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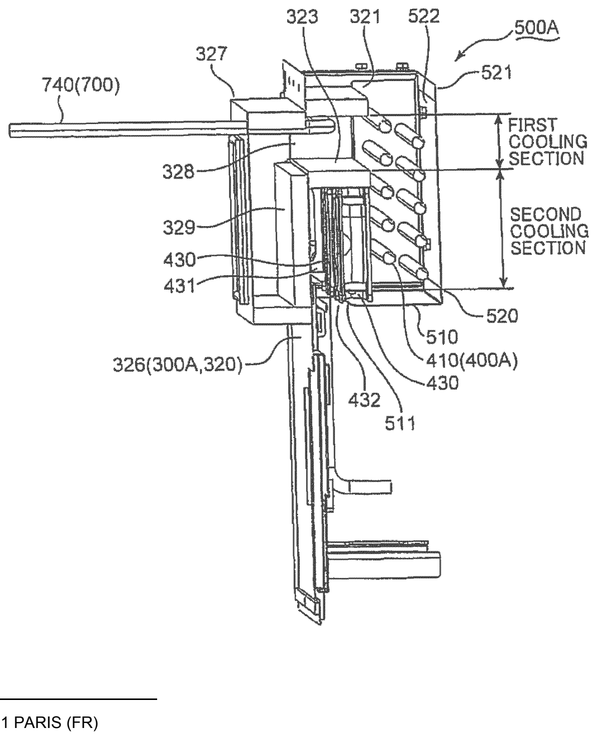
(54) AIR COMPRESSION DEVICE

(57) An air compression device comprising a compressor which generates compressed air, a housing which forms a housing space in which the compressor is housed, a cooling portion which is arranged at an outside of the housing and cools the compressed air, a protection cover which at least partially covers the cooling portion, an outer fan device which generates a cooling air flow toward the cooling portion by using air outside the housing, and an inner fan device which generates cooling air flow toward the compressor, wherein the housing includes an exhaust duct arranged above the outer fan device; the cooling portion includes a cooling pipe having a first cooling section facing the exhaust duct and a second cooling section facing the outer fan device; and the cooling air flow from the inner fan device is discharged to an outside from the housing through the exhaust duct

FIG. 4



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Description

Technical Field

[0001] The present invention relates to an air compression device which generates compressed air.

Background Art

[0002] An air compression device which generates compressed air is used for various uses. The compressed air generated by the air compression device mounted to a vehicle (for example, a railroad vehicle) may be supplied to a brake device which applies braking force to the vehicle or a pneumatic apparatus used for opening and closing a door of the vehicle.

[0003] Patent Literature ! proposes an air compression device mounted to a railroad vehicle. The air compression device includes a housing which houses various inner devices such as a compressor and an after cooler. The housing can appropriately protect the inner device from a flipped stone or the like when the vehicle is travelling. In addition, the housing has a soundproof function against sound generated by the inner device and a dustproof function for the inner device.

[0004] When the compressor compresses air, a large amount of heat is generated from the compressor and the compressed air. The housing has the protection function described above, while the heat is confined in the housing. Accordingly, a conventional air compression device cannot cool the compressed air efficiently.

Citation List

Patent Literature

[0005] Patent Literature I: JP 3150077 U

Summary of Invention

[0006] An object of the present invention is to provide an air compression device capable of cooling compressed air efficiently.

[0007] An air compression device according to one aspect of the present invention is provided with a compressor which generates compressed air, a housing which forms a housing space in which the compressor is housed, a cooling portion which is arranged at and cools the compressed air an outside of the housing, and a protection cover which at least partially covers the cooling portion.

[0008] The air compression device described above can cool the compressed air efficiently while protecting the cooling portion from a flipped stone or the like when a vehicle is travelling, by arranging the cooling portion covered by the protection cover at the outside of the housing, compared to a configuration in which the cooling portion is arranged in the housing space which is apt to be high in temperature.

[0009] The objects, features, and advantageous effects of the present invention will become more apparent from the following detailed description and the accompanying drawings.

Brief Description of Drawings

[0010]

FIG. 1 is a schematic view of an air compression device according to a first embodiment.

FIG. 2 is a schematic perspective view of an air compression device according to a second embodiment.

FIG. 3 is another schematic perspective view of the air compression device shown in FIG. 2.

FIG. 4 is a schematic cross-sectional view of a protection cover of the air compression device shown in FIG. 2.

FIG. 5 is a schematic perspective view of a controller of the air compression device shown in FIG. 3 (a third embodiment).

FIG. 6 is another schematic perspective view of the controller shown in FIG. 5.

FIG. 7 is a schematic view illustrating an inner structure of the controller shown in FIG. 6 (a fourth embodiment).

FIG. 8 is a schematic perspective view illustrating a frame structure of a housing of the air compression device shown in FIG. 2 (a fifth embodiment).

FIG. 9 is a schematic perspective view of the air compression device shown in FIG. 2.

FIG 10 is a schematic perspective view of the air compression device shown in FIG. 2 (a sixth embodiment).

FIG. 11A is a schematic perspective view of a cooling air flow adjusting box of the air compression device shown in FIG. 10.

FIG. 11B is a schematic back view of the cooling air flow adjusting box shown in FIG. 11A.

FIG. 12 is a schematic plane view illustrating an inner structure of the air compression device shown in FIG. 2 (a seventh embodiment).

FIG. 13 is a schematic cross-sectional view of a suction guide structure of the air compression device shown in FIG. 12.

FIG. 14 is a schematic enlarged cross-sectional view of the suction guide structure shown in FIG. 13.

FIG. 15 is a schematic enlarged perspective view of a part of a guide pipe of the air compression device shown in FIG. 12.

Description of Embodiments

First Embodiment

[0011] The present inventors found that cooling efficiency of compressed air is deteriorated when a compressor is continuously driven. In a first embodiment, a technique capable of keeping high compression efficiency in various driving environments will be described.

[0012] FIG. 1 is a schematic view of an air compression device 100 according to the first embodiment. The air compression device 100 will be described with reference to FIG. 1.

[0013] The air compression device 100 is provided with a compressor 200, a housing 300, a cooling portion 400, and a protection cover 500. The compressor 200 may be formed as a general scroll compressor. Alternatively, the compressor 200 may be formed as a general rotary compressor. Further alternatively, the compressor 200 may be formed as a general swing compressor. Further alternatively, the compressor 200 may be formed as a general reciprocating type compressor. The principle of the present embodiment is not limited to a specific structure of the compressor 200.

[0014] The housing 300 forms a housing space 310 in which the compressor 200 is housed. The compressor 200 compresses air and thereby generates compressed air, and therefore the compressor 200 becomes high in temperature. In addition, the compressed air discharged from the compressor 200 is also high in temperature. Accordingly, the housing space 310 including the compressor 200, covered by the housing 300 is apt to be higher in temperature than an outer environment of the housing 300. It is disadvantageous to arrange the cooling portion 400 in the housing space 310 for enhancing cooling efficiency of the cooling portion.

[0015] The cooling portion 400 which cools the compressed air is arranged at an outside of the housing 300. The cooling portion 400 may be held by the housing 300 directly. Alternatively, the cooling portion 400 may be held by other holding member. The principle of the present embodiment is not limited to a specific holding structure for the cooling portion 400.

[0016] The compressed air generated by the compressor 200 flows into the cooling portion 400. As described above, the outer environment outside of the housing 300 is lower in temperature than the housing space 310, and thereby the cooling portion 400 arranged at the outside of the housing 300 can cool the compressed air efficiently compared to a configuration in which the cooling portion is arranged in the housing space 310 of the housing 300.

[0017] The cooling portion 400 may be provided with a pipe which allows the compressed air to pass therethrough and is extended in a meandering manner. In order to cool the compressed air more efficiently, the pipe may be formed of a material having high heal conductivity to enhance a heat dissipation property. In addition, many heat dissipation fins may be mounted to the pipe. Alternatively, the cooling portion 400 may have other structure capable of cooling the compressed air. The principle of the present embodiment is not limited to a specific structure of the cooling portion 400.

[0018] The protection cover 500 is formed to cover at least partially the cooling portion 400. Accordingly, the cooling portion 400 is appropriately protected from a substance (for example, a stone) flipped toward the cooling portion 400. The protection cover 500 may be formed to hold the cooling portion 400. In addition, the protection cover 500 may have an air permeable structure which allows air flow to pass through. A designer which designs the air compression device 100 may adopt various structures in the protection cover 500. Accordingly, the principle of the present embodiment is not limited to a specific structure of the protection cover 500.

Second Embodiment

[0019] The designer can design various air compression devices based on the design principle described in connection with the first embodiment. In a second embodiment, an exemplary air compression device will be described.

[0020] FIG. 2 is a schematic perspective view of an air compression device 100A according to the second embodiment. The air compression device 100A will be described with reference to FIG. 1 and FIG. 2.

[0021] The air compression device 100A is provided with a housing 300A, a cooling portion 400A, a protection cover 500A, a dehumidifying portion 610, a controller 620, and a guide pipe 700. Similar to the first embodiment, a compressor (not shown) is arranged in the housing 300A. The guide pipe 700 is formed to guide compressed air generated by the compressor to the cooling portion 400A. The housing 300A corresponds to the housing 300 described with reference to FIG. 1.

[0022] The housing 300A includes a second wall portion 320 formed in a substantially rectangular shape. The protection cover 500A, the dehumidifying portion 610 and the controller 620 are mounted to an outer side of the second wall portion 320 (outside of the housing 300A). The cooling portion 400A is held by the protection cover 500A. The second wall portion 320 partitions an inner space of the housing 300A in which the compressor is arranged to separate a space in which the cooling portion 400A is arranged (namely, a space surrounded by the protection cover 500A), and thereby the cooling portion 400A hardly receives an influence of heat generation of the compressor. Accordingly, a cooling function of the cooling portion 400A is kept in a high level compared to a configuration in which the cooling portion is arranged at the inner space of the housing 300A. The second wall portion 320 may be formed stronger than the protection cover 500A because the second wall portion 320 is used for holding various devices.

[0023] The guide pipe 700 is connected to the compressor arranged in the housing 300A. The compressed air generated by the compressor is guided to the cooling portion 400A arranged at the outside of the housing 300A by the guide pipe 700.

[0024] The cooling portion 400A includes a cooling pipe 410 which distributes the compressed air, an upstream connection end 420 located at an upstream side of the cooling pipe 410 and a downstream connection end 440 located at a downstream side of the cooling pipe 410. The upstream connection end 420 is connected to the guide pipe 700 at the outside of the housing 300A. The compressed air guided by the guide pipe 700 flows into the cooling pipe 410 from the upstream connection end 420. The cooling pipe 410 forms a flow section for the compressed air elongated in a horizontal direction. The cooling pipe 410 is formed to guide the compressed air toward a lower side gradually in a meandering manner. The downstream connection end 440 arranged below the upstream connection end 420 is connected to a downstream end of the cooling pipe 410 and the dehumidifying portion 610. The compressed air is cooled while flowing along the cooling pipe 410. The compressed air sufficiently cooled flows into the dehumidifying portion 610 from the downstream connection end 440. The cooling portion 400A corresponds to the cooling portion 400 described with reference to FIG. 1.

[0025] The dehumidifying portion 610 is arranged below the cooling portion 400A. The dehumidifying portion 610 includes a connection pipe 611 extended from the cooling portion 400A, a dehumidifying mechanism 612 arranged at a downstream side of the connection pipe 611 and a delivery port 613 arranged at a further downstream side. The connection pipe 611 is connected to the downstream connection end 440 of the cooling portion 400A. The connection pipe 611 is formed to guide the cooled compressed air toward a lower side from the downstream connection end 440. The compressed air flows into the dehumidifying mechanism 612 through the connection pipe 611. The dehumidifying mechanism 612 is formed to dehumidify the compressed air. The dehumidifying mechanism 612 may have various structures (for example, a structure having a drying agent or a hollow fiber membrane) applied to a known dehumidifying portion which dehumidifies the compressed air. The principle of the present embodiment is not limited to a specific structure of the dehumidifying mechanism 612.

[0026] The compressed air is delivered to a pneumatic device at a downstream side through the delivery port 613 after the compressed air is dehumidified by the dehumidifying mechanism 612. The delivery port 613 may be connected to a storage tank designed to store the compressed air.

[0027] Similar to the dehumidifying portion 610, the controller 620 is arranged below the cooling pipe 410 extended in a meandering manner. The controller 620 is electrically connected to various devices arranged in the housing 300A. The controller 620 is formed to control the compressor or other device arranged in the housing 300A.

[0028] FIG. 3 is another schematic perspective view of the air compression device 100A. The air compression device 100A will be described with reference to FIG.2 and FIG. 3.

[0029] In order to facilitate understanding of the air compression device 100A, the cooling portion 400A and the protection cover 500A are removed from the air compression device 100A shown in FIG. 3 for the sake of convenience. As shown in FIG. 3, the air compression device 100A is further provided with four outer fan devices 430 arranged at the outside of the housing 300A. The four outer fan devices 430 are formed to generate a cooling air flow directed to the cooling pipe 410 of the cooling portion 400A. The compressed air in the cooling pipe 410 is cooled by the cooling air flow delivered from the four outer fan devices 430. The air compression device may be provided with one outer fan device 430. Alternatively, the air compression device may be provided with two or three outer fan devices 430. Further alternatively, the air compression device may be provided with more than four outer fan devices 430. The designer can determine the number of the outer fan devices 430 to be installed into the air compression device based on a length of the cooling pipe 410 in a lateral direction and a width of the outer fan device 430. Accordingly, the principle of the present embodiment is not limited to the number of the outer fan devices 430 mounted to the air compression device.

[0030] As shown in FIG. 3, the second wall portion 320 of the housing 300A includes an outer duct portion 321 elongated in a horizontal direction. As shown in FIG. 2, the outer duct portion 321 is surrounded by the protection cover 500A as a whole. The outer duct portion 321 forms a rectangular opening area elongated in the horizontal direction. The heat generated in the housing 300A (a cooling air flow after cooling the compressor by means of a function of a cooling mechanism arranged in the housing 300A) is discharged to the outside of the housing 300A through the outer duct portion 321.

[0031] As shown in FIG. 3, the outer duct portion 321 includes an upper wall 322, a lower wall 323, a support wall 324 and a side wall 325. The upper wall 322 is extended in the horizontal direction. The lower wall 323 is extended in the horizontal direction below the upper wall 322. The guide pipe 700 which guides the compressed air to the cooling portion 400A is extended from the housing 300A between the upper wall 322 and the lower wall 323 so as to pass through the outer duct portion 321. The guide pipe 700 extended from the housing 300A is bent toward the support wall 324 to penetrate the support wall 324. The support wall 324 is formed to support the guide pipe 700. As shown in FIG. 2, the guide pipe 700 is connected to the upstream connection end 420 of the cooling portion 400A at a position near the support wall 324 after penetrating the support wall 324. The side wall 325 of the outer duct portion 321 is arranged at a side opposite to the support wall 324.

[0032] The four outer fan devices 430 which generate the cooling air directed to the cooling portion 400A are arranged below the outer duct portion 321 so as to be aligned in the horizontal direction along the lower wall 323 of the outer duct portion 321. The four outer fan devices 430 are arranged between the lower wall 323 and a group of the dehumidifying portion 610 and the controller 620.

[0033] FIG 4 is a schematic cross-sectional view of the protection cover 500A. The protection cover 500A will be described with reference to FIG. 2 through FIG. 4.

[0034] As shown in FIG. 4, the protection cover 500A includes a baffle plate 510 and a ventilation plate 520. The baffle plate 510 is arranged below the cooling pipe 410 so as to be laid substantially horizontally. The ventilation plate 520 is arranged substantially vertically from the baffle plate 510 so as to face the outer fan device 430.

[0035] The second wall portion 320 of the housing 300A includes a mount plate 326 to which the protection cover 500A and the outer fan device 430 are mounted. A substantially rectangular opening area 328 elongated in the horizontal direction is formed in the mount plate 326. The outer duct portion 321 is arranged to surround the opening area 328 formed in the mount plate 326 (see FIG. 3). The outer fan device 430 is arranged between the mount plate 326 and the cooling pipe 410. Relating to a height position of the outer fan device 430, the outer fan device 430 is arranged between the lower wall 323 of the outer duct portion 321 and the baffle plate 510 of the protection cover 500A. The outer fan device 430 is formed to deliver the cooling air toward the ventilation plate 520. As a result, the compressed air in the cooling pipe 410 located between the outer fan device 430 and the ventilation plate 520 is appropriately cooled.

[0036] A part of the cooling air delivered from the outer fan device 430 is collided with the cooling pipe 410 and the ventilation plate 520 and then the part of the cooling air flows downward. However, since a flow of the cooling air flowing downward is interrupted by the baffle plate 510 of the protection cover 500A, the dehumidifying portion 610 and the controller 620 can be driven appropriately without receiving an influence of the cooling air from the outer fan device 430.

[0037] The ventilation plate 520 includes a rectangular frame plate 521 and an expanded metal 522. The expanded metal 522 is surrounded by the rectangular frame plate 521. Since many ventilation holes are formed in the expanded metal 522, most of the cooling air generated by the outer fan device 430 is discharged to the outside of the protection cover 500A through the expanded metal 522. Accordingly, the compressed air in the cooling pipe 410 is cooled efficiently. A punching metal or other plate member having a ventilation structure may be used instead of the expanded metal 522. The principle of the present embodiment is not limited to a specific ventilation structure of the protection cover 500A.

[0038] The outer fan device 430 is separated from the mount plate 326 of the housing 300A in the horizontal direction. Accordingly, a suction space 431 (see FIG. 4) is formed between the outer fan device 430 and the mount plate 326. The outer fan device 430 is formed to suck air from the suction space 431 to deliver the cooling air toward the cooling pipe 410 and the ventilation plate 520.

[0039] The lower wall 323 of the outer duct portion 321 forms an upper side boundary of the suction space 431. As described above, the inner space of the outer duct portion 321 is used for discharging the air heated in the housing 300A. Since the lower wall 323 partitions the inner space of the outer duct portion 321 to define the suction space 431, the outer fan device 430 does not suck the air heated in the housing 300A. The outer duct portion 321 may be formed of a material having a heat isolation property more superior than that of the material of the mount plate 326 of the housing 300A.

[0040] The baffle plate 510 of the protection cover 500A includes a facing edge 511 facing the mount plate 326 of the housing 300A. The facing edge 511 is separated from the mount plate 326 of the housing 300A. Accordingly, the facing edge 511 forms an opening area 432 (see FIG. 4) continued to the suction space 431 below the outer fan device 430, in cooperation with the mount plate 326 of the housing 300A. Accordingly, the outer fan device 430 sucks outer air of the space below the cooling portion 400A through the opening area 432 and the suction space 431 to deliver the cooling air toward the cooling pipe 410 and the ventilation plate 520.

Third Embodiment

[0041] The outer fan device described in connection with the second embodiment can also contribute to cooling of a controller. In a third embodiment, a cooling technique of a controller will be described.

[0042] FIG. 5 is a schematic perspective view of a controller 620. The controller 620 will be described with reference to FIG. 3 and FIG. 5.

[0043] As shown in FIG. 5, the controller 620 is provided with a control box 621 formed in a rectangular box shape and various electronic devices 622. The electronic devices 622 are housed in the control box 621. At least one of the electronic devices 622 is used for controlling a compressor (not shown) arranged in a housing 300A.

[0044] As shown in FIG. 5, the control box 621 includes a top plate 623, an input connector wall 624 and an output connector wall 625. As shown in FIG. 3, the top plate 623 is located below an outer fan device 430. The input connector wall 624 includes a vertical plate 626 and two input connectors 627. The vertical plate 626 is arranged substantially vertically. The input connector 627 is protruded toward an outer side from the vertical plate 626. Electric power may be supplied to the electronic devices 622 through the input connector 627. The electronic devices 622 may be formed to generate various signals for controlling and driving the compressor while receiving the electric power through the input connector 627.

[0045] The output connector wall 625 includes a mount plate 628 and five output connectors 629. The mount plate 628 includes an upper edge which forms a corner portion in cooperation with the top plate 623, the corner portion being extended in the horizontal direction, and a side edge which forms a corner portion in cooperation with the vertical plate 626 of the input connector wall 624, the corner portion being extended in the vertical direction.

The mount plate 628 is mounted to the housing 300A. The output connector 629 is protruded from the mount plate 628. The output connector 629 is used for electrical connection with various devices arranged in the housing 300A. Some of the five output connectors 629 may be used for outputting a control signal to a driving source (not shown) which drives the compressor. Other(s) of the five output connectors 629 may be used for transmitting a detection signal from a detection element which detects a driving state of the compressor, to the electronic device 622.

[0046] As shown in FIG. 5, the top plate 623 of the control box 621 includes a first opening edge 631, a second opening edge 632, a third opening edge 633 and a fourth opening edge 634. The first opening edge 631, the second opening edge 632, the third opening edge 633 and the fourth opening edge 634 form a rectangular opening 630. The first opening edge 631 and the sccond opening edge 632 are substantially parallel to the mount plate 628 of the output connector wall 625. The first opening edge 631 is located between the second opening edge 632 and the mount plate 628 of the output connector wall 625. The third opening edge 633 and the fourth opening edge 634 are substantially parallel to the vertical plate 626 of the input connector wall 624. The third opening edge 633 is located between the fourth opening edge 634 and the vertical plate 626 of the input connector wall 624.

[0047] The control box 621 includes a first rib 641, a second rib 642, a third rib 643 and a fourth rib 644. Each of the first rib 641, the second rib 642, the third rib 643, and the fourth rib 644 is protruded upward from the top plate 623.

[0048] The first rib 641 is formed in a substantially C-shape. The first rib 641 includes an intermediate portion 645, a first bent portion 646 and a second bent portion 647. The intermediate portion 645 is extended along the first opening edge 631. Each of the first bent portion 646 and the second bent portion 647 is bent from the intermediate portion 645 so as to be extended toward the second opening edge 632 from the first opening edge 631. The first bent portion 646 is located closer to the third rib 643 than the fourth rib 644. The second bent portion 647 is located closer to the fourth rib 644 than the third rib 643.

[0049] The second rib 642 is different from the first rib 641 and is extended substantially linearly along the second opening edge 632.

[0050] The third rib 643 is formed in a substantially J-shape. The third rib 643 includes a first portion 651, a second portion 652 and a third portion 653. The first portion 651 is extended along the third opening edge 633. The second portion 652 is bent from the first portion 651 so as to be extended along the first opening edge 631. The third portion 653 is bent from the second portion 652 so as to be extended toward the second opening edge 632 from the first opening edge 631.

[0051] The third portion 653 of the third rib 643 is arranged to face the first bent portion 646 of the first rib 641. The third portion 653 is separated from the first bent portion 646. Accordingly, a passage 654 is formed between the first bent portion 646 and the third portion 653.

[0052] The fourth rib 644 is formed in a substantially L-shape. The fourth rib 644 includes a first portion 655, a second portion 656 and a third portion 657. The first portion 655 is extended along the fourth opening edge 634. The second portion 656 is bent from the first portion 655 so as to be extended along the first opening edge 631. The third portion 657 is bent from the second portion 656 so as to be extended toward the second opening edge 632 from the first opening edge 631.

[0053] The third portion 657 of the fourth rib 644 is arranged to face the second bent portion 647 of the first rib 641. The third portion 657 is separated from the second bent portion 647. Accordingly, a passage 658 is formed between the second bent portion 647 and the third portion 657.

[0054] FIG. 6 is another schematic perspective view of the controller 620. The controller 620 will be further described with reference to FIG. 3 through FIG. 6.

[0055] As shown in FIG. 6, the control box 621 includes a cover 659 and a suction wall 660. The cover 659 is formed to cover the rectangular opening 630 described with reference to FIG. 5. The suction wall 660 is arranged vertically at a side opposite to the input connector wall 624 described with reference to FIG. 5. The suction wall 660 includes a suction window 661. The suction window 661 allows air to pass through.

[0056] The cover 659 forms an end opening 662 of the passage 654 (see FIG. 5) in cooperation with the first rib 641 (see FIG. 5) and the third rib 643 (sec FIG. 5). Accordingly, the passage 654 is opened toward the housing 300A. The cover 659 forms an end opening 663 of the passage 658 (see FIG. 5) in cooperation with the first rib 641 and the fourth rib 644 (see FIG. 5). Accordingly, the passage 658 is opened toward the housing 300A.

[0057] As described with reference to FIG. 4, the outer fan device 430 sets the suction space 431 to be a negative pressure environment. Since the end openings 662, 663 (see FIG. 6) of the passages 654, 658 arc located at a lower side of the suction space 431, air in the control box 621 is sucked to the suction space 431 through the passages 654, 658. After that, the air sucked from the control box 621 is delivered as cooling air toward the cooling pipe 410 (see FIG. 4) by the outer fan device 430. Accordingly, the designer may not arrange cooling equipment having an excessively high cooling capability in the control box 621. In a case in which the outer fan device 430 can suck the air in the control box 621 sufficiently, the designer may not arrange the cooling equipment in the control box 621.

[0058] As described above, the outer fan device 430 can suck the air in the control box 621. During this time, outer air flows in through the suction window 661. Accordingly, in the control box 621, an inner air flow from the suction window 661 directed to the end openings 662, 663 of the passages 654, 658 is generated. The electronic device 622 (see FIG. 5) arranged in the control box 621 is appropriately cooled by the inner air flow.

Fourth Embodiment

[0059] In the design principle described in connection with the third embodiment, much air is sucked around the top plate of the housing of the controller. Accordingly, in a case in which an electronic device which dissipates a large amount of heat is arranged near the top plate, the controller is cooled effectively. In a fourth embodiment, a technique for cooling a controller effectively will be described.

[0060] FIG. 7 is a schematic view illustrating an inner structure of a controller 620. The controller 620 will be described with reference to FIG. 3, FIG. 6, and FIG. 7.

[0061] The controller 620 may be provided with two drivers 671 and a sequencer 672 as electronic devices 622. The driver 671 is formed to generate a driving signal for driving a compressor or other device arranged in a housing 300A (see FIG. 3). The sequencer 672 may be formed to receive a detection signal generated by various sensors mounted to an air compression device 100A (see FIG. 3). In addition, the sequencer 672 may be formed to receive various signals from other device used with the air compression device 100A. The sequencer 672 may be formed to process these signals so as to control the driver 671.

[0062] The driver 671 dissipates heat having a temperature higher than that of heat dissipated by the sequencer 672. As shown in FIG. 7, since the driver 671 is arranged above the sequencer 672, the heat dissipated by the driver 671 hardly gives an influence to the sequencer 672. Accordingly, the sequencer 672 can be driven stably.

[0063] The driver 671 is arranged near a cover 659 of a control box 621. As shown in FIG. 6, since the cover 659 forms end openings 662, 663 as outflow ports of air sucked by an outer fan device 430, the air around the driver 671 is sucked from the control box 621 effectively.

[0064] The driver 671 may be arranged at a height position crossing a virtual horizontal plane intersecting a suction window 661. In this case, the driver 671 is exposed directly to an inner air flow (a flow of air from the suction window 661 directed to the end openings 662, 663) generated in the control box 621 when the outer fan device 430 is driven. Accordingly, the driver 671 is cooled efficiently.

Fifth Embodiment

[0065] As described in connection with above various embodiments, the cooling portion, the controller and the dehumidifying portion are mounted to the outer side of the housing. Accordingly, the operator can reach these devices easily. In a fifth embodiment, a connection structure of these devices to a housing will be described.

[0066] FIG. 8 is a perspective view schematically illustrating a frame structure of a housing 300A. The housing 300A will be described with reference to FIG. 8.

[0067] The housing 300A includes a bottom plate 330, a support plate 340, a first column 351, a second column 352, a third column 353, a fourth column 354, an intermediate column 355, a first beam member 356 and a second beam member 357. The bottom plate 330 is formed in a substantially rectangular shape. Each of the first column 351, the second column 352, the third column 353 and the fourth column 354 is extended upward from each of four corner portions of the bottom plate 330. The first column 351 and the third column 353 are arranged on one diagonal line of the bottom plate 330. The second column 352 and the fourth column 354 are arranged on another diagonal line of the bottom plate 330. The first column 351 and the second column 352 are used for mounting a second wall portion 320 (see FIG. 2) on which a dehumidifying portion 610 (see FIG. 2), a controller 620 (see FIG. 2) and an outer duct portion 321 are formed.

[0068] The first beam member 356 is extended substantially horizontally between the first column 351 and the second column 352. The second beam member 357 is extended substantially horizontally between the third column 353 and the fourth column 354. The support plate 340 is supported by the first beam member 356 and the second beam member 357 so as to be laid above the bottom plate 330. The intermediate column 355 is extended substantially vertically from the bottom plate 330 to the first beam member 356 between the first column 351 and the second column 352.

[0069] The dehumidifying portion 610 is mounted to close a substantially rectangular space surrounded by the second column 352, the intermediate column 355, the bottom plate 330 and the first beam member 356. The controller 620 is mounted to close a substantially rectangular space surrounded by the first column 351, the intermediate column 355, the bottom plate 330 and the first beam member 356. The second wall portion 320 on which the outer duct portion 321 is formed is mounted to close a substantially rectangular space surrounded by the first column 351, the second column 352 and the first beam member 356.

[0070] Each of the dehumidifying portion 610, the controller 620 and the second wall portion 320 may be fixed by using a screw. In this case, the operator can remove each of the dehumidifying portion 610, the controller 620 and the second wall portion 320 from the housing 300A easily. Accordingly, the operator can perform check and/or repair of an air compression device 100A easily.

[0071] FIG. 9 is a schematic perspective view of the air compression device 100A. The structure of the housing 300A will be further described with reference to FIG. 2, FIG. 8, and FIG. 9.

[0072] The housing 300A further includes side panels 361, 362 (see FIG. 2 and FIG. 9), a top plate 370 (see FIG. 9), a rotation cover 380 (see FIG. 9) and a first wall portion 390 (see FIG. 9). The top plate 370 is connected to upper ends of the first column 351 (see FIG. 8), the second column 352 (see FIG. 8), the third column 353 (see FIG. 8), and the fourth column 354 (see FIG. 8) so as to be laid above the support plate 340 (see FIG. 8). The side panel 361 is arranged to close a space surrounded by the second column 352, the third column 353, the bottom plate 330 and the top plate 370. The side panel 362 opposite to the side panel 361 is arranged to close a space surrounded by the first column 351, the fourth column 354, the bottom plate 330 and the top plate 370. The rotation cover 380 is mounted to the second beam member 357 in a rotation manner. The rotation cover 380 is arranged to close a space surrounded by the second beam member 357, the bottom plate 330, the third column 353 and the fourth column 354. The first wall portion 390 is arranged above the rotation cover 380. The first wall portion 390 is arranged to close a space surrounded by the second beam member 357, the top plate 370, the third column 353, and the fourth column 354.

[0073] The side panels 361, 362, the top plate 370 and the first wall portion 390 may be fixed by using a screw. In this case, the operator can detach each of the side panels 361, 362, the top plate 370, and the first wall portion 390 and can reach various devices arranged in the housing 300A easily. Accordingly, the operator can perform check and/or repair of the air compression device 100A easily.

[0074] Since the rotation cover 380 is mounted to the second beam member 357 in a rotation manner, the operator can push up a lower end portion of the rotation cover 380 and can reach a space between the bottom plate 330 and the support plate 340 easily. Accordingly, the operator can perform check and/or repair of the air compression device 100A easily.

Sixth Embodiment

[0075] The designer can arrange various devices in the housing described in connection with the fifth embodiment. In a sixth embodiment, an exemplary inner structure of an air compression device will be described.

[0076] FIG. 10 is a schematic perspective view of an air compression device 100A. The air compression device 100A will be described with reference to FIG. 1, FIG. 2, and FIG. 8 through FIG. 10.

[0077] The air compression device 100A is provided with a compression mechanism 110 and a cooling mechanism 120. The compression mechanism 110 is formed to generate compressed air. The cooling mechanism 120 is formed to cool the compression mechanism 110.

[0078] The compression mechanism 110 includes a compressor 200A, a motor 210 and a transmission mechanism 220. The compressor 200A corresponds to the compressor 200 described with reference to FIG. 1. The compressor 200A is fixed to an upper surface of a support plate 340. The motor 210 is mounted to a lower surface of the support plate 340. The motor 210 is controlled by a controller 620 (see FIG. 2) to generate driving force for driving the compressor 200A. Since the compressor 200A and the motor 210 are aligned in the vertical direction, the designer can set an area in a horizontal section of the housing 300A to be small.

[0079] The transmission mechanism 220 is formed to transmit the driving force from the motor 210 to the compressor 200A. A side panel 362 described with reference to FIG 9 is arranged vertically at a position next to the transmission mechanism 220. Since the side panel 362 is detached easily as described in connection with the fifth embodiment, the operator can reach the transmission mechanism 220 easily and therefore the operator can perform check and repair of the transmission mechanism 220 easily.

[0080] The transmission mechanism 220 includes an upper pulley 221, a lower pulley 222, an endless belt 223 and a tension pulley 224. The upper pulley 221 is mounted to the compressor 200A. The lower pulley 222 is mounted to the motor 210. The endless belt 223 is looped over the upper pulley 221, the lower pulley 222, and the tension pulley 224. The tension pulley 224 is formed to apply appropriate tensile force to the endless belt 223.

[0081] A rotation cover 380 includes a plurality of slats 381 extended in the horizontal direction. The plurality of slats 381 are aligned in the vertical direction. Outer air can flow into the housing 300A through a gap formed between the slats 381 adjacent to each other. The outer air flowing into the housing 300A is used as a cooling air flow by the cooling mechanism 120.

[0082] The cooling mechanism 120 includes an inner fan device 121 and a cooling air flow adjusting box 122. A first wall portion 390 includes a flat plate 391 and a swelling wall 392. The flat plate 391 is formed to partially close a space surrounded by a third column 353 (see FIG. 8), a fourth column 354 (see FIG. 8), a second beam member 357 (see FIG. 8) and a top plate 370. The swelling wall 392 is mounted to the flat plate 391 by appropriate fixing tool such as a lever lock and a screw available on the market. The swelling wall 392 is swollen toward an outer side from the flat plate 391. The inner fan device 121 is mounted to the swelling wall 392 through an opening area (not shown) formed in the flat plate 391. The swelling wall 392 can be detached from the flat plate 391. The operator can detach the inner fan device 121 from the housing 300A after detaching the swelling wall 392.

[0083] Similar to the motor 210, the inner fan device 121 may be driven by being controlled by the controller 620. When the inner fan device 121 is activated, air in the housing 300A is sucked by the inner fan device 121. During this time, air outside the housing 300A flows in the housing 300A through the rotation cover 380.

[0084] The cooling air flow adjusting box 122 is arranged between the inner fan device 121 and the compressor 200A. The cooling air flow adjusting box 122 is formed to adjust a shape of a flow region of the cooling air blown from the inner fan device 121.

[0085] FIG. 11A is a schematic perspective view of the cooling air flow adjusting box 122. FIG. 11B is a schematic back view of the cooling air flow adjusting box 122. The cooling air flow adjusting box 122 will be described with reference to FIG. 10 through FIG. 11B.

[0086] As shown in FIG. 11A and FIG. 11B, the cooling air flow adjusting box 122 includes a front plate 131, a rear plate 132 and an outer circumferential plate 133. The front plate 131 is arranged to face the inner fan device 121 (see FIG. 10). The front plate 131 includes an outer edge 134 and an inner edge 135. The outer edge 134 forms a substantially rectangular outline of the front plate 131. The inner edge 135 forms a substantially circular opening area. A diameter of the opening area formed by the inner edge 135 is substantially equal to a rotation diameter of a fan blade of the inner fan device 121. Or alternatively, the diameter of the opening area is set to be slightly larger than the rotation diameter of the fan blade. Accordingly, the cooling air generated by the inner fan device 121 can flow into the cooling air flow adjusting box 122 efficiently.

[0087] The rear plate 132 is arranged vertically between the front plate 131 and the compressor 200A (see FIG. 10). The rear plate 132 includes an outer edge 136 and an inner edge 137. Similar to the outer edge 134 of the front plate 131, the outer edge 136 of the rear plate 132 forms a substantially rectangular outline of the rear plate 132. Similar to other general compressors, the compressor 200A has a substantially rectangular outline in a section on a vertical virtual plane including a rotation axis of the compressor 200A. The inner edge 137 of the rear plate 132 forms a substantially rectangular opening area formed to be matched with the sectional shape and the sectional size of the compressor 200A. The outer circumferential plate 133 is connectcd to the outer edges 134, 136 of the front plate 131 and the rear plate 132. Accordingly, the cooling air flowing into the substantially circular opening area formed by the inner edge 135 of the front plate 131 flows out from the substantially rectangular opening area formed by the inner edge 137 of the rear plate 132, and thereby the cooling air hits the compressor 200A efficiently. Accordingly, the compressor 200A is cooled efficiently.

[0088] The cooling air generated by the inner fan device 121 flows toward the compressor 200A through the cooling air flow adjusting box 122. The cooling air is collided with the compressor 200A. As a result, the cooling air can absorb heat from the compressor 200A.

[0089] As shown in FIG. 10, the compressor 200A is arranged between the cooling air flow adjusting box 122 and a second wall portion 320 arranged vertically at a side opposite to the first wall portion 390. Accordingly, the coaling air generated by the inner fan device 121 flows toward the second wall portion 320 after absorbing the heat from the compressor 200A.

[0090] As shown in FIG. 4, the second wall portion 320 includes an inner duct portion 327 arranged in the housing 300A. The inner duct portion 327 forms an opening 328 in cooperation with an outer duct portion 321 arranged at an outside of the housing 300A. The cooling air flow generated by the inner fan device 121 is discharged from the housing 300A through the opening 328. In the present embodiment, an exhaust duct is exemplary described by the outer duct portion 321 and the inner duct portion 327.

[0091] As shown in FIG. 4, a cooling pipe 410 is extended in a meandering manner from a first cooling section to a second cooling section. The outer duct portion 321 is protruded toward the first cooling section. In the first cooling section, the cooling pipe 410 faces the opening 328. In the second cooling section, the cooling pipe 410 faces the outer fan device 430.

[0092] As described above, since the cooling air generated by the inner fan device 121 is discharged from the opening 328, the cooling pipe 410 is exposed to the cooling air generated by the inner fan device 121 in the first cooling section. Accordingly, the compressed air, which flows along the cooling pipe 410 in the first cooling section, is cooled by the cooling air generated by the inner fan device 121. Since the cooling pipe 410 faces the outer fan device 430 in the second cooling section, the cooling pipe 410 is exposed to the cooling air generated by the outer fan device 430 in the second cooling section. Accordingly, the compressed air, which flows along the cooling pipe 410 in the second cooling section, is cooled by the cooling air generated by the outer fan device 430.

[0093] The inner fan device 121 described with reference to FIG. 10 may be formed as an axial fan device which rotates a fan blade around a rotation center axis extended along a virtual horizontal plane formed below the opening 328. In this case, most of the cooling air generated by the inner fan device 121 is collided with the second wall portion 320.

[0094] As shown in FIG. 4, the inner duct portion 327 is provided with a lining member 329 lining a mount plate 326 of the second wall portion 320 facing the inner fan device 121. The lining member 329 may have a sound absorbing property more superior than that of the mount plate 326. The lining member 329 is arranged below the opening 328. The lining member 329 is extended substantially horizontally along a lower edge of the opening 328. Since most of the cooling air collided with the second wall portion 320 flows along the lining member 329, a noise discharged from the opening 328 is reduced. In the present embodiment, a sound absorbing area is exemplary described by an area in which the lining member 329 is arranged.

Seventh Embodiment

[0095] The designer may arrange a plurality of compressors in a housing. In a case in which an air compression device is provided with a plurality of the compressors, the air compression device can generate a large amount of compressed air in a short period of time. In a seventh embodiment, an air compression device provided with a plurality of compressors will be described.

[0096] FIG. 12 is a schematic plane view illustrating an inner structure of an air compression device 100A. The air compression device 100A will be further described with reference to FIG. 12.

[0097] The air compression device 100A is provided with a compression mechanism 140 and a cooling mechanism 150. The compression mechanism 140 is formed to generate compressed air. The cooling mechanism 150 is formed to cool the compression mechanism 140. The compression mechanism 140 is in a mirror image relation with the compression mechanism 110 described in connection with the sixth embodiment. Accordingly, the description of the compression mechanism 110 in the sixth embodiment is used for describing the compression mechanism 140. The cooling mechanism 150 has the same structure as that of the cooling mechanism 120 described in connection with the sixth embodiment. Accordingly, the description of the cooling mechanism 120 in the sixth embodiment is used for describing the cooling mechanism 150.

[0098] The compression mechanism 140 includes a compressor 230. Similar to the compressor 200A of the compression mechanism 110, the compressor 230 is formed to generate compressed air. The compressor 200A includes a port wall 201. The compressor 230 includes a port wall 231. The port wall 201 of the compressor 200A is arranged to face the port wall 231 of the compressor 230. A suction port (not shown) into which an outer air outside of the housing 300A flows and a delivery port (not shown) from which the compressed air is delivered are formed in each of the port walls 201, 231.

[0099] The air compression device 100A is further provided with a suction guide structure 800 arranged between the port walls 201 and 231. The outer air outside the housing 300A flows into each of the compressors 200A, 230 through the suction guide structure 800. Each of the compressors 200A, 230 is formed to compress the outer air flowing in through the suction guide structure 800 and generate the compressed air. The compressed air is delivered toward the outside of the housing 300A through the guide pipe 700 described in connection with the second embodiment.

[0100] FIG. 13 is a schematic cross-sectional view of the suction guide structure 800. The suction guide structure 800 will be described with reference to FIG. 9, FIG. 12 and FIG. 13.

[0101] As shown in FIG. 9, a first wall portion 390 includes a filter cover 393. The filter cover 393 is arranged in a recessed region formed in a chevron-shape formed by a swelling wall 392. Similar to the swelling wall 392, the filter cover 393 is mounted to a flat plate 391. The operator can detach the filter cover 393 from the flat plate 391.

[0102] As shown in FIG. 13, the suction guide structure 800 includes a suction duct 810, a filter device 820 and a trim seal 831. The filter device 820 is arranged between the filter cover 393 and the suction duct 810. The trim seal 831 is formed as a rubber ring member which connects the filter device 820 to the suction duct 810 in an airtight manner.

[0103] The suction duct 810 is formed as a hollow box member formed in a substantially rectangular parallelepiped shape. When the compressors 200A, 230 are activated, a negative pressure environment is generated in the suction duct 810. As a result, the outer air outside the housing 300A flows into the housing 300A through the filter cover 393. After that, the outer air passes through the filter device 820. The filter device 820 removes dust floating in the outer air flowing in. The air purified by the filter device 820 flows into the suction duct 810.

[0104] FIG. 14 is a schematic enlarged cross-sectional view of the suction guide structure 800 around the suction duct 810. The suction guide structure 800 will be further described with reference to FIG 14.

[0105] The suction guide structure 800 further includes two supply pipes 811, 812, and two trim seals 832, 833. The trim seal 832 is used for the connection between the supply pipe 811 and the suction duct 810. The trim seal 833 is used for the connection between the supply pipe 812 and the suction duct 810.

[0106] The supply pipe 811 is connected to the port wall 201 of the compressor 200A from the trim seal 832 mounted to the suction duct 810. The outer air purified by the filter device 820 flows into the compressor 200A through the suction duct 810 and the supply pipe 811.

[0107] The supply pipe 812 is connected to the port wall 231 of the compressor 230 from the trim seal 833 mounted to the suction duct 810. The outer air purified by the filter device 820 flows into the compressor 230 through the suction duct 810 and the supply pipe 812.

[0108] FIG. 15 is a schematic enlarged perspective view of a part of the guide pipe 700. The guide pipe 700 will be described with reference to FIG. 2 through FIG. 4, FIG. 12 and FIG. 15.

[0109] As shown in FIG. 12, the guide pipe 700 includes two discharge pipes 710, 720, a confluence portion 730 and a confluence pipe 740. The discharge pipe 710 is formed to guide the compressed air generated by the compressor 200A to the confluence portion 730 arranged near the first wall portion 390. The discharge pipe 720 is formed to guide the compressed air generated by the compressor 230 to the confluence portion 730. The confluence pipe 740 is extended from the confluence portion 730 toward a second wall portion 320 at a side opposite to the first wall portion 390. The confluence pipe 740 is connected to a cooling pipe 410 at the outside of the housing 300A.

[0110] The guide pipe 700 forms a long flow path for the compressed air in the housing 300A. The cooling air generated by the cooling mechanisms 120, 150 flows within the housing 300A until the cooling air is discharged from an opening 328 (see FIG. 4). Accordingly, the compressed air can be cooled in the housing 300A by the cooling air generated by the cooling mechanisms 120, 150 for a long period of time.

[0111] As shown in FIG. 15, the confluence portion 730 includes a manifold 731 and two check valves 732, 733. Each of the check valves 732, 733 is mounted to the manifold 731. The discharge pipe 710 is connected to the check valve 732. The compressed air flowing along the discharge pipe 710 flows into the manifold 731 through the check valve 732. The check valve 732 is formed to interrupt a flow of the compressed air returned from the manifold 731 to the discharge pipe 710. The discharge pipe 720 is connected to the check valve 733. The compressed air flowing along the discharge pipe 720 flows into the manifold 731 through the check valve 733. The check valve 733 is formed to interrupt a flow of the compressed air returned from the manifold 731 to the discharge pipe 720.

[0112] A confluence inner pipe (not shown), which joins two flows of the compressed air, is formed in the manifold 731. The compressed air joined by the confluence inner pipe is discharged from the manifold 731 through the confluence pipe 740.

[0113] As shown in FIG. 4, the confluence pipe 740 is inserted into the opening 328 through an inner duct portion 327. As shown in FIG. 3, the confluence pipe 740 is bent inside an outer duct portion 321 and is extended toward a support wall 324 of the outer duct portion 321. The confluence pipe 740 is formed to penetrate the support wall 324 and is connected to an upstream connection end 420 of a cooling portion 400A described with reference to FIG. 2.

[0114] The designer can design various air compression devices based on the design principle described in connection with various embodiments described above. A part of various features described in connection with one embodiment among the various embodiments described above may be applied to the air compression device described in connection with other embodiment.

[0115] The exemplary air compression devices described in connection with the various embodiments described above are mainly provided with the following features.

[0116] The air compression device according to one aspect of the embodiments described above is provided with a compressor which generates compressed air, a housing which forms a housing space in which the compressor is housed, a cooling portion which is arranged at an outside of the housing and cools the compressed air, and a protection cover which at least partially covers the cooling portion.

[0117] According to the configuration described above, since the cooling portion is arranged at the outside of the housing and cools the compressed air, the cooling portion hardly receives an influence of heat generation from the compressor housed in the housing. Accordingly, the compressed air is cooled efficiently compared to a configuration in which the cooling portion is arranged in the housing. Since the protection cover at least partially covers the cooling portion, the cooling portion arranged at the outside of the housing is appropriately protected by the protection cover. The protection cover prevents the cooling portion from being damaged by a flipped stone or the like flipped when a vehicle is travelling. The protection cover may be arranged to cover the entire cooling portion. Further, in a case in which a cooling air flow is set to pass through an inside of the cooling portion, cooling air after passing through the cooling portion is discharged toward a predetermined space at the outside while avoiding collision with other surrounding devices. The protection cover may prevent the flipped stone or the like from hitting the cooling portion through the predetermined space by arranging the protection cover at least in a space between the cooling portion and the predetermined space to which the cooling air is discharged.

[0118] Relating to the configuration described above, the air compression device may be further provided with an outer fan device which generates a cooling air flow toward the cooling portion by using air outside the housing.

[0119] According to the configuration described above, since the cooling air flow is generated by the outer fan device by using the air outside the housing and the cooling air flow is directed to the cooling portion, the compressed air passed through the inside of the cooling portion is cooled efficiently compared to a configuration in which the cooling air flow is generated by using air inside the housing.

[0120] Relating to the configuration described above, the air compression device may be further provided with an outer fan device arranged between the housing and the cooling portion, a controller which controls the compressor, and a dehumidifying portion which dehumidifies the compressed air passed through the cooling portion. The controller and dehumidifying portion may be arranged below the cooling portion. The protection cover may include a baffle plate laid below the cooling portion. The baffle plate interrupts an air flow from the cooling portion toward the controller and the dehumidifying portion.

[0121] According to the configuration described above, since the baffle plate interrupts the air flow from the cooling portion toward the controller and the dehumidifying portion, the controller and the dehumidifying portion hardly receive an influence of the air flow heated by the compressed air flowing the cooling portion.

[0122] Relating to the configuration described above, the protection cover may include a ventilation plate arranged vertically from the baffle plate. The cooling portion may be arranged between the ventilation plate and the outer fan device. A ventilation hole is formed in the ventilation plate.

[0123] According to the configuration described above, since the cooling portion is arranged between the ventilation plate and the outer fan device, the cooling portion is appropriately protected from a flipped stone or the like when a vehicle is travelling. Since the ventilation hole is formed in the ventilation plate, the cooling air flow generated by the outer fan device can be discharged to an outside through the ventilation hole of the ventilation plate. Accordingly, the compressed air passed through the cooling portion is cooled efficiently.

[0124] Relating to the configuration described above, the baffle plate may include a facing edge facing the housing. The facing edge forms an opening area in cooperation with the housing, below the outer fan device.

[0125] According to the configuration described above, since the outer fan device can suck air from the opening area formed below the outer fan device, the outer fan device can generate the cooling air flow by using air hardly absorbing heat of the compressed air flowing the cooling portion.

[0126] Relating to the configuration described above, the air compression device may be further provided with an inner fan device which generates cooling air flow toward the compressor. The housing may include an exhaust duct arranged above the outer fan device. The cooling portion may include a cooling pipe having a first cooling section facing the exhaust duct and a second cooling section facing the outer fan device. The cooling air flow from the inner fan device may be discharged to an outside from the housing through the exhaust duct.

[0127] According to the configuration described above, the compressor is appropriately cooled by the cooling air flow generated by the inner fan device. After that, the cooling air flow is discharged through the exhaust duct arranged above the outer fan device, and therefore the compressed air flowing in the first cooling section of the cooling portion can be appropriately cooled by the cooling air flow. After that, since the compressed air flows through the second cooling section of the cooling portion, and therefore the compressed air is cooled by the cooling air flow generated by the outer fan device, the air compression device can cool the compressed air efficiently.

[0128] Relating to the configuration described above, the housing may include a first wall portion to which the inner fan device is mounted, and a second wall portion at a side opposite to the first wall portion. The exhaust duct may include an inner duel portion arranged in the housing space, and an outer duct portion protruded toward the first cooling section from an opening formed in the second wall portion. The inner duct portion may include a sound absorbing area arranged below the opening to face the inner fan device.

[0129] According to the configuration described above, since the sound absorbing area is arranged to face the inner fan device, a noise generated in the housing is hardly leaked toward the outside of the housing.

[0130] Relating to the configuration described above, the air compression device may be further provided with a guide pipe which guides the compressed air from the compressor to the cooling portion. The guide pipe may be connected to the cooling portion through the exhaust duct.

[0131] According to the configuration described above, since the guide pipe is connected to the cooling portion through the exhaust duct, the compressed air flowing through the guide pipe is appropriately cooled by the cooling air flow. Accordingly, the air compression device can cool the compressed air efficiently.

Industrial Applicability

[0132] The principles of the embodiments described above are suitably used in various technical fields which requires compressed air.

Claims

1. An air compression device comprising:

a compressor (200A) which generates compressed air,
a housing (300A) which forms a housing space in which the compressor (200A) is housed,
a cooling portion (400A) which is arranged at an outside of the housing (300A) and cools the compressed air,
a protection cover (500A) which at least partially covers the cooling portion (400A),
an outer fan device (430) which generates a cooling air flow toward the cooling portion (400A) by using air outside the housing (300A), and
an inner fan device (121) which generates cooling airflow toward the compressor (200A), wherein the housing (300A) includes an exhaust duct arranged above the outer fan device (430);
the cooling portion (400A) includes a cooling pipe (410) having a first cooling section facing the exhaust duct and a second cooling section facing the outer fan device (430); and
the cooling air flow from the inner fan device (121) is discharged to an outside from the housing (300A) through the exhaust duct.

2. The air compression device according to claim 1, further comprising:

a controller (620) which controls the compressor (200A), and
a dehumidifying portion (610) which dehumidifies the compressed air passed through the cooling portion (400A), wherein
the controller (620) and the dehumidifying portion (610) are arranged below the cooling portion (400A);
the protection cover (500A) includes a baffle plate (510) laid below the cooling portion (400A); and
the baffle plate (510) is configured to interrupt an air flow from the cooling portion (400A) toward the controller (620) and the dehumidifying portion (610).

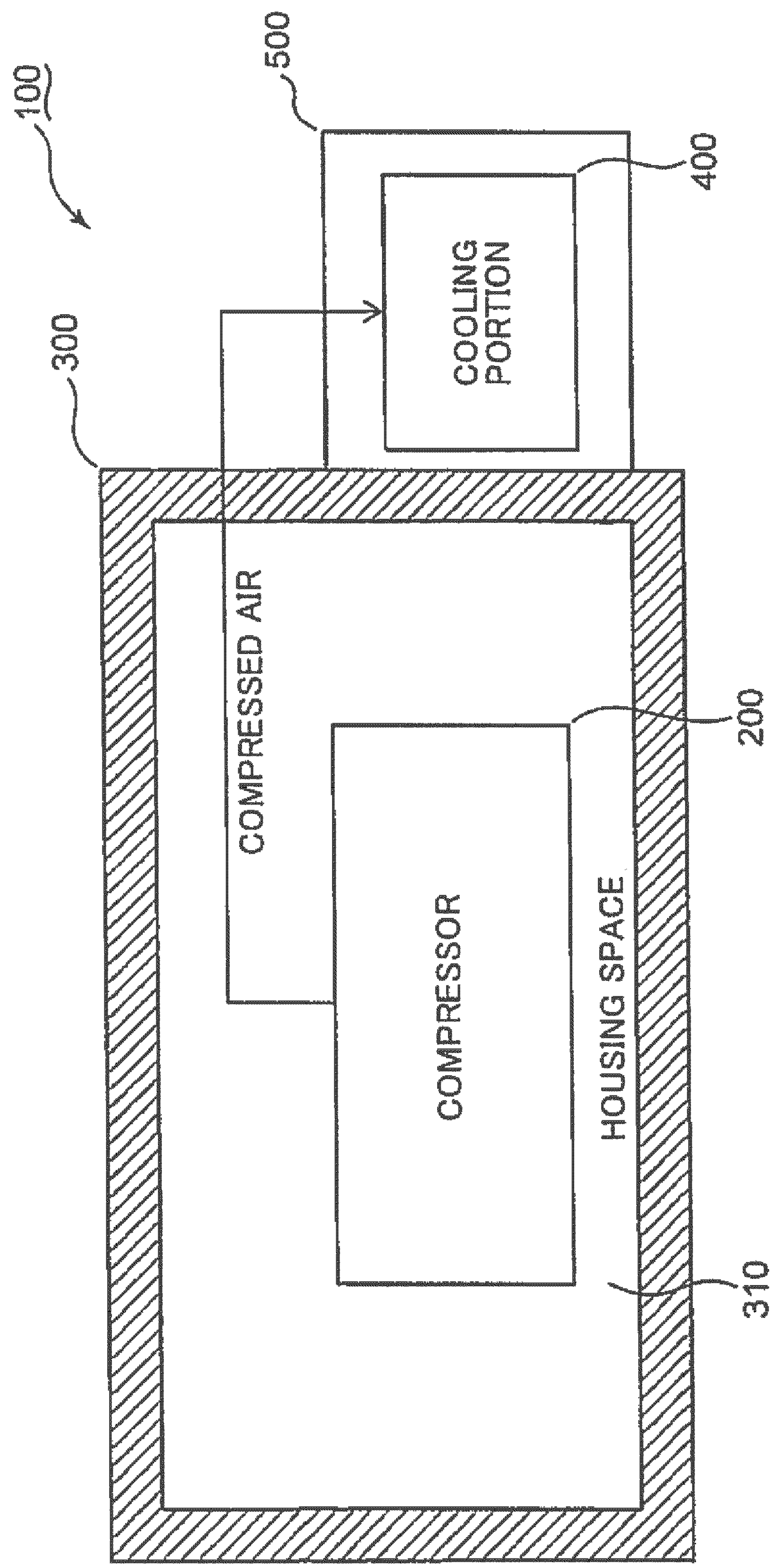
3. The air compression device according to claim 2, wherein
the protection cover (500A) includes a ventilation plate (520) arranged vertically from the baffle plate (510);
the cooling portion (400A) is arranged between the ventilation plate (520) and the outer fan device (430); and
a ventilation hole is formed in the ventilation plate (520).

4. The air compression device according to claim 2 or 3, wherein
the baffle plate (510) includes a facing edge facing the housing (300A); and
the facing edge forms, below the outer fan device (430), an opening area in cooperation with the housing (300A).

5. The air compression device according to claim 1, wherein
the housing includes a first wall portion (390) to which the inner fan device (121) is mounted and a second wall portion (320) at a side opposite to the first wall portion (390);
the exhaust duct includes an inner duct portion (327) arranged in the housing space and an outer duct portion (321) protruded toward the first cooling section from an opening formed in the second wall portion (320); and
the inner duct portion (327) includes a sound absorbing area arranged below the opening to face the inner fan device (121).

6. The air compression device according to claim 5, further comprising a guide pipe (700) which guides the compressed air from the compressor (200A) to the cooling portion (400A),
wherein the guide pipe (700) is connected to the cooling portion (400A) through the exhaust duct.

FIG. 1


100
500
400
COOLING PORTION
300
COMPRESSED AIR
200
COMPRESSOR
HOUSING SPACE
310

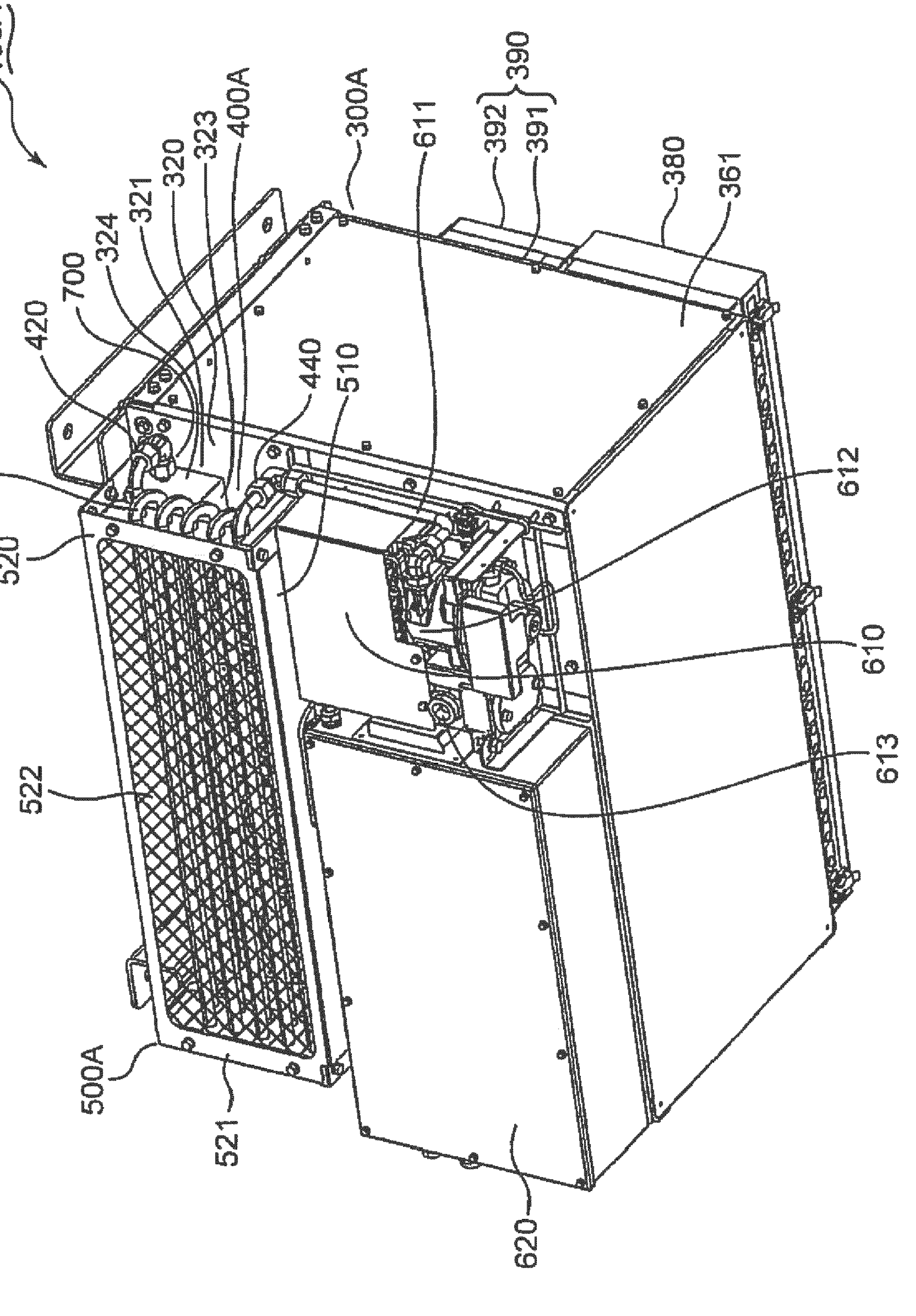

100A
300A
611
392
391
390
380
361
420
700
324
321
320
323
400A
440
510
410
520
612
610
613
522
500A
521
620

FIG. 2

FIG. 3

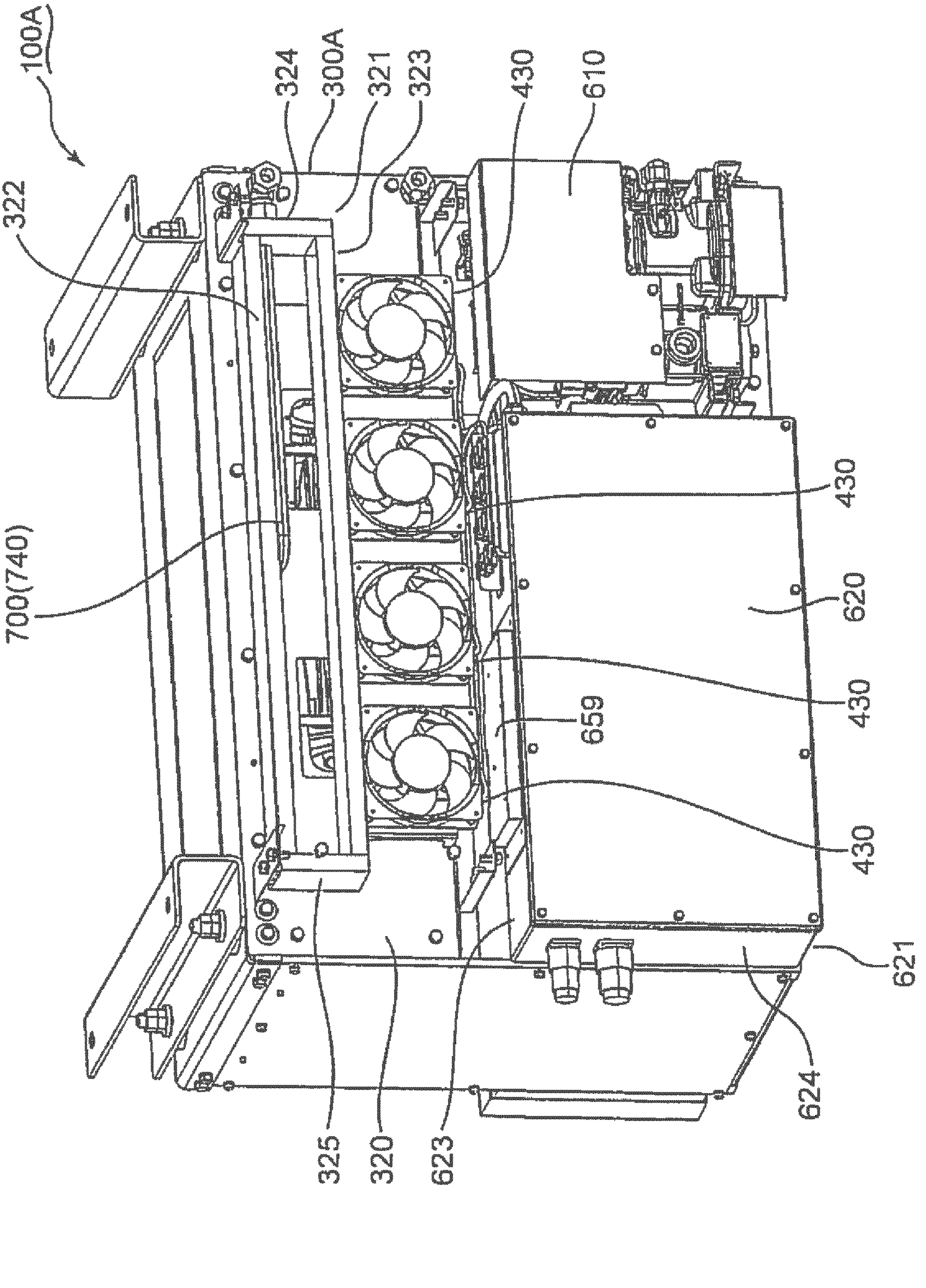
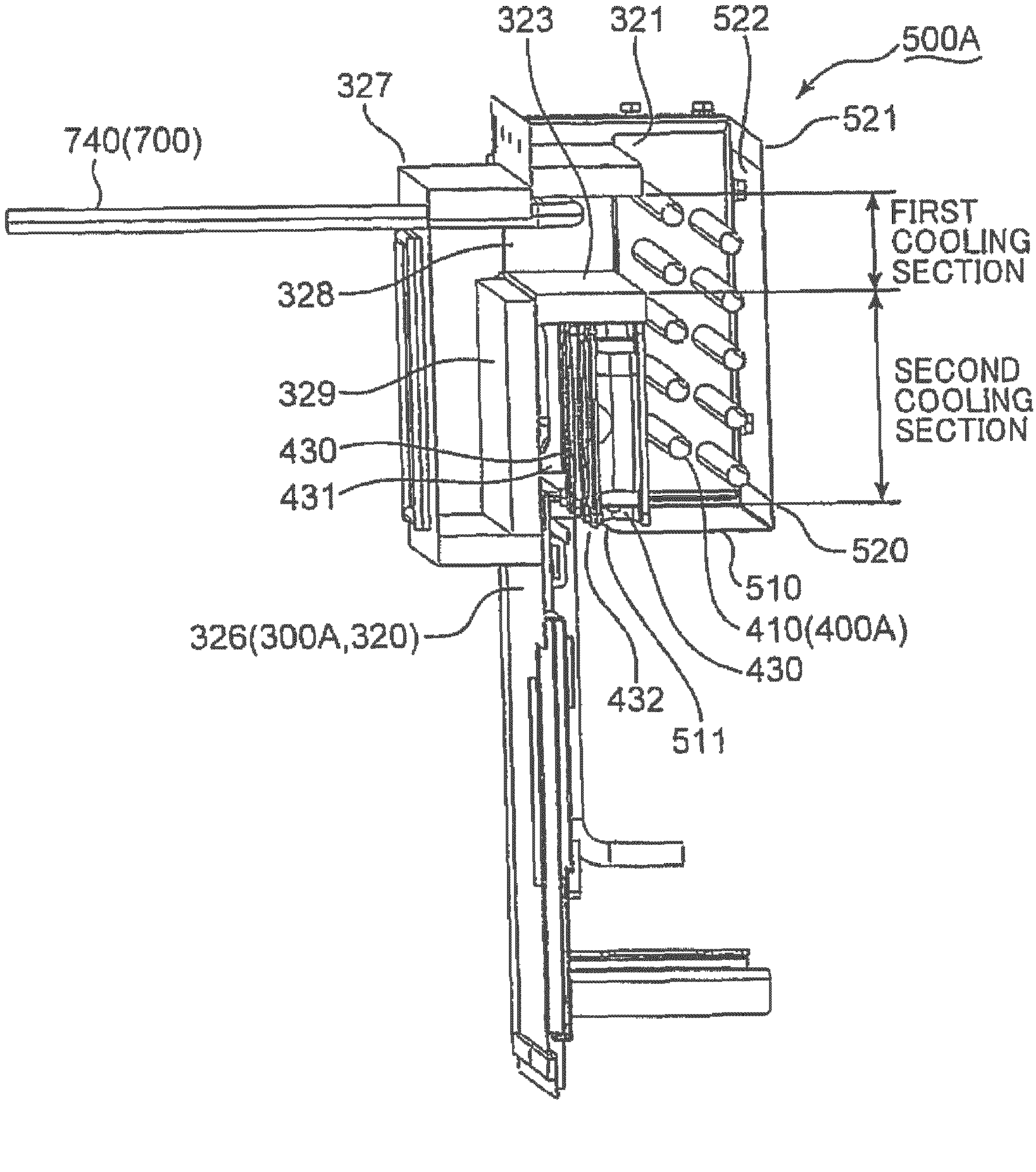

100A
324
300A
321
323
430
610
322
700(740)
430
620
430
659
430
621
624
325
320
623

FIG. 4



323
321
522
500A
327
521
740(700)
FIRST
COOLING
SECTION
328
329
SECOND
COOLING
SECTION
430
431
520
510
326(300A,320)
410(400A)
430
432
511

FIG. 5

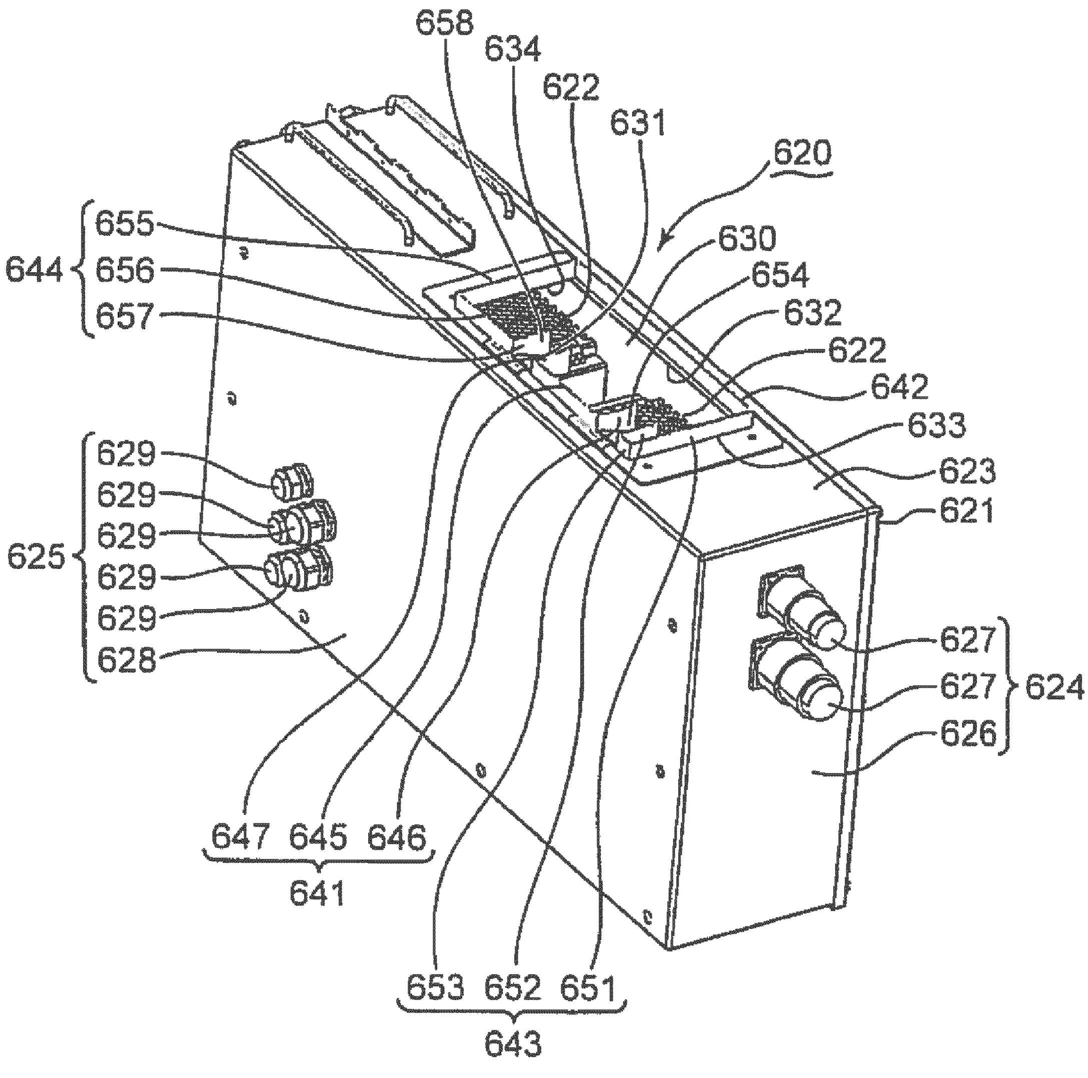

658
634
622
631
620
655
644
656
657
630
654
632
622
642
633
623
621
629
629
629
625
629
629
628
627
627
624
626
647 645 646
641
653 652 651
643

FIG. 6

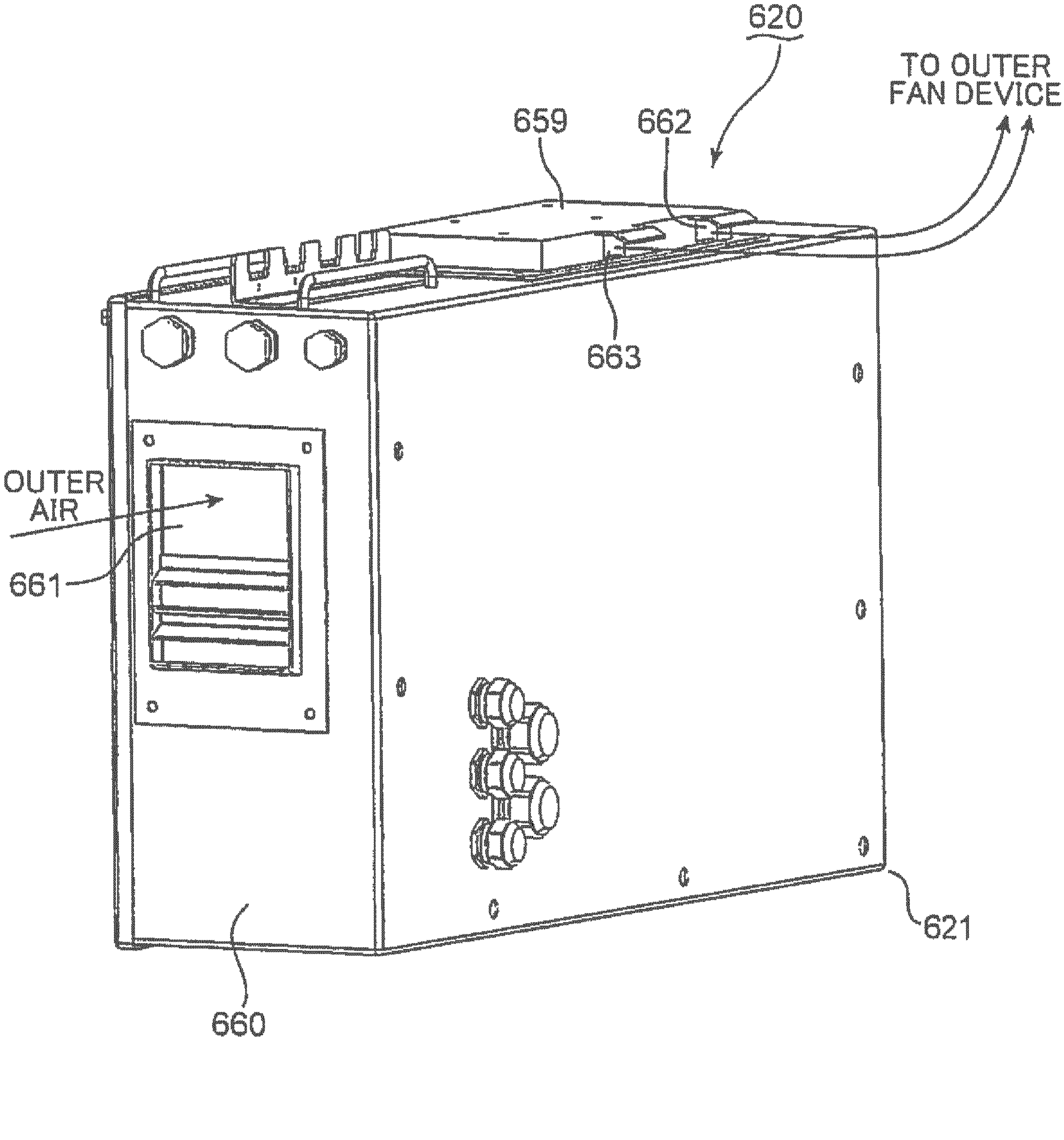


FIG. 7

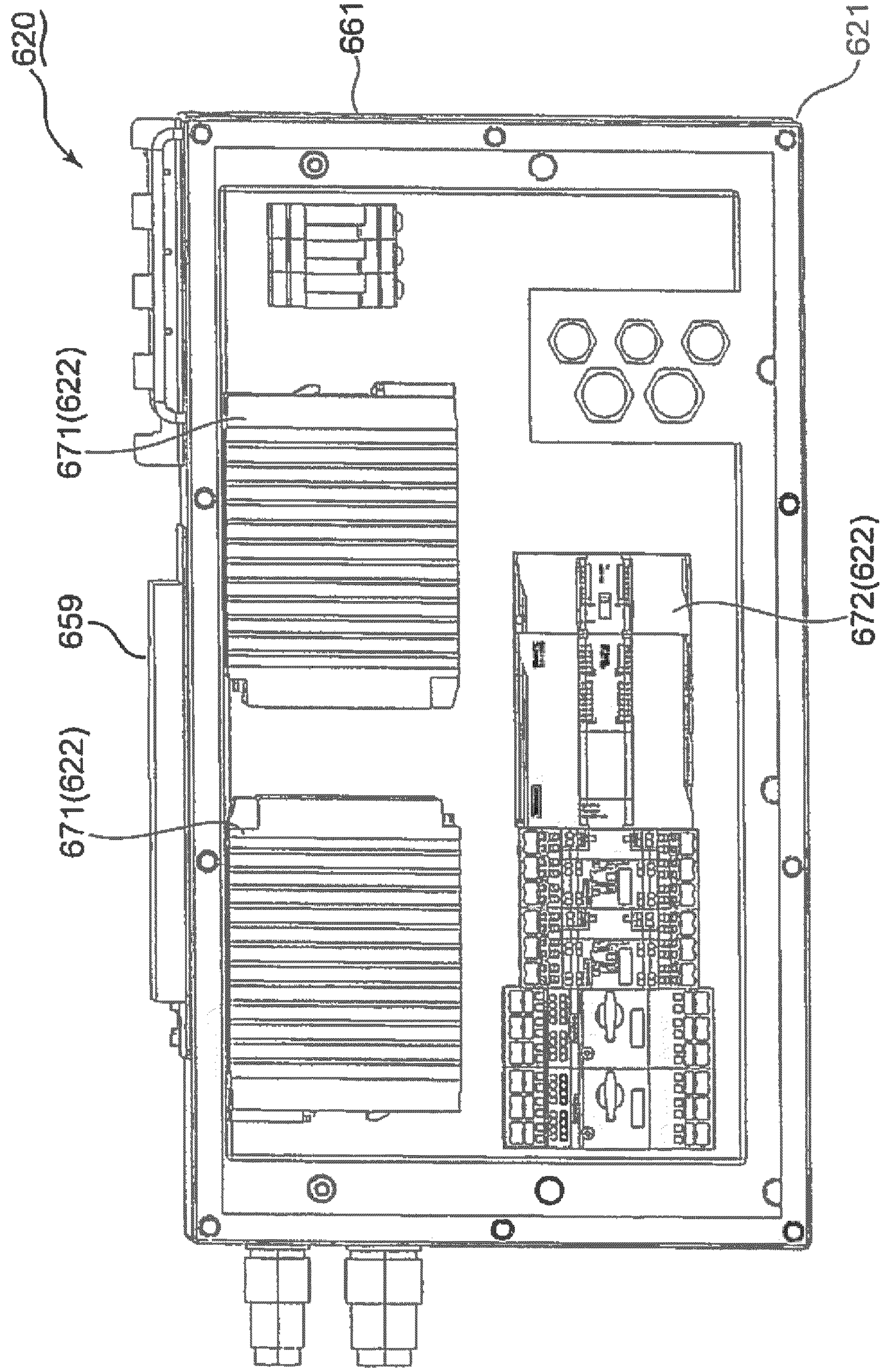


FIG. 8

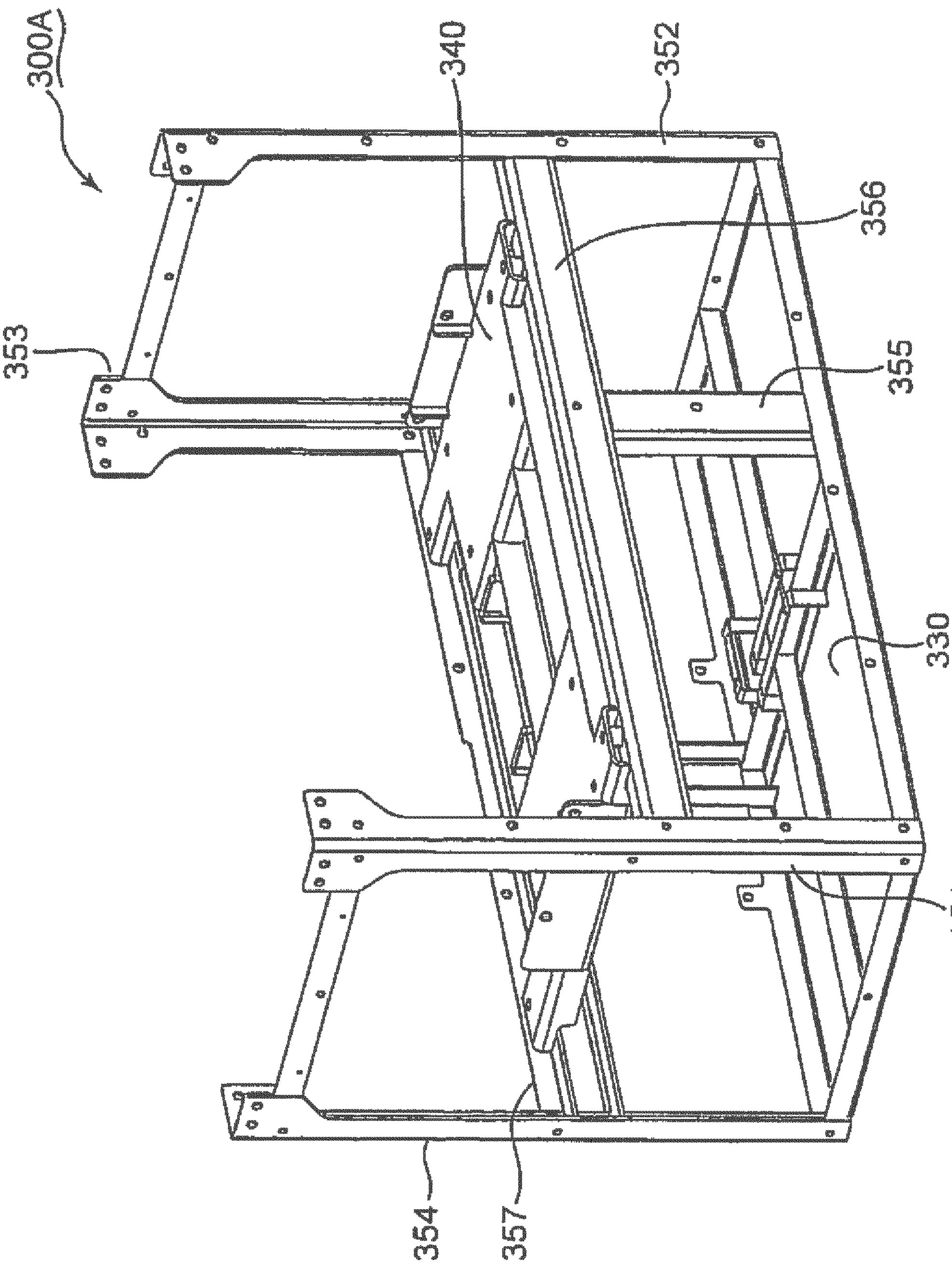


FIG. 9

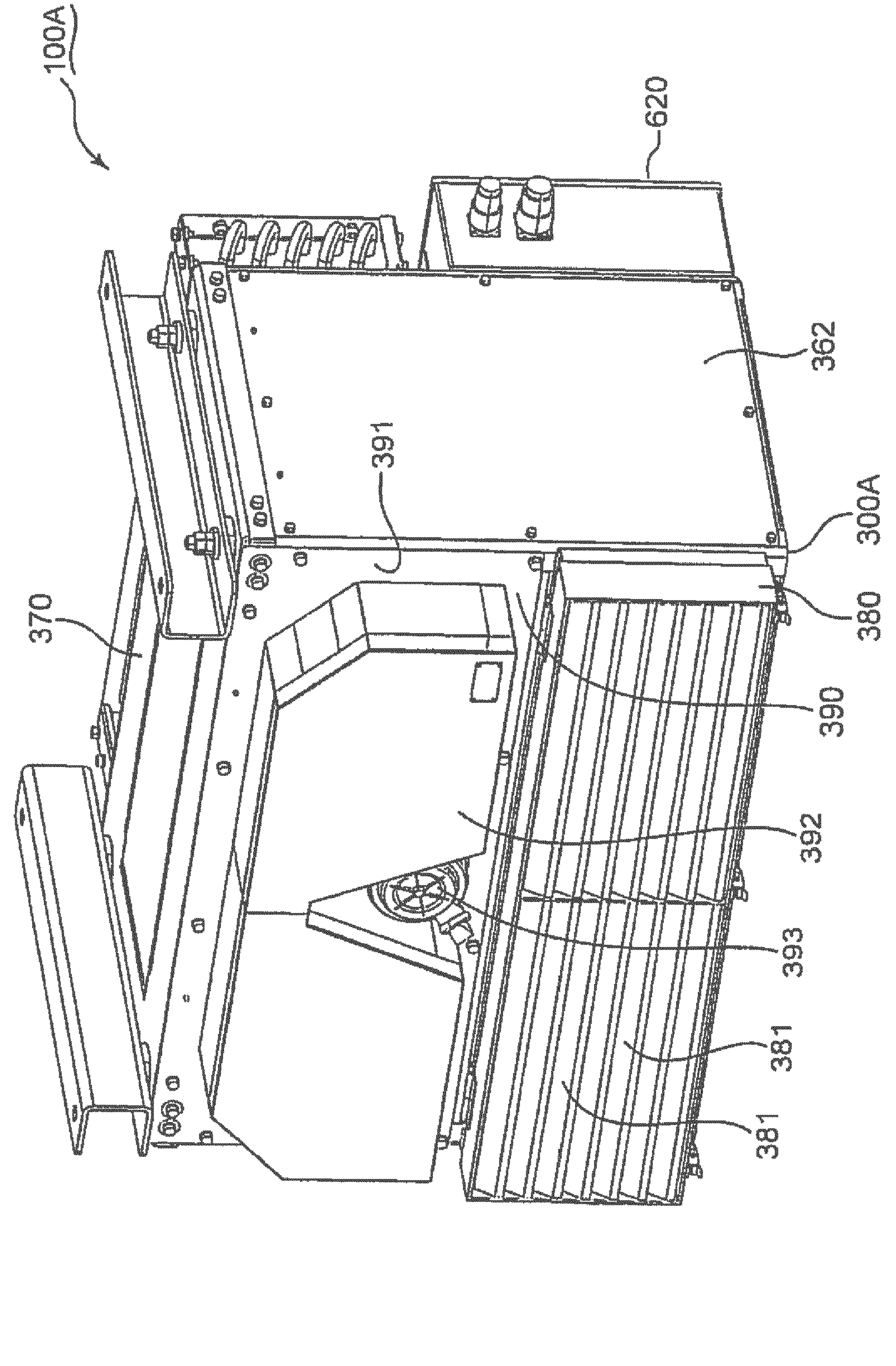


FIG. 10

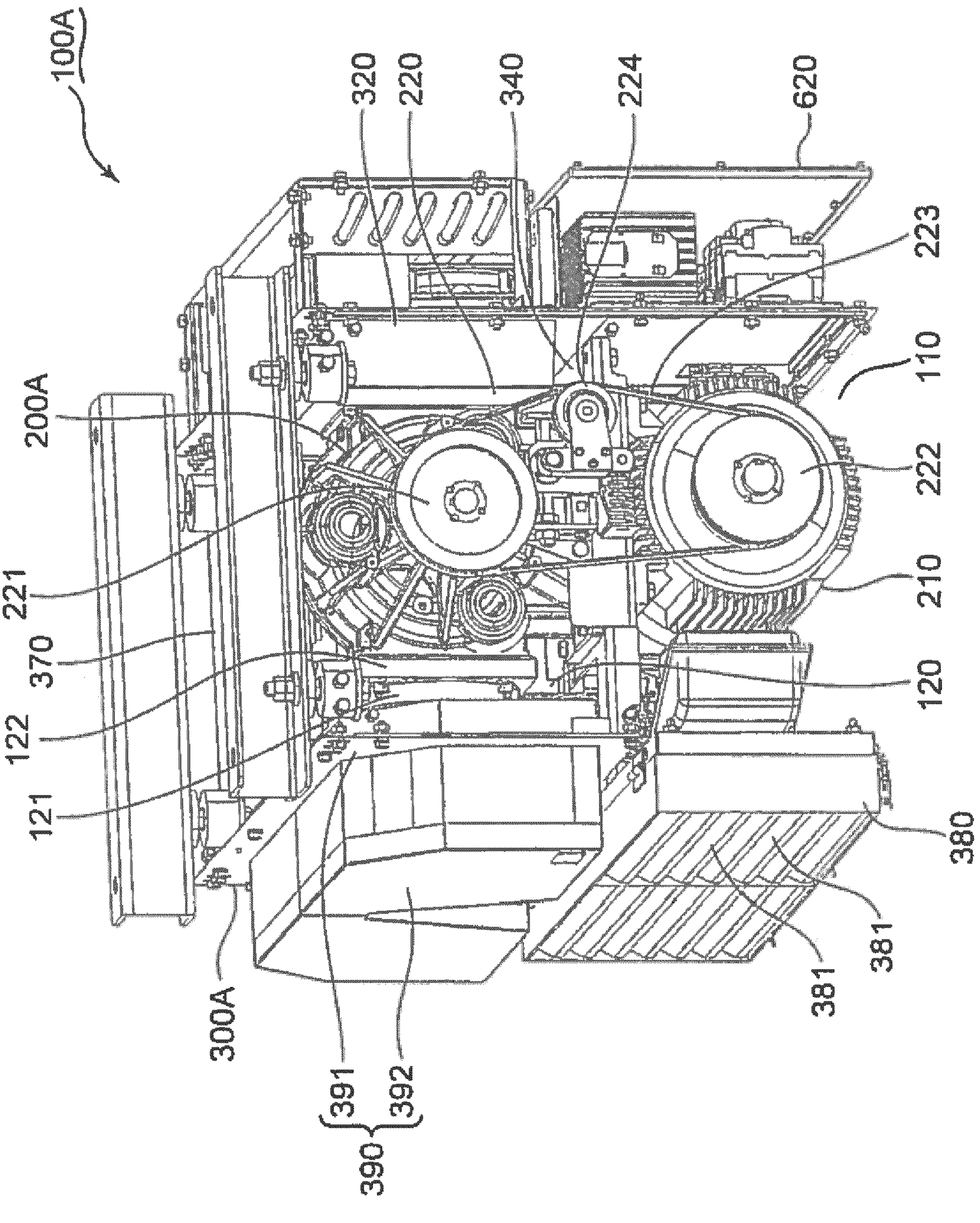

100A
320
220
340
224
620
223
110
222
210
120
380
381
381
200A
221
370
122
121
300A
391
392
390

FIG. 11A

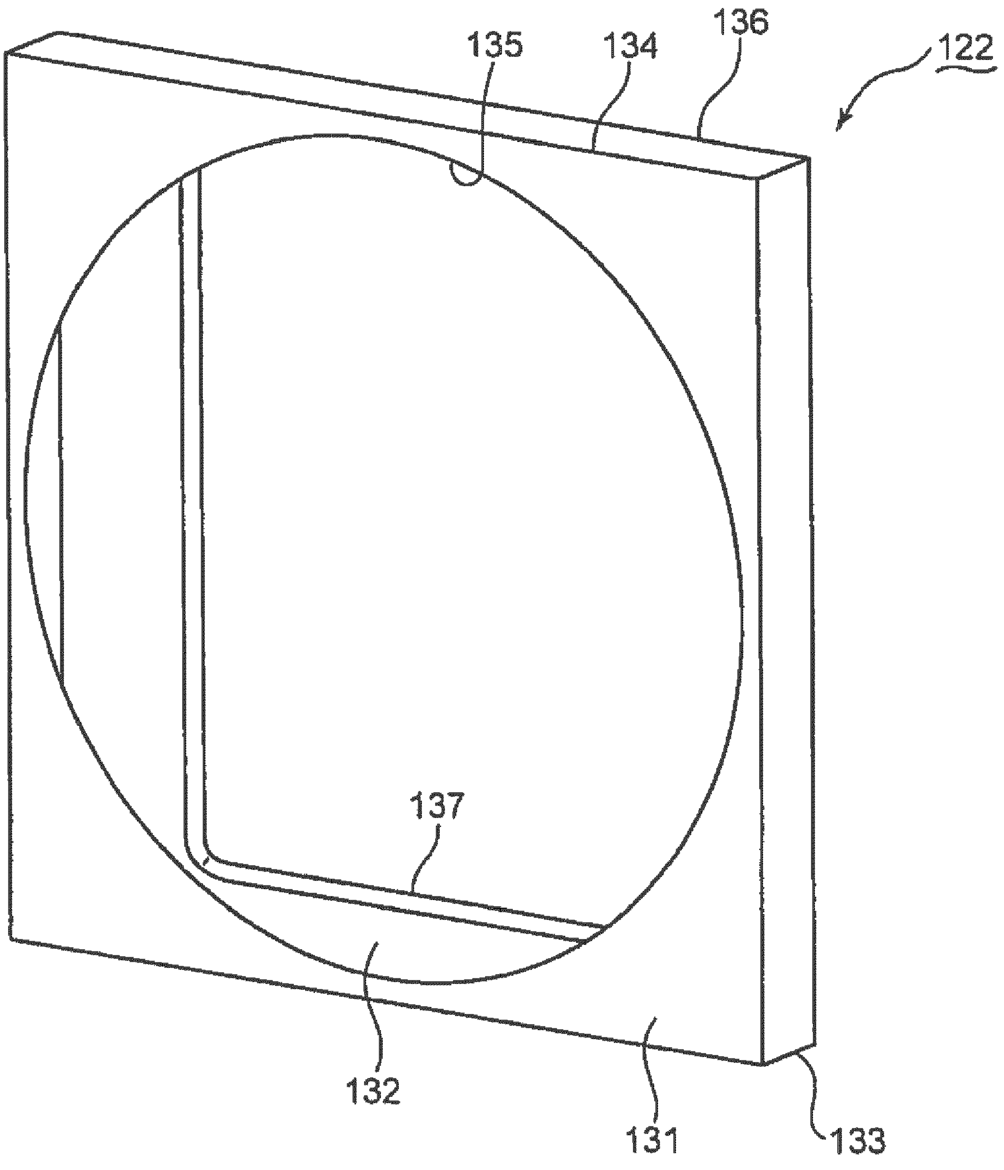
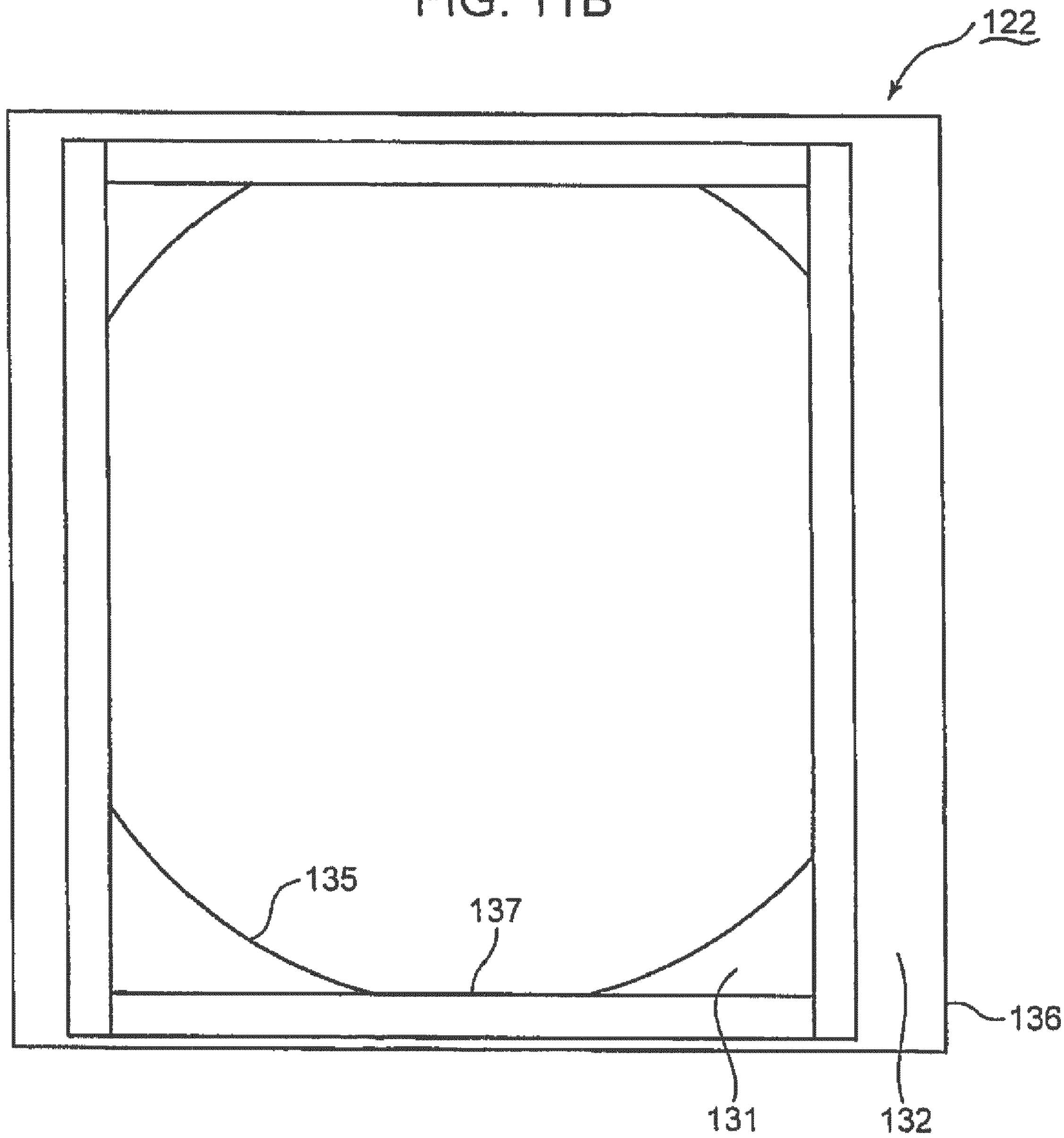
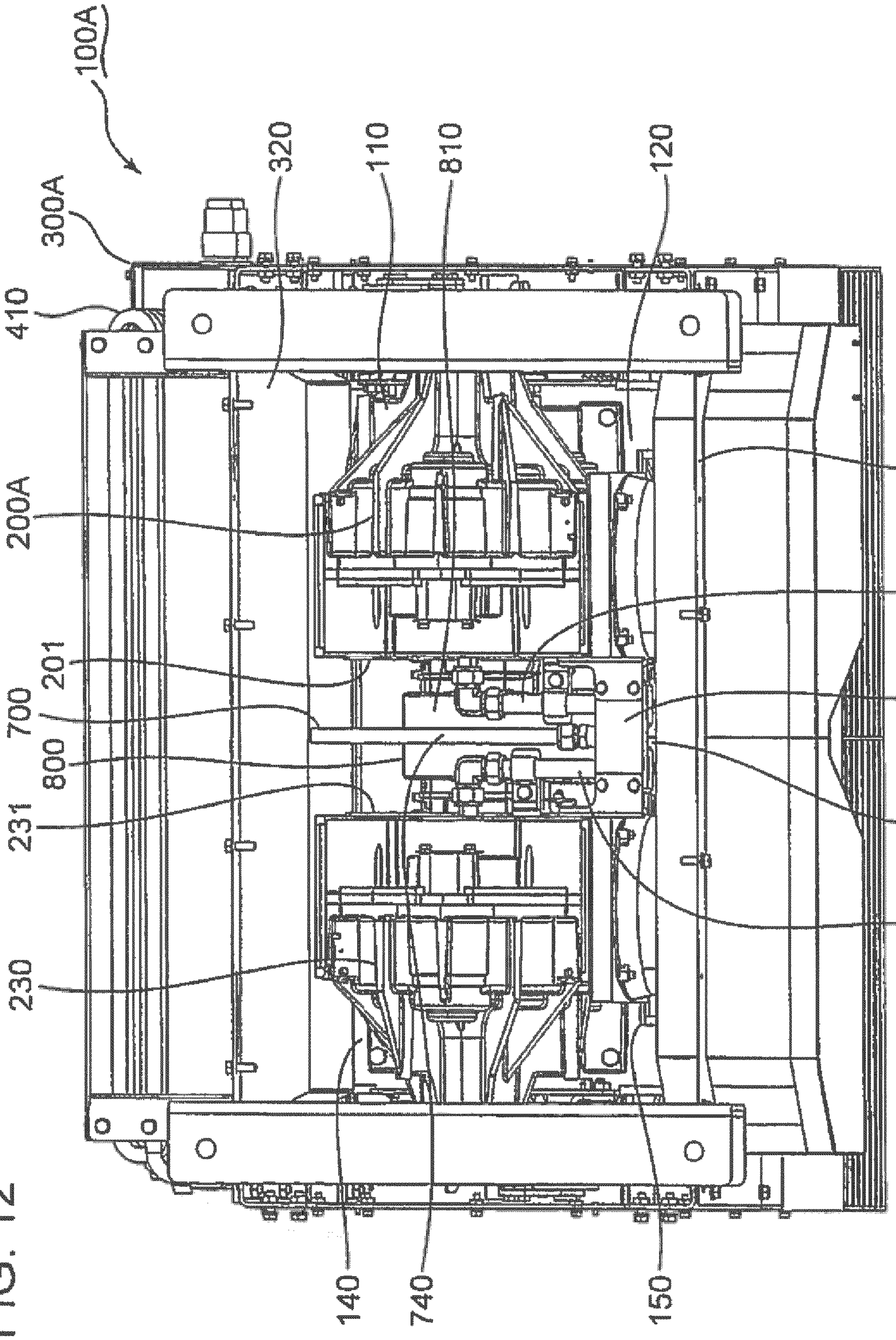


FIG. 11B




100A
300A
410
200A
201
700
800
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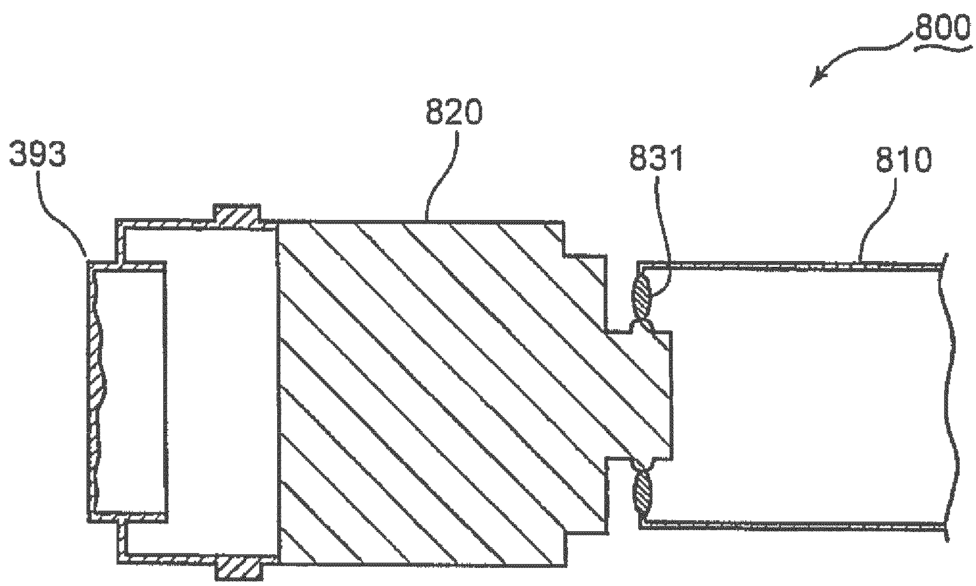
230
320
110
810
120
390
710
731
730
720
140
740
150

FIG. 12

FIG. 13



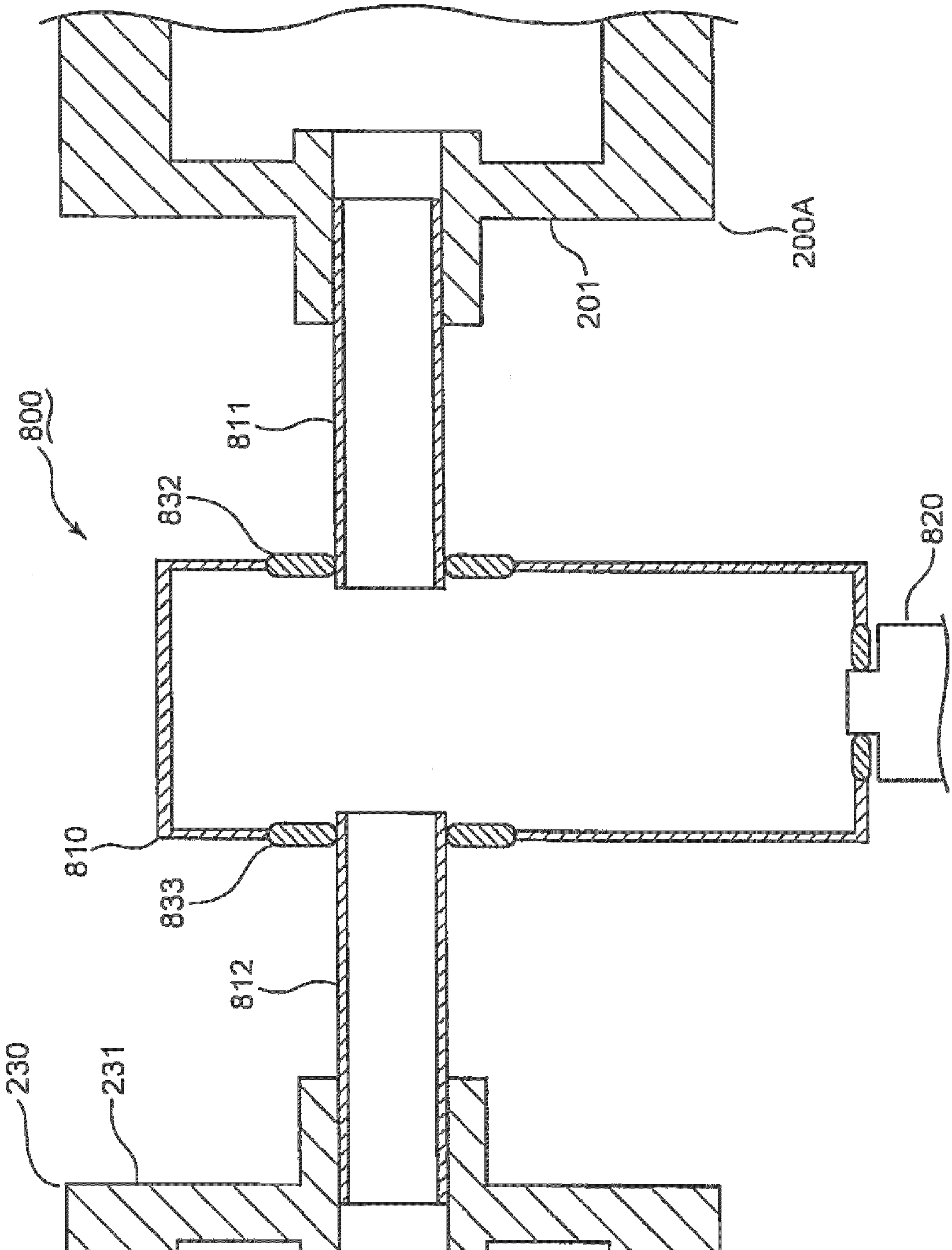
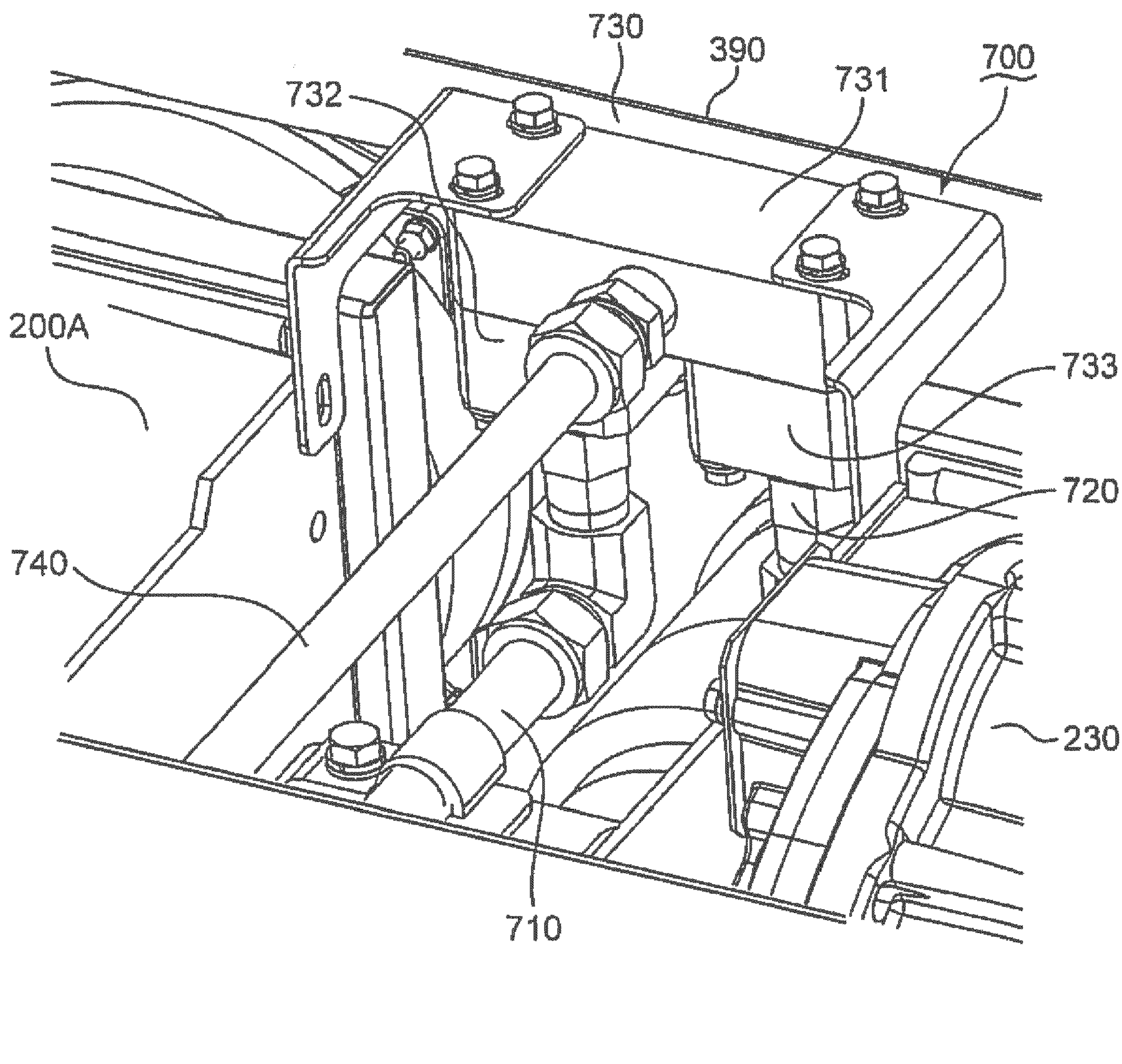


FIG. 14

FIG. 15



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			F04B

The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	6 November 2019	Ziegler, Hans-Jürgen

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