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(54) **SILENCING DEVICE AND REFRIGERATION AND FREEZING DEVICE**

(57) A silencing device (100) and a refrigeration and freezing device. The silencing device (100) includes: a silencing body, wherein a through hole (101) penetrating the silencing body is provided on a side wall of the silencing body, a diameter of the through hole (101) is $\Phi=nP$, where n is a preset coefficient and P is a stable

power of a compressor (301). In the silencing device (100), a calculation formula for a through hole (101) diameter size of the silencing device (100) is provided, which may serve as a design standard, and the calculation method is applicable to various different models of refrigeration and freezing devices.

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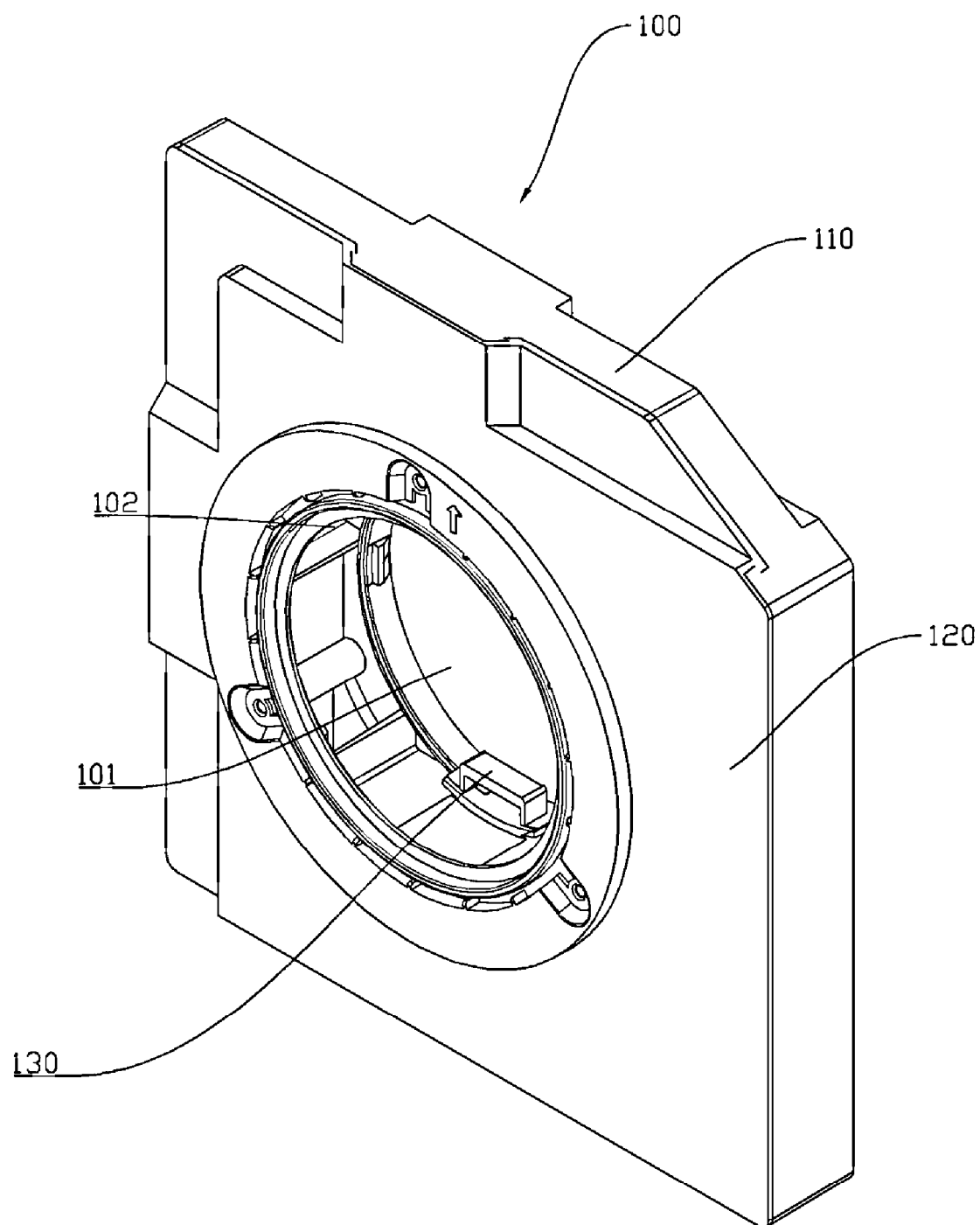


Fig.1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of refrigeration and storage technology, and particularly relates to a silencing device and a refrigeration and freezing device.

BACKGROUND

[0002] Currently, refrigerator noise is an important indicator of refrigerator performance, and compressor noise is the main noise source, with a noise contribution rate exceeding 70%. Moreover, frequent abnormal sounds occurring in a compressor compartment also affect the quality of the refrigerator.

SUMMARY

[0003] The present disclosure provides a silencing device and a refrigeration and freezing device.

[0004] In one aspect, the present disclosure provides a silencing device, including:

a silencing body, wherein a through hole penetrating the silencing body is provided on a side wall of the silencing body, and a diameter of the through hole satisfies the following relationship: $\Phi = nP$, where Φ is the diameter of the through hole, n is a preset coefficient, and P is a stable power of a compressor.

[0005] Optionally, a value range of the preset coefficient is 0.2 to 0.6.

[0006] Optionally, at least one muffling chamber is provided inside the silencing body, at least one sound absorbing hole is provided on a peripheral wall of the through hole, and each of the sound absorbing holes communicates with at least one of the muffling chambers; the silencing body is divided into a first body and a second body along a thickness direction of the silencing body, and the at least one muffling chamber is enclosed by the first body and the second body.

[0007] Optionally, the first body includes a first side plate, a peripheral wall and a muffling chamber partition located on the first side plate; the second body includes a second side plate and an insertion slot located on the second side plate and configured to be inserted and fitted with the muffling chamber partition, and the first side plate, the muffling chamber partition, the peripheral wall and the second side plate jointly enclose the through hole and the at least one muffling chamber.

[0008] Optionally, the second side plate is provided with a projection strip forming the insertion slot.

[0009] Optionally, both side walls of the insertion slot have gaps with the muffling chamber partition.

[0010] Optionally, an edge of the peripheral wall away from the first side plate is welded to the second side plate; a type of the welding is vibration friction welding or ultrasonic welding.

[0011] Optionally, an outer contour of the second side plate is greater than an outer contour of the peripheral wall.

[0012] Optionally, the at least one muffling chamber has a labyrinth structure or a sound flow structure or a honeycomb structure or a straight tube structure; the silencing body adopts sound absorbing metamaterial.

[0013] Optionally, the diameter of the through hole is 10 to 200 mm; the through hole is provided with an installation interface for installing a ventilation grille.

[0014] In another aspect, the present disclosure further provides a refrigeration and freezing device, including: a cabinet, wherein a compressor compartment is provided in the cabinet, the cabinet further includes the silencing device according to any one of the above embodiments, and the through hole of the silencing device communicates with an inner side of the compressor compartment.

[0015] Optionally, the silencing device is installed on an inner side of a compartment wall of the compressor compartment; or the silencing device is installed on an outer side of the compartment wall of the compressor compartment, and correspondingly a through opening corresponding to the through hole is provided on the compartment wall.

[0016] Optionally, the compressor compartment includes a compartment wall, the compressor is provided in the compressor compartment, two of the silencing devices are provided in the cabinet, a first silencing device of the two silencing devices is installed on a left wall of the compartment wall, a second silencing device of the two silencing devices is installed on a right wall of the compartment wall, a first through hole of the first silencing device and a second through hole of the second silencing device are vertically staggered, or the first through hole of the first silencing device and the second through hole of the second silencing device are coaxially arranged.

[0017] Optionally, when the first through hole of the first silencing device and the second through hole of the second silencing device are vertically staggered, the preset coefficient is a first preset coefficient; when the first through hole of the first silencing device and the second through hole of the second silencing device are coaxially arranged, the preset coefficient is a second preset coefficient; the second preset coefficient is greater than or equal to the first preset coefficient.

[0018] Optionally, a central axis of the first through hole is located between a top of the compressor and a top wall of the compartment wall, when the first through hole of the first silencing device and the second through hole of the second silencing device are vertically staggered, the second through hole is lower than the first through hole.

[0019] Optionally, the compressor includes an upper shell and a lower shell, and a connection zone is provided between the upper shell and the lower shell; a central axis of the second through hole is located between the connection zone and a bottom wall of the compartment wall.

[0020] Optionally, a horizontal distance between the first through hole and the compressor is less than a horizontal distance between the second through hole and the compressor.

[0021] Optionally, a heat dissipation fan is further provided in the compressor compartment, the heat dissipation fan is configured to blow air from an air inlet side of the compressor compartment to an air outlet side of the compressor compartment, and the compressor is located at the air outlet side of the compressor compartment.

[0022] Optionally, the refrigeration and freezing device further includes a condenser, the condenser is arranged at the air inlet side in the compressor compartment, and the heat dissipation fan is located between the compressor compartment and the condenser; or the heat dissipation fan is located at the air inlet side of the compressor compartment, and the condenser is located between the compressor compartment and the heat dissipation fan.

[0023] Optionally, the compressor includes an upper shell and a lower shell, and a connection zone is provided between the upper shell and the lower shell; a central axis of the second through hole is located between a center position of the heat dissipation fan in a height direction and the bottom wall of the compartment wall.

[0024] Optionally, a central axis of the second through hole is located between a center position of the condenser in a height direction and a bottom wall of the compartment wall.

[0025] In the silencing device of the present disclosure, a calculation formula for a through hole diameter size of the silencing device is provided, which may serve as a design standard. The calculation method is applicable to various different models of refrigeration and freezing devices. Since the diameter of the through hole of the silencing device is designed according to the stable power of the compressor, the silencing device may take both heat dissipation and silencing into account, thereby improving user experience.

[0026] According to the detailed description of specific embodiments of the present disclosure in combination with the accompanying drawings hereinafter, those skilled in the art will better understand the above and other objectives, advantages and features of the present disclosure.

BRIEF DESCRIPTION OF DRAWINGS

[0027] Hereinafter, some specific embodiments of the present disclosure will be described in detail with reference to the accompanying drawings in an exemplary and non-limiting manner. The same reference numerals in the drawings denote the same or similar components or parts. Those skilled in the art should understand that these drawings are not necessarily drawn to scale.

Fig. 1 is a schematic structural diagram of a silencing device according to an embodiment of the present disclosure.

Fig. 2 is a schematic structural diagram of a first body according to an embodiment of the present disclosure.

Fig. 3 is a schematic structural diagram of a second body according to an embodiment of the present disclosure.

Fig. 4 is a schematic structural diagram of a silencing device according to an embodiment of the present disclosure.

Fig. 5 is a cross-sectional view along A-A of Fig. 4.

Fig. 6 is a schematic structural diagram of a refrigeration and freezing device according to an embodiment of the present disclosure.

Fig. 7 is a schematic structural diagram of a compressor compartment according to an embodiment of the present disclosure.

Fig. 8 is a schematic airflow distribution diagram of a compressor compartment according to an embodiment of the present disclosure.

Fig. 9 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 10 is a schematic airflow distribution diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 11 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 12 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 13 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 14 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

Fig. 15 is a schematic structural diagram of a compressor compartment according to another embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0028] A silencing device and a refrigeration and freezing device according to embodiments of the present disclosure will be described below with reference to Figs. 1 to 15. In the description of the present embodiment, it should be understood that the terms "first" and "second" are used for descriptive purposes only, and cannot be understood as indicating or implying relative importance or implicitly indicating the number of the indicated technical features. Thus, features defined with "first" and "second" may explicitly or implicitly include at least one of the features, that is, include one or more of the features. In the description of the present disclosure, "multiple" means at least two, such as two, three, etc., unless otherwise explicitly and specifically defined. When a feature "includes or includes" one or some features cov-

ered thereby, unless otherwise specifically described, this indicates that other features are not excluded and other features may be further included.

[0029] Unless otherwise clearly specified and defined, terms such as "arrange", "install", "connect", "connection", "fix", "couple", etc. should be understood in a broad sense. For example, they may be fixed connections, or detachable connections, or integrated; they may be mechanical connections, or electrical connections; they may be directly connected, or indirectly connected through intermediate media, may be internal communication between two elements or interactive relationship between two elements, unless otherwise clearly defined. Those of ordinary skill in the art should be able to understand the specific meanings of the above terms in the present disclosure according to specific situations.

[0030] Furthermore, in the description of the present embodiment, a first feature being "above" or "below" a second feature may include the first feature and the second feature being in direct contact, and may also include the first feature and the second feature not being in direct contact but contacting through another feature between them. That is, in the description of the present embodiment, the first feature being "above", "over" and "on" the second feature includes the first feature being directly above and diagonally above the second feature, or merely indicates that the first feature has a horizontal height higher than the second feature. The first feature being "below", "under", or "beneath" the second feature may mean the first feature is directly below or diagonally below the second feature, or merely indicates that the first feature has a horizontal height lower than the second feature.

[0031] In the description of the present embodiment, descriptions with reference to terms such as "one embodiment", "some embodiments", "illustrative embodiment", "example", "specific example", or "some examples" mean that specific features, structures, materials or characteristics described in combination with the embodiment or example are included in at least one embodiment or example of the present disclosure. In the present specification, the illustrative expressions of the above terms do not necessarily refer to the same embodiment or example. Moreover, the described specific features, structures, materials or characteristics may be combined in any one or more embodiments or examples in a suitable manner.

[0032] In the related art, silencing devices may be provided at ventilation windows on the left and right sides of a compressor compartment to reduce noise of the compressor compartment through the silencing devices. Through holes are provided on side walls of the silencing devices, muffling chambers are provided inside silencing bodies, and sound absorbing holes communicating with the muffling chambers are provided on peripheral walls of the through holes. Due to serious heat dissipation problems in the compressor compartment, the energy consumption of refrigerators is affected. In a case where the

compressor compartment has no fan, the compressor compartment dissipates heat through natural convection. That is, after installing silencing devices for silencing, the compressor compartment is basically in a closed state, and heat dissipation is mainly performed through natural convection via through holes on side walls of the silencing devices. The diameter size of the through holes determines the effects of silencing and heat dissipation. An excessively large diameter results in small silencing, while an excessively small diameter results in small heat dissipation. However, there is currently no unified standard for the design of through hole diameters of silencing devices, which results in the silencing devices being unable to take both heat dissipation and silencing into account simultaneously, reducing user experience.

[0033] Fig. 1 is a schematic structural diagram of a silencing device 100. As shown in Fig. 1 and with reference to Figs. 2 to 10, an embodiment of the present disclosure provides a silencing device 100, and the silencing device 100 may be used for a refrigeration and freezing device.

[0034] The silencing device 100 includes a silencing body, at least one muffling chamber 103 is provided inside the silencing body, a through hole 101 penetrating the silencing body is provided on a side wall of the silencing body, at least one sound absorbing hole 102 is provided on a peripheral wall 113 of the through hole 101, and each sound absorbing hole 102 communicates with at least one muffling chamber 103. A diameter Φ of the through hole 101 satisfies the following relationship: $\Phi = nP$.

[0035] Where n is a preset coefficient, P is a stable power of a compressor, where a unit of Φ is millimeter, a unit of P is watt, and a unit of the preset coefficient is millimeter/watt. In some embodiments, one sound absorbing hole 102 communicates with at least one muffling chamber 103. Assuming that five muffling chambers 103 are provided inside the silencing body, one sound absorbing hole 102 communicates with at least one muffling chamber 103 among the five muffling chambers 103.

[0036] The working principle of the silencing device 100 of the present disclosure is as follows: during use, the silencing device 100 may be placed inside or outside a compressor compartment 300 of a refrigerator, and the through hole 101 is made to communicate the inner side and the outer side of the compressor compartment 300. When noise in the compressor compartment 300 propagates from inside to outside, passing through the silencing device 100 inside or outside the compressor compartment 300, the noise enters the interior of the muffling chamber 103 through the through hole 101 and the sound absorbing hole 102 under the blocking action of the side wall of the silencing body. Under the muffling action of the muffling chamber 103, the noise is significantly reduced.

[0037] Specifically, on one hand, a hole wall of the through hole 101 serves as a sound absorbing surface; on the other hand, the through hole 101 serves as a heat

dissipation channel, which may transport heat inside the compressor compartment 300 to an exterior of the compressor, thereby dissipating heat for the compressor compartment 300. The size of the heat dissipation channel directly affects the heat dissipation effect. As shown in Figs. 7 to 10, when the compressor compartment 300 has no fan, heat dissipation of the compressor compartment 300 completely relies on natural convection. During use, the silencing device 100 may be installed on the left side and the right side of the compressor compartment 300; after installing the silencing device 100, the compressor compartment 300 is basically in a closed state, only the silencing devices 100 on a left wall and a right wall of the compressor compartment 300 are provided with through holes 101 that may be used for ventilation, and other positions are basically closed except for screw holes or reserved holes provided on a rear wall and a bottom wall of the compressor compartment 300. Therefore, in a case where the compressor compartment 300 is basically closed and there is no heat dissipation fan in the compressor compartment 300, heat dissipation is mainly performed through natural convection via the through holes 101 of the silencing devices 100 on the left and right sides of the compressor compartment 300.

[0038] In the embodiment of the present disclosure, the stable power of the compressor refers to an operating power when the compressor operates stably. Compressors of different refrigerator models have different stable powers. The greater the stable power of the compressor, the greater the noise and heat generation when the compressor operates stably. Therefore, the embodiment of the present disclosure designs the diameter size of the through hole 101 on the silencing body according to the stable power of the compressor.

[0039] In the embodiment of the present disclosure, a calculation formula for the through hole 101 diameter size of the silencing device 100 is provided, which may serve as a design standard for the diameter size of the through hole 101 of the silencing device 100. The calculation method is applicable to various different models of refrigeration and freezing devices. Since the diameter of the through hole 101 of the silencing device 100 is designed according to the stable power of the compressor, the silencing device 100 may take both heat dissipation and silencing into account simultaneously, thereby improving user experience.

[0040] In some embodiments of the present disclosure, a value range of the preset coefficient is 0.2 to 0.6 millimeter/watt.

[0041] For example: the preset coefficient may be 0.2, 0.3, 0.4, 0.5 or 0.6 millimeter/watt.

[0042] As shown in Figs. 1 to 5, in some embodiments of the present disclosure, at least one muffling chamber 103 is provided inside the silencing body, at least one sound absorbing hole 102 is provided on a peripheral wall 113 of the through hole 101, and each of the sound absorbing holes 102 communicates with at least one of the muffling chambers 103; the silencing body is config-

ured as a split structure, the silencing body is divided into a first body 110 and a second body 120 along a thickness direction thereof, and the muffling chamber 103 is enclosed by the first body 110 and the second body 120.

[0043] Specifically, during a manufacturing process, the first body 110 and the second body 120 are manufactured separately. After the first body 110 and the second body 120 are respectively manufactured, the first body 110 and the second body 120 are assembled together, thereby forming the silencing device 100. In the split manufacturing process, multiple muffling chambers 103 with different lengths, widths and heights are designed according to silencing requirements, so that the muffling chambers 103 of different sizes correspond to different silencing sound pressure frequency bands, thereby enabling the silencing device 100 to have better silencing effects.

[0044] In the embodiment of the present disclosure, since the silencing body has a split structure, production and preparation of the first body 110 and the second body 120 are facilitated, and difficulty of production and processing is reduced. Therefore, the silencing body provided by the embodiment of the present disclosure is simple to manufacture and assemble, which may simplify manufacturing processes and save costs; in addition, in the embodiment of the present disclosure, multiple muffling chambers 103 of different sizes are provided inside the silencing body, which is more conducive to absorbing noise of different frequencies. Moreover, since the silencing body has the muffling chamber 103, the through hole 101 and the sound absorbing hole 102, the silencing body has a heat dissipation function while absorbing sound and reducing noise.

[0045] As shown in Figs. 2 to 5, in some embodiments of the present disclosure, the first body 110 includes a first side plate 111, a peripheral wall 113 and a muffling chamber partition 112 located on the first side plate 111; the second body 120 includes a second side plate 121 and an insertion slot 122 located on the second side plate 121 and configured to be inserted and fitted with the muffling chamber partition 112, and the first side plate 111, the muffling chamber partition 112, the peripheral wall 113 and the second side plate 121 jointly enclose the through hole 101 and the muffling chamber 103.

[0046] In the manufacturing and assembly process, the first body 110 and the second body 120 are manufactured separately first, and then the two are assembled together. Specifically, the muffling chamber partition 112 of the first body 110 is inserted into the insertion slot 122 of the second body 120, and the peripheral wall 113 of the first body 110 is made to contact the second side plate 121 of the second body 120, so that the first body 110 and the second body 120 jointly enclose the through hole 101 and the muffling chamber 103.

[0047] In the embodiment of the present disclosure, since the muffling chamber partition 112 is inserted into the insertion slot 122, on one hand, each muffling chamber 103 may be made into a closed chamber, thereby

improving the sealing effect and silencing effect of each muffling chamber 103; on the other hand, a positioning function may also be achieved, thereby improving the assembly efficiency of the first body 110 and the second body 120.

[0048] As shown in Fig. 5, in some embodiments of the present disclosure, the muffling chamber partition 112 is perpendicular to the first side plate 111 to facilitate production and manufacturing.

[0049] As shown in Fig. 5, the peripheral wall 113 is perpendicular to the first side plate 111, so that the silencing device 100 has an aesthetically pleasing appearance and is convenient for production and manufacturing.

[0050] In some embodiments of the present disclosure, the second side plate 121 is provided with projection strips 123 forming the insertion slot 122. In some embodiments of the present disclosure, a recessed portion forming the insertion slot 122 is provided on a surface of the second side plate.

[0051] In the embodiment of the present disclosure, since the insertion slot 122 is formed by the projection strips 123 arranged at intervals, the depth of the insertion slot 122 may be increased, thereby increasing the size of the portion of the muffling chamber partition 112 inserted into the insertion slot 122, and further improving the sealing effect and silencing effect of each muffling chamber 103.

[0052] In some embodiments of the present disclosure, both side walls of the insertion slot 122 have gaps with the corresponding muffling chamber partition 112.

[0053] In the embodiment of the present disclosure, since the insertion slot 122 and the muffling chamber partition 112 have a clearance fit, the insertion slot 122 is convenient to be inserted in place, and the sealing property of the muffling chamber 103 may be further improved, thereby providing better silencing effects.

[0054] In some embodiments of the present disclosure, an edge of the peripheral wall 113 away from the first side plate 111 is welded to the second side plate 121.

[0055] In the manufacturing and assembly process, the muffling chamber partition 112 of the first body 110 is inserted into the insertion slot 122 of the second body 120, and the peripheral wall 113 of the first body 110 is made to contact the second side plate 121 of the second body 120, and then the connection position between the peripheral wall 113 and the second side plate 121 is welded, thereby fixing the two together.

[0056] In the present embodiment, compared with fastening connection or snap-fit connection methods, the welding method may improve the sealing performance of the silencing device 100, thereby enabling the silencing device 100 to have better silencing effects.

[0057] Further, in some embodiments of the present disclosure, a type of the welding is vibration friction welding.

[0058] Specifically, the edge of the peripheral wall 113 away from the first side plate 111 and the second side

plate 121 are fixedly connected together through vibration friction welding. Vibration friction welding is a technology that achieves welding by using heat generated by interface friction caused by relative vibration of two workpieces. The workpieces are placed on a specified device, and under certain pressure, vibration occurs on the contact surface to generate friction until the interface begins to melt, then the vibration is stopped and pressure is continued to be maintained until solidification, thereby achieving the welding purpose. By using vibration friction welding, the connection strength between the peripheral wall 113 and the second side plate 121 may be improved, the welding speed may also be improved, and no electric welding smoke and pollutants harmful to human body such as manganese and nickel are generated during the welding process.

[0059] In some other embodiments of the present disclosure, a type of the welding is ultrasonic welding.

[0060] Specifically, the edge of the peripheral wall 113 away from the first side plate 111 and the second side plate 121 are fixedly connected together through ultrasonic welding. Compared with traditional welding methods, ultrasonic welding has significant advantages such as fast welding speed, high welding efficiency, good weld quality, aesthetically pleasing welds, and clean and environmentally friendly welding process, which is very suitable for mass production use. Therefore, ultrasonic welding is a fast, clean, and effective assembly process.

[0061] In some embodiments of the present disclosure, an outer contour of the second side plate 121 is greater than an outer contour of the peripheral wall 113, so that welds or solder do not exceed the second body 120 after welding.

[0062] In the present embodiment, since the outer contour of the second side plate 121 is greater than the outer contour of the peripheral wall 113, after welding, welds or solder between the two will not be at the outermost edge of the silencing device 100, thereby making the appearance of the silencing device 100 more aesthetically pleasing.

[0063] In some embodiments of the present disclosure, an outer contour of the second side plate 121 is equal to an outer contour of the peripheral wall 113.

[0064] In some embodiments of the present disclosure, a fixed connection method between the peripheral wall 113 and the second side plate 121 is fastening connection. For example, connection holes are provided on both the second side plate 121 and the edge of the peripheral wall 113 away from the first side plate 111; the muffling chamber partition 112 of the first body 110 is inserted into the insertion slot 122 of the second body 120, and the peripheral wall 113 of the first body 110 is made to contact the second side plate 121 of the second body 120, and then screws are installed in the connection holes to fasten the first body 110 and the second body 120 through the screws. The fastening connection method has advantages of convenient operation and high assembly efficiency.

[0065] In some embodiments of the present disclosure, a fixed connection method between the peripheral wall 113 and the second side plate 121 is snap-fit connection.

[0066] In some embodiments of the present disclosure, at least one of the muffling chambers 103 has a labyrinth structure.

[0067] In the present embodiment, compared with the muffling chambers 103 having sound flow structure, honeycomb structure or straight tube structure, the muffling chamber 103 having labyrinth structure has greater depth and may significantly extend the sound propagation path, forming an acoustic superstructure, thereby further improving the silencing effect of the silencing device 100.

[0068] In some embodiments of the present disclosure, at least one of the muffling chambers 103 has a sound flow structure.

[0069] In some embodiments of the present disclosure, at least one of the muffling chambers 103 has a honeycomb structure.

[0070] In some embodiments of the present disclosure, at least one of the muffling chambers 103 has a straight tube structure.

[0071] In some embodiments of the present disclosure, the silencing body adopts sound absorbing metamaterial.

[0072] Sound absorbing metamaterial (MAT metamaterial, where MAT is an abbreviation for Metamaterial Absorption Technology) adopts a synthetic material with high sound absorption efficiency, and has complex maze pattern structures on it. Each maze channel may absorb specific frequencies, and its sound absorption efficiency reaches up to 99%. In addition, compared with general sound absorbing materials, sound absorbing metamaterial has more stable chemical properties, is safer, and is odorless, has good elasticity, is fire-resistant and flame-retardant, is mold-proof and antibacterial, and has good tactile sensation and weight sensation.

[0073] In some embodiments of the present disclosure, the silencing body adopts ABS (Acrylonitrile butadiene styrene) material.

[0074] In some embodiments of the present disclosure, a diameter of the through hole 101 is 10 to 200 mm.

[0075] For example: the diameter of the through hole 101 is 10 mm, 20 mm, 30 mm, 40 mm, 50 mm, 60 mm, 80 mm, 100 mm, 120 mm, 150 mm, 180 mm or 200 mm.

[0076] Specifically, since the through hole 101 on the silencing body may serve as both a sound entry hole and a heat dissipation hole, a large diameter of the through hole 101 is beneficial for heat dissipation, but a large diameter may lead to a decrease in silencing; a small diameter of the through hole 101 is beneficial for silencing, but heat dissipation will decrease. Therefore, in the present embodiment, by setting the diameter of the through hole 101 to a reasonable size, the silencing device 100 may have both good silencing effects and good heat dissipation effects.

[0077] In some embodiments of the present disclosure, the through hole 101 is provided with an installation interface 130 for installing a ventilation grille. In the embodiment of the present disclosure, the installation interface 130 has a snap-fit structure, which is consistent with existing interfaces and is used for installing ventilation grilles, improving universality and practicality, reducing costs, and being applicable to refrigerators of different categories and different models.

[0078] As shown in Fig. 6, an embodiment of the present disclosure further provides a refrigeration and freezing device, and the refrigeration and freezing device includes a cabinet 200. A compressor compartment 300 is provided in the cabinet 200, the cabinet 200 further includes the silencing device 100 according to any one of the above embodiments, and the through hole 101 of the silencing device 100 communicates with an inner side of the compressor compartment 300.

[0079] In the embodiment of the present disclosure, by installing the silencing device 100 inside the refrigeration and freezing device, noise inside the refrigeration and freezing device may be reduced, thereby improving user experience. In addition, the embodiment of the present disclosure provides a calculation formula for the through hole 101 diameter size of the silencing device 100, which may serve as a design standard for the diameter size of the through hole 101 of the silencing device 100. The calculation method is applicable to various different models of refrigeration and freezing devices. Since the diameter of the through hole 101 of the silencing device 100 is designed according to the stable power of the compressor, the silencing device 100 may take both heat dissipation and silencing into account simultaneously, thereby improving user experience.

[0080] In some embodiments of the present disclosure, the silencing device 100 is installed on an inner side of a compartment wall of the compressor compartment 300. A through opening corresponding to the through hole 101 is provided on the corresponding compartment wall.

[0081] During use, when noise in the compressor compartment 300 propagates from inside to outside, passing through the silencing body, the noise enters the muffling chamber 103 through the through hole 101 and the sound absorbing hole 102 under the blocking action of the side wall of the silencing body, extending the sound propagation path. Under the action of the muffling chamber 103, the noise is significantly reduced. Meanwhile, heat inside the compressor is transported to an exterior of the compressor compartment 300 through the through hole 101 and the through opening.

[0082] In some other embodiments of the present disclosure, the silencing device 100 is installed on an outer side of the compartment wall of the compressor compartment 300, and correspondingly a through opening corresponding to the through hole 101 is provided on the compartment wall. The silencing device 100 is installed within the through opening.

[0083] During use, when noise in the compressor compartment 300 propagates from inside to outside, passing through the silencing body, the noise enters the muffling chamber 103 through the through opening, the through hole 101 and the sound absorbing hole 102 under the blocking action of the side wall of the silencing body. Under the action of the muffling chamber 103, the noise is significantly reduced. Meanwhile, heat inside the compressor is transported to the exterior of the compressor compartment 300 through the through opening and the through hole 101. In addition, installing the silencing device 100 within a foam layer around the compressor compartment 300 does not additionally occupy the volume of the refrigerator, minimizes loss of the refrigerator volume, and provides stable and firm installation that is impact-resistant and meets transportation requirements.

[0084] In some embodiments of the present disclosure, the refrigeration and freezing device further includes a ventilation grille installed at an end of the through hole 101 away from the compressor compartment 300. Further, the ventilation grille is located on an outer side of the compressor compartment 300.

[0085] To facilitate installation and meet universality requirements, the ventilation grille is installed at the end of the through hole 101 away from the compressor compartment 300 through a snap-fit structure. The snap-fit structure includes snap-fit hole strips, snap-fit protrusions and snap-fit fasteners. Both ends of the snap-fit hole strips are connected to hole edges at the end of the through hole 101 away from the compressor compartment 300 to define snap-fit holes. The snap-fit protrusions are arranged within the snap-fit holes and are connected to the hole edges at the end of the through hole 101 away from the compressor compartment 300. The snap-fit fasteners are connected to a surface of the ventilation grille facing the compressor compartment 300, are inserted into the snap-fit holes, and cooperate with the snap-fit protrusions.

[0086] In some embodiments of the present disclosure, the refrigeration and freezing device is a refrigerator.

[0087] A refrigeration system is provided inside the refrigerator, and the refrigeration system has a circulation circuit for circulating flow of refrigerant. The refrigeration system includes a compressor 301, a condenser, a throttling pipeline and an evaporator connected in sequence. At least the compressor is arranged in the compressor compartment 300. The compressor compartment 300 may be at any position of the refrigerator, such as a bottom, middle or top of the refrigerator.

[0088] In some embodiments, the compressor compartment 300 is located at the bottom of the refrigerator, that is, the compressor compartment 300 is located at a bottom of the cabinet 200.

[0089] In some embodiments of the present disclosure, the refrigeration and freezing device is a freezer.

[0090] In some embodiments of the present disclosure, the compartment wall includes a front wall, a rear

wall, a top wall, a bottom wall, a left wall and a right wall. The silencing device 100 is installed on at least one of the left wall and the right wall of the compartment wall.

[0091] In some embodiments, the silencing devices 100 are installed on both the left wall and the right wall of the compartment wall.

[0092] As shown in Figs. 7 and 8, in some embodiments, the compressor compartment 300 includes a compartment wall, a compressor 301 is provided in the compressor compartment 300, the silencing devices 100 are installed on both the left wall and the right wall of the compartment wall, and the through holes 101 of the two silencing devices 100 are coaxially arranged, that is, the two through holes 101 have the same height.

[0093] In some embodiments of the present disclosure, the through holes of the two silencing devices are coaxially arranged, each through hole serves as both an air inlet and an air outlet, and heat flow lines are chaotic. Therefore, the through holes arranged symmetrically have poor heat dissipation effects on the compressor compartment 300, which may easily cause overheating shutdown and affect the service life of the compressor.

[0094] As shown in Figs. 9 and 10, in some embodiments of the present disclosure, a compressor 301 is provided in the compressor compartment 300, the compressor compartment 300 includes a compartment wall, the silencing devices 100 are installed on both the left wall and the right wall of the compartment wall, and the through holes 101 of the two silencing devices 100 are vertically staggered.

[0095] Specifically, the through holes 101 of the two silencing devices 100 are respectively a first through hole 1011 and a second through hole 1012, and the first through hole 1011 is higher than the second through hole 1012. The compartment wall of the compressor compartment 300 includes a front wall, a rear wall, a top wall, a bottom wall, a left wall and a right wall. Except for the through openings and the through holes 101 on the left and right sides of the compressor compartment 300, the compressor compartment 300 is basically closed, and the compressor compartment 300 dissipates heat through the through holes 101 on the left and right sides.

[0096] In some embodiments, since the through holes 101 of the two silencing devices 100 are vertically staggered and have an asymmetric structure, in a scenario where there is no heat dissipation fan in the compressor compartment 300 and natural convection occurs, the scenario includes a case where only a compressor is provided in the compressor compartment 300. When the compressor operates, high-temperature airflow in the compressor compartment 300 flows upward and exits the compressor compartment 300 through the through hole 101 at a higher position (that is, the first through hole 1011). Meanwhile, since the high-temperature airflow flows upward, negative pressure is generated at the bottom of the compressor compartment 300. Under the action of atmospheric pressure, external air enters the

compressor compartment 300 through the through hole 101 at a lower position (that is, the second through hole 1012). That is, the through hole 101 at the higher position (that is, the first through hole 1011) serves as an airflow outlet, and the through hole 101 at the lower position (that is, the second through hole 1012) serves as an airflow inlet, thereby forming an airflow penetrating the compressor compartment 300, quickly carrying away heat inside the compressor compartment 300, and further improving the heat dissipation effect. Therefore, under the premise that the through holes 101 adopt the same diameter size, compared with the coaxial arrangement of the through holes 101 of the two silencing devices 100 (as shown in Figs. 7 to 8), in the present embodiment, adopting the vertically staggered arrangement of the through holes 101 of the two silencing devices 100 may further improve the heat dissipation efficiency of the compressor compartment 300.

[0097] In some embodiments of the present disclosure, when the through holes 101 of the two silencing devices 100 are vertically staggered, the preset coefficient is a first preset coefficient; when the through holes 101 of the two silencing devices 100 are coaxially arranged, the preset coefficient is a second preset coefficient; the second preset coefficient is equal to the first preset coefficient. Therefore, under the premise that the stable power of the compressor remains unchanged, when calculating the diameter size according to the formula $\Phi=nP$, the diameter sizes of the through holes 101 are the same in the above two cases. Therefore, through the above arrangement, compared with the coaxial arrangement of the two through holes 101, adopting the vertically staggered arrangement of the two through holes 101 enables the silencing device 100 to provide better heat dissipation effects under the premise of the same silencing effect.

[0098] In some embodiments of the present disclosure, when the through holes 101 of the two silencing devices 100 are vertically staggered, the preset coefficient is a first preset coefficient; when the through holes 101 of the two silencing devices 100 are coaxially arranged, the preset coefficient is a second preset coefficient; the second preset coefficient is greater than the first preset coefficient.

[0099] Specifically, under the premise that the stable power of the compressor remains unchanged, when calculating the diameter size according to the formula $\Phi=nP$, if the through holes 101 of the two silencing devices 100 are coaxially arranged, the preset coefficient adopted is recorded as the second preset coefficient, and the diameter size of the through holes 101 is recorded as the second diameter size; if the through holes 101 of the two silencing devices 100 are vertically staggered, the preset coefficient adopted is recorded as the first coefficient, and the diameter size of the through holes 101 is recorded as the first diameter size, and the first preset coefficient is less than the second preset coefficient. Therefore, under the premise that the stable power of

the compressor remains unchanged, when calculating the diameter size according to the formula $\Phi=nP$, the first diameter size is less than the second diameter size. Through the above arrangement, compared with the coaxial arrangement of the two through holes 101, adopting the vertically staggered arrangement of the two through holes 101 may enable the silencing device 100 to have better silencing effects under the premise of the same heat dissipation effect; or may enable the silencing device 100 to have better heat dissipation effects and silencing effects.

[0100] As shown in Figs. 9 to 10, in some embodiments of the present disclosure, a central axis of the first through hole 1011 is located between a top of the compressor and a top wall of the compartment wall, and the second through hole 1012 is lower than the first through hole 1011.

[0101] In the present embodiment, since the central axis of the first through hole 1011 is located between the top of the compressor and the top wall of the compartment wall, it not only provides an accurate reference for the design and manufacturing of the first through hole 1011, facilitating the manufacturing and assembly of the silencing device 100 on the air outlet side of the compressor compartment 300, but also is more conducive to the discharge of high-temperature gas from the compressor compartment 300.

[0102] In some embodiments of the present disclosure, the compressor 301 includes an upper shell 3011 and a lower shell 3012, and a connection zone 3013 is provided between the upper shell 3011 and the lower shell 3012; a central axis of the second through hole 1012 is located between the connection zone 3013 and a bottom wall of the compartment wall.

[0103] In the present embodiment, since the central axis of the second through hole 1012 is located between the connection zone 3013 and the bottom wall of the compartment wall. On one hand, a larger height difference between the first through hole 1011 and the second through hole 1012 is provided, which is more conducive to cold air entering the compressor compartment 300, and may extend the flow path of airflow in the compressor compartment 300, enabling the compressor compartment 300 to have better heat dissipation effects. On the other hand, a more accurate reference is provided for the design and manufacturing of the second through hole 1012, which is more convenient for the manufacturing and assembly of the silencing device 100 on the air inlet side of the compressor compartment 300, improving manufacturing precision and production efficiency.

[0104] Further, in some embodiments of the present disclosure, as shown in Fig. 11, the connection zone 3013 between the upper shell 3011 and the lower shell 3012 is a welding zone. That is, the upper shell 3011 and the lower shell 3012 are welded together.

[0105] In some embodiments of the present disclosure, a horizontal distance between the first through hole 1011 and the compressor is less than a horizontal dis-

tance between the second through hole 1012 and the compressor.

[0106] In the present embodiment, since the compressor is close to the first through hole 1011 (that is, the airflow outlet), it is more conducive to the rapid discharge of high-temperature airflow from the compressor compartment 300, thereby further improving the heat dissipation effect.

[0107] In some alternative embodiments of the present disclosure, a horizontal distance between the first through hole 1011 and the compressor is equal to a horizontal distance between the second through hole 1012 and the compressor. That is, the compressor is located at a middle position of the compressor compartment 300, and its distances to both sides of the compressor compartment 300 are equal.

[0108] As shown in Figs. 12-13, in some embodiments of the present disclosure, a heat dissipation fan 302 is further provided in the compressor compartment 300, the heat dissipation fan 302 is configured to blow air from an air inlet side of the compressor compartment 300 to an air outlet side of the compressor compartment 300, and the compressor 301 is located at the air outlet side of the compressor compartment 300.

[0109] Specifically, the first through hole 1011 is located at the air outlet side of the compressor compartment 300, and the second through hole 1012 is located at the air inlet side of the compressor compartment 300. During use, the heat dissipation fan 302 may blow air from the air inlet side of the compressor through the second through hole 1012 toward the first through hole 1011 located at the air outlet side of the compressor compartment 300, so that airflow in the compressor compartment 300 quickly flows out from the side close to the compressor.

[0110] In the embodiment of the present disclosure, the compressor 301 is located at the air outlet side of the compressor compartment 300. Under the action of the heat dissipation fan 302, air with a temperature lower than that of the compressor 301 may be drawn in, and the airflow speed in the compressor compartment 300 may be accelerated, enabling heat in the compressor compartment 300 to be quickly discharged. Therefore, compared with a scheme where only the compressor 301 is provided in the compressor compartment 300, by providing the heat dissipation fan 302 in the compressor compartment 300, the heat dissipation efficiency of the compressor compartment 300 may be further improved, enabling it to have better heat dissipation effects.

[0111] As shown in Fig. 14, in some other embodiments of the present disclosure, the refrigeration and freezing device further includes a condenser 303. The condenser 303 is arranged in the compressor compartment 300, the condenser 303 is located at an air inlet side of the compressor compartment 300, and the heat dissipation fan 302 is located between the compressor compartment 300 and the condenser 303. In the embodiment of the present disclosure, inlet air enters the compressor com-

partment 300 from the condenser 303 side, and the heat dissipation fan 302 may simultaneously dissipate heat for the compressor and the condenser 303. That is, the compressor 301 and the condenser 303 share one heat dissipation fan 302, thereby increasing storage space of the refrigeration and freezing device.

[0112] As shown in Fig. 15, in some embodiments, the refrigeration and freezing device further includes a condenser 303. The condenser 303 is arranged in the compressor compartment 300, the heat dissipation fan 302 is located at the air inlet side of the compressor compartment 300, and the condenser 303 is located between the compressor compartment 300 and the heat dissipation fan 302. In the present embodiment, the heat dissipation fan 302 may simultaneously dissipate heat for the compressor 301 and the condenser 303, that is, the compressor and the condenser 303 share one heat dissipation fan 302, thereby increasing storage space of the refrigeration and freezing device.

[0113] Further, in some embodiments of the present disclosure, as shown in Fig. 13, the compressor includes an upper shell 3011 and a lower shell 3012, and a connection zone 3013 is provided between the upper shell 3011 and the lower shell 3012. A central axis of the second through hole 1012 is located between a center position of the heat dissipation fan 302 in a height direction and a bottom wall of the compartment wall.

[0114] Specifically, the central axis of the second through hole 1012 of the compressor compartment 300 is located between a center position of the heat dissipation fan 302 in a height direction and a center position of the compressor 301 in a height direction.

[0115] In the embodiment of the present disclosure, on one hand, setting a height center of the second through hole 1012 (airflow inlet) between the center positions of the heat dissipation fan 302 and the compressor 301 in the height direction may maximize the intake of air with a temperature lower than that of the compressor 301, thereby forming a larger height difference between the first through hole 1011 and the second through hole 1012, which is more conducive to cold air entering the compressor compartment 300, and may extend the flow path of airflow in the compressor compartment 300, improving the heat dissipation effect. On the other hand, a more accurate reference is provided for the design and manufacturing of the second through hole 1012, which is more convenient for the manufacturing and assembly of the silencing device 100 on the air inlet side of the compressor compartment 300, and may improve manufacturing precision and production efficiency.

[0116] In some other embodiments of the present disclosure, as shown in Fig. 14, a central axis of the second through hole 1012 is located between a center position of the condenser 303 in a height direction and a bottom wall of the compartment wall.

[0117] In the present embodiment, since the central axis of the second through hole 1012 is located between a center position of the condenser 303 in a height direc-

tion and a bottom wall of the compartment wall, on one hand, a larger height difference is formed between the first through hole 1011 and the second through hole 1012, which is more conducive to cold air entering the compressor compartment 300, and may extend the flow path of airflow in the compressor compartment 300, improving the heat dissipation effect. On the other hand, a more accurate reference is provided for the design and manufacturing of the second through hole 1012, which is more convenient for the manufacturing and assembly of the silencing device 100 on the air inlet side of the compressor compartment 300, and may improve manufacturing precision and production efficiency.

[0118] So far, those skilled in the art should recognize that although multiple exemplary embodiments of the present disclosure have been shown and described in detail herein, many other variations or modifications conforming to the principles of the present disclosure may still be directly determined or derived from the content disclosed by the present disclosure without departing from the spirit and scope of the present disclosure. Therefore, the scope of the present disclosure should be understood and recognized as covering all these other variations or modifications.

Claims

1. A silencing device, **characterized in that**, comprising:

a silencing body, wherein a through hole penetrating the silencing body is provided on a side wall of the silencing body, and a diameter of the through hole satisfies the following relationship:

$$\Phi = nP,$$

where Φ is the diameter of the through hole, n is a preset coefficient, and P is a stable power of a compressor.

2. The silencing device according to claim 1, wherein a value range of the preset coefficient is 0.2 to 0.6.

3. The silencing device according to claim 1, wherein,

at least one muffling chamber is provided inside the silencing body, at least one sound absorbing hole is provided on a peripheral wall of the through hole, and each of the sound absorbing holes communicates with at least one of the muffling chambers;
the silencing body is divided into a first body and a second body along a thickness direction thereof, and the at least one muffling chamber is enclosed by the first body and the second body.

4. The silencing device according to claim 3, wherein,

the first body comprises a first side plate, a peripheral wall and a muffling chamber partition located on the first side plate;

the second body comprises a second side plate and an insertion slot located on the second side plate and configured to be inserted and fitted with the muffling chamber partition, and the first side plate, the muffling chamber partition, the peripheral wall and the second side plate jointly enclose the through hole and the at least one muffling chamber.

5. The silencing device according to claim 4, wherein the second side plate is provided with a projection strip forming the insertion slot.

6. The silencing device according to claim 4, wherein both side walls of the insertion slot have gaps with the muffling chamber partition.

7. The silencing device according to claim 4, wherein,

an edge of the peripheral wall away from the first side plate is welded to the second side plate; a type of the welding is vibration friction welding or ultrasonic welding.

8. The silencing device according to claim 7, wherein an outer contour of the second side plate is greater than an outer contour of the peripheral wall.

9. The silencing device according to claim 3, wherein,

the at least one muffling chamber has a labyrinth structure or a sound flow structure or a honeycomb structure or a straight tube structure; the silencing body adopts sound absorbing metamaterial.

10. The silencing device according to claim 1, wherein,

the diameter of the through hole is 10 to 200 mm; the through hole is provided with an installation interface for installing a ventilation grille.

11. A refrigeration and freezing device, comprising a cabinet,

a compressor compartment is provided in the cabinet,

characterized in that, the cabinet further comprises the silencing device according to any one of claims 1 to 10, and the through hole of the silencing device communicates with an inner side of the compressor compartment.

12. The refrigeration and freezing device according to claim 11, wherein,

the silencing device is installed on an inner side of a compartment wall of the compressor compartment; or
the silencing device is installed on an outer side of the compartment wall of the compressor compartment, and correspondingly a through opening corresponding to the through hole is provided on the compartment wall.

13. The refrigeration and freezing device according to claim 12, wherein,

the compressor compartment comprises a compartment wall, a compressor is provided in the compressor compartment, two of the silencing devices are provided in the cabinet, a first silencing device of the two silencing devices is installed on a left wall of the compartment wall, a second silencing device of the two silencing devices is installed on a right wall of the compartment wall, a first through hole of the first silencing device and a second through hole of the second silencing device are vertically staggered, or the first through hole of the first silencing device and the second through hole of the second silencing device are coaxially arranged.

14. The refrigeration and freezing device according to claim 13, wherein,

when the first through hole of the first silencing device and the second through hole of the second silencing device are vertically staggered, the preset coefficient is a first preset coefficient; when the first through hole of the first silencing device and the second through hole of the second silencing device are coaxially arranged, the preset coefficient is a second preset coefficient; the second preset coefficient is greater than or equal to the first preset coefficient.

15. The refrigeration and freezing device according to claim 13, wherein a central axis of the first through hole is located between a top of the compressor and a top wall of the compartment wall, when the first through hole of the first silencing device and the second through hole of the second silencing device are vertically staggered, the second through hole is lower than the first through hole.

16. The refrigeration and freezing device according to claim 15, wherein the compressor comprises an upper shell and a lower shell, and a connection zone is provided between the upper shell and the lower shell; a central axis of the second through hole is located between the connection zone and a bottom wall of

the compartment wall.

17. The refrigeration and freezing device according to claim 13, wherein a horizontal distance between the first through hole and the compressor is less than a horizontal distance between the second through hole and the compressor.

18. The refrigeration and freezing device according to claim 13, wherein, a heat dissipation fan is further provided in the compressor compartment, the heat dissipation fan is configured to blow air from an air inlet side of the compressor compartment to an air outlet side of the compressor compartment, and the compressor is located at the air outlet side of the compressor compartment.

19. The refrigeration and freezing device according to claim 18, wherein, further comprising a condenser,

the condenser is arranged at an air inlet side in the compressor compartment, and the heat dissipation fan is located between the compressor compartment and the condenser; or the heat dissipation fan is located at the air inlet side of the compressor compartment, and the condenser is located between the compressor compartment and the heat dissipation fan.

20. The refrigeration and freezing device according to claim 19, wherein,

the compressor comprises an upper shell and a lower shell, and a connection zone is provided between the upper shell and the lower shell; a central axis of the second through hole is located between a center position of the heat dissipation fan in a height direction and the bottom wall of the compartment wall.

21. The refrigeration and freezing device according to claim 19, wherein,

a central axis of the second through hole is located between a center position of the condenser in a height direction and a bottom wall of the compartment wall.

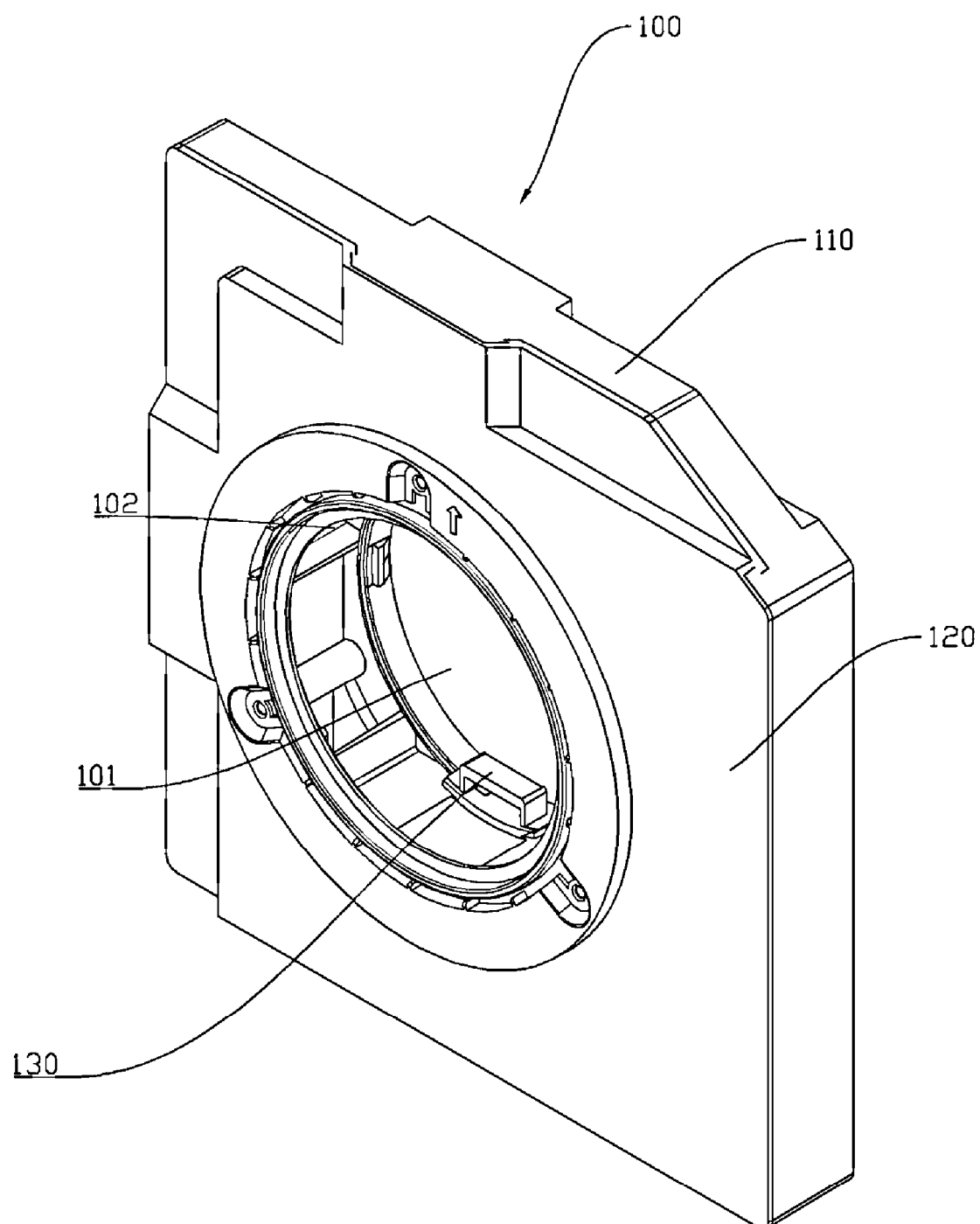


Fig.1

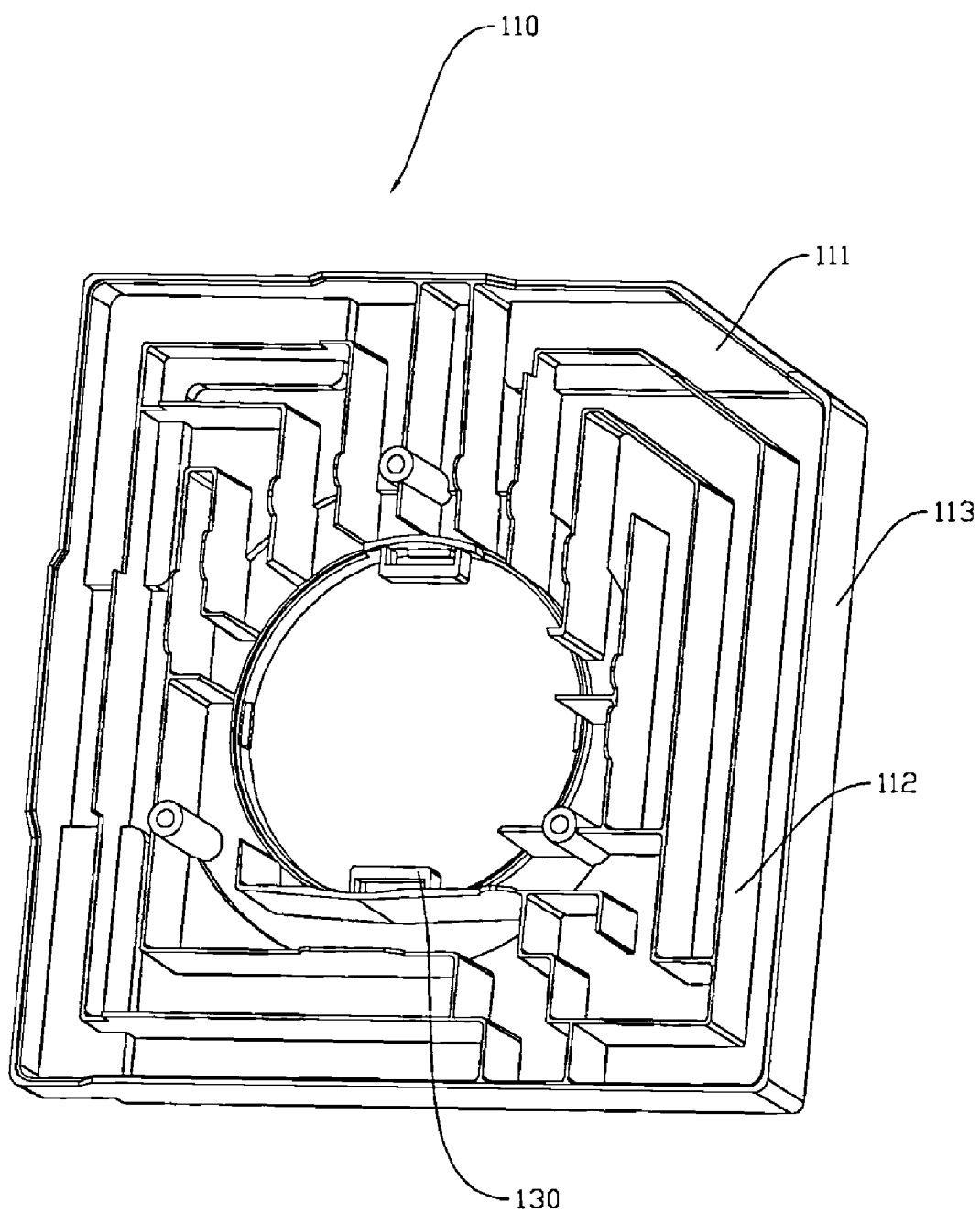


Fig. 2

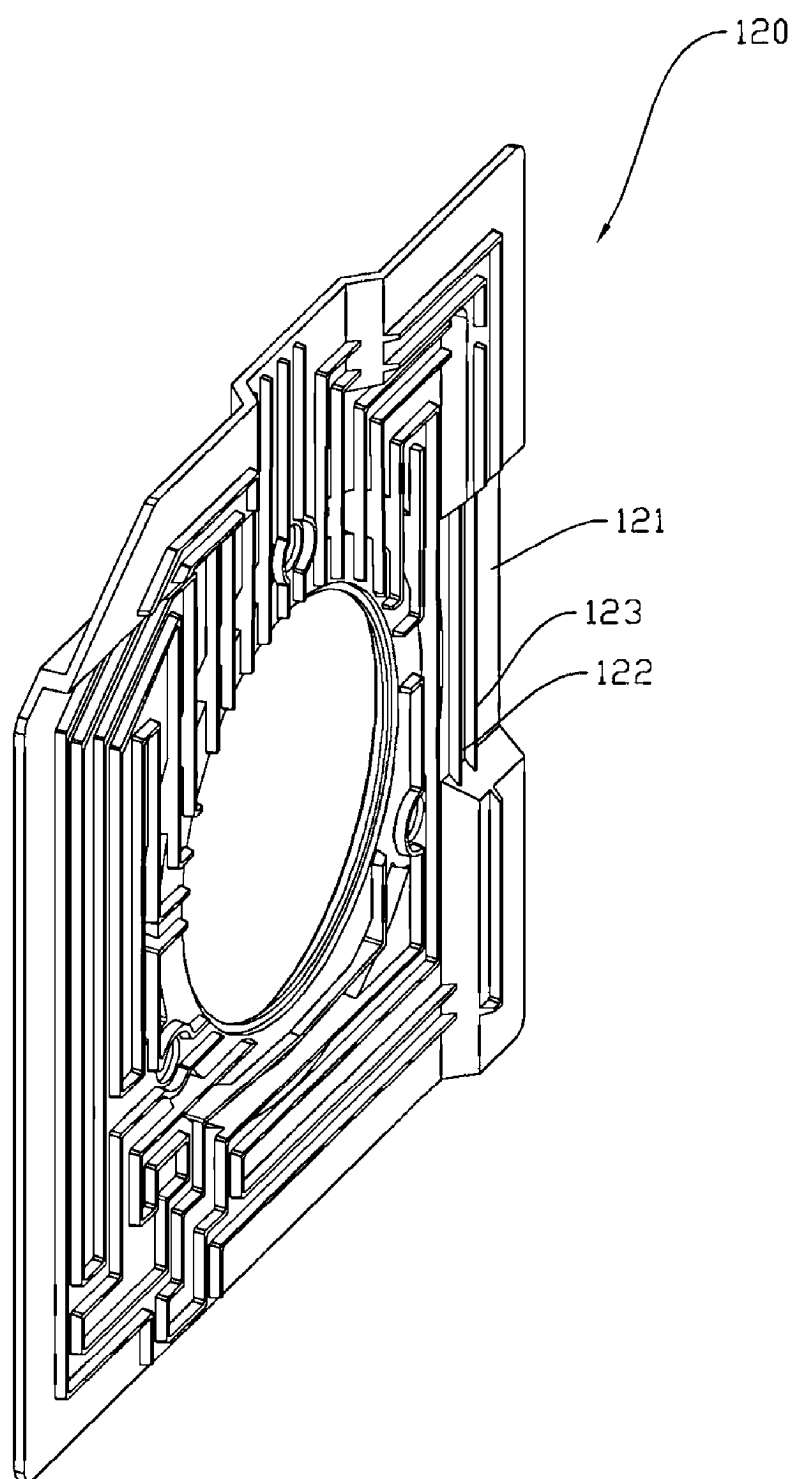


Fig.3

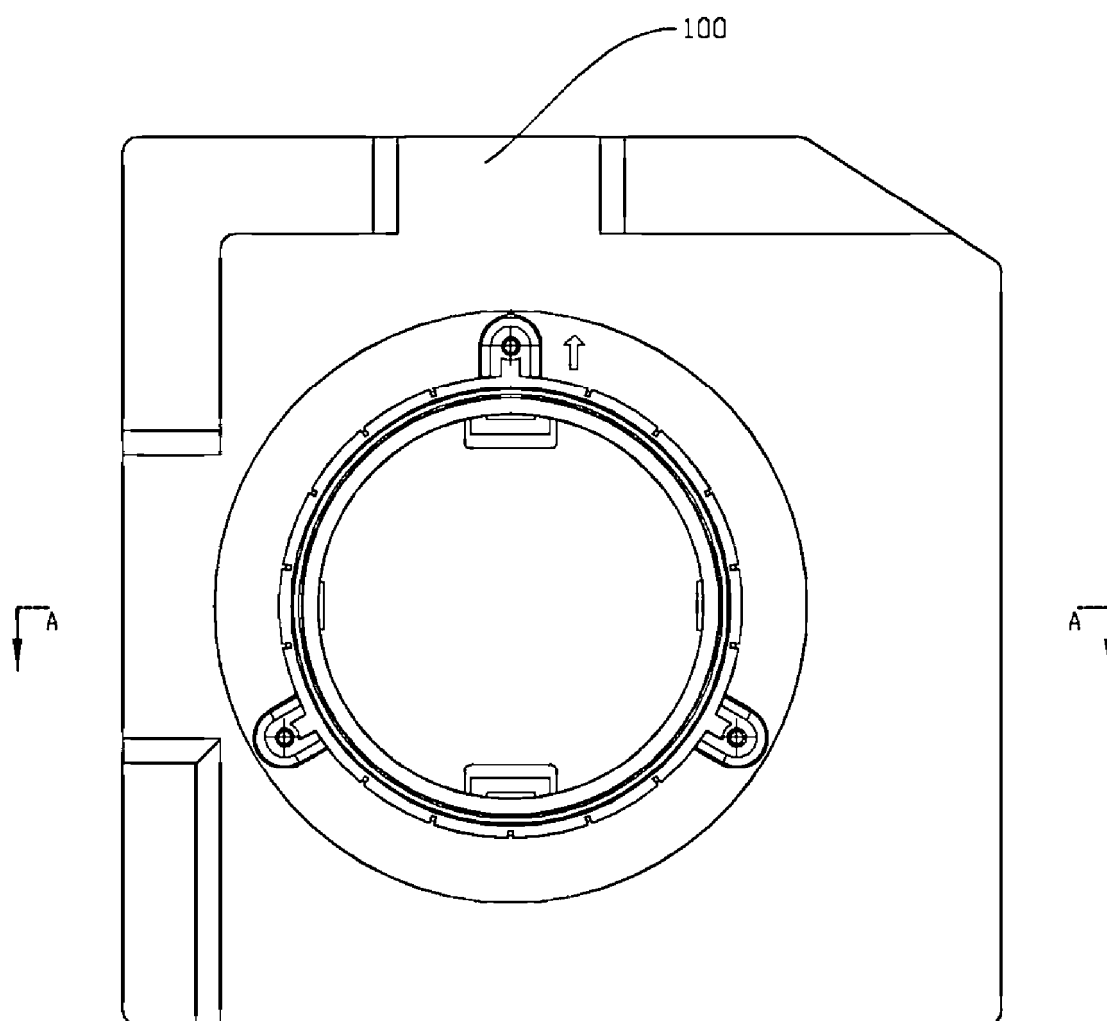


Fig.4

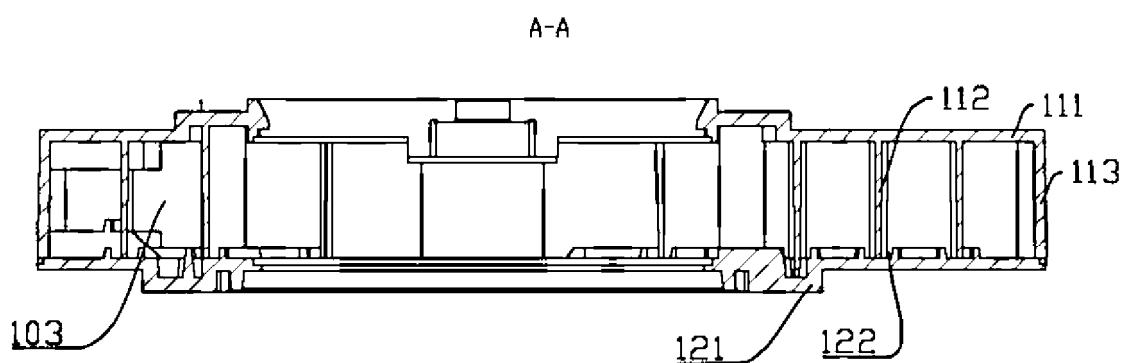


Fig.5

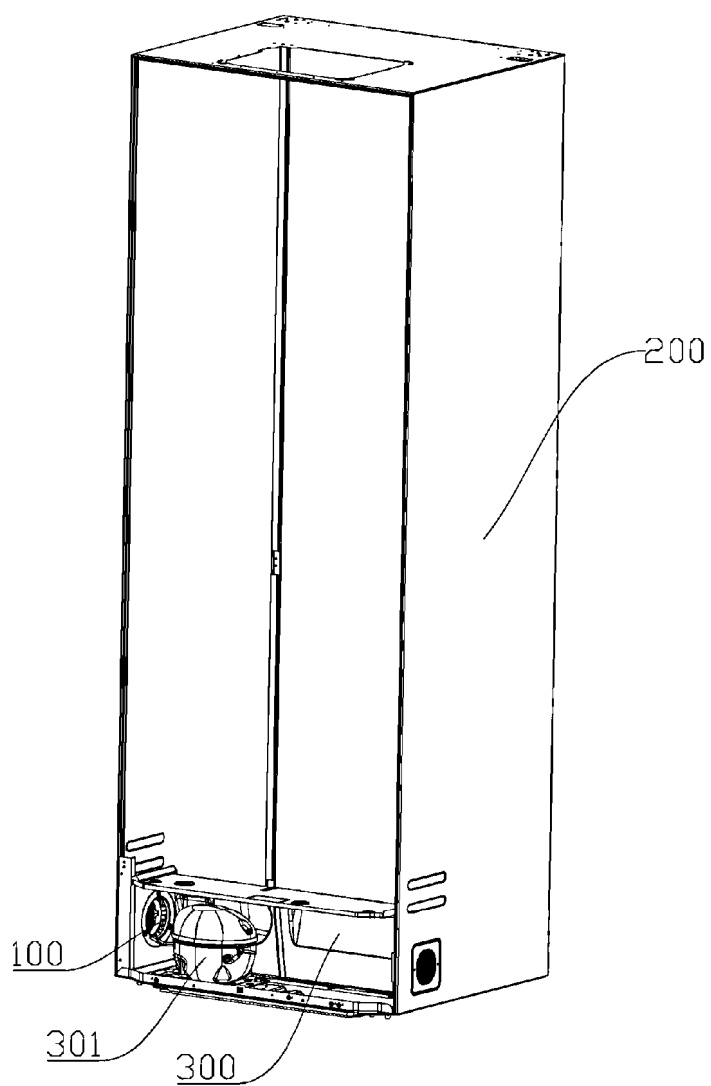


Fig.6

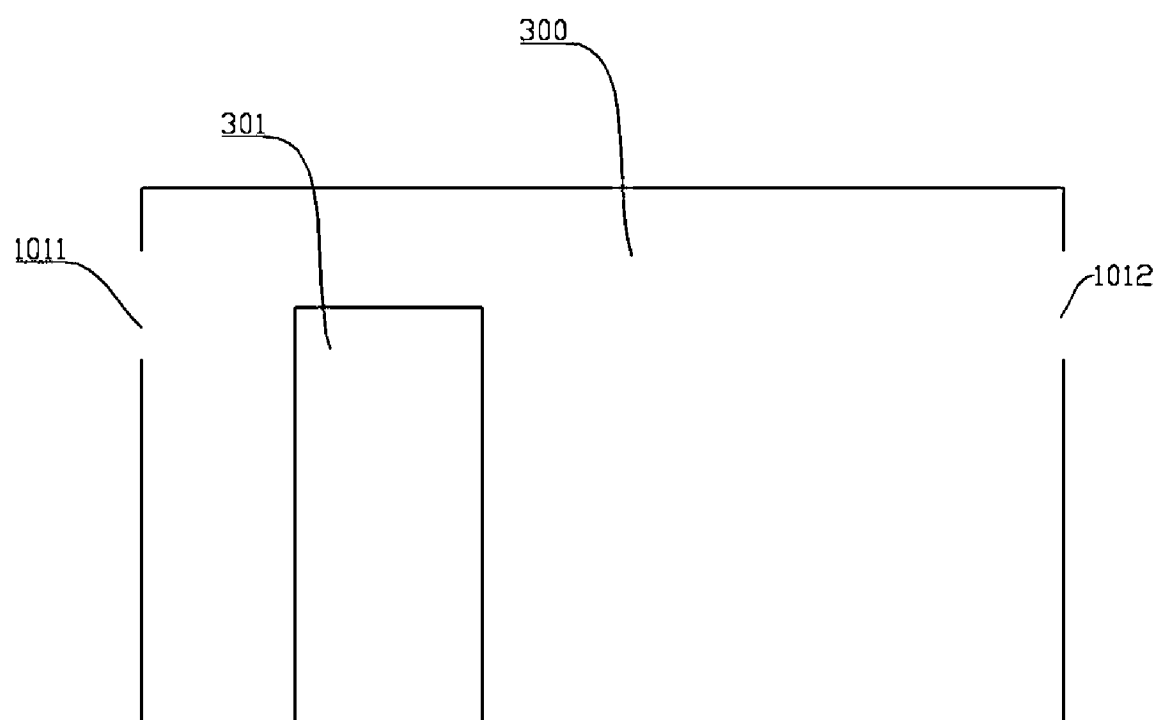


Fig.7

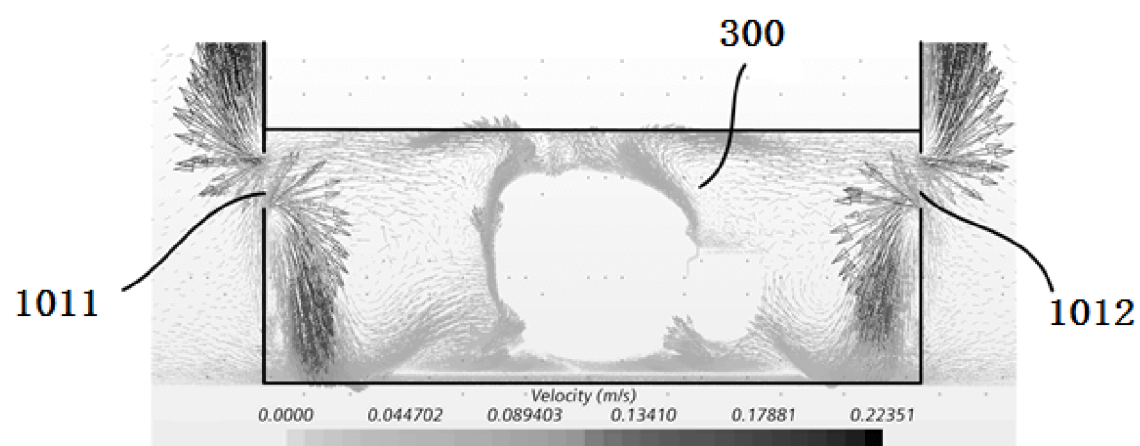


Fig.8

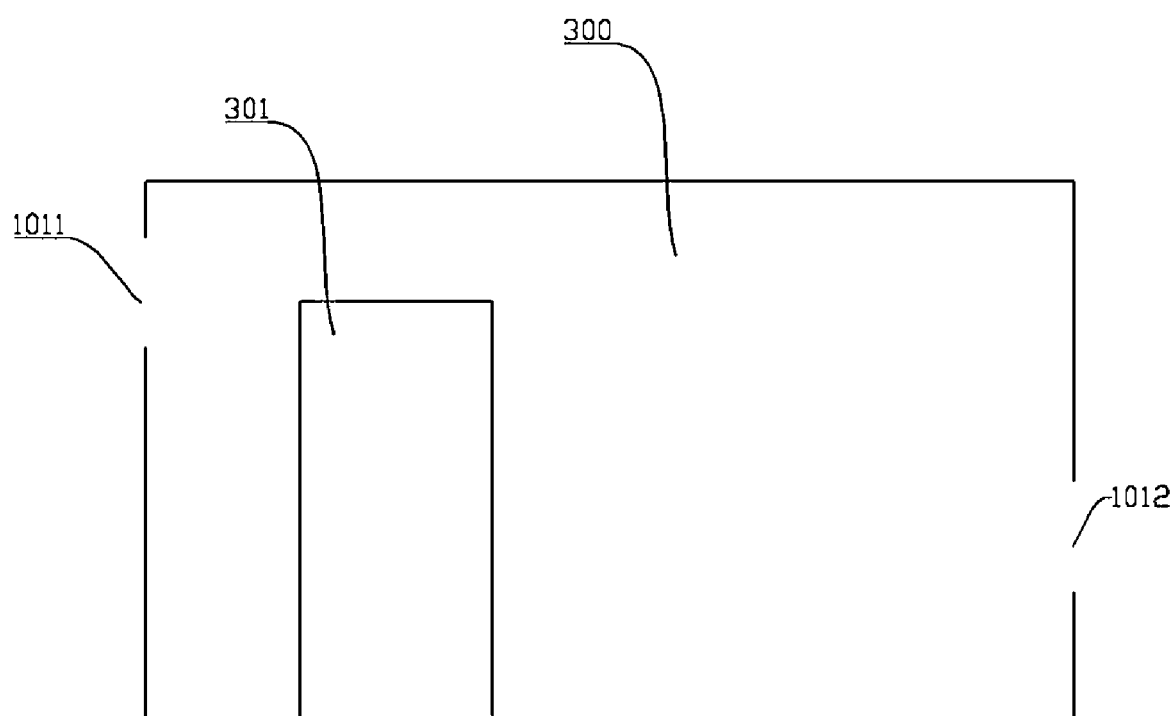


Fig.9

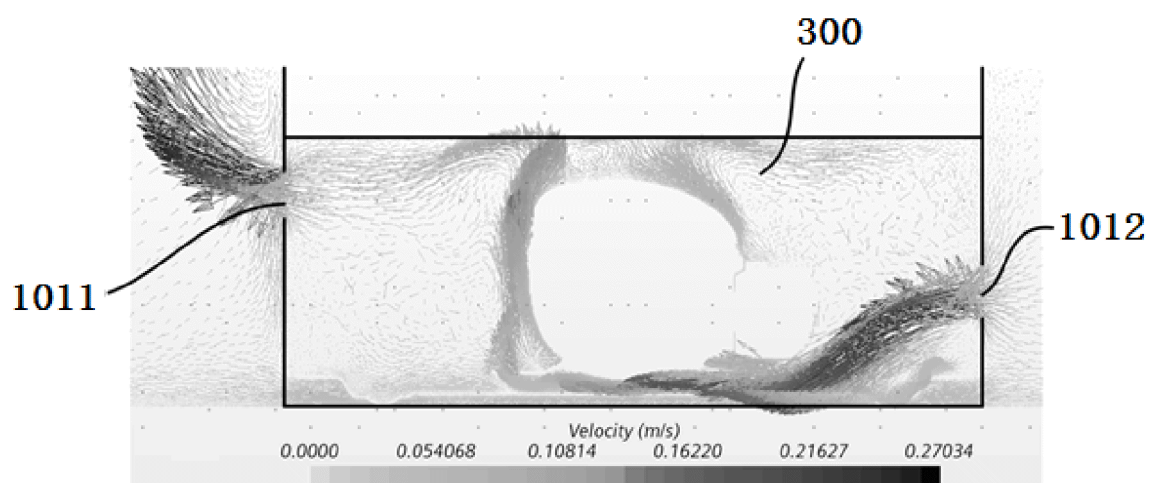


Fig.10

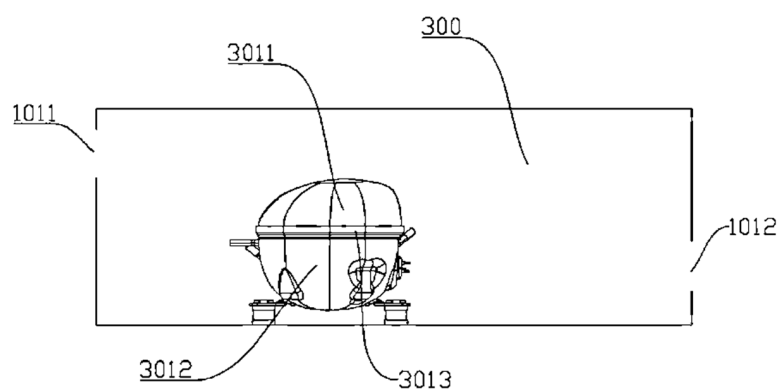


Fig.11

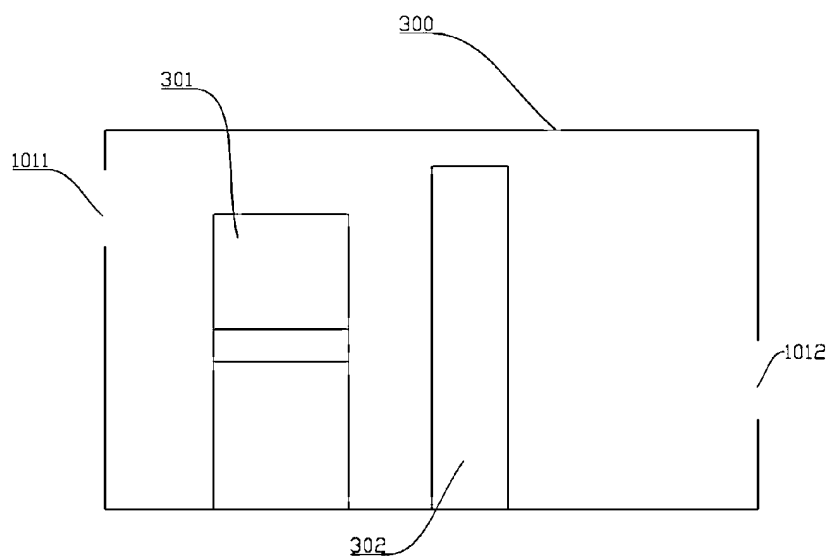


Fig.12

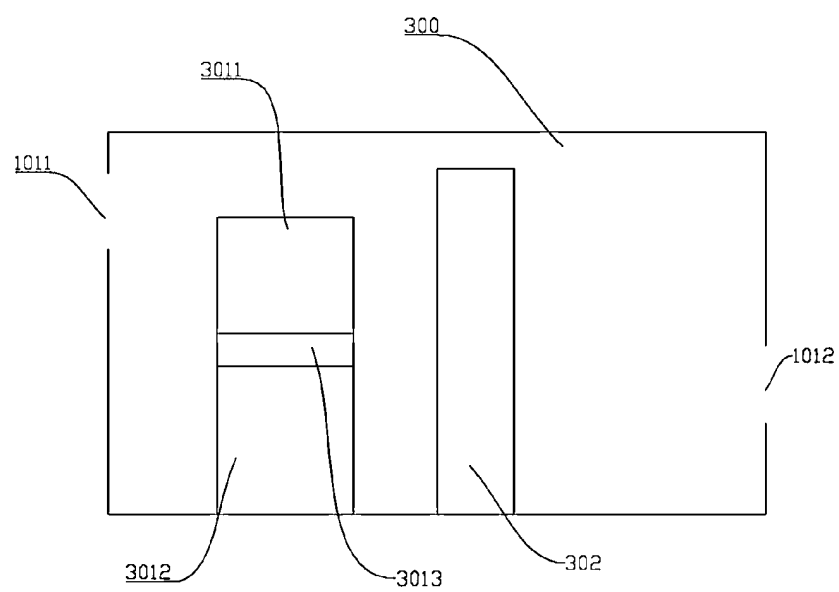


Fig.13

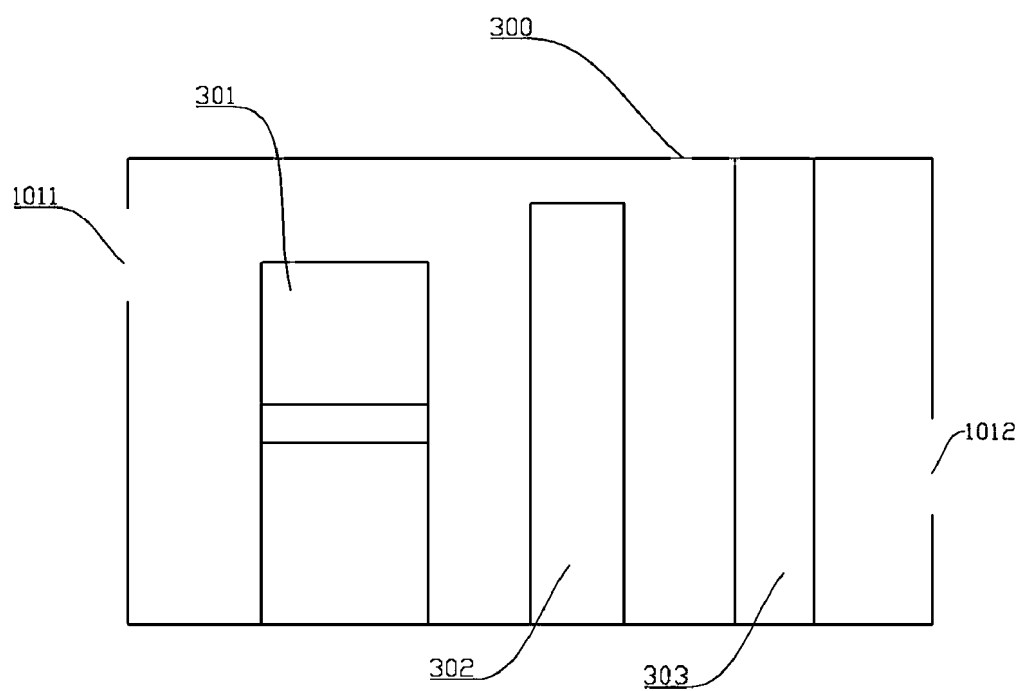


Fig.14

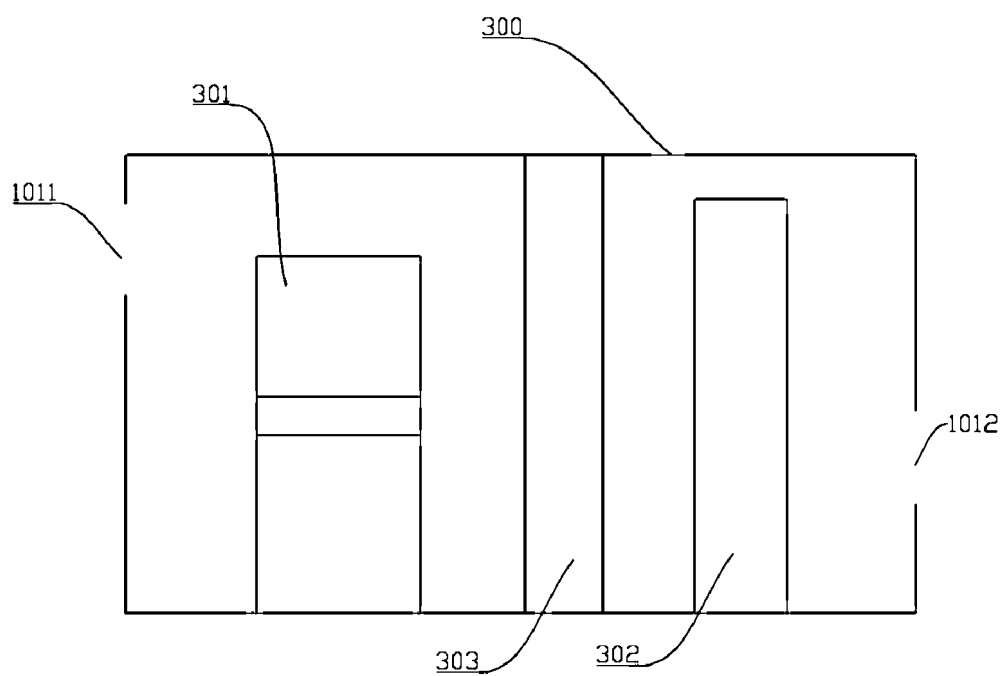


Fig.15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/105002

A. CLASSIFICATION OF SUBJECT MATTER

F25D 11/02(2006.01)i; F25D 23/00(2006.01)i; F04B 39/00(2006.01)i; F04B 39/14(2006.01)i; F04B 39/06(2006.01)i;
F25D 23/10(2006.01)i; F25D 23/06(2006.01)i; F04B 39/12(2006.01)i; F25B 31/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F25D F04B F25B

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

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

CNABS, CNTXT, CNKI, DWPI, WPABS, USTXT, WOTXT, EPTXT: 冷藏, 冷冻, 冰箱, 压缩机, 功率, 频率, 转速, 消音, 通孔, 孔径, 尺寸, refrigerator, refrigerating, freezing, compressor, power, frequency, noise, hole, apertures, size

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 109695998 A (QINGDAO HAIER CO., LTD.) 30 April 2019 (2019-04-30) description, paragraphs [0063]-[0148], and figures 1-13	1, 2
X	CN 109695997 A (QINGDAO HAIER CO., LTD.) 30 April 2019 (2019-04-30) description, paragraphs [0052]-[0117], and figures 1-13	1, 2
Y	CN 109695998 A (QINGDAO HAIER CO., LTD.) 30 April 2019 (2019-04-30) description, paragraphs [0063]-[0148], and figures 1-13	3-21
Y	CN 109695997 A (QINGDAO HAIER CO., LTD.) 30 April 2019 (2019-04-30) description, paragraphs [0052]-[0117], and figures 1-13	3-21
Y	CN 217462476 U (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 20 September 2022 (2022-09-20) description, paragraphs [0047]-[0059], and figures 1-8	3-21
Y	CN 215256700 U (QINGDAO HAIER REFRIGERATOR CO., LTD. et al.) 21 December 2021 (2021-12-21) description, paragraphs [0026]-[0050], and figures 1-5	3-21

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"D" document cited by the applicant in the international application	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

24 September 2024

Date of mailing of the international search report

11 October 2024

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/105002

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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 215638266 U (CHONGQING HAIER REFRIGERATION ELECTRICAL APPLIANCE CO., LTD. et al.) 25 January 2022 (2022-01-25) description, paragraphs [0025]-[0040], and figures 1-5	3-21
A	CN 215633610 U (QINGDAO HAIER SPECIAL REFRIGERATION ELECTRIC APPLIANCE CO., LTD. et al.) 25 January 2022 (2022-01-25) description, paragraphs [0027]-[0044], and figures 1-5b	1-21
A	CN 107036332 A (QINGDAO HAIER SPECIAL FREEZER CO., LTD.) 11 August 2017 (2017-08-11) description, paragraphs [0015]-[0020], and figures 1-3	1-21

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/105002

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Patent document cited in search report			Publication date (day/month/year)		Patent family member(s)			Publication date (day/month/year)
CN	109695998	A	30 April 2019		None			
CN	109695997	A	30 April 2019		None			
CN	217462476	U	20 September 2022		WO	2023185613	A1	05 October 2023
CN	215256700	U	21 December 2021		CN	115247639	A	28 October 2022
					WO	2022227698	A1	03 November 2022
					AU	2022267431	A1	09 November 2023
					EP	4332470	A1	06 March 2024
					US	2024210099	A1	27 June 2024
CN	215638266	U	25 January 2022		WO	2022227712	A1	03 November 2022
					WO	2022227712	A9	01 December 2022
					AU	2022266862	A1	09 November 2023
					EP	4332475	A1	06 March 2024
					US	2024210095	A1	27 June 2024
CN	215633610	U	25 January 2022		None			
CN	107036332	A	11 August 2017		None			