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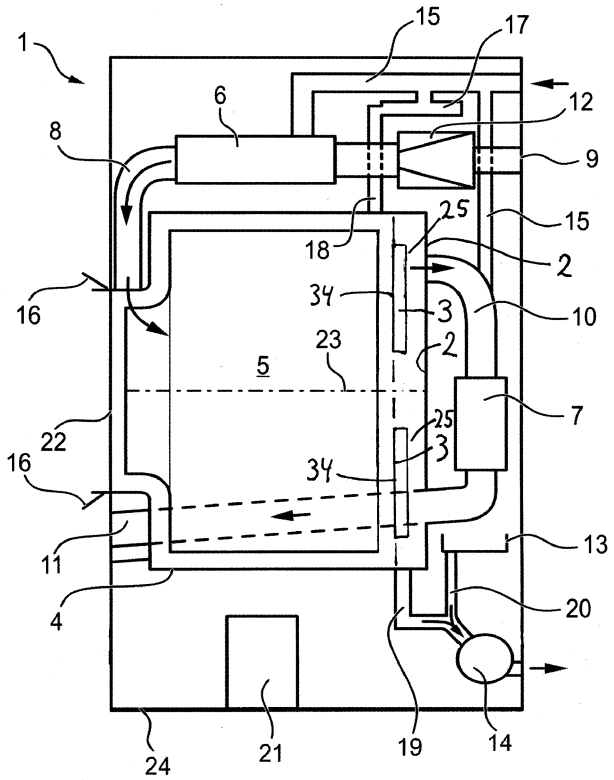
(54) WASHER-DRYER COMPRISING A FLUFF FILTER IN THE TUB AND PROCESS FOR OPERATING THE WASHER-DRYER

(57) The invention relates to a washer-dryer 1, including a tub 4 in which a drum 5 for receiving laundry items is rotatably provided; a process air circuit 8,9,10,11 for passing an air flow of process air through the drum 5 comprising a blower 12 for driving the air flow; an air heating device 6 for heating the process air before the process air enters the drum 5; and a fluff filter 3; wherein the fluff filter 3 is provided inside the tub 4 between the tub 4 and the drum 5. The invention also relates to a process for operating the washer-dryer.

Fig. 1



EP 4 212 662 A1

Description

[0001] The invention relates to a washer-dryer, including a tub in which a drum for receiving laundry items is rotatably provided; a process air circuit for passing an air flow of process air through the drum comprising a blower for driving the air flow; an air heating device for heating the process air before the process air enters the drum; and a fluff filter. The invention also relates to a process for operating the washer-dryer.

[0002] Current solutions for fluff filtering in for example heat pump washer-dryers use a filter mesh in a particular section of the process air circuit. Depending on the type of automation of the filtering, such a filter can be manually cleaned by the user or by means of self-cleaning systems. Most of the self-cleaning systems involve the spraying of water.

[0003] In for example heat pump washer-dryers, the outlet for process air from the tub is located often in the rear part of the tub. The process air is then guided to the evaporator of the heat pump through an air duct. In this concept, the filter is integrated in the air duct and additionally a cleaning system which is generally based on flushing water is involved.

[0004] The publication EP 3 825 450 A1 discloses a laundry treating appliance with a filter. Disclosed is in particular a combination washer/dryer comprising: a tub at least partially defining a tub interior with a tub access opening; a rotatable drum located within the tub interior and at least partially defining a treating chamber with a treating chamber access opening; a drying airduct having an inlet formed in the tub and defining a cross-sectional area at the inlet; and a filter having a front face overlying the inlet and having a surface area greater than the cross-sectional area. In the embodiment shown in Fig. 3A a cross-sectional side-view of the filter of the combination washing and drying machine is shown. The filter can be positioned between the drum and the tub at the inlet of the drying air duct. It can include a seat portion which can extend into at least a portion of the drying air duct past the inlet.

[0005] In view of this situation it was an object of the present invention to provide a washer-dryer which allows an improved filtering of the process air after it has been used for drying laundry items. In particular, the use of the fluff filter should be improved. Preferably, the cleaning of the fluff filter should be improved such that for example fluff can be dealt with in a better way and time intervals between cleaning steps of the fluff filter can become shorter. A further object was the provision of a process for operating this dryer.

[0006] This object is achieved according to the present invention by the washer-dryer and the processes for its operation pursuant to the independent claims. Preferred embodiments of the washer-dryer according to the invention are shown especially in the dependent claims. Preferred embodiments of the processes correspond to preferred embodiments of the washer-dryer and vice versa even if not expressly stated herein.

[0007] The invention is thus directed to a washer-dryer including a tub in which a drum for receiving laundry items is rotatably provided; a process air circuit for passing an air flow of process air through the drum comprising a blower for driving the air flow; an air heating device for heating the process air before the process air enters the drum; and a fluff filter; wherein the fluff filter is provided inside the tub between the tub and the drum.

[0008] In a preferred embodiment of the washer-dryer of the present invention, the air heating device is selected from the group consisting of an electric resistance heater and a condenser of a heat pump, or a combination thereof. Preferably, the air heating device is the condenser of a heat pump.

[0009] A heat pump circuit used in a preferred embodiment of the present invention includes a refrigerant channel for circulating a refrigerant, the condenser as a heat source, the evaporator as a heat sink, an expansion device for expanding the refrigerant flow, and a compressor for driving and compressing the refrigerant, the refrigerant circulating sequentially through the compressor, the condenser, the expansion device and the evaporator.

[0010] In the heat pump circuit the refrigerant is circulated and thereby cyclically compressed and expanded as well as cooled and heated, on purpose of absorbing heat in the evaporator by evaporating the refrigerant at low pressure, and releasing heat in the condenser by condensing the refrigerant at high pressure.

[0011] In accordance with a preferred embodiment of the invention the washer-dryer comprises a control device for controlling operation of the washer-dryer. In the embodiment in which a heat pump is used, the expansion device is usually a variable valve operably connected to the control device. Such operation may be of a switching type, whereby the valve is switched between an open position for recirculating a part of the refrigerant and a closed position which cuts off any recirculation. Alternatively such operation may allow varying the amount of refrigerant which is recirculated, either stepwise or continuously.

[0012] In a particular preferred embodiment of the washer-dryer, the fluff filter is provided on or close to an inner wall of the tub. Preferably, the inner wall is a rear wall of the tub.

[0013] The shape of the fluff filter is not especially limited. In any way, it is preferred that the fluff filter is coaxial with the rotation axis of the drum.

[0014] In a particularly preferred embodiment, the fluff filter has essentially the form of a circular ring that is placed on the rear tub wall or separated by a small gap from the rear tub wall. Such a shape of the fluff filter can be considered to be a donut-shape in the interior side of tub, in particular at the rear part thereof.

[0015] One particular implementation could be one where there is a fluff filter section covering around 300° of the circumference. This section of filter could be dimensioned as desired according to the needs. The outlet

hole (for process air which is to enter the exhaust air duct) is preferably designed to be protected against washing/spinning water to reach the hole and subsequently the exhaust air duct.

[0016] It is therefore preferred in the washer-dryer of the present invention that a hole is provided in the rear wall of the tub to an exhaust air duct of the process air circuit. I.e. the hole serves as an access from the process air to the air duct.

[0017] In the washer-dryer of the present invention, the surface of the fluff filter directly opposite to the drum is preferably in the range of from 100 to 700 cm^2, more preferably in the range of from 200 to 600 cm^2.

[0018] The fluff filter can be fixed to the tub by means of welding or gluing. It is also noted that the air flow might be further improved in that the tub can be slightly modified if more section is required for the fluff filter, i.e. the filter tunnel, for the air flow.

[0019] The invention is moreover directed to a process for the operation of a washer-dryer including a tub in which a drum for receiving laundry items is rotatably provided; a process air circuit for passing an air flow of process air through the drum comprising a blower for driving the air flow; an air heating device for heating the process air before the process air enters the drum; and a fluff filter that is provided inside the tub between the tub and the drum; comprising the following steps in a washing process:

(a) introducing laundry items in the drum;
(b) introducing water and detergent in the tub in an amount sufficient to produce a lye solution in the tub and the drum;
(c) heating the lye solution by means of the air heating device;
(d) washing the laundry items and cleaning the fluff filter by means of the lye solution;
(e) pumping off the used lye solution;
(f) rinsing the laundry items and the fluff filter by means of an aqueous solution; and
(g) pumping off the used aqueous solution.

[0020] Finally, the invention is directed to a process for the operation of a washer-dryer including a tub in which a drum for receiving laundry items is rotatably provided; a process air circuit for passing an air flow of process air through the drum comprising a blower for driving the air flow; an air heating device for heating the process air before the process air enters the drum; and a fluff filter that is provided inside the tub between the tub and the drum; comprising the following steps in a drying process:

(a) introducing laundry items in the drum;
(b) rotating the drum;
(c) heating process air by means of the air heating device;
(d) driving the process air through the process air circuit by means of the blower including driving the process air through the fluff filter in the tub through an outlet hole into an outlet duct; and
(e) repeating steps (a) to (d) until a preset time has passed or a preset humidity level in the laundry items is reached.

[0021] Advantages of the invention include an improvement of the performance of the washer-dryer by allowing a prolonged use of the fluff filter without the necessity of cleaning it since it is possible to have a fluff filter with a large surface area. Moreover, if the cleaning of the fluff filter is eventually necessary, the filter cleaning can occur during a washing process. If drying cycles are always preceded by washing cycles, it is possible to avoid a dedicated cleaning system, for example a water spraying system with nozzles, hosing, electro-valve. This reduces complexity, cost and mechanical failures. However, since the usage of the washer-dryer could be wash only, dry only or wash&dry, it is recommended to include a dedicated cleaning system in the washer-dryer to ensure a clean filter in any scenario or to set up a procedure to ensure filter cleaning between consecutive process programs that involve only the drying of laundry items. Additionally, programs such as "tub and drum cleaning" can be used to clean in depth the filtering system including the fluff filter from time to time apart from the normal way of cleaning the filter in every cycle. This is not possible with other filtering solutions inside air ducts.

[0022] Since the fluff filter is not located inside process air ducts but in the interior side of the tub, preferably in the rear part of the tub, the filter area can be significantly increased compared to the state of the art. For instance, with the present invention filter areas of more than 600 cm^2, for example even more than 700 cm^2, could be implemented. This means that blockage of the fluff filter due to fluff is more difficult to occur which has a big impact on pressure drop, fan behaviour and therefore drying performance. Bigger areas of the fluff filter allow getting the fluff filter dirty due to fluff with no need of cleaning before or after every drying process in the washer-dryer.

[0023] In the present invention, the filter section including the fluff filter can be dimensioned as desired. There is no need to use the full circumference if the fluff filter has for example in essence the shape of a circle ring.

[0024] The present invention allows it moreover that a connection between filter duct and hole-to-air-duct is protected or designed in order to prevent or avoid any liquid water from a washing phase to reaching the air duct.

[0025] Another advantage of the washer-dryer pursuant to the present invention is that fluff and hair is gathered inside the tub so that it can be directly pumped out with a drain pump of the washer-dryer which is in general its main pump that can easily handle dirty water.

[0026] In embodiments of the inventive washer-dryer, the air circulation will be from an inlet bellow, through drum and tub and then through the fluff filter to the evaporator. Since in a preferred embodiment, the donut shape of the fluff filter is aligned with the drum, the air distribution

inside the drum will be improved and a bypass effect reduced.

[0027] Further details, benefits and advantages of the invention will appear from the subsequent description of specific embodiments with references to Figures 1 to 6, wherein

Figure 1 shows a schematic view of a washer-dryer according to a first embodiment of the invention, which includes a heat pump circuit and further a fluff filter inside the tub;

Figure 2 shows a vertically cut section of the rear part of a washer-dryer according to a second embodiment of the invention in which the fluff filter is placed in the drum in a manner such that there is a gap between the fluff filter and the rear tub wall;

Figure 3 shows an enlarged perspective view of a vertically cut section of the rear part of a washer-dryer according to a further embodiment of the invention;

Figure 4 shows a top view on the tub and drum of a washer-dryer according to a further embodiment of the present invention;

Figure 5 shows a top view on the rear part of a tub of a washer-dryer according to a further embodiment of the present invention; and

Figure 6 shows an exploded view of the rear part of a drum and a tub of a washer-dryer according to a still further embodiment of the present invention.

[0028] The washer-dryer 1 shown in Fig. 1 according to a first embodiment of a washer-dryer 1 according to the invention has a tub (also referred to as a "lye container") 4 and a laundry drum 5 rotatably mounted therein about an axis 23. The lye container 4 is connected via a lye drain line 19 to a lye pump 14, which can dispose of an aqueous liquid from the lye container 4 to an outside of the washer-dryer 1. The direction of flow of water or an aqueous liquid, and of process air, respectively, is shown by arrows in Fig. 1. The laundry drum 5 is loaded with laundry items to be treated through an access door, i.e. a filling opening, 22 at the front side of washer-dryer 1. In order to be able to wash laundry in the washer-dryer 1, the washer-dryer 1 is connected to an external water supply of the washer-dryer 1, which is not shown here, via a water supply system 15. The water supply system 15 is connected to a rinsing tray 17, from which portions of detergent or washing aid can be conveyed into the lye container 4 via a supply line 18 with the aid of water from the water supply system 15.

[0029] The washer-dryer shown in Fig. 1 also has a heat pump, of which a condenser 6, an evaporator 7 and a compressor 21 are shown in Fig. 1. The compressor 21 is arranged on a base plate 24. In Fig. 1, the refrigeration circuit of the heat pump connecting these parts and a throttle not shown here is not shown for reasons of clarity.

[0030] In the first embodiment of a washer-dryer 1 according to the invention shown in Fig. 1, the condenser 6 and the evaporator 7 are located on opposite sides of the laundry drum 5, in particular substantially on opposite sides of a surface parallel to a bottom plate 24 through an axis of rotation 23 through the laundry drum 5. Moreover, the condenser 6 is arranged above the laundry drum 5, while the evaporator 7 is arranged below the axis of rotation 23.

[0031] The condenser 6 and evaporator 7 are connected to the water supply system 15 so that they can be cleaned by means of water from the water supply system 15, in particular of lint which may get there during a laundry drying process.

[0032] For drying damp laundry in the laundry drum 5, it is provided in the washer-dryer 1 of Fig. 1, which operates according to the exhaust air principle, that air is drawn as process air from a storage room of washer-dryer 1 by means of a blower 12 from a supply air inlet 9 into the supply air duct 8. In this case, the blower 12 is located directly behind the supply air inlet 9. The condenser 6, in which the process air can be heated, is arranged in the supply air duct 8. The heated process air then passes from the supply air duct 8 via a sleeve 16 into the laundry drum 5. After passing through the laundry drum 5 and drying the damp laundry located therein - not shown here - the then damp-warm process air exits the laundry drum 5 or the lye container 4 through a rear part and passes into an exhaust air duct 10, in which the evaporator 7 is located. In the evaporator 7, the moist warm process air is cooled below the dew point, whereby the moisture contained therein condenses and passes via a condensate collector 13, here designed as a condensate tray, into a condensate drain line 20 and finally to the lye pump 14, with the aid of which the condensate can be pumped off for disposal and conveyed to the outside of the washer-dryer 1. The cooled process air is finally conveyed to an exhaust outlet 11 of the washer-dryer 1, where it can enter the installation room. This is however a non-limiting example. In preferred embodiments, the process air can be circulated repeatedly through the process air circuit.

[0033] In the washer-dryer 1 a fluff filter 3 which is here shaped as a circular ring and thus - considering its three-dimensional nature - as a kind of donut - is placed inside the tub 4, i.e. between the tub 4 and the drum 5. The fluff filter 3 is placed in front of the rear wall 2 of the tub 4. However, there is a gap 25 between fluff filter 3 and the rear wall 2 to allow the air from the drum 5 to flow around and reach the fluff filter 3 over an increased area into the exhaust air duct 10. It is not shown in detail in Fig. 1 in which manner the fluff filter 3 is fixed to the rear wall 2 of

the tub 4, but this can be easily contemplated.

[0034] Figure 2 shows a vertically cut section of the rear part of a washer-dryer according to a second embodiment of the invention in which the fluff filter 3 is placed in the drum 4 on a rear wall 2 of the tub 4 in a manner such that there is a gap 25 between the fluff filter 3 and the rear tub wall 2. Details of the fixation of the fluff filter 3 are not shown in order not to complicate Figure 2.

[0035] The fluff filter 3 forms here a circular ring that is coaxial with the rotation axis 23 of the drum 5. 26 means a central opening in the tub 5 for the (rotation) shaft and bearings. 34 indicates the surface of the fluff filter 3 directly opposite to the drum 5. Process air is led from the drum 5 through the tub 4 including the fluff filter 3 through an outlet hole 27 in the rear tub wall 2 to an exhaust air duct 10.

[0036] Figure 3 shows an enlarged perspective view of a vertically cut section of the rear half of a washer-dryer according to a further embodiment of the invention. 30 indicates the rear half part of the tub 4, 29 the drum support and 31 a bearings section. 28 refers to the rear part of drum backsheet and 3 to the fluff filter. The gap 25 between fluff filter 3 and rear tub wall is indicated by 25.

[0037] Figure 4 shows a top view on the tub 4 and drum 5 of a washer-dryer according to a further embodiment of the present invention. It can be seen from this top view that the fluff filter 3 extends over the drum 5 the border of which can be easily seen from the top. Moreover, it can be seen that the fluff filter 3 forms a circular ring that is coaxial with the rotation axis 23 of the drum 5. The outlet hole 27 provides the access to an exhaust air duct in the rear tub wall.

[0038] Figure 5 shows a top view on the rear part of a tub of a washer-dryer according to a further embodiment of the present invention. 32 refers to solid sections which allow to fix the fluff filter 3 that forms here also a circular ring in a certain distance (gap) to the rear wall of the tub 4 which cannot be seen here in detail. 33 refers to a filter mesh or solid non-filter section facing the outlet hole of the tub 4. It contains here the outlet hole 27 in the rear tub wall.

[0039] Figure 6 shows an exploded view of the rear part of a drum and a rear half part 30 of the tub of a washer-dryer according to a still further embodiment of the present invention. 28 indicates the rear part of drum backsheet, 23 the rotation axis, and 29 the drum support. The fluff filter 3 is the same circular ring shaped fluff filter 3 shown in Figure 5.

LIST OF REFERENCE NUMERALS

[0040]

1	Washer dryer
2	Rear wall of tub; rear tub wall
3	Fluff filter
4	Tub; lye container
5	Drum; laundry drum
6	Condenser
7	Evaporator
8	Supply air duct
9	Supply air inlet
10	Exhaust air duct
11	Exhaust air outlet
12	Blower
13	Condensate collector
14	Pump, lye pump
15	Water supply system
16	Collar; sleeve
17	Rinsing tray; Washing-in bowl; detergent chamber
18	Supply line, connection between rinsing tray induction bowl and tub
19	Lye drain line
20	Condensate drain line
21	Compressor
22	Access door (for introducing laundry items to be treated)
23	Rotation axis
24	Base plate
25	Gap (between fluff filter and rear tub wall)
26	Central opening for shaft and bearings
27	Outlet hole in rear tub wall
28	Rear part of drum backsheet
29	Drum support
30	Rear half part of tub
31	Bearings section
32	Solid sections
33	Filter mesh or solid non-filter section facing the outlet hole of the tub
34	Surface of the fluff filter directly opposite to the drum

Claims

1. A washer-dryer (1), including a tub (4) in which a drum (5) for receiving laundry items is rotatably provided; a process air circuit (8,9,10,11) for passing an air flow of process air through the drum (5) comprising a blower (12) for driving the air flow; an air heating device (6) for heating the process air before the process air enters the drum (5); and a fluff filter (3); **characterized in that** the fluff filter (3) is provided inside the tub (4) between the tub (4) and the drum (5).

2. Washer-dryer (1) according to claim 1, wherein the air heating device (6) is selected from the group consisting of an electric resistance heater and a condenser (6) of a heat pump (6,7,21), or a combination thereof.

3. Washer-dryer (1) according to claim 1 or 2, wherein the fluff filter (3) is provided on or close to an inner wall (2) of the tub (4).

4. Washer-dryer (1) according to claim 3, wherein the

inner wall (2) is a rear wall (2) of the tub (4).

5. Washer-dryer (1) according to any of claims 1 to 4, wherein the fluff filter (3) is coaxial with the rotation axis (23) of the drum (5).

6. Washer-dryer (1) according to any of claims 1 to 5, wherein the fluff filter (3) has essentially the form of a circular ring that is placed on the rear wall (2) of the tub (4) or separated by a small gap from the rear tub wall (2).

7. Washer-dryer (1) according to any of claims 1 to 6, wherein a hole (27) is provided in the rear wall (2) of the tub (4) to an exhaust air duct (10) of the process air circuit.

8. Washer-dryer (1) according to any of claims 1 to 7, wherein the surface of the fluff filter (3) directly opposite to the drum (5) is in the range of from 100 to 700 cm^2.

9. Process for the operation of a washer-dryer (1), including a tub (4) in which a drum (5) for receiving laundry items is rotatably provided; a process air circuit (8,9,10,11) for passing an air flow of process air through the drum (5) comprising a blower (12) for driving the air flow; an air heating device (6) for heating the process air before the process air enters the drum (5); and a fluff filter (3) that is provided inside the tub (4) between the tub (4) and the drum (5); comprising the following steps in a washing process:

(a) introducing laundry items in the drum (5);
(b) introducing water and detergent in the tub (4) in an amount sufficient to produce a lye solution in the tub (4) and the drum (5);
(c) heating the lye solution by means of the air heating device (6);
(d) washing the laundry items and cleaning the fluff filter (3) by means of the lye solution;
(e) pumping off the used lye solution;
(f) rinsing the laundry items and the fluff filter (3) by means of an aqueous solution; and
(g) pumping off the used aqueous solution.

10. Process for the operation of a washer-dryer (1) including a tub (4) in which a drum (5) for receiving laundry items is rotatably provided; a process air circuit (8,9,10,11) for passing an air flow of process air through the drum (5) comprising a blower (12) for driving the air flow; a air heating device (6) for heating the process air before the process air enters the drum (5); and a fluff filter (3) that is provided inside the tub (4) between the tub (4) and the drum (5); comprising the following steps in a drying process:

(a) introducing laundry items in the drum (5);
(b) heating process air by means of the air heating device (6);
(c) driving the process air through the process air circuit by means of the blower (12) including driving the process air through the fluff filter (3) in the tub (4) through an outlet hole (27); and
(d) repeating steps (a) to (c) until a preset time has lapsed or a preset humidity level in the laundry items is reached.

Fig. 1

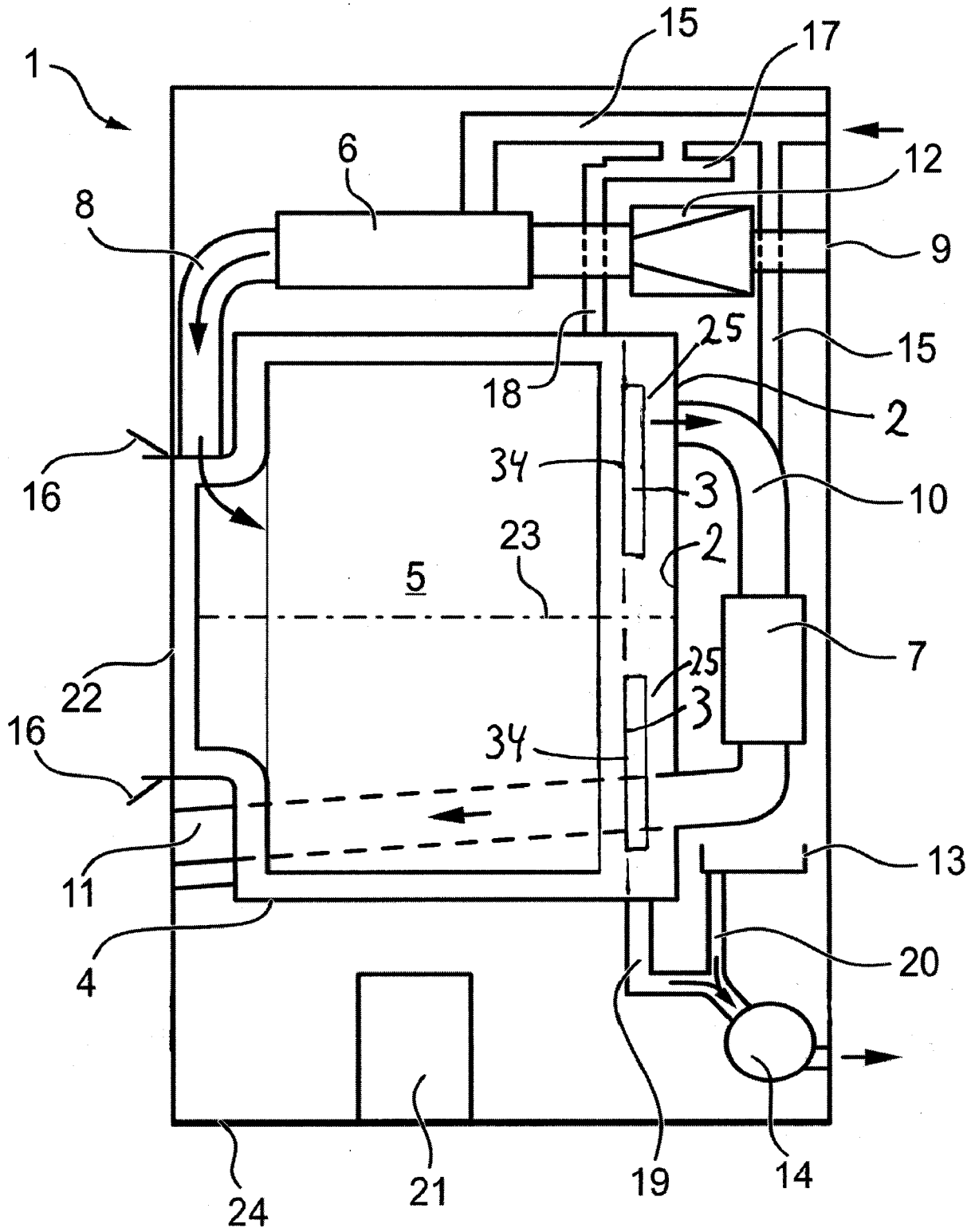

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Fig. 5

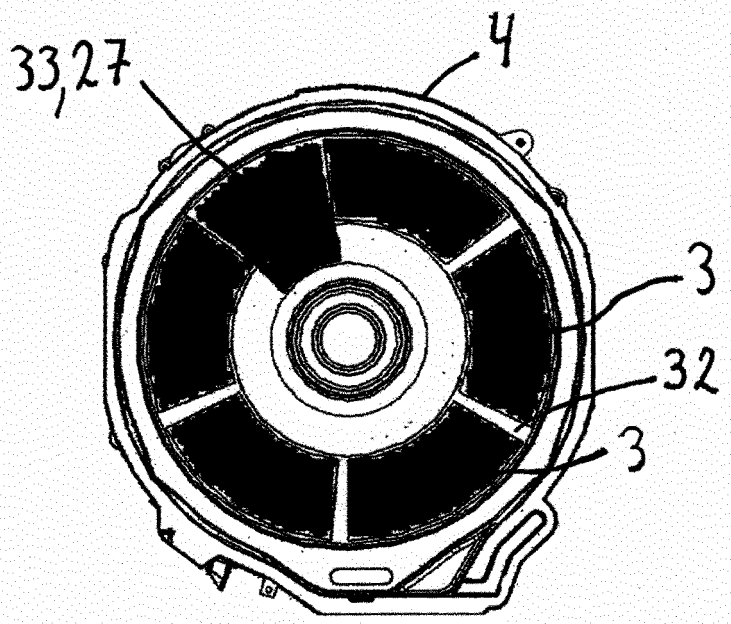


Fig. 6

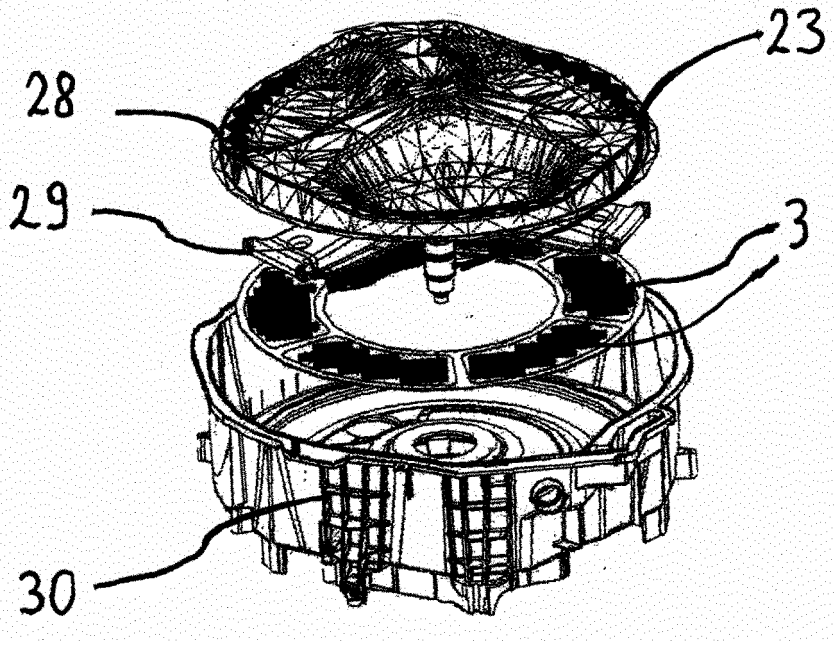


Fig. 2

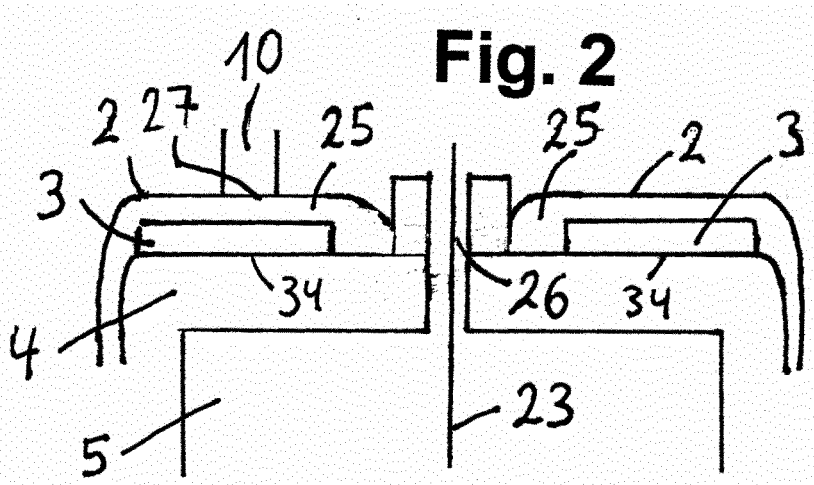


Fig. 3

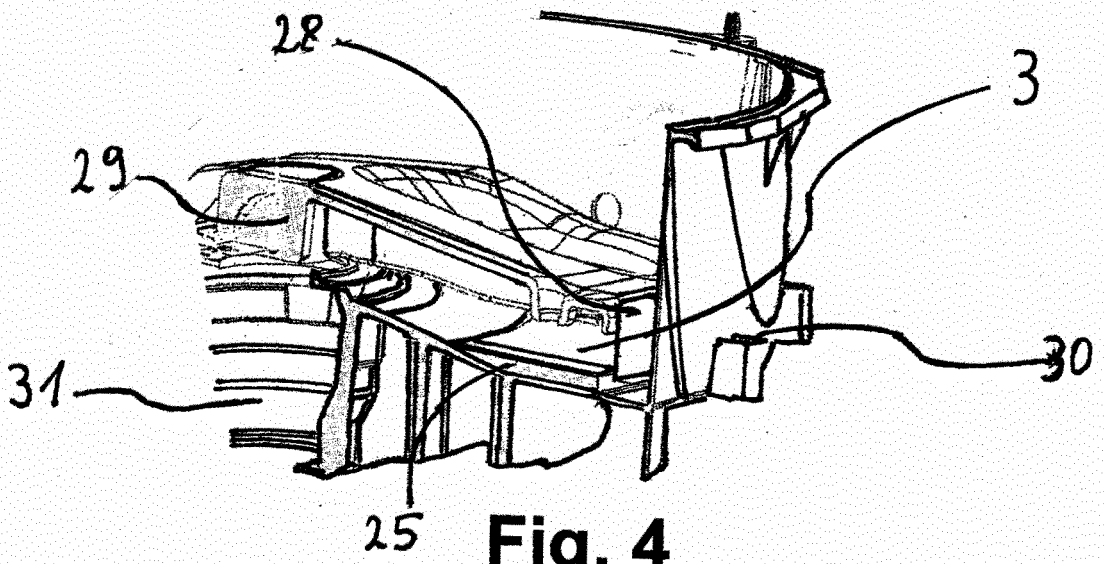
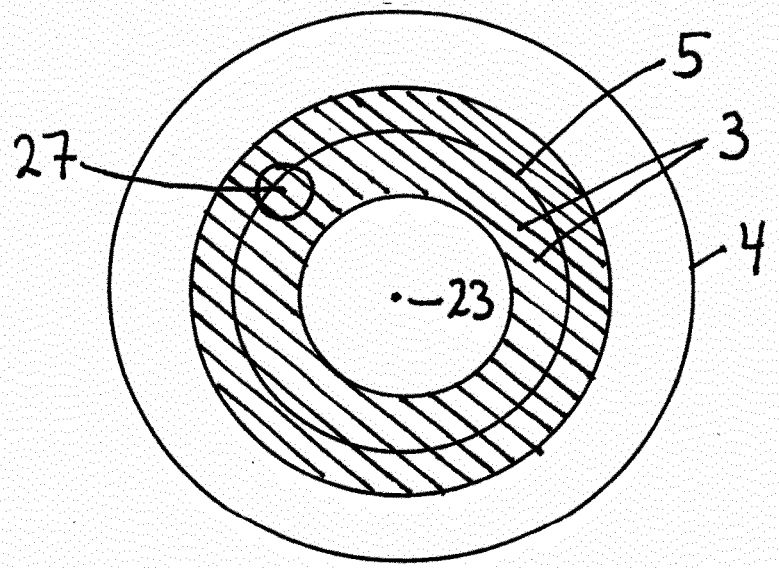


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 3393

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 981 437 A (BORG WARNER) 27 January 1965 (1965-01-27) * page 1, line 11 - page 2, line 7 * * page 2, line 43 - page 3, line 23 * * page 6, lines 4-103; figures *	1-10	INV. D06F25/00 D06F37/26 D06F58/22
X A	US 2010/175432 A1 (KOMORI MASANORI [JP] ET AL) 15 July 2010 (2010-07-15) * abstract * * paragraphs [0096], [0097], [0108] - [0125], [0135] - [0137]; figures *	1-5,7-10 6	
X A	WO 2015/101892 A1 (INDESIT CO SPA [IT]) 9 July 2015 (2015-07-09) * the whole document *	1-4,7-10 5,6	
X	JP H07 79903 B2 (TOSHIBA CORP) 30 August 1995 (1995-08-30) * the whole document *	1-10	
X A	WO 2021/012765 A1 (HISENSE SHANDONG REFRIGERATOR CO LTD [CN]) 28 January 2021 (2021-01-28) * abstract; figures *	1-4,7-10 5,6	TECHNICAL FIELDS SEARCHED (IPC) D06F
X	WO 2016/108795 A1 (ARÇELIK ANONIM SIRKETI [TR]) 7 July 2016 (2016-07-07) * the whole document *	1-10	
X A	US 2014/150279 A1 (KWON IG GEUN [KR] ET AL) 5 June 2014 (2014-06-05) * abstract * * paragraphs [0056] - [0124]; figures *	1-3,8-10 4-7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 May 2023	Prosig, Christina

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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