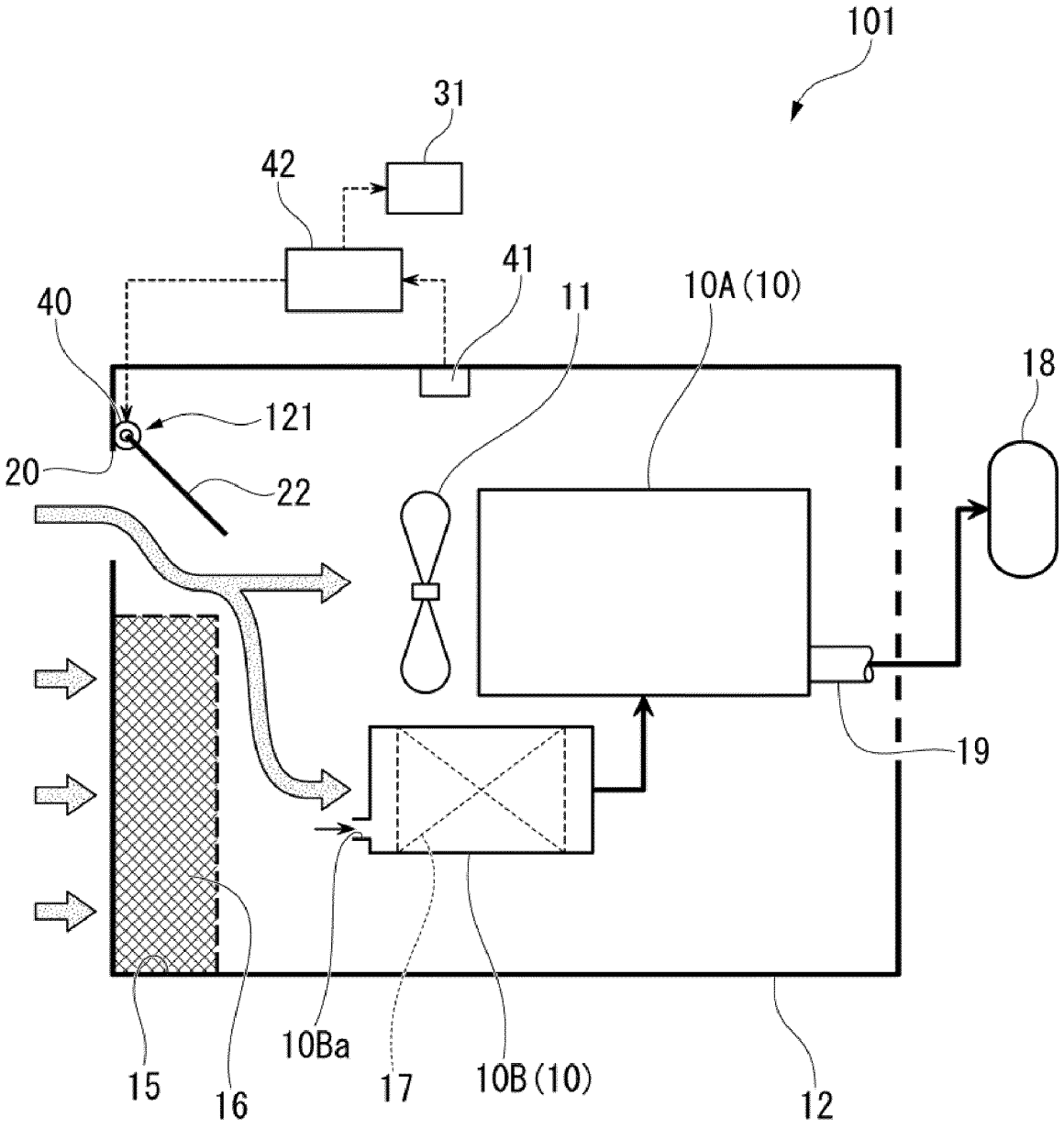

Fig. 9

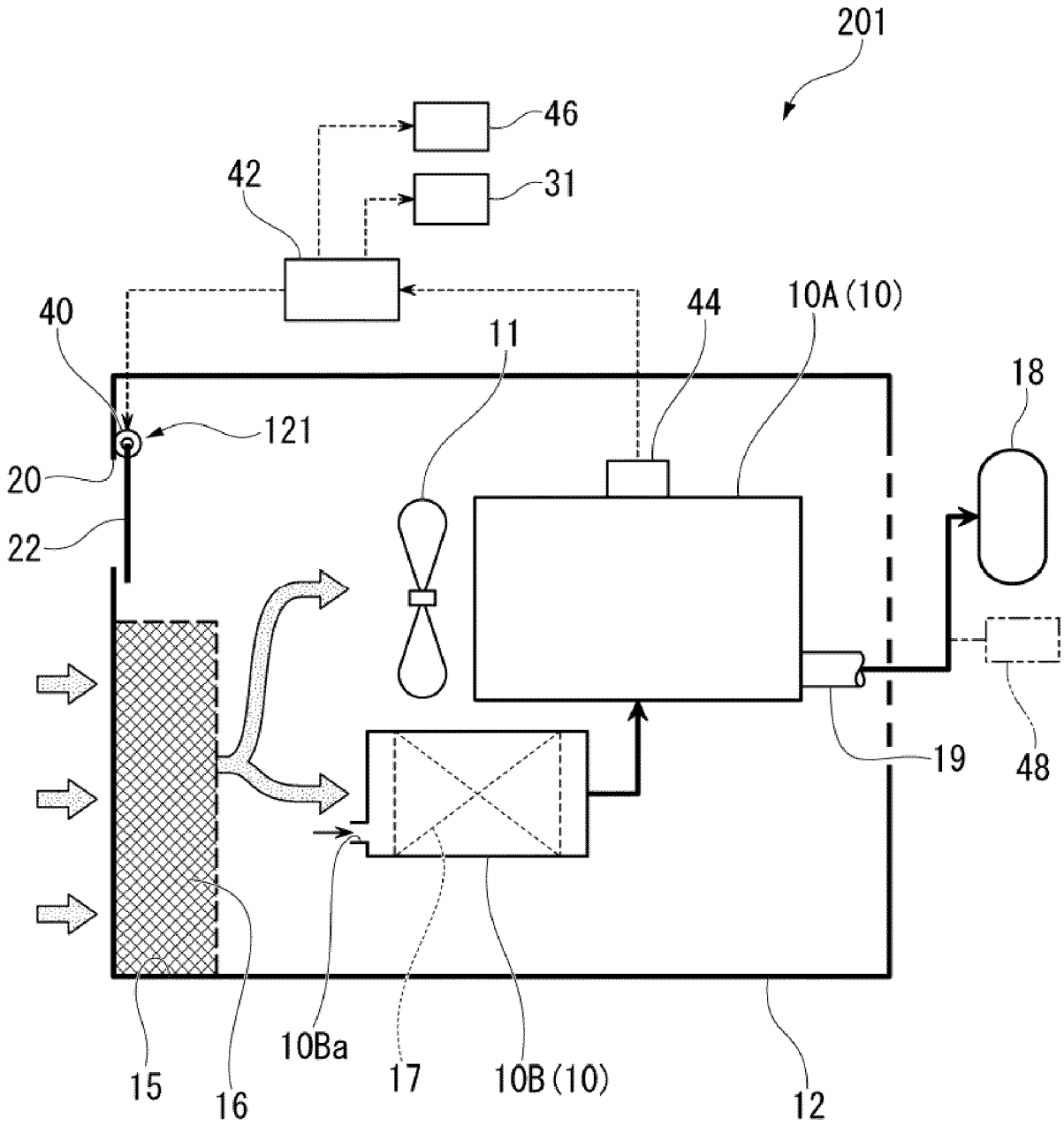
201
46
42
31
40
44
10A (10)
11
18
121
20
22
19
48
10Ba
15
16
17
10B (10)
12

Fig. 10

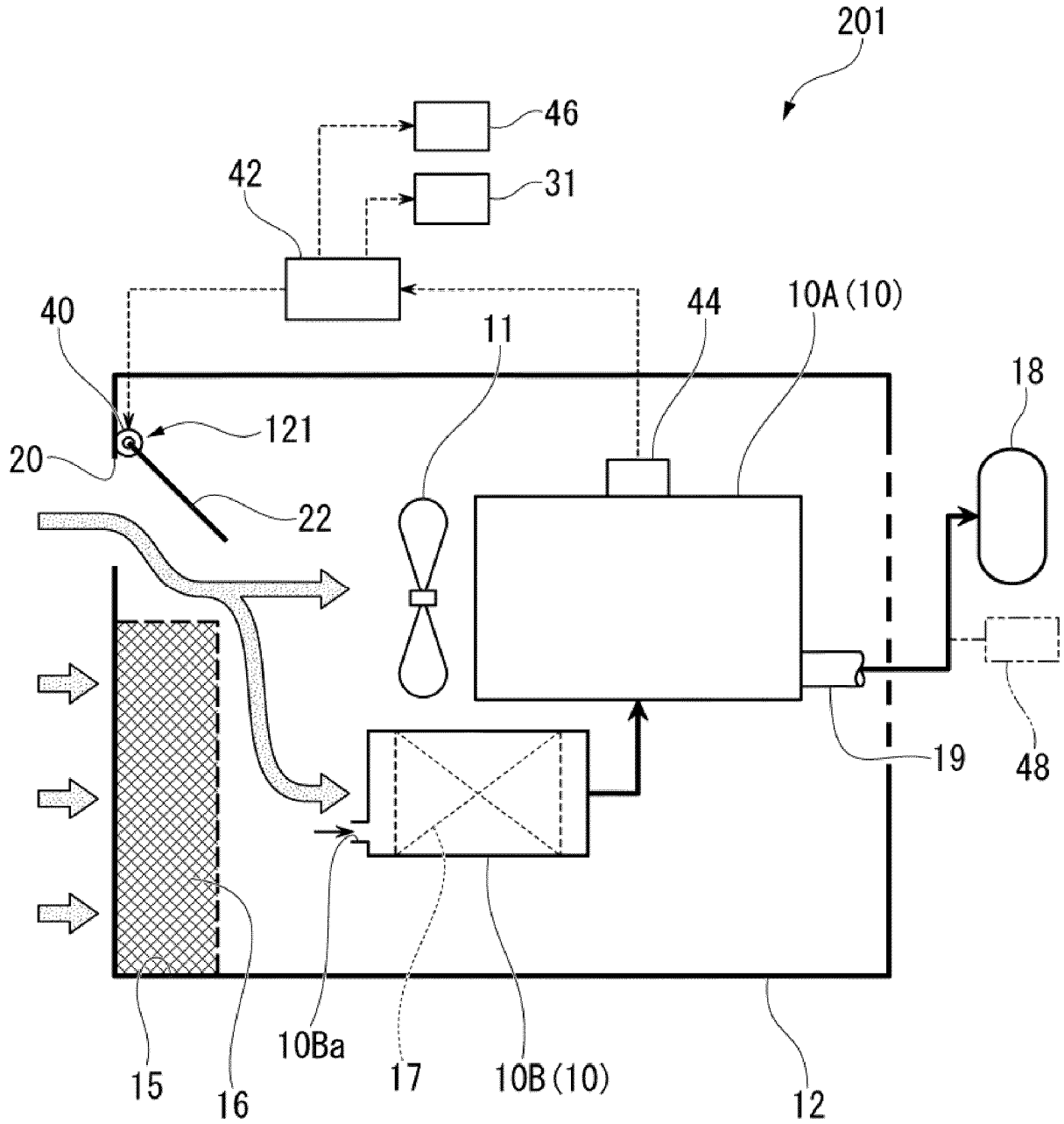
201
46
42
31
40
44
10A (10)
11
18
121
20
22
19
48
10Ba
15
16
17
10B (10)
12

Fig. 11

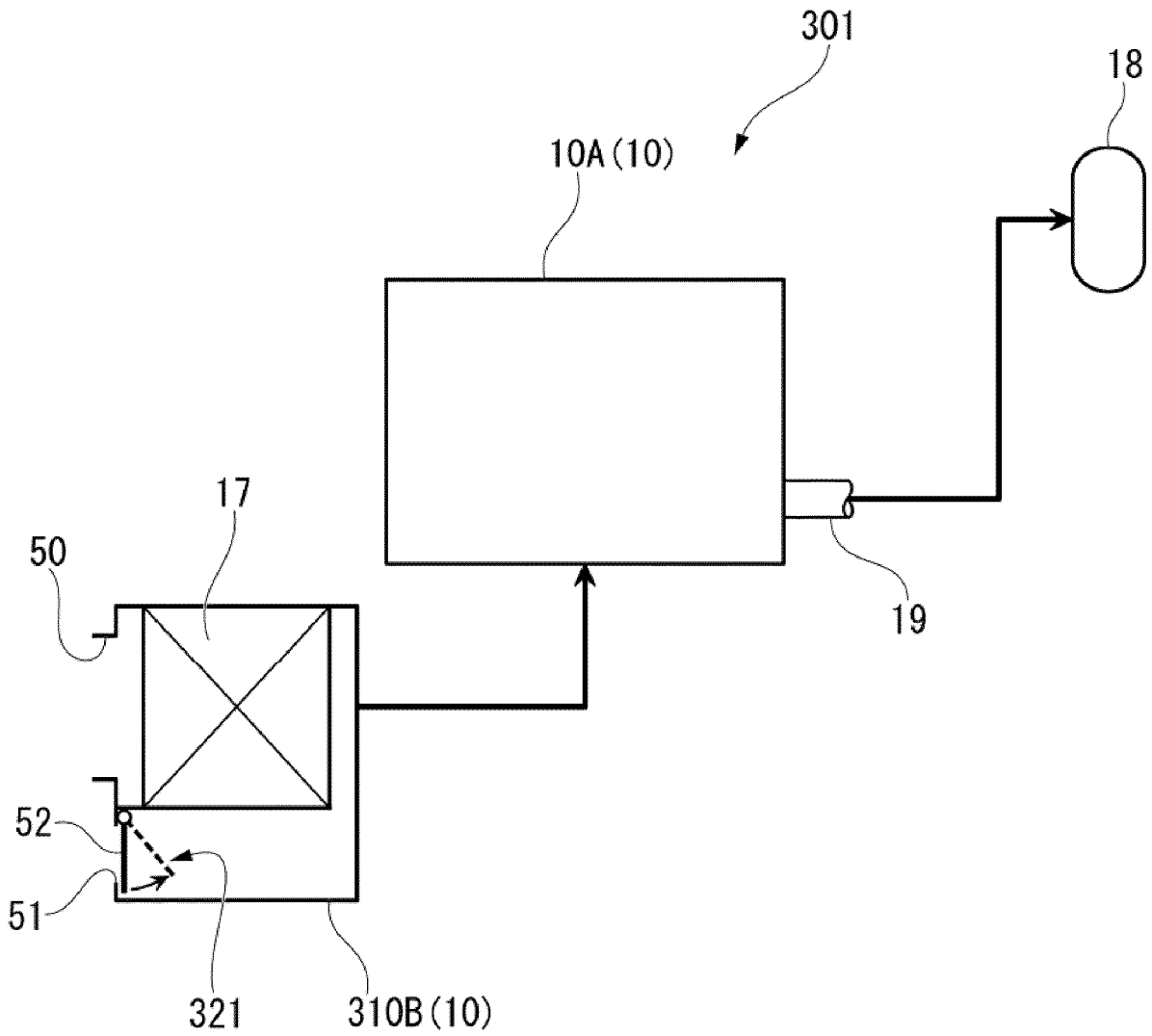

Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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- JP 2014152744 A **[0004]**