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(54) LAUNDRY DRYING MACHINE WITH STEAMING FUNCTION AND RELATED OPERATING METHOD

(57) A laundry dryer (1) with steaming function, comprising:
- a laundry treatment chamber (2),
- a drying process air circuit (3),
- a steamer (20) comprising a steam generator (23), a steam injector (24) to inject steam into the treatment chamber (2), and a steam condensate conduit (40) for leading away any liquid condensed from the steam stream to be injected by the steam injector (24) into the treatment chamber (2), and
- a siphon-trap (41) arranged in the steam condensation conduit (40) to receive steam condensate therefrom.

The dryer further includes an additional input (42) of liquid to siphon-trap (41), additional to the steam condensate.

A method for operating the laundry dryer is also disclosed.

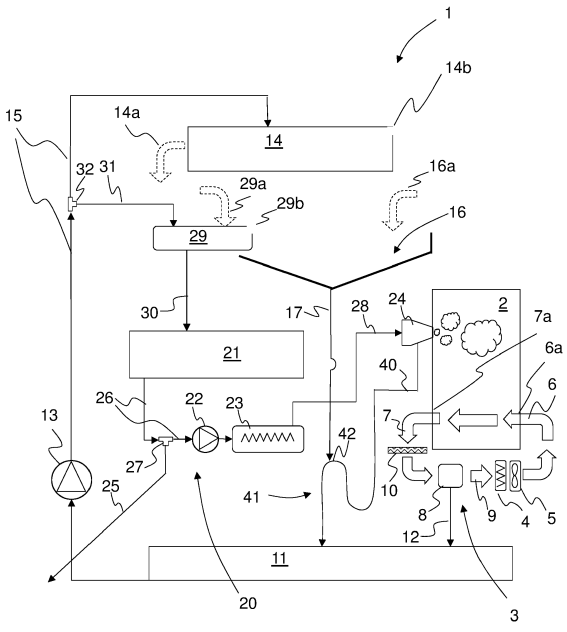

Fig. 1

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Description

[0001] The invention relates to a laundry drying machine with steaming function, and a related operating method. For the sake of brevity, such a machine will be referred to as dryer hereinbelow.

[0002] Laundry dryers, such as tumble dryers, typically comprise a cabinet, or housing, containing a treatment chamber wherein laundry to be treated can be loaded.

[0003] The laundry treatment chamber is typically a rotatable drum, housed inside the cabinet and rotatable with respect to a rotation axis, that can be substantially horizontal or slightly inclined (in the so called "horizontal axis" laundry dryers), or substantially vertical (in the so called "vertical axis" laundry dryers), with respect to a horizontal surface on which the laundry dryer is configured to lay.

[0004] In known tumble dryers, the drum is generally rotatably supported in the cabinet by rollers which are pivoted to a supporting structure static with respect to the cabinet; a further support may be provided by a shaft, defining the rotational axis of the dryer, rotatably connected to the cabinet. In other known laundry dryers, the laundry treatment chamber is static with respect to the cabinet; in this case, the laundry drier is a sort of heated cabinet wherein the laundry can be hung in order to be dried.

[0005] In order to remove water and moisture from the laundry, dryers usually use either a condensation process wherein drying air is passed through the treatment chamber, usually cyclically, and moisture is removed by condensation downstream of the treatment chamber or a process wherein air is passed only once through the treatment chamber and then it is exhausted, as wet air, outside the dryer. More specifically, the invention relates to dryers of the former type, which are sometimes referred to as condensing dryers.

[0006] The laundry treatment quality of dryers may be improved by using steam, which deodorizes and/or sanitizes the laundry and/or (re-) humidifies it in a controlled manner, thus having an anti-wrinkle/anti-crease effect and/or aiding the subsequent ironing process.

[0007] To this end, dryers with a steaming function are generally known. A steamer injects water steam, or a water-based liquor steam, into the treatment chamber of the dryer during a steam program, which may be part (often, the end part) of a drying program or may represent a complete operating program by its own.

[0008] In the present description and in the attached claims, under "steam", water or water-based liquor, in droplet-free vapor state is meant, as opposed to nebulized water or water-based liquor, which contains small airborne liquid state droplets. Steam is typically hot or superheated water or water-based liquor steam.

[0009] In the present description and in the attached claims, under "liquid", liquid water and/or liquid water-based liquor is generally meant, unless otherwise specified.

[0010] If steam is not dry saturated steam, some liquid may enter the treatment chamber and spotty wet the laundry. This might cause halo-like marks on laundry, impairing the drying process result, and other undesired effects like the impression that the laundry drying machine is defective.

[0011] A steamer generally comprises a steam generator fluidly connected to a water and/or water-based liquor source, which may include a steamer liquid tank; a steam injector for injecting steam into the treatment chamber; and a steam delivery conduit connecting the steam generator to the steam injector.

[0012] Especially if the steam delivery conduit connecting the steam generator with the steam injector is long, it may occur that steam gets too cold along the conduit causing some steam to condense at the injector, with the above-mentioned drawback that the laundry may be spotty wet thereby.

[0013] Accordingly, such a steam condensate is usually collected at the bottom of the steam injector (e.g. by a suitable configuration thereof), and brought away through a steam condensate conduit, possibly to a collecting vessel.

[0014] Since the laundry treatment chamber may be at a pressure higher than that downstream of the steam condensate conduit, in particular than that of said collecting vessel where steam condensate is possibly collected, steam might escape along the steam condensate conduit, towards the collecting vessel rather than wholly reaching the volume of the treatment chamber, thereby preventing an effective steam treatment of the laundry.

[0015] In order to avoid the above drawback, it is generally known, e.g. from EP1959048B1 and WO2017/036553A1, to insert a siphon-trap, e.g. a U- or S-shaped trap, in the steam condensate conduit. The liquid seal formed within the trap prevents the steam flow, still allowing the steam condensate flow.

[0016] The Applicant has recognized that, again due to a pressure within the treatment chamber that can be higher than that downstream of the steam condensate conduit, in particular than that of said collecting vessel where steam condensate is driven by the steam condensate conduit and therein collected, another drawback is that drying air circulating within the laundry treatment chamber during a drying program can escape through said steam condensate conduit, causing the collecting vessel to get dirty because of the fluff dispersed in the drying air circulating within the treatment chamber. If said collecting vessel is arranged in the same region where drying air treating devices, such as heat exchangers of a heat pump system to dehumidify and heat drying air, are located, such devices can progressively get clogged, thereby losing their heat exchanging performance. In addition, fluff entering the collection vessel could be transported within the dryer by air circulation and thereby clog further components of the drying machine like air conduits, a fan for propelling drying air, etc.; or said fluff can be transported within the dryer by a liquid stream if the

steam condensate is collected into a shared collecting vessel together with the condensed moisture removed from filtered drying air leaving the treatment chamber by condensation in the drying process air circuit, and the collected condensate is further (re-)circulated within the dryer.

[0017] The Applicant has recognized that the above-mentioned siphon-trap is beneficial also against this drawback.

[0018] However, in order to properly play its role, the siphon-trap needs to contain enough liquid for a liquid plug to form, and such liquid plug should be available as soon as possible since the very first operation of the drying machine.

[0019] However, considering that the siphon-trap is not filled with liquid by the dryer manufacturer, in a dryer according to the prior art, due to the hydraulic piping arrangement for draining steam condensate, the liquid plug is only available when a drying program including a steam program, or a stand-alone steam program, is run. When a steam program has not been performed yet or since long, because of evaporation of the liquid plug, the siphon-trap is or becomes empty and then, when a drying program is run, drying air leaves the treatment chamber through the steam condensate conduit and fluff may circulate within the dryer, with ensuing drawbacks, besides the fact that, at least during an initial phase of a steam treatment carried out on laundry, there might be a loss of steam and/or of steam pressure as discussed above.

[0020] It is an object of the invention to provide for reliably ensuring that the siphon-trap is always and promptly operating effectively.

[0021] A further object of the invention is to provide for a frequent renewal of the liquid plug in the siphon-trap so as to keep it as clean as possible.

[0022] Another object of the invention is to provide for no special requirement to have the liquid plug in the siphon-trap formed, thereby simplifying the use and operation of a laundry drying machine with steaming function.

[0023] The Applicant found that the above objects are achieved, in a laundry dryer with steaming function including a siphon-trap arranged in a steam condensate conduit, by additionally inputting liquid water (or liquid water-based liquor) to the siphon-trap instead of only relying on the amount of liquid condensed from steam at a steam injector during a steam program, possibly part of drying program, which flows along the steam condensate conduit wherein the siphon-trap is formed. With this provision, the siphon-trap is quickly filled and renovated, and therefore it is ensured that it will properly operate to block any air flow from entering the steam condensate conduit, thereby restraining fluff from the treatment chamber from propagating within the laundry dryer. In addition, loss of steam and/or of steam pressure is reduced.

[0024] Furthermore, a method for operating a laundry dryer with steaming function has been found by the Applicant to achieve the above-mentioned objects.

[0025] In a first aspect, the present invention relates to a laundry dryer with steaming function, comprising:

- a laundry treatment chamber,
- a drying process air circuit having a first air opening to lead a process air flow into the treatment chamber, and a second opening to exhaust process air flow from the treatment chamber, the drying process air circuit further comprising a heater for heating process air, a fan for moving said process air flow along the drying process air circuit, and a condenser for removing moisture from process air flow exiting the chamber,
- a steamer comprising a steam generator, a steam injector to inject steam into the treatment chamber, and a steam condensate conduit for leading away any liquid condensed from the steam stream to be injected by the steam injector into the treatment chamber, and
- a siphon-trap arranged in the steam condensation conduit to receive steam condensate therefrom,

characterized by further including an additional input of liquid to siphon-trap, additional to the steam condensate.

[0026] The additional input provides for filling said siphon-trap and forming and/or maintaining a liquid plug, possibly renovated, even when no steam condensate is available.

[0027] The additional input may be fluidly connected, such as by a conduit, to a water or water-based liquor source.

[0028] The additional input may be fluidly connected to receive at least one of:

- recirculated condensed moisture,
- recirculated steam condensate,
- overflown liquid from a steamer liquid tank of the steamer and/or a manual loading unit thereof,
- a liquid provided by a user.

[0029] Preferably, the additional input is configured so that the percentage of liquid input to the additional input that contributes to form a liquid plug in the siphon-trap is up to 50%, preferably up to 20%.

[0030] Preferably, the additional input to the siphon-trap is connected to a recirculation circuit that is fluidly supplied with condensed moisture from process air in the drying process air circuit. This provision aids in ensuring that the liquid plug is promptly formed.

[0031] More preferably, the recirculation circuit further recirculates steam condensate.

[0032] More specifically, preferably, the additional input to the siphon-trap is fluidly connected to a hopper

located to:

- receive a liquid input to the hopper by a user, and/or
- collect any overflown liquid from at least one of the following:
    - a steamer liquid tank,
    - a manual loading unit of the steamer liquid tank, and
    - a removable tank of the recirculation circuit.

[0033] Advantageously, by this provision the intake of liquid by the siphon-trap interferes as little as possible with the other components of the liquid circuit of the dryer, notably with the level of liquid within the steamer liquid tank. This provision also aids in ensuring that the liquid plug is promptly formed.

[0034] More specifically, preferably the additional input of the siphon-trap is connected to a recirculated liquid conduit which leads recirculated liquid from the hopper to a collecting vessel for collecting condensed moisture from the drying process air circuit and/or steam condensate from the steamer, preferably for collecting at least condensed moisture from the drying process air circuit.

[0035] The downstream end of the siphon-trap may thus be connected to the collecting vessel, or it may be connected to the recirculation circuit downstream of the collecting vessel, or it may be connected to a second, dedicated collecting vessel of the recirculation circuit, so that steam condensate may also be recirculated within the laundry dryer.

[0036] Alternatively or additionally to the above features, the additional input to the siphon-trap may be located partially within an exit region of the siphon-trap, so that just the required amount of liquid to form or maintain the liquid plug enters a U-shaped portion of the siphon-trap.

[0037] Preferably the additional input to the siphon-trap is at the uppermost region of the downstream side of the siphon-trap, in particular at a convex surface of an inverted U portion of an S-shaped siphon-trap.

[0038] In this manner, the input liquid, notably recirculated liquid, will split into two flows, one of which may fill the siphon-trap itself, and the other one of which may be recirculated, or may be disposed of.

[0039] Preferably when the siphon-trap is an S-shaped siphon-trap, the additional input to the siphon-trap is located across, but asymmetrically about, a midplane of its inverted U portion. In this manner, the two flows into which the input liquid is easily split may have a desired flow ratio different from 50:50.

[0040] More preferably, the additional input of the siphon-trap is displaced towards an exit branch of the siphon-trap, so that the liquid percentage going to the siphon-trap is up to but not including 50%, and preferably is up to 20%.

[0041] In this manner, when the input liquid rate flow is comparatively large, has it may happen when it is recirculated liquid, just the required amount of liquid to form the liquid plug enters the U-shaped portion of the siphon-trap, the recirculated liquid being however mainly directly conveyed again in the recirculation circuit, e.g. to the collecting vessel.

[0042] Alternatively or additionally to the above features, preferably, a joint for connecting a conduit to the additional input is formed as one-piece with the siphon-trap. This avoids the need of using an external joint such as a T-joint, and greatly aids the assembling and installation process.

[0043] Alternatively or additionally, preferably, the dryer comprises a self-standing body which embodies the siphon-trap, and optionally the joint for connecting a conduit to the additional input.

[0044] In the present description and attached claims, under self-standing body, a body having a sufficient rigidity as to maintain its shape under normal use conditions is meant, and in particular it is used as opposed to the siphon-trap being formed by a hose.

[0045] Even more preferably, the self-standing one-piece body is a blow-molded component made of polymeric material.

[0046] Additionally or alternatively, preferably, the self-standing one-piece body also embodies a flange for mounting to a cabinet of the dryer.

[0047] In a second aspect thereof, the present invention relates to a method for operating the laundry dryer with steaming function as discussed above, comprising forming a liquid plug in said siphon-trap by:

a1) carrying out a drying program,

a2) collecting condensed moisture from laundry being dried during the drying program, and

a3) inputting a portion of the collected condensed moisture to the siphon-trap,

and/or by:

b1) manually inputting a liquid, in particular water or a water-based liquor, into a steamer liquid tank of said steamer, preferably through a manual loading unit thereof, and

b2) deviating a portion of the manually input liquid to the siphon-trap.

[0048] The method may further comprise recirculating within the dryer the condensed moisture formed during a laundry drying program and possibly the steam condensate formed during a steam program.

[0049] The method may further comprise deviating a portion of the recirculated liquid towards the siphon-trap

to form a liquid plug thereinto.

[0050] Alternatively or additionally thereto, the method may further comprise obtaining a liquid for forming the liquid plug by:

- receiving a liquid manually input by a user and/or
- collecting overflown liquid from one or more of the following:
  - a steamer liquid tank,
  - a manual loading unit of the steamer liquid tank, and
  - a removable tank of the recirculation circuit.

[0051] Further features and advantages of the present invention will be more clearly apparent from the following detailed disclosure of some embodiments thereof, made with reference to the attached drawings, wherein:

- FIG. 1 is a block diagram of a laundry dryer of the condensing type according to an embodiment of the invention,
- FIG. 2 is a diagrammatic view of a component of a laundry dryer showing several options according to the invention,
- FIG. 3 is a perspective view of a laundry dryer of the condensing type according to an embodiment of the invention, with some walls of the cabinet and some components removed,
- FIG. 4 is a side view of the laundry dryer of FIG. 3, with some walls of the cabinet removed,
- FIG. 5 is a different perspective view of a particular of the laundry dryer of FIG. 3, and
- FIGs. 6 and 7 are two different perspective views of a component of the laundry dryer of FIG. 3.

[0052] In **FIG. 1** a block diagram of a laundry dryer 1 of the condensing type according to the present invention is shown. In FIG. 1, air paths are diagrammatically represented by hollow, solid line arrows, and liquid paths are diagrammatically represented by solid arrows: those skilled in the art will understand that such paths may be embodied by any suitable means such as pipes, hoses, tubes, conduits, deflectors, and the like, though conduit will be referred to hereinbelow by way of an example. Furthermore, hollow, dotted line arrows diagrammatically represent manual liquid input to/removal from the dryer.

[0053] The dryer 1 comprises, within a cabinet not fully shown in the drawings but comprising a front and a rear wall, two sidewalls and a top wall, all resting on a basement (cf. basement 60 in FIGs. 3-5), a treatment chamber 2 accessible from the outside, such as from an opening at the front wall of the cabinet, tightly closable by a pivoted door, and intended to temporarily store the laundry to be treated (not shown) during one or more treatment programs. Chamber 2 may be for example a stationary compartment, or a drum pivoted to a stationary supporting structure and/or rotatably supported e.g. by rollers, as discussed in the introductory portion of the present disclosure.

[0054] Dryer 1 comprises a drying process air circuit 3.

[0055] Drying process air circuit 3 comprises a heater 4 (which may for example be an electric heater, a condenser of a heat pump system, or a gas burner) and a fan 5 or other air-forcing device for generating a forced hot dry process air flow 6 through the chamber 2 through a first air opening 6a. Hot dry process air flow 6 dries the laundry inside the chamber 2, cooling down and exiting through a second air opening 7a as a moisture-laden process air flow 7, which is fed to a condenser 8 of the drying circuit 3, also named dryer condenser 8 herein. Condenser 8 (which may for example be an evaporator of a heat pump system, or an air-to-air exchanger) removes moisture from the moisture-laden process air flow 7, and the dry cool process air flow 9 exiting condenser 8 is again heated and forced through the chamber 2 by the heater 4 and the fan 5, in a closed process air loop.

[0056] A filter 10 is provided downstream of chamber 2 and upstream of condenser 8, for retaining fluff released by the laundry being dried.

[0057] It should be noted that the above components 4, 5, 8, 10 of the drying process air circuit 3 may be differently arranged along the drying process air circuit 3.

[0058] Furthermore, the drying process air circuit 3 need not necessarily include a closed process air loop shown in FIG. 1; rather, the dry cool process air flow 9 may be disposed of into the environment, and ambient air may be fed to the heater 4 and fan 5 to form the forced hot dry process air flow 6.

[0059] The condensed moisture from dryer condenser 8 is collected at a collecting vessel 11 through a condensed moisture conduit 12.

[0060] The collecting vessel 11 is preferably, as shown, located at the bottom of the dryer 1, being one-piece with its basement 60 (cf. FIG. 3-5), which also bears a motor (not shown) in case the chamber 2 is a rotatable drum.

[0061] The heat exchangers (heater 4 and condenser 8) and the fan 5 are usually accommodated within the same room as the collecting vessel 11. The basement 60 (cf. FIG. 3-5) itself, therefore, is usually part of the drying process air circuit 3.

[0062] A pump 13 is provided to pump the condensed moisture - and the steam condensate, as discussed below - out of collecting vessel 11 into a removable tank 14, which is easily accessible usually from the top and/or the front of the dryer 1, and is preferably configured like a drawer. The removable tank 14 is intended to be emp-

tied by the user, as diagrammatically indicated by a hollow, broken line arrow 14a. The location of the removable tank 14 at the top of the dryer 1 makes the emptying operation more comfortable for the user.

[0063] The liquid conduit outgoing from pump 13 is named uprising conduit 15 herein.

[0064] A hopper 16 is provided below the removable tank 14 to collect any overflown liquid (as diagrammatically indicated by aperture 14b) in case the user fails to empty the removable tank 14 when needed and/or during removal thereof. Liquid falling into hopper 16 is also collected, as through a recirculated liquid conduit 17, at collecting vessel 11.

[0065] Thus, a liquid recirculation circuit of the dryer 1 comprises the collecting vessel 11, the pump 13, the removable tank 14 and the hopper 16.

[0066] During a drying program, a variable amount of condensed moisture is removed from the laundry, and stored at the removable tank 14, the collecting vessel 11 behaving as a buffer liquid container.

[0067] It is noted that pump 13 is switched on and off by a controller (not shown) according to the liquid level in collecting vessel 11, and will be kept on as long as the user fails to empty the removable tank 14. The controller may be configured to switch off the drying process air circuit 3 and/or emit an alarm after a time interval when the pump 13 is continuously on, a condition indicating that the removable tank 14 is full.

[0068] Dryer 1 further comprises a steamer 20.

[0069] Steamer 20 comprises a steamer liquid tank 21, a steamer pump 22 delivering liquid (liquid water and/or liquid water-based liquor) from steamer liquid tank 21 to a steam generator 23, and a steam injector 24 suitably placed at the treatment chamber 2, for injecting steam into the treatment chamber 2. Steamer liquid tank 21 and steamer pump 22 may also be absent and replaced by directly supplying the steam generator 23 with liquid, such as water from a supply such as the water mains by means of a valve.

[0070] Further shown is an optional discharge conduit 25, also called "winter conduit", for emptying steamer liquid tank 21 when needed or desired. Discharge conduit 25, if provided for, may be branched off from the intake conduit 26 of steamer delivery pump 22, e.g. by a T-joint 27, and is closed by a removable plug (not shown) at its other end.

[0071] The steam generator 23 may comprise, for example, a boiler or a tube portion or a container wherein an electric resistor is submersed in a veil of liquid. Steam is supplied from steam generator 23, and when it reaches the steam injector 24 through steam delivery conduit 28, it spreads out into the chamber 2, to treat the laundry.

[0072] Steamer liquid tank 21 may be replenished by the user, for example through a manual loading unit 29 that is easily accessible usually from the top and/or the front of the dryer 1. A hollow, broken line arrow 29a diagrammatically represents the manual feeding of liquid to manual loading unit 29. The actual configuration of such a manual loading unit 29 is not relevant to the present invention and therefore is not described in detail. Manual loading unit 29 is fluidly connected to steamer liquid tank 21, such as by conduit 30.

[0073] The amount of liquid used by steamer 20 during a steam program is variable, but not negligible. To avoid the need for the user to often replenish the steamer liquid tank 21, the latter may also receive recirculated liquid, preferably being connected within the same recirculation circuit for recirculating the condensed moisture.

[0074] To this end, a conduit, named steamer replenishment conduit 31 herein, may e.g. be branched off from the uprising conduit 15 (delivery from pump 13), e.g. through a T-joint 32, leading to the manual loading unit 29 as shown. Alternatively, steamer replenishment conduit 31 can lead directly to steamer liquid tank 21.

[0075] It should be noted that steamer liquid tank 21 is usually sealed so that in case it is full, liquid overflows, e.g. when the pump 13 is still operating, and/or during replenishment by the user, into manual loading unit 29 (through conduit 30) and then out of manual loading unit 29 (as diagrammatically indicated by aperture 29b).

[0076] Hopper 16 is preferably located to also collect this overflown liquid from manual loading unit 29. As said, liquid falling into hopper 16 is collected, through recirculated liquid conduit 17, at collecting vessel 11. Alternatively, there may be a second hopper (not shown), dedicated to manual loading unit 29 and suitably connected to collecting vessel 11, or elsewhere within the recirculation circuit.

[0077] As discussed in the introductory part of the present description, the steam injector 24 is suitably so configured, in a manner *per se* well-known, as to avoid that liquid enters the chamber 2, where it could undesirably wet the laundry, with entailed drawbacks.

[0078] Such liquid mainly arises (besides owing to possible malfunctioning of the steam generator 23) because the steam cools down along its delivery conduit 28, and the longer the delivery conduit 28, the greater the amount of liquid condensing at the steam injector 24, and thus to be removed before it enters the chamber 2.

[0079] The liquid or steam condensate removed from the steam stream at steam injector 24, upstream of the treatment chamber 2, is received and led away by a steam condensate conduit 40.

[0080] Steam condensate conduit 40 is advantageously fluidly connected to the same collecting vessel 11 wherein also the moisture condensed during the drying program and/or the liquid collected by the hopper 16 (and possibly the second hopper dedicated to the liquid overflown from steamer liquid tank 21 and/or manual loading unit 29) is/are collected, to be pumped to the removable tank 14 and/or to the steamer liquid tank 21 as discussed. Alternatively, steam condensate conduit 40 may be fluidly connected to the recirculation circuit downstream of collecting vessel 11, at an intake of pump 13, or to a second collecting vessel (not shown) properly fluidly connected to pump 13 or to a second pump (not shown). In

this manner, the liquid removed from the steam stream before it reaches the chamber 2 may be advantageously recycled.

[0081] Thus, the liquid recirculation circuit of the dryer 1 preferably additionally includes the manual loading unit 29, the steamer liquid tank 21, and the steam condensate conduit 40 (as well as the second hopper, the second collecting vessel, and/or the second pump, if provided for).

[0082] It is noted, however, that steam condensate might also be disposed of.

[0083] It shall be understood that a liquid separator distinct from and closely upstream of the steam injector 24 may be provided for, the steam condensate conduit 40 then being fluidly connected to the liquid separator instead of to the steam injector 24.

[0084] As discussed in the introductory part of the present description, since the laundry treatment chamber 2 may be at a pressure higher than that downstream of the steam condensate conduit 40, in particular than that within collecting vessel 11 where steam condensate and/or condensed moisture are collected, the drying process air, and the entrained fluff, might escape along the steam condensate conduit 40, towards the collecting vessel 11; furthermore during a steam program the steam might escape rather than wholly reaching the volume of the treatment chamber 2, thereby preventing an effective steam treatment of the laundry contained therein. A similar drawback arises when the steam condensate conduit 40 is fluidly connected to the recirculation circuit according to any of the above-mentioned alternatives, and partly arises even when the steam condensate is disposed of.

[0085] To overcome such a drawback, a siphon-trap 41 is formed in the steam condensate conduit 40, to receive steam condensate therefrom. For the sake of brevity, only the case of the steam condensate conduit 40 being fluidly connected to the collecting vessel 11 will be referred to below, the other alternatives applying *mutatis mutandis,* as will be readily understood by those skilled in the art in the light of the present disclosure.

[0086] Siphon-trap 41 may be an S-shaped trap as shown, or it can be a U-shaped trap.

[0087] A liquid plug that is formed into such a siphon-trap 41 prevents any process air entering the steam condensate conduit 40 from the steam injector 24 from exiting downstream of the siphon-trap 41, notably from reaching the collecting vessel 11.

[0088] Advantageously, the liquid plug also prevents any fluff, which may be formed within chamber 2 during a drying program, to reach the collecting vessel 11 and the components downstream thereof, being possibly further circulated as airborne fluff and/or liquid-borne fluff. The fluff might, if allowed to propagate, undesirably dirt the collecting vessel 11, clog the heater 4, the dryer condenser 8, the pumps 13, 22, the fan 5 and/or decrease the performance of the steam generator 23, and/or redirty the laundry.

[0089] Furthermore, the liquid plug also limits the amount of steam leaking from the treatment chamber 2 to be that contained along the steam condensate conduit 40 upstream of the siphon-trap 41. Thus, the steam flow rate input to the chamber 2 is not detrimentally reduced. Conversely, the siphon-trap 41 correctly allows condensed liquid (i.e., the steam condensate) to flow therethrough.

[0090] In order to be effective, however, such a liquid plug must indeed be present in siphon-trap 41. On the other hand, when the dryer 1 is first operated running a steam program after leaving the factory, and/or after the steamer liquid tank 21 has been emptied e.g. during winter to avoid ice formation, there will not be enough steam condensate collected at the steamer injector 24 to form the necessary liquid plug within siphon-trap 41. Furthermore, even after a liquid plug has properly formed within siphon-trap 41, it may occur that, if no steam program -which is usually an optional program during the drying program and is seldom performed as a stand-alone program- is performed for a certain time, the liquid plug naturally evaporates to such an extent as not to be effective any more.

[0091] In the dryer 1 according to the invention, an additional input 42 of liquid to the siphon-trap 41 is provided for, additional to the steam condensate coming from steam injector 24 (or from the distinct liquid separator upstream thereof) along the steam condensate conduit 40 in which the siphon-trap 41 is formed.

[0092] The additional input 41 provides for filling the siphon-trap 41 and forming and/or maintaining a liquid plug, possibly renovated, even when no steam condensate is available.

[0093] Such an additional input 42 may take liquid from any suitable liquid (water or water-based liquor) source, external from or internal to the dryer 1.

[0094] In a particularly advantageous manner, as shown in FIG. 1 the additional input 42 to the siphon-trap 41 is connected to the recirculation circuit of the dryer 1, in particular to the recirculated liquid conduit 17 fluidly connected to the hopper 16 as shown.

[0095] Preferably, the hopper 16 may also be accessible from the outside, so as to directly receive a liquid from a user, as diagrammatically indicated by a hollow, broken line arrow 16a.

[0096] In this manner, the siphon-trap 41 is liquid-fed from the hopper 16, which is in turn liquid-fed, as further discussed below:

- with the condensed moisture from the drying process air program recirculated to, but overflown from, removable tank 14, and/or
- with the steam condensate from the steam program recirculated to, but overflown from, removable tank 14, and/or
- with the liquid overflown from the steamer liquid tank 21, and/or the manual loading unit 29 thereof, and/or

- with the liquid directly input by the user into the hopper 16.

[0097] It is immediately recognized that the risk of the siphon-trap 41 to stay or get empty becomes very low, if not completely null. Even if the user fails to directly input liquid and/or to replenish the steamer liquid tank 21 (through the manual loading unit 29), a liquid plug will be preserved or very soon formed in the siphon-trap 41 from the condensed liquid from any laundry drying program not necessarily including a steaming program. There is no need for any new liquid, e.g. water taken from the water mains, to be input to the siphon-trap 41, though new liquid may be input e.g. at installation of the laundry dryer 1, so as to immediately form the liquid plug within siphon-trap 41 thereby immediately preventing any fluff propagation and making it even possible to first operate the dryer 1 with a pure steam program.

[0098] Furthermore, the liquid plug is promptly restored even if it is pushed out of siphon-trap 41 in the event that the steam generated at the steam generator 23, which is at a pressure that is appreciably higher than the atmospheric pressure at which collecting vessel 11 is, for some reason, is not fully injected into the treatment chamber 2 at steam injector 24, thus reaching the siphon-trap 41.

[0099] As discussed and as shown in FIG. 1, the recirculated liquid conduit 17 extends between the hopper 16 and the siphon-trap 41, at its additional input 42. Thus, advantageously the recirculated liquid from hopper 16 arrives at collecting vessel 11 through the siphon-trap 41 itself. Furthermore, the intake of liquid by the siphon-trap 41 interferes as little as possible with the other components of the liquid circuit of the dryer 1, notably with the liquid level within the steamer liquid tank 21.

[0100] Indeed, it is noted that the flowrate of liquid from hopper 16 (or in general from a liquid source) may be quite large, so that it may not be desirable that all such flowrate involves the siphon-trap 41. This may be addressed by providing for just part of, for example up to 50%, preferably up to 20% of, the recirculated liquid from hopper 16 to arrive at the siphon-trap 41. More in general, the additional input 42 is preferably configured so that the percentage of liquid input thereto that contributes to form a liquid plug in the siphon-trap 41 is up to 50%, preferably up to 20%.

[0101] A preferred provision to meet the above goal is discussed further below with reference to **FIG. 2.**

[0102] A portion of steam condensate conduit 40 including an S-shaped siphon-trap 41 is diagrammatically shown in FIG. 2. The empty arrows indicate the flow of steam condensate, and the dashed arrows indicate the flow of additional liquid input to the siphon-trap 41, according to several possible input points 42 (diagrammatically represented as holes) along siphon-trap 41, and exiting therefrom after the liquid plug 44 has been formed (a further comparative input 53 along steam condensate conduit 40 is also indicated).

[0103] Additional input 50 is at the preferred location, at a convex surface of the inverted U portion of siphon-trap 41, i.e. at the uppermost region of the downstream side of the siphon-trap 41.

[0104] In FIG. 2, liquid plug 44 is shown in an intermediate state during its formation or evaporation. It will be understood that when the liquid plug 44 is fully formed, the free surface of the liquid will reach that uppermost region and then start to exit from the siphon-trap 41 along exit branch 46.

[0105] More preferably, additional input 50 is located across a midplane 45 of the inverted U portion, and therefore partially within an exit region 54 of the siphon-trap 41. By so placing additional input 50, the liquid flow coming from the additional source, such as from the hopper 16, will be divided in the two branches of the inverted U portion, namely in the exit branch 46 to reach e.g. the collecting vessel 11 and in the intermediate branch 47 to form the liquid plug 44.

[0106] Even more preferably, additional input 50 is located asymmetrically about midplane 45, so that the liquid flow entering additional input 50 will be deviated in different percentages in the two branches 46, 48, so as to easily accommodate for different flowrate needs.

[0107] Even more preferably, the additional input 50 is displaced, as shown, towards the exit branch 46 of the siphon-trap 41, so that the liquid percentage going to the siphon-trap 41 and contributing to form the liquid plug 44 is lower than that going directly to the collecting vessel 11 or more in general to the recirculation circuit.

[0108] Preferably, if additional input 50 is configured so that the liquid is injected thereinto along a direction parallel to midplane 45, then the ratio of the area of additional input 50 lying on the exit-branch side of midplane 45 to the area of additional input 50 lying on the intermediate-branch side of midplane 45 ranges from about 50:50 (i.e., the additional input is not displaced towards the exit branch 46) to about 80:20 so that the liquid percentage going to the siphon-trap 41 to form the liquid plug 44 is up to 50%, preferably up to 20%.

[0109] The position of the additional input 50 may also take due account of the liquid injection direction in case it deviates from that parallel to midplane 45. As understood, the more the liquid is injected towards the exit branch 46, the lower the liquid percentage contributing to form liquid plug 44. In turn, it will be understood that the liquid injection direction may be adjusted by adjusting the mutual inclination of a conduit connected to additional input 50 (in turn, by properly configuring the additional input) and/or by providing a baffle or other deflecting means at the additional input 50.

[0110] Other locations of the additional input 42 are possible when conversely it is not desired to provide for only part of the additionally input liquid to contribute to form the liquid plug 44.

[0111] Additional input 51 at the input branch 48 of siphon-trap 41 (shown on the outer side just by way of an example) is an option.

[0112] Additional input 52 at the intermediate branch 47 of siphon-trap 41 (shown on the inner side just by way of an example) is also an option, but in order to reach the exit branch 46, liquid should go in a counterflow direction.

[0113] For completeness, FIG. 1 shows a further input 53 upstream of siphon-trap 41 - which would be an indirect input to siphon-trap 41 - namely at a position along steam condensate conduit 40 higher than the maximum level of the free surface of the liquid plug in the input branch 48 of siphon-trap 41; such a further input is conversely not an option for the additional input 42 to siphon-trap 41, because, during the operation of the laundry dryer, it would not be sealed by the liquid plug and it would provide a path for the fluff-laden process air and/or the steam to escape.

[0114] It will be understood that in case the siphon-trap 41 is a U-shaped trap, a preferred location of the additional input 42 will still be in the exit region thereof, at the uppermost region of the downstream side of the siphon-trap 41, where there is the maximum level of the free surface of the liquid plug. Those skilled in the art will understand that what has been stated above regarding the specific location and/or inclination of the additional input, and/or the other flowrate partition configurations will apply *mutatis mutandis*.

[0115] Additionally to or as an alternative to the above described configuration of the additional input 42, recirculated liquid conduit 17 (or any other conduit leading to the additional input 42) may be branched off, e.g. with a T-joint, thus including a branch leading to siphon-trap 41 and a branch directly arriving at collecting vessel 11 (or to any other point of the recirculation circuit of dryer 1), the two branches being properly sized with respect to each other so as to achieve the desired flowrate partition.

[0116] In **FIGS. 3 and 4** a laundry dryer 1 of the condensing type according to an embodiment of the invention is shown, with some walls of the cabinet and some components removed. The components of the dryer 1 have been identified with the same reference numbers as used in FIG. 1 above.

[0117] Further shown are, i.a., basement 60 within which the collecting vessel 11 is integrally formed, so that they are one-piece.

[0118] A rear wall 61 of the cabinet is shown, within which the first air opening 6a is formed (though this not being visible in FIGs. 3-5), and to which a cover (not shown) is applied to form part of the drying process air circuit 3, upstream of the first air opening 6a.

[0119] An upright 62 extending from basement 60 is also shown, which has a hollow portion that embodies part of the drying process air circuit 3 downstream of second air opening 7a.

[0120] With reference in particular to **FIGs. 5-7,** preferably the siphon-trap 41 may be formed as one-piece with a joint 70 at its additional input 42, which in the case shown is at the preferred location described with reference to additional input 50, for jointing to a conduit providing the liquid to the additional input 42, in particular recirculated liquid conduit 17. Joint 70 may be, as shown, a short length of a conduit having a tapered free end.

[0121] Joints or tapered free ends may also be provided at the input branch 48 and/or at the exit branch 46, as shown, for easy connection with the respectively connected components. The integral joint 70 (as well as the other integral joints) avoids the need of a joint such as a T-joint, and greatly aids the assembling and installation process.

[0122] Joint 70 may also have, as shown, a suitable inclination with respect to the siphon-trap 41, for the reasons detailed above. In particular, the joint 70 is skewed so as to contribute to inject more liquid towards the exit branch 46 than towards the intermediate branch 47 of siphon-trap 41.

[0123] Additionally or alternatively, preferably the siphon-trap 41 may be formed as a self-standing body 71. Self-standing body 71 is preferably obtained by a blown molding process from a suitable plastic material such as HDPE (high density polyethylene).

[0124] Self-standing body 71 preferably comprises, besides the siphon-trap 41 and preferably the joint 70, as shown, at least one of:

- a thin member 72 extending between part of the input branch 48 and part of the intermediate branch 47,
- a thin member 73 extending between part of the exit branch 46 and part of the intermediate branch 47,
- a thin, folded member 74 extending sideways from part of the input branch 48.

[0125] Thin, folded member 74 is preferably so sized and shaped as to match, when properly seated in the laundry dryer 1, upright 62 thereof, so as to allow the siphon-trap 41 to be stably attached to the cabinet of the dryer 1. Thin, folded member 74 may for example include a hole 75 for a screw 76 (FIG. 5) in its folded edge 77. Thus, folded member 74 embodies a mounting flange of self-standing body 71.

[0126] Preferably, as shown, the exit branch 46 and the intermediate branch 47, as well as the thin member 73 extending therebetween, are curved so as to be spaced apart with respect to a midplane of thin member 72 so as to allow ready access to hole 75 by a tool, such as a screwdriver, to act onto the screw 76.

[0127] It shall be understood that a siphon-trap 41 made as a self-standing body 71 and/or with a one-piece joint 70 as discussed above may also be provided for a different dryer than that shown in FIGs. 3-5, and/or when the conduit providing the liquid to its additional input 42 is different from recirculated liquid conduit 17, e.g. is a conduit connected to steamer liquid tank 21. The overall shape of siphon-trap 41 and/or of the self-standing body 71 comprising it may thus depart from that shown in FIGs. 5-7.

[0128] It is understood that a method for operating the above discussed condenser laundry dryer 1 with a steaming function has been disclosed above, comprising forming a liquid plug 44 in said siphon-trap 41 by:

a1) carrying out a drying program,

a2) collecting condensed moisture from laundry being dried during the drying program, and

a3) inputting a portion of the collected condensed moisture to the siphon-trap 41.

[0129] Additionally and/or alternatively, a method for operating the above discussed condenser laundry dryer 1 with a steaming function may comprise forming a liquid plug 44 in said siphon-trap 41 by:

b1) manually inputting a liquid, in particular water or a water-based liquor, into a steamer liquid tank 21 of said steamer 20, preferably through a manual loading unit 29 thereof, and

b2) deviating a portion of the manually input liquid to the siphon-trap 41.

[0130] The operating method may further comprise recirculating within the dryer 1 the condensed moisture formed during a drying program and possibly the steam condensate formed during a steam program.

[0131] The operating method may further comprise deviating a portion of the recirculated liquid towards the siphon-trap 41 to form a liquid plug 44 thereinto.

[0132] Alternatively or additionally, the operating method may further comprise obtaining a liquid for forming the or a liquid plug 44 by:

- receiving a liquid manually input by a user and/or
- collecting overflown liquid from one or more of the following:
  - a steamer liquid tank 21,
  - a manual loading unit 29 of the steamer liquid tank 21, and
  - a removable tank 14 of the recirculation circuit.

[0133] As used herein, the term "about" means that a stated numerical value(s) is/are approximate and small variations would not significantly affect the practice of the invention. Where a numerical limitation is used, unless indicated otherwise by the context, "about" means that the numerical value can vary by $\pm 10\%$ still remaining within the scope of the disclosed subject-matter.

[0134] Unless the context requires otherwise, throughout the specification and claims: forms of verb "comprise" are to be construed in an open, inclusive sense, as "include, but not be limited to"; singular forms "a," "an," and "the" are to be construed in an open, inclusive sense, not limited to "a single one"; term "or" is generally employed in its broadest sense, as "and/or".

[0135] The above is a description of various embodiments of inventive aspects, and further changes can be made without departing from the scope of the present invention. The shape and/or size and/or location and/or orientation of the various components and/or the succession of the various steps can be changed. The functions of an element or module can be carried out by two or more components or modules, and vice-versa. Components shown directly connected to or contacting each other can have intermediate structures arranged in between them. Steps shown directly following each other can have intermediate steps carried out between them. The details shown in a figure and/or described with reference to a figure or to an embodiment can apply in other figures or embodiments. Not all of the details shown in a figure or described in a same context must necessarily be present in a same embodiment. Features or aspects that turn out to be innovative with respect to the prior art, alone or in combination with other features, should be deemed to be described per se, irrespective of what is explicitly described as innovative.

Claims

1. A laundry dryer (1) with steaming function, comprising:

- a laundry treatment chamber (2),
- a drying process air circuit (3) having a first air opening (6a) to lead a process air flow (6, 7, 9) into the treatment chamber (2), and a second opening (7a) to exhaust process air flow (6, 7, 9) from the treatment chamber (2), the drying process air circuit (3) further comprising a heater (4) for heating process air, a fan (5) for moving said process air flow (6, 7, 9) along the drying process air circuit (3), and a condenser (8) for removing moisture from process air flow (6, 7, 9) exiting the chamber (2),
- a steamer (20) comprising a steam generator (23), a steam injector (24) to inject steam into the treatment chamber (2), and a steam condensate conduit (40) for leading away any liquid condensed from the steam stream to be injected by the steam injector (24) into the treatment chamber (2), and
- a siphon-trap (41) arranged in the steam condensation conduit (40) to receive steam condensate therefrom,

characterized by further including an additional input (42, 50, 51, 52) of liquid to siphon-trap (41), ad-

ditional to the steam condensate.

2. The laundry dryer (1) according to claim 1, wherein the additional input (42, 50, 51, 52) is fluidly connected to receive at least one of:

- recirculated condensed moisture,
- recirculated steam condensate,
- overflown liquid from a steamer liquid tank (21) of the steamer (20) and/or a manual loading unit (29) thereof,
- a liquid provided by a user.

3. The laundry dryer (1) according to any of the previous claims, wherein the additional input (42, 50) is configured so that the percentage of liquid input to the additional input (42, 50) that contributes to form a liquid plug (44) in the siphon-trap (41) is up to 50%, preferably up to 20%.

4. The laundry dryer (1) according to any of the previous claims, wherein the additional input (42, 50, 51, 52) to the siphon-trap (41) is connected to a recirculation circuit that is fluidly supplied with condensed moisture from process air in the drying process air circuit (3).

5. The laundry dryer (1) according to claim 4, wherein the recirculation circuit further recirculates steam condensate.

6. The laundry dryer (1) according to any of the previous claims, wherein the additional input (42, 50, 51, 52) to the siphon-trap (41) is fluidly connected to a hopper (16) located to:

- receive a liquid input to the hopper (16) by a user, and/or
- collect any overflown liquid from at least one of the following:
  - a steamer liquid tank (21),
  - a manual loading unit (29) of the steamer liquid tank (21), and
  - a removable tank (14) of the recirculation circuit.

7. The laundry dryer (1) according to claim 6, wherein the additional input (42, 50, 51, 52) of the siphon-trap (41) is connected to a recirculated liquid conduit (17) which leads recirculated liquid from the hopper (16) to a collecting vessel (11) for collecting condensed moisture from the drying process air circuit (3) and/or steam condensate from the steamer (20).

8. The laundry dryer (1) according to any of the previous claims, wherein the additional input (42, 50) to the siphon-trap (41) is at the uppermost region of the downstream side of the siphon-trap (41), in particular at a convex surface of an inverted U portion of an S-shaped siphon-trap (41).

9. The laundry dryer (1) according to any of the previous claims, wherein the siphon-trap (41) is an S-shaped siphon-trap (41), and the additional input (42, 50) to the siphon-trap (41) is located across, but asymmetrically about, a midplane (45) of its inverted U portion.

10. The laundry dryer (1) according to claim 9, wherein the additional input (42, 50) of the siphon-trap (41) is displaced towards an exit branch (46) of the siphon-trap (41), so that the liquid percentage going to the siphon-trap (41) is up to but not including 50%, and preferably is up to 20%.

11. The laundry dryer (1) according to any of the previous claims, wherein a joint (70) for connecting a conduit (17) to the additional input (42, 50, 51, 52) is formed as one-piece with the siphon-trap (41).

12. The laundry dryer (1) according to any of the previous claims, wherein the dryer (1) comprises a self-standing body (71) which embodies the siphon-trap (41), and optionally the or a joint (70) for connecting a conduit (17) to the additional input (42, 50, 51, 52).

13. A method for operating the laundry dryer (1) with steaming function according to any of the preceding claims, comprising forming a liquid plug (44) in said siphon-trap (41) by:

a1) carrying out a drying program,
a2) collecting condensed moisture from laundry being dried during the drying program, and
a3) inputting a portion of the collected condensed moisture to the siphon-trap (41),

and/or by:

b1) manually inputting a liquid, in particular water or a water-based liquor, into a steamer liquid tank (21) of said steamer (20), preferably through a manual loading unit (29) thereof, and
b2) deviating a portion of the manually input liquid to the siphon-trap (41).

14. The method according to claim 13, further comprising recirculating within the dryer (1) the condensed moisture formed during a laundry drying program and possibly the steam condensate formed during a steam program, and further comprising deviating a portion of the recirculated liquid towards the siphon-trap (41) to form a liquid plug (44) thereinto.

15. The method according to any of claims 13-14, further comprising obtaining a liquid for forming the or a liq-

uid plug (44) by:

- receiving a liquid manually input by a user and/or
- collecting overflown liquid from one or more of the following:
  - a steamer liquid tank (21),
  - a manual loading unit (29) of the steamer liquid tank (21), and
  - a removable tank (14) of the recirculation circuit.

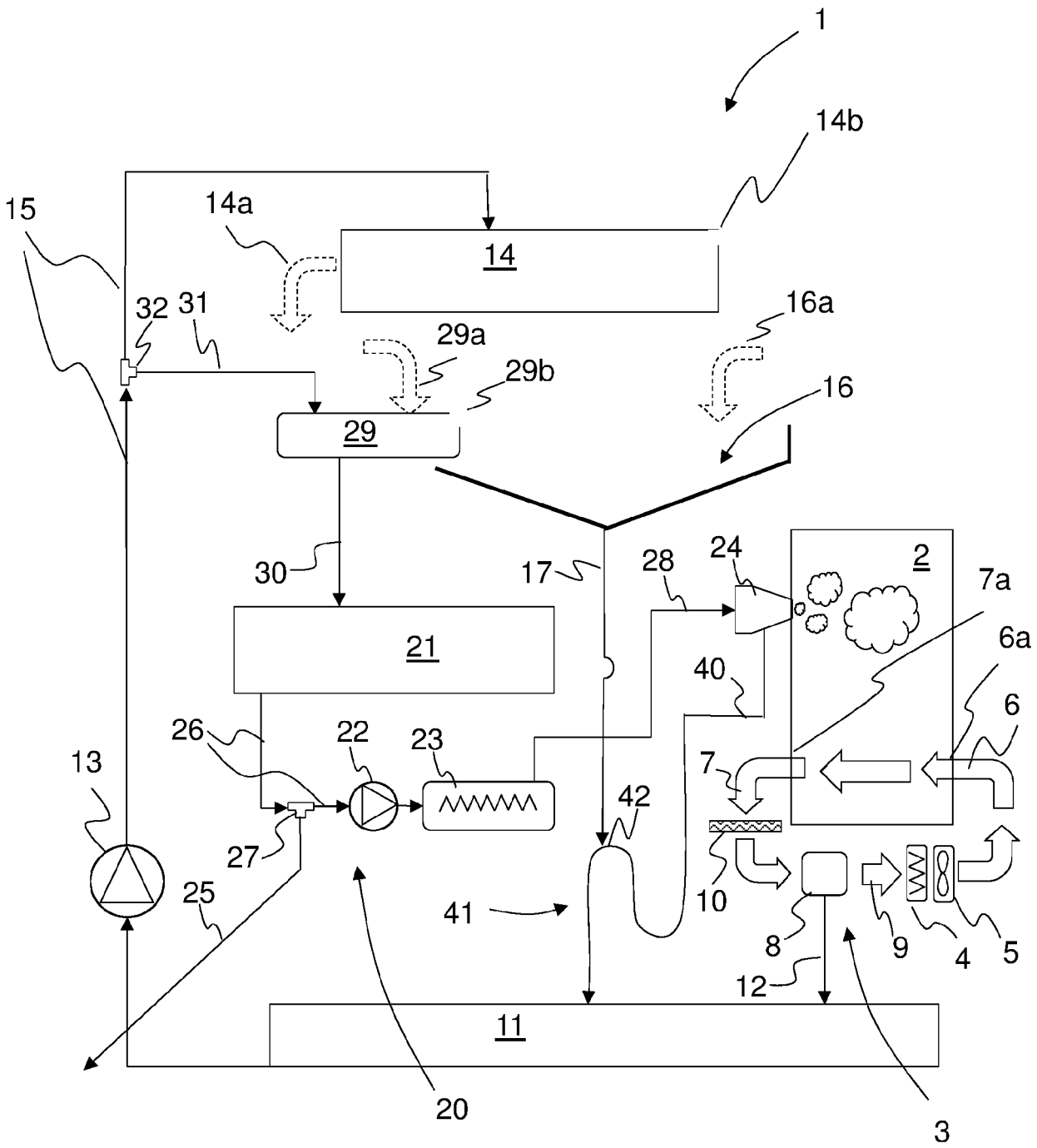
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Fig. 1

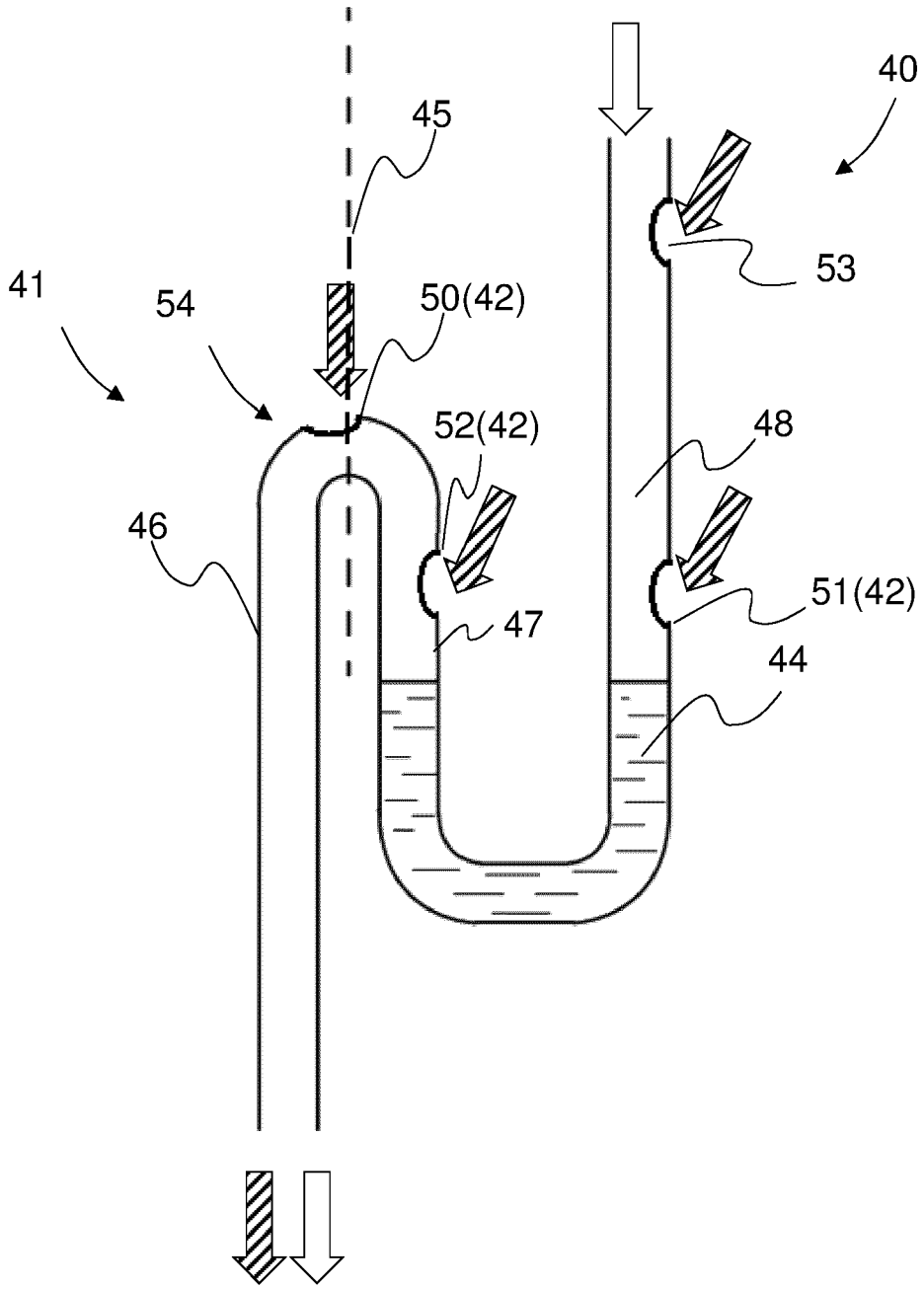

Fig. 2

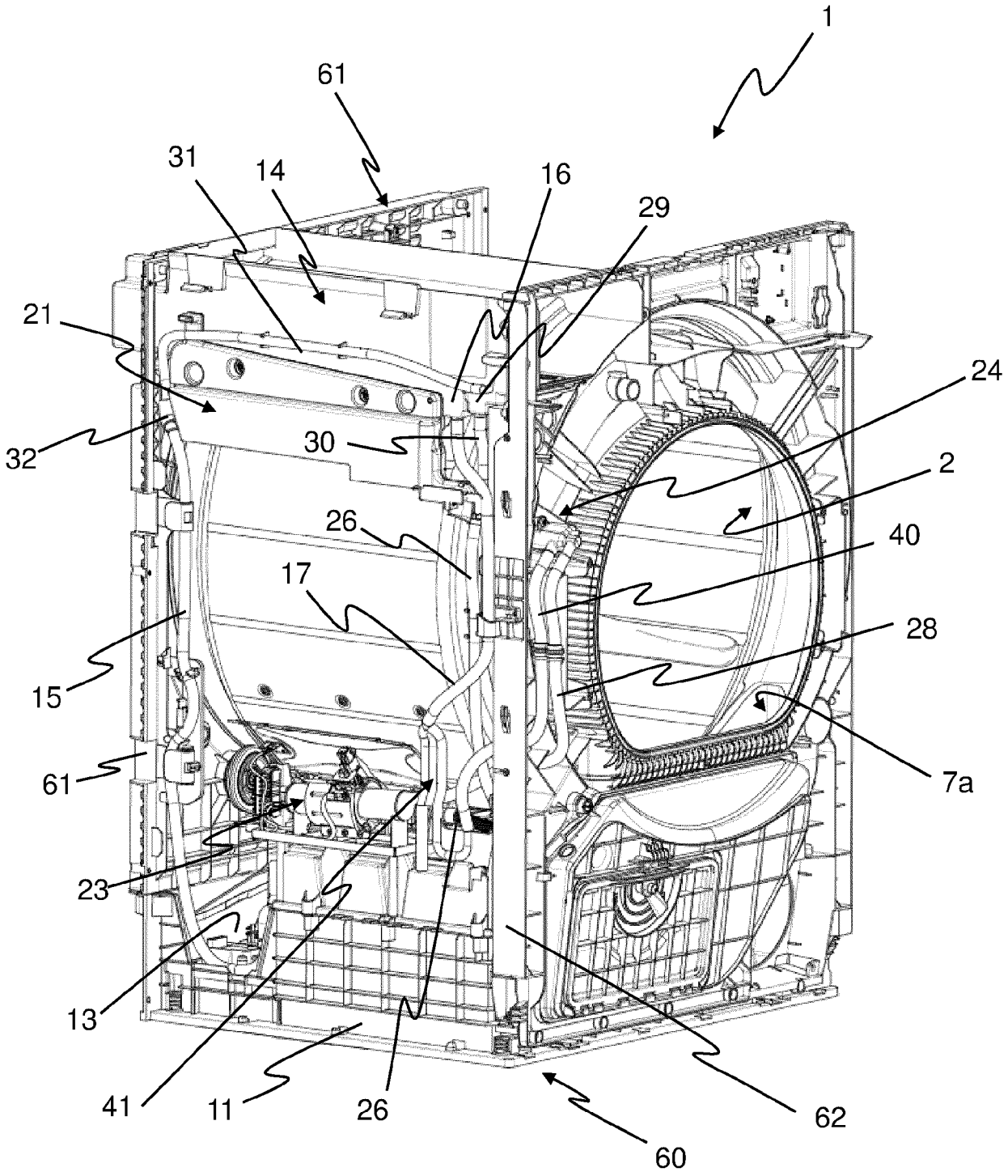

Fig. 3

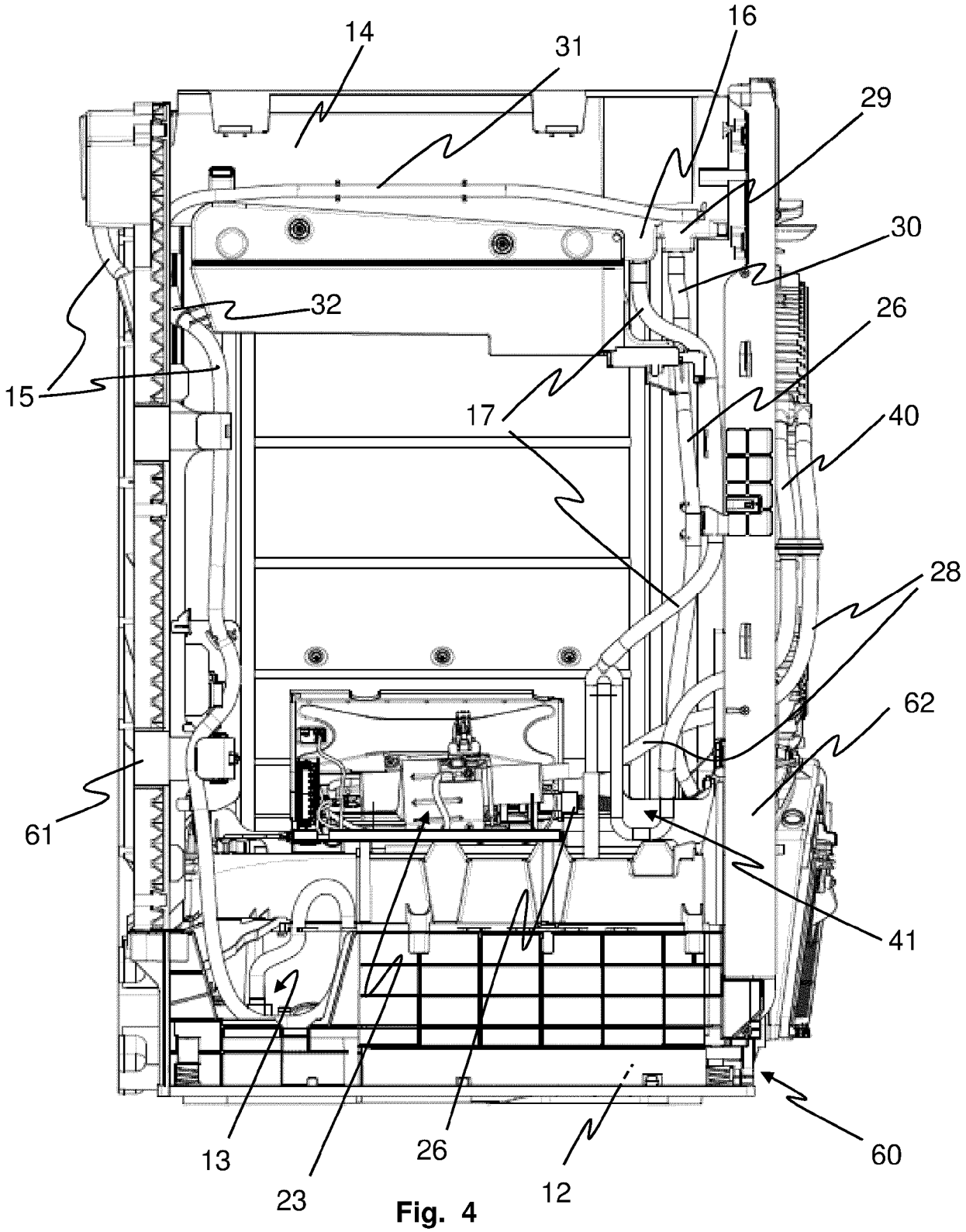

Fig. 4

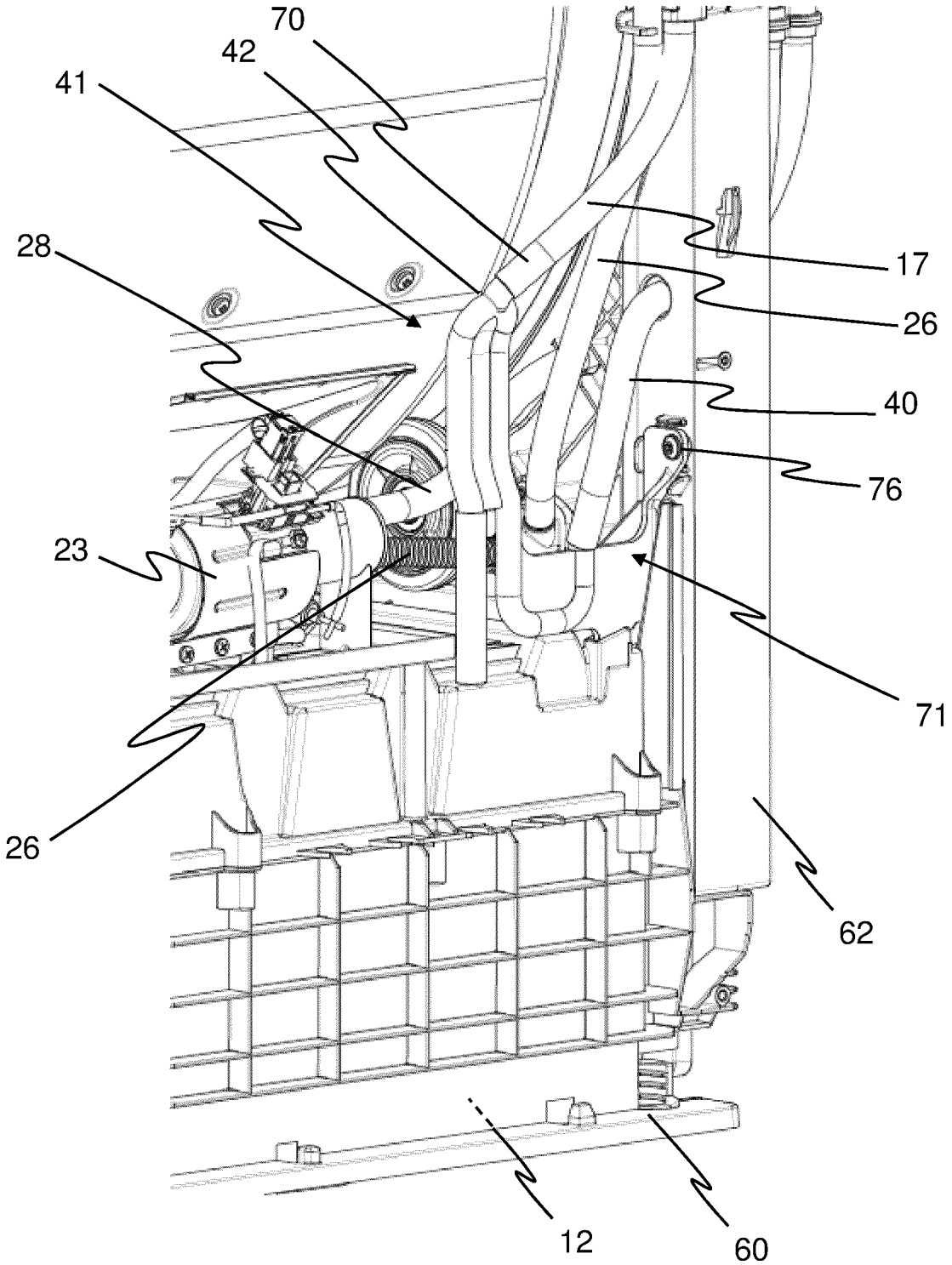

Fig. 5

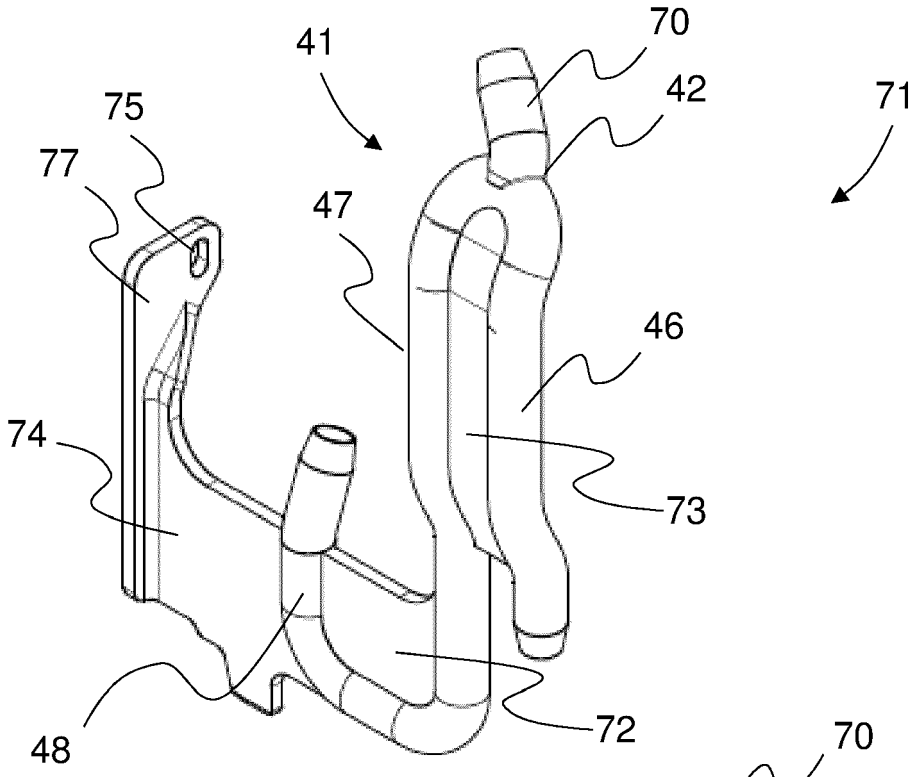

Fig. 6

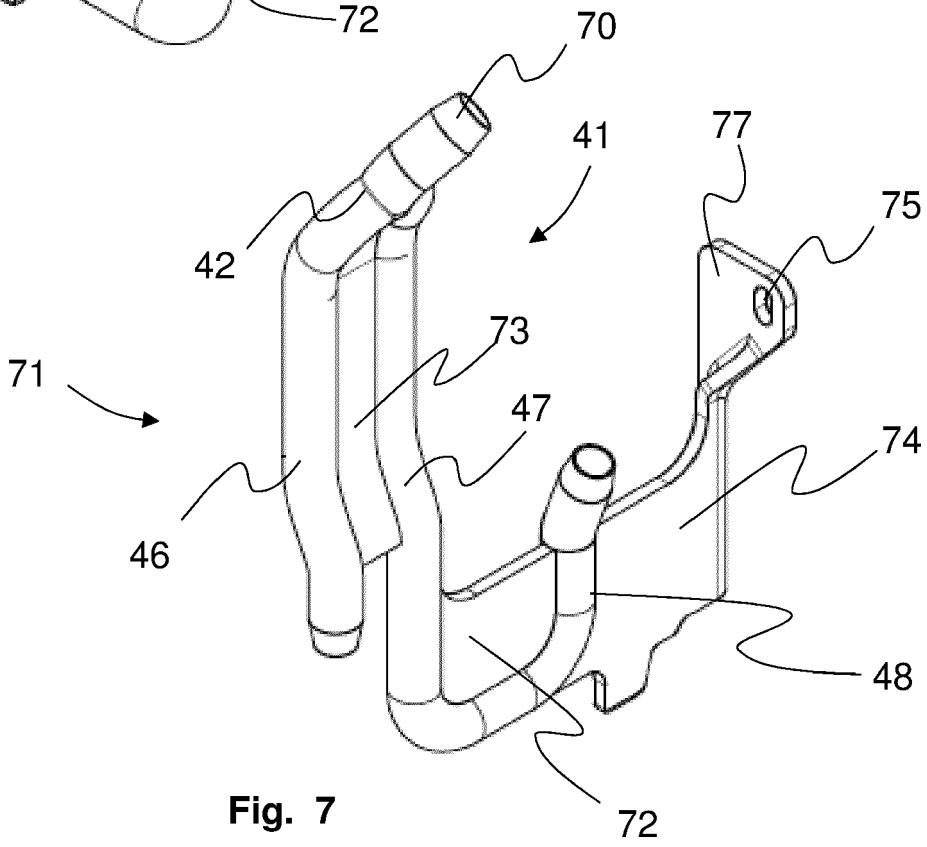

Fig. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 1488

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	US 2008/313920 A1 (FINKE MICHAEL [DE] ET AL) 25 December 2008 (2008-12-25) * figure 1 * * paragraph [0035] - paragraph [0037] * -----	1-3,6,8, 11-13,15	INV. D06F58/20 D06F58/30 ADD.
A	DE 10 2011 081936 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]) 7 March 2013 (2013-03-07) * figure 1 * -----	1-15	D06F58/24 D06F105/40 D06F39/00

TECHNICAL FIELDS SEARCHED (IPC)

D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 May 2021	Werner, Christopher

CATEGORY OF CITED DOCUMENTS

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19-05-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008313920 A1	25-12-2008	AT 530693 T	15-11-2011
		DE 102007028618 A1	02-01-2009
		EP 2006432 A2	24-12-2008
		ES 2371788 T3	10-01-2012
		PL 2006432 T3	29-02-2012
		US 2008313920 A1	25-12-2008
DE 102011081936 A1	07-03-2013	CN 103764896 A	30-04-2014
		DE 102011081936 A1	07-03-2013
		EP 2751327 A1	09-07-2014
		PL 2751327 T3	30-09-2016
		WO 2013030266 A1	07-03-2013

EPO FORM P0459

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Patent documents cited in the description

- EP 1959048 B1 **[0015]**
- WO 2017036553 A1 **[0015]**