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(54) Rotary-drum laundry dryer

(57) Rotary-drum laundry dryer (1) comprising a revolving drum (3) structured for housing the laundry to be dried, a hot-air generator (6) structured to circulate a stream of hot air through said revolving drum (3), and a lower supporting base or socle (9) which is structured for resting on the floor and for housing at least part of the hot-air generator (6); the hot-air generator (6) in turn comprising: an air recirculating conduit (12) having its two ends connected to the revolving drum (3); air circulating means (13) which are located along the air recirculating conduit (12) and are structured to produce, inside the air recirculating conduit (12), an airflow (f) which flows through the revolving drum (3) and over the laundry inside the drum (3); and at least one heat exchanger (15) located along the air recirculating conduit (12) and structured to cool the moist air arriving from the rotatable drum (3) so to cause the condensation of the surplus moisture inside the airflow (f); a segment (12c) of the air recirculating conduit (12) extending across the lower supporting base or socle (9), and being structured so as to house said at least one heat exchanger (15) of the hot-air generator (6); the hot-air generator (6) additionally comprising air filtering means (18) located along the air recirculating conduit (12), upstream of said at least one heat exchanger (15), and a rigid, grid-like protective assembly (19) which is firmly fixed inside said segment (12c) of the air recirculating conduit (12), downstream of the filtering assembly (18) and upstream of the at least one heat exchanger (15), so to bar said segment (12c) of the air recirculating conduit (12) for preventing a generic hard foreign body to reach the heat exchanger (15).

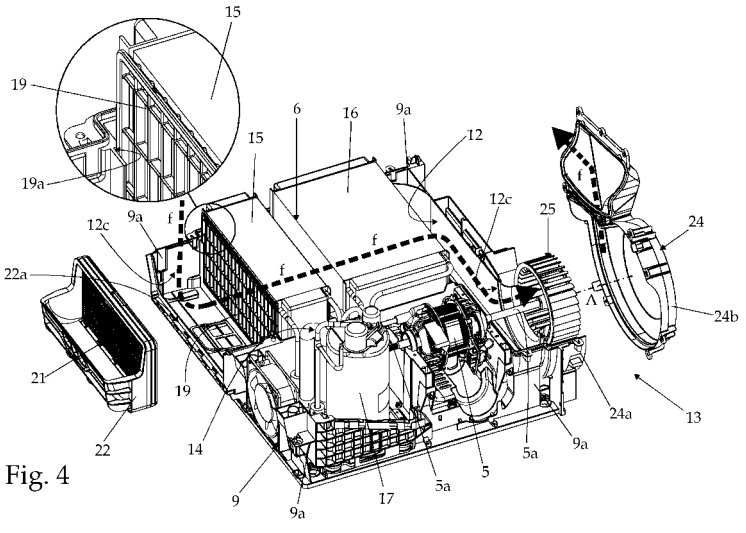

Fig. 4

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Description

[0001] The present invention relates to a rotary-drum laundry dryer.

[0002] In particular, the present invention relates to a rotary-drum home laundry dryer, to which the following description refers purely by way of example without implying any loss of generality.

[0003] As is known, today's rotary-drum home laundry dryers comprise: a substantially parallelepiped-shaped outer boxlike casing structured for resting on the floor; a substantially cylindrical revolving drum structured for housing the laundry to be dried, and which is housed in axially rotating manner inside the casing to rotate about its horizontally-oriented longitudinal axis, directly facing a laundry loading/unloading opening formed in the front wall of the casing; a porthole door hinged to the front wall of the casing to rotate to and from a closing position in which the door rests completely against the front wall of the casing to close the laundry loading/ unloading opening and airtight seal the revolving drum; and an electric motor assembly structured for driving into rotation the revolving drum about its longitudinal axis inside the casing.

[0004] Home laundry dryers of the above type are also provided with an open-circuit or closed-circuit, hot-air generator which is structured to circulate inside the revolving drum a stream of hot air having a low moisture content, and which flows through the revolving drum and over the laundry inside the drum to rapidly dry the laundry; and with an electronic central control unit which controls both the motor assembly and the hot-air generator to perform one of the user-selectable drying cycles stored in the same central control unit.

[0005] In today's high-end rotary-drum home laundry dryers, the hot-air generator is usually a closed-circuit, heat-pump type, hot-air generator that comprises: an air recirculating conduit having its two ends fluidically connected to the revolving drum, on opposite sides of the latter; an electric centrifugal fan located along the air recirculating conduit to produce, inside the latter, an airflow which flows through the revolving drum; a heat-pump assembly having its two heat exchangers located one after the other, along the air recirculating conduit; and finally a manually-removable filtering element which is fitted into the inlet of the air recirculating conduit located on the peripheral frame of the porthole door, i.e. upstream of the two heat exchangers of the heat-pump assembly, and which is structured to stop fluff and/or lint particles upstream of the two heat exchangers of the heat-pump assembly and of the centrifugal fan.

[0006] EP-2034084 discloses a heat-pump type, rotary-drum home laundry dryer having a closed-circuit, heat-pump type, hot-air generator of the type referred above.

[0007] Aim of the present invention is to simplify the structure of today's laundry dryers, so to simplify the assembly of the laundry dryer and/or the maintenance of the closed-circuit, heat-pump type, hot-air generator.

[0008] In compliance with the above aims, according to the present invention there is provided a rotary-drum laundry dryer comprising a revolving drum structured for housing the laundry to be dried, a hot-air generator structured to circulate a stream of hot air through said revolving drum, and a lower supporting base or socle which is structured for resting on the floor and for housing at least part of the hot-air generator;

the hot-air generator in turn comprising: an air recirculating conduit having its two ends connected to the revolving drum; air circulating means which are located along the air recirculating conduit and are structured to produce, inside the air recirculating conduit, an airflow which flows through the revolving drum and over the laundry inside the drum; at least one heat exchanger located along the air recirculating conduit and structured to cool the moist air arriving from the rotatable drum so to cause the condensation of the surplus moisture inside the airflow; and air filtering means located along the air recirculating conduit, upstream of said at least one heat exchanger;

a segment of the air recirculating conduit extending across the lower supporting base or socle, and being structured so as to house said at least one heat exchanger of the hot-air generator;

the laundry dryer being characterized in that the hot-air generator additionally comprises a rigid, grid-like protective assembly which is unremovably fixed inside said segment of the air recirculating conduit, downstream of the filtering assembly and upstream of the at least one heat exchanger, for protecting said at least one heat exchanger.

[0009] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that the lower supporting base or socle comprises a lower shell and an upper shell which are structured/shaped for being coupled to one another to form at least the portion of said segment of the air recirculating conduit wherein the grid-like protective assembly is located, and in that said grid-like protective assembly is jammed in between said lower and upper shells.

[0010] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said grid-like protective assembly is shaped/dimensioned so to not significantly slow down the airflow flowing along of the air recirculating conduit.

[0011] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said rigid, grid-like protective assembly is shaped/dimensioned so to have a free pass-through area at least equal to 60% of the local air-passage section of the air recirculating conduit.

[0012] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said grid-like protective assembly is shaped/dimensioned so to have a free pass-through at least equal to 75% of the local air-passage section of the air recirculating conduit.

[0013] Furthermore and preferably, though not neces-

sarily, the rotary-drum laundry dryer is characterized in that said grid-like protective assembly is shaped/dimensioned so to have an air-passage free surface ratio at least equal to twice the air-passage free surface ratio of the filtering assembly.

[0014] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said grid-like protective assembly preferably comprises a substantially flat, rigid, large-meshed grille.

[0015] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said substantially flat, rigid, large-meshed grille is substantially complementary in shape to that of the local air-passage section of the air recirculating conduit.

[0016] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that the lower supporting base or socle is provided with an access opening which directly communicates with said segment of the air recirculating conduit, upstream of said protective grid-like assembly.

[0017] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said air filtering means comprise a manually-removable, air-permeable panel or septum which is arranged inside said segment of the air recirculating conduit, upstream of the protecting grid-like assembly, so as to obstruct the local air-passage section of said segment of the air recirculating conduit, and is structured/dimensioned so as to stop fluff and/or lint particles upstream of said at least one heat exchanger; said manually-removable, air-permeable panel or septum being removable through said access opening realized in the lower supporting base or socle.

[0018] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that the lower supporting base or socle comprises a lower half-shell structured for resting on the floor, and an upper half-shell stacked up on top of, and rigidly coupled to said lower half-shell; said lower half-shell and upper half-shell being shaped so as to form, when coupled to one another, said segment of the air recirculating conduit which houses said grid-like protective assembly and said at least one heat exchanger of the hot-air generator.

[0019] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said grid-like protective assembly is jammed in between said lower and upper half-shells.

[0020] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized by also comprising an upper boxlike cabinet which is rigidly fixed to the top of the lower supporting base or socle and is structured so to house the revolving drum, and a door which is hinged to said cabinet to rotate to and from a closing position in which said door rests completely against the cabinet to close a corresponding laundry loading/unloading opening; and in that said air filtering means comprise a manually-removable, air-filtering device which is inserted in easy extractable manner into the inlet of the air recirculating conduit, and is structured to obstruct said inlet to stop fluff and/or lint particles at entrance of the air recirculating conduit; the inlet of the air recirculating conduit being located on the peripheral frame of the cabinet that defines/ delimits said laundry loading/unloading opening.

[0021] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that said air circulating means comprise a centrifugal fan which is located outside of the lower supporting base or socle, substantially at one of the two end-openings of said segment of the air recirculating conduit;

[0022] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized by also comprising an electric motor assembly which is mechanically connected to the revolving drum for rotating said drum about its longitudinal axis; said electric motor assembly being fixed on said lower supporting base or socle and the centrifugal fan being mechanically connected to said electric motor assembly.

[0023] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that the hot-air generator is a heat-pump type, hot-air generator which comprises: a first air/refrigerant heat exchanger which is located inside said segment of the air recirculating conduit, and is structured for rapidly cooling down the airflow arriving from the revolving drum to condense and restrain the surplus moisture in the airflow; a second air/refrigerant heat exchanger which is located inside said segment of the air recirculating conduit, downstream of the first air/refrigerant heat exchanger, and which is structured for rapidly heating the airflow arriving from the first air/refrigerant heat exchanger and directed back to the revolving drum; a refrigerant compressing device which is interposed between the refrigerant-outlet of the first air/refrigerant heat exchanger and the refrigerant-inlet of the second air/refrigerant heat exchanger, and which is structured for compressing the gaseous-state refrigerant directed towards the second air/refrigerant heat exchanger; and a refrigerant expansion device which is interposed between the refrigerant-outlet of the second air/refrigerant heat exchanger and the refrigerant-inlet of the first air/refrigerant heat exchanger, and it is structured so as to cause a rapid expansion of the refrigerant directed towards the first air/refrigerant heat exchanger.

[0024] Furthermore and preferably, though not necessarily, the rotary-drum laundry dryer is characterized in that the lower half-shell and the upper half-shell are both realized in plastic material preferably via an injection molding process.

[0025] A non-limiting embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

- Figure 1 shows in isometric view, and with parts removed for clarity, a rotary-drum home laundry dryer realized in accordance with the teachings of the

present invention;

- Figure 2 is a sectioned side view of the lower front portion of the Figure 1 laundry-dryer, with parts removed for clarity;
- Figure 3 is a partly-exploded isometric view of the lower supporting base or socle of the Figure 1 laundry-dryer, with parts removed for clarity; whereas
- Figure 4 shows in isometric view, and with parts removed for clarity, the inside of the Figure 3 lower supporting base or socle of the laundry-dryer, with parts removed for clarity.

[0026] With reference to Figures 1 and 2, number 1 indicates as a whole a preferably household, rotary-drum laundry dryer which comprises:

- a preferably, though not necessarily, parallelepiped-shaped outer boxlike casing 2 structured for resting on the floor;
- a substantially cylindrical, revolving drum 3 structured for housing the laundry to be dried, and which is fixed in axially rotating manner inside the boxlike casing 2, directly facing a laundry loading/ unloading through opening formed in the front wall of casing 2; and
- a porthole door 4 hinged to the front wall of casing 2 to rotate about a preferably, though not necessarily, vertically-oriented reference axis, to and from a closing position in which the door 4 rests completely against the front wall to close the laundry loading/ unloading opening and substantially airtight seal the revolving drum 3.

[0027] Inside the boxlike casing 2, the rotary-drum laundry dryer 1 additionally comprises an electric motor 5 which is mechanically connected to the revolving drum 3 for driving into rotation the drum 3 about its longitudinal axis; a closed-circuit, hot-air generator 6 which is structured to circulate through the revolving drum 3 a stream of hot air having a low moisture level, and which flows over and rapidly dries the laundry located inside drum 3; and finally an electronic central control unit 7 which controls both the electric motor 5 and the hot-air generator 6 to perform one of the user-selectable drying cycles preferably, though not necessarily, stored in the same central control unit 7.

[0028] More specifically, with reference to Figure 1, the boxlike casing 2 preferably comprises a substantially parallelepiped-shaped lower supporting base or socle 9 which is structured for resting on the floor and for housing at least part of the hot-air generator 6; and a substantially parallelepiped-shaped upper boxlike cabinet 10 which is rigidly fixed to the top of the lower supporting base or socle 9 and it is structured so as to house the revolving drum 3.

[0029] In the example shown, in particular, the revolving drum 3 preferably extends inside the boxlike cabinet 10 coaxial to a substantially horizontally-oriented longitudinal reference axis L, and rests on a number of substantially horizontally-oriented, front and rear idle supporting rollers 11 which are located in pairs substantially at the two axial ends of the revolving drum 3, and are fixed in free revolving manner to the casing 2 so as to allow the revolving drum 3 to freely rotate about its reference axis L inside the boxlike cabinet 10.

[0030] With reference to Figures 1 and 3, the front and rear idle supporting rollers 11 are preferably fixed in free revolving manner directly to the top of the lower supporting base or socle 9.

[0031] The laundry loading/unloading opening of casing 2 is therefore realized in the front wall of the upper boxlike cabinet 10, and the porthole door 4 is hinged to the front wall of the aforesaid upper boxlike cabinet 10.

[0032] In addition to the above, the lower supporting base or socle 9 is also preferably structured so to directly support the electric motor 5.

[0033] With reference to Figures 1, 2 and 3, the closed-circuit, hot-air generator 6 instead preferably consists in a heat-pump type, hot-air generator 6 which is structured for gradually drawing air from revolving drum 3; rapidly cooling down the air arriving from revolving drum 3 so to extract and retain the surplus moisture in the air drawn from revolving drum 3; rapidly heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from revolving drum 3; and finally feeding the heated, dehumidified air back into the revolving drum 3, where it flows over the laundry inside the drum to rapidly dry said laundry.

[0034] In other words, with reference to Figures 2, 3 and 4, the hot-air generator 6 provides for continually dehumidifying and heating the air circulating inside revolving drum 3 to rapidly dry the laundry inside the drum, and basically comprises:

- an air recirculating conduit 12 having its two ends in communication with, i.e. flowingly/ fluidly connected to, the revolving drum 3 on opposite sides of the latter;
- a centrifugal fan 13 which is located along the air recirculating conduit 12 to produce, inside the air recirculating conduit 12, an airflow f which flows through the revolving drum 3, over the laundry located inside the drum 3; and
- a heat-pump assembly 14 which is able to rapidly cool the airflow f coming out from revolving drum 3 for condensing and retaining the surplus moisture in the airflow f, and then to rapidly heat the airflow f returning back into revolving drum 3, so that the airflow f re-entering into revolving drum 3 is rapidly heated to a temperature higher than or equal to that of the airflow f coming out of the drum.

[0035] More specifically, with reference to Figures 1, 2 and 4, the heat-pump assembly 14 comprises:

- a first air/refrigerant heat exchanger 15 which is lo-

cated along the air recirculating conduit 12 and is structured for rapidly cooling down the airflow f arriving from revolving drum 3 to condense and restrain the surplus moisture in the airflow f;

- a second air/refrigerant heat exchanger 16 which is located along the air recirculating conduit 12, downstream of heat exchanger 15, and which is structured for rapidly heating the airflow f arriving from heat exchanger 15 and directed back to revolving drum 3, so that the airflow f re-entering into revolving drum 3 is heated rapidly to a temperature higher than or equal to that of the air flowing out of revolving drum 3;
- an electrically-powered refrigerant compressing device 17 which is interposed between the refrigerant-outlet of heat exchanger 15 and the refrigerant-inlet of heat exchanger 16, and which is structured for compressing the gaseous-state refrigerant directed towards heat exchanger 16 so that refrigerant pressure and temperature are much higher at the refrigerant-inlet of heat exchanger 16 than at the refrigerant-outlet of heat exchanger 15; and finally
- an expansion valve or similar passive/operated refrigerant expansion device (for example a capillary tube, a thermostatic valve or an electrically-controlled expansion valve) which is interposed between the refrigerant-outlet of heat exchanger 16 and the refrigerant-inlet of heat exchanger 15, and it is structured so as to cause a rapid expansion of the refrigerant directed towards the first air/refrigerant heat exchanger 15, so that refrigerant pressure and temperature are much higher at the refrigerant-outlet of heat exchanger 16 than at the refrigerant-inlet of heat exchanger 15.

[0036] The air/refrigerant heat exchanger 15 is conventionally referred to as the "evaporator" or "gas-heater" of the heat-pump assembly 14, and it is structured so that the airflow f arriving from revolving drum 3 and the low-pressure and low-temperature refrigerant directed to the suction of the refrigerant compressing device 17 can flow through it simultaneously, allowing the refrigerant having a temperature lower than that of the airflow f, to absorb heat from the airflow f, thus causing condensation of the surplus moisture in the airflow f arriving from revolving drum 3.

[0037] The air/refrigerant heat exchanger 16, in turn, is conventionally referred to as the "condenser" or "gas-cooler" of the heat-pump assembly 14, and it is structured so that the airflow f directed back into revolving drum 3 and the high-pressure and high-temperature refrigerant arriving from the delivery of the refrigerant compressing device 17 can flow through it simultaneously, allowing the refrigerant having a temperature greater than that of the airflow f to release heat to the airflow f, thus rapidly heating the airflow f directed back into the revolving drum 3.

[0038] With reference to Figure 2, in the example shown, in particular, the first mouth or inlet 12i of the air recirculating conduit 12 is preferably integrated in the peripheral frame of the boxlike cabinet 10 that defines/ delimits the laundry loading/unloading opening, and the porthole door 4, when arranged in the closing position, abuts on this peripheral frame so as to substantially airtight seal the laundry loading/unloading opening and at the same time put/leave the mouth or inlet 12i of the air recirculating conduit 12 in direct communication with the inside of revolving drum 3. The second mouth or outlet (not shown) of the air recirculating conduit 12 is instead preferably realized/integrated in the rear wall of the upper boxlike cabinet 10, approximately at the center of the rear rim of revolving drum 3.

[0039] In addition to the above, with reference to Figures 2, 3 and 4, in the example shown a central/intermediate segment 12c of the air recirculating conduit 12 extends in pass-through manner across the lower supporting base or socle 9, and is shaped/dimensioned so as to house, one downstream the other along the flowing direction of the airflow f, both the evaporator 15 and the condenser 16 of the heat-pump assembly 14. In the example shown, in particular, the central segment 12c of air recirculating conduit 12 preferably extends inside the lower supporting base or socle 9 substantially horizontally.

[0040] The centrifugal fan 13 in turn is preferably located outside of the lower supporting base or socle 9, preferably at one of the two end-openings of the central segment 12c of the air recirculating conduit 12, so to directly communicate with, i.e. be flowingly/fluidly connected to, both the central segment 12c of the air recirculating conduit 12 and the inside of revolving drum 3.

[0041] In particular the centrifugal fan 13 is preferably located on the back of the lower supporting base or socle 9, at the exit end-opening or outlet of the central segment 12c of the air recirculating conduit 12, i.e. downstream of both the evaporator 15 and the condenser 16 of heat-pump assembly 14.

[0042] With reference to Figures 1, 2 and 4, the closed-circuit, hot-air generator 6 furthermore comprises a filtering assembly 18 which is located along the air recirculating conduit 12, upstream of evaporator 15, and is structured so as to stop fluff and/or lint particles upstream of both the evaporator 15 and the condenser 16; and a rigid, protective grid-like assembly 19 which is crosswise firmly and also unremovably fixed inside the central segment 12c of the air recirculating conduit 12, downstream of the filtering assembly 18 and immediately upstream of the evaporator 15 of heat-pump assembly 14, so as to prevent a generic hard foreign body from bumping against the evaporator 15.

[0043] The protective grid-like assembly 19 is therefore completely separated and independent from the filtering assembly 18, and is properly shaped/dimensioned so to not significantly slow down the airflow f flowing along of the air recirculating conduit 12.

[0044] The protective grid-like assembly 19 is preferably shaped/dimensioned so that the free pass-through

area of the grid-like assembly 19 (i.e. the portion of the overall front section of the grid-like assembly 19 that does not stop the airflow f, i.e. the portion of grid-like assembly 19 that is permeable to air) is at least 60%, and preferably also 75%, of the local air-passage section of the air recirculating conduit 12 wherein the grid-like assembly 19 is located/arranged. Furthermore the grid-like assembly 19 is preferably shaped/dimensioned so as to have an air-passage free surface ratio (i.e. the ration between the free pass-through area of the grid-like assembly 19 and the overall front section of the same grid-like assembly 19) at least equal to twice the air-passage free surface ratio (i.e. the ration between the free pass-through area of the filtering assembly 18 and the overall front section of the same filtering assembly 18) of the filtering assembly 18.

[0045] In the example shown, in particular, the protective grid-like assembly 19 preferably consists in substantially flat, rigid, large-meshed grille 19 which is preferably complementary in shape to that of the local air-passage section of the air recirculating conduit 12. The flat, large-meshed grille 19 is preferably realized in metal or plastic material.

[0046] With reference to Figures 2, 3 and 4, in the example shown, in particular, the lower supporting base or socle 9 of outer casing 2 is formed/composed by a lower half-shell 9a which is structured for resting on the floor, and by an upper half-shell 9b which is structured for being stacked up on top of, and rigidly coupled to, the lower half-shell 9a, so to preferably directly support the upper boxlike cabinet 10 and preferably also the front and rear idle rollers 11 that support in free revolving manner the revolving drum 3.

[0047] The lower half-shell 9a and the upper half-shell 9b are furthermore preferably shaped so as to form, when coupled to one another, the substantially horizontally-oriented, whole central segment 12c of the air recirculating conduit 12 which houses, one downstream the other along the flowing direction of the airflow f, in unremovable manner the protective grid-like assembly 19 and both the evaporator 15 and the condenser 16 of the heat-pump assembly 14.

[0048] In particular, the lower half-shell 9a and the upper half-shell 9b are preferably structured/shaped so as to firmly and unremovably jam/block in between themselves the flat, large-meshed grille 19, i.e. the protective grid-like assembly 19, and preferably also the evaporator 15 and the condenser 16 of the heat-pump assembly 14.

[0049] In the example shown, in particular, the peripheral edge of the large-meshed grille 19 is preferably structured/shaped to fit into a seat or groove 19a realized partly in the lower half-shell 9a and partly in the upper half-shell 9b, so that the two half-shells 9a and 9b can permanently trap/ensnare the large-meshed grille 19 in between themselves when coupled to one another to form the lower supporting base or socle 9.

[0050] In other words, the lower half-shell 9a and upper half-shell 9b are shaped so as to form the two halves of the central segment 12c of the air recirculating conduit 12, and are structured for being substantially airtight coupled to one another, so as to compose/form the whole central segment 12c of the air recirculating conduit 12, and contemporaneously directly lock/ensnare in between themselves the large-meshed grille 19, the evaporator 15 and the condenser 16.

[0051] In the example shown, the lower half-shell 9a and the upper half-shell 9b are both preferably, though not necessarily, realized in plastic material by means of an injection molding process.

[0052] With reference to Figures 2 and 4, the filtering assembly 18 in turn preferably comprises two manually-removable, air-filtering devices which are located, one downstream the other along the air recirculating conduit 12, upstream of protective grid-like assembly 19, evaporator 15 and condenser 16.

[0053] The first air-filtering device preferably consists in a substantially plug-shaped, air-filtering device 20 which is inserted in easy extractable manner into the inlet 12i of the air recirculating conduit 12, and is structured to obstruct the inlet 12i to stop fluff and/or lint particles at entrance of the air recirculating conduit 12.

[0054] Instead the second air-filtering device preferably consists in an air-permeable panel, narrow-meshed net or septum 21 which is located inside the central segment 12c of the air recirculating conduit 12, immediately upstream of the protecting grid-like assembly 19, so as to completely obstruct the local air-passage section of the central segment 12c of the air recirculating conduit 12, and is structured/dimensioned so as to stop fluff and/or lint particles upstream of evaporator 15.

[0055] The air-passage free surface ratio of the air-permeable panel, narrow-meshed net or septum 21 is preferably less than half the air-passage free surface ratio of the rigid, large-meshed grille 19.

[0056] Moreover, in the example shown the filtering panel or septum 21 is preferably rigidly fixed on a drawer-like supporting structure 22 which is inserted into a corresponding access opening 22a realized on front of the lower supporting base or socle 9, and directly communicating with the central segment 12c of the air recirculating conduit 12, immediately upstream of protective grid-like assembly 19. The drawer-like supporting structure 22 is preferably structured so as to place, when completely inserted into the access opening 22a on front of the lower supporting base or socle 9, the filtering panel or septum 21 in abutment against the flat, large-meshed grille 19 forming the protecting grid-like assembly 19.

[0057] To substantially airtight seal the access opening 22a on front of the lower supporting base or socle 9 and to hide the drawer-like supporting structure 22, the laundry dryer 1 is preferably also provided with a second porthole door 24 which is hinged to the front of the lower supporting base or socle 9 to rotate about a preferably, though not necessarily, vertically-oriented reference axis, to and from a closing position in which the door 24 rests completely against the front of the lower supporting

base or socle 9 to completely close the access opening 22a and cover the drawer-like supporting structure 22 inserted therein.

[0058] With reference to Figures 3 and 4, the centrifugal fan 13 instead preferably comprises an outer housing 24 which is located on the back of the lower supporting base or socle 9, at the end-opening of the central segment 12c of the air recirculating conduit 12, so to directly communicate, i.e. be flowingly/fluidly connected to, both the central segment 12c of the air recirculating conduit 12 and the inside of revolving drum 3; and an impeller 25 which is housed in axially rotating manner inside the outer housing 18 to generate the airflow f when rotating about its reference axis A.

[0059] In the example shown, in particular, the electric motor 5 is preferably fixed/recessed on the lower supporting base or socle 9 so that its drive shaft 5a sticks out from the back of the lower supporting base or socle 9, at the end-opening of the central segment 12c of the air recirculating conduit 12; and the centrifugal fan 13 is mechanically connected to the electric motor 5.

[0060] More specifically, in the examples shown, the centrifugal fan 13 is preferably located on the back of the lower supporting base or socle 9, locally substantially aligned to the drive shaft 5a of electric motor 5, so that the outer housing or propeller housing 24 is locally substantially coaxial to the drive shaft 5a of electric motor 5, and the impeller 19 is rigidly fitted to the axial end of the drive shaft 5a of electric motor 5 so to be directly driven into rotation by the latter.

[0061] Furthermore, with reference to Figures 3 and 4, in the example shown the outer or impeller hosing 24 of centrifugal fan 13 is preferably also at least partly integrated on the back of the lower supporting base or socle 9 formed by the two half-shells 9a and 9b.

[0062] In other words, the outer or impeller housing 24 of centrifugal fan 13 comprises a first portion 24a directly incorporated in the lower supporting base or socle 9, at the end-opening of the central segment 12c of the air recirculating conduit 12, and a second portion 24b which is structured/shaped for being coupled in a rigid and stable, though easily releasable, manner to the first portion 24a of the impeller housing so to close the first portion 24a of the impeller housing for covering up the impeller 25 that is at least partly recessed inside the first portion 24a of outer housing 24.

[0063] More specifically, the first portion 24a of outer or impeller housing 24 is preferably realized in one piece with the lower supporting base or socle 9, whereas the second portion 24b of the impeller housing consists in a substantially basin-shaped, rigid cover 25b which is fixed in a rigid and stable, though easily releasable, manner to the area of the lower supporting base or socle 9 forming the first portion 24a of outer or impeller housing 24, so as to substantially airtight close said first portion 24a and completely cover the impeller 25.

[0064] In particular, the first portion 24a of the outer or impeller housing 15 of centrifugal fan 13 is preferably divided into two distinct and separated sections which are realized in one piece, respectively, with the lower half-shell 9a and with the upper half-shell 9b, so that the whole first portion 24a of the outer housing 24 is formed when the two half-shells 9a and 9b are coupled to one another.

[0065] In the example shown, in particular, the aforesaid two distinct and separated sections forming the first portion 24a of impeller housing 24 are preferably structured and shaped so as to form, when firmly coupled to one another, a first approximately half-volute of the outer housing 24; whereas the second portion 24b of impeller housing preferably consists in a substantially basin-shaped, rigid cover 24b which is shaped so as to form the remaining, complementary second half-volute of the impeller housing 24, and is structured for being substantially airtight coupled to the first half-volute 24a formed by the two half-shells 9a and 9b, to complete the outer housing 24 of centrifugal fan 13.

[0066] In other words, the impeller housing 24 of centrifugal fan 13 is spitted into three distinct and separated pieces which are structured for being substantially airtight coupled to one another to form the volute of the outer housing 24.

[0067] In addition to the above, with reference to Figures 3 and 4, in the example shown the lower half-shell 9a and upper half-shell 9b are also preferably, though not necessarily, structured so that the central segment 12c of the air recirculating conduit 12 is substantially L-shaped, and is oriented so that a first portion of the central segment of the air recirculating conduit 12 extends below the revolving drum 3 while remaining locally substantially parallel to the longitudinal axis L of revolving drum 3, and that a second transversal portion of the central segment of the air recirculating conduit 12 extends below the revolving drum 3 remaining locally substantially perpendicular to the longitudinal axis L of drum 3.

[0068] The protecting grid-like assembly 19, the evaporator 15 and the condenser 16 are located, one downstream the other, inside the first portion of the central segment 12c of the air recirculating conduit 12; whereas the refrigerant compressing device 17 and the electric motor 5 are preferably fixed/recessed on the lower supporting base or socle 9, aligned one after the other in a direction locally substantially parallel to the longitudinal axis L of revolving drum 3, beside the first portion of the central segment 12c of the air recirculating conduit 12, so that the drive shaft 5a of electric motor 5 sticks out from the back of the lower supporting base or socle 9, at the end of the second portion of the central segment 12c of the air recirculating conduit 12.

[0069] In the example shown, in particular, electric motor 5 and refrigerant compressing device 17 are preferably fixed/recessed directly onto the lower half-shell 9a, beside the first portion of the central segment 12c of the air recirculating conduit 12.

[0070] With reference to Figure 4, the centrifugal fan 13 is therefore located on the back of the lower supporting

base or socle 9, at the end of the transversal second portion of the central segment 12c of the air recirculating conduit 12, locally aligned to the drive shaft 5a of the electric motor 5.

[0071] General operation of the rotary-drum home laundry drier 1 is clearly inferable from the above description, with no further explanation required.

[0072] As regards protecting grid-like assembly 19, when the filtering assembly 18 is clogged up, the user is requested to manually remove and clean the filtering assembly 18, and also to use the vacuum cleaner to suck away any fluff or lint particles accumulated inside the central segment 12c of the air recirculating conduit 12, immediately upstream of the evaporator 15.

[0073] Unfortunately, in today's laundry dryers sometimes happens that the mouth of the vacuum-cleaner pipe violently bumps against the evaporator 15 significantly deforming the fins of the heat exchanger.

[0074] Since experimental tests revealed that deformation of the heat-exchanger fins may cause a significant reduction of the heat transfer efficiency, the protecting grid-like assembly 19 prevent the rigid pipe of the vacuum-cleaner to reach the evaporator 15 when the air-permeable panel or septum 21 is removed.

[0075] Obviously, even if the protecting grid-like assembly 19 is unremovably fixed (for the user) inside the air recirculating conduit 12, immediately upstream of the evaporator 15, a complete opening/uncoupling of the lower and upper half-shells 9a and 9b allows a technician to remove/replace the protecting grid-like assembly 19, preferably the same applies to the heat exchanger 15, particularly when the heat exchanger 15 is the evaporator/gas heater of a heap pump system.

[0076] Clearly, changes may be made to the rotary-drum laundry drier 1 as described herein without, however, departing from the scope of the present invention.

[0077] For example, in a less sophisticated embodiment the closed-circuit, hot-air generator 6 may consist of a forced-air, hot-air generator in which the cooling of the airflow f arriving from the revolving drum 3 is performed via a cold airflow arriving from the outside of casing 2.

[0078] More specifically, in this less sophisticated embodiment, the hot-air generator 6 lacks the evaporator 15, the condenser 16, the refrigerant compressing device 17 and the refrigerant expansion device, i.e. the whole heat-pump assembly 14, and instead comprises: an air/air heat exchanger which is located along the central segment 12c of the air recirculating conduit 12, in place of the evaporator 15; and a resistor or similar air-heating device which is located along the air recirculating conduit 12, downstream of said air/air heat exchanger.

[0079] The air/air heat exchanger is structured for being crossed, at the same time, by the airflow f arriving from revolving drum 3 and by a stream of cold air arriving from outside the casing 2, thus allowing the stream of external cold air to absorb heat from the airflow f for causing the condensation of the surplus moisture in the airflow f arriving from revolving drum 3; whereas the resistor is structured for rapidly heating up the dehumidified air directed back into the revolving drum 3.

[0080] In this less sophisticated embodiment, the protecting grid-like assembly 19, i.e. the flat, large-meshed grille 19, is located along the central segment 12c of the air recirculating conduit 12, immediately upstream of the air/air heat exchanger.

Claims

1. Rotary-drum laundry dryer (1) comprising a revolving drum (3) structured for housing the laundry to be dried, a hot-air generator (6) structured to circulate a stream of hot air through said revolving drum (3), and a lower supporting base or socle (9) which is structured for resting on the floor and for housing at least part of the hot-air generator (6);
the hot-air generator (6) in turn comprising: an air recirculating conduit (12) having its two ends connected to the revolving drum (3); air circulating means (13) which are located along the air recirculating conduit (12) and are structured to produce, inside the air recirculating conduit (12), an airflow (f) which flows through the revolving drum (3) and over the laundry inside the drum (3); at least one heat exchanger (15) located along the air recirculating conduit (12) and structured to cool the moist air arriving from the rotatable drum (3) so to cause the condensation of the surplus moisture inside the airflow (f); and air filtering means (18) located along the air recirculating conduit (12), upstream of said at least one heat exchanger (15);
a segment (12c) of the air recirculating conduit (12) extending across the lower supporting base or socle (9), and being structured so as to house said at least one heat exchanger (15) of the hot-air generator (6);
the laundry dryer (1) being **characterized in that** the hot-air generator (6) additionally comprises a rigid, grid-like protective assembly (19) which is unremovably fixed inside said segment (12c) of the air recirculating conduit (12), downstream of the filtering assembly (18) and upstream of the at least one heat exchanger (15), for protecting said at least one heat exchanger (15).

2. Rotary-drum laundry dryer according to Claim 1, **characterized in that** the lower supporting base or socle (9) comprises a lower shell (9a) and an upper shell (9b) which are structured/shaped for being coupled to one another to form at least the portion of said segment (12c) of the air recirculating conduit (12) wherein the grid-like protective assembly (19) is located, and **in that** said grid-like protective assembly (19) is jammed in between said lower and upper shells (9a, 9b).

3. Rotary-drum laundry dryer according to Claim 1 or 2, **characterized in that** said grid-like protective assembly (19) is shaped/dimensioned so to not significantly slow down the airflow (f) flowing along of the air recirculating conduit (12).

4. Rotary-drum laundry dryer according to Claim 3, **characterized in that** said rigid, grid-like protective assembly (19) is shaped/dimensioned so to have a free pass-through area at least equal to 60% of the local air-passage section of the air recirculating conduit (12).

5. Rotary-drum laundry dryer according to Claim 4, **characterized in that** said grid-like protective assembly (19) is shaped/dimensioned so to have a free pass-through area at least equal to 75% of the local air-passage section of the air recirculating conduit (12).

6. Rotary-drum laundry dryer according to Claim 3, 4 or 5, **characterized in that** said grid-like protective assembly (19) is shaped/dimensioned so to have an air-passage free surface ratio at least equal to twice the air-passage free surface ratio of the filtering assembly (18).

7. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized in that** said grid-like protective assembly (19) preferably comprises a substantially flat, rigid, large-meshed grille (19).

8. Rotary-drum laundry dryer according to Claim 7, **characterized in that** said substantially flat, rigid, large-meshed grille (19) is substantially complementary in shape to that of the local air-passage section of the air recirculating conduit (12).

9. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized in that** the lower supporting base or socle (9) is provided with an access opening (22a) which directly communicates with said segment (12c) of the air recirculating conduit (12), upstream of said protective grid-like assembly (19).

10. Rotary-drum laundry dryer according to Claim 9, **characterized in that** said air filtering means (18) comprise a manually-removable, air-permeable panel or septum (21) which is arranged inside said segment (12c) of the air recirculating conduit (12), upstream of the protecting grid-like assembly (19), so as to obstruct the local air-passage section of said segment (12c) of the air recirculating conduit (12), and is structured/dimensioned so as to stop fluff and/or lint particles upstream of said at least one heat exchanger (15); said manually-removable, air-permeable panel or septum (21) being removable through said access opening (22a) realized in the lower supporting base or socle (9).

11. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized in that** the lower supporting base or socle (9) comprises a lower half-shell (9a) structured for resting on the floor, and an upper half-shell (9b) stacked up on top of, and rigidly coupled to said lower half-shell (9a); said lower half-shell (9a) and upper half-shell (9b) being shaped so as to form, when coupled to one another, said segment (12c) of the air recirculating conduit (12) which houses said grid-like protective assembly (19) and said at least one heat exchanger (15) of the hot-air generator (6).

12. Rotary-drum laundry dryer according to Claim 9, **characterized in that** said grid-like protective assembly (19) is jammed in between said lower and upper half-shells (9a, 9b).

13. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized by** also comprising an upper boxlike cabinet (10) which is rigidly fixed to the top of the lower supporting base or socle (9) and is structured so to house the revolving drum (3), and a door (4) which is hinged to said cabinet (10) to rotate to and from a closing position in which said door (4) rests completely against the cabinet (10) to close a corresponding laundry loading/unloading opening; and in that said air filtering means (18) comprise a manually-removable, air-filtering device (20) which is inserted in easy extractable manner into the inlet (12i) of the air recirculating conduit (12), and is structured to obstruct said inlet (12i) to stop fluff and/or lint particles at entrance of the air recirculating conduit (12); the inlet (12i) of the air recirculating conduit (12) being located on the peripheral frame of the cabinet (10) that defines/ delimits said laundry loading/unloading opening.

14. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized in that** said air circulating means (13) comprise a centrifugal fan (13) which is located outside of the lower supporting base or socle (9), substantially at one of the two end-openings of said segment (12c) of the air recirculating conduit (12);

15. Rotary-drum laundry dryer according to Claim 14, **characterized by** also comprising an electric motor assembly (5) which is mechanically connected to the revolving drum (3) for rotating said drum (3) about its longitudinal axis (L); said electric motor assembly (5) being fixed on said lower supporting base or socle (9) and the centrifugal fan (13) being mechanically connected to said electric motor assembly (5).

16. Rotary-drum laundry dryer according to any one of the foregoing claims, **characterized in that** the hot-air generator (6) is a heat-pump type, hot-air generator (6) which comprises:

- a first air/refrigerant heat exchanger (15) which is located inside said segment (12c) of the air recirculating conduit (12), and is structured for rapidly cooling down the airflow (f) arriving from the revolving drum (3) to condense and restrain the surplus moisture in the airflow (f);
- a second air/refrigerant heat exchanger (16) which is located inside said segment (12c) of the air recirculating conduit (12), downstream of the first air/refrigerant heat exchanger (15), and which is structured for rapidly heating the airflow (f) arriving from the first air/refrigerant heat exchanger (15) and directed back to the revolving drum (3);
- a refrigerant compressing device (17) which is interposed between the refrigerant-outlet of the first air/refrigerant heat exchanger (15) and the refrigerant-inlet of the second air/refrigerant heat exchanger (16), and which is structured for compressing the gaseous-state refrigerant directed towards the second air/refrigerant heat exchanger (18); and
- a refrigerant expansion device which is interposed between the refrigerant-outlet of the second air/refrigerant heat exchanger (16) and the refrigerant-inlet of the first air/refrigerant heat exchanger (15), and it is structured so as to cause a rapid expansion of the refrigerant directed towards the first air/refrigerant heat exchanger (17).

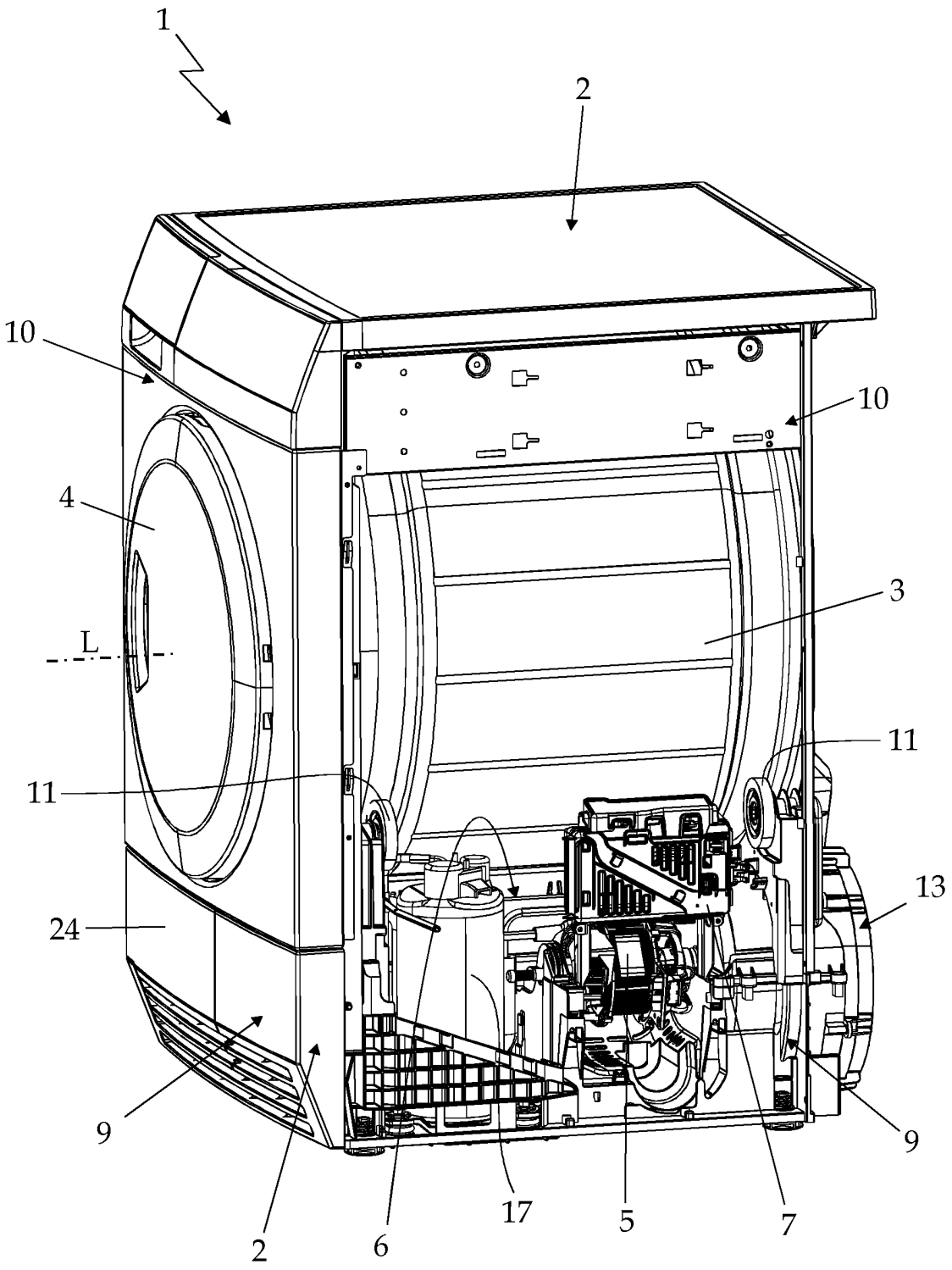

Fig. 1

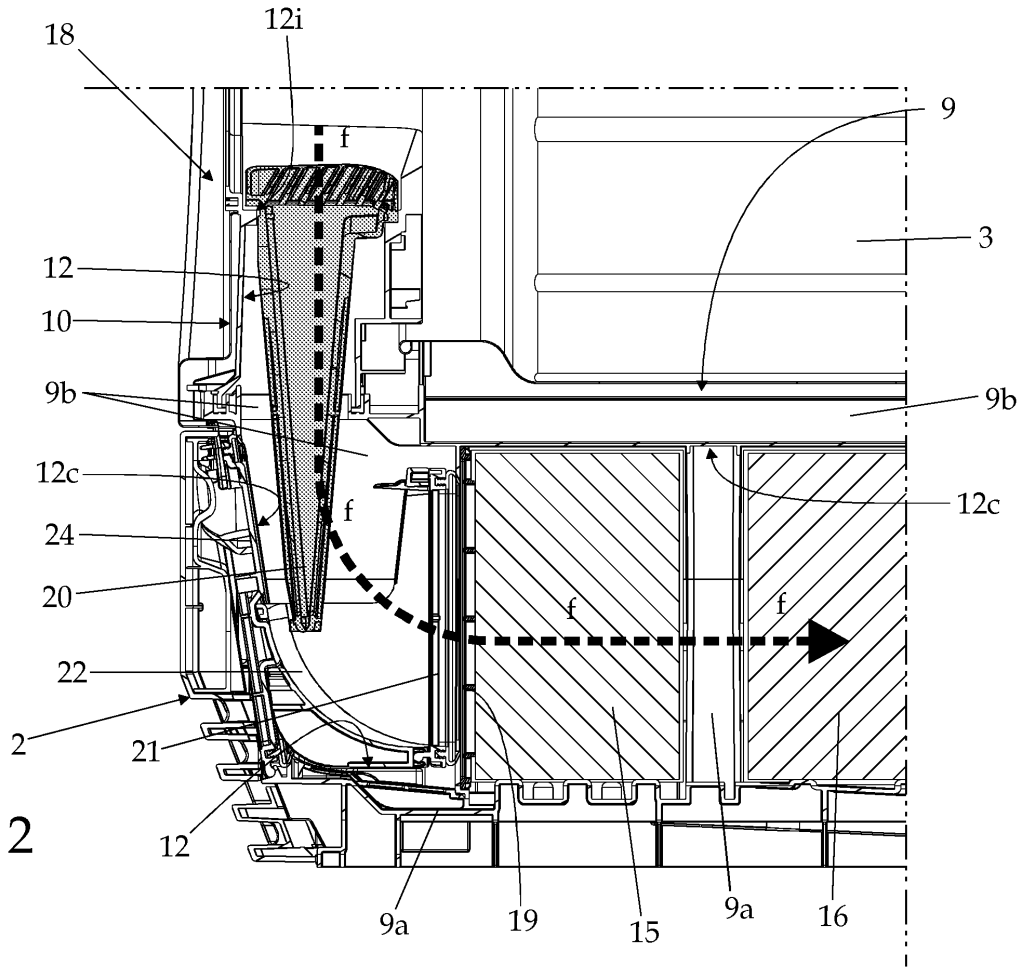

Fig. 2

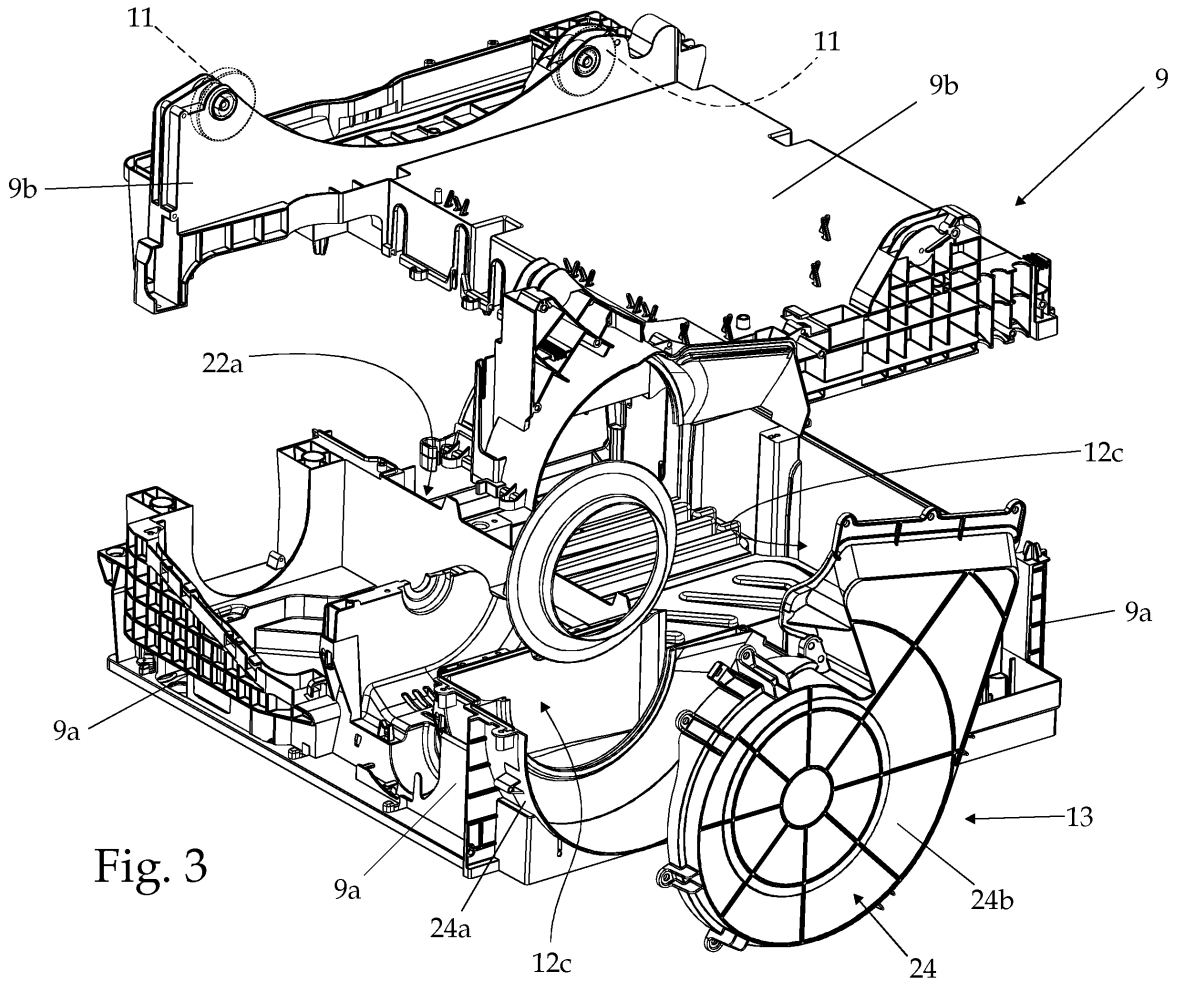

Fig. 3

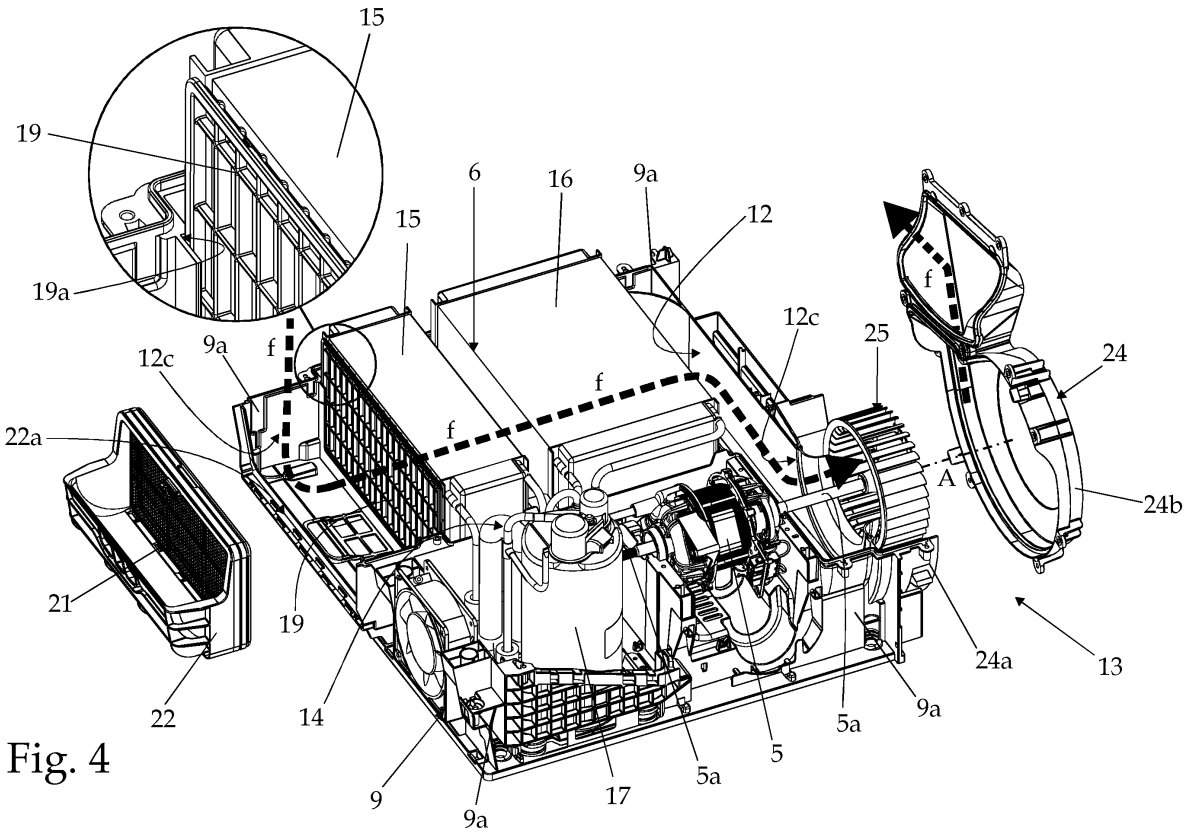
15
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Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 7970

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	3 November 2011	Hannam, Martin

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