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(71) Applicant: **FTL, INC.** [US/US]; 721 W. Whittier Blvd. # R, La Habra, California 90631 (US).

(72) Inventor: **WU, Daochun**; 201900 No. 260, Zone 3, 699 Lane, Jinqiu Rd., Baoshan District, Shanghai, Shanghai (CN).

(74) Agent: **FAGERLAND, Scot**; The Law Office Of Scot S. Fagerland, PC, 2901 S. Sepulveda Blvd. # 331, Los Angeles, California 90064 (US).

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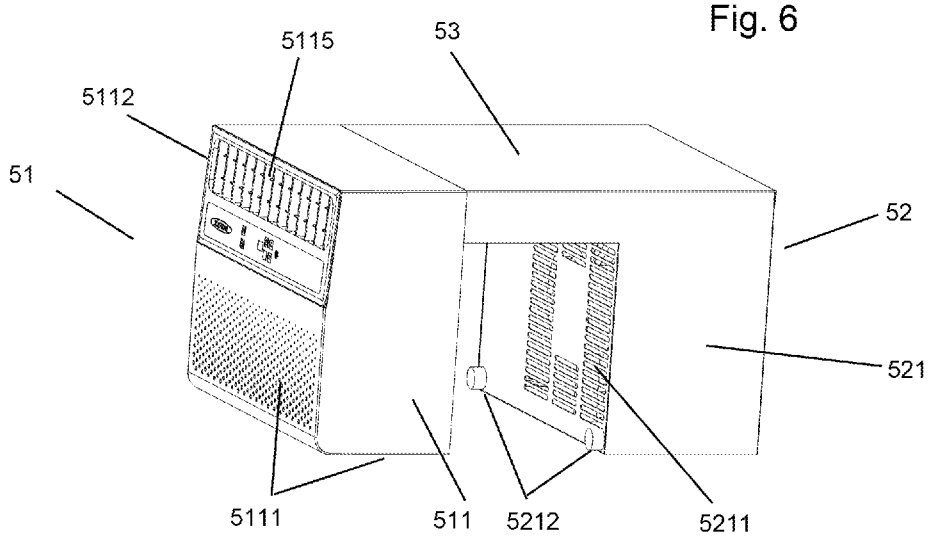
(54) Title: SADDLE AIR CONDITIONER

Fig. 6



(57) Abstract: This invention discloses a low-noise cross-wall ("saddle" shaped) air conditioner window unit. The unit includes an indoors casing that houses the condenser and compressor and an outdoors casing that houses the evaporator. A connecting frame (which straddles the windowsill) connects the indoors and outdoors casings. In a first embodiment, an axial condenser fan and a centrifugal evaporator fan are driven simultaneously by a dual-axle motor housed in the outdoors casing. The axle driving the indoors evaporator fan extends through the connecting frame over the windowsill. In a second embodiment, the evaporator fan is a cross-flow fan. Both features are designed to make the unit lightweight and quiet indoors. The full specification discloses additional novel features such as venting patterns and perforated frames, also for making the unit lightweight, efficient, and / or quiet. Installation is enabled with spacers or fasteners, not requiring support brackets.

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
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Saddle Air Conditioner

1 Field of technology

The present application describes a window air conditioner unit, specifically a saddle-shaped unit.

2 Background

Common household air conditioners include central air conditioners, wall units, and window units. In a wall or window unit, the condenser, compressor, expansion valve, evaporator, and all fans and motors are integrated into one appliance, with the advantages of low cost and convenient installation. Some wall or window units use a single motor to drive both the condenser and evaporator fans. Others use a single motor to drive both fans.

The integration of all machinery into one unit poses some disadvantages. Wall and window units are noisy. At present, most window machines have a cuboid structure. Because such a machine is large, if the wall is not thick enough, it is generally necessary to install brackets on the external wall to support the window machines, making installation difficult. A cuboid structure occupies a large window space. This reduces window visibility and presents challenges when it comes to preventing airflow from inside to outside.

The “saddle” shaped window air conditioner makes the appliance less invasive in the window. This configuration splits the machinery into indoor and outdoor casings. The outdoor casing houses the condenser and compressor and the indoor casing houses the evaporator. The casings are connected by a low-profile crossbar, which can be as little as a few inches high. This crossbar sits on the windowsill. In a lift-up / slide-down window, the pane can then be almost completely closed. This preserves

the view and also makes it much easier to keep the window air tight.

3 Summary of the Invention

All saddle-shaped window units known to date require two motors: one for the indoor casing to drive the evaporator fan and one for the outdoor casing to drive the condenser fan. The present invention provides two alternative embodiments to reduce noise. In the first embodiment, a single motor in the outdoor casing drives an axle that engages both the indoor and outdoor fans. This is accomplished by extending the axle through the connecting frame, over the windowsill. In a second embodiment, the indoor and outdoor fans each have their own motors. The indoor fan is a crossflow (hair-curler-shaped) fan, which is known for its quiet operation. The present invention also addresses issues of frame integrity, stability, and installation.

The preferred embodiment is a coaxial saddle air conditioner, including connecting frame components, indoor components and outdoor components. The connecting frame components comprise a horizontal frame body and two vertical frames connected to the two ends of the horizontal frame body, respectively. The two vertical frame bodies and the horizontal frame body together form an installation groove. The installation groove is used to clamp the two sides of the wall. The indoor components are fixed on the vertical frame inside the wall. These components include an internal machine case and an evaporator, an expansion valve, a volute and a centrifugal (hamster-wheel shaped) fan fixed in the case. The case of the internal machine is provided with an air inlet and an air outlet. The evaporator is disposed at the inner side of the air inlet, and the volute is disposed at the inner side of the evaporator. The air inlet of the volute is connected to the air inlet of the case through the evaporator, and the air outlet of the volute is connected to the air outlet of the case. The centrifugal fan is set in the volute.

The outdoor components are fixed on the vertical frame outside the wall. These components include an external machine case and a condenser, a compressor, a volute,

and an axial (propeller-shaped) fan fixed in the case. The outdoor casing is provided with an air vent. The condenser is disposed at the inner side of the air vent. The axial fan wheel is disposed at the inner side of the condenser.

A single motor is disposed at the inner side of the axial (outdoor) fan. The motor engages two drive shafts on opposite sides of the motor. The centrifugal fan, the double shaft motor, and the axial fan are coaxial. A first output shaft of the dual-axis motor is coaxially connected with the centrifugal fan through the connecting frame components. A second output shaft of the dual-axis motor is coaxially connected with the axial fan. Elimination of the indoor motor greatly reduces indoor noise.

The evaporator, the compressor, the condenser and the expansion valve are connected in series through a pipeline to form a closed loop. The pipeline between the evaporator and the compressor and that between the condenser and the expansion valve pass through the connecting frame components.

Both embodiments also include fasteners, which include fastening support and fastening screw. The fastening support is fixed at the lower part of a vertical frame. The fastening screw is connected to fastening support threads. The inner part of the fastening screw is provided with a retaining block. When installing, the inner part of the fastening screw is tightened to one side of the wall through the retaining block, and the other vertical frame is tightened to the other side of the wall. By providing the fasteners, the gap between the vertical frames and the wall can be adjusted by tightening the fastening screw, making the installation more robust and adaptable to different wall thicknesses. When installing, it is only necessary to place the connecting frame components on the wall through the window. Compared with existing window machine technology, this does not require through holes to install a bracket, making the installation faster and more convenient.

The horizontal frame body may be one wide duct or two or more narrow support beams. In the latter case, a connecting cover plate is arranged over the support beams. A plurality of through holes are uniformly disposed on the side walls of the horizontal

frame body and the vertical frame body. The through holes have a silencing effect and can reduce running noise.

4 Brief description of the figures

In order to more clearly explain the specific embodiment of the utility model or the technical scheme in the existing technology, the figures to be used in the specific embodiment will be briefly described below. In all the figures, similar components or parts are generally marked by like numerals. In the figures, the components or parts are not necessarily drawn to scale.

Figure 1 is a front view of a first embodiment.

Figure 2 is a right view of the first embodiment, with the front of Figure 1 positioned on the left of Figure 2.

Figure 3 is a left view of the first embodiment, with the front of Figure 1 appearing on the right of Figure 3.

Figure 4 is a top view of the first embodiment, with the front of Figure 1 appearing at the bottom of Figure 4.

Figure 5 is a bottom view of the first embodiment, with the front of Figure 1 appearing at the top of Figure 5.

Figure 6 shows an assembly figure of a second embodiment.

Figure 7 is an explosion diagram of the second embodiment.

Figure 8 is a longitudinal cross-sectional view of the second embodiment.

Figure 9 is a schematic diagram of the inner casing, the connecting frame and the outer casing of the second embodiment.

In figures 1 - 5, 1 shows the connecting frame components; 11 is the horizontal frame body; 12 is the vertical frame body; 13 is the installation groove; 14 is a connecting cover plate; 15 shows through holes; 2 shows the air-conditioning internal machine components; 21 is the inner case; 22 is the evaporator; 23 is the volute; 24 is the centrifugal fan; 25 is the air inlet; 26 is the air outlet; 27 is the filter net; 28 is the

temperature probe; 3 shows the air-conditioning external machine components; 31 is the outer case; 32 is the compressor; 33 is the condenser; 34 is the axial flow fan; 35 is the dual-axis motor; 351 is the indoor drive shaft; 352 is the outdoor drive shaft; 36 is the air vent; 37 is the condensed water receiving tray; 38 is the condensed water drain pump; 4 is the fastener; 41 is the fastening support; 42 is the fastening screw; and 43 is the retaining block.

In figures 6 – 9, 51 is the internal machine; 511 is the inner casing; 5111 is the casing air inlet; 5112 is the casing air outlet; 5113 is the inner side plate; 5114 is the inner casing; 512 is the evaporator component; 513 is the air inlet component; 5131 is the volute; 5132 is the cross-flow fan; 5133 is the volute air inlet; 5134 is the volute air outlet; 514 is the thermal insulation foam layer; 515 is the guide grille; 52 is the external machine; 521 is the outer casing; 5211 is the air inlet; 5212 is the spacer; 5213 is the outer casing side plate; 5214 is the outer casing; 5215 is the cover; 522 is the compressor; 523 is the condenser; 5241 is the frame; 52411 is the motor base; 52412 is the blade protection ring; 5242 is the motor; 5243 is the fan blade; 53 is the connecting frame.

5 Detailed description

The embodiments of the technical solutions of the utility model will be described in detail with the attached figures. The following embodiments are only used to more clearly illustrate the technical solutions of the utility model. Therefore, they are only examples and should not be used to limit the protection scope of this patent.

5.1 The first “coaxial” embodiment

As shown in Figure 1 to Figure 5, this embodiment of the utility model provides a coaxial saddle air conditioner, including the connecting frame components 1, the air-conditioning internal machine components 2, and the air-conditioning external machine components 3.

The connecting frame components 1 include a horizontal frame body 11 and two vertical frame bodies 12 respectively connected to the two ends of the horizontal frame body 11. The two vertical frame bodies 12 under the horizontal frame body 11 together form an installation groove 13. The installation groove 13 is used to clamp the two sides of the wall body. The connecting frame components 1 of the present embodiment are relatively arranged in two groups at left and right positions. A connecting cover plate 14 is arranged on the two groups of connecting frame components 1, making the structure firm and material saved and appearance beautiful. Both the horizontal frame body 11 and the vertical frame body 12 are square tubular, and a plurality of through holes 15 are uniformly disposed on the side walls of the horizontal frame body 11 and the vertical frame body 12. The through holes 15 have a silencing effect, reducing running noise.

The air-conditioning internal machine components 2 are fixed on the outer side of the vertical frame 12 inside the wall. These components 2 include an internal machine case 21 and the evaporator 22, the expansion valve, the volute 23 and the centrifugal fan 24 fixed in the case 21. The inner case 21 is provided with an air inlet 25 and an air outlet 26. The air inlet 25 of the inner case 21 is provided with a filter net 27 and a temperature sensing probe 28. The filter 27 can reduce the inhalation of dust and debris to ensure the safe operation of the device, and the temperature sensing probe 28 is used to detect the room temperature. The evaporator 22 is disposed inside the air inlet 25. The volute 23 is composed of volute upper foam components and volute lower foam components. The volute 23 is disposed at the inner side of the evaporator 22. The suction port of the volute 23 is connected to the air inlet 25 of the inner case 21 through the evaporator 22, and the exhaust port of the volute 23 is connected to the air outlet 26 of the inner case 21. The centrifugal fan 24 is disposed in the volute 23.

The air-conditioning external machine components 3 are fixed on the outer side of the vertical frame 12 outside the wall. The components 3 include the external machine case 31 and the compressor 32, the condenser 33, the axial flow fan 34, the dual-axis

motor 35, the condensate water receiving tray 37 and the condensed water drain pump 38 fixed in the case 31. The case of external machine 31 is provided with an air vent 36. The condenser 33 is disposed at the inner side of the air vent 36. The condensate water receiving tray 37 is disposed below the condenser 33, and the condensed water drain pump 38 is used to discharge the condensed water in the condensate water receiving tray 37 out of the outer case 31, thus facilitating the collection and discharge of the condensed water. The axial flow fan 34 is disposed inside the condenser 33. The dual-axis motor 35 is disposed inside the axial flow fan 34. The centrifugal fan 24, the dual-axis motor 35, and the axial flow fan 34 are all coaxial. The indoor drive shaft 351 of the dual-axis motor 35 is coaxially connected with the centrifugal fan 24 through the connecting frame components 1. The outdoor drive shaft 352 of the dual-axis motor 35 is coaxially connected with the axial flow fan 34.

The evaporator 22, the compressor 32, the condenser 33, and the expansion valve are connected in series through a pipeline to form a closed loop. The pipeline between the evaporator 22 and the compressor 32 and that between the condenser 33 and the expansion valve pass through the connecting frame components 1. In operation, first, the low-pressure gaseous refrigerant is sucked into the compressor 32 and compressed into high-temperature and high-pressure gas; second, the gaseous refrigerant flows to the condenser 33, and gradually condenses into high-pressure liquid during heat dissipation to the outside; third, after passing through the expansion valve, it becomes the low-temperature and low-pressure gas-liquid mixture; then it enters the indoor evaporator 22, and continuously vaporizes by absorbing heat from the indoor air, thereby achieving indoor cooling; last, it becomes the low-pressure gas and re-enters the compressor 32. In this way, the air conditioner can continue to operate continuously.

The horizontal frame 11 of the connecting frame components 1 of this application passes through the window and straddles the wall. The air-conditioning internal machine components 2 are installed on the inner wall through the vertical frame body 12 inside wall. The air-conditioning external machine components 3 are installed on the

outer wall through the vertical frame 12 inside the wall. The air-conditioning internal machine components 2 and the external machine components 3 are connected into an integrated structure through the connecting frame components 1. It takes up little window space. And the air-conditioning internal machine components 2 and the external machine components 3 are separated by a wall, making noise small. When installing, it is only necessary to place the connecting frame components 1 on the wall through the window. Compared with the existing window machine technology, this does not require through holes 15 to install bracket, letting the installation more convenient and quick. The axial fan 34 and the centrifugal fan 24 of the application are driven by an outdoor drive shaft 352 and an indoor drive shaft 351, respectively, at both ends of a dual-axis motor 35. The dual-axis motor eliminates an indoor motor, making the structure more streamlined and the volume smaller and the cost lower. The air-conditioning internal machine components 2 do not include a motor, so the running noise is smaller.

The embodiment also includes fasteners 4, which include the fastening support 41 and the fastening screw 42. The fastening support 41 is fixed at the lower part of a vertical frame 12. The fastening screw 42 is connected to the threads of the fastening support 41. The inner part of the fastening screw 42 is provided with the retaining block 43. When installing, the inner part of the fastening screw 42 is tightened to one side of the wall through the retaining block 43, and the other vertical frame 12 is tightened to the other side of the wall. By providing the fasteners 4, the gap between the vertical frames and the wall can be adjusted by tightening the fastening screw 42, making the installation more robust and adaptable to different wall thicknesses.

5.2 The second “Low noise” embodiment

As shown in Figure 6 to Figure 9, the embodiment of the utility model provides a low-noise cross-wall window machine, including an internal machine 51 placed inside the wall, an external machine 52 placed outside the wall, and the connecting frame 53

spanning the wall and connected the upper parts of the internal machine and the external machine.

According to Figure 7 and Figure 8, the internal machine 51 includes an inner casing 511, which is fixedly connected to the connecting frame 53, and an evaporator component 512 and an air supply component 513 in the inner casing 511. The outer casing 521 includes an outer casing 521, which is fixedly connected to the connecting frame 53, and a compressor 522, a condenser 523, and a cooling fan 524 in the outer casing 521. The work principles of the air conditioner are as followings. The low-pressure gaseous refrigerant is sucked into the compressor 522 and compressed into a high-temperature and high-pressure gas. And the gaseous refrigerant flows to the condenser 523 and gradually condenses into a high-pressure liquid in the process of cooling. Then it becomes a low-temperature and low-pressure gas-liquid mixture through the expansion valve, then enters the indoor evaporator, and continuously vaporizes by absorbing the heat of the indoor air, achieving indoor cooling. It becomes a lower-pressure gas again and re-enters the compressor 522. In this way, the air conditioner can work continuously.

There is a casing air inlet 5111 in the lower part of the inner casing 511 and a casing air outlet 5112 in the upper part of the inner casing 511. In order to make the wind more uniform and farther, the casing air outlet 5112 is equipped with a guild grille 515. The air supply component 513 circulates the air cooled by the evaporator into the room. Referring to Figure 7 and Figure 8, the air supply component 51 includes a volute 5131 fixed in the casing and a cross-flow fan 5132 in the volute 5131. The lower part of the volute 5131 corresponds to the air inlet of the casing 5111, and is equipped with an air inlet of the volute 5133. The upper part of the volute 5131 corresponds to the air outlet of the casing 5112, and is equipped with an air outlet of the volute 5134. The evaporator component 512 is placed in the volute air inlet 5133.

The connecting frame 53 of the application is installed on the window, and the internal machine 51 and the external machine 52 are on both sides of the wall. The

internal machine 51 is placed indoors, and the external machine 52 is placed outdoors. The noise generated by the external machine 52 can be isolated by the wall. The cross-flow fan 5132 in the internal machine 51 is used as the air supply structure, which can not only isolate the noise of the external machine 52, but also greatly reduce the noise of the internal machine 51, thereby greatly reducing the noise in the room.

In this embodiment, the casing air inlets 5111 specifically distribute in the side and bottom air inlet mesh holes of the inner casing 511. The evaporator component 512 is obliquely placed at the volute air inlet 5133. When the cross-flow fan 5132 is in operation, the indoor air is taken in from the side and bottom air inlet mesh of the inner casing 511, respectively, and then passes through the inclined evaporator component 512, making the air flow smoothly. It increases the area in which air enters, and reduces the noise of air flow, thereby achieving further noise reduction.

In this embodiment, the outer side of the volute 5131 is covered with a thermal insulation foam layer 514. The thermal insulation foam layer 514, on one hand, has a heat preservation effect to reduce the heat transfer between the air in the volute 5131 and the outside, and on the other hand, it also has the function of sound absorption and noise reduction.

In this embodiment, the condenser 523 is placed on a side of the outer casing 521 away from the connecting frame 53, and the cooling fan 524 is placed on a side of the outer casing 521 adjacent to the connecting frame 53. The cooling fan 524 is used for air cooling and heat dissipation of the condenser. There is an air inlet 5211 on a side of the outer casing 521 adjacent to the connecting frame 53, and a spacer 5212 against the wall on the side near connection frame 53. The wall and the outer casing 521 are separated by the spacer 5212, so as to reduce the noise and vibration transmitted from the outer casing 521 to the wall, and ensure that air can flow into the air inlet 5211 from the gap between the wall and the outer casing 521.

In this embodiment, according to Figure 7 and Figure 8, the cooling fan 524 includes a frame body 5241, a motor 5242 and a fan blade 5243. The frame body 5241

is fixed in the outer casing 521. The frame body 5241 includes a motor base 52411 and a blade protection ring 52412 connected to the motor base 52411. The motor 5242 is mounted on the motor base 52411. The fan blade 5243 is coaxially mounted on the output shaft of the motor 5242 and placed in the blade protection ring 52412. The blade protection ring 52412 protects the blade 5243. The motor base 52411 and the blade protection ring 52412 form an integral frame structure 5241, making it easy to install.

In this embodiment, according to Figure 7 and Figure 9, the inner casing 511 includes an inner side plate 5113 and an inner casing body 5114. The outer casing 521 includes an outer side plate 5213 and an outer casing 5214. The inner side plate 5113 and the outer side plate 5213 are respectively fixed at two ends of the connecting frame 53. The inner hood 5114 covers the inner machine side plate 5113, and the outer hood 5214 covers the outer machine side plate 5213. The inner side plate 5113 and the outer side plate 5213 and the connecting frame 53 form an integral installation structure, which is excellent in loading. After the components are installed, cover the inner hood 5114 and the outer hood 5214. In addition, the outer hood 5214 is integrally formed with a cover body 5215 to cover the connection frame 53. The outer casing 5214 can cover the connecting frame 53 at the same time. The assembly is convenient and the appearance is beautiful.

It should be noted that the above embodiments are only used to illustrate but not limit the technical solutions of the utility model. Although the utility model is described in detail with reference to the foregoing embodiments, the common technicians in the field should understand that he can still modify the technical solutions recorded in the aforementioned embodiments, or replace some or all of the technical features equally; and that the modifications or replacements do not detach the essence of the corresponding technical solutions from the scope of the technical solutions of the utility model, but should cover the scope of the Claim and the Institution of the utility model.

I claim:

1. A saddle-shaped window air conditioner comprising

an indoor casing, an outdoor casing, and a connecting frame connecting the inner casing to the outdoor casing;

said indoor casing comprising an indoor casing air inlet and an indoor casing air outlet;

said connecting frame comprising one or more horizontal frame components, an indoor vertical frame connected to the horizontal frame, an outdoor vertical frame connected to the horizontal frame, and an installation groove beneath the horizontal frame and between the vertical frames;

said indoor casing containing an evaporator, an expansion valve, a volute comprising a volute air inlet and a volute air outlet, and a centrifugal fan set in the volute;

said evaporator situated between the indoor casing air inlet and the volute air inlet;

said volute air outlet leading into the indoor casing air outlet;

said outdoor casing housing a compressor, a condenser, an axial fan, an air vent, and a dual-axis motor;

said condenser situated between the air vent and the axial fan;

said axial fan situated between the condenser and the dual-axis motor;

an outdoor drive shaft connecting the dual-axis motor to the axial fan;

an indoor drive shaft, coaxial with the outdoor drive shaft and connecting the dual-axis motor to the centrifugal fan;

said indoor drive shaft passing through the connecting frame;

a closed loop of refrigerant pipeline connecting the evaporator, the compressor, the condenser, and the expansion valve in series;

the portion of said pipeline between the evaporator and the compressor passing through the connecting frame;

the portion of said pipeline between the condenser and the expansion valve passing through the connecting frame.

2. The air conditioner of Claim 1, further comprising fasteners,

said fasteners comprising fastening support, fastening screw, and retaining block;

said fastening support fixed to the outdoor vertical frame;

said fastening screw having a frame end and a wall end;

said fastening screw frame end adjustably screwed into the fastening support;

said retaining block connected to the fastening screw wall end.

3. The air conditioner of Claim 1,

wherein said connecting frame components comprise exactly two crossbars;

further comprising a connecting cover plate over the crossbars.

4. The air conditioner of Claim 2,

wherein said connecting frame components comprise exactly two crossbars;

further comprising a connecting cover plate over the crossbars.

5. The air conditioner of Claim 3,

wherein the horizontal frame components and the vertical frame are square tubular with side walls;

further comprising a plurality of through holes uniformly disposed on the side walls of the horizontal frame components and of the vertical frame.

6. The air conditioner of Claim 4,

wherein the horizontal frame components and the vertical frame are square tubular with side walls;

further comprising a plurality of through holes uniformly disposed on the side walls of the horizontal frame components and of the vertical frame.

7. A saddle-shaped window air conditioner comprising

an internal machine comprising an upper part, an external machine comprising an upper part, and a connecting frame connecting the upper parts of the internal machine and the external machine;

said internal machine comprising an inner casing fixedly connected to the connecting frame;

said inner casing housing an evaporator component and an air supply component;

said external machine comprising an outer casing fixedly connected to the connecting frame,

said outer casing housing a compressor, a condenser, and a cooling fan;

said inner casing comprising an upper part and a lower part;

a casing air inlet in the lower part of the inner casing, and a casing air outlet in the upper part of the inner casing;

said air supply component comprising a volute with an upper part and a lower part, fixed in the inner casing, and a cross-flow fan in said volute;

such that the casing air inlet opens into the lower part of the volute, and the upper part of the volute opens into the casing air outlet;

said evaporator component disposed between the casing air inlet and the lower part of the volute.

8. The air conditioner of Claim 7,

wherein the inner casing has a front surface and a bottom surface;

wherein the casing air inlet comprises air inlet mesh holes in the front surface and the bottom

surface of the inner casing;

wherein said evaporator component is disposed obliquely so that it faces the air inlet mesh holes on both the front surface and the bottom surface of the inner casing;

9. The air conditioner of Claim 7,

said outer casing comprising a wall-facing surface and an outdoors-facing surface;

further comprising a wall-facing air inlet on the wall-facing surface;

wherein the condenser is situated adjacent to the outdoors-facing surface and the cooling fan is situated between the condenser and the wall-facing air inlet;

further comprising spacers connected to the wall-facing surface.

10. The air conditioner of Claim 8,

said outer casing comprising a wall-facing surface and an outdoors-facing surface;

further comprising a wall-facing air inlet on the wall-facing surface;

wherein the condenser is situated adjacent to the outdoors-facing surface and the cooling fan is situated between the condenser and the wall-facing air inlet;

further comprising spacers connected to the wall-facing surface.

11. The air conditioner of Claim 9,

wherein the cooling fan comprises a frame body, a motor with a output shaft, and fan blades;

wherein the frame body is fixed in the outer casing;

said frame body comprising a motor base and a fan blade protection ring connected to the motor base;

said motor mounted on said motor base;

and said fan blades mounted coaxially on the output shaft of the motor and positioned within the fan blade protection ring.

12. The air conditioner of Claim 10,

wherein the cooling fan comprises a frame body, a motor with a output shaft, and fan blades;

wherein the frame body is fixed in the outer casing;

said frame body comprising a motor base and a fan blade protection ring connected to the motor base;

said motor mounted on said motor base;

and said fan blades mounted coaxially on the output shaft of the motor and positioned within the fan blade protection ring.

Fig. 1

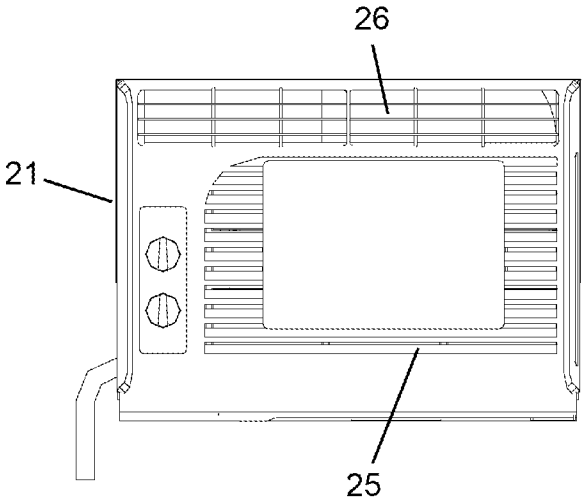
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Fig. 2

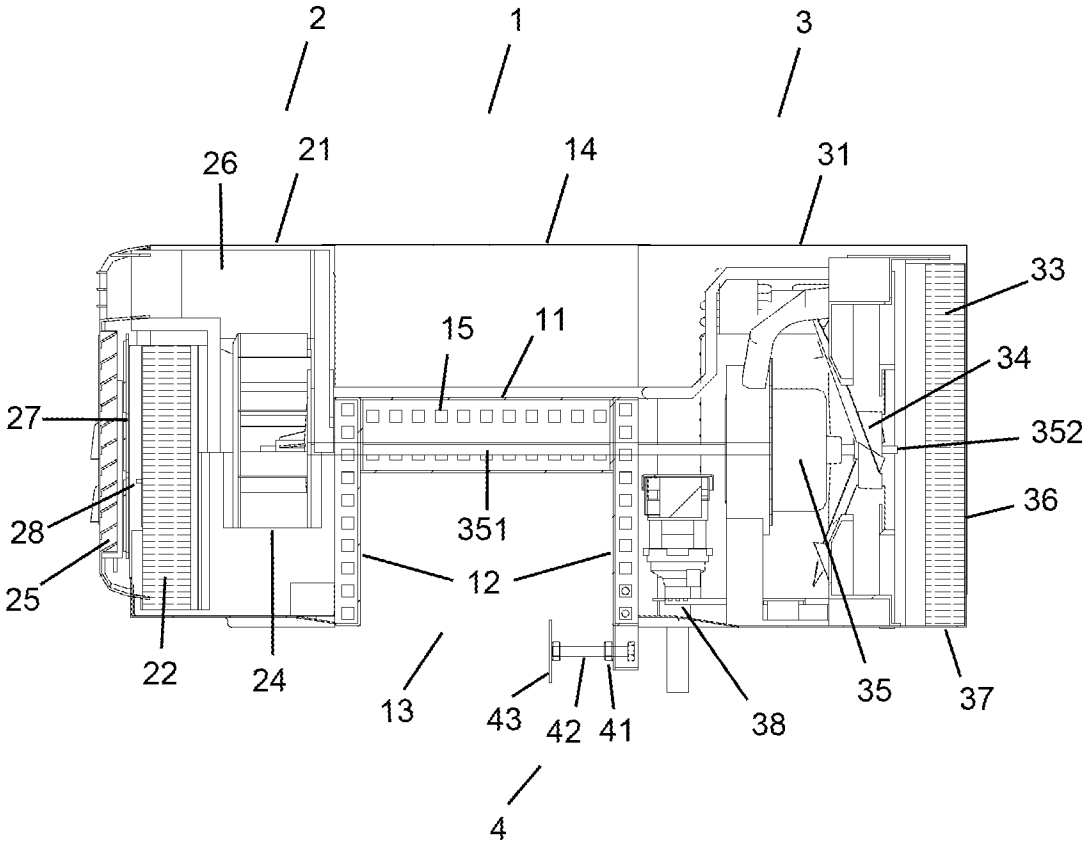
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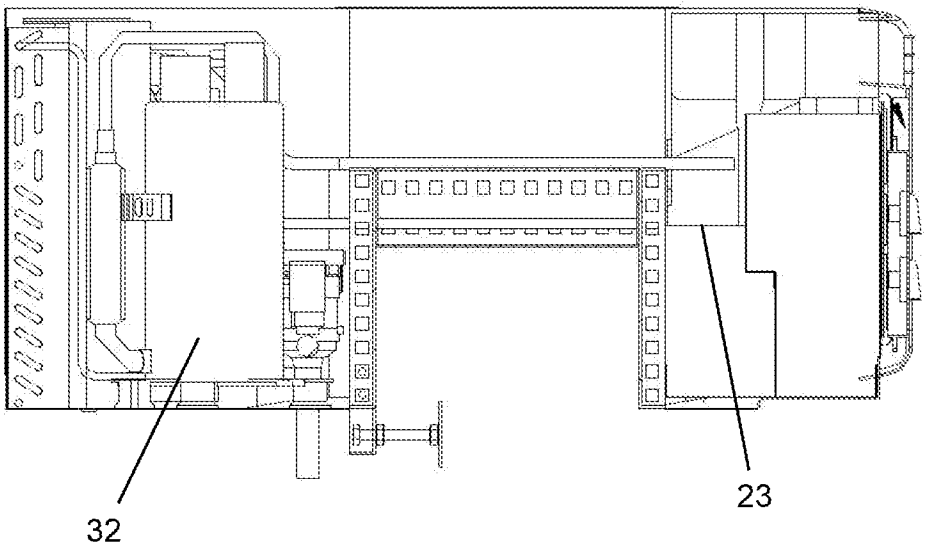
Fig. 3



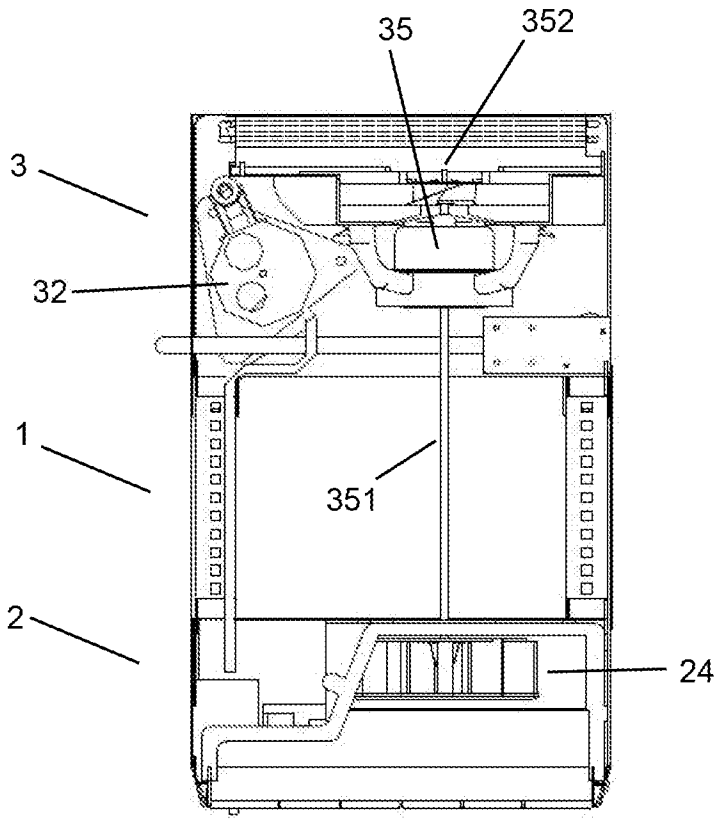


Fig. 4

Fig. 5

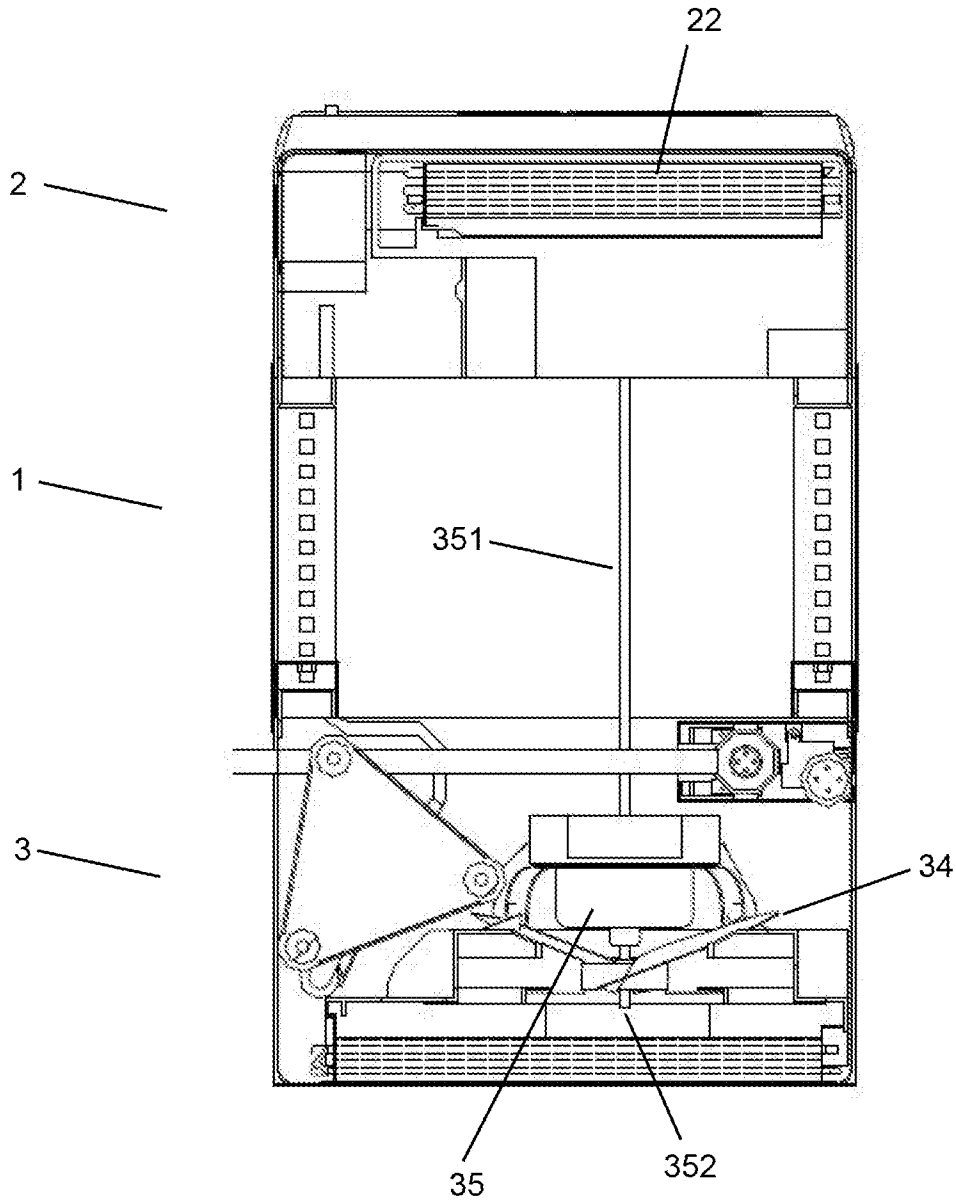
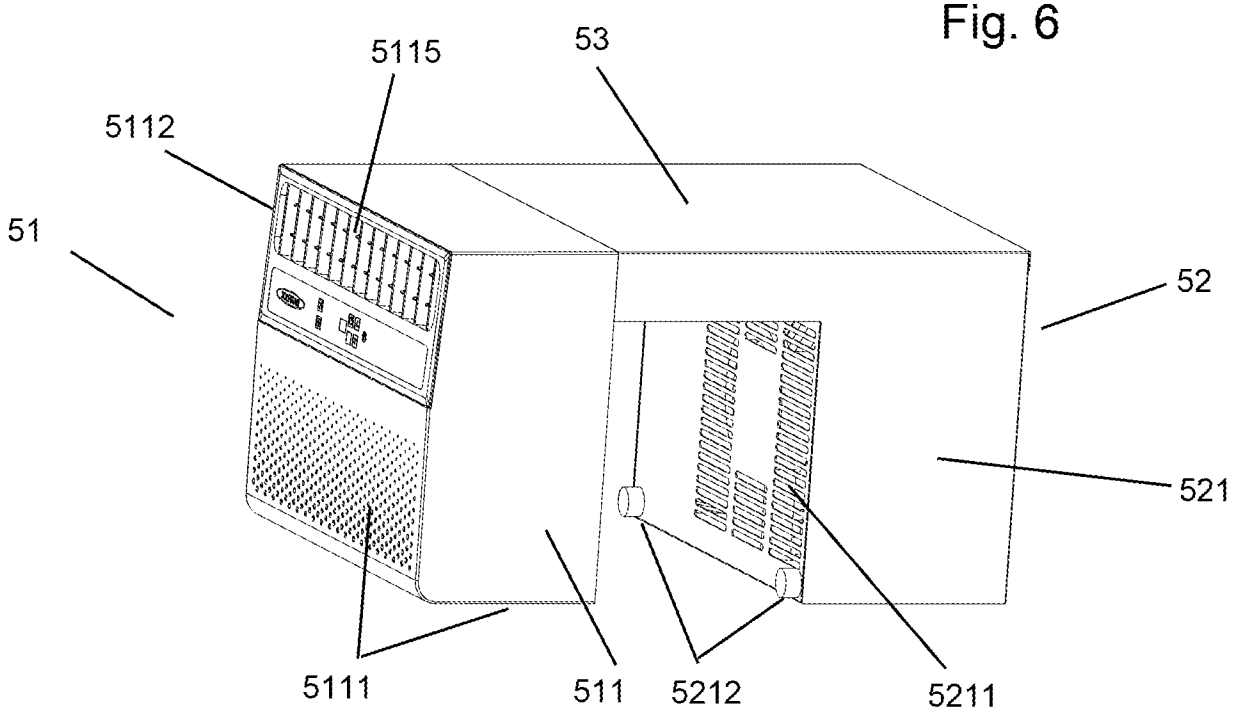


Fig. 6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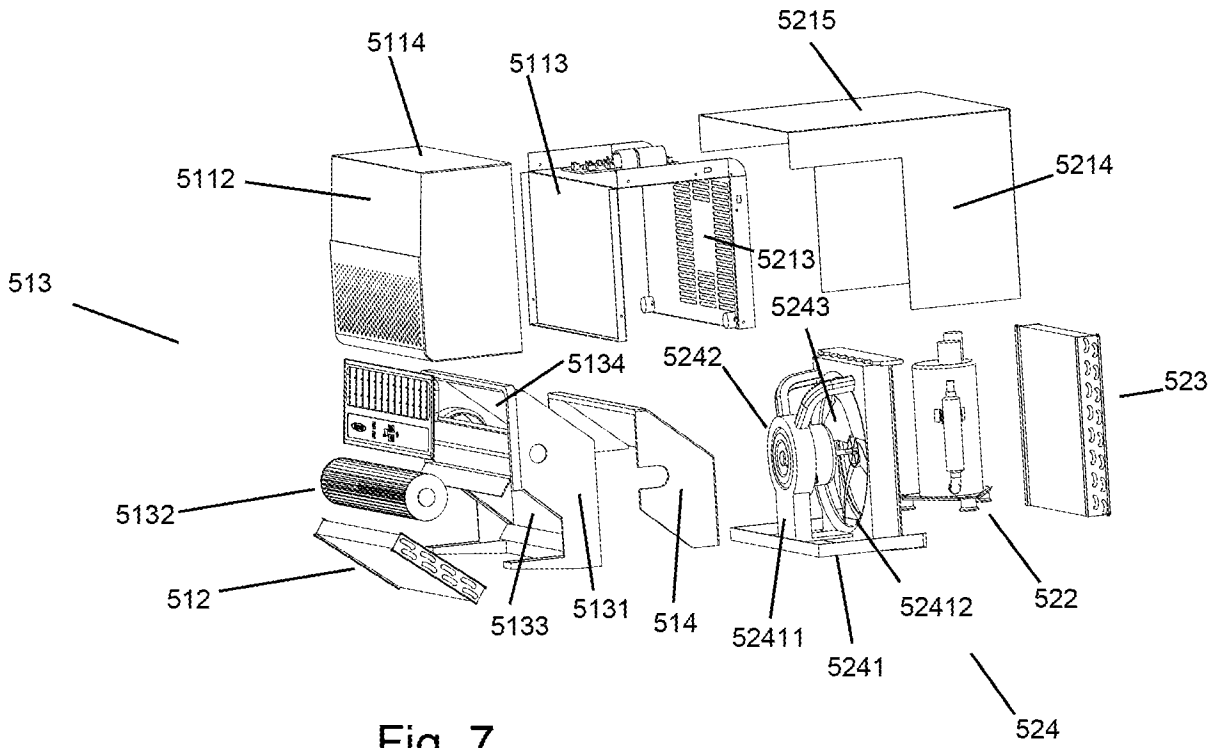
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Fig. 7

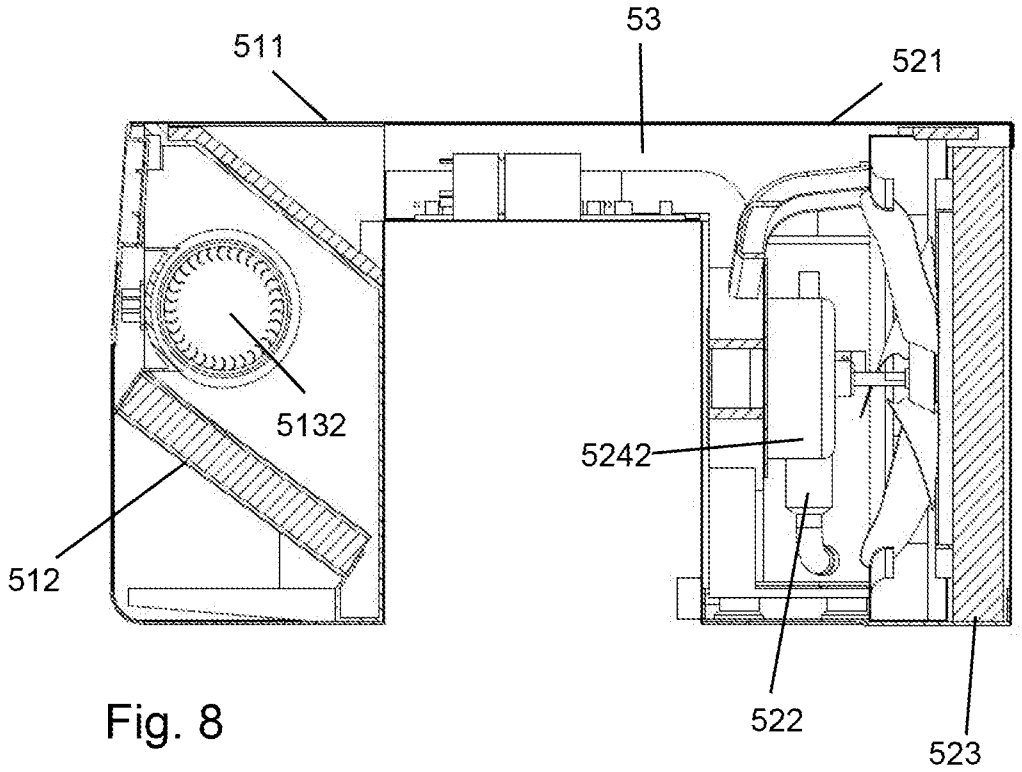

Fig. 8

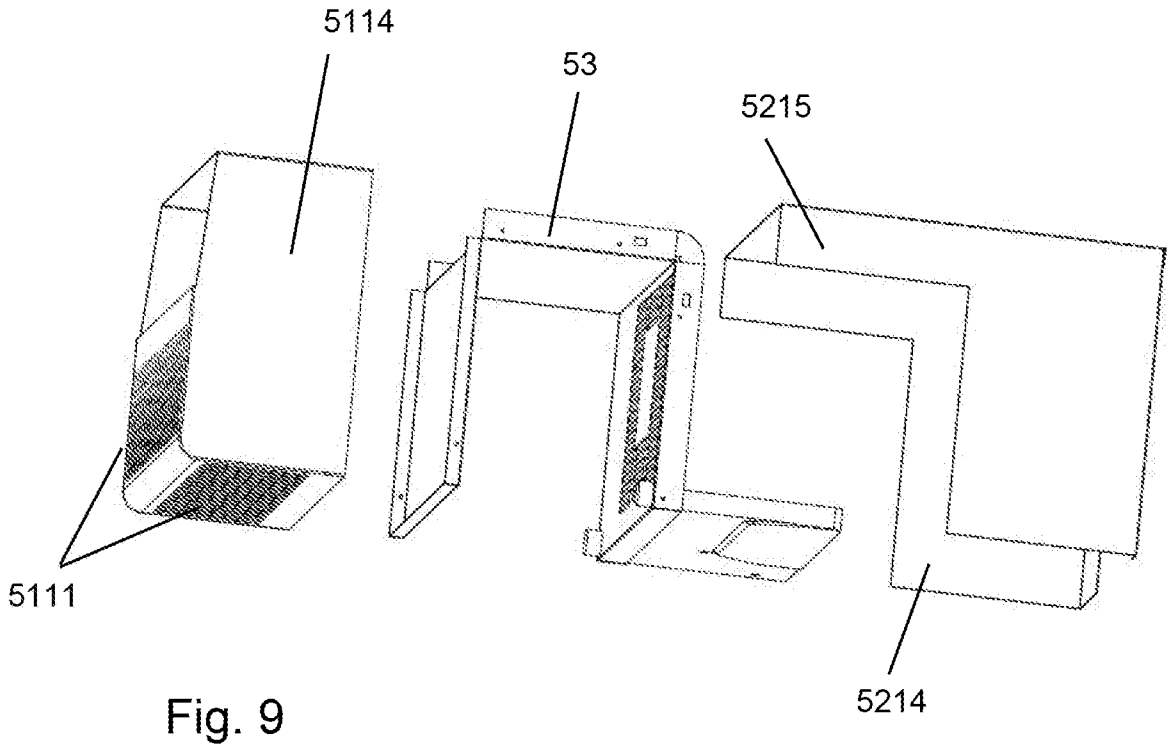

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 19/57601

A. CLASSIFICATION OF SUBJECT MATTER

IPC - F24F 1/0003 (2020.01)

CPC - F24F 1/0003, F24F 1/42, F24F 13/32, F24F 1/06, F24F 1/60, F24F 1/027

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- A	CN 101876467 A (Zhu et al.), 03 November 2011 (03.11.2011), entire document, especially Fig. 1-3; para [0005]-[0007], [0043].	7-10 --- 1-6, 11, 12
A	US 2016/0097547 A1 (Electrolux Appliances Aktiebolag), 07 April 2016 (07.04.2016), entire document.	1-12
A	US 2014/0000061 A1 (Waters), 02 January 2014 (02.01.2014), entire document.	1-12
A	US 2011/0126567 A1 (Asanuma et al.), 02 June 2011 (02.06.2011), entire document.	1-12
A	US 2007/0137237 A1 (Rais), 21 June 2007 (21.06.2007), entire document.	1-12
A	US 2,945,357 A (MacLeod), 19 July 1960 (19.07.1960), entire document.	1-12

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

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2020	20 FEB 2020
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