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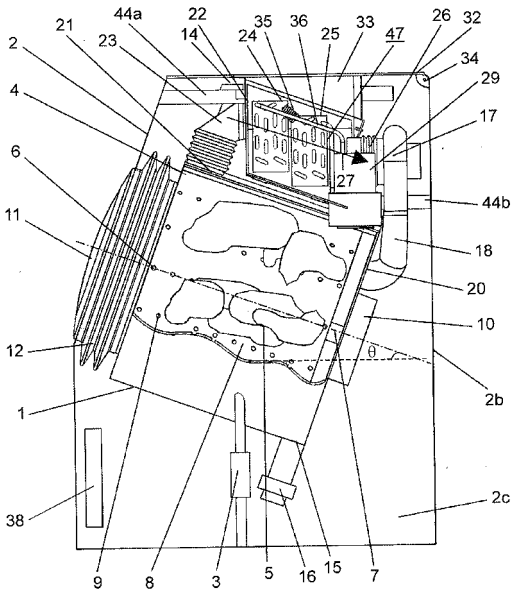
(54) DRUM-TYPE WASHING AND DRYING MACHINE

(57) A drum-type washing and drying machine includes heat pump (47) placed above outer tub (1) for drying the clothes loaded in drum (4). Heat pump (47) is formed of compressor (29), squeezer (35), heat radiator (25), and heat absorber (24) coupled together by pipes (36), and these elements of heat pump (47) can be detached or mounted through a top opening of housing (2).

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a drum-type washing and drying machine for washing and drying clothes.

Background Art

[0002] Fig. 13 shows a conventional drum-type washing and drying machine (hereinafter referred to simply as a drum-type washer) comprising:

housing 51;
outer tub 52 resiliently supported within housing 51;
air-supply tube 53 and air-discharge tube 54 for supplying and discharging air to and from outer tub 52; and
base 59 to which devices forming a heat-pump are mounted. Air-supply tube 53 supplies the air dehumidified and heated by the heat-pump to outer tub 52, and air-discharge tube 54 exhausts outer tub 52 of the air. The heat-pump is formed of blower 55, heat absorber 56, heat radiator 57, and compressor 58, which are rigidly mounted to base 59.

[0003] Tubes 53 and 54 shown in Fig. 13 are made of flexible material, shaped cylindrically, and removable from outer tub 52. The heat-pump can be drawn out backward together with base 59 from housing 51. This structure is disclosed, e.g. Patent Literature 1.

[0004] The structure discussed above allows removing tubes 53 and 54 from outer tub 52, and drawing out the heat-pump together with base 59 backward from housing 51, so that the drum-type washer can be simply assembled in the factory and the heat-pump can be repaired with ease.

[0005] The foregoing structure, however, needs hands to move the heavy washing machine from the place where a user keeps the drum-type washer in order to repair the heat-pump thereof or give the heat-pump maintenance work, so that great amounts of time and labor are required for preparing the repair or the maintenance work and for restoring the heat-pump to the normal place. To be more specific, the drum-type washer, in general, is placed in front of a wall with the rear being closer to the wall, so that no space is available between the wall and the washing machine not only for drawing out the heat pump backward but also for working on the heat pump. The washing machine, rather heavy to lift, should be thus moved away from the wall before it is repaired or given the maintenance work, and restored to the normal place after the work. The repair or the maintenance work has thus required great amounts of time and labor.

Related Art Literature:

[0006]

Patent Literature 1: Unexamined Japanese Patent Application Publication No. 2006 - 110394

Disclosure of Invention

[0007] The present invention addresses the problem discussed above, and aims to provide a drum-type washing and drying machine (hereinafter simply referred to as a drum-type washer) of which heat pump can be repaired or undergo the maintenance work with ease.

[0008] The drum-type washing and drying machine of the present invention includes a heat pump which comprises the following elements:

a compressor;
a heat radiator for radiating the heat from a compressed refrigerant of a high temperature and a high pressure;
a squeezer for decompressing the pressurized refrigerant;
a heat absorber for depriving the decompressed refrigerant of heat; and
pipes connecting the compressor, squeezer, heat radiator and heat absorber together for the refrigerant to circulate through these structural elements.

[0009] The compressor, squeezer, heat radiator, and heat absorber coupled together by the pipes can be removable from a top opening of a housing of the drum-type washing and drying machine..

[0010] The structure discussed above allows saving time and labor necessary for moving and restoring the drum-type washing and drying machine before and after the repair work or the maintenance work for the heat pump, so that the

heat pump can be repaired or undergo the maintenance work with ease. The drum-type washing and drying machine of the present invention thus allows the heat pump to be repaired or undergo the maintenance work with ease.

Brief Description of Drawings

[0011]

Fig. 1 shows a sectional view of an essential part of a drum-type washer in accordance with a first embodiment of the present invention.
Fig. 2 shows a perspective view of the drum-type washer shown in Fig. 1 with a part of inside disclosed.
Fig. 3 shows a perspective view of the drum-type washer in accordance with the first embodiment, where the washer is viewed from the rear with a part of inside disclosed.
Fig. 4 shows a perspective view of the drum-type washer in accordance with the first embodiment, where the washer is viewed from the top with a part of inside disclosed.
Fig. 5 shows a perspective view illustrating a site where the drum-type washer in accordance with the first embodiment is installed.
Fig. 6 shows a top view of a heat pump of the drum-type washer in accordance with the first embodiment.
Fig. 7 shows a perspective view of an outer shell of a heat pump of the drum-type washer in accordance with the first embodiment.
Fig. 8 shows an exploded perspective view of the heat pump of the drum-type washer in accordance with the first embodiment.
Fig. 9 shows a perspective view illustrating how to remove the outer shell of the heat pump of the drum-type washer in accordance with the first embodiment, where the outer shell is viewed from the bottom.
Fig. 10 shows schematically a system concept of the heat-pump of the drum-type washer in accordance with the first embodiment.
Fig. 11 shows a sectional view of an essential part of a drum-type washer in accordance with a second embodiment of the present invention.
Fig. 12 shows a perspective view of the drum-type washer in accordance with the second embodiment, where the washer is viewed from the top with a part of inside disclosed.
Fig. 13 shows an exploded perspective view of a conventional drum-type washer.

Description of Preferred Embodiments

[0012] Exemplary embodiments of the present invention are demonstrated hereinafter with reference to the accompanying drawings. In the drawings, similar elements have the same reference signs and the descriptions thereof are sometimes omitted. The present invention is not limited by the embodiments below.

Exemplary Embodiment 1

[0013] Fig. 1 shows a sectional view of an essential part of a drum-type washing and drying machine (hereinafter referred to simply as a drum-type washer) in accordance with the first embodiment of the present invention. Fig. 2 shows a perspective view of the drum-type washer shown in Fig. 1 with a part of inside disclosed. Fig. 3 shows a perspective view of the drum-type washer, where the washer is viewed from the rear with a part of inside disclosed. Fig. 4 shows a perspective view of the drum-type washer, where the washer is viewed from the top with a part of inside disclosed. Fig. 5 shows a perspective view illustrating a site the drum-type washer is kept. Fig. 6 shows a top view of a heat pump of the drum-type washer. Fig. 7 shows a perspective view of an outer shell of the heat pump of the drum-type washer. Fig. 8 shows an exploded perspective view of the heat pump of the drum-type washer. Fig. 9 shows a perspective view illustrating how to remove the outer shell of the heat pump of the drum-type washer, where the outer shell is viewed from the bottom. Fig. 10 shows schematically a system concept of the heat-pump of the drum-type washer.

[0014] As shown in Fig. 1 - Fig. 3, outer tub 1 is resiliently supported by multiple suspension mechanisms 3 within housing 2. Drum 4 has inlet 6 on the front for loading or unloading clothes 5, shapes like a cylinder having a bottom, and is installed in outer tub 1. Drum 4 rotates on rotary shaft 7, accommodates clothes 5, and is formed of enclosing wall 8 having numerous vents 9. As shown in Fig. 1, outer tub 1, drum 4 and rotary shaft 7 tilt up toward a front (front-up and rear-down) by angle θ, e.g. 20 degrees, relative to the horizontal. Motor 10 is mounted to the outer face of underside 1b of outer tub 1 for rotating drum 4 forward or backward. Housing 2 includes round inlet 6 on the front for loading or unloading clothes 5, and door 11 for opening or closing inlet 6. Inlet 6 confronts opening 1a of outer tub 1, and opening 1a is air-tightly connected to housing 2 with packing 12. Water inlet 13 is placed at the upper part of outer tub 1 and connected to water supply valve 14 placed above outer tub 1. Outer tub 1 includes drain port 15 at underside

1b for draining wash water, and drain port 15 is connected to drain valve 16.

[0015] Blower 17, shown in Fig. 1 forms a blowing means, and is placed over outer tub 1 such that blower 17 is located in the space formed between the top face of housing 2 and outer tub 1 at the upper-rear inside of housing 2. Blower 17 communicates with air-supply duct 18 provided on an outer wall of outer tub 1, and blows air supplied from duct port 18a shown in Figs. 2 and 3 along arrow 19 into drum 4 through air inlet 20. Outer tub 1 includes exhaust port 21 at the top face in front, and the air travels through drum 4 and outer tub 1 and then exhausts from exhaust port 21 to the outside of drum 4.

[0016] On the top face of outer tub 1, elastic connecting member 23 on heat absorber side is placed in front for connecting exhaust port 21 to outer shell 22 of the heat pump, and then heat absorber 24 and heat radiator 25 are placed next to connecting member 23 for forming a heat exchanger of the heat pump. Then elastic connecting member 26 on heat radiator side is placed behind heat radiator 25 for connecting outer shell 22 of the heat pump to blower 17. Those structural elements placed on the top face of outer tub 1 are arranged generally in parallel with rotary shaft 7, i.e. they are tilted up toward a front (front-up and rear-down). The drying air supplied from exhaust port 21 travels along arrow 27 almost linearly in following order of the structural elements arranged as discussed above, i.e. from Connecting member 23 on heat absorber side to connecting member 26 on heat radiator side. Outer shell 22 thus connects outer tub 1 to the heat pump and works as air-circulation path 22 for circulating the drying air.

[0017] As shown in Fig. 1, bottom face 22a of outer shell 22 of the heat pump tilts along arrow 27 showing the flow of drying air, i.e. bottom face 22a is placed generally in parallel with rotary shaft 7 as outer tub 1 is placed (front-up and rear-down). As shown in Fig. 4, outer shell 22 has opening 22b at the top face. Outer shell 22 is removable from housing 2 along vertical direction as indicated by the up-down arrows shown in Fig. 9. Upper inside of housing 2, there are front bracket 44a extending backward and rear bracket 44b extending forward, and they support heat pump 47 within housing 2.

[0018] As shown in Fig. 4, front bracket 44a of housing 2 is fitted to front mounting section 22c provided at the front of outer shell 22, and rear bracket 44b is fitted to rear mounting section 22d shown in Fig. 6, so that outer shell 22 of the heat pump can be fixed to housing 2. In other words, heat pump 47 belongs to the same vibration system as housing 2.

[0019] Heat pump 47 is supported within housing 2 by a supporter formed of front bracket 44a and rear bracket 44b such that a given space can be formed between the underside of outer shell 22 of the heat pump and the top face of outer tub 1. This structure allows preventing outer tub 1 from touching outer shell 22 when tub 1 trembles due to the spin of drum 4.

[0020] The drying air blown by blower 17 travels through air-supply duct 18, air inlet 20 and goes into drum 4, and passes through clothes 5 in drum 4, then goes out from exhaust port 21 as shown with arrow 28 in Fig. 10. The drying air then travels through connecting member 23 on heat absorber side, and goes into heat absorber 24, heat radiator 25 placed in outer shell 22 (not shown in Fig. 10) of the heat pump, and then travels through connecting member 26 on heat radiator side, and finally returns to blower 17. The drying air thus forms an air-circulation path.

[0021] As shown in Fig. 6 and Fig. 8, heat absorber 24, heat radiator 25 and compressor 29 are unitized into the heat pump and placed on base 30. Base 30 is placed along bottom face 22a of outer shell 22 of the heat pump such that base 30 is removable from outer shell 22 in vertical direction as indicated by up-down arrows 28a shown in Fig. 8. Base 30 includes first setting section 30a shaped like a plane on which heat radiator 25 and heat absorber 24 are set, and second setting section 30b shaped like a cylinder in which compressor 29 is accommodated. Second setting section 30b is formed behind first setting section 30a, and located deeper backward above drum 4 than first setting section 30a.

[0022] As shown in Fig. 1, first setting section 30a tilts along arrow 27 indicating the flow of the drying air, namely, it tilts generally in parallel with the top face of outer tub 1, i.e. front-up and rear-down. When base 30 is placed in outer shell 22, the underside of cylindrical second setting section 30b is kept horizontally and lower than first setting section 30a. First setting section 30a of base 30 includes lower separator 30c and upper separator 30d extending vertically as shown in Fig. 8. Those separators isolate heat absorber 24 and heat radiator 25, i.e. heat exchanger side, from compressor 29, i.e. compressor side on first setting section 30a. Heat absorber 24 and heat radiator 25 have their lower ends placed on lower separator 30c, and then upper separator 30d fits onto the upper ends of heat absorber 24 and heat radiator 25 so that heat absorber 24 and heat radiator 25 can be fixed to base 30.

[0023] Discharge port 31 is provided to the lower rear part of outer shell 22 on heat exchanger side for discharging the water dehumidified by heat absorber 24. As shown in Fig. 5, opening 22b of outer shell 22 is covered with cover 33 unified with lid 32 which opens/closes top opening 2a of housing 2. Outer shell 22 of the heat pump and cover 33 form the air-circulation path through which the drying air travels.

[0024] Lid 32 can swing relative to housing 2 on hinge mechanism 34 provided to the rear upper end of housing 2, so that it opens/closes top opening 2a of housing 2. At the same time, cover 33 unified with lid 32 at the inner face of lid 32 opens/closes opening 22b of outer shell 22 of heat pump. In other words, when lid 32 has opening 2a of housing 2 opened, opening 22b of outer shell 22 is opened simultaneously.

[0025] Connecting member 23 on heat absorber side is coupled to entrance 22e provided to the front side of outer shell 22 under lid 32, and connecting member 26 on heat radiator side is coupled to exit 22f provided to the rear side of outer shell 22 under lid 32. This structure allows detaching the connecting members 23 and 26 from outer shell 22 by

opening lid 32.

[0026] Heat pump 47 includes the following structural elements:

compressor 29;
heat radiator 25 for radiating the heat of a refrigerant compressed by compressor 29;
squeezer 35 formed of capillaries for decompressing the pressurized refrigerant;
heat absorber 24 for depriving the ambient air of heat; and
pipe 36 for connecting the foregoing structural elements together for circulating the refrigerant through them.

[0027] As shown in Fig. 10, the refrigerant of the heat pump flows along arrow 37 and circulates to form a heat pump cycle.

[0028] Compressor 29 is coupled electrically to controller 38 provided outside heat pump 47, where controller 38 is placed below outer tub 1. Heat pump 47 and controller 38 are detachable from each other via an electric connecting section formed of connector 38a shown in Fig. 10. Connector 38a is held at a rear corner section over heat pump 47, where the rear corner section is formed between outer shell 22 and lid 32 so that connector 38a can be simply removed from top opening 2a of housing 2 with lid 32 opened.

[0029] As discussed above, the drum-type washing and drying machine of the present invention comprising the following structural elements:

housing 2;
outer tub 1 resiliently supported within housing 2;
cylindrical drum 4 with a bottom, and disposed rotatably in outer tub 1, having inlet 6 on the front for loading clothes 5 therein, and tilted up toward front (front-up and rear-down);
motor 10 for driving drum 4;
heat pump 47 disposed within housing 2 for drying clothes 5 loaded in drum 4;
air-circulation path 22 coupling outer tub 1 to heat pump 47 for circulating drying-air;
blower 17 for blowing air through air-circulation path 22;
air inlet 20 for introducing the drying air into drum 4;
exhaust port 21 for exhausting the drying air from drum 4; and
lid 32 for covering top opening 2a of housing 2 such that lid 32 opens/closes top opening 2a.

[0030] Heat pump 47 comprises the following structural elements:

compressor 29;
heat radiator 25 for radiating heat of a pressurized refrigerant of high temperature and high pressure;
squeezer 35 for decompressing the pressurized refrigerant;
heat absorber 24 for the decompressed refrigerant of low pressure to deprive the ambient air of heat; and
pipes 36 connecting compressor 29, squeezer 35, heat radiator 25, and heat absorber 24 together for the refrigerant to circulate through these elements.

[0031] Compressor 29, squeezer 35, heat radiator 25, and heat absorber 24 coupled together by pipes 36 are disposed above outer tub 1 so that they can be detachable through top opening 2a of housing 2.

[0032] The structure discussed above allows eliminating the time and labor necessary for moving/restoring the drum-type washer from/to the work-place in order to repair or give the washer maintenance work. The washer thus can be repaired or undergo the maintenance work with ease.

[0033] Since heat pump 47 is placed above outer tub 1, the washing water never enters air-circulation path 22 disposed above drum 4. This structure thus prevents heat absorber 24 and heat radiator 25 made of metal excellent in heat conduction, e.g. copper or aluminum, from being corroded by detergent, softening agent, bleaching agent contained in the wash water. This structure also allows simply draining the water produced by heat absorber 24 during the drying operation without using a draining means such as a pump.

[0034] Heat pump 47 can be supported by a supporter provided to housing 2 shown in Fig. 1 so that heat pump 47 is located above outer tub 1. To be more specific, housing 2 is equipped with this another supporter for supporting heat pump 47 such that heat pump 47 can be located above outer tub 1.

[0035] This structure prevents the vibration of outer tub 1 from traveling to heat pump 47 directly, so that adverse affect of vibration of drum 4 during the dehydrating operation can be eliminated. The reliability and durability of heat pump 47 can be thus improved. On top of that, heat pump 47 can be detached or mounted with ease above outer tub 1 which may swing though because tub 1 is resiliently supported in housing 2.

[0036] As shown in Fig. 6 and Fig. 8, heat pump 47 is formed of compressor 29, heat radiator 25 and heat absorber

24 unified together on base 30, and then base30 is detachably mounted to housing 2 as shown in Fig. 1. This structure allows fixing the relative positions among compressor 29, squeezer 35, heat radiator 25, and heat absorber 24 coupled together by pipes 36, so that the stress applied to pipes 36 can be reduced. Heat pump 47 can be thus simply handled when it is detached or mounted from/to housing 2, and actually it can be detached or mounted with ease from/to above outer tub 1.

[0037] An operation of the drum-type washing and drying machine (hereinafter referred to simply as a drum-type washer) as structured above is demonstrated hereinafter following the order of chief steps of the drum-type washer: washing step, rinsing step, dehydrating step, and drying step.

[0038] During the washing step, supply water until the water reaches a predetermined level in outer tub 1 with drain valve 16 closed as shown in Fig. 1. Then drive drum 4 containing clothes 5 and the water for washing. At this time a part of the water enters air-supply duct 18; however, the water never enters heat pump 47 or blower 17 because the route of air-supply duct 18 is lifted upward.

[0039] During the rinsing step after the washing step, the water is supplied into outer tub 1 as is done in the washing step for rinsing clothes 5 by rotating drum 4.

[0040] During the dehydrating step, open the drain valve 16 for draining the water outside the drum-type washer, and then spin drum 4 containing clothes 5 with motor 10 at a high speed for dehydration. During the washing and dehydrating steps, although drum 4 spins and vibrates, which produces vibrations on the entire outer tub 1, the vibrations can be absorbed by suspension mechanisms 3, so that the vibrations are attenuated before they reach housing 2, which thus poorly vibrates.

[0041] During the drying step, compressor 29 of heat pump 47 compresses the refrigerant, and the pressure of compressor 29 allows the refrigerant to circulate in heat radiator 25, squeezer 35 and heat absorber 24 through pipes 36. Heat radiator 25 radiates the heat of the compressed refrigerant, and in heat absorber 24, the refrigerant decompressed by squeezer 35 absorbs heat. At this time blower 17 blows warm air heated by the heat dissipated from heat radiator 25 into drum 4 through air-supply duct 18 and air inlet 20. Drum 4 is driven by motor 10, and clothes 5 are lifted and dropped due to the spin of drum 4, whereby clothes 5 are agitated up and down.

[0042] The warm air blown into drum 4 travels through respective clothes 5, thereby depriving clothes 5 of water, and the damped warm air travels through exhaust port 21, connecting member 23 on heat absorber side, and reaches heat absorber 24. When this damped warm air passes through heat absorber 24, the air is deprived of sensible heat and latent heat, and dehumidified. The air is separated into dry-air and water. The dry-air is heated again by heat radiator 25 placed immediately after heat absorber 24, and becomes warm before it travels through blower 17 and air-supply duct 18, and reaches drum 4, in other words, the air circulates to drum 4.

[0043] The water dewed by heat absorber 24, on the other hand, is discharged outside the drum-type washer, as indicated by arrows 43 in Fig. 8, from discharge port 31 provided at a lower section of the rear end-face, closer to the heat exchanger, of outer shell 22. This is because first setting section 30a tilts up toward a front (front-up and rear-down) like the outer tub 1 does. The water can be discharged from discharge port 31 to the outside directly, or it can be discharged from drain port 15 via outer tub 1 to the outside.

[0044] Use of heat pump 47 allows the refrigerant to recover the heat which heat absorber 24 absorbs from the ambient air, and then allows the refrigerant to dissipate the heat again in heat radiator 25, so that an amount of heat greater than the energy supplied to compressor 29 can be supplied to clothes 5. As a result, a drying time can be shortened and energy can be saved.

[0045] Since drum 4 and outer tub 1 tilt up toward a front (front-up and rear-down), inlet 6 is located at a convenient height for a user to load or unload clothes 5, and spaces having an appropriate width, depth and height for placing some devices can be obtained both at the lower front and the upper rear in housing 2.

[0046] Placement of heat pump 47 above outer tub 1 allows simply taking out compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled together by pipes 36 upward from top opening 2a by opening lid 32 as shown in Fig. 5. Considering a limited area of installation location, the drum-type washer is placed, in general, in front of wall 39 or between walls 39 with a small space reserved between rear face 2b of housing 2 and wall 39, or between at least one of lateral faces 2c of housing 2 and wall 39 as shown in Fig. 5. Lid 32 is one of the structural elements contributing to the external appearance of the drum-type washer, and yet, lid 32 is rather easy to open while the time and labor for moving the drum-type washer can be eliminated. This configuration and the placement of heat pump 47 above outer tub 1 allow taking out compressor 29, squeezer 35, heat radiator 25 and heat absorber 24, forming heat pump 47, upward with ease. As a result, the maintenance work on heat pump 47 can be done with more ease.

[0047] The placement of heat pump 47 above outer tub 1 allows preventing the wash water from entering heat absorber 24 or heat radiator 25 of heat pump 47 through circulation path 22. Heat absorber 24 and heat radiator 25 are generally made of metal excellent in heat conduction, e.g. copper or aluminum, and when the components of detergent, softening agent, bleaching agent contained in the wash water attach to heat absorber 24 or heat radiator 25, the components probably corrode heat absorber 24 or heat radiator 25. The placement of heat pump 47 above outer tub 1 thus prevents the wash water in outer tub 1 located below heat pump 47 from attaching to heat pump 47. The structure discussed

above thus prevents the wash water from entering heat pump 47, so that heat absorber 24 and heat radiator 25 can be prevented from being corroded without taking any measures against corrosion. As a result, the durability and reliability of heat absorber 24 and heat radiator 25 can be improved.

[0048] On top of that, heat absorber 24 can be placed at a comparative upper section among the structural elements of the drum-type washer. This placement allows the water, which is produced by heat absorber 24 in dehumidifying the drying air during the drying step, travels on first setting section 30a tilted up toward a front (front-up and rear-down) as outer tub 1 is tilted, and is discharged from discharge port 31 shown in Fig. 3 or Fig. 6. As a result, the water can be discharged without using an extra mechanical discharging means.

[0049] Heat pump 47 is formed of compressor 29, heat radiator 25, heat absorber 24, and those elements are mounted to and unified with base 30 as shown in Fig. 6 and Fig. 8, and unified base 30 can be mounted to or removed from housing 2. The unit assembly discussed above allows heat pump 47 to be mounted or detached for the repair work or maintenance work free from stress applied to pipes 36, so that the workers do not need to pay much attention to handling pipes 36 of heat pump 47. In other words, this structure eases this burden (handling pipes 36 with great care) for the workers, who can thus work more efficiently.

[0050] Compressor 29 is placed such that the bottom thereof is kept horizontal, namely, in parallel to the horizontal. This structure allows determining whether or not the relative positional relations among compressor 29, squeezer 35, heat radiator 25, and heat absorber 24 can be maintained in the drum-type washer based on this horizontal status as a reference when those elements are taken out. This determination will reduce the possibility of producing the stress applied to pipes 36 caused by a deviation in the relative positional relations.

[0051] Second setting section 30b where compressor 29 is placed is located lower than first setting section 30a where heat radiator 25 and heat absorber 24 are placed. The bottom of compressor 29 having a comparative greater weight among the structural elements of heat pump 47 is thus situated at a rather lower location. This structure allows the workers to take out, in a stable manner, compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 unified together. Even if compressor 29 and other elements coupled with pipes 36 touch housing 2 and encounter with waver unexpectedly, they wave but subside soon because the center gravity of the mass is situated at a rather lower place. This structure thus reduces the possibility of applying the stress, produced by a deviation in the relative positional relations, to pipes 36. Heat pump 47 can be thus placed with the bottom of compressor 29 kept parallel to the horizontal.

[0052] The foregoing structure allows the worker to place compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled by pipes 36 with the bottom of compressor 29 kept parallel to the horizontal when the worker takes out or mounts those elements. As a result, the relative positional relations among those elements can be maintained, and the stress applied to pipes 36 can be reduced.

[0053] Heat pump 47 includes first setting section 30a on which at least one of heat radiator 25 or heat absorber 24 is mounted and second setting section 30b on which compressor 29 is mounted, and the second setting section 30b is situated lower than first setting section 30a. This structure allows compressor 29, having a greater mass than heat radiator 25 or heat absorber 24, to be located at a lower place than heat radiator 25 and heat absorber 24, so that the center gravity of the mass can be lowered for simpler handling and better operability when those elements are removed or mounted. Even if those elements touch housing 2 and receive external force unexpectedly, they wave but subside soon because of the lowered center gravity of the mass. This structure thus reduces the possibility of applying the stress, produced by a deviation in the relative positional relations, to pipes 36.

[0054] First setting section 30a is placed at a forward section above drum 4 and second setting section 30b is placed at a backward section above drum 4, so that the worker can take out the heat pump with ease. On top of that, this structure allows placing the air-circulation path in a compact manner. Since heat radiator 25 and heat absorber 24 placed on first setting section 30a can be divided into two sections, they can be placed in a flexible manner. Taking advantage of this flexible placement, it is desirable for forming a heat transfer mechanism having a maximized heat-transfer area in order to accelerate heat transfer to/from the drying air. Heat radiator 25 and heat absorber 24 thus can be placed in a more flexible manner than compressor 29 placed on second setting section 30b; however a capacity accommodating heat radiator 25 and heat absorber 24 is often obliged to be great.

[0055] During the maintenance work, the worker takes out heat pump 47 upward with lid 32 opening. At this time, the worker often takes it out from the front side because a working space is generally available in front of the drum-type washer, as shown in Fig. 5, for saving the worker from moving the washer. First setting section 30a having a rather greater capacity is thus placed at the forward section above drum 4, and second setting section 30b having a rather smaller capacity is place at the backward section above drum 4. This placement is convenient for the worker to take out heat pump 47 including heat radiator 25 from the drum-type washer, so that the worker can do the job with more ease.

[0056] As shown in Fig. 1, air inlet 20 is placed at the vicinity of the rear face of drum 4, and exhaust port 21 is placed at the vicinity of the front face of drum 4. This structure allows the drying air to circulate from underside 1b, where a large number of clothes 5 exists, of drum 4 toward inlet 6. The drying air thus can stay in drum 4 for a longer time, so that the drying air can be brought into contact with clothes 5 more efficiently, and this structure advantageously uses the drying air to dry clothes 5. On top of that, the air-circulation path, through which the drying air flows, is formed of

outer shell 22 of the heat pump, and this air-circulation path is placed along rotary shaft 7, so that the drying air can flow smooth, and the air-circulation path can be placed in a compact manner. The air-circulation path is placed above drum 4, and is tilted up toward a front (front-up and rear-down), and kept approx. parallel to rotary shaft 7 of drum 4. This structure allows placing the air-circulation path compactly, which allows the worker in charge of the repair or maintenance work to take out heat pump 47 with more ease.

[0057] To be more specific, heat pump 47 includes air-circulation path 22 formed along rotary shaft 7 of drum 4, and either one of air inlet 20 or exhaust port 21 is placed at the front side of drum 4 and the remainder is placed at the rear side of drum 4. First setting section 30a on which at least one of heat radiator 25 or heat absorber 24 is mounted is placed at the forward section above drum 4, and second setting section 30b on which compressor 29 is mounted is placed at the backward section above drum 4.

[0058] The foregoing structure achieves a smooth flow of the drying air, which can thus efficiently circulate in drum 4. In the case where the worker repairs heat pump 47 or gives the maintenance work to heat pump 47 from the front side of drum-type washer, first setting section 30a, where heat radiator 25 or heat absorber 24 is mounted, is placed on the forward section above drum 4. This structure allows the worker to take out heat pump 47 from housing 2 with ease even if heat pump 47 is upsized by enlarging the heat-exchange area in order to increase efficiency both in dehumidifying and heating. Heat pump 47, though it is upsized, can be placed in the air-circulation path compactly.

[0059] Air-circulation path 22 is placed above drum 4 and tilted up toward a front (front-up and rear-down) and kept parallel to rotary shaft 7 of drum 4. This structure allows draining the dew water produced by heat absorber 24 from the rear of drum 4 with ease. On top of that air-circulation path 22 runs along outer tub 1 so that path 22 can be placed compactly. The drying air thus can circulate in drum 4 efficiently. The structure discussed above allows taking out heat pump 47 or the structural elements forming pump 47 from housing 2 with ease in the case of repair or maintenance.

[0060] As shown in Fig. 1, air-circulation path 22 is formed of connecting member 23 coupled to outer tub 1 on heat absorber side, outer shell 22 having heat absorber 24 and heat radiator 25 therein and covered with cover 33, connecting member 26 on heat radiator side, and air-supply duct 18 coupled to outer tub 1. Connecting members 23, 26 and outer shell 22 are placed above drum 4. Entrance 22e communicates with exit 22f of outer shell 22 under lid 32 as shown in Fig. 7 or Fig. 8. Entrance 22e of outer shell 22 is formed between connecting member 23 on heat absorber side and the front side of outer shell 22, and exit 22f is formed between connecting member 26 on heat radiator side and the rear side of outer shell 22. This structure allows the connecting members 23 and 26 to be detachable from outer shell 22 by opening lid 32.

[0061] Air-circulation path 22 formed by outer shell 22 covered with cover 33 is tilted up toward a front (front-up and rear-down) and kept parallel to rotary shaft 7 of drum 4. This structure allows shortening the length of path 22, so that path 22 can be formed more compactly. Path 22 includes opening 22b through which heat radiator 25 and heat absorber 24 can be removed, and cover 33 for covering opening 22b. This structure eliminates the work of a repairman to detach heat pump 47 from the air-circulation path, and the removal off cover 33 allows the repairman to simply take out upsized heat pump 47, in which the structural elements including compressor 29 are connected and unitized together by pipes 36. The repairman can thus repair heat pump 47 efficiently.

[0062] Cover 33 is unitarily formed with lid 32, so that an open of lid 32 simultaneously opens opening 22b of outer shell 22, thereby exposing heat absorber 24, heat radiator 25 and compressor 29 accommodated in outer shell 22.

[0063] In other words, the air-circulation path includes opening 22b through which heat radiator 25 and heat absorber 24 can be removed, and cover 33 detachably mounted for covering the opening 22b. Heat pump 47 accommodates heat radiator 25 and heat absorber 24 in the air-circulation path, and cover 33 finishes up the air-circulation path. This structure allows saving a worker from taking out the air-circulation path coupled to outer tub 1, and instead, allows the worker to simply take out compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled together by pipes 36 from top opening 2a of housing 2.

[0064] The air-circulation path includes opening 22b on the upper side, and cover 33 detachably mounted for covering the opening 22b, and heat radiator 25 and heat absorber 24 can be removed through opening 22b. Heat pump 47 accommodates heat radiator 25 and heat absorber 24 in the air-circulation path. Cover 33 finishes up the air-circulation path, and is unitarily formed with lid 32. This structure allows saving a worker from taking out the air-circulation path coupled to outer tub 1, and instead, allows the worker to simply take out compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled together by pipes 36 from top opening 2a of housing 2 by just removing cover 33. On top of that, an open of lid 32 simultaneously opens opening 22b of outer shell 22, thereby exposing heat radiator 25 and heat absorber 24 accommodated in the air-circulation path for being detached or mounted.

[0065] Lid 32 can swing rearward on hinge mechanism 34 so that it can open/close housing 2. The maintenance work for heat pump 47 is done temporarily in front of the space where the drum-type washer is kept, so that the worker should reserve a place for placing lid 32 to be removed. Since this hinge mechanism can hold lid 32 to open/close housing 2, the worker needs not to find the place. Hinge mechanism 34 also couples lid 32 to housing 2, so that a joining work, necessary when lid 32 is closed, between housing 2 and lid 32 can be simplified.

[0066] Heat pump 47 is electrically connected to controller 38 with a connecting section, i.e. connector 38a, which is

placed near to top opening 2a such that connector 38a can be seen when lid 32 is opened as shown in Fig. 1. This placement allows the worker to simply detach heat pump 47 from connector 38a without any obstacle.

[0067] Outer shell 22 of heat pump is coupled to connecting member 23 on heat absorber side and connecting member 26 on heat radiator side immediately under lid 32 and near top opening 2a, where both of connecting members 23 and 26 are made of flexible material, the flexibility of connecting members 23 and 26 aids the worker in removing heat pump 47 efficiently from outer shell 22. Compressor 29, squeezer 35, heat absorber 24 and heat radiator 25 coupled together by pipes 36 can be detached as a unitized heat pump 47 from above outer tub 1.

[0068] Lid 32 can swing on hinge mechanism 34, which thus saves the worker from removing lid 32 or reserving a space for temporarily placing lid 32. The worker thus can do the repair work or maintenance work with lid 32 connected to housing 2, so that the worker can open/close top opening 2a of housing 2 with ease.

[0069] The drum-type washer includes controller 38 for controlling the operation of heat pump 47, and the electric connecting section between controller 38 and heat pump 47 is formed such that heat pump 47 can be removed from controller 38 through top opening 2a. This structure allows the worker to electrically and safely separate heat pump 47 from controller 38 before the worker takes out heat pump 47, and also allows the worker to connect again to controller 38 without fail after the worker mounts heat pump 47 properly.

[0070] The drum-type washer includes flexible connecting members 23, 26 for coupling heat pump 47 to outer tub 1. First ends of respective connecting members 23, 26 are coupled to the air-circulation path, and second ends thereof are coupled to outer tub 1. At least one of the first or the second ends thereof is removable through top opening 2a of housing 2. The flexibility of connecting members 23 and 26 allows the worker to separate heat pump 47 from outer tub 1 with ease, so that the worker can remove heat pump 47 efficiently.

[0071] In this first embodiment, hinge mechanism 34 between lid 32 and housing 2 is placed on the rear side of housing 2; however, it can be placed on the lateral side, i.e. lid can be opened laterally. The drying air is introduced from the rear of drum 4 and exhausted from the front; however, the drying air can flow in a reversal direction. Heat pump 47 can be taken out together with outer shell 22.

Exemplary Embodiment 2

[0072] The second embodiment of the present invention is demonstrated hereinafter with reference to Figs. 11 and 12. Fig. 11 shows a sectional view of an essential part of a drum-type washing and drying machine (hereinafter simply referred to as a drum-type washer) in accordance with the second embodiment of the present invention. Fig. 12 shows a perspective view of the drum-type washer, where a part of housing 2 is viewed from the top. Similar elements to those used in the first embodiment have the same reference signs, and the descriptions thereof are omitted here.

[0073] The drum-type washer in accordance with the second embodiment differs from the one in accordance with the first embodiment in mounting unitized heat pump 47 detachably above outer tub 1, where compressor 29, squeezer 35, heat absorber 24 and heat radiator 25 are coupled together by pipes 36 and unitized into heat pump 47.

[0074] To be more specific, the bottom of outer shell 22 of heat pump is rigidly mounted onto outer tub 1 with detachable brackets 45. Opening 22b of outer shell 22 is covered with cover 46 independent of lid 32, and cover 46 is detachable vertically as indicated by up-down arrow 48 shown in Fig. 12. An open of lid 32 allows removing cover 46. Heat absorber 24 and heat radiator 25 are placed in the space formed between outer shell 22 and cover 46, thereby forming an air-circulation path through which the drying air circulates.

[0075] The foregoing structure allows heat pump 47 to be detachably mounted to the top face of outer tub 1, and to belong to the vibration system of outer tub 1. The weight of heat pump 47 is thus added to outer tub 1. When the vibration system including outer tub 1 is vibrated by the spin of drum 4, this additional weight allows reducing the vibration amplitude. As a result, the drum-type washer operates more quietly.

[0076] Heat pump 47 can be mounted to the top face of outer tub 1 as shown in Fig. 11. This structure allows constructing heat pump 47 compactly to be accommodated in a limited space formed above outer tub 1 and within housing 2, and the own weight of heat pump 47 thus can reduce the vibrations of outer tub 1.

[0077] Compressor 29, heat radiator 25, and heat absorber 24 are unitarily mounted on base 30 and unitized into heat pump 47, and base 30 is detachably mounted above outer tub 1 as shown in Fig. 1. This structure allows fixing the relative positions among compressor 29, squeezer 35, heat radiator 25, and heat absorber 24 coupled together by pipes 36, so that the stress applied to pipes 36 can be reduced. Heat pump 47 can be thus simply handled when it is detached or mounted from/to housing 2, and can be compactly placed in the limited space formed above outer tub 1 and within housing 2.

[0078] Heat pump 47 can be placed with the bottom of compressor 29 kept parallel to the horizontal. This structure allows a repairman to place compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled by pipes 36 with the bottom of compressor 29 kept parallel to the horizontal when the repairman takes out or mount those elements. As a result, the relative positional relations among those elements can be maintained, and the stress applied to pipes 36 can be reduced.

[0079] Heat pump 47 includes first setting section 30a on which at least one of heat radiator 25 or heat absorber 24 is mounted and second setting section 30b on which compressor 29 is mounted, and the second setting section 30b is kept lower than first setting section 30a. This structure allows compressor 29, having a greater mass than heat radiator 25 or heat absorber 24, to be located at a lower place than heat radiator 25 and heat absorber 24, so that the center gravity of the mass can be lowered for simpler handling and better operability when those elements are removed or mounted. Even if those elements touch housing 2 and receive external force unexpectedly, they wave but subside soon because of the lowered center gravity of the mass. This structure thus reduces the possibility of applying the stress on pipes 36 caused by a deviation in the relative positional relations among the structural elements including compressor 29.

[0080] Heat pump 47 includes air-circulation path 22 formed along rotary shaft 7 of drum 4, and either one of air inlet 20 or exhaust port 21 is placed at the front side of drum 4 and the remainder is placed at the rear side of drum 4. First setting section 30a on which at least one of heat radiator 25 or heat absorber 24 is mounted is placed at a forward section above drum 4, and second setting section 30b on which compressor 29 is mounted is placed at a backward section above drum 4.

[0081] The foregoing structure achieves a smooth flow of the drying air, which can thus efficiently circulate in drum 4. In the case where the repairman repairs heat pump 47 or gives the maintenance work to heat pump 47 from the front side of the drum-type washer, first setting section 30a, where heat radiator 25 or heat absorber 24 is mounted, is placed on the forward section above drum 4. This structure allows the repairman to take out heat pump 47 from housing 2 with ease even if heat pump 47 is upsized by enlarging the heat-exchange area in order to increase efficiency both in dehumidifying and heating. Heat pump 47, though it is upsized, can be placed in air-circulation path 22 compactly.

[0082] Air-circulation path 22 is placed above drum 4 and tilted up toward a front (front-up and rear-down) and kept parallel to rotary shaft 7 of drum 4. This structure allows draining the dew water produced by heat absorber 24 from the rear of drum 4 with ease. On top of that air-circulation path 22 runs along outer tub 1 so that path 22 can be placed compactly. The drying air thus can circulate in drum 4 efficiently. The structure discussed above allows taking out heat pump 47 or the structural elements forming pump 47 from housing 2 with ease in the case of repair or maintenance.

[0083] The air-circulation path includes opening 22b on the upper side, and cover 46 detachably mounted for covering opening 22b, and heat radiator 25 and heat absorber 24 can be removed through opening 22b. Heat pump 47 accommodates heat radiator 25 and heat absorber 24 in the air-circulation path. Cover 46 finishes up the air-circulation path. This structure allows saving a worker from taking out the air-circulation path coupled to outer tub 1, and instead, allows the worker to simply take out compressor 29, squeezer 35, heat radiator 25 and heat absorber 24 coupled together by pipes 36 from top opening 2a of housing 2 by just removing cover 46.

[0084] Lid 32 can swing on hinge mechanism 34, which thus saves the worker from removing lid 32 or reserving a space for temporarily placing lid 32. The worker thus can do the repair work or maintenance work with lid 32 connected to housing 2, so that the worker can open/close top opening 2a of housing 2 with ease.

[0085] The drum-type washer includes controller 38 for controlling the operation of heat pump 47, and an electric connecting section between controller 38 and heat pump 47 is formed such that heat pump 47 can be removed from controller 38 through top opening 2a. This structure allows the worker to electrically and safely separate heat pump 47 from controller 38 before the worker takes out heat pump 47, and also allows the worker to connect it again to controller 38 without fail after the workers mounts heat pump 47 properly.

[0086] The drum-type washer includes flexible connecting members 23, 26 for coupling heat pump 47 to outer tub 1. First ends of respective connecting members 23, 26 are coupled to the air-circulation path, and second ends thereof are coupled to outer tub 1. At least one of the first or the second ends thereof is removable through top opening 2a of housing 2. The flexibility of connecting members 23 and 26 aids the repairman in separating heat pump 47 from outer tub 1 with more ease, so that the repairman can remove heat pump 47 efficiently.

Industrial Applicability

[0087] The drum-type washing and drying machine of the present invention allows the heat pump to be repaired with ease or simply undergo the maintenance work. The present invention is thus useful for the drum-type washing and drying machine including the heat pump for washing and drying clothes.

Description of Reference Signs

[0088]

1	outer tub
1a	opening

1b	underside
2	housing
2a	top opening
3	suspension mechanism
4	drum
5	clothes
6	inlet
7	rotary shaft
8	enclosing wall
9	vent
10	motor
11	door
12	packing
13	water inlet
14	water supply valve
15	drain port
16	drain valve
17	blower
18	air-supply duct
18a	air-supply duct port
19, 27, 28, 28a, 37, 43	arrow
20	air inlet
21	exhaust port
22	outer shell of heat pump (air-circulation path)
22a	bottom face
22b	opening
22c	front mounting section
22d	rear mounting section
22e	entrance

23	connecting member on heat absorber side
24	heat absorber
25	heat radiator
26	connecting section on heat radiator side
29	compressor
30	base
30a	first setting section
30b	second setting section
31	discharge port
32	lid
33, 46	cover
34	hinge mechanism
35	squeezer
36	pipe
38	controller
44a	front bracket
44b	rear bracket
45	bracket
47	heat pump
48	up-down arrow

Claims

1. A drum-type washing and drying machine comprising:

a housing;
an outer tub supported resiliently within the housing;
a cylindrical drum with a bottom, disposed rotatably in the outer tub, having an inlet on a front side thereof for loading clothes therein, and tilted up toward a front;
a motor for driving the drum;
a heat pump disposed in the housing for drying the clothes loaded in the drum;
an air-circulation path coupling the outer tub to the heat pump for circulating drying-air;
a blower for blowing air into the air-circulation path;
an air inlet for introducing the drying-air into the drum;
an exhaust port for exhausting the drying-air from the drum ; and
a lid covering a top opening of the housing for opening and closing the top opening,
wherein the heat pump includes:

a compressor;
a heat radiator for dissipating heat of a compressed refrigerant of high temperature and high pressure;
a squeezer for decompressing the refrigerant of high pressure;
a heat absorber for the decompressed refrigerant of low pressure to absorb heat;
a pipe coupling the compressor, the squeezer, the heat radiator, and the heat absorber together for the refrigerant to circulate therein,

wherein the compressor, the squeezer, the heat radiator, and the heat absorber coupled together by the pipe are disposed above the outer tub to be taken out from the top opening of the housing.

2. The drum-type washing and drying machine of claim 1, further comprising a supporter for supporting the heat pump within the housing, wherein the heat pump is set to the supporter in the housing to be disposed above the outer tub.

3. The drum-type washing and drying machine of claim 1, wherein the heat pump is rigidly mounted above the outer tub.

4. The drum-type washing and drying machine of claim 2, wherein the compressor, the heat radiator, and the heat absorber are unitarily disposed on a base and unitized into the heat pump, and the base is detachably disposed in the housing.

5. The drum-type washing and drying machine of claim 3, wherein the compressor, the heat radiator, and the heat absorber are unitarily disposed on a base and unitized into the heat pump, and the base is detachably disposed above the outer tub.

6. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5, wherein the heat pump is disposed such that a bottom face of the compressor is kept parallel to a horizontal plane.

7. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5,
wherein the heat pump includes a first setting section, where at least one of the heat radiator and the heat absorber is disposed, and a second setting section, where the compressor is disposed,
wherein the second setting section is kept lower than the first setting section.

8. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5,
wherein the heat pump includes the air-circulation path formed along a rotary shaft of the drum, and one of the air inlet and the exhaust port is disposed on a front face of the drum and a remainder is disposed on a rear face of the drum,
wherein a first setting section, where at least one of the heat radiator and the heat absorber is disposed, is placed at a forward section above the drum, and a second setting section, where the compressor is disposed, is placed at a backward section above the drum.

9. The drum-type washing and drying machine of claim 8, wherein the air-circulation path is disposed above the drum and is tilted rearward in a front-up and rear-down manner and kept parallel to the rotary shaft of the drum.

10. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5,
wherein the air-circulation path includes an opening and a cover at an upper side of the path, and the heat radiator and the heat absorber can be detached through the opening which can be covered with the cover,
wherein the heat pump accommodates the heat radiator and the heat absorber in the air-circulation path, and the cover finishes up the air-circulation path.

11. The drum-type washing and drying machine as defined in any one of claims 1, 2 and 4,
wherein the air-circulation path includes an opening and a cover at an upper side of the path, and the heat radiator and the heat absorber can be detached through the opening which can be covered with the cover,
wherein the heat pump accommodates the heat radiator and the heat absorber in the air-circulation path, and the cover finishes up the air-circulation path, and the cover is unitarily formed with the lid.

12. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5, wherein the lid can swing on a hinge mechanism.

13. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5 further comprising a controller, wherein the controller and the heat pump are coupled together electrically with a connecting section, and the heat

pump is detachable from the connecting section through the top opening of the housing.

14. The drum-type washing and drying machine as defined in any one of claim 1 - claim 5 further comprising a flexible connecting member for coupling the heat pump to the outer tub,
wherein a first end of the connecting member is coupled to the air-circulation path and a second end thereof is coupled to the outer tub,
wherein at least one of the first end and the second end of the connecting member is detachable through the top opening of the housing.

FIG. 1

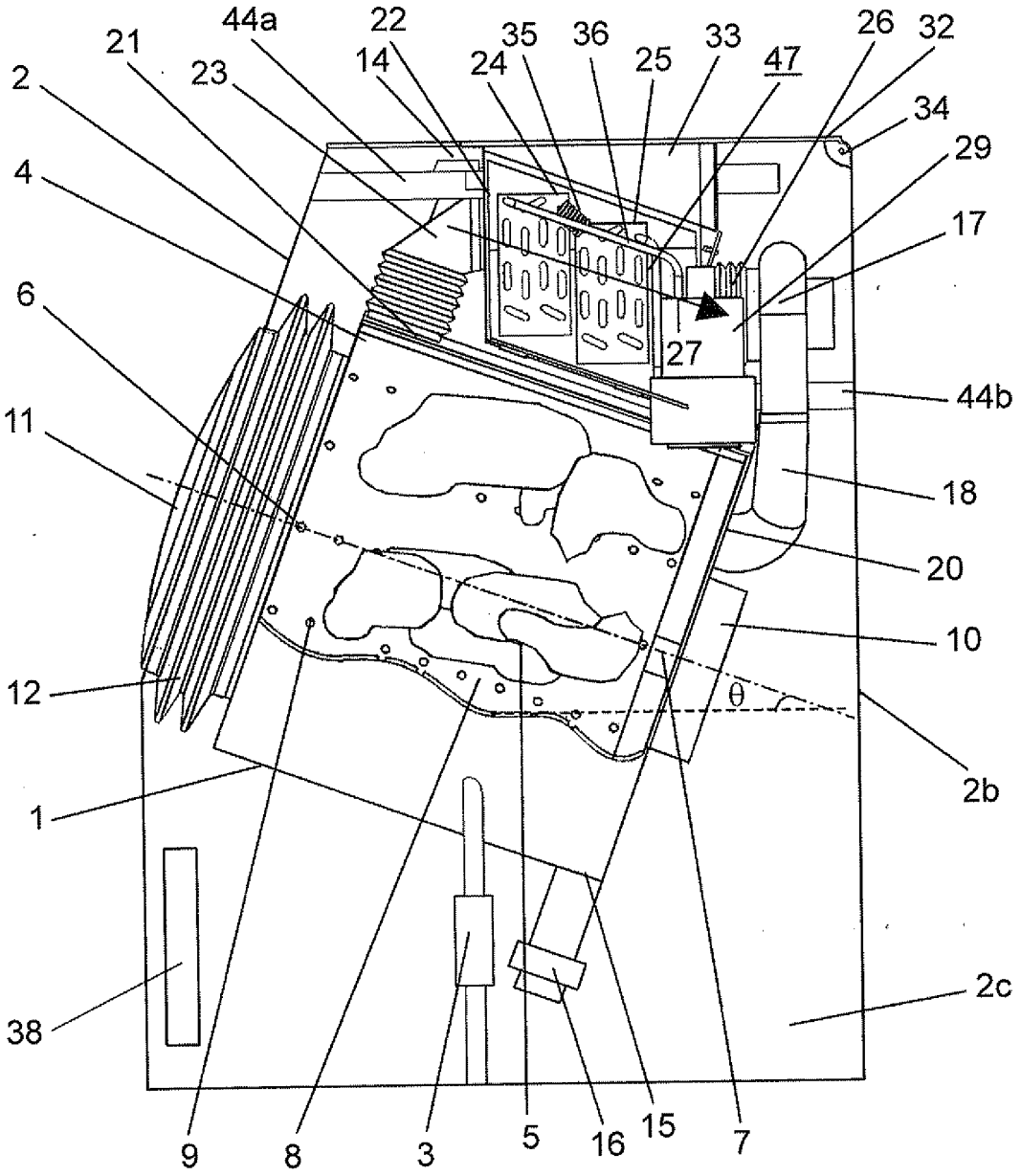
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FIG. 2

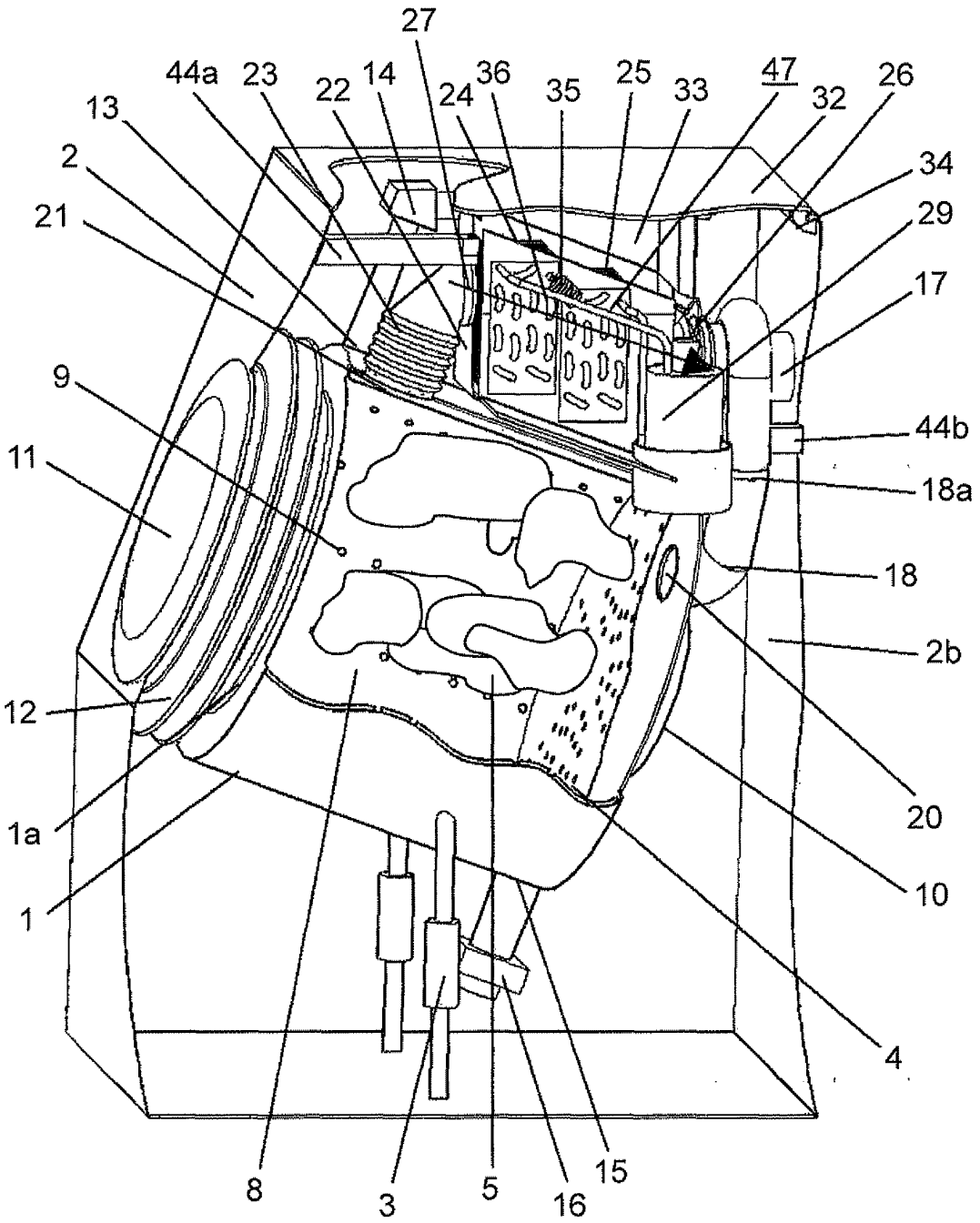
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FIG. 3

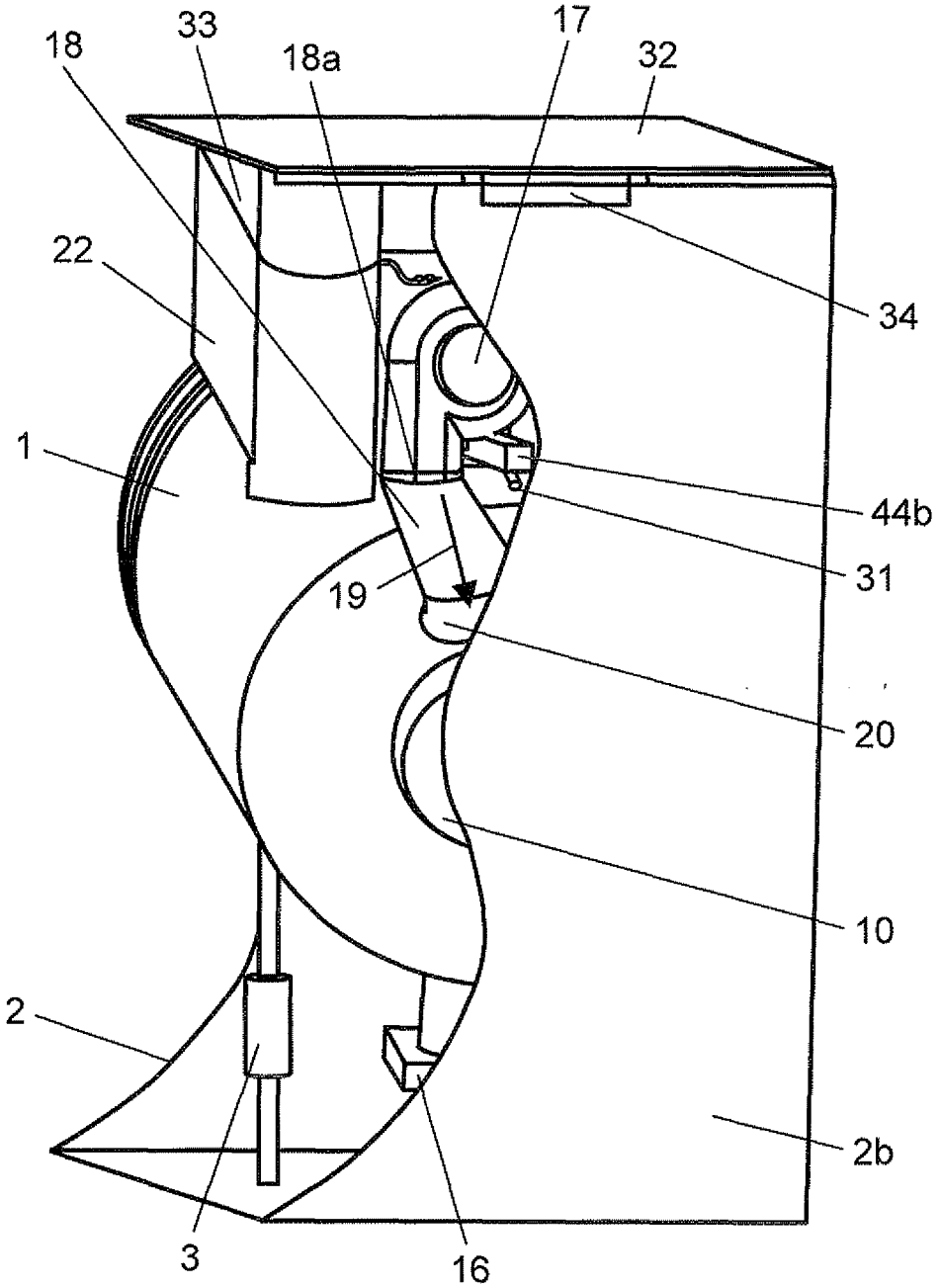
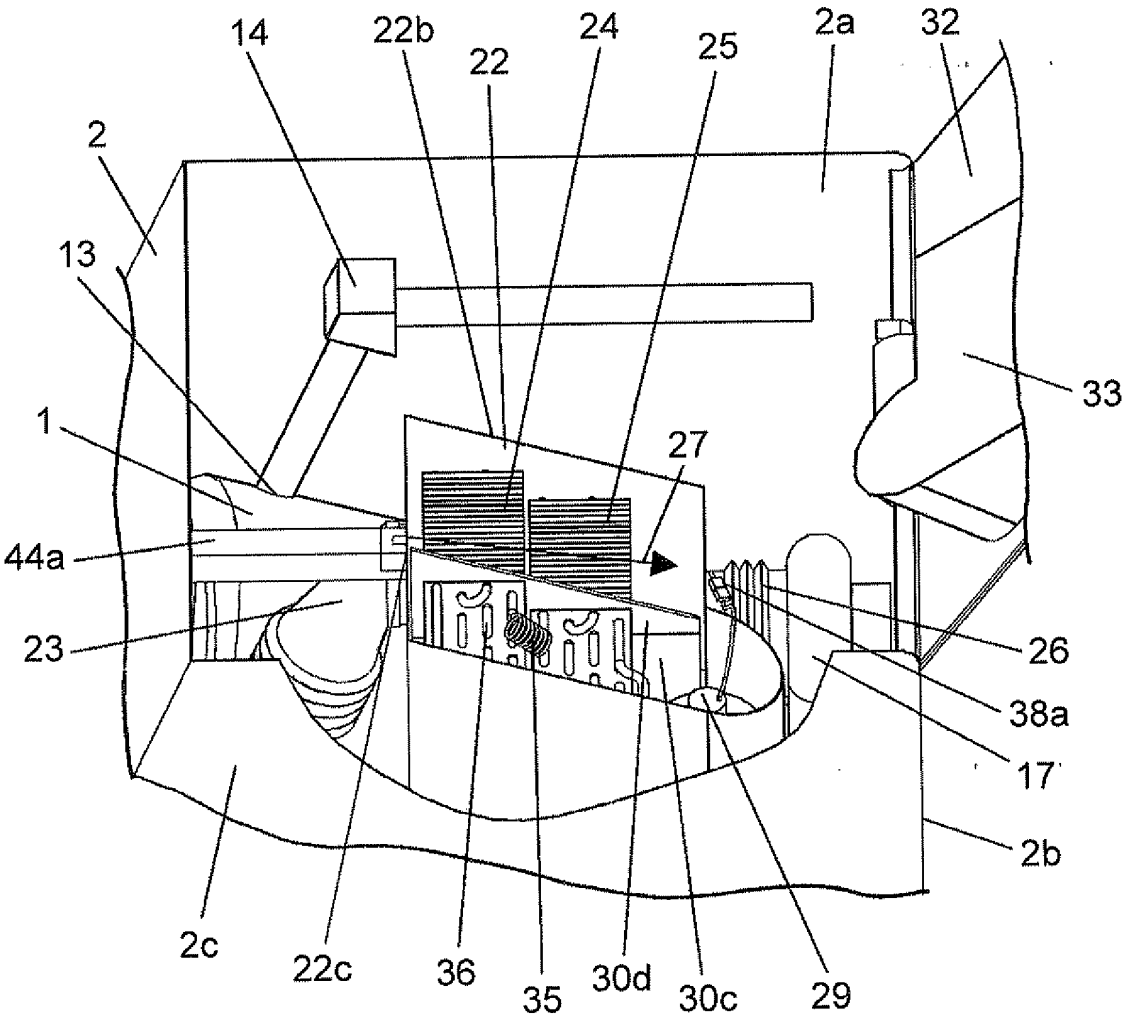


FIG. 4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30d
30c
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FIG. 5

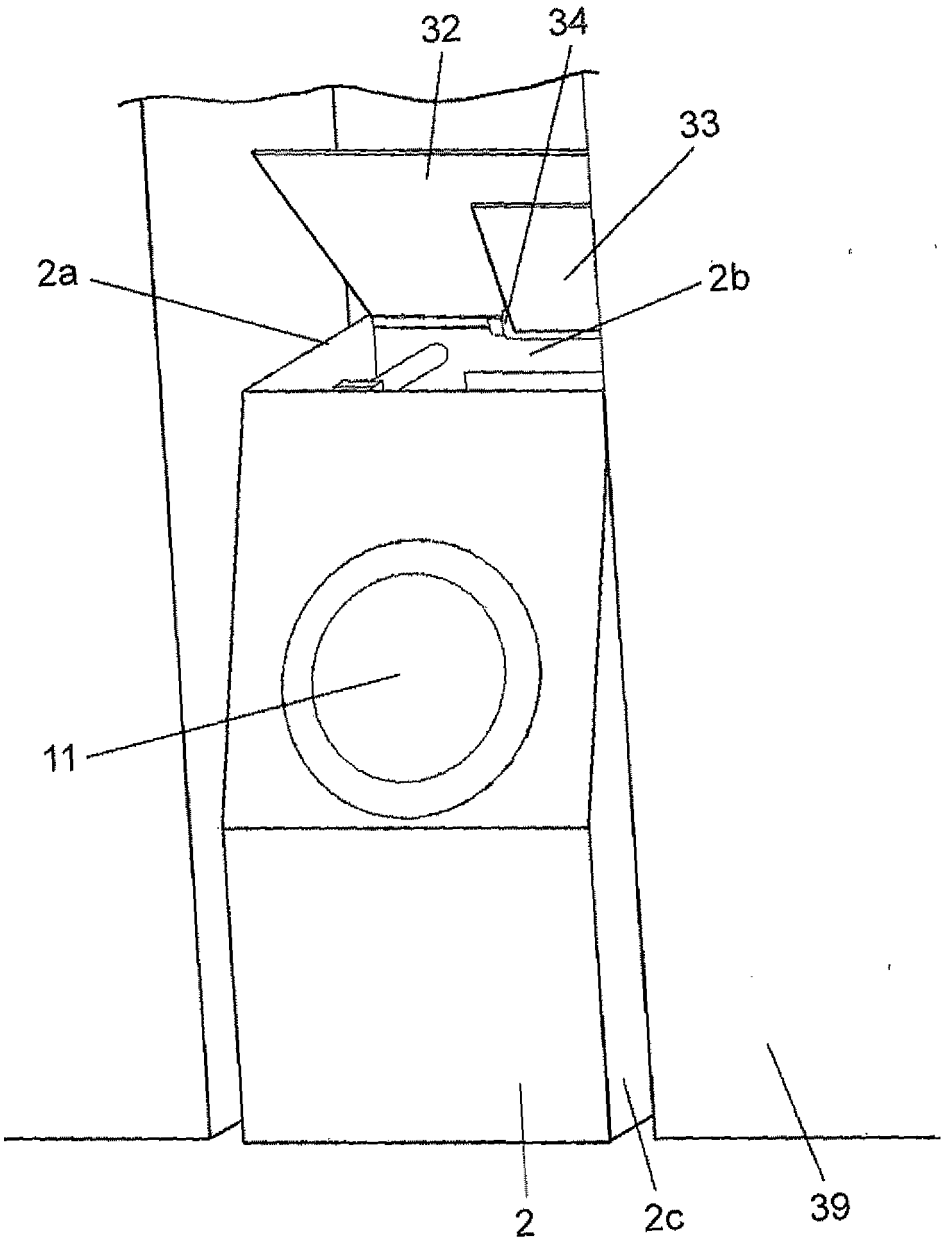

FIG. 6

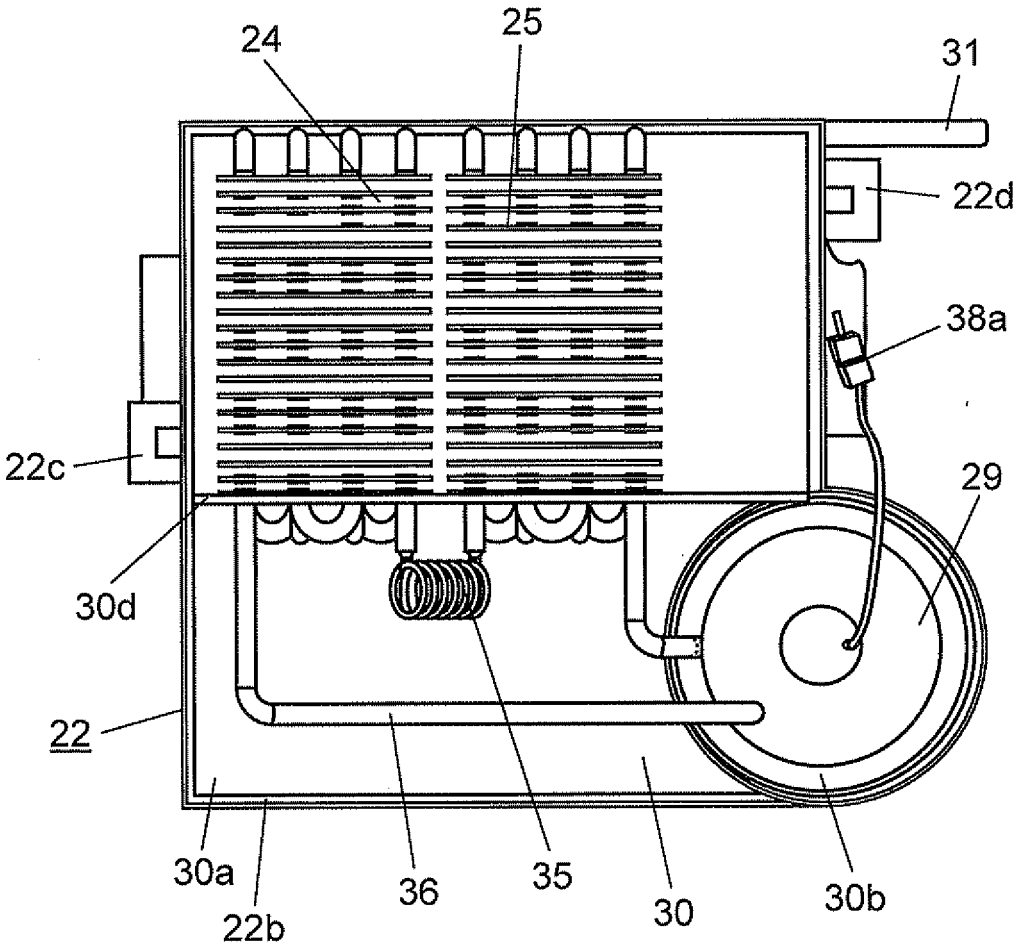

FIG. 7

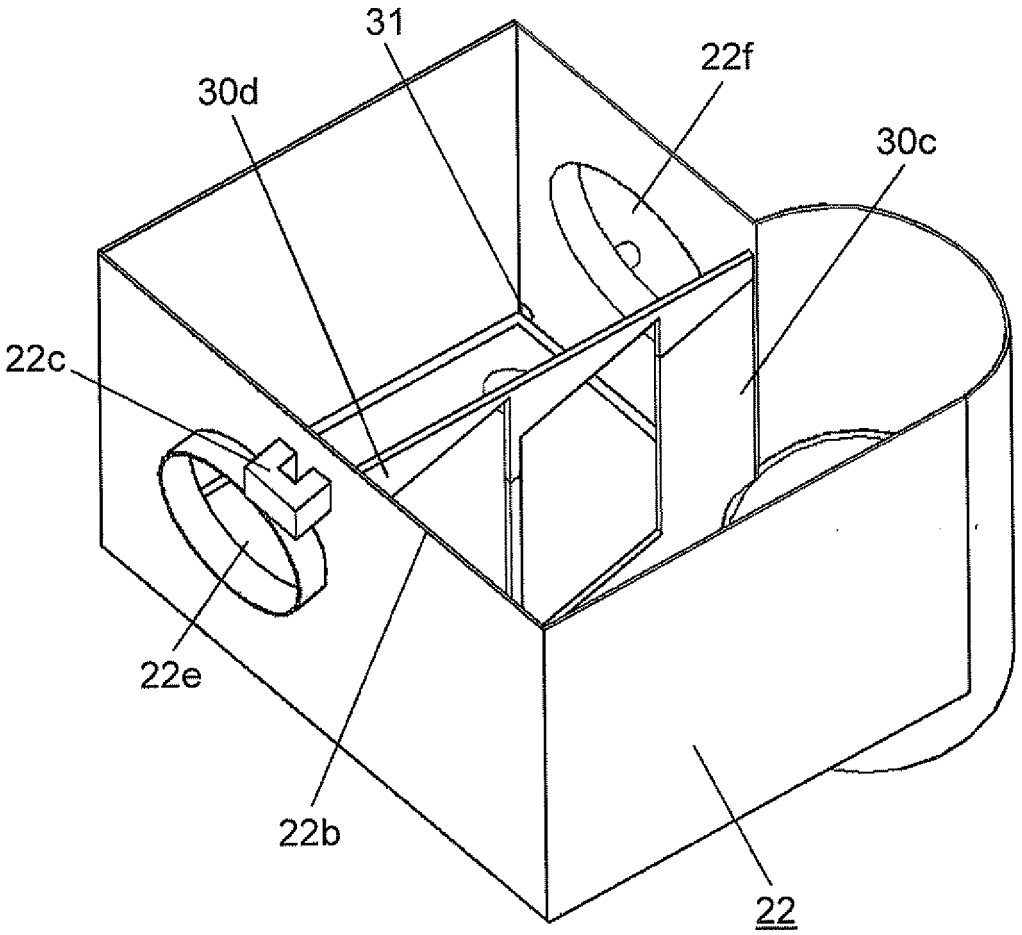

FIG. 8

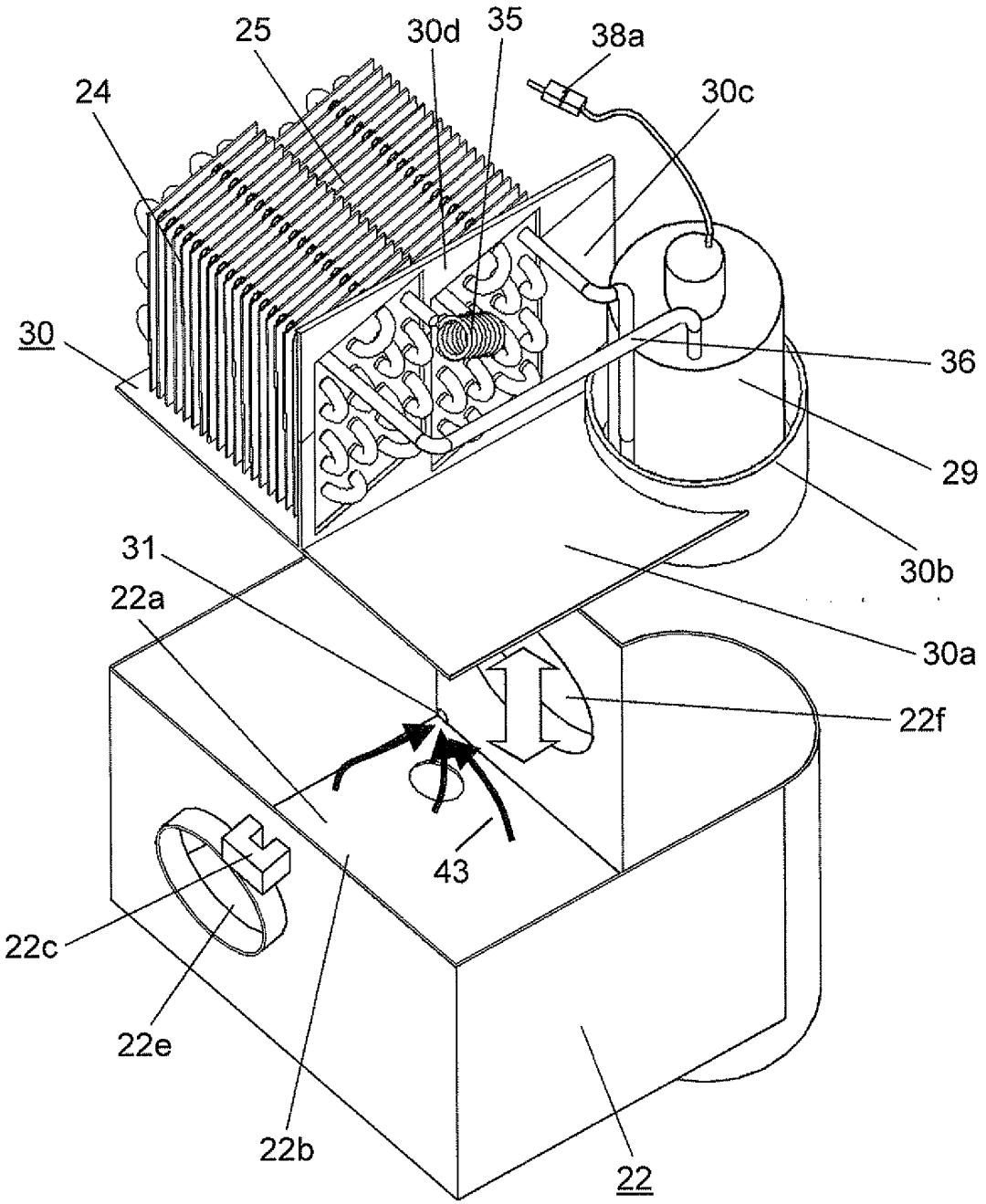

FIG. 9

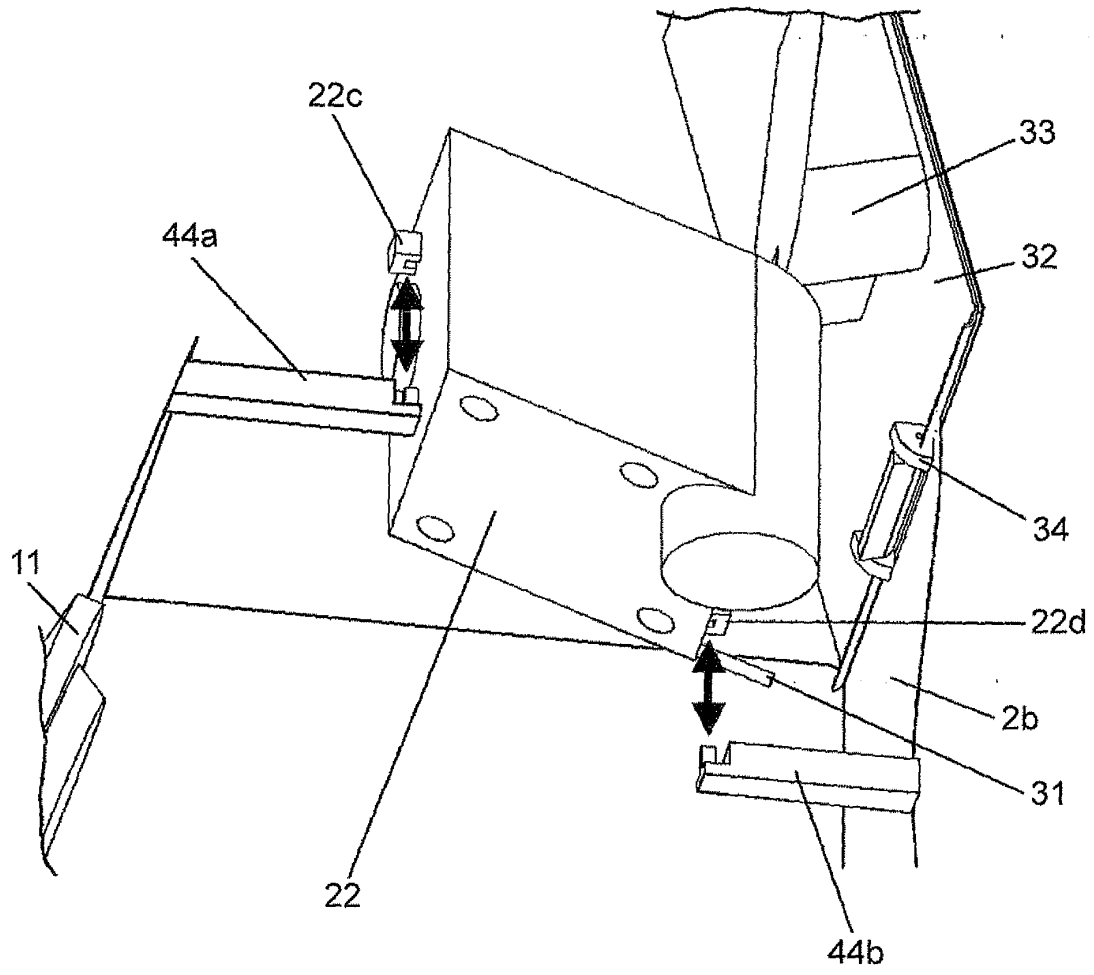

FIG. 10

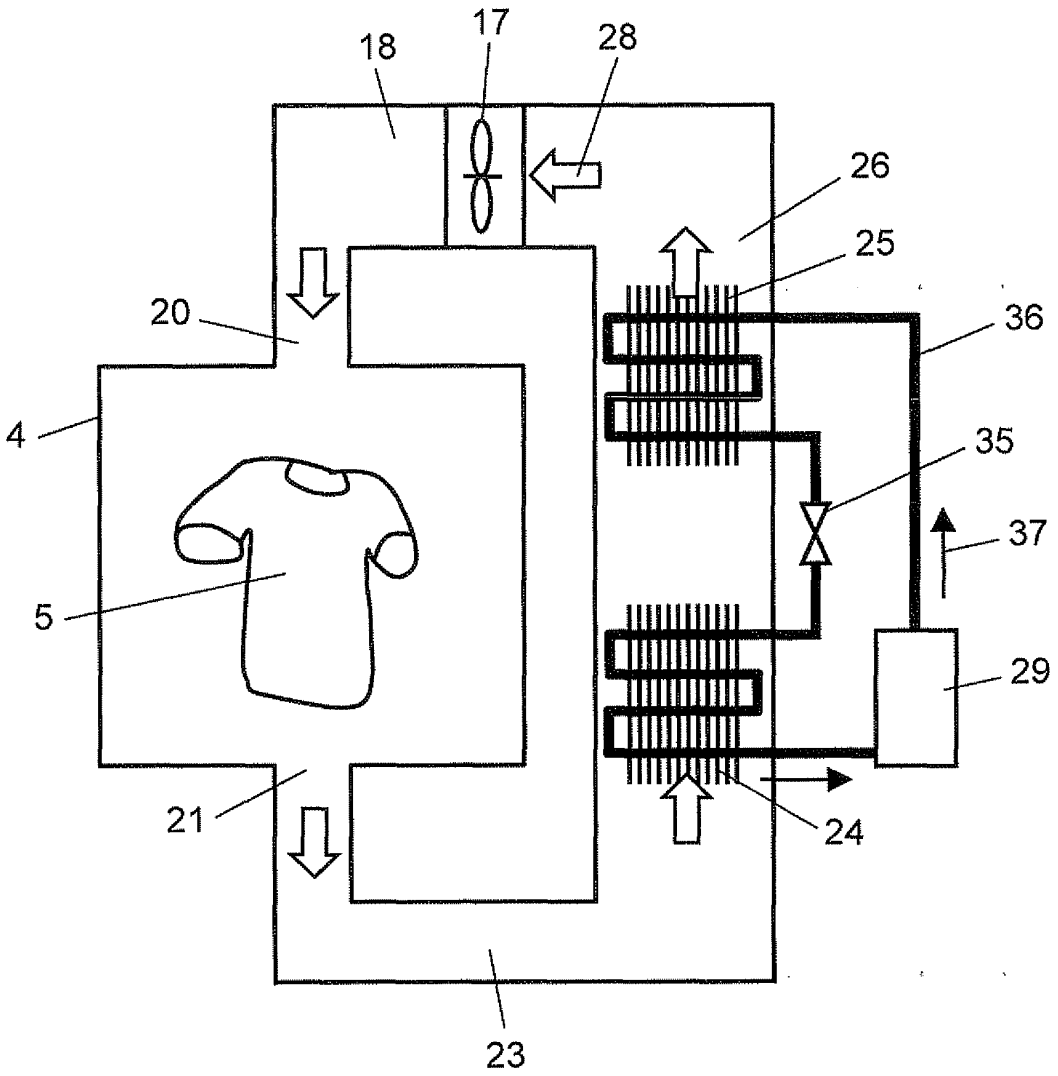

FIG. 11

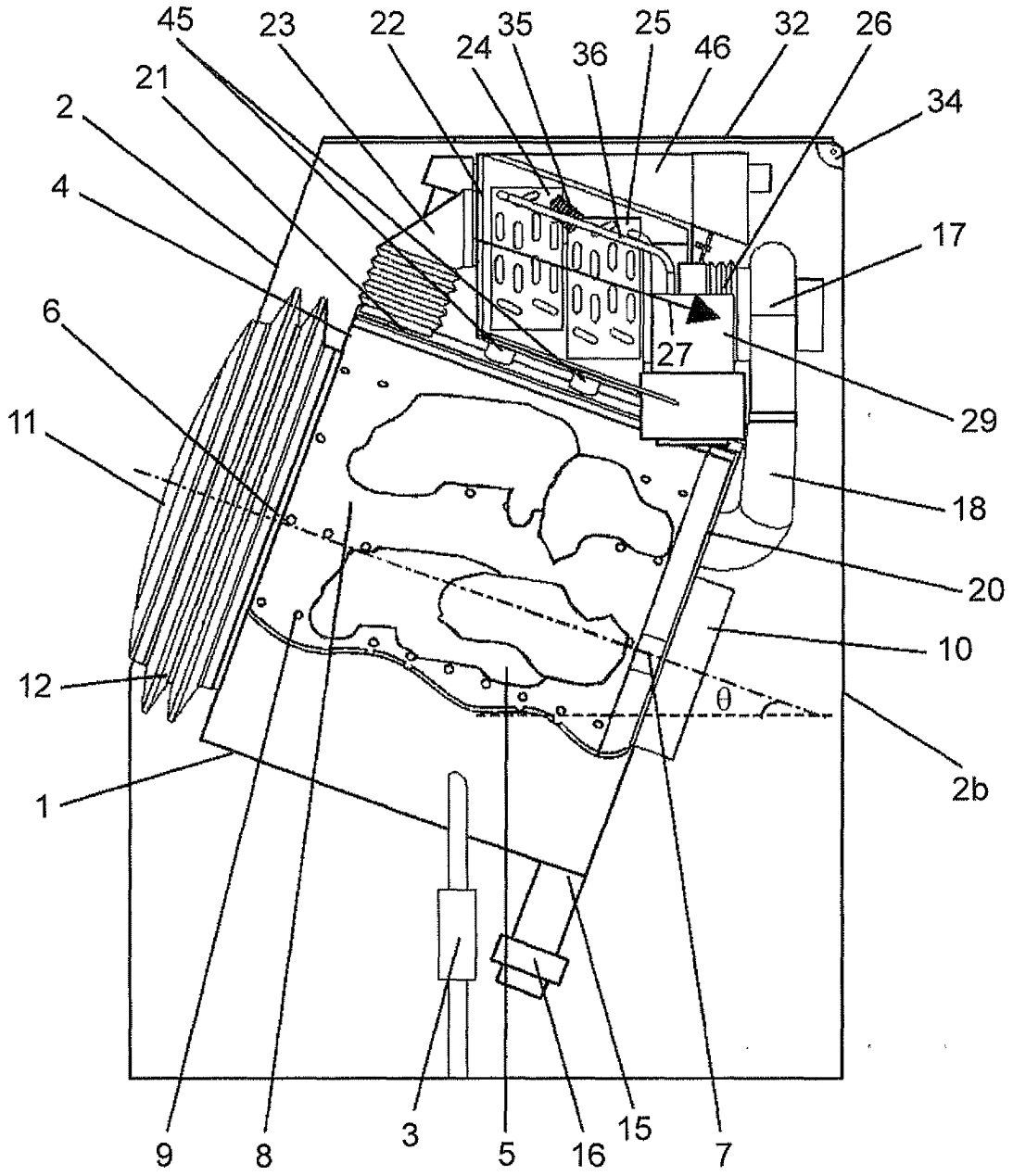
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FIG. 12

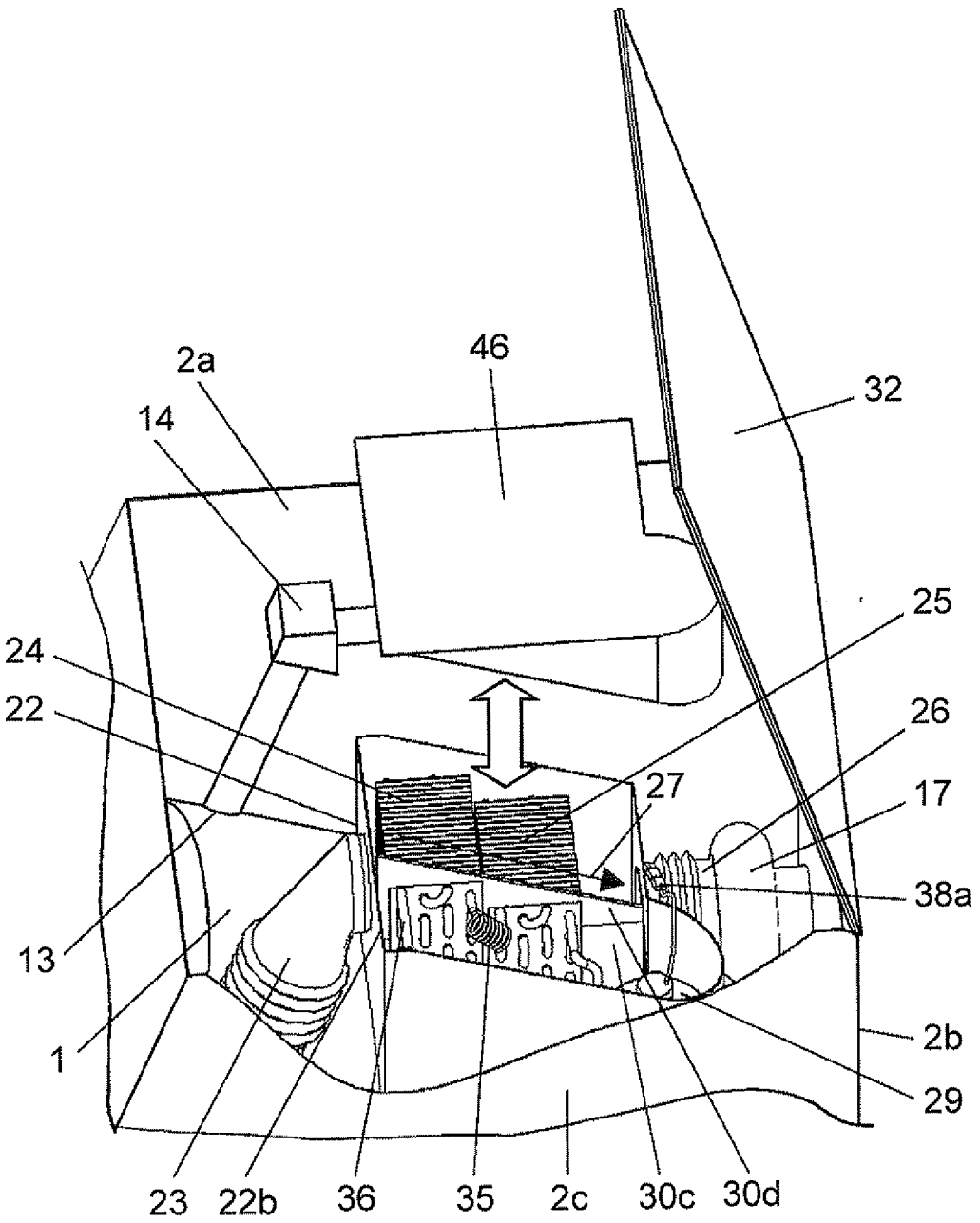
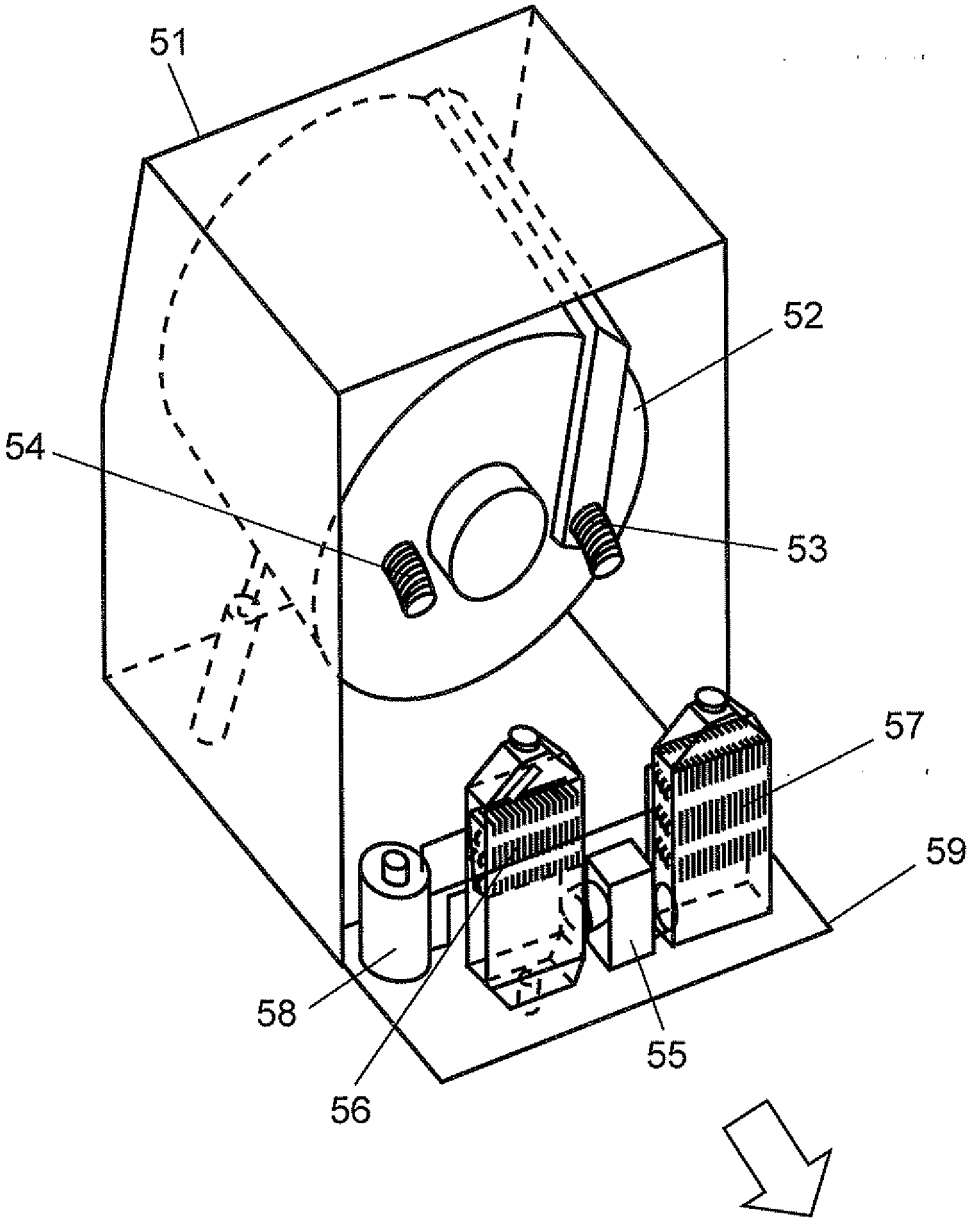


FIG. 13

PRIOR ART



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/002606

A. CLASSIFICATION OF SUBJECT MATTER
D06F25/00(2006.01)i, D06F58/02(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)
D06F25/00, D06F58/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2008-055077 A (Matsushita Electric Industrial Co., Ltd.), 13 March, 2008 (13.03.08), Par. Nos. [0016] to [0026]; Fig. 1 (Family: none)	1,3,5-8, 10-13 2,4,9,14
Y	JP 2004-135715 A (Mitsubishi Electric Corp.), 13 May, 2004 (13.05.04), Par. Nos. [0007] to [0010]; Fig. 1 (Family: none)	2,4,9,14
Y	JP 2007-151799 A (Toshiba Corp.), 21 June, 2007 (21.06.07), Par. No. [0033]; Fig. 1 (Family: none)	9

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-052533 A (Matsushita Electric Industrial Co., Ltd.), 03 March, 2005 (03.03.05), Par. Nos. [0052] to [0053]; Fig. 9 & US 2004/0079121 A1 & EP 1411163 A2 & KR 10-2004-0034495 A & CN 002679207 Y	14

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