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(54) **Home laundry dryer**

(57) A home laundry drier (1) comprising an outer box casing (2) and, inside said casing (2), a revolving drum (3) for housing the laundry to be dried, and a hot-air generator (7) for circulating a stream of hot air inside the revolving drum (3); the hot-air generator (7) comprising an air recirculating conduit (8) connected at both ends to the revolving drum (3), and a heat exchanger (10) located along the recirculating conduit (8) to cool the airflow (f) from the revolving drum (3) and condense the surplus moisture in the airflow (f); the heat exchanger (10) comprising a boxlike container (12) located along the recirculating conduit (8), and a heat-conductive air-guide cartridge (13) inserted in easy-removable manner into the boxlike container (12); the heat-conductive air-guide cartridge (13) being designed to cool the airflow (f) from the laundry drying container (3) for condensing the surplus moisture inside the airflow (f), and also including filtering means (19) designed to keep fluff and/or lint particles within the heat-conductive air-guide cartridge (13).

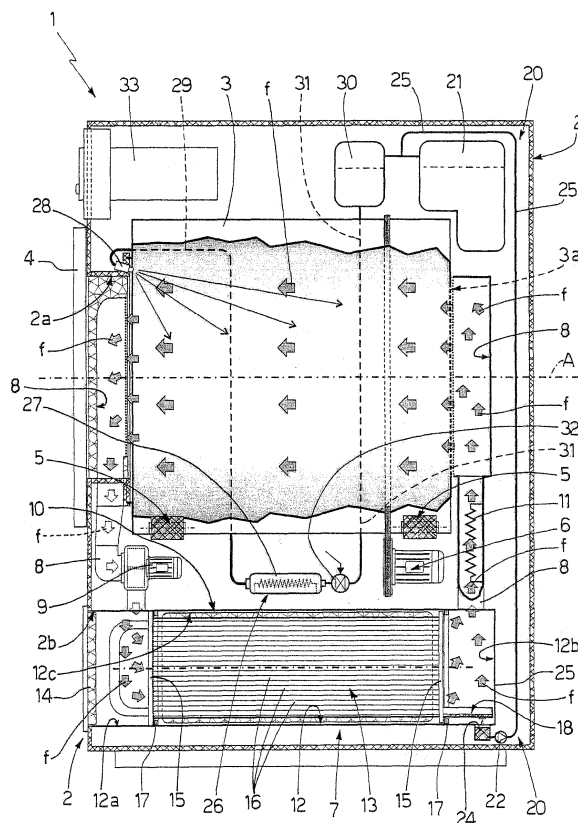


Fig. 1

Description

[0001] The present invention relates to a home laundry drier.

[0002] More specifically, the present invention relates to a rotary-drum home laundry drier with steam generator, to which the following description refers purely by way of example.

[0003] As is known, present rotary-drum home laundry driers comprise a substantially parallelepiped-shaped outer box casing; a cylindrical laundry drying drum housed in axially rotating manner inside the box casing, directly facing a laundry loading and unloading opening formed in the front face of the casing; a door hinged to the front face of the casing to rotate to and from a rest position closing the opening in the front face of the casing to seal the drying drum; and an electric motor for rotating the drying drum about its longitudinal axis inside the casing.

[0004] Rotary-drum home laundry driers of the above type also comprise a closed-circuit, hot-air generator designed to circulate inside the drying drum a stream of hot air with a low moisture content, and which flows through the drying drum and over the laundry inside the drum to rapidly dry the laundry.

[0005] In the most widely marketed driers, the closed-circuit, hot-air generator comprises an air/air heat exchanger and an electric heater located one after the other along an air recirculating conduit, the two ends of which are connected to the drying drum, on opposite sides of the latter; and an electric centrifugal fan or similar located along recirculating conduit to produce, inside the recirculating conduit, an airflow which flows through the drying drum. The air/air heat exchanger provides for rapidly cooling the airflow from the drying drum to condense the surplus moisture in the airflow; and the heater provides for rapidly heating the airflow from the heat exchanger back to the drying drum, so that the air flowing into the drum is heated rapidly to a temperature higher than or equal to that of the same air flowing out of the drying drum.

[0006] Some more recently marketed rotary-drum driers also feature a pressurized-steam generator which, at the end of the drying cycle, feeds a jet of steam into the drying drum to eliminate or at least greatly reduce wrinkling of the fabrics produced during the drying cycle.

[0007] Currently used steam generators have substantially the same structure as ordinary irons with a separated boiler, and comprise a demineralized-water reservoir housed in the highest part of the household appliance casing for easy manual refill with distilled/demineralized water; and an electric steam generating boiler normally located below the demineralized-water reservoir and connected to it by a suitable connecting pipe. Water flows by gravity into the electric boiler under control of an electrovalve or similar placed along the connecting pipe.

[0008] To avoid or greatly reduce manual refilling of the water reservoir, currently used steam generators are

fed with demineralized water by a water drain circuit which drains the distilled water accumulating on the bottom of the heat exchanger by condensation, and feeds it to a high-capacity manually-removable waste-water tank placed inside the casing or to the waste water exhaust duct.

[0009] More specifically, the demineralized-water reservoir of the steam generator is connected to the same electric pump which sucks up the distilled water from the bottom of the heat exchanger, so as to receive part of the distilled water drawn from the heat exchanger.

[0010] To keep fluff and/or lint particles out of the water reservoir, currently used steam generators also have a removable filter interposed between the connecting pipe from the electric pump of the water drain circuit, and the inlet of the steam generator demineralized-water reservoir. This filter must be manually removed and cleaned periodically to ensure efficient operation of the steam generator.

[0011] In currently marketed laundry driers, the user is expected to remove and clean the heat exchanger at given times to avoid uncontrolled formation of mould and bacteria, and to remove and clean the lint filter at given times to avoid its clogging.

[0012] Unfortunately in currently marketed rotary-drum home laundry driers, scheduled removal and cleaning of the lint filter is often useless because the lint filter takes a lot of time to clog up.

[0013] It is the object of the present invention to provide a home laundry drier designed to relieve the user from scheduled removal and cleaning of the steam generator lint filter.

[0014] According to the present invention, there is provided a home laundry drier, as claimed in Claim 1 and preferably, though not necessarily, in any one of the dependent Claims.

[0015] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

- Figure 1 shows a side view, with parts in section and parts removed for clarity, of a home laundry drier in accordance with the teachings of the present invention; and
- Figure 2 shows an enlarged perspective view of the heat exchanger mounted in the Figure 1 home laundry drier.

[0016] With reference to Figure 1, number 1 indicates as a whole a home laundry drier comprising a preferably, though not necessarily, parallelepiped-shaped outer box casing 2; a preferably, though not necessarily, cylindrical bell-shaped laundry drying drum 3 for housing the laundry to be dried, and which is fixed in axially rotating manner inside casing 2, directly facing a laundry loading and unloading opening 2a formed in the front face of casing 2; and a door 4 hinged to the front face of casing 2 to rotate to and from a rest position closing opening 2a in

the front face to seal the laundry drying drum 3.

[0017] More specifically, in the example shown drying drum 3 rests horizontally inside casing 2 on a number of horizontal supporting rollers 5 which are fitted to casing 2 to let drying drum 3 freely rotate about its longitudinal axis A.

[0018] Casing 2, drying drum 3, door 4 and supporting rollers 5 are commonly known parts in the industry, and therefore not described in detail.

[0019] With reference to the attached drawing, laundry drier 1 also comprises an electric motor 6 for rotating, on command, drying drum 3 about its longitudinal axis A inside casing 2; and a closed-circuit, hot-air generator 7 housed inside casing 2 and designed to circulate through drying drum 3 a stream of hot air having a low moisture level, and which flows over and rapidly dries the laundry inside drum 3.

[0020] More specifically, closed-circuit, hot-air generator 7 provides for gradually drawing air from drying drum 3; extracting surplus moisture from the hot air drawn from drying drum 3; heating the dehumidified air to a predetermined temperature, normally higher than the temperature of the air from drying drum 3; and feeding the heated, dehumidified air back into drying drum 3, where it flows over, to rapidly dry, the laundry inside the drum.

[0021] In other words, hot-air generator 7 provides for continually dehumidifying and heating the air circulating inside drum 5 to rapidly dry the laundry inside the drum, and substantially comprises:

an air recirculating conduit 8, the two ends of which are connected to drying drum 3 on opposite sides of drum 3;

an electric centrifugal fan 9, or other type of air circulating pump, located along recirculating conduit 8 to produce, inside recirculating conduit 8, an airflow f, which flows into drying drum 3 and over the laundry inside drum 5;

an air/air heat exchanger 10 or similar - commonly referred to as a condenser - which is located along recirculating conduit 8 so that the airflow f from drying drum 3 and a cold airflow w from outside casing 2 flow through it simultaneously, and which is designed so that the cold airflow w rapidly cools the airflow f from drying drum 3 to condense the surplus moisture inside airflow f; and

an electric heater 11 (in the example shown, a resistor) located along recirculating conduit 8, downstream from heat exchanger 10, and which provides for rapidly heating the airflow f from heat exchanger 10 back to drying drum 3, so that the air flowing into drying drum 3 is heated rapidly to a temperature preferably, though not necessarily, higher than or equal to that of the same air flowing out of drying drum 3.

[0022] With reference to Figure 1, in the example shown the intake end of recirculating conduit 8 is integrated in door 4, and is faced to the front opening of

drying drum 3; the end wall 3a of drying drum 3 is perforated, or at any rate permeable to air, to permit air entry into drum 3; and the exhaust end of recirculating conduit 8 is coupled in airtight manner directly to the end wall 3a of drying drum 3.

[0023] As regards electric centrifugal fan 9, it is structured to produce an airflow f flowing, along recirculating conduit 8, from the intake end of recirculating conduit 8, i.e. door 4, to the exhaust end of recirculating conduit 8, i.e. perforated end wall 3a of drying drum 3.

[0024] With reference to Figures 1 and 2, heat exchanger 10 is located on the bottom of casing 2 and comprises a preferably, though not necessarily, parallelepiped-shaped boxlike container 12 housed inside casing 2 along recirculating conduit 8; and a heat-conductive air-guide cartridge 13 inserted in easy-removable manner into boxlike container 12 to fill up the central section of the container, and to form inside container 12 two separate airtight compartments 12a and 12b each of which is in direct communication with a respective portion of recirculating conduit 8.

[0025] Airtight compartment 12a is in direct communication with the portion of recirculating conduit 8 ending in door 4; airtight compartment 12b is in direct communication with the portion of recirculating conduit 8 ending in front of the perforated end wall 3a of drying drum 3; boxlike container 12 is designed to let the cold airflow w from outside casing 2 circulate through the central section of boxlike container 12 to cool down the air-guide cartridge 13, without entering in any of the two airtight compartments 12a and 12b of container 12; and air-guide cartridge 13 is designed to channel the airflow f from airtight compartment 12a directly to airtight compartment 12b, and to let the airflow f rapidly cool by releasing heat to the cold airflow w while flowing through air-guide cartridge 13.

[0026] More specifically, in the example shown boxlike container 12 is housed inside casing 2 on the bottom of the latter, and communicates with the outside via an first opening 2b formed in the front face of casing 2; laundry drier 1 is provided with a second door 14 hinged to the front face of casing 2 to rotate to and from a rest position closing opening 2b in the front face of casing 2 to seal in airtight manner boxlike container 12; and heat-conductive air-guide cartridge 13 is extractable from boxlike container 12 in a drawer-like manner through opening 2b.

[0027] With reference to Figures 1 and 2, the lateral wall of boxlike container 12 is also provided with a second throughout opening 12c which is located in the central section of boxlike container 12 to let the cold airflow w from outside casing 2 circulate through the central section of boxlike container 12 and all around air-guide cartridge 13, without entering in any of the two airtight compartments 12a and 12b of container 12.

[0028] In turn, heat-conductive air-guide cartridge 13 is substantially parallelepiped-shaped for being extractable from the central section of boxlike container 12 in drawer-like manner, and consist of two plate elements

15 placed one in front of the other along the longitudinal axis of the air-guide cartridge 13 to form the two basis of the parallelepiped, and of a number of rectilinear pipes 16 extending between the two plate elements 15, one next to the other and parallel to the longitudinal axis of air-guide cartridge 13. Each of the two plate elements 15 is shaped almost complementary to the cross section of boxlike container 12, and is designed to rest against a respective annular collar 17 protruding inside boxlike container 12 so as to close the latter in airtight manner and form a respective airtight compartment 12a, 12b of the container.

[0029] Like known home laundry driers, heat-conductive air-guide cartridge 13 is also provided with a condensed-water canister 18 which collects the liquid distilled water produced, when the drier is running, inside heat exchanger 10 by condensation of the surplus moisture in airflow *f* arriving from drying tub 3.

[0030] With reference to Figures 1 and 2, in the example shown condensed-water canister 18 consists of a substantially rectangular-shaped tub 18 jutting out horizontally inside airtight compartment 12b of container 12 from the plate element 15 delimiting said airtight compartment 12b.

[0031] Unlike known home laundry driers, heat-conductive air-guide cartridge 13 also features filtering means 19 designed to keep fluff and/or lint particles within the air-guide cartridge 13, so as to be manually removed during scheduled cleaning and sanitization of air-guide cartridge 13.

[0032] More specifically, with reference to Figure 2, in the example shown filtering means 19 consist of one or more strips 19 of Velcro-like material laying on the bottom of tub 18, between the plate element 15 delimiting the airtight compartment 12b and a through hole 18a realized on the bottom of tub 18 for draining the liquid distilled water produced when the drier is running. Each strip 19 of Velcro-like material is provided with a multitude of preferably, though not necessarily, hook-shaped pins projecting perpendicularly to the bottom surface of tub 18 so as to prevent fluff and/or lint particles to reach the through hole 18a and leave condensed-water canister 18.

[0033] Obviously, in a different non-shown embodiment strips 19 of Velcro-like material may be replaced by a plug-shaped net filter or similar covering the inlet of the through hole 18a realized on the bottom of tub 18, so as to prevent fluff and/or lint particles to leave condensed-water canister 18.

[0034] In other words, in both embodiments lint filtering means 19 keep fluff and/or lint particles on the bottom of condensed-water canister 18.

[0035] With reference to Figure 1, like known home laundry driers hot-air generator 7 is also provided with a water drain circuit 20 for draining away the condensed water from canister 18.

[0036] Preferably, though not necessarily, water drain circuit 20 comprises a high-capacity manually-removable

waste-water tank 21 housed in easily removable manner inside casing 2, preferably, though not necessarily, near the top of the casing; and an electric pump 22 which, on command, sucks the distilled water from a water sump 24 located on the bottom of boxlike container 12, inside airtight compartment 12b and aligned below the through hole 18a of condensed-water canister 18, and feeds said water to waste-water tank 21 via a suitable connecting pipe 25.

[0037] More specifically, in the example shown, electric pump 22 is a submerged electric pump 22 located at the bottom of water sump 24 and it is switched on in known manner when the water level in water sump 24 exceeds a given upper threshold value.

[0038] Finally, with reference to Figure 1, laundry drier 1 comprises a pressurized-steam generator 26, which, on command, produces and feeds a jet of steam into drying drum 3 to eliminate or at least greatly reduce wrinkling of the fabrics produced during the drying cycle.

[0039] Preferably, though not necessarily, pressurized-steam generator 26 comprises an instant in-pressure electric tubular vaporizer 27 designed to receive a given quantity of water and immediately convert it into a stream of low-pressure steam whose pressure is slightly higher than external pressure; a steam injection nozzle 28 located inside casing 2, in the collar connecting the front opening of drying drum 3 to opening 2a in the front face of casing 2, and structured for projecting jets of low-pressure steam directly inside drying drum 3; and a steam exhaust manifold 29 connecting the outlet of tubular vaporizer 27 to the steam injection nozzle 28 for feeding the low-pressure steam produced by tubular vaporizer 27 directly to nozzle 28.

[0040] Finally pressurized-steam generator 26 is provided with a demineralized-water reservoir 30 which is housed inside casing 2, over tubular vaporizer 27, and is connected to tubular vaporizer 27 by a connecting pipe 31; and with an electrovalve 32 or similar which is located along connecting pipe 31 to control the outflow of water from water reservoir 30 to tubular vaporizer 27.

[0041] Obviously, water flows by gravity from water reservoir 29 to tubular vaporizer 26.

[0042] In-pressure electric tubular vaporizer 27, steam injection nozzle 28, steam exhaust manifold 29, demineralized-water reservoir 30 and electrovalve 32 are commonly known parts in the industry, and therefore not described in detail.

[0043] With reference to Figure 1, to avoid or greatly reduce manual refilling with demineralized water, demineralized-water reservoir 30 of pressurized-steam generator 26 is connected to water drain circuit 20 of hot-air generator 7, to receive part of the condensed water drained from of condensed-water canister 18.

[0044] However, unlike known home laundry driers, in laundry drier 1 water drain circuit 20 feeds to demineralized-water reservoir 30 condensed water without fluff and/or lint particles, because air-guide cartridge 13 includes lint filtering means 19 designed to keep fluff and/or

lint particles within condensed-water canister 18.

[0045] More specifically, in the example shown water reservoir 29 is directly connected to connecting pipe 25 of water drain circuit 20 via a T-shaped joint.

[0046] Like any other recently marketed electric household appliance, laundry drier 1 finally comprises an electronic central control unit 33, which controls electric motor 6, heat exchanger 10 - or, rather, the electric cooling fan (not shown) which generates the cold airflow w through the central section of boxlike container 12 -, and heater 11 in predetermined manner, as memorized inside it, to perform the user-selected drying cycle.

[0047] In addition to the above, control unit 33 also controls steam generator 26 (i.e. electric tubular vaporizer 27 and electrovalve 32) in predetermined manner, as memorized inside it, to feed jets of low-pressure steam into drying drum 3 when required by the user-selected drying cycle.

[0048] General operation of drier 1 is clearly inferable from the above description, with no further explanation required.

[0049] Realizing lint filtering means 19 in one piece with air-guide cartridge 13 has lots of advantages: first and foremost, the possibility to clean and sanitize both heat exchanger 10 and lint filtering means 19 in single operation, thus relieving the user from scheduled removal and cleaning of the steam generator lint filter.

[0050] Clearly, changes may be made to home laundry drier 1 as described herein without, however, departing from the scope of the present invention.

[0051] For example, steam injection nozzle 28 may be placed in front of the perforated end wall 3a of drying drum 3, outside of the drum, in the exhaust end of recirculating conduit 8, and may be structured for projecting jets of low-pressure steam through end wall 3a, inside drying drum 3.

[0052] More specifically, steam injection nozzle 28 may be housed in the exhaust end of recirculating conduit 8, in front of the perforated end wall 3a of drying drum 3.

Claims

1. A home laundry drier (1) comprising an outer box casing (2) and, inside the casing, a laundry drying container (3) for housing the laundry to be dried, and a hot-air generator (7) for circulating a stream of hot air inside said laundry drying container (3); said hot-air generator (7) comprising an air recirculating conduit (8) connected at both ends to said laundry drying container (3), and a heat exchanger (10) located along said recirculating conduit (8) to cool the airflow (f) from the laundry drying container (3) and condense the surplus moisture in said airflow (f); said heat exchanger (10) comprising a boxlike container (12) located along said recirculating conduit (8) and a heat-conductive air-guide cartridge (13) which is inserted in easy-removable manner into said boxlike

container (12); the heat-conductive air-guide cartridge (13) being designed to cool the airflow (f) from the laundry drying container (3) for condensing the surplus moisture inside said airflow (f), and the home laundry drier (1) being **characterized in that** said heat-conductive air-guide cartridge (13) includes filtering means (19) designed to keep fluff and/or lint particles within said heat-conductive air-guide cartridge (13).

2. A home laundry drier as claimed in Claim 1, **characterized in that** said heat-conductive air-guide cartridge (13) comprises a condensed-water canister (18) for collecting the liquid distilled water produced inside the heat exchanger (10) by condensation of the surplus moisture in said airflow (f) from the laundry drying container (3); said filtering means (19) being designed to keep fluff and/or lint particles within said condensed-water canister (18).
3. A home laundry drier as claimed in Claim 1 or 2, **characterized in that** said heat-conductive air-guide cartridge (13) is extractable in drawer-like manner from said boxlike container (12).
4. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said heat-conductive air-guide cartridge (13) is housed in easy-removable manner in the central section of the boxlike container (12), and defines inside said boxlike container (12) two separate airtight compartments (12a, 12b) each of which is in communication with a respective portion of said recirculating conduit (8); said boxlike container (12) being designed to let a cold airflow (w) from outside of the outer box casing (2) circulate through the central section of said boxlike container (12) to cool down the heat-conductive air-guide cartridge (13); said heat-conductive air-guide cartridge (13) being designed to channel from one airtight compartment (12a) to the other (12b) the airflow (f) from the laundry drying container (3), and to let the airflow (f) from said laundry drying container (3) cool by releasing heat to said cold airflow (w) while flowing through the heat-conductive air-guide cartridge (13).
5. A home laundry drier as claimed in Claim 4, **characterized in that** said condensed-water canister (18) comprises a tub (18) jutting out horizontally from the heat-conductive air-guide cartridge (13), inside one (12b) of said two airtight compartments (12a, 12b).
6. A home laundry drier as claimed in Claim 5, **characterized in that** said tub (18) is provided, on the bottom, with a through hole (18a) for draining the liquid distilled water, and that said filtering means (19) comprise at least one strip (19) of Velcro-like

material laying on the bottom of said tub (18); said strip (19) of Velcro-like material being provided with a multitude of pins projecting from the bottom surface of said tub (18) to prevent fluff and/or lint particles to reach the through hole (18a) present on the bottom of said tub (18). 5

7. A home laundry drier as claimed in Claim 5, **characterized in that** said tub (18) is provided, on the bottom, with a through hole (18a) for draining the liquid distilled water, and that said filtering means (19) comprise a net filter or similar (19) closing said through hole (18a) to prevent fluff and/or lint particles to leave the condensed-water canister (18). 10
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8. A home laundry drier as claimed in any one of the foregoing Claims, **characterized by** also comprising a water drain circuit (20) for draining the distilled water from the condensed-water canister (18) of said heat-conductive air-guide cartridge (13). 20
9. A home laundry drier as claimed in Claim 8, **characterized in that** said water drain circuit (20) comprises a manually-removable waste-water tank (21) housed in easily removable manner inside the outer box casing (2); and a pump (22) which sucks the condensed water from a water sump (24) located on the bottom of said boxlike container (12), aligned below the through hole (18a) of said condensed-water canister (18), and feeds said condensed water to said waste-water tank (21). 25
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10. A home laundry drier as claimed in any one of the foregoing Claims, **characterized by** also comprising a steam generator (26) which feeds, on command, steam into said laundry drying container (3), and which comprises an tubular vaporizer (27) designed to receive a given quantity of water and immediately convert it into a stream of low-pressure steam, and a water reservoir (30) located above and communicating with said tubular vaporizer (27). 35
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11. A home laundry drier as claimed in Claims 9 and 10, **characterized in that** said water reservoir (30) is connected to the water drain circuit (20) of said hot-air generator (7), to receive part of the condensed water drained from the condensed-water canister (18) of said heat-conductive air-guide cartridge (13). 45
12. A home laundry drier as claimed in any one of the foregoing Claims, **characterized in that** said laundry drying container (3) is a substantially cylindrical bell-shaped drum (3) fixed in axially rotating manner inside the outer box casing (2) of the drier. 50
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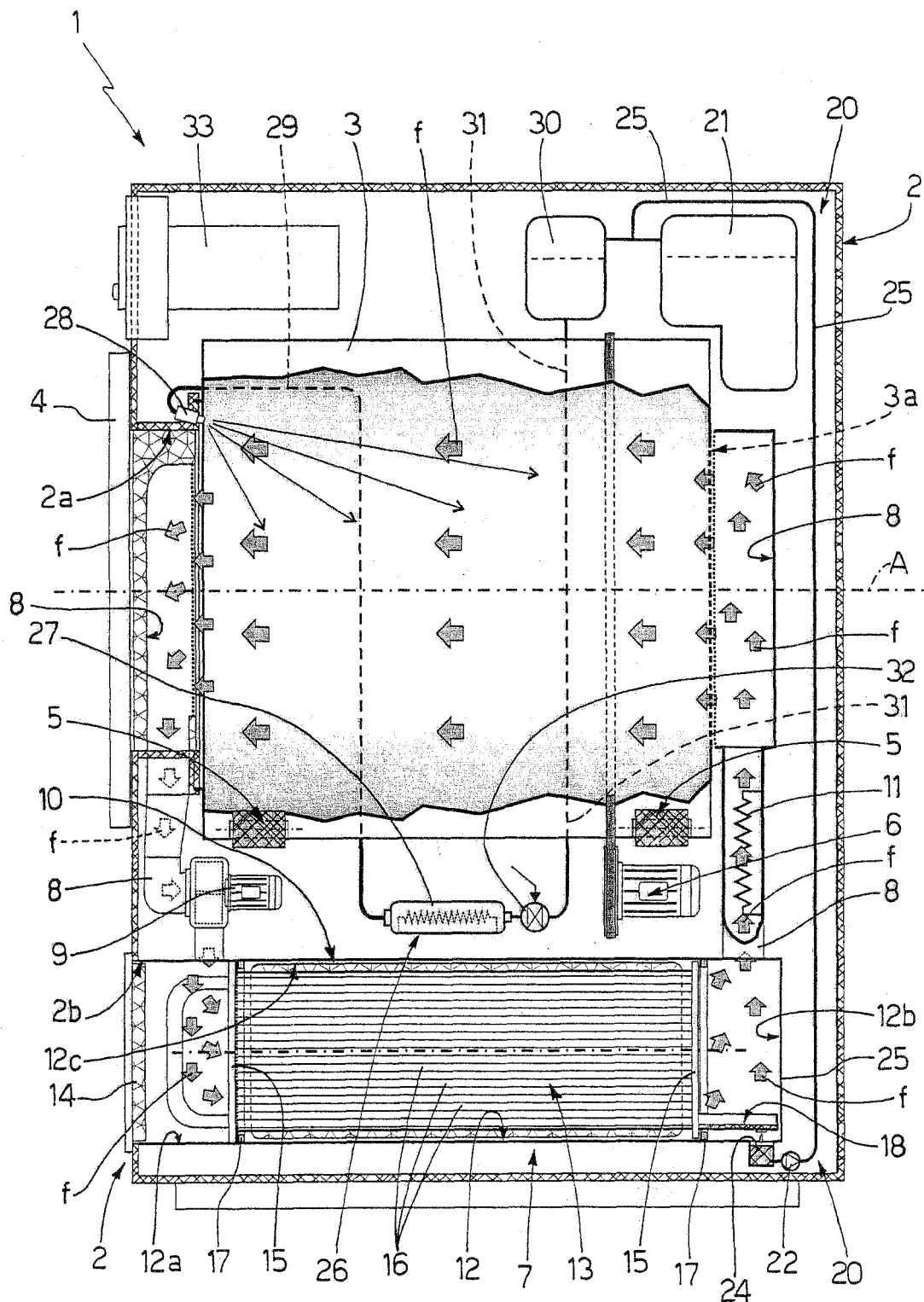


Fig. 1

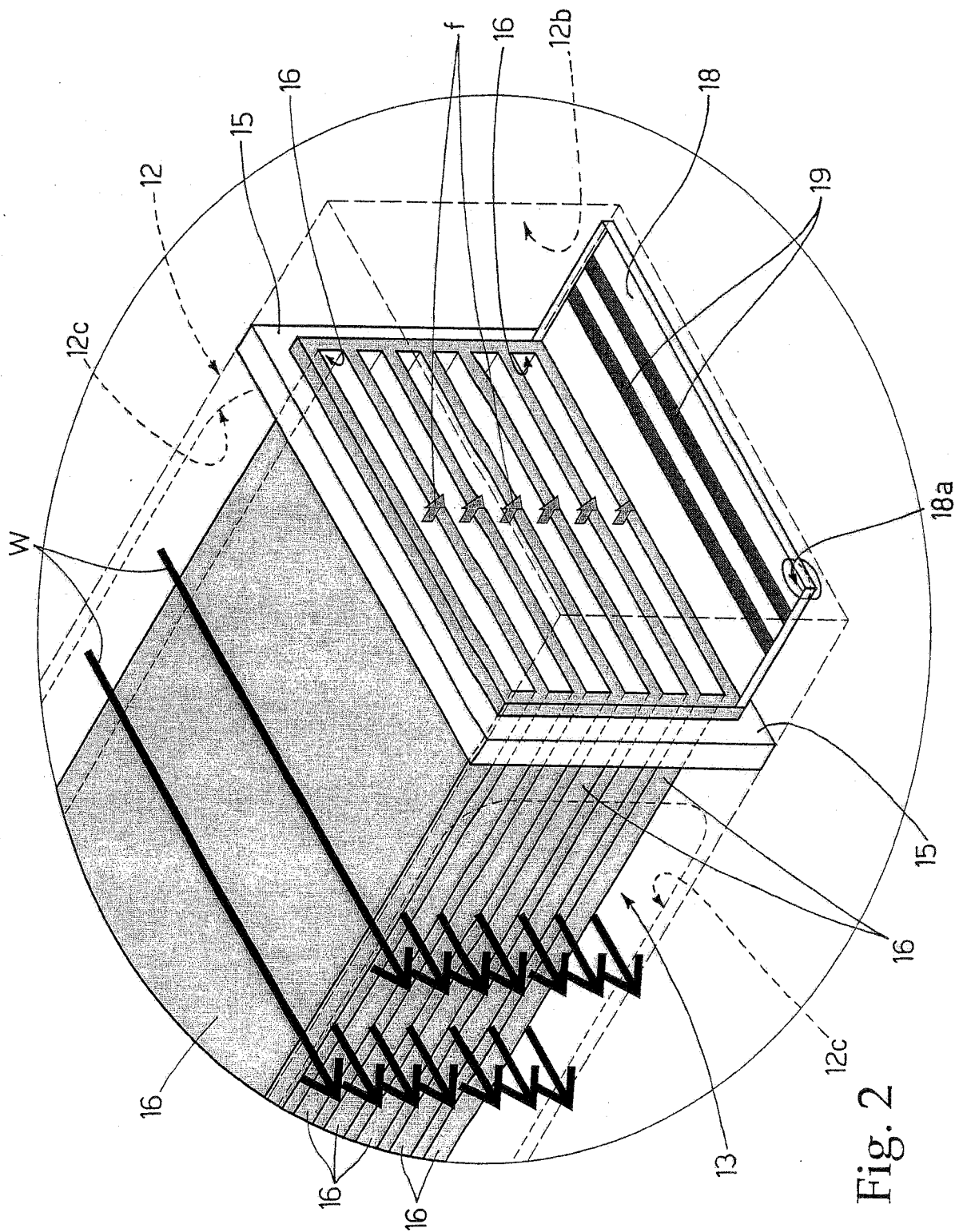


Fig. 2



DOCUMENTS CONSIDERED TO BE RELEVANT			
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Place of search Munich		Date of completion of the search 6 March 2008	Examiner Clivio, Eugenio
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 P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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